Expanded MPE Pilot Test
Interim Action Workplan

Prepared for
Grant County

February 2025

Parametrix

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Certification

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

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Contents

Contents (continued)

Contents (continued)

FIGURES

TABLES

Contents (continued)

APPENDICES

Acronyms and Abbreviations

acfm	actual cubic feet per minute
Amendment	Amendment No. 3 to Agreed Order No. DE 3810
AS	air sparge
ASIL	acceptable source impact level
City	City of Ephrata
County	Grant County
DNS	determination of non-significance
Ecology	Washington State Department of Ecology
FS	feasibility study
GAC	granular activated carbon
HASP	site-specific health and safety plan
HMI	human machine interface
I/O	input/output
IAWP	interim action workplan
inches-Hg	inches of mercury
KO	knockout
L&I	Washington State Department of Labor and Industries
LTT	liquid treatment train
MPE	multi-phase extraction
NAPL	non-aqueous phase liquid
O&M	operation and maintenance
Order	Agreed Order No. DE 3810
OWS	oil water separator
PGG	Pacific Groundwater Group
PLC	programmable logic controller
RI	remedial investigation
SAP	sampling and analysis plan
scfm	standard cubic feet per minute
SQER	small quantity emission rate

Acronyms and Abbreviations (continued)

SVE	soil vapor extraction
TAP	toxic air pollutant
VAE	vacuum-assisted extraction
VFA	vapor flow augmentation
VFD	variable frequency drive
VOC	volatile organic compound
VTT	vapor treatment train
WAC	Washington Administrative Code

1. Introduction

As part of the Model Toxics Control Act cleanup action, this Interim Action Workplan (IAWP) describes the plans to expand the multi-phase extraction (MPE) infrastructure at Ephrata Landfill and perform full system pilot testing for at least 2 years and up to 5 years. Figure 1-1 provides a landfill site overview and Figure 1-2 shows the conceptual expanded MPE system layout at the north end of the Ephrata Landfill. This work is required under the terms of Agreed Order No. DE 3810 (Order) Amendment No. 3 (Amendment) between the Washington State Department of Ecology (Ecology) and Grant County (County).

1.1 Site Information

The Ephrata Landfill is located approximately 3 miles south of the City of Ephrata (City) on the east side of Highway 28 in the western portion of Section 33, Township 21 North, Range 26 East, Willamette Meridian. An old, unlined landfill (original landfill) is situated on the northern part of the landfill property and is the focus of interim actions under the Amendment (Figure 1-1). The City began operating the original landfill in approximately 1942 and owned and operated it until 1974. The City owned the original landfill and leased additional property from the U.S. Bureau of Reclamation. In 1974, the City and County entered into the first of a series of agreements under which the County leased the original landfill and operated the facility. The U.S. Bureau of Reclamation transferred its property to the County in 1990, and the City deeded the original landfill property to the County in 1994. Both properties are now the Ephrata Landfill property.

1.2 Project Background

This project is part of a cleanup of the Ephrata Landfill under the Order. The cleanup addresses releases from the landfill and drums of industrial chemicals that were buried in the landfill prior to their removal in 2008.

A remedial investigation (RI) of the Ephrata Landfill started in 2007 (Pacific Groundwater Group [PGG] 2010) and ended with a supplemental RI (PGG 2021). The RI revealed that the north end of the Ephrata Landfill overlies Columbia River Basalts comprising multiple flows and interflows where releases from the landfill and drums migrated. This interim action involves MPE testing in three hydrostratigraphic units underlying the release area, which are described in Section 1.3.

The draft feasibility study (FS) was submitted to Ecology in 2012 (Parametrix 2012) and updated twice (Parametrix 2018, 2022). The FS recommends MPE in the highly contaminated release areas and natural attenuation of the downgradient plume. Completion of the FS was postponed in 2023 by mutual agreement with Ecology pending the completion of expanded MPE pilot testing.

The current interim actions relate to prior ones, including:

- Drum and contaminated soil removal in 2008 (Parametrix 2016).
- A limited MPE pilot test in 2017 in the P1 zone (Parametrix and PGG 2018).

1.3 Hydrogeologic Setting

The expanded MPE pilot test involves groundwater and vapor extraction from the three uppermost hydrostratigraphic units underlying the north end of the Ephrata Landfill. Starting with the upper unit, these are the P1 zone, the P2 zone, and the Roza aquifer. Figure 1-3 is one of the hydrogeologic cross sections from the supplemental RI report (PGG 2021). The cross section depicts the layering and varying thicknesses of the P1 and P2 zones and Roza aquifer and several wells in the test area and extends farther north.

RI findings relevant to the expanded MPE pilot test IAWP include the following:

- The highest concentrations of groundwater contaminants are limited to the shallow P1 and P2 zones near the area where drums were removed in 2008 (drum area). A mixed non-aqueous phase liquid (NAPL) composed of benzene, toluene, ethylbenzene, xylene isomers, and other aromatic hydrocarbons with some chlorinated solvents has been observed in the P1 zone in the past. NAPL was not observed during the supplemental RI completed from September 2019 through January 2021.
- Groundwater contaminant concentrations decreased by orders of magnitude with vertical and horizontal distance from the drum area. Contaminant migration to the north is mostly limited to the Roza aquifer. There are fewer volatile organic compounds (VOCs) at lower concentrations in the Roza aquifer north of the landfill compared to the drum area.
- New data from the supplemental RI confirm the P1 and P2 zones are laterally discontinuous and heterogenous. The Roza aquifer is more laterally continuous than the P1 and P2 zones, but just as heterogeneous.
- New wells installed for the supplemental RI at the north end of the Ephrata Landfill bound the area where groundwater contaminants in the Roza aquifer are above estimated cleanup levels. The plume lies within the perimeter of contiguous County-owned parcels. Long-term groundwater quality trends indicate the plume is stable and not expanding.
- The transmissivity (a measure of an aquifer's ability to move water) of the P1 and P2 zones and Roza aquifer is highly variable, as confirmed by slug-test-based results for the new wells. The Roza aquifer has very low transmissivity in the drum area. The P1 and P2 zone transmissivity is also low in the drum area, although some P1 and P2 wells have comparably higher transmissivity.
- P1 zone groundwater concentrations during the supplemental RI remained about 10 times lower than before the MPE pilot test in 2017, demonstrating successful contaminant removal.

Observations from the 2017 MPE pilot test relate to transmissivity calculations in the RI. Generally, groundwater extraction volume was substantively less than anticipated based on transmissivity results. This may relate to the variability of these zones, with recharge to the more transmissive areas constrained by the less transmissive areas. Recharge is mainly lateral.

1.4 Report Organization

The remainder of this report is organized as follows:

- Section 2 – Project Administration and Control: Describes the project organization and stakeholders, access control, and required training and certification.
- Section 3 – Expanded MPE System Preliminary Engineering: Describes the existing system and the performance limits.
- Section 4 – Engineer Design Development: Describes the expected system expansions and required equipment.
- Section 5 –Permits: Describes the related permit and requirements.

- Section 6 – Cost Estimation: Describes the preliminary construction cost estimate for the proposed MPE system expansion.
- Section 7 – Testing: Describes the expected testing for operating the MPE pilot system.
- Section 8 – Reporting: Describes the monthly performance reports and the interim action progress and completion reports expected during testing.
- Section 9 – References.

Tables and figures referenced throughout this report are collectively located after Section 9.

Related documents complementing and addressing parts of the IAWP scope under the Amendment are provided in the following appendices:

- Appendix A – Sampling and Analysis Plan (SAP). The SAP covers monitoring and sampling directly related to the expanded MPE system, including groundwater monitoring wells anticipated to be directly influenced by the planned dewatering and vapor extraction.
- Appendix B – Groundwater Monitoring Plan. The groundwater monitoring plan covers monitoring and sampling from groundwater wells that are not anticipated to drain or experience vacuum because of MPE.
- Appendix C – Natural Attenuation Analysis. The natural attenuation analysis describes indicators and trends and informs the selection of natural attenuation parameters to monitor in addition to site contaminants.
- Appendix D –Site-Specific Health and Safety Plan (HASP). This is Parametrix's HASP focusing on construction observation during MPE system expansion and seasonal operation and monitoring of the expanded MPE system.

Appendix A of Parametrix and PGG (2018) contains existing MPE system details, including design and record drawings and the Operation and Maintenance (O&M) manual. Although not attached to this IAWP due to file size, the prior pilot test report, including the O&M manual, was distributed in 2018 and is available electronically from Parametrix on request. The O&M manual component document folder is also separately available electronically on request.

An updated O&M manual will be developed based on approved contractor submittals from construction of the expanded MPE system. The expanded MPE system may be ready to operate before the O&M manual is updated. This IAWP, the existing O&M manual, and contractor submittals will provide crucial information to start the expanded MPE pilot test while the O&M manual update is finalized.

Although the specific operational requirements of new equipment will only be known once construction contract submittals are approved, this IAWP is based on features and controls common for the types of equipment planned, which will also be specified in the construction contract documents. Any adjustments needed to accommodate the new equipment are anticipated to be minor.

2. Project Administration and Control

Table 2-1 contains the names, roles, and contact information for people involved with the expanded MPE construction and full system pilot test. A summary of each entity's involvement in the project follows the list. Grant County is required by Washington law to procure the MPE expansion construction through the public works process. This entails advertising the project and contract award resulting from competitive bidding. The prime construction contractor will only be known once that process is complete.

Parametrix is the project engineer and lead operator of the MPE system. Parametrix will coordinate system repairs and personnel training, restart the system, and monitor and sample the system as described in this workplan.

Prime Contractor is the MPE system expansion construction contractor. This contractor will be the lowest bidder meeting the bidding conditions and selected through public works contracting.

KRCI LLC is a local contractor retained by Parametrix to perform piping repairs, perform other repairs that may be needed from time to time, and assist with maintenance activities.

Friedman and Bruya, Inc. is the analytical laboratory selected for liquid and vapor sample analysis for the MPE restart and seasonal operation.

Mott MacDonald is the project hydrogeologist and groundwater monitoring lead. They also manage the project database.

Grant County Public Works owns and operates the landfill and manages project contracts, invoicing, payment, and reimbursement requests. The County also controls access to the landfill property.

Ecology regulates the site cleanup and controls grant funding.

2.1 Site Access Control

The Ephrata Landfill is a fully fenced facility that is locked except during business hours Monday through Saturday. Public access to the tipping area (active landfill) is through a gated entrance from Neva Lake Road approximately 1,500 feet south of the MPE project area. Public travel on landfill roads is regulated by signage to the tipping area. Landfill personnel monitor unauthorized vehicles that stray from on-site public routes. The MPE project area is physically accessible by driving north (i.e., opposite the signage) from the public entrance.

The MPE project area is more directly accessible from Neva Lake Road through a second gated entrance at the northwestern corner of the landfill near the treatment and support buildings and evaporation pond. This gate is normally locked and is for authorized use only (i.e., County personnel and authorized people). The support building and the containers housing the main treatment equipment are locked with padlocks or door locks. The landfill fence and gates are the only physical barriers to public access to other MPE infrastructure (e.g., wells, piping, and evaporation pond).

The construction contractor will be required to maintain site access control and security during MPE system expansion construction.

2.2 Training and Certification

Field personnel will have current hazardous waste operations and emergency response training in accordance with 29 Code of Federal Regulations 1910.120(e) and consistent with their roles and duration on site in accordance with the HASP (Appendix D).

3. Expanded MPE System Preliminary Engineering

The MPE system comprises extraction and observation wells, field piping, a vapor treatment train (VTT), a liquid treatment train (LTT), a support building, electrical and controls systems, and an evaporation pond. The VTT and LTT are housed in intermodal shipping containers. The original MPE system was installed in 2016 and 2017, and a pilot test was conducted in 2017. The MPE infrastructure expansion involves connecting to additional wells, adding structures where required, adding treatment equipment, and modifying the VTT and LTT controls to support the additions. The planned MPE improvements are described further in this section.

The expanded MPE pilot test will involve adding new MPE well pumps, liquid discharge piping, and vacuum piping to existing wells located in the P1 and P2 zones and Roza aquifer in the source area. Other existing wells will be used for observation and vapor flow augmentation. As detailed below, capabilities of the existing MPE wells and the LTT and VTT systems limit the number of pneumatic well pumps that can be added, the amount of vacuum that can be applied, the number of wells that can be added to the control system, and the changeout frequency of the granular activated carbon (GAC).

The existing MPE wells and the LTT and VTT systems' treatment and capacity were evaluated to identify parts of the existing system that could limit conveyance and treatment capacity. Capacity limitations on some systems can be mitigated by changing the sequence each well is brought online and operated because there is usually an initial surge in groundwater flow and vapor VOC concentrations that recede as the extraction continues. Previous testing demonstrated the P1 zone does not re-charge with water and contaminants at the rate they are extracted, and a similar condition likely exists for the P2 zone.

3.1 Design Criteria

The design criteria for the MPE system expansion are as follows:

- The MPE system expansion infrastructure will be designed for reliable seasonal operation for at least 5 years. The existing MPE infrastructure meets this criterion.
- The system expansion will be designed for seasonal operation from April through October to avoid freezing conditions. Because the system will not be designed to operate in the winter, the new extraction system collection piping will not be insulated or heat traced. However, the system will be designed for efficient winterization to protect assets over the winter months.
- The piping system will be designed so that individual extraction wells can be isolated by closing valves in the liquid, vapor, and pneumatic pipes.
- Each vacuum-assisted extraction (VAE) wellhead will have a vapor sampling port and a vapor flow meter.
- Each groundwater wellhead will have a liquid sampling port and a fluid flow meter.
- Vapor treatment capacity will be increased to at least 550 scfm at a VTT inlet vacuum of at least 3.5 inches of mercury (inches-Hg), which will accommodate the highest estimated vapor extraction from 20 active wells.

- The existing vacuum blower will be retained, and a new one added to provide the increased capacity.
- The VTT and piping changes will allow either blower to be selected to operate, with only one blower in operation at a time.
- The LTT is currently sized to accommodate the highest estimated liquid discharge from 10 active wells, and no additional treatment capacity is planned.
- The evaporation pond is adequately sized to accommodate the estimated seasonal discharge from the 10 recommended MPE wells, and no additional evaporative capacity is planned.
- All continuous well monitoring (i.e., water level monitoring or pressure monitoring) will be by self-contained remote recording devices (i.e., battery powered data loggers) with no signals to the MPE control system.
- New treatment system total electrical loads will be constrained such that the total load (existing and new) will not exceed the existing main circuit breaker capacity (30-kiloamp, 480-volt, 3-phase, 4-wire interrupting capacity; sized for existing and additional loads).

3.2 Extraction, Vapor Flow Augmentation, and Observation Wells

The MPE, VE, and observation wells for the expanded MPE pilot test are listed in the SAP Table 1 (Appendix A). The expanded MPE pilot testing will include new liquid, vapor, and pneumatic connections to wells in the P1 zone, P2 zone, and Roza aquifer (Figure 1-2). All wells will have vapor pressure and water level transducers. Six wells (MW-34p1, MW-65p1, MW-68p1, MW-36p1, MW-64p1, and MW-69p1) were previously equipped with transducers, which are connected to the control system. These transducers will be replaced with the equipment that is being used in the other wells for consistency between wells. All MPE and VE wells and all observation wells will be equipped with water level and vapor pressure transducers with local data loggers. Representative transducer and data storage and transfer device catalog cuts are provided for example in Appendix E. All MPE and VE wells will be fitted with a vapor flow and pressure gauge with local display but no data storage or connection. Sheet M3.2 in Appendix F shows the MPE, VE, and observation well types, typical valving, and controls.

3.2.1 MPE Wells

MPE wells are for dewatering and vapor extraction. These wells will be equipped with LDAP4 pneumatic pumps. Three MPE wells (MW-34p1, MW-65p1, and MW-68p1) were equipped for pilot testing in 2017 and are connected to the VTT, LTT, and controls. The other MPE wells will be fitted with new pumps, pipe connections, and transducers with local data recording. MW-65p1 exhibited a peculiar response when vacuum was applied in the previous pilot testing (Parametrix 2018). MW-65p1 will be used for dewatering without vacuum. Vacuum application will be attempted periodically because the previously observed response may resolve with longer-term dewatering of the P1 zone.

Valves will be added to all extraction wells so any well can be isolated from the rest of the system for maintenance or repair.

3.2.2 Vapor Extraction Wells

VE wells are for vapor extraction, not dewatering. They will have vapor pipe connections and vapor pressure and water level transducers but not liquid or pneumatic pipe connections or pumps. Three

VE wells (MW-36p1, MW-64p1, and MW-69p1) were equipped for pilot testing in 2017 and are connected to the controls but have no pipe connections. The transmitters at these wells will be replaced with local data loggers.

3.2.3 Observation Wells

Observation wells are for vapor pressure and water level monitoring. Observation well construction is summarized in the SAP Table 2 (Appendix A). Wells within 100-feet of MPE or VE wells were selected as observation wells based on the largest observed distance of vacuum influence during the previous pilot test. Wells farther away from the expanded MPE area are addressed in the GWMP.

3.2.4 Vapor Flow Augmentation Wells

Vapor flow augmentation (VFA) wells, also called venting wells, will be used to try to increase air flow through the dewatered zones. Increased air flow can increase dissolution, desorption, and vapor extraction radius of influence. Venting will be accomplished by opening the port or removing the caps of observation wells identified for VFA. The wells will be closed after the VFA test.

Whereas MPE, VE, and observation wells are distinct wells dedicated to their specific functions, VFA wells are not separate wells. Rather, VFA wells will be observation wells identified for venting during VFA testing as described in the SAP (Appendix A).

3.2.5 Well Production Rates

The estimated liquid and vapor flow rates for the expanded MPE pilot test are shown in Tables 3-1 and 3-2. These are estimates for the first extraction season, and liquid extraction may be lower in subsequent seasons. See Appendix G for groundwater extraction rate analysis and Appendix H for vapor extraction rate analysis.

Estimates of vapor extraction rates from the P2 zone and Roza aquifer are lower than observed vapor extraction from MW-34p1 and MW-68p1 during the 2017 MPE pilot test. The oxygen and methane levels measured at the VTT in 2017 indicate significant connection of the P1 zone to both ambient air and the landfill. The P2 zone is expected to have less connection to either ambient air or the landfill, so vapor estimates for P2 wells are adjusted downward by 40% compared to P1 wells. The Roza aquifer is expected to have even less connectivity, so Roza vapor estimates are reduced by 70% compared to P1 wells. The vacuum setting of 3.5 inches-Hg was chosen because it resulted in the highest vapor rate per unit vacuum during the 2017 MPE pilot test.

3.3 Wellfield Piping Extension and New Connections

3.3.1 Existing Wellfield Piping and Connections

The existing piping systems between the treatment system and well field include groundwater, air, and VAE piping and are shown as existing piping in Figure 1-2. The two types of piping configurations, elevated and on grade, are detailed in Figure 3-1. Piping specifications are as follows:

- Groundwater and VAE piping are Schedule 80 PVC.
- Air piping is Schedule 40 carbon steel.

- Existing field piping is installed on-grade with several concrete slab pipe anchors and guides. Where piping crosses the roadway, the piping is installed in a precast culvert or "utilidor."
- Existing field piping is heat traced and insulated.

The existing system has groundwater lateral piping from each well joining a single main header conveyance line near the well field. A vacuum and flow gauge will be added to the VAE piping at each well. Valves will be added to the lateral line of each well on the VAE and groundwater piping to allow the isolation of the well for maintenance or repair.

VAE piping from each well joins a single conveyance line near the well field. Total vapor flow is automatically monitored and recorded at the programmable logic controller (PLC), but individual well flow is not.

Each wellhead has the following on the VAE piping:

- Sample port.
- VAE flow gauge.
- Pressure relief valve/adjustable pressure regulator.
- Ball valve for well flow and vacuum adjustment and isolation.

Pump cycle counts and regulator settings are recorded manually during operation of the MPE system. See Appendix I for the record drawings.

3.3.2 Expanded Field Piping Runs

The existing MPE system will require modifications to suit expanded MPE pilot testing of the P1 zone and adding P2 and Roza aquifer wells. The expanded piping system will not need to be heat traced or insulated because the MPE system will not operate in the winter.

The conceptual expansion piping layout, shown in Figure 1-2, has additional laterals added onto the existing header pipes and a second header pipe added to the system with several laterals. As the design progresses, the piping will be evaluated to determine if the existing piping has the capacity to convey the vapor and water from the additional wells. If there is not sufficient capacity, a parallel header pipe could be added. Figure 3-2 shows a field piping schematic diagram for the expanded MPE system.

3.4 Liquid Treatment Train (LTT)

The existing LTT includes the following major process equipment and treatment steps:

Oil Water Separator (OWS) – The first liquid treatment step is an OWS (T-101). The OWS is a coalescing plate type separator housed in a 194-gallon tank. Oil effluent and bottom sludge are drained to a waste collection tank (T-105) while the liquid effluent is routed to the air sparge (AS) tank (T-102) and the vapor produced by this process is routed to the knockout (KO) tank (T-105).

Waste Collection Tanks – Waste from the OWS (T-101) is discharged into PCO-300 waste collection tanks (T-104 #1 and #2). A liquid level sensor in the tank #1 reports back to the control panel a liquid surface high level alarm (LSH 104) and a liquid surface high high level alarm (LSHH 104). Once tank #1 is full, the content is routed to tank #2 for characterization and disposal. Each tank has 300-gallon capacity. Nothing drained to these tanks during prior MPE pilot testing in the P1 zone.

AS Tank – The second liquid treatment step is a bubble diffuser system in the AS tank (T-102). Air supplied by compressor (C-1) is diffused through the contaminated water and the resulting vapors are conveyed to the KO tank (T-105). The liquid effluent is pumped (P-101) and conveyed to the evaporation pond.

Effluent Pump – Effluent from the AS tank is pumped to the evaporation pond with a three-phase pump (P-101). There are liquid level sensors in the AS tank that trigger the pump to turn on and off with a high-water level alarm light on the control panel.

KO Tank – The KO tank (T-105) treats off gas from the OWS (T-101), waste collection tanks (T-104), and AS tank (T-102). The tank has a mist eliminator, which is a mesh style de-mister inside the outlet at the top of the KO tank. The sparge blower (P-102) moves vapor to the GAC filter (GAC-3) and the liquid drains to the OWS (T-101). There is a dilution air intake filter/silencer prior to the sparge blower in case the vapor pollutant concentration needs to be lowered.

GAC Filter – Off gasses from the LTT are rerouted through the VTT treatment train through the three GAC filters for treatment and discharge to the atmosphere.

See Appendix I for the equipment layout and process diagrams for both the existing LTT and VTT systems.

The LTT process is designed to reduce NAPL and VOCs in the extracted groundwater prior to discharge to the evaporation pond. Metals also precipitate in the system, particularly within the AS tank due to the introduction of oxygen.

Analysis of the existing LTT shows that liquid flow capacity will likely not be the limiting factor on the number of wells that can be added to the MPE system. The peak flows are further reduced by MPE well sequencing. See Section 7.2.1 for initial settings and startup.

3.4.1 Air-sparge System

Additional flow in the LTT could require more frequent maintenance on the system. The air-sparge portion of the LTT causes metal precipitation to occur within the AS tank (T-102) due to the introduction of oxygen to the water that contains dissolved metals. The metals precipitate into the tank, causing significant buildup that periodically requires manual cleaning to prevent blockage of the air diffusers. The addition of several new pumping wells may increase the rate of buildup. If buildup occurs quickly, the groundwater pumps may need to be halted for about 4 hours while the LTT is taken offline to allow manual cleaning of the AS tank and air diffusers. This should not affect vapor extraction.

3.4.2 Evaporation Pond

The evaporation pond, located west of the VTT and LTT (Figure 1-1), covers about 0.75 acres and was originally designed for a continuous year-round groundwater flow of 1.5 gpm. The pond comprises a double, high-density polyethylene liner system with leak detection and is approximately 6 feet deep, including 18 inches of freeboard. The groundwater extraction rate estimated for the first season is just under 1.5 gpm (Appendix G), and wells may be less productive in subsequent seasons.

3.4.3 Liquid Treatment Train Modifications

There are no planned upgrades to the existing LTT system because analysis of the existing LTT shows that liquid treatment capacity is adequate for the estimated flows. To further avoid exceeding the LTT capacity, the system will be started in three sequences, as discussed in Section 7.2.1. This will limit the initial surge of liquid to 70% of the total LTT capacity (see Section 3.2.5 for expected well production rates).

The only planned modification to the LTT system will be relocating the vapor-phase GAC unit (GAC-3) to the VTT system. The off gasses from the LTT system will be treated with the VTT system. See Appendix F for modified piping and instrumentation diagrams and equipment locations.

3.5 Vapor Treatment Train (VTT)

As shown in Appendix I , the existing VTT comprises the following major process equipment and steps:

KO Tank – The KO tank (T-201) is the first treatment step for the vapor coming from the well fields through the condensate sump. The tank has a mist eliminator, which is a mesh style de-mister inside the outlet at the top of the KO tank. The VAE blower (P-202) pulls the vapor from the KO tank through an inline filter and clear trap to the heat exchanger (W-201). There is a dilution air intake filter/silencer prior to the inline filter in case the vapor pollutant concentration needs to be lowered. The liquid that is pulled out of the vapor is pumped by the KO tank transfer pump (P-201) to the OWS (T-101) in the VTT container.

VAE Blower – The VAE blower (P-202) is a rotary claw-style positive displacement vacuum blower with a variable frequency drive (VFD). The VFD cycles between the ranges to automatically maintain the desired pressure setting. The blower is used to set the vacuum pressure in the MPE well system. The VAE blower throttles up or down depending on the vapor flow rate through the system to maintain a constant system pressure. Changes in the blower setting for system pressure is the primary method for controlling flows through the VTT system. The VAE blower discharges vapor to the heat exchanger (W-201).

Heat Exchanger – The heat exchanger (W-201) cools VAE blower (P-202) discharge to prevent it from overheating the GAC filters.

GAC Filters – The final treatment step for vapor in the VTT is a GAC unit train (GAC-1, GAC-2, GAC-3). Once through this polishing step, the vapor is discharged to the atmosphere.

See Appendix I for the equipment layout for both the existing LTT and VTT systems.

The VTT removes condensation, particulates, and VOCs from the extracted vapor.

Analysis of the existing equipment in the VTT indicates there are system capacity limits that may affect the number of wells that can be added for vapor extraction. The constraining system components are the VAE blower (P-202) and the heat exchanger (W-201). See the sections below for detailed discussion of VTT equipment and changes to the VTT system.

3.5.1 Compressor

The existing compressor services the MPE well pumps, air sparge system, and condensate sump. See both Appendix F and Appendix I for existing and proposed compressor diagrams. The existing compressor capacity is 80 actual cubic feet per minute (acfm) (75 standard cubic feet per minute [scfm]). The MPE well pumps are expected to require only 4 acfm after the initial dewatering period, leaving adequate flow for the AS tank (T-102) and the condensate sump located south of the VTT container. The existing compressor is adequate for the proposed operations included in this IAWP.

3.5.2 Vacuum System

The VAE blower sets the vacuum pressure for the entire well system. As more wells are brought online, the vapor flow rate will increase up to the VAE blower capacity. The blower tests run on the existing VAE blower after it was installed in the VTT during the 2017 MPE pilot test shows the pump capacity (Figure 3-3).

The addition of MPE wells and VE wells will require additional vapor flow capacity. A regenerative blower equipped with a VFD will be installed to achieve required vapor flows at inlet vacuums of approximately 3 to 5 inches-Hg. A regenerative blower was selected for higher vacuum pressure at relatively low vapor flows. The specific operating point of a regenerative blower will depend on vapor flow resistance in the P1 and P2 zones and Roza aquifer, system settings such as valve positions, and piping and fitting resistance. Exact resistance to vapor flow cannot be accurately predicted for the expanded MPE areas. The VFD effectively expands the operating range of a particular blower. See Figure 3-4 for an operating characteristic curve for a representative blower.

The existing VAE blower P-202 tag will be updated to P-202A. The proposed blower will be tagged as P-202B. The VAE blower and the proposed blower will not be used for vapor extraction at the same time. The equipment will be piped in parallel, providing the system with alternatives for low vapor flow rate operation and high vapor flow rate operation.

The blower motor will be explosion proof or Class I Division 1 rated as defined by the National Electrical Code. The blower's required footprint will be larger than the existing vacuum pump. To provide room in the VTT container, equipment will need to be relocated. See the discussion of GAC units in Section 3.6.4. Table 3-3 compares the existing VAE blower performance with the proposed blower.

3.5.3 Heat Exchanger

The VTT controls the vapor temperature entering the GAC filter train using the heat exchanger. Vapor temperatures increase when passing through a blower. The exchanger transfers heat from the vapors to the ambient air. The system is closed in a shell-and-tube heat exchanger, so there is no contact of vapors with ambient air. Heated ambient air is vented and discharged outside the VTT container. The VAE blower's (P-202A) temperature alarm set point is 125°F to avoid exceeding the GAC units' maximum allowable temperature of 140°F. The heat exchanger is conservatively sized for the maximum temperature increase and flow for the VAE blower (P-202A). See model number 6302 in Appendix E for the existing heat exchanger's product information. An additional larger heat exchanger will be required for the additional blower. See Table 3-4 for proposed heat exchanger and equipment limits. See Figure 3-5 for heat exchanger single pass curve.

The existing heat exchanger W-201 tag will be updated to W-201A. The proposed heat exchanger will be tagged as W-201B. See model number 6421 in Appendix E for detailed product information. The proposed heat exchanger is from the same manufacturer and will be a single pass shell-and-tube heat exchanger. W-201A and W-201B will not be operated at the same time; instead, they will operate with their respective vacuum blower (P-202A or P-202B). The equipment will be piped in parallel and provide hand valving for equipment isolation. The fan motor will be explosion proof or Class I Division 1 rated as defined by the National Electrical Code. The heat exchanger fan and required footprint will be larger than the existing heat exchanger. To provide room in the VTT container, equipment will need to be relocated. See the discussion of GAC units below.

3.5.4 Granular Activated Carbon

The existing VTT and LTT have GAC filters as the finishing treatment step for the vapor from the extraction wells. When the GAC has been fully saturated, the contaminants can break through the treatment and discharge into the ambient air. The activated carbon inside the units can be replaced; however, the treatment system must be turned off during the process, which takes approximately 1 day. During the 2017 MPE pilot test, the VTT, which had two GAC units in series, experienced two breakthroughs that required the system to be shut down and the carbon replaced. Two GAC units in series are sufficient for the current and proposed work in the IAWP; however, existing 500-pound carbon vessels will be replaced with larger ones. The LTT vapor will be rerouted into the VTT, rather than discharging through a dedicated LTT GAC unit. The GAC system, which will be moved outside, will comprise three 2,000-pound GAC units plumbed so that any two will be used in series, with the third on standby. Installed photoionization detectors will also be added to alarm the system and activate the strobe when a switchover and GAC changeout is needed. The larger units should extend the GAC changeout interval to 11 or more days and reduce the risk of breakthrough emissions to the atmosphere. The three-unit configuration also allows GAC changes while the system is running. GAC sizing and operation strategies may be further refined during 30% design.

GAC relocation to the exterior will allow for easier access to the top of each unit for carbon replacement and general maintenance. The GAC units are primarily made of SA-36 carbon steel, which is prone to rusting. However, the units are coated in Carboline Carboguard 635 and rated for seawater immersion. The units are coated internally and externally with the same product for rust protection and exposure to the elements. A housekeeping pad and removable shelter may be desired for the GAC Units. This shelter may be proposed for the 30% design.

3.6 VTT and LTT Controls

The VTT and LTT controls will need to be modified to accommodate new equipment. Modifications will include adding components and replacing the human machine interface (HMI), as described below.

3.6.1 Existing conditions

The existing control system consists of a main control panel (CP-100), motor control panel (CP-101), and a compressor panel. CP-100 houses a Schneider Electric M221 Nano PLC and a Schneider Electric Magellis HMI with 12.1-inch touchscreen. All signals for the VTT and LTT system are processed, monitored, and controlled from CP-100.

CP-101 primarily houses the motor starters for the 480-volt and 120/208Y motor loads, except for the compressor motor starter, which is in the compressor panel. See Table 3-6 for a detailed list of available input and output (I/O) channels for CP-100.

3.6.2 VTT and LTT Control System Additions

Additions to the VTT and LTT control system will be performed at CP-100 where the existing PLC and HMI for the system reside. Additional PLC equipment may be incorporated into the design updates of CP-100 if the existing PLC does not have adequate capacity to accommodate I/O introduced by new equipment. The new equipment and anticipated I/O from each equipment are discussed in the following sections.

3.6.3 New Blower I/O and Equipment Requirements

The new blower system is expected to be installed as an addition to the existing blower system, and will consist of the blower, a VFD, two vacuum pressure transducers, a positive pressure transducer, and a temperature transmitter. It is assumed that the new blower will have the same signals and auxiliary equipment as the existing soil vapor extraction (SVE) blower, because each piece of equipment is expected to be like-in-kind to existing equipment (specific manufacturers and models will be determined during design). Under this assumption, the signals expected to be added to CP-100 for the new blower are provided in Table 3-7.

3.6.4 New Heat Exchanger I/O and Equipment Requirements

The new heat exchanger system is expected to be installed as an addition to the existing heat exchanger system and will consist of a heat exchanger and a combination motor starter. It is assumed that the new heat exchanger system will have the same signals as the existing heat exchanger system. The signals expected to be added to CP-100 for the new heat exchanger are provided in Table 3-8.

3.6.5 HMI and PLC Programming

The replacement and addition of VTT and LTT system equipment will require programming modifications at the PLC and HMI at the main control panel (CP-100). HMI modifications will incorporate the new equipment into new or existing graphic displays to show process information, alarms, and alarm and operating setpoints for the new equipment. Similarly, PLC modifications will incorporate the new equipment into its program to accommodate their hardwired signals as discussed in earlier sections and integrate the logic necessary to incorporate the new equipment into the VTT and LTT systems. Push buttons, pilot lights, and selector switches on CP-100 associated with the control of existing equipment will be added and mimicked for new equipment of similar type (e.g., heat exchanger and blower).

Consideration will be given to how the new equipment will integrate with the existing equipment, and a control narrative can be produced to document the intended HMI and PLC changes at a later stage of design.

Process data collected by the PLC are currently being historized in the HMI. Historization in the HMI presented issues during the 2017 MPE pilot test because the existing equipment as commissioned produced files that were unnecessarily large due to high sampling rate (around 6 minutes). The existing HMI is obsolete, and the supporting software is no longer available.

The data historization scheme will be reconfigured such that the HMI will no longer historize data, but the PLC will. Once configured, the PLC is expected to produce historized data files that are readable, because the sampling rate will be reduced to 1 hour for manageable file sizes.

3.7 Electrical Service

The existing electrical service is sufficient for the planned loads. The main power and distribution panels will continue to have available capacity after new load additions. Electrical loads and distributions are summarized below.

3.7.1 Existing Conditions

The current multi-point vacuum system is fed by main distribution panel 1 (MDP-1) located inside the support building, the VTT and LTT main distribution panel (VTT/LTT distribution panel), and containers #1 and #2 (VTT/LTT panelboard PBD-1). The main distribution panel feeds the VTT/LTT (VTT/LTT MDP-1) distribution panel via a 200-amp circuit breaker.

MDP-1 is a 400-amp, 480-volt, 3-phase, 3-wire distribution panel that is currently at 43% capacity at 172 amp (calculated). Table 3-9 summarizes existing used capacity for MDP-1.

VTT/LTT MDP-1 is a 200-amp, 480-volt, 3-phase, 3-wire distribution panel that is currently at 55.37% capacity at 111 amp (calculated). Table 3-10 summarizes existing used capacity for VTT/LTT MDP-1.

3.7.2 Required Power Capacity

With the addition of the equipment outlined in Sections 3.2 and 3.4, the main distribution panels would be loaded as shown in Table 3-11 for MDP-1 and Table 3-12 for VTT/LTT MDP-1.

3.7.3 New Blower (20 HP)

A new blower will be fed from VTT/LTT MDP-1 and will require the procurement and installation of a new molded case circuit breaker in VTT/LTT MDP-1, as well as a new VFD and line reactor in the controls room. New conduit and cable will be required from VTT/LTT MDP-1 to the new blower. Conduit and cable types and methods are outlined in Section 3.8.5.

3.7.4 Additional Heat Exchanger (5 HP)

A new heat exchanger will be fed from VTT/LTT MDP-1 and will require the procurement and installation of a new molded case circuit breaker in VTT/LTT MDP-1, as well as a new combination motor starter in the controls room. New conduit and cable will be required from VTT/LTT MDP-1 to the new heat exchanger. Conduit and cable types and methods are outlined in Section 3.8.5.

3.7.5 Conduit and Cable Design Criteria

Conduit shall be sized as required by the National Fire Protection Association 70. All exposed, surface-mounted conduit will be rigid galvanized steel. All direct buried conduit will be Schedule 40 PVC with rigid galvanized steel elbows and risers.

Power, control, and signal conductors will be sized as required by National Fire Protection Association 70. All power conductors will be of type XHHW. All control conductors will be of type THHN. All signal conductors will be twisted shielded pair, with the number of pairs determined by the equipment.

4. Engineer Design Development

This section addresses the conceptual design effort and expected product for expanding the MPE system capacity and performance. Table 4-1 is the preliminary list of plan sheets for engineering design. Table 4-2 is the preliminary list of specification sections.

The expansion of the MPE system is currently at a preliminary level of design. The design will be advanced to the 30% completion level after this workplan is approved by Ecology. The following is a preliminary list of engineering tasks to be completed during design development.

- Calculate thermal expansion for field piping and determine distance between pipe anchors.
- Establish a minimum distance between the header pipe and the wells.
- Survey the site, including location of existing header pipes, lateral pipes, wells, and updated topography.
- Expose existing liner system in areas where grading cover materials might have altered liner drainage contours to determine the need for repairs.
- Identify well access points and detail roadways and roadway crossings.
- Verify existing header pipe capacities are sufficient for added flows.
- Calculate pipe size required for the new header pipes and lateral pipes.
- Identify locations for vapor control valves and vapor flow monitoring to help balance vacuum between wells.
- Evaluate additional venting or temperature control of the existing treatment containers based on new thermal loads.

5. Permits

The Order exempts the County from the procedural requirements of local government permits, instead requiring substantial compliance with permits and conditions that would otherwise be applicable. Some local and state permitting will nonetheless be needed to expand the MPE system and perform the full system pilot test.

Electrical improvements will require Washington State Department of Labor and Industries (L&I) approval. Electrical plan review by L&I is not anticipated for the level of work planned. L&I inspections of physical electrical work will be required. Parametrix anticipates requesting plan review if warranted, with the construction contractor coordinating inspections.

Parametrix will develop a State Environmental Policy Act checklist for the expanded MPE project. Grant County Planning Department previously issued a determination of non-significance (DNS) for work under the Order and a DNS by addendum for the earlier pilot test. A new DNS by addendum is anticipated for the expanded MPE pilot test.

Parametrix or the contractor will develop the notice of intent for project coverage under the Construction Stormwater General Permit.

The project may require a Grading Permit from Grant County for disturbance of slopes. Parametrix will develop the grading permit application if needed once the construction plans are developed, following high-resolution survey of the project area.

The project will continue to adhere to applicable substantive requirements of the solid waste permit, although the County is exempt from the procedural requirements during the Model Toxics Control Act cleanup action.

6. Cost Estimation

Table 6-1 contains the engineer's preliminary opinion of probable construction cost (estimate) for expansion of the MPE pilot system.

The estimate is based on the following assumptions:

- Mobilization is 12% of material and labor costs.
- 10% Contractor overhead and profit.
- 8.2% sales tax in the City of Ephrata.
- 50% contingency.

Utility quantity take-offs are based on Figure 1-2. Equipment pricing is based on vendor quotes and estimated costs for installation are added. Cost estimate details are contained in Appendix J.

The preliminary construction cost estimation is consistent with Class 4 estimation described by the Association for the Advancement of Cost Engineering. Class 4 estimates are based on limited information with a project definition of 1% to 15% (bid documents are considered 100% definition). The Class 4 contingency range is −30% to +50% of estimated cost.

7. Testing

This section, along with the SAP (Appendix A) and O&M manual for the existing MPE system comprise an O&M plan developed in accordance with Washington Administrative Code (WAC) 173-340-400(4)(c).

7.1 Tests During Construction

As part of the expanded MPE system construction, the system will be tested and commissioned as follows:

- Visually inspect the treatment containers and surrounding area. Confirm there are no visible leaks and significant weathering.
- Inspect, clean, and confirm operation of existing HVAC system for both treatment containers.
- Visually inspect the evaporation pond liner.
- Conduct hydraulic testing and air testing of all piping. Monitor existing pressure gauges and flow meter during testing. Confirm accuracy with external pressure gauge and flow meter.
- Test and commission new equipment according to manufacturer recommendations.
- Clean the existing equipment according to manufacturer recommendations (e.g., heat exchanger fouling, sparge tank fouling, filters, and pumps).
- Inspect pump, blower, and motor gaskets prior to operation.
- Inspect the GAC filters coating internally and externally.
- Test the controls system.
- Inspect well head, connections, fittings, and well pump.

7.2 Full MPE System Pilot Test

Prior to the full MPE system pilot test, the above tests will be conducted during construction and all new equipment will be tested. Details regarding the full MPE system pilot test are provided below.

7.2.1 Vacuum and Vapor Settings and Adjustments

The O&M manual describes start-up procedures, LTT operation, and VTT operation for the existing MPE Pilot system. The initial start-up will remain the same. See the text below for LTT and VTT initial settings.

During initial and seasonal startup, the well pumps will operate in sequence. See Tables 3-1 and 3-2 for groundwater well production and well sequencing. These well sequences will be started 1 week apart to avoid overloading the LTT system. Flow meter (FE/FIT 101) will be closely monitored during initial startup and the incoming flow can be throttled using the installed control valves. See Section A of the O&M manual for the operation and setpoints of the LTT system.

The MPE System will initially operate using the VAE blower (P-202A) and blower VFD with a vacuum pressure of 3.5 inches-Hg. As MPE and VE wells are added, the VAE blower's maximum flow capacity will be exceeded. The vacuum system will then be operated at 3.5 inches-Hg using the blower (P-202B) and blower VFD. The vapor flow will be monitored individually at each well and in total at the VTT system. Controls valves will be adjusted to balance the vacuum at each well. The VAE blower P-202A will require operation of heat exchanger W-201A, and the blower P-202B will require operation of the heat exchange W-202B. See Section A of the O&M manual for the operation and setpoints of the LTT system.

7.2.2 Seasonal Shutdown

The MPE pilot system should be cleaned and winterized prior to seasonal shutdown. A list will be included in the MPE system's final O&M manual. Some additional guidance is provided below:

- Remove MPE pumps, data loggers, and pump appurtenances.
- Disconnect vapor lines and vacuum lines from well heads and seal the pipes and wellhead openings.
- Seal MPE, VE, and VAE well heads for the season. Observation wells will remain.
- Drain liquid and vapor lines to prevent freezing condensation and damage to the piping.
- Run the condensate pump until the condensate sump is fully drained. Remove pumps for the seasonal shutdown.
- Clean and service air, particulate, intake, and inline filters.
- Clean and drain AS tank and KO tanks and inspect for fouling. Inspect mist eliminators for corrosion.
- Clean, blow off, and inspect heat exchangers and inspect for fouling.
- Safely depressurize, drain, and clean the compressor and inspect for fouling.
- Service the air dryer and coalescing filter according to manufacturer's recommendations.
- Drain air lines of any condensate or liquid.
- Remove or drain oil waste drums and waste collection tanks.
- Consider if the GAC should be replaced prior to the following year's system restart. Confirm the units are fully drained and cover exterior GAC units for seasonal storage.
- Clean and inspect the treatment train containers' HVAC and exhaust system. The HVAC system will remain on during seasonal shutdown to provide heat and ventilation to the building.

All equipment, controls, and instrumentation shall be stored according to the manufacturer's long-term storage recommendations. For equipment such as pumps or fans requiring yearly maintenance, this maintenance should be performed during seasonal shutdown.

7.2.3 Seasonal Restart

For MPE pilot system restart, the system and individual equipment should be inspected. See Section 7.2.1 for initial settings and startup. Some additional guidance is provided below:

- Inspect the building and HVAC system prior to the seasonal restart.
- Confirm equipment was cleaned, inspected, and serviced during the MPE pilot system's seasonal shutdown.

- Inspect and start equipment according to the manufacturer's recommendations.
- Place MPE well pumps in well heads. Confirm connections to air, vapor, and liquid piping.
- Power and operate compressor and confirm steady pressure. Refer to manufacturer's recommendations for startup procedure.
- Check HMI, pressure and temperature instrumentation, and data loggers for operation. Calibrate data loggers and instrumentation per manufacturer's recommendations.
- Follow initial startup and settings procedure (see Section 7.2.1 for details).

7.3 Operation and Maintenance Plan

This IAWP, along with the existing MPE system O&M manual, comprise a plan developed in accordance with WAC 173-340-400(4)(c). All changes made to the existing treatment system, setpoints, instrumentation, and equipment will be reflected in a future updated O&M manual. This IAWP, along with the existing O&M manual and submittals that will be required during the MPE expansion construction, are sufficient to start the expanded MPE pilot test while the updated O&M manual is completed.

No changes are expected for the LTT system startup, LTT maintenance, and LTT troubleshooting sections of the O&M manual.

The new VTT equipment will be included in the O&M manual update. New equipment will be controlled like similar existing equipment. Existing O&M manual sections will apply as follows to new equipment:

- Section A.2.b "Vacuum Blower VFD" will apply to both the existing VAE blower (P-202A) and the proposed blower (P-202B).
- Section A.2.c "Vacuum Blower" will include the additional blower (P-202A) and operating range. The proposed blower continuous operating range is 0 to 6.25 inches-Hg.
- Section A.2.d "Heat Exchanger" shall apply to both the existing heat exchanger (W-201A) and the proposed blower (W-201B).
- Section B.3 will include the limiting conditions of both the vacuum blowers and heat exchangers. Additional manufacturer and service information will be provided for Sections D and E.

7.4 Emissions and Waste

Air emissions from the evaporation pond, potential wastes from LTT and VTT operations, and disposal of supplies and personal protective equipment (PPE) from monitoring and sampling are addressed below for the expanded MPE pilot test.

7.4.1 Air Emissions

The LTT reduced VOCs in the extracted groundwater by 80.6% overall during the 2017 MPE pilot test. Using this reduction efficiency, the most recent groundwater analytical results for the MPE wells, and the estimated groundwater extraction rates, annual emissions of toxic air pollutants (TAP) from the evaporation pond were estimated for the expanded MPE pilot test. Appendix K summarizes the pond emissions estimate.

Regulations at 173-460 WAC describe acceptable source impact levels (ASIL), small quantity emission rates (SQER), and de minimis rates. ASIL are expressed as concentrations in ambient air, whereas SQER and de minimis thresholds are in pounds per averaging period. Averaging periods are either 24 hours or 1 year, depending on the TAP.

Major emitters must determine ambient air concentrations of TAP using involved emission modeling. The regulation provides for conservative estimation of emissions using good engineering judgment first, so that was done for this IAWP.

There is no direct comparison between groundwater analytical results and ambient air concentrations. However, ambient concentrations were conservatively calculated by assuming that all TAP in the pretreated groundwater discharged to the evaporation pond over a 24-hour period at the initial (i.e., higher) pump rates would concentrate in ambient air within 1 meter immediately above the pond surface. The results suggest that ASIL would be exceeded for some TAP, although this may be an overly conservative estimation.

Comparisons to SQER and de minimis thresholds were also made. For the TAP with a 24-hour averaging period, emissions in pounds from pretreated groundwater were calculated at the higher initial flow rates. For TAP with annual averaging, emissions in pounds were calculated at the first month estimated groundwater flow plus 6 additional months at the long-term estimated flow. The results indicate that no TAP will exceed SQER or de minimis thresholds.

Although this project is exempt from the procedural requirements of air permitting, the emissions estimate (below de minimis) suggests the expanded MPE pilot test would not require a notice of intent to construct a new emissions source.

Although not calculated, VTT emissions of TAP are expected to be negligible with the planned GAC system improvements to prevent breakthrough. VTT emissions were estimated for the breakthrough period during the 2017 MPE pilot test. Adding these emissions to those calculated for the evaporation pond resulted in loading below de minimis thresholds.

7.4.2 Waste Management

Three waste streams are expected to result from the expanded MPE pilot test: (1) personal protective equipment and supplies spent during sampling and monitoring, (2) disposable filters from VTT and LTT operations, and (3) precipitate removed from time to time from LTT AS tank T-201. The three waste streams will be managed using the Statewide Hazardous Waste Handling and Disposal Service contract, currently held by Clean Harbors Environmental Services, Inc.

The sampling waste stream is expected to comprise latex gloves, spent respirator cartridges, disposable protective outerwear, and similar personal protective equipment items and disposable supplies.

Expected LTT wastes include precipitate that accumulates in AS tank T-102. T-102 is cleaned out manually about every 2 months because a sludge containing iron, manganese, and arsenic accumulates on the diffuser caps and tank floor. During the 2017 MPE pilot test, up to a few gallons of sludge were removed part way through the season, with less at the end of testing. This is expected to continue. Other potential waste sources in the LTT include waste collection tank T-104 #1 and #2, although nothing accumulated in either tank during the 2017 MPE pilot test.

Expected VTT wastes include disposable filter elements (two inline Solberg filters in the SVE blower inlet piping) and air compressor particulate filters.

All wastes will be collected in dedicated 55-gallon drums, which will be kept in the support building garage bay and will be closed and sealed when waste is not being added. Drums will be labeled as containing hazardous waste. At least two and up to four drums will be kept on hand, with one drum at a time being filled. Clean Harbors makes regular collections in Grant County every 2 weeks, although it will likely take more than 2 weeks to fill a drum. Full drums will be picked up by Clean Harbors during regular collection trips.

Spent GAC will be collected by the supplier for recycling.

Used compressor oil will be recycled as the first option or drummed for disposal with other wastes if recycling is unavailable.

8. Reporting

Reporting applicable to the expanded MPE pilot testing is defined in the Amendment and summarized below.

8.1 Monthly Performance Reports

The Amendment calls for monthly interim action performance reports. The contents of these reports are outlined in the SAP (Appendix A) and will be prepared by Parametrix. Monthly reports are to include any data received during the reporting month, a summary of progress, upcoming deliverables, and any deviations from plans or the schedule.

8.2 Interim Action Progress (Completion) Report

The Amendment requires delivery of an interim action progress report following the first 2 years of full MPE system pilot testing, including off season monitoring and sampling. Ecology may determine that no further pilot testing is warranted after the first 2 years, the report will become a completion, rather than progress report. If pilot testing continues after the first 2 years, an interim action completion report will be delivered after the extended testing is complete. The Amendment covers both contingencies and the required report delivery timelines.

9. References

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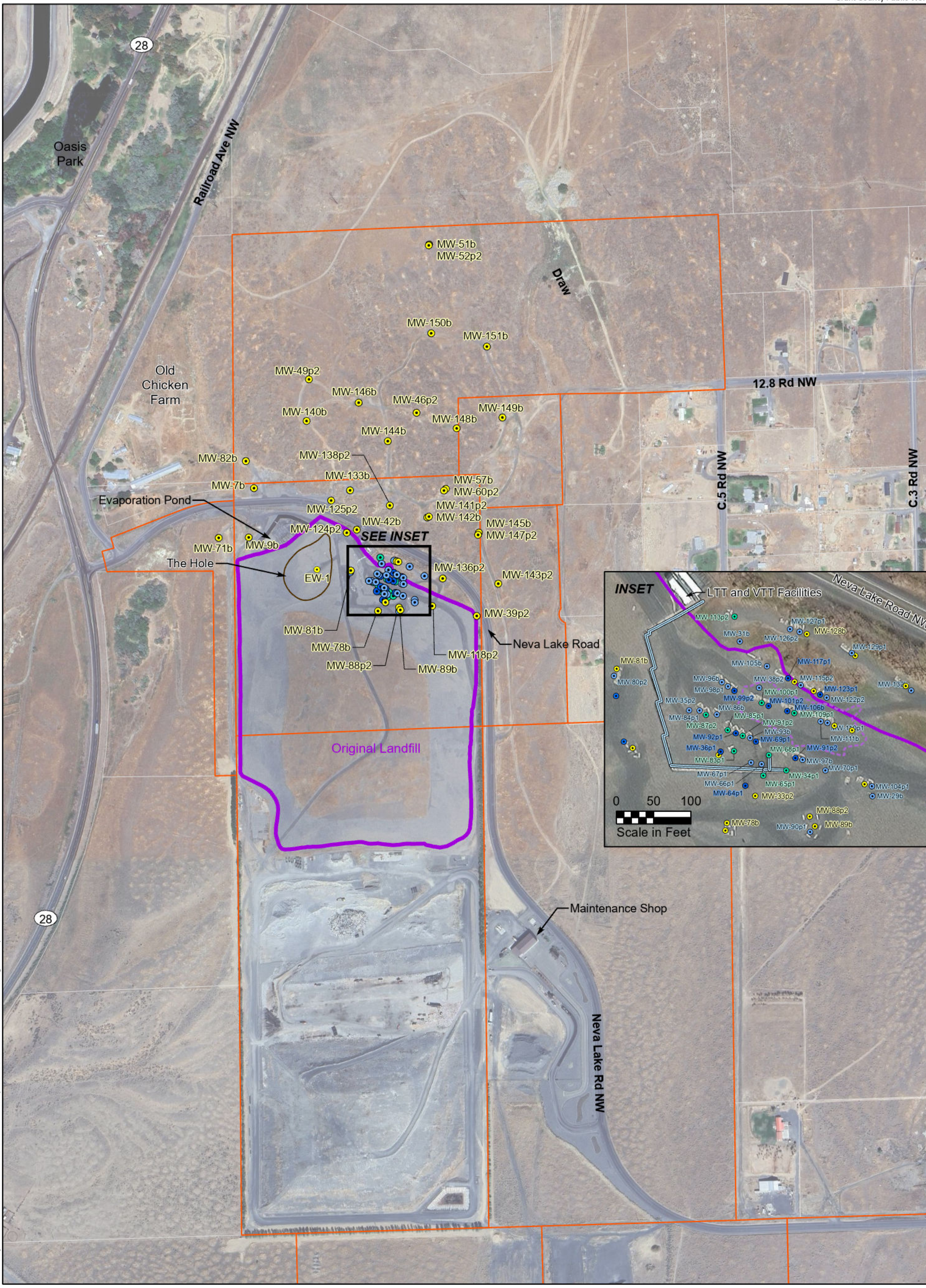
PGG (Pacific Groundwater Group). 2010. Preliminary Public Review Remedial Investigation Report, Ephrata Landfill. Prepared for Grant County Public Works and City of Ephrata. December 2010.

PGG. 2021. Agency Draft Results of Phase 1 North End Supplemental Investigation Ephrata Landfill RI/FS. Prepared by Pacific Groundwater Group, Seattle, Washington. May 2021.

Figures



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- MPE Well
- VE Well
- MPE Observation Well
- GWMP Well
- Existing MPE Pipe
- County-owned Parcel
- Original Landfill

MPE - multi-phase extraction
VE - vapor extraction
GWMP - groundwater monitoring plan

N

0 250 500

Scale in Feet

2021 Google Earth Aerial Photo

Figure 1-1
Ephrata Landfill
Site Map

Figure 1-2
Conceptual Layout, MPE System Expansion

Monitoring Wells
- Multi-phase Extraction
- Vapor Extraction
- Observation
- Existing MPE Pipe
- Existing Discharge Pipe
- Elevated Pipe (Expansion)
- Ground Pipe (Expansion)
- Original Landfill (Capped)

N

0 50 100
Scale in Feet

2021 Google Earth Aerial Photo

Parametrix

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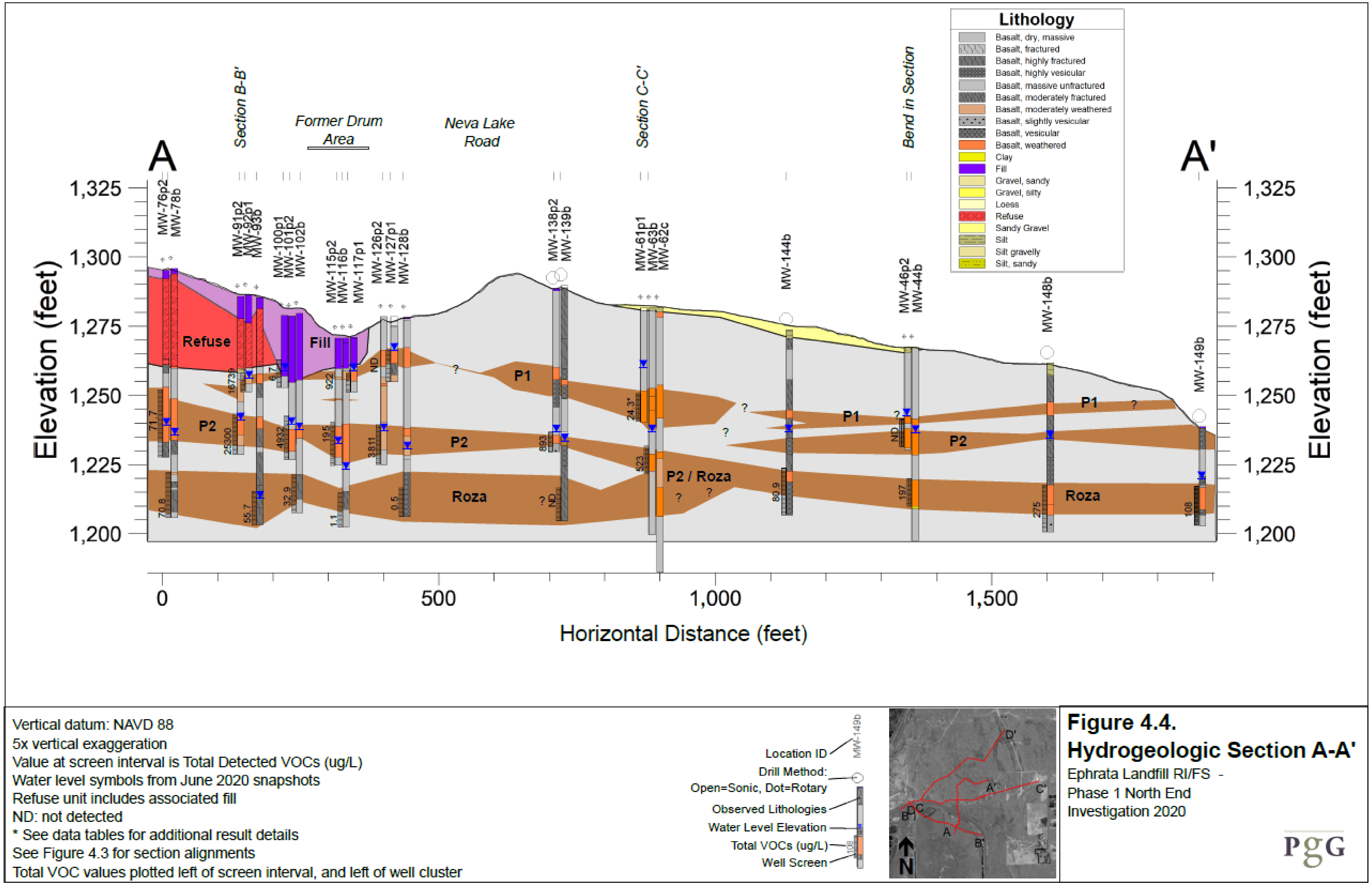
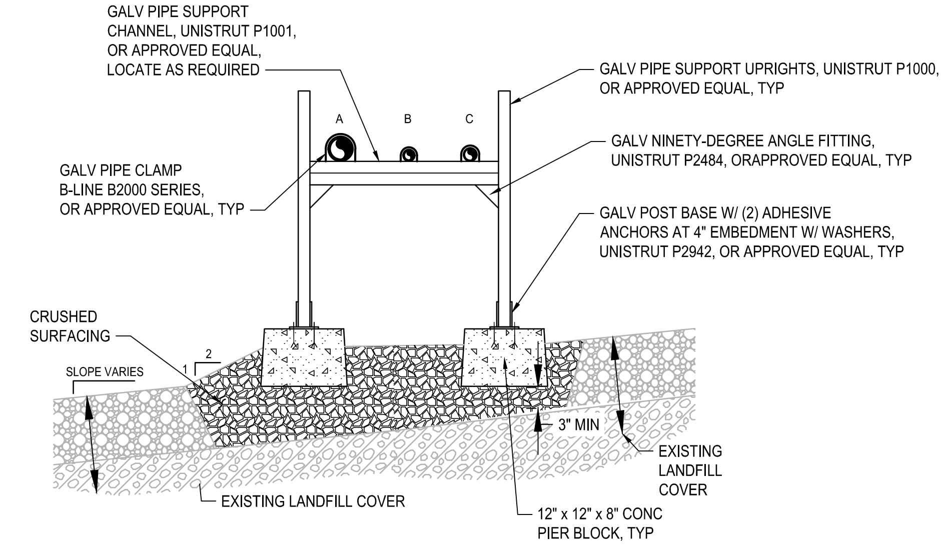


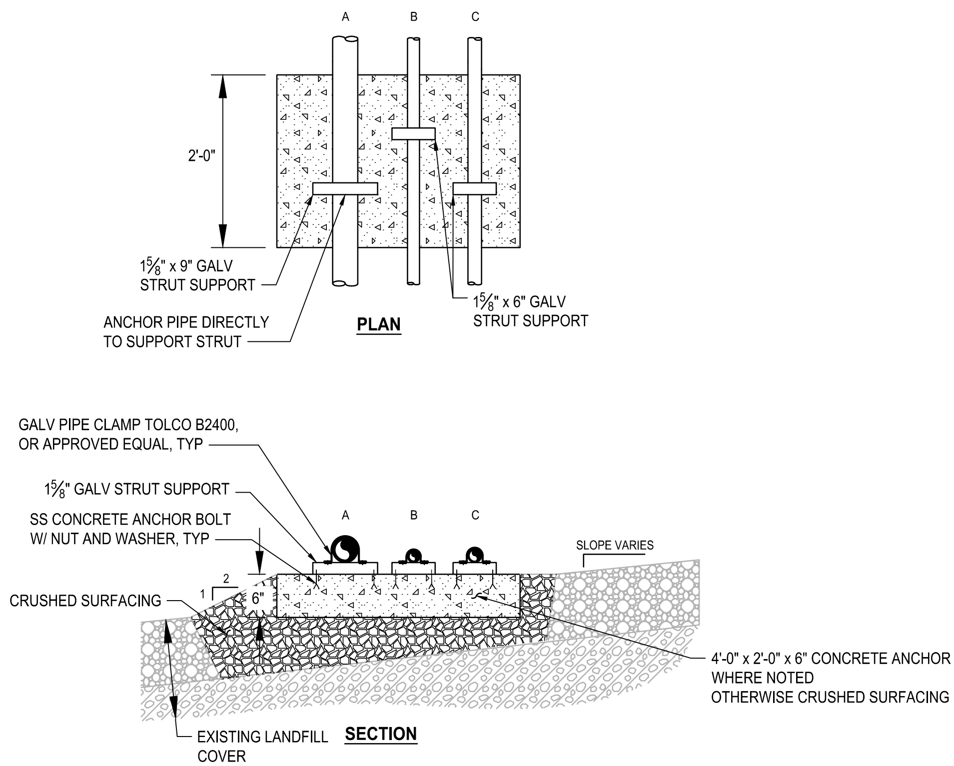
Figure 1-3. Hydrogeologic Cross Section A-A′

PIPE KEY

A SCHEDULE 80 PVC SUCTION PIPE
B SCHEDULE 80 PVC GROUNDWATER PIPE
C SCHEDULE 40 CS COMPRESSED AIR



Elevated Piping



On-grade Piping

Parametrix DATE: January 22, 2025 FILE: WELL TYPE FIGURE

Figure 3-1. Field Piping Types

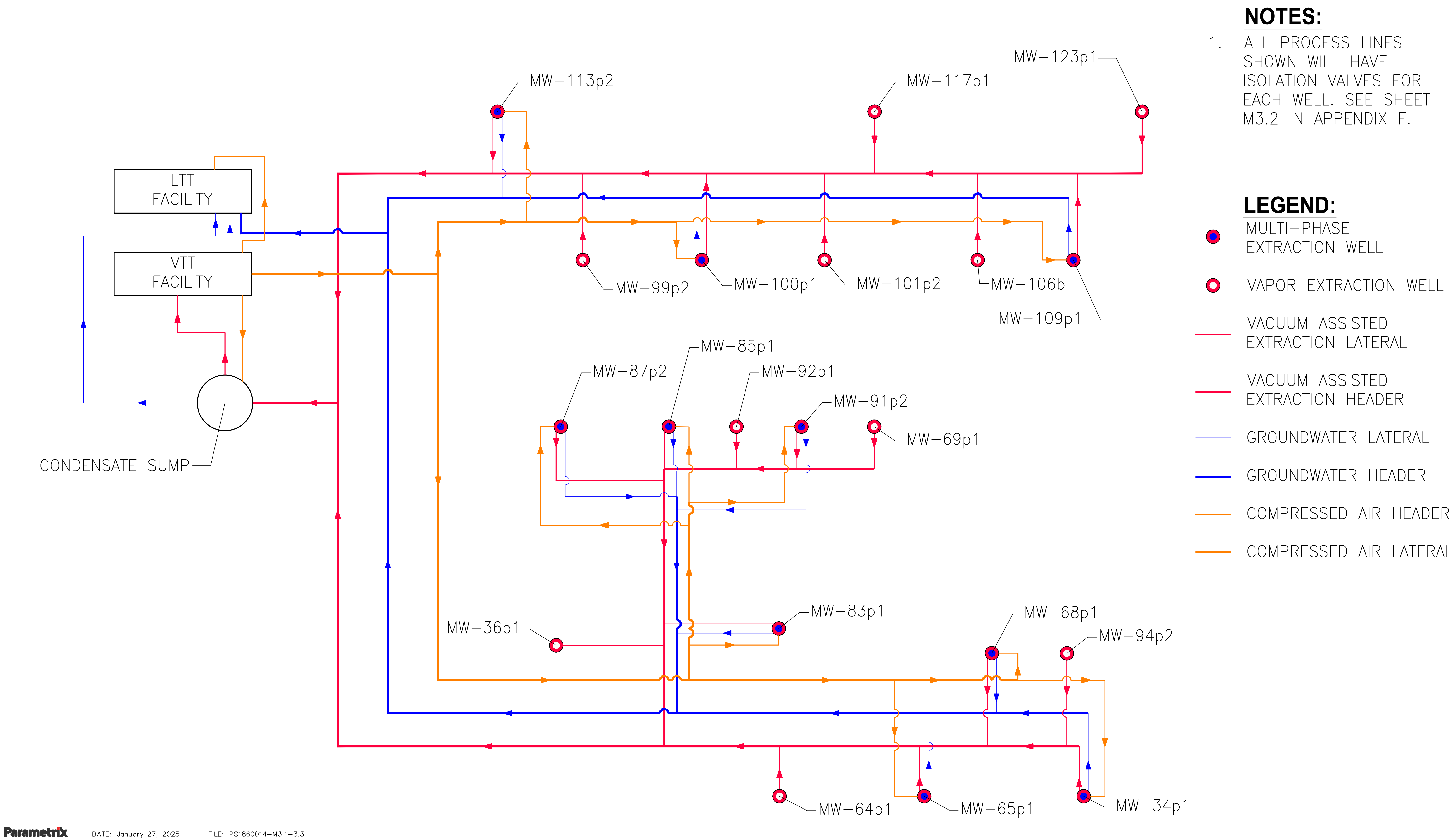
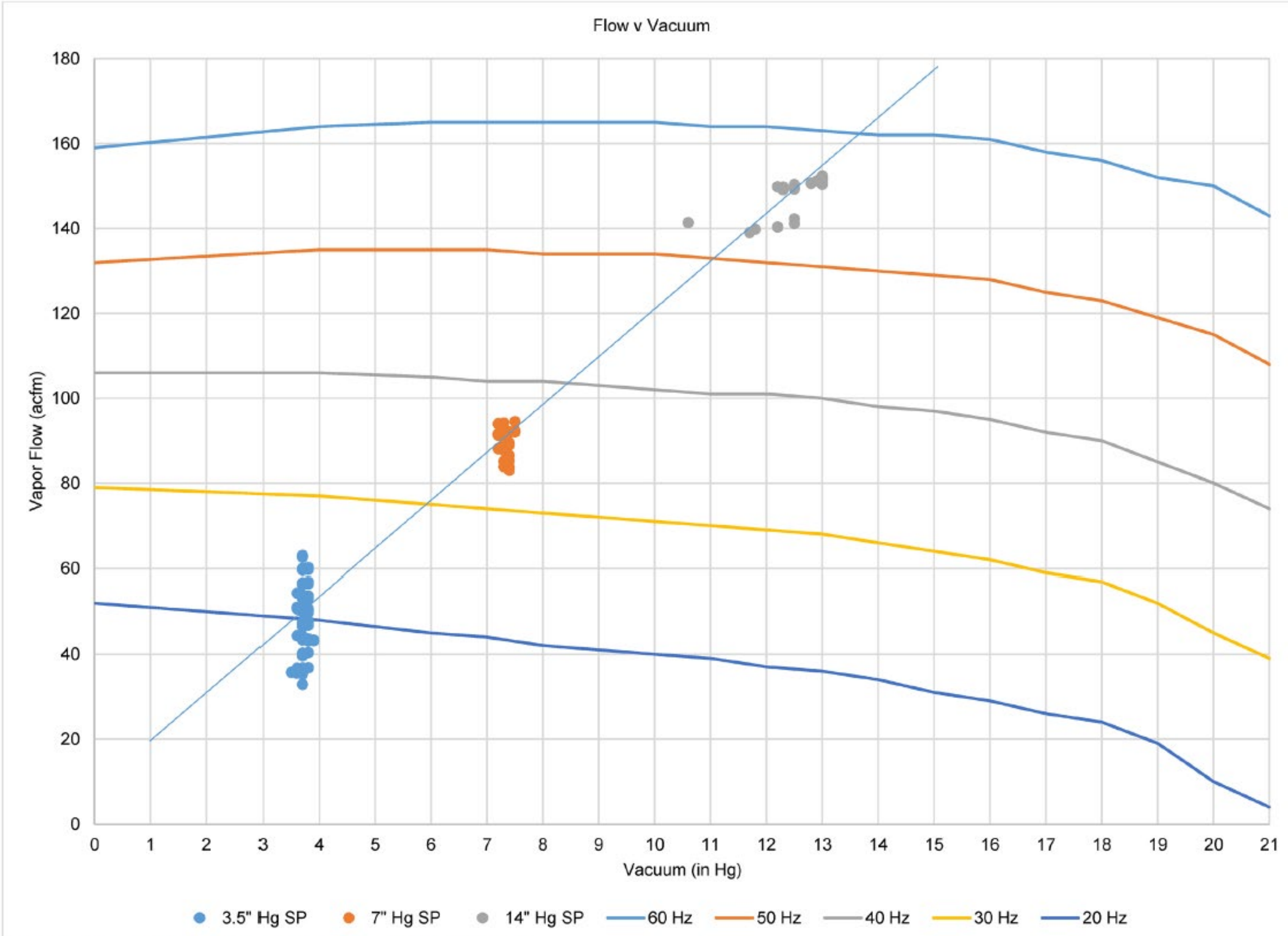


Figure 3-2. Well Field Schematic



" Hg = inches of mercury; Hz = hertz; SP = standard pressure

Figure 3-3. Existing VAE Blower Field Test Curve

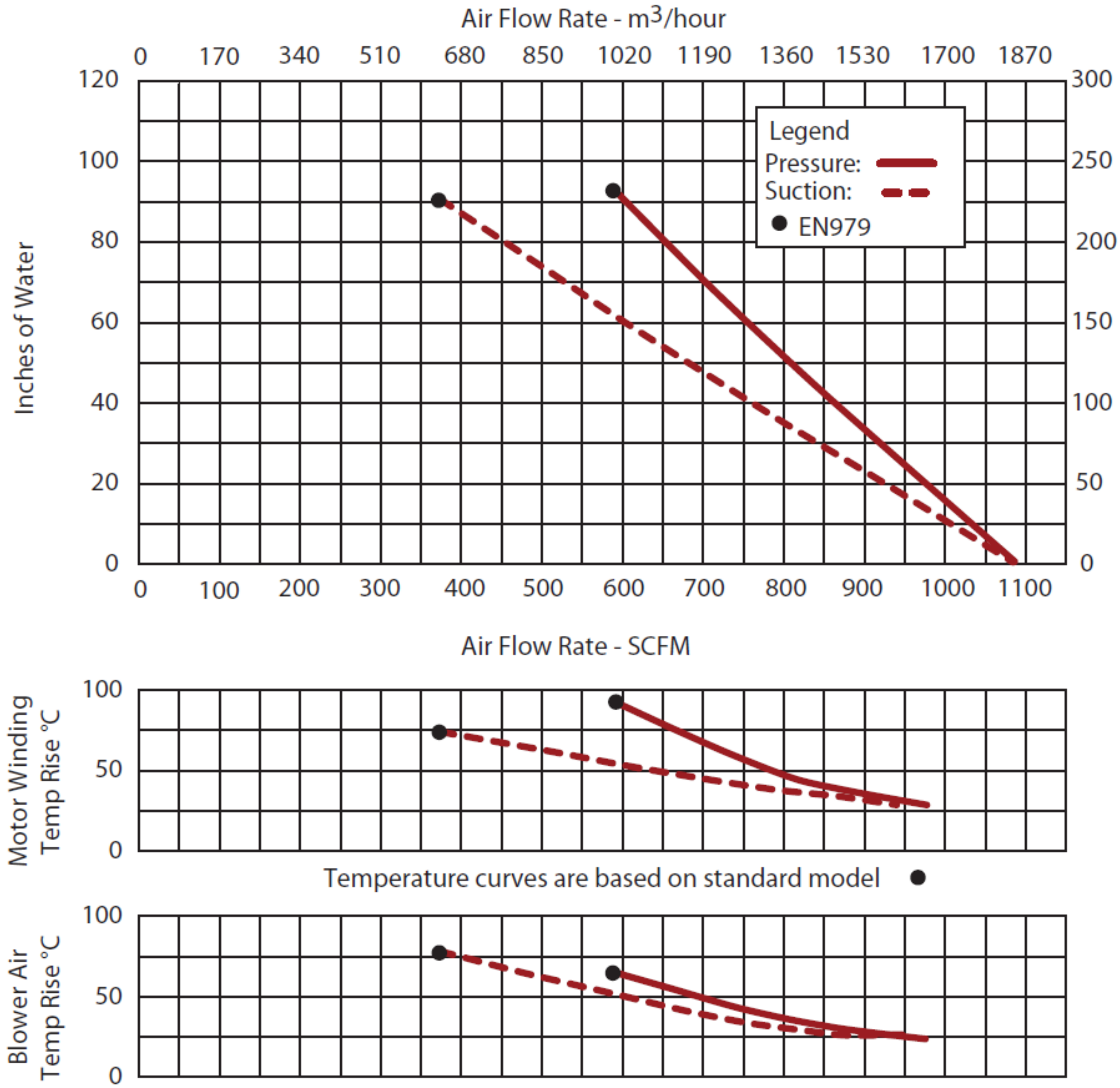


Figure 3-4. Proposed Regenerative Blower Curve

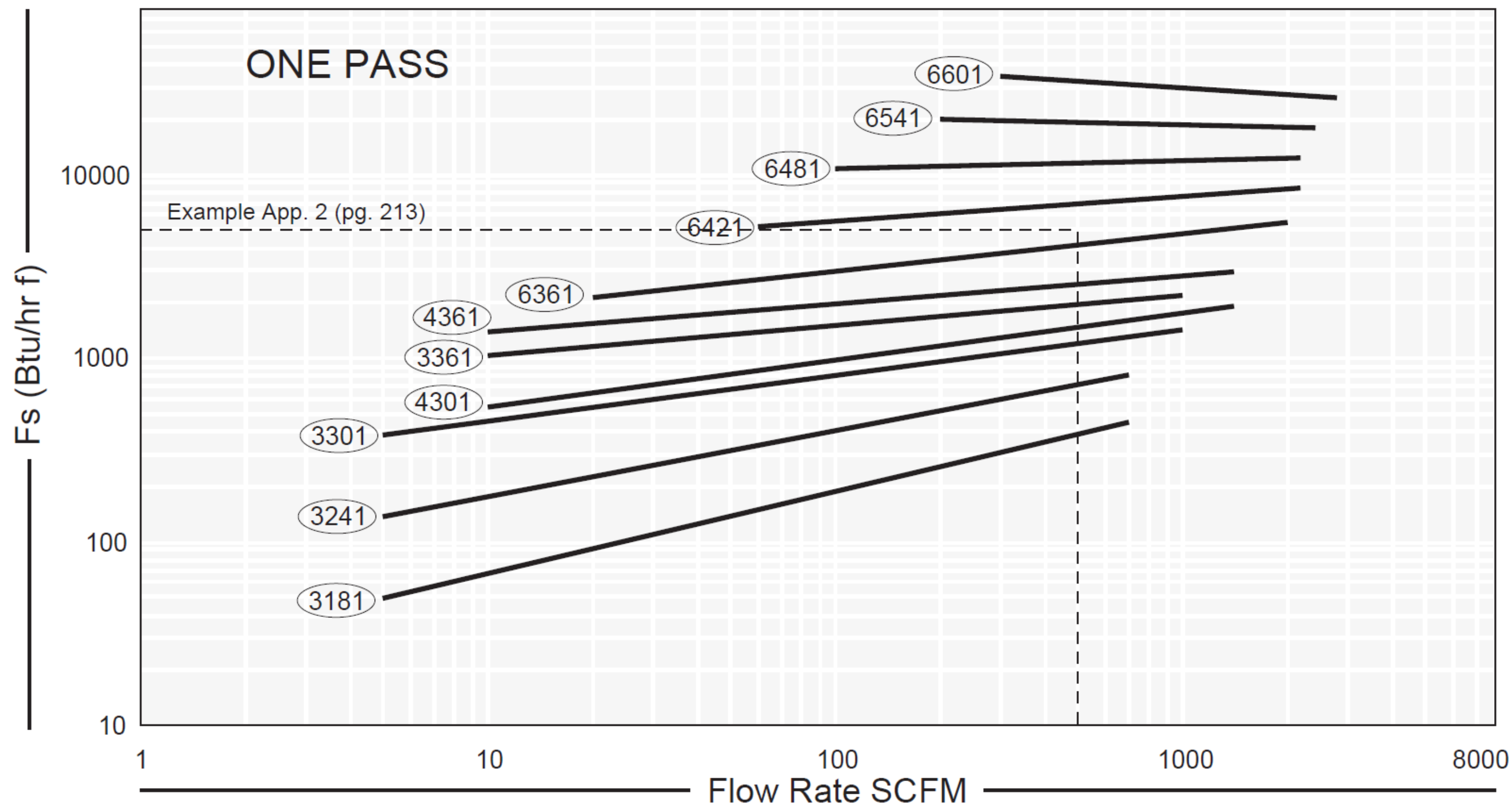


Figure 3-5. Proposed Heat Exchanger Curve

Tables

Table 2-1. Project Contacts

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Prime Contractor	**To be determined through public works bidding**			
Local Contractor (Parametrix Subcontractor)				
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Mott MacDonald				
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Jackey Tuetken	Landfill Foreman	509-350-9651		jdtuetken@grantcountywa.gov
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Table 2-1. Project Contacts (continued)

Name	Role	Phone #1	Phone #2	email
Ecology				
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Jeremy Schmidt	Toxics Cleanup Program	509-724-1164		jesc461@ecy.wa.gov

Table 3-1. Seasonal Groundwater Extraction

Average Rate per Well (gpm) and First Season Total (gal)	
Initial Flow Rate	1.94
First Month Average Flow Rate	0.57
Long-Term Average Flow Rate	0.19
First Season Total Volume	771,676

Table 3-2. Soil Vapor Extraction Rates

Total Vapor Rate for 20 Wells (scfm)	
Low Estimate	169
High Estimate	541

Table 3-3. Blower Performance Comparison

	Existing VAE Blower (P-202A)	Proposed Blower (P-202B)
Vapor Flow (scfm)	116	200 to 700
Vapor Flow (acfm) [1,2]	136	235 to 820
Suction Pressure (inches-Hg)	−3.5 to −12	−3.5 to −7
Potential Temperature Increase (°F)	100 to 320	100 to 200
Recorded Outlet Temperature (°F) [3]	105	N/A

[1] Assumes relative humidity of 10% based on historical Ephrata landfill data. Higher relative humidities increase the acfm.

[2] Assumes temperature of 50 °F based on temperature data for Ephrata. Assumed vapor temperature will remain relatively constant. Higher temperatures increase the acfm.

[3] Recorded during the 2017 MPE pilot test

Table 3-4. Heat Exchanger Performance Comparison

	Existing Heat Exchanger (W-201A)	Proposed Heat Exchanger (W-201B)
Maximum Vapor Flow (scfm)	118	700
Maximum Vapor Flow (acfm) [1,2]	140	820
Inlet Pressure (psi)	14.9	14.9
Inlet Temperature (°F) [3]	175	250
Outlet Temperature (°F) [3]	120	120
Btu/Hour F	370	5142
Alarm Temperature (°F)	130	130

[1] Assumes relative humidity of 10% based on historical Ephrata landfill data. Higher relative humidities increase the acfm.

[2] Assumes temperature of 50 °F based on temperature data for Ephrata. Assumed vapor temperature will remain relatively constant. Higher temperatures increase the acfm.

[3] Recorded during the 2017 MPE pilot test

Table 3-5. Estimated Time to Media Exhaustion on a Flow Basis

	VOC Mass Removal (lbs)	Cumulative Flow (MACF)	Days to media exhaustion at maximum vapor flow (600 acfm)	Days to media exhaustion at minimum vapor flow (200 acfm)
Media Set 2	36	0.5	0.58	1.74
Avg of Media sets	35	2.39	2.76	8.28
Media Set 3	35	4.27	4.94	14.83

Table 3-6. CP-100 Available Input/Output Channels

	Spare Quantity Available	Locations
Digital Inputs	14	Base Unit – Channels 6, 15 Unit 2 – Channels 14, 15 Unit 9 – Channels 6–15
Digital Outputs	13	Base Unit – Channels 8, 9 Unit 8 – Channels 3–7, 10–15
Analog Inputs	6 (5 with ISBs, 1 without)	Unit 4 – Channel 6 with intrinsically safe barrier (ISB) Unit 5 – Channels 2, 5, 7 (all with ISBs) Unit 6 – Channels 5 (ISB), 7 (no ISB)
Analog Outputs	1	Unit 10 – Channel 2

Table 3-7. Blower Signal Details

New Equipment Description	Signal Description	I/O Type	CP-100 PLC I/O Location	Channel Number
Blower VFD	VFD Fault	Digital Input	Unit 9	6
Blower VFD	VFD in Auto	Digital Input	Unit 9	7
Blower VFD	VFD in Manual	Digital Input	Unit 9	8
Blower VFD	VFD Running	Digital Input	Unit 9	9
Blower VFD	VFD Call to Run	Digital Output	Base Unit	8
Blower VFD	VFD Auxiliary Running Relay	Digital Output	Base Unit	9
Blower VFD	VFD Speed Feedback	Analog Input	Unit 6	5
Blower VFD	VFD Speed Command	Analog Output	Unit 10	2
Blower Vacuum Transducer #1	Blower Vacuum Pressure #1	Analog Input	Unit 5	2 (via ISB-6)
Blower Vacuum Transducer #2	Blower Vacuum Pressure #2	Analog Input	Unit 5	5 (via ISB-7)
Blower Discharge Pressure Transducer	Blower Discharge Pressure	Analog Input	Unit 5	7 (via ISB-8)
Blower Discharge Temperature Transmitter	Blower Discharge Temperature	Analog Input	Unit 6	7

Table 3-8. Heat Exchanger Signal Details

New Equipment Description	Signal Description	I/O Type	CP-100 PLC I/O Location	Channel Number
Heat Exchanger 2	HX2 Motor Overload	Digital Input	Unit 9	10
Heat Exchanger 2	HX2 Motor Running	Digital Input	Unit 9	11
Heat Exchanger 2	HX2 in Auto	Digital Input	Unit 9	12
Heat Exchanger 2	HX2 in Manual	Digital Input	Unit 9	13
Heat Exchanger 2	HX2 Call to Run	Digital Output	Unit 8	3
Heat Exchanger 2	HX2 Auto Drain Solenoid	Digital Output	Unit 8	4

Table 3-9. Main Distribution Panel Existing Used Capacity

MDP-1 LOAD SUMMARY (EXISTING CONDITION)		
Load Description	Total Load (Calculated Amps)	Panel Capacity (Amps)
Treatment Train Containers No. 1 and No. 2	188	400 (46.89% Loaded)
Fan Forced Heater (HTR-1)		
PBD-1 (VIA XFMR-1)		
Fan Forced Heater (HTR-2)		

Table 3-10. VTT/LTT Main Distribution Panel Existing Used Capacity

VTT/LTT MDP-1 LOAD SUMMARY		
Load Description	Total Load (Amps)	Panel Capacity (Amps)
SVE Blower (P-202)	111	200 (55.37% Loaded)
KO Tank Transfer Pump (P-201)		
Distribution Transformer (PWR-TRANS-100)		
Heat Exchanger (W-201)		
Air Compressor (C-1)		
Air Sparge Tank Transfer Pump (P-101)		
Phase Monitor (PHM-100)		
VTT Equipment Room Heater (VTT-HRT-201)		
Air Sparge Blower (P-103)		
LTT Equipment Room Heater (LTT-HTR-101)		

Table 3-11. Main Distribution Panel Load Summary

MDP-1 UPDATED LOAD SUMMARY		
Load Description	Total Load (Amps)	Panel Capacity (Amps)
Treatment Train Containers No. 1 and No. 2	228	400 (56.98% Loaded)
Fan Forced Heater (HTR-1)		
PBD-1 (VIA XFMR-1)		
Fan Forced Heater (HTR-2)		

Table 3-12. VTT/LTT Updated Load Summary

VTT/LTT MDP-1 UPDATED LOAD SUMMARY		
Load Description	Total Load (Amps)	Panel Capacity (Amps)
SVE Blower (P-202)	132	200 (65.94% Loaded)
KO Tank Transfer Pump (P-201)		
Distribution Transformer (PWR-TRANS-100)		
Heat Exchanger (W-201)		
Air Compressor (C-1)		
Air Sparge Tank Transfer Pump (P-101)		
Phase Monitor (PHM-100)		
VTT Equipment Room Heater (VTT-HRT-201)		
Air Sparge Blower (P-103)		
LTT Equipment Room Heater (LTT-HTR-101)		
Heat Exchanger (W-202) (New)		
Blower (P-203) (New)		

Table 4-1. Preliminary List of Plan Sheets

G1	Cover Sheet
P1	Process and Instrumentation Legend and Abbreviations
P2	Well Field Process Flow Diagram
P3	LTT Process Flow Diagram
P4	VTT Process Flow Diagram
C1	Civil Legend, Notes, and Abbreviations
C2	Stormwater Conveyance Ditch Plan
C3	Stormwater Details
S1	Structural Legend, Notes, and Abbreviations
S2	GAC Unit Pad and Structure
M1	Mechanical Legend, Notes, and Abbreviations
M2	Pipe, Valve, and Equipment Schedule
M3	LTT Treatment Container Layout and Modifications
M4	VTT Treatment Container Layout and Modifications
M5	Mechanical Details
M6	Mechanical Details
M7	Mechanical Details
E1	Electrical Legend, Notes, and Abbreviations
E2	Electrical Site Plan
E3	Electrical One-Line Diagram
E4	Electrical Schedules
E5	Electrical Details
E6	Electrical Details

Table 4-2. Preliminary List of Specification Sections

01 25 00	Substitution Procedures
01 33 00	Submittal Procedures
03 11 00	Concrete Forming
03 15 19	Anchors, Inserts, Embedded Products
03 20 00	Concrete Reinforcing
03 30 00	Cast in Place Concrete
03 34 13	Controlled Density Fill
09 90 00	Painting
13 05 41	Seismic Restraint
22 13 16	Pipe and Fittings
22 13 19	Valves and Operators
22 33 46	Pipe Hangers and Supports
26 05 00	Common Work Results for Electrical
26 05 19	Low Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 33	Raceways and Boxes for Electrical Systems
26 05 53	Underground Ducts
26 05 53	Identification of Electrical Systems
26 05 73	Short Circuit, Coordination, and Arc Flash Reports
26 27 26	Wiring Devices
26 28 16	Enclosed Switches and Circuit Breakers
26 43 00	Surge Protective Devices
40 70 00	Common Work Results for Process Interconnections
40 70 01	Process Instrumentation Schedule
40 72 43	Level Sensors
40 73 26	Pressure Sensors
40 95 73	Process Control wiring
43 25 50	Positive Displacement Submersible Liquid Pumps
43 31 50	Regenerative Blowers
43 31 60	Heat Exchanger

Table 6-1. Preliminary Construction Cost Estimate

Mobilization	$113,200
Structural	$15,000
Civil	$232,060
Mechanical	$426,150
Electrical and Control	$269,700
Construction Subtotal	$1,056,110
Overhead and Profit (10%)	$105,611
Sales Tax (8.2%)	$95,261
Construction Baseline Total	$1,256,982

Contingency Range		
−30%	**Construction Baseline Total**	**+50%**
$879,887	$1,256,982	$1,885,473

Appendix A

Sampling and Analysis Plan

Ephrata Landfill Expanded MPE Pilot Test Sampling and Analysis Plan

Prepared for
Grant County

February 2025

Parametrix

Ephrata Landfill Expanded MPE Pilot Test Sampling and Analysis Plan

Prepared for

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February 2025.

Ephrata Landfill Expanded MPE Pilot Test Sampling and Analysis Plan

The material and data contained in this document were prepared under the supervision and direction of the undersigned.

Margaret Spence
Senior Consultant

Brian Pippin
Senior Consultant

Contents

Contents (continued)

Contents (continued)

ATTACHMENTS

Acronyms and Abbreviations

Amendment	Amendment No. 3 to Agreed Order No. DE 3810
COC	chain of custody
DQI	data quality indicator
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
GAC	granulated activated carbon
gpm	gallons per minute
GWMP	groundwater monitoring plan
IAWP	interim action workplan
LCS	laboratory control sample
LT	level transducer
LTT	liquid treatment train
MDL	method detection limit
MPE	multi-phase extraction
MS	matrix spike
NAPL	non-aqueous phase liquid
OWS	oil water separator
PGG	Pacific Groundwater Group
PID	photoionization detector
PIT	pressure indicating transducer
PLC	programmable logic controller
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
VAE	vacuum-assisted extraction
VE	vapor extraction
VFA	vapor flow augmentation
VOC	volatile organic compound
VTT	vapor treatment train

1. Introduction

This sampling and analysis plan (SAP) describes data collection, groundwater sampling, and vapor sampling procedures for the full system pilot test following the expansion of the multi-phase extraction (MPE) system at the old Ephrata Landfill (site). This SAP is complementary to and part of the interim action workplan (IAWP) for the expanded MPE pilot test. This SAP also complements the groundwater monitoring plan (GWMP) prepared by Mott MacDonald (IAWP Appendix B), which covers wells outside the anticipated area of dewatering and vacuum influence from the expanded MPE pilot test. This work is required under the terms of Agreed Order No. DE 3810 Amendment No. 3 (Amendment) between the Washington State Department of Ecology (Ecology) and Grant County. This SAP was prepared in accordance with Washington Administrative Code 173-340-820.

The Amendment requires groundwater and vapor extraction seasonally from April through October for at least 2 years and up to 5 years.

The IAWP describes the expanded MPE interim action project. In summary, the existing MPE system is being expanded to new wells, and treatment system upgrades are planned. Expanded MPE pilot testing focuses on three hydrostratigraphic units, the P1 zone, P2 zone, and Roza aquifer, in the area where drums released chemicals before their removal in 2008 (drum area). The supplemental remedial investigation (Pacific Groundwater Group [PGG] 2021) confirmed that the drum area contains the highest groundwater contaminant concentrations at the site. IAWP Figure 1-1 shows the site map. IAWP Figure 1-2 shows the conceptual layout and the expanded MPE area. IAWP Figure 3-2 shows the well field piping schematic diagram.

The IAWP describes project organization. Parametrix has the lead responsibility for expanded MPE system operations, monitoring, and sampling. Mott MacDonald has the lead responsibility for groundwater monitoring outside the pilot test area.

Parametrix's Site-Specific Health and Safety Plan (IAWP Appendix D) covers health and safety during the monitoring and sampling described in this SAP. The IAWP addresses monitoring and sampling waste disposal.

1.1 Expanded MPE System Summary

The expanded MPE pilot testing includes new liquid and vapor connections to existing wells, installation of water level and vapor transducers with local data logging, and treatment system improvements.

1.1.1 Expanded MPE Pilot Test Wells

Table 1 summarizes the wells for the expanded MPE pilot test. The expanded MPE pilot testing will include new liquid, vapor, and pneumatic connections to wells in the P1 zone, P2 zone, and Roza aquifer (IAWP Figure 1-2). The well types and functions for the pilot test are as follows:

- MPE – equipped with groundwater pumps and liquid, vapor, and pneumatic pipe connections.
- Vapor extraction (VE) – vapor pipe connection.
- Observation – no pipe connections.
- Vapor flow augmentation (VFA) – observation wells showing response to vacuum applied to MPE and VE wells.

All wells will have vapor pressure and water level transducers. Six wells (MW-34p1, MW-65p1, MW-68p1, MW-36p1, MW-64p1, and MW-69p1) that were previously equipped with transducers are connected to the control system and will be retained. The remaining MPE and VE wells and all Observation wells will be equipped with water level and vapor pressure transducers with local data recording. Representative transducer and data transfer and storage device catalog cuts are provided for example in IAWP Appendix E. All MPE and VE wells will be fitted with a vapor flow and pressure gauge with local display but no data storage or connection.

Whereas MPE, VE, and Observation wells are distinct wells dedicated to their specific functions, VFA wells are not separate wells. Rather, VFA wells will be Observation wells identified for venting during VFA testing (see Section 1.2).

MPE Wells

MPE wells are for dewatering and vapor extraction. These wells will be equipped with LDAP4 pneumatic pumps. Three MPE wells (MW-34p1, MW-65p1, and MW-68p1) were equipped for pilot testing in 2017 and are connected to the vapor treatment train (VTT), liquid treatment train (LTT), and controls. The other MPE wells will be fitted with new pumps, pipe connections, and transducers with local data recording.

MW-65p1 exhibited a peculiar response when vacuum was applied in the previous pilot testing (Parametrix 2018). MW-65p1 will be used for dewatering without vacuum. Vacuum application will be attempted periodically because the previously observed response may resolve with longer-term dewatering of the P1 zone.

VE Wells

VE wells are for vapor extraction, not dewatering. They will have vapor pipe connections and vapor pressure and water level transducers but not liquid or pneumatic pipe connections or pumps. Three VE wells (MW-36p1, MW-64p1, and MW-69p1) were equipped for pilot testing in 2017 and are connected to the controls but have no pipe connections. All VE wells will require new vapor pipe connections.

Observation Wells

Observation wells are for vapor pressure and water level monitoring. Observation well construction is summarized in Table 2.

VFA Wells

VFA wells, also called venting wells, will be used to try to increase air flow through the dewatered zones. Increased air flow can increase dissolution, desorption, and vapor extraction radius of influence. Venting will be accomplished by opening the port or removing the caps of Observation wells identified for VFA. The wells will be closed after the VFA test.

1.1.2 Treatment System Upgrades

Upgrades to the LTT and VTT are described in the IAWP. In summary, a regenerative blower will be installed to increase vapor capacity in a vacuum range around 3.5 inches of mercury. The granular activated carbon (GAC) filters are being moved and the piping reconfigured so that any of the three filters can be used as the primary filter, the polishing filter, or for standby. IAWP Appendix F shows the proposed treatment system drawings.

1.2 Pilot Testing Approach

The expanded MPE pilot testing will follow the sequence below for each extraction season:

1. Baseline data collection.
2. Dewatering without vacuum followed by MPE and VE in the P1 zone.
3. Dewatering without vacuum followed by MPE and VE in the P2 zone.
4. VE testing in the Roza aquifer during the P2 zone MPE and VE testing.
5. VFA for an interval during the MPE and VE testing in each zone.
6. MPE and VE in the P1 and P2 zones and VE in the Roza aquifer after the P2 and Roza VFA test through the end of each season.

The testing sequence is essentially the same in the P1 and P2 zones. Dewatering, MPE and VE, and VFA tests will be performed first in the P1 zone, which will be maintained in drained condition with vapor extraction throughout the remaining testing. The sequence will be repeated in the P2 zone, with the addition of Roza VE testing once the P2 zone is drained. The P1 and P2 zones will both remain drained with vapor extraction throughout the remainder of each extraction season.

1.2.1 Baseline Data Collection

Baseline data collection will include groundwater monitoring (Section 2) and sampling (Section 3) during the last week of March prior to the MPE system startup and seasonal restarts. Baseline data collection includes all wells involved in the expanded MPE pilot test and complements planned groundwater monitoring outside the test area. All MPE, VE, and observation wells will be sampled. The baseline data collection is complementary to groundwater monitoring outside the pilot test area, which is covered under the GWMP in IAWP Appendix B. In summary, the baseline testing covers wells within about 100 feet of any expanded MPE extraction well, with the GWMP covering wells outside of that range.

1.2.2 Dewatering Without Vacuum

The P1 and P2 zones and Roza aquifer in the expanded MPE pilot test area are confined with few or no vadose pockets. Dewatering is required prior to the application of vacuum and vapor extraction. Based on prior testing (Parametrix and PGG 2018), the P1 zone is expected to drain enough for vapor extraction within about 3 weeks. The P2 zone is less transmissive overall compared to the P1 zone and may take longer to drain.

1.2.3 MPE and VE

MPE and VE will start simultaneously once a zone is drained sufficiently, generally when water levels at all MPE and VE wells are below about the lower third of the screened interval. The Roza aquifer is not being pumped, although it is targeted for vapor extraction at one well (MW-106b), which ordinarily has an open screen. As mentioned above, Roza VE will start once the P2 zone is drained.

1.2.4 VFA

VFA will be started part way through the MPE and VE tests in each zone. VFA is planned for 1 week, although that interval might be extended with Ecology's approval if contaminant removal or vapor radius of influence increase and oxygen and methane levels stay below 10% volume and 20% lower explosive limit, respectively, in vapor extraction piping and equipment. This is not a rigid threshold;

the VTT and LTT are classified spaces, and the equipment specified accordingly (Class I, Division 1, Group D). Flammable vapor mixtures can be processed. The field safety lead and project manager must be notified if methane or oxygen in the treatment system exceeds the above concentrations. Responses to high oxygen and methane are discussed in Section 2.4.

VFA wells will generally be selected from the Observation well list (Table 1). The highest estimated distance for vacuum influence from the MPE wells was about 90 feet during the 2017 MPE pilot test. Each Observation well is within about 100 feet of an MPE or VE well. There is no way to predict which wells might be effective for VFA.

2. Monitoring

This section describes the schedule and procedures for collecting field measurements, including readings with portable instruments and installed data recording equipment. The seasonal field monitoring schedule is summarized in Table 3.

2.1 Baseline Monitoring

This section describes field monitoring during the last week of March prior to each extraction season.

2.1.1 Wells

Record depth to water using an interface probe (sometimes called a water level probe or slope indicator) at all wells listed in Table 1 as follows:

- Open monument cap and remove well cap.
- Collect depth to water using access port (3/4” threaded plug in the well cap) as measurement point.
- Record date, time, initials, and depth to water on Observation Well Form (Attachment A).

Download the water level transducer data for wells listed in Table 1.

Record any non-aqueous phase liquid (NAPL) detections. NAPL can be detected with the interface probe. Any light NAPL will be at the top of the water column and any dense NAPL will be at the bottom. Notify the project manager if a NAPL layer thick enough to sample is encountered.

2.1.2 Treatment System

Treatment system operations are mainly addressed in the IAWP. The following steps should be performed during the week prior to seasonal startup.

Record evaporation pond depth (visual, using the marker located on the northwestern face of the pond). Notify the project manager if the water depth is over 2 feet. Check the pond leak detection pipe (northeastern side of the pond) with an interface probe. Notify the project manager if water is detected.

2.2 Monitoring While Dewatering with No Vacuum

Field monitoring procedures and equipment are discussed below.

2.2.1 Manual Monitoring of Pumps at MPE Wells

Pump settings and operations will be regularly monitored and recorded on MPE Well Forms. Pump monitoring will include date and time pumps are turned on or off, total pump cycle counts, pump cycle rates, and pump air supply pressures (Table 3).

Pump cycle rates will be used to estimate individual pumping rates as follows:

- Each MPE wellhead is equipped with a pump cycle counter.
- Count the number of pump strokes (cycles) over a specified period and record these readings on the MPE Well Form along with date, time, and the observer’s initials.

- Estimate the pumping rate based on LDAP4+B pump design to extract 0.11 to 0.16 gallons per cycle. Also correlate MPE pump cycle counts and rates with the combined liquid extraction rate being metered in the LTT and recorded by the PLC.

Pump air supply pressures will be read from the air supply regulator at each wellhead and recorded on the MPE Well Form along with date, time, and the observer's initials.

2.2.2 Data Recording Transducers

Transducer data will be uploaded as scheduled to a data recording and transfer device. Depending on the recorder model used, the data may need to be transferred to a thumb drive. In that case, a separate thumb drive will be dedicated to each well and labelled accordingly. The transducers should not need to be removed unless there is a problem.

2.3 MPE and VE Monitoring

The well monitoring procedure during MPE and VE is the same as monitoring while dewatering without vacuum, with two additions. During MPE and VE, data will need to be downloaded from the vapor pressure transducer in addition to the water level transducer. The vacuum-assisted extraction (VAE) flow control valve position and vapor pressure and flow on the gauge should also be recorded.

VFA, particularly in the P1 zone, may tend to increase oxygen and methane concentrations in the VTT. Thresholds and responses are discussed in Section 2.4.2. Notify the project manager when VFA is planned.

Observation wells that show vapor pressure reduction during MPE and VE are likely candidates to test as VFA wells. Monitoring during VFA will be at the MPE and VE wells and VTT. Vapor flows will be noted at the MPE and VE wells as summarized in Table 3. The GAC system inlet and exhaust will be monitored as summarized in Table 3 and sampled as summarized in Table 4.

2.4 Treatment System Monitoring

Groundwater and vapor data will be monitored and recorded at multiple points in the treatment system during expanded MPE pilot testing.

2.4.1 Vapor Monitoring

Extracted vapor from the combined MPE wells will be monitored for specific gas concentrations at the discharge end (positive pressure) of the VAE blower. The monitoring will occur at the vapor sample ports at the GAC system inlet (untreated), between the lead GAC unit and polishing GAC unit (partly treated), and at the exhaust (treated). Oxygen and methane will be monitored with an RKI Eagle 2 (or similar) gas detection meter at the GAC inlet only. Concentrations of volatile organic compounds (VOCs) will be monitored at all three locations with a MiniRAE3000 (or similar) photoionization detector (PID) with a 10.6 electron volt gas-discharge lamp and calibrated to yield "total organic vapors" in parts per million as benzene. The gas meter and PID will be calibrated and operated in accordance with the manufacturer's specifications. Ambient air PID readings will be collected initially to evaluate background organic concentrations and possible contributions from equipment tubing.

The following procedures will be used to measure gas concentrations at the vapor sample port:

- Attach clean disposable 1/4-inch flexible tubing (silicone or polyethylene) to the PID's air intake port (use compression fitting if needed) and turn the meter on.

- Purge ambient air vapor through the open end of the tubing and PID until readings are fairly stable for at least 30 seconds.
- Record ambient air concentrations on the Liquid and Vapor Extraction Form (Attachment A) along with date, time, units of concentration, and the observer's initials.
- Turn the PID off and attach the open end of the tubing to the 1/4-inch vapor sample port (use compression fitting if needed).
- Open the sample port and turn the PID on.
- Purge vapor through the PID until readings are stable for 30 seconds.
- Record vapor concentrations on the Liquid and Vapor Extraction Form along with date, time, units of concentration, and the observer's initials.

Except for ambient air readings, repeat the steps above to measure vapor concentrations of methane and oxygen with the gas detection meter.

If total organic concentrations in ambient air are significantly lower than those measured in VAE discharge vapor and if the ambient air concentrations do not change significantly after three or four monitoring events, collection of ambient air PID data may cease.

When VOCs at the middle (partly treated) GAC port exceed 100 parts per million, change the valve positions so the polishing unit becomes the lead unit, the standby unit becomes the polishing unit, and the lead unit goes on standby. Contact the vendor to collect spent GAC for recycling and refill the canister with new GAC.

2.4.2 Oxygen and Methane

The VTT and LTT systems are designed for operation in Class 1, Division 1 areas to safely handle flammable mixtures containing methane and other volatile substances. However, it may be feasible to avoid handling flammable mixtures through system adjustments. The following thresholds for oxygen and methane have been established:

- Oxygen—over 10% volume.
- Methane—over 20% lower explosive limit by volume.

Although not anticipated, if the above thresholds are both exceeded at the VAE blower discharge, gas concentrations may be measured at individual wellheads to evaluate which well(s) may be contributing to elevated methane and possibly entraining landfill gas and/or atmospheric air. This will require pausing the expanded MPE pilot testing and temporary VTT and LTT system shutdown. Notify the project manager immediately if the methane or oxygen threshold is reached to discuss possible responses.

2.4.3 Manual Readings of Total Vapor and Liquid Extraction Rates and Volumes

Total liquid and vapor extraction rates and volumes data will be occasionally recorded manually on the Liquid and Vapor Extraction Form (Attachment A) (see Table 3 for schedule). The date, time, and observer's initials will be recorded with each reading.

A vapor flow meter, which records pressure differential (in H_2O), and a pressure gage, which records pipe vacuum (in Hg), are in the VTT container near the intake to the VAE blower. Readings from these meters are used in standard air flow formulas to calculate air flow rates. Readings are transmitted to the PLC, but they will also be manually read and recorded on the Liquid and Vapor Extraction Form as backup.

A liquid flow meter, which reads total cumulative volume (gallons) and instantaneous flow (gallons per minute [gpm]), is in the VTT container before influent to the oil water separator (OWS). Readings from the liquid meter are transmitted to the PLC, but they will also be manually read and recorded on the Liquid and Vapor Extraction Form as backup.

2.4.4 Other Monitoring

Equipment including, but not limited to, the compressor, VAE blower, and valves will be monitored and adjusted in accordance with the IAWP and MPE operation and maintenance manual (Parametrix 2018). Manual observations and adjustments will be recorded on the Operations Form (Attachment A) as indicated in Table 3.

2.4.5 Control System Records

The PLC program will need to be modified for the planned restart of the existing MPE system, and further changes are needed to accommodate new equipment. Generally, the control system will monitor and record water level and vapor pressure in the six wells already connected to it (MW-34p1, MW-65p1, MW-68p1, MW-36p1, MW-64p1, and MW-69p1) plus multiple treatment system functions, described in the IAWP and existing operation and maintenance manual. Data must be downloaded from the control system from time to time. The current control system functionality will be preserved or improved, although the details will need to be established during engineering design development. Specific control system record keeping requirements will be developed during engineering design.

2.4.6 Evaporation Pond

Check the evaporation pond water level and leak detection pipe monthly during the extraction season. Check the pond water level weekly when it is above the 5-foot marker. Notify the project manager if the water level reaches the 6-foot marker, or if water is detected in the leak detection pipe.

2.5 Field Monitoring Records

Field forms are included in Attachment A. Any corrections made while recording information in the field will use single line strikethroughs and include initials and date. Field instrument calibration will be noted. Field forms and any photos will be retained in Parametrix's project records and reported in accordance with the Amendment.

3. Sampling

This section describes the schedule and procedures for collecting groundwater and vapor samples for laboratory analysis. Groundwater sampling will follow the QA/QC procedures in the remedial investigation sampling analysis and quality assurance project plan (PGG 2007). The seasonal sampling schedule is summarized in Table 4.

Groundwater samples will be analyzed for VOCs using EPA Method 8260D; semi-volatile organic compounds using EPA Method 8270E; total petroleum hydrocarbons using NWTPH methods; inorganic parameters using EPA Methods 325.2, 353.2, 375.2, and 160.1 and Standard Method 2320B; and dissolved and total methods using EPA Method 200.8. Field parameters will be measured using a water quality meter. For groundwater samples, specific analytes and methods are listed in Table 5 and containers per sample are listed in Table 6.

Vapor samples will be analyzed for VOCs using EPA Method TO-15 and gaseous phase petroleum hydrocarbons using the MA-APH method. Specific vapor analytes and methods are listed in Table 7.

The analytical sampling suite for both groundwater and vapor samples may be reduced over time in accordance with previous sampling results and with Ecology approval.

3.1 Groundwater Sampling Procedures

The following procedures apply to groundwater sampling:

- Personnel will wear clean, disposable, and latex gloves.
- Record all sample information on the Groundwater Sample Form (sample ID, date, time, field parameters, analytical parameters, shipment date to laboratory, and observer/comments).
- Record the following information on each sample bottle label:
  - Project name/number
  - Name of collector
  - Date and time of collection
  - Place of collection (Ephrata Landfill)
  - Sample ID (i.e., MW-65p1, OWS Influent, OWS Effluent, Air Sparge Effluent – include sample port ID)
  - Presence of any preservation or filtration
- Filter samples for dissolved metals analysis in the field using a 0.45-micron in-line filter and record on field forms, metals sample bottle, and chain-of-custody (COC) form.
- Place samples in cooler at approximately 4°C with sufficient double bagged (zip-lock) ice to retain cold temperature for 24 hours. Extra ice will be required during hot summer months.
- Fill out laboratory-supplied COC form (one per shipment). If shipping more than one cooler, put an extra copy of COC form in each additional cooler, and indicate on COC form how many coolers are being shipped.
- Ship samples Federal Express overnight to the laboratory in a sealed cooler accompanied by COC form and any other pertinent shipping/sampling documentation. Samples should be shipped overnight on Mondays through Thursdays to meet short holding times and to assure prompt receipt by the laboratory. Samples shipped on Fridays or weekends require prior arrangement with the laboratory.

Sample kits will be provided by, and groundwater samples will be shipped to:

Attention: Eric Young
Friedman and Bruya, Inc.
3012 16th Ave W
Seattle, WA 98119

3.1.1 Baseline Sampling

This section outlines the baseline groundwater sampling procedures, which follow the methods outlined in the GWMP prepared by Mott MacDonald (IAWP Appendix B). All MPE, VE, and observation wells are designated for baseline water quality sampling before the start of each extraction season (Table 4). Groundwater analytes are listed in Table 5. The baseline data collection is complementary to groundwater monitoring outside the pilot test area, which is covered under the GWMP.

3.1.1.1 Baseline Groundwater Pumping Procedures

All designated wells will be purged and sampled using low-flow methods in accordance with U.S. Environmental Protection Agency's (EPA) Low Stress (low flow) Standard Operating Procedures (USEPA 1996, 2017), except for MPE wells that are equipped with LDAP4 pneumatic pumps.

Wells will be pumped with reusable dedicated sampling pumps (Geotech Geosub 2 or similar) capable of flow rates from near zero to 3 gallons per minute with minimal lift. Grant County will attempt to equip each sampling well with a dedicated GrundfosTM Redi-flo2 pump; however, this pump is currently limited for purchase due to supply chain shortages. The pumps will be located within the screened section of the well. Water will be purged at a pumping rate used during previous sampling events per well. Otherwise, adjust pump speed until there is little or no water level drawdown. New tubing will be used at each well.

The reusable pumps will be decontaminated between each well by scrubbing the outside areas of the pump and lead line with Liquinox or similar environmental soap diluted in distilled water. The pump will then be rinsed several times in distilled water and coiled back on the spool.

Groundwater will be pumped into 55-gallon drums. When full, all pumped groundwater collected in the drums will be discharged into the lined evaporation pond at the northwest corner of the original landfill by submerging the sump pump into the 55-gallon drum and connect the garden hose to the evaporation pond.

Wells will be purged until select field parameters reach stabilization (see following section). Purge volume shall be measured with a graduated 5-gallon bucket. All field measurements will be recorded on field sampling forms (Attachment A).

3.1.1.2 Baseline Groundwater Sampling Procedures

The following steps will be followed for groundwater sampling:

1. Remove cap of the monitoring well.
2. Collect water level using clean sounder and record on field sampling form (Attachment A).
3. Calculate and record casing storage volume as a reference.
4. Estimate target pump rate based on qualitative well yields and record on field sampling form. If the static water level suggests there is little water in the well and the well has pumped dry in the past, then pumping well dry at a higher rate is acceptable.

5. Lower clean pump and tubing into well. Gently tag bottom of well with pump and then lift pump:
   a. To mid-screen if expected yield is moderate to high and screen is fully submerged
   b. 1 foot off bottom of well if qualitative well yield is low to very low (well will likely be purged dry) or to mid-point of the saturated portion of the screen if screen is less than 75% fully submerged.
6. Record pump depth on field sampling form (Attachment A).
7. Start the pump at low speed and slowly increase speed until discharge occurs before connecting it to the flow-through cell. Determine the initial purge flow rate from the well using a graduated or suitable container of known volume and a stopwatch to time the rate of filling. Adjust pump rate until there is little or no water level drawdown. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging. During pump startup, drawdown may exceed the 0.3-foot target and then "recover" somewhat as pump flow adjustments are made.

   The water level will be considered stable if water level drawdown is less than 0.3 feet. It should be noted that this goal may be difficult to achieve due to geologic heterogeneities within the screened interval and may require adjustments based on site-specific conditions In lower permeability units assume less than 2 feet over 3 consecutive measurements, but only if the volume of water in the casing above the pump intake is equal to or greater than the volume needed for all required samples.

   After the water level has stabilized, connect the flow-through cell to the pump discharge tube so that the sample goes into the bottom of the flow-through cell. Direct the discharge from the flow-through cell into a graduated bucket.
8. During purging, measure and record the following field parameters every few minutes. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250-milliliter [mL] flow-through cell with a flow rate of 50 mL/min, the monitoring frequency would be every 5 minutes).
   a. Depth to water
   b. Electrical conductivity (EC)
   c. pH
   d. Temperature
   e. Dissolved oxygen (DO)
   f. Redox potential
   g. Color (visual)
   h. Turbidity
   i. Pump rate and purge water cumulative volume

   Redox potential, DO, pH, and EC will be measured in a flow-through cell with a multiprobe meter such as YSI® 556 Multiprobe System or similar. Turbidity will be measured using a separate instrument such as turbidity meter.

9. Purging is considered complete when the below indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:
    a. pH measurements that do not vary by more than 0.1 pH units between readings.
    b. EC and temperature do not indicate a trend (continuously increase or decrease between readings) and do not vary by more than 3% between readings.
    c. DO and redox potential do not indicate a trend (continuously increase or decrease between readings) and do not vary by more than 10% and 10 millivolts (mV) between readings, respectively.
10. If the indicator field parameters listed above continually change in an upward or downward trend, purge until reasonable stability is achieved, then sample. If they change in an inconsistent way and no long-term trends exist, sampling may begin. Even at 0.5 gallons per minute, some wells may not achieve stable water levels because of low yield. In that case, field personnel may choose to reduce the flow rate to a sustainable rate and follow these procedures or evacuate the well and sample as soon as the water level has recovered sufficiently.
11. Disconnect the flow-through cell once field indicator parameter measurements have stabilized and collect samples.
12. Groundwater samples collected from MPE wells will follow the steps listed above, however samples will be collected from in-line liquid sample ports (i.e., quarter-turn ball valve with PTFE tube whip) from individual wells and at the LTT using the following procedures:
    a. Place a 5-gallon bucket on the ground below the sample port to collect overflow liquid during sampling. The overflow water should be contained in sealed/labeled 55-gallon drums and eventually run through the LTT.
    b. Connect a multiparameter water quality meter with a flow-through cell (YSI ProDSS or equivalent) to the sample port, then open the sample port (allowing water to fill the flow-through cell) and maintain a small stream of discharge of about 0.1 to 0.5 gpm.
    c. Monitor the field parameters listed in step 8 with the water quality meter.

3.1.2 LTT Sampling

Water samples from the LTT will be collected from the following locations:

- OWS tank inlet influent (untreated).
- Effluent pipe to the evaporation pond (treated).

3.2 Vapor Sampling Procedures

VTT vapor samples collected using laboratory-supplied SUMMA canisters and analyzed for VOCs (EPA Method TO-15). Vapor samples will be collected from in-line VAE 1/4-inch sample ports in the GAC inlet pipe (untreated) and GAC system exhaust (treated) using the following procedures:

- Personnel will wear clean, disposable, and latex gloves.
- Verify and record initial vacuum of canister.
- Confirm VAE sample port and canister valves are both closed.
- Attach particulate filter to canister.

- Connect canister intake to VAE sample port with laboratory-supplied compression fittings to achieve air-tight connection.
- Open VAE sample port and open canister valve (1/2 turn). Record start time—a 1-liter canister typically takes about 5 minutes to fill.
- Once full, record end time and final vacuum pressure, and close canister valve. (The laboratory performs a leak test both prior to shipment and upon receipt of canisters.)
- Fill out canister labels in accordance with Section 3.3.2:
- Record all sample information on the Vapor Lab Sample Form (sample ID, date, time, field parameters, analytical parameters, canister readings, canister ID, regulator ID, delivery date to laboratory, and observer/comments).
- Fill out laboratory-supplied COC form (one per shipment).
- Place labeled canister(s), COC form, and lab equipment in original shipment package container.
- Ship sample(s) Federal Express overnight to the laboratory accompanied by COC form and any other pertinent shipping/sampling documentation. Samples can be shipped Monday through Friday.

SUMMA canister samples will be provided by and shipped to:

Attention: Eric Young
Friedman and Bruya, Inc.
3012 16th Ave W
Seattle, WA 98119

3.3 Sample Handling and Custody

3.3.1 Sample Containers and Preservatives

For groundwater, containers per sample and preservation are listed in Table 6. All sample containers will be provided by the laboratory and need to be ordered in advance.

3.3.2 Sample Labels

Each sample will be labeled with laboratory provided labels. Each label will include the following information:

- Project name/number.
- Name of sample collector.
- Date and time of sample collection.
- Place of collection.
- Sample identification (ID) (i.e., groundwater influent, groundwater effluent, vapor pre-treatment, vapor post-treatment).
- Presence of any preservation or filtration.

3.3.3 Sample Custody

Each sample will be listed on the COC form(s), an example of which is provided in Attachment B. The laboratory will provide COC form(s) with each sample kit. The field personnel will record all sample custody transfers on the COC form(s) and return it to the laboratory with the samples.

A sample is under a person's custody if it is:

- In that person's physical possession.
- Within that person's sight.
- Secured in a tamper-proof way by that person.
- Secured by that person in an area restricted to authorized personnel.

Field personnel are responsible for custody of the samples until they are delivered to the laboratory. The field portions of COC forms shall be completed in the field by the sampler. Each time one person relinquishes control of the samples to another person, both individuals must complete the appropriate portions of the COC form by signing the form and filling in the date and time of the custody transfer. For this reason, one field personnel individual should retain sample custody during the sampling event whenever feasible.

The laboratory's sample receipt coordinator will sign and date the COC form(s) promptly when the samples arrive. The laboratory is then responsible for the care and custody of samples. The laboratory will track sample custody through their facility using a separate sample tracking form, as discussed in the laboratory QA manual included in Attachment C. Copies of completed COC forms will be kept in the project files.

3.3.4 Sample Disposal

Following sample analysis, the laboratory will store the unused portions for 30 days after the final laboratory data package and invoice is delivered then dispose of all the samples following their standard procedures.

4. Quality Control

One purpose of this SAP is to ensure that the data are of sufficient quality to support contaminant removal and emission calculations. This section describes quality control procedures.

4.1 Measurement Performance Criteria

This section identifies data quality indicators (DQIs) for each analytical parameter and decisions regarding how each DQI will be assessed. The DQIs include sensitivity, bias, representativeness, precision, accuracy, completeness, and comparability. The general approach to assessing each DQI is provided below, including quantitative measurements where appropriate. Analytical methods are specified in Tables 5 and 7.

Sensitivity

Sensitivity is the method detection limit (MDL) which a laboratory following an analytical method can detect and quantify an analyte with reasonable confidence. Laboratory MDLs and reporting limits (RLs) are listed in the summary table included in Attachment D.

Bias

Bias is the difference between the population mean and the true value of the parameter being measured. Bias in water samples will be calculated based on the analyses of field blanks, method blanks, matrix spikes (MS), and laboratory control samples (LCS).

Field blank results that are greater than the RL will be flagged as blank contamination. Typically, associated project samples within 10 times the blank concentration will be qualified as an estimate.

Some of the parameters listed in Tables 5 and 7 require MS and MS duplicates. MS and MS duplicates will be performed for these parameters following the laboratory's standard procedure. Percent recoveries are required to be within the ranges shown in the LCS analysis included in Attachment D.

Representativeness

Representativeness is the degree to which sample data represent a characteristic environmental condition or specific site conditions. Samples will be collected at different stages of MPE system restart.

Precision

Precision is the closeness of results for a sample and duplicate sample, as defined by the relative percent difference (RPD). Required RPD ranges are shown in the LCS analysis included in Attachment D.

Accuracy

Accuracy is the measure of agreement between a measurement's result and the true or known value. LCS, MS, and MS duplicate percent recoveries are required to be within the acceptance criteria ranges in the LCS analysis included in Attachment D.

Completeness

Completeness is a percentage calculated as the ratio of measurements determined to be valid over the total number of measurements collected. The completeness goal is set in terms of the minimum number of samples meeting DQIs. To evaluate groundwater and vapor for this study, all samples must be valid. Other practices to ensure achievement of the completeness goal include using prepared sample containers and coolers from the laboratory, utilizing trained personnel, following the sampling procedures in this SAP, icing samples, packaging samples for transport to avoid breakage, and timely sample processing. Laboratory analysis can improve completeness by processing samples within their holding times. For data analysis, valid sample data may include all unflagged data and J-flagged data reviewed by the project manager.

4.2 Laboratory Analysis QC

Laboratory QA/QC procedures are described in the laboratory's QA manual included in Attachment C. Analysis for LCS and method blanks for each sample parameter method is included in Attachment D.

4.3 Field Monitoring Instruments/Equipment

Installation and procedures for field sampling and monitoring equipment use are discussed in Section 2.2. Field devices will be calibrated and maintained in accordance with the manufacturer's guidelines and specifications. Records of equipment calibration and maintenance will be recorded and maintained in field notes.

Documentation will include the following information, as applicable:

- Name of person maintaining or calibrating the instrument/equipment.
- Date and description of the maintenance or calibration procedure.
- Date and description of any instrument/equipment problem(s).
- Date and description of action to correct problem(s).
- List of follow-up activities after maintenance (i.e., system checks).

For leased equipment, calibration by the lessor is acceptable.

4.4 Laboratory Analysis Instruments/Equipment

Inspection and maintenance of laboratory equipment is the responsibility of the laboratory and is described in the laboratory's QA manual included in Attachment C.

4.5 Field Variances

If conditions in the field vary such that modifications to the sampling procedures and protocols described in this SAP become necessary, field personnel will notify the field lead and obtain a verbal approval prior to implementing any changes. Variances will be recorded in the field forms.

5. Documents and Records

SAP distribution and responsibility for updates are the same as for the IAWP and defined therein.

5.1 Laboratory Documentation and Records

Laboratory data packages will be provided by the laboratory in electronic (PDF and .xlsx or .csv) format. These packages will include a case narrative discussing any problems with the analyses, corrective actions taken, changes to the referenced methods, and an explanation of data qualifiers. In addition to sample results, reporting limits, and method detection limits, the data packages will also report all QC results associated with the study data, including results for all blanks, surrogate compounds, and check standards included in the sample batch, as well as results for analytical duplicates. Legible copies of all COC forms and sample receiving logs associated with the samples analyzed will also be included. This information will be used to evaluate data accuracy.

In addition to the data packages, the laboratory will provide electronic data files containing sample results. The electronic files will be in unprotected .xlsx or .csv format and will include the following fields at a minimum:

- Laboratory sample ID.
- Sample ID.
- Sample type.
- Date analyzed.
- Analytical method.
- Sample filter flag.
- Chemical Abstracts Service number.
- Parameter name.
- Units.
- Result value.
- Result qualifier.
- Dilution factor.
- RL.
- MDL.

Each data file will include all laboratory results and will be consistent with the data reported in the corresponding laboratory data package.

5.2 Reporting

The sampling and monitoring data described in this SAP will be reported as required in the Amendment. The Amendment calls for monthly progress reports, which are to include data obtained during the preceding month. Calculations of emissions and contaminant removal during each season of operations will be included in one of the monthly reports after the system is shut down and analytical results have been evaluated. Pilot test data will also be included and summarized in the interim action completion report.

5.3 Data Management

Data collected by this study, as described in previous subsections, will be maintained as electronic data files. Preparation, maintenance, and storage of documents and records are described in Section 2.5.

The laboratory will provide data in electronic form via unprotected .xlsx or .csv format, with full data packages provided in Adobe PDF. The project manager or designee will review the file contents for consistency of results and qualifiers across file formats. Any discrepancies will be identified for resolution by the laboratory.

Data presented in the monthly reports and interim action completion report will be checked against the original sources. Any data summaries and calculations included in these reports will be checked to confirm the appropriate source data and calculation methods are used.

Data will be submitted to Ecology as required in the Amendment.

6. Field and Laboratory Oversight

This section describes oversight to confirm that field sampling and monitoring activities are conducted according to procedures outlined in this SAP. For this study, field oversight will include readiness reviews of the field sampling team prior to initiating sampling efforts, field activity audits, and post-event review of field sampling and measurement activities.

6.1 Readiness Procedure

Field staff training will include a review of this SAP and laboratory instructions with the field kits. Prior to each sampling and monitoring event, the field sampling team will confirm the following:

- Field equipment is operational and ready for field use.
- Field instruments are calibrated and in proper working order.
- Field logs are on hand.
- The sample kit includes all containers listed in the COC and this SAP for the event.
- All sample containers are intact and properly closed.

6.2 Post-Event Review of Field Sampling and Measurement Activities

Field data verification after each sampling and monitoring event will involve reviewing the field data for errors or omissions and examining the results for compliance with QC acceptance criteria outlined in this SAP. Review of field measurements will include the following:

- Evaluate field records for consistency.
- Confirm calibration procedures were followed and documented.
- Review QC information (any corrections on field forms and confirm QC of data transferred to electronic format).
- Summarize any deviations from methods specified in this SAP, determine any impact on data quality, and identify any necessary modifications to sampling activities prior to the next event.

7. References

Parametrix. 2018. Ephrata Landfill MPE Pilot Study Interim Action Pretreatment Facility and Evaporation Pond Operation and Maintenance Manual. Prepared by Parametrix, Seattle, Washington. February 2018.

Parametrix and PGG. 2018. Supplemental Interim Remedial Action Plan Report, Ephrata Landfill Corrective Action, Pilot Test of Multi-Phase Extraction (MPE) and Additional Monitoring Wells. Prepared for Grant County and City of Ephrata. February 2018.

PGG (Pacific Groundwater Group). 2007. Final Sampling Analysis and Quality Assurance Project Plan, Remedial Investigation (Task 3 and Task 4), Investigation of Source and Extent of Groundwater Contamination, Ephrata Landfill Corrective Action. August 2007.

PGG. 2021. Agency Draft Results of Phase 1 North End Supplemental Investigation Ephrata Landfill RI/FS. Prepared by Pacific Groundwater Group, Seattle, Washington. May 2021.

USEPA, 1996. Revised 2017. Low Stress (low flow) Purging and Sampling Procedure for Collecting Groundwater Samples from Monitoring Wells. EQASOP-GW4. USEPA, 2020. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.

Tables

Table 1. Expanded MPE Pilot Testing Well Summary

Ephrata Landfill, Grant County, Washington

Station ID	Pilot Test Function	LTT Piping Connection	VTT Piping Connection	Water Bearing Unit	Well Dia. (in)	BOW (ft)	TOS (ft)	BOS (ft)	Water Level Transducer Depth (ft)	TOC El. (ft)	TOS El. (ft)	BOS El. (ft)	BOW El. (ft)
MW-100p1	MPE	New	New	P1 zone	6	28.3	20.3	27.8	27.8	1283.3	1263.0	1255.5	1255.0
MW-109p1	MPE	New	New	P1 zone	6	31.1	20.6	30.6	30.6	1281.2	1260.6	1250.6	1250.1
MW-117p1	VE	None	New	P1 zone	6	20.5	15	20	20	1273.1	1258.1	1253.1	1252.6
MW-34p1	MPE	Existing	Existing	P1 zone	4	40.6	34.6	40.6	37.12	1290.6	1258.9	1253.8	1253.3
MW-65p1	MPE	Existing	Existing	P1 zone	4	38.9	31.9	38.9	35.61	1292.1	1256.0	1250.0	1250.0
MW-68p1	MPE	Existing	Existing	P1 zone	4	38.8	30.8	38.8	35.28	1288.9	1255.5	1250.5	1250.5
MW-83p1	MPE	New	New	P1 zone	6	36.9	32.9	36.4	36.4	1290.2	1254.0	1249.0	1249.0
MW-123p1	VE	None	New	P1 zone	6	20.1	14.5	19.6	19.6	1273.4	1260.2	1253.2	1253.2
MW-36p1	VE	None	New	P1 zone	4	42.2	37.2	42.2	41.7	1292.7	1258.1	1250.1	1250.1
MW-64p1	VE	None	New	P1 zone	4	44.2	39.2	44.2	43.7	1293.2	1256.4	1251.4	1251.4
MW-85p1	MPE	New	New	P1 zone	6	37.7	29.2	37.2	37.2	1287.9	1257.3	1253.8	1253.3
MW-69p1	VE	None	New	P1 zone	4	36.1	31.1	36.1	35.6	1287.5	1258.7	1250.7	1250.2
MW-92p1	VE	None	New	P1 zone	6	36.1	29.6	35.6	35.6	1287.8	1258.2	1252.2	1251.7
MW-101p2	VE	None	New	P2 zone	6	55.5	40	55	55	1282.7	1242.7	1227.7	1227.2
MW-113p2	MPE	New	New	P2 zone	6	51.3	40.8	50.8	50.8	1281.9	1241.1	1231.1	1230.6
MW-87p2	MPE	New	New	P2 zone	6	57.7	45.7	57.2	57.2	1289.0	1243.3	1231.8	1231.3
MW-91p2	MPE	New	New	P2 zone	6	55	44.5	54.5	54.5	1287.7	1243.2	1233.2	1232.7
MW-94p2	VE	None	New	P2 zone	6	53.9	43.4	53.4	53.4	1287.1	1243.7	1233.7	1233.2
MW-99p2	VE	None	New	P2 zone	6	56.2	45.7	55.7	55.7	1285.9	1240.2	1230.2	1229.7
MW-106b	VE	None	New	Roza aquifer	6	69.7	59.2	69.2	69.2	1281.0	1221.8	1211.8	1211.3

Notes:

The vertical datum is NAVD88.

Depths are below TOC.

All MPE and VE wells will be equipped with a new magnehelic VFLO meter and guage.

Wells with existing PLC connections have FMX21 water level transducers and DS III vapor pressure tranducers.

No additional wells will be connected to the PLC.

All MPE wells will have a liquid sample port, backflow preventer in the liquid discharge line and a QED LDAP4 pump.

MW-34p1, MW-p1, and MW-68p1 have existing pumps, transducers, liquid ports, and backflow preventers.

All observation wells and each MPE and VE well will be equipped with new Levelogger™ water level vapor pressure data logging transducers.

See Table 2 for observation well details.

Abbreviations:

BOS - bottom of screen depth
BOW - bottom of well depth
Dia. - diameter
El. - elevation
ft - feet
ID - identifier
in - inches
LTT - liquid treatment train
MPE - multi-phase extraction
TOC - top of casing
TOS - top of screen depth
VE - vapor extraction
VTT - vapor treatment train

Observation Wells		
P1 Zone	**P2 Zone**	**Roza Aquifer**
MW-104p1	MW-115p2	MW-105b
MW-110p1	MW-122p2	MW-111b
MW-127p1	MW-126p2	MW-132b
MW-129p1	MW-35p2	MW-29b
MW-66p1	MW-38p2	MW-31b
MW-67p1	MW-80p2	MW-86b
MW-70p1		MW-93b
MW-84p1		MW-96b
MW-90p1		MW-97b
MW-98p1		

Table 2. Observation Well Details
Ephrata Landfill, Grant County, Washington

Station ID	Water Bearing Unit	Well Dia. (in)	BOW (ft)	TOS (ft)	BOS (ft)	Transducer (ft)	TOC El. (ft)	TOS El. (ft)	BOS El. (ft)	BOW El. (ft)
MW-84p1	P1 zone	6	34.5	24.5	34.5	34	1290.4	1265.9	1255.9	1255.9
MW-90p1	P1 zone	6	48.0	42.5	47.5	47.5	1294.3	1251.8	1246.8	1246.3
MW-98p1	P1 zone	6	34.5	24.5	34.5	34	1286.2	1261.7	1251.7	1251.7
MW-104p1	P1 zone	6	46.1	36.5	46.1	45.6	1287.6	1251.1	1241.5	1241.5
MW-110p1	P1 zone	6	30.1	20.5	30.1	29.6	1278.8	1258.3	1248.7	1248.7
MW-127p1	P1 zone	6	22.5	15.5	22.5	22	1280.3	1264.8	1257.8	1257.8
MW-129p1	P1 zone	6	21.5	16.5	21.5	21	1281.8	1265.3	1260.3	1260.3
MW-66p1	P1 zone	4	40.0	36.0	40.0	39.5	1290.3	1254.3	1250.3	1250.3
MW-67p1	P1 zone	4	43.5	34.5	43.5	43	1290.7	1256.2	1247.2	1247.2
MW-70p1	P1 zone	4	36.5	30.5	36.5	36	1286.5	1256.0	1250.0	1250.0
MW-80p2	P2 zone	6	62.3	46.5	61.5	61.8	1296.7	1250.2	1235.2	1234.4
MW-115p2	P2 zone	6	49.5	34.0	49.0	49	1273.3	1239.3	1224.3	1223.8
MW-122p2	P2 zone	6	45.5	35.5	45.5	45	1273.1	1237.6	1227.6	1227.6
MW-126p2	P2 zone	6	52.5	42.5	52.5	52	1280.2	1237.7	1227.7	1227.7
MW-35p2	P2 zone	2	52.5	46.5	52.5	52	1290.7	1244.2	1238.2	1238.2
MW-38p2	P2 zone	2	46.5	36.5	46.5	46	1281.7	1245.2	1235.2	1235.2
MW-86b	Roza aquifer	6	76.4	64.5	74.5	75.9	1290.4	1225.9	1215.9	1214.0
MW-93b	Roza aquifer	6	84.6	73.5	83.5	84.1	1289.7	1216.2	1206.2	1205.1
MW-96b	Roza aquifer	6	77.0	66.5	76.5	76.5	1286.9	1220.4	1210.4	1209.9
MW-97b	Roza aquifer	6	73.5	63.5	73.5	73	1288.6	1225.1	1215.1	1215.1
MW-105b	Roza aquifer	6	67.4	57.5	67.4	66.9	1274.6	1217.1	1207.2	1207.2
MW-111b	Roza aquifer	6	68.6	56.5	68.5	68.1	1280.2	1223.7	1211.7	1211.6
MW-132b	Roza aquifer	6	76.5	61.5	76.5	76	1280.8	1219.3	1204.3	1204.3
MW-29b	Roza aquifer	2	71.0	66.5	71.0	70.5	1288.9	1222.4	1217.9	1217.9
MW-31b	Roza aquifer	2	76.5	66.5	76.5	76	1278.7	1212.2	1202.2	1202.2
	25					25				

Notes:

The vertical datum is NAVD88.

Depths and screen elevations are estimates below TOC assuming a 3.5-ft casing height above the ground surface at the time of well drilling.

All observation wells and each MPE and VE well with no PLC connection will be equipped with new Levelogger^{TM} water level vapor pressure data logging transducers.

Abbreviations:

BOS - bottom of screen depth
BOW - bottom of well depth
Dia. - diameter
El. - elevation
ft - feet
ID - identifier
in - inches
PLC - programmable logic controller
TOC - top of casing
TOS - top of screen depth

Table 3. Expanded MPE Pilot Testing Seasonal Monitoring Summary

Ephrata Landfill, Grant County, Washington

Parameter	Location	Baseline Monitoring	Full Sequence in the P1 Zone, Then Repeat Seqence in the P2 Zone							Form(s)
			Dewatering, No Vacuum		MPE and VE					
		Last Week of March Before Startup	Daily for 3 Days →	Weekly Until Start of MPE and VE	Daily for 3 Days →	Weekly for 3 Weeks →	Monthly →	Prior to Seasonal Shutdown	After Any Valve or Equipment Adjustments or VFA	
Landtec GEM™ readings	VAE discharge sample port	-	-	-	X	X	X	X	-	Liquid and Vapor Extraction
Levelogger™	MPE, VE, and observation wells	X	X	X	X	X	X	X	-	MPE Well, VE Well, Observation Well
Liquid flow rate	FE/FIT 101 readout at HMI	-	X	X	X	X	X	X	-	Liquid and Vapor Extraction
Liquid total volume	FE/FIT 101 readout at HMI	X	X	X	X	X	X	X	-	Liquid and Vapor Extraction
Manual depth to groundwater	All MPE, VE, and observation wells	X	-	-	-	-	-	-	-	MPE Well, VE Well, Observation Well
Manual depth to NAPL	All MPE, VE, and observation wells	X	-	-	-	-	-	-	-	MPE Well, VE Well, ObservationWell
Manual vacuum and vapor flow reading	Magnehelic gage at MPE and VE wells	-	-	-	X	X	X	X	-	MPE Well, VE Well
PIT readings	PIT 201A, 201B	X	-	-	X	X	X	X	-	Observation Well
Pump cycle count	MPE wells	X	X	X	X	X	X	X	X	MPE Well
Pump supply air pressure	Regulators on air supply lines to pumps	-	X	X	X	X	X	X	X	MPE Well
VAE blower makeup air valve position	VTT container	-	-	-	X	X	X	X	X	Operations
VAE blower speed	VTT container	-	-	-	X	X	X	X	X	Operations
VAE flow control valve position	Active MPE wells	-	-	-	X	X	X	X	X	MPE Well
Vapor extraction rate and volume	FE/FIT 201 readout at HMI	-	-	-	X	X	X	X	-	Liquid and Vapor Extraction
Vapor PID readings	VAE discharge sample port	-	-	-	X	X	X	X	-	Liquid and Vapor Extraction

Notes:

With Ecology's approval, the monitoring schedule may be modified based on the first season's results.
Dewatering with no vacuum, then MPE and VE will occur sequentially in the P1 zone, then sequentially in the P2 zone.
Each dewatered zone will be maintained in a dewatered state throughout testing in any deeper zone or aquifer.
Initiation of MPE and VE anticipated once a zone is dewatered to the point that the groundwater level is no higher than one third of the screened interval on average in all wells in a zone or aquifer.
The Roza aquifer VE well (MW-106b) will be brought online after the P2 zone is dewatered.
The VAE blower makeup air is only needed when the rotary claw blower is used.
Pond depth and pond leak detection to be measure before system startup, then monthly until seasonsal shutdown and recorded on the Operations Form.
In addition to the above monitoring, the VTT and LTT equipment will be monitored in accordance with the O&M manual and recorded on the Operations Form.

Abbreviations:

FE - flow element
FIT - flow indicator transmitter
HMI - human machine interface (interactive touchscreen)
LTT - liquid treatment train
MPE - multi-phase extraction
NAPL - non-aqueous phase liquid
O&M - operation and maintenance
PID - photoionization detector (i.e., field meter)
PIT - pressure indicating transmitter
VAE - vacuum-assisted extraction
VE - vapor extraction
VFA - vapor flow augmentation (venting)
VTT - vapor treatment train
→ - indicates sequence of events

Table 4. MPE Groundwater and Vapor Seasonal Sampling and Analysis Schedule
Ephrata Landfill, Grant County, Washington

			Baseline Monitoring		Full Sequence in the P1 Zone, Then Repeat Sequence in the P2 Zone																	
					Dewatering, No Vacuum						MPE and VE						VFA					
			Last Week of March Before Startup		1st day →		1st week →		Last Day Before MPE and VE		1st day →		1st week →		Last Day Before VFA		1st week →		Last Day of VFA		End of Season	
Well/Station	Location	Matrix	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals	VOCs, Petroleum Hydrocarbons	SVOCs, Inorganics, Dissolved and Total Metals
MW-34p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-36p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-65p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-68p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-69p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-83p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-85p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-92p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-100p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-109p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-117p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-123p1	P1 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-87p2	P2 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-91p2	P2 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-94p2	P2 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-99p2	P2 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-101p2	P2 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-113p2	P2 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-114p2	P2 zone	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-102b	Roza aquifer	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-106b	Roza aquifer	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-111b	Roza aquifer	Groundwater	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T-101 Influent	LTT	Groundwater	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Effluent to Pond	LTT	Groundwater	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GAC Inlet	VTT	Vapor	-	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-
GAC Exhaust	VTT	Vapor	-	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-

Notes:

See Table 5 for groundwater analysis methods and parameters and Table 7 for vapor analysis methods and parameters.
With Ecology's approval, the sampling schedule may be modified based on the first season results.
The groundwater and vapor extraction season is April through October.
Planned seasonal stages are dewatering without vacuum, MPE and VE, VFA, then MPE and VE until the end of the season.
Vapor and groundwater field monitoring parameters are addressed in Table 3.

Abbreviations:

GAC - granular activated carbon
LTT - liquid treatment train
MPE - multi-phase extraction
SVOC - semi-volatile organic compound
VE - vapor extraction
VFA - vapor flow augmentation (venting)
VOC - volatile organic compound
VTT - vapor treatment train
→ - indicates sequence of events

Table 5. Groundwater Analytical Parameters
Ephrata Landfill, Grant County, Washington

Parameter	Units	Analytical Method
Organic Parameters – VOCs		
1,4-Dioxane	µg/L	EPA 8260D SIM
1,1,1,2-Tetrachloroethane	µg/L	EPA 8260D
1,1,1-Trichloroethane	µg/L	EPA 8260D
1,1,2,2-Tetrachloroethane	µg/L	EPA 8260D
1,1,2-Trichloroethane	µg/L	EPA 8260D
1,1-Dichloroethane	µg/L	EPA 8260D
1,1-Dichloroethene	µg/L	EPA 8260D
1,1-Dichloropropene	µg/L	EPA 8260D
1,2,3-Trichlorobenzene	µg/L	EPA 8260D
1,2,3-Trichloropropane	µg/L	EPA 8260D
1,2,4-Trichlorobenzene	µg/L	EPA 8260D
1,2,4-Trimethylbenzene	µg/L	EPA 8260D
1,2-Dibromo-3-chloropropane	µg/L	EPA 8260D
1,2-Dibromoethane (EDB)	µg/L	EPA 8260D
1,2-Dichlorobenzene	µg/L	EPA 8260D
1,2-Dichloroethane (EDC)	µg/L	EPA 8260D
1,2-Dichloropropane	µg/L	EPA 8260D
1,3,5-Trimethylbenzene	µg/L	EPA 8260D
1,3-Dichlorobenzene	µg/L	EPA 8260D
1,3-Dichloropropane	µg/L	EPA 8260D
1,4-Dichlorobenzene	µg/L	EPA 8260D
2,2-Dichloropropane	µg/L	EPA 8260D
2-Butanone (MEK)	µg/L	EPA 8260D
2-Chlorotoluene	µg/L	EPA 8260D
2-Hexanone	µg/L	EPA 8260D
4-Chlorotoluene	µg/L	EPA 8260D
4-Methyl-2-pentanone	µg/L	EPA 8260D
Acetone	µg/L	EPA 8260D
Benzene	µg/L	EPA 8260D
Bromobenzene	µg/L	EPA 8260D
Bromodichloromethane	µg/L	EPA 8260D
Bromoform	µg/L	EPA 8260D
Bromomethane	µg/L	EPA 8260D
Carbon tetrachloride	µg/L	EPA 8260D
Chlorobenzene	µg/L	EPA 8260D
Chloroethane	µg/L	EPA 8260D
Chloroform	µg/L	EPA 8260D
Chloromethane	µg/L	EPA 8260D
cis-1,2-Dichloroethene	µg/L	EPA 8260D
cis-1,3-Dichloropropene	µg/L	EPA 8260D
Dibromochloromethane	µg/L	EPA 8260D
Dibromomethane	µg/L	EPA 8260D

Table 5. Groundwater Analytical Parameters
Ephrata Landfill, Grant County, Washington

Parameter	Units	Analytical Method
Dichlorodifluoromethane	µg/L	EPA 8260D
Ethylbenzene	µg/L	EPA 8260D
Hexachlorobutadiene	µg/L	EPA 8260D
Hexane	µg/L	EPA 8260D
Isopropylbenzene	µg/L	EPA 8260D
m,p-Xylene	µg/L	EPA 8260D
Methyl t-butyl ether (MTBE)	µg/L	EPA 8260D
Methylene chloride	µg/L	EPA 8260D
Naphthalene	µg/L	EPA 8260D
n-Propylbenzene	µg/L	EPA 8260D
o-Xylene	µg/L	EPA 8260D
p-Isopropyltoluene	µg/L	EPA 8260D
sec-Butylbenzene	µg/L	EPA 8260D
Styrene	µg/L	EPA 8260D
tert-Butylbenzene	µg/L	EPA 8260D
Tetrachloroethene	µg/L	EPA 8260D
Toluene	µg/L	EPA 8260D
trans-1,2-Dichloroethene	µg/L	EPA 8260D
trans-1,3-Dichloropropene	µg/L	EPA 8260D
Trichloroethene	µg/L	EPA 8260D
Trichlorofluoromethane	µg/L	EPA 8260D
Vinyl chloride	µg/L	EPA 8260D SIM
Organic Parameters – SVOCs		
1,2,4-Trichlorobenzene	µg/L	EPA 8270E
1,2-Dichlorobenzene	µg/L	EPA 8270E
1,2-Diphenylhydrazine	µg/L	EPA 8270E
1,3-Dichlorobenzene	µg/L	EPA 8270E
1,4-Dichlorobenzene	µg/L	EPA 8270E
1-Methylnaphthalene	µg/L	EPA 8270E
2,2'-Oxybis(1-chloropropane)	µg/L	EPA 8270E
2,2’-Oxybis(1-chloropropane)	µg/L	EPA 8270E
2,4,5-Trichlorophenol	µg/L	EPA 8270E
2,4,6-Trichlorophenol	µg/L	EPA 8270E
2,4-Dichlorophenol	µg/L	EPA 8270E
2,4-Dimethylphenol	µg/L	EPA 8270E
2,4-Dinitrophenol	µg/L	EPA 8270E
2,4-Dinitrotoluene	µg/L	EPA 8270E
2,6-Dinitrotoluene	µg/L	EPA 8270E
2-Chloronaphthalene	µg/L	EPA 8270E
2-Chlorophenol	µg/L	EPA 8270E
2-Methylnaphthalene	µg/L	EPA 8270E
2-Methylphenol	µg/L	EPA 8270E
2-Nitroaniline	µg/L	EPA 8270E

Table 5. Groundwater Analytical Parameters
Ephrata Landfill, Grant County, Washington

Parameter	Units	Analytical Method
2-Nitrophenol	µg/L	EPA 8270E
3,3'-Dichlorobenzidine	µg/L	EPA 8270E
3-Methylphenol + 4-Methylphenol	µg/L	EPA 8270E
3-Nitroaniline	µg/L	EPA 8270E
4,6-Dinitro-2-methylphenol	µg/L	EPA 8270E
4-Bromophenyl phenyl ether	µg/L	EPA 8270E
4-Chloro-3-methylphenol	µg/L	EPA 8270E
4-Chloroaniline	µg/L	EPA 8270E
4-Chlorophenyl phenyl ether	µg/L	EPA 8270E
4-Nitroaniline	µg/L	EPA 8270E
4-Nitrophenol	µg/L	EPA 8270E
Acenaphthene	µg/L	EPA 8270E
Acenaphthylene	µg/L	EPA 8270E
Anthracene	µg/L	EPA 8270E
Benz(a)anthracene	µg/L	EPA 8270E
Benzo(a)pyrene	µg/L	EPA 8270E
Benzo(b)fluoranthene	µg/L	EPA 8270E
Benzo(g,h,i)perylene	µg/L	EPA 8270E
Benzo(k)fluoranthene	µg/L	EPA 8270E
Benzoic acid	µg/L	EPA 8270E
Benzyl alcohol	µg/L	EPA 8270E
Benzyl butyl phthalate	µg/L	EPA 8270E
Bis(2-chloroethoxy)methane	µg/L	EPA 8270E
Bis(2-chloroethyl) ether	µg/L	EPA 8270E
Bis(2-ethylhexyl) phthalate	µg/L	EPA 8270E
Carbazole	µg/L	EPA 8270E
Chrysene	µg/L	EPA 8270E
Dibenzo(a,h)anthracene	µg/L	EPA 8270E
Dibenzofuran	µg/L	EPA 8270E
Diethyl phthalate	µg/L	EPA 8270E
Dimethyl phthalate	µg/L	EPA 8270E
Di-n-butyl phthalate	µg/L	EPA 8270E
Di-n-octyl phthalate	µg/L	EPA 8270E
Fluoranthene	µg/L	EPA 8270E
Fluorene	µg/L	EPA 8270E
Hexachlorobenzene	µg/L	EPA 8270E
Hexachlorobutadiene	µg/L	EPA 8270E
Hexachlorocyclopentadiene	µg/L	EPA 8270E
Hexachloroethane	µg/L	EPA 8270E
Indeno(1,2,3-cd)pyrene	µg/L	EPA 8270E
Isophorone	µg/L	EPA 8270E
Naphthalene	µg/L	EPA 8270E
Nitrobenzene	µg/L	EPA 8270E

Table 5. Groundwater Analytical Parameters
Ephrata Landfill, Grant County, Washington

Parameter	Units	Analytical Method
N-Nitrosodimethylamine	µg/L	EPA 8270E
N-Nitroso-di-n-propylamine	µg/L	EPA 8270E
N-Nitrosodiphenylamine	µg/L	EPA 8270E
Pentachlorophenol	µg/L	EPA 8270E
Phenanthrene	µg/L	EPA 8270E
Phenol	µg/L	EPA 8270E
Pyrene	µg/L	EPA 8270E
1,2,4-Trichlorobenzene	µg/L	EPA 8270E
1,2-Dichlorobenzene	µg/L	EPA 8270E
1,2-Diphenylhydrazine	µg/L	EPA 8270E
1,3-Dichlorobenzene	µg/L	EPA 8270E
1,4-Dichlorobenzene	µg/L	EPA 8270E
1-Methylnaphthalene	µg/L	EPA 8270E
2,2'-Oxybis(1-chloropropane)	µg/L	EPA 8270E
2,2’-Oxybis(1-chloropropane)	µg/L	EPA 8270E
2,4,5-Trichlorophenol	µg/L	EPA 8270E
2,4,6-Trichlorophenol	µg/L	EPA 8270E
2,4-Dichlorophenol	µg/L	EPA 8270E
2,4-Dimethylphenol	µg/L	EPA 8270E
2,4-Dinitrophenol	µg/L	EPA 8270E
2,4-Dinitrotoluene	µg/L	EPA 8270E
2,6-Dinitrotoluene	µg/L	EPA 8270E
2-Chloronaphthalene	µg/L	EPA 8270E
2-Chlorophenol	µg/L	EPA 8270E
2-Methylnaphthalene	µg/L	EPA 8270E
2-Methylphenol	µg/L	EPA 8270E
2-Nitroaniline	µg/L	EPA 8270E
2-Nitrophenol	µg/L	EPA 8270E
3,3'-Dichlorobenzidine	µg/L	EPA 8270E
3-Methylphenol + 4-Methylphenol	µg/L	EPA 8270E
3-Nitroaniline	µg/L	EPA 8270E
4,6-Dinitro-2-methylphenol	µg/L	EPA 8270E
4-Bromophenyl phenyl ether	µg/L	EPA 8270E
4-Chloro-3-methylphenol	µg/L	EPA 8270E
4-Chloroaniline	µg/L	EPA 8270E
4-Chlorophenyl phenyl ether	µg/L	EPA 8270E
4-Nitroaniline	µg/L	EPA 8270E
4-Nitrophenol	µg/L	EPA 8270E
Acenaphthene	µg/L	EPA 8270E
Acenaphthylene	µg/L	EPA 8270E
Anthracene	µg/L	EPA 8270E
Benz(a)anthracene	µg/L	EPA 8270E
Benzo(a)pyrene	µg/L	EPA 8270E

Table 5. Groundwater Analytical Parameters
Ephrata Landfill, Grant County, Washington

Parameter	Units	Analytical Method
Benzo(b)fluoranthene	µg/L	EPA 8270E
Benzo(g,h,i)perylene	µg/L	EPA 8270E
Benzo(k)fluoranthene	µg/L	EPA 8270E
Benzoic acid	µg/L	EPA 8270E
Benzyl alcohol	µg/L	EPA 8270E
Benzyl butyl phthalate	µg/L	EPA 8270E
Bis(2-chloroethoxy)methane	µg/L	EPA 8270E
Bis(2-chloroethyl) ether	µg/L	EPA 8270E
Bis(2-ethylhexyl) phthalate	µg/L	EPA 8270E
Carbazole	µg/L	EPA 8270E
Chrysene	µg/L	EPA 8270E
Dibenzo(a,h)anthracene	µg/L	EPA 8270E
Dibenzofuran	µg/L	EPA 8270E
Diethyl phthalate	µg/L	EPA 8270E
Dimethyl phthalate	µg/L	EPA 8270E
Di-n-butyl phthalate	µg/L	EPA 8270E
Di-n-octyl phthalate	µg/L	EPA 8270E
Fluoranthene	µg/L	EPA 8270E
Fluorene	µg/L	EPA 8270E
Hexachlorobenzene	µg/L	EPA 8270E
Hexachlorobutadiene	µg/L	EPA 8270E
Hexachlorocyclopentadiene	µg/L	EPA 8270E
Hexachloroethane	µg/L	EPA 8270E
Indeno(1,2,3-cd)pyrene	µg/L	EPA 8270E
Isophorone	µg/L	EPA 8270E
Naphthalene	µg/L	EPA 8270E
Nitrobenzene	µg/L	EPA 8270E
N-Nitrosodimethylamine	µg/L	EPA 8270E
N-Nitroso-di-n-propylamine	µg/L	EPA 8270E
N-Nitrosodiphenylamine	µg/L	EPA 8270E
Pentachlorophenol	µg/L	EPA 8270E
Phenanthrene	µg/L	EPA 8270E
Phenol	µg/L	EPA 8270E
Pyrene	µg/L	EPA 8270E
Total Petroleum Hydrocarbons		
Gasoline-range hydrocarbons	µg/L	NWTPH-Gx
Diesel-range hydrocarbons	µg/L	NWTPH-Dx
Oil-range hydrocarbons	µg/L	NWTPH-Dx
Inorganic Parameters		
Chloride	mg/L	EPA 325.2
Nitrate as nitrogen	mg/L	EPA 353.2
Nitrate+nitrite as nitrogen	mg/L	EPA 353.2
Nitrite as nitrogen	mg/L	EPA 353.2

Table 5. Groundwater Analytical Parameters
Ephrata Landfill, Grant County, Washington

Parameter	Units	Analytical Method
Sulfate	mg/L	EPA 375.2
Total dissolved solids	mg/L	EPA 160.1
Bicarbonate (as $CaCO_3$)	mg/L	SM2320B
Carbonate (as $CaCO_3$)	mg/L	SM2320B
Hydroxide (as $CaCO_3$)	mg/L	SM2320B
Metals, Total and Dissolved		
Antimony	µg/L	EPA 200.8
Arsenic	µg/L	EPA 200.8
Barium	µg/L	EPA 200.8
Beryllium	µg/L	EPA 200.8
Cadmium	µg/L	EPA 200.8
Chromium	µg/L	EPA 200.8
Cobalt	µg/L	EPA 200.8
Copper	µg/L	EPA 200.8
Iron	µg/L	EPA 200.8
Lead	µg/L	EPA 200.8
Manganese	µg/L	EPA 200.8
Mercury	µg/L	EPA 200.8
Molybdenum	µg/L	EPA 200.8
Nickel	µg/L	EPA 200.8
Selenium	µg/L	EPA 200.8
Silver	µg/L	EPA 200.8
Thallium	µg/L	EPA 200.8
Vanadium	µg/L	EPA 200.8
Zinc	µg/L	EPA 200.8
Field Parameters		
Temperature	Celsius	water quality meter
Conductivity	mS/cm	water quality meter
pH	--	water quality meter
Dissolved oxygen	mg/L	water quality meter
Oxidation-reduction potential	mV	water quality meter
Turbidity	NTU	water quality meter

Notes:

$CaCO_3$ - calcium carbonate

mg/L - milligrams per liter

mS/cm = milliSiemens per centimeter

mV = millivolts

NTU = nephelometric turbidity units

SIM - selected ion monitoring

SVOCs - semi-volatile organic compounds

µg/L - micrograms per liter

VOCs - volatile organic compounds

Table 6. Groundwater Laboratory Analyses Containers

Ephrata Landfill, Grant County, Washington

Analysis	Number of Bottles per Analysis	Bottle	Preservative	Hold Time
Total Metals	1	500 mL HDPE	HNO_3	6 Months
Dissolved Metals	1	500 mL HDPE	HNO_3	6 Months
VOCs (8260)	3	40 mL Vials	HCL	14 Days
SVOCs (8270)	2	500 mL Amber Glass	None	7 Days
Inorganics	2	500 mL HDPE	None	48 Hours
Total Dissolved Solids	1	1 L HDPE	None	7 Days
Gasoline-range hydrocarbons (NWTPH-Gx)	2	40 mL Vials	HCL	14 Days
Diesel-range and oil-range hydrocarbons (NWTPH-Dx	2	500 mL Amber Glass	None	14 Days

Notes:

HCL - hydrochloric acid

HDPE - high-density polyethylene

HNO_3 - nitric acid

mL - milliliter

VOC - volatile organic compound

Table 7. Vapor Analytical Parameters

Ephrata Landfill, Grant County, Washington

Parameters	Units	Analytical Method (Sample Collected in Summa Canister) [1]
Volatile Organic Compounds		
1,1,1-Trichloroethane	µg/m^3	TO-15
1,1,2,2-Tetrachloroethane	µg/m^3	TO-15
1,1,2-Trichloroethane	µg/m^3	TO-15
1,1-Dichloroethane	µg/m^3	TO-15
1,1-Dichloroethene	µg/m^3	TO-15
1,2,4-Trichlorobenzene	µg/m^3	TO-15
1,2,4-Trimethylbenzene	µg/m^3	TO-15
1,2-Dibromoethane (EDB)	µg/m^3	TO-15
1,2-Dichlorobenzene	µg/m^3	TO-15
1,2-Dichloroethane (EDC)	µg/m^3	TO-15
1,2-Dichloropropane	µg/m^3	TO-15
1,3,5-Trimethylbenzene	µg/m^3	TO-15
1,3-Butadiene	µg/m^3	TO-15
1,3-Dichlorobenzene	µg/m^3	TO-15
1,4-Dichlorobenzene	µg/m^3	TO-15
1,4-Dioxane	µg/m^3	TO-15
2,2,4-Trimethylpentane	µg/m^3	TO-15
2-Butanone (MEK)	µg/m^3	TO-15
2-Chlorotoluene	µg/m^3	TO-15
2-Hexanone	µg/m^3	TO-15
2-Propanol	µg/m^3	TO-15
3-Chloropropene	µg/m^3	TO-15
4-Ethyltoluene	µg/m^3	TO-15
4-Methyl-2-pentanone	µg/m^3	TO-15
Acetone	µg/m^3	TO-15
Acrolein	µg/m^3	TO-15
Benzene	µg/m^3	TO-15
Benzyl chloride	µg/m^3	TO-15
Bromodichloromethane	µg/m^3	TO-15
Bromoform	µg/m^3	TO-15
Bromomethane	µg/m^3	TO-15
Butane	µg/m^3	TO-15
Carbon disulfide	µg/m^3	TO-15
Carbon tetrachloride	µg/m^3	TO-15
CFC-113	µg/m^3	TO-15
Chlorobenzene	µg/m^3	TO-15
Chloroethane	µg/m^3	TO-15
Chloroform	µg/m^3	TO-15
Chloromethane	µg/m^3	TO-15
cis-1,2-Dichloroethene	µg/m^3	TO-15
cis-1,3-Dichloropropene	µg/m^3	TO-15
Cyclohexane	µg/m^3	TO-15

Parameters	Units	Analytical Method (Sample Collected in Summa Canister) [1]
Dibromochloromethane	µg/m^3	TO-15
Dichlorodifluoromethane	µg/m^3	TO-15
Ethanol	µg/m^3	TO-15
Ethyl acetate	µg/m^3	TO-15
Ethylbenzene	µg/m^3	TO-15
F-114	µg/m^3	TO-15
Heptane	µg/m^3	TO-15
Hexachlorobutadiene	µg/m^3	TO-15
Hexane	µg/m^3	TO-15
Isopropylbenzene	µg/m^3	TO-15
m,p-Xylene	µg/m^3	TO-15
Methyl Methacrylate	µg/m^3	TO-15
Methyl t-butyl ether (MTBE)	µg/m^3	TO-15
Methylene chloride	µg/m^3	TO-15
Naphthalene	µg/m^3	TO-15
Nonane	µg/m^3	TO-15
o-Xylene	µg/m^3	TO-15
Pentane	µg/m^3	TO-15
Propene	µg/m^3	TO-15
Propylbenzene	µg/m^3	TO-15
Styrene	µg/m^3	TO-15
t-Butyl alcohol (TBA)	µg/m^3	TO-15
Tetrachloroethene	µg/m^3	TO-15
Tetrahydrofuran	µg/m^3	TO-15
Toluene [2]	µg/m^3	TO-15
trans-1,2-Dichloroethene	µg/m^3	TO-15
trans-1,3-Dichloropropene	µg/m^3	TO-15
Trichloroethene	µg/m^3	TO-15
Trichlorofluoromethane	µg/m^3	TO-15
Vinyl acetate	µg/m^3	TO-15
Vinyl bromide	µg/m^3	TO-15
Vinyl chloride	µg/m^3	TO-15
Gaseous Phase Petroleum Hydrocarbons		
C_5-C_8 Aliphatic hydrocarbons	µg/m^3	MA-APH [3]
C_9-C_{12} Aliphatic hydrocarbons	µg/m^3	MA-APH [3]
C_9-C_{10} Aromatic hydrocarbons	µg/m^3	MA-APH [3]

Parameters	Units	Analytical Method (Sample Collected in Summa Canister) [1]
Field Parameters		
Methane	% bv	GEM 5000
Carbon dioxide	% bv	GEM 5000
Carbon monoxide	% bv	GEM 5000
Hydrogen sulfide	% bv	GEM 5000
Oxygen	% bv	GEM 5000
Volatile organic compounds	ppm	PID

Notes:

% bv - percent by volume

CFC - chlorofluorocarbon

EDB - ethylene dibromide

EDC - ethylene dichloride

F - freon

MEK - methyl ethyl ketone

ppm - parts per million

PID - photoionization detector

$\mu g/m^3$ - micrograms per cubic meter

[1, 2] EPA Method TO-15 is the primary analytical method. However, during the first sampling event, both EPA Methods TO-15 and TO-17 will be used to measure specifically for toluene. Following that, If vapor concentrations exceed the upper bound qauntitatve limits of Method TO-15, then EPA Method TO-17 may be evaluated as a alternative analysis method for all VOCs.

[3] MA-APH is used to quantify individual fractions of gaseous phase volatile aliphatic and aromatic hydrocarbons based on the number of carbon atoms includes in the constituent compounds. The method quantified aliphatic hydrocarbons within two specific ranges: C_5 through C_8, and C_9 through C_{12}. Additionally, aromatic hydrocarbons are quantified within the C_9 through C_{10} range.

Attachment A

Field Forms

Operations Form

Sampling and Analysis Plan for Ephrata Landfill: Expanded MPE Pilot Test Interim Action Workplan

Sheet _____________ of _____________

		Pond		System Equipment (monitoring/adjustment notes)							Observer (initials)
Date	Time	Depth	Leak Inspection	Compressor Air Supply Rate	VAE Blower Speed	VAE Blower Make Up Air	Waste Collection Tank	Air Sparge Flow Rate	Activated Carbon Inspection/ Replacement	Other (see MPE O&M Manual)	
	24 hrs	ft	y/n	SCFM	(Hz)	Range from Open to Close	(Level, ft)	(units?)			

MPE Well Form

Well ____________________ Sheet _____________ of _____________

Describe Measuring Point ____

		Depth to		Pressures		Pump						Vapor Concentrations at Wellhead (Ambient Air or VAE Vapor, indicate under Comments)			Observer, Comments
									Pump Cycle Rate						
Date	Time	Water	Magnehelic	PIT / Magnehelic	LT	Pump On	Pump Off	Total Pump Cycle Count	Number of Cycle Counts	Delta Time	Supply Air Press.	CH4	O2	Total Organics	Record VAE Flow Valve Settings Here
	24 hrs	x.xx ft	SCFM	x.xx inch water		Date:Time	Date:Time	count	count	mm:ss	PSI	%	PPM	PPM	

Vapor Extraction Well Form

Well ______________________________

Sheet _____________ of _____________

Describe measuring point ______________________________

Date	Time	Depth to Water	Pressures			Vapor Concentrations at Wellhead (Ambient Air or VAE Vapor, indicate under Comments)			Observer, Comments
			Magnehelic	PIT / Magnehelic	LT	CH4	O2	Total Organics	
	24 hrs	x.xx ft	SCFM	x.xx inch water		%	PPM	PPM	

Observation Well Form

Sampling and Analysis Plan for Ephrata Landfill: Expanded MPE Pilot Test Interim Action Workplan

Well ______________________________

Sheet _____________ of _____________

Describe measuring point ______________________________

Transducer ID #:____________________________

Date	Time	Depth to Water	Pressures		Observer, Comments
			PIT	LT	
	24 hrs	x.xx ft	x.xx inch water		

Liquid and Vapor Extraction Form

Sheet ____________ of ____________

		Liquid Extraction		Vapor Extraction		Ambient Air Concentrations (Through Tubing)	Total Vapor Concentrations in VAE Line (Downgradient of Blower)			Observer/Comments
Date	Time	Volume	Rate	Pressure Differential	Vacuum Pressure	Total Organics	CH4	O2	Total Organics	
	24 hrs	x.xx gallons	x.xx gpm	x.xx in H2O	x.xx in Hg	PPM	%	PPM	PPM	

GROUNDWATER SAMPLING FIELD DATA SHEET

Well #: ______________________
Sample #: ______________________

Project Number: ____________
Project Name: Ephrata Landfill Expanded MPE Pilot Test
Project Address: 3803 Neva Lake Road, Ephrata, WA 98823
Client Name: Grant County Public Works

Date: ____________
Location: ____________
Sampled By: ____________
Purged By: ____________

Casing Diameter: 2"_______ 4"_______ 6"_______ Other ________________

Well Type: MPE__________ VE_______ OBS______________________________

Depth to Water (feet): ______________________
Depth of Well (feet): ______________________
Reference Point (surveyors notch, etc.): ______________________
Day/Time Sampled: ______________________

Purge Volume Measurement Method: ______________________
Date Purged: ______________________
Purge Time (from/to): ______________________
Water Level Probe Used: ______________________

Purge Volume Calculation: $(\pi r^2 h)(7.48\ gal/ft^3)$(3 casing volumes)
Purge Volume (gallons) for 2" = (0.49)(h); 4" = (1.96) (h); 6" = (4.41) (h)
Calculated Purge Volume (gallons): __________ Actual Purge Volume (gallons): __________

criteria: if stable params, purge at least 1 casing volume, if not stable purge at least 3 casing volumes,
depth changes by less than 0.02 feet, pH changes by less than 0.1, and other parameters change by less than 10%

TIME (2400 hr)	DTW (ft)	Rate/Vol.) (gpm/gal)	pH (units)	EC (umhos/cm 25 c)	COLOR (visual)	TURBIDITY (NTU)	D.O. (mg/L)	ORP (mV)	TEMP. (Deg.C)

Purging Equipment: ______________________
Pump Placement: ______________________

Sampling Equipment: ______________________
Flow cell Disconnected (Y/N): ______________________

Laboratory: ______________________
Chain-of-Custody (yes/no): _______ Yes
Shipment Method: ______________________

Date Sent to Lab: ______________________
Field CC Sample Number: ______________________
Split with (names/organizations): ______________________

Well Integrity: ______________________

QA/QC Collected (Y/N) : ______________________
QA/QC Sample Date and Time: ______________________

Quantity:	Container:	Preservatives:	Filtered (type):	Remarks:

Signature: ______________________

Page______ of______

Vapor Lab Sample Form

			Field Parameters			Analytical Parameter (Y or N)	Canister Recordings								
Sample ID (Well/Location)	Sample Date	Sample Time 24 hrs	CH4 %	O2 PPM	Total Organics PPM	VOC-TO15 (Summa Canister)	Canister ID	Regulator ID	Time Start	Time Stop	Canister Vacuum Start ("Hg)	Canister Vacuum Stop ("Hg)	Lab	Shipment Date to Lab	Observer/Comments

Attachment B

Chain-of-Custody Form

SAMPLE CHAIN OF CUSTODY

Report To____________________________

Company____________________________

Address____________________________

City, State, ZIP____________________________

Phone________________Email____________________________

SAMPLERS (*signature*)	
PROJECT NAME	PO #
REMARKS Project Specific RLs - Yes / No	INVOICE TO

Page # ________ of ________

TURNAROUND TIME
Standard Turnaround RUSH__________________ Rush charges authorized by: ________________________
SAMPLE DISPOSAL
Dispose after 30 days Archive Samples Other__________________

						ANALYSES REQUESTED											
Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	NWTPH-Dx	NWTPH-Gx	BTEX EPA 8021	VOCs EPA 8260	PAHs EPA 8270	PCBs EPA 8082						Notes

Friedman & Bruya, Inc.

5500 4th Avenue S

Seattle, WA 98108

Ph. (206) 285-8282

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

FORMS\COC\COC.DOC

Attachment C

Laboratory Quality Assurance Manual

QUALITY ASSURANCE MANUAL

Friedman & Bruya, Inc.

5500 4th Avenue South
Seattle, Washington 98108-2419
(206) 285-8282

Revision Number 18
December 9, 2022

Approved by

Executive Committee Representative: James E. Bruya

Laboratory Director: Eric Young

Quality Assurance Officer: Stephanie Pham

Document Control Number: 218

2.0 TABLE OF CONTENTS

3.0 QUALITY SYSTEM POLICY STATEMENT

Quality Assurance/Quality Control (QA/QC) is of fundamental importance to any chemical testing program. It is the goal of Friedman & Bruya, Inc. (F&BI) to provide analytical data which is scientifically sound and of known and documented quality. To achieve this objective, a quality system has been established to ensure that adequate QA/QC procedures are followed and documented, from sample receipt through to the final report provided to the client. The quality system has been established to meet the requirements of the National Environmental Laboratory Accreditation Program (NELAP). The policies and procedures established are designed to meet the quality requirements of our clients, as well as those of accrediting authorities.

F&BI laboratory management is committed to following good professional practices, and to providing the highest quality of environmental testing services to our clients. An important part of this commitment is the requirement that all F&BI personnel involved with environmental testing activities, including management, are familiar with the established quality system, and implement the policies and procedures of the system in their work.

4.0 ETHICS POLICY STATEMENT

Friedman & Bruya, Inc. (F&BI) believes the practice of chemistry requires training, care, attention to detail and personal integrity that must withstand significant pressure from interested parties. We believe we stand firmly for the chemist's right to practice his/her profession with the highest level of support. For this reason, fraud or the falsification of analytical data by an employee is grounds for immediate dismissal. Management shall review data and perform internal audits to ensure ethical conduct on the part of its employees.

Waste of our clients' time and money, as well as natural resources, is strongly discouraged. Environmental analyses can be very costly and their results exponentially more so. Friedman & Bruya, Inc. was formed to provide our clients with analytical information that met their chemical and analytical needs, while at the same time minimizing cost wherever possible.

Friedman & Bruya, Inc. is proud of its employees. Upon employment, a manual is issued to each employee that describes the policies of Friedman and Bruya, Inc. with regards to employee conduct, fraud, waste and abuse. We believe abuse or harassment is degrading to our employees and our clients. Such behavior is not condoned by Friedman & Bruya, Inc. This covers interactions amongst our employees, as well as those between us and our clients. Where abuse or harassment can be documented, a written warning is issued. If the action or behavior continues, dismissal may result.

All employees of Friedman & Bruya, Inc. are charged with the task of reporting any occurrence of fraud or data falsification to the highest authority within our organization. Management will continually look for fraud and data falsification through standard review practices such as those conducted during the course of data review and internal audits. Management will not attempt to create policies that conflict with our fraud policy. If any employee feels or believes that a management policy conflicts with our fraud policy or that any such policy encourages fraudulent practices on the part of employees, they are encouraged to bring these issues to the attention of their supervisor or to the highest authority within our organization.

5.0 LABORATORY ORGANIZATION

5.1 Ownership and Facility Description

F&BI is a privately owned corporation. No other business affiliations or external business entities exist. The F&BI laboratory is comprised of one building, with approximately 12,000 square feet, which is located at 3012 16 Ave. W., Seattle WA. This laboratory was built with safety, efficiency and quality control in mind. Separate rooms are designated for inorganic, organic and volatiles extractions. Fume hoods are located in each of these rooms as well as in standard storage and preparation rooms. Separate areas are also designated for sample storage, instruments/analysis, office space and records storage. Floor plans of the building can be furnished upon request.

5.2 Personnel Organization

The qualifications and responsibilities for key personnel are listed below. An organizational chart is provided in Figure 5-1.

Laboratory/Technical Director

Qualifications:
The Laboratory/Technical Director should be an individual who has a history of laboratory and personnel management. She/He should have a knowledge of all analyses performed by the laboratory and of QA/QC standards of performance. This person should have a bachelors degree in chemical, environmental, biological sciences, physical sciences or engineering, with at least 24 college semester credit hours in chemistry and with at least 2 years of relevant experience. (A masters or doctoral degree may be substituted for 1 year experience.)
Responsibilities:
The Laboratory/Technical Director reports directly to the Executive Committee. He/She has overall responsibility for the technical operation of the laboratory. Specific responsibilities include the following:
Monitor standards of performance in quality control and quality assurance.
Monitor the validity of the analyses performed and data generated to assure reliable data.
Ensure sufficient numbers of qualified personnel are employed.
Provide educational direction to laboratory staff.
Assign workloads and arranges schedules of Project Leaders.
Evaluate overall effectiveness of the laboratory activity.
Propose new methods and modifications as needed. Institute new programs and procedures as directed by the Executive Committee.
Review all new work to ensure that appropriate facilities and resources are available.
Fill in for the QA Officer in her/his absence.

Quality Assurance Officer

Qualifications:
The Quality Assurance Officer should be an individual who has a history of establishing inter-laboratory and intra-laboratory quality assurance programs. She/He should be capable of evaluating analytical data to distinguish between sample variability, instrument variability and method errors. This person is expected to have a degree in chemistry plus several years practice as an environmental chemist evaluating analytical data for technical validity.
Responsibilities:
The Quality Assurance Officer reports to the Executive Committee and Laboratory/Technical Director. She/He has the responsibility of overseeing the inter-laboratory, intra-laboratory studies, non-conformance report reviews, and demonstration of capability program. She/He also works in a team with other qualified staff to complete all of the quality assurance tasks conducted at F&B. These specific responsibilities include the following:
Training and documentation of F&B staff with regards to QA policy and procedures including coordinated quarterly meetings.
Evaluate data for compliance with standard operating procedures and acceptance criteria.
Conduct internal audits on the entire technical operation annually.
Propose changes in the Quality Assurance Program to improve the quality, efficiency, and/or defensibility of the data generated.
Manage laboratory participation in inter-laboratory comparisons and proficiency programs.
Maintain or modify laboratory accreditation.
Notification of laboratory management and project managers, in writing, of any changes to accreditation.
Assist in training of analysts in analytical quality control procedures.
Maintaining the QA manual, DOCs, and SOPs.

Project Leader

Qualifications:
Project Leaders should be individuals who have a history of analyzing environmental samples. They should have knowledge of quality assurance and how it relates to the validity of analytical data. They should also have knowledge of the specific analytical testing requirements for the needs of our clients. They should be able to recognize problems which can arise when analyzing samples, and be able to discuss with the client proper analytical techniques for meeting the clients' goals. This person is expected to have a degree in chemistry or several years experience in the environmental chemistry field.
Responsibilities:
The Project Leaders report directly to the Quality Assurance Officer on all quality assurance matters. They report directly to the Technical/Laboratory Director on all other matters such as project status and projected work loads. Specific responsibilities include the following:
Support the quality assurance program within the project.

Determine effectiveness of the quality assurance program in the project.
Recommend to the Quality Assurance Officer changes in the quality assurance program.
Document for the client any quality control problems which could not be resolved.
Provide technical overview of laboratory activities.

Laboratory Analysts

Qualifications:
Laboratory Analysts should be individuals who have a history of analyzing environmental samples. They should have knowledge of quality assurance. They should recognize quality assurance results which are out of conformance and be able to determine and remedy possible causes. Laboratory Analysts are expected to have a degree in chemical, environmental, biological sciences, physical sciences or engineering and/or experience in the environmental chemistry field.
Responsibilities:
Specific responsibilities include the following:
Perform analytical procedures and data recording in accordance with accepted methods.
Consult with the Quality Assurance Officer to verify that the laboratory is meeting stated quality control goals.
Evaluate new analytical techniques, procedures, instrumentation and quality control methods, and provide recommendations to the Technical/Laboratory Director and Quality Assurance Officer.
Lead the training of new analysts in laboratory operations and analytical procedures.
Evaluate instrument performance and implement instrument calibration and preventive maintenance program.
Perform data processing and validation.
Initiate non-conformance report forms for out-of-control situations, instrument malfunction, calibration failure, or other non-conformances as appropriate.
Prepare and maintain laboratory quality control records.

General Personnel

Qualifications:
General personnel include all other staff, such as laboratory technicians, sample check-in technicians and office personnel. General personnel should be individuals that pay very close attention to detail and follow written and oral instructions precisely.

Responsibilities:
General personnel are responsible for following established procedures and reporting any quality control problems or questions.

Figure 5-1
Laboratory Organization

Executive Committee/Technical Director:
Responsibilities: Appointed by owner to oversee all operations and functions of the laboratory.

Laboratory Director:
Responsibilities: Reports directly to the Executive Committee.

Quality Assurance Officer:
Responsibilities: Reports directly to The Executive Committee and Laboratory/Technical Director.

Project Leaders:
Responsibilities: Report directly to the Quality Assurance Officer on QA/QC matters and to the Technical/Laboratory Director on all other matters.

Laboratory Analysts/Calculations Chemists:
Responsibilities: Report directly to the Quality Assurance Officer on QA/QC matters and to the Technical/Laboratory Director and/or Executive Committee on all other matters.

Laboratory Analyst/Extraction Manager:
Responsibilities: Reports directly to the Quality Assurance Officer on QA/QC matters and to the Technical/Laboratory Director and/or Executive Committee on all other matters.

Technicians:
Responsibilities: Report directly to the Extraction Manager.

Safety Officer/Committee:
Responsibilities: Reports directly to the Technical/Laboratory Director and/or Executive Committee.

General Personnel:
Responsibilities: Reports directly to the Executive Committee.

6.0 STANDARD OPERATING PROCEDURES

Standard operating procedures (SOPs) are maintained which accurately reflect current laboratory activities. These documents may include, for example, equipment manuals provided by the manufacturer, published analytical methods with any changes or specifications documented, or internally written documents. Hardcopies of all SOPs are organized in folders which are easily accessible to all personnel. (The exception is equipment manuals, which are kept with the corresponding equipment.) There are two general types of SOPs; method SOPs and administrative SOPs. A list of administrative SOPs, along with other quality system documents, is included in Appendix A.

Method SOPs

Method SOPs are generated for each accredited method performed by F&BI. They provide detailed, laboratory specific, procedures for analytical testing methods. Each method SOP references the published analytical procedure upon which it is based. When the referenced analytical procedure has stated QA/QC requirements, the SOP meets the stated requirements. Any additional, laboratory specific, QA/QC requirements are detailed in the method and/or administrative SOPs.

Administrative SOPs

Administrative SOPs provide detailed procedures for all activities of the quality system not included in specific analytical methods, such as sample receiving, personnel training, and creating client reports. Administrative SOPs may be separate documents, or may be included in this document.

6.1 Deviation from SOPs

When a client (or project) has specific requirements of the laboratory, a deviation from existing procedures may be necessary. Typical examples include addition of target analytes and project specific reporting limits. If a deviation is requested, the project manager is responsible for discussing the request with the manager in charge of the analysis and obtaining her/his approval to accept the project. The project manager is also responsible for documenting the request on the appropriate analysis extraction worksheets, and on the final report if necessary.

Deviations from SOPs are documented using the extraction worksheet, sequence tables, injection logs, and/or other documents such as the non-conformance report form as discussed in section 13.3. Frequent departure from policy is not encouraged. However, if frequent departure from a particular policy is noted, the technical/laboratory director will address the possible need for a change in the policy.

7.0 TRAINING

Our company is designed around the idea that our employees are our most valuable asset. We are committed to the professional development of our employees. Since we are a relatively small laboratory, many of our employees wear several hats, and cross training is critical.

7.1 Quality System, Data Integrity, and Safety Training

When hired, each employee receives a company policy manual, data integrity SOP, quality assurance manual, and any SOPs relevant to their responsibilities. She/he also receives a safety training form and an employee attestation form, including data integrity training, to fill out and sign. The office manager is responsible for providing each new employee with copies of the policy manual and quality assurance manual. Each new employee is also provided with safety and general training forms, and copies of the relevant SOPs. Each employee is responsible for completing the required training documents, and for complying with all QA/QC and data integrity requirements. Each employee is also responsible for maintaining the current quality system documents which are relevant to their position, in their individual document file.

7.2 Initial Demonstration of Capability

The first step in training for analytical procedures is to familiarize the trainee with the method. This is achieved through a combination of reading the method SOP and observing an experienced analyst performing the method. The trainee then performs the method under close supervision. Prior to independently performing an analysis, each analyst completes an initial demonstration of capability (DOC). The DOC is performed as follows:

Obtain a quality control sample from an outside source. If not available, the QC sample may be prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

Dilute/prepare enough of the QC sample to make 4 separate aliquots (samples) of the specified concentration. If the concentration is not otherwise specified, it should be approximately 10 times the MDL. Laboratory control samples or MDL study samples may be used to meet this requirement.

Extract and/or analyze each of the 4 samples either concurrently or over a period of days.

Use all of the results to calculate the mean recovery (accuracy) and the standard deviation (precision) for each parameter/analyte. Compare the mean and standard deviation to method acceptance criteria.

If all parameters/analytes meet the acceptance criteria, the DOC is complete and independent analysis of actual samples can begin. If one or more of the parameters/analytes fail at least one of the acceptance criteria, then locate and correct the source of the problem and repeat the entire test (above) for either all of the parameters/analytes or just the parameter(s)/analyte(s) that failed.

7.3 Continuing Demonstration of Capability

At least one of the following, once per year, is completed by each analyst to demonstrate continuing proficiency.

Acceptable performance of a blind sample
Another demonstration of capability
At least four consecutive laboratory control samples with acceptable levels of precision and accuracy (calculated as for DOC above).
Successful analysis of a blind performance sample on a similar test method using the same technology (e.g. GC/MS volatiles by methods 624 and 8260 are considered equivalent).
If none of the above can be performed, analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.

7.4 Continuing Quality System, Data Integrity, and Safety Training

Company wide training meetings are held at least once a quarter. At these meetings quality system, data integrity, and/or safety topics are discussed by the QA officer, technical/laboratory director, and/or safety officer/committee respectively. Employees are also encouraged to participate in relevant external training, such as seminars and instrument training courses.

7.5 Documentation of Training

Documentation of education, experience and training prior to employment at F&BI is kept on file with personnel records. The office manager is responsible for maintaining personnel records. All employees document on the Employee Attestation Form that they have read, understood and will follow the Policy Manual, QA Manual and each SOP distributed to him/her. The attendance at each quarterly training meeting is documented using the Quarterly Training Meeting form. These and other completed training documents, including DOC certificates, are filed. In addition a database summarizing DOC training is maintained. The QA officer is responsible for maintaining the DOC database. The office personnel are responsible for maintaining training files. Additional details of training documentation are found in the "Training" SOP.

8.0 MATERIAL PROCUREMENT AND CONTROL

The quality of reagents, solvents, gases, water, and laboratory vessels used in analyses should be known so that their effect upon analytical results can be defined and anticipated. Materials and equipment purchased by F&BI should meet the requirements stated below or as denoted in specific analytical procedures, and be controlled as stated.

The following general guidelines are used for purchasing and using materials and equipment. More specific requirements can be found in section 9 below, and in administrative and method SOPs.
Specify within the purchase requests the suitable grades of materials.
Verify upon receipt that materials meet requirements and that, as applicable, material certificates/records are provided and maintained in the laboratory record system.
Date all chemicals, standards and reagents with date of receipt, date opened and expiration date.
Store reagents and solvents in accordance with manufacturer's recommendations.
Verify that material storage is properly maintained, and remove materials from use when shelf life has expired.
Record the date put into service for equipment such as balances and analytical instruments.
Record preventive and corrective maintenance procedures performed on equipment.
Verify that equipment, including analytical balances, thermometers, volumetric glassware etc., is properly calibrated prior to use.
Clearly mark any equipment which has been taken out of service.

8.1 Requirements for Reagents, Solvents, and Gases

Chemical reagents, solvents, and gases are available in a variety of grades of purity, ranging from technical grade to ultrapure grades. The purity required varies with the type of analysis and project requirements. For many analyses analytical reagent (AR) grade is satisfactory. Other analyses, such as trace organic analyses, frequently require special ultrapure reagents, solvents, and gases.

<u>General Inorganic Analyses</u>
In general, AR grade reagents and solvents are adequate for inorganic analyses. Primary standard reagents should be used for standardizing all volumetric solutions. All prepared reagents should be checked for accuracy.

<u>Trace Metals Analyses</u>
All standards used for emission spectroscopy should be spectro-quality. It is recommended that other reagents and solvents also be spectro-quality. In many cases, AR grade may be satisfactory. Standards are prepared by the analyst, or purchased provided that purchased materials meet the requirements of the analytical method. Gases used for emission spectroscopy should be high purity.

<u>Organic Chemical Analyses</u>

AR grade is generally the minimum acceptable grade for materials used for organic analyses. Reference grade standards should be used as necessary. Pesticide-quality solvents are generally required for low-concentration work. AR grade solvents are adequate for analyzing industrial waste samples. However, the contents of each solvent lot should be checked to determine suitability for the analyses.

For sample cleanup procedures, the adsorbents most commonly used are florisil, silica gel, and alumina. These are pre-activated according to the analytical method requirements and checked for interfering constituents.

Water
Deionized water is used for dilution and preparation of reagent solutions. Deionized water prepared in the laboratory should be ASTM Type I or better. For trace level inorganic work, Type I Reagent grade is required. Organic-free water is required for organic analyses. Organic-free water may be verified by GC or GC/MS. However, when determining trace organics by solvent extraction and gas chromatography, specialty water such as HPLC grade water with sufficiently low background may need to be used.

8.2 Requirements for Laboratory Containers

Containers used in the laboratory can affect the quality of results. Material composition and volumetric tolerances are discussed below.

Material Composition of Laboratory Vessels
The glass recommended for general use is chemically resistant borosilicate glass, such as that manufactured under the trade names of Pyrex or Kimax. The use of plastic vessels, containers and other apparatus made of Teflon, polyethylene, polystyrene, and polypropylene is desirable for certain specified applications.

Volumetric Tolerances of Laboratory Vessels
All volumetric measurements are made using measuring devices with tolerances appropriate to the level of accuracy needed.

Glassware Cleaning Requirements
All glassware used for sample extraction and analysis is cleaned sufficiently to meet the sensitivity of the method. This is tested on an ongoing basis with method blank samples. The same types of glassware and glassware cleaning techniques are used for method blank samples and client samples. In general, the following glassware cleaning procedures are followed.
Beakers - wash with laboratory grade soap, triple rinse with water
Separatory funnels - remove stopcock, wash stopcock, cap and funnel with laboratory grade soap, triple rinse with water, triple rinse with extraction solvent
KD flasks - wash with laboratory grade soap, triple rinse with water, triple rinse with extraction solvent
Snyder columns - triple rinse with extraction solvent
Concentrator tubes - wash with laboratory grade soap, triple rinse with water, triple rinse with extraction solvent

Syringes - triple rinse with extraction solvent
If lower than normal reporting limits are required or if highly contaminated samples have been extracted, glassware may need additional cleaning such as acid rinsing.

9.0 MEASUREMENT TRACEABILITY AND CALIBRATION

All measuring operations and testing equipment having an effect on the accuracy or validity of analytical results are calibrated and/or verified prior to being put into service and on a continuing basis. Wherever possible, reference standards (such as Class 1 weights and traceable thermometers) and analytical reagent calibration standards are traceable to national standards of measurement. For accredited analyses, where traceability to national standards is not applicable, correlation of results is confirmed using proficiency testing and/or independent analysis.

All equipment and reference materials necessary for correct performance of analysis are under the permanent control of F&BI. A list of major analytical equipment is given in Appendix B.

9.1 Support Equipment Calibration

Support equipment includes devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, thermometers, ovens, refrigerators, freezers, water baths and volumetric dispensing devices such as autopipetes and syringes. In cases where quantitative results are dependent on their accuracy, these devices are calibrated as described below.

Calibration/Verification Prior to Use

When new support equipment is purchased, it is the responsibility of the extraction manager to verify its calibration and traceability prior to putting it into service. Each piece of equipment is numbered, or otherwise identified, and the date put in service is recorded. Any certificates provided by the manufacturer are marked with the equipment identification and kept on file. Specific procedures for calibration (including on-going calibration) of specific types of support equipment are detailed in the “Support Equipment Monitoring and Calibration" SOP. These procedures include:
reference standard(s) used for calibration
specific calibration technique employed
acceptable performance tolerances
calibration frequency
documentation procedures

On-Going Calibration

Requirements for on-going calibration are provided in the specific equipment SOPs. The requirements are based on the type of equipment, stability characteristics of the equipment, and required accuracy. Some equipment is calibrated each working day, some monthly and some less frequently. All support equipment is calibrated annually, using nationally traceable reference standards if possible, over the entire range of use. It is the responsibility of the extraction manager to complete all on-going calibrations.

Corrective Actions

If equipment does not meet the calibration requirements, it is taken out of service unless and until necessary repairs have been made. All such equipment is marked as "out of service" and, if possible, placed in a different location until repaired. Records of all repairs, including service calls, are kept with the equipment records. When a piece of equipment is repaired another initial calibration is performed prior to being put back into service. If equipment cannot be repaired, it is discarded as appropriate. It is the responsibility of the laboratory manager to mark out of service equipment, arrange for repairs, re-calibrate and document all such activities.

In addition, if equipment goes outside the direct control of the laboratory, it is the responsibility of the extraction manager to verify satisfactory function and calibration status before the equipment is returned to service.

If an item of equipment is found to be defective, the effect of the defect on previous calibrations or analyses is examined, and corrective actions are taken if necessary. It is the responsibility of the person who finds a defect to inform the QA officer, Technical Director, or Executive Committee.

9.2 Instrument Calibration

Initial instrument calibration and continuing instrument calibration verification of all analytical instruments is performed to ensure that the data are of known quality. Specific method SOPs describe detailed calibration requirements for each method. It is the responsibility of each analyst to follow and document established calibration procedures. The following sections describe the calibration requirements for all accredited analyses performed by F&BI.

Initial Calibration

The following are essential elements of initial instrument calibration:

Sufficient raw data records are retained to permit reconstruction of the calibration.

Sample results are quantitated against the initial calibration, and may not be quantitated from any continuing instrument calibration verification.

Initial calibrations are verified with a second source standard (a standard obtained from a second manufacturer or lot, if the lot can be demonstrated from the manufacturer as prepared independently from other lots), unless a different requirement is specified in the method.

Appropriate criteria for the acceptance of an initial calibration are established.

If the initial calibration results are outside of the established acceptance criteria corrective action is taken (see below).

Any reported sample results which fall outside of the calibration range are reported as having less certainty.

At least one calibration standard is at or below the method reporting limit.

The lowest calibration standard is above the method detection limit (MDL), with the following exception:

For instrument technology (such as ICP/MS) with validated techniques which use a zero point and a single point calibration standard, the following apply:

Prior to analysis of samples the linear range is established.

Zero point and single point calibration standard are analyzed with each analytical batch. Additional standards may also be analyzed.
A standard corresponding to the limit of quantitation is analyzed with each analytical batch.
The linearity is verified at a frequency established by the method and/or the manufacturer.

Continuing Instrument Calibration Verification
When the initial instrument calibration is not performed on the day of analysis, the validity of the initial calibration is verified prior to sample analysis by a continuing instrument calibration verification (CCV). The following items are essential elements of continuing instrument calibration verification:
A CCV is repeated at the beginning and end of each analytical batch. The concentrations of the calibration verification are varied within the established calibration range. If an internal standard is used, only one CCV is analyzed per batch.
Sufficient raw data records are retained to permit reconstruction of the CCV. These records explicitly connect the continuing verification data to the initial instrument calibration.
Criteria for the acceptance of a CCV are established.
If the CCV results are outside established acceptance criteria, corrective actions are performed (see below).

Corrective Actions
Specific corrective actions are included in method SOPs. Following are general corrective action guidelines:
If the initial calibration results are outside established acceptance criteria, corrective actions are performed. This may include preparation of new standard solutions or instrument maintenance. Data associated with an unacceptable initial instrument calibration should not be reported. However, if such data are reported (usually due to insufficient sample for reanalysis) then it is reported with appropriate qualifiers.
If a CCV falls outside of established acceptance criteria, then corrective actions are performed. This may include preparation of new standard solutions or instrument maintenance. If routine corrective action procedures fail to produce a second consecutive (immediate) CCV within acceptance criteria, then either acceptable performance is demonstrated after corrective action with two consecutive CCVs, or a new initial calibration is performed. If possible, samples associated with a failing CCV are reanalyzed. If reanalysis is not performed, then results are qualified. In the following two situations, results may be reported, even if reanalysis is possible.
a) If the CCV fails high, then associated sample results which are non-detect may be reported.
b) If the CCV fails low, then associated sample results which are above a level which provides sufficient data for client use (if known) may be reported.

9.3 Maintaining Traceability of Standards, Solvents, and Reagents

The following steps are taken to maintain traceability of standards:

All standards are logged into the Standards Logbook and given a Date Code which is written on each container and certificate (if included). Also recorded are description, supplier and manufacturer's Lot # (if provided). The sample check-in technician is responsible for logging in standards.
When opened, all original containers (as provided by the vendor) are labeled with the date opened and an expiration date (based on the date opened). The extraction analyst is responsible for labeling original containers when opened.
Documentation of standards prepared from purchased stocks or neat compounds is maintained in the Standards Prep Logbook. Information recorded includes the Date Code, the preparation date, the expiration date, the amount used, and the preparer's initials. The person preparing the standard is responsible for proper documentation.
Containers of prepared standards are labeled with a unique Standards Prep Logbook ID linking them to the above preparation documentation. They are also labeled with the preparation and expiration dates. The expiration date of a prepared standard may not exceed the expiration date of any of the primary standards used in its preparation. The person preparing the standard is responsible for labeling correctly.
Whenever a standard is used for sample extraction or analysis (e.g. calibration standard, surrogate, etc.) the Standards Prep Logbook ID is written in the sample extraction and analysis records. The extraction analyst is responsible for recording the Logbook ID.
Standards are not used past their expiration dates.

The following steps are taken to maintain traceability of solvents and reagents.

All solvents and reagents are logged into the Solvents and Reagents Logbook and assigned a Solvent Code which is written on each container and certificate (if included). Also recorded are description, supplier and manufacturer's Lot # (if provided). The sample check-in technician is responsible for logging in solvents and reagents.
When a solvent or reagent is used to prepare a standard, the Solvent Code is recorded in the Standards Prep Logbook. The person preparing the standard is responsible for proper documentation. Note: If a reagent solution is prepared, then that is documented in the Standards Prep Logbook as described above.
When a solvent or reagent is used for extraction or analysis, the Solvent Code is recorded in the sample extraction and analysis records. The extraction analyst is responsible for recording the Solvent Code.

9.4 Equipment Maintenance

Preventive maintenance is an important part of the F&BI quality system. A maintenance program has been outlined to provide an organized program of actions to maintain proper instrument performance which will ensure reliability of the measurements and prevent instrument failure during use. This equipment maintenance program is included as Appendix C. Additional information about routine and special maintenance activities can be found in instrument manuals and troubleshooting guides, and in method SOPs.

Implementation

The implementation of the preventive maintenance program is dependent upon the specific instruments and equipment used. The extraction manager is responsible for performing and/or coordinating all support equipment maintenance. The GC, GC/MS, and inorganics supervisors are responsible for performing and/or coordinating all analytical instrument maintenance.

Documentation

Preventive maintenance is documented in maintenance log books. Each instrument has its own maintenance logbook which is updated each time any type of work is performed on the instrument.

10.0 SAMPLE HANDLING PROCEDURES

10.1 Sampling and Sample Acceptance Policy

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. Factors that are taken into account to ensure accurate, reliable results include:
Type of container used
Sample preservation
Amount of sample taken
Sample storage (holding) time
Proper sample labeling/identification
Proper chain-of-custody (COC) documentation

Container, volume, preservation and holding time information for selected analyses for water and soil samples is included in Appendix D. F&BI provides sample containers, including preservative, to our clients when requested.

Each sample container should be labeled, using a durable label and indelible ink, to identify the following:
Client name
Client project name
Sampling date and time
Sample name/number
Sample preservation

A chain-of-custody (COC) form should be filled out for every client project. An example COC form is shown in Figure 10-1. The following information should be included on the COC:
Client (company) name and contact information
Client project name/number
Sampler's name
Sample ID (name/number)
Date and time sampled
Type of sample (e.g. soil, water, etc.)
Requested analysis

<u>Sample Acceptance Policy</u>
It is the client's responsibility to follow proper sampling and documentation protocol. If any samples are received with incomplete documentation, unclear sample labeling, incorrect or damaged sample containers, expired holding time, insufficient sample volume, incorrect sample preservation or any other circumstances that could affect data quality, the sample custodian and/or project manager will notify the client. If the problem can be resolved (e.g. documentation provided) normal analysis will be initiated. If not, data will be reported with qualifiers if necessary. The sample acceptance policy is posted at the sample receiving area, and copies are available upon request.

10.2 Sample Receipt Protocols

Chain-of-Custody
Evidence of sample collection, shipment, laboratory receipt, and laboratory custody until disposal is documented to maintain quality control. Documentation is accomplished through the COC records, shipping records and sample check-in and disposal records.

Sample Condition
Upon receipt, the condition of the samples is recorded. A copy of the sample condition receipt checklist is included in Figure 10-2. If a sample does not meet the sample receipt acceptance criteria the client is consulted for further instructions before proceeding. A record of the client's request is retained.

Sample Tracking
A permanent chronological sample receipt logbook is used to document receipt of all samples. The laboratory project number assigned is recorded on the sample condition checklist and on the COC, providing an unequivocal link to the laboratory and field ID's, the sample collection and analysis information provided on the COC, and the sample condition record.

Each sample received is assigned a unique laboratory ID that maintains an unequivocal link with the unique field ID assigned to each container. The laboratory ID is placed on the sample container as a durable label and is recorded on the COC. The laboratory ID is the link that associates the sample with subsequent laboratory activities such as sample preparation or calibration.

Sample Check-In
Upon sample receipt, the sample custodian completes the following steps (more details are found in the "Sample Receiving" SOP):
Sign and date the COC and attach the waybill (if applicable) to the COC.
Examine all samples and accompanying paperwork, using the Sample Condition Upon Receipt Checklist as a guide.
Verify that sample holding times have not been exceeded and are not close to their limit.
Notify the Project Leader if there are any samples that should be analyzed immediately because of holding time or client request.

The sample custodian then logs the samples into the Sample Check-In Logbook, which contains the following information:
Date received in laboratory
Name of client
Client project name/number
Type and condition of samples as received
Analyses requested
F&BI project number
Initials of person logging in samples

Container size(s) and cooler/sample temperature

The sample custodian then initiates sample analysis by:
Completing the COC documentation
Labeling each container with the unique laboratory ID
Placing the samples in proper laboratory storage
Notifying the project leader of sample arrival by placing copies of the COC and all other project documents in the project leader bin.

10.3 Sample Storage

Samples and sample extracts are stored according to the conditions specified by preservation protocols. The temperatures of sample storage refrigerators are monitored each working day and recorded in the refrigerator temperature logbook. Samples and sample extracts are stored away from all standards, reagents, food and other potentially contaminating sources, and are stored in such a manner to prevent cross contamination. In addition, samples and sample extracts are stored in a secured area in order to protect sample condition and integrity. Placing of samples in the proper storage environment is the responsibility of the sample custodian. Placing of extracts in the proper storage environment is the responsibility of the extraction analyst.

10.4 Sample Disposal

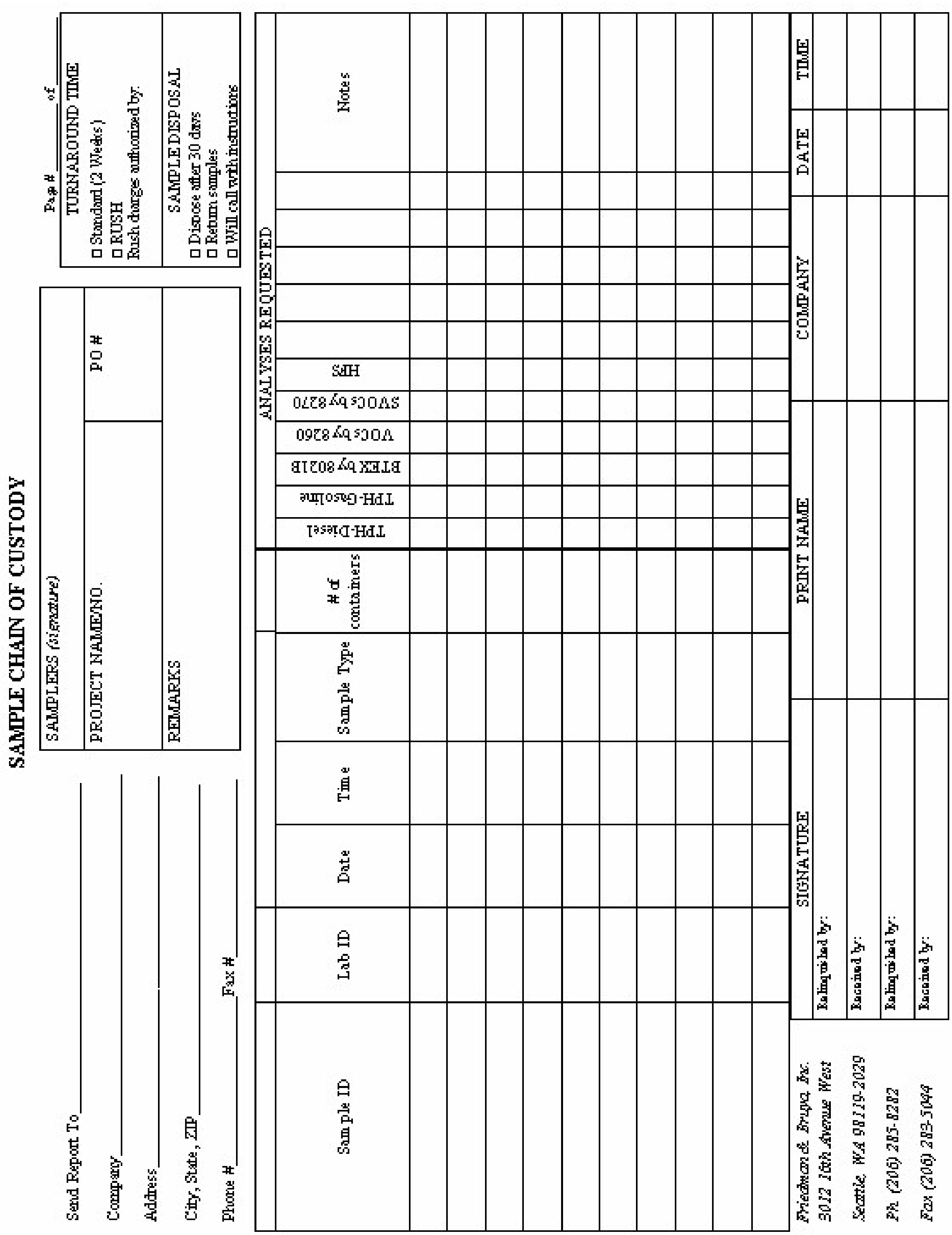
There are several possibilities for sample disposition:
The sample may be consumed during analysis.
Samples may be returned to the client for disposal.
Samples are incorporated into the laboratory waste streams.

The samples may be stored for 30 days after arrival. Proper environmental control and holding times are observed if reanalysis is anticipated. If reanalysis is not anticipated, environmental conditions for storage may not be observed.

The project leader and/or sample custodian determine disposition of samples if not specified on the COC. In general, F&BI will not maintain samples and extracts longer than one month beyond completion of analysis, unless otherwise requested.

After the appropriate storage time, the samples and extracts are disposed of by following approved disposal procedures. All materials known contain hazardous substances are disposed of as a separate waste streams. F&BI has identified 4 primary waste streams; solid waste, organic liquid waste, PCB (HazMat) waste, and acid waste. Disposal procedures are in compliance with all EPA, DOT, and Washington State waste disposal regulations. The extraction manager is responsible for overseeing sample and waste disposal.

Figure 10-1
Chain of Custody Form



Send Report To ____________

Company ____________

Address ____________

City, State, ZIP ____________

Phone # ____________ Fax # ____________

SAMPLE CHAIN OF CUSTODY

SAMPLERS (*signature*)	
PROJECT NAME/NO.	PO #
REMARKS	

Page # ______ of ______

TURNAROUND TIME
☐ Standard (2 Weeks) ☐ RUSH Rush charges authorized by:
SAMPLE DISPOSAL
☐ Dispose after 30 days ☐ Return samples ☐ Will call with instructions

						ANALYSES REQUESTED											
Sample ID	Lab ID	Date	Time	Sample Type	# of containers	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260	SVOCs by 8270	HFS						Notes

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:					
Received by:					
Relinquished by:					
Received by:					

Figure 10-2

SAMPLE CONDITION UPON RECEIPT CHECKLIST

PROJECT # ______________ CLIENT________________________________ INITIALS/ DATE:____________________

If custody seals are present on cooler, are they intact? ☐ NA ☐ YES ☐ NO

Cooler/Sample temperature _______ °C

Were samples received on ice/cold packs? ☐ YES ☐ NO

How did samples arrive?
☐ Over the Counter
☐ Picked up by F&BI
☐ FedEx/UPS/GSO

Number of days samples have been sitting prior to receipt at laboratory _______ days

Is there a Chain-of-Custody* (COC)? ☐ YES ☐ NO
*or other representative documents, letters, and/or shipping memos

Are the samples clearly identified? (explain "no" answer below) ☐ YES ☐ NO

Is the following information provided on the COC* ? (explain "no" answer below)

Sample ID's	☐ Yes	☐ No	# of Containers	☐ Yes	☐ No
Date Sampled	☐ Yes	☐ No	Relinquished	☐ Yes	☐ No
Time Sampled	☐ Yes	☐ No	Requested analysis	☐ Yes	☐ No

Were all sample containers received intact (i.e. not broken, leaking etc.)? (explain "no" answer below) ☐ YES ☐ NO

Were appropriate sample containers used? (explain "no" answer below) ☐ YES ☐ NO

If custody seals are present on samples, are they intact? ☐ NA ☐ YES ☐ NO

Are samples requiring no headspace, headspace free? ☐ NA ☐ YES ☐ NO

Explain "no" items from above (use the back if needed)

11.0 QUALITY CONTROL OBJECTIVES

F&BI follows a comprehensive internal quality control (QC) program to insure precision, accuracy, and reliability of data. QC objectives are established to determine if data generated is acceptable. These objectives are either specified by the method, or are statistically derived from historical laboratory data. Individual method SOPs include details of method QC requirements, which may supersede those given here.

11.1 Demonstration of Capability

Prior to using any test method, and at any time there is a significant change in instrument type or test method, a demonstration of capability (see section 7.2) is performed. In general, this does not test the performance of the method in real world samples, but in the applicable clean matrix.

11.2 Precision

Precision is a measure of the reproducibility of a result. Except as otherwise specified by an accredited method, the QC objective for precision is 20% as measured by Relative Percent Difference (RPD), as determined by duplicate analyses. It is recognized that for analytes at concentrations of less than five to ten times the method detection limit (MDL), it may be difficult to meet this objective.

Precision is usually expressed as Relative Percent Difference (RPD) based on duplicate analyses of a sample. The RPD is calculated as:

$$RPD = \frac{|X1 - X2|}{[(X1+X2)/2]} \times 100$$

where X1 and X2 are, respectively, the first and second values obtained for the analysis. Precision may be evaluated from duplicate sample, matrix spike and/or laboratory control sample analyses.

11.3 Accuracy

Accuracy is a measure of the closeness of a result to the true or expected value. It is generally determined using matrix spike and/or laboratory control sample recoveries. Control charts (see section 11.4) are generated to calculate laboratory specific accuracy objectives. For accredited analysis without enough QC data, or where the method specifies accuracy objectives, method prescribed limits are used. If the method does not specify control limits, then reasonable default limits are used. It is recognized that, for matrix spike samples, unless the sample is homogeneous and the spike concentration is greater than or approximately equal to the native concentration and greater than five to ten times the reporting limit, this objective may be difficult to meet, and therefore such samples will not be used to generate new QA/QC objectives/criteria. Alternatively, accuracy may be assessed through the analysis of appropriate standard reference materials or certified standards or samples, as available.

Accuracy is usually expressed as percent recovery (%R). The %R is calculated as:

$$\%R = ((Xs - Xa)/Ct) \times 100$$

where Xs is the observed concentration of the spiked sample, Xa is the observed concentration of the unspiked sample, and Ct is the concentration of the spike.

11.4 Uncertainty

Laboratory generated control limits (see below) for laboratory control samples represent an estimation of the uncertainty of measurement for a particular analysis.

Control Limits

Control limits are the acceptance criteria used for evaluating the accuracy and precision of results. F&BI has established control limits for precision of 0% to 30% for all accredited analyses, unless method specified limits are more stringent. Initial control limits for accuracy are taken from the method or regulatory requirements. If no method or regulatory criteria exist, control limits are assigned default values. These default values are assigned using the following guidelines.

For laboratory control samples default control limits are 70% to 130%, and default warning limits are 80% to 120%.
For matrix spike samples and surrogate compounds default control limits are 50% to 150%, and default warning limits are 65% to 135%.
Established control limits for a similar method/matrix may be used instead of default limits.

When sufficient data has been generated, the laboratory specific acceptance limits for accuracy are usually used. After a minimum of 20 samples have been analyzed for a particular matrix/method, the mean and standard deviation of the results are calculated. Warning limits are set at 2 standard deviations from the mean, and control (action) limits are set at 3 standard deviations from the mean. Control limits are generally reviewed at least monthly, or when sufficient data has been generated to warrant review, and updated annually.

Control Charts

Control charts are prepared for accredited analytical methods to document the trends in percent recoveries (accuracy) for laboratory control samples, matrix spike samples and surrogates. Results are monitored routinely by the analyst. If 10 consecutive results fall outside of warning or control limits (either all 10 above, or all 10 below), the cause is investigated and necessary corrective actions are taken.

11.5 Completeness

Completeness is determined as the percentage of the sample data for which the associated QC data are found to be acceptable. The QC goal for completeness, as determined by the percentage of valid data generated, is 100%. Precision and accuracy determinations, if outside the QA objectives due to sample-related causes, may be regarded as qualifying, rather than invalidating, the associated data.

11.6 Representativeness

Representativeness is the degree to which the field sample represents the overall sample site or material. F&BI will make every reasonable effort to assure that the samples are adequately homogenized prior to taking aliquots for analysis, so that the reported results are representative of the sample received. However, F&BI does not represent that the samples submitted for analysis are representative of the conditions in the field. Of particular importance is that mixing may substantially lower the measured levels of volatile components. (For this reason, mixing is avoided as much as possible for samples being analyzed for those compounds.)

11.7 Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. To ensure comparability, standard operating procedures as defined in the quality system are used for handling and analysis of all samples.

11.8 Method Detection Limits and Reporting Limits

Method Detection Limits
The method detection limit (MDL) is the minimum concentration that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. For each applicable test method and matrix, MDLs are determined for the compounds of interest by spiking the analyte(s) at a level approximately 5 times the expected MDL into a clean matrix and processing as a sample. A minimum of seven replicates are processed and the mean result is multiplied by the applicable students' value to obtain the MDL. MDLs are determined for each new test method (prior to sample analysis), annually, and each time there is a change in the test method that affects how the test is performed, or when a change in instrumentation occurs that affects the reliability of the analysis.

Reporting Limits
Reporting limits (RL), or practical quantitation limits (PQL), are the routinely reported lower limits of quantitation. RLs are calculated from the MDL and are typically 2 to 10 times the MDL, or equal to or greater than the concentration of the lowest calibration standard. The RLs take into account the day-to-day fluctuations in instrument reliability and other factors. These RLs are the levels to which F&BI routinely reports results. If a result below the RL is reported, typically due to client request, it is qualified as an estimated value.

12.0 ANALYSIS AND EVALUATION OF QUALITY CONTROL SAMPLES

Quality control samples are routinely analyzed with each analytical batch (see below) of field samples to demonstrate that the laboratory is operating within the QC objectives. QC samples are evaluated on an on-going basis, and QC acceptance criteria are defined and used to determine the validity of the data. Specific types of QC samples are described below. Individual method SOPs include details of method QC requirements. A summary of frequency and acceptance limit requirements for QC elements described in this and previous sections is given in Table 12-1. If method requirements are different than those given here, the method requirements will be followed.

12.1 Preparation Batch

The preparation batch is the basic unit for quality control. To ensure that QC results for accredited analyses are representative, all of the samples in a batch, both field and QC samples, are extracted, analyzed and calculated in the same way. In the absence of specific program or method requirements, the requirements for a preparation batch are as follows:

A maximum of 20 (field) samples are in a batch.
All samples in a batch are the same matrix.
QC samples (see below) processed with a batch are; 1 method blank, 1 LCS, 1 MS (if suitable), and either 1 MSD or 1 matrix duplicate (if suitable, if not, then 1 LCSD).
The same reagent lot(s) are used to process the batch.
The same analyst(s) process the entire batch.
The maximum time between the start of processing of the first and last sample in a batch is 24 hours.
QC samples are prepared and analyzed with the associated field samples. However, if field samples in the batch are reanalyzed for a reason not affecting the QC samples (e.g. dilution, surrogate recovery etc.), the QC samples do not require analysis each time a field sample from the preparation batch is analyzed.
Each batch is assigned a unique ID which links it to the associated field samples.

12.2 Method Blank Samples

Purpose
The method blank is used to assess the preparation batch for possible contamination during the preparation and processing steps. It is processed along with and under the same conditions as the associated samples.

Frequency
One method blank is analyzed with each preparation batch.

Composition
The method blank consists of a matrix that is similar to the associated samples and is free of the analytes of interest.

Evaluation Criteria and Corrective Action

The goal is to have no detectable contaminants. If contamination is detected in the method blank sample, the nature of the interference and the effect on the analysis of each sample in the batch is evaluated. The source of contamination is investigated and measures taken to minimize or eliminate the problem. Affected samples are reprocessed, or data are appropriately qualified if:

The concentration of a targeted analyte in the blank is at or above the reporting limit AND is greater than 1/10 of the amount measured in the sample.

The blank contamination otherwise affects the sample results as per the test method requirements or the individual project data quality objectives.

Results of method blank analyses are maintained with the corresponding analytical data set and reported with project results.

12.3 Laboratory Control Sample (LCS)

Purpose

The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps.

Frequency

One LCS is analyzed with each preparation batch. Exceptions are for analytes for which no spiking solutions are available such as total suspended solids, pH or turbidity.

Composition

The LCS is a controlled matrix, free of the analytes of interest, spiked with known and verified concentrations of analytes. Alternatively the LCS may consist of a media containing known and verified concentrations of analytes or as Certified Reference Material (CRM). All analyte concentrations are within the calibration range of the methods. The components spiked are specified in individual method SOPs.

Evaluation Criteria and Corrective Action

LCS results are calculated in percent recovery (see section 11.3). Results are compared to established acceptance criteria. A LCS that is determined to be within the criteria effectively establishes that the analytical system is in control and validates system performance for the samples in the associated batch. If a LCS result is found to be outside the criteria, this indicates that the analytical system is “out of control”. Any affected samples associated with an out of control LCS are reprocessed and re-analyzed (if possible), or the results reported with appropriate data qualifying codes. LCS results are reported on the quality control data summary forms.

12.4 Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Samples

Purpose

Matrix specific QC samples indicate the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. The information from these controls is sample/matrix specific and is not normally used to determine the validity of the entire batch.

Frequency
One MS sample is analyzed with each preparation batch, if a sufficient amount of sample is provided.

Composition
MS/MSD analysis is performed on aliquots of actual samples. The composition is not usually known. Samples are spiked with known and verified concentrations of analytes. All analyte spiking concentrations are within the calibration range of the methods. The components spiked are specified in individual method SOPs.

Evaluation and Corrective Action
The results from MS/MSD analyses are primarily designed to assess the precision and accuracy of analytical results in a given matrix and are expressed as percent recovery (%R) and relative percent difference (RPD) (see section 11). Results are compared to the established acceptance criteria. If results are outside the criteria, the cause is investigated and corrective actions are taken if necessary, or the MS/MSD data are reported with appropriate qualifiers. MS/MSD results are reported on the quality control data summary forms.

12.5 Matrix Duplicate Samples

Purpose
Matrix duplicates are replicate aliquots of the same sample taken through the entire analytical procedure. The results from this analysis indicate the precision of the results for the specific sample using the selected method.

Frequency
One duplicate sample is analyzed with each preparation batch. If sufficient sample is provided, this will be either a MSD or a matrix duplicate. If not, a laboratory control sample duplicate (LCSD) is analyzed.

Composition
Matrix duplicates are performed on replicate aliquots of actual samples. The composition is not usually known.

Evaluation and Corrective Action
The results from matrix duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as RPD. Results are compared to established acceptance criteria. If results are outside the criteria, the cause is investigated and corrective actions are taken if necessary, or the matrix duplicate data are reported with appropriate qualifiers. Duplicate analysis results are summarized on the quality control data summary forms.

12.6 Surrogate Standard Analyses

Purpose
Surrogates are used most often in organic chromatography test methods and are chosen to reflect the chemistries of the targeted components of the method. Added prior to sample preparation/extraction, they provide a measure of recovery for every sample matrix.

Frequency
Except where the matrix precludes its use or when not available, surrogate compounds are added to all samples, standards, and blanks for all appropriate test methods.

Composition
Surrogate compounds are chosen to represent the various chemistries of the target analytes in the method. Individual method SOPs specify the surrogate compound(s) used.

Evaluation Criteria and Corrective Action
Surrogate results are calculated in percent recovery (see section 11.3). Results are compared to established acceptance criteria. Surrogates outside the acceptance criteria are evaluated for the effect indicated for the individual sample results. Corrective actions are taken if necessary, or affected results are reported with appropriate qualifiers. Surrogate results are reported with associated sample results.

12.7 Proficiency Testing (PT) Samples

Purpose
PT samples are blind samples purchased from a certified provider. They are used to evaluate the performance of the total analytical system, including all preparation and analysis steps. They are processed under the same conditions and in the same manner as client samples.

Frequency
F&BI participates in certified proficiency testing programs at a frequency required by accrediting agencies. PT samples are analyzed twice a year for each analyte, method and matrix, when available, for which F&BI is accredited.

Composition
PT samples are either prepared in a clean matrix by the provider, or are prepared in a clean matrix at the laboratory according to the provider's instructions. The specific analyte spiking levels are unknown to the laboratory.

Evaluation Criteria and Corrective Action
PT results are evaluated by the provider and reported directly to the regulatory agency as well as to the laboratory. Any PT results which are reported as not acceptable are reviewed and corrective actions implemented as needed. Reports received from PT sample providers and corrective action documentation are kept on file.

F&BI does not send any PT sample, or portion of a PT sample, to another laboratory for any analysis. Also, F&BI does not knowingly receive any PT sample, or portion of a

PT sample, from another laboratory, or communicate with another laboratory concerning PT samples.

Table 12-1
QC Frequency and Acceptance Limits Summary
(For Accredited Analysis, Method requirements may supersede these.)

Quality Control Element	Frequency	Acceptance Limits
Method Detection Limit (MDL)	Initially, quarterly, and with substantial change to method or instrument.	40CFR Part 136, Appendix B calculations.
Demonstration of Capability (DOC)	Annually for each analyst.	Average of replicates within method established control limits of true value, and not >20% RSD for each analyte.
Initial Calibration	Initially and if ICV or CCV fail.	Per method specific requirements.
Initial Calibration Verification (ICV/Second Source)	Following every initial calibration, prior to sample analysis.	Per method specific requirements.
Continuing Calibration Verification (CCV)	When an initial calibration has not been performed: i) At the beginning and end of analysis of 20 samples (max). Concentrations vary. ii) At the beginning of 12 hour shift if internal calibration used.	Per method specific requirements.
Method Blank (MB)	1 per preparation batch of 20 (or fewer) samples.	Concentration for each analyte below RL or method specific.
Laboratory Control Sample (LCS)	1 per preparation batch of 20 (or fewer) samples.	Per laboratory established control limits (or default limits.)
Matrix Spike (MS)	1 per preparation batch of 20 (or fewer) samples.	Per laboratory established control limits (or default limits.) Does not control batch.
Duplicate Analysis (Sample Duplicate (Dup), MSD or LCSD)	1 per preparation batch of 20 (or fewer) samples. i) Dup or MSD if sufficient sample. ii) LCSD if not.	Percent recovery per laboratory established control limits (or default limits.) RPD 0% to 30%. Dup and MSD do not control batch.
Surrogate	Each field and QC sample for accredited organic analyses.	Per laboratory established control limits (or default limits.)
Proficiency Testing (PT)	Twice per year per accredited	Per PT provider.

Samples	method/analyte/matrix.	

13.0 CORRECTIVE ACTIONS

Corrective actions may be implemented as a result of failure of quality control results to meet established criteria, failure of reported results to meet client's needs, or deviation from established policies and procedures in the SOPs and this QA manual. These are documented with the non-conformance report form which includes an investigation of the root cause, identification of possible corrective actions, and a description of the corrective action taken.

The QA officer reviews each non-conformance report form. This documentation is kept on file with each affected client report, and a copy is kept by the QA officer. During the annual internal audit (see section 16), the QA officer or other qualified F&B staff reviews all non-conformance report forms to look for chronic systematic problems that need more in-depth investigation and alternative corrective action consideration.

In addition, corrective actions may be implemented as a result of internal or external audit findings, or management review (see section 16). These are documented with the internal audit corrective action form, external audit correspondence, and the management review corrective action form respectively.

If corrective action procedures do not resolve or identify the problem, personnel will notify management for direction to take. The findings and actions taken are documented and sent to the QA officer or Technical Director for follow-up during an internal audit.

13.1 QC Analysis Failure

If any quality control results fail to meet established criteria, corrective action procedures are immediately implemented if possible. Corrective actions are identified by the individual responsible for a particular analytical method or instrument. In addition, the analyst performing data calculation or review may initiate corrective actions if needed. Corrective actions may include a review of calculations, a check of instrument maintenance, a review of analytical techniques, and reanalysis of affected samples. Table 13-1 has a general summary of QC analyses and corrective actions. Individual method SOPs detail method specific corrective actions. Corrective actions are documented by the analyst in the analysis records.

If, following corrective actions, quality control results still fail, then affected results are reported with appropriate qualifying flags and the analyst may use a non-conformance report form to further document the causes of the qualified data. In some cases it may not be possible to follow standard QC procedures and/or corrective actions. For example, if insufficient sample is provided, duplicate sample analysis, matrix spike analysis and/or sample re-extraction may not be possible. In these cases, all possible QC procedures are followed, reported data are qualified if needed, and the analyst uses the extraction worksheet, sequence tables, injection logs, and/or non-conformance report form to document.

If the quality control failure may require that analysis is halted for a particular method and/or instrument, it is the responsibility of the analyst to notify his/her supervisor. The supervisor then determines the required action and notifies the laboratory/technical director if analysis should be halted. The analysis can then be resumed only after approval from the laboratory/technical director.

13.2 Client Complaints

Any client complaints are resolved promptly. The project manager has primary responsibility for handing client complaints. Complaints which are not able to be resolved by the project manager may be referred to the laboratory/technical director or executive committee. Complaints are documented by the project manager using the non-conformance report form, client communication form, project notes macro, or a printed record of an e-mail correspondence.

13.3 Deviation from SOPs or QA Manual

Deviations from established policies and procedures as written in laboratory SOPs and this QA manual are documented using the extraction worksheet, sequence tables, injection logs, and/or other documents such as the non-conformance report form. A deviation may occur due to a specific client request, or due to laboratory circumstances.

13.4 Audit Findings

Corrective actions needed as a result of audit findings (internal or external) are initiated by the quality assurance manager or the laboratory/technical director. Audit related corrective actions may include providing additional staff training, updating SOPs or establishing new procedures. Internal audit corrective action documentation is kept on file with internal audit findings. External audit corrective actions are documented through correspondence with the auditor(s).

13.5 Record-Keeping Errors

Entries in records are not obliterated by methods such as erasures, overwritten files or markings. Corrections to record-keeping errors are made by one line marked through the error. The individual making the correction initials and dates the correction, and writes a brief explanation as needed. These criteria are also followed for electronically maintained records as applicable.

13.6 Corrective Actions Which Affect Reported Results

If audits or further data review indicate a substantial error in any data which has already been issued in a final report, the client is notified within 30 days and an amended report is issued if necessary.

Table 13-1
QC Corrective Actions
(For Accredited Analysis, Method requirements may supersede these.)

Quality Control Element	Corrective Action(s)	Documentation
Method Detection Limit (MDL)	Determine source of problem, correct, reanalyze (re-extract if necessary).	Instrument raw data.
Demonstration of Capability (DOC)	Determine source of problem, correct, reanalyze (re-extract if necessary).	Instrument raw data. DOC Certificate
Initial Calibration	Determine source of problem and recalibrate. Reanalyze any affected samples.	Instrument raw data. Flag sample results if not corrected. Non-Conformance Form if not corrected.
Initial Calibration Verification (ICV/Second Source)	Re-inject ICV. If ICV fails a second time, a new initial calibration is required. Reanalyze any affected samples.	Instrument raw data. Flag sample results if not corrected. Non-Conformance Form if not corrected.
Continuing Calibration Verification (CCV)	Determine source of problem and re-inject CCV. If second CCV fails, either correct problem and pass two consecutive CCVs, or a new initial calibration is required. Reanalyze any affected samples unless: i) CCV is high and sample is ND. ii) CCV is low and sample result is above regulatory/action limit.	Instrument raw data. Flag sample results if not corrected. Non-Conformance Form if not corrected.
Method Blank (MB)	Reduce background contamination. Re-extract and reanalyze MB and all affected samples in batch. Sample result can be reported if MB is <1/10 of sample result, or if sample is ND.	Instrument raw data. Flag MB and sample results if not corrected. Non-Conformance Form if not corrected.
Laboratory Control Sample (LCS/LCSD)	Determine source of problem. Correct and: i) If instrument related, reanalyze LCS and all affected samples in batch. ii) If spike related, re-extract and reanalyze LCS. iii) If other, re-extract and reanalyze LCS and all affected samples in batch.	Instrument raw data. Flag LCS and sample results if not corrected. Non-Conformance Form if not corrected.

Note: Verify calculations prior to other corrective actions.

Table 13-1
QC Corrective Actions (continued)
(For Accredited Analysis, Method requirements may supersede these.)

Quality Control Element	Corrective Action(s)	Documentation
Matrix Spike (MS)	Determine source of problem. i) If instrument related, reanalyze MS and all affected samples in batch. ii) If spike related, re-extract and reanalyze MS. iii) If LCS passes, flag failing MS result as matrix effect.	Instrument raw data. Flag MS result if not corrected. Non-Conformance Form if not corrected.
Duplicate Analysis (Sample Duplicate (Dup), or MSD)	Determine source of problem. i) If instrument related, reanalyze duplicate and all affected samples in batch. ii) If other, re-extract and reanalyze sample and duplicate (or MS and MSD). iii) If LCS passes, flag failing result as matrix effect.	Instrument raw data. Flag duplicate result if not corrected. Non-Conformance Form if not corrected.
Surrogate	Determine source of problem. i) If instrument related, reanalyze sample. ii) If spike related, re-extract and reanalyze sample. iii) If matrix related, flag failing result as matrix effect.	Instrument raw data. Flag surrogate result if not corrected. Non-Conformance Form if not corrected.
Proficiency Testing (PT) Samples	Determine and correct source of problem. Pass minimum of 2 of last 3 for each accredited method/analyte/matrix.	PT provider report. Corrective action letters to regulatory agency.

Note: Verify calculations prior to other corrective actions.

14.0 DATA PROCESSING, VALIDATION, AND REPORTING

All analytical data reported by F&BI to a client in a final report is calculated, reviewed and validated, following established quality system procedures. Individual method SOPs describe specific calculation procedures. The following describes our general data reduction, validation and reporting procedures.

14.1 Data Processing and Review

Analytical results are generated from raw data by the analyst, using procedures specific to the analytical methods, and described in the appropriate method SOP. Results for most analyses are generated by computer. However, analysts usually enter data, such as sample volume/weight, to complete the calculations. Summary pages containing these entries are printed for review. Data generated is electronically transferred into the proper electronic form(s) for reporting. These forms are also printed for review.

For analyses which do not have computer generated data, results are hand entered into the computer for reporting. These results are printed and a 100% review of calculations and data entry is completed. If a particular result, which would normally be computer generated, is manually calculated (usually due to a manual integration) then the entire calculation is documented clearly so that the review analyst can perform a complete review.

Manual Integrations
Integration settings are adjusted to minimize the need for manual integrations. However, a manual integration is necessary if the automatic integration of the peak or integration area (for TPH analyses) is clearly affected (e.g. does not extend from baseline to baseline, peak is split, integration is inconsistent between full strength and diluted peak).

If manual integration is performed, this is clearly documented. The raw data affected by the re-integration is printed and included in the instrument data package along with the original integration, and any manual calculations which are done as a result, are documented. The analyst records his/her initials and the date the manual integrations were made. In addition, all manual integrations are reviewed carefully to check for bias.

Quality Control Results
The analyst also calculates and evaluates all quality control results. Analytical data for quality control samples (e.g. method blank, LCS, MS) are calculated and reviewed in the same manner as for all other samples. Results are evaluated using established acceptance criteria, and corrective actions are taken prior to releasing, as final, any associated sample results. After all calculations and QC evaluations are complete, the analyst signs the worksheet(s) and gives it to the calculation review analyst.

Calculation Review

An analyst, independent from the person performing the analysis, is responsible for a 100% review of all raw data, calculations, transcriptions (if needed) and results. Each worksheet reviewed is initialed. Corrections are reviewed by the calculations analyst, and any disagreements are resolved by the QA officer or Technical Director. Upon completion of review, worksheets are given to the project manager to generate a final report.

14.2 Analytical Data Reports

Analytical data and quality control data are summarized in standard report formats, either designed by F&BI or supplied by the client. The project manager combines the electronic files of reviewed analytical results to generate a final report. Prior to release of the report to the client, the project manager reviews and approves the entire report for completeness, and to ensure that any client-specified objectives were successfully achieved. The project manager then authorizes and electronically releases the final report file to office personnel to generate a hardcopy report. Specific procedures for generating a final analytical report are provided in the "Creating Reports" SOP. The following information is included in each final analytical data report issued by F&BI.

The F&BI name, address and phone number, and project manager's name and electronic signature.

The client's project number/name, the F&BI project number, and date of issue (all on each page).

The sample identification provided by the client and the sample identification number assigned by F&BI

Chemical parameters analyzed, reported values, and units of measurement

Reporting limit of the analytical procedure

The dates the samples were received and analyzed

A summary of quality control sample results

Footnotes referenced to specific data if required to explain/qualify reported values

Explanatory text or the cover letter may also include:

Person(s) receiving and transmitting the data

Documentation of samples which did not meet acceptance criteria when received

Brief discussion of samples analyzed and the analytical program

Discussion of any apparent data anomalies

Reference to specific accreditation requirements

<u>Reports for Additional Results</u>

If additional analysis is requested after a final report for a specific laboratory project has been issued, then those additional results are issued in a separate report. A statement that these are additional results for the project is included in the cover letter.

<u>Reports Including Subcontracted Analysis</u>

If any analysis is subcontracted to another laboratory, a statement is included in the cover letter and/or case narrative indicating the subcontracting laboratory and the analysis they performed. The original copy of the subcontracting laboratory's report is provided to the client and a copy is kept with the F&BI project file. No subcontracted work is ever reported as being F&BI data.

Report Review

After the hardcopy data report is prepared, the report is subject to a complete review by another reviewer. Entries such as dates, sample IDs, names and addresses are reviewed. The reviewer completes a report review checklist and attaches it to the report. If any errors are found, they are noted and the report is given back to the project leader to correct.

The final draft is reviewed by the executive committee or its designee to assure that all of the steps listed to this point have been followed. He/She then initials the draft which is filed. After approval, a final report bearing the appropriate signatures is issued to the client.

Amending Issued Final Reports

After issuance of a final report, the laboratory report remains unchanged. If a report which has already been issued as final to the client is amended, the amended report is issued separately. A cover letter is included, which states that amended results are being provided. If needed, further explanation of the amendment is included in the cover letter. All amended reports receive final approval before being released to the client.

15.0 DOCUMENT CONTROL AND RECORDS MANAGEMENT

15.1 Document Control

Internally generated documents which are used to define and implement the quality system are controlled. This includes the Quality Assurance Manual, all SOPs and laboratory logbooks. Documents are controlled in two ways. Each document clearly indicates the effective date of the document, the revision number, and the signature(s) of the approving authority (revision number and signature may not be applicable for logbooks). In addition, a record is kept of who received a signed copy of each document.

Preparation of Controlled Documents
Quality system documents are written by the personnel most familiar with the procedures described. The author of the document is responsible for including the correct revision number and date. The documents are reviewed and released by the QA officer, laboratory/technical director and/or executive committee representative as applicable. They are implemented on the revision date indicated on the document. More specific procedures for writing and organizing quality system documents are described in the "Quality System Document Organization" SOP.

Office personnel are responsible for controlling logbooks. Laboratory logbooks are sequentially assigned a number, which is clearly written on the logbook. The name/use and starting date of the logbook are also written on the logbook and are recorded in the Master Log of Laboratory Logbooks. Completed logbooks are filed with office records, or with the associated instrument, if applicable.

Revision of Controlled Documents
Currently existing quality system documents are reviewed annually during the internal laboratory audit (see section 16). Documents may be revised due to changes initiated by an internal or external audit; or due to changes such as new instrumentation, updated instrument parameters, updated concentrations used for chemical standards etc. A new quality system document is generated if a new quality system procedure is implemented.

To ensure that the beginning and ending effective dates for a document are clearly documented, revision numbers are always whole numbers (starting with revision 1) which are increased by one whole number for each document revision. Therefore the beginning date of a particular revision is the ending date for the immediately previous revision.

Documentation of Controlled Documents
Office personnel are responsible for keeping a record of who received each signed controlled document. The Controlled Document Record includes the document name, a sequentially assigned number which is written on the document before releasing, the person (or company) the document was released to, and the date released. Unsigned copies of documents are not considered controlled.

15.2 Records Management

The purpose of the Records Management system is to standardize the organization, storage and retrieval of all data and documents pertinent to quality and the analytical process. Also, in many cases, F&BI project files must be legally defensible, that is, admissible by the courts and believed as fact. To fulfill these documentation requirements, F&BI maintains a Records Management System which meets the following criteria:

Data and documents are indexed and easily retrievable.
Files are secure.
A formal document inventory can be produced if required by the contract/project.
Laboratory operation/QC documents are cross referenced to applicable projects.
The system is documented in the Quality Assurance Manual and Standard Operating Procedures.
Specific regulatory or contractual requirements can be accommodated.

<u>Analysis Records</u>
Data generated using instruments driven by computers is stored on computer disks coded by the instrument number and date the samples were analyzed. Hard copies of all of the electronic data are also kept. For each instrument, a list of all samples analyzed for each date is kept for easy sample searching. For instruments not controlled by a computer, data are recorded in individual instrument logbooks.

Worksheets are documents filled out by extraction analysts as a sample is processed. These sheets contain measurements such as the weight of the sub-sample, identification and volume of solvent used for any extraction, and documentation of any dilutions or concentrations made. These worksheets are kept with our file copy of any report that is sent to a client.

<u>Laboratory Files</u>
Laboratory records/documents are of two types:
1) Project/Client Files - Documents which are specific to a project/client. All records pertaining to a specific project contain a reference to the laboratory project number which is assigned during sample check-in.
2) Laboratory Files - Documents which pertain to the overall functioning of the laboratory

Project/Client files contain the following:
Chain-of-Custody documents for the project
Extraction worksheets for the project
Electronic file of data generated by Analyst for each sample delivery group and analysis
Electronic file of compiled data for the results of analyses for each sample delivery group generated by Project Manager
Non-conformance report forms for the project
Contract files pertinent to a client
Communication records between project management and the client

Final reports submitted to the client

Laboratory files contain the following:
Sample Check-in Logbook
Raw instrument data, including calibration data
Instrument maintenance records
Internal and external audit records
Training records
QA Manual and SOPs
Any other QA/QC documents pertaining to the overall functioning of the laboratory
General office/business records

15.3 Archived Records

All files are stored at F&BI, in a safe and secure area, for a minimum of 5 years. Access to archived information is documented with an access log. After 5 years, records are purged only with approval from the executive committee representative.

15.4 Change of Ownership

If there is a change of ownership, records will be retained, and details of record availability will be specified in the transaction.

16.0 QUALITY SYSTEM AUDITS

Quality audits are an essential part of F&BI's quality system program. Two types of audits are used: system audits which qualitatively evaluate the operational details of the quality system program, and performance audits which quantitatively evaluate the outputs of the various measurement systems.

16.1 System Audits

Internal Audits

The QA officer arranges for annual internal audits to verify that laboratory operations continue to comply with the requirements of the quality system. These audits are carried out by trained and qualified personnel who are, wherever possible, independent of the activity to be audited. An internal audit of all or part of the system may also be performed at any time due to any circumstance which raises concern regarding compliance with established policies or procedures, or with the data quality.

Target dates for completion of any corrective action investigations resulting from an internal audit are set within a reasonable time frame so that, if necessary, laboratory practice can be changed and/or clients can be contacted. Where the audit findings indicate a substantial error in calibrations or test results, immediate corrective action is taken and any client whose work was involved is notified within 30 days in writing.

Audit findings and any corrective actions that arise from them are documented using the Internal Audit forms, which are included in Appendix E.

External Audits

F&BI is audited on a regular basis by state and independent auditors, as required for accreditation and by client contracts. External audits are documented through correspondence with the auditors.

Managerial Review

The laboratory/technical director conducts an annual review of the quality system and testing and calibration activities to ensure their continuing suitability and effectiveness, and to introduce any necessary changes or improvements in the quality system and laboratory operations.

The review takes account of reports from managerial and supervisory personnel, the outcome of recent internal and external audits, the results of interlaboratory comparisons or proficiency tests, any changes in the volume and type of work undertaken, feedback from clients, corrective actions, and other relevant factors. In addition, pro-active suggestions for preventive actions are included. These include either technical or quality system improvements which will reduce the likelihood of potential non-conformances.

Review findings and any corrective actions that arise from them are documented using the Managerial Review forms, which are included in Appendix E.

16.2 Performance Audits

In addition to periodic system audits, the quality of results is ensured through ongoing checks which monitor the quality of the laboratory's analytical activities. Examples of such checks are:

Internal quality control procedures, as described in section 12 above
Participation in proficiency testing programs, as described in section 12 above
Use of second source standards and/or certified reference materials
Replicate analysis using the same or different test methods
Re-testing of retained samples
Correlation of results for different but related analysis of a sample
Review of historical data from the same sample

17.0 CLIENT COMMUNICATION

17.1 Client Confidentiality

Strict client confidentiality is maintained at all times. No records or results are discussed with, or provided to, anyone other than the client unless the client has given specific permission. Clients are notified by the project manager or office personnel whenever any other party requests information about their records.

In addition, when clients require transmission of test results by facsimile, email or other electronic or electromagnetic means, care is taken to ensure that client confidentiality is maintained. To avoid accidental transmission to a different party, commonly used email addresses are included in an email address book, and commonly used fax numbers are pre-programmed. Also, in case of accidental transmission to the wrong party, email messages and facsimile cover sheets contain a message which states that the information is privileged, confidential, and intended only for the addressee named. Office personnel are responsible for maintaining email addresses and pre-programmed fax numbers.

17.2 Review of Requests, Tenders, and Contracts

Before agreeing to a written or oral contract to provide a client with environmental testing services, a review is conducted to ensure that F&BI has the capability and resources necessary to meet the client's requirements. For routine and other simple tasks, the project leader can provide an oral agreement. For more complex tasks, the laboratory/technical director conducts a review. This may include items such as review of previous proficiency testing results, and running trial testing to determine detection limits or other essential quality control requirements. The laboratory's current accreditation status, and any subcontracted work are also reviewed. The client is informed if, at any time before and during the agreement, F&BI is unable to fulfill the requirements of the contract. Records of written contracts, and other communication regarding the contract, are documented in the Client Report Template, and/or kept in the project/client files.

17.3 Specific Project Communication

After samples have been received, the F&BI project manager communicates with the client, when necessary, regarding sample receipt conditions, specific analysis needs, laboratory capability, and integrity of reported results. Communication is documented in the Project Notes macro, and/or with the Client Communication Record form, which is kept in the project/client files. In addition, any fax or email communication is also kept in the project/client files.

18.0 SUBCONTRACTING ANALYTICAL SAMPLES

It is the policy of F&BI not to subcontract work which we are normally able to perform. For requested analyses which we do not normally perform, the project manager informs the client of the need to subcontract. Work may also be subcontracted if we are temporarily unable to perform one of our normal analyses due to instrument malfunction, or if the client requires certification which we do not have. In these cases the same procedures are followed.

In those cases where we subcontract work, the results reported by the outside laboratory appear under the letterhead of the laboratory reporting the data. Data generated by another laboratory is never reported under our company letterhead. The original report from the contracted laboratory is provided to the client, and a copy is kept with the F&BI project file.

END OF DOCUMENT

APPENDIX A

LIST OF ADMINISTRATIVE SOPS AND QUALITY SYSTEM DOCUMENTS

LIST OF ADMINISTRATIVE SOPS
AND QUALITY SYSTEM DOCUMENTS

ADMINISTRATIVE STANDARD OPERATING PROCEDURES	
Title	**Location**
Creating Reports	sops\admin\Reports
Data Integrity	Sops\admin\Data Integrity
Project Manager Procedure (includes Client Communication Record form)	sops\admin\Project Manager
Qualifiers	Sops\admin\Qualifier
Quality System Document Organization	sops\admin\Document Organization
Sample, Extract, and Waste Disposal	sops\admin\Disposal
Sample Receiving	sops\admin\Sample Receiving
Support Equipment Monitoring and Calibration	sops\admin\Support Equipment
Training Records (includes training forms)	sops\admin\Training
ADDITIONAL QUALITY SYSTEM DOCUMENTS	
Archive Access Log	forms\office\archive
Controlled Document Record	sops\Controlled Document Record
DOC Training Summary Database	fbi\nelap\doc_sum
F&BI Certifications/Accreditations	office records
Final Report Checklist	forms\chklist
Internal Audit/Managerial Review Forms	QAM Appendix E
Laboratory Organization/Personnel Qualifications	fbi\nelap\Lab Organization Chart – Personnel Qualifications
Master Log of Laboratory Logbooks	forms\logbooks\ Master Log
Non-Conformance Report Form	forms\nonconformance
Policy and Health & Safety Manual	sops\Policy and Health & Safety Manual
Quality Assurance Manual	sops\QAM
Sample Condition Upon Receipt Checklist Form	forms\checkin\ SampleCondition
Signature List	office records

APPENDIX B

MAJOR ANALYTICAL EQUIPMENT

MAJOR ANALYTICAL EQUIPMENT

Make/Model	Type	Identifier	Software
Agilent 5890	GC/FID	GC 1	ChemStation
Agilent 5890 with Varian Archon and OI 4560	GC/FID/PID Autosampler Purge & Trap	GC 2	ChemStation
Agilent 5890 with Varian Archon and OI 4560	GC/FID/PID Autosampler Purge & Trap	GC 3	ChemStation
Agilent 5890	GC/FID	GC 4	ChemStation
Agilent 5890	GC/TCD	GC 5	ChemStation
Agilent 5890	GC/FID	GC 6	ChemStation
Agilent 6890	GC/ECD/ECD	GC 7	EnviroQuant
Agilent 5890 with Tekmar 7000	GC/FID Headspace Autosampler	GC 8	ChemStation
Agilent 6890	GC/ECD/ECD	GC 9	EnviroQuant
Agilent 6890 with Agilent 5973	GC MSD	GC/MS 3	EnviroQuant
Agilent 6890N with Agilent 5973N and OI 7361 and OI 4660	GC MSD Autosampler Purge & Trap	GC/MS 4	EnviroQuant
Agilent 6890 with Agilent 5973	GC MSD	GC/MS 6	EnviroQuant
Agilent 7890A with Agilent 5975C Entech Model #7200 CTS and Entech Model #7016D and Entech Model #3100D and Entech Model #31-350ER and Entech Model #39-FP-01 and Entech DDS Model #PG7-50.00-PSIA	GC MSD Preconcentrator Autosampler/ Vacuum Cleaning System Oven/Vacuum Flow Professor Digital Dilution System (DDS)	GC/MS 7	EnviroQuant Maveric Entech Entech Entech 3100D Entech Flow Professor

MAJOR ANALYTICAL EQUIPMENT
(Continued)

Make/Model	Type	Identifier	Software
Agilent 6890N with Agilent 7975C Entech Model #7200 CTS and Entech Model #7016D and Entech Model #3100D and Entech Model #31-350ER and Entech Model #39-FP-01 and Entech DDS Model #PG7-50.00-PSIA	GC MSD Preconcentrator Autosampler/ Vacuum Cleaning System Oven/Vacuum Flow Professor Digital Dilution System (DDS)	GC/MS 8	 EnviroQuant Maveric Entech Entech Entech 3100D Entech 3100D Entech Flow Professor
Agilent 7890 with Agilent 5975C	GC MSD	GC/MS 9	 EnviroQuant
Agilent 7890B with Agilent 5977A and Markes Model # TD- 100	GC MSD Autosampler/ Concentrator	GC/MS 10	EnviroQuant Maveric
Agilent 7890B with Agilent 5977B and OI 4100 and OI 4760	GC MSD Autosampler Purge & Trap	GC/MS 11	 EnviroQuant
Agilent 7890B with Agilent 5977B	GC MSD	GC/MS 12	EnviroQuant
Agilent 7890B with Agilent 5977B and OI 4100 and OI 4760	GC MSD Autosampler Purge & Trap	GC/MS 13	 EnviroQuant
Agilent 8890	GC	GC10, GC13, GC14	EnviroQuant
Agilent 8890 with OI 4100	GC Autosampler	GC11	

and OI 4760	Purge & Trap		EnviroQuant
PerkinElmer NexION 300D	ICP/MS	ICP/MS	PerkinElmer Syngistix
PerkinElmer S10 Autosampler	ICP/MS Autosampler	ICP/MS	PerkinElmer S10 Utility
PerkinElmer SC4DX Autosampler	ICP/MS Autosampler	ICP/MS	ESI SC
Tekran 2600	CVAFS	CVAFS	Tekran
Hach TL2300	Turbidimeter	Turbidimeter	N/A
Mettle-Toledo Seven Compact	pH Meter	pH Meter	N/A
Rae Systems, Model# PGM-30 (2)	Hand Held PID	Hand Held PID	N/A
Buck Scientific, Model# HC-404 (1)	IR analyzer	IR analyzer	N/A
Beckman Model TJ-6 (2)	Centrifuge	Centrifuge	N/A
Vortex Genie 2, Model G-560 (3)	Vortex Mixer	Vortex Mixer	N/A
Buchi Syncore	Concentrator	Concentrator No.1	N/A
Buchi Syncore	Concentrator	Concentrator No.2	N/A
Buchi Syncore	Concentrator	Concentrator No.3	N/A
Thermo Scientific Precision Water Bath, Model #2849	Water Bath	Water Bath	N/A
Organomation Associates, Inc. Model #120 (1)	Water Bath	Water Bath	N/A
Sonics VibraCell	Sonicator	Sonicator No.1	N/A

MAJOR ANALYTICAL EQUIPMENT
(Continued)

Make/Model	Type	Identifier	Software
Branson Ultrasonics Corporation, Sonifier Model# 450	Sonicator	Sonicator No.2	N/A
Branson Ultrasonics Corporation, Sonifier Model# 450	Sonicator	Sonicator No.3	N/A
Sonics VibraCell	Sonicator	Sonicator No.4	N/A
Marathon Electric, Model 0523-N191Q-G588 (1)	Sonicator	Sonicator	N/A
Sonics and Material, Inc. Model# VC600 (1)	Sonicator	Sonicator	N/A
Brenson Ultrasonic Bath, Model #M3800	Cavitator	Cavitator No.1	N/A
Brenson Ultrasonic Bath, Model #M3800	Cavitator	Cavitator No.2	N/A
Torbal, Fulcrum Inc., Model #AGCN 100	Analytical Balance	Analytical Balance	N/A
AND Model #HA-120M (1) (white)	Analytical Balance	Analytical Balance	N/A
AND Model #EK-1200A (1)	Analytical Balance	Analytical Balance	N/A
Mettler Toledo, Model #ML1502E/03 (2)	Analytical Balance	Analytical Balance	N/A
Denver Instrument Model #XP-1500 (1)	Analytical Balance	Analytical Balance	N/A
AEAdams CoreBalance	Analytical Balance	Analytical Balance	N/A
US Electrical Motors, Model #E438 (1)	Tumbler	Tumbler	N/A
Emerson Electric Co. (2)	Vacuum Pump	Vacuum Pump	N/A
ThermoScientific Isotemp 100L Oven FA 120V	Oven	Oven	N/A
Stabil-Therm Gravity Oven Model# OV-484A (1)	Oven	Oven	N/A
Thermolyne Corporation, Model # F6000 (1)	Muffle Furnace	Muffle Furnace	N/A

MAJOR ANALYTICAL EQUIPMENT
(Continued)

Make/Model	Type	Identifier	Software
Barnstead/Thermolyne Model#1415M (1)	Muffle Furnace	Muffle Furnace	N/A
Thermolyne Corporation, Model # HPA2245M (2)	Hot Plate	Hot Plate	N/A
Corning Laboratory, Model#PC-300 (1)	Hot Plate	Hot Plate	N/A
Corning Laboratory Model #PC-420 (1)	Hot Plate/Stirrer	Hot Plate/Stirrer	N/A
CPI-MOD Block (70 mL) Digest Heater Block with Controller (2)	Digester/Heater Block	Digester/Heater Block	N/A
Julabo Labortachnik, Model#FC600 or equivalent (2)	Chilling Unit	Chilling Unit	N/A
PolyScience 6000 Series Chiller Model #0772046	Chilling Unit	Chilling Unit	N/A

APPENDIX C
EQUIPMENT MAINTENANCE PROGRAM
(GENERAL GUIDANCE)

EQUIPMENT MAINTENANCE PROGRAM
(GENERAL GUIDANCE)

Instrument	Activity	Approximate Frequency
GC 1, GC 4, and GC 6 *(Semivolatile TPH)* Agilent 5890 Series II	Clean FID	Weekly or as needed
	Check Gases	Replace at 200 PSI
	Change Liner	Every 200 injections or as needed due to response change
	Change Septum	Every 200 injections
	Replace Syringe	As needed if clogged or broken
	Clip Column	As needed to improve chromatography
	Replace Column	As needed
	Change Gold Seal	As needed
GC 2 and GC 3 *(Volatile TPH and BTEX by 8021B)* Agilent 5890 Series II	Clean FID	Weekly or as needed
	Check Gases	Replace at 200 PSI
	Clean PID	As needed
	Replace PID Lamp	As needed to improve sensitivity
	Replace Column	As needed
OI 4560/4660 Concentrator (GC 2, GC 3, GC/MS 4, GC/MS 9, and GC/MS 7)	Check Purge Flow	Monthly
	Replace Trap	As needed
	Clean Sparge Cell	As needed
	Clean Sparge Filter	As needed if clogged
4552/4551 Autosampler (GC 2, GC 3, GC/MS 4, GC/MS 9, and GC/MS 7)	Tighten Syringe Nut	Once a week
	Autocalibrate	As needed
GC 7 *(PCBs, Organic Lead, Canadian Pulp, EDB)* Agilent 5890 Series II	Check Gases	Replace at 200 PSI
	Change Liner	Every 200 injections or as needed due to response change
	Change Septum	Every 200 injections
	Replace Syringe	As needed if clogged or broken
	Clip Column	As needed to improve chromatography
	Replace Column	As needed
	Change Gold Seal	As needed
	Clean ECD	As needed to improve chromatography

EQUIPMENT MAINTENANCE PROGRAM
(GENERAL GUIDANCE)

Instrument	Activity	Approximate Frequency
GC 5 *(Helium Analyzer)* Agilent 5890 Series II	Clean TCD	As needed
	Check Gases	As needed
	Change Liner	As needed
	Change Septum	As needed
	Replace Syringe	As needed
	Clip Column	As needed
	Replace Column	As needed
GC/MS 3, GC/MS 6, GC/MS 8, and GC/MS 10 *(Semivolatiles and Methamphetamine)*	Check Gases	Replace at 200 PSI
	Change Liner	Every 200 injections or if tune fails due to degradation of DDT > 20
	Change Septum	Every 200 injections
	Replace Syringe	As needed if clogged or broken
	Clip Column	As needed to improve chromatography
	Replace Column	As needed
	Change Gold Seal	As needed
	Change Pump Oil	Every 6 months
	Clean Source	As needed
GC/MS 4, GC/MS 9, and GC/MS 7 *(Volatiles)*	Check Gases	Replace at 200 PSI
	Replace Column	As needed
	Change Pump Oil	Every 6 months
	Clean Source	As needed
CVAFS *(Mercury)*	Clean Liquid Gas Separator	Before each run
	Clean Cuvette	As needed
	Replace Lamp	As needed
	Change Tubing	As needed
ICP/MS *(Metals)*	Change Torch	As needed
	Change Tubing	As needed
	Change Coolant	As needed
	Clean Cones	As needed

APPENDIX D

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Method	Matrix	Minimum Sample Volume	Container	Preservation	Maximum Holding Time
Organic Analysis						
Diesel Range Organics (Extractable	8015M NWTPH-Dx	Water	500 mL	500 mL glass	*Cool, ≤6°C	*7 days to extract, 40 days after extr.
	AK 102	Water	1 L	1 L glass		
TPH)	8015M NWTPH-Dx AK102/103	Soil	50 grams	4 oz glass	Cool, ≤6°C	14 days to extract, 40 days after extr.
Gasoline Range Organics (Purgable TPH)	8015M NWTPH-Gx AK101	Water	40 mL	40 mL VOA	Cool, ≤6°C, HCl to pH<2, no headspace	14 days
	8015M NWTPH-Gx	Soil	20 grams	3 x 5035 kit or MeOH pres. vial	Cool, ≤6°C/Freeze <-7°C	14 days
	AK101	Soil	app. 50 g	4 oz glass septum top	Methanol	28 days
HCID	NWTPH-HCID	Water	500 mL	500 mL glass	Cool, ≤6°C	7 days to extract, 40 days after extr.
		Soil	50 grams	4 oz glass	Cool, ≤6°C	14 days
HEM (O&G), SGT-HEM	1664	Water	1 Liter	1 L glass	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
PCBs	8082A	Water	1 Liter	1 L glass	Cool, ≤6°C	none
	8082A	Soil	50 grams	4 oz glass	Cool, ≤6°C	none
PNAs (PAHs)	8270D or 8270D SIM	Water	500 mL	500 mL glass	Cool, ≤6°C	7 days to extract, 40 days after extr.
	8270D or 8270D SIM	Soil	50 grams	4 oz glass	Cool, ≤6°C	14 days to extract, 40 days after extr.
Purgable Aromatic Hydrocarbons (BTEX, MTBE)	8021B or AK101	Water	40 mL	40 mL VOA	Cool, ≤6°C, HCl to pH<2, no headspace	14 days
	8021B	Soil	20 grams	3 x 5035 kit or MeOH pres. vial	Cool, ≤6°C/Freeze <-7°C	14 days
	AK101	Soil	app. 50 g	4 oz glass septum top	Methanol	28 days
Semivolatile Organic	8270D	Water	1 Liter	1 L glass	Cool, ≤6°C	7 days to extract, 40 days after extr.
Compounds (SVOCs, BNAs)	8270D	Soil	50 grams	4 oz glass	Cool, ≤6 °C	14 days to extract, 40 days after extr.

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Method	Matrix	Minimum Sample Volume	Container	Preservation	Maximum Holding Time
Organic Analysis (Continued)						
Volatile Organic Compounds	8260C	Water	40 mL	40 mL VOA	Cool, ≤6°C, HCl to pH<2, no headspace	14 days
(VOCs)	8260C	Soil	10 grams	40 mL VOA	Freeze within 48 hrs., ≤0°C	14 days

* For NWTPH-Dx and AK102 methods, if preserved with HCl or H_2SO_4 to pH<2, holding time is 14 days to extract.

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Method	Matrix	Minimum Sample Volume	Container	Preservation	Maximum Holding Time
Inorganic Analysis						
Alkalinity	SM2320B	Water	100 mL	500 mL poly	Cool, ≤6°C	14 days
BOD	405.1	Water	1 Liter	1 L glass	Cool, ≤6°C	48 hours
Chloride	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
COD	410.4	Water	100 mL	500 mL poly	H_2SO_4 to pH<2	28 days
Conductivity	120.1	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
Cyanide, total	335.2	Water	1 Liter	1 L glass	NaOH to pH 12	14 days
Fluoride	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
Hardness	SM2340B	Water	100 mL	500 mL poly	HNO_3 to pH,<2	6 months
Nitrate	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	48 hours
Nitrite	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	48 hours
Nitrate-Nitrite	353.2	Water	100 mL	500 mL poly	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
pH	9040/150.1	Water	20 mL	500 mL poly	None	As soon as possible
	9045	Soil	20 grams	4 oz glass	None	28 days
Phosphorus, total	365.2	Water	100 mL	500 mL poly	Cool, ≤6°C, H_2SO_4 to pH<2	28 days
Sulfate	300.0	Water	100 mL	500 mL poly	Cool, ≤6°C	28 days
Sulfide	376.2	Water	500 mL	500 mL poly	Cool, ≤6°C ZnAcetate plus NaOH to pH>9	7 days
Sulfite	377.1	Water	100 mL	500 mL poly	None	24 hours
Total Dissolved Solids (TDS)	SM2540C/ 160.1	Water	500 mL	500 mL poly	Cool, ≤6°C	7 days
Total Organic Carbon (TOC)	415.1/ 9060M	Water	100 mL	500 mL poly	H_2SO_4 to pH<2	28 days
Total Suspended Solids (TSS)	SM2540D	Water	250 mL	500 mL poly	Cool, ≤6°C	7 days
Turbidity	SM2130B	Water	20 mL	500 mL poly	Cool, ≤6°C	48 hours
Metals Analysis						
Metals (except Cr VI and Mercury)	200.8/6020 or 6010	Water	200 mL	500 mL poly or glass	HNO_3 to pH<2 at least 24 hours prior to analysis	6 months
	200.8/6020 or 6010	Soil	20 grams	4 oz glass	Cool, ≤6°C	6 months
Chromium VI	SM3500Cr	Water	100 mL	500 mL poly	Cool, ≤6°C	24 hours
	7196A	Soil	50 grams	4 oz glass	Cool, ≤6°C	30 days
Mercury	1631/200.8/ 6020/7040	Water	125 mL	250 mL poly, fluoropolymer, or glass	HNO_3 to pH<2	28 days (48 hours if not preserved)
	1631/200.8/ 6020/7041	Soil	50 grams	4 oz glass	Cool, ≤6°C	28 days

APPENDIX E

INTERNAL AUDIT/MANAGERIAL REVIEW FORMS

QUALITY ASSURANCE/QUALITY CONTROL INTERNAL AUDIT

Summary

Areas audited

1. *Quality System*:

Quality Assurance Manual and SOPs reviewed ☐
(attach "List of Current SOPs" with reviewed documents marked)

2. *Support Equipment* ☐

3. *Non-Conformance reports (review)* ☐

4. *Project Management/Reports* ☐

5. *Sample receiving, storage, disposal* ☐

6. *Document Control/Training* ☐

7. *Extractions*:

Organic		Inorganic		Volatiles	
3510	☐	200.8	☐	5030	☐
3550	☐	1631	☐	5035	☐
3580	☐	3005	☐	3580	☐
3630	☐	3050	☐		

8. *Analysis/Calculations*:

8260	☐	RSK-175	☐	TPHD	☐	200.8	☐
8270	☐	1664	☐	TSS	☐	6020	☐
8082	☐	Methamphetamine	☐	pH	☐	1631	☐
524.2	☐	Hardness	☐	Spec. Grav.	☐	TO-15	☐
8011	☐	TPHG/BTEX	☐	Turbidity	☐	TO-17	☐
8081	☐	Other	☐				

Total number of corrective actions______________

Comments:____

Does any non-conformance/corrective action require further notification?

Yes ☐ No ☐ (If yes, explain)

____

Attach all internal audit checksheets and corrective action forms and file in the internal QA/QC audit folder.

QA Officer's Signature_____________________________

Date Audit Review Completed_________________

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Sample receiving, storage, disposal

Date:__________ Auditor:__________________ Person(s) Audited:________________

	YES	NO
Is the Master Sample Log-In book in order?	_______	_______
Are COCs filled out correctly during sample check-in?	_______	_______
Are all samples/projects traceable, i.e. labeled?	_______	_______
Are samples stored in the correct refrigerators?	_______	_______
Are refrigerator temperatures recorded daily?	_______	_______
Are standards/solvents logged in?	_______	_______
Are sample disposal records kept?	_______	_______
Disposal Area:		
Does each drum have an up to date contents list?	_______	_______
Are drums properly labeled?	_______	_______
Are waste materials contained properly in each drum?	_______	_______
Are waste disposal records kept?	_______	_______
Are all prior external and internal findings addressed?	_______	_______

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:________ COMMENTS_____________________

____

____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Extractions

Organic ☐ Inorganic ☐ Volatiles ☐

Method(s): _____ _____ _____

_____ _____ _____

Date:__________ Auditor:__________________ Person(s) Audited:________________

	YES	NO	N/A
Are waste containers properly labeled and stored?	_______	_______	_______
Was any new equipment properly validated prior to use?	_______	_______	_______
Are manufacturer's certificates which verify calibration/accuracy available?	_______	_______	_______
Are analytical balances checked daily?	_______	_______	_______
Are autopipets calibrated at least monthly?	_______	_______	_______
Are bottle top dispensers calibrated at least monthly?	_______	_______	_______
Is the oven temperature recorded daily?	_______	_______	_______
Is the water bath temperature recorded daily?	_______	_______	_______
Is the hot block temperature recorded daily?	_______	_______	_______
Is equipment which falls out of calibration repaired or taken out of service?	_______	_______	_______
Are all prior external and internal findings addressed?	_______	_______	_______

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:________ COMMENTS______________________

____

____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Analysis/Calculations Method:________________________________

Date:__________ Auditor:________________ Person(s) Audited:________________

	YES	NO
Are standards traceable to a certified source?	______	______
Are standards labeled with an expiration date?	______	______
Are standards taken out of use after the expiration date?	______	______
Do initial calibrations meet the method requirements?	______	______
Are initial calibrations verified with a second source standard?	______	______
Are initial calibrations verified with continuing calibration verification standards?	______	______
Do QC sample results (method blanks, LCS, MS) meet the method requirements?	______	______
Are corrective actions taken for any result which falls outside of acceptance criteria?	______	______
Is the SOP up to date?	______	______
Are instrument maintenance logs up to date?	______	______
Are MDLs up to date?	______	______
Are reporting limits based on MDLs?	______	______
Are data calculations based on the initial calibration?	______	______
Is data flagged with qualifiers if necessary?	______	______
Are all prior external and internal findings addressed?	______	______

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:_______ COMMENTS____________________

____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Project Management/Reports

Date:__________ Auditor:__________________ Person(s) Audited:________________

	YES	NO
Are extraction worksheets filled out completely and clearly?	_______	_______
Are capability issues communicated to the client and clearly documented?	_______	_______
Are any changes to the COC initialed/dated with the name of the person requesting the change clearly indicated?	_______	_______
Are the subcontracted samples documented to client?	_______	_______
Is the Non-Conformance form used to document client complaints?	_______	_______
Are subcontract lab reports forwarded without change to the client, and clearly identified in our final report?	_______	_______
Are amended reports clearly identified?	_______	_______
Are additional reports clearly identified?	_______	_______
Are draft results/reports clearly identified?	_______	_______
Are flags from analysts left as is?	_______	_______
Is data flagged in an unambiguous manner?	_______	_______
Is there a case narrative when the validity of the data is in question?	_______	_______
Are all prior external and internal findings addressed?	_______	_______

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:________ COMMENTS_____________________

____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Document Control/Training

Date:__________ Auditor:__________________ Person(s) Audited:________________

	YES	NO
Is the employeed signature list up to date?	_______	_______
Are all logbooks numbered and listed in the Master Log of Laboratory Logbooks?	_______	_______
Is the Controlled Document Record used to track distribution of controlled documents?	_______	_______
Is the Archive Access Log used?	_______	_______
Is the List of Current SOPs up to date?	_______	_______
Are the Current SOP binders up to date?	_______	_______
Do Employee Attestation forms list current SOPs and revision numbers?	_______	_______
Have employees initialed Attestation forms for the current revision of all applicable SOPs?	_______	_______
Are DOCs complete and clearly identified?	_______	_______
Is the DOC training summary database up to date?	_______	_______
Are Laboratory Organization and Personnel Qualifications summaries up to date?	_______	_______
Is current accreditation summary up to date?	_______	_______
Are all prior external and internal findings addressed?	_______	_______

Fill out a corrective action form for any “no” answers and for anything else as needed.

Number of corrective actions given:________ COMMENTS______________________

____

QUALITY ASSURANCE/QUALITY CONTROL
INTERNAL AUDIT

Area: Support Equipment

Date:__________ Auditor:__________________ Person(s) Audited:________________

	YES	NO
Are primary reference weights and thermometers clearly labeled?	_______	_______
Are standards NIST traceable?	_______	_______
Are daily standards referenced in logbooks?	_______	_______
Are logbooks (refrigerator, water bath, hot block, oven, balance autopipete, etc.) completed as required?	_______	_______
Are logbooks (refrigerator, water bath, hot block, oven, balance autopipete, etc.) bound or in a 3 ring binder?	_______	_______
Is all calibrated support equipment (thermometers, autopipetes, bottle top dispensers, hot blocks, etc.) clearly labeled?	_______	_______
If any equipment is out of specifications, is it taken out of service and clearly labeled as such?	_______	_______
Are all prior external and internal findings addressed?	_______	_______

Fill out a corrective action form for any "no" answers and for anything else as needed.

Number of corrective actions given:________ COMMENTS_____________________

____

____

INTERNAL QA/QC AUDIT CORRECTIVE ACTION

Area/Analysis________________________

Corrective action given to (name):____

Given by (name):____
(Keep a copy of this form for tracking)

Date given:_________________ Target response date:_________________________
(set based on potential need to notify clients and on work load)

Description of non-compliance:____

____

____

Description of root cause and required corrective action:_____________________
____

____

____

____

Specific documentation required: (Return this form to the auditor with the required documentation attached.)

____

____

____

Corrective action reviewed and approved:

QC Officer (or designee):___________________________ Date:_______________

(Return this form to QC officer along with attached documentation)

QUALITY SYSTEM
MANAGERIAL REVIEW

Date:____________________ Auditor:____________________________________

Review of Calendar Year 20____

Write comments, as needed, in a separate file and attach.

1. Review of most recent internal audit (Date(s)____________________________)

All areas audited	Yes ☐	No ☐
Corrective actions implemented and documented	Yes ☐	No ☐

2. Review of non-conformance reports

Corrective actions implemented and documented	Yes ☐	No ☐

3. Review of proficiency testing (PT) samples

Analysis completed two times per year per analyte per matrix (for NELAP accredited analyses)	Yes ☐	No ☐
Corrective actions implemented and documented	Yes ☐	No ☐

4. Review of current accreditation status.

5. Review of recent audits/assessments by external bodies.

External audit(s) by: State/Company__________________________ Date______________

Corrective actions implemented and documented.	Yes ☐	No ☐

6. If audits or data review resulted in changes to previously reported data, were affected clients notified within 30 days? Yes ☐ No ☐ n/a ☐

7. Changes in volume and/or type of work undertaken which may affect quality.

8. Feedback from clients regarding quality. (Include review of any client complaints.)

9. Other relevant factor(s) which may affect quality.

10. Pro-active preventive actions to avoid potential non-conformances.

MANAGERIAL REVIEW CORRECTIVE ACTION

Area/Analysis_______________

Corrective action given to (name):____

Given by (name):____
(Keep a copy for tracking)

Date given:_________________ Target Response Date:________________________
(set based on potential need to notify clients and on work load)

Description of non-compliance:____

____

____

Root Cause:____

____

Description of required corrective action:_______________________________________

____

Specific documentation required: (Return this sheet to the auditor with the required documentation attached.)

____

____

Corrective action reviewed and approved:

Name:____ Date:_______________
(Technical/Laboratory Director or designee)

File along with attached documentation in the management review folder.

APPENDIX F

DEFINITIONS

DEFINITIONS

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accrediting Authority: the Territorial, State, or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation. (NELAC)

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Audit: a systematic evaluation to determine the conformance to quantitative *and qualitative* specifications of some operational function or activity. (EPA-QAD)

Batch: environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. (NELAC Quality Systems Committee)

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. Blanks include:
<u>Equipment Blank</u>: a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)
<u>Field Blank</u>: blank prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)

Instrument Blank: a clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)
Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)
Reagent Blank: (method reagent blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Blind Sample: a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve: the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Standard: a substance or reference material used to calibrate an instrument. (QAMS)

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30 - 2.2)

Chain of Custody Form: record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses. (NELAC)

Confirmation: verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: Second column confirmation, Alternate wavelength, Derivatization, Mass spectral interpretation, Alternative detectors or, Additional cleanup procedures. (NELAC)

Conformance: an affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action: the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Demonstration of Capability: a procedure to establish the ability of the analyst to generate acceptable accuracy. (NELAC)

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Holding Times (Maximum Allowable Holding Times): the maximum times that samples may be held prior to analysis and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: a known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. (NELAC)

Laboratory: a body that calibrates and/or tests. (ISO 25)

Laboratory Control Sample (LCS): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (NELAC)

Laboratory Control Sample Duplicate (LCSD): a second replicate LCS prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (QAMS)

Matrix: the substrate of a test sample.

Laboratory Duplicate: aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Matrix Spike (MS): a sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (QAMS)

Matrix Spike Duplicate (MSD): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (QAMS)

Method: see Test Method

Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

National Institute of Standards and Technology (NIST): an agency of the US Department of Commerce's Technology Administration that is working with EPA, States, NELAC, and other public and commercial entities to establish a system under which private sector companies and interested States can be accredited by NIST to provide NIST-traceable proficiency testing (PT) to those laboratories testing drinking water and wastewater. (NIST)

National Environmental Laboratory Accreditation Conference (NELAC): a voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP): the overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

National Voluntary Laboratory Accreditation Program (NVLAP): a program administered by NIST that is used by providers of proficiency testing to gain accreditation for all compounds/matrices for which NVLAP accreditation is available, and for which the provider intends to provide NELAP PT samples. (NELAC)

Performance Audit: the routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS): a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting measurement processes which will meet those needs in a cost-effective manner. (NELAC)

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC)

Proficiency Testing Study Provider: any person, private party, or government entity that meets stringent criteria to produce and distribute NELAC PT samples, evaluate study results against published performance criteria and report the results to the laboratories, primary accrediting authorities, PTOB/PTPA, and NELAP. (NELAC)

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Protocol: a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed. (EPA-QAD)

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EPA-QAD)

Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample: an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual: a document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ASQC E-41994)

Quantitation Limits: levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported at a specified degree of confidence. (NELAC)

Range: the difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA-QAD)

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC)

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.08)

Replicate Analyses: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limits: routinely reported lower limits of quantitation, typically 2 to 10 times the MDL.

Sample Tracking: procedures employed to record the possession of the samples from the time of sampling until analysis, reporting, and archiving. These procedures include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples. (NELAC)

Selectivity: the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity: the capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes. (NELAC)

Standard Operating Procedures (SOPs): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM): a certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Supervisor (however named): the individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

Surrogate: a substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (QAMS)

Technical Director: individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Test: a technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method: an adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP or published by a recognized authority. (NELAC)

Testing Laboratory: a laboratory that performs tests (ISO/IEC Guide 2-12.4)

The NELAC Institute (TNI): A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive and transparent process that is responsive to the needs of the community. (TNI)

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

United States Environmental Protection Agency (EPA): the federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Validation: the process of substantiating specified performance criteria. (EPA-QAD)

Verification: confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

Sources:
40CFR Part 136

American Society for Quality Control (ASQC), Definitions of Environmental Quality Assurance Terms

American National Standards Institute (ANSI), Style Manual for Preparation of Proposed American National Standards, Eighth Edition, March 1991

ANSI/ASQC E4, 1994

International Standards Organization (ISO) Guides 2, 30, 8402

International Vocabulary of Basic and General Terms in Metrology (VIM): 1984. Issued by BIPM, IEC, ISO and OIML

National Institute of Standards and Technology (NIST)

National Environmental Laboratory Accreditation Conference (NELAC), July 1998 Standards

The NELAC Institute (TNI), Web site, January 2009.

US EPA Quality Assurance Management Section (QAMS), Glossary of Terms of Quality Assurance Terms, 8/31/92 and 12/6/95

US EPA Quality Assurance Division (QAD)

Attachment D

Laboratory Sample Quality Control and Detection Limits

Analysis For Total Metals By EPA Method 6020/200.8

Client ID:	Method Blank	Client:	Friedman & Bruya
Date Received:	NA	Project:	Study SM-137, UST-112
Date Extracted:	04/13/23	Lab ID:	I3-288 mb
Date Analyzed:	04/13/23	Data File:	I3-288 mb.128
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Antimony	<1
Arsenic	<1
Barium	<1
Beryllium	<1
Cadmium	<1
Chromium	<5
Cobalt	<1
Copper	<5
Lead	<1
Manganese	<1
Mercury	<1
Molybdenum	<1
Nickel	<2
Selenium	<1
Silver	<1
Thallium	<1
Vanadium	<1
Zinc	<5

Analysis For Total Metals By EPA Method 6020/200.8

Client ID:	Method Blank	Client:	
Date Received:	NA	Project:	
Date Extracted:	05/05/23	Lab ID:	I3-349 mb2
Date Analyzed:	05/05/23	Data File:	I3-349 mb2.038
Matrix:	Water	Instrument:	ICPMS2
Units:	ug/L (ppb)	Operator:	SP

Analyte:	Concentration ug/L (ppb)
Antimony	<1
Arsenic	<1
Barium	<1
Beryllium	<1
Cadmium	<1
Chromium	<1
Cobalt	<1
Copper	<5
Iron	<50
Lead	<1
Manganese	<1
Mercury	<1
Molybdenum	<1
Nickel	<1
Selenium	<1
Silver	<1
Thallium	<1
Vanadium	<1
Zinc	<5

Analysis For Organochlorine Pesticides By EPA Method 8081B

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Extracted:	02/21/24	Lab ID:	04-374 mb 1/30
Date Analyzed:	02/21/24	Data File:	022107.D
Matrix:	Soil	Instrument:	GC9
Units:	mg/kg (ppm) Dry Weight	Operator:	AL

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Tetrachlorometaxylene	67	20	157
Decachlorobiphenyl	96	28	158

Compounds:	Concentration mg/kg (ppm) Dry Weight
alpha-BHC	<0.01
gamma-BHC (Lindane)	<0.01
beta-BHC	<0.01
delta-BHC	<0.01
Heptachlor	<0.01
Aldrin	<0.01
Heptachlor Epoxide	<0.01
trans-Chlordane	<0.01
cis-Chlordane	<0.01
4,4'-DDE	<0.01
Endosulfan I	<0.01
Dieldrin	<0.01
Endrin	<0.01
4,4'-DDD	<0.01
Endosulfan II	<0.01
4,4'-DDT	<0.01
Endrin Aldehyde	<0.01
Methoxychlor	<0.01
Endosulfan Sulfate	<0.01
Endrin Ketone	<0.01
Toxaphene	<1

Analysis For Organochlorine Pesticides By EPA Method 8081B

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Extracted:	04/01/24	Lab ID:	04-755 mb
Date Analyzed:	04/01/24	Data File:	040116.D
Matrix:	Water	Instrument:	GC7
Units:	ug/L	Operator:	MG

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Tetrachlorometaxylene	60	20	121
Decachlorobiphenyl	46	11	159

Compounds:	Concentration ug/L
alpha-BHC	<0.005
gamma-BHC (Lindane)	<0.005
beta-BHC	<0.005
delta-BHC	<0.005
Heptachlor	<0.005
Aldrin	<0.005
Heptachlor Epoxide	<0.005
trans-Chlordane	<0.005
cis-Chlordane	<0.005
4,4'-DDE	<0.005
Endosulfan I	<0.005
Dieldrin	<0.005
Endrin	<0.005
4,4'-DDD	<0.005
Endosulfan II	<0.005
4,4'-DDT	<0.005
Endrin Aldehyde	<0.005
Methoxychlor	<0.005
Endosulfan Sulfate	<0.005
Endrin Ketone	<0.005
Toxaphene	<0.05

Analysis For PCBs By EPA Method 8082A

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Extracted:	04/02/24	Lab ID:	04-758 mb 1/30
Date Analyzed:	04/02/24	Data File:	040222.D
Matrix:	Soil	Instrument:	GC7
Units:	mg/kg (ppm) Dry Weight	Operator:	AL

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Tetrachlorometaxylene	102	11	162
Decachlorobiphenyl	105	11	152

Compounds:	Concentration mg/kg (ppm) Dry Weight
Aroclor 1221	<0.02
Aroclor 1232	<0.02
Aroclor 1016	<0.02
Aroclor 1242	<0.02
Aroclor 1248	<0.02
Aroclor 1254	<0.02
Aroclor 1260	<0.02
Aroclor 1262	<0.02
Aroclor 1268	<0.02

Analysis For Volatile Compounds By EPA Method 8260D

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Extracted:	04/04/24 06:00	Lab ID:	04-0767 mb
Date Analyzed:	04/04/24 11:25	Data File:	040412.D
Matrix:	Soil	Instrument:	GCMS4
Units:	mg/kg (ppm) Dry Weight	Operator:	MD

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	102	86	114
Toluene-d8	102	86	115
4-Bromofluorobenzene	96	83	116

Compounds:	Concentration mg/kg (ppm)	Compounds:	Concentration mg/kg (ppm)
Ethanol	<50	trans-1,3-Dichloropropene	<0.05
Dichlorodifluoromethane	<0.5	1,1,2-Trichloroethane	<0.05
Chloromethane	<0.5	2-Hexanone	<0.5
Vinyl chloride	<0.05	1,3-Dichloropropane	<0.05
Bromomethane	<0.5	Tetrachloroethene	<0.025
Chloroethane	<0.5	Dibromochloromethane	<0.05
Trichlorofluoromethane	<0.5	1,2-Dibromoethane (EDB)	<0.05
2-Propanol	<0.5	Chlorobenzene	<0.05
Acetone	<5	Ethylbenzene	<0.05
1,1-Dichloroethene	<0.05	1,1,1,2-Tetrachloroethane	<0.05
Hexane	<0.25	m,p-Xylene	<0.1
Methylene chloride	<0.5	o-Xylene	<0.05
t-Butyl alcohol (TBA)	<2.5	Styrene	<0.05
Methyl t-butyl ether (MTBE)	<0.05	Isopropylbenzene	<0.05
trans-1,2-Dichloroethene	<0.05	Bromoform	<0.05
Diisopropyl ether (DIPE)	<0.05	n-Propylbenzene	<0.05
1,1-Dichloroethane	<0.05	Bromobenzene	<0.05
Ethyl t-butyl ether (ETBE)	<0.05	1,3,5-Trimethylbenzene	<0.05
2,2-Dichloropropane	<0.05	1,1,2,2-Tetrachloroethane	<0.05
cis-1,2-Dichloroethene	<0.05	1,2,3-Trichloropropane	<0.05
Chloroform	<0.05	2-Chlorotoluene	<0.05
2-Butanone (MEK)	<1	4-Chlorotoluene	<0.05
t-Amyl methyl ether (TAME)	<0.05	tert-Butylbenzene	<0.05
1,2-Dichloroethane (EDC)	<0.05	1,2,4-Trimethylbenzene	<0.05
1,1,1-Trichloroethane	<0.05	sec-Butylbenzene	<0.05
1,1-Dichloropropene	<0.05	p-Isopropyltoluene	<0.05
Carbon tetrachloride	<0.05	1,3-Dichlorobenzene	<0.05
Benzene	<0.03	1,4-Dichlorobenzene	<0.05
Trichloroethene	<0.02	1,2-Dichlorobenzene	<0.05
1,2-Dichloropropane	<0.05	1,2-Dibromo-3-chloropropane	<0.5
Bromodichloromethane	<0.05	1,2,4-Trichlorobenzene	<0.25
Dibromomethane	<0.05	Hexachlorobutadiene	<0.25
4-Methyl-2-pentanone	<1	Naphthalene	<0.05
cis-1,3-Dichloropropene	<0.05	1,2,3-Trichlorobenzene	<0.25
Toluene	<0.05		

Analysis For Volatile Compounds By EPA Method 8260D Dual Acquisition

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Extracted:	03/28/24 05:46	Lab ID:	04-0685 mb
Date Analyzed:	03/28/24 10:51	Data File:	032809.D
Matrix:	Water	Instrument:	GCMS13
Units:	ug/L (ppb)	Operator:	IJL

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	93	71	132
Toluene-d8	94	68	139
4-Bromofluorobenzene	103	62	136

Compounds:	Concentration ug/L (ppb)	Compounds:	Concentration ug/L (ppb)
Ethanol	<1,000	trans-1,3-Dichloropropene	<0.4
Dichlorodifluoromethane	<1	1,1,2-Trichloroethane	<0.5
Chloromethane	<10	2-Hexanone	<10
Vinyl chloride	<0.02	1,3-Dichloropropane	<1
Bromomethane	<5	Tetrachloroethene	<1
Chloroethane	<1	Dibromochloromethane	<0.5
Trichlorofluoromethane	<1	1,2-Dibromoethane (EDB)	<0.01
2-Propanol	<10	Chlorobenzene	<1
Acetone	<50	Ethylbenzene	<1
1,1-Dichloroethene	<1	1,1,1,2-Tetrachloroethane	<1
Hexane	<5	m,p-Xylene	<2
Methylene chloride	<5	o-Xylene	<1
t-Butyl alcohol (TBA)	<50	Styrene	<1
Methyl t-butyl ether (MTBE)	<1	Isopropylbenzene	<1
trans-1,2-Dichloroethene	<1	Bromoform	<5
Diisopropyl ether (DIPE)	<1	n-Propylbenzene	<1
1,1-Dichloroethane	<1	Bromobenzene	<1
Ethyl t-butyl ether (ETBE)	<1	1,3,5-Trimethylbenzene	<1
2,2-Dichloropropane	<1	1,1,2,2-Tetrachloroethane	<0.2
cis-1,2-Dichloroethene	<1	1,2,3-Trichloropropane	<1
Chloroform	<1	2-Chlorotoluene	<1
2-Butanone (MEK)	<20	4-Chlorotoluene	<1
t-Amyl methyl ether (TAME)	<1	tert-Butylbenzene	<1
1,2-Dichloroethane (EDC)	<0.2	1,2,4-Trimethylbenzene	<1
1,1,1-Trichloroethane	<1	sec-Butylbenzene	<1
1,1-Dichloropropene	<1	p-Isopropyltoluene	<1
Carbon tetrachloride	<0.5	1,3-Dichlorobenzene	<1
Benzene	<0.35	1,4-Dichlorobenzene	<1
Trichloroethene	<0.5	1,2-Dichlorobenzene	<1
1,2-Dichloropropane	<1	1,2-Dibromo-3-chloropropane	<10
Bromodichloromethane	<0.5	1,2,4-Trichlorobenzene	<1
Dibromomethane	<1	Hexachlorobutadiene	<0.5
4-Methyl-2-pentanone	<10	Naphthalene	<1
cis-1,3-Dichloropropene	<0.4	1,2,3-Trichlorobenzene	<1
Toluene	<1		

Analysis For Semivolatile Compounds By EPA Method 8270E

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Extracted:	04/01/24	Lab ID:	04-0751 mb 1/5
Date Analyzed:	04/02/24	Data File:	040135.D
Matrix:	Soil	Instrument:	GCMS12
Units:	mg/kg (ppm) Dry Weight	Operator:	ya

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
2-Fluorophenol	85	14	115
Phenol-d6	97	29	121
Nitrobenzene-d5	106	16	137
2-Fluorobiphenyl	106	46	122
2,4,6-Tribromophenol	104	17	154
Terphenyl-d14	115	31	167

Compounds:	Concentration mg/kg (ppm)	Compounds:	Concentration mg/kg (ppm)
N-Nitrosodimethylamine	<0.05	3-Nitroaniline	<5
Phenol	<0.5	Acenaphthene	<0.01
Bis(2-chloroethyl) ether	<0.05	2,4-Dinitrophenol	<1.5
2-Chlorophenol	<0.5	Dibenzofuran	<0.05
1,3-Dichlorobenzene	<0.05	2,4-Dinitrotoluene	<0.25
1,4-Dichlorobenzene	<0.05	4-Nitrophenol	<1.5
1,2-Dichlorobenzene	<0.05	Diethyl phthalate	<0.5
Benzyl alcohol	<0.5	Fluorene	<0.01
2,2'-Oxybis(1-chloropr...	<0.05	4-Chlorophenyl phenyl ...	<0.05
2-Methylphenol	<0.5	1,2-Diphenylhydrazine	<0.05
Hexachloroethane	<0.05	N-Nitrosodiphenylamine	<0.05
N-Nitroso-di-n-propyla...	<0.05	4-Nitroaniline	<5
3-Methylphenol + 4-Met...	<1	4,6-Dinitro-2-methylph...	<1.5
Nitrobenzene	<0.05	4-Bromophenyl phenyl e...	<0.05
Isophorone	<0.05	Hexachlorobenzene	<0.05
2-Nitrophenol	<0.5	Pentachlorophenol	<0.25
2,4-Dimethylphenol	<0.5	Phenanthrene	<0.01
Benzoic acid	<2.5	Anthracene	<0.01
Bis(2-chloroethoxy)met...	<0.05	Carbazole	<0.05
2,4-Dichlorophenol	<0.5	Di-n-butyl phthalate	<0.5
1,2,4-Trichlorobenzene	<0.05	Fluoranthene	<0.01
Naphthalene	<0.01	Benzidine	<1
Hexachlorobutadiene	<0.05	Pyrene	<0.01
4-Chloroaniline	<5	Benzyl butyl phthalate	<0.5
4-Chloro-3-methylphenol	<0.5	3,3'-Dichlorobenzidine	<0.5
2-Methylnaphthalene	<0.01	Benz(a)anthracene	<0.01
1-Methylnaphthalene	<0.01	Chrysene	<0.01
Hexachlorocyclopentadiene	<0.15	Bis(2-ethylhexyl) phth...	<0.8
2,4,6-Trichlorophenol	<0.5	Di-n-octyl phthalate	<0.5
2,4,5-Trichlorophenol	<0.5	Benzo(a)pyrene	<0.01
2-Chloronaphthalene	<0.05	Benzo(b)fluoranthene	<0.01
2-Nitroaniline	<0.25	Benzo(k)fluoranthene	<0.01
Dimethyl phthalate	<0.5	Indeno(1,2,3-cd)pyrene	<0.01
Acenaphthylene	<0.01	Dibenz(a,h)anthracene	<0.01

2,6-Dinitrotoluene	<0.25	Benzo(g,h,i)perylene	<0.01

Analysis For Semivolatile Compounds By EPA Method 8270E

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Extracted:	04/01/24	Lab ID:	04-750 mb
Date Analyzed:	04/01/24	Data File:	040114.D
Matrix:	Water	Instrument:	GCMS9
Units:	ug/L (ppb)	Operator:	ya

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
2-Fluorophenol	35	10	60
Phenol-d6	25	10	49
Nitrobenzene-d5	82	15	144
2-Fluorobiphenyl	83	25	128
2,4,6-Tribromophenol	78	10	142
Terphenyl-d14	108	41	138

Compounds:	Concentration ug/L (ppb)	Compounds:	Concentration ug/L (ppb)
N-Nitrosodimethylamine	<0.2	3-Nitroaniline	<20
Phenol	<2	Acenaphthene	<0.02
Bis(2-chloroethyl) ether	<0.2	2,4-Dinitrophenol	<6
2-Chlorophenol	<2	Dibenzofuran	<0.02
1,3-Dichlorobenzene	<0.2	2,4-Dinitrotoluene	<1
1,4-Dichlorobenzene	<0.2	4-Nitrophenol	<6
1,2-Dichlorobenzene	<0.2	Diethyl phthalate	<2
Benzyl alcohol	<2	Fluorene	<0.02
2,2'-Oxybis(1-chloropr...	<0.2	4-Chlorophenyl phenyl ...	<0.2
2-Methylphenol	<2	1,2-Diphenylhydrazine	<0.2
Hexachloroethane	<0.2	N-Nitrosodiphenylamine	<0.2
N-Nitroso-di-n-propyla...	<0.2	4-Nitroaniline	<20
3-Methylphenol + 4-Met...	<4	4,6-Dinitro-2-methylph...	<6
Nitrobenzene	<0.2	4-Bromophenyl phenyl e...	<0.2
Isophorone	<0.2	Hexachlorobenzene	<0.2
2-Nitrophenol	<2	Pentachlorophenol	<1
2,4-Dimethylphenol	<2	Phenanthrene	<0.02
Benzoic acid	<20	Anthracene	<0.02
Bis(2-chloroethoxy)met...	<0.2	Carbazole	<0.02
2,4-Dichlorophenol	<2	Di-n-butyl phthalate	<2
1,2,4-Trichlorobenzene	<0.2	Fluoranthene	<0.02
Naphthalene	<0.2	Benzidine	<4
Hexachlorobutadiene	<0.2	Pyrene	<0.02
4-Chloroaniline	<20	Benzyl butyl phthalate	<2
4-Chloro-3-methylphenol	<2	3,3'-Dichlorobenzidine	<2
2-Methylnaphthalene	<0.2	Benz(a)anthracene	<0.02
1-Methylnaphthalene	<0.2	Chrysene	<0.02
Hexachlorocyclopentadiene	<0.6	Bis(2-ethylhexyl) phth...	<3.2
2,4,6-Trichlorophenol	<2	Di-n-octyl phthalate	<2
2,4,5-Trichlorophenol	<2	Benzo(a)pyrene	<0.02
2-Chloronaphthalene	<0.2	Benzo(b)fluoranthene	<0.02
2-Nitroaniline	<1	Benzo(k)fluoranthene	<0.02
Dimethyl phthalate	<2	Indeno(1,2,3-cd)pyrene	<0.02
Acenaphthylene	<0.02	Dibenz(a,h)anthracene	<0.02

2,6-Dinitrotoluene	<1	Benzo(g,h,i)perylene	<0.04

Analysis For Volatile Compounds By Method MA-APH

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Collected:	04/03/24	Lab ID:	04-0689 mb
Date Analyzed:	04/03/24	Data File:	040311.D
Matrix:	Air	Instrument:	GCMS8
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	94	70	130

Compounds:	Concentration ug/m3
APH EC5-8 aliphatics	<75
APH EC9-12 aliphatics	<25
APH EC9-10 aromatics	<25

Date Extracted: 03/25/24
Date Analyzed: 03/26/24

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 50-150)
Method Blank 04-618 MB	<0.02	<0.02	<0.02	<0.06	<5	81

Date Extracted: 03/28/24
Date Analyzed: 03/29/24

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 50-150)
Method Blank 04-627 MB	<1	<1	<1	<3	<100	104

Date Extracted: 03/27/24
Date Analyzed: 03/27/24

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES
FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL
USING METHOD NWTPH-Dx
Extended to Include Motor Oil Range Compounds

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Diesel Extended (C_{10}-C_{36})	Surrogate (% Recovery) (Limit 50-150)
Method Blank 04-734 MB	<50	104

Date Extracted: 03/28/24
Date Analyzed: 03/28/24

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND RESIDUAL RANGE USING METHOD NWTPH-Dx

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Residual Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 50-150)
Method Blank 04-734 MB2	<50	<250	87

Date Extracted: 03/29/24
Date Analyzed: 03/29/24

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND RESIDUAL RANGE USING METHOD NWTPH-Dx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Residual Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 41-152)
Method Blank 04-745 MB	<100	<250	121

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	Method Blank	Client:	ClientID
Date Received:	Not Applicable	Project:	ProjectID
Date Collected:	04/03/24	Lab ID:	04-0689 mb
Date Analyzed:	04/03/24	Data File:	040311.D
Matrix:	Air	Instrument:	GCMS8
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	94	70	130

Compounds:	Concentration ug/m3	Concentration ppbv	Compounds:	ug/m3	ppbv
Propene	<1.2	<0.7	1,2-Dichloropropane	<0.23	<0.05
Dichlorodifluoromethane	<0.99	<0.2	1,4-Dioxane	<0.36	<0.1
Chloromethane	<3.7	<1.8	2,2,4-Trimethylpentane	<4.7	<1
F-114	<2.1	<0.3	Methyl methacrylate	<4.1	<1
Vinyl chloride	<0.26	<0.1	Heptane	<4.1	<1
1,3-Butadiene	<0.044	<0.02	Bromodichloromethane	<0.067	<0.01
Butane	<4.8	<2	Trichloroethene	<0.11	<0.02
Bromomethane	<3.9	<1	cis-1,3-Dichloropropene	<0.91	<0.2
Chloroethane	<2.6	<1	4-Methyl-2-pentanone	<8.2	<2
Vinyl bromide	<0.44	<0.1	trans-1,3-Dichloropropene	<0.45	<0.1
Ethanol	<7.5	<4	Toluene	<7.5	<2
Acrolein	<0.11	<0.05	1,1,2-Trichloroethane	<0.055	<0.01
Pentane	<5.9	<2	2-Hexanone	<4.1	<1
Trichlorofluoromethane	<2.2	<0.4	Tetrachloroethene	<6.8	<1
Acetone	<4.8	<2	Dibromochloromethane	<0.085	<0.01
2-Propanol	<8.6	<3.5	1,2-Dibromoethane (EDB)	<0.077	<0.01
1,1-Dichloroethene	<0.4	<0.1	Chlorobenzene	<0.46	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1	Ethylbenzene	<0.43	<0.1
Methylene chloride	<35	<10	1,1,2,2-Tetrachloroethane	<0.14	<0.02
t-Butyl alcohol (TBA)	<12	<4	Nonane	<5.2	<1
3-Chloropropene	<3.1	<1	Isopropylbenzene	<9.8	<2
CFC-113	<1.5	<0.2	2-Chlorotoluene	<5.2	<1
Carbon disulfide	<6.2	<2	Propylbenzene	<4.9	<1
Methyl t-butyl ether (MTBE)	<7.2	<2	4-Ethyltoluene	<4.9	<1
Vinyl acetate	<7	<2	m,p-Xylene	<0.87	<0.2
1,1-Dichloroethane	<0.4	<0.1	o-Xylene	<0.43	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1	Styrene	<0.85	<0.2
Hexane	<3.5	<1	Bromoform	<2.1	<0.2
Chloroform	<0.049	<0.01	Benzyl chloride	<0.052	<0.01
Ethyl acetate	<7.2	<2	1,3,5-Trimethylbenzene	<4.9	<1
Tetrahydrofuran	<0.59	<0.2	1,2,4-Trimethylbenzene	<4.9	<1
2-Butanone (MEK)	<5.9	<2	1,3-Dichlorobenzene	<0.6	<0.1
1,2-Dichloroethane (EDC)	<0.04	<0.01	1,4-Dichlorobenzene	<0.23	<0.038
1,1,1-Trichloroethane	<0.55	<0.1	1,2-Dichlorobenzene	<0.6	<0.1
Carbon tetrachloride	<0.31	<0.05	1,2,4-Trichlorobenzene	<0.74	<0.1
Benzene	<0.32	<0.1	Naphthalene	<0.26	<0.05
Cyclohexane	<6.9	<2	Hexachlorobutadiene	<0.21	<0.02

Calculation Data	040311.D04-0689 mb ve15		Air	1	1
15		11	**STANDARD**		

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF SOIL SAMPLES
FOR TOTAL METALS USING EPA METHOD 200.8

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Antimony	mg/kg (ppm)	20	85	87	85-115	2
Arsenic	mg/kg (ppm)	10	96	97	85-115	1
Barium	mg/kg (ppm)	50	92	93	85-115	1
Beryllium	mg/kg (ppm)	5	104	104	85-115	0
Cadmium	mg/kg (ppm)	10	97	98	85-115	1
Chromium	mg/kg (ppm)	50	100	99	85-115	1
Cobalt	mg/kg (ppm)	20	102	103	85-115	1
Copper	mg/kg (ppm)	50	101	101	85-115	0
Lead	mg/kg (ppm)	50	101	101	85-115	0
Manganese	mg/kg (ppm)	20	98	98	85-115	0
Mercury	mg/kg (ppm)	5	110	111	85-115	1
Molybdenum	mg/kg (ppm)	20	95	94	85-115	1
Nickel	mg/kg (ppm)	25	96	97	85-115	1
Selenium	mg/kg (ppm)	5	91	89	85-115	2
Silver	mg/kg (ppm)	10	96	96	85-115	0
Thallium	mg/kg (ppm)	5	101	102	85-115	1
Vanadium	mg/kg (ppm)	30	113	112	85-115	1
Zinc	mg/kg (ppm)	50	100	101	85-115	1

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF WATER SAMPLES
FOR TOTAL METALS USING EPA METHOD 200.8

Laboratory Code: 402378-01 rr (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Antimony	ug/L (ppb)	20	1.05	97	96	70-130	1
Arsenic	ug/L (ppb)	10	<1	93	92	70-130	1
Barium	ug/L (ppb)	50	9.10	96	96	70-130	0
Beryllium	ug/L (ppb)	5	<1	92	91	70-130	1
Cadmium	ug/L (ppb)	5	<1	96	94	70-130	2
Chromium	ug/L (ppb)	20	<1	94	93	70-130	1
Cobalt	ug/L (ppb)	20	<1	93	92	70-130	1
Copper	ug/L (ppb)	20	<5	93	91	70-130	2
Iron	ug/L (ppb)	100	156	88 b	85 b	70-130	3 b
Lead	ug/L (ppb)	10	<1	89	88	70-130	1
Manganese	ug/L (ppb)	20	8.99	90 b	90 b	70-130	0 b
Mercury	ug/L (ppb)	5	<1	84	83	70-130	1
Molybdenum	ug/L (ppb)	10	<1	94	93	70-130	1
Nickel	ug/L (ppb)	20	<1	94	93	70-130	1
Selenium	ug/L (ppb)	5	<1	96	91	70-130	5
Silver	ug/L (ppb)	5	<1	88	87	70-130	1
Thallium	ug/L (ppb)	5	<1	90	88	70-130	2
Vanadium	ug/L (ppb)	20	<1	93	93	70-130	0
Zinc	ug/L (ppb)	50	32.9	91 b	90 b	70-130	1 b

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Antimony	ug/L (ppb)	20	94	85-115
Arsenic	ug/L (ppb)	10	92	85-115
Barium	ug/L (ppb)	50	96	85-115
Beryllium	ug/L (ppb)	5	95	85-115
Cadmium	ug/L (ppb)	5	93	85-115
Chromium	ug/L (ppb)	20	96	85-115
Cobalt	ug/L (ppb)	20	97	85-115
Copper	ug/L (ppb)	20	95	85-115
Iron	ug/L (ppb)	100	97	85-115
Lead	ug/L (ppb)	10	94	85-115
Manganese	ug/L (ppb)	20	95	85-115
Mercury	ug/L (ppb)	5	87	85-115
Molybdenum	ug/L (ppb)	10	93	85-115
Nickel	ug/L (ppb)	20	96	85-115
Selenium	ug/L (ppb)	5	97	85-115
Silver	ug/L (ppb)	5	91	85-115
Thallium	ug/L (ppb)	5	94	85-115
Vanadium	ug/L (ppb)	20	97	85-115
Zinc	ug/L (ppb)	50	96	85-115

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF SOIL SAMPLES FOR
TOTAL MERCURY USING EPA METHOD 1631E

Laboratory Code: 403229-01 x10 (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result (Wet wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Mercury	mg/kg (ppm)	5	<0.025	134	152	71-125	13

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Mercury	mg/kg (ppm)	5	123	68-143

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF WATER SAMPLES FOR
TOTAL MERCURY USING EPA METHOD 1631E

Laboratory Code: 403411-01 (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Mercury	ug/L (ppb)	0.01	<0.1	78	94	71-125	18

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Mercury	ug/L (ppb)	0.01	99	66-126

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF SOIL SAMPLES
FOR TOTAL METALS USING EPA METHOD 6020B

Laboratory Code: 403297-01 x5 (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result (Wet wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Antimony	mg/kg (ppm)	20	<5	92	104	75-125	12
Arsenic	mg/kg (ppm)	10	6.39	76 b	108 b	75-125	35 b
Barium	mg/kg (ppm)	50	68.1	67 b	90 b	75-125	29 b
Beryllium	mg/kg (ppm)	5	<5	98	98	75-125	0
Cadmium	mg/kg (ppm)	10	<5	97	96	75-125	1
Chromium	mg/kg (ppm)	50	13.5	93 b	98 b	75-125	5 b
Cobalt	mg/kg (ppm)	20	<5	96	98	75-125	2
Copper	mg/kg (ppm)	50	<25	87	94	75-125	8
Lead	mg/kg (ppm)	50	36.1	97 b	187 b	75-125	63 b
Manganese	mg/kg (ppm	20	387	<1.00	25	75-125	
Mercury	mg/kg (ppm	5	<5	98	100	75-125	2
Molybdenum	mg/kg (ppm)	20	<5	93	96	75-125	3
Nickel	mg/kg (ppm)	25	21.1	77 b	99 b	75-125	25 b
Selenium	mg/kg (ppm)	5	<5	86	91	75-125	6
Silver	mg/kg (ppm)	10	<5	90	92	75-125	2
Thallium	mg/kg (ppm)	5	<5	84	82	75-125	2
Vanadium	mg/kg (ppm)	30	31.4	69 b	235 b	75-125	109 b
Zinc	mg/kg (ppm)	50	142	49 b	83 b	75-125	52 b

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Antimony	mg/kg (ppm)	20	104	80-120
Arsenic	mg/kg (ppm)	10	87	80-120
Barium	mg/kg (ppm)	50	98	80-120
Beryllium	mg/kg (ppm)	5	111	80-120
Cadmium	mg/kg (ppm)	10	103	80-120
Chromium	mg/kg (ppm)	50	116	80-120
Cobalt	mg/kg (ppm)	20	109	80-120
Copper	mg/kg (ppm)	50	102	80-120
Lead	mg/kg (ppm)	50	100	80-120
Manganese	mg/kg (ppm)	20	97	80-120
Mercury	mg/kg (ppm)	5	90	80-120
Molybdenum	mg/kg (ppm)	20	91	80-120
Nickel	mg/kg (ppm)	25	105	80-120
Selenium	mg/kg (ppm)	5	97	80-120
Silver	mg/kg (ppm)	10	99	80-120
Thallium	mg/kg (ppm)	5	99	80-120
Vanadium	mg/kg (ppm)	30	110	80-120
Zinc	mg/kg (ppm)	50	103	80-120

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF SOIL/SOLID SAMPLES
FOR TCLP METALS USING
EPA METHODS 6020B AND 1311

Laboratory Code: 403454-01 (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Antimony	mg/L (ppm)	2.0	<1	110	110	75-125	0
Arsenic	mg/L (ppm)	1.0	<1	99	99	75-125	0
Barium	mg/L (ppm)	5.0	3.5	101 b	103 b	75-125	2 b
Beryllium	mg/L (ppm)	0.5	<1	96	96	75-125	0
Cadmium	mg/L (ppm)	0.5	<1	99	100	75-125	1
Chromium	mg/L (ppm)	2.0	<1	86	88	75-125	2
Cobalt	mg/L (ppm)	2.0	<1	86	88	75-125	2
Copper	mg/L (ppm)	2.0	<5	87	88	75-125	1
Iron	mg/L (ppm)	10	<50	85	89	75-125	5
Lead	mg/L (ppm)	1.0	<1	97	98	75-125	1
Manganese	mg/L (ppm)	2.0	5.0	72 b	81 b	75-125	12 b
Molybdenum	mg/L (ppm)	1.0	<1	101	103	75-125	2
Nickel	mg/L (ppm)	2.0	<1	88	89	75-125	1
Selenium	mg/L (ppm)	0.5	<1	107	105	75-125	2
Silver	mg/L (ppm)	0.5	<1	86	87	75-125	1
Thallium	mg/L (ppm)	0.5	<1	88	88	75-125	0
Vanadium	mg/L (ppm)	2.0	<1	89	91	75-125	2
Zinc	mg/L (ppm)	5.0	<5	88	89	75-125	1

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Antimony	mg/L (ppm)	2.0	103	80-120
Arsenic	mg/L (ppm)	1.0	91	80-120
Barium	mg/L (ppm)	5.0	95	80-120
Beryllium	mg/L (ppm)	0.5	94	80-120
Cadmium	mg/L (ppm)	0.5	94	80-120
Chromium	mg/L (ppm)	2.0	83	80-120
Cobalt	mg/L (ppm)	2.0	83	80-120
Copper	mg/L (ppm)	2.0	84	80-120
Iron	mg/L (ppm)	10	85	80-120
Lead	mg/L (ppm)	1.0	98	80-120
Manganese	mg/L (ppm)	2.0	80	80-120
Molybdenum	mg/L (ppm)	1.0	94	80-120
Nickel	mg/L (ppm)	2.0	85	80-120
Selenium	mg/L (ppm)	0.5	98	80-120
Silver	mg/L (ppm)	0.5	86	80-120
Thallium	mg/L (ppm)	0.5	86	80-120
Vanadium	mg/L (ppm)	2.0	84	80-120
Zinc	mg/L (ppm)	5.0	86	80-120

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF WATER SAMPLES
FOR TOTAL METALS USING EPA METHOD 6020B

Laboratory Code: 404039-06 (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Antimony	ug/L (ppb)	20	<1	99	101	75-125	2
Arsenic	ug/L (ppb)	10	1.20	103	105	75-125	2
Barium	ug/L (ppb)	50	25.6	99 b	102 b	75-125	3 b
Beryllium	ug/L (ppb)	5	<1	98	100	75-125	2
Cadmium	ug/L (ppb)	5	<1	98	99	75-125	1
Chromium	ug/L (ppb)	20	<1	88	91	75-125	3
Cobalt	ug/L (ppb)	20	<1	87	89	75-125	2
Copper	ug/L (ppb)	20	<5	83	83	75-125	0
Iron	ug/L (ppb)	100	3,600	143 b	233 b	75-125	48 b
Lead	ug/L (ppb)	10	<1	85	86	75-125	1
Manganese	ug/L (ppb)	20	1,190	283 b	406 b	75-125	36 b
Mercury	ug/L (ppb)	5	<1	92	94	75-125	2
Molybdenum	ug/L (ppb)	10	<1	107	109	75-125	2
Nickel	ug/L (ppb)	20	1.75	84	86	75-125	2
Selenium	ug/L (ppb)	5	<1	103	102	75-125	1
Silver	ug/L (ppb)	5	<1	93	95	75-125	2
Thallium	ug/L (ppb)	5	<1	85	87	75-125	2
Vanadium	ug/L (ppb)	20	<1	92	93	75-125	1
Zinc	ug/L (ppb)	50	<5	86	87	75-125	1

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Antimony	ug/L (ppb)	20	103	80-120
Arsenic	ug/L (ppb)	10	90	80-120
Barium	ug/L (ppb)	50	104	80-120
Beryllium	ug/L (ppb)	5	89	80-120
Cadmium	ug/L (ppb)	5	102	80-120
Chromium	ug/L (ppb)	20	88	80-120
Cobalt	ug/L (ppb)	20	91	80-120
Copper	ug/L (ppb)	20	96	80-120
Iron	ug/L (ppb)	100	89	80-120
Lead	ug/L (ppb)	10	93	80-120
Manganese	ug/L (ppb)	20	88	80-120
Mercury	ug/L (ppb)	5	94	80-120
Molybdenum	ug/L (ppb)	10	87	80-120
Nickel	ug/L (ppb)	20	94	80-120
Selenium	ug/L (ppb)	5	94	80-120
Silver	ug/L (ppb)	5	90	80-120
Thallium	ug/L (ppb)	5	86	80-120
Vanadium	ug/L (ppb)	20	89	80-120
Zinc	ug/L (ppb)	50	97	80-120

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF SOIL SAMPLES FOR
ORGANOCHLORINE PESTICIDES
BY EPA METHOD 8081B

Laboratory Code: 402374-01 1/30 (Matrix Spike) 1/30

end

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
alpha-BHC	mg/kg (ppm)	0.1	<0.01	76	76	17-122	0
gamma-BHC (Lindane)	mg/kg (ppm)	0.1	<0.01	77	77	18-128	0
beta-BHC	mg/kg (ppm)	0.1	<0.01	74	79	17-130	7
delta-BHC	mg/kg (ppm)	0.1	<0.01	76	82	20-124	8
Heptachlor	mg/kg (ppm)	0.1	<0.01	84	84	15-133	0
Aldrin	mg/kg (ppm)	0.1	<0.01	81	81	26-125	0
Heptachlor Epoxide	mg/kg (ppm)	0.1	<0.01	75	80	19-132	6
trans-Chlordane	mg/kg (ppm)	0.1	<0.01	81	84	15-157	4
cis-Chlordane	mg/kg (ppm)	0.1	<0.01	79	82	17-133	4
4,4'-DDE	mg/kg (ppm)	0.1	<0.01	81	83	17-139	2
Endosulfan I	mg/kg (ppm)	0.1	<0.01	71	76	19-130	7
Dieldrin	mg/kg (ppm)	0.1	<0.01	79	83	17-140	5
Endrin	mg/kg (ppm)	0.1	<0.01	88	89	20-143	1
4,4'-DDD	mg/kg (ppm)	0.1	<0.01	84	83	20-143	1
Endosulfan II	mg/kg (ppm)	0.1	<0.01	80	80	21-133	0
4,4'-DDT	mg/kg (ppm)	0.1	<0.01	85	83	10-385	2
Endrin Aldehyde	mg/kg (ppm)	0.1	<0.01	65	74	12-123	13
Methoxychlor	mg/kg (ppm)	0.1	<0.01	87	86	10-226	1
Endosulfan Sulfate	mg/kg (ppm)	0.1	<0.01	80	79	17-134	1
Endrin Ketone	mg/kg (ppm)	0.1	<0.01	80	79	10-153	1
Toxaphene	mg/kg (ppm)	4	<0.1	39	42	12-123	7

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF SOIL SAMPLES FOR
ORGANOCHLORINE PESTICIDES
BY EPA METHOD 8081B

Laboratory Code: Laboratory Control Sample 1/30

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
alpha-BHC	mg/kg (ppm)	0.1	90	57-116
gamma-BHC (Lindane)	mg/kg (ppm)	0.1	91	59-118
beta-BHC	mg/kg (ppm)	0.1	92	63-113
delta-BHC	mg/kg (ppm)	0.1	98	58-124
Heptachlor	mg/kg (ppm)	0.1	100	60-117
Aldrin	mg/kg (ppm)	0.1	98	63-113
Heptachlor Epoxide	mg/kg (ppm)	0.1	96	70-130
trans-Chlordane	mg/kg (ppm)	0.1	98	70-130
cis-Chlordane	mg/kg (ppm)	0.1	99	70-130
4,4'-DDE	mg/kg (ppm)	0.1	101	69-121
Endosulfan I	mg/kg (ppm)	0.1	95	70-130
Dieldrin	mg/kg (ppm)	0.1	98	70-130
Endrin	mg/kg (ppm)	0.1	105	65-140
4,4'-DDD	mg/kg (ppm)	0.1	98	70-130
Endosulfan II	mg/kg (ppm)	0.1	95	70-130
4,4'-DDT	mg/kg (ppm)	0.1	99	57-135
Endrin Aldehyde	mg/kg (ppm)	0.1	88	25-133
Methoxychlor	mg/kg (ppm)	0.1	101	57-147
Endosulfan Sulfate	mg/kg (ppm)	0.1	92	70-130
Endrin Ketone	mg/kg (ppm)	0.1	93	70-130
Toxaphene	mg/kg (ppm)	4	88	53-143

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF WATER SAMPLES FOR
ORGANOCHLORINE PESTICIDES
BY EPA METHOD 8081B

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
alpha-BHC	ug/L (ppb)	0.25	65	61	41-101	6
gamma-BHC (Lindane)	ug/L (ppb)	0.25	66	63	43-105	5
beta-BHC	ug/L (ppb)	0.25	56	64	49-104	13
delta-BHC	ug/L (ppb)	0.25	69	68	45-108	1
Heptachlor	ug/L (ppb)	0.25	60	56	39-104	7
Aldrin	ug/L (ppb)	0.25	62	58	43-98	7
Heptachlor Epoxide	ug/L (ppb)	0.25	69	64	52-110	8
trans-Chlordane	ug/L (ppb)	0.25	73	64	39-119	13
cis-Chlordane	ug/L (ppb)	0.25	70	63	47-106	11
4,4'-DDE	ug/L (ppb)	0.25	71	65	48-114	9
Endosulfan I	ug/L (ppb)	0.25	70	65	10-140	7
Dieldrin	ug/L (ppb)	0.25	69	64	54-115	8
Endrin	ug/L (ppb)	0.25	74	69	39-136	7
4,4'-DDD	ug/L (ppb)	0.25	75	70	31-161	7
Endosulfan II	ug/L (ppb)	0.25	74	68	10-144	8
4,4'-DDT	ug/L (ppb)	0.25	74	68	50-121	8
Endrin Aldehyde	ug/L (ppb)	0.25	55	57	47-113	4
Methoxychlor	ug/L (ppb)	0.25	74	69	51-126	7
Endosulfan Sulfate	ug/L (ppb)	0.25	73	69	58-110	6
Endrin Ketone	ug/L (ppb)	0.25	70	66	57-120	6
Toxaphene	ug/L (ppb)	4	100	100	56-123	0

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF SOIL SAMPLES FOR
POLYCHLORINATED BIPHENYLS AS
AROCLOR 1016/1260 BY EPA METHOD 8082A

Laboratory Code: 404010-01 1/30 (Matrix Spike) 1/30

end

Analyte	Reporting Units	Spike Level	Sample Result (Wet Wt)	Percent Recovery MS	Percent Recovery MSD	Control Limits	RPD (Limit 20)
Aroclor 1016	mg/kg (ppm)	0.25	<0.02	95	94	29-125	1
Aroclor 1260	mg/kg (ppm)	0.25	<0.02	92	105	12-177	13

Laboratory Code: Laboratory Control Sample 1/30

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Aroclor 1016	mg/kg (ppm)	0.25	107	55-137
Aroclor 1260	mg/kg (ppm)	0.25	104	51-150

QUALITY ASSURANCE RESULTS
FOR THE ANALYSIS OF WATER SAMPLES FOR
POLYCHLORINATED BIPHENYLS AS
AROCLOR 1016/1260 BY EPA METHOD 8082A

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Aroclor 1016	ug/L (ppb)	0.25	59	66	20-94	11
Aroclor 1260	ug/L (ppb)	0.25	59	72	23-123	20

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR VOLATILES BY EPA METHOD 8260D

Laboratory Code: 404057-03 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Dichlorodifluoromethane	mg/kg (ppm)	2	<0.5	42	41	10-142	2
Chloromethane	mg/kg (ppm)	2	<0.5	65	62	10-126	5
Vinyl chloride	mg/kg (ppm)	2	<0.05	69	66	10-138	4
Bromomethane	mg/kg (ppm)	2	<0.5	66	61	10-163	8
Chloroethane	mg/kg (ppm)	2	<0.5	77	70	10-176	10
Trichlorofluoromethane	mg/kg (ppm)	2	<0.5	81	79	10-176	2
Acetone	mg/kg (ppm)	10	<5	79	71	10-163	11
1,1-Dichloroethene	mg/kg (ppm)	2	<0.05	90	85	10-160	6
Hexane	mg/kg (ppm)	2	<0.25	87	82	10-137	6
Methylene chloride	mg/kg (ppm)	2	<0.5	86	84	10-156	2
Methyl t-butyl ether (MTBE)	mg/kg (ppm)	2	<0.05	87	83	21-145	5
trans-1,2-Dichloroethene	mg/kg (ppm)	2	<0.05	94	85	14-137	10
1,1-Dichloroethane	mg/kg (ppm)	2	<0.05	93	87	19-140	7
2,2-Dichloropropane	mg/kg (ppm)	2	<0.05	102	96	10-158	6
cis-1,2-Dichloroethene	mg/kg (ppm)	2	<0.05	89	86	25-135	3
Chloroform	mg/kg (ppm)	2	<0.05	88	84	21-145	5
2-Butanone (MEK)	mg/kg (ppm)	10	<1	80	74	19-147	8
1,2-Dichloroethane (EDC)	mg/kg (ppm)	2	<0.05	89	84	12-160	6
1,1,1-Trichloroethane	mg/kg (ppm)	2	<0.05	89	84	10-156	6
1,1-Dichloropropene	mg/kg (ppm)	2	<0.05	89	86	17-140	3
Carbon tetrachloride	mg/kg (ppm)	2	<0.05	90	86	9-164	5
Benzene	mg/kg (ppm)	2	<0.03	90	86	29-129	5
Trichloroethene	mg/kg (ppm)	2	<0.02	87	80	21-139	8
1,2-Dichloropropane	mg/kg (ppm)	2	<0.05	92	86	30-135	7
Bromodichloromethane	mg/kg (ppm)	2	<0.05	90	83	23-155	8
Dibromomethane	mg/kg (ppm)	2	<0.05	89	83	23-145	7
4-Methyl-2-pentanone	mg/kg (ppm)	10	<1	96	87	24-155	10
cis-1,3-Dichloropropene	mg/kg (ppm)	2	<0.05	93	85	28-144	9
Toluene	mg/kg (ppm)	2	<0.05	85	82	35-130	4
trans-1,3-Dichloropropene	mg/kg (ppm)	2	<0.05	87	83	26-149	5
1,1,2-Trichloroethane	mg/kg (ppm)	2	<0.05	86	81	10-205	6
2-Hexanone	mg/kg (ppm)	10	<0.5	80	79	15-166	1
1,3-Dichloropropane	mg/kg (ppm)	2	<0.05	84	80	31-137	5
Tetrachloroethene	mg/kg (ppm)	2	<0.025	89	89	20-133	0
Dibromochloromethane	mg/kg (ppm)	2	<0.05	86	79	28-150	8
1,2-Dibromoethane (EDB)	mg/kg (ppm)	2	<0.05	85	83	28-142	2
Chlorobenzene	mg/kg (ppm)	2	<0.05	91	83	32-129	9
Ethylbenzene	mg/kg (ppm)	2	<0.05	86	82	32-137	5
1,1,1,2-Tetrachloroethane	mg/kg (ppm)	2	<0.05	85	84	31-143	1
m,p-Xylene	mg/kg (ppm)	4	<0.1	88	85	34-136	3
o-Xylene	mg/kg (ppm)	2	<0.05	88	84	33-134	5
Styrene	mg/kg (ppm)	2	<0.05	87	85	35-137	2
Isopropylbenzene	mg/kg (ppm)	2	<0.05	88	86	31-142	2
Bromoform	mg/kg (ppm)	2	<0.05	83	82	21-156	1
n-Propylbenzene	mg/kg (ppm)	2	<0.05	87	82	23-146	6
Bromobenzene	mg/kg (ppm)	2	<0.05	87	82	34-130	6
1,3,5-Trimethylbenzene	mg/kg (ppm)	2	<0.05	85	82	18-149	4
1,1,2,2-Tetrachloroethane	mg/kg (ppm)	2	<0.05	90	83	28-140	8
1,2,3-Trichloropropane	mg/kg (ppm)	2	<0.05	82	78	25-144	5
2-Chlorotoluene	mg/kg (ppm)	2	<0.05	86	81	31-134	6

4-Chlorotoluene	mg/kg (ppm)	2	<0.05	84	79	31-136	6
tert-Butylbenzene	mg/kg (ppm)	2	<0.05	86	82	30-137	5
1,2,4-Trimethylbenzene	mg/kg (ppm)	2	<0.05	85	80	10-182	6
sec-Butylbenzene	mg/kg (ppm)	2	<0.05	87	82	23-145	6
p-Isopropyltoluene	mg/kg (ppm)	2	<0.05	89	84	21-149	6
1,3-Dichlorobenzene	mg/kg (ppm)	2	<0.05	87	85	30-131	2
1,4-Dichlorobenzene	mg/kg (ppm)	2	<0.05	85	82	29-129	4
1,2-Dichlorobenzene	mg/kg (ppm)	2	<0.05	87	82	31-132	6
1,2-Dibromo-3-chloropropane	mg/kg (ppm)	2	<0.5	76	69	11-161	10
1,2,4-Trichlorobenzene	mg/kg (ppm)	2	<0.25	87	81	22-142	7
Hexachlorobutadiene	mg/kg (ppm)	2	<0.25	83	76	10-142	9
Naphthalene	mg/kg (ppm)	2	<0.05	83	78	14-157	6
1,2,3-Trichlorobenzene	mg/kg (ppm)	2	<0.25	83	77	20-144	7

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR VOLATILES BY EPA METHOD 8260D

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Dichlorodifluoromethane	mg/kg (ppm)	2	69	10-146
Chloromethane	mg/kg (ppm)	2	83	27-133
Vinyl chloride	mg/kg (ppm)	2	88	22-139
Bromomethane	mg/kg (ppm)	2	81	10-201
Chloroethane	mg/kg (ppm)	2	94	10-163
Trichlorofluoromethane	mg/kg (ppm)	2	96	10-196
Acetone	mg/kg (ppm)	10	106	52-141
1,1-Dichloroethene	mg/kg (ppm)	2	104	47-128
Hexane	mg/kg (ppm)	2	104	43-142
Methylene chloride	mg/kg (ppm)	2	92	10-184
Methyl t-butyl ether (MTBE)	mg/kg (ppm)	2	101	60-123
trans-1,2-Dichloroethene	mg/kg (ppm)	2	106	64-132
1,1-Dichloroethane	mg/kg (ppm)	2	106	64-135
2,2-Dichloropropane	mg/kg (ppm)	2	114	52-170
cis-1,2-Dichloroethene	mg/kg (ppm)	2	103	64-135
Chloroform	mg/kg (ppm)	2	100	61-139
2-Butanone (MEK)	mg/kg (ppm)	10	105	30-197
1,2-Dichloroethane (EDC)	mg/kg (ppm)	2	102	56-135
1,1,1-Trichloroethane	mg/kg (ppm)	2	102	62-131
1,1-Dichloropropene	mg/kg (ppm)	2	100	64-136
Carbon tetrachloride	mg/kg (ppm)	2	100	60-139
Benzene	mg/kg (ppm)	2	104	65-136
Trichloroethene	mg/kg (ppm)	2	100	63-139
1,2-Dichloropropane	mg/kg (ppm)	2	105	61-145
Bromodichloromethane	mg/kg (ppm)	2	102	57-126
Dibromomethane	mg/kg (ppm)	2	102	62-123
4-Methyl-2-pentanone	mg/kg (ppm)	10	107	45-145
cis-1,3-Dichloropropene	mg/kg (ppm)	2	105	65-143
Toluene	mg/kg (ppm)	2	102	66-126
trans-1,3-Dichloropropene	mg/kg (ppm)	2	102	65-131
1,1,2-Trichloroethane	mg/kg (ppm)	2	103	62-131
2-Hexanone	mg/kg (ppm)	10	96	33-152
1,3-Dichloropropane	mg/kg (ppm)	2	99	67-128
Tetrachloroethene	mg/kg (ppm)	2	107	68-128
Dibromochloromethane	mg/kg (ppm)	2	103	55-121
1,2-Dibromoethane (EDB)	mg/kg (ppm)	2	102	66-129
Chlorobenzene	mg/kg (ppm)	2	104	67-128
Ethylbenzene	mg/kg (ppm)	2	102	64-123
1,1,1,2-Tetrachloroethane	mg/kg (ppm)	2	97	64-121
m,p-Xylene	mg/kg (ppm)	4	104	68-128
o-Xylene	mg/kg (ppm)	2	106	67-129
Styrene	mg/kg (ppm)	2	105	67-129
Isopropylbenzene	mg/kg (ppm)	2	104	68-128
Bromoform	mg/kg (ppm)	2	100	56-132
n-Propylbenzene	mg/kg (ppm)	2	98	68-129
Bromobenzene	mg/kg (ppm)	2	99	69-128
1,3,5-Trimethylbenzene	mg/kg (ppm)	2	97	69-129
1,1,2,2-Tetrachloroethane	mg/kg (ppm)	2	100	56-143

1,2,3-Trichloropropane	mg/kg (ppm)	2	98	61-137
2-Chlorotoluene	mg/kg (ppm)	2	98	69-128
4-Chlorotoluene	mg/kg (ppm)	2	96	67-127
tert-Butylbenzene	mg/kg (ppm)	2	100	69-129
1,2,4-Trimethylbenzene	mg/kg (ppm)	2	99	69-128
sec-Butylbenzene	mg/kg (ppm)	2	98	69-130
p-Isopropyltoluene	mg/kg (ppm)	2	104	69-130
1,3-Dichlorobenzene	mg/kg (ppm)	2	101	69-127
1,4-Dichlorobenzene	mg/kg (ppm)	2	99	68-126
1,2-Dichlorobenzene	mg/kg (ppm)	2	101	69-127
1,2-Dibromo-3-chloropropane	mg/kg (ppm)	2	92	58-138
1,2,4-Trichlorobenzene	mg/kg (ppm)	2	100	64-135
Hexachlorobutadiene	mg/kg (ppm)	2	99	50-153
Naphthalene	mg/kg (ppm)	2	97	62-128
1,2,3-Trichlorobenzene	mg/kg (ppm)	2	95	61-126

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR VOLATILES BY EPA METHOD 8260D

Laboratory Code: 403449-09 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Acceptance Criteria
Dichlorodifluoromethane	ug/L (ppb)	10	<1	89	27-164
Chloromethane	ug/L (ppb)	10	<10	96	34-141
Vinyl chloride	ug/L (ppb)	10	<0.02	94	16-176
Bromomethane	ug/L (ppb)	10	<5	130	10-193
Chloroethane	ug/L (ppb)	10	<1	108	50-150
Trichlorofluoromethane	ug/L (ppb)	10	<1	99	50-150
2-Propanol	ug/L (ppb)	0	<10	0	50-150
Acetone	ug/L (ppb)	50	<50	77	15-179
1,1-Dichloroethene	ug/L (ppb)	10	<1	95	50-150
Hexane	ug/L (ppb)	10	<5	107	49-161
Methylene chloride	ug/L (ppb)	10	<5	97	40-143
Methyl t-butyl ether (MTBE)	ug/L (ppb)	10	<1	97	50-150
trans-1,2-Dichloroethene	ug/L (ppb)	10	<1	98	50-150
1,1-Dichloroethane	ug/L (ppb)	10	<1	96	50-150
2,2-Dichloropropane	ug/L (ppb)	10	<1	139	62-152
cis-1,2-Dichloroethene	ug/L (ppb)	10	<1	98	50-150
Chloroform	ug/L (ppb)	10	<1	96	50-150
2-Butanone (MEK)	ug/L (ppb)	50	<20	92	34-168
1,2-Dichloroethane (EDC)	ug/L (ppb)	10	<0.2	98	50-150
1,1,1-Trichloroethane	ug/L (ppb)	10	<1	99	50-150
1,1-Dichloropropene	ug/L (ppb)	10	<1	96	50-150
Carbon tetrachloride	ug/L (ppb)	10	<0.5	106	50-150
Benzene	ug/L (ppb)	10	<0.35	97	50-150
Trichloroethene	ug/L (ppb)	10	<0.5	96	43-133
1,2-Dichloropropane	ug/L (ppb)	10	<1	96	50-150
Bromodichloromethane	ug/L (ppb)	10	<0.5	110	50-150
Dibromomethane	ug/L (ppb)	10	<1	99	50-150
4-Methyl-2-pentanone	ug/L (ppb)	50	<10	109	50-150
cis-1,3-Dichloropropene	ug/L (ppb)	10	<0.4	95	48-145
Toluene	ug/L (ppb)	10	<1	99	50-150
trans-1,3-Dichloropropene	ug/L (ppb)	10	<0.4	90	37-152
1,1,2-Trichloroethane	ug/L (ppb)	10	<0.5	128	50-150
2-Hexanone	ug/L (ppb)	50	<10	89	50-150
1,3-Dichloropropane	ug/L (ppb)	10	<1	94	50-150
Tetrachloroethene	ug/L (ppb)	10	<1	101	50-150
Dibromochloromethane	ug/L (ppb)	10	<0.5	90	33-164
1,2-Dibromoethane (EDB)	ug/L (ppb)	10	<0.01	102	50-150
Chlorobenzene	ug/L (ppb)	10	<1	94	50-150
Ethylbenzene	ug/L (ppb)	10	<1	103	50-150
1,1,1,2-Tetrachloroethane	ug/L (ppb)	10	<1	92	50-150
m,p-Xylene	ug/L (ppb)	20	<2	102	50-150
o-Xylene	ug/L (ppb)	10	<1	100	50-150
Styrene	ug/L (ppb)	10	<1	97	50-150
Isopropylbenzene	ug/L (ppb)	10	<1	97	50-150
Bromoform	ug/L (ppb)	10	<5	91	23-161
n-Propylbenzene	ug/L (ppb)	10	<1	100	50-150
Bromobenzene	ug/L (ppb)	10	<1	94	50-150
1,3,5-Trimethylbenzene	ug/L (ppb)	10	<1	97	50-150
1,1,2,2-Tetrachloroethane	ug/L (ppb)	10	<0.2	109	57-162
1,2,3-Trichloropropane	ug/L (ppb)	10	<1	97	33-151

2-Chlorotoluene	ug/L (ppb)	10	<1	95	50-150
4-Chlorotoluene	ug/L (ppb)	10	<1	96	50-150
tert-Butylbenzene	ug/L (ppb)	10	<1	97	50-150
1,2,4-Trimethylbenzene	ug/L (ppb)	10	<1	95	50-150
sec-Butylbenzene	ug/L (ppb)	10	<1	98	46-139
p-Isopropyltoluene	ug/L (ppb)	10	<1	99	46-140
1,3-Dichlorobenzene	ug/L (ppb)	10	<1	95	50-150
1,4-Dichlorobenzene	ug/L (ppb)	10	<1	95	50-150
1,2-Dichlorobenzene	ug/L (ppb)	10	<1	94	50-150
1,2-Dibromo-3-chloropropane	ug/L (ppb)	10	<10	86	50-150
1,2,4-Trichlorobenzene	ug/L (ppb)	10	<1	94	50-150
Hexachlorobutadiene	ug/L (ppb)	10	<0.5	95	42-150
Naphthalene	ug/L (ppb)	10	<1	101	50-150
1,2,3-Trichlorobenzene	ug/L (ppb)	10	<1	93	44-155

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR VOLATILES BY EPA METHOD 8260D

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Dichlorodifluoromethane	ug/L (ppb)	10	85	86	49-149	1
Chloromethane	ug/L (ppb)	10	92	91	34-143	1
Vinyl chloride	ug/L (ppb)	10	93	92	43-149	1
Bromomethane	ug/L (ppb)	10	131	131	28-182	0
Chloroethane	ug/L (ppb)	10	106	106	59-157	0
Trichlorofluoromethane	ug/L (ppb)	10	104	101	59-141	3
2-Propanol	ug/L (ppb)	0	0	0	70-130	
Acetone	ug/L (ppb)	50	78	74	20-139	5
1,1-Dichloroethene	ug/L (ppb)	10	92	92	67-138	0
Hexane	ug/L (ppb)	10	99	99	50-161	0
Methylene chloride	ug/L (ppb)	10	97	92	29-192	5
Methyl t-butyl ether (MTBE)	ug/L (ppb)	10	94	93	70-130	1
trans-1,2-Dichloroethene	ug/L (ppb)	10	94	94	70-130	0
1,1-Dichloroethane	ug/L (ppb)	10	93	93	70-130	0
2,2-Dichloropropane	ug/L (ppb)	10	136	115	71-148	17
cis-1,2-Dichloroethene	ug/L (ppb)	10	95	94	70-130	1
Chloroform	ug/L (ppb)	10	93	92	70-130	1
2-Butanone (MEK)	ug/L (ppb)	50	89	87	50-157	2
1,2-Dichloroethane (EDC)	ug/L (ppb)	10	94	94	70-130	0
1,1,1-Trichloroethane	ug/L (ppb)	10	96	95	70-130	1
1,1-Dichloropropene	ug/L (ppb)	10	93	91	70-130	2
Carbon tetrachloride	ug/L (ppb)	10	103	101	70-130	2
Benzene	ug/L (ppb)	10	93	92	70-130	1
Trichloroethene	ug/L (ppb)	10	93	92	70-130	1
1,2-Dichloropropane	ug/L (ppb)	10	92	90	70-130	2
Bromodichloromethane	ug/L (ppb)	10	95	95	70-130	0
Dibromomethane	ug/L (ppb)	10	96	95	70-130	1
4-Methyl-2-pentanone	ug/L (ppb)	50	99	95	70-130	4
cis-1,3-Dichloropropene	ug/L (ppb)	10	92	91	70-130	1
Toluene	ug/L (ppb)	10	102	104	70-130	2
trans-1,3-Dichloropropene	ug/L (ppb)	10	95	97	70-130	2
1,1,2-Trichloroethane	ug/L (ppb)	10	98	99	70-130	1
2-Hexanone	ug/L (ppb)	50	86	82	66-132	5
1,3-Dichloropropane	ug/L (ppb)	10	96	98	70-130	2
Tetrachloroethene	ug/L (ppb)	10	104	105	70-130	1
Dibromochloromethane	ug/L (ppb)	10	94	97	63-142	3
1,2-Dibromoethane (EDB)	ug/L (ppb)	10	102	103	70-130	1
Chlorobenzene	ug/L (ppb)	10	96	99	70-130	3
Ethylbenzene	ug/L (ppb)	10	103	105	70-130	2
1,1,1,2-Tetrachloroethane	ug/L (ppb)	10	98	99	70-130	1
m,p-Xylene	ug/L (ppb)	20	103	105	70-130	2
o-Xylene	ug/L (ppb)	10	101	103	70-130	2
Styrene	ug/L (ppb)	10	97	97	70-130	0
Isopropylbenzene	ug/L (ppb)	10	97	98	70-130	1
Bromoform	ug/L (ppb)	10	96	95	50-157	1
n-Propylbenzene	ug/L (ppb)	10	102	101	70-130	1
Bromobenzene	ug/L (ppb)	10	99	99	70-130	0
1,3,5-Trimethylbenzene	ug/L (ppb)	10	100	100	52-150	0

1,1,2,2-Tetrachloroethane	ug/L (ppb)	10	104	103	75-140	1
1,2,3-Trichloropropane	ug/L (ppb)	10	103	101	40-153	2
2-Chlorotoluene	ug/L (ppb)	10	102	100	70-130	2
4-Chlorotoluene	ug/L (ppb)	10	101	99	70-130	2
tert-Butylbenzene	ug/L (ppb)	10	100	98	70-130	2
1,2,4-Trimethylbenzene	ug/L (ppb)	10	99	96	70-130	3
sec-Butylbenzene	ug/L (ppb)	10	100	99	70-130	1
p-Isopropyltoluene	ug/L (ppb)	10	100	99	70-130	1
1,3-Dichlorobenzene	ug/L (ppb)	10	99	98	70-130	1
1,4-Dichlorobenzene	ug/L (ppb)	10	101	99	70-130	2
1,2-Dichlorobenzene	ug/L (ppb)	10	99	98	70-130	1
1,2-Dibromo-3-chloropropane	ug/L (ppb)	10	97	92	70-130	5
1,2,4-Trichlorobenzene	ug/L (ppb)	10	96	92	70-130	4
Hexachlorobutadiene	ug/L (ppb)	10	98	96	70-130	2
Naphthalene	ug/L (ppb)	10	96	92	61-133	4
1,2,3-Trichlorobenzene	ug/L (ppb)	10	94	91	69-143	3

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR SEMIVOLATILES BY EPA METHOD 8270E

Laboratory Code: 403380-04 1/5 (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result (Wet wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Phenol	mg/kg (ppm)	0.83	<0.5	83	84	50-150	1
Bis(2-chloroethyl) ether	mg/kg (ppm)	0.83	<0.05	85	85	50-150	0
2-Chlorophenol	mg/kg (ppm)	0.83	<0.5	83	84	50-150	1
1,3-Dichlorobenzene	mg/kg (ppm)	0.83	<0.05	73	77	36-107	5
1,4-Dichlorobenzene	mg/kg (ppm)	0.83	<0.05	77	79	37-106	3
1,2-Dichlorobenzene	mg/kg (ppm)	0.83	<0.05	76	78	39-106	3
Benzyl alcohol	mg/kg (ppm)	4.2	<0.5	78	79	50-150	1
2,2'-Oxybis(1-chloropropane)	mg/kg (ppm)	0.83	<0.05	84	84	50-150	0
2-Methylphenol	mg/kg (ppm)	0.83	<0.5	88	87	50-150	1
Hexachloroethane	mg/kg (ppm)	0.83	<0.05	81	82	19-129	1
N-Nitroso-di-n-propylamine	mg/kg (ppm)	0.83	<0.05	90	91	50-150	1
3-Methylphenol + 4-Methylphenol	mg/kg (ppm)	0.83	<1	89	90	50-150	1
Nitrobenzene	mg/kg (ppm)	0.83	<0.05	81	82	50-150	1
Isophorone	mg/kg (ppm)	0.83	<0.05	86	105	16-156	20
2-Nitrophenol	mg/kg (ppm)	0.83	<0.5	91	92	50-150	1
2,4-Dimethylphenol	mg/kg (ppm)	0.83	<0.5	86	86	35-117	0
Benzoic acid	mg/kg (ppm)	2.5	<2.5	50	54	10-105	8
Bis(2-chloroethoxy)methane	mg/kg (ppm)	0.83	<0.05	83	83	50-150	0
2,4-Dichlorophenol	mg/kg (ppm)	0.83	<0.5	83	83	50-150	0
1,2,4-Trichlorobenzene	mg/kg (ppm)	0.83	<0.05	84	85	50-150	1
Naphthalene	mg/kg (ppm)	0.83	<0.01	77	77	50-150	0
Hexachlorobutadiene	mg/kg (ppm)	0.83	<0.05	68	71	39-106	4
4-Chloroaniline	mg/kg (ppm)	6.8	<5	66	69	40-101	4
4-Chloro-3-methylphenol	mg/kg (ppm)	0.83	<0.5	97	95	50-150	2
2-Methylnaphthalene	mg/kg (ppm)	0.83	<0.01	76	75	50-150	1
1-Methylnaphthalene	mg/kg (ppm)	0.83	<0.01	76	75	50-150	1
Hexachlorocyclopentadiene	mg/kg (ppm)	0.83	<0.15	69	72	27-127	4
2,4,6-Trichlorophenol	mg/kg (ppm)	0.83	<0.5	93	91	35-130	2
2,4,5-Trichlorophenol	mg/kg (ppm)	0.83	<0.5	94	95	43-126	1
2-Chloronaphthalene	mg/kg (ppm)	0.83	<0.05	81	80	50-150	1
2-Nitroaniline	mg/kg (ppm)	4.2	<0.25	73	74	50-150	1
Dimethyl phthalate	mg/kg (ppm)	0.83	<0.5	88	86	50-150	2
Acenaphthylene	mg/kg (ppm)	0.83	<0.01	72	72	50-150	0
2,6-Dinitrotoluene	mg/kg (ppm)	0.83	<0.25	87	87	50-150	0
3-Nitroaniline	mg/kg (ppm)	4.2	<5	74	73	50-150	1
Acenaphthene	mg/kg (ppm)	0.83	<0.01	70	69	50-150	1
2,4-Dinitrophenol	mg/kg (ppm)	1.7	<1.5	88	92	10-146	4
Dibenzofuran	mg/kg (ppm)	0.83	<0.05	79	78	50-150	1
2,4-Dinitrotoluene	mg/kg (ppm)	0.83	<0.25	102	101	44-141	1
4-Nitrophenol	mg/kg (ppm)	1.7	<1.5	105	112	33-142	6
Diethyl phthalate	mg/kg (ppm)	0.83	<0.5	85	84	50-150	1
Fluorene	mg/kg (ppm)	0.83	<0.01	79	78	50-150	1
4-Chlorophenyl phenyl ether	mg/kg (ppm)	0.83	<0.05	89	88	50-150	1
1,2-Diphenylhydrazine	mg/kg (ppm)	0.83	<0.05	89	87	50-150	2
N-Nitrosodiphenylamine	mg/kg (ppm)	0.83	<0.05	85	84	50-150	1
4-Nitroaniline	mg/kg (ppm)	4.2	<5	82	81	50-150	1
4,6-Dinitro-2-methylphenol	mg/kg (ppm)	0.83	<1.5	112	111	33-155	1
4-Bromophenyl phenyl ether	mg/kg (ppm)	0.83	<0.05	91	89	50-150	2
Hexachlorobenzene	mg/kg (ppm)	0.83	<0.05	91	89	50-150	2
Pentachlorophenol	mg/kg (ppm)	0.83	<0.25	101	102	15-159	1
Phenanthrene	mg/kg (ppm)	0.83	<0.01	86	85	10-170	1
Anthracene	mg/kg (ppm)	0.83	<0.01	85	85	37-139	0
Carbazole	mg/kg (ppm)	0.83	<0.05	83	82	50-150	1
Di-n-butyl phthalate	mg/kg (ppm)	0.83	<0.5	90	89	50-150	1
Fluoranthene	mg/kg (ppm)	0.83	<0.01	88	88	10-203	0
Benzidine	mg/kg (ppm)	1.3	<1	44	48	10-72	9
Pyrene	mg/kg (ppm)	0.83	<0.01	89	87	10-208	2
Benzyl butyl phthalate	mg/kg (ppm)	0.83	<0.5	93	92	50-150	1
3,3'-Dichlorobenzidine	mg/kg (ppm)	1.3	<0.5	76	74	10-119	3
Benz(a)anthracene	mg/kg (ppm)	0.83	<0.01	90	89	37-146	1
Chrysene	mg/kg (ppm)	0.83	<0.01	81	79	36-144	2
Bis(2-ethylhexyl) phthalate	mg/kg (ppm)	0.83	<0.8	93	94	50-150	1
Di-n-octyl phthalate	mg/kg (ppm)	0.83	<0.5	101	101	10-243	0
Benzo(a)pyrene	mg/kg (ppm)	0.83	<0.01	87	87	40-150	0
Benzo(b)fluoranthene	mg/kg (ppm)	0.83	<0.01	90	88	45-157	2
Benzo(k)fluoranthene	mg/kg (ppm)	0.83	<0.01	86	89	50-150	3
Indeno(1,2,3-cd)pyrene	mg/kg (ppm)	0.83	<0.01	110	102	24-145	8
Dibenz(a,h)anthracene	mg/kg (ppm)	0.83	<0.01	109	105	31-137	4
Benzo(g,h,i)perylene	mg/kg (ppm)	0.83	<0.01	102	98	14-141	4

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR SEMIVOLATILES BY EPA METHOD 8270E

Laboratory Code: Laboratory Control Sample 1/5

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Phenol	mg/kg (ppm)	0.83	85	57-113
Bis(2-chloroethyl) ether	mg/kg (ppm)	0.83	88	55-108
2-Chlorophenol	mg/kg (ppm)	0.83	88	60-104
1,3-Dichlorobenzene	mg/kg (ppm)	0.83	79	54-103
1,4-Dichlorobenzene	mg/kg (ppm)	0.83	81	54-102
1,2-Dichlorobenzene	mg/kg (ppm)	0.83	79	55-103
Benzyl alcohol	mg/kg (ppm)	4.2	80	36-147
2,2'-Oxybis(1-chloropropane)	mg/kg (ppm)	0.83	89	56-109
2-Methylphenol	mg/kg (ppm)	0.83	92	62-107
Hexachloroethane	mg/kg (ppm)	0.83	86	54-105
N-Nitroso-di-n-propylamine	mg/kg (ppm)	0.83	92	64-112
3-Methylphenol + 4-Methylphenol	mg/kg (ppm)	0.83	93	63-110
Nitrobenzene	mg/kg (ppm)	0.83	83	55-111
Isophorone	mg/kg (ppm)	0.83	89	52-127
2-Nitrophenol	mg/kg (ppm)	0.83	94	53-122
2,4-Dimethylphenol	mg/kg (ppm)	0.83	88	31-105
Benzoic acid	mg/kg (ppm)	2.5	72	38-99
Bis(2-chloroethoxy)methane	mg/kg (ppm)	0.83	86	63-112
2,4-Dichlorophenol	mg/kg (ppm)	0.83	86	62-112
1,2,4-Trichlorobenzene	mg/kg (ppm)	0.83	89	59-105
Naphthalene	mg/kg (ppm)	0.83	82	59-105
Hexachlorobutadiene	mg/kg (ppm)	0.83	72	54-108
4-Chloroaniline	mg/kg (ppm)	6.8	65	36-111
4-Chloro-3-methylphenol	mg/kg (ppm)	0.83	100	63-116
2-Methylnaphthalene	mg/kg (ppm)	0.83	80	62-108
1-Methylnaphthalene	mg/kg (ppm)	0.83	80	62-108
Hexachlorocyclopentadiene	mg/kg (ppm)	0.83	74	48-123
2,4,6-Trichlorophenol	mg/kg (ppm)	0.83	95	61-114
2,4,5-Trichlorophenol	mg/kg (ppm)	0.83	98	64-121
2-Chloronaphthalene	mg/kg (ppm)	0.83	84	62-112
2-Nitroaniline	mg/kg (ppm)	4.2	74	30-179
Dimethyl phthalate	mg/kg (ppm)	0.83	88	63-124
Acenaphthylene	mg/kg (ppm)	0.83	75	61-111
2,6-Dinitrotoluene	mg/kg (ppm)	0.83	88	63-131
3-Nitroaniline	mg/kg (ppm)	4.2	79	57-114
Acenaphthene	mg/kg (ppm)	0.83	72	61-110
2,4-Dinitrophenol	mg/kg (ppm)	1.7	99	51-143
Dibenzofuran	mg/kg (ppm)	0.83	81	65-118
2,4-Dinitrotoluene	mg/kg (ppm)	0.83	99	47-146
4-Nitrophenol	mg/kg (ppm)	1.7	99	63-127
Diethyl phthalate	mg/kg (ppm)	0.83	89	63-124
Fluorene	mg/kg (ppm)	0.83	80	62-114
4-Chlorophenyl phenyl ether	mg/kg (ppm)	0.83	93	61-116
N-Nitrosodiphenylamine	mg/kg (ppm)	0.83	86	64-116
4-Nitroaniline	mg/kg (ppm)	4.2	82	63-117
4,6-Dinitro-2-methylphenol	mg/kg (ppm)	0.83	113	59-152
4-Bromophenyl phenyl ether	mg/kg (ppm)	0.83	94	66-118
Hexachlorobenzene	mg/kg (ppm)	0.83	94	57-115
Pentachlorophenol	mg/kg (ppm)	0.83	113	56-130
Phenanthrene	mg/kg (ppm)	0.83	89	64-112
Anthracene	mg/kg (ppm)	0.83	87	63-111
Carbazole	mg/kg (ppm)	0.83	85	68-120
Di-n-butyl phthalate	mg/kg (ppm)	0.83	94	52-130
Fluoranthene	mg/kg (ppm)	0.83	91	66-115
Benzidine	mg/kg (ppm)	1.3	0	0-100
Pyrene	mg/kg (ppm)	0.83	90	65-112
Benzyl butyl phthalate	mg/kg (ppm)	0.83	92	56-131
3,3'-Dichlorobenzidine	mg/kg (ppm)	1.3	72	10-100
Benz(a)anthracene	mg/kg (ppm)	0.83	91	64-116
Chrysene	mg/kg (ppm)	0.83	81	66-119
Bis(2-ethylhexyl) phthalate	mg/kg (ppm)	0.83	90	30-165
Di-n-octyl phthalate	mg/kg (ppm)	0.83	99	44-140
Benzo(a)pyrene	mg/kg (ppm)	0.83	88	62-116
Benzo(b)fluoranthene	mg/kg (ppm)	0.83	92	61-118
Benzo(k)fluoranthene	mg/kg (ppm)	0.83	86	65-119
Indeno(1,2,3-cd)pyrene	mg/kg (ppm)	0.83	107	64-130
Dibenz(a,h)anthracene	mg/kg (ppm)	0.83	111	67-131
Benzo(g,h,i)perylene	mg/kg (ppm)	0.83	106	67-126

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR SEMIVOLATILES BY EPA METHOD 8270E

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Phenol	ug/L (ppb)	5	27	29	10-43	7
Bis(2-chloroethyl) ether	ug/L (ppb)	5	75	80	40-114	6
2-Chlorophenol	ug/L (ppb)	5	69	74	21-97	7
1,3-Dichlorobenzene	ug/L (ppb)	5	52	53	39-102	2
1,4-Dichlorobenzene	ug/L (ppb)	5	53	54	41-103	2
1,2-Dichlorobenzene	ug/L (ppb)	5	56	59	43-105	5
Benzyl alcohol	ug/L (ppb)	25	71	77	14-82	8
2,2'-Oxybis(1-chloropropane)	ug/L (ppb)	5	81	88	51-110	8
2-Methylphenol	ug/L (ppb)	5	64	71	19-77	10
Hexachloroethane	ug/L (ppb)	5	45	50	39-104	11
N-Nitroso-di-n-propylamine	ug/L (ppb)	5	84	93	58-117	10
3-Methylphenol + 4-Methylphenol	ug/L (ppb)	5	56	66	12-89	16
Nitrobenzene	ug/L (ppb)	5	78	82	52-111	5
Isophorone	ug/L (ppb)	5	90	93	62-117	3
2-Nitrophenol	ug/L (ppb)	5	69	77	41-117	11
2,4-Dimethylphenol	ug/L (ppb)	5	75	81	10-117	8
Benzoic acid	ug/L (ppb)	40	18	18	10-39	0
Bis(2-chloroethoxy)methane	ug/L (ppb)	5	80	88	56-111	10
2,4-Dichlorophenol	ug/L (ppb)	5	82	90	34-113	9
1,2,4-Trichlorobenzene	ug/L (ppb)	5	59	62	48-104	5
Naphthalene	ug/L (ppb)	5	69	74	50-104	7
Hexachlorobutadiene	ug/L (ppb)	5	46	48	40-107	4
4-Chloroaniline	ug/L (ppb)	25	93	99	34-125	6
4-Chloro-3-methylphenol	ug/L (ppb)	5	85	94	34-111	10
2-Methylnaphthalene	ug/L (ppb)	5	73	79	52-113	8
1-Methylnaphthalene	ug/L (ppb)	5	75	81	51-115	8
Hexachlorocyclopentadiene	ug/L (ppb)	5	47	48	34-126	2
2,4,6-Trichlorophenol	ug/L (ppb)	5	80	89	28-125	11
2,4,5-Trichlorophenol	ug/L (ppb)	5	88	96	39-120	9
2-Chloronaphthalene	ug/L (ppb)	5	73	79	57-130	8
2-Nitroaniline	ug/L (ppb)	25	90	97	51-146	7
Dimethyl phthalate	ug/L (ppb)	5	97	106	64-118	9
Acenaphthylene	ug/L (ppb)	5	82	88	60-114	7
2,6-Dinitrotoluene	ug/L (ppb)	5	87	92	66-121	6
3-Nitroaniline	ug/L (ppb)	25	89	92	42-134	3
Acenaphthene	ug/L (ppb)	5	79	85	57-110	7
2,4-Dinitrophenol	ug/L (ppb)	10	82	88	20-151	7
Dibenzofuran	ug/L (ppb)	5	84	90	52-116	7
2,4-Dinitrotoluene	ug/L (ppb)	5	97	103	55-127	6
4-Nitrophenol	ug/L (ppb)	10	31	32	10-58	3
Diethyl phthalate	ug/L (ppb)	5	102	108	63-118	6
Fluorene	ug/L (ppb)	5	88	94	61-115	7
4-Chlorophenyl phenyl ether	ug/L (ppb)	5	87	91	61-112	4
N-Nitrosodiphenylamine	ug/L (ppb)	5	95	97	60-123	2
4-Nitroaniline	ug/L (ppb)	25	94	99	42-150	5
4,6-Dinitro-2-methylphenol	ug/L (ppb)	5	90	99	13-152	10
4-Bromophenyl phenyl ether	ug/L (ppb)	5	86	90	63-123	5
Hexachlorobenzene	ug/L (ppb)	5	92	96	60-113	4
Pentachlorophenol	ug/L (ppb)	5	100	99	14-137	1
Phenanthrene	ug/L (ppb)	5	92	96	63-113	4
Anthracene	ug/L (ppb)	5	95	97	65-117	2
Carbazole	ug/L (ppb)	5	106	107	62-137	1
Di-n-butyl phthalate	ug/L (ppb)	5	103	108	36-137	5
Fluoranthene	ug/L (ppb)	5	104	105	68-121	1
Benzidine	ug/L (ppb)	7.5	25	25	10-103	0
Pyrene	ug/L (ppb)	5	97	99	62-133	2
Benzyl butyl phthalate	ug/L (ppb)	5	100	101	56-145	1
3,3'-Dichlorobenzidine	ug/L (ppb)	7.5	91	93	31-139	2
Benz(a)anthracene	ug/L (ppb)	5	102	103	66-131	1
Chrysene	ug/L (ppb)	5	101	104	66-129	3
Bis(2-ethylhexyl) phthalate	ug/L (ppb)	5	105	109	52-142	4
Di-n-octyl phthalate	ug/L (ppb)	5	112	114	36-151	2
Benzo(a)pyrene	ug/L (ppb)	5	106	108	66-129	2
Benzo(b)fluoranthene	ug/L (ppb)	5	103	105	55-144	2
Benzo(k)fluoranthene	ug/L (ppb)	5	106	107	58-139	1
Indeno(1,2,3-cd)pyrene	ug/L (ppb)	5	107	111	62-136	4
Dibenz(a,h)anthracene	ug/L (ppb)	5	105	110	55-146	5
Benzo(g,h,i)perylene	ug/L (ppb)	5	103	107	58-137	4

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 403326-04 (Duplicate)

end

Analyte	Reporting Units	Sample Result (Wet Wt)	Duplicate Result (Wet Wt)	RPD (Limit 20)
Benzene	mg/kg (ppm)	<0.02	<0.02	nm
Toluene	mg/kg (ppm)	<0.02	<0.02	nm
Ethylbenzene	mg/kg (ppm)	<0.02	<0.02	nm
Xylenes	mg/kg (ppm)	<0.06	<0.06	nm
Gasoline	mg/kg (ppm)	<5	<5	nm

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	mg/kg (ppm)	1.0	98	70-130
Toluene	mg/kg (ppm)	1.0	94	70-130
Ethylbenzene	mg/kg (ppm)	1.0	93	70-130
Xylenes	mg/kg (ppm)	3.0	93	70-130
Gasoline	mg/kg (ppm)	40	95	70-130

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 403441-01 (Duplicate)

end

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	110	70-130
Toluene	ug/L (ppb)	50	104	70-130
Ethylbenzene	ug/L (ppb)	50	106	70-130
Xylenes	ug/L (ppb)	150	93	70-130
Gasoline	ug/L (ppb)	1,000	100	70-130

QUALITY ASSURANCE RESULTS FROM THE ANALYSIS OF SOIL SAMPLES
FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: 403410-01 (Matrix Spike)

end

Analyte	Reporting Units	Spike Level	Sample Result (Wet Wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	mg/kg (ppm)	5,000	3,000	114	96	63-146	17

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Diesel Extended	mg/kg (ppm)	5,000	102	77-123

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: Laboratory Control Sample

end

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	2,500	92	88	72-139	4

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD MA-APH

Laboratory Code: 403425-01 1/5.7 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 30)
APH EC5-8 aliphatics	ug/m3	3,200	3,000	6
APH EC9-12 aliphatics	ug/m3	200	190	5
APH EC9-10 aromatics	ug/m3	<140	<140	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
APH EC5-8 aliphatics	ug/m3	67	104	70-130
APH EC9-12 aliphatics	ug/m3	67	121	70-130
APH EC9-10 aromatics	ug/m3	67	98	70-130

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: 403425-01 1/5.7 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 30)
Propene	ug/m3	4,800	4,800	0
Dichlorodifluoromethane	ug/m3	<5.6	<5.6	nm
Chloromethane	ug/m3	<21	<21	nm
F-114	ug/m3	<12	<12	nm
Vinyl chloride	ug/m3	<1.5	<1.5	nm
1,3-Butadiene	ug/m3	230	<0.25	nm
Butane	ug/m3	1,100	1,100	0
Bromomethane	ug/m3	<22	<22	nm
Chloroethane	ug/m3	<15	<15	nm
Vinyl bromide	ug/m3	<2.5	<2.5	nm
Ethanol	ug/m3	<43	<43	nm
Acrolein	ug/m3	<0.65	<0.65	nm
Pentane	ug/m3	300	300	0
Trichlorofluoromethane	ug/m3	<13	<13	nm
Acetone	ug/m3	55	51	8
2-Propanol	ug/m3	<49	<49	nm
1,1-Dichloroethene	ug/m3	<2.3	<2.3	nm
trans-1,2-Dichloroethene	ug/m3	<2.3	<2.3	nm
Methylene chloride	ug/m3	<200	<200	nm
t-Butyl alcohol (TBA)	ug/m3	<69	<69	nm
3-Chloropropene	ug/m3	<18	<18	nm
CFC-113	ug/m3	<8.7	<8.7	nm
Carbon disulfide	ug/m3	<36	<36	nm
Methyl t-butyl ether (MTBE)	ug/m3	<41	<41	nm
Vinyl acetate	ug/m3	<40	<40	nm
1,1-Dichloroethane	ug/m3	<2.3	<2.3	nm
cis-1,2-Dichloroethene	ug/m3	<2.3	<2.3	nm
Hexane	ug/m3	69	67	3
Chloroform	ug/m3	<0.28	<0.28	nm
Ethyl acetate	ug/m3	<41	<41	nm
Tetrahydrofuran	ug/m3	<3.4	<3.4	nm
2-Butanone (MEK)	ug/m3	<34	<34	nm
1,2-Dichloroethane (EDC)	ug/m3	<0.23	<0.23	nm
1,1,1-Trichloroethane	ug/m3	<3.1	<3.1	nm
Carbon tetrachloride	ug/m3	<1.8	<1.8	nm
Benzene	ug/m3	19	19	0
Cyclohexane	ug/m3	<39	<39	nm
1,2-Dichloropropane	ug/m3	<1.3	<1.3	nm
1,4-Dioxane	ug/m3	<2.1	<2.1	nm
2,2,4-Trimethylpentane	ug/m3	<27	<27	nm
Methyl methacrylate	ug/m3	<23	<23	nm
Heptane	ug/m3	<23	<23	nm
Bromodichloromethane	ug/m3	<0.38	<0.38	nm
Trichloroethene	ug/m3	<0.61	<0.61	nm
cis-1,3-Dichloropropene	ug/m3	<5.2	<5.2	nm
4-Methyl-2-pentanone	ug/m3	<47	<47	nm
trans-1,3-Dichloropropene	ug/m3	<2.6	<2.6	nm
Toluene	ug/m3	<43	<43	nm
1,1,2-Trichloroethane	ug/m3	<0.31	<0.31	nm
2-Hexanone	ug/m3	<23	<23	nm

Tetrachloroethene	ug/m3	<39	<39	nm
Dibromochloromethane	ug/m3	<0.49	<0.49	nm
1,2-Dibromoethane (EDB)	ug/m3	<0.44	<0.44	nm
Chlorobenzene	ug/m3	<2.6	<2.6	nm
Ethylbenzene	ug/m3	5.4	5.5	2
1,1,2,2-Tetrachloroethane	ug/m3	<0.78	<0.78	nm
Nonane	ug/m3	<30	<30	nm
Isopropylbenzene	ug/m3	<56	<56	nm
2-Chlorotoluene	ug/m3	<30	<30	nm
Propylbenzene	ug/m3	<28	<28	nm
4-Ethyltoluene	ug/m3	<28	<28	nm
m,p-Xylene	ug/m3	15	15	0
o-Xylene	ug/m3	4.7	4.8	2
Styrene	ug/m3	<4.9	<4.9	nm
Bromoform	ug/m3	<12	<12	nm
Benzyl chloride	ug/m3	<0.3	<0.3	nm
1,3,5-Trimethylbenzene	ug/m3	<28	<28	nm
1,2,4-Trimethylbenzene	ug/m3	<28	<28	nm
1,3-Dichlorobenzene	ug/m3	<3.4	<3.4	nm
1,4-Dichlorobenzene	ug/m3	<1.3	<1.3	nm
1,2-Dichlorobenzene	ug/m3	<3.4	<3.4	nm
1,2,4-Trichlorobenzene	ug/m3	<4.2	<4.2	nm
Naphthalene	ug/m3	<1.5	<1.5	nm
Hexachlorobutadiene	ug/m3	<1.2	<1.2	nm

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Propene	ug/m3	23	126	70-130
Dichlorodifluoromethane	ug/m3	67	113	70-130
Chloromethane	ug/m3	28	101	70-130
F-114	ug/m3	94	112	70-130
Vinyl chloride	ug/m3	35	117	70-130
1,3-Butadiene	ug/m3	30	102	70-130
Butane	ug/m3	32	107	70-130
Bromomethane	ug/m3	52	108	70-130
Chloroethane	ug/m3	36	111	70-130
Vinyl bromide	ug/m3	59	121	70-130
Ethanol	ug/m3	25	119	70-130
Acrolein	ug/m3	31	122	70-130
Pentane	ug/m3	40	108	70-130
Trichlorofluoromethane	ug/m3	76	108	70-130
Acetone	ug/m3	32	112	70-130
2-Propanol	ug/m3	33	101	70-130
1,1-Dichloroethene	ug/m3	54	113	70-130
trans-1,2-Dichloroethene	ug/m3	54	112	70-130
Methylene chloride	ug/m3	94	106	70-130
t-Butyl alcohol (TBA)	ug/m3	41	88	70-130
3-Chloropropene	ug/m3	42	96	70-130
CFC-113	ug/m3	100	114	70-130
Carbon disulfide	ug/m3	42	98	70-130
Methyl t-butyl ether (MTBE)	ug/m3	49	98	70-130
Vinyl acetate	ug/m3	48	100	70-130
1,1-Dichloroethane	ug/m3	55	116	70-130
cis-1,2-Dichloroethene	ug/m3	54	107	70-130
Hexane	ug/m3	48	85	70-130
Chloroform	ug/m3	66	115	70-130
Ethyl acetate	ug/m3	49	86	70-130
Tetrahydrofuran	ug/m3	40	98	70-130
2-Butanone (MEK)	ug/m3	40	104	70-130
1,2-Dichloroethane (EDC)	ug/m3	55	117	70-130
1,1,1-Trichloroethane	ug/m3	74	120	70-130
Carbon tetrachloride	ug/m3	85	113	70-130
Benzene	ug/m3	43	105	70-130
Cyclohexane	ug/m3	46	96	70-130
1,2-Dichloropropane	ug/m3	62	119	70-130
1,4-Dioxane	ug/m3	49	99	70-130
2,2,4-Trimethylpentane	ug/m3	63	103	70-130
Methyl methacrylate	ug/m3	55	111	70-130
Heptane	ug/m3	55	105	70-130
Bromodichloromethane	ug/m3	90	120	70-130
Trichloroethene	ug/m3	73	118	70-130
cis-1,3-Dichloropropene	ug/m3	61	114	70-130
4-Methyl-2-pentanone	ug/m3	55	104	70-130
trans-1,3-Dichloropropene	ug/m3	61	121	70-130
Toluene	ug/m3	51	110	70-130
1,1,2-Trichloroethane	ug/m3	74	120	70-130
2-Hexanone	ug/m3	55	96	70-130

Tetrachloroethene	ug/m3	92	117	70-130
Dibromochloromethane	ug/m3	120	116	70-130
1,2-Dibromoethane (EDB)	ug/m3	100	121	70-130
Chlorobenzene	ug/m3	62	107	70-130
Ethylbenzene	ug/m3	59	103	70-130
1,1,2,2-Tetrachloroethane	ug/m3	93	118	70-130
Nonane	ug/m3	71	108	70-130
Isopropylbenzene	ug/m3	66	109	70-130
2-Chlorotoluene	ug/m3	70	105	70-130
Propylbenzene	ug/m3	66	106	70-130
4-Ethyltoluene	ug/m3	66	98	70-130
m,p-Xylene	ug/m3	120	105	70-130
o-Xylene	ug/m3	59	109	70-130
Styrene	ug/m3	58	93	70-130
Bromoform	ug/m3	140	105	70-130
Benzyl chloride	ug/m3	70	161 vo	70-130
1,3,5-Trimethylbenzene	ug/m3	66	102	70-130
1,2,4-Trimethylbenzene	ug/m3	66	93	70-130
1,3-Dichlorobenzene	ug/m3	81	110	70-130
1,4-Dichlorobenzene	ug/m3	81	107	70-130
1,2-Dichlorobenzene	ug/m3	81	108	70-130
1,2,4-Trichlorobenzene	ug/m3	100	95	70-130
Naphthalene	ug/m3	71	95	70-130
Hexachlorobutadiene	ug/m3	140	107	70-130

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-17

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Dichlorodifluoromethane	ng/tube	50	70	70-130
Vinyl chloride	ng/tube	50	82	70-130
2-Propanol	ng/tube	250	111	70-130
1,1-Dichloroethene	ng/tube	50	99	70-130
Hexane	ng/tube	50	97	70-130
t-Butyl alcohol (TBA)	ng/tube	250	106	70-130
Methyl t-butyl ether (MTBE)	ng/tube	50	102	70-130
trans-1,2-Dichloroethene	ng/tube	50	99	70-130
1,1-Dichloroethane	ng/tube	50	99	70-130
2,2-Dichloropropane	ng/tube	50	101	70-130
cis-1,2-Dichloroethene	ng/tube	50	99	70-130
Chloroform	ng/tube	50	99	70-130
2-Butanone (MEK)	ng/tube	50	91	70-130
1,2-Dichloroethane (EDC)	ng/tube	50	99	70-130
1,1,1-Trichloroethane	ng/tube	50	100	70-130
1,1-Dichloropropene	ng/tube	50	99	70-130
Carbon tetrachloride	ng/tube	50	100	70-130
Benzene	ng/tube	50	94	70-130
Trichloroethene	ng/tube	50	102	70-130
1,2-Dichloropropane	ng/tube	50	100	70-130
Bromodichloromethane	ng/tube	50	99	70-130
Dibromomethane	ng/tube	50	99	70-130
4-Methyl-2-pentanone	ng/tube	50	101	70-130
cis-1,3-Dichloropropene	ng/tube	50	102	70-130
Toluene	ng/tube	50	100	70-130
trans-1,3-Dichloropropene	ng/tube	50	104	70-130
1,1,2-Trichloroethane	ng/tube	50	105	70-130
2-Hexanone	ng/tube	50	88	70-130
1,3-Dichloropropane	ng/tube	50	103	70-130
Tetrachloroethene	ng/tube	50	106	70-130
Dibromochloromethane	ng/tube	50	103	70-130
1,2-Dibromoethane (EDB)	ng/tube	50	104	70-130
Chlorobenzene	ng/tube	50	101	70-130
Ethylbenzene	ng/tube	50	102	70-130
1,1,1,2-Tetrachloroethane	ng/tube	50	101	70-130
m,p-Xylene	ng/tube	100	102	70-130
o-Xylene	ng/tube	50	102	70-130
Styrene	ng/tube	50	103	70-130
Isopropylbenzene	ng/tube	50	102	70-130
Bromoform	ng/tube	50	101	70-130
n-Propylbenzene	ng/tube	50	102	70-130
Bromobenzene	ng/tube	50	104	70-130
1,3,5-Trimethylbenzene	ng/tube	50	101	70-130
1,1,2,2-Tetrachloroethane	ng/tube	50	101	70-130
1,2,3-Trichloropropane	ng/tube	50	101	70-130
2-Chlorotoluene	ng/tube	50	105	70-130
4-Chlorotoluene	ng/tube	50	103	70-130
tert-Butylbenzene	ng/tube	50	103	70-130
1,2,4-Trimethylbenzene	ng/tube	50	92	70-130
sec-Butylbenzene	ng/tube	50	91	70-130

p-Isopropyltoluene	ng/tube	50	92	70-130
1,3-Dichlorobenzene	ng/tube	50	90	70-130
1,4-Dichlorobenzene	ng/tube	50	90	70-130
1,2-Dichlorobenzene	ng/tube	50	89	70-130
1,2-Dibromo-3-chloropropane	ng/tube	50	93	70-130
1,2,4-Trichlorobenzene	ng/tube	50	88	70-130
Hexachlorobutadiene	ng/tube	50	87	70-130
Naphthalene	ng/tube	50	91	70-130
1,2,3-Trichlorobenzene	ng/tube	50	89	70-130
2-Methylnaphthalene	ng/tube	50	107	70-130
1-Methylnaphthalene	ng/tube	50	107	70-130
Diesel Fuel Range	ng/tube	2,500	105	70-130
APH EC9-12 aliphatics	ng/tube	1,200	82	70-130
APH EC9-10 aromatics	ng/tube	1,000	111	70-130

ANALYTE	CATEGORY	MATRIX	MDL	RL	LOW LEVEL RL	UNIT	METHOD
Helium	AIR	Air	0.15	0.6	---	ug/m3	ASTMD1946
1,4-Dioxane	VOC SIM	Water	0.12	0.4	---	ug/L	EPA8260D SIM
1,4-Dioxane	VOC SIM	Soil	0.023	0.1	---	mg/kg	EPA8260D SIM
Aroclor 1221	PCB	Soil	0.00021	0.02	0.004	mg/kg	EPA8082
Aroclor 1232	PCB	Soil	0.00021	0.02	0.004	mg/kg	EPA8082
Aroclor 1016	PCB	Soil	0.00021	0.02	0.004	mg/kg	EPA8082
Aroclor 1242	PCB	Soil	0.00021	0.02	0.004	mg/kg	EPA8082
Aroclor 1248	PCB	Soil	0.00023	0.02	0.004	mg/kg	EPA8082
Aroclor 1254	PCB	Soil	0.00023	0.02	0.004	mg/kg	EPA8082
Aroclor 1260	PCB	Soil	0.00023	0.02	0.004	mg/kg	EPA8082
Aroclor 1262	PCB	Soil	0.00023	0.02	0.004	mg/kg	EPA8082
Aroclor 1268	PCB	Soil	0.00023	0.02	0.004	mg/kg	EPA8082
Aroclor 1221	PCB	Water	0.0054	0.1	0.01	ug/L	EPA8082
Aroclor 1232	PCB	Water	0.0054	0.1	0.01	ug/L	EPA8082
Aroclor 1016	PCB	Water	0.0054	0.1	0.01	ug/L	EPA8082
Aroclor 1242	PCB	Water	0.0054	0.1	0.01	ug/L	EPA8082
Aroclor 1248	PCB	Water	0.0059	0.1	0.01	ug/L	EPA8082
Aroclor 1254	PCB	Water	0.0059	0.1	0.01	ug/L	EPA8082
Aroclor 1260	PCB	Water	0.0059	0.1	0.01	ug/L	EPA8082
Aroclor 1262	PCB	Water	0.0059	0.1	0.01	ug/L	EPA8082
Aroclor 1268	PCB	Water	0.0059	0.1	0.01	ug/L	EPA8082
Aroclor 1221	PCB	Product	0.6	1	---	mg/kg	EPA8082
Aroclor 1232	PCB	Product	0.6	1	---	mg/kg	EPA8082
Aroclor 1016	PCB	Product	0.6	1	---	mg/kg	EPA8082
Aroclor 1242	PCB	Product	0.6	1	---	mg/kg	EPA8082
Aroclor 1248	PCB	Product	0.7	1	---	mg/kg	EPA8082
Aroclor 1254	PCB	Product	0.7	1	---	mg/kg	EPA8082
Aroclor 1260	PCB	Product	0.7	1	---	mg/kg	EPA8082
Aroclor 1262	PCB	Product	0.7	1	---	mg/kg	EPA8082
Aroclor 1268	PCB	Product	0.7	1	---	mg/kg	EPA8082
Aroclor 1221	PCB	Wipe	0.62	1	---	ug/wipe	EPA8082
Aroclor 1232	PCB	Wipe	0.62	1	---	ug/wipe	EPA8082
Aroclor 1016	PCB	Wipe	0.62	1	---	ug/wipe	EPA8082
Aroclor 1242	PCB	Wipe	0.62	1	---	ug/wipe	EPA8082
Aroclor 1248	PCB	Wipe	0.56	1	---	ug/wipe	EPA8082
Aroclor 1254	PCB	Wipe	0.56	1	---	ug/wipe	EPA8082
Aroclor 1260	PCB	Wipe	0.56	1	---	ug/wipe	EPA8082
Aroclor 1262	PCB	Wipe	0.56	1	---	ug/wipe	EPA8082
Aroclor 1268	PCB	Wipe	0.56	1	---	ug/wipe	EPA8082
4,4'-DDD	PEST	Soil	0.000015	0.01	0.0001	mg/kg	EPA8081
4,4'-DDE	PEST	Soil	0.000012	0.01	0.0001	mg/kg	EPA8081
4,4'-DDT	PEST	Soil	0.000028	0.01	0.0001	mg/kg	EPA8081
Aldrin	PEST	Soil	0.00001	0.01	0.0001	mg/kg	EPA8081
alpha-BHC	PEST	Soil	0.000012	0.01	0.0001	mg/kg	EPA8081
beta-BHC	PEST	Soil	0.000021	0.01	0.0001	mg/kg	EPA8081
cis-Chlordane	PEST	Soil	0.000012	0.01	0.0001	mg/kg	EPA8081
delta-BHC	PEST	Soil	0.00002	0.01	0.0001	mg/kg	EPA8081
Dieldrin	PEST	Soil	0.000015	0.01	0.0001	mg/kg	EPA8081
Endosulfan I	PEST	Soil	0.00001	0.01	0.0001	mg/kg	EPA8081
Endosulfan II	PEST	Soil	0.000014	0.01	0.0001	mg/kg	EPA8081
Endosulfan Sulfate	PEST	Soil	0.000012	0.01	0.0001	mg/kg	EPA8081
Endrin	PEST	Soil	0.000018	0.01	0.0001	mg/kg	EPA8081
Endrin Aldehyde	PEST	Soil	0.000026	0.01	0.0001	mg/kg	EPA8081
Endrin Ketone	PEST	Soil	0.000055	0.01	0.0001	mg/kg	EPA8081
gamma-BHC (Linc	PEST	Soil	9.5E-06	0.01	0.0001	mg/kg	EPA8081
Heptachlor	PEST	Soil	0.000017	0.01	0.0001	mg/kg	EPA8081
Heptachlor Epoxid	PEST	Soil	0.00001	0.01	0.0001	mg/kg	EPA8081
Methoxychlor	PEST	Soil	0.00004	0.01	0.0001	mg/kg	EPA8081
Toxaphene	PEST	Soil	0.014	1	0.1	mg/kg	EPA8081
trans-Chlordane	PEST	Soil	0.000013	0.01	0.0001	mg/kg	EPA8081
4,4'-DDD	PEST	Water	0.0012	0.1	0.005	ug/L	EPA8081
4,4'-DDE	PEST	Water	0.00072	0.1	0.005	ug/L	EPA8081
4,4'-DDT	PEST	Water	0.001	0.1	0.005	ug/L	EPA8081
Aldrin	PEST	Water	0.00052	0.1	0.005	ug/L	EPA8081
alpha-BHC	PEST	Water	0.00064	0.1	0.005	ug/L	EPA8081
beta-BHC	PEST	Water	0.00061	0.1	0.005	ug/L	EPA8081
cis-Chlordane	PEST	Water	0.0007	0.1	0.005	ug/L	EPA8081
delta-BHC	PEST	Water	0.00053	0.1	0.005	ug/L	EPA8081
Dieldrin	PEST	Water	0.00064	0.1	0.005	ug/L	EPA8081
Endosulfan I	PEST	Water	0.00067	0.1	0.005	ug/L	EPA8081
Endosulfan II	PEST	Water	0.00094	0.1	0.005	ug/L	EPA8081
Endosulfan Sulfate	PEST	Water	0.00083	0.1	0.005	ug/L	EPA8081
Endrin	PEST	Water	0.00063	0.1	0.005	ug/L	EPA8081
Endrin Aldehyde	PEST	Water	0.0011	0.1	0.005	ug/L	EPA8081

ACRONYMS

MDL-method detection limit
RL - reporting limit
ug - microgram
mg - milligram
kg - kilogram
L - liter
m3 - cubic meter

Endrin Ketone	PEST	Water	0.0027	0.1	0.005	ug/L	EPA8081
gamma-BHC (Linc	PEST	Water	0.00076	0.1	0.005	ug/L	EPA8081
Heptachlor	PEST	Water	0.0005	0.1	0.005	ug/L	EPA8081
Heptachlor Epoxid	PEST	Water	0.0008	0.1	0.005	ug/L	EPA8081
Methoxychlor	PEST	Water	0.0013	0.1	0.005	ug/L	EPA8081
Toxaphene	PEST	Water	0.044	1	0.1	ug/L	EPA8081
trans-Chlordane	PEST	Water	0.00048	0.1	0.005	ug/L	EPA8081
1,2-Dibromoethan	8011	Water	0.0098	0.01	---	ug/L	EPA8011
diesel	TPH	Soil	25	50	---	mg/kg	NWTPH-Dx
diesel extended	TPH	Soil	32	250	---	mg/kg	NWTPH-Dx
motor oil	TPH	Soil	37	250	---	mg/kg	NWTPH-Dx
diesel	TPH	Soil	5.4	---	10	mg/kg	NWTPH-Dx
motor oil	TPH	Soil	10	---	50	mg/kg	NWTPH-Dx
diesel	TPH	Water	27	100	---	ug/L	NWTPH-Dx
diesel extended	TPH	Water	110	250	---	ug/L	NWTPH-Dx
motor oil	TPH	Water	110	250	---	ug/L	NWTPH-Dx
gasoline	TPH	Soil	0.6	5	---	mg/kg	NWTPH-Gx
Stoddard	TPH	Soil	1.3	25	---	mg/kg	NWTPH-Gx
benzene	TPH	Soil	0.003	0.02	---	mg/kg	EPA8021
toluene	TPH	Soil	0.0046	0.02	---	mg/kg	EPA8021
ethylbenzene	TPH	Soil	0.0029	0.02	---	mg/kg	EPA8021
xylenes	TPH	Soil	0.0077	0.06	---	mg/kg	EPA8021
Stoddard	TPH	Water	7	500	---	ug/L	NWTPH-Gx
gasoline	TPH	Water	26	100	---	ug/L	NWTPH-Gx
benzene	TPH	Water	0.12	1	---	ug/L	EPA8021
toluene	TPH	Water	0.12	1	---	ug/L	EPA8021
ethylbenzene	TPH	Water	0.1	1	---	ug/L	EPA8021
xylenes	TPH	Water	0.29	3	---	ug/L	EPA8021
1,1,1-Trichloroetha	TO15	Air	0.043	0.55	---	ug/m3	EPATO15
1,1,2,2-Tetrachloro	TO15	Air	0.06	0.14	---	ug/m3	EPATO15
1,1,2-Trichloroetha	TO15	Air	0.047	0.055	---	ug/m3	EPATO15
1,1-Dichloroethane	TO15	Air	0.024	0.4	---	ug/m3	EPATO15
1,1-Dichloroethene	TO15	Air	0.044	0.4	---	ug/m3	EPATO15
1,2,4-Trichloroben	TO15	Air	0.53	0.74	---	ug/m3	EPATO15
1,2,4-Trimethylber	TO15	Air	1.6	4.9	---	ug/m3	EPATO15
1,2-Dibromoethan	TO15	Air	0.058	0.077	---	ug/m3	EPATO15
1,2-Dichlorobenze	TO15	Air	0.17	0.6	---	ug/m3	EPATO15
1,2-Dichloroethane	TO15	Air	0.024	0.04	---	ug/m3	EPATO15
1,2-Dichloropropa	TO15	Air	0.086	0.23	---	ug/m3	EPATO15
1,3,5-Trimethylber	TO15	Air	0.35	4.9	---	ug/m3	EPATO15
1,3-Butadiene	TO15	Air	0.024	0.044	---	ug/m3	EPATO15
1,3-Dichlorobenze	TO15	Air	0.22	0.6	---	ug/m3	EPATO15
1,4-Dichlorobenze	TO15	Air	0.15	0.23	---	ug/m3	EPATO15
1,4-Dioxane	TO15	Air	0.061	0.36	---	ug/m3	EPATO15
2,2,4-Trimethylper	TO15	Air	0.66	4.7	---	ug/m3	EPATO15
2-Butanone (MEK)	TO15	Air	1.1	5.9	---	ug/m3	EPATO15
2-Chlorotoluene	TO15	Air	1.2	5.2	---	ug/m3	EPATO15
2-Hexanone	TO15	Air	2.3	4.1	---	ug/m3	EPATO15
2-Propanol	TO15	Air	0.71	8.6	---	ug/m3	EPATO15
3-Chloropropene	TO15	Air	0.66	3.1	---	ug/m3	EPATO15
4-Ethyltoluene	TO15	Air	1.8	4.9	---	ug/m3	EPATO15
4-Methyl-2-pentan	TO15	Air	2.2	8.2	---	ug/m3	EPATO15
Acetone	TO15	Air	1.3	4.8	---	ug/m3	EPATO15
Acrolein	TO15	Air	0.1	0.11	---	ug/m3	EPATO15
Benzene	TO15	Air	0.038	0.32	---	ug/m3	EPATO15
Benzyl chloride	TO15	Air	0.032	0.052	---	ug/m3	EPATO15
Bromodichloromet	TO15	Air	0.064	0.067	---	ug/m3	EPATO15
Bromoform	TO15	Air	0.65	2.1	---	ug/m3	EPATO15
Bromomethane	TO15	Air	1.3	3.9	---	ug/m3	EPATO15
Butane	TO15	Air	0.48	4.8	---	ug/m3	EPATO15
Carbon disulfide	TO15	Air	0.96	6.2	---	ug/m3	EPATO15
Carbon tetrachlori	TO15	Air	0.04	0.31	---	ug/m3	EPATO15
CFC-113	TO15	Air	0.28	1.5	---	ug/m3	EPATO15
Chlorobenzene	TO15	Air	0.11	0.46	---	ug/m3	EPATO15
Chloroethane	TO15	Air	0.038	2.6	---	ug/m3	EPATO15
Chloroform	TO15	Air	0.037	0.049	---	ug/m3	EPATO15
Chloromethane	TO15	Air	0.072	3.7	---	ug/m3	EPATO15
cis-1,2-Dichloroeth	TO15	Air	0.02	0.4	---	ug/m3	EPATO15
cis-1,3-Dichloropro	TO15	Air	0.15	0.91	---	ug/m3	EPATO15
Cyclohexane	TO15	Air	0.76	6.9	---	ug/m3	EPATO15
Dibromochloromet	TO15	Air	0.076	0.085	---	ug/m3	EPATO15
Dichlorodifluorome	TO15	Air	0.14	0.99	---	ug/m3	EPATO15
Ethanol	TO15	Air	1.3	7.5	---	ug/m3	EPATO15
Ethyl acetate	TO15	Air	1.3	7.2	---	ug/m3	EPATO15
Ethylbenzene	TO15	Air	0.046	0.43	---	ug/m3	EPATO15
F-114	TO15	Air	0.32	2.1	---	ug/m3	EPATO15
Heptane	TO15	Air	0.6	4.1	---	ug/m3	EPATO15

Hexachlorobutadie	TO15	Air	0.092	0.21	---	ug/m3	EPATO15
Hexane	TO15	Air	0.92	3.5	---	ug/m3	EPATO15
Isopropylbenzene	TO15	Air	2	9.8	---	ug/m3	EPATO15
m,p-Xylene	TO15	Air	0.14	0.87	---	ug/m3	EPATO15
Methyl Methacryla	TO15	Air	1.3	4.1	---	ug/m3	EPATO15
Methyl t-butyl ethe	TO15	Air	0.7	7.2	---	ug/m3	EPATO15
Methylene chloride	TO15	Air	1.3	35	---	ug/m3	EPATO15
Naphthalene	TO15	Air	0.018	0.11	0.052	ug/m3	EPATO15
Nonane	TO15	Air	0.76	5.2	---	ug/m3	EPATO15
o-Xylene	TO15	Air	0.058	0.43	---	ug/m3	EPATO15
Pentane	TO15	Air	1.1	5.9	---	ug/m3	EPATO15
Propene	TO15	Air	0.2	1.2	---	ug/m3	EPATO15
Propylbenzene	TO15	Air	0.92	4.9	---	ug/m3	EPATO15
Styrene	TO15	Air	0.28	0.85	---	ug/m3	EPATO15
t-Butyl alcohol (TB	TO15	Air	0.33	12	---	ug/m3	EPATO15
Tetrachloroethene	TO15	Air	0.18	6.8	---	ug/m3	EPATO15
Tetrahydrofuran	TO15	Air	0.15	0.59	---	ug/m3	EPATO15
Toluene	TO15	Air	0.095	7.5	---	ug/m3	EPATO15
trans-1,2-Dichloro	TO15	Air	0.051	0.4	---	ug/m3	EPATO15
trans-1,3-Dichloro	TO15	Air	0.1	0.45	---	ug/m3	EPATO15
Trichloroethene	TO15	Air	0.051	0.11	---	ug/m3	EPATO15
Trichlorofluoromet	TO15	Air	0.21	2.2	---	ug/m3	EPATO15
Vinyl acetate	TO15	Air	0.91	7	---	ug/m3	EPATO15
Vinyl bromide	TO15	Air	0.034	0.44	---	ug/m3	EPATO15
Vinyl chloride	TO15	Air	0.012	0.26	---	ug/m3	EPATO15
Gasoline Range C	TO15	Air	30	330	---	ug/m3	EPATO15
1,2,4-Trichloroben	SVOC	Soil	0.0039	0.05	---	mg/kg	EPA8270E
1,2-Dichlorobenze	SVOC	Soil	0.0036	0.05	---	mg/kg	EPA8270E
1,2-Diphenylhydra	SVOC	Soil	0.0044	0.05	---	mg/kg	EPA8270E
1,3-Dichlorobenze	SVOC	Soil	0.0029	0.05	---	mg/kg	EPA8270E
1,4-Dichlorobenze	SVOC	Soil	0.003	0.05	---	mg/kg	EPA8270E
1-Methylnaphthale	SVOC	Soil	0.0003	0.01	---	mg/kg	EPA8270E
2,2'-Oxybis(1-chlo	SVOC	Soil	0.0031	0.05	---	mg/kg	EPA8270E
2,4,5-Trichlorophe	SVOC	Soil	0.013	0.5	---	mg/kg	EPA8270E
2,4,6-Trichlorophe	SVOC	Soil	0.015	0.5	---	mg/kg	EPA8270E
2,4-Dichlorophenc	SVOC	Soil	0.0061	0.5	---	mg/kg	EPA8270E
2,4-Dimethylphenc	SVOC	Soil	0.014	0.5	---	mg/kg	EPA8270E
2,4-Dinitrophenol	SVOC	Soil	0.016	1.5	---	mg/kg	EPA8270E
2,4-Dinitrotoluene	SVOC	Soil	0.0081	0.25	---	mg/kg	EPA8270E
2,6-Dinitrotoluene	SVOC	Soil	0.0069	0.25	---	mg/kg	EPA8270E
2-Chloronaphthale	SVOC	Soil	0.0016	0.05	---	mg/kg	EPA8270E
2-Chlorophenol	SVOC	Soil	0.012	0.5	---	mg/kg	EPA8270E
2-Methylnaphthale	SVOC	Soil	0.00039	0.01	---	mg/kg	EPA8270E
2-Methylphenol	SVOC	Soil	0.0082	0.5	---	mg/kg	EPA8270E
2-Nitroaniline	SVOC	Soil	0.015	0.25	---	mg/kg	EPA8270E
2-Nitrophenol	SVOC	Soil	0.027	0.5	---	mg/kg	EPA8270E
3,3'-Dichlorobenzi	SVOC	Soil	0.033	0.5	---	mg/kg	EPA8270E
3-Methylphenol +	SVOC	Soil	0.013	1	---	mg/kg	EPA8270E
3-Nitroaniline	SVOC	Soil	0.017	5	---	mg/kg	EPA8270E
4,6-Dinitro-2-meth	SVOC	Soil	0.017	1.5	---	mg/kg	EPA8270E
4-Bromophenyl ph	SVOC	Soil	0.0023	0.05	---	mg/kg	EPA8270E
4-Chloro-3-methyl	SVOC	Soil	0.018	0.5	---	mg/kg	EPA8270E
4-Chloroaniline	SVOC	Soil	0.21	5	---	mg/kg	EPA8270E
4-Chlorophenyl ph	SVOC	Soil	0.0028	0.05	---	mg/kg	EPA8270E
4-Nitroaniline	SVOC	Soil	0.024	5	---	mg/kg	EPA8270E
4-Nitrophenol	SVOC	Soil	0.011	1.5	---	mg/kg	EPA8270E
Acenaphthene	SVOC	Soil	0.00018	0.01	---	mg/kg	EPA8270E
Acenaphthylene	SVOC	Soil	0.00016	0.01	---	mg/kg	EPA8270E
Anthracene	SVOC	Soil	0.00014	0.01	---	mg/kg	EPA8270E
Benz(a)anthracen	SVOC	Soil	0.00023	0.01	---	mg/kg	EPA8270E
Benzo(a)pyrene	SVOC	Soil	0.00028	0.01	---	mg/kg	EPA8270E
Benzo(b)fluoranth	SVOC	Soil	0.00025	0.01	---	mg/kg	EPA8270E
Benzo(g,h,i)peryle	SVOC	Soil	0.0004	0.01	---	mg/kg	EPA8270E
Benzo(k)fluoranth	SVOC	Soil	0.00032	0.01	---	mg/kg	EPA8270E
Benzoic acid	SVOC	Soil	0.1	2.5	---	mg/kg	EPA8270E
Benzyl alcohol	SVOC	Soil	0.012	0.5	---	mg/kg	EPA8270E
Benzyl butyl phtha	SVOC	Soil	0.019	0.5	---	mg/kg	EPA8270E
Bis(2-chloroethoxy	SVOC	Soil	0.0027	0.05	---	mg/kg	EPA8270E
Bis(2-chloroethyl)	SVOC	Soil	0.0035	0.05	---	mg/kg	EPA8270E
Bis(2-ethylhexyl) p	SVOC	Soil	0.035	0.8	---	mg/kg	EPA8270E
Carbazole	SVOC	Soil	0.0019	0.05	---	mg/kg	EPA8270E
Chrysene	SVOC	Soil	0.00018	0.01	---	mg/kg	EPA8270E
Dibenzo(a,h)anthr	SVOC	Soil	0.00049	0.01	---	mg/kg	EPA8270E
Dibenzofuran	SVOC	Soil	0.0034	0.05	---	mg/kg	EPA8270E
Diethyl phthalate	SVOC	Soil	0.0051	0.5	---	mg/kg	EPA8270E
Dimethyl phthalate	SVOC	Soil	0.0053	0.5	---	mg/kg	EPA8270E
Di-n-butyl phthalat	SVOC	Soil	0.019	0.5	---	mg/kg	EPA8270E

Di-n-octyl phthalat	SVOC	Soil	0.019	0.5	---	mg/kg	EPA8270E
Fluoranthene	SVOC	Soil	0.00019	0.01	---	mg/kg	EPA8270E
Fluorene	SVOC	Soil	0.00014	0.01	---	mg/kg	EPA8270E
Hexachlorobenzer	SVOC	Soil	0.002	0.05	---	mg/kg	EPA8270E
Hexachlorobutadie	SVOC	Soil	0.0029	0.05	---	mg/kg	EPA8270E
Hexachlorocyclope	SVOC	Soil	0.0061	0.15	---	mg/kg	EPA8270E
Hexachloroethane	SVOC	Soil	0.0041	0.05	---	mg/kg	EPA8270E
Indeno(1,2,3-cd)py	SVOC	Soil	0.00026	0.01	---	mg/kg	EPA8270E
Isophorone	SVOC	Soil	0.0019	0.05	---	mg/kg	EPA8270E
Naphthalene	SVOC	Soil	0.0004	0.01	---	mg/kg	EPA8270E
Nitrobenzene	SVOC	Soil	0.0047	0.05	---	mg/kg	EPA8270E
N-Nitrosodimethyl	SVOC	Soil	0.0063	0.05	---	mg/kg	EPA8270E
N-Nitroso-di-n-pro	SVOC	Soil	0.003	0.05	---	mg/kg	EPA8270E
N-Nitrosodiphenyl	SVOC	Soil	0.0033	0.05	---	mg/kg	EPA8270E
Pentachloropheno	SVOC	Soil	0.0088	0.25	---	mg/kg	EPA8270E
Phenanthrene	SVOC	Soil	0.00018	0.01	---	mg/kg	EPA8270E
Phenol	SVOC	Soil	0.013	0.5	---	mg/kg	EPA8270E
Pyrene	SVOC	Soil	0.00016	0.01	---	mg/kg	EPA8270E
1,2,4-Trichloroben	SVOC	Water	0.051	0.2	---	ug/L	EPA8270E
1,2-Dichlorobenze	SVOC	Water	0.055	0.2	---	ug/L	EPA8270E
1,2-Diphenylhydra	SVOC	Water	0.028	0.2	---	ug/L	EPA8270E
1,3-Dichlorobenze	SVOC	Water	0.067	0.2	---	ug/L	EPA8270E
1,4-Dichlorobenze	SVOC	Water	0.065	0.2	---	ug/L	EPA8270E
1-Methylnaphthale	SVOC	Water	0.005	0.2	---	ug/L	EPA8270E
2,2'-Oxybis(1-chlo	SVOC	Water	0.046	0.2	---	ug/L	EPA8270E
2,2'-Oxybis(1-chlo	SVOC	Water	0.046	2	---	ug/L	EPA8270E
2,4,5-Trichlorophe	SVOC	Water	0.17	2	---	ug/L	EPA8270E
2,4,6-Trichlorophe	SVOC	Water	0.13	2	---	ug/L	EPA8270E
2,4-Dichlorophenc	SVOC	Water	0.12	2	---	ug/L	EPA8270E
2,4-Dimethylphenc	SVOC	Water	0.78	6	---	ug/L	EPA8270E
2,4-Dinitrophenol	SVOC	Water	2.6	1	---	ug/L	EPA8270E
2,4-Dinitrotoluene	SVOC	Water	0.067	1	---	ug/L	EPA8270E
2,6-Dinitrotoluene	SVOC	Water	0.072	0.2	---	ug/L	EPA8270E
2-Chloronaphthale	SVOC	Water	0.034	2	---	ug/L	EPA8270E
2-Chlorophenol	SVOC	Water	0.16	0.2	---	ug/L	EPA8270E
2-Methylnaphthale	SVOC	Water	0.0059	2	---	ug/L	EPA8270E
2-Methylphenol	SVOC	Water	0.19	1	---	ug/L	EPA8270E
2-Nitroaniline	SVOC	Water	0.35	2	---	ug/L	EPA8270E
2-Nitrophenol	SVOC	Water	0.25	2	---	ug/L	EPA8270E
3,3'-Dichlorobenzi	SVOC	Water	0.81	4	---	ug/L	EPA8270E
3-Methylphenol +	SVOC	Water	0.29	20	---	ug/L	EPA8270E
3-Nitroaniline	SVOC	Water	0.34	6	---	ug/L	EPA8270E
4,6-Dinitro-2-meth	SVOC	Water	0.16	0.2	---	ug/L	EPA8270E
4-Bromophenyl ph	SVOC	Water	0.035	2	---	ug/L	EPA8270E
4-Chloro-3-methyl	SVOC	Water	0.1	20	---	ug/L	EPA8270E
4-Chloroaniline	SVOC	Water	0.61	0.2	---	ug/L	EPA8270E
4-Chlorophenyl ph	SVOC	Water	0.03	20	---	ug/L	EPA8270E
4-Nitroaniline	SVOC	Water	0.88	6	---	ug/L	EPA8270E
4-Nitrophenol	SVOC	Water	0.52	0.02	---	ug/L	EPA8270E
Acenaphthene	SVOC	Water	0.0042	0.02	---	ug/L	EPA8270E
Acenaphthylene	SVOC	Water	0.0031	0.02	---	ug/L	EPA8270E
Anthracene	SVOC	Water	0.0049	0.02	---	ug/L	EPA8270E
Benz(a)anthracen	SVOC	Water	0.006	4	---	ug/L	EPA8270E
Benzo(a)pyrene	SVOC	Water	0.0089	0.02	---	ug/L	EPA8270E
Benzo(b)fluoranth	SVOC	Water	0.0054	0.02	---	ug/L	EPA8270E
Benzo(g,h,i)peryle	SVOC	Water	0.018	0.04	---	ug/L	EPA8270E
Benzo(k)fluoranth	SVOC	Water	0.0045	0.02	---	ug/L	EPA8270E
Benzoic acid	SVOC	Water	5.2	10	---	ug/L	EPA8270E
Benzyl alcohol	SVOC	Water	0.14	2	---	ug/L	EPA8270E
Benzyl butyl phtha	SVOC	Water	0.7	2	---	ug/L	EPA8270E
Bis(2-chloroethoxy	SVOC	Water	0.062	0.2	---	ug/L	EPA8270E
Bis(2-chloroethyl)	SVOC	Water	0.042	0.2	---	ug/L	EPA8270E
Bis(2-ethylhexyl) p	SVOC	Water	0.93	3.2	---	ug/L	EPA8270E
Carbazole	SVOC	Water	0.0034	0.02	---	ug/L	EPA8270E
Chrysene	SVOC	Water	0.0045	0.02	---	ug/L	EPA8270E
Dibenzo(a,h)anthr	SVOC	Water	0.013	0.02	---	ug/L	EPA8270E
Dibenzofuran	SVOC	Water	0.0052	0.02	---	ug/L	EPA8270E
Diethyl phthalate	SVOC	Water	0.11	2	---	ug/L	EPA8270E
Dimethyl phthalate	SVOC	Water	0.062	2	---	ug/L	EPA8270E
Di-n-butyl phthalat	SVOC	Water	0.51	2	---	ug/L	EPA8270E
Di-n-octyl phthalat	SVOC	Water	0.63	2	---	ug/L	EPA8270E
Fluoranthene	SVOC	Water	0.0045	0.02	---	ug/L	EPA8270E
Fluorene	SVOC	Water	0.0032	0.02	---	ug/L	EPA8270E
Hexachlorobenzer	SVOC	Water	0.039	0.2	---	ug/L	EPA8270E
Hexachlorobutadie	SVOC	Water	0.091	0.2	---	ug/L	EPA8270E
Hexachlorocyclope	SVOC	Water	0.11	0.6	---	ug/L	EPA8270E
Hexachloroethane	SVOC	Water	0.079	0.2	---	ug/L	EPA8270E

Indeno(1,2,3-cd)py	SVOC	Water	0.014	0.02	---	ug/L	EPA8270E
Isophorone	SVOC	Water	0.02	0.2	---	ug/L	EPA8270E
Naphthalene	SVOC	Water	0.0078	0.2	---	ug/L	EPA8270E
Nitrobenzene	SVOC	Water	0.075	0.2	---	ug/L	EPA8270E
N-Nitrosodimethyla	SVOC	Water	0.03	0.2	---	ug/L	EPA8270E
N-Nitroso-di-n-pro	SVOC	Water	0.052	0.2	---	ug/L	EPA8270E
N-Nitrosodiphenyla	SVOC	Water	0.021	0.2	---	ug/L	EPA8270E
Pentachloropheno	SVOC	Water	0.44	1	---	ug/L	EPA8270E
Phenanthrene	SVOC	Water	0.005	0.02	---	ug/L	EPA8270E
Phenol	SVOC	Water	0.061	2	---	ug/L	EPA8270E
Pyrene	SVOC	Water	0.0041	0.02	---	ug/L	EPA8270E
1,2,4-Trichloroben	SVOC	Soil	0.0039	---	0.01	mg/kg	EPA8270E
1,2-Dichlorobenze	SVOC	Soil	0.0036	---	0.01	mg/kg	EPA8270E
1,2-Diphenylhydra	SVOC	Soil	0.0044	---	0.01	mg/kg	EPA8270E
1,3-Dichlorobenze	SVOC	Soil	0.0029	---	0.01	mg/kg	EPA8270E
1,4-Dichlorobenze	SVOC	Soil	0.003	---	0.01	mg/kg	EPA8270E
1-Methylnaphthale	SVOC	Soil	0.0003	---	0.002	mg/kg	EPA8270E
2,2'-Oxybis(1-chlo	SVOC	Soil	0.0031	---	0.01	mg/kg	EPA8270E
2,4,5-Trichlorophe	SVOC	Soil	0.013	---	0.1	mg/kg	EPA8270E
2,4,6-Trichlorophe	SVOC	Soil	0.015	---	0.1	mg/kg	EPA8270E
2,4-Dichloropheno	SVOC	Soil	0.0061	---	0.1	mg/kg	EPA8270E
2,4-Dimethylpheno	SVOC	Soil	0.014	---	0.1	mg/kg	EPA8270E
2,4-Dinitrophenol	SVOC	Soil	0.016	---	0.3	mg/kg	EPA8270E
2,4-Dinitrotoluene	SVOC	Soil	0.0081	---	0.05	mg/kg	EPA8270E
2,6-Dinitrotoluene	SVOC	Soil	0.0069	---	0.05	mg/kg	EPA8270E
2-Chloronaphthale	SVOC	Soil	0.0016	---	0.01	mg/kg	EPA8270E
2-Chlorophenol	SVOC	Soil	0.012	---	0.1	mg/kg	EPA8270E
2-Methylnaphthale	SVOC	Soil	0.00039	---	0.002	mg/kg	EPA8270E
2-Methylphenol	SVOC	Soil	0.0082	---	0.1	mg/kg	EPA8270E
2-Nitroaniline	SVOC	Soil	0.015	---	0.05	mg/kg	EPA8270E
2-Nitrophenol	SVOC	Soil	0.027	---	0.1	mg/kg	EPA8270E
3,3'-Dichlorobenzi	SVOC	Soil	0.033	---	0.1	mg/kg	EPA8270E
3-Methylphenol + 4	SVOC	Soil	0.013	---	0.2	mg/kg	EPA8270E
3-Nitroaniline	SVOC	Soil	0.017	---	1	mg/kg	EPA8270E
4,6-Dinitro-2-meth	SVOC	Soil	0.017	---	0.3	mg/kg	EPA8270E
4-Bromophenyl ph	SVOC	Soil	0.0023	---	0.01	mg/kg	EPA8270E
4-Chloro-3-methyl	SVOC	Soil	0.018	---	0.1	mg/kg	EPA8270E
4-Chloroaniline	SVOC	Soil	0.21	---	1	mg/kg	EPA8270E
4-Chlorophenyl ph	SVOC	Soil	0.0028	---	0.01	mg/kg	EPA8270E
4-Nitroaniline	SVOC	Soil	0.024	---	1	mg/kg	EPA8270E
4-Nitrophenol	SVOC	Soil	0.011	---	0.3	mg/kg	EPA8270E
Acenaphthene	SVOC	Soil	0.00018	---	0.002	mg/kg	EPA8270E
Acenaphthylene	SVOC	Soil	0.00016	---	0.002	mg/kg	EPA8270E
Anthracene	SVOC	Soil	0.00014	---	0.002	mg/kg	EPA8270E
Benz(a)anthracen	SVOC	Soil	0.00023	---	0.002	mg/kg	EPA8270E
Benzo(a)pyrene	SVOC	Soil	0.00028	---	0.002	mg/kg	EPA8270E
Benzo(b)fluoranth	SVOC	Soil	0.00025	---	0.002	mg/kg	EPA8270E
Benzo(g,h,i)peryle	SVOC	Soil	0.0004	---	0.002	mg/kg	EPA8270E
Benzo(k)fluoranth	SVOC	Soil	0.00032	---	0.002	mg/kg	EPA8270E
Benzoic acid	SVOC	Soil	0.1	---	0.5	mg/kg	EPA8270E
Benzyl alcohol	SVOC	Soil	0.012	---	0.1	mg/kg	EPA8270E
Benzyl butyl phtha	SVOC	Soil	0.019	---	0.1	mg/kg	EPA8270E
Bis(2-chloroethoxy	SVOC	Soil	0.0027	---	0.01	mg/kg	EPA8270E
Bis(2-chloroethyl)	SVOC	Soil	0.0035	---	0.01	mg/kg	EPA8270E
Bis(2-ethylhexyl) p	SVOC	Soil	0.035	---	0.16	mg/kg	EPA8270E
Carbazole	SVOC	Soil	0.0019	---	0.01	mg/kg	EPA8270E
Chrysene	SVOC	Soil	0.00018	---	0.002	mg/kg	EPA8270E
Dibenzo(a,h)anthr	SVOC	Soil	0.00049	---	0.002	mg/kg	EPA8270E
Dibenzofuran	SVOC	Soil	0.0034	---	0.01	mg/kg	EPA8270E
Diethyl phthalate	SVOC	Soil	0.0051	---	0.1	mg/kg	EPA8270E
Dimethyl phthalate	SVOC	Soil	0.0053	---	0.1	mg/kg	EPA8270E
Di-n-butyl phthalat	SVOC	Soil	0.019	---	0.1	mg/kg	EPA8270E
Di-n-octyl phthalat	SVOC	Soil	0.019	---	0.1	mg/kg	EPA8270E
Fluoranthene	SVOC	Soil	0.00019	---	0.002	mg/kg	EPA8270E
Fluorene	SVOC	Soil	0.00014	---	0.002	mg/kg	EPA8270E
Hexachlorobenzer	SVOC	Soil	0.002	---	0.01	mg/kg	EPA8270E
Hexachlorobutadie	SVOC	Soil	0.0029	---	0.01	mg/kg	EPA8270E
Hexachlorocyclope	SVOC	Soil	0.0061	---	0.03	mg/kg	EPA8270E
Hexachloroethane	SVOC	Soil	0.0041	---	0.01	mg/kg	EPA8270E
Indeno(1,2,3-cd)py	SVOC	Soil	0.00026	---	0.002	mg/kg	EPA8270E
Isophorone	SVOC	Soil	0.0019	---	0.01	mg/kg	EPA8270E
Naphthalene	SVOC	Soil	0.0004	---	0.002	mg/kg	EPA8270E
Nitrobenzene	SVOC	Soil	0.0047	---	0.01	mg/kg	EPA8270E
N-Nitrosodimethyla	SVOC	Soil	0.0063	---	0.01	mg/kg	EPA8270E
N-Nitroso-di-n-pro	SVOC	Soil	0.003	---	0.01	mg/kg	EPA8270E
N-Nitrosodiphenyla	SVOC	Soil	0.0033	---	0.01	mg/kg	EPA8270E
Pentachloropheno	SVOC	Soil	0.0088	---	0.05	mg/kg	EPA8270E

Phenanthrene	SVOC	Soil	0.00018	---	0.002	mg/kg	EPA8270E
Phenol	SVOC	Soil	0.013	---	0.1	mg/kg	EPA8270E
Pyrene	SVOC	Soil	0.00016	---	0.002	mg/kg	EPA8270E
1,2,4-Trichloroben	SVOC	Water	0.028	---	0.2	ug/L	EPA8270E
1,2-Dichlorobenze	SVOC	Water	0.028	---	0.2	ug/L	EPA8270E
1,2-Diphenylhydra	SVOC	Water	0.014	---	0.2	ug/L	EPA8270E
1,3-Dichlorobenze	SVOC	Water	0.034	---	0.2	ug/L	EPA8270E
1,4-Dichlorobenze	SVOC	Water	0.033	---	0.2	ug/L	EPA8270E
1-Methylnaphthale	SVOC	Water	0.0025	---	0.2	ug/L	EPA8270E
2,2'-Oxybis(1-chlo	SVOC	Water	0.023	---	0.2	ug/L	EPA8270E
2,2'-Oxybis(1-chlo	SVOC	Water	0.023	---	2	ug/L	EPA8270E
2,4,5-Trichlorophe	SVOC	Water	0.085	---	2	ug/L	EPA8270E
2,4,6-Trichlorophe	SVOC	Water	0.065	---	2	ug/L	EPA8270E
2,4-Dichlorophenc	SVOC	Water	0.060	---	2	ug/L	EPA8270E
2,4-Dimethylphenc	SVOC	Water	0.39	---	6	ug/L	EPA8270E
2,4-Dinitrophenol	SVOC	Water	1.3	---	1	ug/L	EPA8270E
2,4-Dinitrotoluene	SVOC	Water	0.034	---	1	ug/L	EPA8270E
2,6-Dinitrotoluene	SVOC	Water	0.036	---	0.2	ug/L	EPA8270E
2-Chloronaphthale	SVOC	Water	0.017	---	2	ug/L	EPA8270E
2-Chlorophenol	SVOC	Water	0.080	---	0.2	ug/L	EPA8270E
2-Methylnaphthale	SVOC	Water	0.003	---	2	ug/L	EPA8270E
2-Methylphenol	SVOC	Water	0.095	---	1	ug/L	EPA8270E
2-Nitroaniline	SVOC	Water	0.175	---	2	ug/L	EPA8270E
2-Nitrophenol	SVOC	Water	0.125	---	2	ug/L	EPA8270E
3,3'-Dichlorobenzi	SVOC	Water	0.405	---	4	ug/L	EPA8270E
3-Methylphenol +	SVOC	Water	0.145	---	20	ug/L	EPA8270E
3-Nitroaniline	SVOC	Water	0.170	---	6	ug/L	EPA8270E
4,6-Dinitro-2-meth	SVOC	Water	0.080	---	0.2	ug/L	EPA8270E
4-Bromophenyl ph	SVOC	Water	0.0175	---	2	ug/L	EPA8270E
4-Chloro-3-methyl	SVOC	Water	0.050	---	20	ug/L	EPA8270E
4-Chloroaniline	SVOC	Water	0.305	---	0.2	ug/L	EPA8270E
4-Chlorophenyl ph	SVOC	Water	0.015	---	20	ug/L	EPA8270E
4-Nitroaniline	SVOC	Water	0.440	---	6	ug/L	EPA8270E
4-Nitrophenol	SVOC	Water	0.260	---	0.02	ug/L	EPA8270E
Acenaphthene	SVOC	Water	0.0021	---	0.02	ug/L	EPA8270E
Acenaphthylene	SVOC	Water	0.0016	---	0.02	ug/L	EPA8270E
Anthracene	SVOC	Water	0.0025	---	0.02	ug/L	EPA8270E
Benz(a)anthracen	SVOC	Water	0.0030	---	4	ug/L	EPA8270E
Benzo(a)pyrene	SVOC	Water	0.0045	---	0.02	ug/L	EPA8270E
Benzo(b)fluoranth	SVOC	Water	0.0027	---	0.02	ug/L	EPA8270E
Benzo(g,h,i)peryle	SVOC	Water	0.0090	---	0.04	ug/L	EPA8270E
Benzo(k)fluoranth	SVOC	Water	0.0023	---	0.02	ug/L	EPA8270E
Benzoic acid	SVOC	Water	2.6	---	10	ug/L	EPA8270E
Benzyl alcohol	SVOC	Water	0.070	---	2	ug/L	EPA8270E
Benzyl butyl phtha	SVOC	Water	0.350	---	2	ug/L	EPA8270E
Bis(2-chloroethox	SVOC	Water	0.031	---	0.2	ug/L	EPA8270E
Bis(2-chloroethyl)	SVOC	Water	0.021	---	0.2	ug/L	EPA8270E
Bis(2-ethylhexyl) p	SVOC	Water	0.465	---	3.2	ug/L	EPA8270E
Carbazole	SVOC	Water	0.0017	---	0.02	ug/L	EPA8270E
Chrysene	SVOC	Water	0.0023	---	0.02	ug/L	EPA8270E
Dibenzo(a,h)anthr	SVOC	Water	0.0065	---	0.02	ug/L	EPA8270E
Dibenzofuran	SVOC	Water	0.0026	---	0.02	ug/L	EPA8270E
Diethyl phthalate	SVOC	Water	0.055	---	2	ug/L	EPA8270E
Dimethyl phthalate	SVOC	Water	0.031	---	2	ug/L	EPA8270E
Di-n-butyl phthalat	SVOC	Water	0.255	---	2	ug/L	EPA8270E
Di-n-octyl phthalat	SVOC	Water	0.315	---	2	ug/L	EPA8270E
Fluoranthene	SVOC	Water	0.0023	---	0.02	ug/L	EPA8270E
Fluorene	SVOC	Water	0.0016	---	0.02	ug/L	EPA8270E
Hexachlorobenzer	SVOC	Water	0.0195	---	0.2	ug/L	EPA8270E
Hexachlorobutadie	SVOC	Water	0.0455	---	0.2	ug/L	EPA8270E
Hexachlorocyclope	SVOC	Water	0.0550	---	0.6	ug/L	EPA8270E
Hexachloroethane	SVOC	Water	0.0395	---	0.2	ug/L	EPA8270E
Indeno(1,2,3-cd)py	SVOC	Water	0.007	---	0.02	ug/L	EPA8270E
Isophorone	SVOC	Water	0.010	---	0.2	ug/L	EPA8270E
Naphthalene	SVOC	Water	0.0039	---	0.2	ug/L	EPA8270E
Nitrobenzene	SVOC	Water	0.0375	---	0.2	ug/L	EPA8270E
N-Nitrosodimethyl	SVOC	Water	0.015	---	0.2	ug/L	EPA8270E
N-Nitroso-di-n-pro	SVOC	Water	0.026	---	0.2	ug/L	EPA8270E
N-Nitrosodiphenyl	SVOC	Water	0.0105	---	0.2	ug/L	EPA8270E
Pentachloropheno	SVOC	Water	0.220	---	1	ug/L	EPA8270E
Phenanthrene	SVOC	Water	0.0025	---	0.02	ug/L	EPA8270E
Phenol	SVOC	Water	0.0305	---	2	ug/L	EPA8270E
Pyrene	SVOC	Water	0.0021	---	0.02	ug/L	EPA8270E
1,1,1,2-Tetrachlor	VOC	Soil	0.019	0.05	---	mg/kg	EPA8260D
1,1,1-Trichloroetha	VOC	Soil	0.0021	0.05	---	mg/kg	EPA8260D
1,1,2,2-Tetrachlor	VOC	Soil	0.016	0.05	---	mg/kg	EPA8260D
1,1,2-Trichloroetha	VOC	Soil	0.0056	0.05	---	mg/kg	EPA8260D

1,1-Dichloroethan	VOC	Soil	0.0011	0.05	---	mg/kg	EPA8260D
1,1-Dichloroethen	VOC	Soil	0.0011	0.05	---	mg/kg	EPA8260D
1,1-Dichloroprope	VOC	Soil	0.014	0.05	---	mg/kg	EPA8260D
1,2,3-Trichloroben	VOC	Soil	0.065	0.25	---	mg/kg	EPA8260D
1,2,3-Trichloropro	VOC	Soil	0.0019	0.05	---	mg/kg	EPA8260D
1,2,4-Trichloroben	VOC	Soil	0.0057	0.25	---	mg/kg	EPA8260D
1,2,4-Trimethylber	VOC	Soil	0.0053	0.05	---	mg/kg	EPA8260D
1,2-Dibromo-3-chl	VOC	Soil	0.12	0.5	---	mg/kg	EPA8260D
1,2-Dibromoethan	VOC	Soil	0.00087	0.05	---	mg/kg	EPA8260D
1,2-Dichlorobenze	VOC	Soil	0.0072	0.05	---	mg/kg	EPA8260D
1,2-Dichloroethan	VOC	Soil	0.0017	0.05	---	mg/kg	EPA8260D
1,2-Dichloropropa	VOC	Soil	0.011	0.05	---	mg/kg	EPA8260D
1,3,5-Trimethylber	VOC	Soil	0.0067	0.05	---	mg/kg	EPA8260D
1,3-Dichlorobenze	VOC	Soil	0.0045	0.05	---	mg/kg	EPA8260D
1,3-Dichloropropa	VOC	Soil	0.014	0.05	---	mg/kg	EPA8260D
1,4-Dichlorobenze	VOC	Soil	0.004	0.05	---	mg/kg	EPA8260D
2,2-Dichloropropa	VOC	Soil	0.014	0.05	---	mg/kg	EPA8260D
2-Butanone (MEK)	VOC	Soil	0.72	1	---	mg/kg	EPA8260D
2-Chlorotoluene	VOC	Soil	0.014	0.05	---	mg/kg	EPA8260D
2-Hexanone	VOC	Soil	0.43	0.5	---	mg/kg	EPA8260D
4-Chlorotoluene	VOC	Soil	0.01	0.05	---	mg/kg	EPA8260D
4-Methyl-2-pentan	VOC	Soil	0.38	1	---	mg/kg	EPA8260D
Acetone	VOC	Soil	0.87	5	---	mg/kg	EPA8260D
Benzene	VOC	Soil	0.00096	0.03	---	mg/kg	EPA8260D
Bromobenzene	VOC	Soil	0.017	0.05	---	mg/kg	EPA8260D
Bromodichloromet	VOC	Soil	0.014	0.05	---	mg/kg	EPA8260D
Bromoform	VOC	Soil	0.015	0.05	---	mg/kg	EPA8260D
Bromomethane	VOC	Soil	0.089	0.5	---	mg/kg	EPA8260D
Carbon tetrachlori	VOC	Soil	0.012	0.05	---	mg/kg	EPA8260D
Chlorobenzene	VOC	Soil	0.0063	0.05	---	mg/kg	EPA8260D
Chloroethane	VOC	Soil	0.056	0.5	---	mg/kg	EPA8260D
Chloroform	VOC	Soil	0.008	0.05	---	mg/kg	EPA8260D
Chloromethane	VOC	Soil	0.18	0.5	---	mg/kg	EPA8260D
cis-1,2-Dichloroetl	VOC	Soil	0.0013	0.05	---	mg/kg	EPA8260D
cis-1,3-Dichloropro	VOC	Soil	0.011	0.05	---	mg/kg	EPA8260D
Dibromochloromet	VOC	Soil	0.017	0.05	---	mg/kg	EPA8260D
Dibromomethane	VOC	Soil	0.024	0.05	---	mg/kg	EPA8260D
Dichlorodifluorome	VOC	Soil	0.021	0.5	---	mg/kg	EPA8260D
Ethylbenzene	VOC	Soil	0.0012	0.05	---	mg/kg	EPA8260D
Hexachlorobutadie	VOC	Soil	0.011	0.25	---	mg/kg	EPA8260D
Hexane	VOC	Soil	0.013	0.25	---	mg/kg	EPA8260D
Isopropylbenzene	VOC	Soil	0.0091	0.05	---	mg/kg	EPA8260D
m,p-Xylene	VOC	Soil	0.001	0.1	---	mg/kg	EPA8260D
Methyl t-butyl ethe	VOC	Soil	0.0011	0.05	---	mg/kg	EPA8260D
Methylene chloride	VOC	Soil	0.14	0.5	---	mg/kg	EPA8260D
Naphthalene	VOC	Soil	0.0063	0.05	---	mg/kg	EPA8260D
n-Propylbenzene	VOC	Soil	0.0045	0.05	---	mg/kg	EPA8260D
o-Xylene	VOC	Soil	0.00068	0.05	---	mg/kg	EPA8260D
p-Isopropyltoluene	VOC	Soil	0.0022	0.05	---	mg/kg	EPA8260D
sec-Butylbenzene	VOC	Soil	0.0048	0.05	---	mg/kg	EPA8260D
Styrene	VOC	Soil	0.0067	0.05	---	mg/kg	EPA8260D
tert-Butylbenzene	VOC	Soil	0.0092	0.05	---	mg/kg	EPA8260D
Tetrachloroethene	VOC	Soil	0.002	0.025	---	mg/kg	EPA8260D
Toluene	VOC	Soil	0.0011	0.05	---	mg/kg	EPA8260D
trans-1,2-Dichloro	VOC	Soil	0.0023	0.05	---	mg/kg	EPA8260D
trans-1,3-Dichloro	VOC	Soil	0.015	0.05	---	mg/kg	EPA8260D
Trichloroethene	VOC	Soil	0.0014	0.02	---	mg/kg	EPA8260D
Trichlorofluoromet	VOC	Soil	0.043	0.5	---	mg/kg	EPA8260D
Vinyl chloride	VOC	Soil	0.0019	0.05	---	mg/kg	EPA8260D
1,1,1,2-Tetrachlor	VOC	Soil	0.0095	---	0.05	mg/kg	EPA8260D
1,1,1-Trichloroetha	VOC	Soil	0.00105	---	0.002	mg/kg	EPA8260D
1,1,2,2-Tetrachlor	VOC	Soil	0.008	---	0.05	mg/kg	EPA8260D
1,1,2-Trichloroetha	VOC	Soil	0.0028	---	0.05	mg/kg	EPA8260D
1,1-Dichloroethan	VOC	Soil	0.00055	---	0.002	mg/kg	EPA8260D
1,1-Dichloroethen	VOC	Soil	0.00055	---	0.002	mg/kg	EPA8260D
1,1-Dichloroprope	VOC	Soil	0.007	---	0.05	mg/kg	EPA8260D
1,2,3-Trichloroben	VOC	Soil	0.0325	---	0.25	mg/kg	EPA8260D
1,2,3-Trichloropro	VOC	Soil	0.00095	---	0.05	mg/kg	EPA8260D
1,2,4-Trichloroben	VOC	Soil	0.00285	---	0.25	mg/kg	EPA8260D
1,2,4-Trimethylber	VOC	Soil	0.00265	---	0.05	mg/kg	EPA8260D
1,2-Dibromo-3-chl	VOC	Soil	0.06	---	0.5	mg/kg	EPA8260D
1,2-Dibromoethan	VOC	Soil	0.000435	---	0.005	mg/kg	EPA8260D
1,2-Dichlorobenze	VOC	Soil	0.0036	---	0.05	mg/kg	EPA8260D
1,2-Dichloroethan	VOC	Soil	0.00085	---	0.002	mg/kg	EPA8260D
1,2-Dichloropropa	VOC	Soil	0.0055	---	0.05	mg/kg	EPA8260D
1,3,5-Trimethylber	VOC	Soil	0.00335	---	0.05	mg/kg	EPA8260D
1,3-Dichlorobenze	VOC	Soil	0.00225	---	0.05	mg/kg	EPA8260D

1,3-Dichloropropa	VOC	Soil	0.007	---	0.05	mg/kg	EPA8260D
1,4-Dichlorobenze	VOC	Soil	0.002	---	0.05	mg/kg	EPA8260D
2,2-Dichloropropa	VOC	Soil	0.007	---	0.05	mg/kg	EPA8260D
2-Butanone (MEK	VOC	Soil	0.36	---	1	mg/kg	EPA8260D
2-Chlorotoluene	VOC	Soil	0.007	---	0.05	mg/kg	EPA8260D
2-Hexanone	VOC	Soil	0.215	---	0.5	mg/kg	EPA8260D
4-Chlorotoluene	VOC	Soil	0.005	---	0.05	mg/kg	EPA8260D
4-Methyl-2-pentan	VOC	Soil	0.19	---	1	mg/kg	EPA8260D
Acetone	VOC	Soil	0.435	---	5	mg/kg	EPA8260D
Benzene	VOC	Soil	0.00048	---	0.001	mg/kg	EPA8260D
Bromobenzene	VOC	Soil	0.0085	---	0.05	mg/kg	EPA8260D
Bromodichloromet	VOC	Soil	0.007	---	0.05	mg/kg	EPA8260D
Bromoform	VOC	Soil	0.0075	---	0.05	mg/kg	EPA8260D
Bromomethane	VOC	Soil	0.0445	---	0.5	mg/kg	EPA8260D
Carbon tetrachlori	VOC	Soil	0.006	---	0.05	mg/kg	EPA8260D
Chlorobenzene	VOC	Soil	0.00315	---	0.05	mg/kg	EPA8260D
Chloroethane	VOC	Soil	0.028	---	0.1	mg/kg	EPA8260D
Chloroform	VOC	Soil	0.004	---	0.05	mg/kg	EPA8260D
Chloromethane	VOC	Soil	0.09	---	0.5	mg/kg	EPA8260D
cis-1,2-Dichloroeth	VOC	Soil	0.00065	---	0.002	mg/kg	EPA8260D
cis-1,3-Dichloropro	VOC	Soil	0.0055	---	0.05	mg/kg	EPA8260D
Dibromochloromet	VOC	Soil	0.0085	---	0.05	mg/kg	EPA8260D
Dibromomethane	VOC	Soil	0.012	---	0.05	mg/kg	EPA8260D
Dichlorodifluorome	VOC	Soil	0.0105	---	0.5	mg/kg	EPA8260D
Ethylbenzene	VOC	Soil	0.0006	---	0.001	mg/kg	EPA8260D
Hexachlorobutadie	VOC	Soil	0.0055	---	0.25	mg/kg	EPA8260D
Hexane	VOC	Soil	0.0065	---	0.25	mg/kg	EPA8260D
Isopropylbenzene	VOC	Soil	0.00455	---	0.05	mg/kg	EPA8260D
m,p-Xylene	VOC	Soil	0.0005	---	0.002	mg/kg	EPA8260D
Methyl t-butyl ethe	VOC	Soil	0.00055	---	0.002	mg/kg	EPA8260D
Methylene chloride	VOC	Soil	0.07	---	0.2	mg/kg	EPA8260D
Naphthalene	VOC	Soil	0.00315	---	0.01	mg/kg	EPA8260D
n-Propylbenzene	VOC	Soil	0.00225	---	0.05	mg/kg	EPA8260D
o-Xylene	VOC	Soil	0.00034	---	0.001	mg/kg	EPA8260D
p-Isopropyltoluene	VOC	Soil	0.0011	---	0.05	mg/kg	EPA8260D
sec-Butylbenzene	VOC	Soil	0.0024	---	0.05	mg/kg	EPA8260D
Styrene	VOC	Soil	0.00335	---	0.05	mg/kg	EPA8260D
tert-Butylbenzene	VOC	Soil	0.0046	---	0.05	mg/kg	EPA8260D
Tetrachloroethene	VOC	Soil	0.001	---	0.002	mg/kg	EPA8260D
Toluene	VOC	Soil	0.00055	---	0.001	mg/kg	EPA8260D
trans-1,2-Dichloro	VOC	Soil	0.00115	---	0.002	mg/kg	EPA8260D
trans-1,3-Dichloro	VOC	Soil	0.0075	---	0.05	mg/kg	EPA8260D
Trichloroethene	VOC	Soil	0.0007	---	0.002	mg/kg	EPA8260D
Trichlorofluoromet	VOC	Soil	0.0215	---	0.5	mg/kg	EPA8260D
Vinyl chloride	VOC	Soil	0.00095	---	0.002	mg/kg	EPA8260D
1,1,1,2-Tetrachloro	VOC	Water	0.16	1	---	ug/L	EPA8260D
1,1,1-Trichloroetha	VOC	Water	0.017	1	---	ug/L	EPA8260D
1,1,2,2-Tetrachloro	VOC	Water	0.17	0.2	---	ug/L	EPA8260D
1,1,2-Trichloroetha	VOC	Water	0.084	0.5	---	ug/L	EPA8260D
1,1-Dichloroethane	VOC	Water	0.017	1	---	ug/L	EPA8260D
1,1-Dichloroethene	VOC	Water	0.021	1	---	ug/L	EPA8260D
1,1-Dichloroprope	VOC	Water	0.12	1	---	ug/L	EPA8260D
1,2,3-Trichloroben	VOC	Water	0.24	1	---	ug/L	EPA8260D
1,2,3-Trichloropro	VOC	Water	0.01	1	---	ug/L	EPA8260D
1,2,4-Trichloroben	VOC	Water	0.23	1	---	ug/L	EPA8260D
1,2,4-Trimethylben	VOC	Water	0.084	1	---	ug/L	EPA8260D
1,2-Dibromo-3-chl	VOC	Water	0.8	10	---	ug/L	EPA8260D
1,2-Dibromoethan	VOC	Water	0.0049	1	---	ug/L	EPA8260D
1,2-Dichlorobenze	VOC	Water	0.12	1	---	ug/L	EPA8260D
1,2-Dichloroethane	VOC	Water	0.037	0.2	---	ug/L	EPA8260D
1,2-Dichloropropa	VOC	Water	0.24	1	---	ug/L	EPA8260D
1,3,5-Trimethylben	VOC	Water	0.083	1	---	ug/L	EPA8260D
1,3-Dichlorobenze	VOC	Water	0.11	1	---	ug/L	EPA8260D
1,3-Dichloropropa	VOC	Water	0.12	1	---	ug/L	EPA8260D
1,4-Dichlorobenze	VOC	Water	0.13	1	---	ug/L	EPA8260D
2,2-Dichloropropa	VOC	Water	0.33	1	---	ug/L	EPA8260D
2-Butanone (MEK	VOC	Water	1.9	20	---	ug/L	EPA8260D
2-Chlorotoluene	VOC	Water	0.26	1	---	ug/L	EPA8260D
2-Hexanone	VOC	Water	3.7	10	---	ug/L	EPA8260D
4-Chlorotoluene	VOC	Water	0.098	1	---	ug/L	EPA8260D
4-Methyl-2-pentan	VOC	Water	3.4	10	---	ug/L	EPA8260D
Acetone	VOC	Water	2.9	50	---	ug/L	EPA8260D
Benzene	VOC	Water	0.019	0.35	---	ug/L	EPA8260D
Bromobenzene	VOC	Water	0.19	1	---	ug/L	EPA8260D
Bromodichloromet	VOC	Water	0.2	0.5	---	ug/L	EPA8260D
Bromoform	VOC	Water	0.17	5	---	ug/L	EPA8260D
Bromomethane	VOC	Water	2.1	5	---	ug/L	EPA8260D

Carbon tetrachlori	VOC	Water	0.16	0.5	---	ug/L	EPA8260D
Chlorobenzene	VOC	Water	0.1	1	---	ug/L	EPA8260D
Chloroethane	VOC	Water	0.05	1	---	ug/L	EPA8260D
Chloroform	VOC	Water	0.18	1	---	ug/L	EPA8260D
Chloromethane	VOC	Water	1.1	10	---	ug/L	EPA8260D
cis-1,2-Dichloroeth	VOC	Water	0.033	1	---	ug/L	EPA8260D
cis-1,3-Dichloropro	VOC	Water	0.15	0.4	---	ug/L	EPA8260D
Dibromochloromet	VOC	Water	0.21	0.5	---	ug/L	EPA8260D
Dibromomethane	VOC	Water	0.16	1	---	ug/L	EPA8260D
Dichlorodifluorome	VOC	Water	0.29	1	---	ug/L	EPA8260D
Ethylbenzene	VOC	Water	0.023	1	---	ug/L	EPA8260D
Hexachlorobutadie	VOC	Water	0.29	0.5	---	ug/L	EPA8260D
Hexane	VOC	Water	0.17	5	---	ug/L	EPA8260D
Isopropylbenzene	VOC	Water	0.057	1	---	ug/L	EPA8260D
m,p-Xylene	VOC	Water	0.044	2	---	ug/L	EPA8260D
Methyl t-butyl ethe	VOC	Water	0.014	1	---	ug/L	EPA8260D
Methylene chloride	VOC	Water	0.82	5	---	ug/L	EPA8260D
Naphthalene	VOC	Water	0.19	1	---	ug/L	EPA8260D
n-Propylbenzene	VOC	Water	0.1	1	---	ug/L	EPA8260D
o-Xylene	VOC	Water	0.023	1	---	ug/L	EPA8260D
p-Isopropyltoluene	VOC	Water	0.068	1	---	ug/L	EPA8260D
sec-Butylbenzene	VOC	Water	0.075	1	---	ug/L	EPA8260D
Styrene	VOC	Water	0.39	1	---	ug/L	EPA8260D
tert-Butylbenzene	VOC	Water	0.066	1	---	ug/L	EPA8260D
Tetrachloroethene	VOC	Water	0.043	1	---	ug/L	EPA8260D
Toluene	VOC	Water	0.062	1	---	ug/L	EPA8260D
trans-1,2-Dichloro	VOC	Water	0.046	1	---	ug/L	EPA8260D
trans-1,3-Dichloro	VOC	Water	0.12	0.4	---	ug/L	EPA8260D
Trichloroethene	VOC	Water	0.03	0.5	---	ug/L	EPA8260D
Trichlorofluoromet	VOC	Water	0.19	1	---	ug/L	EPA8260D
Vinyl chloride	VOC	Water	0.015	0.02	---	ug/L	EPA8260D
Calcium	METALS	Water	0.0087	0.05	---	mg/L	EPA200.8
Magnesium	METALS	Water	0.0097	0.05	---	mg/L	EPA200.8
Hardness (as CaC	METALS	Water	0.000062	0.35	---	mg/L	EPA200.8
Antimony	METALS	Soil	0.098	5	1	mg/kg	EPA6020/200.8
Arsenic	METALS	Soil	0.17	1	0.2	mg/kg	EPA6020/200.8
Barium	METALS	Soil	0.11	1	0.2	mg/kg	EPA6020/200.8
Beryllium	METALS	Soil	0.057	1	0.2	mg/kg	EPA6020/200.8
Cadmium	METALS	Soil	0.05	1	0.2	mg/kg	EPA6020/200.8
Chromium	METALS	Soil	0.52	5	1	mg/kg	EPA6020/200.8
Cobalt	METALS	Soil	0.028	1	0.2	mg/kg	EPA6020/200.8
Copper	METALS	Soil	0.1	5	1	mg/kg	EPA6020/200.8
Lead	METALS	Soil	0.032	1	0.2	mg/kg	EPA6020/200.8
Manganese	METALS	Soil	0.047	1	0.2	mg/kg	EPA6020/200.8
Mercury	METALS	Soil	0.033	1	0.2	mg/kg	EPA6020/200.8
Molybdenum	METALS	Soil	0.065	1	0.2	mg/kg	EPA6020/200.8
Nickel	METALS	Soil	0.093	1	0.2	mg/kg	EPA6020/200.8
Selenium	METALS	Soil	0.12	1	0.2	mg/kg	EPA6020/200.8
Silver	METALS	Soil	0.13	1	0.2	mg/kg	EPA6020/200.8
Thallium	METALS	Soil	0.031	1	0.2	mg/kg	EPA6020/200.8
Thorium	METALS	Soil	0.081	1	0.2	mg/kg	EPA6020/200.8
Uranium	METALS	Soil	0.083	1	0.2	mg/kg	EPA6020/200.8
Vanadium	METALS	Soil	0.49	5	1	mg/kg	EPA6020/200.8
Zinc	METALS	Soil	0.58	5	1	mg/kg	EPA6020/200.8
Antimony	METALS	Water	0.039	5	1	ug/L	EPA6020/200.8
Arsenic	METALS	Water	0.18	1	0.2	ug/L	EPA6020/200.8
Barium	METALS	Water	0.064	1	0.2	ug/L	EPA6020/200.8
Beryllium	METALS	Water	0.094	1	0.2	ug/L	EPA6020/200.8
Cadmium	METALS	Water	0.036	1	0.2	ug/L	EPA6020/200.8
Chromium	METALS	Water	0.079	1	0.2	ug/L	EPA6020/200.8
Cobalt	METALS	Water	0.037	1	0.2	ug/L	EPA6020/200.8
Copper	METALS	Water	0.48	5	1	ug/L	EPA6020/200.8
Iron	METALS	Water	6.3	50	---	ug/L	EPA6020/200.8
Lead	METALS	Water	0.064	1	0.2	ug/L	EPA6020/200.8
Manganese	METALS	Water	0.063	1	0.2	ug/L	EPA6020/200.8
Mercury	METALS	Water	0.037	1	0.2	ug/L	EPA6020/200.8
Molybdenum	METALS	Water	0.076	1	0.2	ug/L	EPA6020/200.8
Nickel	METALS	Water	0.11	1	0.2	ug/L	EPA6020/200.8
Selenium	METALS	Water	0.41	1	0.5	ug/L	EPA6020/200.8
Silver	METALS	Water	0.035	1	0.2	ug/L	EPA6020/200.8
Thallium	METALS	Water	0.018	1	0.2	ug/L	EPA6020/200.8
Vanadium	METALS	Water	0.058	5	1	ug/L	EPA6020/200.8
Zinc	METALS	Water	0.68	5	1	ug/L	EPA6020/200.8
Mercury (1631E)	METALS	Soil	0.0088	0.025	0.01	mg/kg	EPA1631E
Mercury (1631E)	METALS	Water	0.0008	0.01	0.0008	ug/L	EPA1631E
Total Suspended S	CONVENTIONAL	Water	1	5	1	mg/L	SM2540D
EC5-8 aliphatics	APH	Air	47	75	---	ug/m3	MA-APH

EC9-12 aliphatics APH	Air	2.5	25	---	ug/m3	MA-APH
EC9-10 aromatics APH	Air	2.5	25	---	ug/m3	MA-APH

Appendix B

Groundwater Monitoring Plan

Groundwater Monitoring Plan

Ephrata Landfill Interim Action

January 2025

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Groundwater Monitoring Plan

Ephrata Landfill Interim Action

January 2025

Document reference:

Contents

Tables

Figures

Appendices

1 Introduction

Mott MacDonald (formerly Pacific Groundwater Group (PGG)) has prepared this plan for groundwater well monitoring to be conducted at the Ephrata Landfill (site) in Grant County, Washington (Figure 1). This plan is a part of interim action work plan (IAWP) prepared for the treatment of groundwater and soil gas contaminated with volatile organic compounds (VOCs) and non-aqueous phase liquid (NAPL).

VOCs are the main groundwater contaminant of concern (COC) at the site and include chlorinated compounds and benzene, toluene, ethylbenzene, and xylene (BTEX). NAPL is present in the P1 shallow water-bearing zone below the former drum cache (herein referred to as the Drum Source Area). Arsenic and manganese are the metals of primary concern.

1.1 Monitoring Program Objectives

This groundwater monitoring plan is written to satisfy the interim action requirements in the Amendment No. 3 of the Agreed Order (AO) between the Grant County and Washington Department of Ecology (Ecology) that became effective on July 3, 2024. This groundwater monitoring plan also includes the sampling and analysis, quality assurance and quality control procedures.

Discussions between Ecology and representatives of Grant County Public Works concluded that performing the interim action will result in partial cleanup of the site prior to completing the Cleanup Action Plan. Based on those discussions, the objectives of this monitoring program include:

- Evaluate the multi-phase extraction (MPE) system performance and impacts on groundwater quality in the P1, P2, and Roza water bearing zones.
- Monitor groundwater quality in accordance with guidelines established in Washington Administrative Code (WAC) 173-340-820.
- Gather additional data to refine the natural attenuation analysis for the dissolved phase plume.

This work will be conducted consistent with WAC 173-340 (Model Toxics Control Act, MTCA), the AO, and its amendments.

1.2 Document Organization

The groundwater monitoring plan is organized into the following sections:

- Section 2 describes the groundwater monitoring program including monitoring well network, sampling schedule, groundwater analytical methods, sampling and analysis procedures and quality assurance and quality control (QA/QC).
- Section 3 describes reporting and data submittal requirements.

2 Groundwater Monitoring Program

The following sections describe the sampling schedule, field procedures, and data analysis procedures for groundwater monitoring at the Ephrata Landfill.

2.1 Monitoring Well Network

Current groundwater sampling at the site includes required quarterly monitoring of 16 wells in accordance with solid waste performance monitoring under WAC 173-351 and supplemental post-remedial investigation (RI) annual monitoring of 39 monitoring wells that was performed from 2022 through 2024. All routine quarterly and post-RI annual monitoring data is submitted to Ecology's Environmental Information Management System (EIM).

Groundwater monitoring under the IAWP will include sampling 23 groundwater monitoring wells listed in Table 1. The groundwater monitoring well locations are shown on Figures 1 and 2.

2.2 Monitoring Schedule

Groundwater monitoring will begin on a semi-annual basis after the existing MPE system restart, which is planned to occur on April 1, 2025. The first semi-annual groundwater monitoring event will commence after the P1 MPE restart. One semi-annual event will be conducted during the MPE system off season, and one semi-annual event will be conducted during the extraction season.

Semi-annual groundwater monitoring reports will be submitted within 60 days of the end of each extraction season and each off season.

2.3 Groundwater Analytical Program

Groundwater samples will be collected from groundwater monitoring wells listed in Table 1 and analyzed for all COCs and geochemical parameters listed in Table 2. In addition to the standard RI monitoring parameters, samples from P2 and Roza downgradient wells will also be analyzed for the listed natural attenuation parameters to support the evaluation of natural attenuation (Table 2).

2.4 Groundwater Sampling Procedures

This section describes the method and procedures for collecting groundwater samples at the site.

2.4.1 Static Water Level Measurements

Static water levels will be measured in each well prior to pumping using a decontaminated electronic well sounder. Water levels will be measured through dedicated sounding tubes in each well and measured from the top of the well plate. Depth to water will be measured and recorded in field notes to the nearest 0.01 foot.

In addition to collecting static water levels from sampled wells, static water levels will also be collected for gauging only from 21 monitoring wells in the P2 water bearing zone and the Roza aquifer listed in Table 1. If the well is fitted with the datalogging pressure transducer, the water level data will be downloaded from the equipment for synoptic water level use each groundwater monitoring event. Table 1 shows which wells are equipped with the transducers.

Well sounders will be decontaminated by scrubbing the length of the sounder that was submerged in the well with Liquinox or similar environmental soap diluted in distilled water. The same length of sounder will then be rinsed in distilled water.

2.4.2 Groundwater Pumping Procedures

All monitoring wells will be purged and sampled using low-flow methods in accordance with U.S. Environmental Protection Agency's (EPA) Low Stress (low flow) Standard Operating Procedures (USEPA 1996, 2017).

Wells will be pumped with reusable dedicated sampling pumps (Geotech Geosub 2 or similar) capable of flow rates from near zero to 3 gallons per minute with minimal lift. Grant County will attempt to equip each sampling well with dedicated Grundfos™ Redi-flo2 pump; however, this pump is currently limited for purchase due to supply chain shortage. The pumps will be located within the screened section of the well. Water will be purged at a pumping rate used during previous sampling events per each well. Otherwise, adjust pump speed until there is little or no water level drawdown. New tubing will be used at each well.

The reusable pumps will be decontaminated between each well by scrubbing the outside areas of pump and lead line with Liquinox or similar environmental soap diluted in distilled water. The pump will then be rinsed several times in distilled water and coiled back on spool.

Groundwater will be pumped into 55-gallon drums. When full, all pumped groundwater collected in the drums will be discharged into the lined evaporation pond at the northwest corner of the original landfill by submerging the sump pump into the 55-gallon drum and connect the garden hose to the evaporation pond.

Wells will be purged until select field parameters reach stabilization (see following section). Purge volume shall be measured with a graduated 5-gallon bucket. All field measurements will be recorded on field sampling forms (Appendix A).

The following section describes the sampling procedures in more detail.

2.4.3 Groundwater Sampling Procedures

The following steps will be followed for groundwater sampling:

1. Remove cap of the monitoring well.
2. Collect water level using clean sounder and record on field sampling form.
3. Calculate and record casing storage volume as a reference.
4. Estimate target pump rate based on qualitative well yields and record on field sampling form. If the static water level suggests there is little water in the well and the well has pumped dry in the past, then pumping well dry at a higher rate is acceptable.
5. Lower clean pump and tubing into well. Gently tag bottom of well with pump and then lift pump:
   - To mid-screen if expected yield is moderate to high and screen is fully submerged
   - 1-foot off bottom of well if qualitative well yield is low to very low (well will likely be purged dry) or to mid-point of the saturated portion of the screen if screen is less than 75% fully submerged.
6. Record pump depth on field sampling form.

7. Start the pump at low speed and slowly increase speed until discharge occurs before connecting it to the flow-through-cell. Determine the initial purge flow rate from the well using a graduated or suitable container of known volume and a stopwatch to time the rate of filling. Adjust pump rate until there is little or no water level drawdown. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made.

   The water level will be considered stable if water level drawdown is less than 0.3 feet. It should be noted that this goal may be difficult to achieve due to geologic heterogeneities within the screened interval and may require adjustments based on site-specific conditions (Puls and Barcelona 1996). In lower permeability units assume less than 2 feet over 3 consecutive measurements, but only if the volume of water in the casing above the pump intake is equal to or greater than the volume needed for all required samples.

   After the water level has stabilized, connect the flow-through cell to the pump discharge tube so that the sample goes into the bottom of the flow-through cell. Direct the discharge from the flow-through cell into a graduated bucket.

8. During purging, measure and record the following field parameters every few minutes. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 milliliters (mL) flow-through-cell with a flow rate of 50 mL/min, the monitoring frequency would be every five minutes).
   - Depth to water
   - Electrical conductivity (EC)
   - pH
   - Temperature
   - Dissolved oxygen (DO)
   - Redox potential
   - Color (visual)
   - Turbidity
   - Pump rate and purge water cumulative volume

Redox potential, DO, pH, and EC will be measured in a flow through cell with a multiprobe meter such as YSI® 556 Multiprobe System or similar. Turbidity will be measured using a separate instrument such as turbidity meter.

9. Purging is considered complete when the below indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:
   - pH measurements that do not vary by more than 0.1 pH units between readings.
   - Electrical Conductivity and Temperature do not indicate a trend (continuously increase or decrease between readings) and do not vary by more than three percent between readings.
   - Dissolved Oxygen and Redox Potential do not indicate a trend (continuously increase or decrease between readings) and do not vary by more than 10 percent and 10 millivolts (mV) between readings, respectively.

10. If the indicator field parameters listed above continually change in an upward or downward trend, purge until reasonable stability is achieved, then sample. If they change in an inconsistent way and no long-term trends exist, sampling may begin. Even at 0.5 gallons per minute, some wells may not achieve stable water levels because of low yield. In that case,

field personnel may choose to reduce the flow rate to a sustainable rate and follow these procedures or evacuate the well and sample as soon as the water level has recovered sufficiently.

11. Disconnect the flow-through cell once field indicator parameter measurements have stabilized and collect samples.

2.4.4 Groundwater Collection and Handling

The following steps will be followed for collection and handling of groundwater samples:

1. Collect samples of groundwater for analysis of parameters listed in Table 2. Collect samples in a manner that minimizes contact of the samples with air. Collect samples in the following order: volatile organic compounds, other organics, and then inorganic constituents. Do not change the pumping rate while sampling. Hands and clothing should be clean when sampling. Clean, disposable, latex gloves are to be worn when filling bottles. Follow individual sample container requirements for sample collection, handling, preservation, and shipment. Sample containers for volatile organic and alkalinity analyses should contain no bubbles (head space) after filling.

   Samples for total metals are not filtered, whereas samples for dissolved metals will be filtered in the field using a 0.45 micron in-line filter. The filtration shall be recorded on the sampling form, the metals bottle, and the chain of custody form. The example of the sampling form and chain of custody is included in Appendix A.
2. The following information shall be recorded on all containers, field data sheets, and sample chain of custody record:
   - Project name and number
   - Name of collector
   - Date and time of collection
   - Place of collection
   - The sample identification designation which shall be the well number
   - Analysis type (i.e. dissolved metals)
   - Presence of any preservative or filtration
3. Samples will be placed in a cooler with sufficient bagged ice or chemical ice to retain a temperature of 4 degrees Celsius or less for 24 hours.
4. Samples will be shipped to the laboratory in a sealed cooler accompanied by chain of custody forms. One chain of custody form will be used per laboratory shipment. Each cooler that is shipped will contain a copy of the chain of custody and have completed custody seals attached. Custody seals will consist of pre-printed stickers signed and dated by sampler after samples have been sealed in cooler for shipment. Seals will be placed on outside of each shipped cooler such that they will break if the cooler is tampered with or opened after leaving custody of samplers. Samples collected during the last sampling day may be hand delivered to the analytical lab.

2.5 Quality Assurance and Quality Control

Groundwater data will be reviewed for QA/QC upon receipt from the analytical laboratory. The purpose of the QA/QC review is to assess the suitability of the data for groundwater monitoring purposes. QA/QC review will follow USEPA Contract Laboratory Program (CLP) guidelines (USEPA 2008 and 2010). The following section summarizes the QA/QC objectives for groundwater data.

2.5.1 Groundwater Data Quality Objectives

Quality assurance objectives for groundwater data are usually expressed in terms of accuracy and precision. The groundwater data will be evaluated using the parameters discussed below. Definitions of these characteristics are as follows:

Accuracy. A sample spike is prepared by adding a known amount of a pure compound to the environmental sample (before extraction for extractables), and the compound is the same or similar (as in isotopically labeled compounds) as that being assayed for in the environmental sample. These spikes simulate the background interferences found in the actual samples. The calculated percent recovery of the spike is taken as a measure of the accuracy of the total analytical method. When there is no change in volume due to the spike, percent recovery is calculated as follows:

$$PR = \frac{(O - X) \times 100}{T}$$

Where:

PR = percent recovery

O = measured value of analyte concentration after addition of spike

X = measured value of analyte concentration in the sample before the spike is added

T = value of the spike

Tolerance limits for acceptable percent recovery established by the lab in accordance with CLP guidelines will be followed for this project. Sample spike recoveries that fall outside the tolerance limits must be assessed and the problem identified and corrected. The result for that analyte in the unspiked sample is suspect and may not be reported for regulatory compliance purposes.

Surrogate spikes are also a measure of accuracy. All samples are spiked with surrogate compounds prior to sample extraction. The sample itself may produce effects due to such factors as matrix interferences. Since these effects are frequently beyond the control of the laboratory, the evaluation and review of surrogate spike recovery data is subjective and based on analytical experience and professional judgment of the laboratory.

Precision. Aliquots are made in the laboratory of the same sample and each aliquot is treated exactly the same throughout the analytical method. The percent difference between the values of the laboratory duplicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$RPD = \frac{2(D_1 - D_2) \times 100}{(D_1 + D_2)}$$

Where:

RPD = relative percent difference

D1 = first sample value

D2 = second (duplicated) sample value

The tolerance limit for percent differences between laboratory duplicates will be +/- 20 percent. If the precision values are outside this limit, the laboratory should recheck the calculations and/or identify the problem. Reanalysis may be required. The result for that analyte in the unspiked sample is suspect and will be flagged when reported; it may not be viable for regulatory compliance purposes.

Representativeness. Representativeness is a qualitative term to evaluate how closely the measured results typify the environmental conditions. The sampling plan design, sampling techniques, and sample handling protocols are developed to ensure representative samples.

Comparability. Comparability is a qualitative term that expresses the confidence with which one data set can be compared with another. The use of standard techniques for sample collection and certified analytical laboratories for analyses will make the data comparable between sampling events.

Completeness. Completeness is the percentage of valid measurements collected out of the planned number of measurements. Results will be considered valid if all the precision and accuracy targets are met.

2.5.2 Laboratory Quality Control

All laboratory analyses will be completed by Analytical Resource, Inc (ARI) in Tukwila, Washington. ARI is an accredited laboratory in accordance with WAC 173-50. Target practical quantification limits (PQLs), or reporting limits, for relatively simple groundwater matrices will be sufficiently low to allow site data to be compared to the MTCA groundwater cleanup levels (WAC 173-340) for COCs as listed in Table 2. However, PQLs will vary between samples and analytical methods, therefore no guarantee can be made that all PQLs will be below all cleanup levels.

ARI will follow their standard QA protocol during analysis of groundwater samples. Appendix B contains ARI Quality Assurance Manual. ARI may subcontract to other accredited labs.

2.5.3 Laboratory Data Review

Analytical data will be evaluated by Mott MacDonald's project QA/QC manager with respect to the requirements of the project as specified herein. The manager will evaluate the data following Level III data-validation guidelines. These guidelines require the lab to report method blank, matrix spike and lab replicate results, but not raw data or instrument-calibration information. These guidelines are found in the CLP Guidelines.

2.6 Evaluation of Groundwater Sample Results

The groundwater chemistry analytical results from monitoring wells will be compared to state groundwater quality criteria, not background. The criteria will be either groundwater quality standards under WAC 173-200 or MTCA Method B criteria under WAC 173-340. Each groundwater monitoring event those wells and constituents above the groundwater quality criteria will be identified.

Groundwater quality for the site will continue to be compared to the groundwater cleanup level (GWCL) or MTCA Method B criteria until a cleanup standard and cleanup action plan has been established for the original landfill in accordance with MTCA (WAC 173-340). Future groundwater compliance monitoring and analysis for the original solid waste landfill will require discussion with Ecology and Grant County Department of Health.

3 Reporting

The results of groundwater monitoring activities will be documented semi-annually in the Groundwater Monitoring Report. The electronic copy of final semi-annual reports will be submitted to Ecology for review and approval. A hard copy of the report will be submitted at Ecology request. The Groundwater Monitoring Report will include the following:

- Summary tables of groundwater monitoring data for the sampling period;
- A brief summary of statistical results and/or statistical trends for the monitoring period
- A copy of potentiometric surface maps for each groundwater monitoring event that occurred during the monitoring period;
- A summary of groundwater flow rate and direction, including analysis of changes in flow rates or direction due to the MPE system operation;
- A summary of geochemical parameters, including cation-anion balances and trilinear diagrams, as appropriate; and,
- An update evaluation of system operation with respect to groundwater monitoring data; contaminant fate and transport; contaminant mass removal rates in groundwater; natural attenuation of indicator hazardous substances in groundwater; and/or exposure pathways, if applicable.

Groundwater data will be submitted after each semi-annual to Ecology's EIM database within 30 days of submitting the associated semi-annual groundwater monitoring report. Laboratory and field measurements will be imported after formal QA/QC of data.

4 References

Pacific Groundwater Group (PGG), 2007. Final Sampling Analysis and Quality Assurance Project Plan, Remedial Investigation (Task 3 and Task 4), Investigation of Source and Extent of Groundwater Contamination, Ephrata Landfill Corrective Action. August 2007.

Parametrix. 2018. Revised Agency Draft Ephrata Landfill Feasibility Study. Prepared or Grant County and City of Ephrata. March 2018.

Puls, R.W., and M.J. Barcelona, 1996. Low flow (minimal drawdown) ground water sampling procedures. USEPA/ORD EPA/ 540/S-95/504. Washington, DC: USEPA.

USEPA, 1996. Revised 2017. Low Stress (low flow) Purging and Sampling Procedure for Collecting Groundwater Samples from Monitoring Wells. EQASOP-GW4.

USEPA, 2020. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.

TABLES

Table 1. Groundwater Monitoring Well Network
Ephrata Landfill RI/FS

Sampling Wells			Wells for Water Level Measurement Only			
Source Area	Downgradient		Source Area		Downgradient	
The Hole	P2 Wells	Roza Wells	P2 Wells	Roza Wells	P2 Wells	Roza Wells
EW-1*	MW-39p2	MW-57b	MW-33p2	MW-78b	MW-46p2	MW-9b
	MW-40p2	MW-71b	MW-88p2	MW-81b*	MW-49p2	MW-7b*
	MW-124p2	MW-82b	MW-118p2	MW-89b	MW-52p2	MW-42b
	MW-125p2*	MW-133b		MW-128b	MW-60p2	MW-51b
	MW-136p2	MW-140b				
	MW-138p2*	MW-142b*				
	MW-141p2	MW-144b*				
	MW-143p2	MW-145b				
	MW-147p2	MW-146b				
		MW-148b*				
		MW-149b*				
		MW-150b				
		MW-151b				

Note:
* - These wells are fitted with transducers and the data will be downloaded each groundwater monitoring event for synoptic water levels.

MOTT MACDONALD

Table 2. Analytical Parameters, Methods, and Screening Levels
Ephrata Landfill RI/FS

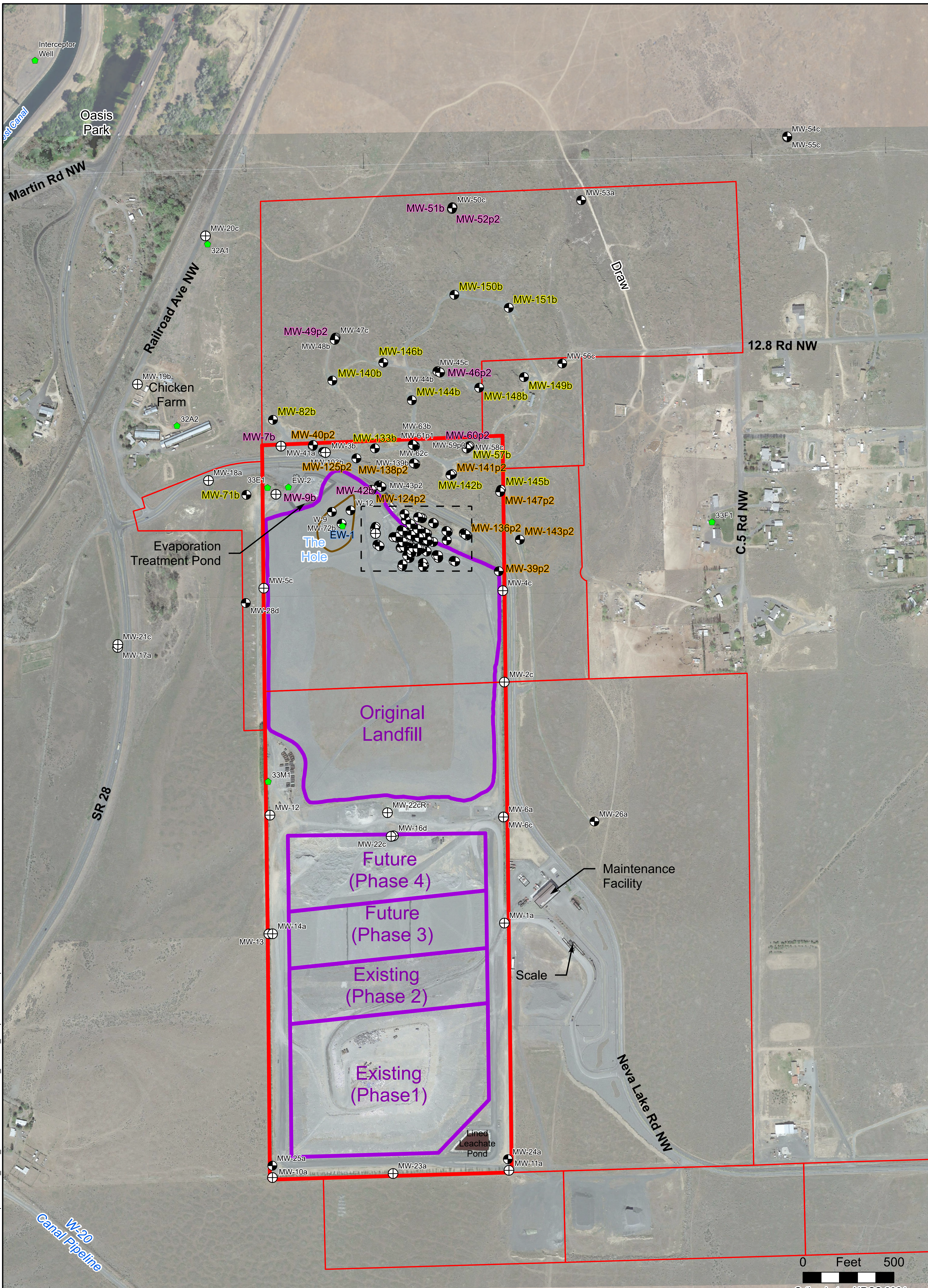
						MTCA Method B SFV (WAC 173-340)		WA Drinking Water Standards (WAC 246-290) Primary MCL
Parameter	Units	Analytical Method	ARI Standard Reporting Limit	Screening Level	Screening Level Source	MTCA B Cancer	MTCA B Non-Cancer	
Volatile Organic Compounds								
1,1,1,2-Tetrachloroethane	ug/L	SW8260D	0.2	1.7	MTCA-B C	1.68	240	
1,1,1-Trichloroethane	ug/L	SW8260D	0.2	200	MCL		16000	200
1,1,2,2-Tetrachloroethane	ug/L	SW8260D	0.2	0.22	MTCA-B C	0.22	160	
1,1,2-Trichloroethane	ug/L	SW8260D	0.2	0.77	MTCA-B C	0.77	32	5
1,1,2-Trichlorotrifluoroethane	ug/L	SW8260D	0.2	240,000	MTCA-B NC		240000	
1,1-Dichloroethane	ug/L	SW8260D	0.2	7.7	MTCA-B C	7.68	1600	
1,1-Dichloroethene	ug/L	SW8260D	0.2	7	MCL		400	7
1,1-Dichloropropene	ug/L	SW8260D	0.2					
1,2,3-Trichlorobenzene	ug/L	SW8260D	0.5					
1,2,3-Trichloropropane	ug/L	SW8260D	0.5	0.00038	MTCA-B C	0.00038	32	
1,2,4-Trichlorobenzene	ug/L	SW8260D	0.5	1.5	MTCA-B C	1.51	80	70
1,2,4-Trimethylbenzene	ug/L	SW8260D	0.2	80	MTCA-B NC		80	
1,2-Dibromo-3-chloropropane	ug/L	SW8260D	0.5	0.055	MTCA-B C	0.0547	1.6	0.2
1,2-Dibromoethane	ug/L	SW8260D	0.2	0.022	MTCA-B C	0.02188	72	0.05
1,2-Dichlorobenzene	ug/L	SW8260D	0.2	600	MCL		720	600
1,2-Dichloroethane (EDC)	ug/L	SW8260D	0.2	0.48	MTCA-B C	0.48	48	5
1,2-Dichloropropane	ug/L	SW8260D	0.2	1.2	MTCA-B C	1.22	720	5
1,3,5-Trimethylbenzene	ug/L	SW8260D	0.2	80	MTCA-B NC		80	
1,3-Dichlorobenzene	ug/L	SW8260D	0.2					
1,3-Dichloropropane	ug/L	SW8260D	0.2					
1,4-Dichlorobenzene	ug/L	SW8260D	0.2	8.1	MTCA-B C	8.1	560	75
1,4-Dioxane	ug/L	SW8260D SIM		0.44	MTCA-B C	0.44	240	
2,2-Dichloropropane	ug/L	SW8260D	0.2					
2-Butanone	ug/L	SW8260D	5	4,800	MTCA-B NC		4800	
2-Chloroethylvinylether	ug/L	SW8260D	1				0	
2-Chlorotoluene	ug/L	SW8260D	0.2	160	MTCA-B NC		160	
2-Hexanone	ug/L	SW8260D	5	40	MTCA-B NC		40	
4-Chlorotoluene	ug/L	SW8260D	0.2					
4-Isopropyltoluene	ug/L	SW8260D	0.2					
4-Methyl-2-Pentanone (MIBK)	ug/L	SW8260D	5	640	MTCA-B NC		640	
Acetone	ug/L	SW8260D	5	7,200	MTCA-B NC		7200	
Acrolein	ug/L	SW8260D	5	4	MTCA-B NC		4	
Acrylonitrile	ug/L	SW8260D	1	0.081	MTCA-B C	0.081	320	
Benzene	ug/L	SW8260D	0.2	0.8	MTCA-B C	0.8	32	5
Bromobenzene	ug/L	SW8260D	0.2	64	MTCA-B NC		64	
Bromochloromethane	ug/L	SW8260D	0.2					
Bromodichloromethane	ug/L	SW8260D	0.2	0.71	MTCA-B C	0.71	160	
Bromoethane	ug/L	SW8260D	0					
Bromoform	ug/L	SW8260D	0.2	5.5	MTCA-B C	5.5	160	
Bromomethane	ug/L	SW8260D	1	11	MTCA-B NC		11.2	
Carbon Disulfide	ug/L	SW8260D	0.2	800	MTCA-B NC		800	
Carbon Tetrachloride	ug/L	SW8260D	0.2	0.63	MTCA-B C	0.625	32	5
Chlorobenzene	ug/L	SW8260D	0.2	100	MCL		160	100
Chloroethane	ug/L	SW8260D	0.2					
Chloroform	ug/L	SW8260D	0.2	1.4	MTCA-B C	1.41	80	
Chloromethane	ug/L	SW8260D	0.5					
cis-1,2-Dichloroethene	ug/L	SW8260D	0.2	16	MTCA-B NC		16	70
cis-1,3-Dichloropropene	ug/L	SW8260D	0.2					
Dibromochloromethane	ug/L	SW8260D	0.2	0.52	MTCA-B C	0.52	160	
Dibromomethane	ug/L	SW8260D	0.2	80	MTCA-B NC		80	
Dichlorodifluoromethane (CFC 12)	ug/L	SW8260D	0.2	1600	MTCA-B NC		1600	
Ethylbenzene	ug/L	SW8260D	0.2	700	MCL		800	700
Hexachlorobutadiene	ug/L	SW8260D	0.5	0.56	MTCA-B C	0.56	8	
Iodomethane	ug/L	SW8260D	1					
Isopropylbenzene (Cumene)	ug/L	SW8260D	0.2	800	MTCA-B NC		800	
Methyl tert-Butyl Ether	ug/L	SW8260D	0.5	24	MTCA-B Carc	24		
Methylene Chloride	ug/l	SW8260D	1	5	MCL	21.88	48	5
Naphthalene	ug/L	SW8260D	0.5	160	MTCA-B NC		160	
n-Butylbenzene	ug/L	SW8260D	0.2	400	MTCA-B NC		400	
n-Propylbenzene	ug/L	SW8260D	0.2	800	MTCA-B NC		800	
o-Xylene	ug/L	SW8260D	0.2	1,600	MTCA-B NC		1600	
sec-Butylbenzene	ug/L	SW8260D	0.2	800	MTCA-B NC		800	
Styrene	ug/L	SW8260D	0.2	100	MCL		1600	100
tert-Butylbenzene	ug/L	SW8260D	0.2	800	MTCA-B NC		800	
Tetrachloroethene (PCE)	ug/L	SW8260D	0.2	5	MCL	20.83	48	5

Table 2. Analytical Parameters, Methods, and Screening Levels
Ephrata Landfill RI/FS

Parameter	Units	Analytical Method	ARI Standard Reporting Limit	Screening Level	Screening Level Source	MTCA Method B SFV (WAC 173-340)		WA Drinking Water Standards (WAC 246-290) Primary MCL
						MTCA B Cancer	MTCA B Non-Cancer	
Toluene	ug/L	SW8260D	0.2	640	MTCA-B NC		640	1000
Total Xylenes	ug/L	SW8260D	0.6	1,600	MTCA-B NC		1600	10000
trans-1,2-Dichloroethene	ug/L	SW8260D	0.2	100	MCL		160	100
trans-1,3-Dichloropropene	ug/L	SW8260D	0.2					
trans-1,4-Dichloro-2-butene	ug/L	SW8260D	1					
Trichloroethene (TCE)	ug/L	SW8260D	0.2	0.54	MTCA-B C	0.54	4	5
Trichlorofluoromethane	ug/L	SW8260D	0.2	2,400	MTCA-B NC		2400	
Vinyl Acetate	ug/L	SW8260D	0.2	8,000	MTCA-B NC		8000	
Vinyl Chloride	ug/L	SW8260D	0.2 (0.02 for SIM)	0.029	MTCA-B C	0.029	24	2
Xylene Isomers, M+P	ug/L	SW8260D	0.4	1,600	MTCA-B NC		1600	
Inorganic Parameters								
Chloride	mg/L	EPA 325.2	1					
Nitrate as Nitrogen	mg/L	EPA 353.2	0.01	10	MCL			10
Nitrate+Nitrite as Nitrogen	mg/L	EPA 353.2	0.01	10	MCL			10
Nitrite as Nitrogen	mg/L	EPA 353.2	0.01	1	MCL			1
Sulfate	mg/L	EPA 375.2	2					
Total Dissolved Solids	mg/L	EPA 160.1	5					
Metals*								
Arsenic, Dissolved	ug/L	E200.8	0.2	0.058	MTCA-B C	0.058	4.8	10
Arsenic, Total	ug/L	E200.8	0.2	0.058	MTCA-B C	0.058	4.8	10
Iron, Dissolved	ug/L	E200.8	20	11,000	MTCA-B NC		11000	
Iron, Total	ug/L	E200.8	20	11,000	MTCA-B NC		11000	
Manganese, Dissolved	ug/L	E200.8	0.5	750	MTCA-B NC		750	
Manganese, Total	ug/L	E200.8	0.5	750	MTCA-B NC		750	
Additional Parameters for Downgradient Wells Only (See Table 1 for Reference)								
Acetylene	ug/L	RSK175	1.06					
Ethane	ug/L	RSK175	1.23					
Ethene	ug/L	RSK175	1.14					
Methane	ug/L	RSK175	0.65					
Alkalinity (as CaCO3)	mg/L	SM2320B	1					
Bicarbonate (as CaCO3)	mg/L	SM2320B	1					
Carbonate (as CaCO3)	mg/L	SM2320B	1					
Hydroxide (as CaCO3)	mg/L	SM2320B	1					

Notes:
Vinyl chloride results quantified using method 8260 or 8260SIM.
*Arsenic naturally elevated above MTCA-B screening level (site-specific background defined as 14.7 ug/L in the revised FS; Parametrix 2018)
Blank Screening Level = no criteria
SFV: Standard formula value from Ecology CLARC database.
ARI: Analytical Resources Inc., an Ecology-accredited analytical laboratory.

FIGURES



K:\PONY\Ephrata\CA_2005_JE0511\GIS\AGP\AGP_RI\AGP_RI.aprx Site Map 1/27/2025

- Former Drum Cache Outline
- Landfill Extents
- Landfill Facility Boundary
- County Owned Parcels
- North End Source Area (See Figure 2)
- "The Hole"
- Remedial Investigation Monitoring Wells
- Solid Waste Monitoring Wells
- Other Well

Groundwater Monitoring Well Locations Per Aquifer:

- MW-124p2 - Well to be Sampled in P2 Zone
- MW-124b - Well to be Sampled in Roza Aquifer
- EW-1 - Well to be Sampled in The Hole
- MW-128b - Well for Water Level Measurement Only
- MW-42b - Other Well Labels

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Figure 1

Ephrata Landfill Site Map

Ephrata Landfill

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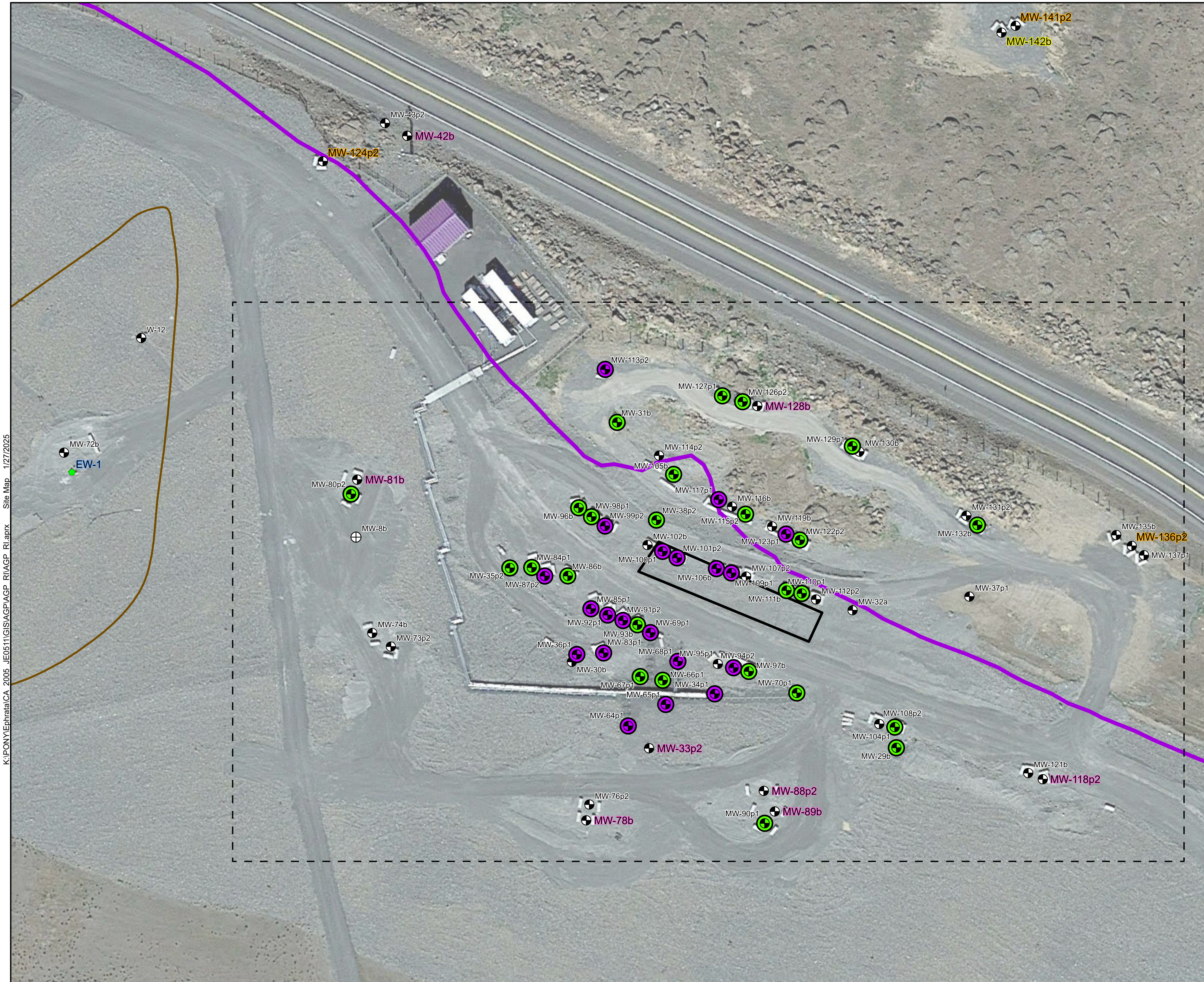

K:\PONY\EphrataICA_2005_JE0511\GIS\AGP\AGP_RI\AGP_RI.aprx Site Map 1/27/2025

- Remedial Investigation Monitoring Wells
- Solid Waste Monitoring Wells
- Other Well
- Expanded MPE Pilot Observation Wells
- Expanded MPE Pilot Testing Wells
- Former Drum Cache Outline
- "The Hole"
- County Owned Parcels
- Landfill Extents
- Landfill Facility Boundary
- North End Source Area

Groundwater Monitoring Well Locations Per Aquifer:

- MW-124p2 - Well to be Sampled in P2 Zone
- MW-124b - Well to be Sampled in Roza Aquifer
- EW-1 - Well to be Sampled in The Hole
- MW-128b - Well for Water Level Measurement Only
- MW-42b - Other Well Labels

Note:
Expanded MPE Pilot Testing and Observation Wells are not part of the groundwater monitoring well network and shown for reference. The *Ephrata Landfill Expanded MPE Pilot Test Sampling and Analysis Plan* describes data collection, groundwater sampling, and vapor sampling procedures for the full system pilot test (Parametrix, 2024).

0 Feet 100

N

Orthophoto: NRCS 2021

Figure 2
Groundwater Monitoring Well Locations in Drum Source Area

Ephrata Landfill

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APPENDICES

Appendix A: Chain of Custody and Field Sampling Form

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested:	Date:
ARI Client Company:	Phone:	Page: of
Client Contact:		No. of Coolers: Cooler Temps:
Client Project Name:		
Client Project #:	Samplers:	

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested								Notes/Comments

Comments/Special Instructions	Relinqushed by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name:	Printed Name:	Printed Name:	Printed Name:
	Company:	Company:	Company:	Company:
	Date & Time:	Date & Time:	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer. Sediment samples submitted under PSDDA/PSEP/SMS protocol will be stored frozen for up to one year and then discarded.

GROUNDWATER SAMPLING FIELD DATA SHEET

Well #: ___________________________

Sample #:_________________________

Project Number:________________ Date: ____________________

Project Name: ____ Location: ____________________

Project Address:____ Sampled By:____________________

Client Name: ____ Purged By: ____________________

Casing Diameter: 2"_______ 4"________ 6"________ Other ____________________

Depth to Water (feet):__________________________________ Purge Volume Measurement Method:______________________

Depth of Well (feet):__________________________________ Date Purged:____

Reference Point (surveyors notch, etc.):____________________ Purge Time (from/to):____________________________________

Day/Time Sampled:____________________________________ Water Level Probe Used:________________________________

Purge Volume Calculation: ($\pi r^2 h$)(7.48 gal/ft³)(3 casing volumes)

Purge Volume (gallons) for 2" = (0.49)(h); 4" = (1.96) (h); 6" = (4.41) (h)

Calculated Purge Volume (gallons):_____ Actual Purge Volume (gallons):___________

criteria: if stable params purge at least 1 casing volume, if not stable purge at least 3 casing volumes,
depth changes by less than 0.02 feet, pH changes by less than 0.1, and other parameters change by less than 10%

TIME (2400 hr)	DTW (ft)	Rate/Vol.) (gpm/gal)	pH (units)	EC (umhos/cm 25 c)	COLOR (visual)	TURBIDITY (NTU)	D.O. (mg/L)	ORP (mV)	TEMP. (Deg.C)

Purging Equipment:____________________________________ Sampling Equipment:__________________________________

Pump Placement:______________________________________ Flow cell Disconnected (Y/N):_____________________________

Laboratory:_ ARI Date Sent to Lab:____

Chain-of-Custody (yes/no):________ Yes Field CC Sample Number:______________________________

Shipment Method:_____________________________________ Split with (names/organizations):________________________

Well Integrity:________________________________ QA/QC Collected (Y/N) :__________________________________

QA/QC Sample Date and Time:______________________________

Quantity:	Container:	Preservatives:	Filtered (type):	Remarks:

Signature:__________________________________ Page_______ of_______

Appendix B: Analytical Resources Inc. Quality Assurance Manual

Analytical Resources, LLC. Quality Assurance Plan

Analytical Resources, LLC
Analytical Chemists and Consultants

Quality Assurance Plan

Analytical Resources, LLC
4611 S. 134th Place, Suite 100
Tukwila, WA 98168-3240

Revision 21.0
1/23/2023

Uncontrolled Copy
When Printed

This Quality Assurance Plan is approved and authorized for release by:

Mark Weidner, Laboratory Technical Director

Brian N. Bebee, Organic Analysis Section Technical Director

Casey English, Inorganic Analysis Section Technical Director

Bob Congleton, Quality Assurance Manager

Quality Assurance Plan

Analytical Resources, LLC

Table of Contents:

SECTION 1: INTRODUCTION

Quality Assurance Policy and Objectives

Analytical Resources, LLC (ARLLC) strives to consistently provide accurate, reproducible and legally defensible data that meets its client's expectations. ARLLC's management has developed the policies and procedures described in this document to accomplish this goal and will provide the resources necessary to ensure that they are implemented in a timely, cost-effective manner.

This Laboratory Quality Assurance Plan (LQAP) has been prepared to conform to requirements of:

1. ISO/IEC 17025

2. TNI Standard 2016 particularly Volume 1, Modules 1,2 and 4

3. Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.4, 2021.

The principal tenet of the Quality Assurance Program at Analytical Resources, LLC. (ARLLC) is that every employee knows she/he is a vital component of the program, and holds a responsibility to produce high-quality, defensible, reproducible data in a timely manner. While production of quality data is a global philosophy held by the entire laboratory, each individual is responsible for ensuring that the data they produce meets the required quality objectives outlined in this LQAP.

Document sections detail policies on data ethics, data confidentiality, individual staff responsibilities, building security, laboratory operations including data validation and review, data storage, sample containers, sample receipt and custody, corrective actions and laboratory evaluations.

Appendices include specifically defined Quality Assurance Policies, including

1. Corrections to benchsheets
2. How to line out unused portions of benchsheets
3. Stop Work Orders

4. Annual SOP reviews
5. Standard format for describing dilutions
6. Standardized SOP formats
7. Manual adjustments of data
8. Performance Testing Samples
9. Modifications to analytical methods, procedures or reports
10. Reporting of data from dual column instruments
11. How to calculation uncertainty
12. Rounding of numbers and reporting limits
13. Use of the “J”-flag
14. Calculation of holding times
15. Subcontracting samples

1.2 Ethics Policy on Data Quality and Confidentiality

To ensure uncompromised data quality and client confidentiality, ARLLC has established the following corporate ethics policy. The policy applies to all ARLLC employees at every organizational level.

General

ARLLC’s corporate commitment to integrity and honesty in the workplace is clearly stated in the ARLLC Employee’s Handbook, under “Standards of Conduct” which is attached as Appendix H. The ARLLC commitment to excellence in data quality extends to and includes all aspects of data production, review and reporting.

Any attempt by management or any employee to compromise this commitment presents a case for serious disciplinary action. Any indications or allegations of waste, fraud or abuse will be rigorously investigated by ARLLC management, with the penalties for verified cases to be employment termination, and if appropriate, prosecution. In addition to these steps, any such charges related to data generated for the federal government will also be reported to the Inspector General of the appropriate department.

Circumstances

All ARLLC employees will immediately report to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any associated components).

Misrepresentation of data includes (but is not limited to) the following:

- *Altering an instrument, computer or clock to falsify time or output*
- *Altering the content of a logbook or data sheet in order to misrepresent data*
- *Falsifying analyst identity*
- *Changing documents with correction fluid with the intent of falsifying information*
- *Preparing or submitting counterfeit data packages or reports*
- *Unauthorized release (either written or verbal) of confidential data*
- *Illegal calibration techniques (peak shaving, fraudulent integrator parameters)*
- *Any attempt to misrepresent data or events as they actually occur in the course of data production or reporting*

Responsibilities

It is the responsibility of all ARLLC employees to report any situation which may be adverse to data quality or confidentiality, or which may impact the final data quality. All ARLLC employees have the obligation to discuss known or suspected violations of this policy with laboratory management, who in turn are obliged to inform the ARLLC's Laboratory Director. If a satisfactory resolution is not obtained or is not possible at laboratory level, all ARLLC employees have the right and responsibility to discuss the matter directly with the Laboratory Director.

It is the responsibility of ARLLC's Laboratory Director to promptly investigate any reports of known or suspected violations. The ARLLC Laboratory Manager has the authority and responsibility to resolve all known or potential violations of the policy.

It is the responsibility of ARLLC management to provide all of its employees with the facilities, equipment, and training to achieve the quality goals stated in the policy.

Documentation

To reaffirm an awareness of and commitment to the highest standards of data quality, excellence, and integrity, all employees are required to sign the following "Commitment to Excellence in Data Quality" statement:

> "As an ARLLC employee, I have the right and responsibility to report any situation which may adversely affect quality, or which may impact the final quality or integrity of data produced for our clients."
>
> "I will report immediately to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any of its as sociated components). Examples of this include (but are not limited to): alteration of an instrument computer or clock, alteration of the contents of logbooks and/or data sheets in order to misrepresent data, misrepresentation of analyst identity, intentional falsification of documents with correction fluid ("white-out"), preparation and submittal of counterfeit data packages, use of illegal calibration techniques (peak shaving, use of fraudulent integrator parameters, etc.), or any attempt to misrepresent data or events as they actually occur in the course of an analysis."
>
> "I will likewise alert management of any situation or activity which may be averse to the confidentiality of clients' data."
>
> "I will not knowingly participate in any such activity, nor fail to report such activities of which I may become aware. I understand that any voluntary participation on my part in such activities may result in the termination of my employment, and possible legal prosecution."
>
> "Where circumstances permit, I will report any actual or suspected violations of this policy to my lab or section supervisor. If a satisfactory resolution is not obtained or is not possible at that level, I have the right and obligation to discuss the matter directly with the ARLLC Laboratory Manager."

Confidentiality

All information related to client projects, such as client work plans, documentation and analytical data will be considered proprietary and confidential. This information will be released only to the client or an authorized representative. Should an outside agency request information related to a client project, the client will be contacted for approval prior to releasing any information.

Some programs or contractual agreements (such as the USEPA Contract Laboratory Program) may have specific requirements for protecting a client's confidentiality. Project Managers will be responsible for strict control of access to any such confidential information or documentation. All company computers with access to data are password-protected.

SECTION 2.0: QA MANAGEMENT AND RESPONSIBILITIES

2.1 Overall Structure

ARLLC's laboratory management includes the Laboratory Director Chief, the Chief Operations Officer, Laboratory Technical Directors, the Client Service Manager and the Quality Manager. Key administrative personnel such as Laboratory Supervisors, the IT Manager and Project Managers support the management structure. ARLLC's organizational structure is outlined in Appendix A. Section 2.2 outlines management's roles and responsibilities.

The Board of Directors shall direct ARLLC′s QA Policy and shall determine the philosophy of the QA Program. It shall be the responsibility of management to translate this policy into practical procedures with respect to the business plan developed for ARLLC, and direct laboratory personnel regarding the incorporation of these procedures into daily laboratory activities.

Management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an efficient and effective laboratory operation and to communicate the importance of meeting customer, statutory, and regulatory requirements. Management ensures that the system documentation is known and available so that appropriate personnel aware of their responsibilities. When changes to the management system occur or are planned, management ensures that the integrity of the system is maintained.

Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

2.2 Hierarchical Responsibilities

Laboratory Director

The Laboratory Director shall interpret overall QA Policy based on the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and determine the broad practicality of policies based on methodologies, technological advances, and the current environmental market. It shall be the interpretation of these policies that will, in turn, direct the growth ARLLC, the addition or withdrawal of methods to ARLLC′s repertoire, and ARLLC′s marketing focus.

At a minimum of once a year, usually at the end of year summary, the Laboratory Director shall include on the agenda of the Board of Directors meeting a discussion of ARLLC′s QA Policy. This discussion will include the reputation of ARLLC for producing quality analyses, the effect of QA policies on turn-around time, competitive edge and cost-of-analysis, needs for stricter or more flexible policies, and the response of employees to the QA policies in place at that time.

At a minimum of once every quarter the Laboratory Director or Chief Operating Officer shall attend management meetings, which include on the agenda the subject 'QA Program'. This meeting will be included in the Steering Committee meeting schedule, which is held on a biweekly basis, and the last meeting of each quarter (calendar year) will include the quarterly QA report as the focus. The schedule and topics for Steering Committee meetings will be set at the beginning of each year and distributed to the members through calendar invitation. This format will allow for the dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. Management shall also use these meetings to discuss requirements of clients that are not met by ARLLC′s present QA Program, and the appropriate response to these requirements.

The Laboratory Director may be required to act as a technical advisor at any impromptu meetings called by management to address QA issues that cannot be immediately resolved within a laboratory section.

It shall also be the Laboratory Director's authority and responsibility to hold final review approval for all SOPs of ARLLC. Once an SOP has been updated and reviewed by the laboratory section, it shall go through the Section and Laboratory Managers for approval, and then to the LTD for final approval before the SOP is released.

The Technical Director of the Organics Division is the deputy Laboratory Technical Director. Whenever the Laboratory Director is absent for 15 or more consecutive days the Technical Director - Organics Division will temporarily assume her/his duties.

ARLLC’s primary accreditation bodies will be notified when the Laboratory Director will be absent for 35 consecutive days.

Chief Operating Officer

The Chief Operating Officer is responsible to coordinate Client Services and Information Technology activities to result in an integrated approach to quality data production. It shall be the Chief Operating Officer's responsibility to coordinate Client Services, Laboratory Management, and Information Technology Services, to ensure that QA Program requirements and data quality objectives are met.

The Chief Operating Officer plans and initiates periodic management meetings, at which the QA Program will be an agenda item. Management shall use these meetings to discuss requirements of clients that are not met by ARLLC′s present QA Program, the appropriate response to these requirements, and dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. The management meeting schedule is detailed under the Steering Committee definition. The Chief Operating Officer or designee is responsible for recording the minutes of the meeting.

It is the responsibility of the Chief Operating Officer, along with the QA Manager, Laboratory Director, Section Managers and Client Services, to establish testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

The Chief Operating Officer has the authority to direct Client Services to discontinue the bidding/contracting process for a new project, refuse samples, or to re-schedule projects based on Data Quality Objectives or current workload. The Chief Operating Officer also shall evaluate staffing and equipment needs based on information from the Section Managers and Client Services and may elect to meet new project requirements by increasing staffing levels or purchasing additional equipment.

The Chief Operating Officer serves as a senior-level technical reference for all laboratory activities, and as such will be brought in to advise on out-of-control events and trends, corrective actions, and/or other QA issues that require his/her expertise.

ARLLC’s Client Services Manager is the deputy Chief Operating Officer and will assume the Chief Operating Officer duties whenever the Chief Operating Officer is absent for more than seven consecutive days.

Laboratory Technical Directors- Organic Division and Inorganic Division

Laboratory Technical Directors shall have the final authority in decisions concerning implementation of QA policy in their laboratory sections. It is their expertise that will determine if testing activities meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and the needs of the client.

Laboratory Technical Directors are responsible for correcting out of control events within their respective laboratories. Laboratory Technical Directors and supervisors shall instruct employees in the proper employment of QA Policies.

Laboratory Technical Directors are responsible for completing or delegating updates of laboratory procedures and quality assurance manual sections as scheduled by the QA Manager. They will review and approve all laboratory Standard Operation Procedures.

The Laboratory Technical Directors are best able to determine capacity of the Laboratory Sections. To ensure that analyses are completed within required hold times, the Laboratory Technical Directors will give Supervisors the authority to balance employee workloads and modify employee work schedules. It is the Laboratory Technical Directors' responsibility to take reports from supervisors and work with the Laboratory Director to increase staffing levels or reject samples as needed. It is the Laboratory Technical Directors' responsibility to work with the Laboratory Director and section supervisors and analysts to ensure that sample capacity does not affect the quality of data generated from that laboratory section.

It is the responsibility of the Laboratory Technical Directors, along with the QA Manager, Laboratory Director, Chief Operating Officer, and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and which accreditation processes ARLLC will pursue. It is the responsibility of the Laboratory Technical Directors, with the Section Supervisors, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Laboratory Technical Directors will be responsible for reviewing training records of analysts produced by the Section Supervisor. Training shall be the responsibility of the Section Supervisor, but it is the responsibility of the Laboratory Technical Directors to oversee this training.

It is the Laboratory Technical Directors' responsibility to work with the Section Supervisor and Project Manager to ensure that Project Requirements are achievable and valid for the given methods. At times, ARLLC's clients have requests or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently performed by the laboratory, or 3) unachievable by the instrumentation used in the laboratory. It is the responsibility of the Laboratory Technical Directors, Section Supervisors and Project Manager to work with the client to resolve these issues before samples are accepted.

Clients may also request modifications to the methods that must be approved by the Section Supervisor, the Section Manager and the Quality Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and information technology (computer services), as needed for implementation.

The Laboratory Technical Directors are responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts or Section Supervisor.

The Laboratory Technical Directors have the authority to re-classify analysts or require additional training of analysts based on their performance.

The Laboratory Technical Directors have the responsibility of balancing client requests and requirements with the QA policies of ARLLC. It is the Laboratory Technical Directors' task to evaluate a client's Data Quality Objectives (submitted through Client Services), and with the Project Managers, Laboratory Supervisors and Quality Manager to determine the feasibility of laboratory performance. Feasibility will be based on the quality objectives requested, current QA Manual, present workload (in-house and scheduled/pending), the technology in place, and staffing levels available. Current workload in-house will be evaluated using reports from Information Technology, and scheduled/pending workload will be evaluated using written and verbal input from Client Services.

Deputies for the Organics and Inorganics Technical Directors are the Organics Extraction Laboratory Supervisor and the Metals Instrument Laboratory Supervisor respectively.

Laboratory Supervisor

To ensure that analyses are completed within required hold times, the Laboratory Supervisors have the authority to balance employee workloads and modify employee work schedules. The Laboratory Supervisors, with the input of the Laboratory Technical Director, have the authority to request overtime from employees should the workload warrant the additional effort, or to modify employee schedules to extend the operating hours of the laboratory section.

The Laboratory Supervisors shall oversee the day-to-day section operations, using LIMS printouts and verbal or written workload estimates and requests from Project Managers to adjust section efforts as needed. It is also the Laboratory Supervisors responsibility to inform management, when capacities are limited, so that the appropriate adjustments can be made to reduce workloads or increase laboratory capacities. At no time should sample capacity be allowed to affect the quality of data generated from any laboratory section.

It is the Laboratory Supervisors responsibility to ensure that employees have the proper training for their positions. This training will include training in the methods, use of the LIMS system if applicable, training in correct documentation procedures, and all information necessary for adherence to the ARLLC QA Program. The Laboratory Supervisors shall either perform the training personally or designate the trainer for given methods or procedures. It is the Laboratory Supervisor's responsibility to test each employee for each method or procedure, and to thoroughly document each employee's advances and current capabilities. The Laboratory Supervisors shall have the authority to require further training or supervision for any employee and shall be the authority to approve each employee for working without supervision. All employee training records are maintained in the SharePoint *Employee Records* library.

It is the Laboratory Supervisors responsibility to work with the Laboratory Technical Director and Project Manager to ensure that project requirements are achievable and valid for the given methods. At times clients have requests and/or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently part of the method as performed by the laboratory, or 3) unachievable by the instruments used in the laboratory. It is the responsibility of the Laboratory Supervisors, Laboratory Technical Director and Project Manager to work with the client to resolve these issues before samples are accepted.

It is the responsibility of the Laboratory Supervisors to ensure that each analyst reads and understands all requirements submitted with each sample set, including those for any special analyte, calibration, or data deliverable. It is the Laboratory Supervisors responsibility to clarify any issues, with the input of the Laboratory Technical Director and the Project Manager for the client.

Clients also at times will request modifications to methods, which must be approved by the Laboratory Supervisors and Laboratory Technical Director. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and IT personnel (computer services) as needed for implementation.

It is the Laboratory Supervisors responsibility to ensure that each employee understands the requirements of all projects they work with. This may necessitate section meetings or project-specific cross-section teams to work with Project Managers for large, specialty projects to ensure that everyone has the same understanding of project requirements.

The Laboratory Supervisors is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts, and for ensuring that the analysts complete all documentation. If the Laboratory Supervisors and laboratory section analysts cannot resolve the issues in a timely manner, the Laboratory Supervisors will request the assistance of laboratory management to bring the section into compliance. The Laboratory Supervisors will also inform Project Management and his/her Laboratory Technical Director of possible delays in the analytical process.

The Laboratory Supervisors shall have the authority, usually in consultation with Laboratory Technical Director or Project Management to use professional judgment in requiring samples be re-prepared and shall determine which analysts have the authority to require re-preparation of samples.

It is the responsibility of the Laboratory Supervisors to inform the Quality Manager, Laboratory Technical Director and Information Technology personnel of any changes in methodologies that will require revision of SOPs, MDLs, Control Limits or the LIMS programming. This includes changes in spiking compounds, spiking levels, preparation methods and analytical methods.

Analysts

Analysts are responsible for following the current SOPs (with project-specific modifications if required) in preparing and analyzing client samples and quality control samples to meet the project specific Data Quality Objectives. It is the analyst's responsibility to ensure that he/she understands all requirements of a project before proceeding with sample preparation or analysis.

Analysts are responsible for working with the Laboratory Supervisors to ensure that all sample preparations and analyses are performed within required holding times and required turn-around times, and that all documentation is completed in a timely fashion. It is each analyst's responsibility to bring any recurrent or anticipated problems to the attention of laboratory management.

It is each analyst's responsibility to correct his/her own errors, to document corrective actions thoroughly, to perform peer review, and to ensure that fellow employees within the section follow documentation procedures.

Laboratory Supervisors may give lead analysts responsibility for training and evaluation of new staff members. This training will include instruction in the methods, use of the LIMS system if applicable, correct documentation procedures, and all information necessary for adherence to the QA Program. Analysts will be responsible for maintaining all instruments and equipment in optimum operating condition and documenting this maintenance as required by the QA Program.

It is the responsibility of each analyst to request the assistance of Laboratory Supervisors or other managers in resolving out-of-control situations that cannot be corrected in a timely manner, and to perform the documentation of all corrective action activities.

Quality Manager

The Quality Manager is responsible for the oversight of the QA Program as defined by the Board of Directors and interpreted by the Laboratory Technical Director, the Chief Operations Officer and Laboratory Technical Directors.

The Quality Manager is responsible for maintaining all required outside accreditation and will coordinate with appropriate accrediting bodies

Part of this oversight will be monitoring of the QA Program through submission of performance testing (PT) samples, blind QA samples and double-blind QA samples. The Quality Manager will be responsible for submitting these samples to the laboratory for analysis, overseeing submission of the results to the appropriate agencies.

Internal assessments of ARLLC's Quality System will examine all phases of laboratory operation annually. External assessments are scheduled by ARLLC's accrediting bodies.

The Quality Manager is responsible for scheduling an annual review of ARLLC's laboratory Quality Assurance Manual (LQAP) and all SOPs. The Steering Committee members will be reminded of the need for the review in the first month of each calendar year and will have until the end of the first quarter to complete their reviews. The Quality Manager will review and oversee maintenance of bench sheets, logbooks, control charts, MDL studies, MDL/LOD verifications and any other quality related documents.

The Quality Manager is responsible for oversight of the Corrective Action database, an application for recording and tracking progress of corrective actions. The Quality Manager will assign tasks to laboratory or IT personnel for resolution of quality issues in a timely manner and will review each resolution before closing an issue.

The Quality Manager is responsible for evaluation of the laboratories' adherence to defined protocols through periodic audits of completed projects and of the laboratory facilities. System audits will take place quarterly (calendar year) according to the "Quarterly QA Tasks" list (See: Appendix I) and results will be documented in the SharePoint/ARI QA/Internal Audits library. There will be an annual audit of Test Methods and non-technical systems following the "ARLLC Annual Test Methods and non-Technical Audit Schedule" (See: Appendix I which includes audits of technologies such as lachat, pesticides, hydrocarbons, as well as subcontract accreditations, services to the clients, recommendations for improvement and complaints.

The Quality Manager will be responsible for evaluation of outside accreditation requested by Client Services. The QA Manager will deliberate with other management personnel on the feasibility of pursuing accreditation based on the scope of the accreditation, the effort required to pursue accreditation and the scope of work that might become available once the accreditation is obtained. If a decision is made to pursue an accreditation, it is the responsibility of the Quality Manager to coordinate laboratory efforts towards the accreditation.

The Quality Manager will serve as a resource for quality-related issues for all Laboratory Sections and will serve management in an advisory capacity.

The Quality Manager will plan, implement and maintain ARLLC's technical training program.

The Quality Manager will have and maintain the minutes of the Steering Committee taken by the Chief Operating Officer.

documented training in elementary statistics and Quality Systems theory.

Information Technology

ARLLC currently operates two tiers of hardware systems, a legacy system for instrument support of older instruments, and a modern tier for end users (project managers, data processing, accounting, sample receiving and new instrumentation and main servers). Information Technology (IT) personnel are responsible for ensuring that computer hardware and software meet the requirements of the company.

Servers are purchased and installed with the support of approved third-party providers who consult on project requirements (backup servers, mirroring, security, access) and required no further validation of hardware or software installed after sign-off with the vendor. Hardware and software associated with instrument control and data acquisition for new instruments and provided by an approved vendor are presumed to be vetted by that vendor and are accepted as provided.

IT personnel are responsible for formatting replacements for legacy tier workstations that are used to host instruments that are not compatible with modern software. These replacements are formatted from scratch with a new hard drive by IT personnel and are tested based on the application needs of the instrument, sometime requiring a separate network for instrument control. The workstations are signed off once the analyst can establish communication with the instrument and any ancillary equipment (i.e., autosampler), process any acquired data using the instrument specific application, and move the data through to Element LIMS for reporting.

The modern tier computer systems will be purchased only from approved vendors. IT personnel are responsible for assuring these systems are loaded with a clean operating system (currently Windows 10) and core applications (Acrobat Reader, Excel, Word, etc.) approved by IT personnel, the Laboratory Director and/or the Technical Directors. Systems must have a minimum of a Core i5 processor and 8GB RAM. Once core applications have been loaded, IT personnel are responsible for joining the device to the local domain. All the applications are checked for proper configuration by IT personnel before moving into production.

IT personnel are responsible for staying informed on improvements in the computer industry that can be advantageous to the Company in terms of increased efficiency or security. Laboratory managers and supervisors are responsible for requesting upgrades or replacements of legacy computer equipment as needed. The Laboratory Director with the Chief Operating Officer and Laboratory Technical Directors (Managers) are responsible for approving purchases.

Updates to the current LIMS system are assumed to be tested by the vendor and ARLLC IT personal review published revision notes prior to distribution. Before updates are installed, IT personnel are responsible for creating an additional backup of each program section, and alerting users that an update has been rolled out. Users are responsible for notifying IT personnel through the Helpdesk when issues occur, if a 'roll back' to a working version is required. If a rollback is required, it is the responsibility of IT personnel to investigate the issue with the update and contact the vendor for resolution if required.

Information Technology personnel are responsible for ensuring that the LIMS correctly reflects the preparations and analyses performed and that the LIMS is updated to include the current SOP, MDL, RL and QL data, as submitted by the QA Manager. Information Technology personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that electronic data matches the hardcopy deliverables submitted.

Staff assigned as 'data reviewers' (the Laboratory Director, the Technical Directors and/or the Laboratory Supervisors) are responsible for a secondary check on calculations for newly created analyses, including correct MDL, RL and QL values, preparation volumes and cleanups and final calculated results. This check may include comparison to calibration values generated by instrument data systems, comparison to QA summary lists, or comparison of data system final results to hand calculated final results.

It is the responsibility of the Information Technology Manager to update, or to designate the task of updating, the LIMS as determined by Laboratory Management, including adjustment to current MDL/RL data, additions of analytes to methods, changes in method designations or changes in calculations for methodologies.

Information Technology will be responsible for generating the work list scripts required to allow analysts to enter data into the LIMS, and for generating the report scripts that produce final hardcopy or electronic reports for clients.

Information Technology Management and personnel are also responsible for generation and review of electronic data deliverables (EDD), as requested by clients through Project Management. Information Technology personnel will review the EDD for compliance with the Software Quality Assurance SOP #101S before the data is released to the client.

Information Technology will be responsible for informing laboratory Section Managers and Project Managers of any discrepancies found between the EDD and the hardcopy, and for following up on corrections to hardcopy and EDD as required.

Information Technology will be responsible for sending out the calendar invitations for the Steering Committee and noting the meeting focus, based on the format set by the Chief Operating Officer, and for recording any video meetings of the Steering Committee.

ARLLC's Chief Operating Officer is the deputy Information Technology Manager. When the Information Technology Manager is absent the Chief Operating Officer perform Information Technology duties.

Client Services

Client Services (CS) (Project Managers, Sample Receiving, and Sales Management) personnel are the primary interface between ARLLC's clients and the laboratory sections. CS staff shall be responsible, with the assistance of the Section Managers and Supervisors, for ensuring that the laboratories understand and can meet the Data Quality Goals and Requirements of each

Project before committing laboratory services to the project. CS will monitor the quality of sample processing after they are received.

Client Services Management and Project Managers shall ensure that the laboratories can meet the data quality objectives for a project. The Project Managers are responsible for knowing the capabilities of the laboratory, in order to develop project proposals or accept samples without consultation with laboratory management. It is the responsibility of Client Services to consult with the Laboratory Manager and Section Managers, or supervisors designated by Management, when data quality goals are not included in standard Company policies. Clients may, at times, request modifications to methods that must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and IT personnel as needed for verification of feasibility. Laboratory Management may determine that a project should not be pursued based on the specific Data Quality Objectives and on current or projected laboratory capacity.

Project Managers shall be responsible for ensuring that project requirements and analytical requests are submitted correctly to all laboratory sections. Once samples have been logged into the laboratory, it is the responsibility of the Project Managers to ensure that all information is available to the laboratories concerning the Data Quality Objectives and deliverables requirements. It is also the responsibility of the Project Managers to convey changes in client requirements to the laboratories and ensure that all paperwork reflects the changes if necessary.

It is the responsibility of Project Managers and Client Services Management to ensure that specific EDD formats are submitted to IT personnel and approved as feasible before contracting with a client to provide the EDD.

It is the responsibility of Project Managers to notify clients of out-of-control events, “problem” samples, or anticipated turn-around time delays, as conveyed to them by Laboratory Management. It is also the responsibility of Project Management to work with Laboratory Management in setting priorities during times of heavy sample workloads.

Project Managers shall be responsible for coordinating data submissions and compiling hardcopy data for final submission to the client. This involves conducting a fourth level data review, from which any data which is found to contain errors that were not found earlier in the review process is returned to the Data Reviewer for correction and/or corrective action. Quality errors (other than a typo or data entry error) should be recorded in the Corrective Action database for tracking purposes. The Project Manager will be responsible for compiling all analyst notes into a project narrative. This will include discussion of any sample receipt discrepancies, sample preparation and analysis difficulties or non-compliance, and any corrective actions that may have been required during processing. It will also discuss quality control analyses and results if applicable to the sample set.

Project Managers shall work with Laboratory Management in determination of the direction of growth for ARLLC, as the Project Managers are best able to define the analytical needs of clients based on new technologies and new environmental regulations.

ARLLC's Chief Operating Officer is the deputy Client Services Manager. When the Client Services Manager is absent the Chief Operating Officer perform Client Services Manager duties.

Steering Committee

A group consisting of the above listed managers, supervisors as well as some lead analysts, that meet on a biweekly basis on Tuesdays to discuss incoming work, quality improvement issues, staffing and training improvements, equipment and supply issues, changes in analyses, and to review section reports. There will be no meeting on weeks with Holidays, and no more than four meetings per month. The chair for each meeting will rotate depending on the focus.

The Chief Operating Officer will set the focus of each meeting. Currently the focus of the first meeting each month will be Incoming Samples, the second meeting each month will be budget oriented, the third meeting each month will be centered on Laboratory Operations. The focus of the last meeting each month through a quarter will be Marketing and Sales (first month), Client complaints and accolades (second month) and QA Report and Quality Improvements (third month). Any or all of these topics may be covered in any weekly meeting based on need.

SECTION 3: PERSONNEL QUALIFICATIONS AND TRAINING

The production of quality analytical data is dependent upon a laboratory staff with qualifications and training necessary to perform assigned tasks. All personnel employed by ARLLC will receive adequate training and instruction specific to their responsibilities. Prior to assigning a staff member full responsibility for performing a laboratory procedure, her/his skills are evaluated and verified acceptable. It is the obligation of ARLLC′s supervisors and managers to ensure that personnel are qualified to successfully perform all assigned duties.

ARLLC′s training program is described in SOP 1017S (*Training and Demonstration of Proficiency*). The procedures described in the SOP ensure that all ARLLC employees are proficient at the tasks required to produce quality analytical data. The SOP also provides for periodic review of each employees training and proficiency status, which may indicate any need for additional or remedial training. All training and review procedures are documented as described in the SOP.

Basic elements of ARLLC′s training program are:

1. All employees are required to read and document their knowledge of non-technical documents that describe general policies in place at ARLLC including ARLLC′s *Employee Manual* and ARLLC′s *Chemical Hygiene Plan*.
2. All technical employees are required to read and document their knowledge of ARLLC′s *Laboratory Quality Assurance Plan* and quality assurance policies.
3. All new employees must attend a Quality Assurance Orientation during which ARLLC′s general and specific requirements for the production of quality analytical data are introduced.
4. All new technical employees will attend a laboratory specific technical orientation conducted by their laboratory supervisor or manager that provides specific information about laboratory operation.
5. All employees will complete an ‘on the job’ training program designated by their supervisor. The training program will be laboratory, SOP and employee specific. The training is incremental with each step documented in an employee Training File. While an analyst is in the training period, her/his supervisor or trainer must approve all their `analytical work.

6. Upon completion of the training program a technical employee must complete an Initial Demonstration of Capability (IDOC) as described in ARLLC SOP 1017S. An analyst is considered proficient and may perform analytical procedures without supervision only after they have completed training and a successful IDOC.

7. The proficiency of each employee performing a given laboratory SOP is continually monitored and documented as described SOP 1017S. To maintain proficiency, an employee must continually generate data that meets all of ARLLC's published acceptance criteria for a given SOP. Unacceptable results or insufficient number of analyses performed in a calendar quarter will result in revocation of proficiency. This will result in a remedial training program.

8. Each analyst is responsible for maintaining a training record as described in SOP 1017S. The training record will document an employee's experience, training and capability. The training file will be maintained in ARLLC's "cloud" based Microsoft SharePoint™

SECTION 4: FACILITIES AND EQUIPMENT

4.1 Facilities

ARLLC′s physical facilities allow for efficient sample processing and analysis while maintaining consideration for the health and safety of the staff. The facility accommodates the following operations:

Sample receipt and storage
Sample container preparation and shipment
Sample preparation and analysis (organic and inorganic)
Project planning and management
Quality assurance
Data review and report generation
Computer programming and operations
Records storage
Instrument spare parts storage
Frozen sample archive
Short-term hazardous waste storage

A detailed description of ARLLC′s facilities is included as Appendix C.

4.2 Security

<u>Facilities</u>

To ensure sample and process security, access to ARLLC's facilities is limited to employees and escorted visitors. All outside entrances are locked and/or continuously monitored. Visitors must register at the reception desk, be escorted while in the laboratory and sign out prior to leaving. Key access to the facility is controlled; keys are issued only on a limited "as needed" basis.

Because of the strictly controlled access and a 24-hour monitored alarm system, ARLLC considers the entire facility is a secure area. This eliminates the need for locked sample and data storage within the building.

<u>Data Access</u>

ARLLC's Information Technology (IT) Manager controls security of, and access to, electronic data on all data systems. ARLLC's IT team has implemented processes and procedures to ensure data integrity and prevent intentional intrusion by outside parties. These measures are robust but not so restrictive that they prevent data accessibility. These measures include building security, limited computer system access, password systems, two-step authentication for remote or mobile systems, encryption, firewalls and the use of virus protection programs. ARLLC′s Intranet is protected from outside tampering by a proxy server (firewall) connection to the Internet.

LIMS - System Security

Building/Computer Room Security

Access to the building is restricted to employees, vendors with security passes, and escorted visitors. Room 203 contains the computer and main console for the LIMS system. This room is closed and locked at all times. Access to this room is limited to IT personnel, escorted repair technicians, and escorted visitors. Only IT personnel will be allowed access to the main console.

System Password Policy

Username and password restrict access to the LIMS computer. Remote access to the LIMS server is not allowed.

Database Access Restrictions

Interaction with the database is menu-controlled and allows the LIMS Manager to restrict access. Technicians may be given the ability to fill a limited number of work lists, with no authorization to distribute data. Some users may be given “read only” access to the database.

Users will be given access to the database only to complete tasks for those analyses for which they are responsible. No users are to be given access to the shell or command prompt unless 1) they have completed the appropriate training and 2) administrative access to the computer systems is required by their job function

4.3 Safety

The safety and well-being of staff is imperative. ARLLC’s facilities are designed and equipped to minimize personnel exposure to hazardous substances or situations. The Chemical Hygiene Plan details safety procedures and requirements that ARLLC staff must follow. An active safety committee meets monthly to review the safety activities of all laboratory sections and to ensure that all operations and equipment meet safety criteria. *The Chemical Hygiene Plan* is reviewed annually and updated as needed to incorporate any changes to ARLLC′s safety program.

4.4 Instrumentation and Support Equipment

4.4.1 Instrumentation

Generation of quality data is dependent upon instrumentation and support equipment that is in optimum operating condition. All instrumentation and support equipment will be optimally maintained following method requirements and/or manufacturer's recommendations. Preventative maintenance is performed on a scheduled basis, with more frequent maintenance during periods of increased sample load or after analysis of highly contaminated samples. All instrument maintenance is documented in Element LIMS. When non-routine maintenance is required, the following information must be recorded:

1. A statement of the problem or symptom that requires correction.
2. Details of the maintenance procedure including listing the parts repaired or replaced.
3. Documentation that the instrument has returned to routine performance.

ARLLC maintains an inventory of all instruments and other additional pieces of equipment such as sample trays, auto-sampler towers, and concentrators within Element LIMS' *static table.* Each piece of equipment is tracked via its serial number (or another unique ID) within the static table to facilitate historical reconstruction of any analytical event.

ARLLC also maintains a physical inventory of spare parts, and/or orders parts on an expedited basis, to minimize downtime.

Appendix D is a current list of laboratory instrumentation and equipment.

4.4.2 Support Equipment

4.4.2.1 Thermometers in use at ARLLC are traceable to an NIST standard and calibrated or verified as described in SOP 1020S. Electronic thermometers are verified quarterly and liquid in glass thermometers annually. When appropriate, thermometers are assigned a correction factor based upon the most recent calibration. ARLLC personnel must calculate and record corrected temperatures based on the correction factor.

4.4.2.2 Water Bath temperatures are recorded before each use to ensure the temperature is acceptable for its intended use.

4.4.2.3 Incubator temperatures (corrected) are recorded at least twice a day while in use. The date and time for each observation is recorded.

4.4.2.4 Oven temperatures are recorded at the beginning and end of each workday they are in-use.

4.4.2.4 Refrigerator and Freezer temperatures are recorded automatically every 30 minutes by ARLLC's electronic "ThermoLogger". QA staff are notified via e-mail when a recorded temperature is out of compliance. "Thermologger" temperature probes are verified / calibrated quarterly.

4.4.2.4 Balance accuracy is verified daily prior to use with two Class S weights that bracket the normal weighting range of the balance. A balance must be accurate to ±0.1% or ±0.5 mg whichever is greater. All analytical balances are professionally cleaned and calibrated annually by an outside contractor. Class S weights are calibrated every five years by an outside contractor.

4.4.2.5 pH Meters are standardized prior to each use with at least two standard buffers, one at 4.0 and one at 7.0 pH units.

4.4.2.6 The accuracy of Variable Volume Pipettes and Mechanical Burettes is routinely verified on a daily, weekly or monthly basis as described in ARLLC's SOP 1015S.

4.4.2.8 Sample Containers: – ARLLC supplies clients with containers for the collection of field samples. All containers supplied for organic and trace metals analyses are pre-cleaned and certified by the manufacturer. When the manufacturer's certified concentration is greater than ARLLC's reporting limit for a specific project, a container is used to prepare a method (bottle) blank. ARLLC certifies that the containers from the same lot are suitable for sample collection when target analytes are not detected in the bottle blank. Containers for conventional analyses are not pre-cleaned and are certified internally by ARLLC following the procedures in Appendix 12.3 of ARLLC SOP 001S (Sample Receiving).

Container lot numbers are recorded when containers are sent to a client.

4.4.3 Chemical Standards and Reagents

4.4.3.1 Reagent Water Supply

ARLLC maintains a centralized water purification system. The quality of the water produced is monitored and documented daily in a bound logbook. All reagent / de-ionized water used within the laboratory must meet or exceed ASTM Type II Standards. In addition, water used in the Volatile Organic Laboratory is filtered through activated charcoal to ensure it does not contain organic compounds.

4.4.3.2 Chemical Standards

Most standards used to determine the concentration of target analytes are purchased as certified solutions. These standards are traceable to a National Institute of Standards & Technology (NIST) standards and documented with a Certificate of Analysis. In addition, all quantitative standards (traceable, non-traceable and those prepared by ARLLC) are verified by comparison to a second standard reference material obtained from an alternate source. The source, date of receipt, required storage conditions and an expiration date for all standards are recorded in ARLLC's Element LIMS system. SOP 1013S *"Purchasing and Documentation of Supplies Equipment and Services"* outlines procedures for receiving, preparation and storage of analytical standards

4.4.3.3 Chemical Reagents

Many of the analytical processes in use at ARLLC require chemical reagents not directly used in the calibration process. These reagents provide for analyte preservation, adjustment of pH, formation of colorimetric indicators, etc. All reagents are purchased in a grade and purity sufficient for their intended use. All reagents and accompanying Certificates of Analysis are documented in Element LIMS. Each original reagent container is labeled with the date it is opened and an expiration date as appropriate.

Solutions prepared from reagents are recorded in the LIMS system. Reagent containers are labeled with Reagent Number, date of preparation, expiration date, and preparer's identification.

Procedures for Reagent Receiving and Preparation are detailed in SOP 1024S.

Trace Metals Acids

To ensure the quality of acids, nitric and hydrochloric, used for trace metals analyses, ARLLC purchases only the highest quality, certified “metals free” acids. Each lot received is analyzed for purity prior to use to ensure that it is acceptable. When possible, an entire lot of acid will be reserved for use exclusively by ARLLC. This minimizes the possibility of receiving contaminated or unacceptable acid.

Solvents

To ensure the quality of solvents used for sample preparation and analysis, ARLLC uses only the highest purity solvents available. A portion of each lot of solvent received is analyzed to verify its stated purity. Only solvent lots determined acceptable will be used for sample processing. Whenever possible, entire solvent lots will be reserved for use. This minimizes the possibility of receiving contaminated or unacceptable solvents.

Compressed and Cryogenic Gases

To reduce the possibility of system contamination, compressed and cryogenic gases used for operating analytical instrumentation will be of a specified purity level. A cylinder suspected of introducing contamination into a system is immediately replaced.

4.5 Computer Systems

ARLLC maintains several distinct and separate data systems. These are used to automate such diverse functions as accounting, payroll, sales and marketing, sample receiving, instrument data collection, production of hardcopy and electronic data deliverables, intra- and internet applications and project management. Specific information about these systems is contained in Appendix D and various SOPs.

ARLLC maintains a Laboratory Information Management System (LIMS) that stores analytical data, calculates final results and produces final reports (both hardcopy and electronic). The LIMS system is the major data system used at ARLLC.

SECTION 5: LABORATORY DOCUMENTATION AND RECORDS

All laboratory operations and procedures performed during sample receipt, processing and reporting are thoroughly documented in electronic or handwritten records. These records are objective evidence of the work performed and are detailed enough to allow recreation of all procedures performed by the laboratory.

All routine procedures performed at ARLLC are documented in Standard Operating Procedures (SOPs). Electronic, controlled copies of all SOPs are maintained in ARLLC's "cloud" based Microsoft SharePoint™ file system. SOPs are reviewed and/or edited annually or when processes or procedures change.

If ARLLC is sold or transferred to a different ownership group, all records will be handled as specified in client contracts. In the absence of contractual requirements, records will be transferred to the new owner(s) as specified in the purchase/sale agreement."

5.1 Responsibilities

All staff members are responsible for complete and accurate documentation of laboratory activities. Each laboratory section employs a comprehensive set of documents (bench sheets, forms, etc.) to record all activities performed in that section. All staff members are responsible for reviewing and documenting their understanding of appropriate SOPs. ARLLC's QA Manager is responsible for maintaining control of laboratory documents and ensuring their consistent use.

To ensure that all documents including SOPs accurately reflect the activities performed at ARLLC, section supervisors and managers are required to review all documents and recommend changes to the LQAP annually. ARLLC's QA Manager is responsible for coordinating document revisions and ensuring that all staff members have access to the most current laboratory documents.

5.2 Document Control

ARLLC′s Quality Assurance Program requires that all forms and SOPs used within the laboratory be monitored to ensure that only the currently approved versions are in use. The QA Manager maintains electronic versions of all SOPs, forms and manuals in ARLLC's "cloud" based Microsoft SharePoint™ file system. These electronic files are the only official controlled copies.

Printed copies are considered “Uncontrolled”. Documents in use by individual analysts or sent to clients are “Uncontrolled”. All documents will include a revision date. The LQAP and SOPs will also have an effective date. The time between the revision and effective dates is used for training and orderly implementation of changes. The listing of documents (SOPs, forms, bench sheets, etc.) in ARLLC’s “cloud” based Microsoft SharePoint™ file system is considered the only official listing of ARLLC’s QA documents. SharePoint also includes copies of prior versions of QA documents.

The QA Manager coordinates the generation of new forms or SOPs and modifications to existing documents. Document number assignments will be as follows:

Laboratory Section	Form Number	SOP Number
Client Services	0001 - 0999	001 - 099
Computer Systems	1000 - 1999	100 - 199
Data Services	2000 - 2999	200 - 299
Extractions	3000 - 3999	300 - 399
GC Laboratory	4000 - 4999	400 - 499
Metals Laboratory	5000 - 5999	500 - 599
Conventional Laboratory	6000 - 6999	600 - 699
Volatile Organic Laboratory	8000 - 8999	700 - 799
Semi-volatile Laboratory	7000 - 7999	800 - 899
Quality Assurance Monitoring	10000 - 10999	1000 - 1099

Document numbers will include an F for forms and an S for SOPs i.e., 101F or 1234S.

Laboratory forms and SOPs will be generated or revised on an “as needed” basis and will be reviewed and revised at least annually. SOPs are prepared in a consistent format provided in SOP 1006S, “Document Preparation, Control, and Archival. A comprehensive review of all laboratory documentation will be performed annually coordinated by the QA Manager.

All documents generated by the laboratory are considered proprietary and must not be shared outside of the laboratory without prior consent from ARLLC.

5.3 Reference Documentation

To provide an understanding of the procedures employed to generate quality data, a comprehensive set of reference materials is available to staff members. The laboratory maintains copies of the following method compilations:

Code of Federal Regulations (Section 40)
Test Methods for Evaluating Solid Waste (USEPA SW-846)
Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series methods)
Standard Methods for the Examination of Water and Wastewater
Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)
Hazardous Waste Remedial Actions Program (HAZWRAP)
IEC/ISO 17025
State of Alaska Department of Environmental Conservation (ADEC)
Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods
Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)
Washington State SARA
Washington State EPH/VPH Methods
TNI -The NELAC Institute Standard 2016
Department of Defense Quality Systems Manual (QSM Versions 5.4 (2021))
Washington State Sediment Sampling and Analysis Plan

Other methods followed within the laboratory are also available. Published modifications to analytical methods will be reviewed and incorporated into laboratory SOPs. If a method for a parameter is developed by ARLLC, it will be detailed in an SOP. SOPs will be available for all laboratory activities. A listing is available in ARLLC's SharePoint™ "SOP" Library.

The Laboratory Quality Assurance Manual provides an overview of the laboratory-wide Quality Assurance program. An electronic copy of the Quality Assurance Manual is available to all laboratory sections in ARLLC's SharePoint™ "Popular Documents" Library.

ARLLC maintains a file of various laboratory and environmental publications and reference texts. These reference materials are available to all staff in ARLLC's SharePoint™ "QA Reference" site. Operation and maintenance manuals are available for all equipment and instrumentation used within the laboratory. Additionally, senior level staff members are available to serve as reference sources. These staff members have numerous years of pertinent experience and can provide insight and guidance for all procedures and laboratory activities.

5.4 Quality Assurance Policies

Quality Assurance Policies provide standards and procedures to guide ARLLC employees in proper implementation of the QA Program. Appendix P includes current QA Policies.

5.5 Worksheets and Logbooks

Use of Laboratory Forms and Logbooks

All activities noted in writing on laboratory forms and logs are recorded in blue ink. Initials of the staff member performing the activity, as well as the date the activity is performed are noted on all forms and logs. Any supplementary information about the activity, such as unusual observations or suspected procedural errors is noted on the forms and logs.

A change to existing information is annotated by drawing a single line through the original entry, initialing, and dating the deletion. Correct information is then written above the deleted entry. When appropriate to clarify the intent of the change a note describing the reason for the change is added. The use of correction fluids or other techniques that cover an entry in its entirety is forbidden on laboratory documents.

Since sample processing within an analytical laboratory involves many detailed steps, documentation can be quite extensive and varied. The following guidelines ensure consistency in laboratory record keeping:

Analytical Standard Preparation

Document the preparation of all stock and working standards in Element LIMS. Each record includes preparation date, initial and final concentrations (including solute and solvent amounts), standard ID number, expiration date and the identity of the person preparing the standard. Stock solution entries include standard lot number and supplier. Working solution entries include the stock solution ID number.

Sample Storage Temperature Logs

The temperature of all refrigerators and freezers used for sample and standards storage is monitored daily using the electronic “Thermologger” system monitored and maintained by QA.

Balance Calibration Logs

The true and measured values for each calibration check weight are recorded in balance specific logbooks, along with the date and recorder's initials. Any actions taken, such as notifying QA of malfunctions is indicated alongside the entry for that date.

Instrument Sequence Logs

The Instrument Sequence Logs maintained in Element LIMS document the daily operation of each analytical instrument. The logs document the ID, date and time for each sample analyzed. In addition, instrument conditions, analyst ID and standards used and any unusual circumstances are recorded in the log. Comments related to sample analysis and minor maintenance are noted on the instrument logs. For GC/MS analyses, instrument performance is documented by recording internal standard response alongside the sample identification.

Sample Preparation/Analysis Worksheets

Sample preparation and analysis activities are documented on appropriate worksheets. Sample identifications, weights or volumes used, intermediate cleanups, final volumes, preparation dates and analyst initials will be noted as well as any observations about sample condition. Any issues encountered during sample preparation are also noted. Surrogate and spiking solution ID numbers, and concentrations added to the samples, must be indicated on the bench sheets. Worksheets are generated manually, scanned and attached to an analytical batch in Element LIMS as a PDF file.

For some parameters, analytical results are summarized on an analysis worksheet. Sample identifications, sample preparation information, sample results, quality control results, analysis date, analyst initials and reported detection limits must be indicated on the worksheet. Any necessary data qualifiers are also noted on the worksheet. Worksheet data is manually entered in Element LIMS

Maintenance Logs

All maintenance performed on instrumentation or laboratory equipment must be documented in Element LIMS. Maintenance performed, date and analyst performing the maintenance, and steps taken to verify that the maintenance was successful are detailed. A demonstration that GC instruments are in-control following maintenance is documented in the instrument run log.

5.6 Document /Data Storage and Archival

Logbooks

Completed hardcopy logbooks are forwarded to the QA Manager to be indexed and archived for 10 years.

Analytical Records

Copies of all analytical records (project information, instrument logs, chromatograms, calibrations, quantification reports, etc.) are maintained as part electronic files on ARLLC's servers. The files are backed up to "Cloud" storage daily. All electronic data is archived for five (5) years or as specified by contract.

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SECTION 6: PURCHASING SERVICES AND SUPPLIES

ARLLC ensures that purchased supplies, consumables and services that affect the quality of environmental tests are of required or specified quality. This includes all chemicals (solvents, chemical standards, reagents, etc.) used in an analytical process and services provided by an outside vendor such as balance, weight and thermometer calibrations, support equipment maintenance and service contracts for instrumentation.

Laboratory managers or their designee are responsible for the quality and suitability of supplies and equipment routinely used in their laboratory section. This involves accurately defining required specifications for all purchased supplies, equipment and services. Purchasing documents are prepared that adequately describes the services or supplies and their specifications.

Suppliers are approved based on the quality of their products, their ability to deliver products as requested, the overall quality of their services, and competitive pricing. Documentation used in the evaluation process may include but is not limited to: Certifications by recognized accrediting organizations, evidence of quality furnished by the supplier, certificates of analysis, recommendations from other purchasers, and records of historical compliance with ARLLC's requirements. A list of approved vendors is maintained by ARLLC's QA department, is available to all staff and is reviewed and updated annually. Quality critical consumables and equipment must be purchased from an approved vendor or specifically approved by a laboratory manager.

Upon receipt, ARLLC inspects all supplies received for consistency with the order and to document any shipping damage such as breakage or leaks. ARLLC's purchaser must verify that the quality of any chemical received (expiration date, concentration, grade, etc.) meet specifications. Supplies received are stored according to manufacturer's recommendations, laboratory SOPs or test method specifications. Purchased supplies and reagents that affect the quality of the tests are not used until they are inspected or otherwise verified as complying with requirements defined in ARLLC's analytical SOPs.

Chemical or certified products are documented in Element LIMS and are labeled with an Element ID. Electronic copies of all quality documents received with the supplies and services (specifications, certificates of analyses, warranties, maintenance records, calibration recordetc.tc) are archived and electronically linked to the Element LIMS identification. Details are found in SOP 1013S, Chemical and Certified Product Receiving.

SECTION 7: SAMPLE COLLECTION

Analytical Resources Inc. is not routinely involved with sample collection. The laboratory does, however, supply clean sampling containers to its clients upon request. Contamination free container are essential to maintaining the integrity of samples collected in the field.

7.1 Sample Container Preparation and Shipment

To minimize the possibility of contamination from containers furnished by outside sources, ARLLC will furnish all necessary sample containers for client projects. Sample containers provided by ARLLC are either pre-cleaned to EPA specifications, certified clean by the manufacturer or tested for contamination by ARLLC. Lot numbers for containers are tracked to link bottle orders to lot numbers.

As per client request, the appropriate blank sample labels are either provided to the client in bulk fashion (loose) or are affixed to each sample container prior sending the containers to a client. The sample label allows for recording of the following information at the time of collection: client name, client sample identification, sampling site, date and time of sample collection, analytical parameters, and any preservatives used. Sample labels provided by ARLLC are coated to prevent bleeding of recorded information when they become wet.

To ensure that the correct number of appropriate sample containers are prepared and submitted to the client, a Bottle Request is completed by a Client Services staff member or Project Manager at the time sample containers are ordered by the client. All necessary preservatives are also noted on the Bottle Request. The Bottle Request is then forwarded to appropriate personnel in the Sample Receiving Section for order preparation. All required containers will be gathered, and preservatives added as specified. A copy of the Bottle Request accompanies the sample containers to allow the client to verify that the order is properly filled. Additional containers will be supplied for quality control purposes and in case of container breakage or sampling complications. A listing of containers and preservatives recommended for analyses performed by ARLLC are listed in the document “Summary of Sample Containers, Preservatives and Holding Time Requirements” in ARLLC’s “cloud” based Microsoft SharePoint™ file system

To facilitate transportation of containers to the sampling site, sample containers will be placed in coolers along with appropriate packing material. The inclusion of packing materials, such as vermiculite or “bubblewrap”, is provided to minimize the possibility of container breakage and cross-contamination. Sample containers will be organized in the coolers per analytical or client specifications. Depending on client preference and project requirements, coolers and sample containers will be shipped to a specified location, delivered by ARLLC courier, or held at the laboratory for pick up. To ensure that sample identification, analytical parameters, and sample custody are properly documented, Chain of Custody records will accompany all sample container shipments. When appropriate, as for drinking water source sampling events or for parameters that require preservation in the field, sample collection instructions will also be included with shipments.

SECTION 8: SAMPLE RECEIPT AND CONTROL

All samples received must adhere to ARLLC's "Sample Acceptance Policy" reproduced in Appendix E. Acceptable samples are logged into Element LIMS which provides for tracking the location and status of samples throughout the analytical process. Following analysis, remaining sample is safely disposed following Washington State Department of Ecology protocol. Documentation of all sample control activities and adherence to standard procedures is an important aspect of ensuring that data quality objectives are met. All samples received by the laboratory are processed in a central Sample Receiving area. To ensure the safety of staff members receiving samples, coolers will be opened under a hood or in a well-ventilated area. Appropriate personal protection, such as disposable gloves, safety glasses and laboratory coats are worn during sample receipt and log-in and all general safety practices specified in ARLLC's Chemical Hygiene Plan are followed.

8.1 Sample Admission

Sample receiving procedures are detailed in ARLLC's SOP 1001 and outlined below:

1.Chain of Custody documentation is completed.

2. Each sample container is examined to verify that the condition is acceptable, and that sample integrity has not been compromised during shipment. The condition of samples and their packaging material is documented on a "Cooler Receipt Form".

3.The number and type of sample containers received will be verified against the Chain of Custody record

4. A corrective action is initiated for sample containers broken during shipment. Compromised sample is disposed following procedures detailed in ARLLC's Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

5 Samples are logged into ARLLC's Element LIMS, each sample container is assigned a sequential sample identification number and a Work Order (WO) is generated for the set of samples. The sample identifiers are used to monitor each sample and container throughout the analytical process. The date and time of receipt, sample temperature and any unusual

observations concerning the samples are recorded in Element LIMS. Discrepancies between the Chain of Custody record and sample containers will be noted, as well as discrepancy resolutions.

6. Client specific quality control requirements and any other pertinent information indicated on the Chain of Custody Record is recorded in Element LIMS and sample labels printed and the status of the samples is set to “Received”. The sample information in LIMS is now available to authorized laboratory personnel for review.

7. Sample containers are labelled and delivered to the appropriate laboratory section. The accuracy of sample container labeling is verified by a second person.

8. ARLLC’s Project Manager will review the documentation in Element LIMS and edit it as necessary to ensure the client’s expectations will be met. When necessary, Clients are consulted to resolve any remaining discrepancies. When the Project Manager is satisfied that the information in Element is complete and correct, she/he will set the sample status to “Available”.

9. Laboratory supervisors are responsible for timely analysis of all “Available” samples.

8.2 Subcontracting Policies

ARLLC may subcontract analysis to other laboratories. QA Policy 15 (Appendix I) is followed to ensure that data produced by a subcontractor is high quality, defensible and will meet the client’s expectations.

8.3 Sample Custody

To ensure the integrity of sample processing, ARLLC documents the custody of all samples from the time they arrive at the lab until their final disposal.

The National Enforcement Investigations Center (NEIC) of EPA defines custody in the following ways:

It is in your actual possession, or
It is in your view, after being in your physical possession, or
It was in your possession, then you locked or sealed it up to prevent tampering, or
It is in a secure area.

Sample and extract custody are documented in ARLLC's Element LIMS. All specific locations where samples (including extracts and digestates) are stored or processed in ARLLC's facility are assigned a unique LIMS identification. Each sample container is also assigned a unique LIMS identification. Location and sample labels include an identifying bar code. When a sample is moved from one location to another the change is documented in LIMS by scanning the bar code of the location and sample. LIMS also records the analyst who moved the sample. This process produces an electronic "Chain of Custody" for each sample container as it moves through the laboratory from initial receipt through final disposal.

8.4 Special Custody Considerations

To avoid possible cross-contamination of low-level samples in ARLLC's VOA laboratory, those samples known or suspected to contain high levels of contaminants, such as underground storage tank (UST) samples, will be segregated from other samples prior to analysis.

Samples with a very short holding time or require "RUSH" analysis may be delivered directly to the lab.

Soil samples for the USEPA Contract Laboratory Program are considered USDA "Regulated Soil", must be segregated from other samples and require special disposal procedures. The special requirements are outlined in Sample Receiving SOP 101S.

Clients may request that samples be preserved and archived prior to analysis.

8.5 Sample Archival and Disposal

After completion of analysis, unused sample aliquots are routinely stored for 30 days (water) or 60 days (soil). Samples with specific storage requirements such as "freeze and hold" are designated in Element LIMS and annotated labels are applied. Sample volumes that are to be shared between multiple laboratories are designated as "shared" in Element LIMS and the sample containers receive yellow markers prior to delivery to Refrigerator 36 ("share" refrigerator).

Analytical data in Element LIMS is used to identify samples containing analytes at or above regulatory disposal levels. Those are identified and handled as hazardous waste. A designated staff member coordinates periodic pickup of hazardous waste by an USEPA approved TSD

(Treatment, Storage, and Disposal) Company and maintains hazardous waste disposal records Specific guidelines for handling hazardous samples and waste are detailed in ARLLC's Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

SECTION 9: PROJECT MANAGEMENT AND TRACKING

9.1 Project Management

Concise and accurate communication between a client and ARLLC, and within the laboratory, is a critical component of the analytical process. ARLLC's Project Managers (PM) coordinate this communication. PMs serve as the central focus for all project related activities and communications. The PM confirms that project requirements are consistent with laboratory capabilities, and coordinates with laboratory sections to provide analytical results within specified project timelines.

ARLLC's PM will review work plans and requirements for all pending projects. Any questions related to the work plan are resolved prior to project commencement. The PM will consult with appropriate analytical sections to clarify any issues regarding procedures and capabilities. Project deliverables requirements are finalized at this time. Upon receipt and log-in of project samples, the PM will review all documentation to ensure that samples were properly logged in, and that analytical and QC requirements were correctly specified. The Project Manager also provides any additional project related information that will assist the analytical sections with sample analysis. Laboratory sections do not proceed with a given work order until it is reviewed and approved by a PM. Exceptions are parameters with critical (less than 48 hour) holding times or those that arrive on weekends or holidays when none of the Project Managers can be contacted.

Throughout the project, the Project Manager will monitor all analytical activities to help ensure that the project is completed and delivered on schedule. Any issues arising during sample processing is promptly discussed with the client. Likewise, the analytical staff will be informed of any client concerns or project modifications. The PM will also resolve issues that arise during subsequent review of the analytical data by the client.

9.2 Project Tracking

Monitoring the laboratory workload ensures that adequate staffing and equipment will be available to produce quality analytical data that meets client's expectations. At the time a client project is tentatively scheduled, information regarding the project will be documented in the Element LIMS. Project specifics, sample quantities, parameters and anticipated sample delivery dates and analytical costs are specified. Work plans and other project specific information is attached archived in Element LIMS as electronic files. Schedules for pending projects are communicated to the lab sections through periodic distribution of database printouts.

Each laboratory section is responsible for ensuring that all analyses are completed following project requirements on or before the due date. Analysts must be aware of holding times, special analytical requirements, and required turnaround times. Analytical sections will remain in close communication with the Project Management staff so that any issues arising during sample analysis can be promptly addressed or discussed with the client.

Project Managers or their designee are responsible for monitoring project status. Status reports are generated as needed from Element LIMS and are distributed to lab sections and Project Managers. These reports allow the Project Managers to identify samples which must be expedited to meet project timelines. Additionally, verbal communication between Project Managers and lab sections provides information about project status. When requested, preliminary and interim results may be forwarded to the client.

When analysis for a work order is complete, the project manager will compose a "Case Narrative" detailing the analytical process. The narrative will reference issues or concerns raised during the analysis and indicate how they were resolved. The PM then uses Element LIMS to generate a final report and invoice which are delivered to ARLLC's client. Electronic signatures are required for all outgoing digital reports, unless other arrangements have been approved by the client prior to data delivery. All ARLLC projects managers have unique electronic signatures, and they are purchased through a 3rd party provider, Entrust Datacard. Signatures are assigned to project managers and are applied to reports and packages. The signatures are secured by a vendor supplied security token and a passphrase known only to that specific project manager. The certificates are allocated for either one or two years at a time and cannot be used to secure documents past the fixed expiration date.

Clients can express their complaints, concerns, or commendations at any time by directly contacting their project manager(s) or via the link to the online survey that is included in all outbound emails initiated by any ARLLC staff member. We may also be contacted via our web site (www.arilabs.com). All feedback – negative or positive – is added to the Corrective Actions database and is discussed during the weekly Management Review meetings.

Whenever possible, ARLLC will acknowledge the receipt of any complaint, and provide the complainant with progress reports and the final outcome. Resulting outcomes from any complaint will be made by, or reviewed and approved by, individuals not involved in the original activities in question. ARLLC will then provide formal notice of the end of the complaint-handling process (i.e., Corrective Action) to the client/complainant.

SECTION 10: ANALYTICAL METHODS

To ensure that analytical data generated are consistent and comparable, ARLLC follows clearly defined protocols for all laboratory processes and procedures. Standard Operating Procedures (SOPs) provide detailed guidelines for completing a procedure. Document control procedures and periodic audits ensure that operations are performed in accordance with the most current SOPs. All routine deviations from published methods will be noted in the SOPs. Analysis or project specific deviations are noted in Analyst Notes and reported in an Analytical Narrative.

10.1 Responsibilities

ARLLC staff are responsible for performing procedures in accordance with the guidelines specified in ARLLC's SOPs. Laboratory Management is responsible for ensuring that staff faithfully follow current SOPs. The QA Manager is responsible for coordinating periodic review and revision of SOPs. The QA Manager is also responsible for maintaining SOP document control and ensuring that the most current versions of all SOPs are available to staff members.

Deviations from SOP and method-specific analytical procedures is only allowed when prior approval has been obtained from both the client and laboratory management (documented on form 0071F). The project manager is responsible for obtaining written consent from their client regarding any departures from documented policies.

10.2 Methods

Laboratory procedures may reference any established methods specified in active versions of the following publications:

1. *Code of Federal Regulations (Section 40)*
2. *Test Methods for Evaluating Solid Waste (USEPA SW-846)*
3. *USEPA Contract Laboratory Program Statement of Work for Organic Analysis*
4. *USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis*
5. *Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series)*
6. *Standard Methods for the Examination of Water and Wastewater*
7. *Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)*
8. *Navy Installation Restoration Laboratory Quality Assurance Guide (February 1996)*
9. *Hazardous Waste Remedial Actions Program (HAZWRAP)*
10. *State of Alaska Department of Environmental Conservation (ADEC)*
11. *Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods*

12. *Washington Department of Ecology (WA-Ecology) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)*
13. *The Department of Defense Quality Systems Manual (DoD-QSM 5.4 (2021))*
14. *Washington State Sediment Sampling and Analysis Plan*

The laboratory will adhere to established methods whenever possible. Occasionally, however, procedures may be modified to meet client or project specific requests. These modifications are thoroughly documented in project files. A complete listing of SOPs is available in ARLLC's SharePoint™ SOP Library. The SOP documents available in SharePoint™ are the official, controlled versions. Analyst may print an uncontrolled version for personnel use but are required to adhere to the electronic version in SharePoint™.

10.3 Standard Operating Procedures

Standard Operating Procedures (SOPs) are detailed, step-by-step instructions for completing a laboratory operation. An SOP is available for all procedures within the laboratory, from initial project identification to final data archival. SOPs are generated for procedures developed within the laboratory and for those that follow published analytical methods.

To ensure consistency in defining procedural guidelines, all SOPs that describe analytical procedures will contain the following sections:

1) Method, matrix or matrices, detection limit, scope & application, components to be analyzed
2) Summary of the test method
3) Definitions
4) Interferences
5) Safety
6) Equipment and supplies
7) Reagents and standards
8) Sample collection, preservation, shipment and storage
9) Quality control
10) Calibration and standardization
11) Procedure
12) Data analysis and calculations
13) Method performance
14) Pollution prevention
15) Data assessment and acceptance criteria for quality control measures
16) Corrective actions for out-of-control data
17) Contingencies for handling out-of-control or unacceptable data
18) Waste management
19) References
20) Appendices, tables, diagrams, flowcharts and validation data

SOPs will be monitored through the laboratory document control system. Each SOP will be assigned a document control number as detailed in Section 5.2 of this LQAP. SOPs are revised whenever a laboratory procedure is changed or modified. All SOPs are reviewed annually by analysts proficient in performing the procedure. SOPs will be generated for each new procedure implemented within the laboratory. Review, modification, new SOP generation, and distribution will be coordinated through the QA Manager who will periodically audit the laboratory sections to verify that the most current versions of all SOPs are in use.

10.4 Method Selection and Use

Method selection is based on availability of analytical instruments and equipment, chemical standards, expected method performance and marketability. Methods defined and accepted by regulatory agencies and familiar to ARLLC's clients are preferred. The Laboratory Director or designee, in consultation with marketing, client service, and supervisory staff are responsible for selecting appropriate methods. Client or project-specific methods are used when appropriate.

ARLLC prefers the most recently promulgated method for all procedures. Section supervisors and managers are responsible for ensuring that the procedures in use reflect the requirements of the promulgated methods. Any modifications made to the method must be documented in SOPs. Method modifications may be acceptable, provided all acceptance criteria specified in the method are met.

Section supervisors and managers will review newly promulgated methods and modify established SOPs as appropriate. When possible, the annual SOP review will be coordinated with anticipated method promulgation dates. This is especially useful for large method compilations, such as SW-846. If the annual SOP review and method promulgation cannot be coordinated, SOPs are revised as soon as possible after a method has been promulgated, especially when method changes are significant.

SOPs will be generated to reflect the most commonly used methods and protocols. When ARLLC uses two or more methods for an analysis, each will have an SOP. Several methods may be incorporated into one SOP, provided that each method is clearly identified and defined in the SOP. Method modifications or special requirements for ongoing projects, or for specific programs (DoD, CLP, TNI, etc.), will be incorporated into the SOP. These requirements will be annotated to indicate that they are project/program specific. Analysts and technicians are responsible for meeting the program specific procedures.

10.5 Method Performance

Acceptable method performance is documented for all methods prior to use. Section supervisors and managers are responsible for ensuring that method performance is acceptable and support procedures have been performed.

Method performance requires the following:

An SOP for the method. The SOP must provide sufficient detail to perform the analysis and must accurately reflect the published method. Any steps in the method for which analyst discretion is allowed must be clearly defined.

A method detection limit (MDL) performed for the method. Method detection limits must be at or lower than method-specified detection limits.

Method precision and accuracy determined. This may be determined using an MDL or IDL study. Replicates will be evaluated for precision; analyte values will be compared with spike amounts to determine accuracy. Any method-specified precision and accuracy criteria must be met.

All method performance results are reviewed and compiled by the section supervisor and reported to the QA Section. A final SOP is generated and distributed. SOPs are updated in ARLLC's SharePoint™ SOP Library.

SECTION 11: INSTRUMENT CONTROL

11.1 Detection Limits

To verify that reported limits are within instrument and method capabilities, three levels of detection have been established: method detection limits (MDL) or instrument detection limits (IDL), Limits of Detection (LOD) and Limit of Quantitation (LOQ) or reporting limits (RL). MDLs and IDLs are statistically based values, determined from replicate analyses of analytical standards. LOQ or RL are equivalent to the lowest concentration of analyte used to calibrate a specific analytical procedure. All limits will be calculated, summarized, and maintained (in SharePoint) by the QA Manager and are documented in Element LIMS. The QA Manager will share newly generated MDLs with primary analysts any time updates are made to existing limits.

<u>Method Detection Limits</u>

The method detection limit (MDL) is considered the lowest concentration of an analyte that a method can detect with 99% confidence. Detailed procedures ARLLC uses to determine MDLs are published in SOP 1018S. Method detection limits are established and verified for all analytical parameters except those for which there is no spike available.

MDL studies are conducted for all analyses performed by the laboratory on representative water, sediment and, tissue samples when appropriate and suitable sample matrices are available. MDL studies are performed on all instruments used for sample analysis. To allow for reevaluation of method performance, at least two spiked samples are analyzed each calendar quarter. These analyses are used to evaluate MDLs on an annual basis. An MDL study must be performed annually for each method used to analyze drinking water. MDL studies must be performed following changes in analytical methods or instrumentation.

11.2 Analytical Standards

Generation of high-quality results is dependent upon the use of accurately prepared analytical standards. Many stock standards used within the laboratory are commercially prepared solutions with certified analyte concentrations. Neat standards used for stock standard preparation are of the highest purity obtainable. Standard preparations are fully documented in Element LIMS.

Responsibilities

Laboratory staff involved with standards preparation must use good laboratory practices to ensure that all standards are correctly and accurately prepared, validated and documented. Management is responsible for ensuring that all staff members follow specified standards, preparation and inventory procedures. The QA Manager is responsible for periodically auditing standard preparation records to verify compliance with the laboratory Quality Assurance Program.

Organic Standards

ARLLC's Organic Analysis Lab uses commercially prepared stock solutions for instrument calibration and QC sample preparation. The manufacturers certify the accuracy and traceability of these standards. Analyte concentration(s), supplier, lot number and expiration date for the purchased standards are documented in Element LIMS. Stock solutions will be stored according to the manufacturer's instruction.

The purchased standards are diluted to prepare spiking solutions for instrument calibration and QC sample preparation. Working standard solutions are stored in amber bottles with Teflon-lined caps at appropriate temperatures. Each standard solution is labeled with the solution number, compound, analyst initials and its expiration date. The preparation and expiration of these working standards is documented in Element LIMS.

Working standards are verified accurate by comparing them with second source standards purchased from an alternate supplier.

Occasionally ARLLC will prepare standard solutions from neat chemicals. Requirements for preparation and documentation of such standards are published in ARLLC SOP 1018S.

Metals Standard Preparation

Commercially prepared single element stock solutions are used in ARLLC's Metals Laboratory. Preparation of working solutions from these single element stocks is documented in Element LIMS including the preparation date, expiration date, and analyst initials. Working calibration standards are prepared weekly for ICP analyses and bi-monthly for ICP-MS. Calibration verification standards are prepared as needed for ICP and ICP-MS analyses.

Standards preparation is performed in accordance with good laboratory practices. All preparation equipment will be thoroughly cleaned prior to and after use.

Inorganic (Wet Chemistry) Standard Preparation

Working standards for wet chemistry parameters are prepared on a daily basis and documented in Element LIMS. Stock and check standard solutions are replaced when they expire or are consumed. Stock and check standard solutions are labeled with the compound, preparation data (weight and volume), units of concentration, preparation date, expiration date, and analyst initials.

Standards preparation is performed in accordance with good laboratory practice. Glassware and other preparation equipment is thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Stock standards will be stored in appropriate containers at recommended temperatures.

11.3 Calibration

Instrumentation used in analytical processes must be in optimal operating condition and properly calibrated to ensure that ARLLC's data is of known and documented quality. Instrument verification and calibration are essential components of ARLLC's analytical procedures. Optimum operating conditions are verified through various tuning and calibration procedures outlined below. The procedures and acceptance criteria for evaluating the operation and calibration of instrumentation are detailed in ARLLC's analytical SOPs.

Gas Chromatography and Gas Chromatography/Mass Spectrometry (GC/MS)

The performance of GC/MS systems for either VOA or SVOA analyses is verified and documented through analysis of the following standard solutions:

1. Tune check is required prior to GCMS initial calibrations and prior to 600 series method sequences.

2. Calibration Standards- between five and eight calibration standards are analyzed immediately following instrument performance is verified. Each GC/MS must meet calibration criteria specified in the analytical SOP.

3. A Continuing Calibration Verification standard is analyzed at a minimum of every 12 hours for GC/MS or 10 samples for GC analyses during an analytical sequence. For continuing calibrations, minimum response factor and percent difference criteria are considered in evaluating the acceptability of the calibration.

The composition of the standards is method/analysis specific. System evaluation is performed prior to sample analysis. Evaluation criteria used for GC/MS analyses are as specified in analytical SOPs.

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data and will also note any corrective actions taken. Verification and calibration data is maintained in ARLLC's Element LIMS.

Internal standard responses and retention times for all standards are evaluated immediately after analysis. This serves as a baseline from which all sample internal standard responses and retention times are evaluated.

Inductively Coupled Plasma Atomic Emission Spectrometry (ICP)

1. Initial standardization is performed daily by analyzing a blank and four multiple element standards with a single concentration for each analytical wavelength.

2. The calibration is immediately verified with the analysis of an initial calibration verification standard (ICV) obtained from a source independent from the IC standard. The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values must be within $\pm$ 10% of the true value.

3. After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank must be $\pm$1 RL. Calibration blanks (CCB) are analyzed immediately following each calibration verification standard analysis.

4. Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Control limits have been set at $\pm$0.5RL and any sample determined to have a concentration below this standard is reported as undetected.

5. The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using standards of increasing concentrations. These standards are analyzed against the normal calibration curve and must be within 10% of their true value to verify linearity. At a minimum this upper range will be checked

every six months or whenever major changes are made to the instrument. Any sample analyzed with a concentration above 90% of this linear dynamic range must be diluted and reanalyzed.

6. To verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed at the start of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Cold Vapor Atomic Absorption (CVAA) Spectroscopy

1. CVAA instrumentation is initially calibrated using a minimum of three standards of varying concentrations and a calibration blank. Initial calibration is performed daily.

2. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The initial calibration verification standard value must be within ± 10% of the true value whereas the CCV will be considered in control if it is within ±20% for CVAA analysis.

3. After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank should be ±1 RL. Calibration blanks (CCB) are analyzed immediately following each calibration verification standard analysis.

4. Following calibration verification, a standard at the reporting limit is analyzed for all elements. Control limits have been set at 70–130% and any sample determined to have a concentration below this standard is reported as undetected. Any sample determined to have a concentration above the high calibration standard must be diluted and reanalyzed.

Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

1. Initial standardization is performed daily by analyzing a blank and four multiple element standards.

2. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

3. After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank must be ±1 RL. Calibration blanks (CCB) are analyzed immediately following each calibration verification standard analysis.

4. Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Control limits have been set at ±0.5RL and any sample determined to have a concentration below this standard is reported as undetected.

5. The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using high level standards. These standards are analyzed daily, or as necessary, against the normal calibration curve and must be within 10% of their true value to verify linearity. Any sample analyzed with a concentration above 90% this linear dynamic range must be diluted and reanalyzed.

6. To verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed at the beginning of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Inorganic Analyses other than Metals (Conventional Analyses)

Instrumentation and equipment used in analyzing samples for conventional wet chemical parameters (predominantly inorganic anions and aggregate organic characteristics) are evaluated through the analysis of either internally prepared primary standards or externally derived Standard Reference Materials.

Depending upon the analysis, calibration is based upon direct stoichiometric relationships, regression analysis, or a combination of the two. Stoichiometry generally involves standardization of a titrant against a known primary standard and then the use of that titrant for determining the concentration of an unknown analyte (e.g., the use of sodium thiosulfate in the iodometric titration of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between analyte concentration and the response produced by the measurement employed. Regression analysis is used for colorimetric determinations, ion specific electrode analysis and ion chromatography. The curve of response versus concentration is fit by the method of least squares using linear, polynomial or logarithmic regression dependent upon the pattern of response being measured. The regression coefficient will be greater than or equal to 0.995 for the calibration to be considered acceptable.

Calibration is repeated as required by the analytical method, ARLLC's SOP or specific instrumentation. Immediately following calibration, the analysis of an Initial Calibration Verification standard (ICV) and Initial Calibration Verification Blank (ICB) verify the standardized titrant or the calibration curve. The verification standard is derived from a source other than that used for standardization or development of the standard curve. The ICV must return a value within 10% of its known concentration. The ICB must be less than the Reporting Limit (RL) or the lowest point on the standard curve, whichever is less. Initial calibration verification must be successfully completed prior to the analysis of samples.

Calibration verification is repeated after every ten samples processed during an analytical run. This Continuing Calibration Verification (CCV) will validate the method performance through an analytical sequence. If the continuing calibration values for either the standard or blank are out-of-control, the analyst will prepare a fresh CCV standard to verify the outlying condition. When the condition is verified, the analysis will stop, and the method will be re-calibrated. All samples run between the outlying CCV and the preceding in-control CCV will be re-analyzed. In-control verification standards and blanks must bracket all samples within an analytical run.

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SECTION 12: DATA VALIDATION and REVIEW

ARLLC performs four levels of review on one hundred percent of laboratory data generated. The review process is outlined below and detailed in SOPs 206S-Inorganic Data Review and 207S-Organic Data Review.

The four levels of review are:

1. Analyst review
2. Peer review
3. Supervisory review
4. Administrative review.

In addition, Quality Assurance coordinates a review of 10% or more of all completed data packages for compliance with ARLLC's Quality Assurance Plan. The data validation outlined below is in addition to the initial project review in Section 7 and QA reviews outlined in Section 11. A determination, at any point during the analysis, reporting, or review process that data may be unacceptable, requires a prompt corrective action. Corrective actions are determined on a case-by-case basis. Every employee involved in data reporting and review must have knowledge of ARLLC's quality control requirements and be responsible for identifying occurrences that require corrective action.

Two levels of review, such as Peer and Supervisory, may occur concurrently.

12.1 Analyst review:

Each analyst is responsible for producing quality data that meets ARLLC′s established requirements for precision and accuracy and will meet a client's expectation.

Prior to sample preparation or analysis an analyst will verify that:

1. Sample holding time has not expired.
2. A description of the sample or extract condition is described accurately on the laboratory bench sheet.
3. Specified methods of analysis are appropriate and will meet project required Data Quality Objectives.

4. Equipment and Instrumentation are in proper operating condition.
5. Instrument calibration and/or calibration verification are in control.

During sample preparation or analysis an analyst will:

1. Verify that Method Blanks and Blank Spike Samples are in control.
2. Verify that QC (replicate, matrix spike analyses, CRM, etc.) samples meet precision and accuracy requirements.
3. In addition to verifying that quality control requirements are acceptable, the analyst will review each sample to determine if any compound of interest is present at levels above the calibrated range of the instrument.
5. Check for data translation or transcription errors
6. Record all details of the analysis in the appropriate bench sheet or logbook.
7. Note any unusual circumstances encountered.

Following the analysis or sample preparation an analyst will:

1. Examine each sample and blank to identify false positive or false negative results.
2. Determine whether any sample requires reanalysis due to unacceptable QC.
3. Review data for any unusual observances that may compromise the quality of the data, such as matrix interference
4. Verify that data entry and calculations are accurate with no transcription errors
5. Document anomalous results or analytical concerns on the bench sheet, corrective action form or Analyst Notes for incorporation into the case narrative.
6. Note data with qualifying flags as necessary.
7. Enter reviewed data into Element LIMS, incorporate all necessary sample and quality control information into the data package and forward it for further review.

12.2 Peer review:

A second analyst trained in the appropriate SOPs will complete a peer review. Peer review will include at a minimum:

1. Verification that all QA (holding times, calibrations, method blanks, BS, spiked sample analyses, etc.) criteria are in control.
2. Review of the data for possible calculation and transcription errors.
3. Review bench sheets and analyst notes for completeness and clarity.
4. Approve the analytical results or recommend corrective action to the laboratory supervisor.
5. All corrections should be saved, and data should be re-queried to verify completeness before continuing review.

When a second trained analyst is. not available a peer review is not completed.

12.3 Supervisory Review:

Following analyst and peer review, data is forwarded to the laboratory supervisor for review. The supervisor will:

1. Review the data package for completeness and clarity.
2. Follow-up on the peer review recommendations.
3. All corrections should be saved, and data should be re-queried to verify completeness before continuing review

Designated reviewers normally perform the peer and supervisory reviews for GC-MS data.

12.4 Administrative Review:

Administrative review is the final data validation process. Designated reviewers in the Metals, Conventional and Organic laboratories perform administrative reviews. Personnel performing the administrative review are responsible for the final sign-off and release of the data. Administrative reviewers release the data to a Project Manager for incorporation into the final data deliverable package.

Administrative review will:

1. Verify that the analytical package submitted for reporting is complete and contains all necessary information and documentation.

2. Verify that appropriate and necessary data qualifying flags have been applied (Listed in Appendix N).
3. Verify that method blank and BS data are acceptable, quality control requirements are met for surrogates in all samples and blanks, and that all necessary re-analyses or dilutions were performed.
4. Check the technical validity (i.e., are total metal ≥ dissolved metals, is the cation/anion balance correct, etc.) of the complete data set.
5. Verify that all necessary final data reports are generated and that all necessary data and documentation are included in the package.
6. Approve data reports for release.

12.5 Quality Assurance Review

10% of all final data packages are reviewed by ARLLC's QA staff for QA/QC compliance This assessment includes, but is not limited to, review of the following areas:

1. Reporting and analysis requirements
2. Initial and continuing calibration records
3. Quality control sample results (method blank, BS, spikes, replicates, reference materials)
4. Internal and surrogate standard results
5. Detection and reporting limits
6. Analyte identifications

Data review activities are summarized and documented by the reviewer. The review notes are filed with the associated raw data in the project file. Any QA-related deficiencies identified during the data review will be forwarded to the QAM for corrective action.

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SECTION 13: QUALITY CONTROL SAMPLE ANALYSIS AND EVALUATION

Routine analysis of quality control (QC) samples is necessary to assess or validate the quality of data produced in ARLLC's laboratory. ARLLC routinely utilizes the following quality control analyses as defined in Section 11.3:

1. method blank (MB)
2. storage blank (SB)
3. surrogate standard analyses (SS)
4. blank spike (BS)
5. blank spike duplicate (BSD)
6. certified reference material (CRM)
7. sample (matrix) duplicate (MD)
8. matrix spike (MS)
9. matrix spike duplicate (MSD)

The number and type of QC analyses depend on the analytical method and/or the QA/QC protocol required for a specific project. A range of acceptable results is defined for each type of QC analysis. When the results of all quality control analysis are acceptable, the analysis is considered to be "in-control" and the data suitable for its intended use. Conversely, quality control sample results that do not meet the specified acceptance criteria indicate that the procedure may not be generating acceptable data and corrective action may be necessary to bring the process back "in-control".

Detailed information concerning sample preparation batches, QC analyses and surrogate standards follow:

13.1 Sample Preparation Batch

All QC samples are associated with a discrete sample preparation batch. A preparation batch is defined as 20 or fewer field samples of similar matrix processed together by the same analysts, at the same time, following the same method and using the same lot of reagents. Additional batch requirements may be specified in ARLLC's standard operating procedures. Each preparation batch is uniquely identified. All samples, field and QC, are assigned an Element LIMS ID number and are linked to their respective preparation batch. Each sample batch will contain all required QC samples in addition to a maximum of twenty field samples.

ARLLC will accommodate client, QC protocol or QAPP specific sample batching schemes.

13.2 QC Sample Requirements

Each preparation batch will include, at a minimum, a method blank (MB) and a blank spike (BS). Additional QC samples may be analyzed based upon the specific QC protocol, data deliverable or client requirements. ARLLC recommends that QC samples used to measure analytical precision also be included in each sample batch. These may include: a matrix spike and a matrix spike duplicate pair; a sample duplicate and a matrix spike pair or a Blank Spike Duplicate (BSD) for comparison with the Blank Spike (BS).

13.3 QC Sample Definitions

13.3.1 Method Blank (MB)

A method blank is an aliquot of water or solid sample matrix that is free of target analytes and processed as part of a sample batch. An acceptable method blank verifies that contaminants or compounds of interest are not introduced into samples during laboratory processing. Method blanks are spiked with surrogate standards for all organic analyses.

ARLLC defines an acceptable method blank as one that contains no target analytes at a concentration greater than ARLLC's reporting limit or 5% of an appropriate regulatory limit or 10% of the analyte concentration in the sample whichever is greatest. Clients may specify other MB acceptance criteria on a project basis.

A minimum of one method blank will be included in each preparation batch. A maximum of twenty samples may be associated with one method blank. An acceptable method blank is required prior to analysis of field samples from a preparation batch.

The results of the method blank analysis will be reported with the sample results.

13.3.2 Storage Blank (SB)

Storage blanks are organic-free water samples placed in each volatile organic sample storage refrigerator to monitor for possible cross-contamination of samples within the storage units. A storage blank from each refrigerator will be analyzed every 7 days. Storage Blank analyses is reviewed by laboratory management and archived in ARLLC's Element LIMS.

13.3.3 Blank Spike Sample (BS)

A BS is processed as part of each preparation batch and is used to determine method efficiency. A BS is an aliquot of water or solid matrix free of target analytes to which selected target analytes are added in known quantities. Analytes spiked into BS samples are listed in ARLLC's method SOPs. BS samples are spiked with surrogate standards for all organic analyses.

Following analysis, the percent recovery of each added analyte is calculated and compared to historical control limits. Current control limits are available in Element LIMS. When calculated recovery values for all spiked analytes are within specified limits, the analytical process is considered in control. Any recovery value not within specified limits requires corrective action prior to analysis of client samples from the associated preparation batch.

A minimum of one BS will be prepared for each sample preparation batch. BS analyses for those methods not requiring pre-analysis sample preparation are performed after each continuing calibration. The results of all BS performed are reported with the sample results. A maximum of twenty samples may be associated with one BS.

Clients or QA protocol may require the analysis of a duplicate BS. When BS duplicates are analyzed the failure to meet QC limits of any analyte in either BS will trigger a corrective action.

13.3.4 Replicate Analysis

Replicate analyses are often used to determine method precision. Replicates are two or more identical analyses performed on subsamples of the same field sample at the same time.

Replicate analyses should be performed on samples that are expected to contain measurable concentrations of target analytes.

The calculated percent difference between replicates must be within specified limits or corrective actions are required. Percent differences exceeding the specified limit signal the need for procedure evaluation unless the excessive difference between the replicate samples is clearly matrix related.

For inorganic analyses, a minimum of one replicate set is processed for each analytical batch. Replicate sample analyses are not routinely performed for organic parameters. Instead, analytical precision is evaluated through the analysis of a duplicate matrix spike sample (MSD).

In order to perform replicate analyses, ARLLC's must receive sufficient volume to prepare the replicate aliquots.

Field replicates submitted to the laboratory are analyzed as discrete samples.

13.3.5 Matrix Spike

A matrix spike is an environmental sample to which known quantities of selected target analytes are added. The matrix spike is processed as part of an analytical batch and is used to measure the efficiency and accuracy of the analytical process for a particular sample matrix. The analytes spiked into MS samples are listed in ARLLC's method specific SOPs. MS samples are spiked with surrogate standards for all organic analyses.

Following MS analysis, the percent recovery of each spiked analyte is calculated and compared to historical control limits. If recovery values for the spiked compounds fall within specified limits, the analytical process is considered to be in control. When calculated recovery is outside of historical limits corrective action is recommended.

Matrix spike duplicate (MSD) analyses are often used to measure method precision and accuracy. In this case the relative percent difference (RPD) for recovery of spiked compounds is calculated and compared to established criteria.

When directed by a client, ARLLC will prepare a matrix spike and a duplicate with each batch of samples for inorganic analysis and an MS/MSD set for each batch of samples for organic analyses. Analyte recovery and RPD values are reported with sample data.

13.3.6 Reference Material (RM)

A CRM (Certified Reference Material) is material analyzed and certified by an outside organization to contain known quantities of selected target analytes independent of analytical method. CRMs are purchased from outside suppliers and are supplied with acceptance criteria and a signed certificate of analysis.

SRM (Standard Reference Material) are like CRMs but may come with no certificate of analysis (i.e., Puget Sound Reference Material)

Analysis of a RM (Reference Material) is used to assess the overall accuracy of ARLLC's analytical process. RMs are routinely analyzed with each batch of samples for wet chemistry (conventional analysis) and for organic and metals analysis when requested.

Any information received with a SRM will be attached to the standard entry in Element. Each CRM must be accompanied with a signed certificate of analysis from the vendor. The certificate of analysis .pdf must be attached to the standard entry in Element. Control limits will be taken directly from the certificate using the acceptance interval whenever possible. Standard deviation, uncertainty and expanded uncertainty may not be used to generate CRM control limits. When acceptance interval limits are not provided by the vendor then ARLLC will use control limits of 50-150%. Compound recovery values not within the specified limit may signal the need to evaluate the analytical process.

It is important to realize that certified values in a RM may be determined using analytical methods different from those routinely used by ARLLC. For this reason, direct comparison of ARLLC's results with certified values may not be a valid indicator of the laboratory's proficiency.

13.3.7 Other Quality Indicators

In addition to analyzing the quality control samples outlined previously, various indicators are added to environmental samples to measure the efficiency and accuracy of ARLLC's analytical process. Surrogate standards are added to extractable organic samples prior to extraction to monitor extraction efficiency. Surrogate standards are also added to volatile organic samples prior to analysis to monitor purging efficiency. Internal standards are added to metals digestates for ICP-MS analyses and to organic samples or extracts prior to analysis to verify instrument operation.

The calculated recovery of surrogate analytes is compared to historical control limits to aid in assessing analytical efficiency for a given sample matrix.

13.4 Acceptance Limits / Control Limits

Acceptance limits provide a means for evaluating whether a process is in control. Acceptance limits are normally calculated from ARLLC's historic but may also be specified in an analytical method or QA protocol. These are based on internal, historical data for organic analyses and method specified limits for inorganic analyses. Samples associated with a specific program or contract (such as the USEPA Contract Laboratory Program) are evaluated against program/contract-specified criteria. Routine samples are evaluated against internally generated control limits. Project specific control limits may be used when requested following review and approved by laboratory management.

QC Limits are calculated in Element LIMS using historic data as described in SOP 1005S. Control limits will be generated for BS compound recoveries and surrogate recoveries on a method / matrix specific basis. Advisory control limits are utilized for analyses performed on an infrequent basis until a sufficient number of usable data points (20 or more) are collected. Control limits are updated at least annually but may be updated more frequently if method or instrument changes have been made. Laboratory control and acceptance limits are published in Element LIMS.

Analysts are required to verify that all QC analyzes are in control when performing an initial data review. All out of control QC recoveries require a documented corrective action. ARLLC will not use control limits for organic analyses that are greater than 80% for the lower limit or less than 120% for the upper limit.

13.5 Control Charts

Control charts, in conjunction with other control sample analyses, are useful in verifying that an analytical procedure is performing as expected. The control chart provides a pictorial representation of how closely control sample results approximate expected values, as well as showing analytical trends. Indicated on the control chart are the mean and upper and lower warning and action limits. The warning and action limits are used to determine whether or not an analytical process is in control. The mean is used to determine whether results obtained for a procedure are trending upward or downward, which may ultimately affect the accuracy of sample results.

Control charts are generated from historical data using Element LIMS. The QA Manager will coordinate generation of control charts based on laboratory data at least quarterly. These control charts are distributed to and reviewed by section supervisors and managers. Any significant trends or variations in results will be identified, and the source of the trend corrected. At the bench/instrument level, individual results from quality control samples are evaluated against the acceptance limits.

SECTION 14: LABORATORY CORRECTIVE ACTIONS AND REESTABLISHMENT OF CONTROL

To produce quality data, it is important that all aspects of the analytical process are under control and that all specified quality control criteria are met. Occasionally, however, procedures, reagents, standards, and instrumentation fail to meet specified criteria. Should any of those situations occur, the quality of data produced may be compromised. When procedures no longer appear to be in control, sample processing is halted, and appropriate actions will be taken to identify and rectify any instrument malfunctions or process-related issues. Prior to resuming sample analysis, verification of control is made through the analysis of various control samples. Actions taken and observations made during reestablishment of control are fully documented on the associated laboratory bench sheet or Analyst Notes form. Only when control is regained and all actions documented will sample processing resume. This ensures that no results generated during the suspect period are reported.

14.1 Responsibilities

It is the responsibility of all laboratory personnel involved with sample processing to determine whether or not a procedure is in control and to verify that all data are produced under conditions that are "in control". It is at the analytical level that unacceptable conditions are most easily detected and corrected. Laboratory personnel are also responsible for employing and documenting all necessary corrective actions taken to regain control of a procedure. Samples processed during suspect periods are reprocessed, and suspect data will be appropriately annotated to indicate that it is of questionable quality. Analytical staff will verify that all data submitted for review has been generated under acceptable conditions. All anomalies are documented on the Analyst Notes form and must include such information as: type and source of anomaly, reasons for the anomaly, and actions taken to correct the problem. All personnel involved with subsequent and final data review are responsible for verifying that data is generated under acceptable conditions. If suspect data are identified at the review level, responsible analysts are contacted to determine whether additional actions (such as reanalysis) will be taken. In addition, reviewers will confirm that anomalies noted by the analyst were addressed and that appropriate corrective actions were taken.

On occasion, it is not possible to generate data that meet all Quality Control Standards. This may be due to sample volume limitations or sample matrix effects. It is the responsibility of the analytical and data review staff to document these situations and to maintain communication with the Project Management staff. The Project Management staff, in turn, is responsible for notifying the client or specifying any additional further action. Project Managers must also ensure that clients fully understand which data are questionable and the why acceptable results could not be generated.

It is the responsibility of the QA Manager to perform regular reviews of corrective action procedures to ensure that unacceptable conditions or suspect data will be identified prior to releasing results. Section managers and supervisors are responsible for ensuring that appropriate corrective action procedures are in place and that all staff members are trained to identify and act upon “out of control” situations.

14.2 Corrective Actions

There are various stages of the analytical process where the procedure may fall out of control and require corrective action. In general, all procedures and equipment are monitored to verify that control is maintained during sample processing. The following details those stages as well as the actions taken to reestablish and verify control.

Sample Preparation

During sample preparation, all glassware associated with a specific sample will be clearly labeled to eliminate the possibility of sample mix-up or mislabeling. Laboratory staff will ensure that sample-identifying labels are accurately completed and that correct sample identification is maintained at all times. If a sample appears to have been misidentified or mixed with another sample during preparation, the suspect samples will be discarded and new aliquots taken. If there is insufficient sample for a second preparation, the situation will be documented on the bench sheet and the PM notified immediately.

Addition of surrogate standards or matrix spiking solutions is carefully monitored to ensure that all samples are accurately fortified. Volumes and standard solution numbers of all standards added to samples are recorded on the bench sheet. If there is suspicion that a sample has been incorrectly spiked a new sample aliquot should be prepared. If there is insufficient volume for re-preparation, the bench sheet is annotated to indicate which samples may be inaccurately fortified.

When sample matrix hinders processing following standard procedures, the section supervisor or manager must be consulted for guidance on appropriate actions. Preparation of less sample or alternate procedures may be necessary. Deviations from normal analytical protocols must be documented on the bench sheet.

If at any time during sample preparation, sample integrity appears compromised or a procedural error is noted, the sample will be discarded and re-prepared. If insufficient sample volume is available for re-preparation, the situation is documented on the bench sheet and the PM immediately notified.

Calibration and Tuning

Prior to sample analysis, all analytical instruments are calibrated and tuned to ensure that equipment meets criteria necessary for production of quality data. Analytical instruments must meet the calibration criteria specified in ARLLC's SOP. When these criteria are not met, corrective actions must be completed. All corrective actions are accurately and completely documented in the "analysts notes" and attached to the calibration data in Element LIMS. The corrective action must, explain the problem, list actions taken, and document verification that the issue was resolved. Samples will not be analyzed until an initial verification of system performance has been made. When continuing calibration results do not meet criteria, sample analysis will not resume until corrective actions are completed and the system re-calibrated.

GC/MS Analyses - Analysis of the instrument performance check solution (BFB or DFTPP) will meet the specified ion abundance criteria. Initial calibration standards at a minimum of five concentrations will meet specified response factor and percent relative standard deviation criteria. If criteria are not met for initial calibration; the system will be inspected for malfunction. The initial tuning and calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve is performed at the frequency specified in ARLLC's SOP or the referenced analytical method. All response factor criteria must be met. Additionally, the percent difference between the initial and continuing calibrations will meet specified criteria. If criteria are not met, the system will be inspected for malfunction. The initial tuning and calibration verification will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

Internal standard responses and retention times for standards will meet specified criteria. Any sample not meeting internal standard criteria will be reanalyzed. If reanalysis yields the same response and the instrument is determined to be functioning correctly, the failure to meet criteria will be attributed to sample matrix interference. No further re-analyses will be required.

GC Analyses - Organochlorine pesticide calibrations will be evaluated using criteria specified in ARLLC's SOPs. The Resolution Check standard must meet resolution criteria and Endrin and DDT breakdown in the Performance Evaluation Mix standard must meet criteria. Initial calibrations will meet percent relative standard deviation criteria. If, during the initial calibration sequence, criteria are not met, the system will be inspected for malfunction and the initial calibration be reanalyzed. Samples are not analyzed until all initial calibration criteria are met.

Continuing calibrations using a mid-level calibration standard or a Performance Evaluation Mix standard are analyzed at the frequency required by the reference method. Specific method or matrix requirements are documented in the ARLLC's SOPs. If continuing calibration criteria are not met, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples previously analyzed between the acceptable and unacceptable continuing calibration are reanalyzed.

If, during the analytical sequence, retention time shifting occurs, the system is inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration is performed. After the system has been successfully corrected or re-calibrated, all samples with retention times outside the specified windows will be reanalyzed.

For all GC analyses other than chlorinated pesticides, initial calibration standards analyzed at a minimum of five concentrations will meet percent relative standard deviation criteria. If criteria are not met for initial calibration, the system will be inspected for malfunction. The calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

The calibration is verified after every 10 samples. All percent differences between the initial and continuing calibrations must meet specified criteria. When criteria are not met, the system will be inspected for malfunction and re-calibration will be performed. Samples analyzed between an acceptable and unacceptable calibration check will be reanalyzed.

Metals and Inorganic Analyses - Initial calibrations will be verified by analyzing a calibration check standard immediately after calibration. The calibration is verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values must be within ± 10% of the true value.

The calibration check standard analyzed after every 10 samples will meet percent difference criteria. If the calibration check standard is not acceptable, the system will be inspected for malfunction and re-calibration will be performed as necessary. Samples analyzed between acceptable and unacceptable calibration check standards will be reanalyzed.

Instrument Blanks

Prior to sample analysis, instrument and/or calibration blanks may be analyzed and evaluated for the presence of target analytes. When analytes are detected at levels above reporting limits, the source of contamination will be identified. Sample analysis will not commence until analyte levels in instrument and calibration blanks are below the reporting limits. Instrument and calibration blanks are analyzed for VOA analysis only if sample carryover is suspected.

Instrument and calibration blanks may also be analyzed throughout the analytical sequence. These will not contain target analytes at levels above the method detection limits for organic parameters or the reporting limit for inorganic parameters. If one or more analytes exceed the RL, an additional blank is analyzed. If analyte levels are still above the method detection limits, the system is inspected for malfunctions and the source of contamination identified and removed. Sample analysis will not resume until instrument and calibration blank analyte levels are below the RL. Organic samples analyzed between acceptable and unacceptable blanks will be evaluated using the following guidelines:

If no target analytes are detected in the samples, reanalysis is not be required.

If sample target analyte levels are above the method detection limits, reanalysis is samples at the analyst's discretion. Reanalysis will be dependent upon the concentration of the analyte and whether or not there is likelihood that contamination results from sample carryover.

If the analytes present at unacceptable levels in the instrument blank are not of interest or concern in the associated samples, reanalysis may not be required. This is often a consideration for ICP analyses where analytes of concern may be only a subset of the possible analytes.

Methods for the analysis of inorganic analytes require that all samples associated with an out-of-control blank be re-analyzed.

Method Blanks (MB)

Prior to any sample analysis, method blanks are evaluated for the presence of target analytes. Acceptance criteria for MBs are published in reference methods or quality systems documentation and detailed in ARLLC's analytical SOPs. When analytes are detected at or above acceptance criteria, a corrective action must be initiated.

Blank Spike Samples

Prior to sample analysis, a blank spike (BS) will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If BS recoveries are out of control, corrective action is required. Corrective actions may include one or more actions from a written explanation in the case narrative up to re-preparation and reanalysis of the entire sample batch.

Internal Standards

Some of ARLLC's analytical procedures utilizes an internal standard (IS) to assess method performance. Acceptance criteria for ISs are published in reference methods or detailed in quality systems documentation. If any internal standard does not meet acceptance criteria, a corrective action must be initiated as detailed in ARLLC's method specific SOPs.

Surrogate

Surrogate standards are commonly used to assess method performance. Acceptance limits for surrogate recovery are published in quality systems documentation or reference methods and detailed in ARLLC's analytical SOPs. When surrogate recovery values are outside acceptance limits, a corrective action must be initiated. Corrective actions are generally method specific and may result in repreparation and reanalysis of samples.

Matrix Spikes

Matrix spike (MS) analyses are performed when required by specific analytical protocol or client request. MSs are evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If unacceptable recoveries are obtained a corrective action is initiated as detailed in ARLLC's analytical SOPs. A post-digestion spike analysis will be performed for all metals analyses that must adhere to EPA-CLP guidelines or when specifically requested by ARLLC's client

Sample and Matrix Spike Replicates

When required by analytical protocol or client's request, sample and matrix spike replicates are evaluated to verify that percent differences between the replicates are within acceptance limits. If unacceptable recoveries are obtained a corrective action is initiated as detailed in ARLLC's analytical SOPs.

Samples

In addition to monitoring sample quality control indicators, ARLLC evaluates samples to determine the need for reanalysis. Conditions considered while evaluating samples are:

If a target analyte detected in a sample exceeds the upper limit of the instrument calibration range, the sample is diluted and reanalyzed. Dilution and reanalysis continue until the analyte concentration falls within the linear range of calibration. If the sample requires dilution to such a level that surrogates are no longer detectable and analytical accuracy is questionable, the sample may be re-prepared using less sample.

Samples will be evaluated for matrix interference that may affect analyte detection and quantification. Appropriate cleanup procedures will be employed to remove interference. Samples may be diluted and reanalyzed to minimize background interference. When interference cannot be removed, reported results will be qualified as appropriate.

When, in an analyst's judgement, low-level analytes detected in a sample may result from carryover, the sample will be reanalyzed. If analyte levels remain approximately the same the initial results will be considered valid. If analytes are not detected during reanalysis, it will be assumed that the initial detection was due to carryover, and the initial results will not be reported.

If an instrument malfunction or procedural error occurs during analysis, all affected samples will be reanalyzed. If the malfunction appears to be an isolated incident, it will not be necessary to inspect the analytical system. If the malfunction appears to be an ongoing problem, the system will be inspected, and maintenance/corrective actions performed prior to resuming analysis.

Sample Storage Temperatures

Acceptable temperatures range for samples that require cooling for preservation are 0°C ≤ T ≤ 6°C for refrigerators and < -15°C for freezers. ARLLC employs an electronic monitoring system to record refrigerator and freezer temperatures every 30 minutes. When a temperature is outside the acceptance range, the system sends an e-mail message to the appropriate laboratory supervisor and the QA department. Laboratory Supervisors are responsible for determining why the temperature is "out of control" and performing a corrective action. When the cooling device will be "out of control" for more than 30 minutes the samples are temporarily transferred to a properly functioning cooler or freezer.

Balance Calibrations and Certified Weights

Analysts verify and document the accuracy of analytical balances daily before use. Balances must demonstrate a variance of < 5% or 5 mg whichever is less for weights that bracket the working range of the balance. Staff must remove an out-of-control balance from service and notify the laboratory supervisor who will initiate a corrective action. The balance is retired from service until it is repaired and demonstrated to be back in control. Staff document daily balance checks in a balance specific balance logbook.

In addition, ARLLC outsources an annual service and calibration for each balance to a NIST certified vendor.

Water Supply System

The water supply for the volatile organic and inorganic laboratories will be monitored daily for the presence of contaminants through the analysis of method and/or instrument blanks. Organic contaminants, especially chloroform, are early indicators of the need for preventative maintenance. If organic or other contaminants are detected, the system filters are changed. After filters have been changed, an additional aliquot of water will be analyzed to confirm that contaminants are no longer present.

The water supply for the metals laboratory is monitored daily. When the resistivity falls below 18 megaohm, system maintenance is performed.

Section 15: LABORATORY EVALUATIONS, AUDITS AND CORRECTIVE ACTION SYSTEM

15.1 Internal Audits

Routine evaluations or internal audits of laboratory activities ensure complete and effective implementation of established policies, procedures and quality control requirements. Findings from the evaluations allow ARLLC to discover and correct activities not in compliance with the laboratory Quality Assurance Program or accreditation program requirements. ARLLC's QAM schedules internal audits on an annual basis following the guidelines in Appendix K.

Checklists described in SOP 1005S ensure consistent and complete audits. Deficiencies noted during the course of an audit are documented as an issue using ARLLC's Corrective Action System. Issues are investigated, a root cause analysis performed, and appropriate corrective actions implemented. Follow-up audits ensure that corrective actions have been satisfactorily implemented.

When an audit finding indicates possible errors or deficiencies in analytical data, ARLLC will correct the error and notify all affected clients within 2 working days.

Activities or procedures routinely audited include: The QAM or designee routinely audits the following activities:

Balance verification records
Sample storage cooler temperature records
Oven, incubator and water bath temperature records
Chain of Custody records
Standard preparation records
Documentation and Response to Client Complaints
Chain of Custody Procedures
Documentation of Computer and Software Revisions
Calibration records
Maintenance records

Control charts

Adherence to SOPs and methods

Support system records (DI water, balances, pipettes, etc.)

Detailed review of specific analytical methods

Data package review

15.2 Audits by Outside Agencies (External Audits)

Agencies that accredit ARLLC perform periodic assessments (external audits) of laboratory procedures and/or QA documentation. These assessments may take place at ARLLC’s facility (on-site audits) or may be a review of documents delivered to the assessor’s location (off-site audits). External audits provide an independent evaluation of laboratory procedures without internal influence or bias. ARLLC will review all comments, deficiencies, and areas of potential improvement noted by external assessors and implement appropriate corrective actions.

Appendix M lists agencies that accredit and audit ARLLC’s laboratory.

15.3 Performance Testing (PT) Analyses

PT sample analysis is an integral part of ARLLC’s QA program. PT samples contains specific analytes in concentrations unknown to ARLLC personnel. Laboratories obtain PT samples from, and report analytical results back, to a specific PT provider. The provider compares the laboratory’s results with “true” values and reports the results directly to accrediting agencies. Accuracy of the reported result indicates the laboratory's ability to perform a given analysis. Performance Testing (PT) sample analysis is a means of evaluating individual performance as well as the overall analytical system. PT sample analysis is a requirement of certification and accreditation programs. ARLLC routinely analyzes two PT samples annually for each of its accredited analyte/matrix combinations. ARLLC also uses PT analyses to document the analytical proficiency of individual analysts

Reports/results from PT providers are shared with department supervisors, who, in turn, share the data with the pertinent analyst(s). For every PT result outside of the PT providers acceptance range, the QA Manager opens a corrective action within the CA database and assigns the initial response responsibility to the appropriate department supervisor.

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15.4 Quality Assurance Reports to Management and Staff

In order to ensure that laboratory managers are kept apprised of quality related activities and laboratory performance on an ongoing basis, quality assurance is discussed each week during the ARLLC Staff Meeting that includes executive and supervisory staff. The agenda, at a minimum includes:

1. Information concerning current and ongoing internal and external audits
2. Status and results of current or ongoing internal or external proficiency analyses
3. Identification of Quality Control problems in the laboratory
4. Information on all ongoing Corrective Actions
5. Current status of external certifications
6. Current status of the Staff Training Program
7. Outline of new and/or future Quality Assurance Program initiatives

The application of the above combined activities provides comprehensive monitoring and assessment of laboratory performance and ensures that all data produced by ARLLC will be of the highest possible quality.

15.5 Annual Management Review

In the last quarter of each year, executive management will perform a comprehensive review of ARLLC quality system and analytical procedures to assess their continued suitability and effectiveness. Management will consider the following during the review process:

1. Suitability of policies and procedures
2. Reports from management and supervisory personnel
3. Results of internal audits
4. Corrective and preventative actions
5. Results of recent external quality systems audits
6. PT results
7. Changes in volume and type of analyses performed
8. Client Feedback
9. Complaints
10. Recommendations for Improvement

11. Topics specific to Department of Defense (DoD) accreditation (see: Form 12207F *Annual DoD Management Review*)
12. Other relevant factors such as quality control activities, available resources and analyst training

15.6 Corrective Action System

The Corrective Action System is an electronic system used by ARLLC to record errors, omissions or other issues of concern and document corrective and preventative actions taken in response to those issues. The details of the system are discussed in SOP 1005S.

Corrective Actions are initiated when any deficiencies or concerns are noted in the laboratory QA program through any of the following mechanisms:

1. <u>Internal Assessments.</u>
2. External Assessments.
3. Out of Control PT results.
4. Review of Analyst Notes.
5. Employee concerns or observations.
6. Anonymous Reports using Anon Staff Survey (located on intranet homepage)
7. Management Review.
8. Client complaints or concerns.

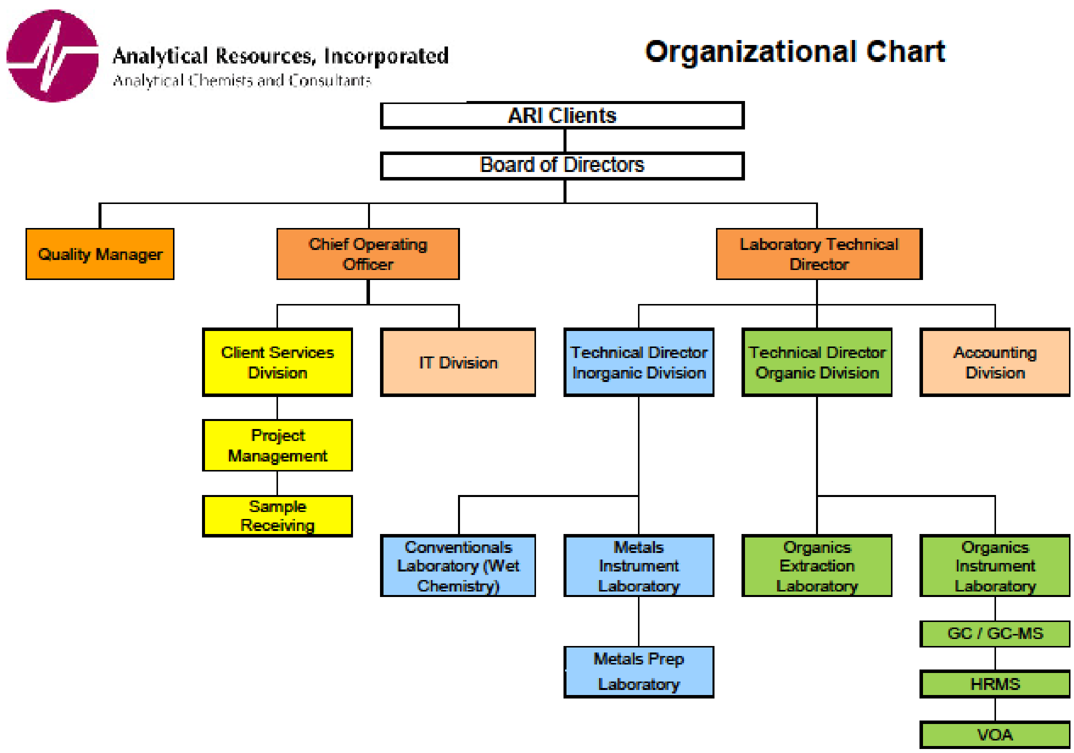
After discussing the issue with the appropriate personnel, the filed corrective actions are discussed in the weekly workload meeting with all managers and supervisors and included on the QA Quarterly report. As the issues are worked on and documented in the system, key personnel are kept informed of status via automatic email updates. The goal is to resolve all issues in a thorough and timely manner.

Section 16: APPENDICES

A. Laboratory Organization and Key Personnel Resumes
B. Training and Demonstration of Proficiency
C. Laboratory Facilities
D. Laboratory Instrumentation and Computers
E. Standard Operating Procedures
F. Sample Collection Containers, Preservation and Holding Times
G. Laboratory Workflow
H. Analytical Methods
I. Method Detection Limits and Reporting Limits
J. Quality Control Recovery Limits
K. Internal Audit Schedule
L. Laboratory Accreditations
M. Data Reporting Qualifiers
N. Standards for Personal Conduct
O. QA Policies
P. References

Appendix A

Laboratory Organization Chart
and
Key Personnel Resumes



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KEY PERSONNEL RESUMES

Mark Weidner

Data Review (and former Laboratory Technical Director)

Profile

Mr. Weidner co-founded Analytical Resources, Inc., along with Brian Bebee, Sue Dunnihoo and David Mitchell. Prior to his co-founding of Analytical Resources, Inc. in 1985, Mr. Weidner was the Head Mass Spectroscopist at Michigan State University and an instructor at the Finnigan Institute. As Laboratory Director, Mr. Weidner is responsible for overall laboratory performance, as well as facility expansion and major purchasing. Mr. Weidner is intimately familiar with all operational and analytical aspects of Analytical Resources and initiated many of the procedures currently in use.

Education:

M.S., Medicinal Chemistry, Purdue University, W. Lafayette, IN (1978)

B.S., Biochemistry, Michigan State University, E. Lansing, MI (1975)

Experience:

Laboratory Director/Co-founder, Analytical Resources, LLC, Seattle, WA (1985 to present).

Senior Chemist, City of Seattle, Seattle, WA (1981 to 1985).

Instructor, Finnigan Institute, Cincinnati, OH (1979 to 1981).

Mass Spectroscopist, Michigan State University (1978 to 1979).

Brian Bebee

Data Review (and former Technical Director-Organics Division)

Profile:

Mr. Bebee co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and David Mitchell. Prior to his co-founding of Analytical Resources, Inc., Mr. Bebee had gained extensive GC/MS experience as a GC/MS Chemist at the Municipality of Metropolitan Seattle, (METRO). When he co-founded ARI in 1985, Mr. Bebee became the Organics Division Manager until 1993, when he assumed the position of Laboratory Manager. As Laboratory Manager, Mr. Bebee is responsible for the day-to-day laboratory operations, including personnel, instrument, and procedural concerns. He is also responsible for the direct supervision of the Volatile and Semivolatile Laboratories.

Education:

A.A., Oceanography, Marine Biology, Biology, Shoreline Community College (1973).

Experience:

Laboratory Manager, Analytical Resources, LLC, Seattle, WA (1987 to present).

Organics Division Manager/Co-founder, Analytical Resources, LLC, Seattle, WA (1985 to 1987).

GC/MS/DS Operator, Municipality of Metropolitan Seattle, Seattle, WA (1980 to 1985).

Senior Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1976 to 1980).

Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1973 to 1976)

Matthew D. Bates

Network and IT Manager and Acting Lab Director

Profile:

Mr. Bates has extensive experience in all aspects of the operation and management of an environmental chemistry lab. His stints as a lab technician and analyst have provided a broad base of knowledge that helps with the design and continual improvement of data flows, management, and security. Analytical Resources, LLC uses a commercial off-the-shelf (COTS) LIMS (Laboratory Information Management System), Promium Element v6.22:1007. Mr. Bates assists in managing the IT resources of the lab, providing services ranging from instrument workstation deployment and maintenance, end user support, AD/AAD support, website management, IT lifecycle planning, network management, remote user support, phone system support, and security auditing.

Experience:

2008-Present	ARLLC Network and IT Manager
1998-2008	ARLLC LIMS Technician and Administrator
1994-1998	ARLLC Laboratory Technician, SVOA GC/MS
1991-1994	ARLLC Laboratory Technician/Supervisor, Organic Extractions

Education:

1991 BA Chemistry-Whitman College, WA

2008 Continuing Education-South Seattle College

Susan Dunnihoo

Chief Operating Officer

Profile:

Ms. Dunnihoo co-founded Analytical Resources, Inc, along with Mark Weidner, Brian Bebee, and David Mitchell. Prior to her co-founding of Analytical Resources, Inc., Ms. Dunnihoo had gained extensive experience in environmental chemistry through her work at Laucks Testing Laboratories, the City of Tacoma, and the Municipality of Metropolitan Seattle (METRO). As Director of Client Services, Ms. Dunnihoo is responsible for assisting project managers in responding to the needs of ARI clients, and for communicating to the laboratory the analytical capabilities that required to satisfy future client needs. Ms. Dunnihoo also acts as project manager for a number of projects.

Education

Graduate work in Chemical Oceanography, University of Washington (1976-1980)

ACS Certified BA, Chemistry, Augsburg College, Minneapolis, MN (1976)

Experience

Director, Client Services, Analytical Resources, LLC, Seattle, WA (2007-present)

Client Services Manager, Analytical Resources, LLC, Seattle, WA (1998-2007)

Computer Services Manager, Analytical Resources, LLC, Seattle, WA (1985 to 2000)

Corporate Secretary, Analytical Resources, LLC, Seattle, WA (1985 to present)

Chemist, Laucks Testing Laboratories, Seattle, WA (1983 to 1985)

Chemist, City of Tacoma, Plant II, Tacoma, WA (1982 to 1983)

GC/MS/DS Operator, METRO TPSS Lab, Seattle, WA (1980 to 1982)

Van Thomas Spohn

Inorganic Division Manager

Profile:

Mr. Spohn oversees ARI's volatile and semivolatile GC/MS sections, which include the analysis of VOC, TPHg, SVOC, TBT's, all GC/MS-SIM analyses and Dioxin/Furans. He also oversees ARI's GC section which includes the analysis of Pesticides, PCBs, Herbicides and Petroleum Hydrocarbons. He has extensive experience in the environmental chemistry field, with an emphasis in gas chromatography and GC/MS interpretation of volatile and semivolatile organics. Mr. Spohn is experienced with in-house proprietary methods, CLP, EPA standard methods and protocols, as well as the operation, maintenance, and repair of Hewlett Packard GC, GC/MS instrumentation and their data systems. Mr. Spohn has been employed in the GC/MS section of ARI since 1989. Mr. Spohn is responsible for overseeing all staff in his sections. The delegation of workloads, method development of in-house methodologies, and ensuring daily QA/QC practices are upheld. Mr. Spohn is responsible for peer review of the data in his section prior to final submittal to reviewers, and for final review of data already peer reviewed.

Experience

2002-present	ARI GC-GC/MS Supervisor
1989-2002	ARI GC/MS Operator
1987- 1989	Laucks Testing Laboratories –GC/MS operator
1986-1987	Certified Industrial Hygiene Services, Seattle Washington
1985-1986	Federal Way Water and Sewer – Federal Way

Education

1987 B.S. Biochemistry –Washington State University, Pullman Washington Member of Alpha Chi Sigma, Professional Chemistry Fraternity

Certified Asbestos Field Survey Technician, Certificate Number 2593, I.D. No. S- 6975

Casey English

Inorganic Division Manager

Profile:

Mr. English oversees ARLLC's Inorganic Division, which includes Metals Sample Preparation, the Metals Instrument Laboratory, the Conventional Wet Chemistry Laboratory and the inorganic data group. As a Section Manager, Mr. English holds the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QA Manager and Project Managers.

Mr. English is experienced in the environmental chemistry field, with an emphasis in inorganic analyses. Mr. English is experienced developing and maintaining both in-house proprietary methods and more routine methods and protocols (EPA, Standard Methods, etc.). He is experienced with the operation, maintenance, and repair of a large number of laboratory instruments.

Experience

2021-present	Analytical Resources Inorganic Division Manager
2015-2021	Analytical Resources Conventionals Supervisor
2008-2015	Analytical Resources conventionals Analyst

Bob Congleton

Quality Assurance Manager

Profile

Mr. Congleton has worked at Analytical Resources, LLC since 2005. Currently, he oversees ARLLC's Quality Assurance/Quality Control Program. Mr. Congleton is also responsible for managing the laboratory's hazardous waste disposal activities and leads the safety program.

Education

2013: M.A. Policy Studies – University of Washington (Bothell)
2001: B.S. Conservation of Wildland Resources – University of Washington (Seattle)

Experience

2017-present: QA Manager
2014-present: Hazardous Waste Coordinator
2008-2014: Project Assistant
2005-2008: Sample Receiving

Peter Kepler
Dioxin Analyst
Analytical Resources, LLC

Education

- BA in Biology, Colgate University, 1978
- JD, DePaul University, 1985

Experience

- Joined Analytical Resources in July 1986
- GC analyst/supervisor, 1986 - 1995
- Pesticide/PCB/Herbicide methods, including CLP contract
- GC/MS analyst, 1996 - 2010
- Various SemiVoa 8270 parameters
- Responsible for developing custom reports using Report Writer macros
- HRGC/MS analyst, 2010 -Present
- Dioxin 1613, 8290, and HRSM CLP methods

Analytical Resources, LLC
Analytical Chemists and Consultants

PROFESSIONAL EXPERIENCE

Project Manager, Analytical Resources Inc. —Tukwila, WA 2017-Current

Analytical Chemists and Consultants Laboratory specializing in environmental analyses within strict quality standards delivering on time data.

- Provide legally defensible data in a fast paced, accredited laboratory in accordance with Laboratory SOPs, Environmental Protection Agency's (EPA) and local governing agencies' guidelines. Accredited by Washington Department of Ecology, Oregon Environmental Laboratory Accreditation Program, US Department of Defense, and others.

Senior Environmental Chemist/Team Lead, San Antonio Water System—San Antonio, TX 2007 to 2015

Drinking Water and Wastewater utility serving customers within the greater San Antonio metropolitan area.

- Provided quantitative, accurate and legally defensible data to all internal customers; conducted chemical and microbiological analysis of contamination within environmental samples in accordance with standard operating procedures (SOPs) and strict quality assurance/control (QA/QC) requirements.
- Managed operations of Trace Metals and Sample Receiving Sections through development of analysis plans— scheduling, coordinating, prioritizing and performing analyses of samples within requested TAT. Researched, generated and maintained SOPs; trained and ensured compliance to SOPs. Evaluated data from analysis and incoming COCs and verified proper input into Labworks Laboratory Information Management Systems (LIMS).
- Performed and maintained continual demonstration of capabilities (CDOCs) in several sections—Trace Metals by ICP ICP-MS and CVAA; General Chemistry by Distilled Ammonia and Total Kjeldahl Nitrogen (TKN) and Total Organic Carbon (TOC); Microbiology CDOCs to detect coliforms and E. coli using IDEXX-Colilert and Fecal Coliform by membrane filtration.

Scientist I – Quality Control Production, DPT Laboratories—San Antonio, TX 2004 to 2007 *Pharmaceutical development and manufacturing organization recognized for its excellence in semi-solid and liquid dosage forms.*

- Performed daily analyses using various instrumentation including HPLC-UV, HPLC- ECD, GC-FID, AA, FTIR and UV/Vis, consistently ensuring the timely release of pre- and post-packaging products including high profile products and those with controlled substances within a fast-paced, pharmaceutical CGMP, QC production laboratory.
- Consistently supported departmental goals by effectively completing tasks such as daily processing utilizing Empower Software, data calculation and initial review, review of departmental data for the release of products by deadline and with a low error rate, troubleshooting of instrumentation and chromatographic anomalies, process validation assays, and maintenance of the waste disposal schedule.

Chemistry Supervisor, Food Safety Net Services—San Antonio, TX 2002 to 2003

Leading provider of food safety laboratory services, serving multiple industries including agriculture, pharmaceuticals, hospitality, food service, retail, personal care products and more.

- Scheduled all analyses and ensured tasks were completed according to customer specifications and deadlines.
- Analyses included various wet chemistry techniques, distillation, organic extraction, Total Kjeldahl Nitrogen; various fat testing methods, and UV/Vis spectrophotometry.

Chemist, Hytek Finishes—Kent, WA 1997 to 2001

Largest independent supplier of specialized metal finishing, non-destructive testing, plating, anodizing and organic coating services in the Pacific Northwest and one of the largest in North America.

- Maintained quality control of three fast-paced, metal finishing shops with minimal supervision; performed all laboratory analyses including various wet chemistry techniques, atomic absorption spectroscopy, UV/Vis spectrophotometry, pH, titrations, corrosion resistance testing, Taber abrasion testing and adhesion testing.

- Effectively communicated statistical data and laboratory procedure during internal/external clients; through this quality assurance auditor from Boeing frequently brought their external auditors for site visits as a showcase.

EDUCATION

Bachelor of Arts in Chemistry
University of Washington—Seattle, WA
Associate in Arts, Honors
Peninsula College—Port Angeles, WA

Profile

Mr. Nhon Luu has worked at Analytical Resources, LLC since 2010. Currently working in the Dioxin Prep Laboratory.

Education

1987 Graduated from High School- Curlew, Wauconda Washington.

Experience

2012-Present: Dioxin Lab Tech.
2010-2012: Extraction Lab Tech.

Appendix B

Training

Qualification Requirements

In addition to on-the-job training, ARLLC recommends a specific level of education and experience for the following positions:

GC/MS Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years' experience operating GC/MS systems and one-year supervisory experience.

GC Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years' experience operating GC systems and one-year supervisory experience.

Sample Preparation Laboratory Supervisor

A Bachelor's degree in chemistry or scientific/engineering discipline, three years' experience in organic sample preparation and one-year supervisory experience.

Data Systems/LIMS Manager

A Bachelor's degree with four or more computer-related courses and three years' experience in systems management or programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

Programmer Analyst

A Bachelor's degree with four or more computer-related courses and two years' experience in systems or application programming. A minimum of one-year experience with software utilized for laboratory report generation is also recommended.

Quality Assurance Manager

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

Project Manager

A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

GC/MS Chemist

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one-year experience operating a GC/MS system. Three years of GC/MS operations and spectral interpretation experience may be substituted in lieu of educational requirements.

Mass Spectral Interpretation Specialist

A Bachelor's degree in chemistry or a scientific/engineering discipline and participation in training course(s) in mass spectral interpretation. Also, at least two years of experience in mass spectral interpretation is recommended.

Purge and Trap Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and one-year experience operating a purge and trap type liquid concentrator interfaced to a GC/MS system.

GC Chemist

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one-year experience operating a GC system. Three years of GC operations and maintenance experience may be substituted in lieu of educational requirements.

Pesticide Analysis Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one-year experience operating a GC system. Three years of GC operations and spectral interpretation experience may be substituted in lieu of educational requirements.

ICP Spectroscopist

A Bachelor's degree in chemistry or a scientific/engineering discipline and Four years of applied experience with ICP analysis of environmental samples. Four years of ICP experience may be substituted in lieu of educational requirements.

ICP Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining ICP instrumentation. Three years of ICP experience may be substituted in lieu of educational requirements.

Atomic Absorption (AA) Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining graphite furnace and cold vapor AA instrumentation. Three years of AA experience may be substituted in lieu of educational requirements.

Conventionals (Classical Chemistry) Analyst

A Bachelor's degree in chemistry of a scientific/engineering discipline and one year of experience with classical chemistry procedures. Three years of classical chemistry experience may be substituted in lieu of educational requirements.

Sample Preparation Expert

A high school diploma and one college level course in chemistry. One year of experience in sample preparation is also recommended.

Appendix C

Laboratory Facilities

ANALYTICAL RESOURCES LLC. occupies a total of 23,500 square feet of floor space located at 4611 S. 134th Place in Tukwila, Washington. The laboratory facility, constructed between September 2001 and June 2002, includes:

- State-of-the-art heating, ventilation and air conditioning (HVAC) systems to ensure a clean comfortable working environment while maintaining air flow balance designed to minimize the possibility of sample cross contamination between laboratory areas.
- A central service area provides space for five walk-in coolers (356 ft^2 total), and a small walk-in freezer, metals archive storage, and sample cooler storage. A 400 ft^2. walk-in freezer covered by a mezzanine for dry storage was added in 2005.
- A data network linking all workstations to a centralized server room. All connections are made to managed switches and hubs and are protected by the latest firewall technology and uninterruptible power supplies.
- Distribution systems to deliver pressurized Air, Zero Grade Air, Argon, Helium, Hydrogen, Nitrogen and to the laboratory areas from a central location.
- A system to deliver ASTM Type 1 water directly to sinks in each laboratory area. Water is purified by filtration, ion exchange and reverse osmosis and continuously re-circulated through a filtration + ion exchange + UV radiation polishing loop that delivers water directly to the laboratories.
- An isolated and ventilated hazardous waste storage area.
- An electronic repair shop and storage room.
- Alarm monitored fire sprinkler and intrusion detection systems

The facilities are divided into five functionally-distinct sections as detailed below:

1) The Organics Division features three main laboratory areas as described below:
   - The Organics Extraction Laboratory (2400 ft^2.) is utilized to isolate and concentrate organic compounds from various environmental sample matrices. The laboratory contains approximately 200 linear feet of bench space and nine fume hoods. It is equipped with two gel permeation chromatographs, an accelerated solvent extractor (ASE) and a gas chromatograph for extract screening purposes. The laboratory includes a separate area for extraction of aqueous samples, a glassware cleaning area and individual workstations for the laboratory supervisor and analyst.
   - The Semivolatile Organics Analysis Laboratory (3000 ft^2) has 124 linear feet of instrument bench space plus personal workstations. The Laboratory is equipped with seven Gas Chromatographs (GCs) with six GC-MS instruments, one High Resolution GC/MS (HRGC-MS) and a fume hood for preparation of standard solutions and dilution of samples. Each gas chromatograph is individually vented to the outside for removal of heat and potentially contaminated GC exhaust gases.
   - The Volatile Organics Analysis (VOA) Laboratory (2500 ft^2) houses seven GC-MS and two GC-PID instruments dedicated to volatile organics analysis. Each instrument is vented to the outside. The laboratory area includes two fume hoods, a sample/standards preparation area, a TCLP preparation/tumbler room and sample holding refrigerators. The HVAC system maintains a positive air pressure in the laboratory using filtered air from outside of the building. This eliminates the possibility of cross contamination of samples with solvents from other areas of the laboratory.

2) The Inorganic Division includes a Trace Metals Laboratory and the Conventional Analyses Laboratory:

- Trace Metals Laboratory (3000 ft^2)
  - The Metals Preparation Laboratory (1200 ft^2) contains four 8-foot polypropylene fume hoods. An additional eight-foot polypropylene laminar flow fume hood is housed in a separate Class 1000 clean room. The lab is equipped with tumblers, hot-plates, digestion blocks, facilities for glassware cleaning, and two spectrophotometers for cold vapor analysis of mercury, a TCLP tumbler room, and storage areas.
  - The Metals Instrument Laboratory (1300 ft^2) features two inductively coupled argon plasma spectrometers (ICP) for simultaneous analysis of metals species, and two ICP-mass spectrometers for analysis of metals species at low detection levels.
  - A 500 ft^2. Office provides desk area for Trace Metals laboratory personnel.
- The Conventional Analyses (Wet Chemistry) Laboratory (2500 ft^2) contains approximately 200 linear feet of bench space, eight fume hoods and includes a separate microbiology lab. Instruments in this lab include two Rapid-Flow Analyzers, two TOC analyzers, two ion chromatographs, two uv/visible spectrophotometers, and various other equipment necessary for the evaluation of inorganic parameters.

3) The Sample Receiving Facility consists of an area to accept and log-in samples to ARLLC's Laboratory Information Management System (LIMS) and an area to prepare and ship sampling supplies.

- The Sample Receiving Facility (1000 ft^2) is equipped with two fume hoods, and 70 feet of bench space. Four computer terminals are available to log samples into ARLLC's LIMS.
- The Sampling Containers Facility (500 ft^2) is used to prepare sampling containers for shipment to ARLLC's client designated locations.

4) Administrative Areas (8600 ft^2) include:
   - The Quality Assurance Section
   - Executive Offices
   - Project Management Section
   - The Human Resources Section
   - The Information Technology Section (previously 'Computer Services')
   - One Conference Room
   - A Lunch Room
   - Several Storage Areas

Appendix D

Laboratory Instrumentation And Computers

LABORATORY INSTRUMENTATION and COMPUTERS

Organic Extractions Laboratory Equipment

(MARS 3) CEM MARS™ (2011) – Microwave extraction apparatus.

(MARS 6) CEM MARS™ (2019) – Microwave extraction apparatus.

(MARS 6) CEM MARS™ (2019) – Microwave extraction apparatus.

(GPC 1) Varian Prostar 410 – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 26 position autosampler used for clean-up of samples prior to final analysis.

(GPC 2) Varian Prostar 410 – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 26 position autosampler used for clean-up of samples prior to final analysis.

(GPC 3) Varian Prostar 410 – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 26 position autosampler used for clean-up of samples prior to final analysis.

Zymark Turbo-Vap LV (1999) - 24 place

Zymark Turbo-Vap LV (2002) - 24 place

Zymark Turbo-Vap LV (2007) - 24 place

Biotage Turbo-Vap II (2014) – 6 Place

Zymark Rapid Trace Solid Phase Extraction Workstations (2007) - 13 each

Dioxin Extractions Laboratory Equipment

Zymark Turbo-Vap LV (2010) - 24 place

Rotovap R-205 with V-805 Vacuum Controller (2010) – 2 each

Glas-Col Combo Heating Mantle (2010) – 6 place – 3 each

Vacuum Manifold – 6Place (2010) – for SPE

Gas Chromatograph - High Resolution Mass Spectrometer (GC/HRMS)

(HR1) Waters Autospec Premier (2009) – An HRGC-HRMS system with Masslynx Version 4.1 data acquisition & quantitation software. System includes an Agilent 7890A GC and 7683B autosampler.

(HR2) Waters Autospec Ultima (2015) – An HRGC-HRMS system with Masslynx Version 4.1 data acquisition & quantitation software. System includes an Agilent 6890 GC and 7683B autosampler.

Gas Chromatograph - Mass Spectrometers (GC/MS)

(NT2) Hewlett Packard (1999) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. System includes Agilent 6890 GC, 5973 MSD, a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT3) Hewlett Packard (1999) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. System includes an HP 6890 Plus GC, an HP 5973 MSD, an OI Analytical Eclipse 4660 and a Varian Archon autosampler for VOA analysis of aqueous or solid samples.

(NT5) Hewlett Packard (2002) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT6) Hewlett Packard (2002) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an HP 6890 Plus GC, an HP 5973 MSD and an HP 7683 autosampler.

(NT7) Hewlett Packard (2007) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with an HP 6890 GC, an HP 5973N MSD, a Varian Archon autosampler and Tekmar Stratum.

(NT8) Agilent (2008) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with Agilent 6890N GC, 5975C MSD, and 7683 autosampler.

(NT10) Agilent (2008) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system is equipped with Aglient 6850 GC, an Agilent 5975C inert MSD and an Agilent 6850 autosampler.

(NT11) Hewlett Packard (2009) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 6890 N GC, an HP 5973N MSD and an HP 7683 autosampler.

(NT12) Hewlett Packard (2011) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes a Hewlett-Packard 6890 GC, an HP 5973N MSD and an HP 7683 autosampler.

(NT14) Hewlett Packard (2014) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890A GC, an HP 5975C Inert MSD and an HP 7683 autosampler.

(NT15) Hewlett Packard (2014) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 6850 GC, an HP 5975C MSD and a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT16) Agilent (2015) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890B GC, an Agilent 5977A MSD and a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT17) Agilent (2020) - A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890B GC, an Agilent 5977B MSD and an Agilent 7693A autosampler.

(NT18) Agilent (2022) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890B GC, an Agilent 5975B MSD and a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

(NT19) Agilent (2022) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890A GC, an Agilent 5975C MSD and an Agilent 7693B autosampler.

(NT20) Agilent (2022) – A GC-MS system networked with a Windows 2012 Server running Thruput Target 4.145 data analysis software. The system includes an Agilent 7890B GC, an HP 5977B MSD and a Teledyne Tekmar Atomx Purge and Trap for VOA analysis of aqueous or solid samples.

Gas Chromatographs

(OE-GC1) Hewlett Packard 5890 Series II (2003) – A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and ChemStation. Used for screening samples before full extraction.

(OE-GC2) Hewlett Packard 6890 Series II (2014) – A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and ChemStation. Used for screening samples before full extraction.

(FID3A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and Agilent ChemStation data system.

(FID4A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP ChemStation data system.

(PID 1) Hewlett Packard 5890 Series II – (2006) –A GC system equipped with PID and FID detectors in series, a Teledyne Tekmar Atomx sample concentrator and HP ChemStation data system.

(ECD5) Hewlett Packard 6890 (2002) – A GC system equipped with dual µECD detectors, an HP 7683 autosampler and an HP ChemStation data system.

(ECD6) Hewlett Packard 6890 P (2008) – A GC system equipped with dual µECD detectors, an Agilent 6890 autosampler and an HP ChemStation data system.

(FID6) Hewlett Packard 5890E Series II (2008) – A GC system equipped with dual FID detectors, an HP 7694 headspace autosampler and HP ChemStation data acquisition system.

(FID7) Agilent 6850 (2008) – A GC system equipped with a single FID detectors, an Agilent 6850 autosampler and HP ChemStation data acquisition system.

(ECD7) Hewlett Packard 6890 (2008) – A GC system equipped with dual µECD detectors, an Agilent 6890 autosampler, and HP ChemStation data system.

(ECD8) Hewlett Packard 6890N – (2011) – A GC system equipped with dual µECD detectors, an Agilent 7683 autosampler, and HP ChemStation data system.

(FID8) Agilent 6890N (2008) – A GC system equipped with dual FID detectors, an Agilent 7683B autosampler and HP ChemStation data acquisition system.

(ECD9) Hewlett Packard 7890 – (2015) – A GC system equipped with dual µECD detectors, an Agilent 7693 autosampler and an HP ChemStation data system.

(ECD10) Agilent 7890B – (2021) – A GC system equipped with dual µECD detectors, an Agilent 7693 autosampler and an HP ChemStation data system.

(ECD11) Agilent 7890B – A GC system equipped with dual µECD detectors, an Agilent 7693B autosampler and an HP ChemStation data system.

Inorganic Instrumentation

Perkin-Elmer NexIon 300D ICP-MS (2011) - A completely automated reaction cell & collision cell ICP-Mass Spectrometer with Elemental Scientific SC-2 Fast autosampler and multitasking software.

Perkin-Elmer NexIon 350D ICP-MS (2015) - A completely automated reaction cell & collision cell ICP-Mass Spectrometer with Elemental Scientific SC-2 Fast autosampler and multitasking software.

Perkin-Elmer Optima 7300DV ICP (2009) – Automated dual view simultaneous ICP with an Elemental Scientific SC-2 Fast autosampler system

Perkin-Elmer Optima 4300 ICP (2001) - A completely automated dual view simultaneous ICP with auto-sampler and multitasking software.

CETAC M-6000A Mercury Analyzer (2000) – A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler.

Leeman Labs Hydra II Mercury Analyzer (2016) – A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler.

Dionex Ion Chromatography DX 500 (1997) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Peaknet software.

Dionex Ion Chromatography 2100 (2009) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Chromeleon CHM-2 Version 7.0 software.

Shimadzu UV1800 (2016) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Shimadzu UV1800 (2016) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Lachat QuickChem 8000 Flow Injection Analyzer (2003) – Automated flow injection instrument dedicated to low level nutrient analysis

Lachat QuickChem 8500 Flow Injection Analyzer (2007) – Automated flow injection instrument dedicated to low level nutrient analysis

Dohrmann Apollo 9000 (2009) - Total Organic Carbon (TOC) Analyzer, including a boat sampler for solids analysis.

Shimadzu TOC-LCSH (2014) - TOC analyzer with autosampler for aqueous samples.

TOC Cube (2018) – TOC analyzer for soil samples.

Accumet AR60 (2013) - pH Meter

Accumet XL60 (2011) – ISE/pH Meter

ORION Model 115 (2010) – Conductivity Meter

ORION 5 Star (2014) – RDO Meter

Hach Ratio 2100N - Turbidimeter

Kontes Midi-Vap Cyanide Distillation Systems (3 each)(1995-2008) – Each of the systems is capable of simultaneously distilling up to 10 samples for cyanide analysis using small sample aliquots.

Centrifuge (1987) - Beckman Model GP with swinging bucket rotor and inserts for 250 ml bottles and scintillation vials

Aim 600 Block Digestion System (2006) with Controller

Environmental Express Hot Block digestion blocks (10 ea.) (1999-2008) for digestion of samples prior to trace metals analysis.

Hach COD Digestion Blocks (2 each)

Incubators: VWR Model 2020 (2each) BOD incubator
Precision Model 2860 Coliform Incubator Oven
Precision Model 2862 Coliform Incubator Oven
Thermolyne Coliform Water Bath Incubator

Network Infrastructure

ARLLC has a Windows Active Directory network that handles all user authentication, access control, and services. User profiles are created on the AD server and permissions are assigned per roles and responsibilities and group and user levels. The primary server combines three virtual machines, each one individually handling database, file, and LDAP services. The stack is managed through a HyperV hypervisor. The entire stack is backed up locally, with incremental snapshots taken every 30 minutes daily and a full synchronization every morning. The full synchronization is pushed to a cloud storage service, Datto, for secure, offsite storage. ARLLC uses Key Methods for additional IT support outside the scope of internal staff.

ARLLC uses Element, developed by Promium, as a Laboratory Information Management System. All data related to sample control, preparation, analysis, reporting, and business operations are retained on this system. User profiles, separate from those on the domain, are used to control access to the different functions of the application and users can be granted read/write permission as needed to fulfill their duties. The application is fully supported by Promium and administrative users have access to the staff engineers. ARLLC employs a full-time Element developer to build reports and queries needed for reporting data to end users and implementing controls and processes needed for operational flow. Most changes, including additions and deletions, in Element are audited and can be reviewed by management.

Office 365 hosting is used for all e-mail, messaging, and file sharing services. It's centrally managed by ARLLC IT staff and has a full suite of access control and auditing tools. General lab documentation is controlled via the SharePoint application of Office 365, allowing for document control and versioning.

All servers are secured in a locked room where only management and IT staff have access. Some users have external access to the network but this is limited to current employees and only through an end-to-end encrypted VPN service, NetCloud.

Note: Extensive in-house replacement parts are available for lab instruments and computers, including spare circuit boards. A majority of all service maintenance is performed by ARLLC employees.

Appendix E

Analytical Methods

ORGANIC ANALYSES

Parameter	Methods	Technique
Volatiles (GC/MS)	524.3/624/8260	CGC/MS
	Low Level Vinyl Chloride & 1,1 – Dichloroethene	GC-MS-SIM
Volatiles (GC)		
Volatile Aromatics	602/8021B (No longer active)	GC/PID
Semivolatiles (GC/MS)		
Semivolatile Organics	625/8270E	GC/MS
Polynuclear Aromatic	Hydrocarbons (PNA/PAH) GC/MS-SIM	625/8270E
Butyl Tin Species	Krone (1988)	GC/MS-SIM
Pesticides/GC Analyses		
Chlorinated Pesticides	608/8081A	GC/ECD
Aroclors/PCBs	608/8082	GC/ECD
PCB Congeners	ARLLC Method	GC/ECD
Phenols	604/8041	GC/FID
Chlorinated Phenols	8041 (mod)	GC/ECD
Pentachlorophenol	8151A (mod)	GC/ECD
Organophosphorous Pesticides	614/8141A	GC/NPD
Chlorinated Hydrocarbons	612/8121	GC/ECD
Glycols	ARLLC Method(SOP 426S R2)	GC/FID
Hydrocarbon ID	NWTPH-HCID	GC/FID
Gasoline Range Hydrocarbons	(N)WTPH-G/AK101/WI-GRO	GC/FID
Diesel Range Hydrocarbons	(NWTPH-D/AK102/WI-DRO)	GC/FID
Extractable Petroleum Hydrocarbons	WDOE 6/1997	GC/FID
Volatile Petroleum Hydrocarbons	WDOE 6/1997	GC/PID
Organic Sample Preparation and Clean Up		
TCLP / SPLP Extraction		1311 / 1312
Sonication		3550B
Soxhlet		3540C
Accelerated Solvent Extraction (ASE)		3545B
Separatory Funnel		3510C
Continuous Liquid-Liquid		3520C
Alumina Clean-up		3610B
Florisil	Clean-up	3620B
Gel Permeation (GPC)		3640A
Silica Gel		3630C
Sulfur Clean-up		3660B
Sulfuric Acid Clean-up		3665A

INORGANIC ANALYSES

Parameter	Methods	Technique
Wet Chemistry		
Acidity	2310/305.1	Titrimetric
Alkalinity	2320/310.1	Titrimetric
Ammonia	4500NH_3H/350.1	AutomatedPhenate/ISE
Biological Oxygen Demand-BOD		
Carbonaceous – BOD	5210.B/405.1	5-day Winkler Titration
Bromide	4500Br.B	Phenol Red Colorimetric
Anions	300.0	Ion Chromatography
Cation Exchange Capacity	9080	Neutral Ammonium Acetate
Chemical Oxygen Demand	5220.D/410.4	Closed Reflux, Colorimetric
Chromium Hexavalent (Cr6+)	3500Cr-D/7196A	Diphenylcarbazide
Chloride	4500CI.E/325.2	Automated Ferricyanide
Coliform, Total / Fecal	9222.B/D	Membrane Filtration
Color	2120.B/110.2	Visual Comparison
Conductivity	2510/120.1	Electrometric
Corrosivity (CaCO3 Saturation)	2330	Calc. (pH, Alk, TDS, Ca)
Cyanide, Total	4500CN.C/335.2/9010	PBA, Colorometric
Cyanide, Amenable	4500CN.G/335.1	Alkaline Chlorination
Cyanide, WAD	4500CN.I	Weak Acid Distillation
Dissolved Oxygen	4500-O.C/360.2	Winkler Titration
Fats/Oils/Grease	5520.B/413.1/9070A	Gravimetric
Fluoride	4500F.C/340.2	Ion Specific Electrode
	300.0	Ion Chromatography
Hardness, Calculation	2340.B/6010B	Ca, Mg Calculation
Heterotrophic Plate Count	9215.D	Membrane Filtration
Iron (II) ferrous	3500Fe.D	Phenanthrolene
Nitrate + Nitrite	4500NO_3F/353.2	Automated Cd Reduction
Nitrate	4500NO_3F/353.2	Calculated
	300.0	Ion Chromatography
Nitrite	4500NO_3.F/353.2mod	Automated Colorimetric
	300.0	Ion Chromatography
Oil & Grease, Solids	5520.D/907	Gravimetric
Oil & Grease, Polar/Non Polar	5520.F	Gravimetric
PH	150.1	Electrometric
Phenols	5530.D/420.1/9065	4-AAP w/ Distillation
Phosphorous, Total	4500P.B/365.2	Colorimetric w/ digestion
Phosphorous, Ortho (SRP)	4500P.B/365.2	Colorimetric
	300.0	Ion Chromatography
Salinity	2520	Conductimetric
Total Kjeldahl Nitrogen (TKN)	4500N.org/351.4	Block Digest/ISE
Total Solids	2540.B/160.3	Gravimetric, 104^{o}C
Total Suspended Solids (TSS)	2540.D.160.2	Gravimetric, 104^{o}C
Total Dissolved Solids (TDS)	2540.C/160.1	Gravimetric, 180^{o}C
Total Volatile Solids (TVS)	2540.E/160.4	Gravimetric, 550^{o}C

Settleable Solids	2540.F	Volumetric
Streptococcus, Fecal	9230.C	Membrane Filtration
Sulfide	$4500S^2$ E / 376.1/9034	Iodometric
Sulfide, Low Level	$4500S^2$ D / 376.2	Methylene Blue
Sulfide, Acid Volatile	$4500S^2$ D / 376.2	Methylene Blue
Sulfate	$4500SO_4{}^2$.F / 375.2 / 9036	Auto. Methylthymol Blue
	300.0	Ion Chromatography
Sulfite	$4500SO_3{}^2$.B.377.1	Iodometric
Total Organic Carbon (TOC)	5310 B / 415.1 / 9060A,PSEP	Combustion NDIR
Turbidity	2130.B / 180.1	Nephelometric
Total Lipids in Tissue	Bligh & Dyer (mod)	Gravimetric

Trace Metals Analyses

Inductively Coupled Plasma (ICP):

Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Th, Ti, Tl, V, Zn (Li, Th, U, W - special request only)	200.7 / 6010B	ICP

Cold Vapor (CVAA):

Hg	7470A / 7471A	CVAA

Inductively Coupled Plasma/Mass Spectroscopy (ICP-MS):

Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Th, Tl, U, V, Zn	200.8/ 6020 Mod.	ICP/MS

Trace Metals Sample Preparation

Toxicity Characteristic Leaching Procedure	1311
Synthetic Precipitation Leaching Procedure	1312
Digestion for Total Recoverable or Dissolved Metals	3005A
Digestion of Aqueous Samples for Total Metals by ICP	3010A
Digestion of Aqueous Samples for Total Metals by GFAA	3020A
Digestion of Sediment, Sludge and Soil	3050B

Appendix F

Laboratory Accreditations

The National Environmental Laboratory Accreditation Program (NELAP), the State of Washington Department of Ecology and the State of Alaska Department of Environmental Conservation currently certify Analytical Resources Inc. to perform environmental analysis.

ARLLC is approved to perform analyzes for the United States Department of Defense (DoD) agencies following the DoD Quality Systems Manual (DoD-QSM)

The Boeing Company and Battelle Pacific Northwest Laboratories have audited and approved ARLLC's laboratory QA/QC Program

ARLLC analyzes drinking water, wastewater and solid matrix performance testing (PT) samples for all accredited methods semiannually.

List of Accreditations

1) National Environmental Laboratory Accreditation Conference (NELAC) – Accrediting authority is Oregon Environmental Laboratory Accreditation Program (ORELAP).
2) State of Washington, Department of Ecology - Environmental Laboratory Accreditation Program
3) The Alaska State Department of Environmental Conservation - Laboratory Approval Program
4) United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) Administered by Perry Johnson Laboratory Accreditation (PJLA).
5) The State of California Environmental Laboratory Accreditation Program (CA-ELAP)

Continuing Contracts Resulting from On-Site Laboratory Audits

1) The Boeing Company Corporate Environmental Affairs Division
2) The City of Seattle
3) The Port of Seattle

Appendix G

Data Reporting Qualifiers

Data Reporting Qualifiers

Effective 7/10/2009

Inorganic Data

U Indicates that the target analyte was not detected at the reported concentration

* Flagged value is not within established control limits

B This analyte was detected in the method blank

CONF Confluent growth

N Matrix Spike recovery not within established control limits

NA Not Applicable, analyte not spiked

H- The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD

TNTC Too numerous to count

W Weight of sample in some pipette aliquots was below the level required for accurate weighing

Organic Data

* Flagged value is not within established control limits

A The reported TIC is a suspected aldol-condensation product

B This analyte was detected in an associated Method Blank

C The identification of the analyte is confirmed by GC/MS when the primary analytical method employed is GC/ECD as appropriate

D The reported value is from a dilution

D1 Surrogate was not detected due to sample extract dilution

E- Estimated concentration calculated for an analyte response above the valid instrument calibration range. Dilution of the sample or extract is required to obtain valid quantification of the analyte.

EMPC	Estimated Maximum Possible Concentration (EMPC) defined in EPA Statement of Work DLM02.2 as a value "calculated for 2,3,7,8-substituted isomers for which the quantitation and /or confirmation ion(s) has signal to noise in excess of 2.5, but does not meet identification criteria" **(Dioxin/Furan analysis only)**
F	Samples were frozen prior to particle size determination
H	Hold time violation – Hold time was exceeded
HC	The natural concentration of the spiked analyte is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible
HT	The reported value is quantitated using peak heights rather than peak areas
J-	Estimated concentration when the value is less than ARLLC's established reporting limits
L	Analyte concentration is <= 5 times the reporting limit and the replicate control limit defaults to +/-RL instead of 20% RPD
M	Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses
N	The reported TIC has a >= 80% match on the mass spectral library search
NRS	This surrogate not reported due to chromatographic interference
P	The reported value is greater than 25% difference between the concentrations determined on two GC columns where applicable
P1	The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference
PC	Preservation was checked and failed
Q	Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20% RSD, <20% Drift or minimum RRF).
S	The reported value is determined using a single-point ICAL by GC/ECD analytical method as appropriate
SM	Sample matrix was not appropriate for the requested analysis. Normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity, and saturation calculations
SS	Sample did not contain the proportion of "fines" required to perform the pipette portion of the grainsize analysis

T	The total of all fines fractions. This flag is used to report total fines when only sieve analysis is required, and balances total grainsize with sample weight

U	Indicates that the target analyte was not detected at the reported concentration

Text1	Custom value

X	Analyte signal includes interference from polychlorinated diphenyl ethers. **(Dioxin/Furan analysis only)**

X	Custom value

Y	The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

Y	Custom value

Y1	Raised reporting limit due to interference

Z	Analyte signal includes interference from the sample matrix or perfluoro kerosene ions. **(Dioxin/Furan analysis only)**

Z	Custom value

Appendix H

Standards for Personal Conduct

Standards of Conduct

Since effective working relationships depend upon each of us, ARLLC expects certain minimum standards of personal conduct.

This list highlights general ARLLC expectations and standards and does not include all possible offenses or types of conduct that may result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

Employees engaged in the following activities, or similar activities, may be terminated:

- theft or embezzlement
- disclosure of trade secrets or industrial espionage;
- willful violation of safety or security regulations;
- conviction of a felony;
- working for a competitor or establishing a competing business.

In addition, dismissal may result from other serious offenses such as:

- being intoxicated, under the influence or in possession of illegal drugs on the job;
- falsification of records;
- abuse, destruction, waste or unauthorized use of equipment, facilities or materials;
- gambling on the premises;
- chronic tardiness or absenteeism;
- insubordination;
- unwillingness to perform the job;
- unauthorized requisition of materials from vendors.

There may be no alcoholic beverages consumed on ARLLC premises, other than at times designated as Company functions, at which non-alcoholic beverages will also be provided.

Personal and corporate honesty and integrity have built the character of ARLLC. This good character is fundamental to our well-being, future growth and progress. It is vitally important that we avoid both the fact and the appearance of conflicts of personal interest with that of the firm, its clients, and any other professional contacts.

This policy requires that ARLLC employees have no relationships or engage in any activities that might impair their independence of judgment. Employees must not accept gifts, benefits, or hospitality that might tend to influence them in the performance of their duties. It is expected that there will be no employment by any competing company, nor any employment by any outside interest or engagement in outside activity which might impair an employee's ability to render the full-time service to the company that employment involves.

If any possible conflict of interest situation arises, the individual concerned must make prior disclosure of the facts so that action may be taken to determine whether a problem exists and, if so, how best to eliminate it. Likewise, any financial interest in an organization doing business with ARLLC or which competes with us should be revealed to Company management. (Excluded from this requirement is ownership of securities traded in major stock exchanges or other recognized trading markets.)

Our standards are those generally expected of employees in any well-regarded, ethical business organization.

ARLLC further expects that each employee will:

- Be dressed and groomed appropriately for a business office. Employees in the laboratory areas are expected to dress in compliance with established safety procedures. Specific standards will be discussed with each employee during Health and Safety orientation. Your supervisor and the Administrative Services Manager always are available to answer questions.
- Maintain the confidential nature of Company information. Removal of Company documents, records, stored materials, computer printouts, or any similar information, or copies of such material or information from the office without specific permission is prohibited. Likewise, revealing confidential information to an unauthorized person or using such information in an unauthorized way is prohibited. If there could be any possible question about the applicability of this requirement to a given circumstance, ask your supervisor.
- Use Company computer capabilities and facilities only for authorized business at authorized times and locations; observe strictly all computer security measures and precautions; enter, alter or delete no computer instructions or stored material apart from that required by faithful performance of assigned duties; remove, copy, use or permit to be used no computer software developed for, purchased by, or otherwise used by ARLLC except as required by faithful performance of assigned duties.
- Conduct business dealings with clients and members of the public in a courteous manner.

Appendix I

Quality Assurance Policies

Quarterly QA Tasks

Year: __________ Quarter ___________

- ☐ Logbook Review
- ☐ Balances
- ☐ Pipette Verifications
- ☐ Dispenser Verifications
- ☐ Sash-hood Flow
- ☐ ThermoLogger Verification
- ☐ Oven Electronic Thermometers
- ☐ IR Thermometers
- ☐ Fluke and Oakton Thermometers (for all ranges)
- ☐ Liquid Thermometers (annual only, Qtr. 4)
- ☐ Ethics and Haz Waste Training (annual only, use attendance form 12206F)
- ☐ DoD Management Review (12207F, annual only: Qtr. 4)
- ☐ TCLP Tumbler RPM Check
- ☐ Audit Sections for Posted Obsolete Operator Aids
- ☐ QA Orientation (as needed)
- ☐ Client Feedback Review
- ☐ Project Completeness Review (10% of QSM5.1 Projects)
- ☐ Log MDL jobs (Metals, Dioxins, VOAs, 524.3)
- ☐ Compile MDL Workorder Results
- ☐ Control Chart Review for Trends (QSM5.1-1.7.3.2.3.d)
- ☐ Update MDLs/LODs/LOQs and CLs (annual Qtr. 1) in Element
- ☐ IDOC/DOC Training Records Review
- ☐ Test Methods (see schedule)
- ☐ Standards Review for CofA
- ☐ Add MRL/LOD Data for Previous Qtr (2-yrs max)
- ☐ Add Intra-Lab PT Tracking Data for Previous Quarter
- ☐ Update Accreditation Locations (if necessary: checklist 12201F)

Review all audit forms for completeness prior to archiving in: *SharePoint/ARI QA/Internal Audits Library*

ARLLC Annual Test-Methods and non-Technical Audit Schedule

Quarter 1:
- ☐ Microbiology
- ☐ Color
- ☐ Cyanide
- ☐ Ammonia, Auto
- ☐ Ammonia, ISE
- ☐ COD
- ☐ TOC
- ☐ Lachat
- ☐ Sulfide
- ☐ Gravimetric (Solids, Oil/Grease)

Quarter 2:
- ☐ Colormetric
- ☐ IC
- ☐ Probe (BOD, pH , Conductivity, Salinity)
- ☐ Alkalinity
- ☐ ICP
- ☐ ICPMS
- ☐ CVAA

Quarter 3:
- ☐ Chlorinated Pesticides
- ☐ Dioxins/Furans
- ☐ PCBs
- ☐ Petroleum Hydrocarbons
- ☐ Requests, Tenders, and Contracts (e.g., subcontractor accreditations)
- ☐ Services to the Client

Quarter 4:
- ☐ Organics Extraction Lab
- ☐ SVOA
- ☐ SVOA - SIM
- ☐ VOC
- ☐ VOC – SIM
- ☐ Purchasing Services and Supplies
- ☐ Recommendations for Improvement
- ☐ Complaints

QUALITY ASSURANCE POLICY

POLICY NUMBER: **1**

SUBJECT: **CORRECTIONS TO DATA/BENCHSHEETS**

DATE: **8/2/96**

Manual corrections made on any raw data, bench sheet, logbook or document used during sample processing will be made in the following manner:

1. Draw a single line through the information to be deleted or corrected. The original information must remain readable.

2. Enter any new information, preferably above the original information.

3. Initial and date the correction.

QUALITY ASSURANCE POLICY

POLICY NUMBER: **2**

SUBJECT: **LINING OUT UNUSED BENCHSHEET PORTIONS**

DATE: **8/2/96**

All unused portions of logbook pages and benchsheets will be lined through so that information cannot be added at a later date. This will be completed in the following manner:

1. Line out unused portions of a logbook page or benchsheet by drawing a single line or "Z" through the unused portions.

2. Initial and date the page beside the lineout.

3. Do not line out a page or section until it is certain that no additional information will be added to the unused portions.

Analytical Resources, LLC
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER: 3

SUBJECT: STOP WORK ORDERS

DATE: 8/28/96

It is the responsibility of all staff members to address situations that may require the issuance of a "stop work order". Potential and actual "stop work orders" will be handled as follows:

1. If an analyst or technician observes a situation which will or may have a negative impact on data quality, that person will notify her/his section supervisor immediately.

2. The section supervisor will assess the situation. If it appears that a "stop work order" may be required, the section supervisor will notify the appropriate manager (inorganic or organic).

3. The supervisor and manager will then decide if a "stop work order" should be issued. The manager will make a final decision on whether or not to issue a "stop work order". The incident will be reported to the Quality Assurance Program Manager using a Corrective Action Request form.

4. If a "stop work order" is issued, the manager will inform the Project Managers and the QA section. The section supervisor will notify section staff of the order.

5. The laboratory manager involved will oversee the development and implementation of a Corrective Action Plan (CAP). Upon completion of the CAP the "stop work order" may be rescinded.

6. Prior to rescinding a "stop work order", verification must be made that control has been regained and that work may begin. Only the inorganic or organic manager may rescind a "stop work order".

7. When the "stop work order" is rescinded, the Project Managers, analytical staff and QA section will be notified. The QA section will require documentation verifying that the procedure is back in control.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 4

SUBJECT: SOP Review

DATE: 9/3/96

All Standard Operating Procedure (SOP) documents will be reviewed and updated at least annually by qualified staff members. Laboratory management will review and approve all modifications to the SOPs.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 5

SUBJECT: Reporting Dilutions

DATE: 9/11/96

Dilution factors will be recorded as whole numbers followed by "X" (i.e., 5X, 10X, etc.). This reporting convention will be used on run logs, bench sheets, raw data and final reports for all diluted samples, extracts or digestates or standards.

QUALITY ASSURANCE POLICY

POLICY NUMBER: **6**

SUBJECT: **Formatting for SOPs – Computer Related**

DATE: **1/31/00**

Conventions for formatting computer-related instructions in SOPs

Commands should be indented and formatted as **bold courier** and one or two font sizes smaller:

```
USE PARAMS ORDER PARAMS
BROW
```

Many systems and languages are *case-sensitive*, and case should match the syntax and/or stylistic standards of the language.

If only one command, like ***SET CENTURY ON***, is needed, it can be included in the rest of the text, so long as it is also italicized.

If the user must substitute a particular value in place of a general descriptor, italicize the descriptor, make it lowercase, and *do not make it bold*:

```
USE PARAMS ORDER PARAMS
COPY TO TEMPARM FOR JOB = 'job' .AND. SAMPLE = 'sample'
```

In general, keywords, variable names, formatting codes, and descriptors should be in `courier` and *italicized*.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**7**
SUBJECT:	**Manual Adjustment of Data**
DATE of IMPLEMENTATION:	**1/1/01**

Modern chromatographic instruments include computer software to identify a detector response as a chromatographic peak, characterize that peak and determine the relative height or area of the signal. The software utilizes parameters (threshold, slope, etc) that are adjusted by the instrument operator to optimize the results.

A single set of operator controlled settings that determine peak characteristics for an entire data file is defined as an "automated procedure". An automated procedure often characterizes chromatographic peaks incorrectly. ARI requires that trained analysts identify and resolve these errors using an alternate automated procedure or a "manual adjustment" of the data. Manual adjustment is defined as the process used by an analyst to adjust an individual peak or a subset of data in a chromatographic file.

1. The settings for a routine automated procedure normally used to process chromatographic data must be described in the method Standard Operating Procedure (SOP).

2. Trained analysts may substitute one automated procedure for another in order to optimize peak characteristics. The use of an alternate automated procedure must be permanently documented using either a software generated log file or analyst notes.

3. Manual adjustment of chromatographic peak characteristics will be used to correct the results of an automated procedure that, in a trained analyst's opinion, are clearly incorrect and will result in erroneous peak identification, integration or quantification.

4. Manual adjustment will be implemented in a reasonable and consistent manner. Guidelines for performing manual adjustment will be documented in method SOPs.

5. All manually adjusted data will be clearly identified for approval in the data review process. A permanent record of all manual adjustments will be maintained in both electronic and hardcopy versions of the raw data.

6. Manual adjustment of chromatographic files will not be used to falsify data for any purpose. Falsification of data through the use of manual peak adjustment is unethical, unlawful and will result in termination of the offending analyst.

Approval:

____
Quality Assurance Program Manager   Date

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**8**
SUBJECT:	**Performance Testing Samples**
IMPLEMENTATION DATE:	**1/1/01 (Modified 11/12/18)**

As described in section 15.3 of the LQAP, Performance Testing (PT) samples will be analyzed on a periodic basis to monitor laboratory performance and/or meet the requirements of an external accreditation program. PT samples contain target analytes in concentrations unknown to laboratory personnel. PT samples are purchased from a third-party PT provider that sends graded PT results directly to ARI's Accrediting Bodies (ABs).

PT samples will be logged-in, prepared, analyzed and reported as a routine sample without special consideration.

When PT samples are not commercially available for individual analytes, analytical proficiency will be demonstrated using intra-laboratory comparisons. On a quarterly basis, Blank Spikes will be analyzed by multiple analysts and the data compiled and statistically evaluated to determine the laboratory's precision, accuracy, and z-scores for analyzing these method/matrix/analyte combinations.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**9**
SUBJECT:	**Modifications to Analytical Methods Procedures or Reports**
DATE of IMPLEMENTATION:	**8/24/05**

This Policy defines the processes used to initiate and validate modifications to analytical processes, QA/QC protocol, data processing programs and algorithms, data reporting formats or other changes to analytical procedures or SOPs at Analytical Resources, LLC. The procedures outlined will also be used to validate project specific changes to analytical protocol and new analytical methods.

Changes to analytical procedures must be approved by ARLLC's Management (Managers and/or Supervisors) and be well documented using the following procedure:

1. Modification may be requested by any staff member. The modification must be requested using ARLLC's Corrective Actions Tracking System. Corrective Action requests for changes to analytical protocol or reports will assigned to the appropriate manager or supervisor by the initiator. As an alternative the request may be assigned to the QA Section. The Corrective Actions assignee may approve the project or re-assign the request for approval to a third party. The QA Section will monitor the progress of all requests.

2. The requestor must detail and justify the proposed modifications or additions when initiating a Corrective Action issue. Modifications must be approved by ARLLC management prior to any work performed to establish the modification.

3. The following must be in place before final approval and/or implementation of the proposed modification.

   A. A new or revised SOP as appropriate including the modification or new protocol.
   B. An Initial Demonstration of Proficiency as defined in ARLLC SOP 1018S for new or modified analytical procedures.
   C. An MDL study following the procedure in ARLLC SOP 1018S for new or modified analytical procedure.
   D. When appropriate, successful analysis of a blind Performance Evaluation Sample using new or modified procedures or data processing protocol.
   E. Documentation that new or modified software provides the desired result.

4. ARLLC staff must have sufficient training to implement the procedural changes.

5. Notification of the modifications must be distributed to all affected personnel including appropriate client personnel.

Analytical Resources, LLC
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**10**
SUBJECT:	**Reporting of Target and Spiked Analytes For Dual Column GC Analyses**
DATE of IMPLEMENTATION:	**8/24/05**

Analytical Resources Inc. uses single injection, dual column gas chromatographs to simultaneously identify and confirm the presence of target or spiked analytes in some GC analyses. Only one quantitative value is reported for each target or spiked analyte. ARLLC's policy for deciding which value to report is outlined as follows:

1. ARLLC considers each column equally valid for compound identification and quantification. Both GC columns must be compliant with all quality assurance parameters outlined in ARLLC's SOPs and LQAP. Both GC columns must produce valid initial and continuing calibrations using the same calibration model.

2. The analytical value reported will be determined by comparison of the quantitative results of confirmed analytes as follows.

a. The relative percent difference (RPD) between the results on the two columns (R_1 & R_2) is calculated using the formula:

$$RPD = \frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} \times 100$$

b. If the RPD is less than 40% the greater of the two values is reported for both target analytes and spiked compounds. When required by specific QA protocol, by contract or client request the lower value will be reported for target analytes.

c. If the RPD is greater than 40%, ARLLC's analyst must examine the chromatogram for anomalies (overlapping peaks, incorrect integration, negative peaks) and either correct the anomalies (i.e., perform manual integrations) or report the most appropriate target analyte value. The higher value will be reported for spiked analytes. ARLLC's analyst must provide a written evaluation of all analyses where an RPD exceeds 40% and this information must be passed on to ARLLC's client or the data user.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**11**
SUBJECT:	**Calculation of Analytical Uncertainty**
DATE of IMPLEMENTATION:	**8/31/06**

Analytical Resources Inc. will use the procedure[1] proposed by Thomas Georgian, PhD to estimate analytical uncertainty. Dr. Georgian's proposes using the formulae below to calculate uncertainty:

For biased corrected analytical results:

100 (c/R)(1± L / R)
Where:
c = Measured concentration of the analyte
R = Average Blank Spike recovery
L = ½ the warning or control range

And for unbiased results i.e., R = 100

c (± L / 100)

Example:

For a 10-ppb analytical result when the mean BS recovery is 50% and the control limits are 20% to 80% an interval for the analytical results is calculated as follows:

100 (10 ppb / 50)(1±30 / 50) = 20 ± 12 ppb

[1] Estimation of Laboratory Analytical Uncertainty Using Laboratory Control Samples, Thomas Georgian, Ph.D., *Environmental Testing & Analysis*, November/December 2000.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**12**
SUBJECT:	**Rounding of Numbers and Reporting Limits**
DATE of IMPLEMENTATION:	**6/10/14 (modifications proposed)**

I. ARLLC reports analytical results in concentration units as follows:

A. Values expressed as a concentration (mg/L, µg/Kg etc.) will be reported using 3 significant figures.

B. Values expressed as percent (control limits, RSD etc.) are reported using the appropriate whole number. Examples: 6.38 rounds to 6, 9.95 rounds to 10, 99.93 rounds to 100, 145.48 rounds to 145.

II. ARLLC rounds numbers to the appropriate level of precision using the following rules:

A. If the figure following those to be retained is greater than or equal to 5, the absolute value of the result is to be rounded up: otherwise, the absolute value of the result is rounded down. Examples: -0.4365 rounds to -0.437 and 2.3564 rounds to -2.356; 11.443 is rounded down to 11.44 and 11.455 is rounded up to 11.46.

B. When a series of multiple operations is performed (add, subtract, divide, multiply), all available significant figures are carried through the calculations and the result is rounded to the appropriate number of significant figures.

III. ARLLC compares concentration values to reporting limits prior to rounding final concentration values. Example: with an RL of 0.50, 0.499 is undetected at 0.50 (0.50U) and 0.504 is detected at 0.50.

III. ARLLC will round quality control results prior to determining if the value is in control. Example: for spike recovery limits of ± 10% (90 – 110%), a recovery of 110.47 is in control at 110% and a calculated recovery of 110.50 is out of control at 111%.

Analytical Resources, LLC
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**13**
SUBJECT:	**Use of “J” Flag when Reporting Analytical Data**
DATE of IMPLEMENTATION:	**3/1/09**

1. ARLLC uses a “J” flag to indicate that a quantitative result chemical analysis is an estimated value. In general, “J” flags note positively identified target analytes that are below an instrument’s verified calibrated range.
2. A “J” indicates quantitative values with a high degree of uncertainty. Data users must consider the greater uncertainty when using “J” flagged quantitative values.
3. ARLLC will not report analytes below the RL (“J” flag is not used) for any single column GC fuel analysis unless there is a positive pattern identified for the fuel (HCID, TPH-D, BTEX, TPH-G.
4. ARLLC will not report analytes below the RL for any single column GC analysis that quantifies specific analytes or has no pattern (RSK-175, Direct Aqueous Injection)
5. ARLLC uses “J” flags when reporting results of GC-MS (VOA and SVOA) and dual column GC analyses using the following criteria:
   A. All analyses must meet ARLLC established QA criteria for calibration and spike recovery.
   B. Analytes must meet method specific identification criteria (i.e., spectral match, retention time and/or relative retention time).
   C. The analyte concentration must exceed the greater of either the MDL or ½ the reporting limit before a “J” flag is applied.
   D. An analyte in a method blank will be “J” flagged only when any associated sample contains the same analyte.
   E. The application of a “J” flag is discretionary, depending on the professional judgment of ARLLC’s data reviewers. GC-MS parameters such as ion ratios, spectral match, background contamination and instrument noise are weighted when considering the application of “J” flags.
6. Some typical circumstances that may warrant the use of a “J” flag:
   A. A compound identified at a concentration between the MDL or ½ RL and ARLLC’s reporting limit (normally the low concentration used to calibrate the instrument).
   B. The quantified values in a dual column GC analysis differ by > 40% with obvious interference on one column. ARLLC may report the value with the lowest concentration or the least interference.
   C. The analyte is present at low concentration due to extract dilution and identified in a previous analysis of less dilute extract.
   D. Analytes < the RL and reported in previous analyses from the same sampling site.
   E. An analyte is < the RL in a sample and greater than the RL a duplicate or replicate analysis. This often applies to Matrix Spike and Blank Spike samples and their duplicates.

Analytical Resources, LLC
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**14**
SUBJECT:	**Calculation of Holding Times**
DATE of IMPLEMENTATION:	**7/1/13**

1. Holding Time (HT) (Maximum Allowable Holding Time) definition: The maximum elapsed time that samples may be held prior to analysis and still be considered valid or not compromised. (40 CFR Part 136). (DoD Clarification): The time elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, as appropriate. A specific time as defined in this policy will include the year, month, day of the month, hour and minute for each event.

2. Holding times are prescribed in published analytical methods and are normally specified in either days or hours. ARLLC will determine holding times based on the published time units specified. The time of sample collection is considered time (hour, day etc.) zero.

3. Holding time will commences as follows:
   a. **Environmental Samples**: The moment the sample is separated from its natural environment. ARLLC will assume this is the sampling time recorded on the Chain of Custody form delivered to the lab with the sample.
   b. **Extracts for Organic Analysis**: The moment the extract is delivered to the instrument laboratory as documented in ARLLC's chain of custody records.

4. Elapsed holding time will end as follows:
   a. **Samples for VOA Analysis**: At the time trap desorption/GC analysis begins as recorded by the chromatography data system.
   b. **Samples for Solvent Extraction**: The moment the extraction solvent touches the sample. This is a batch process with the beginning and ending time recorded on the extraction bench sheet.
   c. **Samples for Acid Digestion**: The moment acid touches the sample. This is a batch process with the beginning and ending time recorded on the preparation bench sheet.
   d. **Samples for Solids Analysis**: The moment the sample is placed in the oven or filtration begins as recorded on the analysis bench sheet.
   e. **Samples to be Distilled**: At the moment the sample is placed in the distillation flask. This is a batch process with the beginning and ending time recorded on the analysis bench sheet.
   f. **Sediment for Pore Water Extraction**: When the sediment is placed in a centrifuge tube.
   g. **Extracts for Organic Analysis**: The moment the sample, extract or digestate is introduced into the instrument as recorded by the instrument data system.

5. Reporting of Holding Times: The time of sample collection, preparation, and analysis are included in the final laboratory report, regardless of the length of holding time. If the time of the sample collection is not provided, ARLLC will assume the most conservative time of day. When the date of sampling is not available, the assumed holding time will start when the samples are formally accepted by ARLLC. For batch processing, the start and stop dates and times of the batch preparation will be reported.

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**15**
SUBJECT:	**Subcontracting Samples**
DATE of IMPLEMENTATION:	**7/1/13**

ARLLC may subcontract analysis to other laboratories. The following policies are followed to help ensure that data produced by a subcontractor will meet ARLLC's expectation for quality, defensibility, repeatability and will meet ARLLC's client's expectations.

1. ARLLC's client must be made aware that samples will be subcontracted and what laboratory will perform the analyses.
2. Subcontractor laboratories must qualify to perform the analyses using the same criteria applied to ARLLC. When appropriate, subcontracted laboratories must submit proof of certification or accreditation, quality assurance plans, standard operating procedures, results of method detection limit studies and control limits to ARLLC.
3. ARLLC may request that subcontract laboratories analyze, a double-blind performance testing (PT) sample for the subcontracted analysis obtained from commercial vendors at the subcontractor's expense.
4. ARLLC may at its discretion perform an on-site assessment of a subcontract laboratory. Failure to submit requested documents or refusal of an on-site assessment will disqualify laboratories from subcontracting ARLLC sample analyses.
5. Department of Defense (DoD) work to be performed under the Quality Systems Manual (DoD-QSM) must be subcontracted to a DoD Environmental Laboratory Accreditation Program (DoD-ELAP) accredited laboratory.
6. The sample information and analytical requirements for subcontracted analyses are first entered into ARLLC LIMS in the same way that samples for in-house analyses are processed. Subcontractor laboratories are contacted to verify their preparedness, and samples are then submitted to them using ARLLC chain-of-custody forms.
7. The laboratory must be willing to maintain an annual contract with ARLLC and must list ARLLC as a co-insured on the subcontract laboratory's professional and general liability insurance policies.
8. Financial stability is also evaluated on a lab-by-lab basis.

Appendix J

References

ISO/IEC 17025. General Requirements for the Competence of Testing and Calibration Laboratories.

UNIDO. 2009. Complying with ISO/IEC 17025. United Nations Industrial Development Organization.

ISO 9001. Standards for Quality Management Systems.

EPA 2001. EPA Requirements for Quality Management Plans. EPA QA/R-2. EPA/240/B-01/002

ANSI/ASQC E4-1994. Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs. American National Standard.

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Appendix C

Natural Attenuation Analysis

Ephrata RI/FS Natural Attenuation Evaluation

Memorandum

January 2025

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Ephrata RI/FS Natural Attenuation Evaluation

Memorandum

January 2025

Document reference:

Contents

Tables

Figures

Appendices

Appendix D:

D1. Concentration time series plots of additional parameters for P1 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

D2. Concentration time series plots of additional parameters for P2 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

D3. Concentration time series plots of additional parameters for Roza Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

D4. Concentration time series plots of additional parameters for Interflow Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

D5. Concentration time series plots of total arsenic and manganese including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

1 Introduction

The purpose of this evaluation is to assess the effectiveness of natural attenuation in reducing contaminant levels over time at the Grant County Ephrata Landfill (site) located in Ephrata, Washington. The evaluation employs trend analysis using parametric and non-parametric statistical methods to test and model the trends of groundwater analytical data including a list of contaminant constituents.

The trend analysis identifies which wells show a statistically significant reduction in concentrations of chlorinated ethenes, thereby indicating probable biodegradation. In addition to the trend analysis, source decay rates and associated restoration timeframes are calculated for wells that exhibit a decreasing concentration trend. Also evaluated are geochemical parameters and other indicators of environmental conditions that influence the reductive dechlorination process, aiding in the interpretation of the data.

Given the inherent variability and complexity of natural attenuation processes, the accuracy and uncertainty of the results are critical considerations. It is emphasized that the results should be interpreted with professional judgment by using the statistical significance of the estimated trends, which is necessary to make informed decisions regarding the remediation and management of the groundwater contamination at the site.

2 Summary of Findings

There are 74 wells in four aquifer and water bearing zones at the Ephrata Landfill with sufficient data (at least 4 samples) to support the statistics for an evaluation of natural attenuation and trend analysis. Data from January 1, 2008 through April 30, 2024 were included in the analysis. Section 6 provides detailed conclusions of the evaluation.

The following summary provides an evaluation of trends and restoration timeframes for individual wells located between the original landfill and county-owned parcels, focusing on the proposed indicator hazardous substances (IHS) (Parametrix 2022). Restoration timeframes were calculated for wells with decreasing trends using first-order decay rates and represent the estimated time required for these wells to achieve cleanup levels. It is important to note that these estimates are specific to individual wells with a decreasing concentration trend and do not account for stable or non-trending wells, which may delay overall site compliance. The restoration timeframe for the site, defined as the time when all wells at the point of compliance meet cleanup levels, may be longer than the calculated restoration times for individual wells. The findings should be interpreted within this context, with particular attention to the trends across all wells in an aquifer zone or constituent group to assess the feasibility of achieving compliance within the estimated timeframes.

<u>The results of the evaluation find that for total molar concentrations of chlorinated ethenes:</u>

- 17 wells indicate decreasing trends.
- 2 wells indicate probable decreasing trends.
- 27 wells indicate stable trends.
- 24 wells indicate no trends.
- 3 wells indicate increasing trends.
- 1 well indicates a probable increasing trend.

<u>The results for the wells that are located between the original landfill and county-owned parcels based on total molar concentrations of chlorinated ethenes:</u>

- 7 wells indicate decreasing trends, with concentrations decreasing (primarily in the Roza and Interflow aquifers).
- 2 wells indicate probable decreasing trends (P2 zone and Roza aquifer).
- 2 wells show increasing trends (Roza and Interflow aquifers).
- 1 well shows a probable increasing trend (Interflow zone).
- 17 wells indicate stable trends (the majority located in the Roza aquifer, followed by P1 Zone, P2 Zone, and Interflow aquifer).
- 12 wells show no observable trends (P2 zone, Roza aquifer, and Interflow aquifer).

Restoration timeframes are provided for each individual chlorinated ethene in subsequent sections.

<u>The results of the evaluation are based on analyses of individual IHS (proposed)[1] from samples collected from the wells located between the original landfill and county owned parcel boundary:</u>

[1] The attenuation analysis is based on calculated cleanup levels adjusted for total site risk for the indicator hazardous substances proposed in the draft RI/FS Completion letter (Parametrix 2022)

Arsenic, Dissolved:

- Stable trends are observed in 3 wells within the P2 zone.
- No trend is observed in 1 well in the P2 zone.

Arsenic, Total:

- Stable trend is observed in 1 well within the P2 zone.

Manganese, Dissolved:

- Decreasing trends in 1 well within the P2 zone and 3 wells within the Roza aquifer.
- Probably decreasing trends are noted in 1 well within the Roza aquifer.
- Increasing trends are seen in 1 well in the P2 zone and 1 well in the Roza aquifer.
- Stable trends are found in 5 wells in the Roza aquifer.
- No trend is observed in 1 well in the P1 zone, 3 wells in the P2 zone, and 1 well in the Interflow aquifer.
- The restoration time for manganese, dissolved is estimated at 54 years in the P2 zone and between 29 to 115 years in the Roza aquifer.

Manganese, Total:

- Decreasing trends in 5 wells within the Roza aquifer.
- Probably decreasing trends are noted in 1 well within the Roza aquifer.
- Increasing trends are seen in 1 well in the P2 zone,1 well in the Roza aquifer, and 1 well in the Interflow aquifer.
- Stable trends are found in 1 well in P2 and 4 wells in the Roza aquifer.
- No trend is observed in 1 well in the P1 zone and 2 wells in the P2 zone.
- The restoration time for manganese, total is estimated between 48 to 89 years in the P2 zone and between 4 to 68 years in the Roza aquifer.

1,1-Dichloroethane:

- Decreasing trends are observed in 1 well in the P2 zone and 3 wells in the Roza aquifer.
- Increasing trends are noted in 1 well each in the P2 zone and Interflow aquifer.
- Stable trends are found in 4 wells in the Roza aquifer.
- No trend is observed in 2 wells in the P1 zone and 1 well in the Interflow aquifer.
- The restoration time for 1,1-Dichloroethane ranges from 28 years in the P2 zone to 0.6-48 years in the Roza aquifer.

1,2-Dichloroethane (EDC):

- Decreasing trends in 1 well in the P2 zone and 3 wells in the Roza aquifer.
- Increasing trends in 1 well each in the P2 zone, Roza aquifer, and Interflow aquifer.
- Stable trends are observed in 3 wells in the Roza aquifer and 1 well in the Interflow aquifer.
- No trend is noted in 3 wells in the P1 zone and 2 wells in the P2 zone.
- The restoration time is 13 years in the P2 zone and ranges from 3 to 19 years in the Roza aquifer.

1,2-Dichloropropane:

- Decreasing trends are noted in 2 wells in the Roza aquifer.
- Increasing trends are observed in 1 well in the Roza aquifer.
- Stable trends are found in 2 wells each in the P1 and P2 zones, and 1 well in the Interflow aquifer.
- No trend is observed in 1 well each in the P1 and P2 zones.
- The restoration time for 1,2-Dichloropropane ranges from 5 to 11 years in the Roza aquifer.

1,4-Dichlorobenzene:

- Probably decreasing trends are seen in 1 well in the Roza aquifer.
- Increasing trends are observed in 1 well in the Interflow aquifer.
- Stable trends are found in 1 well in the P2 zone.
- No trend is observed in 2 wells in the P2 zone and 3 wells in the Roza aquifer.
- The restoration time for 1,4-Dichlorobenzene is estimated at 172 years in the Roza aquifer.

Benzene:

- Decreasing trends in 1 well each in the P2 zone and Roza aquifer.
- Stable trends are observed in 2 wells in the P2 zone.
- No trend is found in 2 wells in the Roza aquifer.
- The restoration time for benzene is 10 years in the P2 zone and 13 years in the Roza aquifer.

cis-1,2-Dichloroethene:

- Decreasing trends are observed in 1 well in the Roza aquifer.
- The restoration time for cis-1,2-Dichloroethene is estimated at 6 years in the Roza aquifer.

Trichloroethene (TCE):

- Decreasing trends in 1 well in the Interflow aquifer.
- Increasing trends in 1 well in the P2 zone, 2 wells in the Roza aquifer, and 1 well in the Interflow aquifer.
- Stable trends are found in 1 well in the P2 zone and 2 wells in the Roza aquifer.
- No trend is observed in 4 wells in the P2 zone, 2 wells in the Roza aquifer, and 1 well in the Interflow aquifer.
- The restoration time for TCE is 11 years in the Interflow aquifer.

Vinyl Chloride:

- Decreasing trends in 3 wells in the Roza aquifer and 1 well in the Interflow aquifer.
- Increasing trends in 1 well each in the Roza aquifer and Interflow aquifer.
- Stable trends are found in 3 wells in the P2 zone and 3 wells in the Roza aquifer.
- No trend is observed in 1 well in the P1 zone, 2 wells in the P2 zone, 3 wells in the Roza aquifer, and 1 well in the Interflow aquifer.
- The restoration time for vinyl chloride ranges from 6 to 20 years in the Roza aquifer and 4 years in the Interflow aquifer.

3 Hydrogeological Conceptual Site Model

The hydrogeologic conditions at the Ephrata Landfill have been well characterized and refined during previous investigations (Pacific Groundwater Group (PGG) 2010, PGG 2012, PGG 2017, PGG 2022). This natural attenuation analysis primarily focuses on evaluation of the P1, P2, Roza and Interflow aquifers. These shallow zones are found only at the north end of the landfill, which is the focus of this analysis, where the upper layers of basalt have not been eroded away. The P1, P2, and Roza are not used for local water supply. The Interflow aquifer (below the Roza) covers a larger area and extends beneath the entire original landfill. It also extends to the east where several domestic water supply wells use the aquifer for water supply.

The P1, P2, and Roza are water-bearing zones occurring in soft, weathered, highly fractured and/or highly vesicular and mineralized basalt zones (interpreted as interflows) (PGG 2010). These water-bearing zones occur between more massive basalt (interpreted as dense flow interiors), which act as aquitards limiting the vertical migration of contaminants to deeper water-bearing zones. Areas where the intervening massive basalt is thin and or fractured allow for greater hydraulic connection between the zones and provide pathways for vertical migration of contaminants.

3.1 P1 Zone

The P1 is a relatively thin and discontinuous water-bearing zone. In the former drum area (Figure 1), the zone occurs at an elevation of about 1255 to 1260 feet or about 15 to 40 feet below ground surface, depending on the land surface elevation. The zone is projected to intersect the basalt ledge where the drums were stacked, and the groundwater encountered on that ledge is interpreted as P1 groundwater. The zone is characterized by highly to moderately weathered soft brown basalt. The zone is generally five feet thick or less in the former drum area and typically underlain by massive basalt with minimal vesicles or weathering that separates it from the underlying P2 (PGG 2022).

The zone mainly pinches out within about 200 feet or less east, west, and south of the former drum area and does not appear to project into the Hole. Where encountered in these areas and where encountered farther from the drum area, the P1 is unsaturated. The zone becomes discontinuous to the north. The estimated lateral extent of the P1 is confined to within the landfill property boundary and portions of the County owned property to the north (PGG 2022).

3.2 P2 Zone

The P2 is laterally more continuous than the overlying P1. In the former drum area the zone occurs at an elevation of about 1230 to 1245 feet or about 30 to 60 feet below ground surface, depending on the land surface elevation. Like the P1, the zone is typically characterized as highly to moderately weathered soft brown basalt. At some locations, the zone is vesicular. The zone is generally 5 to 15 feet thick and typically underlain by hard massive or fractured basalt that separates it from the underlying Roza.

North of Neva Lake Road, the hydrogeologic distinction between the P2 and Roza diminishes. This and other observations of groundwater levels and chemistry suggest the P2 zone identified in the former drum area develops greater hydraulic connectivity and might merge with with the Roza to the north. The lateral extent of the P2 is mainly confined within the landfill property and County-owned property to the north, east, and west. The zone likely extends somewhat farther north than any site monitoring well location; however, contamination has not been detected in P2 wells north of the landfill (PGG 2022).

3.3 Roza Aquifer

The Roza aquifer is relatively continuous at the north end of the site and is typically encountered at elevations of 1200 to 1225 feet with a thickness ranging from about 5 to 15 feet. Although the Roza is a geological unit, in this report, the term 'Roza' is used to refer to the aquifer present within this geological unit. The aquifer is commonly characterized as moderately-to-highly vesicular, fractured basalt with reddish-brown weathering interpreted as the top of a basalt flow.

The estimated lateral extent of the Roza aquifer is primarily based on projection of the aquifer to the erosional surface of the subsurface basalt. The aquifer is believed to pinch-out or lose saturation beneath the original landfill (PGG 2010). Like the P2, the lateral extent of the Roza aquifer is mainly confined within the landfill property boundary and County owned property to the north, east, and west, though the lateral limit of the aquifer is projected to occur farther east beneath private property near the north end of C.5 Rd NW. The extent of the aquifer farther north and west of County owned property is less well defined due to limited data; however, contamination has not been detected in the aquifer in those directions (PGG 2022).

3.4 Interflow Aquifer

The Interflow aquifer is a confined basalt aquifer that occurs below the Roza aquifer with a top elevation ranging from about 1120 to 1170 feet and with aquifer thicknesses of 11 to 20 feet. It underlies the entire northern part of the site, but to the south appears to sub-crop into Outwash aquifer or Ringold Formation just north of the new landfill cell. To the southeast and southwest, the Interflow aquifer also likely sub-crops into the Outwash aquifer (PGG 2010).

4 Methodology

4.1 Data Utilization and Exploratory Data Analysis

The evaluation of natural attenuation is based on analyzing the historical groundwater analytical data collected from multiple monitoring wells across different aquifer and water bearing zones at the landfill site. Within the scope of this study, only the data collected after January 1, 2008 through April 30, 2024, were used to evaluate natural attenuation. For undetected measurements, half of the detection limit is used in the analyses.

Python scripts are utilized for both preprocessing and analyzing the data. This approach not only allows automation of statistical analysis and calculation of multiple well data but also facilitates reproducibility, when the database is updated with new measurements. The groundwater analytical parameters used in the natural attenuation analysis are given in Table 1.

4.2 Natural Attenuation Evaluation of Chlorinated Ethenes

Chlorinated ethenes undergo complex but predictable microbial degradation processes. These processes are influenced by the redox conditions present in the environment. Under certain redox conditions, chlorinated ethenes act as electron acceptors, facilitating microbial metabolism through reductive dechlorination. This means that microorganisms respire by transferring electrons to the chlorinated ethenes, effectively dechlorinating them. Under other redox conditions, lightly chlorinated ethenes like dichloroethene (DCE) and vinyl chloride (VC) can act as electron donors, being oxidized by microorganisms to generate energy in the form of electrons.

Highly chlorinated ethenes like tetrachloroethene (PCE) and TCE undergo reductive dechlorination under anoxic conditions, transforming into less chlorinated compounds such as DCE and VC, and ultimately into ethene. The efficiency of these transformations is highly dependent on the redox conditions. For instance, the reduction of PCE and TCE to DCE typically occurs under mildly reducing conditions facilitated by nitrate (NO_3) or iron (Fe(III)) reducing environments. More strongly reducing conditions, such as those driven by methanogenesis or sulfate (SO_4) reduction, are necessary for the further transformation of DCE to VC.

Hydrogen (H_2) availability is crucial for the efficiency of reductive dechlorination, as it serves as an electron donor. Under anaerobic conditions, H_2 is continuously produced by microorganisms metabolizing organic matter. The affinity of different terminal electron-accepting processes for H_2 varies, influencing the steady-state concentrations of H_2. For instance, methanogenesis and SO_4 reduction, which exhibit lower affinities for H_2, are characterized by relatively higher H_2 concentrations compared to Fe(III) and NO_3 reduction. The complete degradation of chlorinated ethenes often requires sequential anoxic and oxic conditions. Initially, under reducing conditions, PCE and TCE are transformed into DCE and VC. As these compounds migrate to more oxic conditions, they can be further oxidized to CO_2.

In this study, the natural attenuation of chlorinated ethenes in different aquifer zones over time was evaluated using i) total molar sum of the chlorinated ethenes, and ii) individual concentrations of ethenes and other IHSs listed in Table 1. Restoration timeframes are then calculated for each individual chlorinated ethene along with other IHSs.

4.2.1 Data Processing and Analysis

Conversion of groundwater concentrations from micrograms per liter (µg/L) to molar equivalents (micromoles per liter) allows for the evaluation of molar fractions. This conversion is crucial because chlorinated ethenes and their breakdown products have different molecular weights. Evaluating data on a molar basis enables a direct comparison of the number of moles of the parent compound (e.g., TCE) and its breakdown products (e.g., cis-1,2-DCE and VC) within a given sample. In addition, molar analysis provides a better understanding of plume attenuation. A reduction in total molar-based concentration of chlorinated ethenes is strong evidence of attenuation.

The concentration data for chlorinated ethenes, such as PCE, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE and VC, is processed to account for anomalies, such as non-detects or values below detection limits. The processed data is then used to calculate the molar concentration for each measurement to facilitate comparison and analysis. The last total molar concentrations are also compared to the cleanup level (CUL)[2] of VC to assess whether natural attenuation is sufficient to achieve desired remediation goals. If the combined concentration of ethenes exceeds CUL of VC, it suggests that even if some of those compounds are not currently VC, there is a potential that they could degrade into VC, posing a future risk.

Trend analysis (see section 4.3) is performed using the Mann-Kendall test to determine whether contaminant concentrations are increasing, decreasing, or stable over time. For wells showing a decreasing trend, an exponential model was fit to the time series of concentrations in each well to calculate decay rates and restoration timeframes for individual chlorinated ethenes and other IHSs. This evaluation aims to understand the behavior of chlorinated ethenes and other IHSs within different aquifer zones.

Overall, analysis results in detailed trends for each IHS, identifying whether each is decreasing (indicating effective natural attenuation), increasing, or stable.

4.3 Trend Analysis

Trend analysis applied in this study involves both regression analysis and non-parametric statistical assessments of temporal groundwater analytical data.

The parametric methods include linear and exponential regression models, which assess how well the data fits specific model forms. The linear regression model identifies trends by fitting a straight line to the data, while the exponential regression model fits a curve representing exponential decay or growth. The non-parametric method used is the Mann-Kendall test, which evaluates the overall monotonic trend over time without assuming any specific model.

Differences between regression analyses and the Mann-Kendall test arise because regression models are sensitive to the chosen model and short-term trends, while the Mann-Kendall test focuses on the general direction of the entire dataset and is more robust to fluctuations and outliers.

For example, when there is a small number of data points and the Mann-Kendall test indicates no trend or stable, but an exponential regression model shows a sharp increase or decrease, the disparity occurs because of one of several reasons:

[2] The cleanup levels for the IHSs were calculated and adjusted for total site risk and proposed in the draft RI/FS Completion letter (Parametrix 2022).

- With only a few data points, the exponential model can be heavily influenced by small changes, leading to an exaggerated curve.
- Exponential models are particularly sensitive to increases in the data, even if they are minor, causing them to project unrealistic decay/growth into the future.
- Recent data points with slight increases can make the exponential model fit a steep curve, while the Mann-Kendall test, which looks at overall trends, sees the data as stable.

4.3.1 Mann-Kendall Analysis

The Mann-Kendall trend test is a non-parametric method used to identify trends in datasets, particularly useful for analyzing data sets that contain outliers, are non-normally distributed, or have missing entries. Unlike parametric methods, the Mann-Kendall test does not presume any specific distribution for the dataset.

The Mann-Kendall test evaluates the null hypothesis (H_0) that there is no trend within a dataset against the alternative hypothesis (H_1) that a trend does exist (Gilbert, 1987). It does this by examining the relative magnitudes of sample data rather than the data values themselves. Each data point is compared with all subsequent data points.

To refine the results of the original Mann-Kendall test, a decision matrix (Table 2), as described in Aziz et al. (2003), is implemented, which categorizes the trend based on the Confidence Factor (CF) and the Coefficient of Variation (COV). This matrix enhances the interpretability of the results by assigning a qualitative measure to the trend.

Key parameters and statistics used in the Mann-Kendall analysis are as follows:

- **S Statistic**: This is the primary statistic calculated, representing the number of positive differences minus the number of negative differences between all data point pairs. For each pair, a comparison is made:
  - If a data point occurring later in time is greater than one earlier in time, the score is increased.
  - If the later data point is smaller, the score is decreased.

  The formula for calculating the S statistic is:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \text{sign}(x_j - x_i)$$

where x_j and x_i are data points in the time series, and sign(x) is the sign function, defined as:

$$\text{sign}(x) = \begin{cases} 1 \ if \ \ x > 0 \\ 0 \ if \ \ x = 0 \\ -1 \ if \ \ x < 0 \end{cases}$$

- **CF**: Reflects the probability that the observed trend (increasing or decreasing) is real, as opposed to occurring by chance. It is based on the standard normal deviate (Z) associated with the S statistic.

- **COV**: Measures the relative variability of the dataset. It is used to differentiate between a "no trend" result, which indicates significant scatter in the dataset, and a "stable" condition, where variations are minimal.

The trend analysis results are categorized based on the S statistic, CF, and COV values. Trends are identified as increasing or decreasing with different levels of confidence, or as stable when variations are minimal. Classification of concentration trends based on Mann-Kendall test results is given in Table 2. This classification helps in determining the state of the site's natural attenuation processes, guiding further monitoring and intervention strategies based on the trend analysis outcomes.

4.4 Calculation of Source Decay Rates

The rate of natural attenuation for each contaminant is quantified using the first-order kinetic decay model. This model is predicated on the assumption that the rate of decrease in contaminant concentration at a specific location is directly proportional to its current concentration. The first-order attenuation rate constant, *k*, is determined by linear regression of the natural logarithm of contaminant concentrations against time (as described in Newell, 2002).

The model is expressed by the differential equation:

$$\frac{dC}{dt} = -kC$$

where:

C is the concentration of the contaminant,

k is the first-order decay rate constant,

t is time.

The solution to this differential equation provides the concentration of the contaminant as a function of time:

$$C(t) = C_0 e^{-kt}$$

where:

C_0 is the initial concentration at time t=0,

e is the base of the natural logarithm.

To estimate the decay rate constant (*k*), taking the natural logarithm of both sides of the equation, which linearizes it:

$$\ln\big(C(t)\big) = \ln(C_0) - kt$$

This linear form ($y = mx + b$) allows *k* to be estimated using linear regression of ln(C(t)) against time *t*,

where:

the slope of the regression line ($-k$) represents the decay rate constant,

the intercept ($\ln(C_0)$) represents the natural logarithm of the initial concentration.

4.4.1 Goodness of Fit: R-Squared (R^2)

The R^2 value is a key metric used to evaluate the goodness of fit of the regression model. It represents the proportion of the variance in the dependent variable (ln($C(t)$)) that is predictable from the independent variable (time t).

$$R^2 = 1 - \frac{\sum_{i=1}^{n}\left(\ln(C_i) - \widehat{\ln(C_i)}\right)^2}{\sum_{i=1}^{n}\left(\ln(C_i) - \overline{\ln(C)}\right)^2}$$

Where:

$\ln(C_i)$ is the natural logarithm of the observed concentration at time i,

$\widehat{\ln(C_i)}$ is the predicted value from the regression model at time i,

$\overline{\ln(C)}$ is the mean of the observed logarithmic concentrations.

R^2 values range from 0 to 1, where 0 means the model explains none of the variance and 1 means it explains all of the variance, indicating the strength of the model's explanatory power in this context.

4.4.2 Confidence Intervals for Decay Rate Constant (k)

Confidence intervals (CI) provide a range of values that describe the uncertainty around the estimated decay rate constant. They are especially important in conveying the precision and reliability of the estimation. The CI for k can be estimated from the standard error of the slope (SE_{slope}) in the regression equation:

$$\text{CI}_k = \hat{k} \pm t^* \text{SE}_{slope}$$

where:

$\hat{k}$ is the estimated decay rate constant,

t^* is the critical value from the t-distribution for a specified confidence level (e.g., 95%), which depends on the degrees of freedom ($n-2$ where n is the number of data points),

SE_{slope} is calculated as:

$$\text{SE}_{slope} = \sqrt{\frac{1}{n-2}\frac{\sum_{i=1}^{n}\left(\ln(C_i) - \widehat{\ln(C_i)}\right)^2}{\sum_{i=1}^{n}\left(t_i - \bar{t}\right)^2}}$$

where t_i are the time points and $\bar{t}$ is the mean of the time points.

4.5 Estimation of Restoration Timeframes

Based on the first-order decay model, the time t required for the contaminant concentration to reduce from an initial concentration C_{start} to a target concentration C_{goal} can be estimated using the decay rate constant k obtained from the regression analysis of logarithmic concentration data over time.

$$t = \frac{-\ln\left(\frac{C_{\text{goal}}}{C_{\text{start}}}\right)}{k}$$

where:

C_{start} is the initial concentration of the contaminant.

C_{goal} is the target concentration considered safe or acceptable.

k is the first-order decay rate constant, estimated from the logarithmic regression.

4.5.1 CI for Timeframe Estimation

CI for the restoration timeframes provide a range within which the actual restoration time is expected to fall with a certain level of confidence. This is crucial for risk assessment and planning future monitoring and intervention efforts.

To include the upper and lower confidence bounds for the decay rate constant *k*, time to remediation goal can be calculated as follows:

Lower bound estimate for restoration time (t_{lower}):

$$t_{\text{lower}} = \frac{-\ln\left(\frac{C_{\text{goal}}}{C_{\text{start}}}\right)}{k_{\text{upper}}}$$

Upper bound estimate for restoration time (t_{upper}):

$$t_{\text{upper}} = \frac{-\ln\left(\frac{C_{\text{goal}}}{C_{\text{start}}}\right)}{k_{\text{lower}}}$$

These calculations provide a range for the expected restoration time, considering the uncertainty in the decay rate constant estimation. This approach makes sure that remediation planning can account for the best-case and worst-case scenarios based on the observed data variability and the statistical confidence in the decay rate estimates.

4.6 Evaluation of Geochemical Indicators for Anaerobic Degradation

The methodology for evaluation of geochemical environment employs a set indicator alongside a scoring scheme as outlined by the U.S. EPA (1998). Although the entire suite of geochemical indicators is not measured for this study, we used the following subset of 12 indicators and their respective criteria to count the number of indicators meeting the criteria for a qualitative evaluation (the lowest score of 0 and the highest score of 12):

- Low nitrate (< 2 mg/L)
- Low Oxidation Reduction Potential (ORP) (< 50mV)
- Elevated dissolved iron (> 1000 µg/L)
- Elevated ethene (> 10 µg/L)

- Elevated ethane (> 100 µg/L)
- Elevated methane (> 500 µg/L)
- Elevated alkalinity (> 2 times above background)
- Elevated chloride (> 2 times above background)
- Elevated total benzene, toluene, ethylbenzene, and xylenes (BTEX) (> 100 µg/L)
- Detection of DCE (with 80 percent total DCE being cis-1,2-DCE)
- Detection of 1,1-Dichloroethane (1,1-DCA)
- Detection of chloroethane (CA)

Field measurements of dissolved oxygen (DO) are excluded from this analysis due to concerns regarding the reliability of the measurement. Additionally, trend analyses are performed on the geochemical parameters to assess how geochemical conditions change over time at the landfill site.

5 Results

5.1 Mann-Kendall Trend Results based on Total Molar Concentrations of Chlorinated Ethenes

The evaluation of natural attenuation was conducted for the wells located in different aquifer zones at the landfill site. The evaluation in this section is focused on the total molar mass of the following chlorinated ethenes: PCE, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and VC. The CUL is assumed to be the CUL for VC, which is 0.09 µg/L (0.0014 µmol/L). The source decay rates and restoration times are calculated based on individual chlorinated ethene concentrations (see section 5.2).

Detailed statistics of the Mann-Kendall test, including the trend classification, S-statistic, CF, and COV, are provided in Tables 3 - 6 which also includes the R^2[3] values obtained from an exponential fit. The plots of the trends are presented in Appendix A1 - A4. The geospatial distribution of the trends and comparisons are also mapped and given in Figures 1 - 4.

5.1.1 P1 Zone

Within the P1 zone, all 25 wells had total molar mass concentrations of chlorinated ethenes above the CUL for VC. These wells include MW-100p1, MW-104p1, MW-109p1, MW-110p1, MW-117p1, MW-123p1, MW-127p1, MW-129p1, MW-34p1, MW-36p1, MW-37p1, MW-61p1, MW-64p1, MW-65p1, MW-66p1, MW-67p1, MW-68p1, MW-69p1, MW-70p1, MW-83p1, MW-85p1, MW-90p1, MW-92p1, MW-95p1, and MW-98p1. This suggests that the natural attenuation process in the P1 zone has not yet reduced the chlorinated ethenes to the desired concentration goal (Table 3, Figure 1, Appendix A1). Geochemical indicator scores for P1 zone are given in Table 7.

5.1.1.1 Wells with Decreasing Trends

Among the wells with concentrations above the CUL, the Mann-Kendall test indicates that only two wells, MW-34p1 and MW-83p1, exhibit a decreasing trend in total molar concentrations:

- MW-34p1: A geochemical indicator rating of 9, which is the highest among P1 zone wells.
- MW-83p1: A geochemical indicator score of 7.

Geochemical indicator ratings suggest favorable environments for reductive dechlorination.

5.1.1.2 Wells Without Decreasing Trends

The wells with concentrations above the CUL for VC, but not showing a decreasing trend include:

- Stable Trend:
  - MW-117p1, MW-123p1, MW-37p1, and MW-85p1.

[3] R^2 values below 0.05 were included as <0.05 from Tables 17 through 24.

- MW-37p1: Despite the stable Mann-Kendall trend result, total molar mass concentration fits a decreasing exponential model with an R^2 value of 0.89. No geochemical indicator score is available for this well.

- No Trend:
  - MW-36p1, MW-65p1, MW-68p1, MW-69p1, MW-92p1, and MW-95p1. Both MW-92p1 and MW-95p1 have the second highest geochemical score of 8 which is the second highest score among the P1 wells.
  - MW-95p1: Total molar mass concentration fits a decreasing exponential model with an R^2 value of 0.84. It also has a high geochemical indicator score of 8.

5.1.2 P2 Zone

In the P2 zone, only one well, MW-46p2, had concentrations below the CUL for VC. In contrast, the remaining 34 wells, including MW-101p2, MW-107p2, MW-108p2, MW-112p2, MW-113p2, MW-114p2, MW-115p2, MW-118p2, MW-122p2, MW-124p2, MW-125p2, MW-126p2, MW-131p2, MW-136p2, MW-138p2, MW-141p2, MW-143p2, MW-147p2, MW-33p2, MW-35p2, MW-38p2, MW-39p2, MW-40p2, MW-43p2, MW-49p2, MW-52p2, MW-60p2, MW-76p2, MW-80p2, MW-87p2, MW-88p2, MW-91p2, MW-94p2, and MW-99p2, have concentrations above the CUL, indicating that the natural attenuation process has not yet reduced the chlorinated ethenes to the desired concentration goal (Table 4, Figure 2, Appendix A2). Geochemical indicator scores for P2 zone are given in Table 8.

5.1.2.1 Wells with Decreasing Trends

The Mann-Kendall test indicates that five wells (MW-33p2, MW-35p2, MW-38p2, MW-80p2, and MW-107p2) exhibit a decreasing trend in total molar concentrations, while one well (MW-46p2) shows a “probably decreasing” trend. Geochemical indicator score for the wells with a decreasing trend ranges between 6 and 10. Both MW-33p2 and MW-35p2 have the highest score of 10. MW-46p2 has a low geochemical score of 1.

5.1.2.2 Wells Without Decreasing Trends

The wells with concentrations above the CUL, but not showing a decreasing trend include:

- Stable Trend: MW-115p2, MW-125p2, MW-126p2, MW-147p2, MW-40p2, MW-49p2, MW-91p2, and MW-99p2.
- No Trend: MW-101p2, MW-113p2, MW-114p2, MW-124p2, MW-138p2, MW-143p2, MW-39p2, MW-43p2, MW-52p2, and MW-87p2.

5.1.3 Roza Aquifer

In the Roza aquifer, only one well, MW-48b, had concentrations below the CUL for VC. In contrast, the remaining 34 wells, including MW-102b, MW-103b, MW-105b, MW-116b, MW-121b, MW-128b, MW-130b, MW-132b, MW-133b, MW-135b, MW-139b, MW-140b, MW-142b, MW-144b, MW-145b, MW-146b, MW-148b, MW-149b, MW-150b, MW-151b, MW-19b, MW-29b, MW-30b, MW-31b, MW-3b, MW-42b, MW-44b, MW-51b, MW-57b, MW-63b, MW-71b, MW-72b, MW-74b, MW-78b, MW-7b, MW-81b, MW-82b, MW-86b, MW-89b, MW-93b, MW-96b, MW-97b and MW-9b, have concentrations above the CUL, indicating that the natural attenuation process has not yet reduced the chlorinated ethenes to the desired concentration goal (Table 5, Figure 3, Appendix A3). Geochemical indicator scores for Roza aquifer are given in Table 9.

5.1.3.1 Wells with Decreasing Trends

The Mann-Kendall test indicates that four wells (MW-3b, MW-42b, MW-7b and MW-9b) exhibit a decreasing trend in total molar concentrations, while one well (MW-48b) already under CUL shows a “probably decreasing” trend. Geochemical indicator score for the wells with a decreasing trend ranges between 2 and 8. While MW-3b and MW-42b having relatively higher geochemical indicator score (8 and 7, respectively), wells MW-7b and MW-9b have lower score of 4 and 2, respectively. Both wells have increasing nitrate trends which may indicate more oxidizing conditions related to reduced denitrification. Decreasing trend in alkalinity (as CaCO3) and sulfate concentrations also suggest a transitioning to more oxidized conditions. Furthermore, in these two wells, decreasing trends in chloride do not suggest further breakdown of chlorinated constituents at this location.

5.1.3.2 Wells Without Decreasing Trends

The wells with concentrations above the CUL, but not showing a decreasing trend include:

- Stable Trend: W-103b, MW-140b, MW-142b, MW-144b, MW-145b, MW-148b, MW-151b, MW-19b, MW-30b, MW-44b, MW-57b, MW-71b, MW-81b and MW-82b. Wells MW-44b and MW-81b have geochemical score of 7.
- No Trend: MW-133b, MW-29b, MW-31b, MW-51b and MW-63b. Wells MW-63b and MW-133b have relatively higher geochemical indicator score (8 and 9, respectively), indicating a favorable environment for reductive dichlorination.

5.1.4 Interflow Aquifer

In the Interflow aquifer, all of the 14 wells (MW-20c, MW-21c, MW-22c, MW-2c, MW-45c, MW-47c, MW-4c, MW-50c, MW-54c, MW-56c, MW-58c, MW-5c, MW-62c and MW-6c) have concentrations above the CUL, indicating that the natural attenuation process has not yet reduced the chlorinated ethenes to the desired concentration goal (Table 6, Figure 4, Appendix A4). Geochemical indicator scores for Interflow aquifer are given in Table 10.

5.1.4.1 Wells with Decreasing Trends

The Mann-Kendall test indicates that six wells (MW-20c, MW-21c, MW-22c, MW-4c, MW-5c and MW-6c) exhibit a decreasing trend in total molar concentrations. Geochemical indicator results for these wells range between 0 and 2 except one well with a score of 4 (MW-5c). Overall geochemical trends also suggest a shift towards more oxidizing conditions in these wells.

5.1.4.2 Wells Without Decreasing Trends

The wells with concentrations above the CUL, but not showing a decreasing trend include:

- Increasing Trend: MW-2c
- Probably Increasing Trend: MW-45c
- Stable Trend: MW-47c.
- No Trend: MW-50c, MW-54c and MW-31b, MW-58c. Even though Mann-Kendall test results doesn’t suggest a decreasing trend, MW-58c has the highest geochemical indicator score (6).

5.2 Mann-Kendall Trend Analysis and Restoration Timeframe Calculation Results for the IHSs

Following sub-sections provide a summary of wells with constituents that exceed the proposed CULs. For each well, it includes:

1) Constituents Above CULs: Lists all constituents for which the concentration is above the CUL.
2) Trends Analysis: For constituents above the CULs, the report details the observed trends based on the Mann-Kendall trend test.
3) Restoration Timeframes: A restoration timeframe is reported for the wells that have either a decreasing or probably decreasing trend while having the last measured concentration above the CUL.

The trends are only reported for constituents that have sufficient data (at least 4 samples). If there are fewer than 4 samples or no data available for a constituent, this is also noted. Detailed statistics of the Mann-Kendall test, including the trend classification, S-statistic, CF, and COV, and the R^2 values for both linear and exponential models are provided in Tables 11 - 14. The plots of the trends are presented in Appendix B1 - B4. The geospatial distribution of the trends and comparisons are also mapped and given in Figures 5 - 44.

The trend analysis of geochemical parameters including dissolved oxygen, pH, alkalinity, oxidation-reduction potential (ORP), nitrogen, methane, sulfate, and dissolved iron are provided in Tables 17 - 20 and Appendices C1-C4.

The trend analysis of the constituents that are not listed as IHS are also presented in Tables 21 - 24 and Appendix D1 – D5.

5.2.1 P1 Zone

MW-100p1:

- Constituents above CULs: Manganese, Dissolved; VC
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), VC (n=1)

MW-104p1:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, VC
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), 1,1-DCA (n=1), VC (n=1)

MW-109p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, TCE, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=3), Manganese, Dissolved (n=3), 1,1-DCA (n=3), 1,2-Dichloroethane (EDC) (n=3), 1,2-Dichloropropane (n=3), TCE(n=3), VC (n=3)

MW-110p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, TCE, VC

- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), TCE(n=1), VC (n=1)

MW-117p1:

- Constituents above CULs: TCE, VC
- Stable trends: TCE(n=4)
- No trend: VC (n=4)

MW-123p1:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloropropane, cis-1,2-DCE, TCE, VC
- Stable trends: 1,1-DCA (n=4), 1,2-Dichloropropane (n=4), cis-1,2-DCE (n=4), TCE(n=4), VC (n=4)

MW-34p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, VC
- Decreasing trends: Arsenic, Dissolved (n=21), 1,1-DCA (n=22), 1,2-Dichloroethane (EDC) (n=23), 1,4-Dichlorobenzene (n=23), Benzene (n=23), VC (n=23)
- Stable trends: Manganese, Dissolved (n=21)
- Arsenic, Dissolved: R^2 value of 0.30, restoration timeframe of 36 years (CI: 23 and 93 years).
- 1,1-DCA: R^2 value of 0.93, restoration timeframe of 3 years (CI: 3 and 3 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.87, restoration timeframe of 3 years (CI: 3 and 4 years).
- 1,4-Dichlorobenzene: R^2 value of 0.57, restoration timeframe of 7 years (CI: 5 and 10 years).
- Vinyl Chloride: R^2 value of 0.90, restoration timeframe of 7 years (CI: 6 and 8 years).
- Benzene: R^2 value of 0.80, restoration timeframe of 1 years (CI: 1 and 1 years).

MW-36p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE, VC
- Decreasing trends: Manganese, Dissolved (n=4), 1,1-DCA (n=4), VC (n=4)
- Stable trends: 1,2-Dichloroethane (EDC) (n=4), Benzene (n=4)
- No trend: 1,4-Dichlorobenzene (n=4), TCE(n=4)
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=3)
- 1,1-DCA: R^2 value of 0.94, restoration timeframe of 9 years (CI: 6 and 18 years).
- Manganese, Dissolved: R^2 value of 0.97, restoration timeframe of 29 years (CI: 21 and 46 years).
- Vinyl Chloride: R^2 value of 0.97, restoration timeframe of 5 years (CI: 3 and 7 years).

MW-37p1:

- Constituents above CULs: Manganese, Dissolved, VC
- No trend: Manganese, Dissolved (n=4), VC (n=5)

MW-64p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,4-Dichlorobenzene, Benzene, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=2), Manganese, Dissolved (n=2), 1,4-Dichlorobenzene (n=2), Benzene (n=2), VC (n=2)

MW-65p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, VC
- Increasing trends: Arsenic, Dissolved (n=7)
- Decreasing trends: 1,4-Dichlorobenzene (n=8)
- Probably increasing trends: Manganese, Dissolved (n=7), Benzene (n=8)
- No trend: 1,2-Dichloroethane (EDC) (n=8), VC (n=8)
- 1,4-Dichlorobenzene: R^2 value of 0.56, restoration timeframe of 6 years (CI: 4 and 21 years).

MW-66p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,4-Dichlorobenzene, Benzene, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=2), Manganese, Dissolved (n=2), 1,4-Dichlorobenzene (n=2), Benzene (n=2), VC (n=2)

MW-67p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=2), Manganese, Dissolved (n=2), 1,2-Dichloroethane (EDC) (n=2), 1,4-Dichlorobenzene (n=2), Benzene (n=2), TCE(n=2), VC (n=2)

MW-68p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, VC
- Increasing trends: Arsenic, Dissolved (n=10), 1,2-Dichloropropane (n=13)
- Stable trends: 1,1-DCA (n=13), Benzene (n=13)
- Probably increasing trends: Manganese, Dissolved (n=10), VC (n=13)
- Probably decreasing trends: 1,4-Dichlorobenzene (n=13)
- No trend: 1,2-Dichloroethane (EDC) (n=13)
- 1,4-Dichlorobenzene: R^2 value of 0.09, restoration timeframe of 14 years (CI: 5 and -20 years).

MW-69p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, cis-1,2-DCE, TCE, VC
- Decreasing trends: Manganese, Dissolved (n=5), 1,2-Dichloropropane (n=5)
- Stable trends: 1,1-DCA (n=5), 1,2-Dichloroethane (EDC) (n=5), Benzene (n=5)
- Probably increasing trends: 1,4-Dichlorobenzene (n=5)

- No trend: Arsenic, Dissolved (n=5), cis-1,2-DCE (n=5), TCE(n=5), VC (n=5)
-

MW-70p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,2-Dichloroethane (EDC), Benzene, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=2), Manganese, Dissolved (n=2), 1,2-Dichloroethane (EDC) (n=2), Benzene (n=2), VC (n=2)
- 1,2-Dichloropropane: R^2 value of 0.75, restoration timeframe of 20 years (CI: 11 and 94 years).
- Manganese, Dissolved: R^2 value of 0.61, restoration timeframe of 44 years (CI: 21 and -527 years).

MW-83p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, TCE, VC
- Decreasing trends: Manganese, Dissolved (n=4), 1,1-DCA (n=4)
- Stable trends: Arsenic, Dissolved (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), Benzene (n=4)
- No trend: 1,4-Dichlorobenzene (n=4), TCE(n=4), VC (n=4)
- 1,1-DCA: R^2 value of 0.94, restoration timeframe of 12 years (CI: 8 and 23 years).
- Manganese, Dissolved: R^2 value of 0.90, restoration timeframe of 25 years (CI: 15 and 83 years).

MW-85p1:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, TCE, VC
- Decreasing trends: Manganese, Dissolved (n=4)
- Stable trends: 1,4-Dichlorobenzene (n=4), VC (n=4)
- No trend: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), TCE(n=4)
- Manganese, Dissolved: R^2 value of 0.92, restoration timeframe of 40 years (CI: 25 and 108 years).

MW-90p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,4-Dichlorobenzene, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,4-Dichlorobenzene (n=1), VC (n=1)

MW-92p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, TCE, VC
- Stable trends: Arsenic, Dissolved (n=4), Manganese, Dissolved (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,4-Dichlorobenzene (n=4), Benzene (n=4)
- No trend: 1,1-DCA (n=4), 1,2-Dichloropropane (n=4), TCE(n=4), VC (n=4)

MW-95p1:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, VC
- Decreasing trends: Manganese, Dissolved (n=4)
- Stable trends: Arsenic, Dissolved (n=4), 1,1-DCA (n=4), 1,4-Dichlorobenzene (n=4)
- No trend: 1,2-Dichloroethane (EDC) (n=4), VC (n=4)
- Manganese, Dissolved: R^2 value of 0.89, restoration timeframe of 23 years (CI: 13 and 88 years).

MW-98p1:

- Constituents above CULs: VC
- Not enough data to perform Mann-Kendall for the following constituents: VC (n=1)

5.2.2 P2 Zone

MW-101p2:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, Benzene, TCE, VC
- Decreasing trends: 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4)
- Stable trends: 1,1-DCA (n=4), Benzene (n=4)
- No trend: Manganese, Dissolved (n=4), TCE(n=4), VC (n=4)
- 1,2-Dichloropropane: R^2 value of 0.98, restoration timeframe of 5 years (CI: 4 and 6 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.94, restoration timeframe of 3 years (CI: 2 and 5 years).

MW-107p2:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE, VC
- Increasing trends: Manganese, Dissolved (n=4)
- Decreasing trends: VC (n=4)
- Stable trends: Benzene (n=4), TCE(n=4)
- No trend: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,4-Dichlorobenzene (n=4)
- VC: R^2 value of 0.97, restoration timeframe of 6 years (CI: 4 and 10 years).

MW-108p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), VC (n=1)

MW-112p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), 1,4-Dichlorobenzene (n=1), Benzene (n=1), VC (n=1)

MW-113p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, TCE, VC
- Stable trends: Arsenic, Dissolved (n=4), 1,2-Dichloropropane (n=4), Benzene (n=4)
- No trend: Manganese, Dissolved (n=4), 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,4-Dichlorobenzene (n=4), TCE(n=4), VC (n=4)

MW-114p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, TCE, VC
- Increasing trends: Manganese, Dissolved (n=4), 1,4-Dichlorobenzene (n=4)
- Stable trends: Benzene (n=4)
- No trend: Arsenic, Dissolved (n=4), 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), TCE(n=4), VC (n=4)

MW-115p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, VC
- Stable trends: Arsenic, Dissolved (n=4), 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4)
- No trend: Manganese, Dissolved (n=4), VC (n=4)

MW-118p2:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, TCE, VC
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), TCE(n=1), VC (n=1)

MW-122p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, Benzene, TCE, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), Benzene (n=1), TCE(n=1), VC (n=1)

MW-124p2:

- Constituents above CULs: Manganese, Dissolved, TCE, VC
- Stable trends: Manganese, Dissolved (n=4)
- No trend: TCE(n=4), VC (n=4)

MW-125p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, VC
- Decreasing trends: Manganese, Dissolved (n=4)
- Stable trends: Arsenic, Dissolved (n=4), VC (n=4)
- Manganese, Dissolved: R^2 value of 0.86, restoration timeframe of 54 years (CI: 30 and 294 years).

MW-126p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE, VC
- Increasing trends: Manganese, Dissolved (n=4)
- Decreasing trends: Benzene (n=4)
- Stable trends: Arsenic, Dissolved (n=4), VC (n=4)
- No trend: 1,2-Dichloroethane (EDC) (n=4), 1,4-Dichlorobenzene (n=4), TCE(n=4)
- Benzene: R^2 value of 0.63, restoration timeframe of 10 years (CI: 4 and -17 years).

MW-131p2:

- Constituents above CULs: Manganese, Dissolved, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1)

MW-136p2:

- Constituents above CULs: 1,2-Dichloropropane, TCE
- Not enough data to perform Mann-Kendall for the following constituents: 1,2-Dichloropropane (n=1), TCE(n=1)

MW-138p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE, VC
- Increasing trends: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4)
- Stable trends: 1,4-Dichlorobenzene (n=4), Benzene (n=4)
- No trend: Arsenic, Dissolved (n=4), Manganese, Dissolved (n=4), TCE(n=4), VC (n=4)

MW-141p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1)

MW-143p2:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, TCE
- Decreasing trends: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4)
- Stable trends: 1,2-Dichloropropane (n=4)
- No trend: TCE(n=4)
- 1,1-DCA: R^2 value of 0.87, restoration timeframe of 28 years (CI: 15 and 147 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.99, restoration timeframe of 13 years (CI: 11 and 15 years).

MW-33p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, VC
- Decreasing trends: Manganese, Dissolved (n=25), 1,1-DCA (n=26), 1,4-Dichlorobenzene (n=26), VC (n=26)

- Probably decreasing trends: Arsenic, Dissolved (n=24), 1,2-Dichloroethane (EDC) (n=26)
- Arsenic, Dissolved: R^2 value of <0.05, restoration timeframe of 27 years (CI: 9 and -32 years).
- 1,1-DCA: R^2 value of 0.42, restoration timeframe of 6 years (CI: 4 and 10 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.15, restoration timeframe of 7 years (CI: 4 and 37 years).
- Manganese, Dissolved: R^2 value of 0.76, restoration timeframe of 50 years (CI: 41 and 62 years).
- 1,4-Dichlorobenzene: R^2 value of 0.39, restoration timeframe of 22 years (CI: 15 and 39 years).
- VC: R^2 value of 0.18, restoration timeframe of 26 years (CI: 15 and 102 years).

MW-35p2:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, TCE, VC
- Decreasing trends: 1,1-DCA (n=25), 1,2-Dichloroethane (EDC) (n=26), 1,2-Dichloropropane (n=26), TCE(n=26), VC (n=26)
- No trend: Manganese, Dissolved (n=24), 1,4-Dichlorobenzene (n=26)
- TCE: R^2 value of 0.14, restoration timeframe of 18 years (CI: 10 and 131 years).
- 1,2-Dichloropropane: R^2 value of 0.36, restoration timeframe of 5 years (CI: 3 and 8 years).
- 1,1-DCA: R^2 value of 0.09, restoration timeframe of 26 years (CI: 13 and -254 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.47, restoration timeframe of 24 years (CI: 17 and 38 years).
- VC: R^2 value of 0.32, restoration timeframe of 32 years (CI: 21 and 66 years).

MW-38p2:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, Benzene, TCE, VC
- Decreasing trends: 1,1-DCA (n=26), 1,2-Dichloroethane (EDC) (n=26), 1,2-Dichloropropane (n=26), Benzene (n=26), TCE(n=25), VC (n=26)
- Stable trends: Manganese, Dissolved (n=23)
- TCE: R^2 value of 0.37, restoration timeframe of 33 years (CI: 22 and 62 years).
- 1,2-Dichloropropane: R^2 value of 0.83, restoration timeframe of 14 years (CI: 12 and 16 years).
- 1,1-DCA: R^2 value of 0.72, restoration timeframe of 28 years (CI: 23 and 35 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.83, restoration timeframe of 9 years (CI: 8 and 10 years).
- VC: R^2 value of 0.81, restoration timeframe of 13 years (CI: 11 and 16 years).
- Benzene: R^2 value of 0.70, restoration timeframe of 13 years (CI: 10 and 17 years).

MW-39p2:

- Constituents above CULs: Manganese, Dissolved, TCE
- Increasing trends: TCE(n=6)
- No trend: Manganese, Dissolved (n=6)

MW-43p2:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, TCE, VC
- Stable trends: TCE(n=4), VC (n=4)
- No trend: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4)

MW-76p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, TCE, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), 1,4-Dichlorobenzene (n=1), Benzene (n=1), TCE(n=1), VC (n=1)

MW-80p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, VC
- Stable trends: Arsenic, Dissolved (n=4), Manganese, Dissolved (n=4), VC (n=4)

MW-87p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE, VC
- Decreasing trends: Benzene (n=4)
- Stable trends: Arsenic, Dissolved (n=4), Manganese, Dissolved (n=4), 1,1-DCA (n=4), 1,4-Dichlorobenzene (n=4), VC (n=4)
- No trend: 1,2-Dichloroethane (EDC) (n=4), TCE(n=4)
- Benzene: R^2 value of 0.85, restoration timeframe of 1 years (CI: 0 and 6 years).

MW-88p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), VC (n=1)

MW-91p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, TCE, VC
- Decreasing trends: Benzene (n=4)
- Stable trends: Arsenic, Dissolved (n=4), Manganese, Dissolved (n=4), 1,2-Dichloroethane (EDC) (n=4), TCE(n=4), VC (n=4)
- No trend: 1,1-DCA (n=4), 1,2-Dichloropropane (n=4), 1,4-Dichlorobenzene (n=4)
- Benzene: R^2 value of 0.96, restoration timeframe of 2 years (CI: 2 and 4 years).

MW-94p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, cis-1,2-DCE, TCE, VC
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), 1,4-Dichlorobenzene (n=1), Benzene (n=1), cis-1,2-DCE (n=1), TCE(n=1), VC (n=1)

MW-99p2:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, TCE, VC
- Decreasing trends: VC (n=4)
- Stable trends: Arsenic, Dissolved (n=4), 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), TCE(n=4)
- No trend: Manganese, Dissolved (n=4), 1,4-Dichlorobenzene (n=4), Benzene (n=4)
- VC: R^2 value of 0.96, restoration timeframe of 10 years (CI: 7 and 18 years).

5.2.3 Roza Aquifer

MW-102b:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, cis-1,2-DCE, TCE, VC
- Increasing trends: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), cis-1,2-DCE (n=4), TCE(n=4), VC (n=4)

MW-103b:

- Constituents above CULs: Manganese, Dissolved, VC
- Stable trends: Manganese, Dissolved (n=16), VC (n=16)

MW-105b:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1)

MW-116b:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Arsenic, Dissolved (n=1), Manganese, Dissolved (n=1)

MW-132b:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1)

MW-133b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, Benzene, VC
- Stable trends: Manganese, Dissolved (n=4)
- No trend: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), 1,4-Dichlorobenzene (n=4), Benzene (n=4), VC (n=4)

MW-135b:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1)

MW-139b:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1)

MW-142b:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, TCE
- Stable trends: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), TCE(n=4)

MW-144b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE, VC
- Stable trends: Manganese, Dissolved (n=4), 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), VC (n=4)
- No trend: 1,4-Dichlorobenzene (n=4), Benzene (n=4), TCE(n=4)

MW-146b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, VC
- Increasing trends: Manganese, Dissolved (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), VC (n=4)
- Stable trends: 1,1-DCA (n=4)

MW-148b:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, cis-1,2-DCE, TCE, VC
- Decreasing trends: cis-1,2-DCE (n=4)
- Stable trends: 1,1-DCA (n=4), 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4), VC (n=4)
- No trend: TCE(n=4)
- cis-1,2-DCE: R^2 value of 0.92, restoration timeframe of 6 years (CI: 4 and 14 years).

MW-149b:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, VC
- Not enough data to perform Mann-Kendall for the following constituents: 1,1-DCA (n=3), 1,2-Dichloroethane (EDC) (n=3), 1,2-Dichloropropane (n=3), VC (n=3)

MW-150b:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=3)

MW-151b:

- Constituents above CULs: 1,1-DCA
- Decreasing trends: 1,1-DCA (n=4)
- 1,1-DCA: R^2 value of 0.95, restoration timeframe of 1 years (CI: 0 and 1 years).

MW-29b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, TCE, VC
- Increasing trends: 1,4-Dichlorobenzene (n=5)
- Decreasing trends: 1,2-Dichloropropane (n=5), TCE(n=5)
- Stable trends: 1,1-DCA (n=5)
- Probably decreasing trends: 1,2-Dichloroethane (EDC) (n=5)
- No trend: Manganese, Dissolved (n=4), VC (n=5)
- TCE: R^2 value of 0.90, restoration timeframe of 4 years (CI: 3 and 8 years).
- 1,2-Dichloropropane: R^2 value of 0.87, restoration timeframe of 17 years (CI: 11 and 36 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.96, restoration timeframe of 15 years (CI: 12 and 21 years).

MW-30b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloropropane, TCE, VC
- Stable trends: 1,1-DCA (n=5), TCE(n=5)
- No trend: 1,2-Dichloropropane (n=5), VC (n=5)
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=3)

MW-31b:

- Constituents above CULs: Manganese, Dissolved, VC
- Stable trends: Manganese, Dissolved (n=4)
- No trend: VC (n=5)

MW-3b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, cis-1,2-DCE, TCE, VC

- Decreasing trends: Manganese, Dissolved (n=34), 1,1-DCA (n=38), 1,2-Dichloroethane (EDC) (n=38), 1,2-Dichloropropane (n=38), cis-1,2-DCE (n=38), TCE(n=39), VC (n=36)
- TCE: R^2 value of 0.33, restoration timeframe of 0 years (CI: 0 and 0 years).
- 1,2-Dichloropropane: R^2 value of 0.32, restoration timeframe of 19 years (CI: 14 and 33 years).
- 1,1-DCA: R^2 value of 0.71, restoration timeframe of 4 years (CI: 3 and 4 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.31, restoration timeframe of 13 years (CI: 9 and 22 years).
- Manganese, Dissolved: R^2 value of 0.54, restoration timeframe of 98 years (CI: 77 and 137 years).
- VC: R^2 value of 0.49, restoration timeframe of 56 years (CI: 43 and 80 years).
- cis-1,2-DCE: R^2 value of 0.14, restoration timeframe of 6 years (CI: 3 and 19 years).

MW-42b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, TCE, VC
- Decreasing trends: Manganese, Dissolved (n=24), 1,1-DCA (n=24), 1,2-Dichloroethane (EDC) (n=24), 1,2-Dichloropropane (n=24), VC (n=24)
- Stable trends: TCE(n=24)
- 1,2-Dichloropropane: R^2 value of 0.85, restoration timeframe of 5 years (CI: 5 and 6 years).
- 1,1-DCA: R^2 value of 0.88, restoration timeframe of 10 years (CI: 9 and 11 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.96, restoration timeframe of 4 years (CI: 3 and 4 years).
- Manganese, Dissolved: R^2 value of 0.53, restoration timeframe of 36 years (CI: 27 and 55 years).
- VC: R^2 value of 0.79, restoration timeframe of 20 years (CI: 17 and 24 years).

MW-44b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, TCE, VC
- Increasing trends: TCE(n=16)
- Decreasing trends: 1,1-DCA (n=16), 1,2-Dichloroethane (EDC) (n=16), 1,2-Dichloropropane (n=16)
- Probably decreasing trends: 1,4-Dichlorobenzene (n=16)
- No trend: Manganese, Dissolved (n=16), VC (n=16)
- 1,2-Dichloropropane: R^2 value of 0.74, restoration timeframe of 11 years (CI: 9 and 16 years).
- 1,1-DCA: R^2 value of 0.35, restoration timeframe of 48 years (CI: 29 and 135 years).
- 1,2-Dichloroethane (EDC): R^2 value of 0.65, restoration timeframe of 19 years (CI: 14 and 29 years).
- 1,4-Dichlorobenzene: R^2 value <0.05, restoration timeframe of 172 years (CI: 33 and -55 years).

MW-63b:

- Constituents above CULs: Manganese, Dissolved, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, Benzene, TCE
- Increasing trends: TCE(n=8)
- Decreasing trends: Benzene (n=8)

- Probably decreasing trends: Manganese, Dissolved (n=8)
- No trend: 1,2-Dichloroethane (EDC) (n=8), 1,4-Dichlorobenzene (n=8)
- Manganese, Dissolved: R^2 value of 0.21, restoration timeframe of 115 years (CI: 45 and -206 years).
- Benzene: R^2 value of 0.70, restoration timeframe of 13 years (CI: 8 and 27 years).

MW-72b:

- Constituents above CULs: Manganese, Dissolved, VC
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), VC (n=1)

MW-74b:

- Constituents above CULs: Manganese, Dissolved, VC
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), VC (n=1)

MW-78b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, TCE, VC
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), 1,4-Dichlorobenzene (n=1), TCE(n=1), VC (n=1)

MW-7b:

- Constituents above CULs: Manganese, Dissolved, 1,2-Dichloroethane (EDC), VC
- Decreasing trends: Manganese, Dissolved (n=56), 1,2-Dichloroethane (EDC) (n=60), VC (n=57)
- 1,2-Dichloroethane (EDC): R^2 value of 0.61, restoration timeframe of 3 years (CI: 3 and 4 years).
- Manganese, Dissolved: R^2 value of 0.81, restoration timeframe of 29 years (CI: 26 and 33 years).
- VC: R^2 value of 0.83, restoration timeframe of 15 years (CI: 14 and 17 years).

MW-81b:

- Constituents above CULs: Arsenic, Dissolved, Manganese, Dissolved, 1,1-DCA, 1,4-Dichlorobenzene, TCE, VC
- Stable trends: Arsenic, Dissolved (n=4), 1,1-DCA (n=4), 1,4-Dichlorobenzene (n=4), TCE(n=4), VC (n=4)
- No trend: Manganese, Dissolved (n=4)

MW-82b:

- Constituents above CULs: Manganese, Dissolved
- Stable trends: Manganese, Dissolved (n=4)

MW-89b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,4-Dichlorobenzene, VC

- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,4-Dichlorobenzene (n=1), VC (n=1)

MW-93b:

- Constituents above CULs: Manganese, Dissolved, 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, VC
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1), 1,1-DCA (n=1), 1,2-Dichloroethane (EDC) (n=1), 1,2-Dichloropropane (n=1), VC (n=1)

MW-96b:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1)

MW-97b:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=1)

MW-9b:

- Constituents above CULs: Manganese, Dissolved, VC
- Decreasing trends: Manganese, Dissolved (n=60), VC (n=63)
- Manganese, Dissolved: R^2 value of 0.58, restoration timeframe of 56 years (CI: 47 and 68 years).
- VC: R^2 value of 0.84, restoration timeframe of 6 years (CI: 6 and 7 years).

5.2.4 Interflow Aquifer

Mann Kendall trend Analysis summary for the wells that has at least one IHS constituent is above the CUL:

MW-2c:

- Constituents above CULs: Manganese, Dissolved, TCE, VC
- Increasing trends: Manganese, Dissolved (n=61), VC (n=66)
- No trend: TCE(n=66)

MW-56c:

- Constituents above CULs: Manganese, Dissolved
- Not enough data to perform Mann-Kendall for the following constituents: Manganese, Dissolved (n=2)

MW-58c:

- Constituents above CULs: 1,1-DCA, 1,2-Dichloroethane (EDC), 1,2-Dichloropropane, 1,4-Dichlorobenzene, TCE, VC
- Increasing trends: 1,1-DCA (n=4), 1,4-Dichlorobenzene (n=4), TCE(n=4)
- Stable trends: 1,2-Dichloroethane (EDC) (n=4), 1,2-Dichloropropane (n=4)
- No trend: VC (n=4)

MW-5c:

- Constituents above CULs: 1,2-Dichloroethane (EDC), TCE, VC
- Increasing trends: 1,2-Dichloroethane (EDC) (n=64)
- Decreasing trends: TCE(n=65), VC (n=65)
- VC: R^2 value of 0.17, restoration timeframe of 4 years (CI: 3 and 7 years).
- TCE: R^2 value of 0.62, restoration timeframe of 11 years (CI: 10 and 13 years).

6 Summary

6.1 Results Based on Total Molar Concentrations of Chlorinated Ethenes

The following section summarizes the Mann-Kendall test results of the total molar concentrations of chlorinated ethenes that have the last concentration measurements above the VC CUL. The rest of the wells are below the CUL for VC for total molar concentrations and either show a either stable trend, no trend, or increasing trend according to Mann-Kendall test.

6.1.1 P1 Zone

- Two wells (MW-34P1 and MW-83P1) (out of 12 wells with equal or more than four measurements), total molar concentrations exhibit decreasing trends.
- Four wells (MW-117p1, MW-123p1, MW-37p1, and MW-85p1) have stable trends.
- Six wells (MW-36p1, MW-65p1, MW-68p1, MW-69p1, MW-92p1, and MW-95p1) have no trends.
- Geochemical indicator scores range between 1-9 with a mean and median of 5.2 and 6.0, respectively (no geochemical indicator score is available for wells MW-137p1 and MW-84p1).

6.1.2 P2 Zone

- Five wells (MW-33p2, MW-35p2, MW-38p2, MW-80p2, and MW-107p2) exhibit decreasing trends in total molar concentrations (out of 24 wells with equal or more than four measurements).
- One well (MW-46p2) already under CUL shows a “probably decreasing” trend.
- Stable trends are observed in eight wells (MW-115p2, MW-125p2, MW-126p2, MW-147p2, MW-40p2, MW-49p2, MW-91p2, and MW-99p2).
- No trends are observed in 10 wells (MW-101p2, MW-113p2, MW-114p2, MW-124p2, MW-138p2, MW-143p2, MW-39p2, MW-43p2, MW-52p2, and MW-87p2).
- Geochemical indicator scores range between 0-10 with a mean and median of 5.5 and 6.0, respectively (no geochemical indicator score is available for well, MW-73p2).

6.1.3 Roza Aquifer

- Four wells (MW-3b, MW-42b, MW-7b and MW-9b) exhibit a decreasing trend in total molar concentrations (out of 26 wells with equal or more than four measurements).
- One well (MW-48b) already under CUL shows a “probably decreasing” trend.
- 14 wells have a stable trend (MW-103b, MW-140b, MW-142b, MW-144b, MW-145b, MW-148b, MW-151b, MW-19b, MW-30b, MW-44b, MW-57b, MW-71b, MW-81b and MW-82b).
- Seven wells show no trend (MW-133b, MW-29b, MW-31b, MW-51b and MW-63b. Wells MW-63b and MW-133b)
- All wells except MW-48b in Roza Aquifer zone have a total molar concentration greater than CUL of VC molar concentration.

- Geochemical indicator scores range between 0-9 with a mean and median of 4.1 and 4.0, respectively (no geochemical indicator score is available for well, MW-106b).

6.1.4 Interflow Aquifer

- Six wells (MW-20c, MW-21c, MW-22c, MW-4c, MW-5c and MW-6c) exhibit decreasing trends in total molar concentrations (out of 14 wells with equal or more than four measurements).
- One well has an increasing trend (MW-2c) while one well shows a "probably decreasing" trend (MW-45c).
- One well has a stable trend (MW-47c).
- Four wells have no trends (MW-50c, MW-54c, MW-31b and MW-58c).
- Geochemical indicator scores range between 0-6 with a mean and median of 2.3 and 2.0, respectively (no geochemical indicator score is available for well, MW-55c).

6.2 Results Based on Trend Analysis and Restoration Timeframe Calculation of Individual IHSs

Following section summarizes the Mann-Kendall test results of the IHSs that have the last concentration measurements above the CUL. Calculated restoration timeframe ranges are also reported for the wells that have a decreasing or possibly decreasing trends.

6.2.1 Arsenic, Dissolved

- In the P1 zone, 15 out of 24 wells have concentrations above the CUL. Among wells above the CUL, one well (MW-34p1 (n=21)) shows a decreasing trend while two wells have increasing trends (MW-65p1 (n=7) and MW-68p1 (n=10)) (Tables 15-16 and Figure 45). A restoration timeframe of 36 years calculated for the well MW-34p1 (R^2 = 0.30 with CI of 23 and 36 years)
- In the P2 zone, 18 out of 35 wells have concentrations above the CUL. Among wells above the CUL, only one well (MW-33p2 (n=24)) shows a possibly decreasing trend while no other well has a measured concentration with an increasing trend (Tables 15-16 and Figure 46).
- In the Roza aquifer, two wells out of 35 wells have concentrations above the CUL. One of these wells has a stable trend (MW-81b) while a trend value couldn't be determined for the other well (MW-116b) since it only has one dissolved arsenic measurement (Tables 13, 16-17 and Figure 47).
- In the Interflow aquifer, none of the 14 wells have concentrations above the CUL (Tables 15-16 and Figure 48).

6.2.2 Arsenic, Total

- In the P1 zone, 6 out of 9 wells have concentrations above the CUL: MW-109p1 (n=2), MW-36p1 (n=3), MW-69p1 (n=3), MW-83p1 (n=3), MW-92p1 (n=3) and MW-95p1 (n=3). However, none of these wells have been sampled 4 times or more to calculate concentration trends.
- In the P2 zone, 12 out of 21 wells have concentrations above the CUL : MW-107p2 (n=3), MW-113p2 (n=3), MW-114p2 (n=3), MW-115p2 (n=3), MW-125p2 (n=3), MW-126p2 (n=3), MW-138p2 (n=3), MW-33p2 (n=6), MW-80p2 (n=3), MW-87p2 (n=3), MW-91p2 (n=3) and MW-99p2 (n=3). Among wells above the CUL, only one well has been sampled 4 or more times to calculate a

concentration trend (MW-33p2 (n=6)). This well shows a stable trend (Tables 25 and Appendix D5).

- In the Roza aquifer, two wells out of 22 wells have concentrations above the CUL: MW-133b (n=3) and MW-81b (n=3). A concentration trend was not calculated because there are fewer than four analyzed samples for these two wells.
- In the Interflow aquifer, none of the 8 wells have concentrations above the CUL.

6.2.3 Manganese, Dissolved

- In the P1 zone, 19 out of 24 wells have concentrations above the CUL. Among wells above the CUL, five wells (MW-36p1 (n=4), MW-69p1 (n=5), MW-83p1 (n=4), MW-85p1 (n=4) and MW-95p1 (n=4)) show decreasing trends while two wells are in possibly increasing trend (MW-65p1 (n=7) and MW-68p1 (n=10)) (Tables 15-16 and Figure 45). Calculated restoration timeframes range between 23 and 44 years (with CI of 13 and 108 years).
- In the P2 zone, 28 out of 35 wells have concentrations above the CUL. Among wells above the CUL, two wells (MW-125p2 (n=4) and MW-33p2 (n=25)) show decreasing trends while only one well is in increasing trend (MW-146b (n=4)) (Tables 15-16 and Figure 46). Calculated restoration timeframes range between 50 and 54 years (with CI of 30 and 214 years).
- In the Roza aquifer, 28 out of 44 wells have concentrations above the CUL. Among wells above the CUL, five wells (MW-3b (n=34), MW-42b (n=24) MW-7b (n=56), MW-9b (n=60), MW-63b (n=8)) show decreasing/possibly decreasing trends while three wells are in increasing trends (MW-107p2 (n=4), MW-114p2 (n=4) and MW-126p2 (n=4)) (Tables 15-16 and Figure 47). Calculated restoration timeframes range between 29 and 115 years (with CI of 26 and 137years).
- In the Interflow aquifer, 2 out of 14 wells have concentrations above the CUL. While one of these wells shows an increasing trend (MW-2c (n=61)), a trend value for the other well (MW-56c) couldn’t be determined since it only has two measurements (Tables 15-16 and Figure 48).

6.2.4 Manganese, Total

- In the P1 zone, 20 out of 25 wells have concentrations above the CUL. Among wells above the CUL, six wells (MW-36p1 (n=4), MW-69p1 (n=5), MW-83p1 (n=4), MW-85p1 (n=4), MW-92p1 (n=4), and MW-95p1 (n=4)) show decreasing trends while MW-68p1 (n=10) and MW-65p1 (n=7) show increasing and probably increasing trends and MW-34p1 (n=21) and MW-37p1 (n=4) have stable and no trends, respectively (Table 26 and Appendix D5). Calculated restoration timeframes range between 23 and 56 years (with CI of 14 and 82 years).
- In the P2 zone, 31 out of 35 wells have concentrations above the CUL. Among wells above the CUL, three wells (MW-33p2 (n=23), MW-38p2 (n=23) and MW-91p2 (n=4)) show decreasing trends while three wells are in increasing trend (MW-107p2 (n=4), MW-114p2 (n=4) and MW-126p2 (n=4)) (Table 26 and Appendix D5). Calculated restoration timeframes range between 48 and 89 years (with CI of 34 and 3471 years).
- In the Roza aquifer, 30 out of 43 wells have concentrations above the CUL). Among wells above the CUL, seven wells MW-140b (n=4), MW-30b (n=4), MW-31b (n=4), MW-42b (n=20), MW-7b (n=19), MW-9b (n=20), and MW-63b show decreasing/possibly decreasing trends while one well is in increasing and

possibly increasing trends (MW-146b (n=4) and MW-3b (n=20)). 5 wells also are in stable trend (MW-133b (n=4), MW-144b (n=4), MW-29b (n=4), MW-44b (n=14) and MW-82b (n=4)) while one well shows no trend (MW-81b (n=4)) (Tables 26 and Appendix D5). Calculated restoration timeframes range between 4 and 68 years (with CI of 4 and 113 years).

- In the Interflow aquifer, 4 out of 14 wells have concentrations above the CUL. While one of these wells shows an increasing trend (MW-2c (n=20)), one well (MW-2c (n=22)) is in an increasing trend (Tables 26 and Appendix D5). Calculated restoration timeframe for the decreasing well is 7 years with a CI of 6 and 10 years.

6.2.5 1,1-DCA

- In the P1 zone, 13 out of 25 wells have concentrations above the CUL. Among wells above the CUL, three wells (MW-34p1 (n=22), MW-36p1 (n=4) and MW-83p1 (n=4)) show decreasing trends while no well has an increasing trend (Tables 15-16 and Figure 45). Calculated restoration timeframes range between 3 and 12 years (with CI of 3 and 23 years).
- In the P2 zone, 21 out of 35 wells have concentrations above the CUL. Among wells above the CUL, four wells (MW-143p2 (n=4), MW-33p2 (n=26), MW-35p2 (n=25) and MW-38p2 (n=26)) show decreasing trends while one well has an increasing trend (MW-138p2 (n=4)) (Tables 15-16 and Figure 46). Calculated restoration timeframes range between 1 and 28 years (with CI of 0 and 147 years).
- In the Roza aquifer, 17 out of 44 wells have concentrations above the CUL. Among wells above the CUL, four wells (MW-151b (n=4), MW-3b (n=38), MW-42b (n=24) and MW-44b (n=16)) show decreasing trends while one well has an increasing trend (MW-102b (n=4)) (Tables 15-16 and Figure 47). Calculated restoration timeframes range between 4 and 48 years (with CI of 3 and 135 years).
- In the Interflow Aquifer, 1 out of 14 wells have concentrations above the CUL. This well (MW-58c (n=4)) shows an increasing trend according to the Mann-Kendall test (Tables 15-16 and Figure 48).

6.2.6 1,2-Dichloroethane (EDC)

- In the P1 Zone, 13 out of 25 wells have concentrations above the CUL. Among wells above the CUL, only one well (MW-34p1 (n=23)) show a decreasing trend while no well has an increasing trend (Tables 15-16 and Figure 45).A restoration timeframe of 3 years calculated for the well MW-34p1 (R^2 = 0.87 with CI of 3 and 4 years)
- In the P2 Zone, 23 out of 35 wells have concentrations above the CUL. Among wells above the CUL, four wells (MW-101p2 (n=4), MW-143p2 (n=4), MW-35p2 (n=26) and MW-38p2 (n=26)) show decreasing trends while one well has a possibly decreasing trend (MW-33p2 (n=26)). One well also shows an increasing trend (MW-138p2 (n=4)) (Tables 15-16 and Figure 46). Calculated restoration timeframes range between 2 and 38 years (with CI of 3 and 135 years).
- In the Roza aquifer, 16 out of 44 wells have concentrations above the CUL. Among wells above the CUL, four wells (MW-3b (n=38), MW-42b (n=24), MW-44b (n=16) and MW-7b (n=60)) show decreasing trends while one well has a possibly decreasing trend (MW-29b (n=5)). Two wells also have increasing trends (MW-102b (n=4) and MW-146b (n=4)) (Tables 15-16 and Figure 47).

Calculated restoration timeframes range between 3 and 15 years (with CI of 3 and 29 years).

- In the Interflow aquifer, 1 out of 14 wells have concentration above the CUL. This well (MW-5c (n=64)) shows an increasing trend according to the Mann-Kendall test (Tables 15-16 and Figure 48).

6.2.7 1,2-Dichloropropane

- In the P1 zone, 7 out of 25 wells have concentrations above the CUL. Among wells above the CUL, only one well (MW-69p1 (n=5)) shows a decreasing trend while no well has an increasing trend and one well has a possibly decreasing trend (MW-68p1 (n=13)) (Tables 15-16 and Figure 45). A restoration timeframe of 20 years calculated for the well MW-69p1 (R^2 = 0.75 with CI of 11 and 94 years)
- In the P2 zone, 18 out of 35 wells have concentrations above the CUL. Among wells above the CUL, three wells (MW-101p2 (n=4), MW-143p2 (n=4), MW-35p2 (n=26) and MW-38p2 (n=26)) show decreasing trends (MW-101p2 (n=4), MW-35p2 (n=26) and MW-38p2 (n=26)) (Tables 15-16 and Figure 46). Calculated restoration timeframes range between 5 and 14 years (with CI of 3 and 16 years).
- In the Roza aquifer, 13 out of 44 wells have concentrations above the CUL. Among wells above the CUL, four wells (MW-29b (n=5), MW-3b (n=38), MW-42b (n=24) and MW-44b (n=16)) show decreasing trends while one well has a possibly decreasing trend (MW-29b (n=5)). Two wells also show increasing trends (MW-102b (n=4) and MW-146b (n=4)) (Tables 15-16 and Figure 47). Calculated restoration timeframes range between 5 and 19 years (with CI of 5 and 36 years).
- In the Interflow Aquifer, 1 out of 14 wells have concentrations above the CUL. This well (MW-58c, (n=4)) shows a stable trend (Table 14 and Figure 48).

6.2.8 1,4-Dichlorobenzene

- In the P1 Zone, 13 out of 25 wells have concentration above the CUL. Among wells above the CUL, two wells (MW-34p1 (n=23) and MW-65p1 (n=8)) show a decreasing trend while one well (MW-68p1 (n=13)) has a possibly decreasing trend. One well also show a possibly increasing trend (MW-69p1 (n=5)) (Tables 11, 16, 17 and Figure 45). Calculated restoration timeframes range between 6 and 14 years (with CI of 4 and 21 years).
- In the P2 Zone, 13 out of 35 wells have concentration above the CUL. Among wells above the CUL, only one well (MW-33p2 (n=26)) shows a decreasing trend while one well also has an increasing trend (MW-114p2 (n=4)) (Tables 12,16,17 and Figure 46). A restoration timeframe of 22 years calculated for the well MW-33p2 (R^2 = 0.39 with CI of 15 and 39 years).
- In the Roza aquifer, 8 out of 44 wells have concentration above the CUL. Among wells above the CUL, only one well (MW-44b (n=16)) shows a possibly decreasing trend. One well also shows possibly increasing trend (MW-29b (n=5)) (Tables 13,16,17 and Figure 47).
- In the Interflow aquifer, 1 out of 14 wells have concentration above the CUL. This well (MW-58c (n=4)) shows an increasing trend (Tables 14,17 and Figure 48).

6.2.9 Benzene

- In P1 Zone, 11 out of 25 wells have concentration above the CUL. Among wells above the CUL, only one well (MW-34p1 (n=23)) shows a decreasing trend while one well (MW-68p1 (n=13)) has a possibly decreasing trend. One well also show a possibly increasing trend (MW-65p1 (n=8)) (Tables 11, 16, 17 and Figure 45). A restoration timeframe of 1 years calculated for the well MW-34p1 (R^2 = 0.80 with CI of 0.9 and 1.3 years).
- In P2 Zone, 14 out of 35 wells have concentration above the CUL. Among wells above the CUL, only four wells (MW-126p2 (n=4), MW-38p2 (n=26), MW-87p2 (n=4) and MW-91p2 (n=4)) show a decreasing trend (Table 12 and Figure 46). Calculated restoration timeframes range between 1 and 13 years (with CI of 0.4 and 17 years).
- In Roza Aquifer, 3 out of 44 wells have concentration above the CUL. Among wells above the CUL, only one well (MW-63b (n=8)) shows a decreasing trend. (Table 13 and Figure 47). A restoration timeframe of 13 years calculated for the well MW-63b (R^2 = 0.70 with CI of 8 and 27 years).
- In the Interflow Aquifer, none of 14 wells have concentration above the CUL (Table 14 and Figure 48).

6.2.10 cis-1,2-DCE

- In the P1 zone, 2 out of 25 wells have concentrations above the CUL. Among wells above the CUL, MW-123p1 (n=4) has a stable trend while MW-69p1 (n=5) shows no trend (Table 11 and Figure 45).
- In the P2 zone, 1 out of 35 wells has concentrations above the CUL and it has only one measurement (Table 12 and Figure 46).
- In the Roza Aquifer, 3 out of 44 wells have concentrations above the CUL. Among wells above the CUL, two wells (MW-148b (n=4) and MW-3b (n=38) shows decreasing trends while one well also has an increasing trend (MW-102b (n=4)) (Table 13 and Figure 47). Calculated restoration timeframes are 6 years (with CI of 3 and 19 years).
- In the Interflow Aquifer, none of 14 wells have concentrations above the CUL (Table 14 and Figure 48).

6.2.11 TCE

- In the P1 zone, 10 out of 25 wells have concentrations above the CUL. Among wells above the CUL, only seven wells have equal or greater than four measurements. Five of these wells (MW-36p1 (n=4), MW-69p1 (n=5), MW-83p1 (n=4), MW-85p1 (n=4) and MW-92p1 (n=4) have no trends while two show stable trends (MW-117p1 (n=4) and MW-123p1 (n=4)) (Table 11 and Figure 45).
- In the P2 zone, 20 out of 35 wells have concentrations above the CUL. Among wells above the CUL, 15 wells have equal or greater than four measurements. Two of these well show (MW-35p2 (n=26) and MW-38p2 (n=25)) decreasing trends while one has an increasing trend (MW-39p2 (n=6)). Eight of these wells have no trend while four of them shows stable trends (Table 12 and Figure 46). Calculated restoration timeframes range between 4 and 33 years (with CI of 3 and 131 years).
- In the Roza Aquifer, 12 out of 44 wells have concentrations above the CUL. Among wells above the CUL, two wells (MW-3b (n=39) and MW-29b (n=5)) show decreasing trends while three wells (MW-44b (n=48), MW-63b (n=8) and

MW-102b (n=4)) also have increasing trends. The rest of the wells don't have increasing or decreasing trends as four wells have stable trends and two have no trends (Table13 and Figure 47). Calculated restoration timeframes range between 0.2 and 4 years (with CI of 0.2 and 8 years).

- In the Interflow Aquifer, 3 out of 14 wells have concentrations above the CUL. One well (MW-5c (n=65)) has a decreasing trend while one (MW-58c (n=4)) has an increasing trend and one has no trend (MW-2c (n=66)) (Table 14 and Figure 48). A restoration timeframe of 11 years calculated for the well MW-5c (R^2 = 0.62 with CI of 10 and 13 years).

6.2.12 VC

- In the P1 zone, 22 out of 25 wells have concentrations above the CUL. Among wells above the CUL, 12 wells have equal or greater than four measurements. Two wells (MW-34p1 (n=23) and MW-36p1 (n=4)) show decreasing trends while one well (MW-68p1 (n=25) has a possibly increasing trend. The rest of the wells don't have increasing or decreasing trends with seven wells having no trends and two wells having stable trends (Table 11 and Figure 45). Calculated restoration timeframes range between 5 and 7 years (with CI of 3 and 8 years).
- In the P2 zone, 24 out of 35 wells have concentrations above the CUL. Among wells above the CUL, 15 wells have equal or greater than four measurements. Five of these well show (MW-107p2 (n=4), MW-33p2 (n=26), MW-35p2 (n=26), MW-38p2 (n=26) and MW-99p2 (n=4)) decreasing trends. The rest of the 12 wells show either no trend or stable trends (Table 12 and Figure 46). Calculated restoration timeframes range between 6 and 32 years (with CI of 4 and 102 years).
- In the Roza aquifer, 21 out of 44 wells have concentrations above the CUL. Among wells above the CUL, 17 wells have equal or greater than four measurements. Four of these wells show (MW-3b (n=36), MW-42b (n=24), MW-7b (n=57) and MW-9b (n=63)) decreasing trends while two of the wells have increasing trends (MW-102b (n=4) and MW-146b (n=4)). The rest of the 9 wells show either a no trend or stable trends (Table 13 and Figure 47). Calculated restoration timeframes range between 6 and 56 years (with CI of 6 and 80 years).
- Interflow Aquifer, 3 out of 14 wells have concentrations above the CUL. One well (MW-5c (n=65)) has a decreasing trend while one (MW-2c (n=66)) has an increasing trend and one has no trend (MW-58c (n=4)) (Table 14 and Figure 48). A restoration timeframe of 4 years calculated for the well MW-5c (R^2 = 0.17 with CI of 3 and 7 years).

6.3 Restoration Timeframes and Concentration Trends for the Wells Between Original Landfill and County Owned Parcel Boundary

The following section summarizes the trends and restoration times of all the IHS constituent samples taken from P1, P2, Roza, and Interflow wells that are located between the original landfill boundary and country owned parcels. For each constituent, only wells that exceed the CUL are reported, along with their respective trends and restoration timeframes with upper and lower CI if a decreasing trend (or probably decreasing trend) is estimated based on Mann-Kendall analysis. Finally, trends and restoration time results for these wells are also summarized based on total molar concentrations of chlorinated ethenes that have the last concentration measurements above the CUL of VC.

6.3.1. Trend and restoration timeframes for individual IHSs

Arsenic, Dissolved:

<u>P1 wells:</u>

- Observed concentrations are below CUL

<u>P2 wells:</u>

- Stable trends: MW-113p2 (n=4), MW-125p2 (n=4), MW-126p2 (n=4)
- No trends: MW-138p2 (n=4)

<u>Roza wells:</u>

- Observed concentrations are below CUL

<u>Interflow wells:</u>

- Observed concentrations are below CUL

Arsenic, Total:

<u>P1 wells:</u>

- No wells located between the original landfill and the county-owned parcel boundary were sampled for total arsenic.

<u>P2 wells:</u>

- 4 out of 9 wells have total arsenic concentrations above CUL (50 µg/L): MW-113p2 (n=3), MW-125p2 (n=3), MW-126p2 (n=3), MW-138p2 (n=3). However, none of these wells have been sampled 4 times or more to calculate concentration trends.

<u>Roza wells:</u>

- 1 out of 19 wells has total arsenic concentrations exceeding the cleanup level (CUL) of 50 µg/L: MW-133b (n=3). However, this well has not been sampled four or more times.

<u>Interflow wells:</u>

- Observed concentrations are below CUL

Manganese, Dissolved:

<u>P1 wells:</u>

- No trends: MW-37p1 (n=4)

<u>P2 wells:</u>

- Decreasing trends: MW-125p2 (n=4, t = 54 years with CI of 30 and 294 years)
- Increasing trends: MW-126p2 (n=4)
- No trends: MW-113p2 (n=4), MW-138p2 (n=4), MW-39p2 (n=6)

<u>Roza wells:</u>

- Decreasing trends: MW-42b (n=24, t = 36 years with CI of 27 and 55 years), MW-7b (n=56, t = 29 years with CI of 26 and 33 years), MW-9b (n=60, t = 56 years with CI of 47 and 68 years)
- Probably decreasing trends: MW-63b (n=8, t = 115 years with CI of 45 and -206 years)

- Stable trends: MW-103b (n=16), MW-133b (n=4), MW-144b (n=4), MW-31b (n=4), MW-82b (n=4)
- Increasing trends: MW-146b (n=4)
- No trends: MW-44b (n=16)

Interflow wells:

- Increasing trends: MW-2c (n=61)

Manganese, Total:

P1 wells:

- No trends: MW-37p1 (n=4)

P2 wells:

- Stable trends: MW-125p2 and MW-46p2 (n=7)
- Increasing trends: MW-126p2 (n=4)
- No trends: MW-113p2 (n=4), MW-138p2 (n=4)

Roza wells:

- Decreasing trends: MW-140b (n=4, t = 4 years with a CI of 2 and 10 years), MW-31b (n=4, t = 8 years with a CI of 2 and -4 years), MW-42b (n=20, t = 39 years with a CI of 26 and 80 years), MW-7b (n=19, t = 68 years with a CI of 49 and 113 years) and MW-9b (n=20, t = 13 years with a CI of 11 and 16 years)
- Probably decreasing trends: MW-63b (n=8, t = 79 years with a CI of 50 and 190 years)
- Stable trends: MW-133b (n=4), MW-144b (n=4), MW-44b (n=14) and MW-82b (n=4)
- Increasing trends: MW-146b (n=4)

Interflow wells:

- Increasing trends: MW-2c (n=22)

1,1-DCA:

P1 wells:

- Observed concentrations are below CUL

P2 wells:

- Decreasing trends: MW-143p2 (n=4, t = 28 years with CI of 15 and 147 years)
- Increasing trends: MW-138p2 (n=4)
- No trends: MW-113p2 (n=4), MW-43p2 (n=4)

Roza wells:

- Decreasing trends: MW-151b (n=4, t = 0.6 years with CI of 0.4 and 1.2 years), MW-42b (n=24, t = 10 years with CI of 9 and 11 years), MW-44b (n=16, t = 48 years with CI of 29 and 135 years)
- Stable trends: MW-142b (n=4), MW-144b (n=4), MW-146b (n=4), MW-148b (n=4)
- No trends: MW-133b (n=4)

Interflow wells:

– Increasing trends: MW-58c (n=4)

1,2-Dichloroethane (EDC):

P1 wells:

– Observed concentrations are below CUL

P2 wells:

– Decreasing trends: MW-143p2 (n=4, t = 13 years with CI of 11 and 15 years)
– Increasing trends: MW-138p2 (n=4)
– No trends: MW-113p2 (n=4), MW-126p2 (n=4), MW-43p2 (n=4)

Roza wells:

– Decreasing trends: MW-42b (n=24, t = 4 years with CI of 3 and 4 years), MW-44b (n=16, t = 19 years with CI of 14 and 29 years), MW-7b (n=60, t = 3 years with CI of 3 and 4 years)
– Stable trends: MW-142b (n=4), MW-144b (n=4), MW-148b (n=4)
– Increasing trends: MW-146b (n=4)
– No trends: MW-133b (n=4), MW-63b (n=8)

Interflow wells:

– table trends: MW-58c (n=4)
– Increasing trends: MW-5c (n=64)

1,2-Dichloropropane:

P1 wells:

– Observed concentrations are below CUL

P2 wells:

– Stable trends: MW-113p2 (n=4), MW-143p2 (n=4)
– No trends: MW-43p2 (n=4)

Roza wells:

– Decreasing trends: MW-42b (n=24, t = 5 years with CI of 5 and 6 years), MW-44b (n=16, t = 11 years with CI of 9 and 16 years)
– Stable trends: MW-142b (n=4), MW-148b (n=4)
– Increasing trends: MW-146b (n=4)
– No trends: MW-133b (n=4)

Interflow wells:

– Stable trends: MW-58c (n=4)

1,4-Dichlorobenzene:

P1 wells:

– Observed concentrations are below CUL

P2 wells:

- Stable trends: MW-138p2 (n=4)
- No trends: MW-113p2 (n=4), MW-126p2 (n=4)

Roza wells:

- Probably decreasing trends: MW-44b (n=16, t = 172 years with CI of 33 and -55 years)
- No trends: MW-133b (n=4), MW-144b (n=4), MW-63b (n=8)

Interflow wells:

- Increasing trends: MW-58c (n=4)

Benzene:

P1 wells:

- Observed concentrations are below CUL

P2 wells:

- Decreasing trends: MW-126p2 (n=4, t = 10 years with CI of 4 and -17 years)
- Stable trends: MW-113p2 (n=4), MW-138p2 (n=4)

Roza wells:

- Decreasing trends: MW-63b (n=8, t = 13 years with CI of 8 and 27 years)
- No trends: MW-133b (n=4), MW-144b (n=4)

Interflow wells:

- Observed concentrations are below CUL

cis-1,2-DCE:

P1 wells:

- Observed concentrations are below CUL

P2 wells:

- Observed concentrations are below CUL

Roza wells:

- Decreasing trends: MW-148b (n=4, t = 6 years with CI of 4 and 14 years)

Interflow wells:

- Observed concentrations are below CUL

TCE:

P1 wells:

- Observed concentrations are below CUL

P2 wells:

- Stable trends: MW-43p2 (n=4)
- Increasing trends: MW-39p2 (n=6)
- No trends: MW-113p2 (n=4), MW-126p2 (n=4), MW-138p2 (n=4), MW-143p2 (n=4)

Roza wells:

- Stable trends: MW-142b (n=4), MW-42b (n=24)
- Increasing trends: MW-44b (n=16), MW-63b (n=8)
- No trends: MW-144b (n=4), MW-148b (n=4)

Interflow wells:

- Decreasing trends: MW-5c (n=65, t = 11 years with CI of 10 and 13 years)
- Increasing trends: MW-58c (n=4)
- No trends: MW-2c (n=66)

VC:

P1 wells:

- No trends: MW-37p1 (n=5)

P2 wells:

- Stable trends: MW-125p2 (n=4), MW-126p2 (n=4), MW-43p2 (n=4)
- No trends: MW-113p2 (n=4), MW-138p2 (n=4)

Roza wells:

- Decreasing trends: MW-42b (n=24, t = 20 years with CI of 17 and 24 years), MW-7b (n=57, t = 15 years with CI of 14 and 17 years), MW-9b (n=63, t = 6 years with CI of 6 and 7 years)
- Stable trends: MW-103b (n=16), MW-144b (n=4), MW-148b (n=4)
- Increasing trends: MW-146b (n=4)
- No trends: MW-133b (n=4), MW-31b (n=5), MW-44b (n=16)

Interflow wells:

- Decreasing trends: MW-5c (n=65, t = 4 years with CI of 3 and 7 years)
- Increasing trends: MW-2c (n=66)
- No trends: MW-58c (n=4)

6.3.2. Trend and restoration timeframes based on total molar concentration of chlorinated ethenes

P1 wells:

- Stable trends: MW-37p1 (n=5)

P2 wells:

- Probably decreasing trends: MW-46p2 (n=9)
- Stable trends: MW-125p2 (n=4), MW-126p2 (n=4), MW-147p2 (n=4), MW-49p2 (n=4)
- No trends: MW-113p2 (n=4), MW-138p2 (n=4), MW-143p2 (n=4), MW-39p2 (n=6), MW-43p2 (n=4), MW-52p2 (n=4)

Roza wells:

- Decreasing trends: MW-42b (n=24, t = 65 years with CI of 54 and 83 years), MW-7b (n=57, t = 37 years with CI of 33 and 41 years), MW-9b (n=63, t = 38 years with CI of 35 and 41 years)
- Probably decreasing trends: MW-48b (n=9)
- Increasing trends: MW-146b (n=4)
- Stable trends: MW-103b (n=16), MW-140b (n=4), MW-142b (n=4), MW-144b (n=4), MW-145b (n=4), MW-148b (n=4), MW-151b (n=4), MW-44b (n=16), MW-57b (n=4), MW-71b (n=4), MW-82b (n=4)
- No trends: MW-133b (n=4), MW-31b (n=5), MW-51b (n=4), MW-63b (n=8)

Interflow wells:

- Decreasing trends: MW-22c (n=60, t = 36 years with CI of 32 and 40 years), MW-4c (n=65, t = 142 years with CI of 83 and 477 years), MW-5c (n=64, t = 62 years with CI of 57 and 66 years), MW-6c (n=62, t = 53 years with CI of 46 and 63 years)
- Increasing trends: MW-2c (n=65)
- Probably increasing trends: MW-45c (n=9)
- Stable trends: MW-47c (n=4)
- No trends: MW-50c (n=4), MW-58c (n=4)

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TABLES

Table 1. The List of Constituents Used in the Natural Attenuation Analysis.

IHS Parameters	Geochemical Parameters	Other Parameters
Arsenic	Oxidation Reduction Potential	1,1,1-Trichloroethane
Manganese	Nitrate as Nitrogen	1,1-Dichloroethene
1,1-Dichloroethane	Methane	1,2-Dichloroethane
1,2-Dichloroethane (EDC)	Ph	1,2,4-Trimethylbenzene
1,2-Dichloropropane	Dissolved Oxygen	1,3,5-Trimethylbenzene
1,4-Dichlorobenzene	Alkalinity (as CaCO3)	Acetone
Benzene	Sulfate	bis(2-Ethylhexyl) phthalate
cis-1,2-Dichloroethene (DCE)	Iron, Dissolved	Chloroform
Trichloroethene (TCE)	Chloride	Cis-1,2-Dichloroethene
Vinyl Chloride (VC)		Ethylbenzene
		Methylene Chloride
		Tetrachloroethene (PCE)
		Toluene
		Total Xylenes

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Table 2. Classification of Concentration Trends Based on Mann-Kendall Test Results

S	CF	Trend Interpretation
S > 0	CF > 95%	Increasing
S > 0	90% ≤ CF < 95%	Probably Increasing
S > 0	CF < 90%	No Trend
S ≤ 0	CF < 90% and COV ≥ 1	No Trend
S ≤ 0	CF < 90% and COV < 1	Stable
S < 0	90% ≤ CF < 95%	Probably Decreasing
S < 0	CF > 95%	Decreasing

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

Table 3. Mann-Kendall Test Statistics Based on Chlorinated Ethenes for P1 Wells

Well	Aquifer/Zone	Mann-Kendall Analysis				Comparison with Cgoal (expressed as umol-L VC)				
		trend result	CF (%)	COV	S	# of samples	Last C Date	Last C (umol-L)	Cgoal (umol-L)	Last C vs Cgoal
MW-100p1	P1					1	6/19/2020	0.023	0.001	Above
MW-104p1	P1					1	6/15/2020	0.018	0.001	Above
MW-109p1	P1					3	4/5/2024	0.702	0.001	Above
MW-110p1	P1					1	7/2/2020	0.13	0.001	Above
MW-117p1	P1	Stable	83.3	0.81	-4	4	4/11/2024	0.268	0.001	Above
MW-123p1	P1	Stable	62.5	0.77	-2	4	4/11/2024	0.564	0.001	Above
MW-127p1	P1					1	6/11/2020	0.005	0.001	Above
MW-129p1	P1					1	6/11/2020	0.005	0.001	Above
MW-34p1	P1	Decreasing	99.9	1.82	-119	23	7/1/2020	0.057	0.001	Above
MW-36p1	P1	No Trend	62.5	1.06	-2	4	4/10/2024	0.134	0.001	Above
MW-37p1	P1	Stable	88.3	0.7	-6	5	7/2/2020	0.019	0.001	Above
MW-61p1	P1					2	6/19/2019	0.005	0.001	Above
MW-64p1	P1					2	7/2/2020	0.032	0.001	Above
MW-65p1	P1	No Trend	54.8	1.44	2	8	7/1/2020	0.026	0.001	Above
MW-66p1	P1					2	7/1/2020	0.025	0.001	Above
MW-67p1	P1					2	6/30/2020	0.055	0.001	Above
MW-68p1	P1	No Trend	70.9	0.82	10	13	7/1/2020	0.119	0.001	Above
MW-69p1	P1	No Trend	75.8	1.51	-4	5	4/10/2024	6.836	0.001	Above
MW-70p1	P1					2	7/1/2020	0.036	0.001	Above
MW-83p1	P1	Decreasing	95.8	0.85	-6	4	4/10/2024	0.486	0.001	Above
MW-85p1	P1	Stable	62.5	0.84	-2	4	4/11/2024	0.127	0.001	Above
MW-90p1	P1					1	6/30/2020	0.024	0.001	Above
MW-92p1	P1	No Trend	37.5	1.13	0	4	4/9/2024	4.438	0.001	Above
MW-95p1	P1	No Trend	83.3	1.25	-4	4	4/10/2024	0.027	0.001	Above
MW-98p1	P1					1	6/15/2020	0.022	0.001	Above

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

C: Concentration

Last C: Last measured concentration

C_{goal}: Target concentration

VC: Vinyl Chloride

Table 4. Mann-Kendall Test Statistics Based on Chlorinated Ethenes for P2 Wells

Well	Aquifer/Zone	Mann-Kendall Analysis				Comparison with Cgoal (expressed as umol-L VC)				
		trend result	CF (%)	COV	S	# of samples	Last C Date	Last C (umol-L)	Cgoal (umol-L)	Last C vs Cgoal
MW-101p2	P2	No Trend	83.3	1.68	-4	4	4/10/2024	0.107	0.001	Above
MW-107p2	P2	Decreasing	95.8	0.84	-6	4	4/5/2024	0.096	0.001	Above
MW-108p2	P2					1	6/15/2020	0.127	0.001	Above
MW-112p2	P2					1	6/18/2020	0.068	0.001	Above
MW-113p2	P2	No Trend	37.5	1.49	0	4	4/9/2024	0.574	0.001	Above
MW-114p2	P2	No Trend	62.5	1.46	2	4	4/9/2024	7.407	0.001	Above
MW-115p2	P2	Stable	62.5	0.99	-2	4	4/11/2024	0.028	0.001	Above
MW-118p2	P2					1	6/26/2020	0.156	0.001	Above
MW-122p2	P2					1	6/15/2020	0.128	0.001	Above
MW-124p2	P2	No Trend	62.5	0.17	2	4	4/8/2024	0.104	0.001	Above
MW-125p2	P2	Stable	83.3	0.6	-4	4	4/2/2024	0.022	0.001	Above
MW-126p2	P2	Stable	37.5	0.45	0	4	4/11/2024	0.12	0.001	Above
MW-131p2	P2					1	6/12/2020	0.006	0.001	Above
MW-136p2	P2					1	6/24/2020	0.034	0.001	Above
MW-138p2	P2	No Trend	83.3	0.71	4	4	4/1/2024	0.151	0.001	Above
MW-141p2	P2					1	6/23/2020	0.005	0.001	Above
MW-143p2	P2	No Trend	62.5	0.15	2	4	4/2/2024	0.066	0.001	Above
MW-147p2	P2	Stable	72.9	0.07	-3	4	4/8/2024	0.005	0.001	Above
MW-33p2	P2	Decreasing	99.2	0.99	-111	26	6/24/2021	0.032	0.001	Above
MW-35p2	P2	Decreasing	100	1	-144	25	6/24/2021	0.309	0.001	Above
MW-38p2	P2	Decreasing	100	1.39	-220	25	6/24/2021	0.495	0.001	Above
MW-39p2	P2	No Trend	50	0.29	1	6	6/18/2019	0.027	0.001	Above
MW-40p2	P2	Stable	59.2	0.43	-2	5	9/16/2010	0.004	0.001	Above
MW-43p2	P2	No Trend	62.5	0.38	2	4	9/16/2010	0.155	0.001	Above
MW-46p2	P2	Probably Decreasing	94	1.14	-16	9	3/14/2013	0.001	0.001	Below
MW-49p2	P2	Stable	50	0.79	-1	4	9/15/2010	0.002	0.001	Above
MW-52p2	P2	No Trend	83.3	0.7	4	4	9/16/2010	0.002	0.001	Above
MW-60p2	P2					2	6/17/2019	0.005	0.001	Above
MW-76p2	P2					1	7/1/2020	0.19	0.001	Above
MW-80p2	P2	Decreasing	95.8	0.56	-6	4	4/8/2024	0.055	0.001	Above
MW-87p2	P2	No Trend	62.5	0.3	2	4	4/9/2024	0.141	0.001	Above
MW-88p2	P2					1	6/30/2020	0.03	0.001	Above
MW-91p2	P2	Stable	62.5	0.6	-2	4	4/9/2024	0.433	0.001	Above
MW-94p2	P2					1	6/24/2020	1.314	0.001	Above
MW-99p2	P2	Stable	83.3	0.51	-4	4	4/9/2024	0.114	0.001	Above

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

C: Concentration

Last C: Last measured concentration

C_{goal}: Target concentration

VC: Vinyl Chloride

Table 5. Mann-Kendall Test Statistics Based on Chlorinated Ethenes for Roza Wells

Well	Aquifer/Zone	Mann-Kendall Analysis				Comparison with Cgoal (expressed as umol-L VC)				
		trend result	CF (%)	COV	S	# of samples	Last C Date	Last C (umol-L)	Cgoal (umol-L)	Last C vs Cgoal
MW-102b	Roza	Increasing	95.8	0.49	6	4	4/10/2024	0.535	0.001	Above
MW-103b	Roza	Stable	62.4	0.23	-8	16	3/14/2024	0.167	0.001	Above
MW-105b	Roza					1	6/26/2020	0.005	0.001	Above
MW-116b	Roza					1	6/23/2020	0.005	0.001	Above
MW-121b	Roza					1	6/23/2020	0.005	0.001	Above
MW-128b	Roza					1	6/24/2020	0.005	0.001	Above
MW-130b	Roza					1	6/24/2020	0.005	0.001	Above
MW-132b	Roza					1	6/26/2020	0.005	0.001	Above
MW-133b	Roza	No Trend	62.5	0.8	2	4	4/4/2024	0.155	0.001	Above
MW-135b	Roza					1	6/26/2020	0.005	0.001	Above
MW-139b	Roza					1	6/19/2020	0.005	0.001	Above
MW-140b	Roza	Stable	37.5	0	0	4	4/12/2024	0.005	0.001	Above
MW-142b	Roza	Stable	83.3	0.11	-4	4	4/1/2024	0.05	0.001	Above
MW-144b	Roza	Stable	83.3	0.47	-4	4	4/2/2024	0.051	0.001	Above
MW-145b	Roza	Stable	37.5	0	0	4	4/3/2024	0.005	0.001	Above
MW-146b	Roza	Increasing	95.8	0.49	6	4	4/2/2024	0.075	0.001	Above
MW-148b	Roza	Stable	83.3	0.1	-4	4	4/5/2024	0.264	0.001	Above
MW-149b	Roza					3	4/2/2024	0.118	0.001	Above
MW-150b	Roza					3	4/4/2024	0.005	0.001	Above
MW-151b	Roza	Stable	83.3	0.32	-4	4	4/3/2024	0.009	0.001	Above
MW-19b	Roza	Stable	79.3	0.16	-21	21	3/12/2013	0.005	0.001	Above
MW-29b	Roza	No Trend	59.2	0.36	2	5	6/20/2019	0.276	0.001	Above
MW-30b	Roza	Stable	59.2	0.88	-2	5	6/21/2019	0.028	0.001	Above
MW-31b	Roza	No Trend	75.8	0.75	4	5	7/1/2020	0.033	0.001	Above
MW-3b	Roza	Decreasing	100	0.32	-308	36	9/27/2017	0.42	0.001	Above
MW-42b	Roza	Decreasing	100	0.37	-192	24	6/24/2021	0.221	0.001	Above
MW-44b	Roza	Stable	85	0.36	-24	16	6/25/2021	0.102	0.001	Above
MW-48b	Roza	Probably Decreasing	94	1.14	-16	9	3/14/2013	0.001	0.001	Below
MW-51b	Roza	No Trend	83.3	0.7	4	4	9/14/2010	0.002	0.001	Above
MW-57b	Roza	Stable	72.9	0.14	-3	4	4/3/2024	0.005	0.001	Above
MW-63b	Roza	No Trend	54.8	1.13	2	8	6/25/2021	0.045	0.001	Above
MW-71b	Roza	Stable	83.3	0.22	-4	4	4/3/2024	0.024	0.001	Above
MW-72b	Roza					1	6/18/2020	0.038	0.001	Above
MW-74b	Roza					1	6/30/2020	0.007	0.001	Above
MW-78b	Roza					1	6/29/2020	0.272	0.001	Above
MW-7b	Roza	Decreasing	100	0.76	-1134	57	3/14/2024	0.06	0.001	Above
MW-81b	Roza	Stable	62.5	0.27	-2	4	4/8/2024	0.999	0.001	Above
MW-82b	Roza	Stable	37.5	0	0	4	4/3/2024	0.005	0.001	Above
MW-86b	Roza					1	6/18/2020	0.005	0.001	Above
MW-89b	Roza					1	6/29/2020	0.067	0.001	Above
MW-93b	Roza					1	6/29/2020	0.076	0.001	Above
MW-96b	Roza					1	6/25/2020	0.005	0.001	Above
MW-97b	Roza					1	6/29/2020	0.006	0.001	Above
MW-9b	Roza	Decreasing	100	1	-1695	63	3/14/2024	0.018	0.001	Above

Notes:

S: Mann-Kendall test statistics
CF: Confidence factor
COV: Coefficient of variation
C: Concentration
Last C: Last measured concentration
C_{goal}: Target concentration
VC: Vinyl Chloride

Table 6. Mann-Kendall Test Statistics Based on Chlorinated Ethenes for Interflow Wells

Well	Aquifer / Zone	Mann-Kendall Analysis				Comparison with Cgoal (expressed as umol-L VC)				
		trend result	CF (%)	COV	S	# of samples	Last C Date	Last C (umol-L)	Cgoal (umol-L)	Last C vs Cgoal
MW-20c	Interflow	Decreasing	100	0.14	-666	65	3/14/2024	0.005	0.001	Above
MW-21c	Interflow	Decreasing	100	0.33	-538	59	3/13/2024	0.005	0.001	Above
MW-22c	Interflow	Decreasing	100	0.47	-1441	60	3/12/2024	0.013	0.001	Above
MW-2c	Interflow	Increasing	100	0.29	1564	65	3/12/2024	0.036	0.001	Above
MW-45c	Interflow	Probably Increasing	91	0.26	14	9	3/14/2013	0.005	0.001	Above
MW-47c	Interflow	Stable	50	0.79	-1	4	9/15/2010	0.002	0.001	Above
MW-4c	Interflow	Decreasing	100	0.15	-602	65	3/12/2024	0.005	0.001	Above
MW-50c	Interflow	No Trend	83.3	0.7	4	4	9/14/2010	0.002	0.001	Above
MW-54c	Interflow	No Trend	89.5	0.66	5	4	9/16/2010	0.002	0.001	Above
MW-56c	Interflow					2	3/14/2013	0.002	0.001	Above
MW-58c	Interflow	No Trend	62.5	0.11	2	4	6/25/2021	0.405	0.001	Above
MW-5c	Interflow	Decreasing	100	0.38	-1708	64	3/13/2024	0.034	0.001	Above
MW-62c	Interflow					2	6/19/2019	0.005	0.001	Above
MW-6c	Interflow	Decreasing	100	0.36	-1140	62	3/13/2024	0.006	0.001	Above

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

C: Concentration

Last C: Last measured concentration

C_{goal}: Target concentration

VC: Vinyl Chloride

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Table 7. Biodegradation Geochemical Indicator Results for P1 Zone

Wells	Aquifer/Zone	1,1-DCA (ug/L)	CA (ug/L)	cis-1,2-DCE (% DCE)	Ethane (ug/L)	Ethene (ug/L)	Methane (ug/L)	Alkalinity (mg/L CaCO3)	BTEX (ug/L)	Nitrate (mg/L-N)	Chloride (mg/L)	Dissolved Fe (ug/L)	ORP (mV)	Total Number of Geochemical Indicators
MW-100p1	P1	1.47	0.21	100					0.3	5.45	83.9D	468D	18	5
MW-104p1	P1	4.9	0.73Q	100					0.45	0.06U	431D	21300D	-71	6
MW-109p1	P1	137	12.2	25	1.23U	1.49	14.7		0	46.1H	24.3D	200U	164.8	2
MW-110p1	P1	47	0.2U	77					29.57	0.02UH	51D	4470D	-67	6
MW-117p1	P1	2.48	0.2U	8					2.72	23.1	21.3D	40U	62.2	1
MW-123p1	P1	4.91	0.2U	87					20.3	31.5	5.99	40U	59.5	2
MW-127p1	P1	0.2U	0.2U						0	26.8	75.6D	20U	82	1
MW-129p1	P1	0.2U	0.2U						0	28.2	39.6D	20U	97	1
MW-34p1	P1	13.5	0.2U	74	1.2U	253	7080	1190	3.22	0.02U	488D	26900D	-185	9
MW-36p1	P1	123	33						4392	0.21U	185D	22100D	-120.3	7
MW-37p1	P1	1.04	0.2U	100	1.2U	1.1U	0.7U	516	0.64	5.17H	69.2D	535	67	3
MW-61p1	P1	0.2U	0.2U						0.26	0.02U	5.31	32.1	49	2
MW-64p1	P1	0.85	8.33	100					4.95	0.02UH	589D	17000D	-149	7
MW-65p1	P1	1.82	5.94	39					5.74	0.02U	554D	44200D	-191	7
MW-66p1	P1	0.76	0.2U	100					3.14	0.02U	458D	33200D	-168	6
MW-67p1	P1	2U	2U						2002.92	0.02U	545D	32400D	-153	5
MW-68p1	P1	61.5	10.5	79					8.22	0.02U	449D	23800D	-187	7
MW-69p1	P1	968	100U	100					21730	0.06U	119D	14500D	-62.8	7
MW-70p1	P1	0.2U	4.71Q	100					4.58	0.02U	126D	7710D	-84	6
MW-83p1	P1	195	26.9						5357	0.06U	127D	12800D	-107.6	7
MW-85p1	P1	25.2	3.23						489.5	0.0207	161D	8440D	-85	7
MW-90p1	P1	8.1	1.13	100					1.53	0.02U	255D	21400	-101	7
MW-92p1	P1	390	26.2	71					10507.21	0.06U	96.4D	17600D	-93	8
MW-95p1	P1	7.64	0.67	100					140.05	0.11U	73.5D	12600D	-124.3	8
MW-98p1	P1	1.31	0.2U	100					0	4.65	31.4D		120	3

Notes:

Shading indicates geochemical conditions consistent with or favorable for reductive dechlorination

Background Alkalinity (as CaCO3) = 219 mg/L (PGG 2010)(2x = 438 mg/L)

Background Chloride = 13.2 mg/L (PGG 2010)(2x = 26.4 mg/L)

Results Qualifiers:

U= Analyte not detected (reporting limit shown)

D= Inorganic analysis required dilution

Q= Continuing calibration out of control (detected result represents estimate)

H= Analyzed ouside of holding time (detected result represents estimate)

BTEX: Benzene, Toluene, Ethylbenzene, Xylenes

Fe: Iron

ORP: Oxidation-Reduction Potential

CA: Chloroethane

DCE: Dichloroethene; DCA: Dichloroethane

% DCE: percent of detected DCE isomers present as cis-1,2 DCE.

Table 8. Biodegradation Geochemical Indicator Results for P2 Zone

Wells	Aquifer/Zone	1,1-DCA (ug/L)	CA (ug/L)	cis-1,2-DCE (% DCE)	Ethane (ug/L)	Ethene (ug/L)	Methane (ug/L)	Alkalinity (mg/L CaCO3)	BTEX (ug/L)	Nitrate (mg/L-N)	Chloride (mg/L)	Dissolved Fe (ug/L)	ORP (mV)	Total Number of Geochemical Indicators
MW-101p2	P2	288	868						75.11	0.02U	229D	3890D	-136.5	6
MW-107p2	P2	17.5	168		16.1	16.6	1500		18.8	0.02U,H	478D	2940D	-139.9	8
MW-108p2	P2	18.2	1.77Q	100					0.89	0.02U	437D	419	-73	6
MW-112p2	P2	16.9	38.1	52					4.16	0.02UH	487D	3980D	-96	6
MW-113p2	P2	219	151						5109.96	0.06U	591D	16800D	-92.3	7
MW-114p2	P2	58.6	229						3730.8	0.0234	489D	4300D	-69.4	7
MW-115p2	P2	12.1	22.3	72					4.67	0.02U	342D	1710D	-85.5	7
MW-118p2	P2	13.6	0.61Q	100					0.55	0.0231	266D	40U	49	6
MW-122p2	P2	38.6	160	86					3.14	0.02U	368D	185	-100	6
MW-124p2	P2	2.95	0.98	89	1.77	1.14U	37.8	526	0	0.042H	230D	377D	41.2	7
MW-125p2	P2	0.28	0.2U	100	1.23U	1.14U	454	554	0.57	0.02U	87.3D	3210D	-114.7	7
MW-126p2	P2	5U	241						24.2	0.02U	419D	161D	-76.9	4
MW-131p2	P2	2.78	0.22M	100					0	0.02U	77.2D	20U	10	6
MW-136p2	P2	1.79	0.2U	33					0	9.56	83.6D	40U	-12	3
MW-138p2	P2	68.5	284	100	33.9	3.91	2920	1010	1742.3	2.01U	474D	13700D	-37.5	10
MW-141p2	P2	0.2U	0.2U		1.23U	1.14U	0.65U	148	0	0.112	4.09	22.4	-153	2
MW-143p2	P2	7.68	0.2U	87	1.23U	1.14U	0.65U	236	0	8.77	102D	200U	55.1	3
MW-147p2	P2	0.2U	0.2U		1.23U	1.14U	0.65U	167	0	4.57H	6.03	40U	75.4	0
MW-33p2	P2	6	8.23	100	2.4	32.1	3290	1210	1.51	0.748	314D	1940D	-39	10
MW-35p2	P2	62.3	54.2	91	1.2U	43.6	1800	804	2.97	0.0536	1100D	1950D	16	10
MW-38p2	P2	319	197	55	1.2U	48.2	260	334	30.2	0.754	351D	550D	-3.5	6
MW-39p2	P2	0.73	0.27	100	1.23U	1.14U	3.91	1020	0	0.0354	540D	611D	41	7
MW-40p2	P2	0.2U	0.2U		1.2U	1.1U	0.7U	121	0	4.48	47.7	50U	65.3	1
MW-43p2	P2	11	19	95	1.2U	1.1U	8.5	244	0	0.297	200	50U	37.1	6
MW-46p2	P2	0.2U	0.2U		1.2U	1.1U	0.7U	128	0	0.01U	5.6	50U	66	1
MW-49p2	P2	0.2U	0.2U		1.2U	1.1U	0.7U	103	0	0.01U	3.2	50U	44.4	2
MW-52p2	P2	0.2U	0.2U		1.2U	1.1U	0.7U	121	0	0.014	3.6	50U	70.9	1
MW-60p2	P2	0.2U	0.2U						0	3.22	3.59	20U	155	0
MW-76p2	P2	17.6	1.71Q	97					6.57	0.02U	1010D	5700	-45	7
MW-80p2	P2	2.35	3.32	100					0.32	0.279	1050D	3100D	-97.6	7
MW-87p2	P2	8.85	40						1528	0.06U	587D	23000D	-112	7
MW-88p2	P2	9.9	6.43	100					0.94	0.02U	144D	816	-84	6
MW-91p2	P2	37.7	25	100					2379.35	0.02U	760D	6090D	-31	8
MW-94p2	P2	83.8	18.5	89					16.03	0.02U	350D	3340D	-125	7
MW-99p2	P2	30.5	435	59					1229.1	0.06U	391D	10000D	-63.3	7

Notes:

Shading indicates geochemical conditions consistent with or favorable for reductive dechlorination

Background Alkalinity (as CaCO3) = 219 mg/L (PGG 2010)(2x = 438 mg/L)

Background Chloride = 13.2 mg/L (PGG 2010)(2x = 26.4 mg/L)

Results Qualifiers:

- U= Analyte not detected (reporting limit shown)
- D= Inorganic analysis required dilution
- Q= Continuing calibration out of control (detected result represents estimate)
- H= Analyzed ouside of holding time (detected result represents estimate)
- M= Estimated result for a GC/MS analyte detected and confirmed by lab but with low spectral match parameters

BTEX: Benzene, Toluene, Ethylbenzene, Xylenes

Fe: Iron

ORP: Oxidation-Reduction Potential

CA: Chloroethane

DCE: Dichloroethene; DCA: Dichloroethane

% DCE: percent of detected DCE isomers present as cis-1,2 DCE.

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Table 9. Biodegradation Geochemical Indicator Results for Roza Aquifer

Wells	Aquifer/Zone	1,1-DCA (ug/L)	CA (ug/L)	cis-1,2-DCE (% DCE)	Ethane (ug/L)	Ethene (ug/L)	Methane (ug/L)	Alkalinity (mg/L CaCO3)	BTEX (ug/L)	Nitrate (mg/L-N)	Chloride (mg/L)	Dissolved Fe (ug/L)	ORP (mV)	Total Number of Geochemical Indicators
MW-144b	Roza	10.2	159	69	30.6	1.14U	2250	674	54.53	0.02U	329D	2220D	28.3	9
MW-133b	Roza	113	67.2	72	7.15	2.43	504	878	604.44	0.02U	429D	7040D	26.4	9
MW-63b	Roza	2.04	636		29.9	1.41	2690	837	26.5	0.02U	422D	8160D	-47	8
MW-3b	Roza	4.58	1.26	96	1.2U	3.2	410	1030	0.77	0.06U	777D	5290D	-30	8
MW-81b	Roza	17.6	1.22	91					0.92	0.02U	1050D	1180D	-23.6	7
MW-44b	Roza	32.6	170	100	13.3	1.14U	1270	808	1.67	0.02U	350D	1210D	10	7
MW-42b	Roza	11.5	1.53	88	1.23U	1.14U	10	725	0	0.02U	248D	290D	43	7
MW-93b	Roza	7.97	0.65Q	100					0.28	0.02U	81.1D	40U	-118	6
MW-89b	Roza	7.26	1.86Q	100					1.21	0.02U	215D	901D	-75	6
MW-78b	Roza	15.9	0.58Q	94					0.67	0.056	282D	40U	-33	6
MW-30b	Roza	6.8	1.55	100	1.2U	1.1U	32	155	0	0.036	26.7D	50U	-117	6
MW-29b	Roza	32.1	3.62	95	1.2U	1.7	59.1	288	1.06	0.02U	464D	628D	-43.3	6
MW-148b	Roza	80.9	1.8	90	1.23U	1.14U	28.7	206	1.6	0.452H	113D	200U	-2.1	6
MW-146b	Roza	10	10.5	100	5.57	1.14U	351	705	0.79	0.02U	271D	354D	55.1	6
MW-103b	Roza	1.08	0.2U	100				1770	0.31	0.02U	417D	1630		6
MW-72b	Roza	0.55	0.96						0.2	0.0336H	2100D	842	-18	5
MW-97b	Roza	0.23	0.2U	100					0	0.0607	5.38	40U	-109	4
MW-7b	Roza	2.03	0.2U	100	1.6	2.6	201	518	0	4.7	240D	50U	-12	4
MW-149b	Roza	19.1	2.88	90	1.23U	1.14U	3.25	172	0.75	7.44	28.5D	200U	94.6	4
MW-142b	Roza	33.6	1.19	85	1.23U	1.14U	25	165	0	2.89	50.3D	200U	157	4
MW-140b	Roza	1.7	0.2U		1.23U	1.14U	0.65U	220	0.28	1.79	47.5D	40U	112.1	4
MW-121b	Roza	0.22	0.2U						0	0.02U	30.2	20U	31	4
MW-102b	Roza	27.8	7.76	51					2.39	0.564	36.8D	100U	65.1	4
MW-96b	Roza	2.24	0.2U						3.62	0.022	8.43	74.2D	-72	3
MW-86b	Roza	0.29	0.2U						0	0.02UH	4.73	20U	11	3
MW-71b	Roza	1.3	0.2U	100	1.23U	1.14U	0.65U	383	0	21.3	147D	200U	103	3
MW-31b	Roza	2.79	0.29Q	55	1.2U	1.5	40.6	122	0	0.02U	8.06	20U	-94	3
MW-151b	Roza	3.62	0.2U	100	1.23U	1.14U	0.65U	318	0	2.24	86D	200U	152.4	3
MW-150b	Roza	1.52	0.2U		1.23U	1.14U	5.2	228	0	1.52	46.8D	200U	103.2	3
MW-9b	Roza	0.2U	0.2U	100	1.2U	1.1U	16.4	581	0	24.8	65.6D	50U	146	2
MW-82b	Roza	0.2U	0.2U		1.23U	1.14U	757	131	0	0.02U	3.14	100U	-81.9	2
MW-74b	Roza	0.2U	0.2U						0	0.02U	3.95	20U	-109	2
MW-145b	Roza	0.24	0.2U		1.23U	1.14U	0.65U	168	0	3.87	4.62	200U	18.3	2
MW-139b	Roza	0.2U	0.2U		1.23U	1.14U	65.4	130	0	0.02U	4.35	20U	-119	2
MW-135b	Roza	0.2U	0.2U						0	0.02U	5.16	40U	-67	2
MW-132b	Roza	0.2U	0.2U						0	0.02U	4.12	40U	-95	2
MW-130b	Roza	0.2U	0.2U						0	1.35	7.05	40U	-74	2
MW-128b	Roza	0.2U	0.2U						0.51	0.02U	3.72	100U	-41	2
MW-116b	Roza	0.2U	0.2U						0	0.02U	3.79	40.1	-106	2
MW-105b	Roza	0.2U	0.2U						0	0.0322	4.4	40U	-36	2
MW-57b	Roza	0.28	0.2U		1.23U	1.14U	0.65U	156	0	6.83	8.43	200U	220	1
MW-51b	Roza	0.2U	0.2U		1.2U	1.1U	0.7U	163	0	0.803	8.2	50U	85.7	1
MW-19b	Roza	0.2U	0.2U		1.2U	1.1U	0.7U	141	0	0.11	19.4	50U	94	1
MW-48b	Roza	0.2U	0.2U		1.2U	1.1U	0.7U	178	0	3.24	5.3	50U	80.31	0

Notes:

Shading indicates geochemical conditions consistent with or favorable for reductive dechlorination

Background Alkalinity (as CaCO3) = 219 mg/L (PGG 2010)(2x = 438 mg/L)

Background Chloride = 13.2 mg/L (PGG 2010)(2x = 26.4 mg/L)

Results Qualifiers:

U= Analyte not detected (reporting limit shown)

D= Inorganic analysis required dilution

Q= Continuing calibration out of control (detected result represents estimate)

H= Analyzed ouside of holding time (detected result represents estimate)

BTEX: Benzene, Toluene, Ethylbenzene, Xylenes

Fe: Iron

ORP: Oxidation-Reduction Potential

CA: Chloroethane

DCE: Dichloroethene; DCA: Dichloroethane

% DCE: percent of detected DCE isomers present as cis-1,2 DCE.

Table 10. Biodegradation Geochemical Indicator Results for Interflow Aquifer

Wells	Aquifer / Zone	1,1-DCA (ug/L)	CA (ug/L)	cis-1,2-DCE (% DCE)	Ethane (ug/L)	Ethene (ug/L)	Methane (ug/L)	Alkalinity (mg/L CaCO3)	BTEX (ug/L)	Nitrate (mg/L-N)	Chloride (mg/L)	Dissolved Fe (ug/L)	ORP (mV)	Total Number of Geochemical Indicators
MW-58c	Interflow	23.8	17.7	90	4.17	1.14U	168	252	1.65	0.0444	448D	20U	-108	6
MW-5c	Interflow	0.64	0.2U	100	1.2U	1.1U	0.7U	317	0	1.83	599D	50U	143	4
MW-2c	Interflow	2.44	0.2U	100	1.2U	1.1U	0.7U	226	0	3.65	868D	50U	95	3
MW-45c	Interflow	0.2U	0.2U	100	1.2U	1.1U	0.7U	111	0	3.54	83.2	50U	7.3	3
MW-21c	Interflow	0.2U	0.2U		1.2U	1.1U	12.5	117	0	138	28.5D	50U	27	2
MW-22c	Interflow	0.96	0.2U		1.2U	1.1U	0.7U	315	0	24.7	151D	50U	111	2
MW-50c	Interflow	0.2U	0.2U		1.2U	1.1U	0.7U	126	0	0.01U	6.1	50U	19.9	2
MW-54c	Interflow	0.2U	0.2U		1.2U	1.1U	0.7U	121	0	0.065	6.4	330	-6.1	2
MW-56c	Interflow	0.2U	0.2U	100				134	0	2.52	27.4	50U		2
MW-62c	Interflow	0.2U	0.2U							0.02U	7.15	30	-11	2
MW-6c	Interflow	0.42	0.2U		1.2U	1.1U	1	361	0	13.3	221D	50U	120	2
MW-47c	Interflow	0.2U	0.2U		1.2U	1.1U	0.7U	145	0	1.65	7.6	50U	30.3	1
MW-4c	Interflow	0.2U	0.2U		1.2U	1.1U	0.7U	130	0	0.02U	10.7D	50U	64	1
MW-20c	Interflow	0.2U	0.2U		1.2U	1.1U	15.8	160	0	1.13	5.48	50U	130	0

Notes:

Shading indicates geochemical conditions consistent with or favorable for reductive dechlorination

Background Alkalinity (as CaCO3) = 219 mg/L (PGG 2010)(2x = 438 mg/L)

Background Chloride = 13.2 mg/L (PGG 2010)(2x = 26.4 mg/L)

Results Qualifiers:

U= Analyte not detected (reporting limit shown)

D= Inorganic analysis required dilution

Q= Continuing calibration out of control (detected result represents estimate)

H= Analyzed ouside of holding time (detected result represents estimate)

BTEX: Benzene, Toluene, Ethylbenzene, Xylenes

Fe: Iron

ORP: Oxidation-Reduction Potential

CA: Chloroethane

DCE: Dichloroethene; DCA: Dichloroethane

% DCE: percent of detected DCE isomers present as cis-1,2 DCE.

Table 11. Results of Mann-Kendall Test and Regression Analysis for IHSs in P1 Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponantial R^2	trend result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-100p1	Arsenic, Dissolved							1	2.67	5	Below						
	Manganese, Dissolved							1	2830	50	Above						
	1,1-Dichloroethane							1	1.47	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.24	3	Below						
	1,4-Dichlorobenzene							1	0.59	2	Below						
	Benzene							1	0.3	2	Below						
	cis-1,2-Dichloroethene							1	1	15	Below						
	Trichloroethene (TCE)							1	0.25	0.4	Below						
	Vinyl Chloride							1	0.523	0.09	Above						
MW-104p1	Arsenic, Dissolved							1	4.15	5	Below						
	Manganese, Dissolved							1	6650	50	Above						
	1,1-Dichloroethane							1	4.9	3	Above						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	1.46	3	Below						
	1,4-Dichlorobenzene							1	0.39	2	Below						
	Benzene							1	0.45	2	Below						
	cis-1,2-Dichloroethene							1	0.64	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.47	0.09	Above						
MW-109p1	Arsenic, Dissolved							3	5.96	5	Above						
	Manganese, Dissolved							3	1030	50	Above						
	1,1-Dichloroethane							3	137	3	Above						
	1,2-Dichloroethane (EDC)							3	0.5	0.3	Above						
	1,2-Dichloropropane							3	3.48	3	Above						
	1,4-Dichlorobenzene							3	0.5	2	Below						
	Benzene							3	0.5	2	Below						
	cis-1,2-Dichloroethene							3	13.6	15	Below						
	Trichloroethene (TCE)							3	1.79	0.4	Above						
	Vinyl Chloride							3	7.53	0.09	Above						
MW-110p1	Arsenic, Dissolved							1	6.57	5	Above						
	Manganese, Dissolved							1	2770	50	Above						
	1,1-Dichloroethane							1	47	3	Above						
	1,2-Dichloroethane (EDC)							1	0.73	0.3	Above						
	1,2-Dichloropropane							1	35	3	Above						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.48	2	Below						
	cis-1,2-Dichloroethene							1	3.52	15	Below						
	Trichloroethene (TCE)							1	0.55	0.4	Above						
	Vinyl Chloride							1	4.77	0.09	Above						
MW-117p1	Arsenic, Dissolved	<0.05	<0.05	Stable	62.5	0.52	-2	4	1.76	5	Below						
	Manganese, Dissolved	<0.05	0.16	No Trend	83.3	1.97	-4	4	1.25	50	Below						
	1,1-Dichloroethane	0.27	0.60	No Trend	83.3	1.13	-4	4	2.48	3	Below						
	1,2-Dichloroethane (EDC)	0.22	0.43	Stable	72.9	0.83	-3	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	No Trend	62.5	1.37	-2	4	2.1	3	Below						
	1,4-Dichlorobenzene	0.15	0.40	Stable	72.9	0.99	-3	4	0.1	2	Below						
	Benzene	<0.05	0.23	No Trend	72.9	1.82	-3	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.24	0.39	Stable	83.3	0.60	-4	4	1.87	15	Below						
	Trichloroethene (TCE)	0.34	0.26	Stable	62.5	0.37	-2	4	2.41	0.4	Above						
	Vinyl Chloride	0.07	0.34	No Trend	83.3	1.46	-4	4	0.159	0.09	Above						
MW-123p1	Arsenic, Dissolved	<0.05	0.08	No Trend	62.5	1.30	-2	4	1.52	5	Below						
	Manganese, Dissolved	0.39	0.28	Stable	62.5	0.88	-2	4	6.8	50	Below						
	1,1-Dichloroethane	0.24	0.33	Stable	50.0	0.40	-1	4	4.91	3	Above						
	1,2-Dichloroethane (EDC)	<0.05	0.13	Stable	62.5	0.96	-2	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	0.09	Stable	62.5	0.54	-2	4	16.8	3	Above						
	1,4-Dichlorobenzene	0.22	0.22	Stable	62.5	0.77	-2	4	0.1	2	Below						
	Benzene	0.22	0.22	Stable	62.5	0.77	-2	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	0.07	Stable	37.5	0.98	0	4	38.3	15	Above						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	62.5	0.80	-2	4	10	0.4	Above						
	Vinyl Chloride	0.09	0.08	Stable	37.5	0.90	0	4	0.904	0.09	Above						
MW-127p1	Arsenic, Dissolved							1	0.735	5	Below						
	Manganese, Dissolved							1	27.7	50	Below						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-129p1	Arsenic, Dissolved							1	1.53	5	Below						
	Manganese, Dissolved							1	0.25	50	Below						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-34p1	Arsenic, Dissolved	0.30	0.30	Decreasing	98.5	0.22	-73	21	17.4	5	Above	0.034	0.013	0.055	36	93	23
	Manganese, Dissolved	0.27	0.28	Stable	80.1	0.38	-29	21	6810	50	Above						
	1,1-Dichloroethane	0.62	0.93	Decreasing	99.9	1.96	-110	22	13.5	3	Above	0.540	0.485	0.595	3	3	3
	1,2-Dichloroethane (EDC)	0.72	0.87	Decreasing	99.6	1.80	-100	23	1.81	0.3	Above	0.538	0.458	0.618	3	4	3
	1,2-Dichloropropane	0.69	0.83	Decreasing	99.5	1.67	-92	22	0.42	3	Below						
	1,4-Dichlorobenzene	0.31	0.57	Decreasing	100.0	2.23	-212	23	11.1	2	Above	0.254	0.172	0.335	7	10	5
	Benzene	0.42	0.80	Decreasing	100.0	2.35	-152	23	3.22	2	Above	0.464	0.377	0.551	1	1	1
	cis-1,2-Dichloroethene	0.14	0.65	Decreasing	99.7	1.99	-107	23	1.37	15	Below						
	Trichloroethene (TCE)	0.32	0.61	Decreasing	100.0	2.73	-139	23	0.32	0.4	Below						
	Vinyl Chloride	0.56	0.90	Decreasing	100.0	2.07	-128	23	2.13	0.09	Above	0.466	0.407	0.525	7	8	6

Table 11. Results of Mann-Kendall Test and Regression Analysis for IHSs in P1 Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponantial R^2	trend result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-36p1	Arsenic, Dissolved							3	12.8	5	Above						
	Manganese, Dissolved	0.99	0.97	Decreasing	95.8	0.25	-6	4	4170	50	Above	0.152	0.097	0.206	29	46	21
	1,1-Dichloroethane	1.00	0.94	Decreasing	95.8	0.63	-6	4	123	3	Above	0.431	0.212	0.651	9	18	6
	1,2-Dichloroethane (EDC)	0.06	0.21	Stable	62.5	0.99	-2	4	2.5	0.3	Above						
	1,2-Dichloropropane	0.41	0.56	Stable	83.3	0.78	-4	4	2.5	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	No Trend	37.5	1.01	0	4	6.14	2	Above						
	Benzene	0.09	0.27	Stable	62.5	0.95	-2	4	2.5	2	Above						
	cis-1,2-Dichloroethene	<0.05	<0.05	No Trend	37.5	1.20	0	4	2.5	15	Below						
	Trichloroethene (TCE)	<0.05	0.18	No Trend	37.5	1.26	0	4	2.5	0.4	Above						
	Vinyl Chloride	0.89	0.97	Decreasing	95.8	0.97	-6	4	1.4	0.09	Above	0.594	0.395	0.793	5	7	3
MW-37p1	Arsenic, Dissolved	<0.05	<0.05	Stable	37.5	0.79	0	4	1.37	5	Below						
	Manganese, Dissolved	0.92	0.65	No Trend	37.5	1.12	0	4	1080	50	Above						
	1,1-Dichloroethane	0.56	0.91	Probably Decreasing	92.1	0.78	-7	5	1.04	3	Below						
	1,2-Dichloroethane (EDC)	0.38	0.40	Stable	59.2	0.67	-2	5	0.1	0.3	Below						
	1,2-Dichloropropane	0.72	0.97	Decreasing	95.8	0.68	-8	5	1.08	3	Below						
	1,4-Dichlorobenzene	0.05	<0.05	Stable	75.8	0.69	-4	5	0.25	2	Below						
	Benzene	0.34	0.39	Stable	88.3	0.73	-6	5	0.1	2	Below						
	cis-1,2-Dichloroethene	0.67	0.93	Probably Decreasing	92.1	0.69	-7	5	0.41	15	Below						
	Trichloroethene (TCE)	0.64	0.96	Decreasing	95.8	0.75	-8	5	0.1	0.4	Below						
	Vinyl Chloride	0.35	0.23	No Trend	75.8	0.75	4	5	0.71	0.09	Above						
MW-61p1	Arsenic, Dissolved							1	0.649	5	Below						
	Manganese, Dissolved							1	5.12	50	Below						
	1,1-Dichloroethane							2	0.1	3	Below						
	1,2-Dichloroethane (EDC)							2	0.1	0.3	Below						
	1,2-Dichloropropane							2	0.1	3	Below						
	1,4-Dichlorobenzene							2	0.1	2	Below						
	Benzene							2	0.1	2	Below						
	cis-1,2-Dichloroethene							2	0.1	15	Below						
	Trichloroethene (TCE)							2	0.1	0.4	Below						
	Vinyl Chloride							2	0.01	0.09	Below						
MW-64p1	Arsenic, Dissolved							2	31.3	5	Above						
	Manganese, Dissolved							2	2260	50	Above						
	1,1-Dichloroethane							2	0.85	3	Below						
	1,2-Dichloroethane (EDC)							2	0.1	0.3	Below						
	1,2-Dichloropropane							2	0.36	3	Below						
	1,4-Dichlorobenzene							2	12.4	2	Above						
	Benzene							2	4.95	2	Above						
	cis-1,2-Dichloroethene							2	0.34	15	Below						
	Trichloroethene (TCE)							2	0.1	0.4	Below						
	Vinyl Chloride							2	1.55	0.09	Above						
MW-65p1	Arsenic, Dissolved	0.85	0.62	Increasing	98.5	0.45	15	7	28.4	5	Above						
	Manganese, Dissolved	0.59	0.52	Probably Increasing	93.2	0.27	11	7	7210	50	Above						
	1,1-Dichloroethane	0.18	0.49	No Trend	54.8	0.64	2	8	1.82	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	0.10	No Trend	54.8	1.28	2	8	0.53	0.3	Above						
	1,2-Dichloropropane	<0.05	0.09	No Trend	68.3	1.52	5	8	0.1	3	Below						
	1,4-Dichlorobenzene	0.51	0.56	Decreasing	99.7	0.49	-22	8	11.1	2	Above	0.278	0.082	0.475	6	21	4
	Benzene	0.12	0.12	Probably Increasing	91.1	0.36	12	8	5.74	2	Above						
	cis-1,2-Dichloroethene	<0.05	0.19	No Trend	64.0	1.70	4	8	0.3	15	Below						
	Trichloroethene (TCE)	0.20	0.33	No Trend	76.4	1.51	-7	8	0.1	0.4	Below						
	Vinyl Chloride	<0.05	0.16	No Trend	72.6	0.81	6	8	1.01	0.09	Above						
MW-66p1	Arsenic, Dissolved							2	19.8	5	Above						
	Manganese, Dissolved							2	2430	50	Above						
	1,1-Dichloroethane							2	0.76	3	Below						
	1,2-Dichloroethane (EDC)							2	0.1	0.3	Below						
	1,2-Dichloropropane							2	0.1	3	Below						
	1,4-Dichlorobenzene							2	2.84	2	Above						
	Benzene							2	3.14	2	Above						
	cis-1,2-Dichloroethene							2	0.21	15	Below						
	Trichloroethene (TCE)							2	0.1	0.4	Below						
	Vinyl Chloride							2	1.23	0.09	Above						
MW-67p1	Arsenic, Dissolved							2	29.5	5	Above						
	Manganese, Dissolved							2	6550	50	Above						
	1,1-Dichloroethane							2	1	3	Below						
	1,2-Dichloroethane (EDC)							2	1	0.3	Above						
	1,2-Dichloropropane							2	1	3	Below						
	1,4-Dichlorobenzene							2	9.09	2	Above						
	Benzene							2	2.92	2	Above						
	cis-1,2-Dichloroethene							2	1	15	Below						
	Trichloroethene (TCE)							2	1	0.4	Above						
	Vinyl Chloride							2	0.66	0.09	Above						
MW-68p1	Arsenic, Dissolved	0.43	0.16	Increasing	99.2	0.39	27	10	19.2	5	Above						
	Manganese, Dissolved	0.19	0.17	Probably Increasing	94.6	0.20	19	10	9060	50	Above						
	1,1-Dichloroethane	0.16	0.10	Stable	50.0	0.49	0	13	61.5	3	Above						
	1,2-Dichloroethane (EDC)	0.08	0.26	No Trend	59.7	0.64	5	13	1.86	0.3	Above						
	1,2-Dichloropropane	<0.05	0.21	Increasing	97.1	1.03	32	13	8.76	3	Above						
	1,4-Dichlorobenzene	0.12	0.09	Probably Decreasing	93.0	0.54	-25	13	21.8	2	Above	0.170	-0.118	0.458	14	-20	5
	Benzene	0.09	0.12	Stable	73.2	0.63	-11	13	8.22	2	Above						
	cis-1,2-Dichloroethene	<0.05	0.48	No Trend	78.6	0.86	14	13	2.81	15	Below						
	Trichloroethene (TCE)	<0.05	0.21	No Trend	52.5	0.98	2	13	0.39	0.4	Below						
	Vinyl Chloride	<0.05	0.06	Probably Increasing	93.0	0.92	25	13	4.84	0.09	Above						
MW-69p1	Arsenic, Dissolved	0.37	0.48	No Trend	59.2	0.35	2	5	30.4	5	Above						
	Manganese, Dissolved	0.73	0.61	Decreasing	99.7	0.33	-10	5	3790	50	Above	0.099	-0.008	0.206	44	-527	21
	1,1-Dichloroethane	0.06	0.11	Stable	75.8	0.36	-4	5	968	3	Above						
	1,2-Dichloroethane (EDC)	0.67	0.51	Stable	50.0	0.84	-1	5	50	0.3	Above						
	1,2-Dichloropropane	0.88	0.75	Decreasing	95.8	0.48	-8	5	50	3	Above	0.144	0.030	0.258	20	94	11
	1,4-Dichlorobenzene	0.57	0.54	Probably Increasing	92.1	1.04	7	5	50	2	Above						
	Benzene	0.74	0.69	Stable	50.0	0.60	-1	5	50	2	Above						
	cis-1,2-Dichloroethene	0.77	0.57	No Trend	75.8	1.81	-4	5	298	15	Above						
	Trichloroethene (TCE)	0.24	<0.05	No Trend	50.0	0.93	1	5	50	0.4	Above						
	Vinyl Chloride	0.29	0.51	No Trend	75.8	0.80	4	5	128	0.09	Above						

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Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponantial R^2	trend result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-70p1	Arsenic, Dissolved							2	7.41	5	Above						
	Manganese, Dissolved							2	3910	50	Above						
	1,1-Dichloroethane							2	0.1	3	Below						
	1,2-Dichloroethane (EDC)							2	0.34	0.3	Above						
	1,2-Dichloropropane							2	1.39	3	Below						
	1,4-Dichlorobenzene							2	1.31	2	Below						
	Benzene							2	2.44	2	Above						
	cis-1,2-Dichloroethene							2	0.56	15	Below						
	Trichloroethene (TCE)							2	0.1	0.4	Below						
	Vinyl Chloride							2	1.66	0.09	Above						
MW-83p1	Arsenic, Dissolved	0.73	0.71	Stable	83.3	0.27	-4	4	12.5	5	Above						
	Manganese, Dissolved	0.95	0.90	Decreasing	95.8	0.28	-6	4	3620	50	Above	0.170	0.052	0.289	25	83	15
	1,1-Dichloroethane	0.96	0.94	Decreasing	95.8	0.58	-6	4	195	3	Above	0.360	0.179	0.542	12	23	8
	1,2-Dichloroethane (EDC)	0.09	0.18	Stable	72.9	0.90	-3	4	10	0.3	Above						
	1,2-Dichloropropane	0.64	0.70	Stable	72.9	0.75	-3	4	10	3	Above						
	1,4-Dichlorobenzene	<0.05	<0.05	No Trend	50.0	1.12	1	4	10	2	Above						
	Benzene	0.13	0.27	Stable	72.9	0.86	-3	4	10	2	Above						
	cis-1,2-Dichloroethene	0.91	0.85	Stable	89.6	0.85	-5	4	10	15	Below						
	Trichloroethene (TCE)	<0.05	0.34	No Trend	50.0	1.25	1	4	10	0.4	Above						
	Vinyl Chloride	0.69	0.50	No Trend	83.3	1.61	-4	4	2.53	0.09	Above						
MW-85p1	Arsenic, Dissolved	0.89	0.87	Stable	83.3	0.16	-4	4	4.52	5	Below						
	Manganese, Dissolved	0.94	0.92	Decreasing	95.8	0.17	-6	4	3340	50	Above	0.104	0.039	0.170	40	108	25
	1,1-Dichloroethane	0.75	0.83	No Trend	83.3	1.27	-4	4	25.2	3	Above						
	1,2-Dichloroethane (EDC)	0.64	0.52	No Trend	50.0	1.07	-1	4	1	0.3	Above						
	1,2-Dichloropropane	0.85	0.92	Stable	89.6	0.87	-5	4	1	3	Below						
	1,4-Dichlorobenzene	0.69	0.74	Stable	83.3	0.39	-4	4	2.32	2	Above						
	Benzene	0.84	0.92	Stable	89.6	0.87	-5	4	1	2	Below						
	cis-1,2-Dichloroethene	0.56	0.33	Stable	62.5	0.91	-2	4	1	15	Below						
	Trichloroethene (TCE)	0.54	0.09	No Trend	50.0	1.23	-1	4	1	0.4	Above						
	Vinyl Chloride	0.28	0.07	Stable	62.5	0.62	-2	4	5.14	0.09	Above						
MW-90p1	Arsenic, Dissolved							1	11.2	5	Above						
	Manganese, Dissolved							1	4790	50	Above						
	1,1-Dichloroethane							1	8.1	3	Above						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.99	3	Below						
	1,4-Dichlorobenzene							1	2.52	2	Above						
	Benzene							1	1.53	2	Below						
	cis-1,2-Dichloroethene							1	0.78	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.8	0.09	Above						
MW-92p1	Arsenic, Dissolved	0.93	0.93	Stable	83.3	0.15	-4	4	8.26	5	Above						
	Manganese, Dissolved	0.78	0.78	Stable	83.3	0.14	-4	4	4630	50	Above						
	1,1-Dichloroethane	0.12	<0.05	No Trend	62.5	1.14	2	4	390	3	Above						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.61	0	4	7.87	0.3	Above						
	1,2-Dichloropropane	0.10	<0.05	No Trend	62.5	0.77	2	4	12.8	3	Above						
	1,4-Dichlorobenzene	0.20	0.30	Stable	62.5	0.71	-2	4	2.97	2	Above						
	Benzene	<0.05	<0.05	Stable	37.5	0.56	0	4	7.21	2	Above						
	cis-1,2-Dichloroethene	0.24	0.15	Stable	83.3	0.58	-4	4	8.69	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	No Trend	50.0	0.72	1	4	10	0.4	Above						
	Vinyl Chloride	0.18	<0.05	No Trend	62.5	1.31	2	4	261	0.09	Above						
MW-95p1	Arsenic, Dissolved	0.78	0.78	Stable	83.3	0.08	-4	4	17.2	5	Above						
	Manganese, Dissolved	0.91	0.89	Decreasing	95.8	0.32	-6	4	3900	50	Above	0.187	0.050	0.325	23	88	13
	1,1-Dichloroethane	0.90	0.76	Stable	83.3	0.90	-4	4	7.64	3	Above						
	1,2-Dichloroethane (EDC)	0.79	0.84	No Trend	83.3	1.26	-4	4	0.32	0.3	Above						
	1,2-Dichloropropane	0.82	0.85	No Trend	83.3	1.38	-4	4	0.94	3	Below						
	1,4-Dichlorobenzene	0.69	0.55	Stable	83.3	0.68	-4	4	9.36	2	Above						
	Benzene	0.82	0.67	Stable	83.3	0.71	-4	4	1.45	2	Below						
	cis-1,2-Dichloroethene	0.74	0.73	No Trend	83.3	1.26	-4	4	0.75	15	Below						
	Trichloroethene (TCE)	0.90	0.94	No Trend	89.6	1.03	-5	4	0.1	0.4	Below						
	Vinyl Chloride	0.78	0.84	No Trend	83.3	1.31	-4	4	1.01	0.09	Above						
MW-98p1	1,1-Dichloroethane							1	1.31	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.21	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	1.23	15	Below						
	Trichloroethene (TCE)							1	0.32	0.4	Below						
	Vinyl Chloride							1	0.28	0.09	Above						

Notes:

S: Mann-Kendall test statistics
CF: Confidence factor
COV: Coefficient of variation
C: Concentration
Last C: Last measured concentration
C_{goal}: Target concentration
ks: First order source decay rate (best fit)
ks_{lower}: Lower bound (90%) of first order decay rate
ks_{upper}: Upper bound (90%) of first order decay rate
t(ks): Restoration timeframe based on best fit (ks)
t(ks_{lower}): Lower bound (90%) restoration timeframe
t(ks_{upper}): Upper bound (90%) restoration timeframe
R^2: Coefficient of determination (goodness of fit)

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Table 12. Results of Mann-Kendall Test and Regression Analysis for IHSs in P2 Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponantial R^2	trend result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-101p2	Arsenic, Dissolved	0.23	0.27	Stable	62.5	0.20	-2	4	3.28	5	Below						
	Manganese, Dissolved	0.71	0.70	No Trend	83.3	0.37	4	4	3390	50	Above						
	1,1-Dichloroethane	0.82	0.78	Stable	83.3	0.80	-4	4	288	3	Above						
	1,2-Dichloroethane (EDC)	0.83	0.94	Decreasing	95.8	1.32	-6	4	2.34	0.3	Above	0.779	0.390	1.168	3	5	2
	1,2-Dichloropropane	0.89	0.98	Decreasing	95.8	0.85	-6	4	25.8	3	Above	0.476	0.342	0.610	5	6	4
	1,4-Dichlorobenzene	0.06	<0.05	Stable	37.5	0.69	0	4	1	2	Below						
	Benzene	0.53	0.37	Stable	62.5	0.69	-2	4	7.41	2	Above						
	cis-1,2-Dichloroethene	0.71	0.77	No Trend	83.3	1.85	-4	4	1	15	Below						
	Trichloroethene (TCE)	0.69	0.62	No Trend	83.3	1.18	-4	4	1	0.4	Above						
	Vinyl Chloride	0.72	0.76	No Trend	83.3	1.72	-4	4	1.13	0.09	Above						
MW-107p2	Arsenic, Dissolved	0.32	0.54	Stable	83.3	0.80	-4	4	3.31	5	Below						
	Manganese, Dissolved	0.87	0.96	Increasing	95.8	0.61	6	4	7720	50	Above						
	1,1-Dichloroethane	0.47	0.69	No Trend	83.3	1.05	-4	4	17.5	3	Above						
	1,2-Dichloroethane (EDC)	0.64	0.40	No Trend	50.0	1.33	-1	4	1	0.3	Above						
	1,2-Dichloropropane	0.74	0.94	Decreasing	95.8	1.81	-6	4	1	3	Below						
	1,4-Dichlorobenzene	0.18	0.07	No Trend	83.3	0.66	4	4	6.43	2	Above						
	Benzene	0.06	<0.05	Stable	62.5	0.71	-2	4	18.8	2	Above						
	cis-1,2-Dichloroethene	0.92	0.90	No Trend	89.6	1.23	-5	4	1	15	Below						
	Trichloroethene (TCE)	0.92	0.89	Stable	89.6	0.41	-5	4	1	0.4	Above						
	Vinyl Chloride	0.98	0.97	Decreasing	95.8	0.84	-6	4	3.2	0.09	Above	0.589	0.361	0.817	6	10	4
MW-108p2	Arsenic, Dissolved							1	5.5	5	Above						
	Manganese, Dissolved							1	1480	50	Above						
	1,1-Dichloroethane							1	18.2	3	Above						
	1,2-Dichloroethane (EDC)							1	2.28	0.3	Above						
	1,2-Dichloropropane							1	15.2	3	Above						
	1,4-Dichlorobenzene							1	1.04	2	Below						
	Benzene							1	0.89	2	Below						
	cis-1,2-Dichloroethene							1	4.17	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	5.04	0.09	Above						
MW-112p2	Arsenic, Dissolved							1	18	5	Above						
	Manganese, Dissolved							1	2400	50	Above						
	1,1-Dichloroethane							1	16.9	3	Above						
	1,2-Dichloroethane (EDC)							1	1.04	0.3	Above						
	1,2-Dichloropropane							1	5.15	3	Above						
	1,4-Dichlorobenzene							1	2.04	2	Above						
	Benzene							1	3.88	2	Above						
	cis-1,2-Dichloroethene							1	0.98	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	2.87	0.09	Above						
MW-113p2	Arsenic, Dissolved	0.35	0.15	Stable	62.5	0.57	-2	4	6.29	5	Above						
	Manganese, Dissolved	0.13	<0.05	No Trend	83.3	0.68	4	4	12200	50	Above						
	1,1-Dichloroethane	0.40	<0.05	No Trend	37.5	1.59	0	4	219	3	Above						
	1,2-Dichloroethane (EDC)	0.45	0.19	No Trend	37.5	1.55	0	4	10	0.3	Above						
	1,2-Dichloropropane	0.06	<0.05	Stable	37.5	0.86	0	4	11.2	3	Above						
	1,4-Dichlorobenzene	<0.05	<0.05	No Trend	62.5	0.69	2	4	24.8	2	Above						
	Benzene	0.12	<0.05	Stable	37.5	0.80	0	4	9.96	2	Above						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	37.5	0.93	0	4	1	15	Below						
	Trichloroethene (TCE)	0.49	0.30	No Trend	37.5	1.84	0	4	10	0.4	Above						
	Vinyl Chloride	0.44	0.14	No Trend	62.5	1.64	2	4	25.4	0.09	Above						
MW-114p2	Arsenic, Dissolved	0.50	0.48	No Trend	83.3	0.58	4	4	11.3	5	Above						
	Manganese, Dissolved	0.95	0.87	Increasing	95.8	0.47	6	4	11500	50	Above						
	1,1-Dichloroethane	<0.05	<0.05	No Trend	37.5	1.33	0	4	58.6	3	Above						
	1,2-Dichloroethane (EDC)	0.43	<0.05	No Trend	62.5	1.05	-2	4	2.5	0.3	Above						
	1,2-Dichloropropane	0.64	<0.05	No Trend	62.5	1.50	-2	4	8.39	3	Above						
	1,4-Dichlorobenzene	0.99	0.94	Increasing	95.8	0.65	6	4	16.8	2	Above						
	Benzene	0.09	0.08	Stable	37.5	0.67	0	4	12.8	2	Above						
	cis-1,2-Dichloroethene	0.68	0.14	No Trend	62.5	1.74	-2	4	2.5	15	Below						
	Trichloroethene (TCE)	0.59	0.09	No Trend	37.5	1.53	0	4	2.5	0.4	Above						
	Vinyl Chloride	0.41	0.08	No Trend	62.5	1.69	2	4	456	0.09	Above						
MW-115p2	Arsenic, Dissolved	<0.05	0.06	Stable	37.5	0.51	0	4	10.8	5	Above						
	Manganese, Dissolved	0.06	<0.05	No Trend	62.5	1.21	2	4	1730	50	Above						
	1,1-Dichloroethane	0.44	0.08	Stable	62.5	0.94	-2	4	12.1	3	Above						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.64	0	4	0.53	0.3	Above						
	1,2-Dichloropropane	0.12	<0.05	Stable	62.5	0.71	-2	4	8.14	3	Above						
	1,4-Dichlorobenzene	0.56	0.69	No Trend	89.6	1.47	5	4	1.59	2	Below						
	Benzene	<0.05	<0.05	No Trend	62.5	0.78	2	4	0.91	2	Below						
	cis-1,2-Dichloroethene	0.22	0.29	No Trend	62.5	0.70	2	4	1.58	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	No Trend	50.0	1.41	-1	4	0.1	0.4	Below						
	Vinyl Chloride	0.79	0.81	No Trend	83.3	1.03	-4	4	0.212	0.09	Above						
MW-118p2	Arsenic, Dissolved							1	2.06	5	Below						
	Manganese, Dissolved							1	182	50	Above						
	1,1-Dichloroethane							1	13.6	3	Above						
	1,2-Dichloroethane (EDC)							1	1.13	0.3	Above						
	1,2-Dichloropropane							1	13.9	3	Above						
	1,4-Dichlorobenzene							1	0.96	2	Below						
	Benzene							1	0.31	2	Below						
	cis-1,2-Dichloroethene							1	5.79	15	Below						
	Trichloroethene (TCE)							1	0.85	0.4	Above						
	Vinyl Chloride							1	5.29	0.09	Above						
MW-122p2	Arsenic, Dissolved							1	5.02	5	Above						
	Manganese, Dissolved							1	302	50	Above						
	1,1-Dichloroethane							1	38.6	3	Above						
	1,2-Dichloroethane (EDC)							1	7.23	0.3	Above						
	1,2-Dichloropropane							1	68.2	3	Above						
	1,4-Dichlorobenzene							1	1.37	2	Below						
	Benzene							1	2.11	2	Above						
	cis-1,2-Dichloroethene							1	8.7	15	Below						
	Trichloroethene (TCE)							1	0.84	0.4	Above						
	Vinyl Chloride							1	1.03	0.09	Above						

Table 12. Results of Mann-Kendall Test and Regression Analysis for IHSs in P2 Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponantial R^2	trend result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-124p2	Arsenic, Dissolved	0.78	0.89	Decreasing	95.8	1.28	-6	4	3.11	5	Below						
	Manganese, Dissolved	0.49	0.28	Stable	62.5	0.69	-2	4	409	50	Above						
	1,1-Dichloroethane	0.13	0.14	Stable	83.3	0.09	-4	4	2.95	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	0.37	0.40	Stable	83.3	0.11	-4	4	2.92	3	Below						
	1,4-Dichlorobenzene	0.32	0.50	Stable	37.5	0.50	0	4	0.34	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	No Trend	62.5	0.18	2	4	6.62	15	Below						
	Trichloroethene (TCE)	0.31	0.42	No Trend	62.5	0.32	2	4	1.03	0.4	Above						
	Vinyl Chloride	0.81	0.80	No Trend	83.3	0.49	4	4	0.578	0.09	Above						
MW-125p2	Arsenic, Dissolved	0.11	0.15	Stable	37.5	0.23	0	4	8.04	5	Above						
	Manganese, Dissolved	0.87	0.86	Decreasing	95.8	0.14	-6	4	3860	50	Above	0.081	0.015	0.147	54	294	30
	1,1-Dichloroethane	0.76	0.88	No Trend	83.3	1.54	-4	4	0.28	3	Below						
	1,2-Dichloroethane (EDC)	0.71	0.71	Stable	72.9	0.87	-3	4	0.1	0.3	Below						
	1,2-Dichloropropane	0.78	0.83	No Trend	83.3	1.20	-4	4	0.55	3	Below						
	1,4-Dichlorobenzene	0.89	0.94	Stable	89.6	0.95	-5	4	0.1	2	Below						
	Benzene	0.33	0.35	Stable	72.9	0.09	-3	4	0.37	2	Below						
	cis-1,2-Dichloroethene	0.84	0.83	Decreasing	95.8	0.72	-6	4	0.77	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	0.64	0.73	Stable	83.3	0.60	-4	4	0.686	0.09	Above						
MW-126p2	Arsenic, Dissolved	0.72	0.66	Stable	83.3	0.47	-4	4	5.81	5	Above						
	Manganese, Dissolved	0.88	0.89	Increasing	95.8	0.46	6	4	7830	50	Above						
	1,1-Dichloroethane	0.12	0.14	No Trend	62.5	1.30	2	4	2.5	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	No Trend	62.5	0.68	2	4	2.5	0.3	Above						
	1,2-Dichloropropane	<0.05	<0.05	No Trend	62.5	0.76	2	4	2.5	3	Below						
	1,4-Dichlorobenzene	0.50	0.59	No Trend	83.3	0.26	4	4	9.31	2	Above						
	Benzene	0.68	0.63	Decreasing	95.8	0.31	-6	4	12.1	2	Above	0.187	-0.106	0.480	10	-17	4
	cis-1,2-Dichloroethene	0.21	0.15	No Trend	62.5	0.48	2	4	2.5	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	No Trend	62.5	0.76	2	4	2.5	0.4	Above						
	Vinyl Chloride	0.85	0.91	Stable	83.3	0.79	-4	4	0.564	0.09	Above						
MW-131p2	Arsenic, Dissolved							1	1.47	5	Below						
	Manganese, Dissolved							1	104	50	Above						
	1,1-Dichloroethane							1	2.78	3	Below						
	1,2-Dichloroethane (EDC)							1	0.42	0.3	Above						
	1,2-Dichloropropane							1	3.63	3	Above						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.21	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.0283	0.09	Below						
MW-136p2	Arsenic, Dissolved							1	1.22	5	Below						
	Manganese, Dissolved							1	29.9	50	Below						
	1,1-Dichloroethane							1	1.79	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	4.22	3	Above						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.59	15	Below						
	Trichloroethene (TCE)							1	1.2	0.4	Above						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-138p2	Arsenic, Dissolved	0.83	0.84	No Trend	83.3	0.08	4	4	5.95	5	Above						
	Manganese, Dissolved	0.70	0.68	No Trend	83.3	0.12	4	4	10600	50	Above						
	1,1-Dichloroethane	0.56	0.76	Increasing	95.8	1.69	6	4	68.5	3	Above						
	1,2-Dichloroethane (EDC)	0.93	0.97	Increasing	95.8	0.84	6	4	1.31	0.3	Above						
	1,2-Dichloropropane	0.76	0.95	Increasing	95.8	1.22	6	4	2.81	3	Below						
	1,4-Dichlorobenzene	0.15	0.14	Stable	62.5	0.18	-2	4	15.8	2	Above						
	Benzene	0.88	0.85	Stable	83.3	0.56	-4	4	12.3	2	Above						
	cis-1,2-Dichloroethene	0.91	0.95	Increasing	95.8	0.71	6	4	1.24	15	Below						
	Trichloroethene (TCE)	0.76	0.83	No Trend	89.6	1.22	5	4	2.5	0.4	Above						
	Vinyl Chloride	0.28	0.14	No Trend	62.5	0.89	2	4	4.56	0.09	Above						
MW-141p2	Arsenic, Dissolved							1	8.23	5	Above						
	Manganese, Dissolved							1	58.8	50	Above						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-143p2	Arsenic, Dissolved	0.99	0.95	Decreasing	95.8	0.40	-6	4	1.16	5	Below						
	Manganese, Dissolved	0.66	0.51	No Trend	62.5	1.48	-2	4	2.5	50	Below						
	1,1-Dichloroethane	0.86	0.87	Decreasing	95.8	0.06	-6	4	7.68	3	Above	0.034	0.006	0.061	28	147	15
	1,2-Dichloroethane (EDC)	0.99	0.99	Decreasing	95.8	0.14	-6	4	0.87	0.3	Above	0.084	0.069	0.100	13	15	11
	1,2-Dichloropropane	0.27	0.27	Stable	62.5	0.03	-2	4	13.9	3	Above						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	37.5	0.11	0	4	3.4	15	Below						
	Trichloroethene (TCE)	0.57	0.60	No Trend	62.5	0.23	2	4	1.67	0.4	Above						
	Vinyl Chloride	0.49	0.45	Stable	62.5	0.21	-2	4	0.0351	0.09	Below						
MW-147p2	Arsenic, Dissolved	0.85	0.84	Decreasing	95.8	0.49	-6	4	1.38	5	Below						
	Manganese, Dissolved	0.44	0.73	No Trend	83.3	1.19	-4	4	1.25	50	Below						
	1,1-Dichloroethane	0.71	0.71	Stable	72.9	0.40	-3	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	0.71	0.71	No Trend	72.9	1.02	-3	4	0.01	0.09	Below						

Table 12. Results of Mann-Kendall Test and Regression Analysis for IHSs in P2 Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	trend result	CF (%)	COV	S	# of sample	Last C (μg/L)	CUL (μg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-33p2	Arsenic, Dissolved	<0.05	<0.05	Probably Decreasing	92.5	0.54	-59	24	10.5	5	Above	0.028	-0.023	0.079	27	-32	9
	Manganese, Dissolved	0.80	0.76	Decreasing	100.0	0.38	-235	25	5480	50	Above	0.095	0.076	0.114	50	62	41
	1,1-Dichloroethane	0.34	0.42	Decreasing	100.0	0.92	-171	26	6	3	Above	0.113	0.067	0.159	6	10	4
	1,2-Dichloroethane (EDC)	0.15	0.15	Probably Decreasing	91.8	0.79	-64	26	0.45	0.3	Above	0.061	0.011	0.110	7	37	4
	1,2-Dichloropropane	0.17	0.09	No Trend	66.2	1.80	-20	26	1.42	3	Below						
	1,4-Dichlorobenzene	0.35	0.39	Decreasing	100.0	0.48	-163	26	10	2	Above	0.073	0.041	0.104	22	39	15
	Benzene	0.52	0.87	Decreasing	100.0	1.40	-282	26	1.51	2	Below						
	cis-1,2-Dichloroethene	0.07	<0.05	Stable	66.3	0.78	-20	26	0.67	15	Below						
	Trichloroethene (TCE)	0.20	0.19	Decreasing	96.6	1.20	-84	26	0.38	0.4	Below						
	Vinyl Chloride	0.21	0.18	Decreasing	99.8	1.07	-131	26	1.19	0.09	Above	0.098	0.025	0.172	26	102	15
MW-35p2	Arsenic, Dissolved	0.37	0.47	Decreasing	100.0	0.85	-135	23	1.97	5	Below						
	Manganese, Dissolved	<0.05	<0.05	No Trend	55.9	0.14	7	24	9800	50	Above						
	1,1-Dichloroethane	0.19	0.09	Decreasing	97.5	1.12	-85	25	62.3	3	Above	0.115	-0.012	0.241	26	-254	13
	1,2-Dichloroethane (EDC)	0.30	0.47	Decreasing	100.0	0.85	-163	26	4.91	0.3	Above	0.118	0.074	0.162	24	38	17
	1,2-Dichloropropane	0.23	0.36	Decreasing	99.9	0.81	-137	26	5.1	3	Above	0.118	0.063	0.173	5	8	3
	1,4-Dichlorobenzene	<0.05	0.09	No Trend	82.9	0.36	44	26	14.5	2	Above						
	Benzene	0.69	0.81	Decreasing	100.0	1.11	-244	26	1.74	2	Below						
	cis-1,2-Dichloroethene	<0.05	0.16	Decreasing	99.6	1.45	-115	25	12.6	15	Below						
	Trichloroethene (TCE)	0.16	0.14	Decreasing	97.4	1.33	-89	26	2.29	0.4	Above	0.096	0.013	0.178	18	131	10
	Vinyl Chloride	0.17	0.32	Decreasing	99.9	1.12	-144	26	8.46	0.09	Above	0.140	0.069	0.211	32	66	21
MW-38p2	Arsenic, Dissolved	0.19	0.16	Probably Decreasing	90.3	0.41	-47	22	1.42	5	Below						
	Manganese, Dissolved	<0.05	<0.05	Stable	72.8	0.43	-24	23	1390	50	Above						
	1,1-Dichloroethane	0.52	0.72	Decreasing	100.0	0.91	-231	26	319	3	Above	0.170	0.133	0.206	28	35	23
	1,2-Dichloroethane (EDC)	0.58	0.83	Decreasing	100.0	1.31	-251	26	6.55	0.3	Above	0.352	0.296	0.408	9	10	8
	1,2-Dichloropropane	0.83	0.83	Decreasing	100.0	0.84	-274	26	74.8	3	Above	0.234	0.196	0.271	14	16	12
	1,4-Dichlorobenzene	0.25	0.57	Decreasing	100.0	1.99	-194	26	1	2	Below						
	Benzene	0.57	0.70	Decreasing	100.0	0.91	-204	26	16.7	2	Above	0.166	0.129	0.204	13	17	10
	cis-1,2-Dichloroethene	0.50	0.77	Decreasing	100.0	1.62	-217	25	10.4	15	Below						
	Trichloroethene (TCE)	0.42	0.37	Decreasing	100.0	0.62	-142	25	12	0.4	Above	0.103	0.055	0.152	33	62	22
	Vinyl Chloride	0.65	0.81	Decreasing	100.0	1.25	-232	26	12	0.09	Above	0.377	0.313	0.441	13	16	11
MW-39p2	Arsenic, Dissolved	0.24	0.30	No Trend	50.0	0.28	1	6	2.29	5	Below						
	Manganese, Dissolved	0.94	0.62	No Trend	64.0	1.24	3	6	731	50	Above						
	1,1-Dichloroethane	0.35	0.29	Probably Increasing	93.2	0.32	9	6	0.73	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1	3	Below						
	1,4-Dichlorobenzene	0.56	0.39	Increasing	95.2	0.79	10	6	1.15	2	Below						
	Benzene	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	No Trend	64.0	0.23	3	6	1.64	15	Below						
	Trichloroethene (TCE)	0.25	0.23	Increasing	95.2	0.21	10	6	0.51	0.4	Above						
	Vinyl Chloride	0.10	0.24	Stable	64.0	0.93	-3	6	0.069	0.09	Below						
MW-40p2	Arsenic, Dissolved	0.85	0.93	Decreasing	95.8	0.78	-8	5	0.25	5	Below						
	Manganese, Dissolved	0.12	0.56	No Trend	75.8	1.29	-4	5	3	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	40.8	0.49	0	5	0.1	15	Below						
	Trichloroethene (TCE)	0.73	0.73	No Trend	88.3	1.07	-6	5	0.01	0.4	Below						
	Vinyl Chloride	0.73	0.73	No Trend	88.3	1.07	-6	5	0.01	0.09	Below						
MW-43p2	Arsenic, Dissolved							3	1	5	Below						
	Manganese, Dissolved							3	10	50	Below						
	1,1-Dichloroethane	0.58	0.61	No Trend	62.5	0.40	2	4	11	3	Above						
	1,2-Dichloroethane (EDC)	0.77	0.80	No Trend	72.9	0.45	3	4	2.1	0.3	Above						
	1,2-Dichloropropane	0.59	0.65	No Trend	62.5	0.39	2	4	21	3	Above						
	1,4-Dichlorobenzene	0.14	0.14	Stable	62.5	0.58	-2	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.52	0.53	No Trend	62.5	0.41	2	4	13	15	Below						
	Trichloroethene (TCE)	0.06	0.07	Stable	37.5	0.25	0	4	0.65	0.4	Above						
	Vinyl Chloride	0.23	<0.05	Stable	62.5	0.79	-2	4	0.12	0.09	Above						
MW-46p2	Arsenic, Dissolved	0.44	0.52	Decreasing	95.8	0.50	-15	8	0.3	5	Below						
	Manganese, Dissolved	0.55	0.40	Probably Decreasing	92.9	1.11	-13	8	5	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	2	Below						
	cis-1,2-Dichloroethene	0.41	0.41	Probably Decreasing	91.0	1.13	-14	9	0.01	15	Below						
	Trichloroethene (TCE)	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01	0.4	Below						
	Vinyl Chloride	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01	0.09	Below						
MW-49p2	Arsenic, Dissolved							2	0.9	5	Below						
	Manganese, Dissolved							2	3	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.09	0.09	No Trend	50.0	0.58	1	4	0.1	15	Below						
	Trichloroethene (TCE)	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01	0.4	Below						
	Vinyl Chloride	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01	0.09	Below						
MW-52p2	Arsenic, Dissolved							3	0.4	5	Below						
	Manganese, Dissolved							3	27	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.87	0.87	No Trend	83.3	0.94	4	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.09	Below						

Table 12. Results of Mann-Kendall Test and Regression Analysis for IHSs in P2 Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponantial R^2	trend result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-60p2	Arsenic, Dissolved							2	1.91	5	Below						
	Manganese, Dissolved							2	0.516	50	Below						
	1,1-Dichloroethane							2	0.1	3	Below						
	1,2-Dichloroethane (EDC)							2	0.1	0.3	Below						
	1,2-Dichloropropane							2	0.1	3	Below						
	1,4-Dichlorobenzene							2	0.1	2	Below						
	Benzene							2	0.1	2	Below						
	cis-1,2-Dichloroethene							2	0.1	15	Below						
	Trichloroethene (TCE)							2	0.1	0.4	Below						
	Vinyl Chloride							2	0.01	0.09	Below						
MW-76p2	Arsenic, Dissolved							1	6.38	5	Above						
	Manganese, Dissolved							1	7780	50	Above						
	1,1-Dichloroethane							1	17.6	3	Above						
	1,2-Dichloroethane (EDC)							1	5.7	0.3	Above						
	1,2-Dichloropropane							1	14.1	3	Above						
	1,4-Dichlorobenzene							1	3.92	2	Above						
	Benzene							1	2.11	2	Above						
	cis-1,2-Dichloroethene							1	9.1	15	Below						
	Trichloroethene (TCE)							1	1.66	0.4	Above						
	Vinyl Chloride							1	4.27	0.09	Above						
MW-80p2	Arsenic, Dissolved	<0.05	<0.05	Stable	62.5	0.45	-2	4	7.84	5	Above						
	Manganese, Dissolved	<0.05	<0.05	Stable	37.5	0.40	0	4	4500	50	Above						
	1,1-Dichloroethane	0.97	0.91	Decreasing	95.8	0.77	-6	4	2.35	3	Below						
	1,2-Dichloroethane (EDC)	0.89	0.85	Stable	83.3	0.69	-4	4	0.1	0.3	Below						
	1,2-Dichloropropane	1.00	0.98	Decreasing	95.8	0.59	-6	4	0.49	3	Below						
	1,4-Dichlorobenzene	0.11	0.30	Stable	62.5	0.67	-2	4	0.72	2	Below						
	Benzene	0.94	0.96	Decreasing	95.8	0.64	-6	4	0.32	2	Below						
	cis-1,2-Dichloroethene	0.74	0.73	No Trend	83.3	1.09	-4	4	0.62	15	Below						
	Trichloroethene (TCE)	0.98	0.99	Decreasing	95.8	0.61	-6	4	0.32	0.4	Below						
	Vinyl Chloride	0.50	0.56	Stable	83.3	0.54	-4	4	2.73	0.09	Above						
MW-87p2	Arsenic, Dissolved	0.29	0.24	Stable	62.5	0.25	-2	4	12.9	5	Above						
	Manganese, Dissolved	0.16	0.16	Stable	83.3	0.02	-4	4	7640	50	Above						
	1,1-Dichloroethane	0.21	0.10	Stable	62.5	0.67	-2	4	8.85	3	Above						
	1,2-Dichloroethane (EDC)	0.28	0.11	No Trend	50.0	0.69	1	4	2.5	0.3	Above						
	1,2-Dichloropropane	0.52	0.54	No Trend	89.6	0.54	5	4	2.5	3	Below						
	1,4-Dichlorobenzene	0.39	0.38	Stable	72.9	0.11	-3	4	18.7	2	Above						
	Benzene	0.92	0.85	Decreasing	95.8	0.43	-6	4	2.5	2	Above	0.285	0.036	0.534	1	6	0
	cis-1,2-Dichloroethene	0.28	0.11	No Trend	50.0	0.69	1	4	2.5	15	Below						
	Trichloroethene (TCE)	0.28	0.11	No Trend	50.0	0.69	1	4	2.5	0.4	Above						
	Vinyl Chloride	0.12	0.16	Stable	62.5	0.31	-2	4	1.84	0.09	Above						
MW-88p2	Arsenic, Dissolved							1	5.45	5	Above						
	Manganese, Dissolved							1	2040	50	Above						
	1,1-Dichloroethane							1	9.9	3	Above						
	1,2-Dichloroethane (EDC)							1	0.65	0.3	Above						
	1,2-Dichloropropane							1	1.62	3	Below						
	1,4-Dichlorobenzene							1	1.14	2	Below						
	Benzene							1	0.94	2	Below						
	cis-1,2-Dichloroethene							1	0.48	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	1.34	0.09	Above						
MW-91p2	Arsenic, Dissolved	<0.05	<0.05	Stable	37.5	0.14	0	4	12.2	5	Above						
	Manganese, Dissolved	0.89	0.89	Stable	83.3	0.15	-4	4	6900	50	Above						
	1,1-Dichloroethane	0.71	0.67	No Trend	62.5	1.54	-2	4	37.7	3	Above						
	1,2-Dichloroethane (EDC)	0.77	0.77	Stable	83.3	0.77	-4	4	1	0.3	Above						
	1,2-Dichloropropane	0.74	0.60	No Trend	83.3	1.25	-4	4	3.66	3	Above						
	1,4-Dichlorobenzene	<0.05	<0.05	No Trend	62.5	0.49	2	4	13.8	2	Above						
	Benzene	0.98	0.96	Decreasing	95.8	0.62	-6	4	5.35	2	Above	0.397	0.225	0.569	2	4	2
	cis-1,2-Dichloroethene	0.47	0.25	Stable	62.5	0.84	-2	4	7.22	15	Below						
	Trichloroethene (TCE)	0.77	0.77	Stable	83.3	0.77	-4	4	1	0.4	Above						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.70	0	4	19.3	0.09	Above						
MW-94p2	Arsenic, Dissolved							1	11.5	5	Above						
	Manganese, Dissolved							1	1640	50	Above						
	1,1-Dichloroethane							1	83.8	3	Above						
	1,2-Dichloroethane (EDC)							1	11.2	0.3	Above						
	1,2-Dichloropropane							1	186	3	Above						
	1,4-Dichlorobenzene							1	2.05	2	Above						
	Benzene							1	8.55	2	Above						
	cis-1,2-Dichloroethene							1	16.4	15	Above						
	Trichloroethene (TCE)							1	3.28	0.4	Above						
	Vinyl Chloride							1	68.2	0.09	Above						
MW-99p2	Arsenic, Dissolved	0.62	0.55	Stable	37.5	0.64	0	4	6.26	5	Above						
	Manganese, Dissolved	0.76	0.83	No Trend	83.3	0.34	4	4	7400	50	Above						
	1,1-Dichloroethane	0.24	0.36	Stable	62.5	0.74	-2	4	30.5	3	Above						
	1,2-Dichloroethane (EDC)	0.42	0.41	Stable	83.3	0.67	-4	4	0.86	0.3	Above						
	1,2-Dichloropropane	0.35	0.26	Stable	62.5	0.70	-2	4	10.6	3	Above						
	1,4-Dichlorobenzene	0.40	0.30	No Trend	62.5	0.51	2	4	5.63	2	Above						
	Benzene	<0.05	<0.05	No Trend	62.5	0.39	2	4	17.5	2	Above						
	cis-1,2-Dichloroethene	0.17	0.17	Stable	37.5	0.68	0	4	2.68	15	Below						
	Trichloroethene (TCE)	<0.05	0.12	Stable	62.5	0.59	-2	4	1.17	0.4	Above						
	Vinyl Chloride	0.97	0.96	Decreasing	95.8	0.57	-6	4	3.61	0.09	Above	0.360	0.202	0.517	10	18	7

Notes:

S: Mann-Kendall test statistics
CF: Confidence factor
COV: Coefficient of variation
C: Concentration
Last C: Last measured concentration
C_{goal}: Target concentration
CUL: Clean-up level
ks: First order source decay rate (best fit)
ks_{lower}: Lower bound (90%) of first order decay rate
ks_{upper}: Upper bound (90%) of first order decay rate
t(ks): Restoration timeframe based on best fit (ks)
t(ks_{lower}): Lower bound (90%) restoration timeframe
t(ks_{upper}): Upper bound (90%) restoration timeframe
R^2: Coefficient of determination (goodness of fit)

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Table 13. Results of Mann-Kendall Test and Regression Analysis for IHSs in Roza Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-102b	Arsenic, Dissolved	<0.05	<0.05	Stable	37.5	0.37	0	4	2.4	5	Below						
	Manganese, Dissolved	0.74	0.88	No Trend	89.6	1.62	-5	4	3.98	50	Below						
	1,1-Dichloroethane	0.92	0.83	Increasing	95.8	0.51	6	4	27.8	3	Above						
	1,2-Dichloroethane (EDC)	1.00	0.96	Increasing	95.8	0.41	6	4	2.49	0.3	Above						
	1,2-Dichloropropane	0.96	0.91	Increasing	95.8	0.39	6	4	34.7	3	Above						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	0.39	0.43	Stable	37.5	0.33	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.89	0.83	Increasing	95.8	0.38	6	4	16	15	Above						
	Trichloroethene (TCE)	0.84	0.78	Increasing	95.8	0.46	6	4	15.7	0.4	Above						
	Vinyl Chloride	0.60	0.90	Increasing	95.8	1.51	6	4	4.13	0.09	Above						
MW-103b	Manganese, Dissolved	0.07	<0.05	Stable	76.5	0.30	-17	16	7960	50	Above						
	1,1-Dichloroethane	0.27	0.31	Decreasing	98.5	0.36	-49	16	1.08	3	Below						
	1,2-Dichloroethane (EDC)	0.24	0.28	Decreasing	97.6	0.34	-45	16	0.1	0.3	Below						
	1,2-Dichloropropane	0.13	0.15	Decreasing	95.2	0.31	-38	16	1.88	3	Below						
	1,4-Dichlorobenzene	0.08	0.13	Stable	72.1	0.36	-14	16	0.43	2	Below						
	Benzene	<0.05	<0.05	No Trend	57.2	0.28	5	16	0.31	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	69.0	0.32	-12	16	6.45	15	Below						
	Trichloroethene (TCE)	0.13	0.18	Probably Increasing	93.7	0.50	34	16	0.25	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	67.4	0.20	-11	16	5.98	0.09	Above						
MW-105b	Arsenic, Dissolved							1	1.76	5	Below						
	Manganese, Dissolved							1	57.6	50	Above						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.0271	0.09	Below						
MW-116b	Arsenic, Dissolved							1	6.17	5	Above						
	Manganese, Dissolved							1	281	50	Above						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.0275	0.09	Below						
MW-121b	Arsenic, Dissolved							1	1.91	5	Below						
	Manganese, Dissolved							1	34.4	50	Below						
	1,1-Dichloroethane							1	0.22	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.36	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.21	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-128b	Arsenic, Dissolved							1	2.02	5	Below						
	Manganese, Dissolved							1	28.2	50	Below						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-130b	Arsenic, Dissolved							1	1.99	5	Below						
	Manganese, Dissolved							1	34.4	50	Below						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-132b	Arsenic, Dissolved							1	2.11	5	Below						
	Manganese, Dissolved							1	71.5	50	Above						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-133b	Arsenic, Dissolved	0.35	0.21	Stable	62.5	0.73	-2	4	4.58	5	Below						
	Manganese, Dissolved	0.29	0.20	Stable	37.5	0.53	0	4	7680	50	Above						
	1,1-Dichloroethane	0.51	0.50	No Trend	62.5	1.59	2	4	113	3	Above						
	1,2-Dichloroethane (EDC)	0.49	0.45	No Trend	62.5	0.77	2	4	2.11	0.3	Above						
	1,2-Dichloropropane	0.11	0.22	No Trend	62.5	0.49	2	4	6.95	3	Above						
	1,4-Dichlorobenzene	0.47	0.32	No Trend	37.5	1.64	0	4	11.4	2	Above						
	Benzene	0.45	0.25	No Trend	37.5	1.51	0	4	5.44	2	Above						
	cis-1,2-Dichloroethene	0.22	0.28	No Trend	62.5	0.36	2	4	3.87	15	Below						
	Trichloroethene (TCE)	0.38	0.32	No Trend	72.9	0.62	3	4	0.36	0.4	Below						
	Vinyl Chloride	0.43	0.21	No Trend	37.5	1.46	0	4	5.99	0.09	Above						
MW-135b	Arsenic, Dissolved							1	2.53	5	Below						
	Manganese, Dissolved							1	103	50	Above						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-139b	Arsenic, Dissolved							1	2.69	5	Below						
	Manganese, Dissolved							1	102	50	Above						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						

Table 13. Results of Mann-Kendall Test and Regression Analysis for IHSs in Roza Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-140b	Arsenic, Dissolved	0.79	0.77	Stable	83.3	0.56	-4	4	0.662	5	Below						
	Manganese, Dissolved	0.67	0.57	No Trend	37.5	1.34	0	4	11.9	50	Below						
	1,1-Dichloroethane	0.90	0.86	Increasing	95.8	0.29	6	4	1.7	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	No Trend	50.0	0.43	1	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.09	Below						
MW-142b	Arsenic, Dissolved	0.45	0.48	Stable	83.3	0.14	-4	4	0.958	5	Below						
	Manganese, Dissolved	0.96	0.94	Decreasing	95.8	1.04	-6	4	2.5	50	Below						
	1,1-Dichloroethane	0.47	0.48	Stable	62.5	0.12	-2	4	33.6	3	Above						
	1,2-Dichloroethane (EDC)	0.29	0.28	Stable	62.5	0.10	-2	4	2.5	0.3	Above						
	1,2-Dichloropropane	0.74	0.72	Stable	83.3	0.12	-4	4	31.3	3	Above						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.76	0.73	Stable	83.3	0.12	-4	4	3.4	15	Below						
	Trichloroethene (TCE)	0.51	0.51	Stable	72.9	0.06	-3	4	0.7	0.4	Above						
	Vinyl Chloride	<0.05	<0.05	Stable	62.5	0.04	-2	4	0.0321	0.09	Below						
MW-144b	Arsenic, Dissolved	0.40	0.39	No Trend	62.5	0.12	2	4	2.76	5	Below						
	Manganese, Dissolved	0.68	0.64	Stable	83.3	0.21	-4	4	6630	50	Above						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.25	0	4	10.2	3	Above						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.17	0	4	0.61	0.3	Above						
	1,2-Dichloropropane	<0.05	<0.05	No Trend	50.0	0.39	1	4	2.17	3	Below						
	1,4-Dichlorobenzene	0.47	0.41	No Trend	37.5	1.11	0	4	9.38	2	Above						
	Benzene	0.42	0.28	No Trend	37.5	1.03	0	4	5.73	2	Above						
	cis-1,2-Dichloroethene	0.26	0.40	Stable	62.5	0.64	-2	4	1.4	15	Below						
	Trichloroethene (TCE)	0.51	0.51	No Trend	72.9	1.00	3	4	0.5	0.4	Above						
	Vinyl Chloride	0.46	0.58	Stable	83.3	0.46	-4	4	1.57	0.09	Above						
MW-145b	Arsenic, Dissolved	0.96	0.99	Decreasing	95.8	0.47	-6	4	1.18	5	Below						
	Manganese, Dissolved	0.72	0.77	No Trend	83.3	1.80	-4	4	2.5	50	Below						
	1,1-Dichloroethane	0.81	0.80	No Trend	89.6	0.46	5	4	0.24	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	No Trend	50.0	0.47	1	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.09	Below						
MW-146b	Arsenic, Dissolved	<0.05	<0.05	No Trend	62.5	0.08	2	4	2.32	5	Below						
	Manganese, Dissolved	0.99	0.99	Increasing	95.8	0.39	6	4	2750	50	Above						
	1,1-Dichloroethane	0.27	0.25	Stable	83.3	0.12	-4	4	10	3	Above						
	1,2-Dichloroethane (EDC)	0.87	0.94	Increasing	95.8	0.32	6	4	0.55	0.3	Above						
	1,2-Dichloropropane	0.86	0.95	Increasing	95.8	0.44	6	4	3.38	3	Above						
	1,4-Dichlorobenzene	0.55	0.64	No Trend	83.3	1.12	4	4	1.91	2	Below						
	Benzene	0.51	0.51	No Trend	72.9	1.27	3	4	0.79	2	Below						
	cis-1,2-Dichloroethene	0.98	0.99	Increasing	95.8	0.39	6	4	3.36	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	0.89	0.94	Increasing	95.8	0.70	6	4	2.33	0.09	Above						
MW-148b	Arsenic, Dissolved	0.79	0.80	Stable	83.3	0.24	-4	4	1.27	5	Below						
	Manganese, Dissolved	0.91	0.88	Decreasing	95.8	0.46	-6	4	5.48	50	Below						
	1,1-Dichloroethane	0.39	0.38	Stable	83.3	0.07	-4	4	80.9	3	Above						
	1,2-Dichloroethane (EDC)	0.33	0.31	Stable	62.5	0.11	-2	4	7.37	0.3	Above						
	1,2-Dichloropropane	0.22	0.22	Stable	62.5	0.09	-2	4	113	3	Above						
	1,4-Dichlorobenzene	0.52	0.34	No Trend	72.9	0.59	3	4	0.5	2	Below						
	Benzene	0.38	0.22	No Trend	72.9	0.55	3	4	0.5	2	Below						
	cis-1,2-Dichloroethene	0.91	0.92	Decreasing	95.8	0.11	-6	4	21.5	15	Above	0.061	0.025	0.097	6	14	4
	Trichloroethene (TCE)	0.43	0.40	No Trend	72.9	0.12	3	4	0.5	0.4	Above						
	Vinyl Chloride	0.09	<0.05	Stable	62.5	0.25	-2	4	0.325	0.09	Above						
MW-149b	Arsenic, Dissolved							3	1.45	5	Below						
	Manganese, Dissolved							3	2.5	50	Below						
	1,1-Dichloroethane							3	19.1	3	Above						
	1,2-Dichloroethane (EDC)							3	2.35	0.3	Above						
	1,2-Dichloropropane							3	29.4	3	Above						
	1,4-Dichlorobenzene							3	0.1	2	Below						
	Benzene							3	0.1	2	Below						
	cis-1,2-Dichloroethene							3	9.12	15	Below						
	Trichloroethene (TCE)							3	0.3	0.4	Below						
	Vinyl Chloride							3	0.615	0.09	Above						
MW-150b	Arsenic, Dissolved							3	0.672	5	Below						
	Manganese, Dissolved							3	59.8	50	Above						
	1,1-Dichloroethane							3	1.52	3	Below						
	1,2-Dichloroethane (EDC)							3	0.1	0.3	Below						
	1,2-Dichloropropane							3	0.1	3	Below						
	1,4-Dichlorobenzene							3	0.1	2	Below						
	Benzene							3	0.1	2	Below						
	cis-1,2-Dichloroethene							3	0.1	15	Below						
	Trichloroethene (TCE)							3	0.1	0.4	Below						
	Vinyl Chloride							3	0.01	0.09	Below						
MW-151b	Arsenic, Dissolved	0.90	0.89	Decreasing	95.8	0.17	-6	4	1.23	5	Below						
	Manganese, Dissolved	0.55	0.41	Stable	62.5	0.84	-2	4	6.21	50	Below						
	1,1-Dichloroethane	0.89	0.95	Decreasing	95.8	0.57	-6	4	3.62	3	Above	0.304	0.157	0.452	1	1	0
	1,2-Dichloroethane (EDC)	0.71	0.71	Stable	72.9	0.52	-3	4	0.1	0.3	Below						
	1,2-Dichloropropane	0.78	0.77	Stable	83.3	0.49	-4	4	0.49	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.85	0.80	Stable	83.3	0.37	-4	4	0.53	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	0.76	0.58	No Trend	83.3	1.06	-4	4	0.0341	0.09	Below						
MW-19b	Arsenic, Dissolved	<0.05	<0.05	No Trend	69.8	0.70	11	17	0.3	5	Below						
	Manganese, Dissolved	0.13	0.16	Probably Decreasing	93.1	0.95	-28	14	43	50	Below						
	1,1-Dichloroethane	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1	3	Below						
	1,2-Dichloroethane (EDC)	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1	0.3	Below						
	1,2-Dichloropropane	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1	3	Below						
	1,4-Dichlorobenzene	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1	2	Below						
	Benzene	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1	2	Below						
	cis-1,2-Dichloroethene	0.11	0.11	Probably Increasing	92.0	0.21	18	21	0.1	15	Below						
	Trichloroethene (TCE)	0.25	0.25	Increasing	98.6	0.36	47	22	0.1	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	57.3	0.54	-6	22	0.01	0.09	Below						
MW-29b	Arsenic, Dissolved	0.17	0.16	Stable	62.5	0.72	-2	4	0.561	5	Below						
	Manganese, Dissolved	0.83	0.76	No Trend	83.3	0.30	4	4	1710	50	Above						
	1,1-Dichloroethane	0.76	0.85	Stable	88.3	0.31	-6	5	32.1	3	Above						
	1,2-Dichloroethane (EDC)	0.86	0.96	Probably Decreasing	92.1	0.42	-7	5	1.94	0.3	Above	0.122	0.087	0.157	15	21	12
	1,2-Dichloropropane	0.68	0.87	Decreasing	95.8	0.50	-8	5	26.1	3	Above	0.128	0.060	0.195	17	36	11
	1,4-Dichlorobenzene	0.36	0.29	Increasing	95.8	0.63	8	5	4.4	2	Above						
	Benzene	0.06	<0.05	No Trend	75.8	0.81	4	5	1.06	2	Below						
	cis-1,2-Dichloroethene	0.86	0.95	Decreasing	95.8	0.37	-8	5	8.2	15	Below						
	Trichloroethene (TCE)	0.72	0.90	Decreasing	97.8	0.48	-9	5	0.7	0.4	Above	0.128	0.070	0.185	4	8	3
	Vinyl Chloride	0.13	0.20	No Trend	59.2	0.53	2	5	11.3	0.09	Above						

MOTT MACDONALD

Table 13. Results of Mann-Kendall Test and Regression Analysis for IHSs in Roza Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-30b	Arsenic, Dissolved							3	0.6	5	Below						
	Manganese, Dissolved							3	158	50	Above						
	1,1-Dichloroethane	0.51	0.32	Stable	40.8	0.60	0	5	6.8	3	Above						
	1,2-Dichloroethane (EDC)	<0.05	0.10	No Trend	50.0	0.82	1	5	0.28	0.3	Below						
	1,2-Dichloropropane	0.96	0.74	No Trend	50.0	1.78	1	5	4.54	3	Above						
	1,4-Dichlorobenzene	<0.05	0.07	No Trend	50.0	0.83	1	5	0.25	2	Below						
	Benzene	0.16	0.21	Stable	82.1	0.87	-5	5	0.1	2	Below						
	cis-1,2-Dichloroethene	0.77	0.61	No Trend	59.2	0.67	2	5	1.82	15	Below						
	Trichloroethene (TCE)	0.19	0.12	Stable	59.2	0.79	-2	5	0.51	0.4	Above						
	Vinyl Chloride	0.13	0.05	No Trend	88.3	1.78	-6	5	0.114	0.09	Above						
MW-31b	Arsenic, Dissolved	0.81	0.93	Stable	83.3	0.48	-4	4	0.1	5	Below						
	Manganese, Dissolved	0.06	0.06	Stable	50.0	0.04	-1	4	88.6	50	Above						
	1,1-Dichloroethane	0.54	0.25	Increasing	95.8	0.66	8	5	2.79	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	No Trend	50.0	0.85	1	5	0.22	0.3	Below						
	1,2-Dichloropropane	0.86	0.61	No Trend	67.5	1.27	3	5	1.37	3	Below						
	1,4-Dichlorobenzene	0.09	0.09	Stable	59.2	0.99	-2	5	0.1	2	Below						
	Benzene	0.09	0.09	Stable	59.2	0.99	-2	5	0.1	2	Below						
	cis-1,2-Dichloroethene	0.31	0.29	No Trend	75.8	1.05	4	5	0.48	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	No Trend	59.2	0.91	2	5	0.1	0.4	Below						
	Vinyl Chloride	0.11	<0.05	No Trend	75.8	0.80	4	5	1.32	0.09	Above						
MW-3b	Arsenic, Dissolved	0.25	0.28	Increasing	99.8	0.56	174	31	3.5	5	Below						
	Manganese, Dissolved	0.57	0.54	Decreasing	100.0	0.18	-335	34	15000	50	Above	0.058	0.042	0.074	98	137	77
	1,1-Dichloroethane	0.66	0.71	Decreasing	100.0	0.42	-469	38	4.58	3	Above	0.115	0.095	0.136	4	4	3
	1,2-Dichloroethane (EDC)	0.44	0.31	Decreasing	100.0	0.34	-386	38	0.72	0.3	Above	0.068	0.039	0.097	13	22	9
	1,2-Dichloropropane	0.33	0.32	Decreasing	100.0	0.20	-298	38	6.44	3	Above	0.040	0.023	0.056	19	33	14
	1,4-Dichlorobenzene	0.54	0.59	Decreasing	100.0	0.36	-425	38	1.25	2	Below						
	Benzene	0.39	0.72	Decreasing	100.0	0.99	-594	38	0.77	2	Below						
	cis-1,2-Dichloroethene	0.16	0.14	Decreasing	100.0	0.44	-266	38	19.7	15	Above	0.047	0.014	0.079	6	19	3
	Trichloroethene (TCE)	0.23	0.33	Decreasing	100.0	0.74	-299	39	0.41	0.4	Above	0.106	0.065	0.148	0	0	0
	Vinyl Chloride	0.45	0.49	Decreasing	100.0	0.36	-345	36	12.8	0.09	Above	0.088	0.062	0.114	56	80	43
MW-42b	Arsenic, Dissolved	0.11	0.13	Increasing	96.6	0.17	70	23	1.93	5	Below						
	Manganese, Dissolved	0.57	0.53	Decreasing	100.0	0.37	-152	24	969	50	Above	0.082	0.054	0.110	36	55	27
	1,1-Dichloroethane	0.89	0.88	Decreasing	100.0	0.50	-217	24	11.5	3	Above	0.138	0.120	0.156	10	11	9
	1,2-Dichloroethane (EDC)	0.89	0.96	Decreasing	100.0	0.72	-247	24	0.62	0.3	Above	0.196	0.181	0.211	4	4	3
	1,2-Dichloropropane	0.87	0.85	Decreasing	100.0	0.46	-218	24	5.9	3	Above	0.129	0.110	0.149	5	6	5
	1,4-Dichlorobenzene	0.74	0.91	Decreasing	100.0	0.92	-232	24	0.4	2	Below						
	Benzene	0.38	0.72	Decreasing	100.0	1.44	-186	24	0.1	2	Below						
	cis-1,2-Dichloroethene	0.74	0.75	Decreasing	100.0	0.38	-198	24	13	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	84.0	0.31	-41	24	1.92	0.4	Above						
	Vinyl Chloride	0.80	0.79	Decreasing	100.0	0.64	-196	24	2.04	0.09	Above	0.158	0.128	0.187	20	24	17
MW-44b	Arsenic, Dissolved	<0.05	<0.05	No Trend	55.4	0.18	4	16	4.43	5	Below						
	Manganese, Dissolved	<0.05	<0.05	No Trend	51.8	0.18	2	16	2900	50	Above						
	1,1-Dichloroethane	0.30	0.35	Decreasing	97.6	0.38	-45	16	32.6	3	Above	0.050	0.018	0.082	48	135	29
	1,2-Dichloroethane (EDC)	0.56	0.65	Decreasing	99.1	0.46	-54	16	1.58	0.3	Above	0.088	0.057	0.119	19	29	14
	1,2-Dichloropropane	0.59	0.74	Decreasing	99.8	0.58	-65	16	11.3	3	Above	0.117	0.084	0.150	11	16	9
	1,4-Dichlorobenzene	<0.05	<0.05	Probably Decreasing	92.5	0.26	-33	16	5.66	2	Above	0.006	-0.019	0.031	172	-55	33
	Benzene	0.78	0.84	Decreasing	100.0	0.77	-109	16	1.67	2	Below						
	cis-1,2-Dichloroethene	0.33	0.39	Decreasing	98.6	0.43	-50	16	4.85	15	Below						
	Trichloroethene (TCE)	0.38	0.49	Increasing	98.5	1.22	48	16	0.5	0.4	Above						
	Vinyl Chloride	0.07	0.07	No Trend	55.4	0.39	4	16	2.15	0.09	Above						
MW-48b	Arsenic, Dissolved	0.25	0.24	Stable	89.0	0.15	-13	9	1.5	5	Below						
	Manganese, Dissolved	0.34	0.22	No Trend	89.0	1.32	-13	9	4	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	2	Below						
	cis-1,2-Dichloroethene	0.41	0.41	Probably Decreasing	91.0	1.13	-14	9	0.01	15	Below						
	Trichloroethene (TCE)	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01	0.4	Below						
	Vinyl Chloride	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01	0.09	Below						
MW-51b	Arsenic, Dissolved	0.30	0.32	Stable	62.5	0.52	-2	4	0.9	5	Below						
	Manganese, Dissolved	0.35	0.38	No Trend	72.9	0.15	3	4	11	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.87	0.87	No Trend	83.3	0.94	4	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.09	Below						
MW-57b	Arsenic, Dissolved							3	1.42	5	Below						
	Manganese, Dissolved							3	2.5	50	Below						
	1,1-Dichloroethane	0.84	0.84	No Trend	72.9	0.62	3	4	0.28	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	0.09	0.13	No Trend	62.5	0.31	2	4	0.57	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	0.26	0.26	No Trend	72.9	1.38	-3	4	0.01	0.09	Below						
MW-63b	Arsenic, Dissolved	0.66	0.68	No Trend	76.4	0.17	7	8	4.12	5	Below						
	Manganese, Dissolved	0.16	0.21	Probably Decreasing	94.6	0.17	-14	8	6910	50	Above	0.043	-0.024	0.110	115	-206	45
	1,1-Dichloroethane	0.58	0.56	No Trend	80.1	2.49	-8	8	2.04	3	Below						
	1,2-Dichloroethane (EDC)	0.21	<0.05	No Trend	54.8	1.05	2	8	1	0.3	Above						
	1,2-Dichloropropane	0.44	0.64	Increasing	97.8	1.12	19	8	1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	No Trend	72.6	0.22	6	8	12.7	2	Above						
	Benzene	0.77	0.70	Decreasing	99.7	0.33	-22	8	20.9	2	Above	0.182	0.088	0.277	13	27	8
	cis-1,2-Dichloroethene	0.31	<0.05	No Trend	76.4	1.42	7	8	1	15	Below						
	Trichloroethene (TCE)	0.34	0.31	Increasing	97.7	1.03	17	8	1	0.4	Above						
	Vinyl Chloride	0.61	0.59	Probably Decreasing	91.1	2.02	-12	8	0.01	0.09	Below						
MW-71b	Arsenic, Dissolved	0.19	0.20	Stable	62.5	0.06	-2	4	1.4	5	Below						
	Manganese, Dissolved	0.96	0.95	Decreasing	95.8	0.78	-6	4	14.6	50	Below						
	1,1-Dichloroethane	0.67	0.68	Stable	83.3	0.23	-4	4	1.3	3	Below						
	1,2-Dichloroethane (EDC)	0.67	0.70	Stable	83.3	0.23	-4	4	0.2	0.3	Below						
	1,2-Dichloropropane	0.62	0.64	Stable	83.3	0.20	-4	4	1.67	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.18	0.23	Stable	62.5	0.30	-2	4	1.53	15	Below						
	Trichloroethene (TCE)	0.28	0.32	Stable	83.3	0.15	-4	4	0.27	0.4	Below						
	Vinyl Chloride	0.63	0.47	Stable	62.5	0.77	-2	4	0.0305	0.09	Below						
MW-72b	Arsenic, Dissolved							1	4.22	5	Below						
	Manganese, Dissolved							1	8330	50	Above						
	1,1-Dichloroethane							1	0.55	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.2	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	2.11	0.09	Above						
MW-74b	Arsenic, Dissolved							1	4.18	5	Below						
	Manganese, Dissolved							1	59.7	50	Above						
	1,1-Dichloroethane							1	0.1	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.128	0.09	Above						

Table 13. Results of Mann-Kendall Test and Regression Analysis for IHSs in Roza Wells

Well	IHS Constituent	Regression Analysis		Mann Kendall Analysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-78b	Arsenic, Dissolved							1	0.897	5	Below						
	Manganese, Dissolved							1	125	50	Above						
	1,1-Dichloroethane							1	15.9	3	Above						
	1,2-Dichloroethane (EDC)							1	1.39	0.3	Above						
	1,2-Dichloropropane							1	18.1	3	Above						
	1,4-Dichlorobenzene							1	2.49	2	Above						
	Benzene							1	0.67	2	Below						
	cis-1,2-Dichloroethene							1	7.73	15	Below						
	Trichloroethene (TCE)							1	2.82	0.4	Above						
	Vinyl Chloride							1	9.15	0.09	Above						
MW-7b	Arsenic, Dissolved	0.29	0.30	Increasing	99.8	0.62	163	30	1.3	5	Below						
	Manganese, Dissolved	0.84	0.81	Decreasing	100.0	0.63	-1118	56	3480	50	Above	0.146	0.130	0.162	29	33	26
	1,1-Dichloroethane	0.77	0.90	Decreasing	100.0	0.68	-1440	60	2.03	3	Below						
	1,2-Dichloroethane (EDC)	0.78	0.61	Decreasing	100.0	0.52	-1296	60	0.42	0.3	Above	0.106	0.088	0.125	3	4	3
	1,2-Dichloropropane	0.67	0.67	Decreasing	100.0	0.42	-999	60	2.97	3	Below						
	1,4-Dichlorobenzene	0.72	0.78	Decreasing	100.0	0.91	-1314	60	0.21	2	Below						
	Benzene	0.55	0.86	Decreasing	100.0	1.27	-1320	60	0.1	2	Below						
	cis-1,2-Dichloroethene	0.72	0.76	Decreasing	100.0	0.68	-1186	60	2.73	15	Below						
	Trichloroethene (TCE)	0.62	0.73	Decreasing	100.0	0.67	-1281	61	0.1	0.4	Below						
	Vinyl Chloride	0.76	0.83	Decreasing	100.0	0.85	-1151	57	1.67	0.09	Above	0.191	0.171	0.210	15	17	14
MW-81b	Arsenic, Dissolved	0.66	0.65	Stable	62.5	0.13	-2	4	6.31	5	Above						
	Manganese, Dissolved	0.86	0.92	No Trend	83.3	0.66	4	4	3510	50	Above						
	1,1-Dichloroethane	0.74	0.78	Stable	83.3	0.48	-4	4	17.6	3	Above						
	1,2-Dichloroethane (EDC)	1.00	0.95	Decreasing	95.8	0.53	-6	4	0.29	0.3	Below						
	1,2-Dichloropropane	0.79	0.81	Stable	83.3	0.48	-4	4	1.56	3	Below						
	1,4-Dichlorobenzene	0.76	0.75	Stable	83.3	0.41	-4	4	2.35	2	Above						
	Benzene	0.87	0.87	Decreasing	95.8	0.46	-6	4	0.92	2	Below						
	cis-1,2-Dichloroethene	0.94	0.83	Decreasing	95.8	0.65	-6	4	6.6	15	Below						
	Trichloroethene (TCE)	0.89	0.86	Stable	83.3	0.54	-4	4	1.01	0.4	Above						
	Vinyl Chloride	0.14	0.07	Stable	37.5	0.45	0	4	56.5	0.09	Above						
MW-82b	Arsenic, Dissolved	<0.05	0.05	Stable	37.5	0.50	0	4	2.87	5	Below						
	Manganese, Dissolved	0.85	0.82	Stable	83.3	0.22	-4	4	74.7	50	Above						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.09	Below						
MW-86b	Arsenic, Dissolved							1	1.81	5	Below						
	Manganese, Dissolved							1	48.1	50	Below						
	1,1-Dichloroethane							1	0.29	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-89b	Arsenic, Dissolved							1	3.82	5	Below						
	Manganese, Dissolved							1	7480	50	Above						
	1,1-Dichloroethane							1	7.26	3	Above						
	1,2-Dichloroethane (EDC)							1	0.37	0.3	Above						
	1,2-Dichloropropane							1	1.25	3	Below						
	1,4-Dichlorobenzene							1	2.99	2	Above						
	Benzene							1	1.21	2	Below						
	cis-1,2-Dichloroethene							1	0.5	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	3.65	0.09	Above						
MW-93b	Arsenic, Dissolved							1	4.03	5	Below						
	Manganese, Dissolved							1	209	50	Above						
	1,1-Dichloroethane							1	7.97	3	Above						
	1,2-Dichloroethane (EDC)							1	0.98	0.3	Above						
	1,2-Dichloropropane							1	7.64	3	Above						
	1,4-Dichlorobenzene							1	0.2	2	Below						
	Benzene							1	0.28	2	Below						
	cis-1,2-Dichloroethene							1	3.94	15	Below						
	Trichloroethene (TCE)							1	0.22	0.4	Below						
	Vinyl Chloride							1	1.93	0.09	Above						
MW-96b	Arsenic, Dissolved							1	3.32	5	Below						
	Manganese, Dissolved							1	55	50	Above						
	1,1-Dichloroethane							1	2.24	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.1	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.1	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-97b	Arsenic, Dissolved							1	2.29	5	Below						
	Manganese, Dissolved							1	72	50	Above						
	1,1-Dichloroethane							1	0.23	3	Below						
	1,2-Dichloroethane (EDC)							1	0.1	0.3	Below						
	1,2-Dichloropropane							1	0.25	3	Below						
	1,4-Dichlorobenzene							1	0.1	2	Below						
	Benzene							1	0.1	2	Below						
	cis-1,2-Dichloroethene							1	0.24	15	Below						
	Trichloroethene (TCE)							1	0.1	0.4	Below						
	Vinyl Chloride							1	0.01	0.09	Below						
MW-9b	Arsenic, Dissolved	<0.05	<0.05	Stable	84.6	0.49	-61	31	4.5	5	Below						
	Manganese, Dissolved	0.48	0.58	Decreasing	100.0	0.48	-912	60	1750	50	Above	0.064	0.052	0.076	56	68	47
	1,1-Dichloroethane	0.53	0.83	Decreasing	100.0	1.20	-1660	64	0.1	3	Below						
	1,2-Dichloroethane (EDC)	0.46	0.57	Decreasing	100.0	0.85	-939	64	0.1	0.3	Below						
	1,2-Dichloropropane	0.73	0.85	Decreasing	100.0	0.60	-1609	64	0.36	3	Below						
	1,4-Dichlorobenzene	0.33	0.39	Decreasing	100.0	1.04	-639	64	0.1	2	Below						
	Benzene	0.57	0.70	Decreasing	100.0	0.80	-1104	64	0.1	2	Below						
	cis-1,2-Dichloroethene	0.70	0.92	Decreasing	100.0	0.91	-1770	64	0.48	15	Below						
	Trichloroethene (TCE)	0.74	0.80	Decreasing	100.0	0.54	-1591	65	0.1	0.4	Below						
	Vinyl Chloride	0.44	0.84	Decreasing	100.0	1.45	-1653	63	0.291	0.09	Above	0.181	0.164	0.198	6	7	6

Notes:

S: Mann-Kendall test statistics
CF: Confidence factor
COV: Coefficient of variation
C: Concentration
Last C: Last measured concentration
C_{goal}: Target concentration
CUL: Clean-up level
ks: First order source decay rate (best fit)
ks_{lower}: Lower bound (90%) of first order decay rate
ks_{upper}: Upper bound (90%) of first order decay rate
t(ks): Restoration timeframe based on best fit (ks)
t(ks_{lower}): Lower bound (90%) restoration timeframe
t(ks_{upper}): Upper bound (90%) restoration timeframe
R^2: Coefficient of determination (goodness of fit)

Table 14. Results of Mann-Kendall Test and Regression Analysis for IHSs in Interflow Wells

Well	IHS Constituent	Regression Alysis		Mann Kendall Alysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-20c	Arsenic, Dissolved	0.15	0.15	Decreasing	96.7	0.12	-107	32	1.3	5	Below						
	Manganese, Dissolved	0.13	<0.05	Increasing	99.9	1.31	435	61	2	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1	2	Below						
	Benzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Probably Increasing	94.8	0.11	62	65	0.1	15	Below						
	Trichloroethene (TCE)	0.12	0.12	Increasing	99.7	0.20	179	66	0.1	0.4	Below						
	Vinyl Chloride	0.41	0.40	Decreasing	100.0	1.24	-649	66	0.01	0.09	Below						
MW-21c	Arsenic, Dissolved	<0.05	0.13	Increasing	99.6	0.92	153	31	0.8	5	Below						
	Manganese, Dissolved	0.89	0.95	Decreasing	100.0	0.42	-1357	56	33.9	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	No Trend	55.0	1.17	-7	59	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1	2	Below						
	Benzene	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Probably Increasing	94.7	0.12	56	59	0.1	15	Below						
	Trichloroethene (TCE)	0.11	0.16	Increasing	99.9	0.43	209	60	0.1	0.4	Below						
	Vinyl Chloride	0.40	0.40	Decreasing	100.0	1.22	-585	60	0.01	0.09	Below						
MW-22c	Arsenic, Dissolved	0.32	0.37	Increasing	97.4	0.29	104	29	3	5	Below						
	Manganese, Dissolved	0.06	0.24	Increasing	100.0	4.28	479	57	2	50	Below						
	1,1-Dichloroethane	0.82	0.60	Decreasing	100.0	0.51	-1385	60	0.96	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	0.30	Stable	50.0	0.00	0	60	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	0.30	Stable	50.0	0.00	0	60	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	0.30	Stable	50.0	0.00	0	60	0.1	2	Below						
	Benzene	<0.05	0.30	Stable	50.0	0.00	0	60	0.1	2	Below						
	cis-1,2-Dichloroethene	0.83	0.81	Decreasing	100.0	0.59	-1224	60	0.1	15	Below						
	Trichloroethene (TCE)	0.88	0.84	Decreasing	100.0	0.55	-1538	61	0.29	0.4	Below						
	Vinyl Chloride	0.40	0.38	Decreasing	100.0	1.22	-561	61	0.01	0.09	Below						
MW-2c	Arsenic, Dissolved	0.25	0.21	Increasing	98.6	1.09	127	32	0.6	5	Below						
	Manganese, Dissolved	0.88	0.75	Increasing	100.0	0.65	1480	61	110	50	Above						
	1,1-Dichloroethane	<0.05	<0.05	Decreasing	98.2	0.13	-369	65	2.44	3	Below						
	1,2-Dichloroethane (EDC)	0.07	0.07	Increasing	98.4	0.24	138	65	0.1	0.3	Below						
	1,2-Dichloropropane	0.86	0.90	Increasing	100.0	0.60	1663	65	1.26	3	Below						
	1,4-Dichlorobenzene	0.77	0.71	Increasing	100.0	0.56	1367	65	0.88	2	Below						
	Benzene	0.39	0.47	Increasing	100.0	0.45	596	65	0.1	2	Below						
	cis-1,2-Dichloroethene	0.91	0.95	Increasing	100.0	0.58	1779	65	1.49	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	No Trend	59.0	0.13	42	66	0.54	0.4	Above						
	Vinyl Chloride	0.86	0.65	Increasing	100.0	0.59	1583	66	0.323	0.09	Above						
MW-45c	Arsenic, Dissolved	0.29	0.28	Probably Decreasing	91.0	0.38	-14	9	1	5	Below						
	Manganese, Dissolved	0.28	0.26	Decreasing	96.2	0.84	-18	9	9	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	0.3	Below						
	1,2-Dichloropropane	0.76	0.76	Increasing	98.3	0.55	21	9	0.31	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1	2	Below						
	cis-1,2-Dichloroethene	0.77	0.66	Increasing	99.9	0.43	28	9	0.39	15	Below						
	Trichloroethene (TCE)	0.27	0.30	No Trend	84.6	1.40	-11	9	0.01	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Probably Increasing	91.0	0.57	14	9	0.05	0.09	Below						
MW-47c	Arsenic, Dissolved	0.59	0.59	Stable	72.9	0.03	-3	4	1.6	5	Below						
	Manganese, Dissolved	0.06	0.07	Stable	62.5	0.31	-2	4	18	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.09	0.09	No Trend	50.0	0.58	1	4	0.1	15	Below						
	Trichloroethene (TCE)	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01	0.4	Below						
	Vinyl Chloride	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01	0.09	Below						
MW-4c	Arsenic, Dissolved	<0.05	0.11	Decreasing	98.8	0.40	-118	32	0.2	5	Below						
	Manganese, Dissolved	<0.05	<0.05	Stable	65.1	0.06	-63	61	29.5	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1	2	Below						
	cis-1,2-Dichloroethene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1	15	Below						
	Trichloroethene (TCE)	0.12	0.12	Increasing	99.7	0.20	179	66	0.1	0.4	Below						
	Vinyl Chloride	0.42	0.42	Decreasing	100.0	1.25	-685	66	0.01	0.09	Below						
MW-50c	Arsenic, Dissolved	0.81	0.82	Stable	89.6	0.16	-5	4	0.4	5	Below						
	Manganese, Dissolved	0.93	0.91	Decreasing	95.8	0.11	-6	4	35	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.87	0.87	No Trend	83.3	0.94	4	4	0.1	15	Below						
	Trichloroethene (TCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.09	Below						
MW-54c	Arsenic, Dissolved	0.50	0.54	Stable	89.6	0.74	-5	4	0.9	5	Below						
	Manganese, Dissolved	1.00	0.99	Decreasing	95.8	0.20	-6	4	36	50	Below						
	1,1-Dichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	Benzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1	2	Below						
	cis-1,2-Dichloroethene	0.87	0.87	No Trend	83.3	0.94	4	4	0.1	15	Below						
	Trichloroethene (TCE)	0.16	0.16	Stable	50.0	0.60	-1	4	0.01	0.4	Below						
	Vinyl Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01	0.09	Below						
MW-56c	Arsenic, Dissolved							2	0.8	5	Below						
	Manganese, Dissolved							2	122	50	Above						
	1,1-Dichloroethane							2	0.1	3	Below						
	1,2-Dichloroethane (EDC)							2	0.1	0.3	Below						
	1,2-Dichloropropane							2	0.1	3	Below						
	1,4-Dichlorobenzene							2	0.1	2	Below						
	Benzene							2	0.1	2	Below						
	cis-1,2-Dichloroethene							2	0.085	15	Below						
	Trichloroethene (TCE)							2	0.01	0.4	Below						
	Vinyl Chloride							2	0.01	0.09	Below						
MW-58c	Arsenic, Dissolved							3	0.783	5	Below						
	Manganese, Dissolved							3	15.9	50	Below						
	1,1-Dichloroethane	0.87	0.87	Increasing	95.8	0.11	6	4	23.8	3	Above						
	1,2-Dichloroethane (EDC)	0.50	0.51	Stable	37.5	0.04	0	4	1.96	0.3	Above						
	1,2-Dichloropropane	0.06	0.06	Stable	62.5	0.03	-2	4	11.8	3	Above						
	1,4-Dichlorobenzene	0.93	0.93	Increasing	95.8	0.18	6	4	2.94	2	Above						
	Benzene	0.99	0.99	Decreasing	95.8	0.04	-6	4	1.65	2	Below						
	cis-1,2-Dichloroethene	0.49	0.51	No Trend	83.3	0.14	4	4	7.77	15	Below						
	Trichloroethene (TCE)	0.98	0.98	Increasing	95.8	0.07	6	4	1.02	0.4	Above						
	Vinyl Chloride	0.16	0.16	No Trend	62.5	0.13	2	4	18.9	0.09	Above						

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Table 14. Results of Mann-Kendall Test and Regression Analysis for IHSs in Interflow Wells

Well	IHS Constituent	Regression Alysis		Mann Kendall Alysis				Comparison to CUL				Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	CUL (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
MW-5c	Arsenic, Dissolved	0.39	0.35	Increasing	100.0	0.44	223	32	1.5	5	Below						
	Manganese, Dissolved	0.23	0.42	Increasing	100.0	0.91	865	60	8.4	50	Below						
	1,1-Dichloroethane	0.68	0.70	Decreasing	100.0	0.22	-1359	64	0.64	3	Below						
	1,2-Dichloroethane (EDC)	0.77	0.90	Increasing	100.0	0.89	1611	64	14.7	0.3	Above						
	1,2-Dichloropropane	0.89	0.90	Decreasing	100.0	0.49	-1625	64	0.25	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Probably Increasing	92.3	0.50	115	64	0.1	2	Below						
	Benzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1	2	Below						
	cis-1,2-Dichloroethene	0.89	0.89	Decreasing	100.0	0.43	-1696	64	1.46	15	Below						
	Trichloroethene (TCE)	0.66	0.62	Decreasing	100.0	0.21	-1306	65	0.62	0.4	Above	0.039	0.033	0.045	11	13	10
	Vinyl Chloride	0.40	0.17	Decreasing	100.0	0.36	-963	65	0.106	0.09	Above	0.041	0.022	0.060	4	7	3
MW-62c	Arsenic, Dissolved							1	0.2	5	Below						
	Manganese, Dissolved							1	37.2	50	Below						
	1,1-Dichloroethane							2	0.1	3	Below						
	1,2-Dichloroethane (EDC)							2	0.1	0.3	Below						
	1,2-Dichloropropane							2	0.1	3	Below						
	1,4-Dichlorobenzene							2	0.1	2	Below						
	Benzene							2	0.1	2	Below						
	cis-1,2-Dichloroethene							2	0.1	15	Below						
	Trichloroethene (TCE)							2	0.1	0.4	Below						
	Vinyl Chloride							2	0.01	0.09	Below						
MW-6c	Arsenic, Dissolved	0.74	0.53	Increasing	100.0	0.42	271	29	4.3	5	Below						
	Manganese, Dissolved	0.08	0.06	Decreasing	97.0	0.15	-282	58	22.6	50	Below						
	1,1-Dichloroethane	0.58	0.63	Decreasing	100.0	0.43	-1050	62	0.42	3	Below						
	1,2-Dichloroethane (EDC)	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1	0.3	Below						
	1,2-Dichloropropane	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1	3	Below						
	1,4-Dichlorobenzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1	2	Below						
	Benzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1	2	Below						
	cis-1,2-Dichloroethene	0.33	0.26	Decreasing	100.0	0.43	-721	62	0.1	15	Below						
	Trichloroethene (TCE)	0.77	0.78	Decreasing	100.0	0.57	-1332	63	0.1	0.4	Below						
	Vinyl Chloride	0.33	0.27	Decreasing	100.0	1.14	-490	63	0.01	0.09	Below						

Notes:

S: Mann-Kendall test statistics
CF: Confidence factor
COV: Coefficient of variation
C: Concentration
Last C: Last measured concentration
C_{goal}: Target concentration
CUL: Clean-up level
ks: First order source decay rate (best fit)
ks_{lower}: Lower bound (90%) of first order decay rate
ks_{upper}: Upper bound (90%) of first order decay rate
t(ks): Restoration timeframe based on best fit (ks)
t(ks_{lower}): Lower bound (90%) restoration timeframe
t(ks_{upper}): Upper bound (90%) restoration timeframe
R^2: Coefficient of determination (goodness of fit)

Table 15. Wells Showing Decreasing Trend in IHSs based on Mann-Kendall Test Results

IHS	P1 ZONE	P2 ZONE	ROZA AQUIFER	INTERFLOW AQUIFER
Arsenic, Dissolved	MW-34p1 (n=21)	MW-33p2 (n=24)*		
Manganese, Dissolved	MW-36p1 (n=4) MW-69p1 (n=5) MW-83p1 (n=4) MW-85p1 (n=4) MW-95p1 (n=4)	MW-125p2 (n=4) MW-33p2 (n=25)	MW-3b (n=34) MW-42b (n=24) MW-7b (n=56) MW-9b (n=60) MW-63b (n=8)*	
1,1-Dichloroethane	MW-34p1 (n=22) MW-36p1 (n=4) MW-83p1 (n=4)	MW-143p2 (n=4) MW-33p2 (n=26) MW-35p2 (n=25) MW-38p2 (n=26)	MW-151b (n=4) MW-3b (n=38) MW-42b (n=24) MW-44b (n=16)	
1,2-Dichloroethane (EDC)	MW-34p1 (n=23)	MW-101p2 (n=4) MW-143p2 (n=4) MW-35p2 (n=26) MW-38p2 (n=26) MW-33p2 (n=26)*	MW-3b (n=38) MW-42b (n=24) MW-44b (n=16) MW-7b (n=60) MW-29b (n=5)*	
1,2-Dichloropropane	MW-69p1 (n=5)	MW-101p2 (n=4) MW-35p2 (n=26) MW-38p2 (n=26)	MW-29b (n=5) MW-3b (n=38) MW-42b (n=24) MW-44b (n=16)	
1,4-Dichlorobenzene	MW-34p1 (n=23) MW-65p1 (n=8) MW-68p1 (n=13)*	MW-33p2 (n=26)	MW-44b (n=16)*	
Benzene	MW-34p1 (n=23)	MW-126p2 (n=4) MW-38p2 (n=26) MW-87p2 (n=4) MW-91p2 (n=4)	MW-63b (n=8)	
cis-1,2-Dichloroethene			MW-148b (n=4) MW-3b (n=38)	
Trichloroethene (TCE)		MW-35p2 (n=26) MW-38p2 (n=25)	MW-29b (n=5) MW-3b (n=39)	MW-5c (n=65)
Vinyl Chloride	MW-34p1 (n=23) MW-36p1 (n=4)	MW-107p2 (n=4) MW-33p2 (n=26) MW-35p2 (n=26) MW-38p2 (n=26) MW-99p2 (n=4)	MW-3b (n=36) MW-42b (n=24) MW-7b (n=57) MW-9b (n=63)	MW-5c (n=65)

Notes:

Only the wells that exceed the clean-up levels are shown in the table

n: Sample size

* Possibly decreasing trend

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Table 16. Wells Showing Increasing Trend based on Mann-Kendall Test Results

IHS	P1 ZONE	P2 ZONE	ROZA AQUIFER	INTERFLOW AQUIFER
Arsenic, Dissolved	MW-65p1 (n=7) MW-68p1 (n=10)			
Manganese, Dissolved	MW-65p1 (n=7)* MW-68p1 (n=10)*	MW-107p2 (n=4) MW-114p2 (n=4) MW-126p2 (n=4)	MW-146b (n=4)	MW-2c (n=61)
1,1-Dichloroethane		MW-138p2 (n=4)	MW-102b (n=4)	MW-58c (n=4)
1,2-Dichloroethane (EDC)		MW-138p2 (n=4)	MW-102b (n=4) MW-146b (n=4)	MW-5c (n=64)
1,2-Dichloropropane	MW-68p1 (n=13)		MW-102b (n=4) MW-146b (n=4)	
1,4-Dichlorobenzene	MW-69p1 (n=5)*	MW-114p2 (n=4)	MW-29b (n=5)	MW-58c (n=4)
Benzene	MW-65p1 (n=8)*			
cis-1,2-Dichloroethene			MW-102b (n=4)	
Trichloroethene (TCE)		MW-39p2 (n=6)	MW-102b (n=4) MW-44b (n=16) MW-63b (n=8)	MW-58c (n=4)
Vinyl Chloride	MW-68p1 (n=13)*		MW-102b (n=4) MW-146b (n=4)	MW-2c (n=66)

Notes:

Only the wells that exceed the clean-up levels are shown in the table

n: Sample size

* Possibly increasing trend

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Table 17. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-100p1	Oxidation Reduction Potential							1	18
	Nitrate as Nitrogen							1	5.45
	pH							1	6.15
	Dissolved Oxygen							1	0
	Sulfate							1	64.5
	Iron, Dissolved							1	468
	Chloride							1	83.9
MW-104p1	Oxidation Reduction Potential							1	-71
	Nitrate as Nitrogen							1	0.03
	pH							1	6.56
	Dissolved Oxygen							1	0
	Sulfate							1	245
	Iron, Dissolved							1	21300
	Chloride							1	431
MW-109p1	Oxidation Reduction Potential							3	164.8
	Nitrate as Nitrogen							3	46.1
	Methane							1	14.7
	pH							3	6.92
	Dissolved Oxygen							3	0.07
	Sulfate							3	80
	Iron, Dissolved							3	100
	Chloride							3	24.3
MW-110p1	Oxidation Reduction Potential							1	-67
	Nitrate as Nitrogen							1	0.01
	pH							1	6.83
	Dissolved Oxygen							1	0
	Sulfate							1	24.6
	Iron, Dissolved							1	4470
	Chloride							1	51
MW-117p1	Oxidation Reduction Potential							3	62.2
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	50.0	0.67	1	4	23.1
	pH							3	7.34
	Dissolved Oxygen							3	0.48
	Sulfate	<0.05	<0.05	No Trend	62.5	0.56	2	4	44.7
	Iron, Dissolved	<0.05	<0.05	No Trend	50.0	1.88	1	4	20
	Chloride	<0.05	<0.05	No Trend	37.5	1.40	0	4	21.3
MW-123p1	Oxidation Reduction Potential							3	59.5
	Nitrate as Nitrogen	0.05	0.12	Stable	37.5	0.33	0	4	31.5
	pH							3	7.1
	Dissolved Oxygen							3	1.57
	Sulfate	0.84	0.80	Increasing	95.8	0.31	6	4	62.5
	Iron, Dissolved	0.77	0.77	No Trend	83.3	0.38	4	4	20
	Chloride	0.09	0.10	Stable	37.5	0.09	0	4	5.99
MW-127p1	Oxidation Reduction Potential							1	82
	Nitrate as Nitrogen							1	26.8
	pH							1	7.23
	Dissolved Oxygen							1	0
	Sulfate							1	49.6
	Iron, Dissolved							1	10
	Chloride							1	75.6

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Table 17. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-129p1	Oxidation Reduction Potential							1	97
	Nitrate as Nitrogen							1	28.2
	pH							1	7.22
	Dissolved Oxygen							1	0
	Sulfate							1	43
	Iron, Dissolved							1	10
	Chloride							1	39.6
MW-34p1	Oxidation Reduction Potential	0.78		Decreasing	99.7	-0.36	-10	5	-185
	Nitrate as Nitrogen	0.05	<0.05	No Trend	85.6	1.35	31	19	0.01
	Methane							1	7080
	pH	0.70	0.67	No Trend	86.4	0.06	7	6	7.09
	Dissolved Oxygen	0.90	<0.05	Probably Decreasing	92.1	0.60	-7	6	0
	Alkalinity (as CaCO3)	0.26	0.28	Stable	71.9	0.08	-5	7	1190
	Sulfate	0.12	0.09	Increasing	99.5	1.27	75	19	30.4
	Iron, Dissolved	0.67	0.66	Decreasing	100.0	0.55	-136	21	26900
	Chloride	0.32	0.30	Stable	87.6	0.58	-34	19	488
MW-36p1	Oxidation Reduction Potential							3	-120.3
	Nitrate as Nitrogen	<0.05	0.11	No Trend	50.0	1.23	1	4	0.105
	pH							3	6.52
	Dissolved Oxygen							3	0.05
	Sulfate							3	25.6
	Iron, Dissolved							3	22100
	Chloride							3	185
MW-37p1	Oxidation Reduction Potential	<0.05	<0.05	Stable	59.2	0.68	-2	5	67
	Nitrate as Nitrogen	0.44	0.48	Stable	75.8	0.27	-4	5	5.17
	Methane							1	0.35
	pH	0.18	0.18	No Trend	88.3	0.12	6	5	6.62
	Dissolved Oxygen							3	0
	Alkalinity (as CaCO3)							3	516
	Sulfate	0.97	0.81	No Trend	59.2	1.37	2	5	1650
	Iron, Dissolved	0.99	0.99	No Trend	72.9	1.67	3	4	535
	Chloride	0.51	0.56	Stable	59.2	0.11	-2	5	69.2
MW-61p1	Oxidation Reduction Potential							1	49
	Nitrate as Nitrogen							2	0.01
	pH							2	8.57
	Dissolved Oxygen							1	7.81
	Sulfate							2	37.2
	Iron, Dissolved							1	32.1
	Chloride							2	5.31
MW-64p1	Oxidation Reduction Potential							1	-149
	Nitrate as Nitrogen							2	0.01
	pH							2	6.85
	Dissolved Oxygen							1	0
	Sulfate							2	5
	Iron, Dissolved							2	17000
	Chloride							2	589
MW-65p1	Oxidation Reduction Potential							1	-191
	Nitrate as Nitrogen	0.16	0.27	No Trend	84.5	1.23	-8	7	0.01
	pH							2	7.04
	Dissolved Oxygen							1	0
	Sulfate	<0.05	<0.05	No Trend	50.0	1.96	1	7	10
	Iron, Dissolved	0.75	0.55	Increasing	99.5	0.47	17	7	44200
	Chloride	0.64	0.40	No Trend	88.1	0.58	9	7	554

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Table 17. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-66p1	Oxidation Reduction Potential							1	-168
	Nitrate as Nitrogen							2	0.01
	pH							2	7.09
	Dissolved Oxygen							1	0
	Sulfate							2	40
	Iron, Dissolved							2	33200
	Chloride							2	458
MW-67p1	Oxidation Reduction Potential							1	-153
	Nitrate as Nitrogen							2	0.01
	pH							2	6.88
	Dissolved Oxygen							1	0
	Sulfate							2	10
	Iron, Dissolved							2	32400
	Chloride							2	545
MW-68p1	Oxidation Reduction Potential							1	-187
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	66.6	1.48	4	7	0.01
	pH							2	7.27
	Dissolved Oxygen							1	
	Sulfate	0.18	0.19	No Trend	88.1	0.66	9	7	51.5
	Iron, Dissolved	<0.05	0.14	No Trend	63.6	0.40	5	10	23800
	Chloride	0.17	0.21	Probably Increasing	93.2	0.48	11	7	449
MW-69p1	Oxidation Reduction Potential							4	-62.8
	Nitrate as Nitrogen	0.45	0.61	No Trend	88.3	0.71	6	5	0.03
	pH	<0.05	<0.05	Stable	40.8	0.01	0	5	6.74
	Dissolved Oxygen							3	0.05
	Sulfate	0.17	0.11	No Trend	88.3	0.53	6	5	42.1
	Iron, Dissolved	0.56	0.75	No Trend	59.2	0.59	2	5	14500
	Chloride	0.88	0.82	Decreasing	95.8	0.30	-8	5	119
MW-70p1	Oxidation Reduction Potential							1	-84
	Nitrate as Nitrogen							2	0.01
	pH							2	6.76
	Dissolved Oxygen							1	0
	Sulfate							2	119
	Iron, Dissolved							2	7710
	Chloride							2	126
MW-83p1	Oxidation Reduction Potential							2	-107.6
	Nitrate as Nitrogen	0.50	0.50	No Trend	72.9	0.67	3	4	0.03
	pH							2	6.45
	Dissolved Oxygen							2	0.11
	Sulfate	0.16	0.12	No Trend	62.5	0.28	2	4	24.5
	Iron, Dissolved	0.73	0.71	Stable	83.3	0.41	-4	4	12800
	Chloride	0.60	0.59	Stable	83.3	0.20	-4	4	127
MW-85p1	Oxidation Reduction Potential							3	-85
	Nitrate as Nitrogen							3	0.0207
	pH							3	6.72
	Dissolved Oxygen							3	0.05
	Sulfate	0.99	0.95	Increasing	95.8	0.70	6	4	52.5
	Iron, Dissolved	0.55	0.50	Stable	83.3	0.47	-4	4	8440
	Chloride							3	161

Table 17. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-90p1	Oxidation Reduction Potential							1	-101
	Nitrate as Nitrogen							1	0.01
	pH							1	6.55
	Dissolved Oxygen							1	0
	Sulfate							1	219
	Iron, Dissolved							1	21400
	Chloride							1	255
MW-92p1	Oxidation Reduction Potential	0.07		Stable	62.5	-0.35	-2	4	-93
	Nitrate as Nitrogen							3	0.03
	pH	0.55	0.56	No Trend	62.5	0.05	2	4	6.65
	Dissolved Oxygen	<0.05	<0.05	No Trend	50.0	1.84	1	4	0.02
	Sulfate	0.49	0.72	No Trend	83.3	0.82	4	4	29.9
	Iron, Dissolved	0.07	0.08	Stable	62.5	0.28	-2	4	17600
	Chloride	<0.05	<0.05	Stable	37.5	0.23	0	4	96.4
MW-95p1	Oxidation Reduction Potential							2	-124.3
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	50.0	1.61	1	4	0.055
	pH							2	6.62
	Dissolved Oxygen							2	0.17
	Sulfate	0.18	0.11	Stable	62.5	0.55	-2	4	50.5
	Iron, Dissolved	<0.05	<0.05	Stable	62.5	0.20	-2	4	12600
	Chloride	0.90	0.92	Stable	83.3	0.54	-4	4	73.5
MW-98p1	Oxidation Reduction Potential							1	120
	Nitrate as Nitrogen							1	4.65
	pH							1	7.77
	Dissolved Oxygen							1	0
	Sulfate							1	57.2
	Chloride							1	31.4

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

R^2: Coefficient of determination (goodness of fit)

Table 18. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-101p2	Oxidation Reduction Potential							3	-136.5
	Nitrate as Nitrogen	<0.05	<0.05	Stable	37.5	0.0	0	4	0.01
	pH							3	6.45
	Dissolved Oxygen							3	0.11
	Sulfate	0.11	0.10	No Trend	62.5	0.4	2	4	13.5
	Iron, Dissolved	0.20	0.62	No Trend	83.3	1.4	4	4	3890
	Chloride	0.41	0.40	No Trend	62.5	0.1	2	4	229
MW-107p2	Oxidation Reduction Potential							3	-139.9
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	50	2.0	-1	4	0.01
	Methane							1	1500
	pH							3	6.76
	Dissolved Oxygen							3	0.09
	Sulfate	<0.05	<0.05	No Trend	62.5	0.8	2	4	28.4
	Iron, Dissolved	0.75	0.57	No Trend	83.3	1.0	4	4	2940
	Chloride	0.06	<0.05	No Trend	62.5	0.6	2	4	478
MW-108p2	Oxidation Reduction Potential							1	-73
	Nitrate as Nitrogen							1	0.01
	pH							1	6.83
	Dissolved Oxygen							1	0
	Sulfate							1	135
	Iron, Dissolved							1	419
	Chloride							1	437
MW-112p2	Oxidation Reduction Potential							1	-96
	Nitrate as Nitrogen							1	0.01
	pH							1	6.41
	Dissolved Oxygen							1	0
	Sulfate							1	13.5
	Iron, Dissolved							1	3980
	Chloride							1	487
MW-113p2	Oxidation Reduction Potential							3	-92.3
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	50	1.3	1	4	0.03
	pH							3	6.43
	Dissolved Oxygen							3	0.08
	Sulfate	0.24	0.29	No Trend	62.5	0.3	2	4	24.7
	Iron, Dissolved	<0.05	<0.05	Stable	37.5	0.7	0	4	16800
	Chloride	0.15	0.08	No Trend	62.5	0.5	2	4	591
MW-114p2	Oxidation Reduction Potential							3	-69.4
	Nitrate as Nitrogen	0.55	0.34	No Trend	50	1.1	-1	4	0.0234
	pH							3	6.65
	Dissolved Oxygen							3	0.87
	Sulfate	0.76	0.90	Increasing	95.8	0.7	6	4	30.7
	Iron, Dissolved	<0.05	0.35	No Trend	62.5	1.3	2	4	4300
	Chloride	0.57	0.62	No Trend	62.5	0.3	2	4	489
MW-115p2	Oxidation Reduction Potential							3	-85.5
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	62.5	2.0	-2	4	0.01
	pH							3	6.91
	Dissolved Oxygen							3	0.05
	Sulfate	0.27	0.32	No Trend	62.5	0.3	2	4	46.6
	Iron, Dissolved	0.32	<0.05	No Trend	37.5	1.4	0	4	1710
	Chloride	0.54	0.27	No Trend	83.3	0.8	4	4	342
MW-118p2	Oxidation Reduction Potential							1	49
	Nitrate as Nitrogen							1	0.0231
	pH							1	6.26
	Dissolved Oxygen							1	0
	Sulfate							1	116
	Iron, Dissolved							1	20
	Chloride							1	266

Table 18. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-122p2	Oxidation Reduction Potential							1	-100
	Nitrate as Nitrogen							1	0.01
	pH							1	6.86
	Dissolved Oxygen							1	0
	Sulfate							1	19.2
	Iron, Dissolved							1	185
	Chloride							1	368
MW-124p2	Oxidation Reduction Potential							3	41.2
	Nitrate as Nitrogen	0.83	0.82	No Trend	89.55	0.7	5	4	0.042
	Methane	0.11	0.34	Stable	37.5	0.7	0	4	37.8
	pH							3	7.18
	Dissolved Oxygen							3	0.14
	Alkalinity (as CaCO3)	<0.05	<0.05	Stable	37.5	0.1	0	4	526
	Sulfate	0.77	0.74	No Trend	83.3	0.6	4	4	66
	Iron, Dissolved	0.67	0.51	No Trend	37.5	1.5	0	4	377
	Chloride	0.58	0.60	No Trend	62.5	0.2	2	4	230
MW-125p2	Oxidation Reduction Potential							3	-114.7
	Nitrate as Nitrogen	<0.05	<0.05	Stable	37.5	0.0	0	4	0.01
	Methane	0.26	0.30	No Trend	62.5	0.2	2	4	454
	pH							3	6.92
	Dissolved Oxygen							3	0.07
	Alkalinity (as CaCO3)	0.15	0.17	Stable	62.5	0.1	-2	4	554
	Sulfate							3	146
	Iron, Dissolved	0.31	0.34	Stable	62.5	0.2	-2	4	3210
	Chloride	0.90	0.87	Decreasing	95.8	0.3	-6	4	87.3
MW-126p2	Oxidation Reduction Potential							3	-76.9
	Nitrate as Nitrogen	<0.05	<0.05	Stable	37.5	0.0	0	4	0.01
	pH							3	6.88
	Dissolved Oxygen							3	0.76
	Sulfate	0.56	0.62	No Trend	83.3	0.9	4	4	36.9
	Iron, Dissolved	0.96	0.94	Decreasing	95.8	1.1	-6	4	161
	Chloride	0.69	0.64	No Trend	83.3	0.3	4	4	419
MW-131p2	Oxidation Reduction Potential							1	10
	Nitrate as Nitrogen							1	0.01
	pH							1	7.27
	Dissolved Oxygen							1	2.78
	Sulfate							1	30.2
	Iron, Dissolved							1	10
	Chloride							1	77.2
MW-136p2	Oxidation Reduction Potential							1	-12
	Nitrate as Nitrogen							1	9.56
	pH							1	6.73
	Dissolved Oxygen							1	0
	Sulfate							1	36.3
	Iron, Dissolved							1	20
	Chloride							1	83.6
MW-138p2	Oxidation Reduction Potential							3	-37.5
	Nitrate as Nitrogen	0.51	0.38	No Trend	72.9	1.6	3	4	1.005
	Methane	0.99	0.97	Decreasing	95.8	0.4	-6	4	2920
	pH							3	6.71
	Dissolved Oxygen							3	0.05
	Alkalinity (as CaCO3)	0.64	0.61	No Trend	83.3	0.1	4	4	1010
	Sulfate	0.08	0.06	No Trend	62.5	0.3	2	4	22.5
	Iron, Dissolved	<0.05	<0.05	No Trend	62.5	0.2	2	4	13700
	Chloride	0.44	0.47	No Trend	83.3	0.1	4	4	474

Table 18. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-141p2	Oxidation Reduction Potential							1	-153
	Nitrate as Nitrogen							1	0.112
	Methane							1	0.325
	pH							1	6.98
	Dissolved Oxygen							1	0
	Alkalinity (as CaCO3)							1	148
	Sulfate							1	15.3
	Iron, Dissolved							1	22.4
	Chloride							1	4.09
MW-143p2	Oxidation Reduction Potential							3	55.1
	Nitrate as Nitrogen	0.64	0.63	No Trend	83.3	0.2	4	4	8.77
	Methane	<0.05	<0.05	No Trend	50	1.2	-1	4	0.325
	pH							3	7.03
	Dissolved Oxygen							3	0.06
	Alkalinity (as CaCO3)	0.36	0.34	Stable	62.5	0.1	-2	4	236
	Sulfate	0.11	0.13	Stable	62.5	0.2	-2	4	70
	Iron, Dissolved	0.85	0.99	Increasing	95.8	0.9	6	4	100
	Chloride	0.40	0.41	Stable	62.5	0.0	-2	4	102
MW-147p2	Oxidation Reduction Potential							3	75.4
	Nitrate as Nitrogen	0.58	0.61	No Trend	83.3	0.1	4	4	4.57
	Methane	<0.05	0.23	No Trend	72.9	1.9	-3	4	0.325
	pH							3	8.11
	Dissolved Oxygen							3	2.57
	Alkalinity (as CaCO3)	0.28	0.29	Stable	62.5	0.1	-2	4	167
	Sulfate	0.22	0.22	Stable	83.3	0.0	-4	4	28.9
	Iron, Dissolved	<0.05	<0.05	No Trend	50	1.5	1	4	20
	Chloride	0.77	0.76	No Trend	83.3	0.1	4	4	6.03
MW-33p2	Oxidation Reduction Potential	<0.05	<0.05	Stable	50	-1.4	0	7	-39
	Nitrate as Nitrogen	0.13	0.22	Increasing	98.744929	3.4	97	26	0.748
	Methane							1	3290
	pH	0.35	0.36	Increasing	99.937537	0.1	139	25	6.81
	Dissolved Oxygen	0.75	0.53	No Trend	62.5	0.8	2	4	6.34
	Alkalinity (as CaCO3)	<0.05	<0.05	No Trend	50	0.2	1	11	1210
	Sulfate	<0.05	0.06	Probably Increasing	92.407808	0.8	66	26	38
	Iron, Dissolved	0.18	0.10	Probably Decreasing	92.940351	1.9	-64	25	1940
	Chloride	0.80	0.56	Decreasing	99.999992	0.5	-239	26	314
MW-35p2	Oxidation Reduction Potential	0.59		No Trend	64	-0.8	3	6	16
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	64.749176	1.1	18	26	0.0536
	Methane							1	1800
	pH	0.29	0.29	Increasing	99.189583	0.1	92	23	7.9
	Dissolved Oxygen							2	3
	Alkalinity (as CaCO3)	0.07	0.07	Stable	62.225156	0.1	-5	11	804
	Sulfate	0.06	0.10	Probably Increasing	92.082744	1.2	65	26	29.6
	Iron, Dissolved	0.24	0.06	Probably Decreasing	90.266661	1.9	-53	24	1950
	Chloride	0.11	0.08	Probably Increasing	93.844479	0.1	67	25	1100
MW-38p2	Oxidation Reduction Potential	<0.05	<0.05	Stable	50	-3.3	-1	6	-3.5
	Nitrate as Nitrogen	0.32	0.34	Increasing	98.572885	2.2	100	26	0.754
	Methane							1	260
	pH	0.15	0.16	No Trend	88.795597	0.1	47	23	6.93
	Dissolved Oxygen							3	2
	Alkalinity (as CaCO3)	0.76	0.78	Decreasing	98.8	0.2	-22	9	334
	Sulfate	<0.05	<0.05	Stable	86.957667	0.9	-52	26	264
	Iron, Dissolved	0.12	<0.05	No Trend	72.374042	2.3	-24	24	550
	Chloride	0.80	0.79	Increasing	99.999948	0.2	210	25	351

Table 18. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-39p2	Oxidation Reduction Potential	0.44		Decreasing	95.8	0.7	-6	4	41
	Nitrate as Nitrogen	0.27	0.80	Decreasing	97.2	1.1	-11	6	0.0354
	Methane							2	3.91
	pH	0.61	0.58	No Trend	75.8	0.1	4	5	8.58
	Dissolved Oxygen	0.37	0.37	No Trend	83.3	0.8	4	4	6.83
	Alkalinity (as CaCO3)	0.58	0.55	Increasing	95.8	0.2	8	5	1020
	Sulfate	0.34	0.32	Stable	86.4	0.3	-7	6	49.8
	Iron, Dissolved	0.61	0.44	No Trend	81.45	1.3	6	6	611
	Chloride	0.86	0.78	Stable	40.8	0.4	0	5	540
MW-40p2	Oxidation Reduction Potential							3	65.3
	Nitrate as Nitrogen	<0.05	<0.05	Stable	67.5	0.6	-3	5	4.48
	Methane							1	0.35
	pH	0.28	0.27	Stable	75.8	0.1	-4	5	8.2
	Dissolved Oxygen							3	5
	Alkalinity (as CaCO3)	0.30	0.29	Stable	83.3	0.0	-4	4	121
	Sulfate	0.29	0.27	No Trend	88.3	0.1	6	5	153
	Iron, Dissolved	0.05	0.06	No Trend	50	1.0	1	5	25
	Chloride	0.16	0.15	No Trend	62.5	0.1	2	4	47.7
MW-43p2	Oxidation Reduction Potential							3	37.1
	Nitrate as Nitrogen	0.73	0.65	Increasing	95.8	0.6	6	4	0.297
	Methane							1	8.5
	pH	0.13	0.12	No Trend	62.5	0.1	2	4	8.06
	Dissolved Oxygen							3	6
	Alkalinity (as CaCO3)							3	244
	Sulfate	0.45	0.41	No Trend	62.5	0.4	2	4	90.4
	Iron, Dissolved							3	25
	Chloride	1.00	0.97	Increasing	95.8	0.6	6	4	200
MW-46p2	Oxidation Reduction Potential							2	66
	Nitrate as Nitrogen	0.36	0.50	robably Decreasin	94	1.3	-16	9	0.005
	Methane							1	0.35
	pH	0.21	0.21	No Trend	82.1	0.0	10	9	8.22
	Dissolved Oxygen							1	4
	Alkalinity (as CaCO3)	<0.05	<0.05	No Trend	61.9	0.1	4	9	128
	Sulfate	0.19	0.17	Stable	89	0.1	-13	9	105
	Iron, Dissolved	<0.05	<0.05	Stable	45.2	0.0	0	8	25
	Chloride	0.44	0.47	Decreasing	99.085	0.1	-23	9	5.6
MW-49p2	Oxidation Reduction Potential							3	44.4
	Nitrate as Nitrogen	0.62	0.64	No Trend	83.3	1.2	-4	4	0.005
	Methane							2	0.35
	pH	0.86	0.85	No Trend	83.3	0.1	4	4	8.31
	Dissolved Oxygen							1	2
	Alkalinity (as CaCO3)	0.17	0.16	Stable	50	0.0	-1	4	103
	Sulfate	0.88	0.86	Increasing	95.8	0.1	6	4	56.8
	Iron, Dissolved							2	25
	Chloride	0.60	0.60	Stable	72.9	0.1	-3	4	3.2
MW-52p2	Oxidation Reduction Potential							3	70.9
	Nitrate as Nitrogen	0.07	0.20	Stable	37.5	0.5	0	4	0.014
	Methane							1	0.35
	pH	0.91	0.90	Increasing	95.8	0.0	6	4	8.48
	Dissolved Oxygen							2	6
	Alkalinity (as CaCO3)							3	121
	Sulfate	0.09	0.09	Stable	37.5	0.1	0	4	27.4
	Iron, Dissolved							3	25
	Chloride	0.44	0.45	Stable	72.9	0.0	-3	4	3.6

Table 18. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-60p2	Oxidation Reduction Potential							1	155
	Nitrate as Nitrogen							2	3.22
	pH							2	9.12
	Dissolved Oxygen							1	5.8
	Sulfate							2	20.4
	Iron, Dissolved							2	10
	Chloride							2	3.59
MW-76p2	Oxidation Reduction Potential							1	-45
	Nitrate as Nitrogen							1	0.01
	pH							1	6.42
	Dissolved Oxygen							1	0
	Sulfate							1	35
	Iron, Dissolved							1	5700
	Chloride							1	1010
MW-80p2	Oxidation Reduction Potential							3	-97.6
	Nitrate as Nitrogen	0.56	0.74	No Trend	89.55	1.6	5	4	0.279
	pH							3	6.41
	Dissolved Oxygen							3	0.09
	Sulfate	0.11	0.14	No Trend	62.5	1.3	2	4	24.4
	Iron, Dissolved	0.05	<0.05	Stable	37.5	0.9	0	4	3100
	Chloride	<0.05	<0.05	Stable	62.5	0.3	-2	4	1050
MW-87p2	Oxidation Reduction Potential	<0.05	<0.05	Stable	37.5	-0.7	0	4	-112
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	50	1.2	1	4	0.03
	pH	0.40	0.41	No Trend	62.5	0.0	2	4	6.45
	Dissolved Oxygen	0.07	<0.05	No Trend	62.5	1.2	2	4	0.05
	Sulfate	0.75	0.77	No Trend	83.3	0.6	4	4	38.9
	Iron, Dissolved	0.05	<0.05	Stable	37.5	0.2	0	4	23000
	Chloride	0.09	0.09	Stable	62.5	0.1	-2	4	587
MW-88p2	Oxidation Reduction Potential							1	-84
	Nitrate as Nitrogen							1	0.01
	pH							1	6.59
	Dissolved Oxygen							1	0
	Sulfate							1	153
	Iron, Dissolved							1	816
	Chloride							1	144
MW-91p2	Oxidation Reduction Potential	0.45		No Trend	62.5	-0.8	2	4	-31
	Nitrate as Nitrogen							3	0.01
	pH	0.31	0.32	Stable	37.5	0.0	0	4	6.59
	Dissolved Oxygen	0.58	<0.05	No Trend	83.3	1.2	4	4	1.65
	Sulfate							4	37.1
	Iron, Dissolved	0.29	0.59	No Trend	62.5	0.8	2	4	6090
	Chloride	0.42	0.52	No Trend	83.3	0.4	4	4	760
MW-94p2	Oxidation Reduction Potential							1	-125
	Nitrate as Nitrogen							1	0.01
	pH							1	6.27
	Dissolved Oxygen							1	0
	Sulfate							1	7.48
	Iron, Dissolved							1	3340
	Chloride							1	350
MW-99p2	Oxidation Reduction Potential							3	-63.3
	Nitrate as Nitrogen	0.51	0.51	No Trend	72.9	0.7	3	4	0.03
	pH							3	6.55
	Dissolved Oxygen							3	0.09
	Sulfate	0.92	0.94	Increasing	95.8	0.7	6	4	36.8
	Iron, Dissolved	<0.05	<0.05	Stable	37.5	0.8	0	4	10000
	Chloride	0.61	0.58	No Trend	62.5	0.4	2	4	391

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

R^2: Coefficient of determination (goodness of fit)

M M MOTT MACDONALD

Table 19. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Roza Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-102b	Oxidation Reduction Potential							3	65.1
	Nitrate as Nitrogen	0.10	0.16	Stable	37.5	0.27	0	4	0.564
	pH							3	7.56
	Dissolved Oxygen							3	3.52
	Sulfate	0.89	0.91	Decreasing	95.8	0.19	-6	4	19.3
	Iron, Dissolved	0.45	0.35	No Trend	72.9	0.69	3	4	50
	Chloride	0.12	0.10	No Trend	62.5	0.19	2	4	36.8
MW-103b	Nitrate as Nitrogen	0.14	0.18	Probably Increasing	94.3	2.78	21	16	0.01
	pH	0.27	0.27	Increasing	95.5	0.02	35	15	6.88
	Alkalinity (as CaCO3)	0.14	0.12	No Trend	51.8	0.20	2	16	1770
	Sulfate	<0.05	<0.05	No Trend	83.9	0.22	23	16	750
	Iron, Dissolved	0.19	0.09	Decreasing	97.6	0.38	-45	16	1630
	Chloride	0.41	0.46	Decreasing	99.6	0.32	-60	16	417
MW-105b	Oxidation Reduction Potential							1	-36
	Nitrate as Nitrogen							1	0.0322
	pH							1	7.61
	Dissolved Oxygen							1	0
	Sulfate							1	44.9
	Iron, Dissolved							1	20
	Chloride							1	4.4
MW-116b	Oxidation Reduction Potential							1	-106
	Nitrate as Nitrogen							1	0.01
	pH							1	6.4
	Dissolved Oxygen							1	0
	Sulfate							1	19.4
	Iron, Dissolved							1	40.1
	Chloride							1	3.79
MW-121b	Oxidation Reduction Potential							1	31
	Nitrate as Nitrogen							1	0.01
	pH							1	6.81
	Dissolved Oxygen							1	0
	Sulfate							1	56.4
	Iron, Dissolved							1	10
	Chloride							1	30.2
MW-128b	Oxidation Reduction Potential							1	-41
	Nitrate as Nitrogen							1	0.01
	pH							1	7.48
	Dissolved Oxygen							1	0
	Sulfate							1	24.9
	Iron, Dissolved							1	50
	Chloride							1	3.72
MW-130b	Oxidation Reduction Potential							1	-74
	Nitrate as Nitrogen							1	1.35
	pH							1	6.78
	Dissolved Oxygen							1	0
	Sulfate							1	41.4
	Iron, Dissolved							1	20
	Chloride							1	7.05
MW-132b	Oxidation Reduction Potential							1	-95
	Nitrate as Nitrogen							1	0.01
	pH							1	7.54
	Dissolved Oxygen							1	0
	Sulfate							1	41.5
	Iron, Dissolved							1	20
	Chloride							1	4.12

Table 19. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Roza Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-133b	Oxidation Reduction Potential							3	26.4
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	50.0	0.67	1	4	0.01
	Methane	0.20	<0.05	No Trend	62.5	0.79	2	4	504
	pH							3	6.9
	Dissolved Oxygen							3	0.68
	Alkalinity (as CaCO3)	0.31	0.27	No Trend	62.5	0.20	2	4	878
	Sulfate	0.34	0.39	Stable	37.5	0.35	0	4	63.5
	Iron, Dissolved	0.14	<0.05	No Trend	62.5	1.06	2	4	7040
	Chloride	0.48	0.46	No Trend	62.5	0.52	2	4	429
MW-135b	Oxidation Reduction Potential							1	-67
	Nitrate as Nitrogen							1	0.01
	pH							1	7.4
	Dissolved Oxygen							1	0
	Sulfate							1	44
	Iron, Dissolved							1	20
	Chloride							1	5.16
MW-139b	Oxidation Reduction Potential							1	-119
	Nitrate as Nitrogen							1	0.01
	Methane							1	65.4
	pH							1	7.27
	Dissolved Oxygen							1	0
	Alkalinity (as CaCO3)							1	130
	Sulfate							1	27.9
	Iron, Dissolved							1	10
	Chloride							1	4.35
MW-140b	Oxidation Reduction Potential							2	112.1
	Nitrate as Nitrogen	0.95	0.86	Increasing	95.8	0.53	6	4	1.79
	Methane	0.71	0.71	Stable	72.9	0.80	-3	4	0.325
	pH							2	7.79
	Dissolved Oxygen							2	3.65
	Alkalinity (as CaCO3)							2	220
	Sulfate	0.17	0.19	No Trend	62.5	0.18	2	4	53.5
	Iron, Dissolved	0.26	0.41	No Trend	72.9	0.84	3	4	20
	Chloride	1.00	0.97	Increasing	95.8	0.32	6	4	47.5
MW-142b	Oxidation Reduction Potential							3	157
	Nitrate as Nitrogen	0.70	0.68	Stable	83.3	0.09	-4	4	2.89
	Methane	<0.05	0.36	Stable	37.5	0.97	0	4	25
	pH							3	7.74
	Dissolved Oxygen							3	4.35
	Alkalinity (as CaCO3)	<0.05	<0.05	Stable	62.5	0.04	-2	4	165
	Sulfate	0.13	0.14	Stable	62.5	0.06	-2	4	18.2
	Iron, Dissolved	0.26	0.45	No Trend	62.5	0.64	2	4	100
	Chloride	0.05	0.08	Stable	37.5	0.18	0	4	50.3
MW-144b	Oxidation Reduction Potential							3	28.3
	Nitrate as Nitrogen	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	Methane	0.67	0.58	No Trend	83.3	0.48	4	4	2250
	pH							3	6.88
	Dissolved Oxygen							3	0.03
	Alkalinity (as CaCO3)	0.09	0.09	Stable	62.5	0.03	-2	4	674
	Sulfate	0.61	0.65	Stable	83.3	0.55	-4	4	73
	Iron, Dissolved	0.48	0.43	Stable	83.3	0.16	-4	4	2220
	Chloride	<0.05	<0.05	Stable	37.5	0.18	0	4	329

Table 19. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Roza Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-145b	Oxidation Reduction Potential							3	18.3
	Nitrate as Nitrogen	0.75	0.74	No Trend	83.3	0.32	4	4	3.87
	Methane	0.71	0.77	No Trend	83.3	1.96	-4	4	0.325
	pH							3	8.11
	Dissolved Oxygen							3	1.18
	Alkalinity (as CaCO3)	0.26	0.26	Stable	62.5	0.04	-2	4	168
	Sulfate	0.06	0.06	Stable	62.5	0.07	-2	4	18.4
	Iron, Dissolved	0.19	0.34	No Trend	62.5	0.89	2	4	100
	Chloride	0.66	0.65	Stable	83.3	0.03	-4	4	4.62
MW-146b	Oxidation Reduction Potential							3	55.1
	Nitrate as Nitrogen	0.92	0.87	No Trend	89.6	1.37	-5	4	0.01
	Methane	0.67	0.96	Increasing	95.8	1.41	6	4	351
	pH							3	7.03
	Dissolved Oxygen							3	0.06
	Alkalinity (as CaCO3)	0.89	0.91	No Trend	83.3	0.23	4	4	705
	Sulfate	0.69	0.74	No Trend	83.3	0.27	4	4	261
	Iron, Dissolved	0.83	0.81	No Trend	83.3	0.26	4	4	354
	Chloride	0.89	0.90	No Trend	83.3	0.39	4	4	271
MW-148b	Oxidation Reduction Potential							3	-2.1
	Nitrate as Nitrogen	0.77	0.75	Decreasing	95.8	0.08	-6	4	0.452
	Methane	0.54	0.57	Increasing	95.8	0.70	6	4	28.7
	pH							3	8.02
	Dissolved Oxygen							3	0.32
	Alkalinity (as CaCO3)	0.07	0.07	Stable	50.0	0.03	-1	4	206
	Sulfate	0.09	0.11	No Trend	62.5	0.08	2	4	29.9
	Iron, Dissolved	0.79	0.83	No Trend	89.6	0.78	5	4	100
	Chloride	0.76	0.76	No Trend	83.3	0.06	4	4	113
MW-149b	Oxidation Reduction Potential							3	94.6
	Nitrate as Nitrogen							3	7.44
	Methane							3	3.25
	pH							3	7.57
	Dissolved Oxygen							3	2.82
	Alkalinity (as CaCO3)							3	172
	Sulfate							3	23.2
	Iron, Dissolved							3	100
	Chloride							3	28.5
MW-150b	Oxidation Reduction Potential							3	103.2
	Nitrate as Nitrogen							3	1.52
	Methane							3	5.2
	pH							3	7.99
	Dissolved Oxygen							3	0.99
	Alkalinity (as CaCO3)							3	228
	Sulfate							2	87.3
	Iron, Dissolved							3	100
	Chloride							2	46.8
MW-151b	Oxidation Reduction Potential							3	152.4
	Nitrate as Nitrogen	0.48	0.63	No Trend	83.3	0.48	4	4	2.24
	Methane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.325
	pH							3	7.45
	Dissolved Oxygen							3	0.61
	Alkalinity (as CaCO3)	0.94	0.94	Stable	89.6	0.08	-5	4	318
	Sulfate	0.85	0.85	Stable	83.3	0.26	-4	4	114
	Iron, Dissolved	0.48	0.45	No Trend	62.5	0.93	2	4	100
	Chloride	0.65	0.62	Stable	83.3	0.20	-4	4	86

MOTT MACDONALD

Table 19. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Roza Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-19b	Oxidation Reduction Potential							3	94
	Nitrate as Nitrogen	0.41	0.49	Increasing	100.0	0.83	115	21	0.11
	Methane							1	0.35
	pH	0.45	0.43	Probably Increasing	91.2	0.03	49	22	7.62
	Dissolved Oxygen							2	6.02
	Alkalinity (as CaCO3)	0.26	0.26	Increasing	98.9	0.08	61	18	141
	Sulfate	0.16	0.17	Decreasing	98.0	0.10	-69	21	535
	Iron, Dissolved	0.16	0.11	Probably Increasing	91.6	1.17	25	14	25
	Chloride	<0.05	<0.05	Stable	78.4	0.08	-27	21	19.4
MW-29b	Oxidation Reduction Potential	0.24		Stable	40.8	-0.58	0	5	-43.3
	Nitrate as Nitrogen	0.30	0.73	Decreasing	99.7	1.22	-10	5	0.01
	Methane							1	59.1
	pH	0.25	0.23	Increasing	95.8	0.12	8	5	7.34
	Dissolved Oxygen	<0.05	0.10	No Trend	62.5	0.53	2	4	6.15
	Alkalinity (as CaCO3)	0.99	0.99	Increasing	95.8	0.10	6	4	288
	Sulfate	0.23	0.18	Stable	59.2	0.30	-2	5	50
	Iron, Dissolved	0.59	0.46	Increasing	95.8	0.52	6	4	628
	Chloride	0.13	0.15	No Trend	88.3	0.19	6	5	464
MW-30b	Oxidation Reduction Potential	0.49		Stable	83.3	-1.83	-4	4	-117
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	75.8	1.46	-4	5	0.036
	Methane							1	32
	pH	0.91	0.89	Increasing	95.8	0.14	6	4	7.79
	Dissolved Oxygen	0.11	0.14	No Trend	62.5	1.09	2	4	0.7
	Alkalinity (as CaCO3)	0.89	0.88	Increasing	95.8	0.05	6	4	155
	Sulfate	0.77	0.86	Decreasing	95.8	0.30	-8	5	24.1
	Iron, Dissolved							3	25
	Chloride	0.93	0.88	No Trend	59.2	0.54	2	5	26.7
MW-31b	Oxidation Reduction Potential	0.17		Stable	88.3	-6.90	-6	5	-94
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	67.5	0.64	3	5	0.01
	Methane							1	40.6
	pH	0.15	0.14	Increasing	95.8	0.15	8	5	7.62
	Dissolved Oxygen	0.40	<0.05	Stable	82.1	0.93	-5	5	0
	Alkalinity (as CaCO3)	0.33	0.33	Stable	72.9	0.02	-3	4	122
	Sulfate	0.96	0.93	Increasing	99.7	0.24	10	5	69
	Iron, Dissolved	0.19	0.47	No Trend	62.5	1.28	-2	4	10
	Chloride	0.69	0.59	No Trend	62.5	0.25	2	4	8.06
MW-3b	Oxidation Reduction Potential							3	-30
	Nitrate as Nitrogen	0.11	0.18	Increasing	99.4	1.33	181	39	0.03
	Methane							1	410
	pH	0.14	0.14	Increasing	98.7	0.02	186	39	6.87
	Dissolved Oxygen							2	4.92
	Alkalinity (as CaCO3)	0.31	0.32	Decreasing	100.0	0.09	-268	38	1030
	Sulfate	<0.05	<0.05	Decreasing	95.4	0.26	-135	38	1010
	Iron, Dissolved	0.49	0.14	Decreasing	100.0	0.30	-330	34	5290
	Chloride	0.41	0.40	Decreasing	100.0	0.28	-359	38	777
MW-42b	Oxidation Reduction Potential	<0.05	<0.05	No Trend	59.2	1.40	-2	5	43
	Nitrate as Nitrogen	0.05	<0.05	Stable	76.9	0.76	-29	24	0.01
	Methane							2	10
	pH	0.09	0.09	Increasing	95.9	0.05	71	24	7.51
	Dissolved Oxygen	0.90	0.56	No Trend	59.2	1.18	2	5	5.7
	Alkalinity (as CaCO3)	<0.05	<0.05	Stable	54.0	0.06	-2	9	725
	Sulfate	0.35	0.46	Decreasing	100.0	0.57	-173	24	93.8
	Iron, Dissolved	<0.05	<0.05	Stable	50.0	0.56	-1	24	290
	Chloride	0.82	0.83	Decreasing	100.0	0.16	-195	24	248

Table 19. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Roza Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-44b	Oxidation Reduction Potential	<0.05	<0.05	No Trend	40.8	6.22	0	5	10
	Nitrate as Nitrogen	0.94	0.94	Increasing	99.9	0.36	63	16	0.01
	Methane							2	1270
	pH	0.09	0.09	No Trend	53.9	0.06	3	15	7.43
	Dissolved Oxygen	0.95	0.70	No Trend	50.0	1.60	-1	5	5.78
	Alkalinity (as CaCO3)	0.77	0.74	Increasing	96.4	0.09	21	10	808
	Sulfate	0.66	0.72	Increasing	100.0	0.65	88	16	168
	Iron, Dissolved	<0.05	<0.05	Increasing	99.0	0.67	53	16	1210
	Chloride	0.32	0.35	Decreasing	99.6	0.11	-60	16	350
MW-48b	Oxidation Reduction Potential							3	80.31
	Nitrate as Nitrogen	0.10	0.10	No Trend	50.0	0.04	1	9	3.24
	Methane							1	0.35
	pH	0.25	0.25	No Trend	82.1	0.03	10	9	7.8
	Dissolved Oxygen							1	8
	Alkalinity (as CaCO3)	<0.05	<0.05	Stable	84.6	0.03	-11	9	178
	Sulfate	0.09	0.09	Stable	82.1	0.15	-10	9	20.4
	Iron, Dissolved	<0.05	<0.05	Stable	46.0	0.00	0	9	25
	Chloride	<0.05	<0.05	No Trend	54.0	0.08	2	9	5.3
MW-51b	Oxidation Reduction Potential							3	85.7
	Nitrate as Nitrogen	0.09	0.10	Stable	37.5	0.26	0	4	0.803
	Methane							1	0.35
	pH	<0.05	<0.05	Stable	37.5	0.04	0	4	8.22
	Dissolved Oxygen							3	2
	Alkalinity (as CaCO3)	0.07	0.07	Stable	50.0	0.04	-1	4	163
	Sulfate	0.10	0.11	No Trend	62.5	0.12	2	4	51.4
	Iron, Dissolved	<0.05	<0.05	Stable	37.5	0.00	0	4	25
	Chloride	0.21	0.20	No Trend	62.5	0.14	2	4	8.2
MW-57b	Oxidation Reduction Potential							2	220
	Nitrate as Nitrogen							3	6.83
	Methane							1	0.325
	pH							3	7.91
	Dissolved Oxygen							2	8.72
	Alkalinity (as CaCO3)							1	156
	Sulfate							3	28.5
	Iron, Dissolved							3	100
	Chloride							3	8.43
MW-63b	Oxidation Reduction Potential							2	-47
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	59.4	1.59	3	8	0.01
	Methane							1	2690
	pH	0.05	0.06	No Trend	61.4	0.09	3	7	7.32
	Dissolved Oxygen							1	6.43
	Alkalinity (as CaCO3)							1	837
	Sulfate	<0.05	<0.05	Stable	54.8	0.70	-2	8	13.7
	Iron, Dissolved	0.52	0.64	No Trend	54.8	0.50	2	8	8160
	Chloride	0.55	0.54	Decreasing	96.9	0.07	-16	8	422
MW-71b	Oxidation Reduction Potential							3	103
	Nitrate as Nitrogen	0.80	0.79	Stable	83.3	0.15	-4	4	21.3
	Methane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.325
	pH							3	7.29
	Dissolved Oxygen							3	0.4
	Alkalinity (as CaCO3)	0.59	0.59	Stable	83.3	0.08	-4	4	383
	Sulfate	<0.05	<0.05	Stable	62.5	0.16	-2	4	201
	Iron, Dissolved	0.59	0.72	No Trend	89.6	1.25	5	4	100
	Chloride	0.38	0.40	Stable	83.3	0.11	-4	4	147

Table 19. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Roza Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-72b	Oxidation Reduction Potential							1	-18
	Nitrate as Nitrogen							1	0.0336
	pH							1	6.31
	Dissolved Oxygen							1	0
	Sulfate							1	865
	Iron, Dissolved							1	842
	Chloride							1	2100
MW-74b	Oxidation Reduction Potential							1	-109
	Nitrate as Nitrogen							1	0.01
	pH							1	8.24
	Dissolved Oxygen							1	
	Sulfate							1	31.5
	Iron, Dissolved							1	10
	Chloride							1	3.95
MW-78b	Oxidation Reduction Potential							1	-33
	Nitrate as Nitrogen							1	0.056
	pH							1	7.1
	Dissolved Oxygen							1	0
	Sulfate							1	27.7
	Iron, Dissolved							1	20
	Chloride							1	282
MW-7b	Oxidation Reduction Potential							3	-12
	Nitrate as Nitrogen	0.42	0.77	Increasing	100.0	1.49	1156	61	4.7
	Methane							1	201
	pH	0.66	0.66	Increasing	100.0	0.03	1090	60	7.21
	Dissolved Oxygen							2	4.32
	Alkalinity (as CaCO3)	0.75	0.67	Decreasing	100.0	0.38	-1121	60	518
	Sulfate	0.76	0.76	Decreasing	100.0	0.51	-1094	60	281
	Iron, Dissolved	0.77	0.74	Decreasing	100.0	1.24	-1125	56	25
	Chloride	0.85	0.81	Decreasing	100.0	0.63	-1264	60	240
MW-81b	Oxidation Reduction Potential							3	-23.6
	Nitrate as Nitrogen							3	0.01
	pH							3	6.43
	Dissolved Oxygen							3	0.34
	Sulfate	0.82	0.82	No Trend	83.3	0.14	4	4	33.6
	Iron, Dissolved	<0.05	<0.05	Stable	37.5	0.78	0	4	1180
	Chloride	0.11	0.11	Stable	62.5	0.21	-2	4	1050
MW-82b	Oxidation Reduction Potential							3	-81.9
	Nitrate as Nitrogen	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	Methane	<0.05	0.24	Stable	37.5	0.93	0	4	757
	pH							3	8.01
	Dissolved Oxygen							3	0.06
	Alkalinity (as CaCO3)	<0.05	<0.05	Stable	37.5	0.07	0	4	131
	Sulfate	0.11	0.08	No Trend	62.5	0.33	2	4	15.4
	Iron, Dissolved	0.17	0.29	Stable	62.5	0.60	-2	4	50
	Chloride	0.48	0.49	Stable	83.3	0.06	-4	4	3.14

Table 19. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Roza Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-86b	Oxidation Reduction Potential							1	11
	Nitrate as Nitrogen							1	0.01
	pH							1	7.05
	Dissolved Oxygen							1	0
	Sulfate							1	24.3
	Iron, Dissolved							1	10
	Chloride							1	4.73
MW-89b	Oxidation Reduction Potential							1	-75
	Nitrate as Nitrogen							1	0.01
	pH							1	6.15
	Dissolved Oxygen							1	0
	Sulfate							1	137
	Iron, Dissolved							1	901
	Chloride							1	215
MW-93b	Oxidation Reduction Potential							1	-118
	Nitrate as Nitrogen							1	0.01
	pH							1	7.2
	Dissolved Oxygen							1	0
	Sulfate							1	52
	Iron, Dissolved							1	20
	Chloride							1	81.1
MW-96b	Oxidation Reduction Potential							1	-72
	Nitrate as Nitrogen							1	0.022
	pH							1	7.18
	Dissolved Oxygen							1	0
	Sulfate							1	16
	Iron, Dissolved							1	74.2
	Chloride							1	8.43
MW-97b	Oxidation Reduction Potential							1	-109
	Nitrate as Nitrogen							1	0.0607
	pH							1	7.13
	Dissolved Oxygen							1	0
	Sulfate							1	70
	Iron, Dissolved							1	20
	Chloride							1	5.38
MW-9b	Oxidation Reduction Potential							3	146
	Nitrate as Nitrogen	<0.05	<0.05	No Trend	73.3	0.39	111	65	24.8
	Methane							1	16.4
	pH	0.10	0.10	Increasing	97.9	0.02	353	64	6.98
	Dissolved Oxygen							2	1.68
	Alkalinity (as CaCO3)	0.88	0.88	Decreasing	100.0	0.16	-1562	64	581
	Sulfate	0.52	0.58	Decreasing	100.0	0.61	-1176	64	274
	Iron, Dissolved	<0.05	<0.05	Stable	56.5	0.51	-9	60	25
	Chloride	0.55	0.82	Decreasing	100.0	1.13	-1638	64	65.6

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

R^2: Coefficient of determination (goodness of fit)

Table 20. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Interflow Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-20c	Oxidation Reduction Potential			NA				3	130
	Nitrate as Nitrogen	0.18	0.15	Decreasing	100.0	0.13	-636	66	1.13
	Methane			NA				1	15.8
	pH	0.12	0.11	Increasing	100.0	0.05	612	65	8.01
	Dissolved Oxygen			NA				2	6.1
	Alkalinity (as CaCO3)	<0.05	<0.05	Increasing	99.2	0.20	426	65	160
	Sulfate	0.34	0.33	Decreasing	100.0	0.12	-788	65	24.4
	Iron, Dissolved	<0.05	<0.05	Stable	62.4	0.53	-20	61	25
	Chloride	<0.05	<0.05	Stable	78.1	0.14	-138	65	5.48
MW-21c	Oxidation Reduction Potential			NA				3	27
	Nitrate as Nitrogen	0.67	0.66	Increasing	100.0	0.15	1147	60	138
	Methane			NA				1	12.5
	pH	<0.05	<0.05	No Trend	74.1	0.03	105	62	7.73
	Dissolved Oxygen			NA				2	4.09
	Alkalinity (as CaCO3)	<0.05	<0.05	Stable	87.0	0.50	-172	59	117
	Sulfate	0.13	0.10	Increasing	100.0	0.22	643	59	81.9
	Iron, Dissolved	<0.05	<0.05	No Trend	86.5	0.54	51	56	25
	Chloride	<0.05	<0.05	Increasing	99.7	0.20	422	59	28.5
MW-22c	Oxidation Reduction Potential			NA				3	111
	Nitrate as Nitrogen	0.36	<0.05	Increasing	100.0	0.35	1258	61	24.7
	Methane			NA				1	0.35
	pH	<0.05	<0.05	No Trend	63.7	0.02	56	61	7.57
	Dissolved Oxygen			NA				2	8.02
	Alkalinity (as CaCO3)	0.07	0.22	Increasing	100.0	1.03	1341	60	315
	Sulfate	0.36	0.31	Increasing	100.0	0.19	936	60	60
	Iron, Dissolved	0.06	0.08	Increasing	98.7	1.65	125	57	25
	Chloride	<0.05	<0.05	No Trend	56.8	0.21	28	60	151
MW-2c	Oxidation Reduction Potential			NA				3	95
	Nitrate as Nitrogen	0.86	0.89	Decreasing	100.0	0.34	-1757	66	3.65
	Methane			NA				1	0.35
	pH	<0.05	<0.05	No Trend	85.5	0.02	188	65	7.17
	Dissolved Oxygen			NA				2	3.88
	Alkalinity (as CaCO3)	0.87	0.90	Increasing	100.0	0.47	1756	65	226
	Sulfate	<0.05	<0.05	No Trend	87.9	0.15	208	65	72
	Iron, Dissolved	<0.05	<0.05	Stable	56.4	0.51	-9	61	25
	Chloride	<0.05	0.06	Stable	61.6	0.14	-53	65	868
MW-45c	Oxidation Reduction Potential			NA				3	7.3
	Nitrate as Nitrogen	0.57	0.55	Increasing	99.4	0.10	24	9	3.54
	Methane			NA				1	0.35
	pH	<0.05	<0.05	No Trend	54.0	0.02	2	9	7.96
	Dissolved Oxygen	<0.05	<0.05	Stable	62.5	0.80	-2	4	0.5
	Alkalinity (as CaCO3)	0.36	0.36	Decreasing	97.8	0.04	-20	9	111
	Sulfate	0.50	0.50	Increasing	97.8	0.10	20	9	51.1
	Iron, Dissolved	<0.05	<0.05	Stable	46.0	0.00	0	9	25
	Chloride	0.54	0.54	Increasing	98.8	0.13	22	9	83.2
MW-47c	Oxidation Reduction Potential			NA				3	30.3
	Nitrate as Nitrogen	<0.05	<0.05	Stable	37.5	0.15	0	4	1.65
	Methane			NA				1	0.35
	pH	0.13	0.12	No Trend	62.5	0.24	2	4	8.17
	Dissolved Oxygen			NA				2	2
	Alkalinity (as CaCO3)	0.39	0.39	Stable	72.9	0.02	-3	4	145
	Sulfate	<0.05	<0.05	No Trend	62.5	0.05	2	4	35
	Iron, Dissolved	<0.05	<0.05	Stable	37.5	0.00	0	4	25
	Chloride	<0.05	<0.05	Stable	50.0	0.02	-1	4	7.6

Table 20. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Interflow Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-4c	Oxidation Reduction Potential			NA				3	64
	Nitrate as Nitrogen	<0.05	0.05	Increasing	100.0	1.76	654	66	0.01
	Methane			NA				1	0.35
	pH	0.10	0.08	Increasing	99.8	0.04	513	65	8.43
	Dissolved Oxygen			NA				2	4.02
	Alkalinity (as CaCO3)	<0.05	<0.05	Increasing	98.0	0.17	359	65	130
	Sulfate	0.14	0.13	Decreasing	100.0	0.13	-611	65	34.4
	Iron, Dissolved	<0.05	<0.05	No Trend	84.4	1.19	78	61	25
	Chloride	<0.05	<0.05	No Trend	65.3	0.10	70	65	10.7
MW-50c	Oxidation Reduction Potential			NA				3	19.9
	Nitrate as Nitrogen	<0.05	<0.05	Stable	37.5	0.00	0	4	0.005
	Methane			NA				1	0.35
	pH	0.47	0.47	No Trend	83.3	0.03	4	4	8.2
	Dissolved Oxygen			NA				3	0.15
	Alkalinity (as CaCO3)	0.46	0.46	No Trend	72.9	0.01	3	4	126
	Sulfate	0.46	0.45	Stable	62.5	0.13	-2	4	41
	Iron, Dissolved	0.46	0.46	No Trend	72.9	1.51	-3	4	25
	Chloride	0.11	0.11	No Trend	50.0	0.03	1	4	6.1
MW-54c	Oxidation Reduction Potential			NA				3	-6.1
	Nitrate as Nitrogen	0.87	0.83	No Trend	83.3	1.01	4	4	0.065
	Methane			NA				1	0.35
	pH	0.16	0.16	Stable	83.3	0.06	-4	4	8.55
	Dissolved Oxygen			NA				3	0.6
	Alkalinity (as CaCO3)	0.33	0.32	Stable	62.5	0.05	-2	4	121
	Sulfate	0.41	0.40	Stable	62.5	0.26	-2	4	41.2
	Iron, Dissolved	0.35	0.05	No Trend	50.0	1.62	-1	4	330
	Chloride	0.41	0.40	Stable	37.5	0.23	0	4	6.4
MW-56c	Nitrate as Nitrogen			NA				2	2.52
	pH			NA				2	8.1
	Alkalinity (as CaCO3)			NA				2	134
	Sulfate			NA				2	27.8
	Iron, Dissolved			NA				2	25
	Chloride			NA				2	27.4
MW-58c	Oxidation Reduction Potential			NA				2	-108
	Nitrate as Nitrogen	0.68	0.39	Stable	83.3	0.97	-4	4	0.0444
	Methane			NA				1	168
	pH			NA				3	8.93
	Dissolved Oxygen			NA				1	6.91
	Alkalinity (as CaCO3)			NA				1	252
	Sulfate	0.89	0.91	Increasing	95.8	0.17	6	4	28.3
	Iron, Dissolved	<0.05	<0.05	Stable	37.5	0.00	0	4	10
	Chloride	0.46	0.41	No Trend	83.3	0.16	4	4	448
MW-5c	Oxidation Reduction Potential			NA				3	143
	Nitrate as Nitrogen	0.87	0.86	Decreasing	100.0	0.50	-1573	65	1.83
	Methane			NA				1	0.35
	pH	0.08	0.08	Increasing	95.0	0.03	285	64	7.34
	Dissolved Oxygen			NA				2	2.04
	Alkalinity (as CaCO3)	0.84	0.86	Increasing	100.0	0.18	1536	64	317
	Sulfate	0.50	0.51	Decreasing	100.0	0.30	-1345	64	94.6
	Iron, Dissolved	<0.05	<0.05	No Trend	87.6	1.02	57	60	25
	Chloride	0.41	0.41	Increasing	100.0	0.09	899	64	599

Table 20. Results of Mann-Kendall Test and Regression Analysis for Geochemical Parameter in Interflow Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-62c	Oxidation Reduction Potential			NA				1	-11
	Nitrate as Nitrogen			NA				2	0.01
	pH			NA				2	8.15
	Dissolved Oxygen			NA				1	5.17
	Sulfate			NA				2	21.8
	Iron, Dissolved			NA				1	30
	Chloride			NA				2	7.15
MW-6c	Oxidation Reduction Potential			NA				3	120
	Nitrate as Nitrogen	0.67	0.64	Decreasing	100.0	0.20	-1390	63	13.3
	Methane			NA				1	1
	pH	0.31	0.31	Increasing	100.0	0.03	755	62	7.29
	Dissolved Oxygen			NA				2	3.24
	Alkalinity (as CaCO3)	0.13	0.13	Decreasing	100.0	0.14	-585	62	361
	Sulfate	<0.05	<0.05	No Trend	84.6	0.24	169	62	80.8
	Iron, Dissolved	<0.05	<0.05	Decreasing	95.6	0.19	-81	58	25
	Chloride	0.80	0.86	Decreasing	100.0	0.40	-1582	62	221

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

R^2: Coefficient of determination (goodness of fit)

Table 21. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-100p1	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.27
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.32
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.5
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-104p1	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	7.57
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-109p1	Tetrachloroethene (PCE)							3	0.5
	1,1,1-Trichloroethane							3	182
	1,1-Dichloroethene							3	40.7
	1,2,4-Trimethylbenzene							3	0.5
	1,3,5-Trimethylbenzene							3	0.5
	Acetone							2	12.5
	Chloroform							3	0.5
	Ethylbenzene							3	0.5
	Methylene Chloride							3	2.5
	Toluene							3	0.5
	Total Xylenes							3	1.5
MW-110p1	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	1.36
	1,1-Dichloroethene							1	1.08
	1,2,4-Trimethylbenzene							1	4.04
	1,3,5-Trimethylbenzene							1	0.75
	Acetone							1	146
	Chloroform							1	0.1
	Ethylbenzene							1	2.79
	Methylene Chloride							1	0.5
	Toluene							1	10.6
	Total Xylenes							1	15.7
MW-117p1	Tetrachloroethene (PCE)	0.16	0.06	Stable	37.5	0.90	0	4	1.14
	1,1,1-Trichloroethane	0.47	<0.05	No Trend	62.5	1.16	-2	4	60.2
	1,1-Dichloroethene	0.46	0.06	No Trend	62.5	1.04	-2	4	21.3
	1,2,4-Trimethylbenzene	0.39	0.48	Stable	72.9	0.68	-3	4	0.1
	1,3,5-Trimethylbenzene	0.22	0.22	Stable	62.5	0.94	-2	4	0.1
	Acetone	0.30	0.41	Stable	72.9	0.78	-3	4	2.5
	Chloroform	0.28	0.42	Stable	72.9	0.63	-3	4	0.24
	Ethylbenzene	0.44	0.48	Stable	72.9	0.48	-3	4	0.27
	Methylene Chloride	0.12	0.38	No Trend	72.9	1.12	-3	4	0.5
	Toluene	0.11	0.20	No Trend	62.5	1.62	2	4	1.7
	Total Xylenes	<0.05	0.11	Stable	62.5	0.88	-2	4	0.75

Table 21. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-123p1	Tetrachloroethene (PCE)	0.35	0.43	Stable	62.5	0.46	-2	4	3.28
	1,1,1-Trichloroethane	0.07	0.42	No Trend	83.3	1.63	-4	4	1.3
	1,1-Dichloroethene	0.19	0.44	Stable	83.3	0.96	-4	4	5.4
	1,2,4-Trimethylbenzene	0.06	<0.05	No Trend	37.5	1.60	0	4	1.94
	1,3,5-Trimethylbenzene	0.05	<0.05	No Trend	37.5	1.50	0	4	1.07
	Acetone	0.58	0.40	No Trend	72.9	1.05	-3	4	2.5
	Chloroform	0.27	0.30	Stable	72.9	0.45	-3	4	0.2
	Ethylbenzene	<0.05	<0.05	No Trend	37.5	1.27	0	4	5.31
	Methylene Chloride	0.22	0.22	Stable	62.5	0.77	-2	4	0.5
	Toluene	<0.05	<0.05	No Trend	37.5	1.28	0	4	1.09
	Total Xylenes	<0.05	<0.05	No Trend	37.5	1.32	0	4	13.9
MW-127p1	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-129p1	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-34p1	Tetrachloroethene (PCE)	0.32	0.69	Decreasing	100.0	2.73	-167	23	0.1
	1,1,1-Trichloroethane	0.22	0.64	Decreasing	100.0	1.82	-165	23	0.1
	1,1-Dichloroethene	0.33	0.73	Decreasing	100.0	2.65	-149	23	0.1
	1,2,4-Trimethylbenzene	<0.05	0.13	Decreasing	100.0	2.42	-182	23	59.8
	1,3,5-Trimethylbenzene	<0.05	0.10	Decreasing	100.0	2.34	-142	23	17.3
	Acetone	0.26	0.54	Decreasing	99.8	2.87	-110	23	22.9
	Bis(2-ethylhexyl) Phthalate	0.45	0.18	Stable	52.2	0.80	-2	14	6.5
	Chloroform	0.34	0.69	Decreasing	100.0	2.67	-163	23	0.1
	Ethylbenzene	<0.05	0.43	Decreasing	100.0	2.32	-209	23	81.9
	Methylene Chloride	0.50	0.67	Decreasing	100.0	2.16	-155	23	0.5
	Toluene	<0.05	0.55	Decreasing	100.0	2.30	-210	23	12.8
	Total Xylenes	<0.05	0.25	Decreasing	100.0	3.33	-104	16	70.8
MW-36p1	Tetrachloroethene (PCE)	<0.05	0.13	No Trend	37.5	1.26	0	4	2.5
	1,1,1-Trichloroethane	0.35	0.52	Stable	83.3	0.79	-4	4	2.5
	1,1-Dichloroethene	<0.05	<0.05	No Trend	62.5	1.18	-2	4	2.5
	1,2,4-Trimethylbenzene	0.14	0.17	No Trend	62.5	0.33	2	4	353
	1,3,5-Trimethylbenzene	<0.05	0.11	Stable	37.5	0.48	0	4	77.5
	Acetone	<0.05	0.08	No Trend	37.5	1.25	0	4	62.5
	Chloroform	<0.05	0.20	No Trend	37.5	1.26	0	4	2.5
	Ethylbenzene	0.08	0.15	Stable	37.5	0.35	0	4	882
	Methylene Chloride	<0.05	0.26	No Trend	37.5	1.27	0	4	12.5
	Toluene	0.77	0.75	Stable	83.3	0.76	-4	4	1310
	Total Xylenes	0.27	0.36	Stable	62.5	0.44	-2	4	2200

Table 21. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-37p1	Tetrachloroethene (PCE)	0.50	0.93	Stable	88.3	0.87	-6	5	0.1
	1,1,1-Trichloroethane	0.34	0.87	Decreasing	95.8	1.15	-8	5	0.1
	1,1-Dichloroethene	0.60	0.95	Stable	88.3	0.76	-6	5	0.1
	1,2,4-Trimethylbenzene	0.27	0.27	Stable	88.3	0.84	-6	5	0.1
	1,3,5-Trimethylbenzene	0.27	0.27	Stable	88.3	0.84	-6	5	0.1
	Acetone	0.09	0.11	No Trend	50.0	0.58	1	5	2.5
	Chloroform	0.68	0.95	Probably Decreasing	92.1	0.68	-7	5	0.1
	Ethylbenzene	0.24	0.11	Probably Decreasing	92.1	0.52	-7	5	0.22
	Methylene Chloride	0.07	<0.05	Stable	75.8	0.63	-4	5	0.5
	Toluene	0.18	0.09	No Trend	88.3	1.21	-6	5	0.42
	Total Xylenes							1	0.3
MW-61p1	Tetrachloroethene (PCE)							2	0.1
	1,1,1-Trichloroethane							2	0.1
	1,1-Dichloroethene							2	0.1
	1,2,4-Trimethylbenzene							2	0.1
	1,3,5-Trimethylbenzene							2	0.1
	Acetone							2	24
	Chloroform							2	0.1
	Ethylbenzene							2	0.1
	Methylene Chloride							2	0.5
	Toluene							2	0.26
	Total Xylenes							1	0.3
MW-64p1	Tetrachloroethene (PCE)							2	0.1
	1,1,1-Trichloroethane							2	0.1
	1,1-Dichloroethene							2	0.1
	1,2,4-Trimethylbenzene							2	0.87
	1,3,5-Trimethylbenzene							2	0.38
	Acetone							2	18.9
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform							2	0.1
	Ethylbenzene							2	8.78
	Methylene Chloride							2	0.5
	Toluene							2	3.22
	Total Xylenes							1	5.14
MW-65p1	Tetrachloroethene (PCE)	0.18	0.18	No Trend	50.0	1.77	1	8	0.1
	1,1,1-Trichloroethane	0.06	0.58	No Trend	54.8	1.11	-2	8	0.1
	1,1-Dichloroethene	0.08	0.21	No Trend	50.0	1.22	1	8	0.1
	1,2,4-Trimethylbenzene	0.52	0.77	Decreasing	97.3	0.88	-20	8	25.8
	1,3,5-Trimethylbenzene	0.55	0.88	Decreasing	97.3	0.87	-20	8	2.89
	Acetone	<0.05	<0.05	No Trend	76.4	1.57	7	8	13.7
	Bis(2-ethylhexyl) Phthalate	0.20	0.20	No Trend	76.5	0.50	5	6	3.8
	Chloroform	0.16	0.12	No Trend	54.8	1.94	2	8	0.1
	Ethylbenzene	0.48	0.52	Decreasing	98.4	0.96	-18	8	82.5
	Methylene Chloride	0.16	0.12	No Trend	54.8	1.94	2	8	0.5
	Toluene	0.49	0.89	Decreasing	97.3	1.05	-20	8	5.04
	Total Xylenes	0.26	0.80	Probably Decreasing	93.2	1.04	-9	6	33.4
MW-66p1	Tetrachloroethene (PCE)							2	0.1
	1,1,1-Trichloroethane							2	0.1
	1,1-Dichloroethene							2	0.1
	1,2,4-Trimethylbenzene							2	12.1
	1,3,5-Trimethylbenzene							2	1.08
	Acetone							2	14.1
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform							2	0.1
	Ethylbenzene							2	26.7
	Methylene Chloride							2	0.5
	Toluene							2	5.03
	Total Xylenes							1	13

Table 21. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-67p1	Tetrachloroethene (PCE)							2	1
	1,1,1-Trichloroethane							2	1
	1,1-Dichloroethene							2	1
	1,2,4-Trimethylbenzene							2	3.08
	1,3,5-Trimethylbenzene							2	1
	Acetone							2	54.2
	Bis(2-ethylhexyl) Phthalate							1	3
	Chloroform							2	1
	Ethylbenzene							2	11.6
	Methylene Chloride							2	5
	Toluene							1	2000
	Total Xylenes							1	8.09
MW-68p1	Tetrachloroethene (PCE)	0.09	0.52	Stable	69.1	0.87	-9	13	0.1
	1,1,1-Trichloroethane	0.27	0.76	No Trend	62.0	0.83	6	13	0.82
	1,1-Dichloroethene	0.13	0.63	Stable	62.1	0.79	-6	13	0.1
	1,2,4-Trimethylbenzene	0.39	0.45	Decreasing	99.6	0.48	-45	13	209
	1,3,5-Trimethylbenzene	0.61	0.84	Decreasing	99.1	0.43	-40	13	15.3
	Acetone	<0.05	0.15	Stable	74.9	0.89	-12	13	17.6
	Bis(2-ethylhexyl) Phthalate	0.15	0.35	Probably Increasing	92.9	1.05	13	8	11.1
	Chloroform	<0.05	0.32	No Trend	50.0	0.95	1	13	0.1
	Ethylbenzene	0.30	0.43	Decreasing	97.8	1.03	-34	13	341
	Methylene Chloride	<0.05	<0.05	No Trend	62.3	1.03	6	13	0.5
	Toluene	0.36	0.78	No Trend	90.0	1.02	-22	13	498
	Total Xylenes	0.31	0.84	Decreasing	95.7	0.58	-26	12	237
MW-69p1	Tetrachloroethene (PCE)	0.56	<0.05	No Trend	50.0	1.32	1	5	50
	1,1,1-Trichloroethane	0.81	0.81	No Trend	88.3	1.94	-6	5	50
	1,1-Dichloroethene	0.70	0.50	No Trend	75.8	1.17	-4	5	50
	1,2,4-Trimethylbenzene	0.77	0.71	Stable	88.3	0.32	-6	5	341
	1,3,5-Trimethylbenzene	0.87	0.78	Stable	88.3	0.40	-6	5	120
	Acetone	0.73	0.40	No Trend	82.1	1.04	-5	5	1250
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform	0.34	<0.05	No Trend	50.0	1.02	1	5	50
	Ethylbenzene	0.92	0.90	Decreasing	95.8	0.49	-8	5	1470
	Methylene Chloride	0.56	0.41	Probably Increasing	92.1	1.06	7	5	250
	Toluene	0.71	0.38	No Trend	75.8	1.13	-4	5	15300
	Total Xylenes	0.72	0.68	Stable	83.3	0.27	-4	4	4960
MW-70p1	Tetrachloroethene (PCE)							2	0.1
	1,1,1-Trichloroethane							2	0.1
	1,1-Dichloroethene							2	0.1
	1,2,4-Trimethylbenzene							2	0.1
	1,3,5-Trimethylbenzene							2	0.1
	Acetone							2	5.99
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform							2	0.1
	Ethylbenzene							2	0.91
	Methylene Chloride							2	0.5
	Toluene							2	0.22
	Total Xylenes							1	1.01
MW-83p1	Tetrachloroethene (PCE)	<0.05	0.31	No Trend	50.0	1.24	1	4	10
	1,1,1-Trichloroethane	0.99	0.95	Decreasing	95.8	0.77	-6	4	10
	1,1-Dichloroethene	0.11	0.22	Stable	72.9	0.88	-3	4	10
	1,2,4-Trimethylbenzene	0.20	0.27	Stable	62.5	0.33	-2	4	299
	1,3,5-Trimethylbenzene	0.64	0.60	Stable	83.3	0.54	-4	4	50.7
	Acetone	<0.05	0.27	No Trend	50.0	1.24	1	4	250
	Chloroform	<0.05	0.34	No Trend	50.0	1.25	1	4	10
	Ethylbenzene	0.90	0.82	Decreasing	95.8	0.46	-6	4	737
	Methylene Chloride	<0.05	0.46	No Trend	50.0	1.26	1	4	50
	Toluene	0.96	0.98	Decreasing	95.8	0.83	-6	4	2730
	Total Xylenes	0.97	0.85	Decreasing	95.8	0.56	-6	4	1890

Table 21. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P1 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-85p1	Tetrachloroethene (PCE)	0.54	0.09	No Trend	50.0	1.23	-1	4	1
	1,1,1-Trichloroethane	0.67	0.61	No Trend	50.0	1.04	-1	4	1
	1,1-Dichloroethene	0.54	0.09	No Trend	50.0	1.23	-1	4	1
	1,2,4-Trimethylbenzene	0.89	0.85	Stable	83.3	0.94	-4	4	27.1
	1,3,5-Trimethylbenzene	0.88	0.92	Decreasing	95.8	1.36	-6	4	1
	Acetone	0.57	0.21	No Trend	50.0	1.19	-1	4	25
	Chloroform	0.54	0.09	No Trend	50.0	1.23	-1	4	1
	Ethylbenzene	0.91	0.96	Decreasing	95.8	0.89	-6	4	96.5
	Methylene Chloride	0.54	0.09	No Trend	50.0	1.23	-1	4	5
	Toluene	0.59	0.21	No Trend	37.5	1.32	0	4	286
	Total Xylenes	0.88	0.99	Decreasing	95.8	1.17	-6	4	107
MW-90p1	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-92p1	Tetrachloroethene (PCE)	<0.05	<0.05	No Trend	50.0	0.72	1	4	10
	1,1,1-Trichloroethane	0.29	0.16	Stable	62.5	0.85	-2	4	22.8
	1,1-Dichloroethene	0.27	0.31	Stable	62.5	0.96	-2	4	2.02
	1,2,4-Trimethylbenzene	0.24	0.16	Stable	62.5	0.59	-2	4	590
	1,3,5-Trimethylbenzene	0.36	0.17	Stable	62.5	0.80	-2	4	171
	Acetone	<0.05	<0.05	No Trend	50.0	0.72	1	4	250
	Chloroform	0.31	0.42	No Trend	62.5	1.03	-2	4	1.35
	Ethylbenzene	0.12	0.11	Stable	62.5	0.59	-2	4	1790
	Methylene Chloride	0.35	0.62	No Trend	72.9	1.13	-3	4	2.5
	Toluene	0.25	0.06	No Trend	37.5	1.16	0	4	3880
	Total Xylenes	0.11	0.10	Stable	62.5	0.68	-2	4	4830
MW-95p1	Tetrachloroethene (PCE)	0.71	0.71	No Trend	72.9	1.11	-3	4	0.1
	1,1,1-Trichloroethane	0.82	0.93	No Trend	89.6	1.27	-5	4	0.1
	1,1-Dichloroethene	0.71	0.71	No Trend	72.9	1.21	-3	4	0.1
	1,2,4-Trimethylbenzene	0.71	0.70	No Trend	83.3	1.52	-4	4	10.1
	1,3,5-Trimethylbenzene	0.70	0.65	No Trend	62.5	1.68	-2	4	1.95
	Acetone	<0.05	<0.05	Stable	37.5	0.50	0	4	5.15
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	0.71	0.70	No Trend	83.3	1.52	-4	4	56.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	0.61	0.20	No Trend	62.5	1.44	-2	4	25
	Total Xylenes	0.52	0.18	No Trend	62.5	1.01	-2	4	57.5
MW-98p1	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	6.75
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3

Notes:
S: Mann-Kendall test statistics
CF: Confidence factor
COV: Coefficient of variation
R^2: Coefficient of determination (goodness of fit)

Table 22. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-101p2	Tetrachloroethene (PCE)	0.11	<0.05	Stable	62.5	0.79	-2	4	1
	1,1,1-Trichloroethane	0.74	0.89	No Trend	83.3	1.73	-4	4	2.43
	1,1-Dichloroethene	0.70	0.62	No Trend	62.5	1.56	-2	4	5.25
	1,2,4-Trimethylbenzene	0.61	0.35	No Trend	62.5	1.48	-2	4	10.3
	1,3,5-Trimethylbenzene	0.68	0.35	No Trend	50.0	1.75	-1	4	2.5
	Acetone	<0.05	<0.05	Stable	37.5	0.77	0	4	25
	Chloroform	0.64	0.39	No Trend	62.5	1.25	-2	4	1
	Ethylbenzene	0.49	0.23	No Trend	62.5	1.21	-2	4	13.4
	Methylene Chloride	<0.05	<0.05	Stable	83.3	0.44	-4	4	12
	Toluene	0.69	0.44	No Trend	62.5	1.88	-2	4	11.1
	Total Xylenes	0.61	0.21	No Trend	37.5	1.64	0	4	43.2
MW-107p2	Tetrachloroethene (PCE)	0.83	0.86	No Trend	89.6	0.46	5	4	1
	1,1,1-Trichloroethane	<0.05	0.29	No Trend	72.9	1.85	-3	4	1
	1,1-Dichloroethene	0.16	0.50	No Trend	72.9	1.39	-3	4	1
	1,2,4-Trimethylbenzene	0.89	0.94	Stable	89.6	0.73	-5	4	1
	1,3,5-Trimethylbenzene	0.19	0.11	Stable	50.0	0.25	-1	4	1
	Acetone	0.49	0.25	No Trend	72.9	0.70	3	4	25
	Chloroform	0.34	0.15	No Trend	72.9	0.64	3	4	1
	Ethylbenzene	0.15	0.39	No Trend	72.9	1.18	-3	4	1
	Methylene Chloride	0.15	0.23	Stable	72.9	0.53	-3	4	5
	Toluene	0.78	0.77	Stable	89.6	0.60	-5	4	1
	Total Xylenes	0.16	0.39	No Trend	72.9	1.13	-3	4	3
MW-108p2	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	8.23
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-112p2	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.9
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	21.2
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.28
	Total Xylenes							1	0.3
MW-113p2	Tetrachloroethene (PCE)	0.50	0.50	No Trend	72.9	1.92	3	4	10
	1,1,1-Trichloroethane	0.43	0.09	No Trend	50.0	1.75	1	4	11.9
	1,1-Dichloroethene	0.08	<0.05	Stable	37.5	0.83	0	4	1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.81	0	4	493
	1,3,5-Trimethylbenzene	0.28	<0.05	No Trend	37.5	1.11	0	4	106
	Acetone	0.22	0.09	No Trend	62.5	0.89	2	4	25
	Chloroform	0.50	0.50	No Trend	72.9	1.38	3	4	1
	Ethylbenzene	0.10	<0.05	Stable	37.5	0.86	0	4	1160
	Methylene Chloride	0.19	<0.05	No Trend	50.0	1.21	1	4	10.4
	Toluene	0.09	<0.05	No Trend	37.5	1.17	0	4	2240
	Total Xylenes	0.37	<0.05	No Trend	37.5	1.19	0	4	1700

Table 22. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-114p2	Tetrachloroethene (PCE)	0.08	<0.05	Stable	37.5	0.97	0	4	2.5
	1,1,1-Trichloroethane	0.76	0.82	No Trend	89.6	1.31	5	4	6.97
	1,1-Dichloroethene	0.62	0.11	No Trend	37.5	1.60	0	4	2.5
	1,2,4-Trimethylbenzene	0.93	0.87	Increasing	95.8	0.93	6	4	437
	1,3,5-Trimethylbenzene	0.87	0.94	Increasing	95.8	0.95	6	4	170
	Acetone	0.79	0.90	No Trend	83.3	0.79	4	4	62.5
	Chloroform	0.60	0.13	No Trend	37.5	1.61	0	4	2.5
	Ethylbenzene	0.95	0.82	Increasing	95.8	0.91	6	4	1030
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.80	0	4	12.5
	Toluene	0.16	0.67	No Trend	83.3	1.73	4	4	948
	Total Xylenes	0.63	0.89	No Trend	83.3	1.05	4	4	1740
MW-115p2	Tetrachloroethene (PCE)	<0.05	<0.05	No Trend	50.0	1.49	-1	4	0.1
	1,1,1-Trichloroethane	<0.05	0.22	No Trend	72.9	1.97	-3	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	No Trend	62.5	1.58	-2	4	0.62
	1,2,4-Trimethylbenzene	0.50	0.50	No Trend	72.9	1.13	3	4	0.62
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.50	0.50	No Trend	72.9	1.05	3	4	13.6
	Chloroform	0.93	0.92	Stable	89.6	0.80	-5	4	0.1
	Ethylbenzene	0.27	0.11	No Trend	50.0	0.95	1	4	0.65
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	0.14	<0.05	No Trend	50.0	0.97	1	4	0.85
	Total Xylenes	0.50	0.50	No Trend	72.9	1.24	3	4	2.26
MW-118p2	Tetrachloroethene (PCE)							1	0.47
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.24
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-122p2	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	1.2
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.31
	Ethylbenzene							1	0.1
	Methylene Chloride							1	1.13
	Toluene							1	0.1
	Total Xylenes							1	1.03
MW-124p2	Tetrachloroethene (PCE)	0.24	0.31	No Trend	62.5	0.20	2	4	1.51
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.85	0.82	Increasing	95.8	0.20	6	4	0.81
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.09	0.09	No Trend	62.5	0.33	2	4	5.93
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	0.71	0.71	Stable	72.9	0.46	-3	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3

Table 22. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-125p2	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone							3	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	0.51	0.51	No Trend	72.9	0.40	3	4	0.2
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-126p2	Tetrachloroethene (PCE)	<0.05	<0.05	No Trend	62.5	0.76	2	4	2.5
	1,1,1-Trichloroethane	<0.05	<0.05	No Trend	62.5	0.76	2	4	2.5
	1,1-Dichloroethene	<0.05	<0.05	No Trend	62.5	0.76	2	4	2.5
	1,2,4-Trimethylbenzene	0.88	0.67	Stable	83.3	0.80	-4	4	2.5
	1,3,5-Trimethylbenzene	0.95	0.81	Decreasing	95.8	0.75	-6	4	2.5
	Acetone	<0.05	<0.05	No Trend	62.5	0.61	2	4	62.5
	Chloroform	<0.05	<0.05	No Trend	62.5	0.76	2	4	2.5
	Ethylbenzene	0.87	0.72	Stable	83.3	0.90	-4	4	12.1
	Methylene Chloride	0.15	0.20	No Trend	62.5	0.77	2	4	12.5
	Toluene	0.70	0.48	No Trend	62.5	1.87	-2	4	2.5
	Total Xylenes	0.76	0.75	No Trend	83.3	1.33	-4	4	7.5
MW-131p2	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-136p2	Tetrachloroethene (PCE)							1	0.94
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	1.2
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.29
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-138p2	Tetrachloroethene (PCE)	0.76	0.83	No Trend	89.6	1.22	5	4	2.5
	1,1,1-Trichloroethane	0.42	0.63	No Trend	72.9	1.01	3	4	0.5
	1,1-Dichloroethene	0.42	0.63	No Trend	72.9	1.01	3	4	0.5
	1,2,4-Trimethylbenzene	0.53	0.37	No Trend	83.3	1.61	4	4	155
	1,3,5-Trimethylbenzene	0.26	0.24	No Trend	62.5	0.82	2	4	0.5
	Acetone							3	62.5
	Chloroform	0.76	0.83	No Trend	89.6	1.22	5	4	2.5
	Ethylbenzene	0.68	0.75	No Trend	83.3	1.52	4	4	498
	Methylene Chloride	<0.05	<0.05	No Trend	62.5	0.18	2	4	7.44
	Toluene	0.51	0.68	No Trend	83.3	1.98	4	4	717
	Total Xylenes	0.56	0.84	Increasing	95.8	1.82	6	4	515

Table 22. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-141p2	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-143p2	Tetrachloroethene (PCE)	0.89	0.85	Increasing	95.8	0.31	6	4	1.91
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.42	0.42	No Trend	83.3	0.28	4	4	0.52
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.71	0.71	No Trend	72.9	1.11	-3	4	2.5
	Chloroform	0.06	<0.05	Stable	37.5	0.13	0	4	0.3
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-147p2	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.71	0.71	Stable	72.9	0.85	-3	4	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-33p2	Tetrachloroethene (PCE)	0.20	0.22	Decreasing	95.1	2.01	-68	26	0.1
	1,1,1-Trichloroethane	0.19	0.34	Decreasing	99.8	1.93	-110	26	0.1
	1,1-Dichloroethene	0.16	<0.05	Probably Decreasing	91.2	0.91	-56	26	0.1
	1,2,4-Trimethylbenzene	0.27	0.43	Decreasing	100.0	1.82	-159	26	0.1
	1,3,5-Trimethylbenzene	0.38	0.53	Decreasing	100.0	1.99	-161	26	0.1
	Acetone	<0.05	<0.05	Stable	67.1	0.87	-21	26	11.9
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	0.19	0.33	Decreasing	99.8	1.95	-110	26	0.1
	Ethylbenzene	0.30	0.53	Decreasing	100.0	2.01	-191	26	0.1
	Methylene Chloride	0.67	0.88	Decreasing	100.0	1.17	-261	26	0.5
	Toluene	0.36	0.54	Decreasing	100.0	1.72	-178	26	0.1
	Total Xylenes	<0.05	<0.05	Stable	45.2	0.00	0	8	0.3
MW-35p2	Tetrachloroethene (PCE)	0.12	0.07	No Trend	88.3	1.37	-55	26	2.28
	1,1,1-Trichloroethane	0.12	0.39	Decreasing	99.9	1.70	-134	25	0.1
	1,1-Dichloroethene	0.14	0.18	Decreasing	99.4	1.85	-115	26	0.7
	1,2,4-Trimethylbenzene	<0.05	0.36	Decreasing	98.5	1.12	-100	26	0.1
	1,3,5-Trimethylbenzene	<0.05	0.31	Decreasing	97.9	1.13	-93	26	0.1
	Acetone	0.12	0.47	Decreasing	100.0	4.46	-169	26	11.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	0.24	0.41	Decreasing	100.0	1.97	-162	26	0.52
	Ethylbenzene	0.08	0.45	Decreasing	99.7	1.00	-127	26	0.23
	Methylene Chloride	0.26	0.65	Decreasing	100.0	1.53	-228	26	1.53
	Toluene	0.06	0.33	Decreasing	99.9	1.45	-137	26	0.26
	Total Xylenes	0.23	0.23	Probably Decreasing	91.1	2.37	-12	8	0.74

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Table 22. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-38p2	Tetrachloroethene (PCE)	0.54	0.80	Decreasing	100.0	1.45	-236	26	1
	1,1,1-Trichloroethane	0.46	0.71	Decreasing	100.0	1.72	-199	25	4.34
	1,1-Dichloroethene	0.48	0.71	Decreasing	100.0	1.58	-205	25	8.51
	1,2,4-Trimethylbenzene	0.36	0.59	Decreasing	100.0	1.99	-179	26	1
	1,3,5-Trimethylbenzene	0.37	0.59	Decreasing	100.0	1.94	-200	26	1
	Acetone	0.18	0.64	Decreasing	100.0	3.43	-215	26	25
	Bis(2-ethylhexyl) Phthalate							1	2.3
	Chloroform	0.56	0.78	Decreasing	100.0	1.19	-238	26	8.01
	Ethylbenzene	0.42	0.58	Decreasing	100.0	2.07	-166	25	1
	Methylene Chloride	0.48	0.46	Decreasing	100.0	1.56	-172	26	10.7
	Toluene	0.26	0.59	Decreasing	100.0	2.45	-191	26	13.5
	Total Xylenes	<0.05	<0.05	No Trend	54.8	1.23	2	8	3
MW-39p2	Tetrachloroethene (PCE)	0.37	0.53	Stable	57.0	0.38	-2	6	0.58
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1
	1,1-Dichloroethene	0.13	0.13	Stable	64.0	0.90	-3	6	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1
	Acetone	0.95	0.67	No Trend	81.5	1.36	6	6	45.2
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1
	Ethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	6	0.1
	Methylene Chloride	0.99	0.99	No Trend	76.5	0.35	5	6	0.5
	Toluene	0.06	0.06	Stable	64.0	0.61	-3	6	0.1
	Total Xylenes							1	0.3
MW-40p2	Tetrachloroethene (PCE)	0.55	0.52	No Trend	88.3	0.41	6	5	0.33
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1
	1,1-Dichloroethene	0.73	0.73	No Trend	88.3	1.07	-6	5	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1
	Acetone	<0.05	<0.05	Stable	40.8	0.00	0	5	2.5
	Bis(2-ethylhexyl) Phthalate							1	5
	Chloroform	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1
	Ethylbenzene	<0.05	<0.05	Stable	40.8	0.00	0	5	0.1
	Methylene Chloride	<0.05	<0.05	Stable	40.8	0.00	0	5	0.25
	Toluene	0.20	0.20	Stable	59.2	0.37	-2	5	0.1
MW-43p2	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.26	0	4	0.93
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.32	0.30	No Trend	62.5	0.23	2	4	0.67
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.59	0.59	Stable	72.9	0.57	-3	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	1
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	0.14	0.12	No Trend	50.0	0.58	1	4	1.3
	Toluene	0.12	0.12	No Trend	50.0	0.67	1	4	0.1
MW-46p2	Tetrachloroethene (PCE)	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	1,1-Dichloroethene	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Acetone	<0.05	<0.05	Stable	46.0	0.00	0	9	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Ethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Methylene Chloride	0.72	0.72	Increasing	96.2	0.38	18	9	0.5
	Toluene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1

Table 22. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-49p2	Tetrachloroethene (PCE)	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.59	0.59	Stable	72.9	0.40	-3	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.25
	Toluene	0.59	0.59	No Trend	72.9	1.20	-3	4	0.1
MW-52p2	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.25
	Toluene	0.46	0.46	Stable	72.9	0.40	-3	4	0.1
MW-60p2	Tetrachloroethene (PCE)							2	0.1
	1,1,1-Trichloroethane							2	0.1
	1,1-Dichloroethene							2	0.1
	1,2,4-Trimethylbenzene							2	0.1
	1,3,5-Trimethylbenzene							2	0.1
	Acetone							2	2.5
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform							2	0.1
	Ethylbenzene							2	0.1
	Methylene Chloride							2	0.5
	Toluene							2	0.1
	Total Xylenes							1	0.3
MW-76p2	Tetrachloroethene (PCE)							1	1.84
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.28
	1,2,4-Trimethylbenzene							1	1.37
	1,3,5-Trimethylbenzene							1	0.31
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.99
	Methylene Chloride							1	0.5
	Toluene							1	0.3
	Total Xylenes							1	3.17
MW-80p2	Tetrachloroethene (PCE)	0.70	0.70	No Trend	72.9	1.30	-3	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.70	0.70	Stable	72.9	0.82	-3	4	0.1
	1,2,4-Trimethylbenzene	0.09	0.09	No Trend	50.0	1.06	1	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.97	0.91	Decreasing	95.8	0.95	-6	4	2.5
	Chloroform	0.70	0.70	No Trend	72.9	1.37	-3	4	0.1
	Ethylbenzene	0.09	0.09	No Trend	50.0	1.30	1	4	0.1
	Methylene Chloride	0.70	0.70	No Trend	72.9	1.40	-3	4	0.5
	Toluene	<0.05	0.21	Stable	62.5	0.97	-2	4	0.1
	Total Xylenes	<0.05	0.08	Stable	50.0	0.71	-1	4	0.3

Table 22. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in P2 Wells

Well	Constituent	Regression Analysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-87p2	Tetrachloroethene (PCE)	0.28	0.11	No Trend	50.0	0.69	1	4	2.5
	1,1,1-Trichloroethane	0.28	0.11	No Trend	50.0	0.69	1	4	2.5
	1,1-Dichloroethene	0.28	0.11	No Trend	50.0	0.69	1	4	2.5
	1,2,4-Trimethylbenzene	0.24	0.14	No Trend	62.5	0.69	2	4	282
	1,3,5-Trimethylbenzene	0.46	0.21	No Trend	62.5	1.01	2	4	92.4
	Acetone	0.28	0.11	No Trend	50.0	0.69	1	4	62.5
	Chloroform	0.28	0.11	No Trend	50.0	0.69	1	4	2.5
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.66	0	4	568
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.86	0	4	12.5
	Toluene	0.09	<0.05	No Trend	62.5	1.93	-2	4	2.5
	Total Xylenes	0.34	0.54	No Trend	62.5	1.34	2	4	960
MW-88p2	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	13.8
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-91p2	Tetrachloroethene (PCE)	0.77	0.77	Stable	83.3	0.77	-4	4	1
	1,1,1-Trichloroethane	0.78	0.86	No Trend	83.3	1.21	-4	4	2.98
	1,1-Dichloroethene	0.57	0.41	Stable	72.9	0.58	-3	4	2.5
	1,2,4-Trimethylbenzene	0.90	0.89	Stable	83.3	0.58	-4	4	199
	1,3,5-Trimethylbenzene	0.97	0.98	Decreasing	95.8	0.66	-6	4	69.3
	Acetone	0.61	0.46	Stable	72.9	0.60	-3	4	57.3
	Chloroform	0.77	0.77	Stable	83.3	0.77	-4	4	1
	Ethylbenzene	0.90	0.92	Stable	83.3	0.47	-4	4	414
	Methylene Chloride	0.77	0.77	Stable	83.3	0.77	-4	4	5
	Toluene	0.75	0.80	No Trend	83.3	1.54	-4	4	984
	Total Xylenes	0.96	0.97	Decreasing	95.8	0.79	-6	4	976
MW-94p2	Tetrachloroethene (PCE)							1	0.5
	1,1,1-Trichloroethane							1	7.3
	1,1-Dichloroethene							1	2.01
	1,2,4-Trimethylbenzene							1	0.5
	1,3,5-Trimethylbenzene							1	0.5
	Acetone							1	12.5
	Chloroform							1	2.91
	Ethylbenzene							1	0.5
	Methylene Chloride							1	2.5
	Toluene							1	2.93
	Total Xylenes							1	4.55
MW-99p2	Tetrachloroethene (PCE)	0.09	0.09	No Trend	50.0	1.38	1	4	0.1
	1,1,1-Trichloroethane	0.48	0.06	No Trend	62.5	1.09	-2	4	1
	1,1-Dichloroethene	0.59	0.58	Stable	83.3	0.51	-4	4	1.04
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.66	0	4	123
	1,3,5-Trimethylbenzene	0.10	<0.05	Stable	62.5	0.88	-2	4	27.8
	Acetone	0.07	<0.05	No Trend	37.5	1.05	0	4	12.2
	Chloroform	<0.05	<0.05	Stable	37.5	0.54	0	4	2.18
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.70	0	4	384
	Methylene Chloride	0.10	0.07	No Trend	62.5	0.35	2	4	17.6
	Toluene	<0.05	<0.05	No Trend	37.5	1.44	0	4	91.6
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.88	0	4	736

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

R^2: Coefficient of determination (goodness of fit)

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-102b	Tetrachloroethene (PCE)	0.81	0.76	Increasing	95.8	0.51	6	4	3.85
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.84	0.76	Increasing	95.8	0.59	6	4	15.5
	1,2,4-Trimethylbenzene	0.51	0.51	No Trend	72.9	0.71	3	4	0.32
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Chloroform	0.85	0.80	Increasing	95.8	0.40	6	4	6.14
	Ethylbenzene	0.68	0.78	No Trend	89.6	0.89	5	4	0.54
	Methylene Chloride	0.81	0.80	No Trend	89.6	0.41	5	4	1.08
	Toluene	0.51	0.51	No Trend	72.9	1.22	3	4	0.72
	Total Xylenes	0.51	0.51	No Trend	72.9	0.82	3	4	1.13
MW-103b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	71.7	0.67	-12	16	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	50.0	0.00	0	16	0.1
	1,1-Dichloroethene	0.20	0.28	Probably Decreasing	92.6	0.37	-33	16	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	16	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	16	0.1
	Acetone	<0.05	<0.05	Stable	50.0	0.54	-1	16	2.5
	Bis(2-ethylhexyl) Phthalate							3	1.5
	Chloroform	<0.05	<0.05	Stable	50.0	0.00	0	16	0.1
	Ethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	16	0.1
	Methylene Chloride	<0.05	<0.05	Stable	50.0	0.00	0	16	0.5
	Toluene	<0.05	<0.05	Stable	50.0	0.00	0	16	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	16	0.3
MW-105b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.29
	Methylene Chloride							1	0.5
	Toluene							1	0.3
	Total Xylenes							1	0.3
MW-116b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	1.11
	Total Xylenes							1	0.3
MW-121b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-128b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.21
	Methylene Chloride							1	0.5
	Toluene							1	0.3
	Total Xylenes							1	0.3

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-130b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-132b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.25
	Total Xylenes							1	0.3
MW-133b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.67	0.83	No Trend	83.3	0.96	4	4	1.07
	1,2,4-Trimethylbenzene	0.51	0.51	No Trend	72.9	1.99	3	4	113
	1,3,5-Trimethylbenzene	0.51	0.51	No Trend	72.9	1.88	3	4	6.58
	Acetone							3	8.03
	Chloroform	0.71	0.71	No Trend	72.9	1.28	-3	4	0.1
	Ethylbenzene	0.51	0.51	No Trend	72.9	2.00	3	4	342
	Methylene Chloride	0.51	0.51	No Trend	72.9	0.85	3	4	1.97
	Toluene	0.51	0.51	No Trend	72.9	1.98	3	4	37
	Total Xylenes	0.51	0.51	No Trend	72.9	1.99	3	4	220
MW-135b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-139b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-140b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.71	0.71	No Trend	72.9	1.14	-3	4	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	0.51	0.51	No Trend	72.9	0.62	3	4	0.28
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3

MOTT MACDONALD

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-142b	Tetrachloroethene (PCE)	0.10	0.11	Stable	50.0	0.06	-1	4	0.35
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.09	<0.05	Stable	62.5	0.34	-2	4	0.6
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Chloroform	0.62	0.61	Stable	83.3	0.16	-4	4	0.44
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-144b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	0.51	0.51	No Trend	72.9	1.00	3	4	0.5
	1,1-Dichloroethene	<0.05	<0.05	Stable	50.0	0.62	-1	4	0.1
	1,2,4-Trimethylbenzene	0.51	0.51	No Trend	72.9	1.77	3	4	3.15
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.09	0.09	No Trend	50.0	0.50	1	4	2.5
	Chloroform	0.51	0.51	No Trend	72.9	1.00	3	4	0.5
	Ethylbenzene	0.51	0.62	No Trend	89.6	1.92	5	4	13.4
	Methylene Chloride	0.32	0.16	No Trend	50.0	0.98	1	4	3.19
	Toluene	0.51	0.51	No Trend	72.9	1.97	3	4	22.8
	Total Xylenes	0.51	0.51	No Trend	72.9	1.82	3	4	12.6
MW-145b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.71	0.71	Stable	72.9	0.66	-3	4	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-146b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-148b	Tetrachloroethene (PCE)	0.59	0.42	No Trend	72.9	0.62	3	4	0.5
	1,1,1-Trichloroethane	0.77	0.77	No Trend	83.3	0.77	4	4	0.5
	1,1-Dichloroethene	0.46	0.43	Stable	37.5	0.13	0	4	2.47
	1,2,4-Trimethylbenzene	0.77	0.77	No Trend	83.3	0.77	4	4	0.5
	1,3,5-Trimethylbenzene	0.77	0.77	No Trend	83.3	0.77	4	4	0.5
	Acetone	0.77	0.77	No Trend	83.3	0.77	4	4	12.5
	Chloroform	0.94	0.93	Stable	89.6	0.45	-5	4	0.5
	Ethylbenzene	0.70	0.83	No Trend	89.6	1.23	5	4	1.6
	Methylene Chloride	<0.05	0.17	No Trend	50.0	1.20	1	4	2.5
	Toluene	0.77	0.77	No Trend	83.3	0.77	4	4	0.5
	Total Xylenes	0.77	0.77	No Trend	83.3	0.77	4	4	1.5
MW-149b	Tetrachloroethene (PCE)							3	0.1
	1,1,1-Trichloroethane							3	0.1
	1,1-Dichloroethene							3	1.03
	1,2,4-Trimethylbenzene							3	0.23
	1,3,5-Trimethylbenzene							3	0.1
	Acetone							3	2.5
	Chloroform							3	0.34
	Ethylbenzene							3	0.4
	Methylene Chloride							3	0.5
	Toluene							3	0.35
	Total Xylenes							3	0.3

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-150b	Tetrachloroethene (PCE)							3	0.1
	1,1,1-Trichloroethane							3	0.1
	1,1-Dichloroethene							3	0.1
	1,2,4-Trimethylbenzene							3	0.1
	1,3,5-Trimethylbenzene							3	0.1
	Acetone							3	2.5
	Chloroform							3	0.1
	Ethylbenzene							3	0.1
	Methylene Chloride							3	0.5
	Toluene							3	0.1
	Total Xylenes							3	0.3
MW-151b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	0.51	0.51	No Trend	72.9	0.80	3	4	9.14
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-19b	Tetrachloroethene (PCE)	0.25	0.25	Increasing	98.6	0.36	47	22	0.1
	1,1,1-Trichloroethane	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1
	1,1-Dichloroethene	0.25	0.25	Increasing	98.6	0.36	47	22	0.1
	1,2,4-Trimethylbenzene	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1
	1,3,5-Trimethylbenzene	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1
	Acetone	<0.05	0.09	Increasing	97.0	0.46	47	21	2.5
	Bis(2-ethylhexyl) Phthalate	0.18	0.18	Stable	59.2	0.49	-2	5	0.5
	Chloroform	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1
	Ethylbenzene	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1
	Methylene Chloride	<0.05	0.14	Increasing	99.2	0.52	66	21	0.5
	Toluene	0.11	0.11	Probably Decreasing	92.0	0.73	-18	21	0.1
MW-29b	Tetrachloroethene (PCE)	0.65	0.91	Decreasing	99.7	0.65	-10	5	0.1
	1,1,1-Trichloroethane	0.41	0.43	Stable	88.3	0.67	-6	5	0.1
	1,1-Dichloroethene	0.86	0.97	Decreasing	95.8	0.45	-8	5	0.23
	1,2,4-Trimethylbenzene	0.41	0.43	Stable	88.3	0.67	-6	5	0.1
	1,3,5-Trimethylbenzene	0.41	0.43	Stable	88.3	0.67	-6	5	0.1
	Acetone	<0.05	0.09	No Trend	50.0	0.59	1	5	7.26
	Chloroform	0.41	0.43	Stable	88.3	0.67	-6	5	0.1
	Ethylbenzene	0.21	0.36	Probably Decreasing	92.1	1.30	-7	5	0.1
	Methylene Chloride	0.76	0.90	Decreasing	95.8	0.50	-8	5	0.5
	Toluene	0.14	0.46	Decreasing	99.7	1.94	-10	5	0.1
	Total Xylenes							1	0.3
MW-30b	Tetrachloroethene (PCE)	<0.05	0.10	No Trend	75.8	1.05	-4	5	0.3
	1,1,1-Trichloroethane	0.39	0.84	Decreasing	99.7	1.01	-10	5	0.1
	1,1-Dichloroethene	0.08	<0.05	Stable	88.3	0.81	-6	5	0.1
	1,2,4-Trimethylbenzene	0.09	0.09	Stable	59.2	0.99	-2	5	0.1
	1,3,5-Trimethylbenzene	0.09	0.09	Stable	59.2	0.99	-2	5	0.1
	Acetone	<0.05	<0.05	Stable	67.5	0.81	-3	5	5.42
	Chloroform	0.16	0.21	Stable	82.1	0.87	-5	5	0.1
	Ethylbenzene	0.19	0.26	Probably Decreasing	92.1	1.35	-7	5	0.1
	Methylene Chloride	<0.05	<0.05	Stable	59.2	0.61	-2	5	0.5
	Toluene	0.21	0.44	Decreasing	97.8	1.61	-9	5	0.1
	Total Xylenes							1	0.3
MW-31b	Tetrachloroethene (PCE)	0.49	0.47	Probably Increasing	92.1	1.07	7	5	0.1
	1,1,1-Trichloroethane	0.19	0.25	No Trend	50.0	0.78	1	5	0.1
	1,1-Dichloroethene	0.12	<0.05	No Trend	75.8	0.93	4	5	0.4
	1,2,4-Trimethylbenzene	0.09	0.09	Stable	59.2	0.99	-2	5	0.1
	1,3,5-Trimethylbenzene	0.09	0.09	Stable	59.2	0.99	-2	5	0.1
	Acetone	0.12	0.17	Probably Decreasing	92.1	1.85	-7	5	2.5
	Chloroform	0.09	0.09	Stable	59.2	0.99	-2	5	0.1
	Ethylbenzene	0.09	0.14	No Trend	50.0	1.28	-1	5	0.1
	Methylene Chloride	<0.05	<0.05	No Trend	50.0	0.72	1	5	0.5
	Toluene	0.06	0.36	No Trend	82.1	1.86	-5	5	0.1
	Total Xylenes							1	0.3

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-3b	Tetrachloroethene (PCE)	0.10	0.14	Increasing	97.7	1.06	111	39	0.1
	1,1,1-Trichloroethane	0.11	0.11	Decreasing	98.2	0.62	-65	38	0.1
	1,1-Dichloroethene	0.52	0.52	Decreasing	100.0	0.23	-419	39	0.44
	1,2,4-Trimethylbenzene	0.11	0.11	Decreasing	98.2	0.62	-65	38	0.1
	1,3,5-Trimethylbenzene	0.11	0.11	Decreasing	98.2	0.62	-65	38	0.1
	Acetone	0.13	0.14	Decreasing	99.4	0.82	-149	38	2.5
	Bis(2-ethylhexyl) Phthalate	0.73	0.73	Increasing	98.2	0.57	24	10	1.5
	Chloroform	0.11	0.11	Decreasing	98.2	0.62	-65	38	0.1
	Ethylbenzene	0.14	0.16	Decreasing	99.6	0.62	-98	38	0.1
	Methylene Chloride	0.44	0.38	Decreasing	100.0	0.90	-264	38	1.05
	Toluene	0.11	0.11	Decreasing	98.2	0.62	-65	38	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-42b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	72.4	0.30	-25	24	3.52
	1,1,1-Trichloroethane	0.20	0.22	Decreasing	97.7	1.19	-65	24	0.1
	1,1-Dichloroethene	0.56	0.60	Decreasing	100.0	0.37	-170	24	1.55
	1,2,4-Trimethylbenzene	0.16	0.24	Decreasing	99.1	1.58	-80	24	0.1
	1,3,5-Trimethylbenzene	0.20	0.18	Decreasing	97.7	1.23	-65	24	0.1
	Acetone	0.29	0.35	Decreasing	99.6	1.02	-95	24	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	0.20	0.21	Decreasing	97.7	1.21	-65	24	0.1
	Ethylbenzene	0.40	0.46	Decreasing	99.8	1.09	-104	24	0.1
	Methylene Chloride	0.82	0.91	Decreasing	100.0	0.88	-226	24	0.5
	Toluene	0.20	0.21	Decreasing	97.7	1.19	-65	24	0.1
	Total Xylenes	<0.05	<0.05	Stable	46.0	0.00	0	9	0.3
MW-44b	Tetrachloroethene (PCE)	0.47	0.70	Increasing	99.9	1.57	66	16	0.5
	1,1,1-Trichloroethane	0.06	<0.05	Stable	53.9	0.86	-3	16	0.5
	1,1-Dichloroethene	0.29	0.35	Stable	89.7	0.45	-29	16	0.5
	1,2,4-Trimethylbenzene	0.17	0.07	Probably Decreasing	92.5	0.80	-31	16	0.5
	1,3,5-Trimethylbenzene	0.06	<0.05	Stable	53.9	0.86	-3	16	0.5
	Acetone	0.13	0.13	Stable	83.7	0.74	-22	16	12.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	0.06	<0.05	Stable	53.9	0.86	-3	16	0.5
	Ethylbenzene	0.37	0.27	Decreasing	99.2	0.77	-52	16	0.5
	Methylene Chloride	0.86	0.83	Decreasing	100.0	0.46	-95	16	2.5
	Toluene	0.13	0.13	Stable	81.3	0.74	-20	16	0.5
	Total Xylenes	0.52	0.59	Probably Increasing	93.2	0.94	11	7	1.5
MW-48b	Tetrachloroethene (PCE)	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	1,1-Dichloroethene	0.25	0.25	No Trend	76.2	1.50	-8	9	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Acetone	<0.05	<0.05	Stable	46.0	0.00	0	9	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Ethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Methylene Chloride	0.72	0.72	Increasing	96.2	0.38	18	9	0.5
	Toluene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
MW-51b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.25
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
MW-57b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes							2	0.3

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-63b	Tetrachloroethene (PCE)	0.36	0.35	Increasing	97.7	1.04	17	8	1
	1,1,1-Trichloroethane	0.11	<0.05	No Trend	76.4	1.07	7	8	1
	1,1-Dichloroethene	0.10	0.08	No Trend	83.2	0.90	9	8	1
	1,2,4-Trimethylbenzene	0.35	0.51	Decreasing	96.9	0.86	-16	8	3.04
	1,3,5-Trimethylbenzene	0.22	0.46	Probably Decreasing	92.9	1.22	-13	8	1
	Acetone	0.39	<0.05	No Trend	59.4	1.26	3	8	25
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform	0.44	0.64	Increasing	97.8	1.12	19	8	1
	Ethylbenzene	0.67	0.72	Decreasing	99.7	1.21	-22	8	5.6
	Methylene Chloride	0.24	0.29	Probably Decreasing	92.9	0.32	-13	8	5
	Toluene	0.58	0.76	Decreasing	99.8	2.81	-23	8	1
	Total Xylenes	0.71	0.85	Decreasing	99.9	1.51	-19	7	3
MW-71b	Tetrachloroethene (PCE)	0.62	0.57	No Trend	83.3	0.22	4	4	0.68
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-72b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Methylene Chloride							1	0.5
MW-74b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.49
	Total Xylenes							1	0.3
MW-78b	Tetrachloroethene (PCE)							1	3.32
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.26
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	6.56
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-7b	Tetrachloroethene (PCE)	<0.05	<0.05	No Trend	81.5	0.68	143	61	0.34
	1,1,1-Trichloroethane	<0.05	<0.05	Probably Decreasing	94.7	0.48	-57	60	0.1
	1,1-Dichloroethene	0.80	0.73	Decreasing	100.0	0.60	-1261	61	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-57	60	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-57	60	0.1
	Acetone	<0.05	<0.05	No Trend	63.0	0.34	31	59	2.5
	Bis(2-ethylhexyl) Phthalate	<0.05	0.07	No Trend	77.6	0.51	11	13	1.5
	Chloroform	<0.05	<0.05	Probably Decreasing	94.7	0.48	-57	60	0.1
	Ethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-57	60	0.1
	Methylene Chloride	0.48	0.54	Decreasing	100.0	1.01	-765	60	0.5
	Toluene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-57	60	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	27	0.3

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-81b	Tetrachloroethene (PCE)	0.83	0.72	Stable	83.3	0.51	-4	4	2.08
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.94	0.86	Decreasing	95.8	0.38	-6	4	0.33
	1,2,4-Trimethylbenzene	0.09	0.09	No Trend	50.0	0.73	1	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	0.13	Stable	62.5	0.87	-2	4	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	0.09	0.09	No Trend	50.0	0.67	1	4	0.1
	Methylene Chloride	0.84	0.93	No Trend	89.6	1.08	-5	4	0.5
	Toluene	<0.05	<0.05	Stable	50.0	0.62	-1	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-82b	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone							3	2.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.5
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes	<0.05	<0.05	Stable	37.5	0.00	0	4	0.3
MW-86b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	27.5
MW-89b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	7.68
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-93b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	30.4
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.57
	Total Xylenes							1	0.64
MW-96b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.5
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	2.5
	Chloroform							1	0.1
	Ethylbenzene							1	1.59
	Methylene Chloride							1	0.5
	Toluene							1	0.39
	Total Xylenes							1	1.64

Table 23. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Roza Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-97b	Tetrachloroethene (PCE)							1	0.1
	1,1,1-Trichloroethane							1	0.1
	1,1-Dichloroethene							1	0.1
	1,2,4-Trimethylbenzene							1	0.1
	1,3,5-Trimethylbenzene							1	0.1
	Acetone							1	7.69
	Chloroform							1	0.1
	Ethylbenzene							1	0.1
	Methylene Chloride							1	0.5
	Toluene							1	0.1
	Total Xylenes							1	0.3
MW-9b	Tetrachloroethene (PCE)	0.69	0.79	Decreasing	100.0	0.52	-1421	64	0.86
	1,1,1-Trichloroethane	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	1,1-Dichloroethene	0.10	<0.05	Decreasing	99.5	0.33	-230	65	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	Acetone	<0.05	<0.05	Stable	78.8	0.24	-65	64	2.5
	Bis(2-ethylhexyl) Phthalate	0.62	0.62	Increasing	99.9	0.39	60	17	1.5
	Chloroform	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	Ethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	Methylene Chloride	0.05	0.13	Increasing	98.6	0.24	259	64	0.5
	Toluene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	30	0.3

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

R^2: Coefficient of determination (goodness of fit)

Table 24. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Interflow Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-20c	Tetrachloroethene (PCE)	0.12	0.12	Increasing	99.7	0.20	179	66	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1
	1,1-Dichloroethene	0.12	0.12	Increasing	99.7	0.20	179	66	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1
	Acetone	0.13	0.19	Increasing	100.0	0.27	328	65	2.5
	Bis(2-ethylhexyl) Phthalate	<0.05	<0.05	Stable	40.8	0.00	0	5	0.5
	Chloroform	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1
	Ethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1
	Methylene Chloride	0.22	0.35	Increasing	100.0	0.27	638	65	0.5
	Toluene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-62	65	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	30	0.3
MW-21c	Tetrachloroethene (PCE)	0.06	0.16	Increasing	99.9	1.25	209	60	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1
	1,1-Dichloroethene	0.11	0.16	Increasing	99.9	0.46	209	60	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1
	Acetone	0.13	0.13	Increasing	99.7	0.10	162	59	2.5
	Bis(2-ethylhexyl) Phthalate	<0.05	<0.05	Stable	40.8	0.43	0	5	0.5
	Chloroform	<0.05	<0.05	Stable	55.0	0.96	-7	59	0.1
	Ethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1
	Methylene Chloride	0.20	0.32	Increasing	100.0	0.28	529	59	0.5
	Toluene	<0.05	<0.05	Probably Decreasing	94.7	0.49	-56	59	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	25	0.3
MW-22c	Tetrachloroethene (PCE)	0.88	0.63	Decreasing	100.0	0.51	-1498	60	1
	1,1,1-Trichloroethane	<0.05	0.30	Stable	50.0	0.00	0	60	0.1
	1,1-Dichloroethene	0.15	0.10	Decreasing	99.9	0.58	-493	61	0.24
	1,2,4-Trimethylbenzene	<0.05	0.30	Stable	50.0	0.00	0	60	0.1
	1,3,5-Trimethylbenzene	<0.05	0.30	Stable	50.0	0.00	0	60	0.1
	Acetone	0.13	0.20	Increasing	100.0	0.37	308	60	2.5
	Bis(2-ethylhexyl) Phthalate	0.06	<0.05	No Trend	70.7	0.90	8	12	1.5
	Chloroform	0.53	0.33	Decreasing	100.0	0.28	-1059	60	0.63
	Ethylbenzene	<0.05	0.30	Stable	50.0	0.00	0	60	0.1
	Methylene Chloride	0.22	0.41	Increasing	100.0	0.37	609	60	0.5
	Toluene	<0.05	0.30	Stable	50.0	0.00	0	60	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	28	0.3
MW-2c	Tetrachloroethene (PCE)	<0.05	<0.05	No Trend	59.9	0.13	46	66	1.47
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	1,1-Dichloroethene	0.07	0.10	Increasing	99.6	0.32	301	66	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	Acetone	0.15	0.21	Increasing	100.0	0.21	333	64	2.5
	Bis(2-ethylhexyl) Phthalate	<0.05	0.13	Increasing	98.5	1.28	49	17	4.5
	Chloroform	<0.05	<0.05	Stable	72.8	0.18	-33	65	0.1
	Ethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	Methylene Chloride	0.48	0.48	Increasing	100.0	0.23	694	65	0.5
	Toluene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	30	0.3
MW-45c	Tetrachloroethene (PCE)	<0.05	0.05	Probably Increasing	91.0	0.40	14	9	0.064
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	1,1-Dichloroethene	0.24	0.24	No Trend	76.2	1.50	-8	9	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Acetone	<0.05	<0.05	Stable	46.0	0.00	0	9	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Ethylbenzene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1
	Methylene Chloride	0.72	0.72	Increasing	96.2	0.38	18	9	0.5
	Toluene	<0.05	<0.05	Stable	46.0	0.00	0	9	0.1

Table 24. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Interflow Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-47c	Tetrachloroethene (PCE)	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	0.59	0.59	No Trend	72.9	1.38	-3	4	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.25
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
MW-4c	Tetrachloroethene (PCE)	0.12	0.12	Increasing	99.7	0.20	179	66	0.1
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	1,1-Dichloroethene	0.12	0.12	Increasing	99.7	0.20	179	66	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	Acetone	<0.05	0.07	Increasing	97.3	0.29	194	65	2.5
	Bis(2-ethylhexyl) Phthalate	0.94	0.94	No Trend	76.5	0.61	5	6	1.5
	Chloroform	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	Ethylbenzene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	Methylene Chloride	0.43	0.45	Increasing	100.0	0.23	644	65	0.5
	Toluene	<0.05	<0.05	Stable	50.0	0.00	0	65	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	30	0.3
MW-50c	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	2.7
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.25
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
MW-54c	Tetrachloroethene (PCE)	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.01
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	0.5
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	<0.05	<0.05	Stable	37.5	0.00	0	4	0.25
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
MW-56c	Tetrachloroethene (PCE)							2	0.036
	1,1,1-Trichloroethane							2	0.1
	1,1-Dichloroethene							2	0.01
	1,2,4-Trimethylbenzene							2	0.1
	1,3,5-Trimethylbenzene							2	0.1
	Acetone							2	2.5
	Chloroform							2	20
	Ethylbenzene							2	0.1
	Methylene Chloride							2	0.5
	Toluene							2	0.1

Table 24. Results of Mann-Kendall Test and Regression Analysis for Additional Parameters in Interflow Wells

Well	Constituent	Regression Alysis		Mann Kendall Analysis				Number of Samples	Last Concentration
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S		
MW-58c	Tetrachloroethene (PCE)	0.89	0.88	Increasing	95.8	0.17	6	4	0.97
	1,1,1-Trichloroethane	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,1-Dichloroethene	<0.05	<0.05	Stable	62.5	0.10	-2	4	0.49
	1,2,4-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Acetone	<0.05	<0.05	Stable	37.5	0.00	0	4	2.5
	Bis(2-ethylhexyl) Phthalate							1	4.4
	Chloroform	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Ethylbenzene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Methylene Chloride	0.54	0.54	No Trend	62.5	0.05	2	4	2.35
	Toluene	<0.05	<0.05	Stable	37.5	0.00	0	4	0.1
	Total Xylenes							3	0.3
MW-5c	Tetrachloroethene (PCE)	0.90	0.89	Decreasing	100.0	0.41	-1707	64	1.74
	1,1,1-Trichloroethane	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	1,1-Dichloroethene	<0.05	<0.05	No Trend	81.0	0.28	84	65	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	Acetone	0.12	0.17	Increasing	100.0	0.19	272	64	2.5
	Bis(2-ethylhexyl) Phthalate	0.06	0.30	Increasing	99.7	1.51	62	17	4.5
	Chloroform	0.70	0.61	Decreasing	100.0	0.34	-1250	64	0.1
	Ethylbenzene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	Methylene Chloride	0.08	0.17	Increasing	100.0	0.26	406	64	0.5
	Toluene	<0.05	<0.05	Probably Decreasing	94.8	0.47	-61	64	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	29	0.3
MW-62c	Tetrachloroethene (PCE)							2	0.1
	1,1,1-Trichloroethane							2	0.1
	1,1-Dichloroethene							2	0.1
	1,2,4-Trimethylbenzene							2	0.1
	1,3,5-Trimethylbenzene							2	0.1
	Acetone							2	2.5
	Bis(2-ethylhexyl) Phthalate							1	1.5
	Chloroform							2	0.1
	Ethylbenzene							2	0.1
	Methylene Chloride							2	0.5
	Toluene							2	0.1
	Total Xylenes							1	0.3
MW-6c	Tetrachloroethene (PCE)	0.60	0.67	Decreasing	100.0	0.38	-1202	63	0.37
	1,1,1-Trichloroethane	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1
	1,1-Dichloroethene	<0.05	<0.05	Probably Decreasing	91.1	0.18	-107	63	0.1
	1,2,4-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1
	1,3,5-Trimethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1
	Acetone	0.09	0.13	Increasing	98.2	0.18	164	62	2.5
	Bis(2-ethylhexyl) Phthalate	0.68	0.68	Increasing	99.9	0.40	55	16	1.5
	Chloroform	0.15	0.20	Decreasing	100.0	0.49	-287	62	0.1
	Ethylbenzene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1
	Methylene Chloride	0.22	0.36	Increasing	100.0	0.27	565	62	0.5
	Toluene	<0.05	<0.05	Probably Decreasing	94.7	0.48	-59	62	0.1
	Total Xylenes	<0.05	<0.05	Stable	50.0	0.00	0	30	0.3

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

R^2: Coefficient of determination (goodness of fit)

Table 25. Results of Mann-Kendall Test and Regression Analysis for Arsenic, Total

Aquifer/Zone	Well	Regression Analysis		Mann Kendall Analysis				Comparison to CUL (5 µg/L)			Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
P1	MW-109p1							2	6.46	Above						
	MW-117p1							3	1.78	Below						
	MW-123p1							3	1.85	Below						
	MW-36p1							3	9.24	Above						
	MW-69p1							3	30.4	Above						
	MW-83p1							3	14	Above						
	MW-85p1							3	4.43	Below						
	MW-92p1							3	7.39	Above						
	MW-95p1							3	17.1	Above						
P2	MW-101p2							3	3.64	Below						
	MW-107p2							3	5.89	Above						
	MW-113p2							3	7.6	Above						
	MW-114p2							3	11.2	Above						
	MW-115p2							3	11.4	Above						
	MW-124p2							3	2.66	Below						
	MW-125p2							3	7.77	Above						
	MW-126p2							3	7.68	Above						
	MW-138p2							3	5.92	Above						
	MW-143p2							3	1.24	Below						
	MW-147p2							3	1.41	Below						
	MW-33p2	<0.05	<0.05	Stable	50.0	0.10	-1	6	6.93	Above						
	MW-35p2	0.22	0.21	Stable	57.0	0.22	-2	6	3.88	Below						
	MW-38p2	0.13	0.15	No Trend	76.5	0.53	5	6	3.22	Below						
	MW-39p2							1	2.01	Below						
	MW-49p2							1	1.2	Below						
	MW-60p2							1	2.06	Below						
	MW-80p2							3	7.01	Above						
	MW-87p2							3	14.2	Above						
	MW-91p2							3	11.5	Above						
	MW-99p2							3	7.01	Above						
Roza	MW-102b							3	2.33	Below						
	MW-103b	0.14	0.13	Stable	87.0	0.13	-26	16	4.83	Below						
	MW-133b							3	5.62	Above						
	MW-140b							3	1.53	Below						
	MW-142b							3	0.958	Below						
	MW-144b							3	2.53	Below						
	MW-145b							3	1.28	Below						
	MW-146b							3	1.95	Below						

Roza	MW-148b							3	2	Below						
	MW-149b							2	1.38	Below						
	MW-150b							2	0.738	Below						
	MW-151b							3	1.33	Below						
	MW-3b	0.27	0.20	Stable	89.5	0.37	-34	18	4.13	Below						
	MW-42b	0.19	0.19	Stable	84.5	0.13	-8	7	1.54	Below						
	MW-44b							1	3.85	Below						
	MW-57b							2	1.36	Below						
	MW-63b							1	4.61	Below						
	MW-71b							3	1.45	Below						
	MW-7b	0.12	<0.05	Stable	87.4	0.42	-103	41	2.34	Below						
	MW-81b							3	6.85	Above						
	MW-82b							3	3.26	Below						
	MW-9b	0.16	0.24	Decreasing	100.0	0.27	-361	44	4.7	Below						
Interflow	MW-20c	<0.05	<0.05	No Trend	83.9	0.06	94	43	1.32	Below						
	MW-21c	0.33	0.34	Decreasing	99.7	0.23	-229	39	0.897	Below						
	MW-22c	0.52	0.60	Decreasing	100.0	0.19	-608	41	2.28	Below						
	MW-2c	0.22	0.11	No Trend	68.1	0.71	46	43	0.792	Below						
	MW-4c	<0.05	<0.05	No Trend	67.6	0.14	46	44	0.256	Below						
	MW-58c							1	0.569	Below						
	MW-5c	0.31	0.30	Stable	89.0	0.26	-118	43	1.41	Below						
	MW-6c	0.93	0.94	Decreasing	100.0	0.19	-809	44	2.9	Below						

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

C: Concentration

Last C: Last measured concentration

C_{goal}: Target concentration

CUL: Clean-up level

ks: First order source decay rate (best fit)

ks_{lower}: Lower bound (90%) of first order decay rate

ks_{upper}: Upper bound (90%) of first order decay rate

t(ks): Restoration timeframe based on best fit (ks)

t(ks_{lower}): Lower bound (90%) restoration timeframe

t(ks_{upper}): Upper bound (90%) restoration timeframe

R^2: Coefficient of determination (goodness of fit)

As background is defined as 14.7 ug/L in the revised FS (Parametrix 2018a), however, a CUL value of 5 ug/L was used in the calculations as proposed by (Parametrix 2022).

Table 26. Results of Mann-Kendall Test and Regression Analysis for Manganese, Total

Aquifer/Zone	Well	Regression Analysis		Mann Kendall Analysis				Comparison to CUL (50 µg/L)			Source Decay Rate, ks (/year)			Restoration Time Frames from Last Concentration, t (year)		
		Linear R^2	Exponential R^2	Trend Result	CF (%)	COV	S	# of sample	Last C (µg/L)	Last C vs CUL	ks	ks_{lower}	ks_{upper}	t (ks)	t (ks_{lower})	t (ks_{upper})
P1	MW-100p1							1	2850	Above						
	MW-104p1							1	7040	Above						
	MW-109p1							3	1080	Above						
	MW-110p1							1	2850	Above						
	MW-117p1	<0.05	0.10	No Trend	83.3	1.94	-4	4	5.38	Below						
	MW-123p1	0.65	0.61	Stable	83.3	0.57	-4	4	7.93	Below						
	MW-127p1							1	35	Below						
	MW-129p1							1	1.01	Below						
	MW-34p1	0.44	0.40	Stable	85.5	0.45	-36	21	6950	Above						
	MW-36p1	0.98	0.96	Decreasing	95.8	0.28	-6	4	4050	Above	0.170	0.098	0.243	26	45	18
	MW-37p1	0.98	0.97	No Trend	62.5	0.93	2	4	1110	Above						
	MW-61p1							2	35	Below						
	MW-64p1							2	2070	Above						
	MW-65p1	0.53	0.48	Probably Increasing	93.2	0.30	11	7	7400	Above						
	MW-66p1							2	2170	Above						
	MW-67p1							2	6910	Above						
	MW-68p1	0.27	0.19	Increasing	97.7	0.20	23	10	10000	Above						
	MW-69p1	0.31	0.41	Decreasing	95.8	0.53	-8	5	3760	Above	0.114	-0.071	0.299	38	-61	14
	MW-70p1							2	4400	Above						
	MW-83p1	0.98	0.95	Decreasing	95.8	0.30	-6	4	3770	Above	0.188	0.102	0.274	23	42	16
	MW-85p1	0.95	0.96	Decreasing	95.8	0.16	-6	4	3650	Above	0.093	0.052	0.134	46	82	32
	MW-90p1							1	4930	Above						
	MW-92p1	0.99	0.98	Decreasing	95.8	0.13	-6	4	4590	Above	0.081	0.057	0.104	56	79	44
	MW-95p1	0.99	0.96	Decreasing	95.8	0.25	-6	4	3950	Above	0.157	0.094	0.220	28	47	20
	MW-98p1							1	131	Above						
P2	MW-101p2	0.52	0.46	No Trend	83.3	0.39	4	4	3430	Above						
	MW-107p2	0.84	0.94	Increasing	95.8	0.67	6	4	8760	Above						
	MW-108p2							1	1770	Above						
	MW-112p2							1	2660	Above						
	MW-113p2	<0.05	<0.05	No Trend	62.5	0.67	2	4	10000	Above						
	MW-114p2	0.90	0.84	Increasing	95.8	0.43	6	4	10300	Above						
	MW-115p2	<0.05	<0.05	No Trend	37.5	1.13	0	4	1750	Above						
	MW-118p2							1	187	Above						
	MW-122p2							1	408	Above						
	MW-124p2	0.66	0.62	Stable	62.5	0.45	-2	4	472	Above						
	MW-125p2	0.68	0.70	Stable	83.3	0.17	-4	4	3760	Above						
	MW-126p2	0.90	0.94	Increasing	95.8	0.46	6	4	8330	Above						
	MW-131p2							1	119	Above						
	MW-136p2							1	39.1	Below						

	MW-138p2	0.49	0.48	No Trend	83.3	0.12	4	4	10700	Above						
	MW-141p2							1	103	Above						
	MW-143p2	0.29	0.18	Stable	62.5	0.47	-2	4	12.2	Below						
	MW-147p2	0.41	0.45	Stable	62.5	0.39	-2	4	33.7	Below						
	MW-33p2	0.78	0.70	Decreasing	100.0	0.37	-191	23	5650	Above	0.092	0.070	0.115	51	68	41
	MW-35p2	<0.05	<0.05	Stable	59.4	0.11	-10	23	10100	Above						
	MW-38p2	<0.05	0.13	Decreasing	98.8	0.44	-87	23	1270	Above	0.036	0.001	0.072	89	3471	45
	MW-39p2							3	624	Above						
	MW-40p2							2	699	Above						
	MW-43p2							2	146	Above						
P2	MW-46p2	0.10	<0.05	Stable	71.9	0.94	-5	7	62	Above						
	MW-49p2							3	877	Above						
	MW-52p2							2	55	Above						
	MW-60p2							2	1.02	Below						
	MW-76p2							1	8720	Above						
	MW-80p2	<0.05	<0.05	Stable	37.5	0.42	0	4	5450	Above						
	MW-87p2	0.34	0.35	Stable	62.5	0.10	-2	4	6730	Above						
	MW-88p2							1	3590	Above						
	MW-91p2	0.95	0.96	Decreasing	95.8	0.18	-6	4	6910	Above	0.102	0.059	0.146	48	84	34
	MW-94p2							1	1700	Above						
	MW-99p2	0.43	0.37	No Trend	83.3	0.19	4	4	8450	Above						
	MW-102b	0.71	0.81	No Trend	83.3	1.94	-4	4	4.92	Below						
	MW-105b							1	669	Above						
	MW-116b							1	322	Above						
	MW-121b							1	34.6	Below						
	MW-128b							1	33.9	Below						
	MW-130b							1	55.1	Above						
	MW-132b							1	210	Above						
	MW-133b	0.32	0.23	Stable	37.5	0.49	0	4	7560	Above						
	MW-135b							1	163	Above						
	MW-139b							1	130	Above						
	MW-140b	0.94	0.91	Decreasing	95.8	0.82	-6	4	323	Above	0.519	0.183	0.855	4	10	2
	MW-142b	0.93	0.90	Decreasing	95.8	1.01	-6	4	2.5	Below						
Roza	MW-144b	0.76	0.75	Stable	62.5	0.24	-2	4	6370	Above						
	MW-145b	0.64	0.73	Stable	83.3	0.68	-4	4	43.2	Below						
	MW-146b	0.99	0.99	Increasing	95.8	0.37	6	4	2660	Above						
	MW-148b	0.69	0.66	Stable	62.5	1.00	-2	4	23.3	Below						
	MW-149b							3	2.5	Below						
	MW-150b							2	155	Above						
	MW-151b	0.87	0.93	No Trend	83.3	1.02	-4	4	2.5	Below						
	MW-19b	0.34	0.57	Decreasing	100.0	1.24	-101	19	34	Below						
	MW-29b	0.07	0.08	Stable	37.5	0.16	0	4	1350	Above						
	MW-30b	0.39	0.44	Decreasing	95.8	0.39	-6	4	208	Above	0.049	-0.066	0.164	29	-22	9
	MW-31b	0.24	0.32	Decreasing	95.8	0.91	-6	4	95.4	Above	0.080	-0.159	0.320	8	-4	2
	MW-3b	0.09	0.08	Probably Increasing	90.9	0.12	42	20	14800	Above						
	MW-42b	0.44	0.39	Decreasing	99.8	0.38	-90	20	965	Above	0.075	0.037	0.114	39	80	26

Roza	MW-44b	<0.05	<0.05	Stable	74.4	0.13	-13	14	2320	Above						
	MW-48b	0.08	<0.05	No Trend	50.0	0.95	1	7	3	Below						
	MW-51b							2	14	Below						
	MW-57b							3	2.5	Below						
	MW-63b	0.68	0.65	Probably Decreasing	94.6	0.14	-14	8	7990	Above	0.064	0.027	0.102	79	190	50
	MW-71b	0.93	0.89	Decreasing	95.8	0.79	-6	4	17.3	Below						
	MW-72b							1	8760	Above						
	MW-74b							1	129	Above						
	MW-78b							1	149	Above						
	MW-7b	0.52	0.53	Decreasing	100.0	0.16	-98	19	10800	Above	0.079	0.048	0.110	68	113	49
	MW-81b	0.82	0.90	No Trend	83.3	0.66	4	4	3460	Above						
	MW-82b	0.33	0.38	Stable	83.3	0.47	-4	4	78.2	Above						
	MW-86b							1	54.3	Above						
	MW-89b							1	7390	Above						
	MW-93b							1	260	Above						
	MW-96b							1	91.7	Above						
	MW-97b							1	159	Above						
	MW-9b	0.75	0.84	Decreasing	100.0	0.55	-160	20	1990	Above	0.282	0.232	0.332	13	16	11
Interflow	MW-20c	<0.05	<0.05	No Trend	58.6	0.99	7	21	3	Below						
	MW-21c	0.75	0.73	Decreasing	100.0	0.16	-136	20	101	Above	0.096	0.072	0.119	7	10	6
	MW-22c	<0.05	<0.05	No Trend	71.0	2.28	16	20	14	Below						
	MW-2c	0.55	0.70	Increasing	100.0	1.22	166	22	71	Above						
	MW-45c	<0.05	<0.05	Stable	55.7	0.61	-2	7	13	Below						
	MW-47c							2	19	Below						
	MW-4c	0.09	0.08	Probably Increasing	92.4	0.08	51	22	28	Below						
	MW-50c							2	41	Below						
	MW-54c							2	269	Above						
	MW-56c							2	179	Above						
	MW-58c	0.73	0.67	Stable	83.30	0.34	-4	4	10.4	Below						
	MW-5c	0.53	0.67	Increasing	100.00	0.76	140	22	4	Below						
	MW-62c							2	27.3	Below						
	MW-6c	0.77	0.74	Increasing	100.0	0.28	124	19	42	Below						

Notes:

S: Mann-Kendall test statistics

CF: Confidence factor

COV: Coefficient of variation

C: Concentration

Last C: Last measured concentration

C_{goal}: Target concentration

CUL: Clean-up level

ks: First order source decay rate (best fit)

ks_{lower}: Lower bound (90%) of first order decay rate

ks_{upper}: Upper bound (90%) of first order decay rate

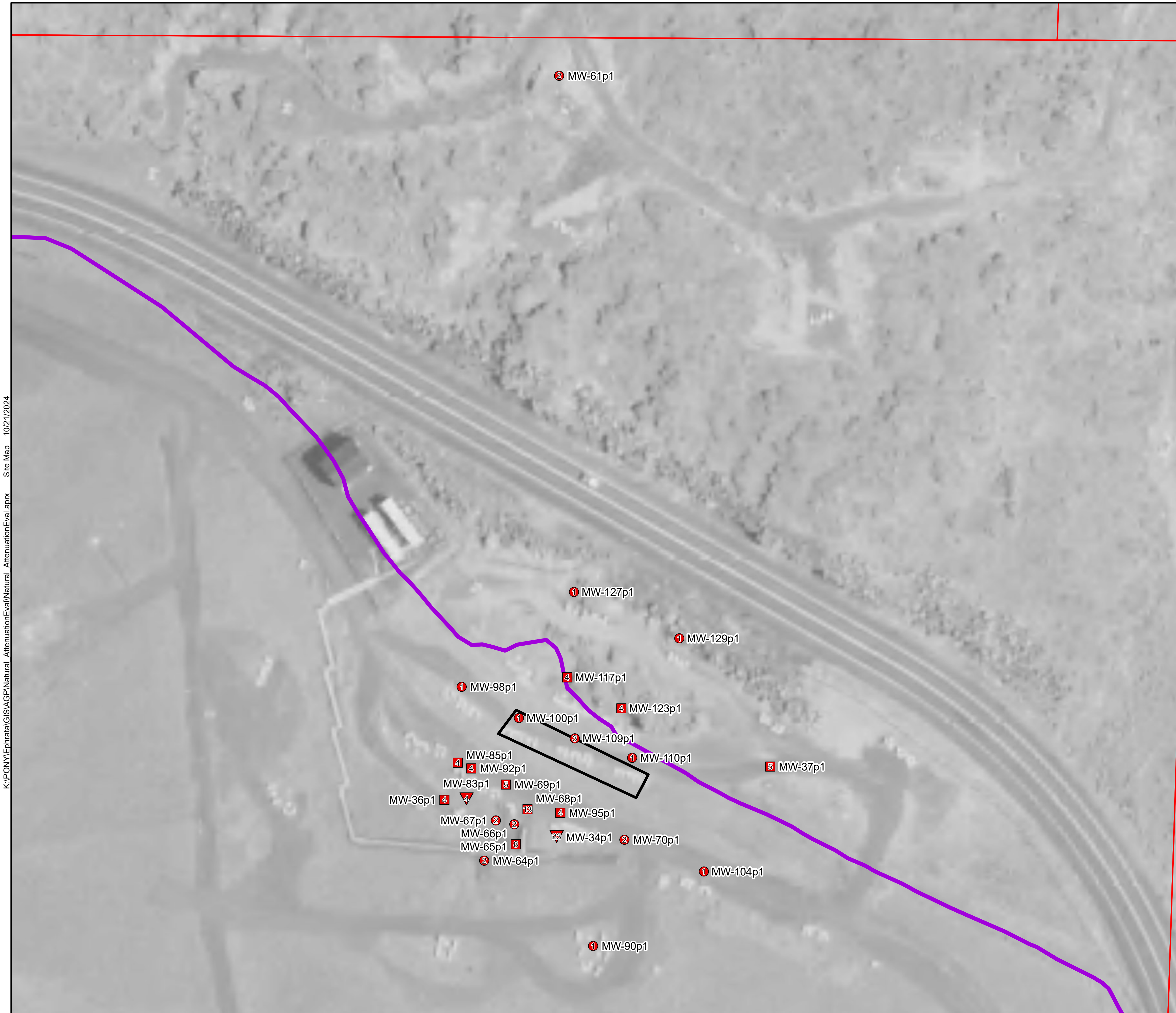
t(ks): Restoration timeframe based on best fit (ks)

$t(ks_{lower})$: Lower bound (90%) restoration timeframe

$t(ks_{upper})$: Upper bound (90%) restoration timeframe

R^2: Coefficient of determination (goodness of fit)

FIGURES



K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 10/21/2024

Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 75

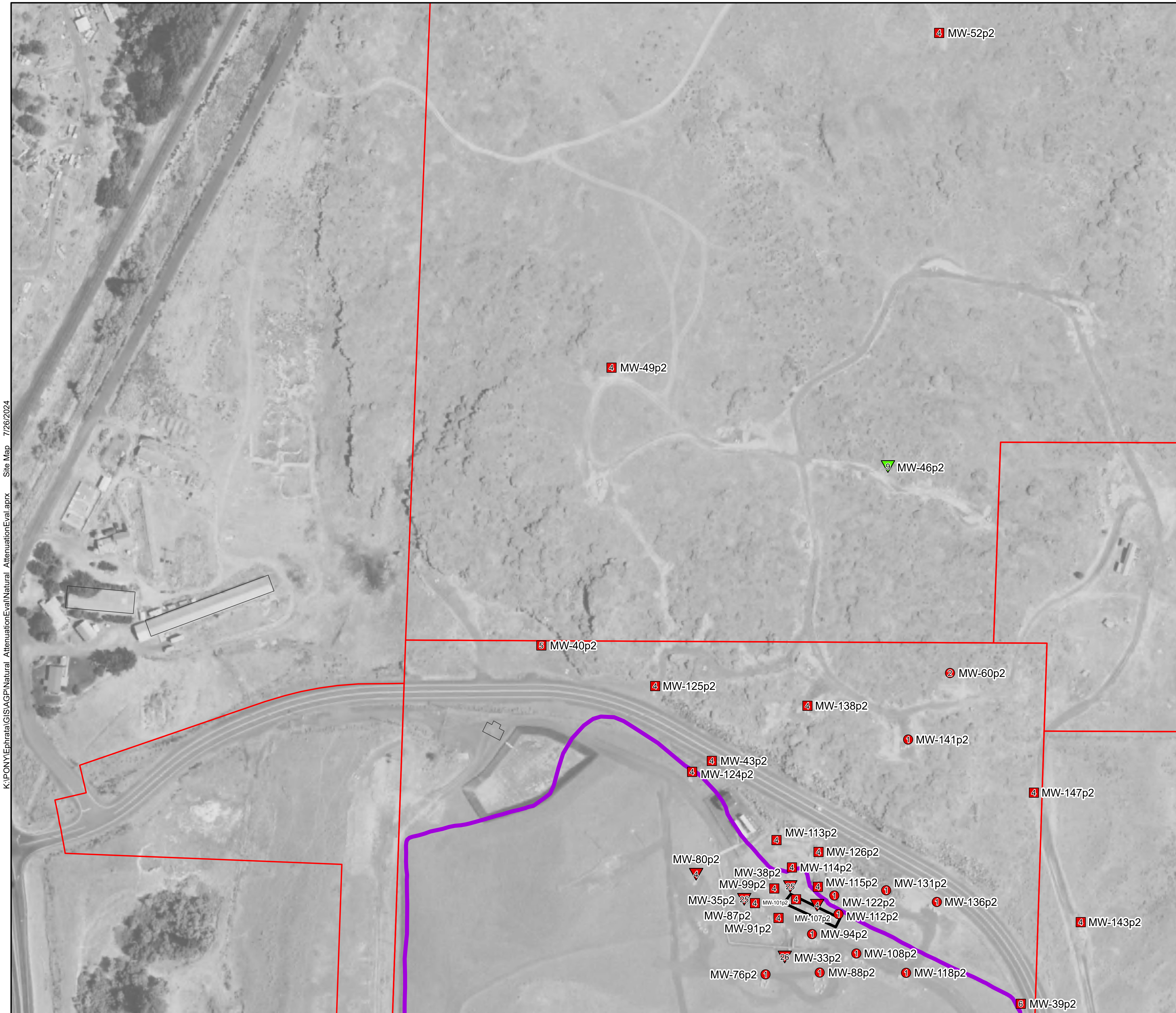
Orthophoto: NRCS 2021

Figure 1

P1 Zone - Chlorinated Ethenes (Comparison with VC-CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

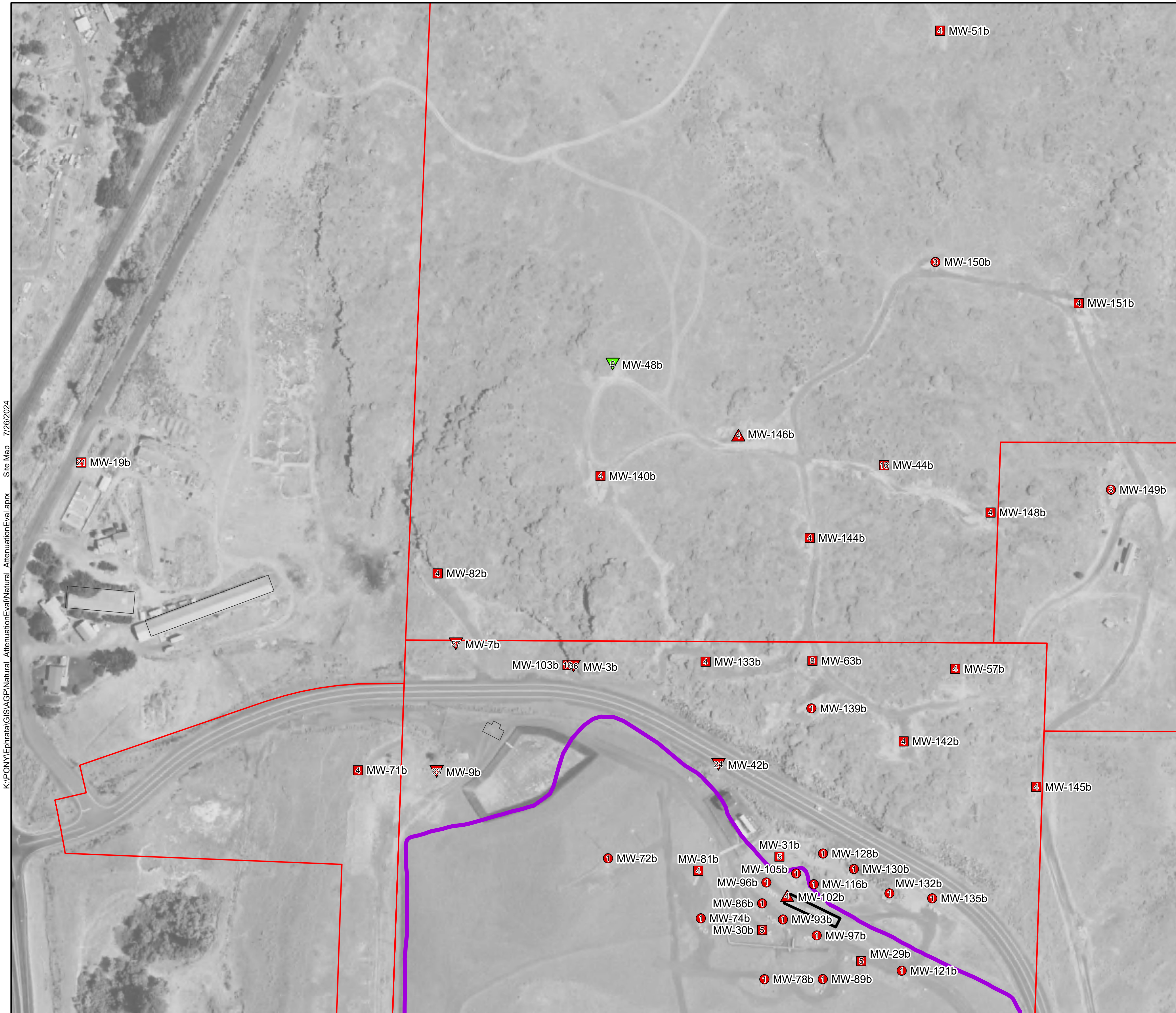
Orthophoto: NRCS 2021

Figure 2

P2 Zone - Chlorinated Ethenes (Comparison with VC-CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

0 Feet 200
Orthophoto: NRCS 2021

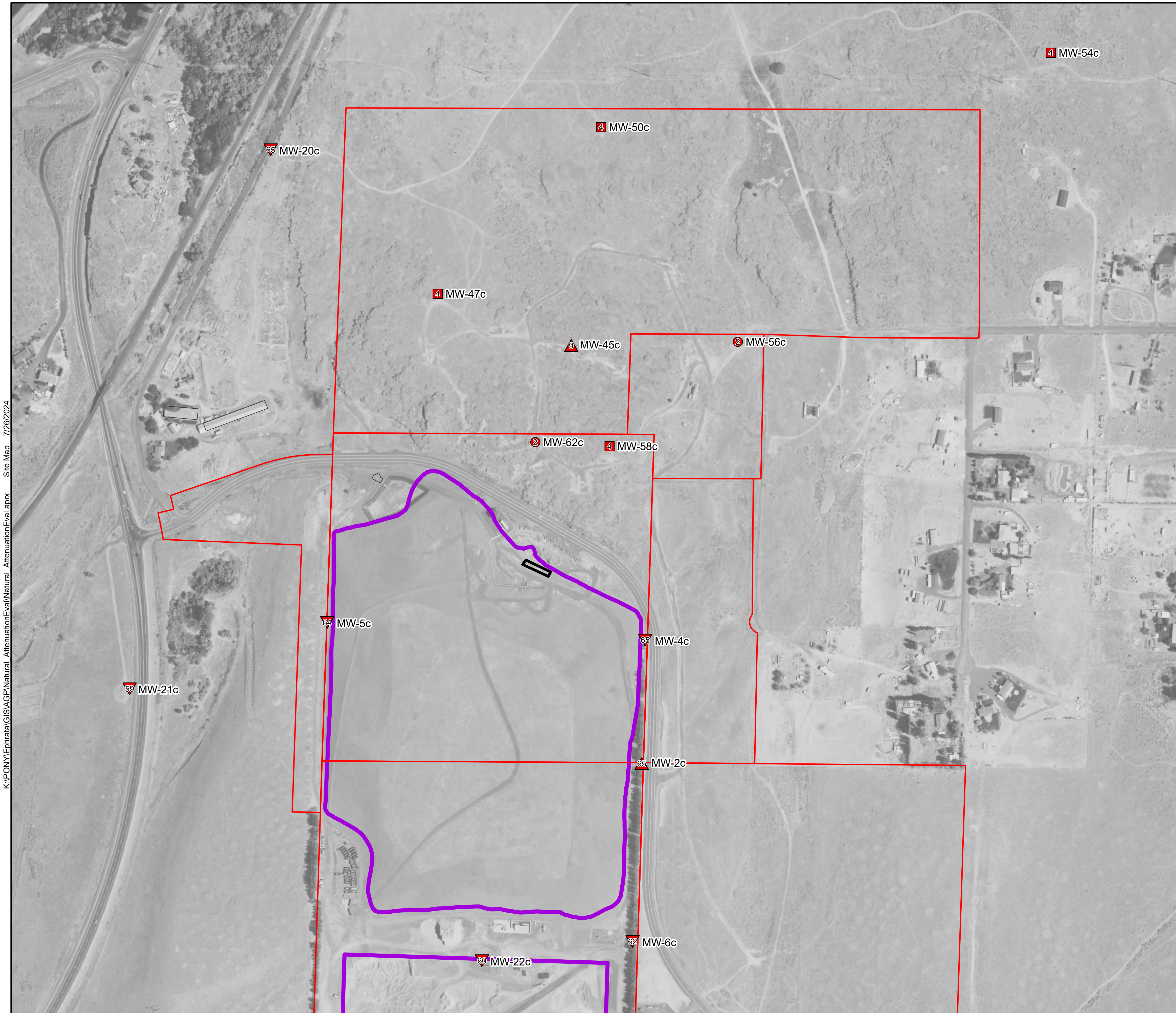
K:\PONY\Ephrata\GIS\AGP\Natural AttenuationEval\Natural AttenuationEval.aprx Site Map 7/26/2024

Figure 3

Roza Aquifer - Chlorinated Ethenes (Comparison with VC-CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

N

0 Feet 400

Orthophoto: NRCS 2021

Figure 4

Interflow Aquifer - Chlorinated Ethenes (Comparison with VC-CUL and Mann-Kendall Trend)

Ephrata Landfill

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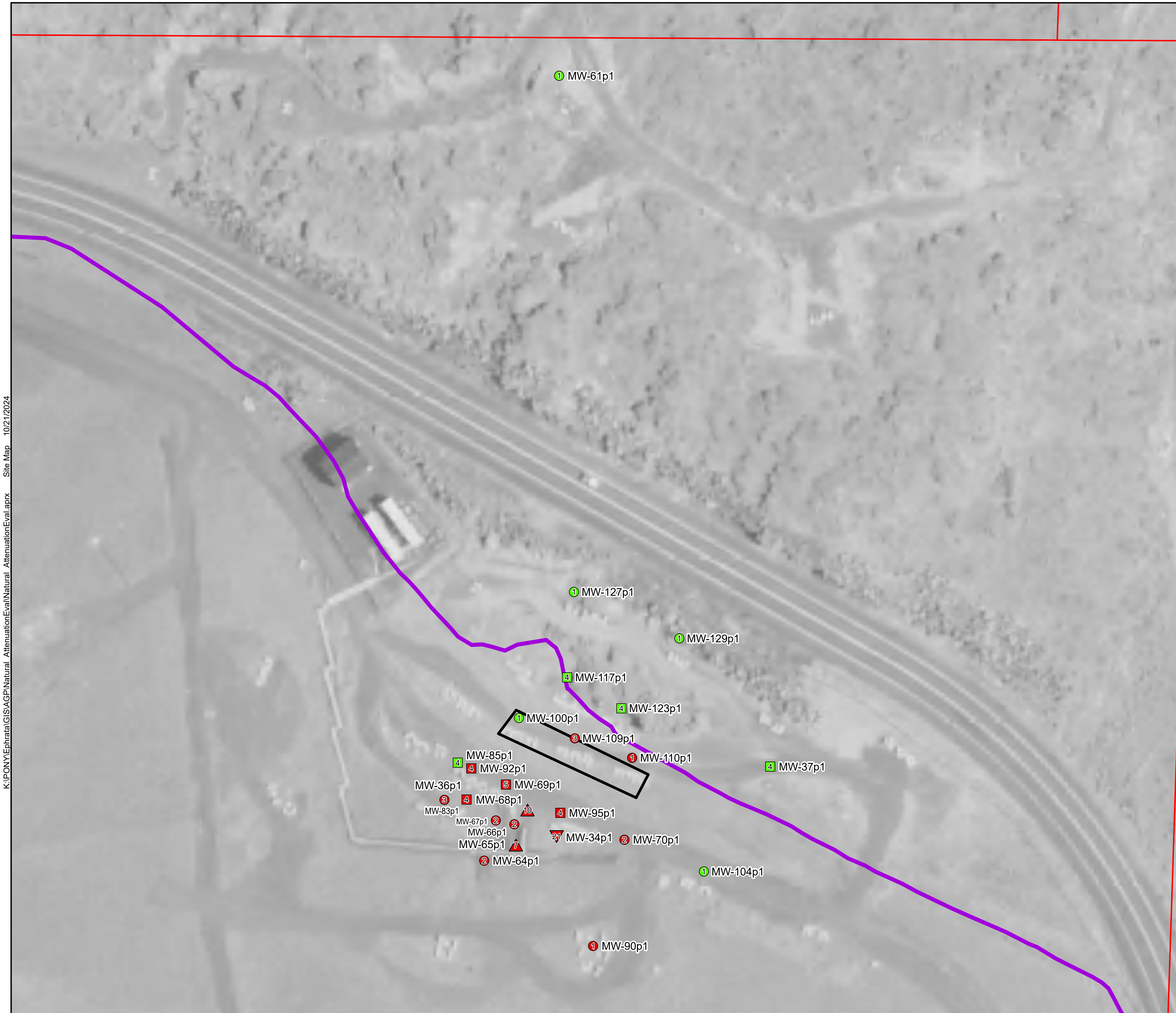
K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

N

0 Feet 75

Orthophoto: NRCS 2021

Figure 5

P1 Zone - Arsenic (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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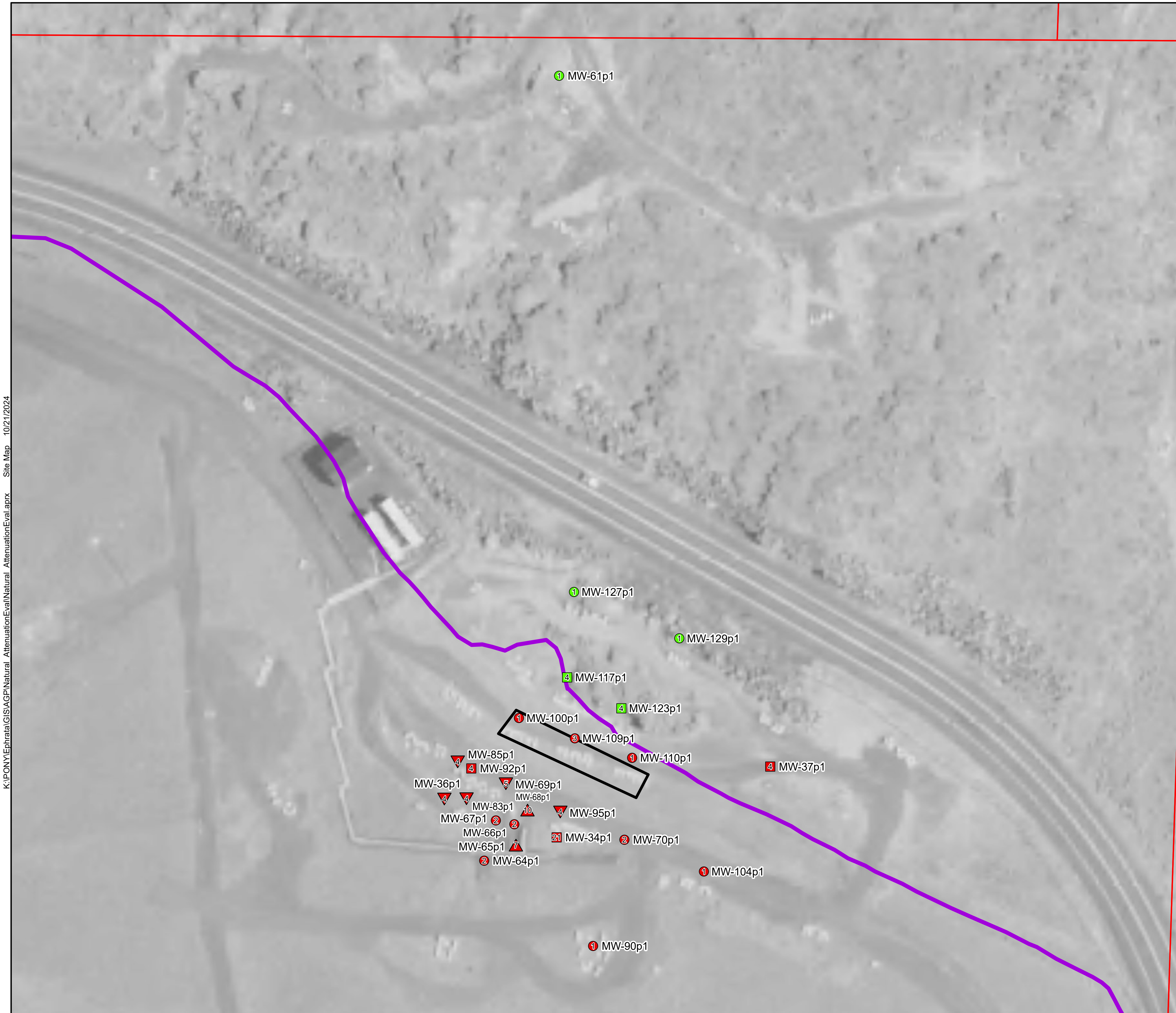
K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 10/21/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

N

0 Feet 75

Orthophoto: NRCS 2021

Figure 6

P1 Zone - Manganese (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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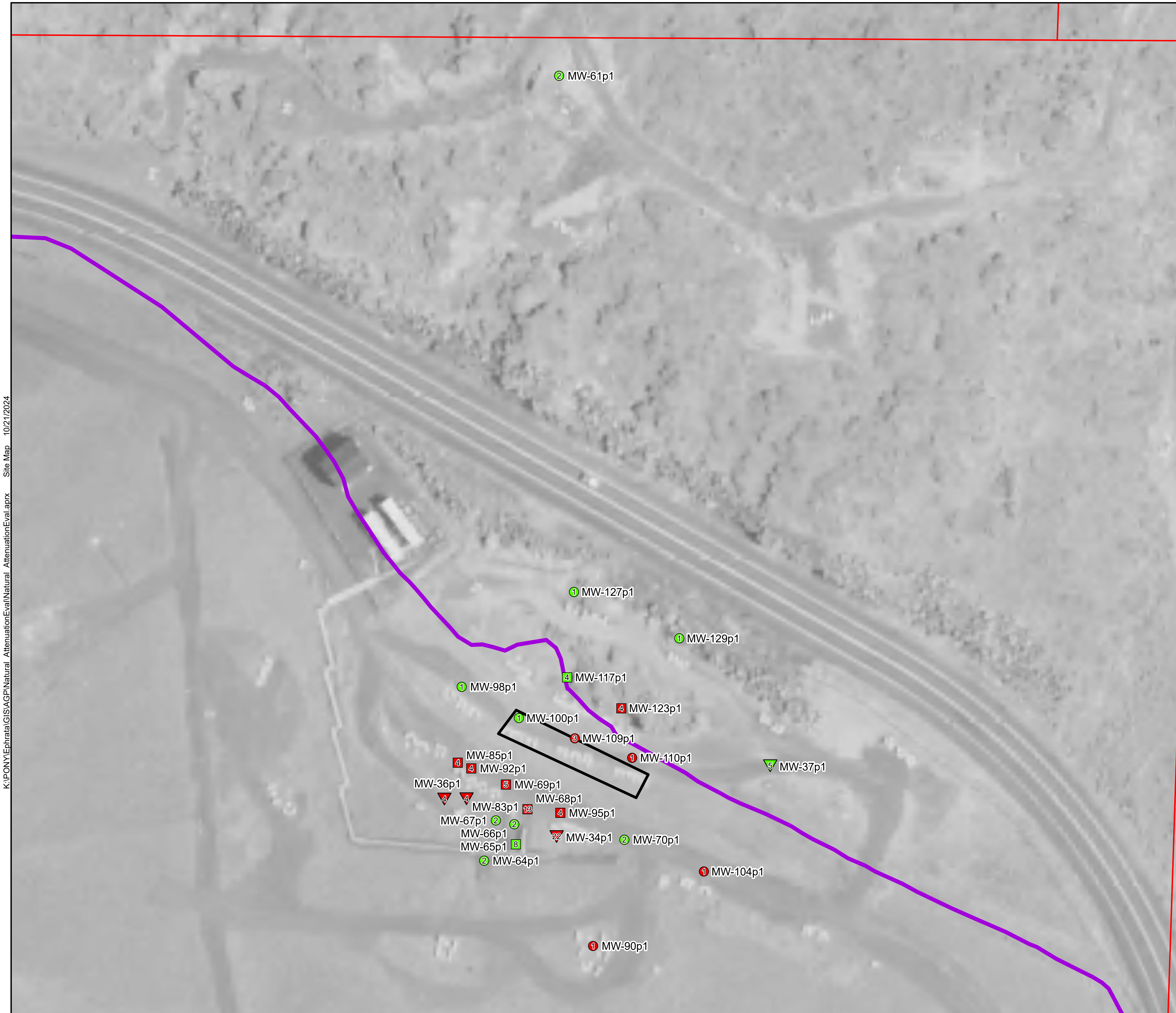
K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 10/21/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

0 Feet 75

Orthophoto: NRCS 2021

Figure 7

P1 Zone - 1,1-Dichloroethane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural AttenuationEval\Natural AttenuationEval.aprx Site Map 10/21/2024

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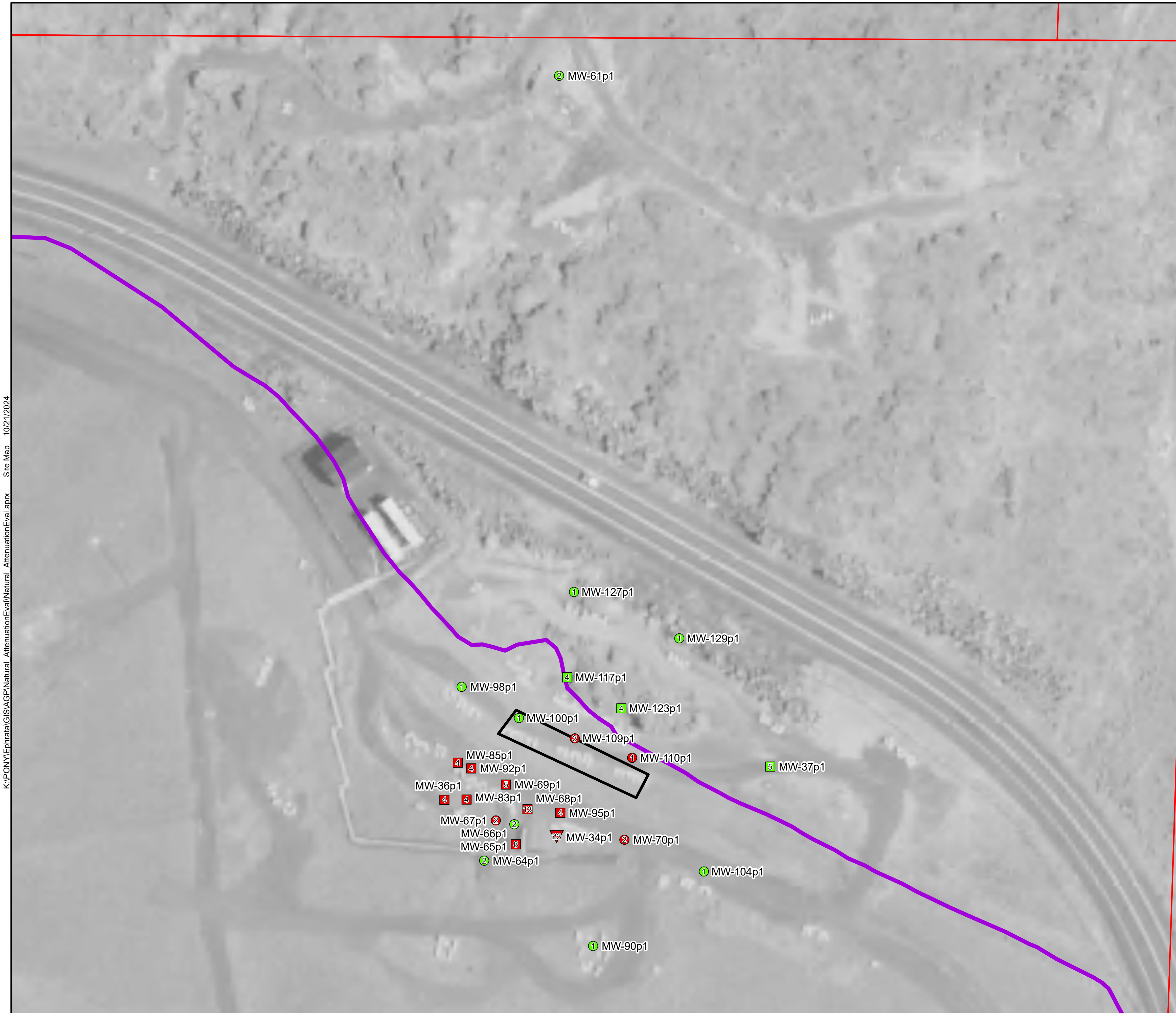


Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 75

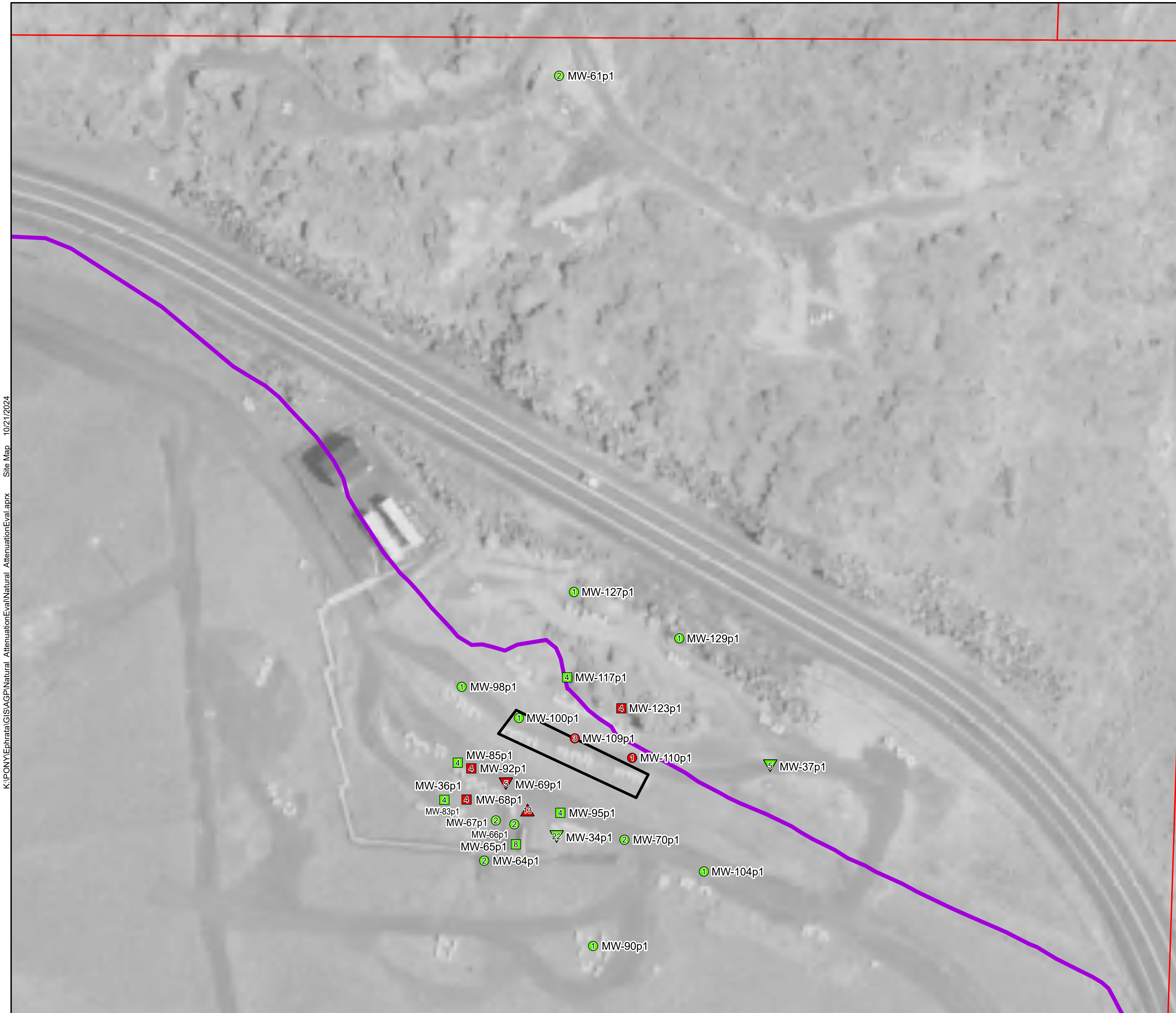
Orthophoto: NRCS 2021

Figure 8

P1 Zone - 1,2-Dichloroethane (EDC) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 75

Orthophoto: NRCS 2021

Figure 9

P1 Zone - 1,2-Dichloropropane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 10/21/2024

Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

0 Feet 75

Orthophoto: NRCS 2021

Figure 10

P1 Zone - 1,4-Dichlorobenzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 75

Orthophoto: NRCS 2021

Figure 11

P1 Zone - Benzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

N

0 Feet 75

Orthophoto: NRCS 2021

Figure 12

P1 Zone - cis-1,2-Dichloroethene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural AttenuationEval\Natural AttenuationEval.aprx Site Map 10/21/2024

Figure 13

P1 Zone - Trichloroethene (TCE) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 75

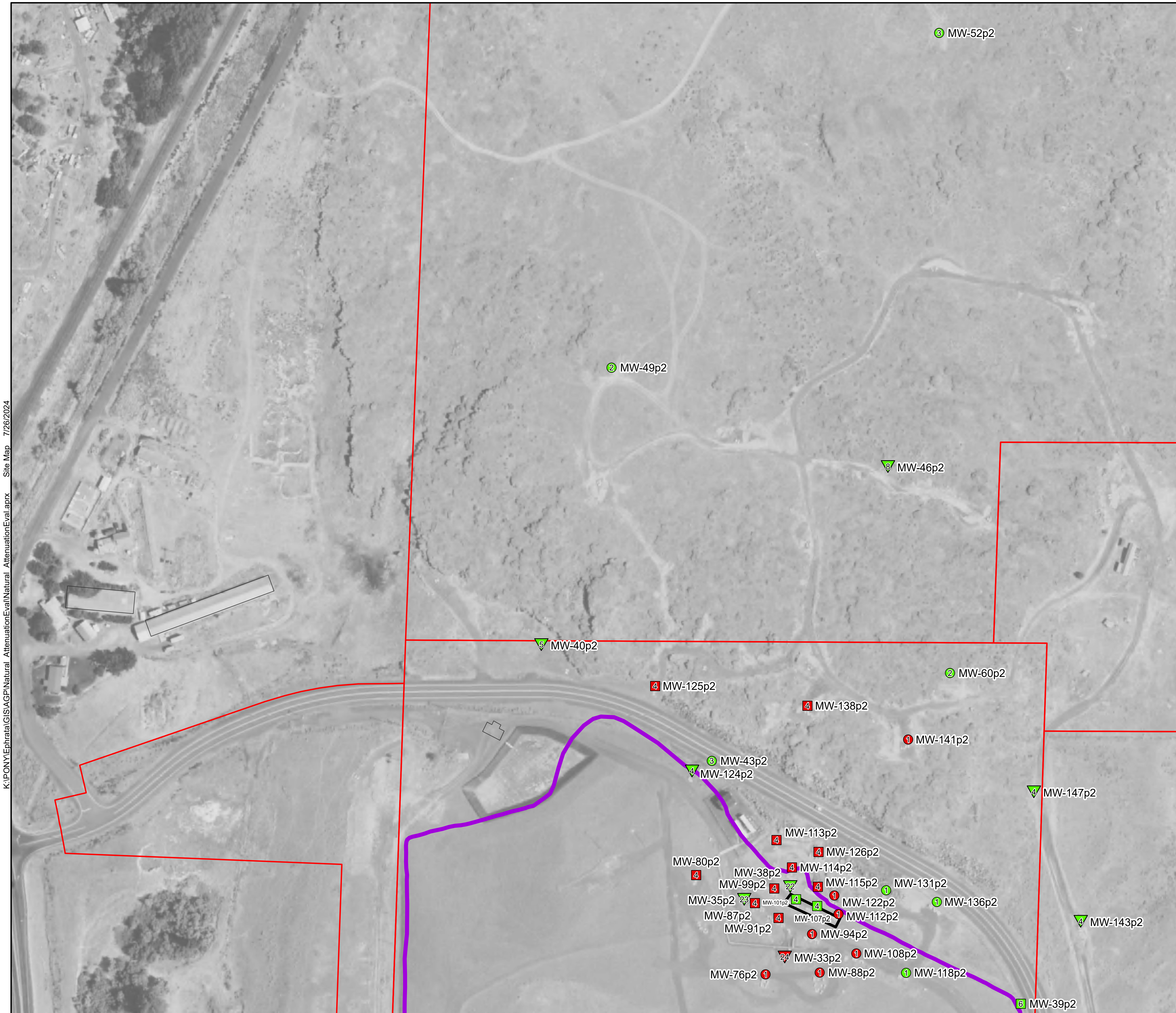
Orthophoto: NRCS 2021

Figure 14

P1 Zone - Vinyl Chloride (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

Figure 15

P2 Zone - Arsenic (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural AttenuationEval\Natural AttenuationEval.aprx Site Map 7/26/2024

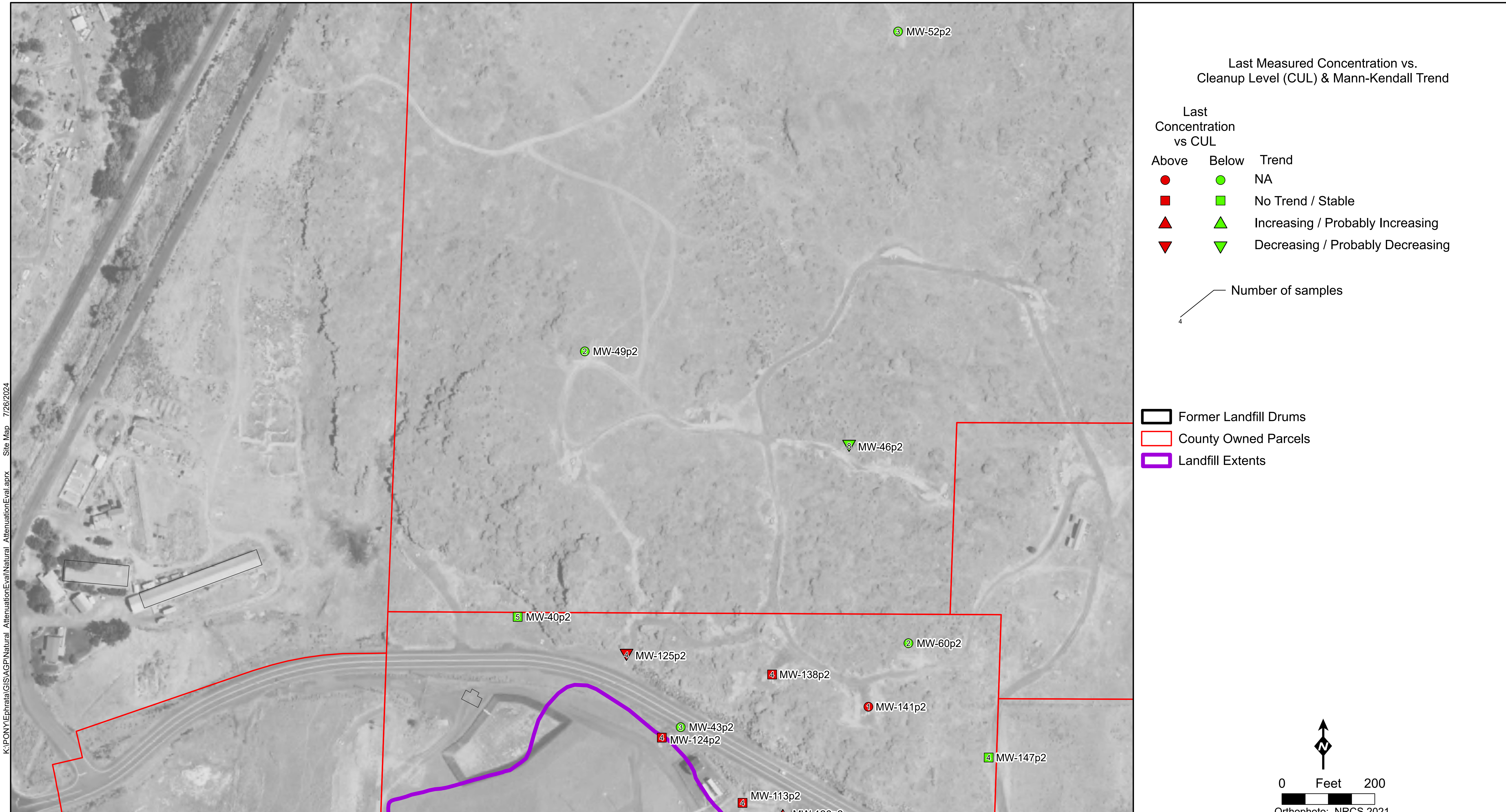
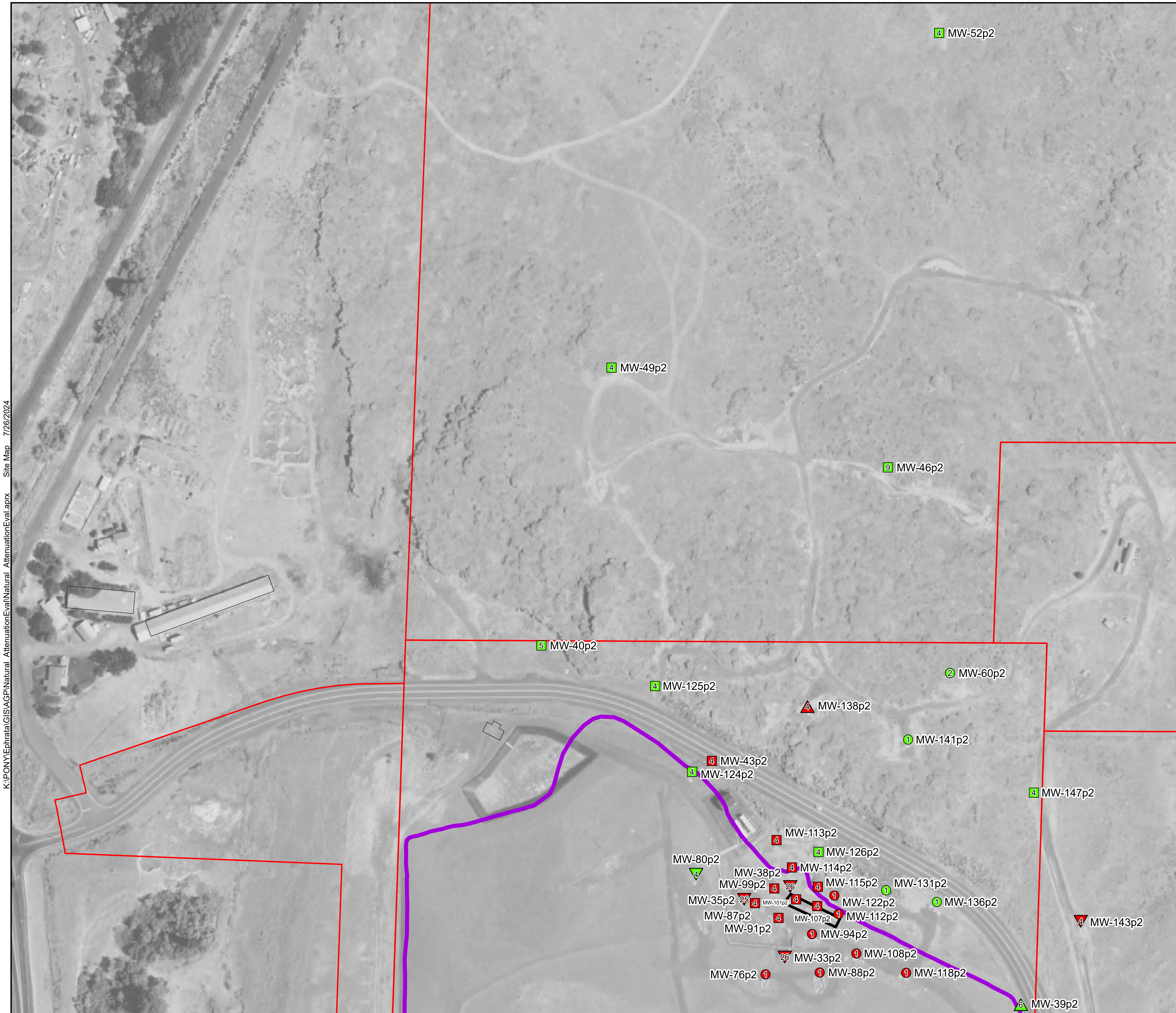


Figure 16

P2 Zone - Manganese (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

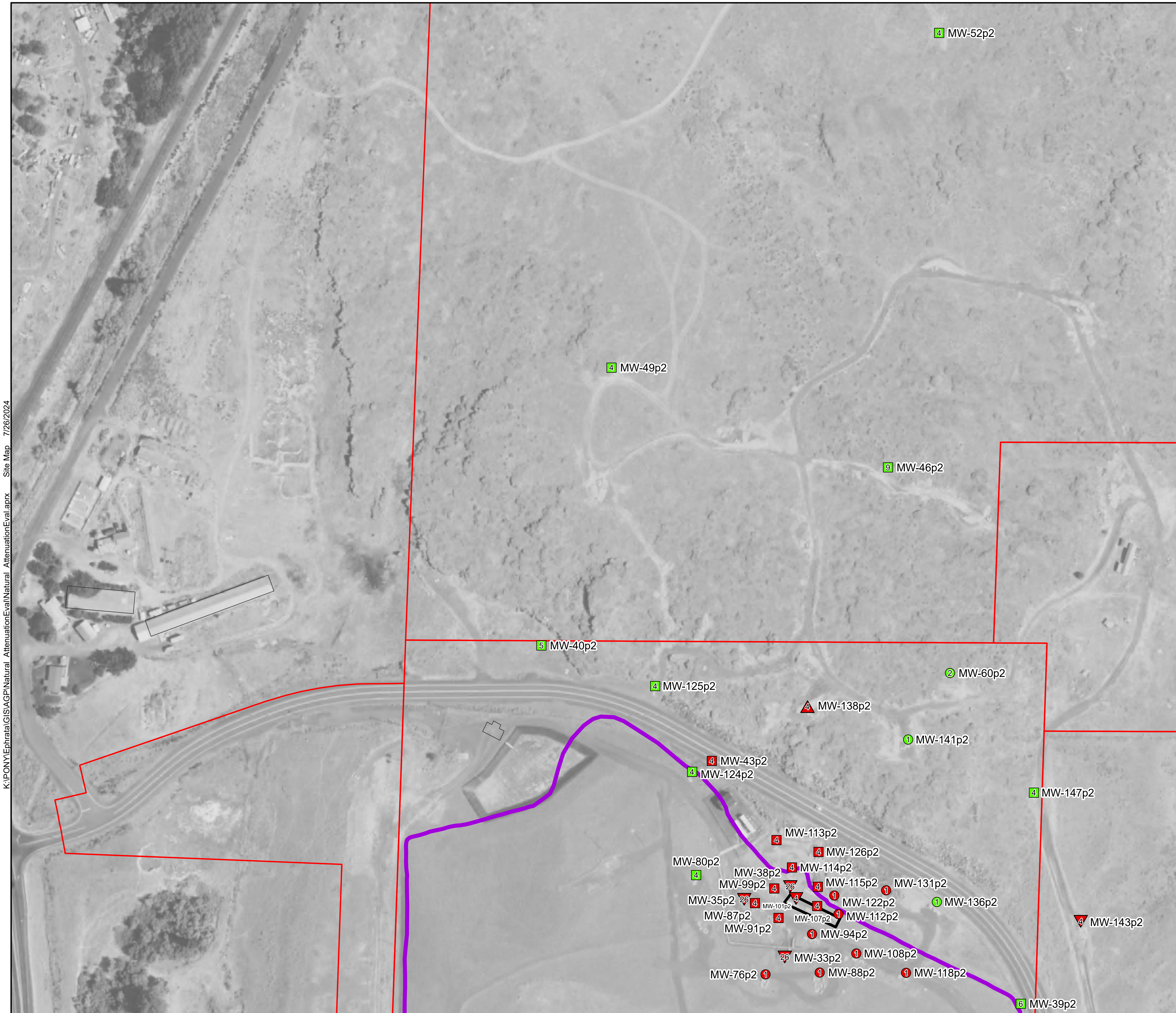
Orthophoto: NRCS 2021

Figure 17

P2 Zone - 1,1-Dichloroethane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

Figure 18

P2 Zone - 1,2-Dichloroethane (EDC) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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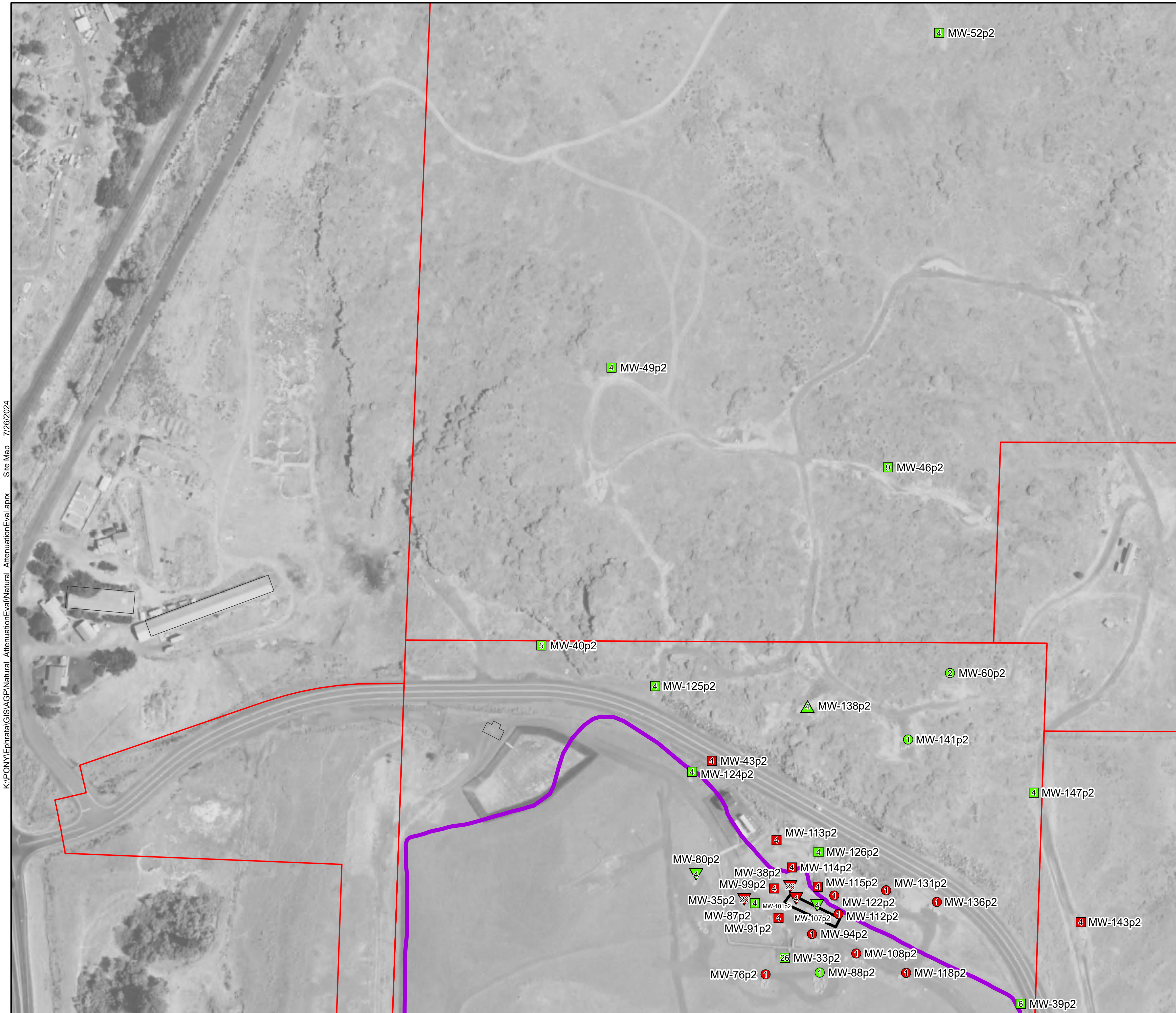
K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

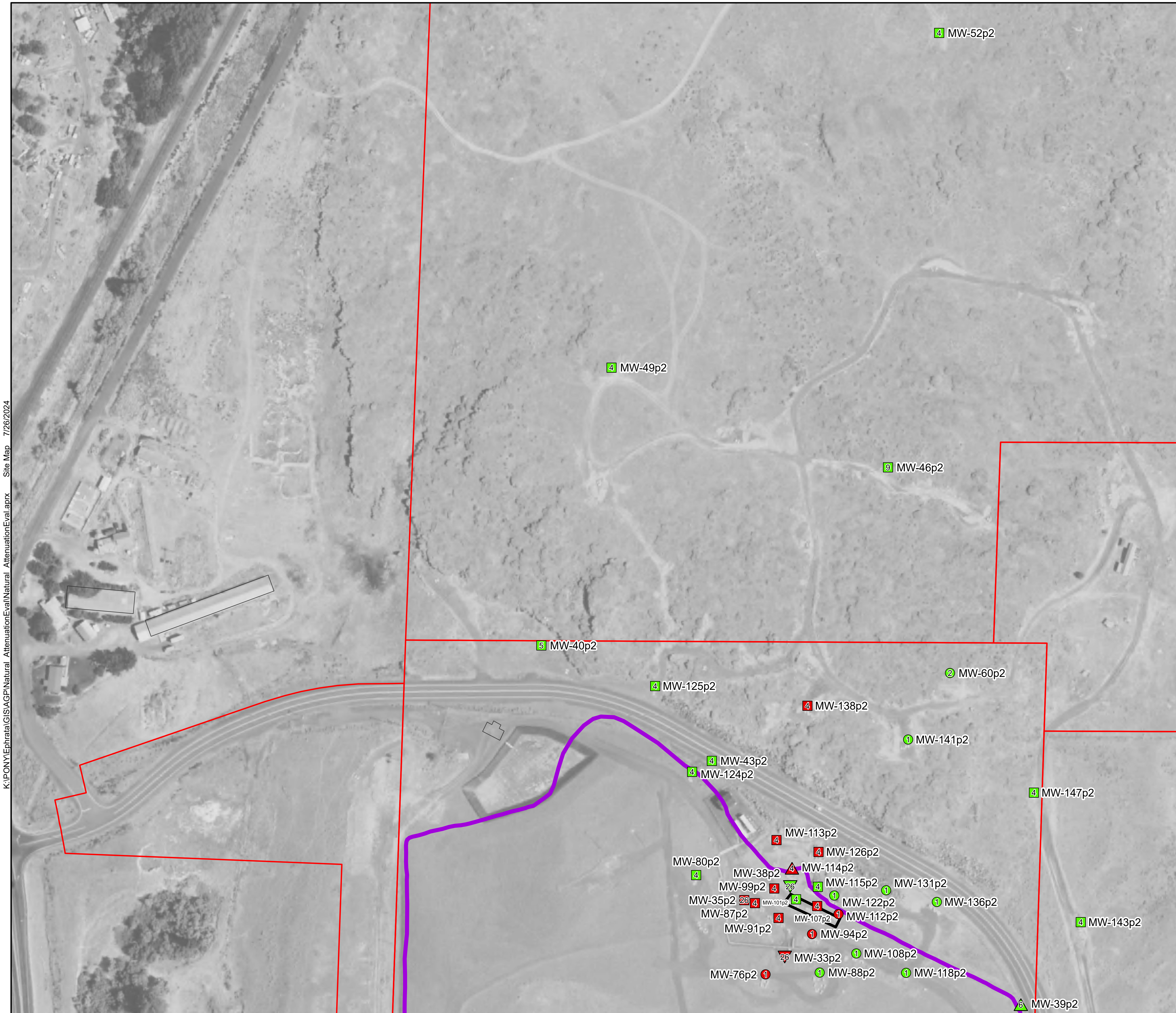
Figure 19

P2 Zone - 1,2-Dichloropropane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

N

0 Feet 200

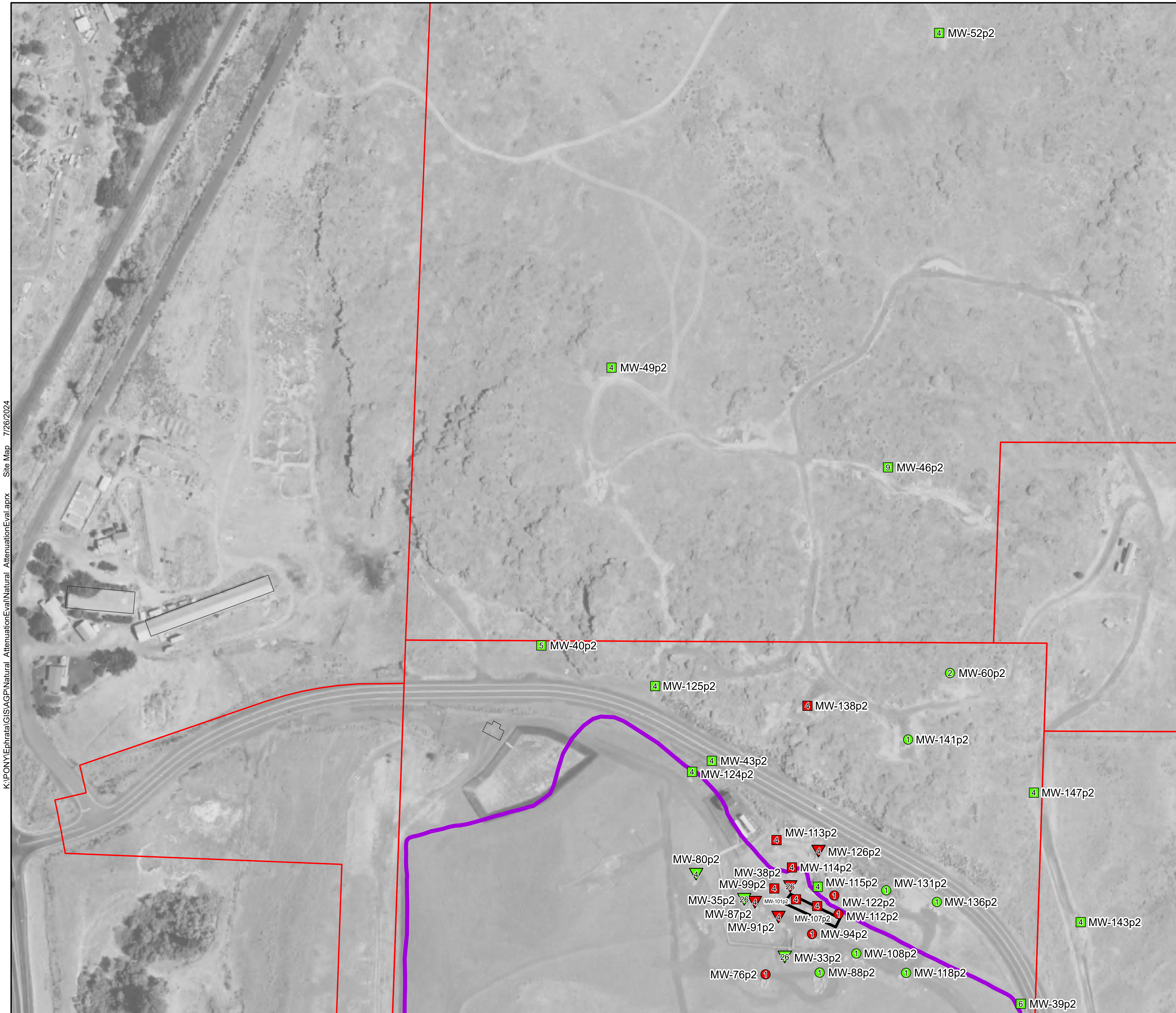
Orthophoto: NRCS 2021

Figure 20

P2 Zone - 1,4-Dichlorobenzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

Figure 21

P2 Zone - Benzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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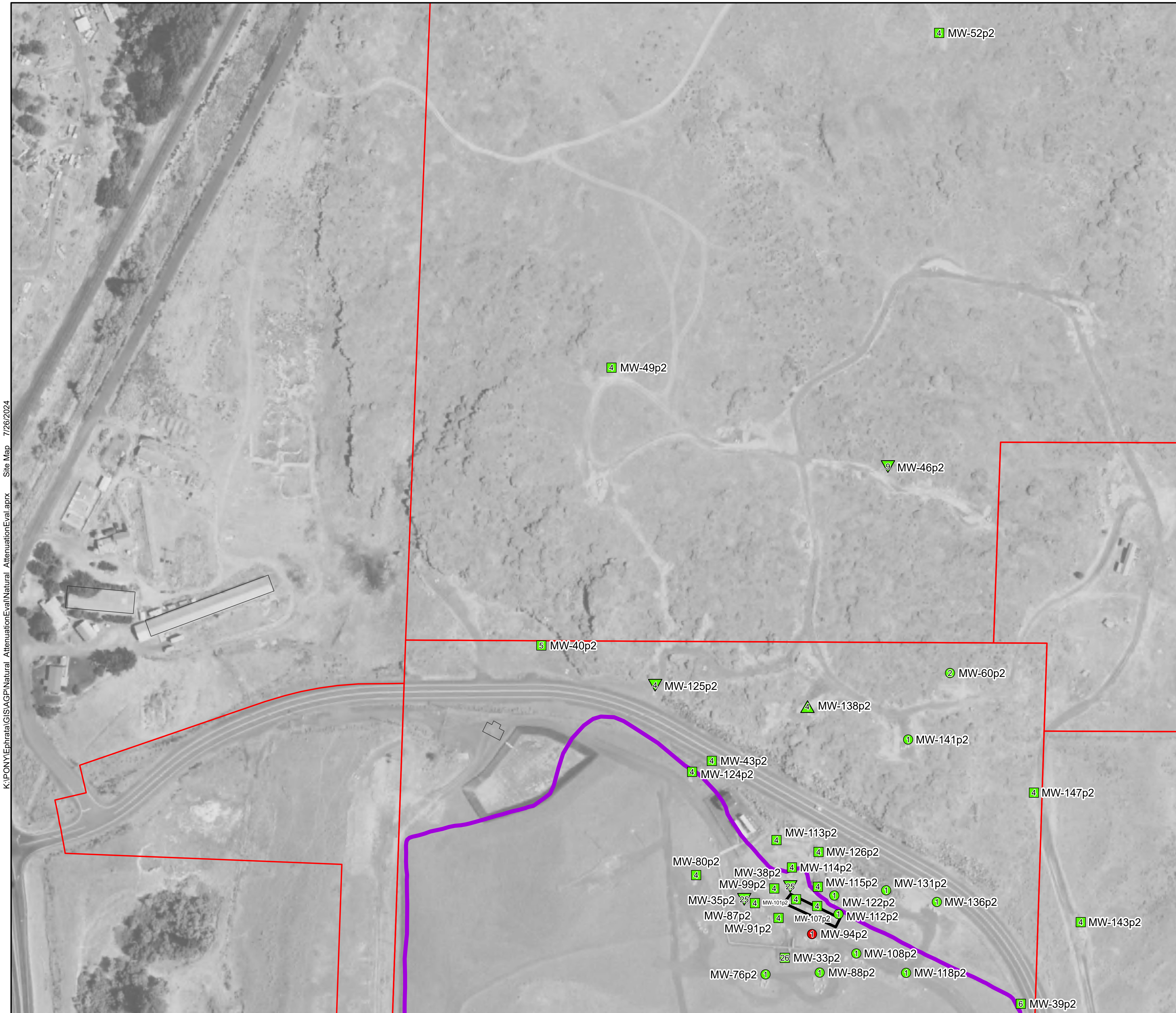


Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
● (red)	● (green)	NA
■ (red)	■ (green)	No Trend / Stable
▲ (red)	▲ (green)	Increasing / Probably Increasing
▼ (red)	▼ (green)	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 200

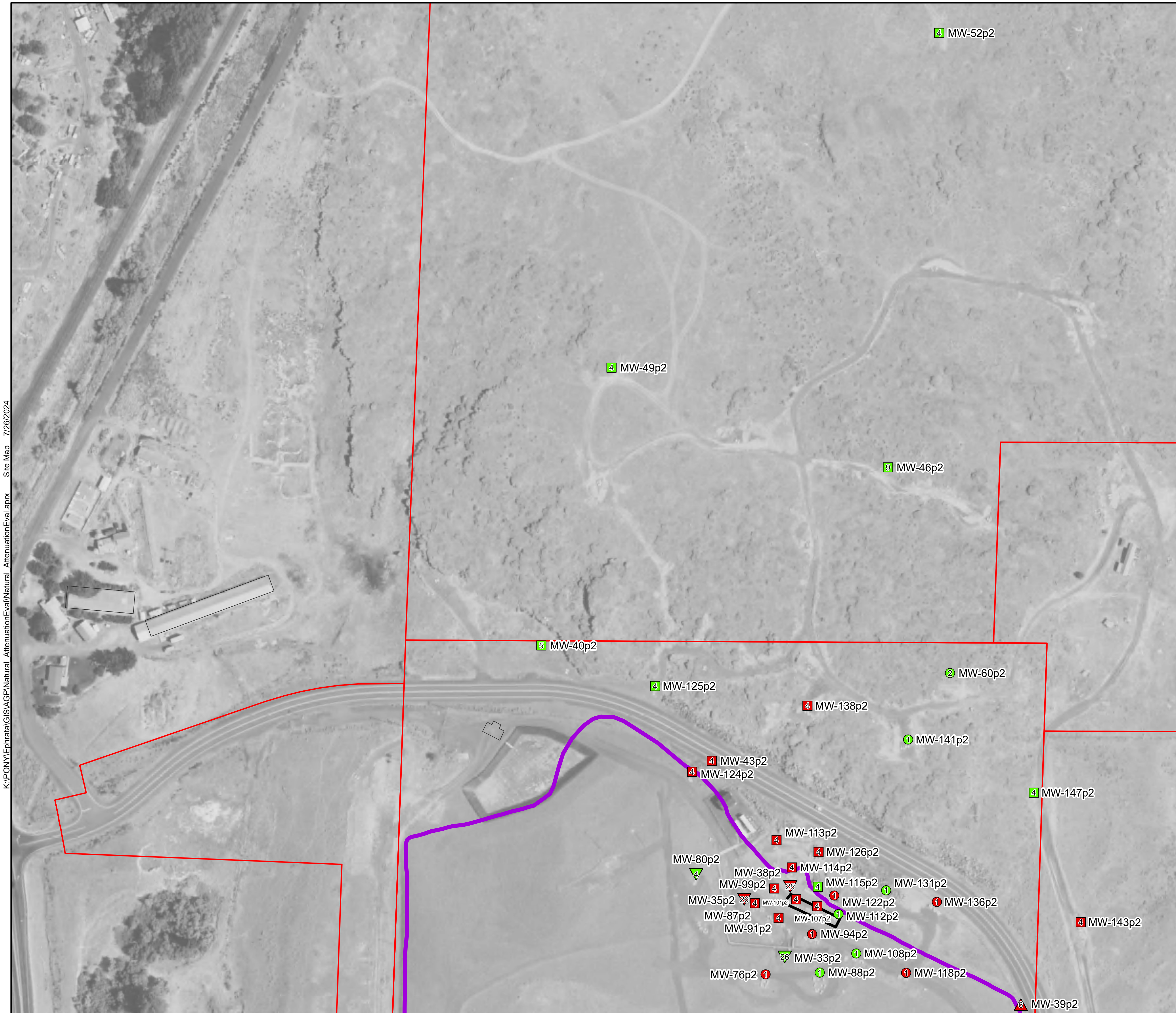
Orthophoto: NRCS 2021

Figure 22

P2 Zone - cis-1,2-Dichloroethene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

Figure 23

P2 Zone - Trichloroethene (TCE) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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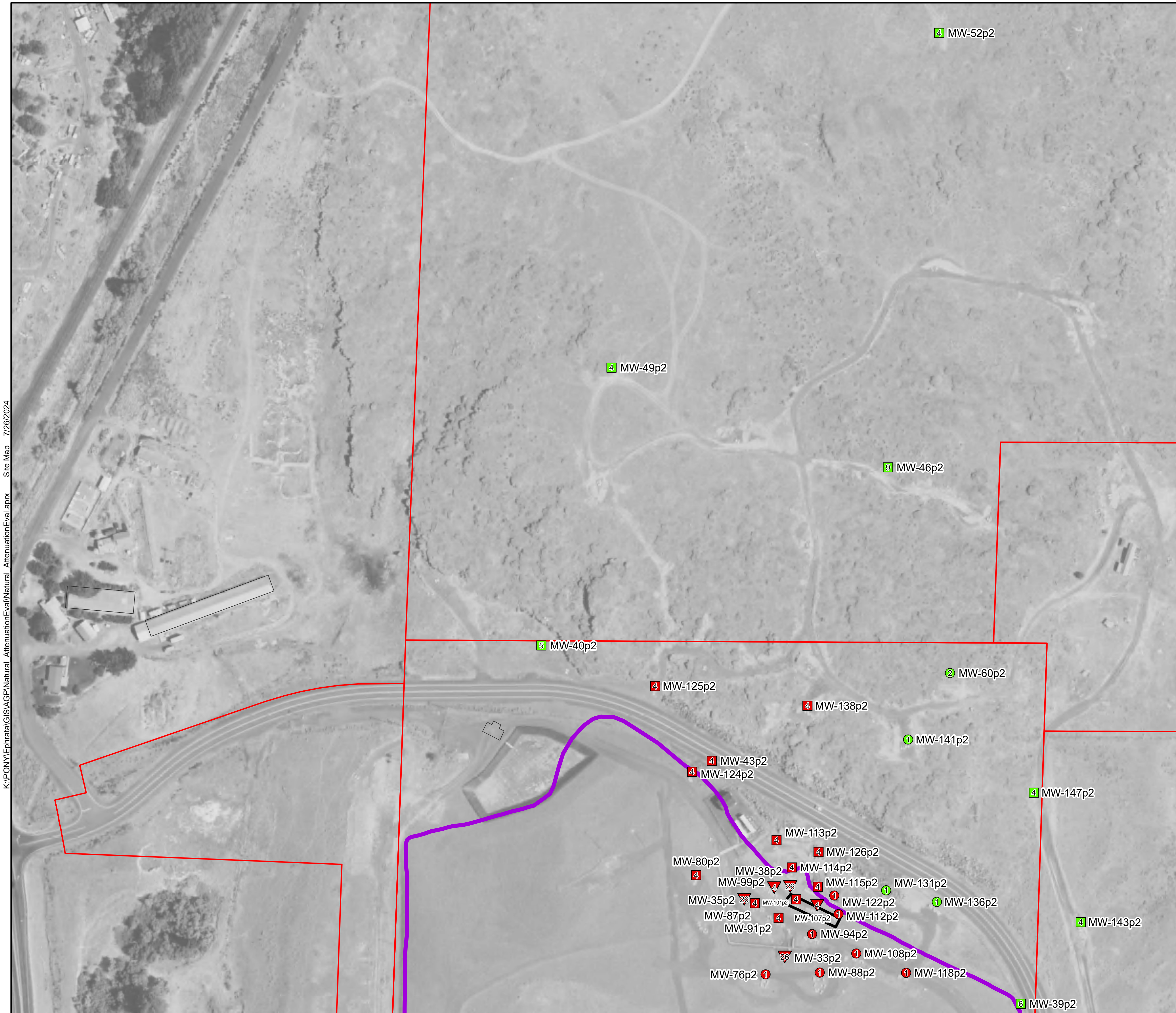
K:\PONY\Ephrata\GIS\AGP\Natural AttenuationEval\Natural AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 200

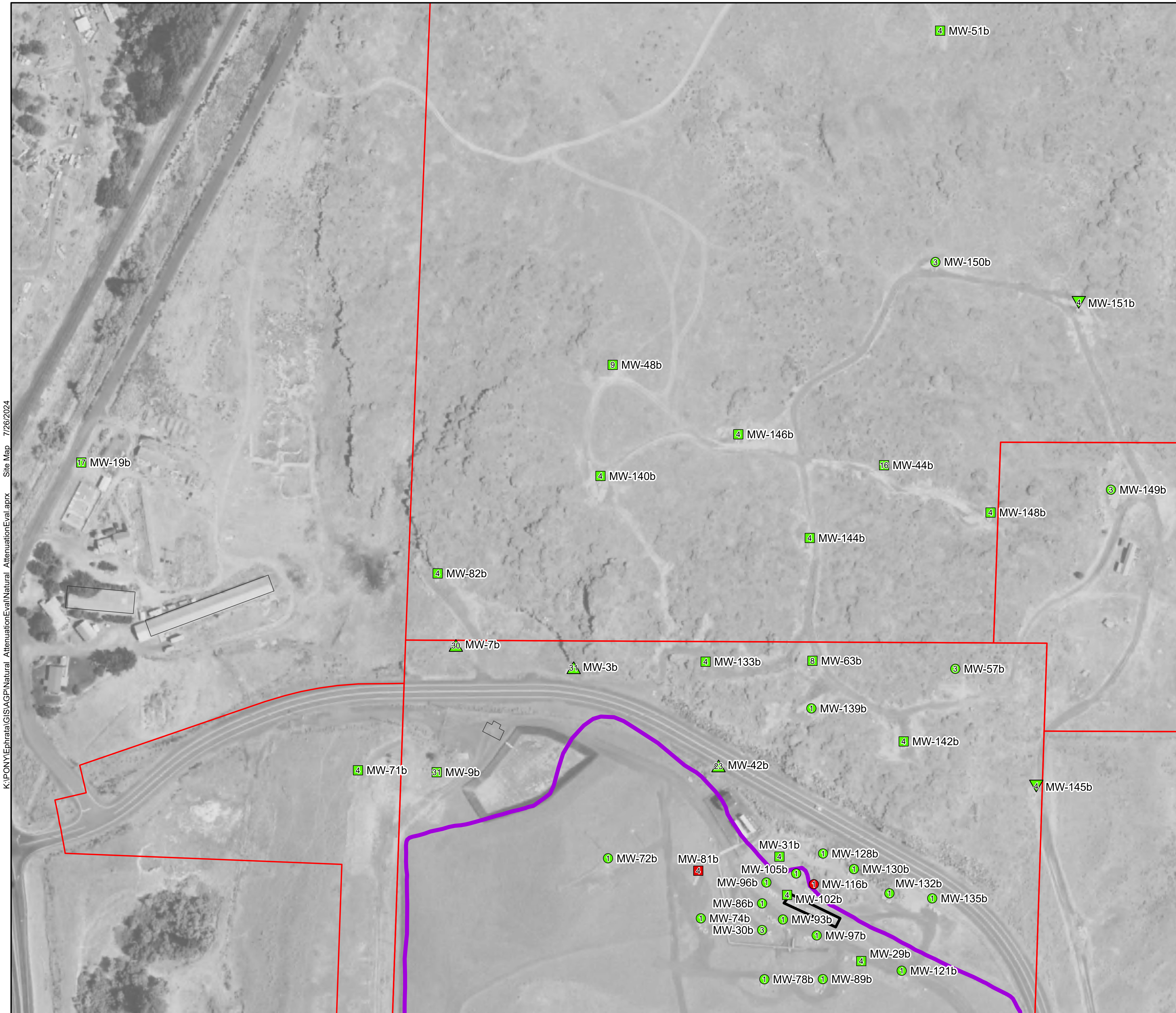
Orthophoto: NRCS 2021

Figure 24

P2 Zone - Vinyl Chloride (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 200

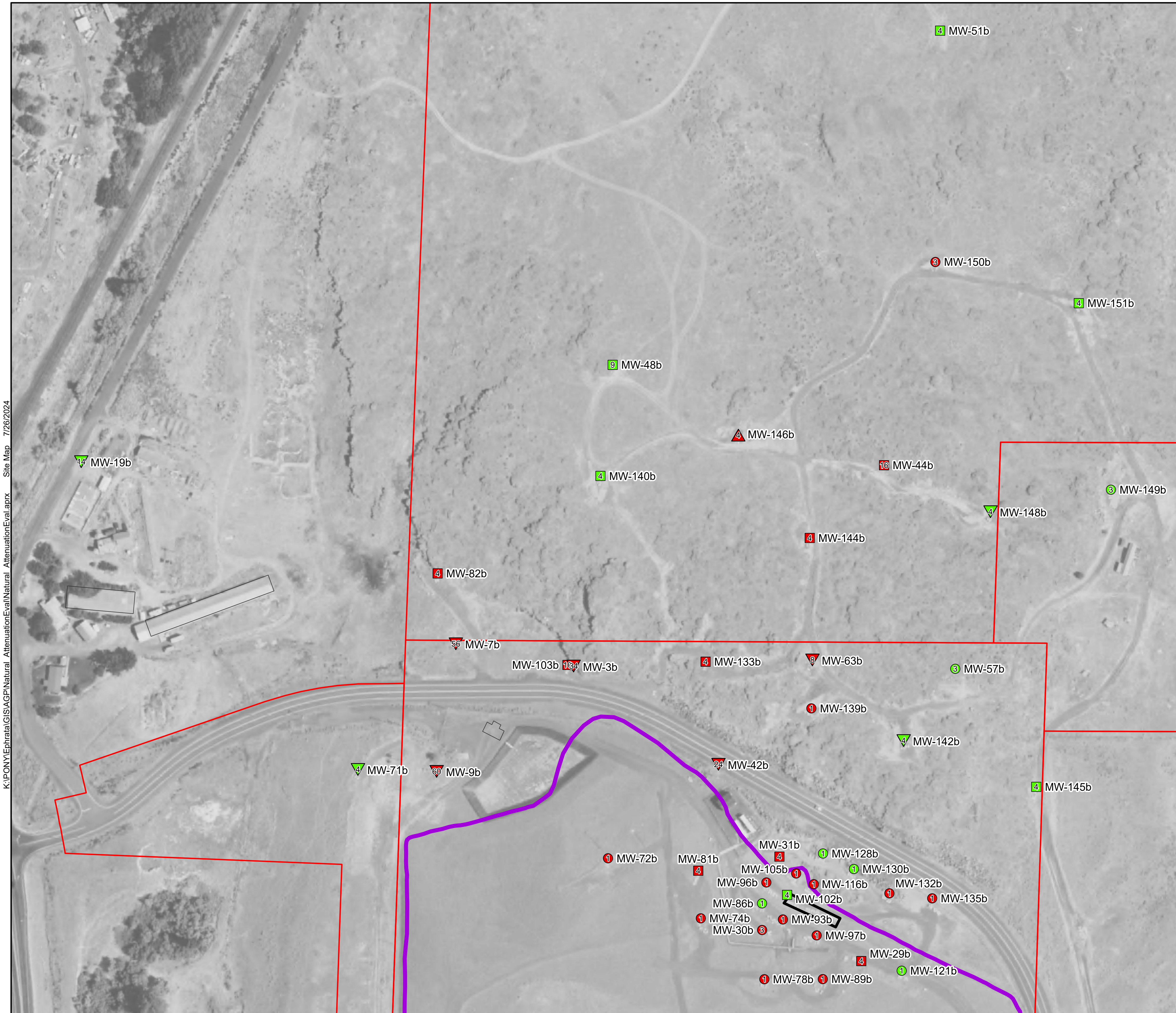
Orthophoto: NRCS 2021

Figure 25

Roza Aquifer - Arsenic (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL

Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

Figure 26

Roza Aquifer - Manganese (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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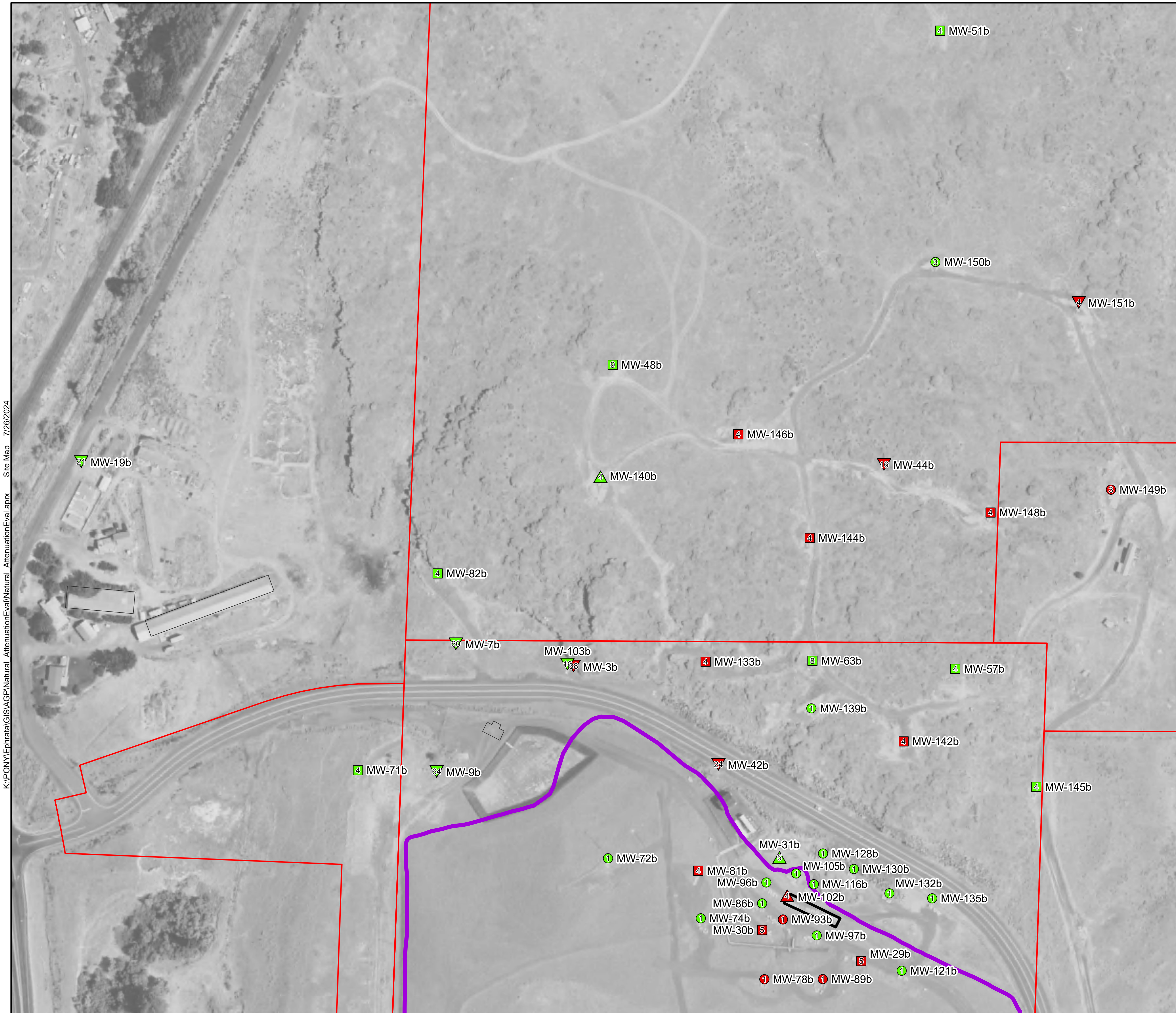
K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

4

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

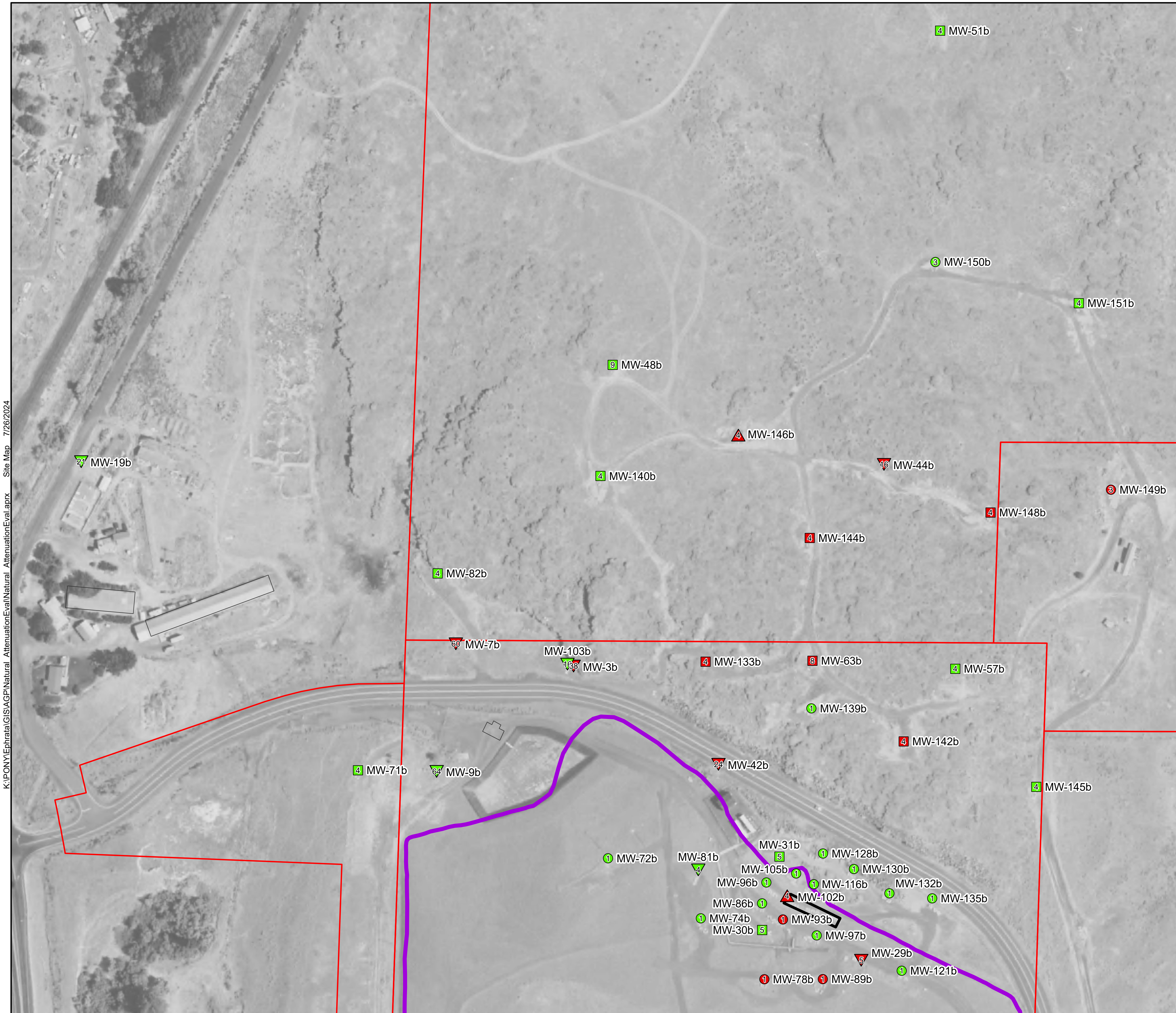
Figure 27

Roza Aquifer - 1,1-Dichloroethane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

Figure 28

Roza Aquifer - 1,2-Dichloroethane (EDC) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

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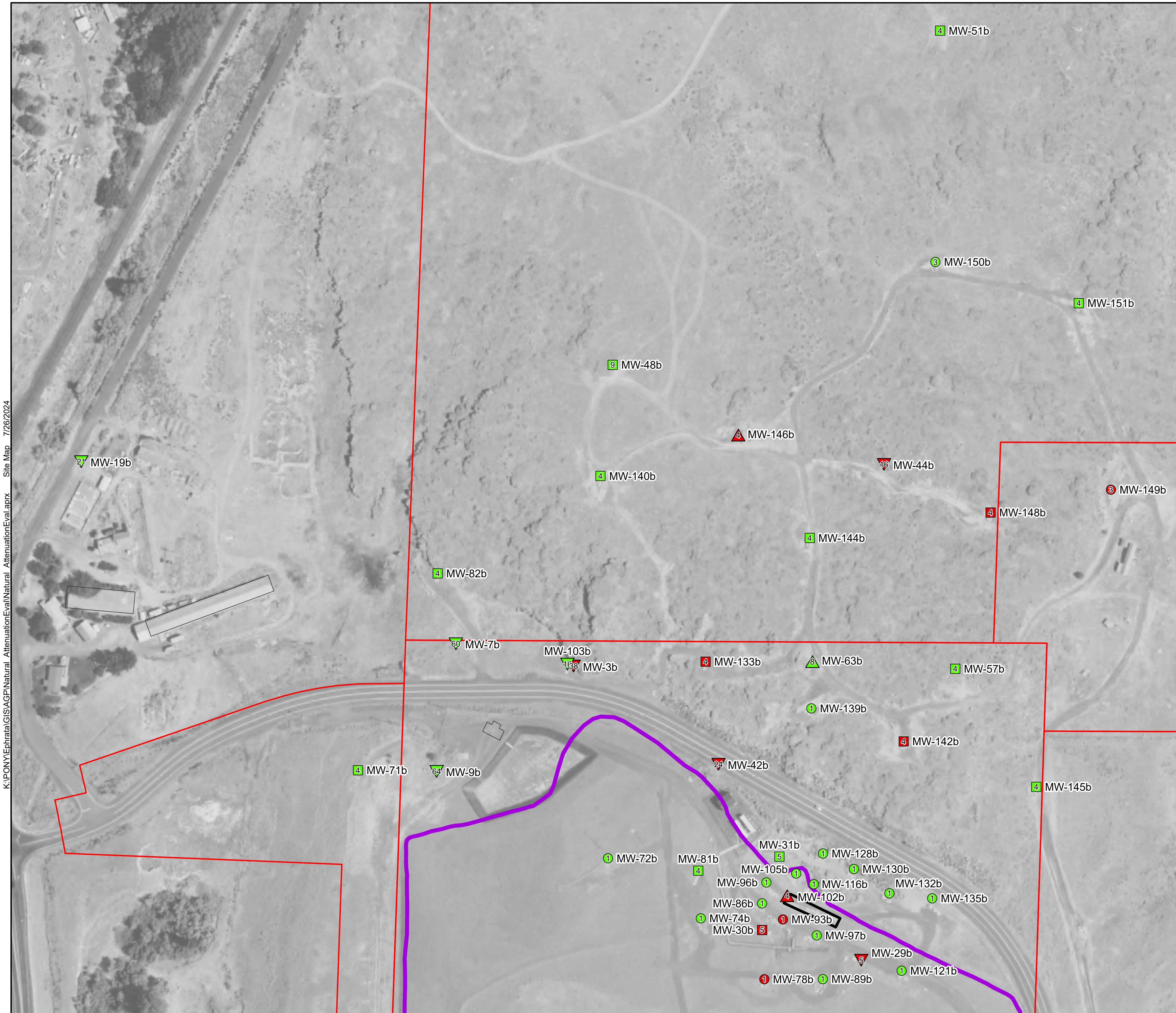


Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

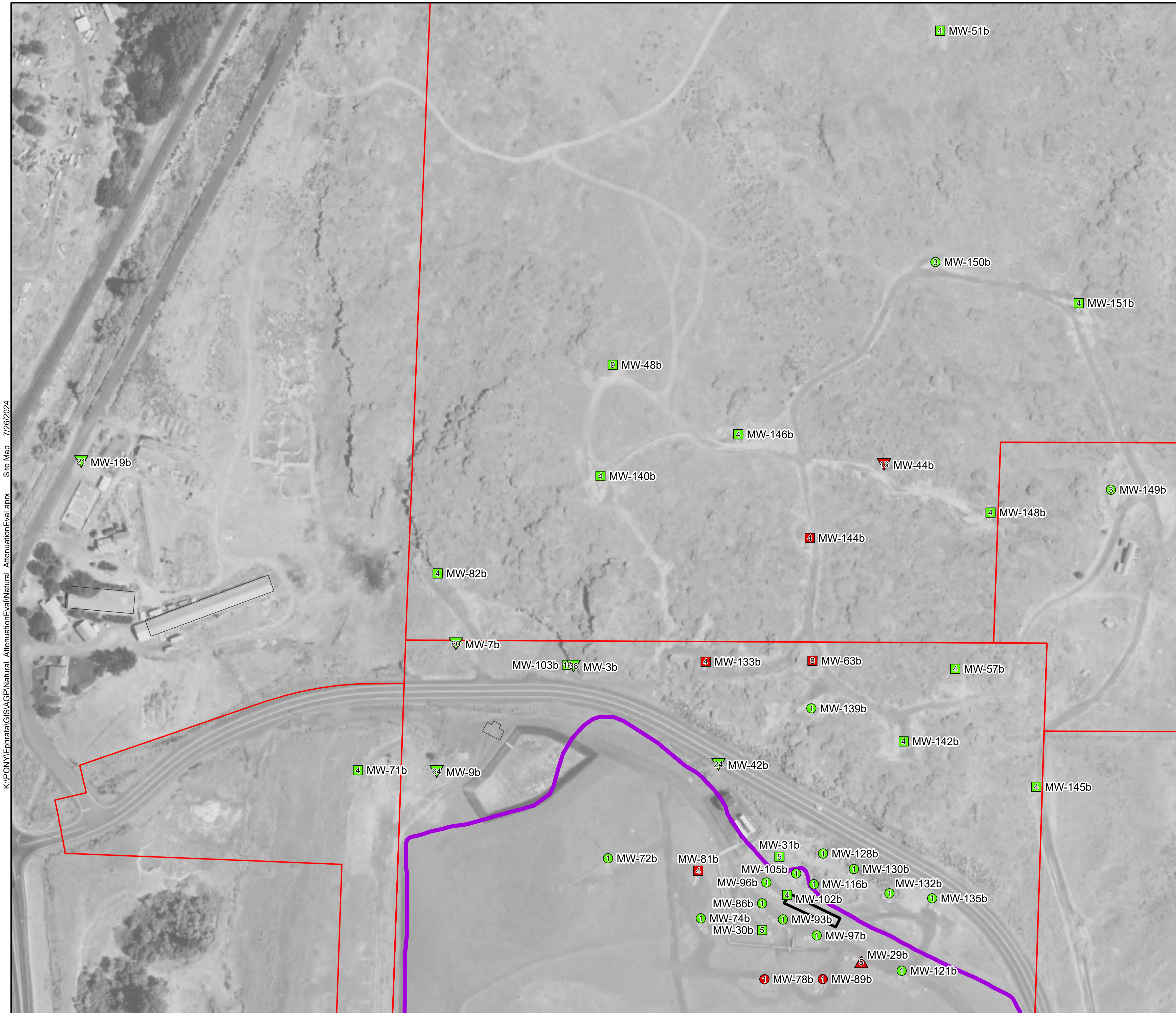
Figure 29

Roza Aquifer - 1,2-Dichloropropane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

0 Feet 200

Orthophoto: NRCS 2021

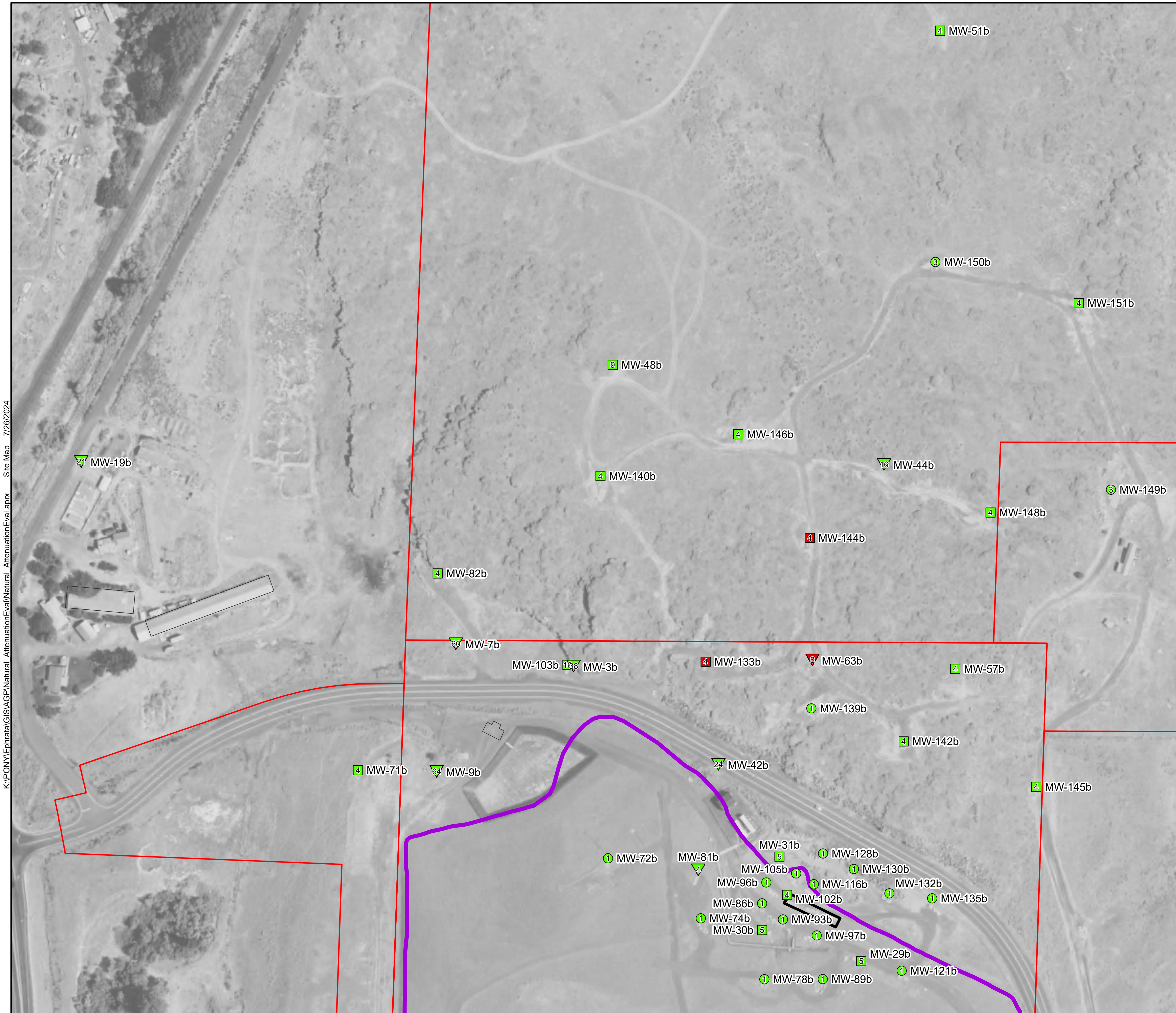
Figure 30

Roza Aquifer - 1,4-Dichlorobenzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



K:\PONY\Ephrata\GIS\AGP\Natural AttenuationEval\Natural AttenuationEval.aprx Site Map 7/26/2024

Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 200

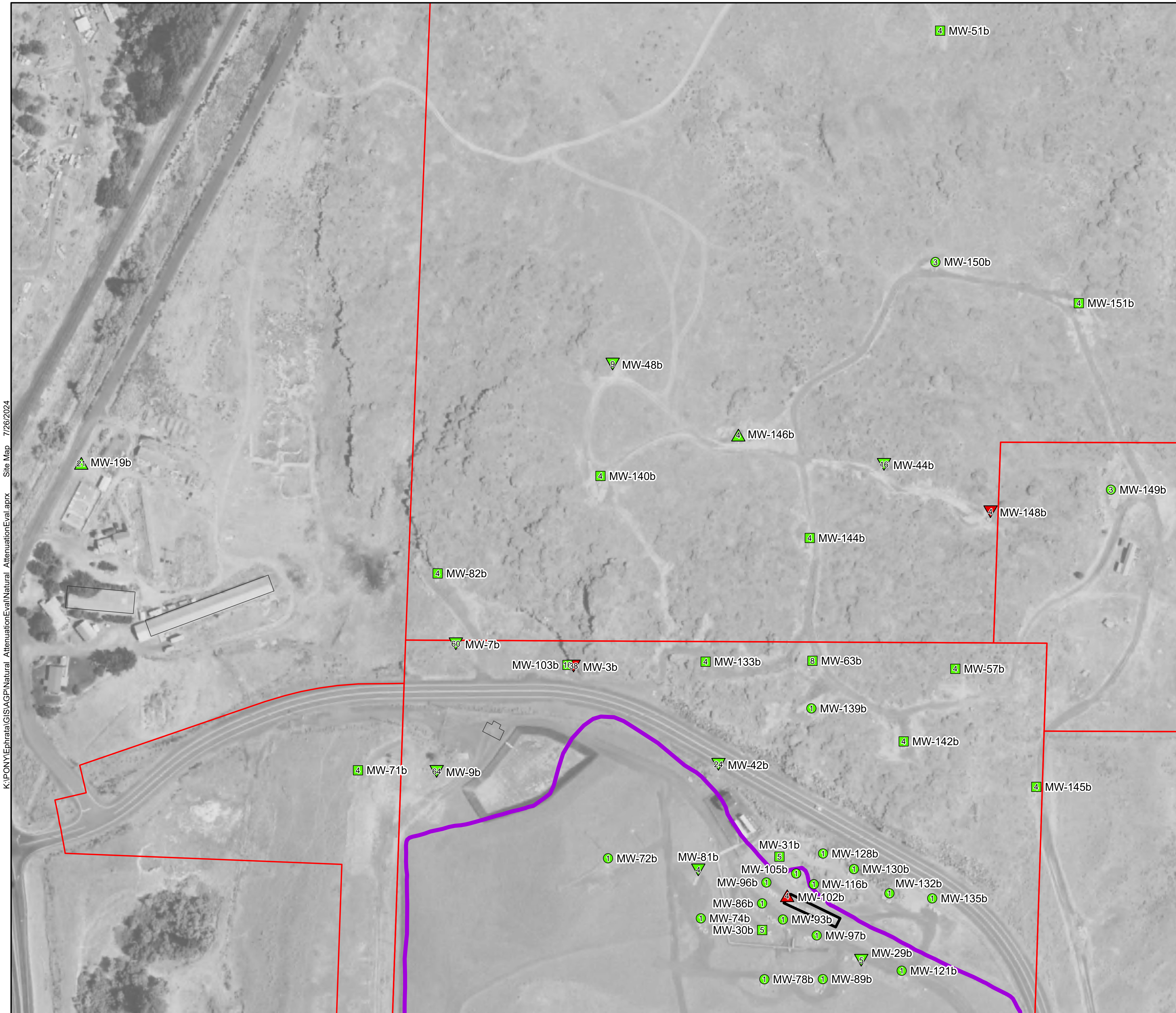
Orthophoto: NRCS 2021

Figure 31

Roza Aquifer - Benzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024

Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 200

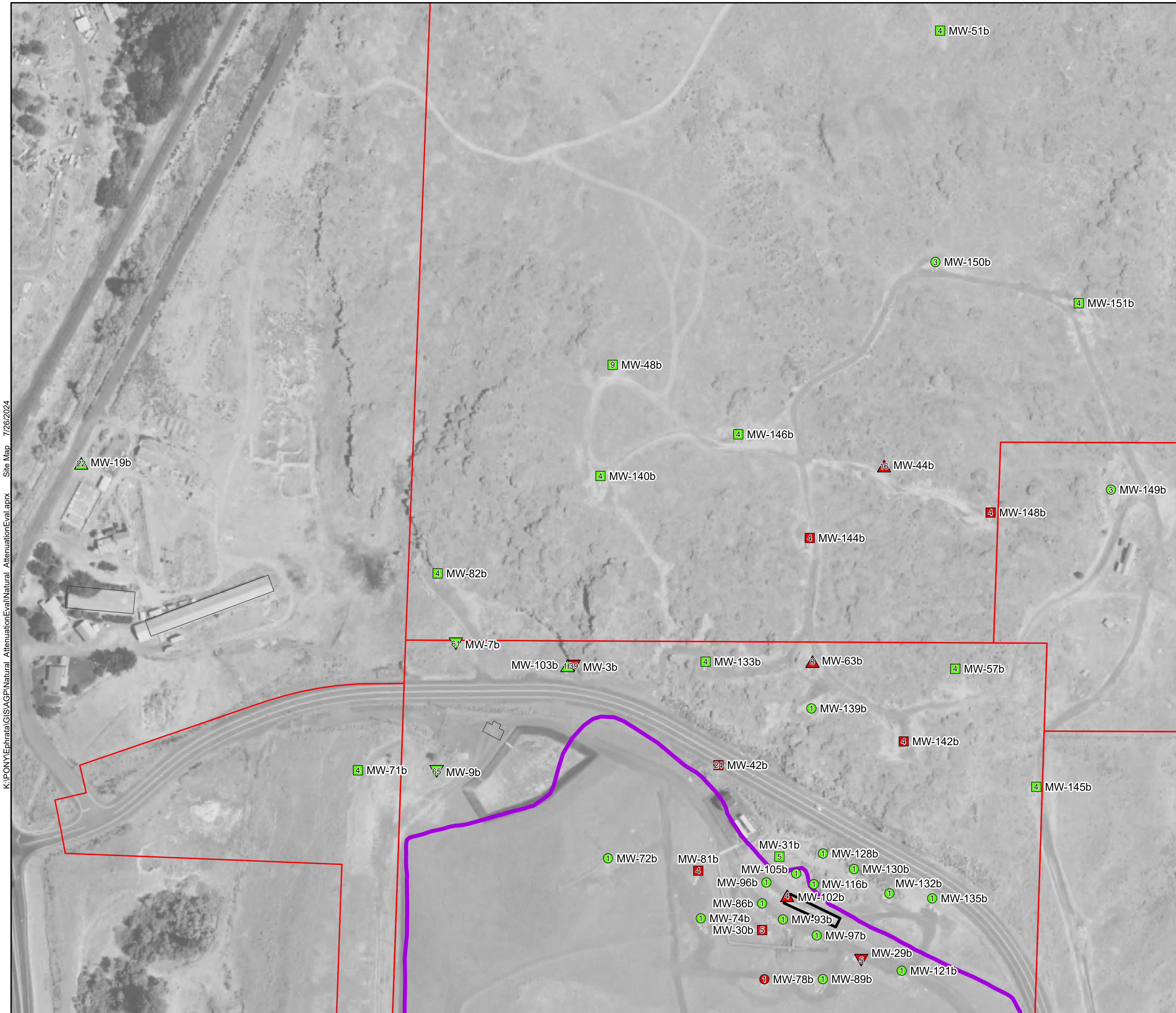
Orthophoto: NRCS 2021

Figure 32

Roza Aquifer - cis-1,2-Dichloroethene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

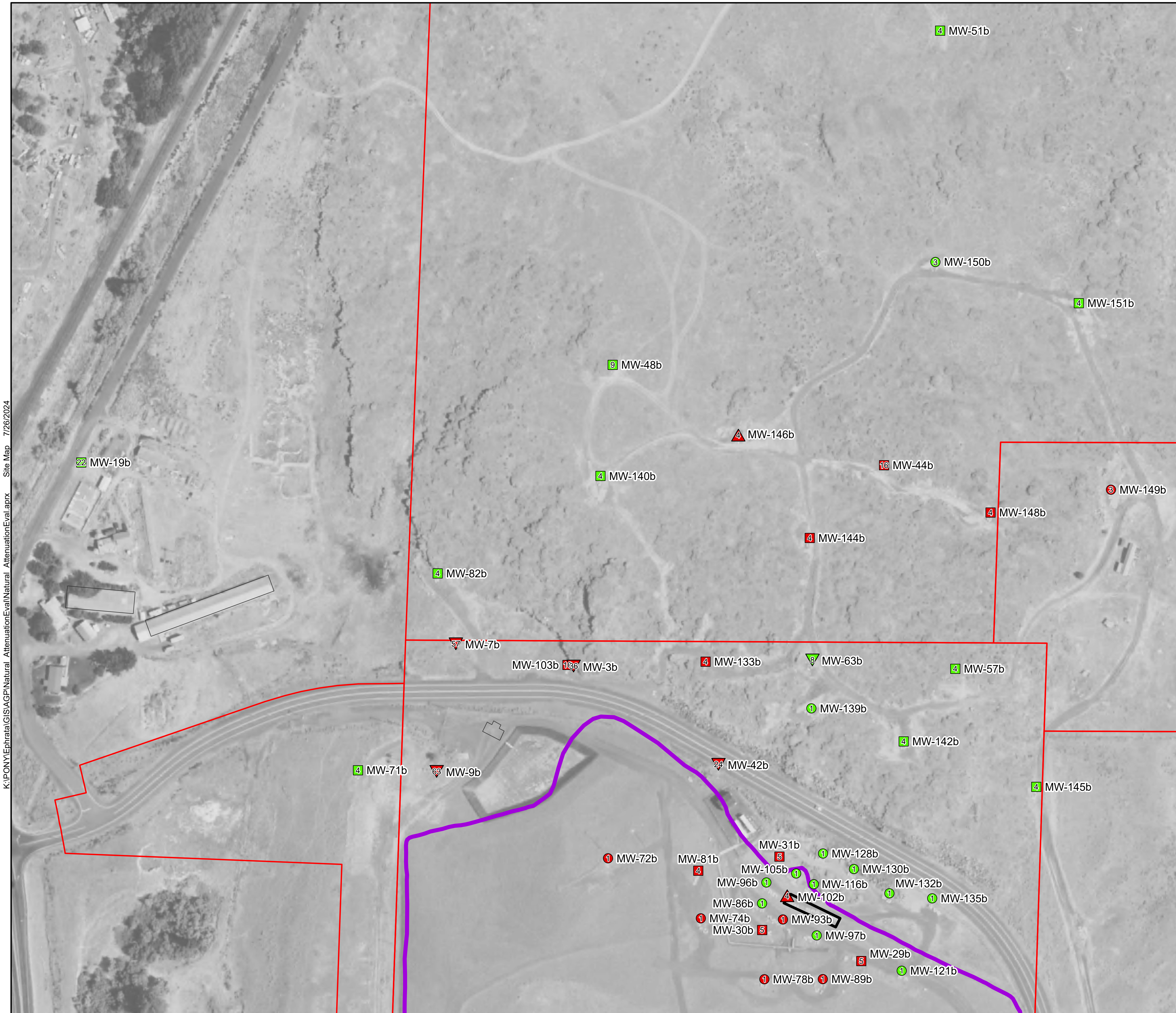
Figure 33

Roza Aquifer - Trichloroethene (TCE) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

N

0 Feet 200

Orthophoto: NRCS 2021

Figure 34

Roza Aquifer - Vinyl Chloride (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024

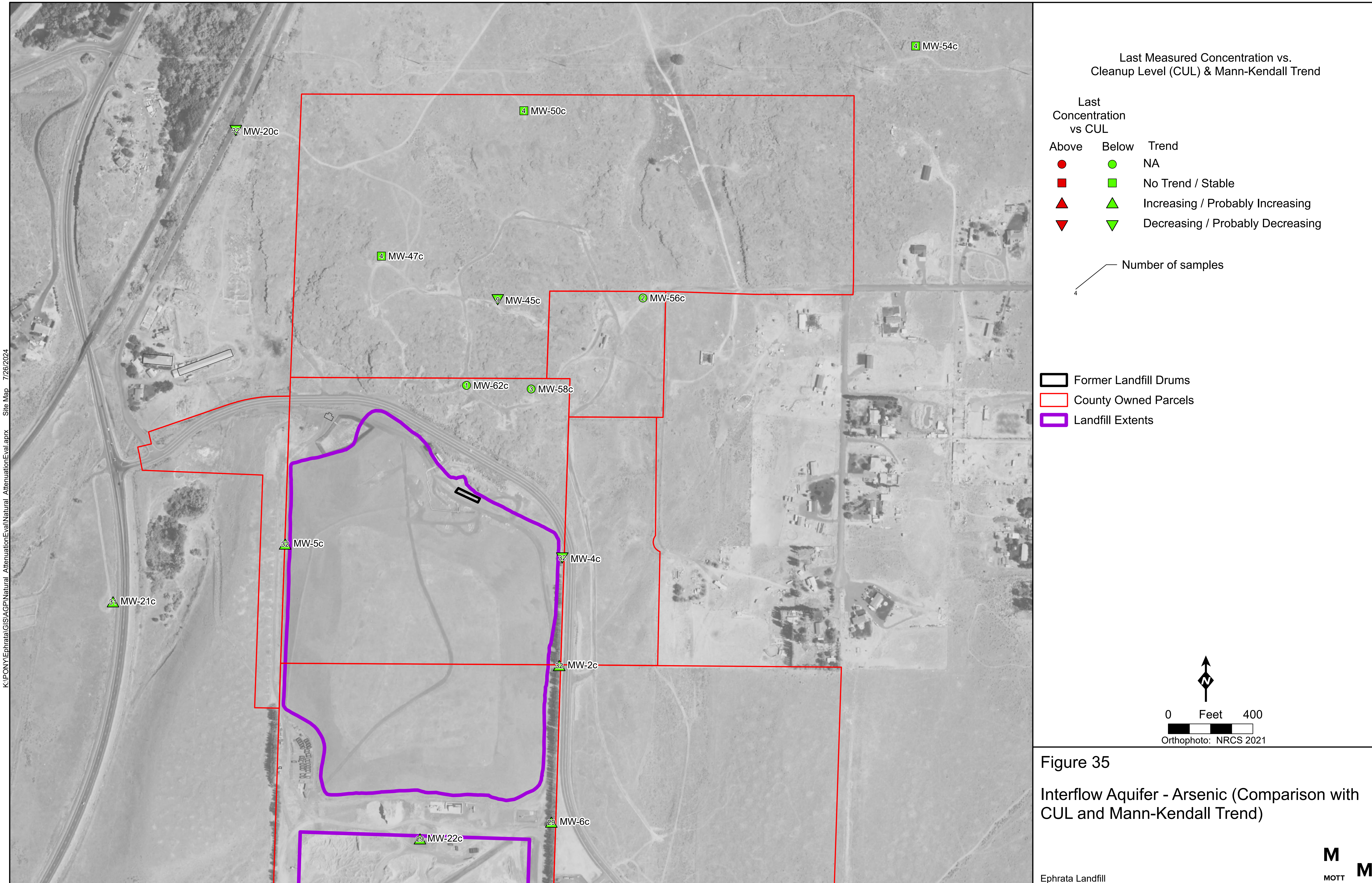


Figure 35

Interflow Aquifer - Arsenic (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

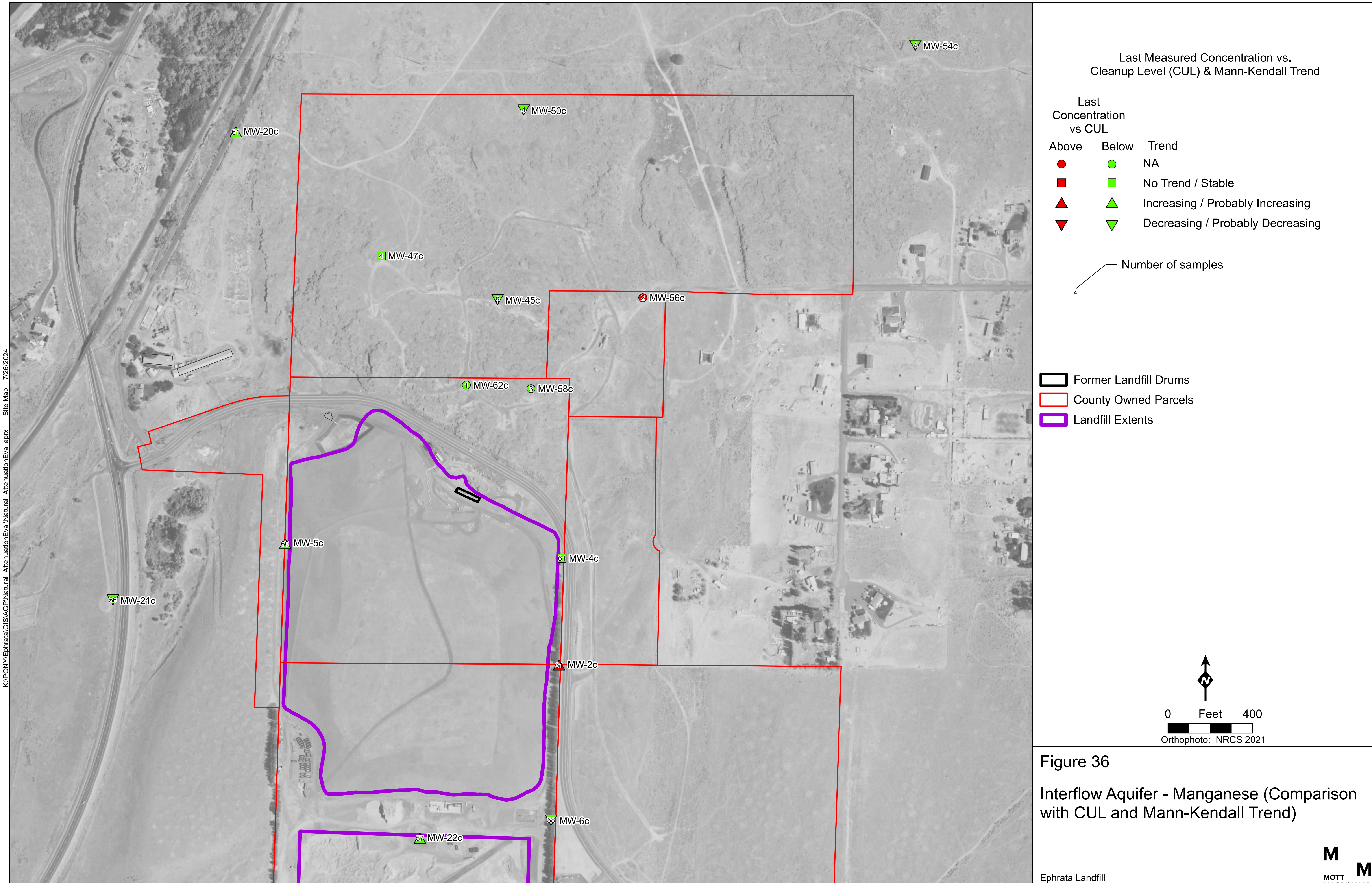
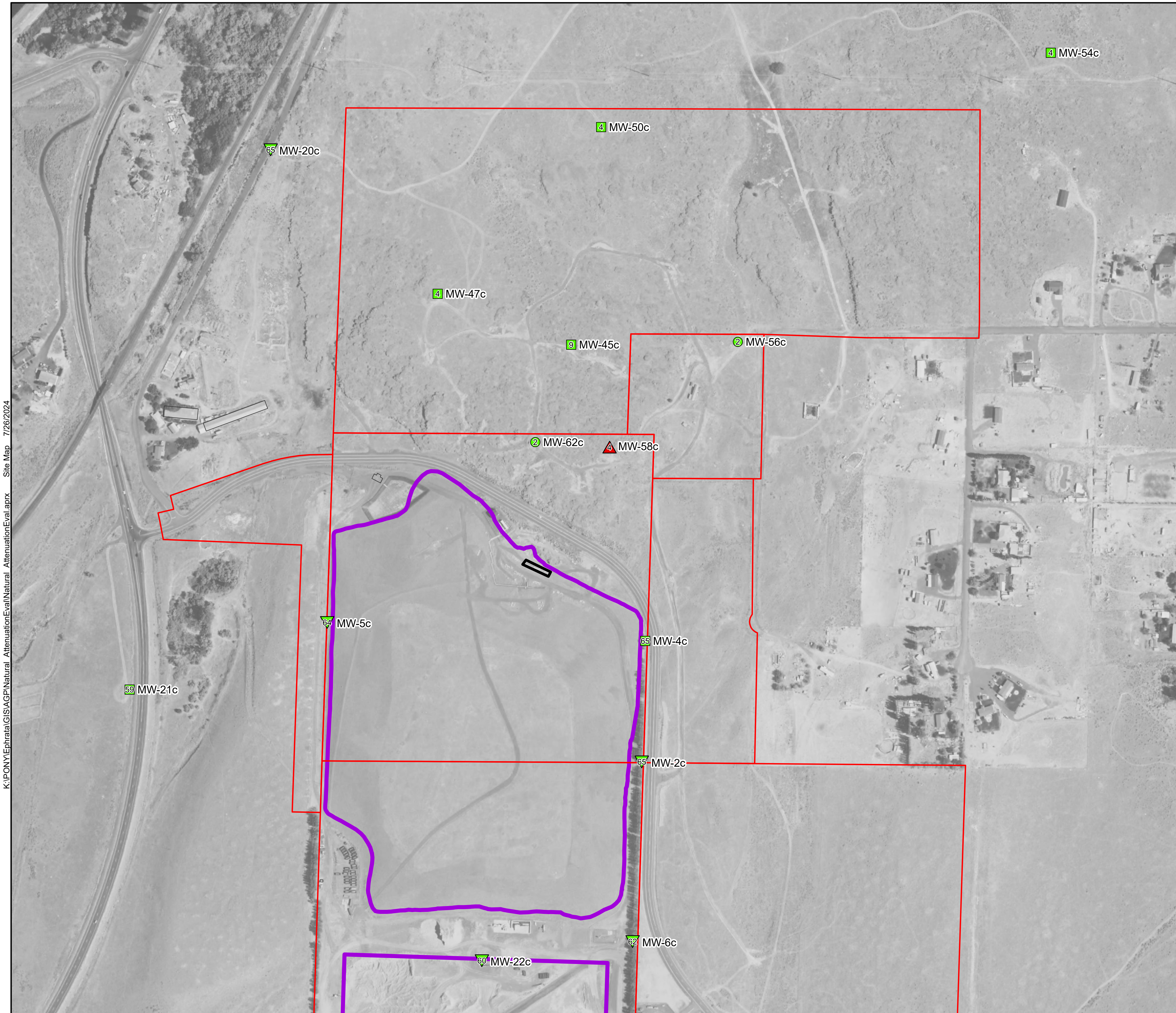


Figure 36

Interflow Aquifer - Manganese (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
● (red)	● (green)	NA
■ (red)	■ (green)	No Trend / Stable
▲ (red)	▲ (green)	Increasing / Probably Increasing
▼ (red)	▼ (green)	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

0 Feet 400

Orthophoto: NRCS 2021

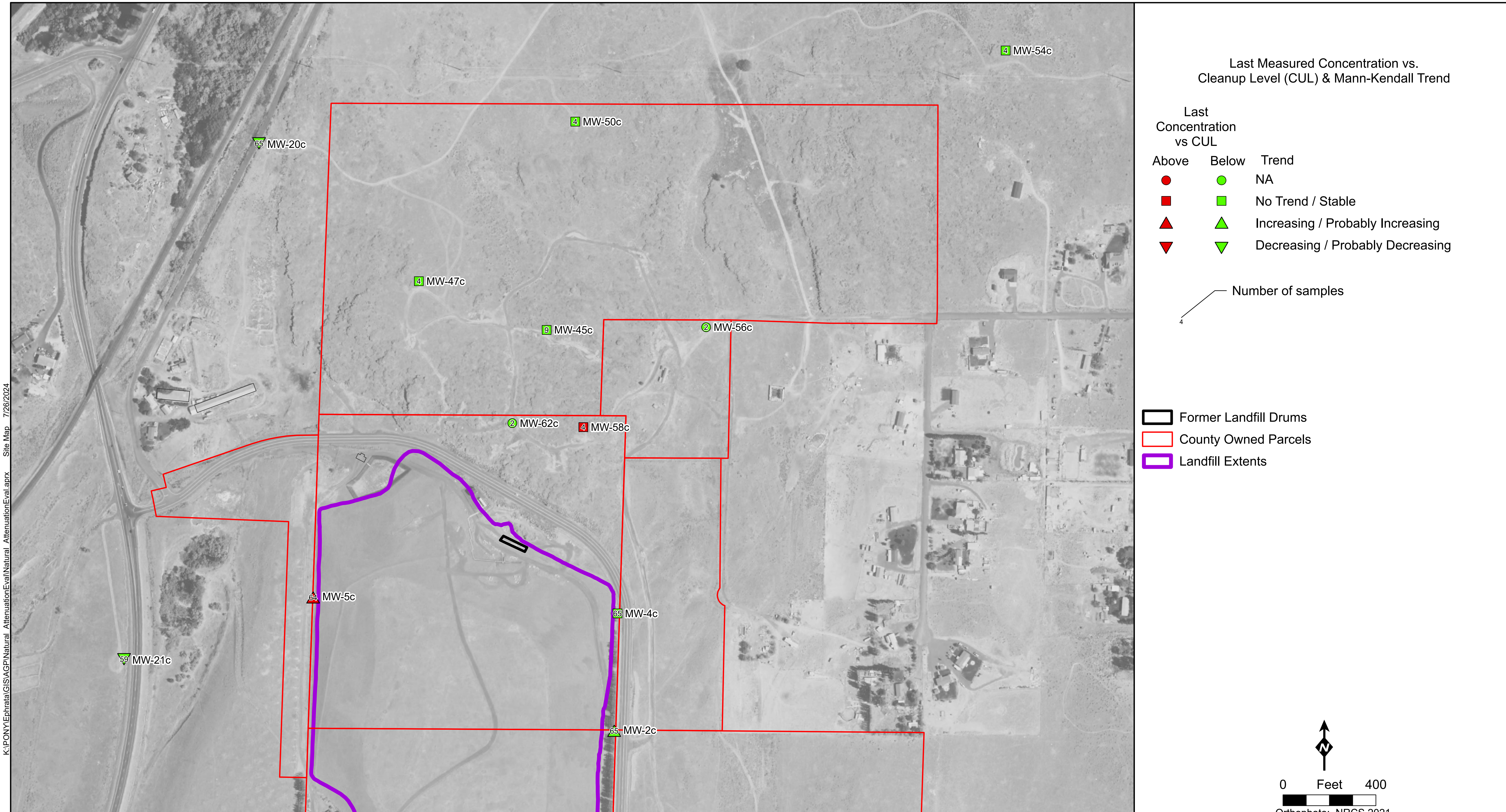
Figure 37

Interflow Aquifer - 1,1-Dichloroethane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



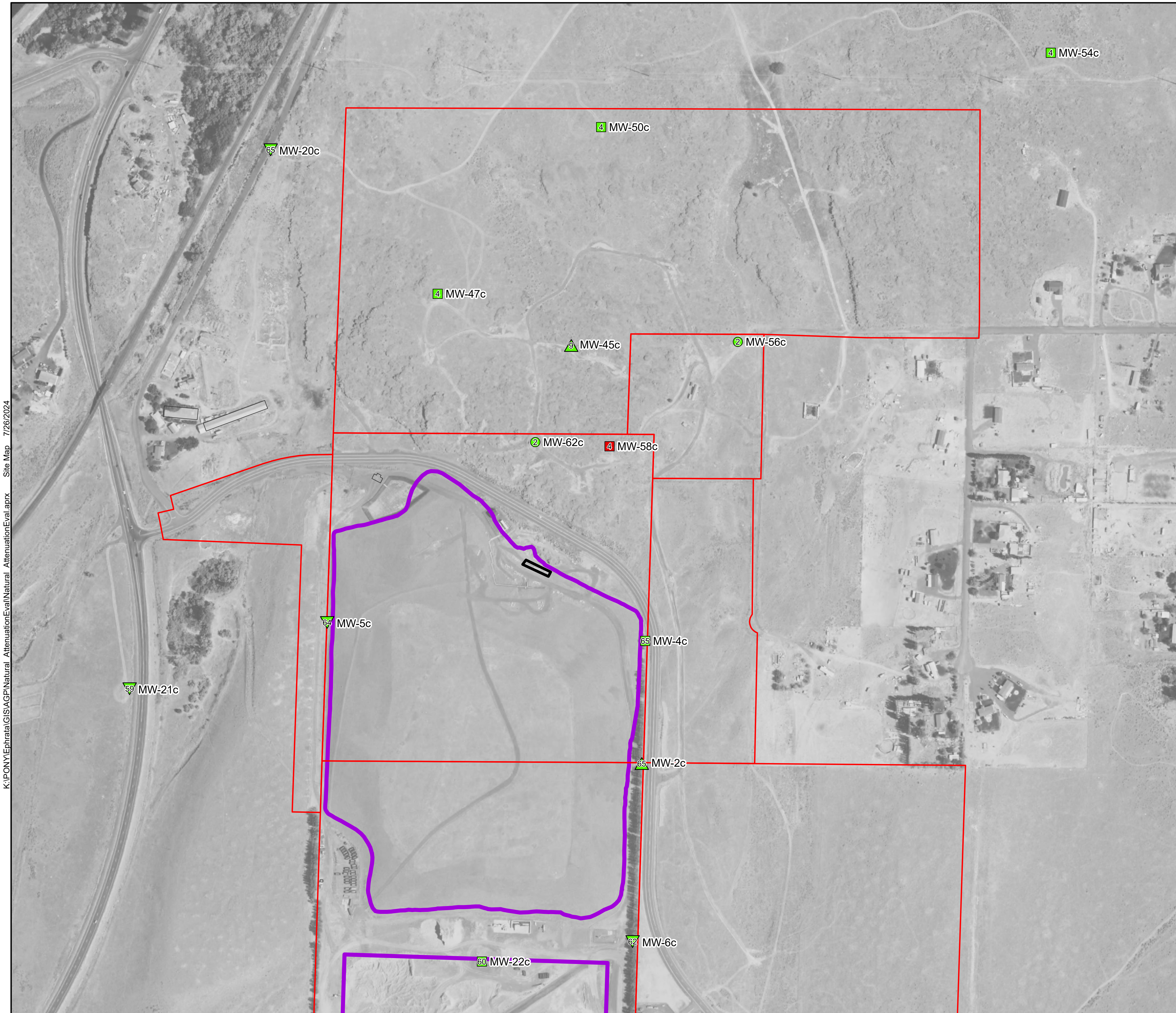
K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024

Figure 38

Interflow Aquifer - 1,2-Dichloroethane (EDC) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

N

0 Feet 400

Orthophoto: NRCS 2021

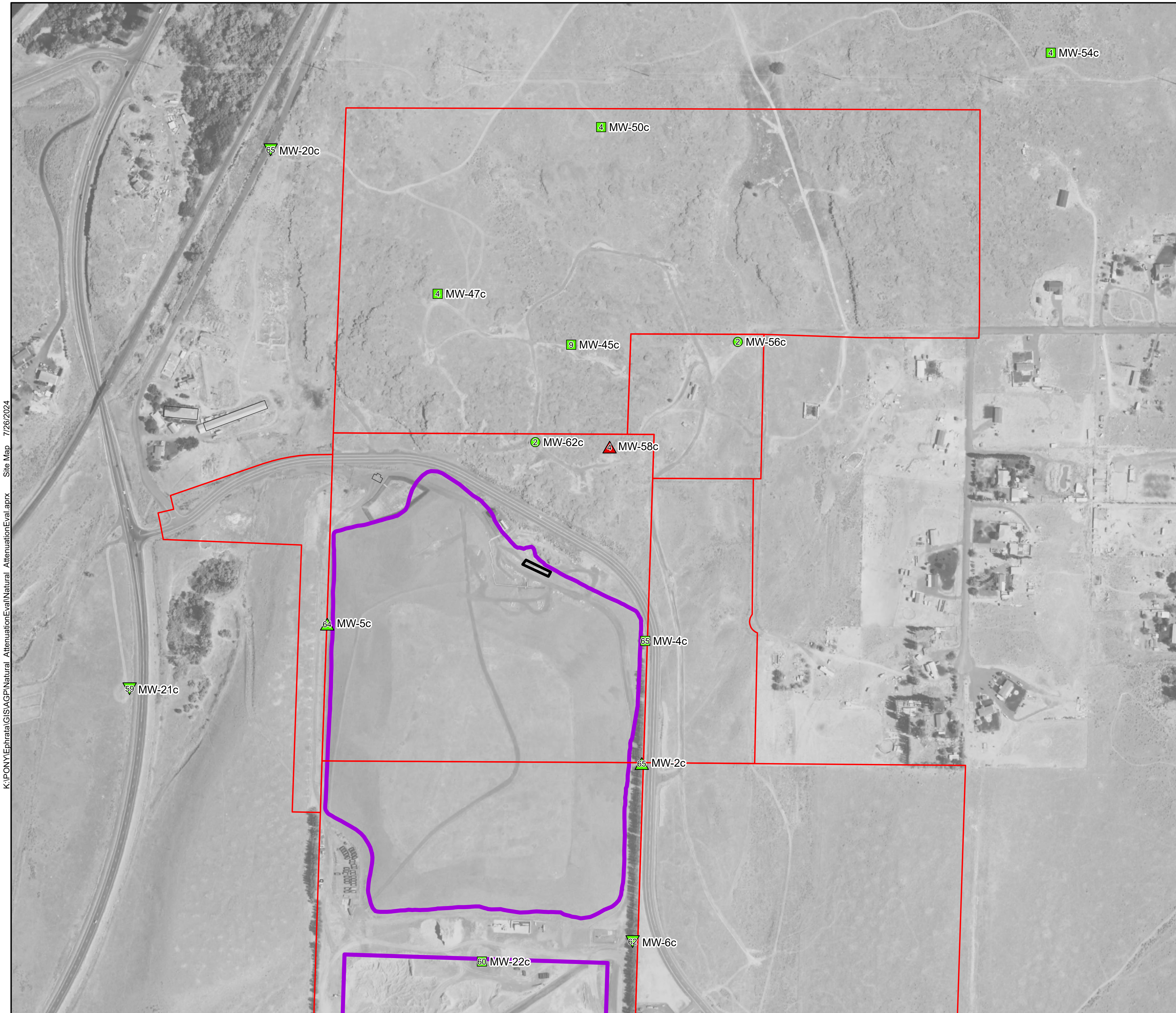
Figure 39

Interflow Aquifer - 1,2-Dichloropropane (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 400

Orthophoto: NRCS 2021

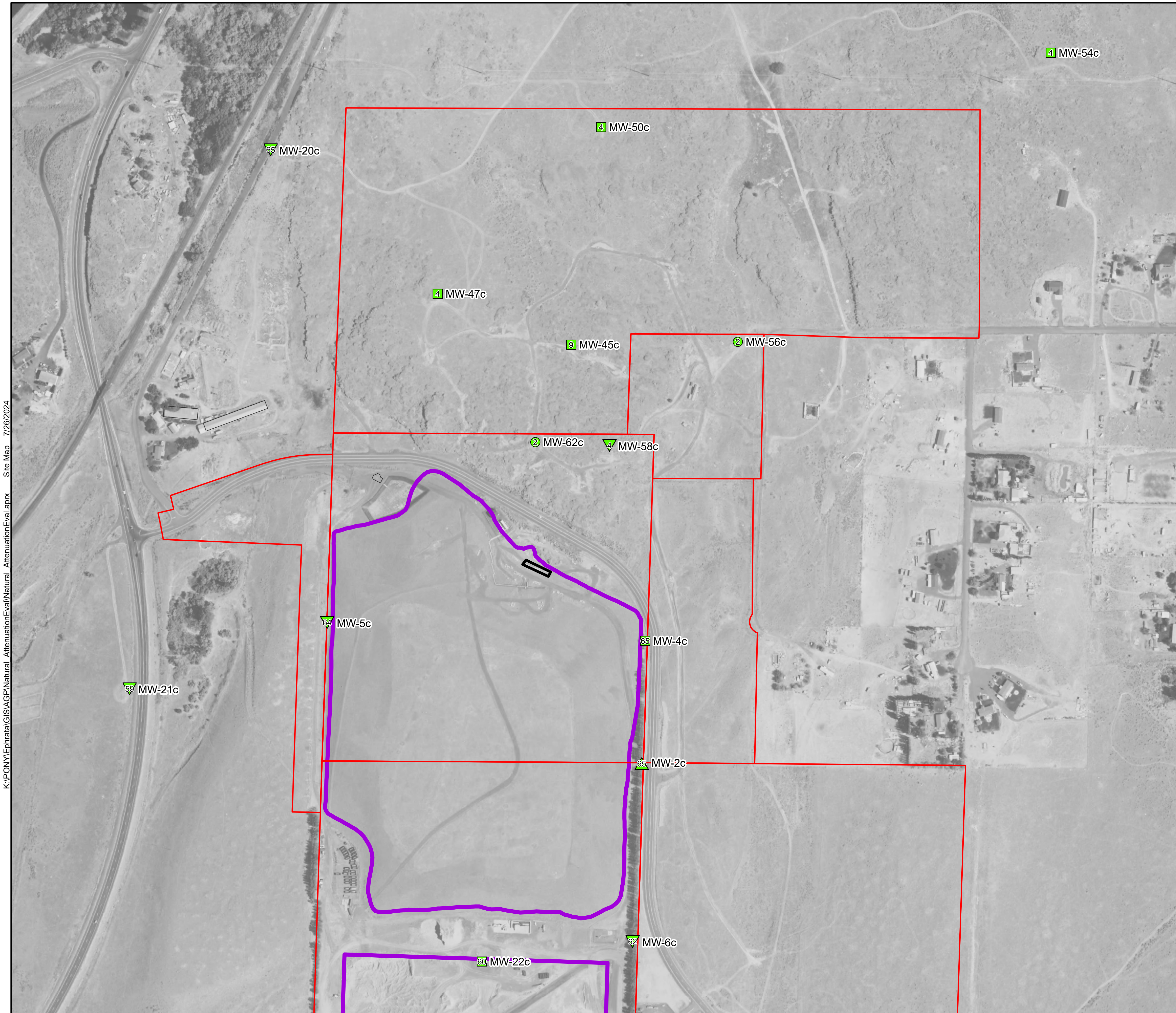
Figure 40

Interflow Aquifer - 1,4-Dichlorobenzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural AttenuationEval\Natural AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL

Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

Number of samples

4

Former Landfill Drums

County Owned Parcels

Landfill Extents

N

0 Feet 400

Orthophoto: NRCS 2021

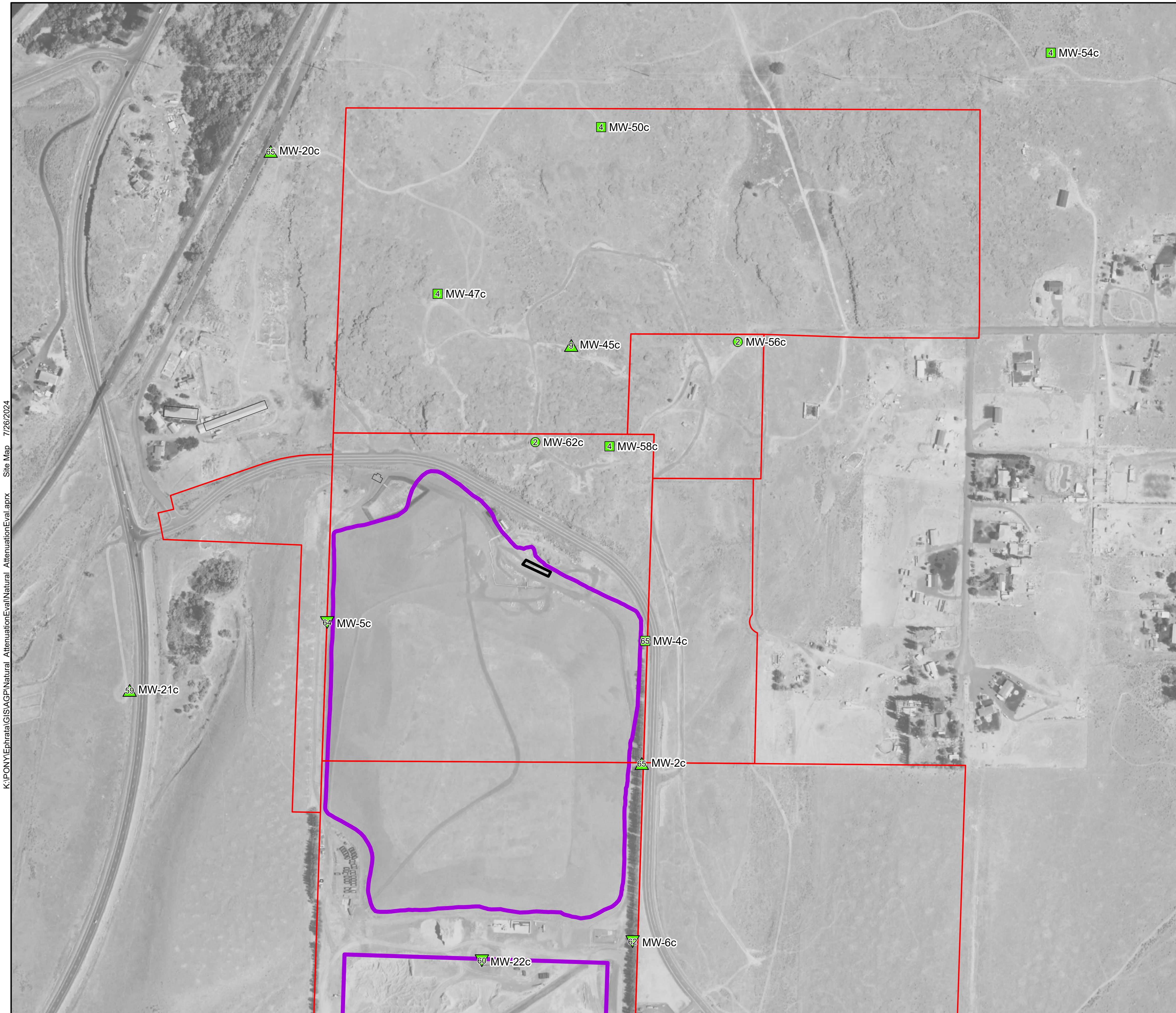
Figure 41

Interflow Aquifer - Benzene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

M M MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx   Site Map   7/26/2024

Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 400

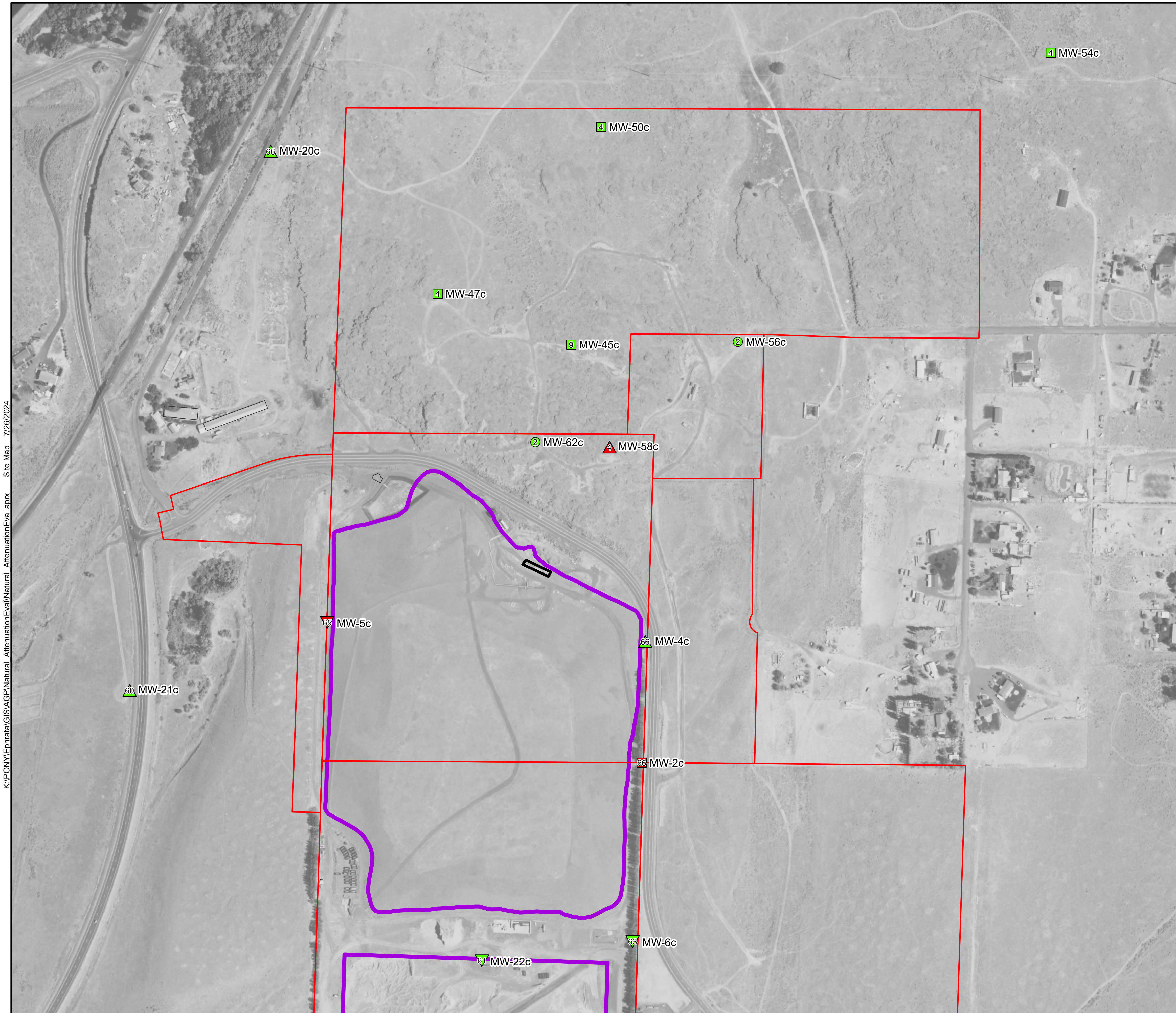
Orthophoto: NRCS 2021

Figure 42

Interflow Aquifer - cis-1,2-Dichloroethene (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD



Last Measured Concentration vs.
Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
●	●	NA
■	■	No Trend / Stable
▲	▲	Increasing / Probably Increasing
▼	▼	Decreasing / Probably Decreasing

4 — Number of samples

Former Landfill Drums
County Owned Parcels
Landfill Extents

N

0 Feet 400

Orthophoto: NRCS 2021

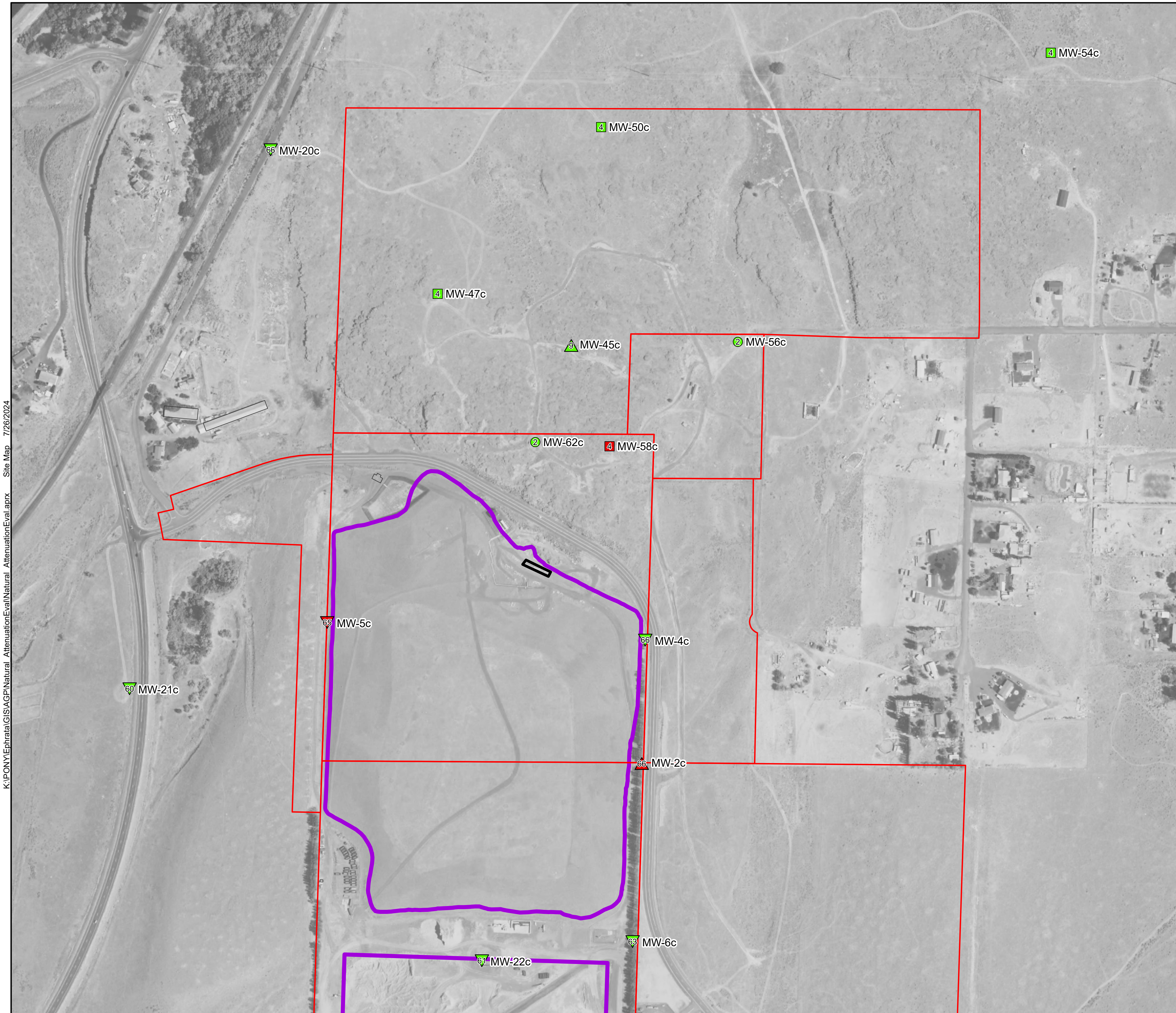
Figure 43

Interflow Aquifer - Trichloroethene (TCE) (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024



Last Measured Concentration vs. Cleanup Level (CUL) & Mann-Kendall Trend

Last Concentration vs CUL: Above	Below	Trend
● (red)	● (green)	NA
■ (red)	■ (green)	No Trend / Stable
▲ (red)	▲ (green)	Increasing / Probably Increasing
▼ (red)	▼ (green)	Decreasing / Probably Decreasing

Number of samples

- Former Landfill Drums
- County Owned Parcels
- Landfill Extents

0 Feet 400

Orthophoto: NRCS 2021

Figure 44

Interflow Aquifer - Vinyl Chloride (Comparison with CUL and Mann-Kendall Trend)

Ephrata Landfill

MOTT MACDONALD

K:\PONY\Ephrata\GIS\AGP\Natural_AttenuationEval\Natural_AttenuationEval.aprx Site Map 7/26/2024

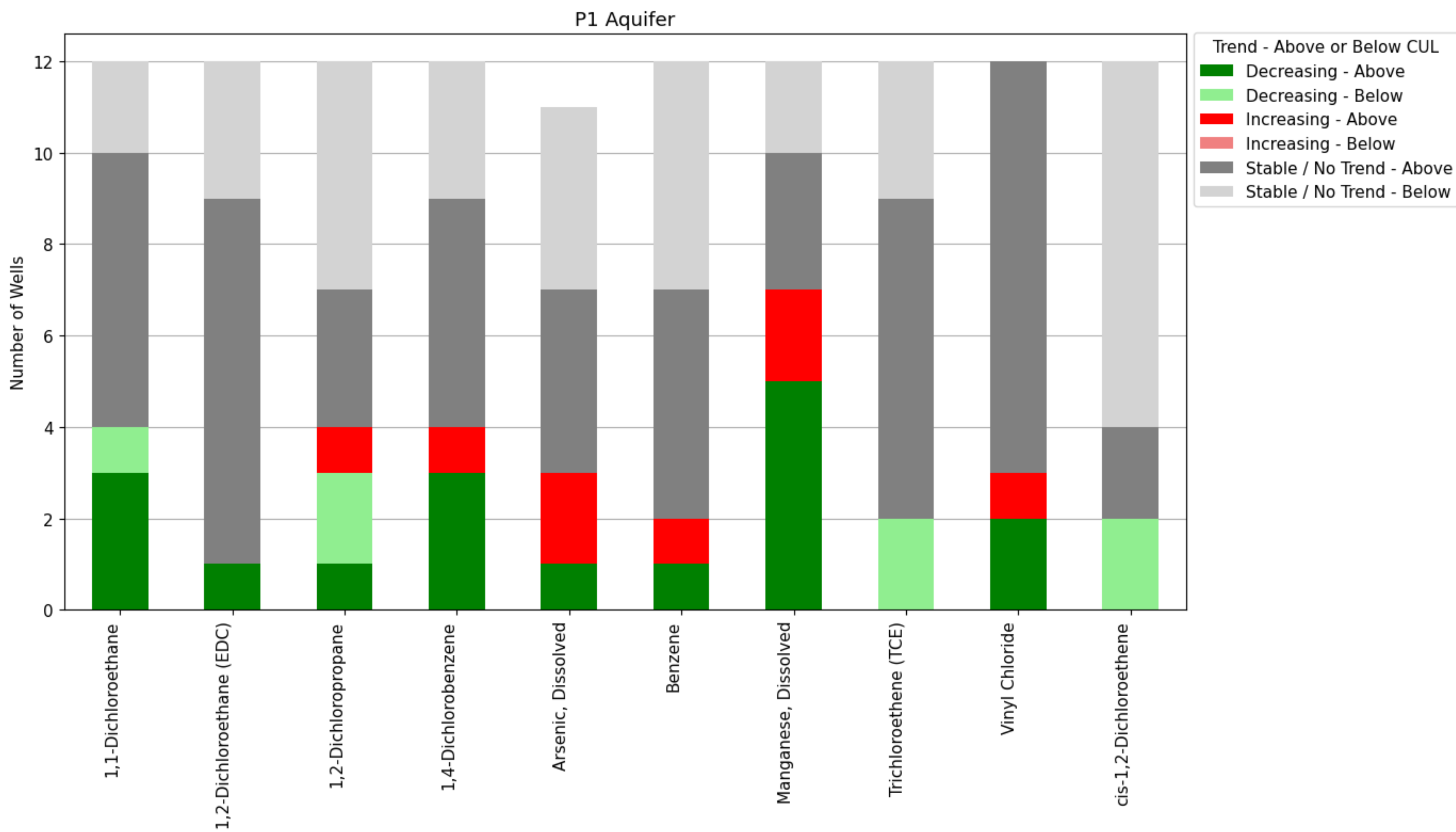


Figure 45. Distribution of Mann-Kendall Trends and CUL Compliance for IHS Constituents in P1 Zone

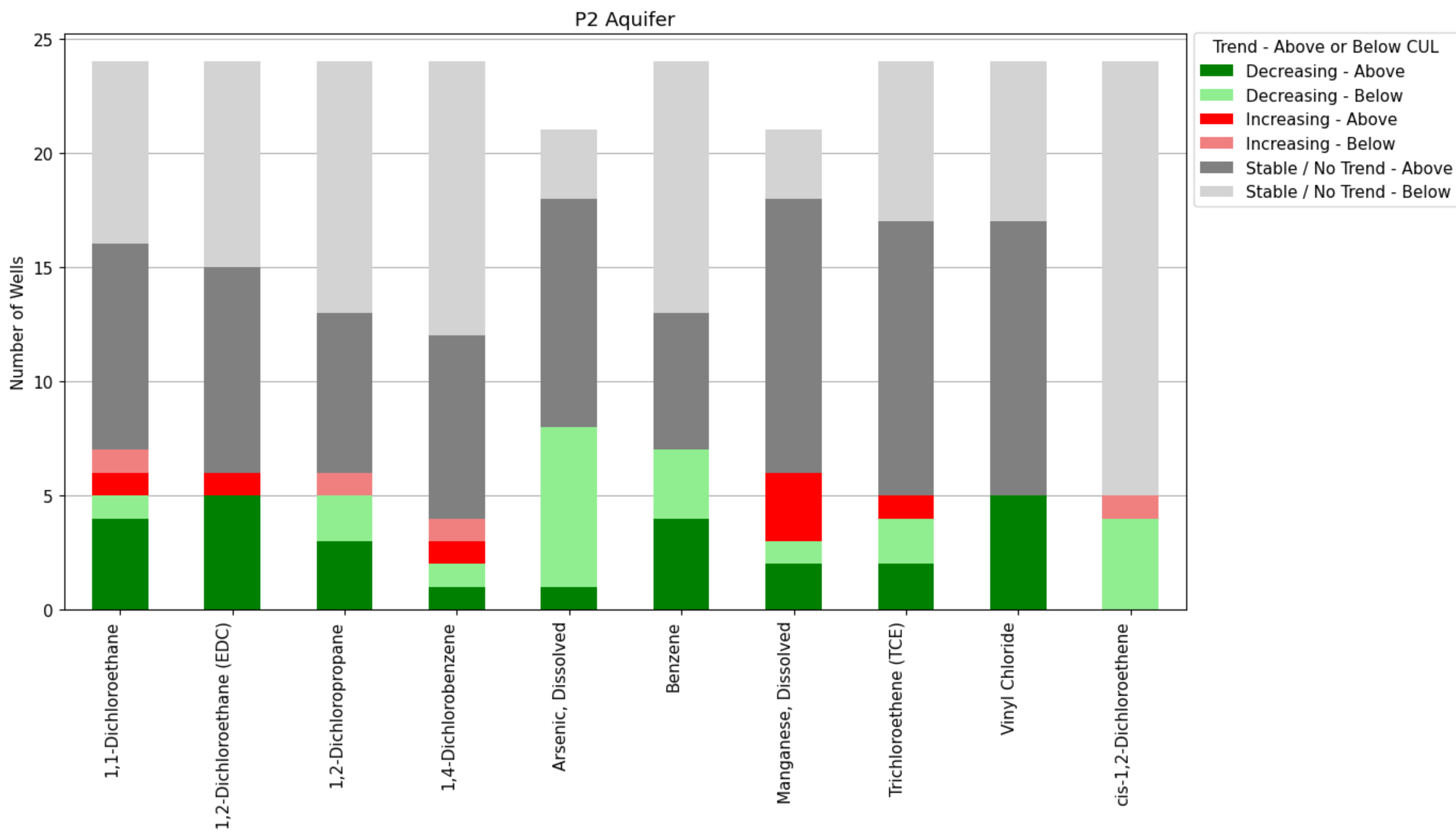


Figure 46. Distribution of Mann-Kendall Trends and CUL Compliance for IHS Constituents in P2 Zone

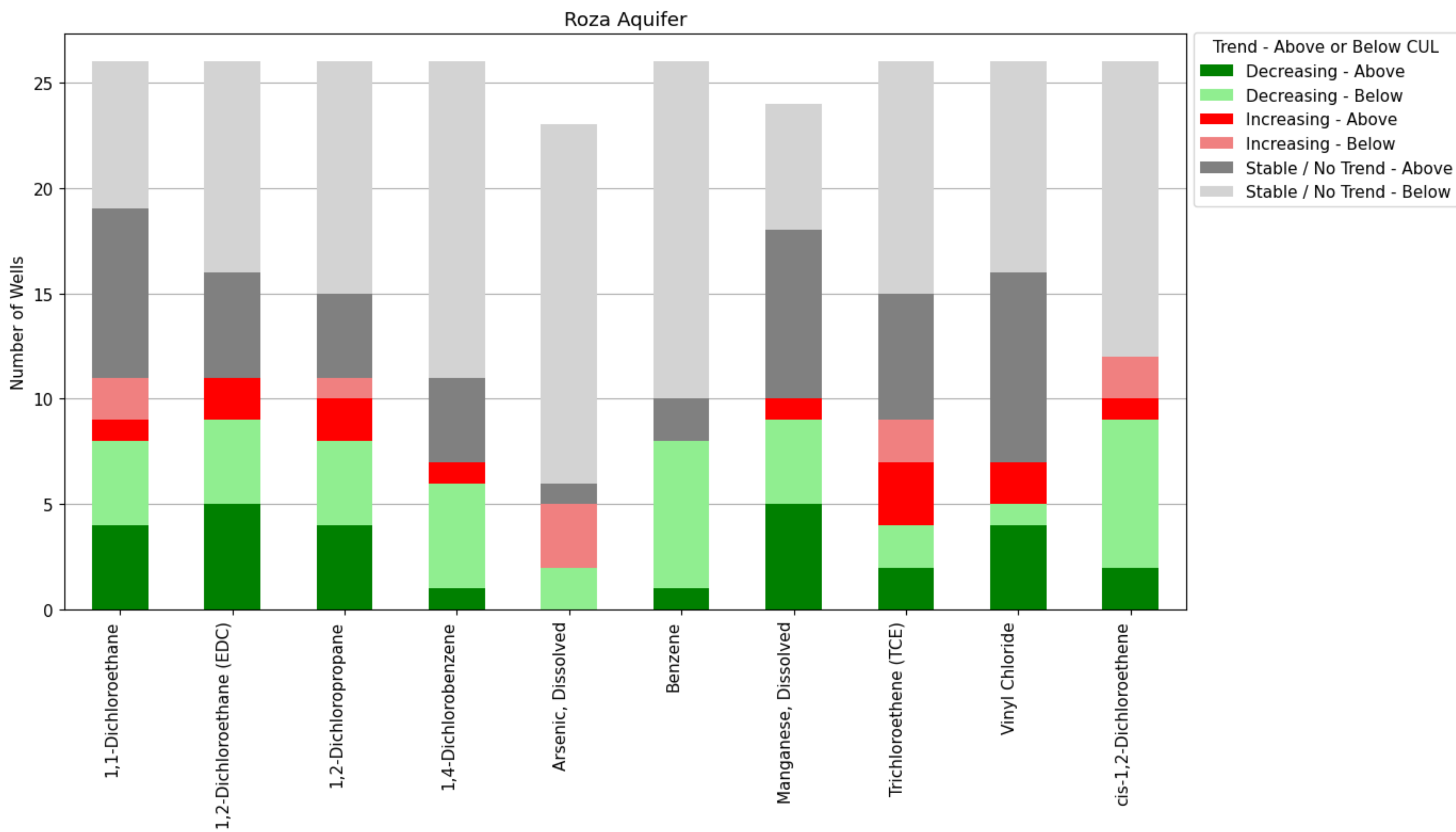


Figure 47. Distribution of Mann-Kendall Trends and CUL Compliance for IHS Constituents in Roza Aquifer

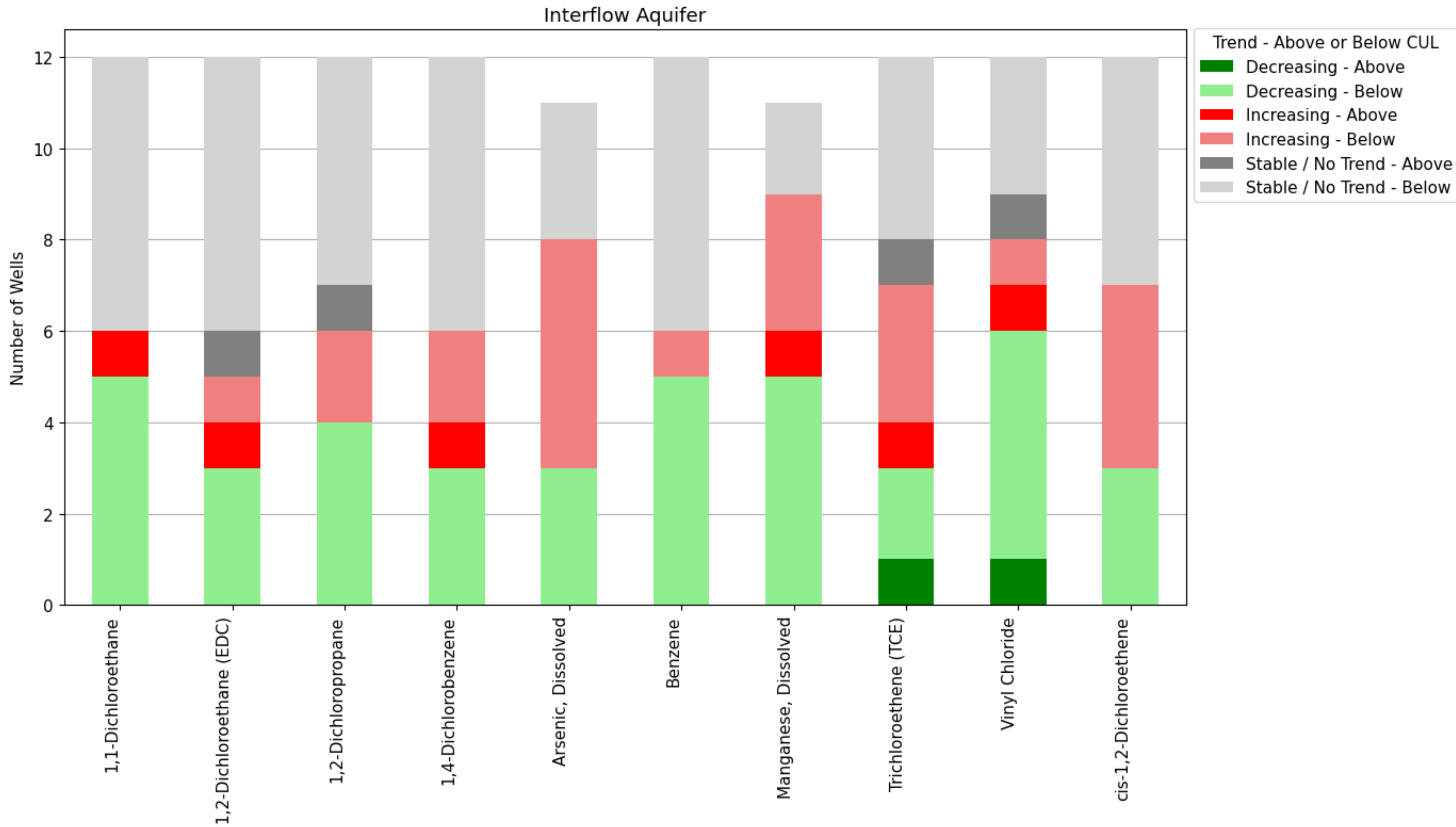


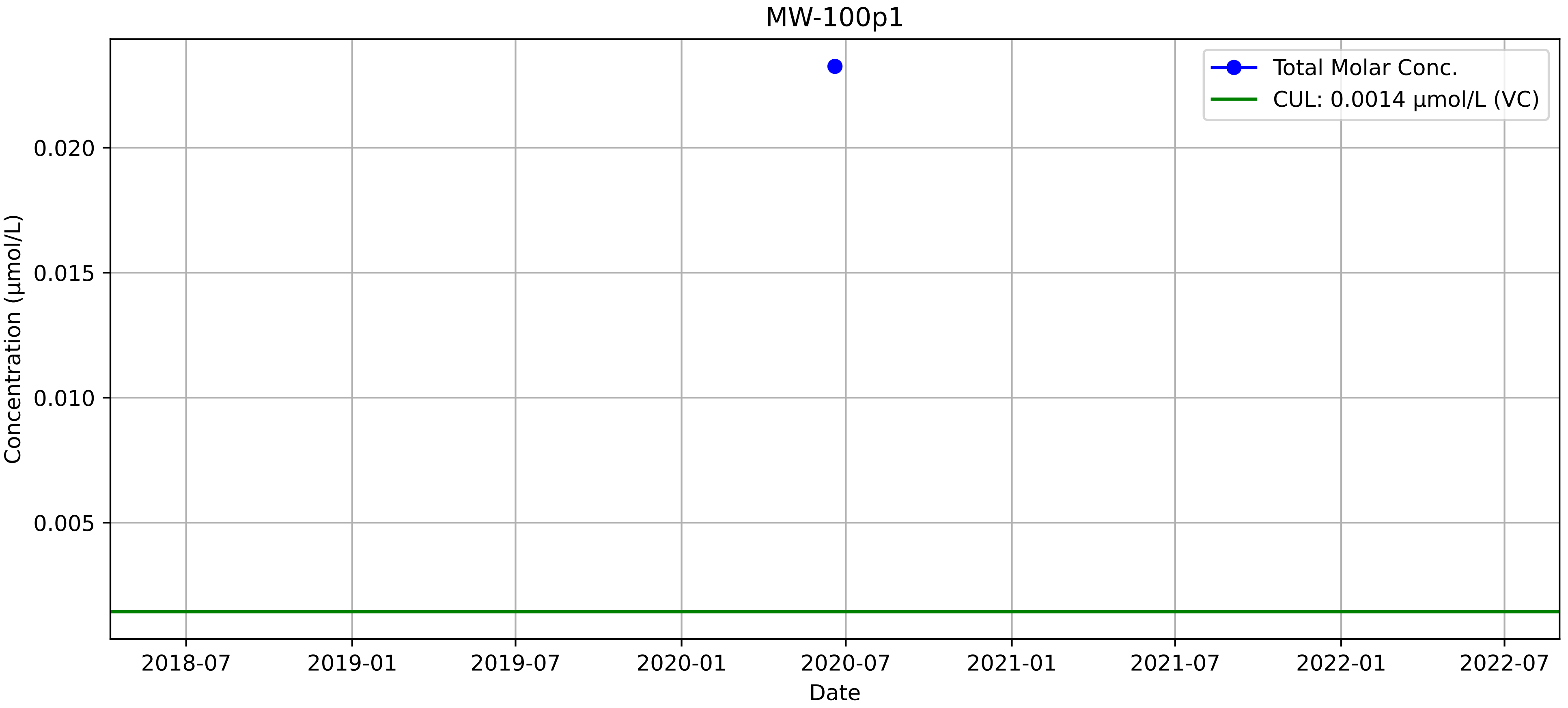
Figure 48. Distribution of Mann-Kendall Trends and CUL Compliance for IHS Constituents in Interflow Aquifer

APPENDICES

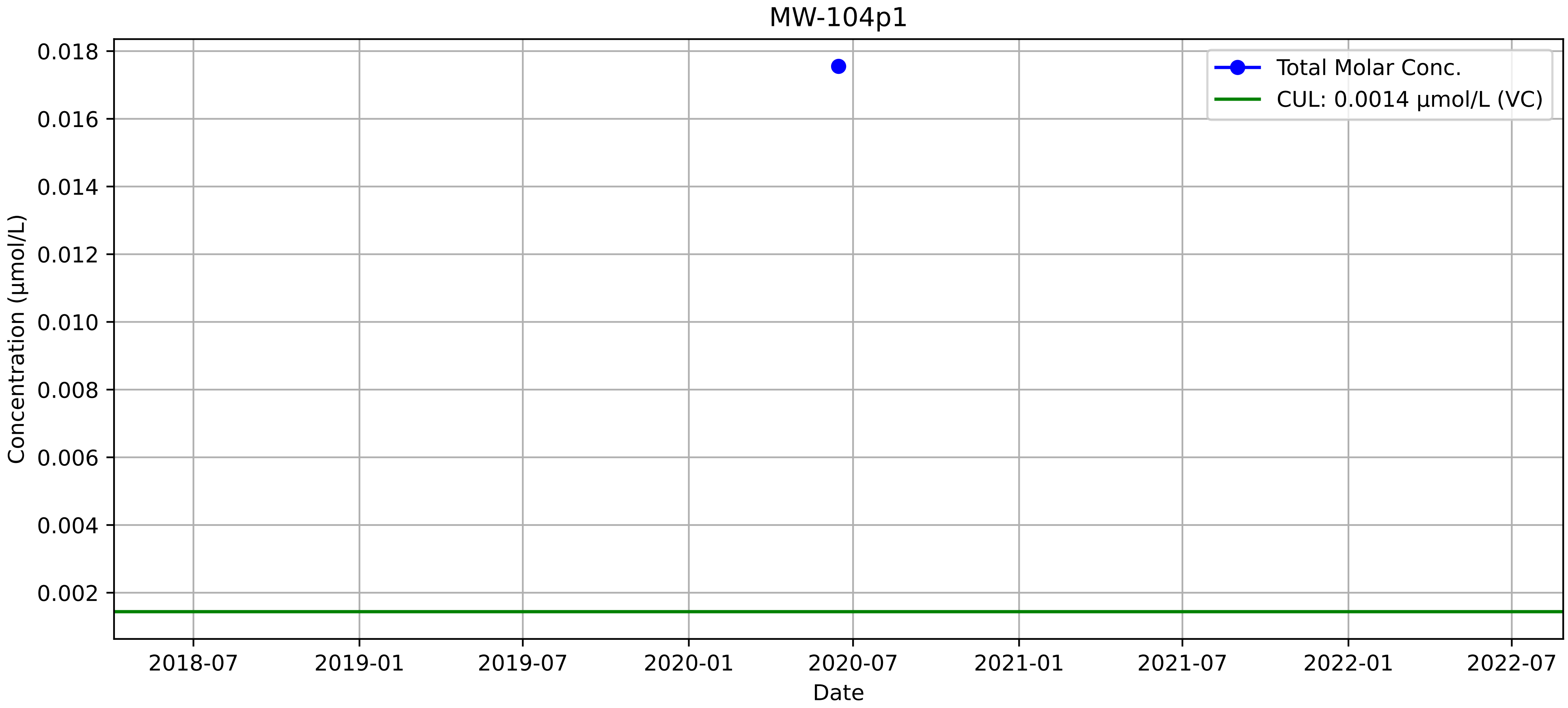
APPENDIX A

Total molar concentration time series plots of chlorinated ethenes

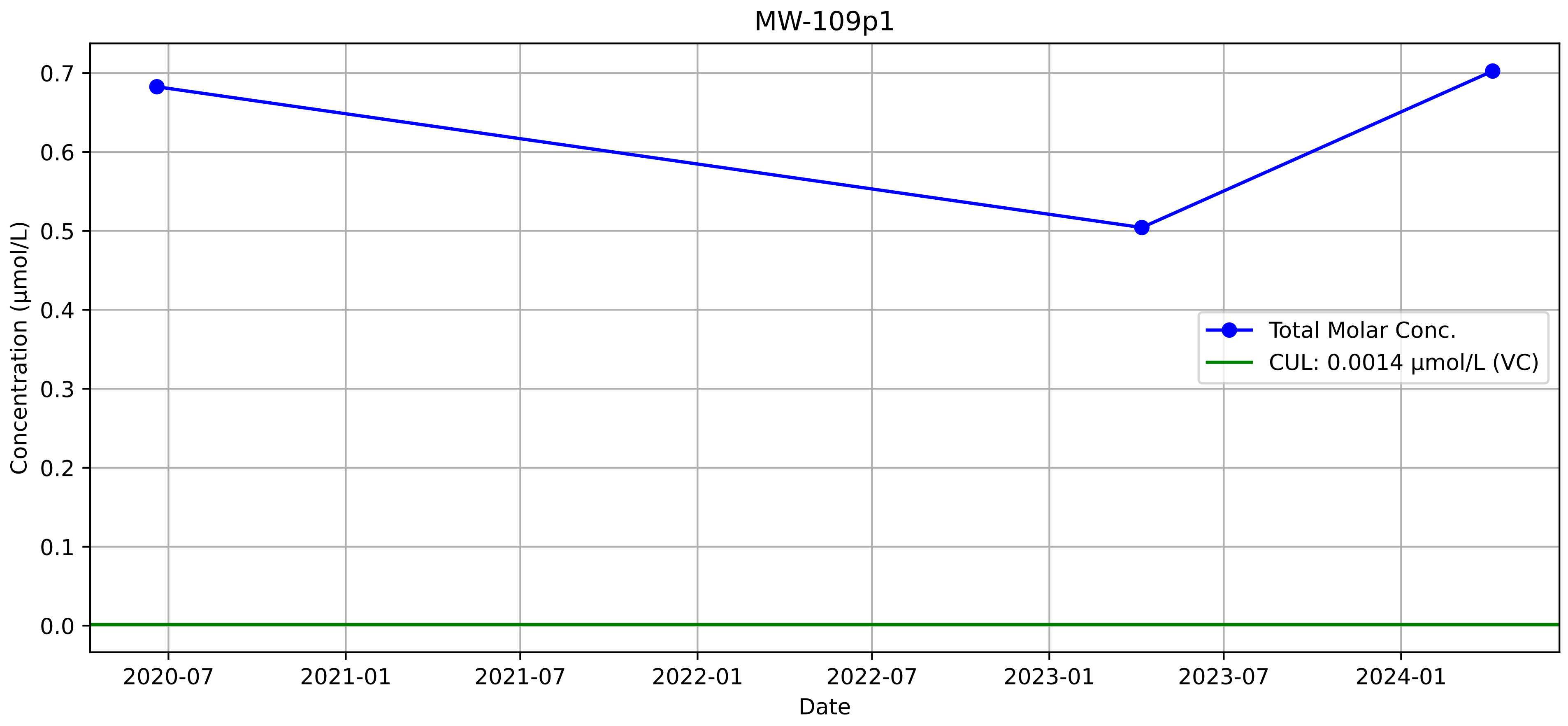
A1. Total molar concentration time series plots of chlorinated ethenes for P1 zone wells

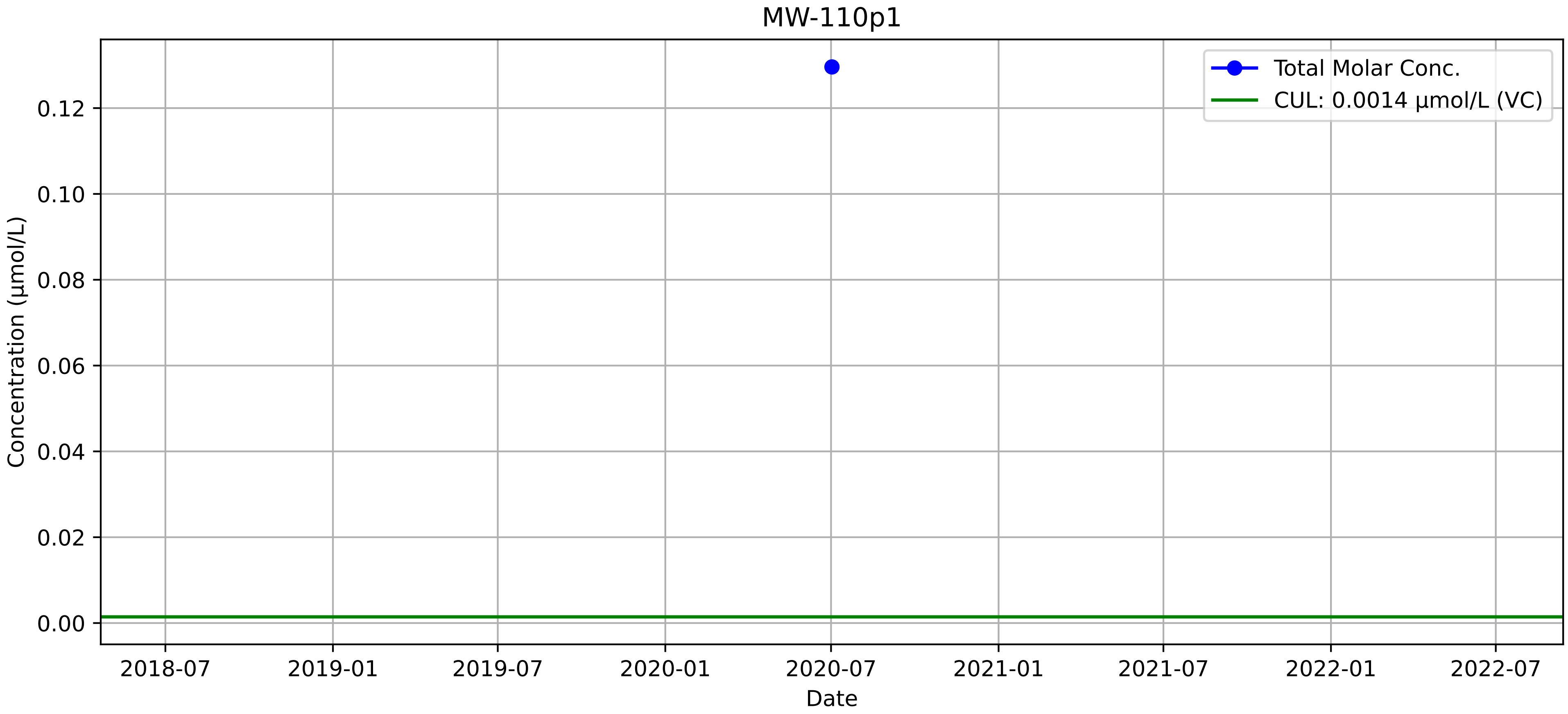


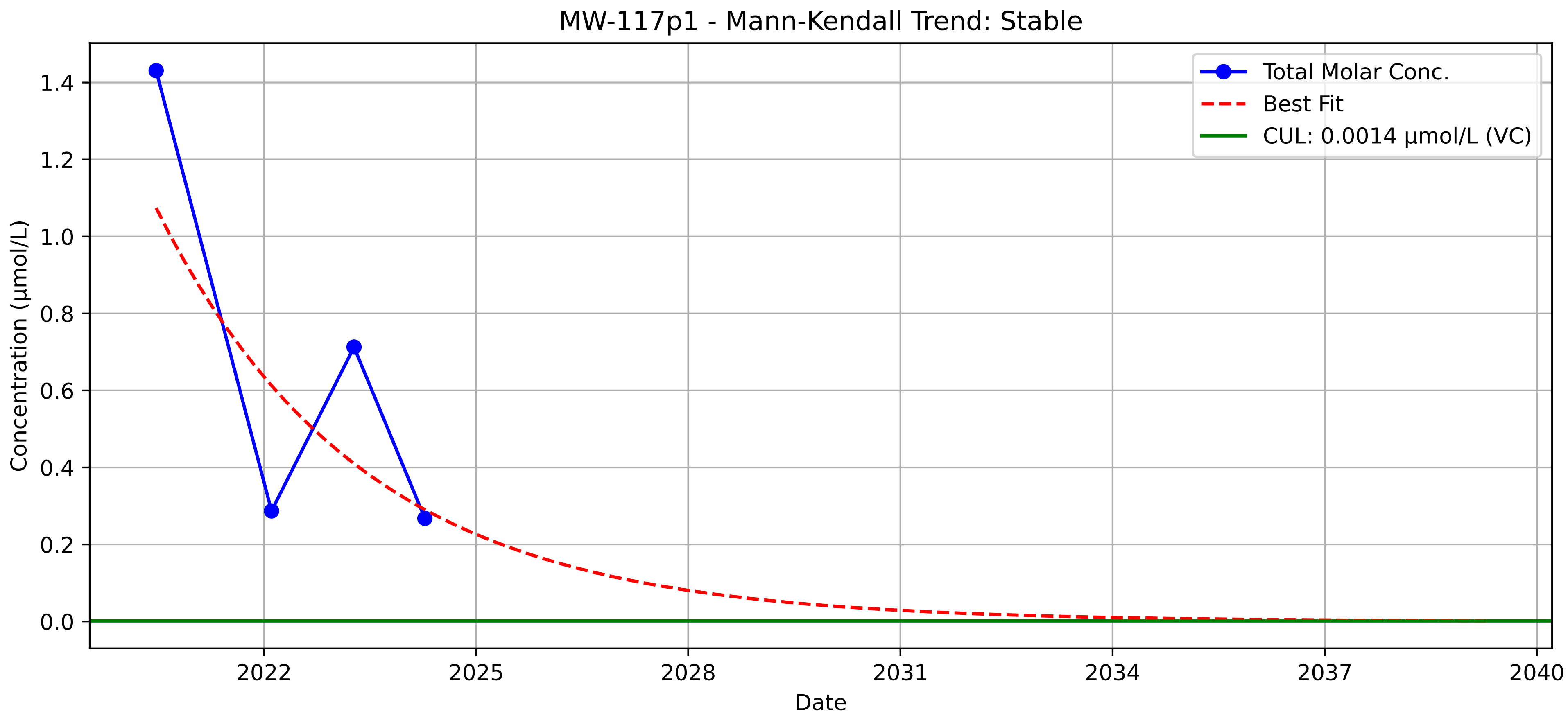
MW-100p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
0.020
0.015
0.010
0.005
Concentration (µmol/L)
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

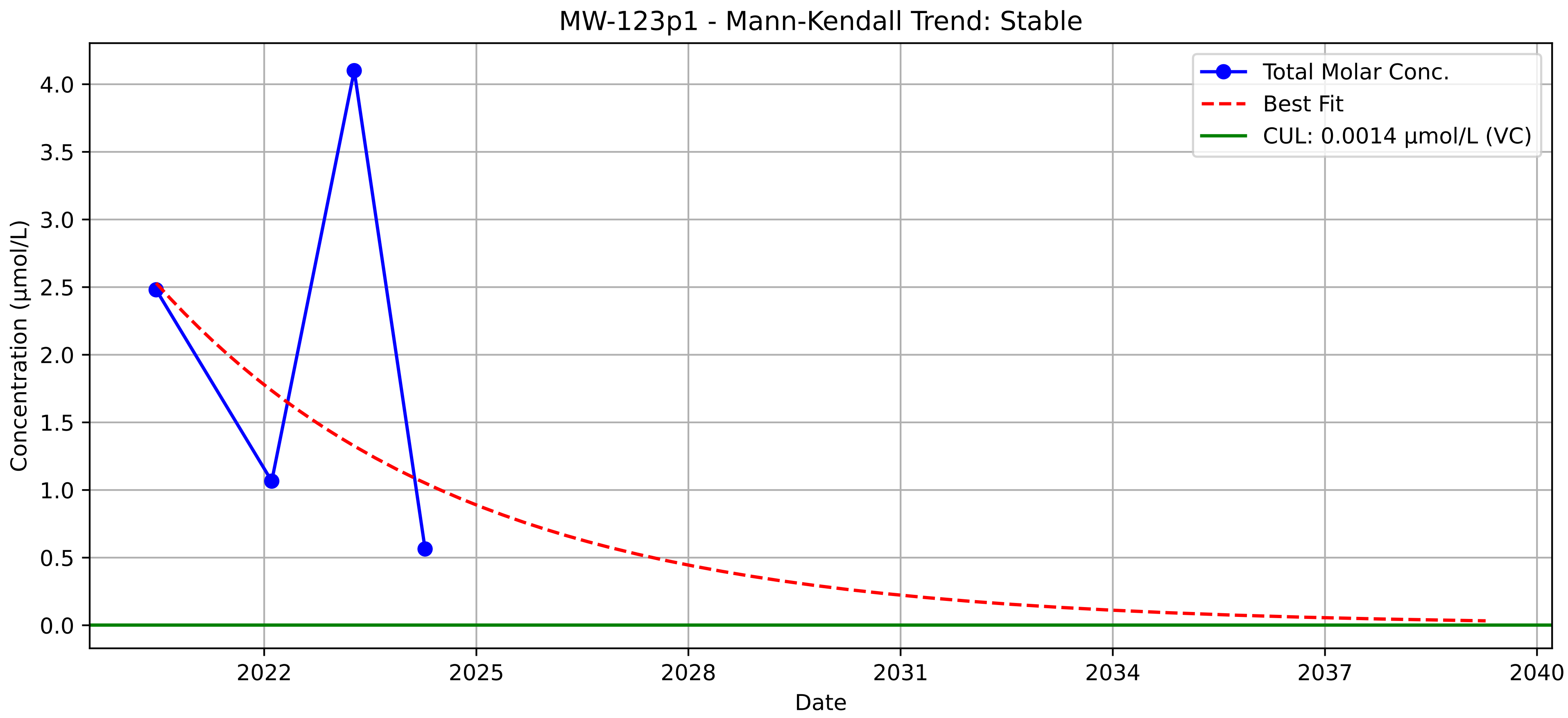


MW-104p1
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
Concentration (µmol/L)
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)

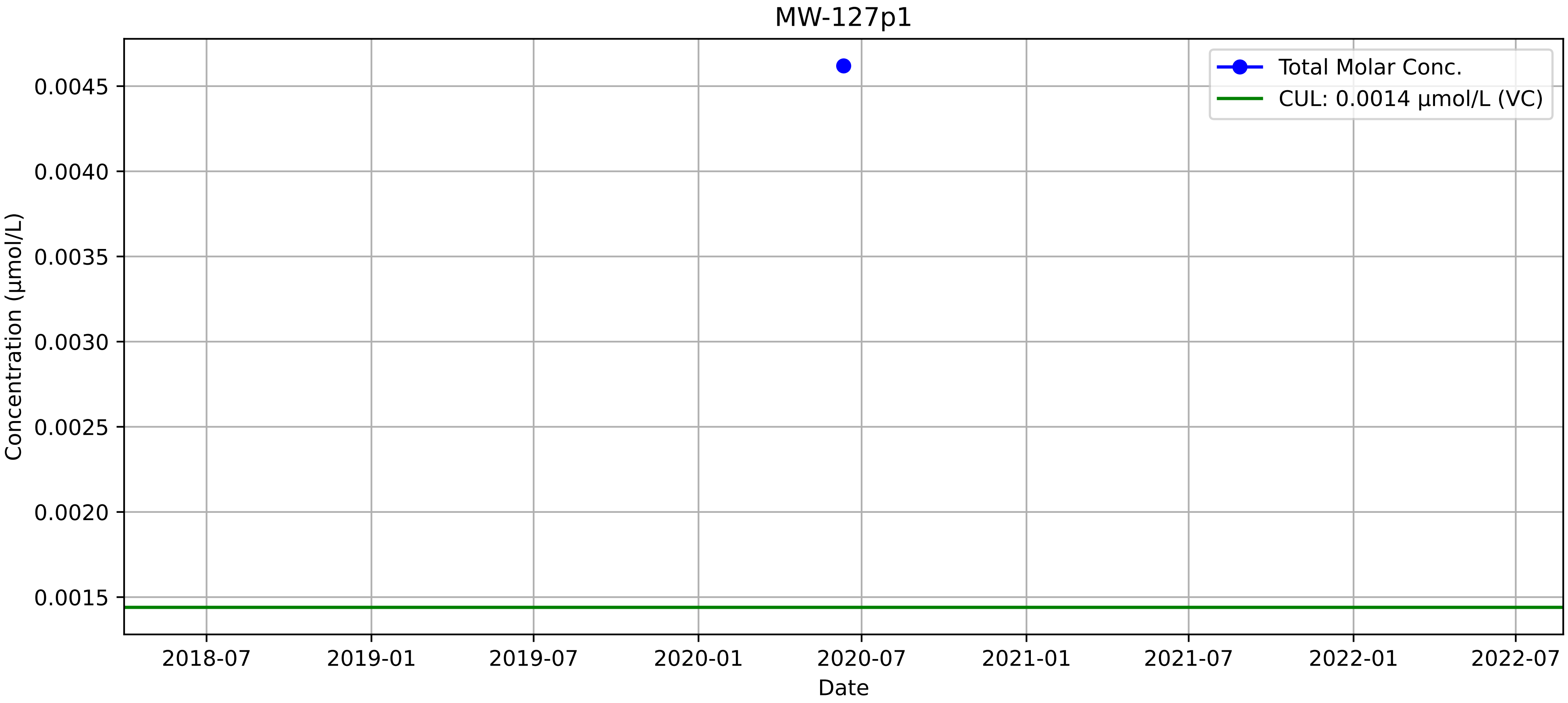

MW-109p1
Concentration (µmol/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
2023-07
2024-01
Date
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)


MW-110p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

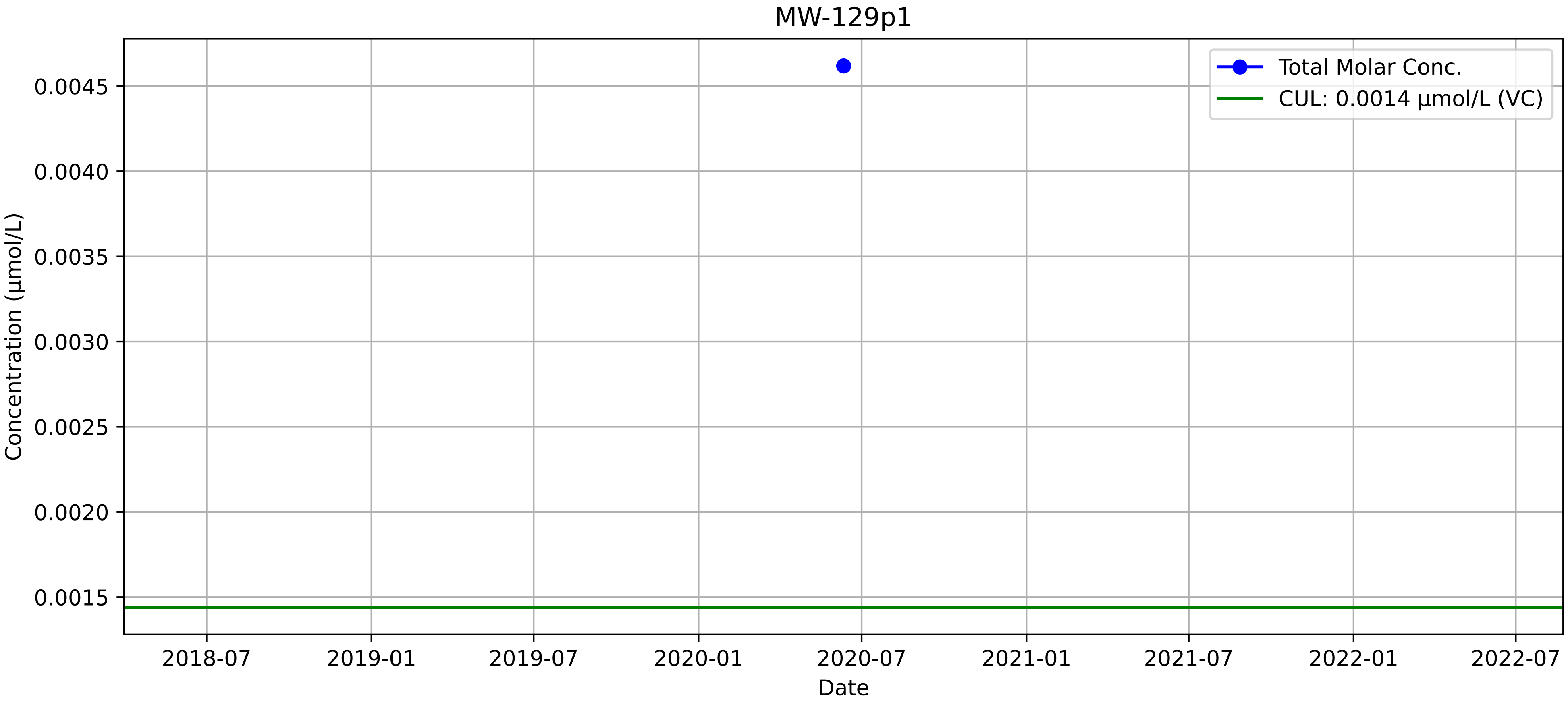

MW-117p1 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2022
2025
2028
2031
2034
2037
2040
Date

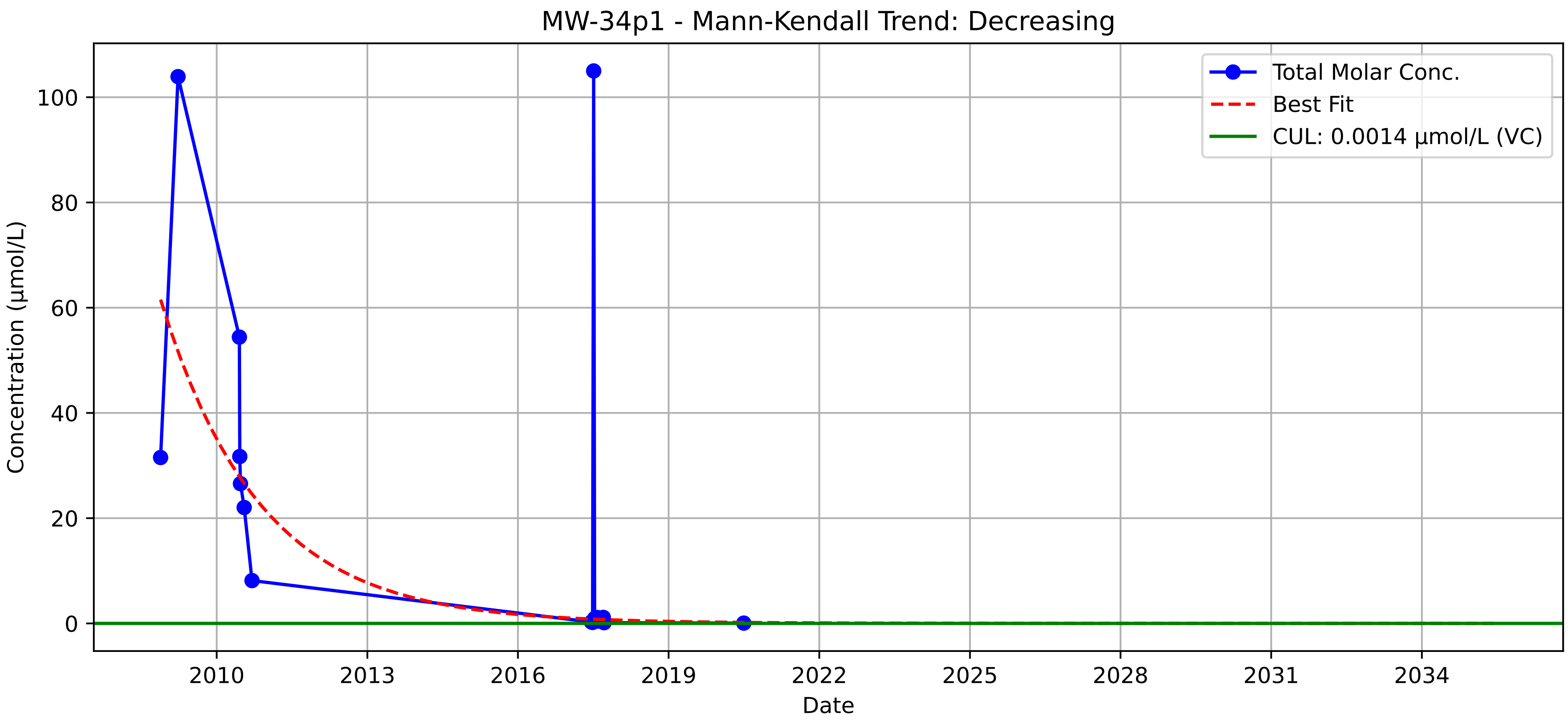


MW-123p1 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
2022
2025
2028
2031
2034
2037
2040
Date

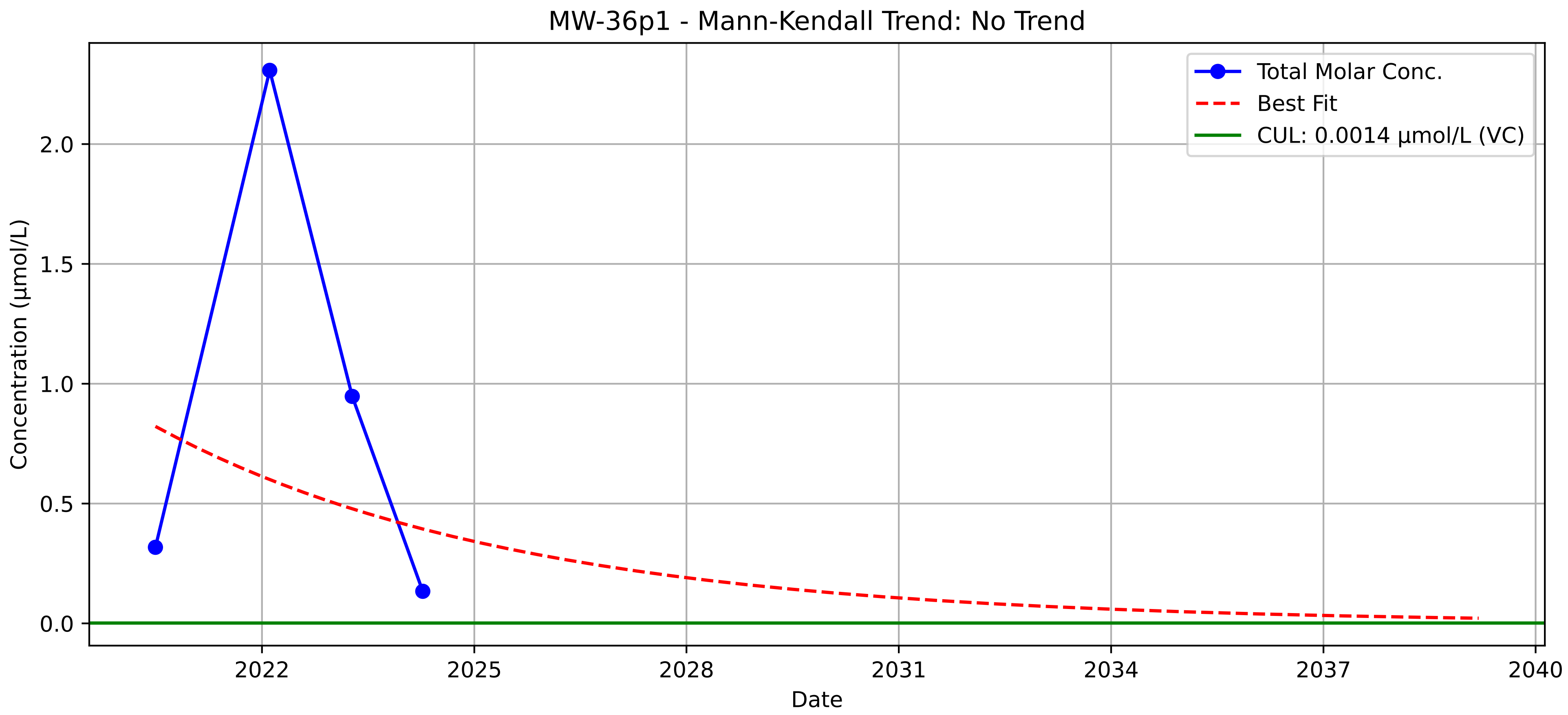


MW-127p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

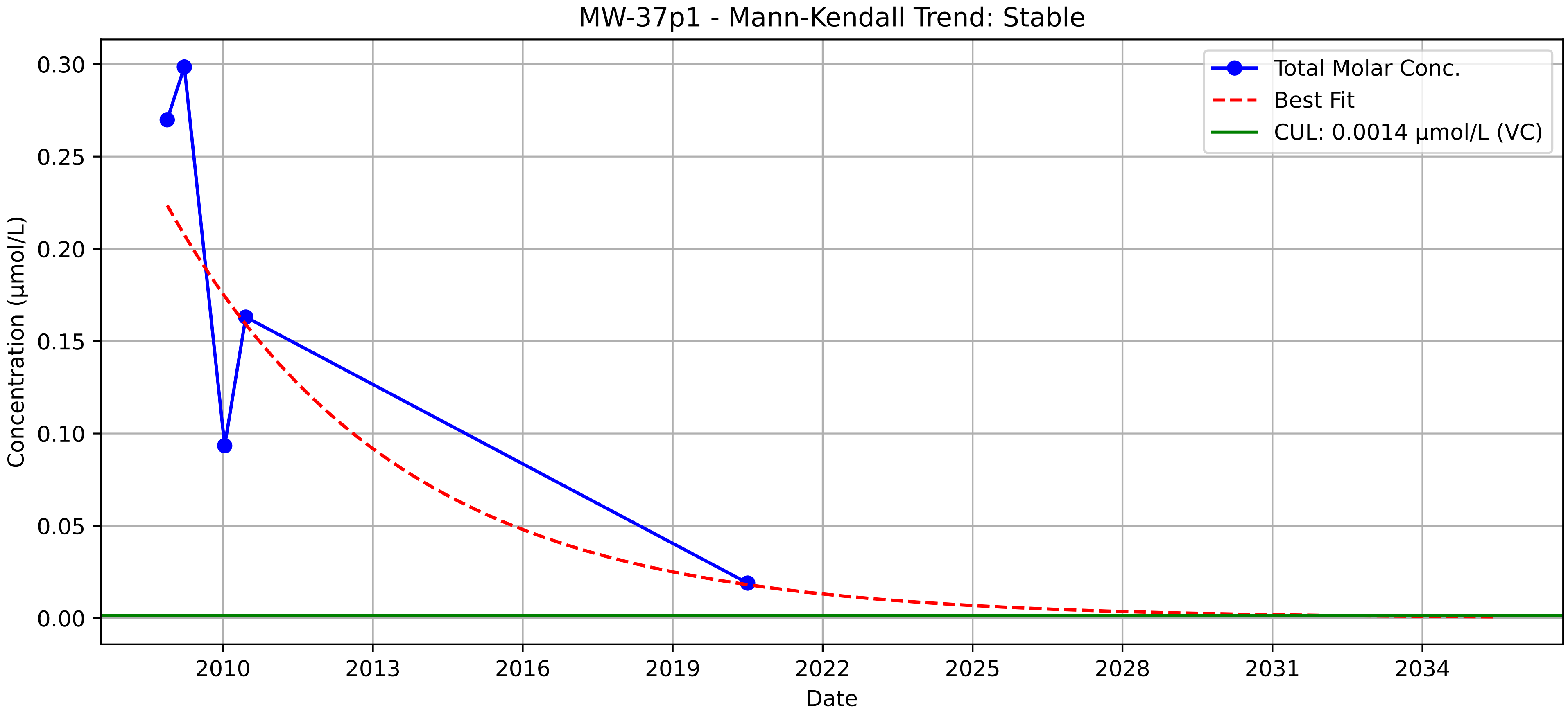

MW-129p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

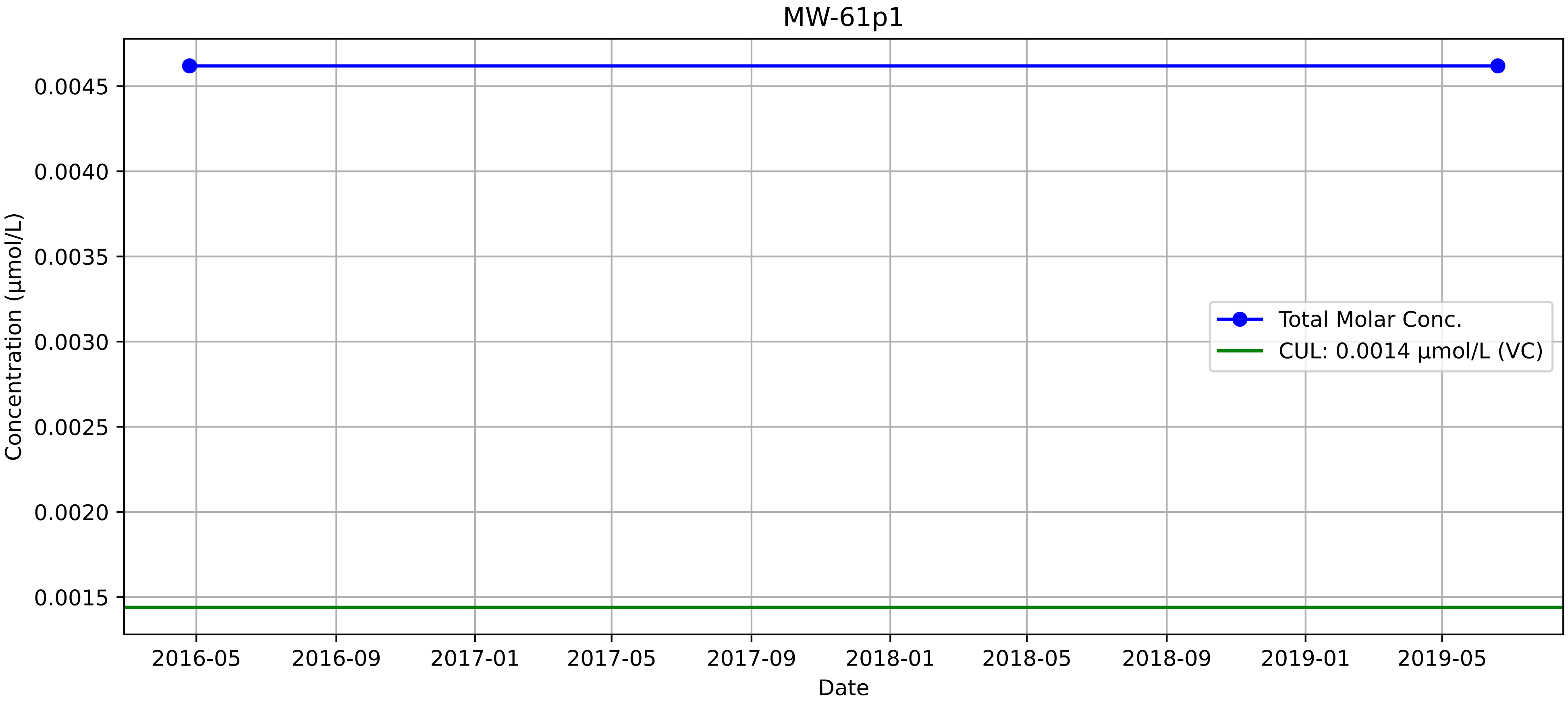


MW-34p1 - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
20
40
60
80
100
2010
2013
2016
2019
2022
2025
2028
2031
2034
Date

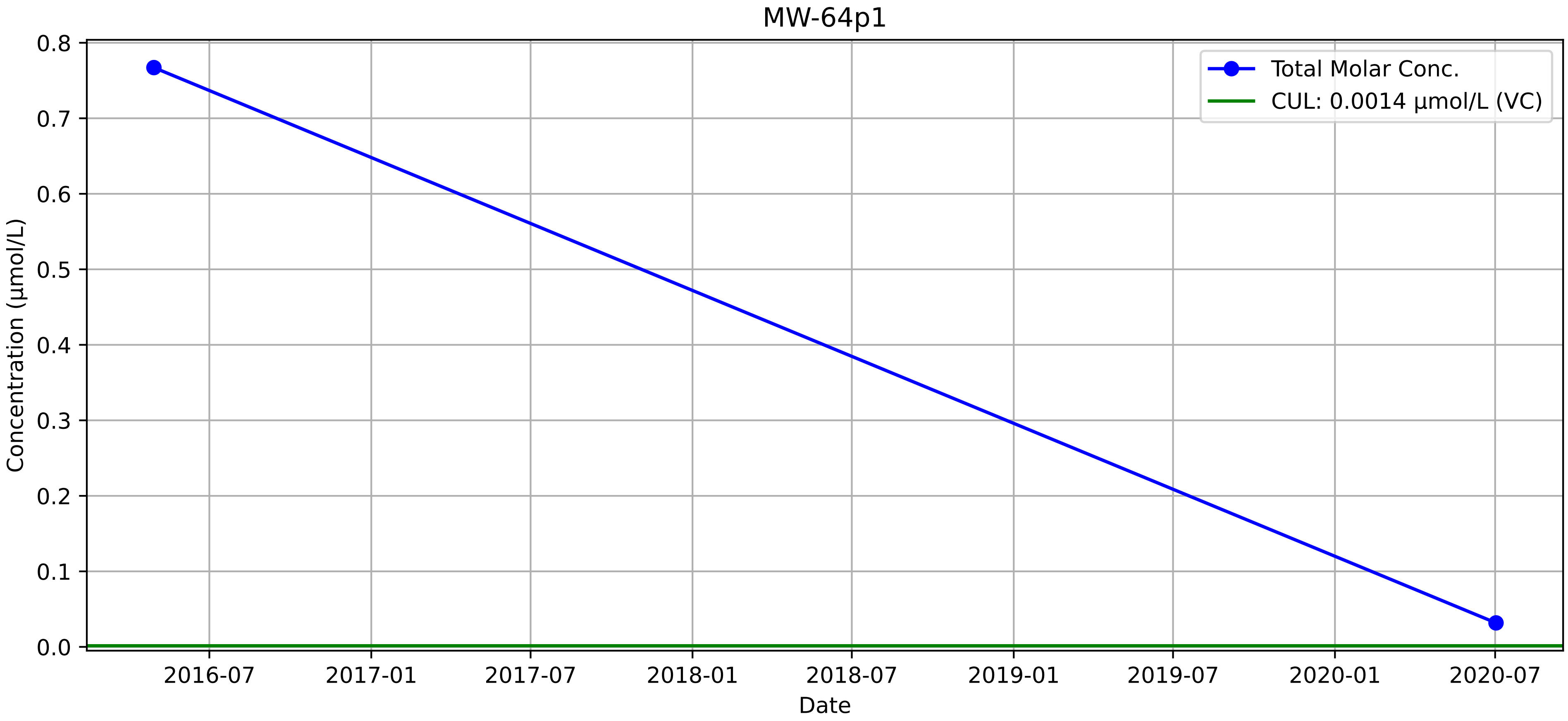


MW-36p1 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
2.0
1.5
1.0
0.5
0.0
2022
2025
2028
2031
2034
2037
2040
Date

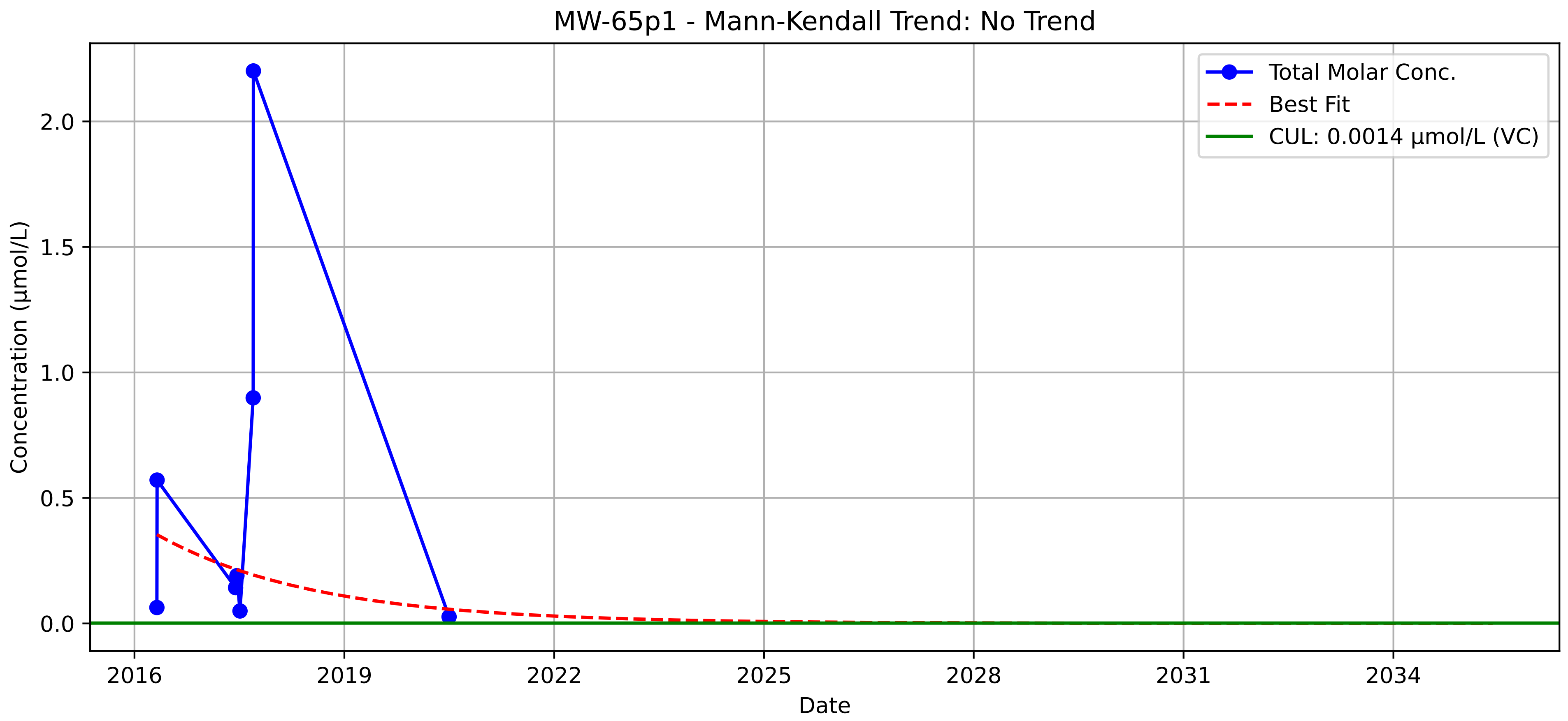

MW-37p1 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2010
2013
2016
2019
2022
2025
2028
2031
2034
Date



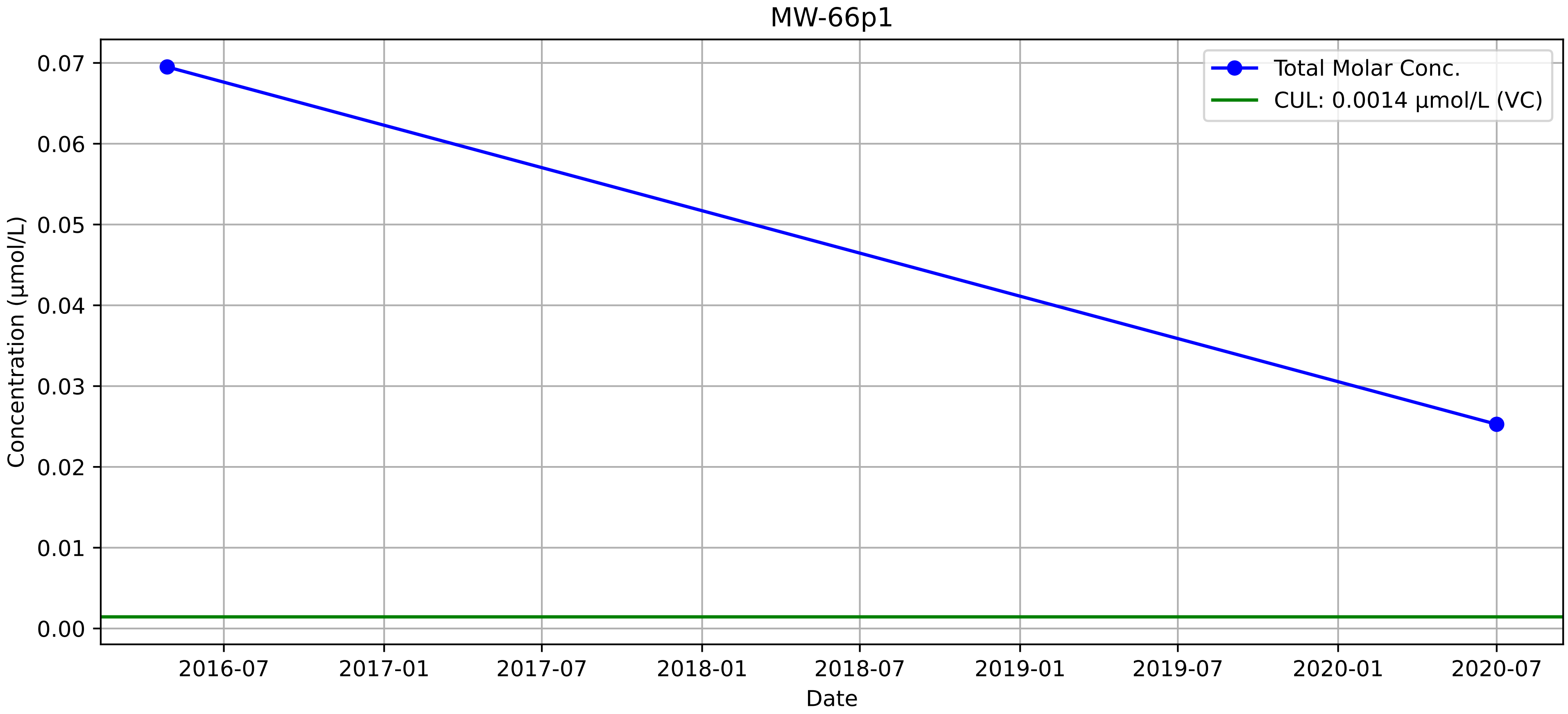
MW-61p1
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05
2018-09
2019-01
2019-05
Date

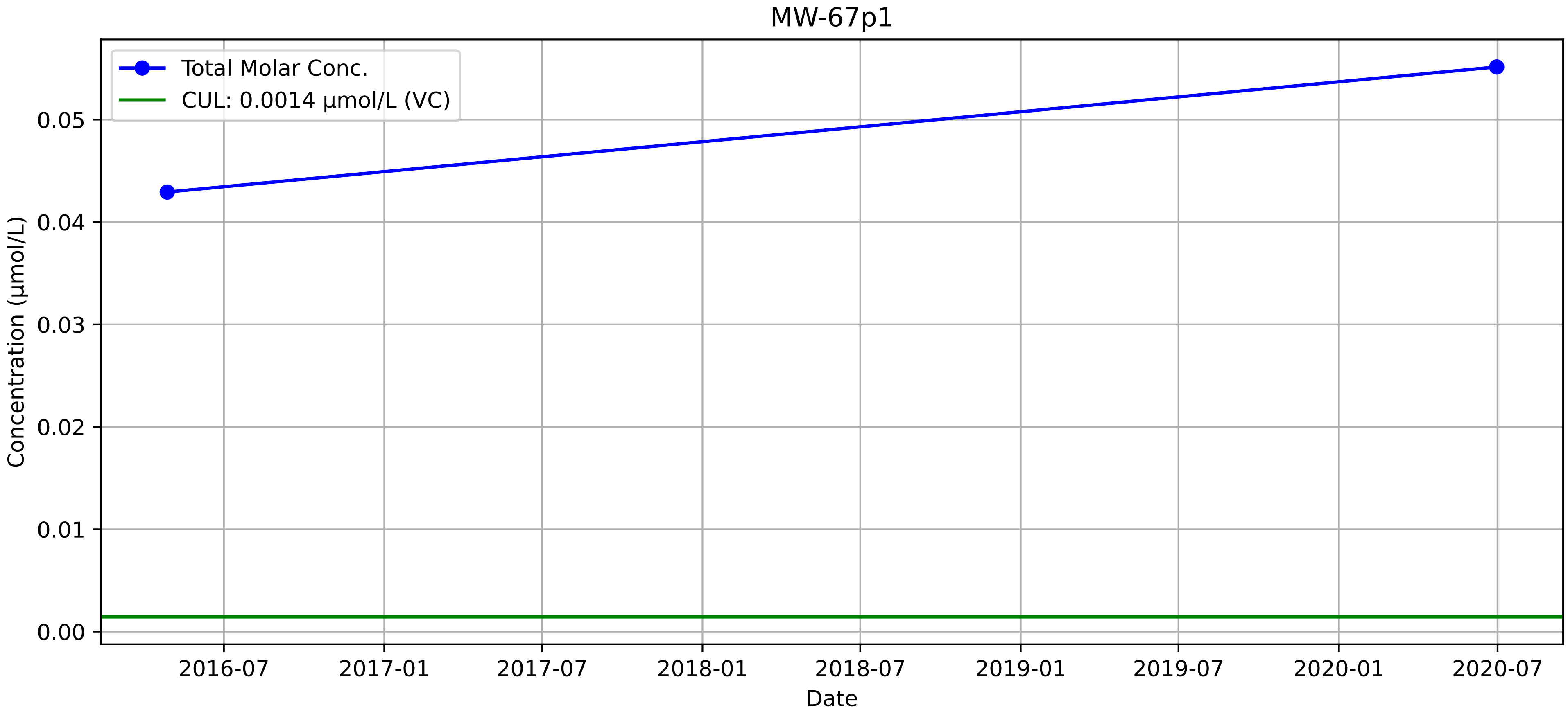


MW-64p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
Date

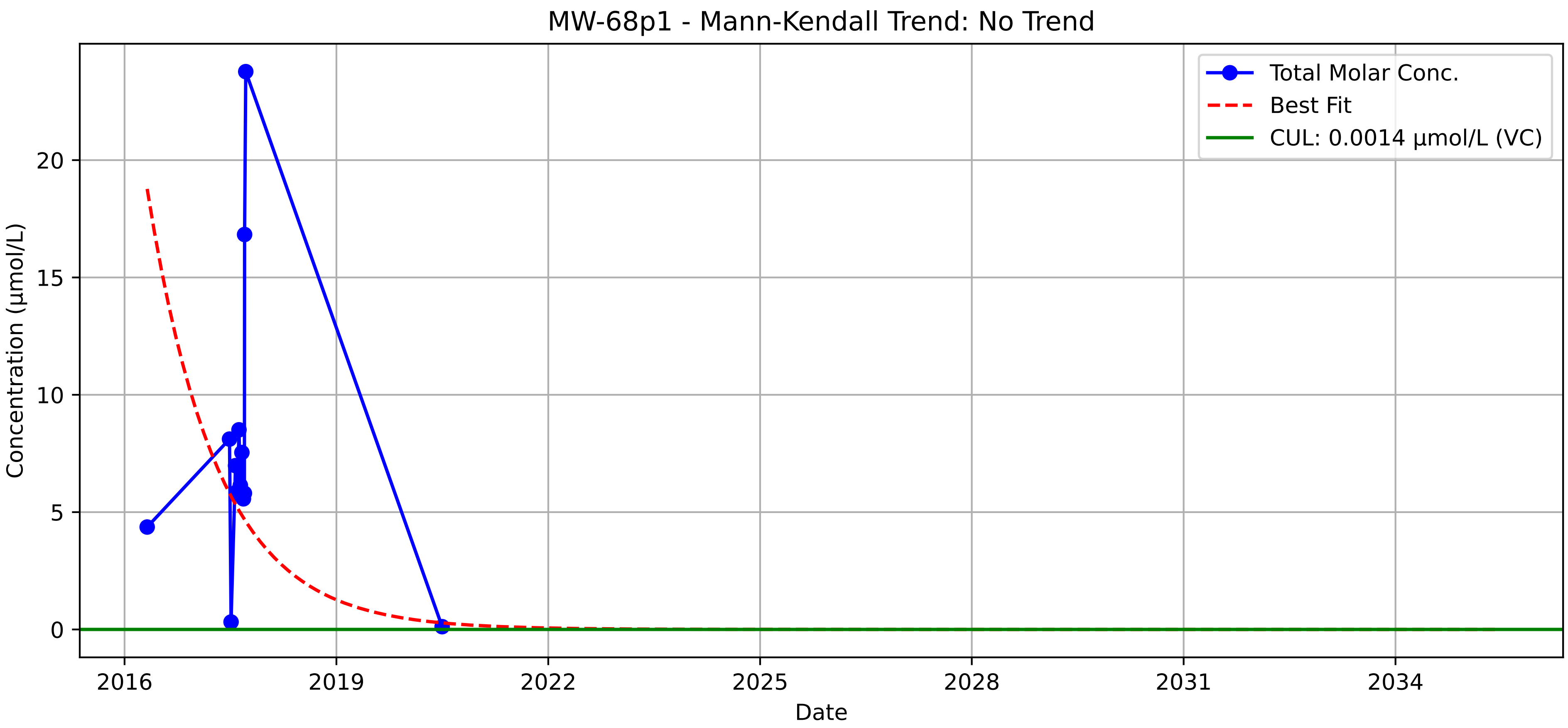


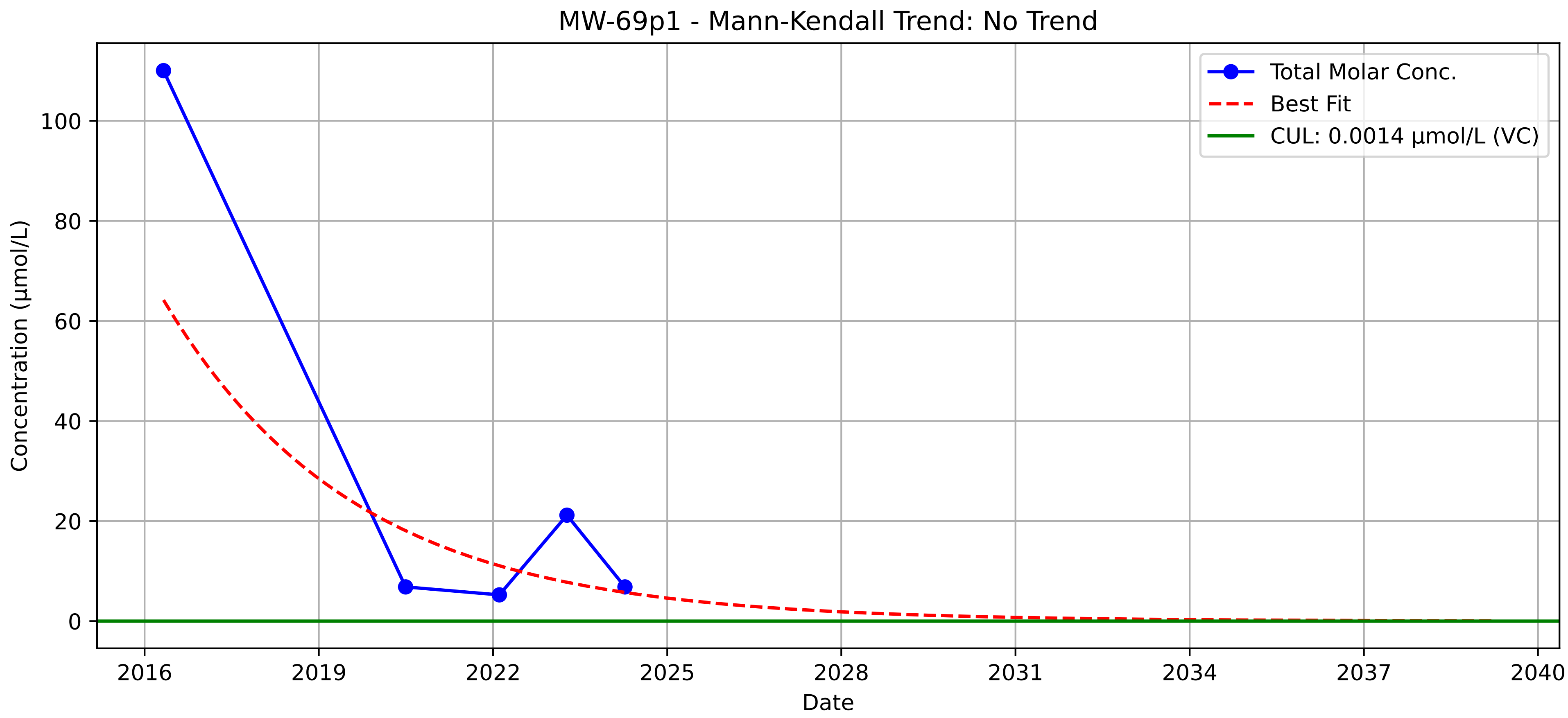
MW-65p1 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.5
1.0
1.5
2.0
2016
2019
2022
2025
2028
2031
2034
Date

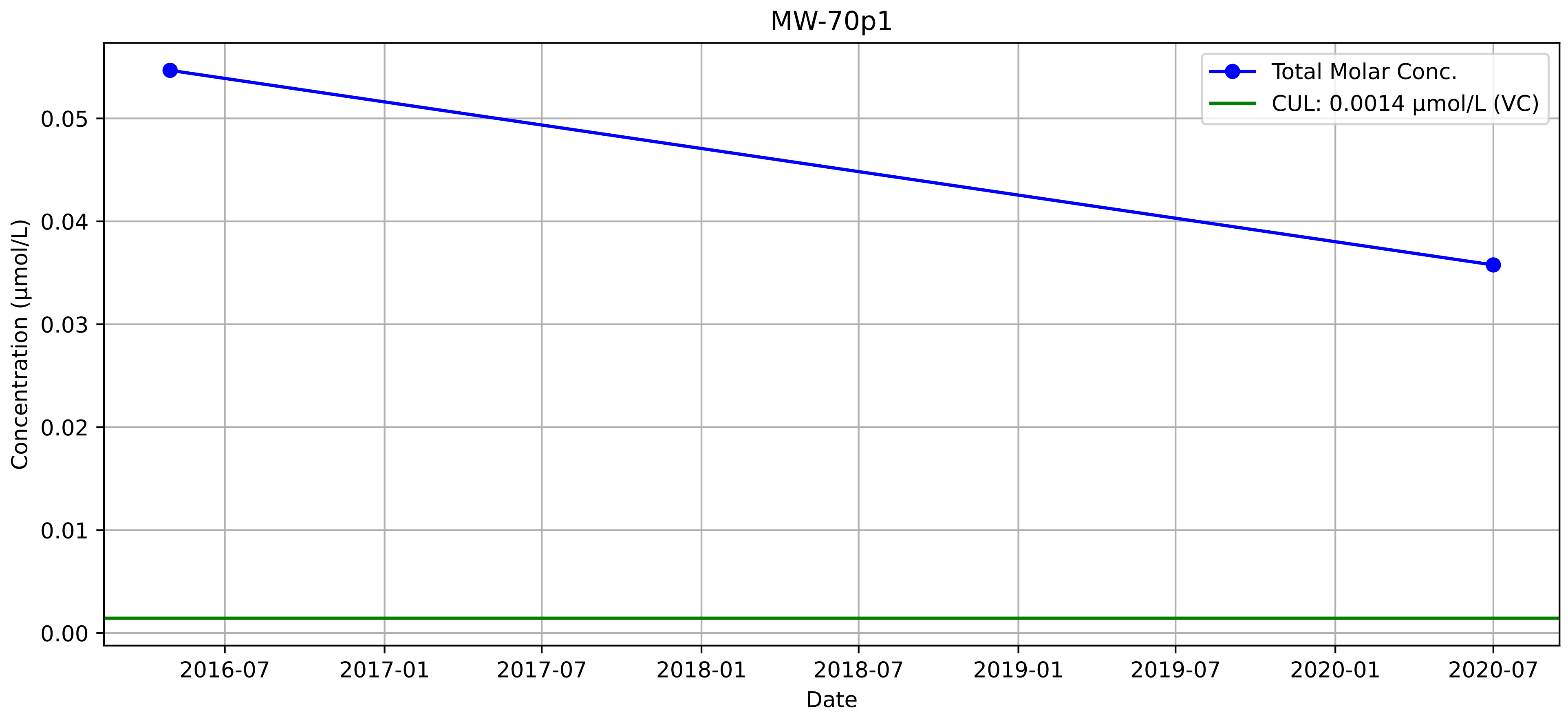

MW-66p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
Date



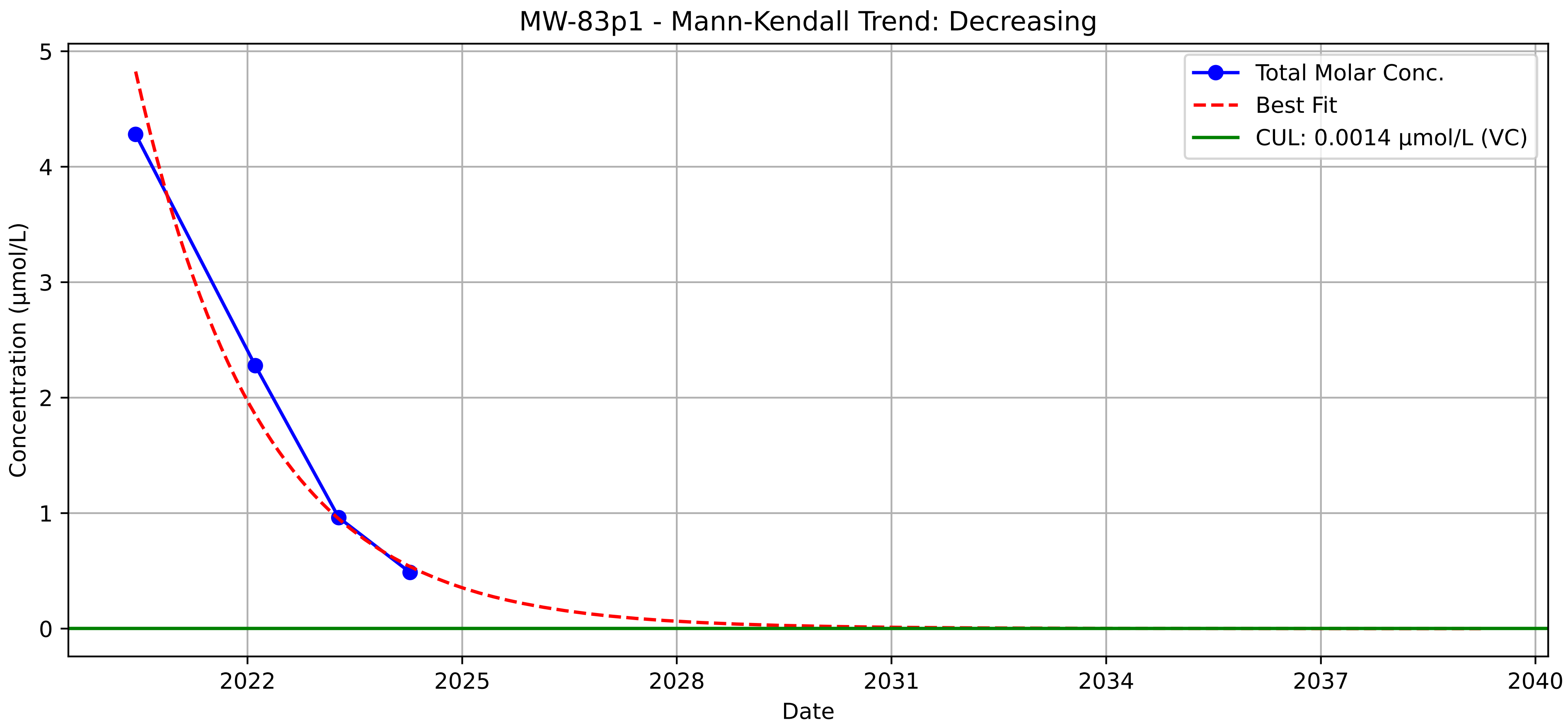
MW-67p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.01
0.02
0.03
0.04
0.05
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
Date


MW-68p1 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
5
10
15
20
2016
2019
2022
2025
2028
2031
2034
Date

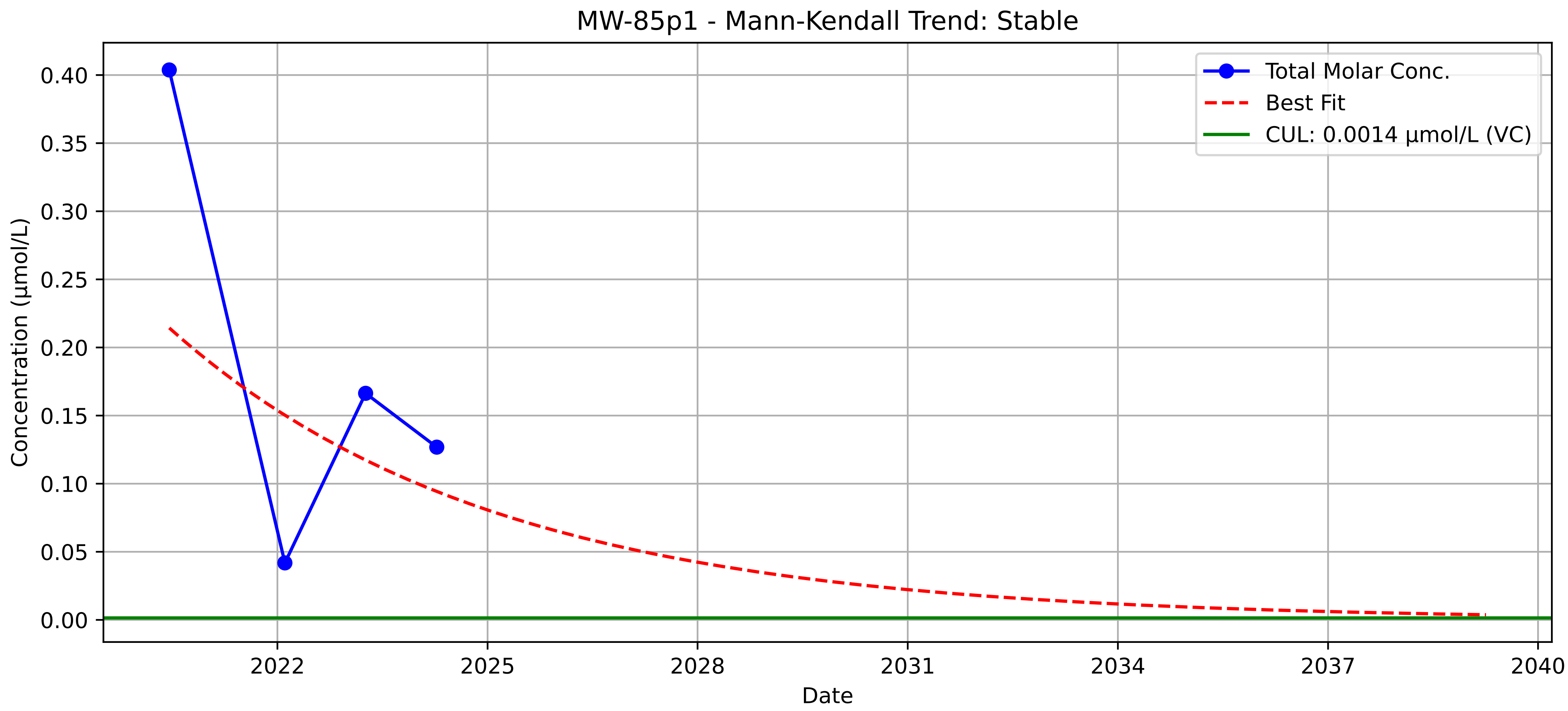

MW-69p1 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
20
40
60
80
100
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date

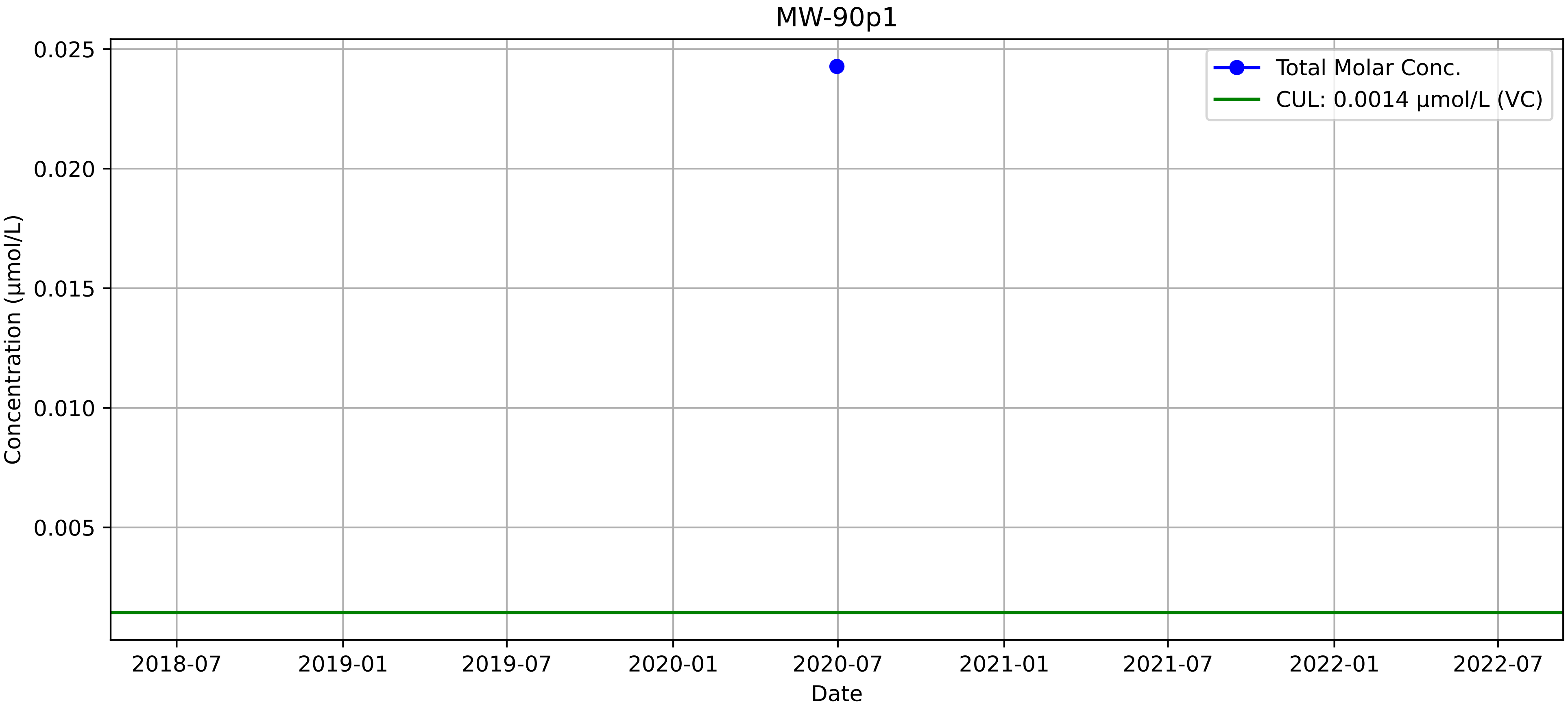


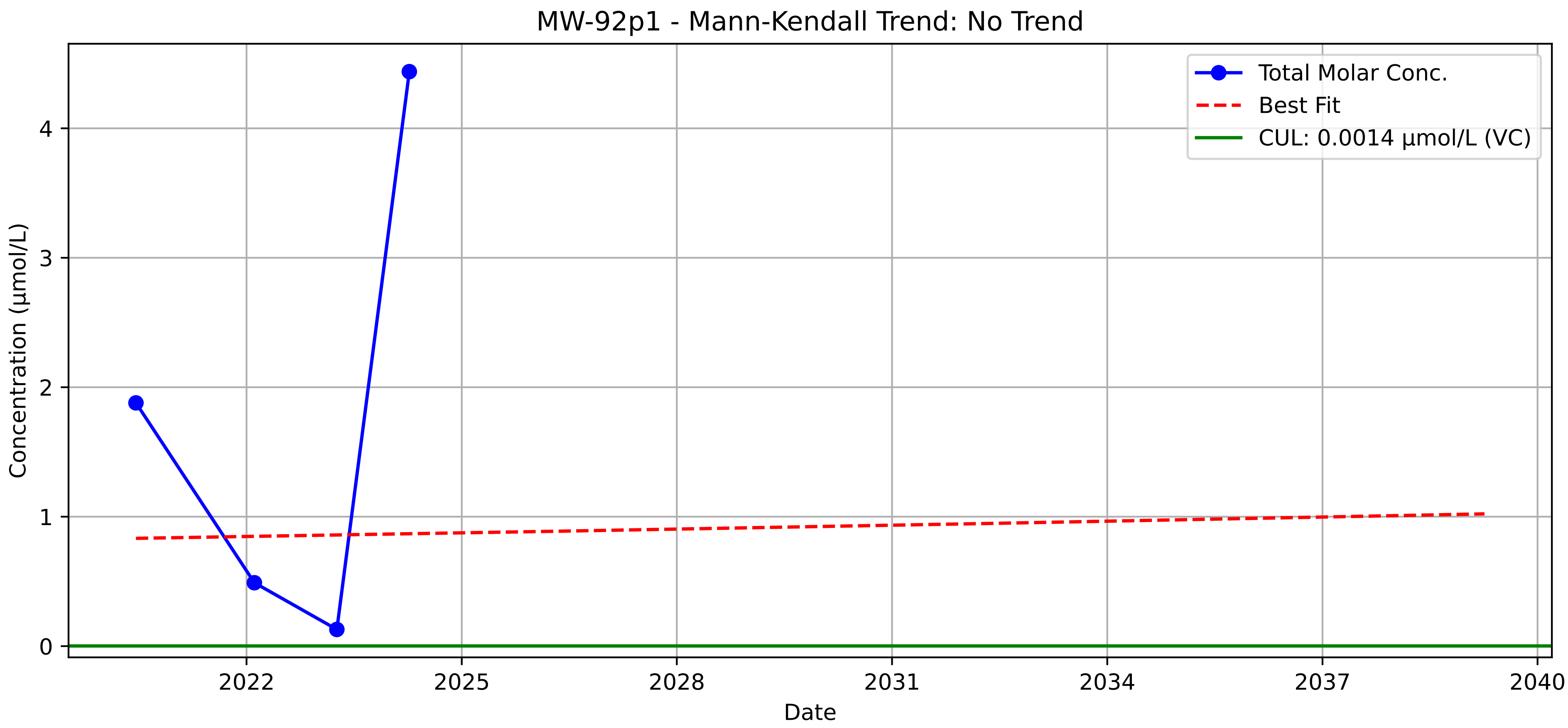
MW-70p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.05
0.04
0.03
0.02
0.01
0.00
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
2020-07
Date

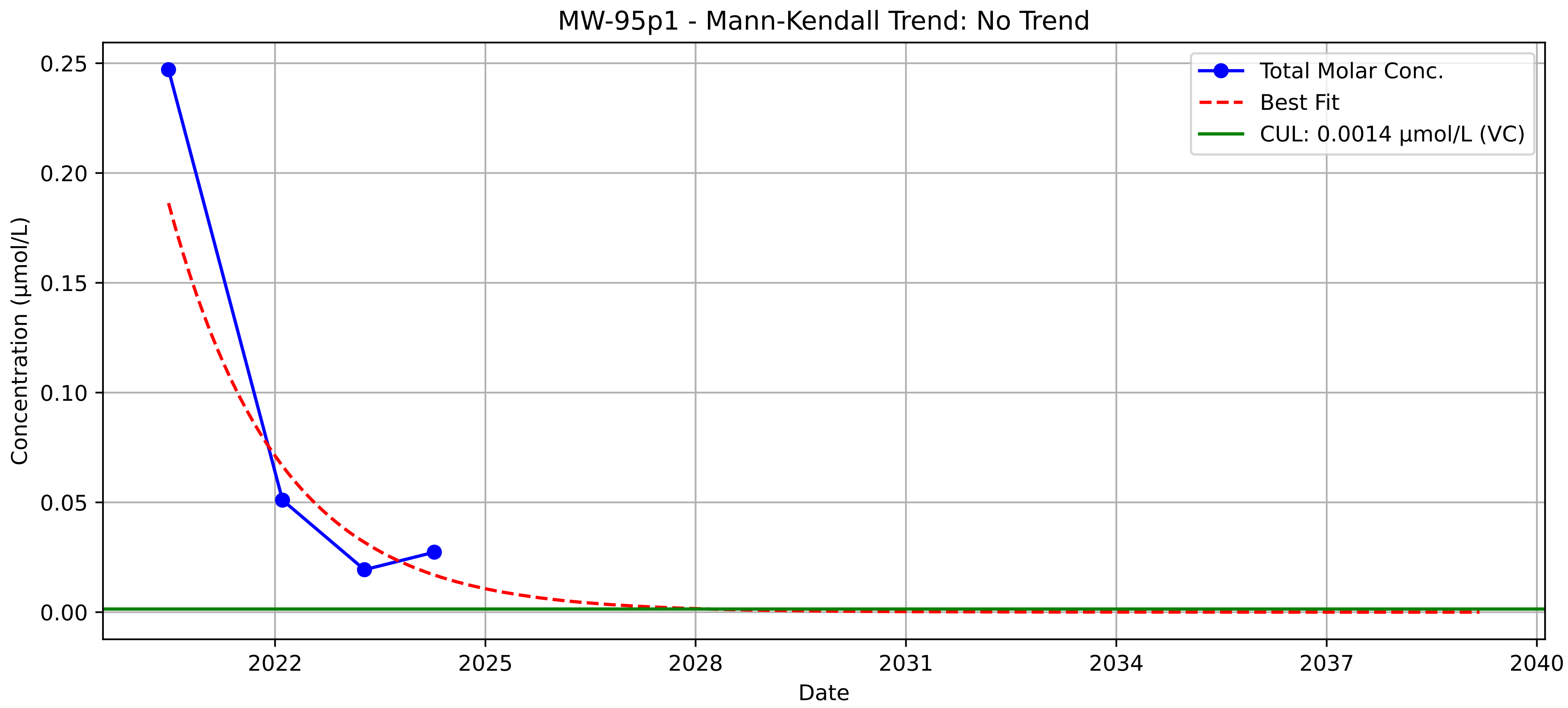


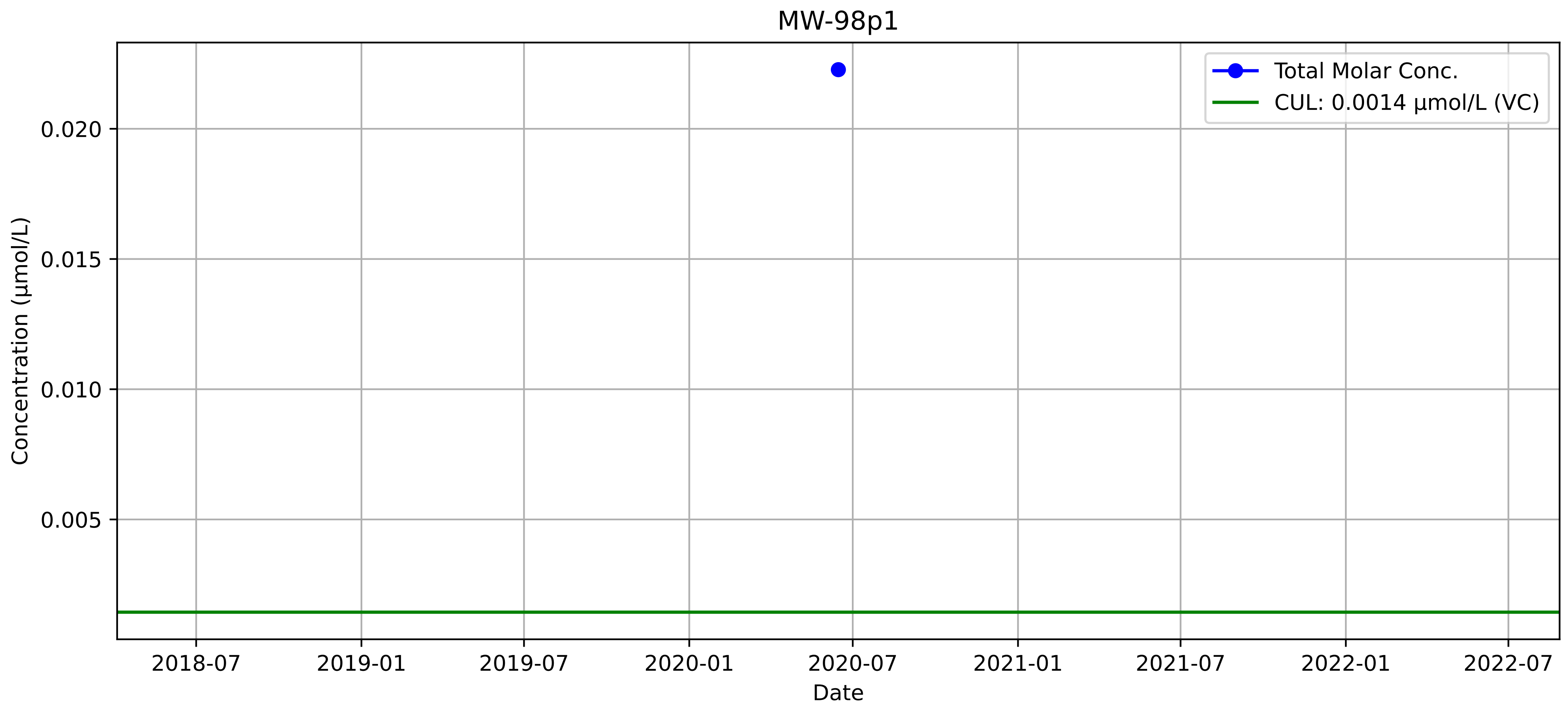
MW-83p1 - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
Date
0
1
2
3
4
5
2022
2025
2028
2031
2034
2037
2040


MW-85p1 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2022
2025
2028
2031
2034
2037
2040
Date


MW-90p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.025
0.020
0.015
0.010
0.005
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

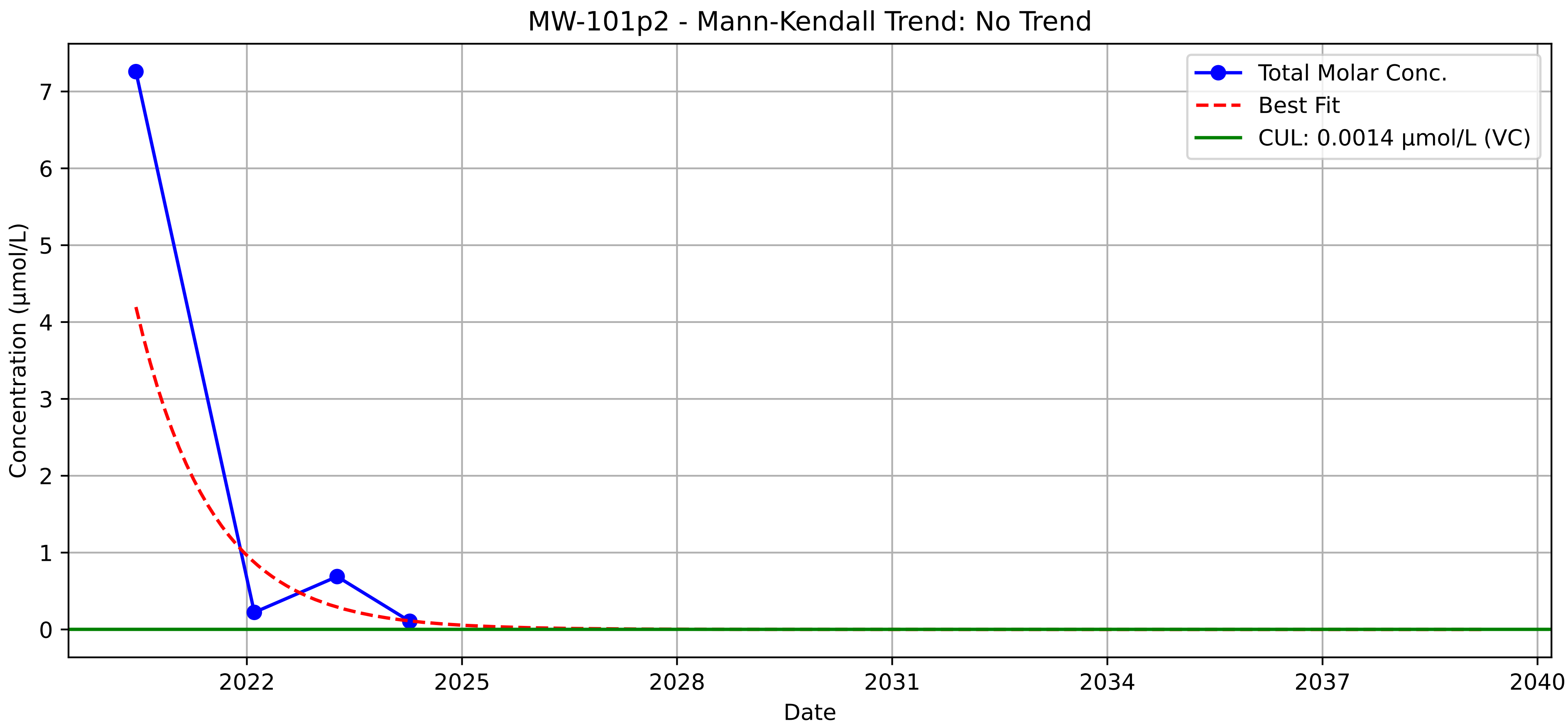

MW-92p1 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
1
2
3
4
2022
2025
2028
2031
2034
2037
2040
Date


MW-95p1 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.25
0.20
0.15
0.10
0.05
0.00
2022
2025
2028
2031
2034
2037
2040
Date

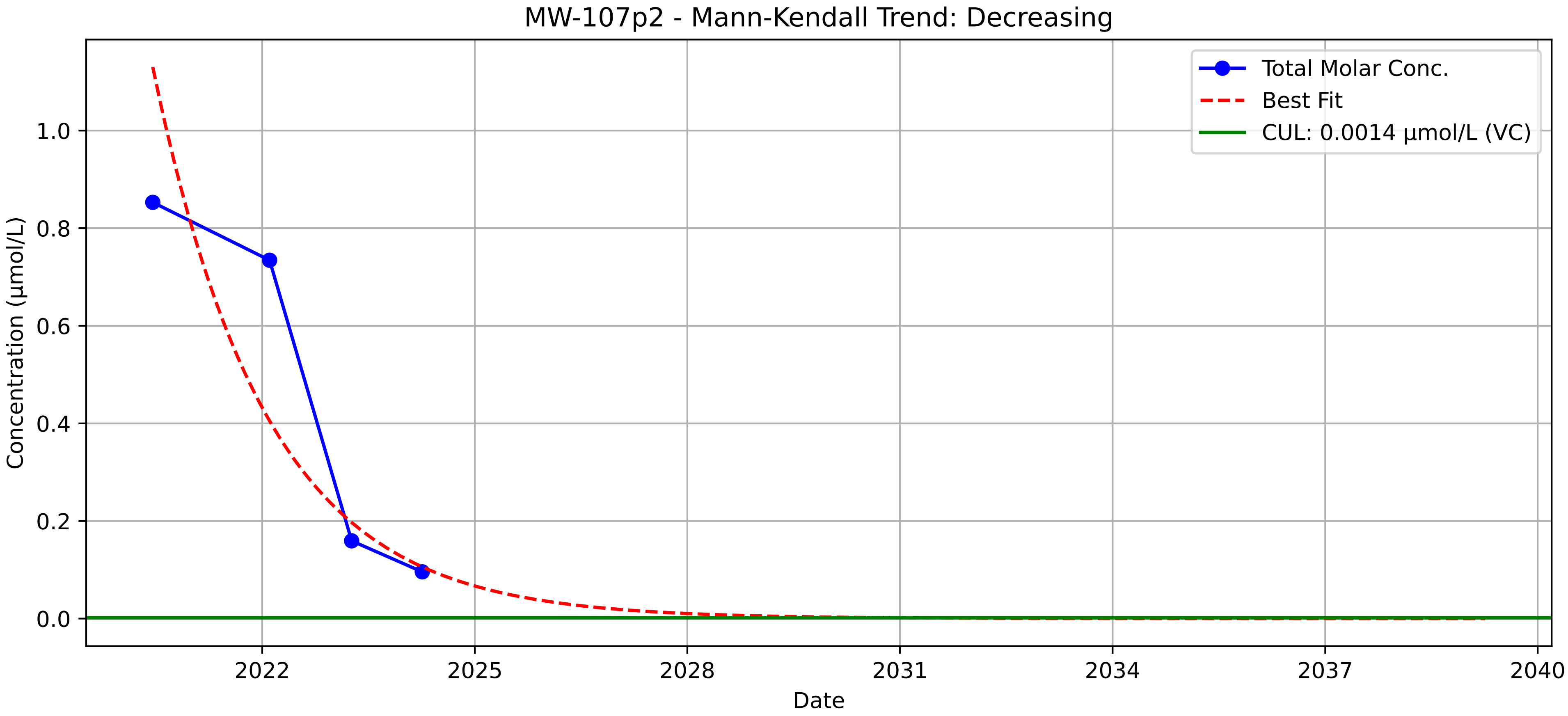


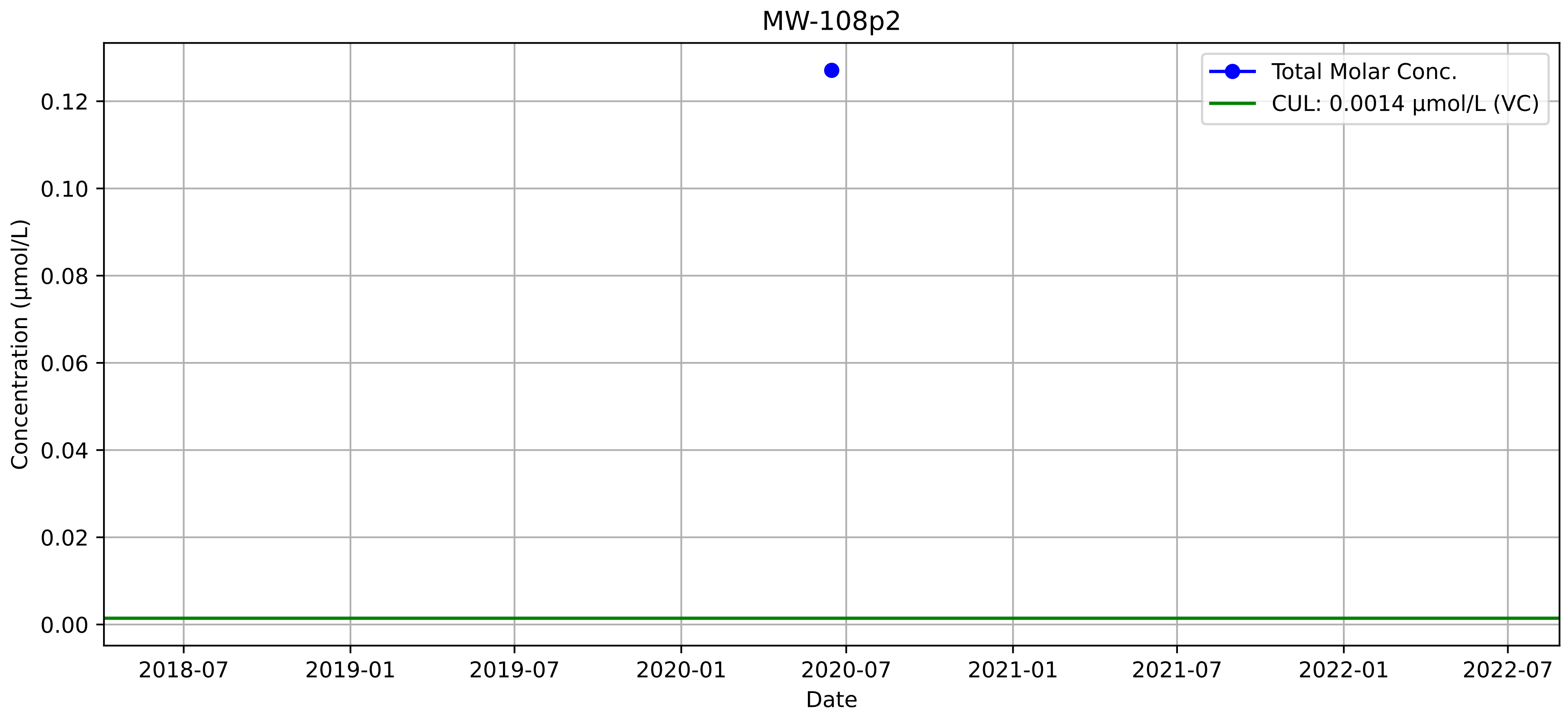
MW-98p1
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
0.020
0.015
0.010
0.005
Concentration (µmol/L)
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

A2. Total molar concentration time series plots of chlorinated ethenes for P2 zone wells

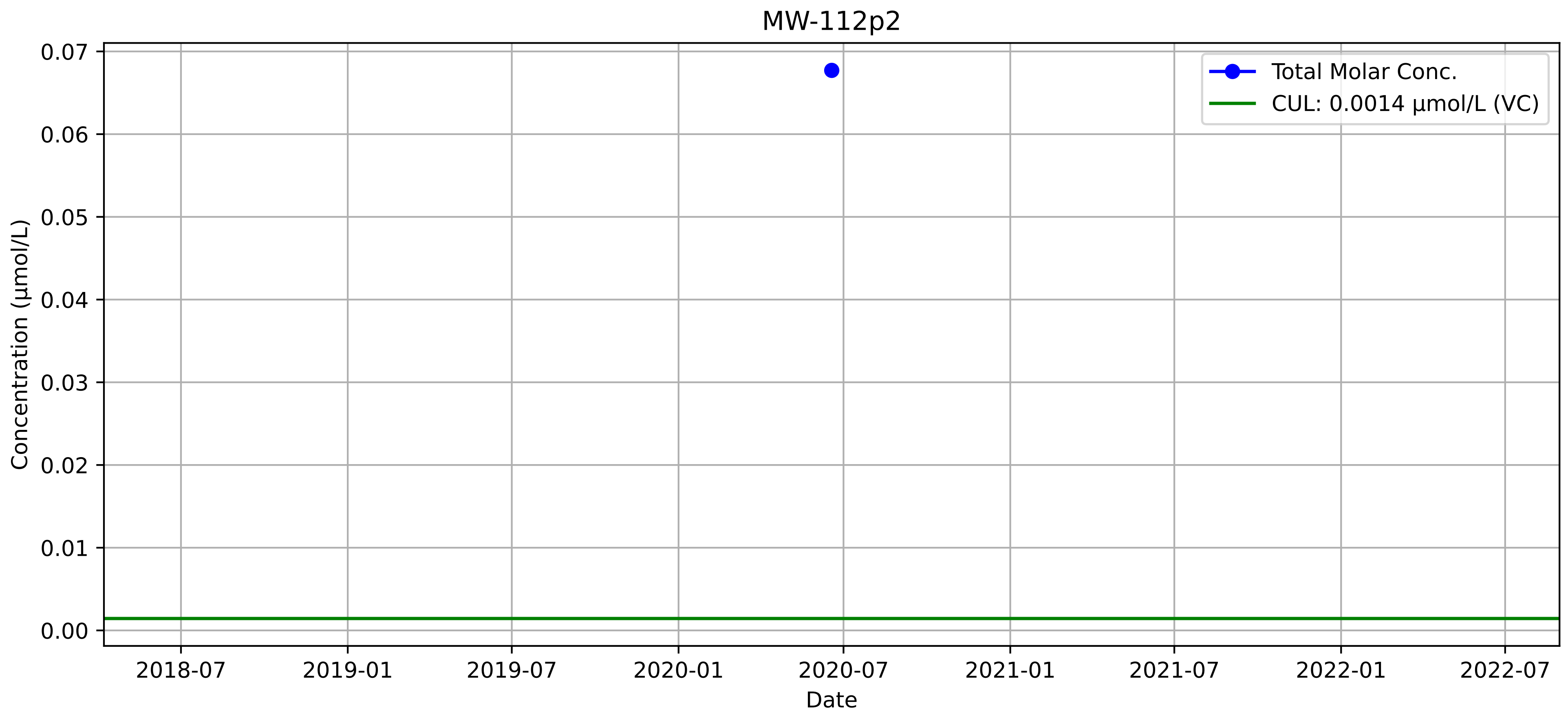


MW-101p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
1
2
3
4
5
6
7
2022
2025
2028
2031
2034
2037
2040
Date

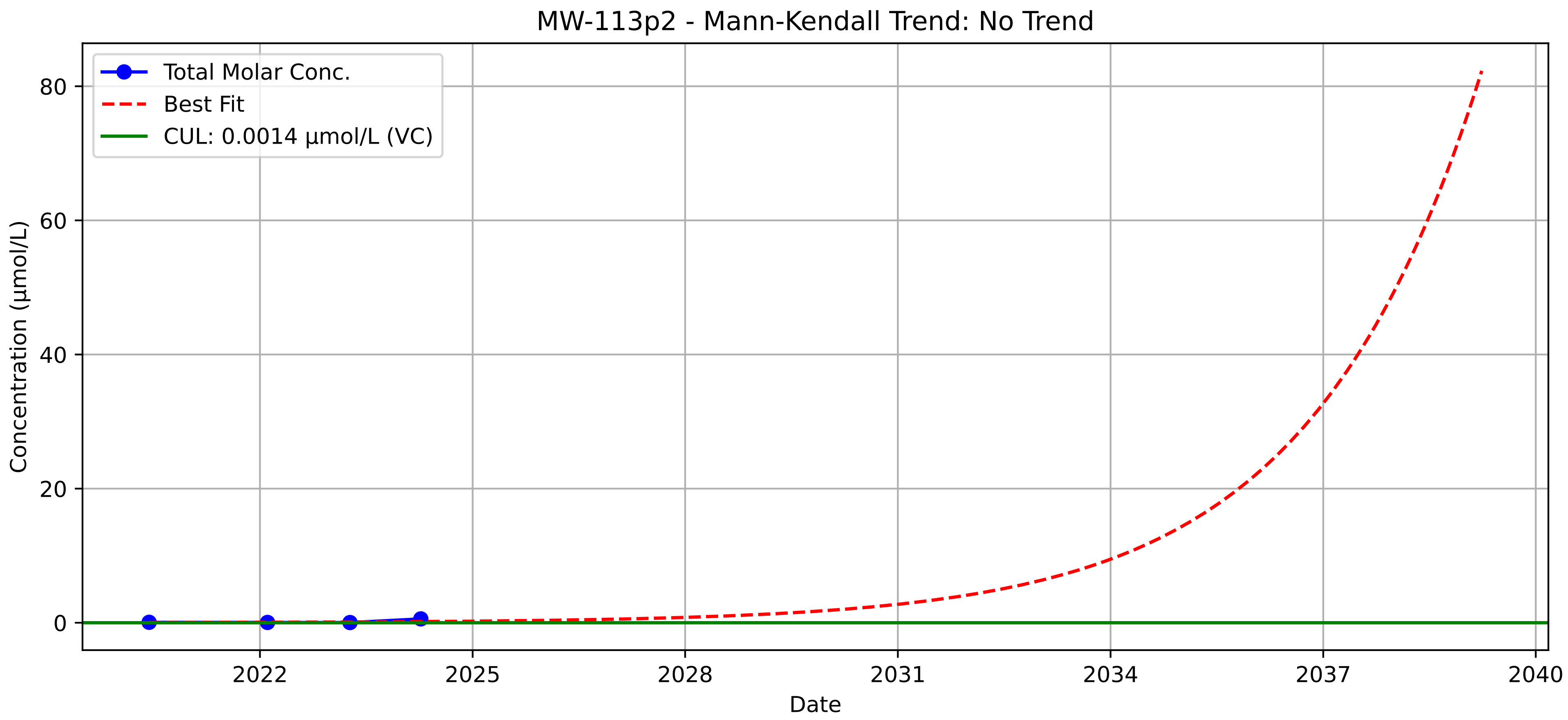

MW-107p2 - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
1.0
0.8
0.6
0.4
0.2
0.0
2022
2025
2028
2031
2034
2037
2040
Date



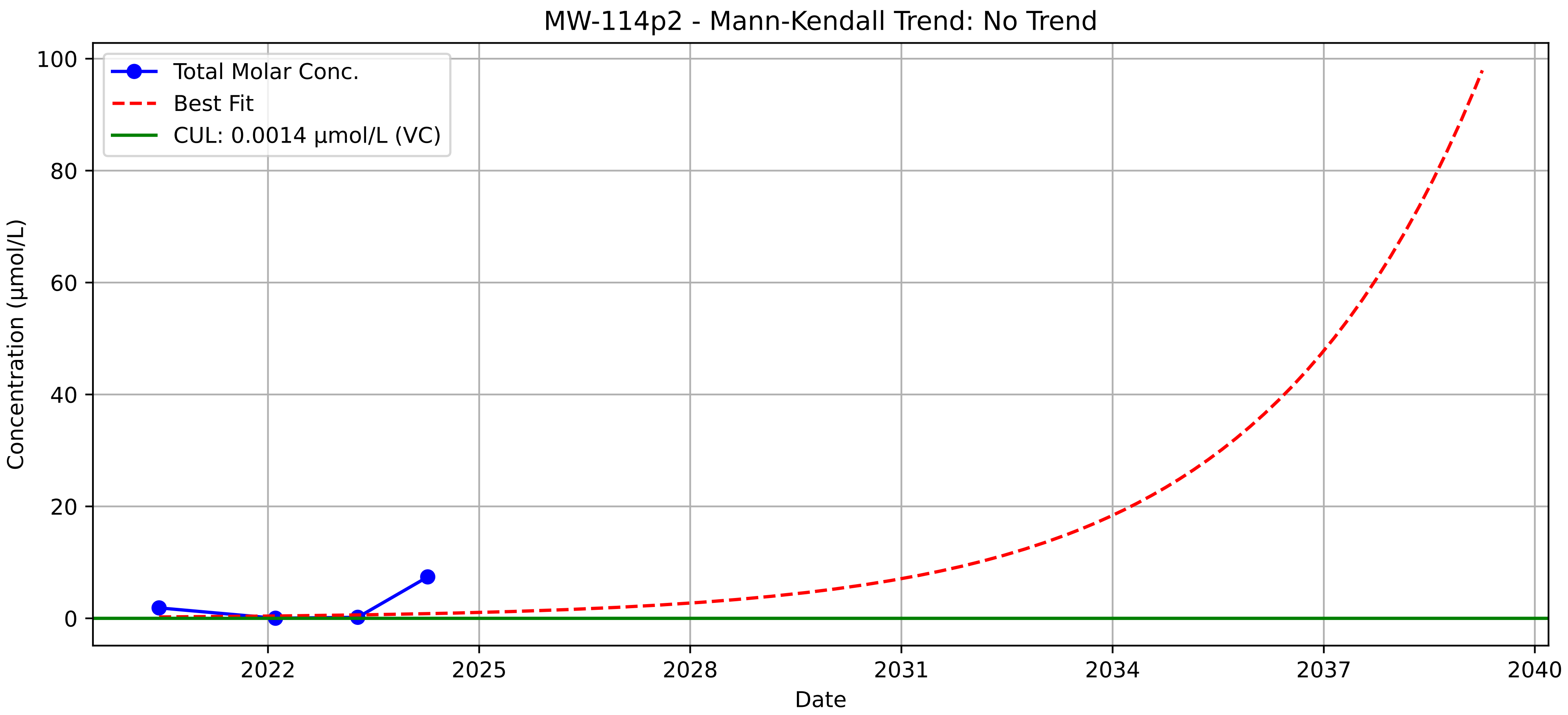
MW-108p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

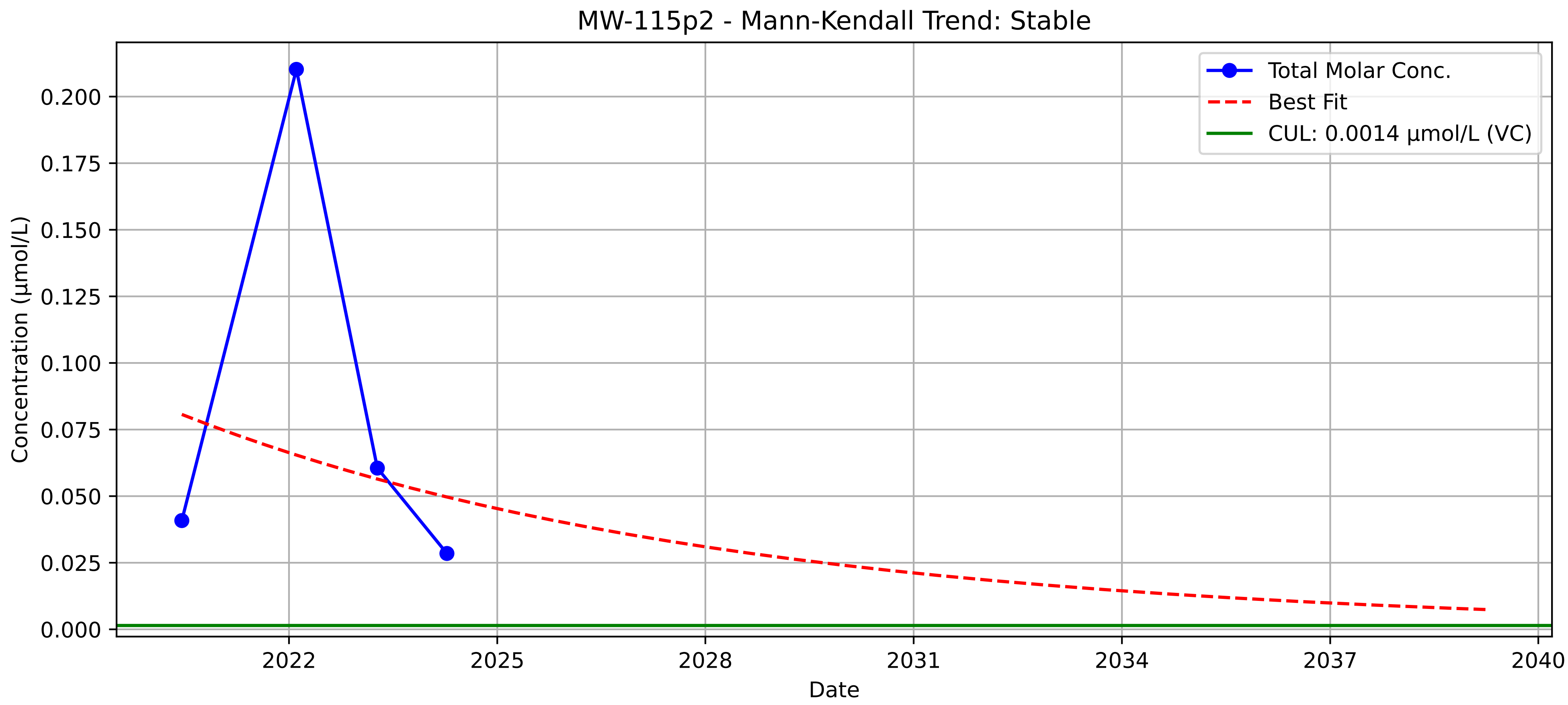


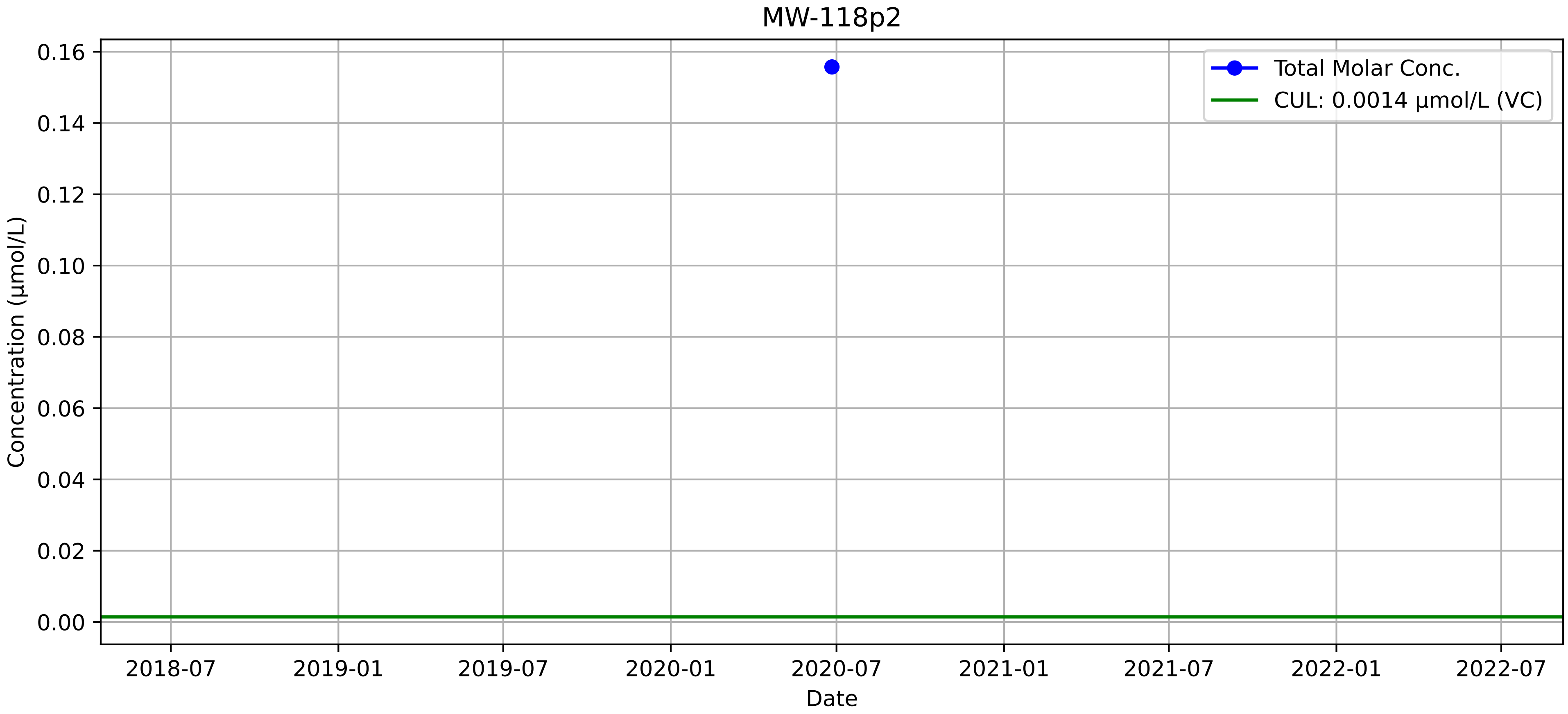
MW-112p2
Concentration (µmol/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)



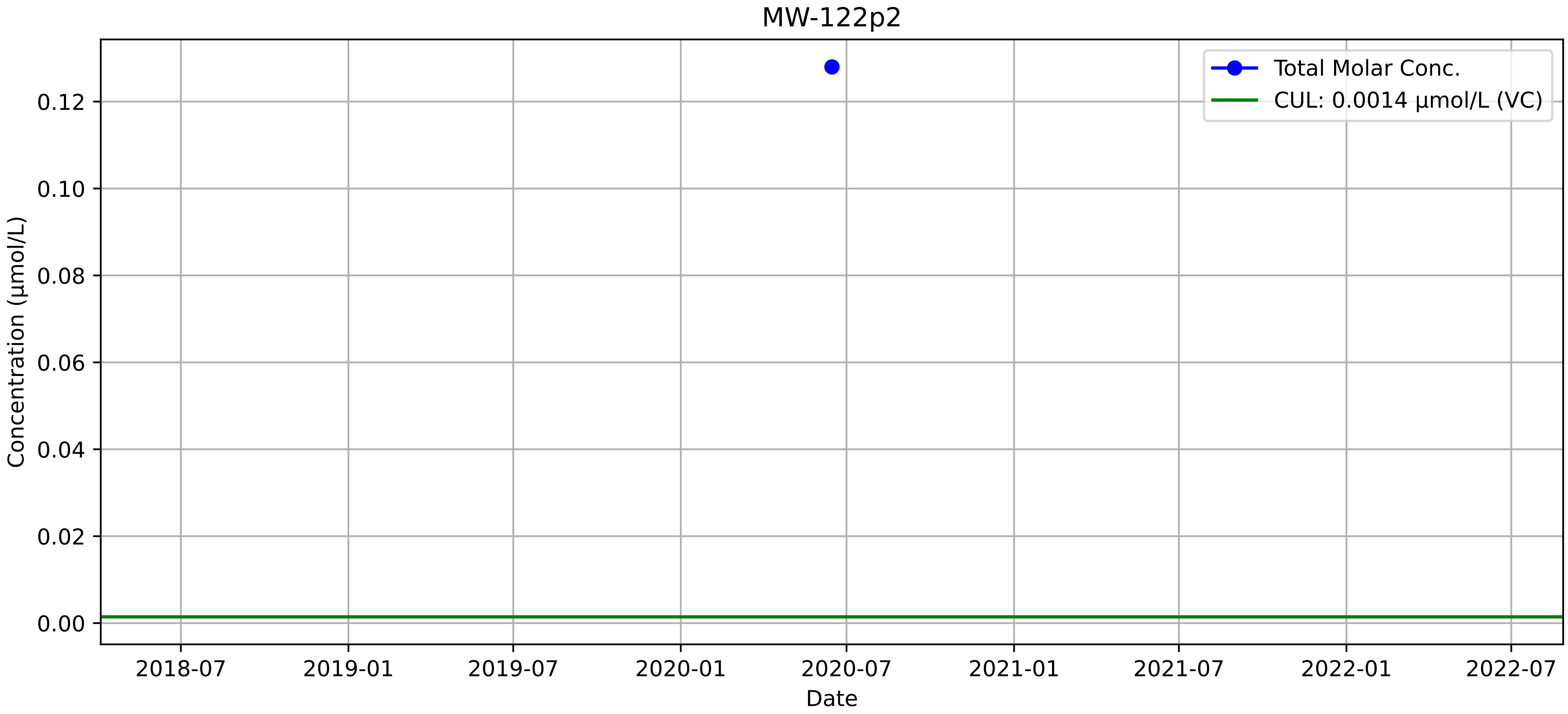
MW-113p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
20
40
60
80
2022
2025
2028
2031
2034
2037
2040
Date


MW-114p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
Date
0
20
40
60
80
100
2022
2025
2028
2031
2034
2037
2040

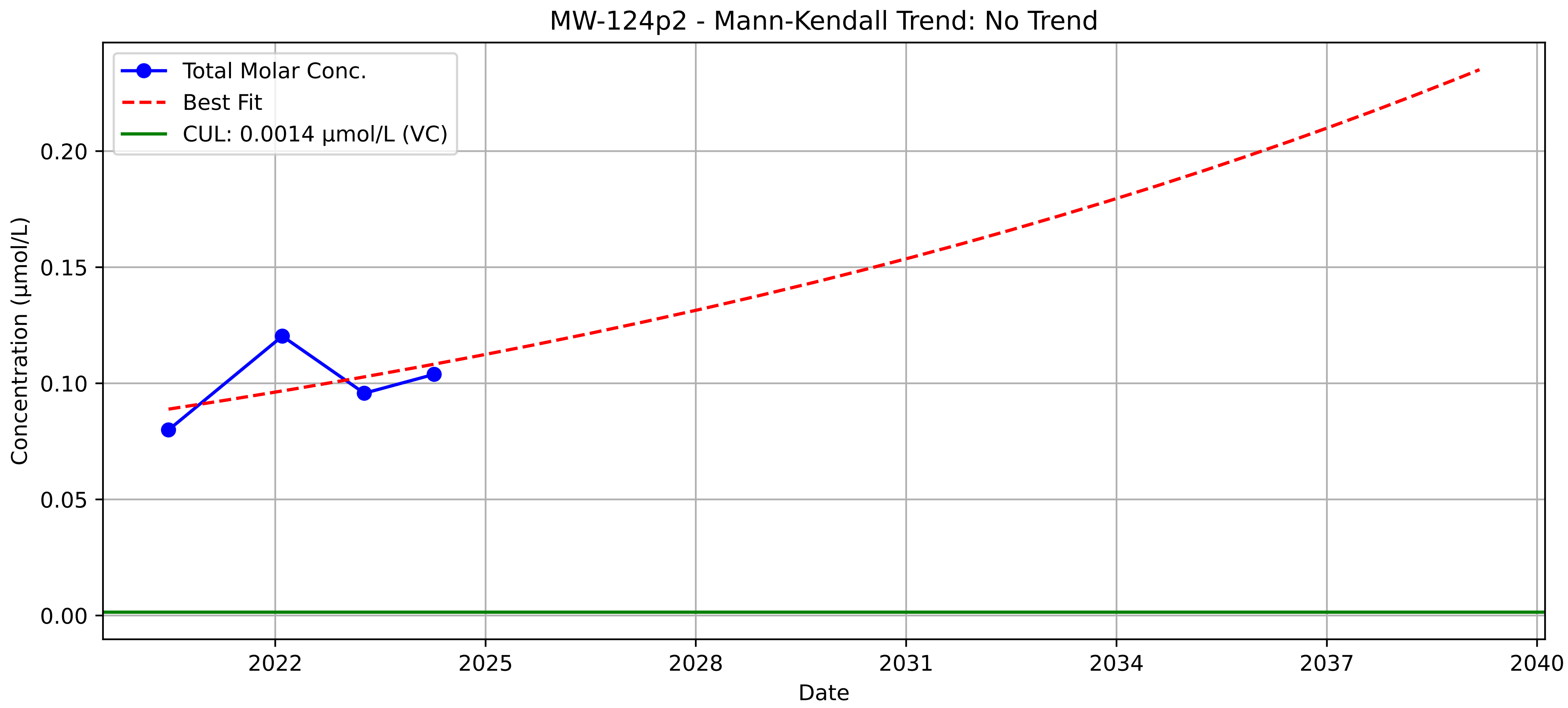

MW-115p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
2022
2025
2028
2031
2034
2037
2040
Date



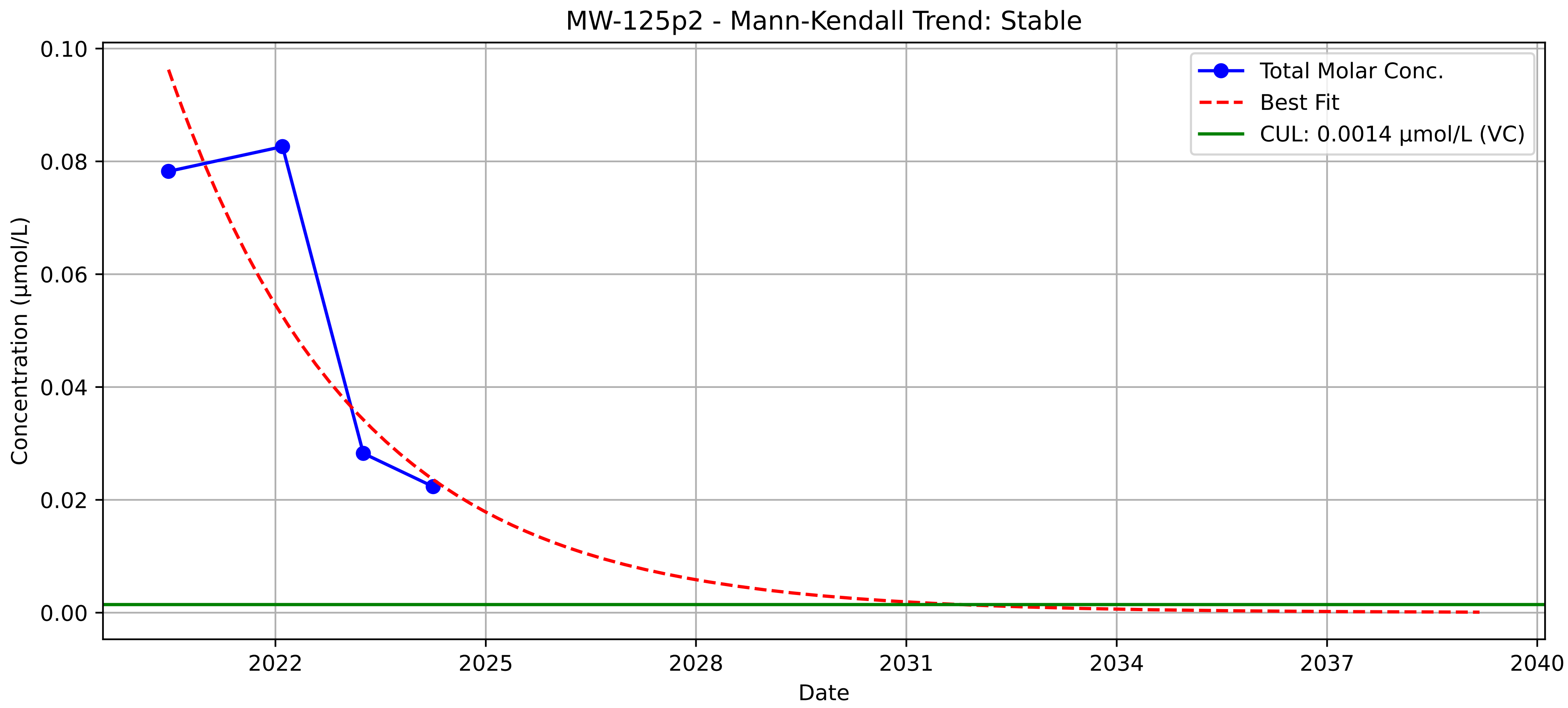
MW-118p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

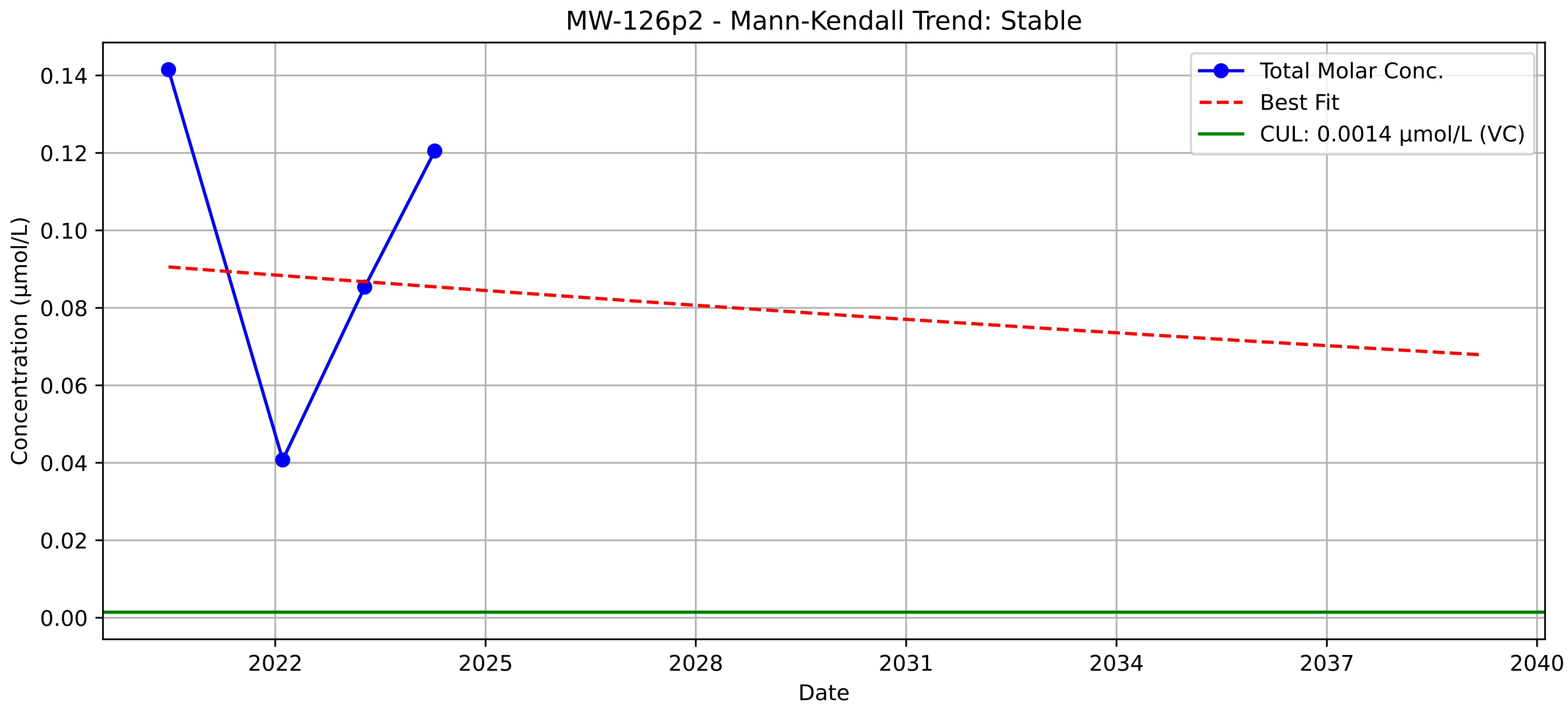


MW-122p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

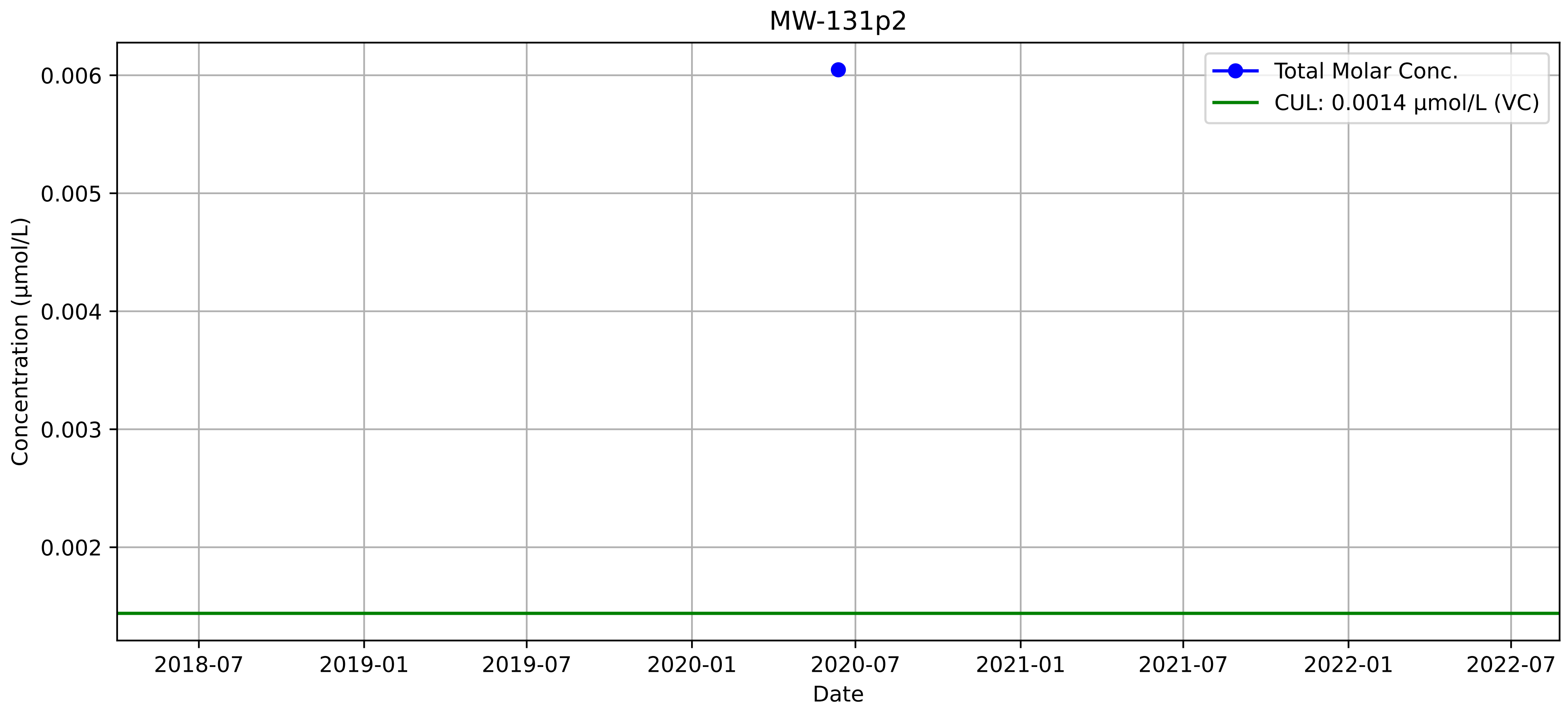


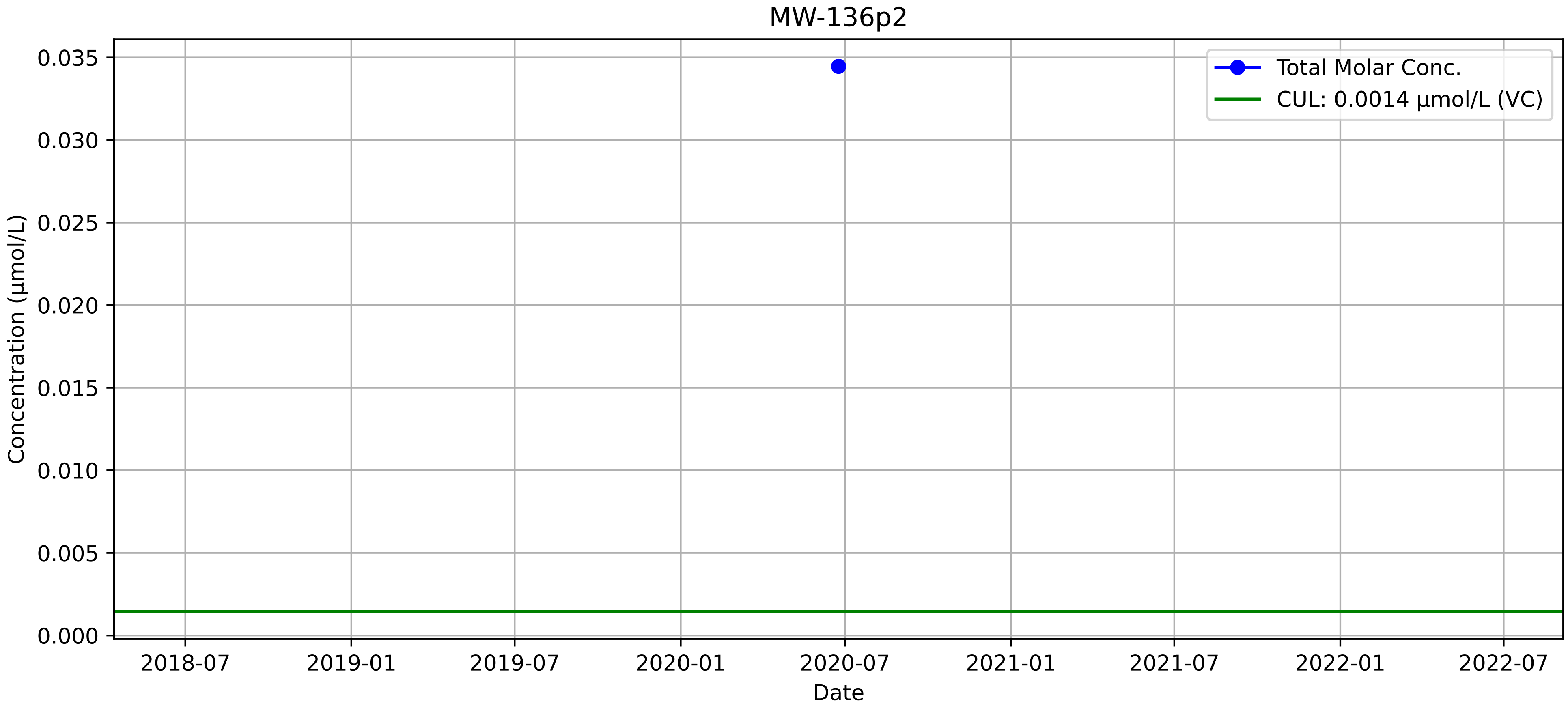
MW-124p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.20
0.15
0.10
0.05
0.00
2022
2025
2028
2031
2034
2037
2040
Date


MW-125p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.10
0.08
0.06
0.04
0.02
0.00
2022
2025
2028
2031
2034
2037
2040
Date

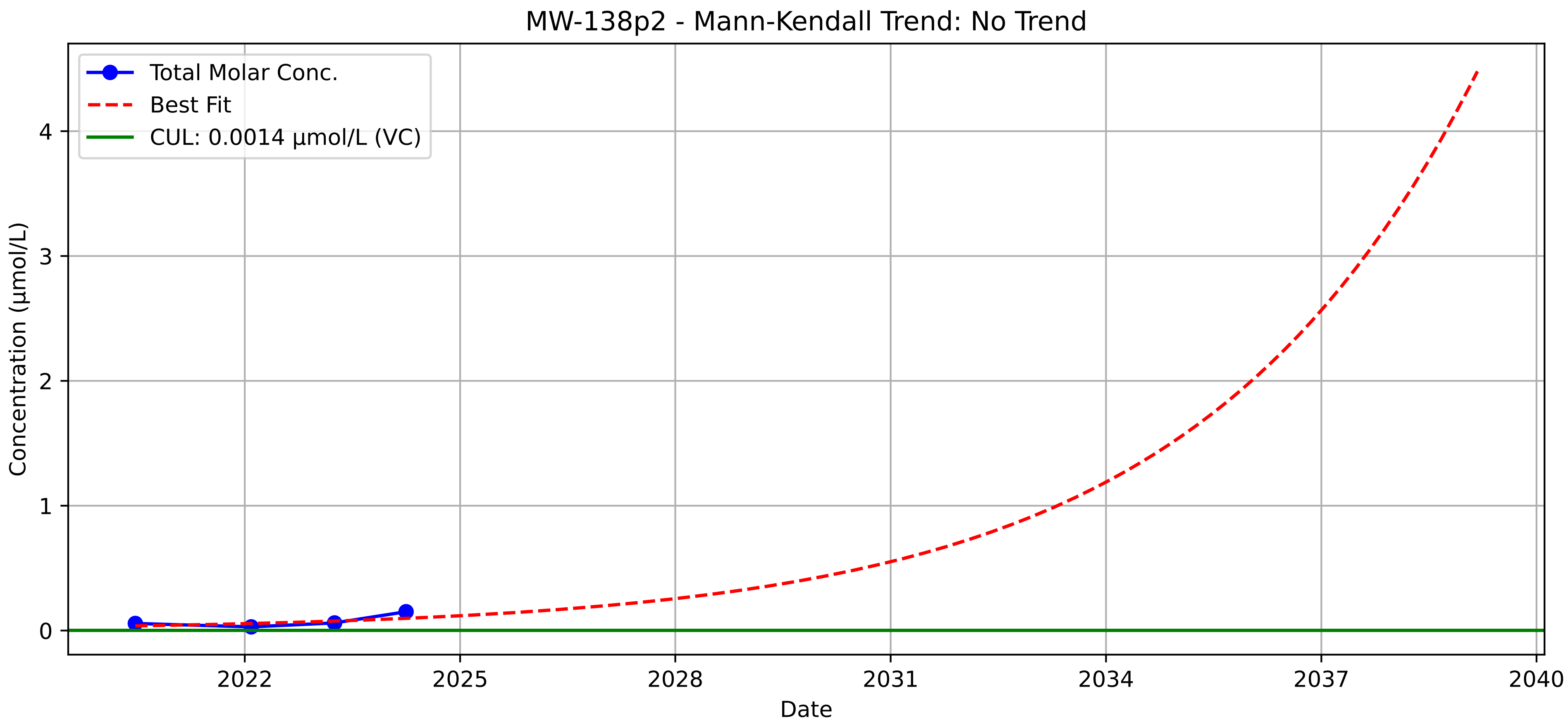


MW-126p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2022
2025
2028
2031
2034
2037
2040
Date

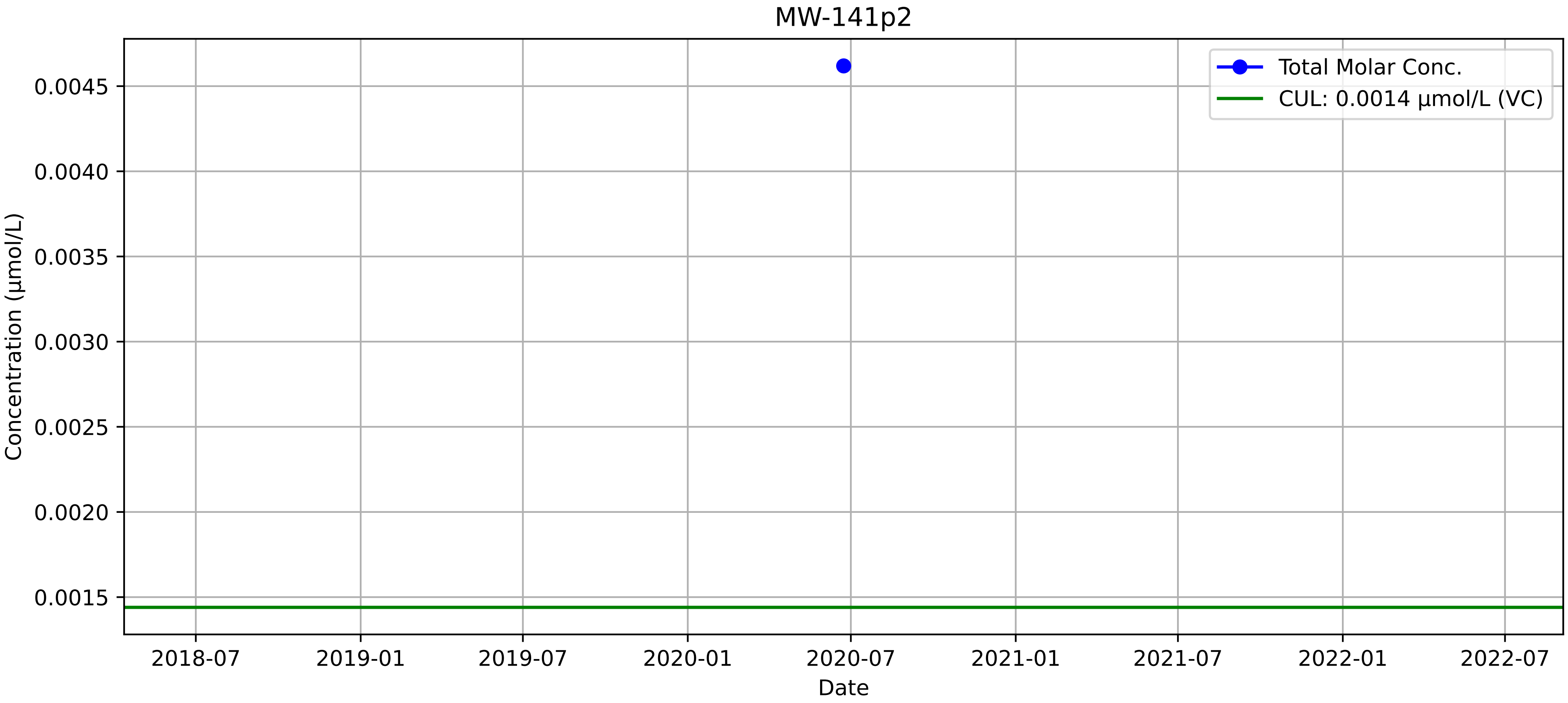

MW-131p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date



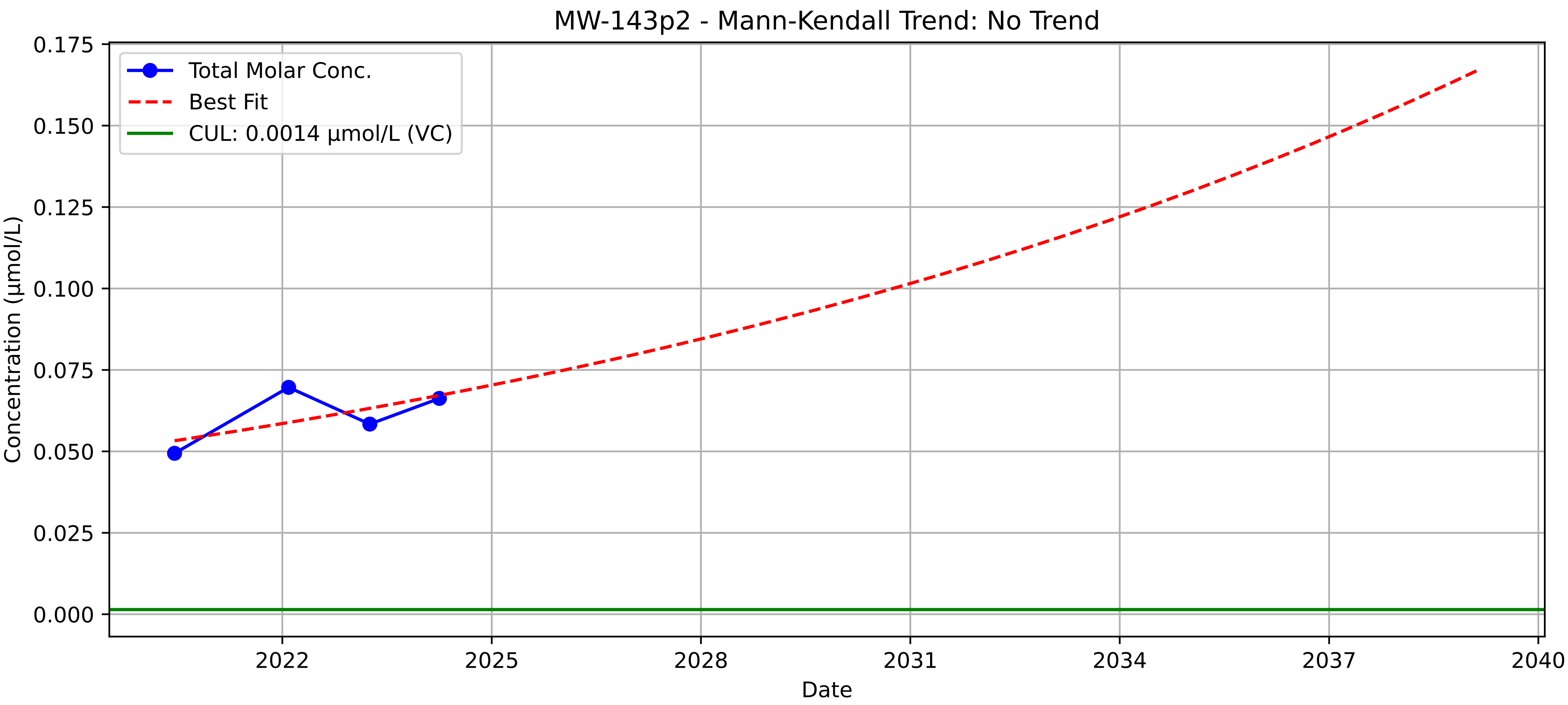
MW-136p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date



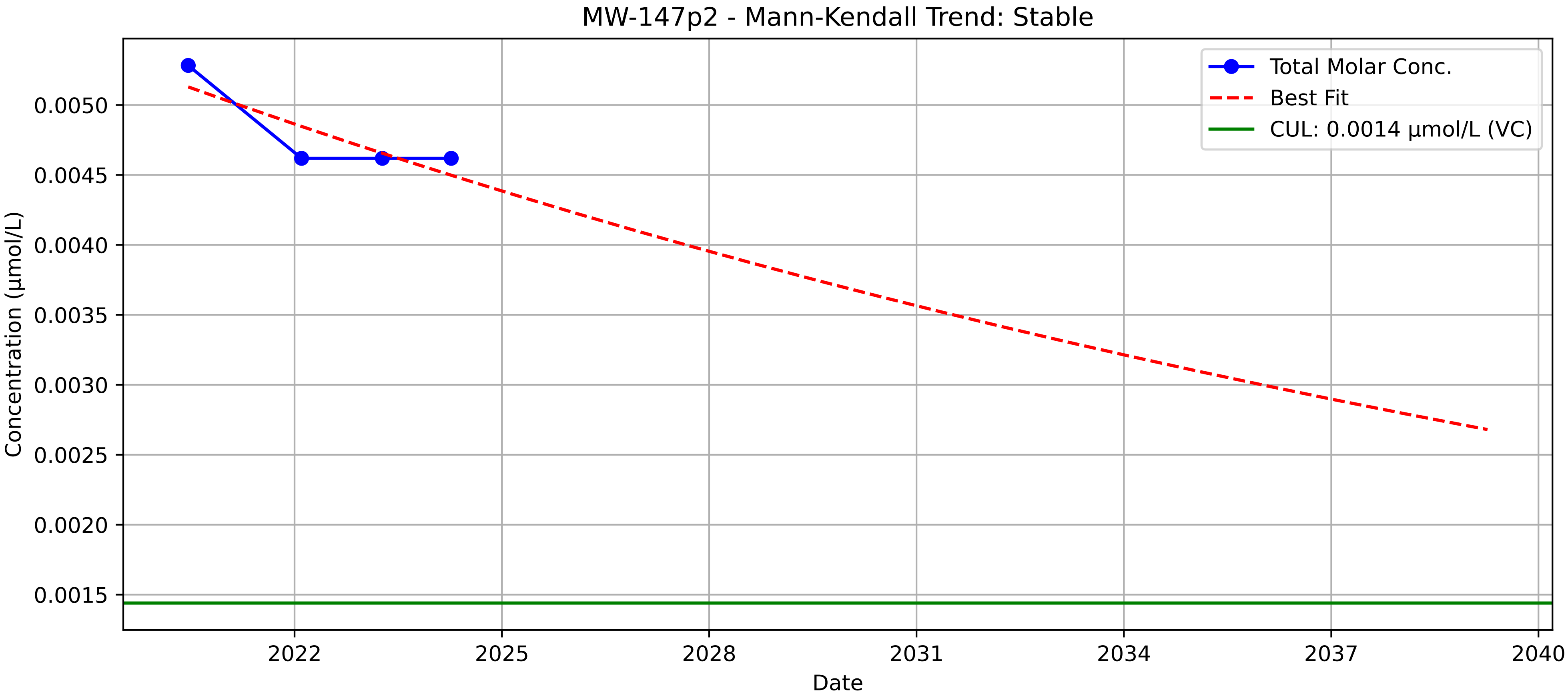
MW-138p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
1
2
3
4
2022
2025
2028
2031
2034
2037
2040
Date



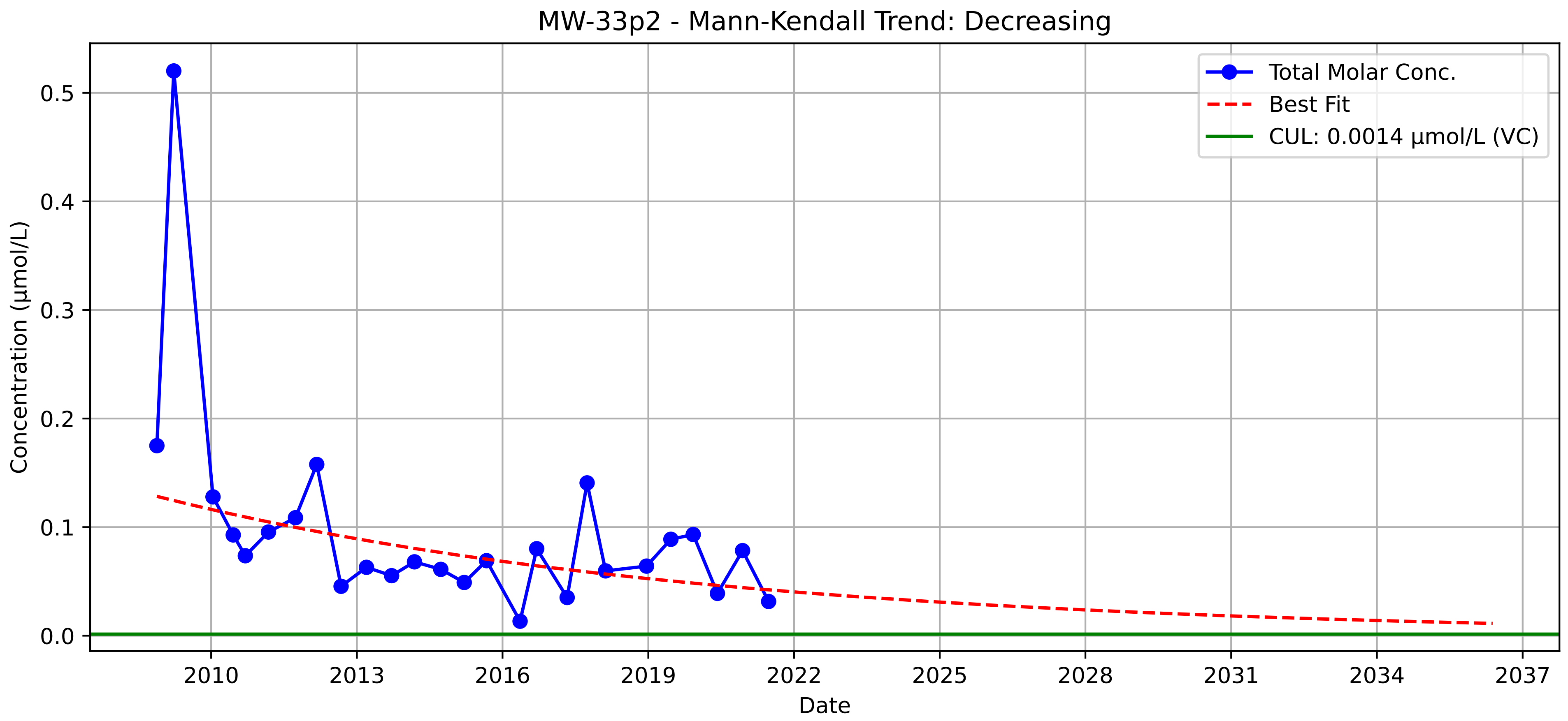
MW-141p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date



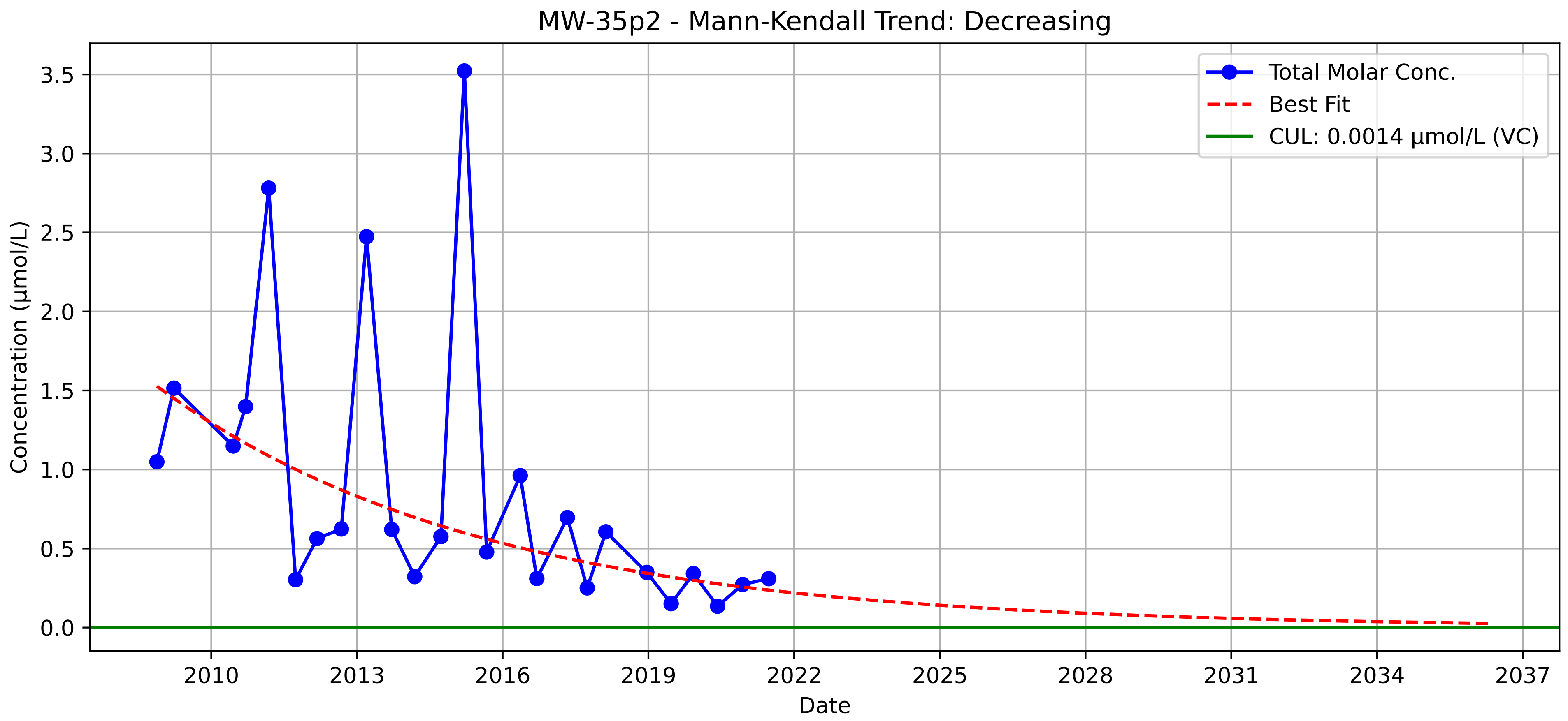
MW-143p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
2022
2025
2028
2031
2034
2037
2040
Date



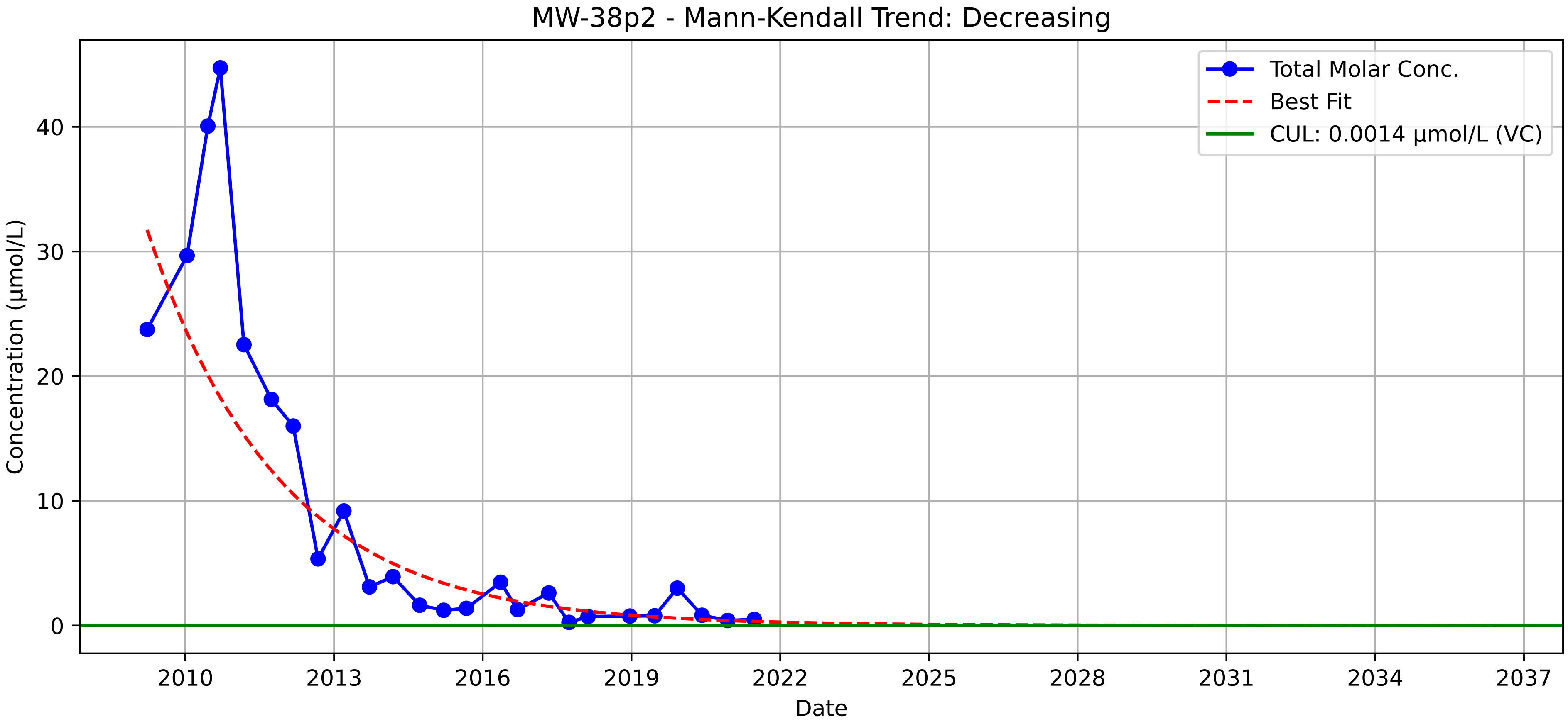
MW-147p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2022
2025
2028
2031
2034
2037
2040
Date



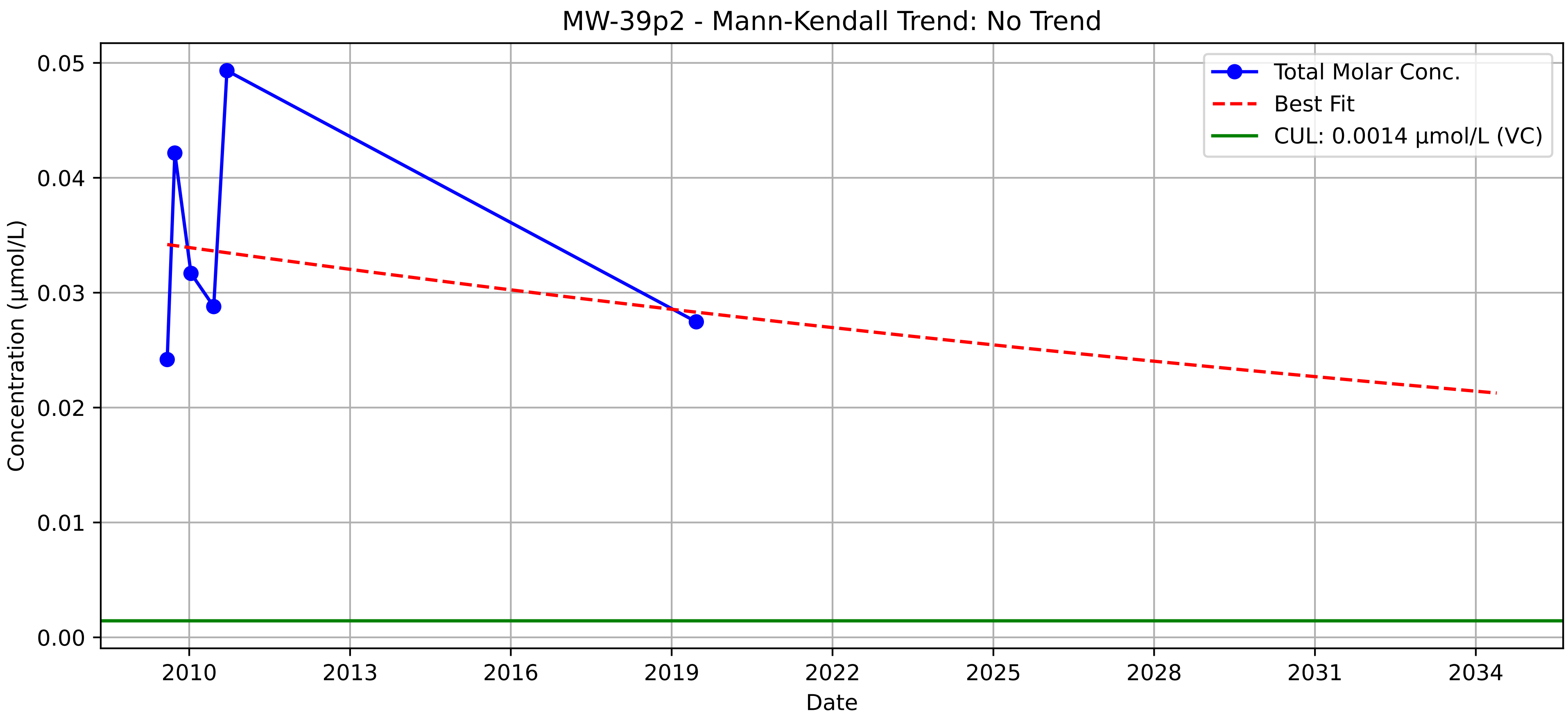
MW-33p2 - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.1
0.2
0.3
0.4
0.5
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
Date



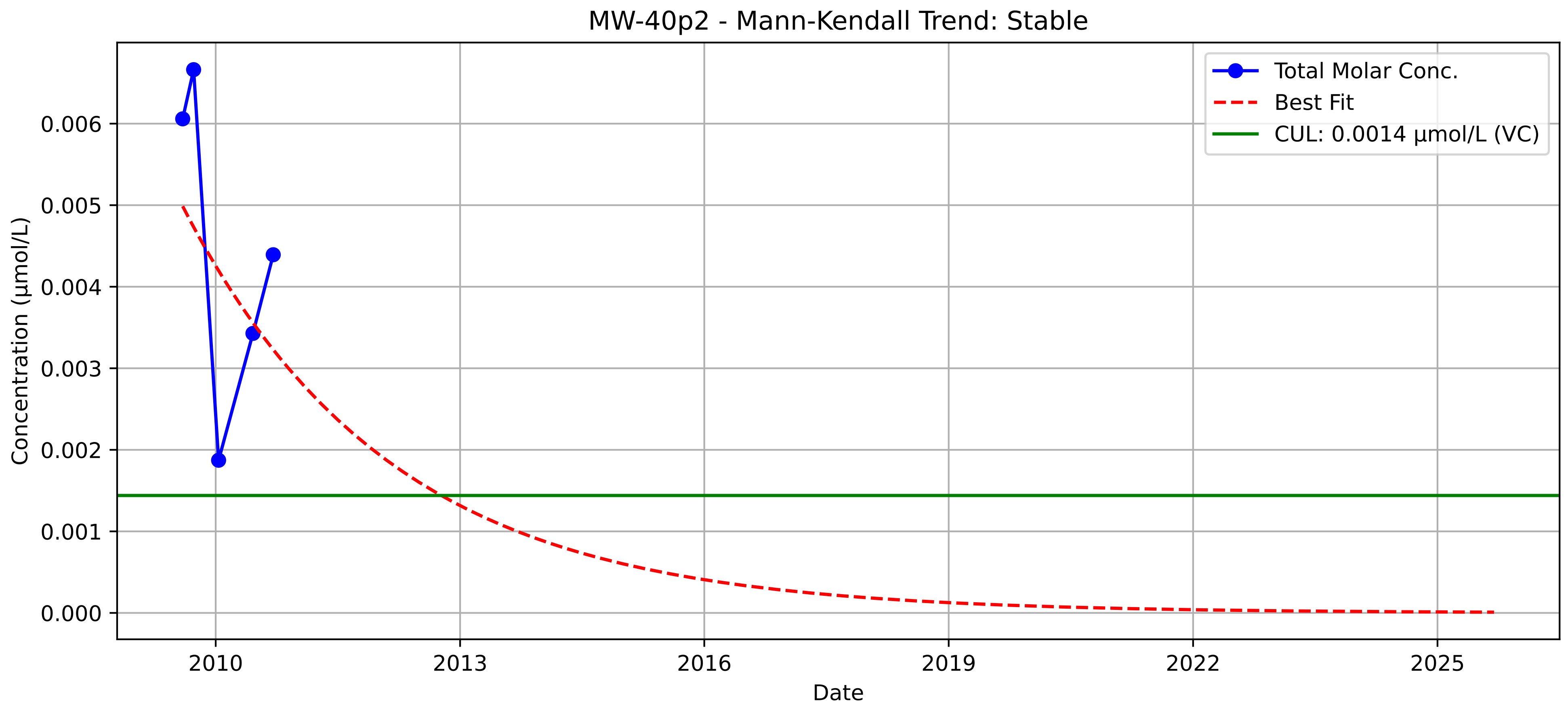
MW-35p2 - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
Date
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037



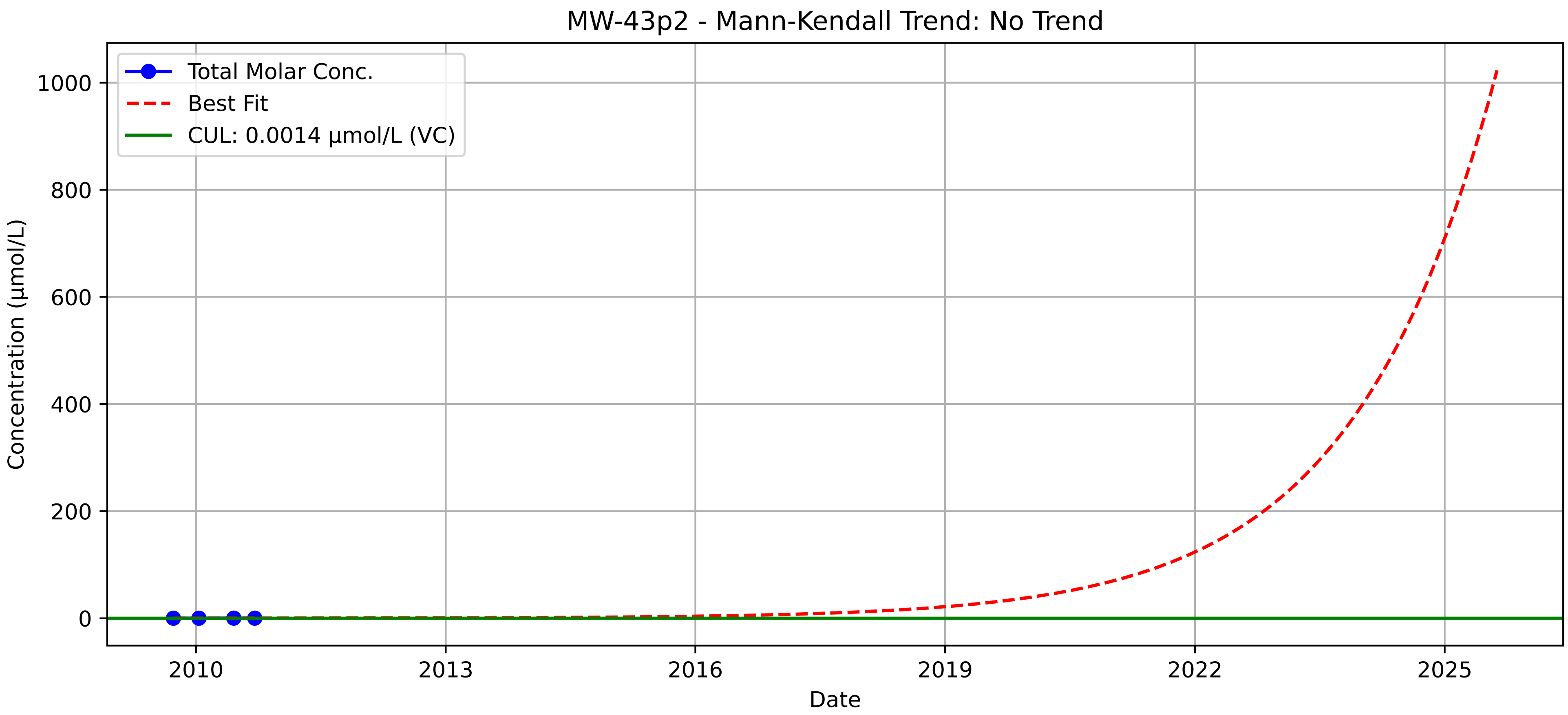
MW-38p2 - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
10
20
30
40
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
Date



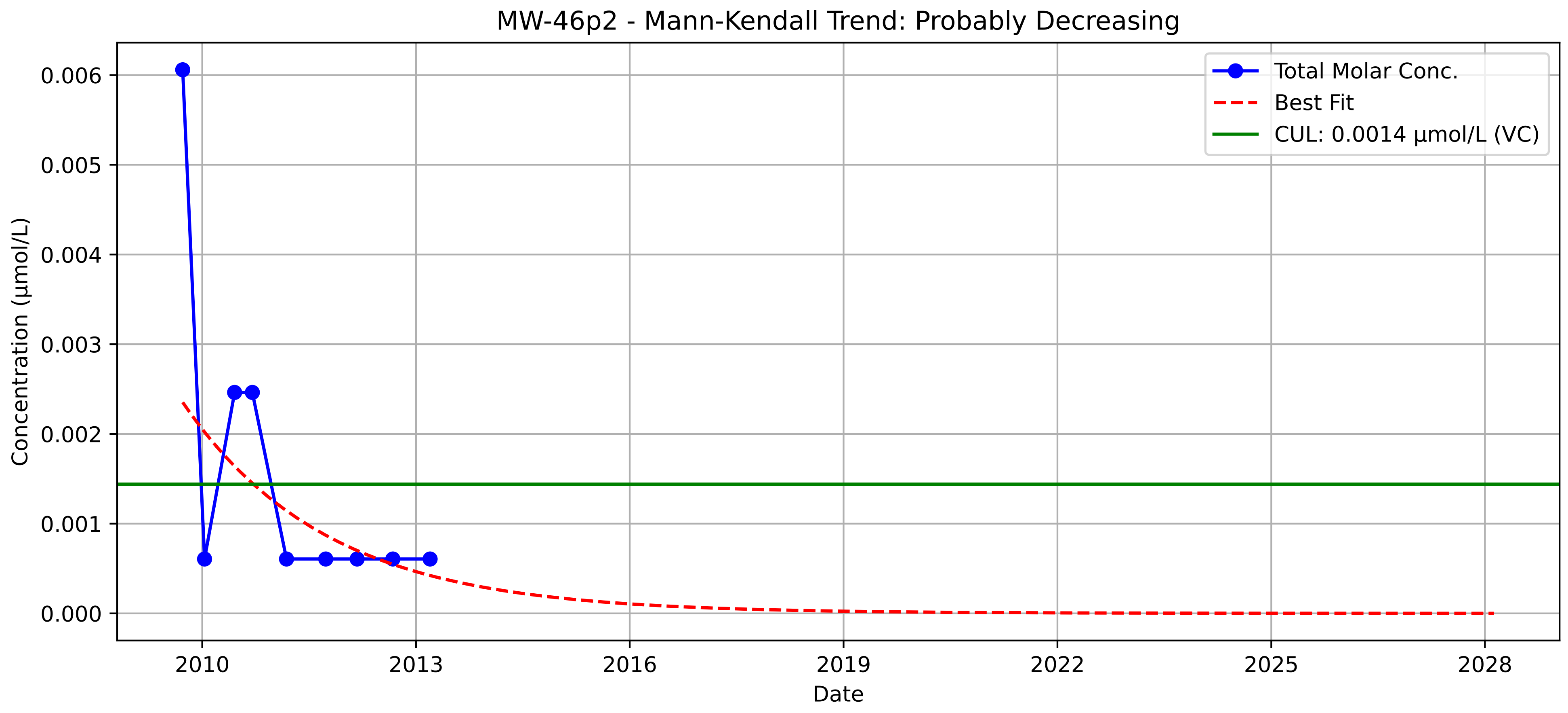
MW-39p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.05
0.04
0.03
0.02
0.01
0.00
2010
2013
2016
2019
2022
2025
2028
2031
2034
Date



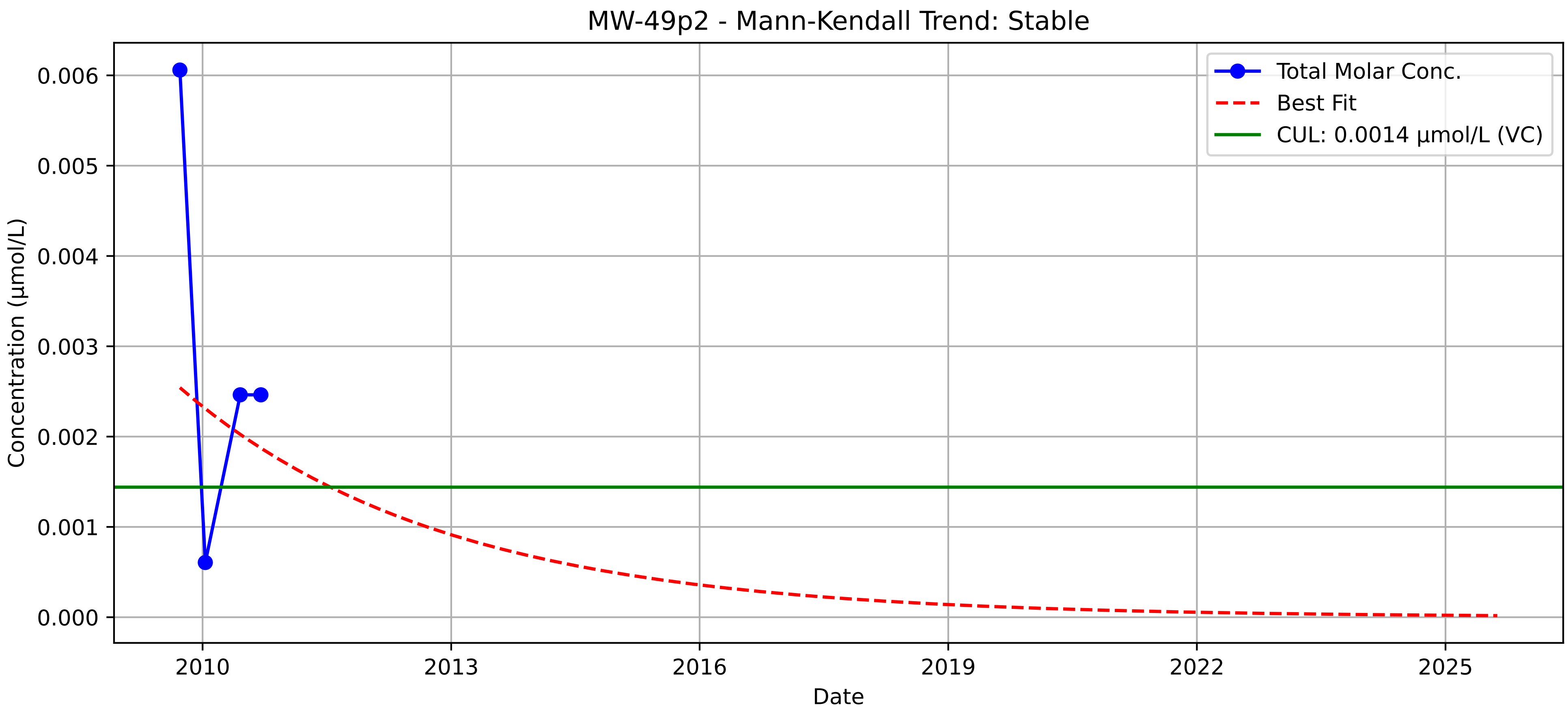
MW-40p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
2010
2013
2016
2019
2022
2025
Date



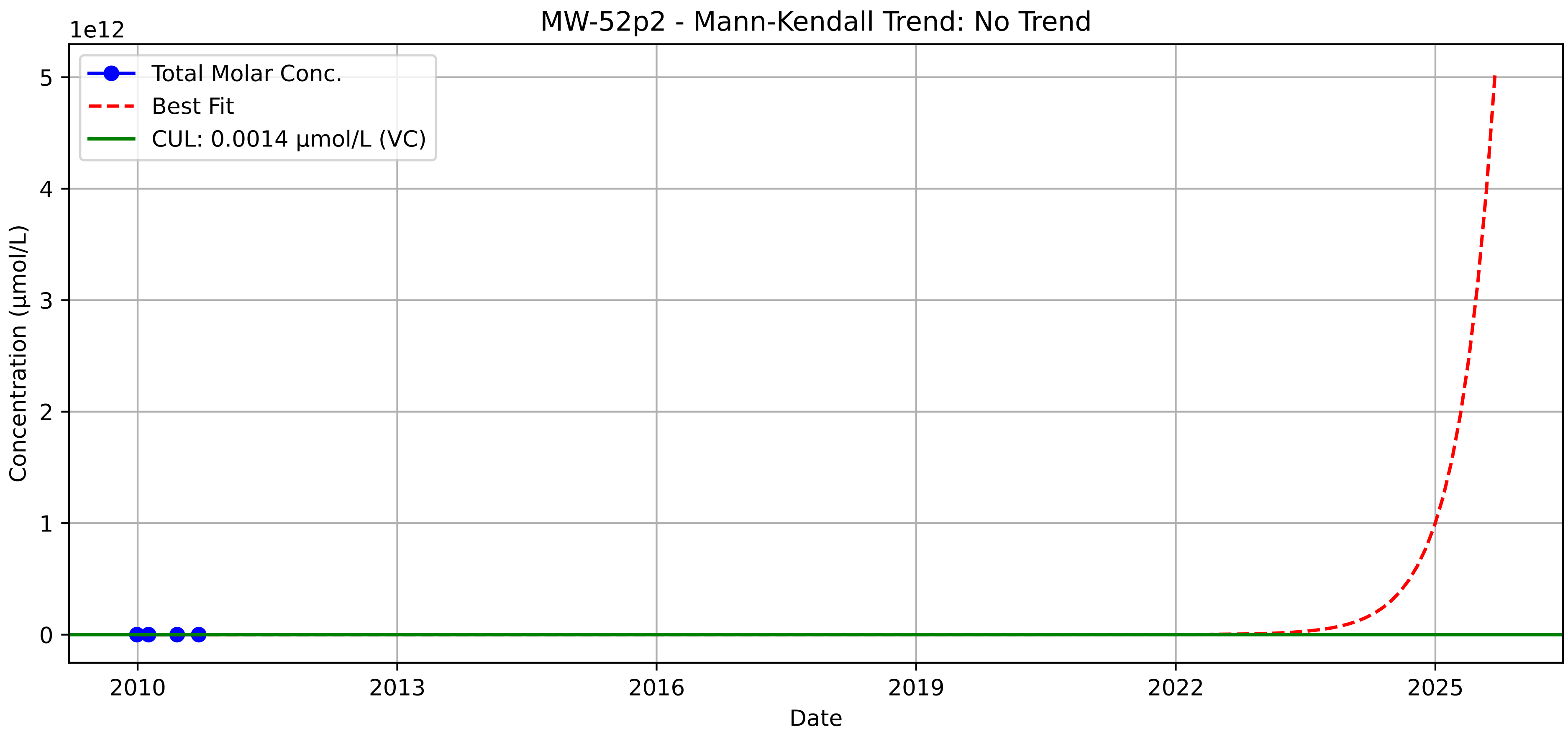
MW-43p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
1000
800
600
400
200
0
2010
2013
2016
2019
2022
2025
Date



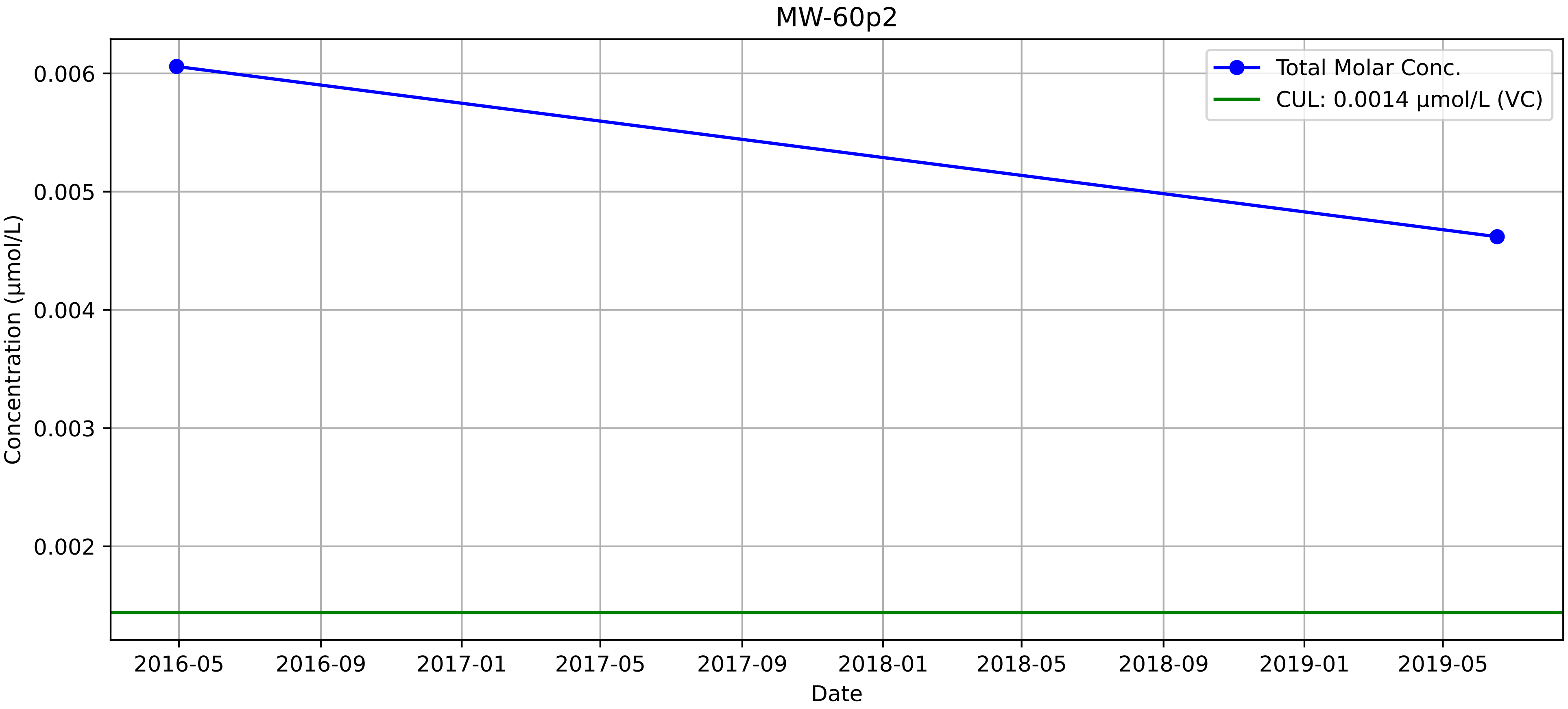
MW-46p2 - Mann-Kendall Trend: Probably Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
2010
2013
2016
2019
2022
2025
2028
Date



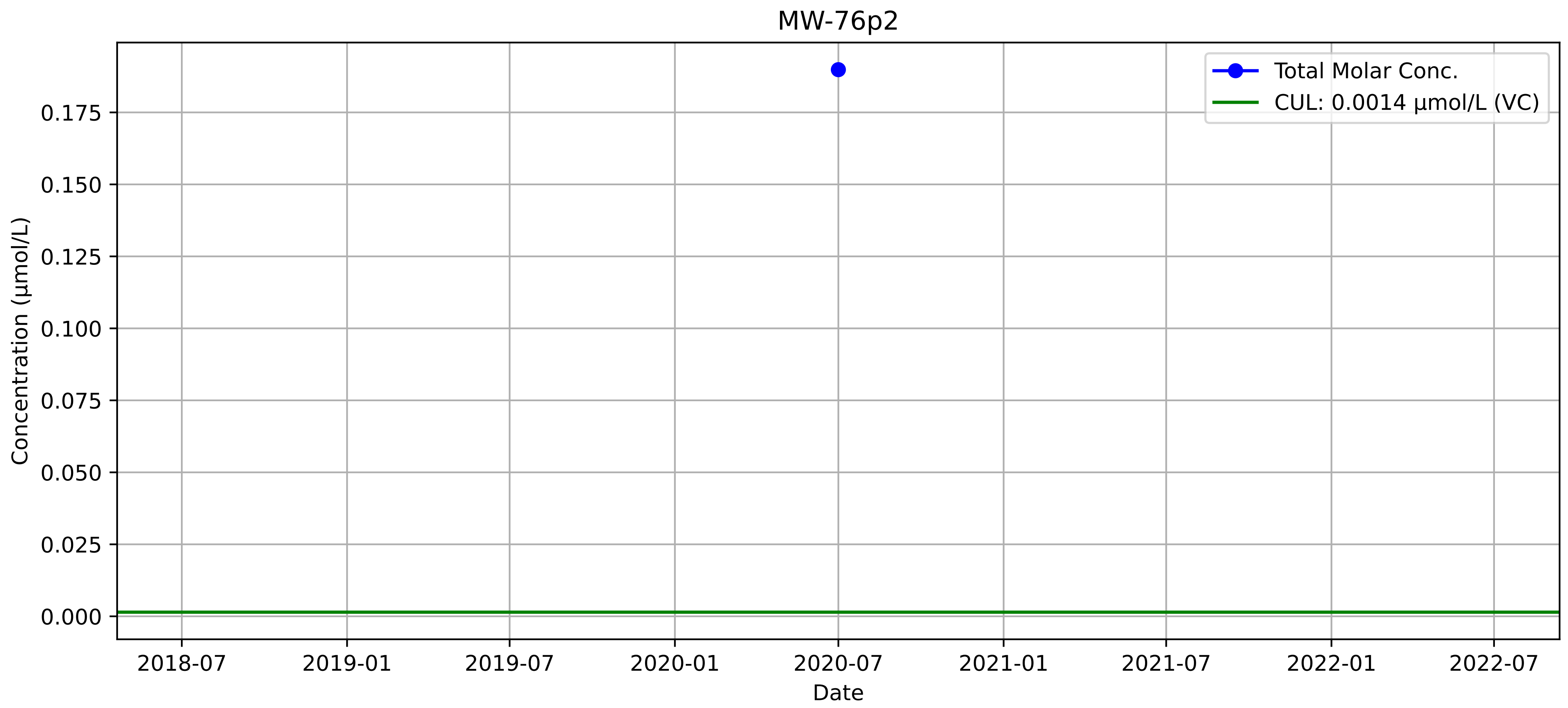
MW-49p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
2010
2013
2016
2019
2022
2025
Date

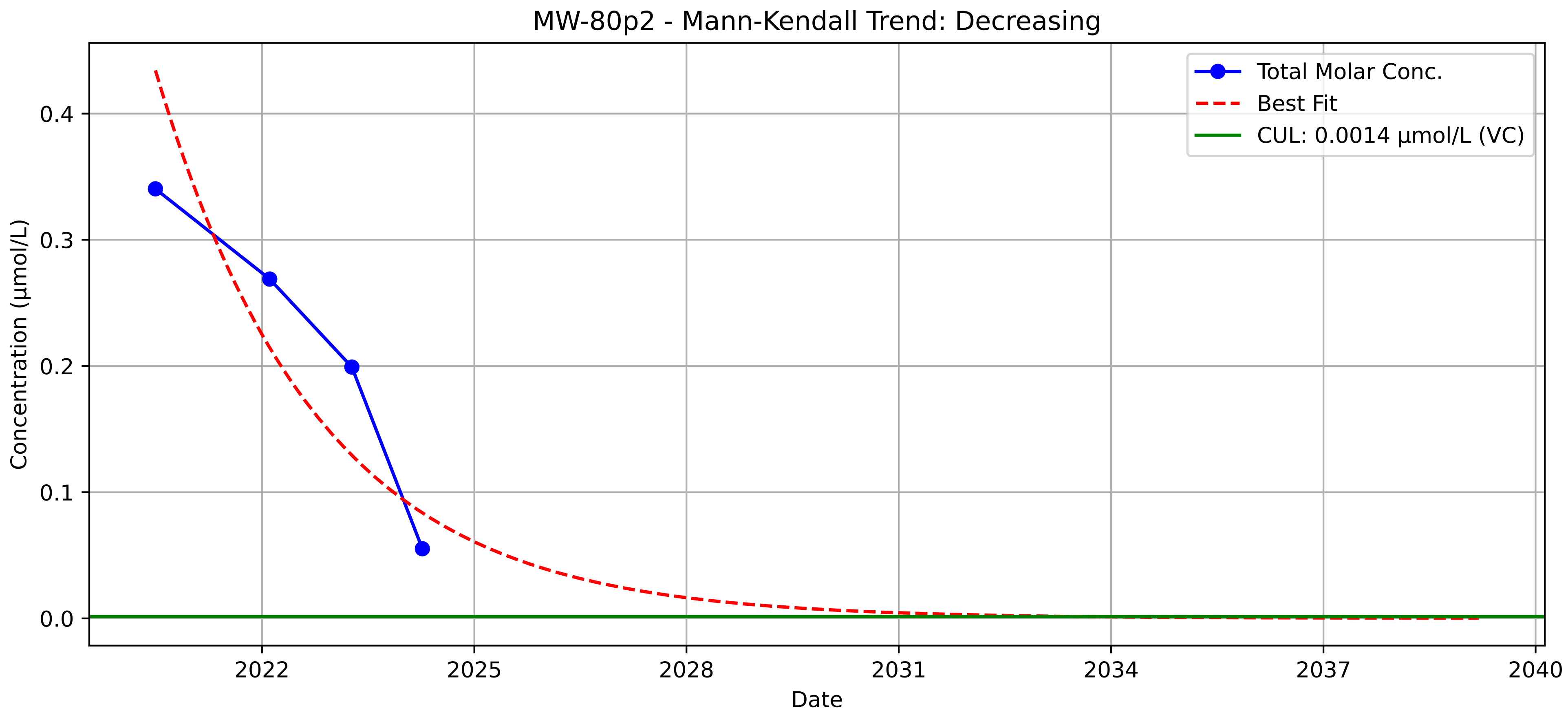


MW-52p2 - Mann-Kendall Trend: No Trend
1e12
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
1
2
3
4
5
2010
2013
2016
2019
2022
2025
Date

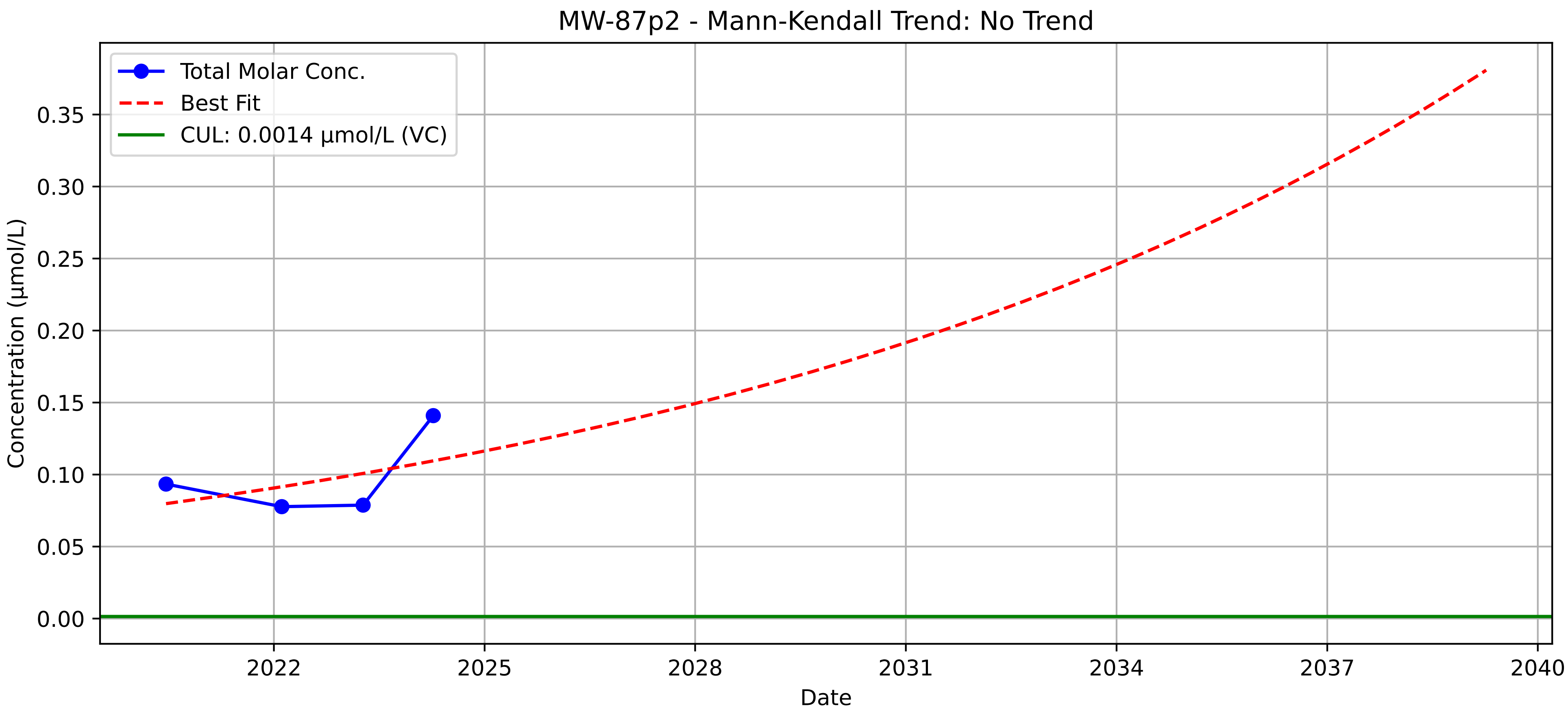


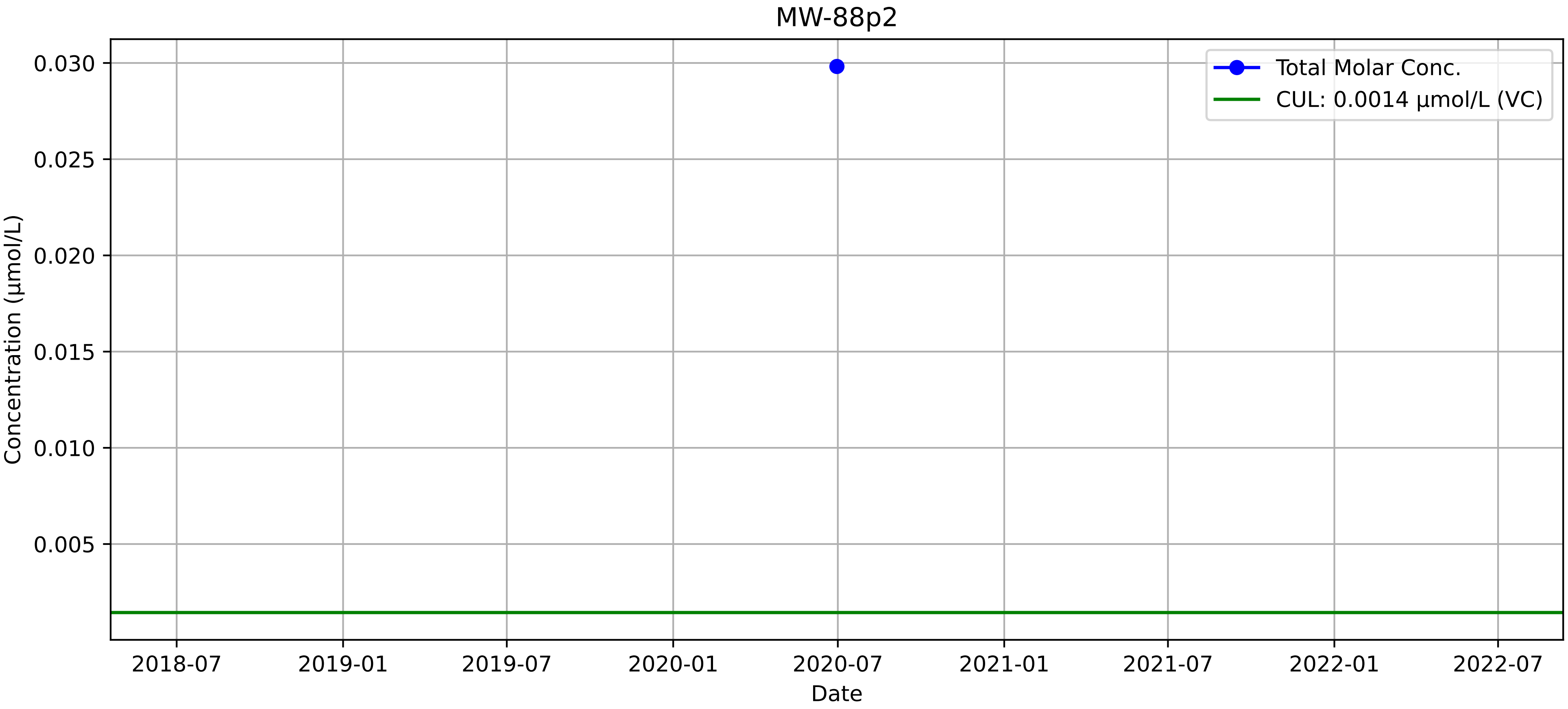
MW-60p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05
2018-09
2019-01
2019-05
Date

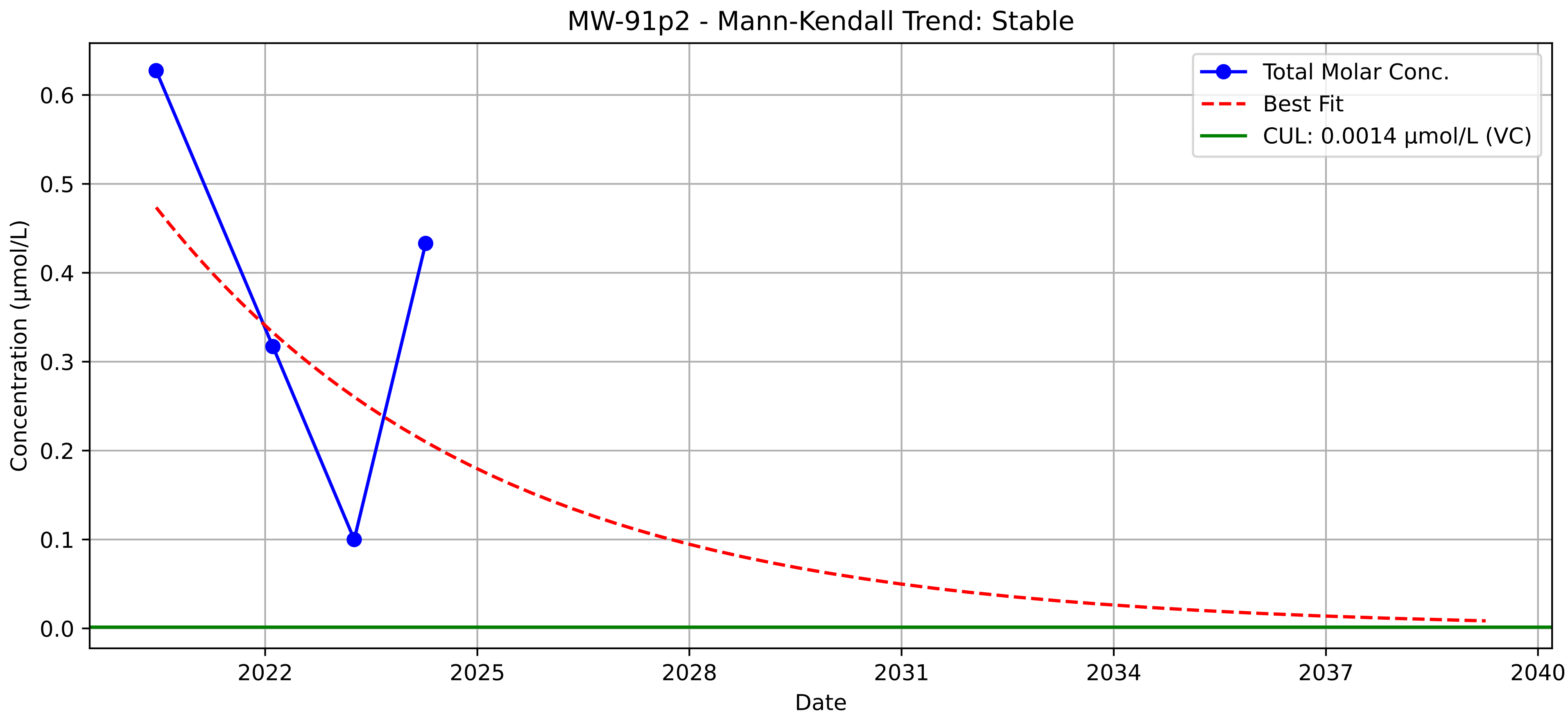

MW-76p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

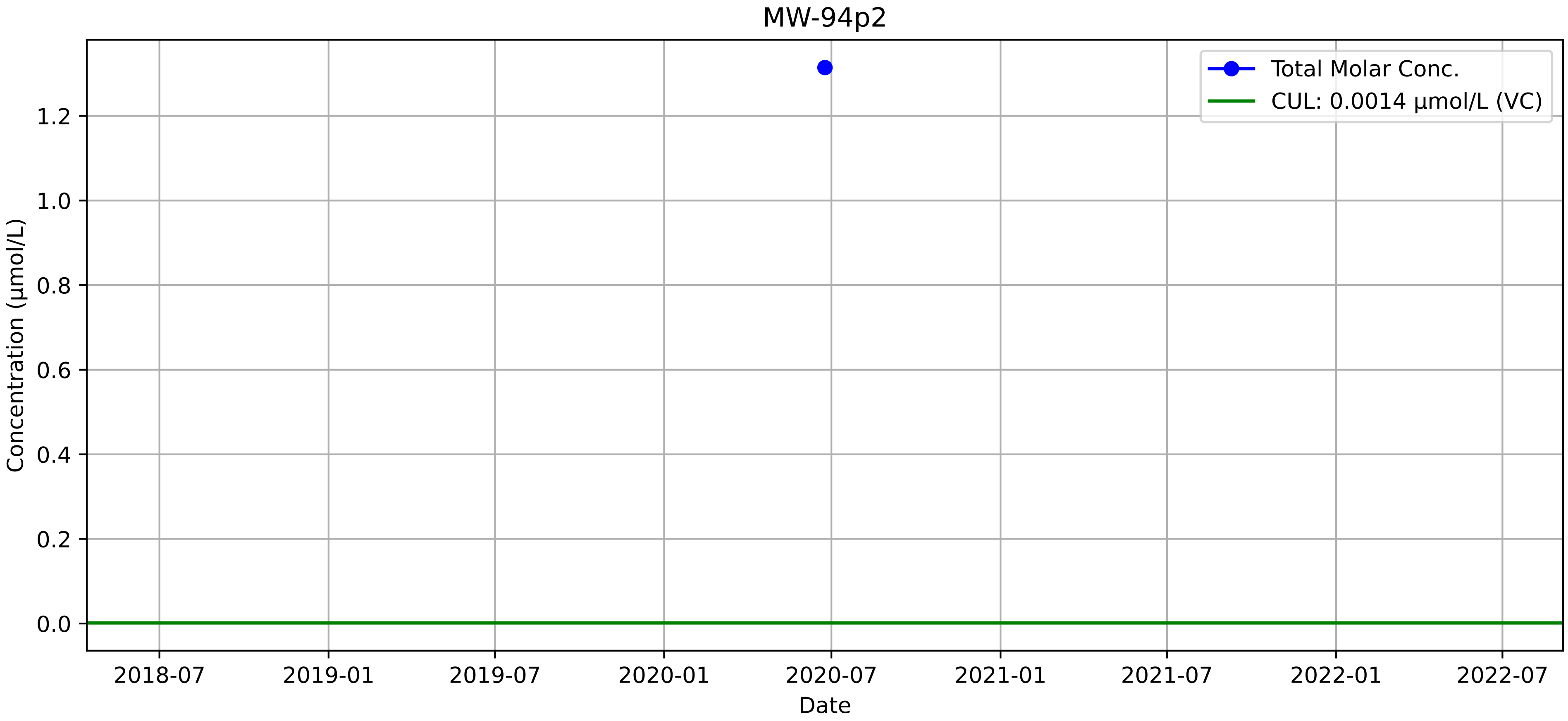


MW-80p2 - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.4
0.3
0.2
0.1
0.0
2022
2025
2028
2031
2034
2037
2040
Date

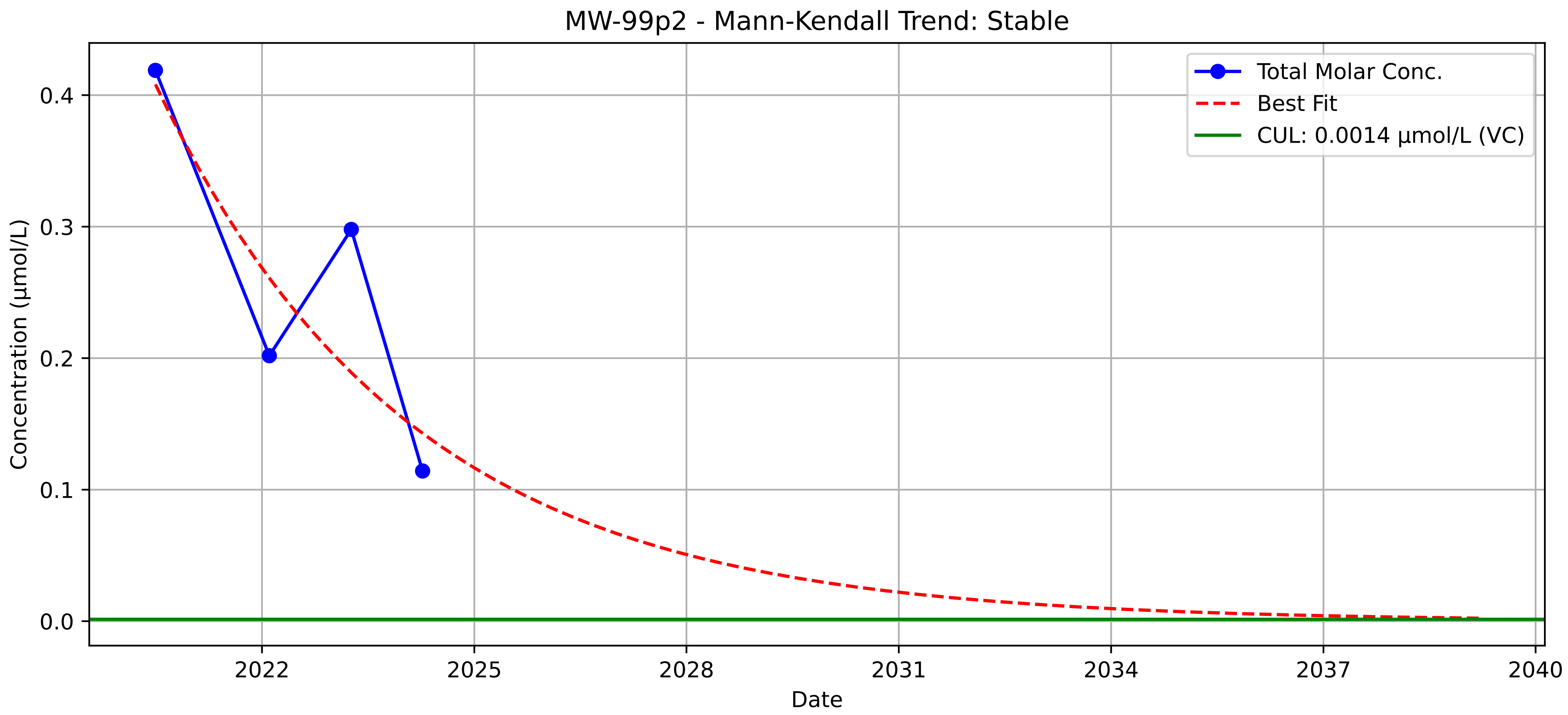

MW-87p2 - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2022
2025
2028
2031
2034
2037
2040
Date


MW-88p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.030
0.025
0.020
0.015
0.010
0.005
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

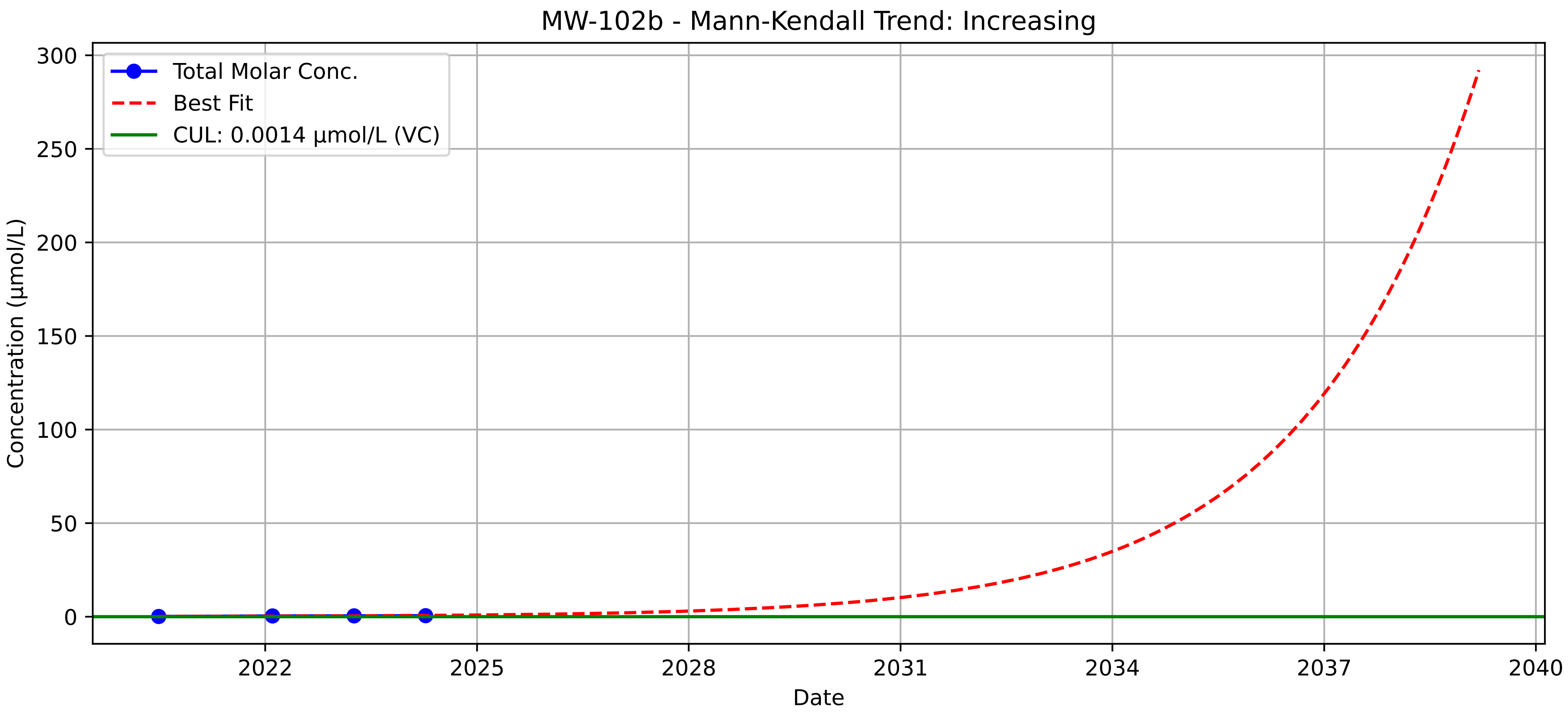

MW-91p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
2022
2025
2028
2031
2034
2037
2040
Date



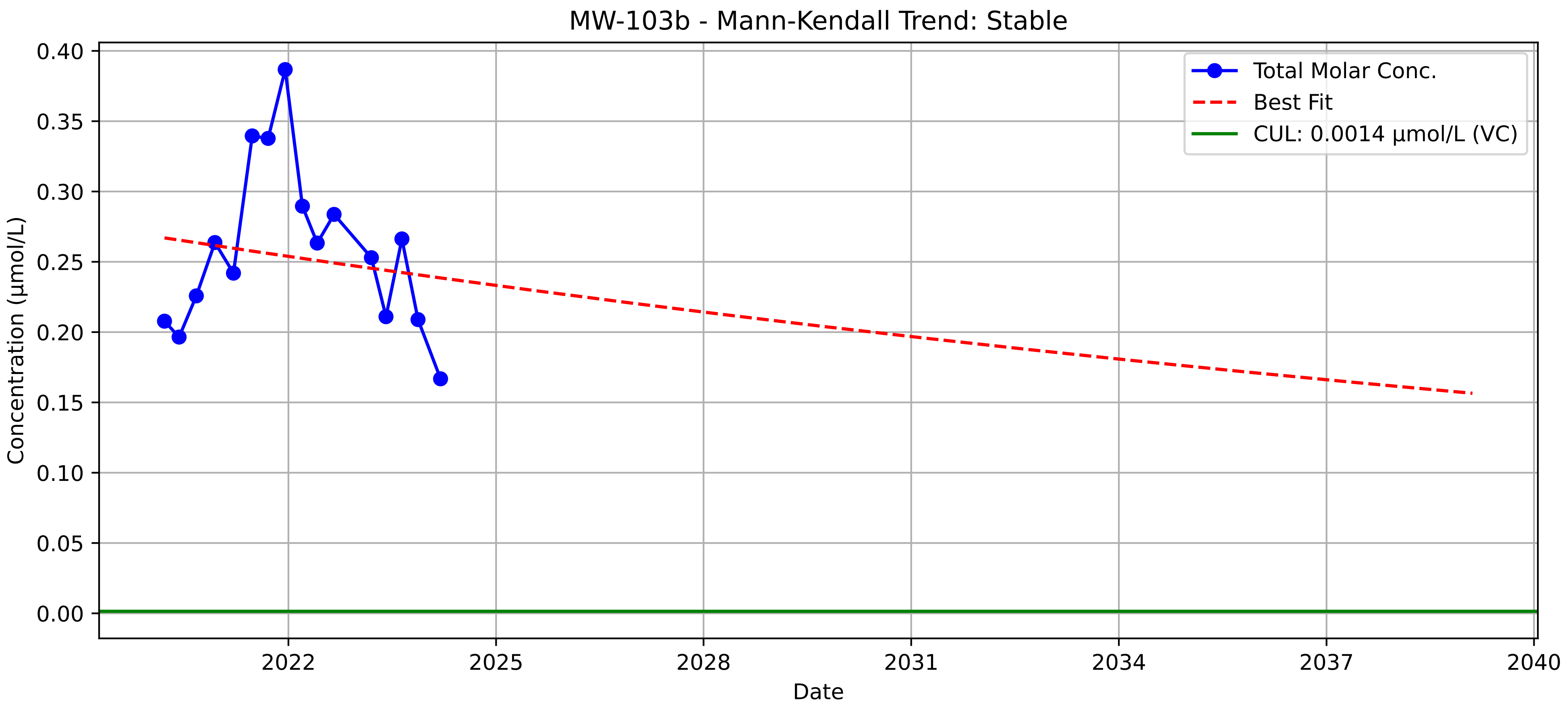
MW-94p2
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date


MW-99p2 - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.4
0.3
0.2
0.1
0.0
2022
2025
2028
2031
2034
2037
2040
Date

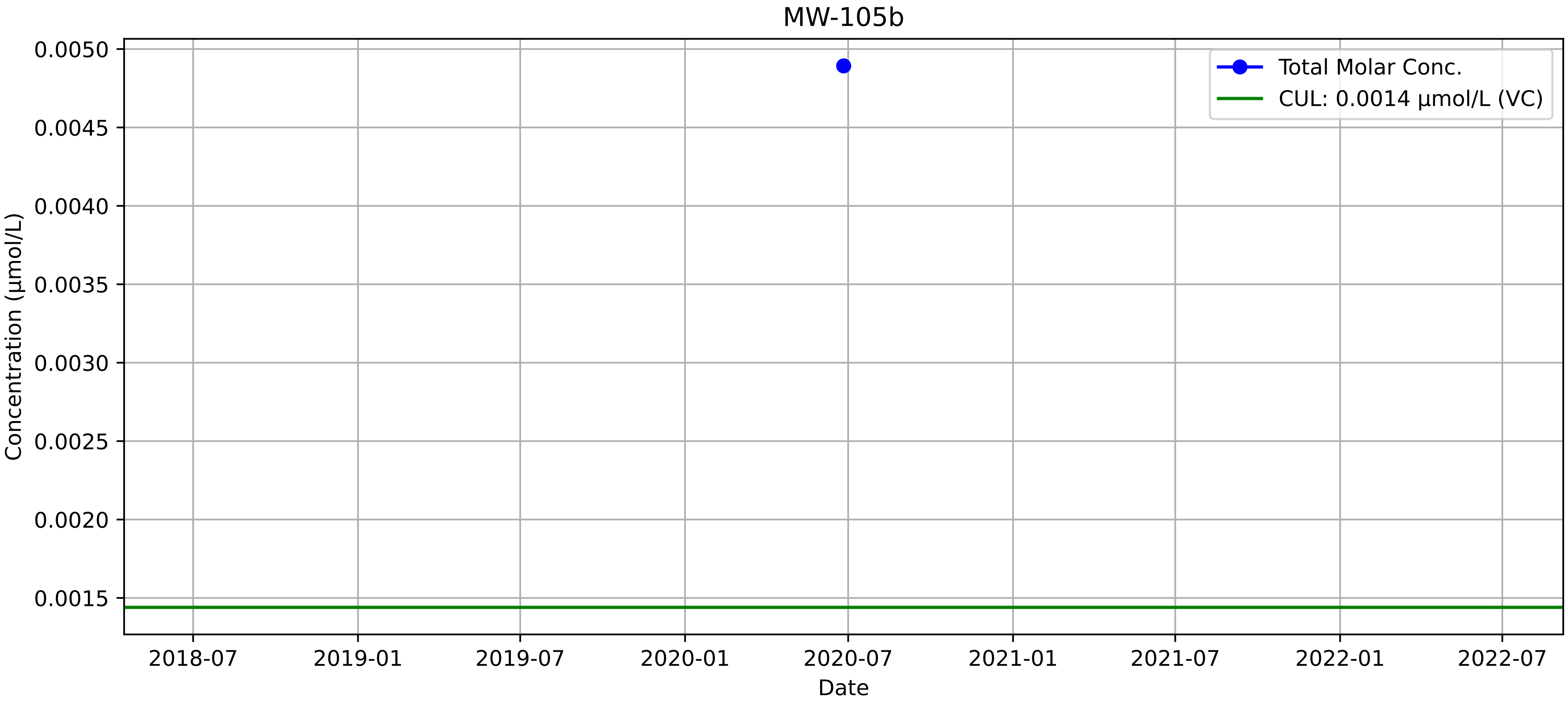
A3. Total molar concentration time series plots of chlorinated ethenes for Roza Aquifer wells



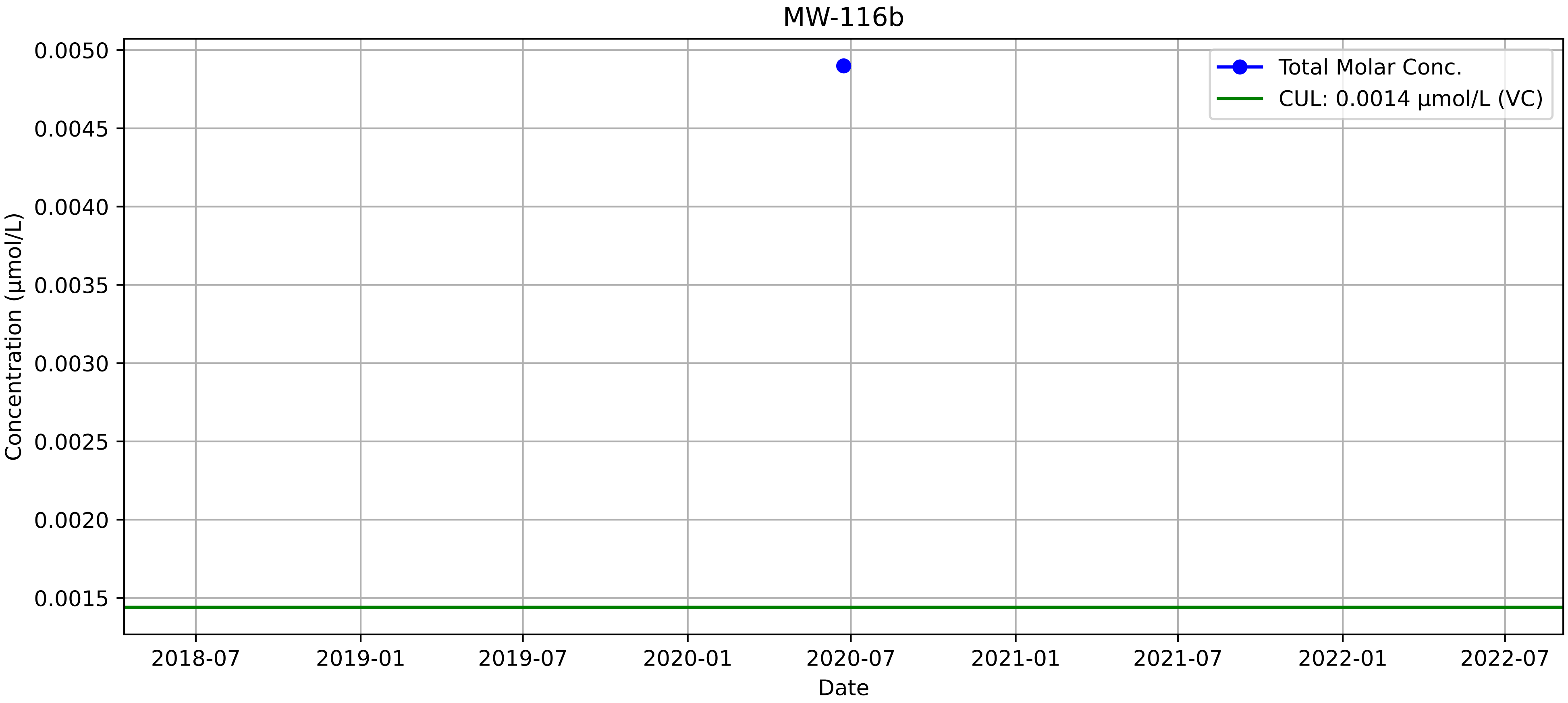
MW-102b - Mann-Kendall Trend: Increasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
300
250
200
150
100
50
0
2022
2025
2028
2031
2034
2037
2040
Date



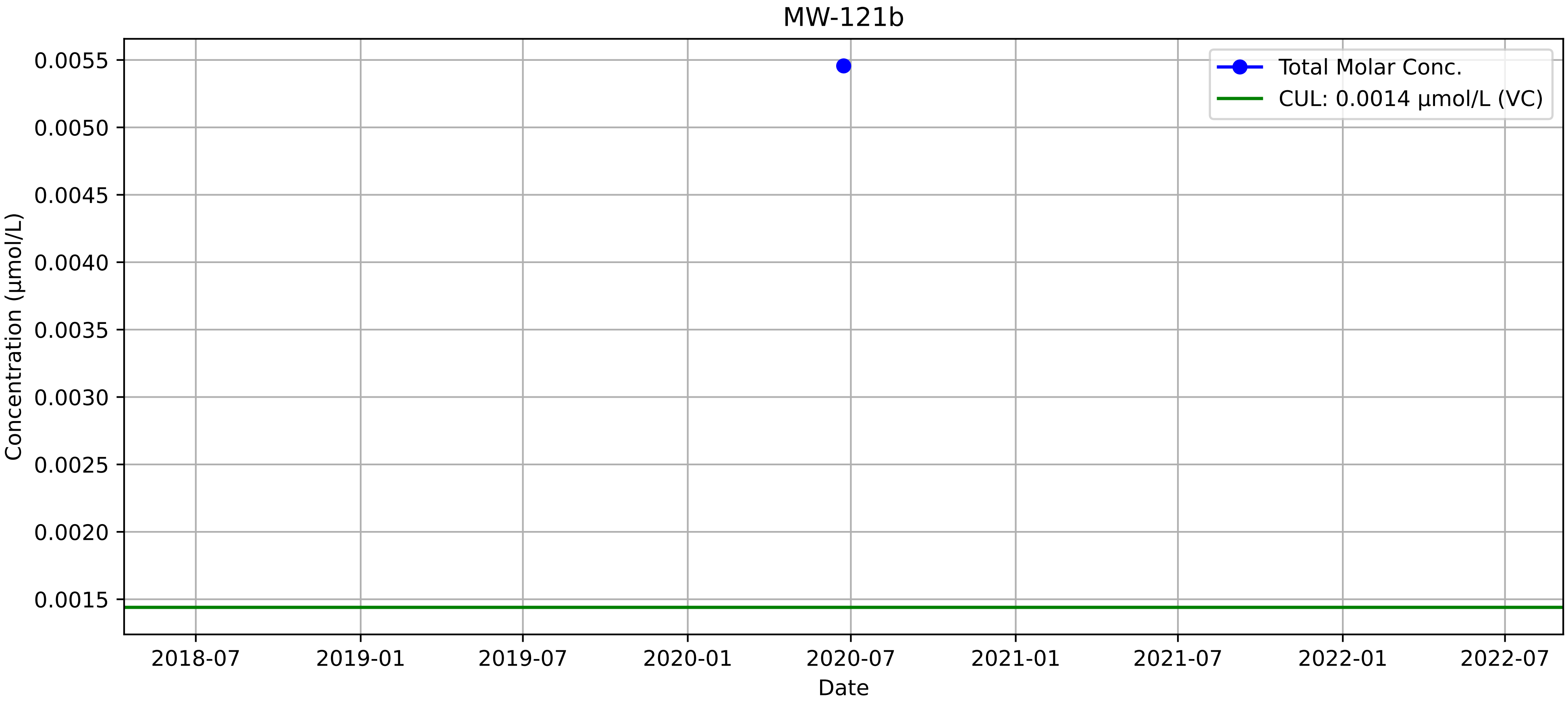
MW-103b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2022
2025
2028
2031
2034
2037
2040
Date

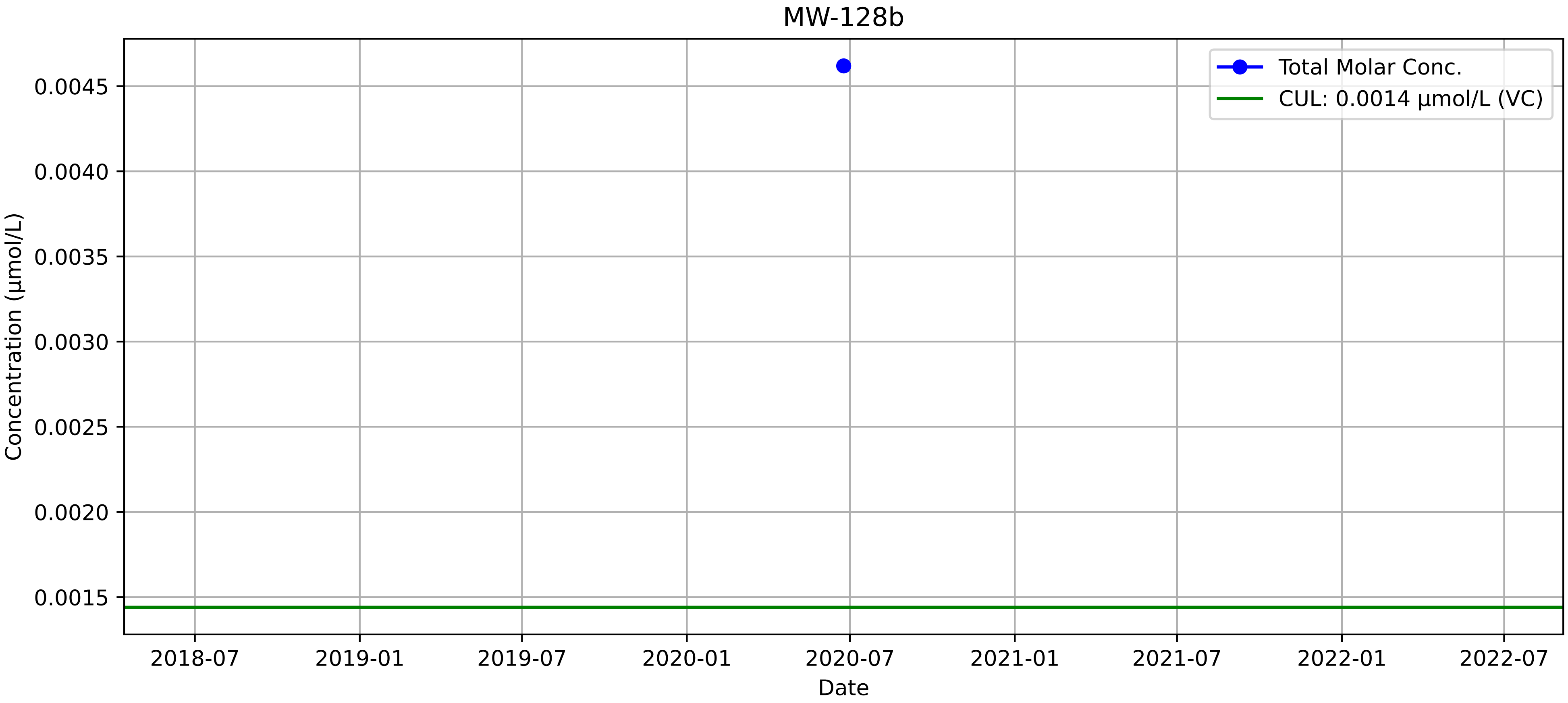


MW-105b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

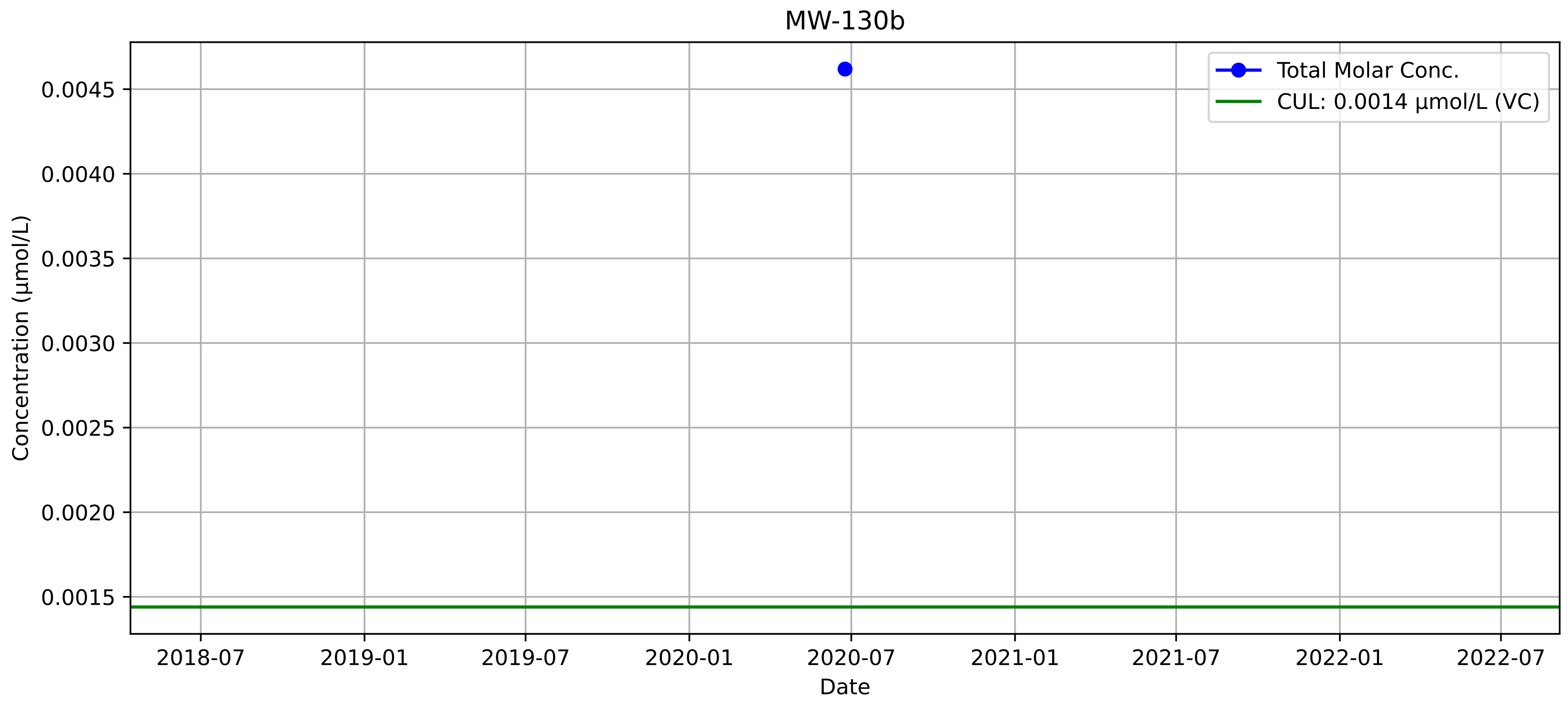


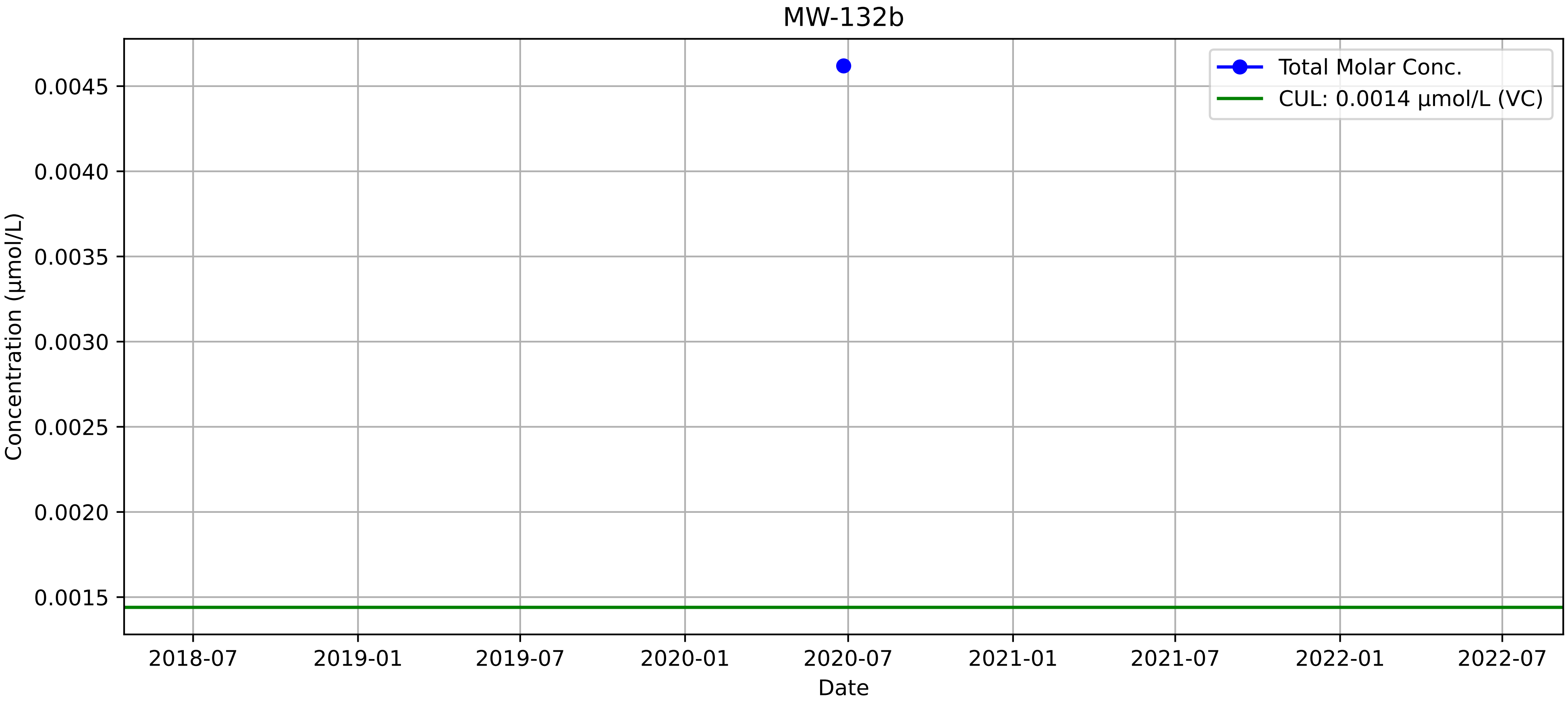
MW-116b
Concentration (µmol/L)
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
Date
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)

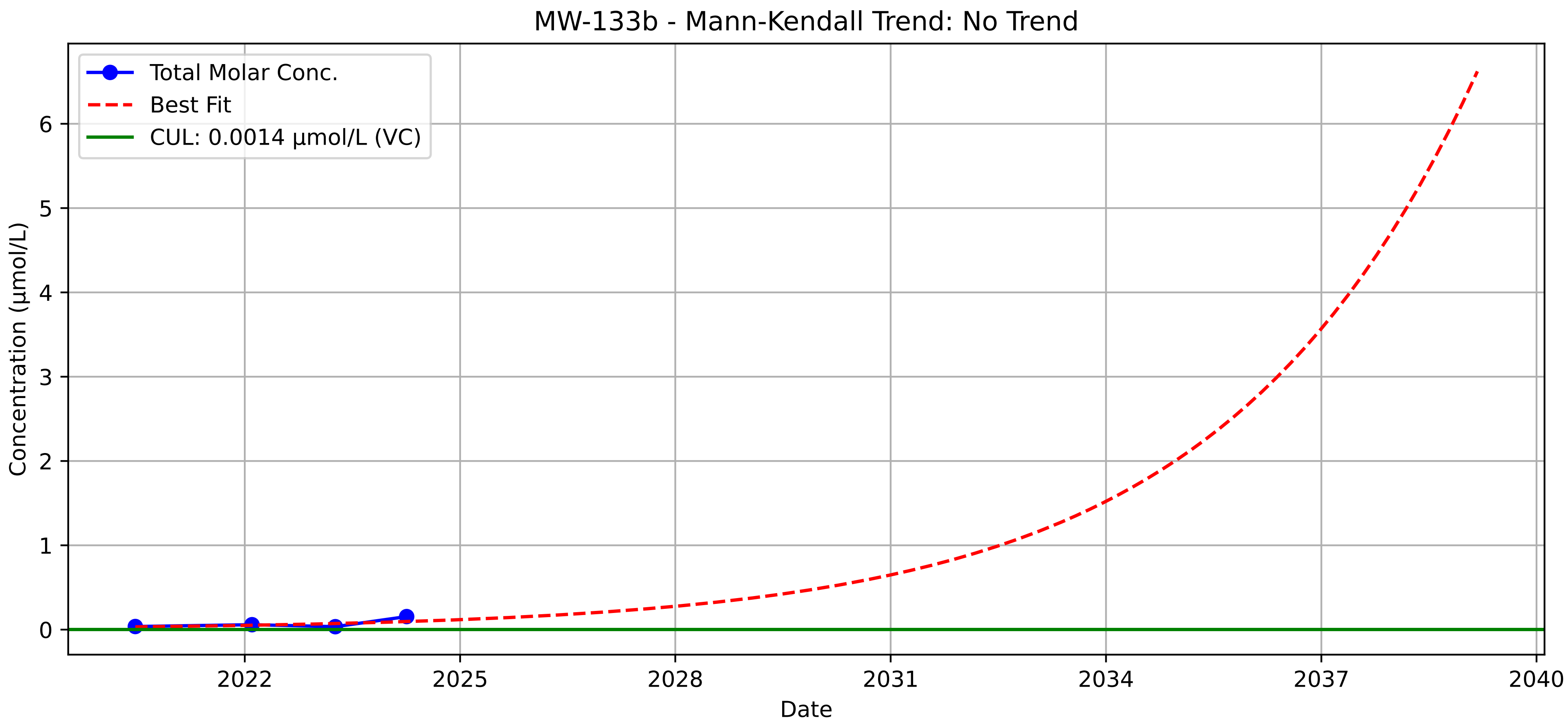

MW-121b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date



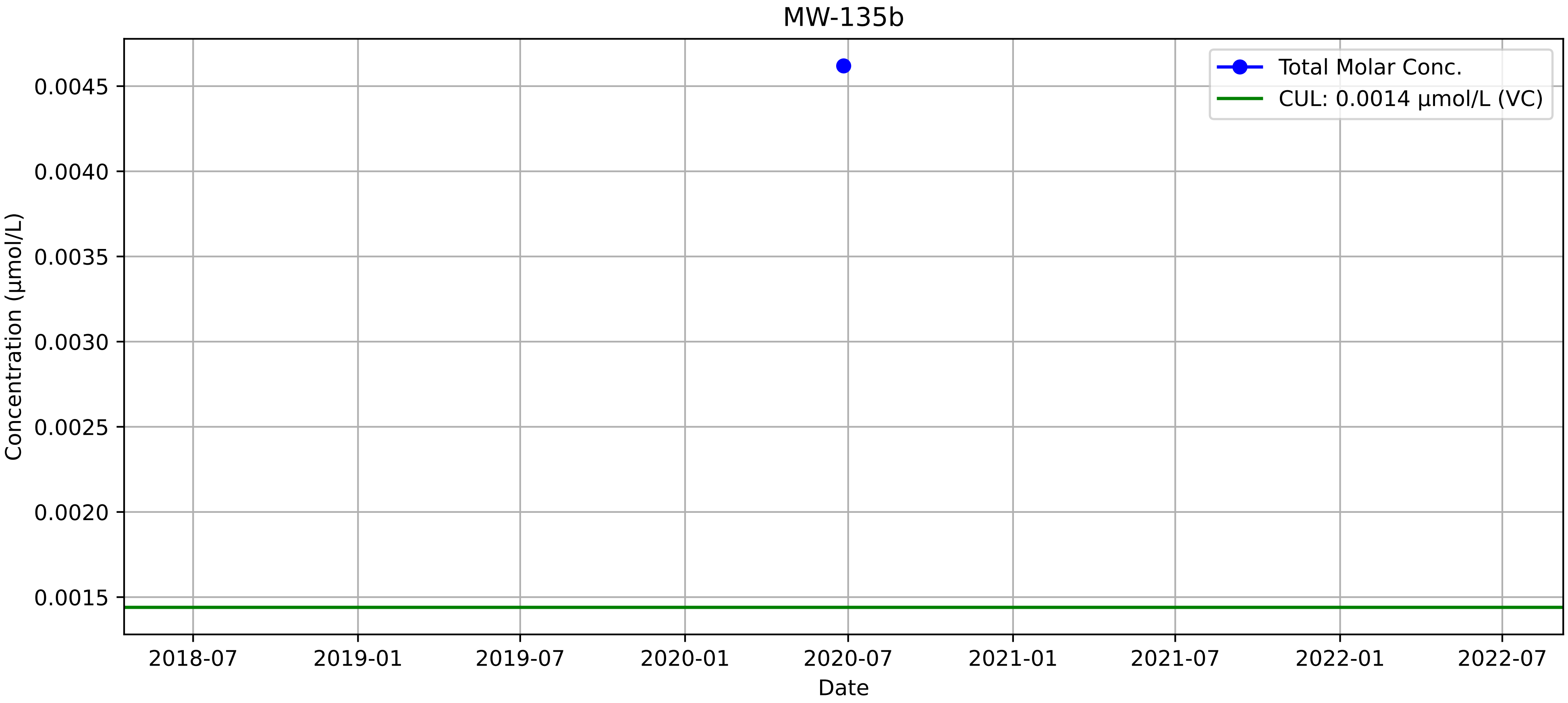
MW-128b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
Concentration (µmol/L)
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date


MW-130b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

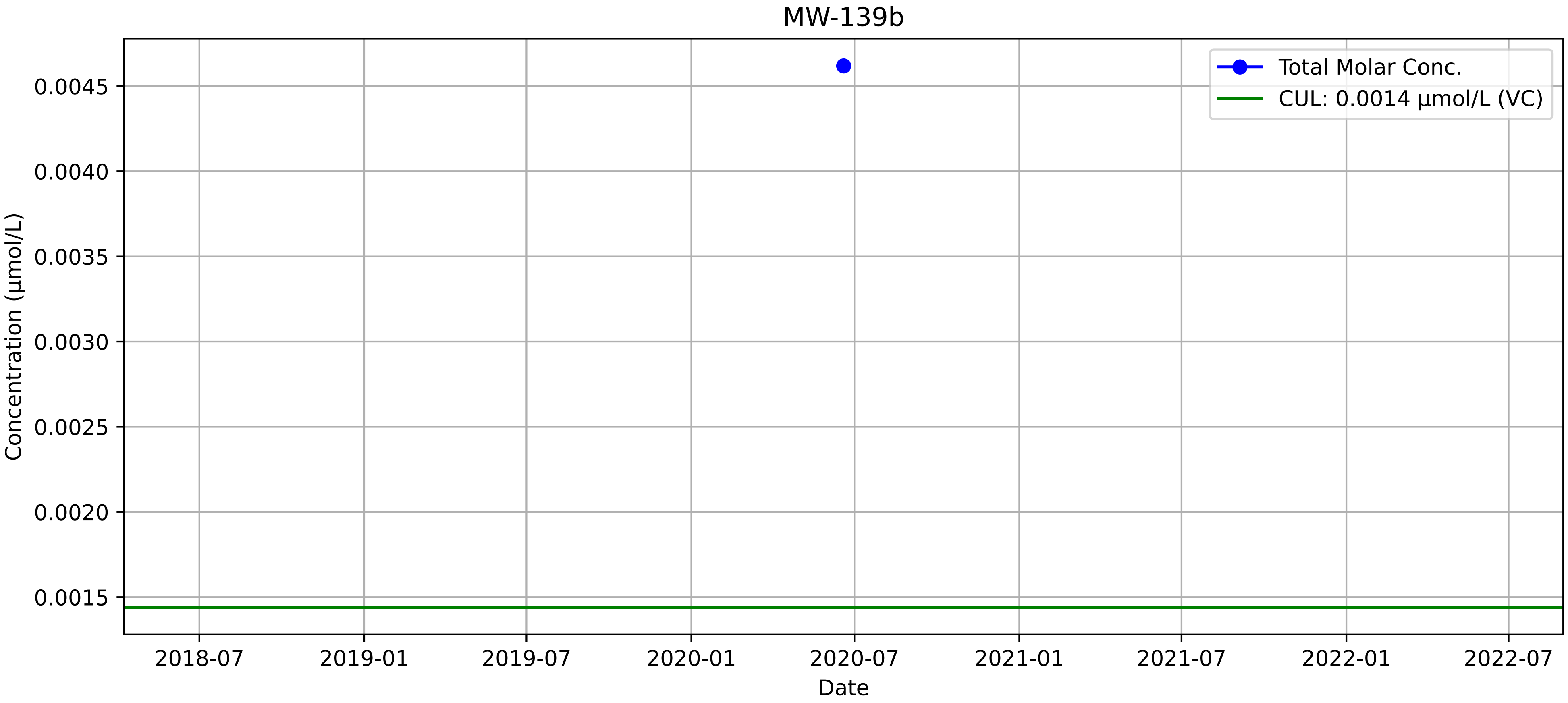

MW-132b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

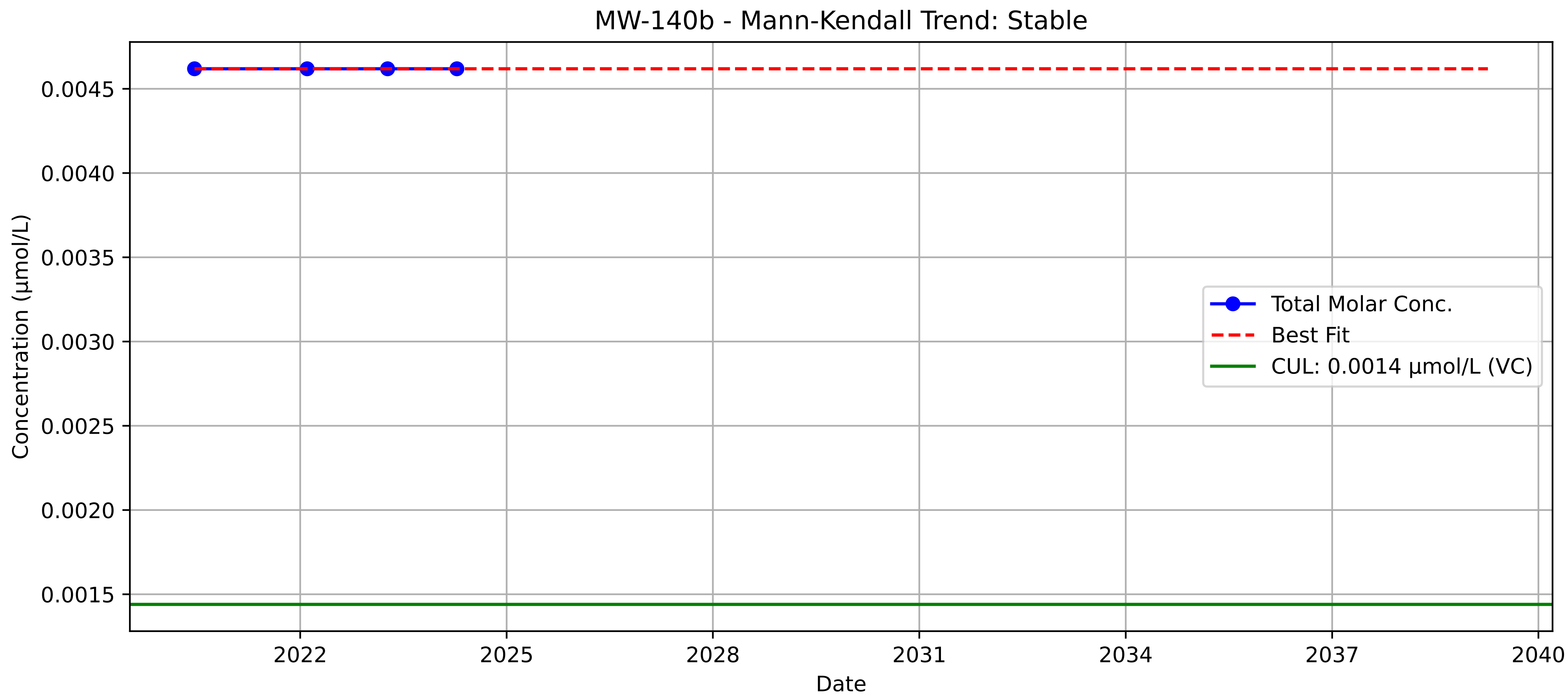


MW-133b - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
1
2
3
4
5
6
2022
2025
2028
2031
2034
2037
2040
Date

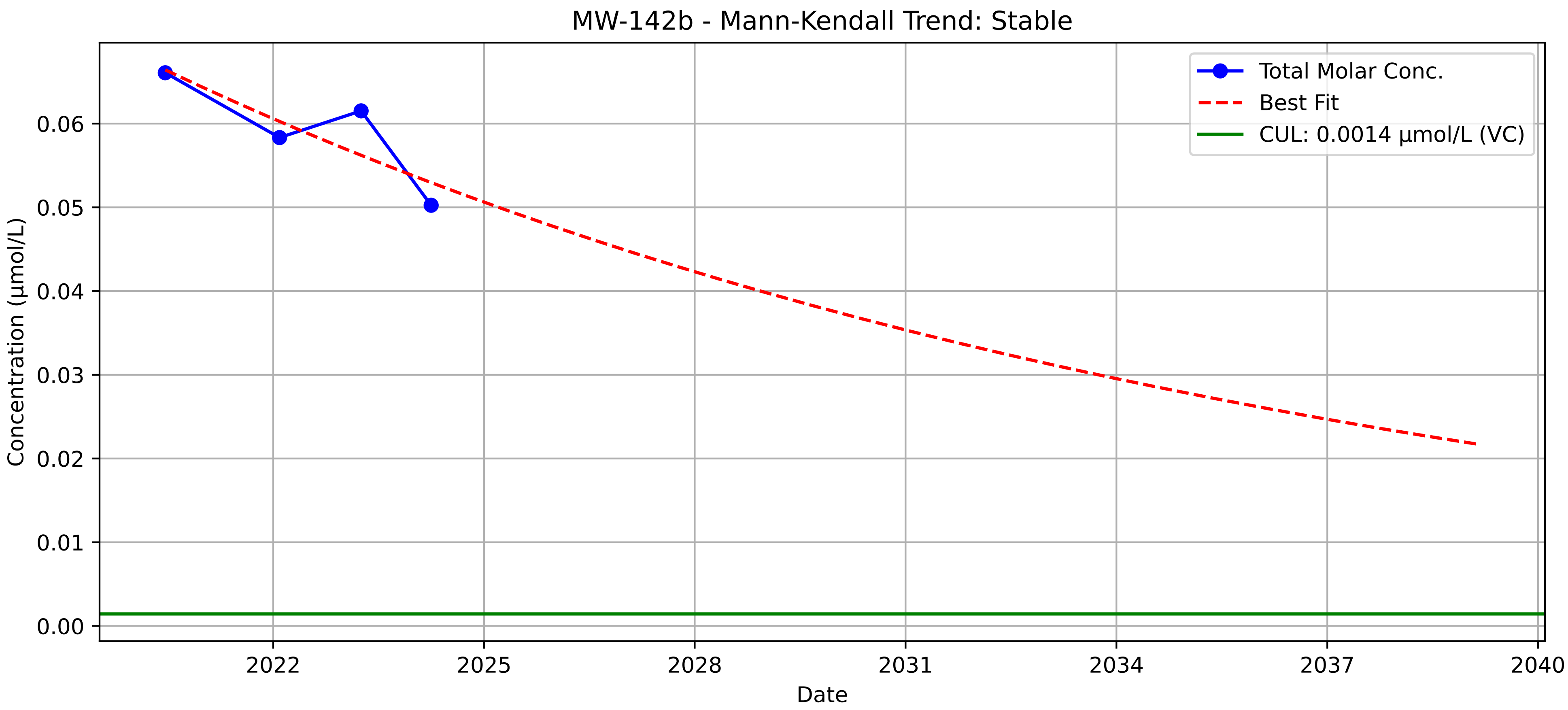


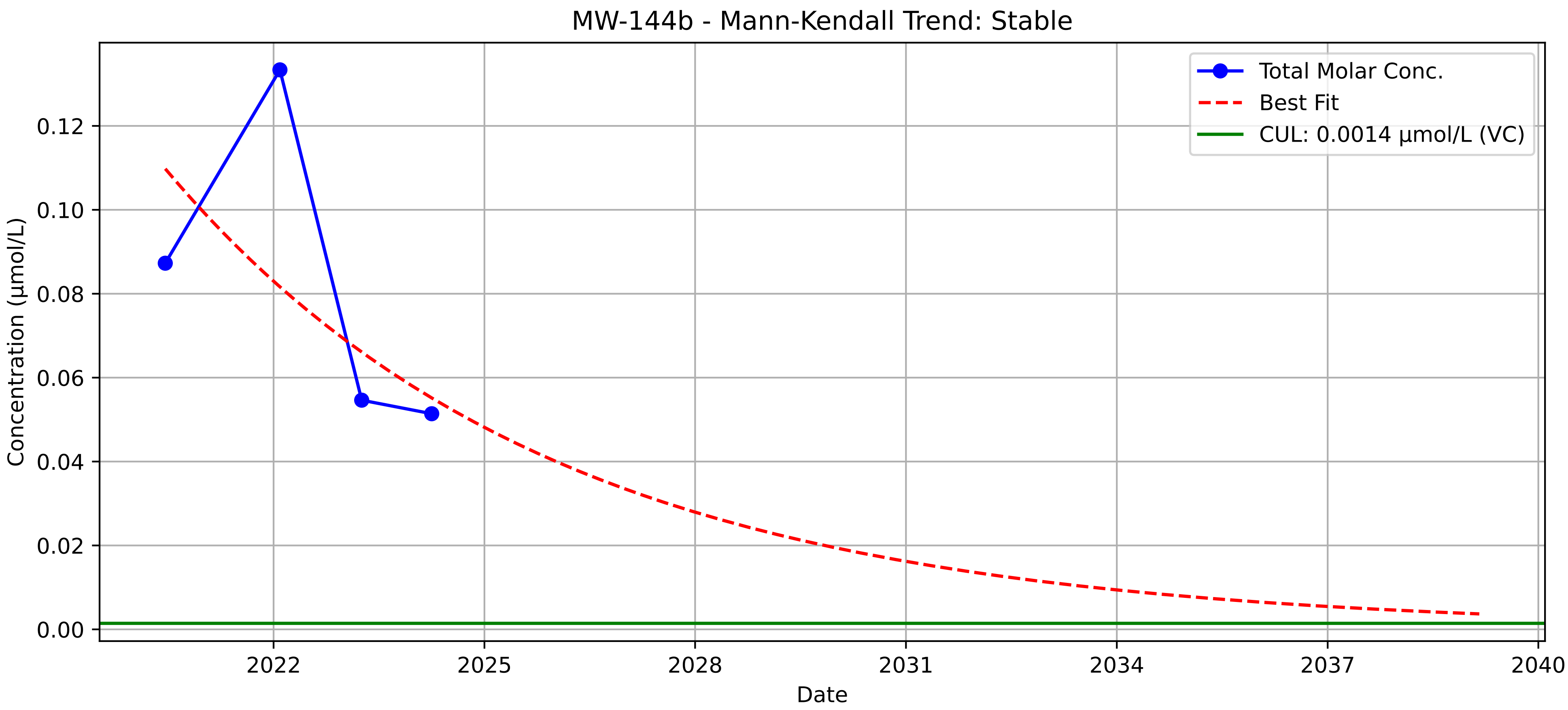
MW-135b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date


MW-139b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

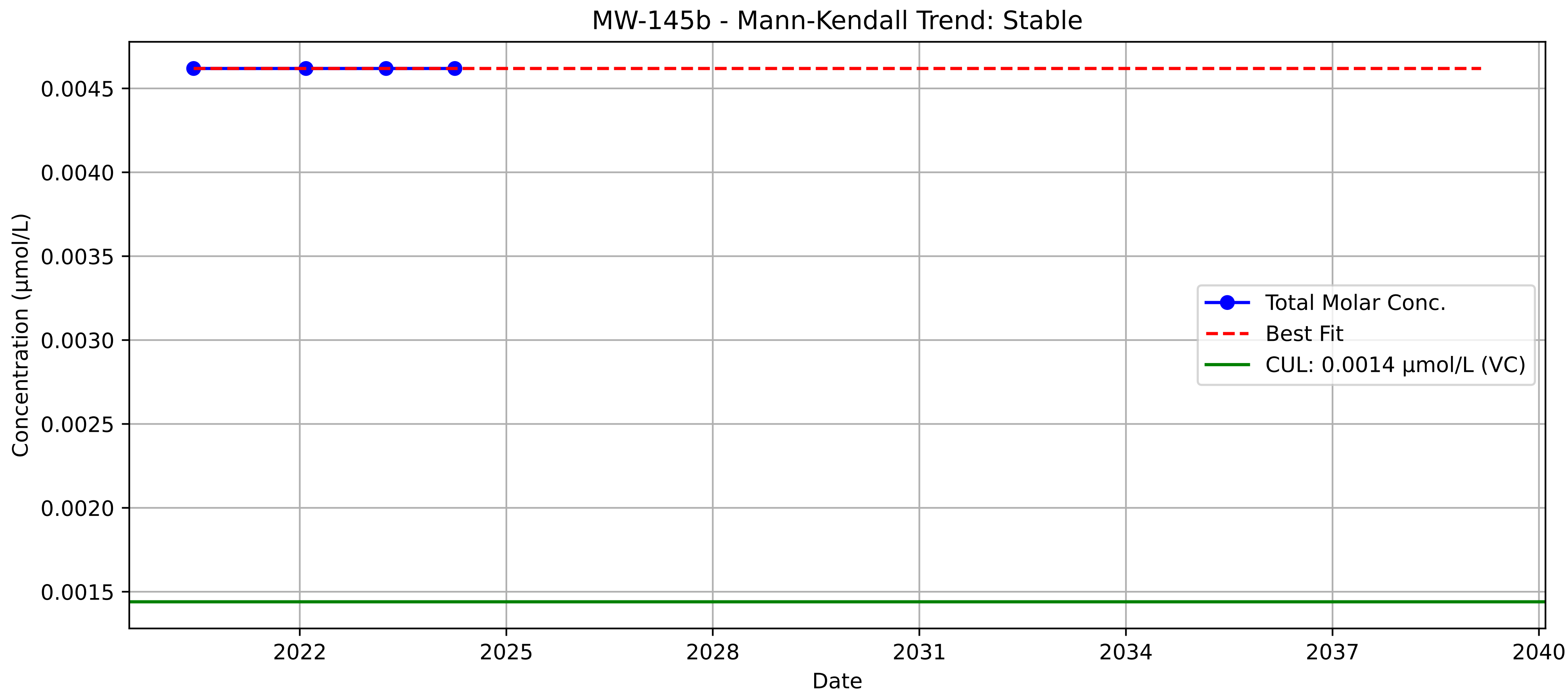


MW-140b - Mann-Kendall Trend: Stable
Concentration (µmol/L)
Date
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2022
2025
2028
2031
2034
2037
2040
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)

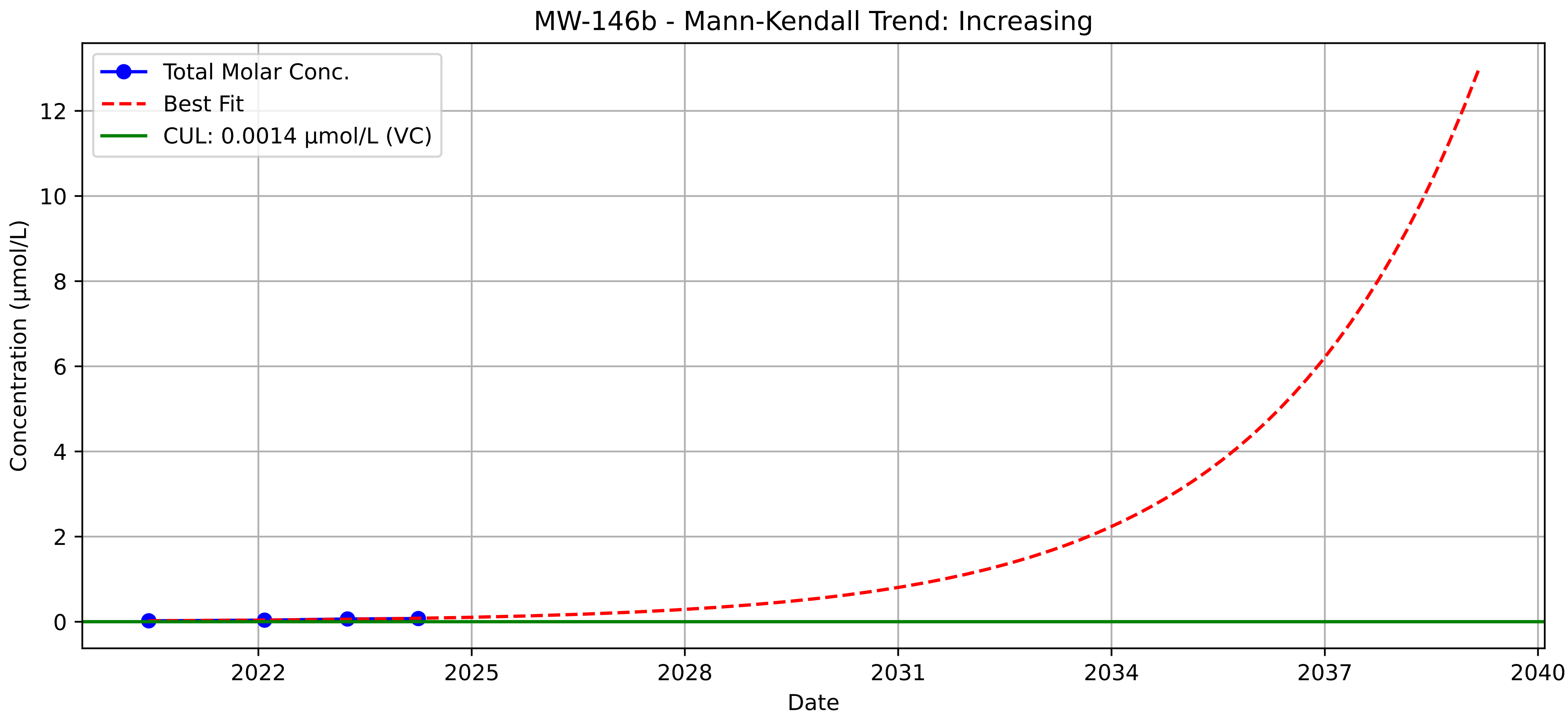

MW-142b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
2022
2025
2028
2031
2034
2037
2040
Date

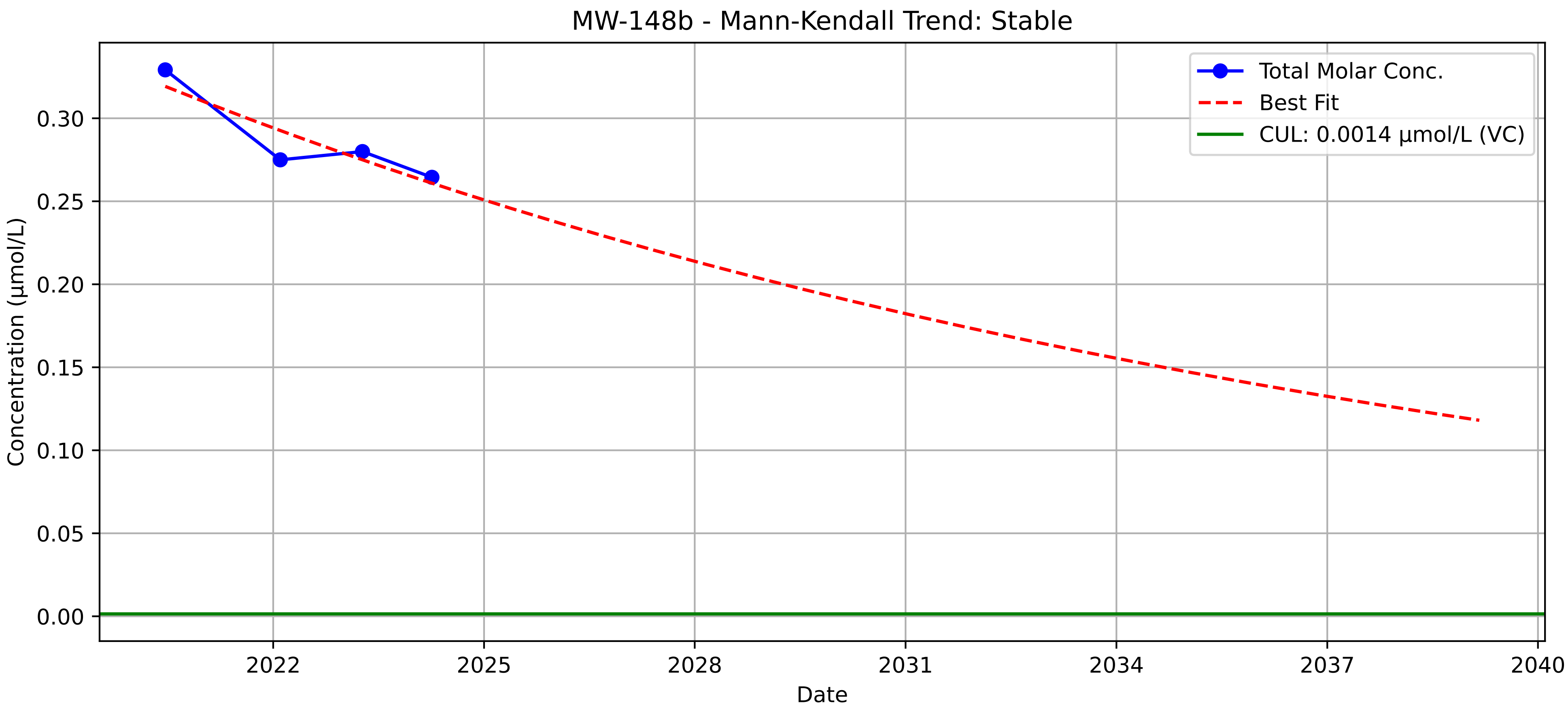


MW-144b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
2022
2025
2028
2031
2034
2037
2040
Date

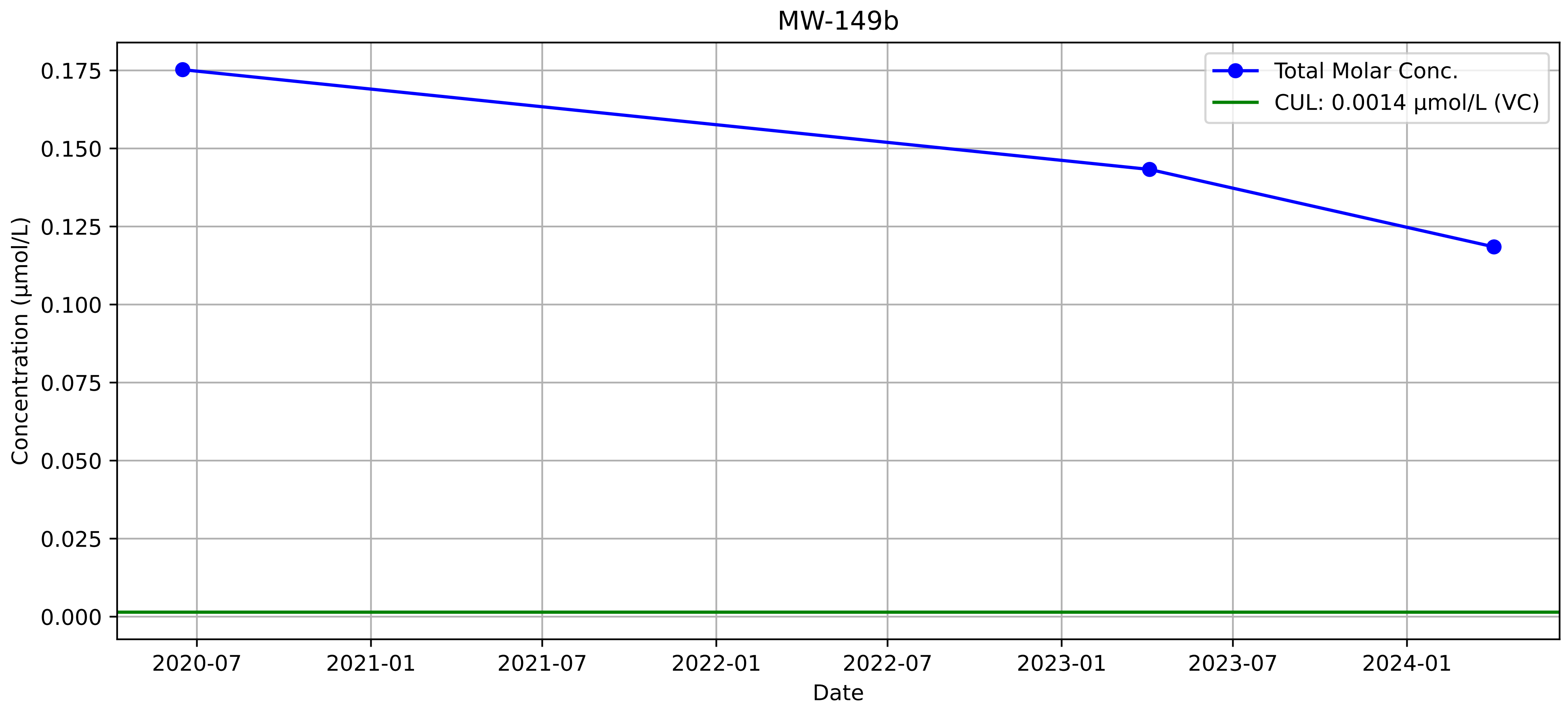


MW-145b - Mann-Kendall Trend: Stable
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
Concentration (µmol/L)
2022
2025
2028
2031
2034
2037
2040
Date
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)

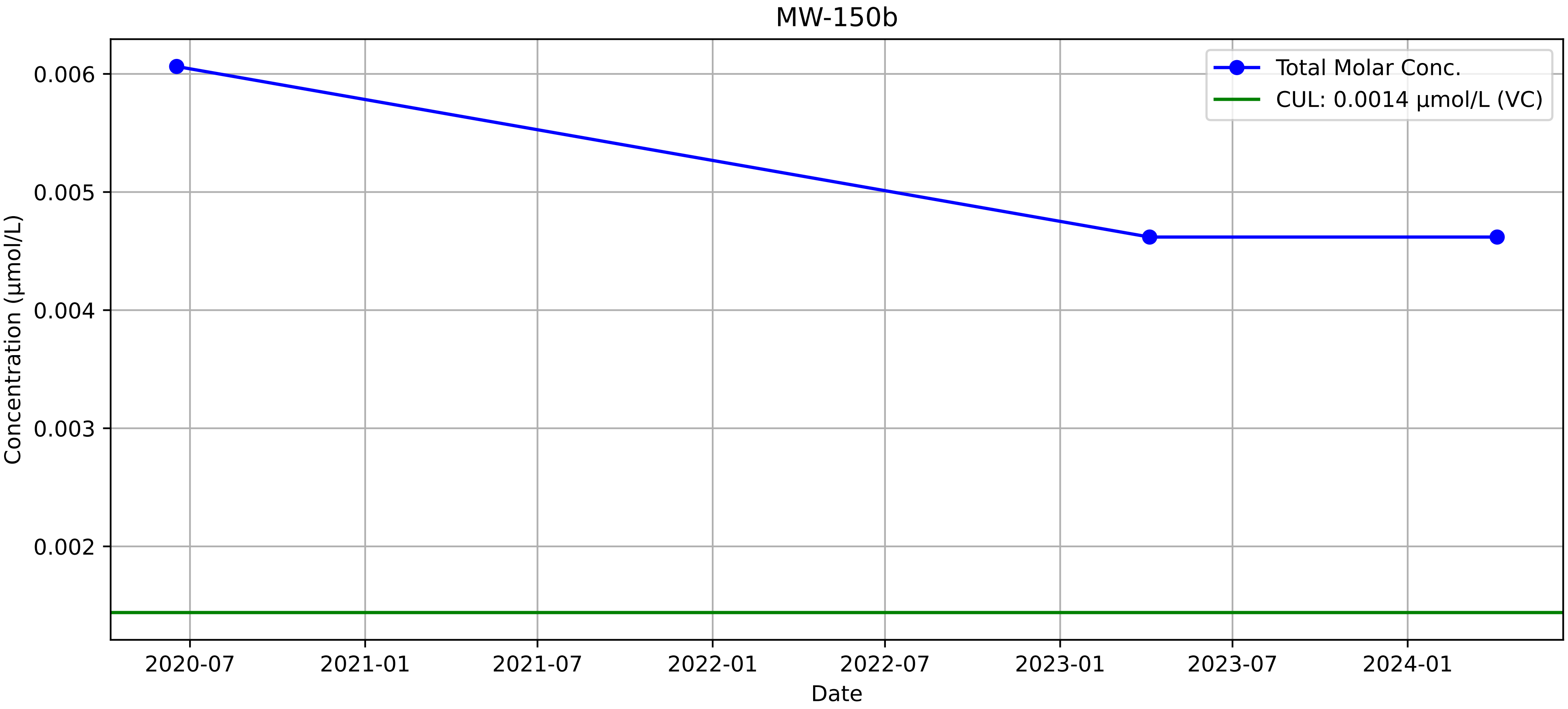

MW-146b - Mann-Kendall Trend: Increasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
2
4
6
8
10
12
2022
2025
2028
2031
2034
2037
2040
Date



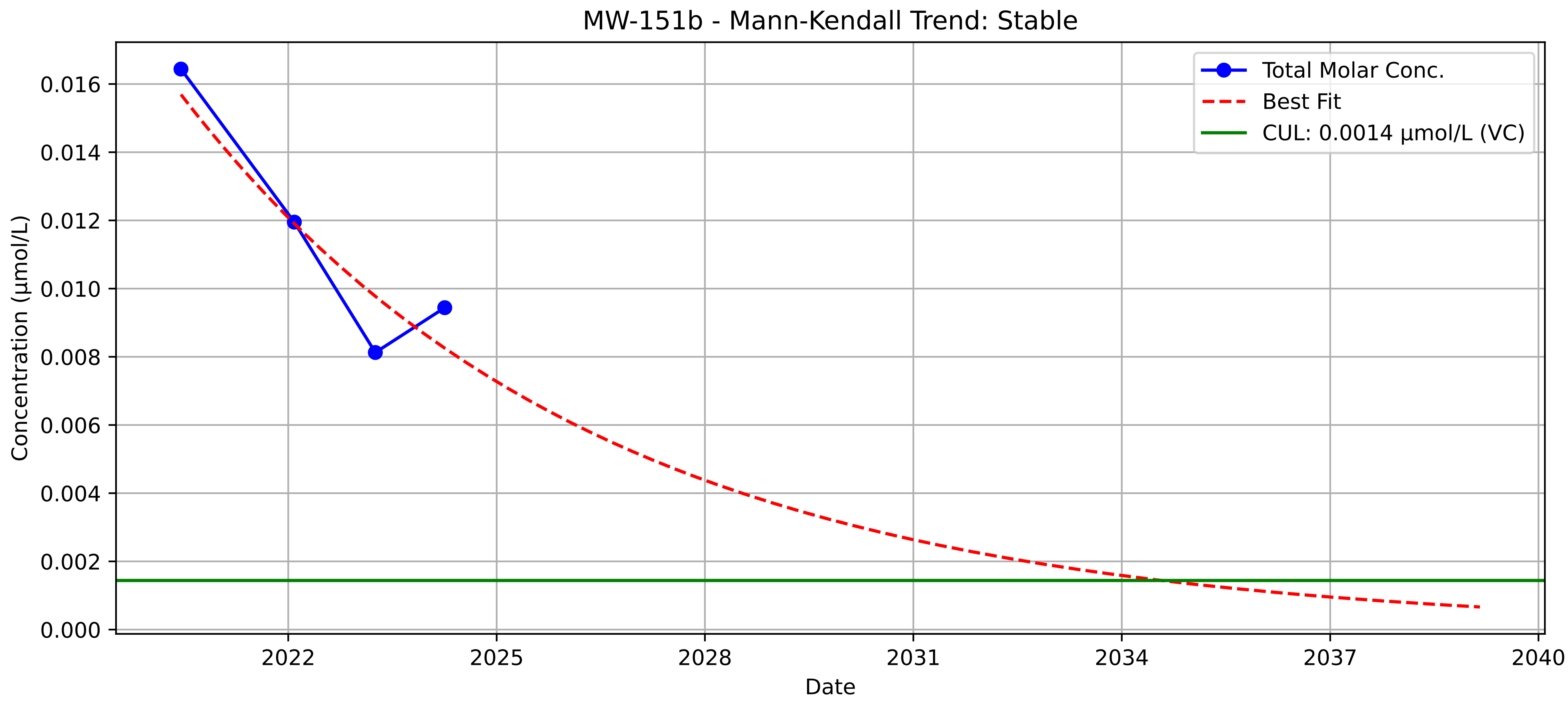
MW-148b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2022
2025
2028
2031
2034
2037
2040
Date



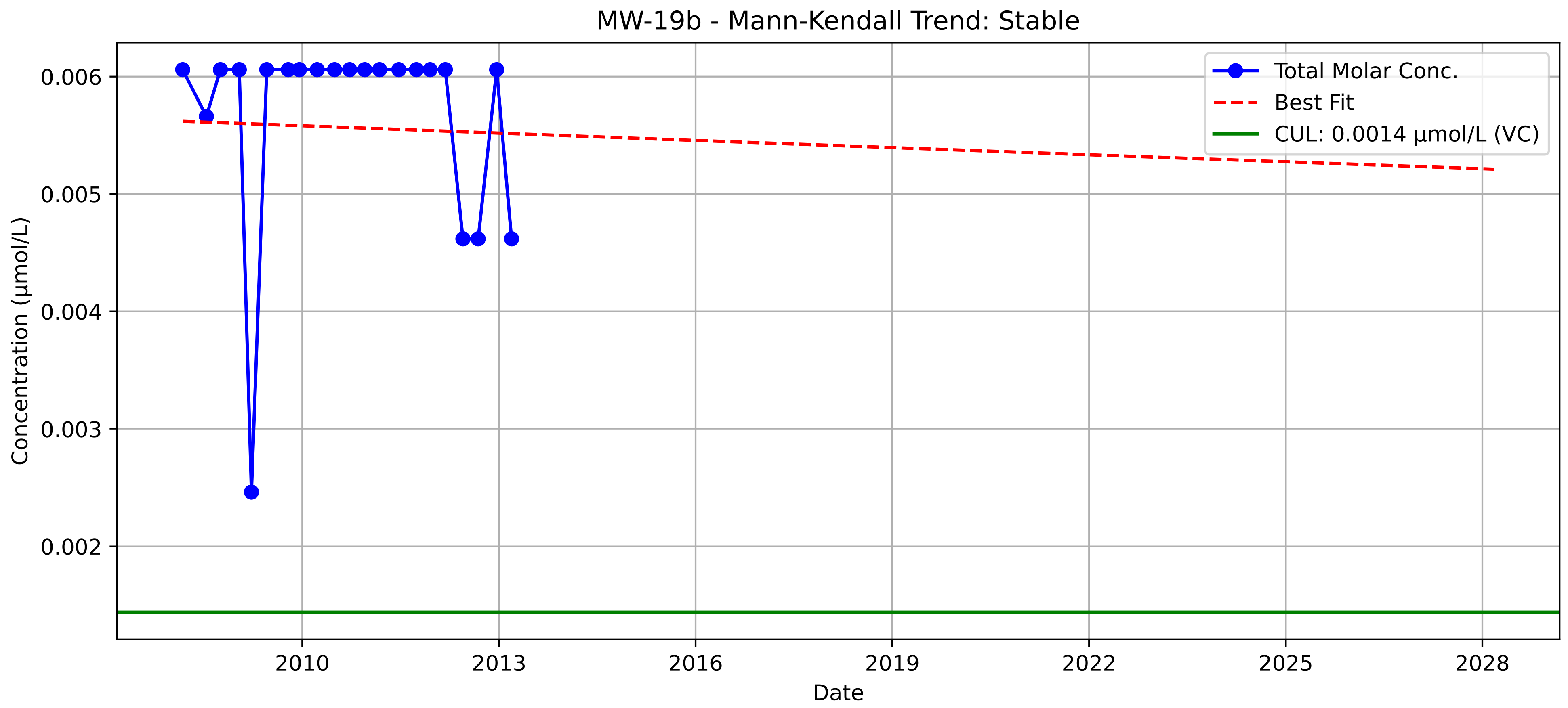
MW-149b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
2023-07
2024-01
Date

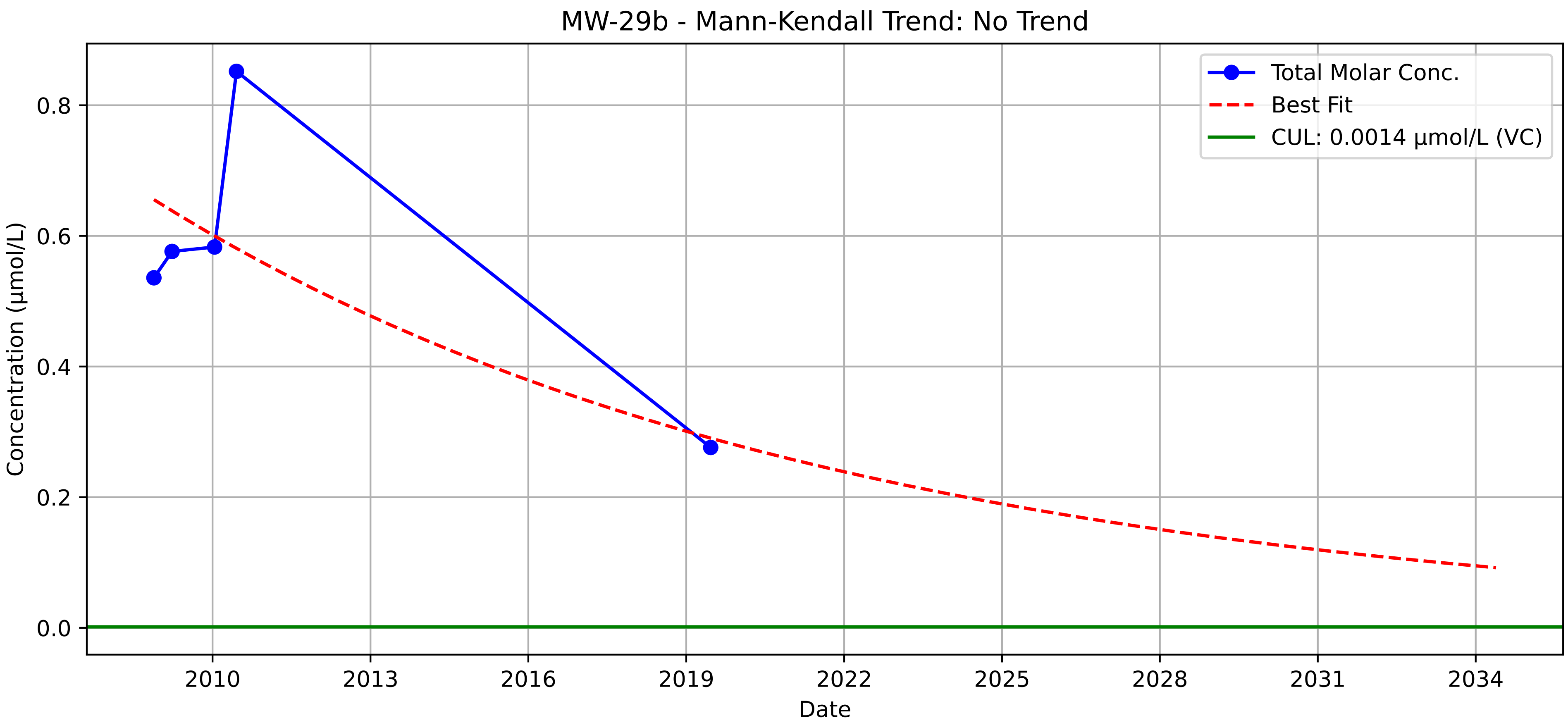


MW-150b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2020-07
2021-01
2021-07
2022-01
2022-07
2023-01
2023-07
2024-01
Date

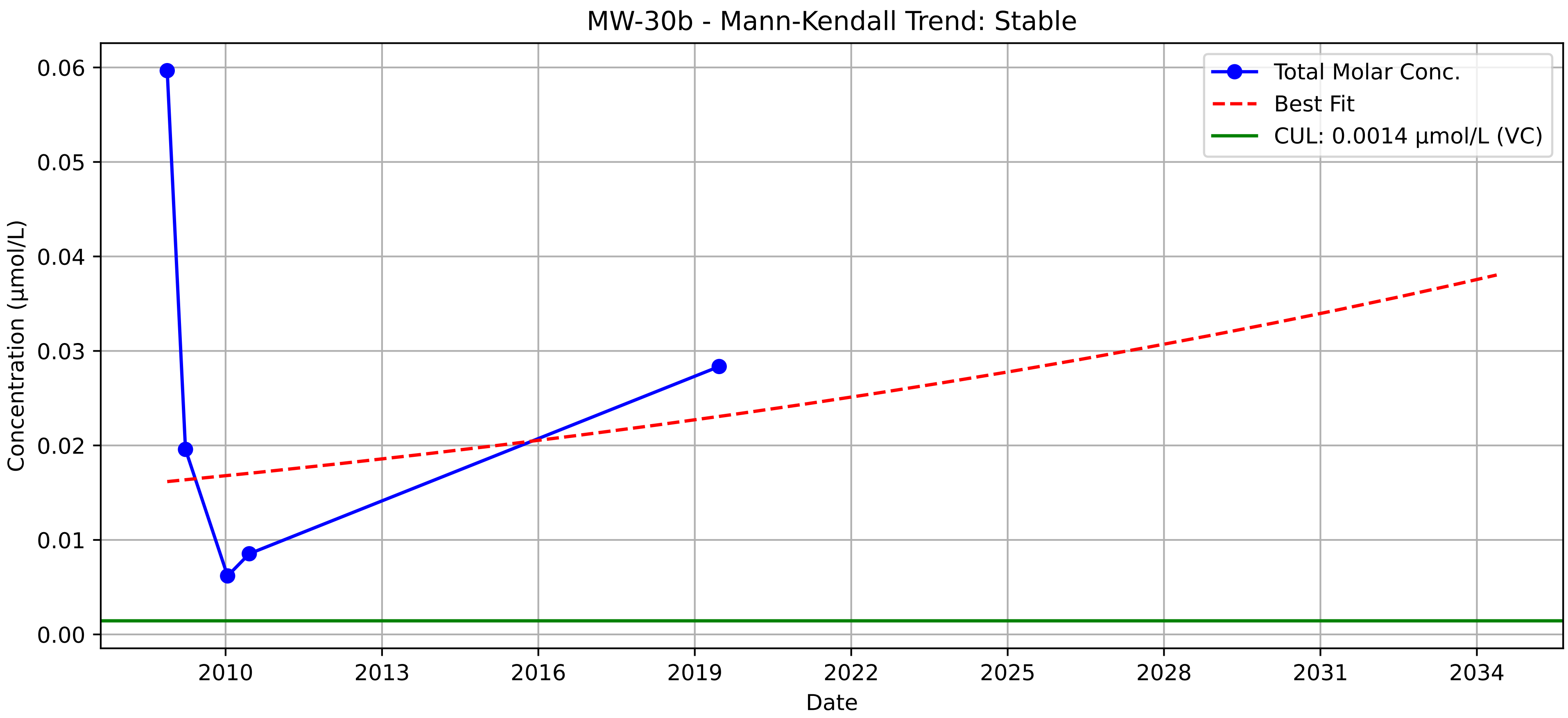


MW-151b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
2022
2025
2028
2031
2034
2037
2040
Date

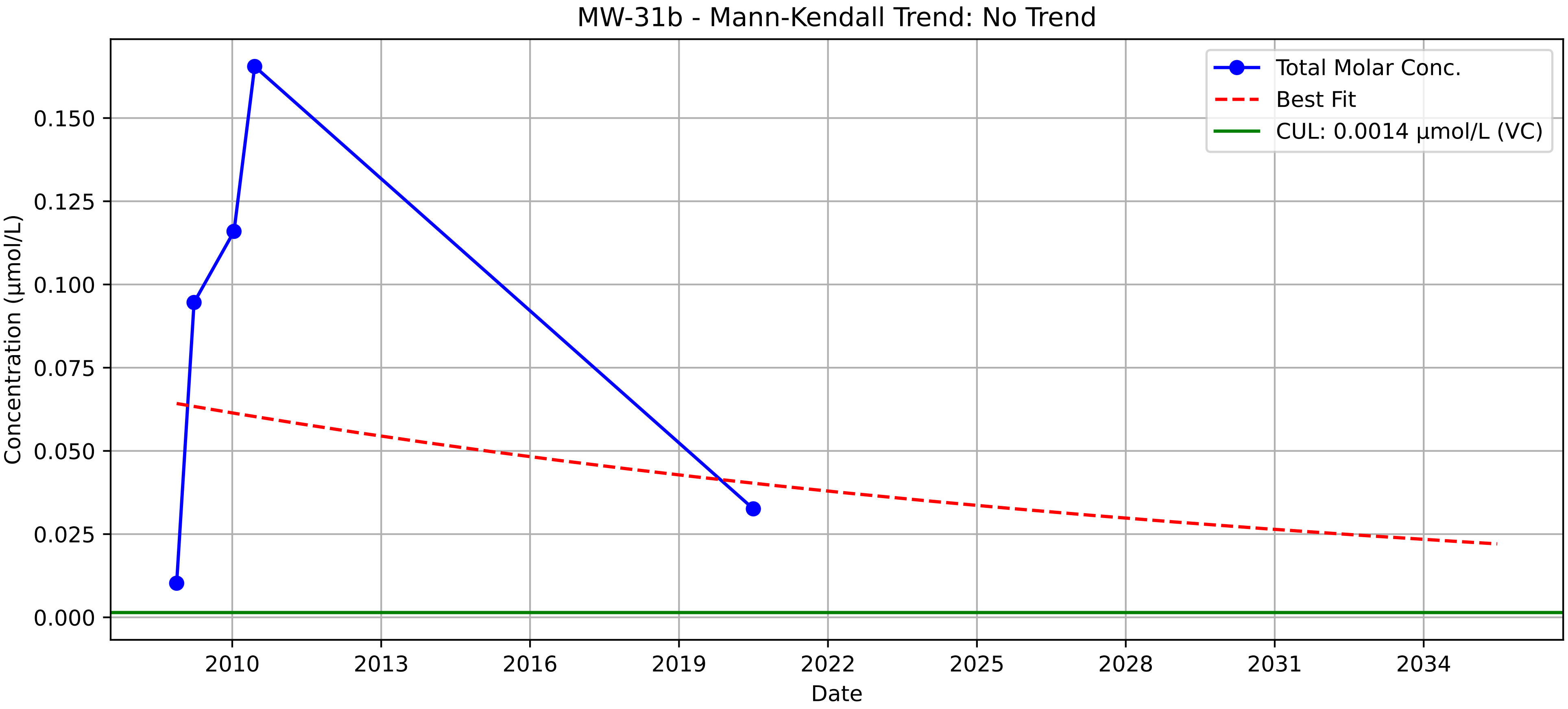

MW-19b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
0.006
0.005
0.004
0.003
0.002
Concentration (µmol/L)
2010
2013
2016
2019
2022
2025
2028
Date

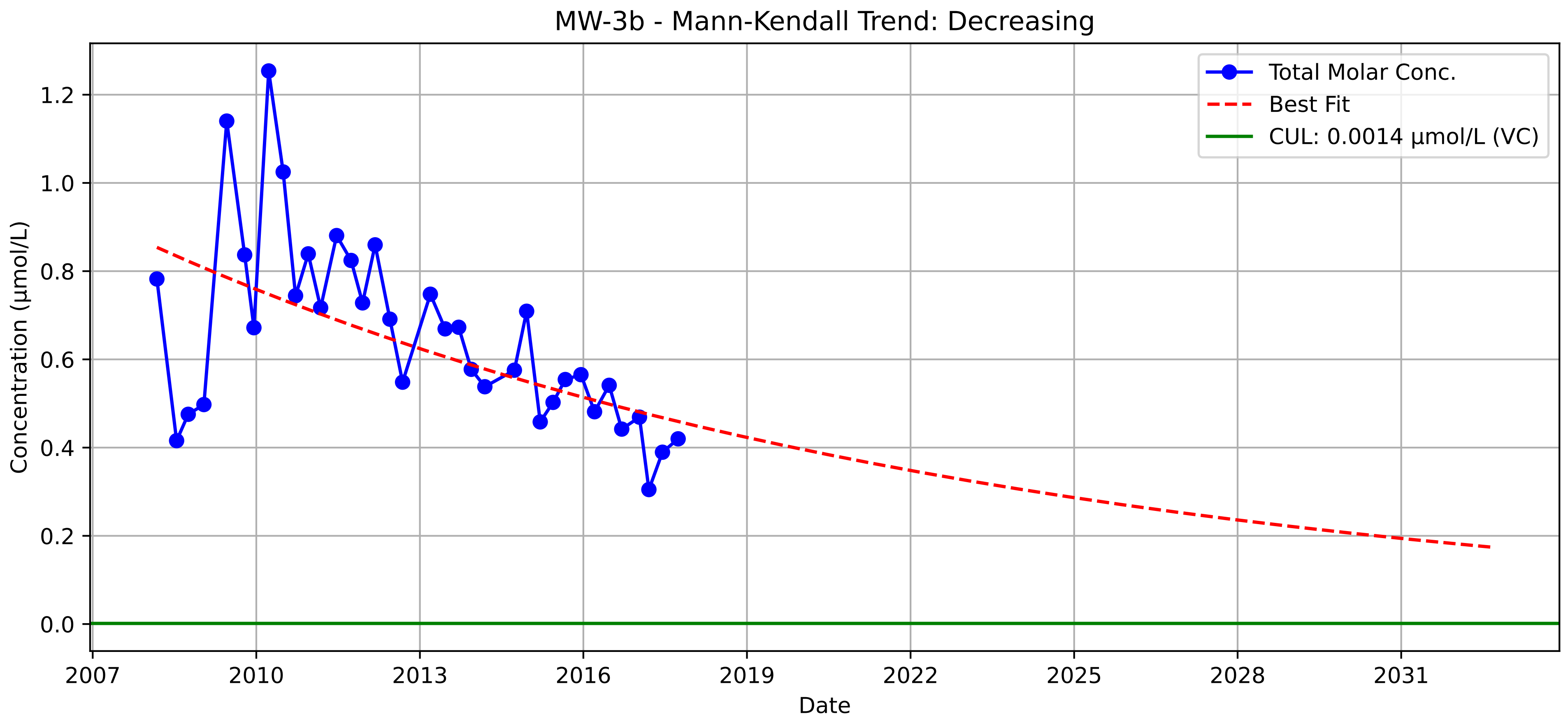


MW-29b - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.2
0.4
0.6
0.8
2010
2013
2016
2019
2022
2025
2028
2031
2034
Date

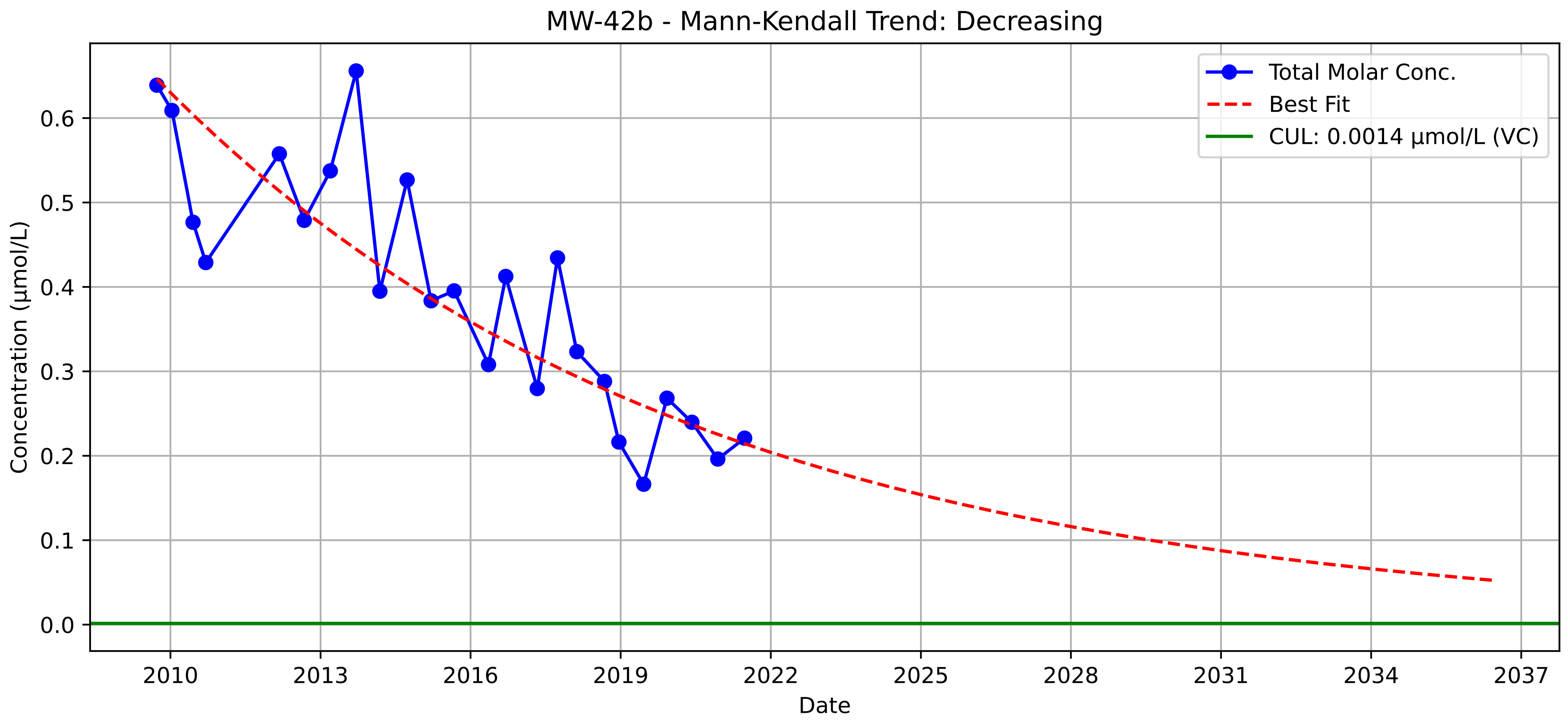


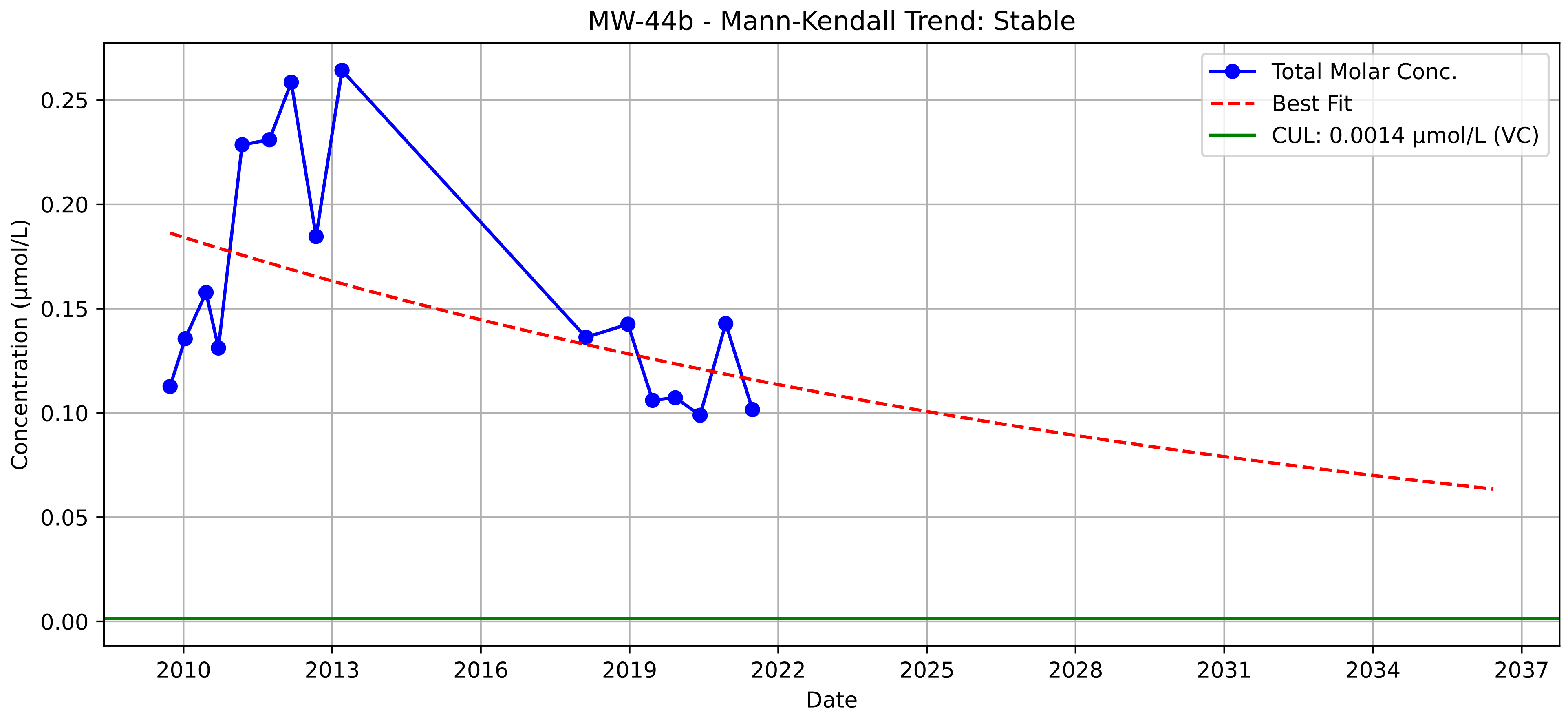
MW-30b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2010
2013
2016
2019
2022
2025
2028
2031
2034
Date


MW-31b - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.000
0.025
0.050
0.075
0.100
0.125
0.150
2010
2013
2016
2019
2022
2025
2028
2031
2034
Date

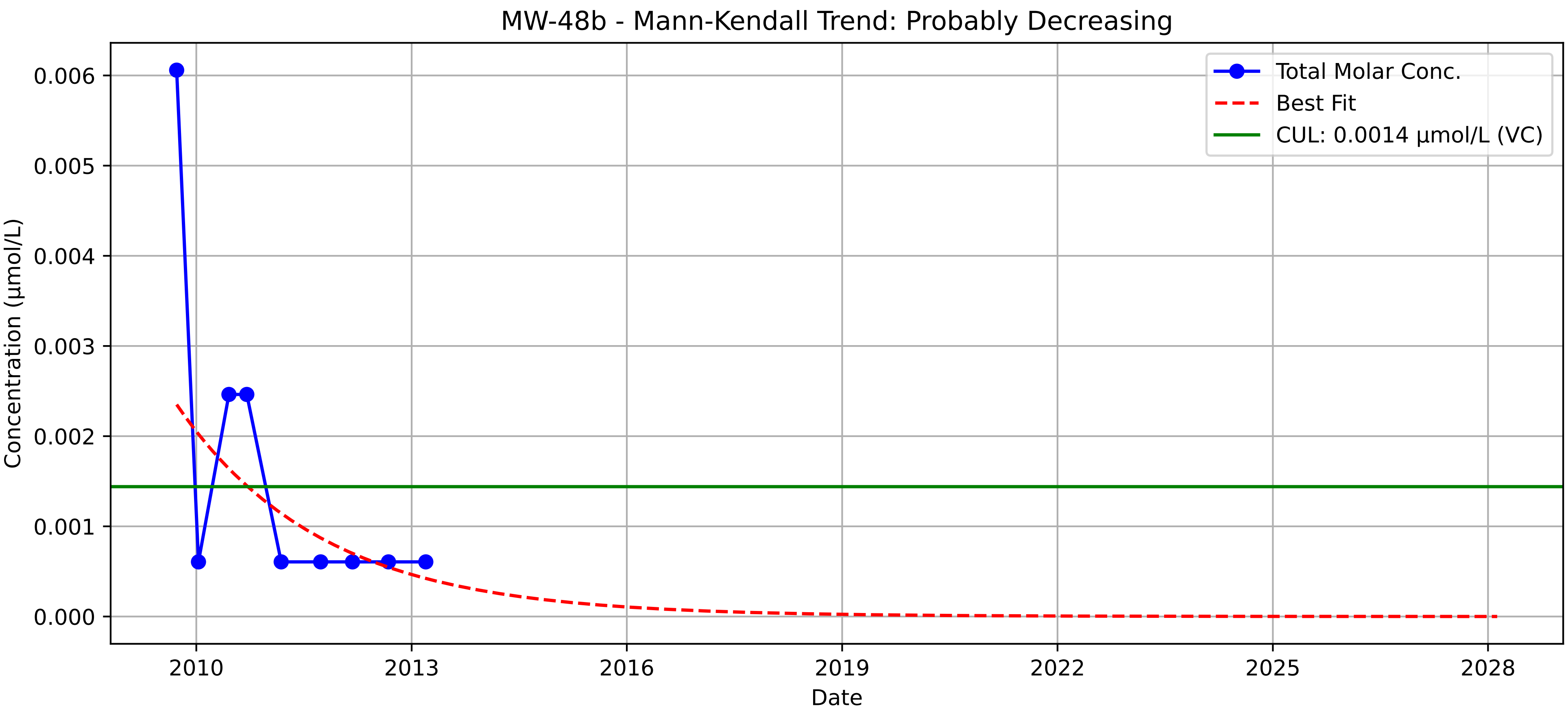


MW-3b - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
2007
2010
2013
2016
2019
2022
2025
2028
2031
Date

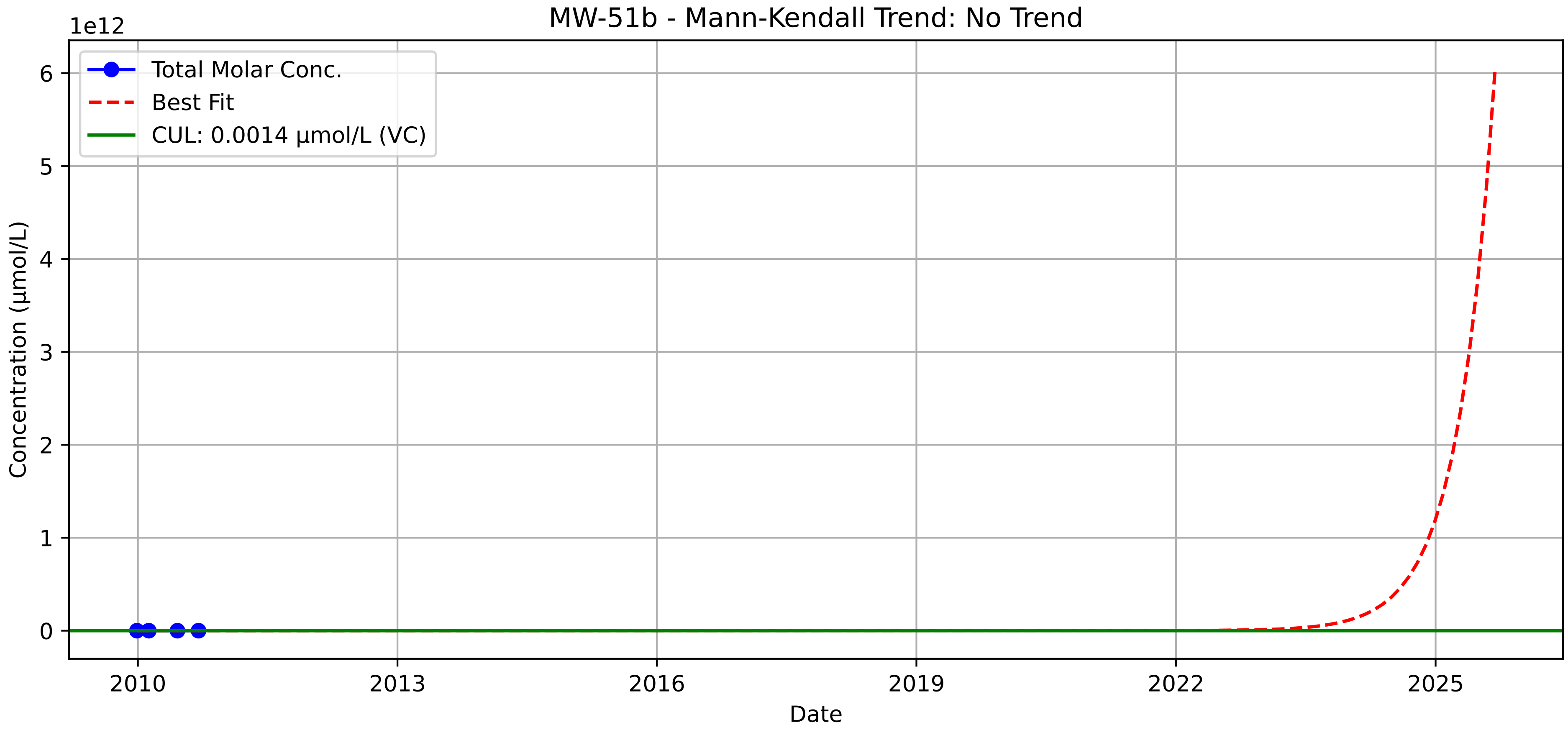

MW-42b - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
Date



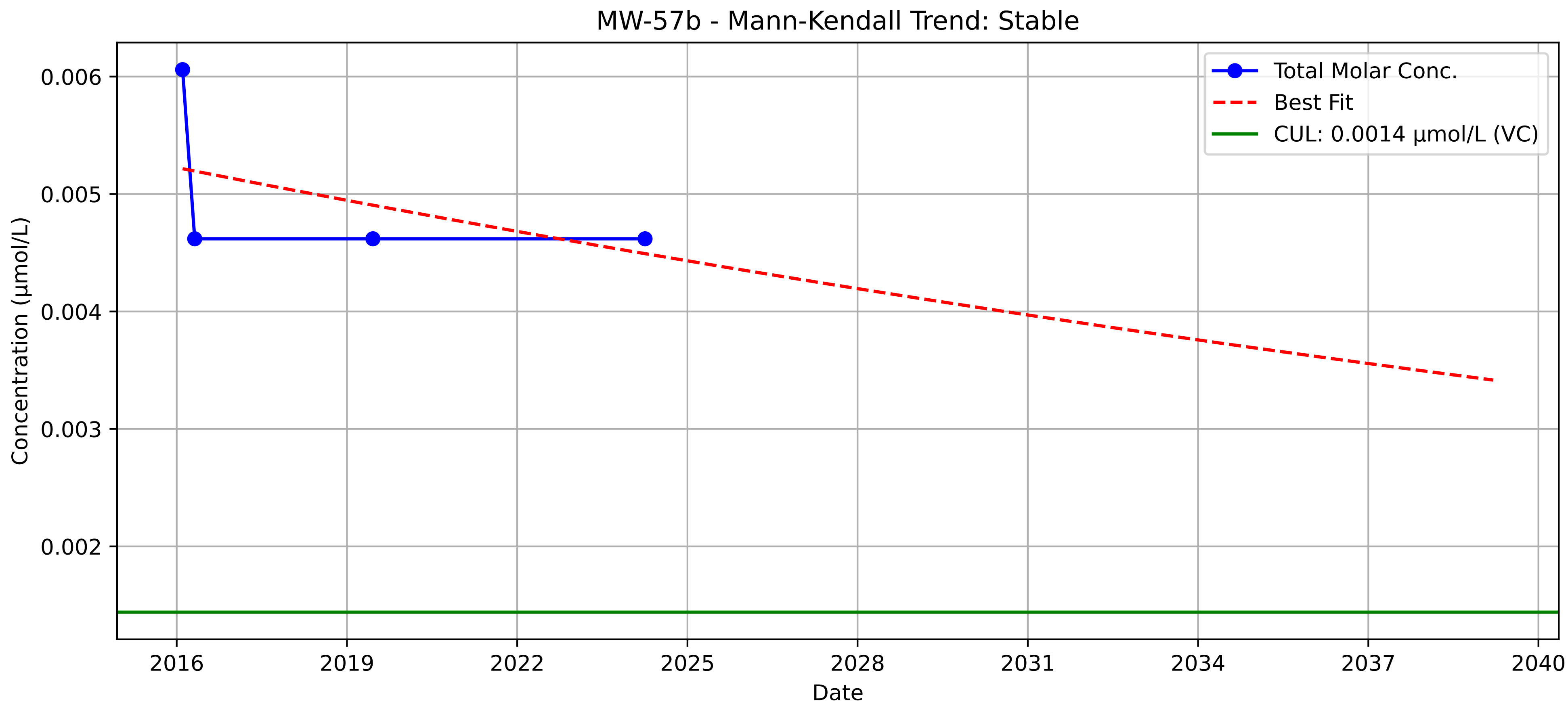
MW-44b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.05
0.10
0.15
0.20
0.25
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
Date



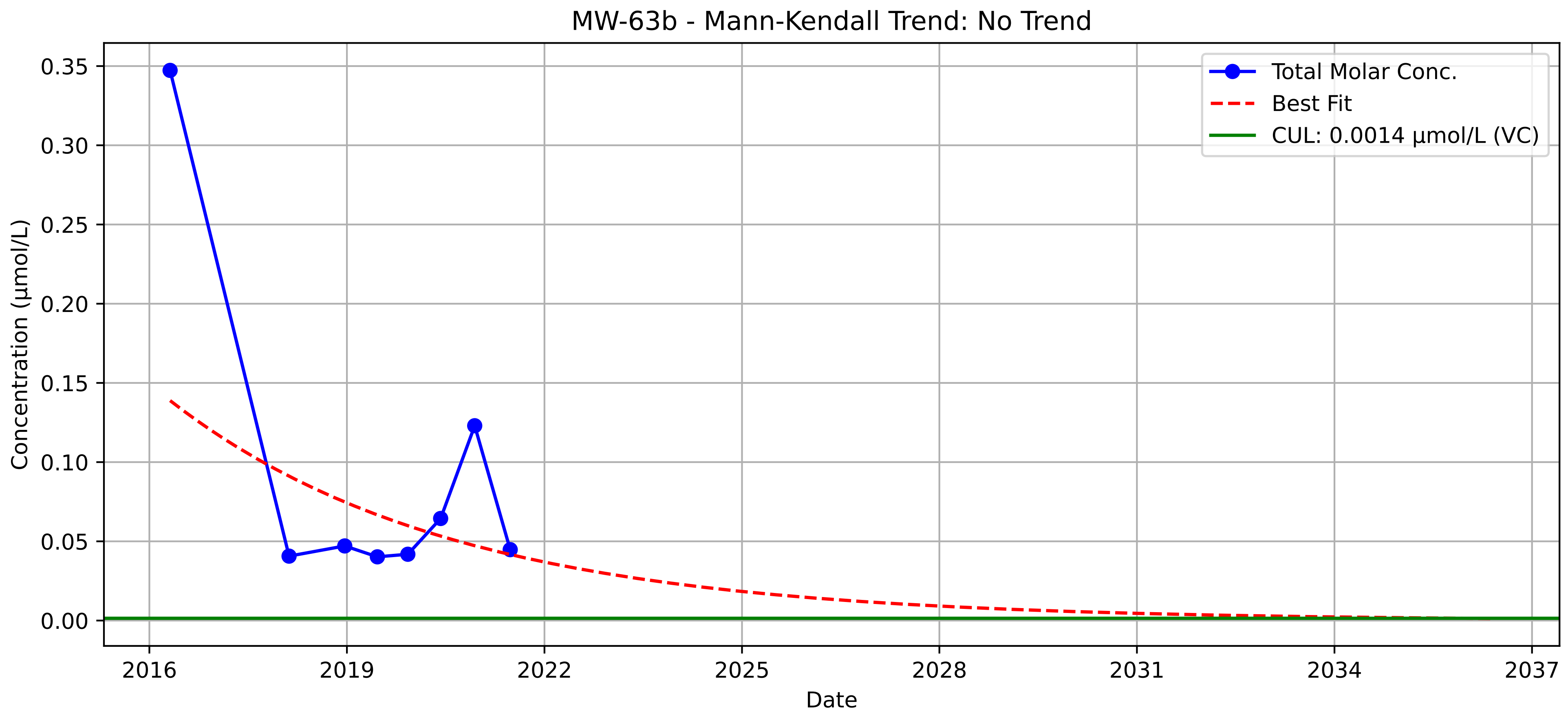
MW-48b - Mann-Kendall Trend: Probably Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
2010
2013
2016
2019
2022
2025
2028
Date



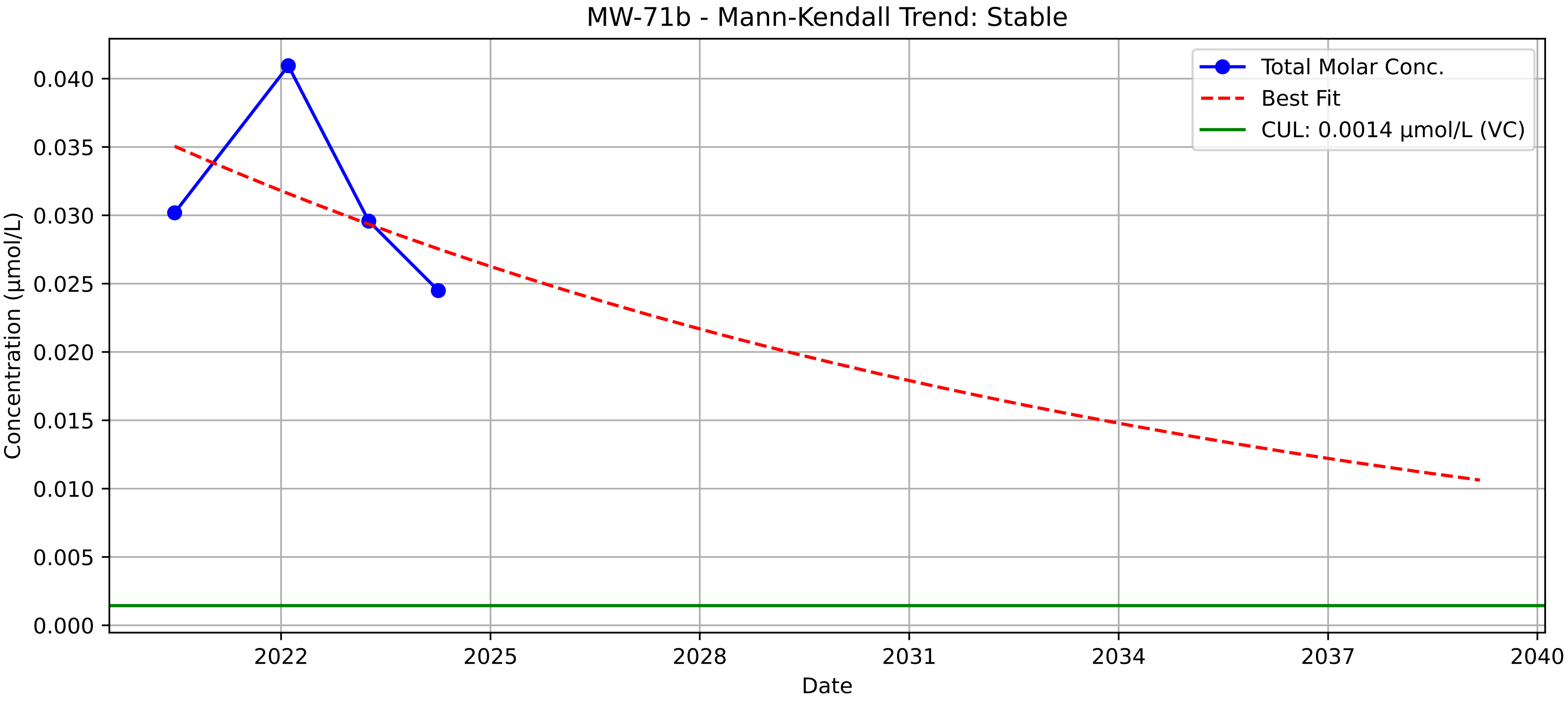
MW-51b - Mann-Kendall Trend: No Trend
1e12
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
1
2
3
4
5
6
2010
2013
2016
2019
2022
2025
Date



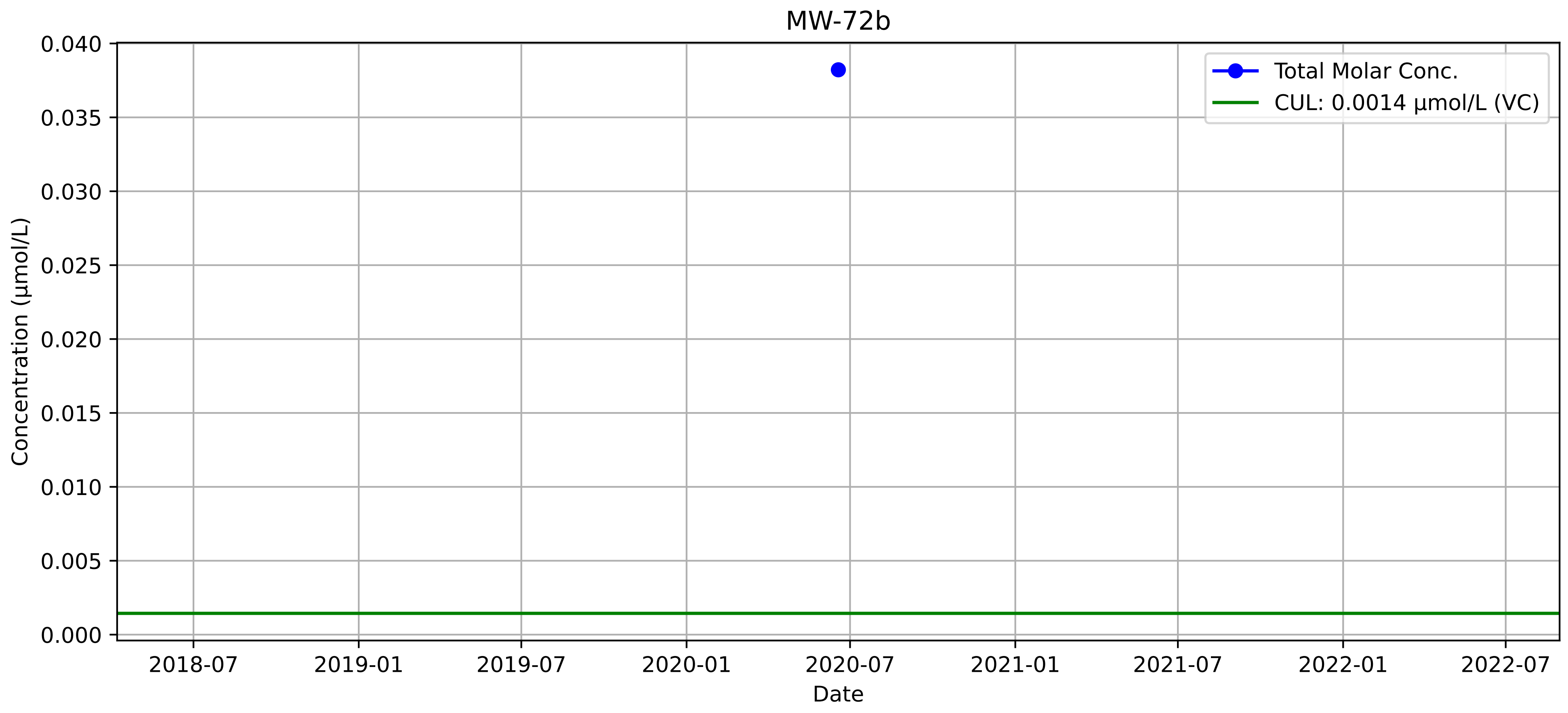
MW-57b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date



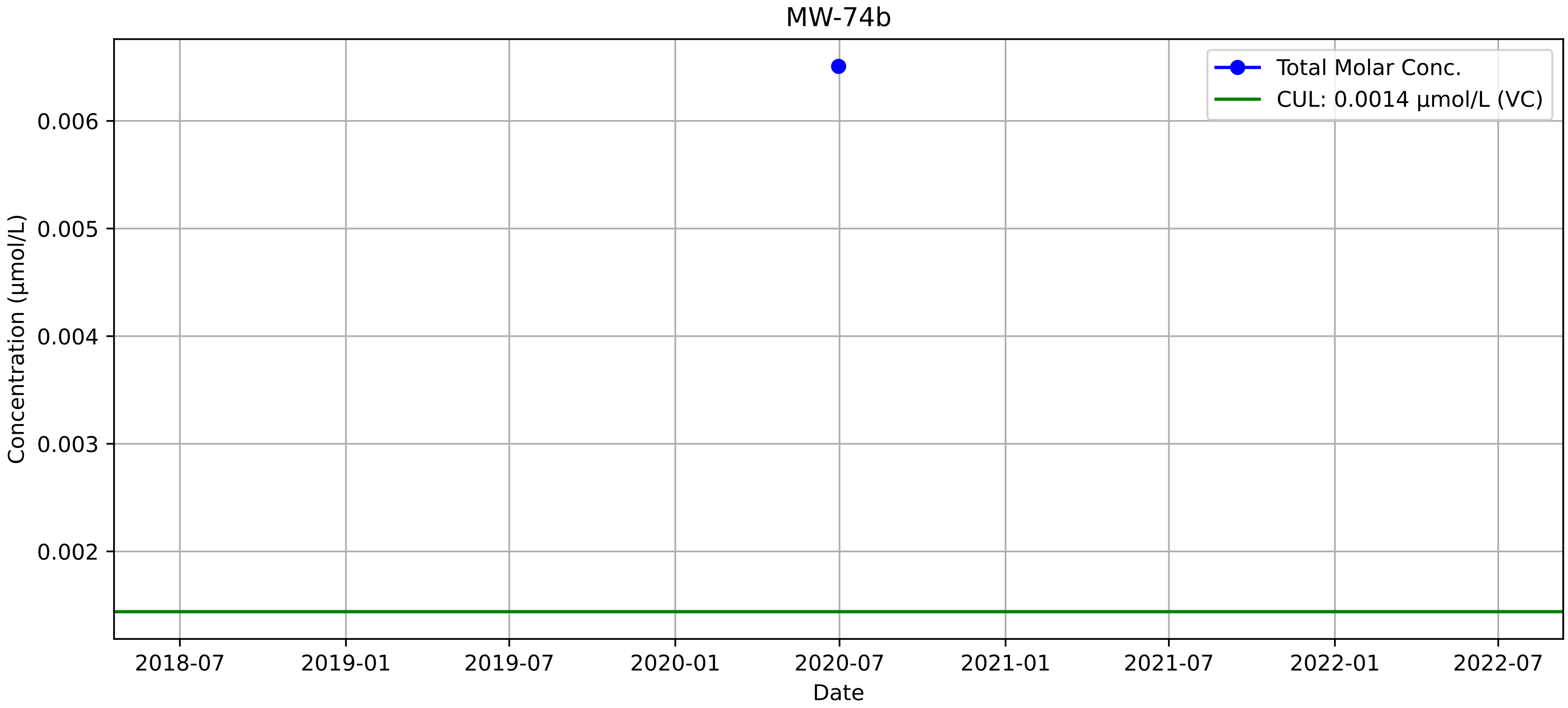
MW-63b - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2016
2019
2022
2025
2028
2031
2034
2037
Date



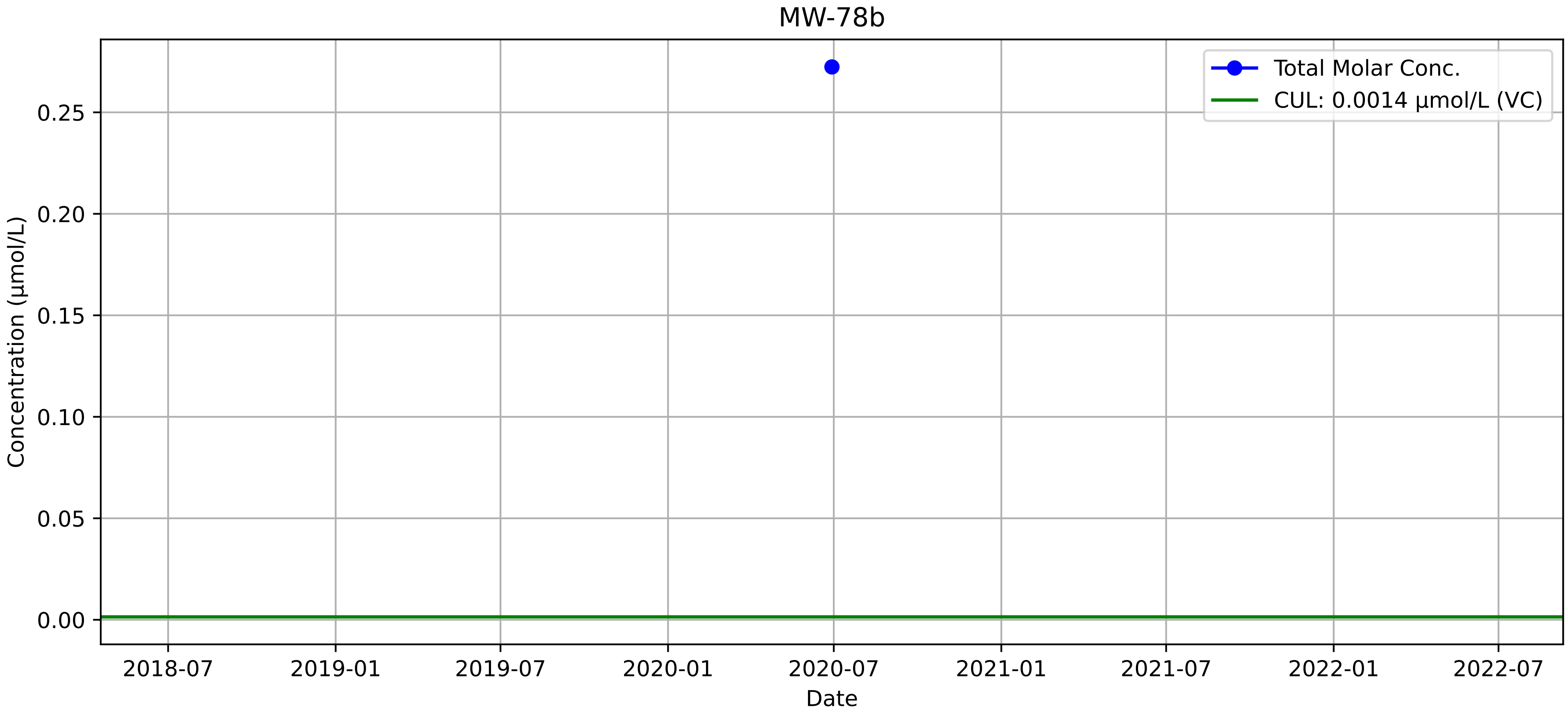
MW-71b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
Date
2022
2025
2028
2031
2034
2037
2040



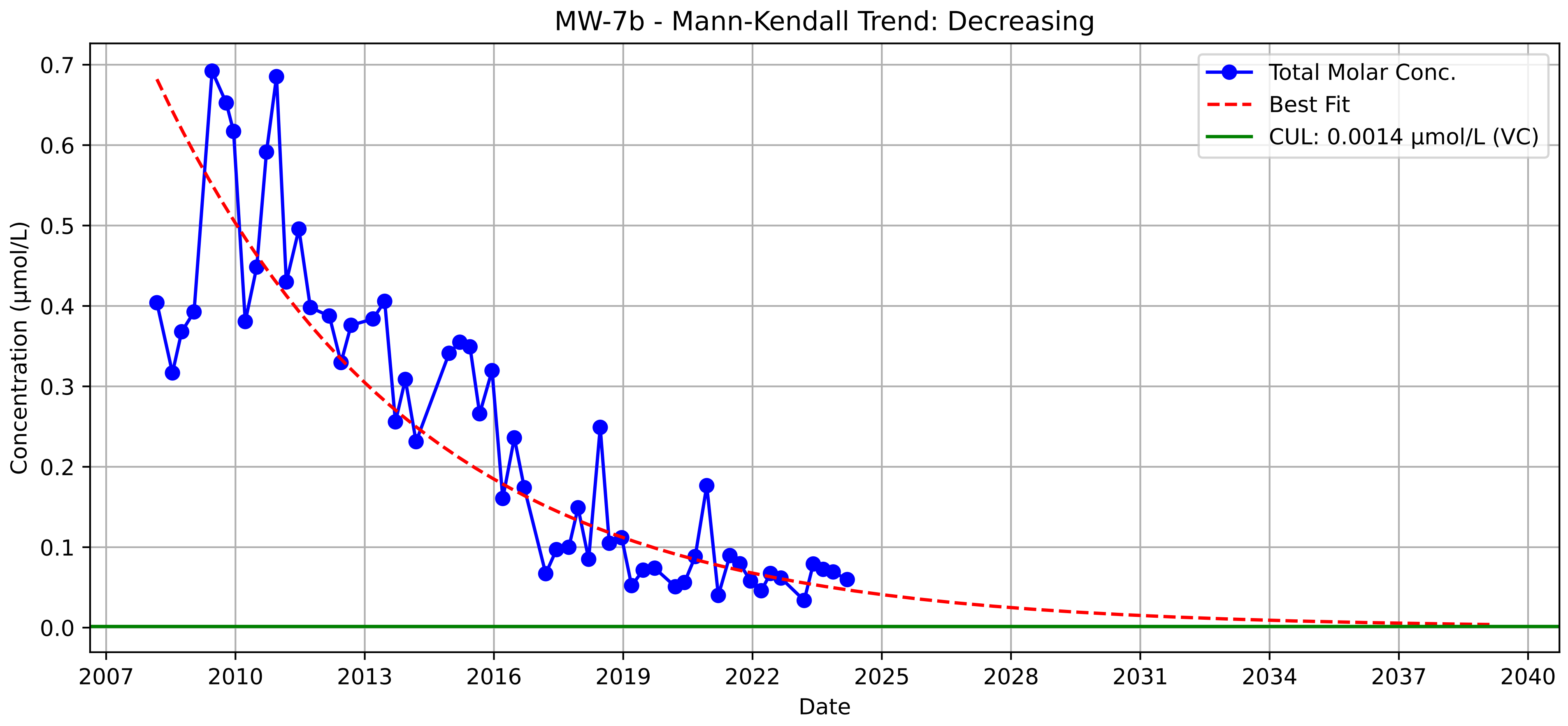
MW-72b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date



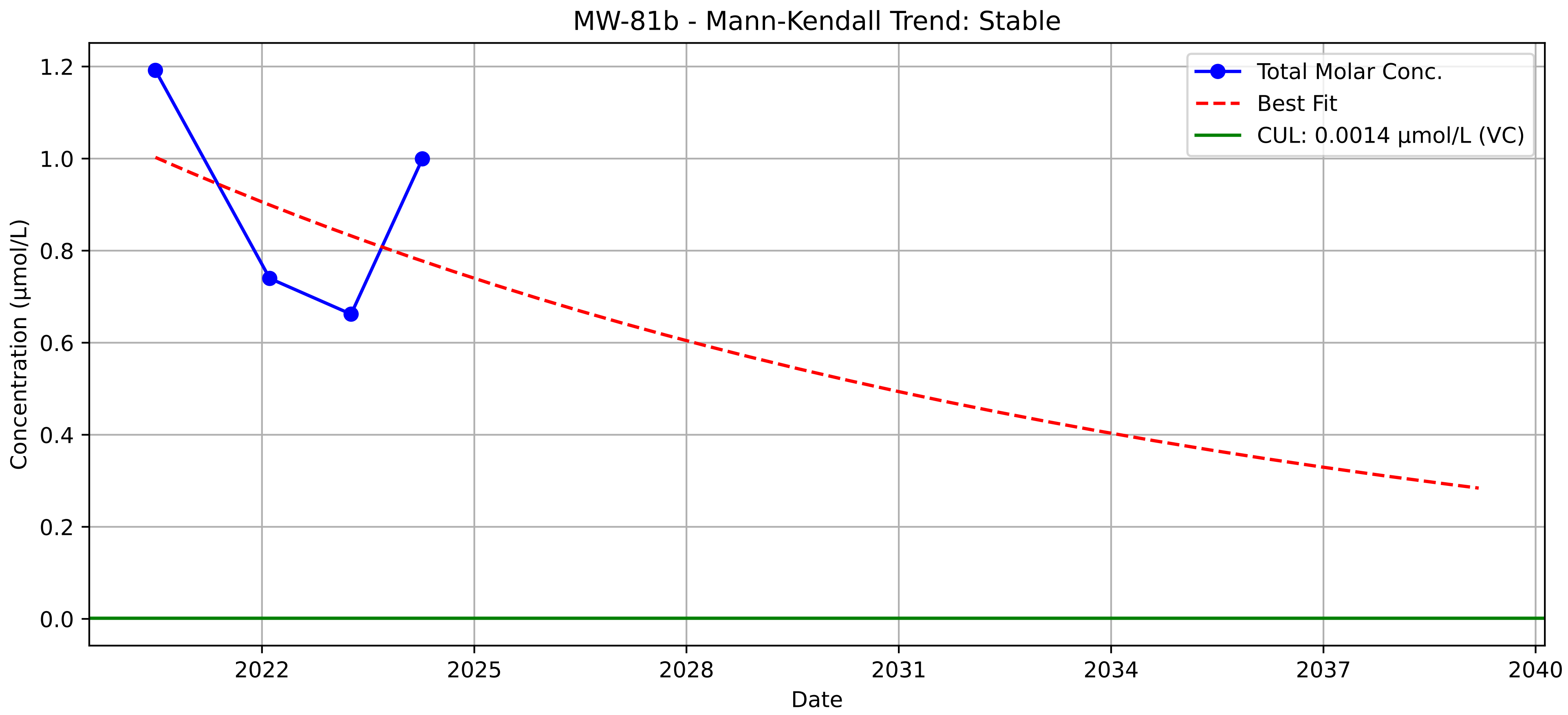
MW-74b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date



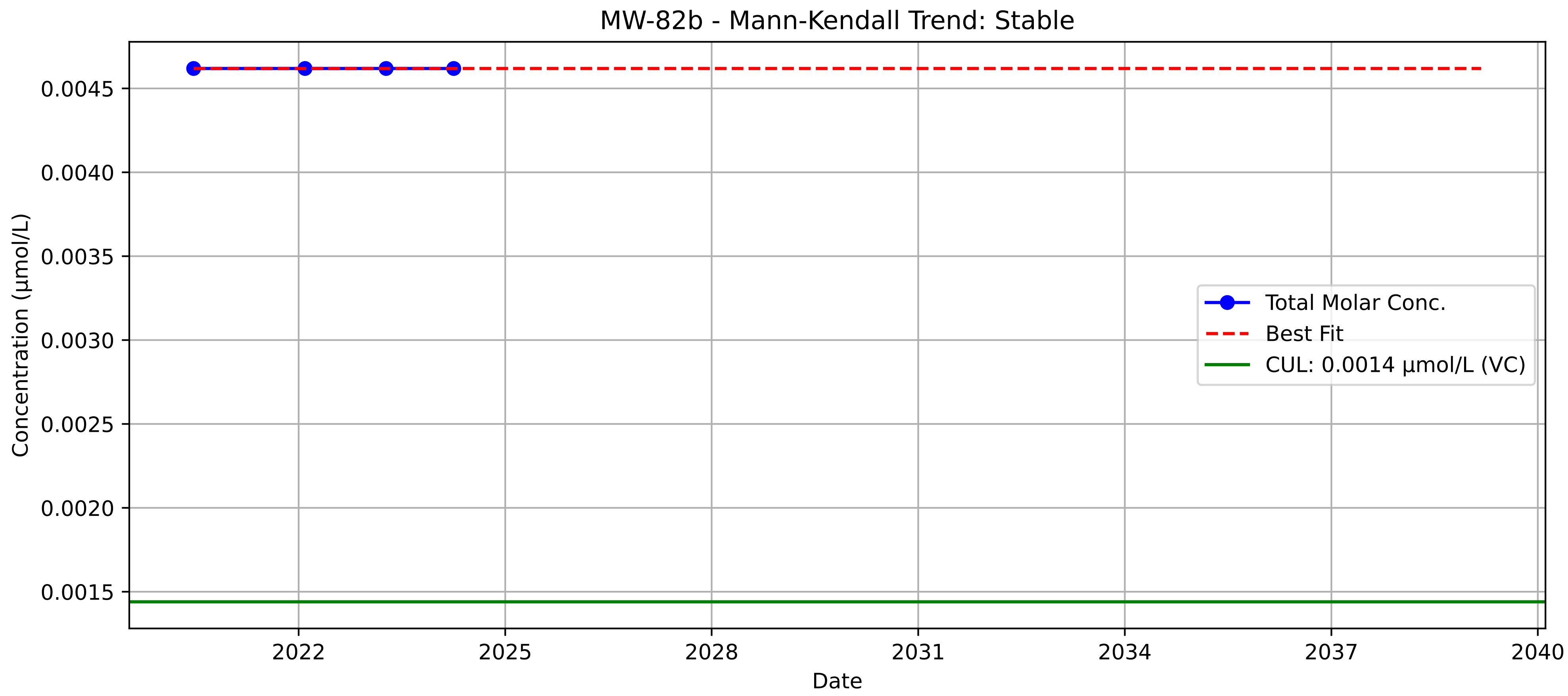
MW-78b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.25
0.20
0.15
0.10
0.05
0.00
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date



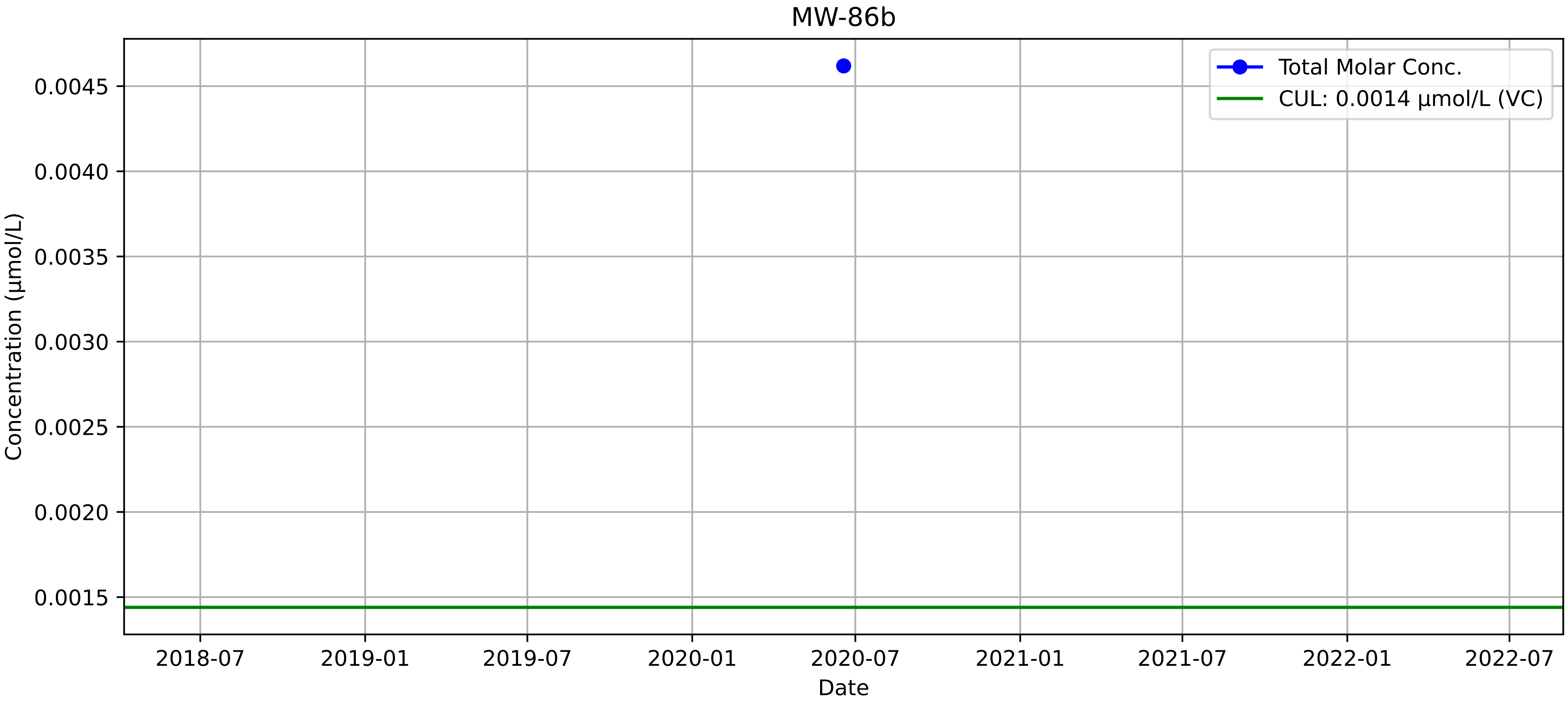
MW-7b - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date



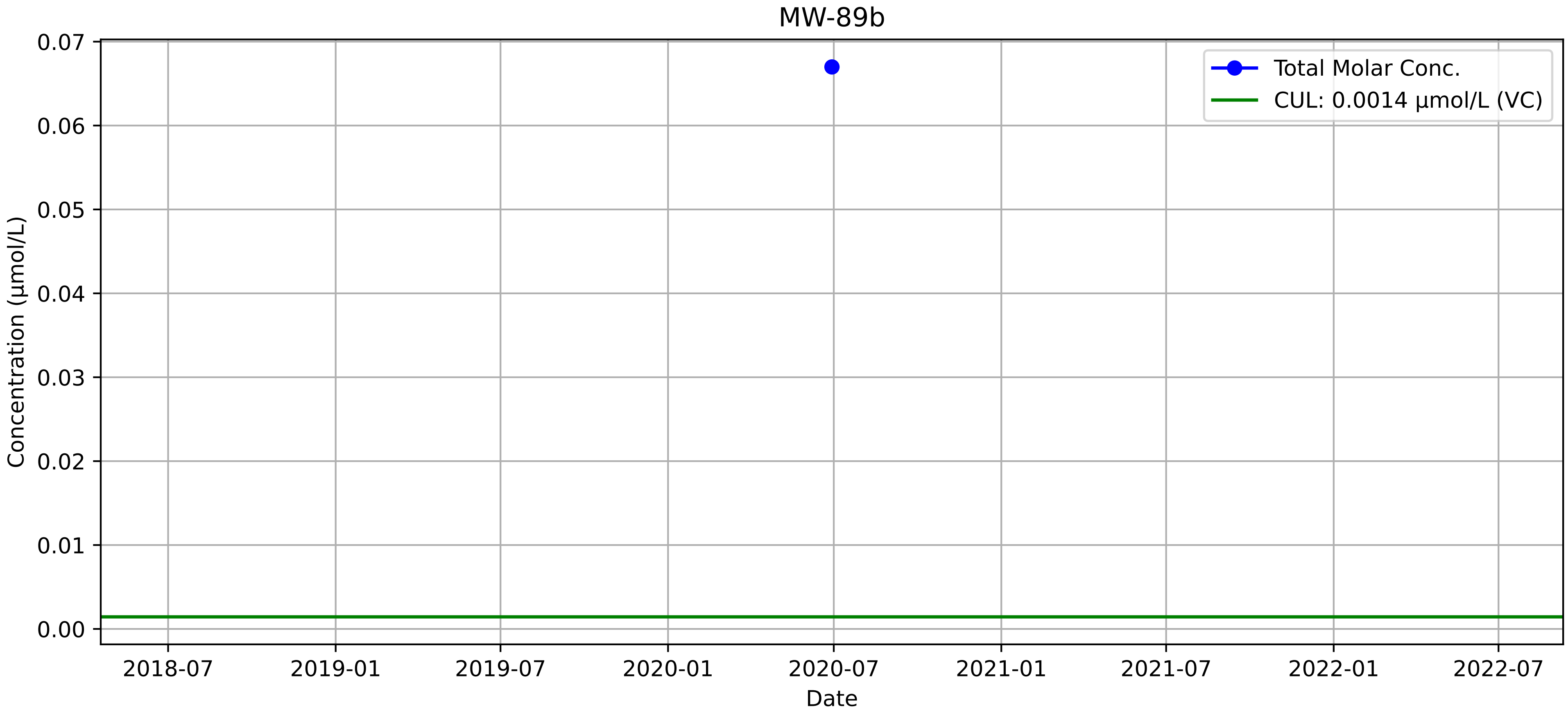
MW-81b - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
2022
2025
2028
2031
2034
2037
2040
Date

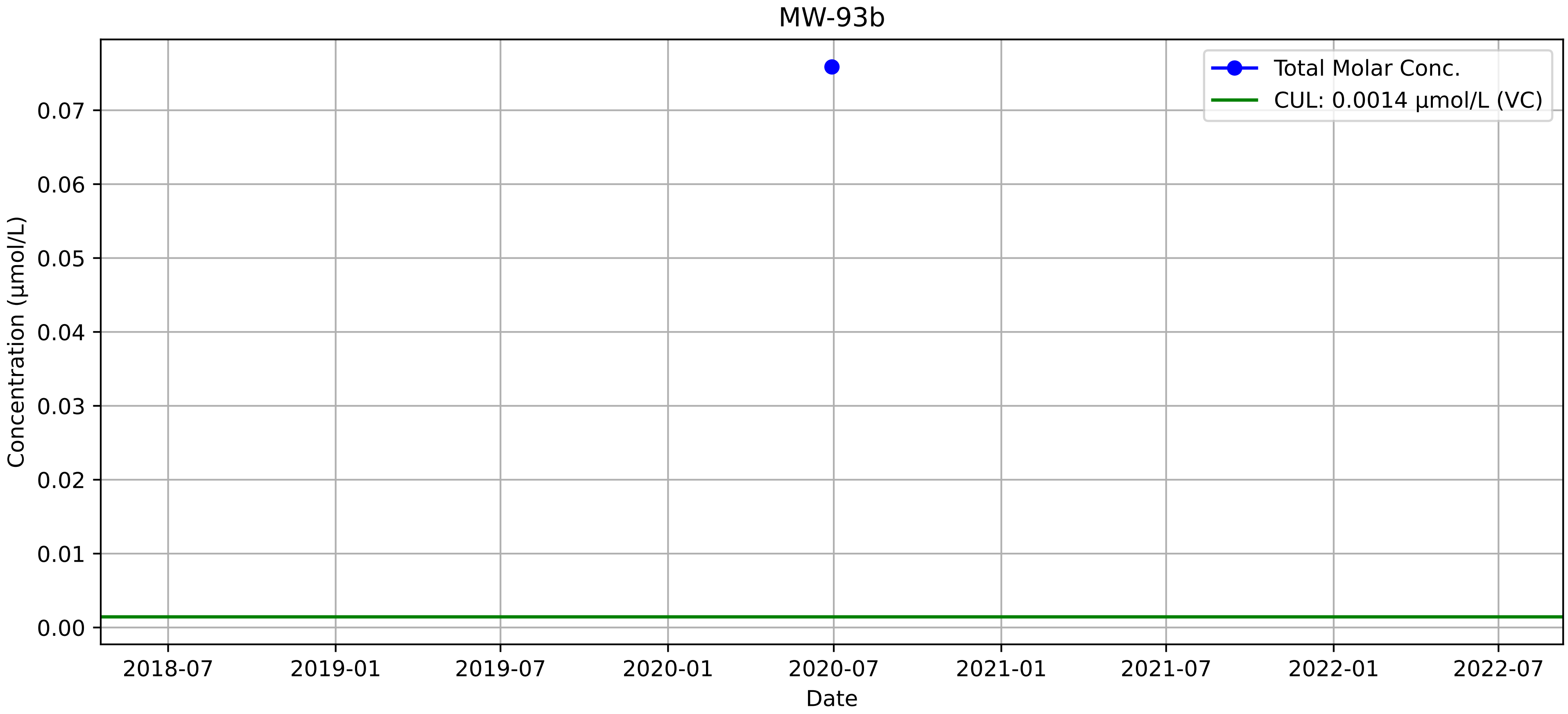


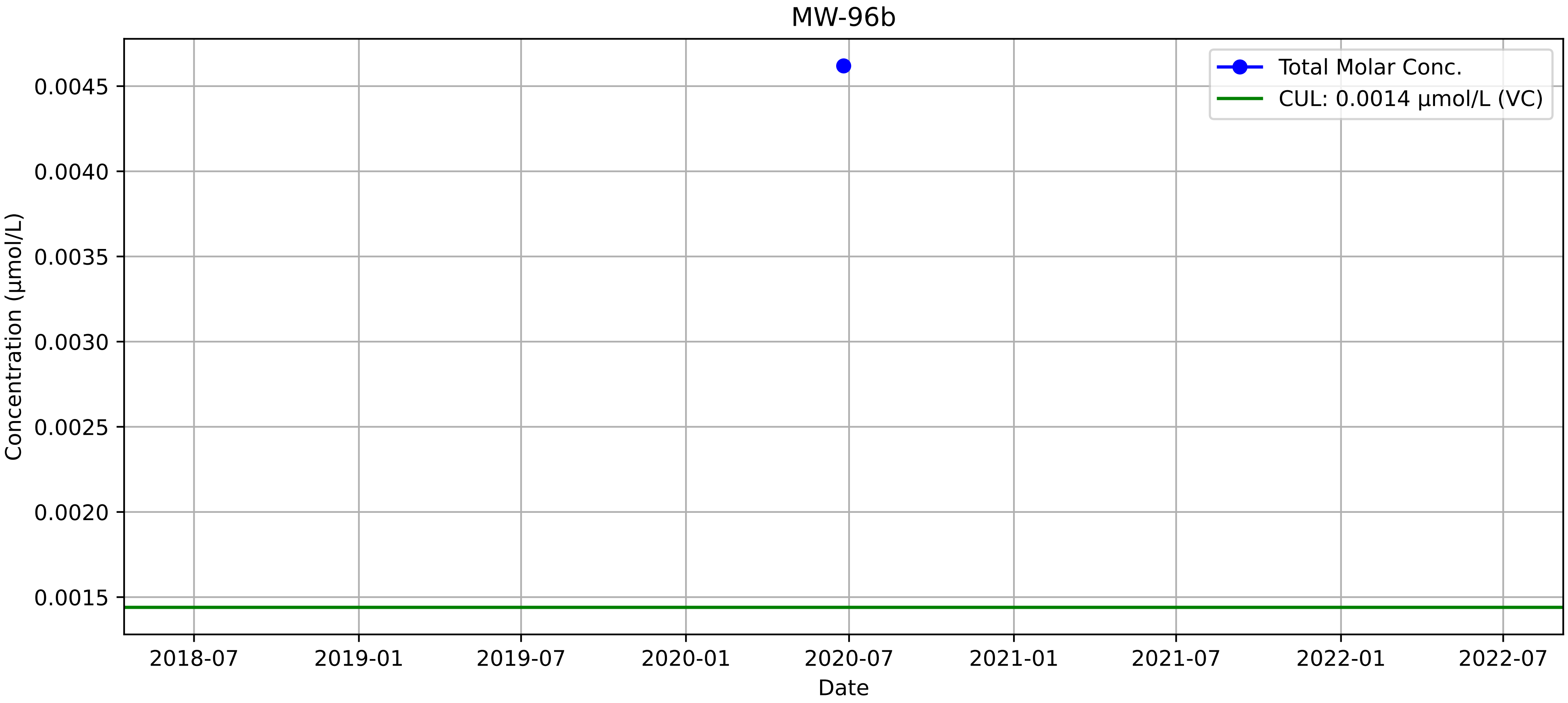
MW-82b - Mann-Kendall Trend: Stable
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2022
2025
2028
2031
2034
2037
2040
Date
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)

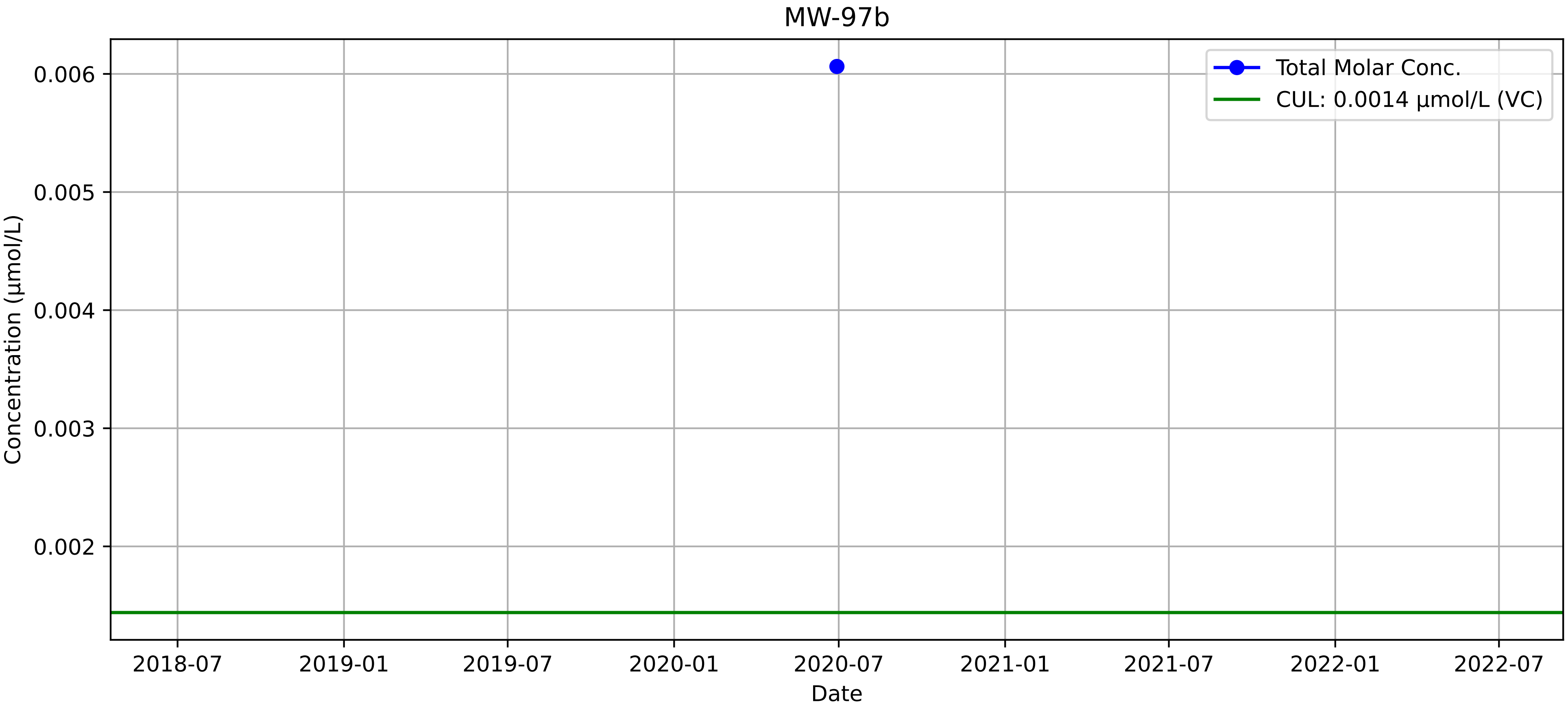


MW-86b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

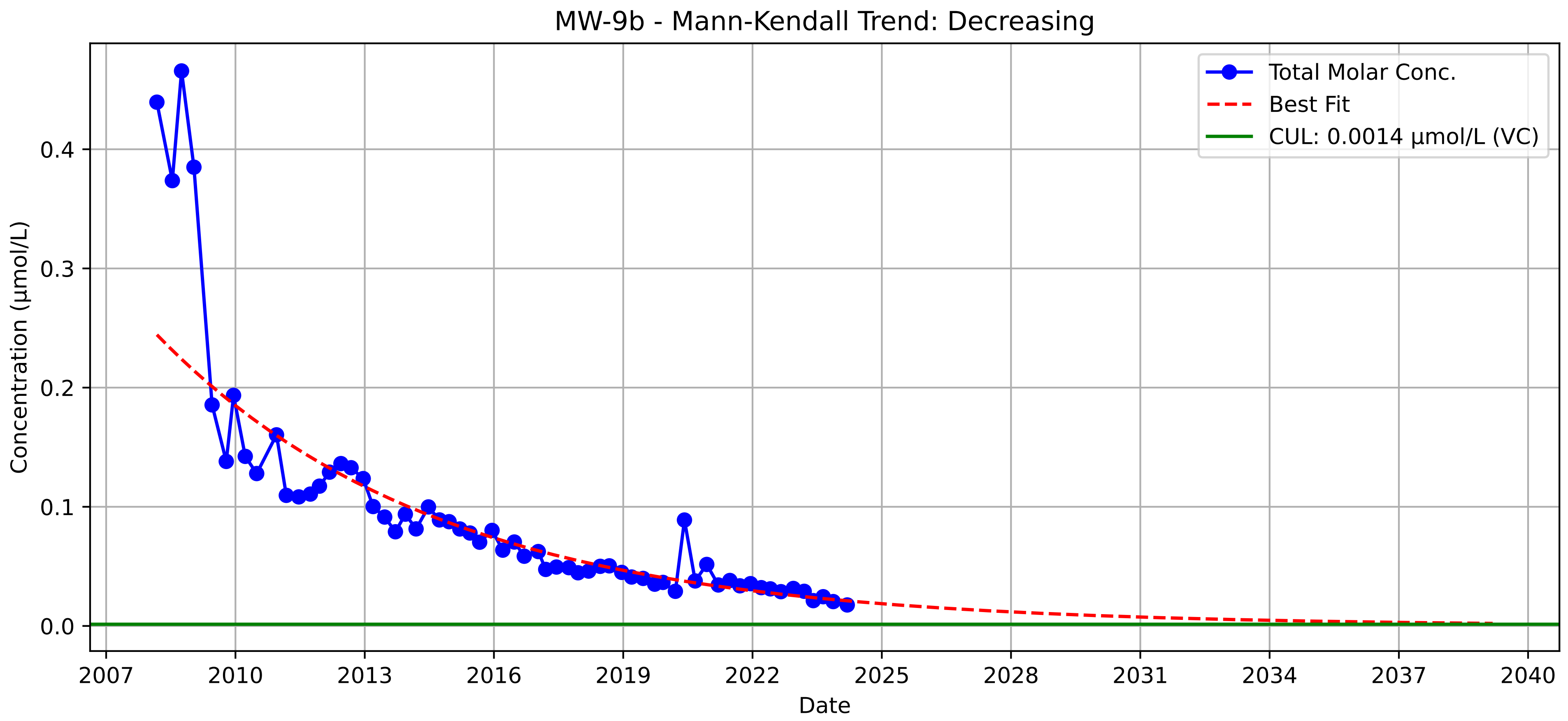

MW-89b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date


MW-93b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date


MW-96b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

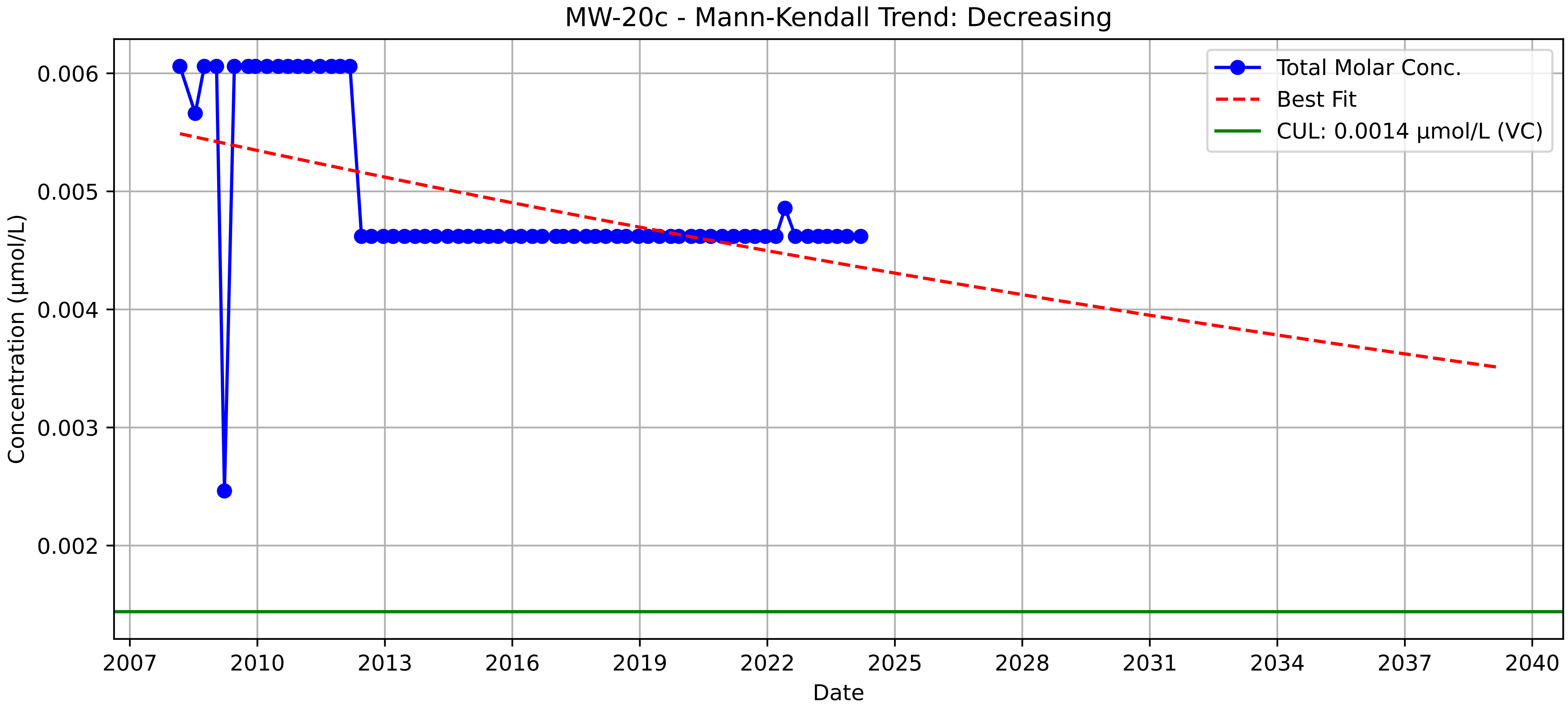


MW-97b
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2018-07
2019-01
2019-07
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
Date

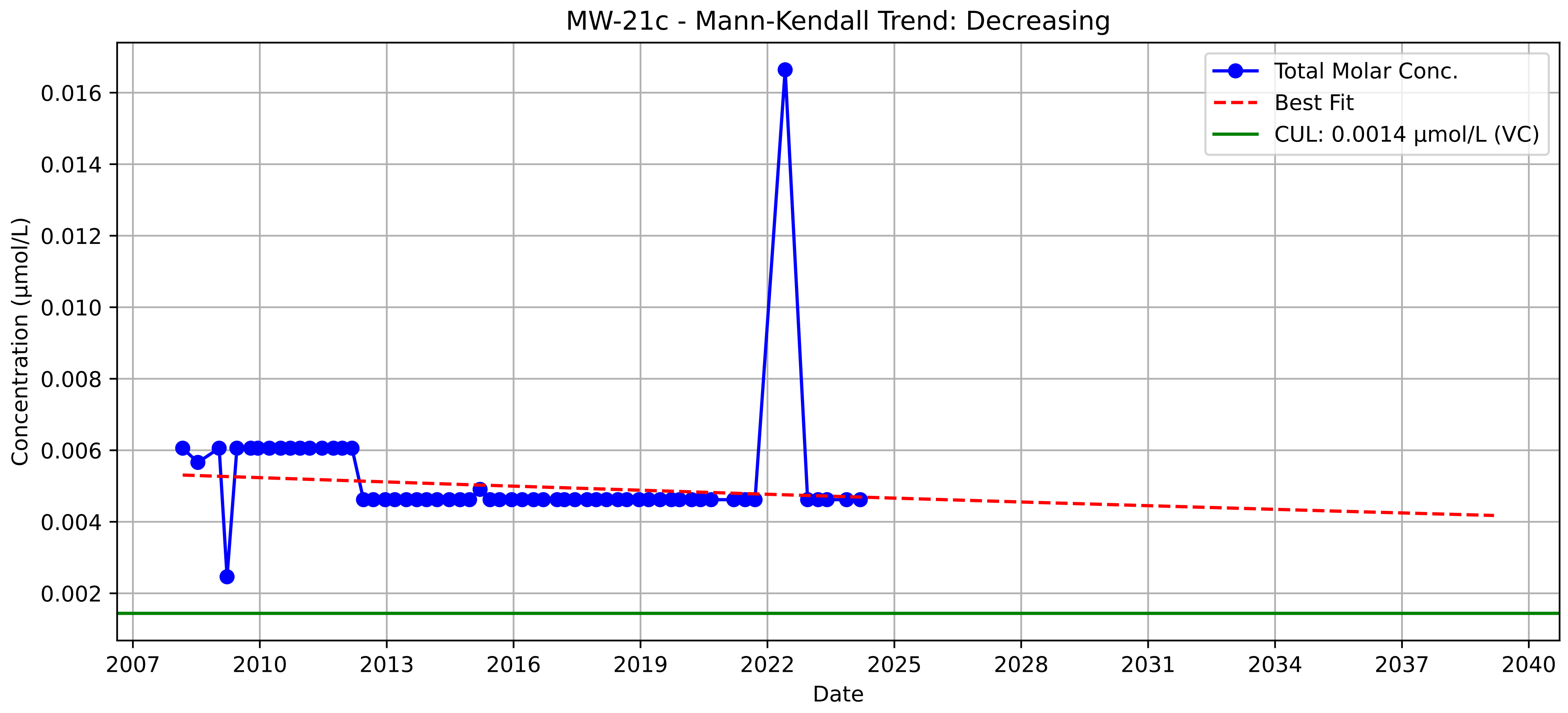


MW-9b - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.1
0.2
0.3
0.4
Date
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040

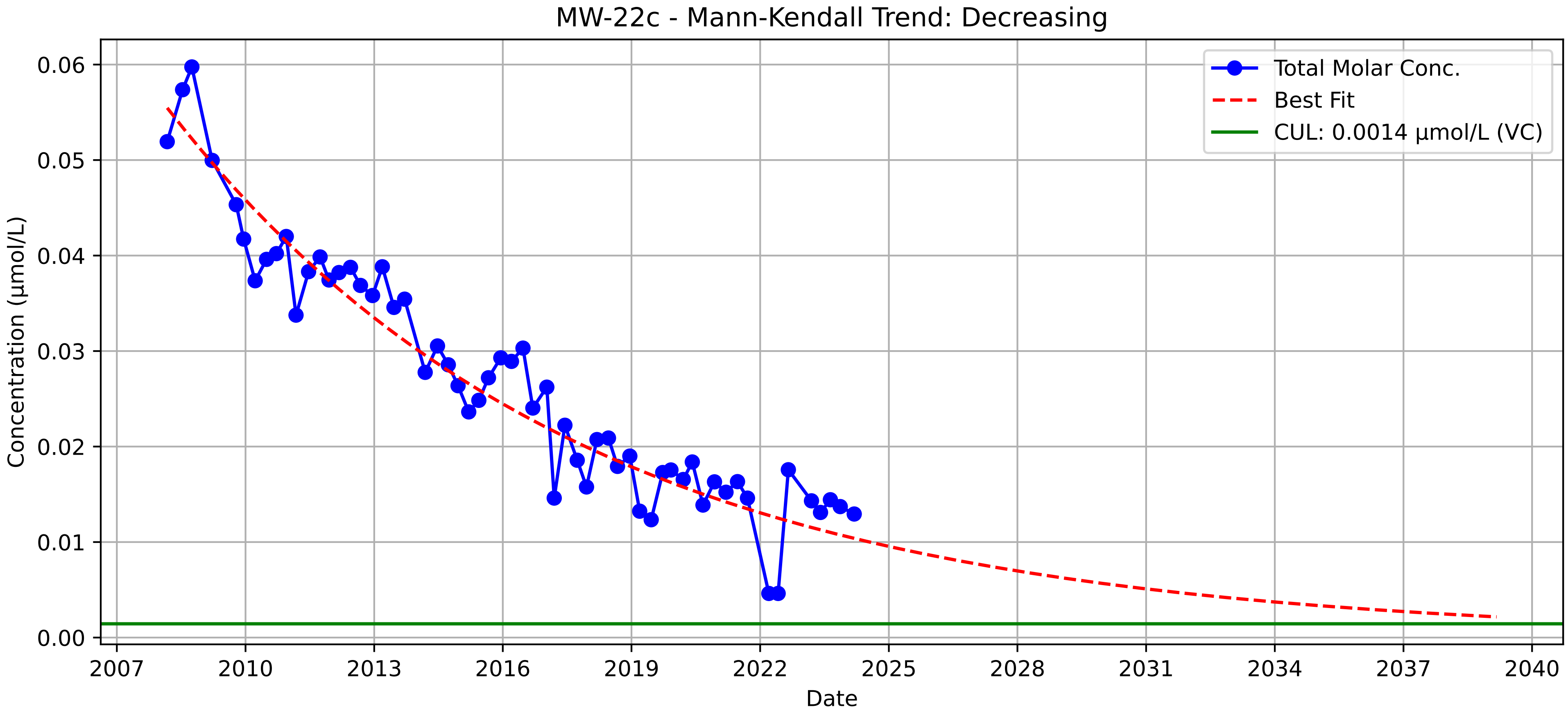
A4. Total molar concentration time series plots of chlorinated ethenes for Interflow Aquifer wells

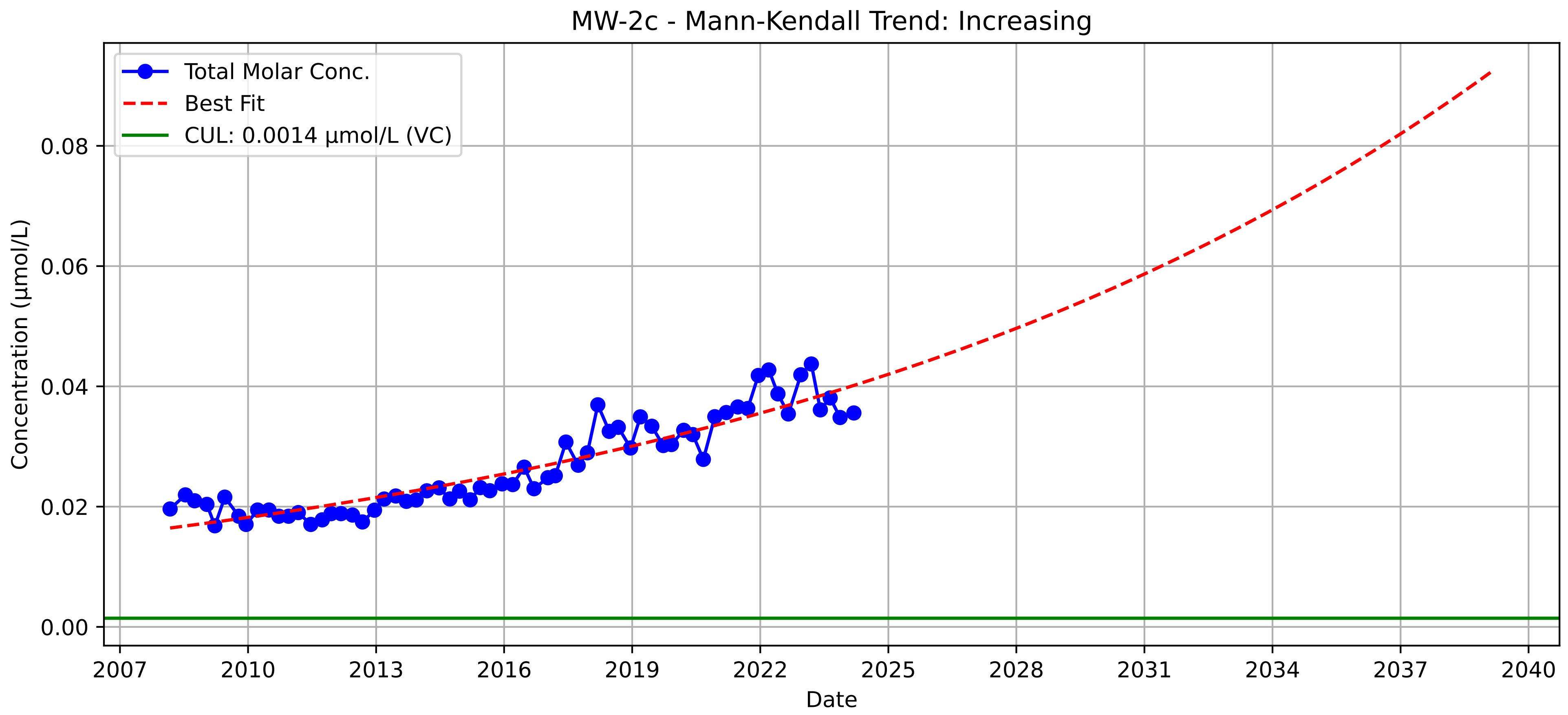


MW-20c - Mann-Kendall Trend: Decreasing
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date

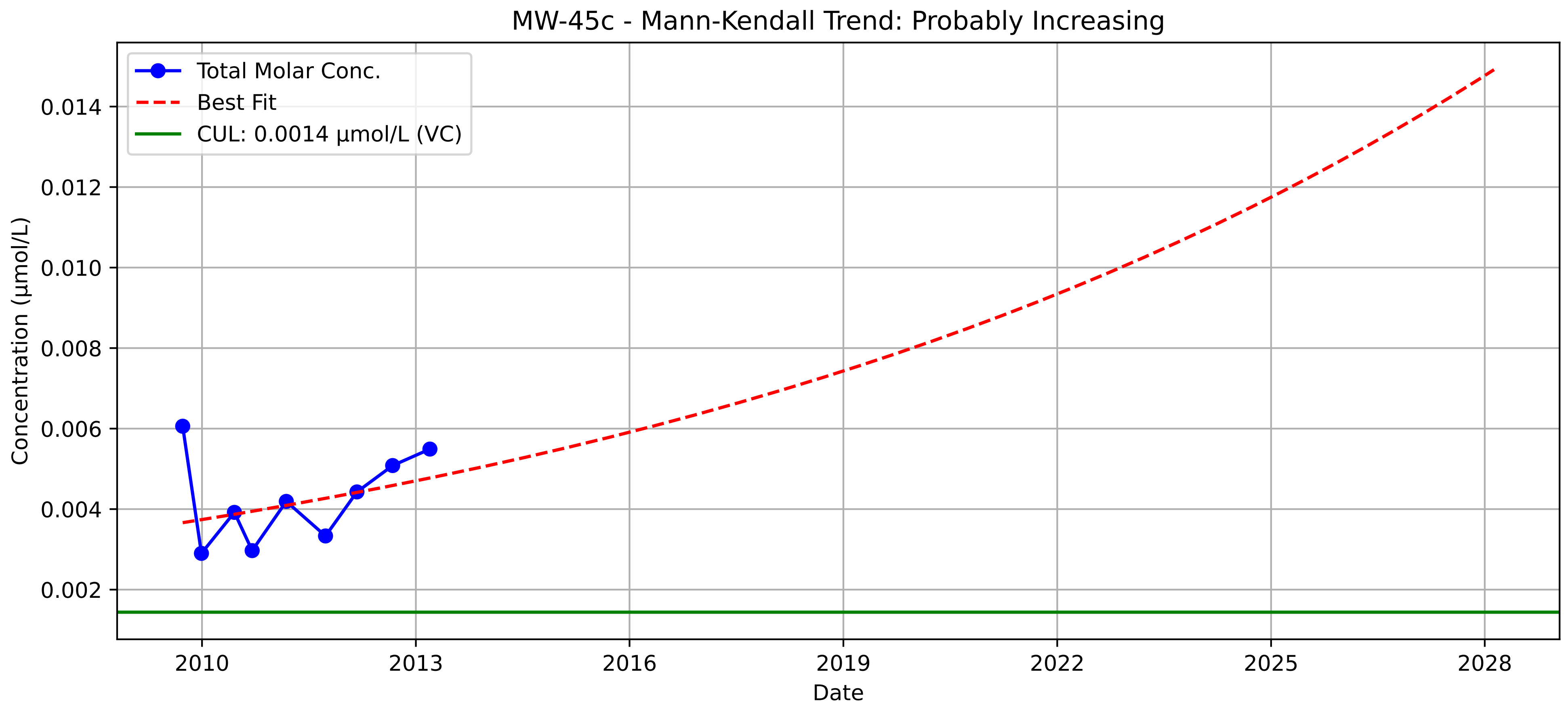


MW-21c - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date

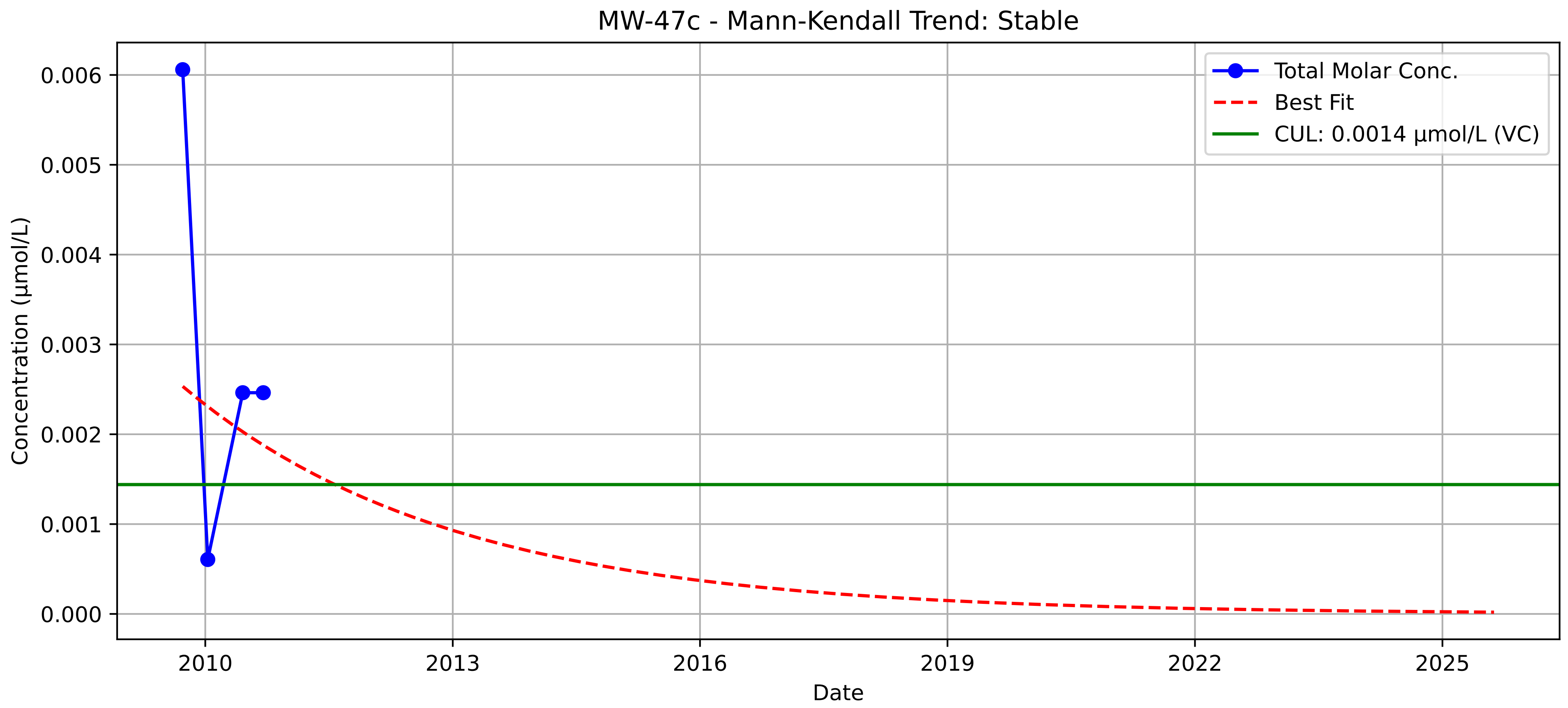

MW-22c - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
Date
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040



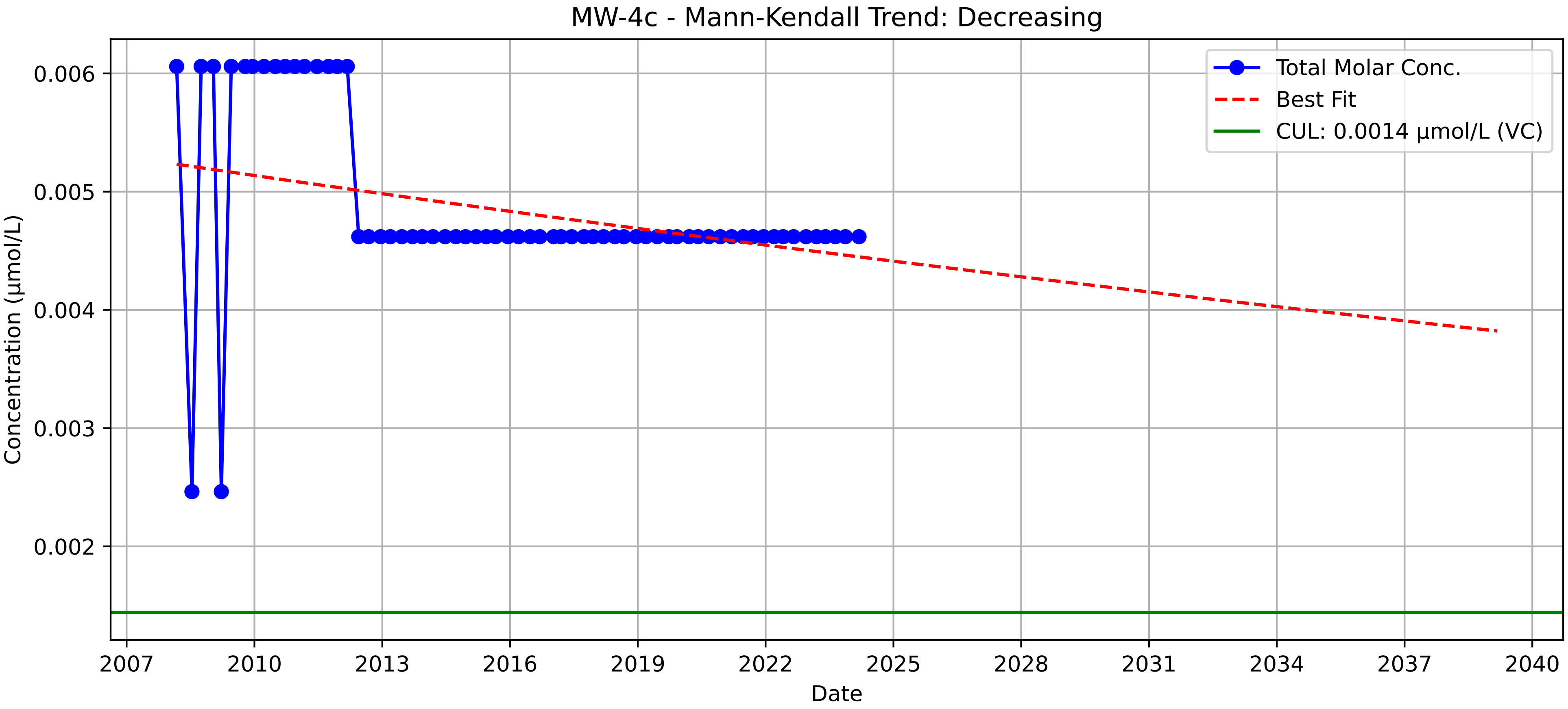
MW-2c - Mann-Kendall Trend: Increasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.02
0.04
0.06
0.08
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date



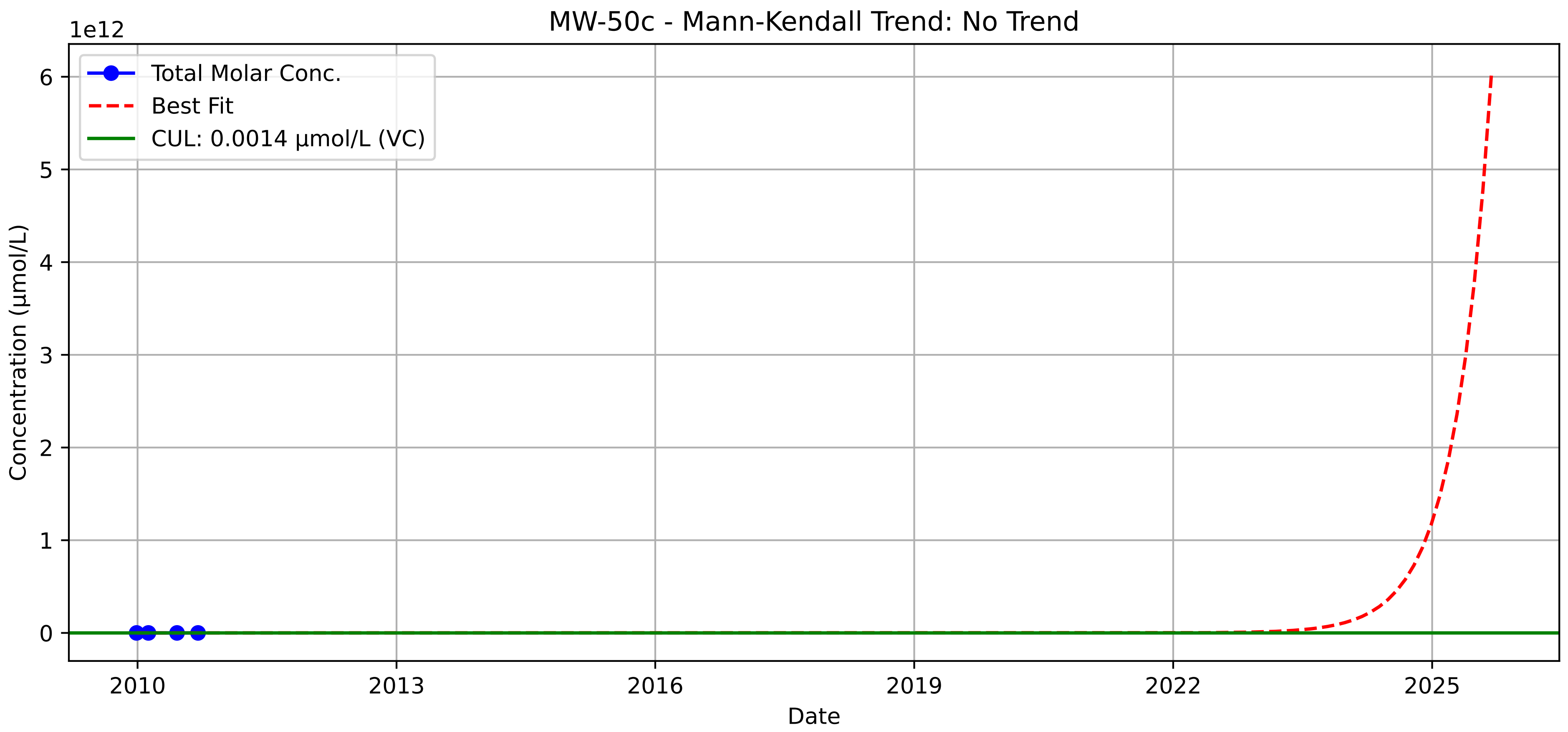
MW-45c - Mann-Kendall Trend: Probably Increasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.014
0.012
0.010
0.008
0.006
0.004
0.002
2010
2013
2016
2019
2022
2025
2028
Date

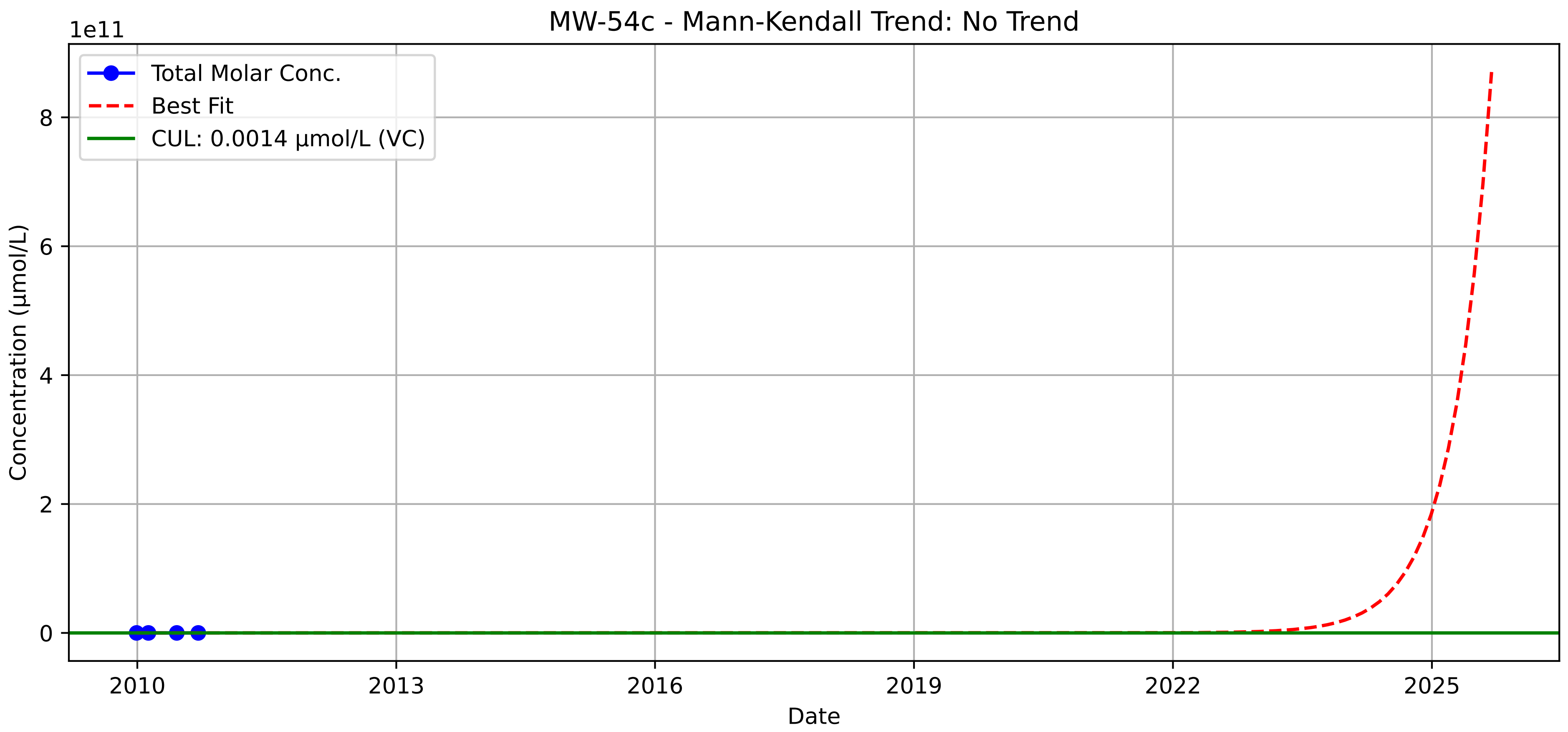


MW-47c - Mann-Kendall Trend: Stable
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
2010
2013
2016
2019
2022
2025
Date

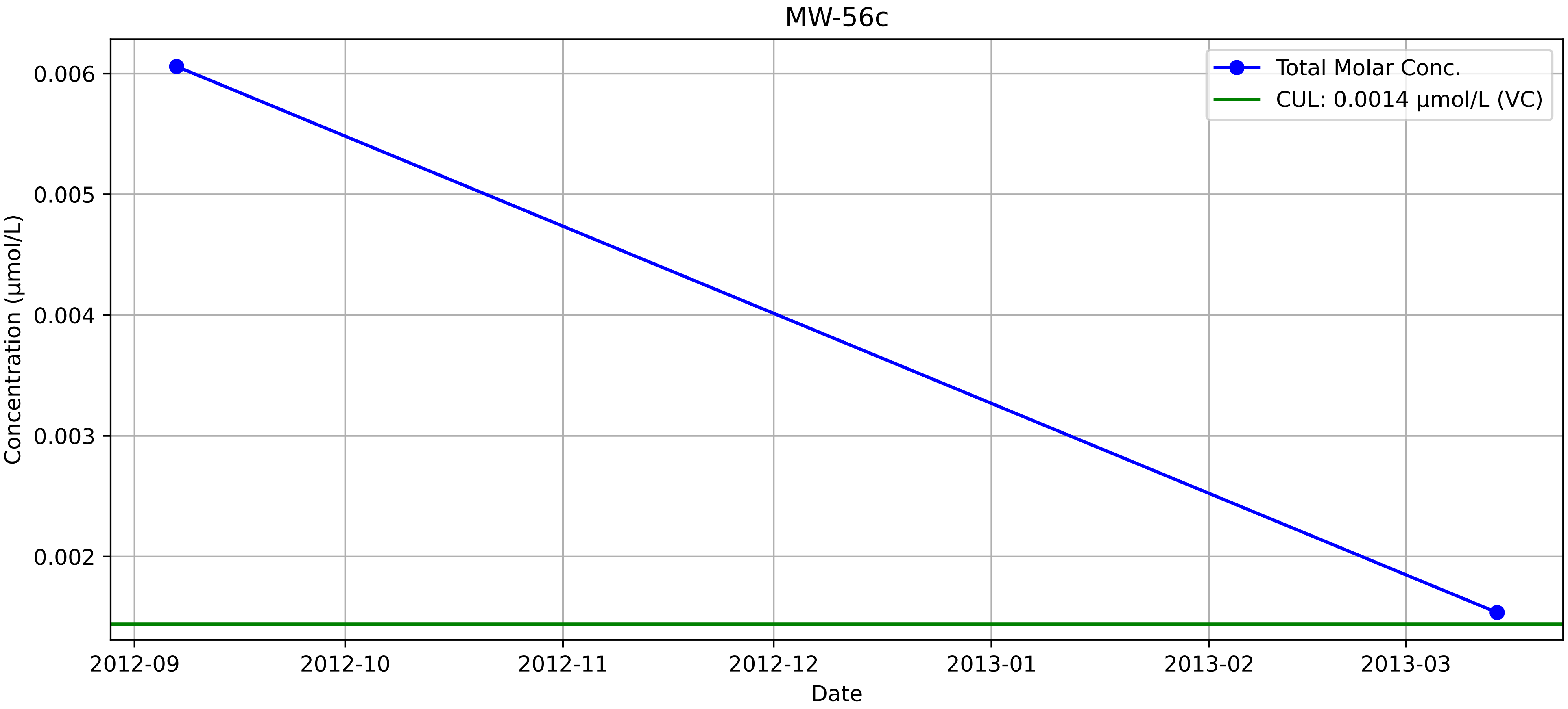


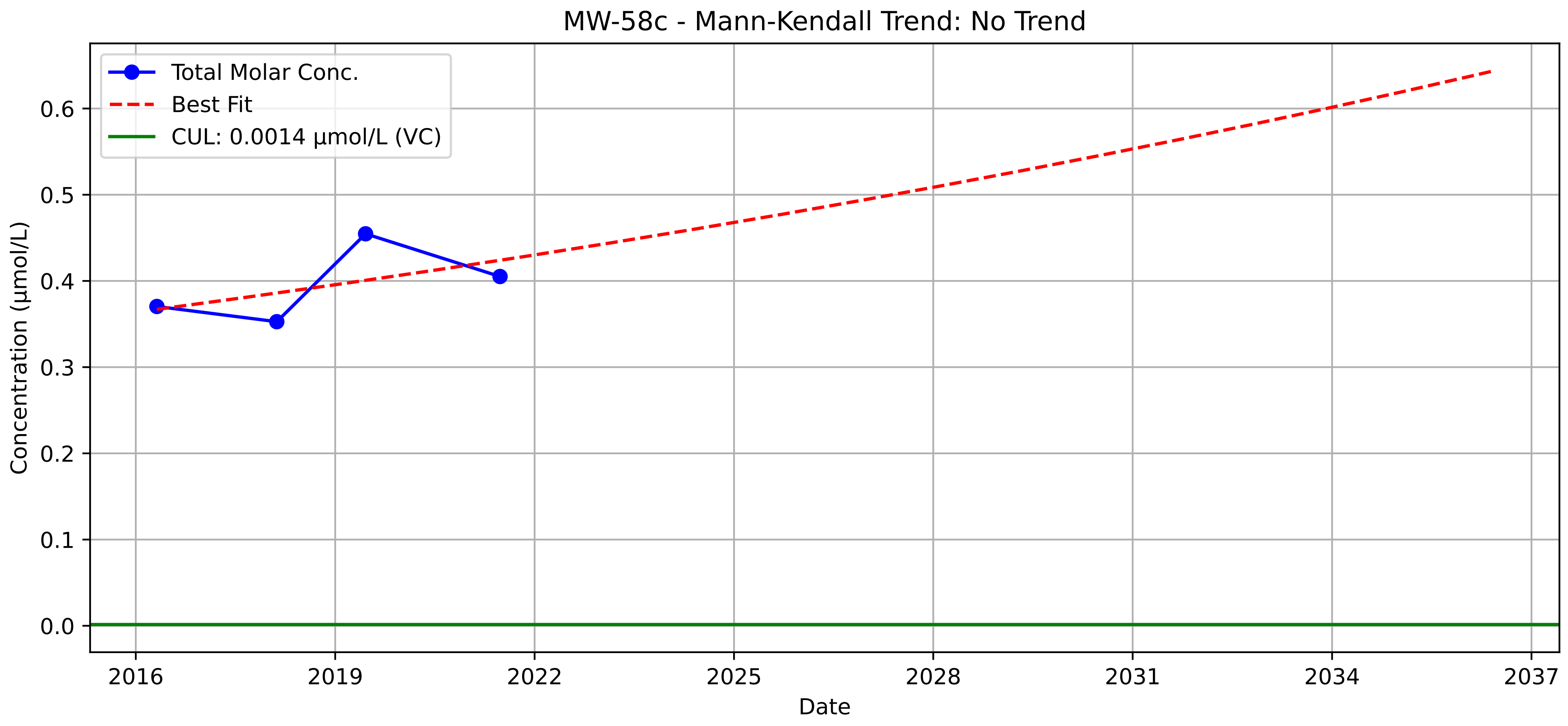
MW-4c - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date


MW-50c - Mann-Kendall Trend: No Trend
1e12
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
1
2
3
4
5
6
2010
2013
2016
2019
2022
2025
Date

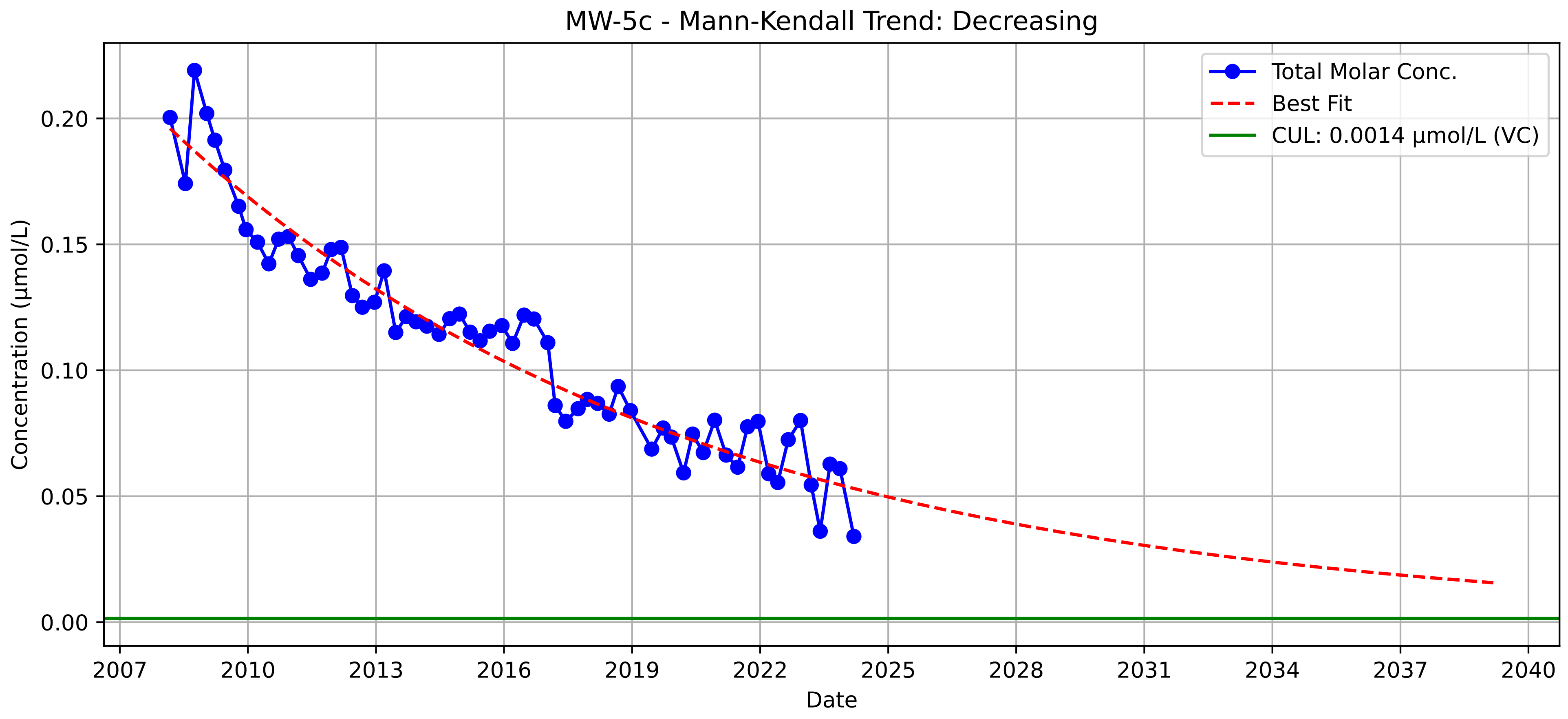


MW-54c - Mann-Kendall Trend: No Trend
1e11
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0
2
4
6
8
2010
2013
2016
2019
2022
2025
Date

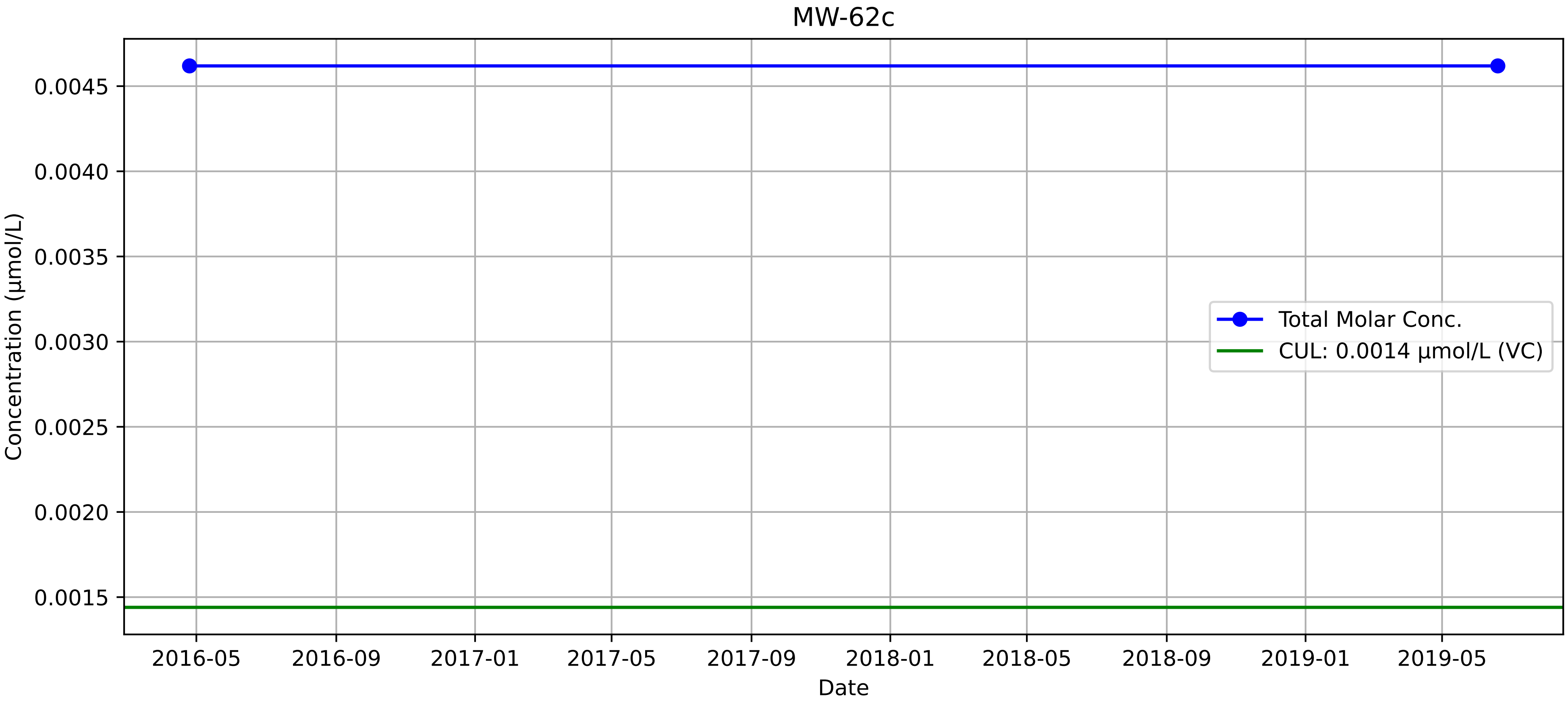

MW-56c
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.006
0.005
0.004
0.003
0.002
2012-09
2012-10
2012-11
2012-12
2013-01
2013-02
2013-03
Date



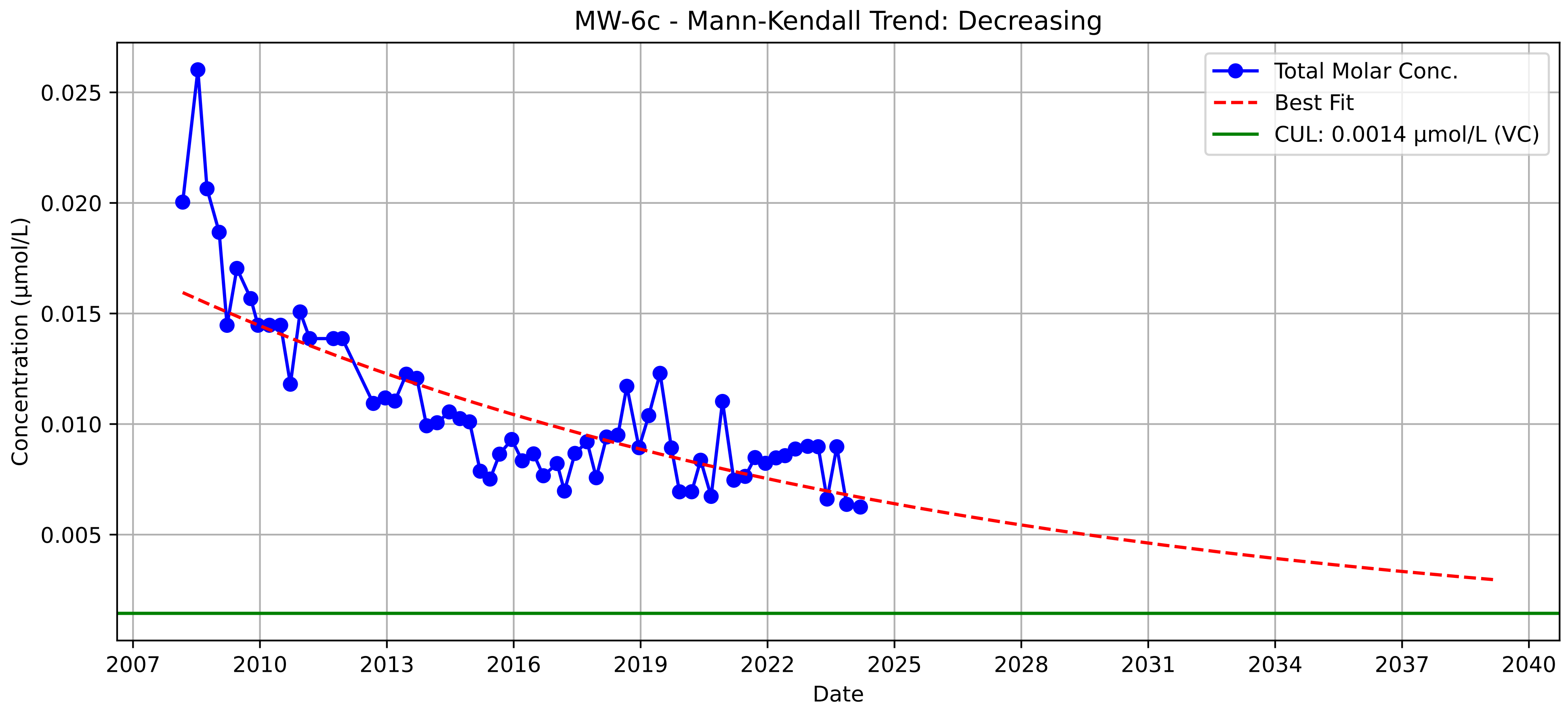
MW-58c - Mann-Kendall Trend: No Trend
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
2016
2019
2022
2025
2028
2031
2034
2037
Date



MW-5c - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.00
0.05
0.10
0.15
0.20
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date



MW-62c
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
Concentration (µmol/L)
Total Molar Conc.
CUL: 0.0014 µmol/L (VC)
2016-05
2016-09
2017-01
2017-05
2017-09
2018-01
2018-05
2018-09
2019-01
2019-05
Date



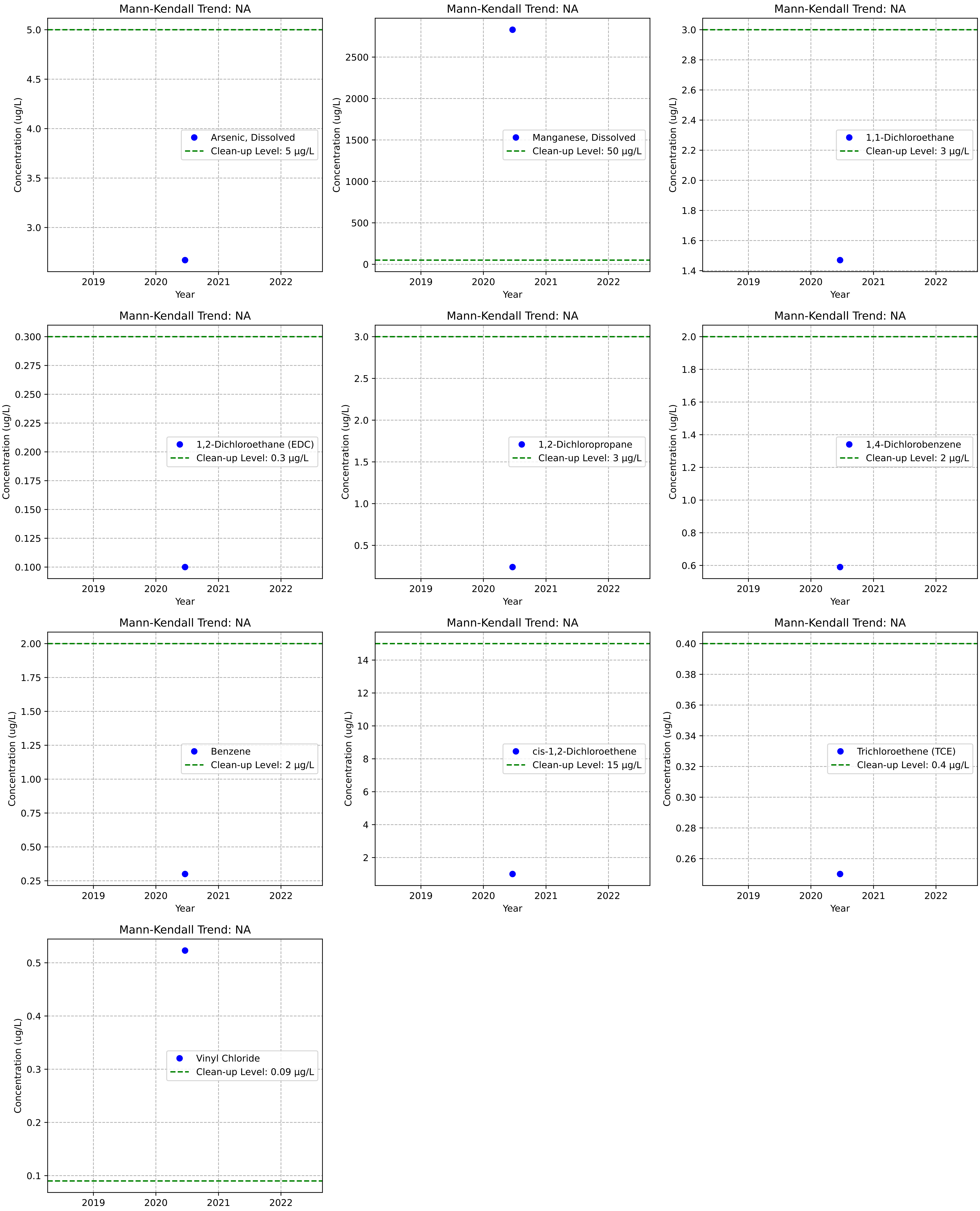
MW-6c - Mann-Kendall Trend: Decreasing
Total Molar Conc.
Best Fit
CUL: 0.0014 µmol/L (VC)
Concentration (µmol/L)
0.025
0.020
0.015
0.010
0.005
2007
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
Date

APPENDIX B

Concentration time series plots of IHS constituents, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

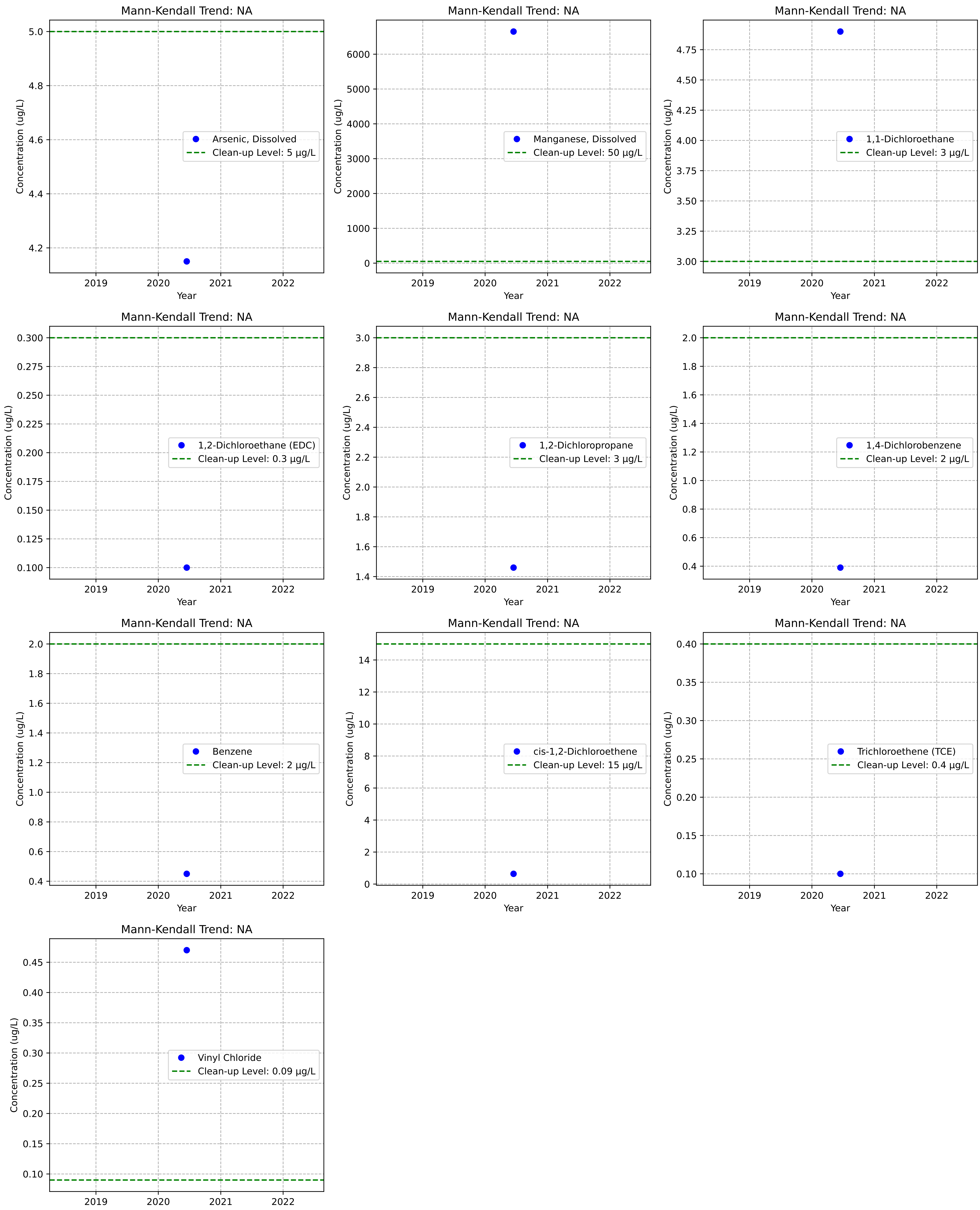
B1. Concentration time series plots of IHS constituents for P1 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

MW-100p1

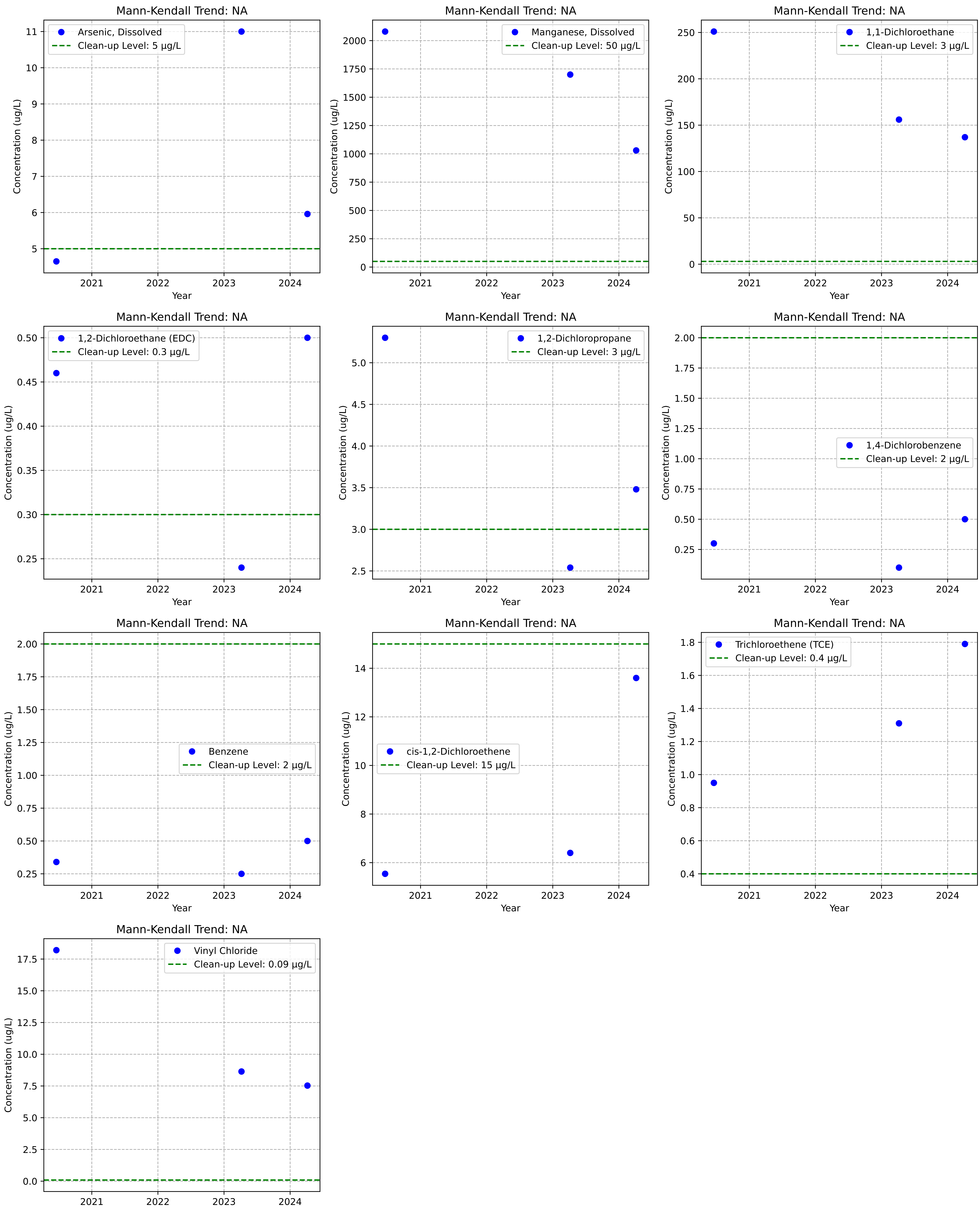


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-104p1

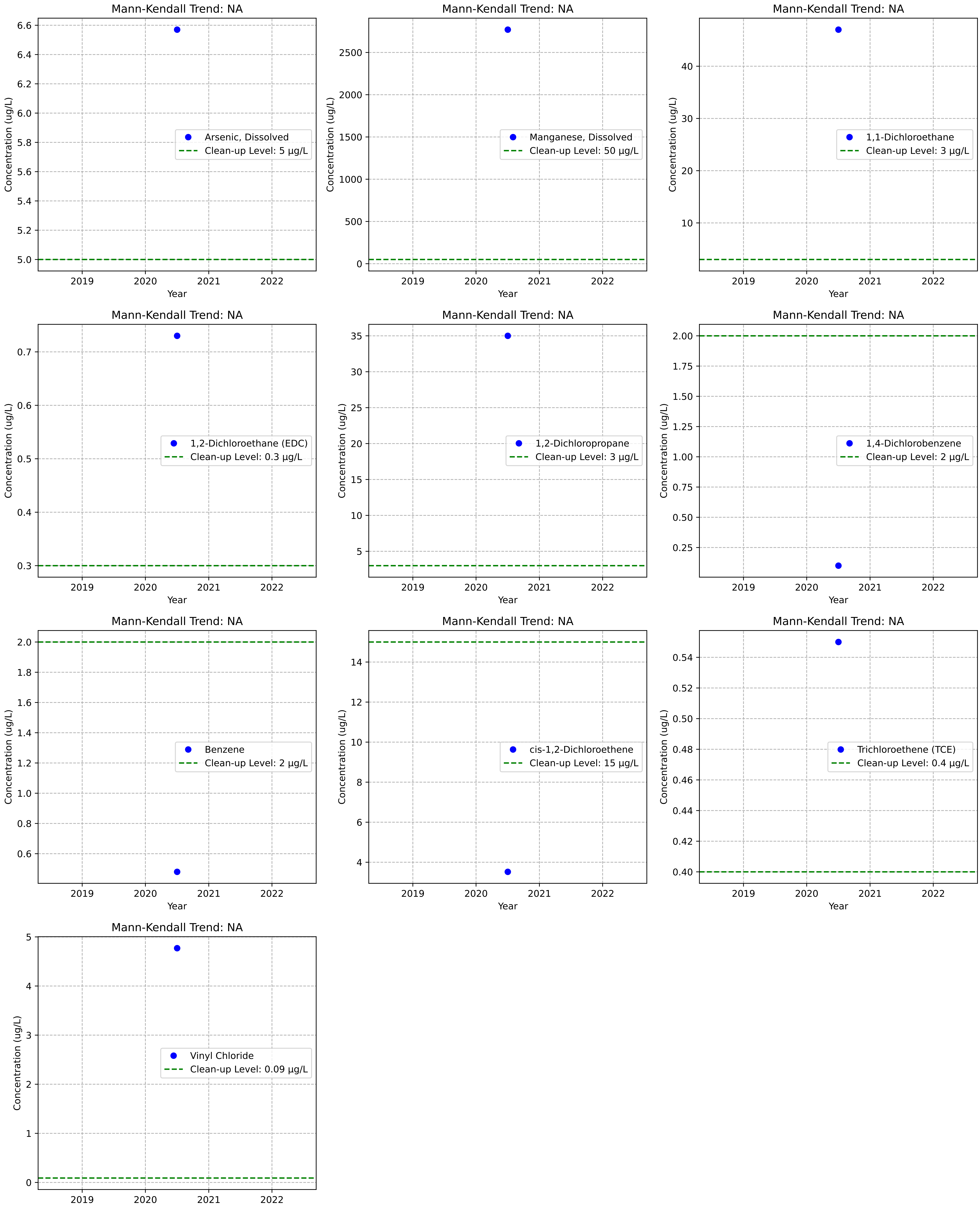

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-109p1



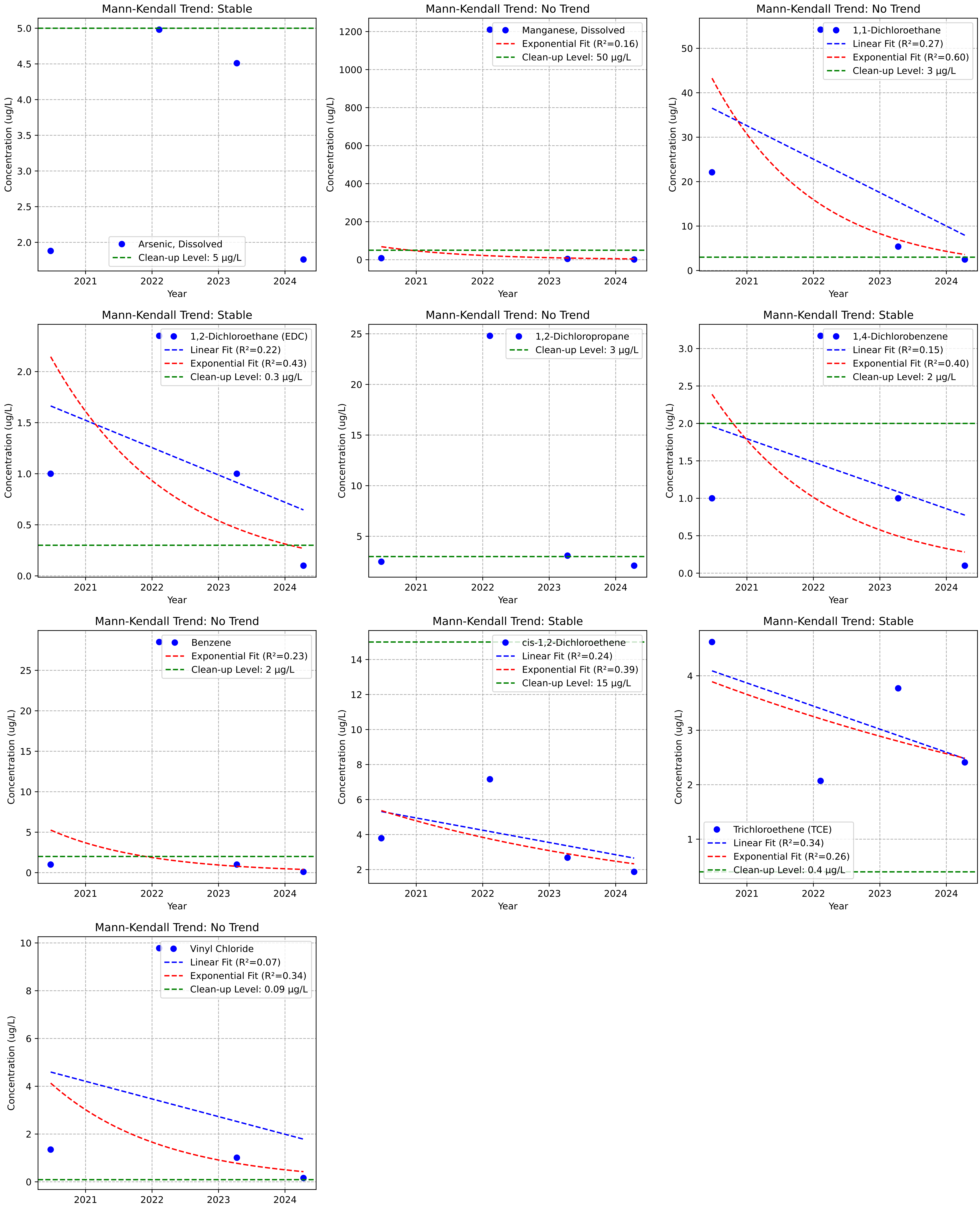
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-110p1

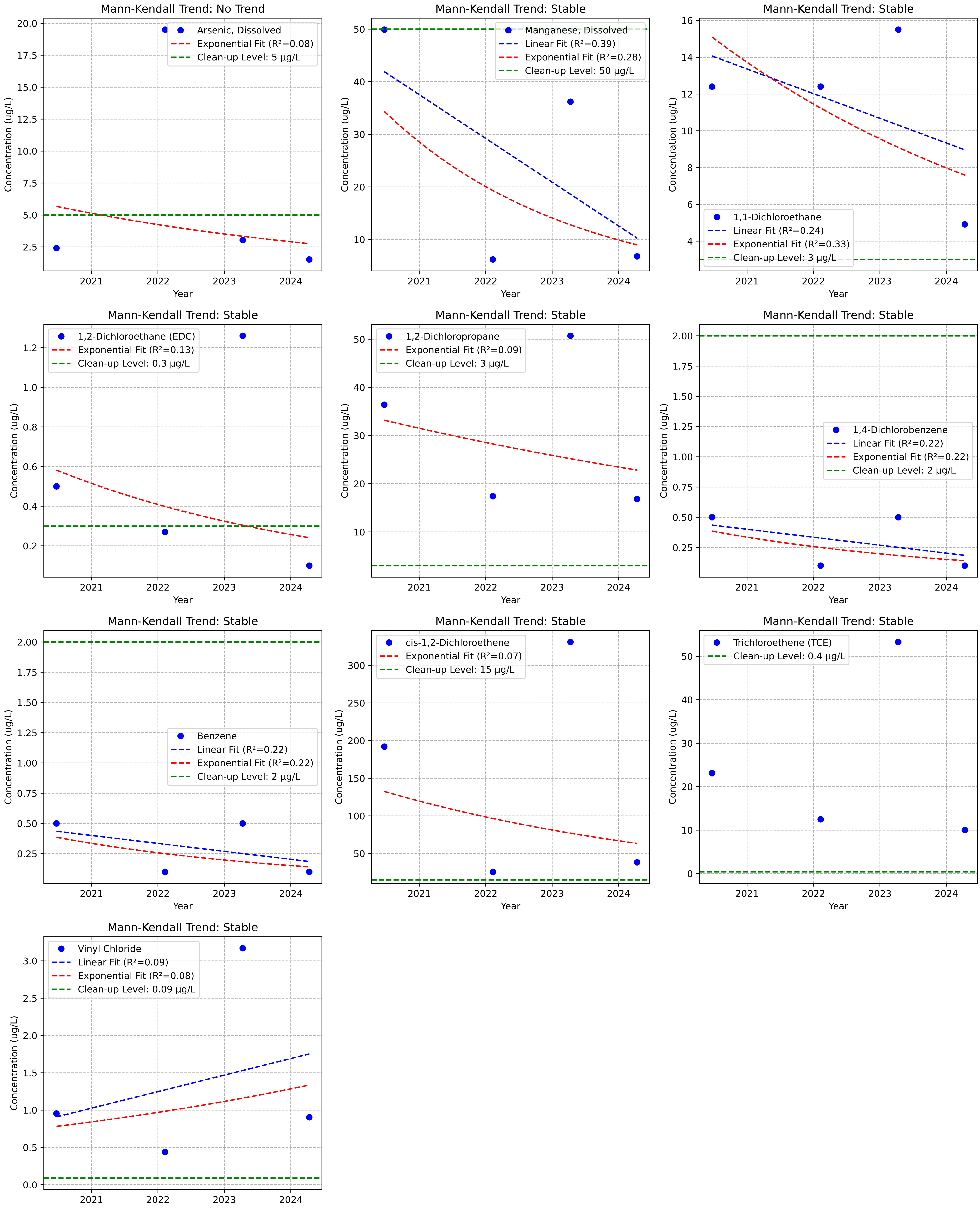


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-117p1

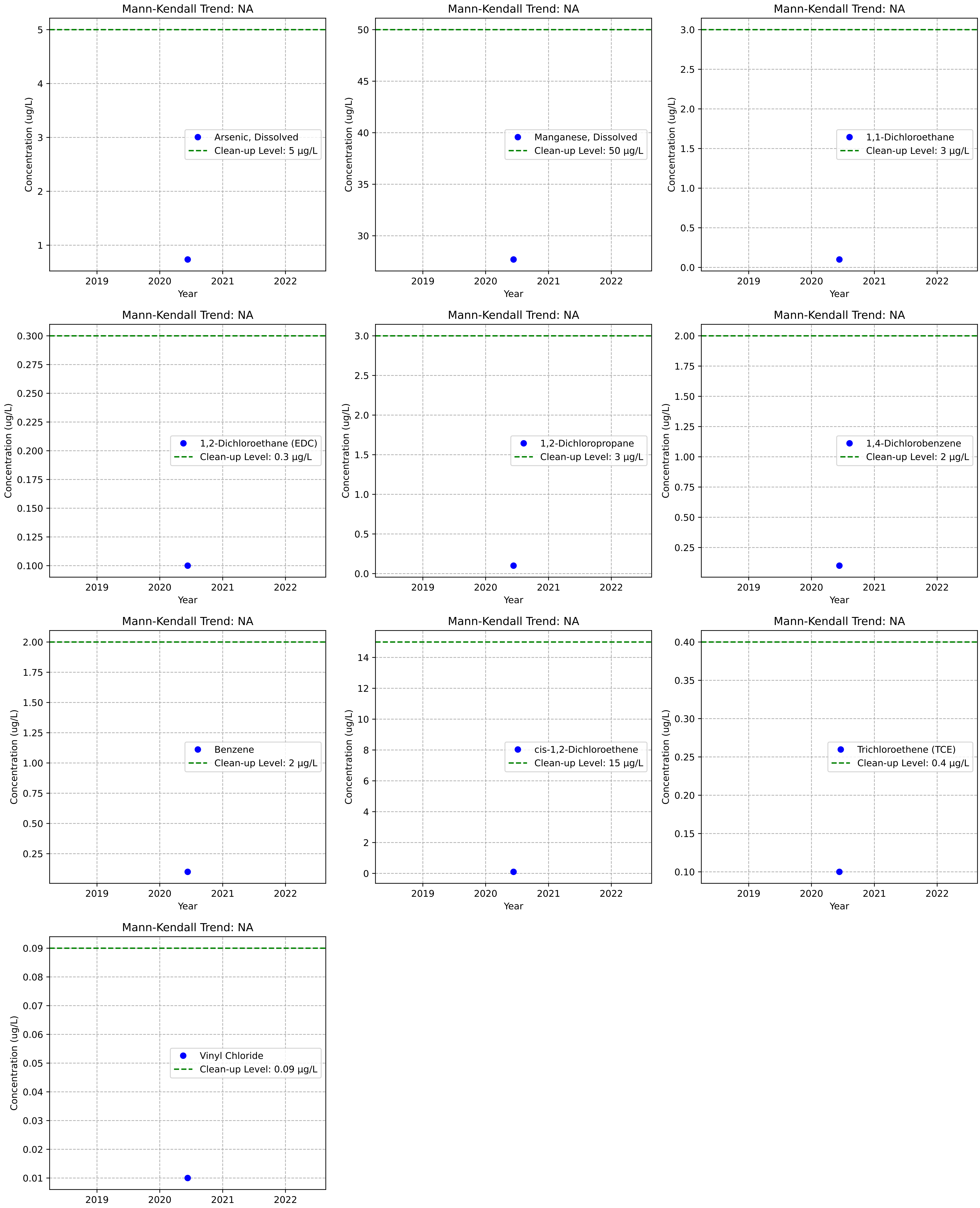

Mann-Kendall Trend: Stable
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Exponential Fit (R²=0.16)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.27)
Exponential Fit (R²=0.60)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.22)
Exponential Fit (R²=0.43)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.15)
Exponential Fit (R²=0.40)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Exponential Fit (R²=0.23)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.24)
Exponential Fit (R²=0.39)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.34)
Exponential Fit (R²=0.26)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.07)
Exponential Fit (R²=0.34)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-123p1



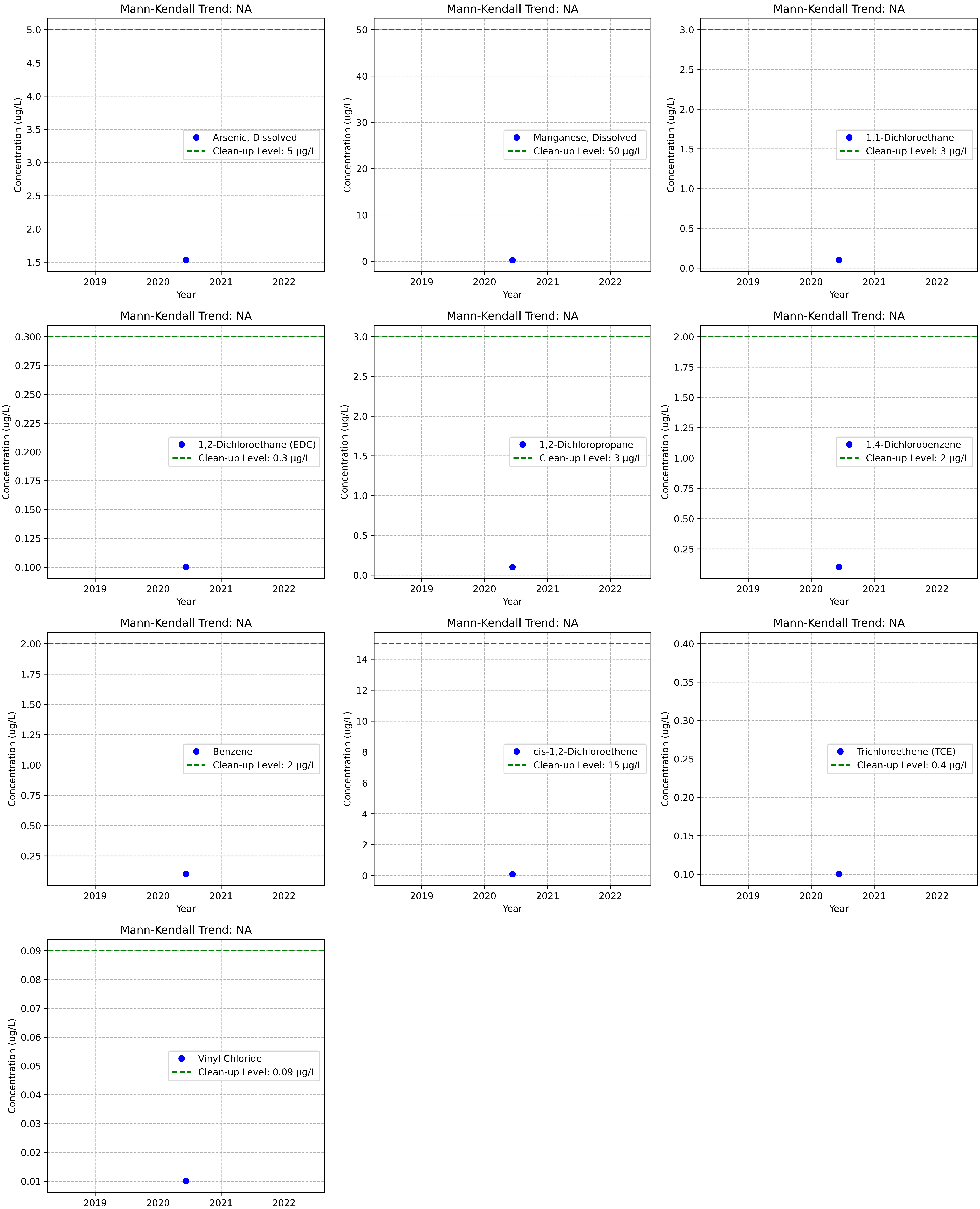
Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Exponential Fit (R²=0.08)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.39)
Exponential Fit (R²=0.28)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.24)
Exponential Fit (R²=0.33)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Exponential Fit (R²=0.13)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Exponential Fit (R²=0.09)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.22)
Exponential Fit (R²=0.22)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.22)
Exponential Fit (R²=0.22)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Exponential Fit (R²=0.07)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.09)
Exponential Fit (R²=0.08)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-127p1



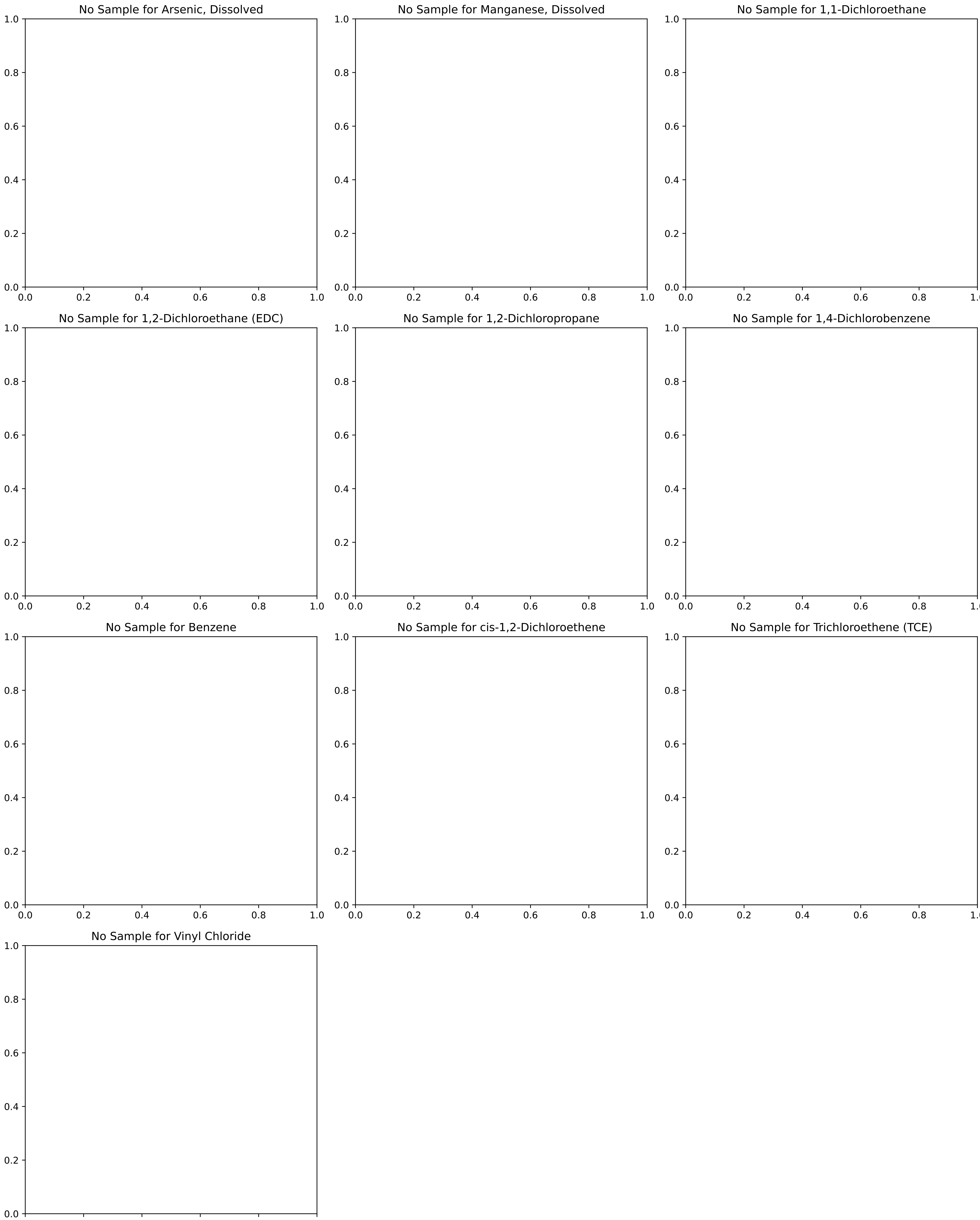
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-129p1

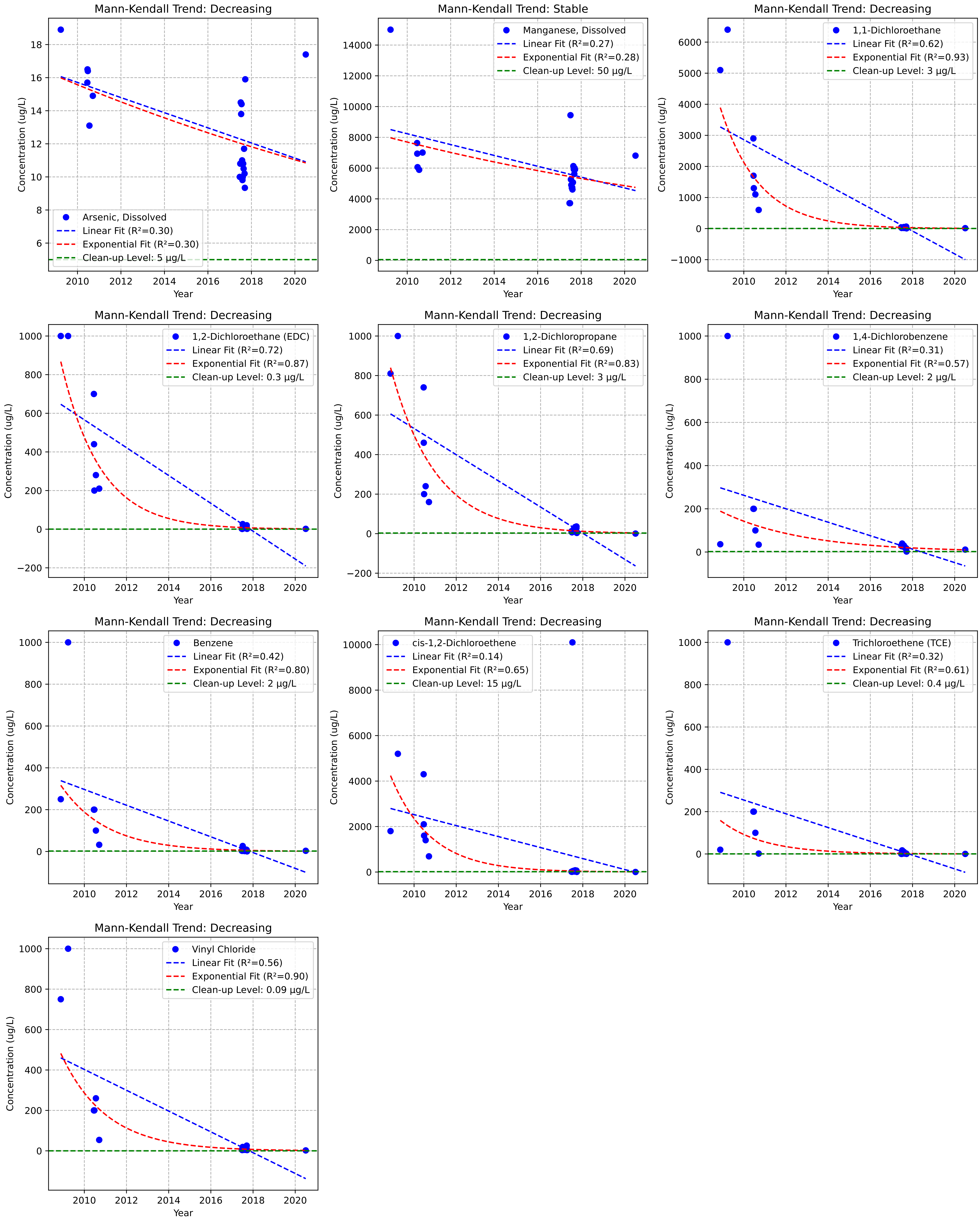


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

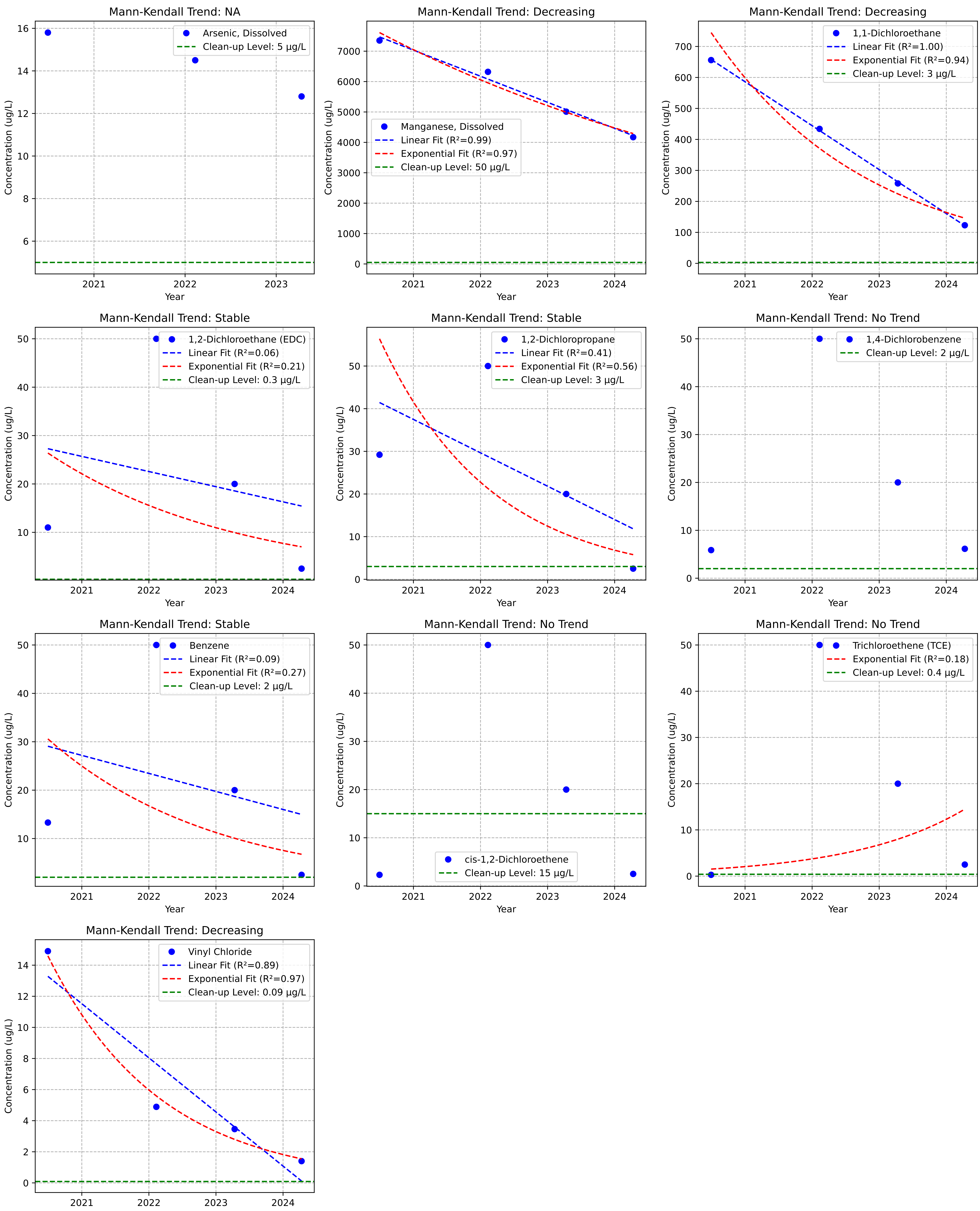
No Data for MW-137p1



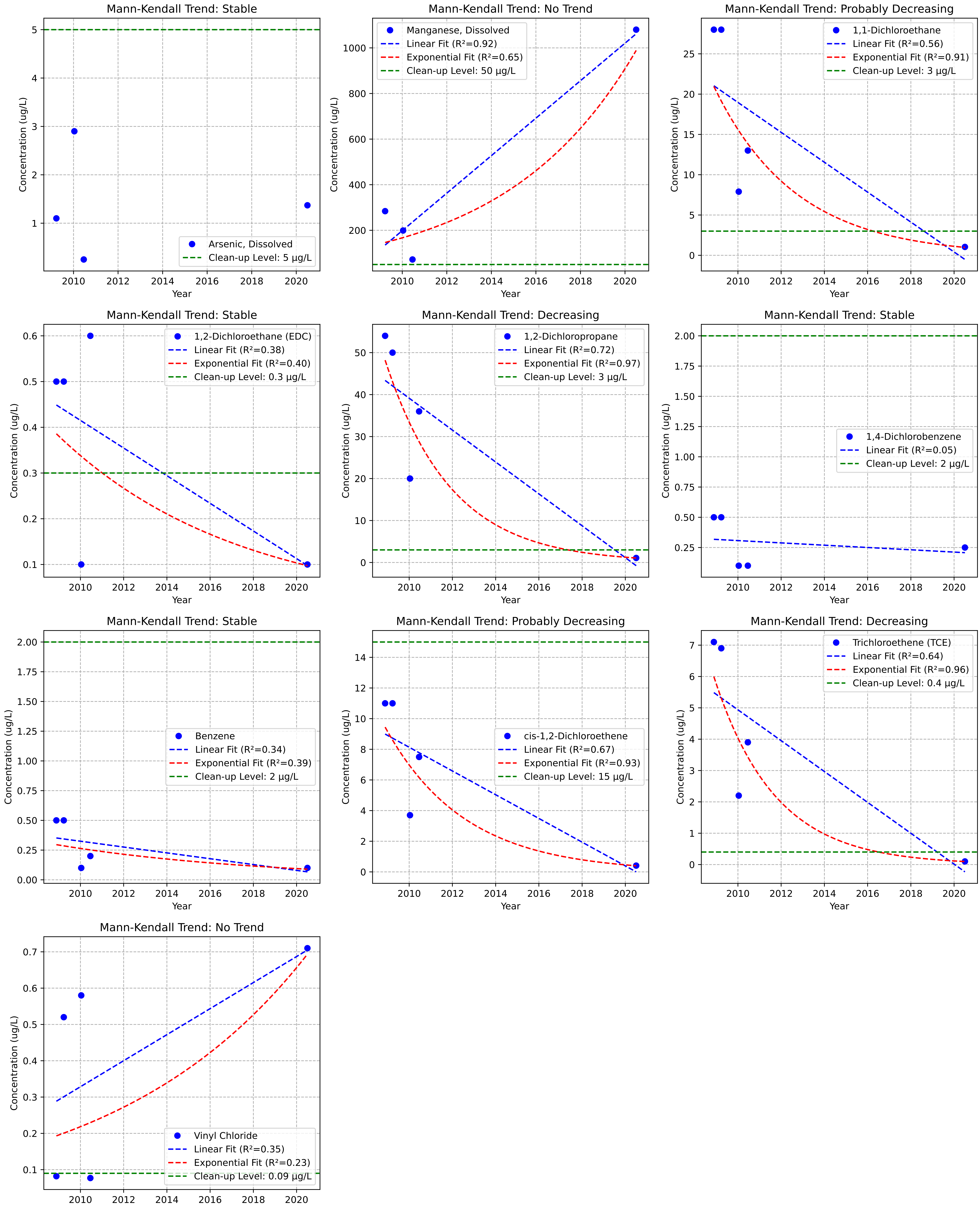
MW-34p1


Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.30)
Exponential Fit (R²=0.30)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.27)
Exponential Fit (R²=0.28)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.62)
Exponential Fit (R²=0.93)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.72)
Exponential Fit (R²=0.87)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.69)
Exponential Fit (R²=0.83)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.31)
Exponential Fit (R²=0.57)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.42)
Exponential Fit (R²=0.80)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.14)
Exponential Fit (R²=0.65)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.32)
Exponential Fit (R²=0.61)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.56)
Exponential Fit (R²=0.90)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

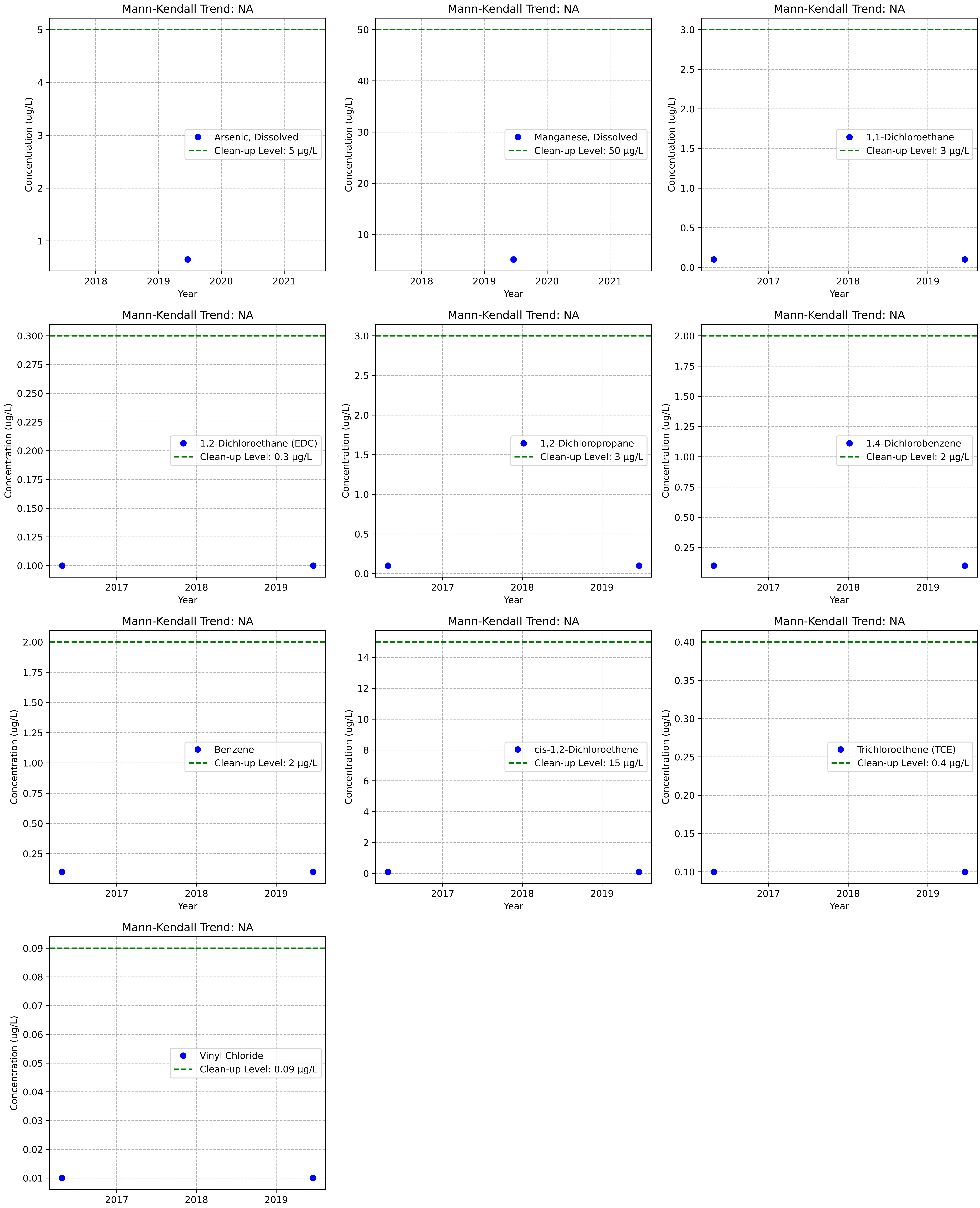
MW-36p1


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.99)
Exponential Fit (R²=0.97)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=1.00)
Exponential Fit (R²=0.94)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.06)
Exponential Fit (R²=0.21)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.41)
Exponential Fit (R²=0.56)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.27)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Exponential Fit (R²=0.18)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.89)
Exponential Fit (R²=0.97)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-37p1

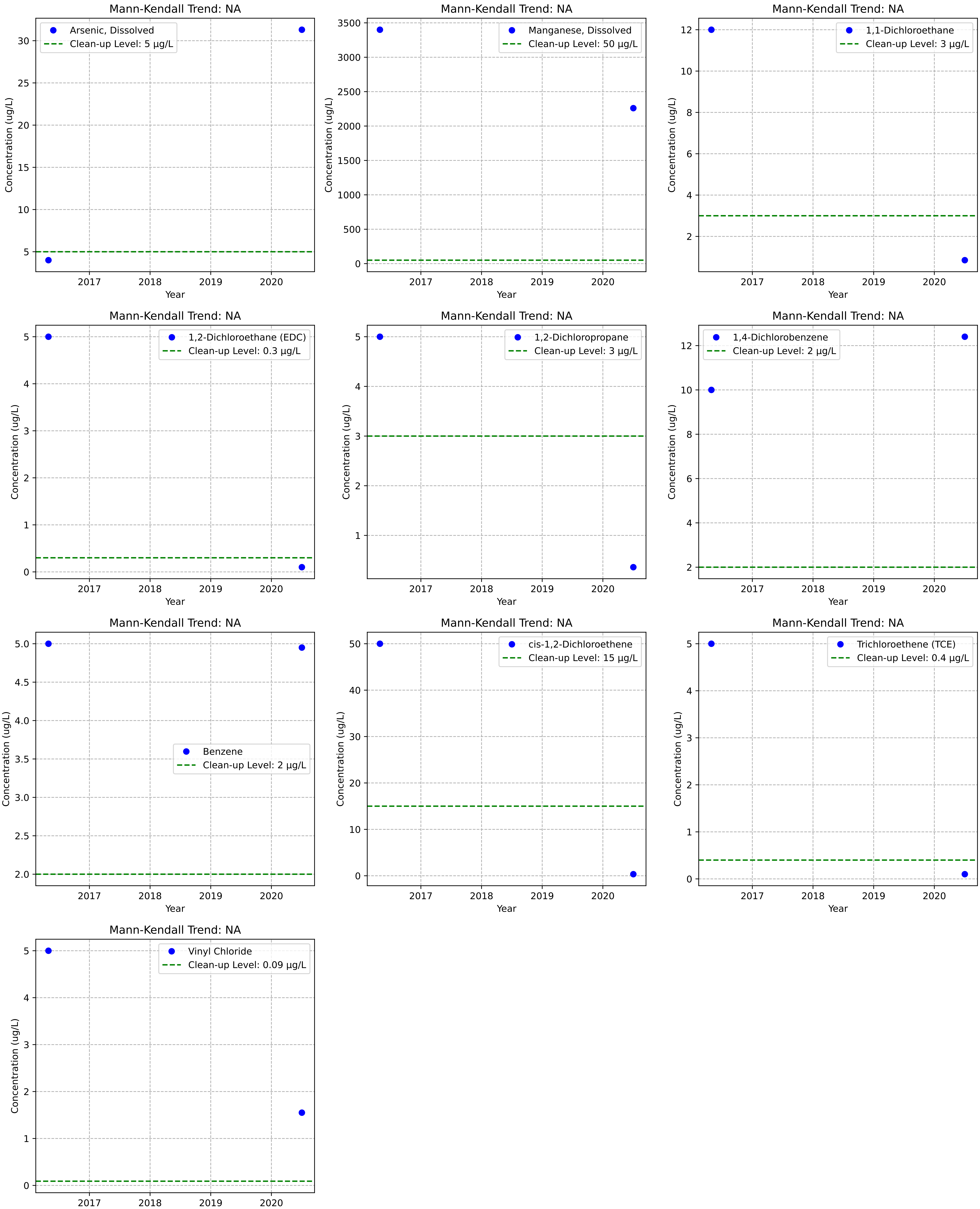

Mann-Kendall Trend: Stable
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.92)
Exponential Fit (R²=0.65)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Probably Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.56)
Exponential Fit (R²=0.91)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.38)
Exponential Fit (R²=0.40)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.72)
Exponential Fit (R²=0.97)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.05)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.34)
Exponential Fit (R²=0.39)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.67)
Exponential Fit (R²=0.93)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.64)
Exponential Fit (R²=0.96)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.35)
Exponential Fit (R²=0.23)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-61p1

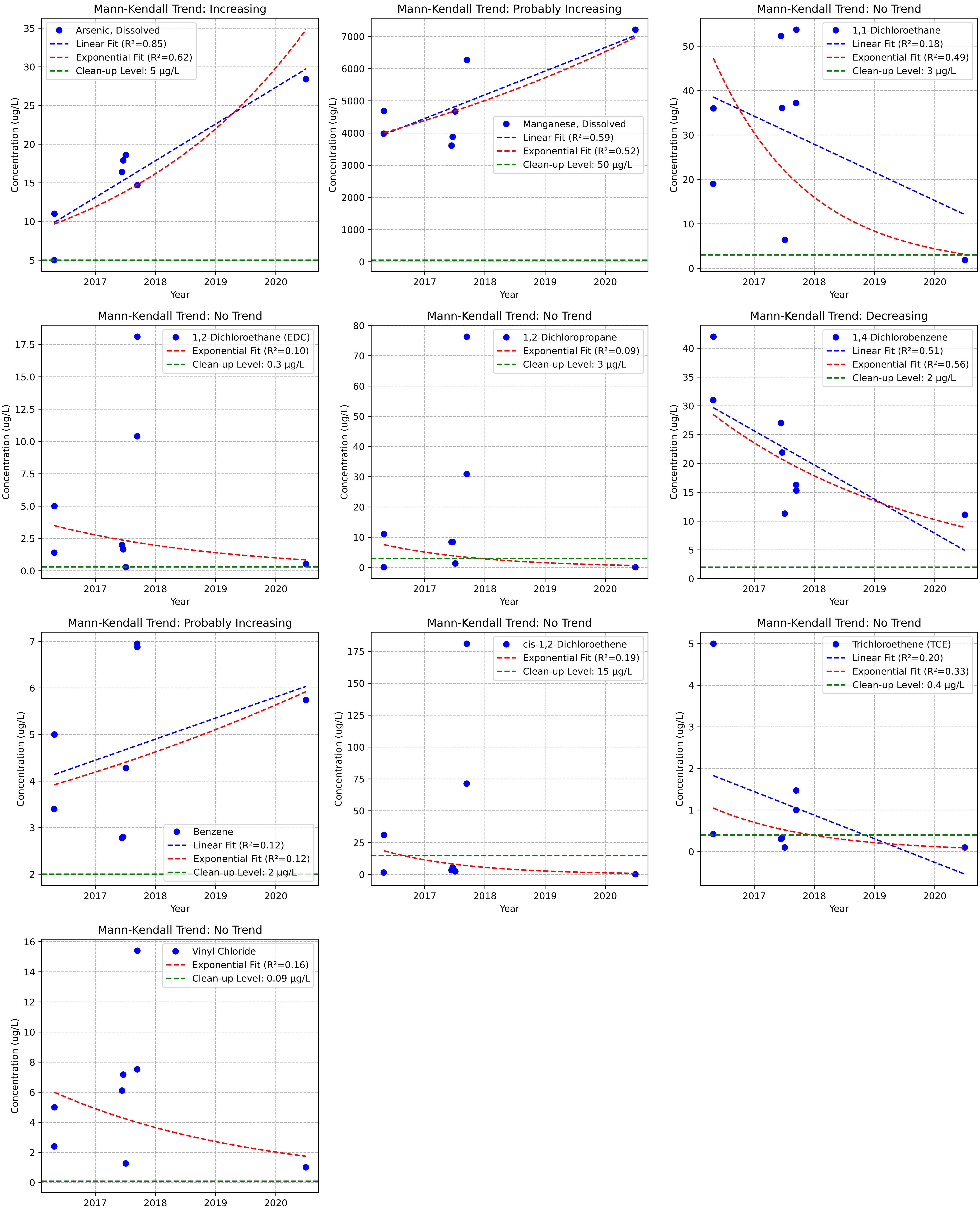


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-64p1

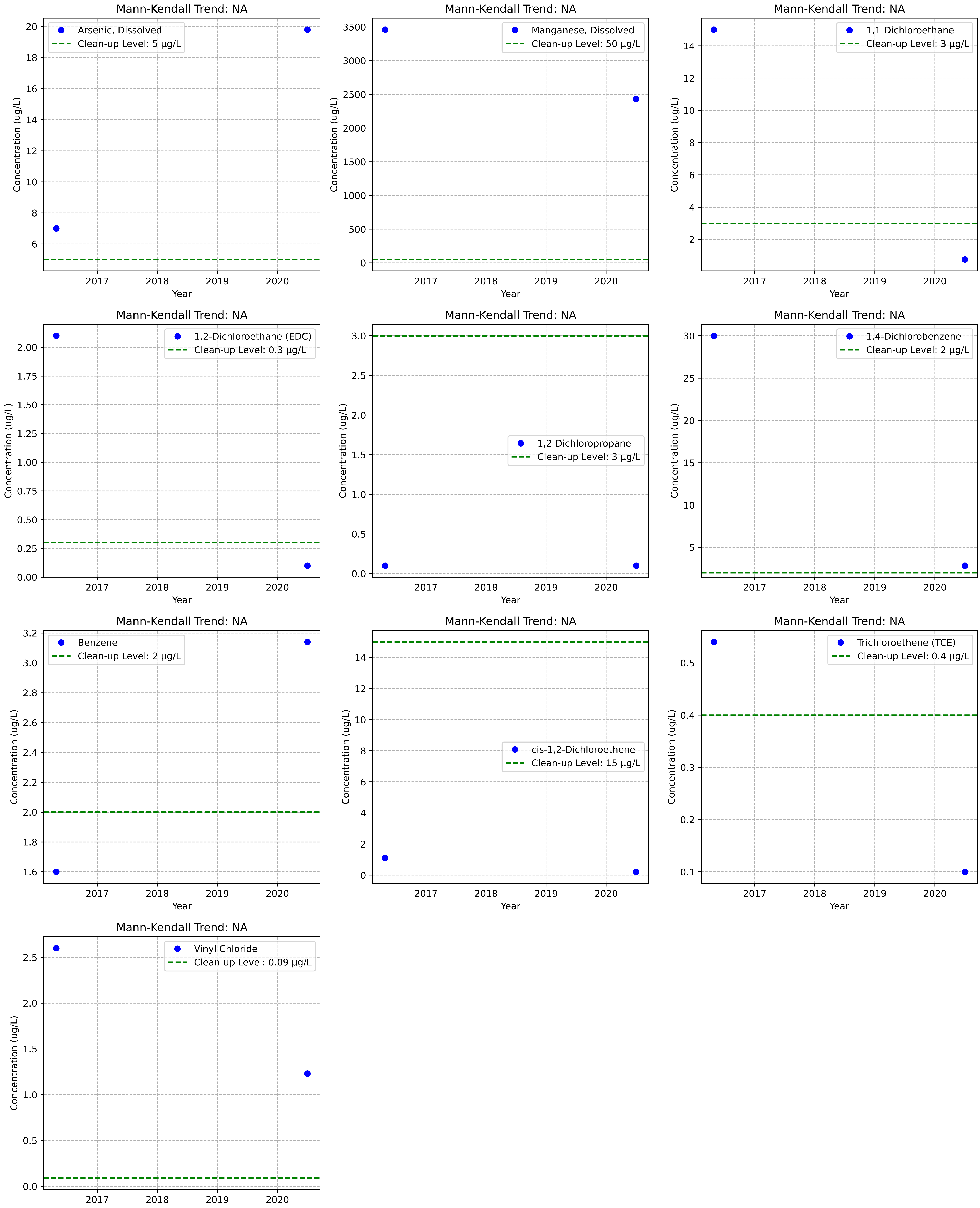

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2017
2018
2019
2020

MW-65p1

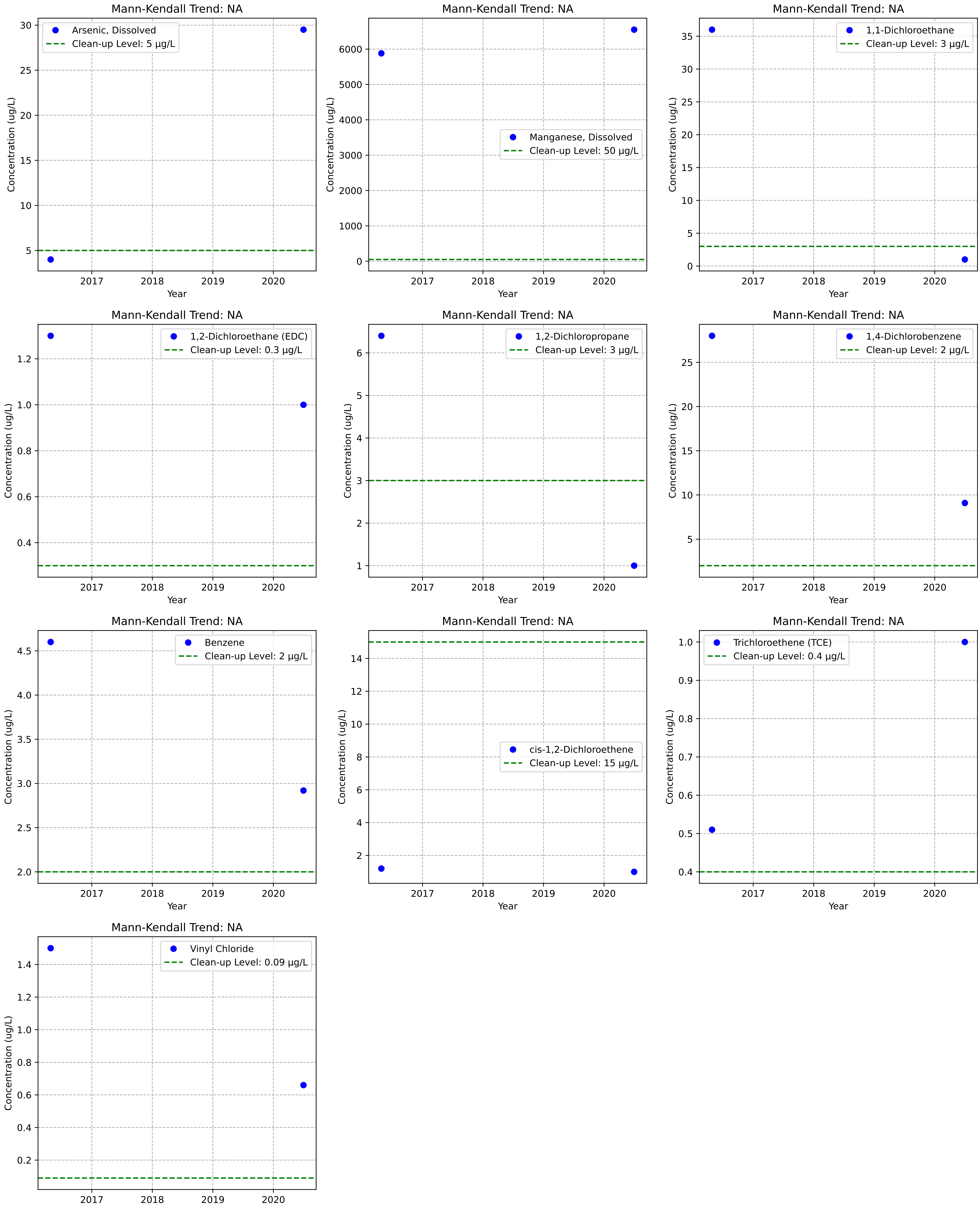


Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.85)
Exponential Fit (R²=0.62)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Probably Increasing
Manganese, Dissolved
Linear Fit (R²=0.59)
Exponential Fit (R²=0.52)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.18)
Exponential Fit (R²=0.49)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Exponential Fit (R²=0.10)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Exponential Fit (R²=0.09)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.56)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Increasing
Benzene
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Exponential Fit (R²=0.19)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.20)
Exponential Fit (R²=0.33)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Exponential Fit (R²=0.16)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

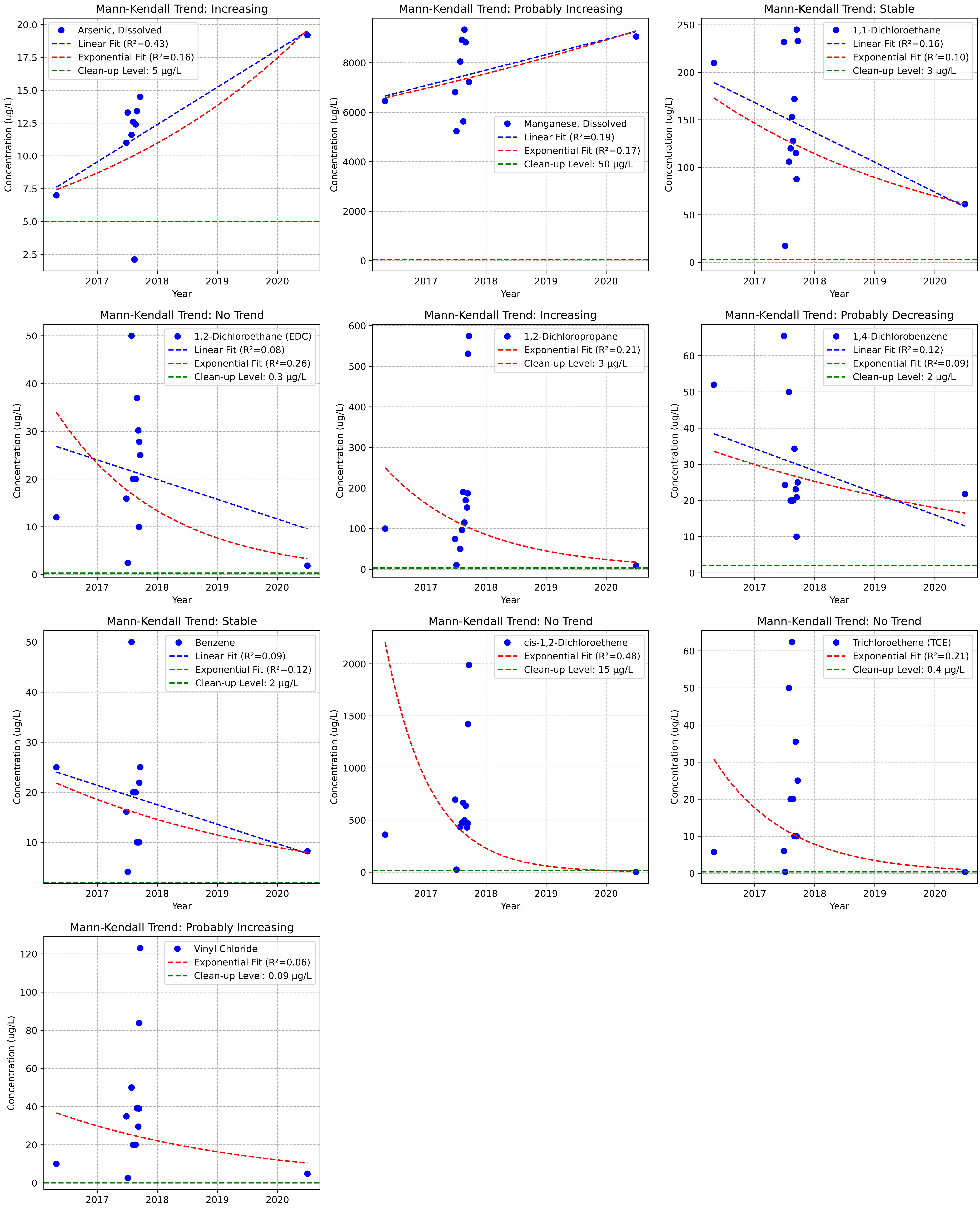
MW-66p1


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2017
2018
2019
2020

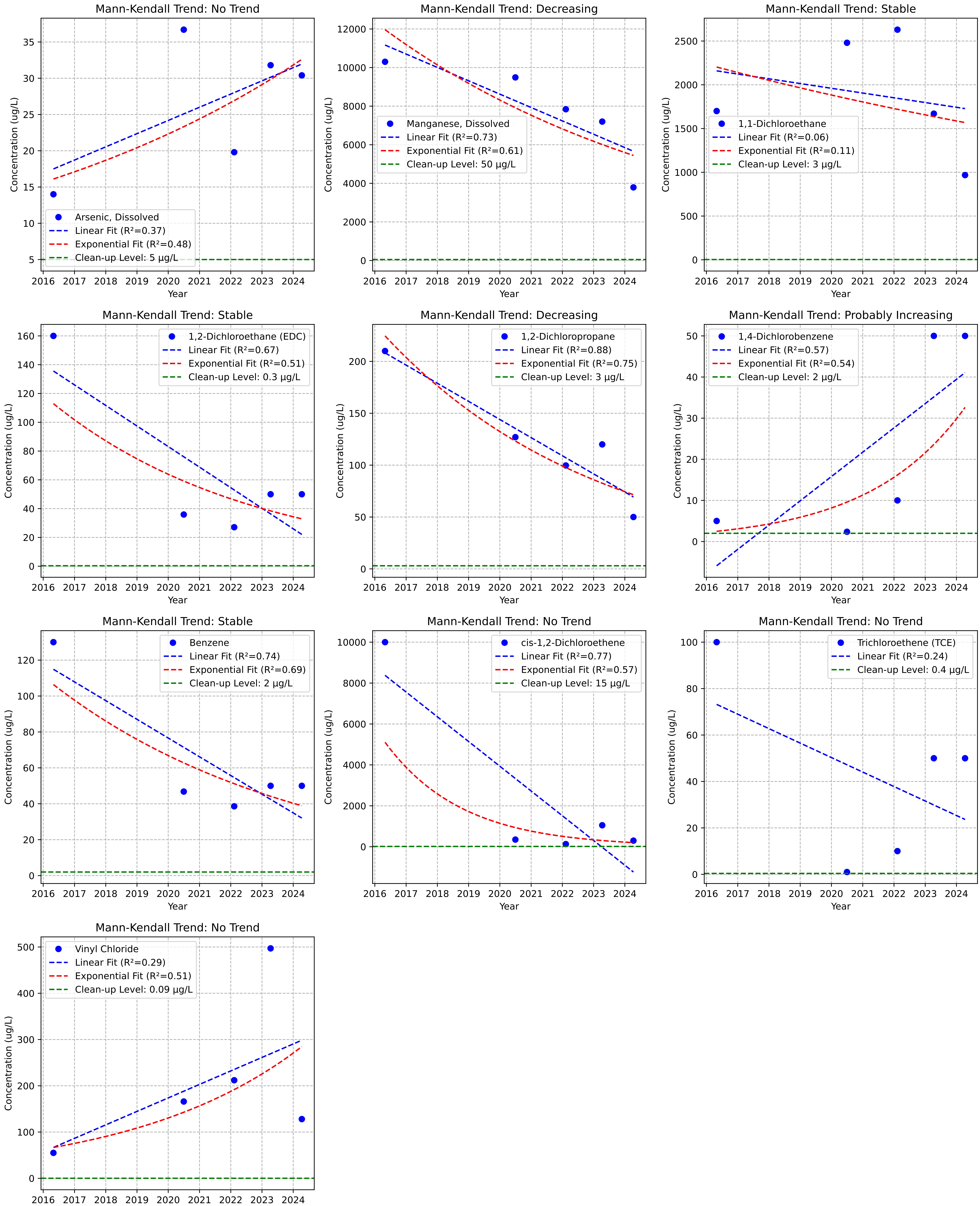
MW-67p1


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2017
2018
2019
2020

MW-68p1

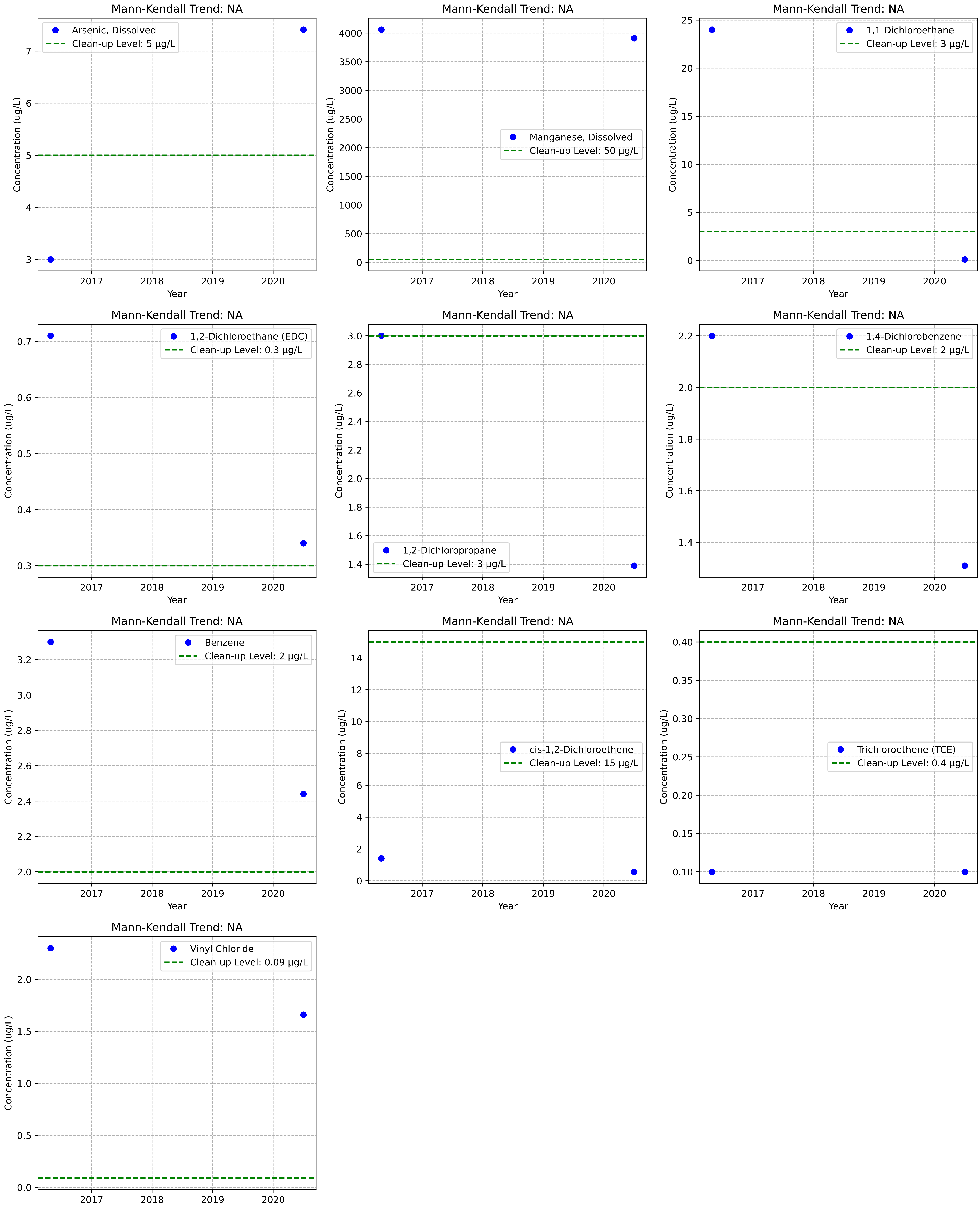

Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.43)
Exponential Fit (R²=0.16)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Probably Increasing
Manganese, Dissolved
Linear Fit (R²=0.19)
Exponential Fit (R²=0.17)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.16)
Exponential Fit (R²=0.10)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.08)
Exponential Fit (R²=0.26)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloropropane
Exponential Fit (R²=0.21)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.12)
Exponential Fit (R²=0.09)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.12)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Exponential Fit (R²=0.48)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Exponential Fit (R²=0.21)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Probably Increasing
Vinyl Chloride
Exponential Fit (R²=0.06)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-69p1

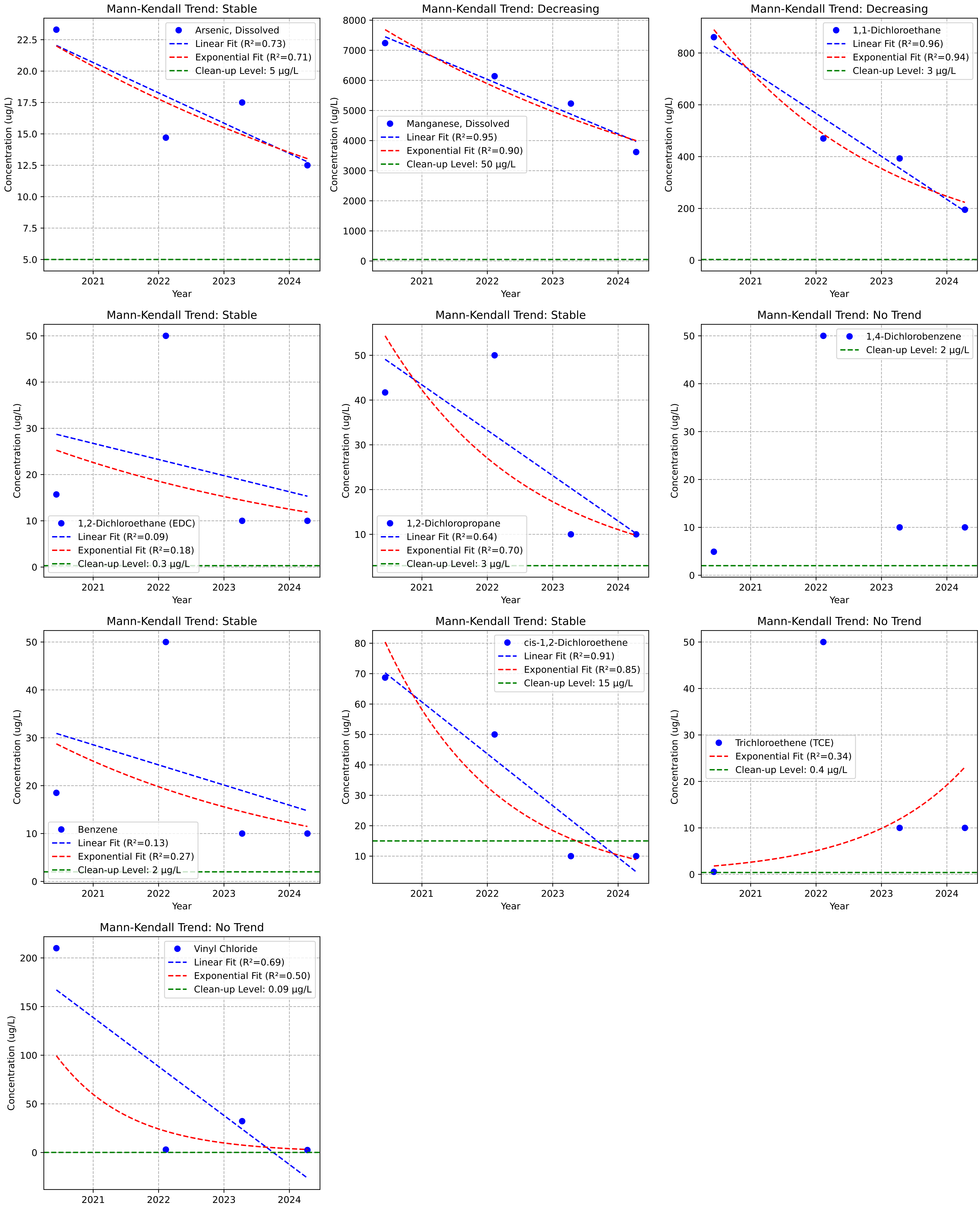


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Linear Fit (R²=0.37)
Exponential Fit (R²=0.48)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.73)
Exponential Fit (R²=0.61)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.06)
Exponential Fit (R²=0.11)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.67)
Exponential Fit (R²=0.51)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.88)
Exponential Fit (R²=0.75)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Increasing
1,4-Dichlorobenzene
Linear Fit (R²=0.57)
Exponential Fit (R²=0.54)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.74)
Exponential Fit (R²=0.69)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.57)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.24)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.29)
Exponential Fit (R²=0.51)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-70p1

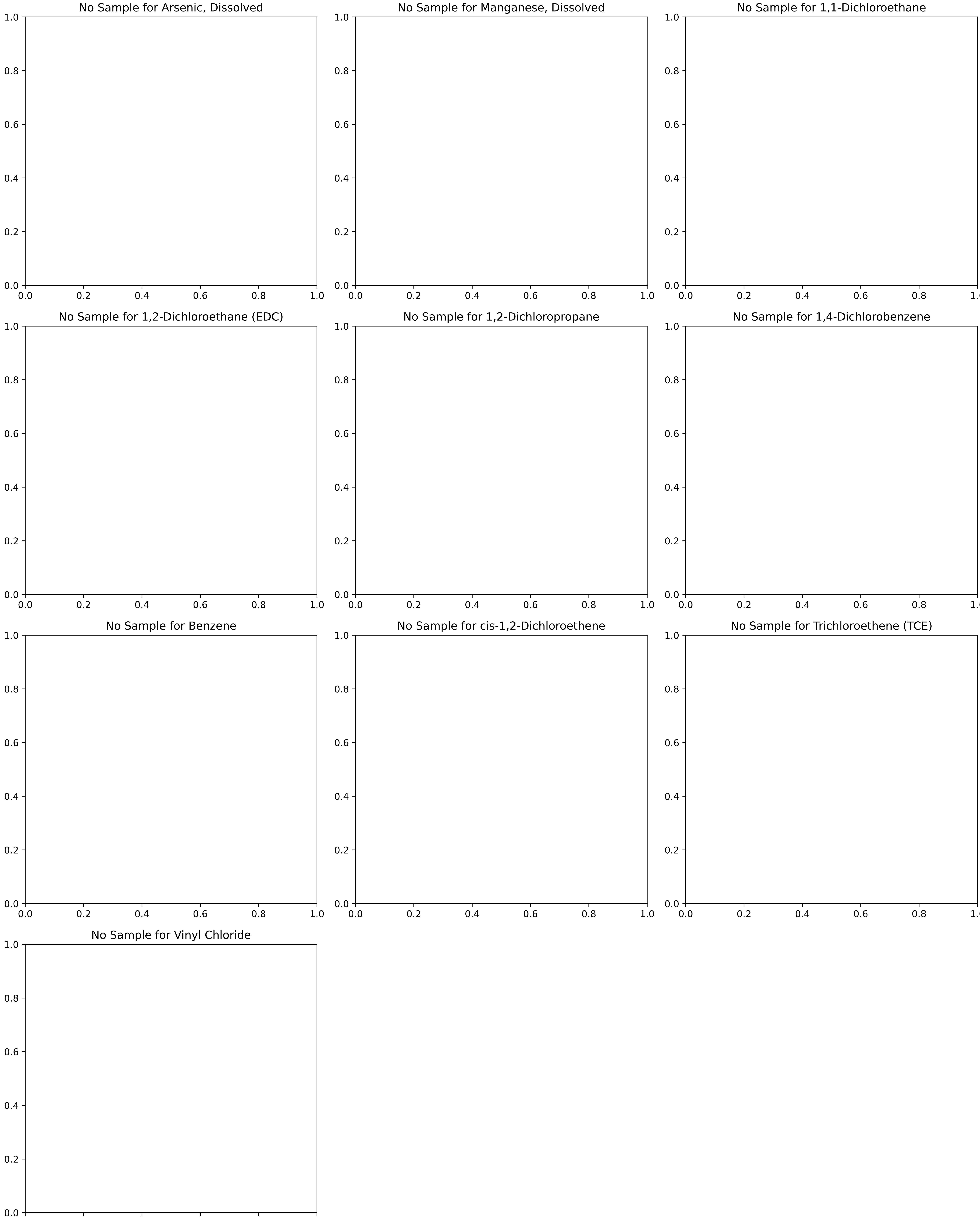

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2017
2018
2019
2020

MW-83p1

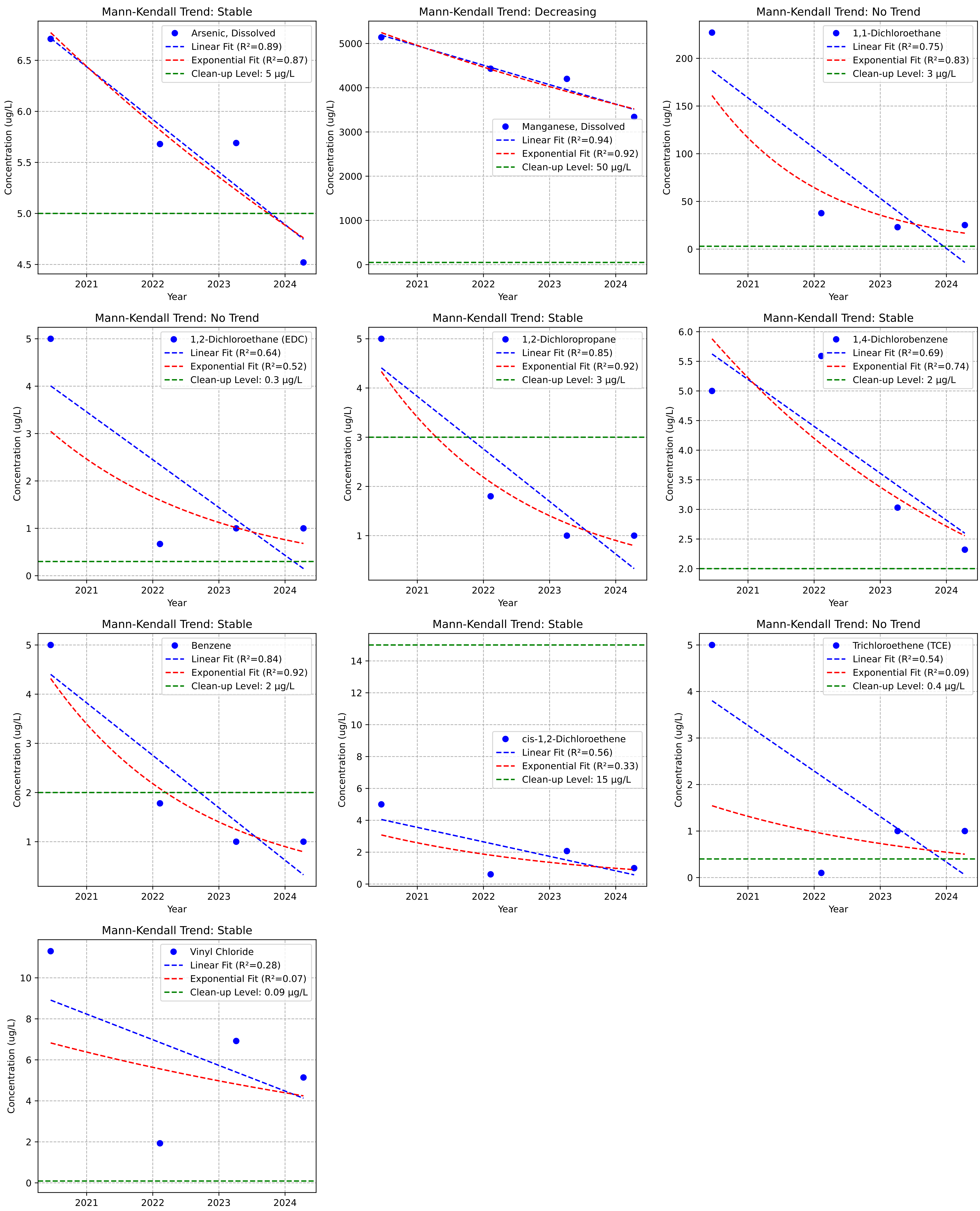


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.73)
Exponential Fit (R²=0.71)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.95)
Exponential Fit (R²=0.90)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.96)
Exponential Fit (R²=0.94)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.09)
Exponential Fit (R²=0.18)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.64)
Exponential Fit (R²=0.70)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.13)
Exponential Fit (R²=0.27)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.91)
Exponential Fit (R²=0.85)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Exponential Fit (R²=0.34)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.69)
Exponential Fit (R²=0.50)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

No Data for MW-84p1

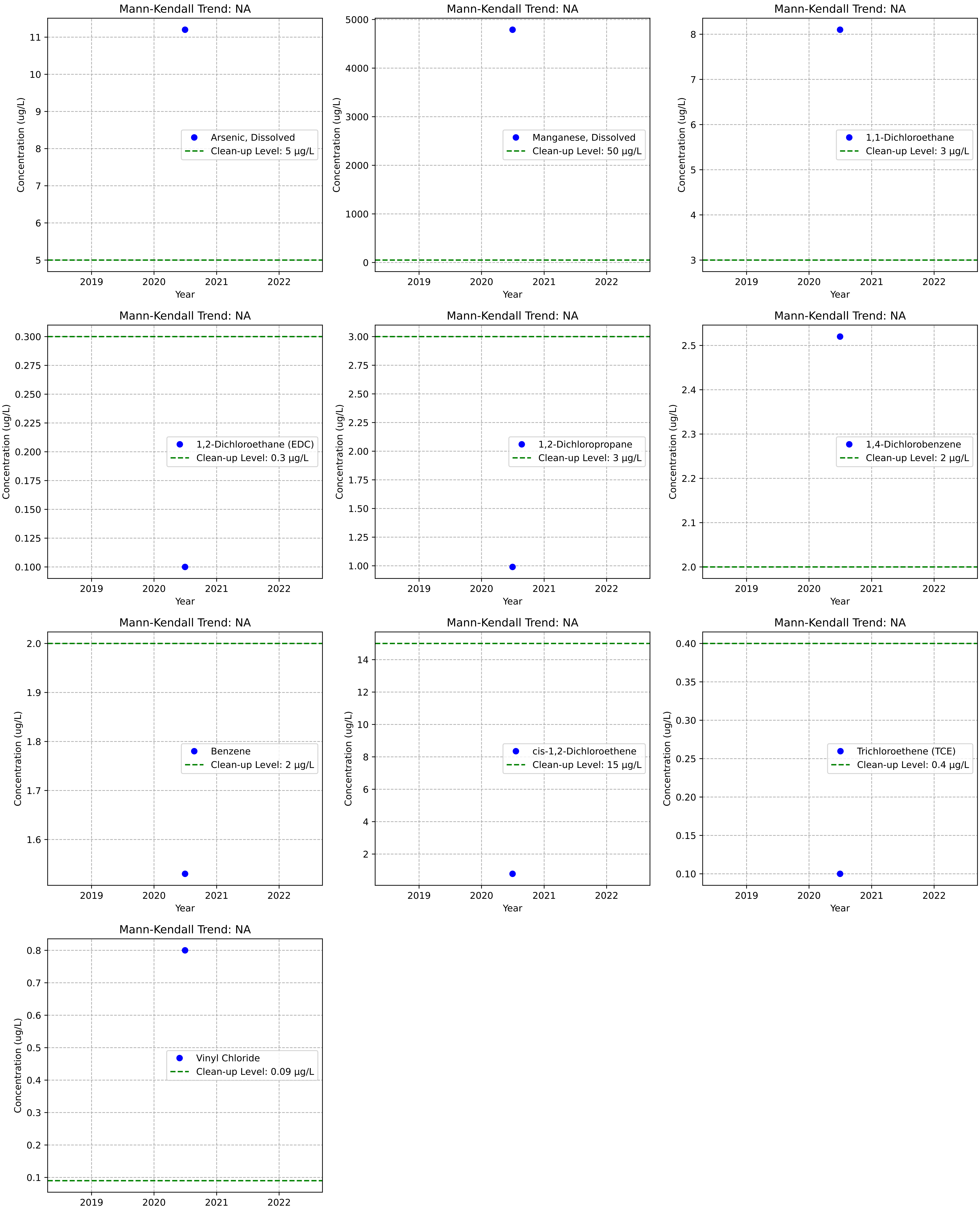


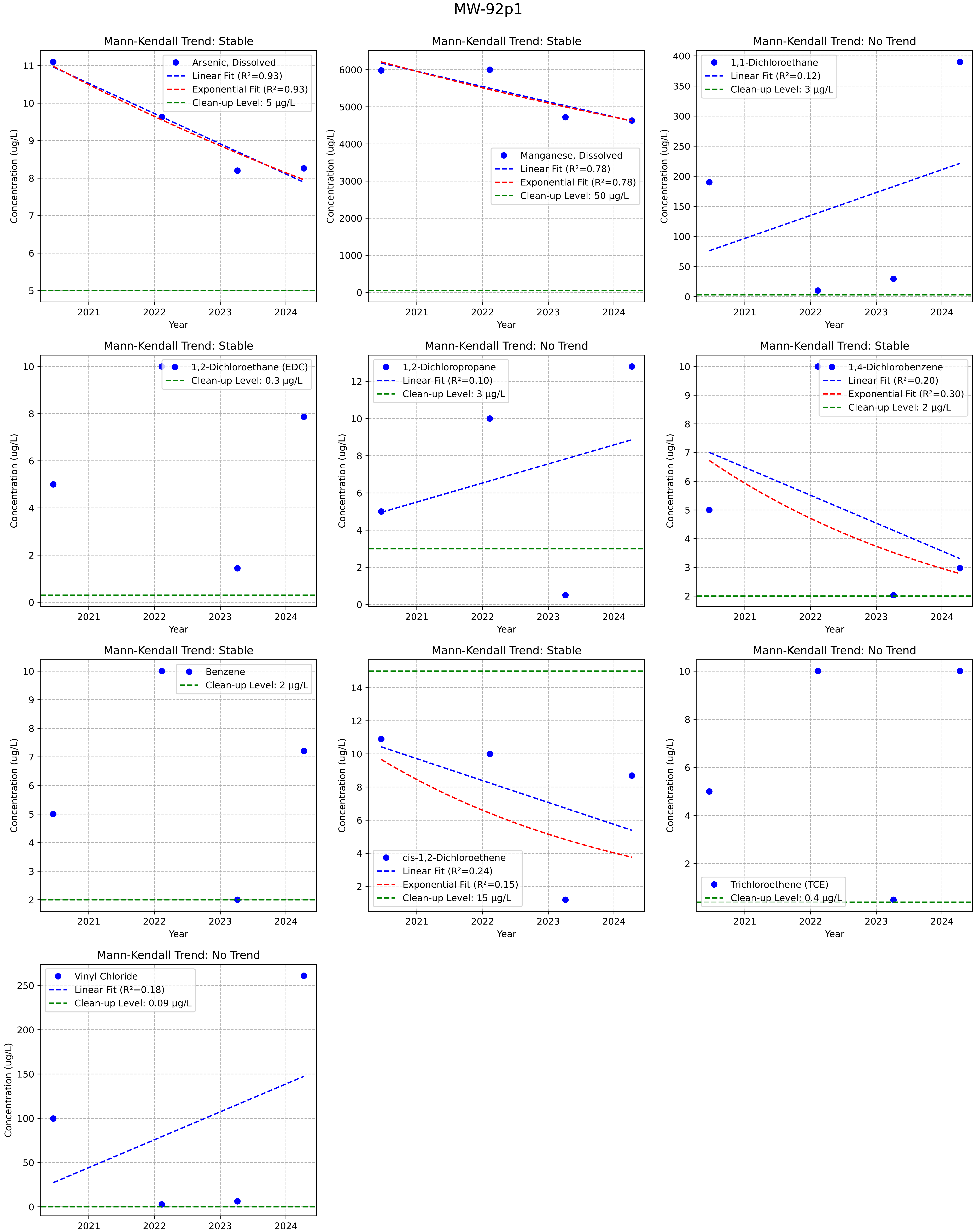
MW-85p1



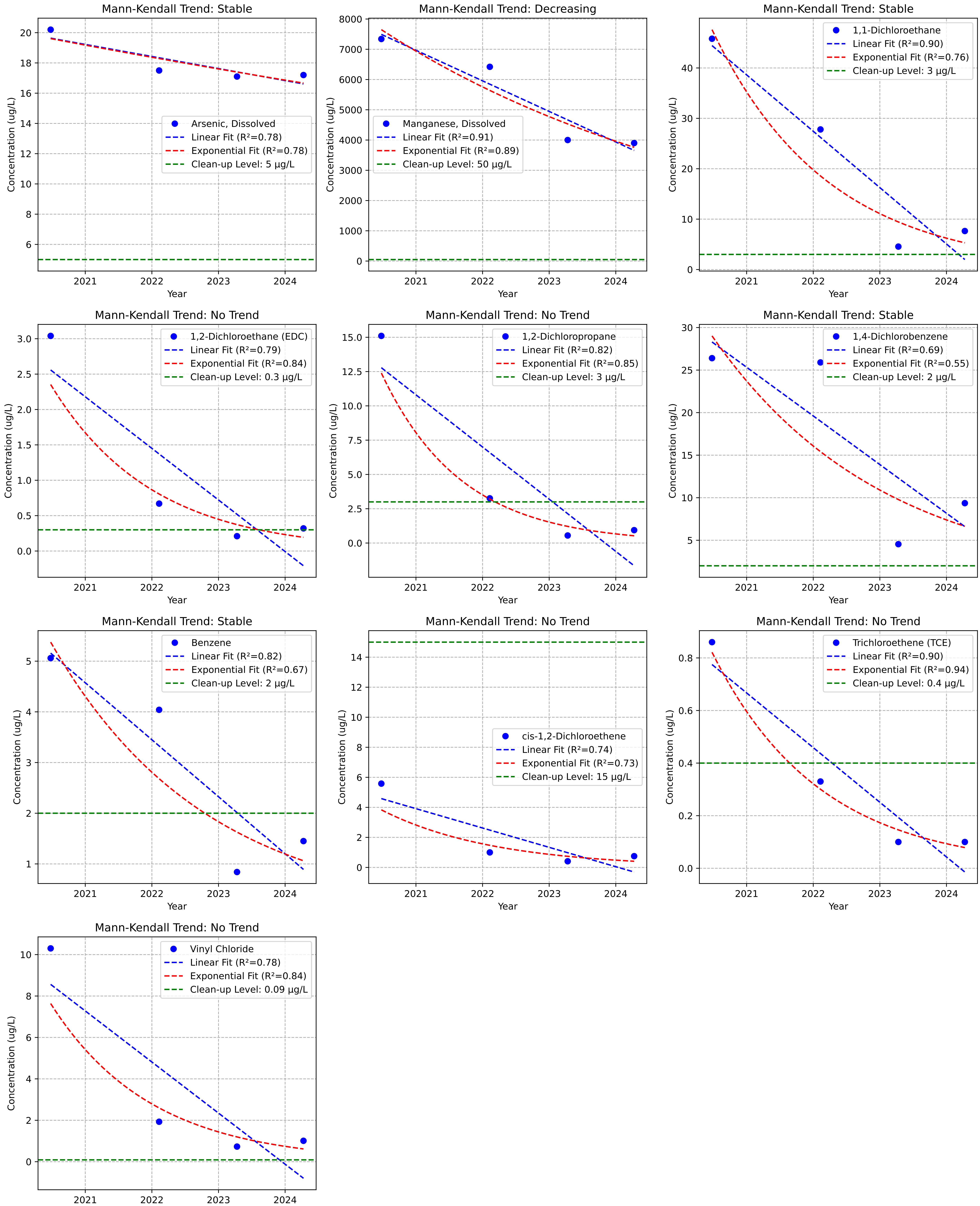
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.89)
Exponential Fit (R²=0.87)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.94)
Exponential Fit (R²=0.92)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.75)
Exponential Fit (R²=0.83)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.64)
Exponential Fit (R²=0.52)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.85)
Exponential Fit (R²=0.92)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.69)
Exponential Fit (R²=0.74)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.84)
Exponential Fit (R²=0.92)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.56)
Exponential Fit (R²=0.33)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.54)
Exponential Fit (R²=0.09)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.28)
Exponential Fit (R²=0.07)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-90p1


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

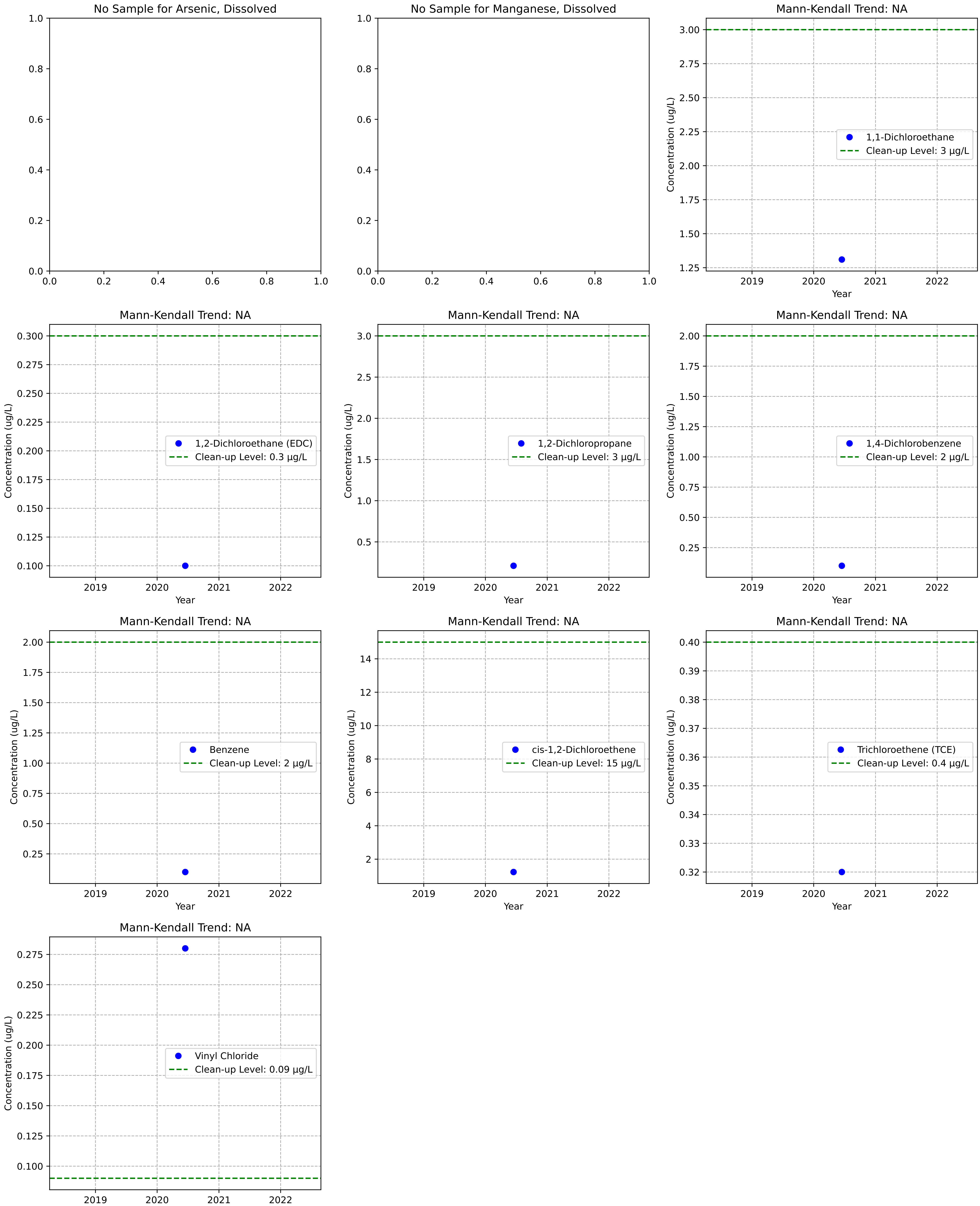

MW-92p1
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.93)
Exponential Fit (R²=0.93)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.78)
Exponential Fit (R²=0.78)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.12)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.10)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.20)
Exponential Fit (R²=0.30)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.24)
Exponential Fit (R²=0.15)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.18)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-95p1



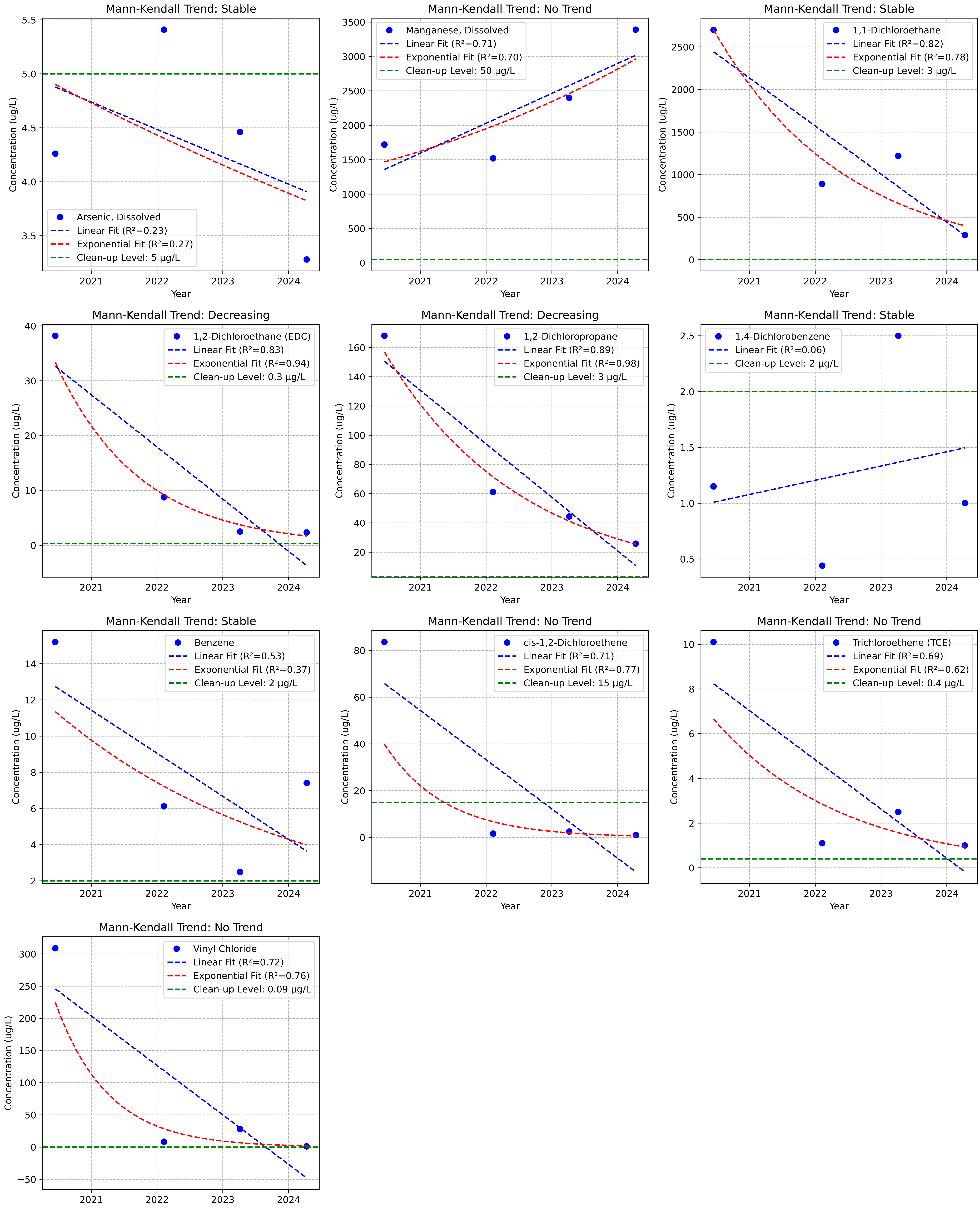
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.78)
Exponential Fit (R²=0.78)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.91)
Exponential Fit (R²=0.89)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.90)
Exponential Fit (R²=0.76)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.79)
Exponential Fit (R²=0.84)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.82)
Exponential Fit (R²=0.85)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.69)
Exponential Fit (R²=0.55)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.82)
Exponential Fit (R²=0.67)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.74)
Exponential Fit (R²=0.73)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.90)
Exponential Fit (R²=0.94)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.78)
Exponential Fit (R²=0.84)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

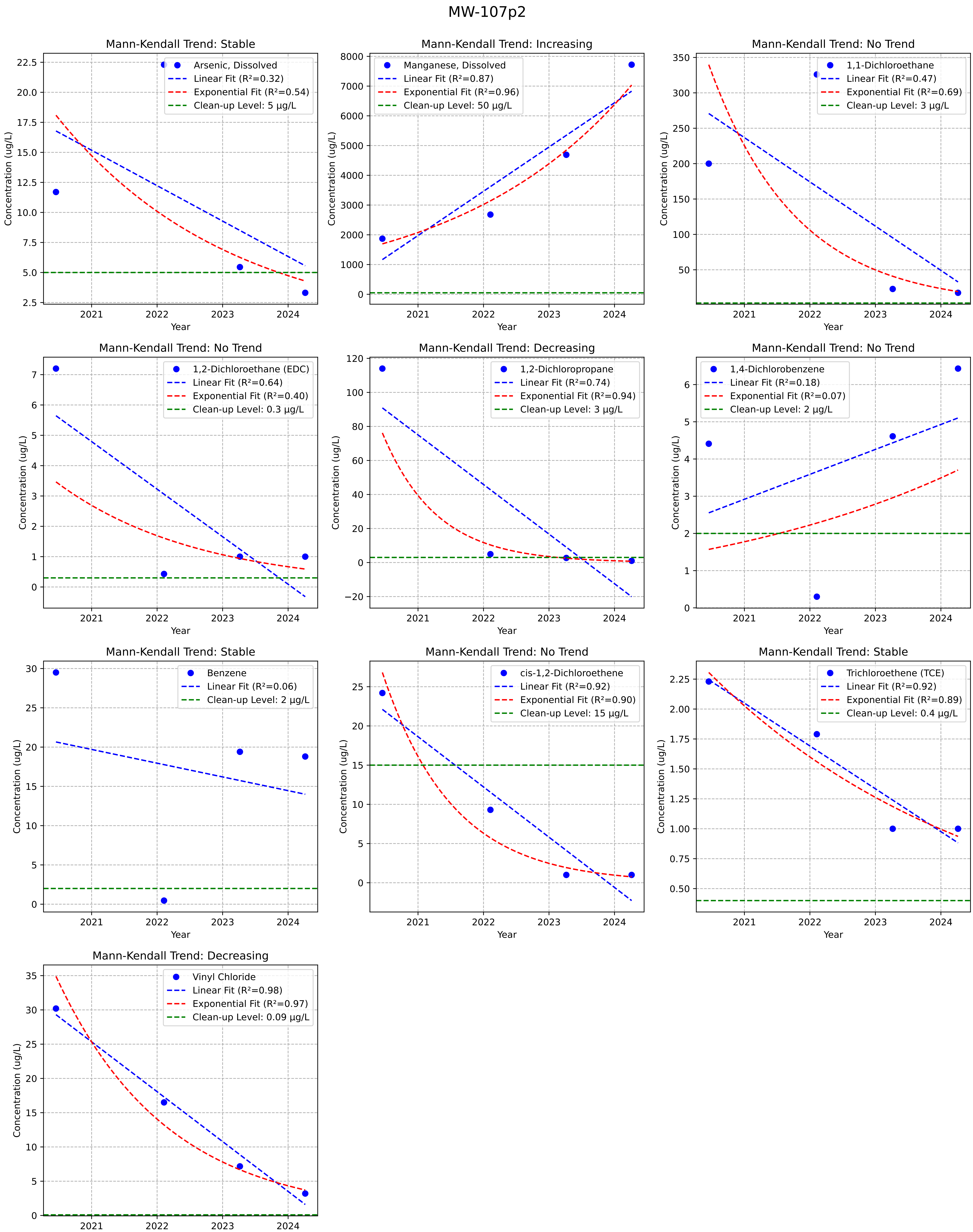
MW-98p1


No Sample for Arsenic, Dissolved
No Sample for Manganese, Dissolved
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 μg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 μg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 μg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 μg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 μg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 μg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 μg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 μg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

B2. Concentration time series plots of IHS constituents for P2 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

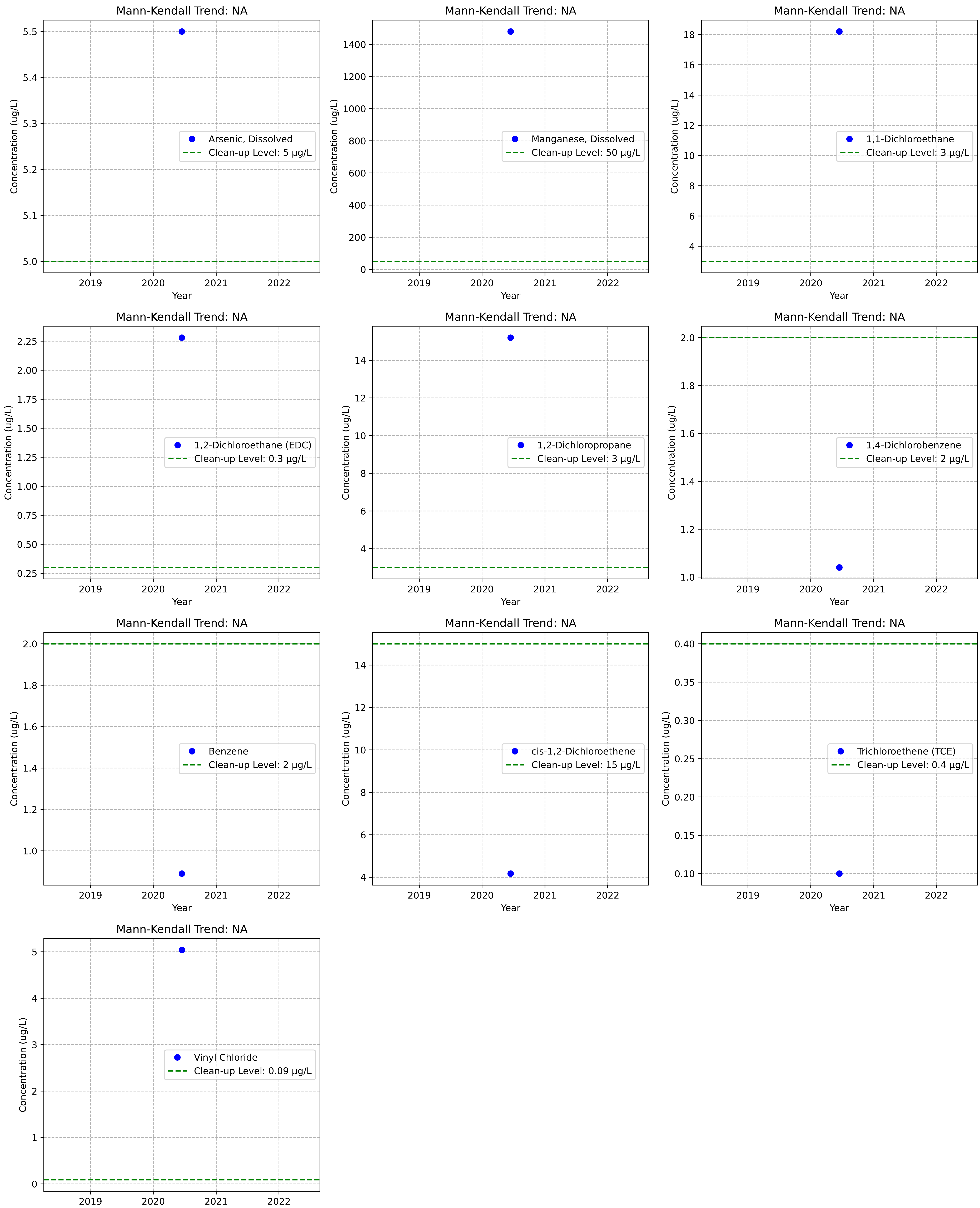
MW-101p2


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.23)
Exponential Fit (R²=0.27)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.71)
Exponential Fit (R²=0.70)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.82)
Exponential Fit (R²=0.78)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.83)
Exponential Fit (R²=0.94)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.89)
Exponential Fit (R²=0.98)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.06)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.53)
Exponential Fit (R²=0.37)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.71)
Exponential Fit (R²=0.77)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.69)
Exponential Fit (R²=0.62)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.72)
Exponential Fit (R²=0.76)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024



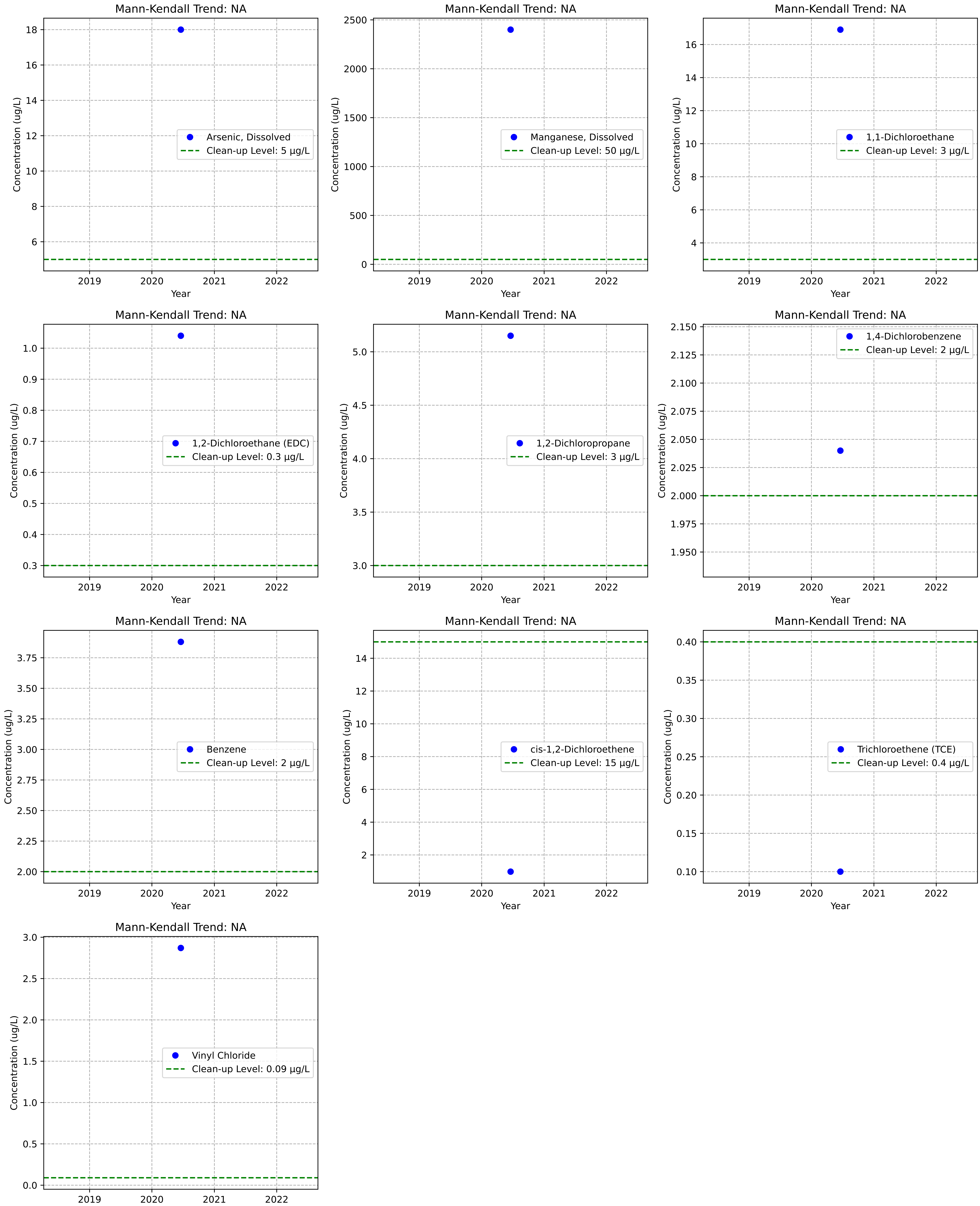
MW-107p2
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.32)
Exponential Fit (R²=0.54)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.87)
Exponential Fit (R²=0.96)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.47)
Exponential Fit (R²=0.69)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.64)
Exponential Fit (R²=0.40)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.74)
Exponential Fit (R²=0.94)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.18)
Exponential Fit (R²=0.07)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.06)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.92)
Exponential Fit (R²=0.90)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.92)
Exponential Fit (R²=0.89)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.98)
Exponential Fit (R²=0.97)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-108p2

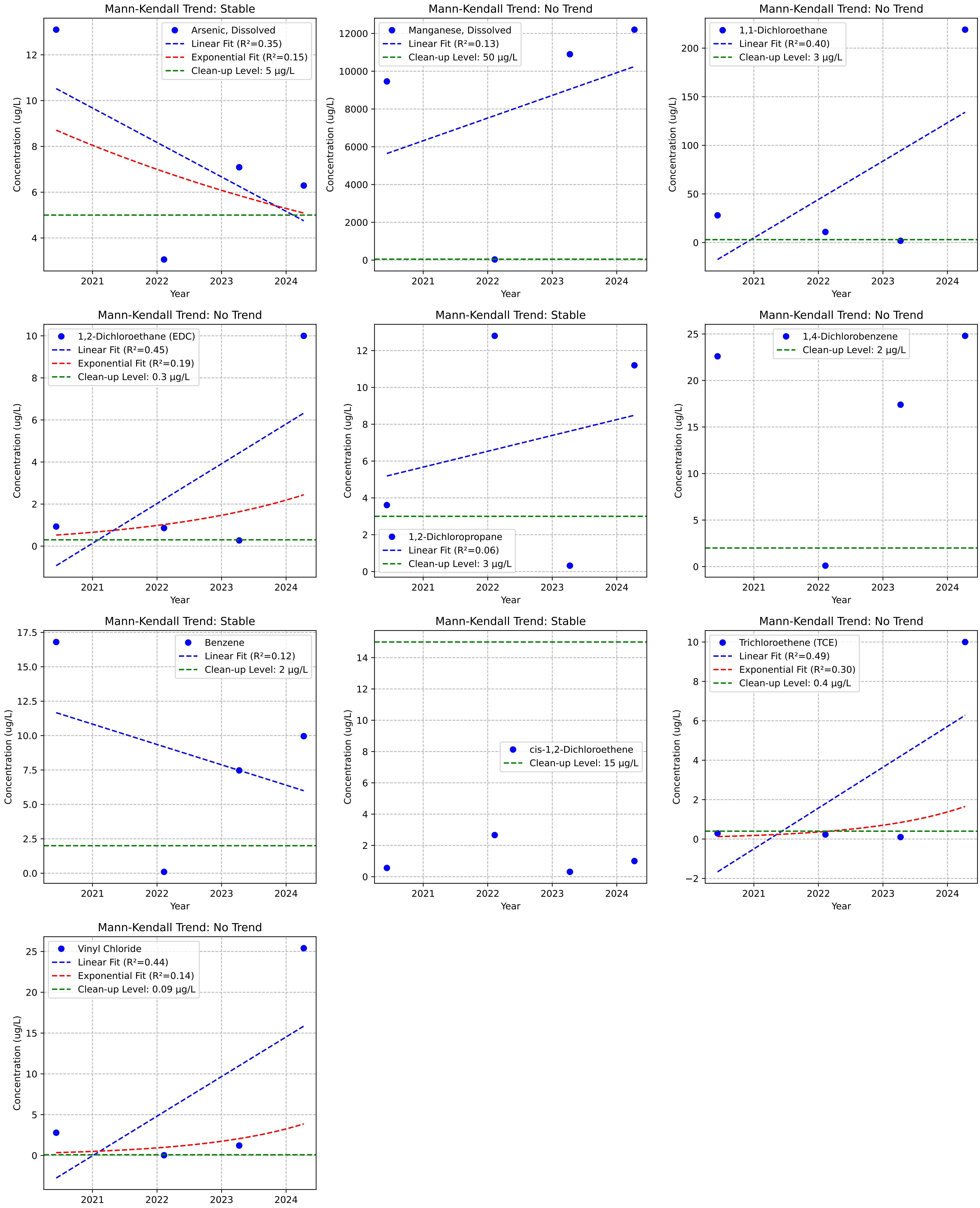


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-112p2

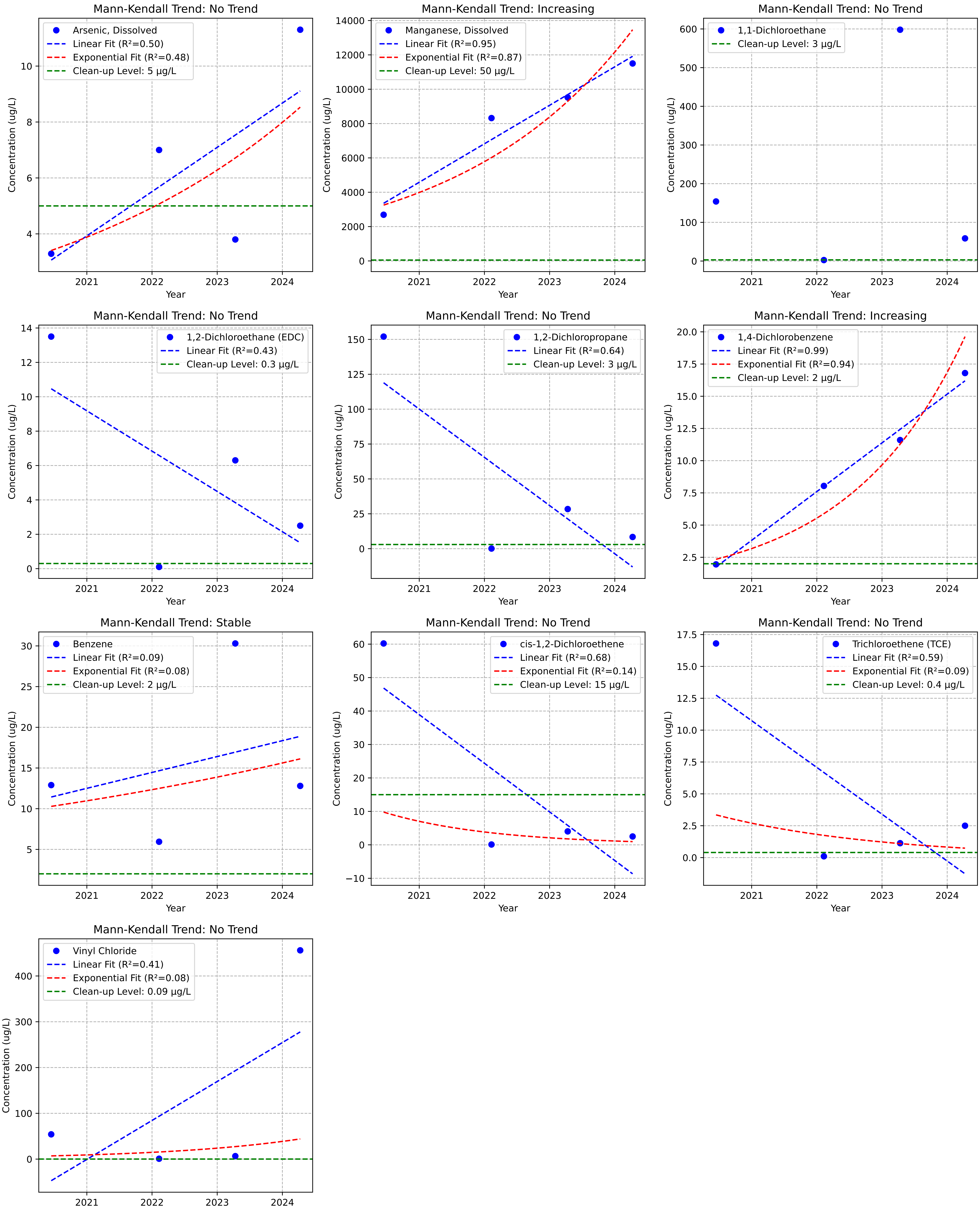

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-113p2

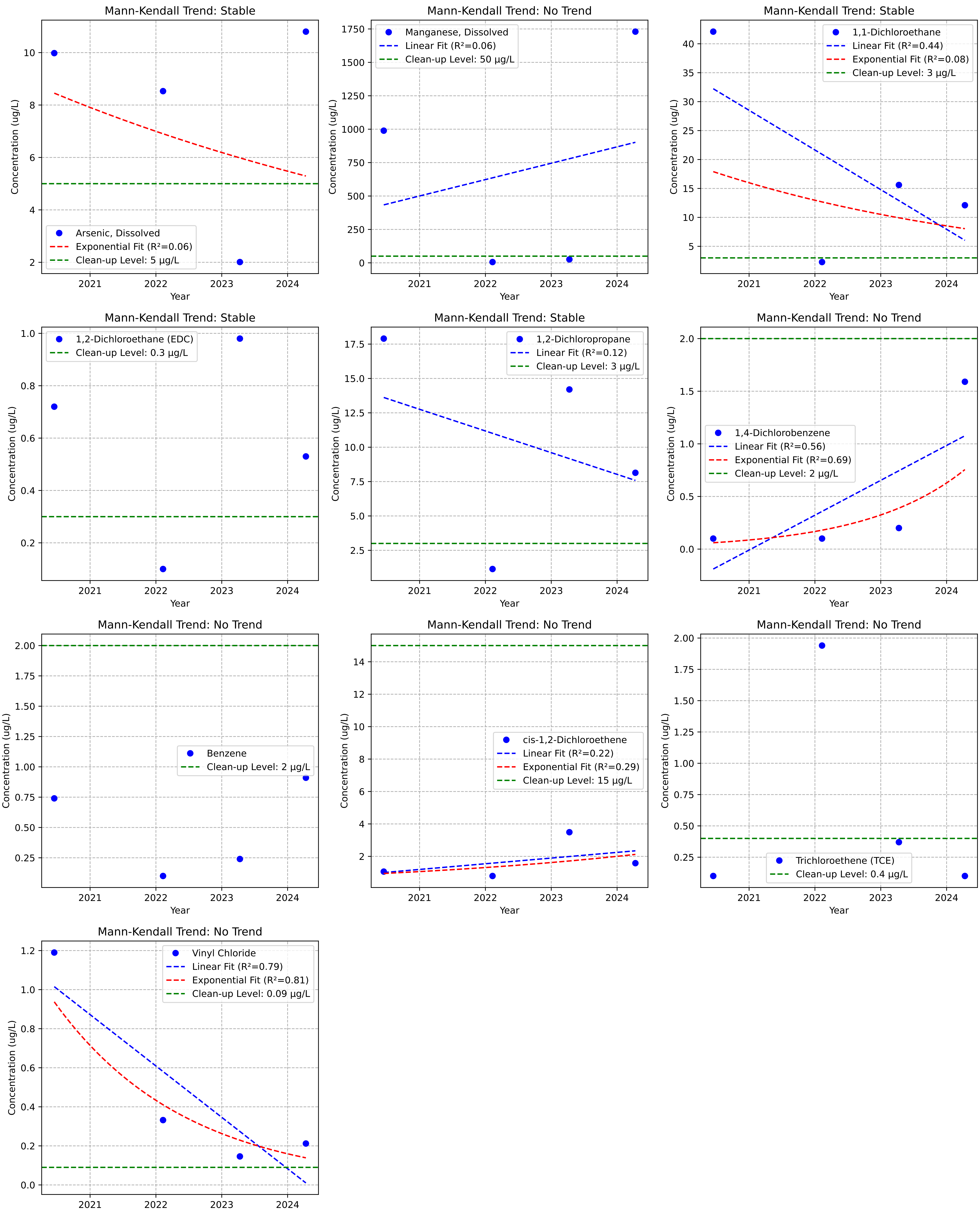


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.35)
Exponential Fit (R²=0.15)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.13)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.40)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.45)
Exponential Fit (R²=0.19)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.06)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.12)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.49)
Exponential Fit (R²=0.30)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.44)
Exponential Fit (R²=0.14)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

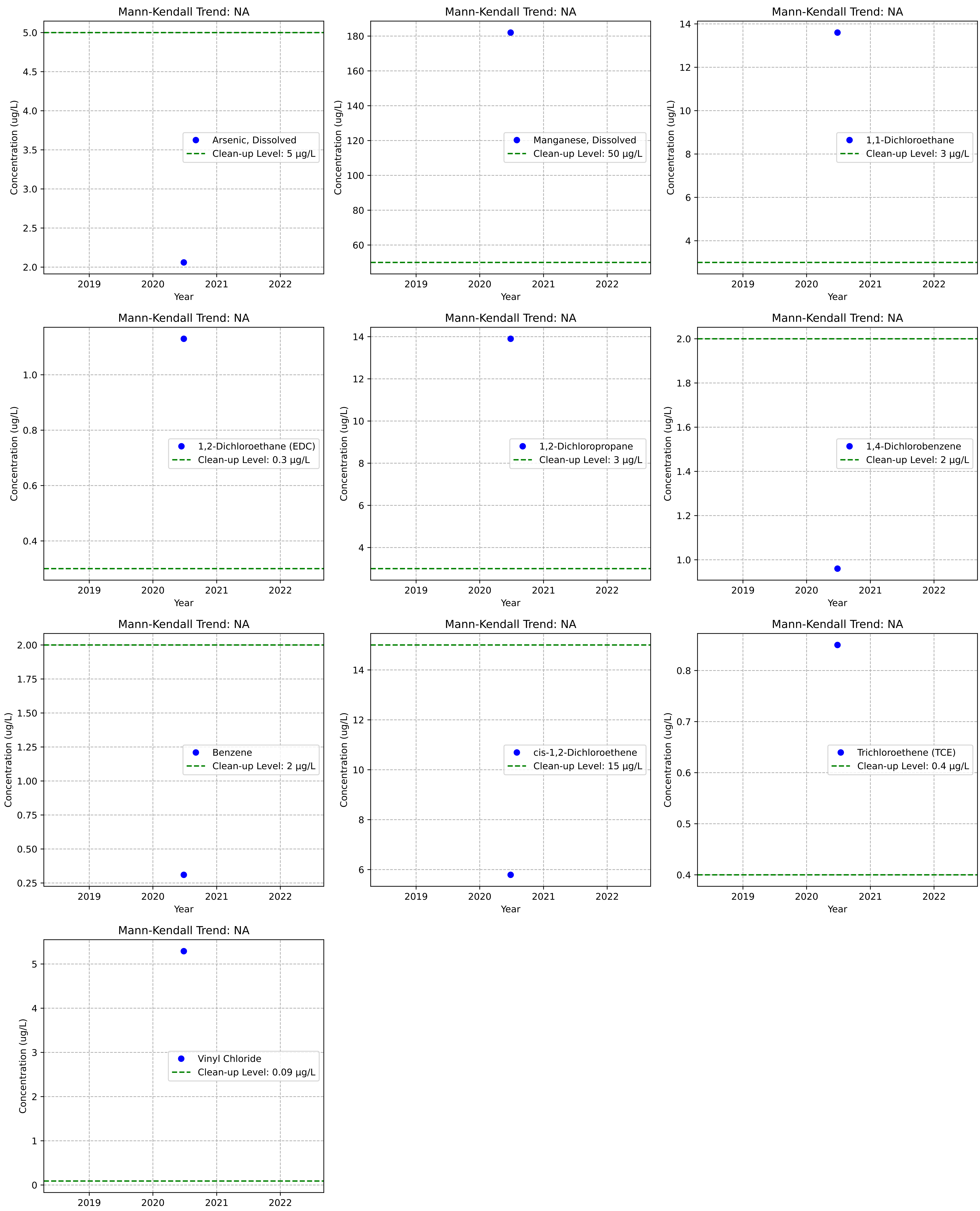
MW-114p2


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Linear Fit (R²=0.50)
Exponential Fit (R²=0.48)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.95)
Exponential Fit (R²=0.87)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.43)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.64)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,4-Dichlorobenzene
Linear Fit (R²=0.99)
Exponential Fit (R²=0.94)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.08)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.68)
Exponential Fit (R²=0.14)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.59)
Exponential Fit (R²=0.09)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.41)
Exponential Fit (R²=0.08)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-115p2

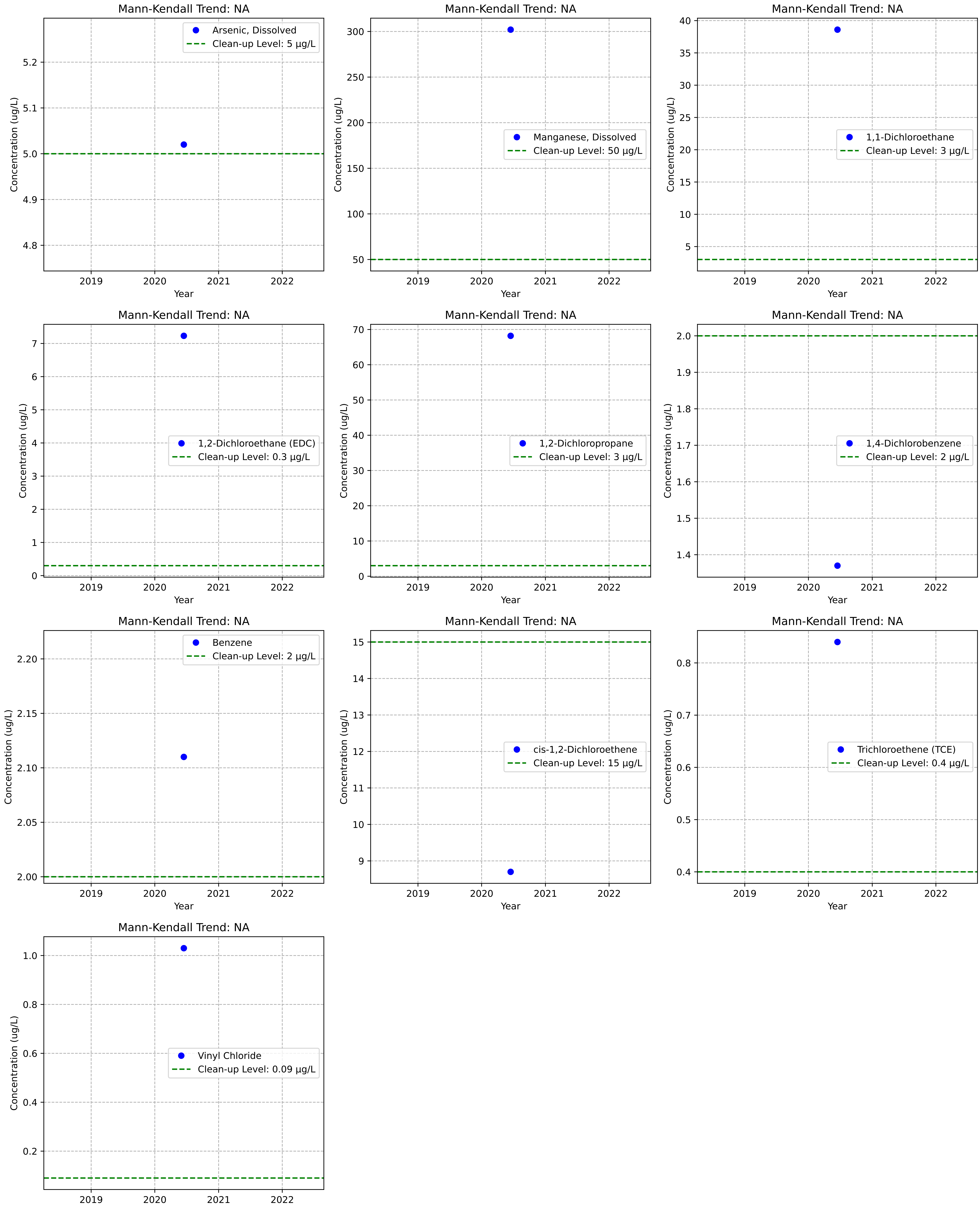

Mann-Kendall Trend: Stable
Arsenic, Dissolved
Exponential Fit (R²=0.06)
Clean-up Level: 5 μg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.06)
Clean-up Level: 50 μg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.44)
Exponential Fit (R²=0.08)
Clean-up Level: 3 μg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 μg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.12)
Clean-up Level: 3 μg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.56)
Exponential Fit (R²=0.69)
Clean-up Level: 2 μg/L
Mann-Kendall Trend: No Trend
Benzene
Clean-up Level: 2 μg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.22)
Exponential Fit (R²=0.29)
Clean-up Level: 15 μg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Clean-up Level: 0.4 μg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.79)
Exponential Fit (R²=0.81)
Clean-up Level: 0.09 μg/L
Concentration (ug/L)
Year

MW-118p2

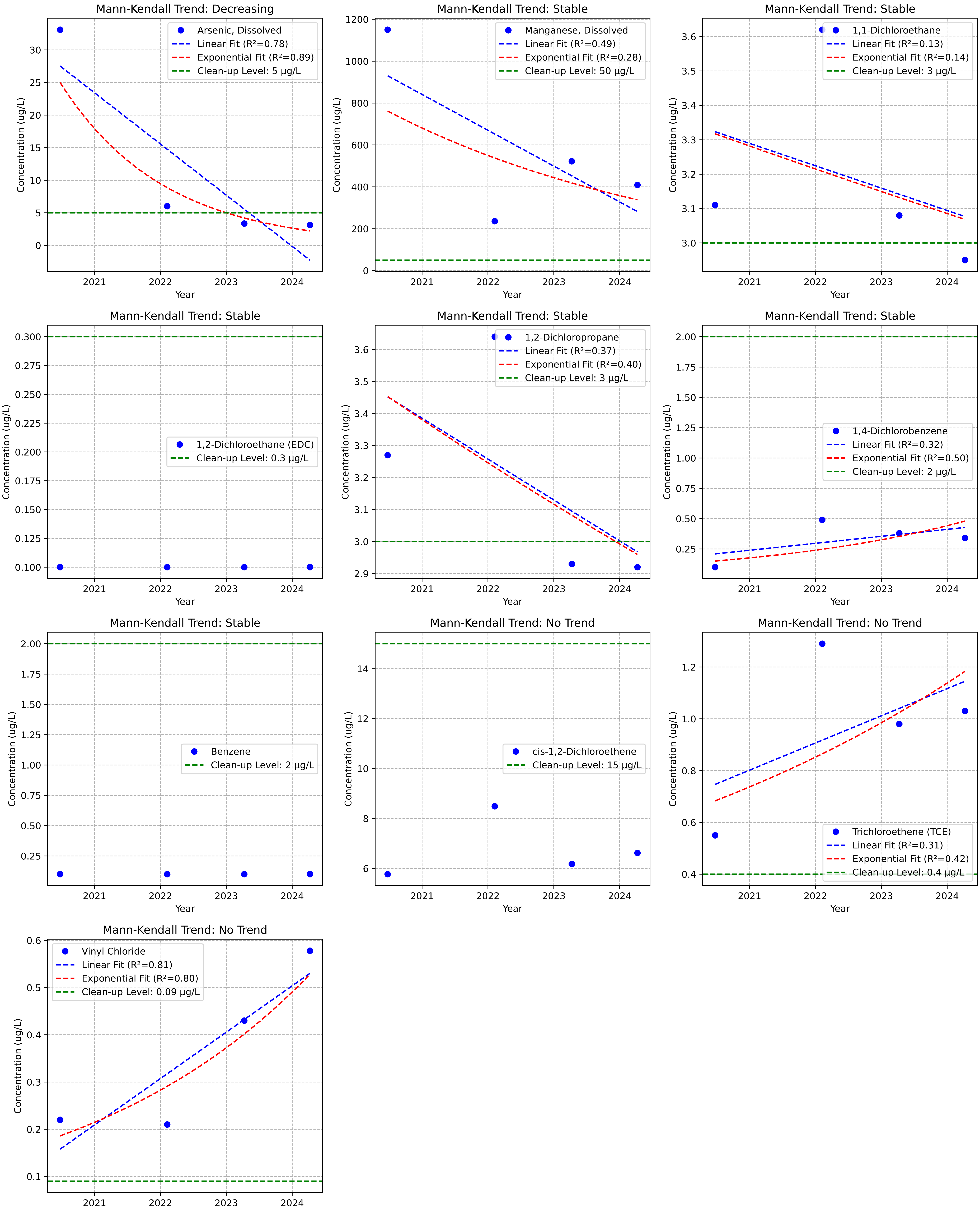


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Manganese, Dissolved
Clean-up Level: 50 µg/L
1,1-Dichloroethane
Clean-up Level: 3 µg/L
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
1,2-Dichloropropane
Clean-up Level: 3 µg/L
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Benzene
Clean-up Level: 2 µg/L
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-122p2

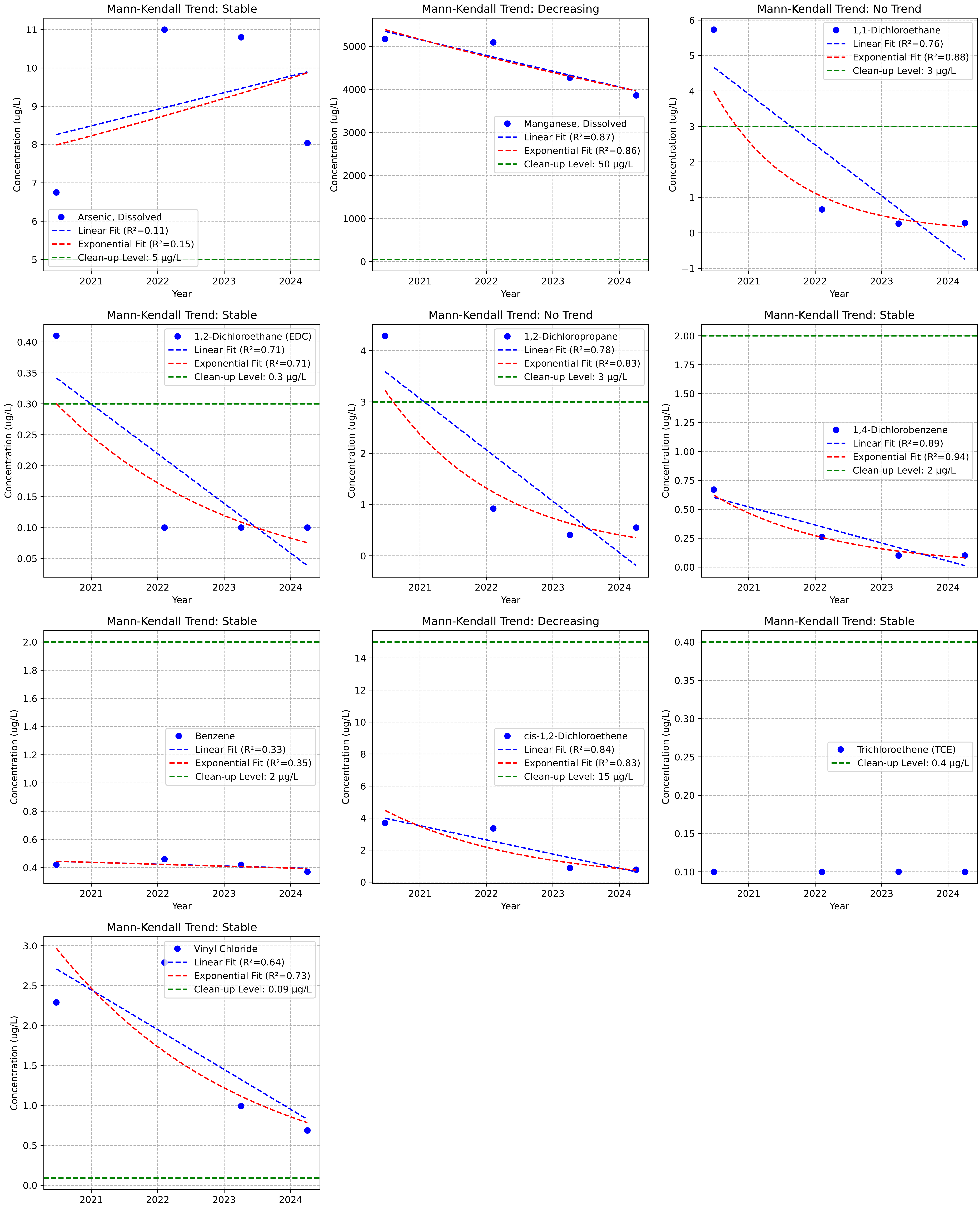

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-124p2



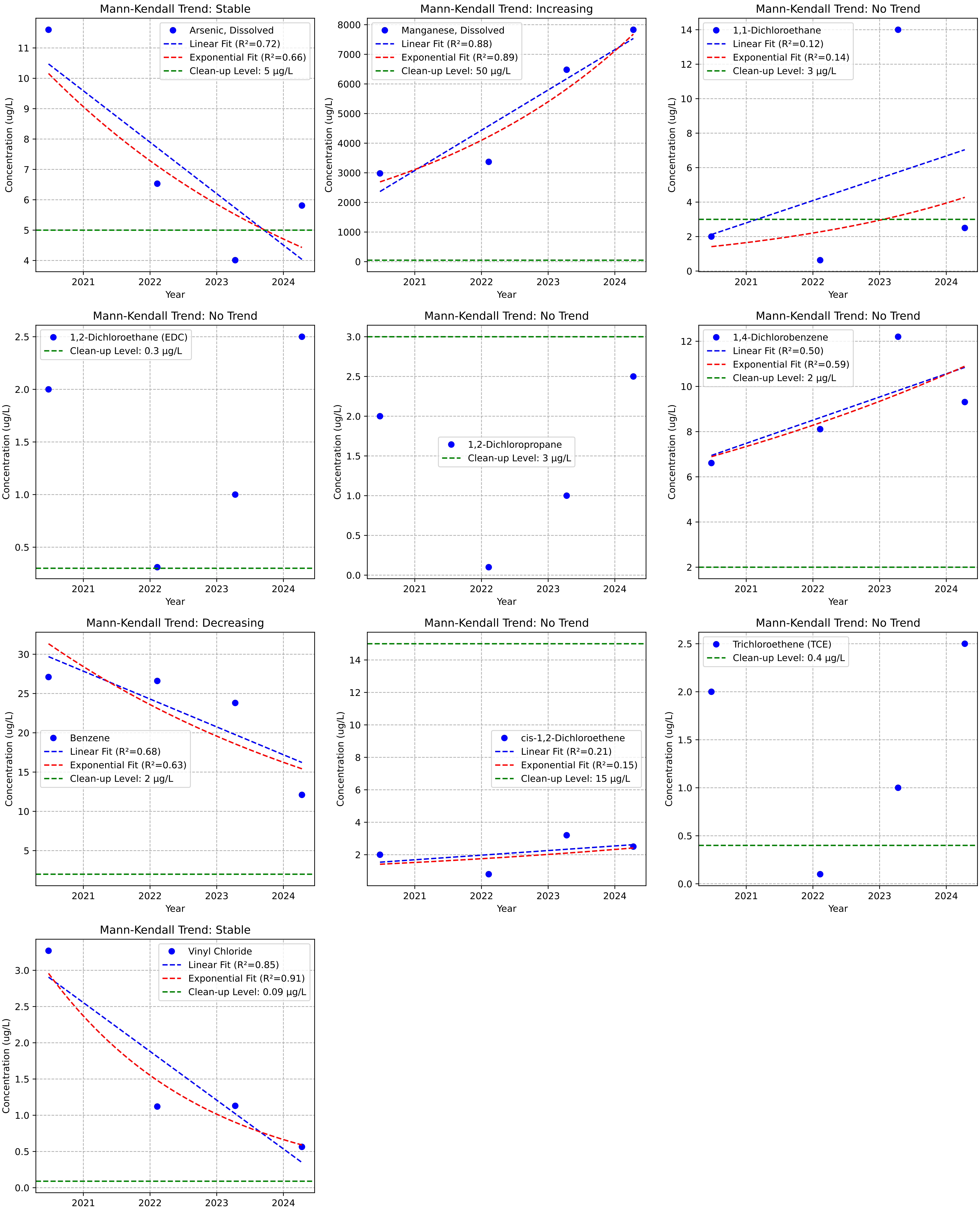
Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.78)
Exponential Fit (R²=0.89)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.49)
Exponential Fit (R²=0.28)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.13)
Exponential Fit (R²=0.14)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.37)
Exponential Fit (R²=0.40)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.32)
Exponential Fit (R²=0.50)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.31)
Exponential Fit (R²=0.42)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.81)
Exponential Fit (R²=0.80)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-125p2



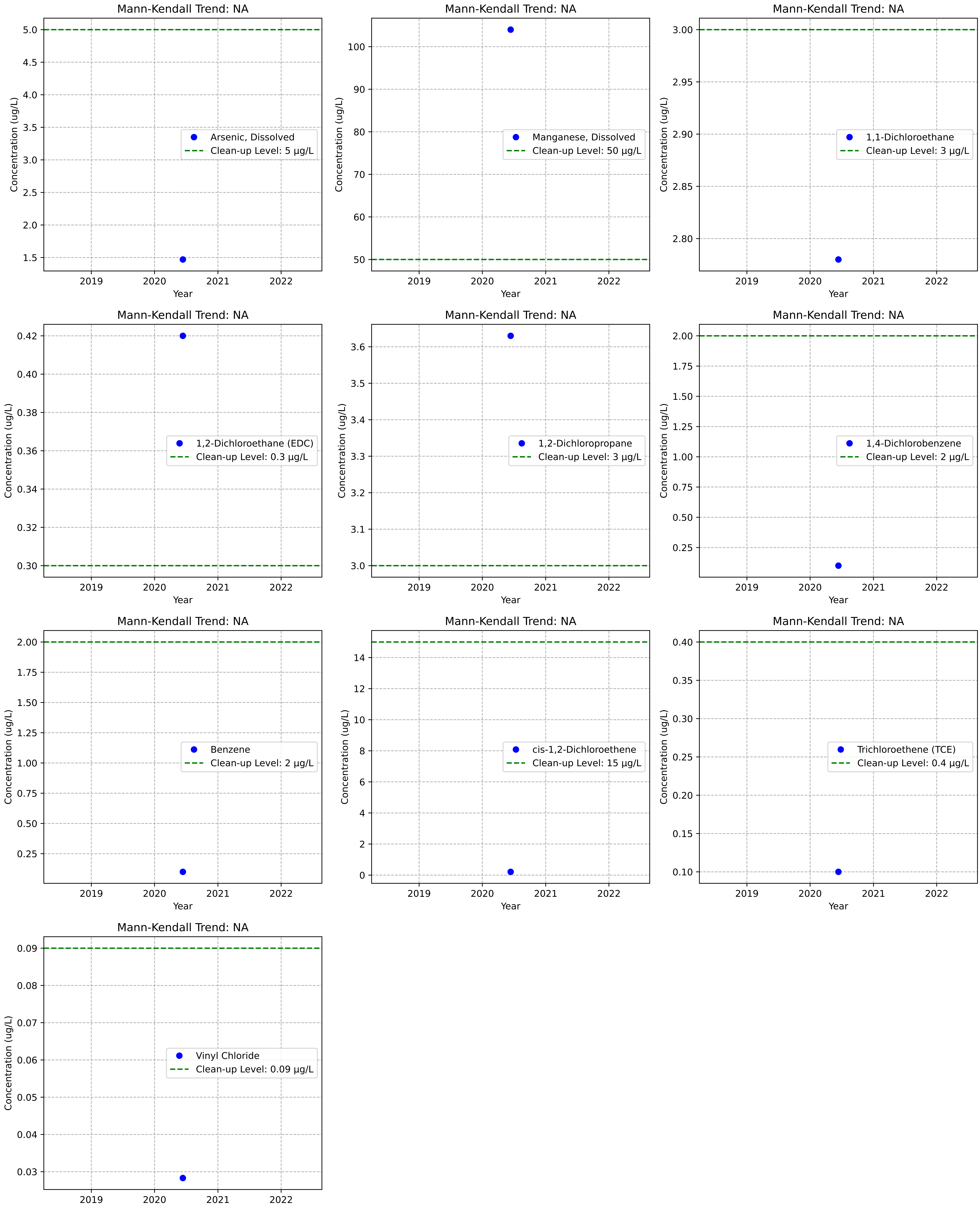
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.11)
Exponential Fit (R²=0.15)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.87)
Exponential Fit (R²=0.86)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.76)
Exponential Fit (R²=0.88)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.78)
Exponential Fit (R²=0.83)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.89)
Exponential Fit (R²=0.94)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.33)
Exponential Fit (R²=0.35)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.84)
Exponential Fit (R²=0.83)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.64)
Exponential Fit (R²=0.73)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-126p2

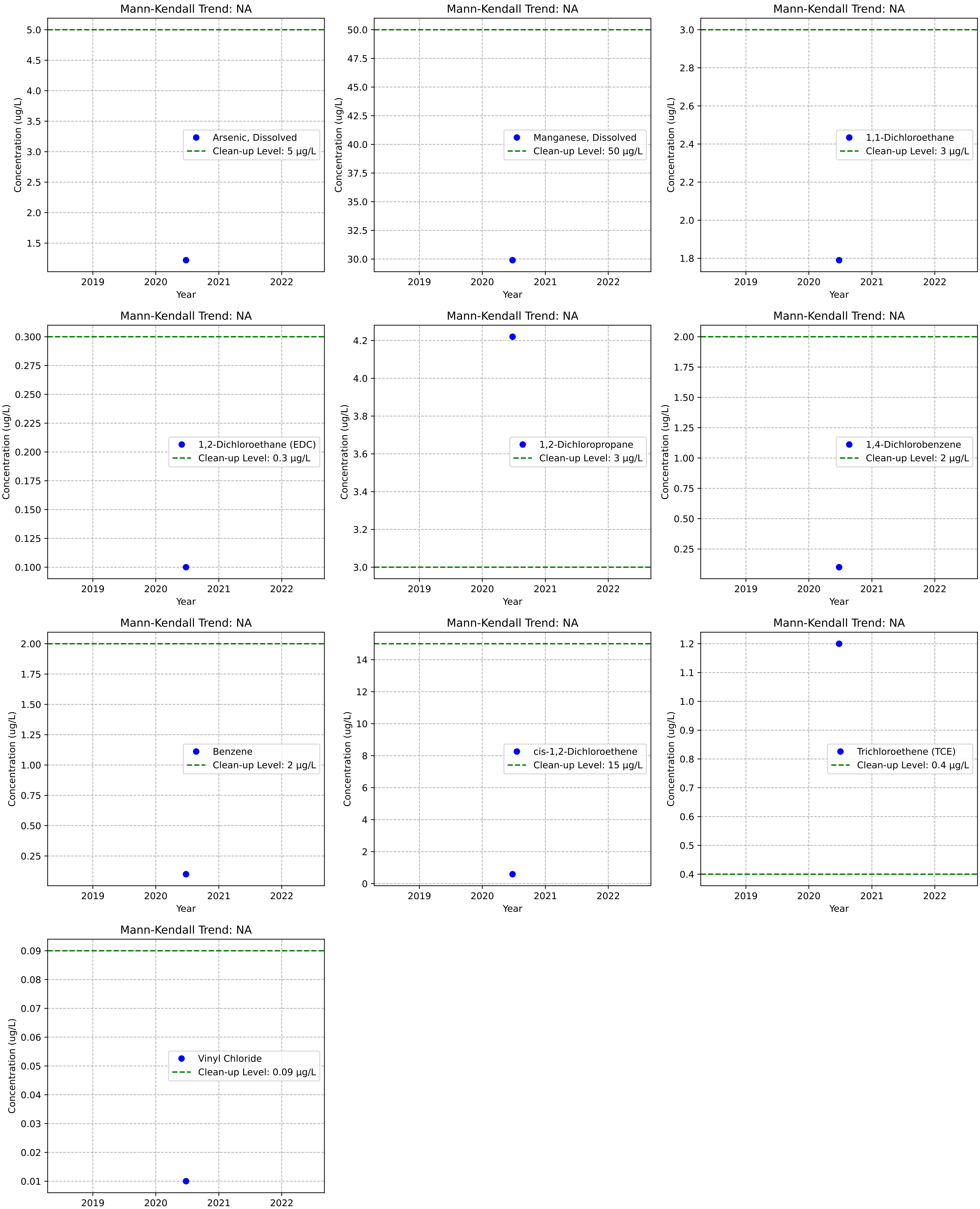


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.72)
Exponential Fit (R²=0.66)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.88)
Exponential Fit (R²=0.89)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.12)
Exponential Fit (R²=0.14)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.50)
Exponential Fit (R²=0.59)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.68)
Exponential Fit (R²=0.63)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.21)
Exponential Fit (R²=0.15)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.85)
Exponential Fit (R²=0.91)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-131p2

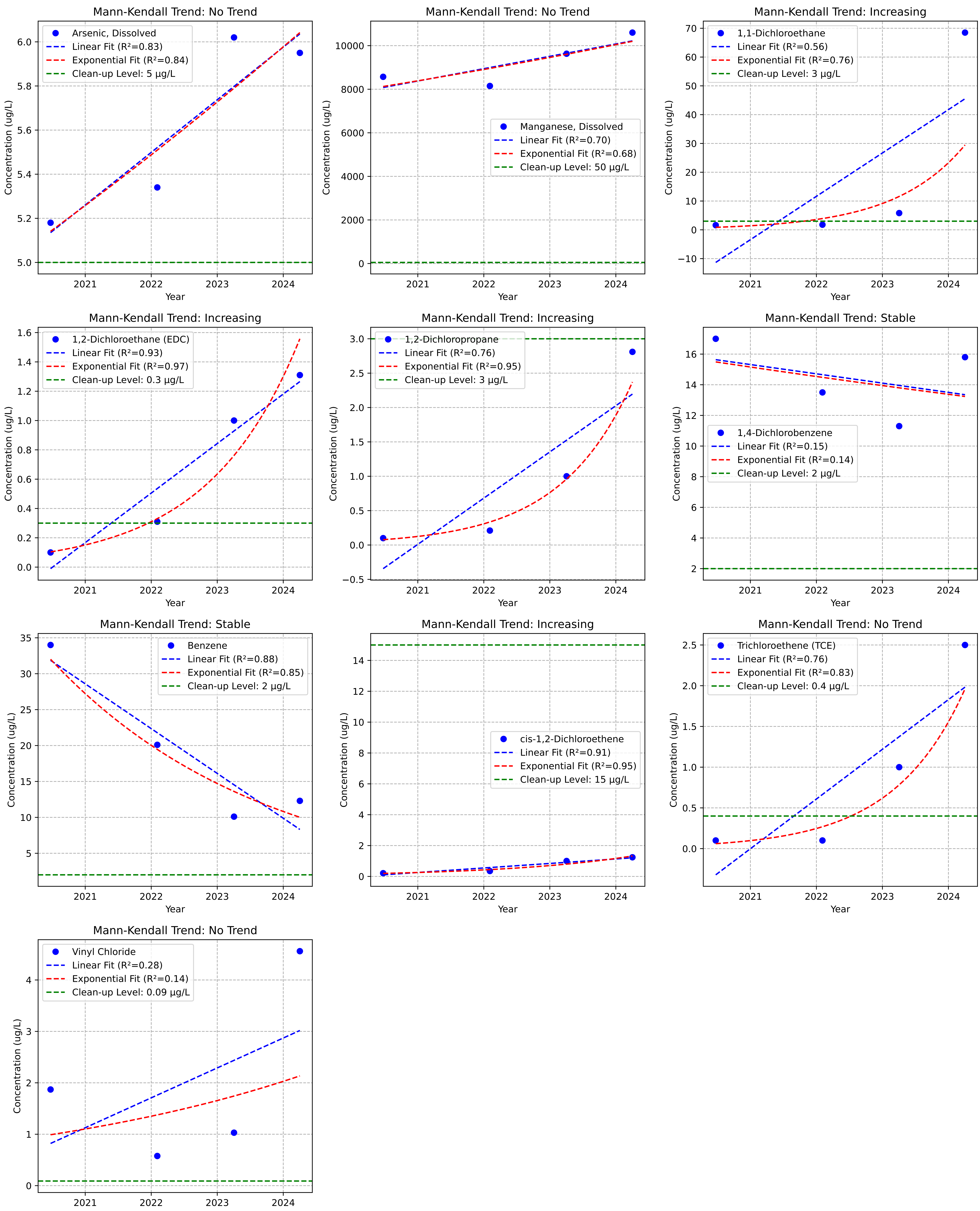

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-136p2

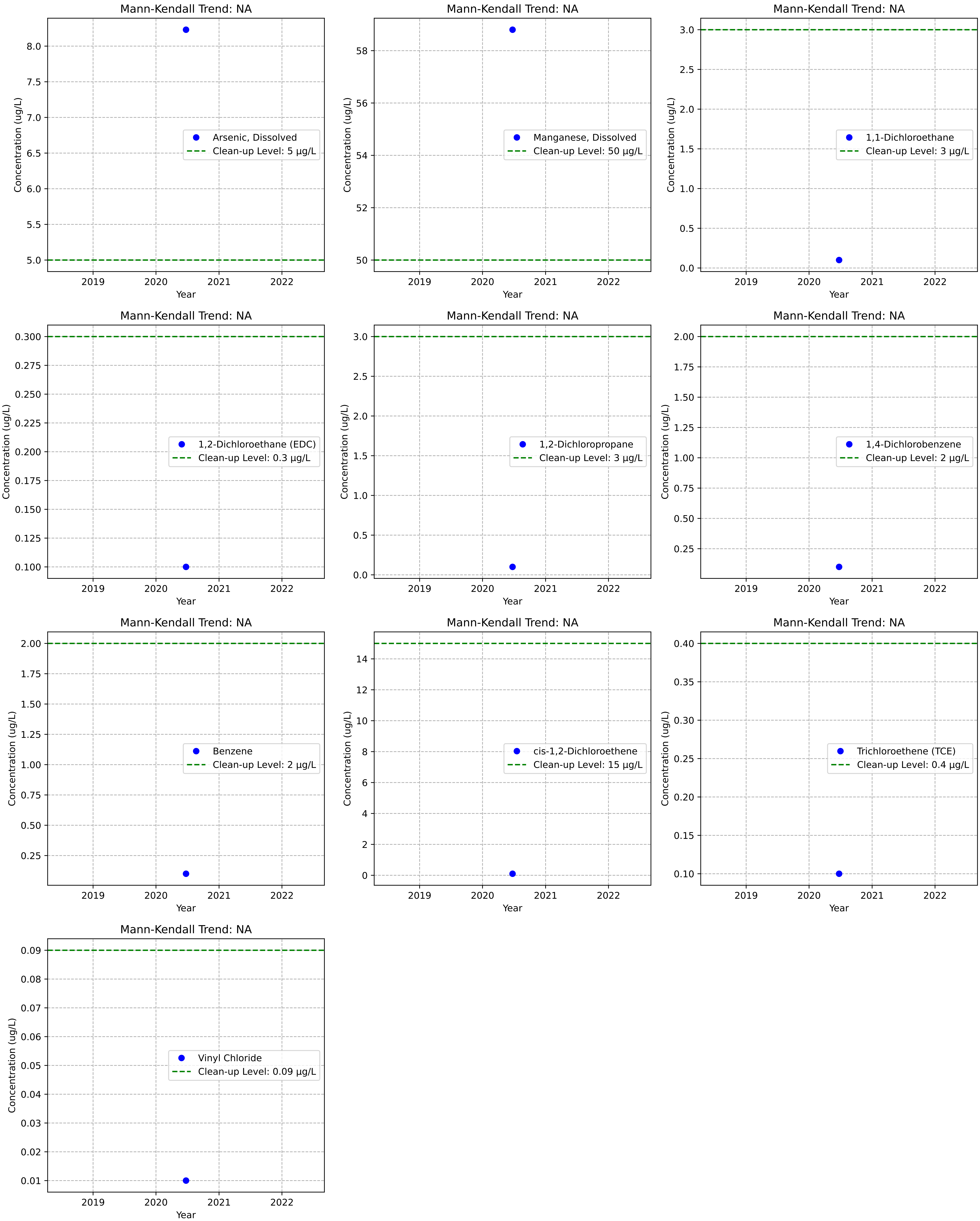


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

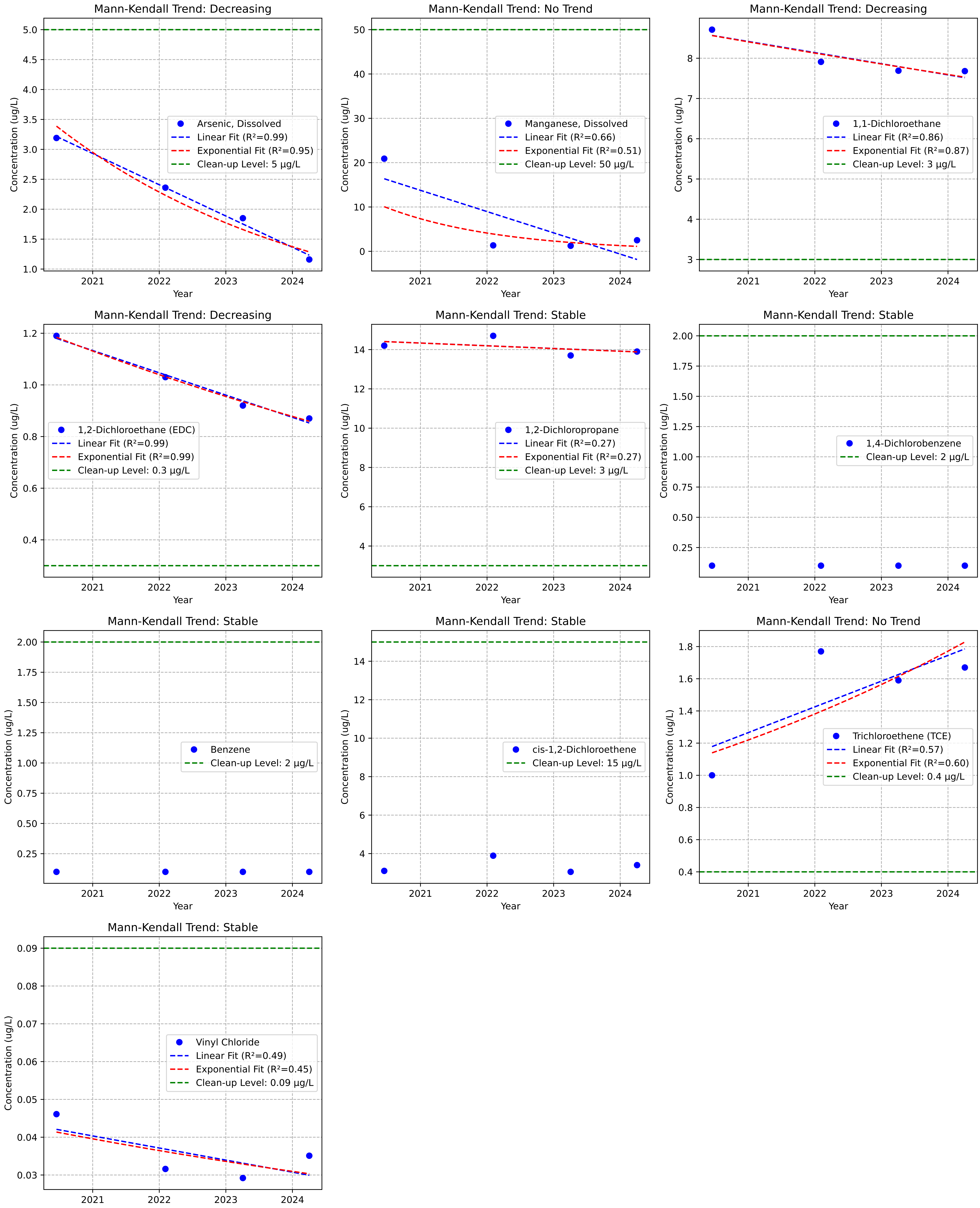
MW-138p2


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Linear Fit (R²=0.83)
Exponential Fit (R²=0.84)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.70)
Exponential Fit (R²=0.68)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Increasing
1,1-Dichloroethane
Linear Fit (R²=0.56)
Exponential Fit (R²=0.76)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.93)
Exponential Fit (R²=0.97)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloropropane
Linear Fit (R²=0.76)
Exponential Fit (R²=0.95)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.15)
Exponential Fit (R²=0.14)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.88)
Exponential Fit (R²=0.85)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Increasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.91)
Exponential Fit (R²=0.95)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.76)
Exponential Fit (R²=0.83)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.28)
Exponential Fit (R²=0.14)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-141p2

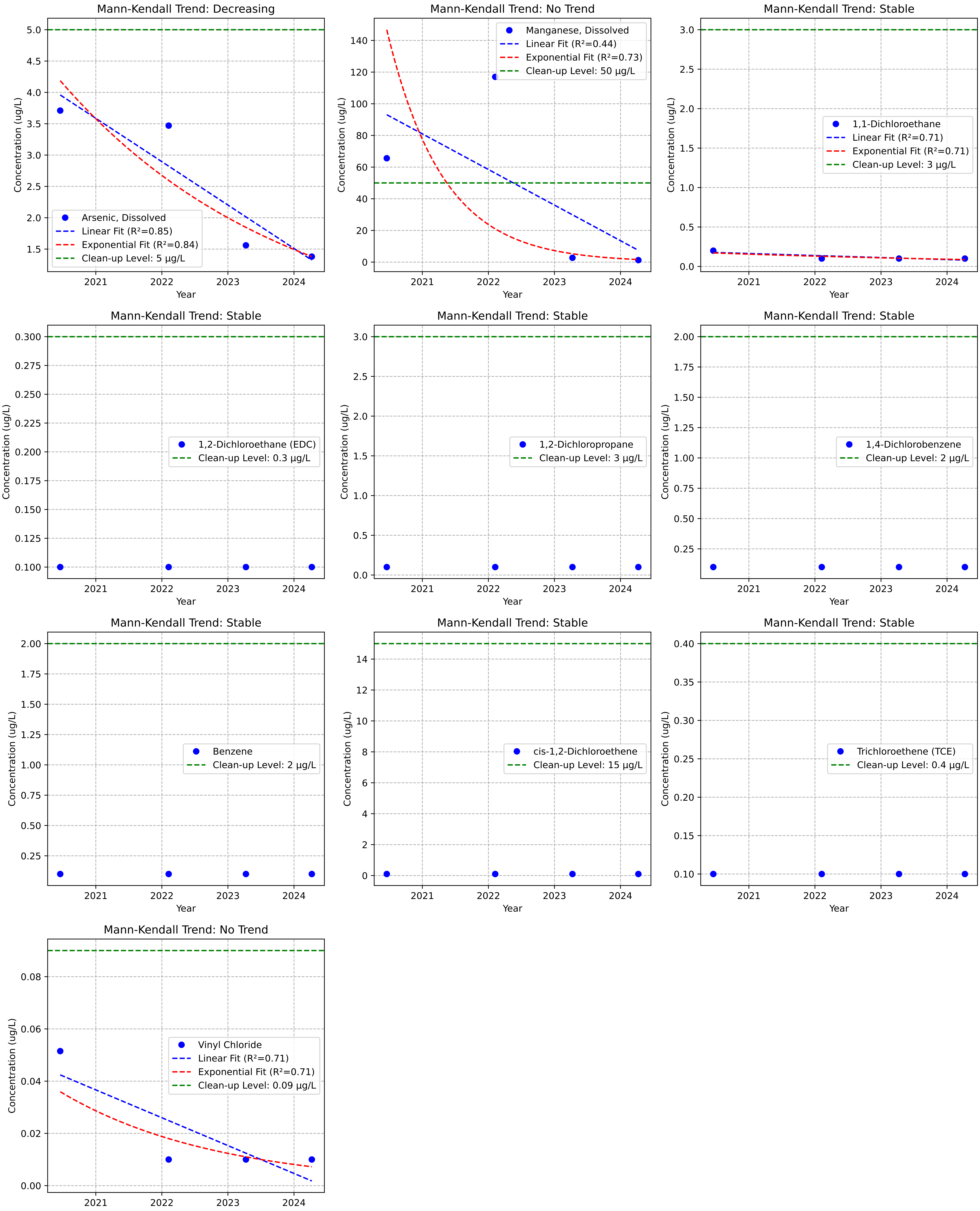

Mann-Kendall Trend: NA
Concentration (ug/L)
Year
2019
2020
2021
2022
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L

MW-143p2

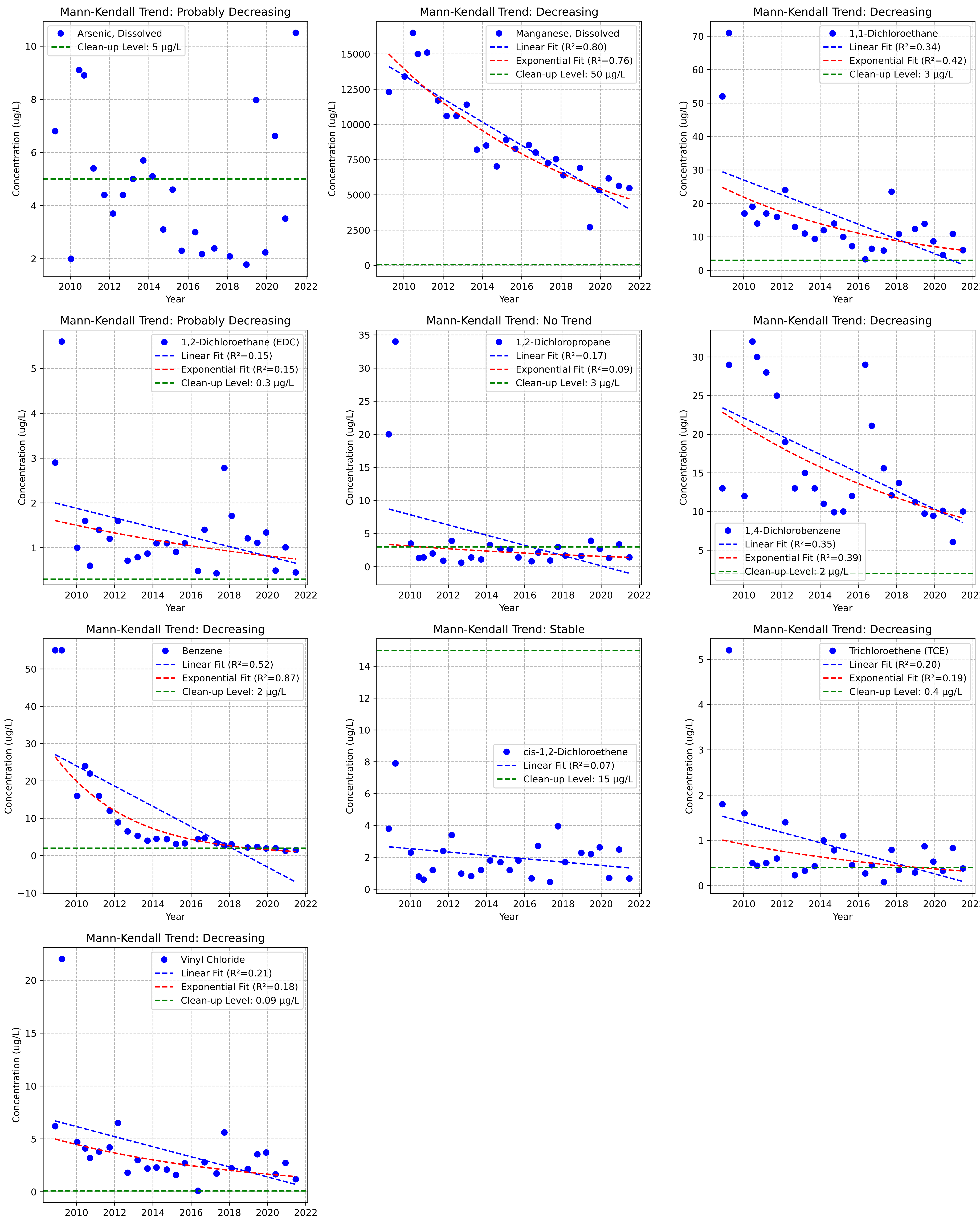


Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.99)
Exponential Fit (R²=0.95)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.66)
Exponential Fit (R²=0.51)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.86)
Exponential Fit (R²=0.87)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.99)
Exponential Fit (R²=0.99)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.27)
Exponential Fit (R²=0.27)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.57)
Exponential Fit (R²=0.60)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.49)
Exponential Fit (R²=0.45)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

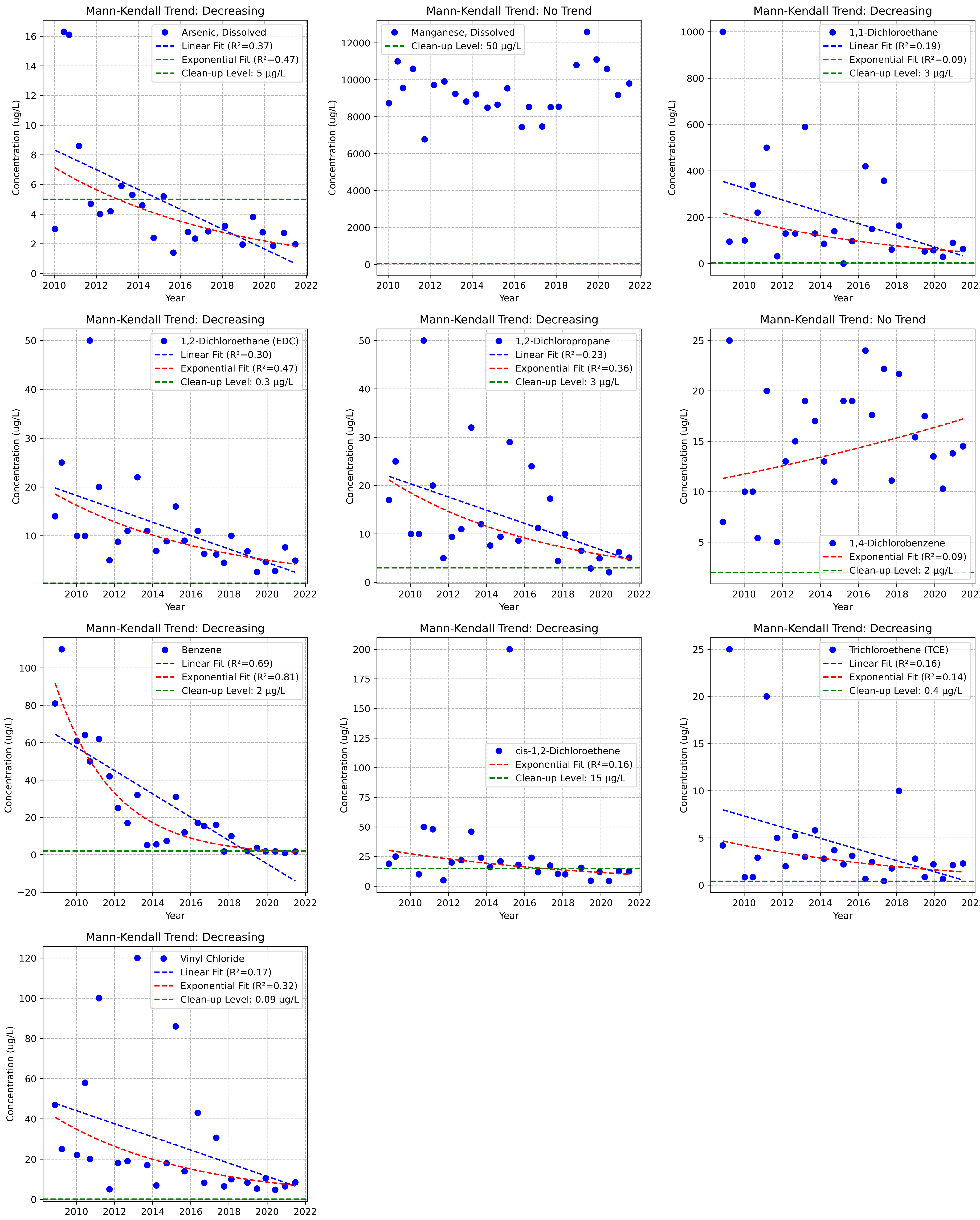
MW-147p2


Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.85)
Exponential Fit (R²=0.84)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.44)
Exponential Fit (R²=0.73)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

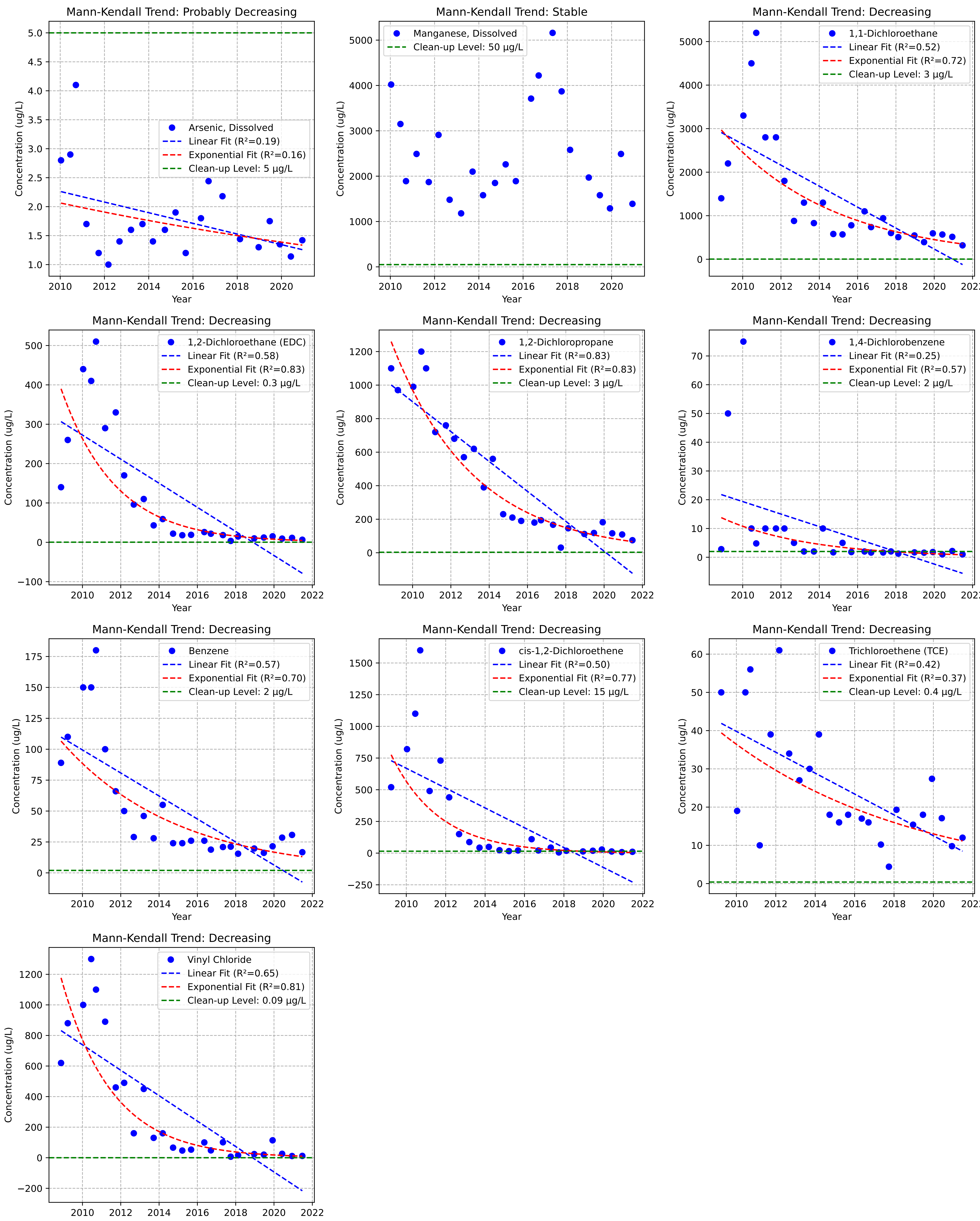
MW-33p2


Mann-Kendall Trend: Probably Decreasing
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.80)
Exponential Fit (R²=0.76)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.34)
Exponential Fit (R²=0.42)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.15)
Exponential Fit (R²=0.15)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.17)
Exponential Fit (R²=0.09)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.35)
Exponential Fit (R²=0.39)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.52)
Exponential Fit (R²=0.87)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.07)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.20)
Exponential Fit (R²=0.19)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.21)
Exponential Fit (R²=0.18)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

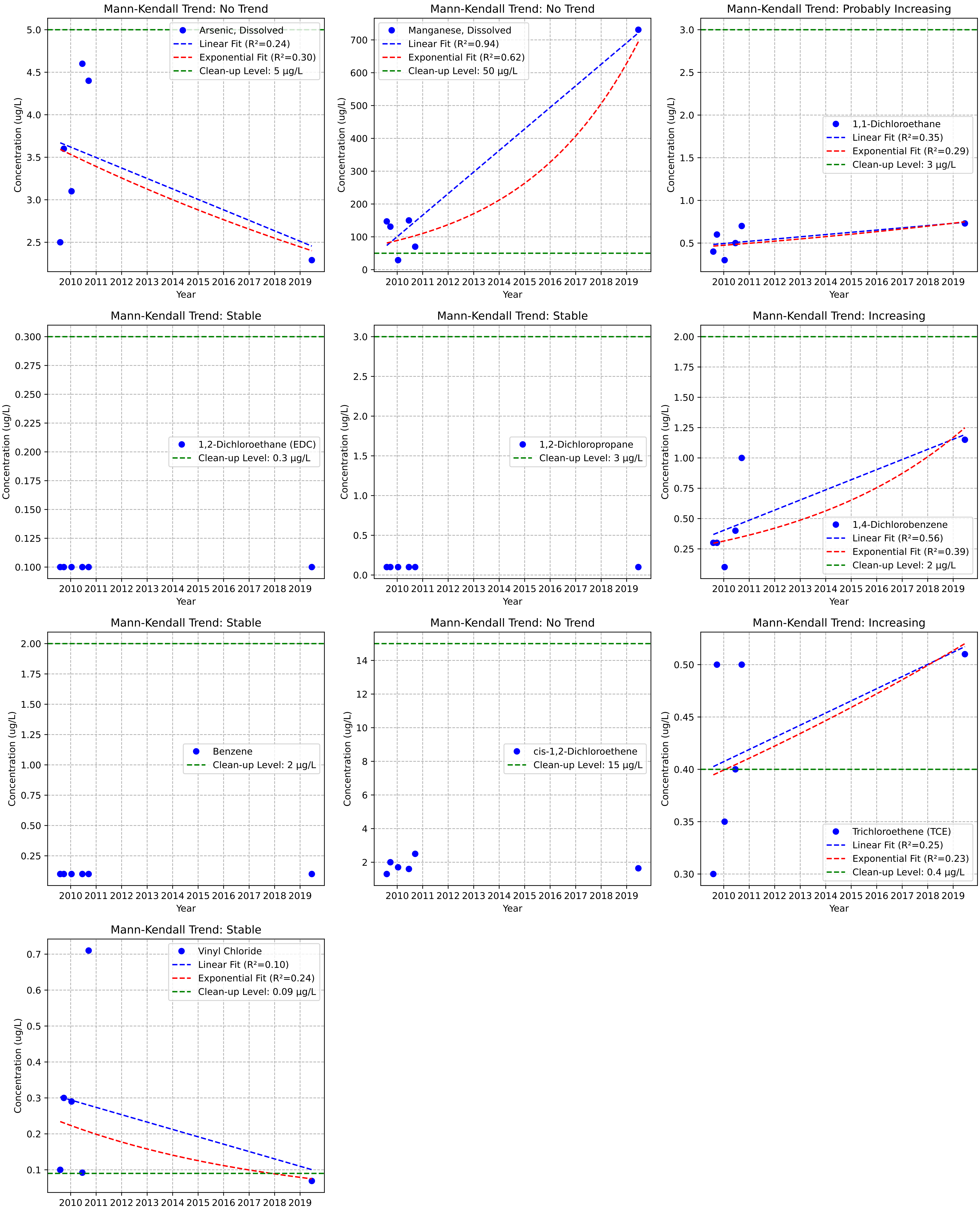
MW-35p2

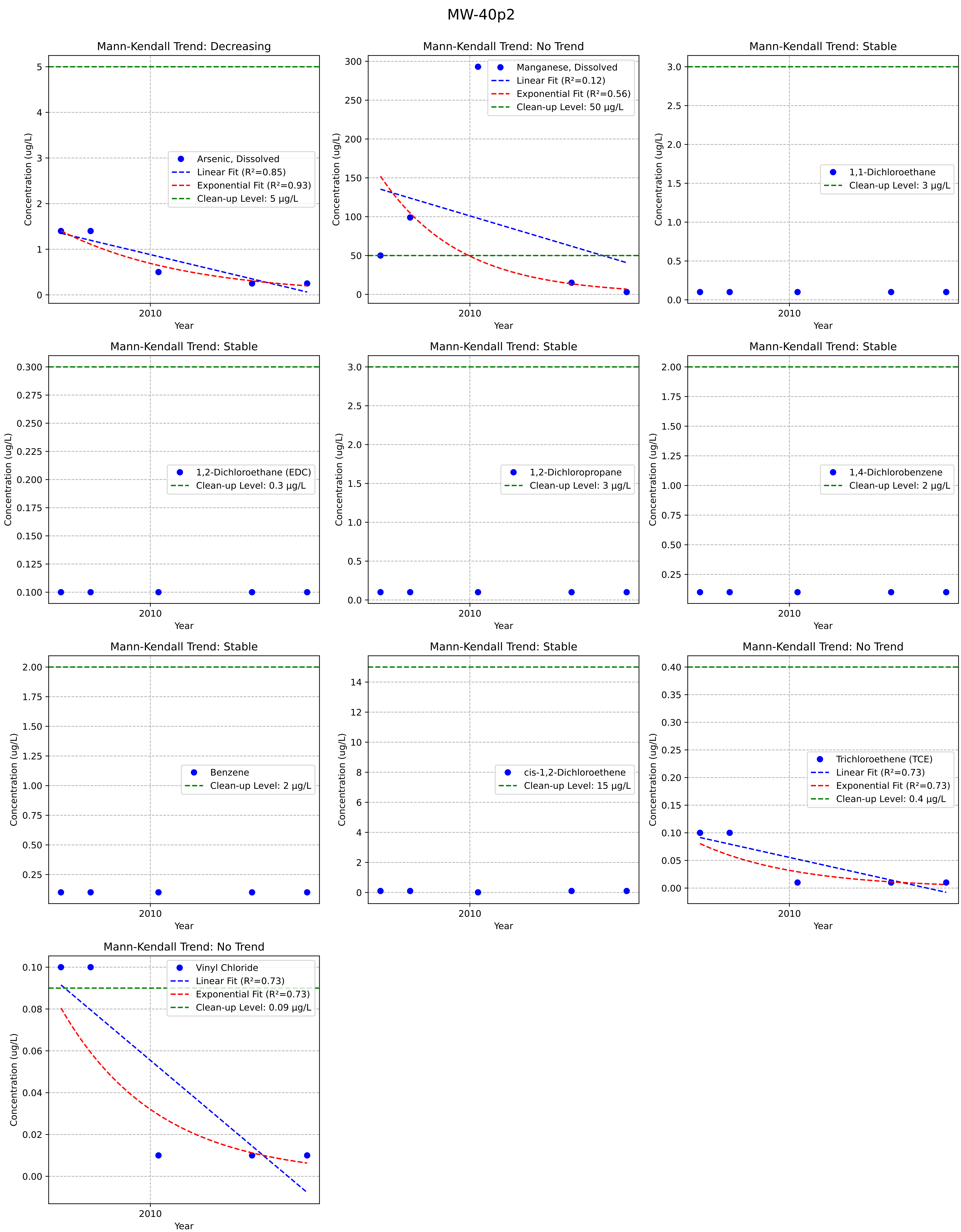

Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.37)
Exponential Fit (R²=0.47)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.19)
Exponential Fit (R²=0.09)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.30)
Exponential Fit (R²=0.47)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.23)
Exponential Fit (R²=0.36)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Exponential Fit (R²=0.09)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.69)
Exponential Fit (R²=0.81)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Exponential Fit (R²=0.16)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.16)
Exponential Fit (R²=0.14)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.17)
Exponential Fit (R²=0.32)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-38p2


Mann-Kendall Trend: Probably Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.19)
Exponential Fit (R²=0.16)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.52)
Exponential Fit (R²=0.72)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.58)
Exponential Fit (R²=0.83)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.83)
Exponential Fit (R²=0.83)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.25)
Exponential Fit (R²=0.57)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.57)
Exponential Fit (R²=0.70)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.50)
Exponential Fit (R²=0.77)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.42)
Exponential Fit (R²=0.37)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.65)
Exponential Fit (R²=0.81)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

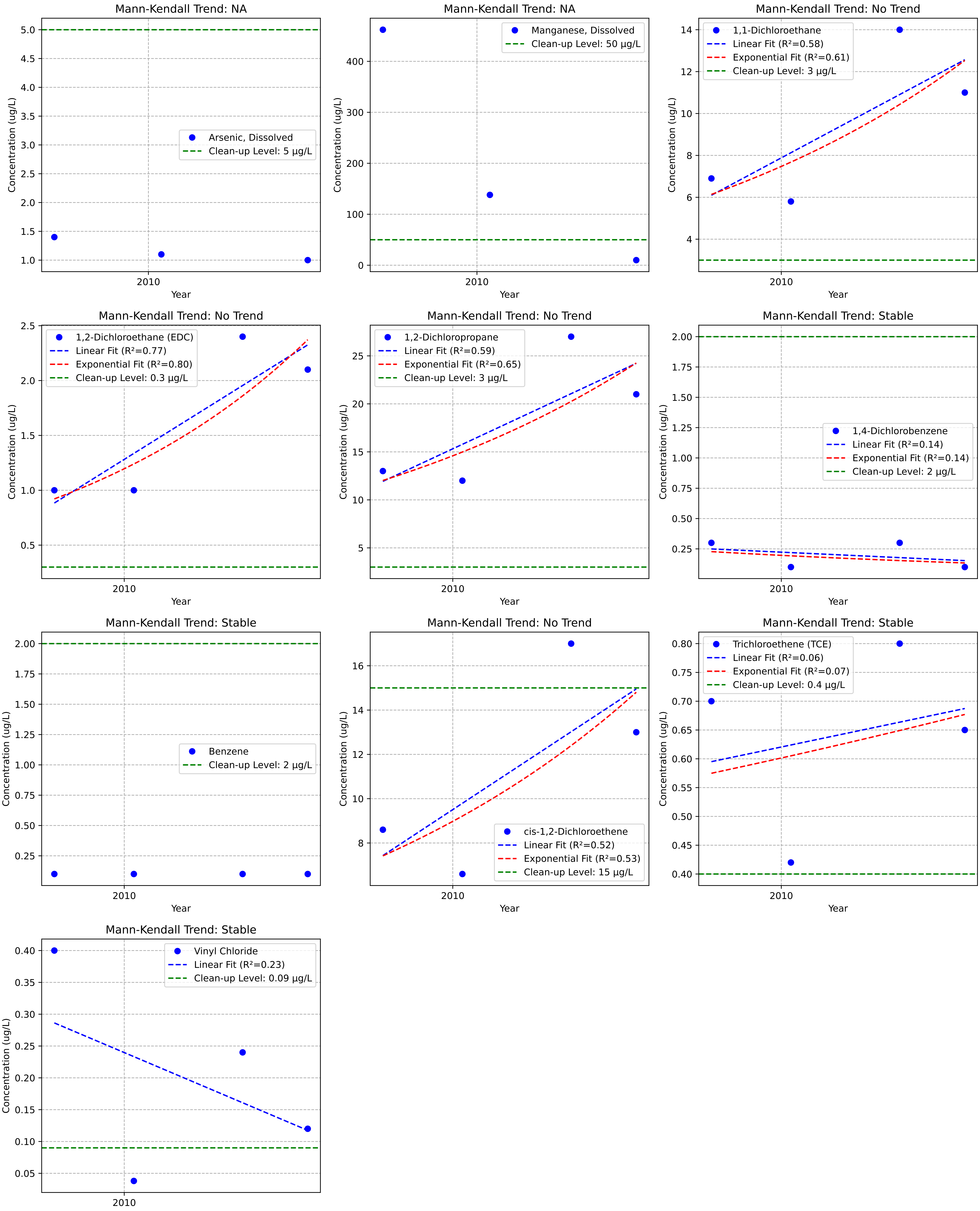
MW-39p2


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Linear Fit (R²=0.24)
Exponential Fit (R²=0.30)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.94)
Exponential Fit (R²=0.62)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Probably Increasing
1,1-Dichloroethane
Linear Fit (R²=0.35)
Exponential Fit (R²=0.29)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,4-Dichlorobenzene
Linear Fit (R²=0.56)
Exponential Fit (R²=0.39)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.25)
Exponential Fit (R²=0.23)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.10)
Exponential Fit (R²=0.24)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year



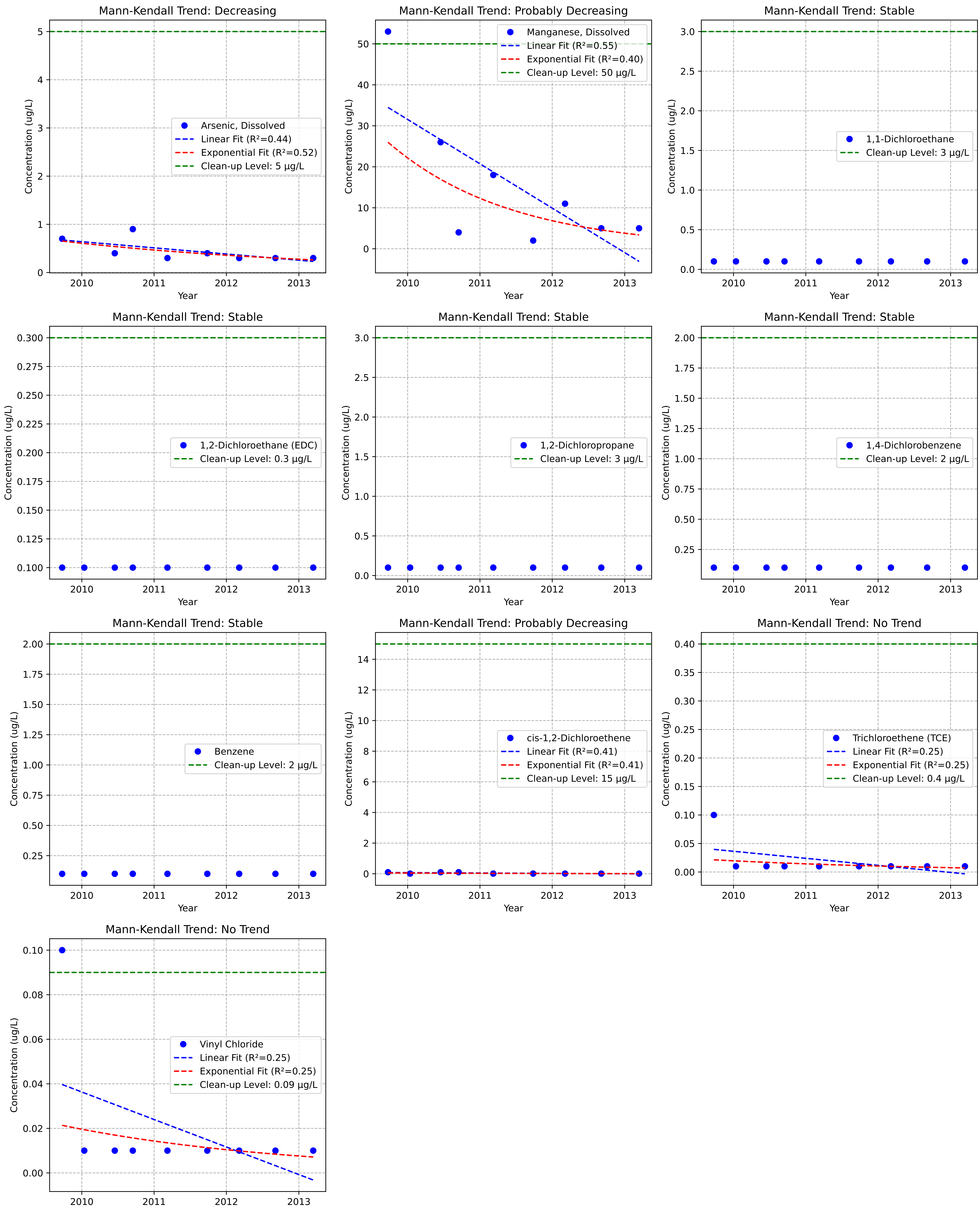
MW-40p2
Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.85)
Exponential Fit (R²=0.93)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.12)
Exponential Fit (R²=0.56)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.73)
Exponential Fit (R²=0.73)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.73)
Exponential Fit (R²=0.73)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

MW-43p2

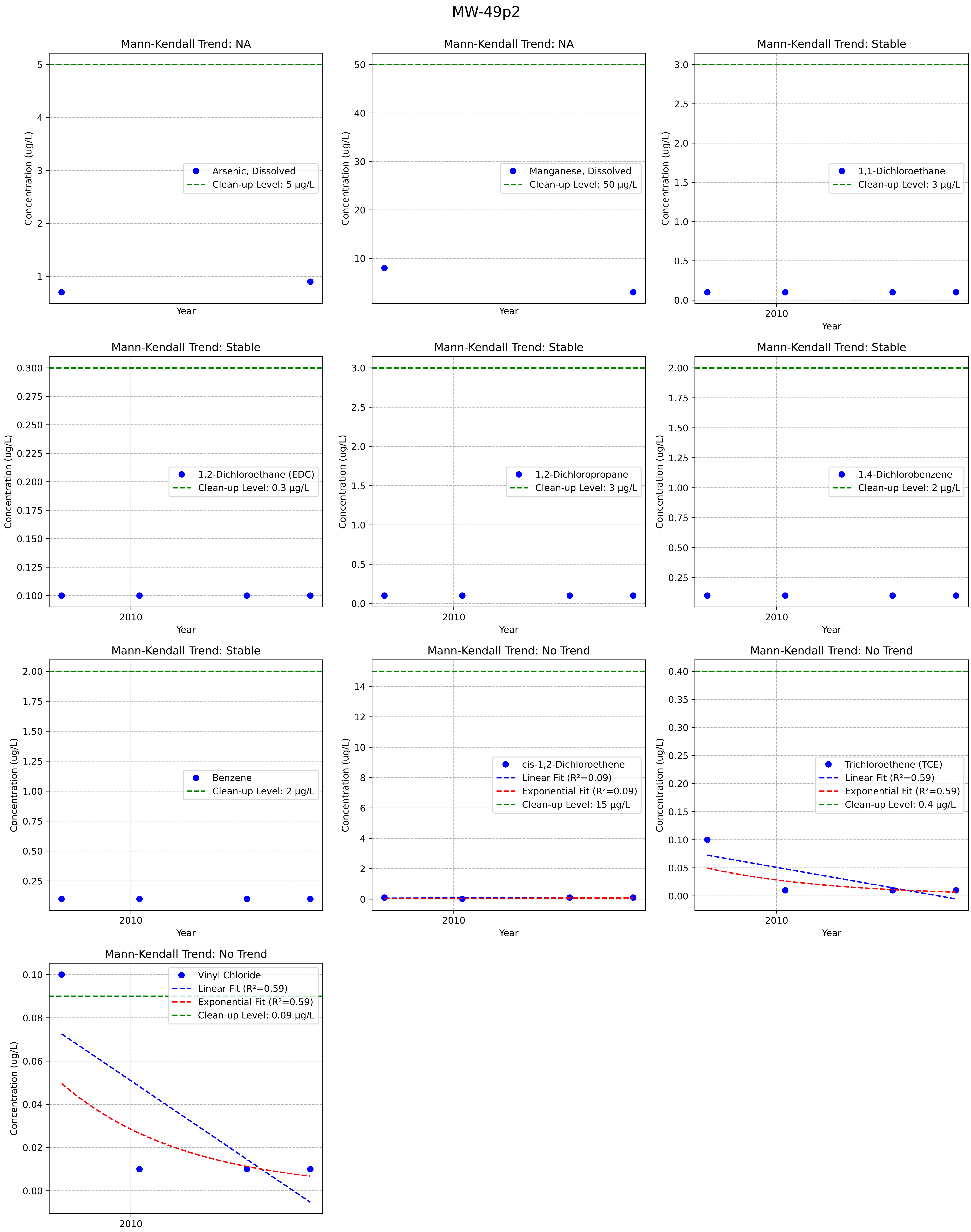


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.58)
Exponential Fit (R²=0.61)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.77)
Exponential Fit (R²=0.80)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.59)
Exponential Fit (R²=0.65)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.14)
Exponential Fit (R²=0.14)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.52)
Exponential Fit (R²=0.53)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.06)
Exponential Fit (R²=0.07)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.23)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

MW-46p2

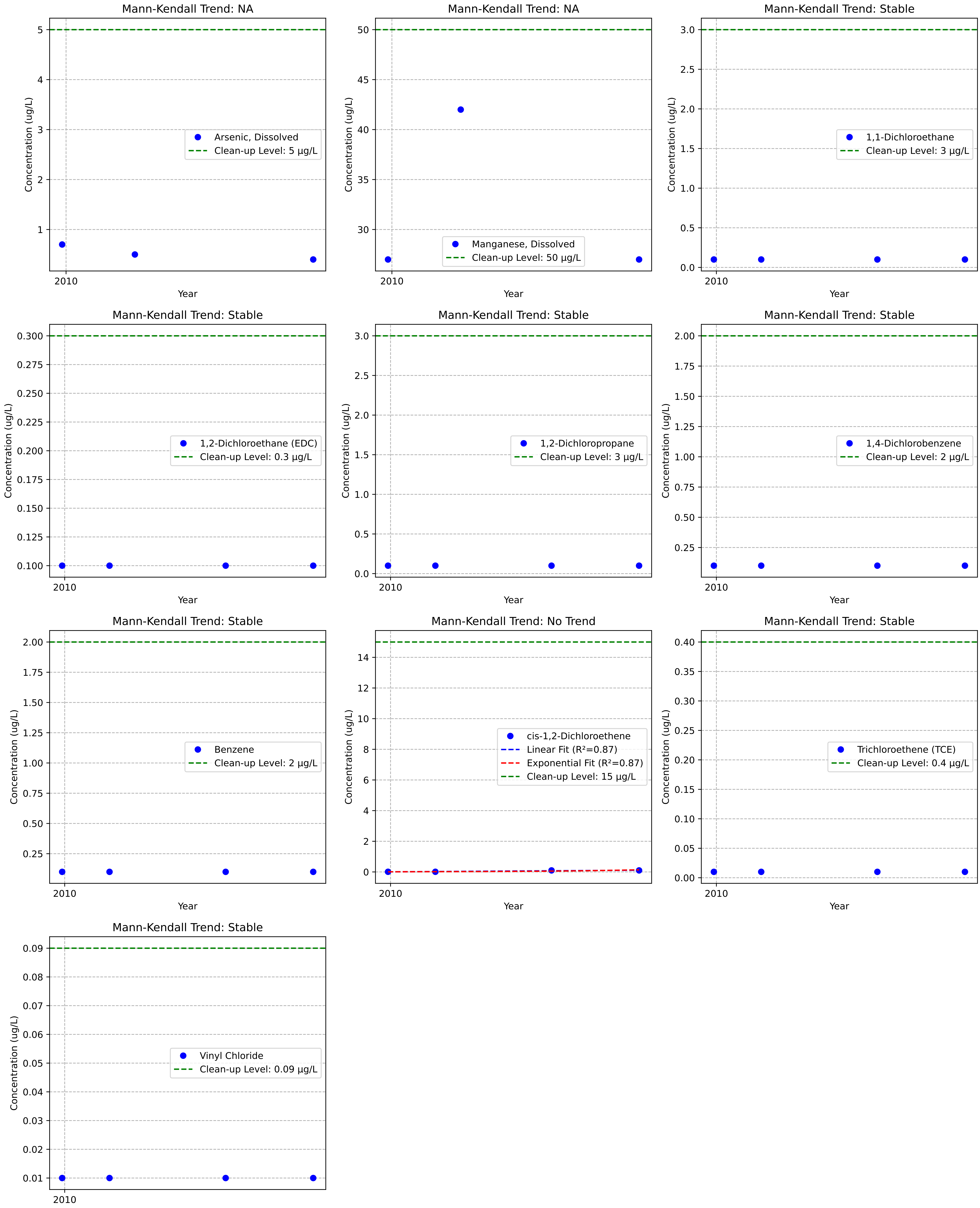


Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.44)
Exponential Fit (R²=0.52)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Probably Decreasing
Manganese, Dissolved
Linear Fit (R²=0.55)
Exponential Fit (R²=0.40)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.41)
Exponential Fit (R²=0.41)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010
2011
2012
2013



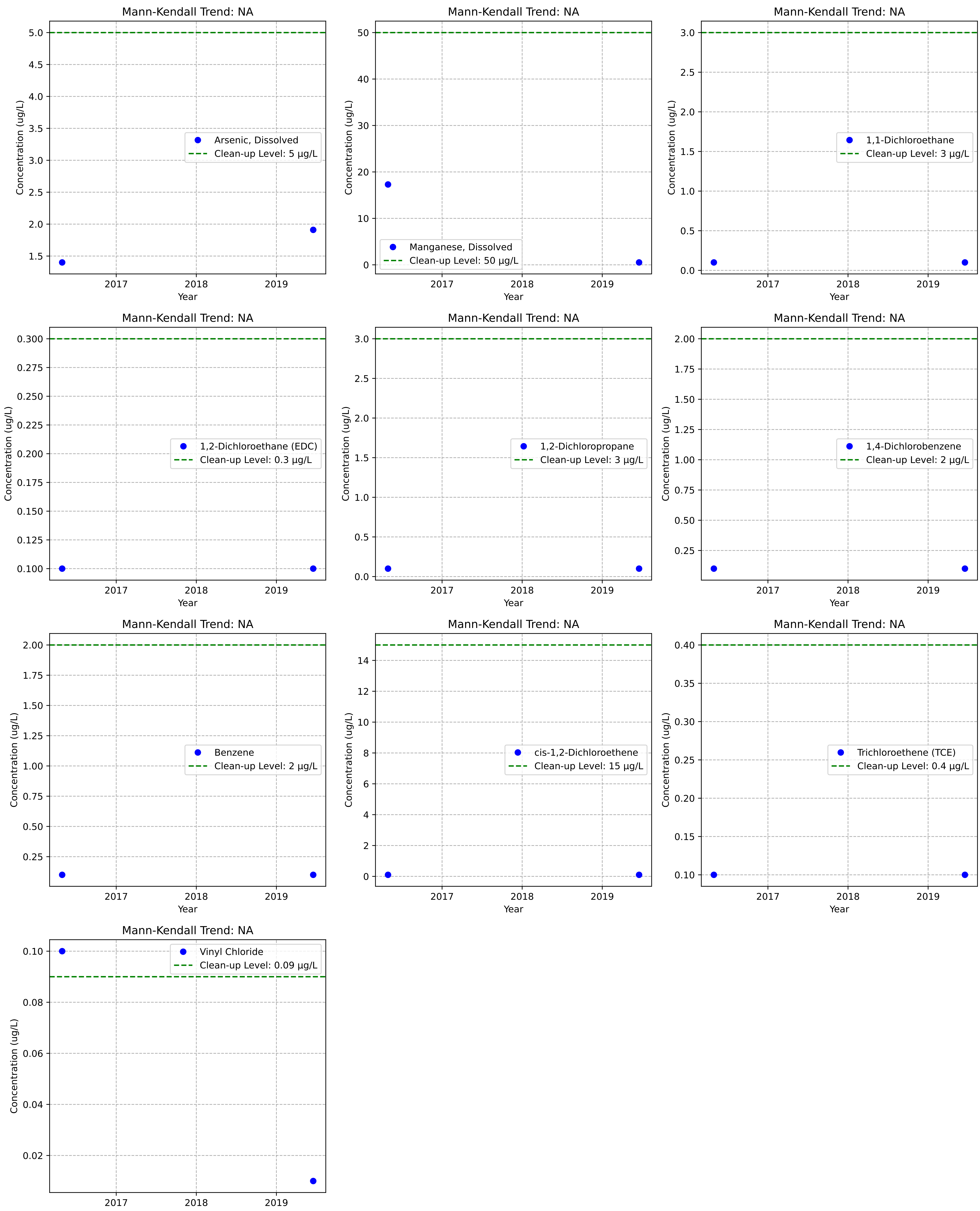
MW-49p2
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

MW-52p2



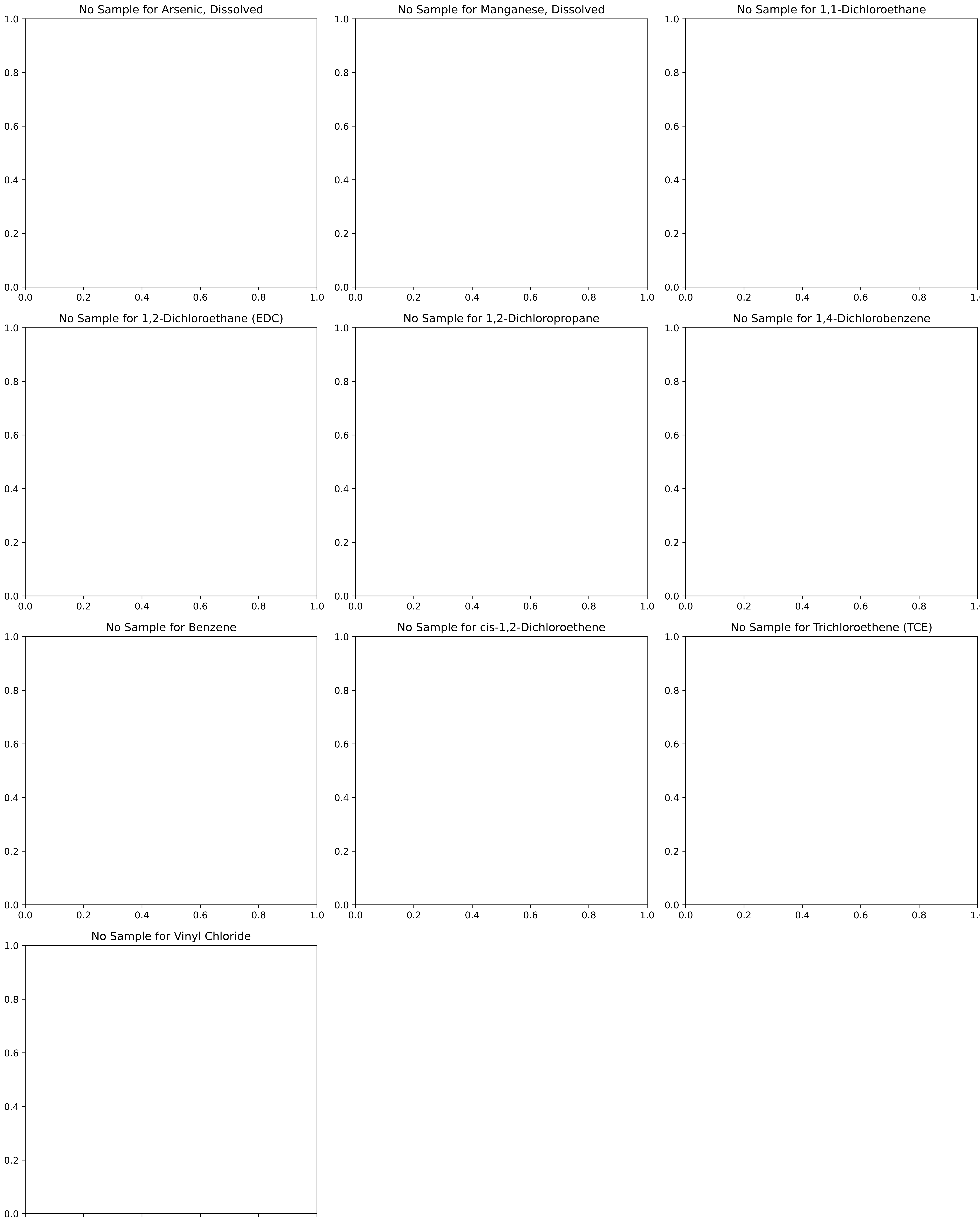
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.87)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

MW-60p2

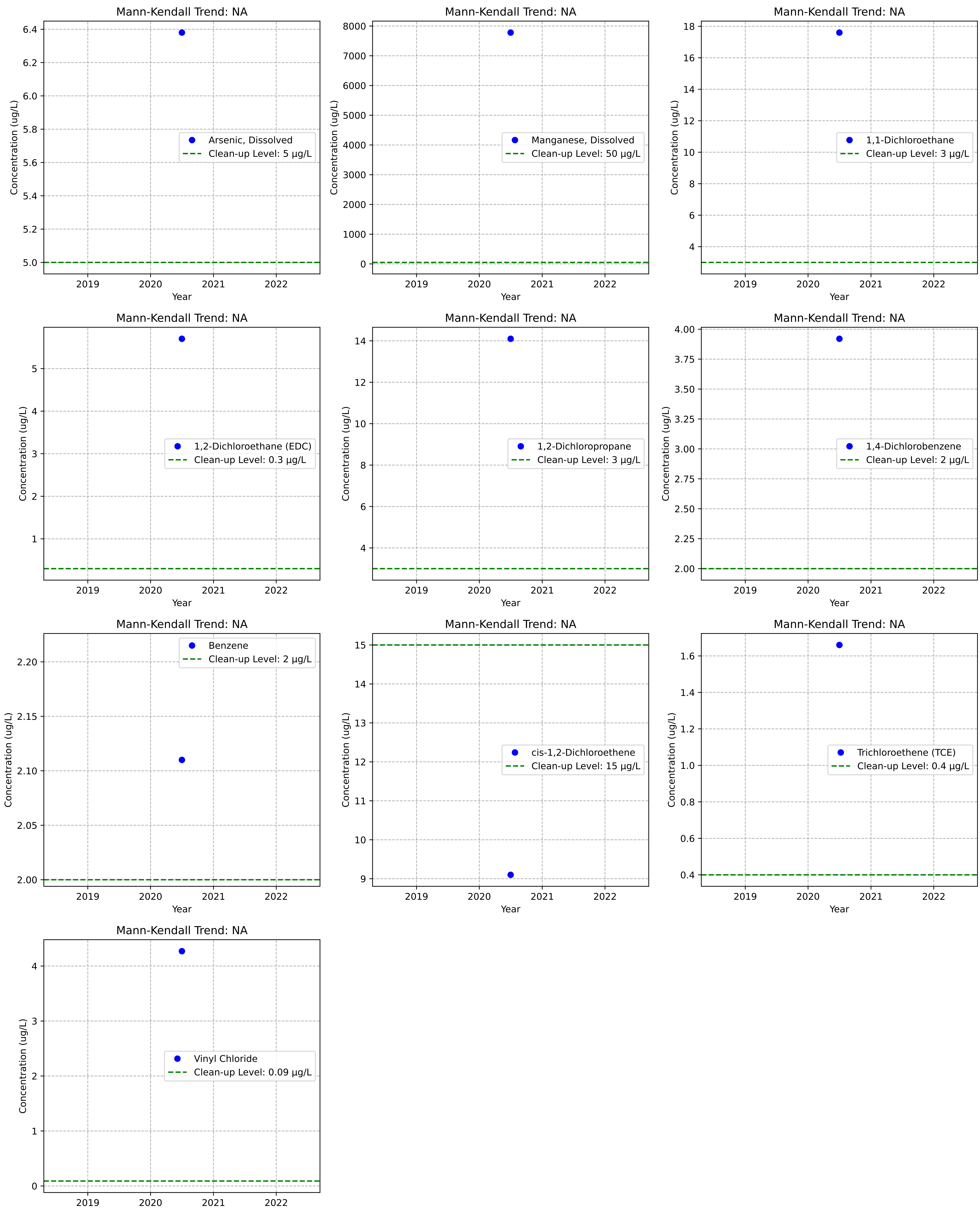


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2017
2018
2019

No Data for MW-73p2

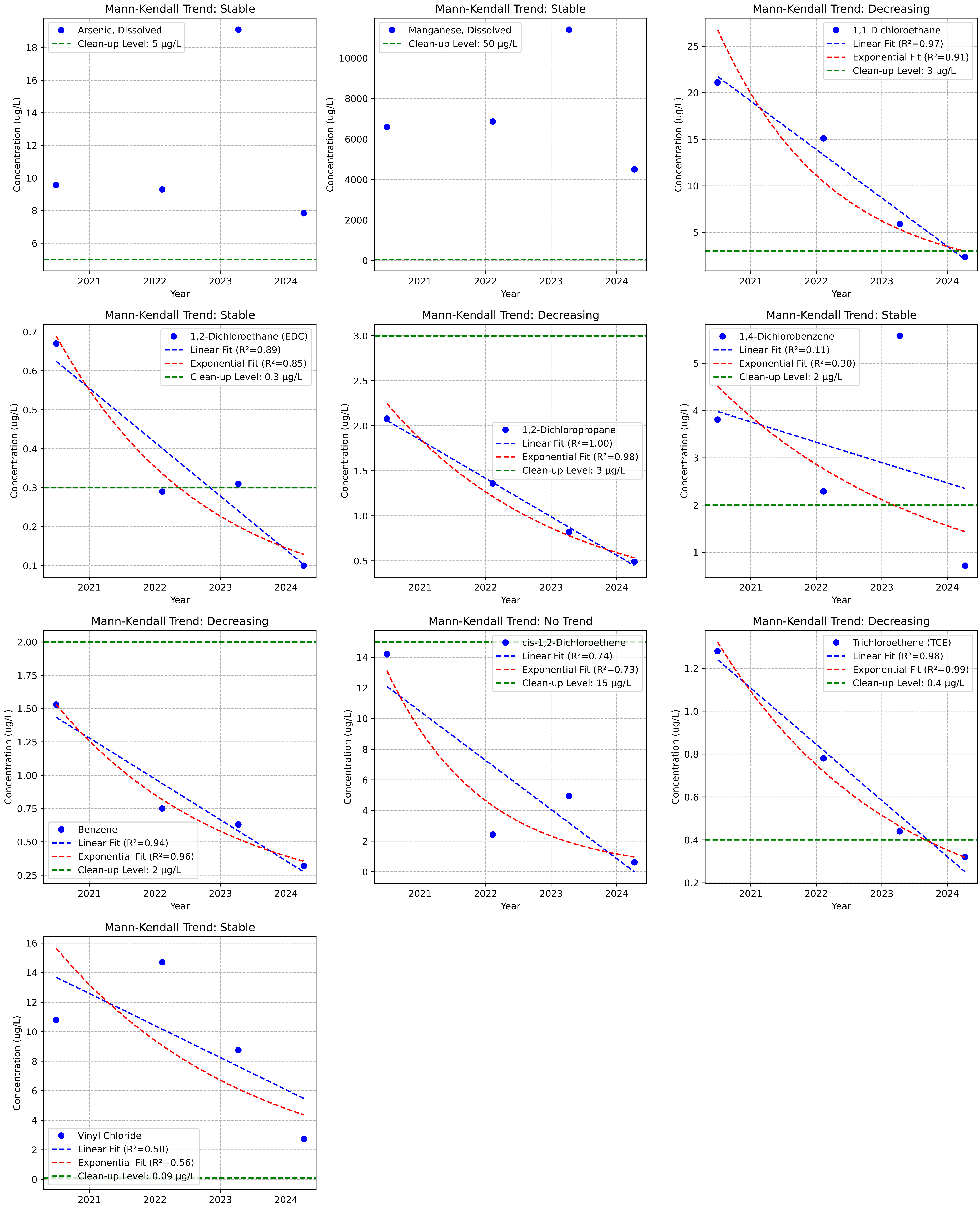


MW-76p2

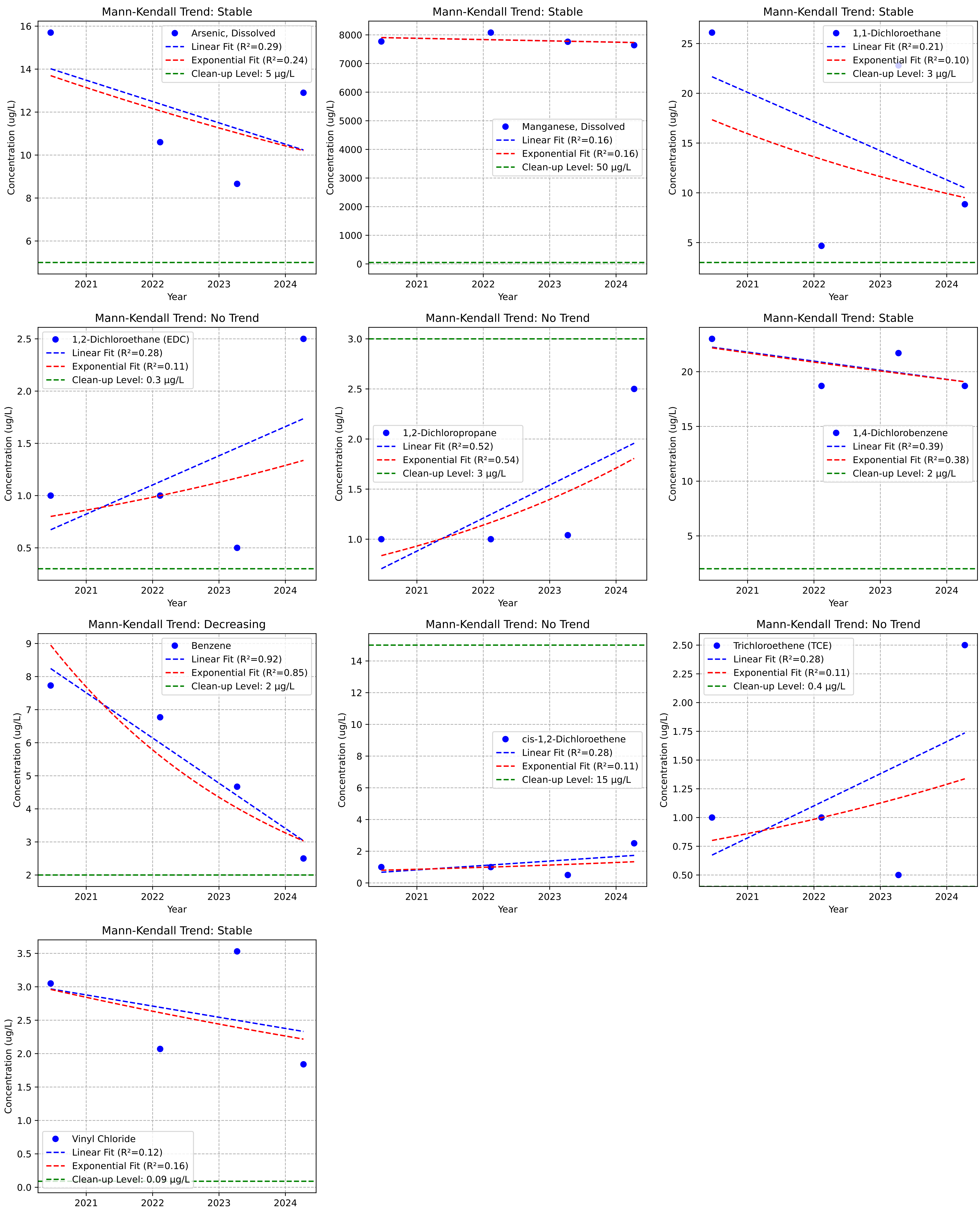


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-80p2

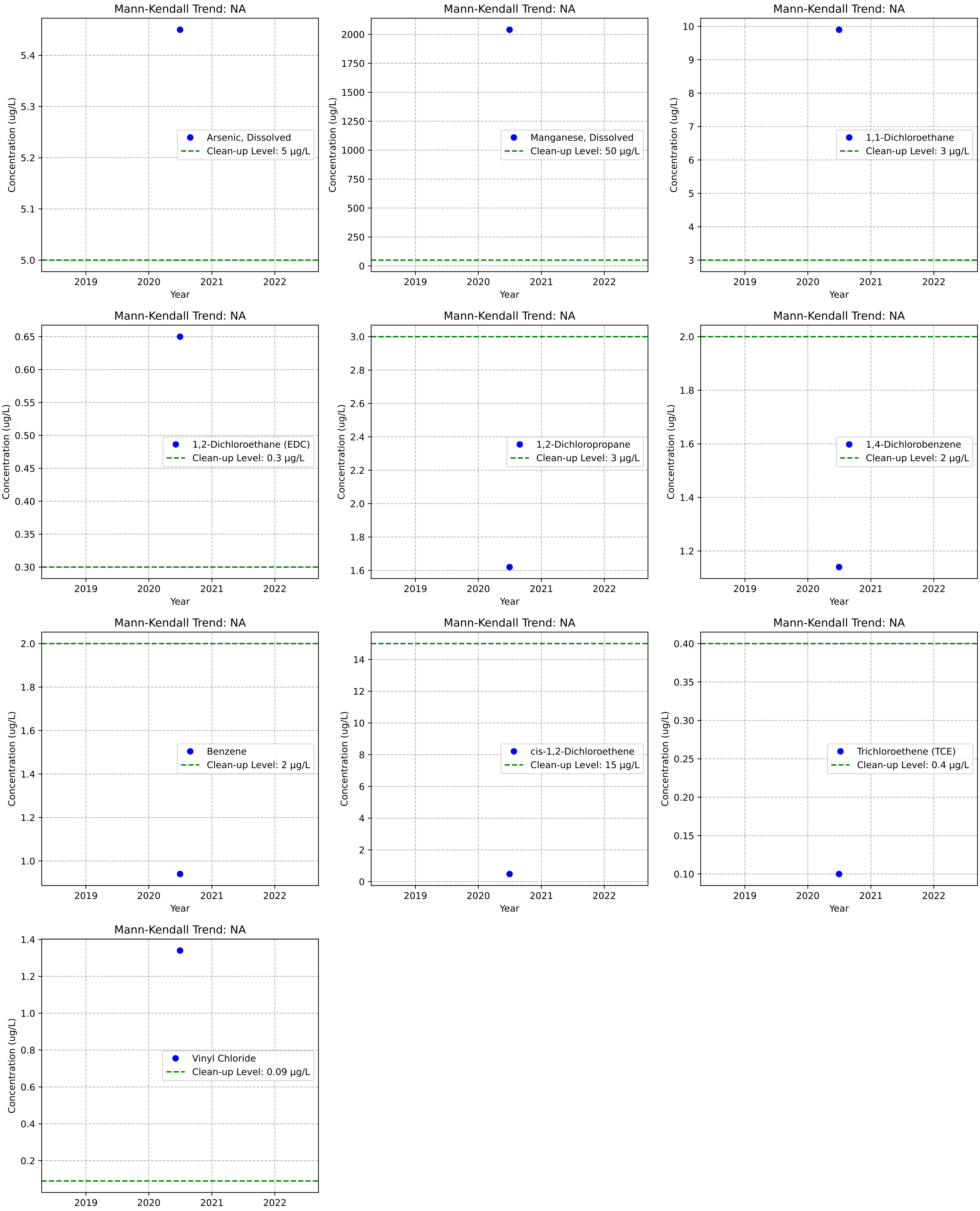

Mann-Kendall Trend: Stable
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.97)
Exponential Fit (R²=0.91)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.89)
Exponential Fit (R²=0.85)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=1.00)
Exponential Fit (R²=0.98)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.30)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.94)
Exponential Fit (R²=0.96)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.74)
Exponential Fit (R²=0.73)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.98)
Exponential Fit (R²=0.99)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.50)
Exponential Fit (R²=0.56)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-87p2



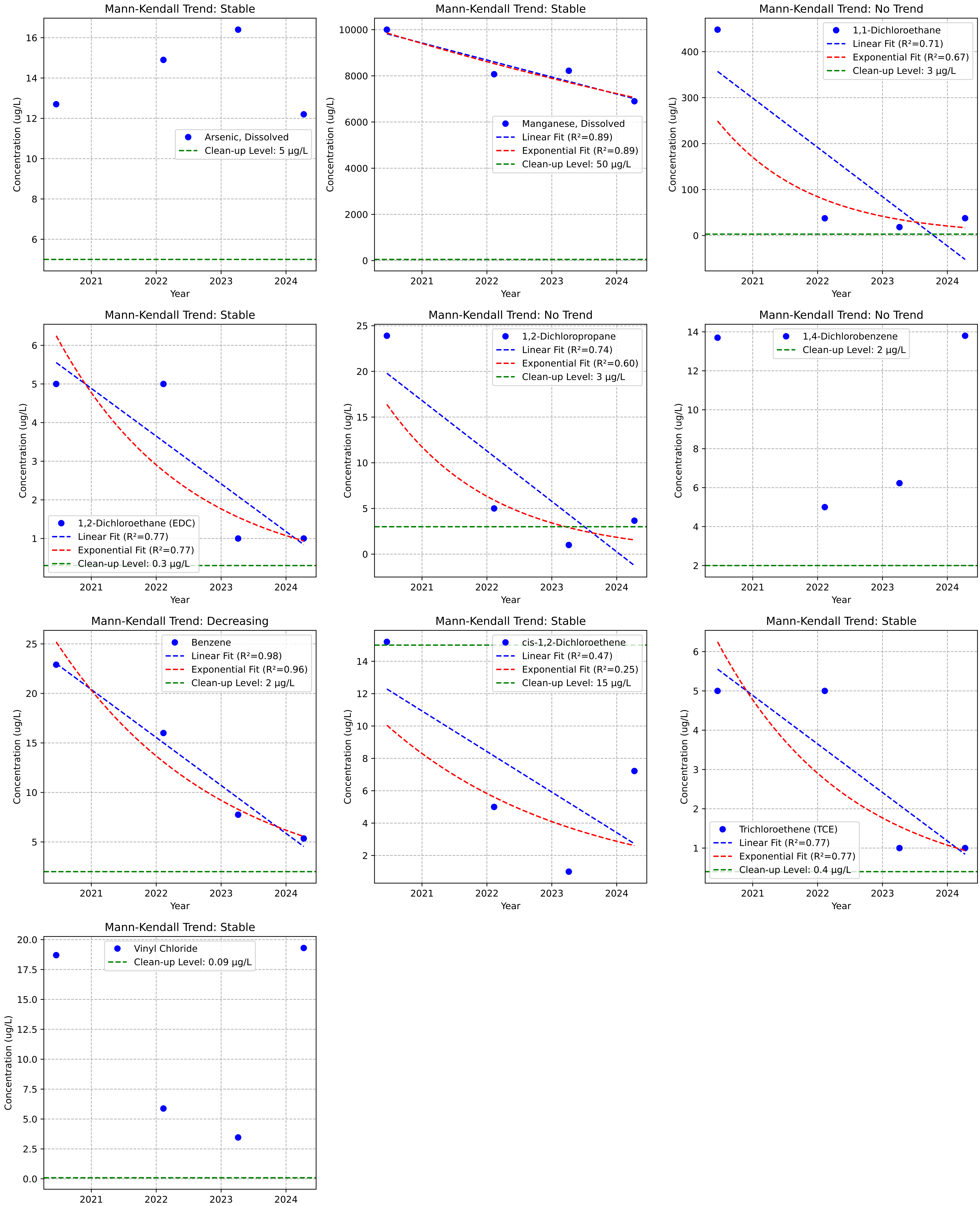
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.29)
Exponential Fit (R²=0.24)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.16)
Exponential Fit (R²=0.16)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.21)
Exponential Fit (R²=0.10)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.52)
Exponential Fit (R²=0.54)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.39)
Exponential Fit (R²=0.38)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.92)
Exponential Fit (R²=0.85)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.12)
Exponential Fit (R²=0.16)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-88p2



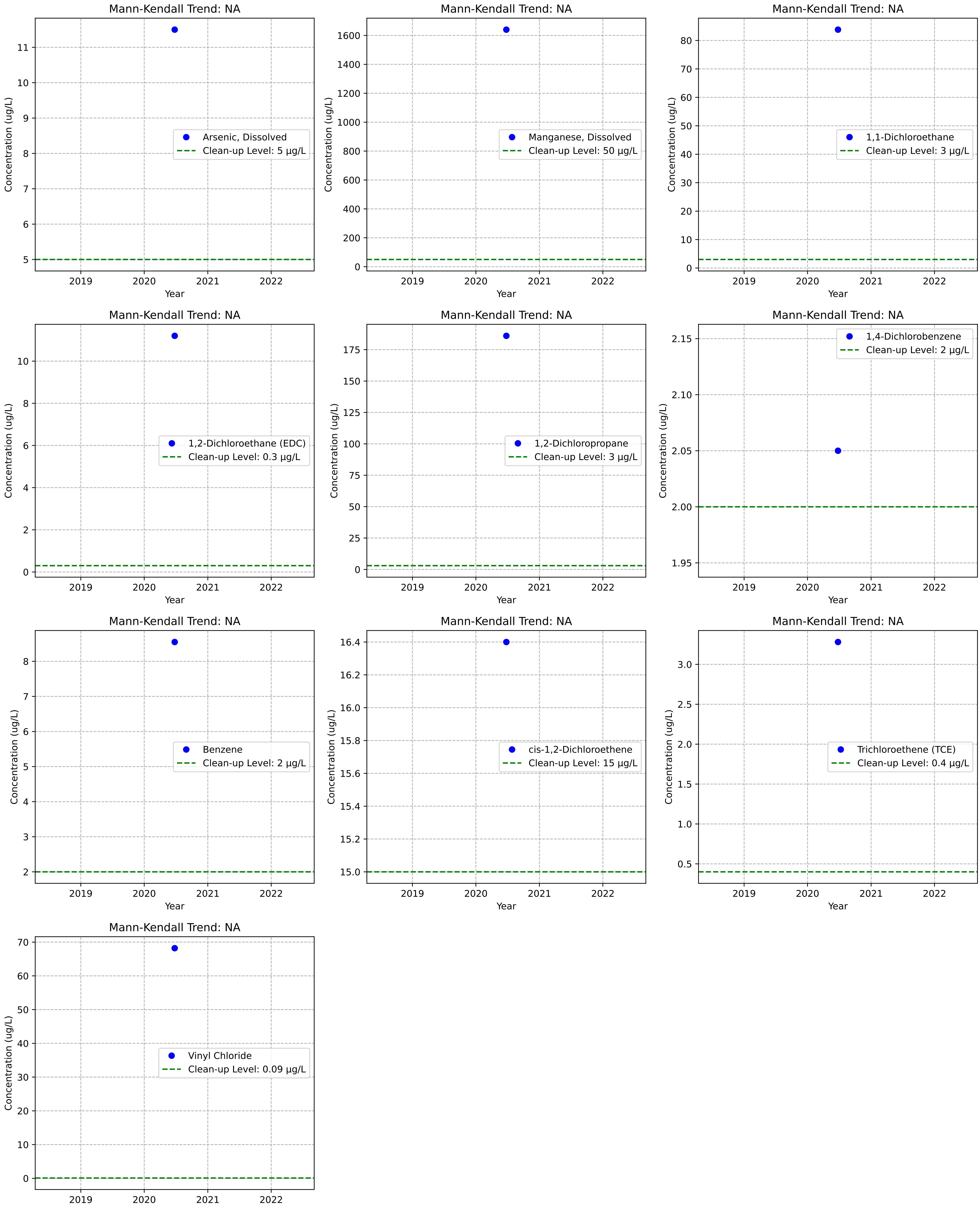
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 μg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 μg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 μg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 μg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 μg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 μg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 μg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 μg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 μg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 μg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-91p2

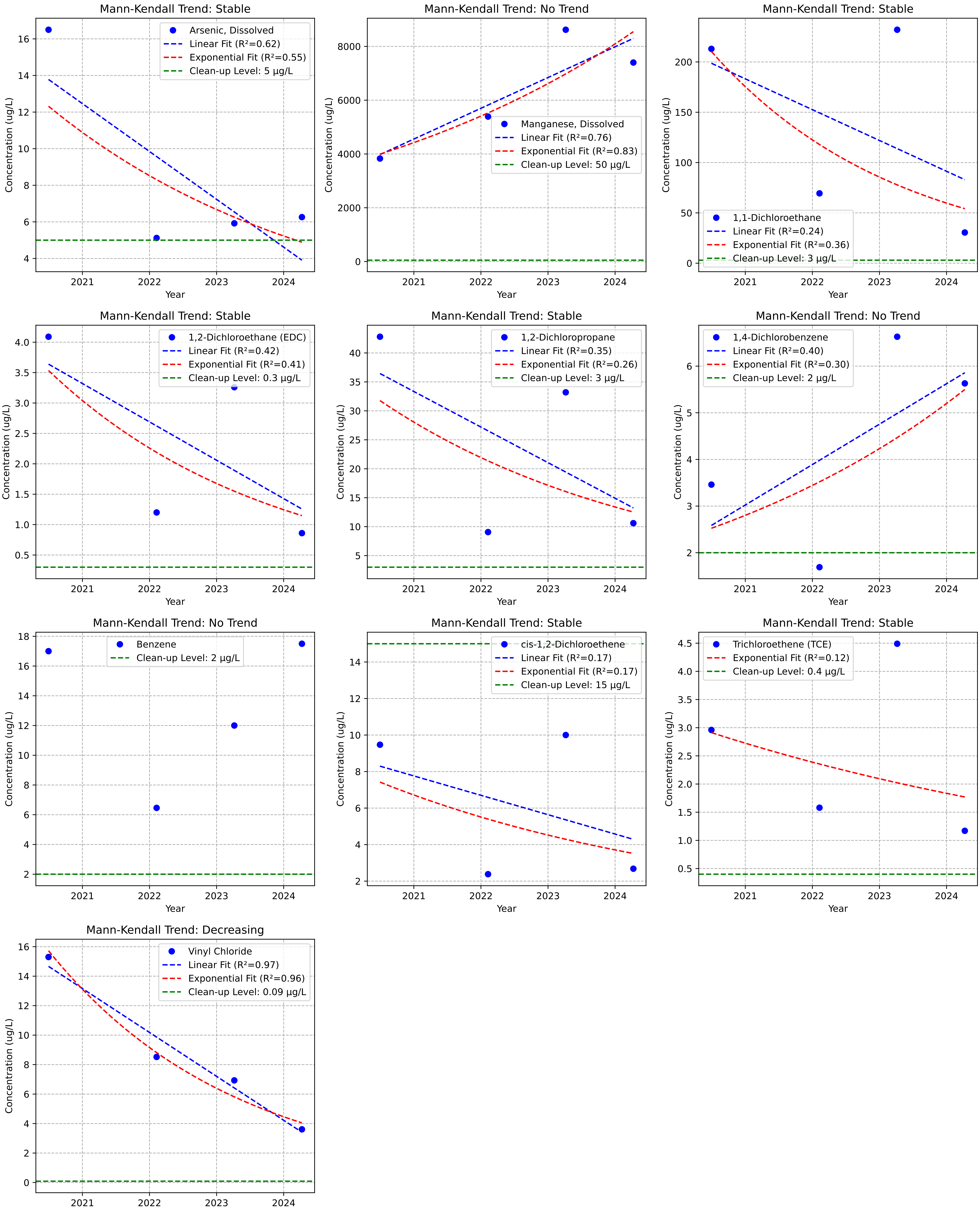


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.89)
Exponential Fit (R²=0.89)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.71)
Exponential Fit (R²=0.67)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.74)
Exponential Fit (R²=0.60)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.98)
Exponential Fit (R²=0.96)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.47)
Exponential Fit (R²=0.25)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-94p2


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

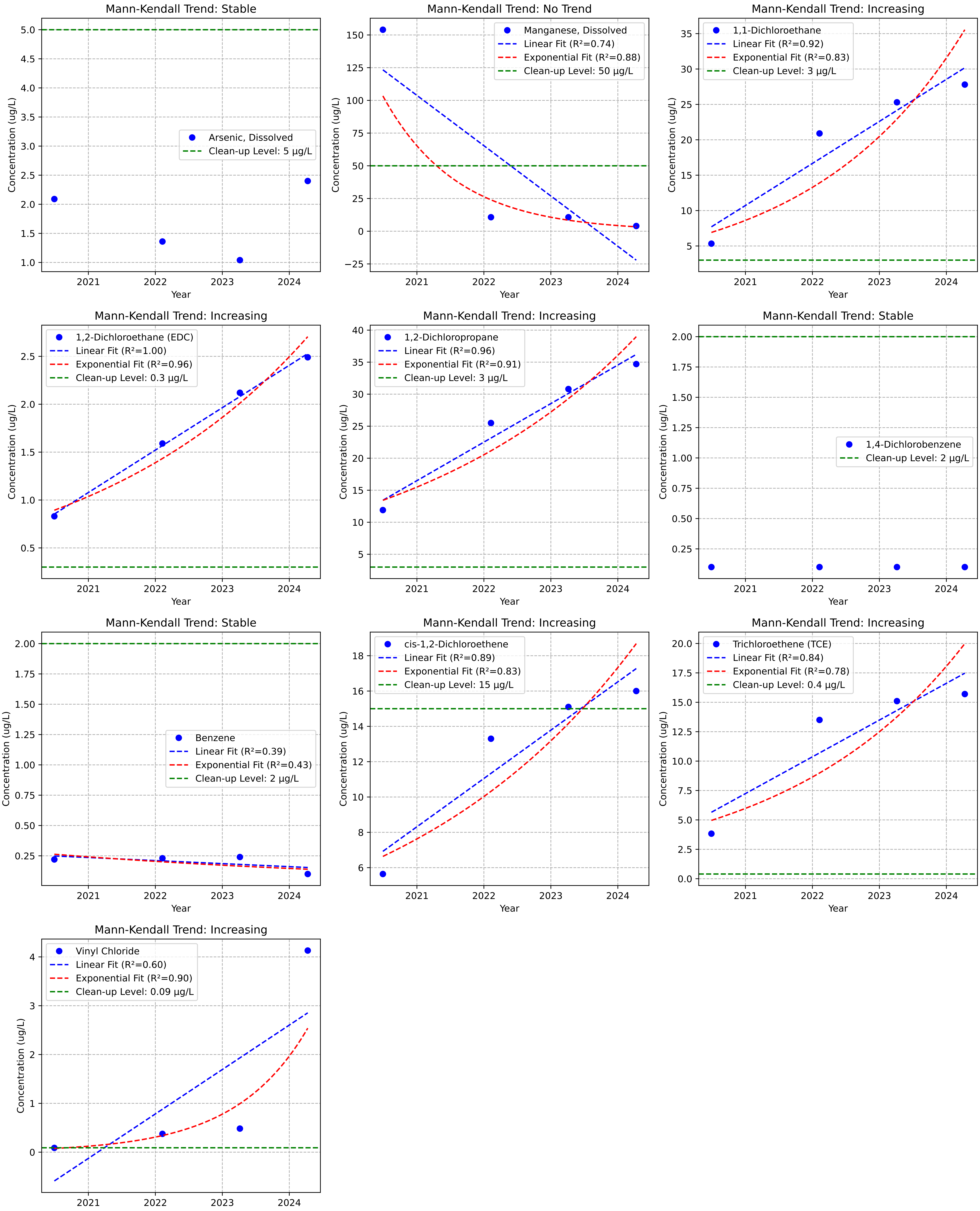
MW-99p2



Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.62)
Exponential Fit (R²=0.55)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.76)
Exponential Fit (R²=0.83)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.24)
Exponential Fit (R²=0.36)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.42)
Exponential Fit (R²=0.41)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.35)
Exponential Fit (R²=0.26)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.40)
Exponential Fit (R²=0.30)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.17)
Exponential Fit (R²=0.17)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Exponential Fit (R²=0.12)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.97)
Exponential Fit (R²=0.96)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

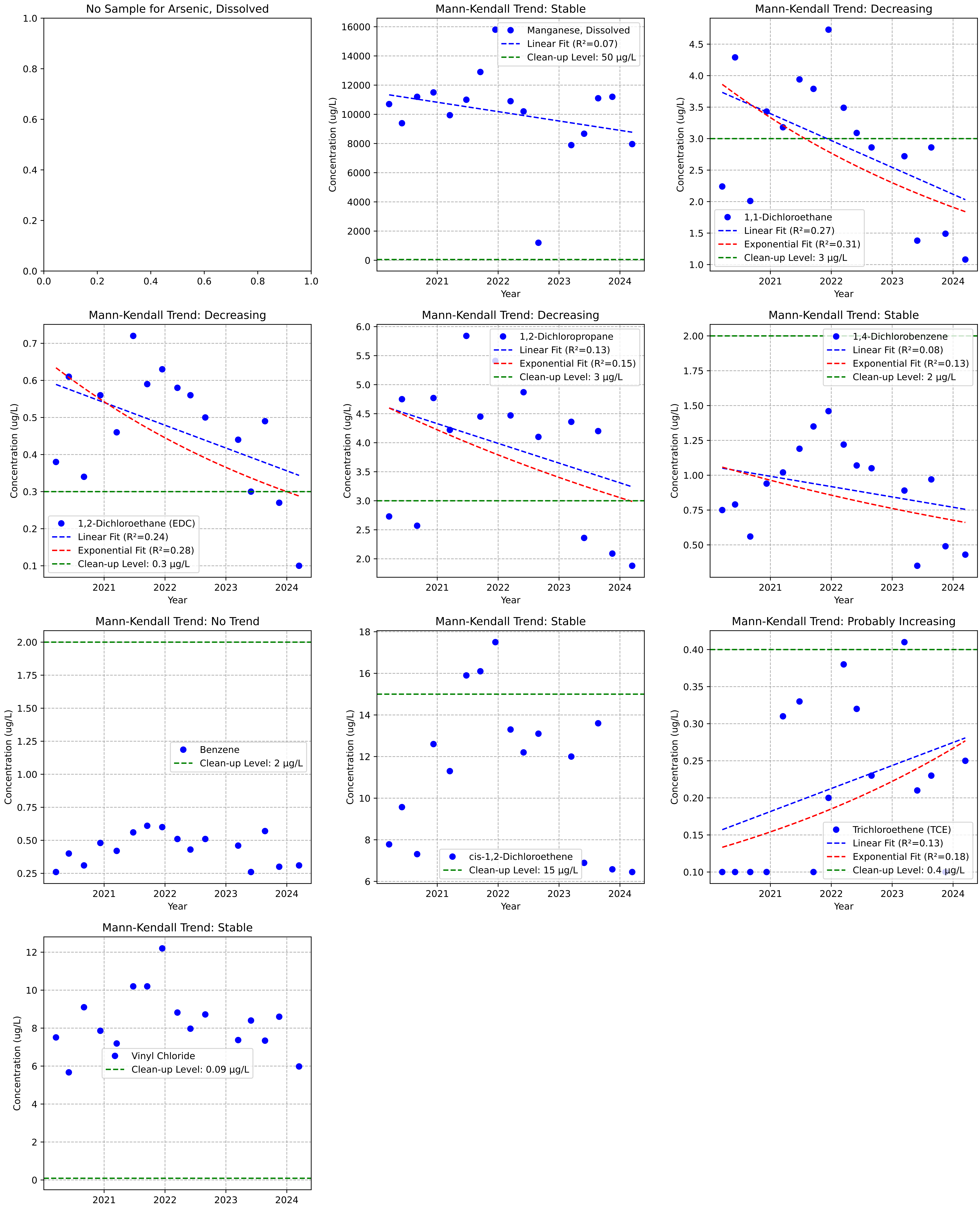
B3. Concentration time series plots of IHS constituents for Roza Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

MW-102b



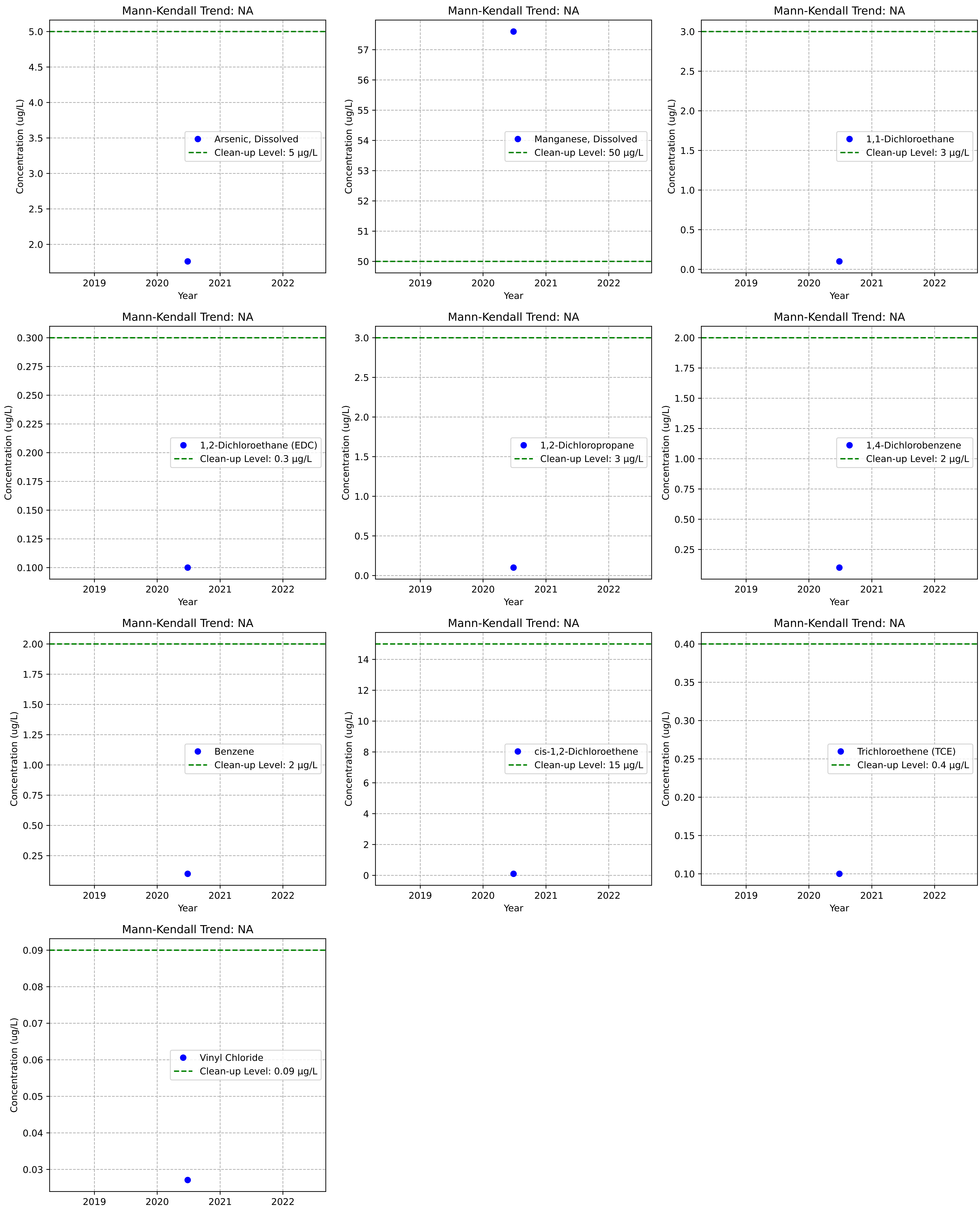
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.74)
Exponential Fit (R²=0.88)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Increasing
1,1-Dichloroethane
Linear Fit (R²=0.92)
Exponential Fit (R²=0.83)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=1.00)
Exponential Fit (R²=0.96)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloropropane
Linear Fit (R²=0.96)
Exponential Fit (R²=0.91)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.39)
Exponential Fit (R²=0.43)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Increasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.89)
Exponential Fit (R²=0.83)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.84)
Exponential Fit (R²=0.78)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Increasing
Vinyl Chloride
Linear Fit (R²=0.60)
Exponential Fit (R²=0.90)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-103b



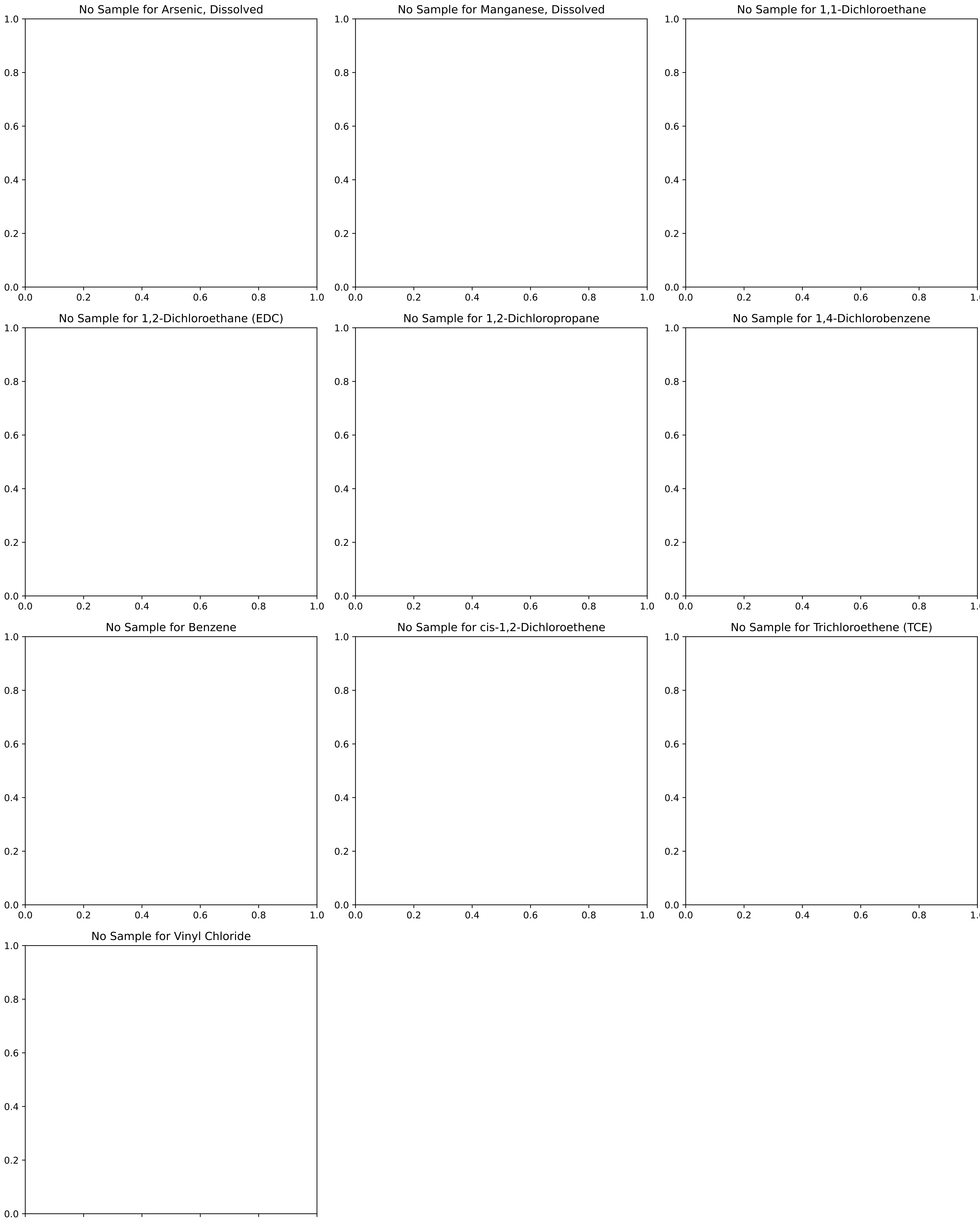
No Sample for Arsenic, Dissolved
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.07)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.27)
Exponential Fit (R²=0.31)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.24)
Exponential Fit (R²=0.28)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.13)
Exponential Fit (R²=0.15)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.08)
Exponential Fit (R²=0.13)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Probably Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.13)
Exponential Fit (R²=0.18)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-105b

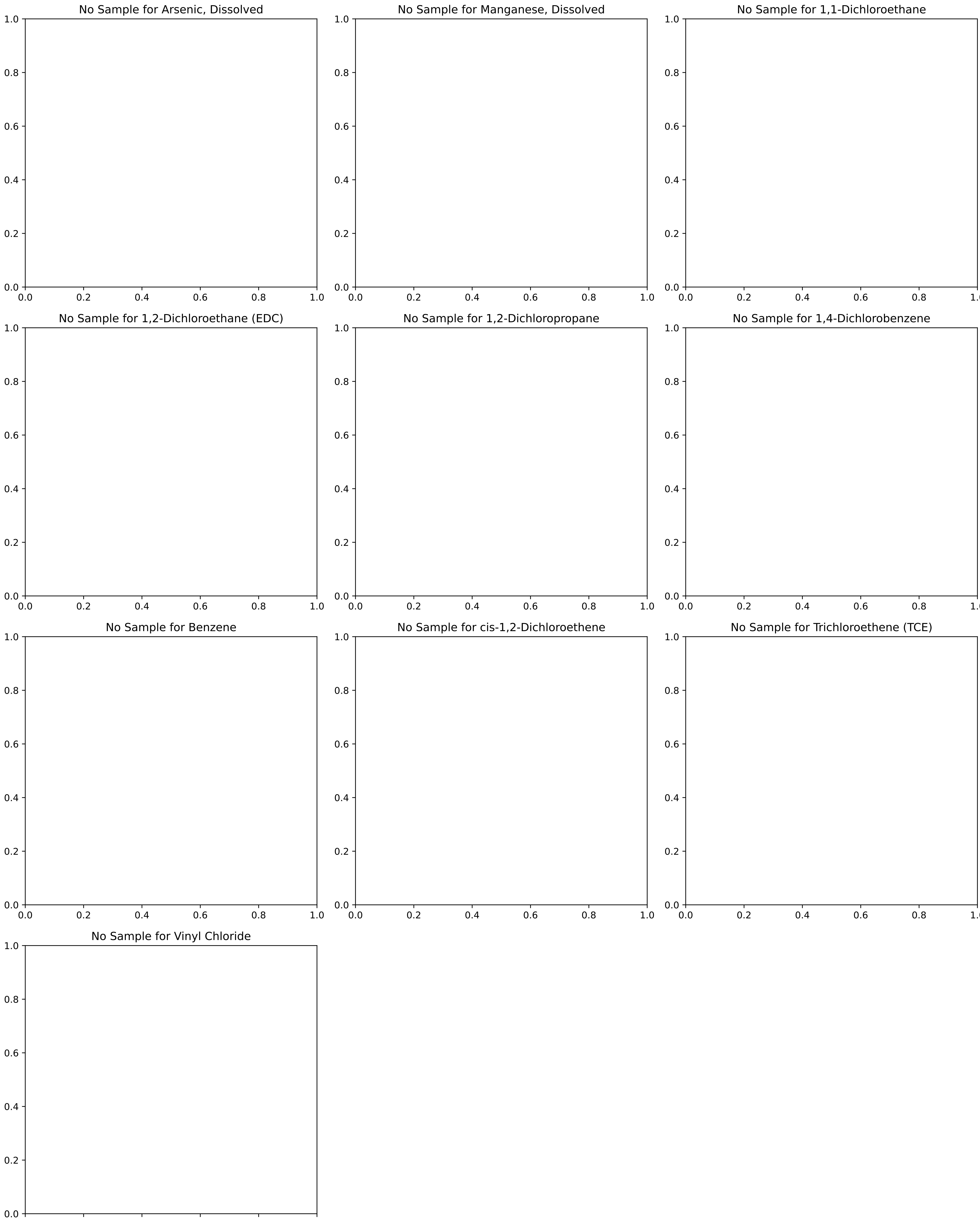


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

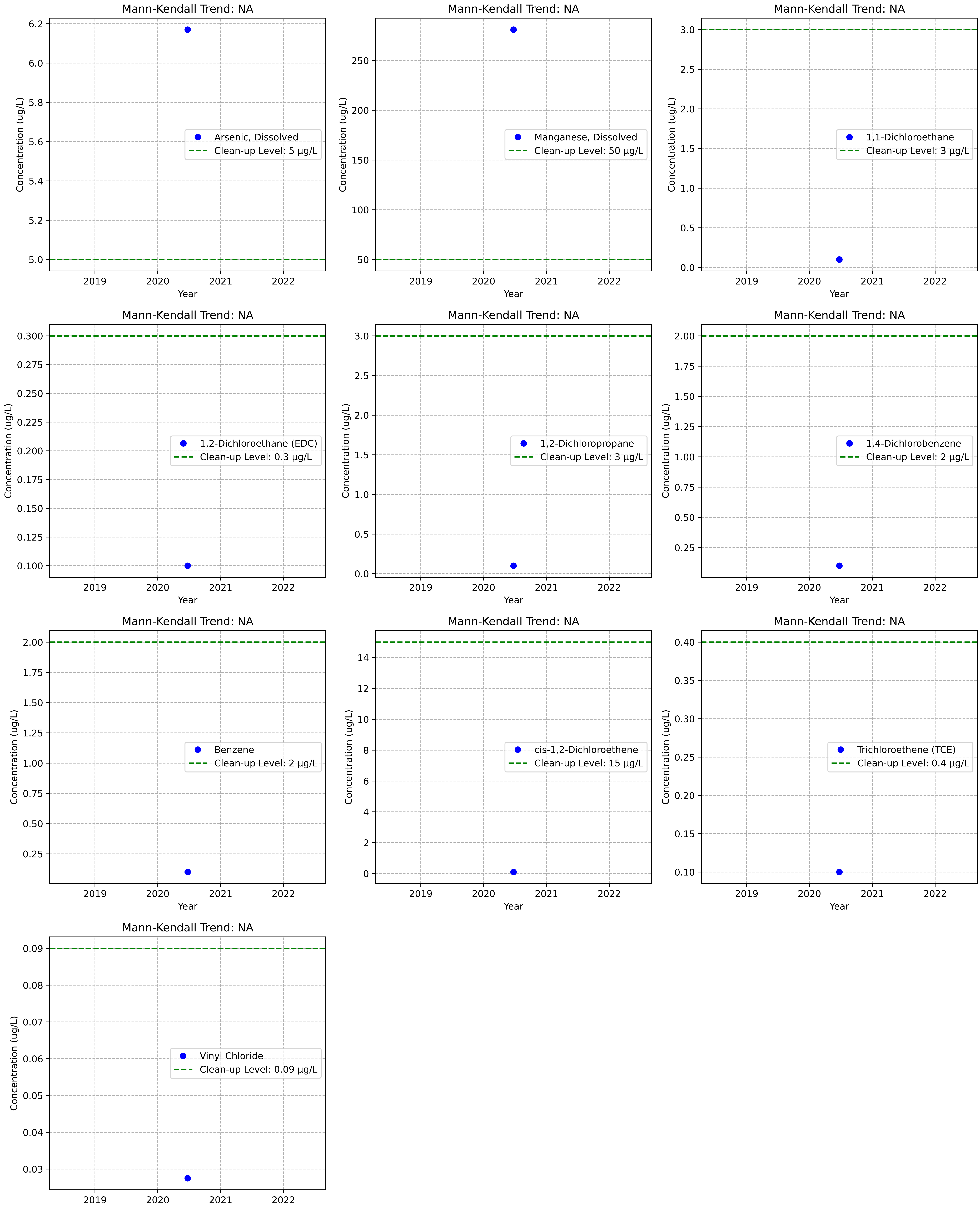
No Data for MW-106b



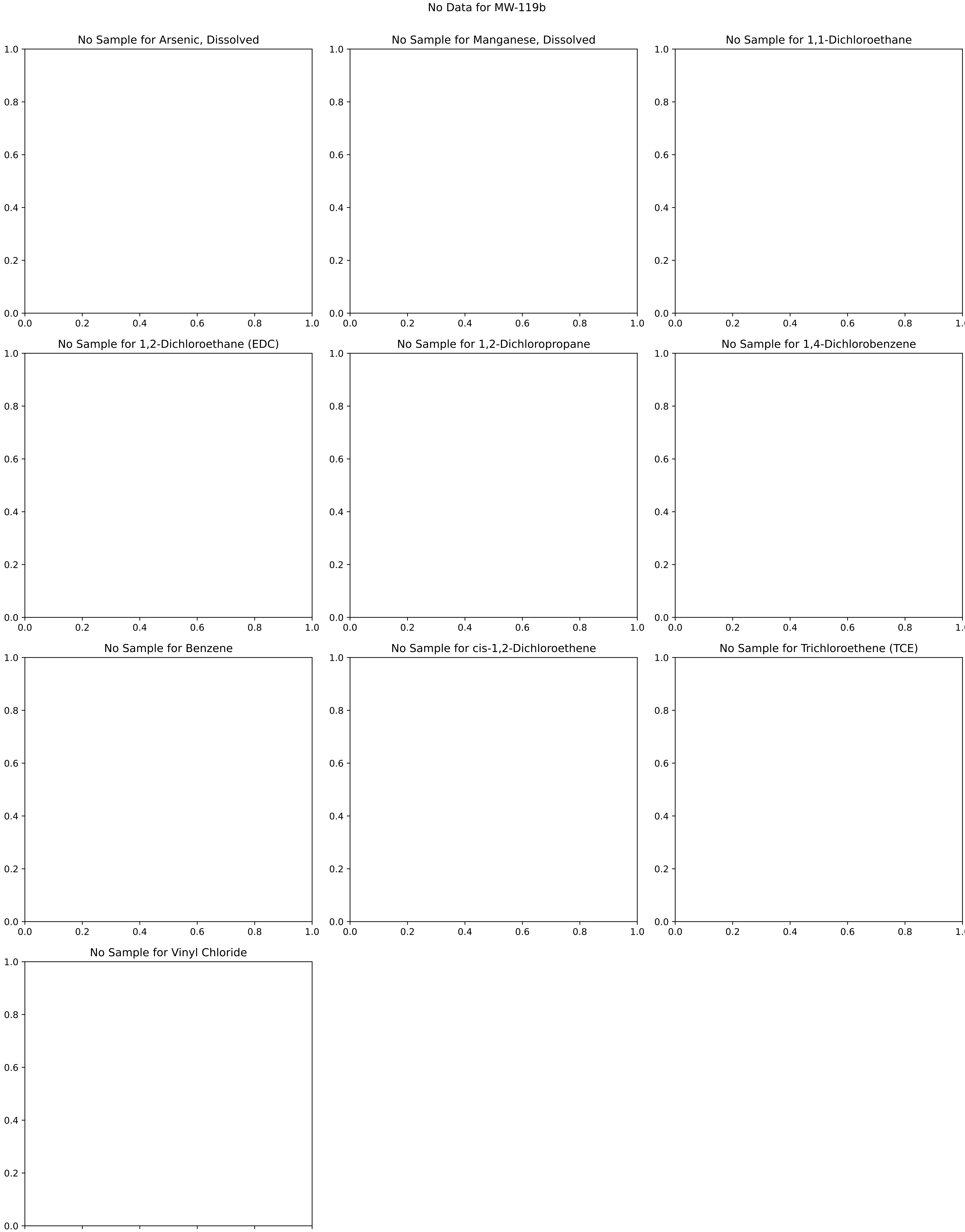
No Data for MW-111b



MW-116b

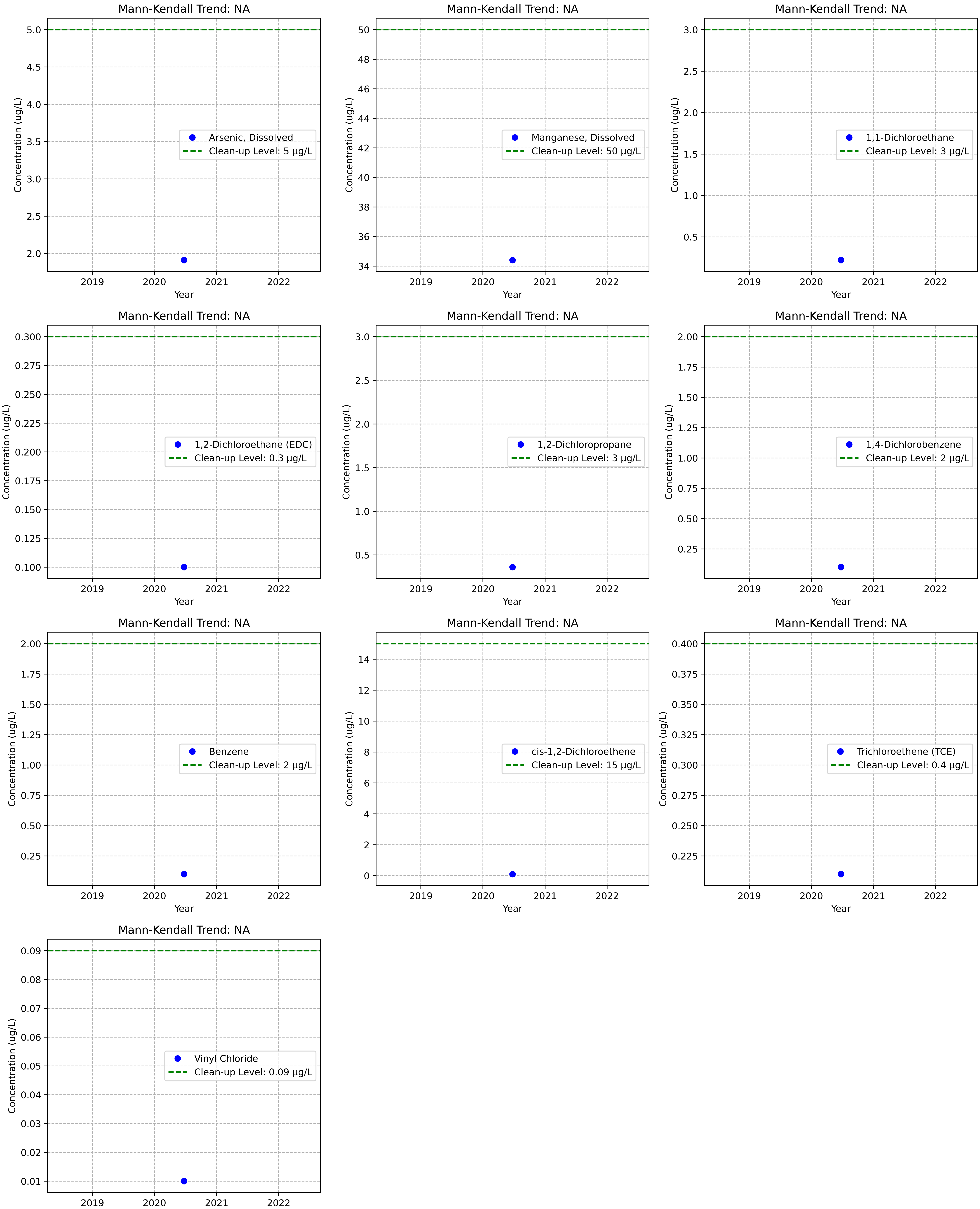


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

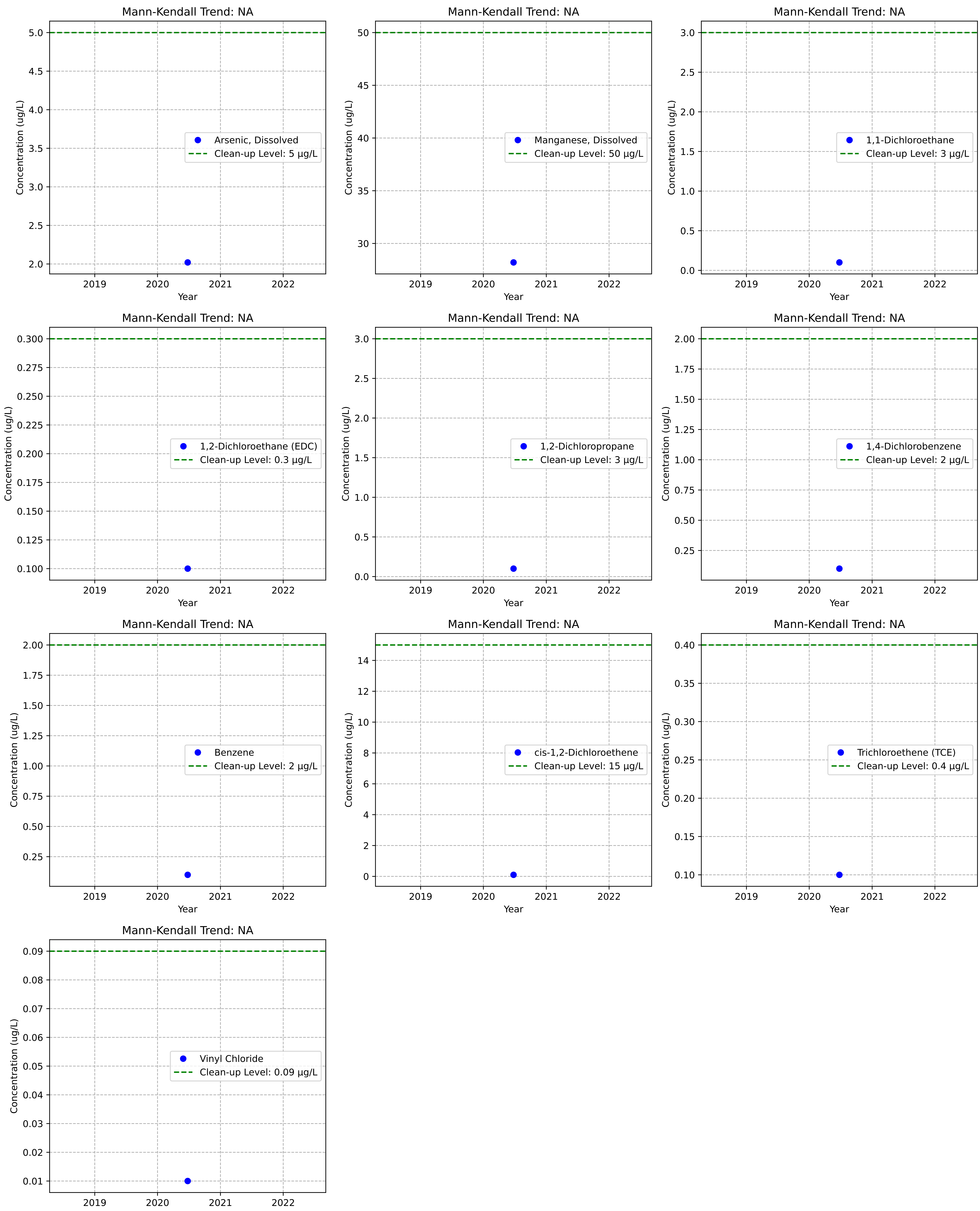


No Data for MW-119b
No Sample for Arsenic, Dissolved
No Sample for Manganese, Dissolved
No Sample for 1,1-Dichloroethane
No Sample for 1,2-Dichloroethane (EDC)
No Sample for 1,2-Dichloropropane
No Sample for 1,4-Dichlorobenzene
No Sample for Benzene
No Sample for cis-1,2-Dichloroethene
No Sample for Trichloroethene (TCE)
No Sample for Vinyl Chloride

MW-121b

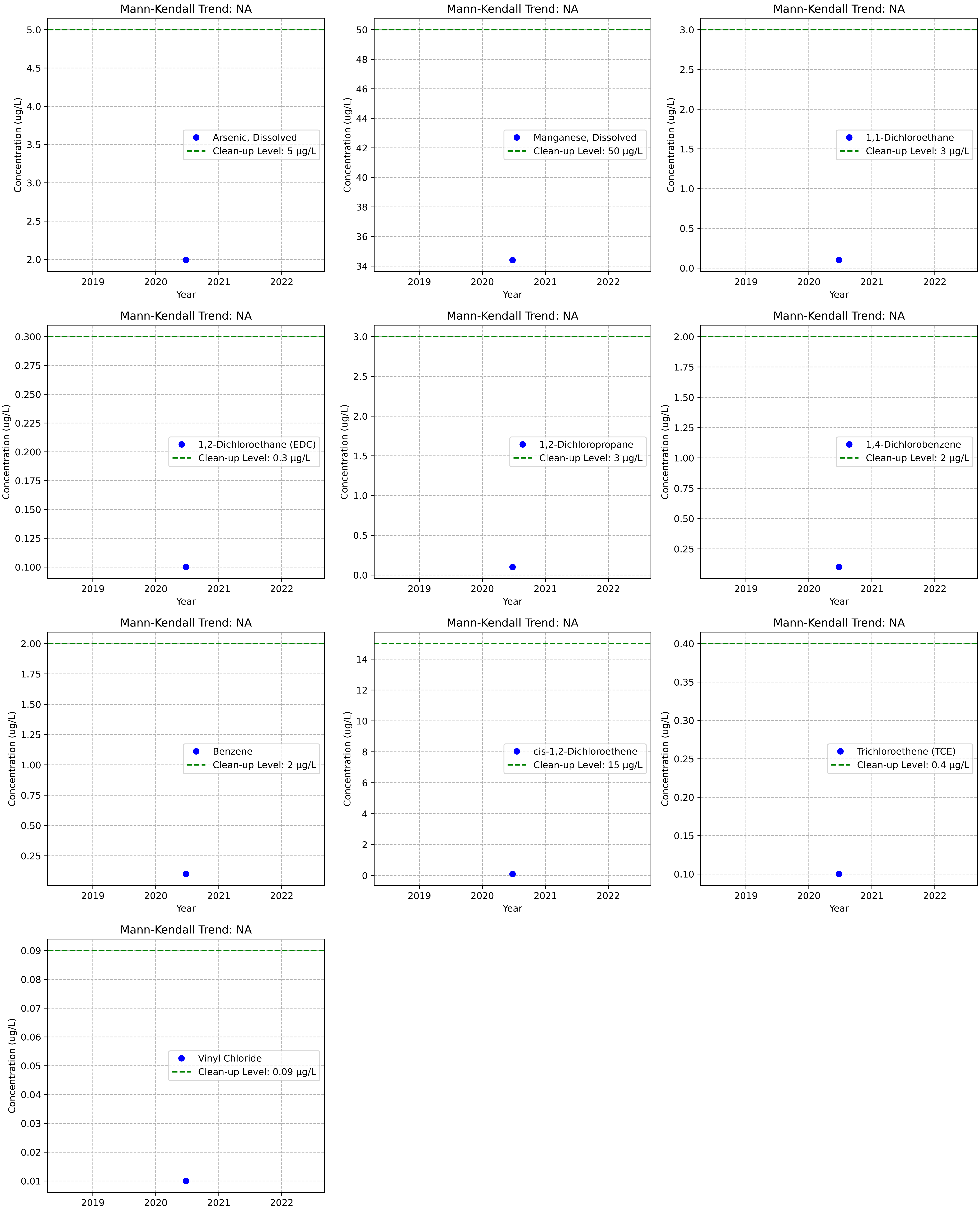

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-128b



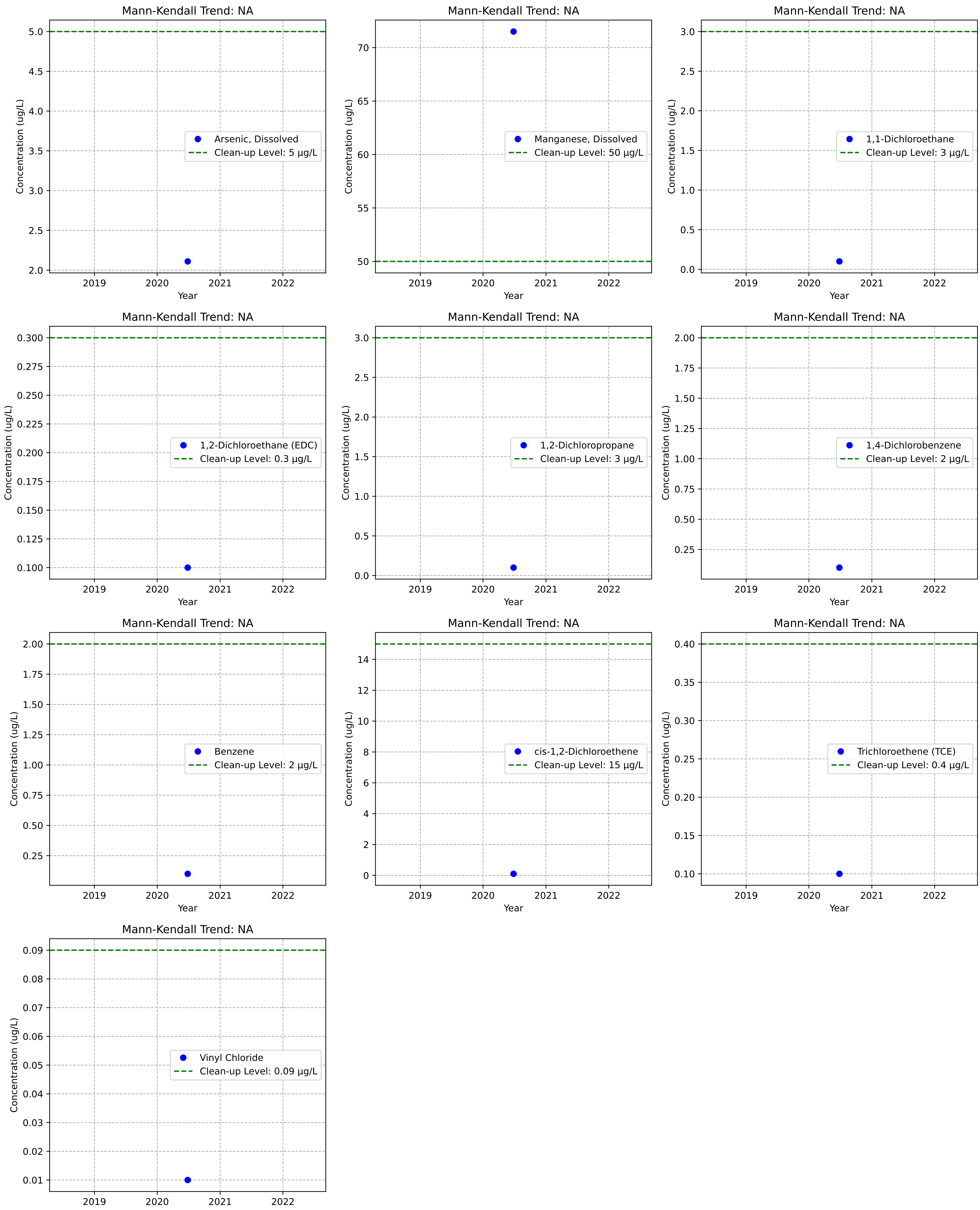
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L

MW-130b

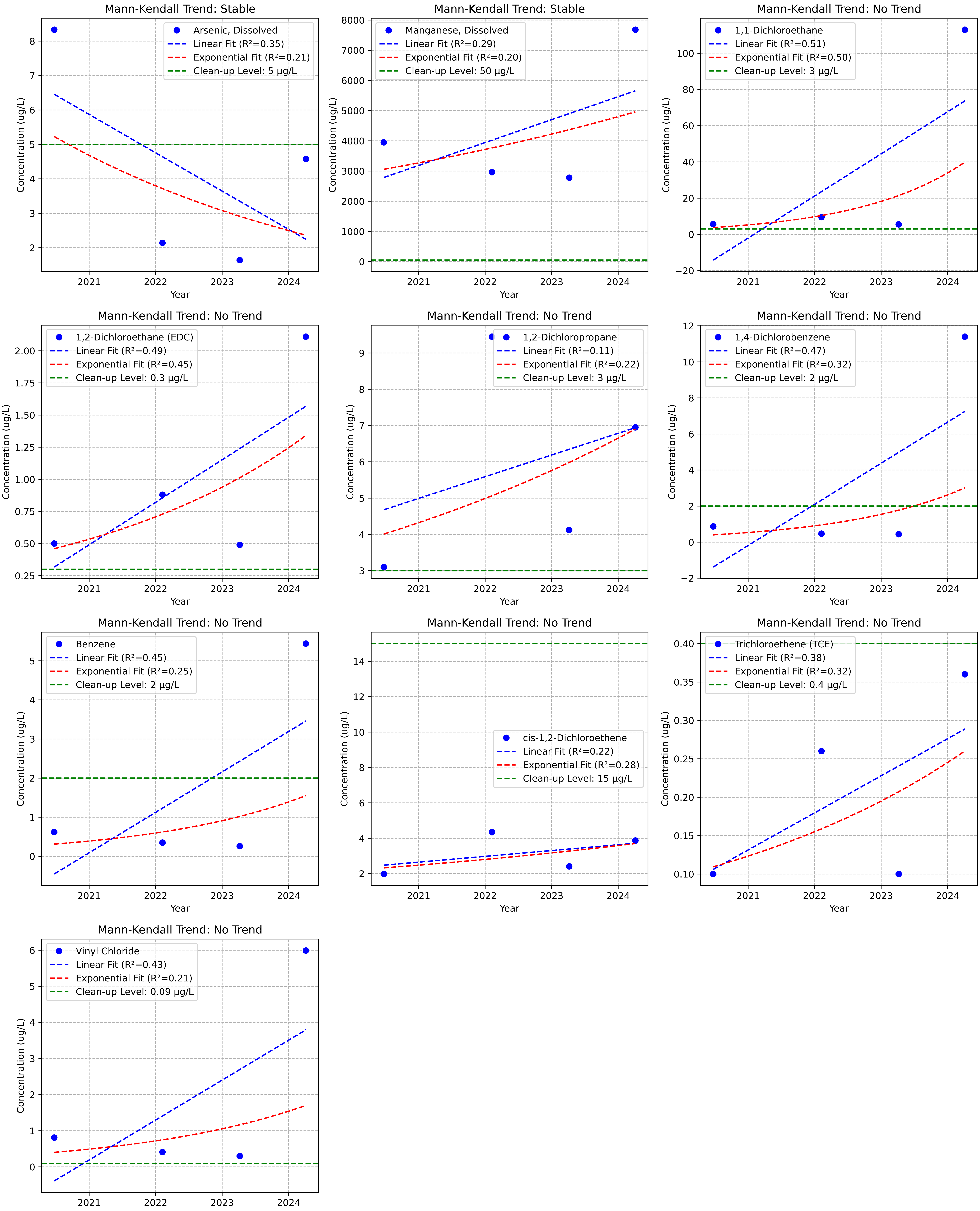


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-132b

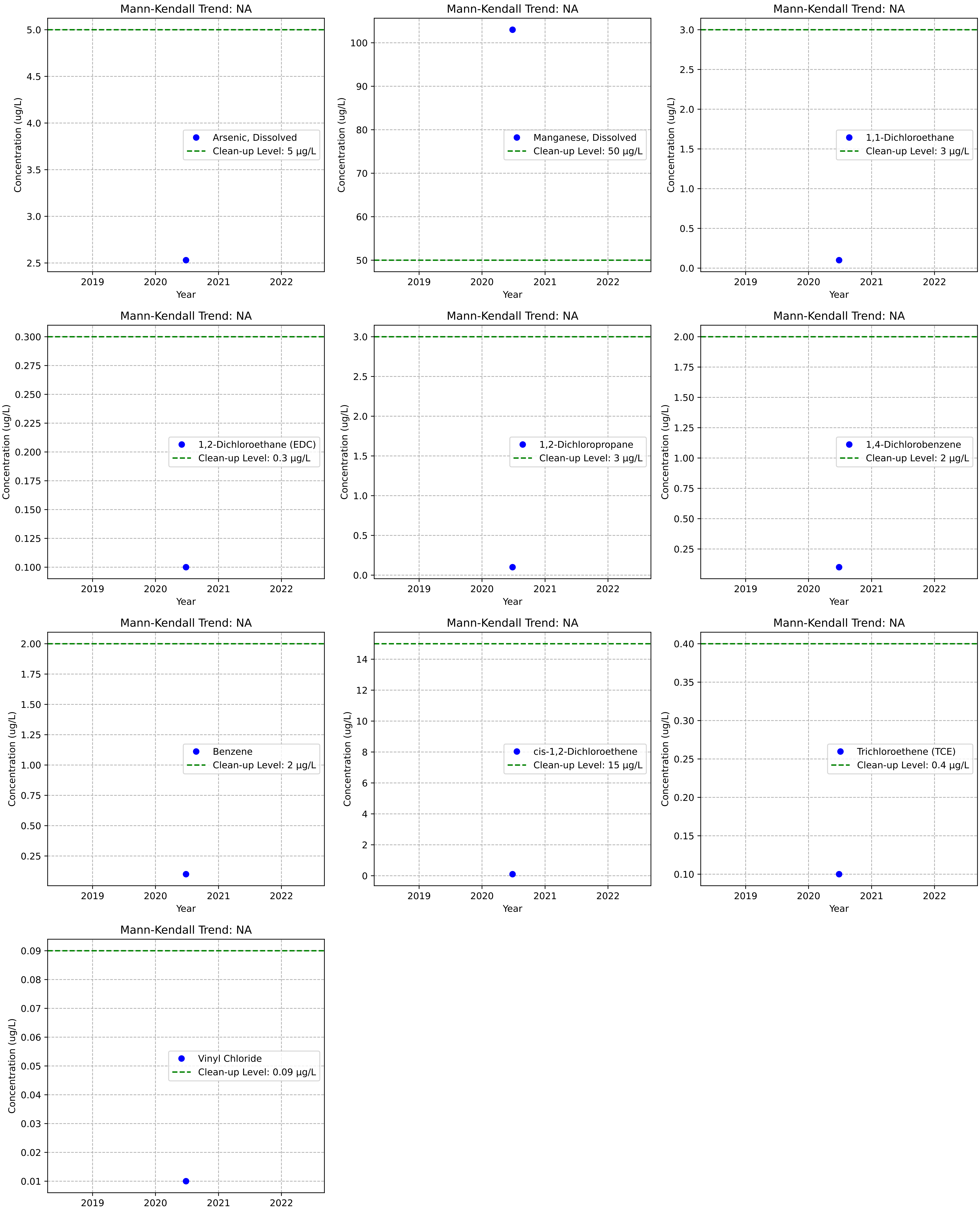

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
5.0
4.5
4.0
3.5
3.0
2.5
2.0
2019
2020
2021
2022
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
70
65
60
55
50
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Concentration (ug/L)
Year
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Concentration (ug/L)
Year
14
12
10
8
6
4
2
0
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Concentration (ug/L)
Year
0.40
0.35
0.30
0.25
0.20
0.15
0.10
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01

MW-133b

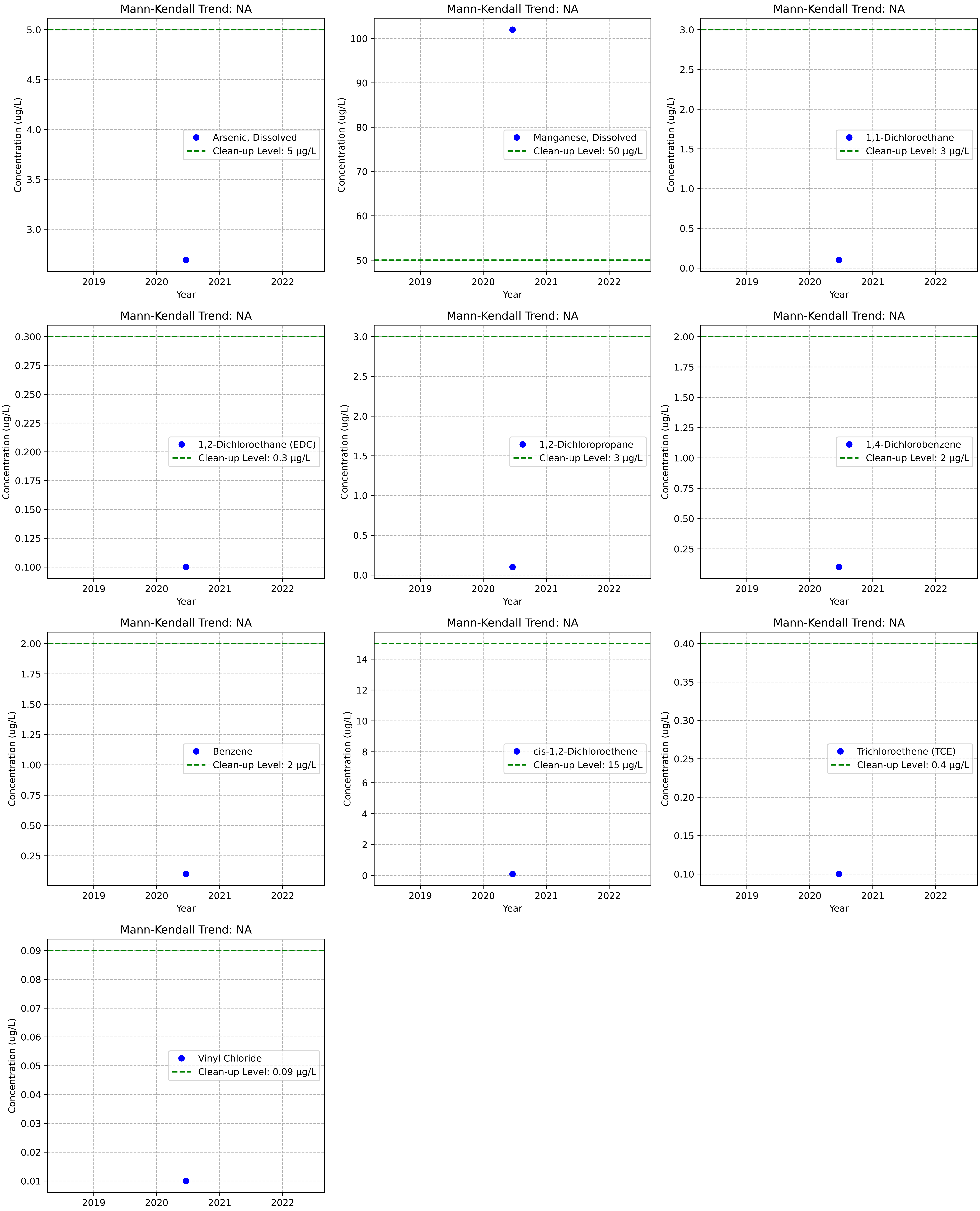


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.35)
Exponential Fit (R²=0.21)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.29)
Exponential Fit (R²=0.20)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.51)
Exponential Fit (R²=0.50)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.49)
Exponential Fit (R²=0.45)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.11)
Exponential Fit (R²=0.22)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.47)
Exponential Fit (R²=0.32)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Linear Fit (R²=0.45)
Exponential Fit (R²=0.25)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.22)
Exponential Fit (R²=0.28)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.38)
Exponential Fit (R²=0.32)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.43)
Exponential Fit (R²=0.21)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

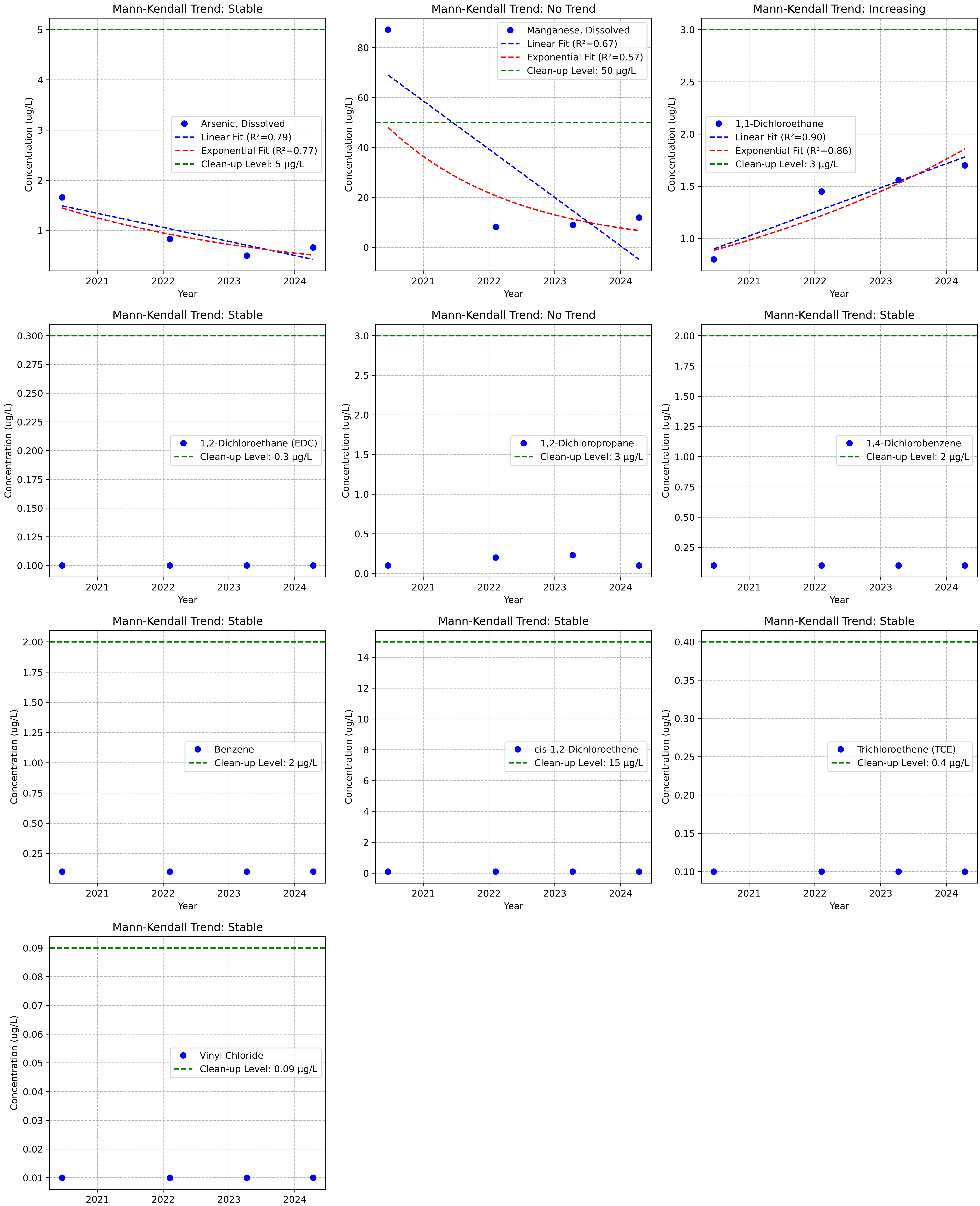
MW-135b


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

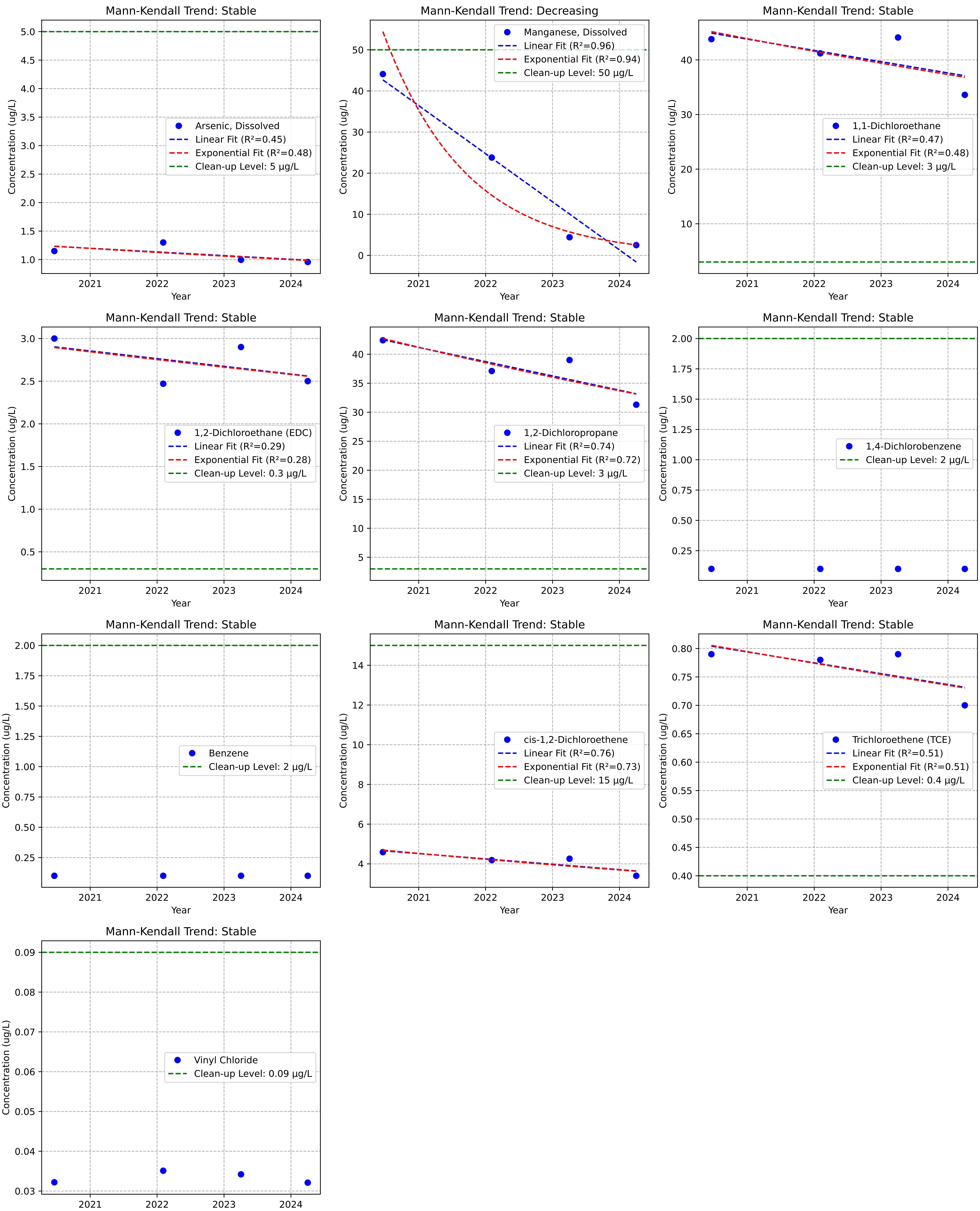
MW-139b


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

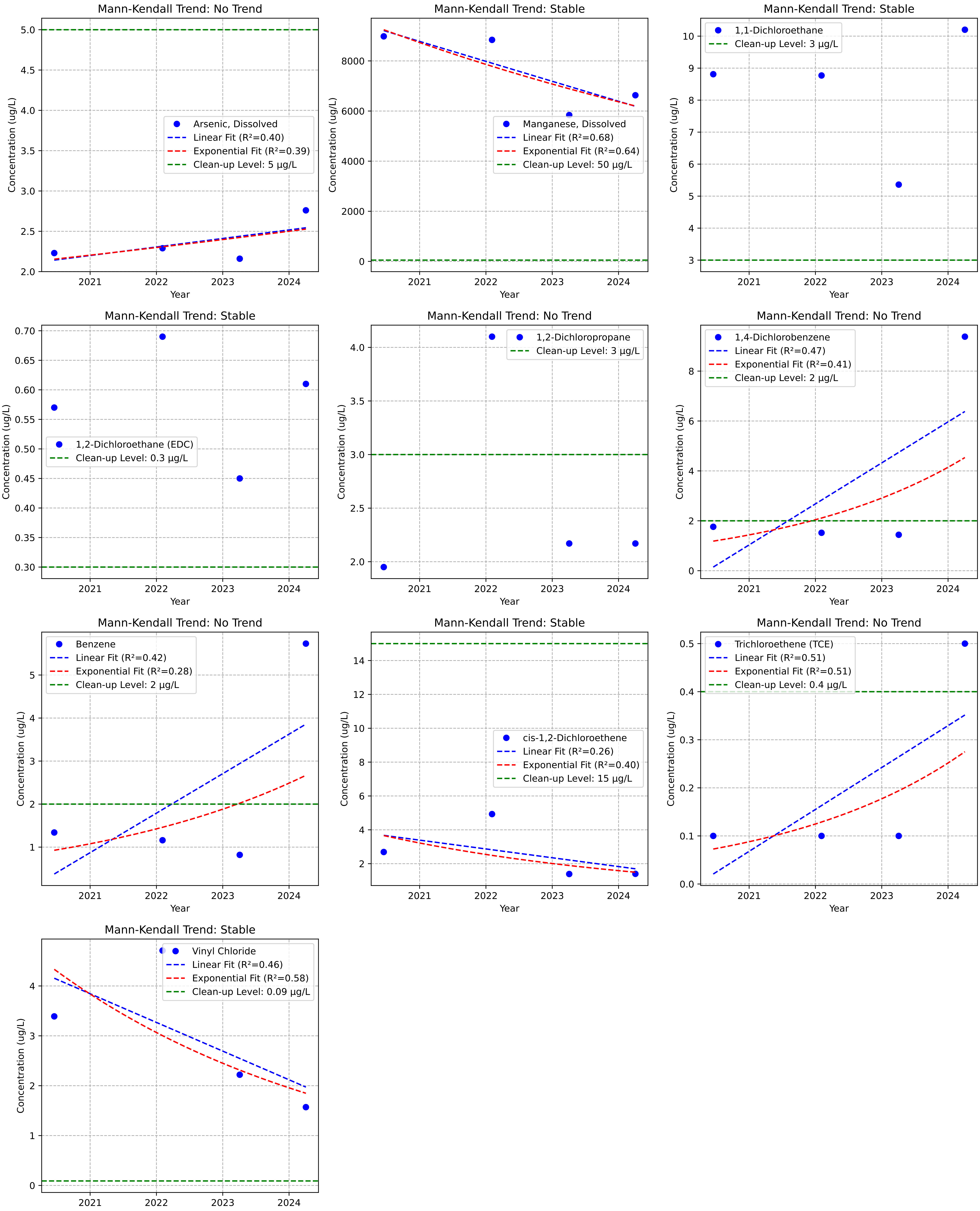
MW-140b


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.79)
Exponential Fit (R²=0.77)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.67)
Exponential Fit (R²=0.57)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Increasing
1,1-Dichloroethane
Linear Fit (R²=0.90)
Exponential Fit (R²=0.86)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

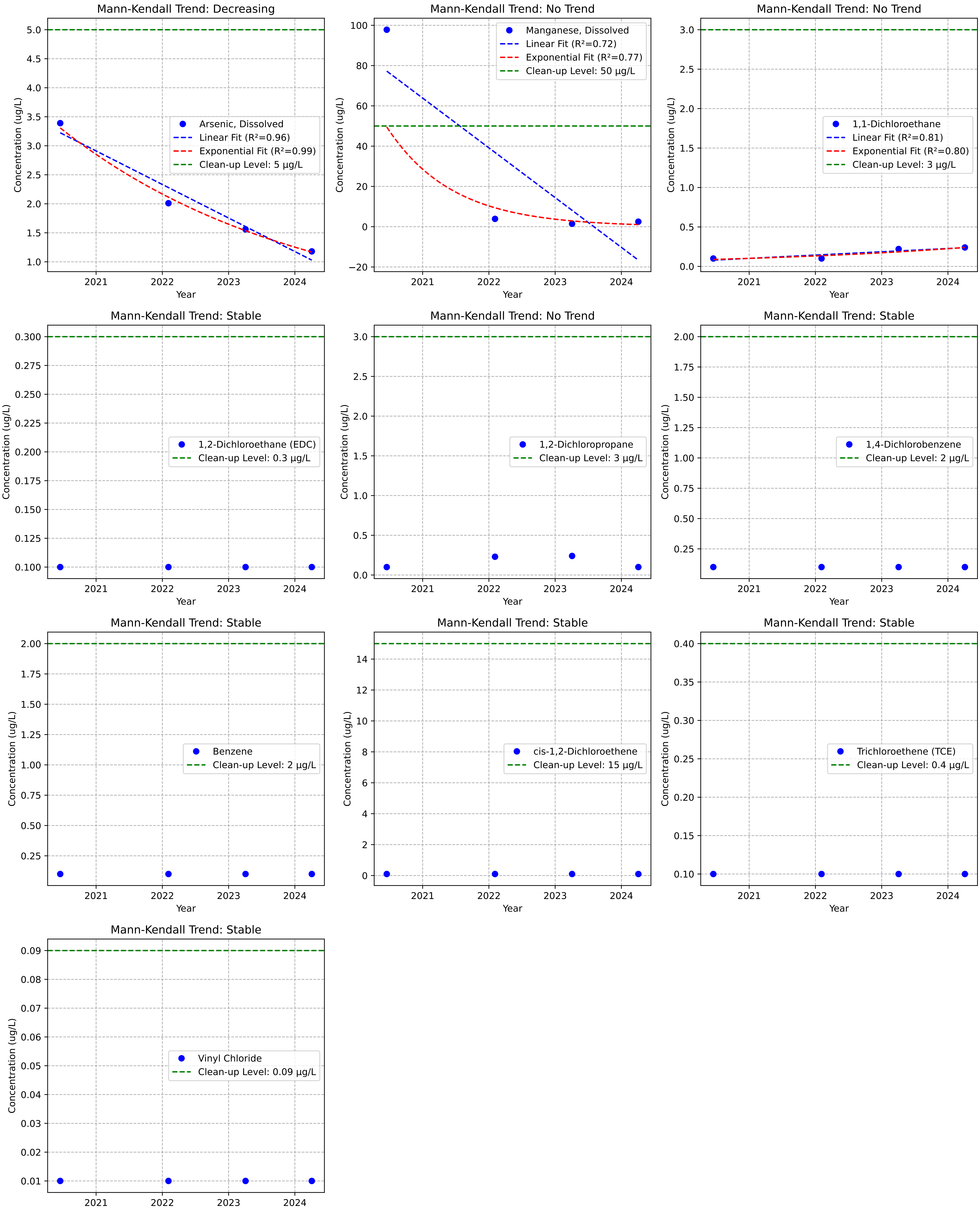
MW-142b


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.45)
Exponential Fit (R²=0.48)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.96)
Exponential Fit (R²=0.94)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.47)
Exponential Fit (R²=0.48)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.29)
Exponential Fit (R²=0.28)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.74)
Exponential Fit (R²=0.72)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.76)
Exponential Fit (R²=0.73)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

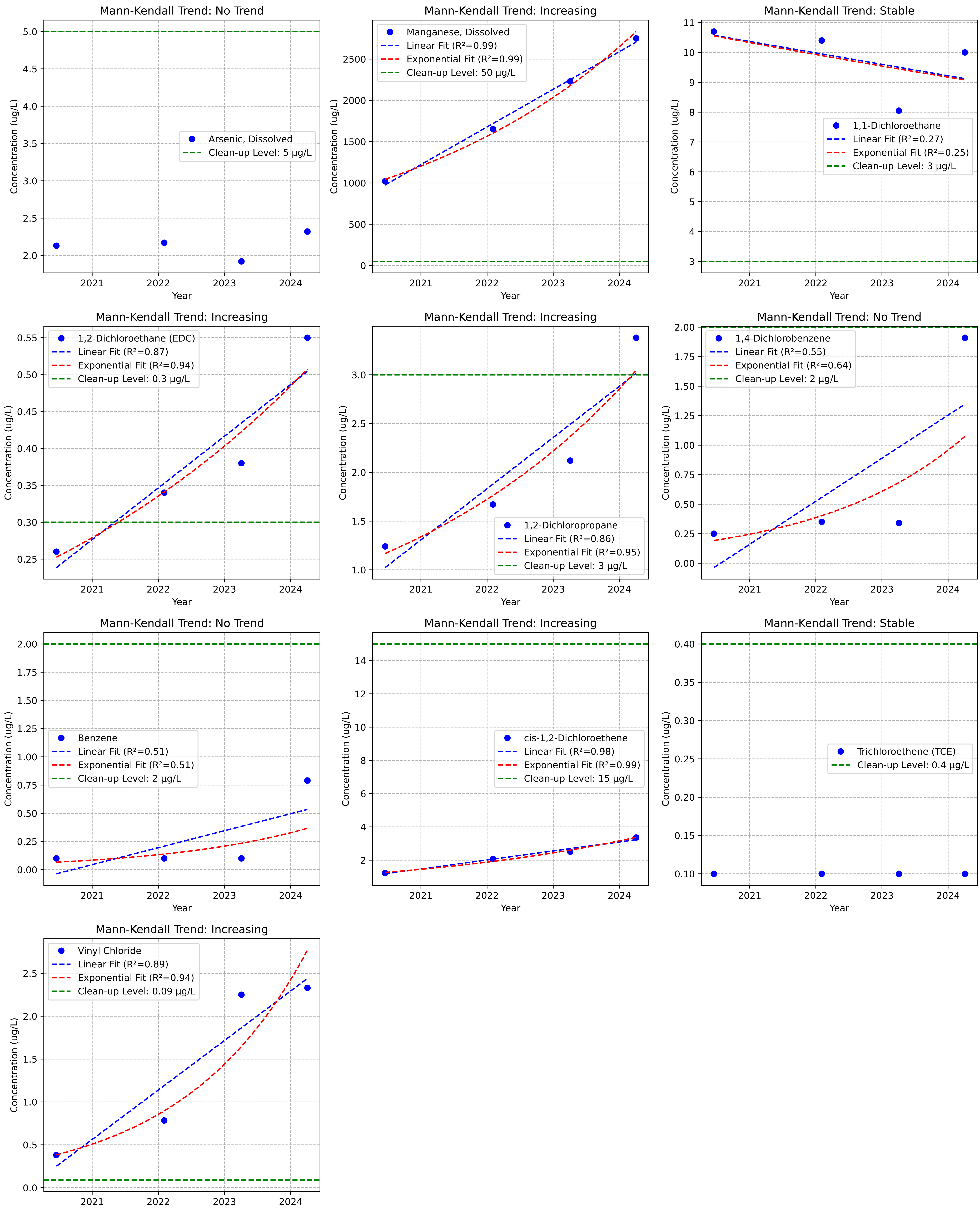
MW-144b


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Linear Fit (R²=0.40)
Exponential Fit (R²=0.39)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.68)
Exponential Fit (R²=0.64)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.47)
Exponential Fit (R²=0.41)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Linear Fit (R²=0.42)
Exponential Fit (R²=0.28)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.26)
Exponential Fit (R²=0.40)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.46)
Exponential Fit (R²=0.58)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

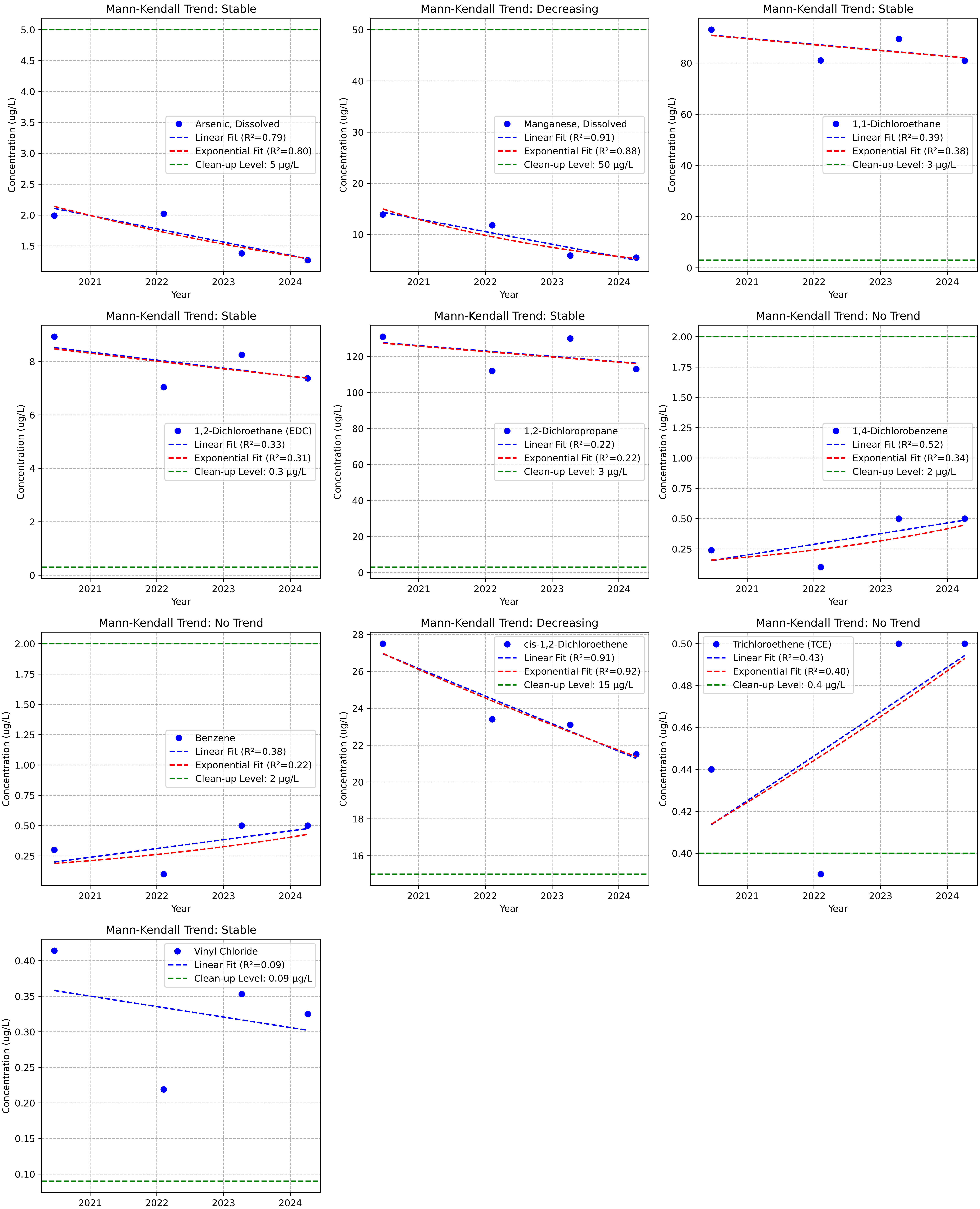
MW-145b


Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.96)
Exponential Fit (R²=0.99)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.72)
Exponential Fit (R²=0.77)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.81)
Exponential Fit (R²=0.80)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

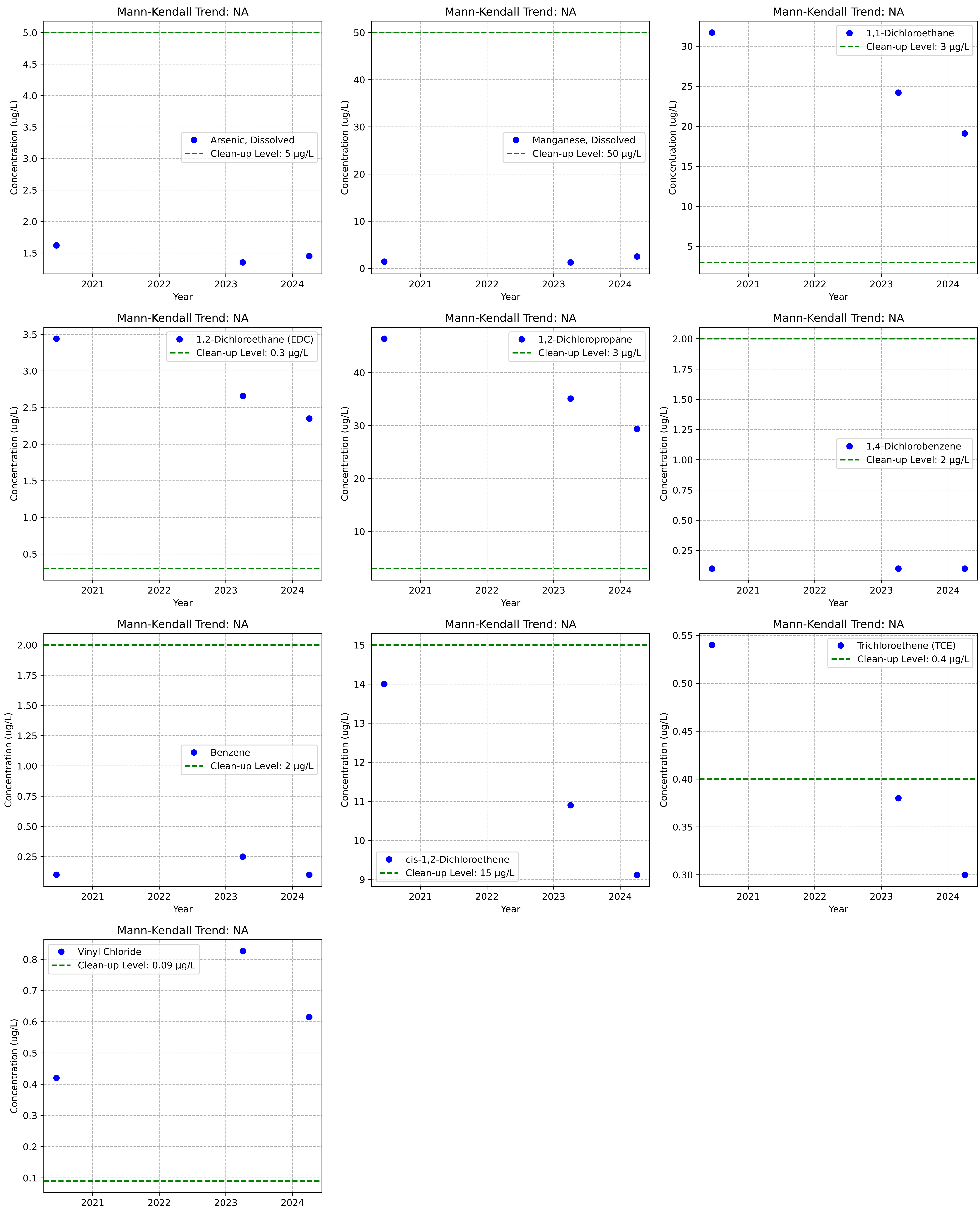
MW-146b


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.99)
Exponential Fit (R²=0.99)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.27)
Exponential Fit (R²=0.25)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.87)
Exponential Fit (R²=0.94)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloropropane
Linear Fit (R²=0.86)
Exponential Fit (R²=0.95)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.55)
Exponential Fit (R²=0.64)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Increasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.98)
Exponential Fit (R²=0.99)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Increasing
Vinyl Chloride
Linear Fit (R²=0.89)
Exponential Fit (R²=0.94)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

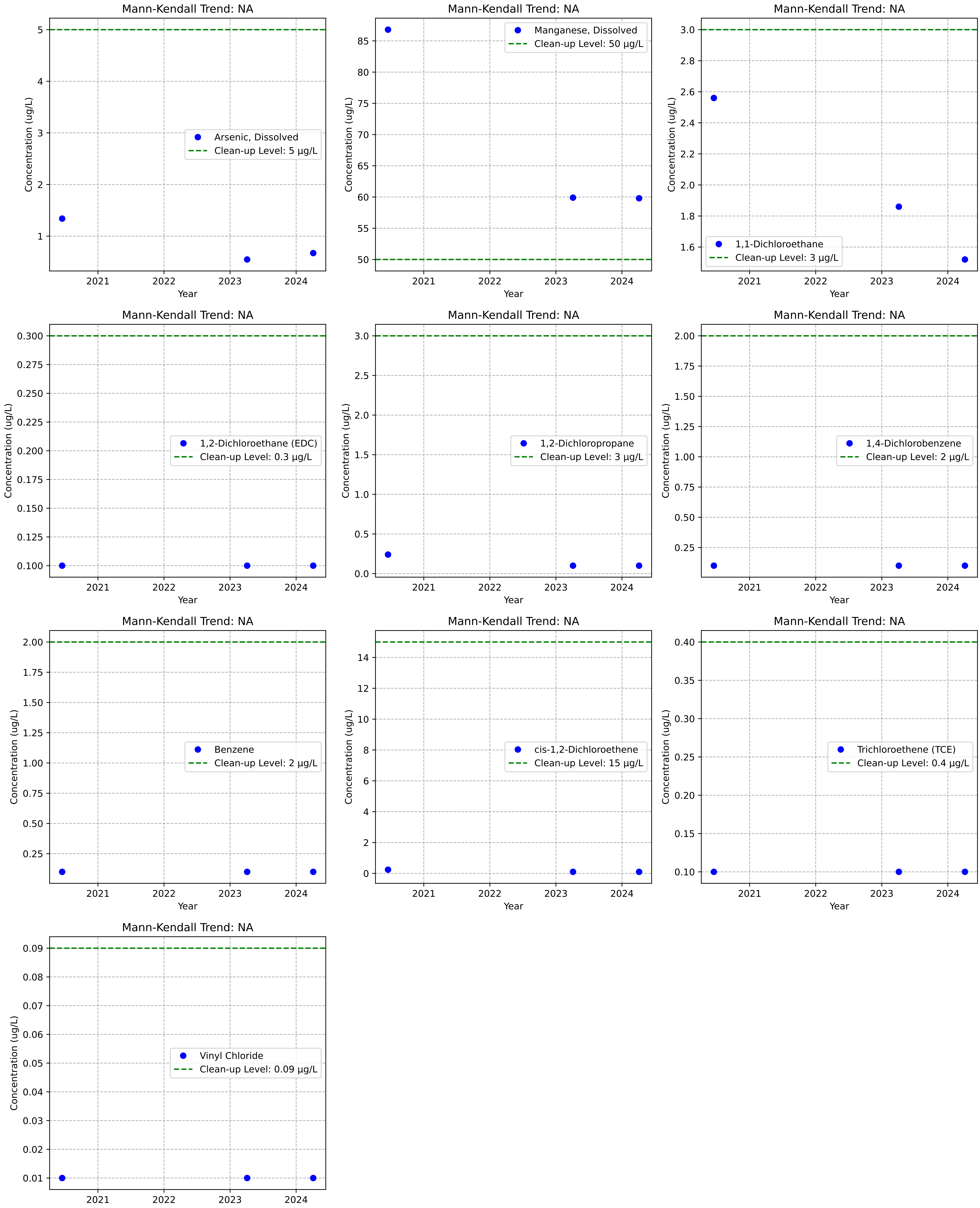
MW-148b


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.79)
Exponential Fit (R²=0.80)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.91)
Exponential Fit (R²=0.88)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.39)
Exponential Fit (R²=0.38)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.33)
Exponential Fit (R²=0.31)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.22)
Exponential Fit (R²=0.22)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Linear Fit (R²=0.52)
Exponential Fit (R²=0.34)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Linear Fit (R²=0.38)
Exponential Fit (R²=0.22)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.91)
Exponential Fit (R²=0.92)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.43)
Exponential Fit (R²=0.40)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.09)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

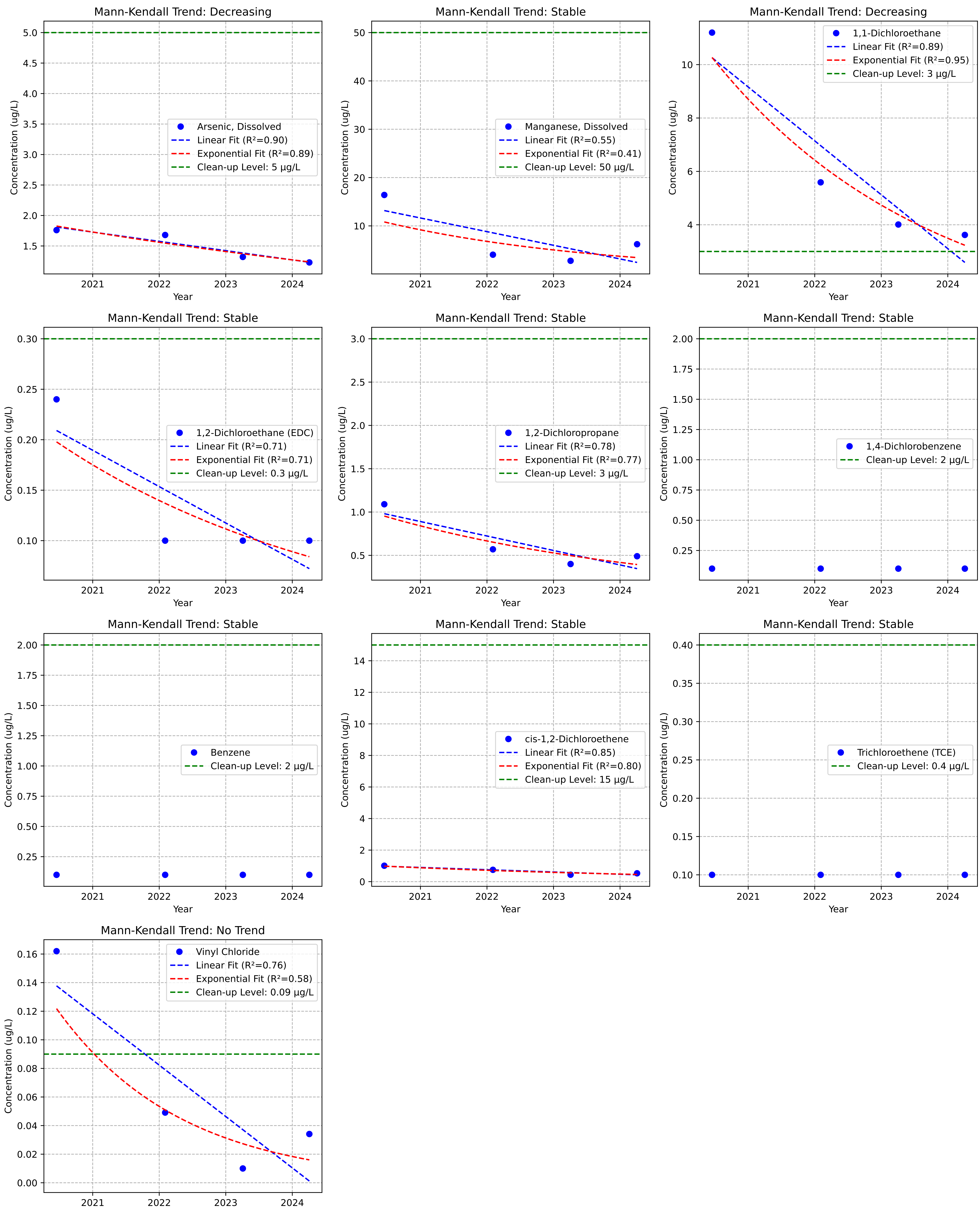
MW-149b


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

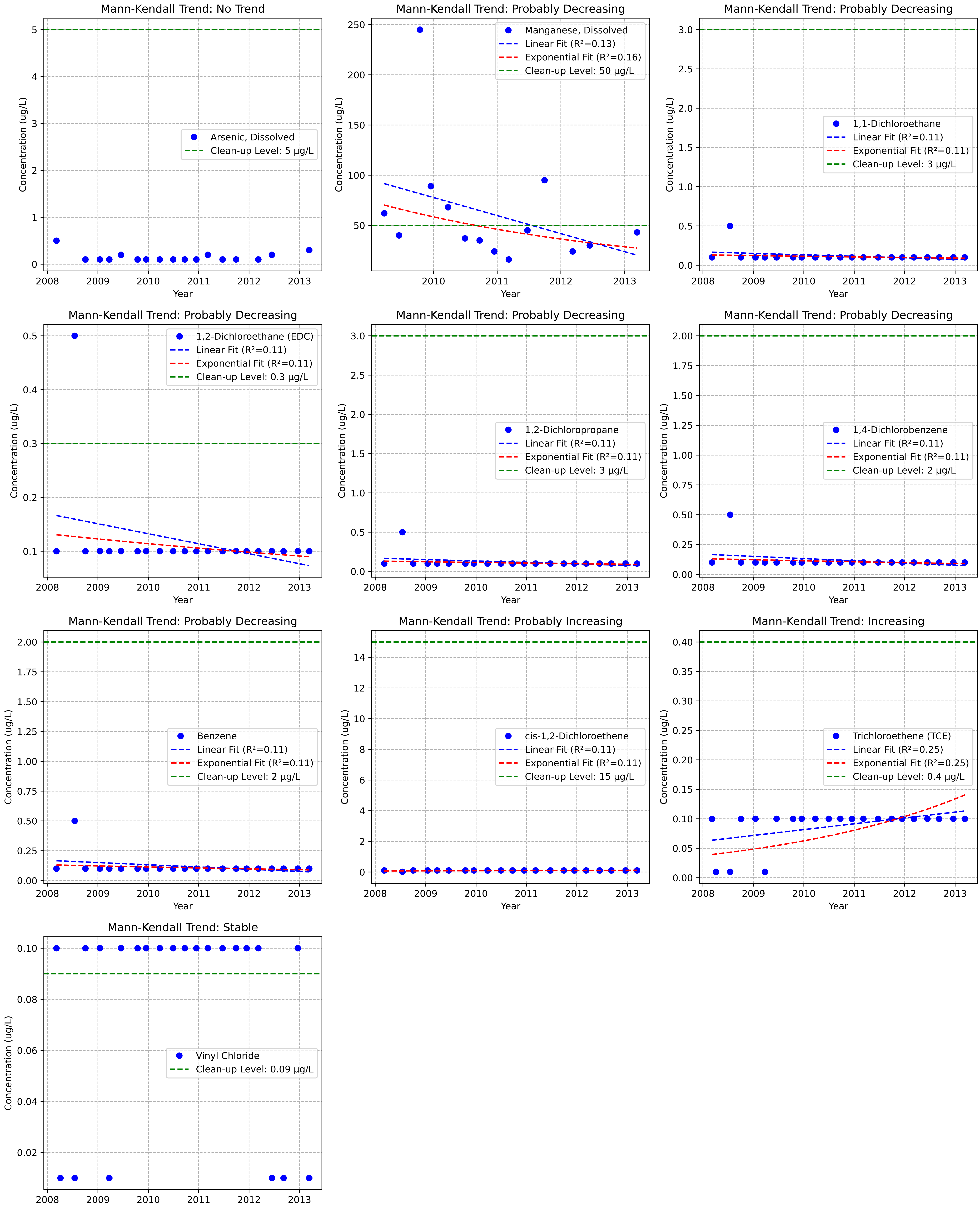
MW-150b


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

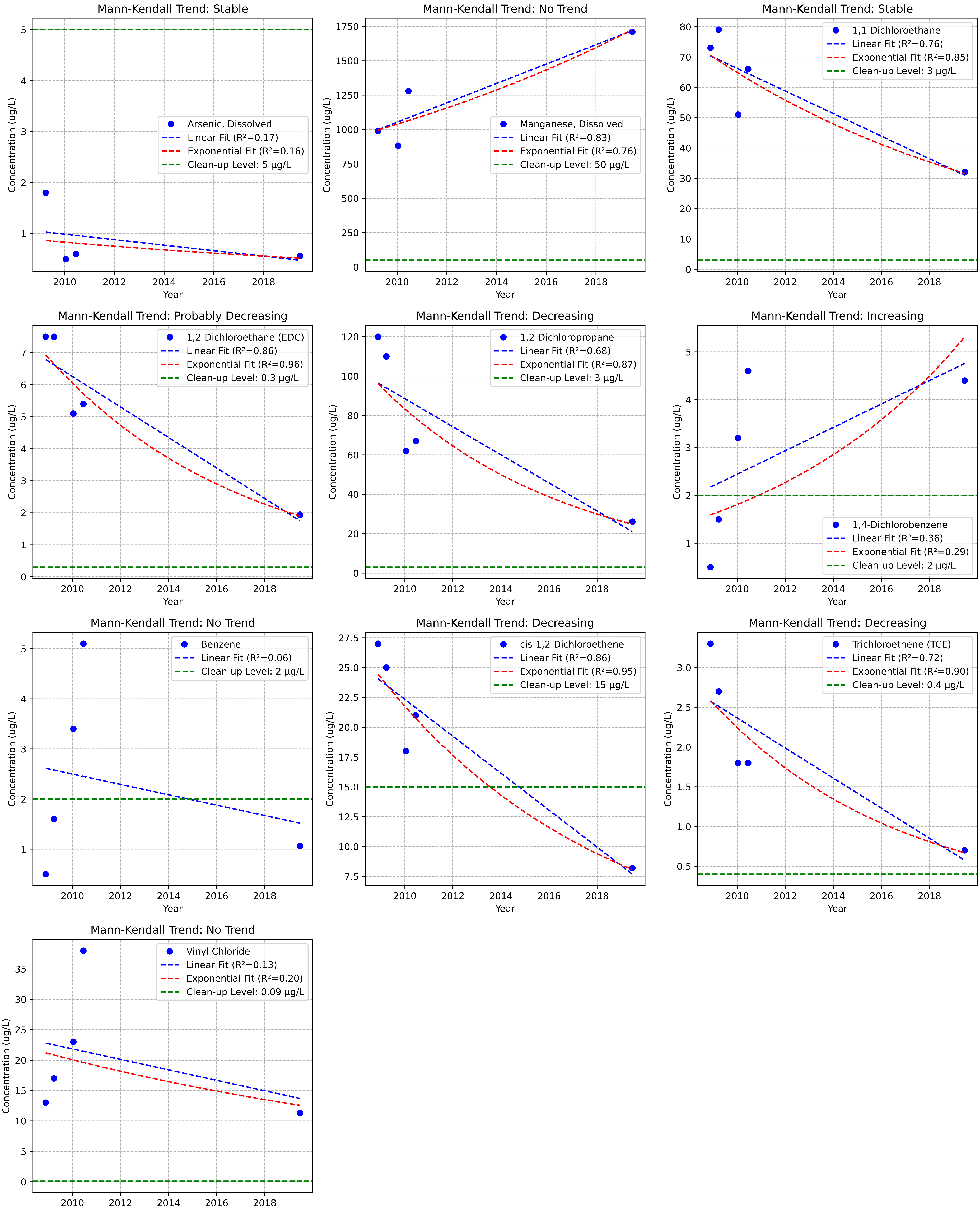
MW-151b


Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.90)
Exponential Fit (R²=0.89)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.55)
Exponential Fit (R²=0.41)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.89)
Exponential Fit (R²=0.95)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.78)
Exponential Fit (R²=0.77)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.85)
Exponential Fit (R²=0.80)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.76)
Exponential Fit (R²=0.58)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

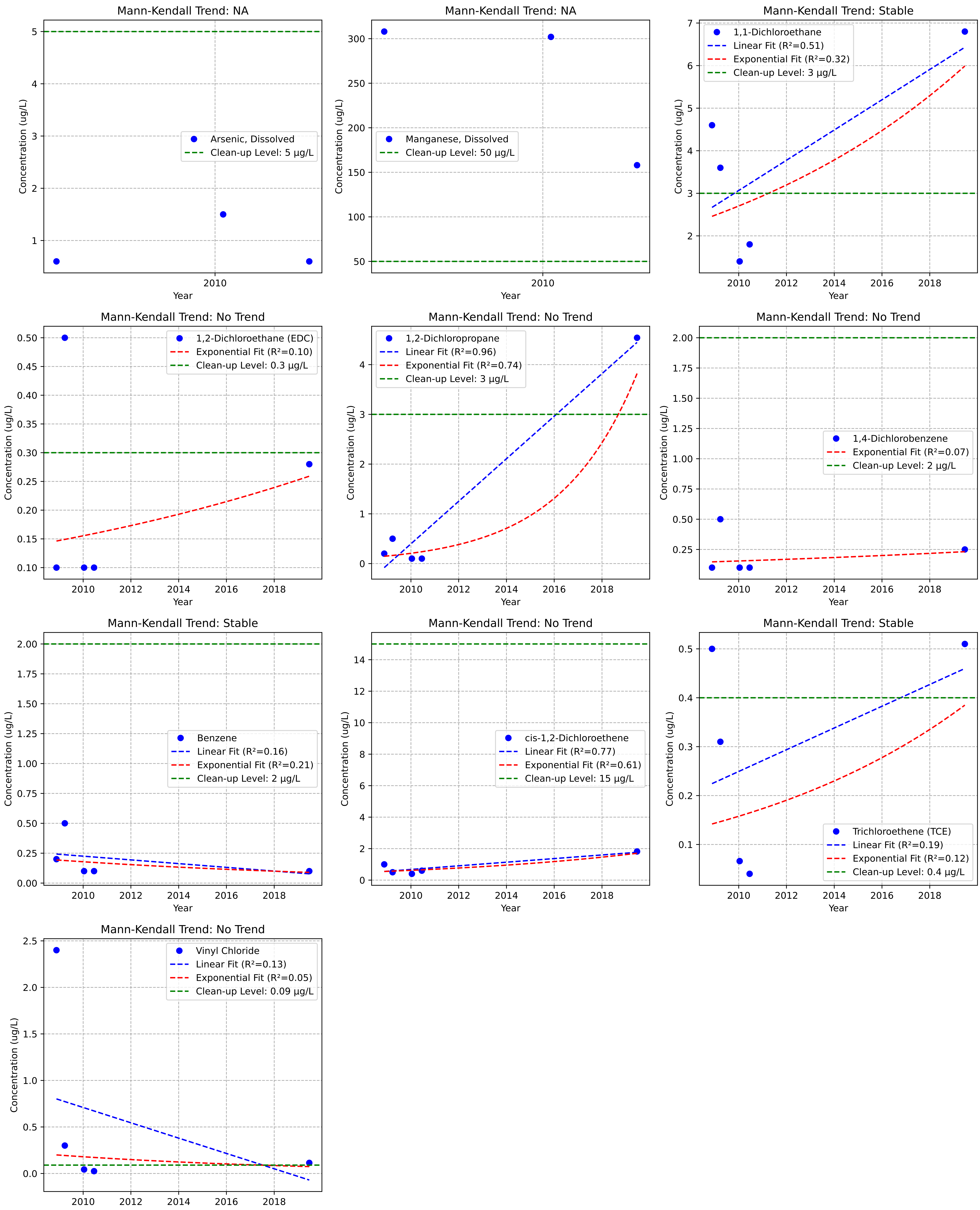
MW-19b


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Probably Decreasing
Manganese, Dissolved
Linear Fit (R²=0.13)
Exponential Fit (R²=0.16)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Probably Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
Benzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Increasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-29b

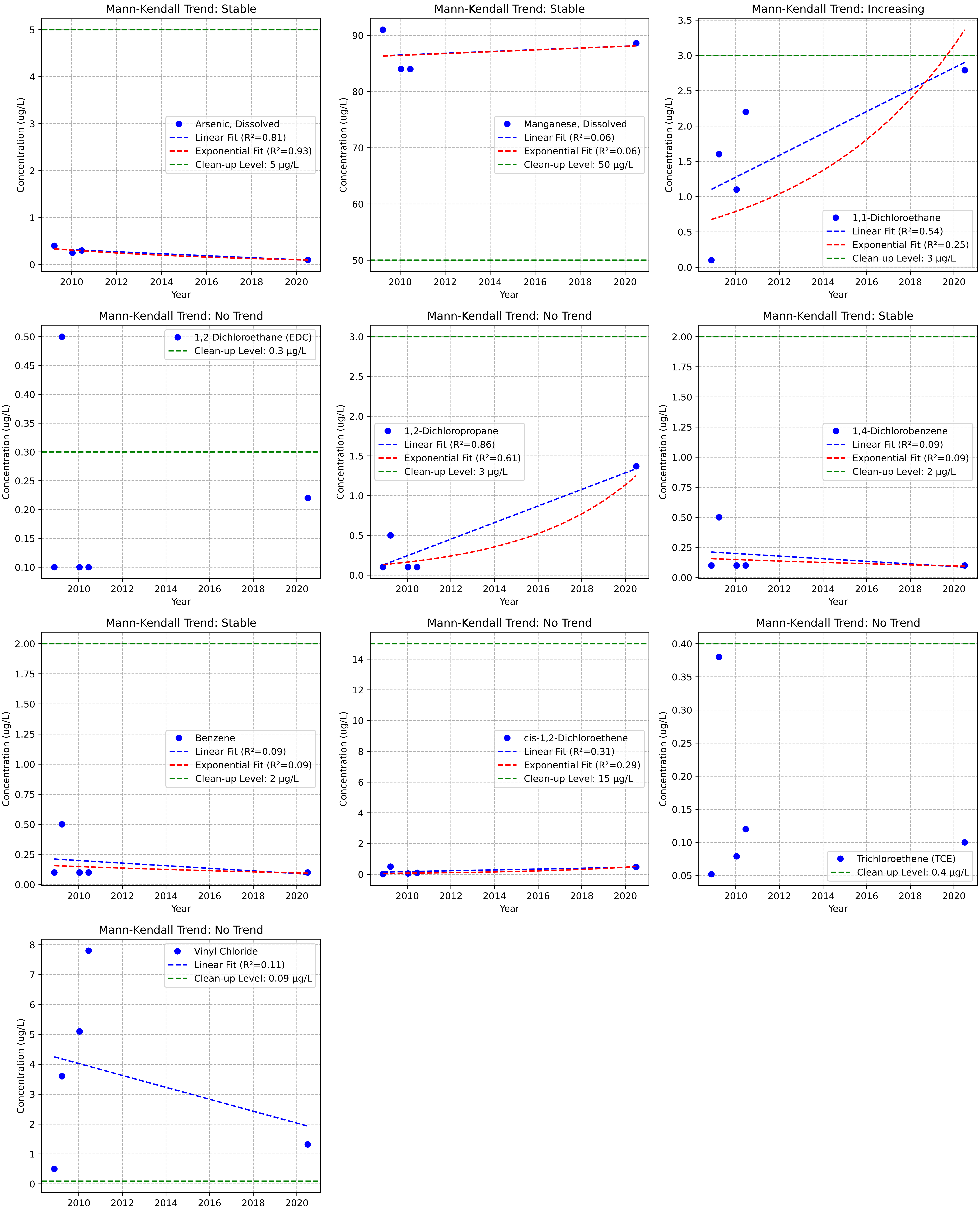

Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.17)
Exponential Fit (R²=0.16)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.83)
Exponential Fit (R²=0.76)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.76)
Exponential Fit (R²=0.85)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.86)
Exponential Fit (R²=0.96)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.68)
Exponential Fit (R²=0.87)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,4-Dichlorobenzene
Linear Fit (R²=0.36)
Exponential Fit (R²=0.29)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
Benzene
Linear Fit (R²=0.06)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.86)
Exponential Fit (R²=0.95)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.72)
Exponential Fit (R²=0.90)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.13)
Exponential Fit (R²=0.20)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-30b

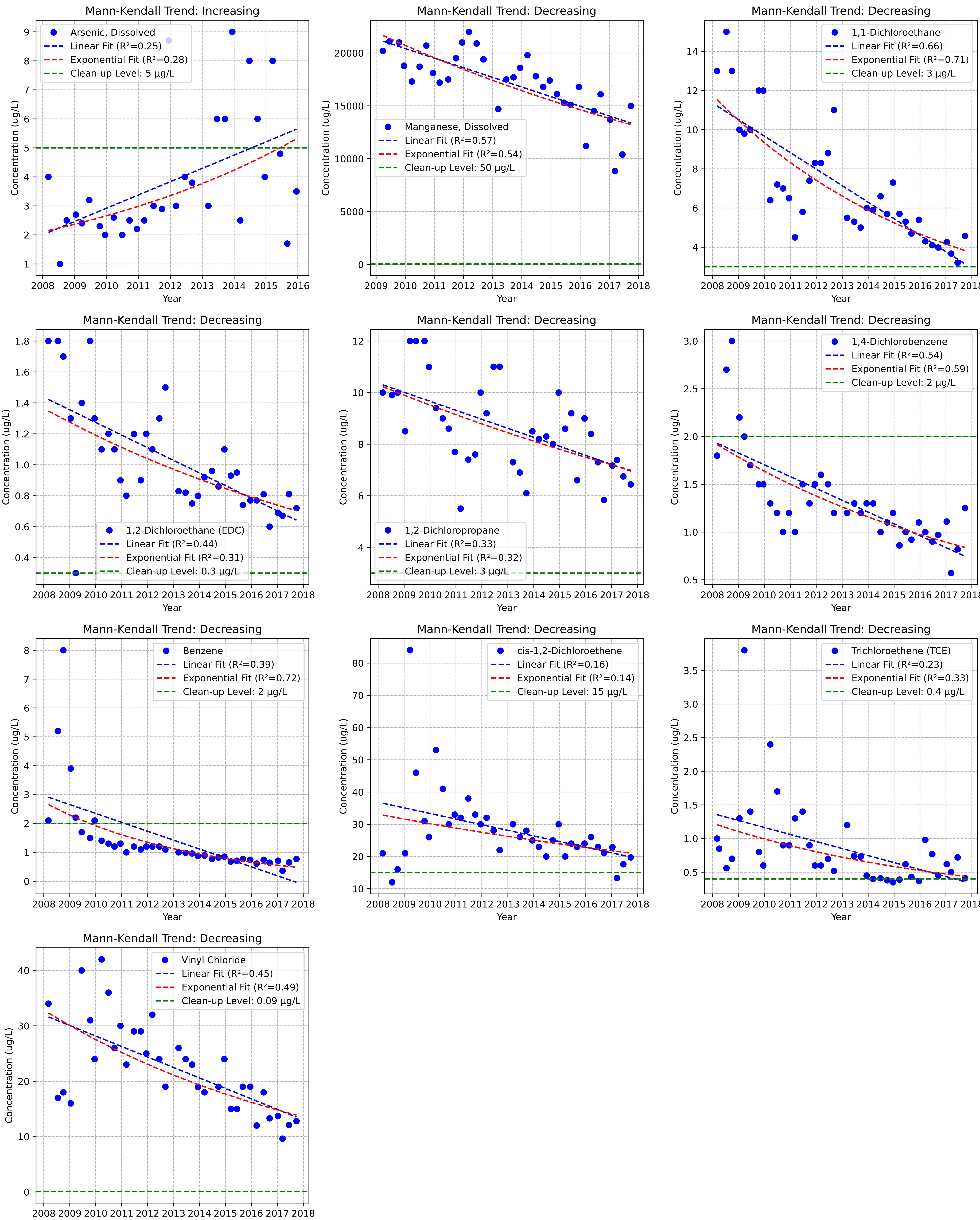


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.51)
Exponential Fit (R²=0.32)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Exponential Fit (R²=0.10)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.96)
Exponential Fit (R²=0.74)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Exponential Fit (R²=0.07)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.16)
Exponential Fit (R²=0.21)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.61)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.19)
Exponential Fit (R²=0.12)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.13)
Exponential Fit (R²=0.05)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

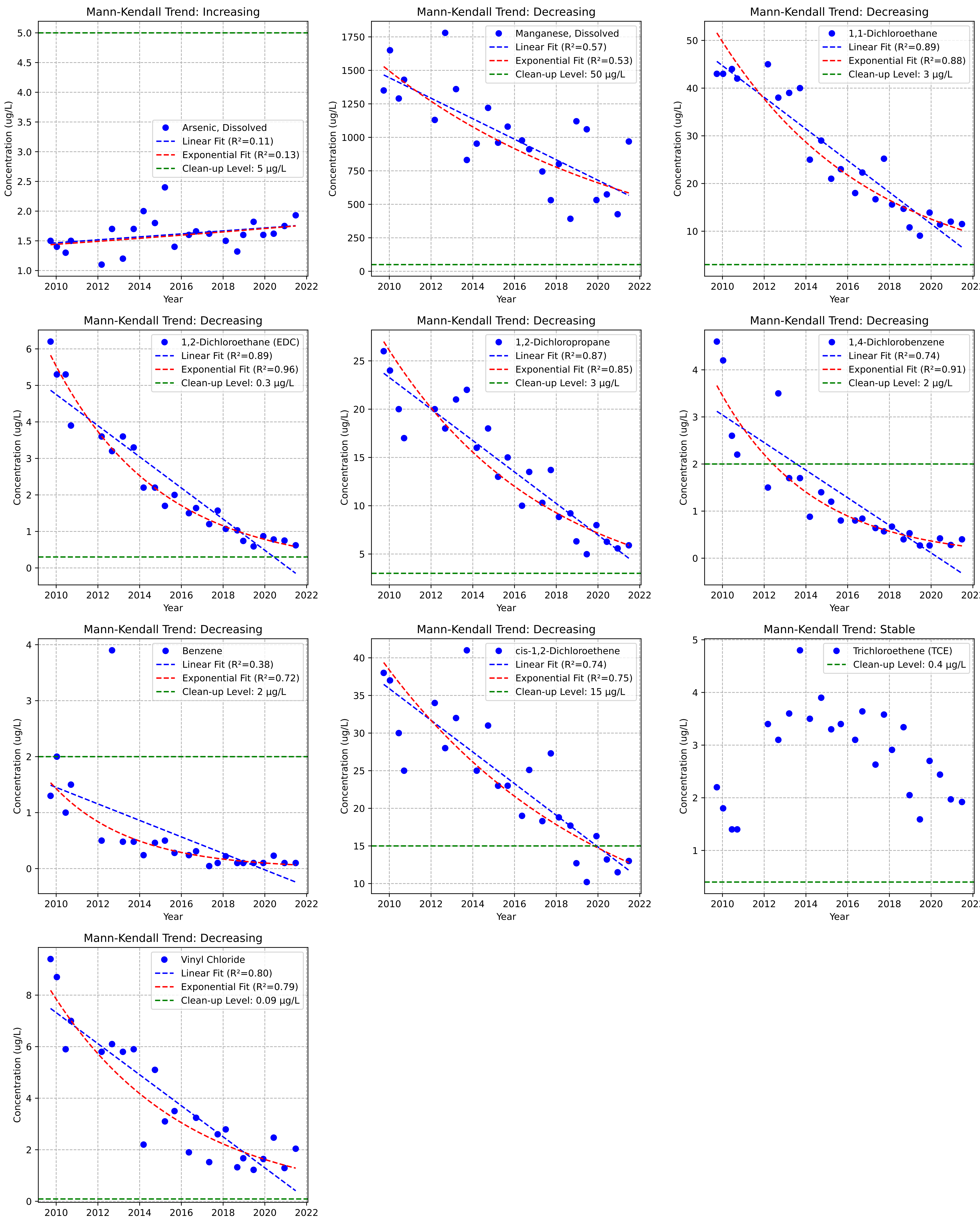
MW-31b


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.81)
Exponential Fit (R²=0.93)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.06)
Exponential Fit (R²=0.06)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Increasing
1,1-Dichloroethane
Linear Fit (R²=0.54)
Exponential Fit (R²=0.25)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.86)
Exponential Fit (R²=0.61)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.31)
Exponential Fit (R²=0.29)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.11)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

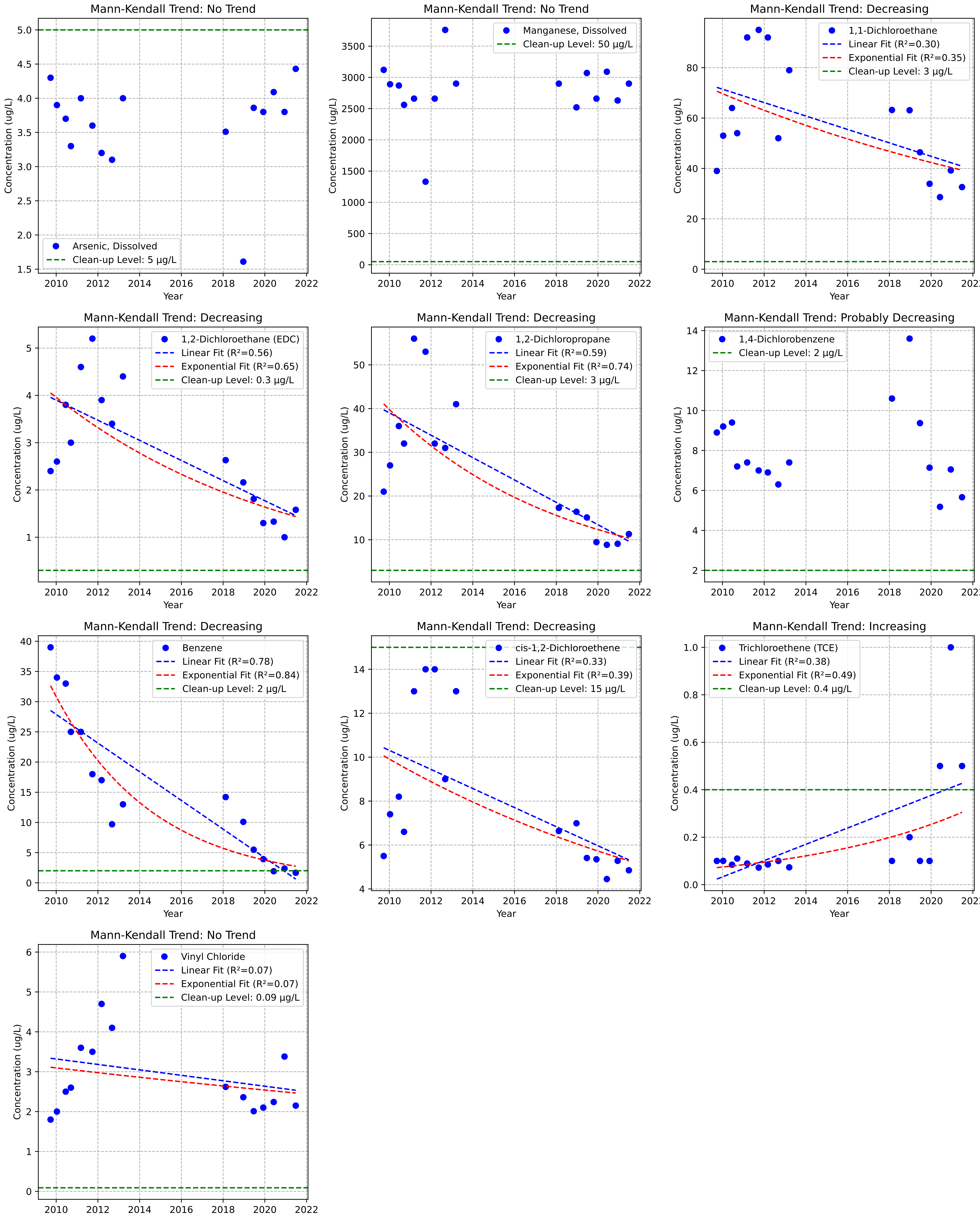
MW-3b


Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.25)
Exponential Fit (R²=0.28)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.57)
Exponential Fit (R²=0.54)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.66)
Exponential Fit (R²=0.71)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.44)
Exponential Fit (R²=0.31)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.33)
Exponential Fit (R²=0.32)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.54)
Exponential Fit (R²=0.59)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.39)
Exponential Fit (R²=0.72)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.16)
Exponential Fit (R²=0.14)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.23)
Exponential Fit (R²=0.33)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.45)
Exponential Fit (R²=0.49)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-42b

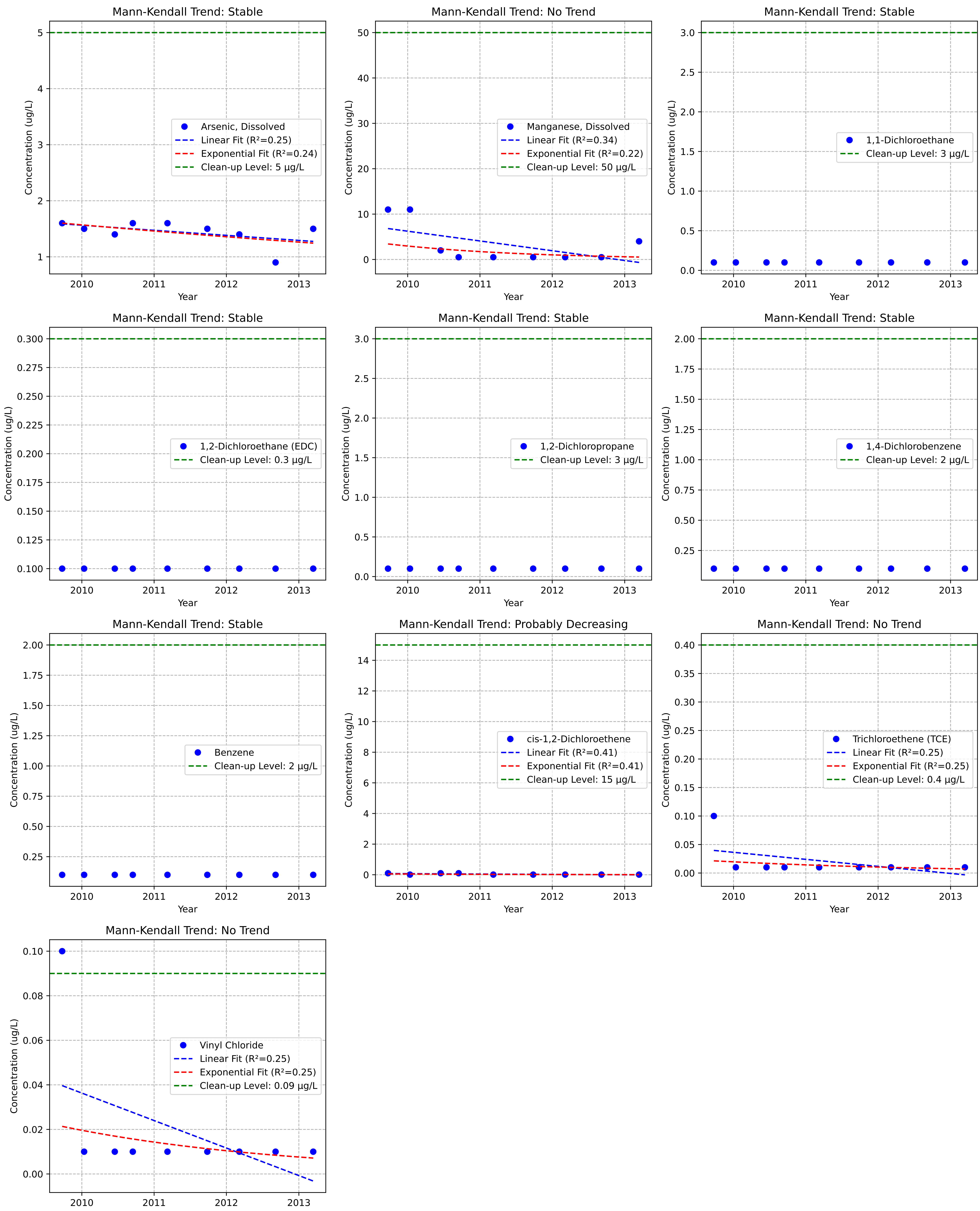

Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.11)
Exponential Fit (R²=0.13)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.57)
Exponential Fit (R²=0.53)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.89)
Exponential Fit (R²=0.88)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.89)
Exponential Fit (R²=0.96)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.87)
Exponential Fit (R²=0.85)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.74)
Exponential Fit (R²=0.91)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.38)
Exponential Fit (R²=0.72)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.74)
Exponential Fit (R²=0.75)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.80)
Exponential Fit (R²=0.79)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-44b

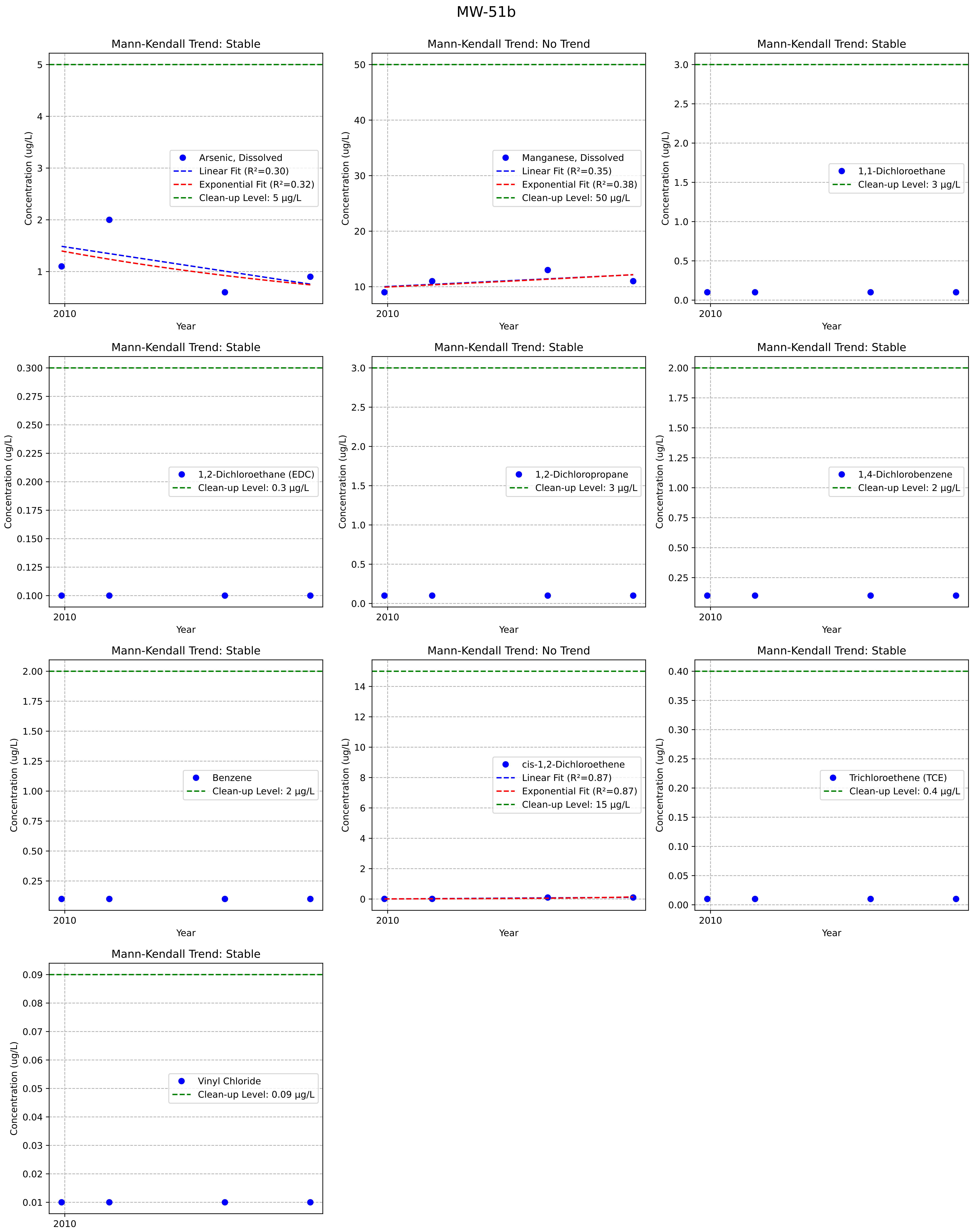


Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.30)
Exponential Fit (R²=0.35)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.56)
Exponential Fit (R²=0.65)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.59)
Exponential Fit (R²=0.74)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.78)
Exponential Fit (R²=0.84)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.33)
Exponential Fit (R²=0.39)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.38)
Exponential Fit (R²=0.49)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.07)
Exponential Fit (R²=0.07)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-48b

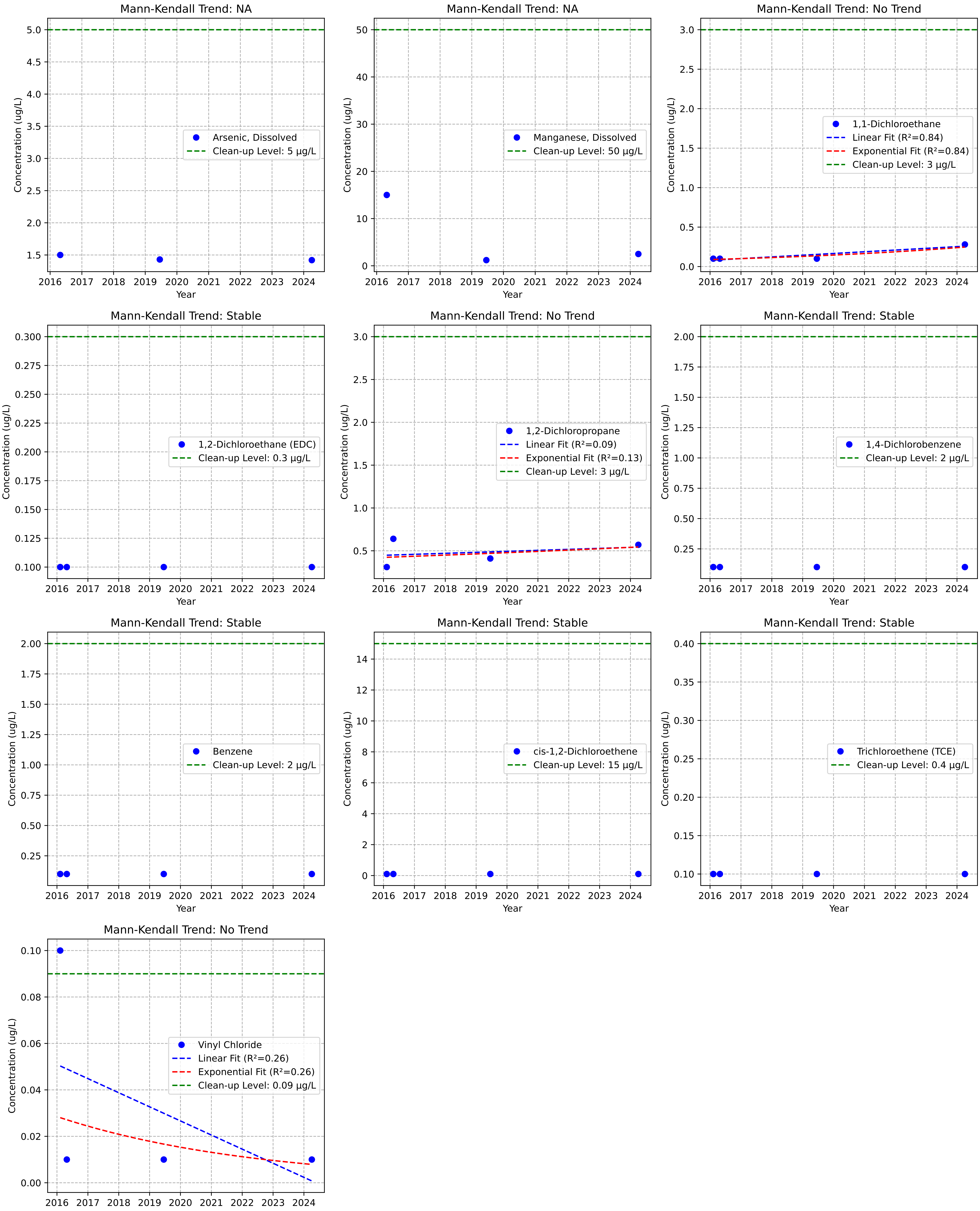


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.25)
Exponential Fit (R²=0.24)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.34)
Exponential Fit (R²=0.22)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.41)
Exponential Fit (R²=0.41)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010
2011
2012
2013



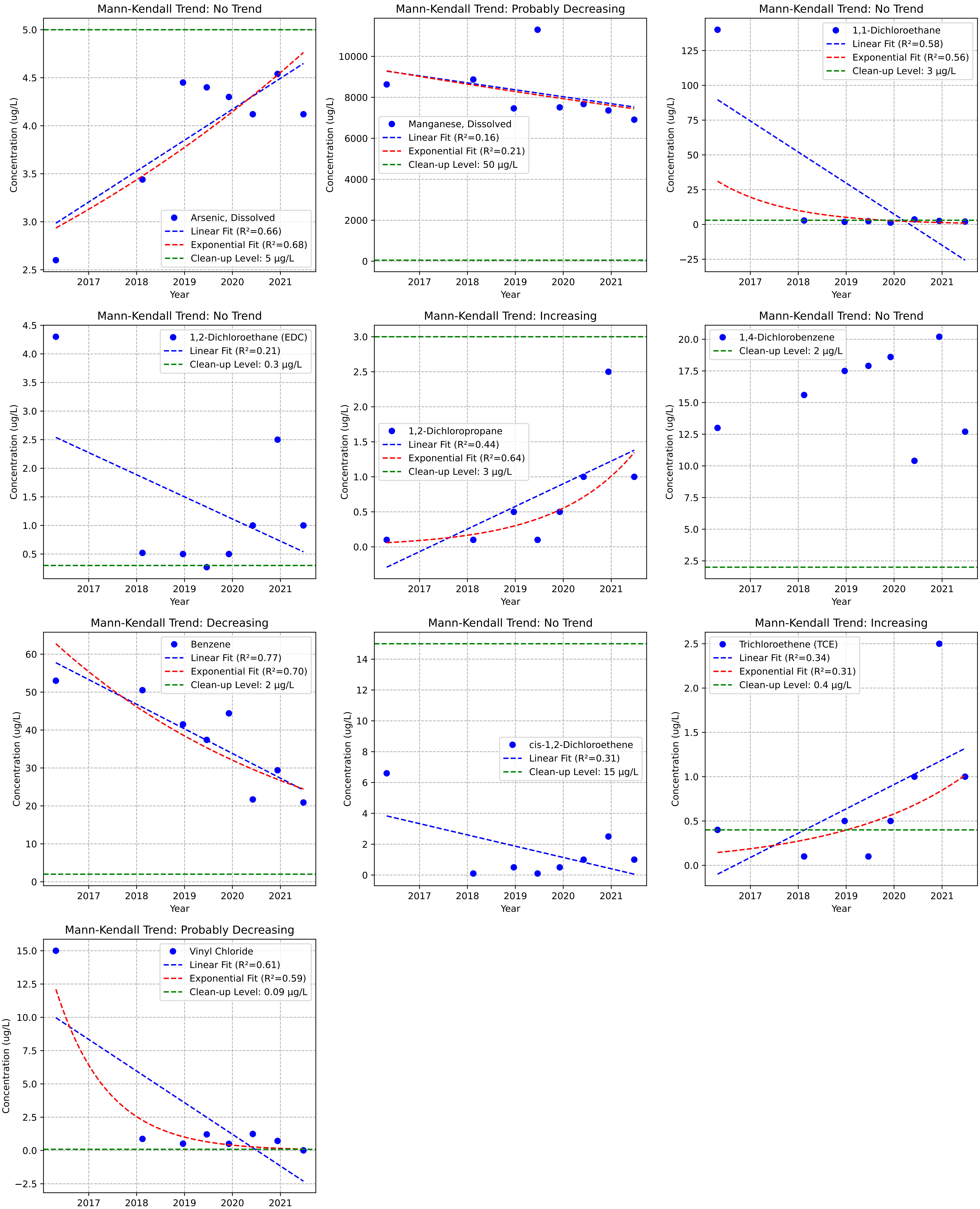
MW-51b
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.30)
Exponential Fit (R²=0.32)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.35)
Exponential Fit (R²=0.38)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.87)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

MW-57b

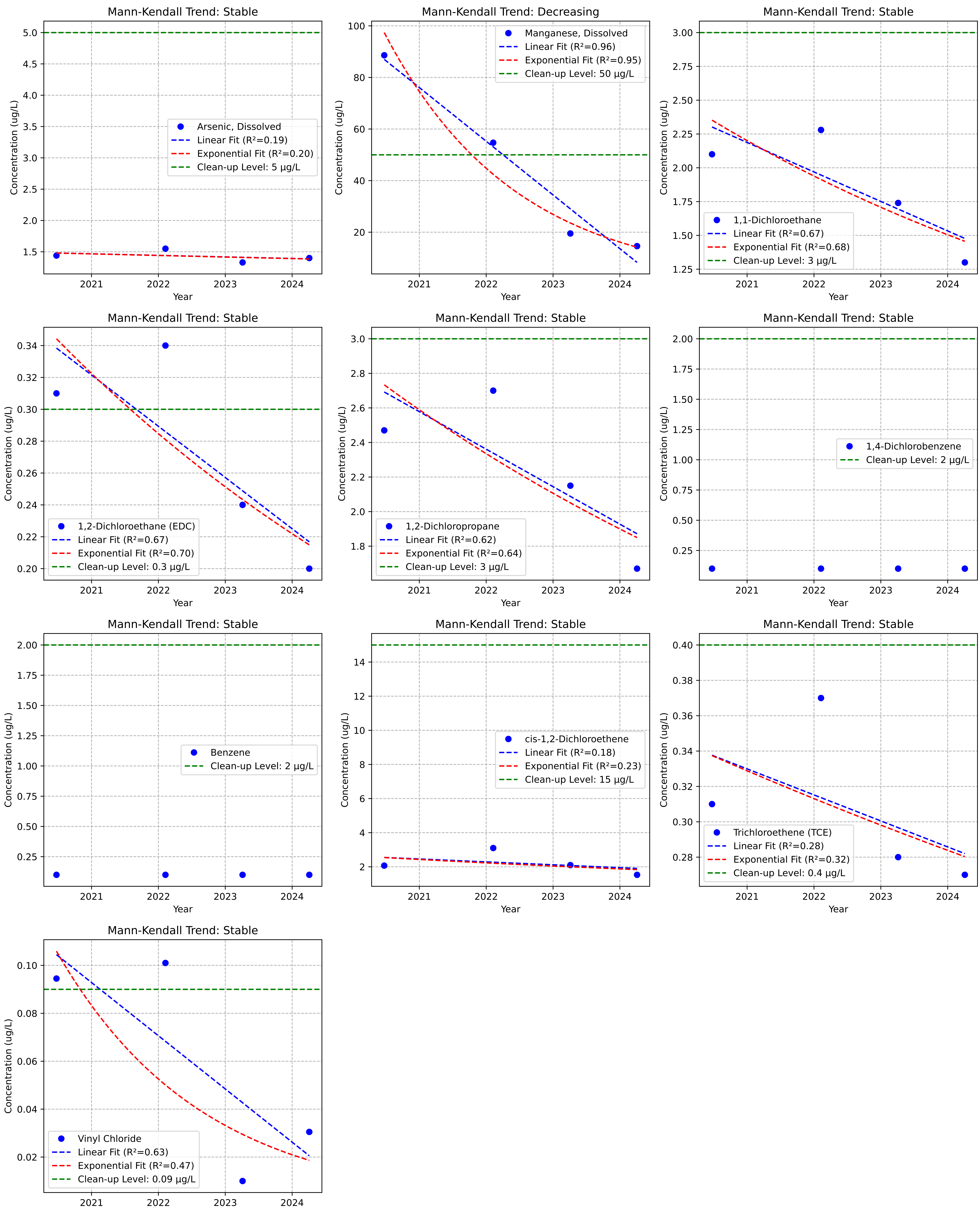


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.84)
Exponential Fit (R²=0.84)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloropropane
Linear Fit (R²=0.09)
Exponential Fit (R²=0.13)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.26)
Exponential Fit (R²=0.26)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-63b

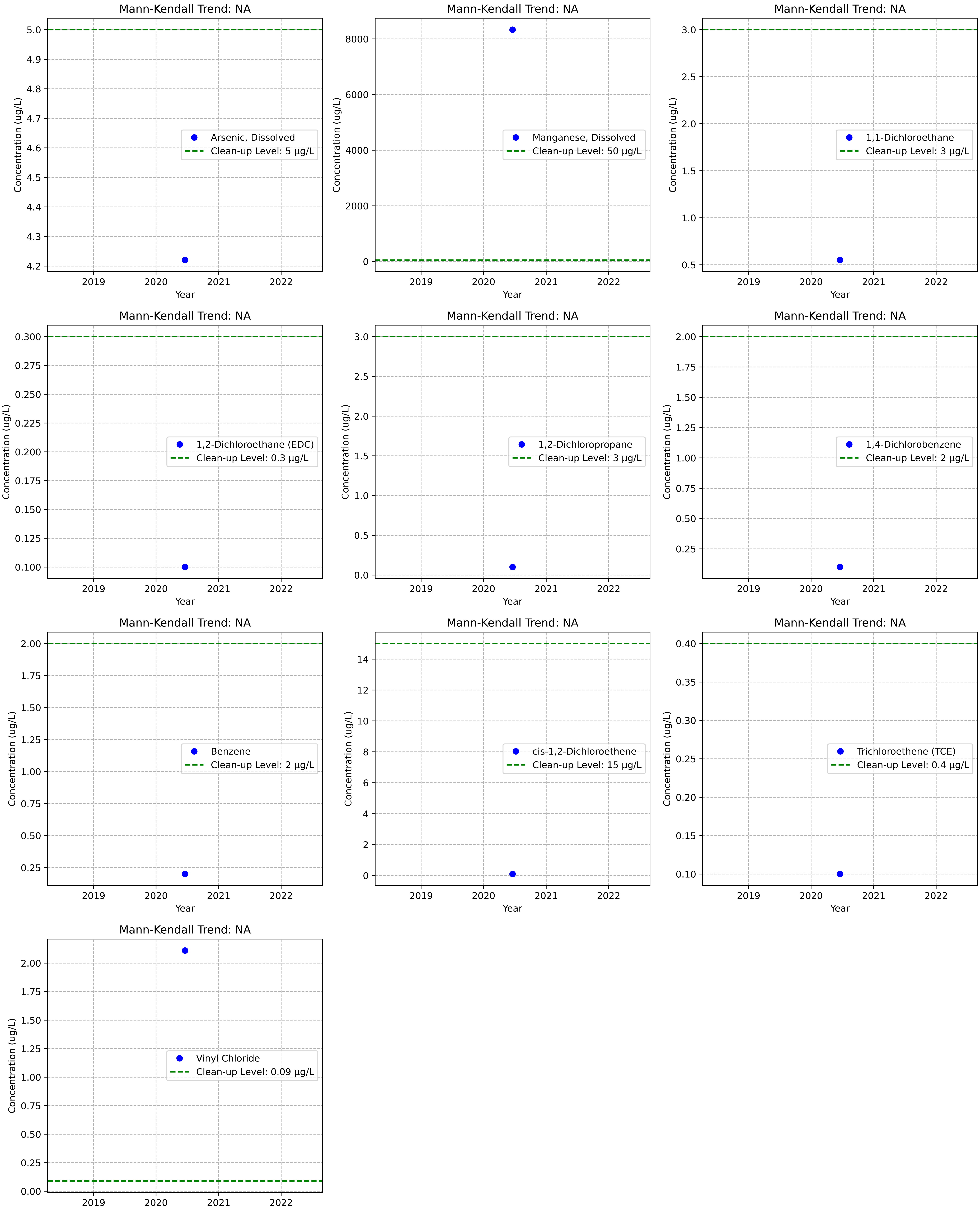

Mann-Kendall Trend: No Trend
Arsenic, Dissolved
Linear Fit (R²=0.66)
Exponential Fit (R²=0.68)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Probably Decreasing
Manganese, Dissolved
Linear Fit (R²=0.16)
Exponential Fit (R²=0.21)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Linear Fit (R²=0.58)
Exponential Fit (R²=0.56)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.21)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloropropane
Linear Fit (R²=0.44)
Exponential Fit (R²=0.64)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: No Trend
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.70)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.31)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.34)
Exponential Fit (R²=0.31)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Probably Decreasing
Vinyl Chloride
Linear Fit (R²=0.61)
Exponential Fit (R²=0.59)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2017
2018
2019
2020
2021

MW-71b



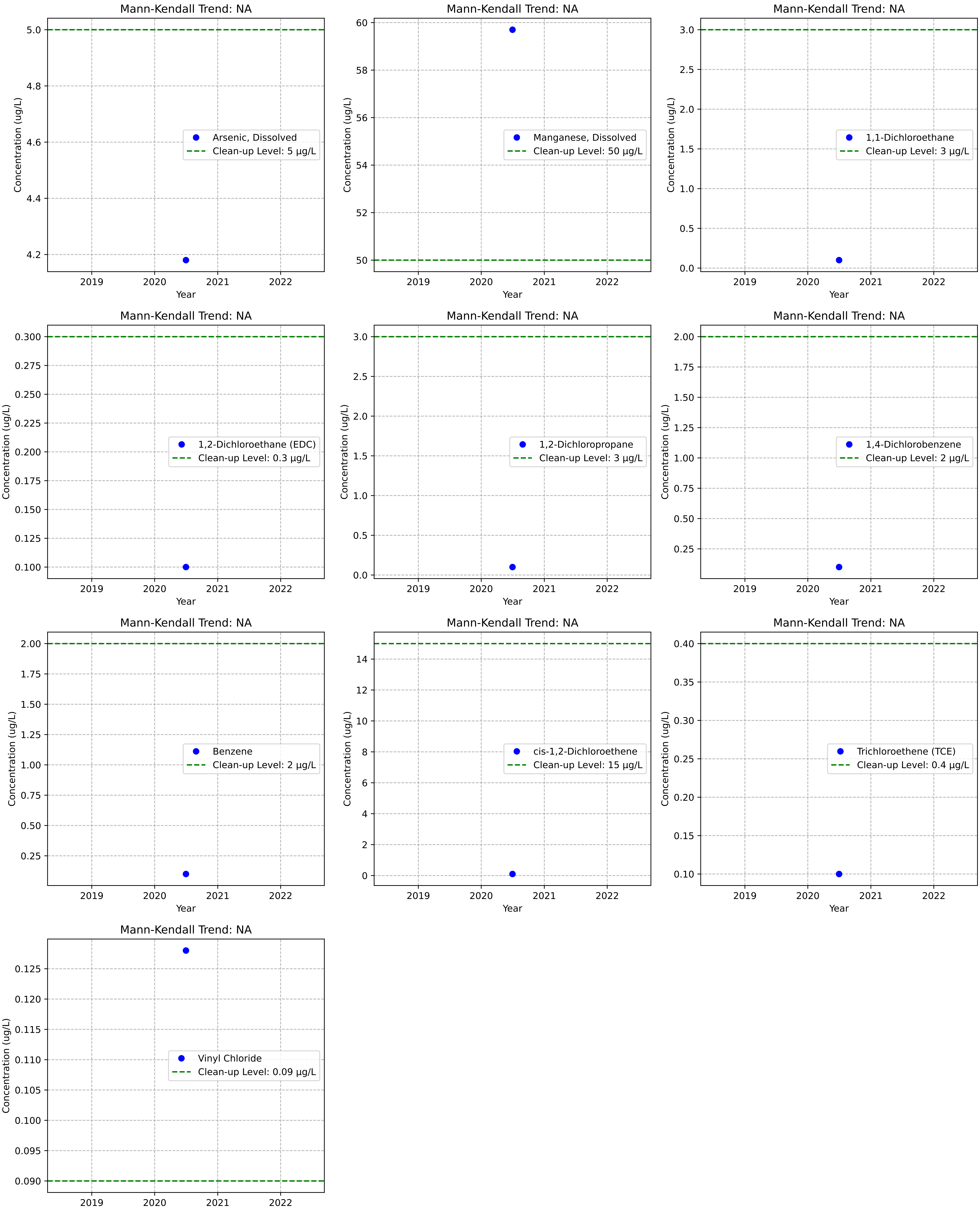
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.19)
Exponential Fit (R²=0.20)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.96)
Exponential Fit (R²=0.95)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.67)
Exponential Fit (R²=0.68)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.67)
Exponential Fit (R²=0.70)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.62)
Exponential Fit (R²=0.64)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Linear Fit (R²=0.18)
Exponential Fit (R²=0.23)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.28)
Exponential Fit (R²=0.32)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.63)
Exponential Fit (R²=0.47)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-72b

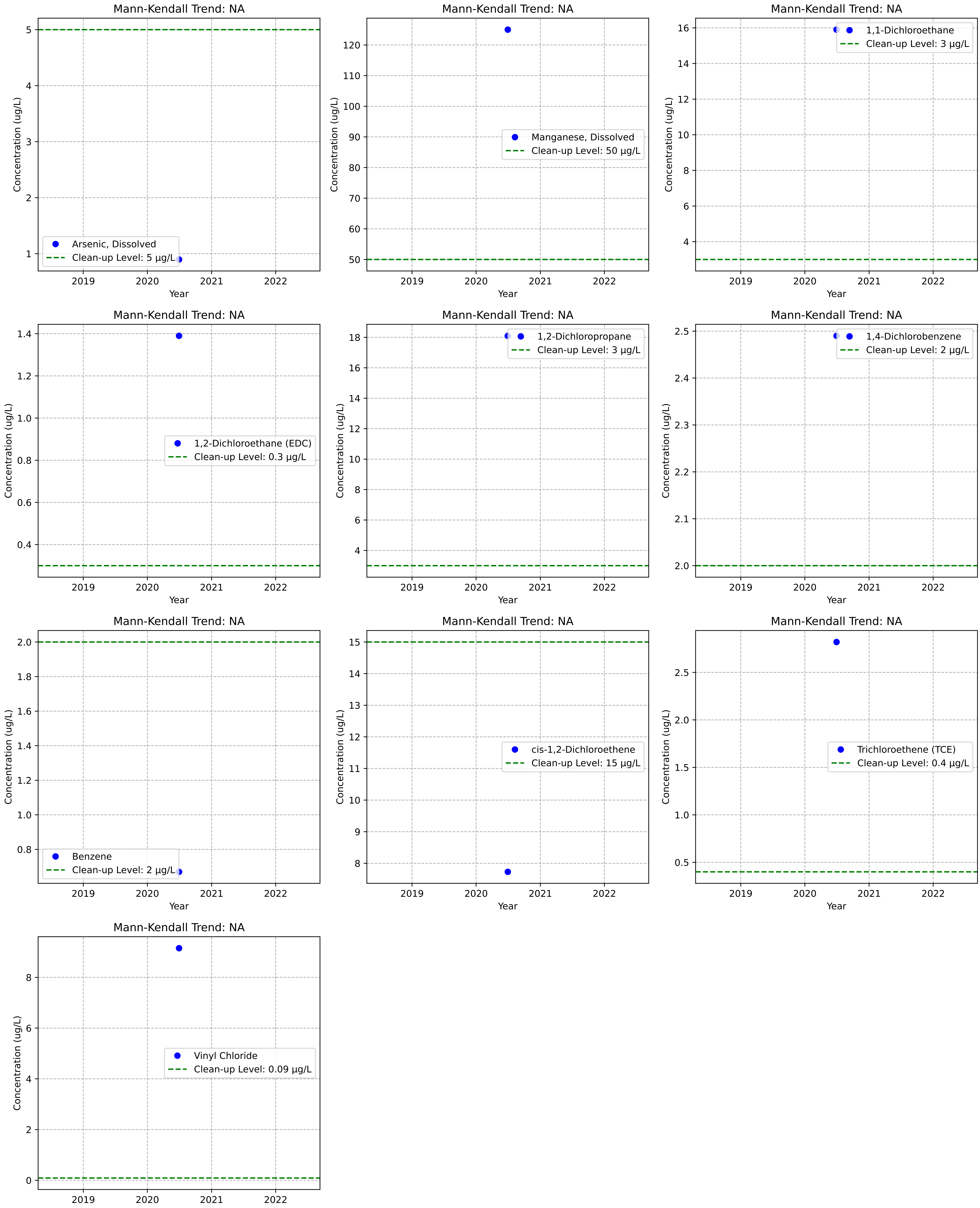


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-74b

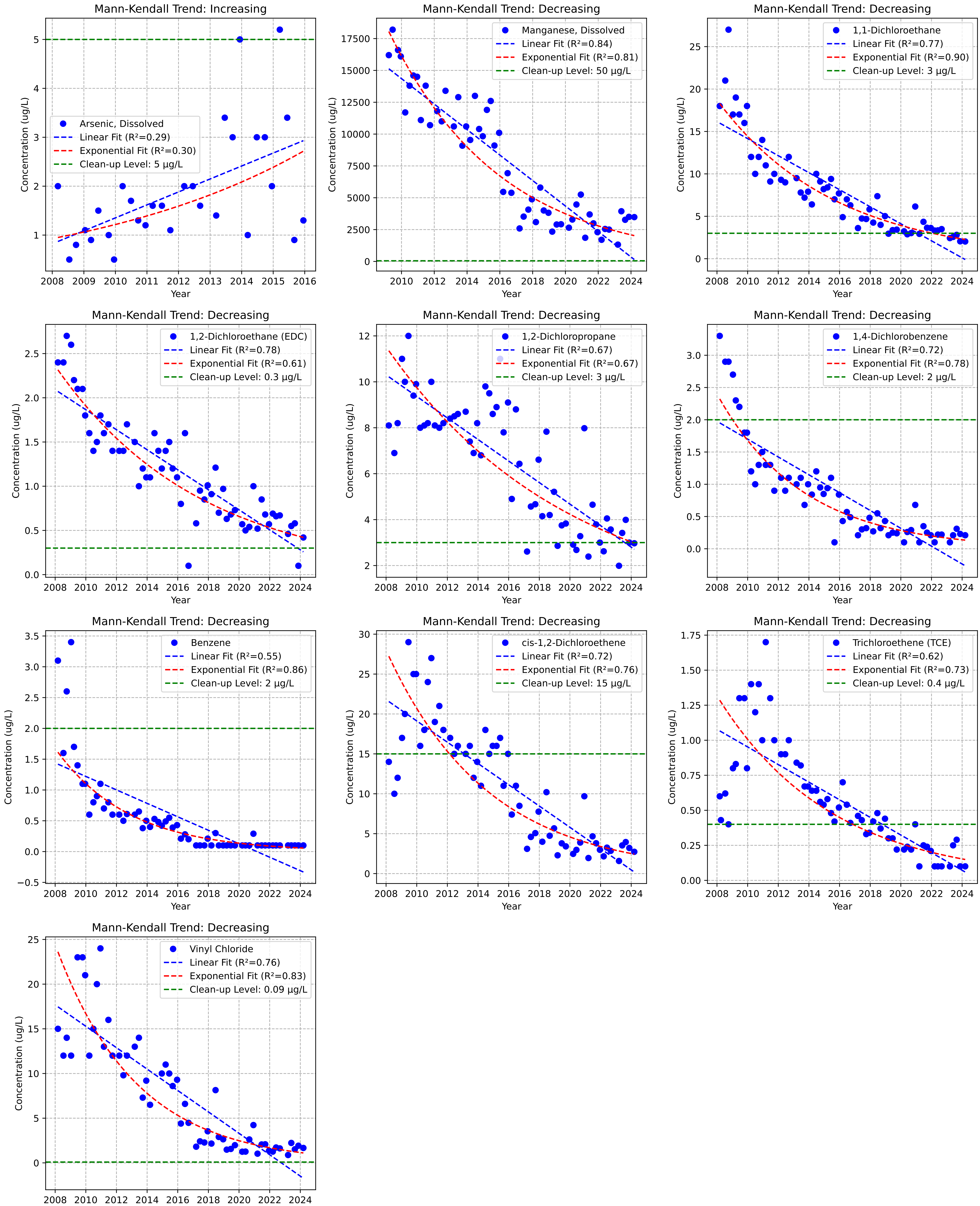

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-78b

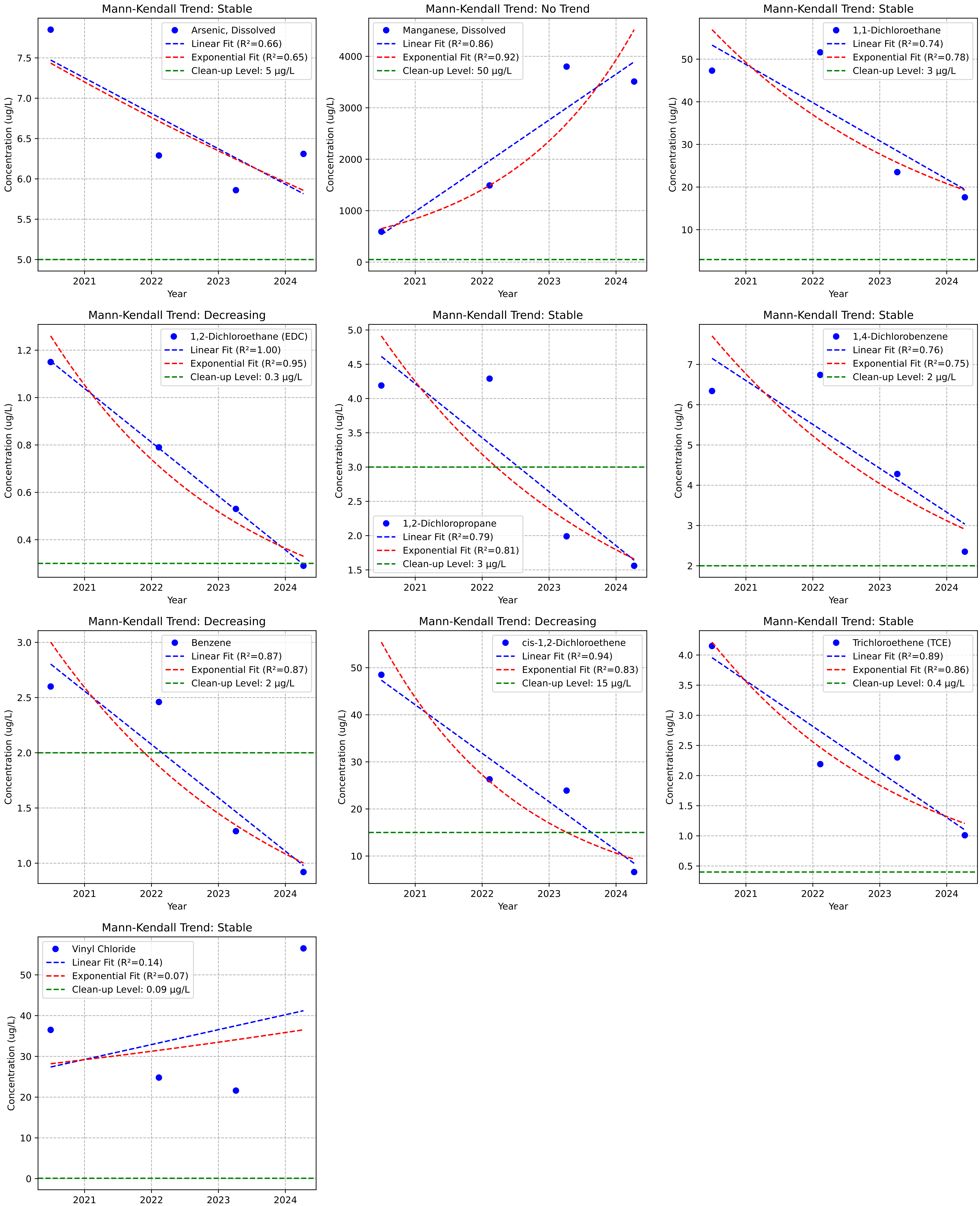


Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
2019
2020
2021
2022

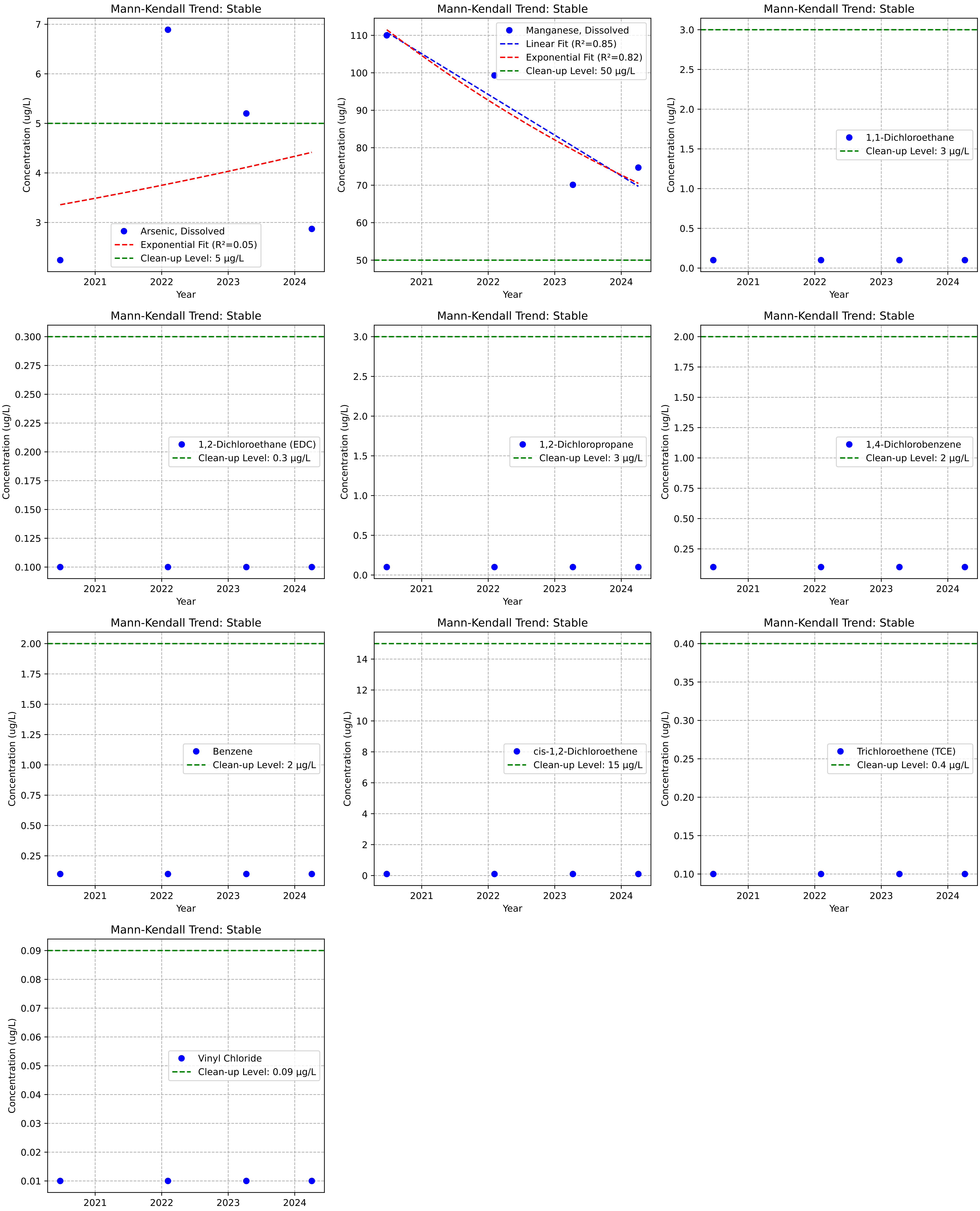
MW-7b


Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.29)
Exponential Fit (R²=0.30)
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.84)
Exponential Fit (R²=0.81)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.77)
Exponential Fit (R²=0.90)
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.78)
Exponential Fit (R²=0.61)
Clean-up Level: 0.3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.67)
Exponential Fit (R²=0.67)
Clean-up Level: 3 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.72)
Exponential Fit (R²=0.78)
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.55)
Exponential Fit (R²=0.86)
Clean-up Level: 2 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.72)
Exponential Fit (R²=0.76)
Clean-up Level: 15 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.62)
Exponential Fit (R²=0.73)
Clean-up Level: 0.4 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.76)
Exponential Fit (R²=0.83)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

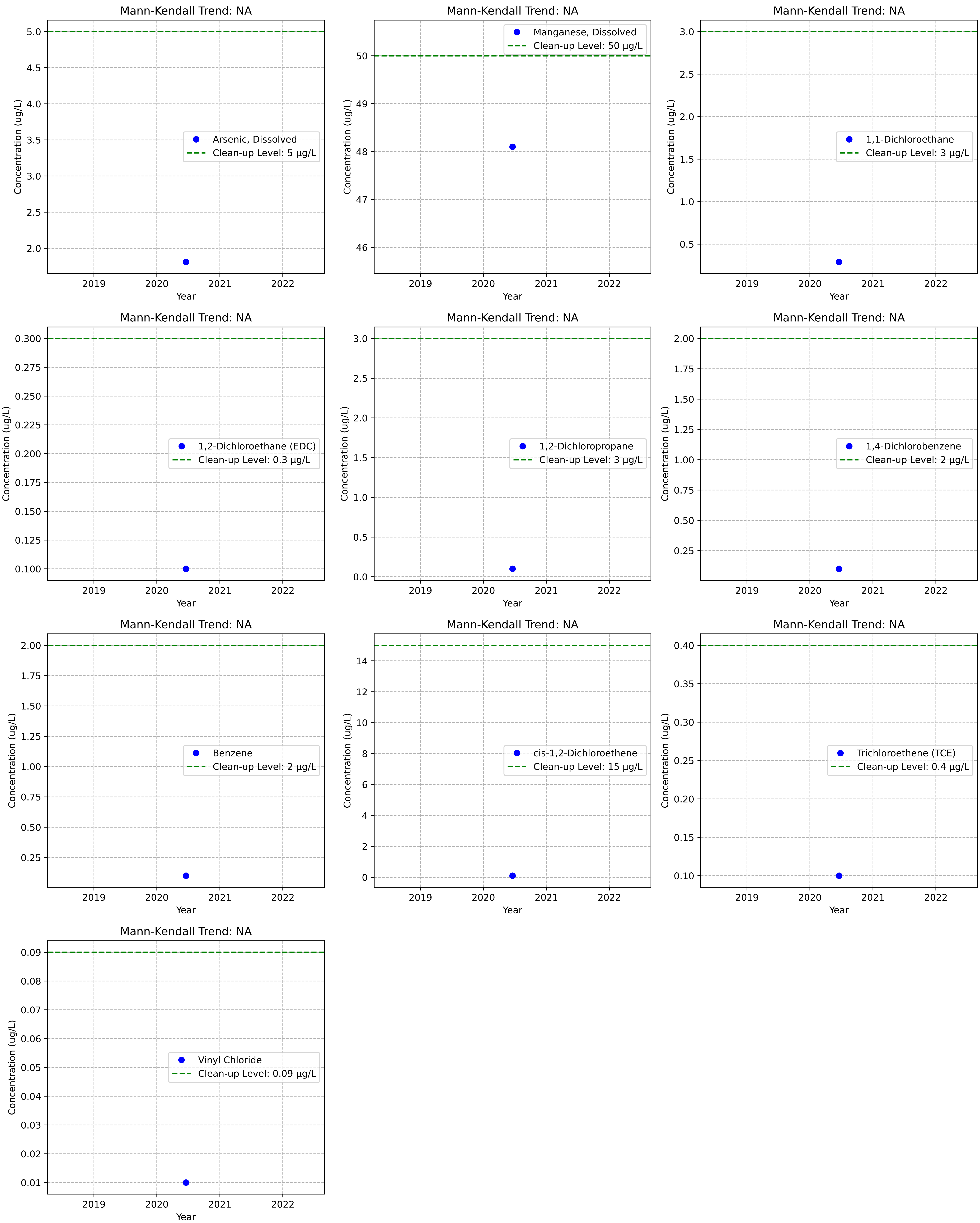
MW-81b


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.66)
Exponential Fit (R²=0.65)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Manganese, Dissolved
Linear Fit (R²=0.86)
Exponential Fit (R²=0.92)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Linear Fit (R²=0.74)
Exponential Fit (R²=0.78)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=1.00)
Exponential Fit (R²=0.95)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.79)
Exponential Fit (R²=0.81)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Linear Fit (R²=0.76)
Exponential Fit (R²=0.75)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.87)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.94)
Exponential Fit (R²=0.83)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.89)
Exponential Fit (R²=0.86)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Linear Fit (R²=0.14)
Exponential Fit (R²=0.07)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

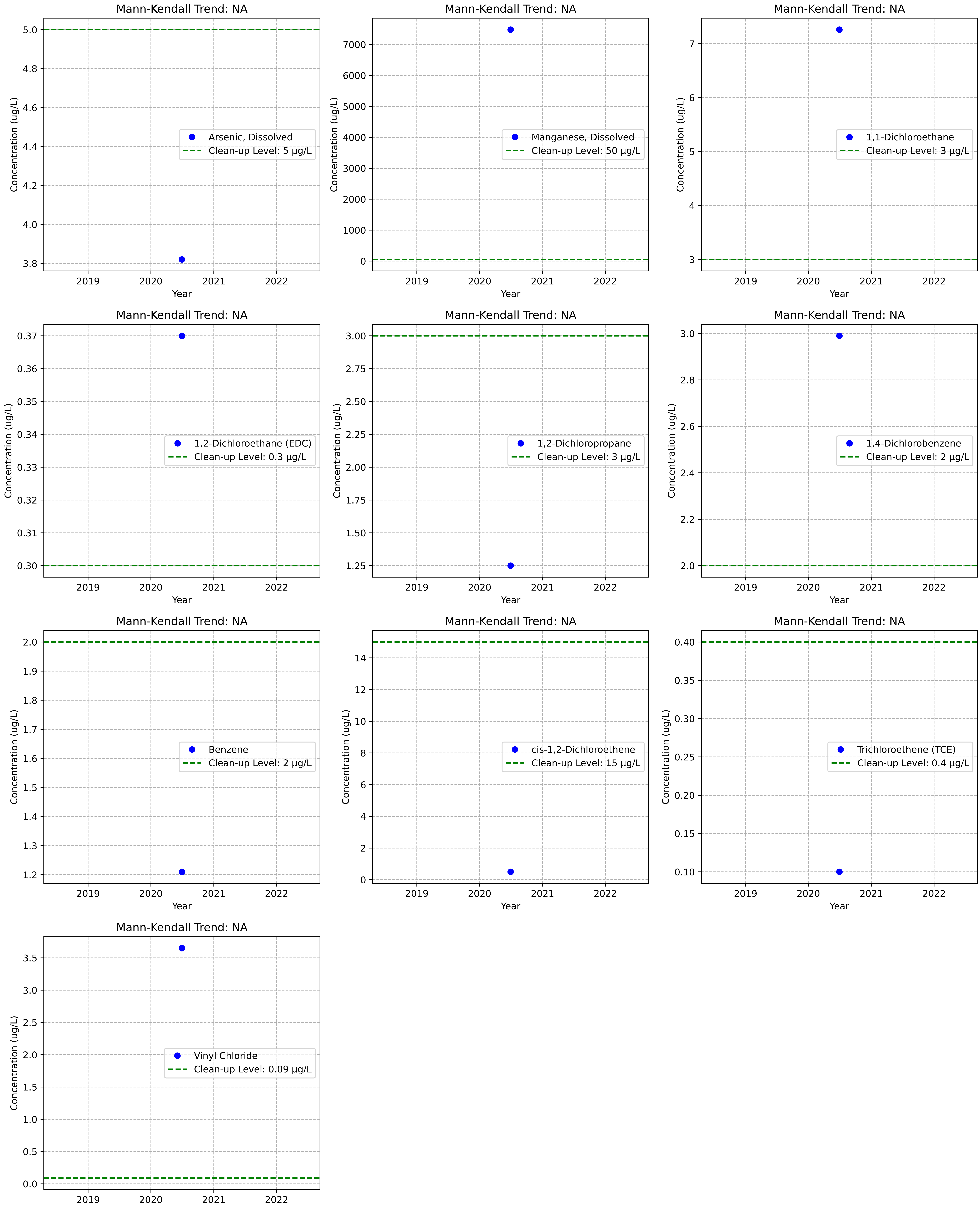
MW-82b


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Exponential Fit (R²=0.05)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.85)
Exponential Fit (R²=0.82)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

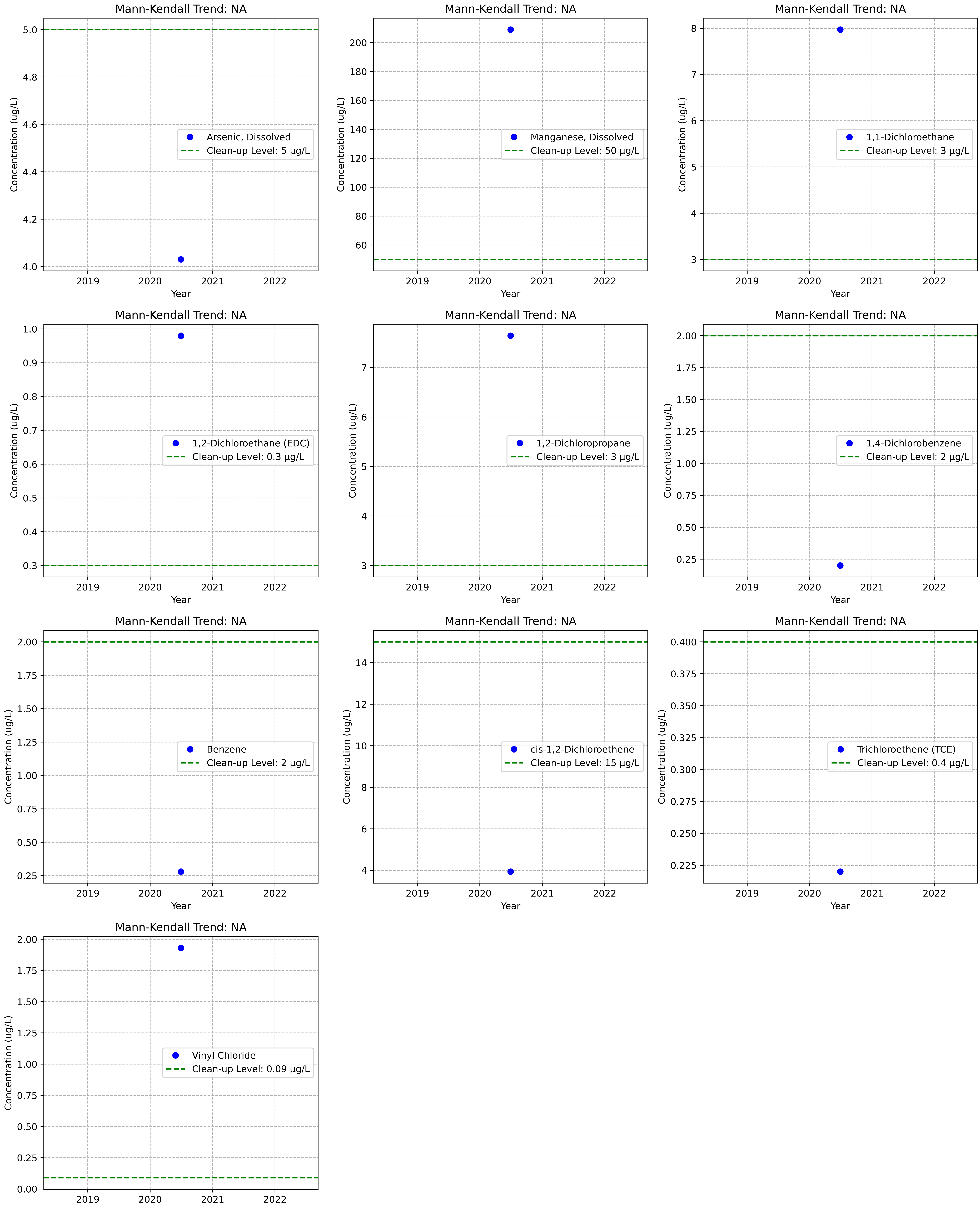
MW-86b


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-89b

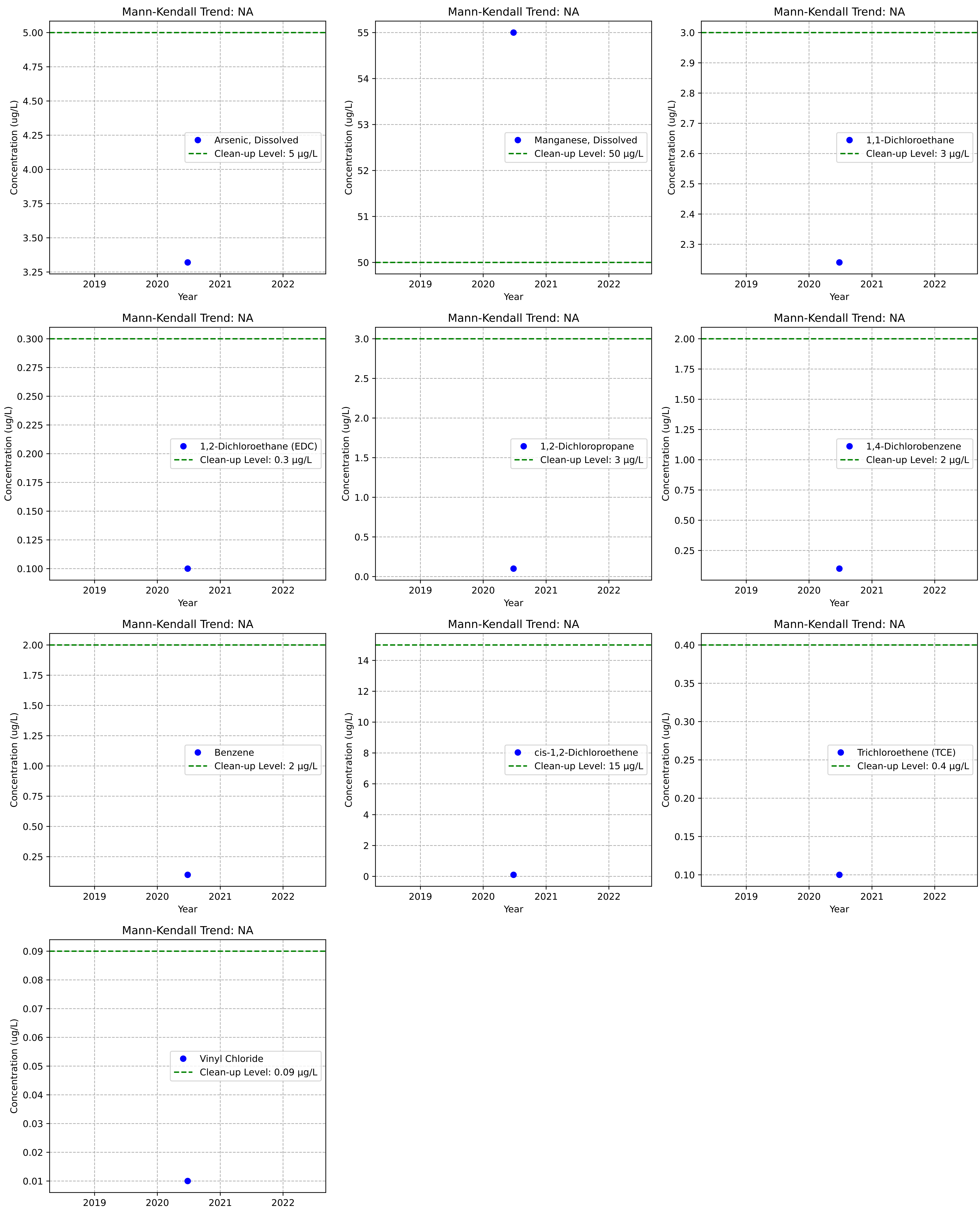

Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-93b



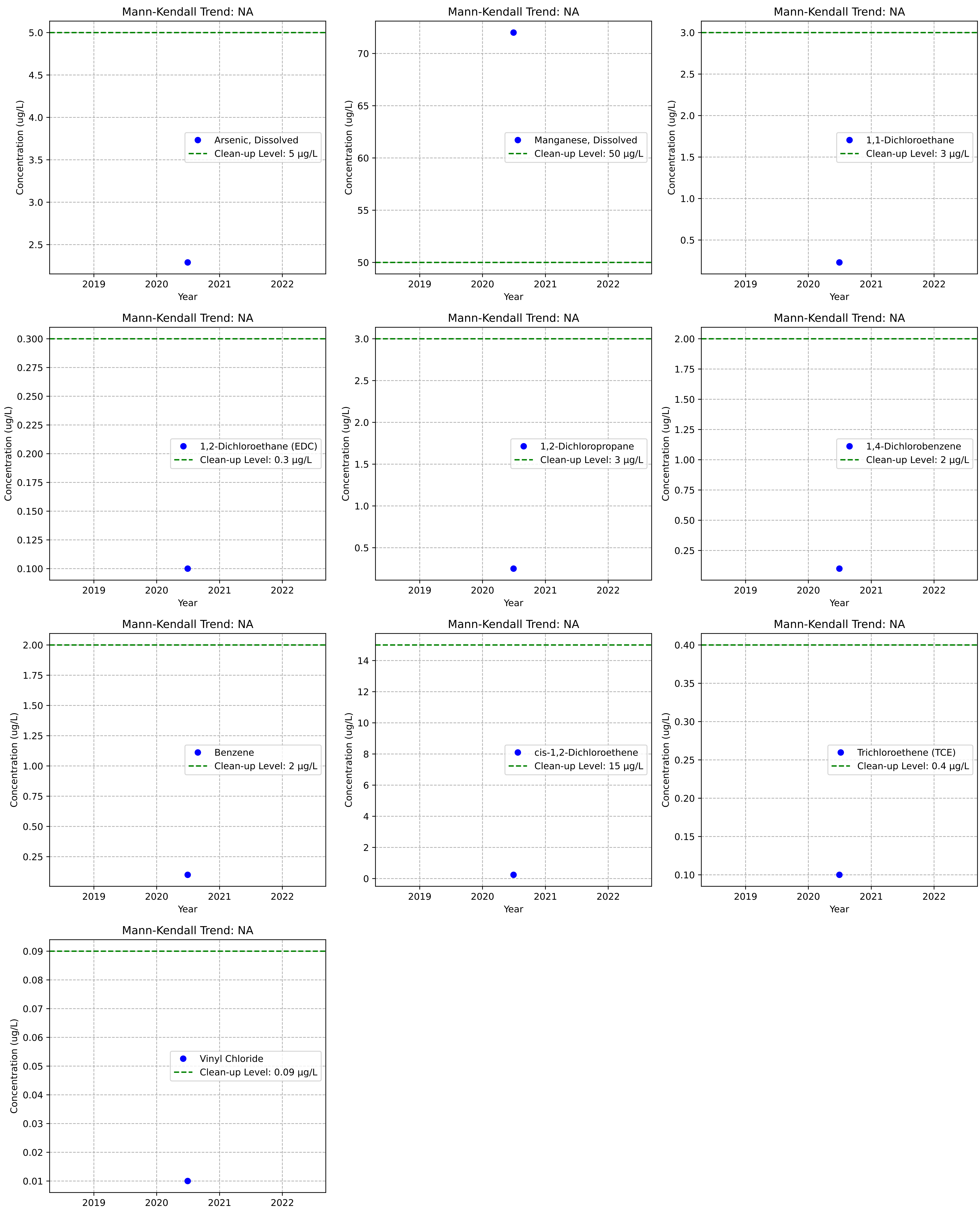
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-96b



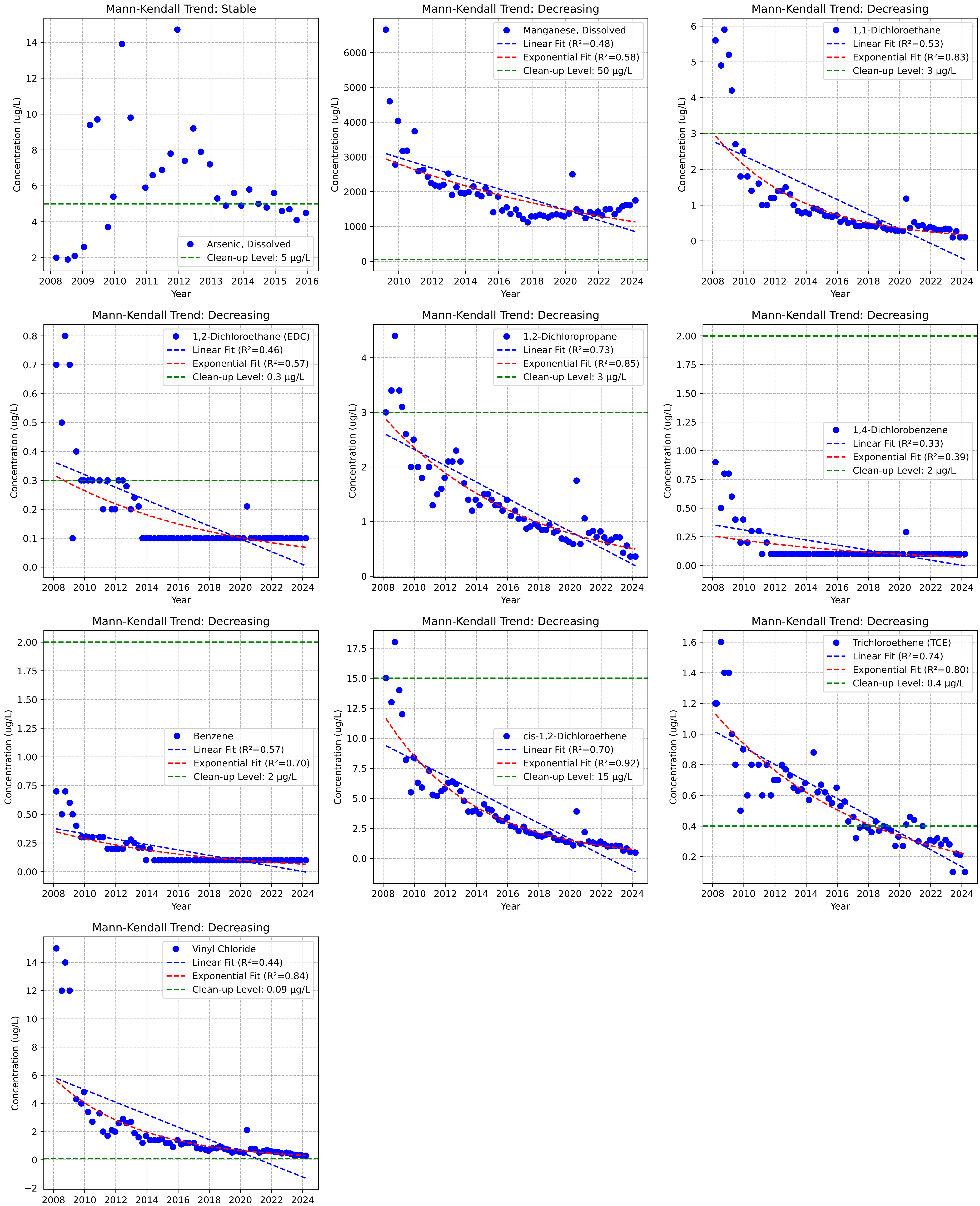
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-97b



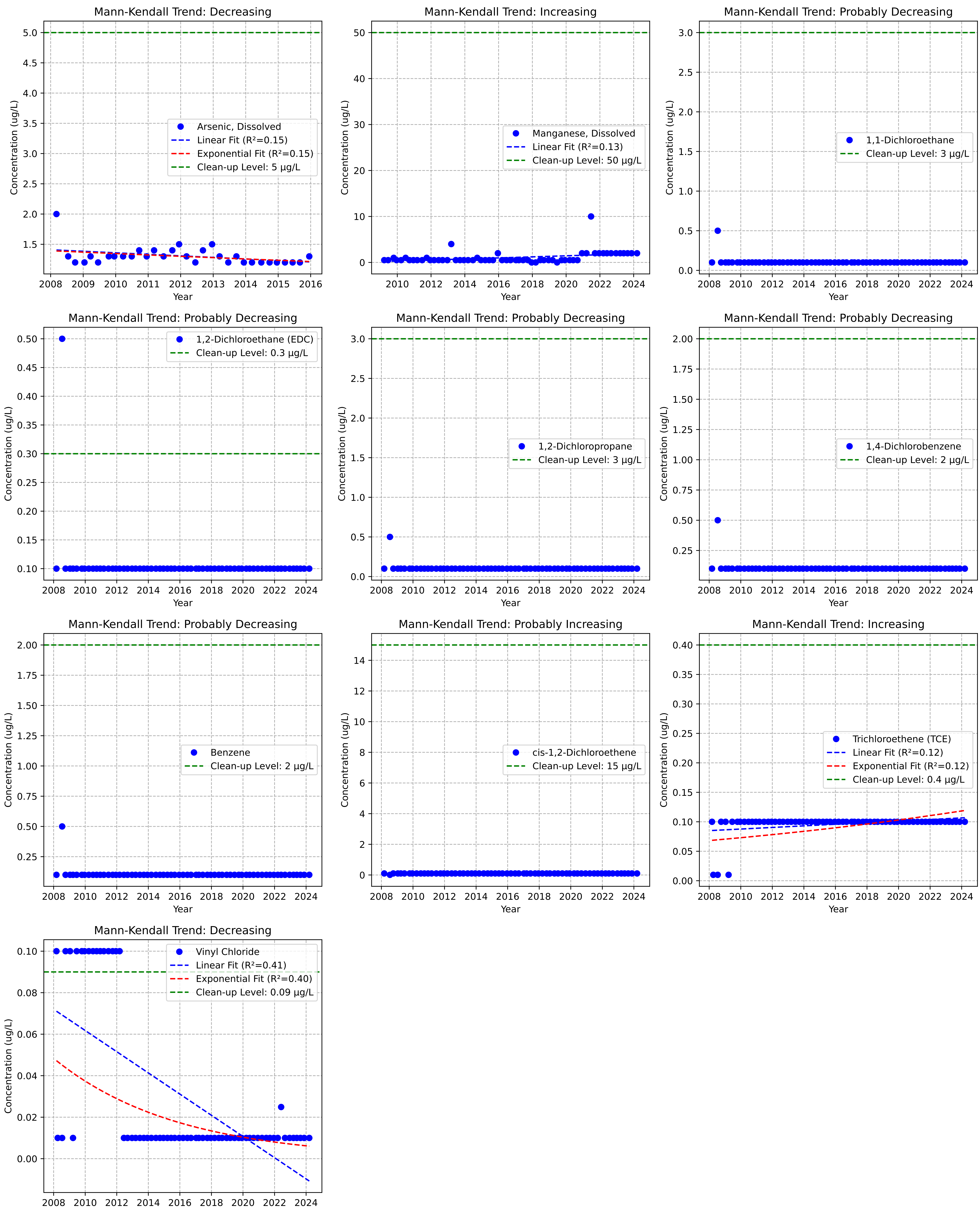
Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2019
2020
2021
2022

MW-9b

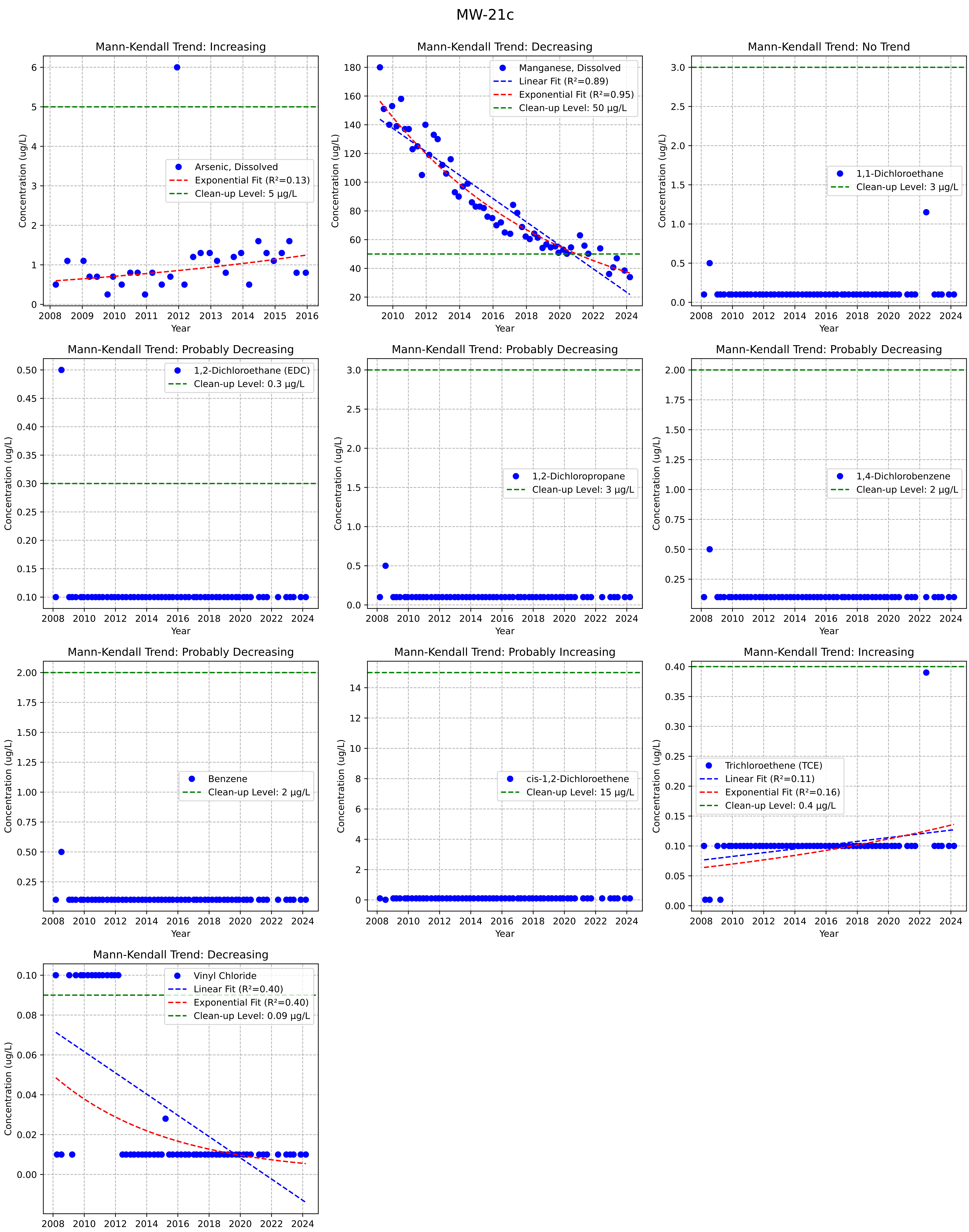

Mann-Kendall Trend: Stable
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.48)
Exponential Fit (R²=0.58)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.53)
Exponential Fit (R²=0.83)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.46)
Exponential Fit (R²=0.57)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.73)
Exponential Fit (R²=0.85)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Decreasing
1,4-Dichlorobenzene
Linear Fit (R²=0.33)
Exponential Fit (R²=0.39)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.57)
Exponential Fit (R²=0.70)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.70)
Exponential Fit (R²=0.92)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.74)
Exponential Fit (R²=0.80)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.44)
Exponential Fit (R²=0.84)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

B4. Concentration time series plots of IHS constituents for Interflow Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

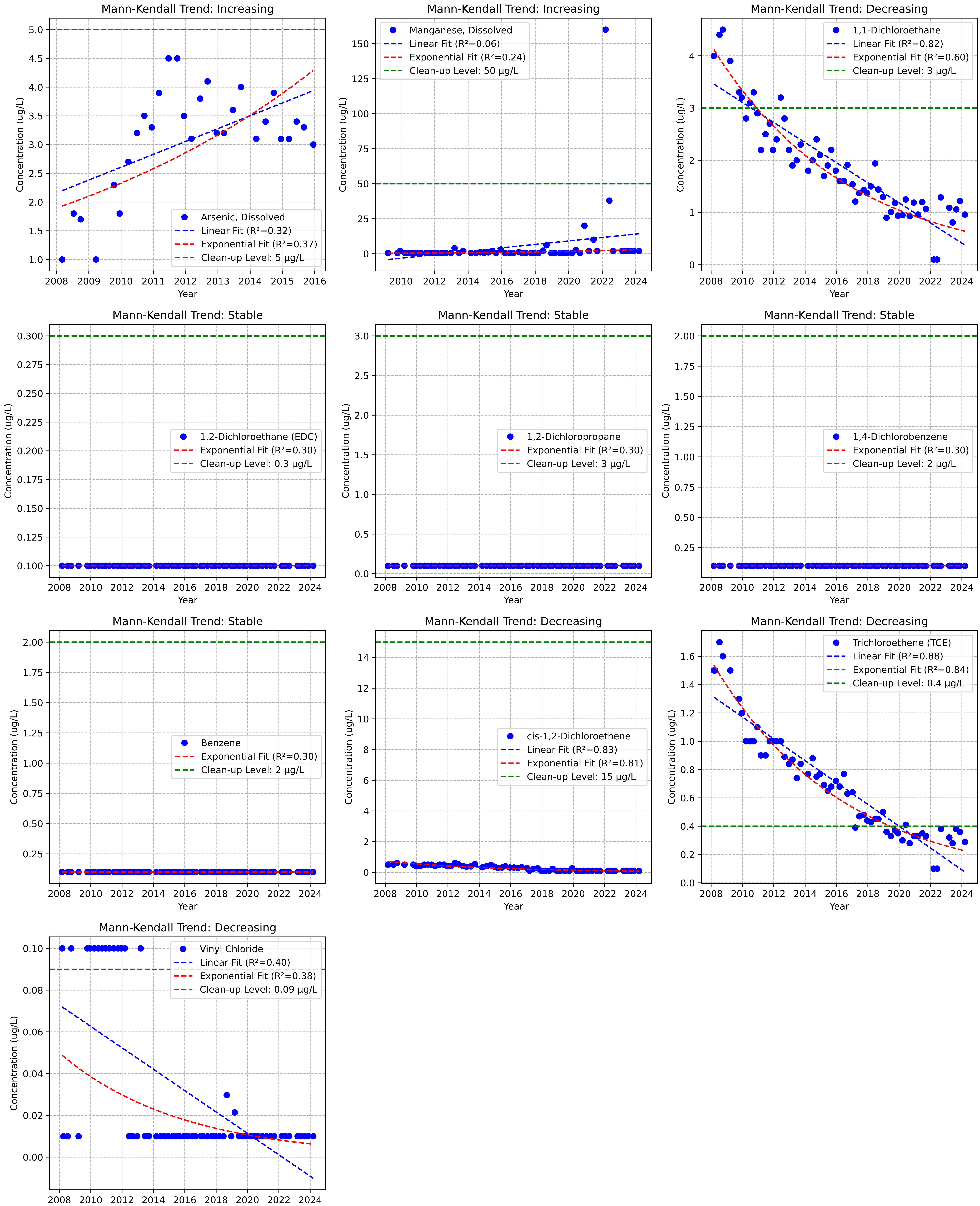
MW-20c



Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.15)
Exponential Fit (R²=0.15)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.13)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Probably Decreasing
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Increasing
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.41)
Exponential Fit (R²=0.40)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

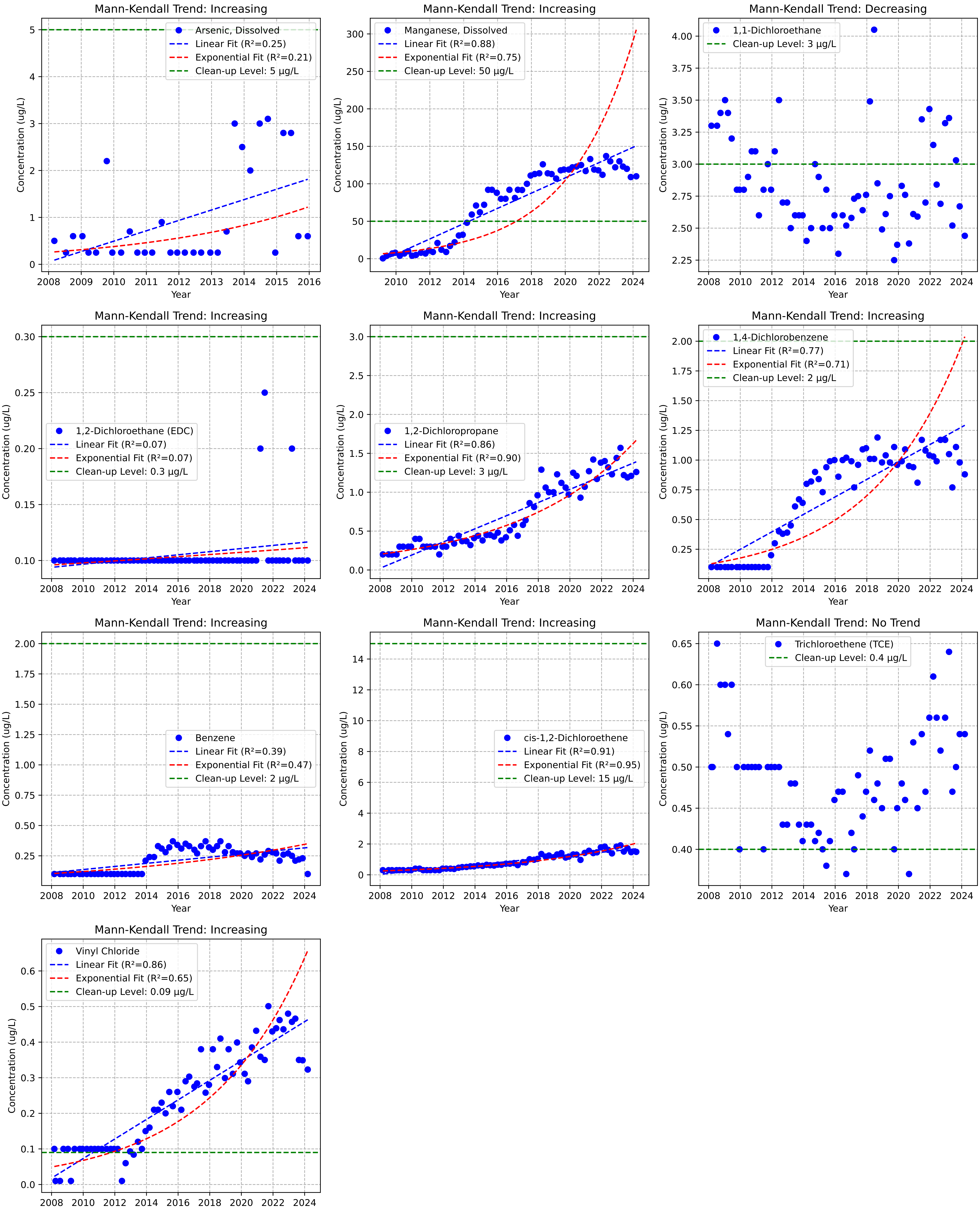

MW-21c
Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Exponential Fit (R²=0.13)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.89)
Exponential Fit (R²=0.95)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: No Trend
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Increasing
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.11)
Exponential Fit (R²=0.16)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.40)
Exponential Fit (R²=0.40)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-22c

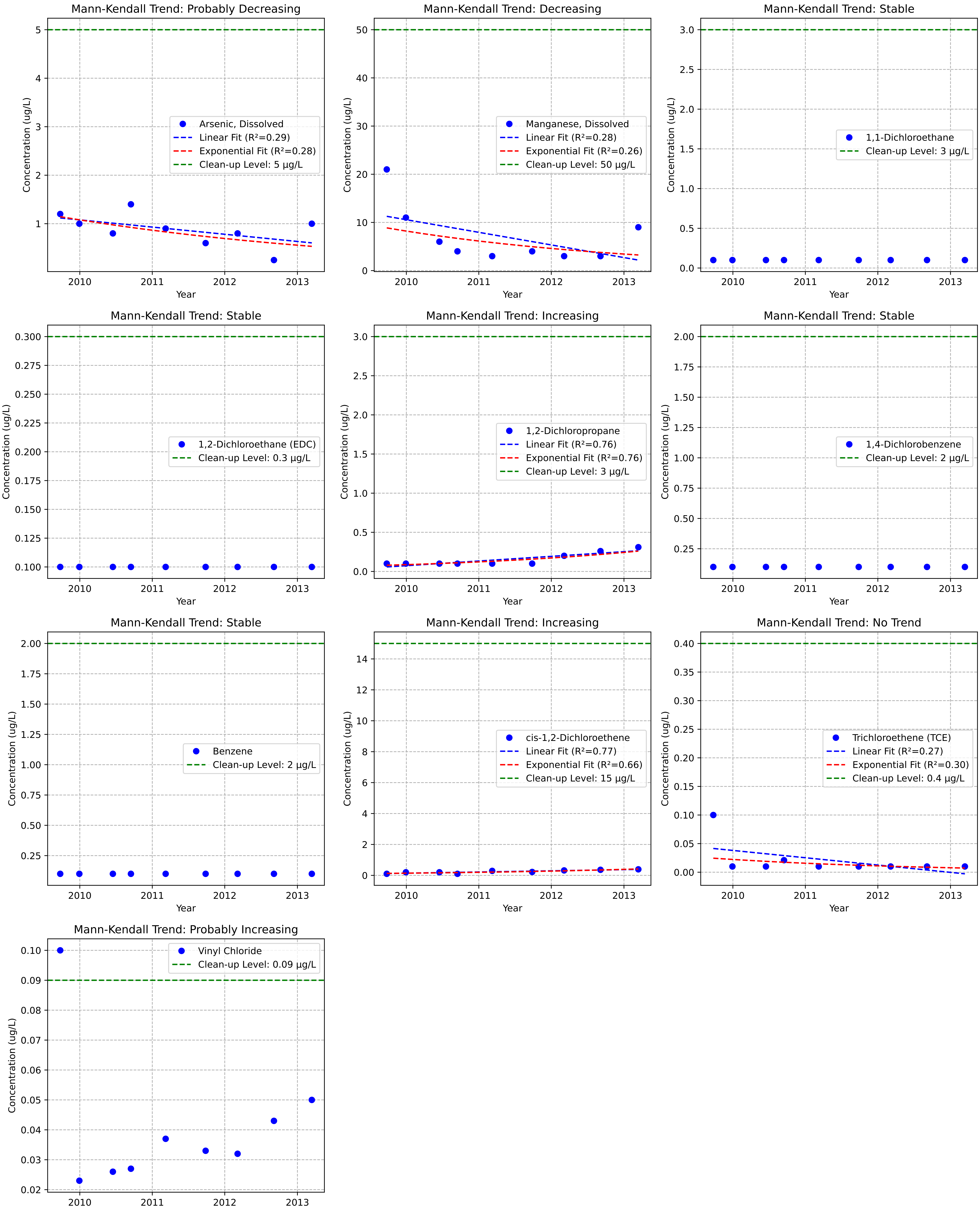


Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.32)
Exponential Fit (R²=0.37)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.06)
Exponential Fit (R²=0.24)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.82)
Exponential Fit (R²=0.60)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Exponential Fit (R²=0.30)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Exponential Fit (R²=0.30)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Exponential Fit (R²=0.30)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Exponential Fit (R²=0.30)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.83)
Exponential Fit (R²=0.81)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.88)
Exponential Fit (R²=0.84)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.40)
Exponential Fit (R²=0.38)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

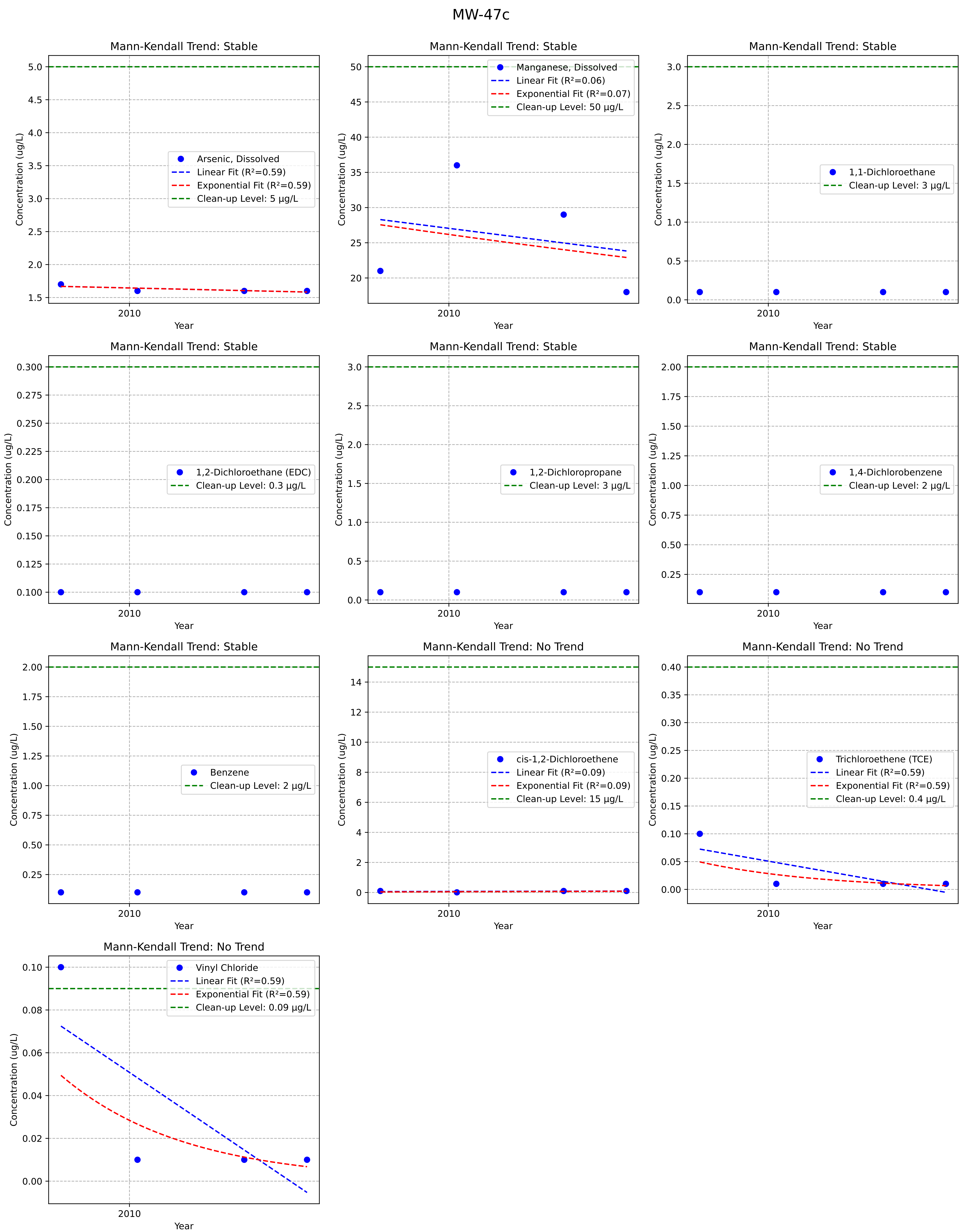
MW-2c


Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.25)
Exponential Fit (R²=0.21)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.88)
Exponential Fit (R²=0.75)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.07)
Exponential Fit (R²=0.07)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloropropane
Linear Fit (R²=0.86)
Exponential Fit (R²=0.90)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,4-Dichlorobenzene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.71)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Increasing
Benzene
Linear Fit (R²=0.39)
Exponential Fit (R²=0.47)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Increasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.91)
Exponential Fit (R²=0.95)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Increasing
Vinyl Chloride
Linear Fit (R²=0.86)
Exponential Fit (R²=0.65)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

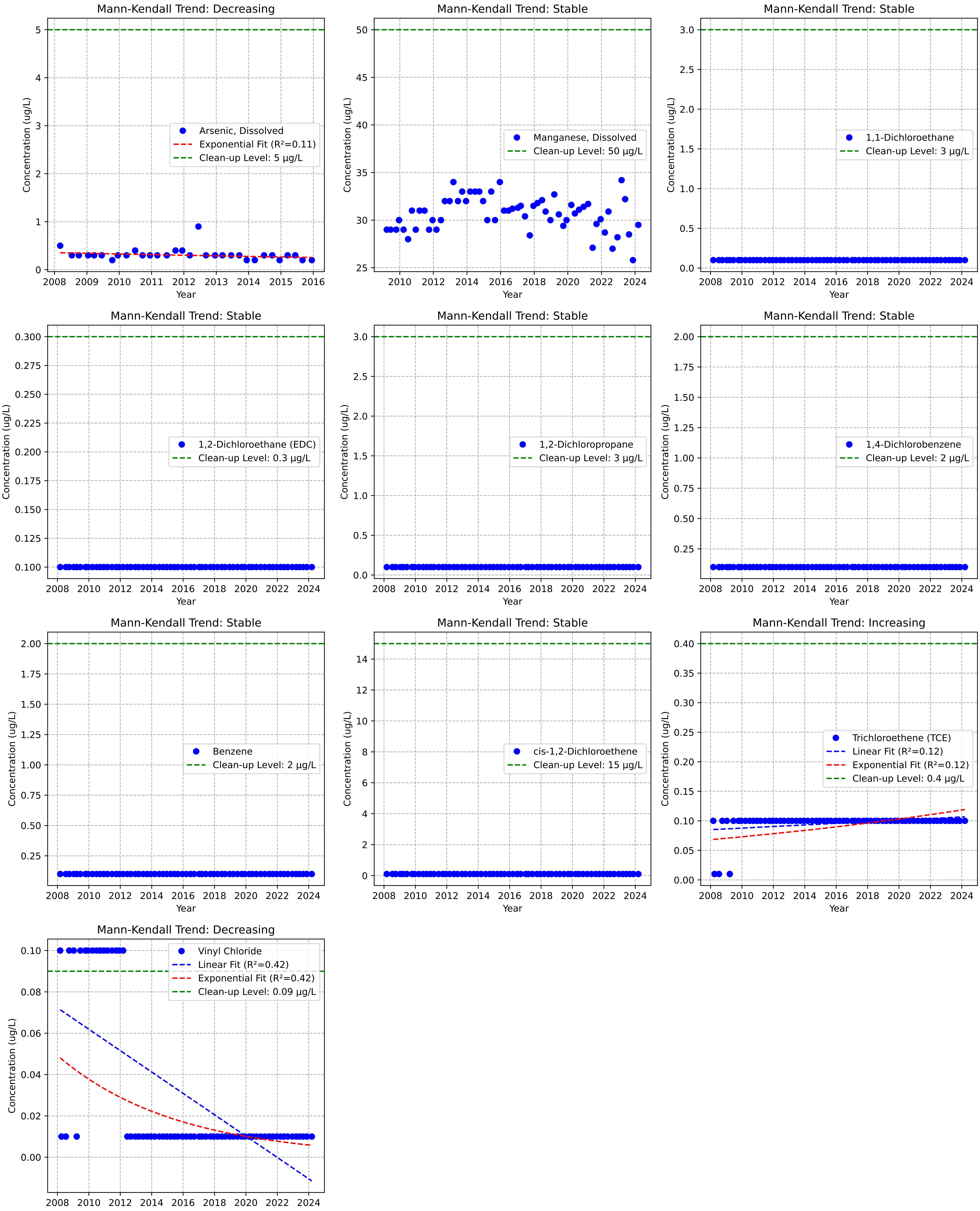
MW-45c



Mann-Kendall Trend: Probably Decreasing
Arsenic, Dissolved
Linear Fit (R²=0.29)
Exponential Fit (R²=0.28)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.28)
Exponential Fit (R²=0.26)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloropropane
Linear Fit (R²=0.76)
Exponential Fit (R²=0.76)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Increasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.66)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.27)
Exponential Fit (R²=0.30)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Probably Increasing
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

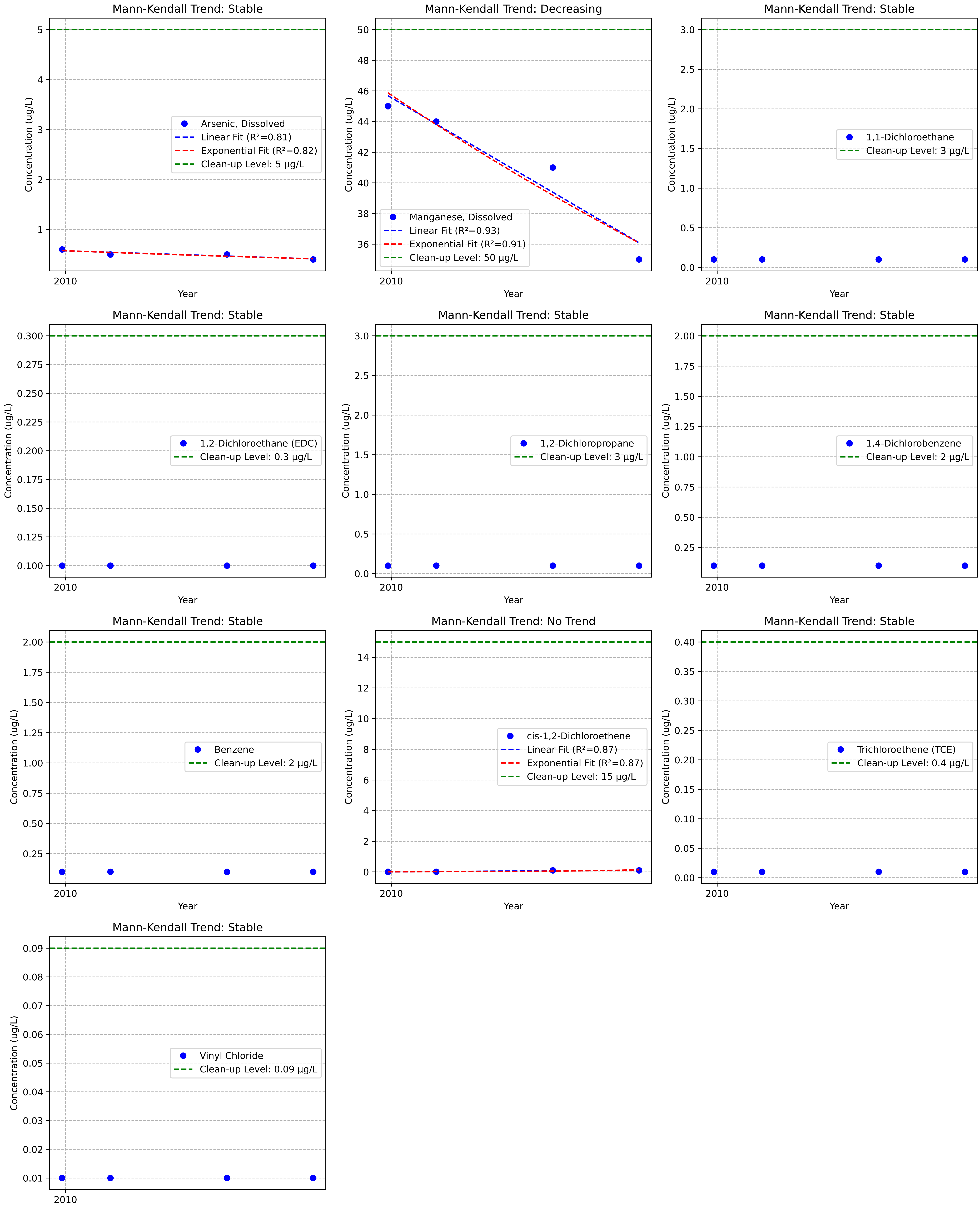

MW-47c
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Linear Fit (R²=0.06)
Exponential Fit (R²=0.07)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: No Trend
Trichloroethene (TCE)
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

MW-4c



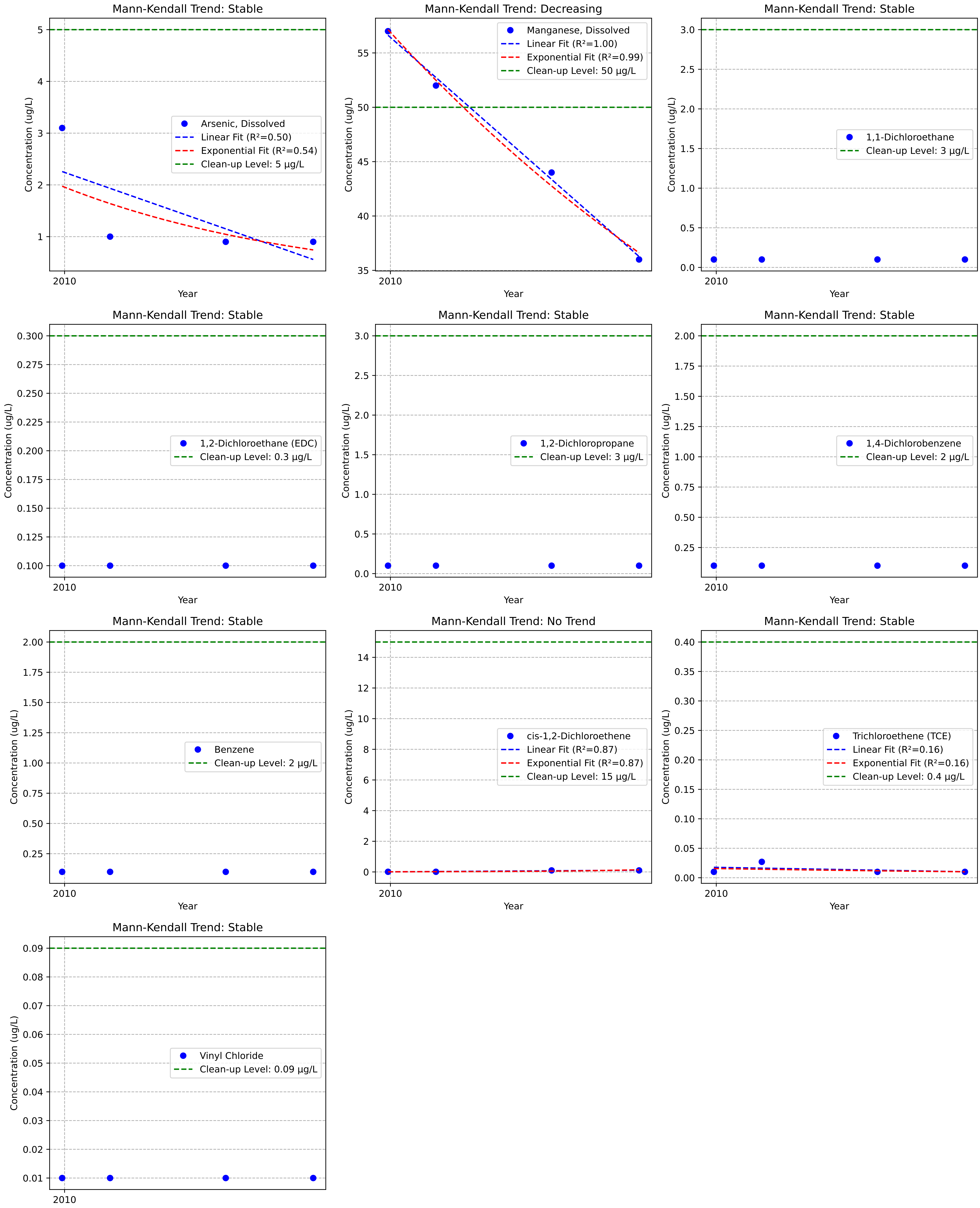
Mann-Kendall Trend: Decreasing
Arsenic, Dissolved
Exponential Fit (R²=0.11)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.42)
Exponential Fit (R²=0.42)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

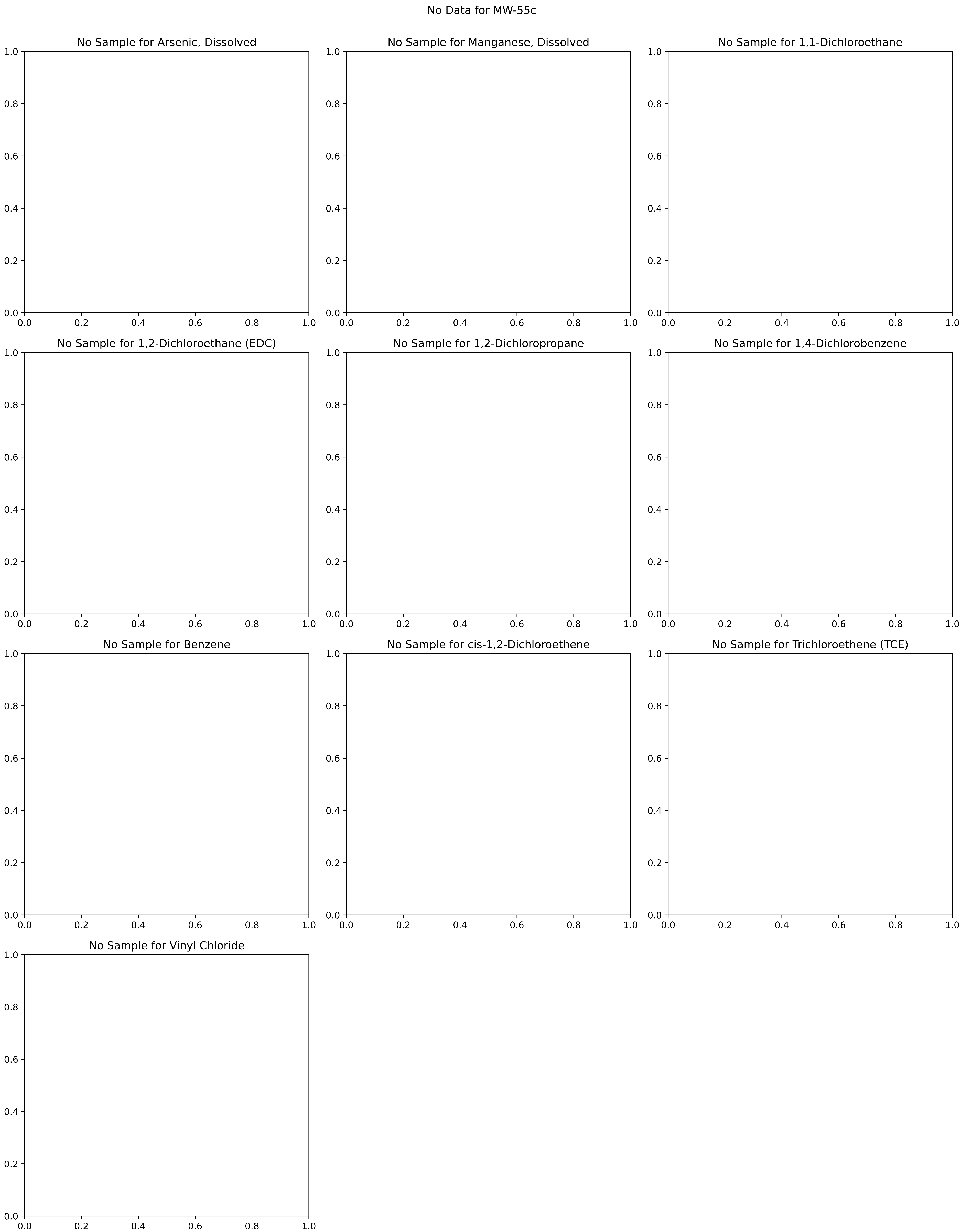
MW-50c



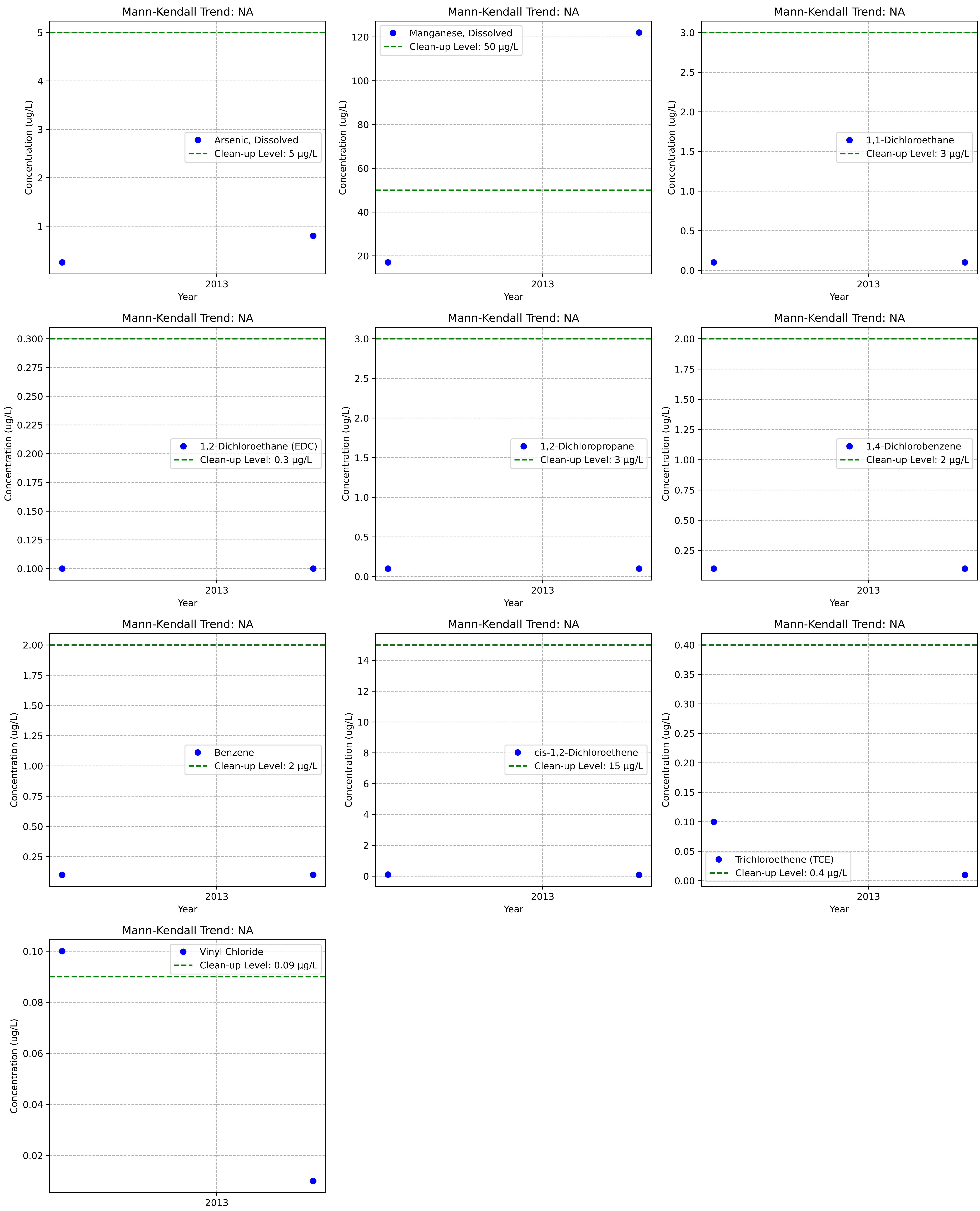
Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.81)
Exponential Fit (R²=0.82)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.93)
Exponential Fit (R²=0.91)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.87)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

MW-54c


Mann-Kendall Trend: Stable
Arsenic, Dissolved
Linear Fit (R²=0.50)
Exponential Fit (R²=0.54)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=1.00)
Exponential Fit (R²=0.99)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Stable
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Stable
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.87)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Stable
Trichloroethene (TCE)
Linear Fit (R²=0.16)
Exponential Fit (R²=0.16)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Stable
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year
2010

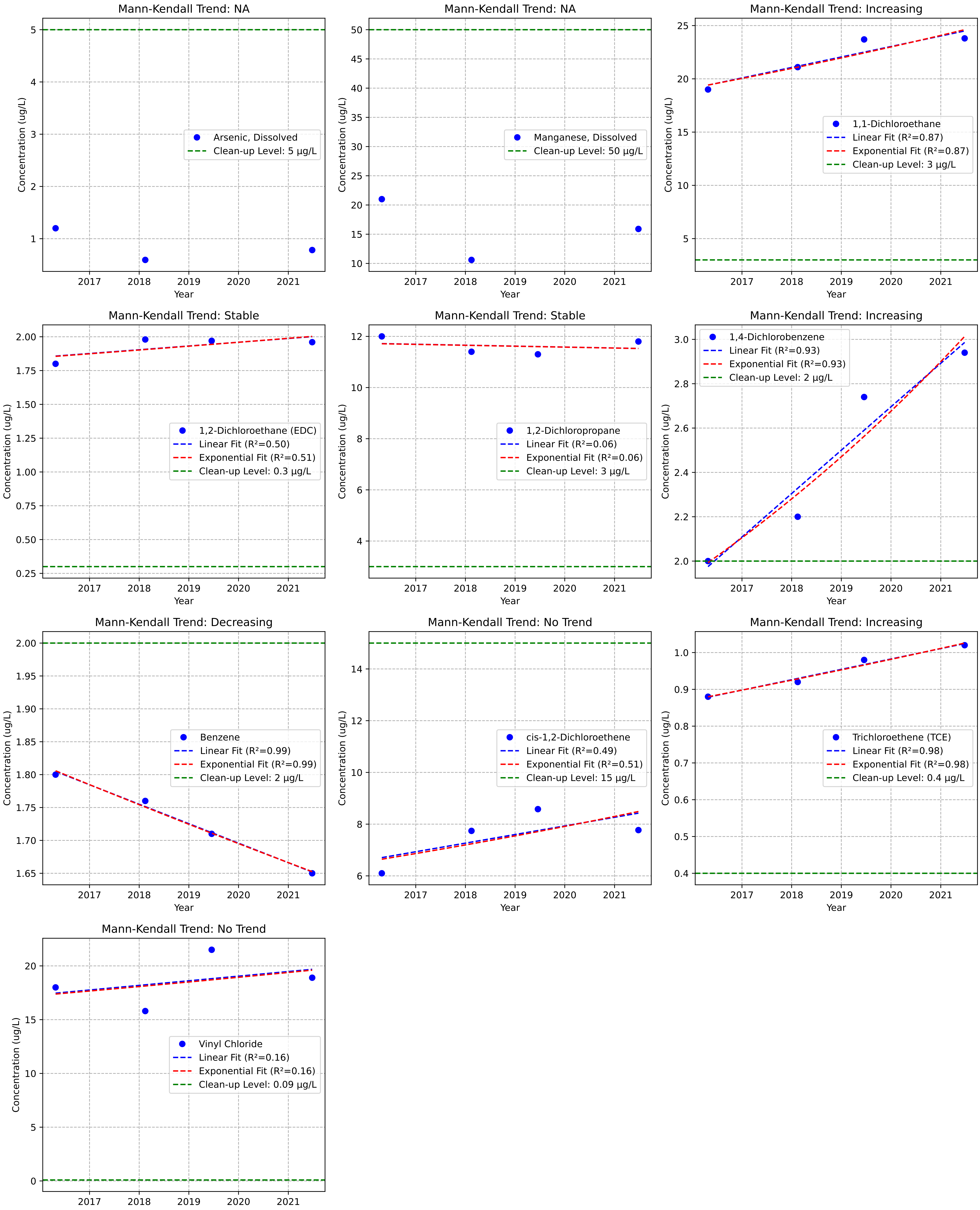

No Data for MW-55c
No Sample for Arsenic, Dissolved
No Sample for Manganese, Dissolved
No Sample for 1,1-Dichloroethane
No Sample for 1,2-Dichloroethane (EDC)
No Sample for 1,2-Dichloropropane
No Sample for 1,4-Dichlorobenzene
No Sample for Benzene
No Sample for cis-1,2-Dichloroethene
No Sample for Trichloroethene (TCE)
No Sample for Vinyl Chloride

MW-56c

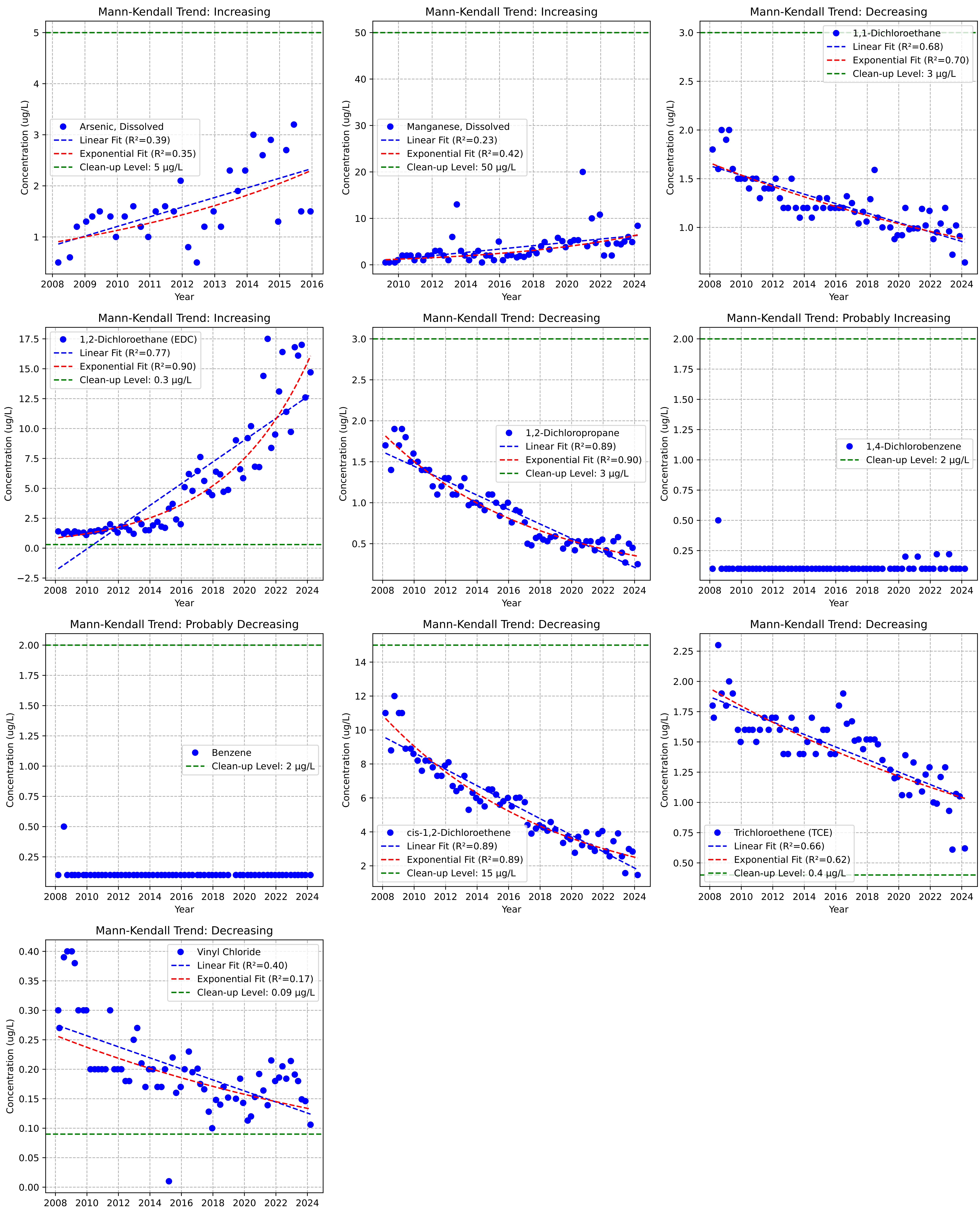


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
2013
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L

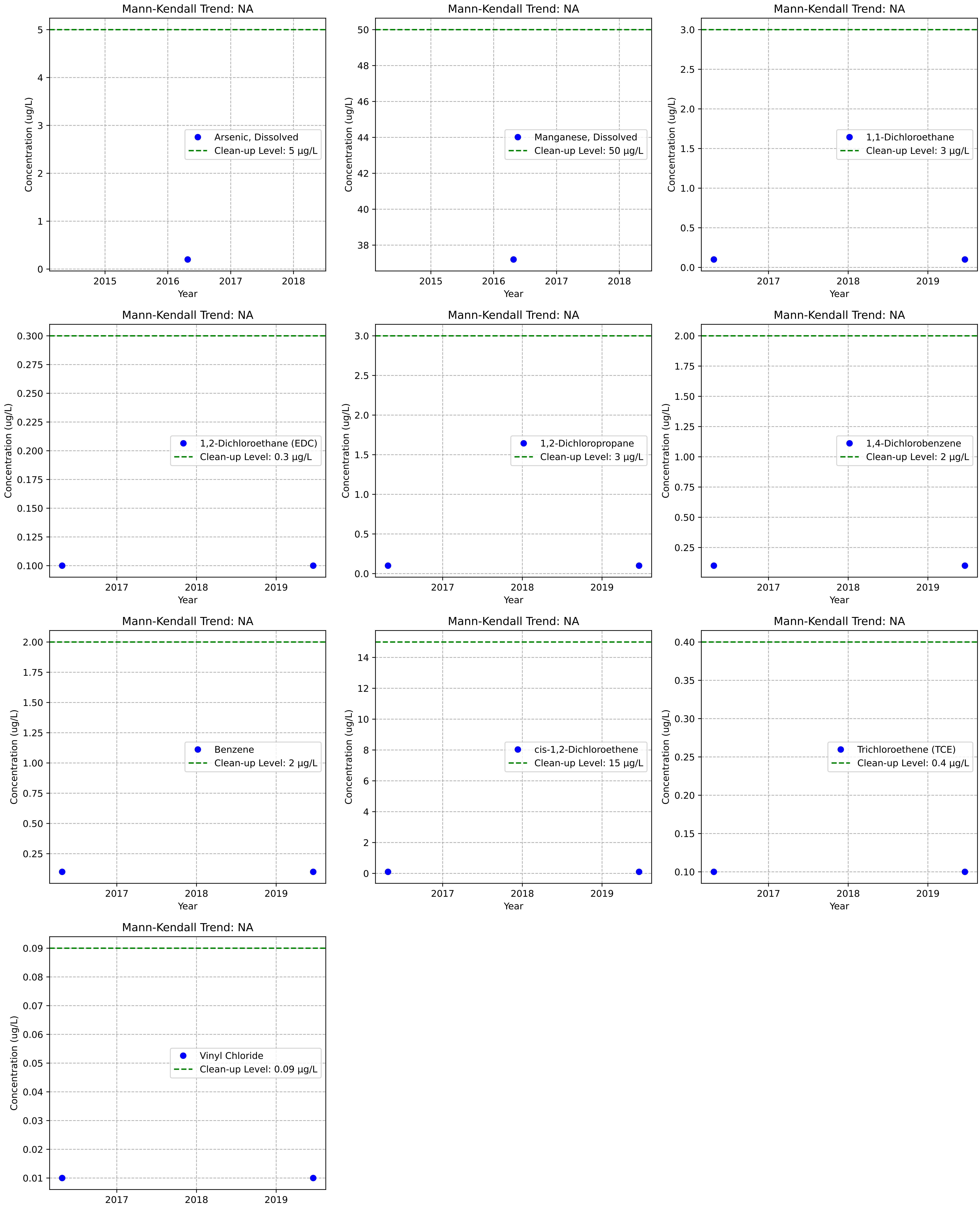
MW-58c


Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Increasing
1,1-Dichloroethane
Linear Fit (R²=0.87)
Exponential Fit (R²=0.87)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.50)
Exponential Fit (R²=0.51)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Stable
1,2-Dichloropropane
Linear Fit (R²=0.06)
Exponential Fit (R²=0.06)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,4-Dichlorobenzene
Linear Fit (R²=0.93)
Exponential Fit (R²=0.93)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
Benzene
Linear Fit (R²=0.99)
Exponential Fit (R²=0.99)
Clean-up Level: 2 µg/L
Mann-Kendall Trend: No Trend
cis-1,2-Dichloroethene
Linear Fit (R²=0.49)
Exponential Fit (R²=0.51)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Increasing
Trichloroethene (TCE)
Linear Fit (R²=0.98)
Exponential Fit (R²=0.98)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: No Trend
Vinyl Chloride
Linear Fit (R²=0.16)
Exponential Fit (R²=0.16)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-5c

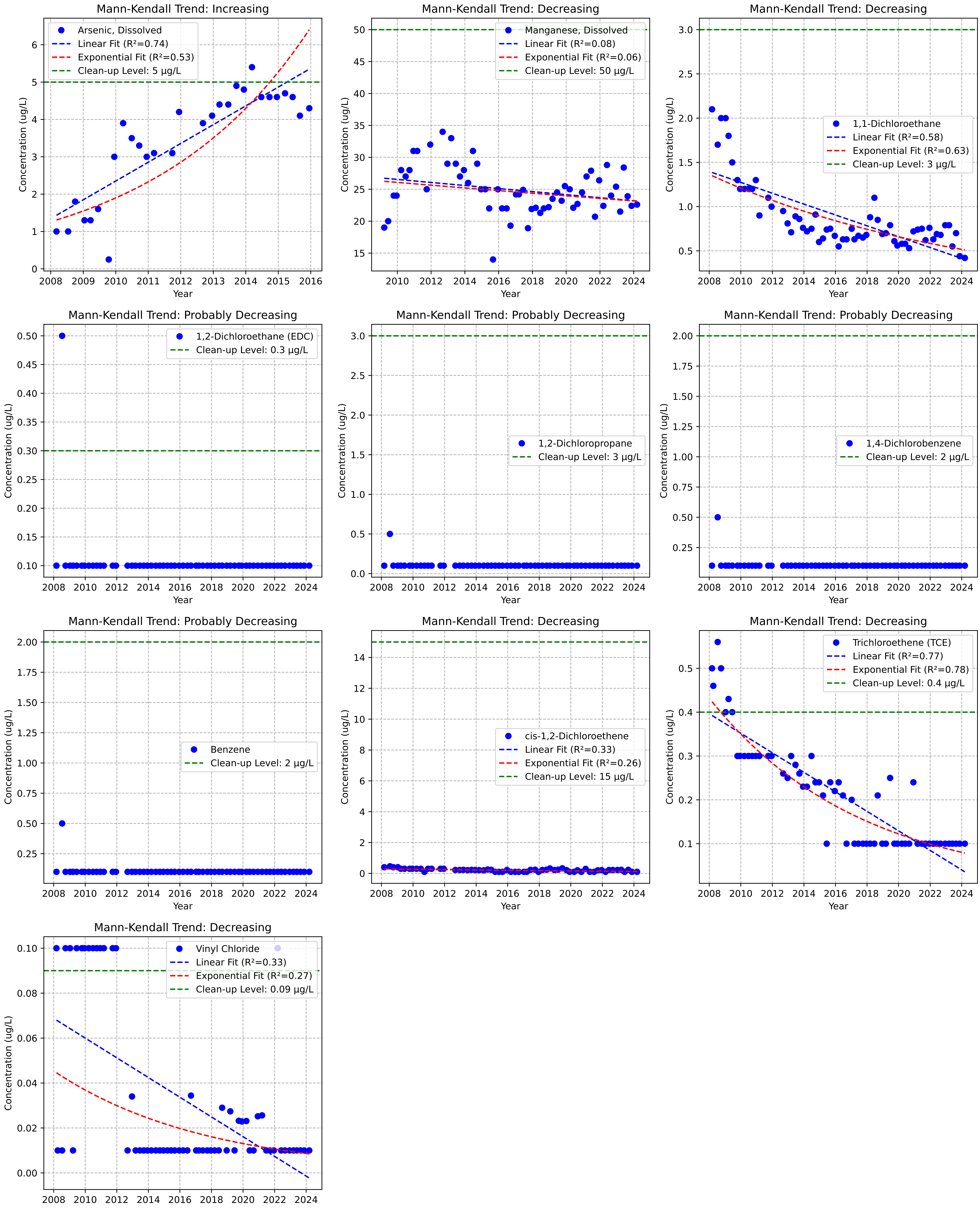

Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.39)
Exponential Fit (R²=0.35)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Manganese, Dissolved
Linear Fit (R²=0.23)
Exponential Fit (R²=0.42)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.68)
Exponential Fit (R²=0.70)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Increasing
1,2-Dichloroethane (EDC)
Linear Fit (R²=0.77)
Exponential Fit (R²=0.90)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Decreasing
1,2-Dichloropropane
Linear Fit (R²=0.89)
Exponential Fit (R²=0.90)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Increasing
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.89)
Exponential Fit (R²=0.89)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.66)
Exponential Fit (R²=0.62)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.40)
Exponential Fit (R²=0.17)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-62c



Mann-Kendall Trend: NA
Arsenic, Dissolved
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Manganese, Dissolved
Clean-up Level: 50 µg/L
Mann-Kendall Trend: NA
1,1-Dichloroethane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: NA
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: NA
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: NA
cis-1,2-Dichloroethene
Clean-up Level: 15 µg/L
Mann-Kendall Trend: NA
Trichloroethene (TCE)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: NA
Vinyl Chloride
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

MW-6c

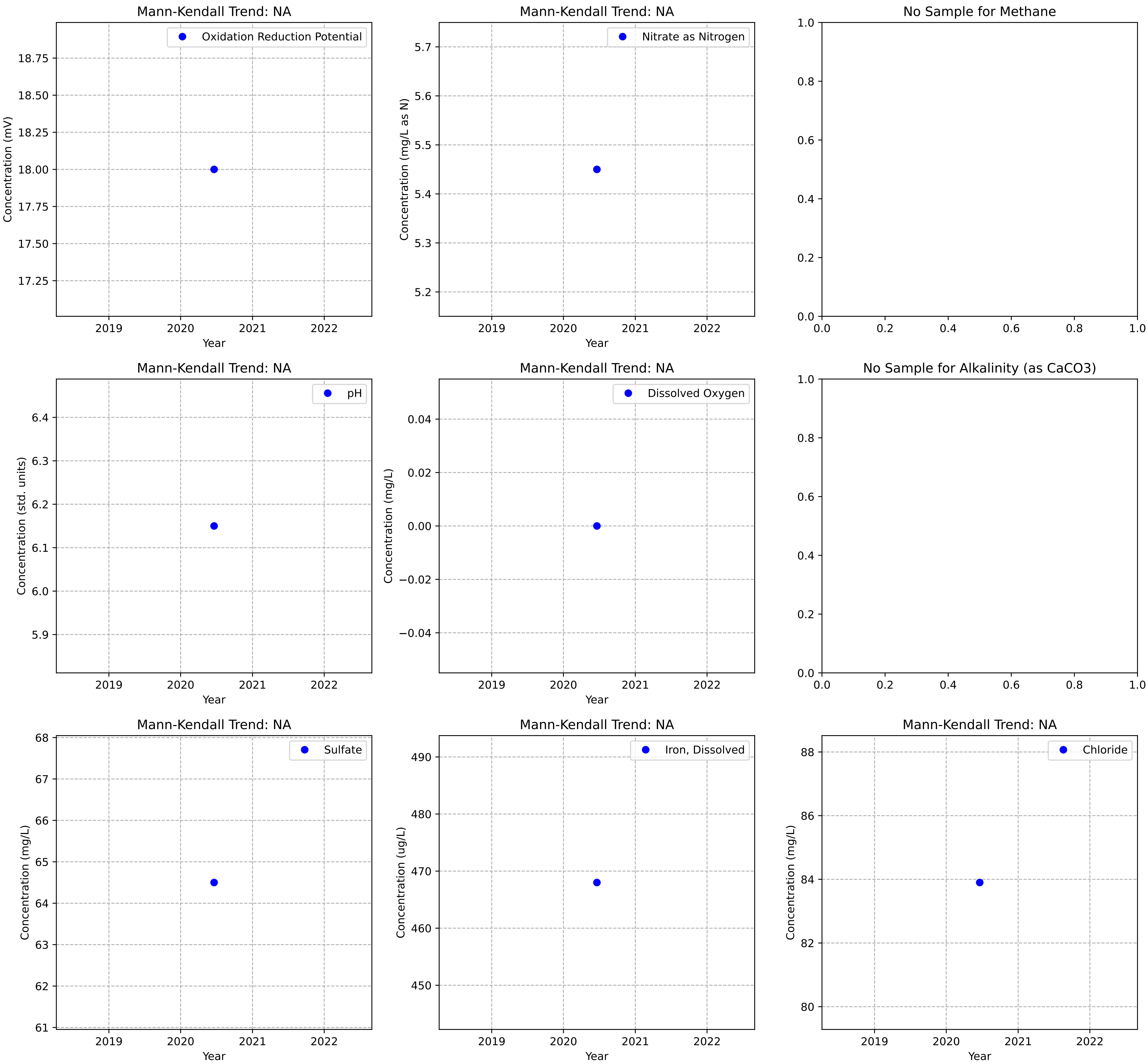

Mann-Kendall Trend: Increasing
Arsenic, Dissolved
Linear Fit (R²=0.74)
Exponential Fit (R²=0.53)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Dissolved
Linear Fit (R²=0.08)
Exponential Fit (R²=0.06)
Clean-up Level: 50 µg/L
Mann-Kendall Trend: Decreasing
1,1-Dichloroethane
Linear Fit (R²=0.58)
Exponential Fit (R²=0.63)
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloroethane (EDC)
Clean-up Level: 0.3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,2-Dichloropropane
Clean-up Level: 3 µg/L
Mann-Kendall Trend: Probably Decreasing
1,4-Dichlorobenzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Probably Decreasing
Benzene
Clean-up Level: 2 µg/L
Mann-Kendall Trend: Decreasing
cis-1,2-Dichloroethene
Linear Fit (R²=0.33)
Exponential Fit (R²=0.26)
Clean-up Level: 15 µg/L
Mann-Kendall Trend: Decreasing
Trichloroethene (TCE)
Linear Fit (R²=0.77)
Exponential Fit (R²=0.78)
Clean-up Level: 0.4 µg/L
Mann-Kendall Trend: Decreasing
Vinyl Chloride
Linear Fit (R²=0.33)
Exponential Fit (R²=0.27)
Clean-up Level: 0.09 µg/L
Concentration (ug/L)
Year

APPENDIX C

Concentration time series plots of geochemical indicators, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

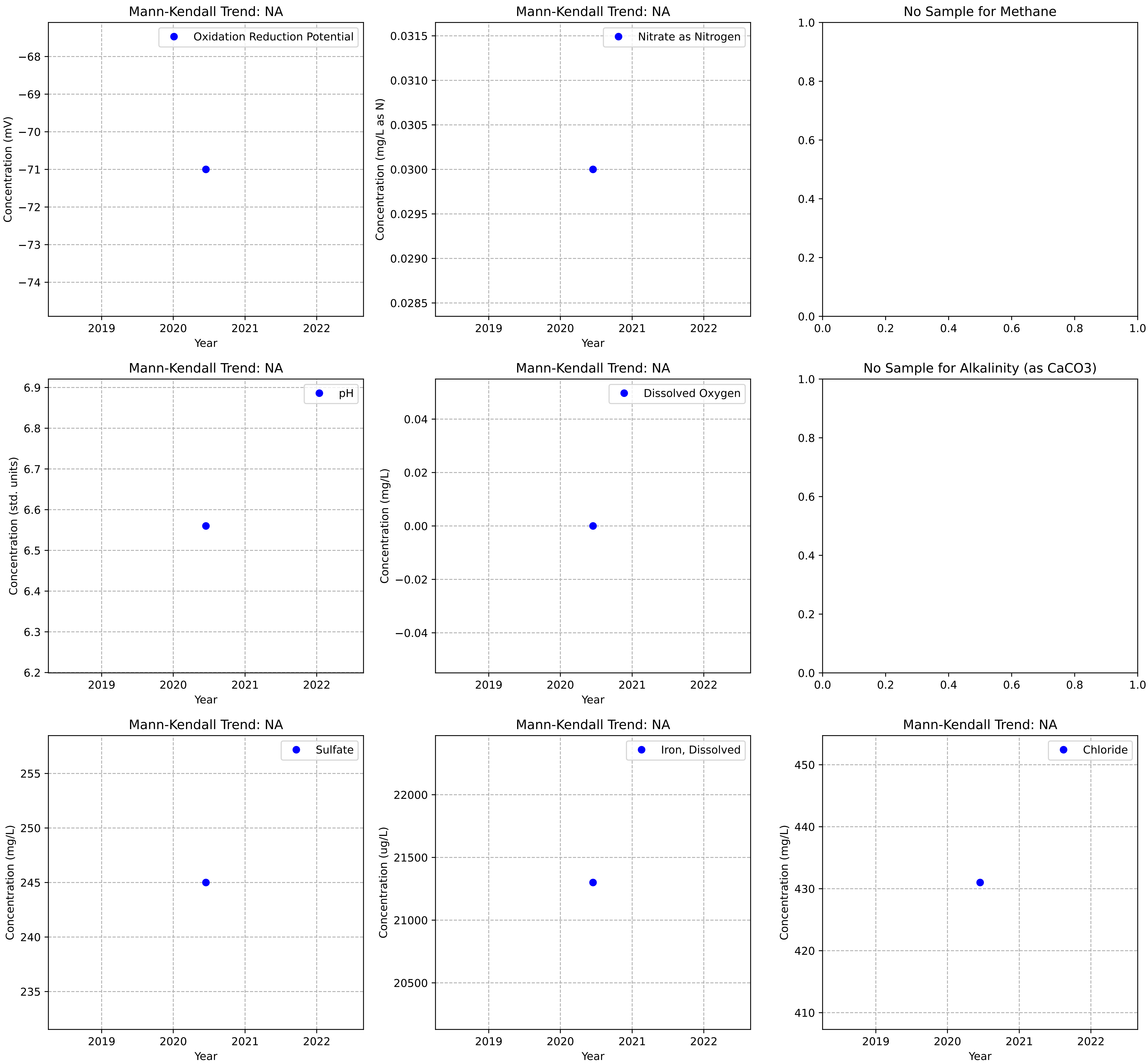
C1. Concentration time series plots of geochemical indicators for P1 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

MW-100p1

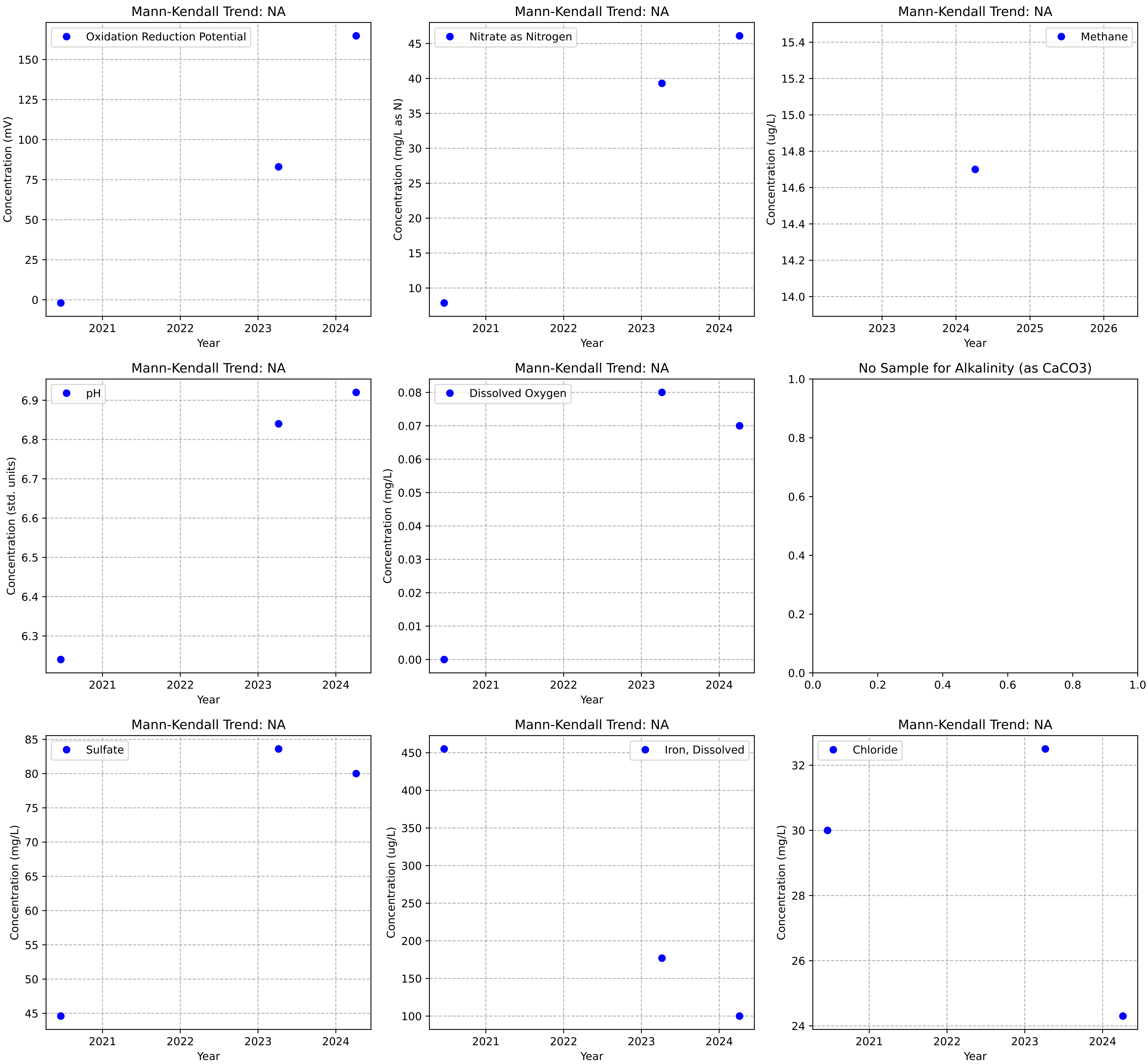


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

MW-104p1

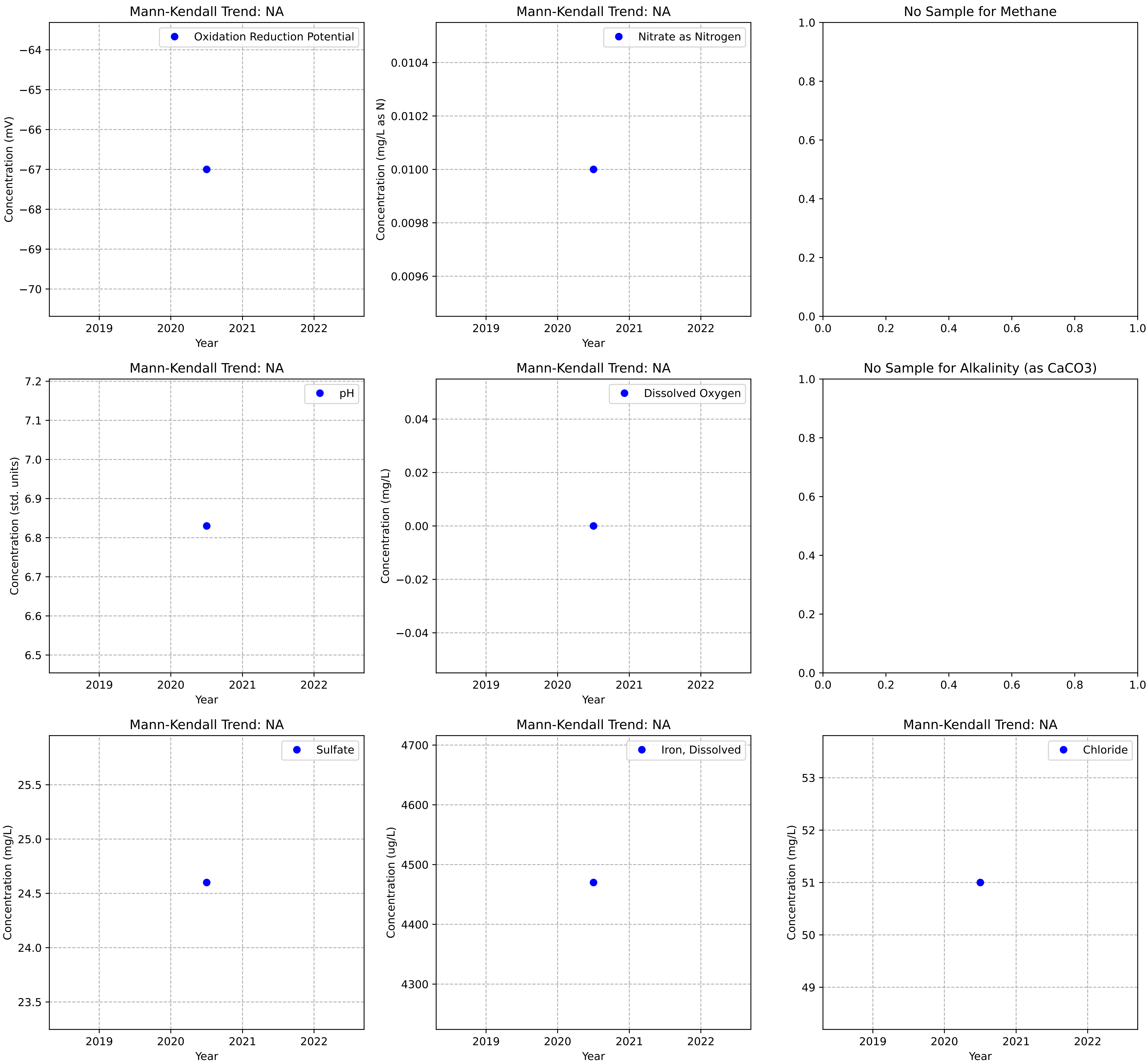

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

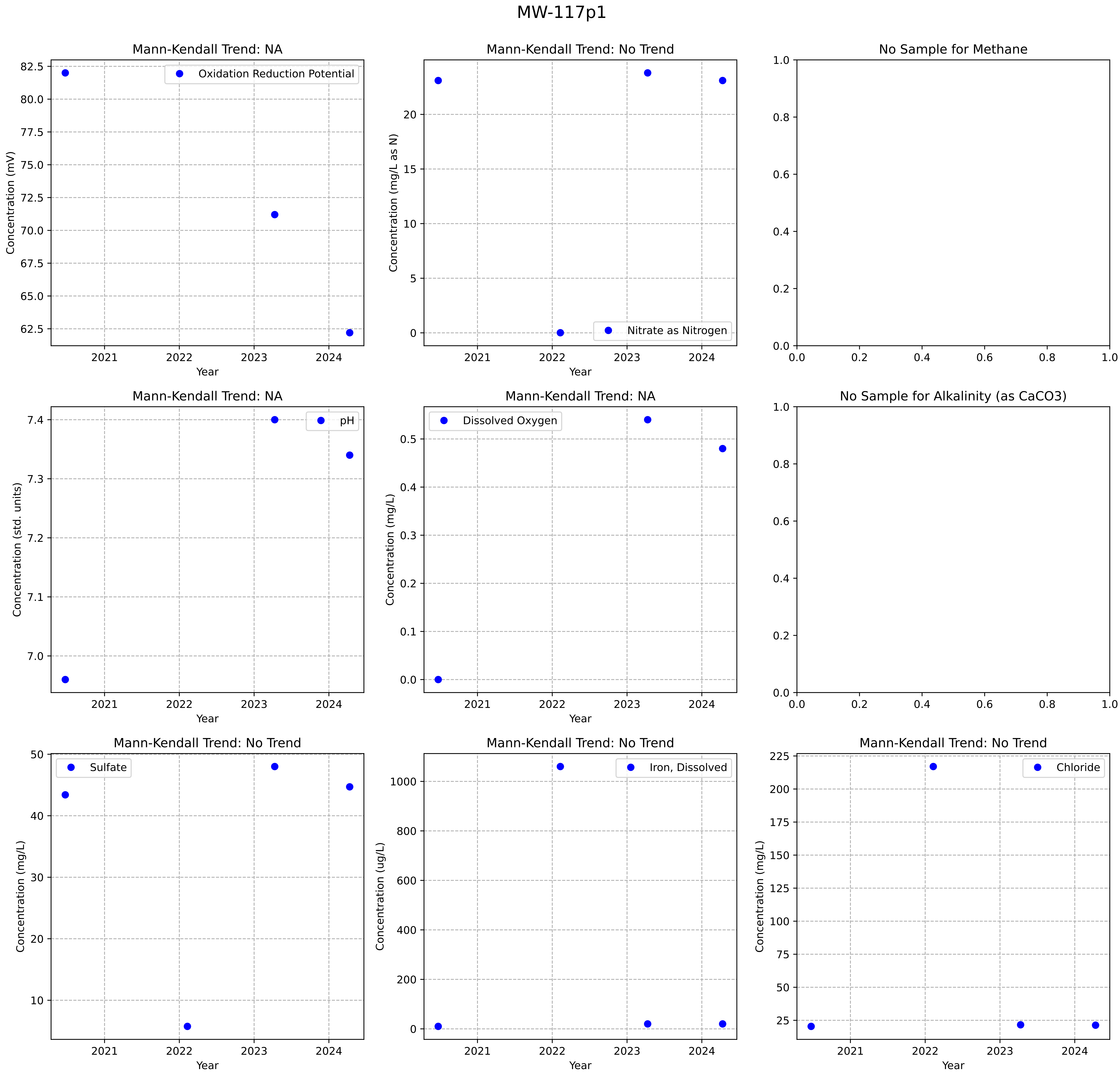
MW-109p1

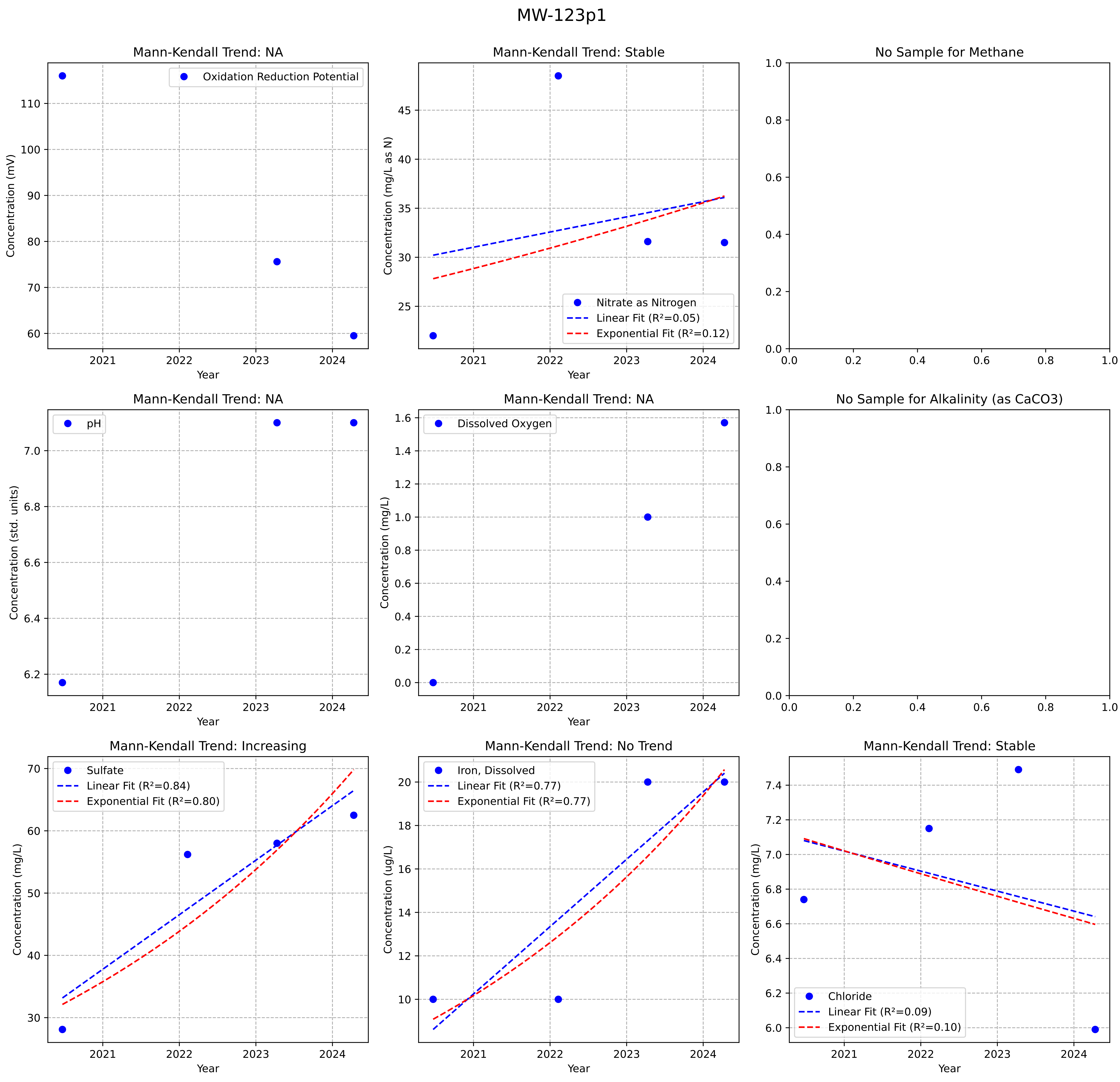


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

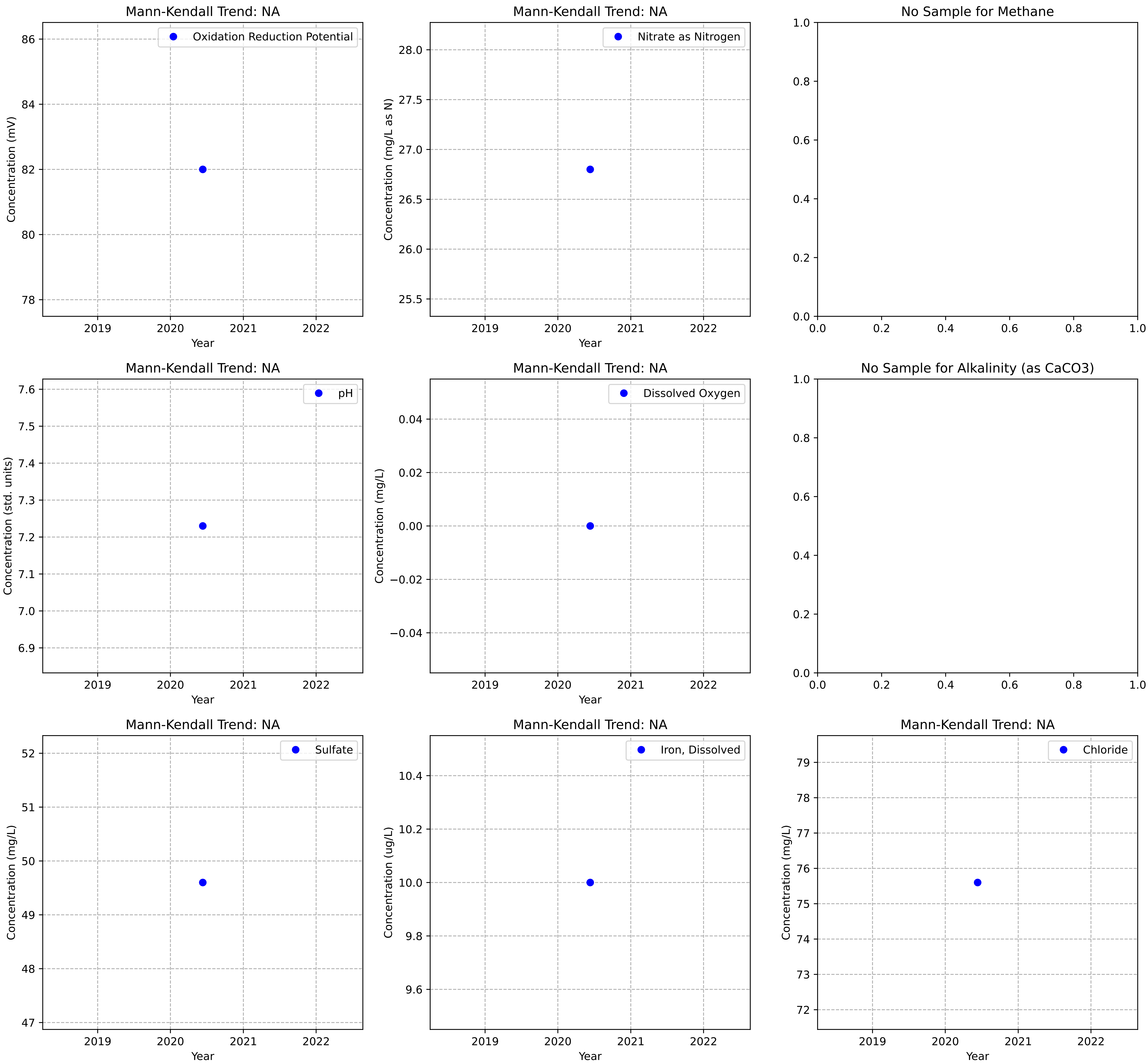
MW-110p1

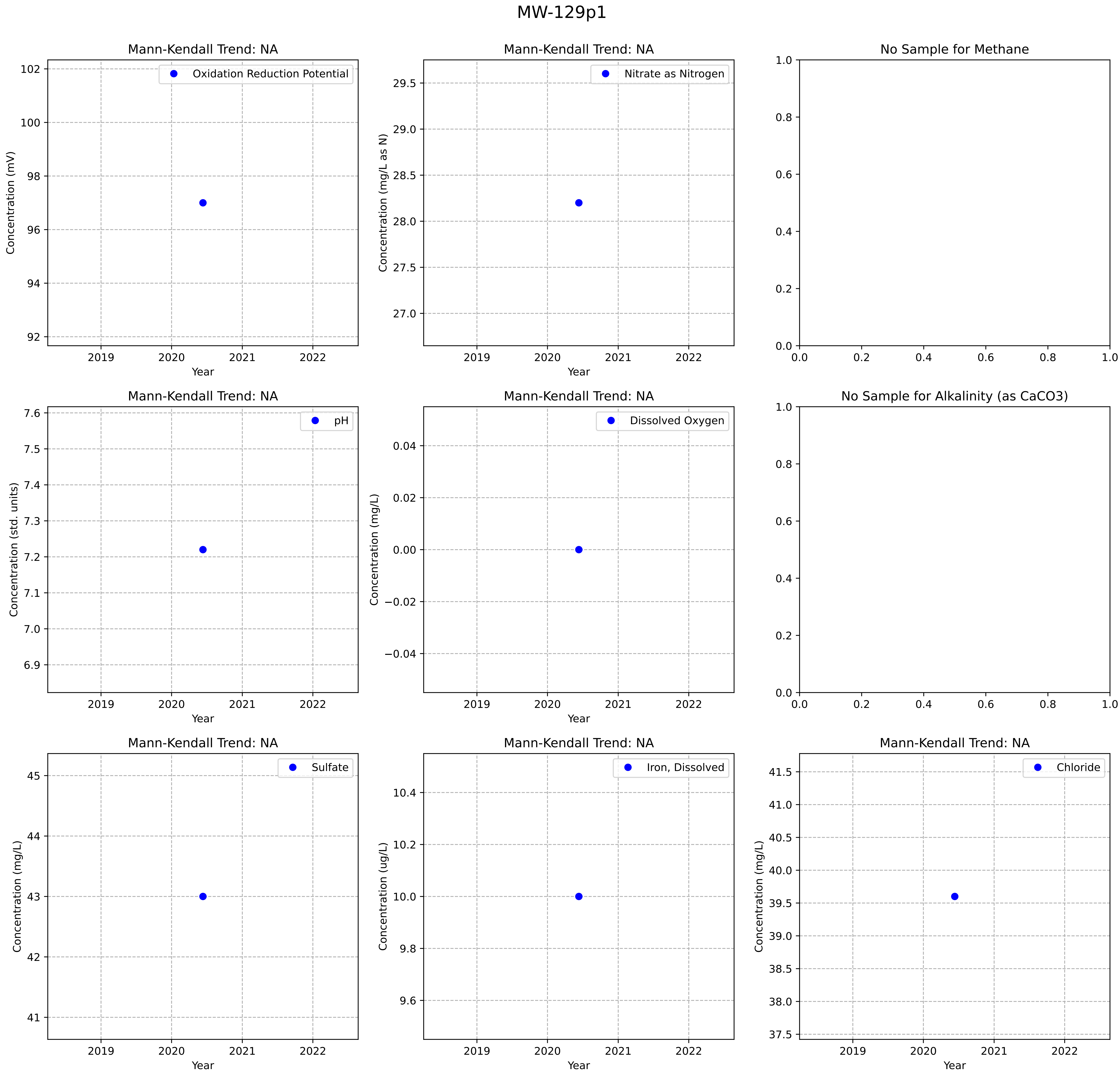

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
−64
−65
−66
−67
−68
−69
−70
Year
2019
2020
2021
2022
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
0.0104
0.0102
0.0100
0.0098
0.0096
No Sample for Methane
1.0
0.8
0.6
0.4
0.2
0.0
Mann-Kendall Trend: NA
pH
Concentration (std. units)
7.2
7.1
7.0
6.9
6.8
6.7
6.6
6.5
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
0.04
0.02
0.00
−0.02
−0.04
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
25.5
25.0
24.5
24.0
23.5
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
4700
4600
4500
4400
4300
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
53
52
51
50
49


MW-117p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Concentration (ug/L)
Mann-Kendall Trend: No Trend
Chloride
Concentration (mg/L)

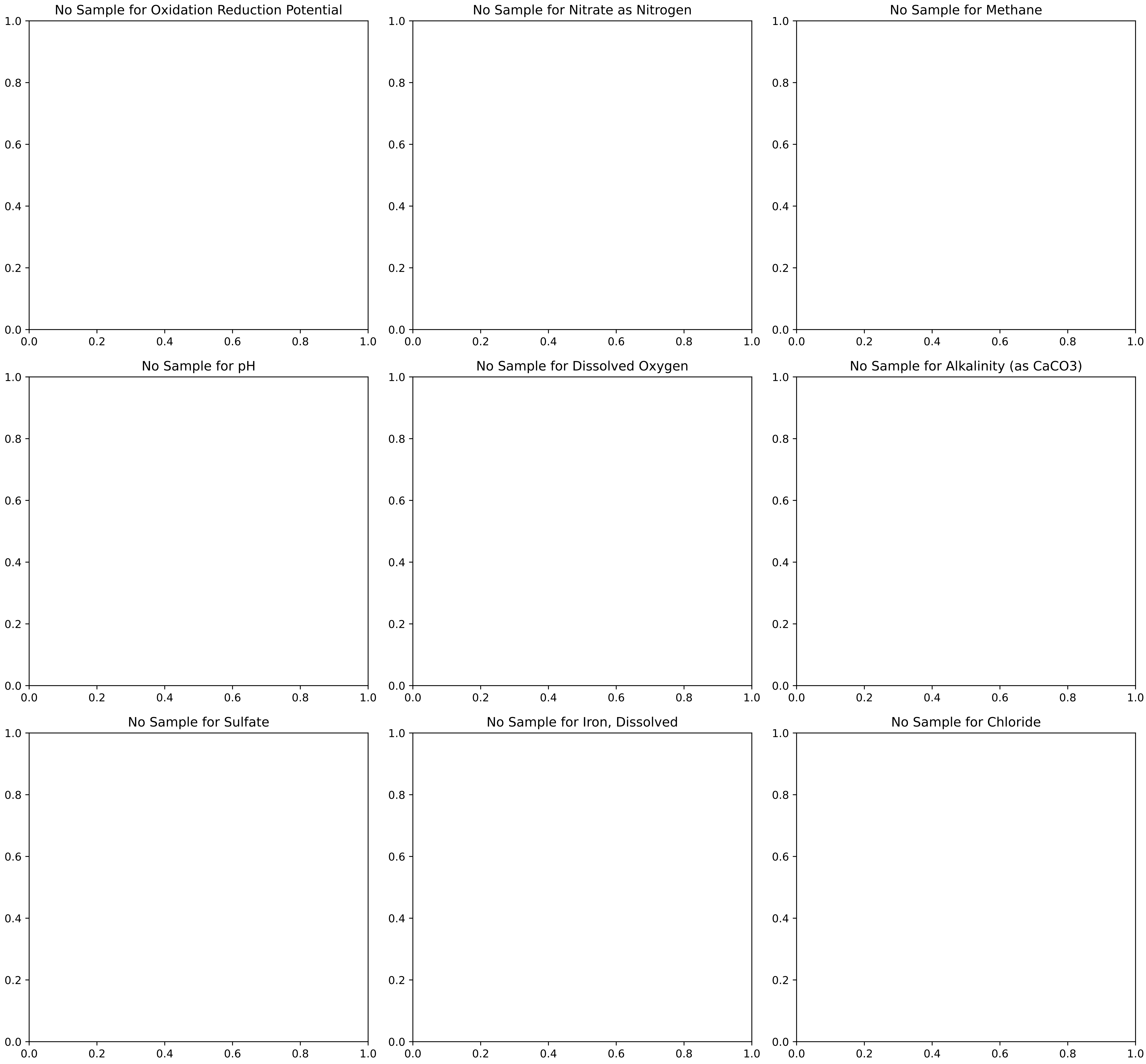

MW-123p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.05)
Exponential Fit (R²=0.12)
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.84)
Exponential Fit (R²=0.80)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Concentration (ug/L)
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.09)
Exponential Fit (R²=0.10)
Concentration (mg/L)

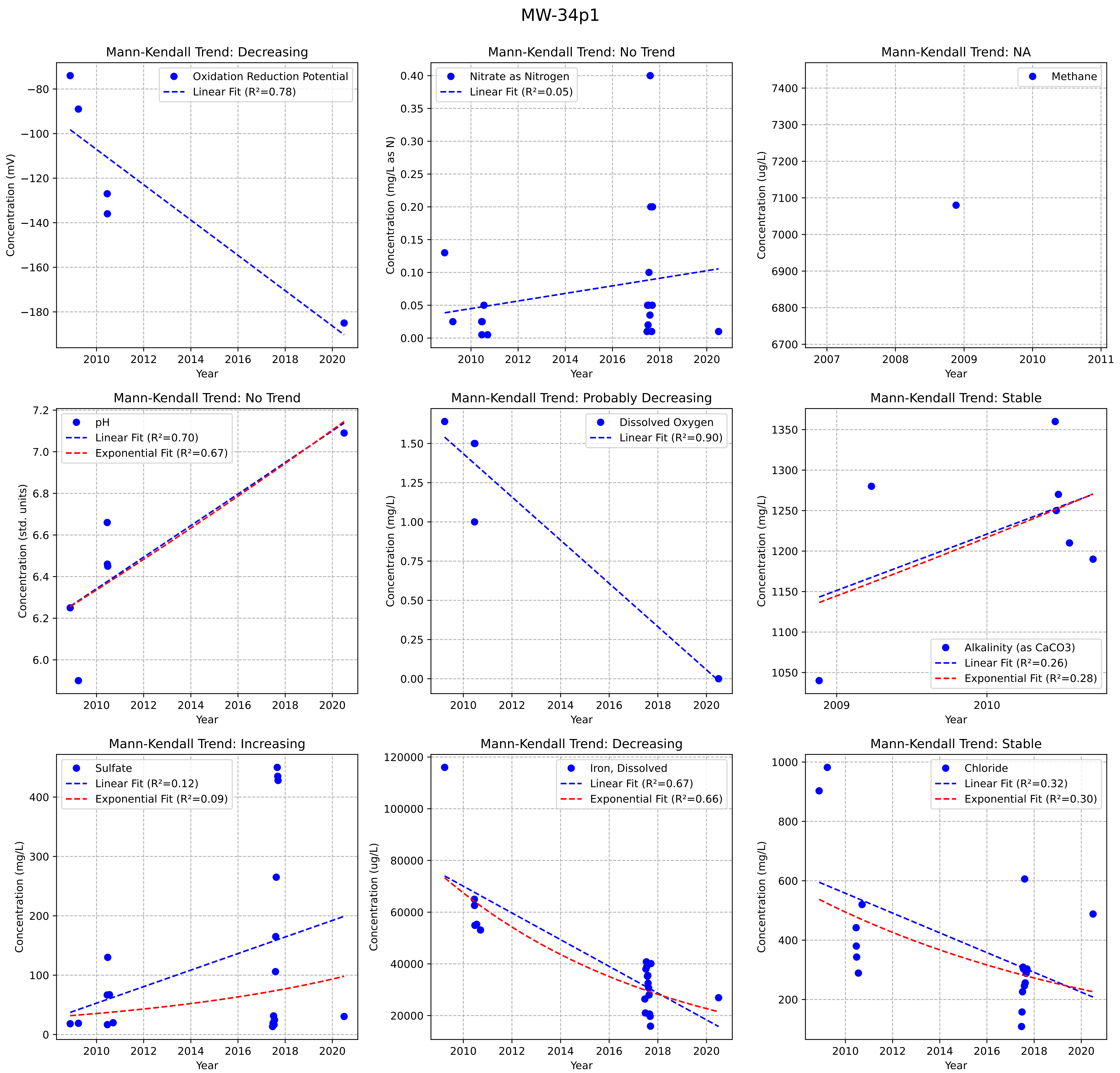
MW-127p1


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

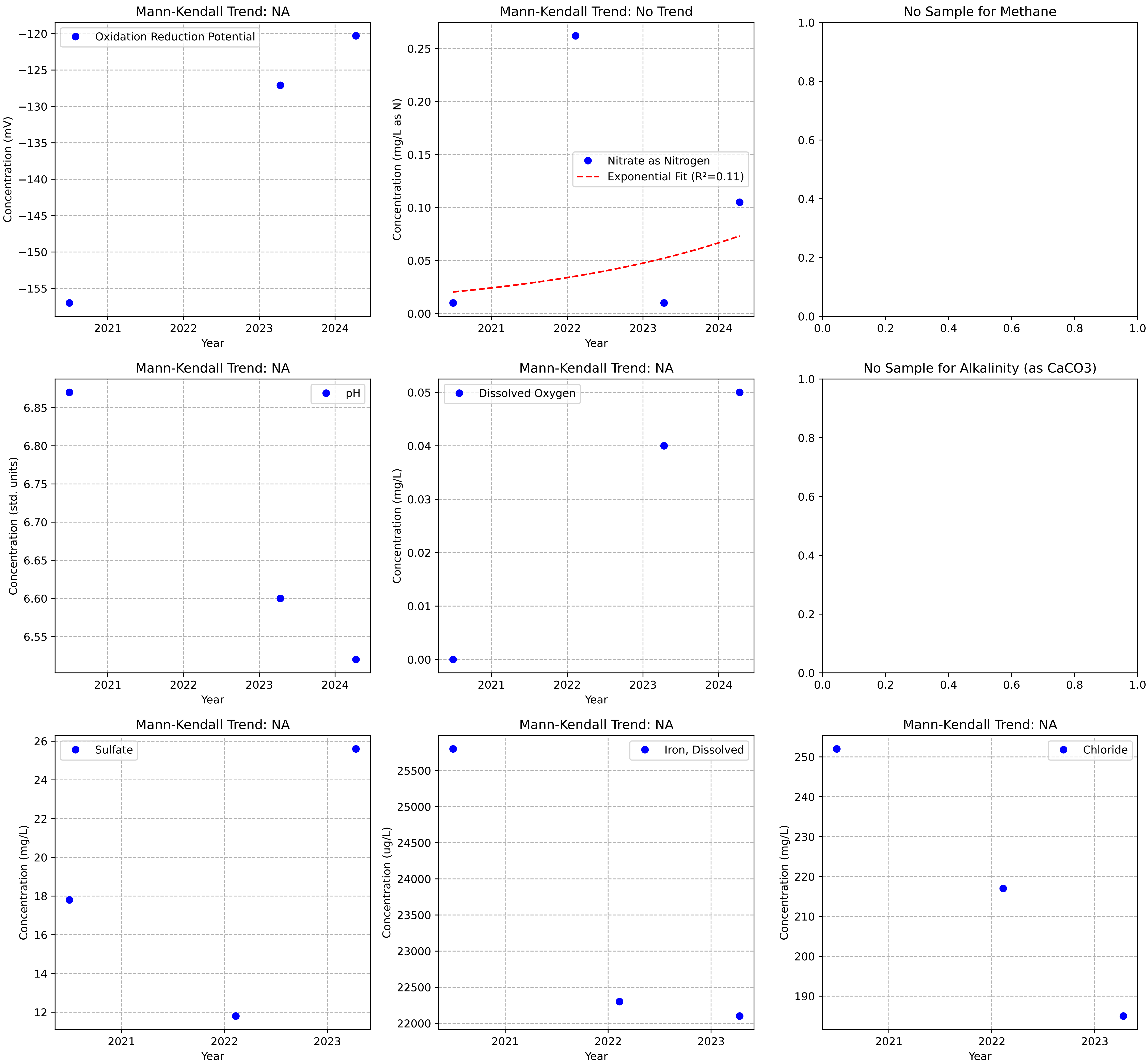

MW-129p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

No Data for MW-137p1

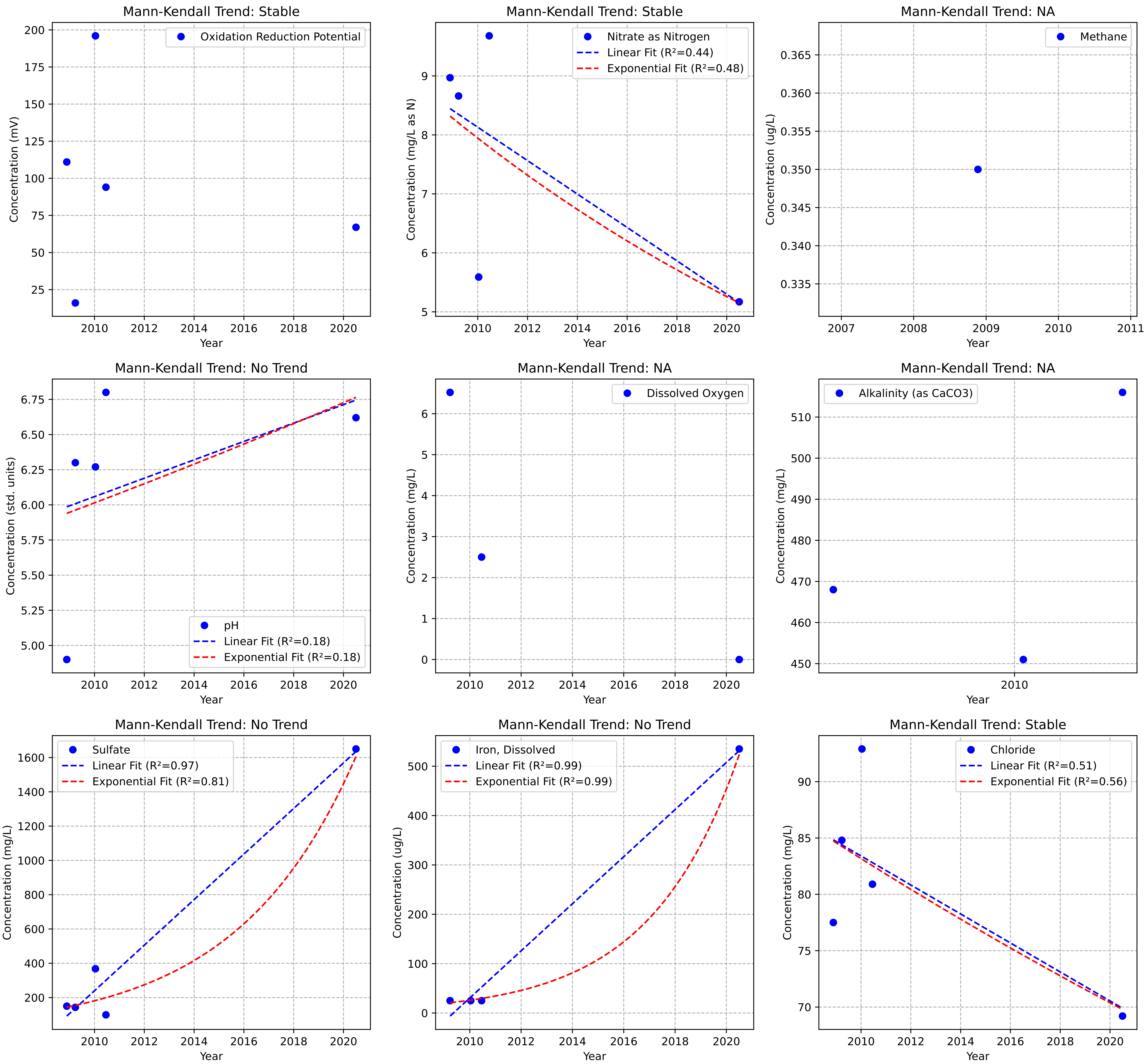



MW-34p1
Mann-Kendall Trend: Decreasing
Oxidation Reduction Potential
Linear Fit (R²=0.78)
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.05)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.70)
Exponential Fit (R²=0.67)
Concentration (std. units)
Year
Mann-Kendall Trend: Probably Decreasing
Dissolved Oxygen
Linear Fit (R²=0.90)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.26)
Exponential Fit (R²=0.28)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.12)
Exponential Fit (R²=0.09)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Iron, Dissolved
Linear Fit (R²=0.67)
Exponential Fit (R²=0.66)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.32)
Exponential Fit (R²=0.30)
Concentration (mg/L)
Year

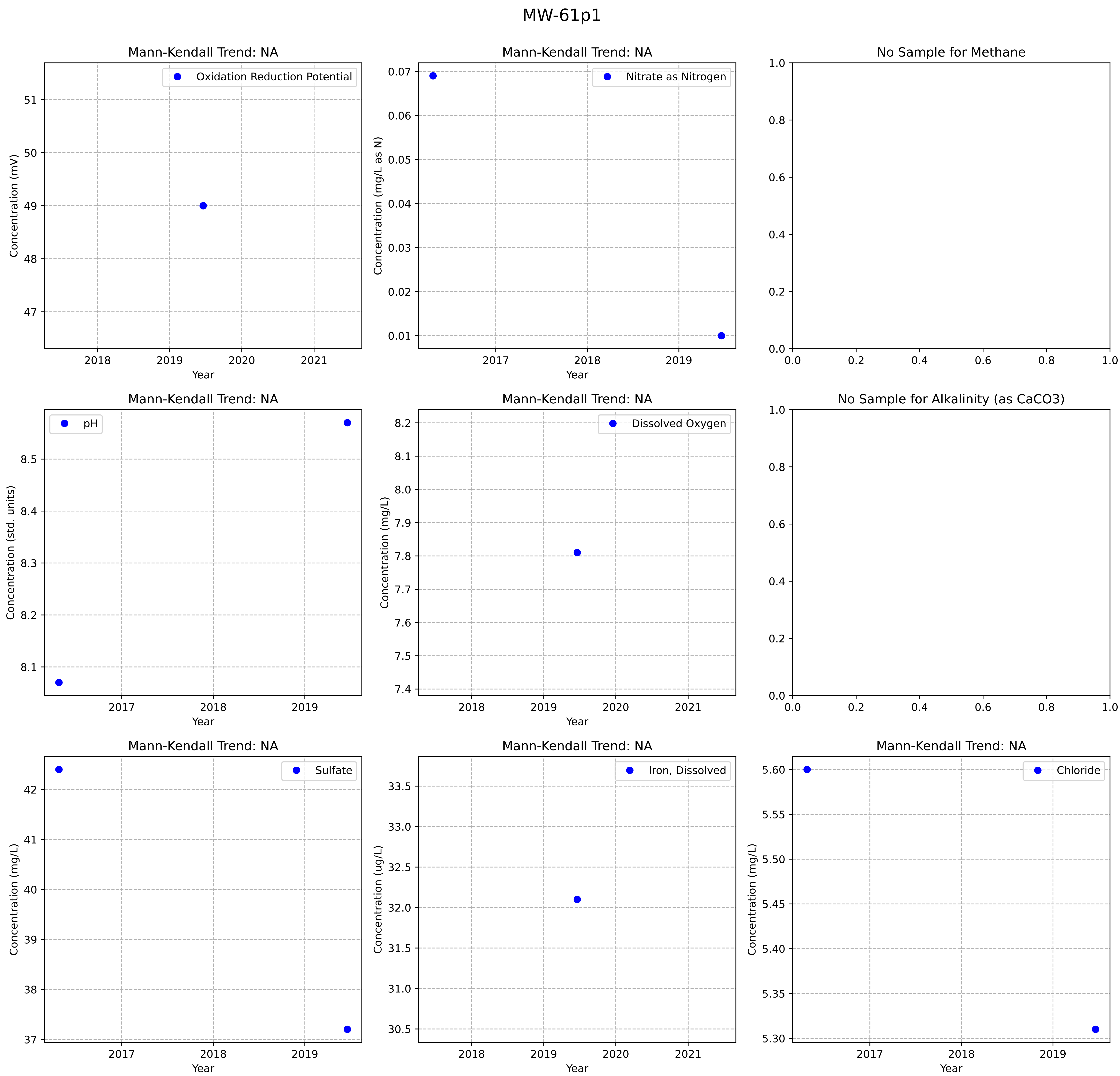
MW-36p1

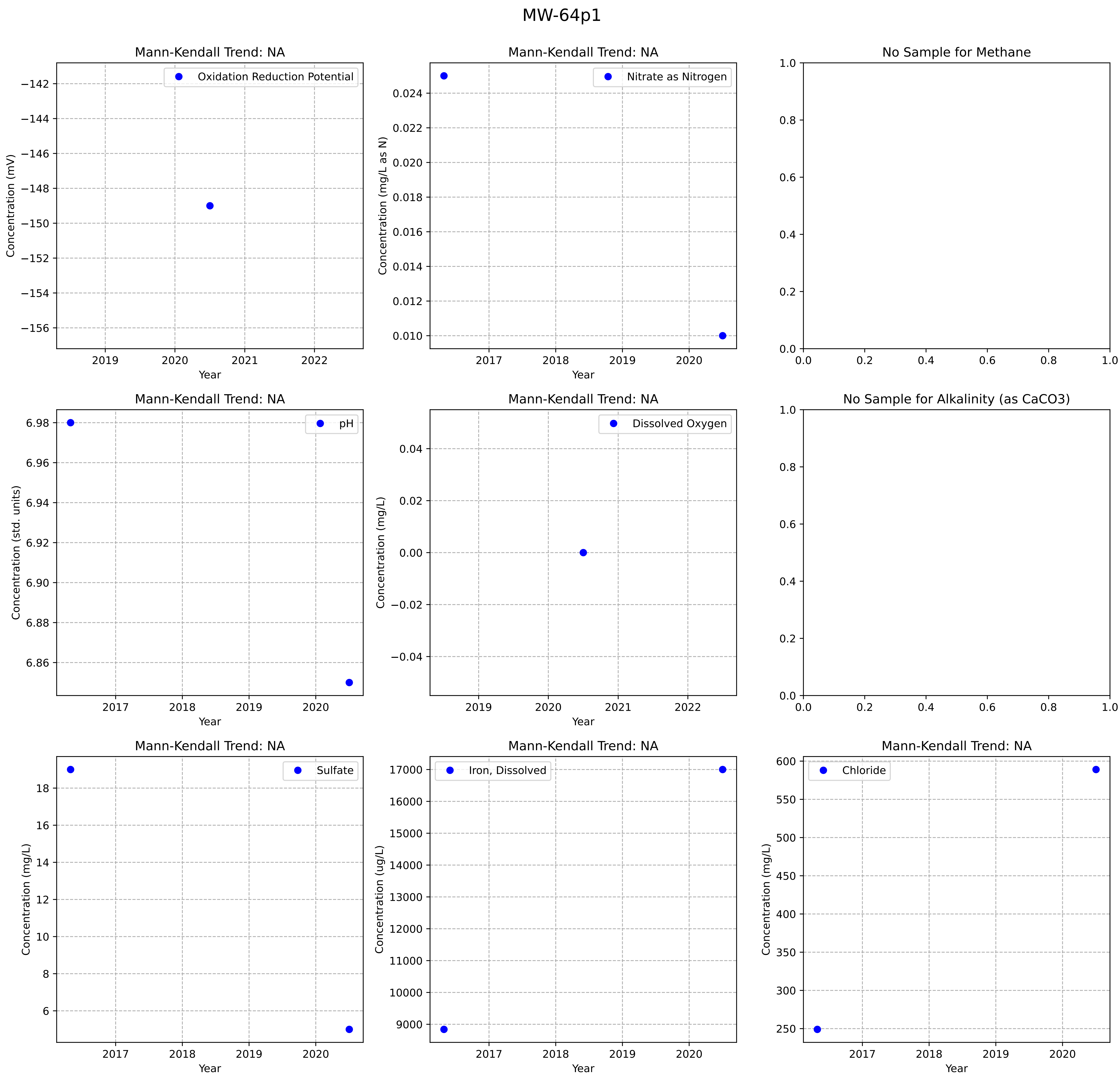

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Exponential Fit (R²=0.11)
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

MW-37p1

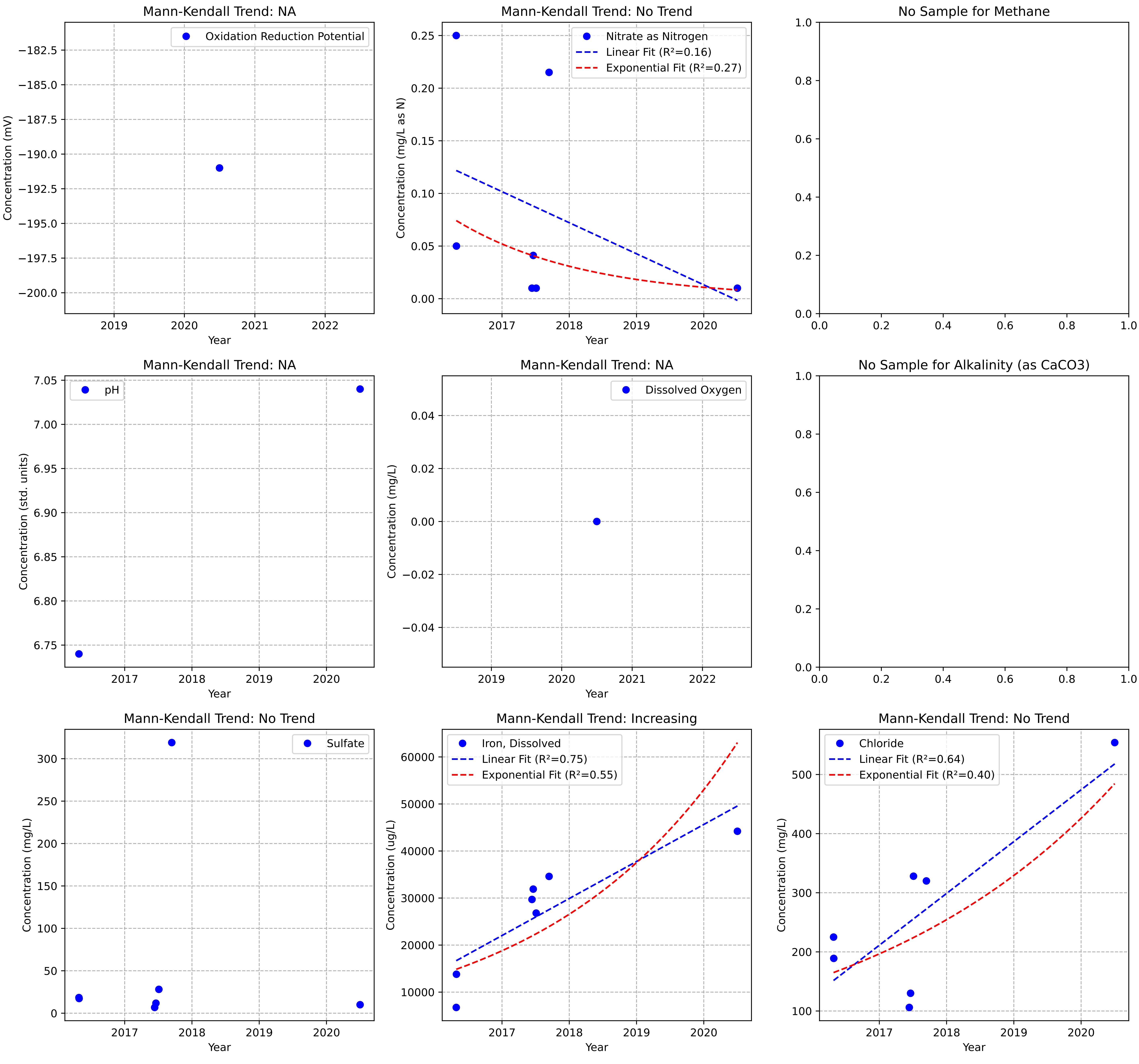


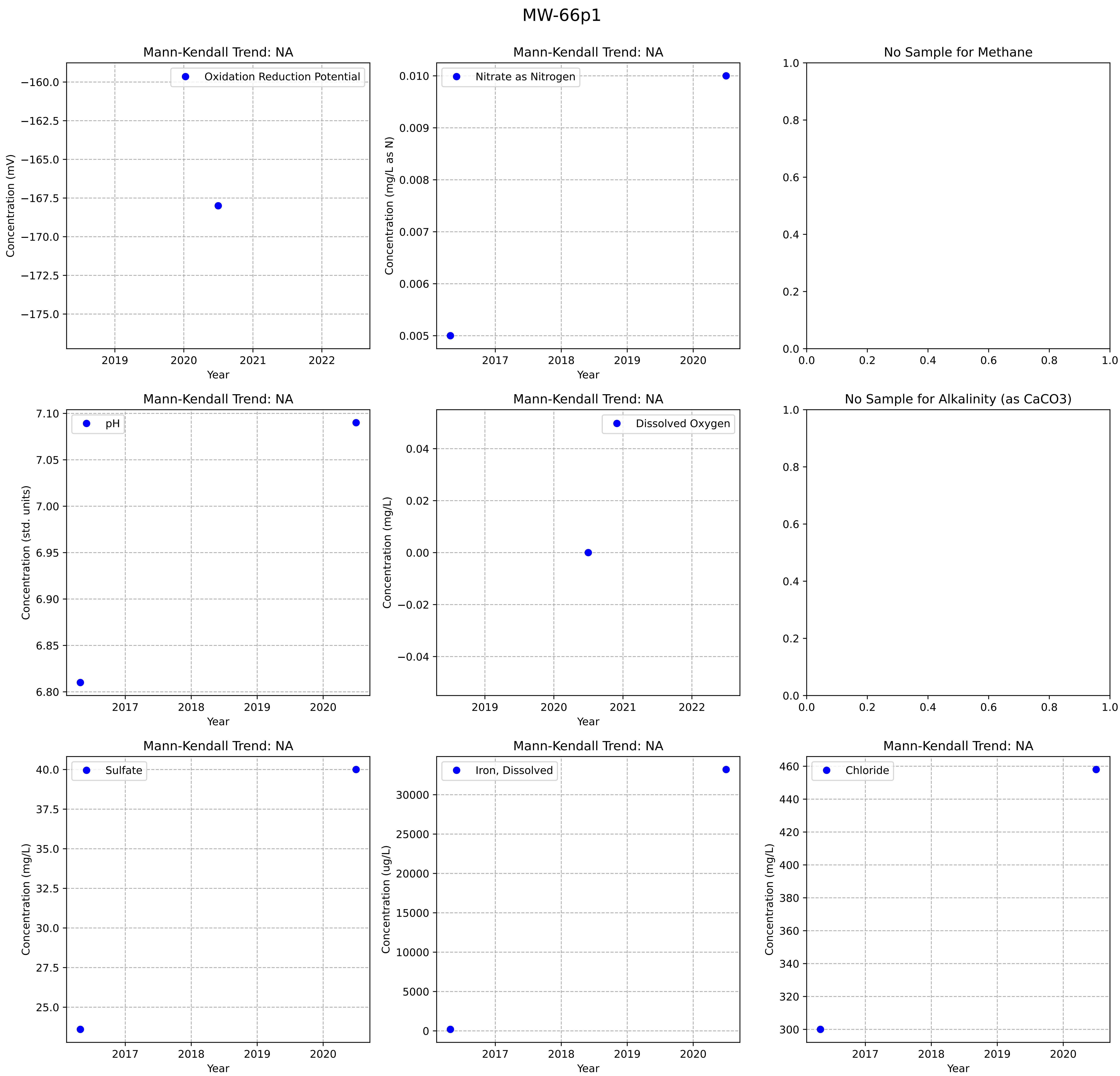
Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.44)
Exponential Fit (R²=0.48)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.18)
Exponential Fit (R²=0.18)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.97)
Exponential Fit (R²=0.81)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.99)
Exponential Fit (R²=0.99)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.51)
Exponential Fit (R²=0.56)
Concentration (mg/L)
Year


MW-61p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

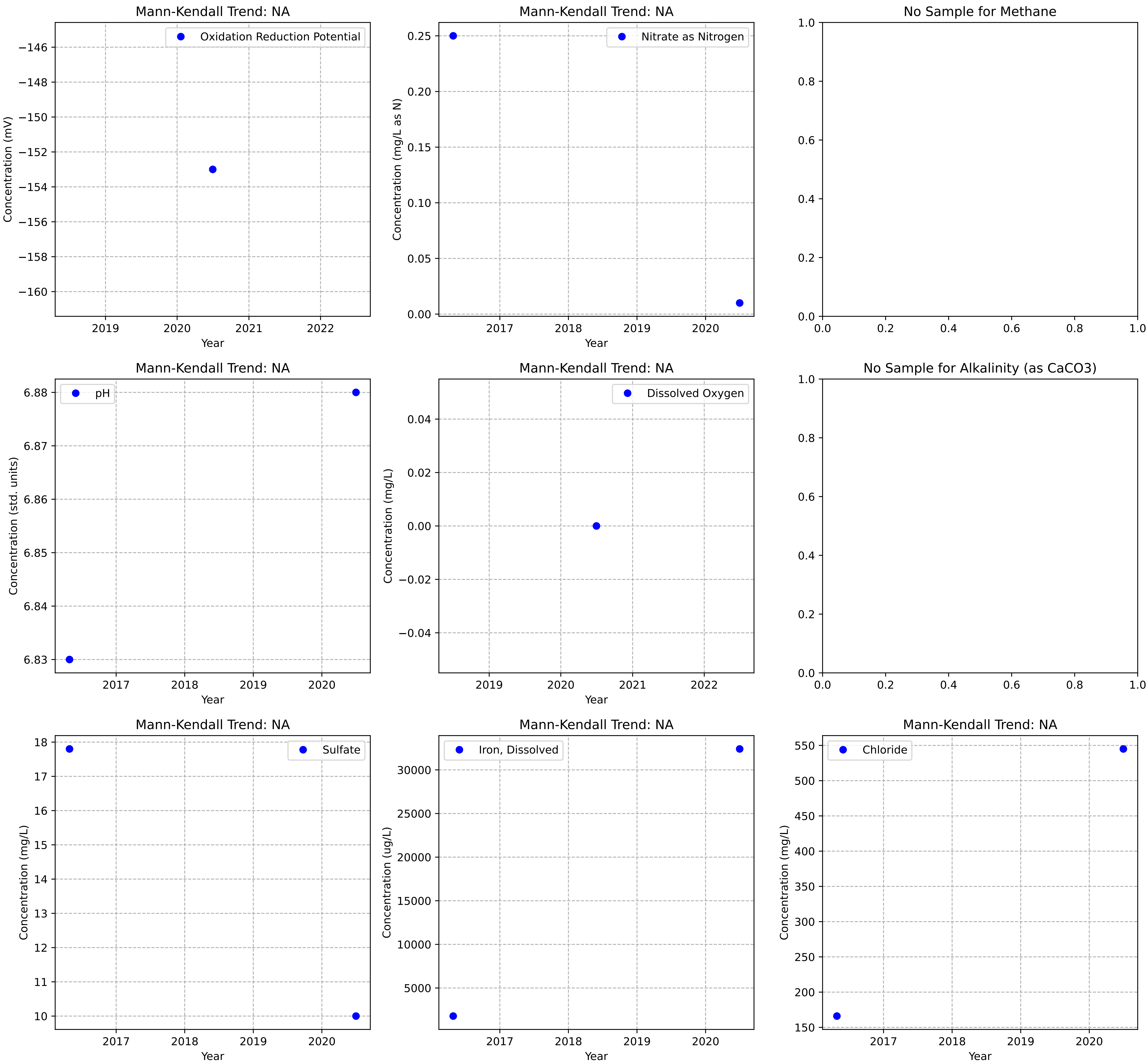

MW-64p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

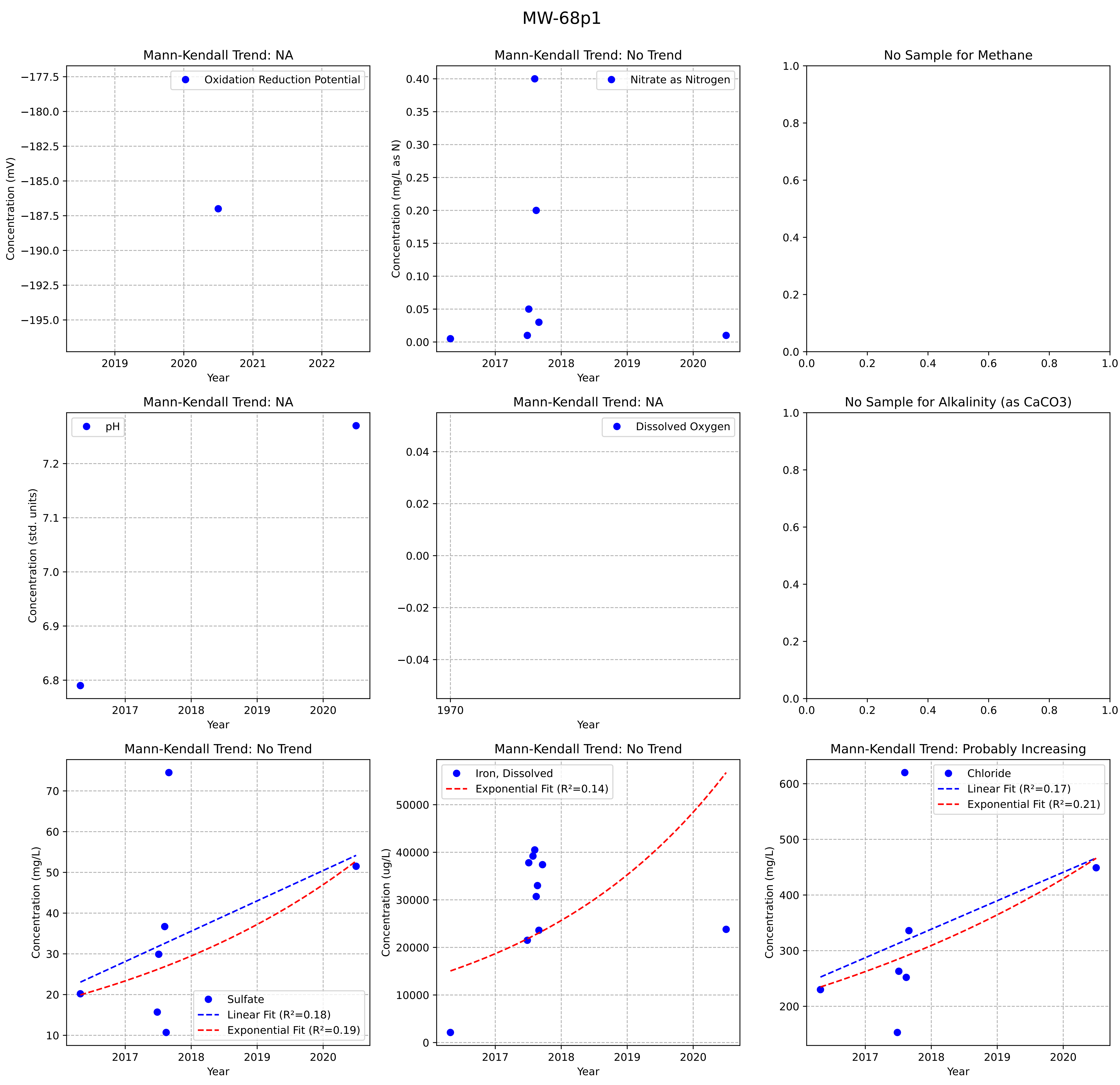
MW-65p1

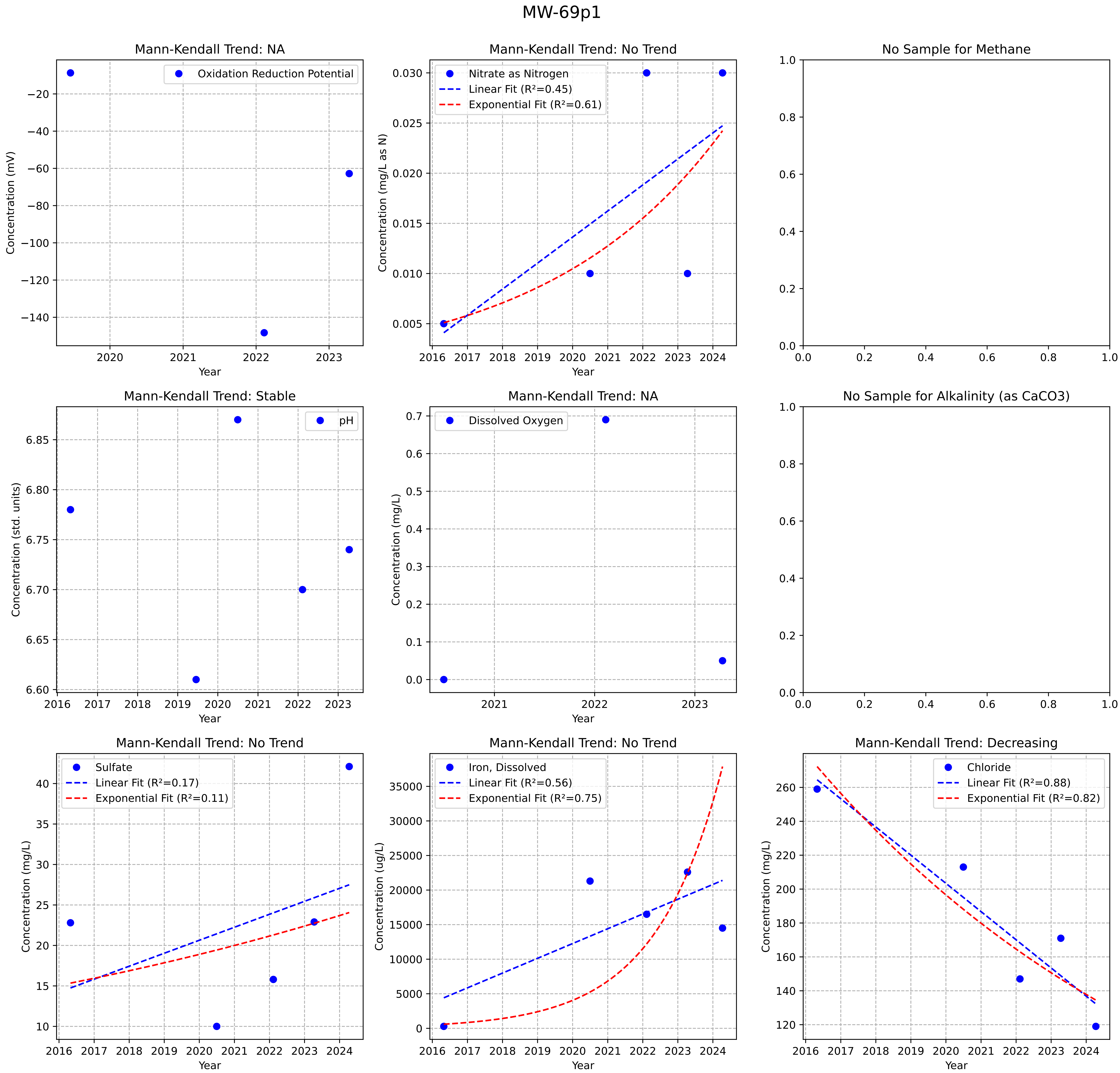

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.16)
Exponential Fit (R²=0.27)
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Iron, Dissolved
Linear Fit (R²=0.75)
Exponential Fit (R²=0.55)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.64)
Exponential Fit (R²=0.40)
Concentration (mg/L)
Year


MW-66p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

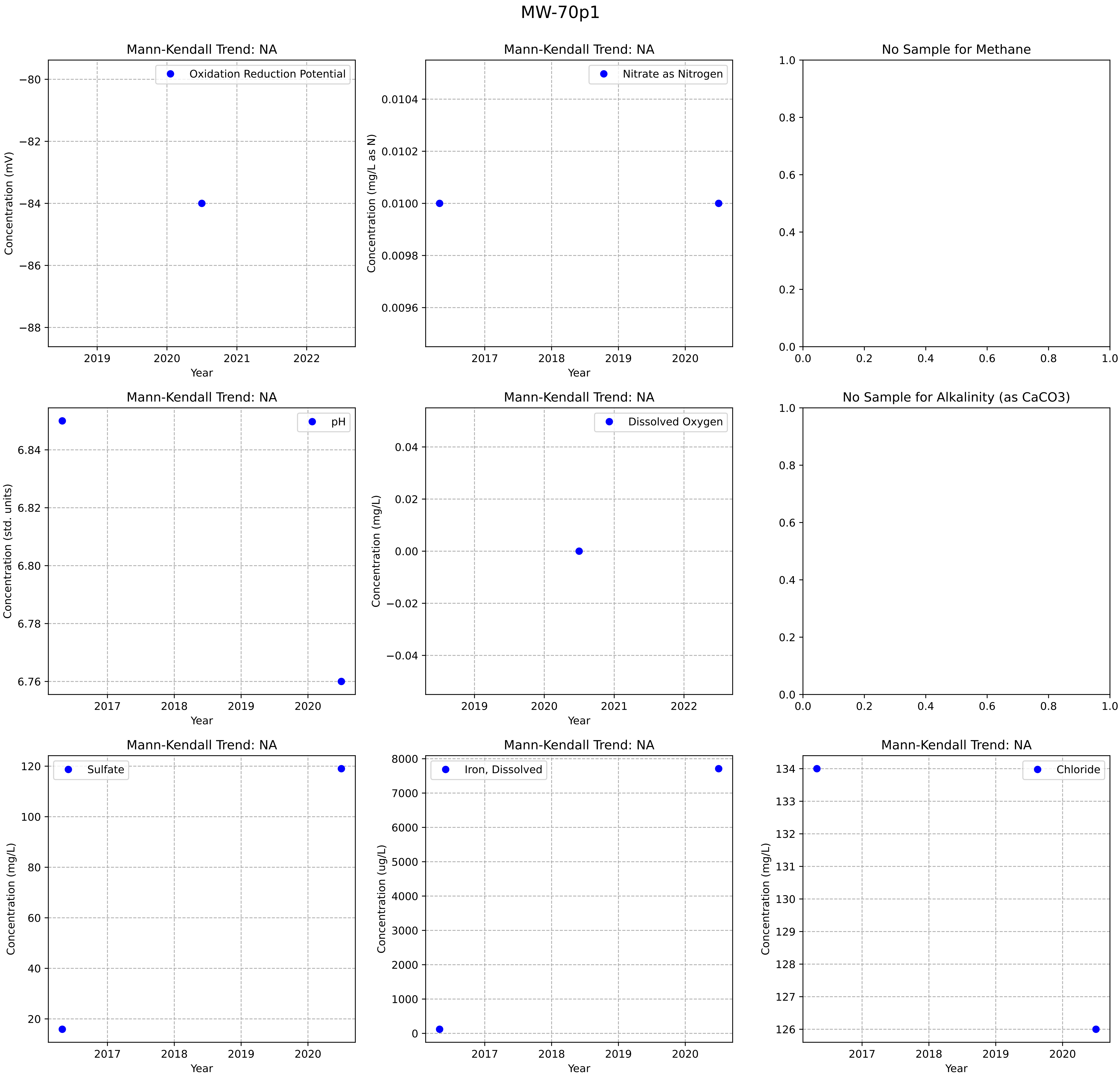
MW-67p1

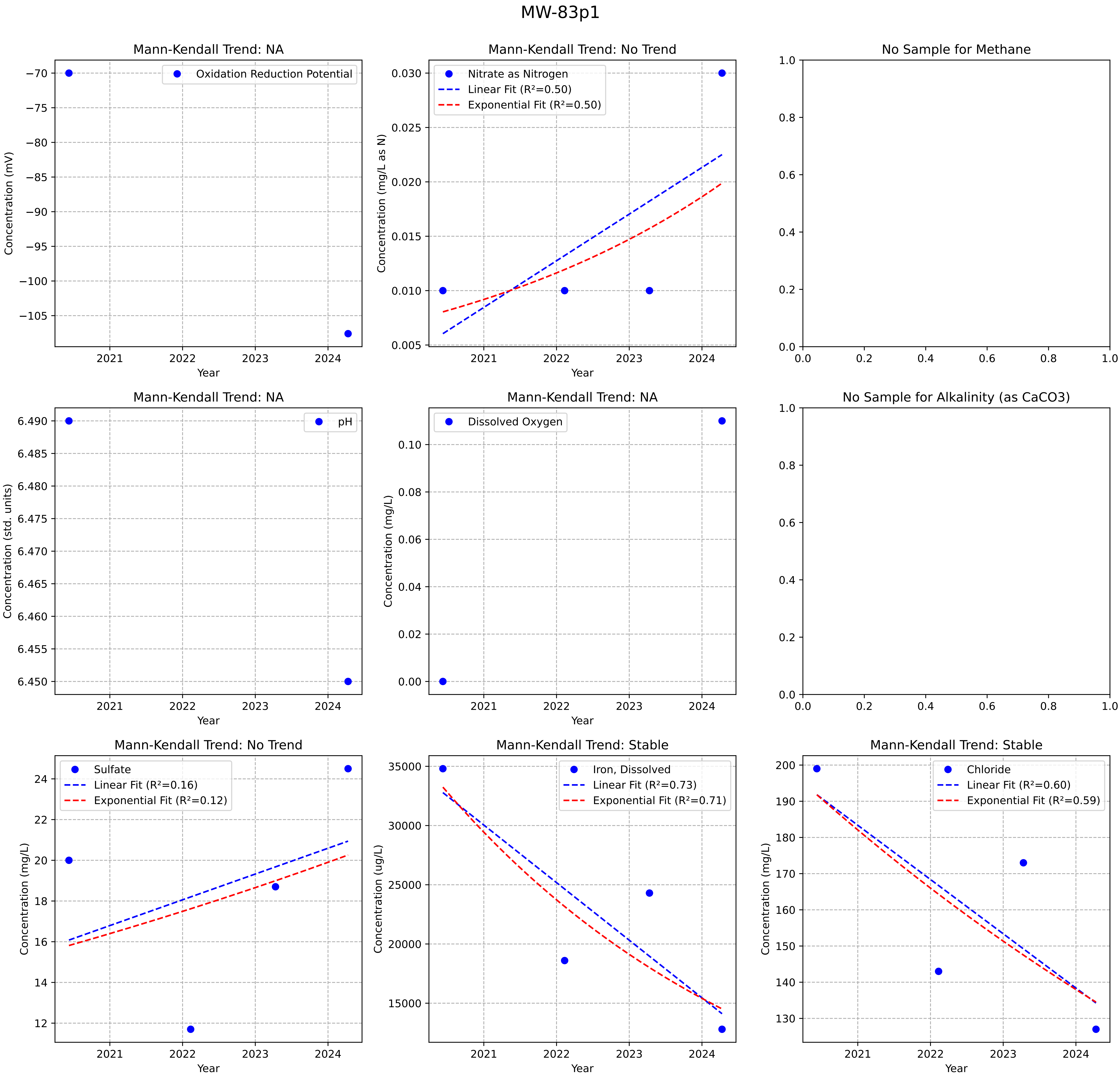

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year


MW-68p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.18)
Exponential Fit (R²=0.19)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Exponential Fit (R²=0.14)
Concentration (ug/L)
Year
Mann-Kendall Trend: Probably Increasing
Chloride
Linear Fit (R²=0.17)
Exponential Fit (R²=0.21)
Concentration (mg/L)
Year



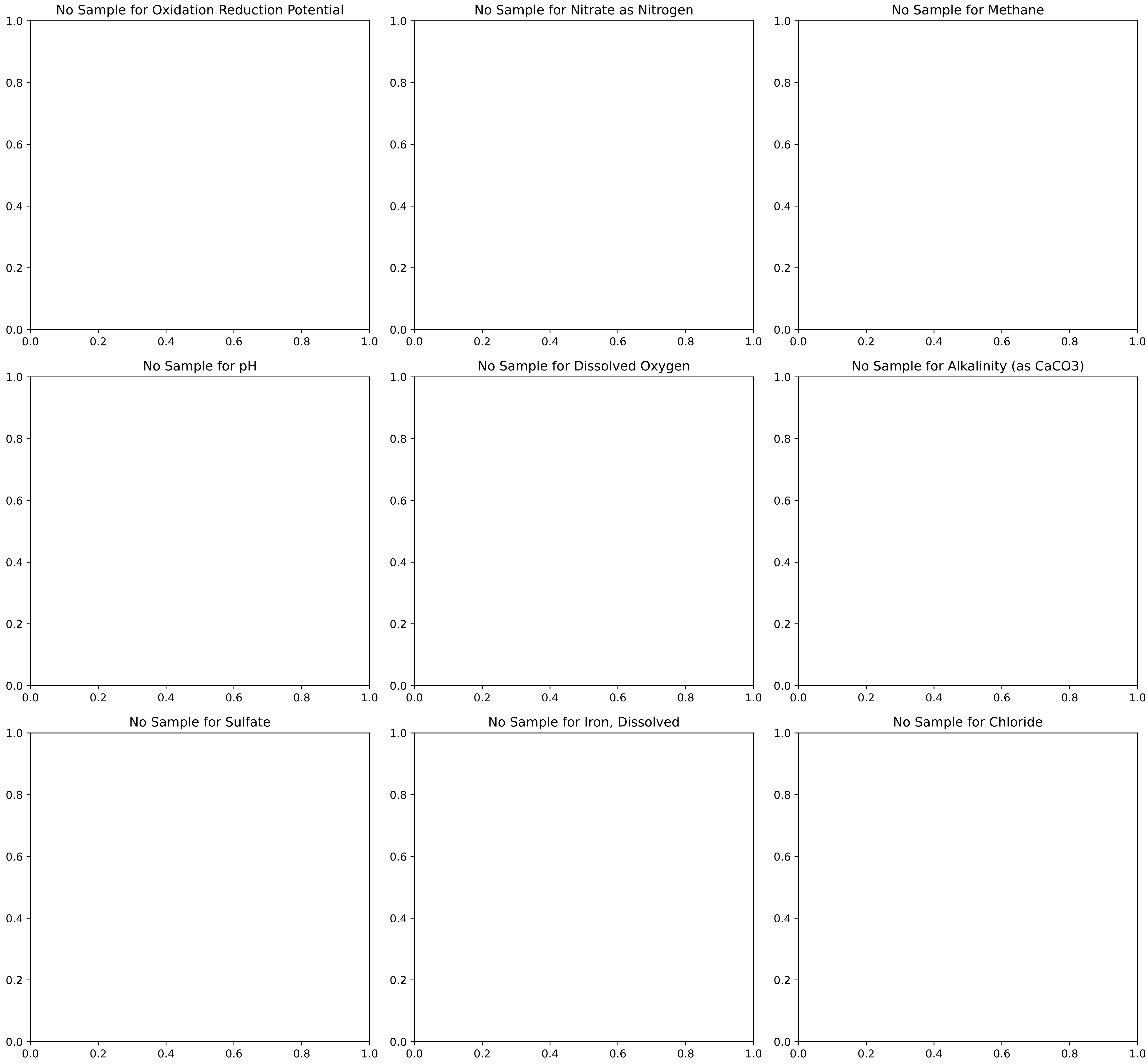
MW-69p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.45)
Exponential Fit (R²=0.61)
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: Stable
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.17)
Exponential Fit (R²=0.11)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.56)
Exponential Fit (R²=0.75)
Concentration (ug/L)
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.88)
Exponential Fit (R²=0.82)
Concentration (mg/L)

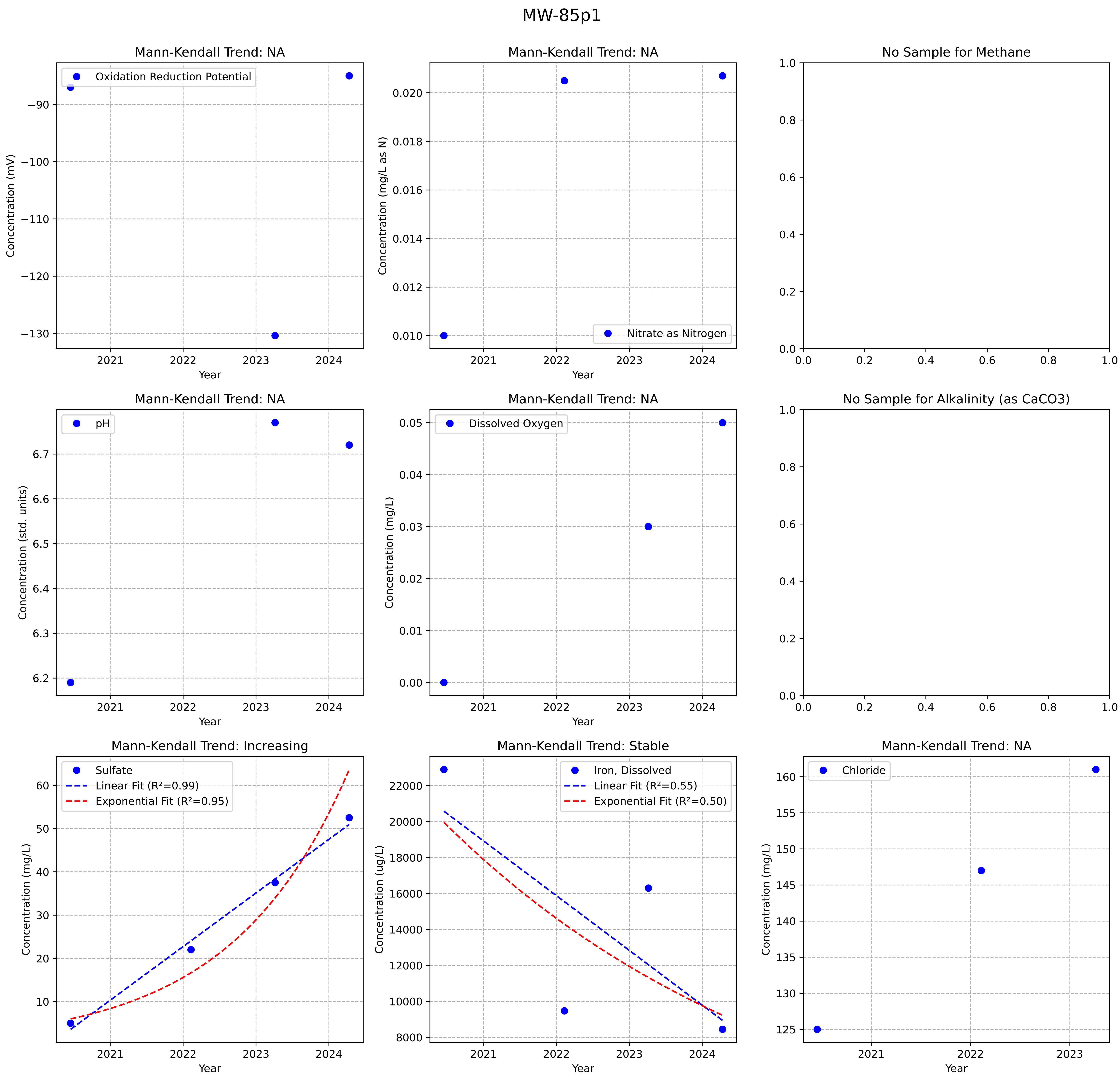

MW-70p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year



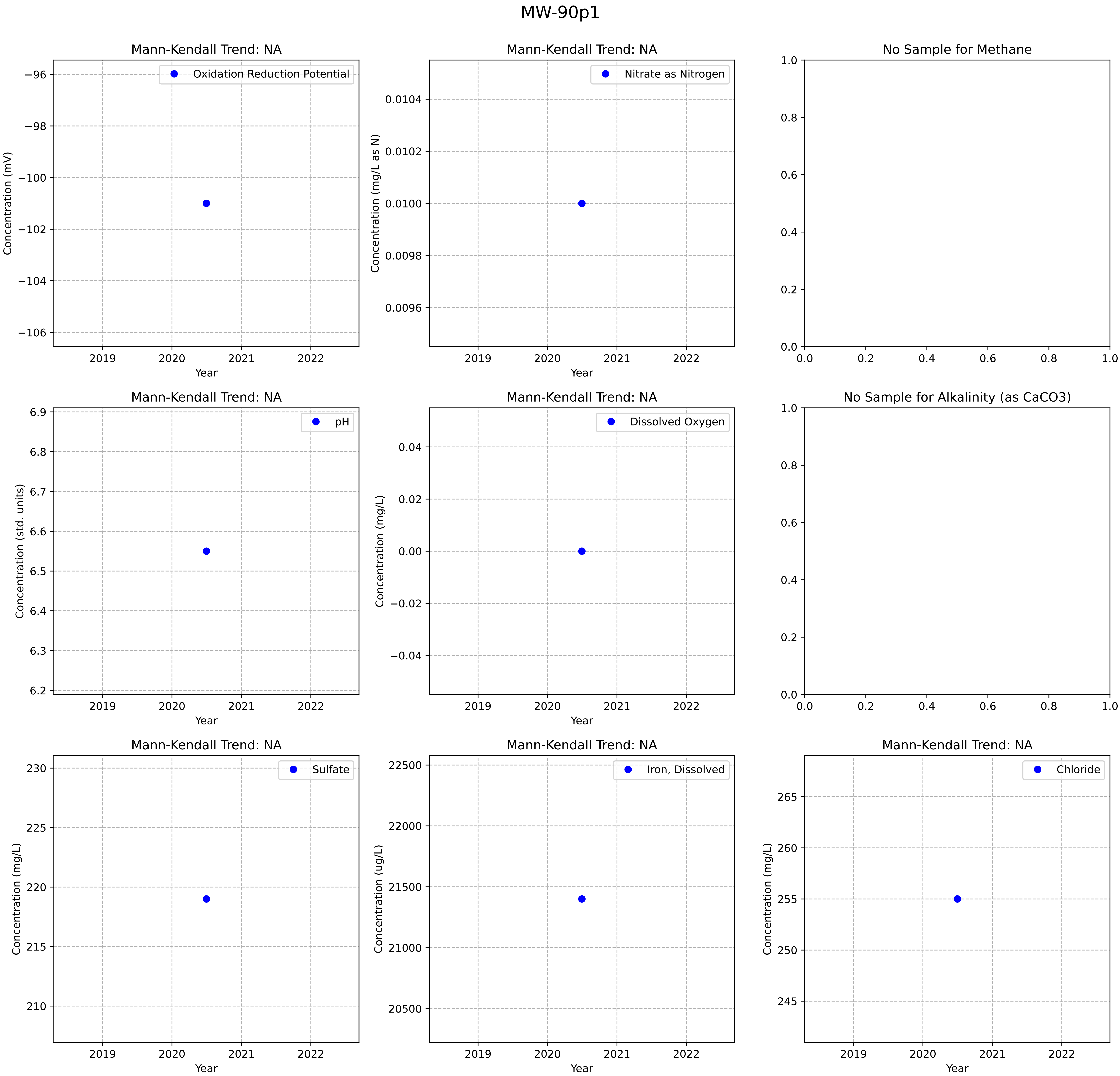
MW-83p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.50)
Exponential Fit (R²=0.50)
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.16)
Exponential Fit (R²=0.12)
Concentration (mg/L)
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.73)
Exponential Fit (R²=0.71)
Concentration (ug/L)
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.60)
Exponential Fit (R²=0.59)
Concentration (mg/L)

No Data for MW-84p1

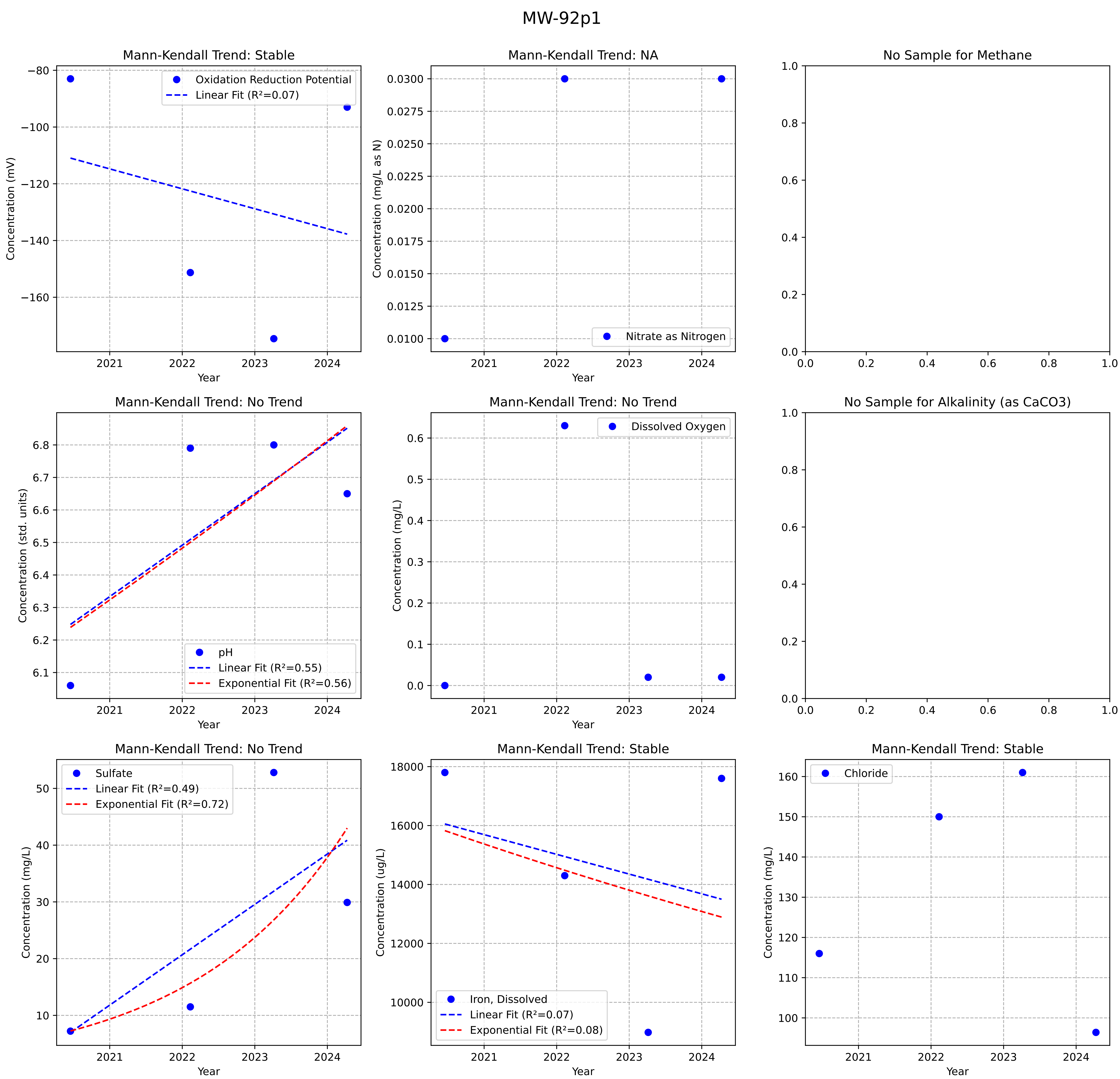




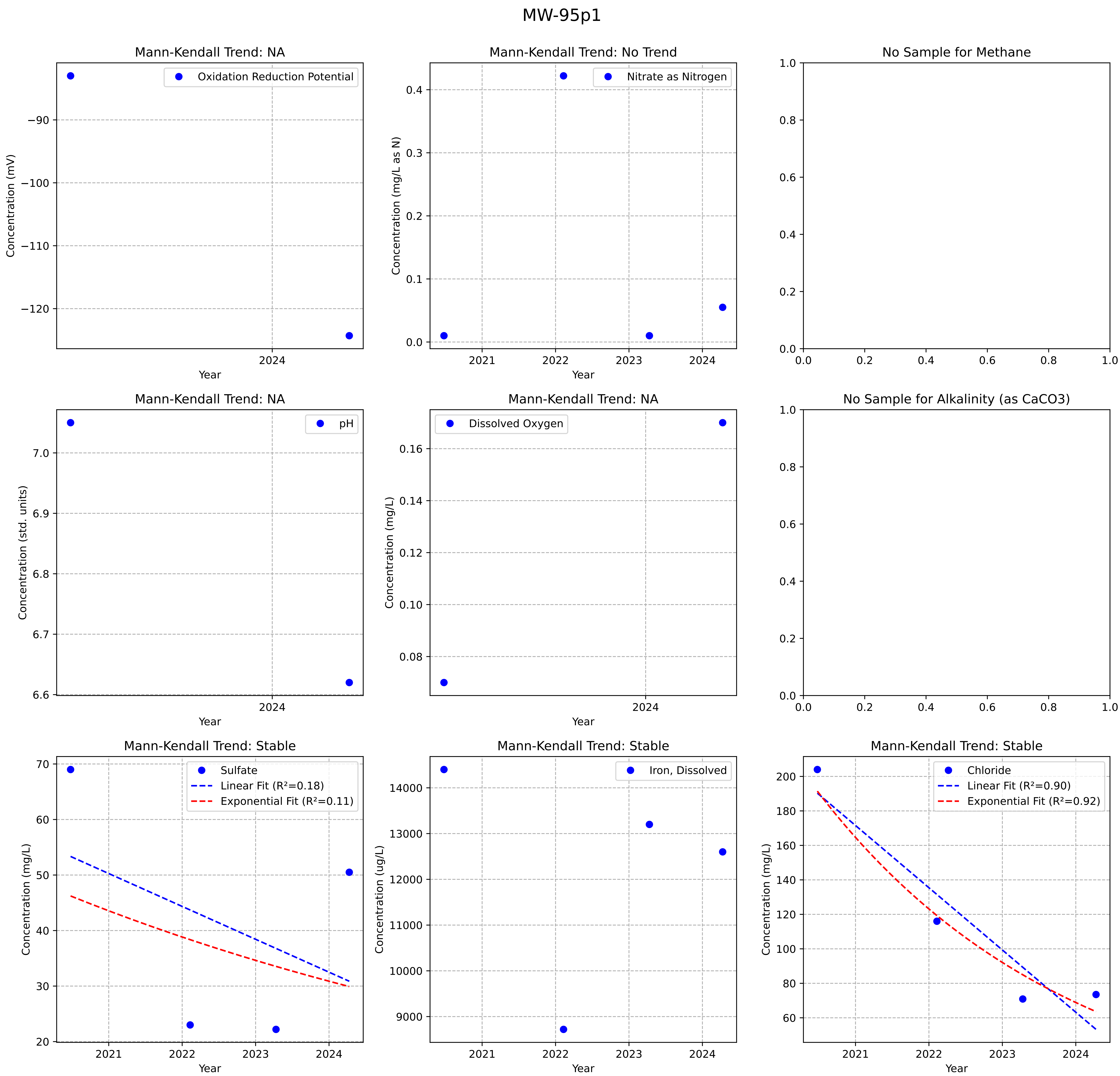
MW-85p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.99)
Exponential Fit (R²=0.95)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.55)
Exponential Fit (R²=0.50)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year


MW-90p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

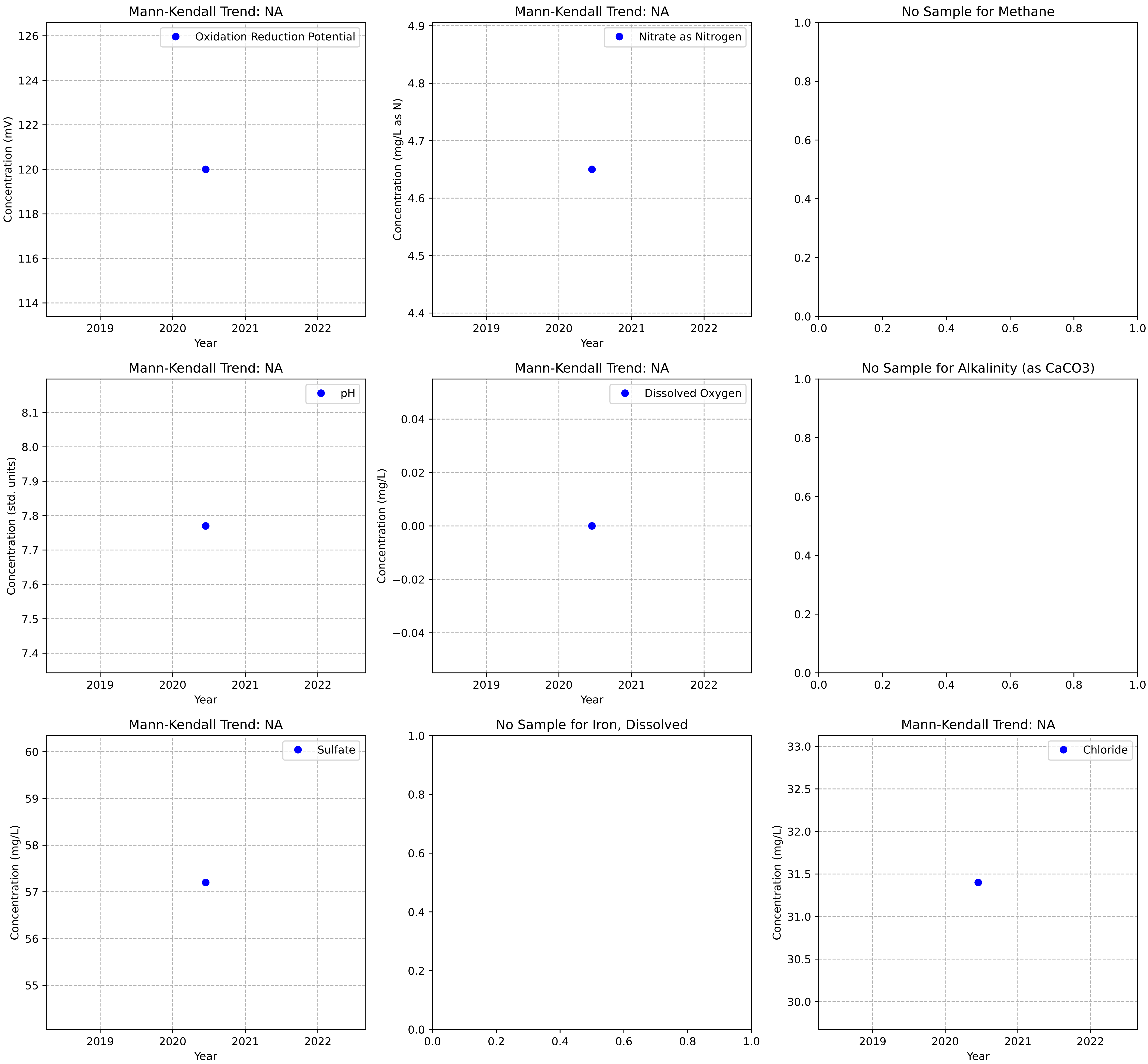
MW-92p1



MW-92p1
Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Linear Fit (R²=0.07)
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.55)
Exponential Fit (R²=0.56)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.49)
Exponential Fit (R²=0.72)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.07)
Exponential Fit (R²=0.08)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Concentration (mg/L)
Year

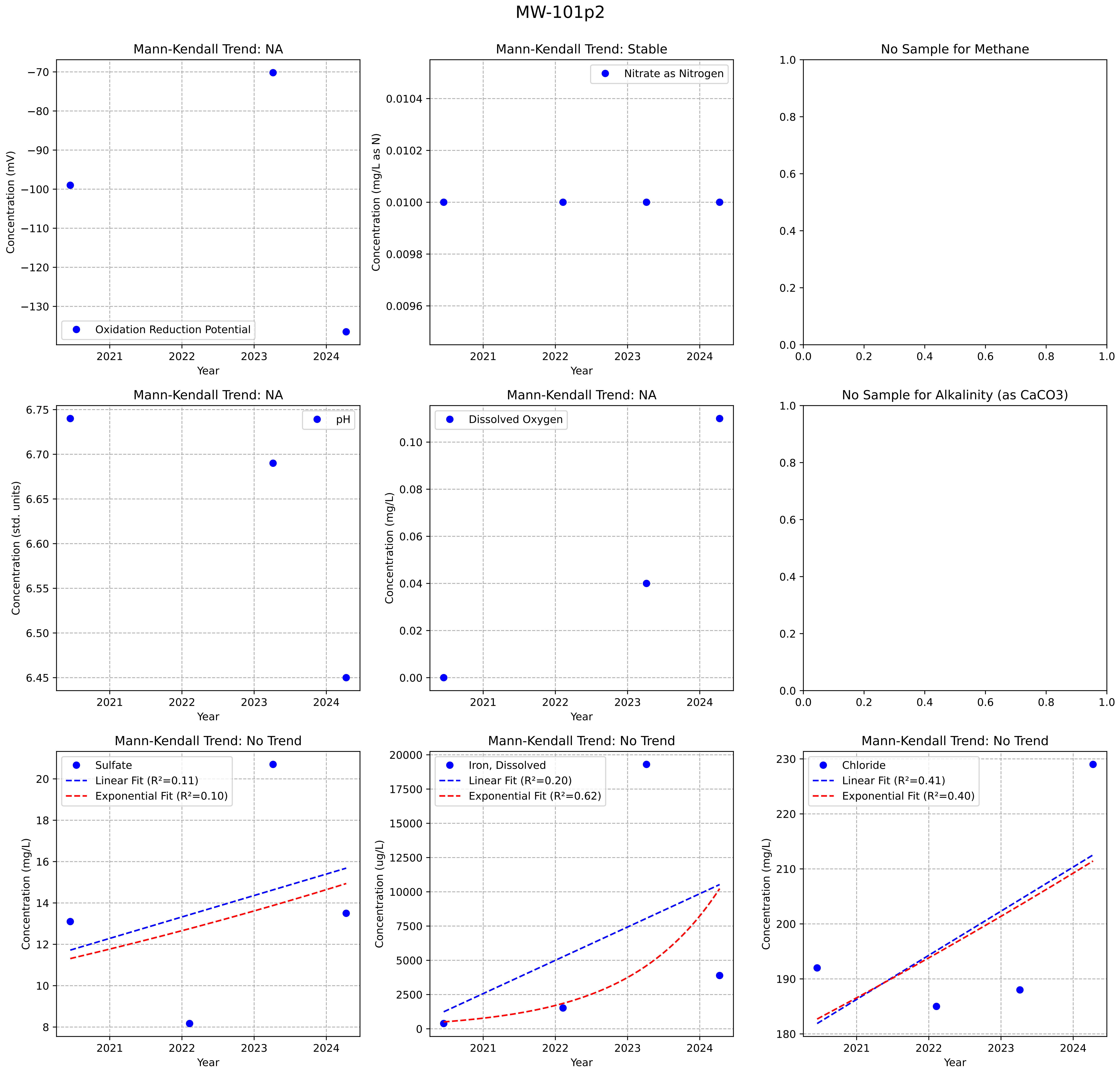

MW-95p1
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.18)
Exponential Fit (R²=0.11)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.90)
Exponential Fit (R²=0.92)
Concentration (mg/L)
Year

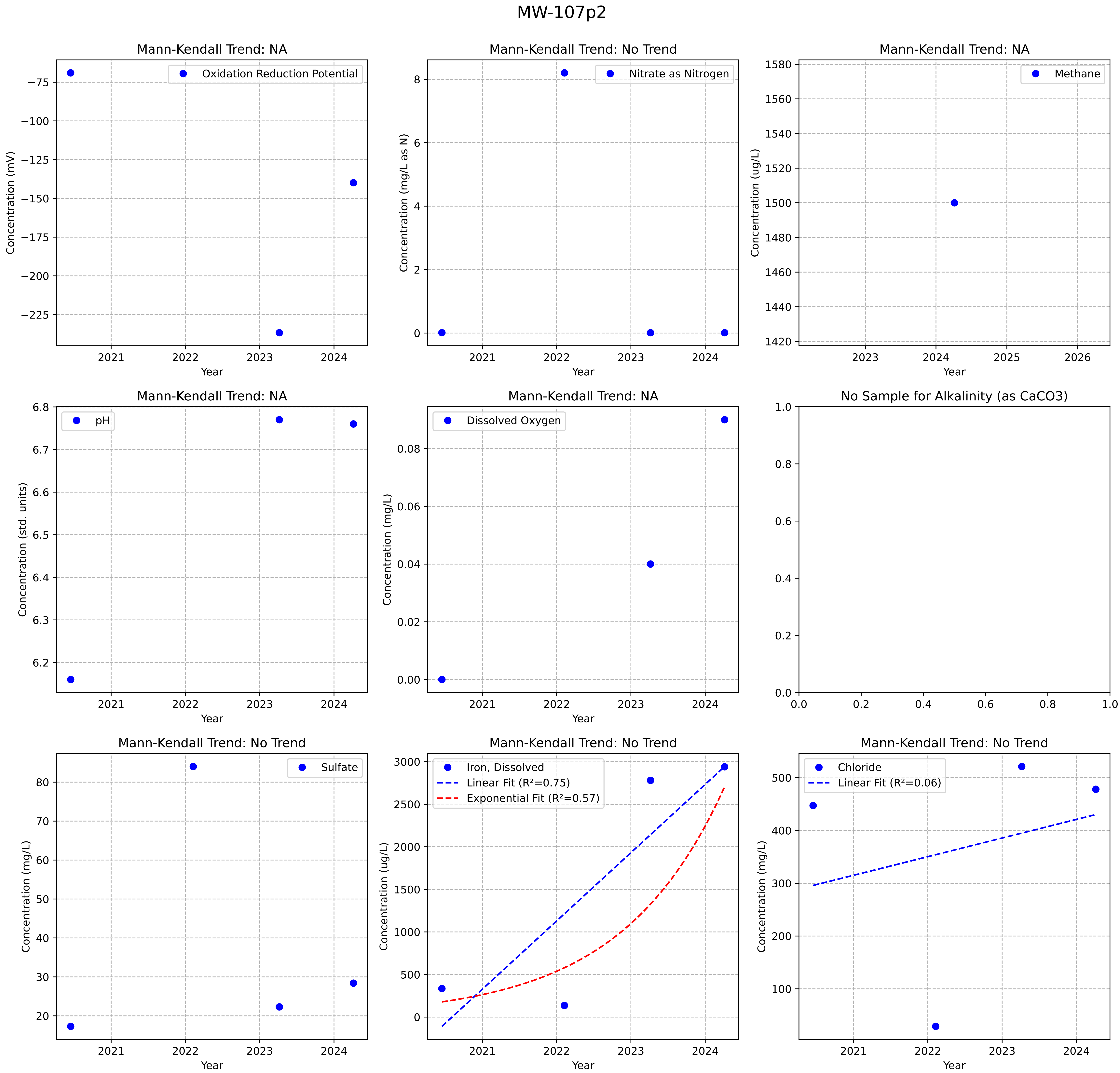
MW-98p1



Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
126
124
122
120
118
116
114
2019
2020
2021
2022
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
4.9
4.8
4.7
4.6
4.5
4.4
Year
No Sample for Methane
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
pH
Concentration (std. units)
8.1
8.0
7.9
7.8
7.7
7.6
7.5
7.4
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
0.04
0.02
0.00
−0.02
−0.04
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
60
59
58
57
56
55
Year
No Sample for Iron, Dissolved
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
33.0
32.5
32.0
31.5
31.0
30.5
30.0
Year

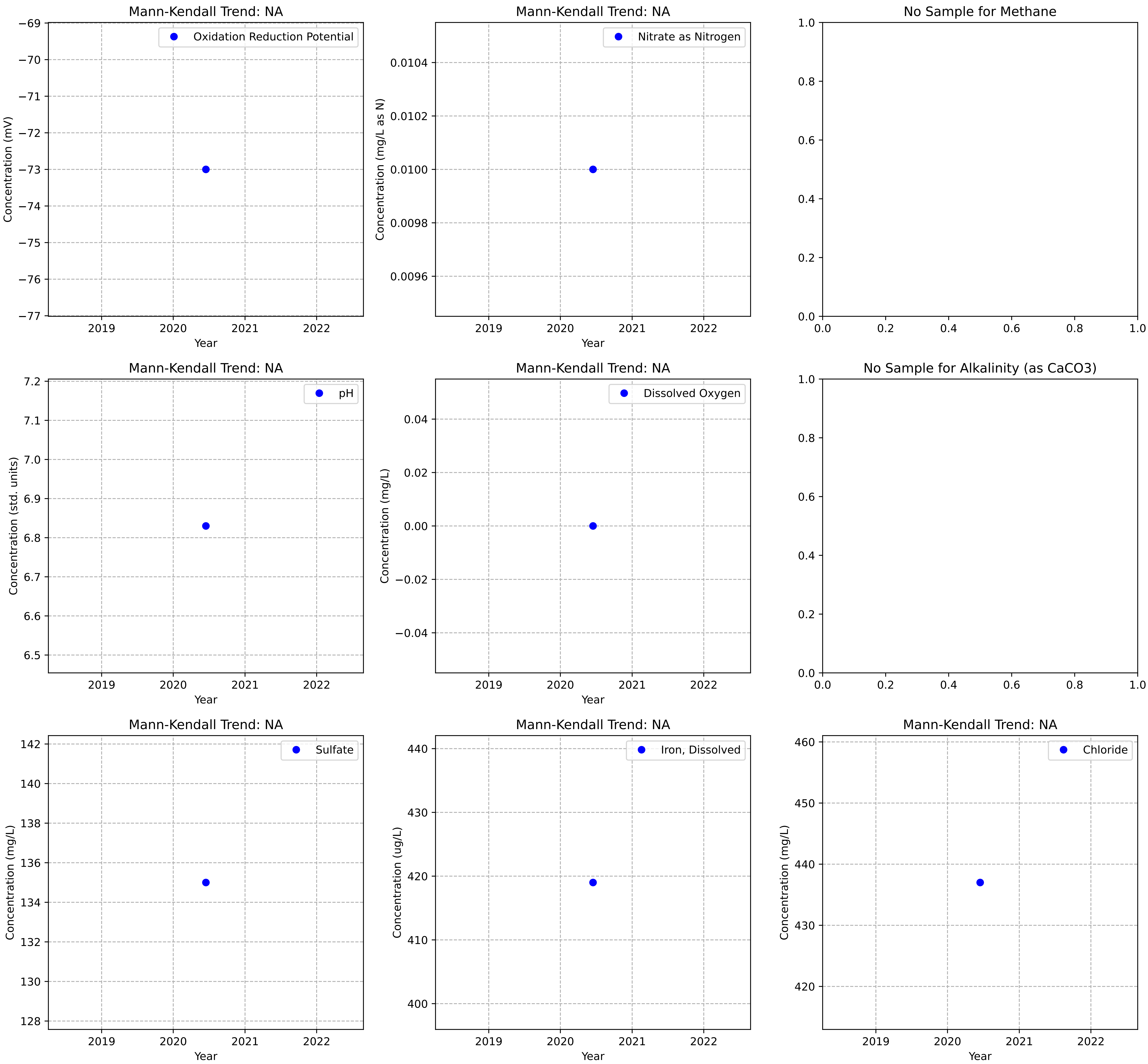
C2. Concentration time series plots of geochemical indicators for P2 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values


MW-101p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.11)
Exponential Fit (R²=0.10)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.20)
Exponential Fit (R²=0.62)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.41)
Exponential Fit (R²=0.40)
Concentration (mg/L)
Year

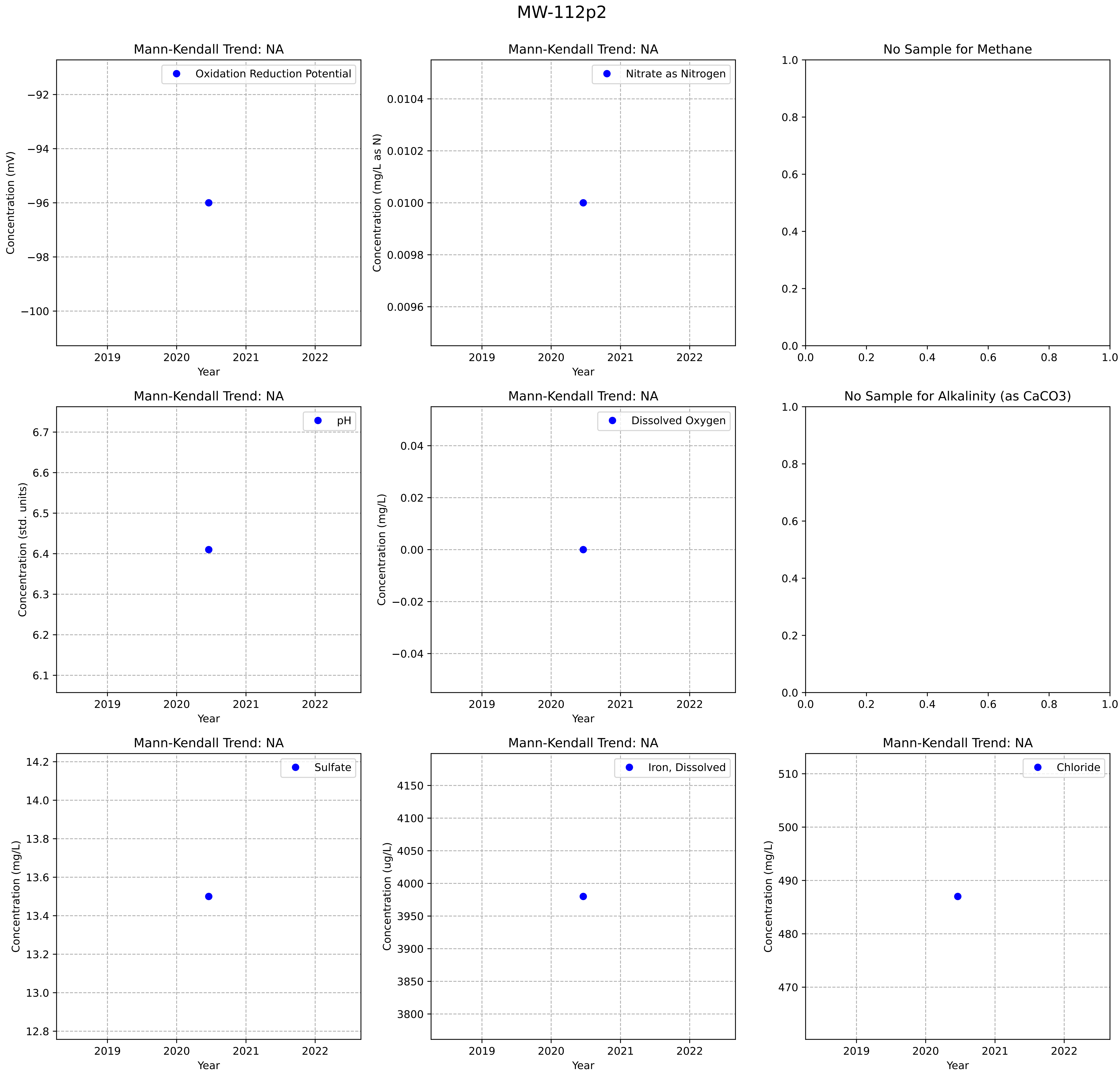


MW-107p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.75)
Exponential Fit (R²=0.57)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.06)
Concentration (mg/L)
Year

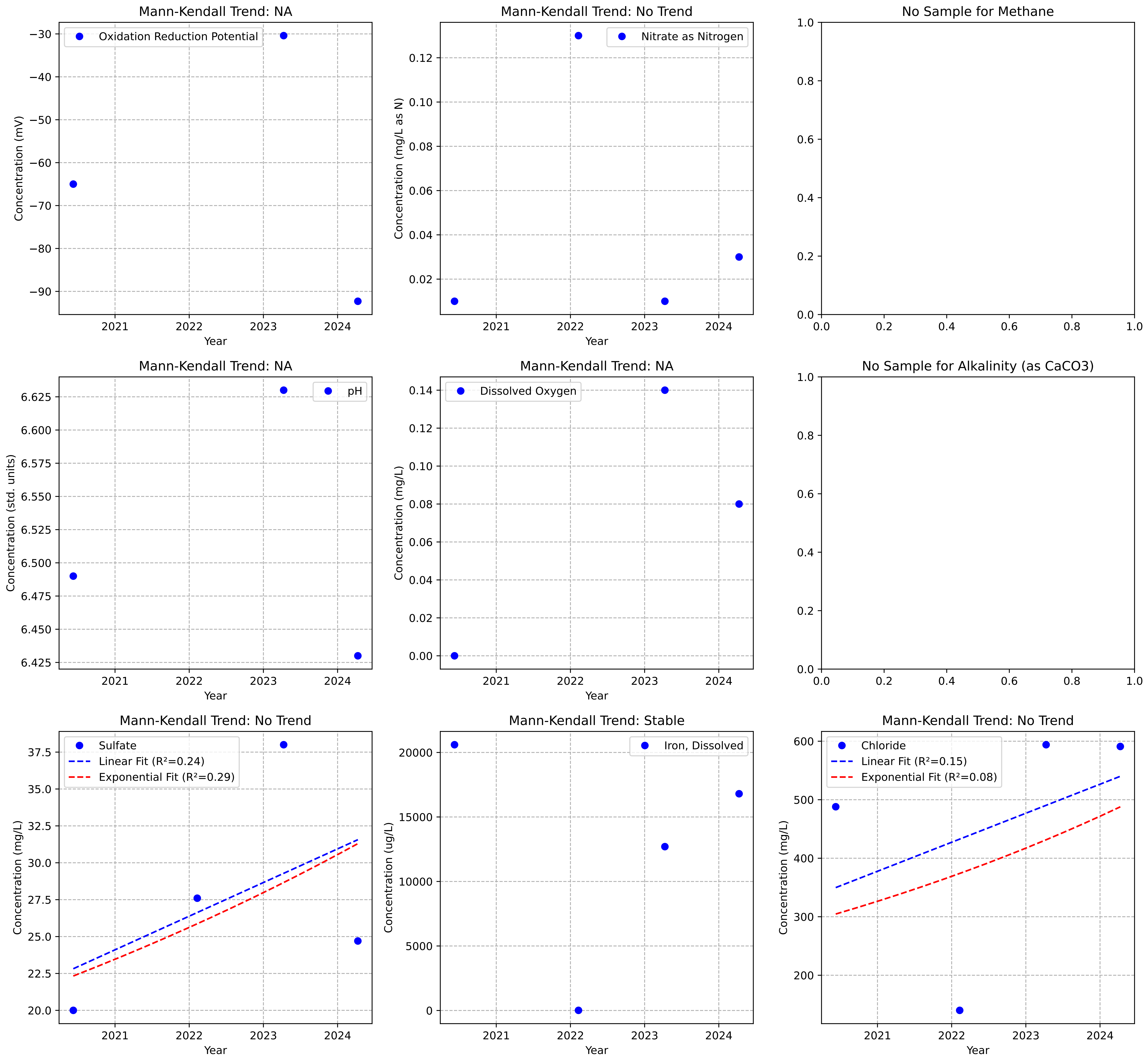
MW-108p2



Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

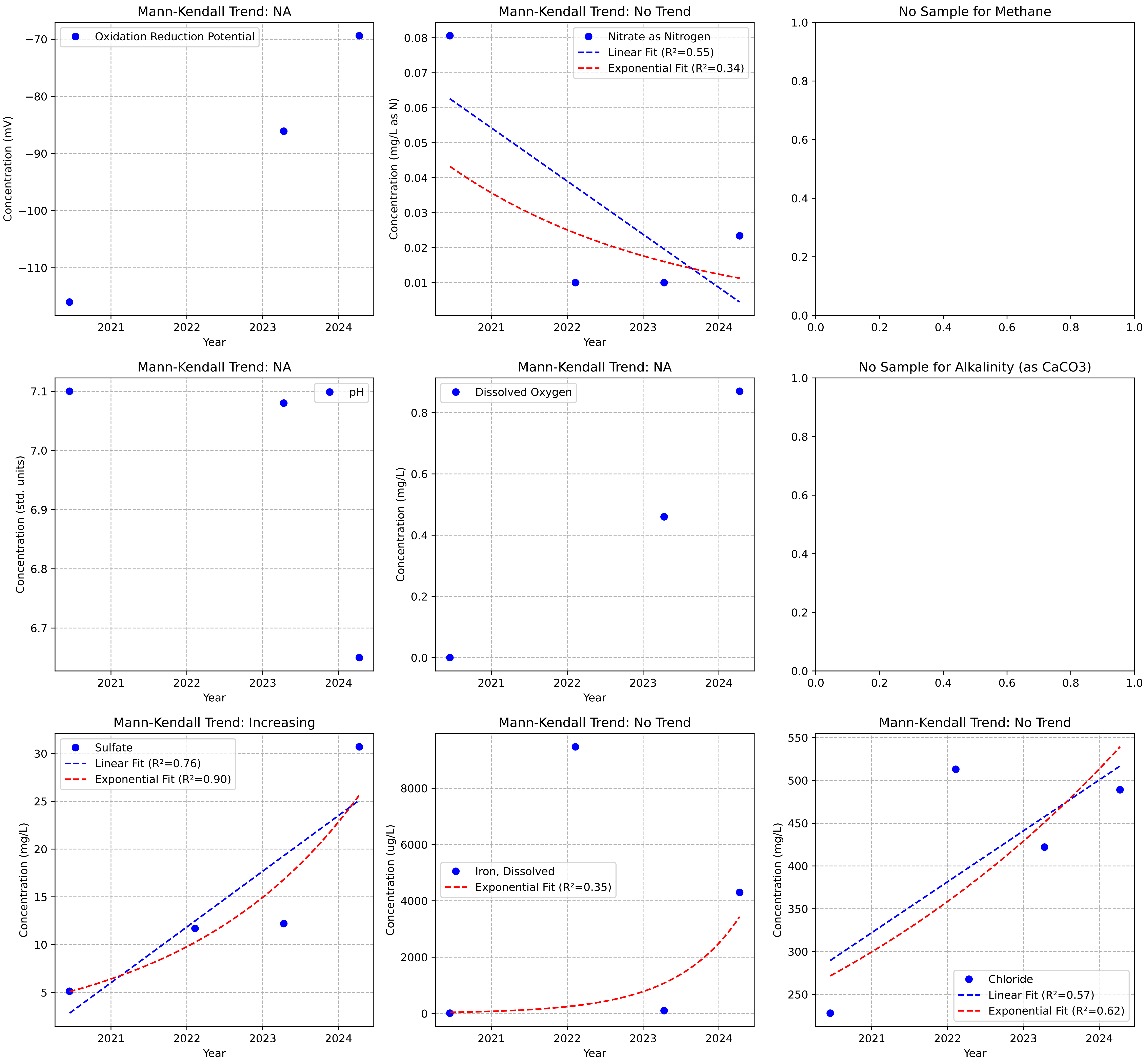

MW-112p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

MW-113p2

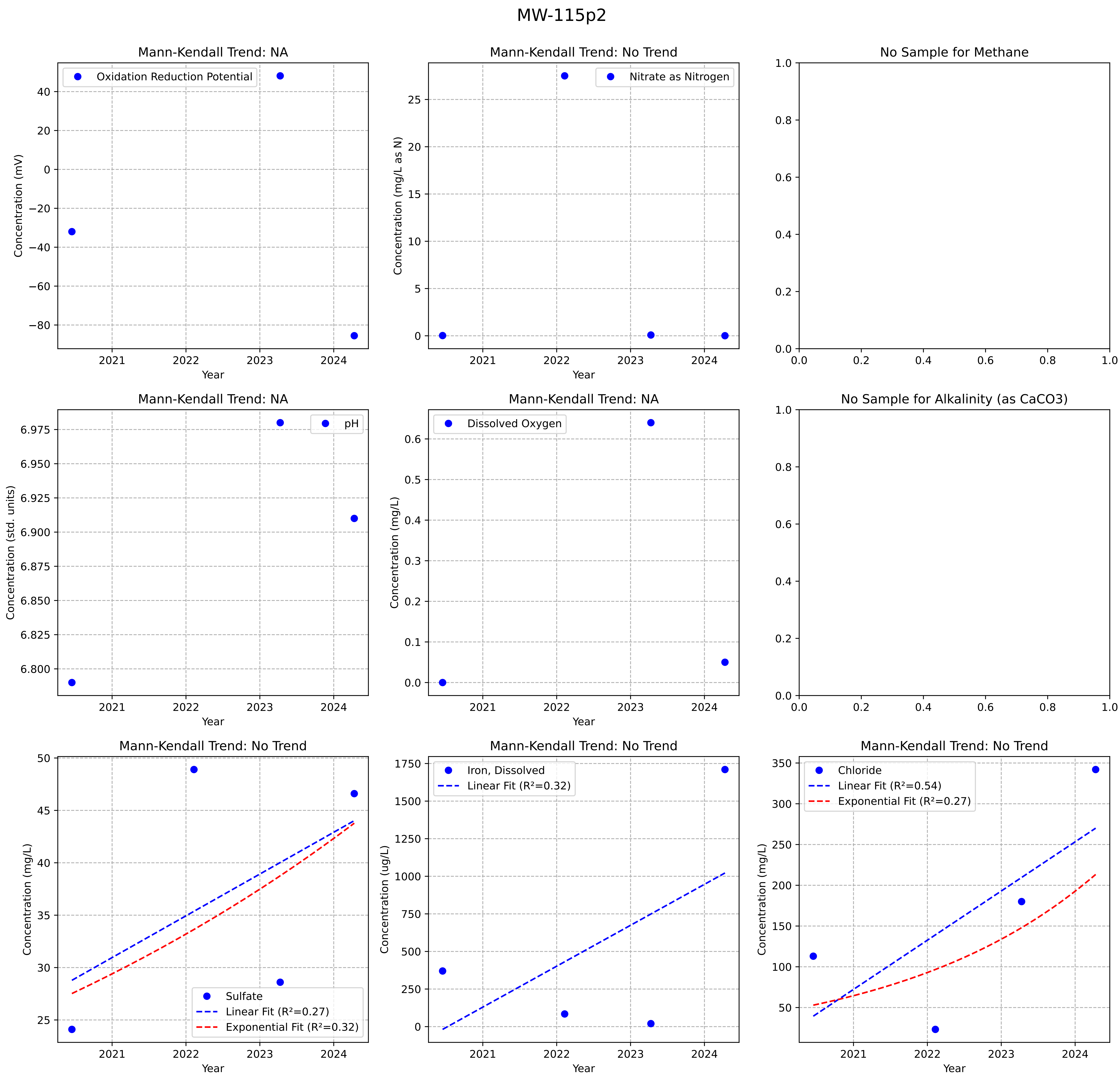


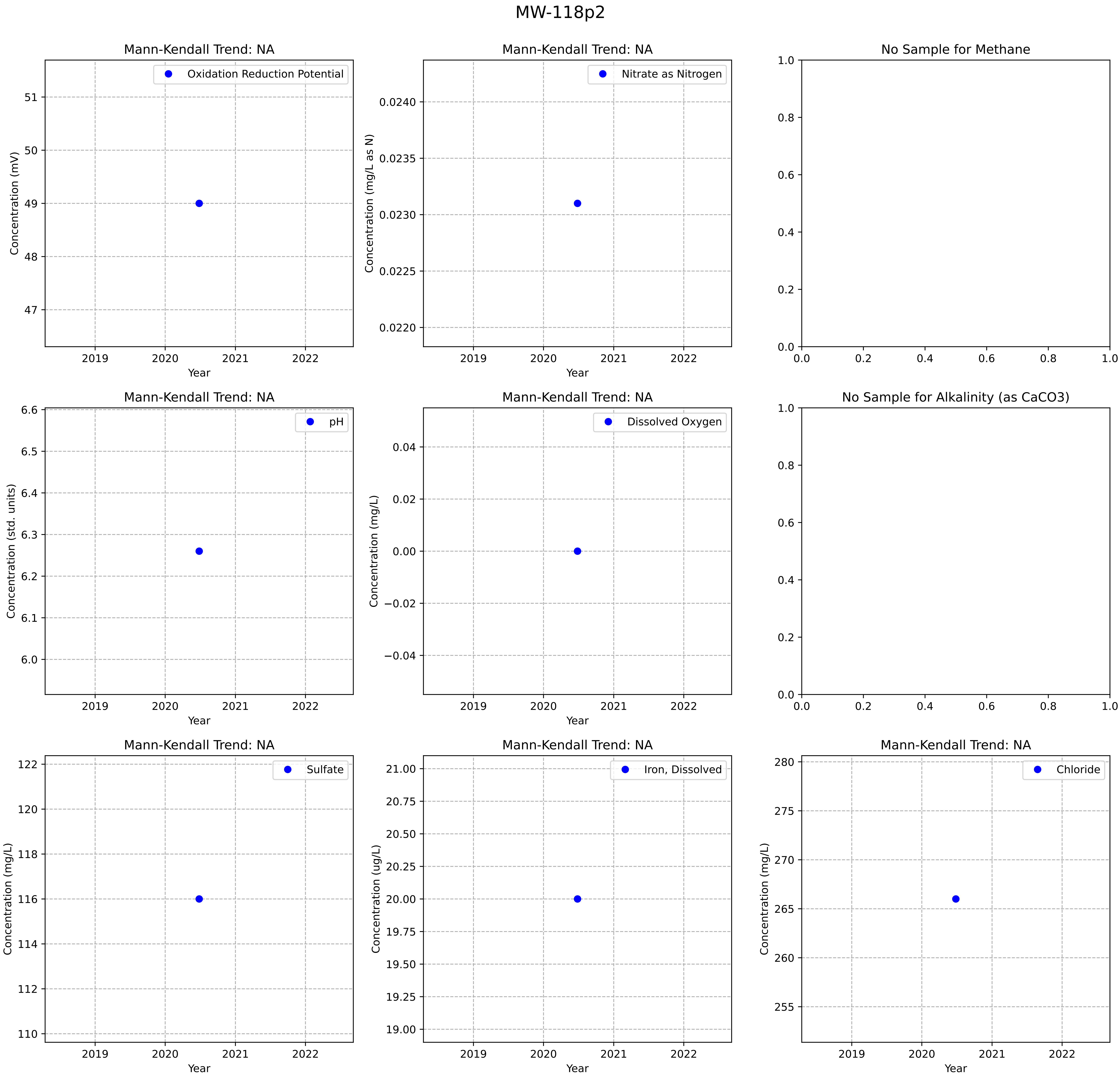
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.24)
Exponential Fit (R²=0.29)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.15)
Exponential Fit (R²=0.08)
Concentration (mg/L)
Year

MW-114p2



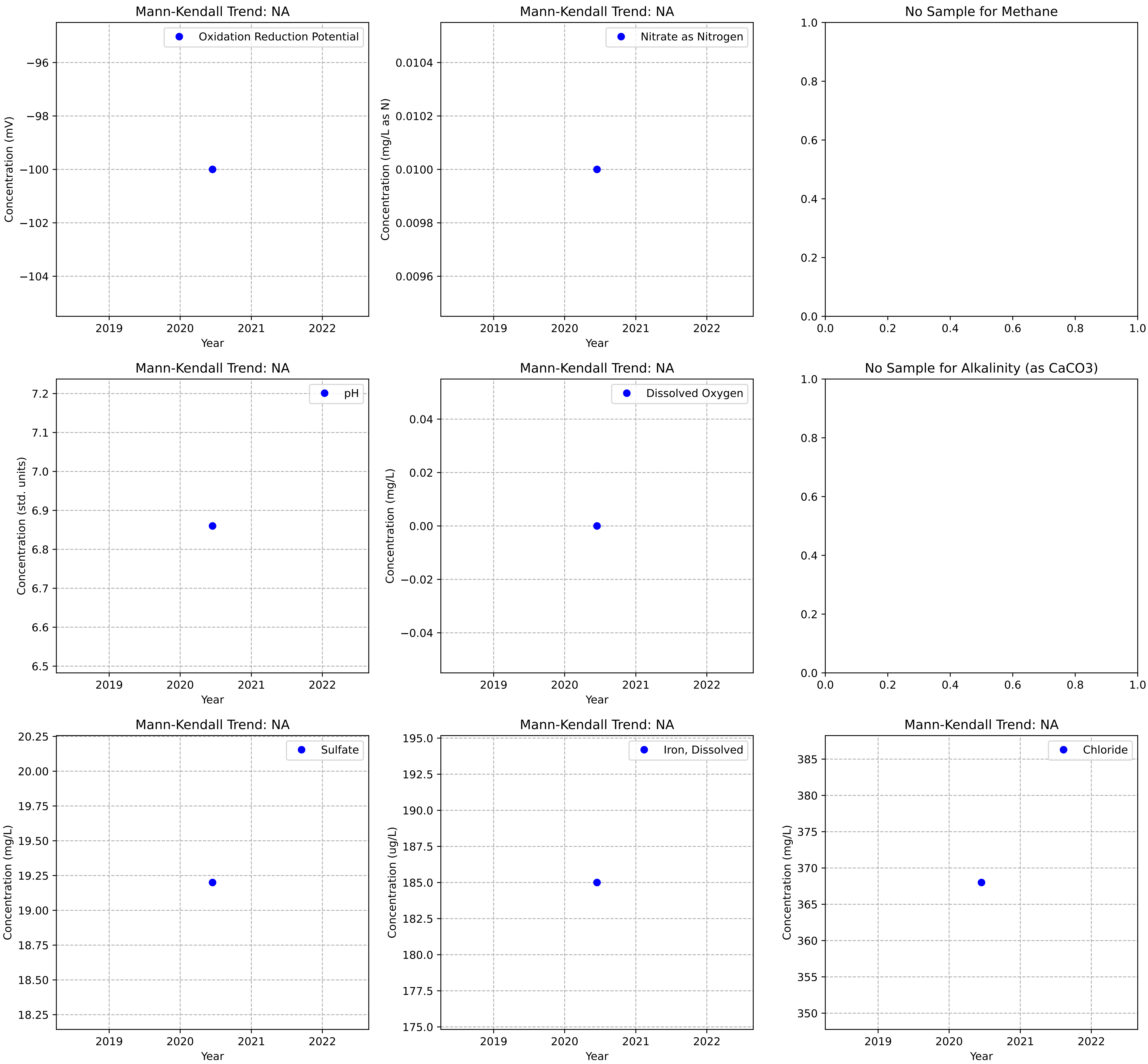
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.55)
Exponential Fit (R²=0.34)
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.76)
Exponential Fit (R²=0.90)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Exponential Fit (R²=0.35)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.57)
Exponential Fit (R²=0.62)
Concentration (mg/L)
Year

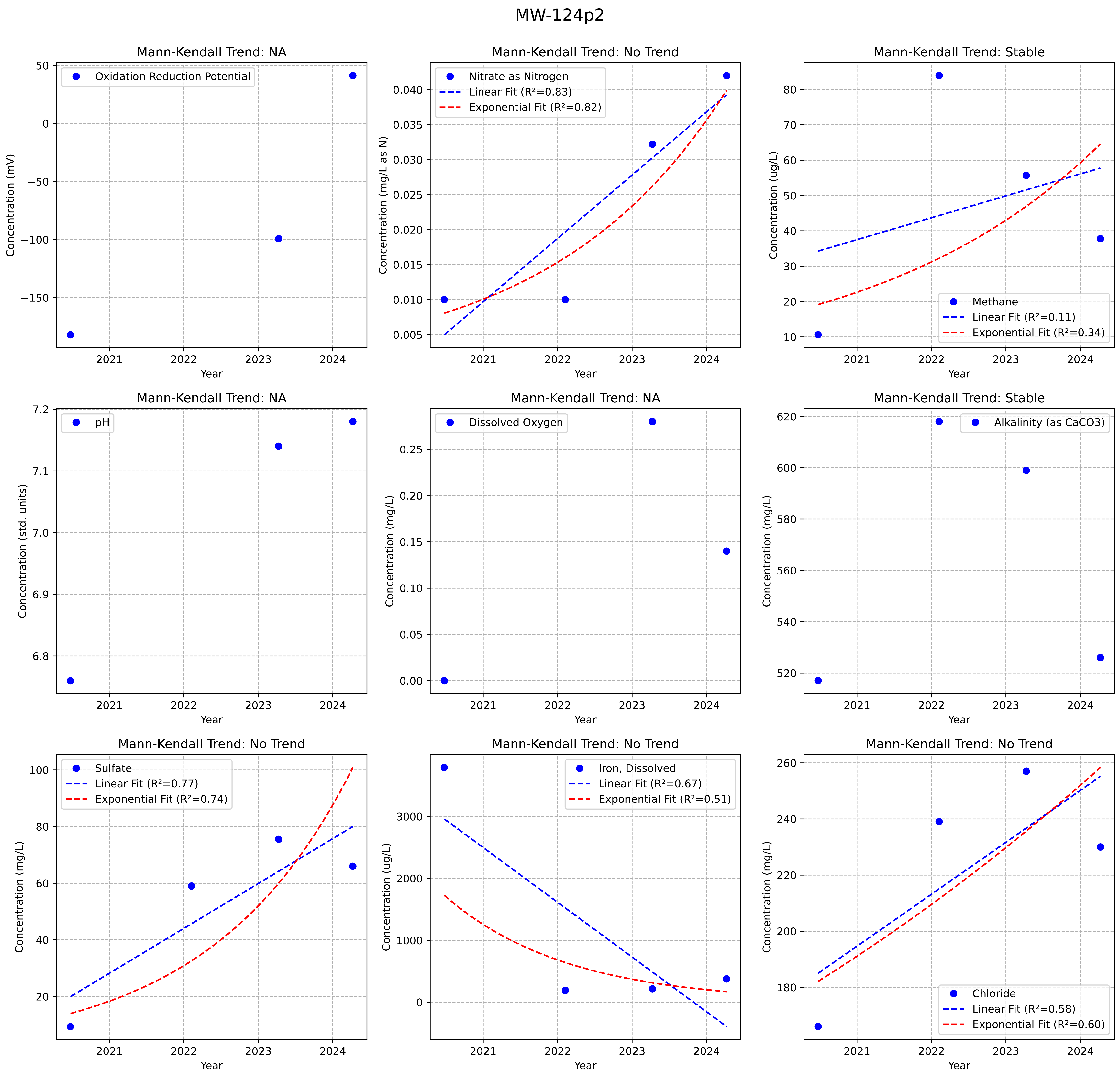

MW-115p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.27)
Exponential Fit (R²=0.32)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.32)
Concentration (ug/L)
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.54)
Exponential Fit (R²=0.27)
Concentration (mg/L)



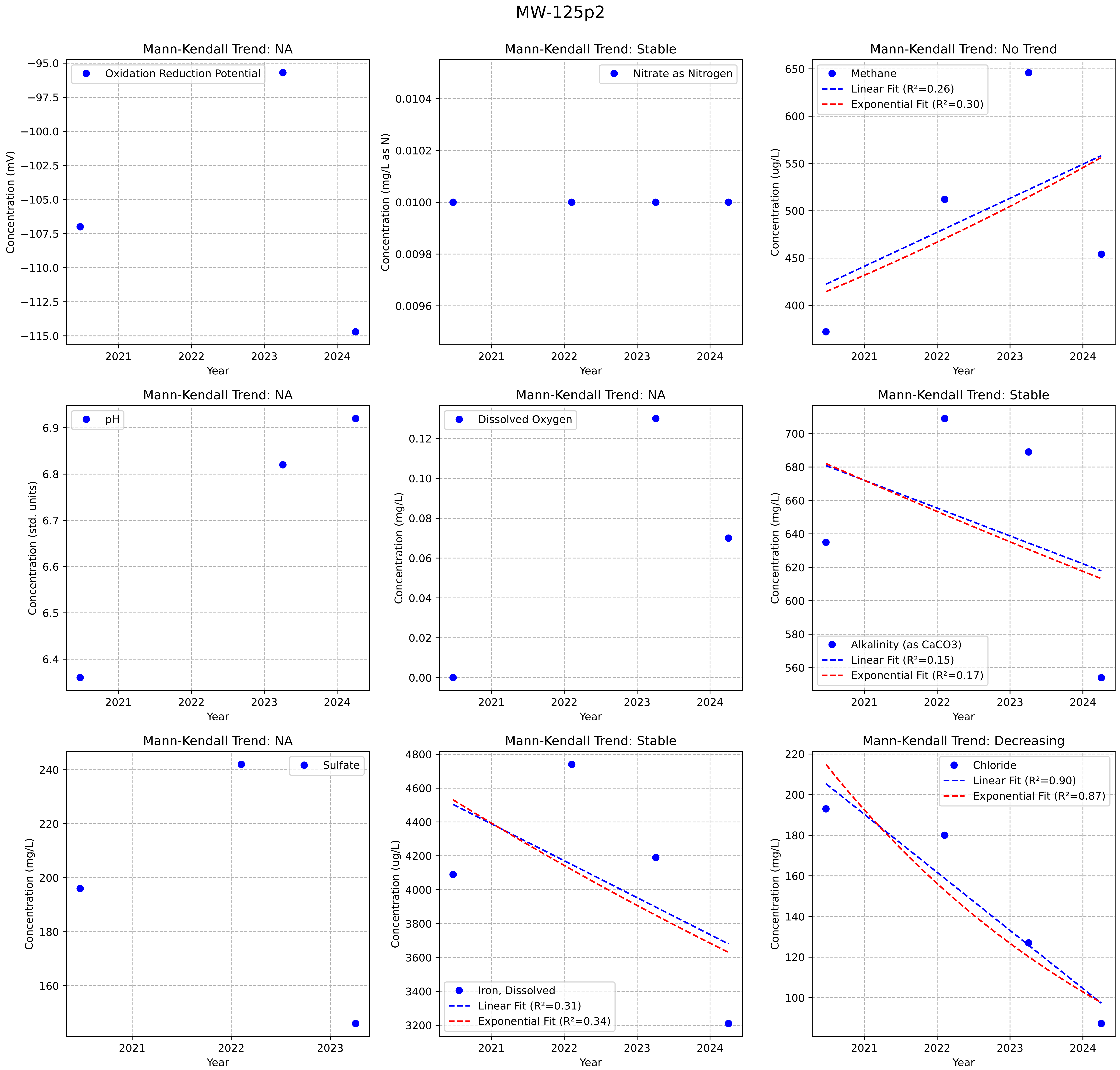
MW-118p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

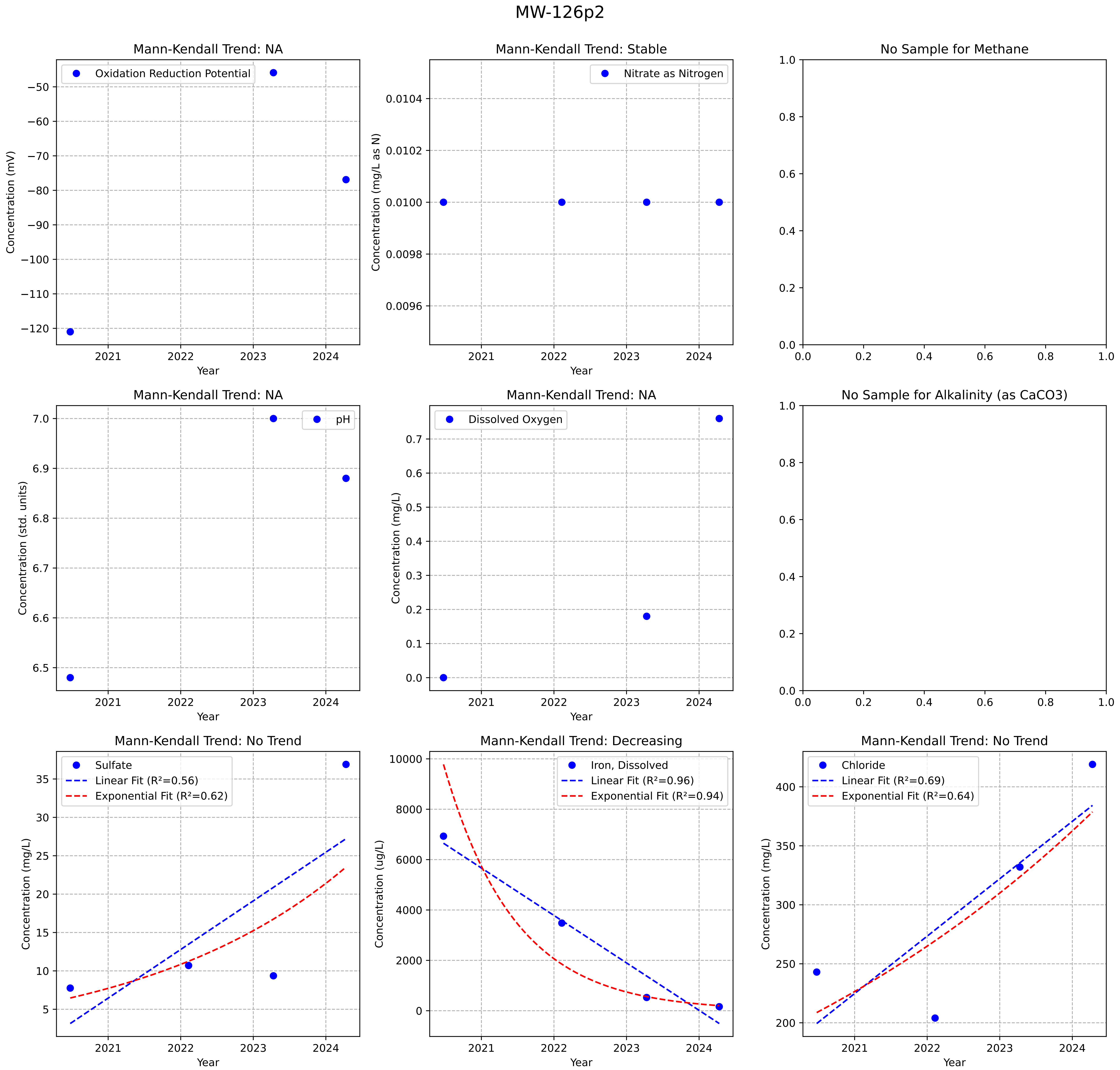
MW-122p2


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year



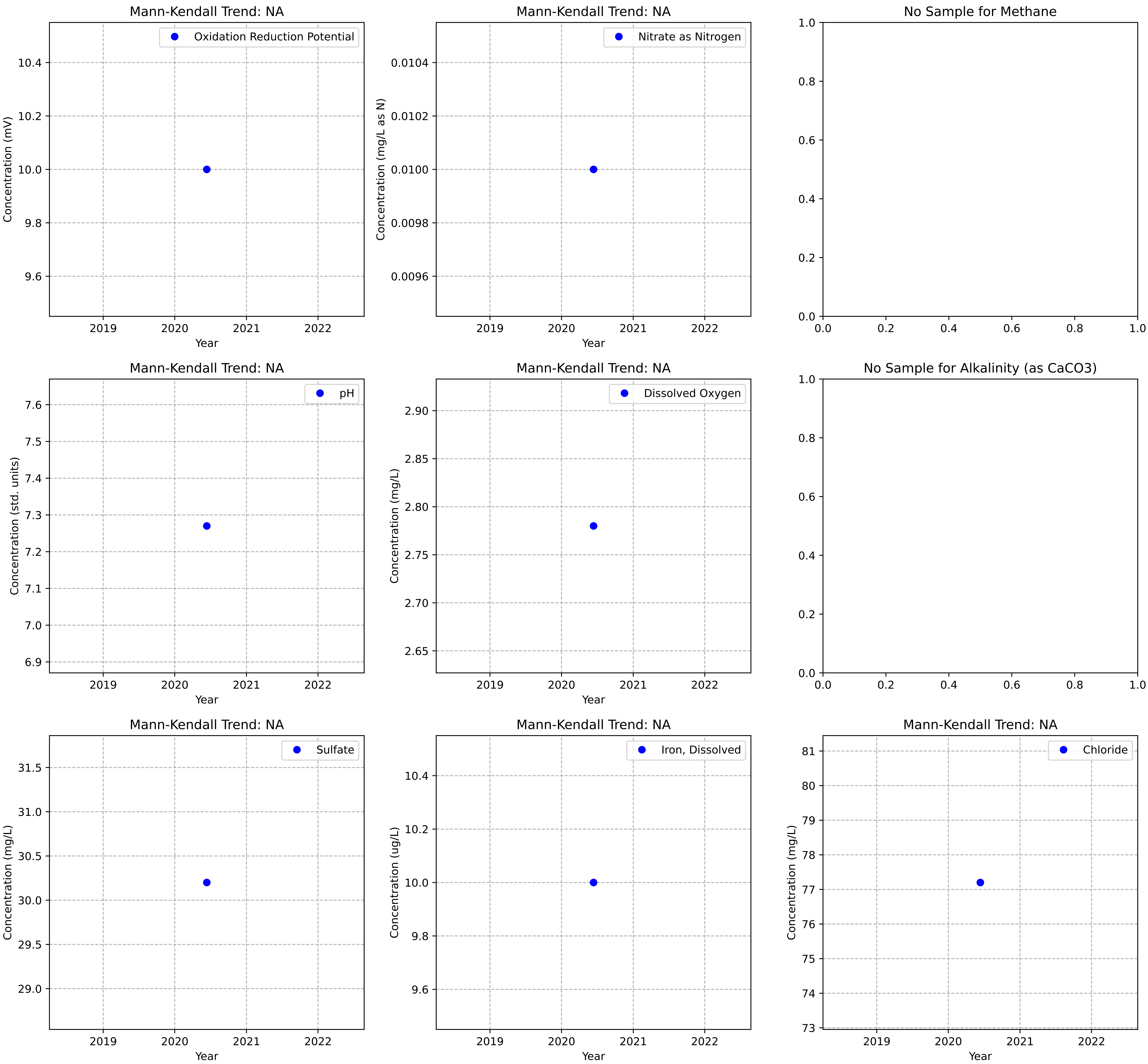
MW-124p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.83)
Exponential Fit (R²=0.82)
Concentration (mg/L as N)
Mann-Kendall Trend: Stable
Methane
Linear Fit (R²=0.11)
Exponential Fit (R²=0.34)
Concentration (ug/L)
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.77)
Exponential Fit (R²=0.74)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.67)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.58)
Exponential Fit (R²=0.60)
Concentration (mg/L)


MW-125p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: No Trend
Methane
Linear Fit (R²=0.26)
Exponential Fit (R²=0.30)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.15)
Exponential Fit (R²=0.17)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.31)
Exponential Fit (R²=0.34)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.90)
Exponential Fit (R²=0.87)
Concentration (mg/L)
Year



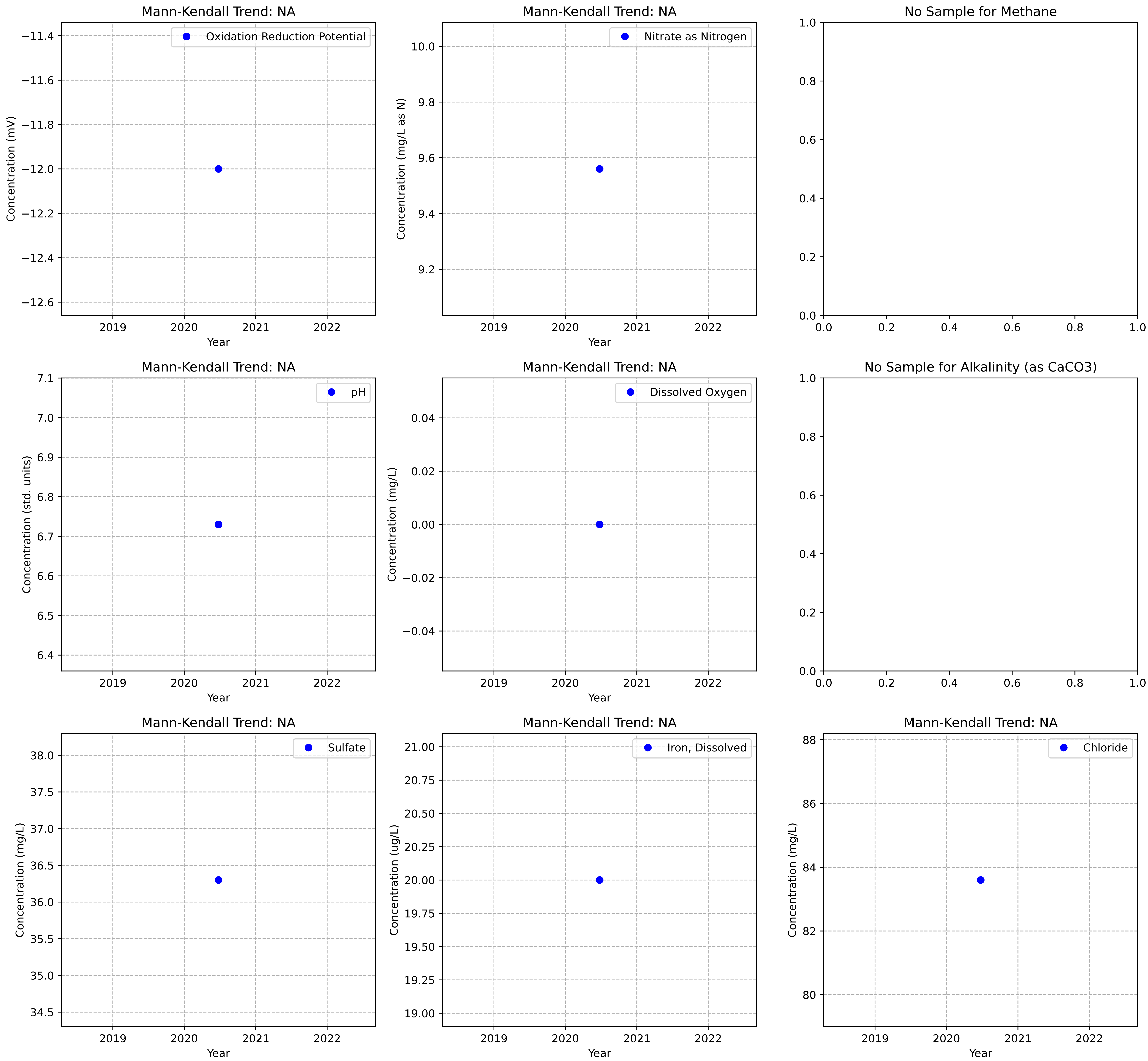
MW-126p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.56)
Exponential Fit (R²=0.62)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Iron, Dissolved
Linear Fit (R²=0.96)
Exponential Fit (R²=0.94)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.69)
Exponential Fit (R²=0.64)
Concentration (mg/L)
Year

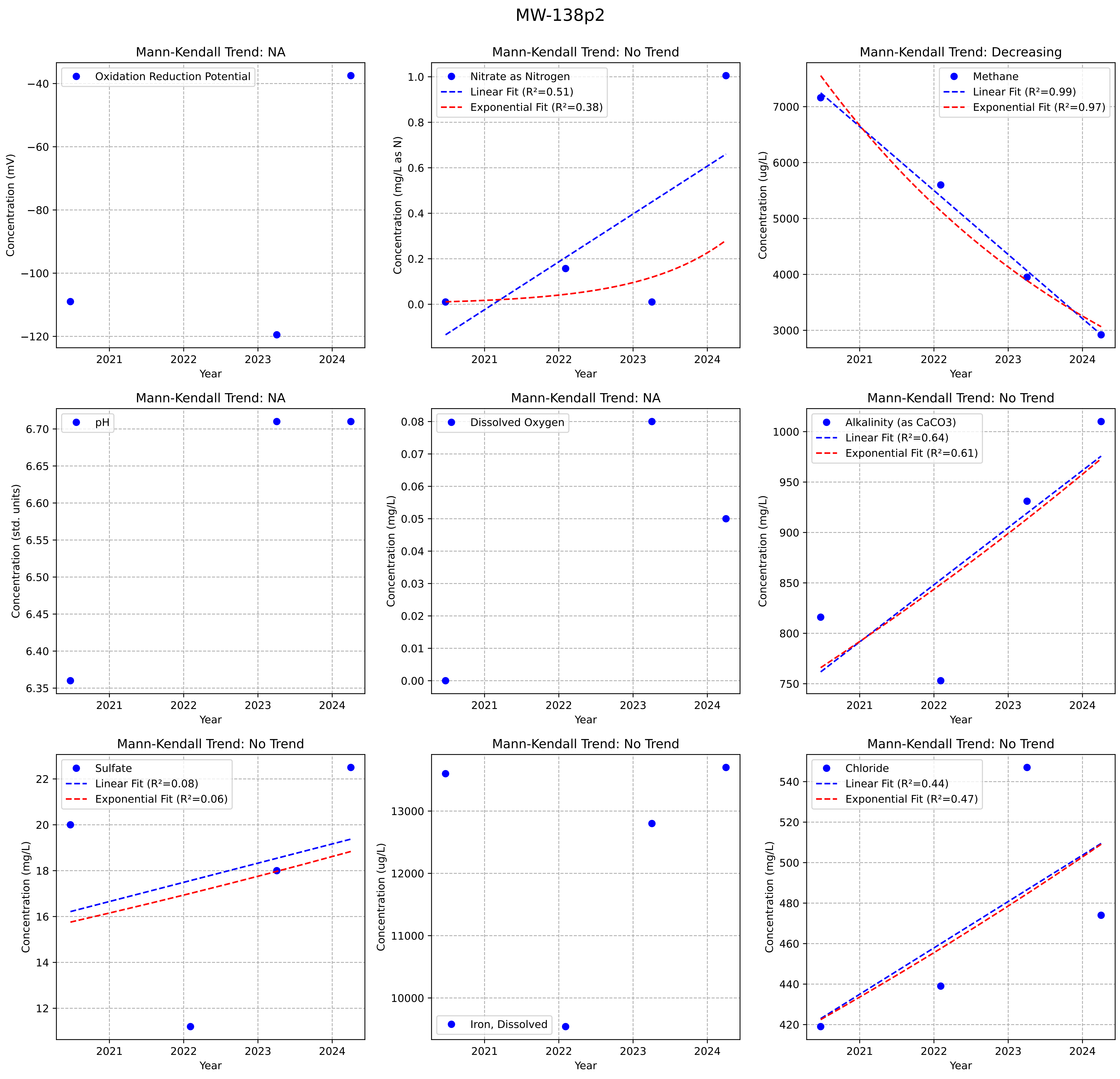
MW-131p2



Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

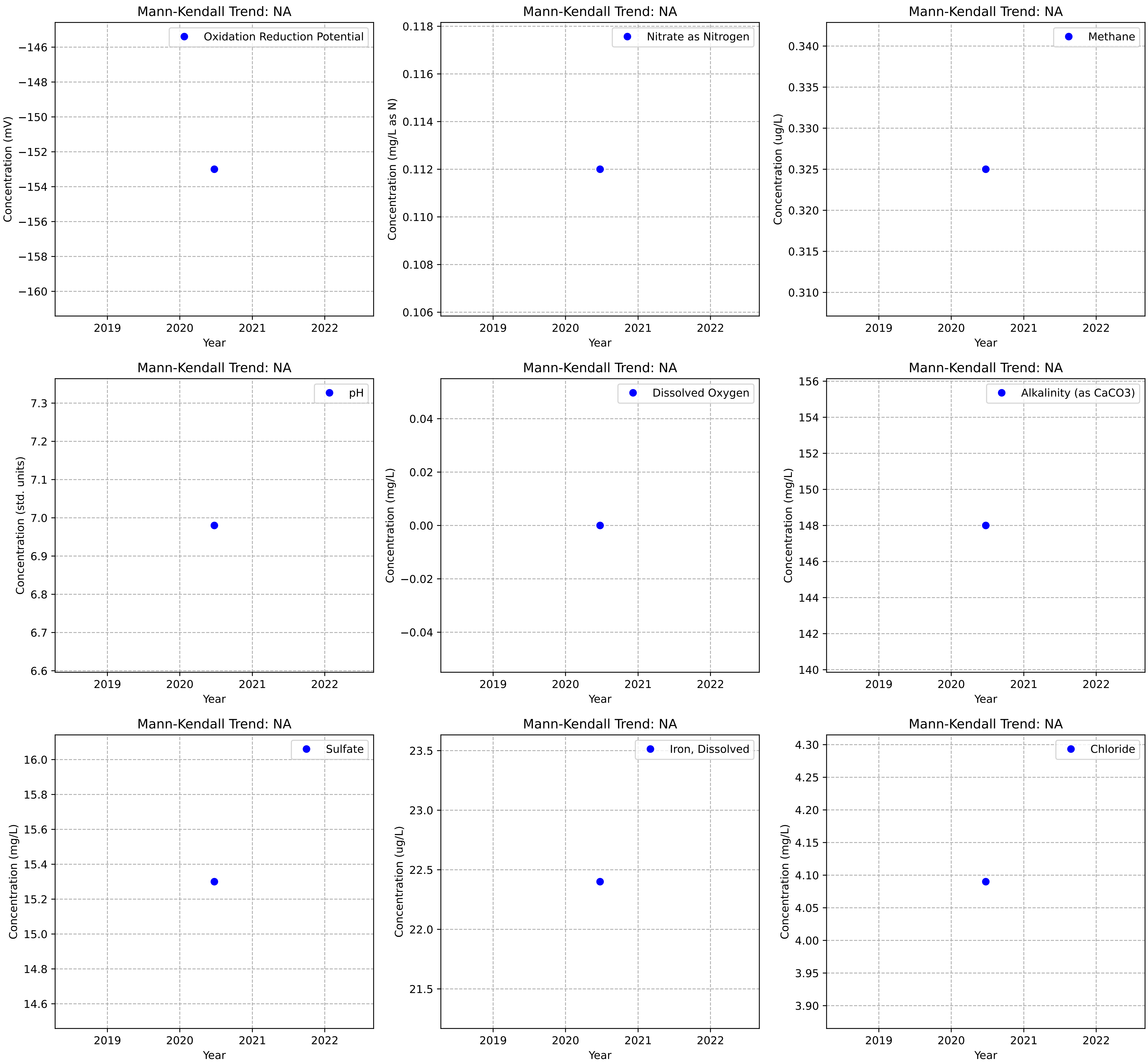
MW-136p2

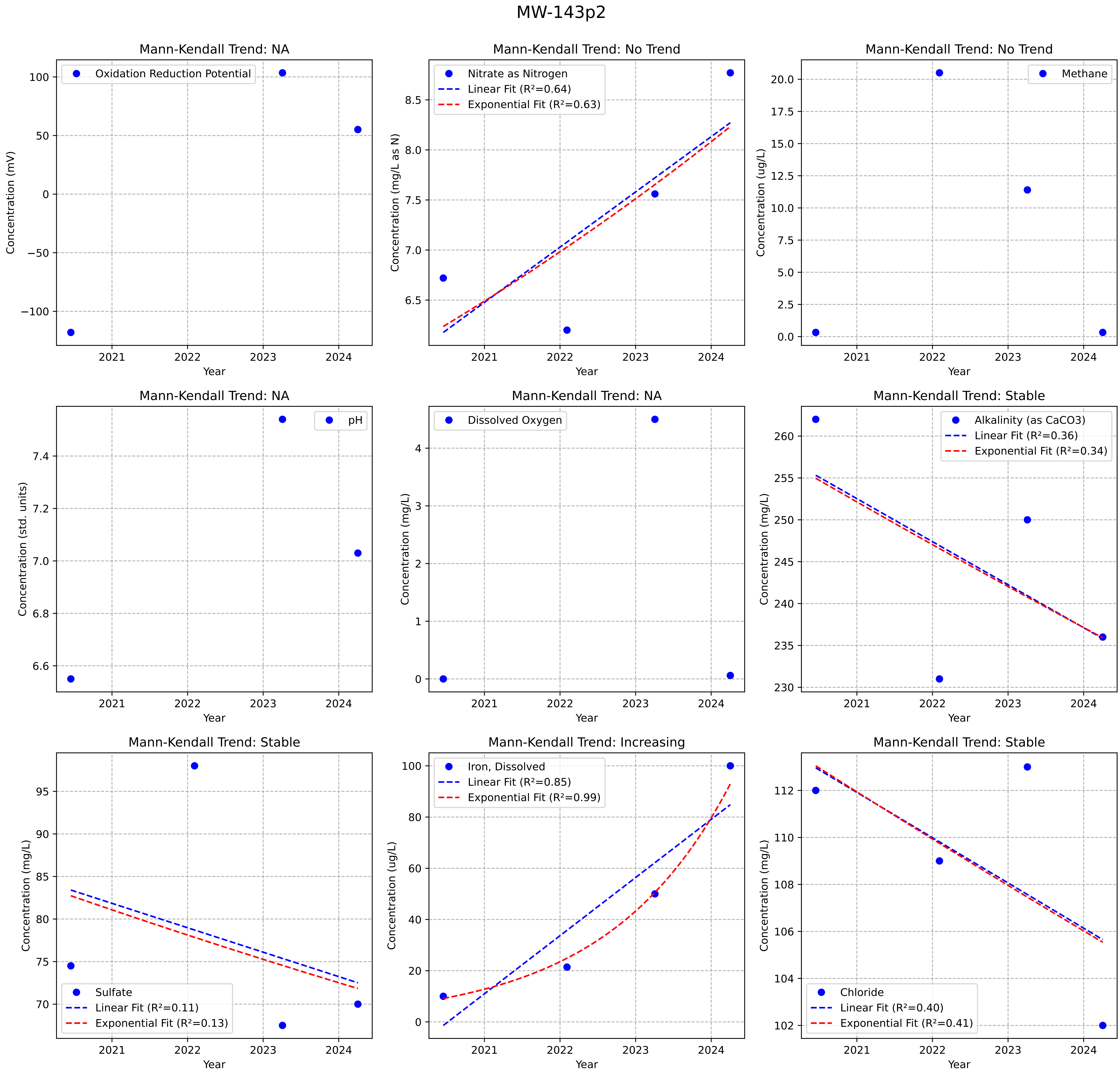

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year



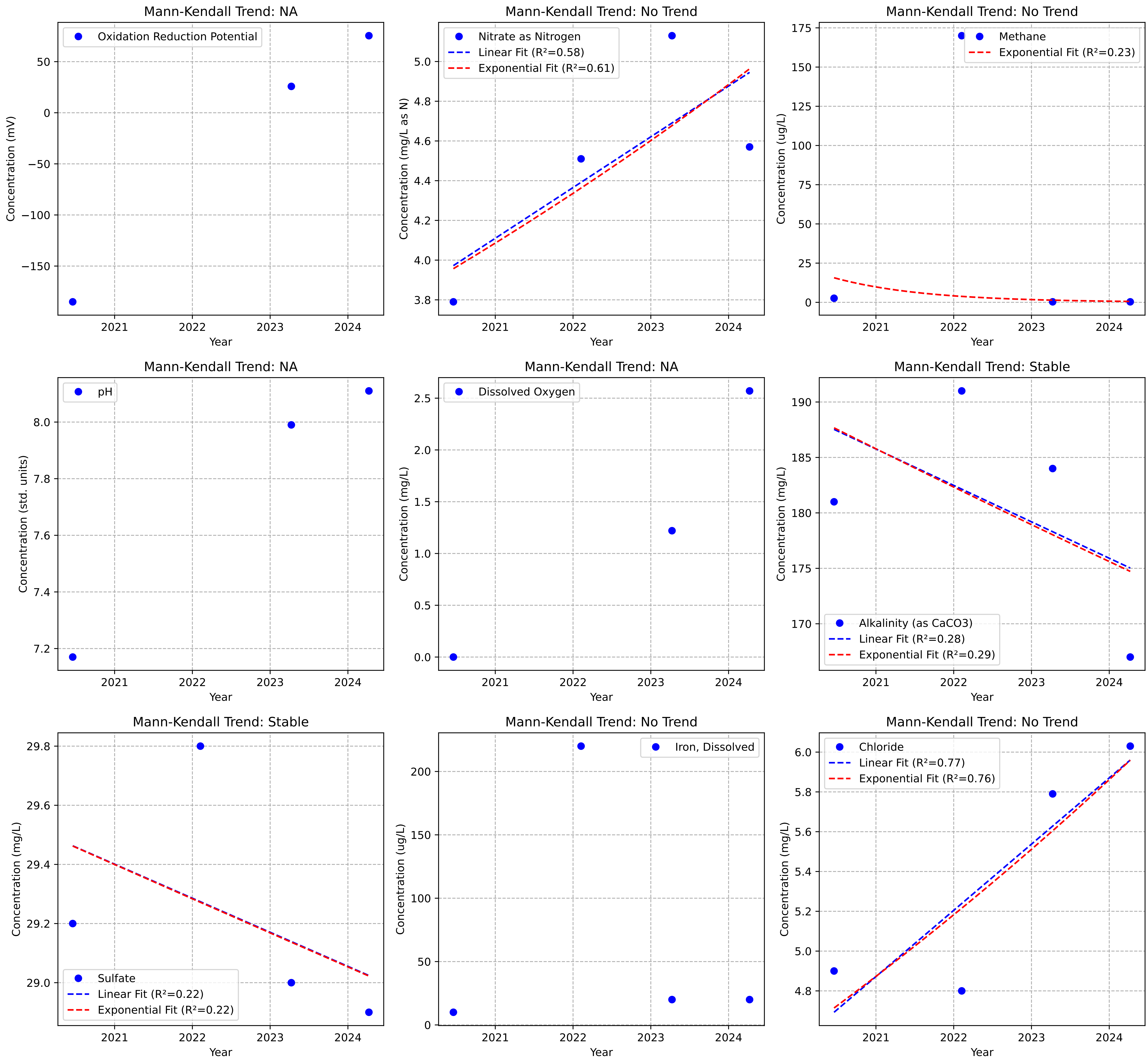
MW-138p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.51)
Exponential Fit (R²=0.38)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: Decreasing
Methane
Linear Fit (R²=0.99)
Exponential Fit (R²=0.97)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Alkalinity (as CaCO3)
Linear Fit (R²=0.64)
Exponential Fit (R²=0.61)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.08)
Exponential Fit (R²=0.06)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.44)
Exponential Fit (R²=0.47)
Concentration (mg/L)
Year

MW-141p2

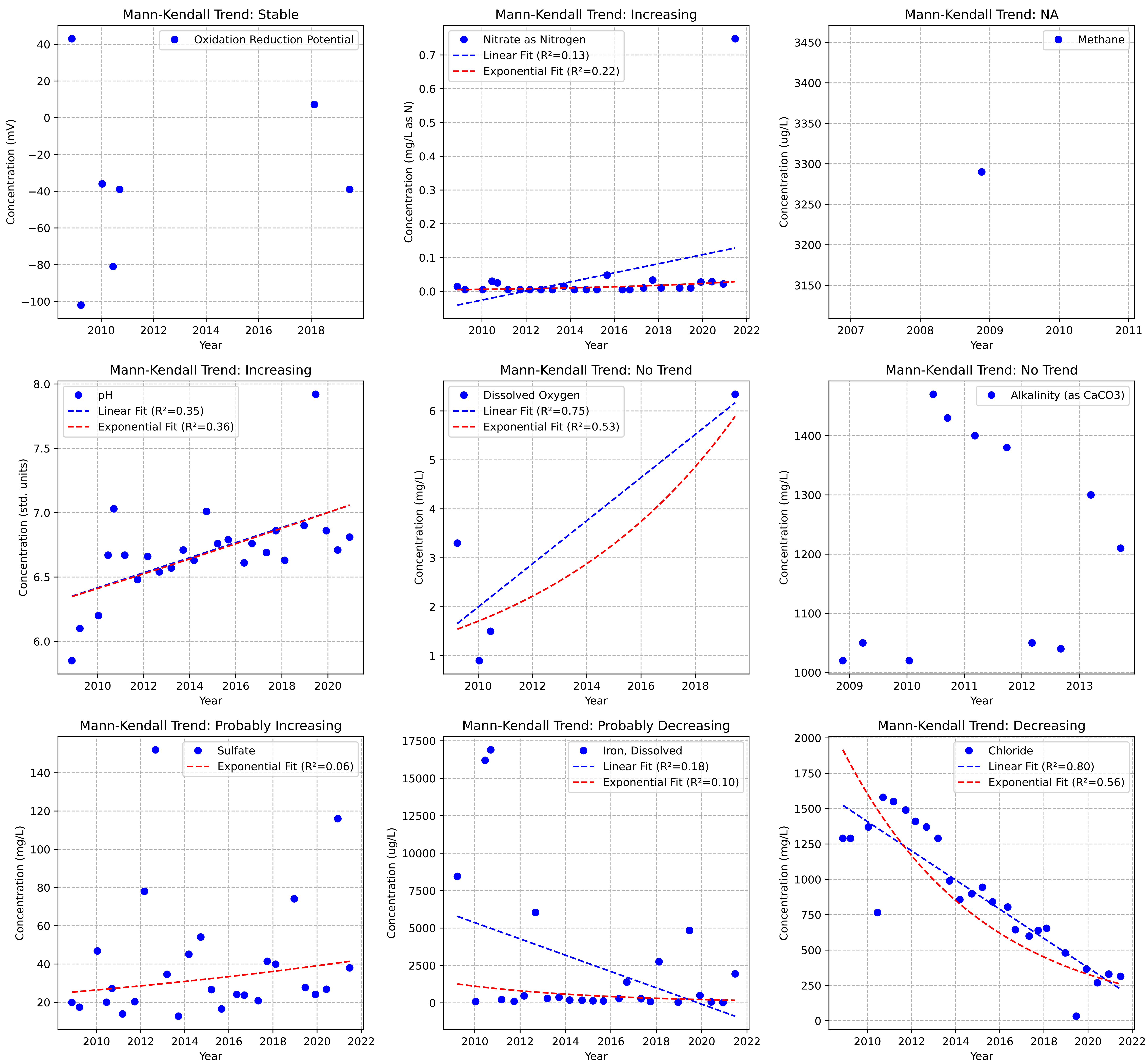

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

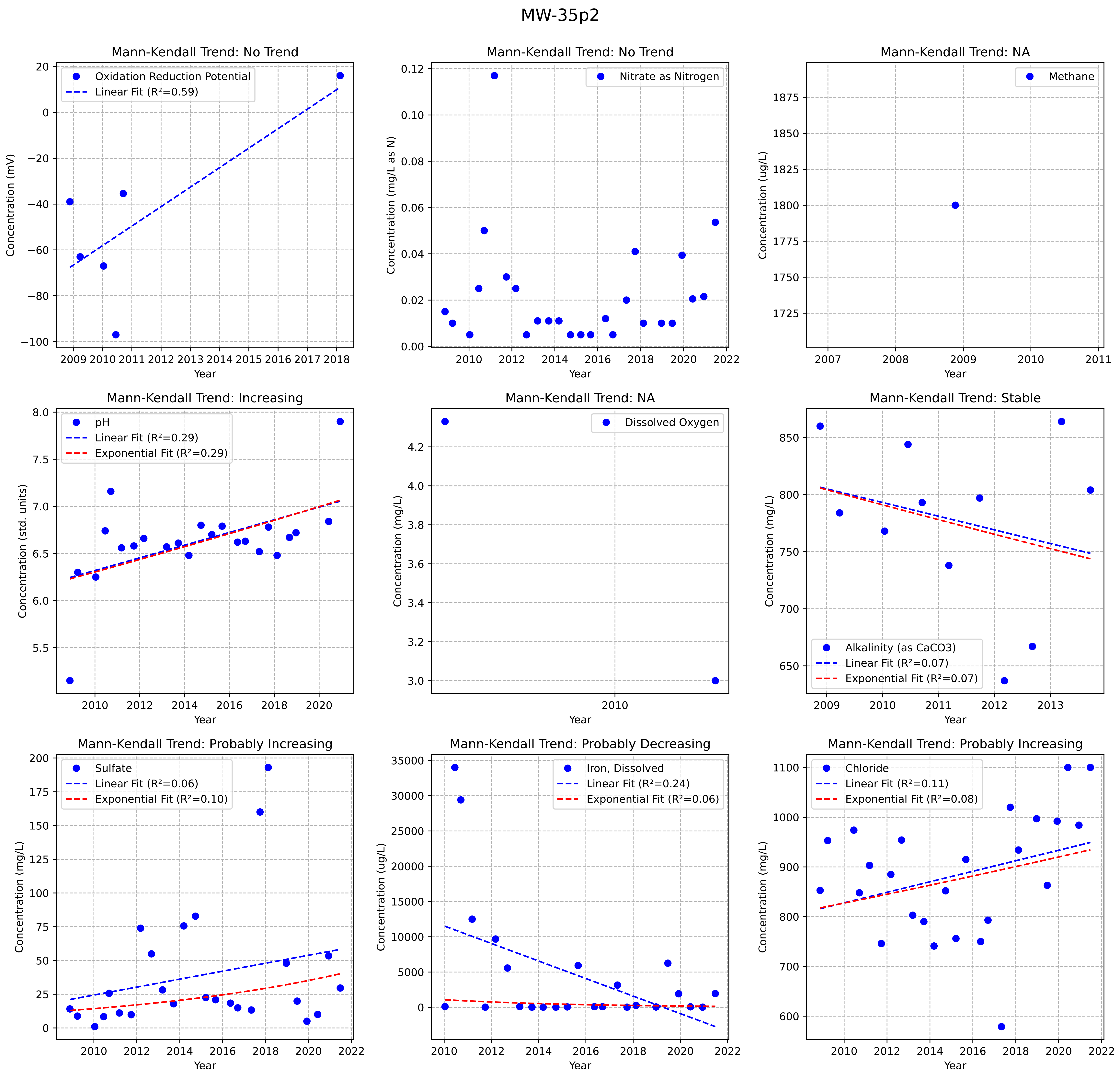

MW-143p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.64)
Exponential Fit (R²=0.63)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: No Trend
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.36)
Exponential Fit (R²=0.34)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.11)
Exponential Fit (R²=0.13)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Iron, Dissolved
Linear Fit (R²=0.85)
Exponential Fit (R²=0.99)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.40)
Exponential Fit (R²=0.41)
Concentration (mg/L)
Year

MW-147p2

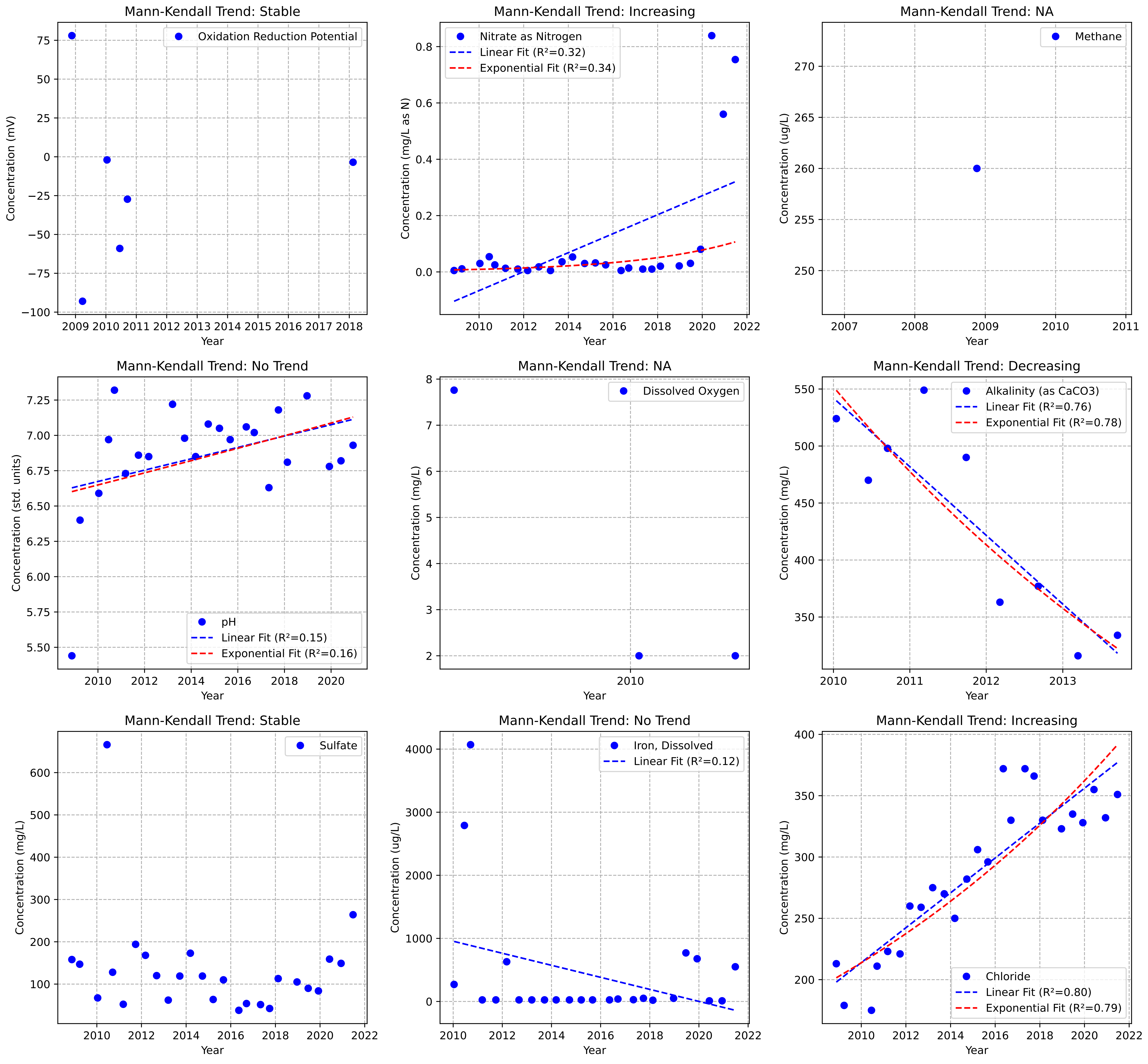

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.58)
Exponential Fit (R²=0.61)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: No Trend
Methane
Exponential Fit (R²=0.23)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.28)
Exponential Fit (R²=0.29)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.22)
Exponential Fit (R²=0.22)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.77)
Exponential Fit (R²=0.76)
Concentration (mg/L)
Year

MW-33p2


Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.13)
Exponential Fit (R²=0.22)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.35)
Exponential Fit (R²=0.36)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Linear Fit (R²=0.75)
Exponential Fit (R²=0.53)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Probably Increasing
Sulfate
Exponential Fit (R²=0.06)
Concentration (mg/L)
Year
Mann-Kendall Trend: Probably Decreasing
Iron, Dissolved
Linear Fit (R²=0.18)
Exponential Fit (R²=0.10)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.80)
Exponential Fit (R²=0.56)
Concentration (mg/L)
Year

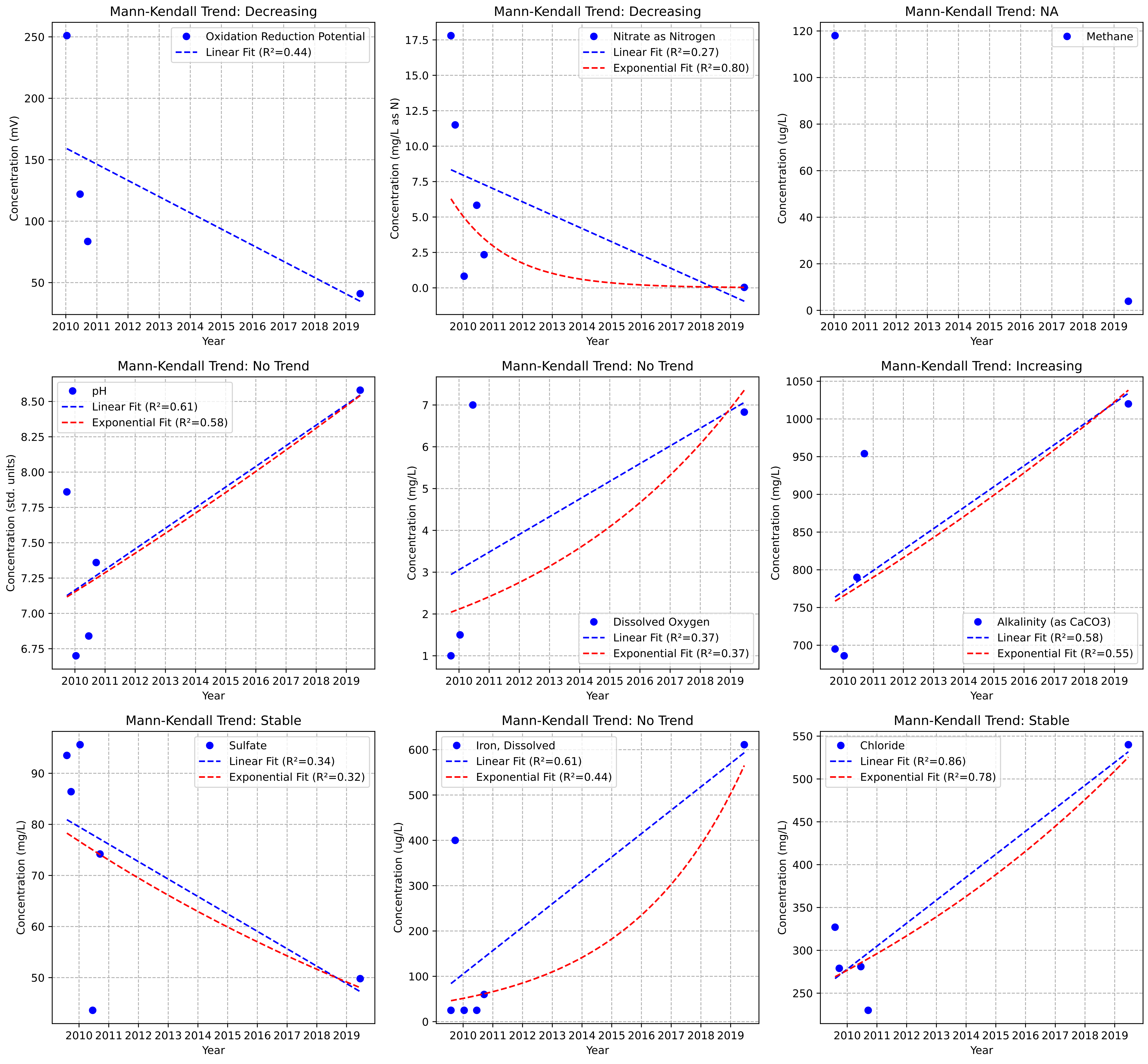

MW-35p2
Mann-Kendall Trend: No Trend
Oxidation Reduction Potential
Linear Fit (R²=0.59)
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.29)
Exponential Fit (R²=0.29)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.07)
Exponential Fit (R²=0.07)
Concentration (mg/L)
Year
Mann-Kendall Trend: Probably Increasing
Sulfate
Linear Fit (R²=0.06)
Exponential Fit (R²=0.10)
Concentration (mg/L)
Year
Mann-Kendall Trend: Probably Decreasing
Iron, Dissolved
Linear Fit (R²=0.24)
Exponential Fit (R²=0.06)
Concentration (ug/L)
Year
Mann-Kendall Trend: Probably Increasing
Chloride
Linear Fit (R²=0.11)
Exponential Fit (R²=0.08)
Concentration (mg/L)
Year

MW-38p2

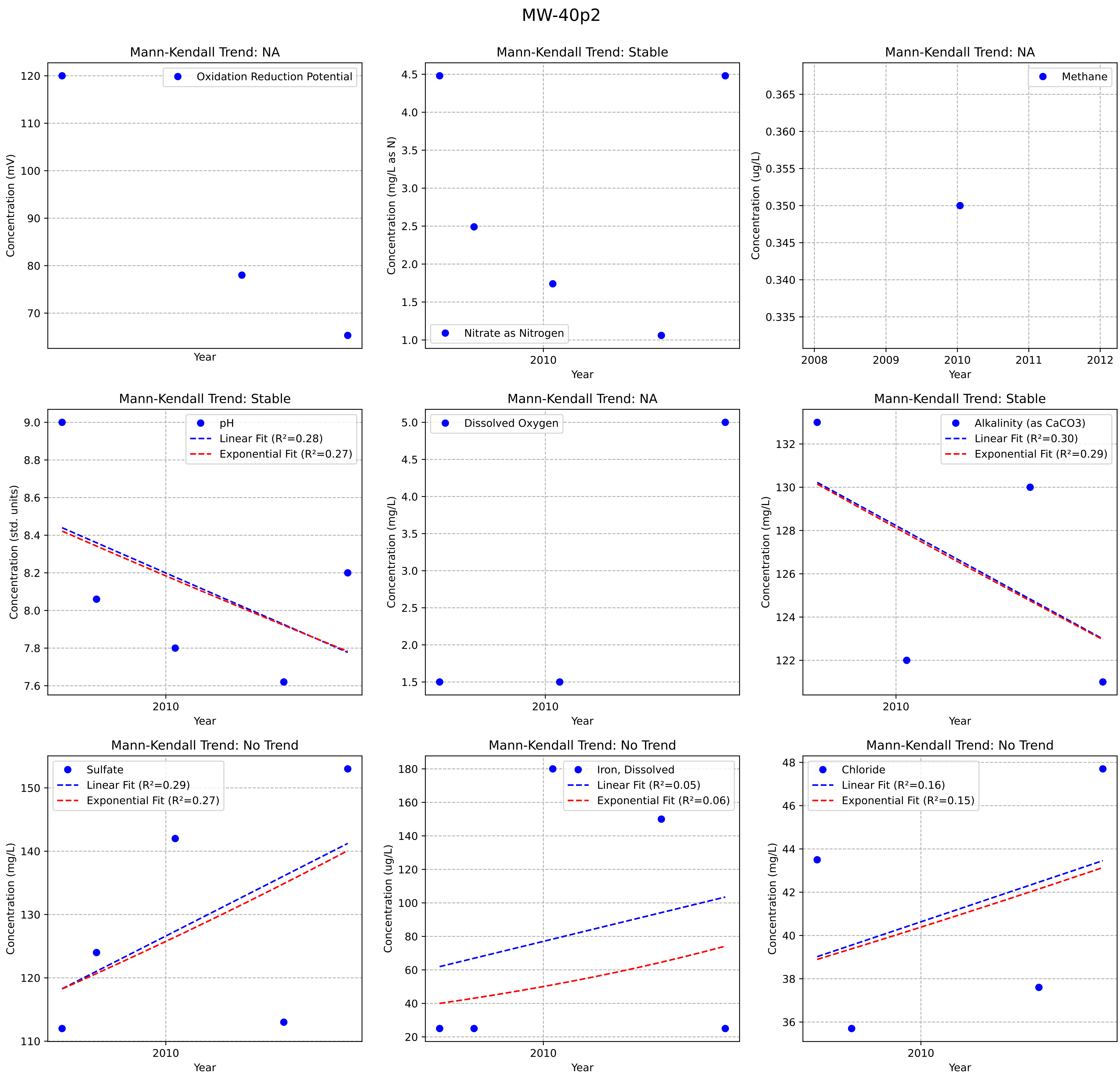


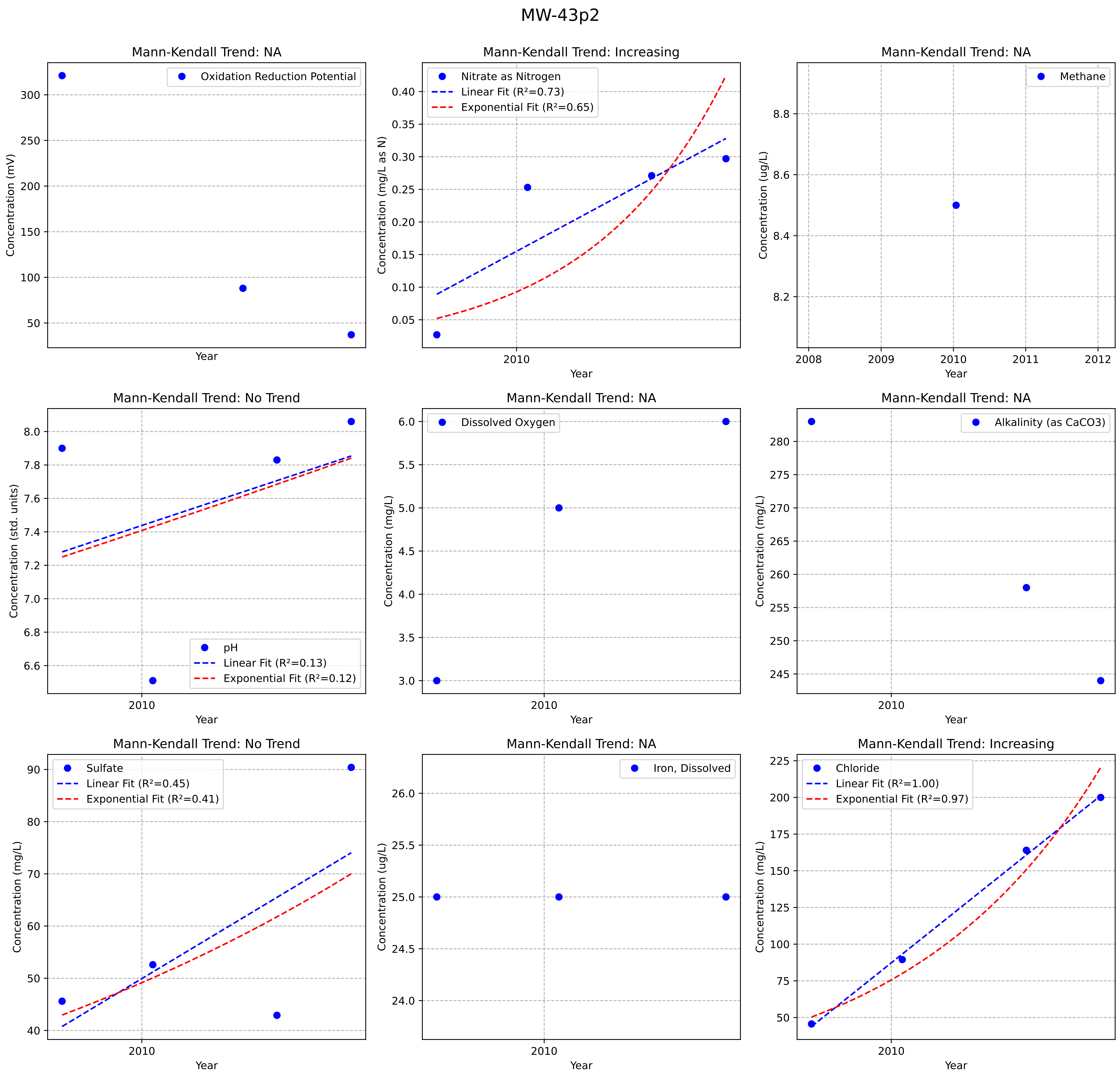
Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.32)
Exponential Fit (R²=0.34)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.15)
Exponential Fit (R²=0.16)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.76)
Exponential Fit (R²=0.78)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.12)
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
Chloride
Linear Fit (R²=0.80)
Exponential Fit (R²=0.79)
Concentration (mg/L)
Year

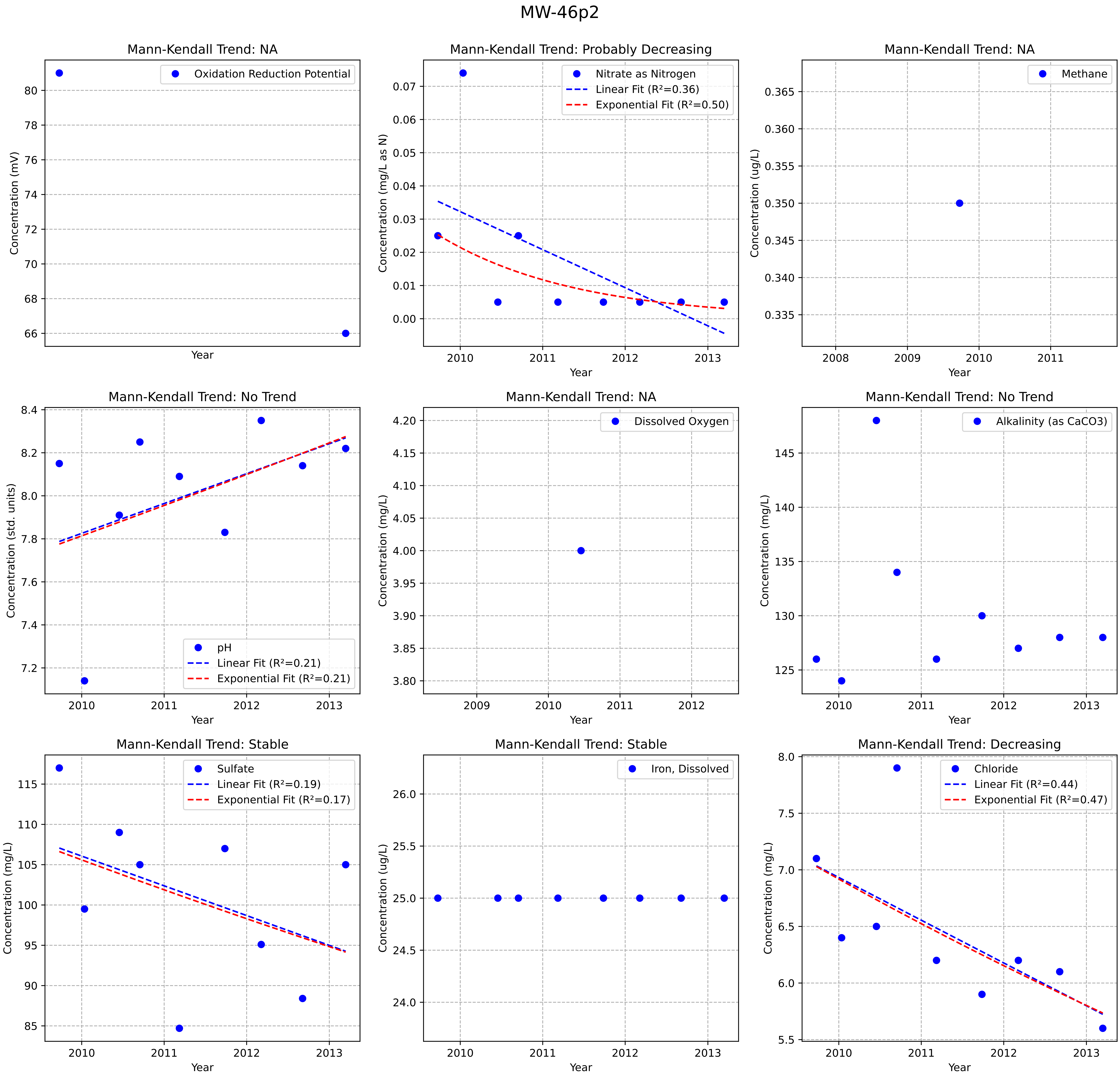
MW-39p2



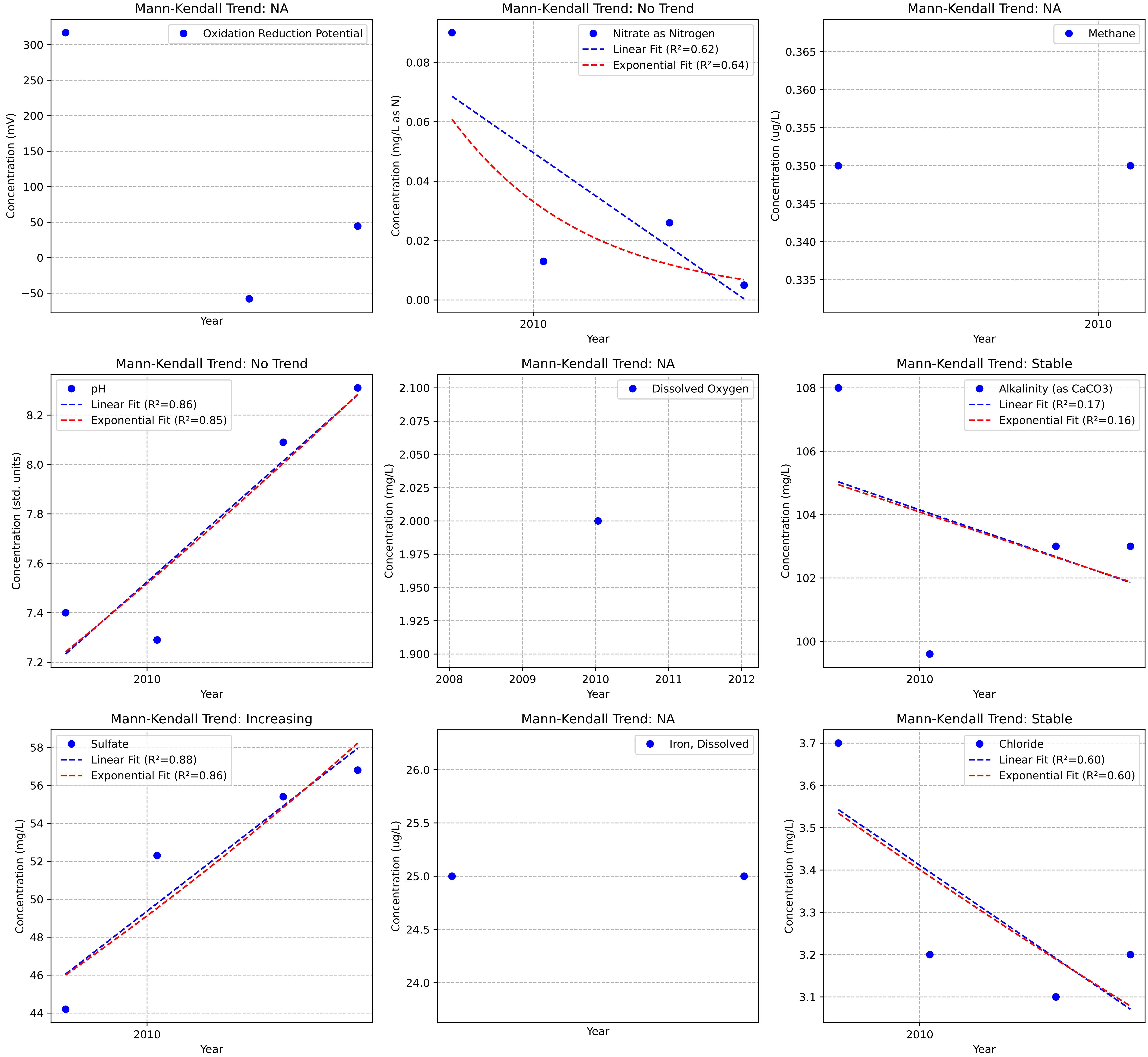
Mann-Kendall Trend: Decreasing
Oxidation Reduction Potential
Linear Fit (R²=0.44)
Concentration (mV)
Year
Mann-Kendall Trend: Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.27)
Exponential Fit (R²=0.80)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.61)
Exponential Fit (R²=0.58)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Linear Fit (R²=0.37)
Exponential Fit (R²=0.37)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.58)
Exponential Fit (R²=0.55)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.34)
Exponential Fit (R²=0.32)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.61)
Exponential Fit (R²=0.44)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.86)
Exponential Fit (R²=0.78)
Concentration (mg/L)
Year


MW-40p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
pH
Linear Fit (R²=0.28)
Exponential Fit (R²=0.27)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.30)
Exponential Fit (R²=0.29)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.29)
Exponential Fit (R²=0.27)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.05)
Exponential Fit (R²=0.06)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.16)
Exponential Fit (R²=0.15)
Concentration (mg/L)
Year

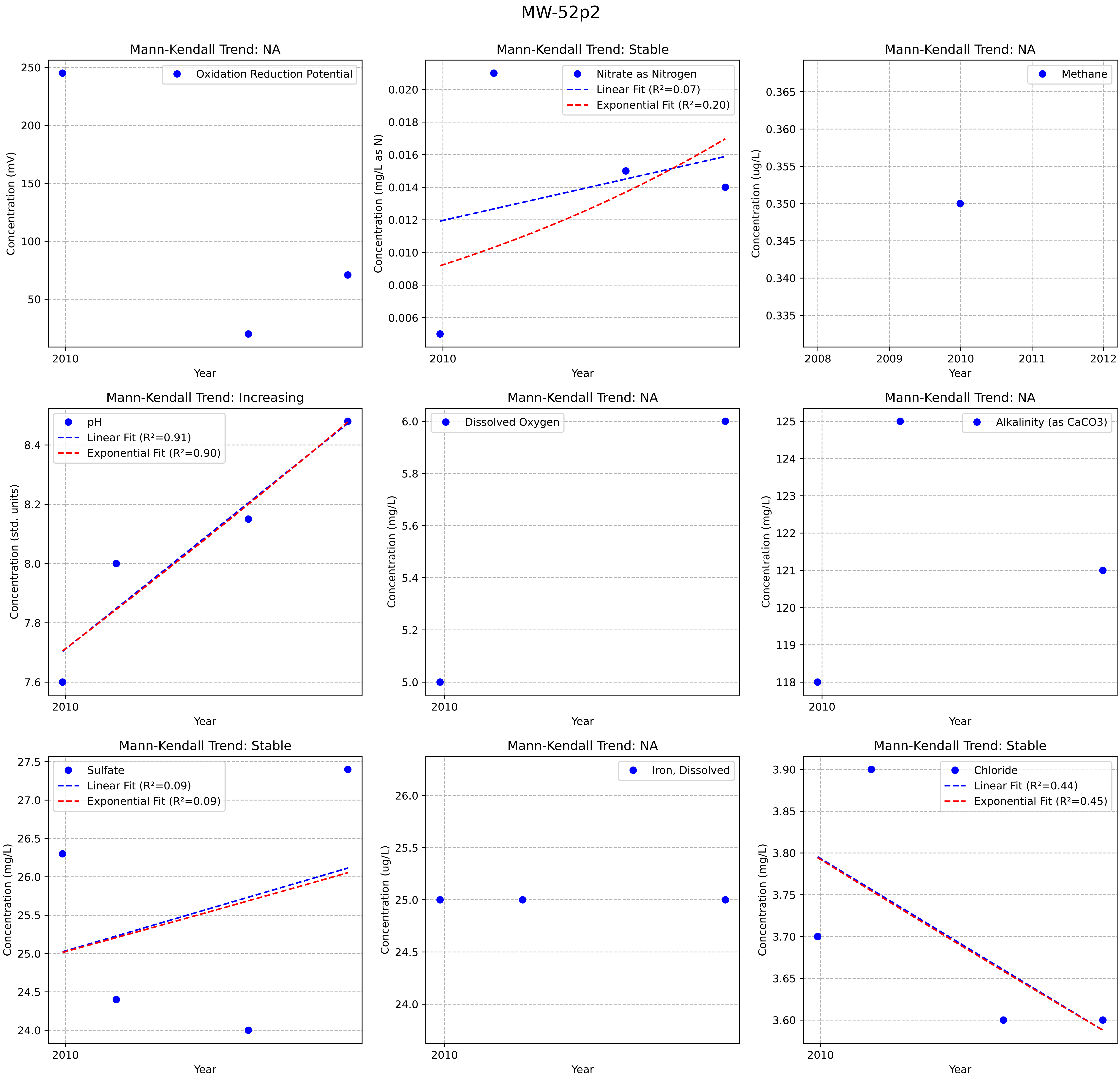

MW-43p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.73)
Exponential Fit (R²=0.65)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.13)
Exponential Fit (R²=0.12)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.45)
Exponential Fit (R²=0.41)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
Chloride
Linear Fit (R²=1.00)
Exponential Fit (R²=0.97)
Concentration (mg/L)
Year

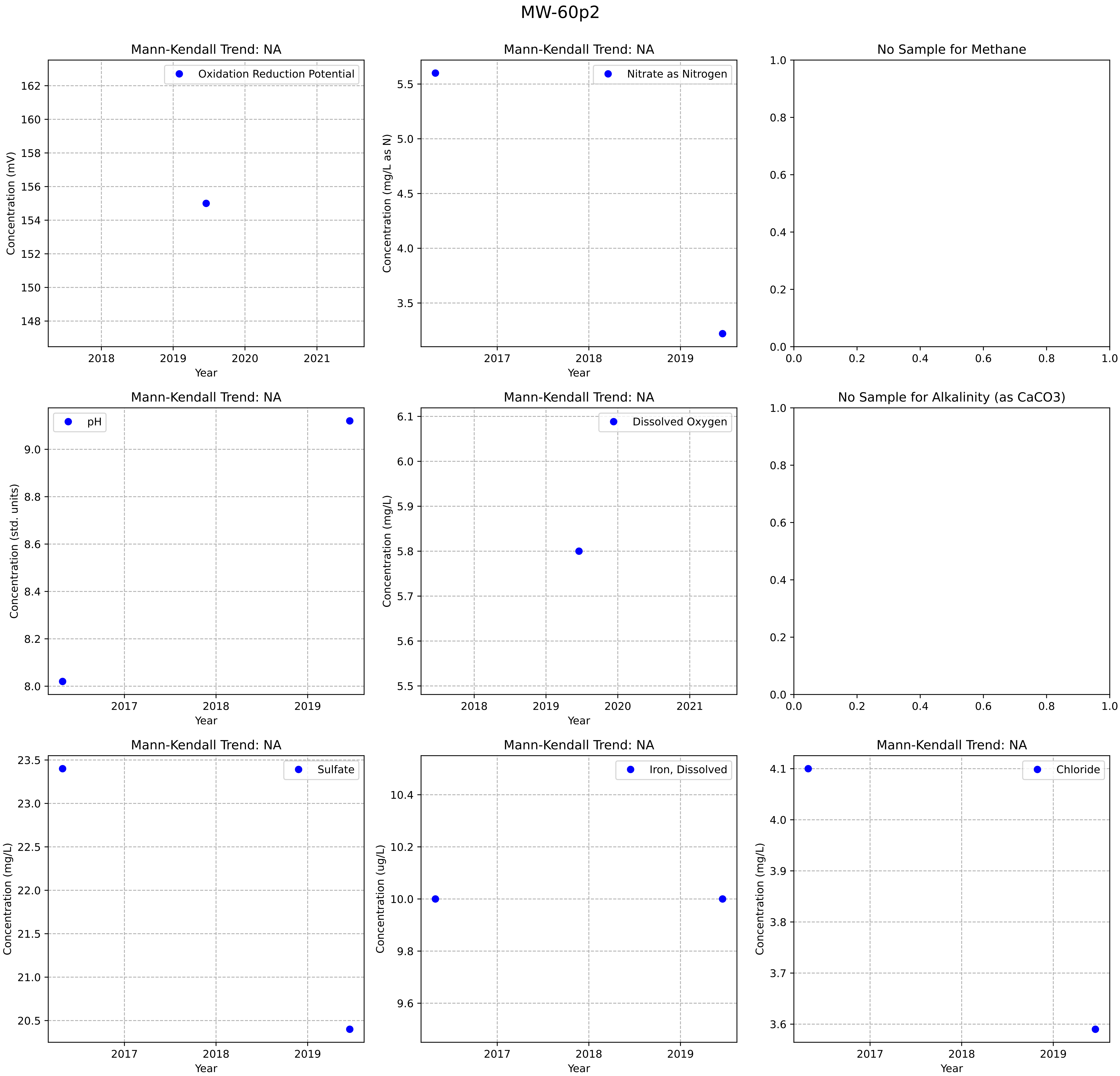

MW-46p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Probably Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.36)
Exponential Fit (R²=0.50)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.21)
Exponential Fit (R²=0.21)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.19)
Exponential Fit (R²=0.17)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.44)
Exponential Fit (R²=0.47)
Concentration (mg/L)
Year

MW-49p2

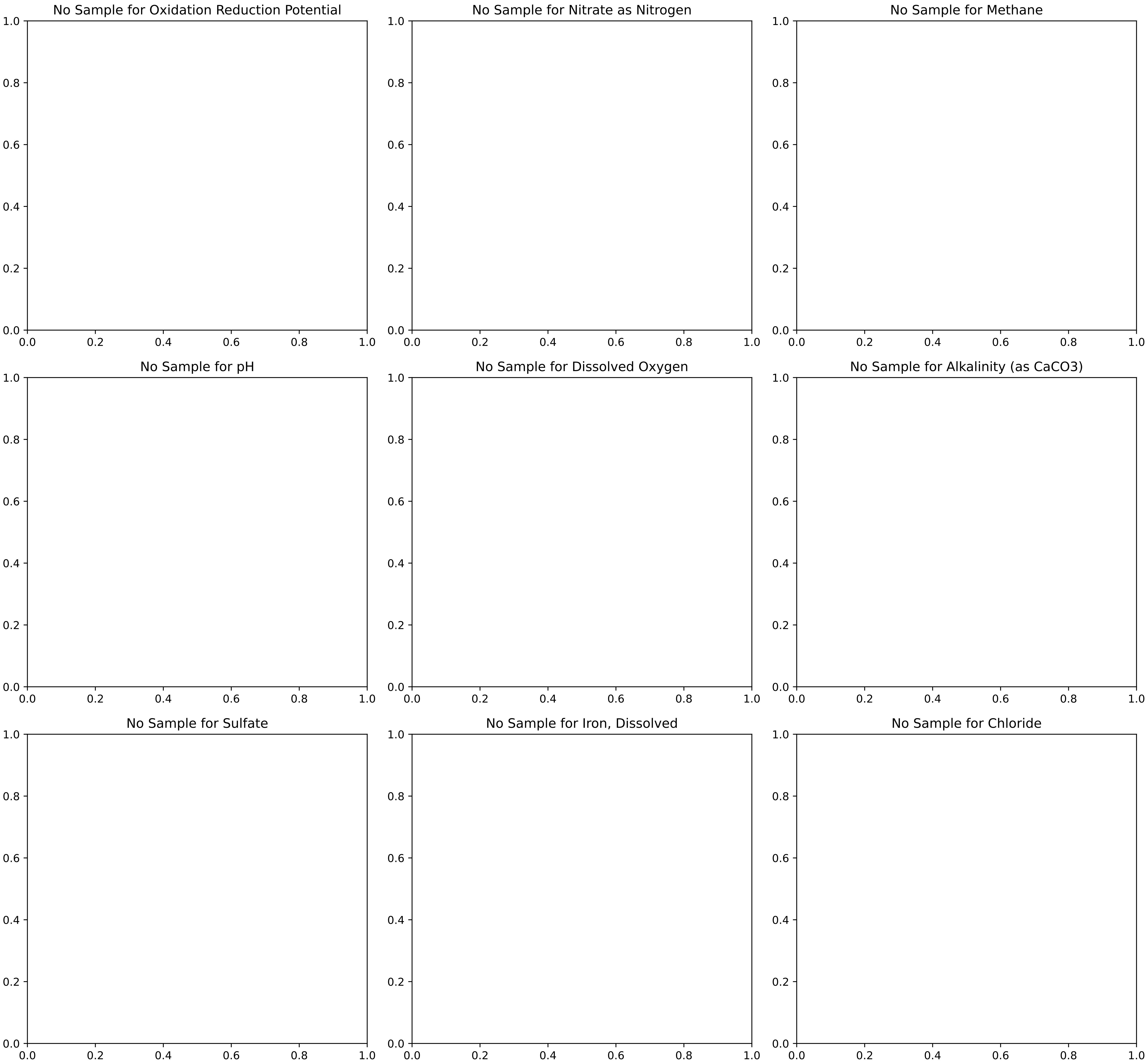


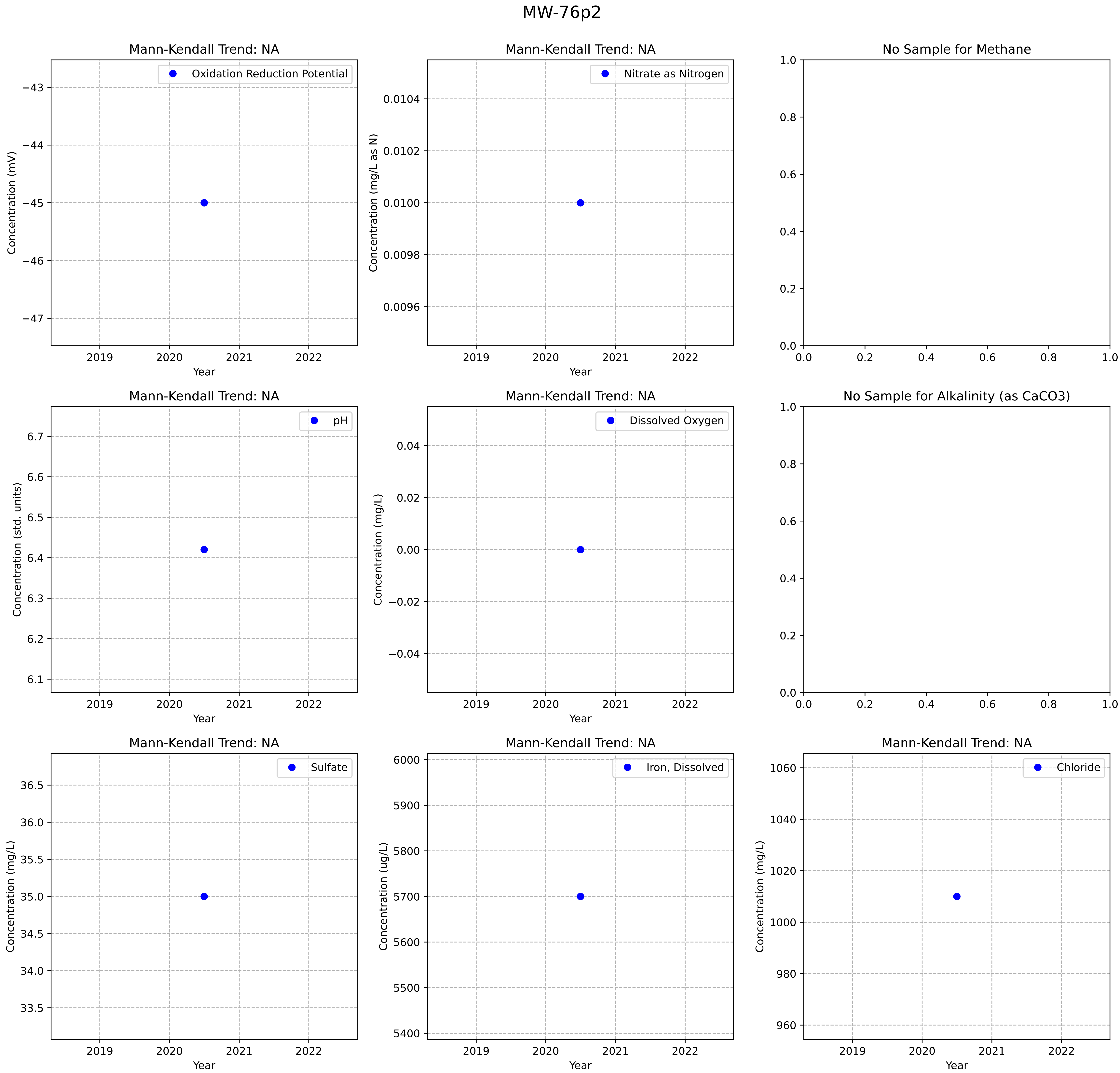
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.62)
Exponential Fit (R²=0.64)
Concentration (mg/L as N)
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.86)
Exponential Fit (R²=0.85)
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.17)
Exponential Fit (R²=0.16)
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.88)
Exponential Fit (R²=0.86)
Mann-Kendall Trend: NA
Iron, Dissolved
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.60)
Exponential Fit (R²=0.60)


MW-52p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
2010
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.07)
Exponential Fit (R²=0.20)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.91)
Exponential Fit (R²=0.90)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.44)
Exponential Fit (R²=0.45)
Concentration (mg/L)
Year

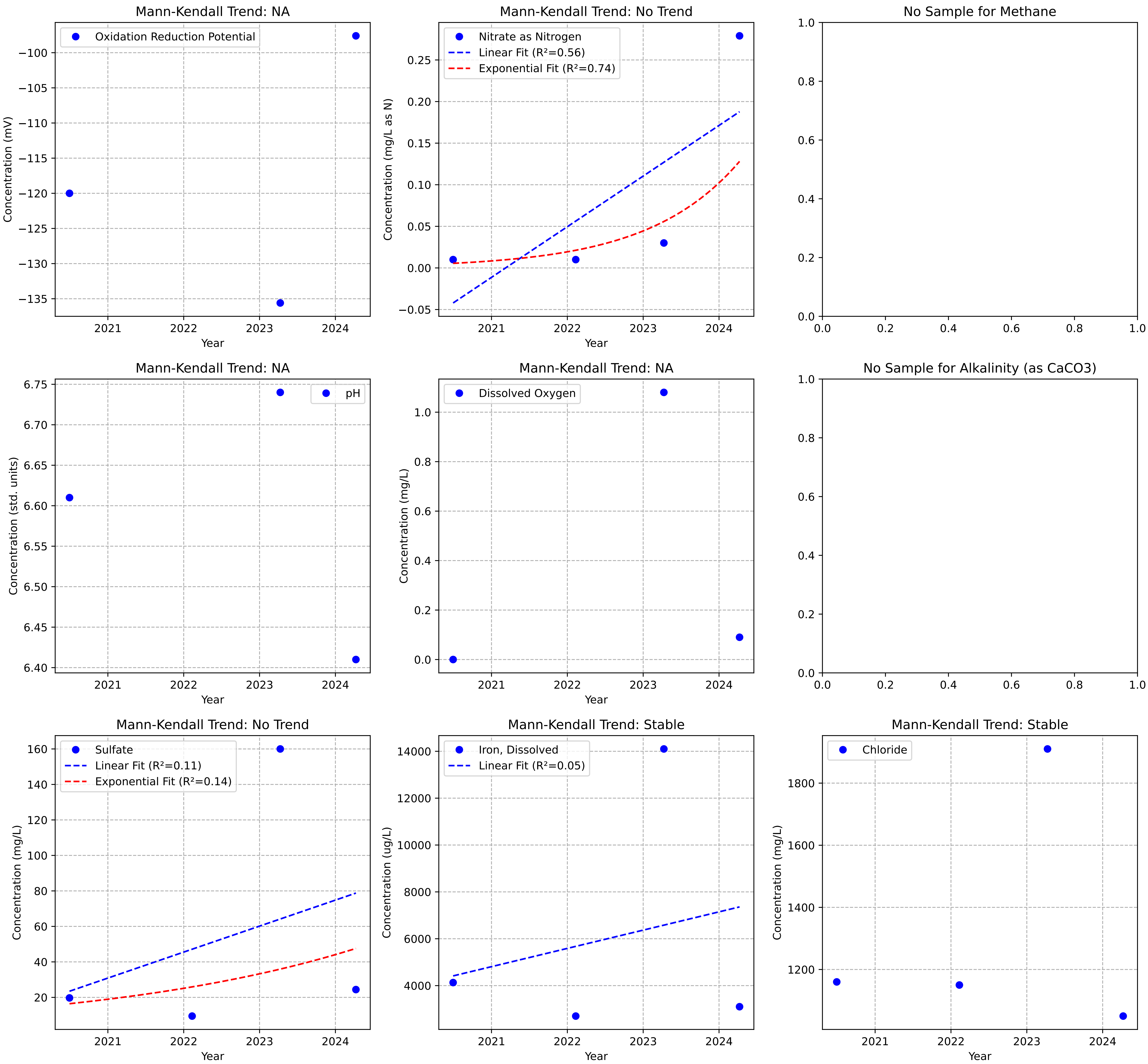

MW-60p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

No Data for MW-73p2



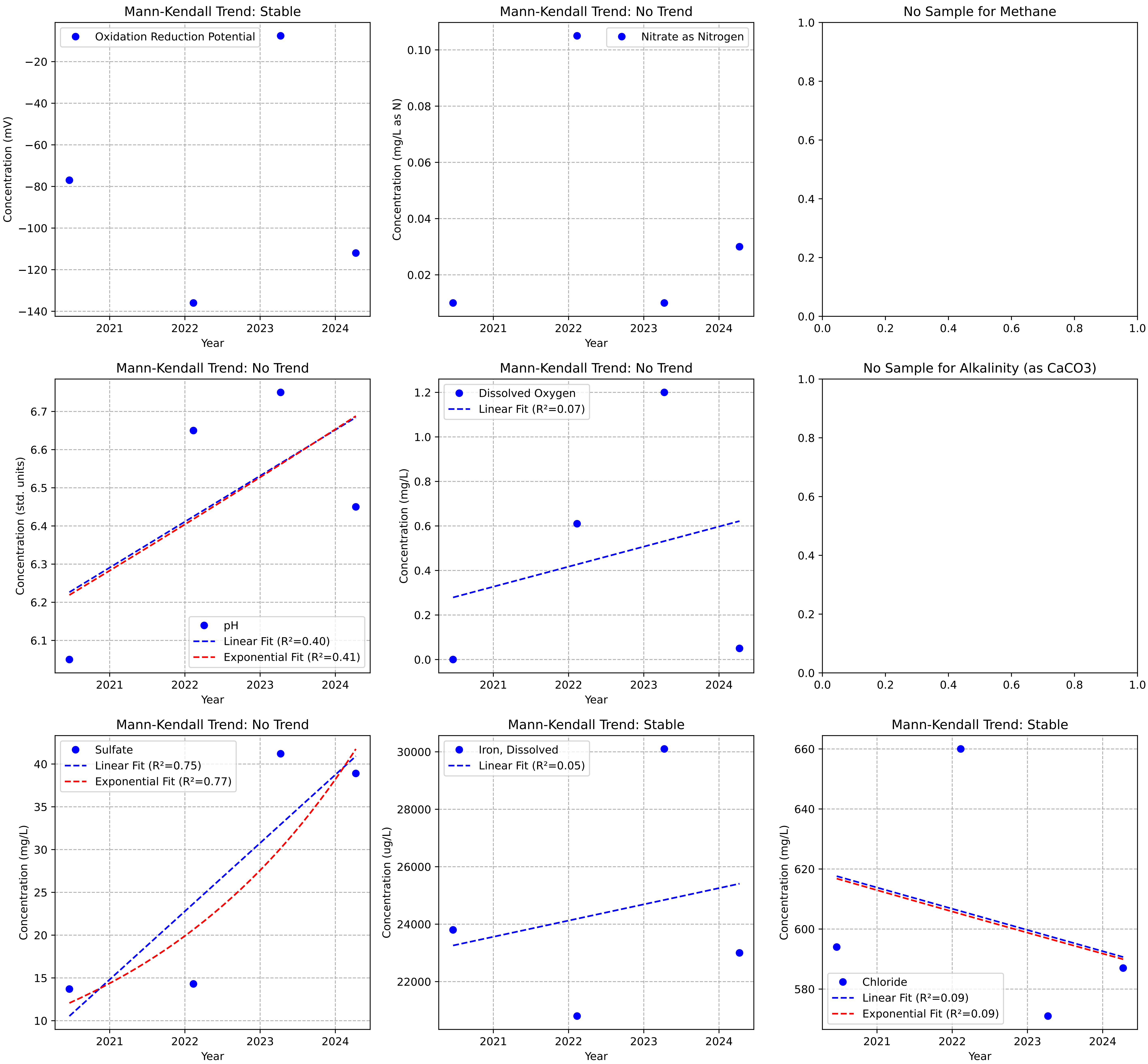

MW-76p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

MW-80p2

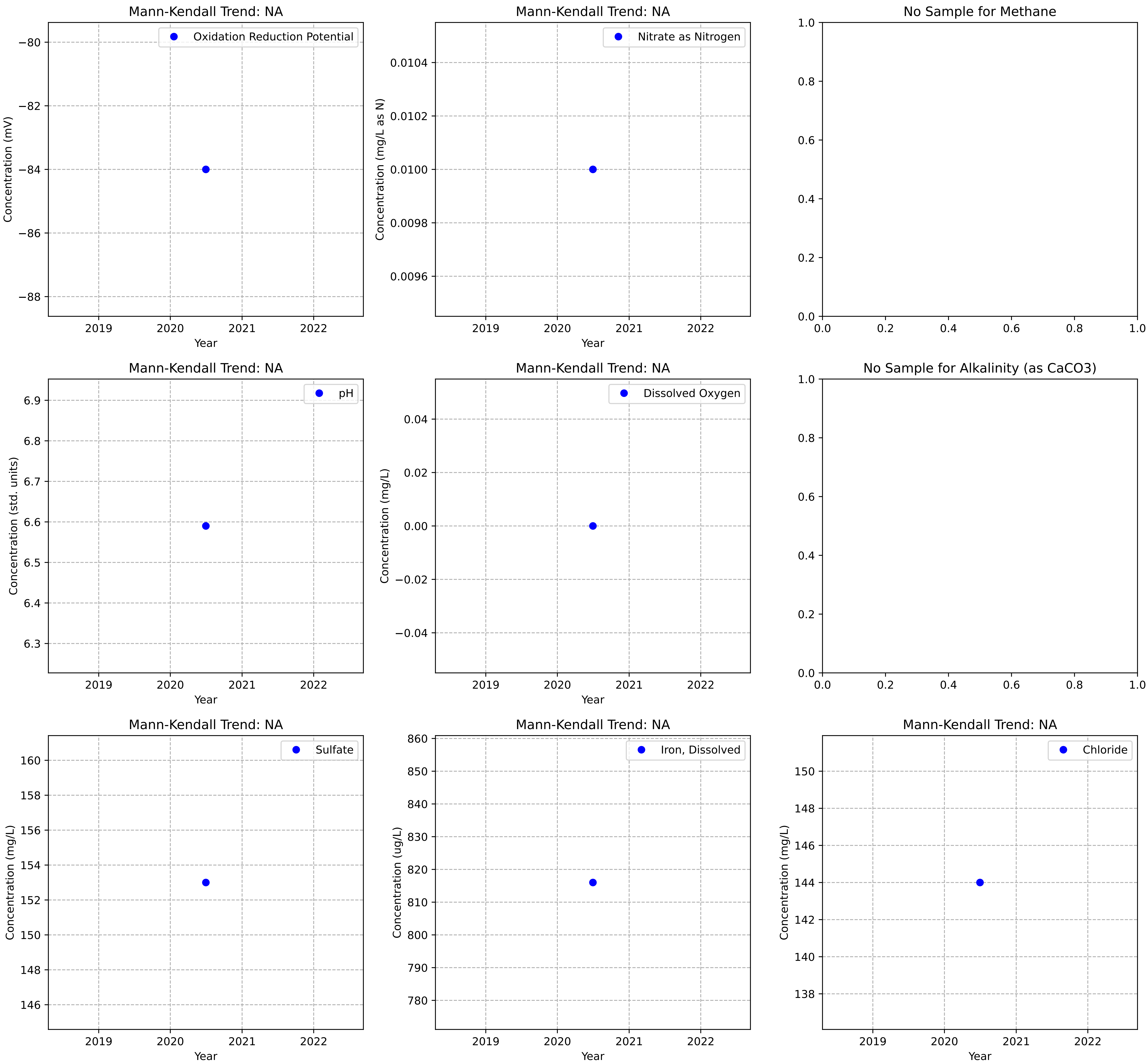


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.56)
Exponential Fit (R²=0.74)
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.11)
Exponential Fit (R²=0.14)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.05)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Concentration (mg/L)
Year

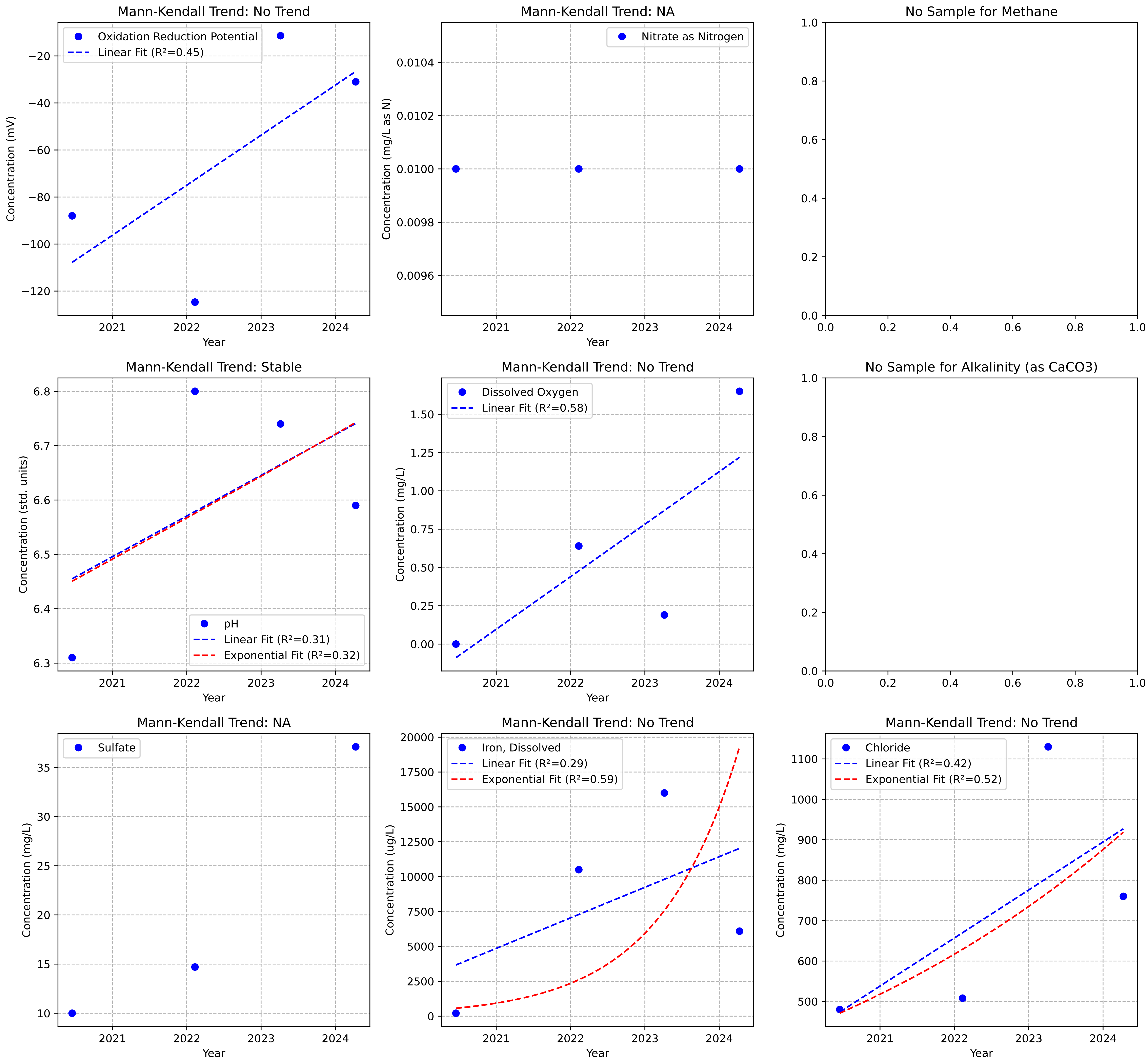
MW-87p2


Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.40)
Exponential Fit (R²=0.41)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Linear Fit (R²=0.07)
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.75)
Exponential Fit (R²=0.77)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.05)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Concentration (mg/L)
Year

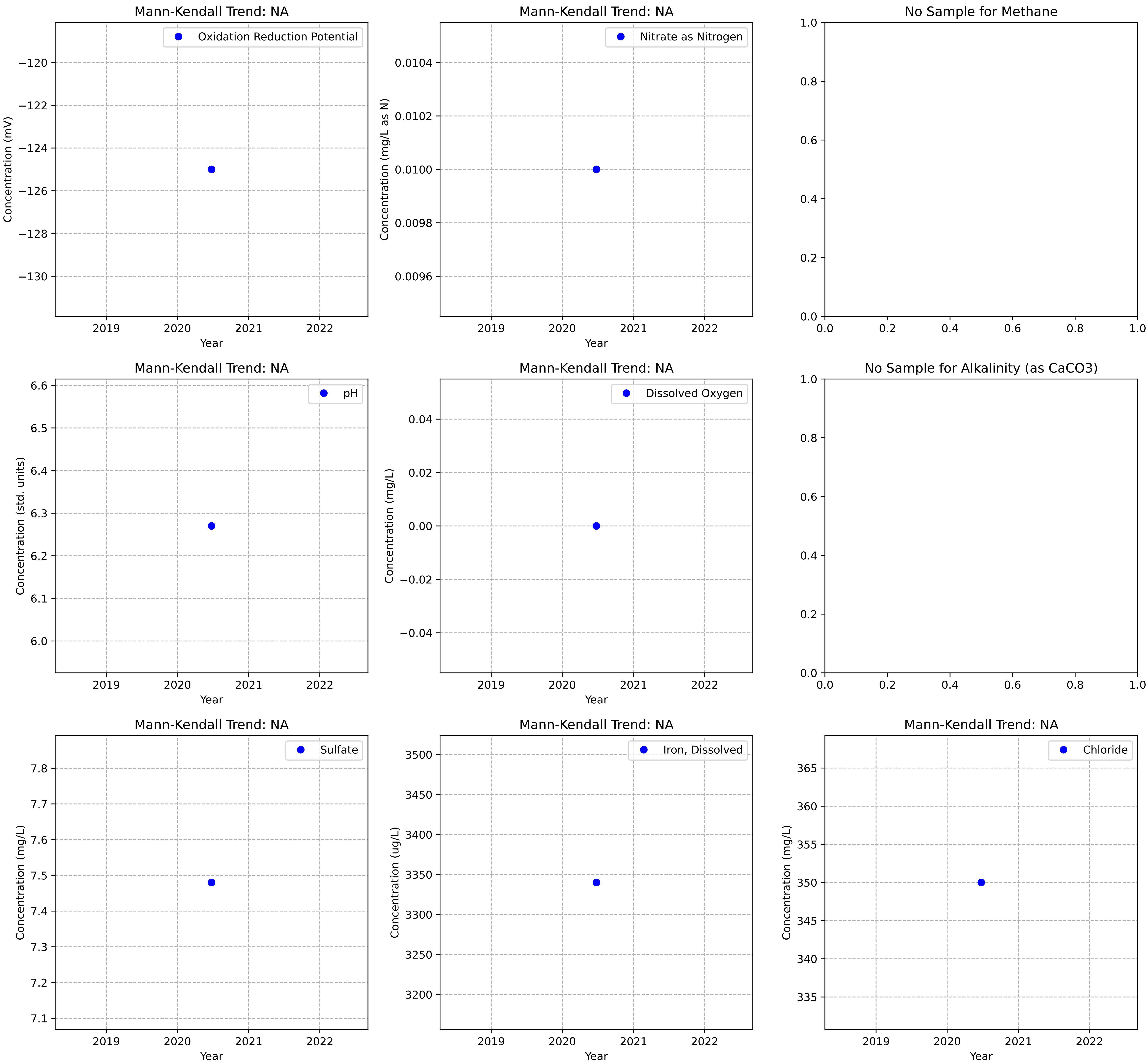
MW-88p2


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

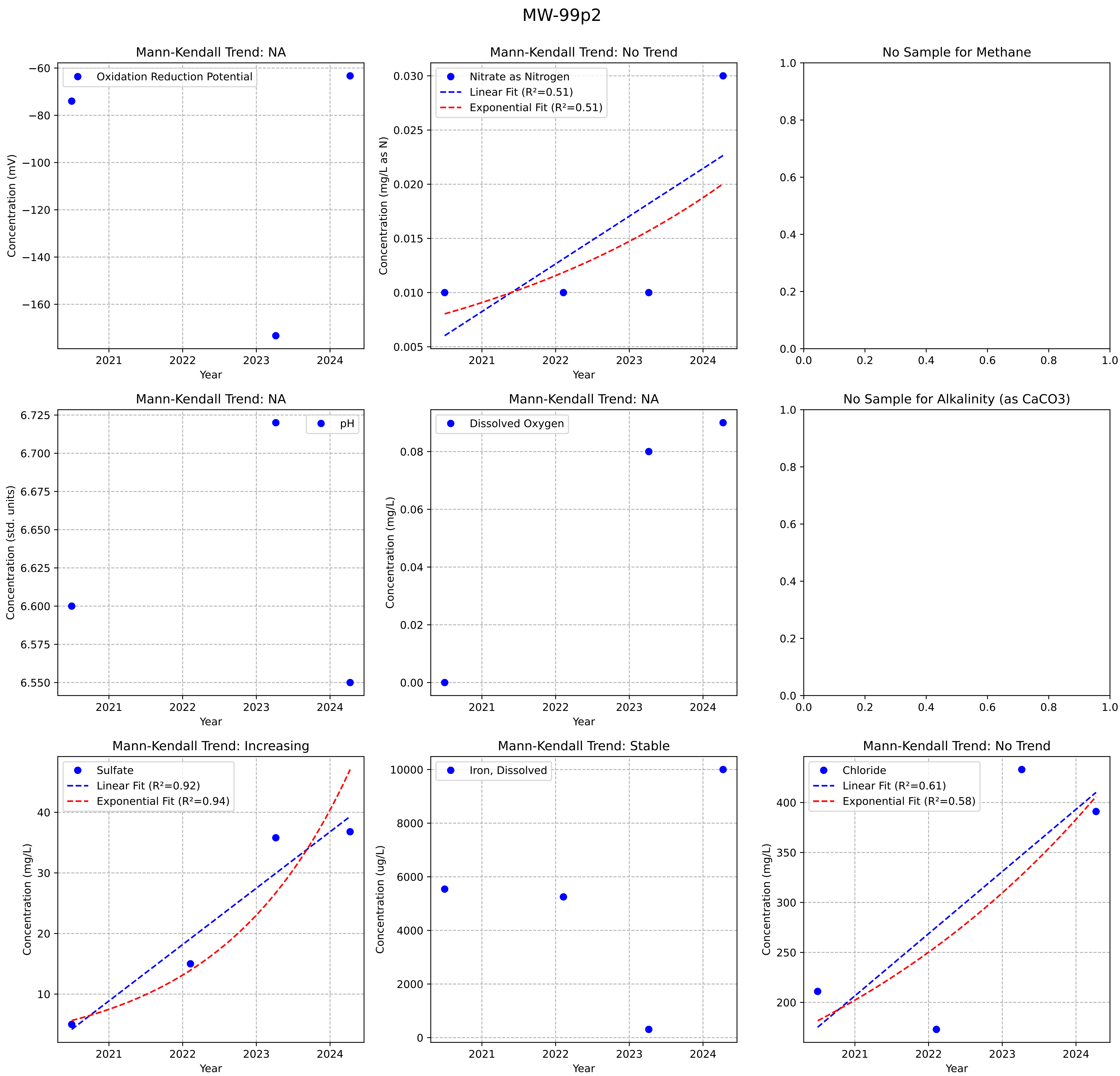
MW-91p2


Mann-Kendall Trend: No Trend
Oxidation Reduction Potential
Linear Fit (R²=0.45)
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: Stable
pH
Linear Fit (R²=0.31)
Exponential Fit (R²=0.32)
Concentration (std. units)
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Linear Fit (R²=0.58)
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.29)
Exponential Fit (R²=0.59)
Concentration (ug/L)
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.42)
Exponential Fit (R²=0.52)
Concentration (mg/L)

MW-94p2

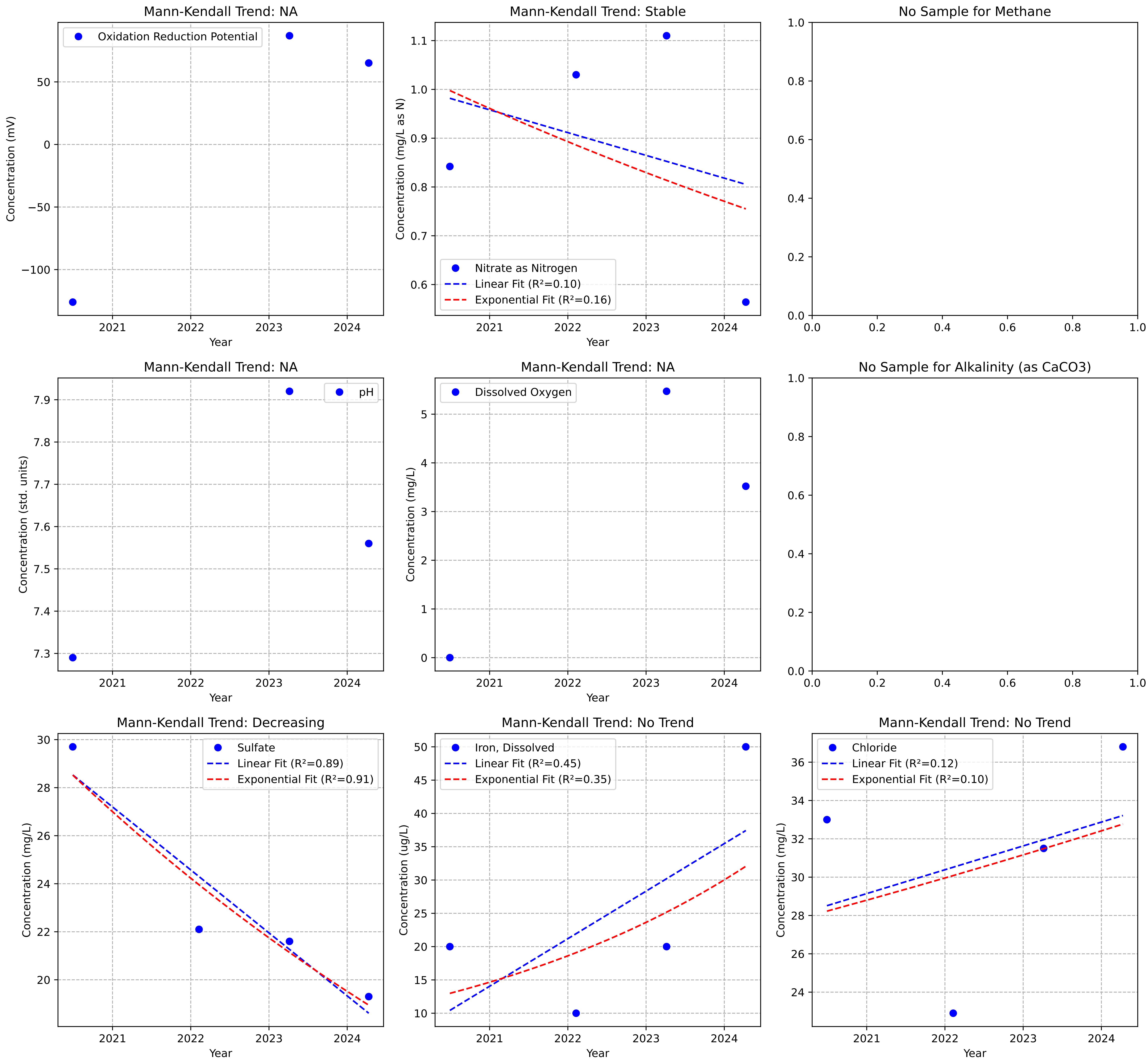


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
−120
−122
−124
−126
−128
−130
Year
2019
2020
2021
2022
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
0.0104
0.0102
0.0100
0.0098
0.0096
Year
No Sample for Methane
1.0
0.8
0.6
0.4
0.2
0.0
Mann-Kendall Trend: NA
pH
Concentration (std. units)
6.6
6.5
6.4
6.3
6.2
6.1
6.0
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
0.04
0.02
0.00
−0.02
−0.04
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
3500
3450
3400
3350
3300
3250
3200
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
365
360
355
350
345
340
335
Year


MW-99p2
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.92)
Exponential Fit (R²=0.94)
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.61)
Exponential Fit (R²=0.58)

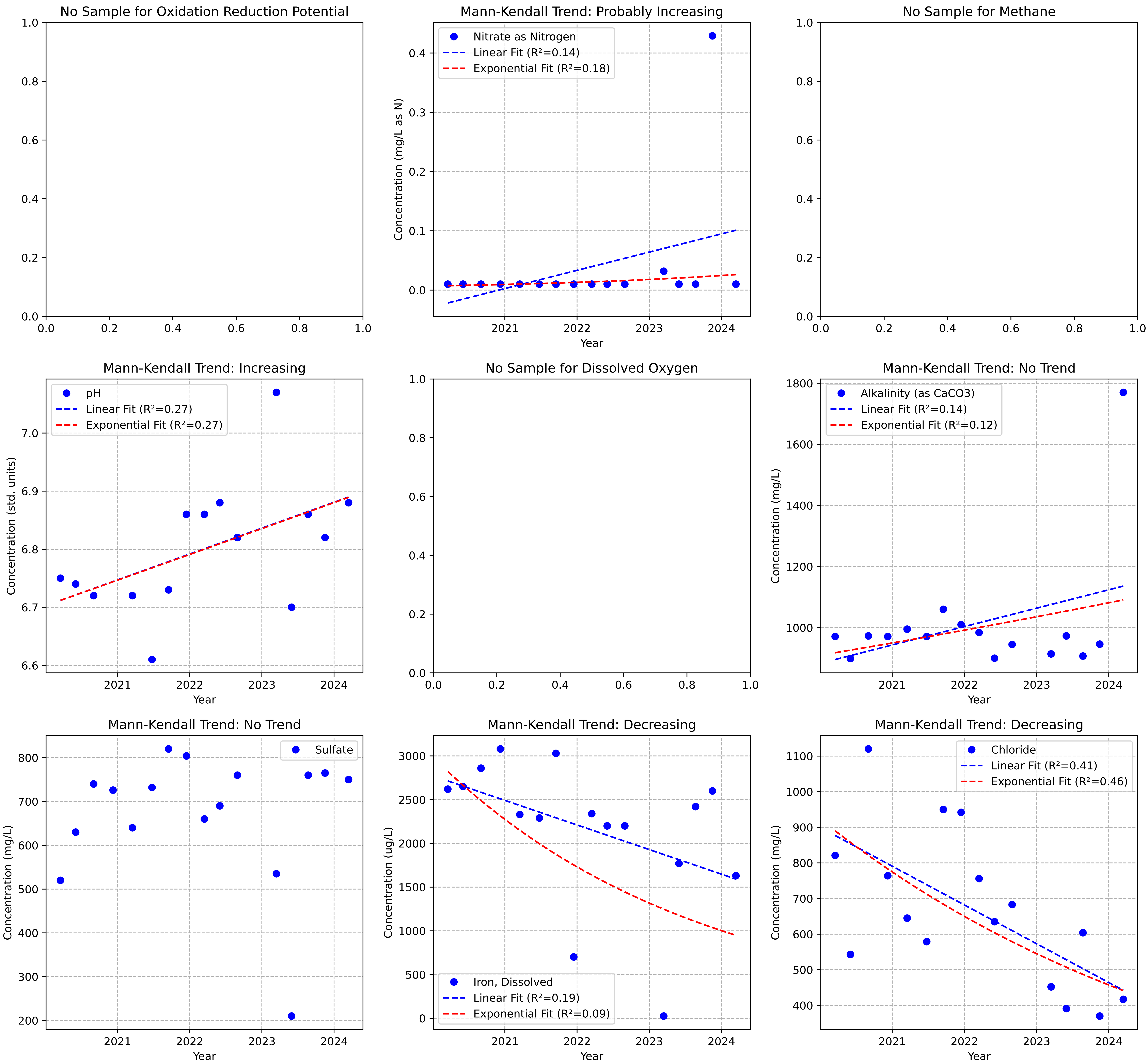
C3. Concentration time series plots of geochemical indicators for Roza Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

MW-102b

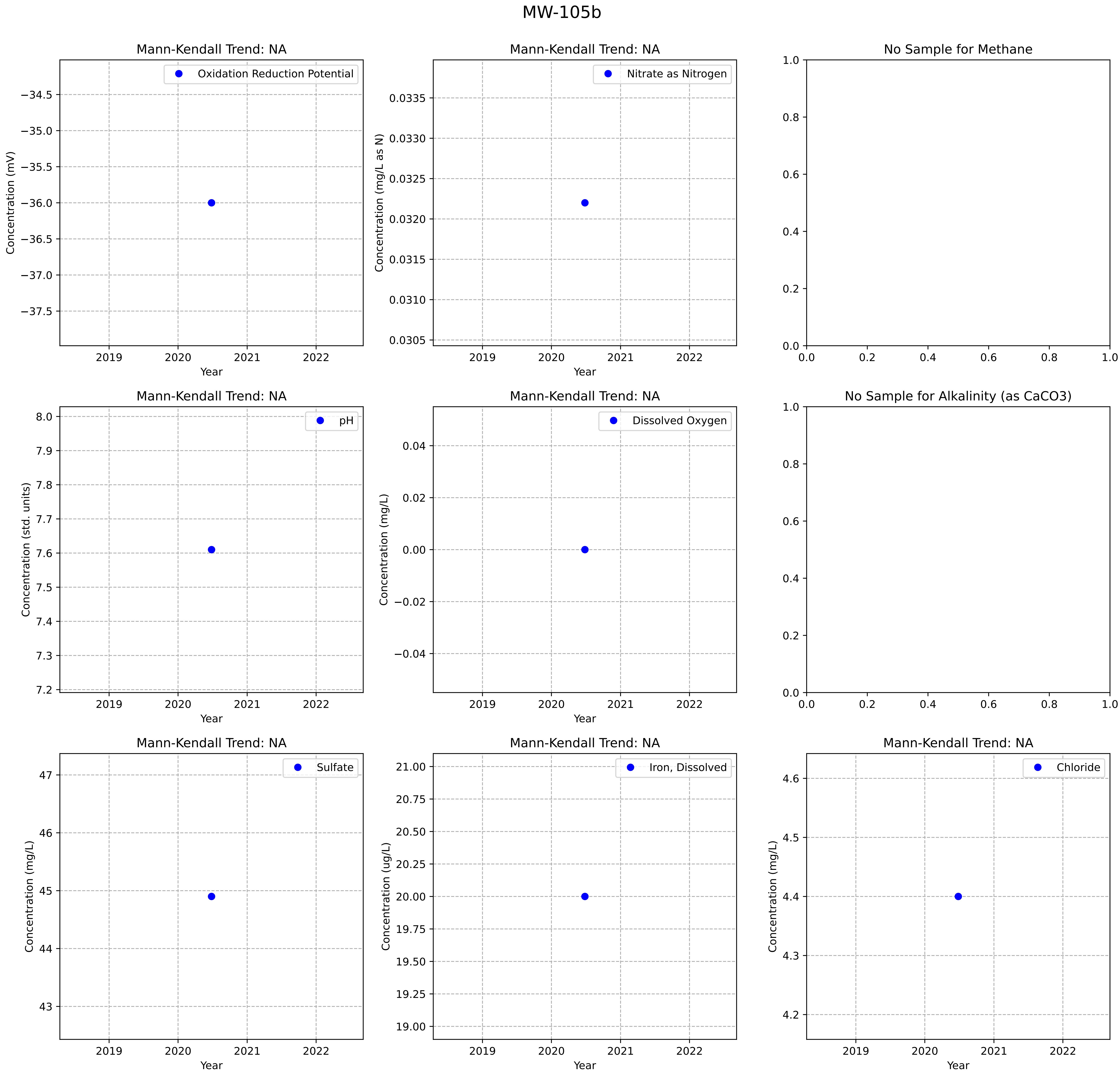


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.10)
Exponential Fit (R²=0.16)
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.89)
Exponential Fit (R²=0.91)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.45)
Exponential Fit (R²=0.35)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.12)
Exponential Fit (R²=0.10)
Concentration (mg/L)
Year

MW-103b

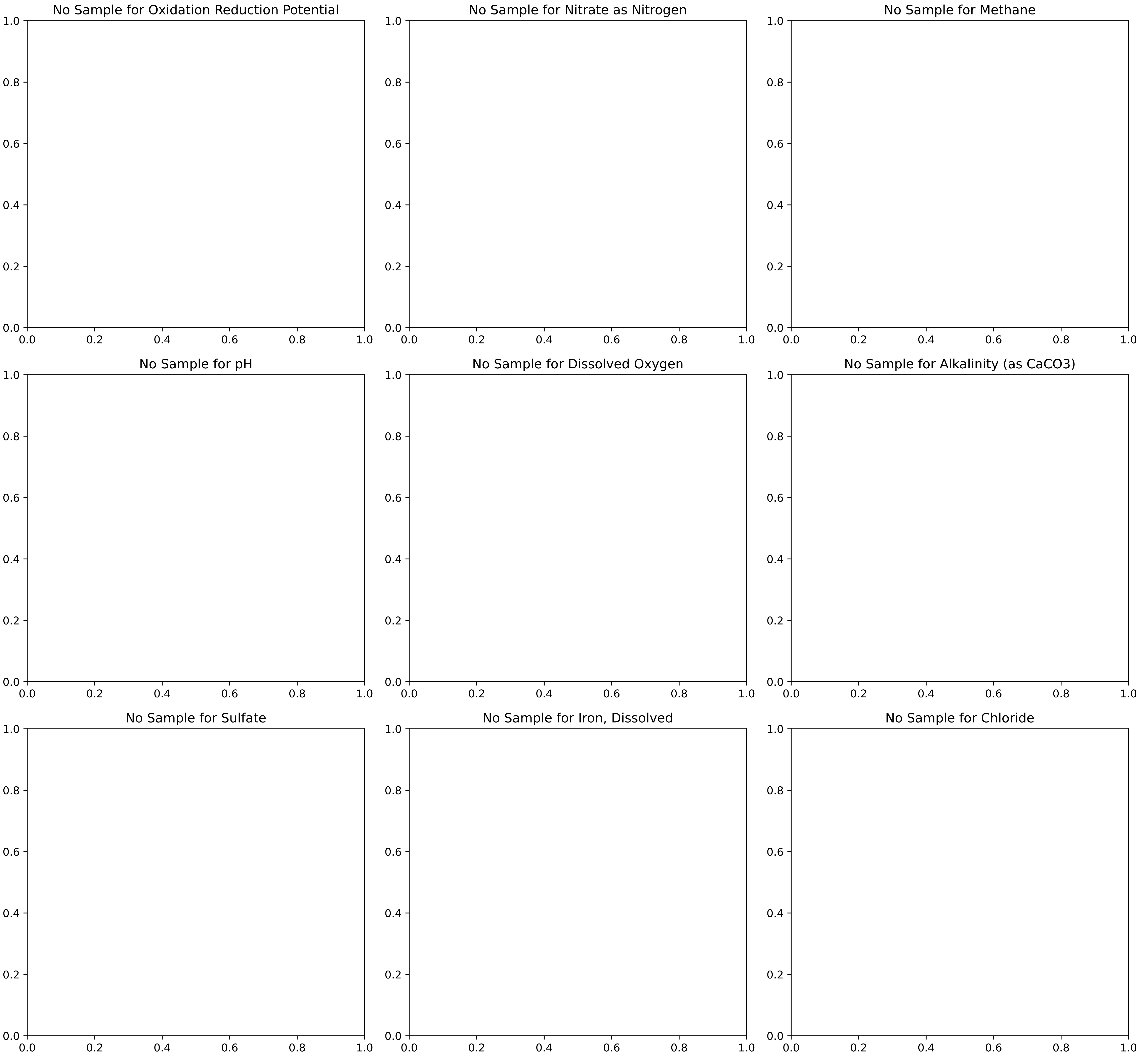


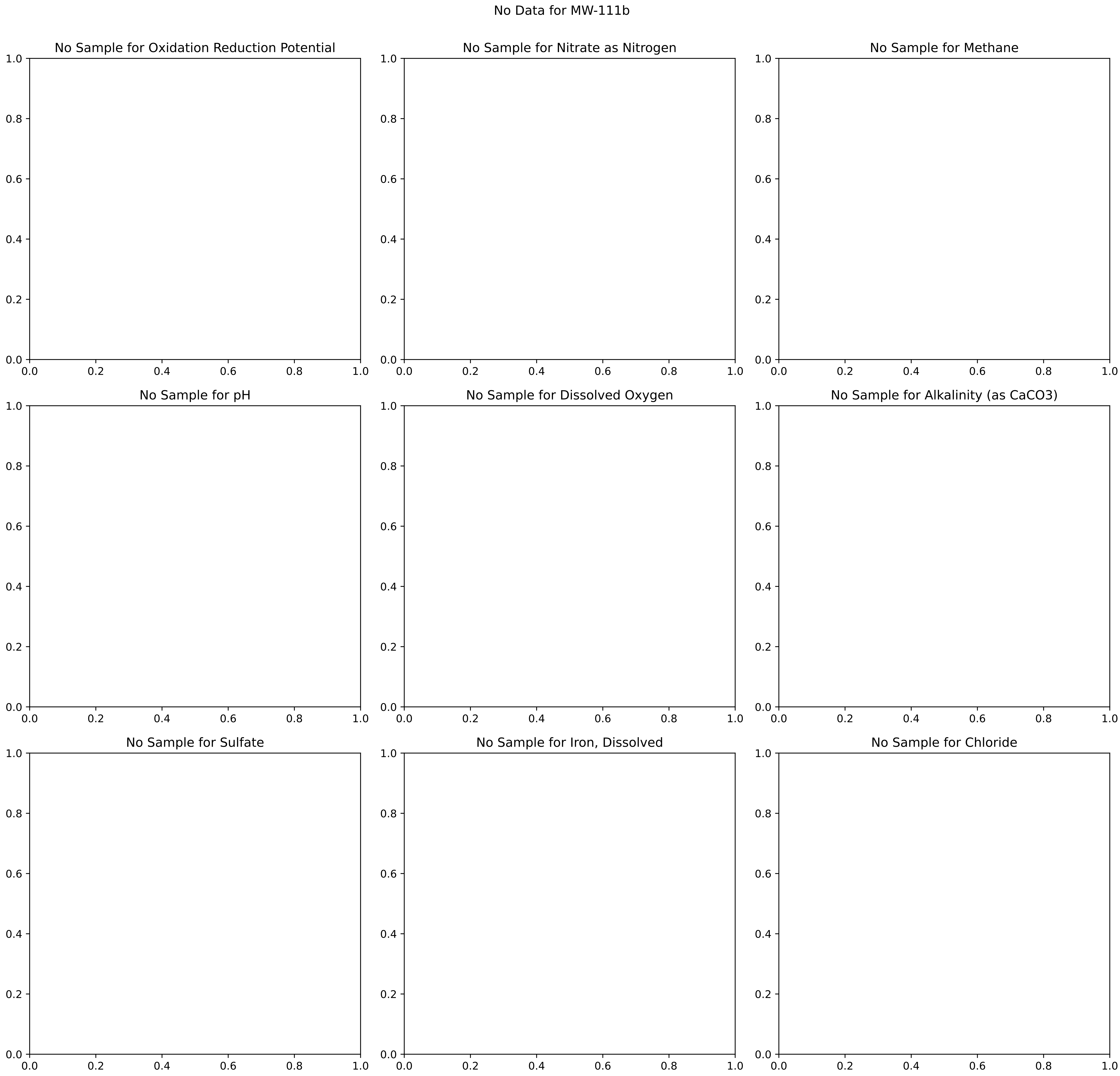
No Sample for Oxidation Reduction Potential
Mann-Kendall Trend: Probably Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.14)
Exponential Fit (R²=0.18)
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.27)
Exponential Fit (R²=0.27)
Concentration (std. units)
Year
No Sample for Dissolved Oxygen
Mann-Kendall Trend: No Trend
Alkalinity (as CaCO3)
Linear Fit (R²=0.14)
Exponential Fit (R²=0.12)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Iron, Dissolved
Linear Fit (R²=0.19)
Exponential Fit (R²=0.09)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.41)
Exponential Fit (R²=0.46)
Concentration (mg/L)
Year



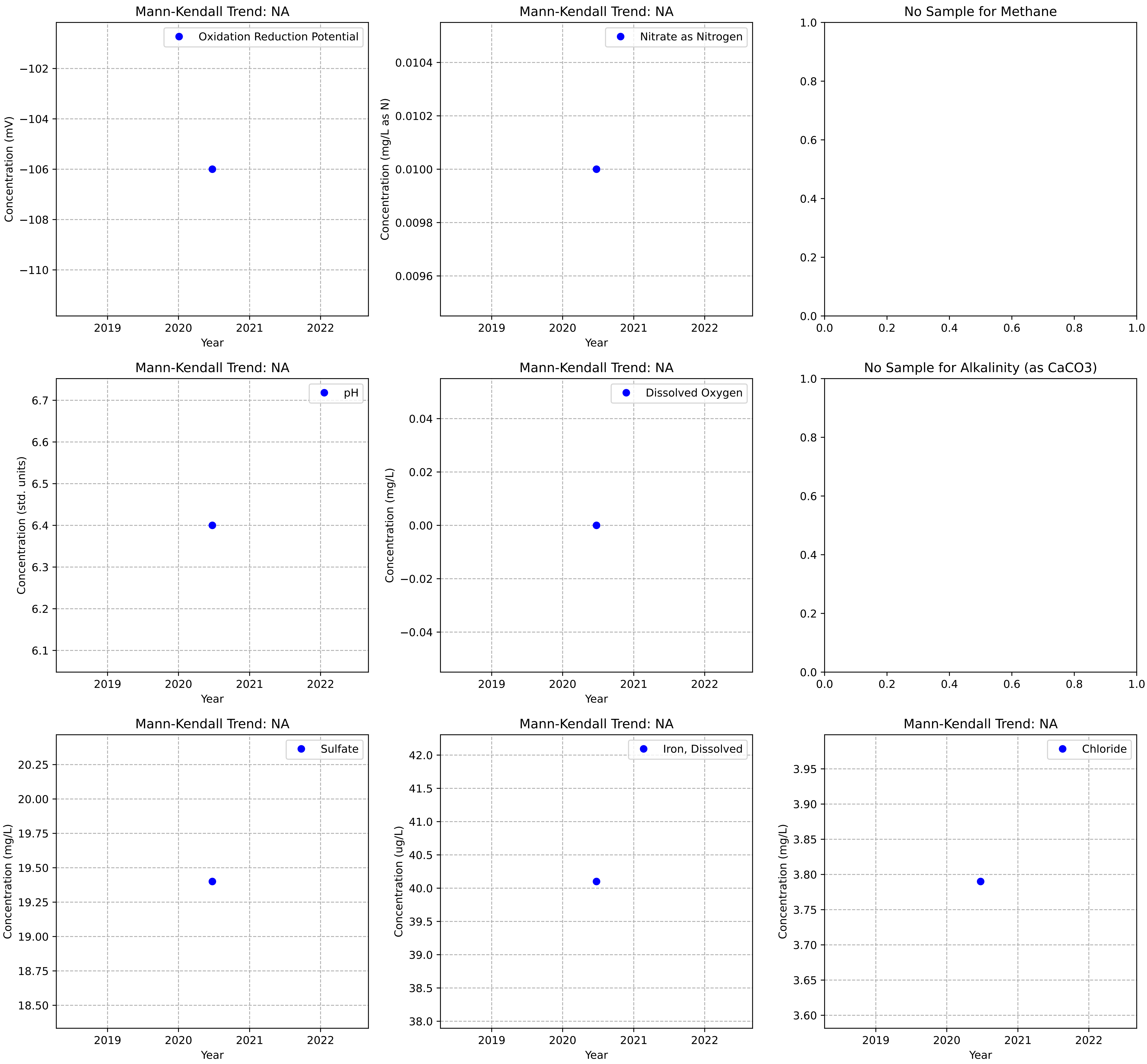
MW-105b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

No Data for MW-106b

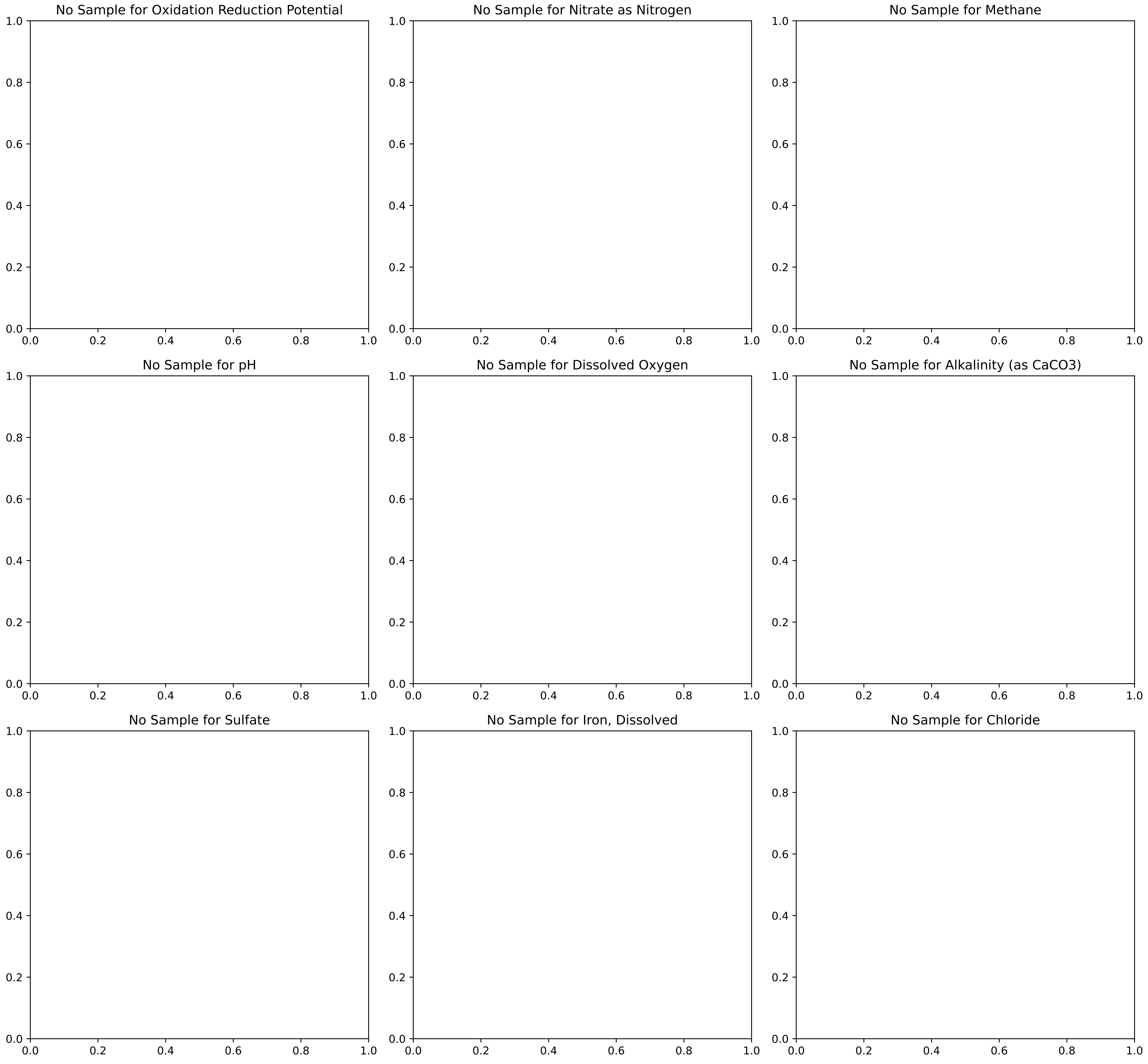



No Data for MW-111b
No Sample for Oxidation Reduction Potential
No Sample for Nitrate as Nitrogen
No Sample for Methane
No Sample for pH
No Sample for Dissolved Oxygen
No Sample for Alkalinity (as CaCO3)
No Sample for Sulfate
No Sample for Iron, Dissolved
No Sample for Chloride

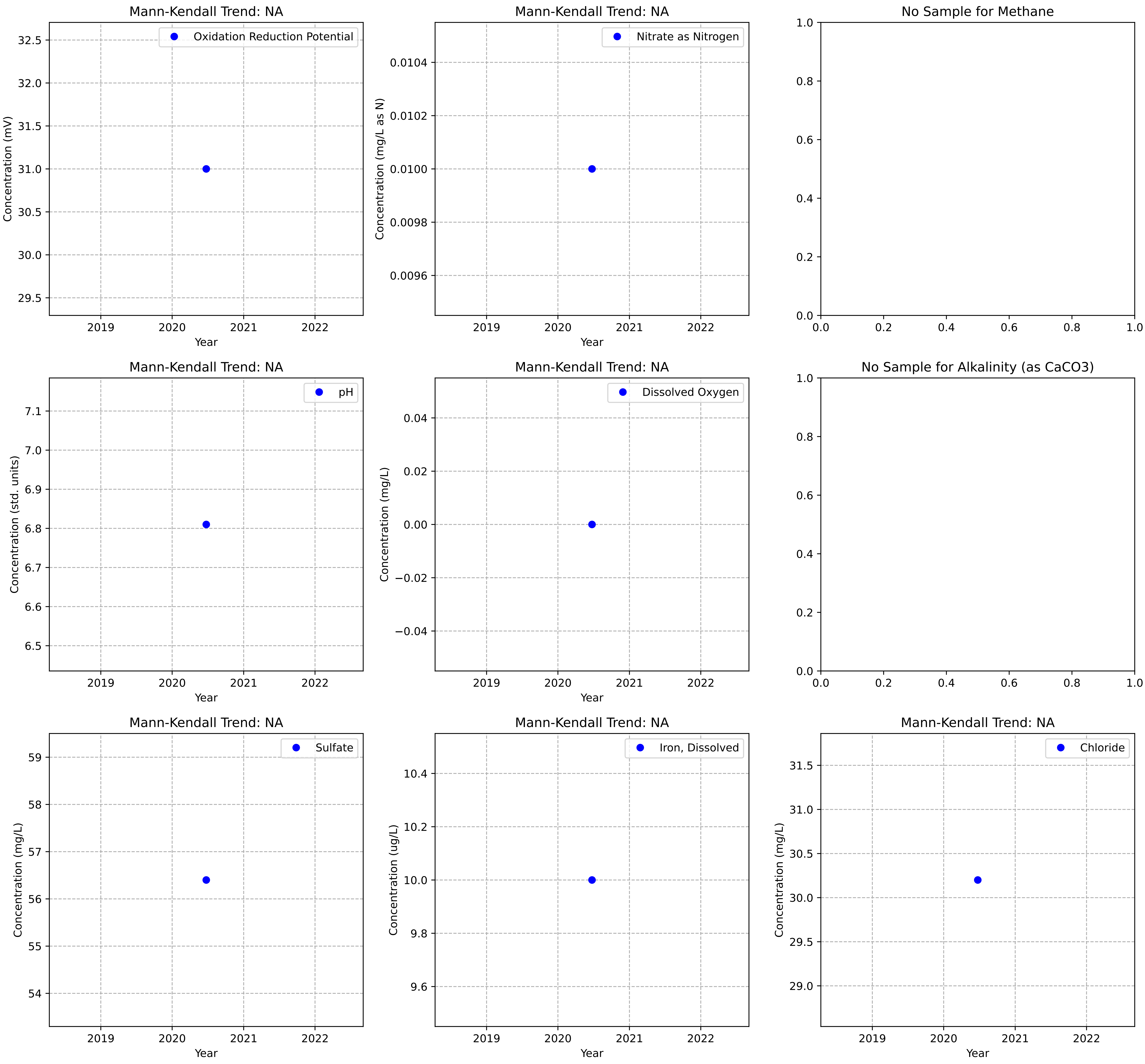
MW-116b


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

No Data for MW-119b

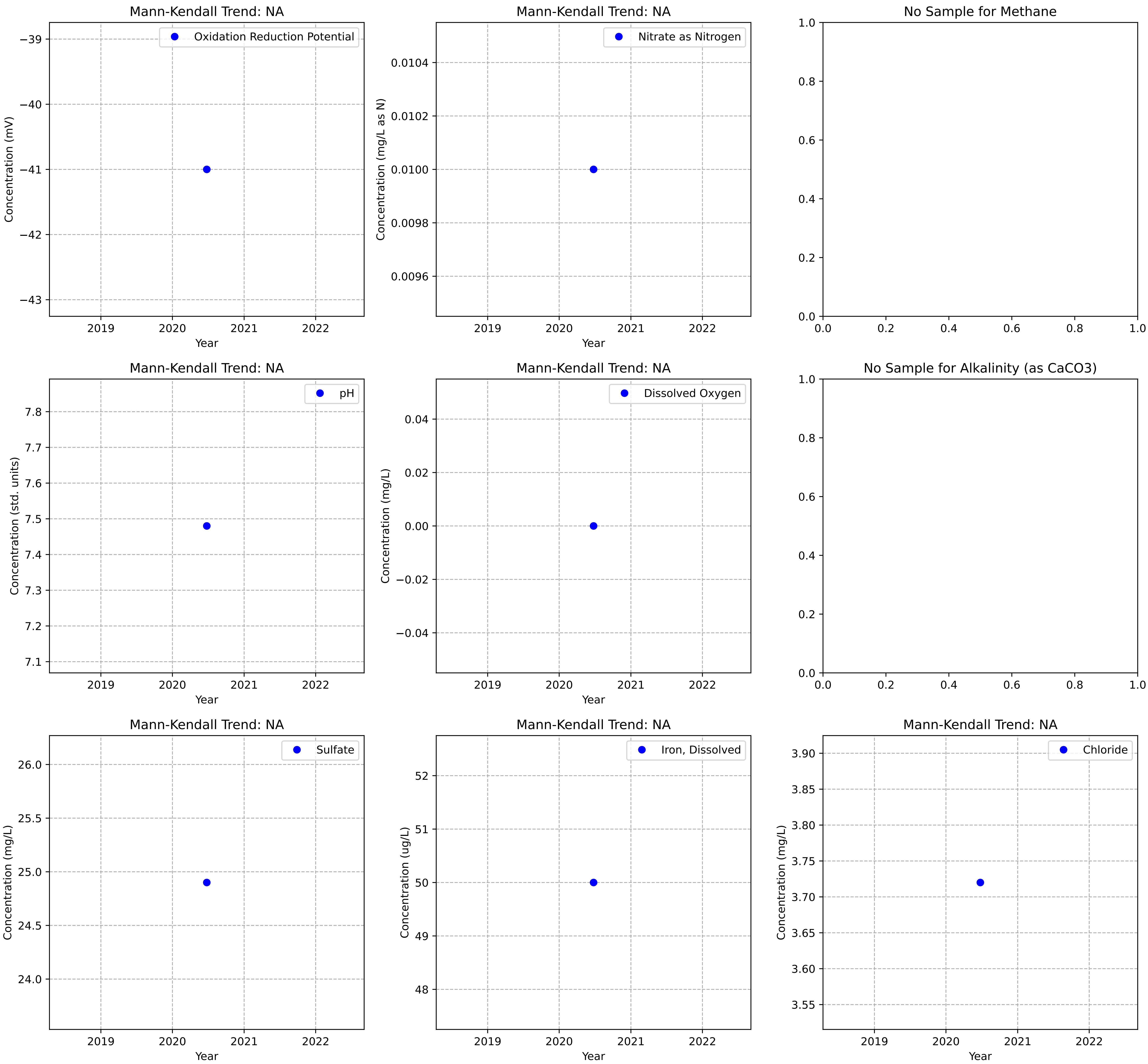


MW-121b

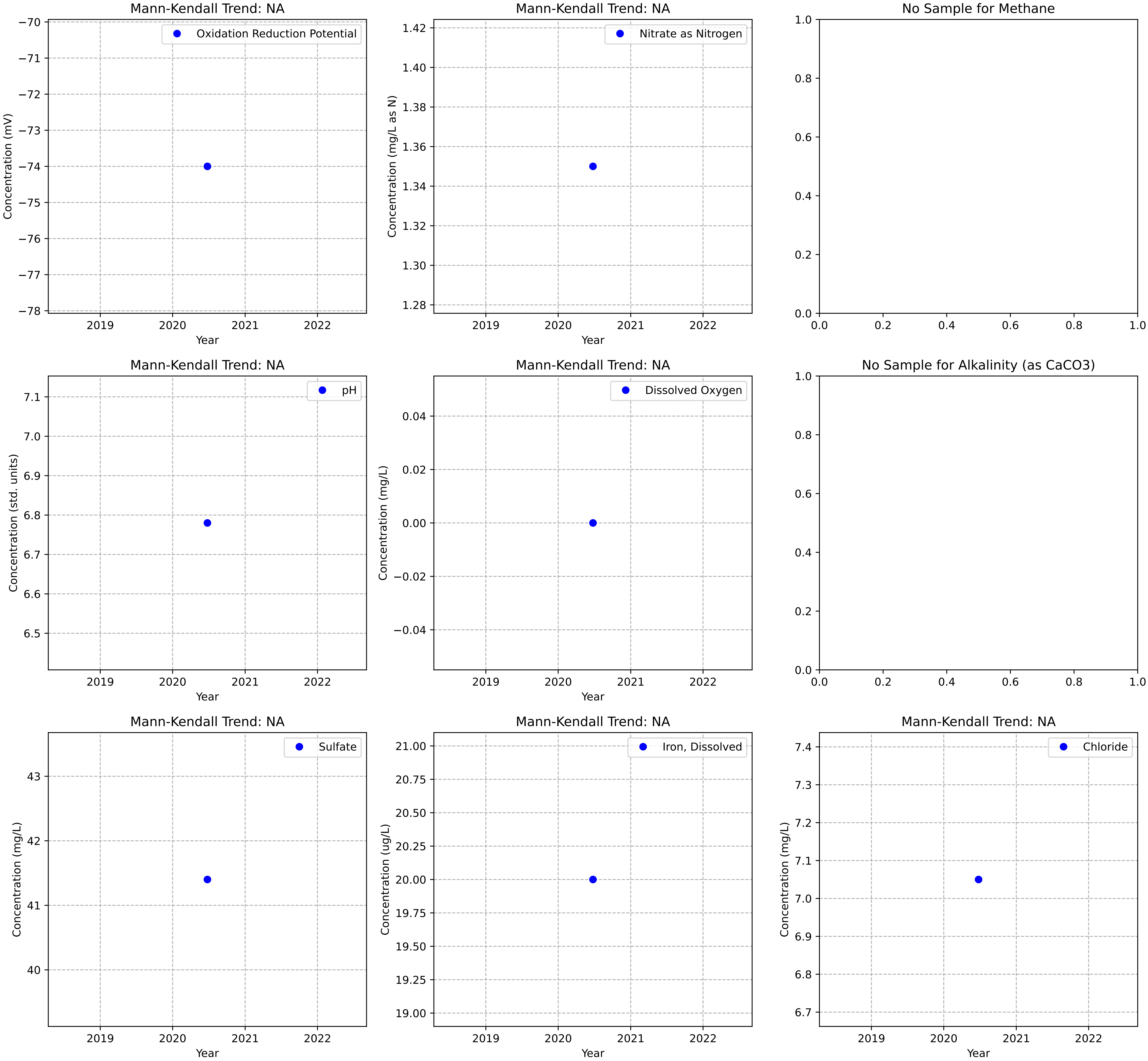


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

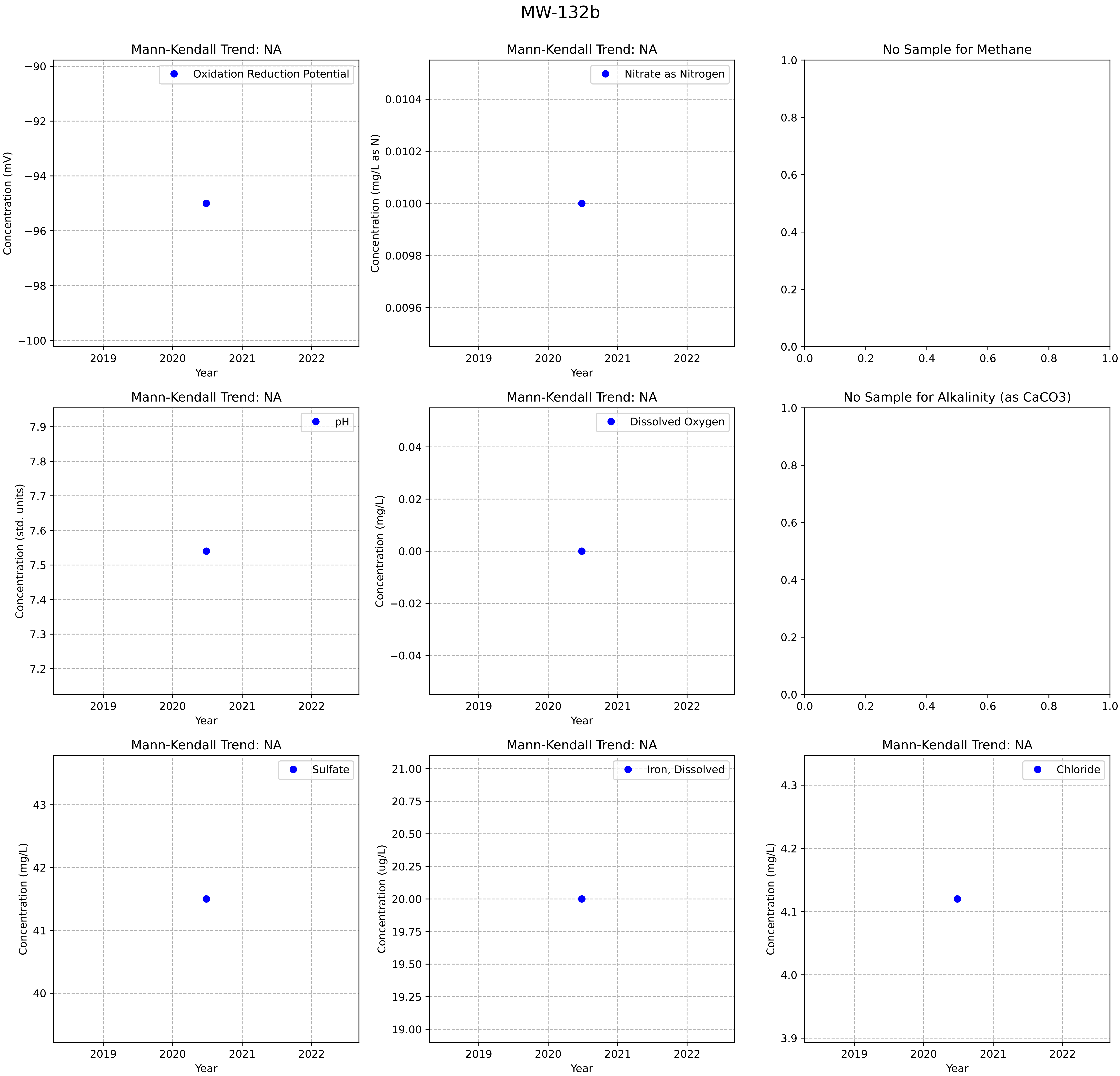
MW-128b

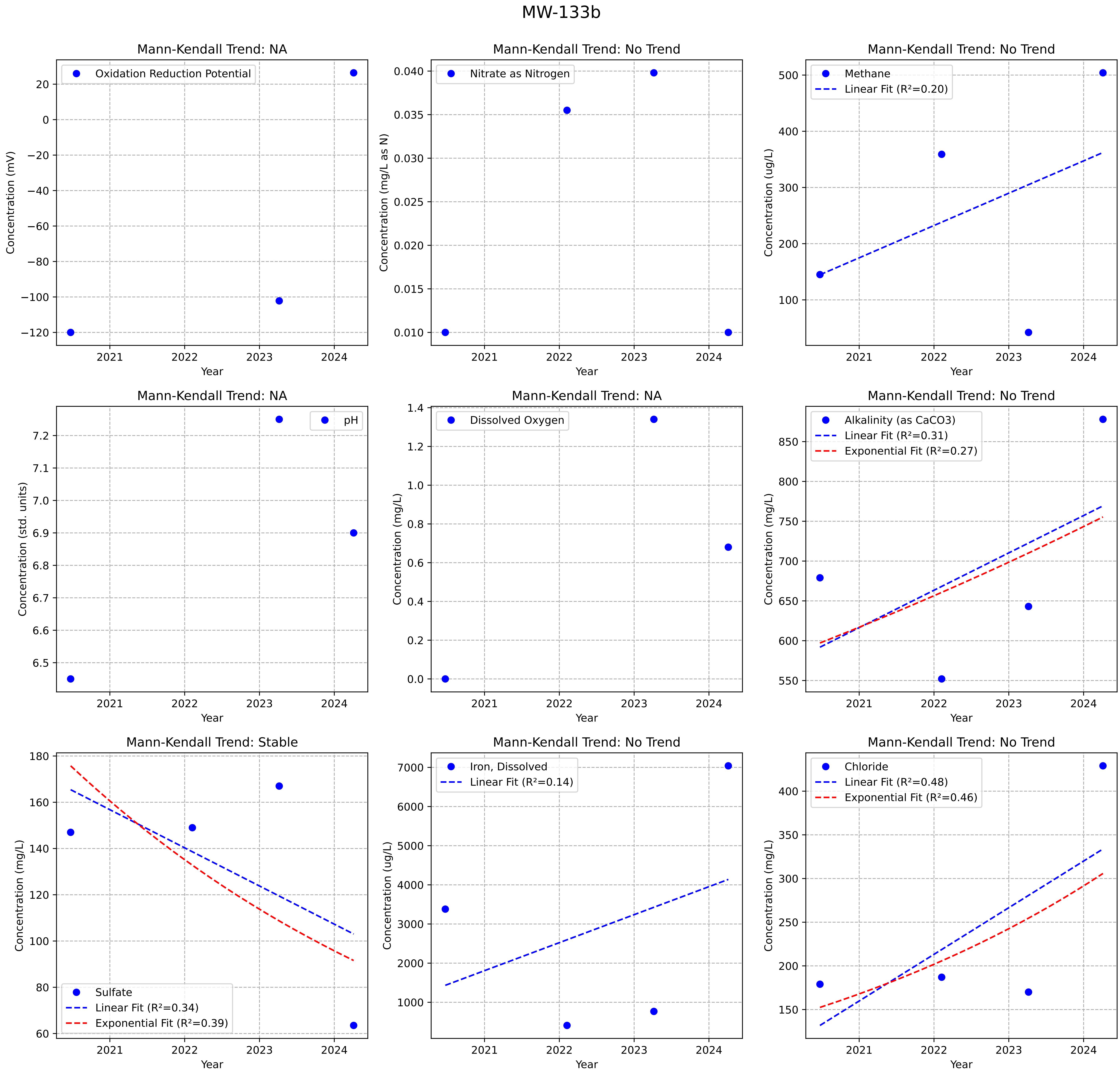

Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

MW-130b

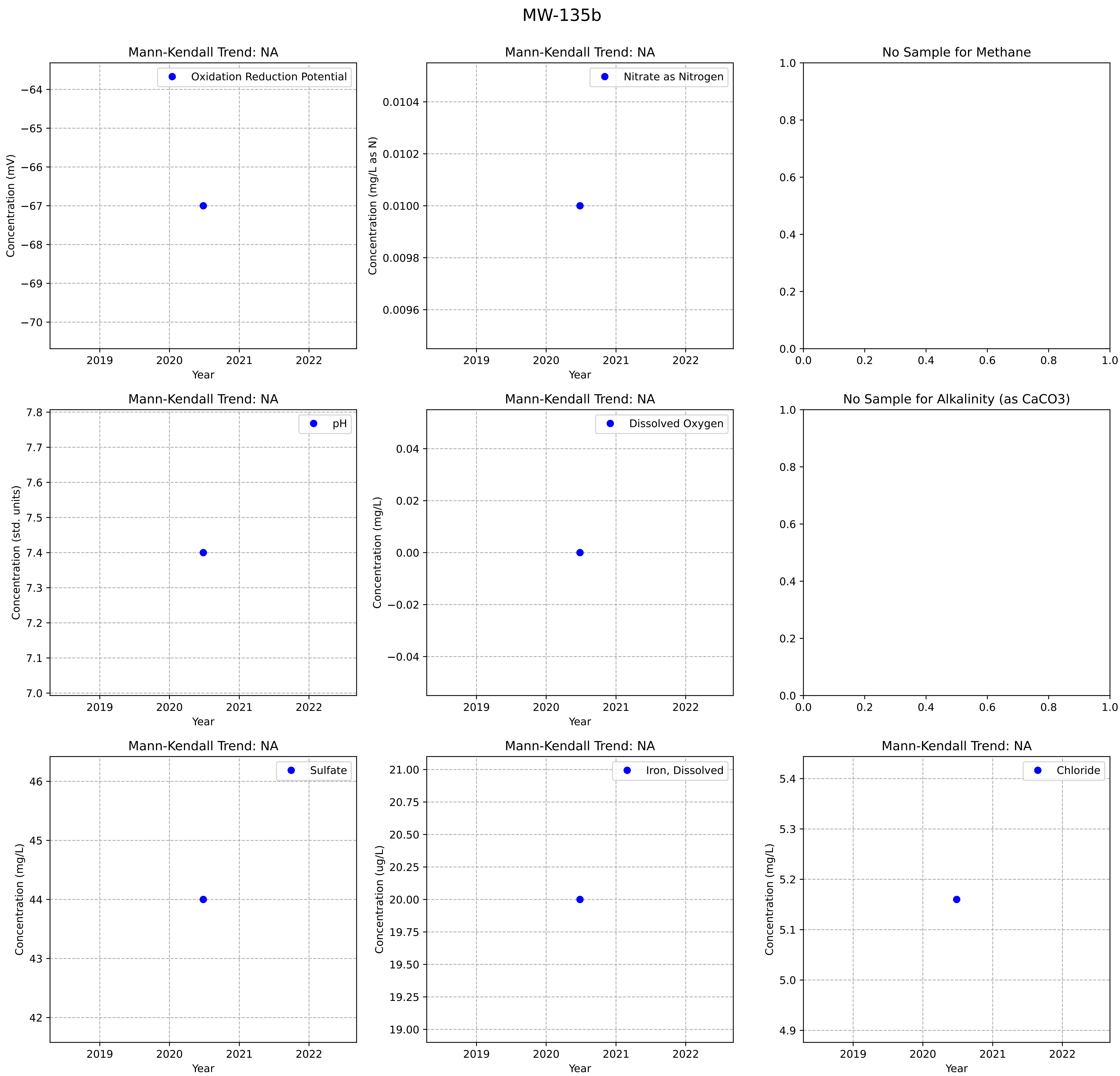


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

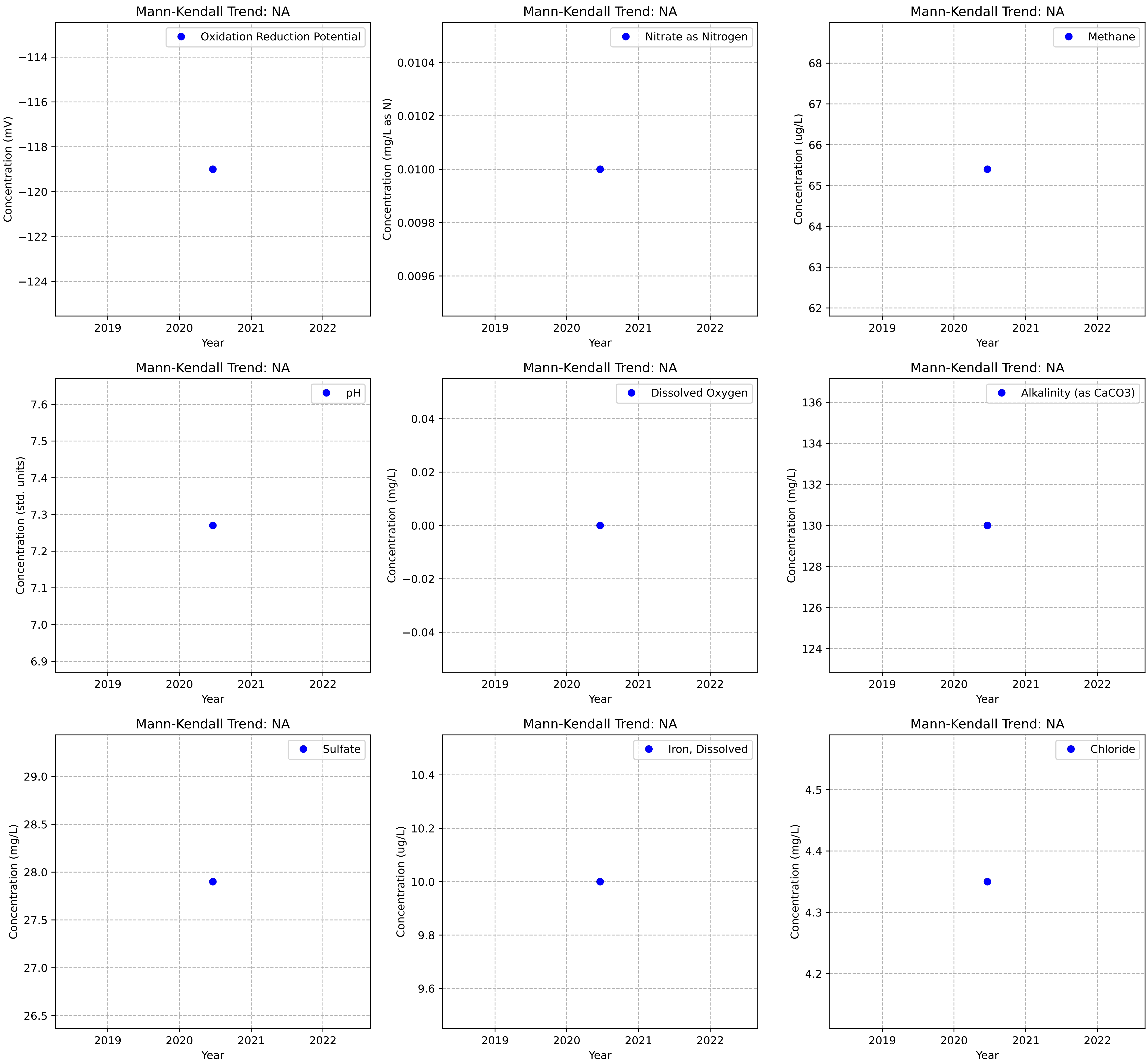

MW-132b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

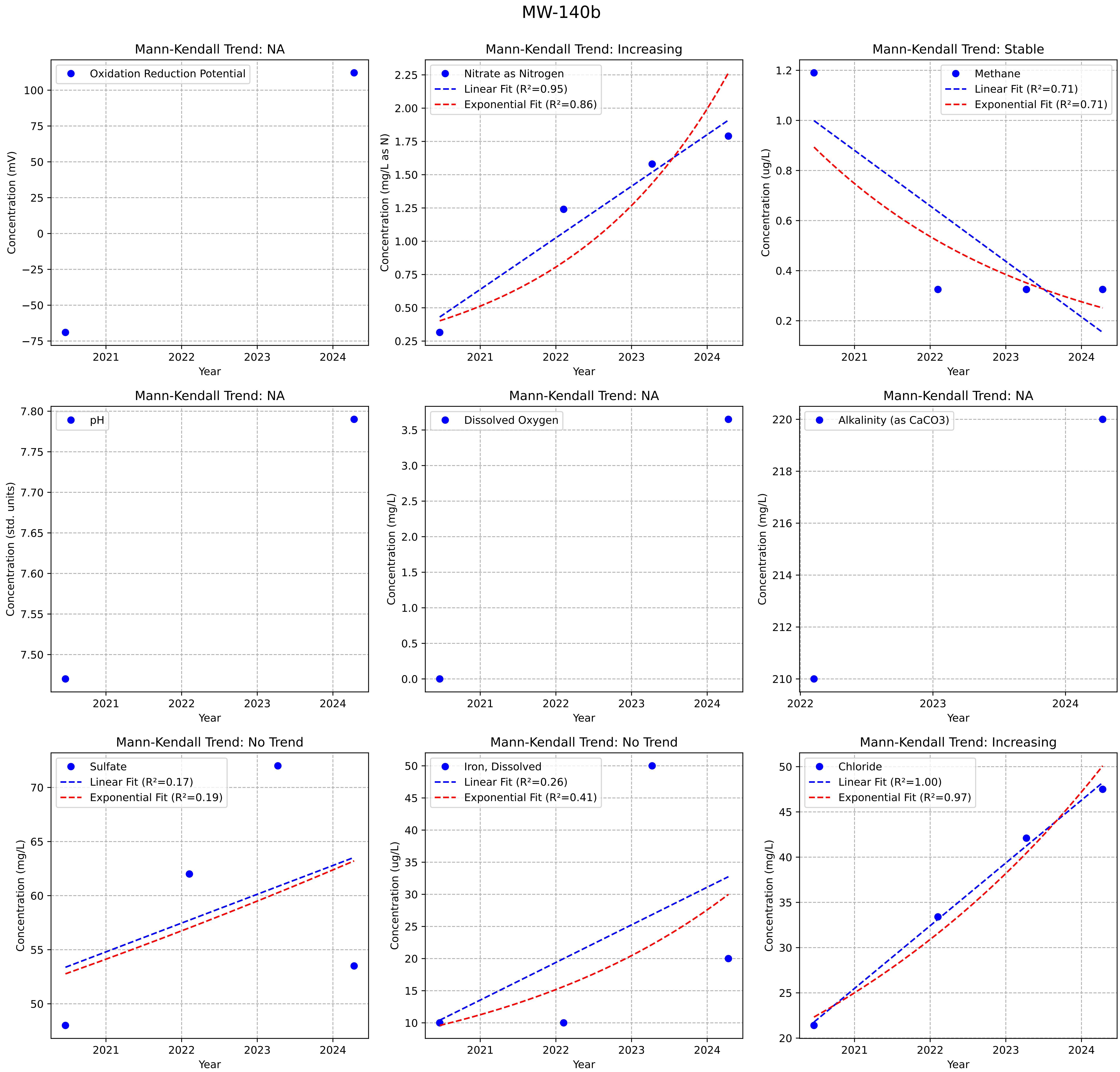


MW-133b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: No Trend
Methane
Linear Fit (R²=0.20)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Alkalinity (as CaCO3)
Linear Fit (R²=0.31)
Exponential Fit (R²=0.27)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.34)
Exponential Fit (R²=0.39)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.14)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.48)
Exponential Fit (R²=0.46)
Concentration (mg/L)
Year


MW-135b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

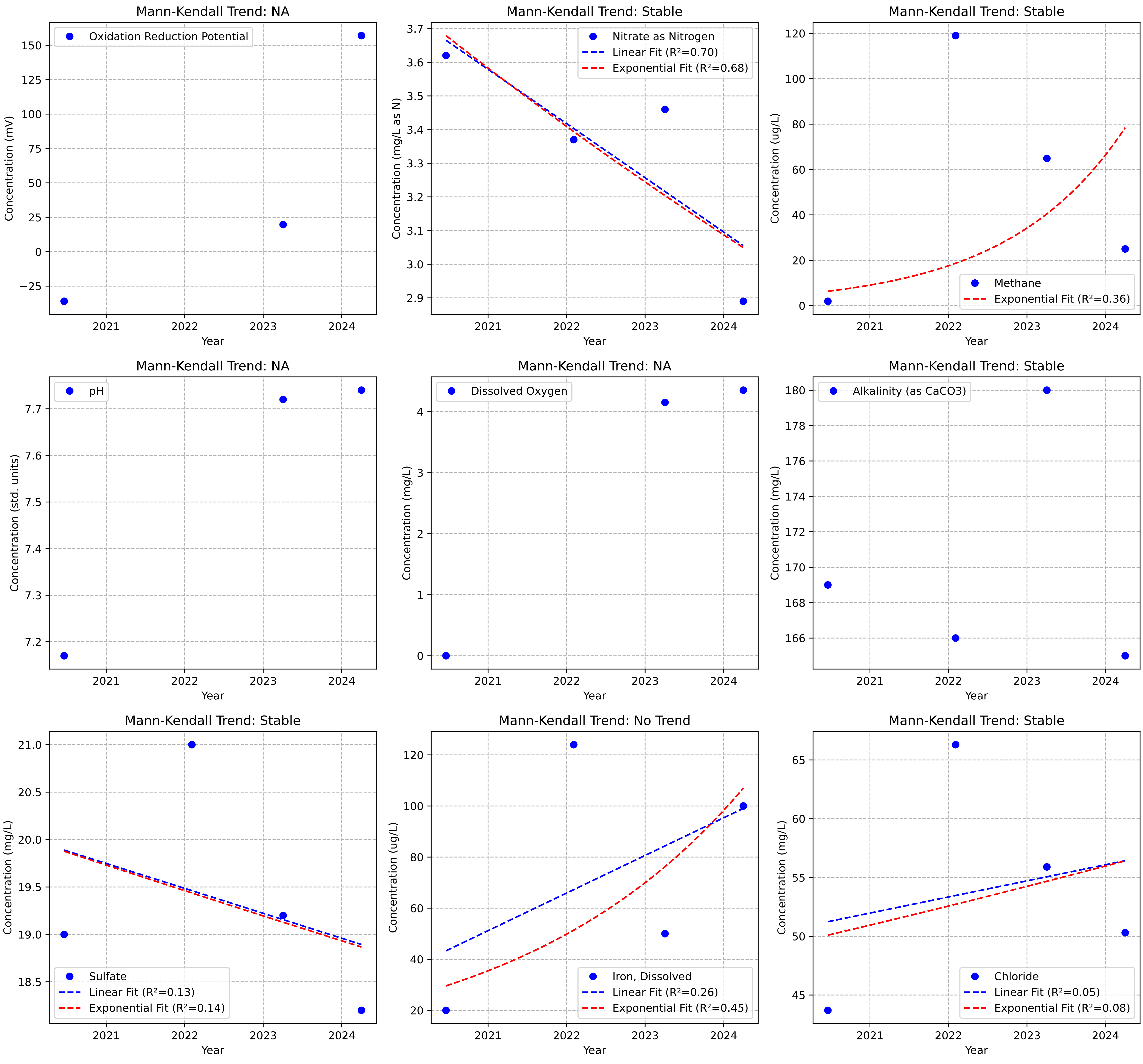
MW-139b


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
−114
−116
−118
−120
−122
−124
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
0.0104
0.0102
0.0100
0.0098
0.0096
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
68
67
66
65
64
63
62
Mann-Kendall Trend: NA
pH
Concentration (std. units)
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
0.04
0.02
0.00
−0.02
−0.04
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
136
134
132
130
128
126
124
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
29.0
28.5
28.0
27.5
27.0
26.5
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
10.4
10.2
10.0
9.8
9.6
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
4.5
4.4
4.3
4.2
2019
2020
2021
2022
Year

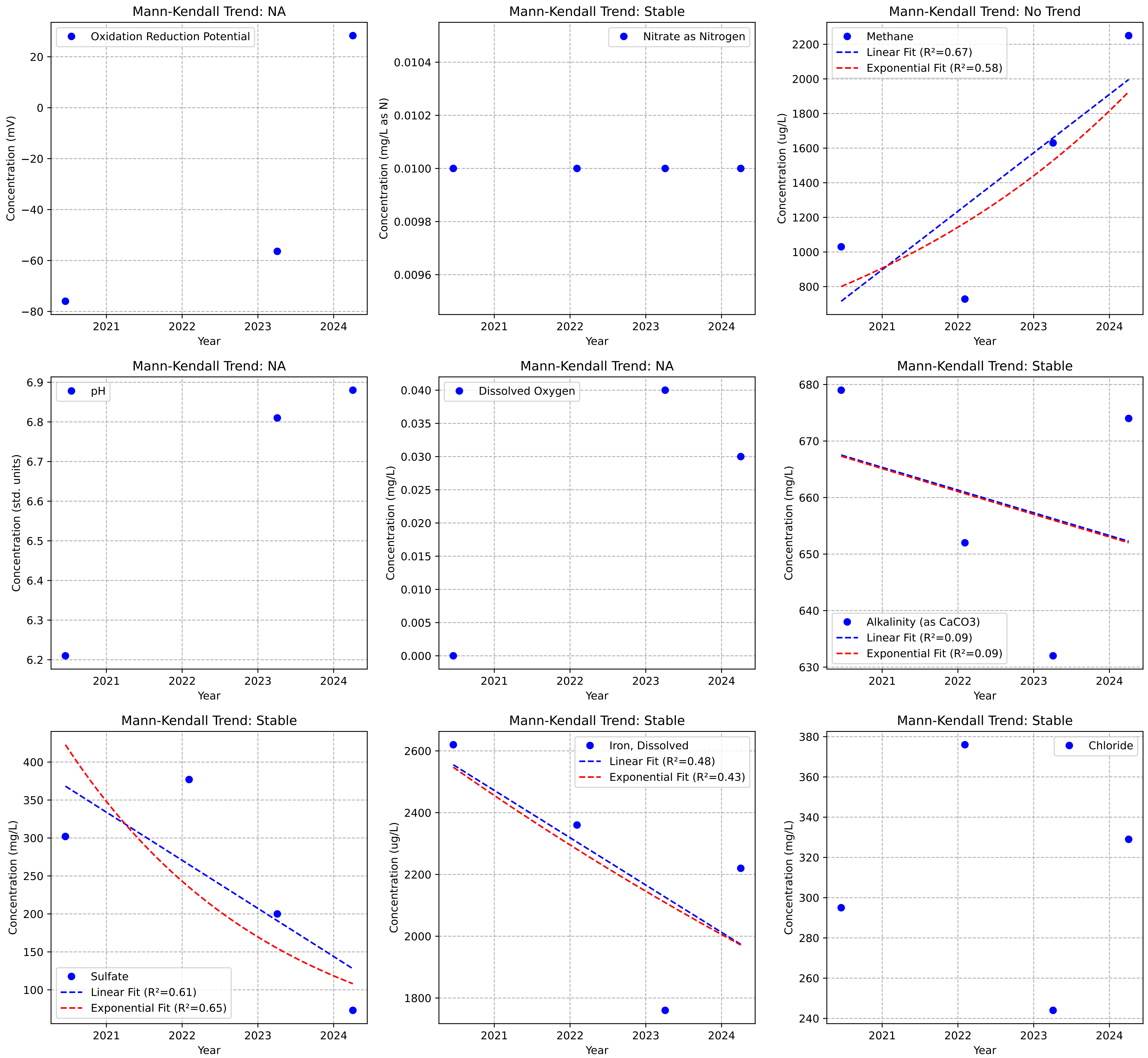


MW-140b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.95)
Exponential Fit (R²=0.86)
Concentration (mg/L as N)
Mann-Kendall Trend: Stable
Methane
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Concentration (ug/L)
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.17)
Exponential Fit (R²=0.19)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.26)
Exponential Fit (R²=0.41)
Concentration (ug/L)
Mann-Kendall Trend: Increasing
Chloride
Linear Fit (R²=1.00)
Exponential Fit (R²=0.97)
Concentration (mg/L)

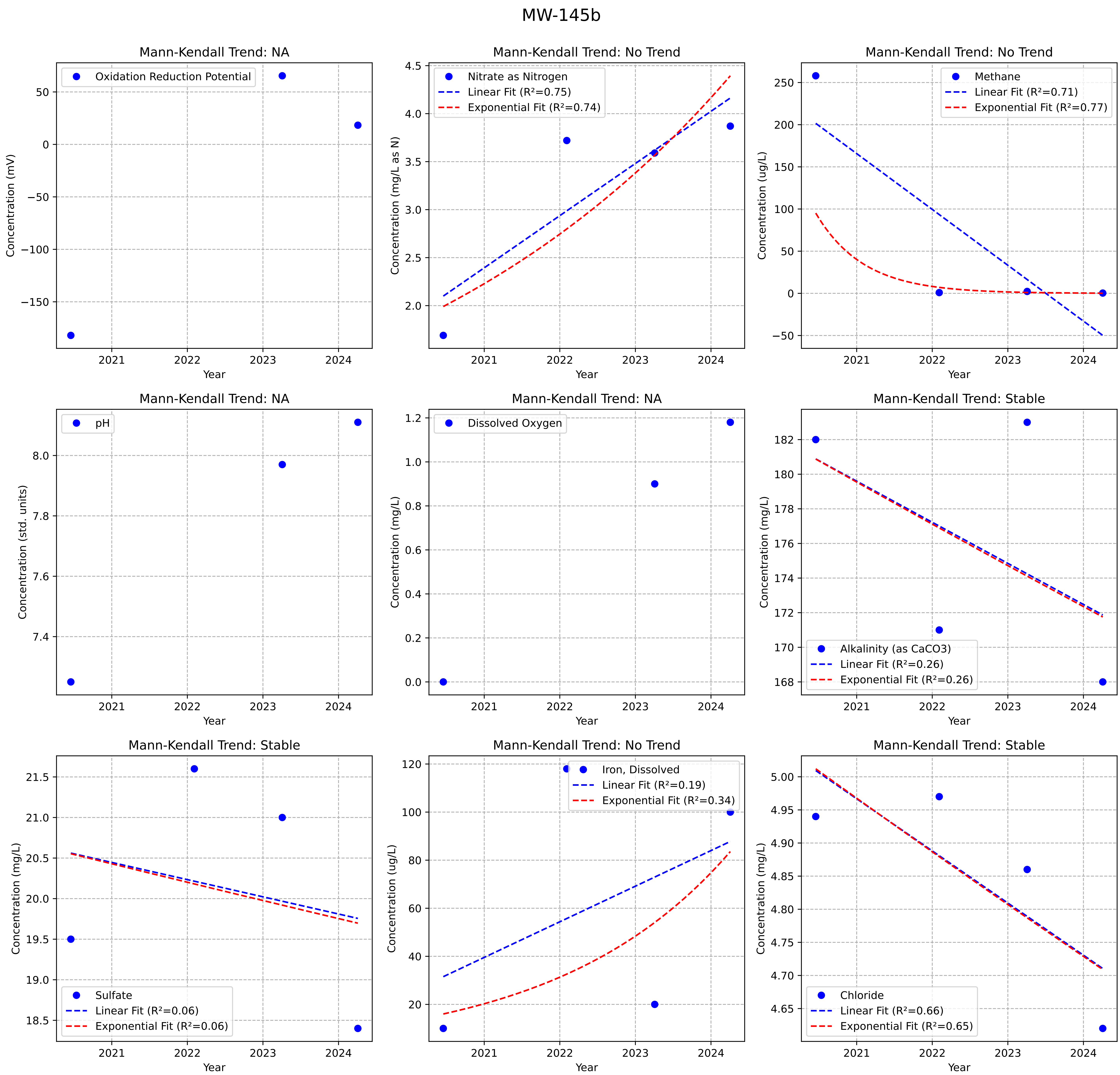
MW-142b


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.70)
Exponential Fit (R²=0.68)
Concentration (mg/L as N)
Mann-Kendall Trend: Stable
Methane
Exponential Fit (R²=0.36)
Concentration (ug/L)
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Concentration (mg/L)
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.13)
Exponential Fit (R²=0.14)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.26)
Exponential Fit (R²=0.45)
Concentration (ug/L)
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.05)
Exponential Fit (R²=0.08)
Concentration (mg/L)

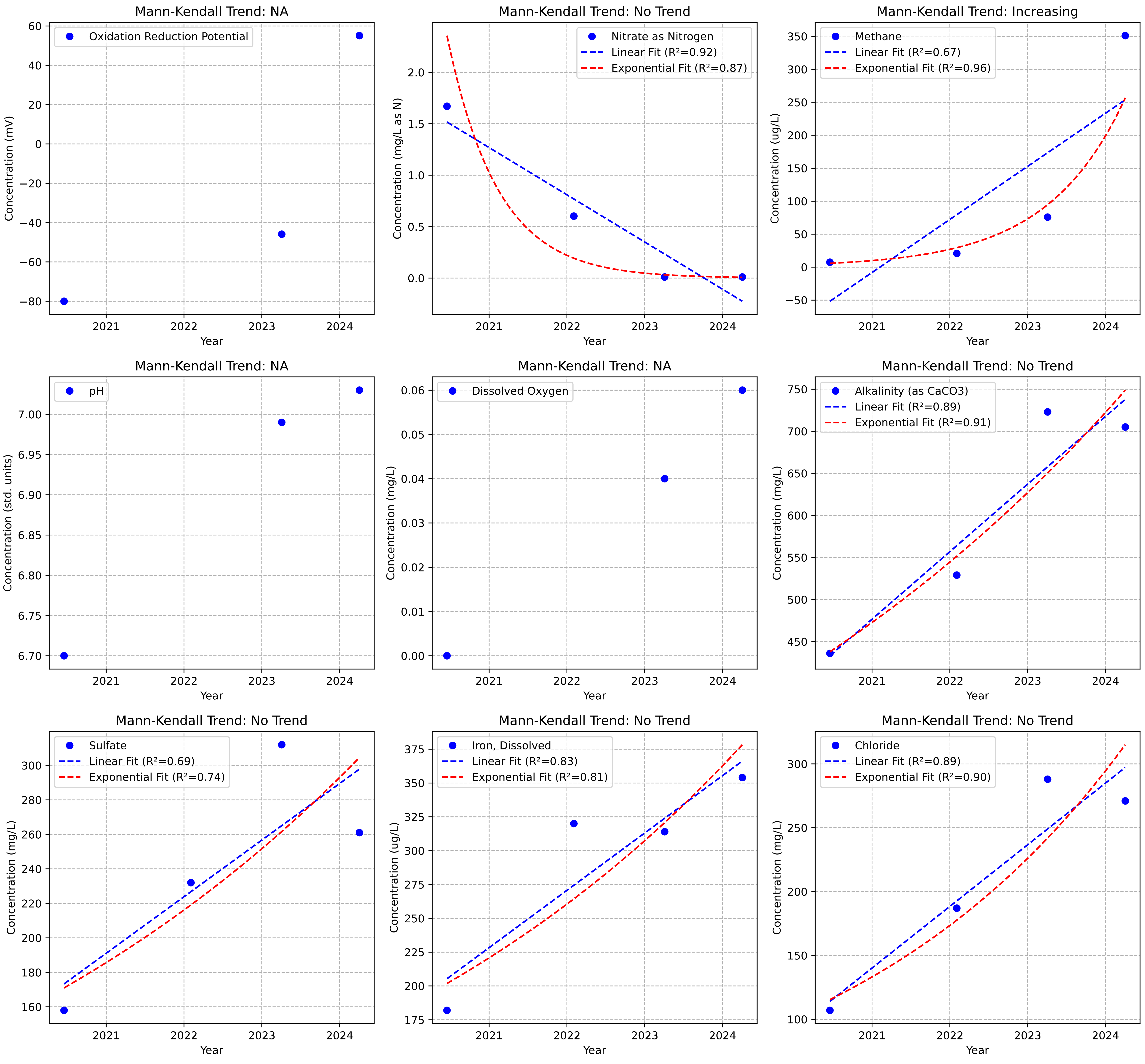
MW-144b



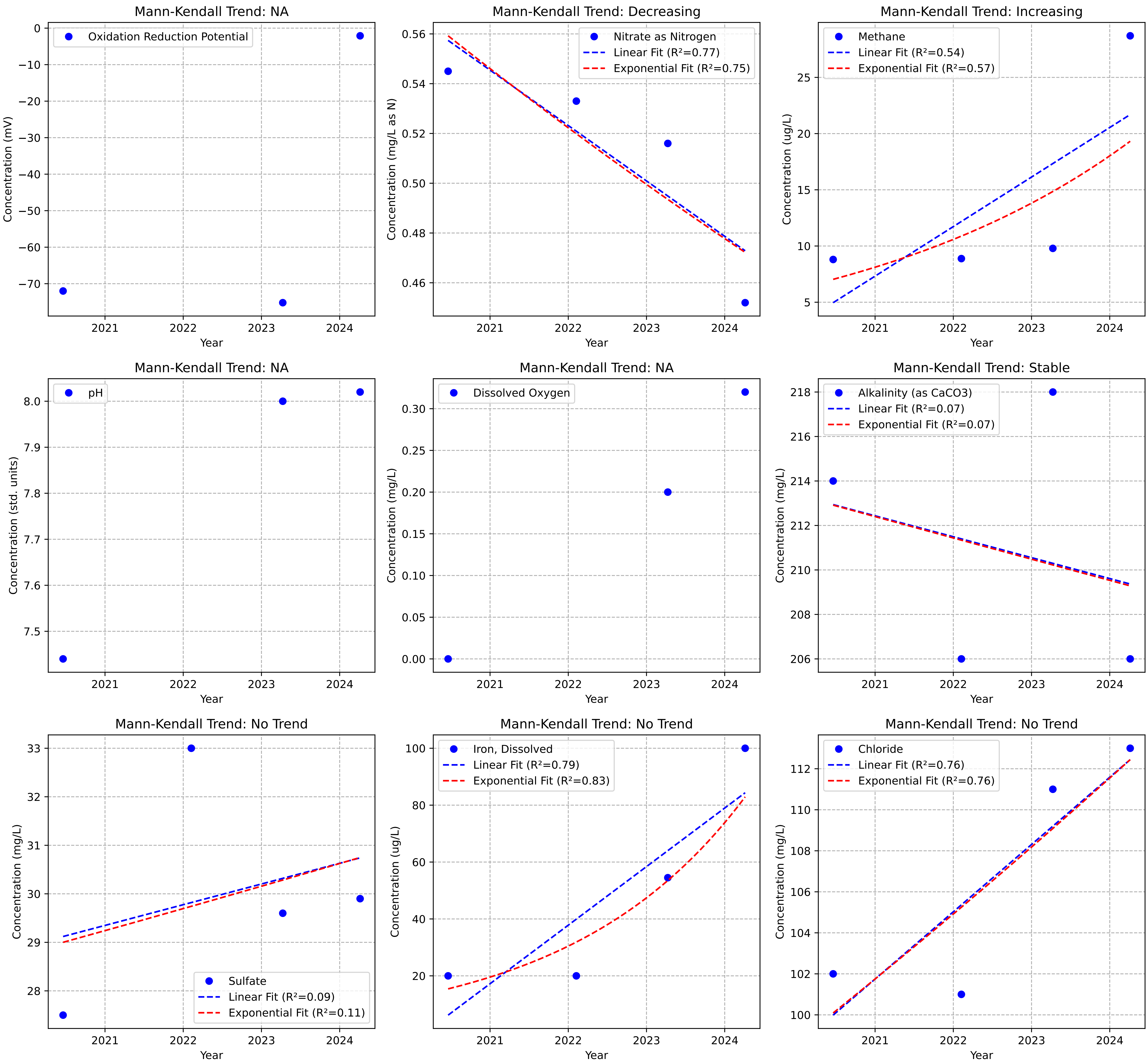
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Mann-Kendall Trend: No Trend
Methane
Linear Fit (R²=0.67)
Exponential Fit (R²=0.58)
Concentration (ug/L)
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Concentration (mg/L)
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.61)
Exponential Fit (R²=0.65)
Concentration (mg/L)
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.48)
Exponential Fit (R²=0.43)
Concentration (ug/L)
Mann-Kendall Trend: Stable
Chloride
Concentration (mg/L)
Year


MW-145b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.75)
Exponential Fit (R²=0.74)
Concentration (mg/L as N)
Mann-Kendall Trend: No Trend
Methane
Linear Fit (R²=0.71)
Exponential Fit (R²=0.77)
Concentration (ug/L)
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.26)
Exponential Fit (R²=0.26)
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.06)
Exponential Fit (R²=0.06)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.19)
Exponential Fit (R²=0.34)
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.66)
Exponential Fit (R²=0.65)

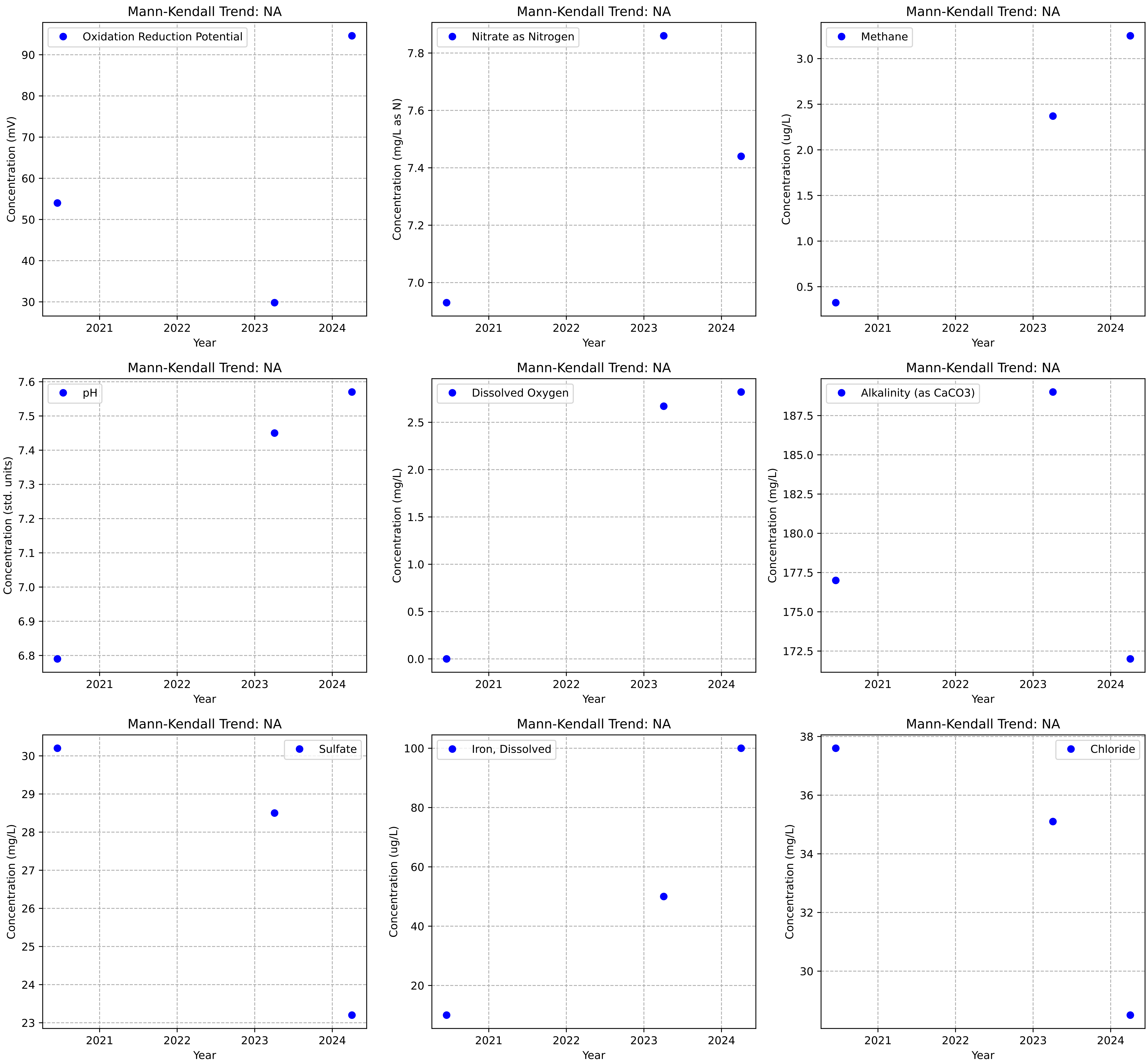
MW-146b


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.92)
Exponential Fit (R²=0.87)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: Increasing
Methane
Linear Fit (R²=0.67)
Exponential Fit (R²=0.96)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Alkalinity (as CaCO3)
Linear Fit (R²=0.89)
Exponential Fit (R²=0.91)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.69)
Exponential Fit (R²=0.74)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.83)
Exponential Fit (R²=0.81)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.89)
Exponential Fit (R²=0.90)
Concentration (mg/L)
Year

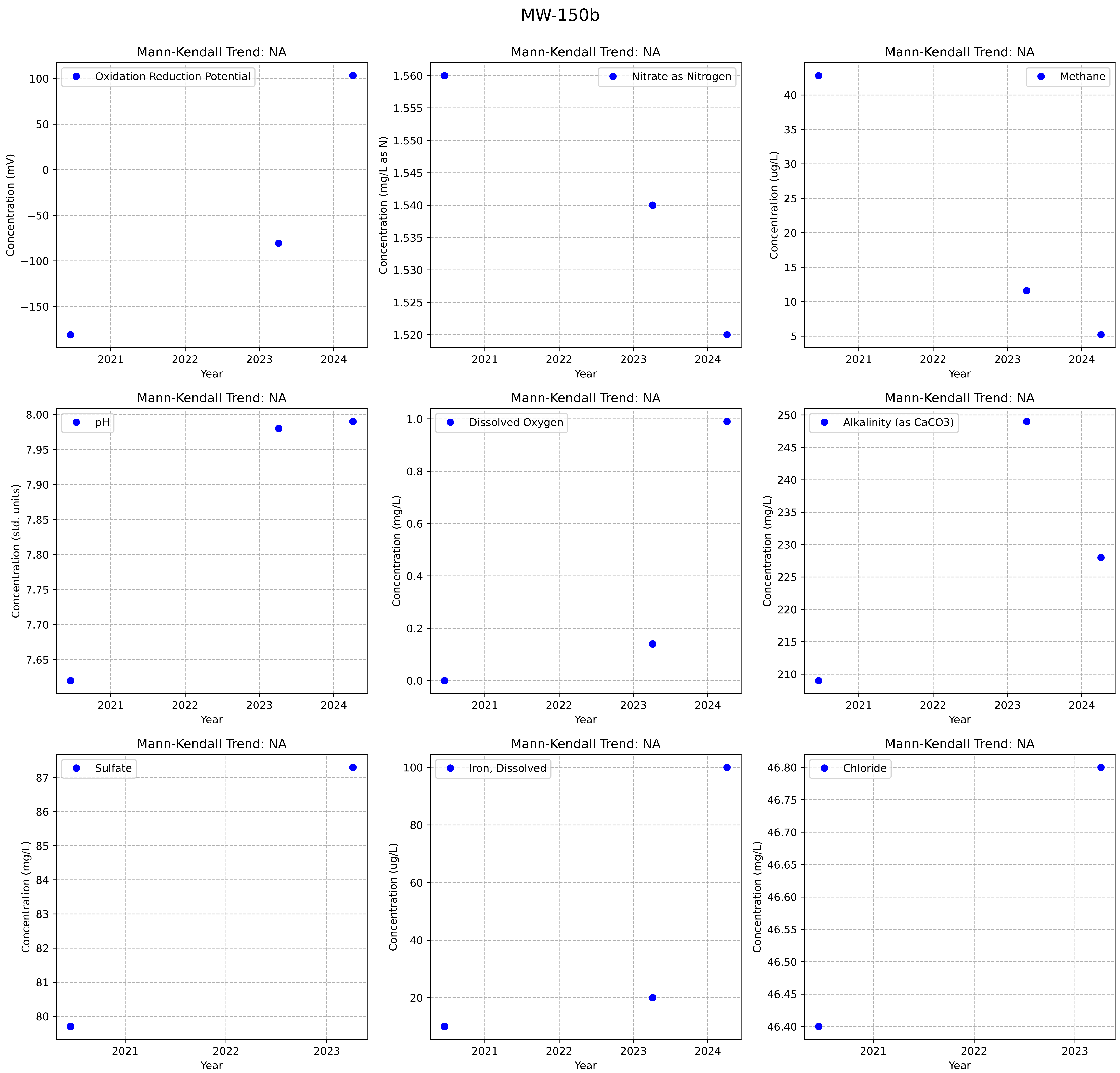
MW-148b


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.77)
Exponential Fit (R²=0.75)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: Increasing
Methane
Linear Fit (R²=0.54)
Exponential Fit (R²=0.57)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.07)
Exponential Fit (R²=0.07)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.09)
Exponential Fit (R²=0.11)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.79)
Exponential Fit (R²=0.83)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.76)
Exponential Fit (R²=0.76)
Concentration (mg/L)
Year

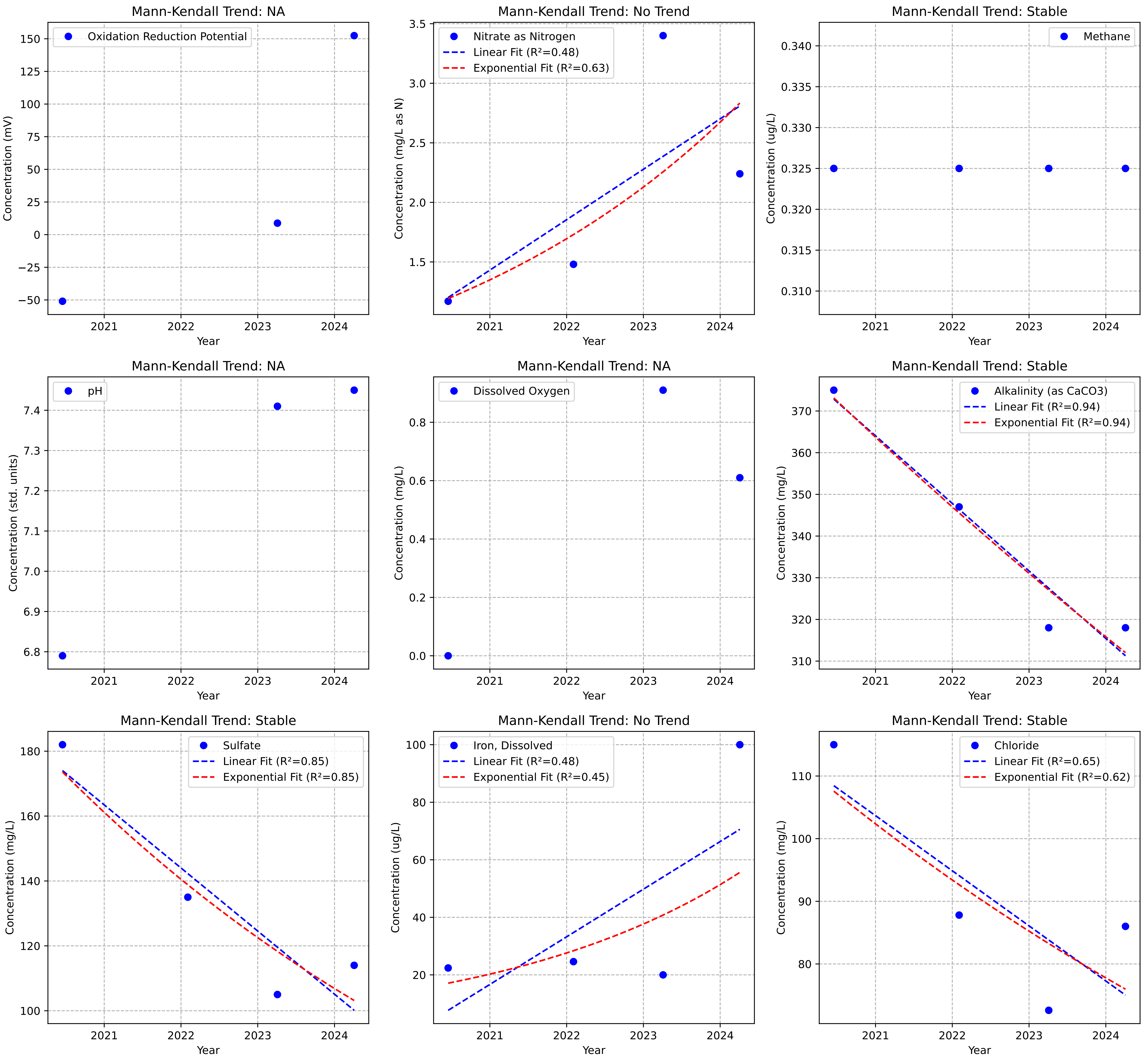
MW-149b



Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

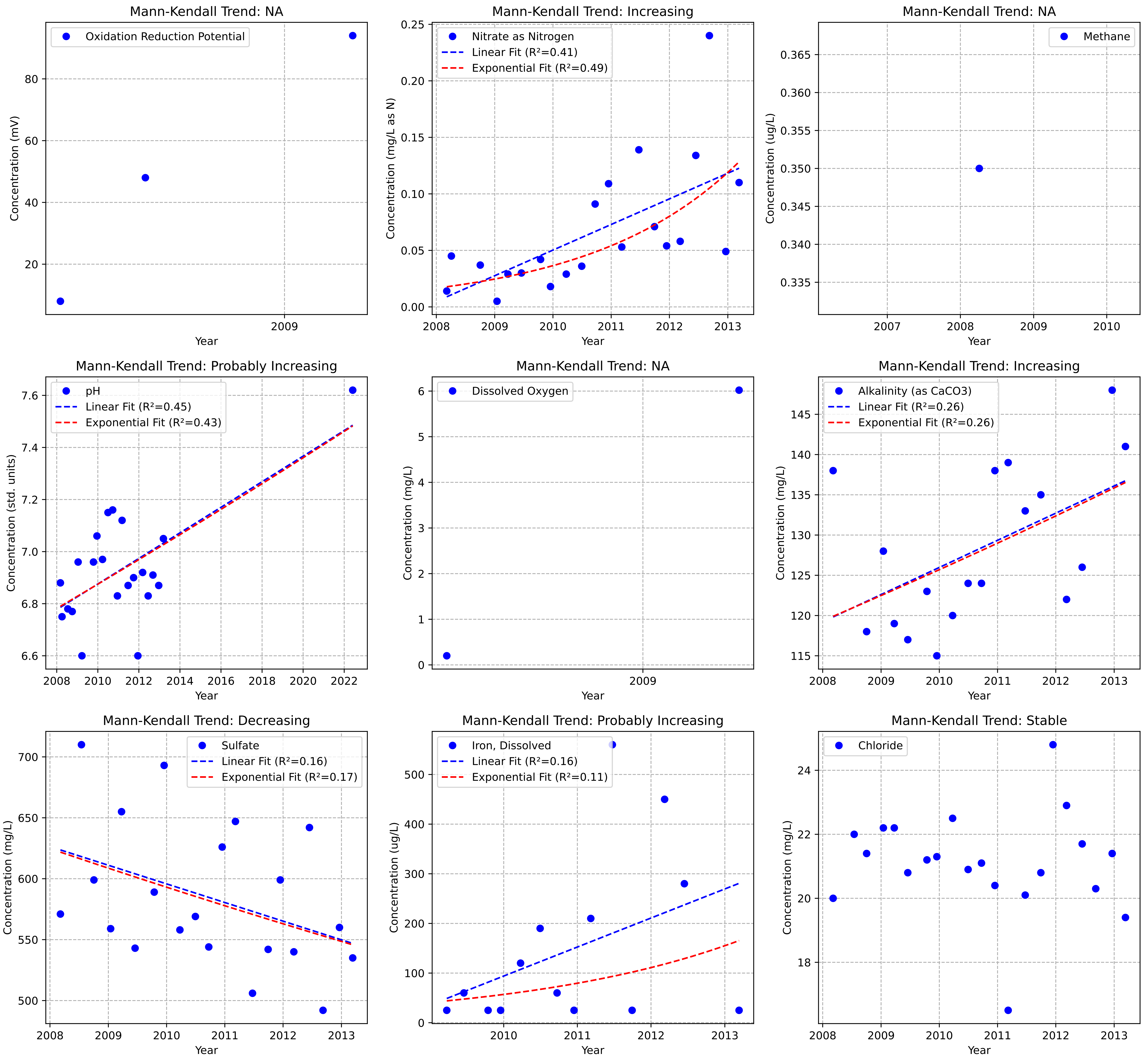

MW-150b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

MW-151b

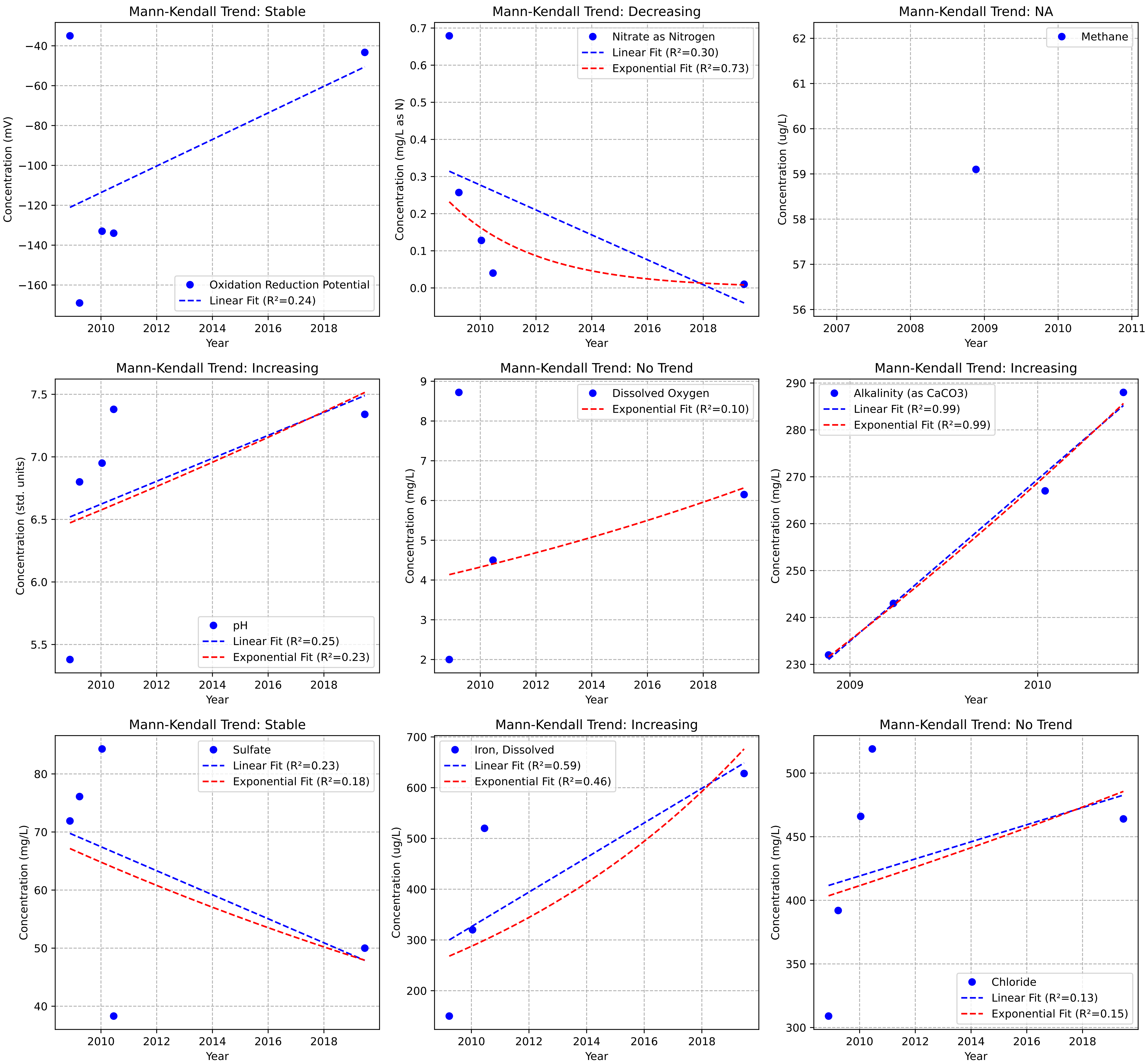


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.48)
Exponential Fit (R²=0.63)
Concentration (mg/L as N)
Mann-Kendall Trend: Stable
Methane
Concentration (ug/L)
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.94)
Exponential Fit (R²=0.94)
Concentration (mg/L)
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.85)
Exponential Fit (R²=0.85)
Concentration (mg/L)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.48)
Exponential Fit (R²=0.45)
Concentration (ug/L)
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.65)
Exponential Fit (R²=0.62)
Concentration (mg/L)
Year
2021
2022
2023
2024

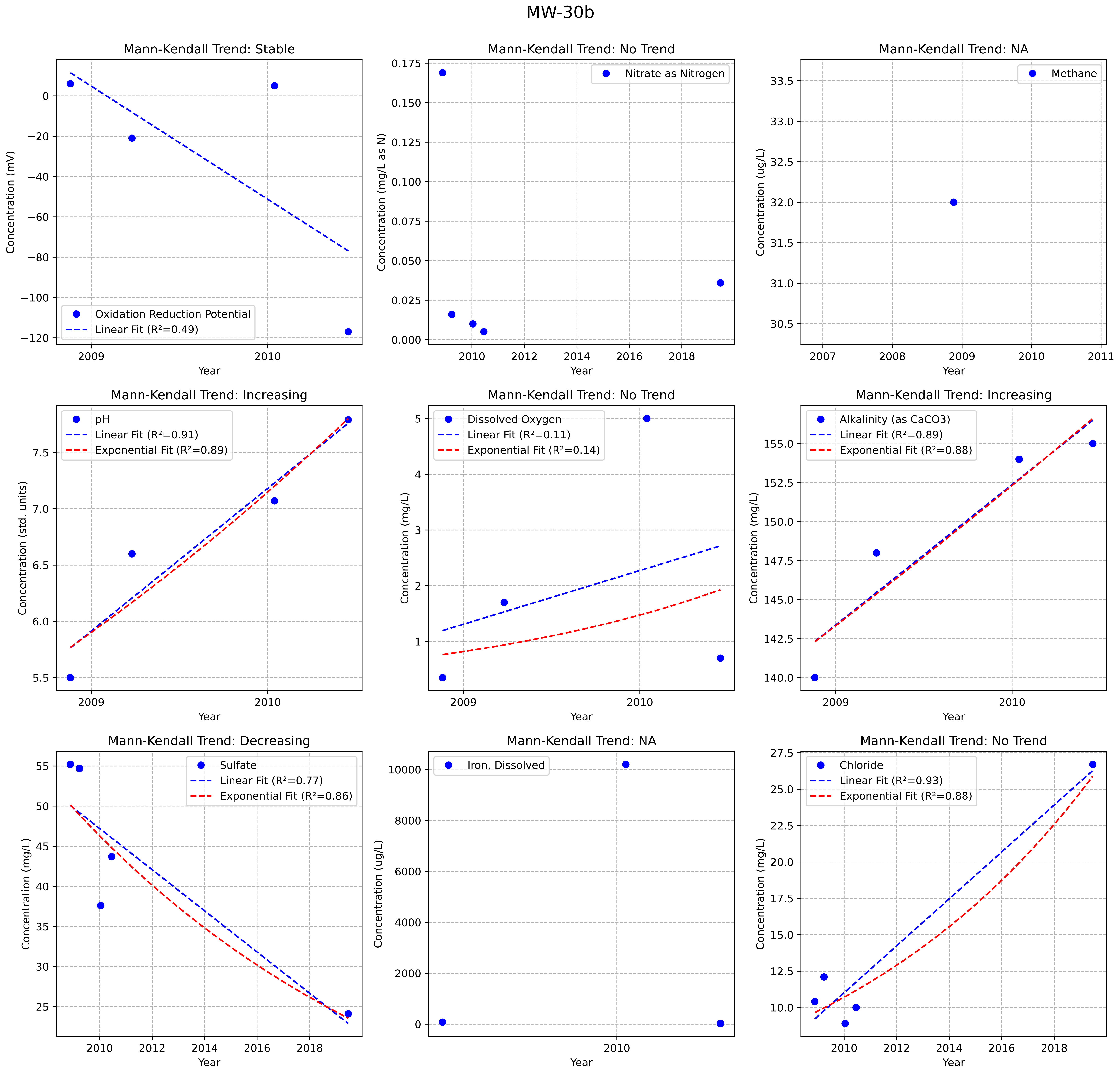
MW-19b


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.41)
Exponential Fit (R²=0.49)
Concentration (mg/L as N)
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Mann-Kendall Trend: Probably Increasing
pH
Linear Fit (R²=0.45)
Exponential Fit (R²=0.43)
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.26)
Exponential Fit (R²=0.26)
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.16)
Exponential Fit (R²=0.17)
Mann-Kendall Trend: Probably Increasing
Iron, Dissolved
Linear Fit (R²=0.16)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Stable
Chloride

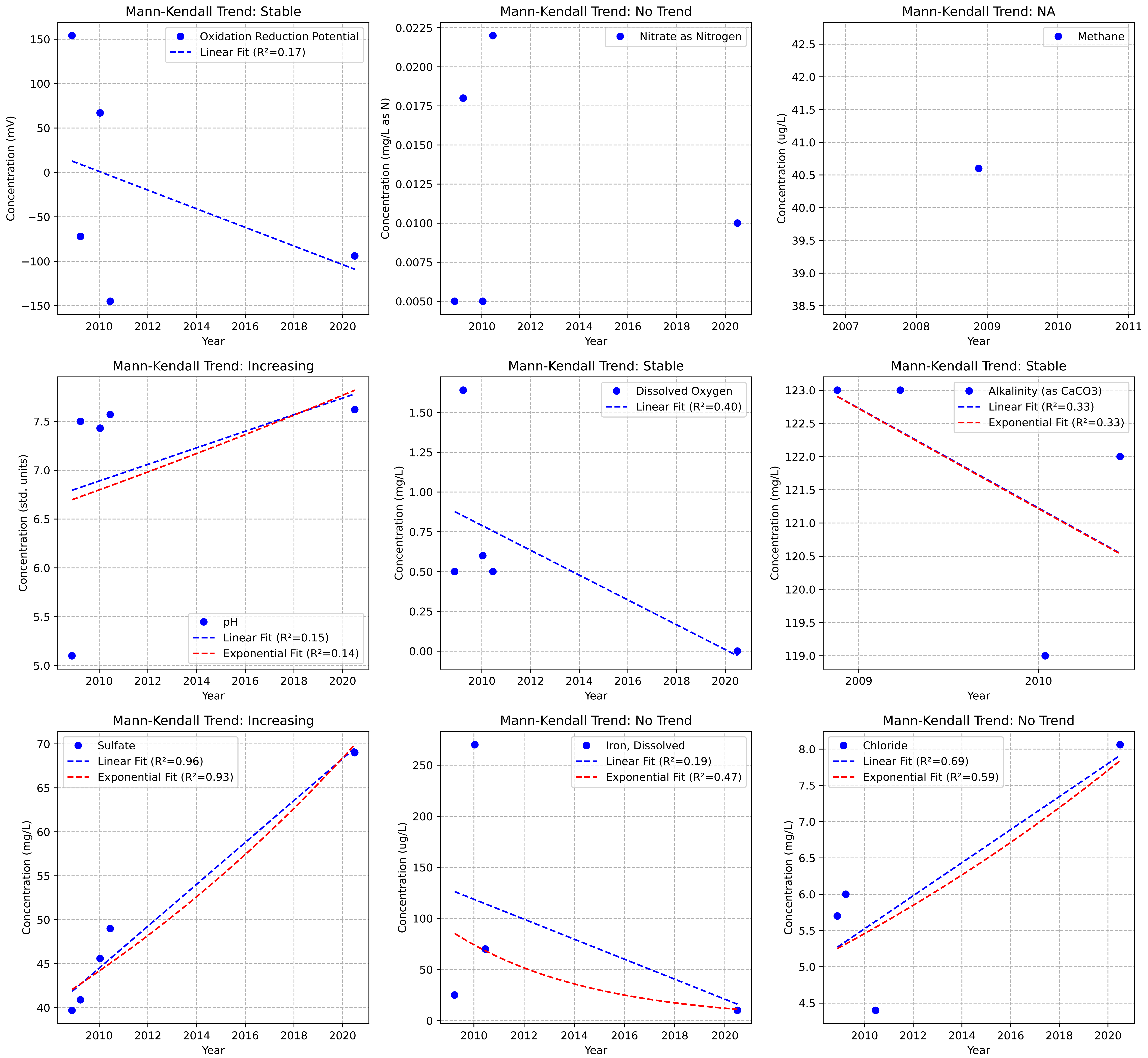
MW-29b



Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Linear Fit (R²=0.24)
Concentration (mV)
Year
Mann-Kendall Trend: Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.30)
Exponential Fit (R²=0.73)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.25)
Exponential Fit (R²=0.23)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Exponential Fit (R²=0.10)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.99)
Exponential Fit (R²=0.99)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.23)
Exponential Fit (R²=0.18)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Iron, Dissolved
Linear Fit (R²=0.59)
Exponential Fit (R²=0.46)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.13)
Exponential Fit (R²=0.15)
Concentration (mg/L)
Year

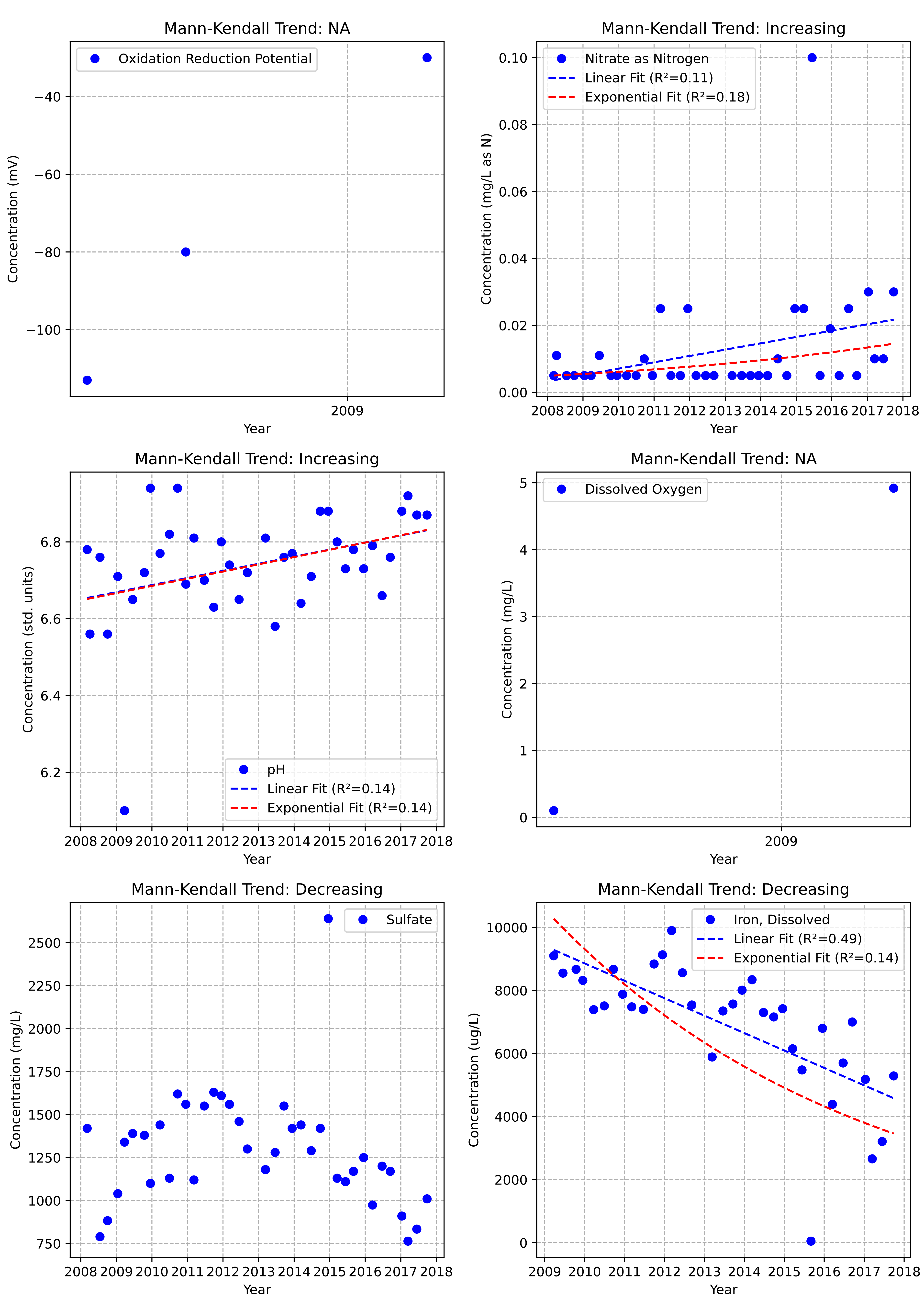

MW-30b
Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Linear Fit (R²=0.49)
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.91)
Exponential Fit (R²=0.89)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Linear Fit (R²=0.11)
Exponential Fit (R²=0.14)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.89)
Exponential Fit (R²=0.88)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.77)
Exponential Fit (R²=0.86)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.93)
Exponential Fit (R²=0.88)
Concentration (mg/L)
Year

MW-31b



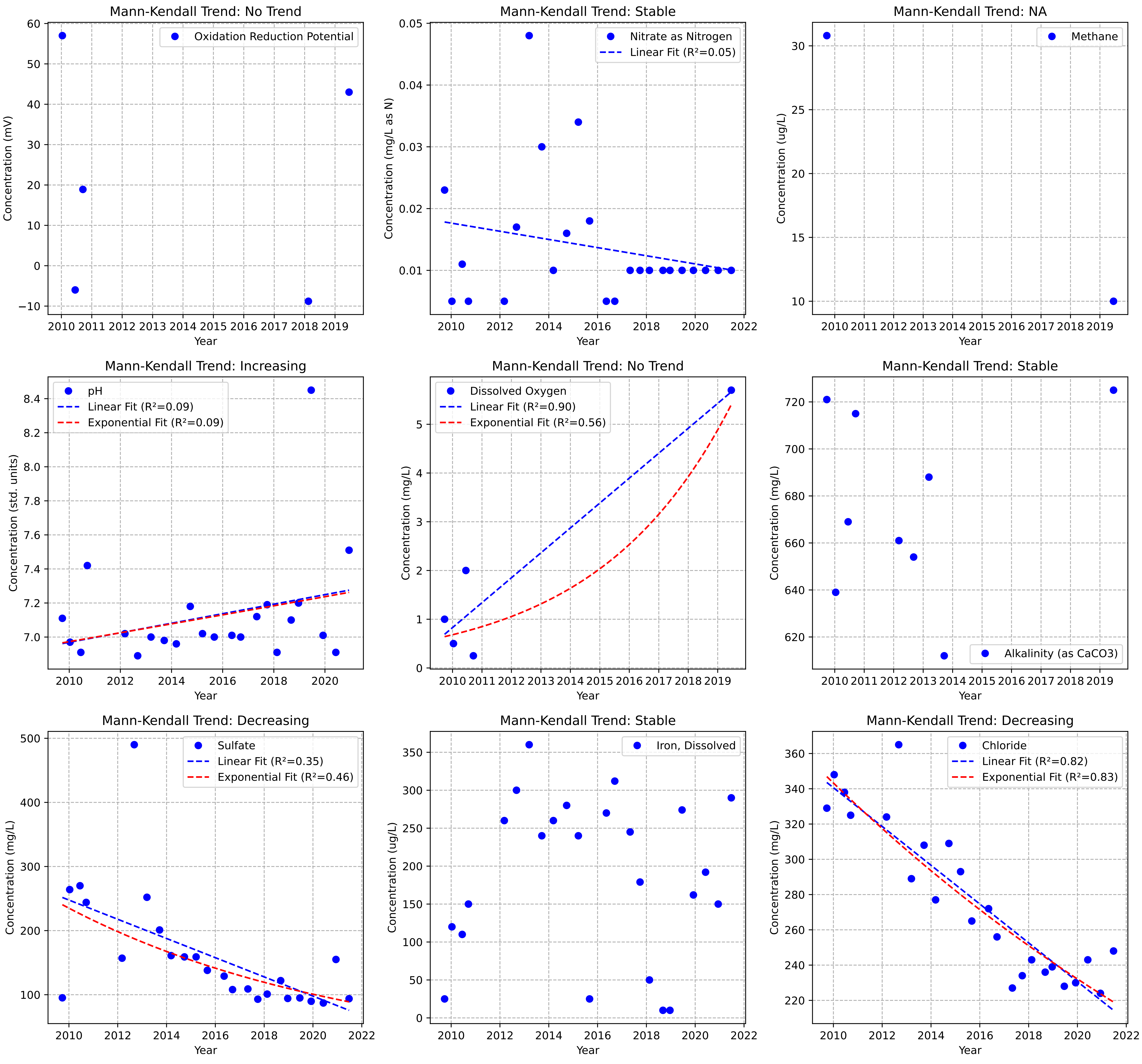
Mann-Kendall Trend: Stable
Oxidation Reduction Potential
Linear Fit (R²=0.17)
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.15)
Exponential Fit (R²=0.14)
Concentration (std. units)
Year
Mann-Kendall Trend: Stable
Dissolved Oxygen
Linear Fit (R²=0.40)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.33)
Exponential Fit (R²=0.33)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.96)
Exponential Fit (R²=0.93)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.19)
Exponential Fit (R²=0.47)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.69)
Exponential Fit (R²=0.59)
Concentration (mg/L)
Year

MW-3b

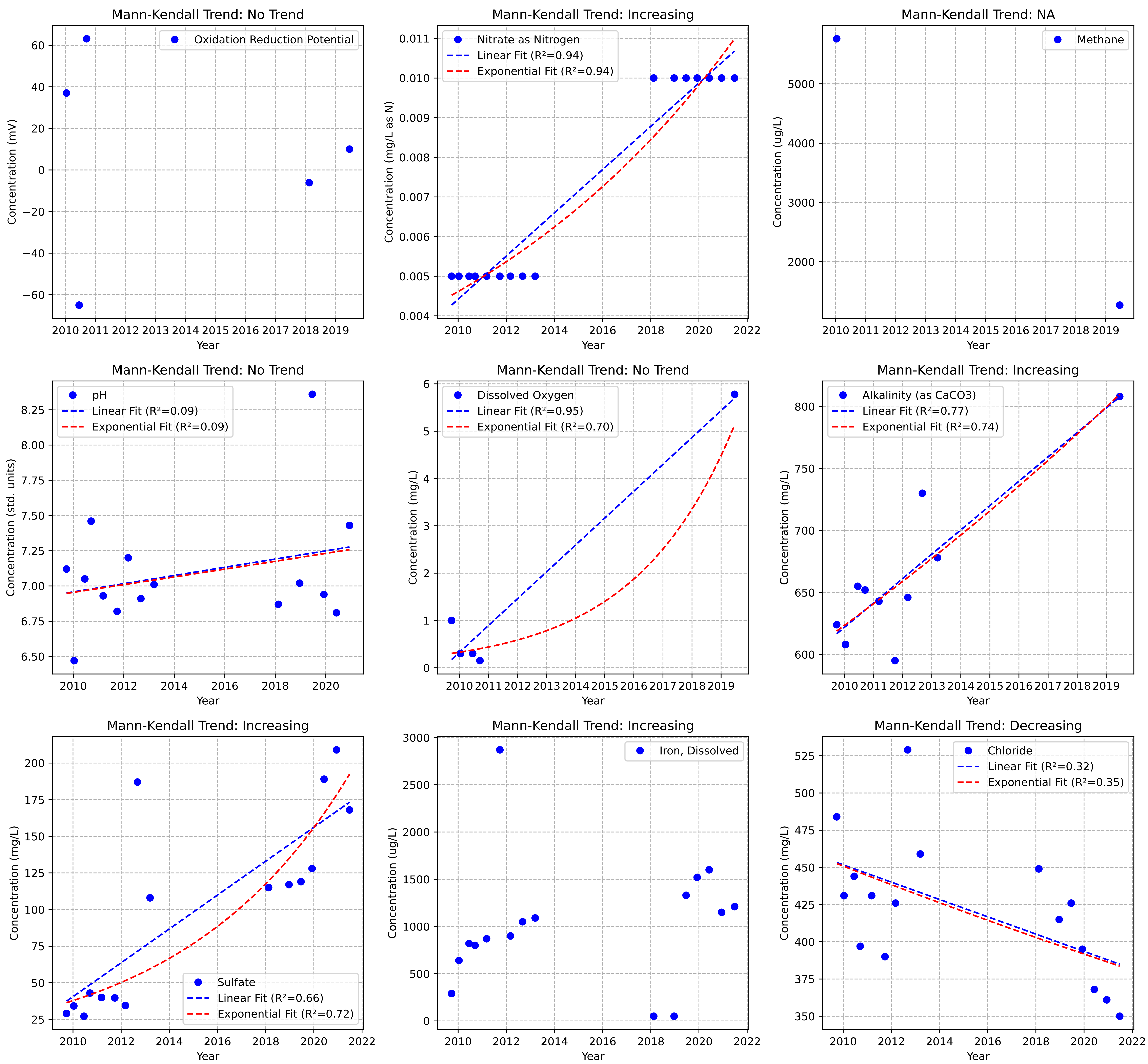


MW-3b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.11)
Exponential Fit (R²=0.18)
Concentration (mg/L as N)
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.14)
Exponential Fit (R²=0.14)
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Decreasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.31)
Exponential Fit (R²=0.32)
Concentration (mg/L)
Mann-Kendall Trend: Decreasing
Sulfate
Concentration (mg/L)
Mann-Kendall Trend: Decreasing
Iron, Dissolved
Linear Fit (R²=0.49)
Exponential Fit (R²=0.14)
Concentration (ug/L)
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.41)
Exponential Fit (R²=0.40)
Concentration (mg/L)

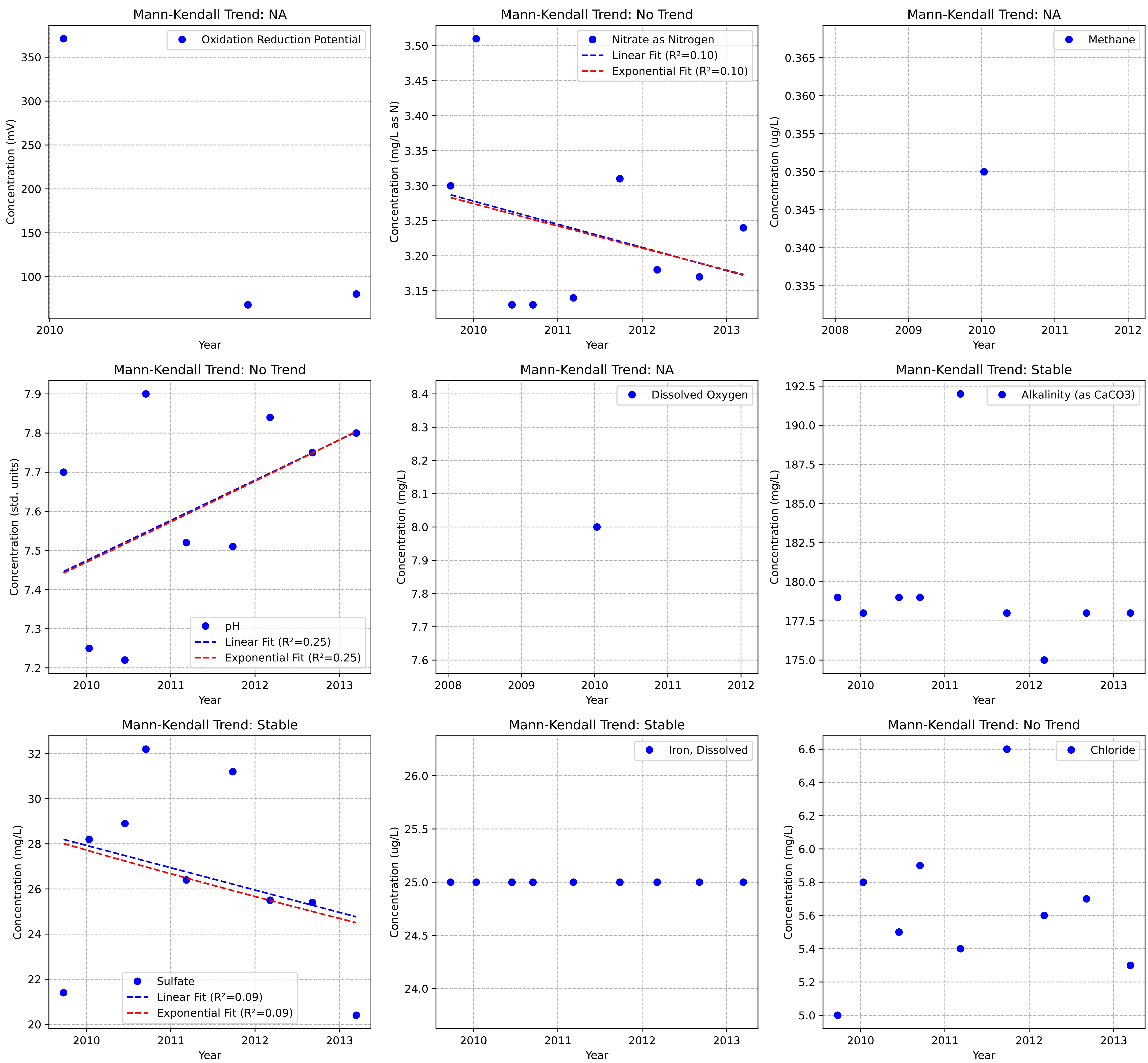
MW-42b


Mann-Kendall Trend: No Trend
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.05)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Linear Fit (R²=0.90)
Exponential Fit (R²=0.56)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.35)
Exponential Fit (R²=0.46)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.82)
Exponential Fit (R²=0.83)
Concentration (mg/L)
Year

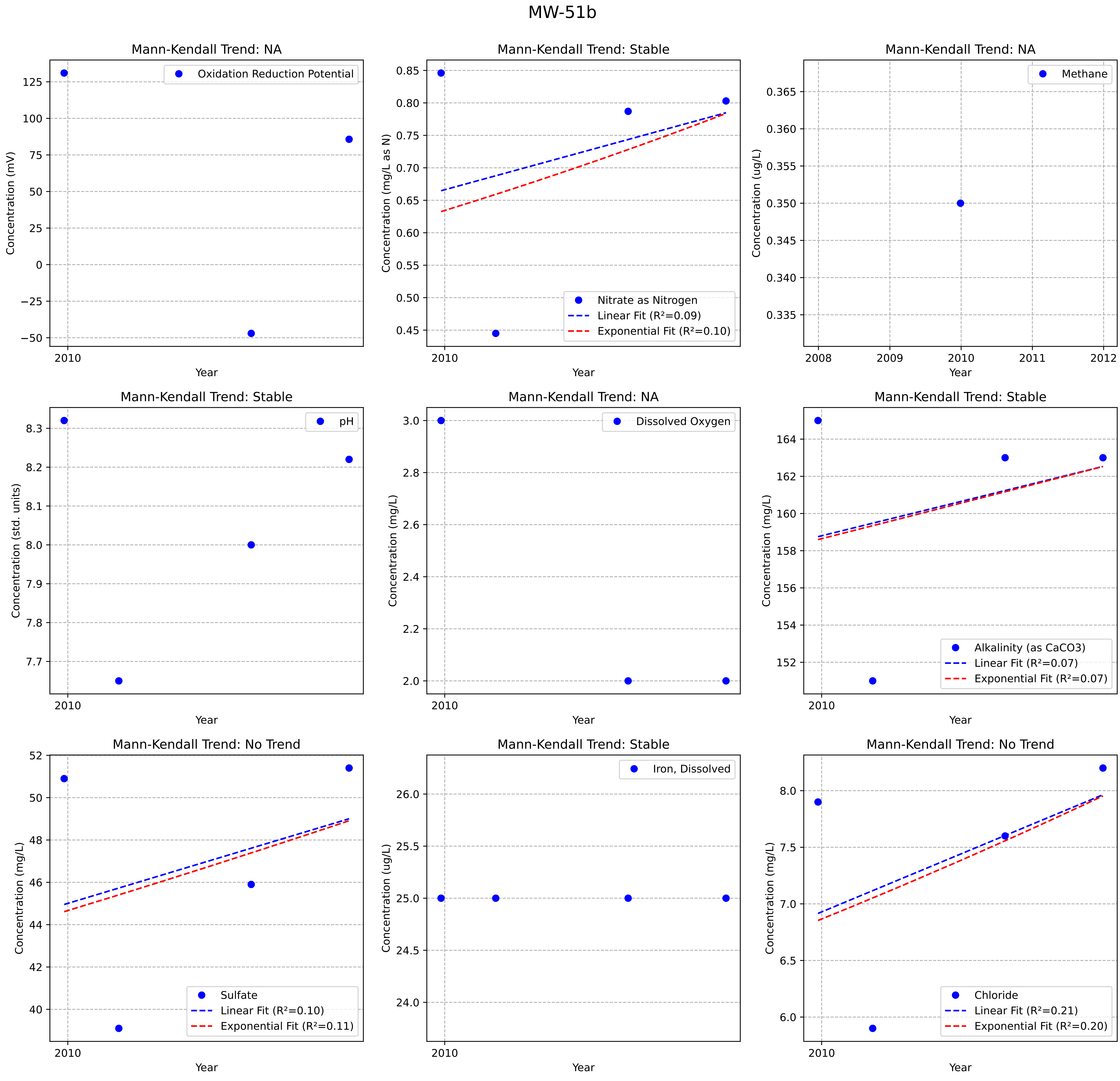
MW-44b

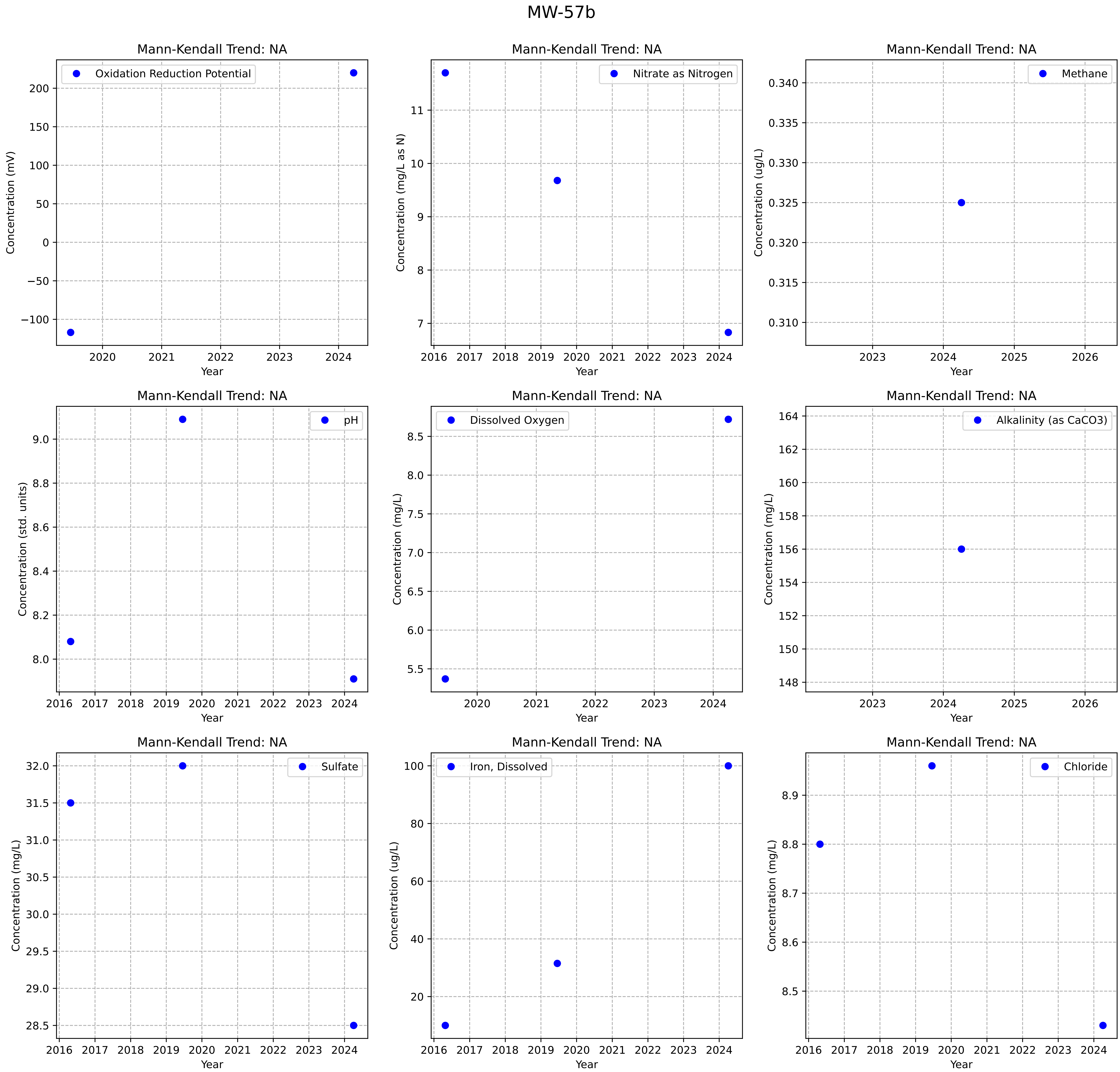

Mann-Kendall Trend: No Trend
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.94)
Exponential Fit (R²=0.94)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Concentration (std. units)
Year
Mann-Kendall Trend: No Trend
Dissolved Oxygen
Linear Fit (R²=0.95)
Exponential Fit (R²=0.70)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.77)
Exponential Fit (R²=0.74)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.66)
Exponential Fit (R²=0.72)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.32)
Exponential Fit (R²=0.35)
Concentration (mg/L)
Year

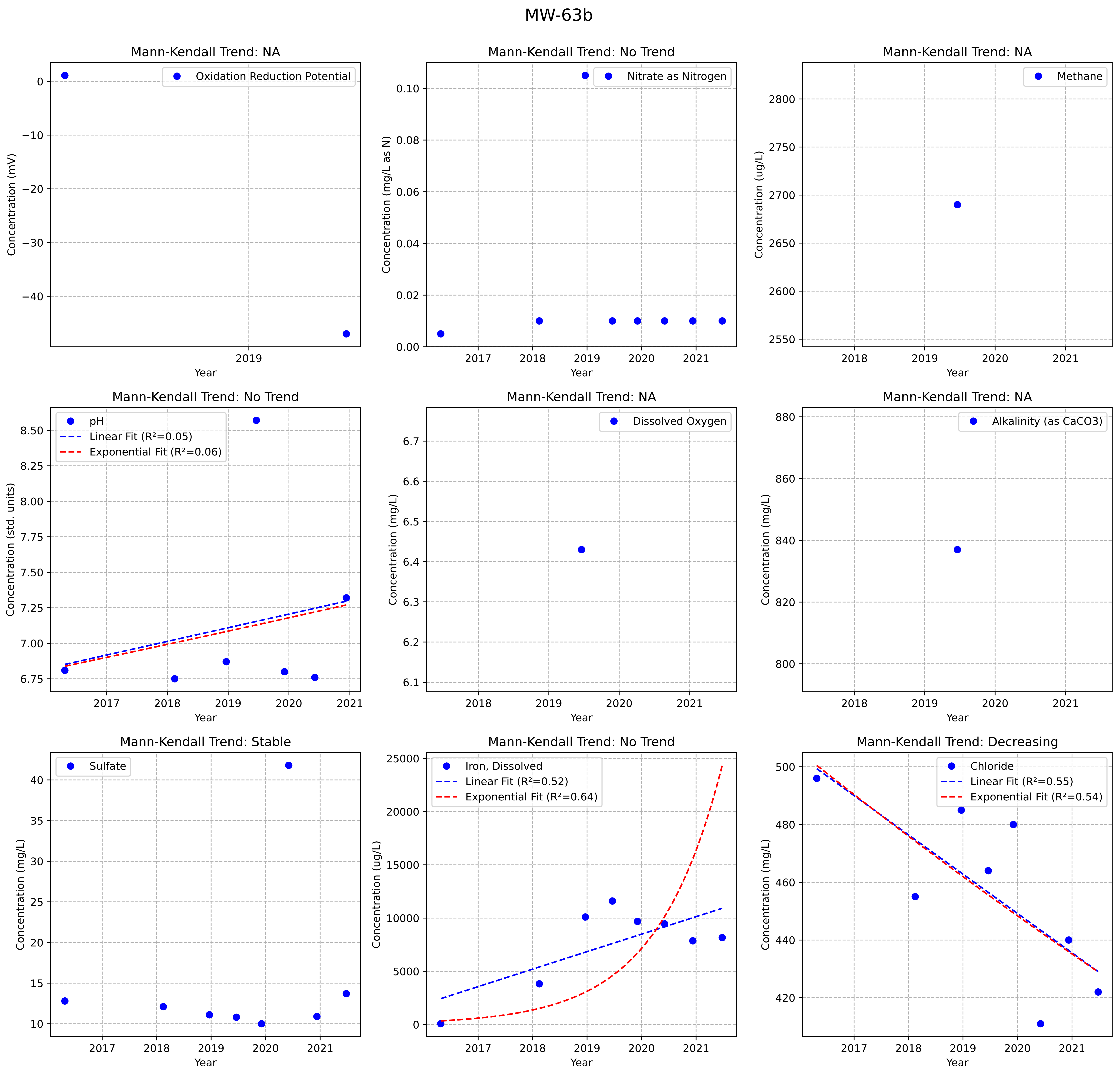
MW-48b



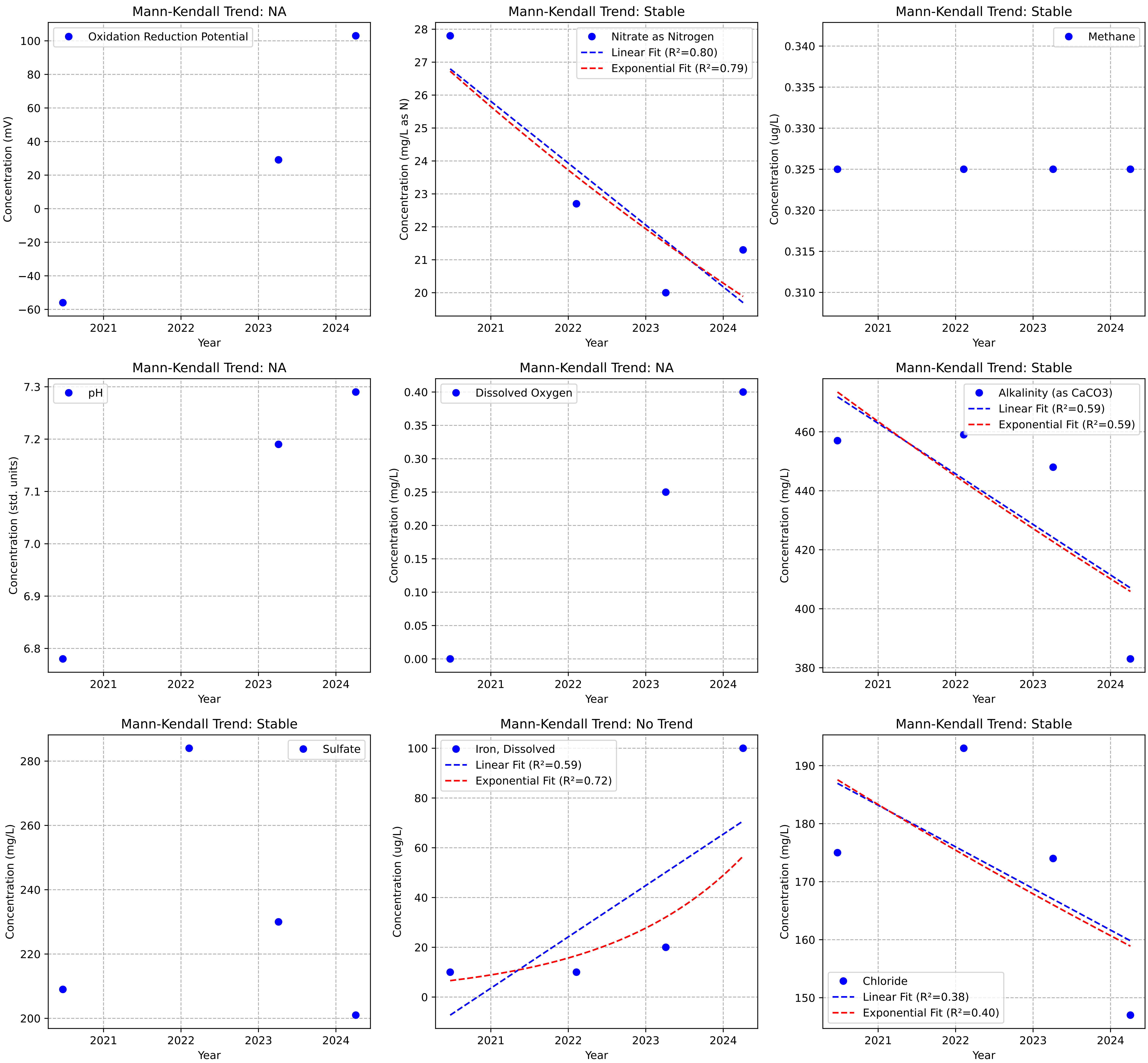
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.10)
Exponential Fit (R²=0.10)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Concentration (mg/L)
Year


MW-51b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.09)
Exponential Fit (R²=0.10)
Concentration (mg/L as N)
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Mann-Kendall Trend: Stable
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.07)
Exponential Fit (R²=0.07)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.10)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Stable
Iron, Dissolved
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.21)
Exponential Fit (R²=0.20)


MW-57b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

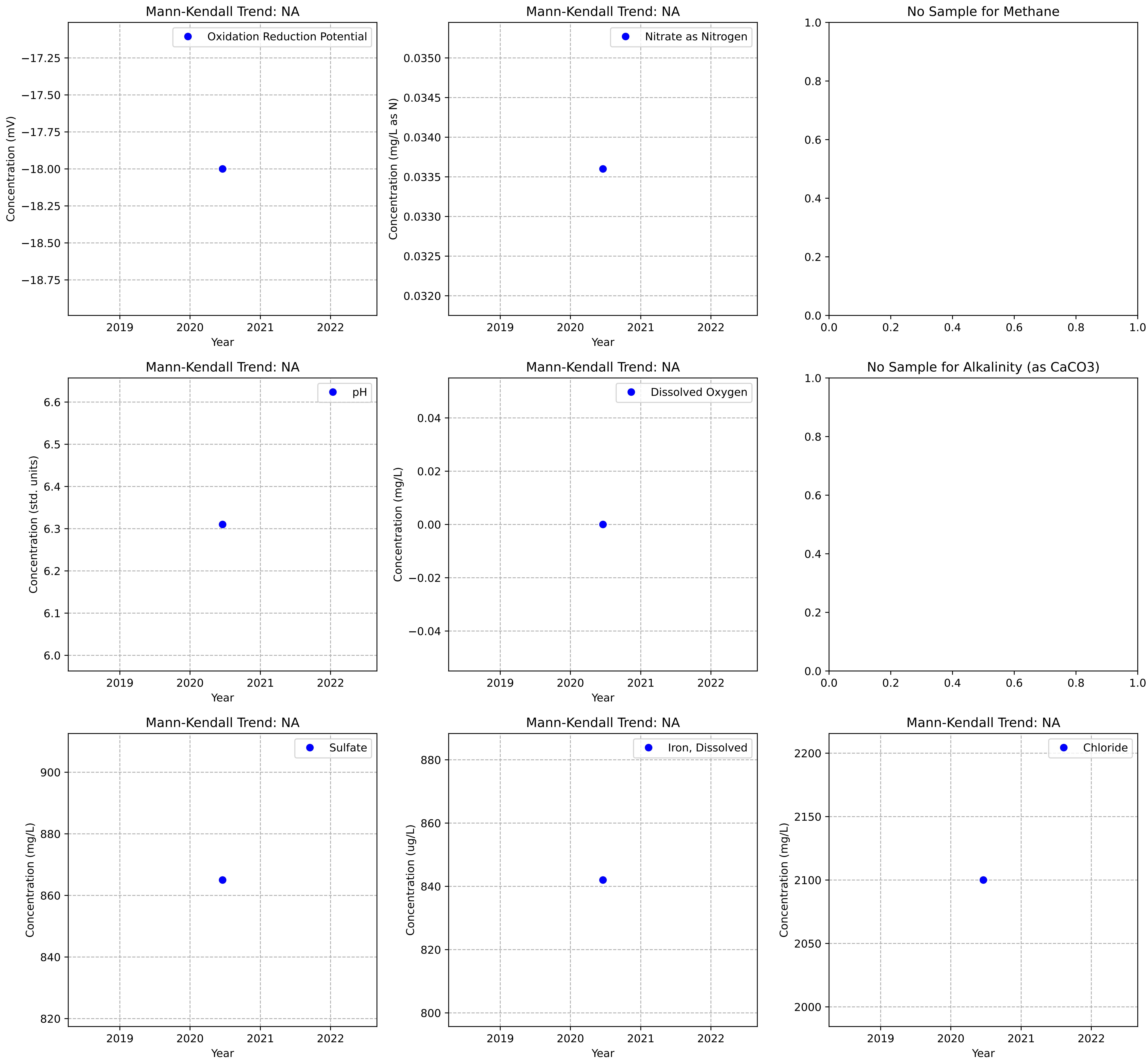

MW-63b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.05)
Exponential Fit (R²=0.06)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.52)
Exponential Fit (R²=0.64)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.55)
Exponential Fit (R²=0.54)
Concentration (mg/L)
Year

MW-71b

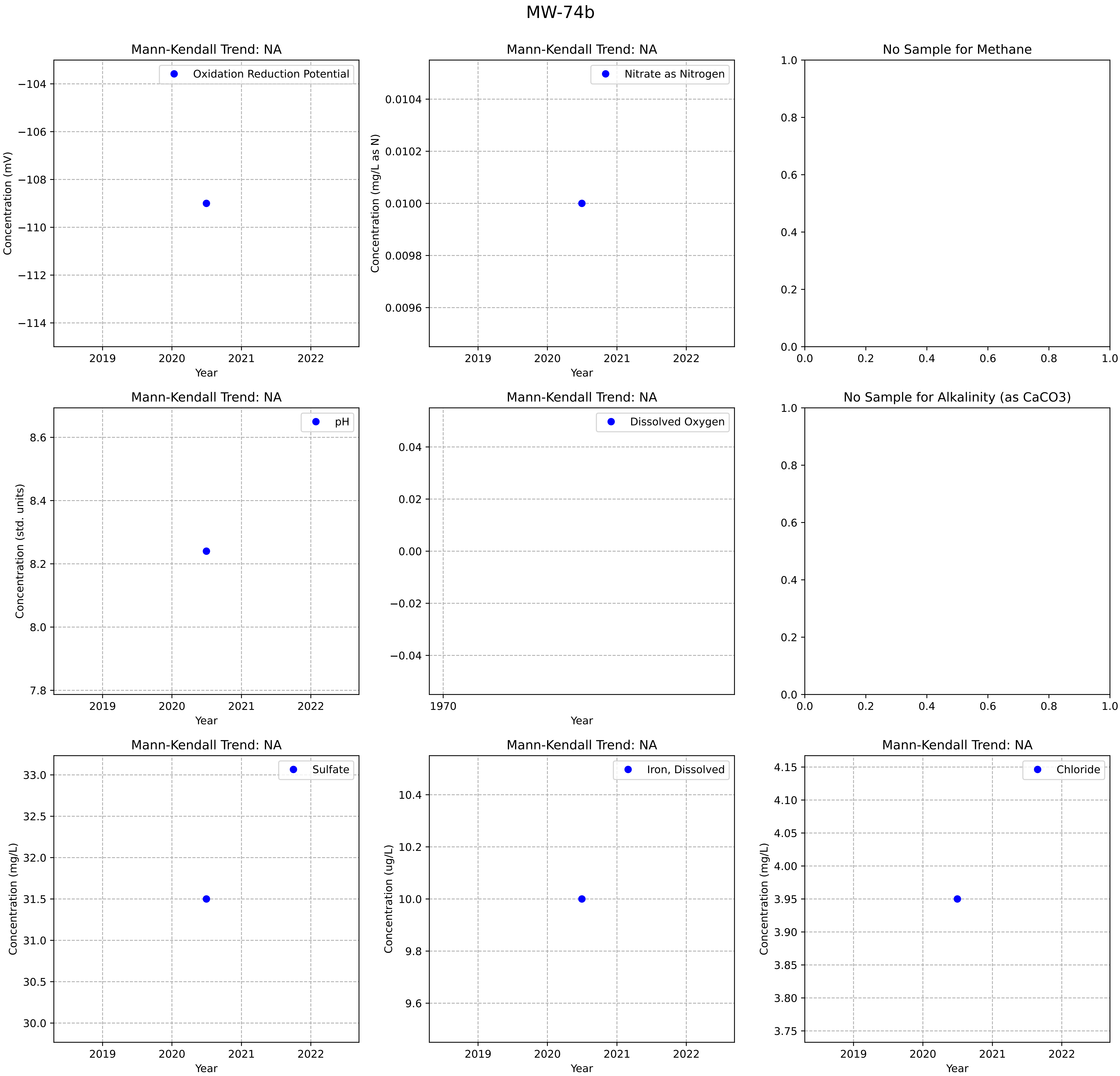


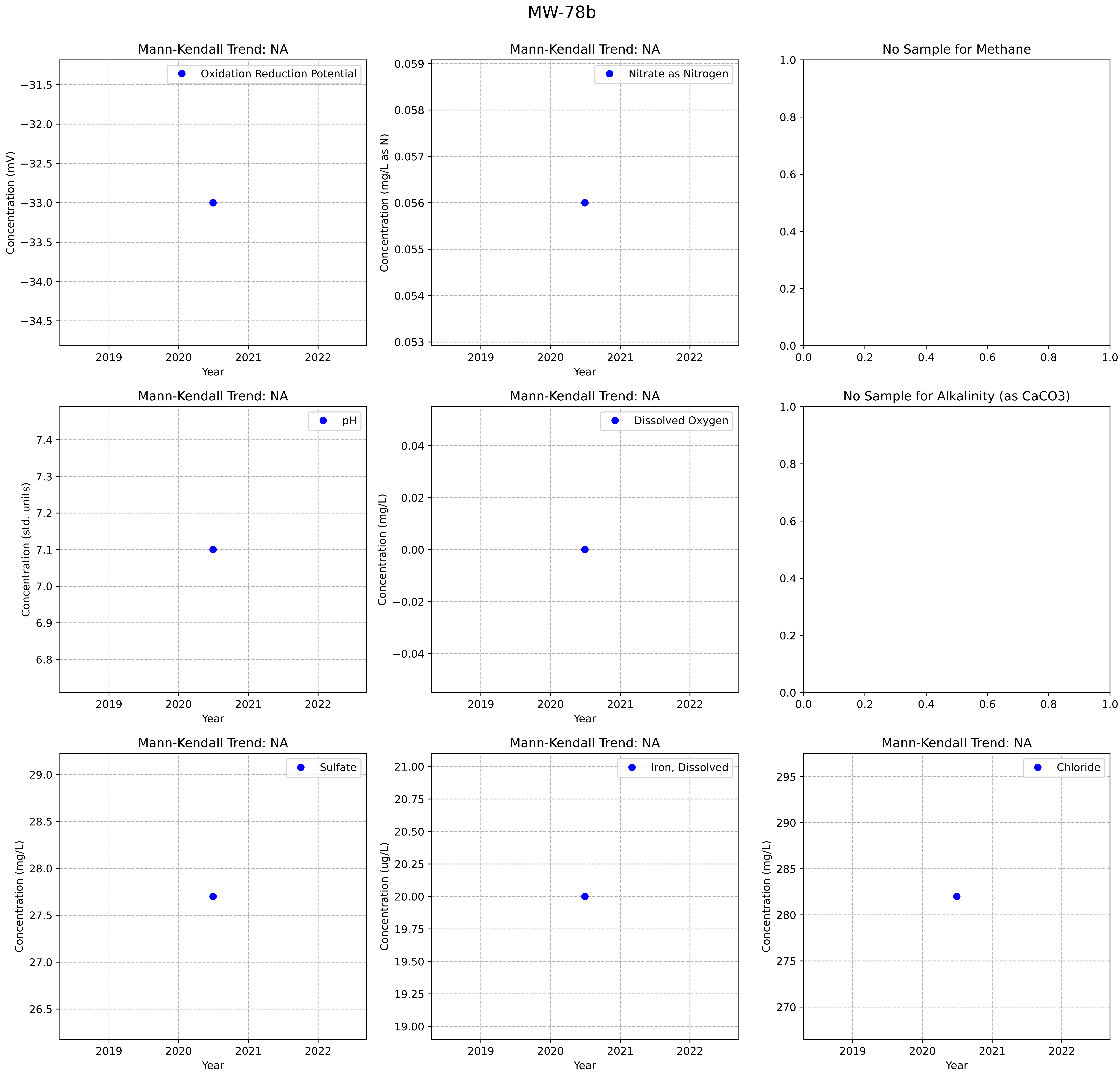
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.80)
Exponential Fit (R²=0.79)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: Stable
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.59)
Exponential Fit (R²=0.72)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.38)
Exponential Fit (R²=0.40)
Concentration (mg/L)
Year

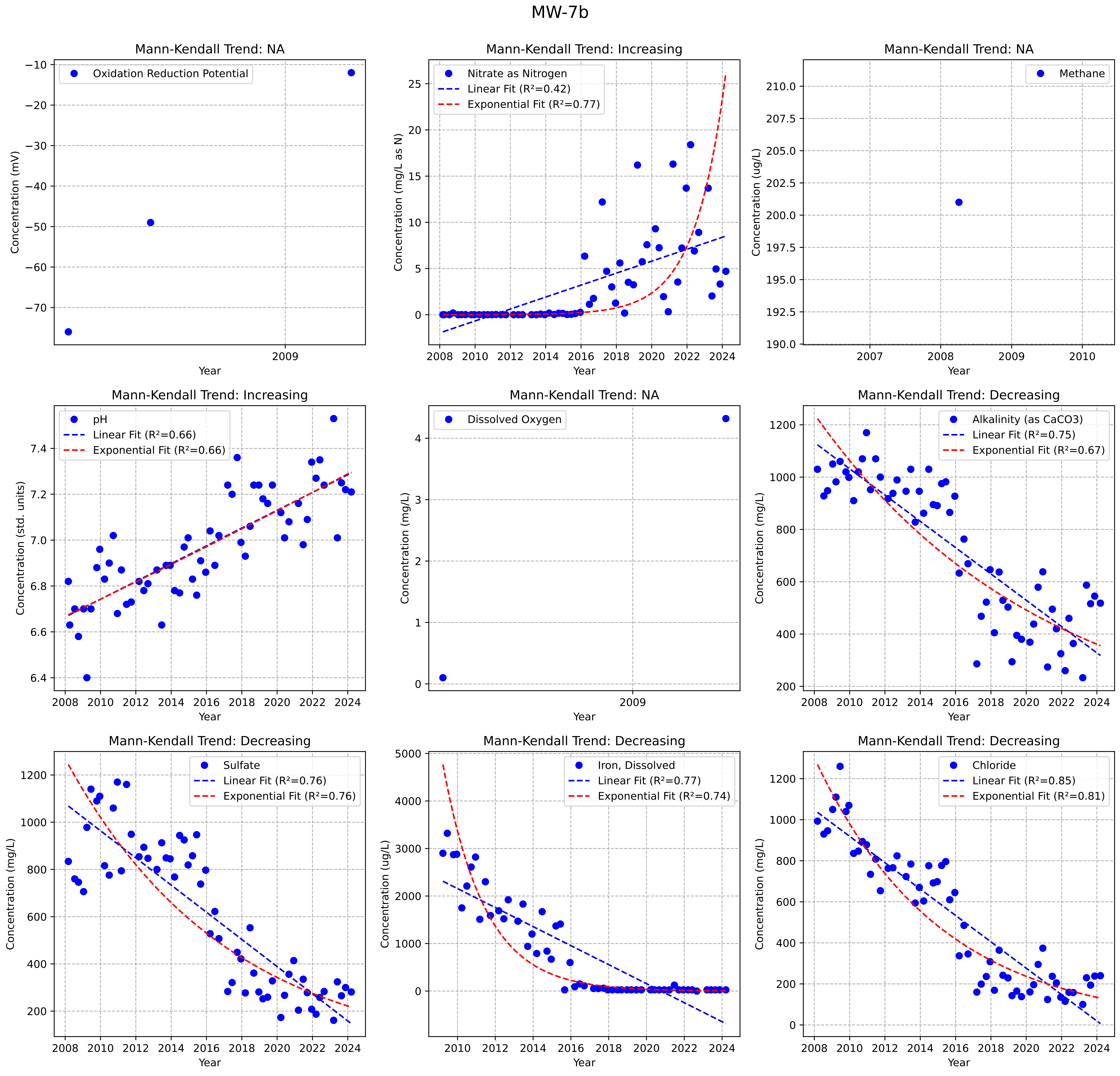
MW-72b

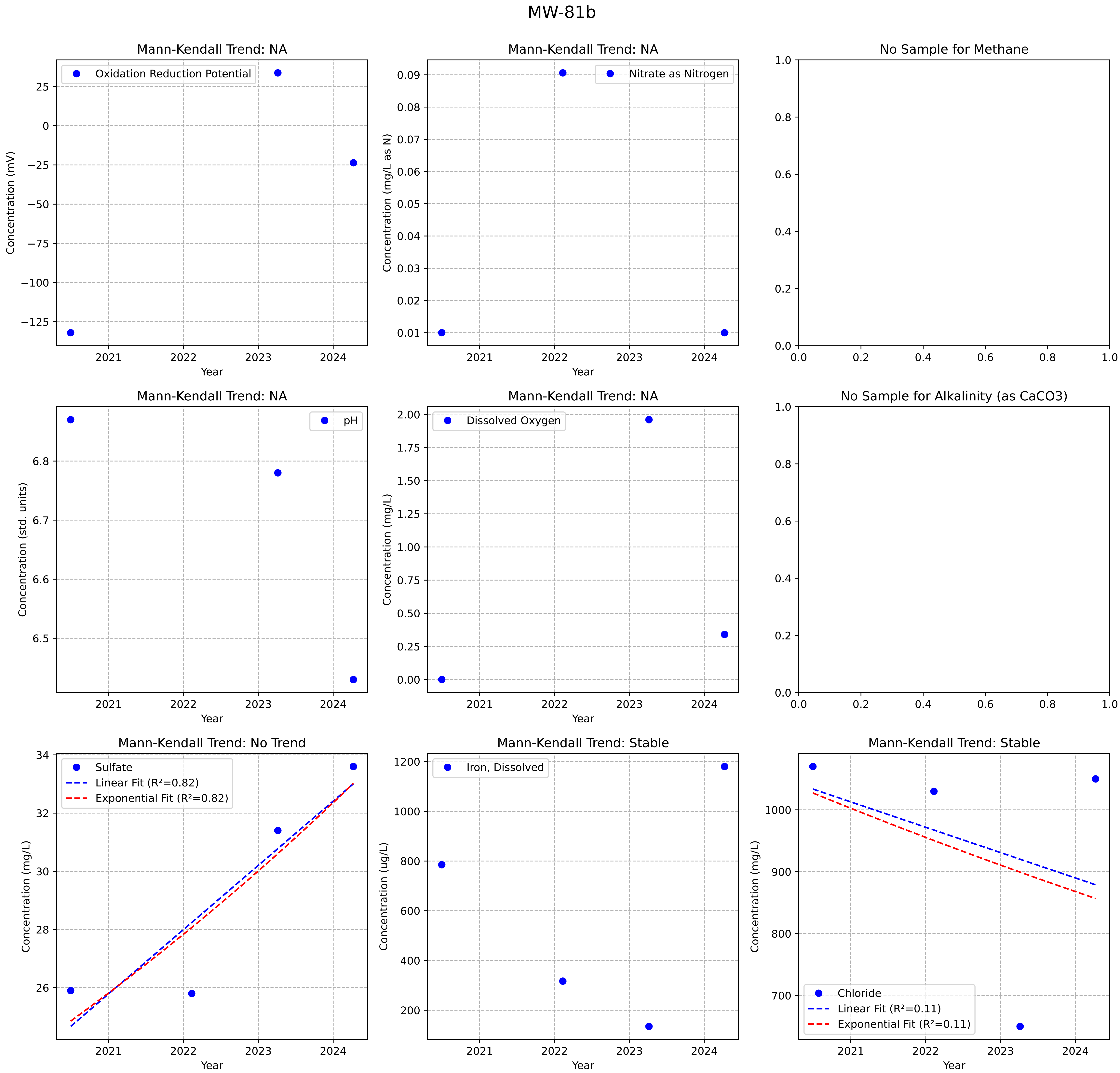


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

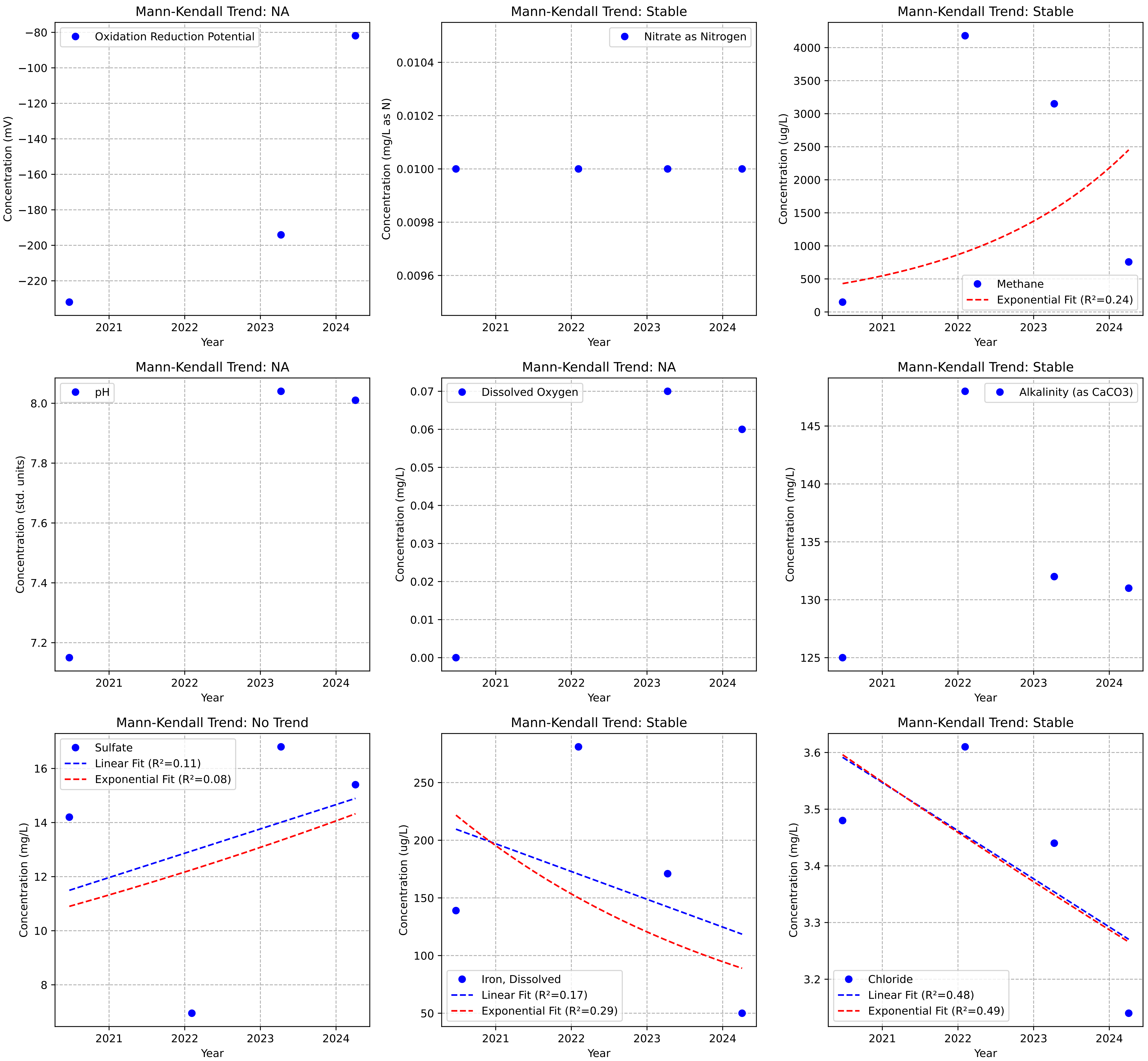

MW-74b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
−104
−106
−108
−110
−112
−114
2019
2020
2021
2022
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
0.0104
0.0102
0.0100
0.0098
0.0096
2019
2020
2021
2022
Year
No Sample for Methane
1.0
0.8
0.6
0.4
0.2
0.0
Mann-Kendall Trend: NA
pH
Concentration (std. units)
8.6
8.4
8.2
8.0
7.8
2019
2020
2021
2022
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
0.04
0.02
0.00
−0.02
−0.04
1970
Year
No Sample for Alkalinity (as CaCO3)
1.0
0.8
0.6
0.4
0.2
0.0
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
33.0
32.5
32.0
31.5
31.0
30.5
30.0
2019
2020
2021
2022
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
10.4
10.2
10.0
9.8
9.6
2019
2020
2021
2022
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
4.15
4.10
4.05
4.00
3.95
3.90
3.85
3.80
3.75
2019
2020
2021
2022
Year

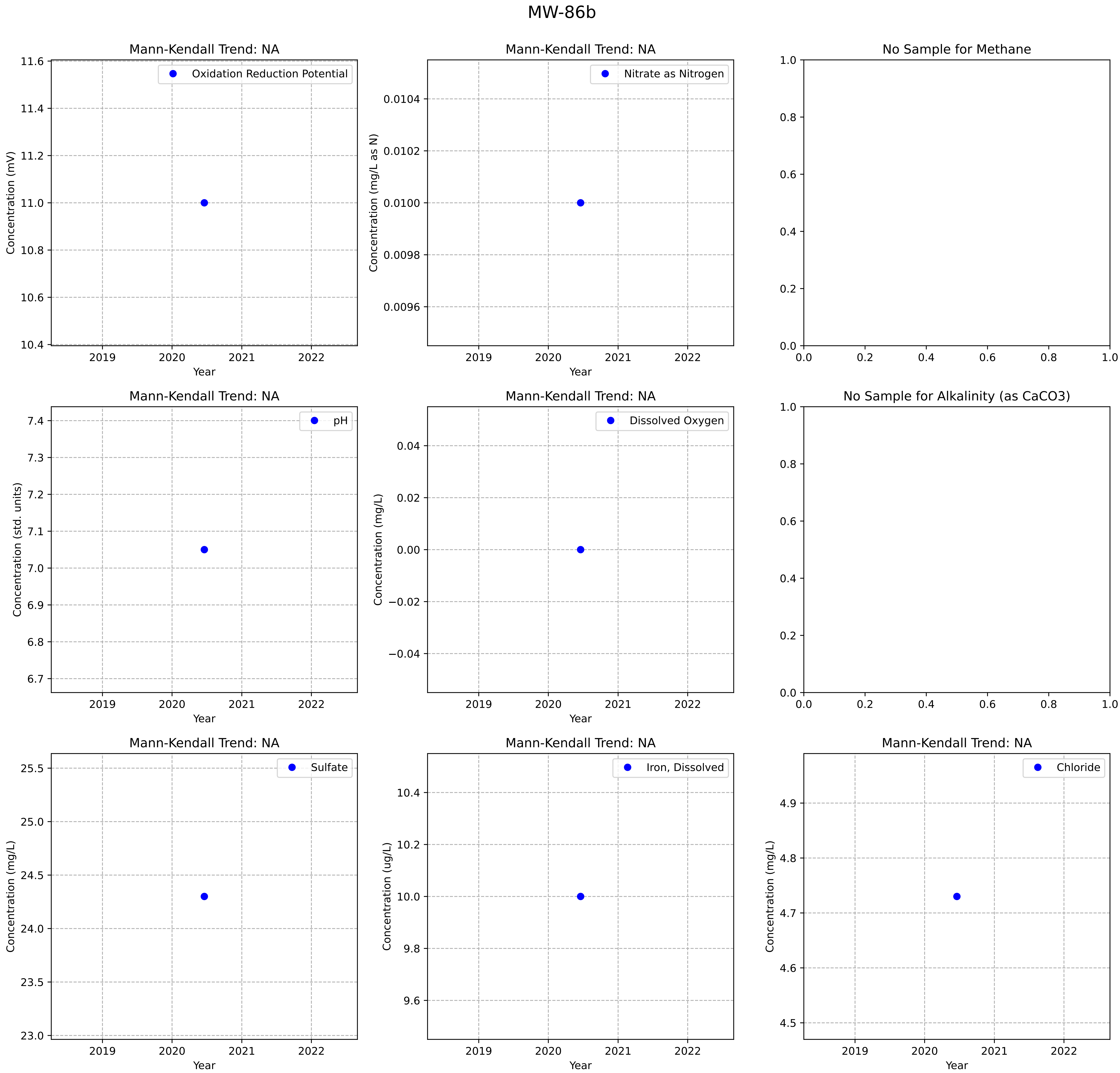

MW-78b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

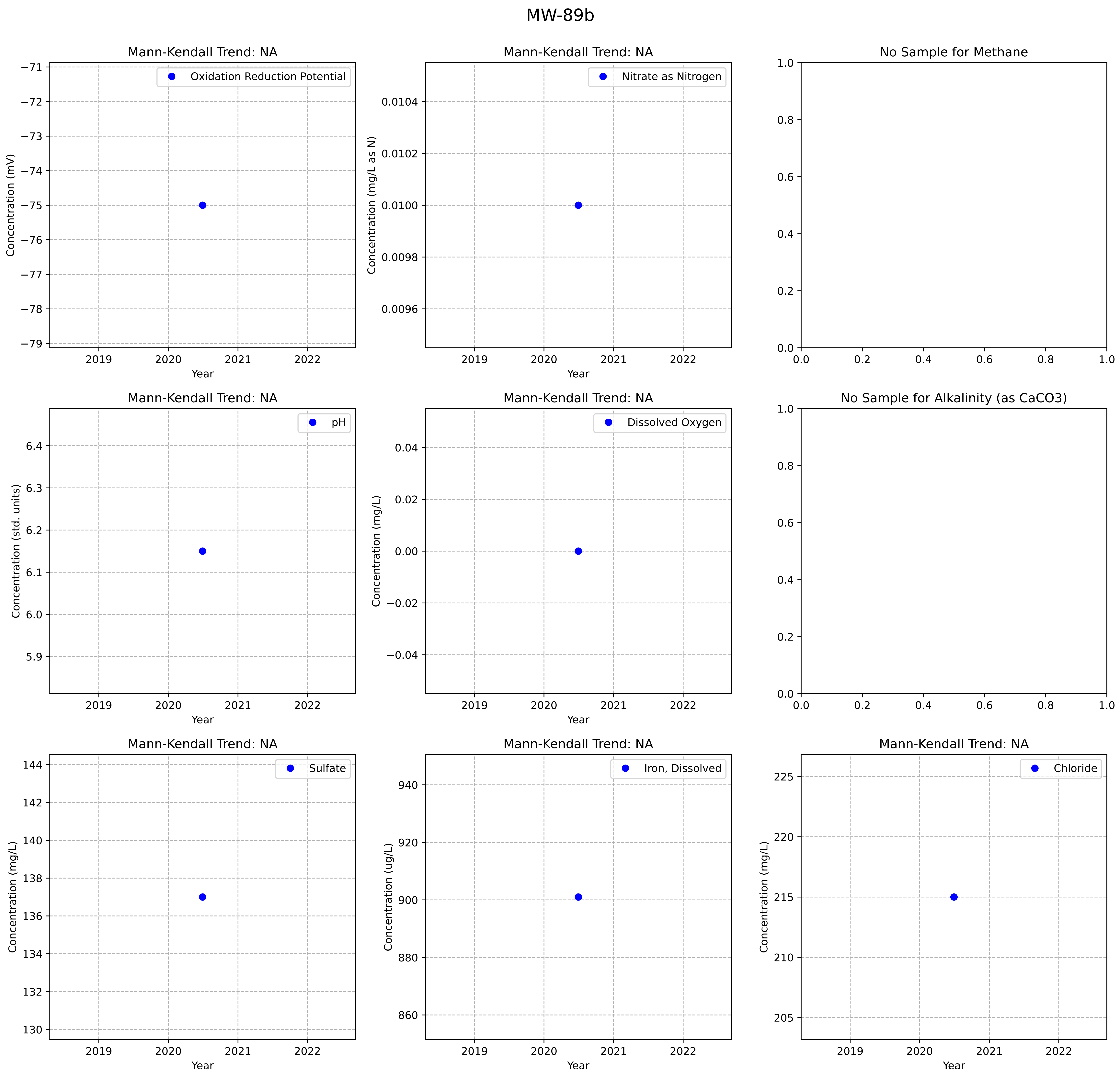

MW-7b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.42)
Exponential Fit (R²=0.77)
Concentration (mg/L as N)
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.66)
Exponential Fit (R²=0.66)
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Decreasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.75)
Exponential Fit (R²=0.67)
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.76)
Exponential Fit (R²=0.76)
Mann-Kendall Trend: Decreasing
Iron, Dissolved
Linear Fit (R²=0.77)
Exponential Fit (R²=0.74)
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.85)
Exponential Fit (R²=0.81)

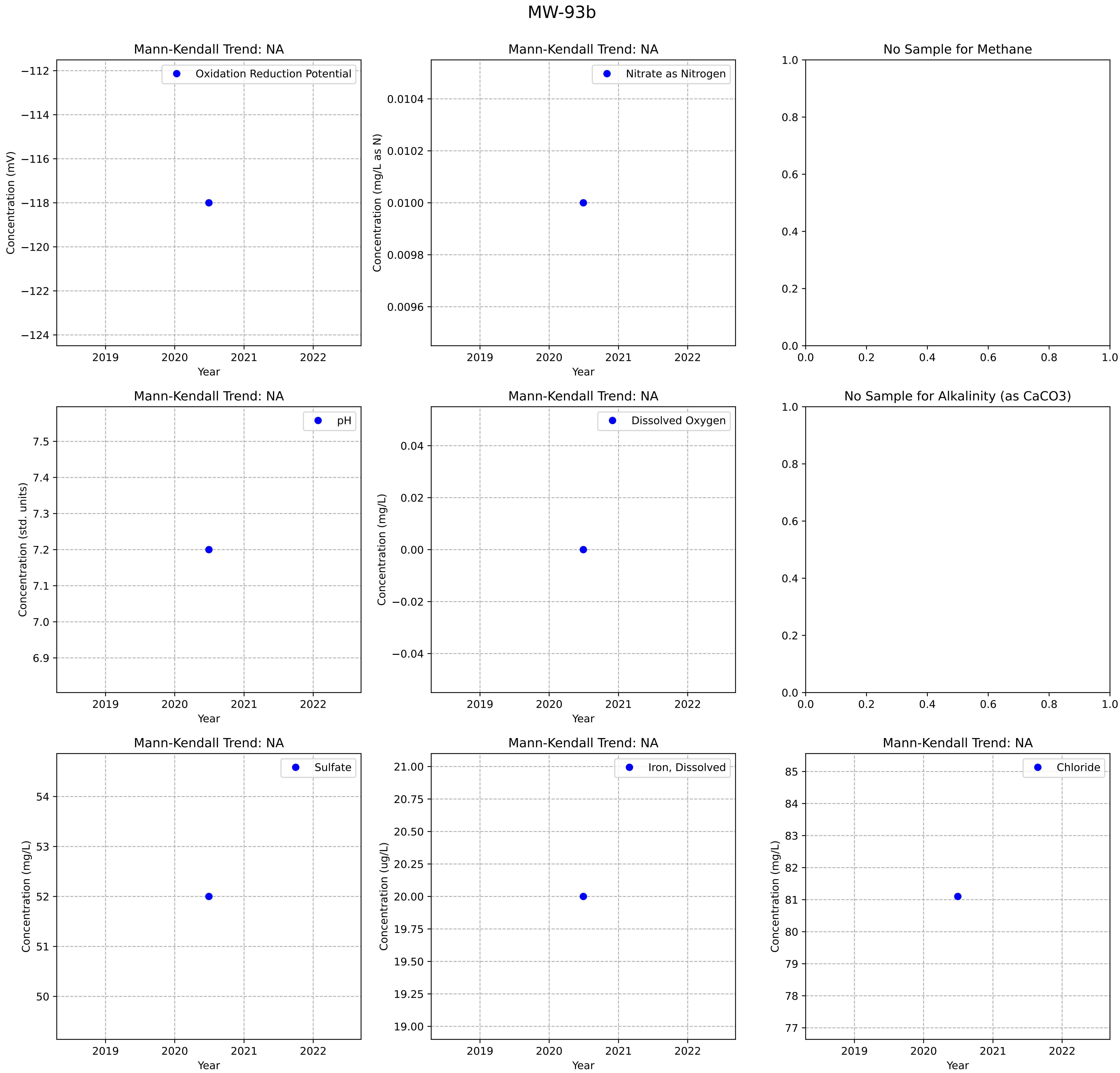

MW-81b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.82)
Exponential Fit (R²=0.82)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Concentration (mg/L)
Year

MW-82b


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: Stable
Methane
Exponential Fit (R²=0.24)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Linear Fit (R²=0.11)
Exponential Fit (R²=0.08)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Linear Fit (R²=0.17)
Exponential Fit (R²=0.29)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.48)
Exponential Fit (R²=0.49)
Concentration (mg/L)
Year

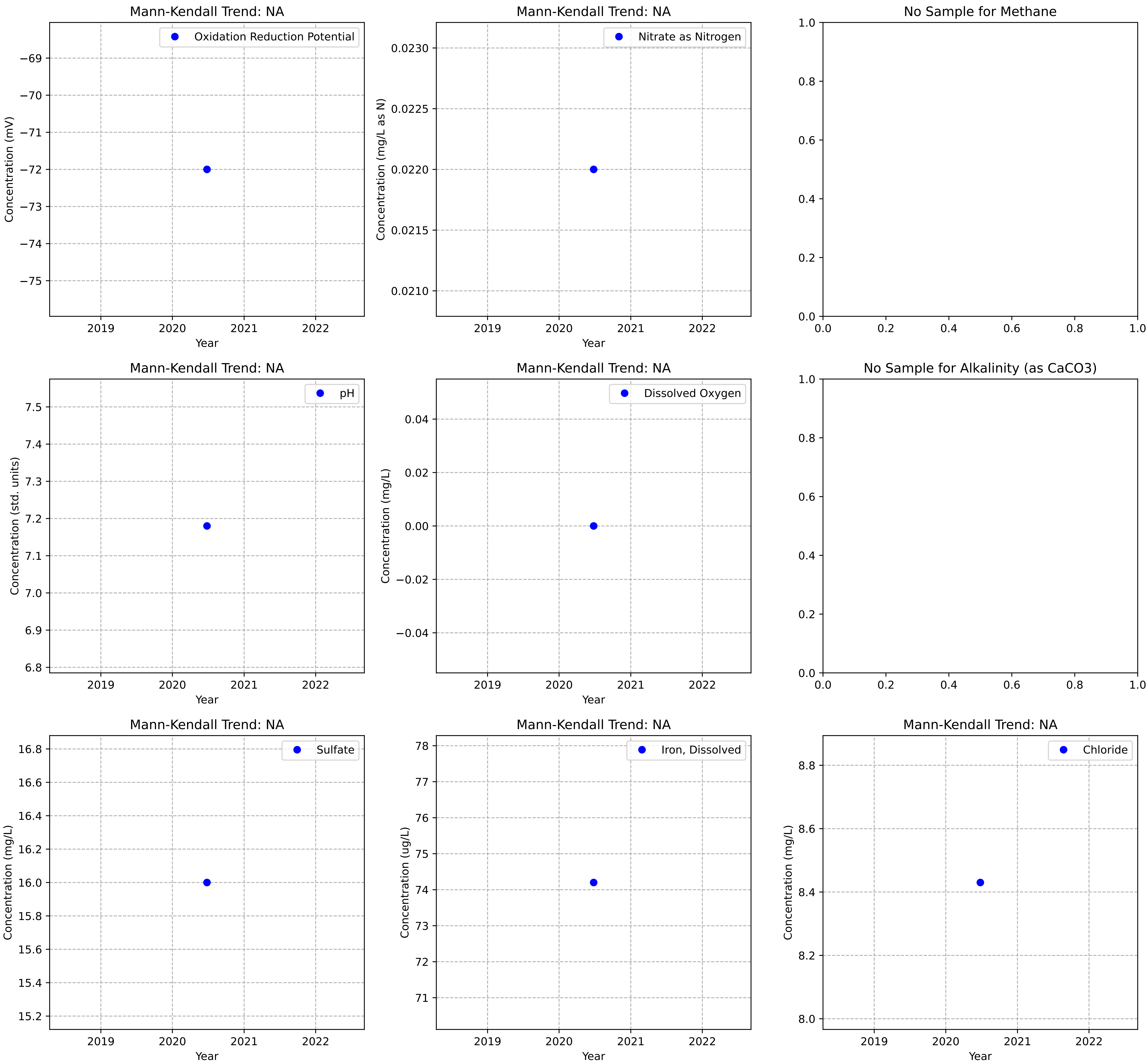

MW-86b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year


MW-89b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

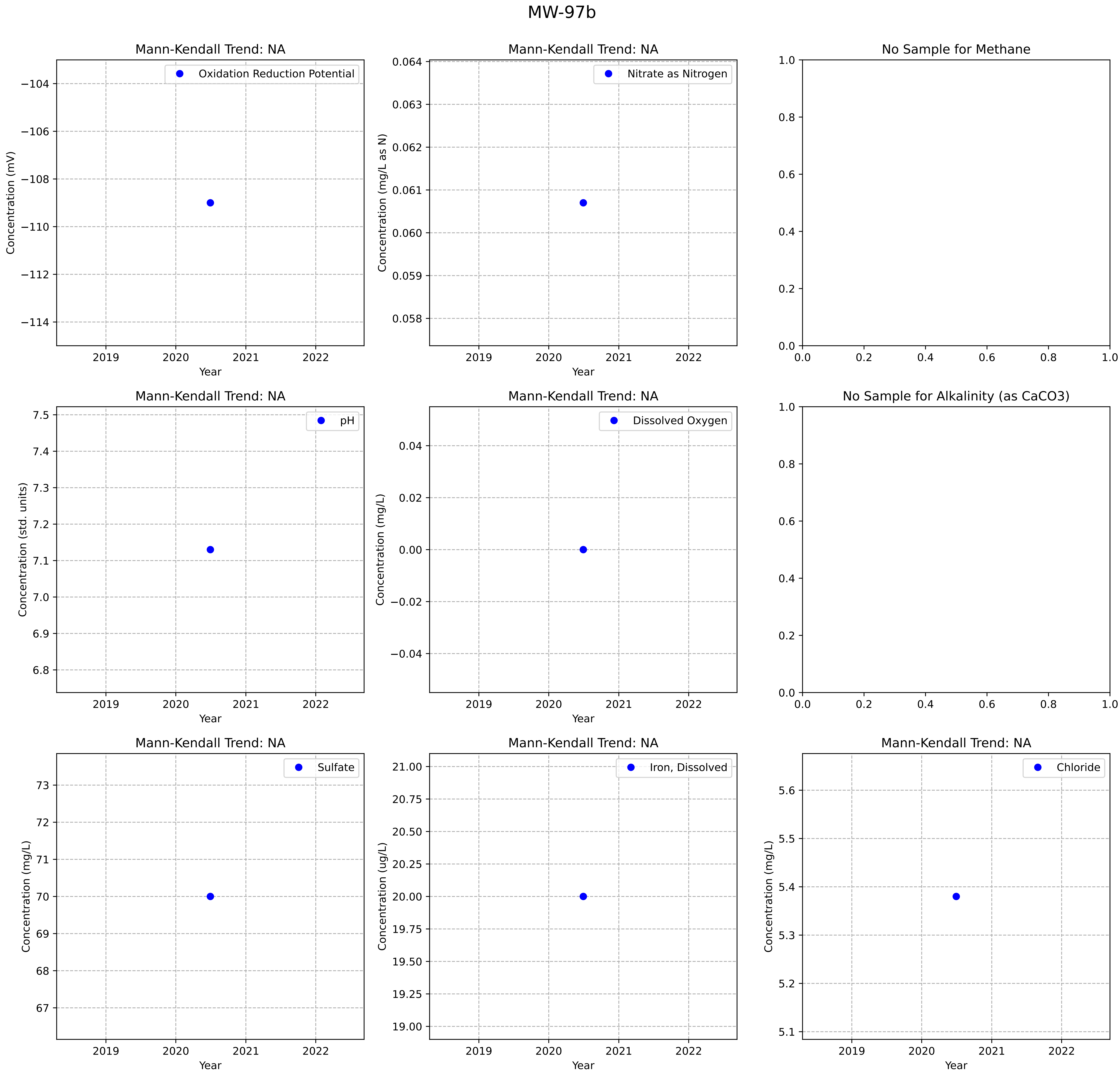


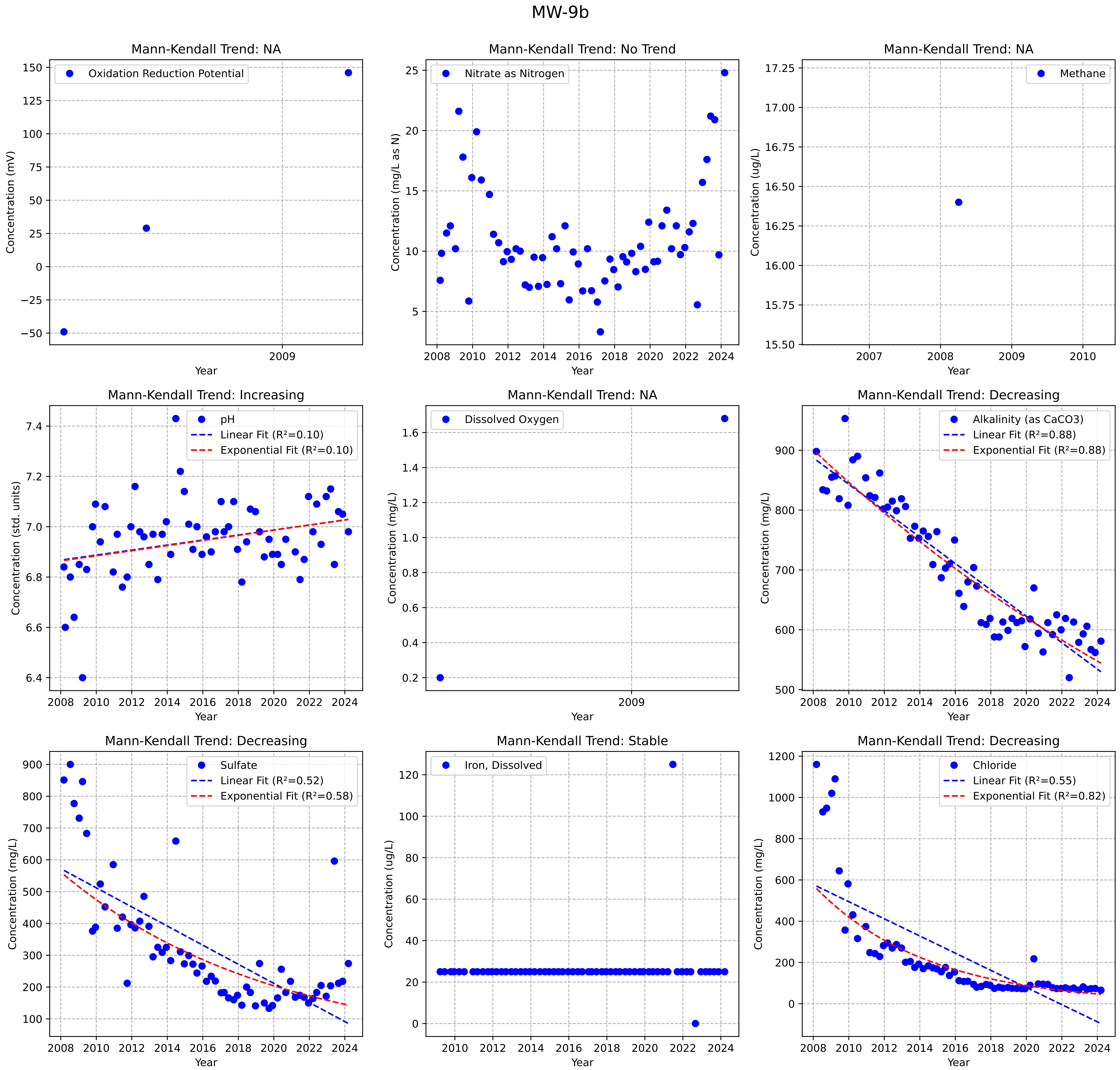
MW-93b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
−112
−114
−116
−118
−120
−122
−124
2019
2020
2021
2022
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
0.0104
0.0102
0.0100
0.0098
0.0096
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
7.5
7.4
7.3
7.2
7.1
7.0
6.9
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
0.04
0.02
0.00
−0.02
−0.04
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
54
53
52
51
50
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
21.00
20.75
20.50
20.25
20.00
19.75
19.50
19.25
19.00
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
85
84
83
82
81
80
79
78
77
Year

MW-96b



Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

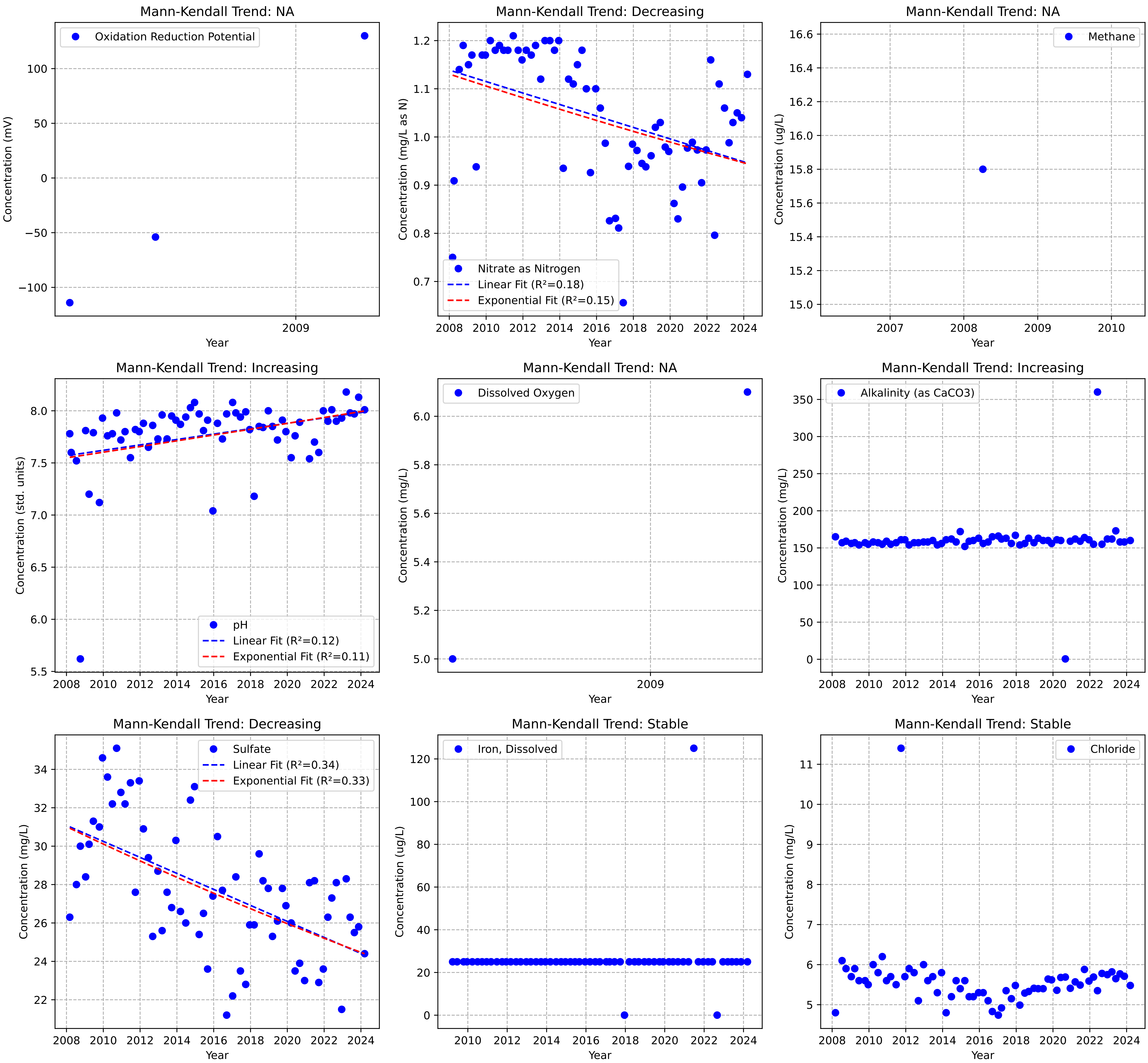

MW-97b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year



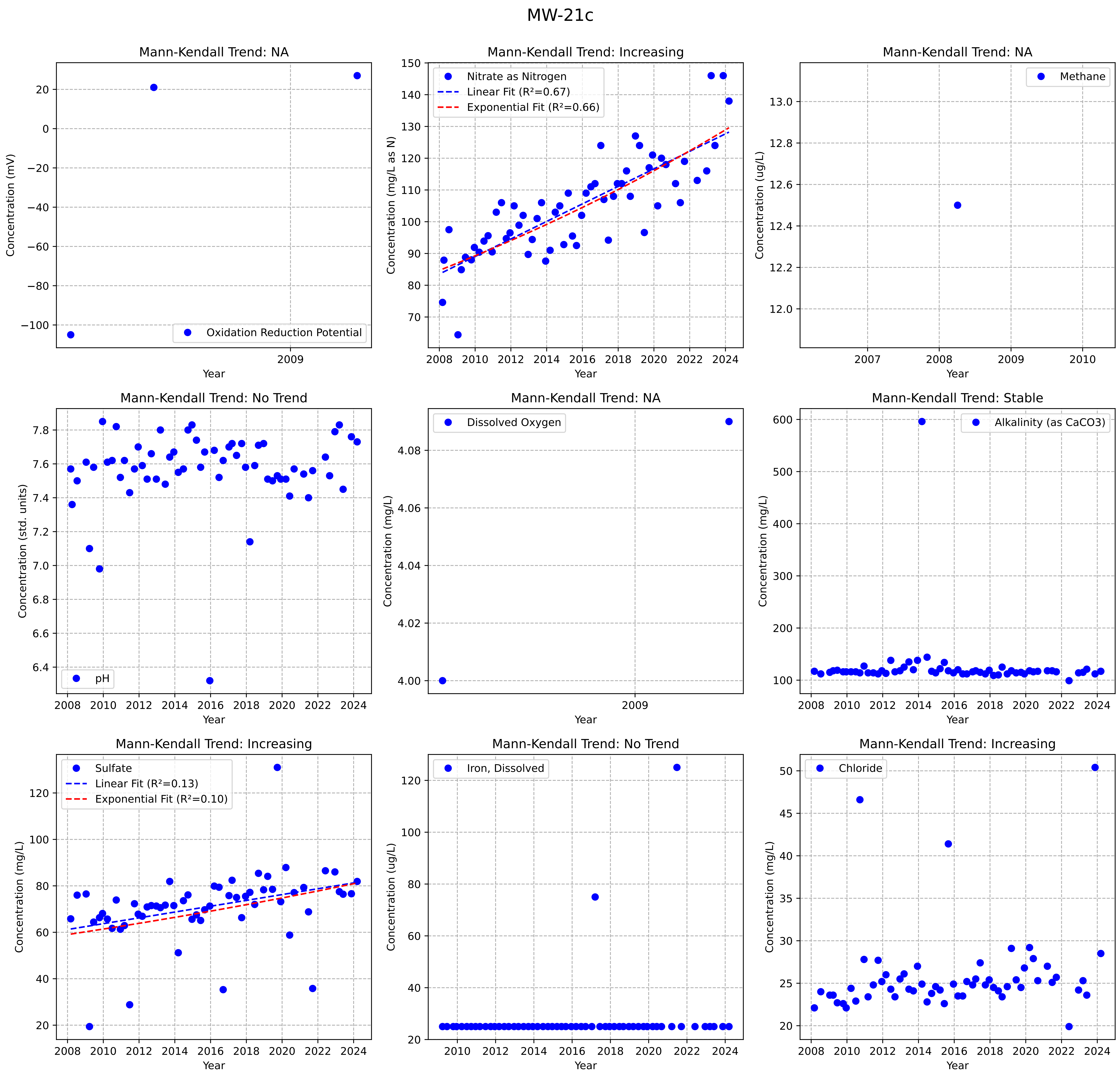
MW-9b
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.10)
Exponential Fit (R²=0.10)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.88)
Exponential Fit (R²=0.88)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.52)
Exponential Fit (R²=0.58)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.55)
Exponential Fit (R²=0.82)
Concentration (mg/L)
Year

C4. Concentration time series plots of geochemical indicators for Interflow Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

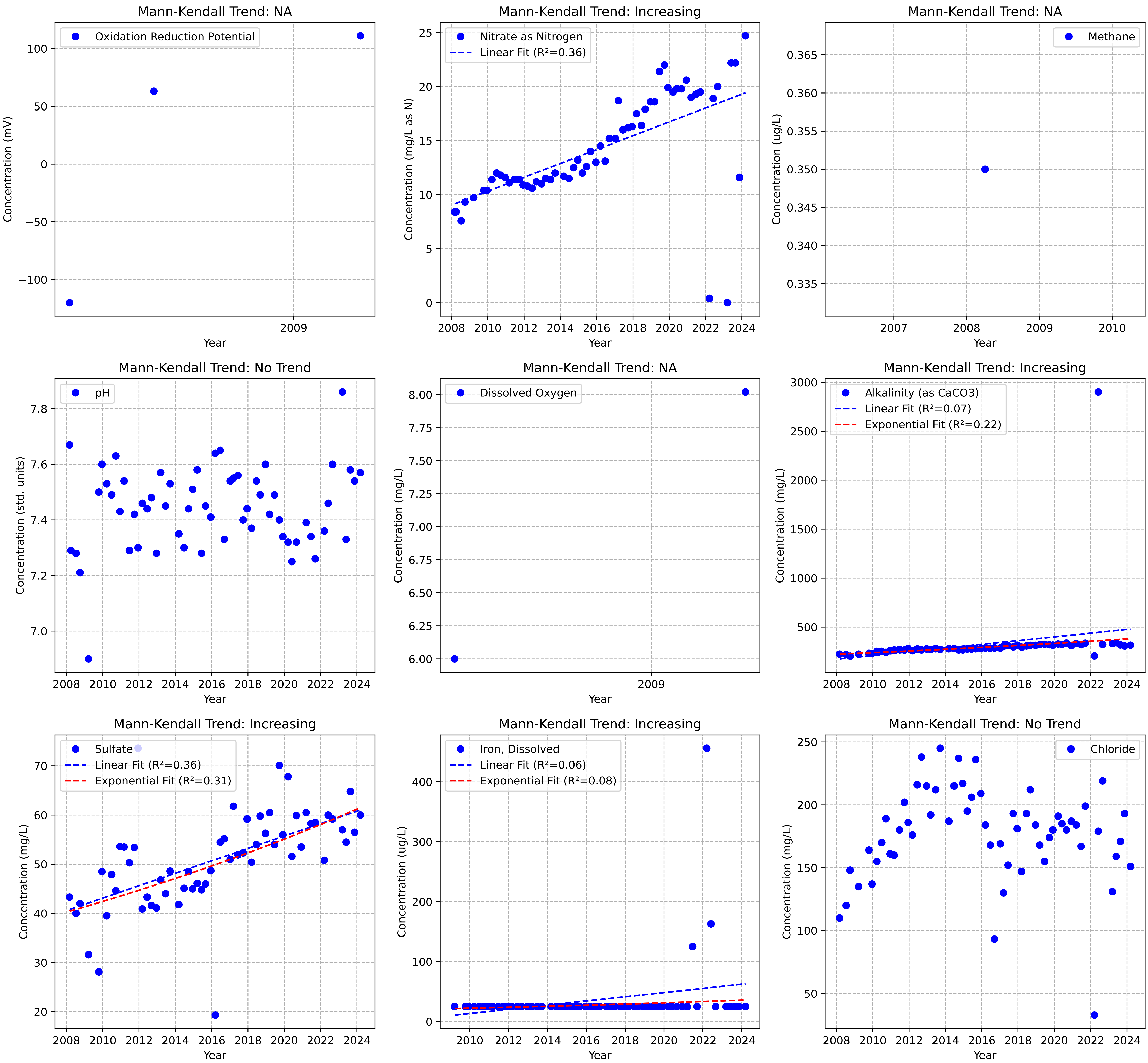
MW-20c



Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.18)
Exponential Fit (R²=0.15)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.12)
Exponential Fit (R²=0.11)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.34)
Exponential Fit (R²=0.33)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Concentration (mg/L)
Year

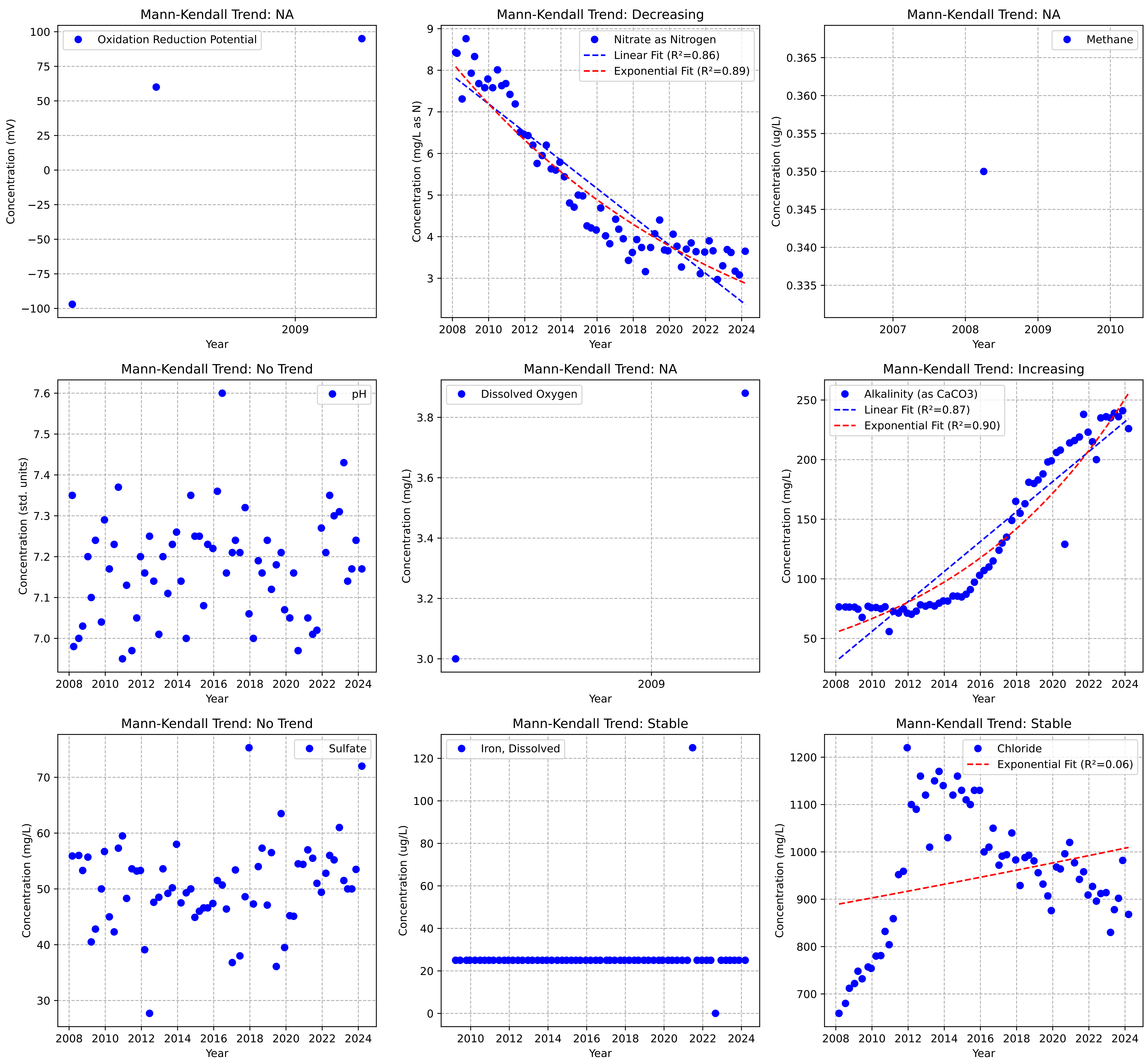

MW-21c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.67)
Exponential Fit (R²=0.66)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.13)
Exponential Fit (R²=0.10)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
Chloride
Concentration (mg/L)
Year

MW-22c

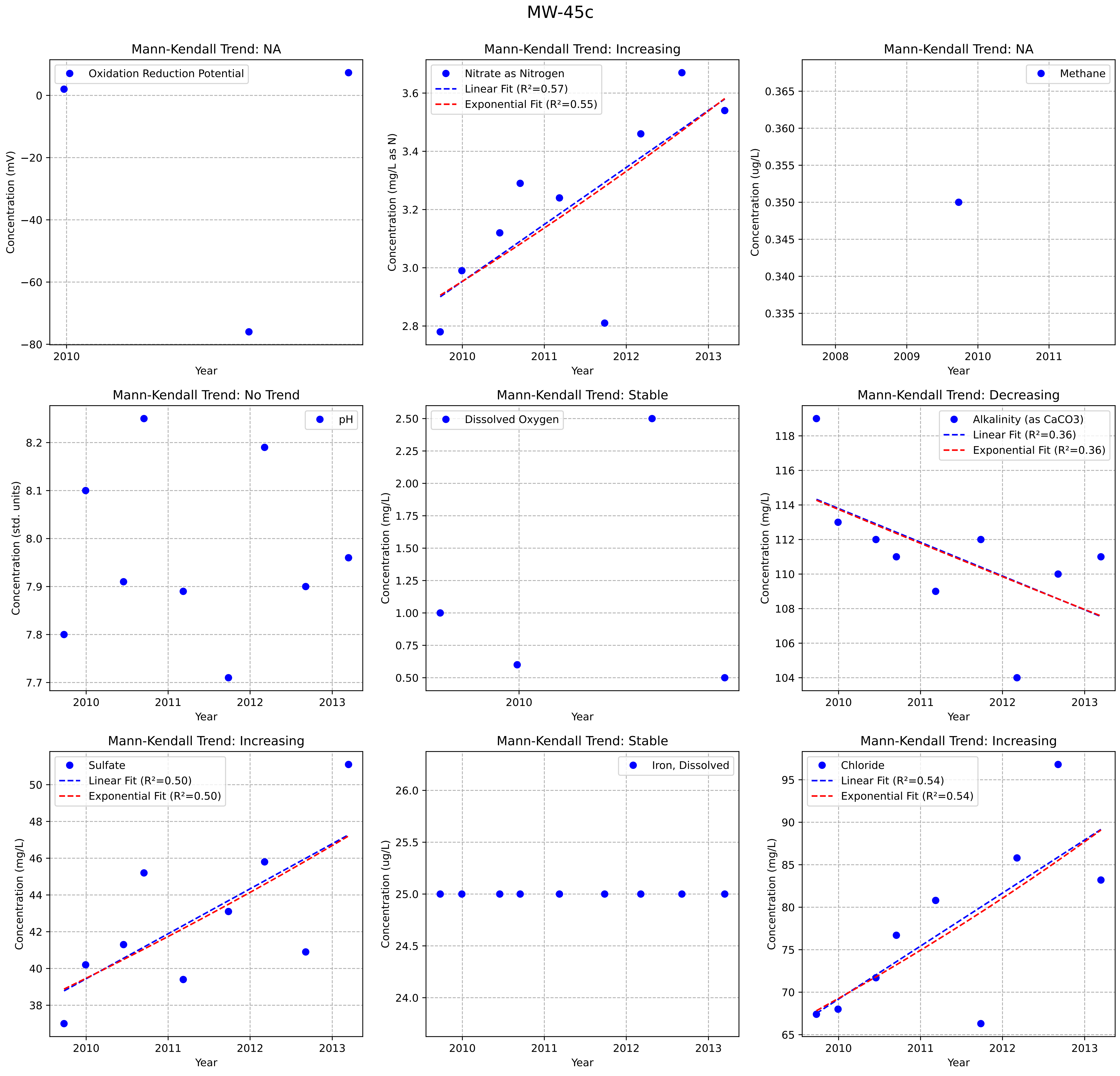


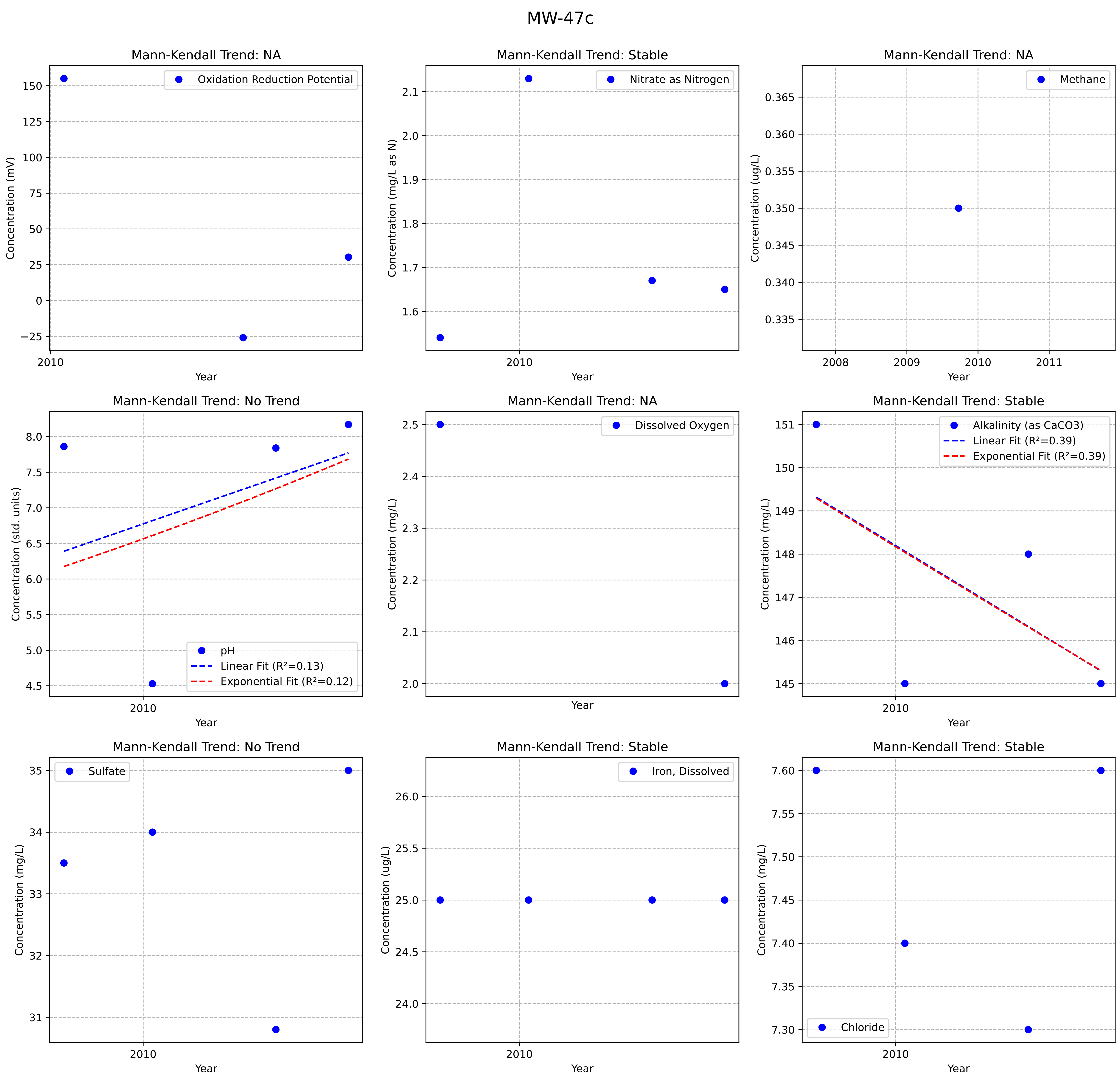
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.36)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.07)
Exponential Fit (R²=0.22)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.36)
Exponential Fit (R²=0.31)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Iron, Dissolved
Linear Fit (R²=0.06)
Exponential Fit (R²=0.08)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Concentration (mg/L)
Year

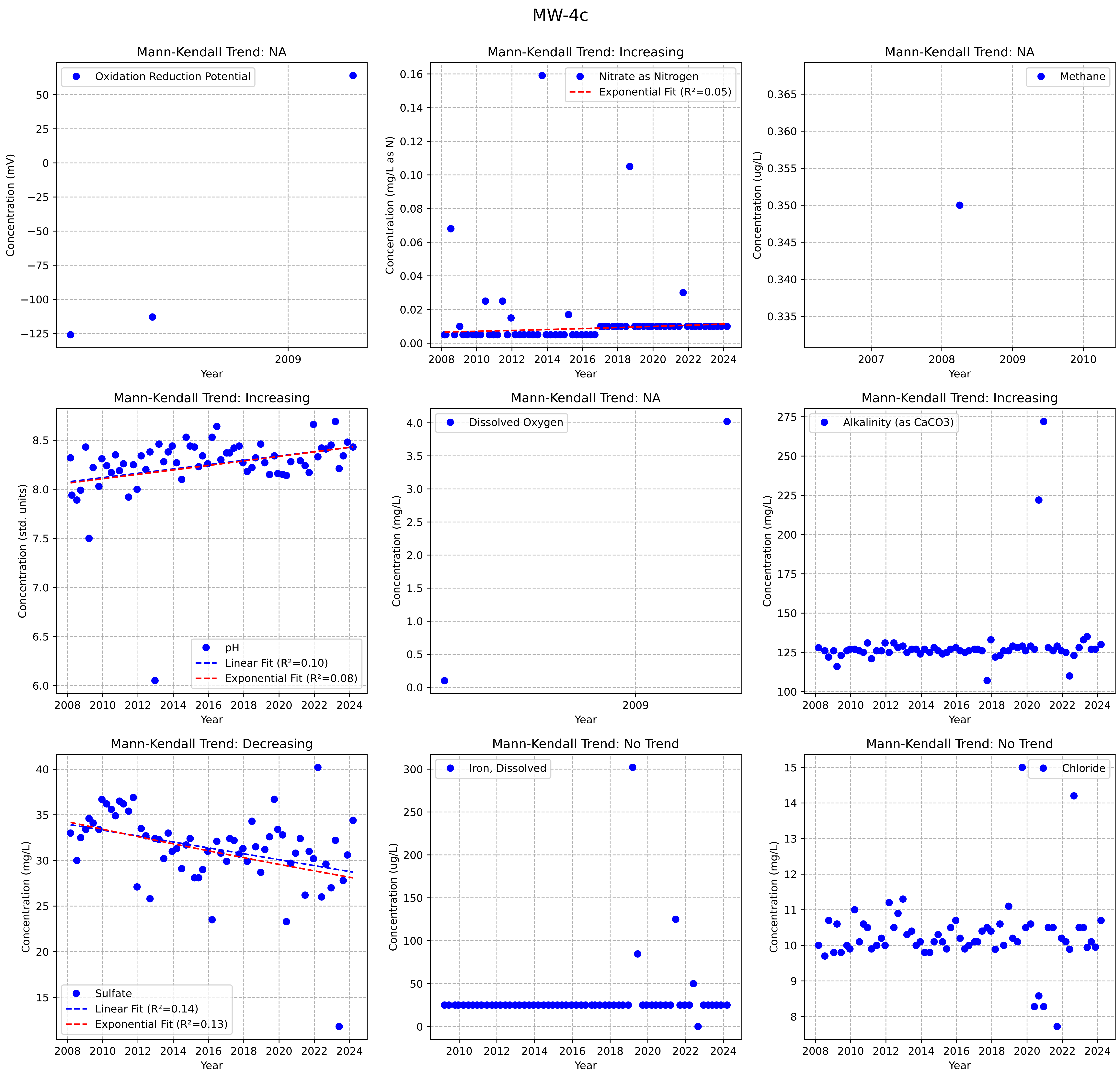
MW-2c

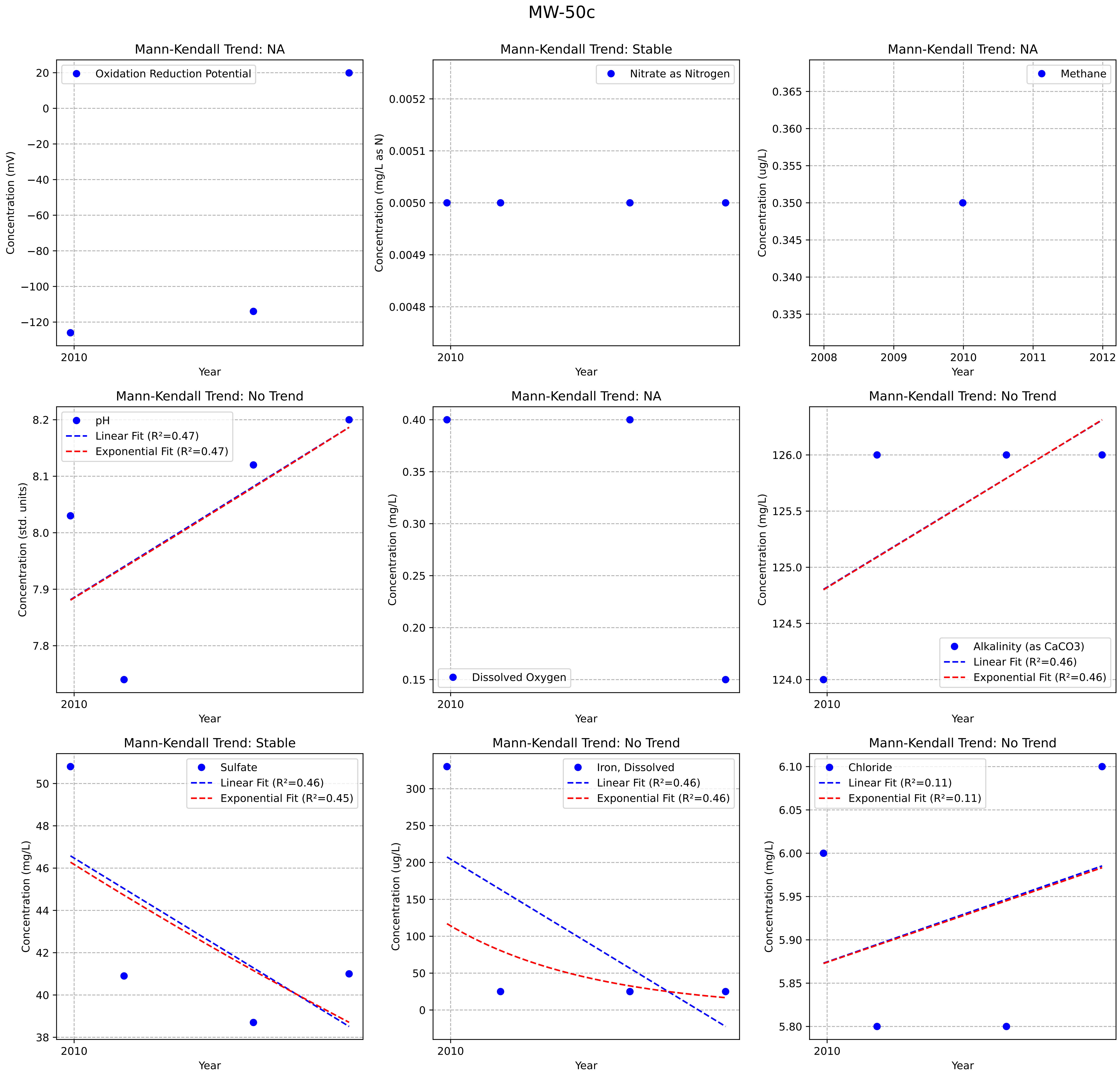


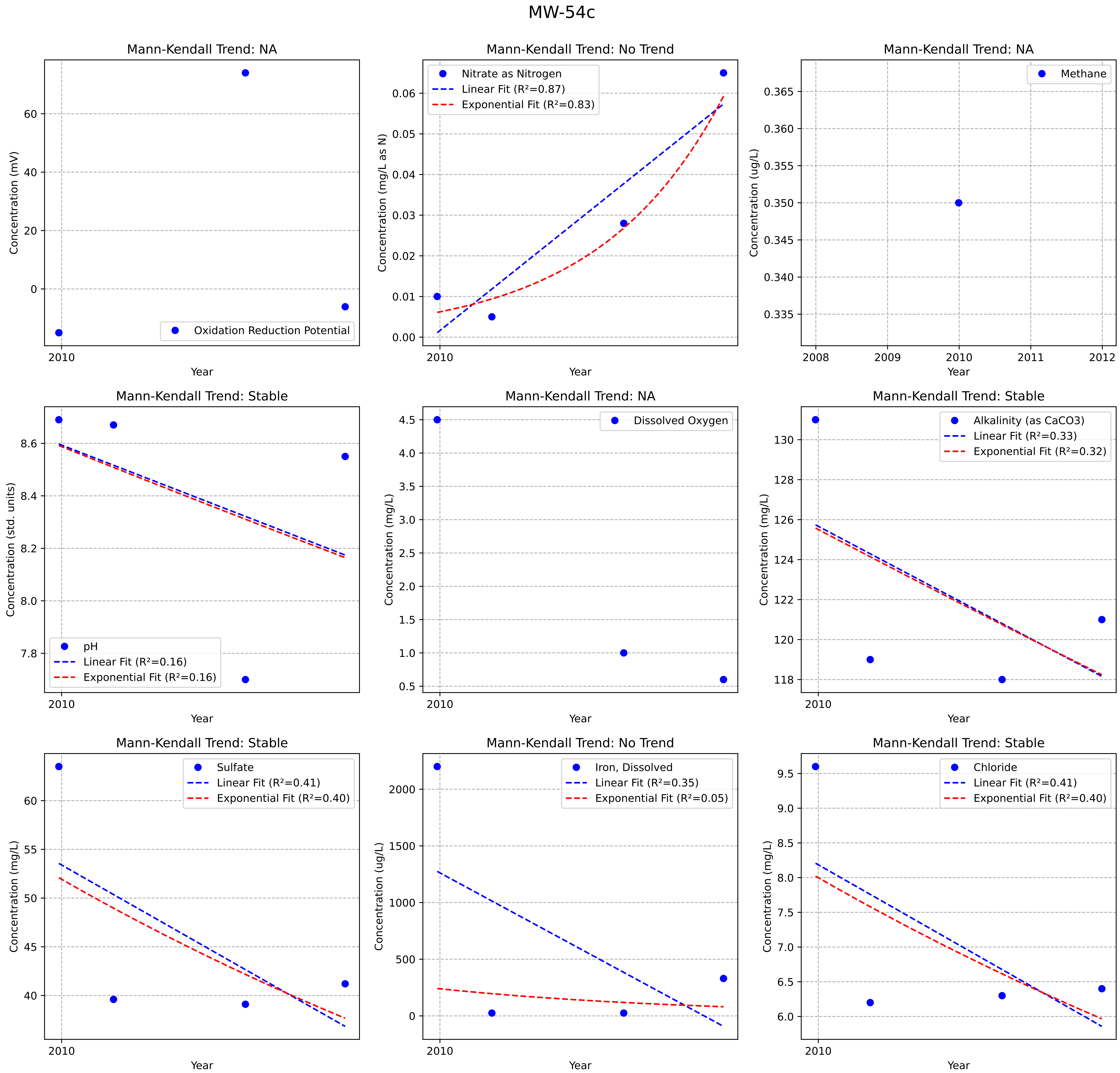
MW-2c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.86)
Exponential Fit (R²=0.89)
Concentration (mg/L as N)
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Mann-Kendall Trend: No Trend
pH
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.87)
Exponential Fit (R²=0.90)
Mann-Kendall Trend: No Trend
Sulfate
Mann-Kendall Trend: Stable
Iron, Dissolved
Mann-Kendall Trend: Stable
Chloride
Exponential Fit (R²=0.06)


MW-45c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Linear Fit (R²=0.57)
Exponential Fit (R²=0.55)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Concentration (std. units)
Year
Mann-Kendall Trend: Stable
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.36)
Exponential Fit (R²=0.36)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.50)
Exponential Fit (R²=0.50)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
Chloride
Linear Fit (R²=0.54)
Exponential Fit (R²=0.54)
Concentration (mg/L)
Year


MW-47c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.13)
Exponential Fit (R²=0.12)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.39)
Exponential Fit (R²=0.39)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloride
Concentration (mg/L)
Year

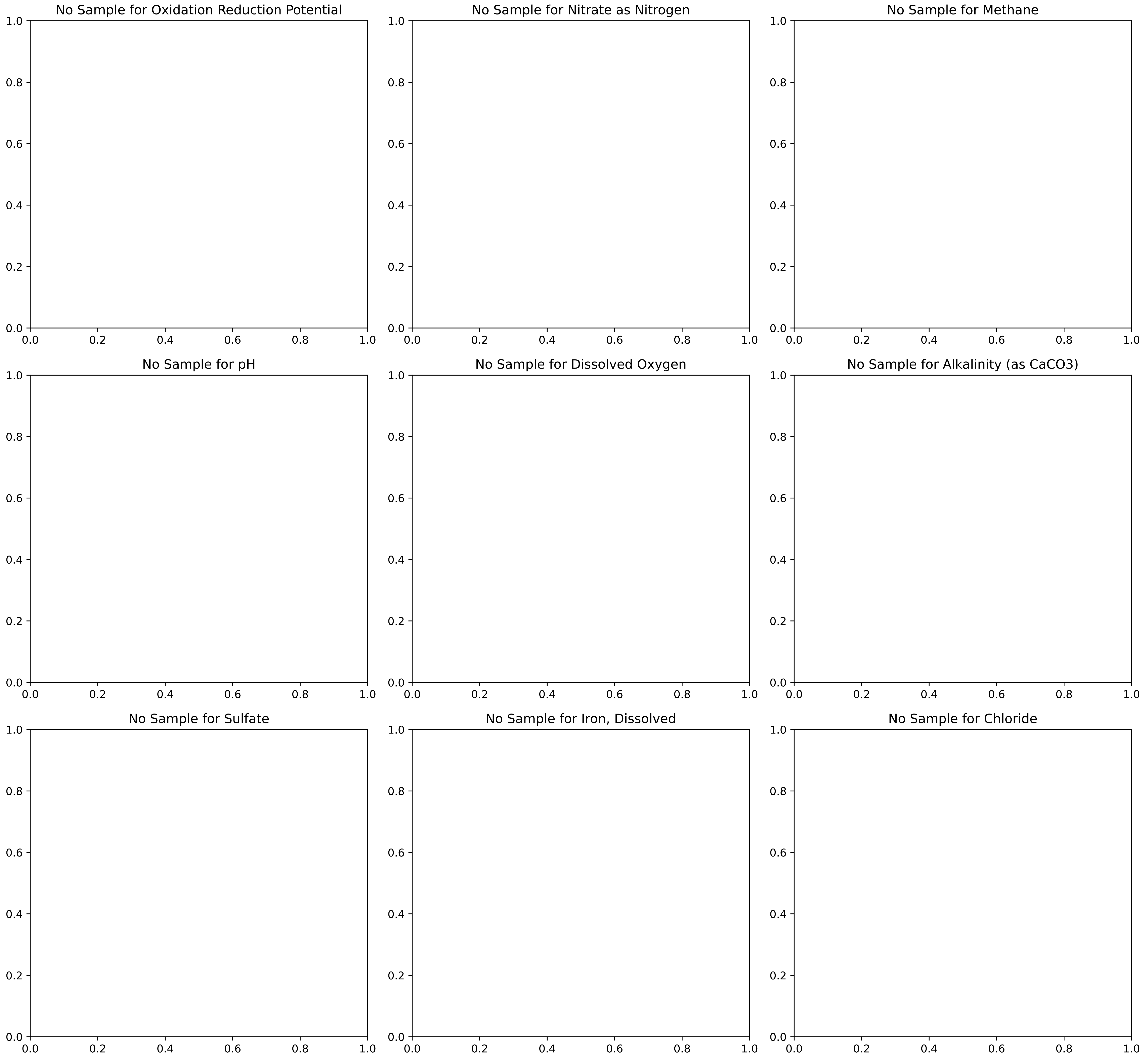

MW-4c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Increasing
Nitrate as Nitrogen
Exponential Fit (R²=0.05)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.10)
Exponential Fit (R²=0.08)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.14)
Exponential Fit (R²=0.13)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Concentration (mg/L)
Year


MW-50c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
pH
Linear Fit (R²=0.47)
Exponential Fit (R²=0.47)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Alkalinity (as CaCO3)
Linear Fit (R²=0.46)
Exponential Fit (R²=0.46)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.46)
Exponential Fit (R²=0.45)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.46)
Exponential Fit (R²=0.46)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Concentration (mg/L)
Year

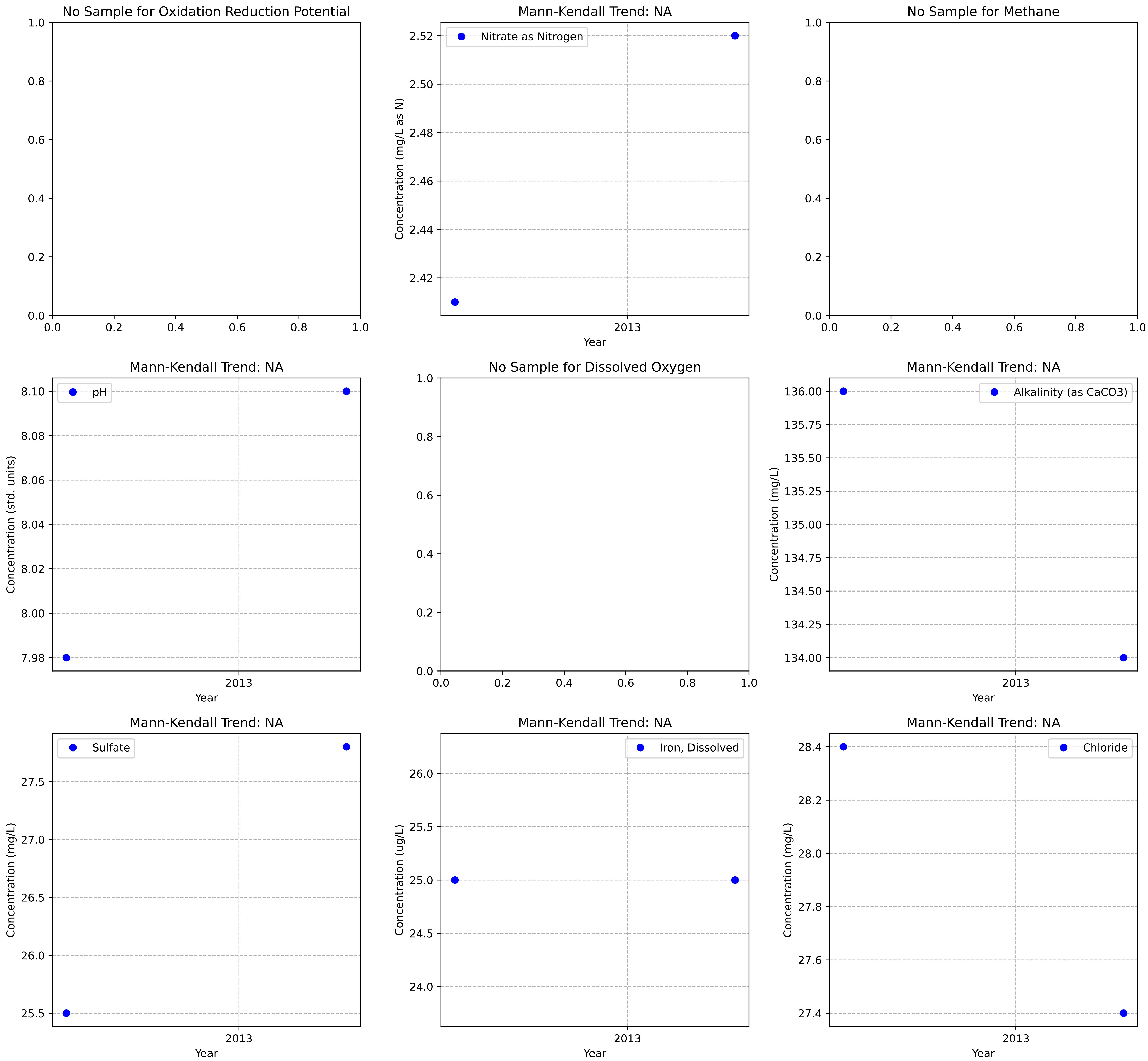


MW-54c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: No Trend
Nitrate as Nitrogen
Linear Fit (R²=0.87)
Exponential Fit (R²=0.83)
Concentration (mg/L as N)
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Mann-Kendall Trend: Stable
pH
Linear Fit (R²=0.16)
Exponential Fit (R²=0.16)
Concentration (std. units)
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Mann-Kendall Trend: Stable
Alkalinity (as CaCO3)
Linear Fit (R²=0.33)
Exponential Fit (R²=0.32)
Mann-Kendall Trend: Stable
Sulfate
Linear Fit (R²=0.41)
Exponential Fit (R²=0.40)
Mann-Kendall Trend: No Trend
Iron, Dissolved
Linear Fit (R²=0.35)
Exponential Fit (R²=0.05)
Mann-Kendall Trend: Stable
Chloride
Linear Fit (R²=0.41)
Exponential Fit (R²=0.40)

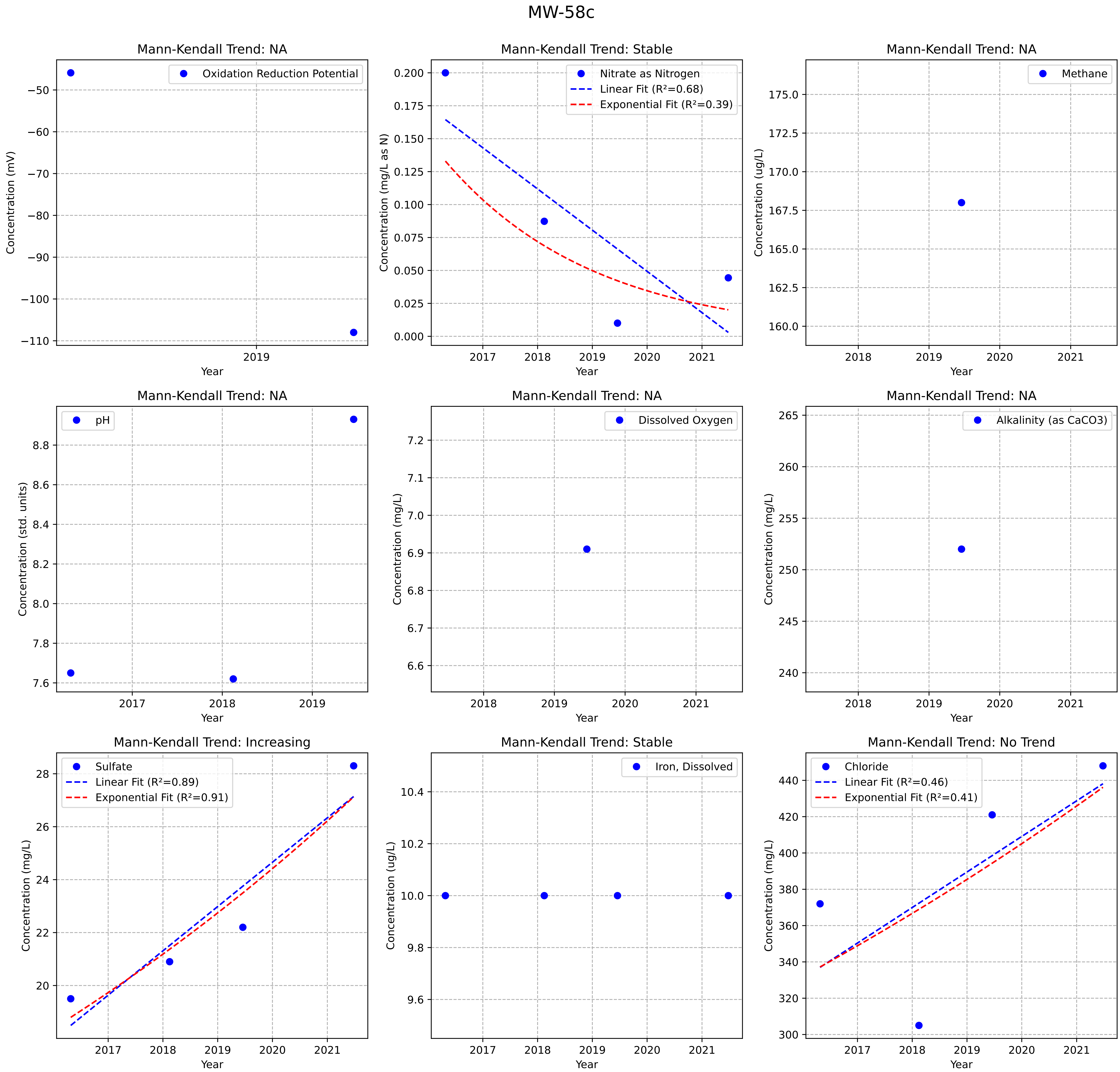
No Data for MW-55c



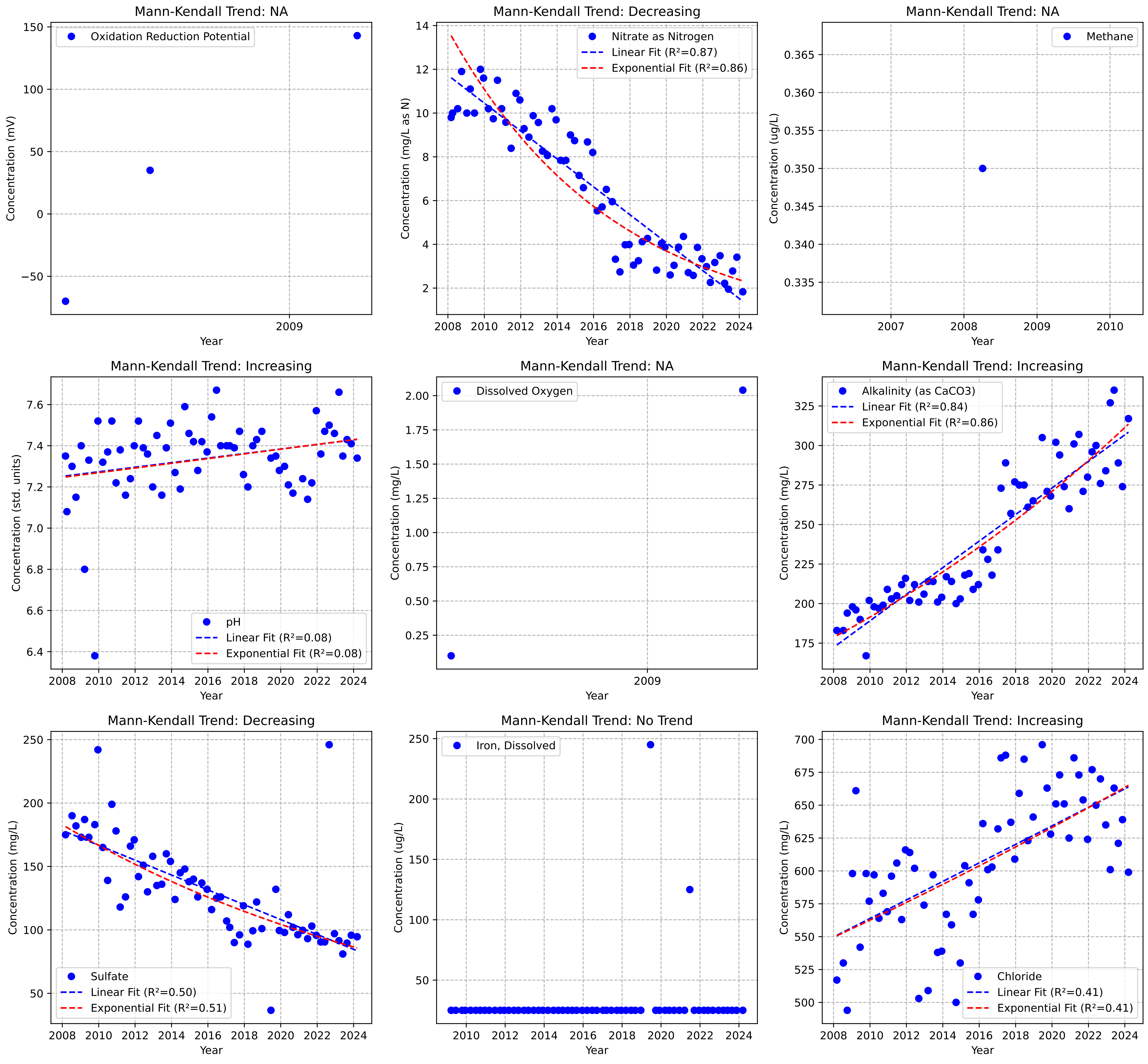
MW-56c



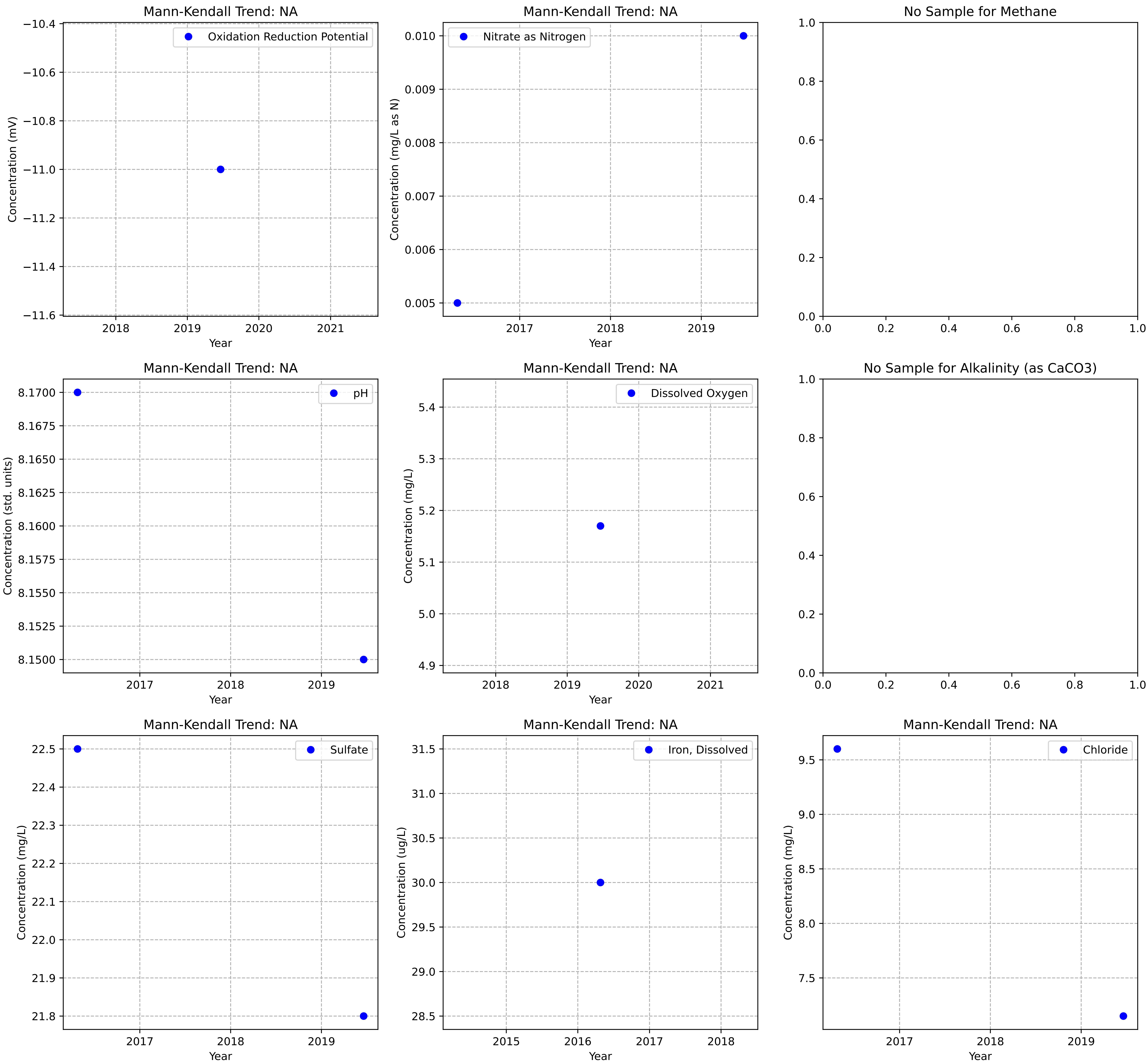
No Sample for Oxidation Reduction Potential
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
2013
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
No Sample for Dissolved Oxygen
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Mann-Kendall Trend: NA
Sulfate
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Mann-Kendall Trend: NA
Chloride

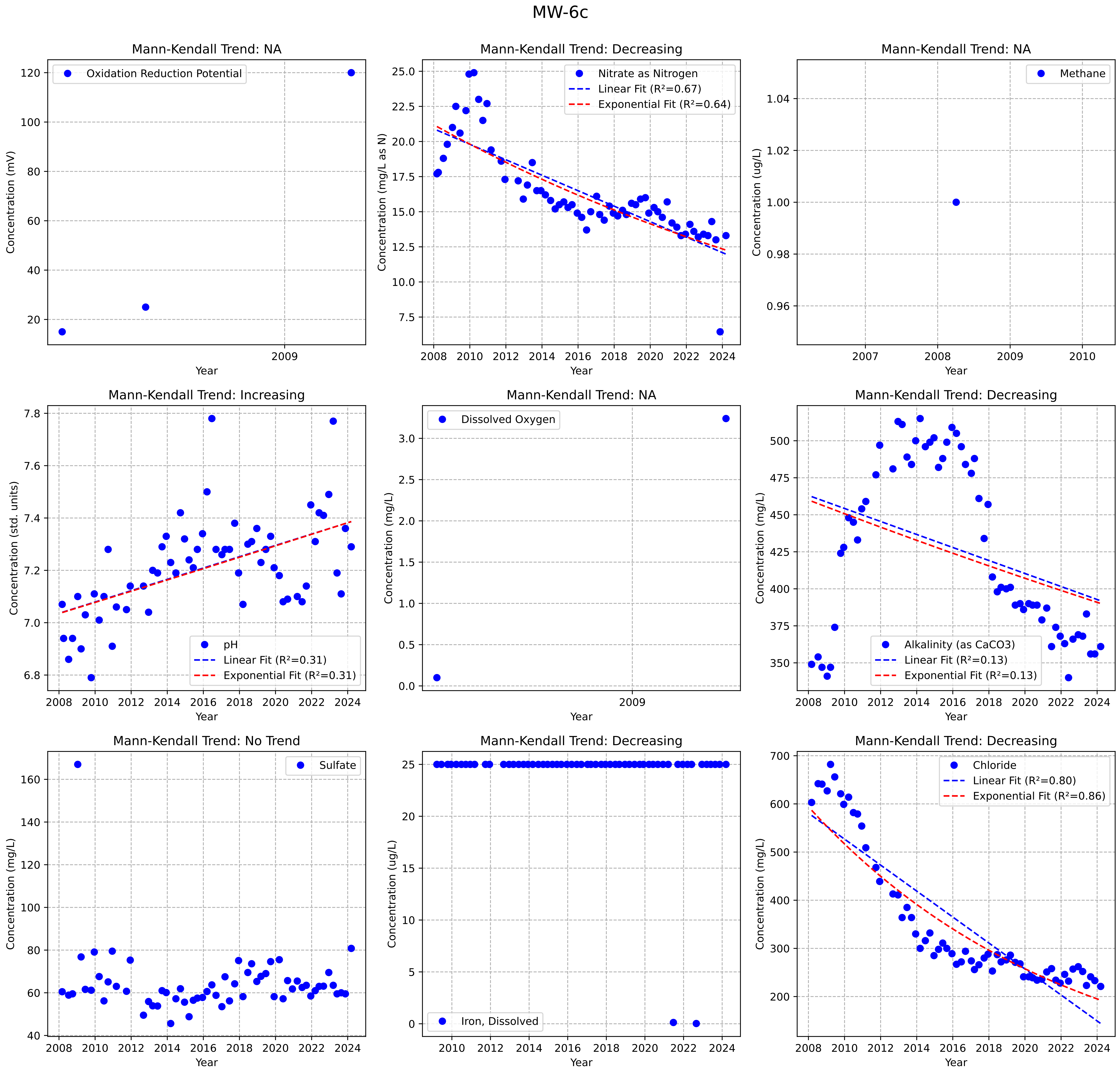

MW-58c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Stable
Nitrate as Nitrogen
Linear Fit (R²=0.68)
Exponential Fit (R²=0.39)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Alkalinity (as CaCO3)
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Sulfate
Linear Fit (R²=0.89)
Exponential Fit (R²=0.91)
Concentration (mg/L)
Year
Mann-Kendall Trend: Stable
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloride
Linear Fit (R²=0.46)
Exponential Fit (R²=0.41)
Concentration (mg/L)
Year

MW-5c


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.87)
Exponential Fit (R²=0.86)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.08)
Exponential Fit (R²=0.08)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Increasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.84)
Exponential Fit (R²=0.86)
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Sulfate
Linear Fit (R²=0.50)
Exponential Fit (R²=0.51)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
Chloride
Linear Fit (R²=0.41)
Exponential Fit (R²=0.41)
Concentration (mg/L)
Year

MW-62c


Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: NA
Nitrate as Nitrogen
Concentration (mg/L as N)
Year
No Sample for Methane
Mann-Kendall Trend: NA
pH
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
No Sample for Alkalinity (as CaCO3)
Mann-Kendall Trend: NA
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: NA
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloride
Concentration (mg/L)
Year

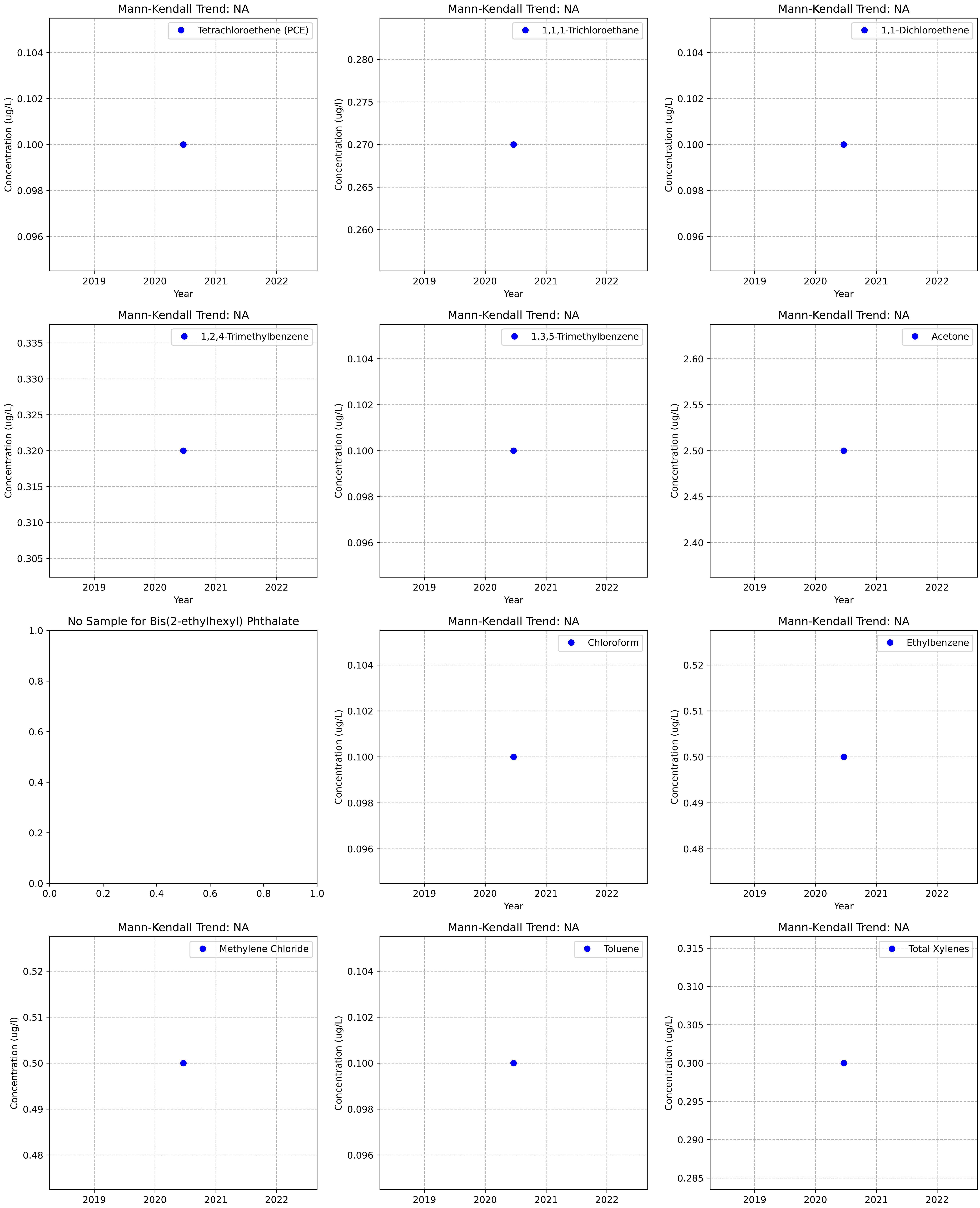

MW-6c
Mann-Kendall Trend: NA
Oxidation Reduction Potential
Concentration (mV)
Year
Mann-Kendall Trend: Decreasing
Nitrate as Nitrogen
Linear Fit (R²=0.67)
Exponential Fit (R²=0.64)
Concentration (mg/L as N)
Year
Mann-Kendall Trend: NA
Methane
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
pH
Linear Fit (R²=0.31)
Exponential Fit (R²=0.31)
Concentration (std. units)
Year
Mann-Kendall Trend: NA
Dissolved Oxygen
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Alkalinity (as CaCO3)
Linear Fit (R²=0.13)
Exponential Fit (R²=0.13)
Concentration (mg/L)
Year
Mann-Kendall Trend: No Trend
Sulfate
Concentration (mg/L)
Year
Mann-Kendall Trend: Decreasing
Iron, Dissolved
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloride
Linear Fit (R²=0.80)
Exponential Fit (R²=0.86)
Concentration (mg/L)
Year

APPENDIX D

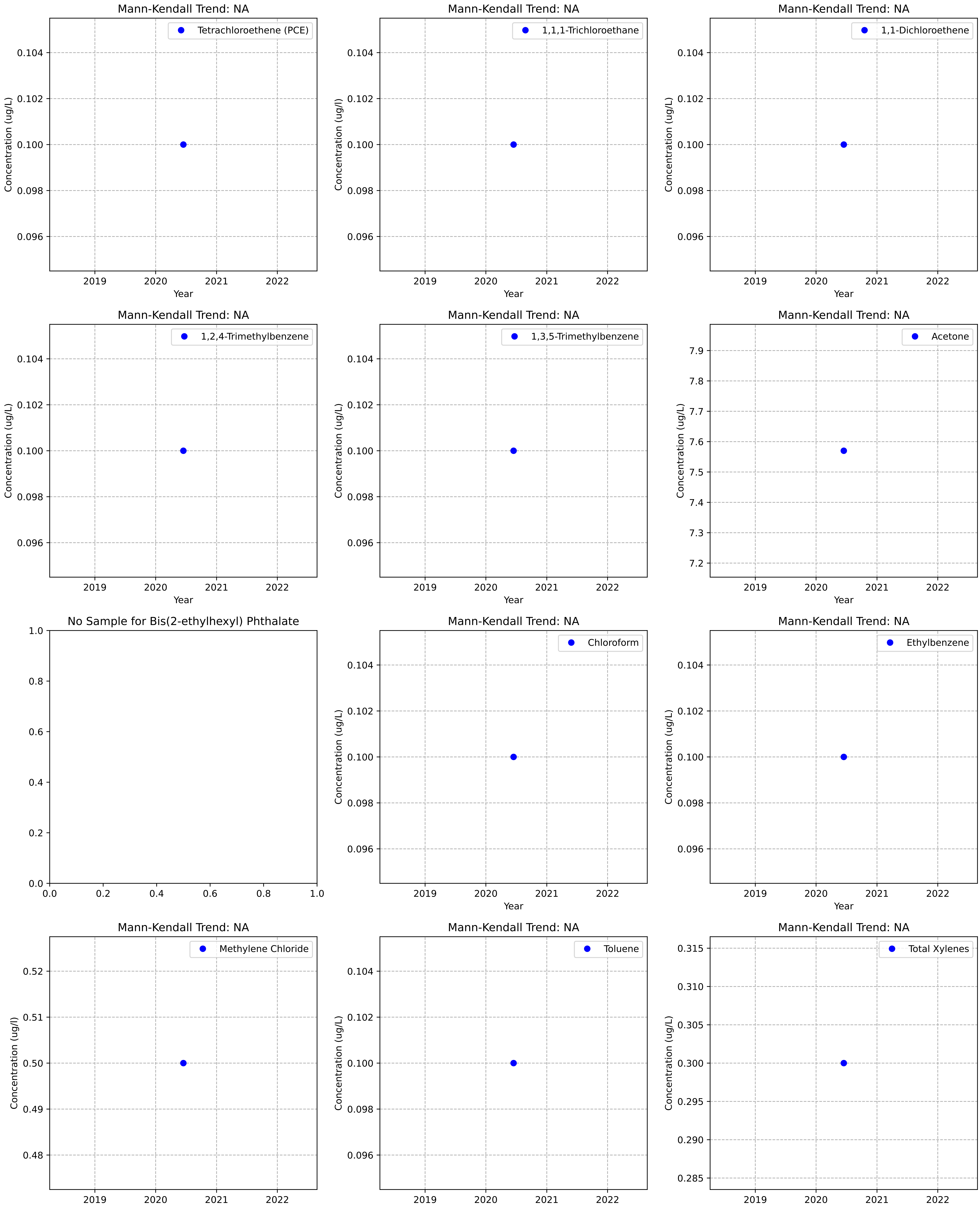
Concentration time series plots of additional parameters, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

D1. Concentration time series plots of additional parameters for P1 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

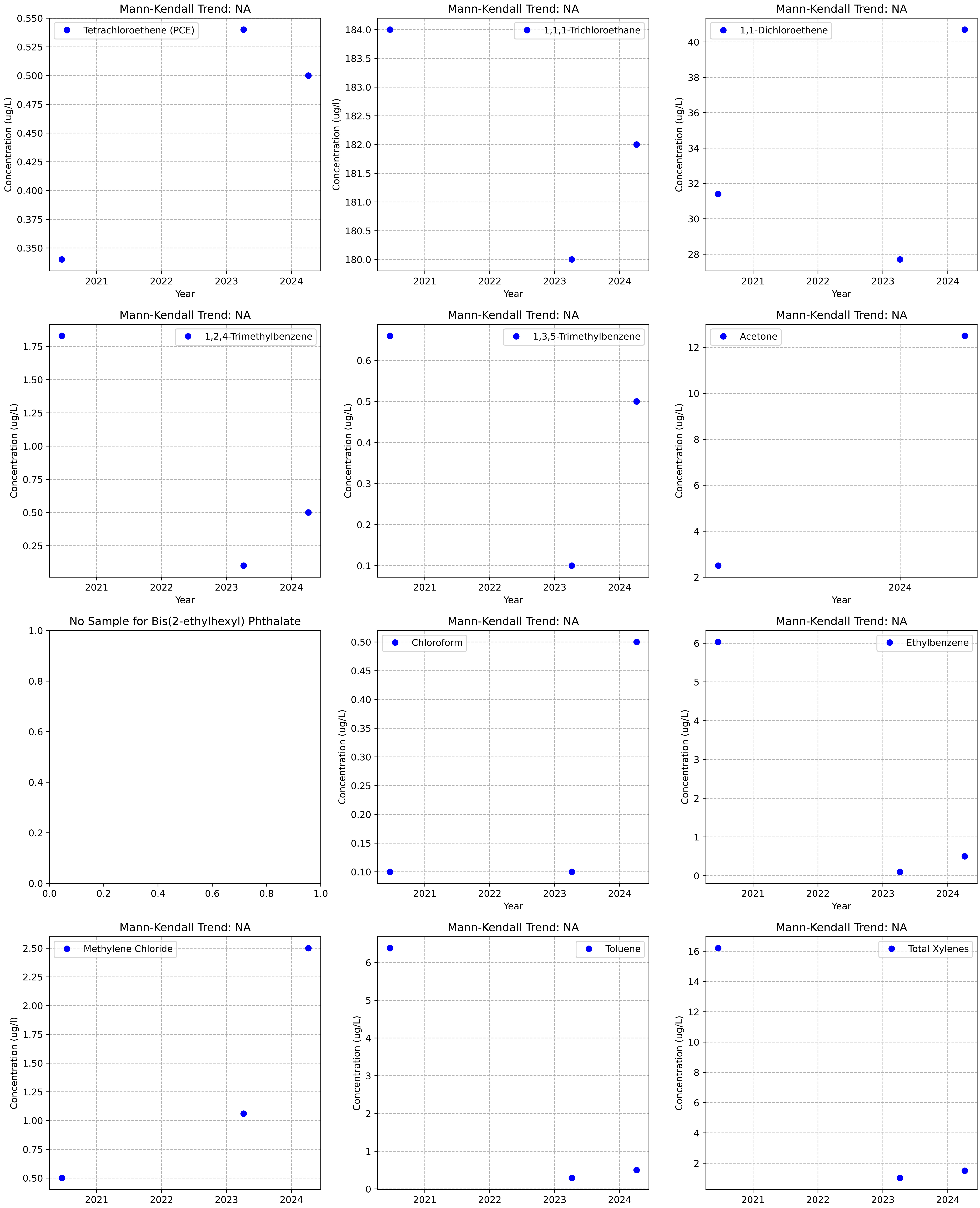
MW-100p1


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

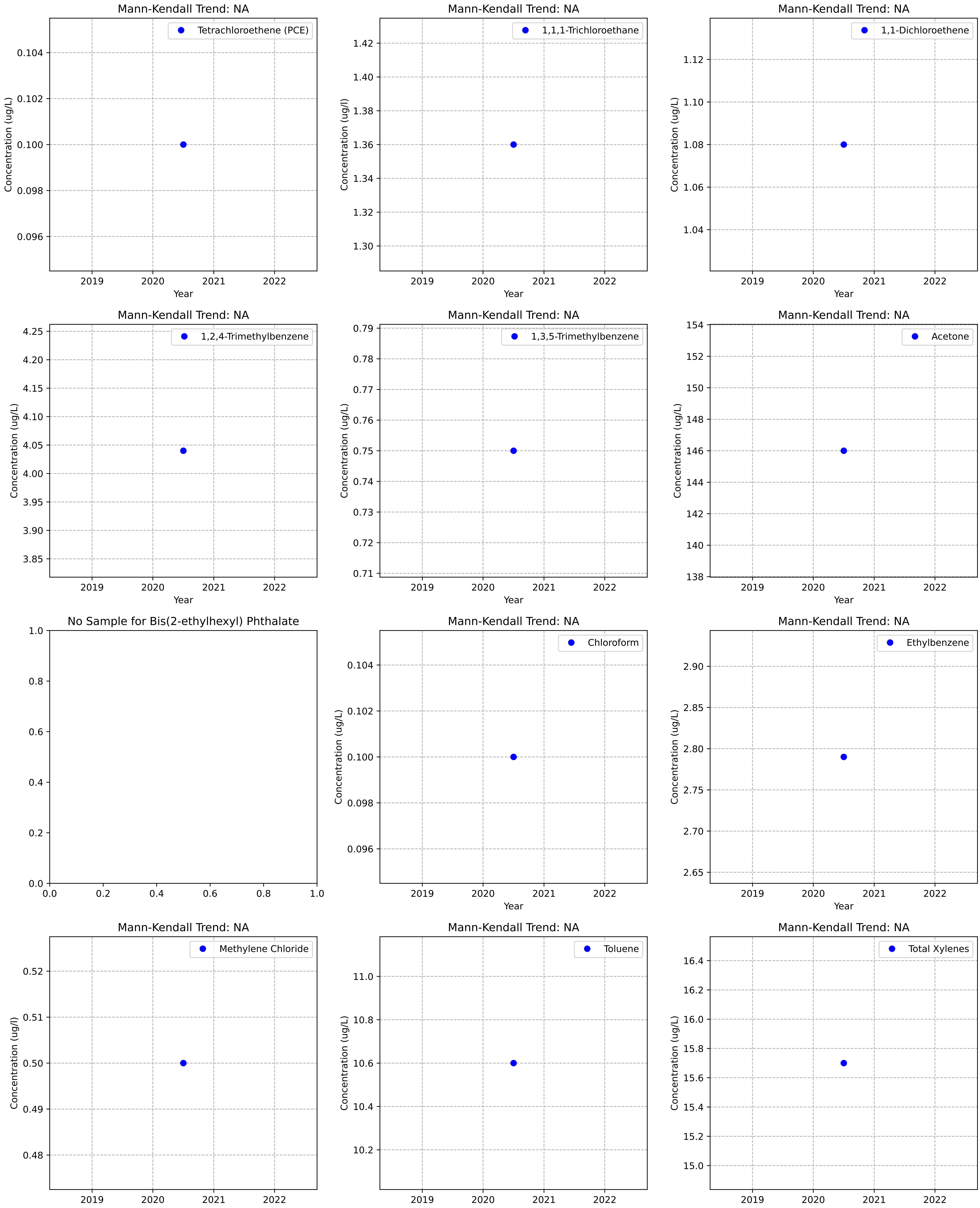
MW-104p1


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

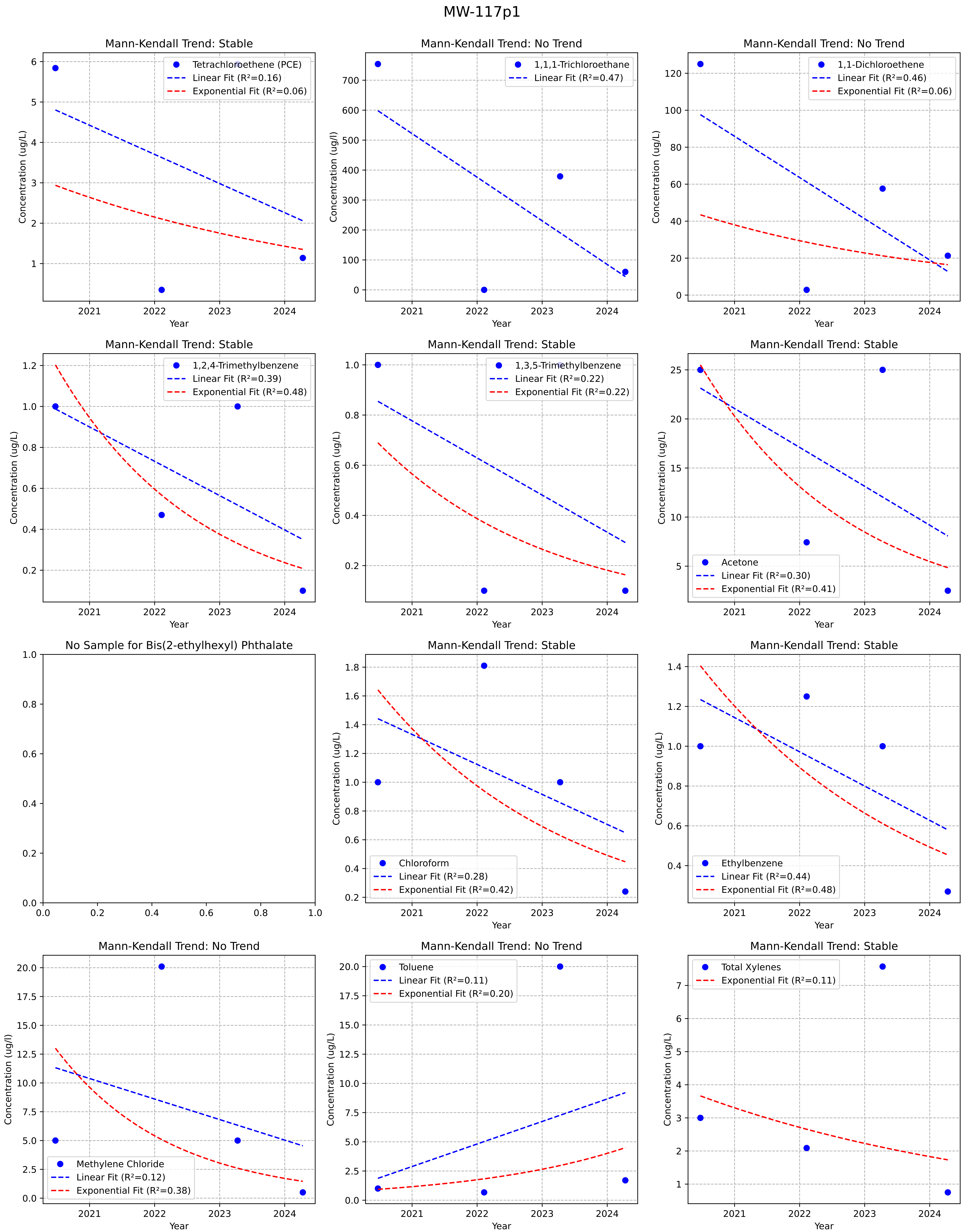
MW-109p1


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

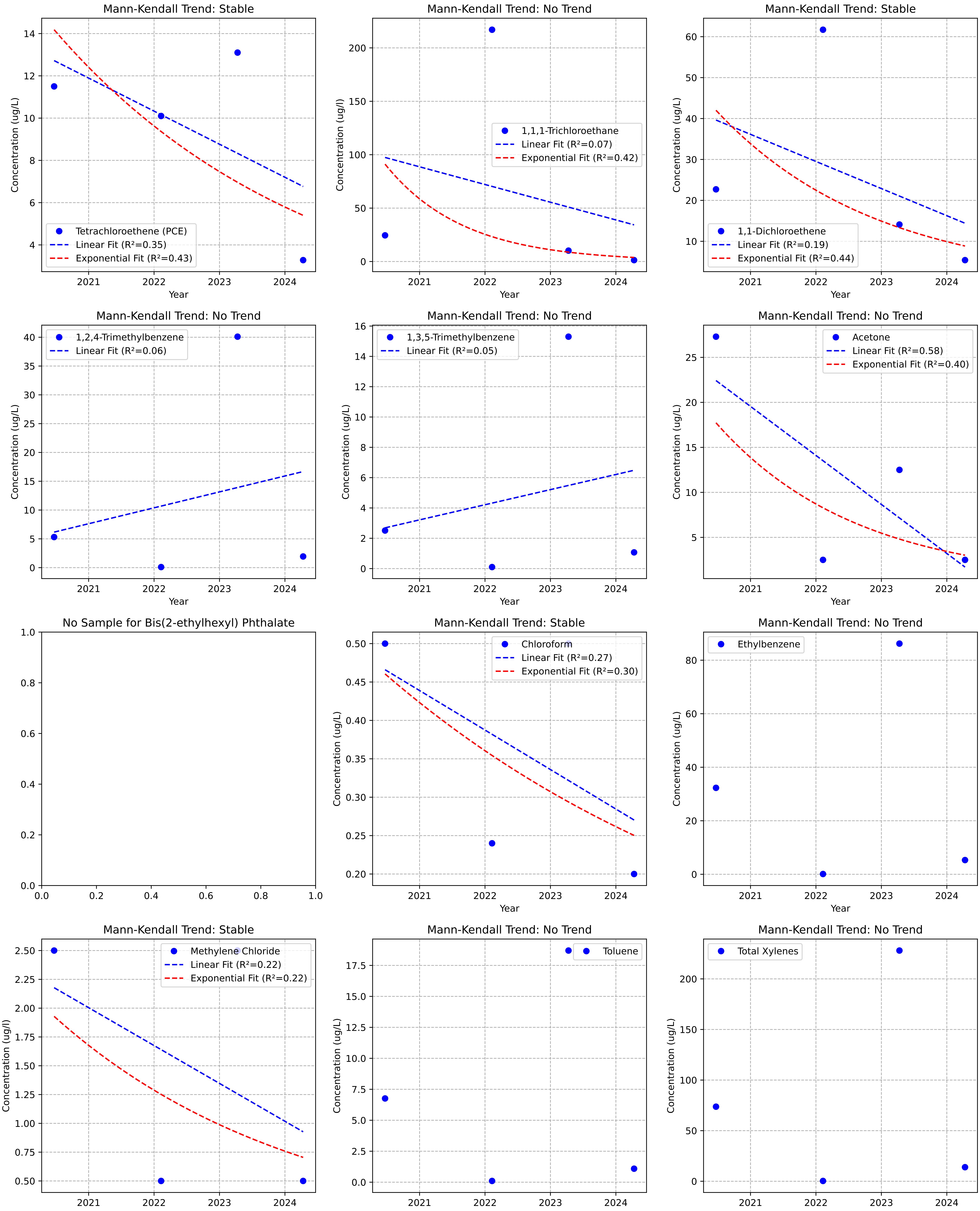
MW-110p1



Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

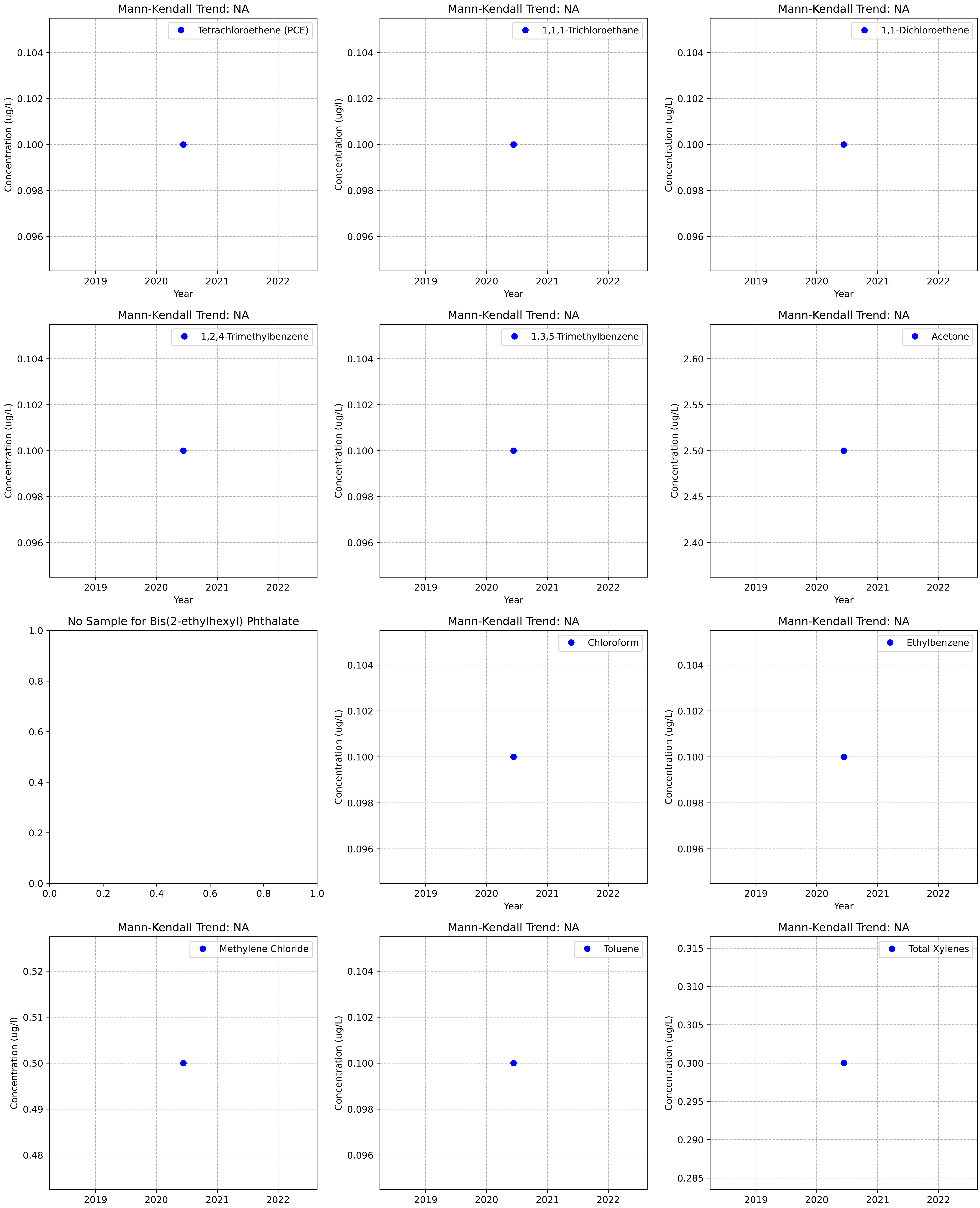

MW-117p1
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.16)
Exponential Fit (R²=0.06)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.47)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.46)
Exponential Fit (R²=0.06)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.39)
Exponential Fit (R²=0.48)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.22)
Exponential Fit (R²=0.22)
Mann-Kendall Trend: Stable
Acetone
Linear Fit (R²=0.30)
Exponential Fit (R²=0.41)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.28)
Exponential Fit (R²=0.42)
Mann-Kendall Trend: Stable
Ethylbenzene
Linear Fit (R²=0.44)
Exponential Fit (R²=0.48)
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.12)
Exponential Fit (R²=0.38)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.20)
Mann-Kendall Trend: Stable
Total Xylenes
Exponential Fit (R²=0.11)
Concentration (ug/L)
Concentration (ug/l)
Year

MW-123p1



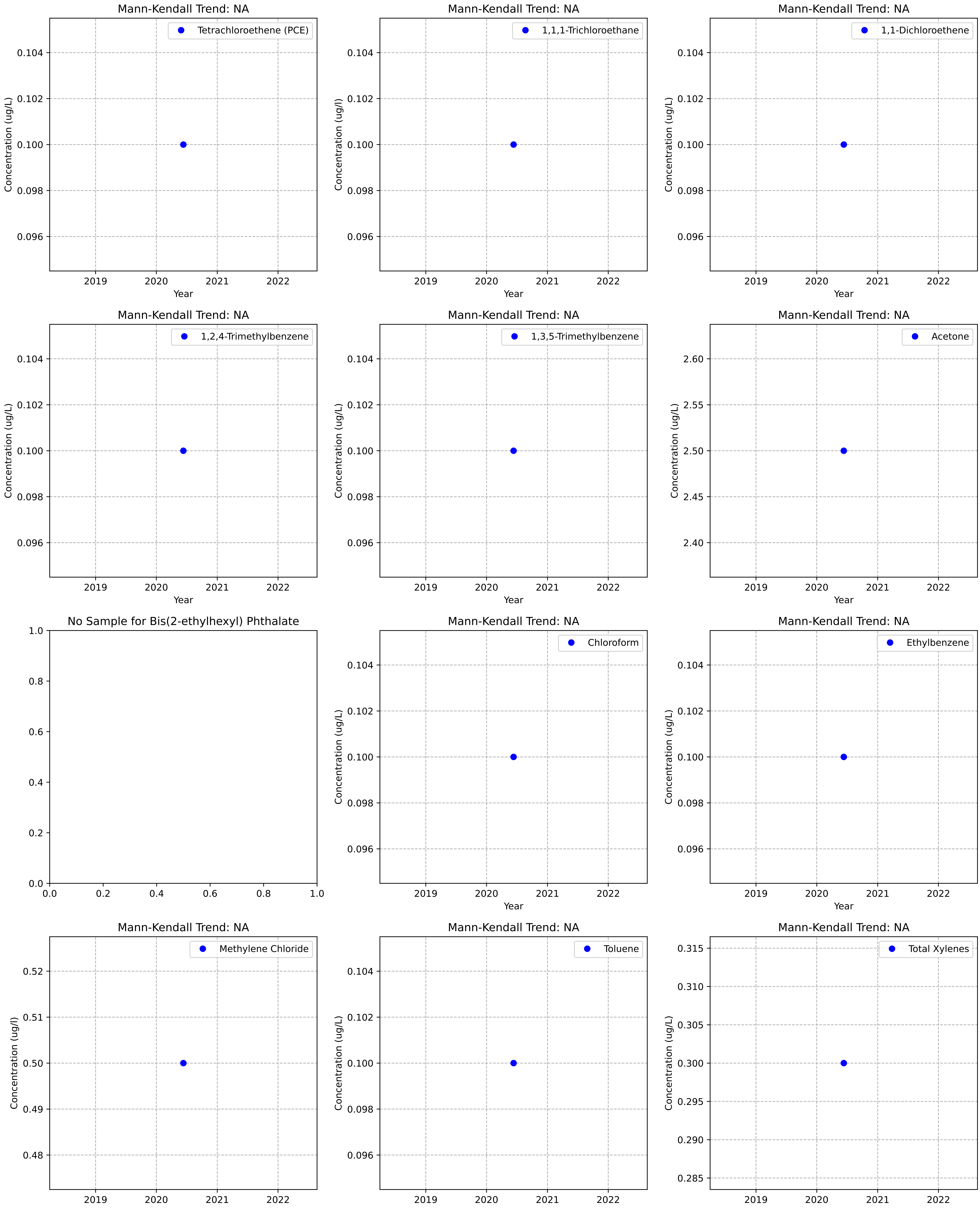
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.35)
Exponential Fit (R²=0.43)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.07)
Exponential Fit (R²=0.42)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.19)
Exponential Fit (R²=0.44)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.06)
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.05)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.58)
Exponential Fit (R²=0.40)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.27)
Exponential Fit (R²=0.30)
Mann-Kendall Trend: No Trend
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Linear Fit (R²=0.22)
Exponential Fit (R²=0.22)
Mann-Kendall Trend: No Trend
Toluene
Mann-Kendall Trend: No Trend
Total Xylenes
Concentration (ug/L)
Year

MW-127p1

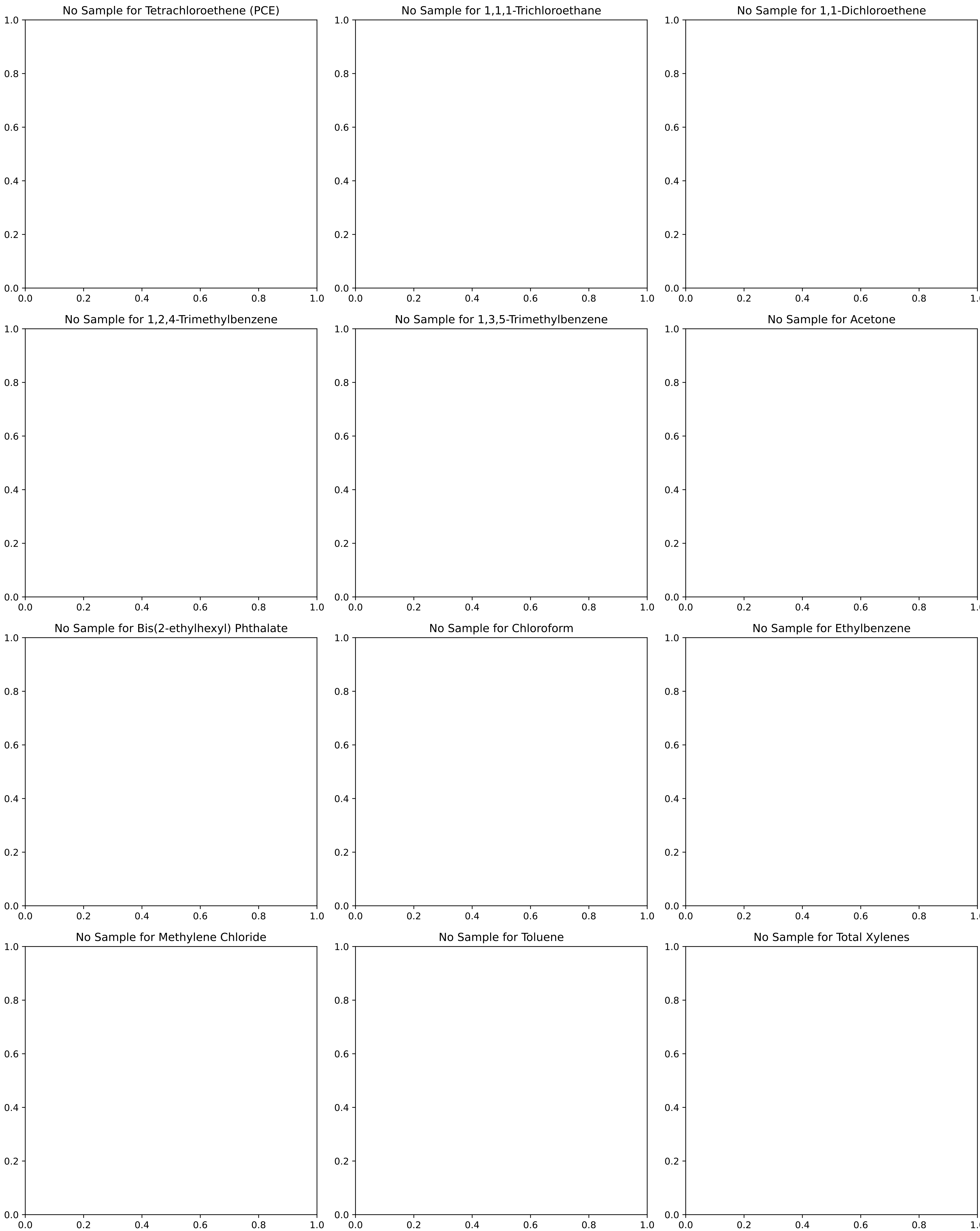


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

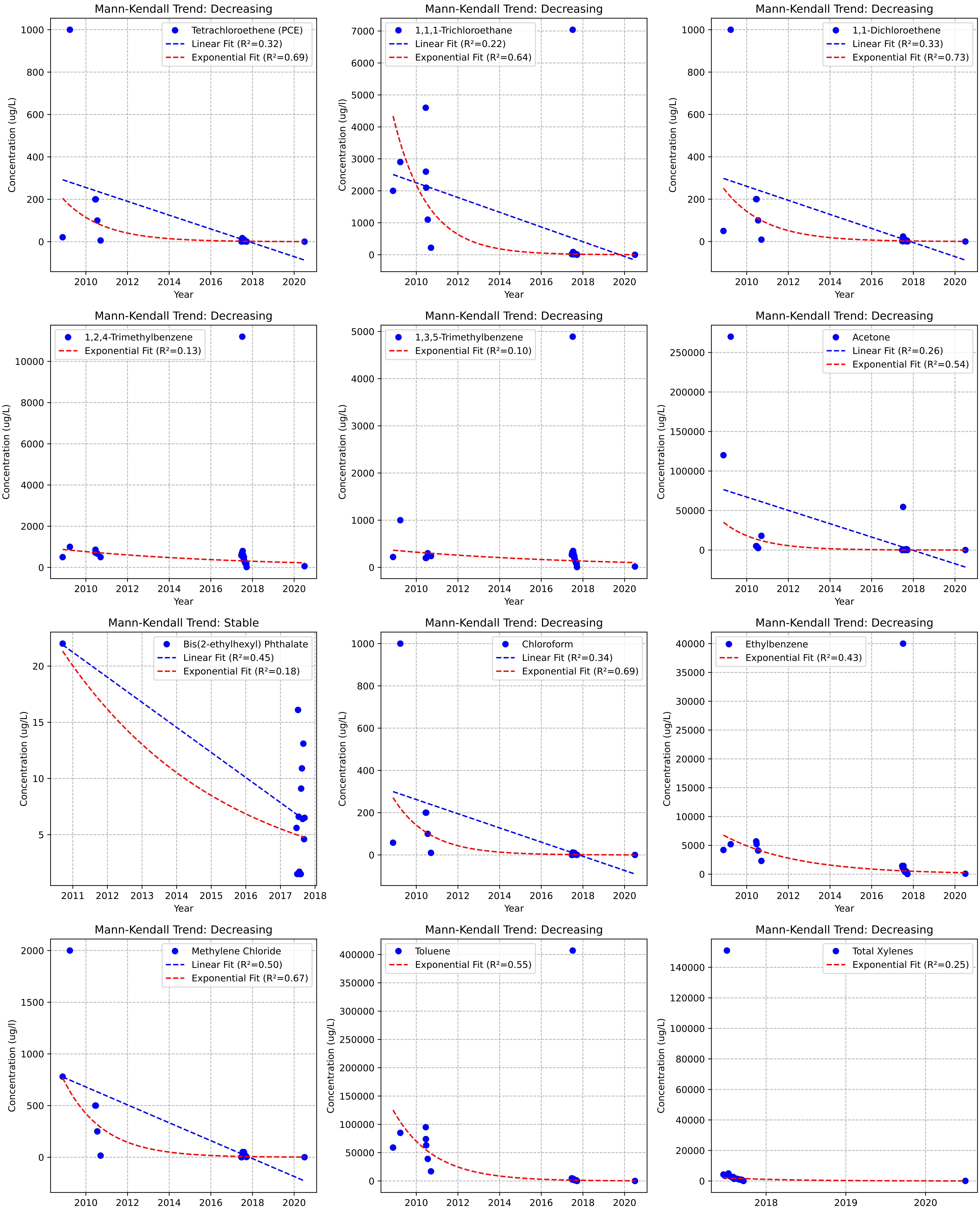
MW-129p1


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Year

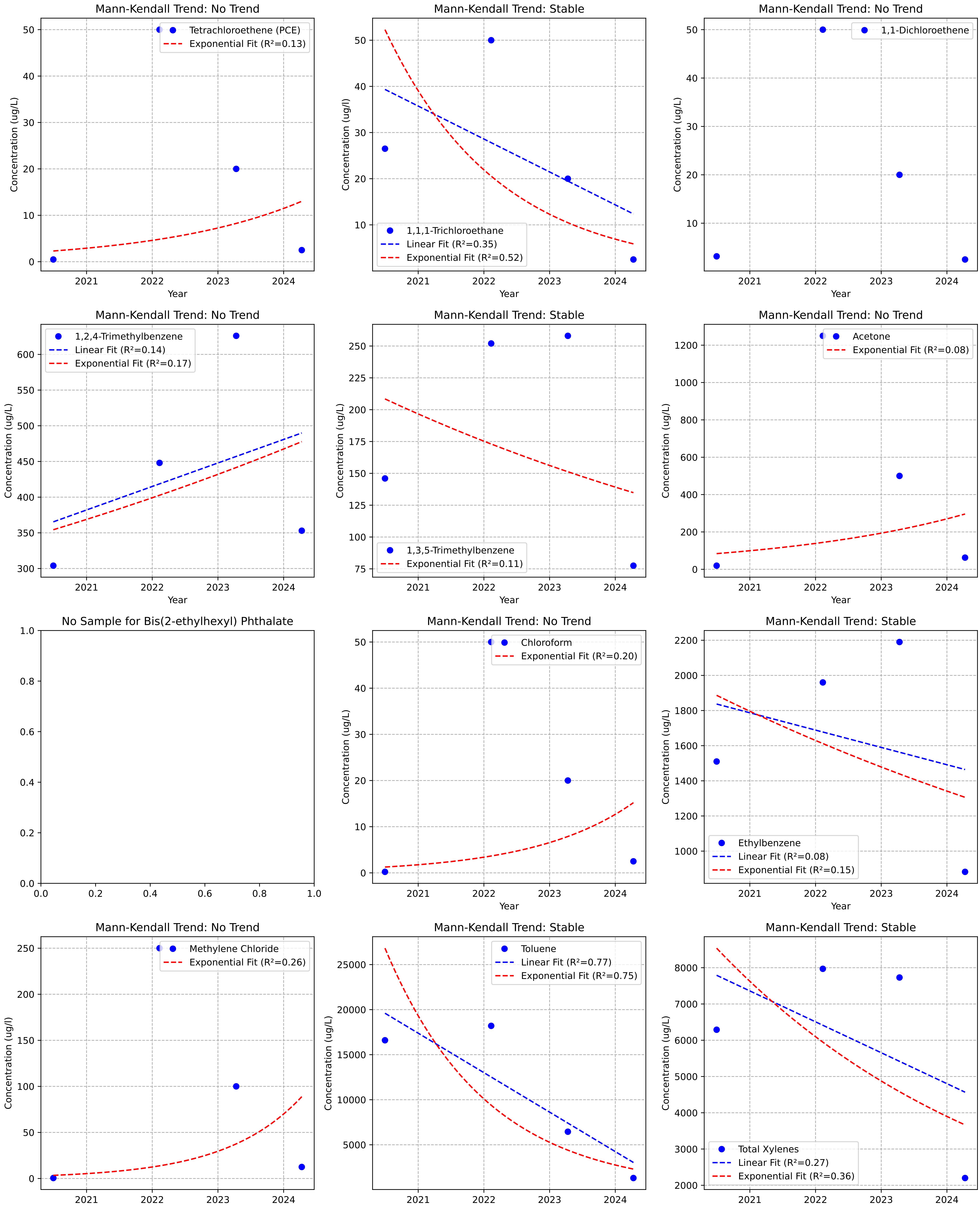
No Data for MW-137p1



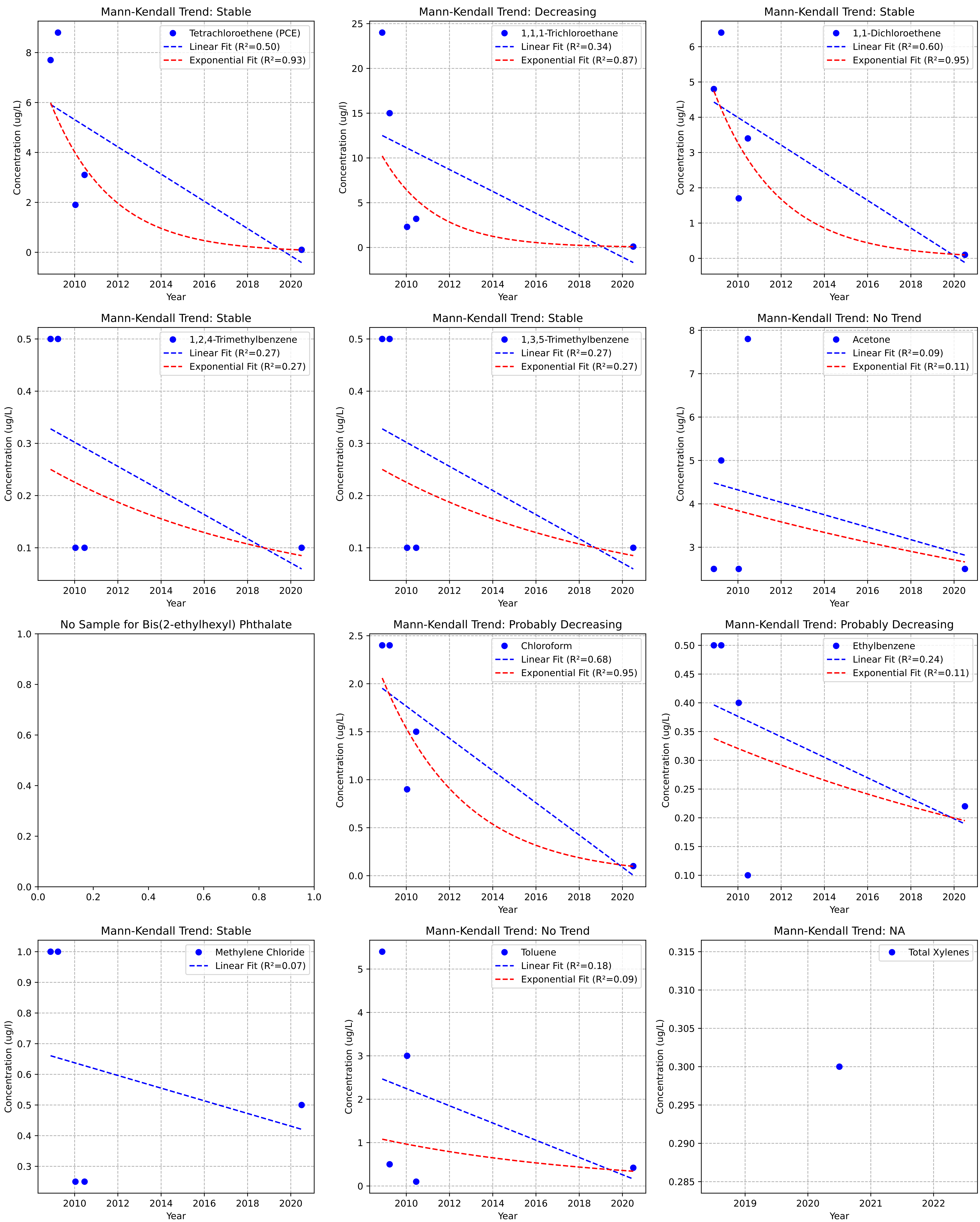
MW-34p1


Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.32)
Exponential Fit (R²=0.69)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.22)
Exponential Fit (R²=0.64)
Concentration (ug/l)
Year
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.33)
Exponential Fit (R²=0.73)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Exponential Fit (R²=0.13)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Exponential Fit (R²=0.10)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Acetone
Linear Fit (R²=0.26)
Exponential Fit (R²=0.54)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.45)
Exponential Fit (R²=0.18)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.34)
Exponential Fit (R²=0.69)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Ethylbenzene
Exponential Fit (R²=0.43)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.50)
Exponential Fit (R²=0.67)
Concentration (ug/l)
Year
Mann-Kendall Trend: Decreasing
Toluene
Exponential Fit (R²=0.55)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Total Xylenes
Exponential Fit (R²=0.25)
Concentration (ug/L)
Year

MW-36p1

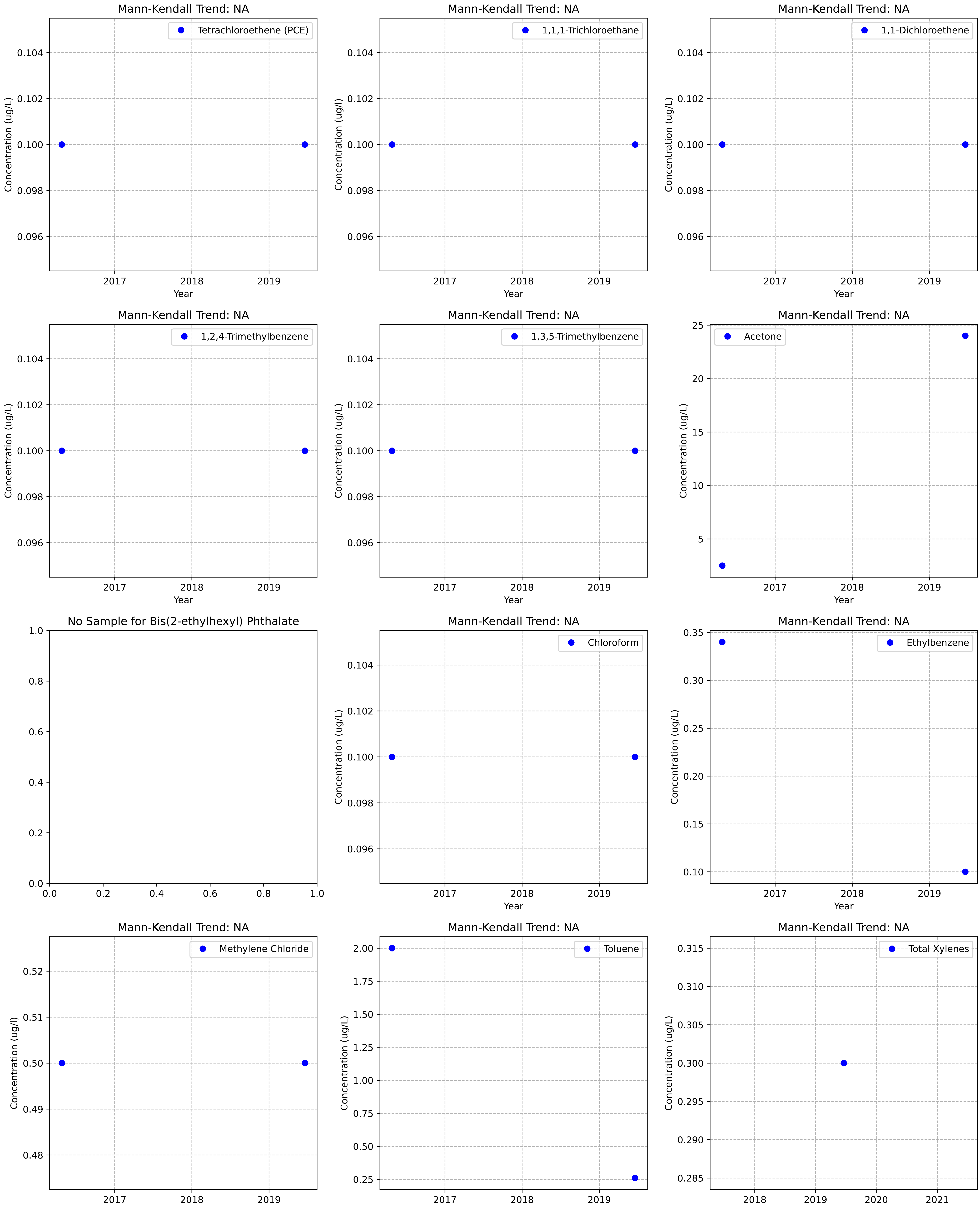

Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Exponential Fit (R²=0.13)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Linear Fit (R²=0.35)
Exponential Fit (R²=0.52)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.14)
Exponential Fit (R²=0.17)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Exponential Fit (R²=0.11)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Acetone
Exponential Fit (R²=0.08)
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Exponential Fit (R²=0.20)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Ethylbenzene
Linear Fit (R²=0.08)
Exponential Fit (R²=0.15)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Methylene Chloride
Exponential Fit (R²=0.26)
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
Toluene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.75)
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
Total Xylenes
Linear Fit (R²=0.27)
Exponential Fit (R²=0.36)
Concentration (ug/l)
Year

MW-37p1



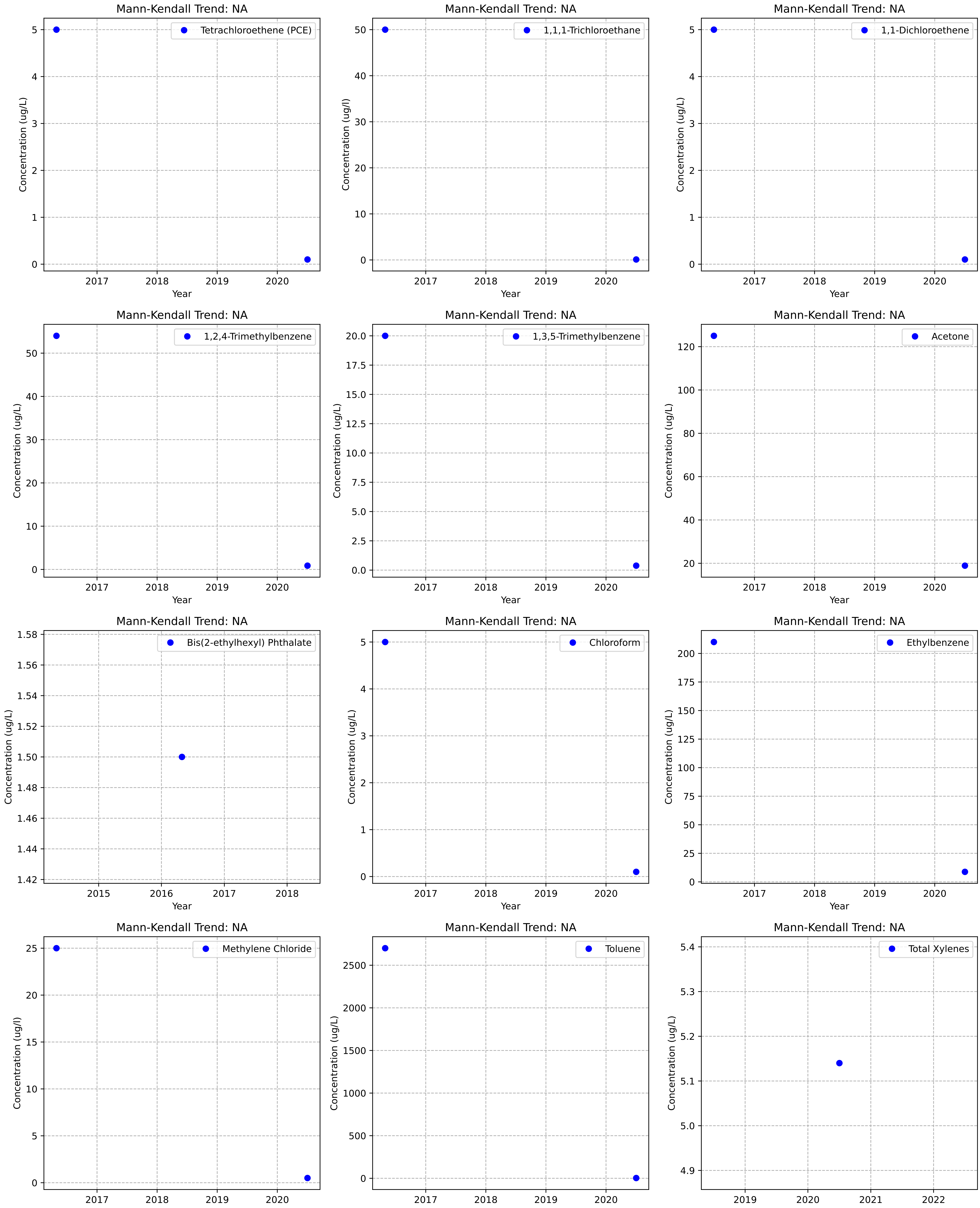
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.50)
Exponential Fit (R²=0.93)
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.34)
Exponential Fit (R²=0.87)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.60)
Exponential Fit (R²=0.95)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.27)
Exponential Fit (R²=0.27)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.27)
Exponential Fit (R²=0.27)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.09)
Exponential Fit (R²=0.11)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Probably Decreasing
Chloroform
Linear Fit (R²=0.68)
Exponential Fit (R²=0.95)
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Linear Fit (R²=0.24)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Stable
Methylene Chloride
Linear Fit (R²=0.07)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.18)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Year

MW-61p1



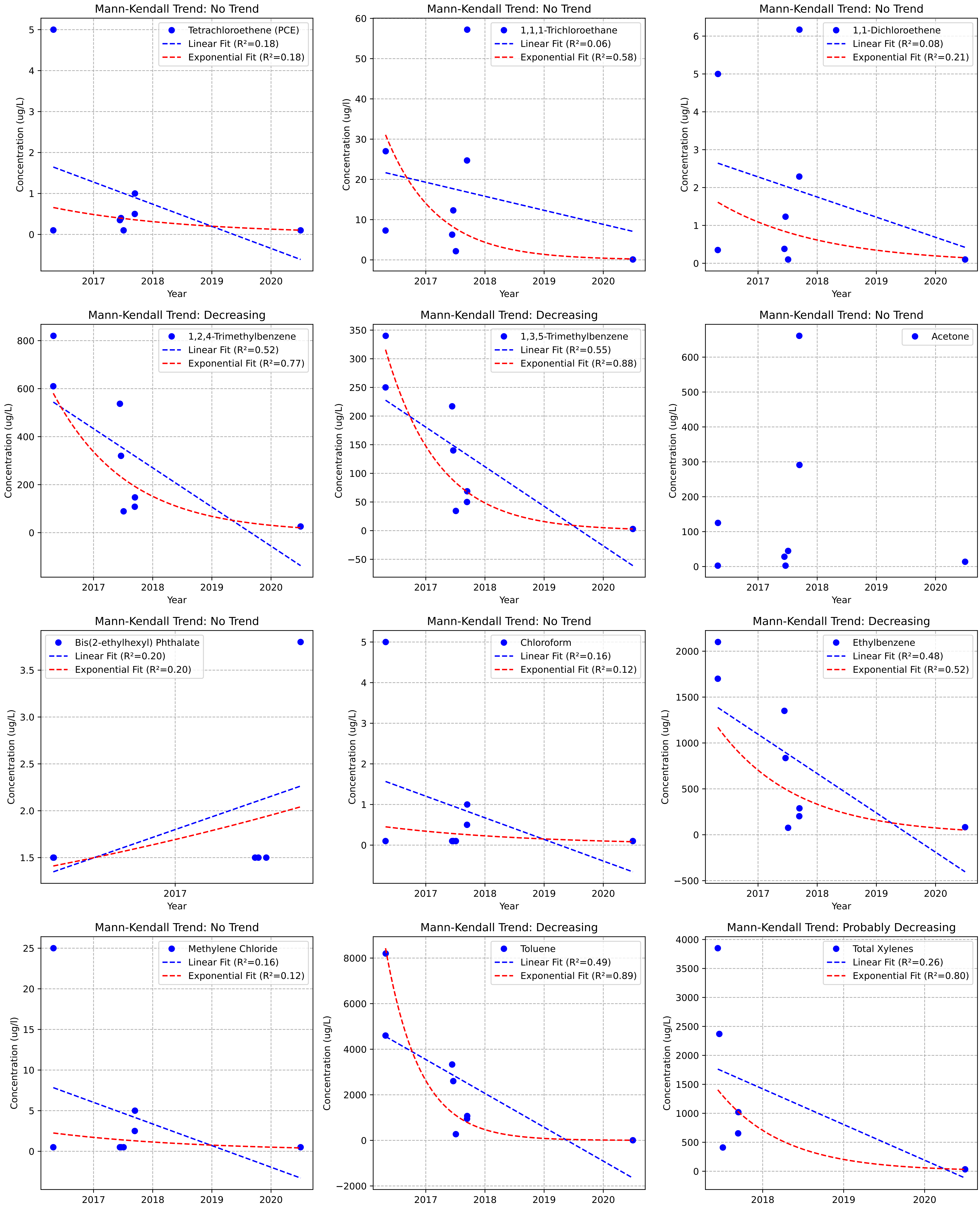
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-64p1



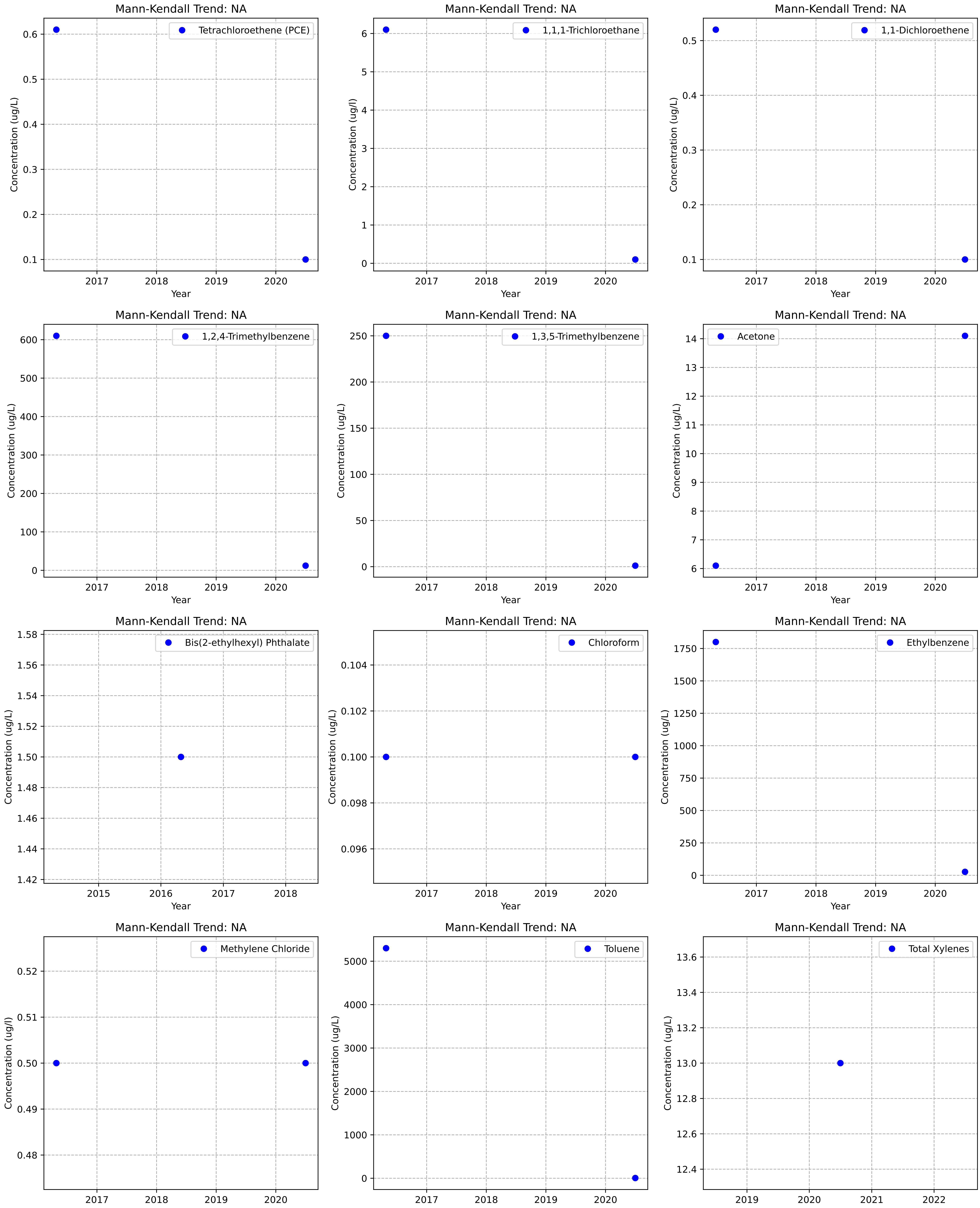
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-65p1



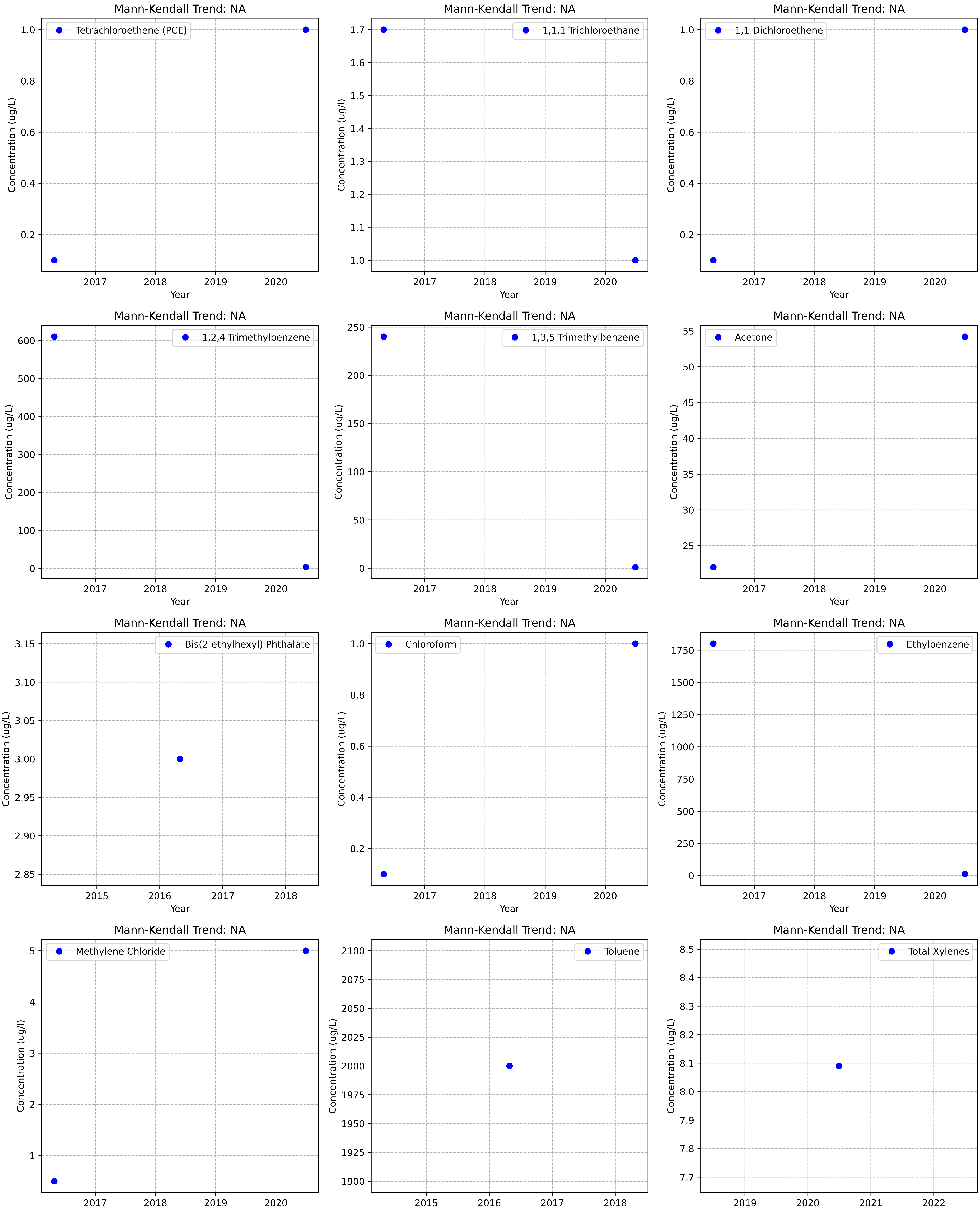
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.18)
Exponential Fit (R²=0.18)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.06)
Exponential Fit (R²=0.58)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.08)
Exponential Fit (R²=0.21)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.52)
Exponential Fit (R²=0.77)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.55)
Exponential Fit (R²=0.88)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Acetone
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.20)
Exponential Fit (R²=0.20)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.16)
Exponential Fit (R²=0.12)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.48)
Exponential Fit (R²=0.52)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.16)
Exponential Fit (R²=0.12)
Concentration (ug/l)
Year
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.49)
Exponential Fit (R²=0.89)
Concentration (ug/L)
Year
Mann-Kendall Trend: Probably Decreasing
Total Xylenes
Linear Fit (R²=0.26)
Exponential Fit (R²=0.80)
Concentration (ug/l)
Year

MW-66p1

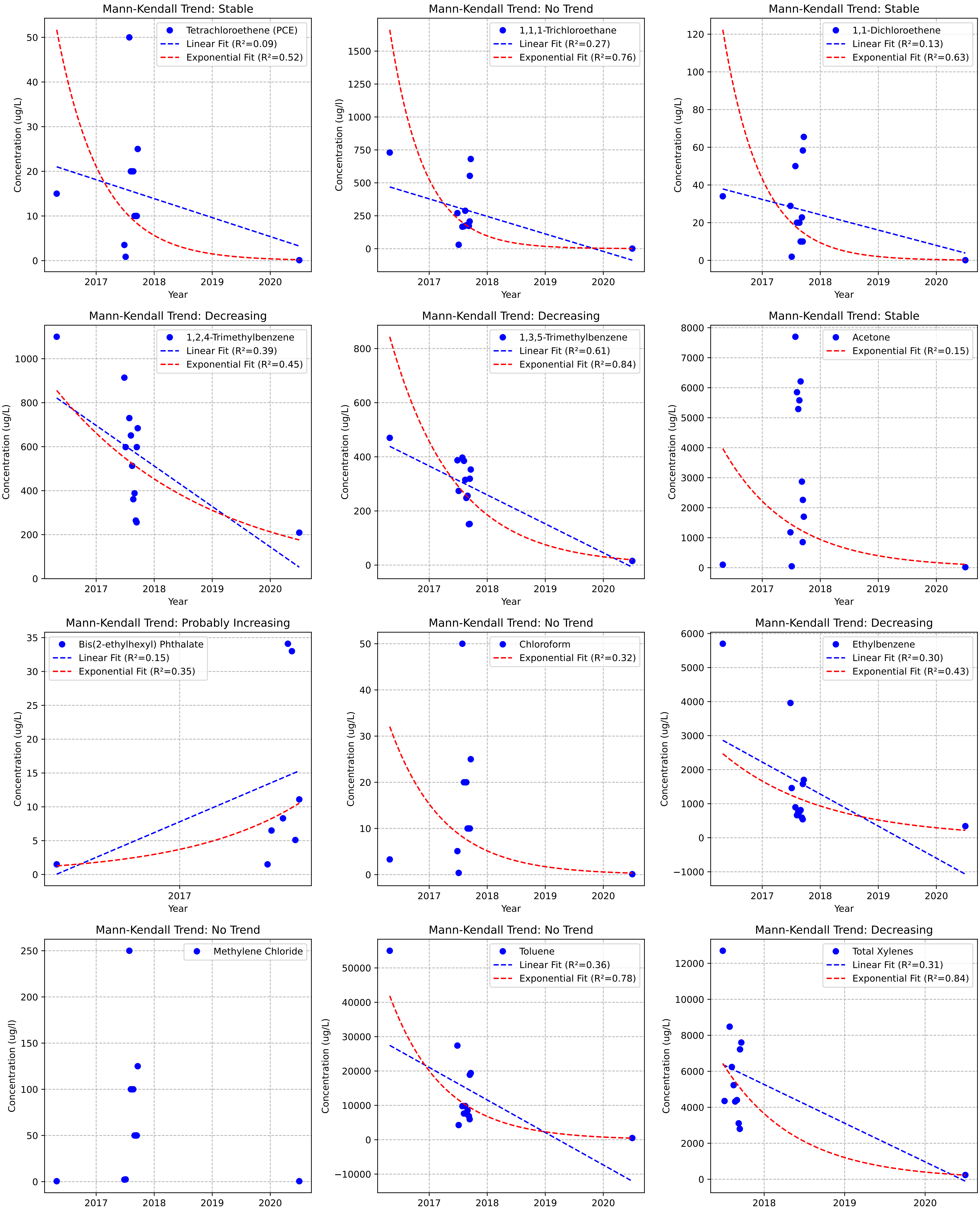


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
1,1-Dichloroethene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Acetone
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Chloroform
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Ethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
Toluene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Year

MW-67p1

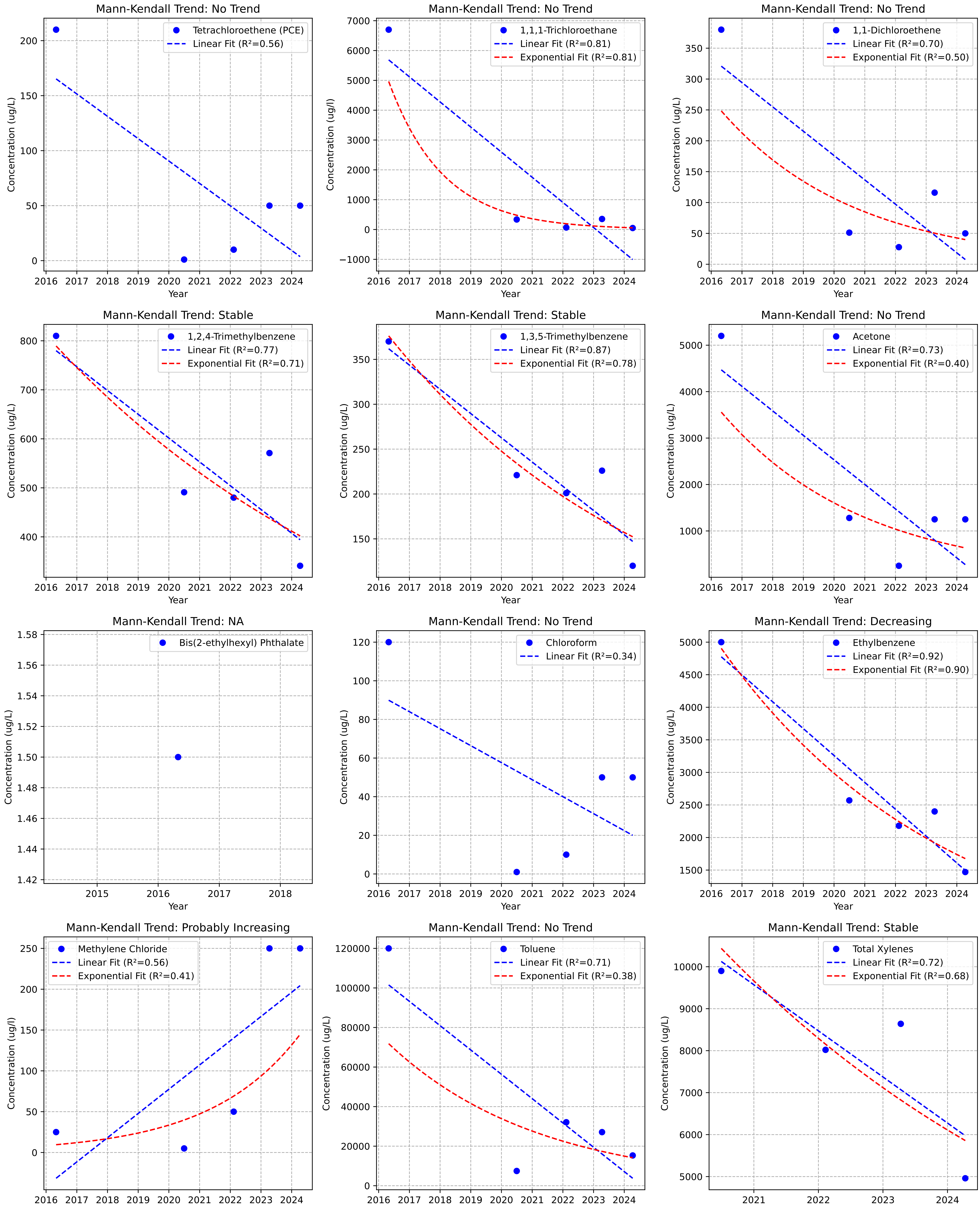

Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-68p1



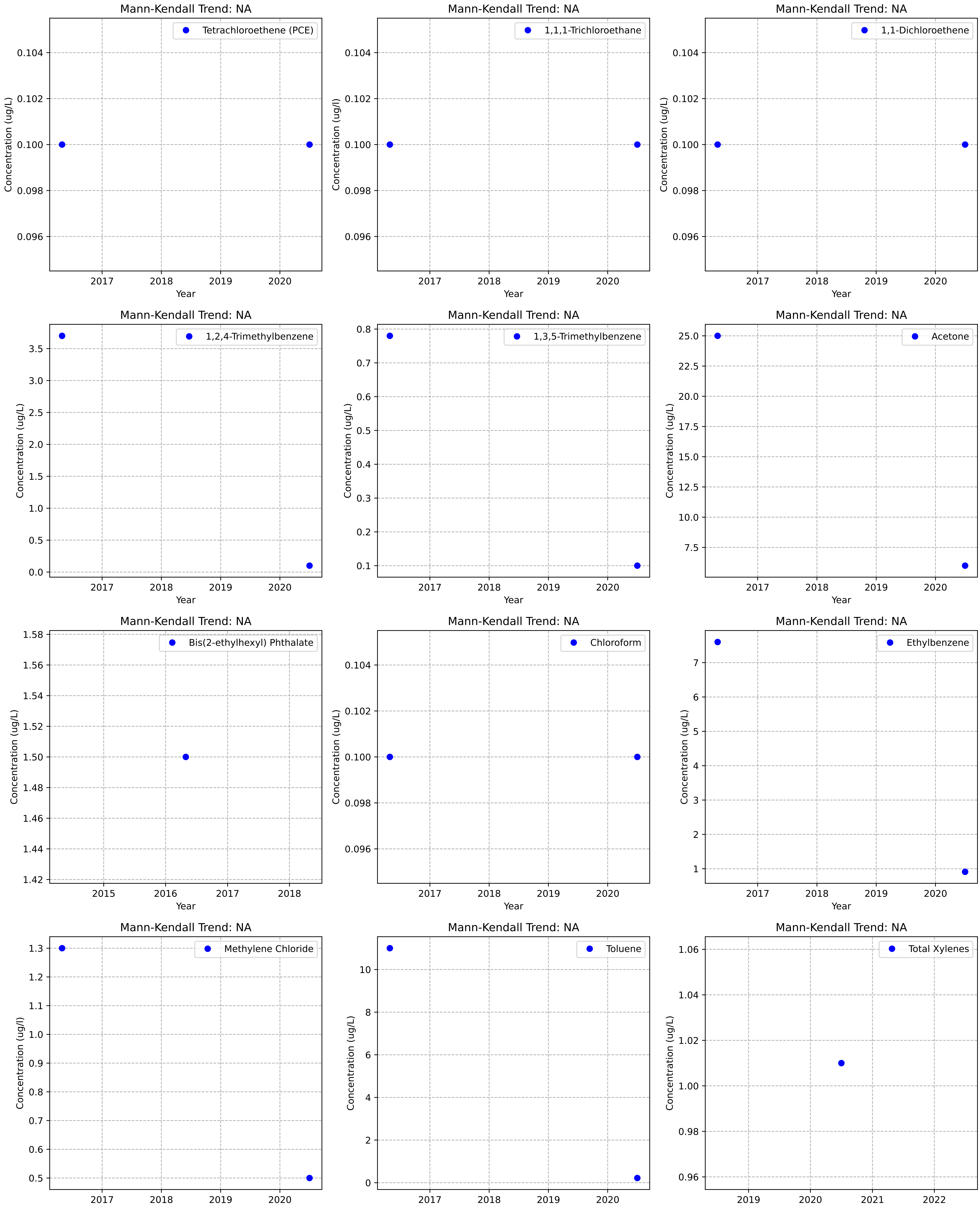
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.09)
Exponential Fit (R²=0.52)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.27)
Exponential Fit (R²=0.76)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.13)
Exponential Fit (R²=0.63)
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.39)
Exponential Fit (R²=0.45)
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.61)
Exponential Fit (R²=0.84)
Mann-Kendall Trend: Stable
Acetone
Exponential Fit (R²=0.15)
Mann-Kendall Trend: Probably Increasing
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.15)
Exponential Fit (R²=0.35)
Mann-Kendall Trend: No Trend
Chloroform
Exponential Fit (R²=0.32)
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.30)
Exponential Fit (R²=0.43)
Mann-Kendall Trend: No Trend
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.36)
Exponential Fit (R²=0.78)
Mann-Kendall Trend: Decreasing
Total Xylenes
Linear Fit (R²=0.31)
Exponential Fit (R²=0.84)
Concentration (ug/L)
Concentration (ug/l)
Year

MW-69p1



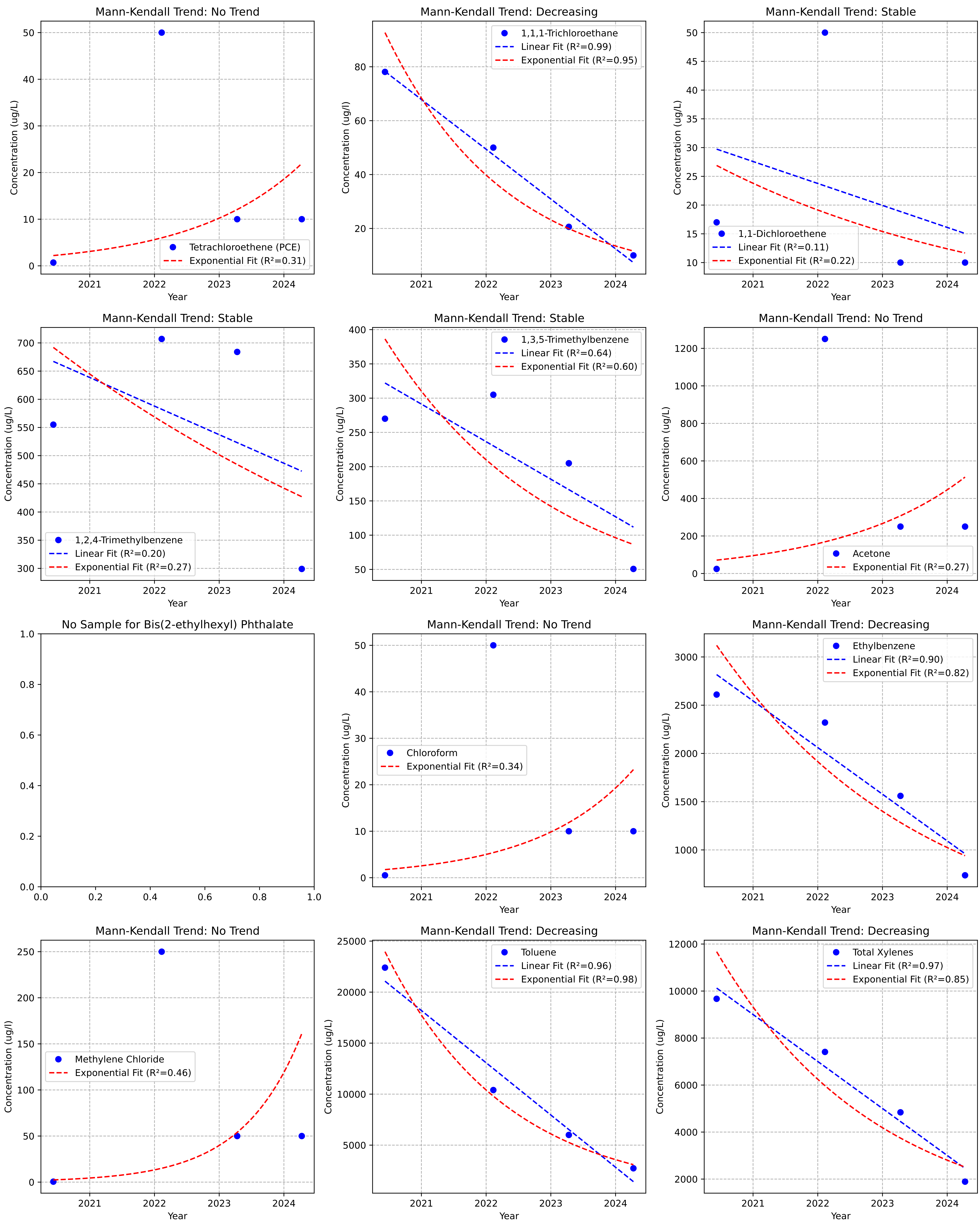
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.56)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.81)
Exponential Fit (R²=0.81)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.70)
Exponential Fit (R²=0.50)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.71)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.78)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.73)
Exponential Fit (R²=0.40)
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.34)
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.92)
Exponential Fit (R²=0.90)
Mann-Kendall Trend: Probably Increasing
Methylene Chloride
Linear Fit (R²=0.56)
Exponential Fit (R²=0.41)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.71)
Exponential Fit (R²=0.38)
Mann-Kendall Trend: Stable
Total Xylenes
Linear Fit (R²=0.72)
Exponential Fit (R²=0.68)
Concentration (ug/l)
Concentration (ug/L)
Year

MW-70p1



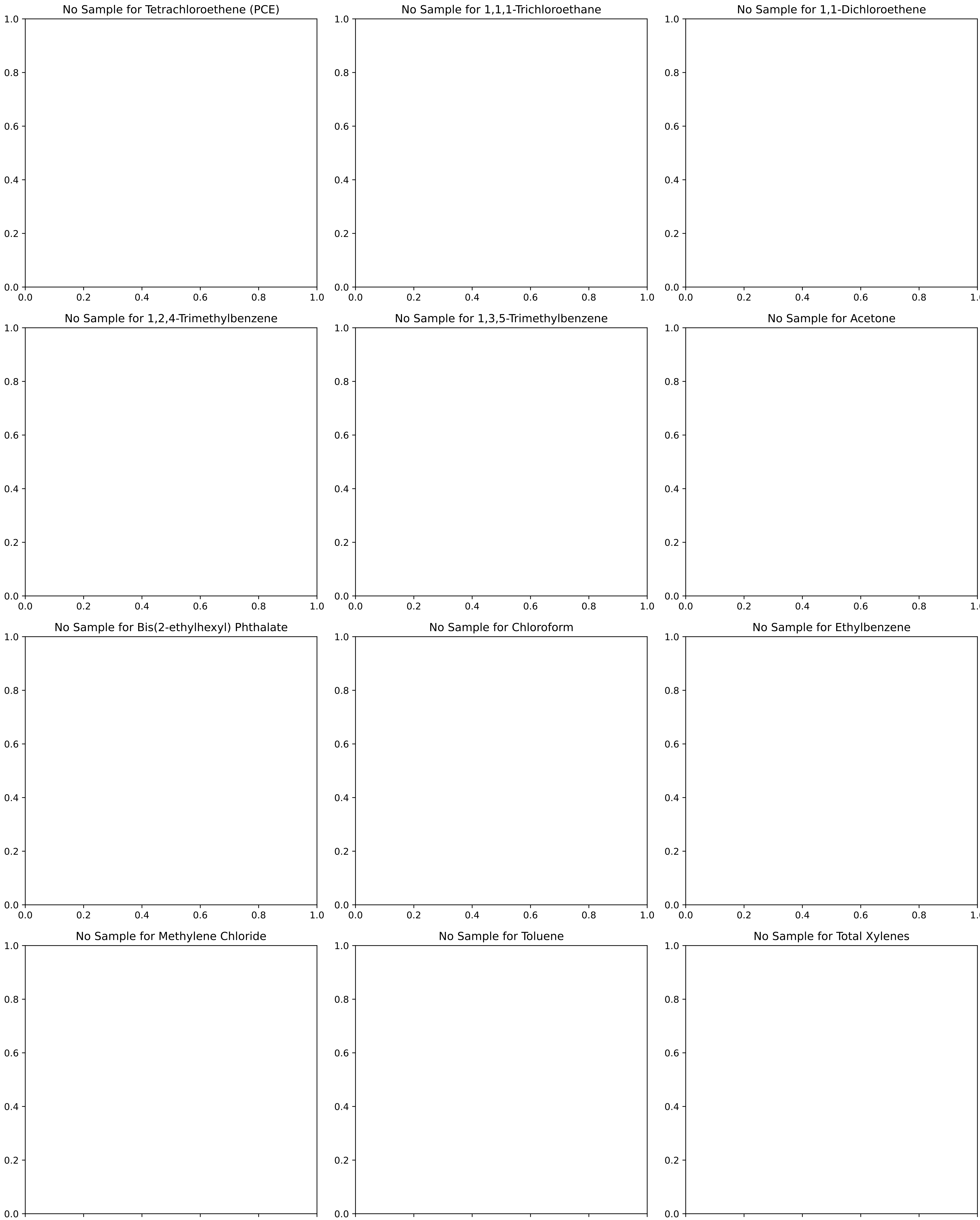
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
1,1,1-Trichloroethane
1,1-Dichloroethene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
Acetone
Bis(2-ethylhexyl) Phthalate
Chloroform
Ethylbenzene
Methylene Chloride
Toluene
Total Xylenes
Concentration (ug/L)
Year

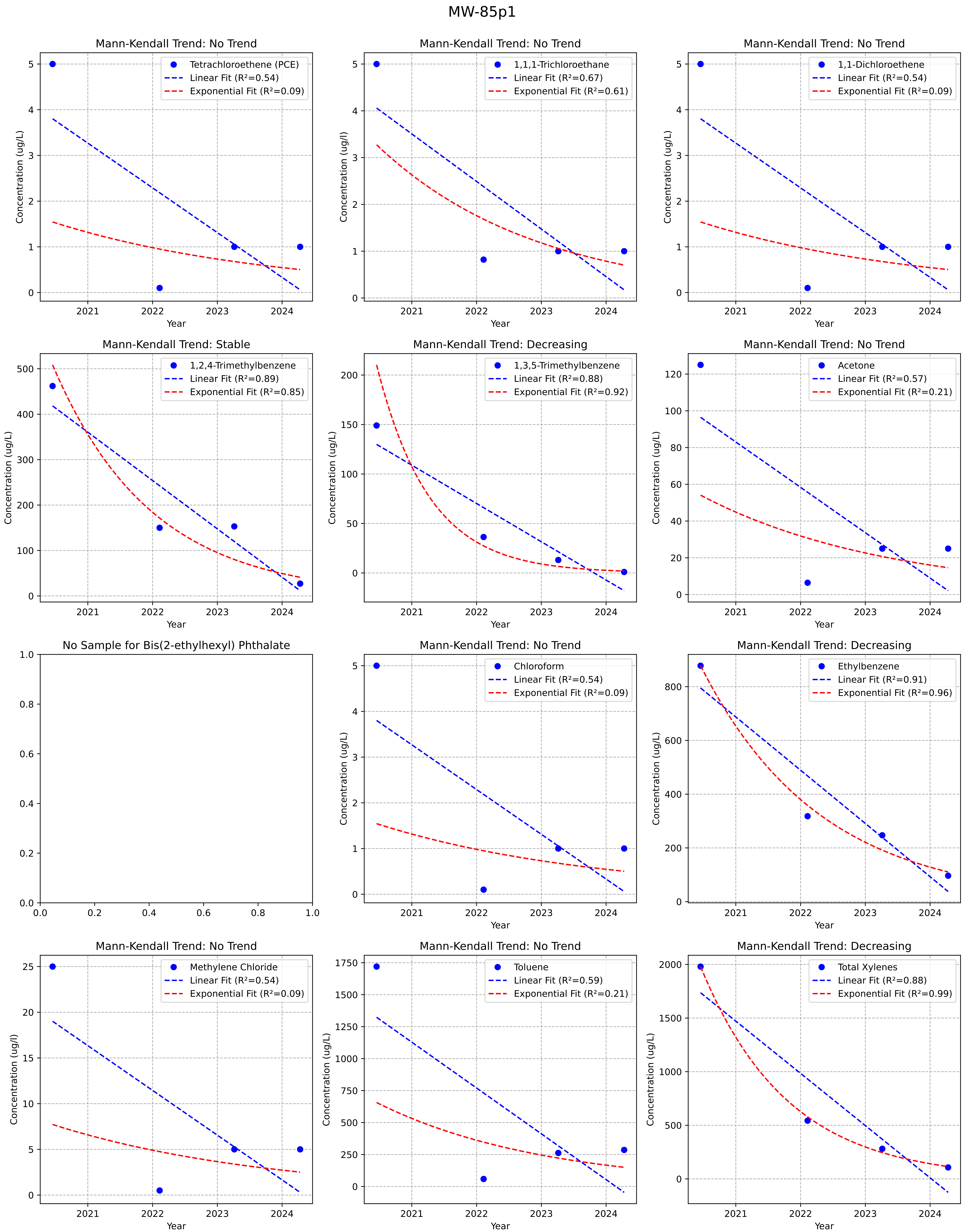
MW-83p1



Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Exponential Fit (R²=0.31)
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.99)
Exponential Fit (R²=0.95)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.22)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.20)
Exponential Fit (R²=0.27)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.64)
Exponential Fit (R²=0.60)
Mann-Kendall Trend: No Trend
Acetone
Exponential Fit (R²=0.27)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Exponential Fit (R²=0.34)
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.90)
Exponential Fit (R²=0.82)
Mann-Kendall Trend: No Trend
Methylene Chloride
Exponential Fit (R²=0.46)
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.96)
Exponential Fit (R²=0.98)
Mann-Kendall Trend: Decreasing
Total Xylenes
Linear Fit (R²=0.97)
Exponential Fit (R²=0.85)
Concentration (ug/L)
Concentration (ug/l)
Year

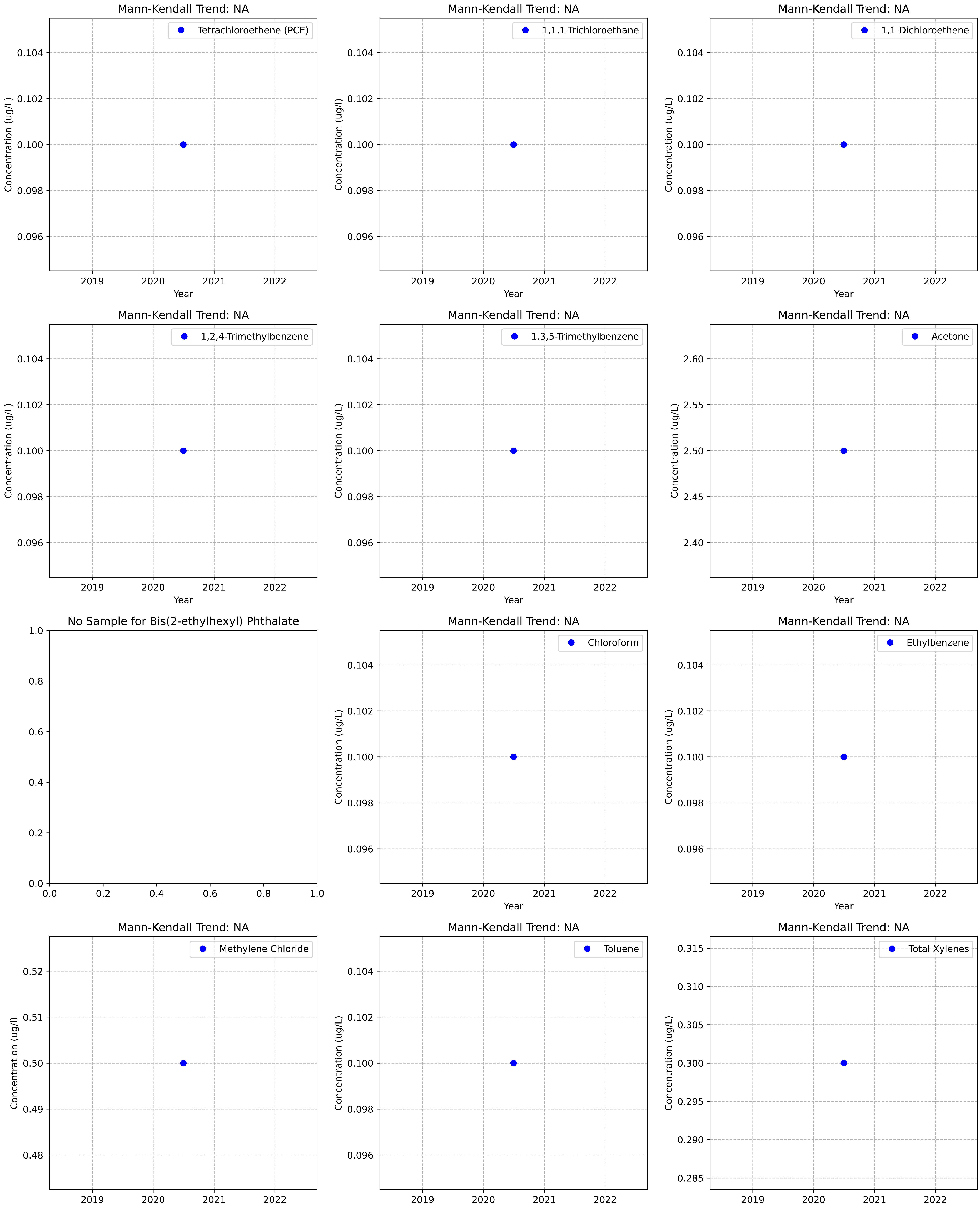
No Data for MW-84p1





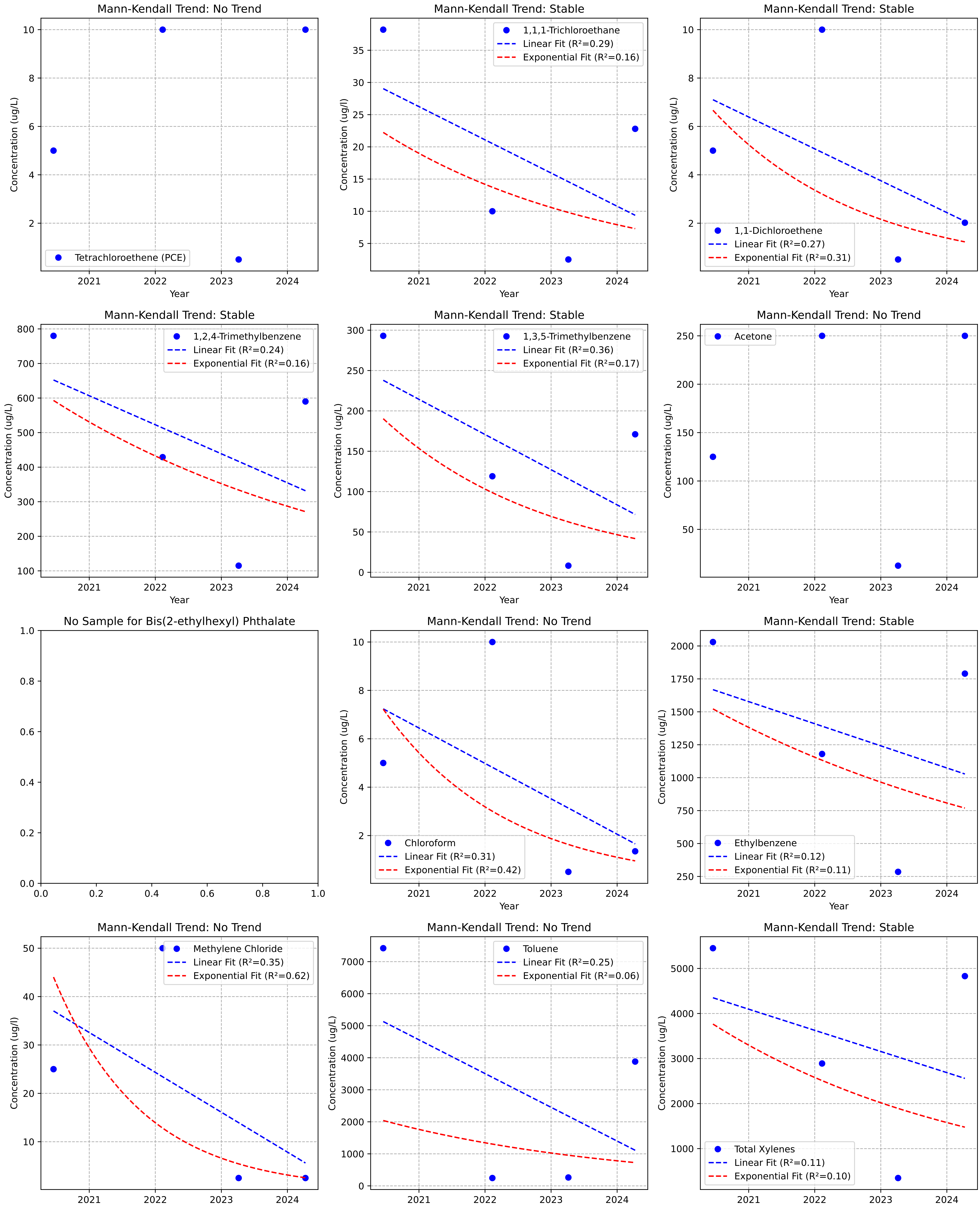
MW-85p1
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.54)
Exponential Fit (R²=0.09)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.67)
Exponential Fit (R²=0.61)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.54)
Exponential Fit (R²=0.09)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.89)
Exponential Fit (R²=0.85)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.88)
Exponential Fit (R²=0.92)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.57)
Exponential Fit (R²=0.21)
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.54)
Exponential Fit (R²=0.09)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.91)
Exponential Fit (R²=0.96)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.54)
Exponential Fit (R²=0.09)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.59)
Exponential Fit (R²=0.21)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Total Xylenes
Linear Fit (R²=0.88)
Exponential Fit (R²=0.99)
Concentration (ug/l)
Year

MW-90p1



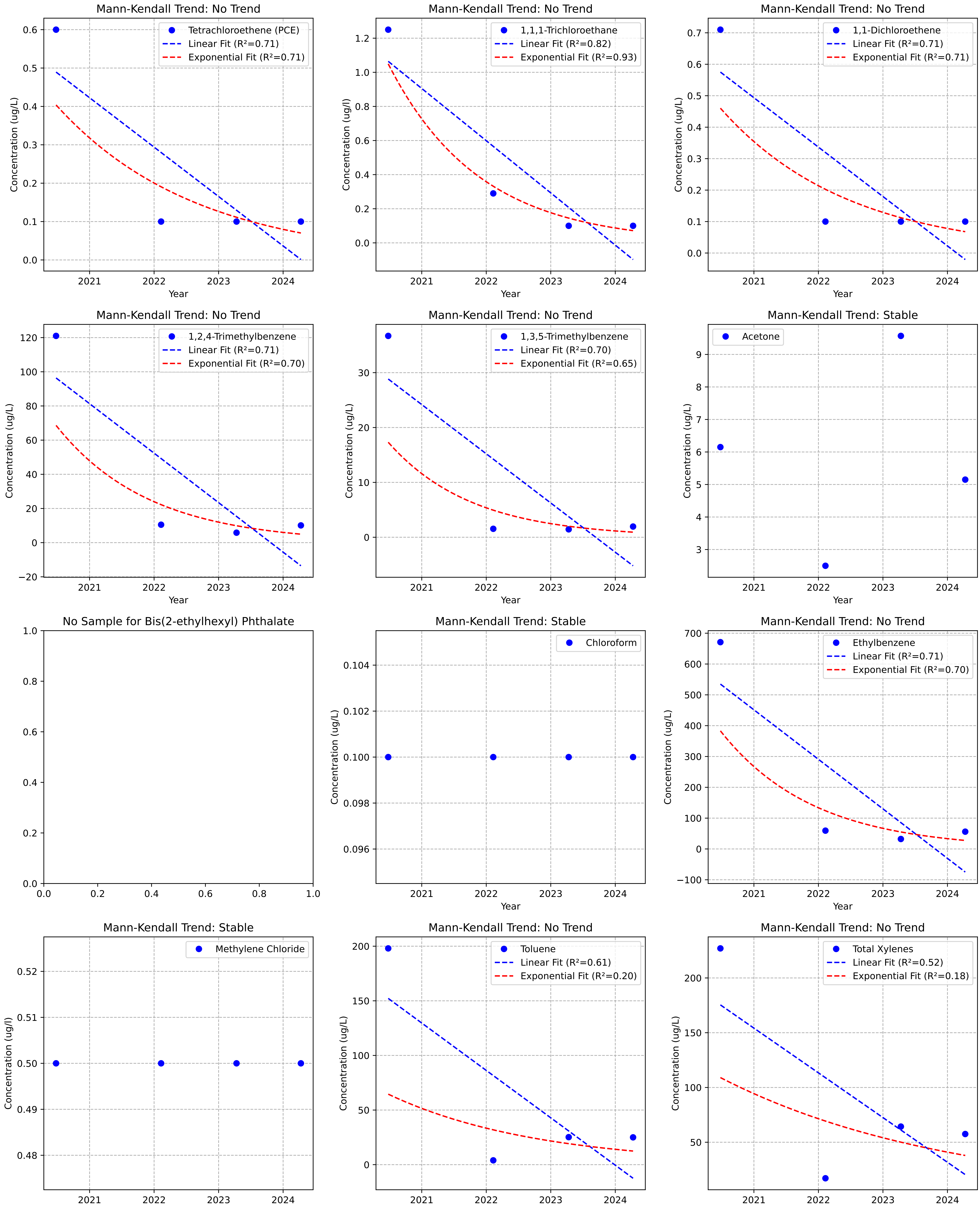
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

MW-92p1



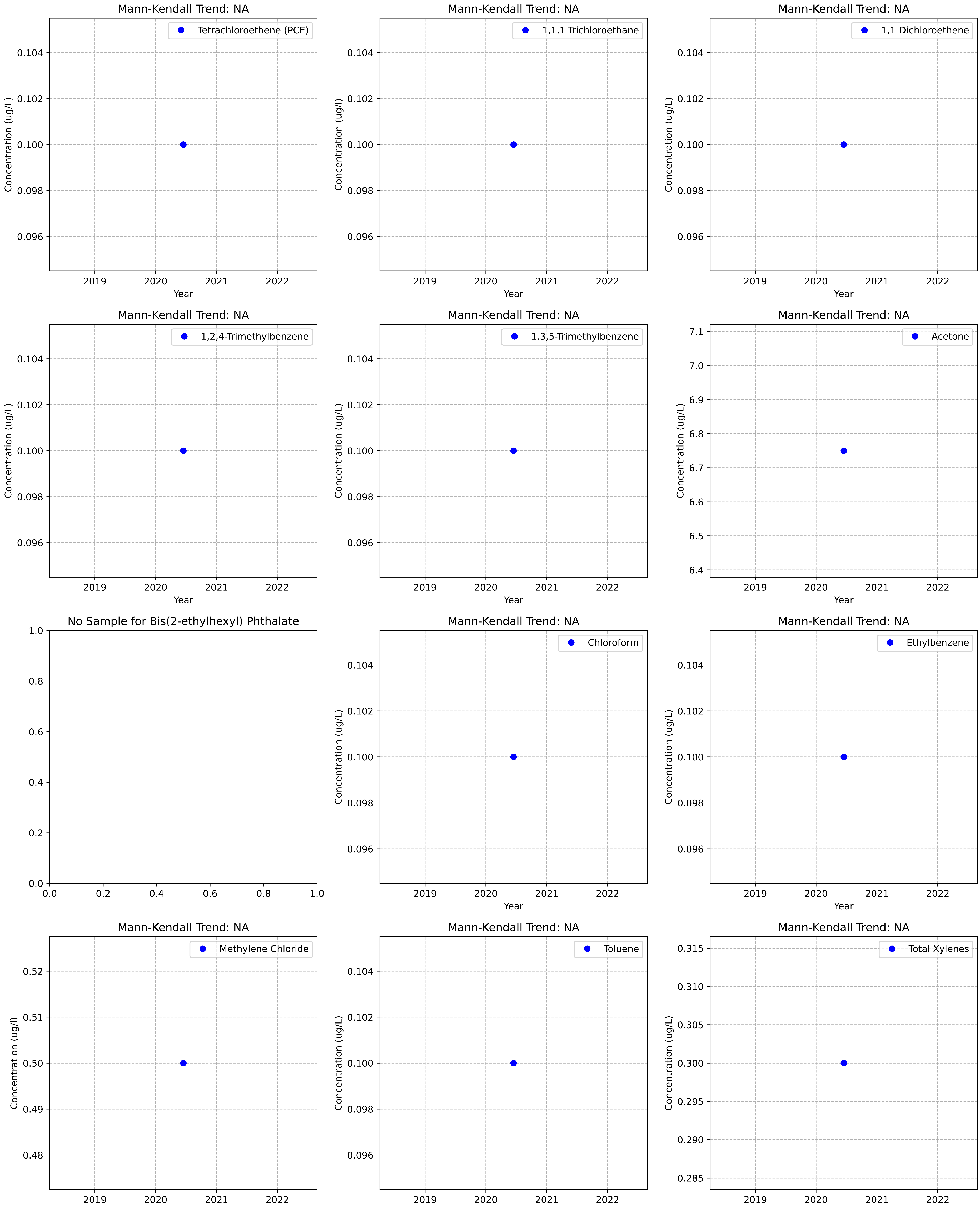
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Linear Fit (R²=0.29)
Exponential Fit (R²=0.16)
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.27)
Exponential Fit (R²=0.31)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.24)
Exponential Fit (R²=0.16)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.36)
Exponential Fit (R²=0.17)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Acetone
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.31)
Exponential Fit (R²=0.42)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Ethylbenzene
Linear Fit (R²=0.12)
Exponential Fit (R²=0.11)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.35)
Exponential Fit (R²=0.62)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.25)
Exponential Fit (R²=0.06)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Total Xylenes
Linear Fit (R²=0.11)
Exponential Fit (R²=0.10)
Concentration (ug/L)
Year

MW-95p1



Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.82)
Exponential Fit (R²=0.93)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.71)
Exponential Fit (R²=0.70)
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.70)
Exponential Fit (R²=0.65)
Mann-Kendall Trend: Stable
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.71)
Exponential Fit (R²=0.70)
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.61)
Exponential Fit (R²=0.20)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.52)
Exponential Fit (R²=0.18)
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

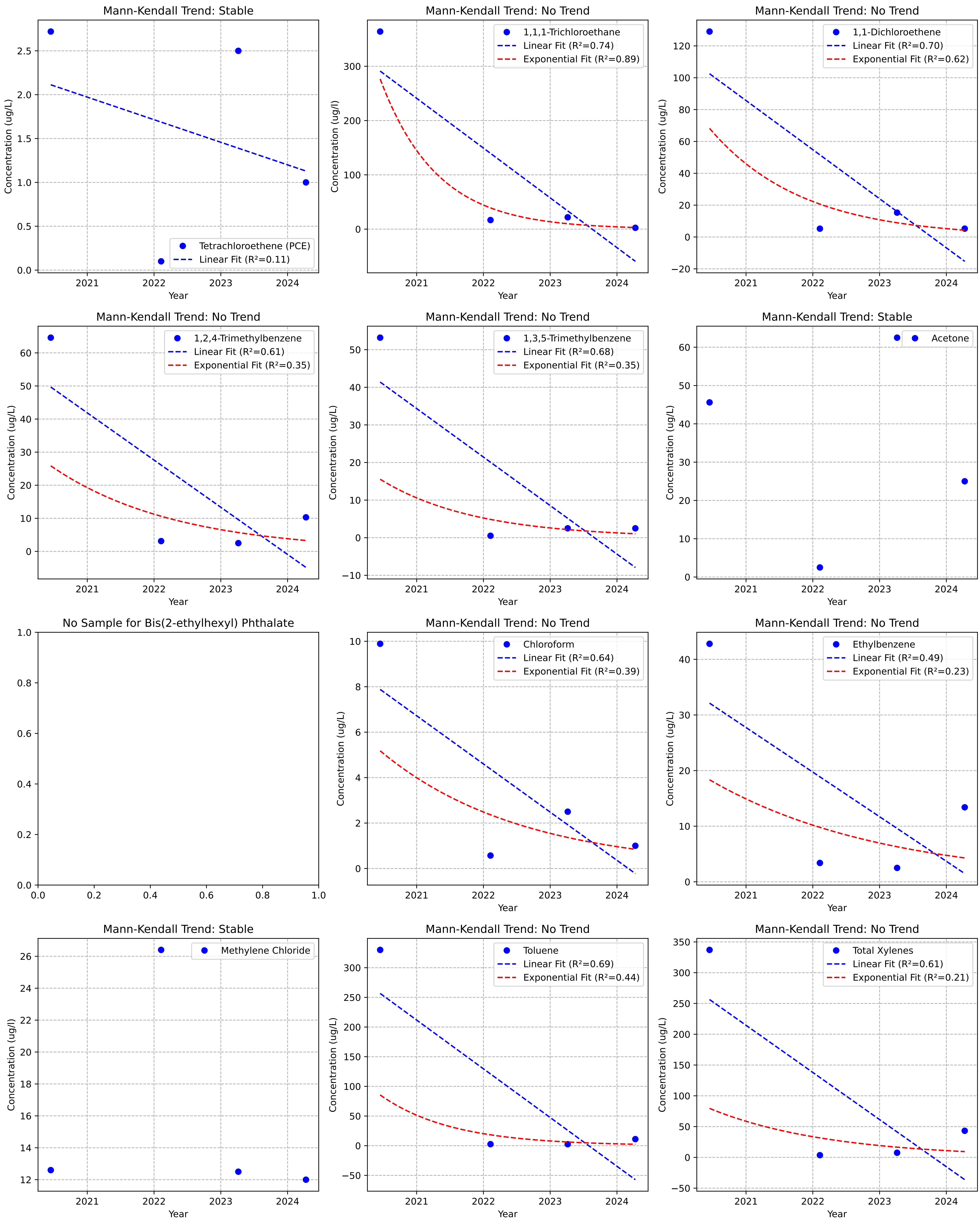
MW-98p1



Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
1,1-Dichloroethene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Acetone
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Ethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
Toluene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Year

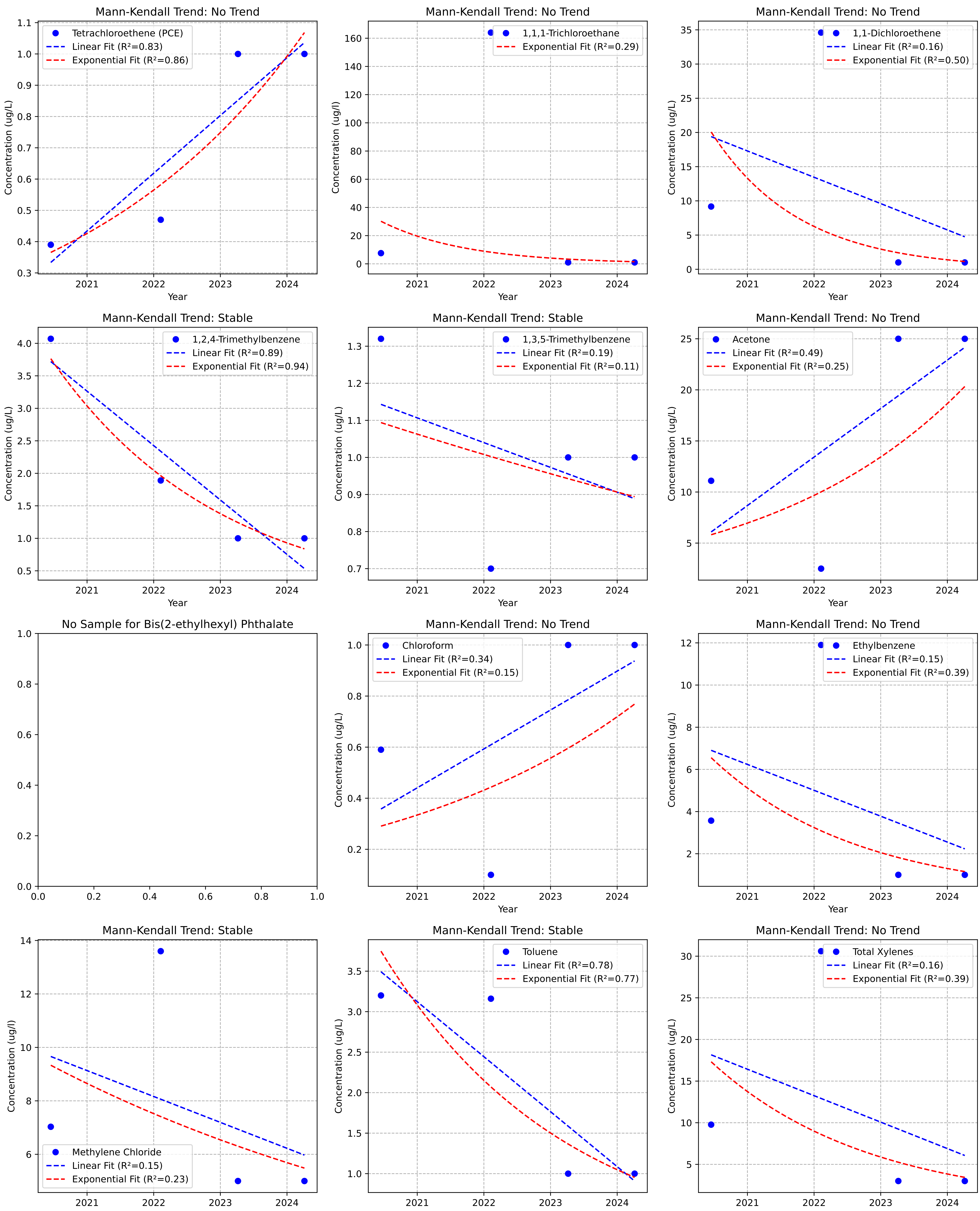
D2. Concentration time series plots of additional parameters for P2 Zone wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

MW-101p2



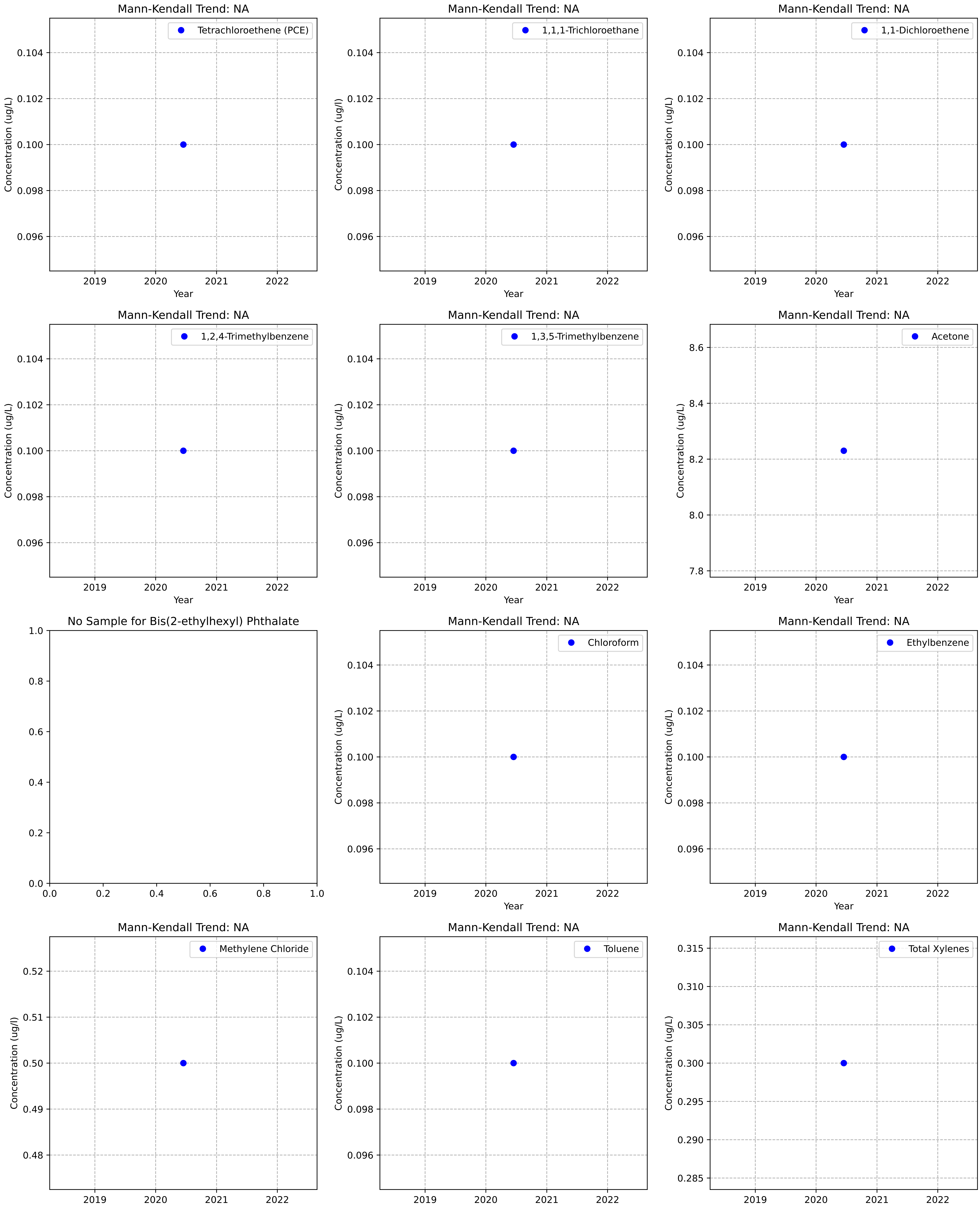
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.11)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.74)
Exponential Fit (R²=0.89)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.70)
Exponential Fit (R²=0.62)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.61)
Exponential Fit (R²=0.35)
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.68)
Exponential Fit (R²=0.35)
Mann-Kendall Trend: Stable
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.64)
Exponential Fit (R²=0.39)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.49)
Exponential Fit (R²=0.23)
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.69)
Exponential Fit (R²=0.44)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.61)
Exponential Fit (R²=0.21)
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

MW-107p2

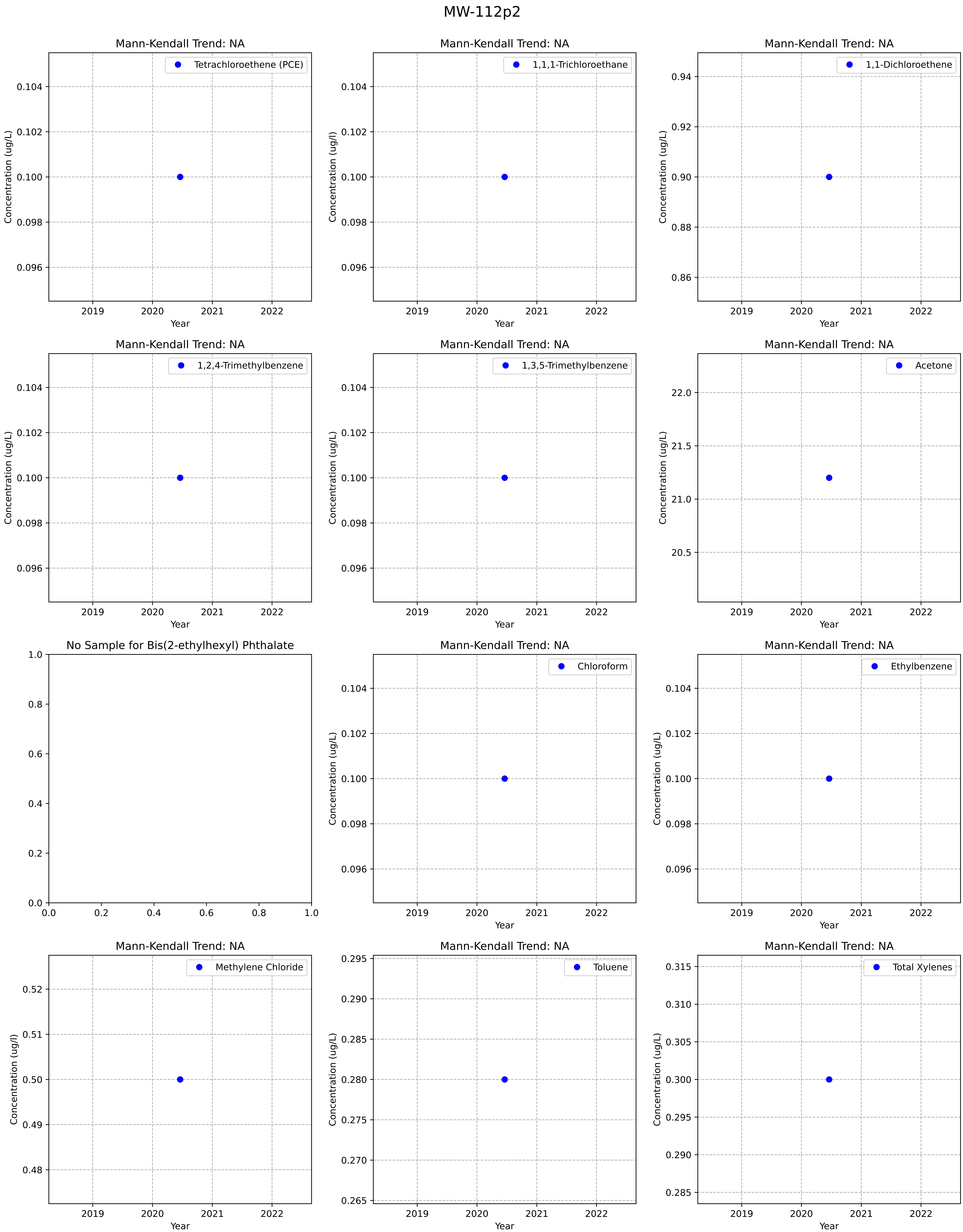


Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.83)
Exponential Fit (R²=0.86)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Exponential Fit (R²=0.29)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.16)
Exponential Fit (R²=0.50)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.89)
Exponential Fit (R²=0.94)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.19)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.49)
Exponential Fit (R²=0.25)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.34)
Exponential Fit (R²=0.15)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.15)
Exponential Fit (R²=0.39)
Mann-Kendall Trend: Stable
Methylene Chloride
Linear Fit (R²=0.15)
Exponential Fit (R²=0.23)
Mann-Kendall Trend: Stable
Toluene
Linear Fit (R²=0.78)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.16)
Exponential Fit (R²=0.39)
Concentration (ug/L)
Concentration (ug/l)
Year

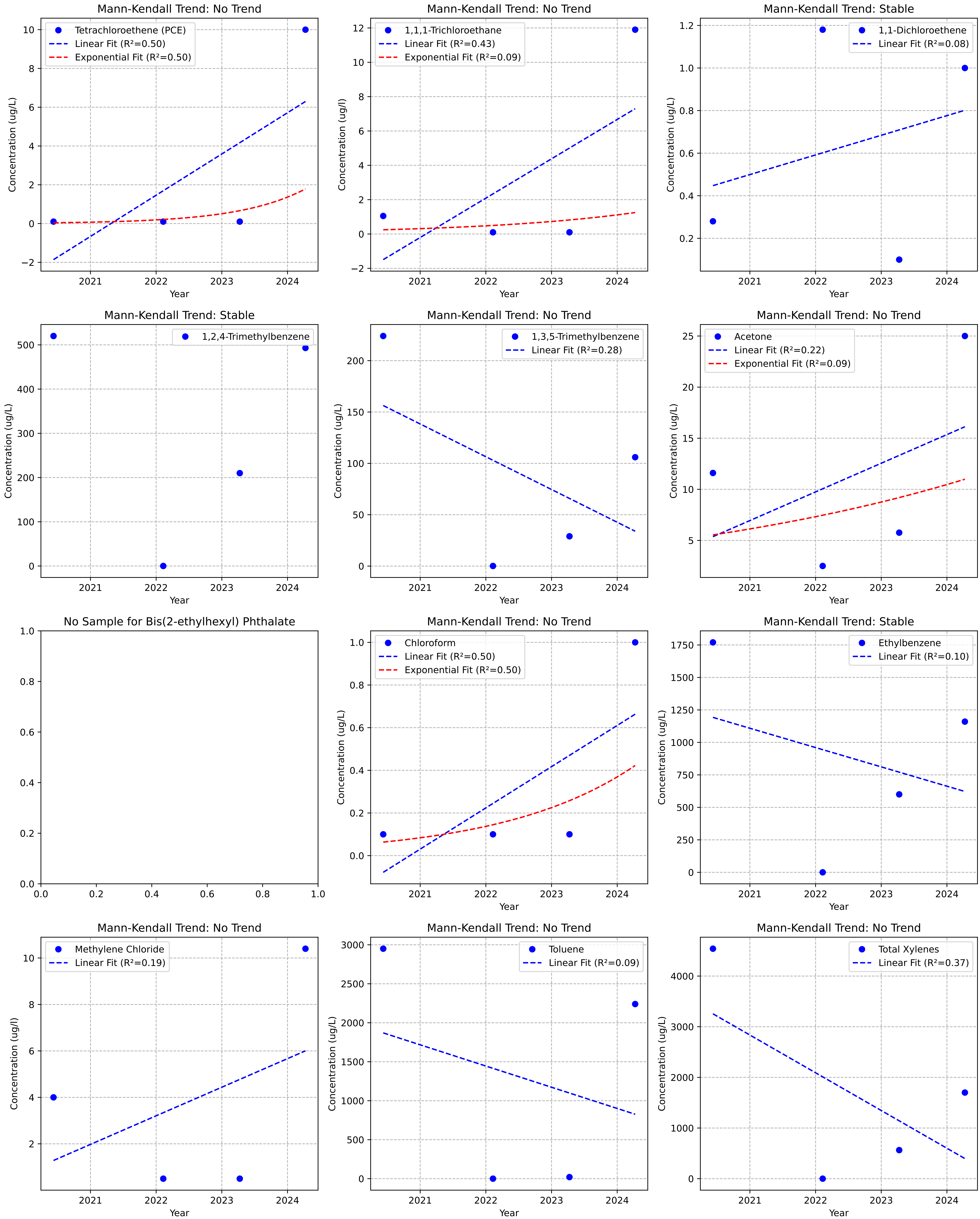
MW-108p2



Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022
0.096
0.098
0.100
0.102
0.104
7.8
8.0
8.2
8.4
8.6
0.0
0.2
0.4
0.6
0.8
1.0
0.48
0.49
0.50
0.51
0.52
0.285
0.290
0.295
0.300
0.305
0.310
0.315

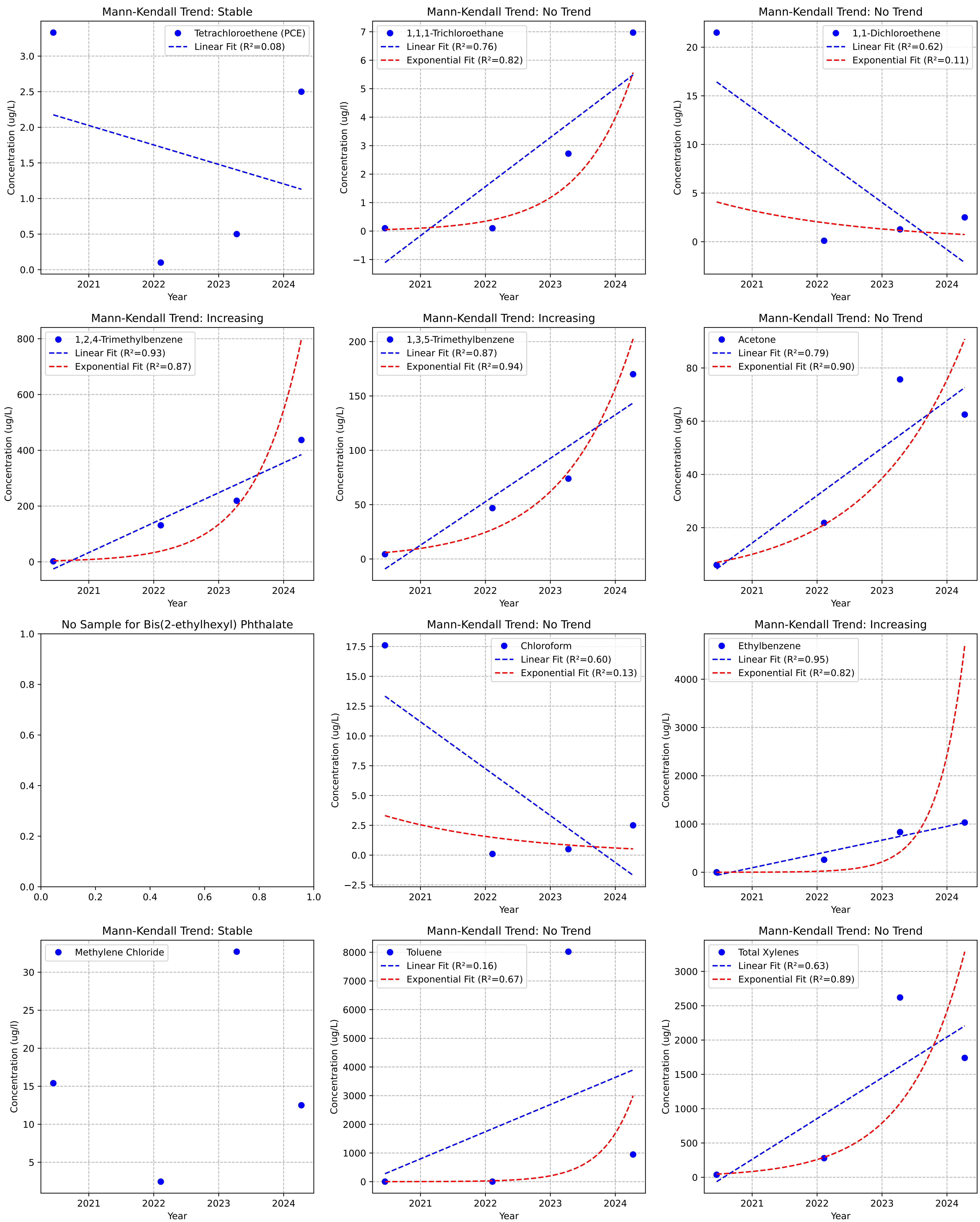

MW-112p2
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

MW-113p2



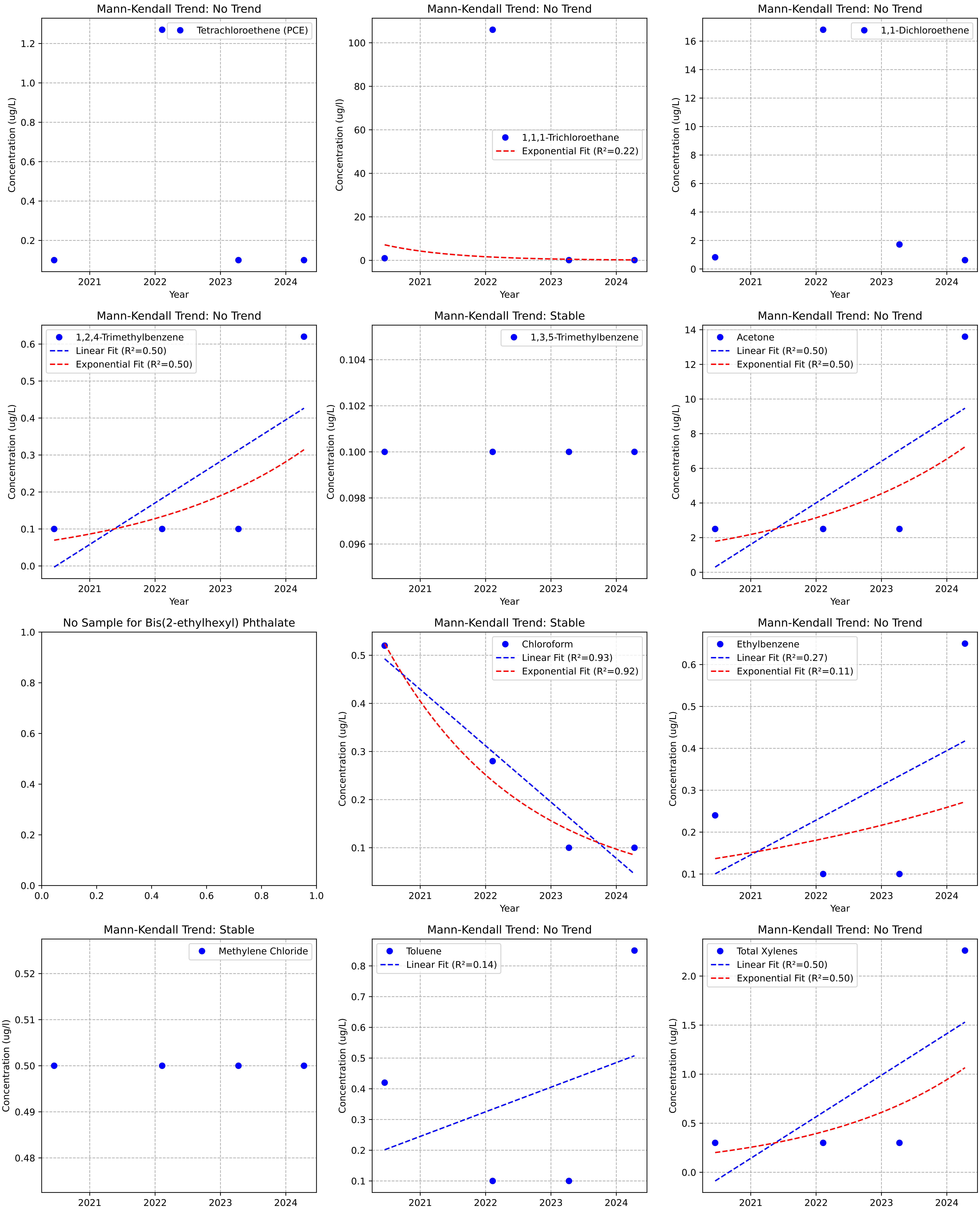
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.50)
Exponential Fit (R²=0.50)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.43)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.08)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.28)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.22)
Exponential Fit (R²=0.09)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.50)
Exponential Fit (R²=0.50)
Mann-Kendall Trend: Stable
Ethylbenzene
Linear Fit (R²=0.10)
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.19)
Concentration (ug/l)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.09)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.37)

MW-114p2

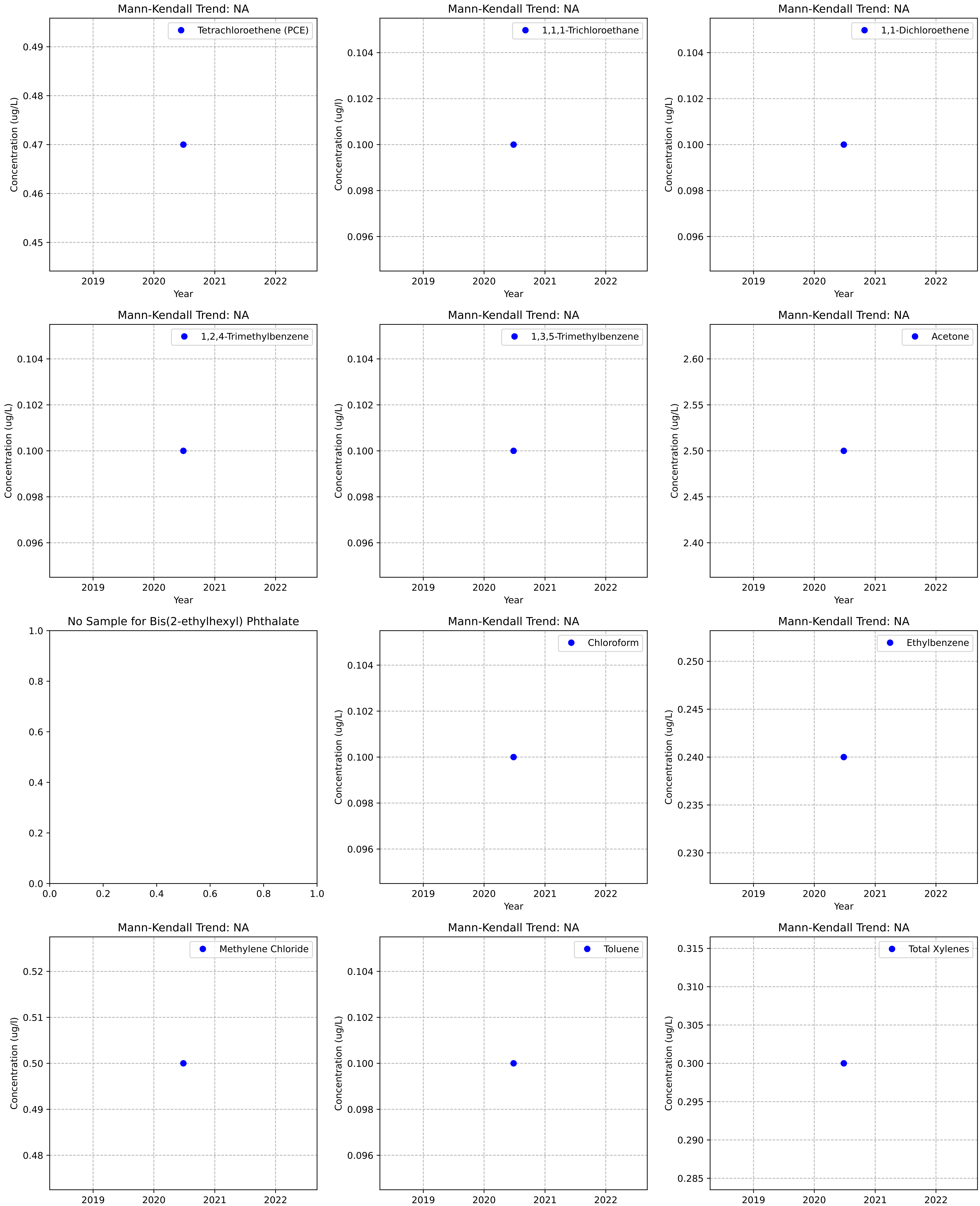


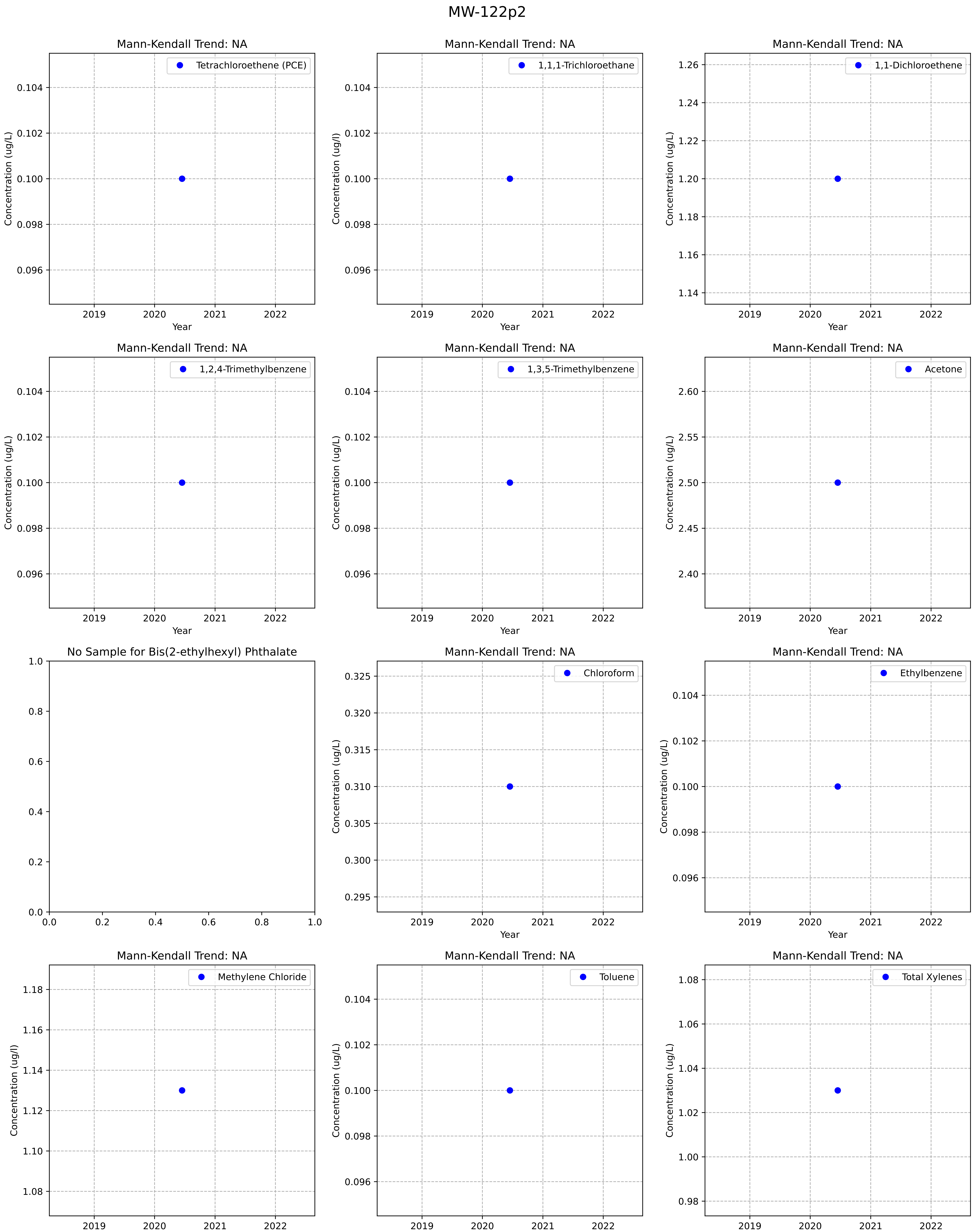
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.08)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.76)
Exponential Fit (R²=0.82)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.62)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Increasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.93)
Exponential Fit (R²=0.87)
Mann-Kendall Trend: Increasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.94)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.79)
Exponential Fit (R²=0.90)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.60)
Exponential Fit (R²=0.13)
Mann-Kendall Trend: Increasing
Ethylbenzene
Linear Fit (R²=0.95)
Exponential Fit (R²=0.82)
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.16)
Exponential Fit (R²=0.67)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.63)
Exponential Fit (R²=0.89)
Concentration (ug/L)
Year

MW-115p2


Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Exponential Fit (R²=0.22)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.50)
Exponential Fit (R²=0.50)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.50)
Exponential Fit (R²=0.50)
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.93)
Exponential Fit (R²=0.92)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.27)
Exponential Fit (R²=0.11)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.14)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.50)
Exponential Fit (R²=0.50)
Concentration (ug/L)
Year

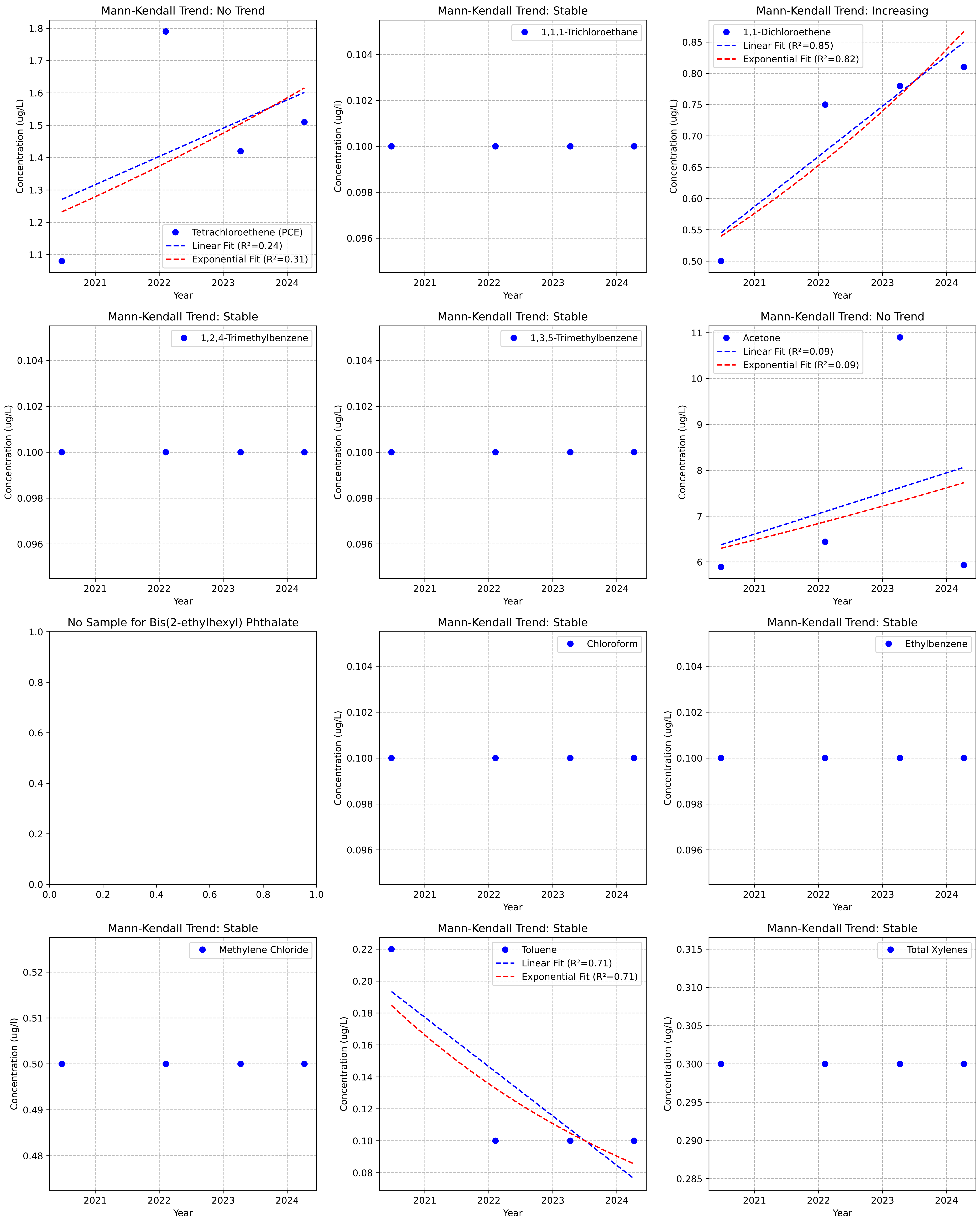
MW-118p2


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Concentration (ug/L)
0.45
0.46
0.47
0.48
0.49
2019
2020
2021
2022
Year
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Concentration (ug/l)
0.096
0.098
0.100
0.102
0.104
Mann-Kendall Trend: NA
1,1-Dichloroethene
Concentration (ug/L)
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Concentration (ug/L)
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Concentration (ug/L)
Mann-Kendall Trend: NA
Acetone
Concentration (ug/L)
2.40
2.45
2.50
2.55
2.60
No Sample for Bis(2-ethylhexyl) Phthalate
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Chloroform
Concentration (ug/L)
Mann-Kendall Trend: NA
Ethylbenzene
Concentration (ug/L)
0.230
0.235
0.240
0.245
0.250
Mann-Kendall Trend: NA
Methylene Chloride
Concentration (ug/l)
0.48
0.49
0.50
0.51
0.52
Mann-Kendall Trend: NA
Toluene
Concentration (ug/L)
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
0.285
0.290
0.295
0.300
0.305
0.310
0.315



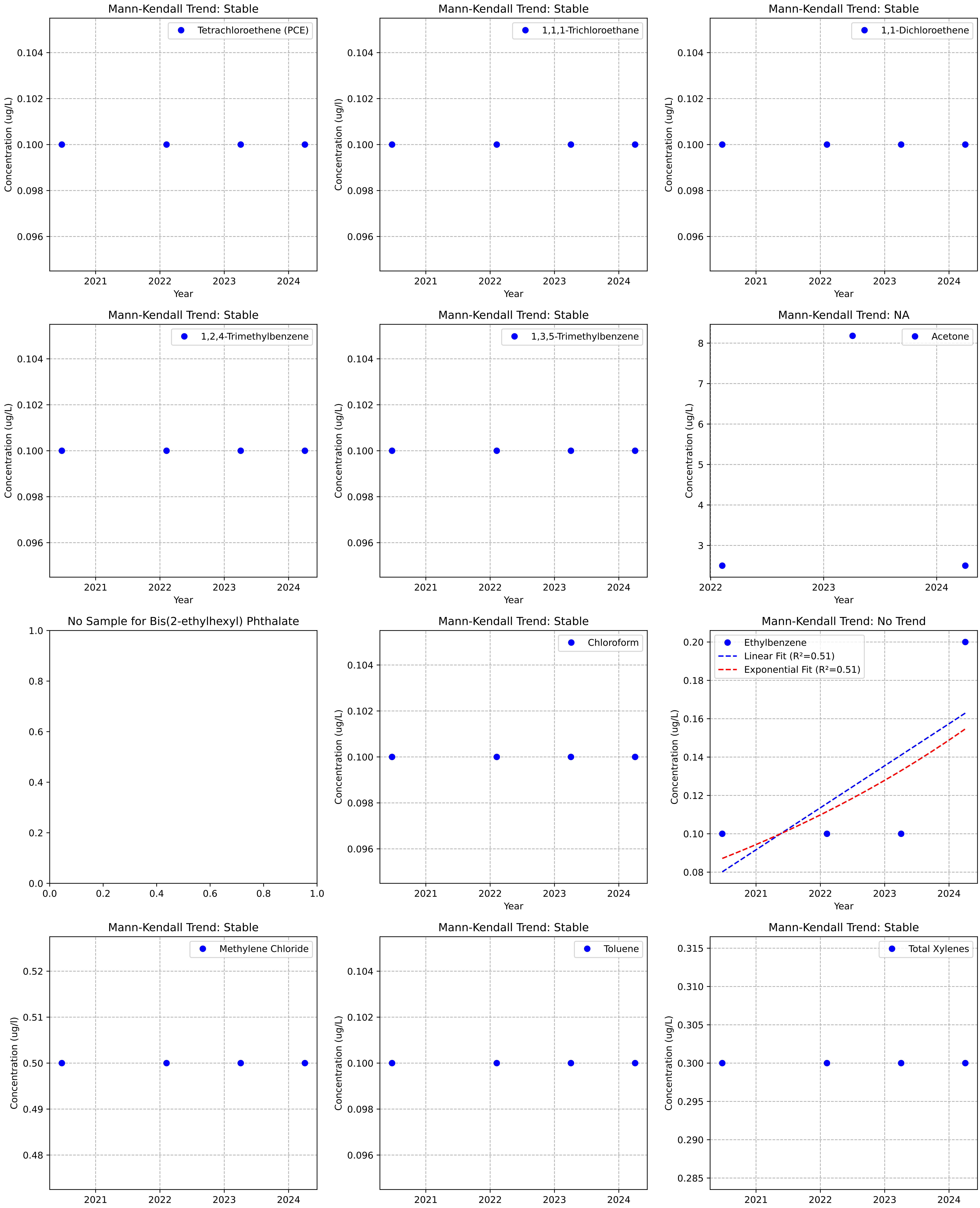
MW-122p2
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Year

MW-124p2

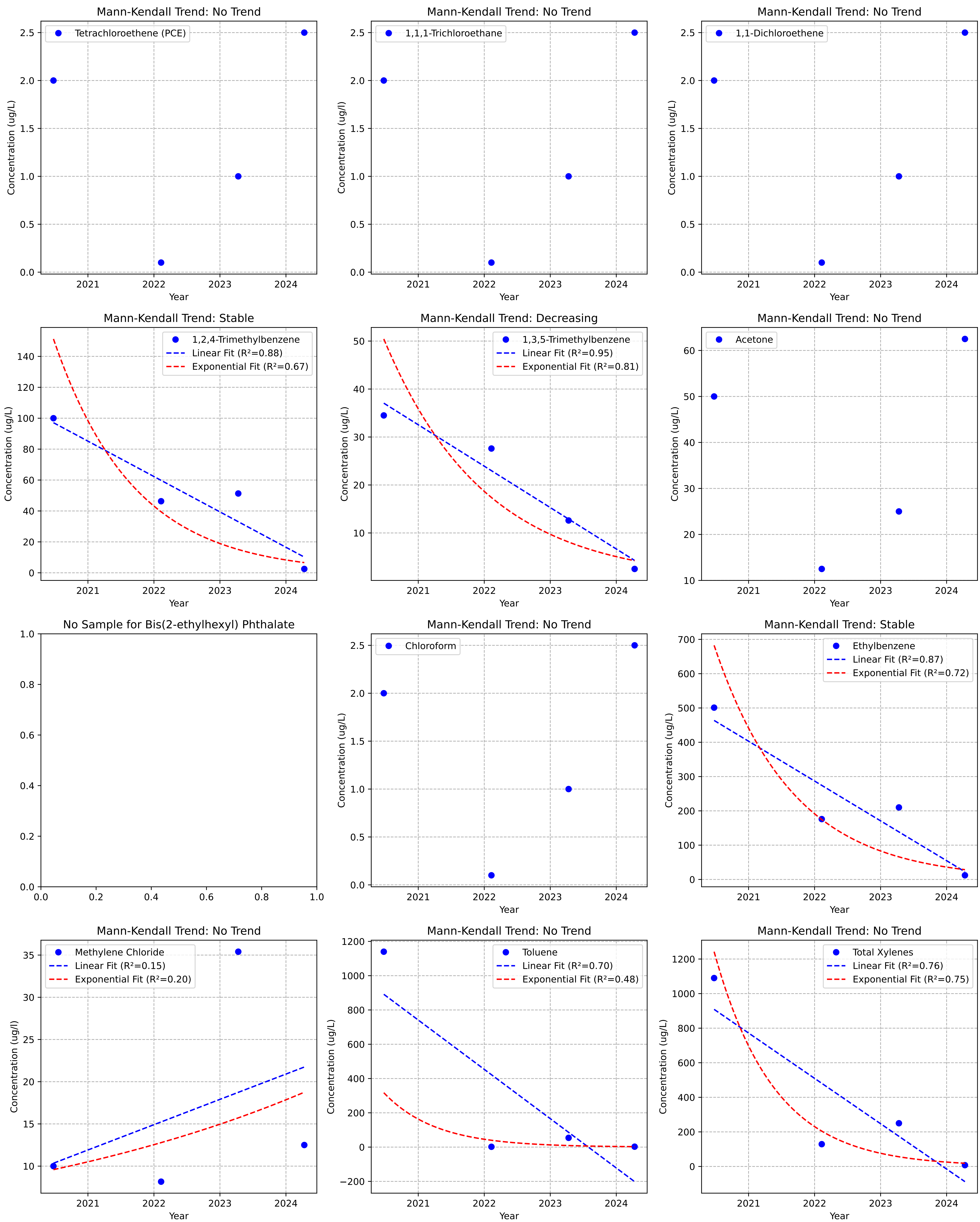


Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.24)
Exponential Fit (R²=0.31)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Increasing
1,1-Dichloroethene
Linear Fit (R²=0.85)
Exponential Fit (R²=0.82)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-125p2

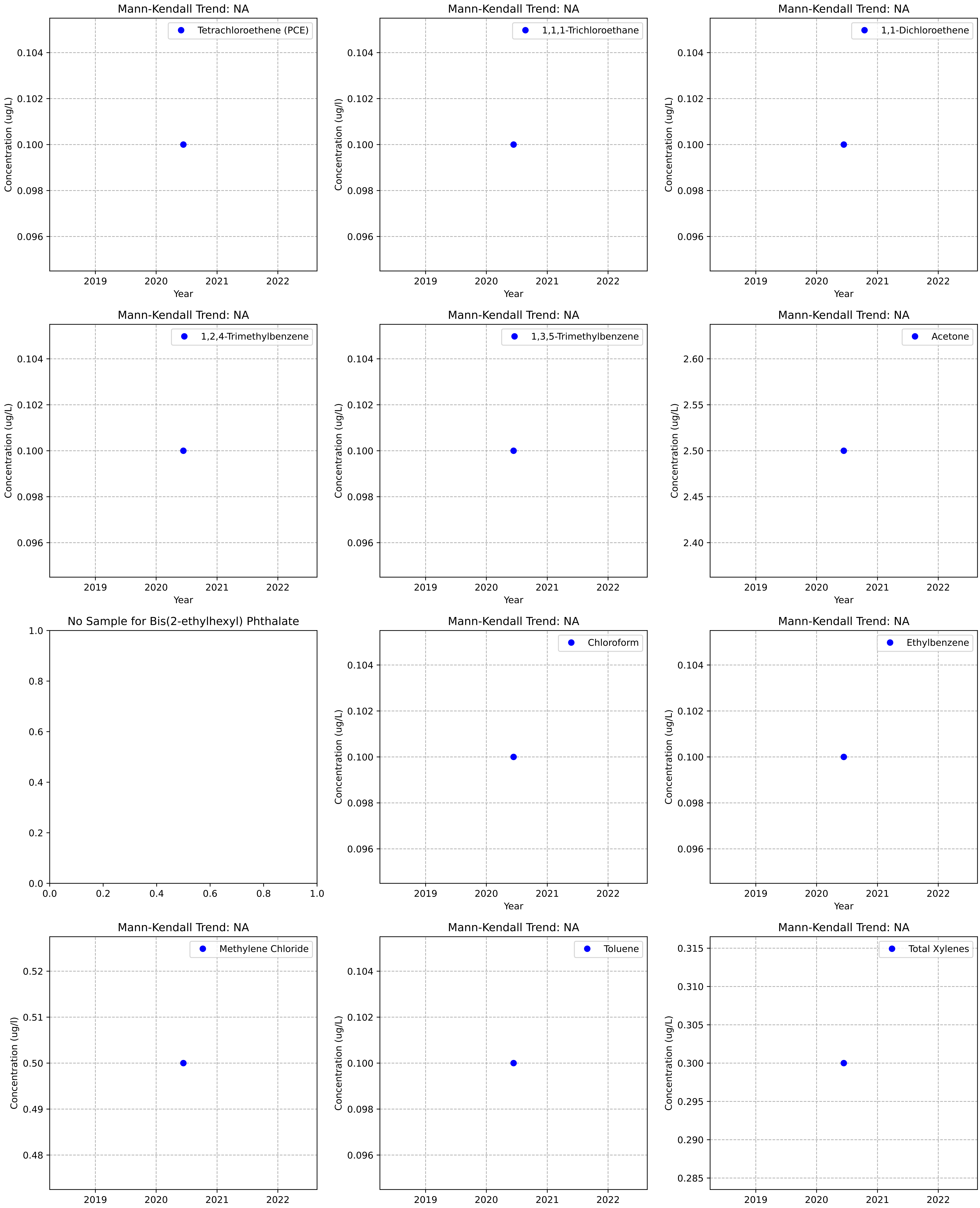

Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-126p2



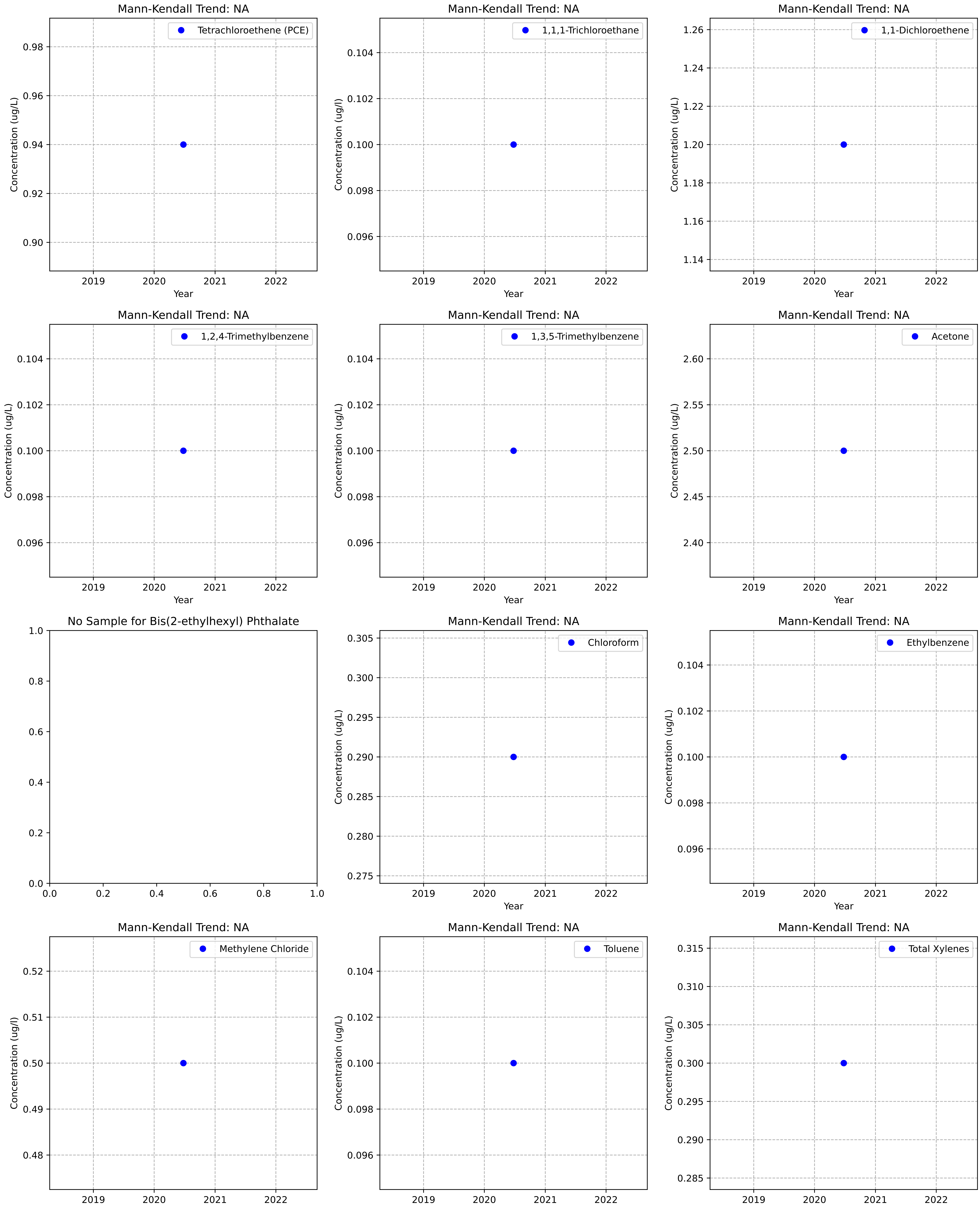
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.88)
Exponential Fit (R²=0.67)
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.95)
Exponential Fit (R²=0.81)
Mann-Kendall Trend: No Trend
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Linear Fit (R²=0.87)
Exponential Fit (R²=0.72)
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.15)
Exponential Fit (R²=0.20)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.70)
Exponential Fit (R²=0.48)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.76)
Exponential Fit (R²=0.75)
Concentration (ug/L)
Concentration (ug/l)
Year

MW-131p2

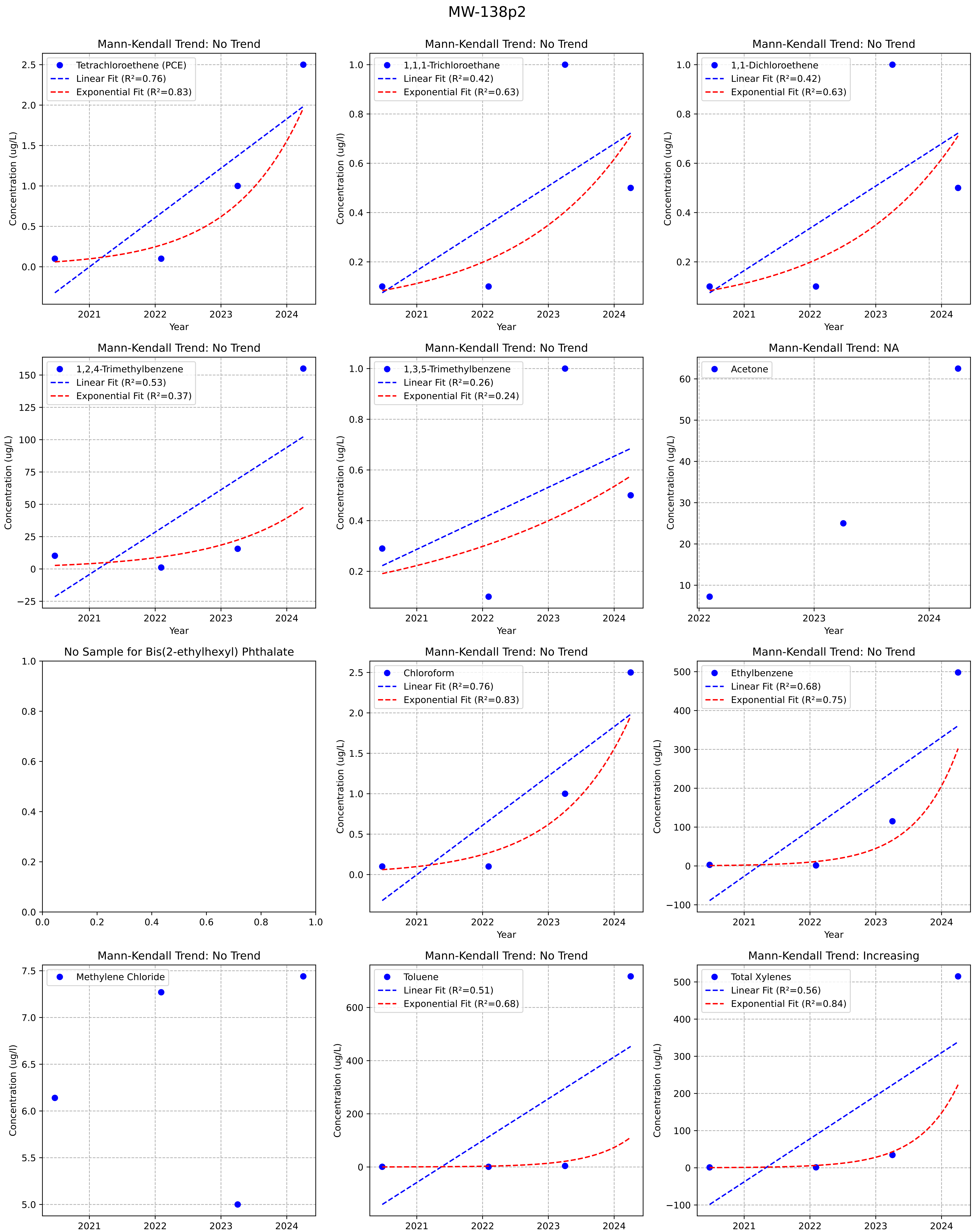


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

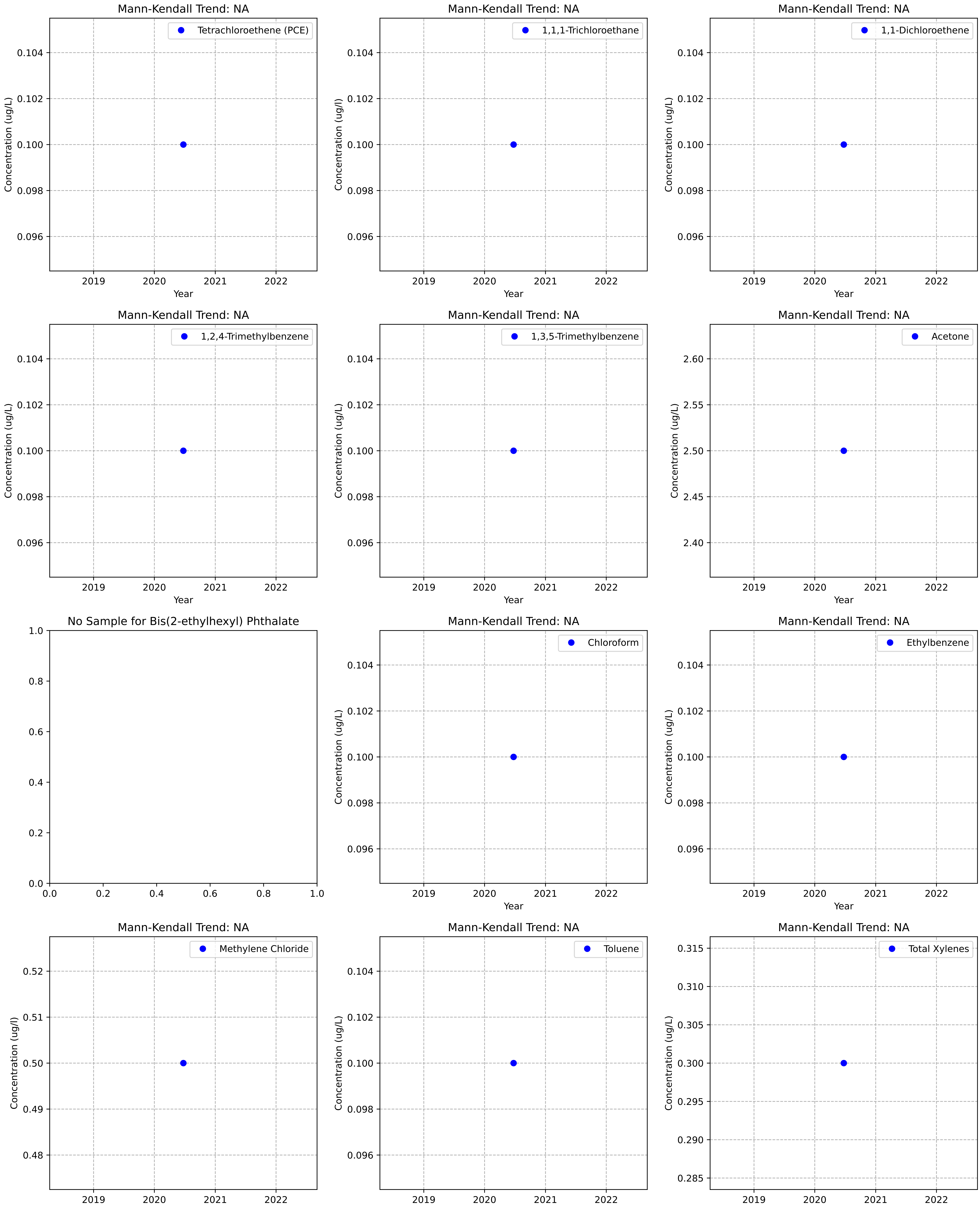
MW-136p2



Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Concentration (ug/L)
0.90
0.92
0.94
0.96
0.98
Year
2019
2020
2021
2022
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Concentration (ug/l)
0.096
0.098
0.100
0.102
0.104
Mann-Kendall Trend: NA
1,1-Dichloroethene
Concentration (ug/L)
1.14
1.16
1.18
1.20
1.22
1.24
1.26
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
2.40
2.45
2.50
2.55
2.60
No Sample for Bis(2-ethylhexyl) Phthalate
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Chloroform
0.275
0.280
0.285
0.290
0.295
0.300
0.305
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
0.48
0.49
0.50
0.51
0.52
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
0.285
0.290
0.295
0.300
0.305
0.310
0.315

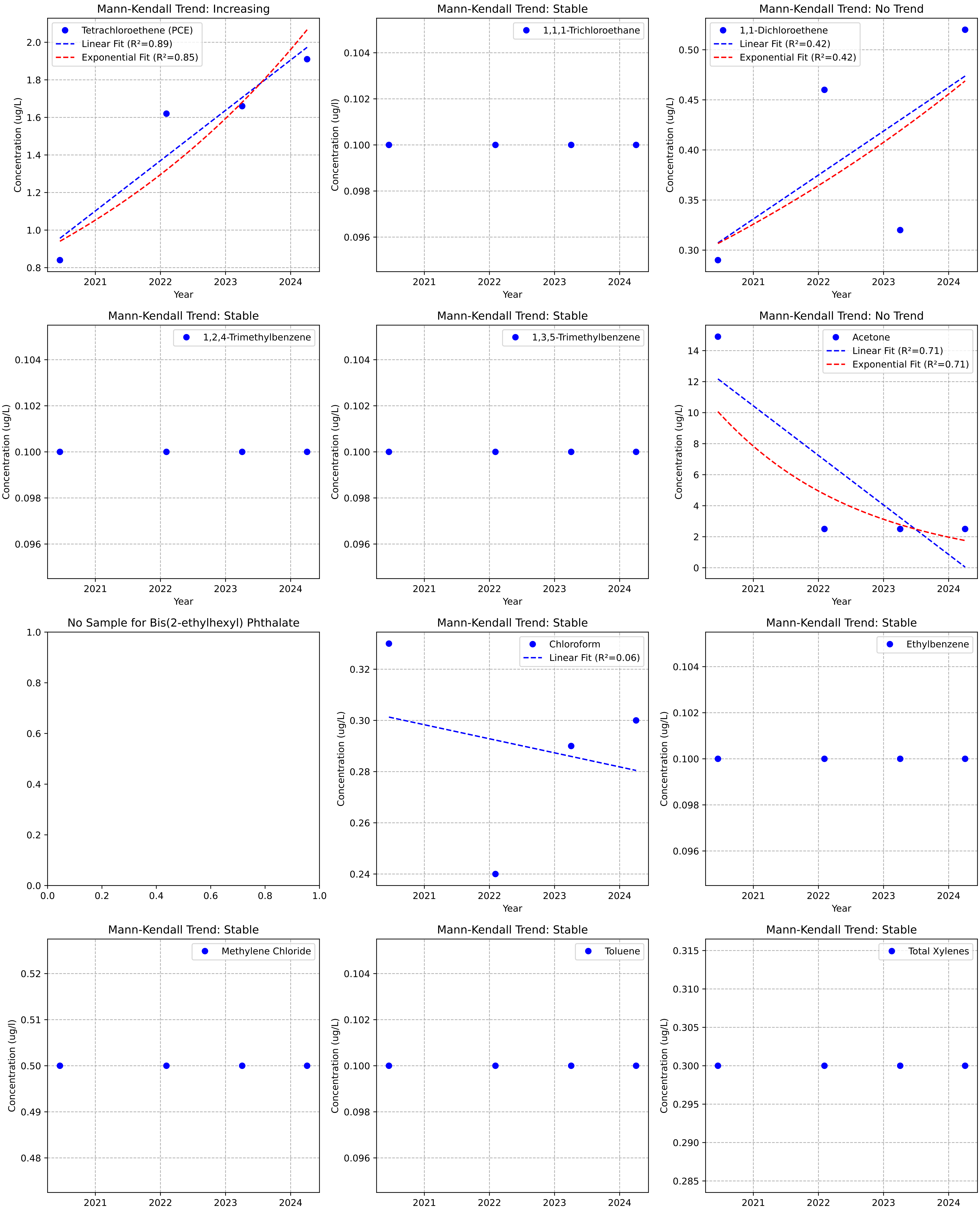

MW-138p2
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.76)
Exponential Fit (R²=0.83)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.42)
Exponential Fit (R²=0.63)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.42)
Exponential Fit (R²=0.63)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.53)
Exponential Fit (R²=0.37)
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.26)
Exponential Fit (R²=0.24)
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.76)
Exponential Fit (R²=0.83)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.68)
Exponential Fit (R²=0.75)
Mann-Kendall Trend: No Trend
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.68)
Mann-Kendall Trend: Increasing
Total Xylenes
Linear Fit (R²=0.56)
Exponential Fit (R²=0.84)
Concentration (ug/L)
Year

MW-141p2



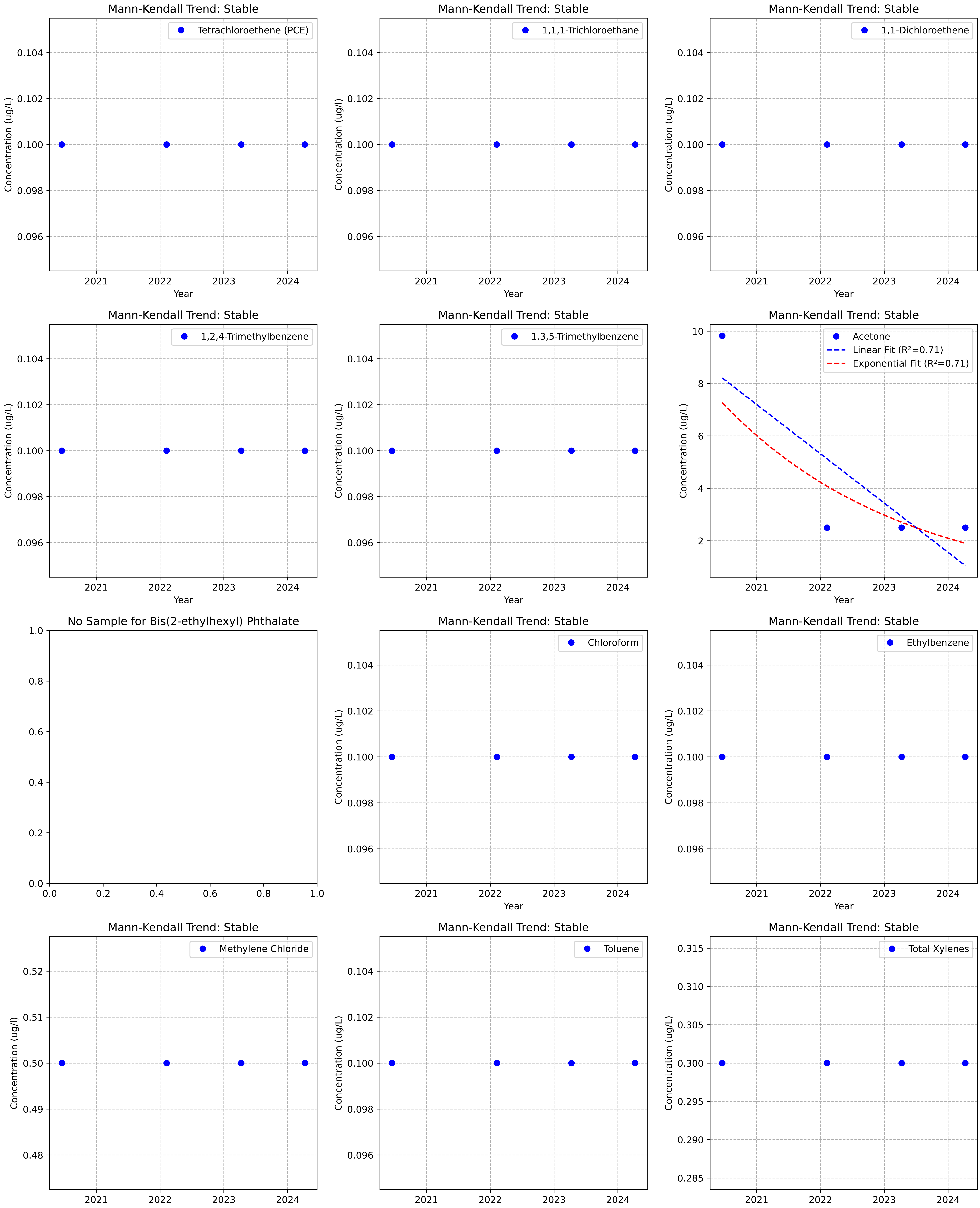
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-143p2

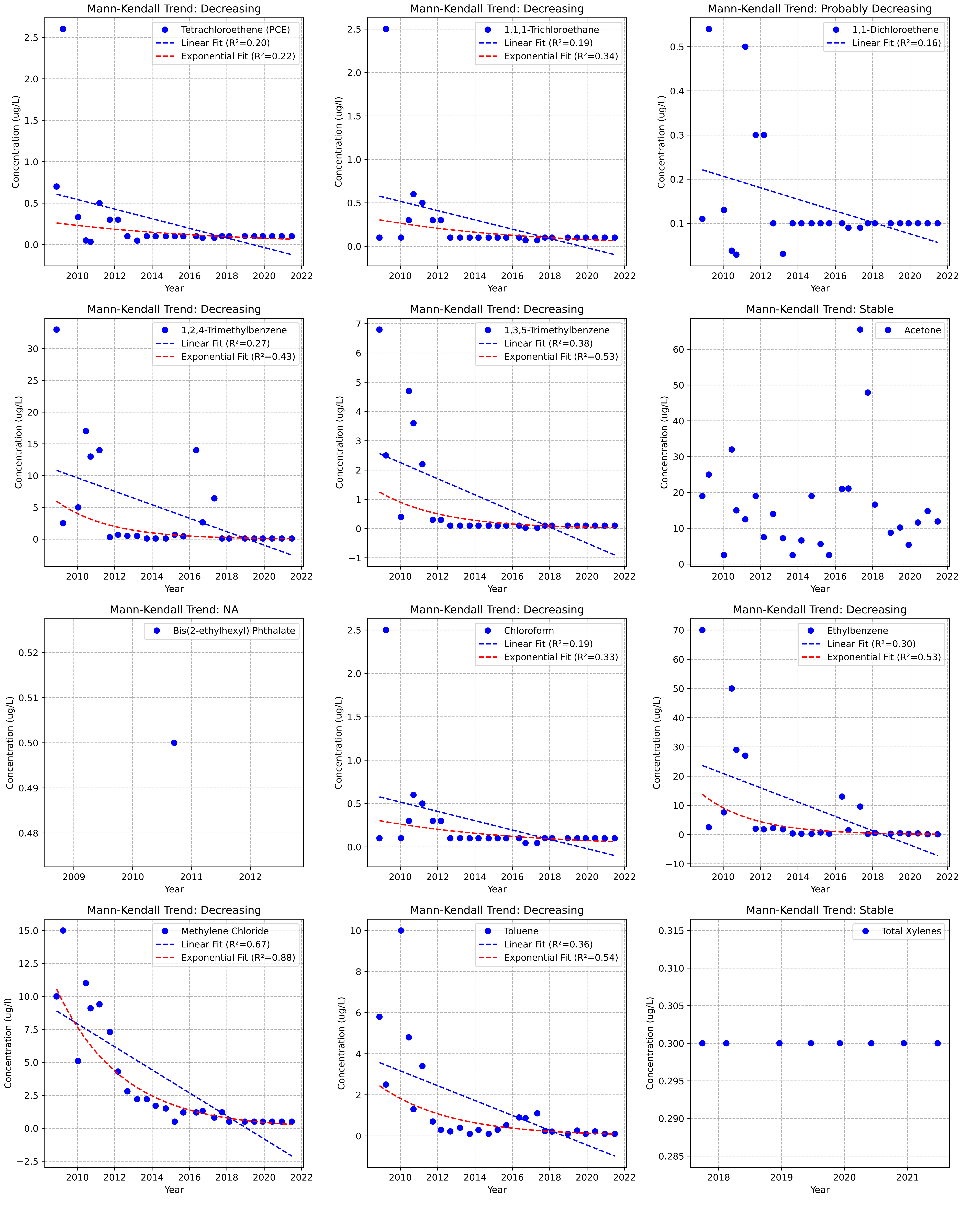


Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.89)
Exponential Fit (R²=0.85)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.42)
Exponential Fit (R²=0.42)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.06)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Ethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
Toluene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

MW-147p2

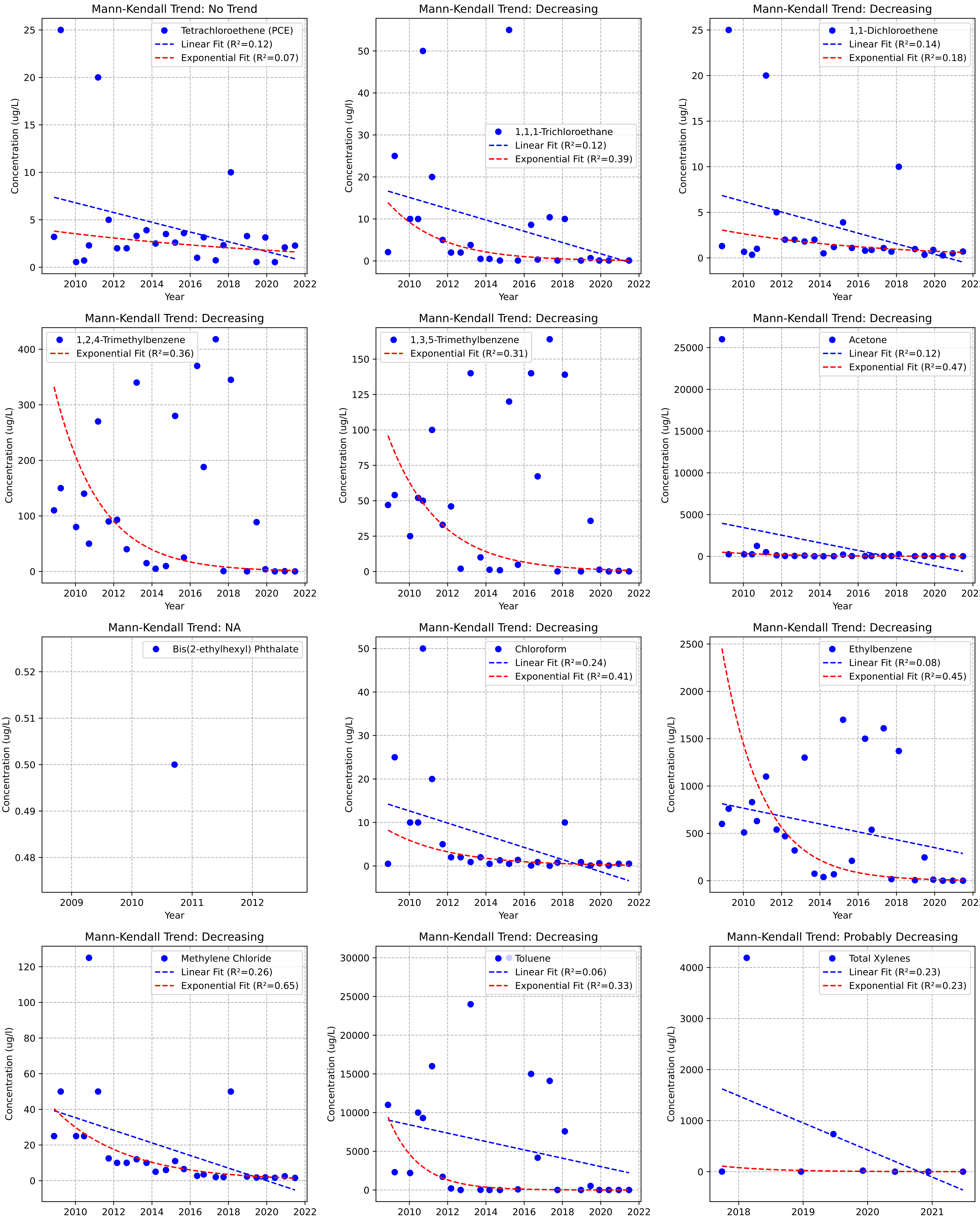

Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Acetone
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Ethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
Toluene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

MW-33p2



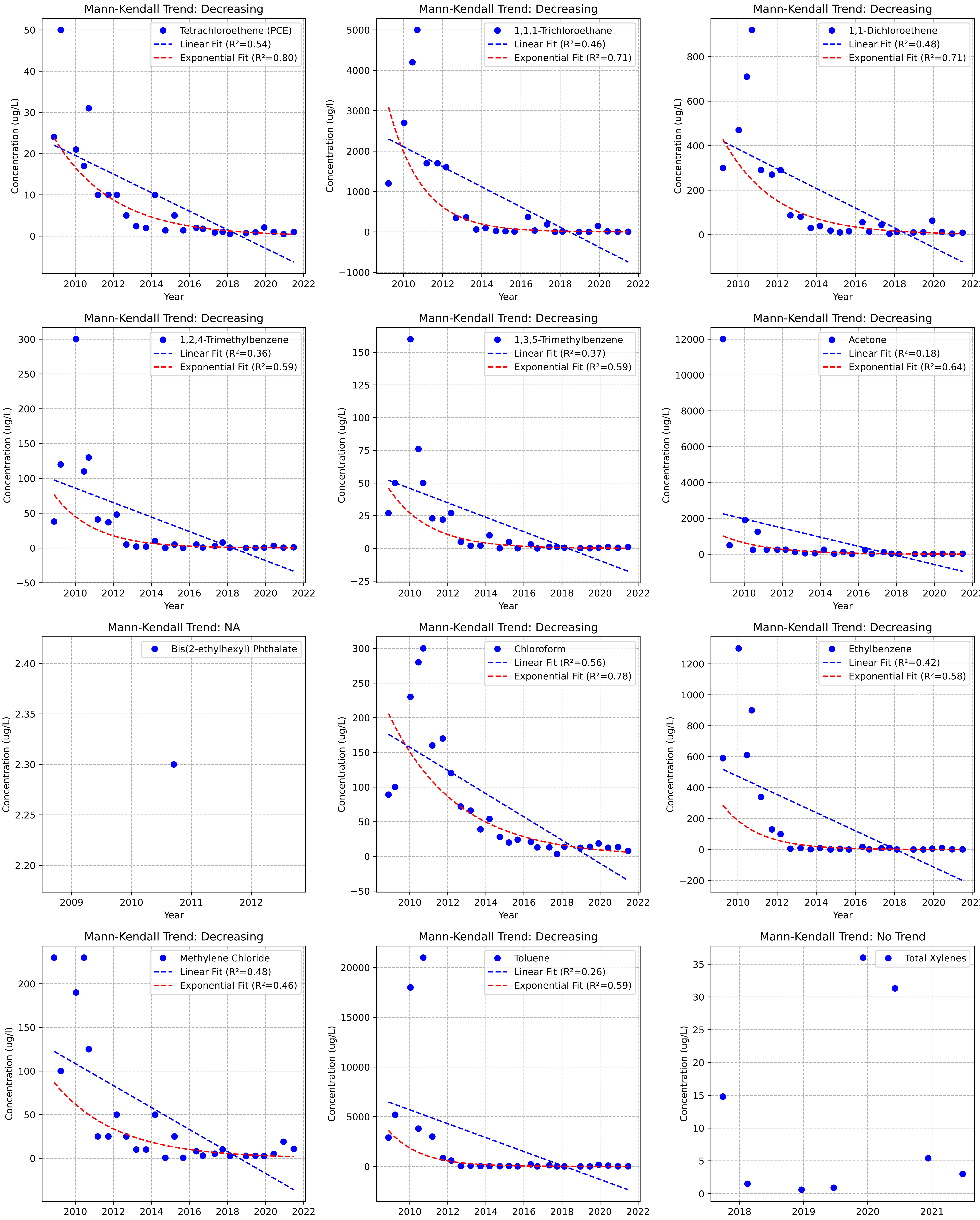
Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.20)
Exponential Fit (R²=0.22)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.19)
Exponential Fit (R²=0.34)
Concentration (ug/l)
Year
Mann-Kendall Trend: Probably Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.16)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.27)
Exponential Fit (R²=0.43)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.38)
Exponential Fit (R²=0.53)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Acetone
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.19)
Exponential Fit (R²=0.33)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.30)
Exponential Fit (R²=0.53)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.67)
Exponential Fit (R²=0.88)
Concentration (ug/l)
Year
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.36)
Exponential Fit (R²=0.54)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

MW-35p2



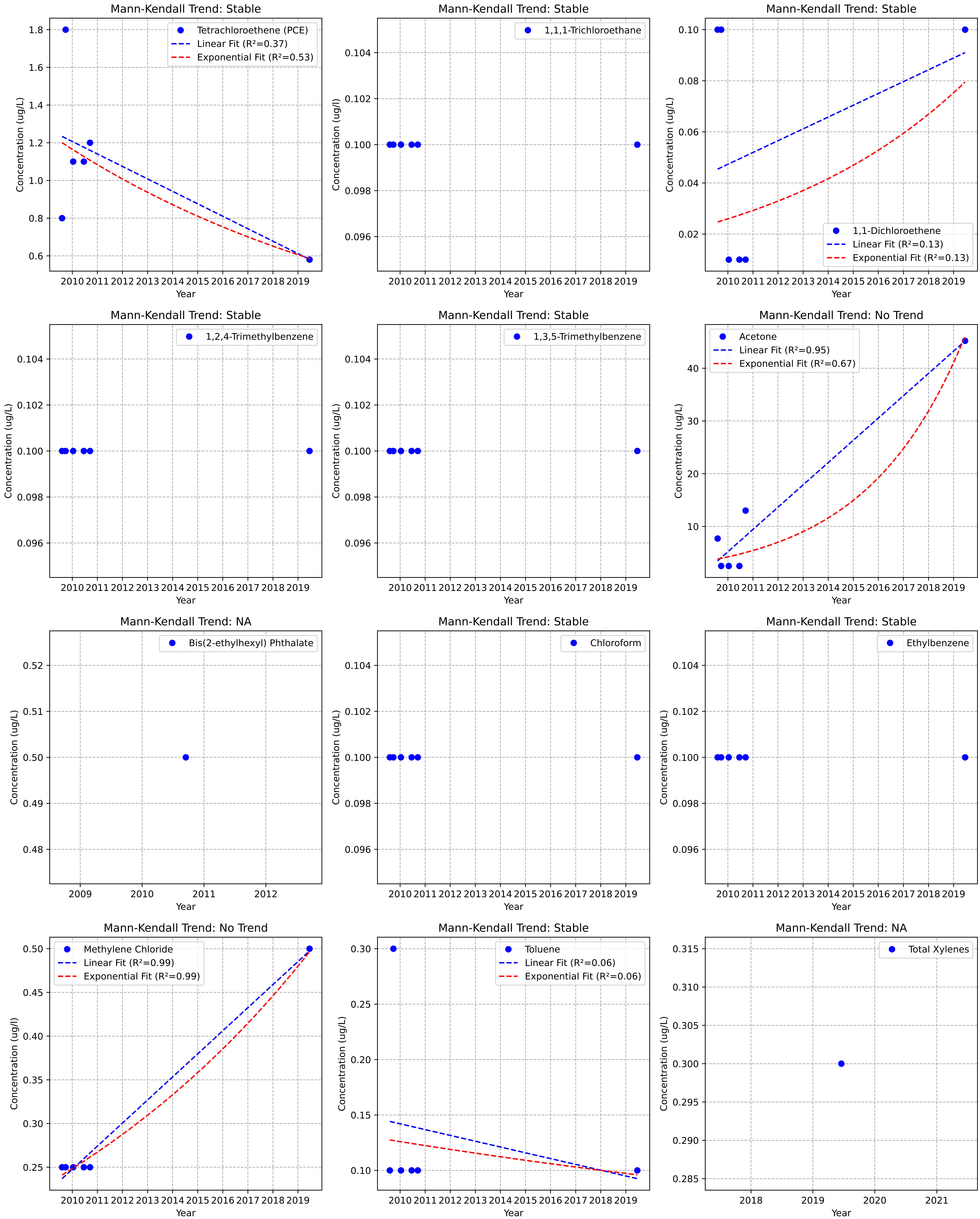
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.12)
Exponential Fit (R²=0.07)
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.12)
Exponential Fit (R²=0.39)
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.14)
Exponential Fit (R²=0.18)
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Exponential Fit (R²=0.36)
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Exponential Fit (R²=0.31)
Mann-Kendall Trend: Decreasing
Acetone
Linear Fit (R²=0.12)
Exponential Fit (R²=0.47)
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.24)
Exponential Fit (R²=0.41)
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.08)
Exponential Fit (R²=0.45)
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.26)
Exponential Fit (R²=0.65)
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.06)
Exponential Fit (R²=0.33)
Mann-Kendall Trend: Probably Decreasing
Total Xylenes
Linear Fit (R²=0.23)
Exponential Fit (R²=0.23)
Concentration (ug/L)
Concentration (ug/l)
Year

MW-38p2



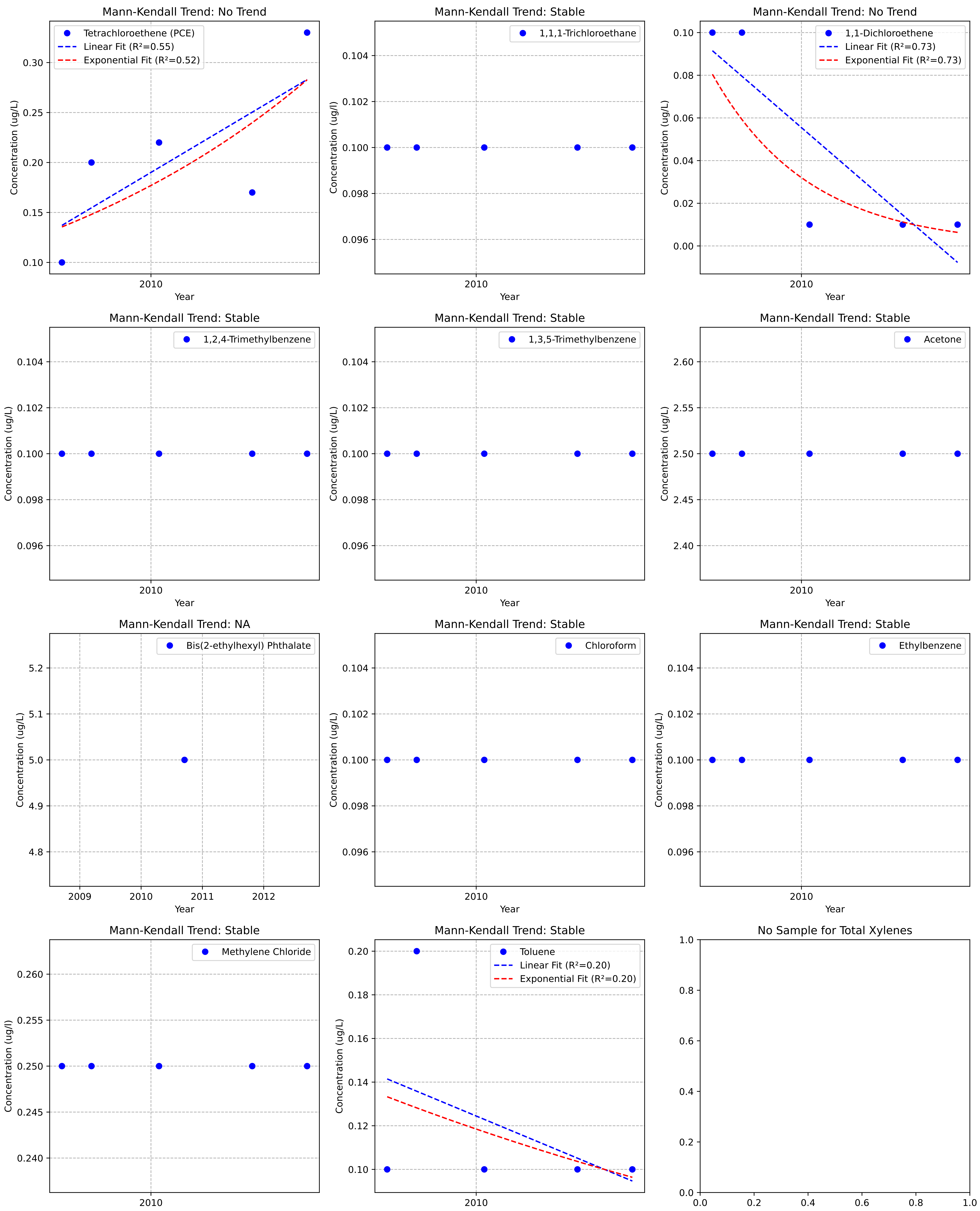
Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.54)
Exponential Fit (R²=0.80)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.46)
Exponential Fit (R²=0.71)
Concentration (ug/l)
Year
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.48)
Exponential Fit (R²=0.71)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.36)
Exponential Fit (R²=0.59)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.37)
Exponential Fit (R²=0.59)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Acetone
Linear Fit (R²=0.18)
Exponential Fit (R²=0.64)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.56)
Exponential Fit (R²=0.78)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.42)
Exponential Fit (R²=0.58)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.48)
Exponential Fit (R²=0.46)
Concentration (ug/l)
Year
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.26)
Exponential Fit (R²=0.59)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Total Xylenes
Concentration (ug/L)
Year

MW-39p2

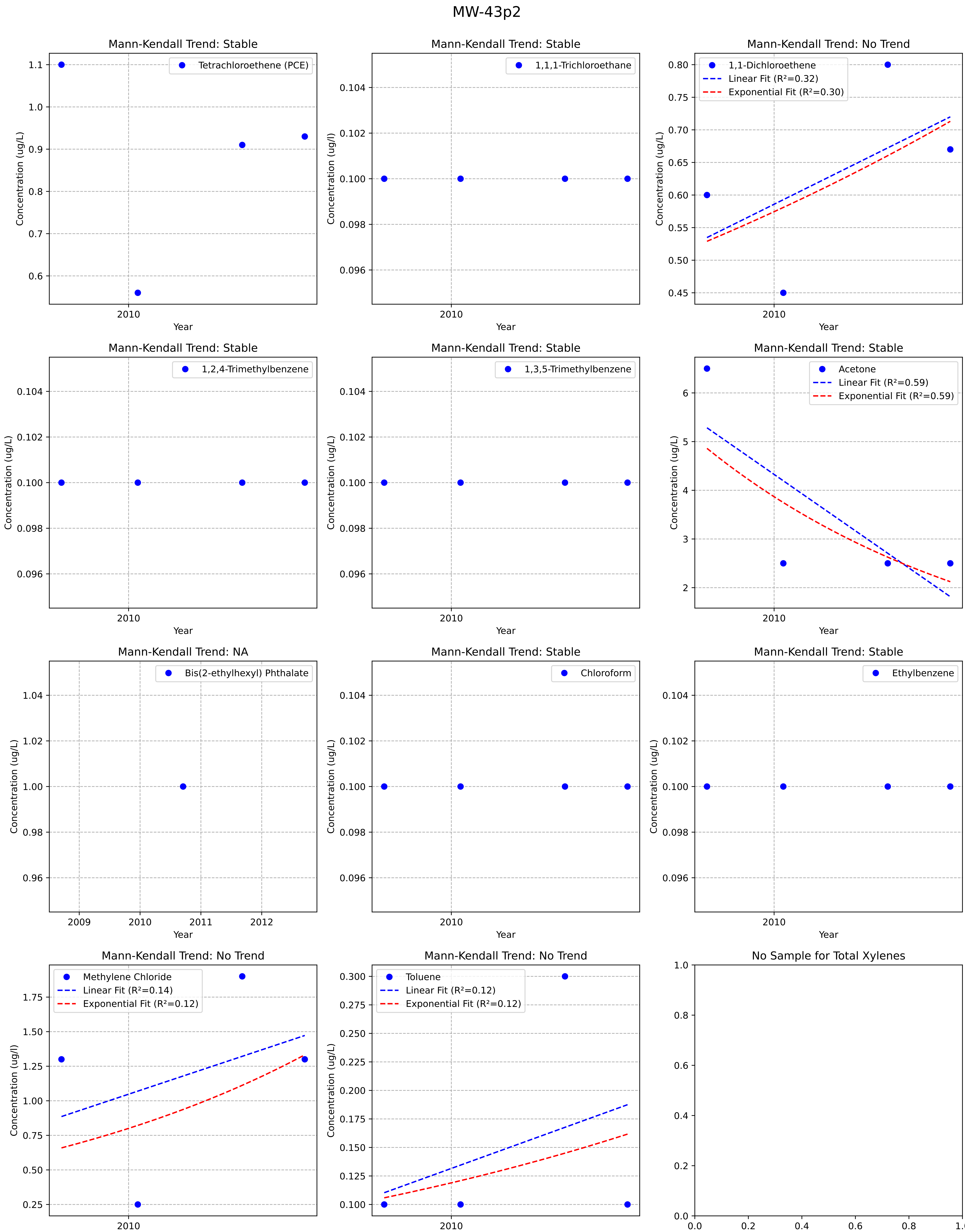


Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.37)
Exponential Fit (R²=0.53)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.13)
Exponential Fit (R²=0.13)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.95)
Exponential Fit (R²=0.67)
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.99)
Exponential Fit (R²=0.99)
Mann-Kendall Trend: Stable
Toluene
Linear Fit (R²=0.06)
Exponential Fit (R²=0.06)
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

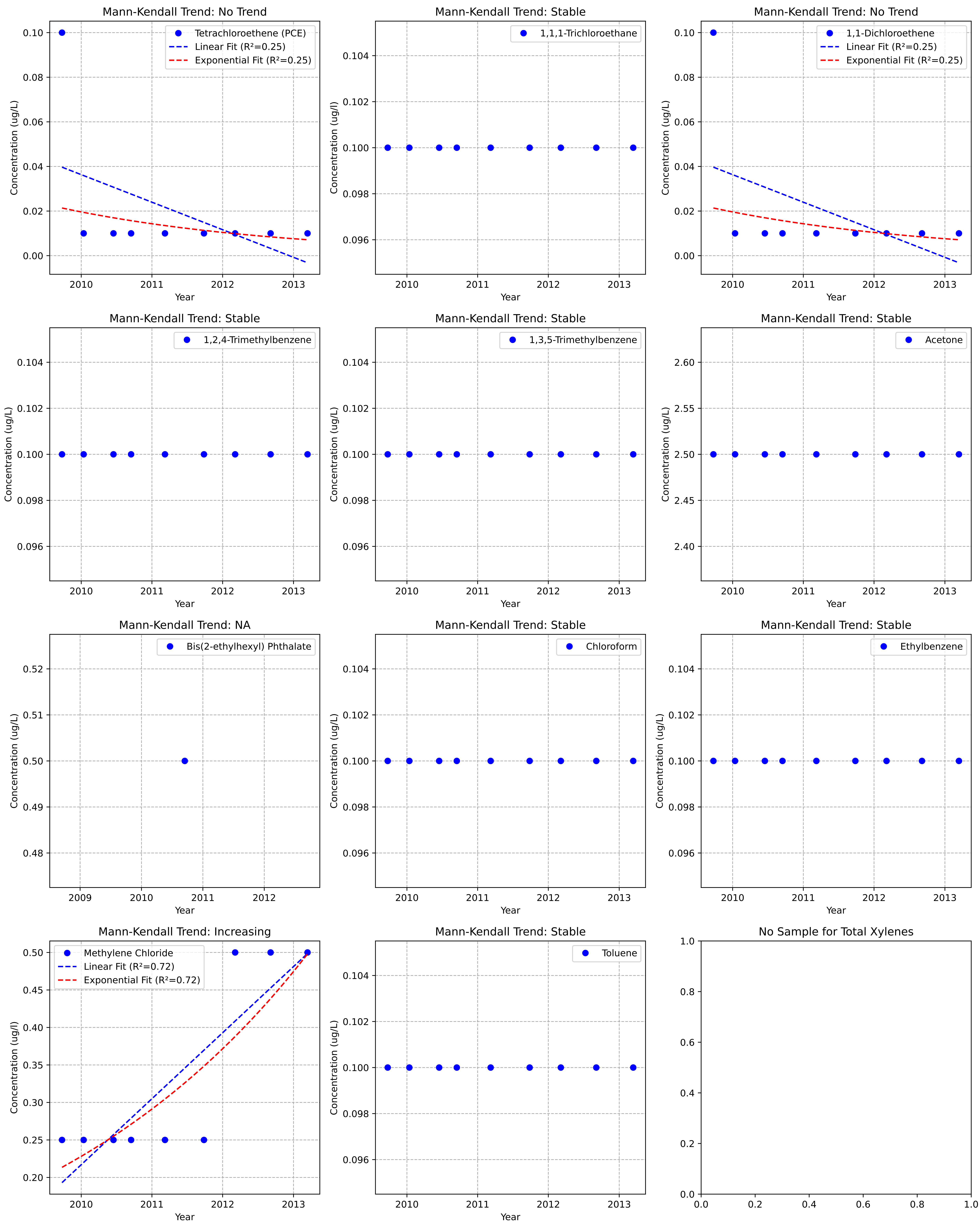
MW-40p2



Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.55)
Exponential Fit (R²=0.52)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.73)
Exponential Fit (R²=0.73)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Linear Fit (R²=0.20)
Exponential Fit (R²=0.20)
No Sample for Total Xylenes
Concentration (ug/L)
Year

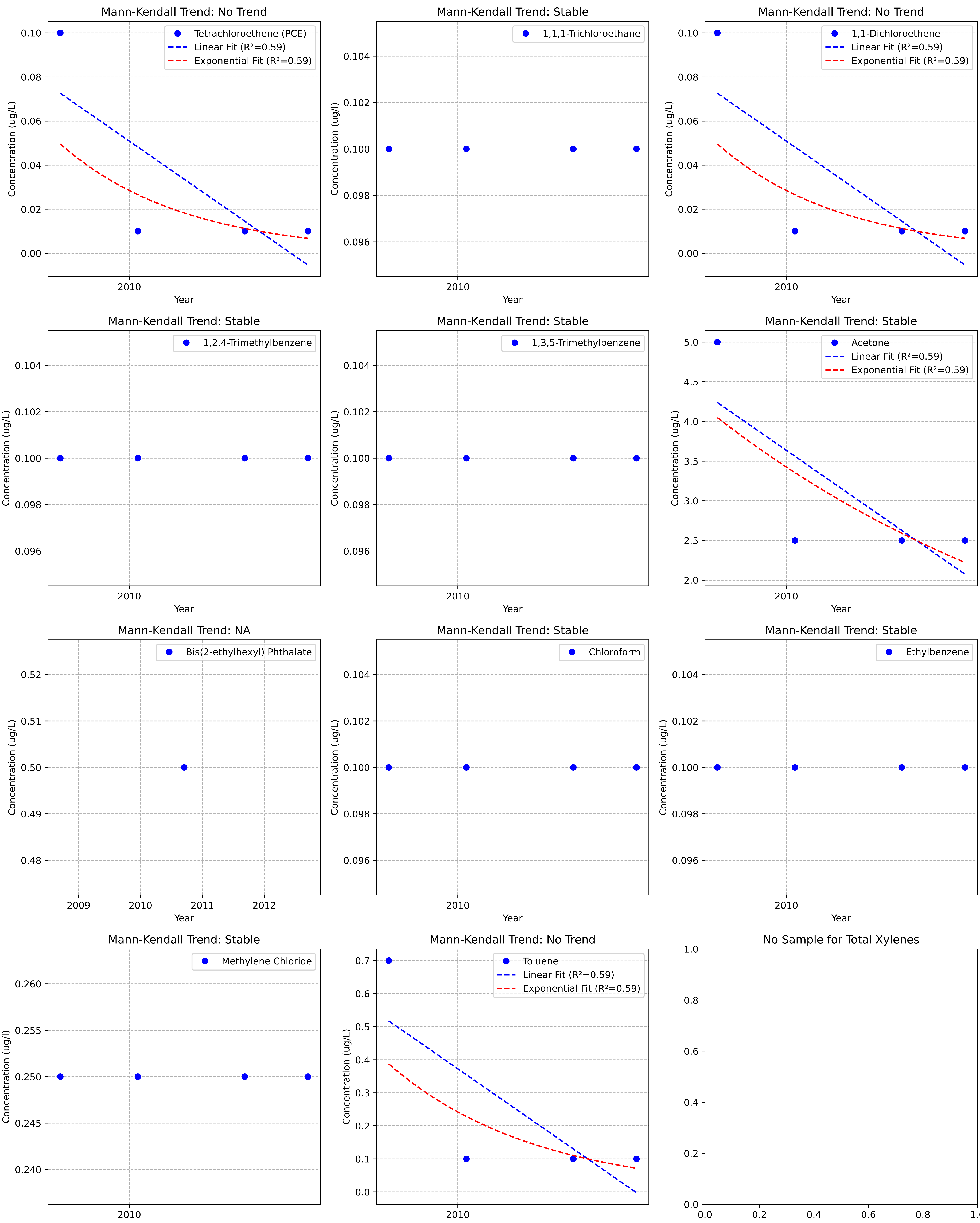

MW-43p2
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.32)
Exponential Fit (R²=0.30)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.14)
Exponential Fit (R²=0.12)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-46p2

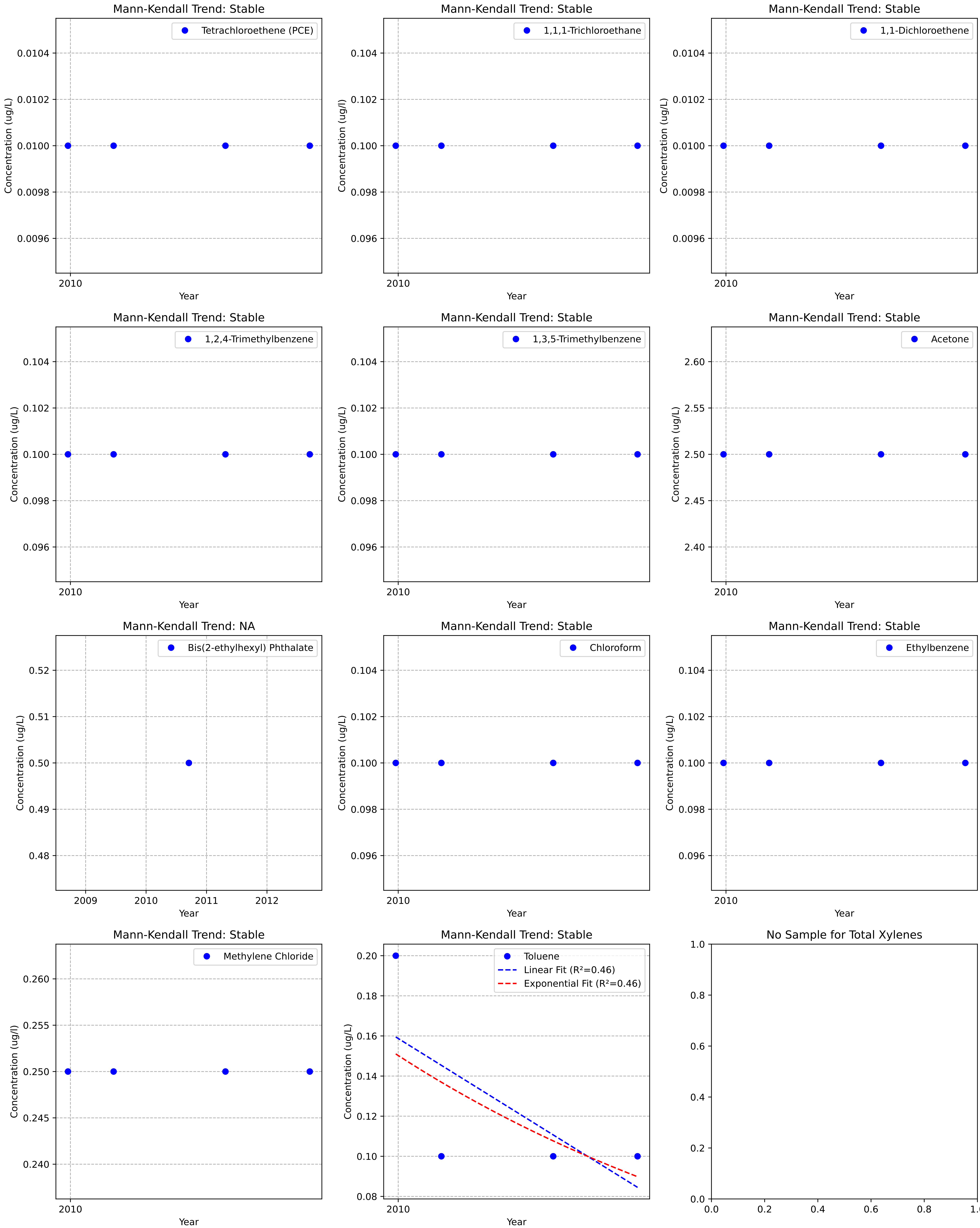


Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.72)
Exponential Fit (R²=0.72)
Mann-Kendall Trend: Stable
Toluene
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

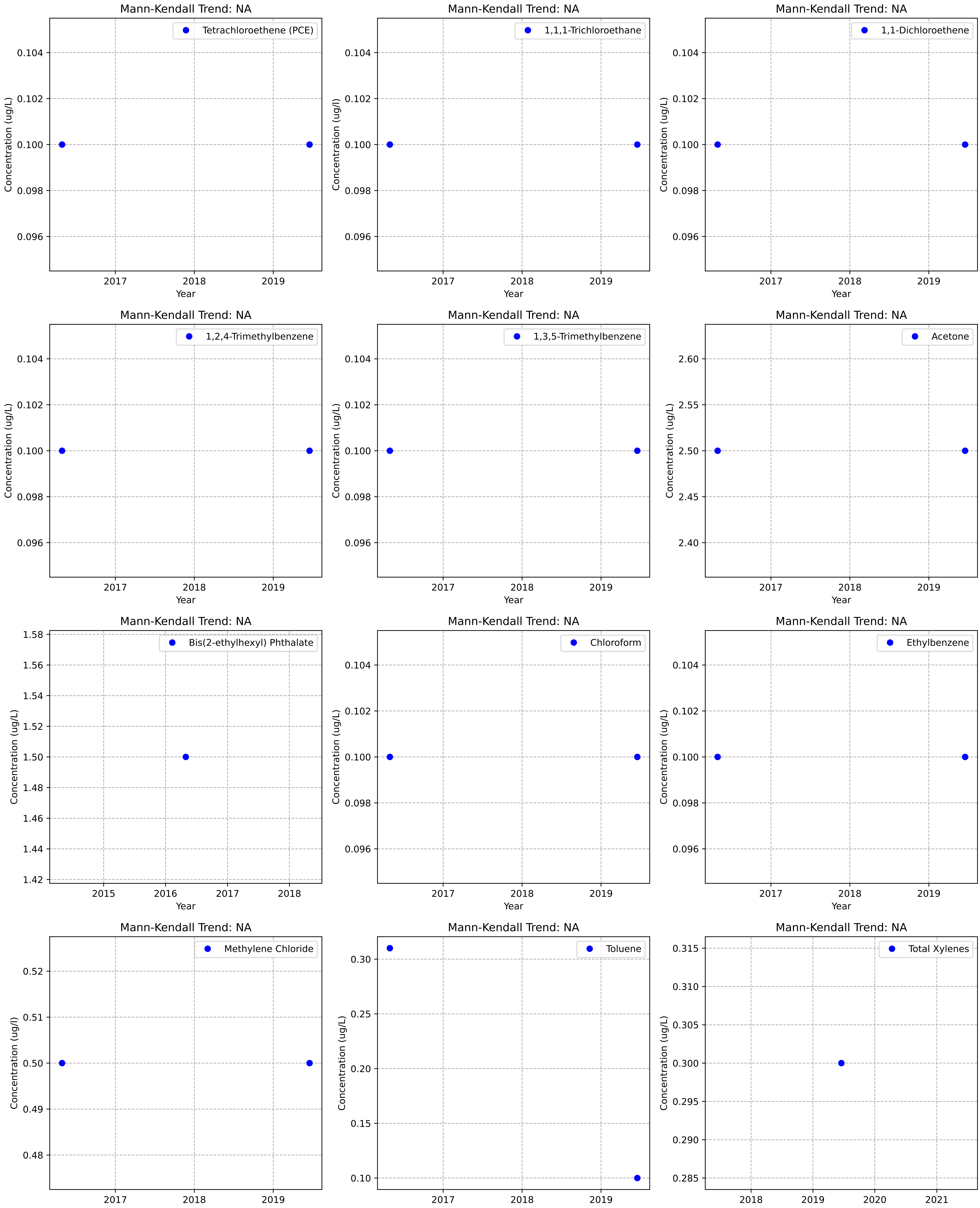
MW-49p2


Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-52p2

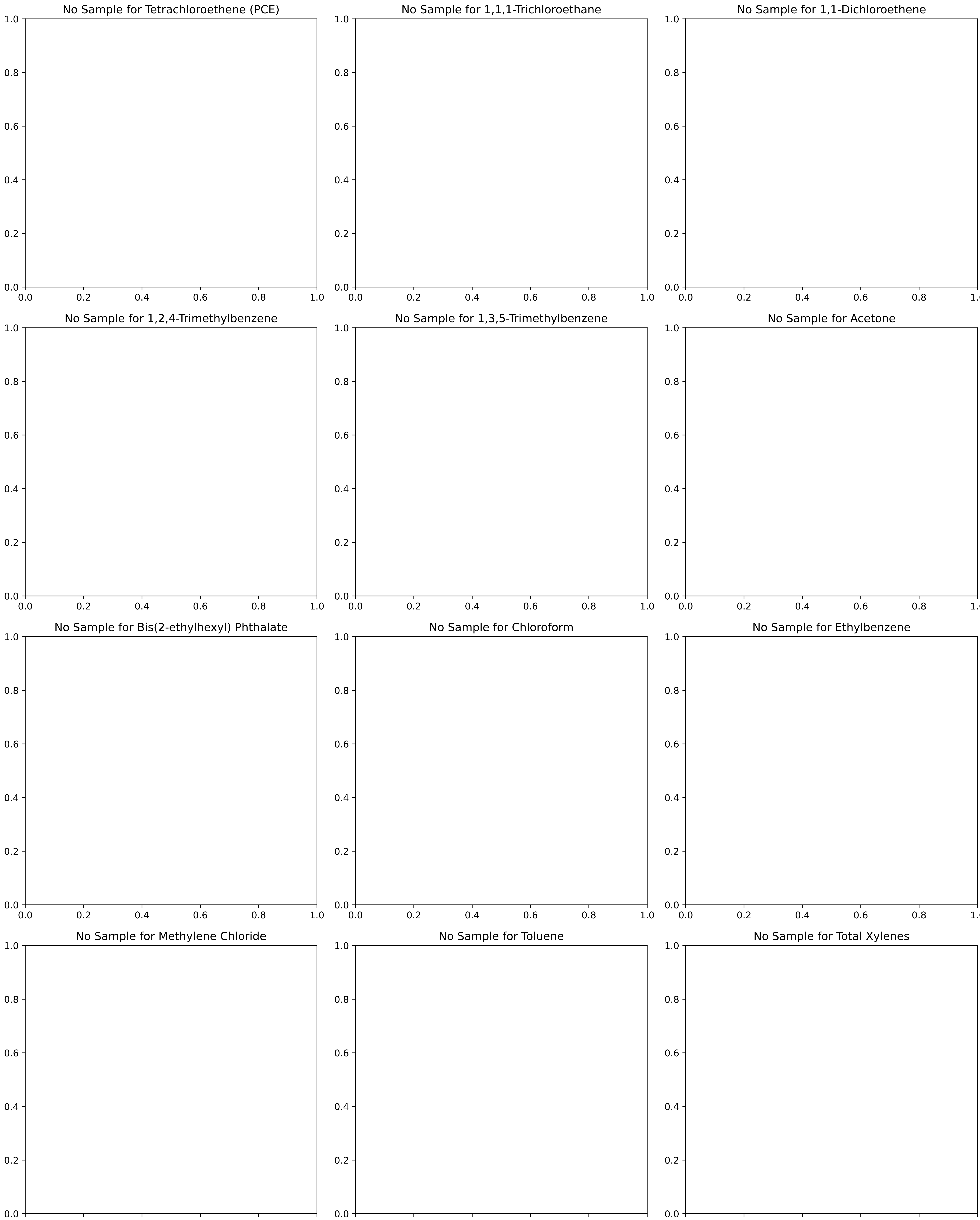

Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Linear Fit (R²=0.46)
Exponential Fit (R²=0.46)
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

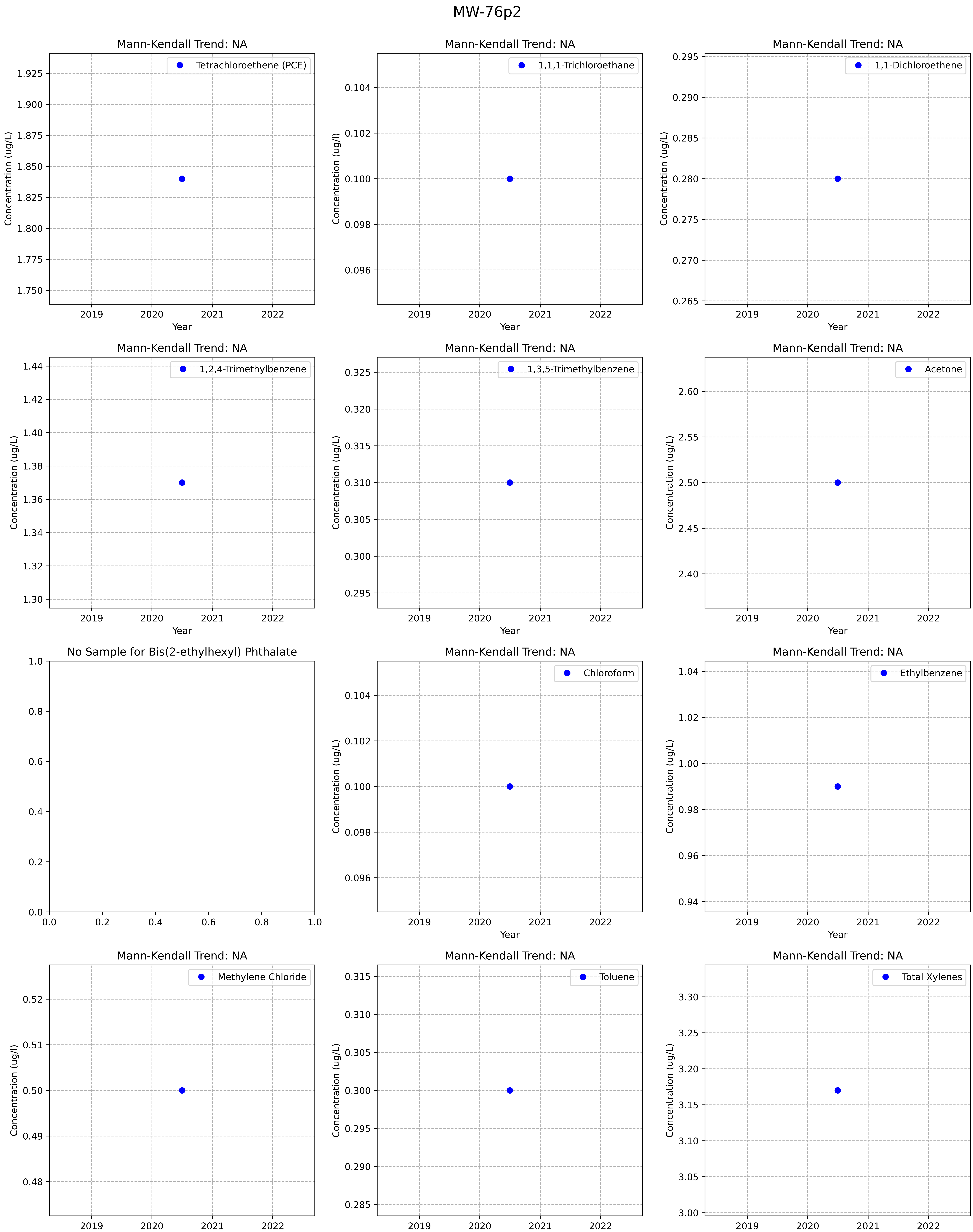
MW-60p2



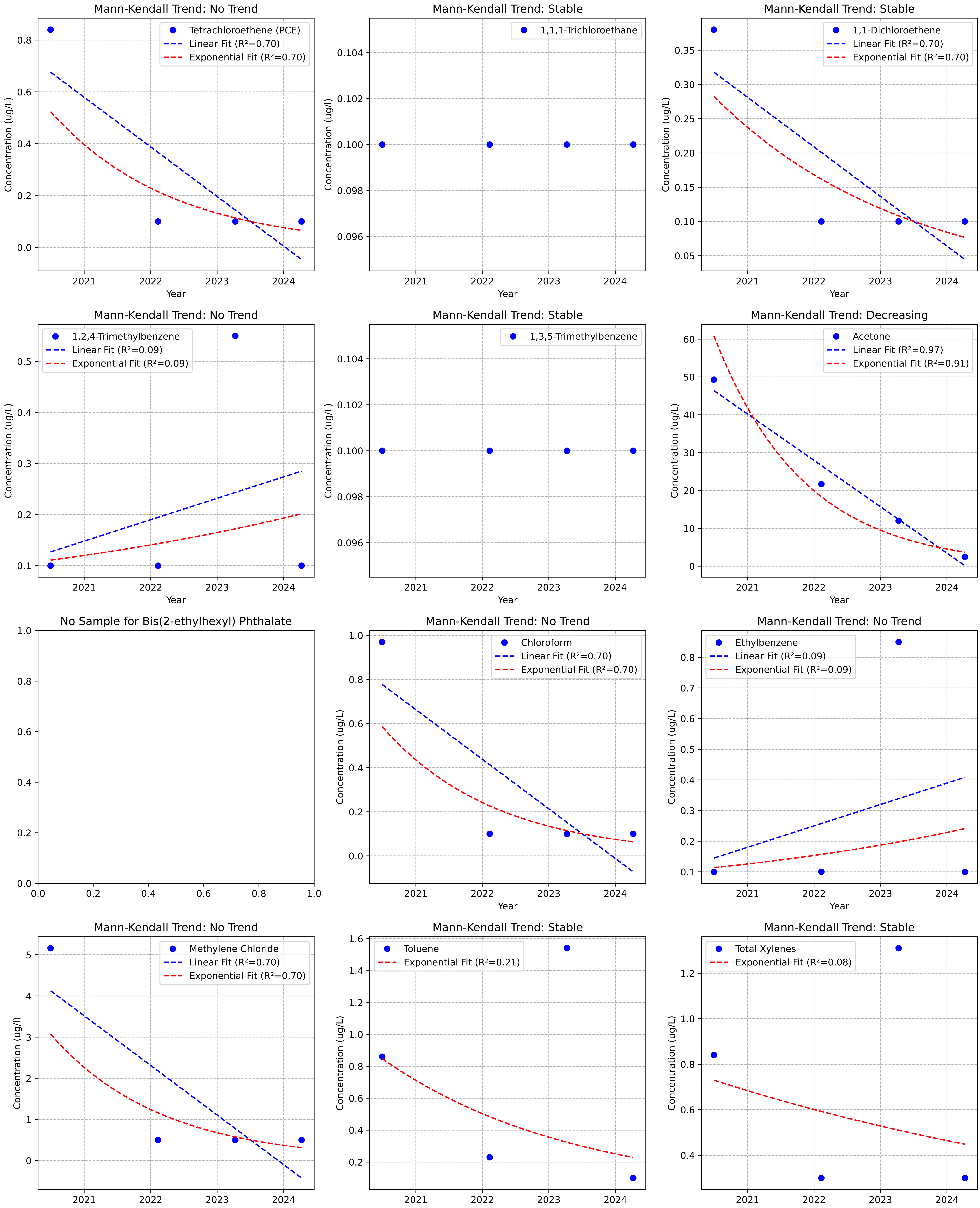
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
1,1,1-Trichloroethane
1,1-Dichloroethene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
Acetone
Bis(2-ethylhexyl) Phthalate
Chloroform
Ethylbenzene
Methylene Chloride
Toluene
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

No Data for MW-73p2

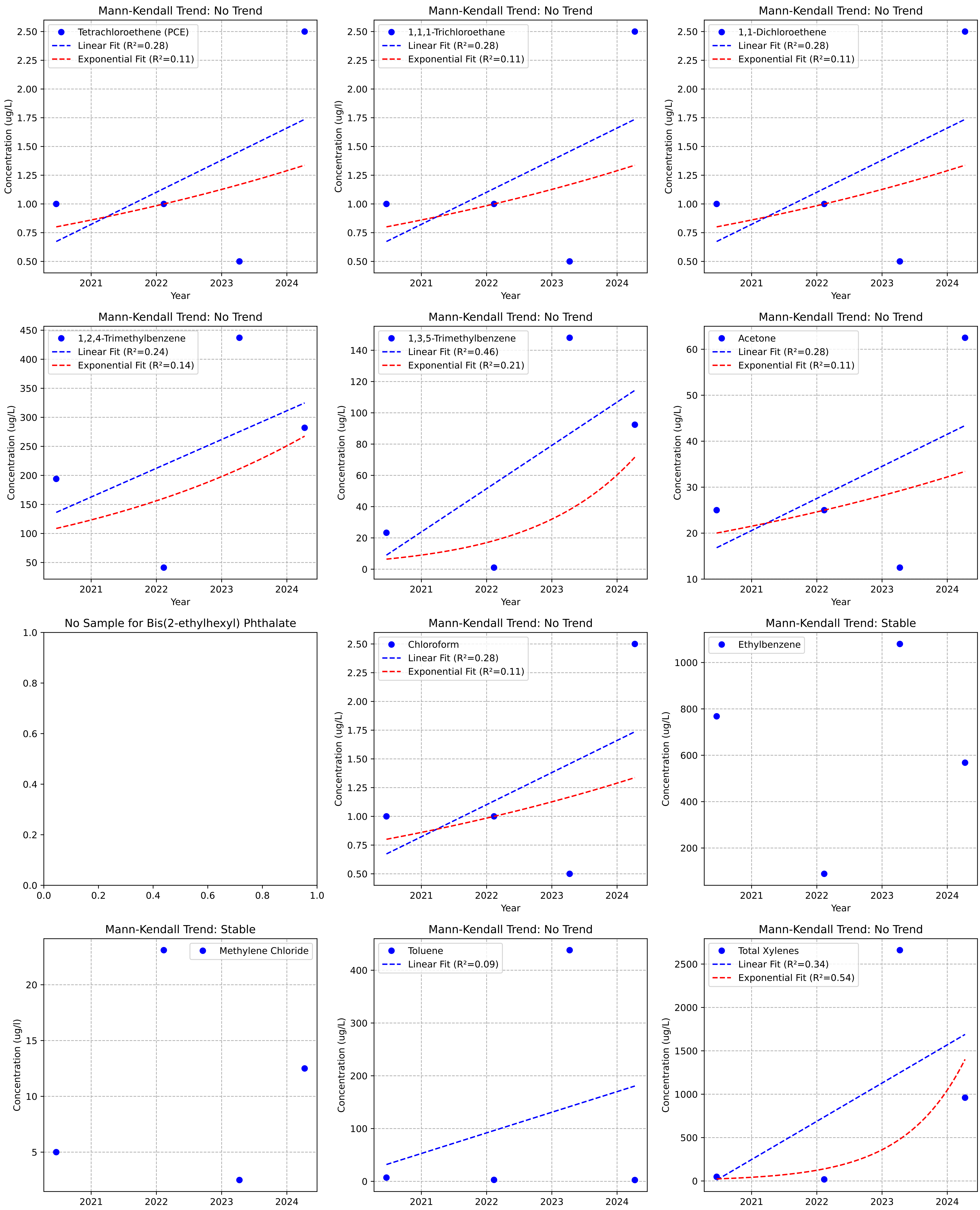



MW-76p2
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
1,1,1-Trichloroethane
1,1-Dichloroethene
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Chloroform
Ethylbenzene
Methylene Chloride
Toluene
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-80p2

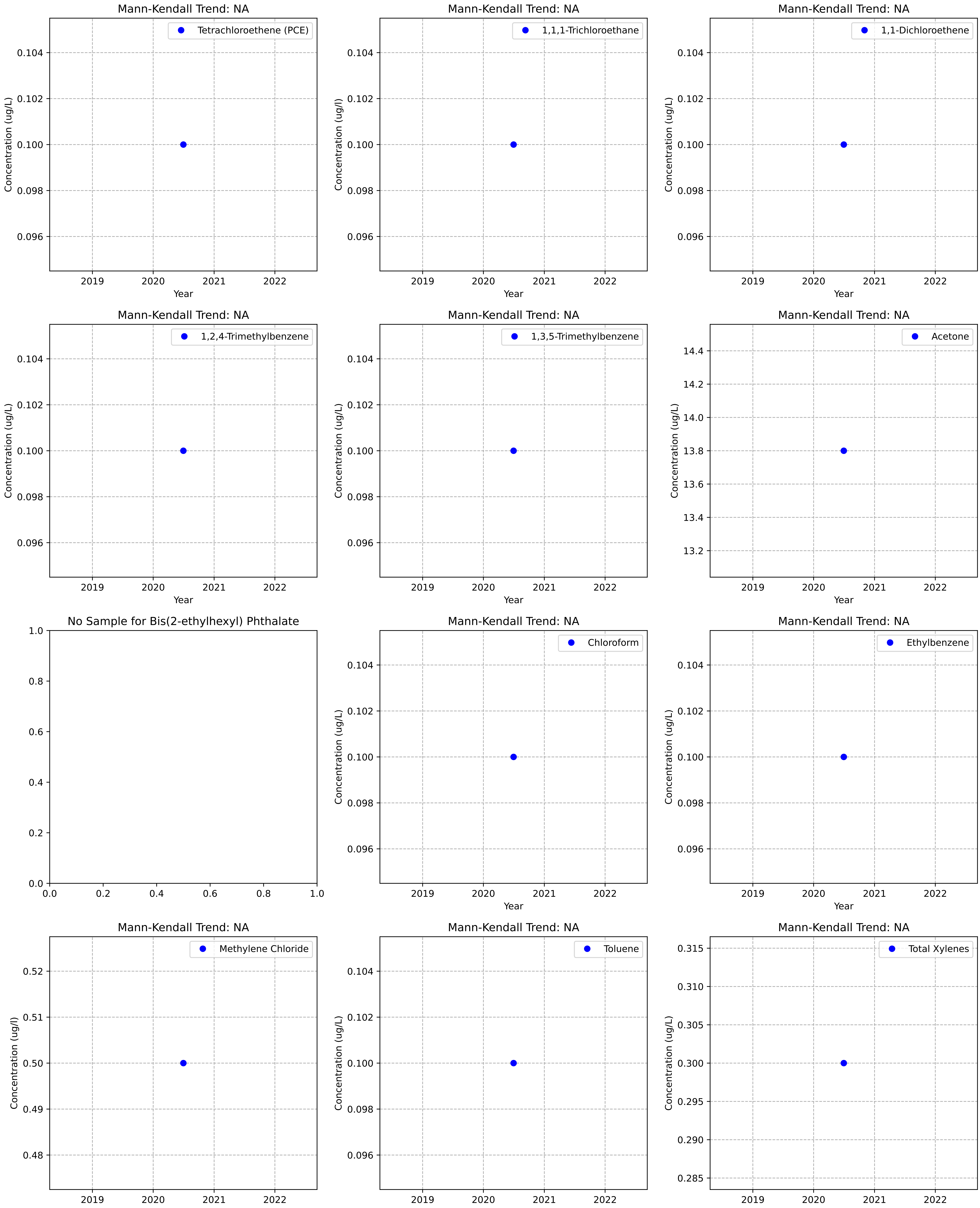

Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.70)
Exponential Fit (R²=0.70)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.70)
Exponential Fit (R²=0.70)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Decreasing
Acetone
Linear Fit (R²=0.97)
Exponential Fit (R²=0.91)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.70)
Exponential Fit (R²=0.70)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.70)
Exponential Fit (R²=0.70)
Mann-Kendall Trend: Stable
Toluene
Exponential Fit (R²=0.21)
Mann-Kendall Trend: Stable
Total Xylenes
Exponential Fit (R²=0.08)
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

MW-87p2



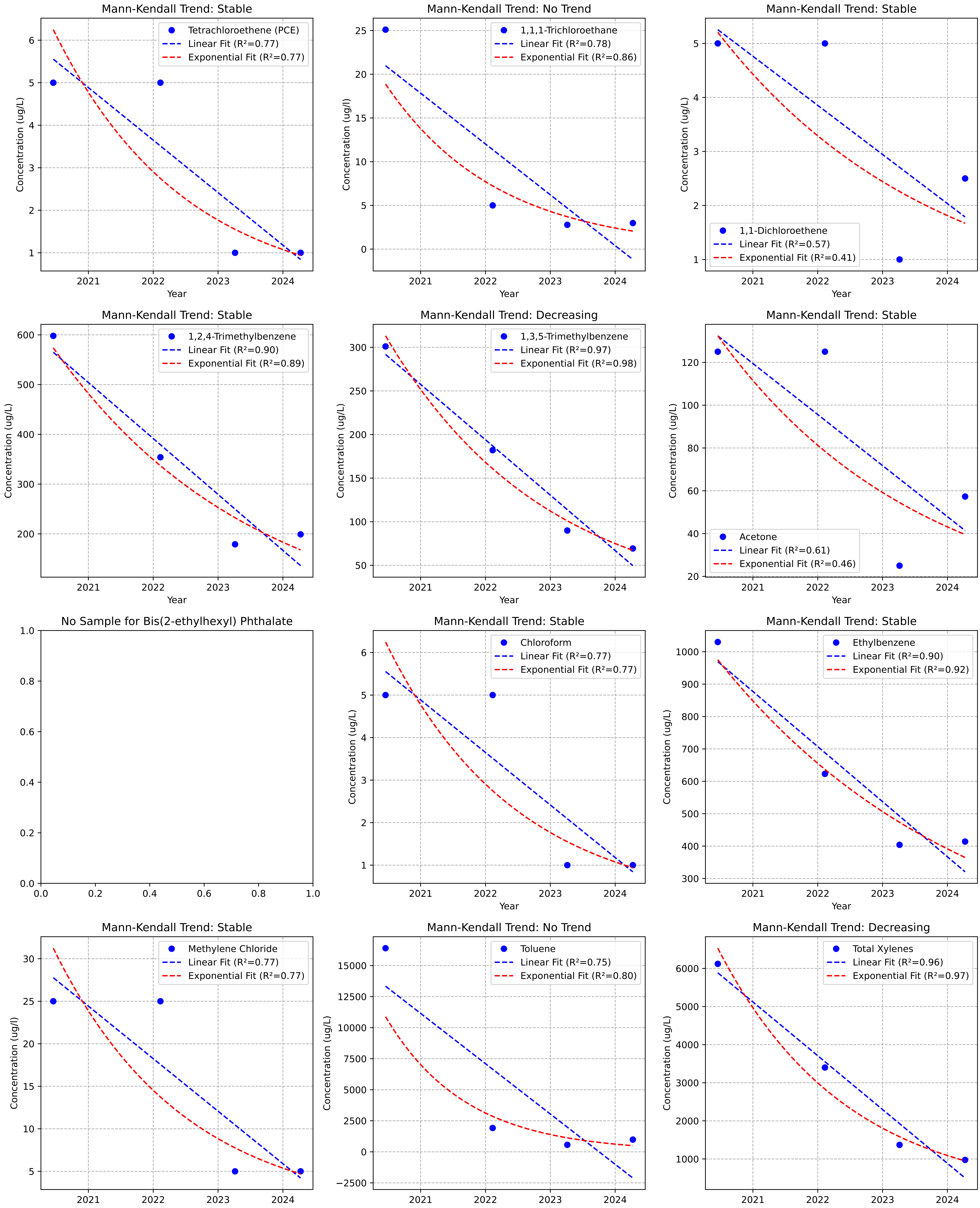
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.24)
Exponential Fit (R²=0.14)
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.46)
Exponential Fit (R²=0.21)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.28)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.09)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.34)
Exponential Fit (R²=0.54)
Concentration (ug/L)
Concentration (ug/l)
Year

MW-88p2



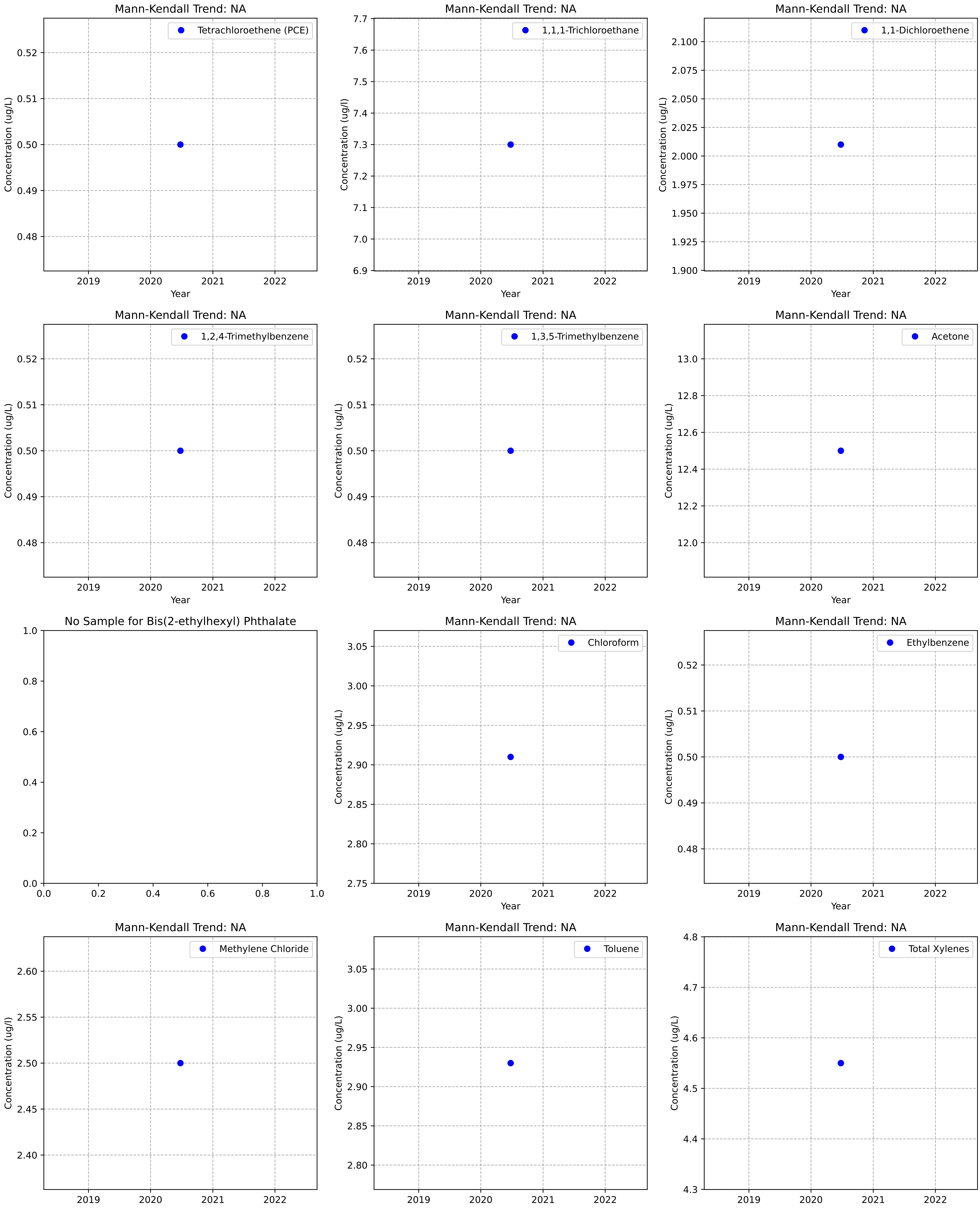
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

MW-91p2



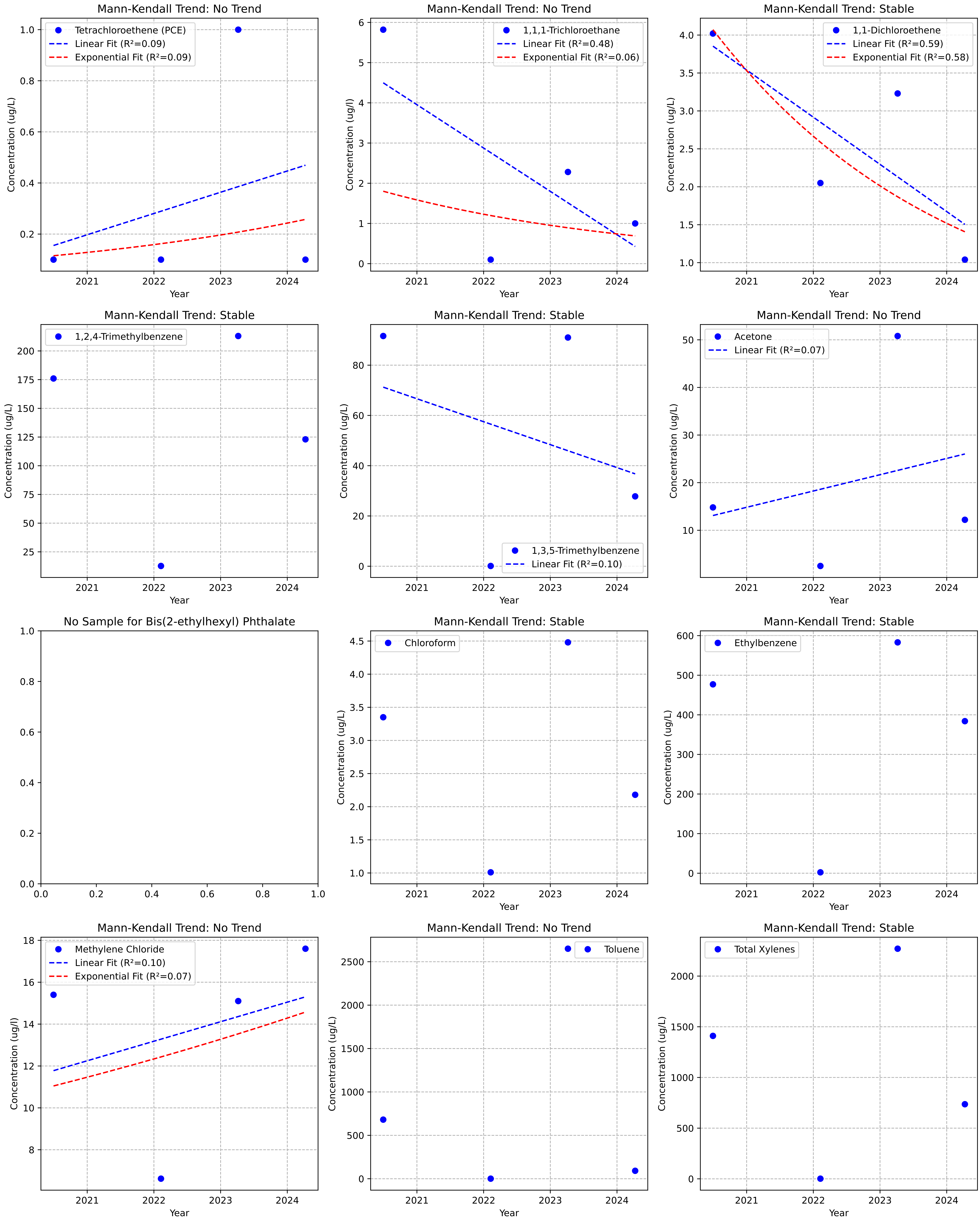
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.78)
Exponential Fit (R²=0.86)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.57)
Exponential Fit (R²=0.41)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.90)
Exponential Fit (R²=0.89)
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.97)
Exponential Fit (R²=0.98)
Mann-Kendall Trend: Stable
Acetone
Linear Fit (R²=0.61)
Exponential Fit (R²=0.46)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: Stable
Ethylbenzene
Linear Fit (R²=0.90)
Exponential Fit (R²=0.92)
Mann-Kendall Trend: Stable
Methylene Chloride
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.75)
Exponential Fit (R²=0.80)
Mann-Kendall Trend: Decreasing
Total Xylenes
Linear Fit (R²=0.96)
Exponential Fit (R²=0.97)
Concentration (ug/L)
Year

MW-94p2



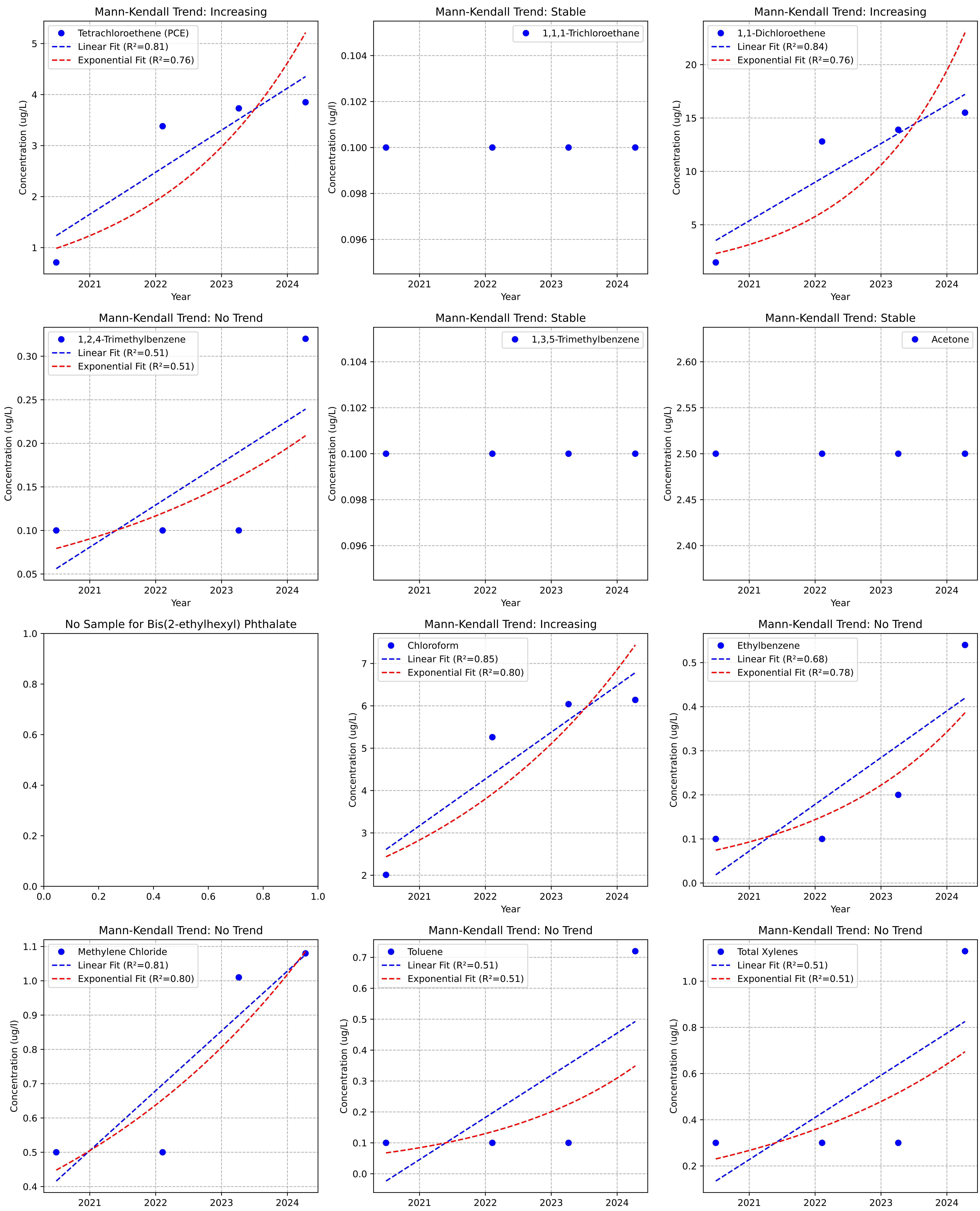
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

MW-99p2

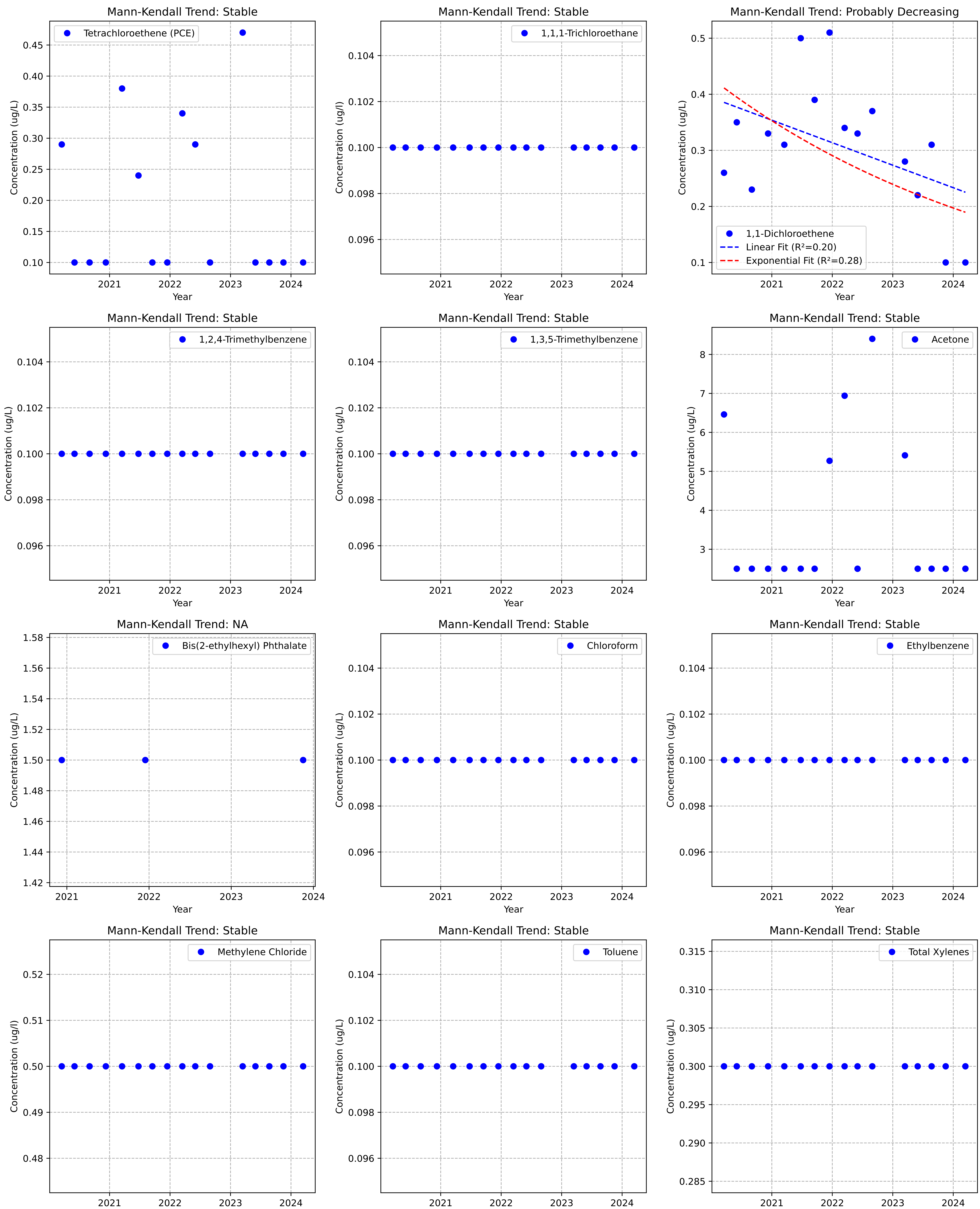

Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.48)
Exponential Fit (R²=0.06)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.59)
Exponential Fit (R²=0.58)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.10)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.07)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.10)
Exponential Fit (R²=0.07)
Mann-Kendall Trend: No Trend
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

D3. Concentration time series plots of additional parameters for Roza Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

MW-102b

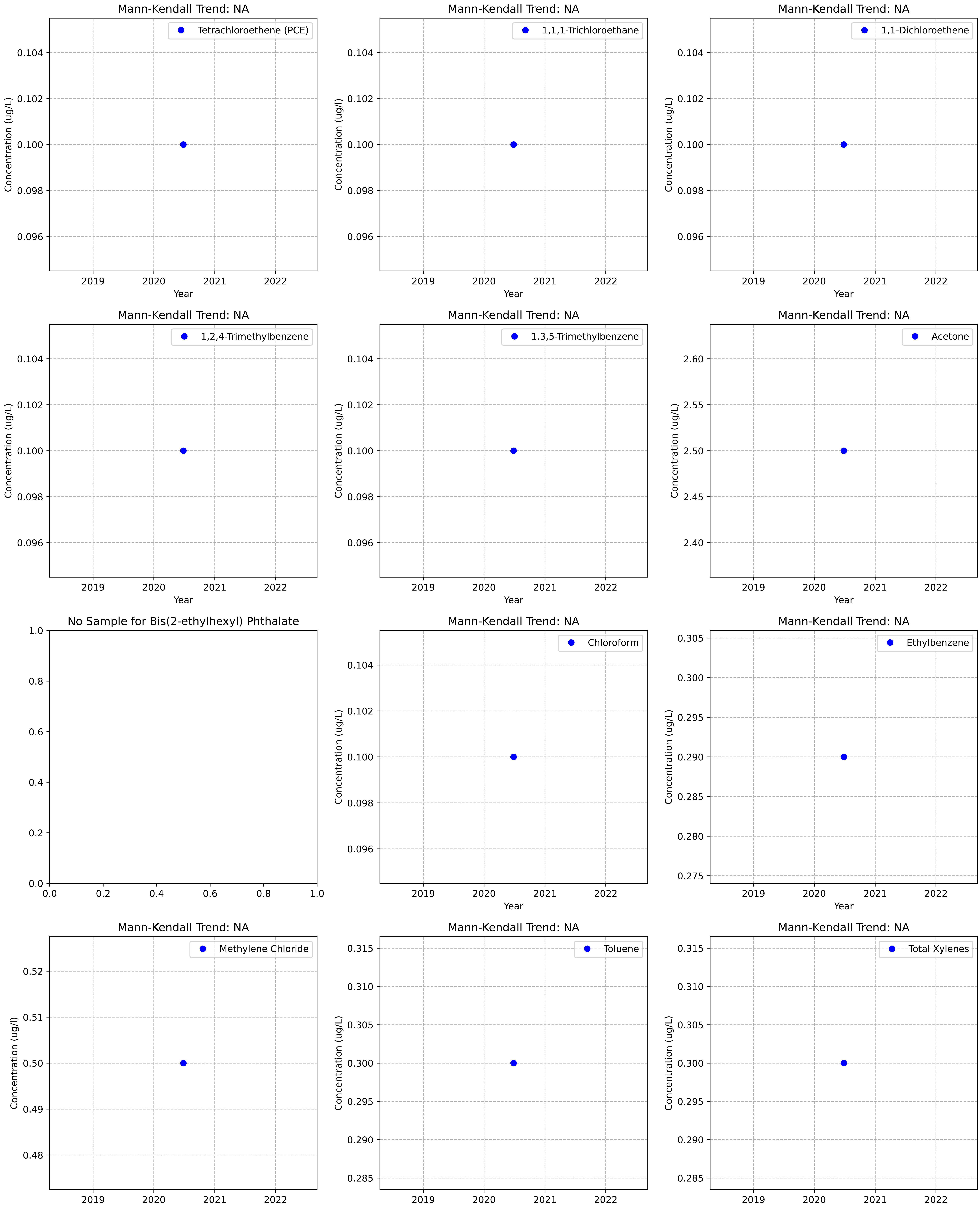

Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.81)
Exponential Fit (R²=0.76)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Increasing
1,1-Dichloroethene
Linear Fit (R²=0.84)
Exponential Fit (R²=0.76)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Increasing
Chloroform
Linear Fit (R²=0.85)
Exponential Fit (R²=0.80)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.68)
Exponential Fit (R²=0.78)
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.81)
Exponential Fit (R²=0.80)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Year

MW-103b



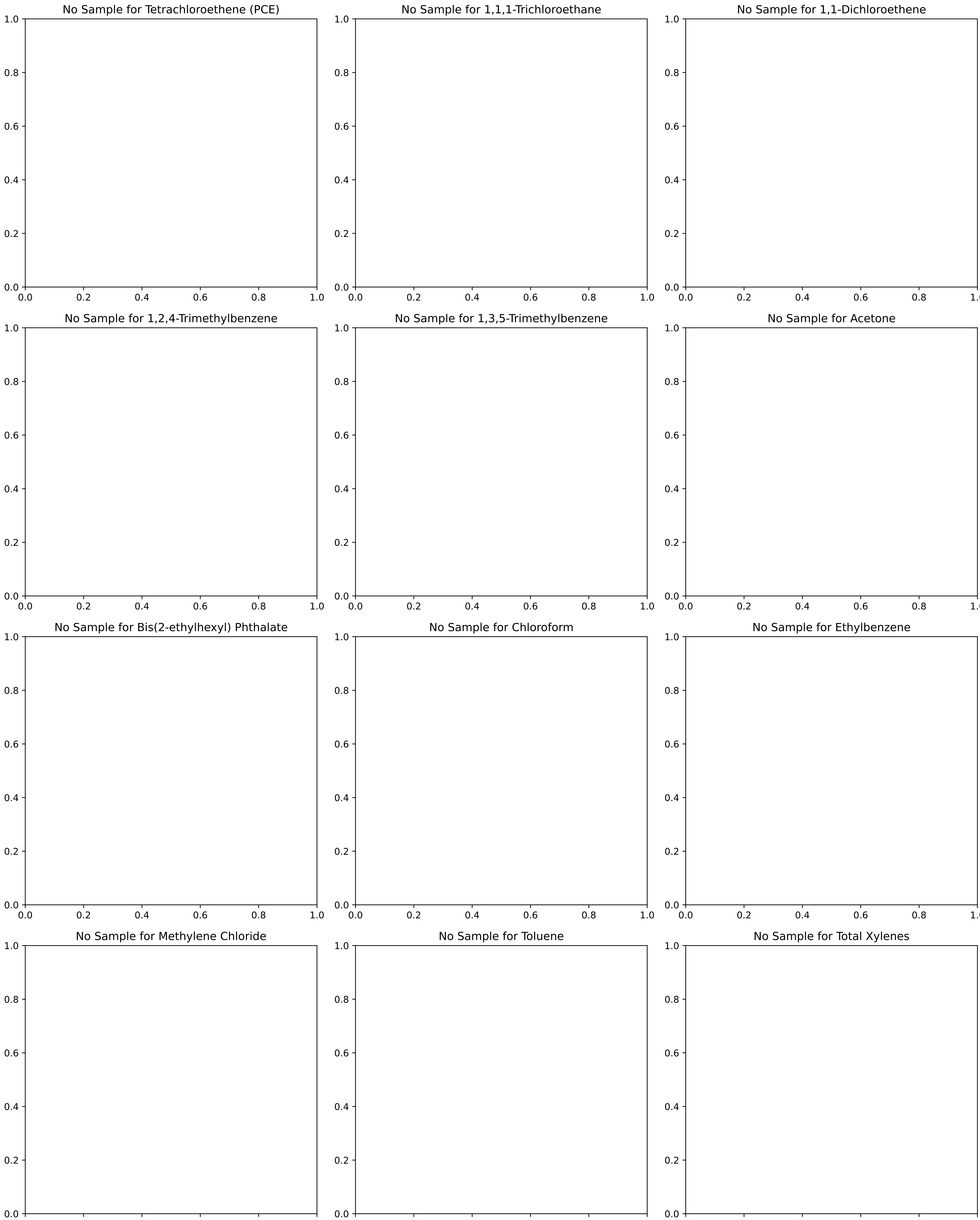
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Probably Decreasing
1,1-Dichloroethene
Linear Fit (R^2=0.20)
Exponential Fit (R^2=0.28)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-105b

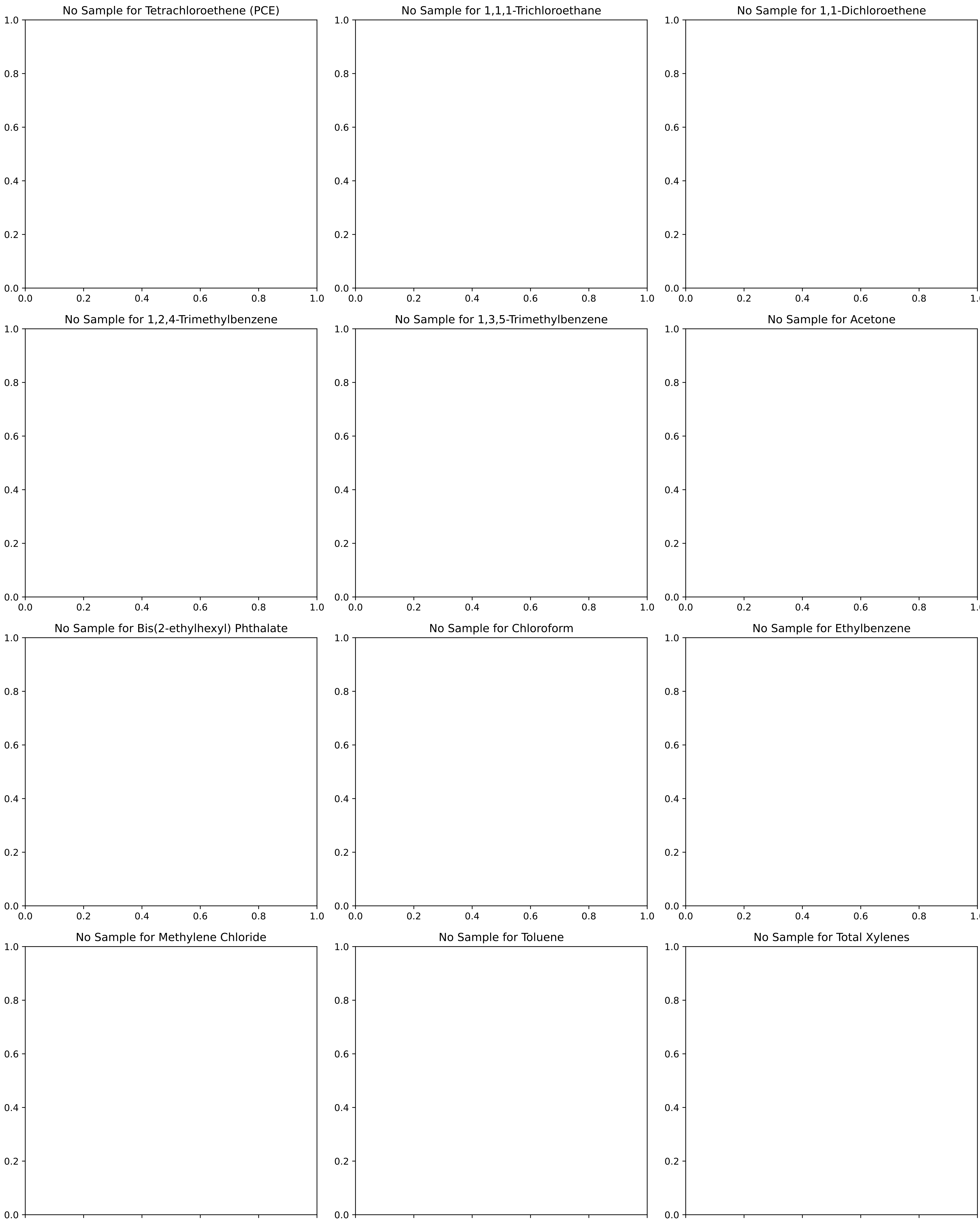


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

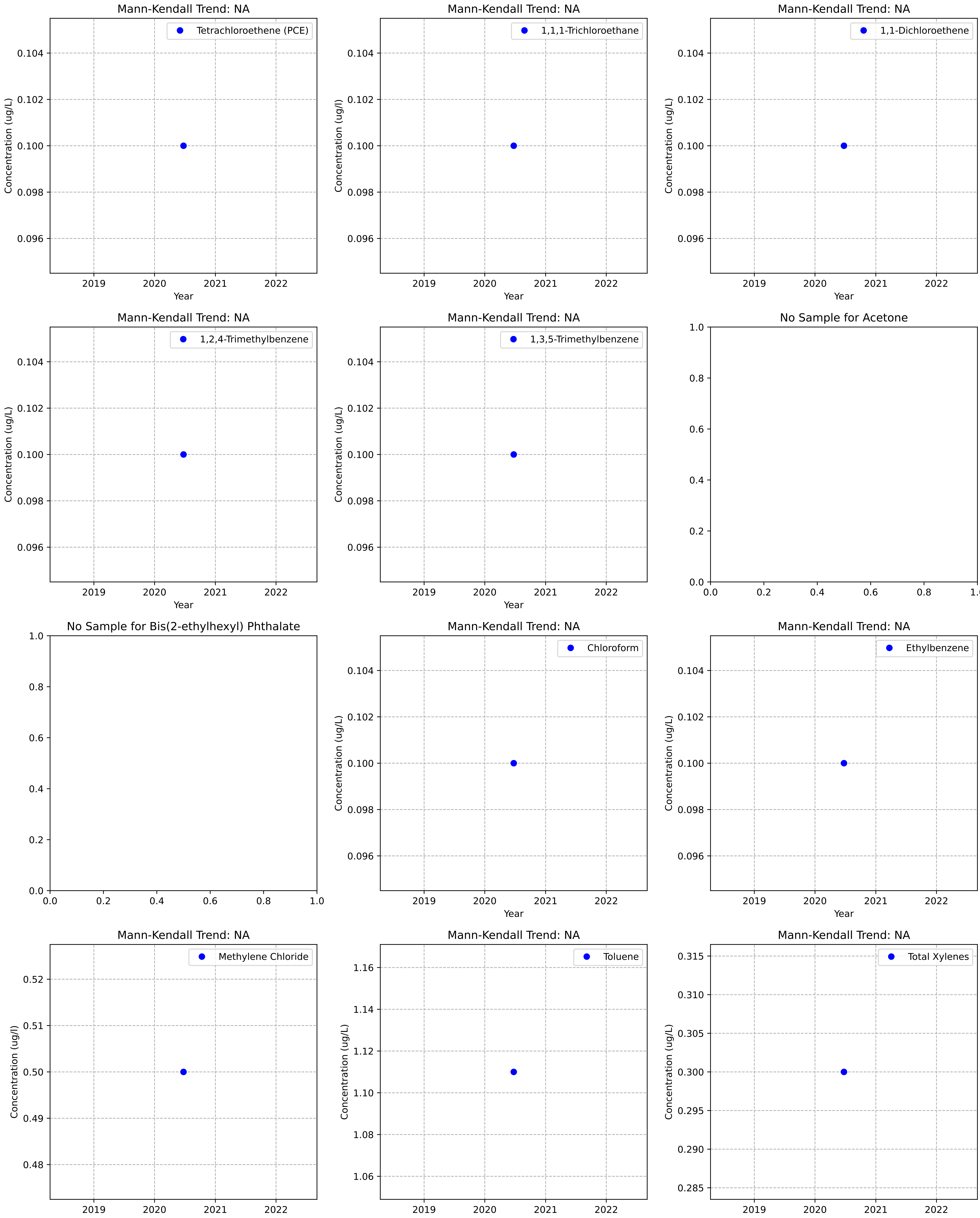
No Data for MW-106b



No Data for MW-111b

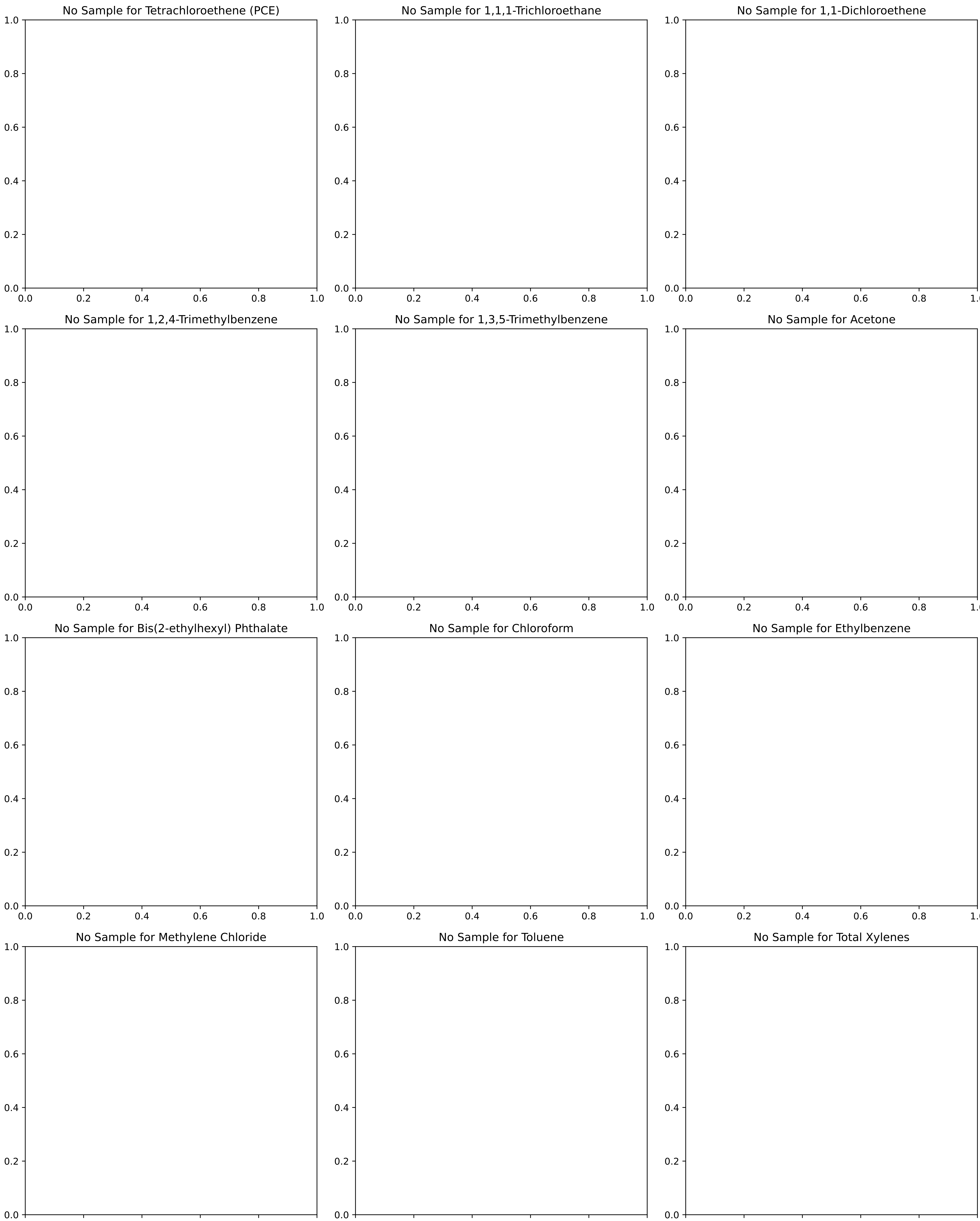


MW-116b

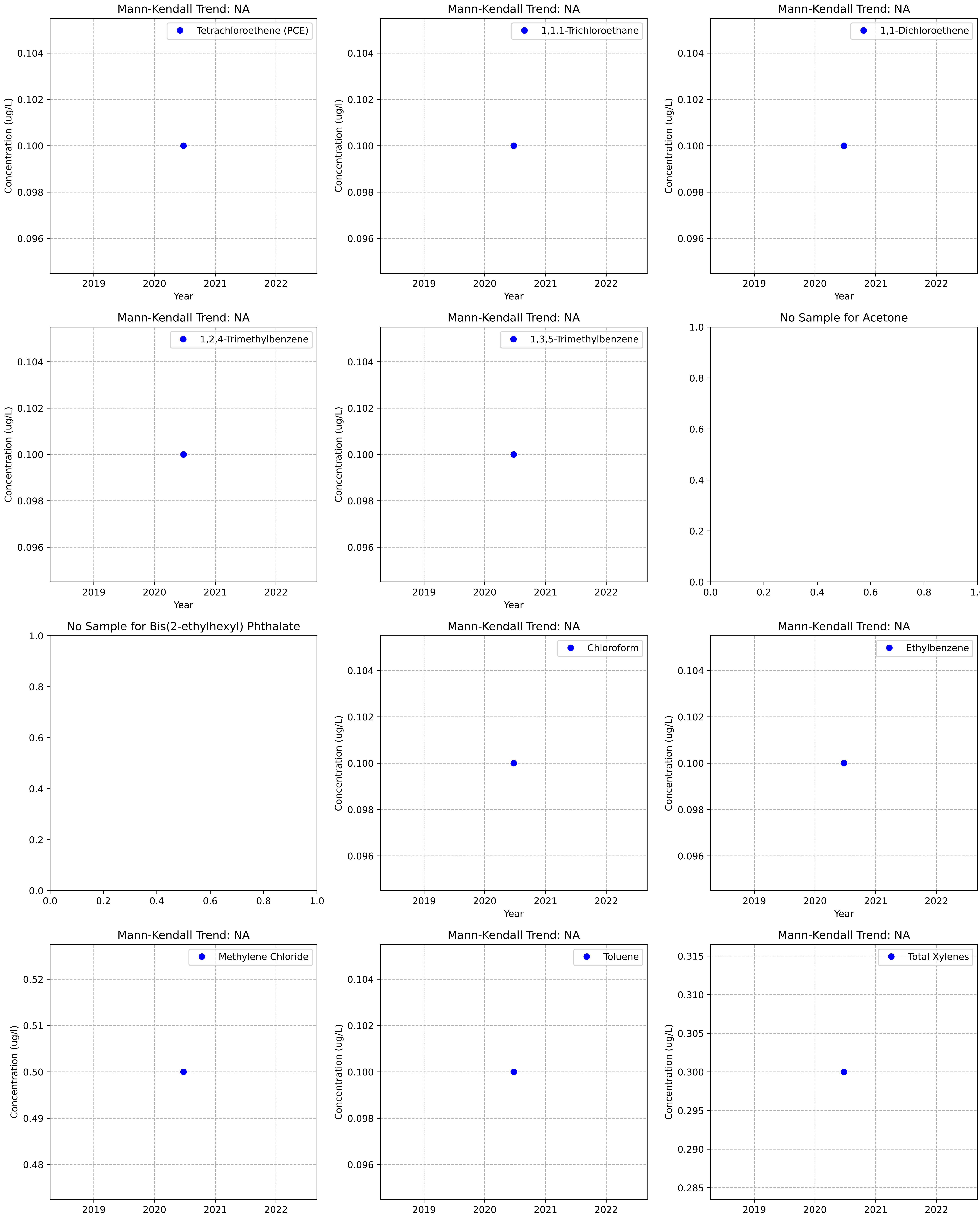


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
No Sample for Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

No Data for MW-119b

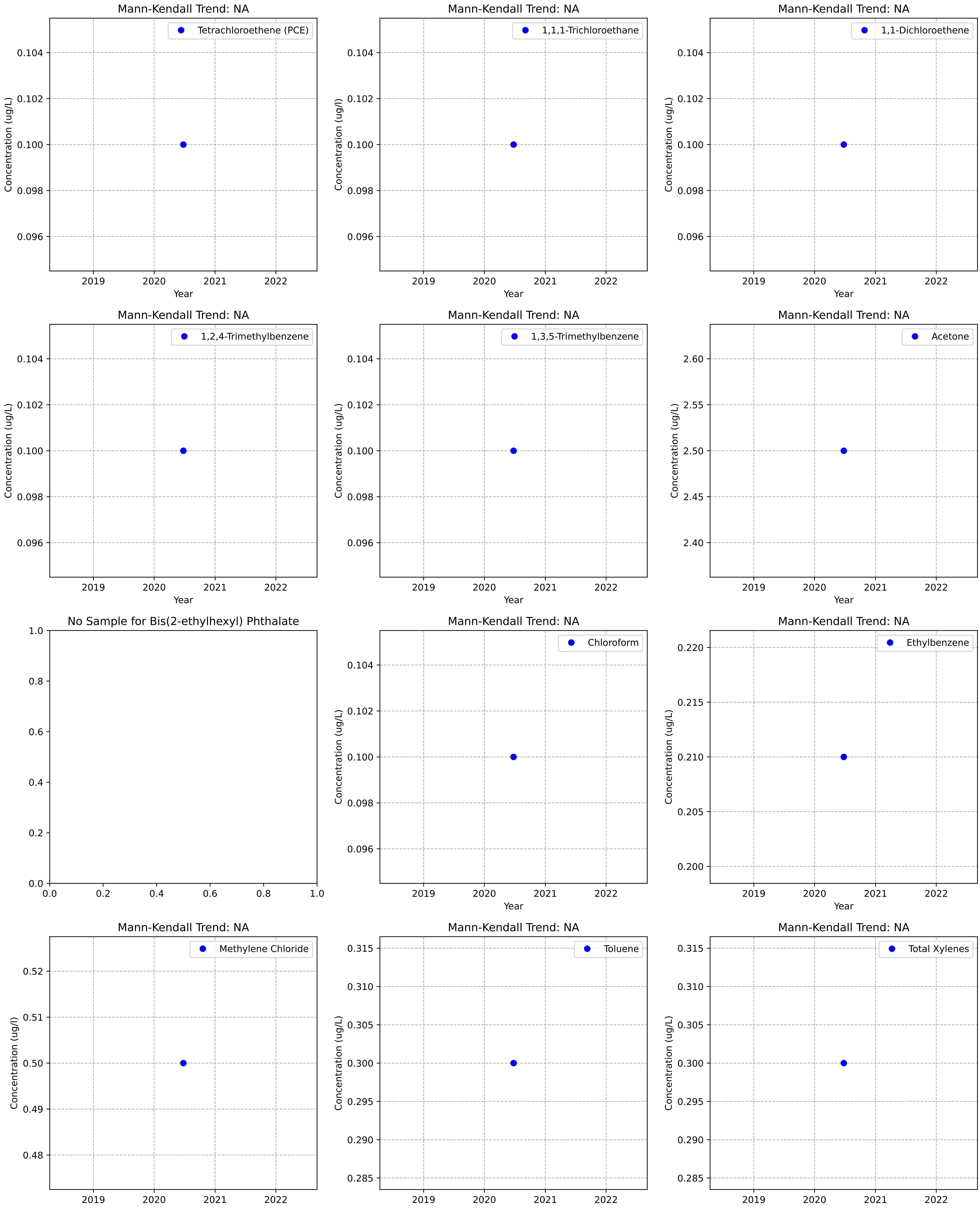


MW-121b



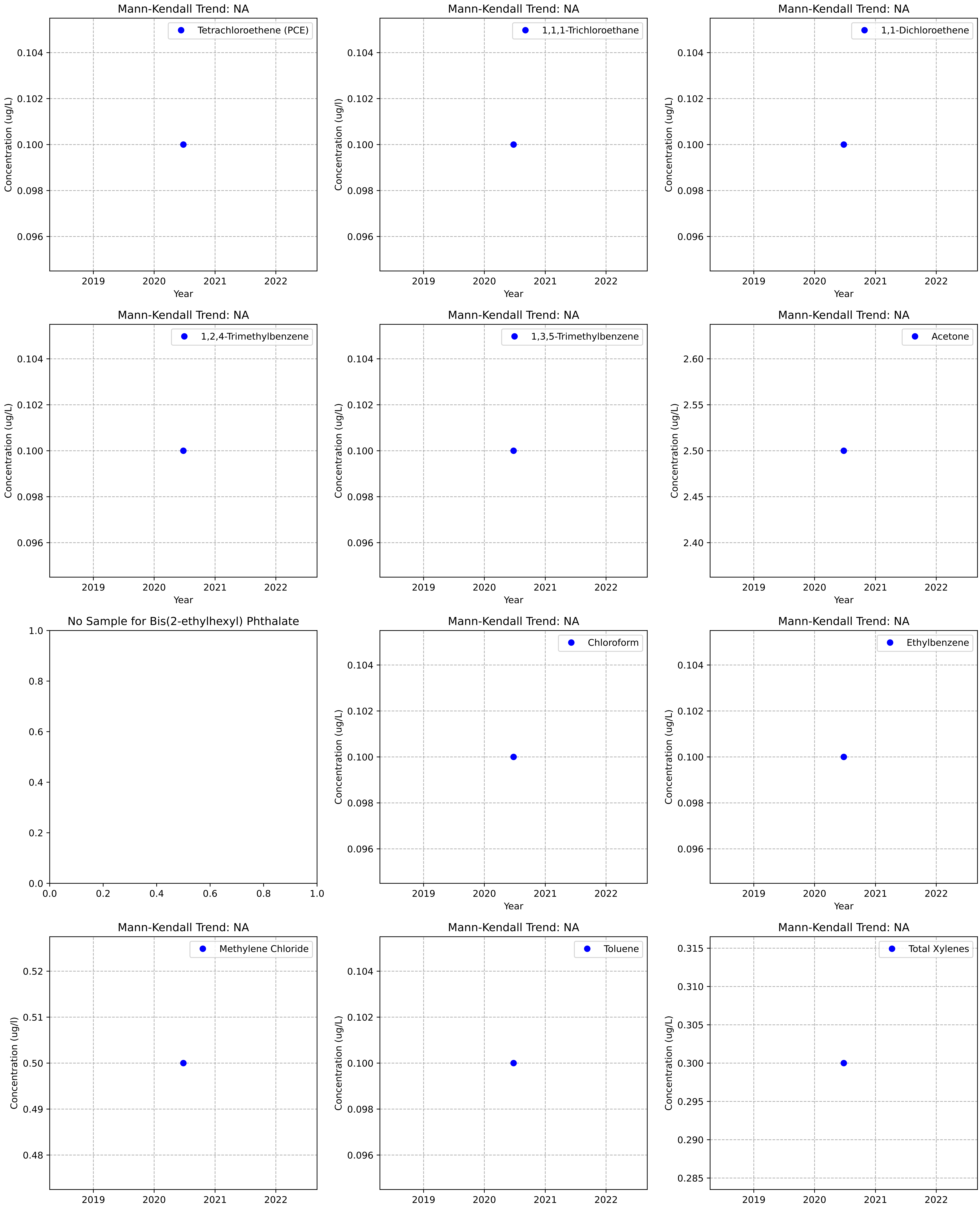
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
No Sample for Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-128b

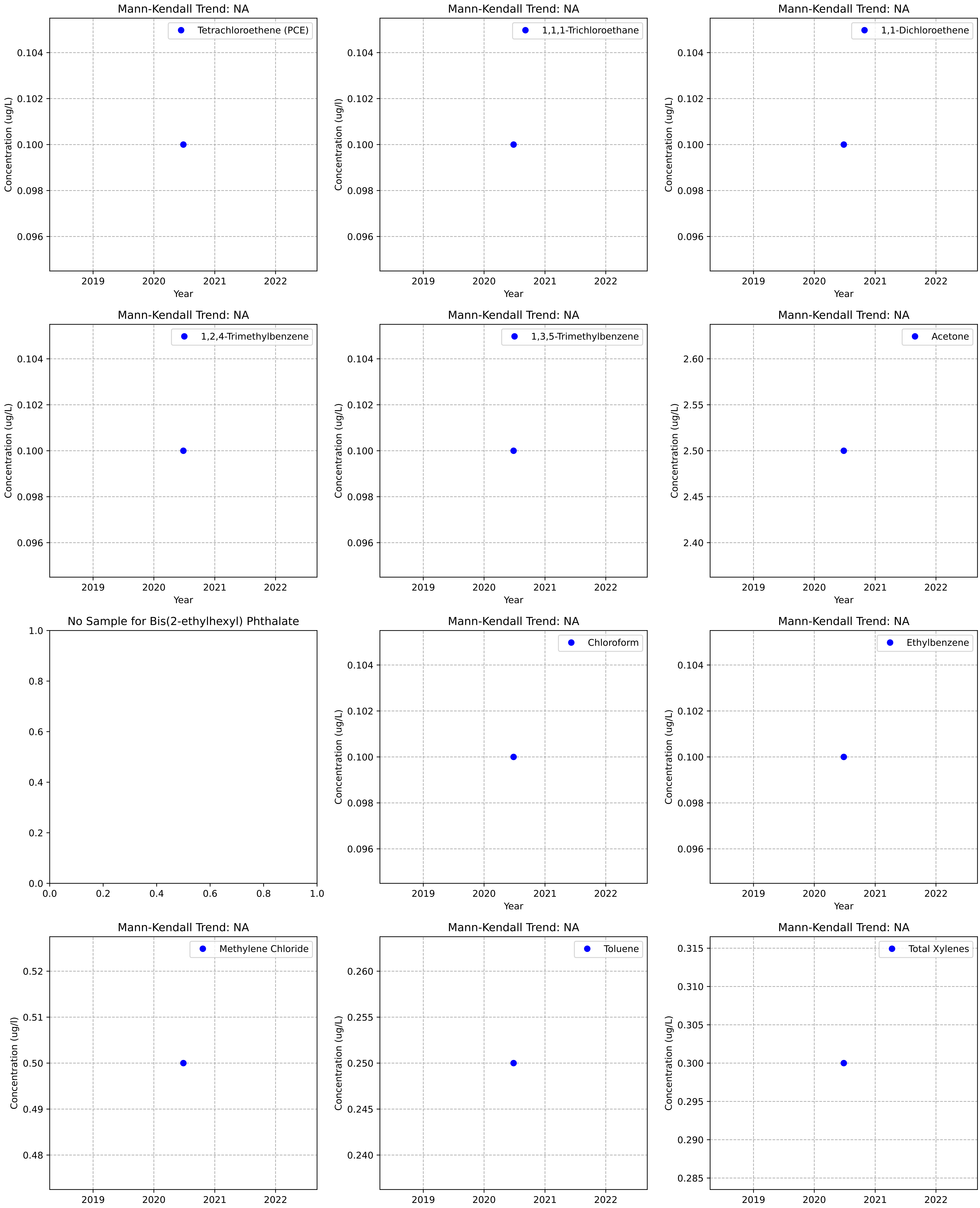


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

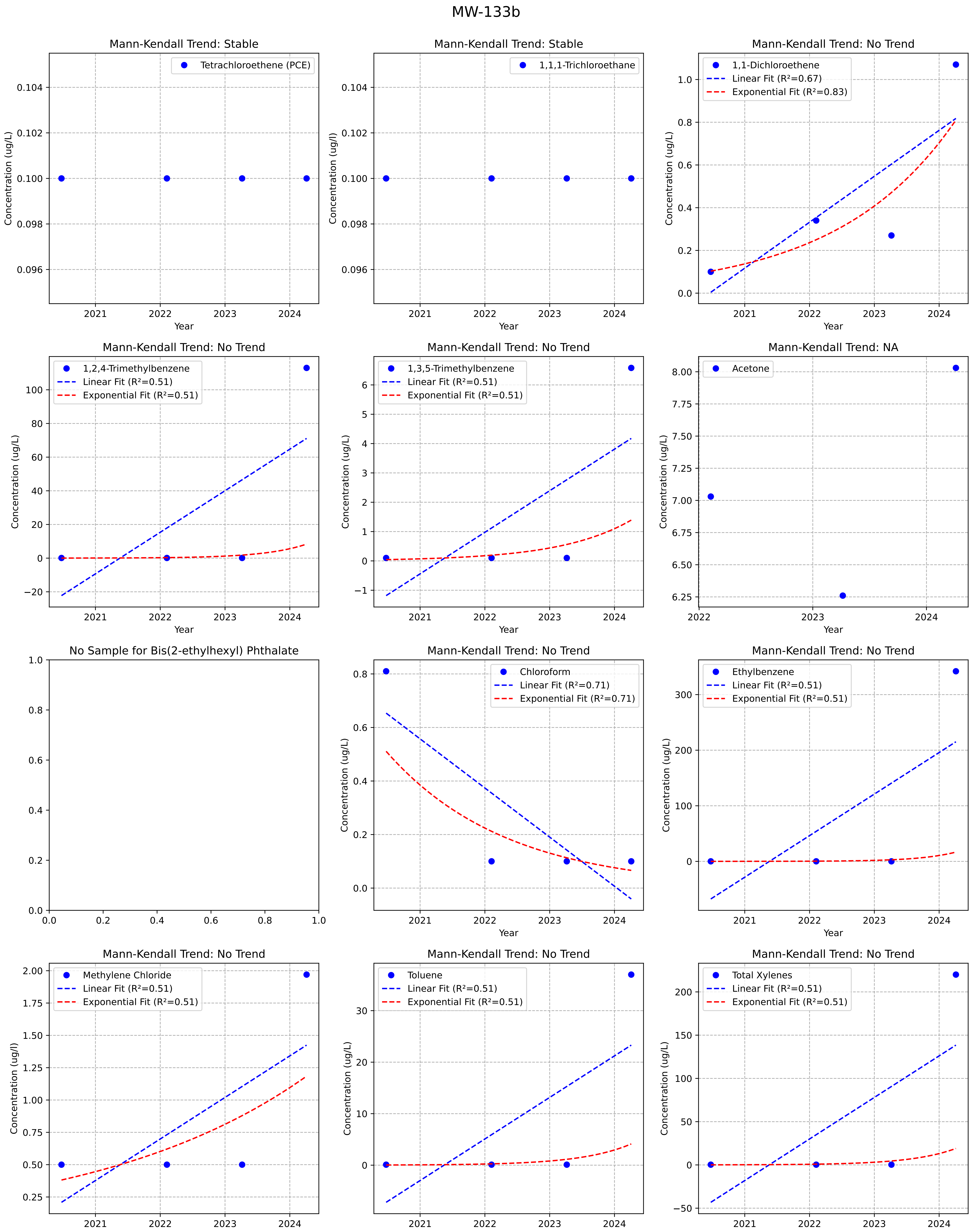
MW-130b


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

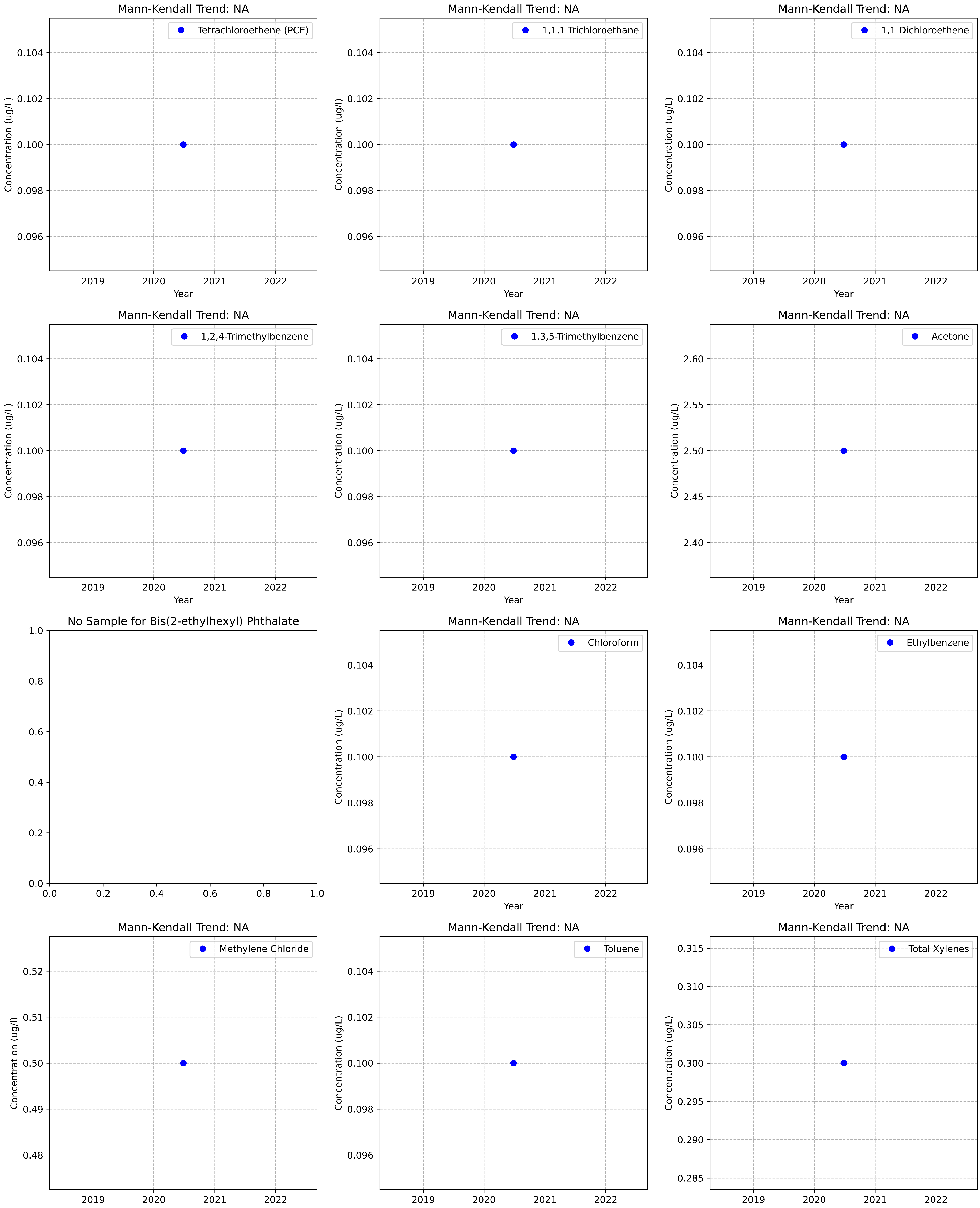
MW-132b



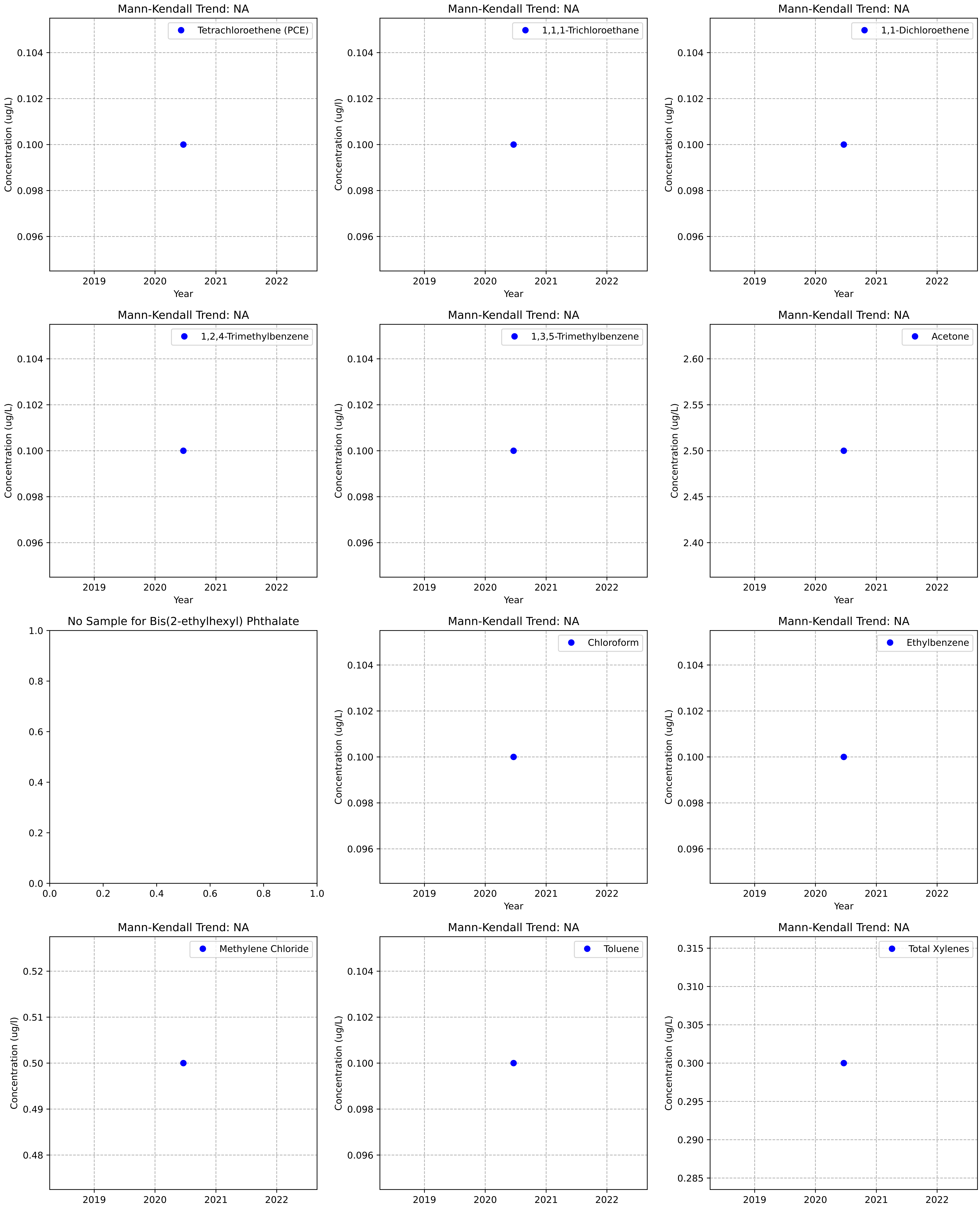
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

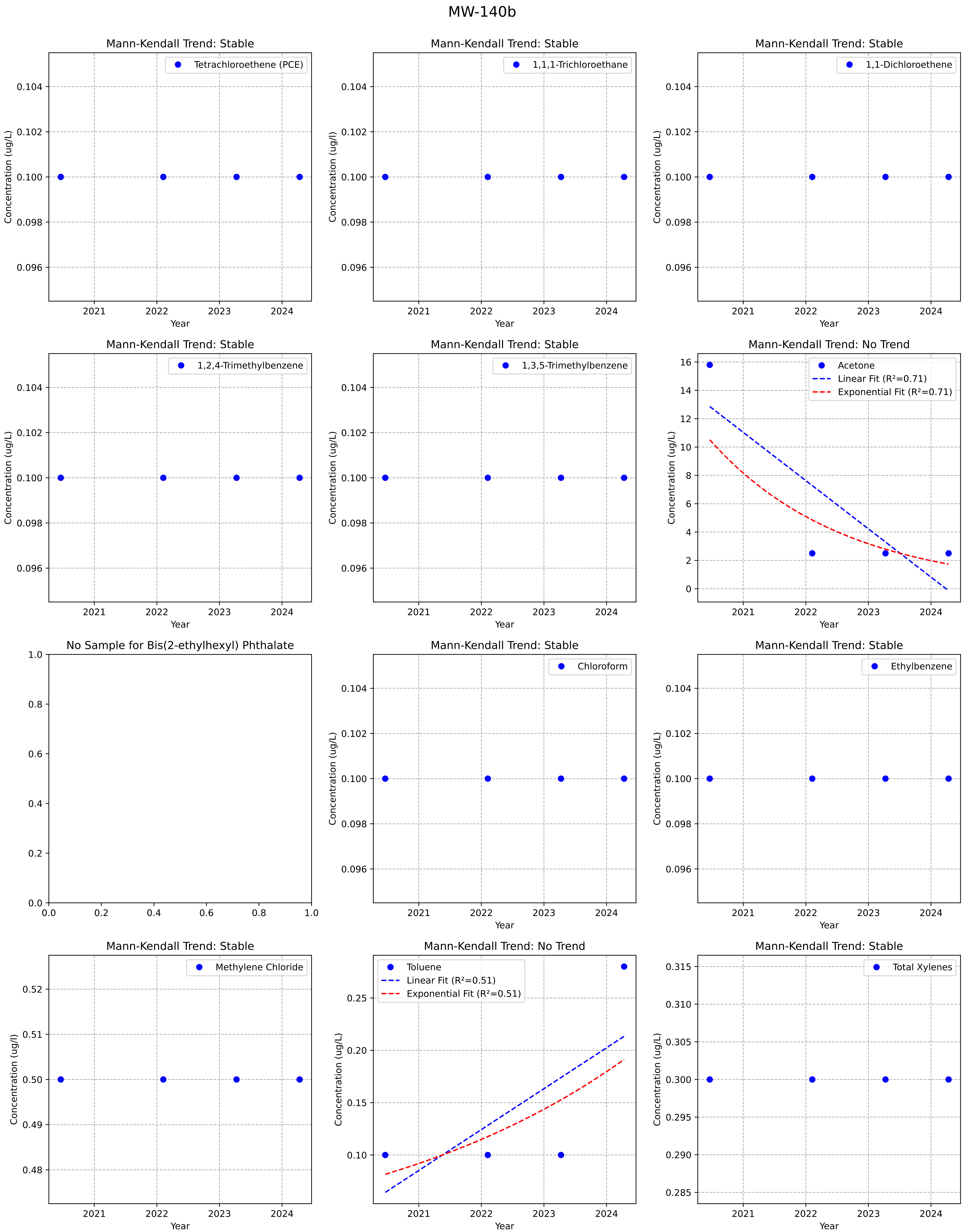

MW-133b
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.67)
Exponential Fit (R²=0.83)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Acetone
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Year

MW-135b

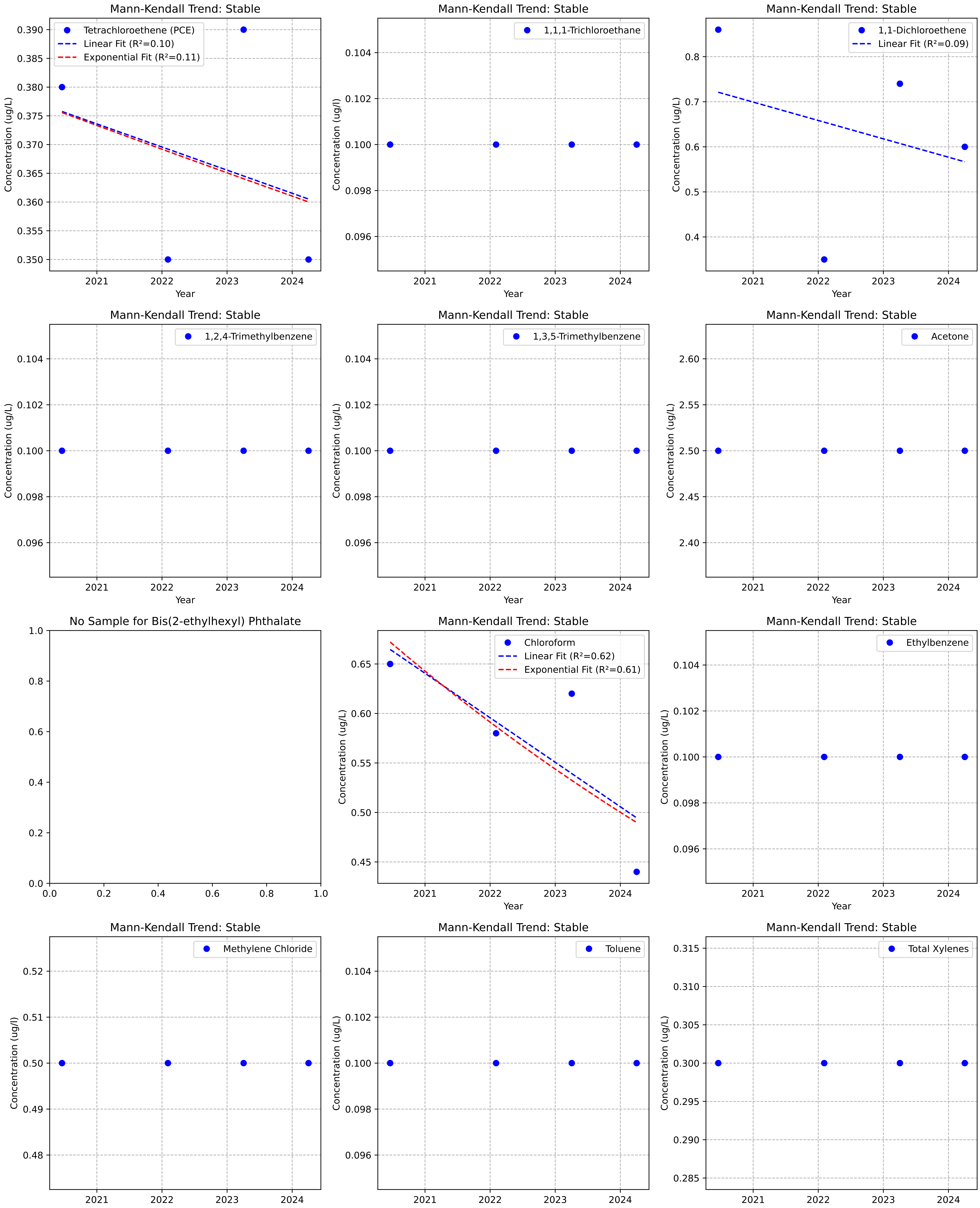

Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

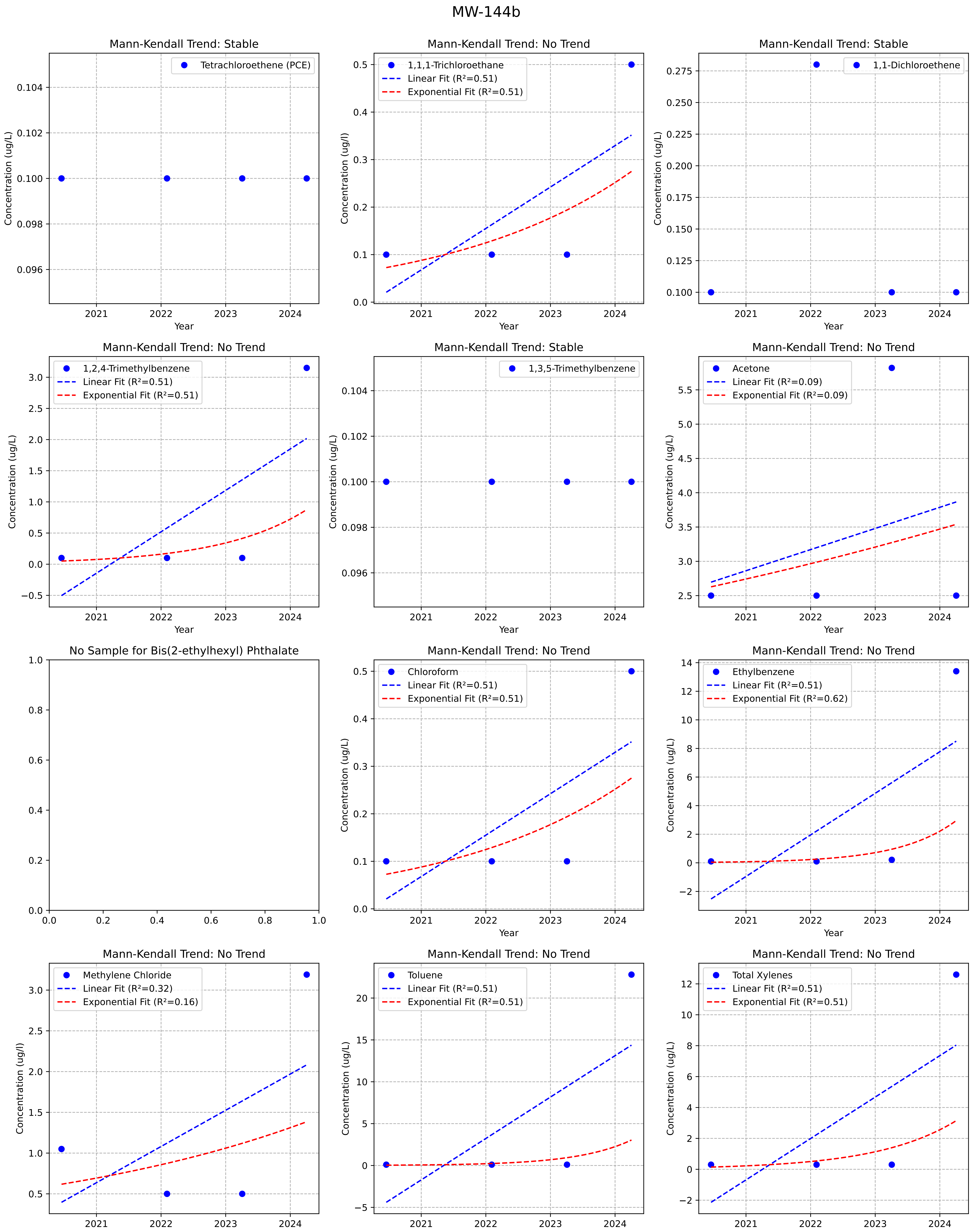
MW-139b


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

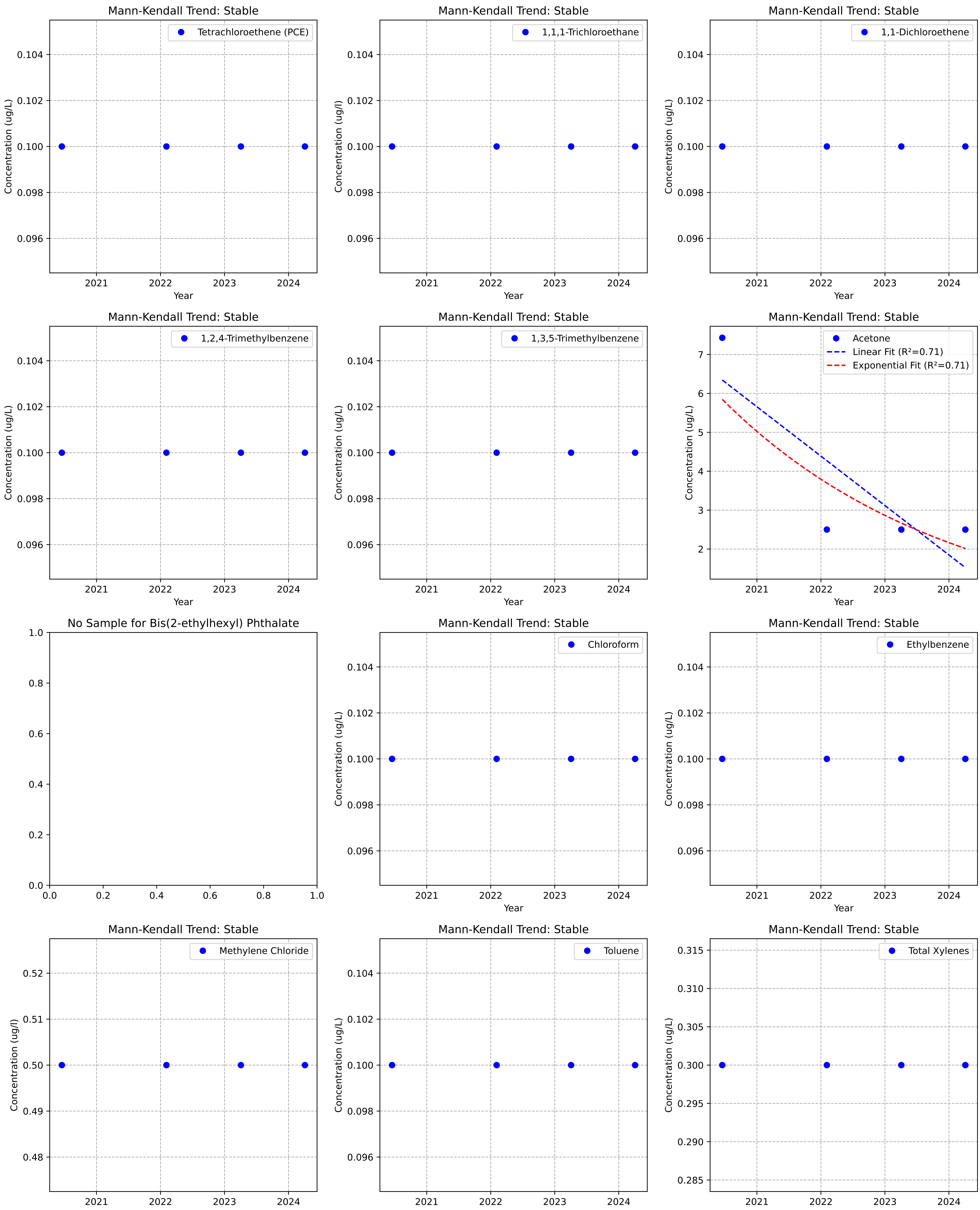

MW-140b
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-142b


Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.10)
Exponential Fit (R²=0.11)
Concentration (ug/L)
0.390
0.385
0.380
0.375
0.370
0.365
0.360
0.355
0.350
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Concentration (ug/l)
0.104
0.102
0.100
0.098
0.096
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.09)
Concentration (ug/L)
0.8
0.7
0.6
0.5
0.4
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
Acetone
Concentration (ug/L)
2.60
2.55
2.50
2.45
2.40
2021
2022
2023
2024
Year
No Sample for Bis(2-ethylhexyl) Phthalate
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.62)
Exponential Fit (R²=0.61)
Concentration (ug/L)
0.65
0.60
0.55
0.50
0.45
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
Ethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
Methylene Chloride
Concentration (ug/l)
0.52
0.51
0.50
0.49
0.48
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
Toluene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2021
2022
2023
2024
Year
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
0.315
0.310
0.305
0.300
0.295
0.290
0.285
2021
2022
2023
2024
Year

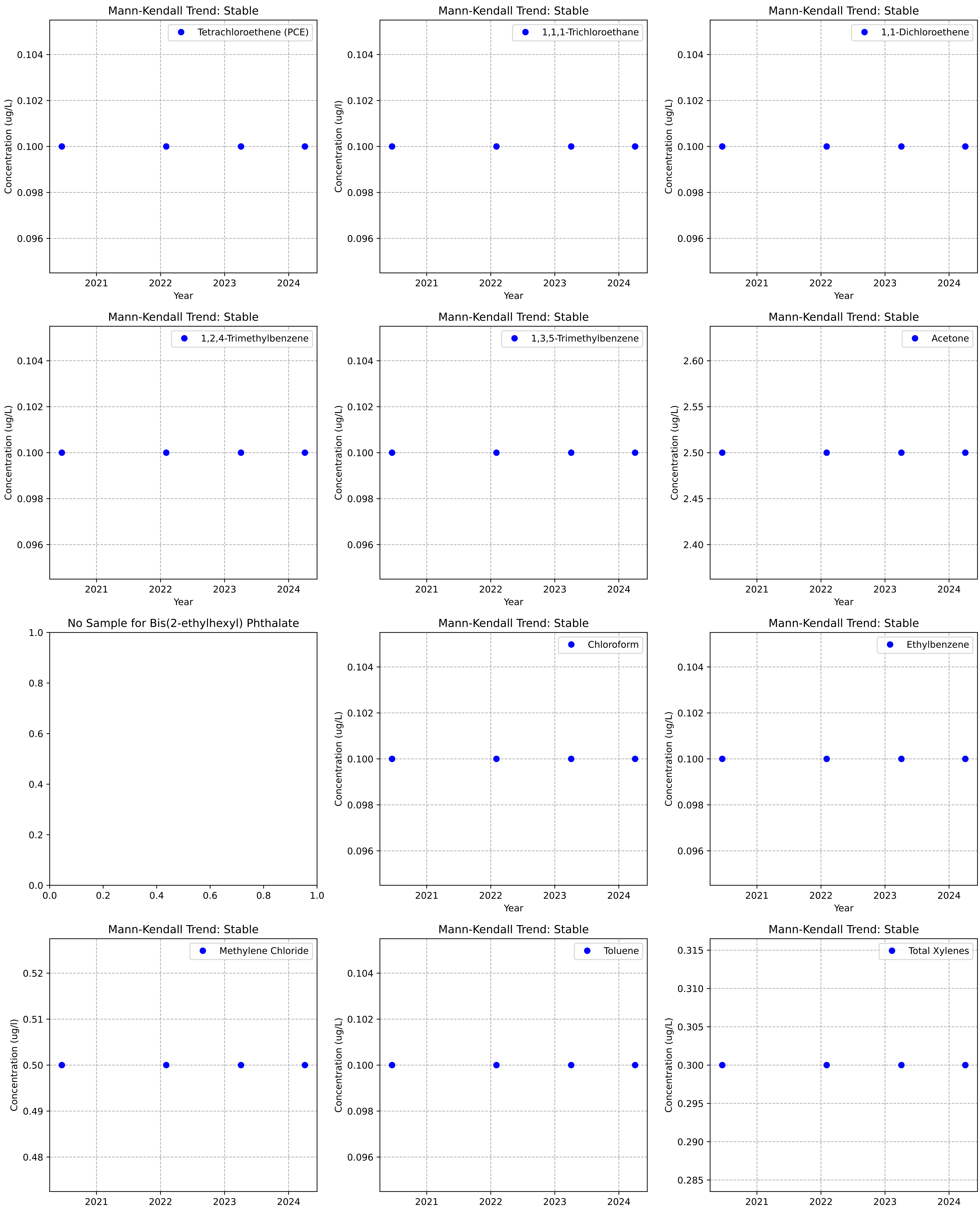

MW-144b
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: No Trend
Chloroform
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.62)
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.32)
Exponential Fit (R²=0.16)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

MW-145b



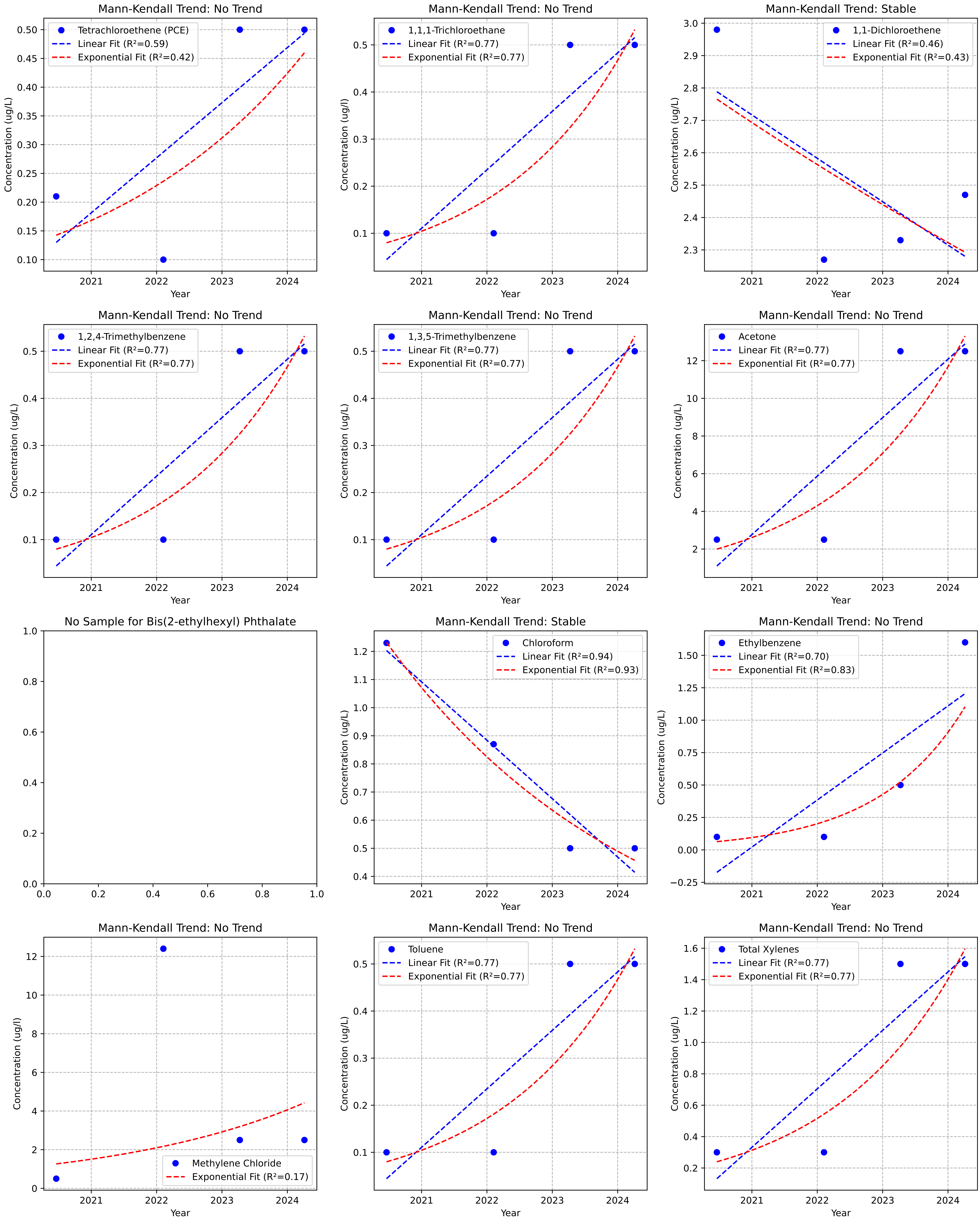
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Linear Fit (R²=0.71)
Exponential Fit (R²=0.71)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

MW-146b

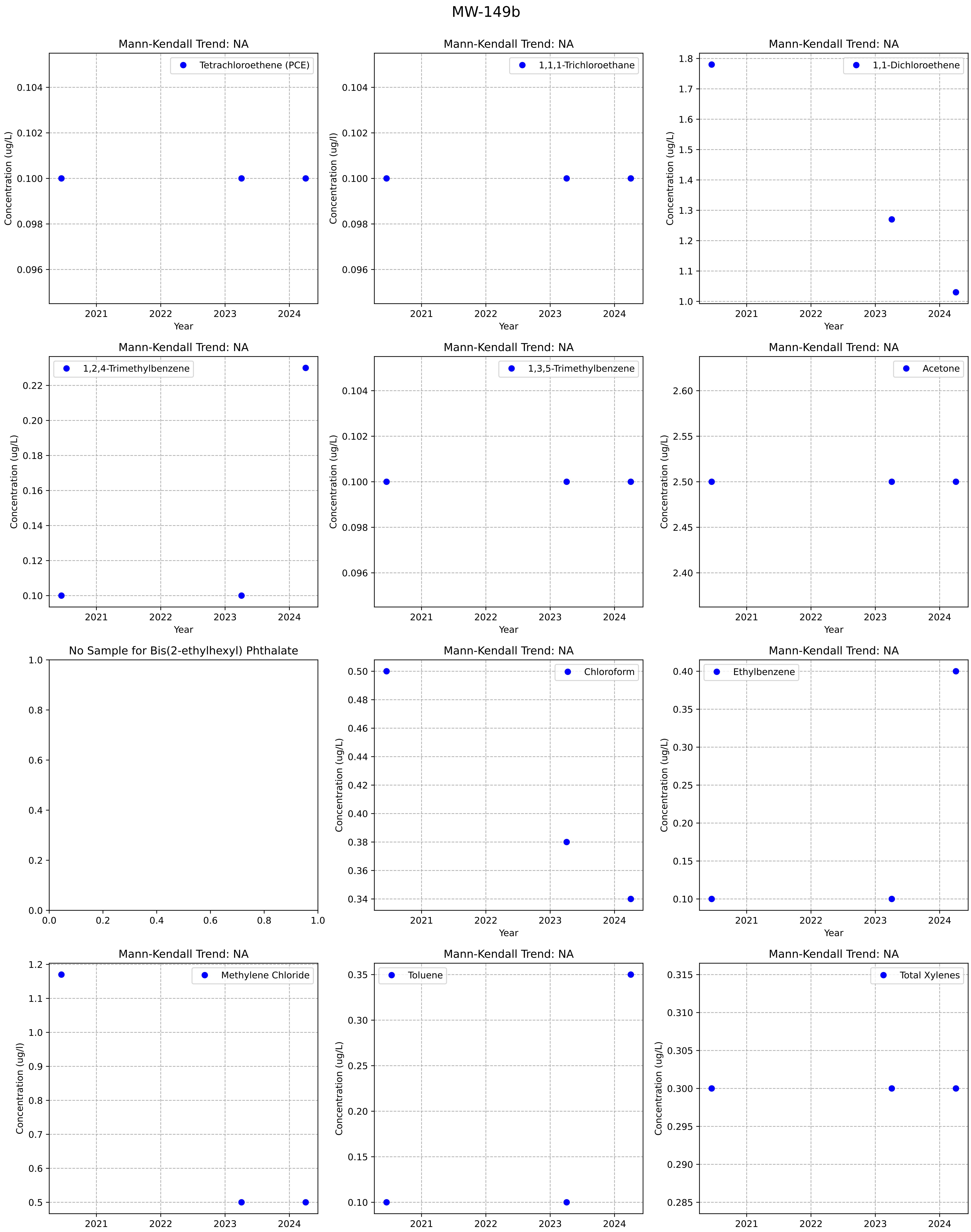


Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

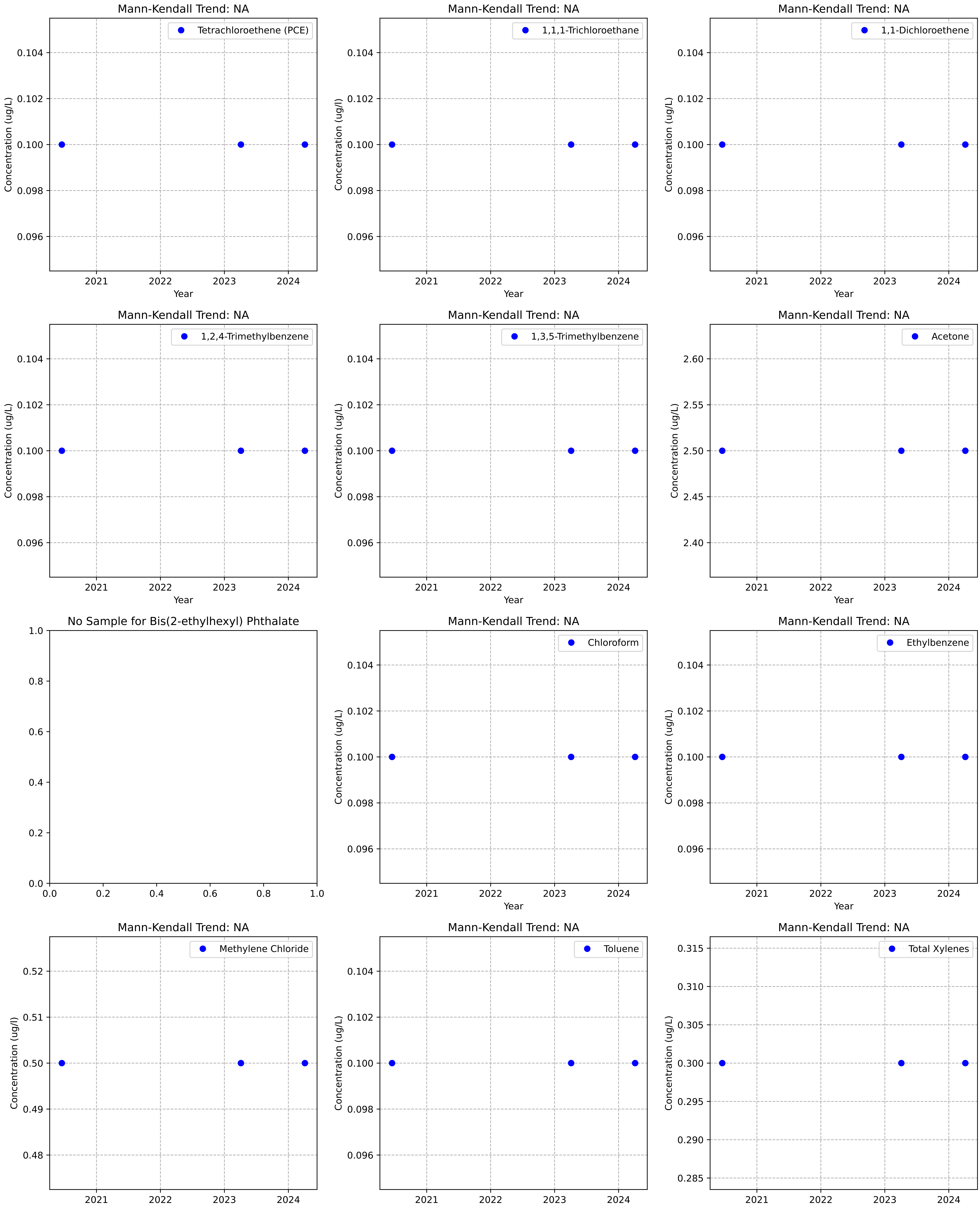
MW-148b



Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.59)
Exponential Fit (R²=0.42)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.46)
Exponential Fit (R²=0.43)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: No Trend
1,3,5-Trimethylbenzene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.94)
Exponential Fit (R²=0.93)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.70)
Exponential Fit (R²=0.83)
Mann-Kendall Trend: No Trend
Methylene Chloride
Exponential Fit (R²=0.17)
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Mann-Kendall Trend: No Trend
Total Xylenes
Linear Fit (R²=0.77)
Exponential Fit (R²=0.77)
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

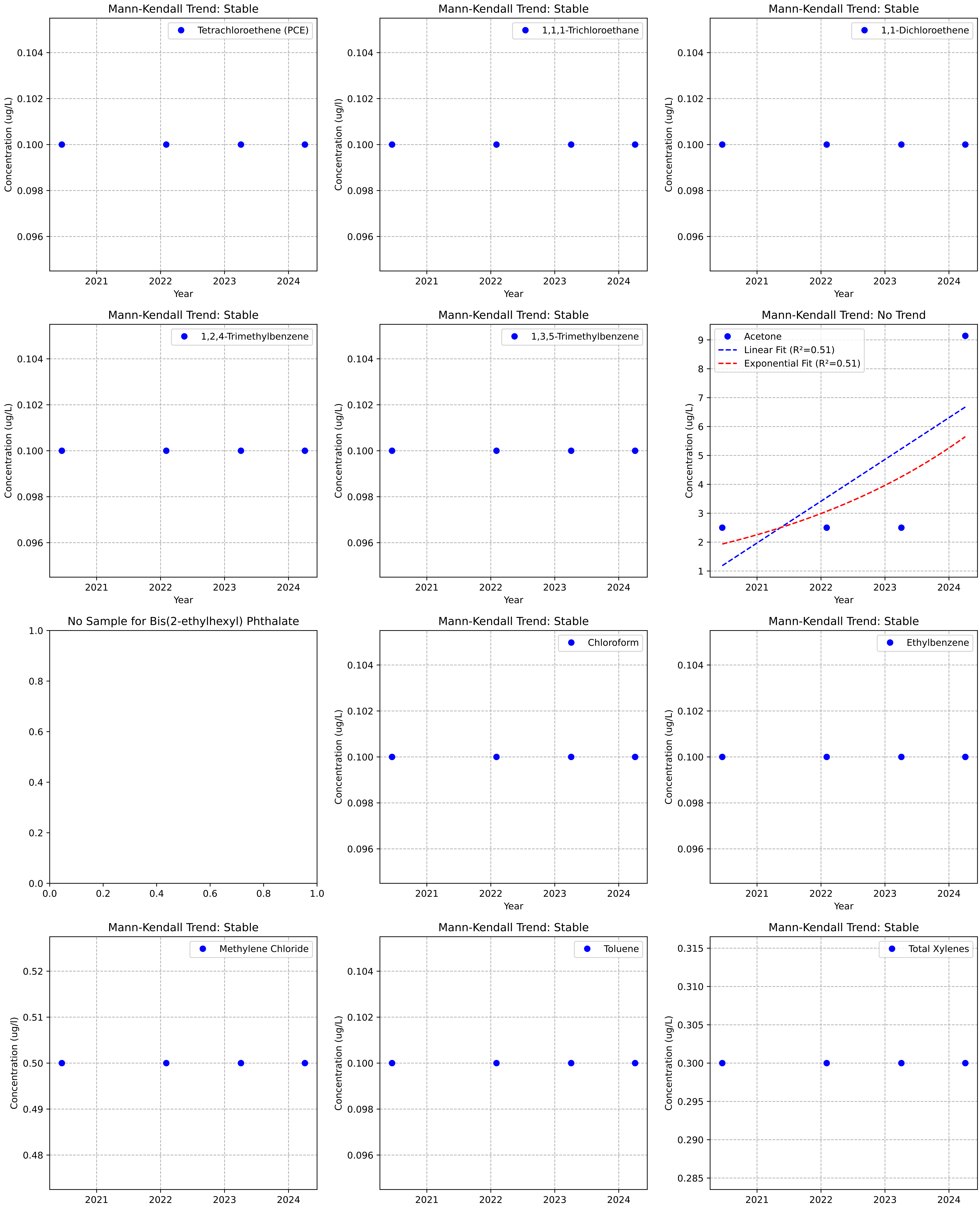

MW-149b
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-150b



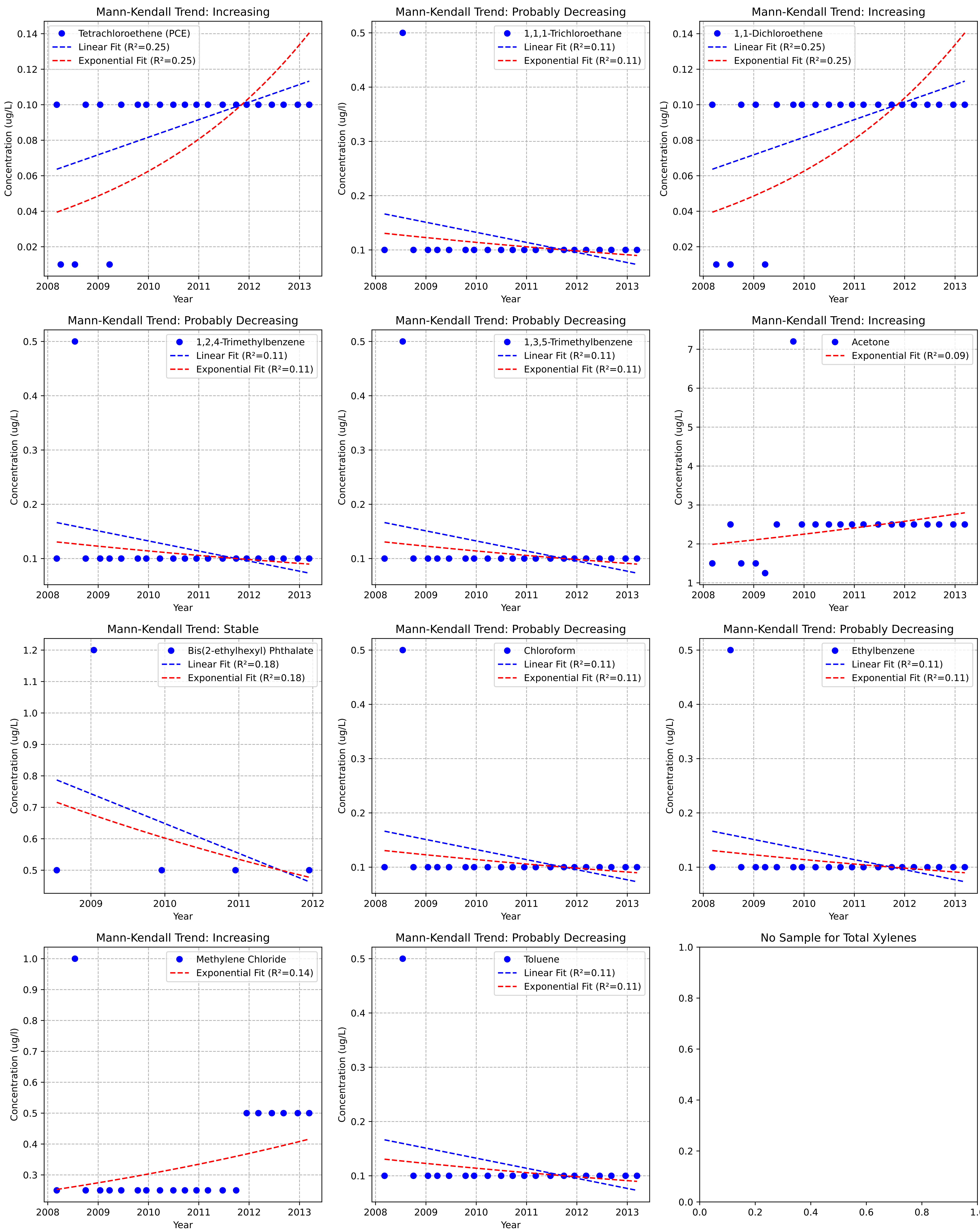
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-151b

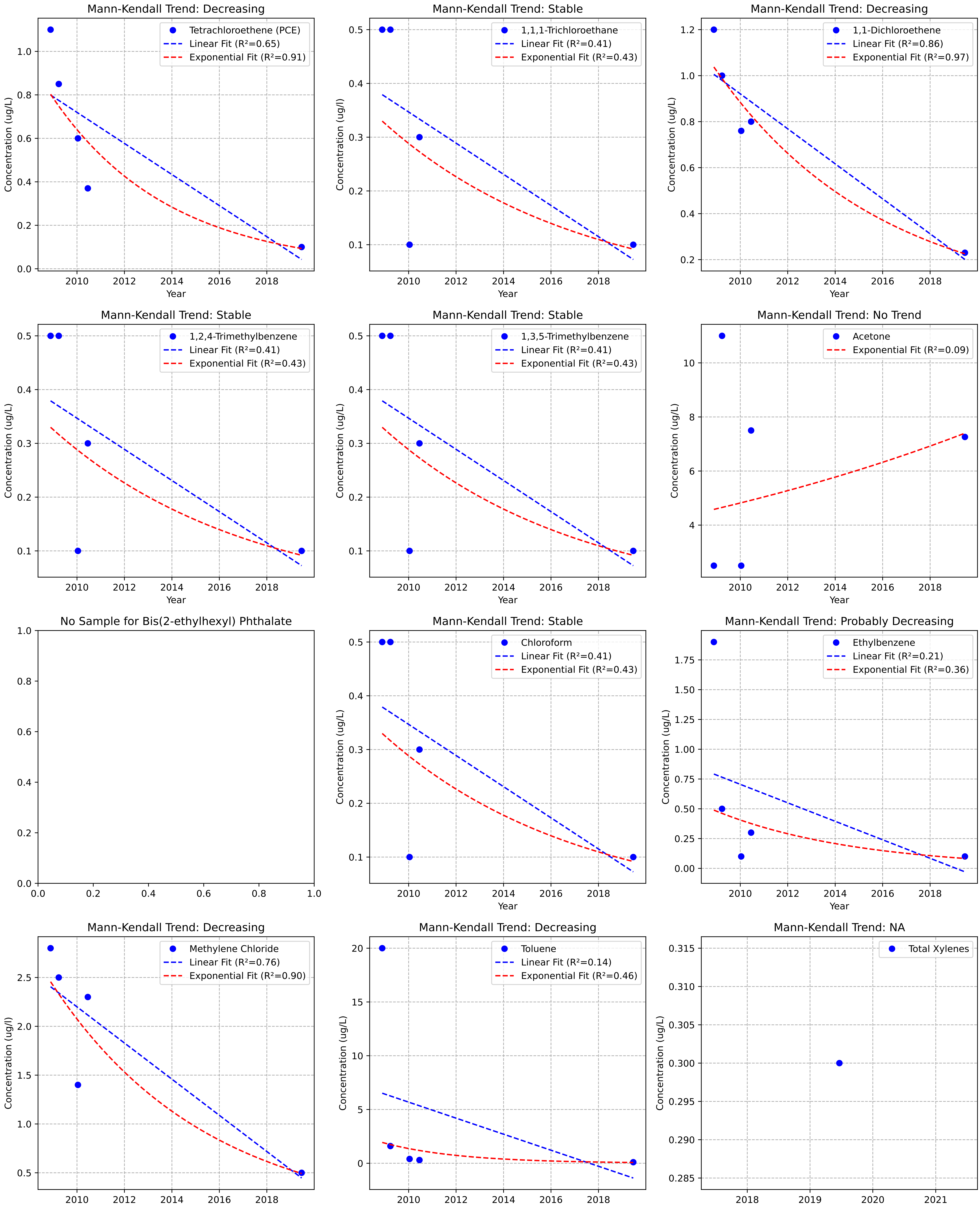


Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.51)
Exponential Fit (R²=0.51)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

MW-19b

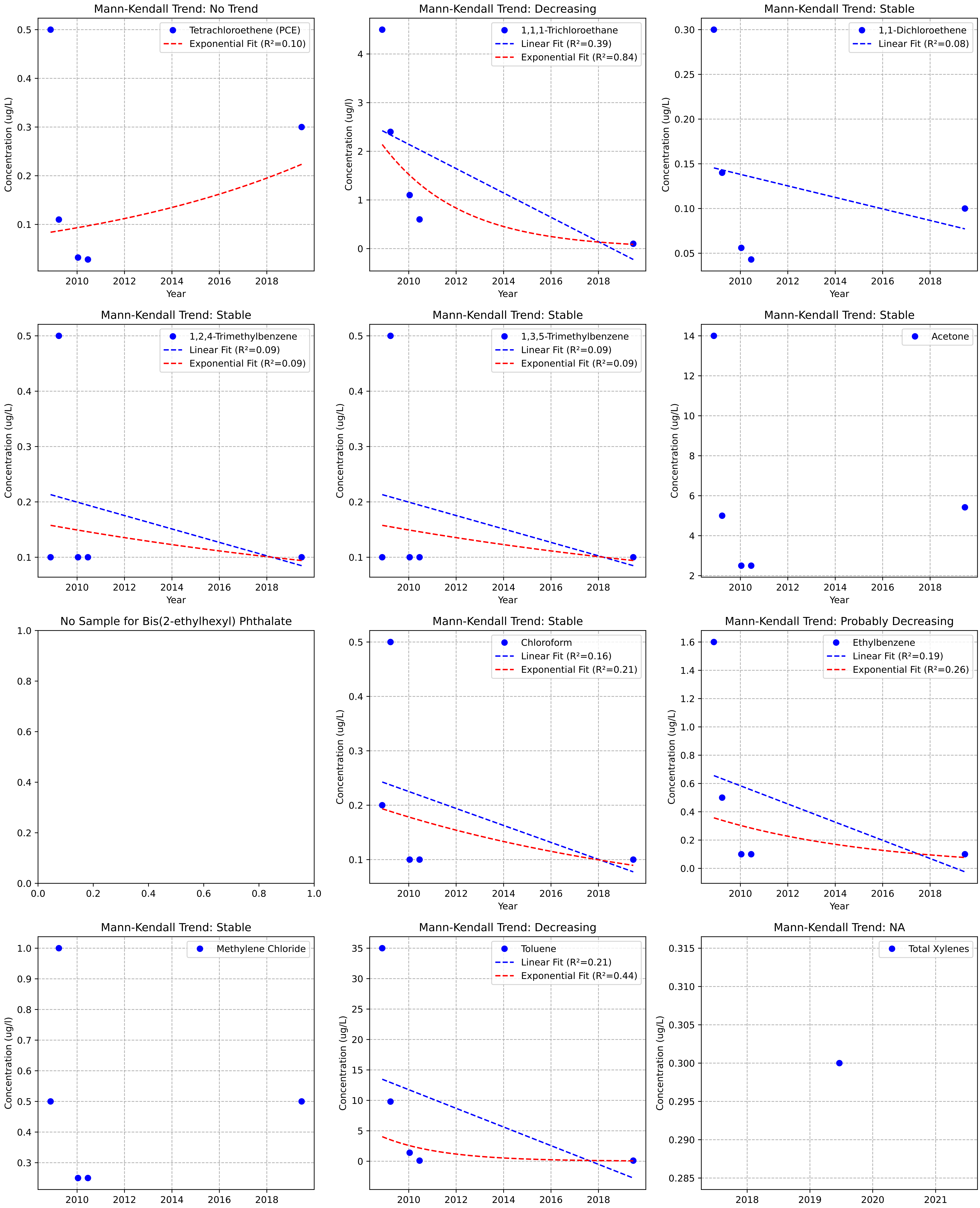

Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Mann-Kendall Trend: Probably Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Increasing
1,1-Dichloroethene
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Increasing
Acetone
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Stable
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.18)
Exponential Fit (R²=0.18)
Mann-Kendall Trend: Probably Decreasing
Chloroform
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Increasing
Methylene Chloride
Exponential Fit (R²=0.14)
Mann-Kendall Trend: Probably Decreasing
Toluene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-29b



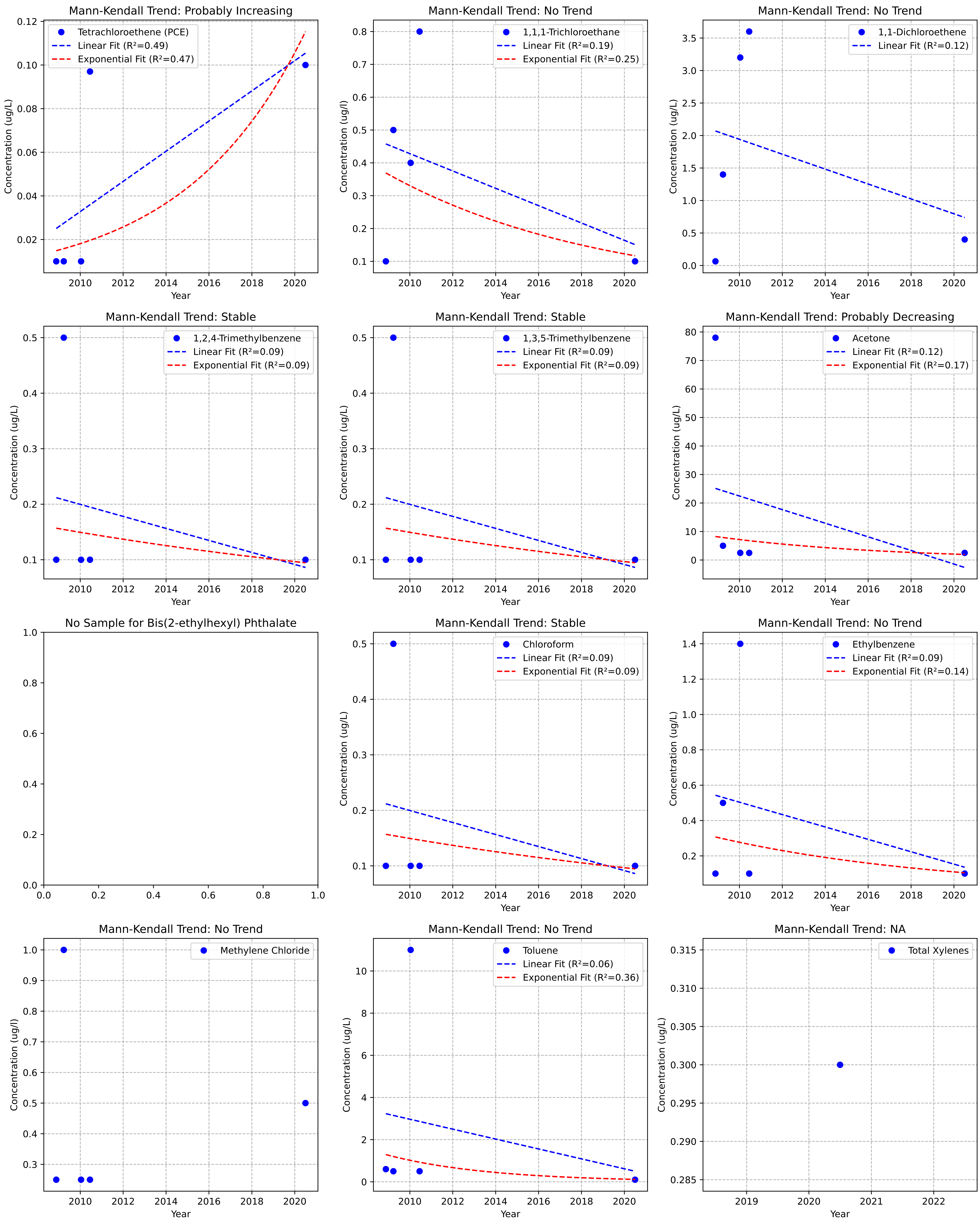
Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.65)
Exponential Fit (R²=0.91)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Linear Fit (R²=0.41)
Exponential Fit (R²=0.43)
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.86)
Exponential Fit (R²=0.97)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.41)
Exponential Fit (R²=0.43)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.41)
Exponential Fit (R²=0.43)
Mann-Kendall Trend: No Trend
Acetone
Exponential Fit (R²=0.09)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.41)
Exponential Fit (R²=0.43)
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Linear Fit (R²=0.21)
Exponential Fit (R²=0.36)
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.76)
Exponential Fit (R²=0.90)
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.14)
Exponential Fit (R²=0.46)
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Year

MW-30b



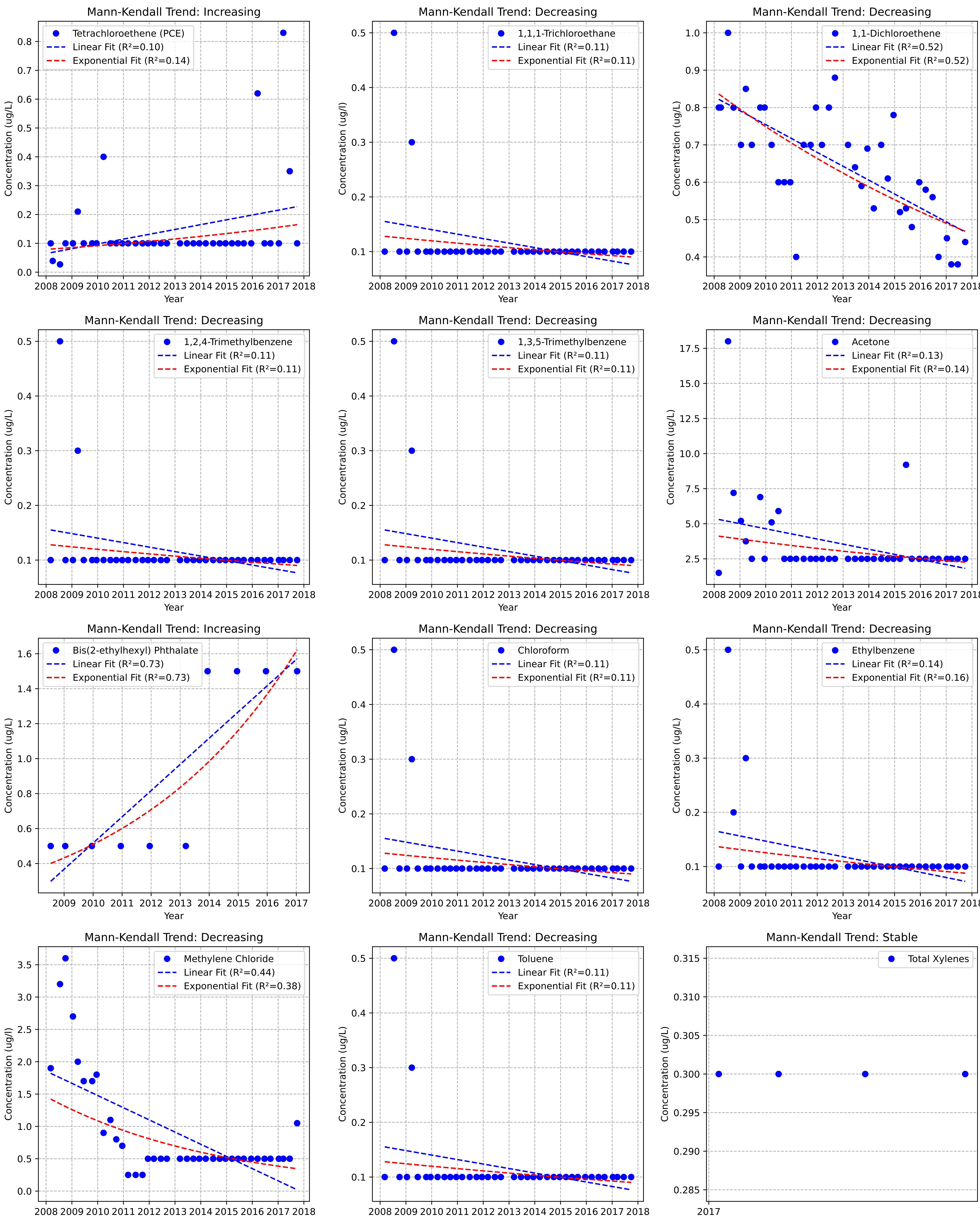
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Exponential Fit (R²=0.10)
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.39)
Exponential Fit (R²=0.84)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.08)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Stable
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.16)
Exponential Fit (R²=0.21)
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Linear Fit (R²=0.19)
Exponential Fit (R²=0.26)
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.21)
Exponential Fit (R²=0.44)
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-31b

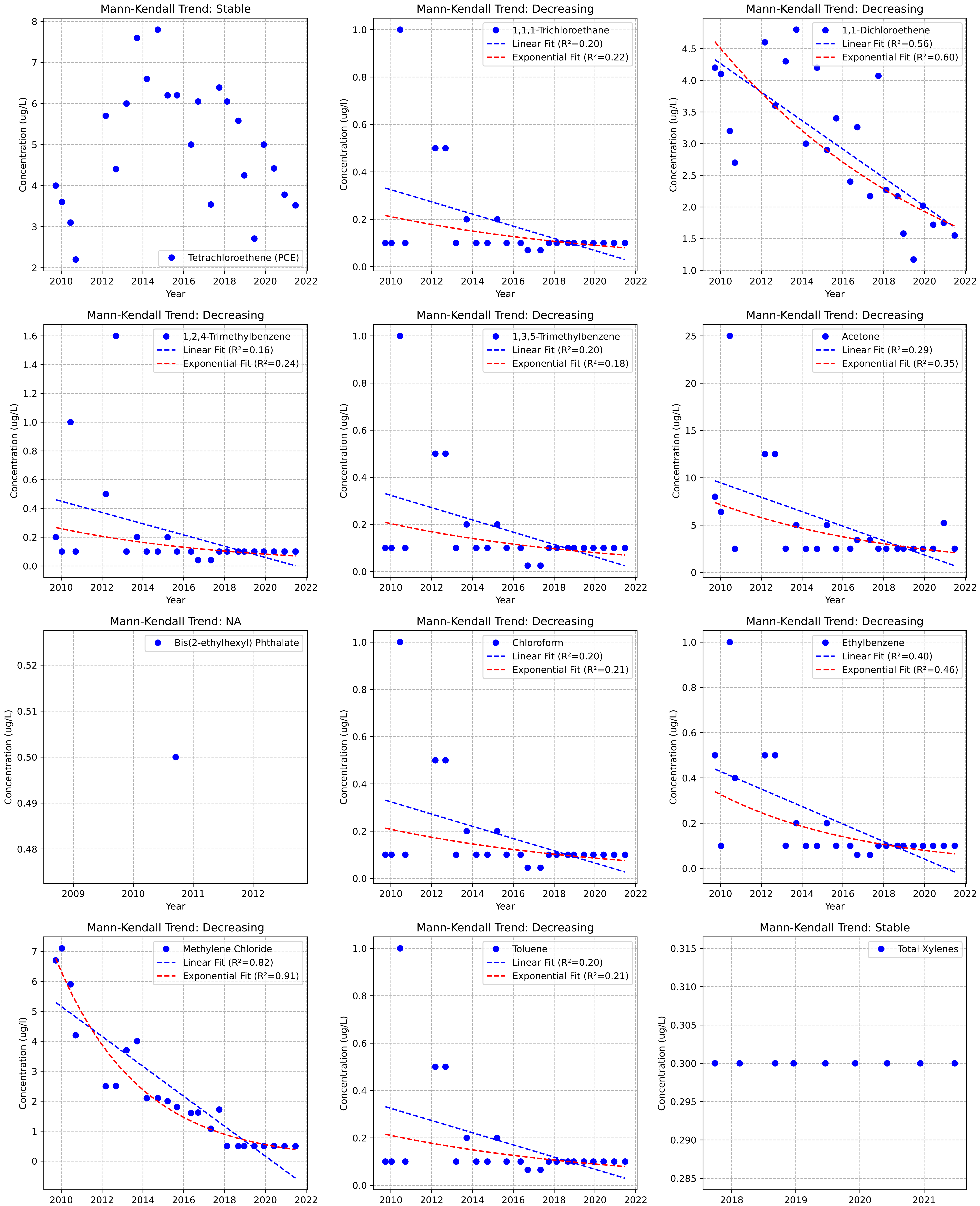


Mann-Kendall Trend: Probably Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.49)
Exponential Fit (R²=0.47)
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.19)
Exponential Fit (R²=0.25)
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.12)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Probably Decreasing
Acetone
Linear Fit (R²=0.12)
Exponential Fit (R²=0.17)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.14)
Mann-Kendall Trend: No Trend
Methylene Chloride
Mann-Kendall Trend: No Trend
Toluene
Linear Fit (R²=0.06)
Exponential Fit (R²=0.36)
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-3b

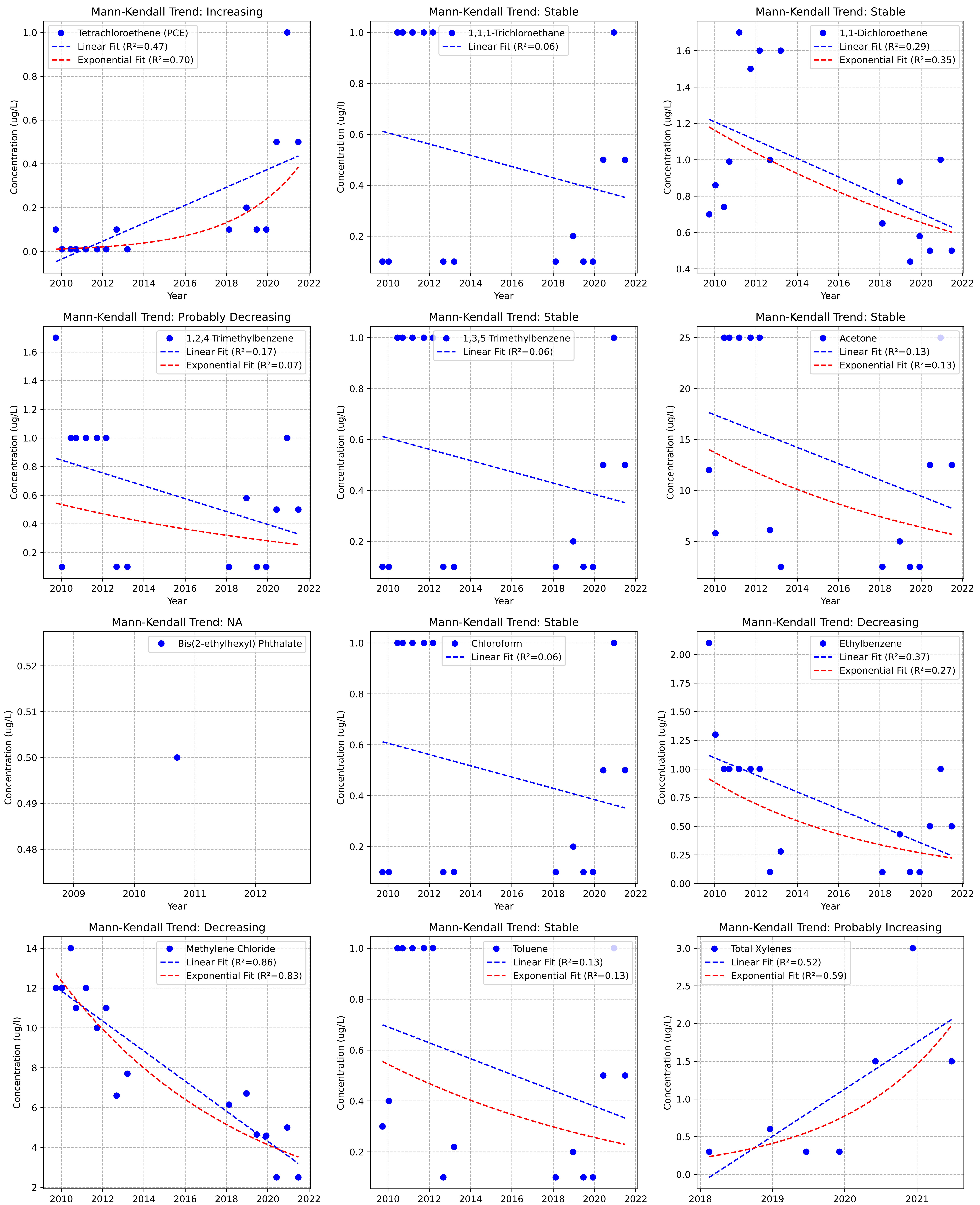

Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.10)
Exponential Fit (R²=0.14)
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.52)
Exponential Fit (R²=0.52)
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Decreasing
Acetone
Linear Fit (R²=0.13)
Exponential Fit (R²=0.14)
Mann-Kendall Trend: Increasing
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.73)
Exponential Fit (R²=0.73)
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.14)
Exponential Fit (R²=0.16)
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.44)
Exponential Fit (R²=0.38)
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.11)
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-42b



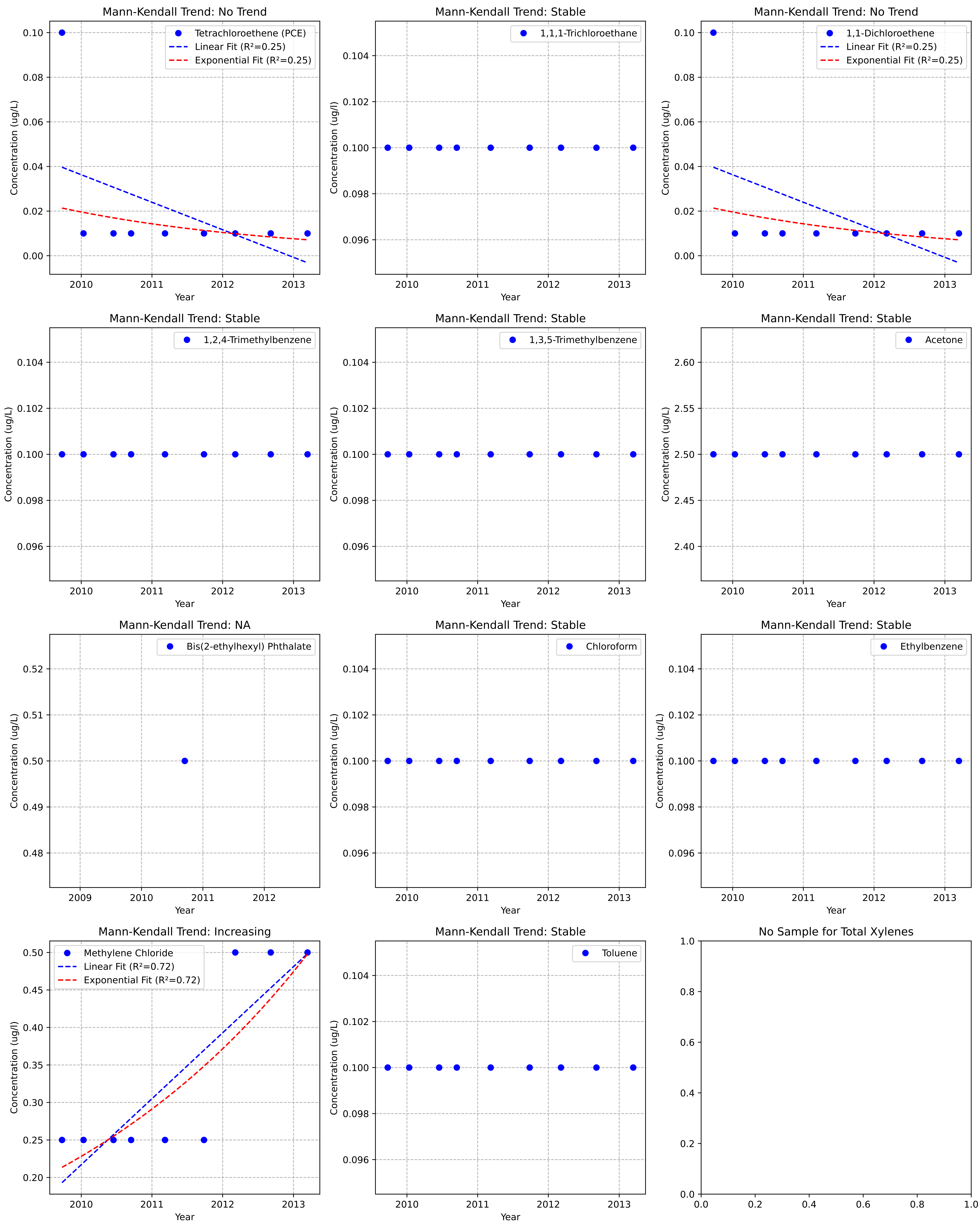
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Decreasing
1,1,1-Trichloroethane
Linear Fit (R²=0.20)
Exponential Fit (R²=0.22)
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.56)
Exponential Fit (R²=0.60)
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.16)
Exponential Fit (R²=0.24)
Mann-Kendall Trend: Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.20)
Exponential Fit (R²=0.18)
Mann-Kendall Trend: Decreasing
Acetone
Linear Fit (R²=0.29)
Exponential Fit (R²=0.35)
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.20)
Exponential Fit (R²=0.21)
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.40)
Exponential Fit (R²=0.46)
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.82)
Exponential Fit (R²=0.91)
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.20)
Exponential Fit (R²=0.21)
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

MW-44b



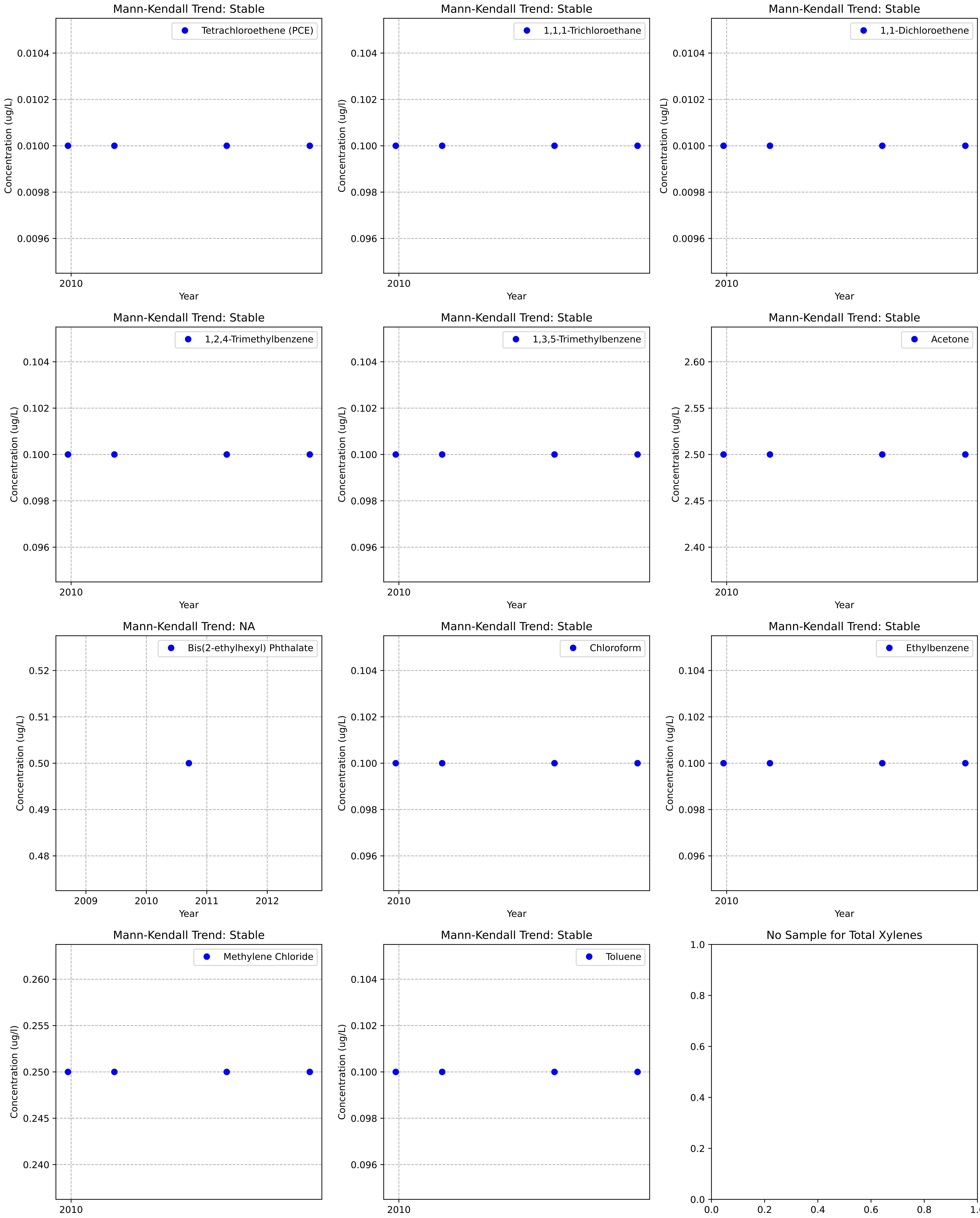
Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.47)
Exponential Fit (R²=0.70)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Linear Fit (R²=0.06)
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Linear Fit (R²=0.29)
Exponential Fit (R²=0.35)
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.17)
Exponential Fit (R²=0.07)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Linear Fit (R²=0.06)
Mann-Kendall Trend: Stable
Acetone
Linear Fit (R²=0.13)
Exponential Fit (R²=0.13)
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Linear Fit (R²=0.06)
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.37)
Exponential Fit (R²=0.27)
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.86)
Exponential Fit (R²=0.83)
Mann-Kendall Trend: Stable
Toluene
Linear Fit (R²=0.13)
Exponential Fit (R²=0.13)
Mann-Kendall Trend: Probably Increasing
Total Xylenes
Linear Fit (R²=0.52)
Exponential Fit (R²=0.59)
Concentration (ug/L)
Concentration (ug/l)
Year

MW-48b



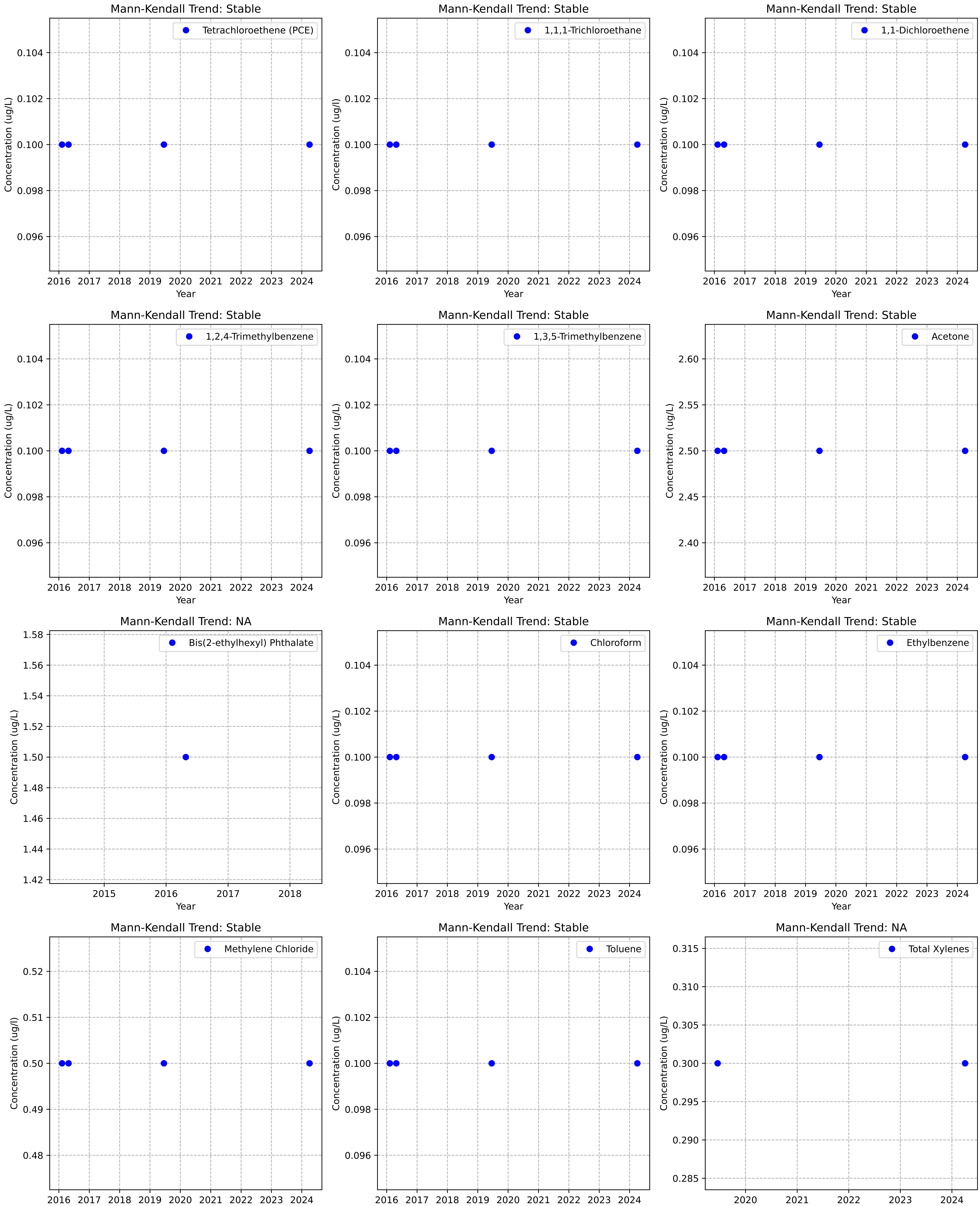
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.25)
Exponential Fit (R²=0.25)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.72)
Exponential Fit (R²=0.72)
Mann-Kendall Trend: Stable
Toluene
No Sample for Total Xylenes
Concentration (ug/L)
Year

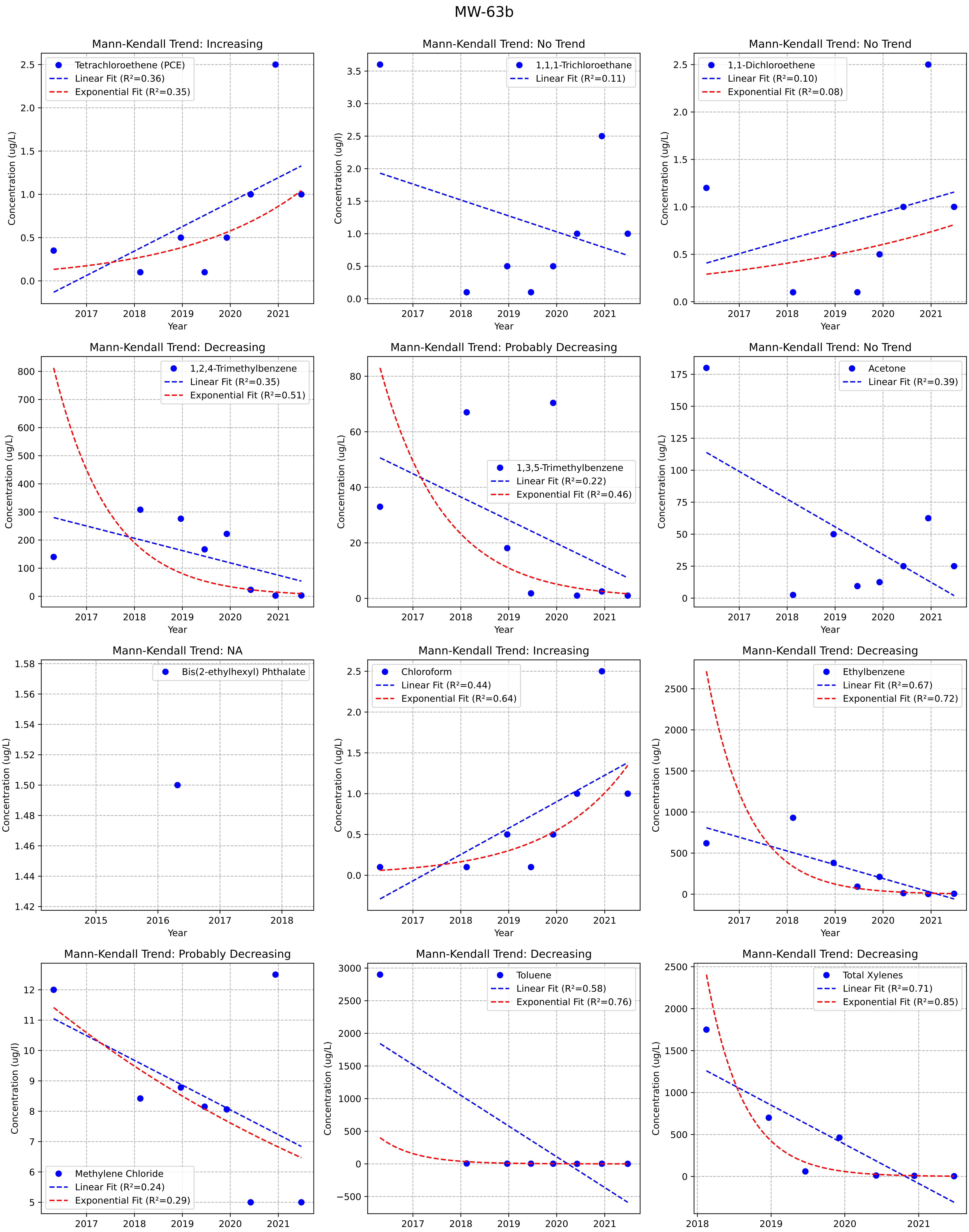
MW-51b



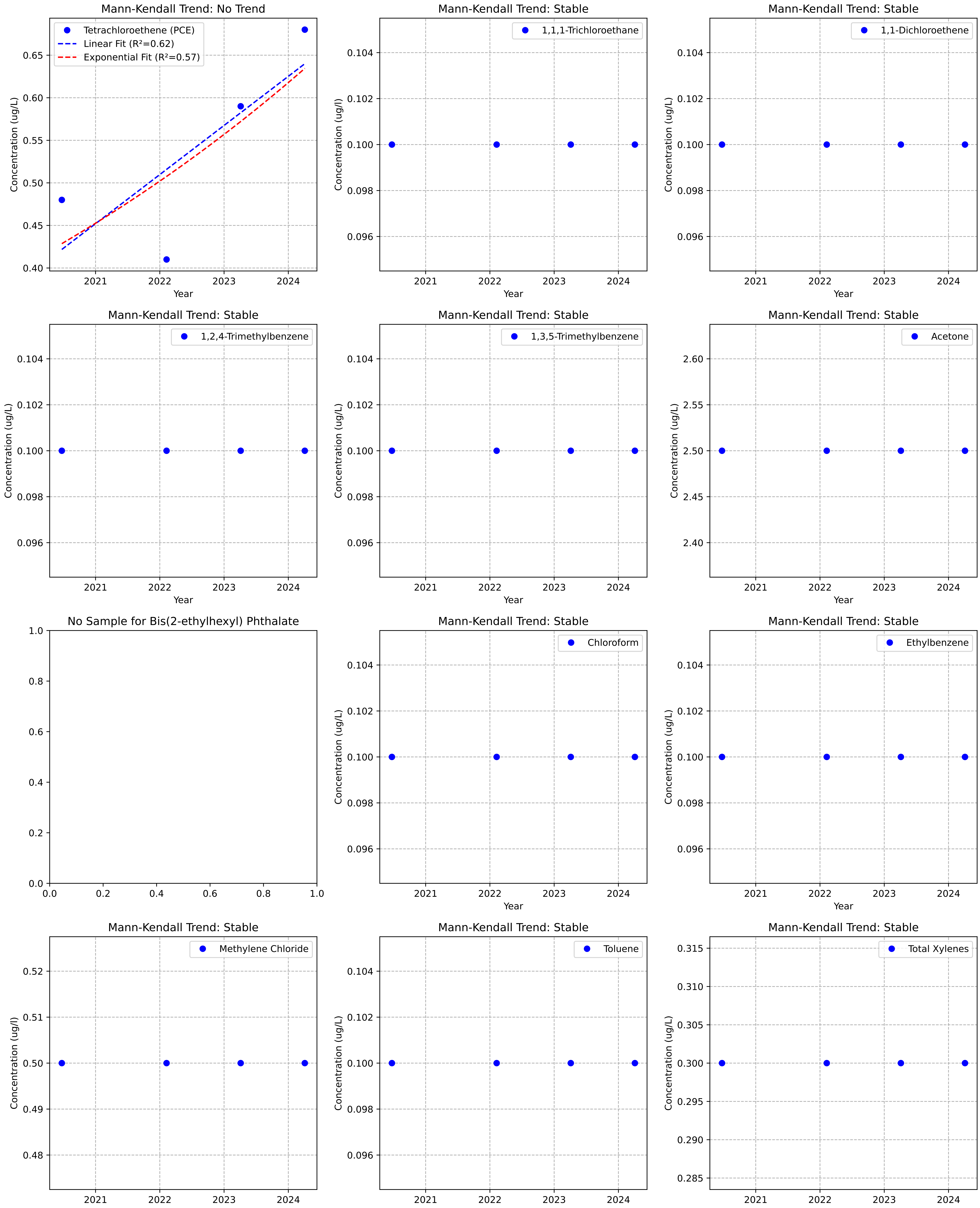
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Concentration (ug/L)
0.0104
0.0102
0.0100
0.0098
0.0096
2010
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Concentration (ug/l)
0.104
0.102
0.100
0.098
0.096
2010
Year
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Concentration (ug/L)
0.0104
0.0102
0.0100
0.0098
0.0096
2010
Year
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2010
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2010
Year
Mann-Kendall Trend: Stable
Acetone
Concentration (ug/L)
2.60
2.55
2.50
2.45
2.40
2010
Year
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Concentration (ug/L)
0.52
0.51
0.50
0.49
0.48
2009
2010
2011
2012
Year
Mann-Kendall Trend: Stable
Chloroform
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2010
Year
Mann-Kendall Trend: Stable
Ethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2010
Year
Mann-Kendall Trend: Stable
Methylene Chloride
Concentration (ug/l)
0.260
0.255
0.250
0.245
0.240
2010
Year
Mann-Kendall Trend: Stable
Toluene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2010
Year
No Sample for Total Xylenes
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

MW-57b


Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

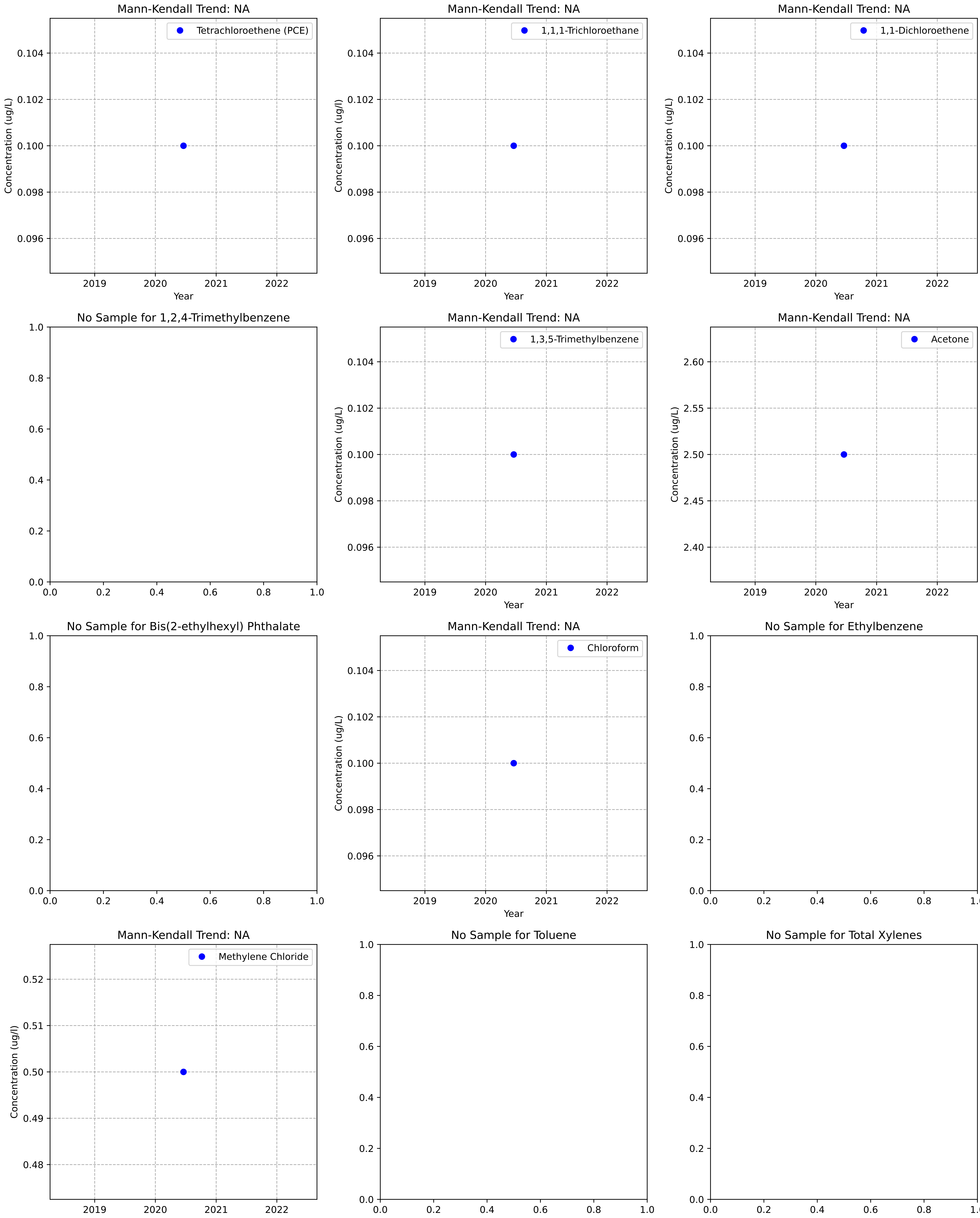

MW-63b
Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.36)
Exponential Fit (R²=0.35)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
1,1,1-Trichloroethane
Linear Fit (R²=0.11)
Concentration (ug/l)
Year
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.10)
Exponential Fit (R²=0.08)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
1,2,4-Trimethylbenzene
Linear Fit (R²=0.35)
Exponential Fit (R²=0.51)
Concentration (ug/L)
Year
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Linear Fit (R²=0.22)
Exponential Fit (R²=0.46)
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Acetone
Linear Fit (R²=0.39)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
Chloroform
Linear Fit (R²=0.44)
Exponential Fit (R²=0.64)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Ethylbenzene
Linear Fit (R²=0.67)
Exponential Fit (R²=0.72)
Concentration (ug/L)
Year
Mann-Kendall Trend: Probably Decreasing
Methylene Chloride
Linear Fit (R²=0.24)
Exponential Fit (R²=0.29)
Concentration (ug/l)
Year
Mann-Kendall Trend: Decreasing
Toluene
Linear Fit (R²=0.58)
Exponential Fit (R²=0.76)
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Total Xylenes
Linear Fit (R²=0.71)
Exponential Fit (R²=0.85)
Concentration (ug/L)
Year

MW-71b

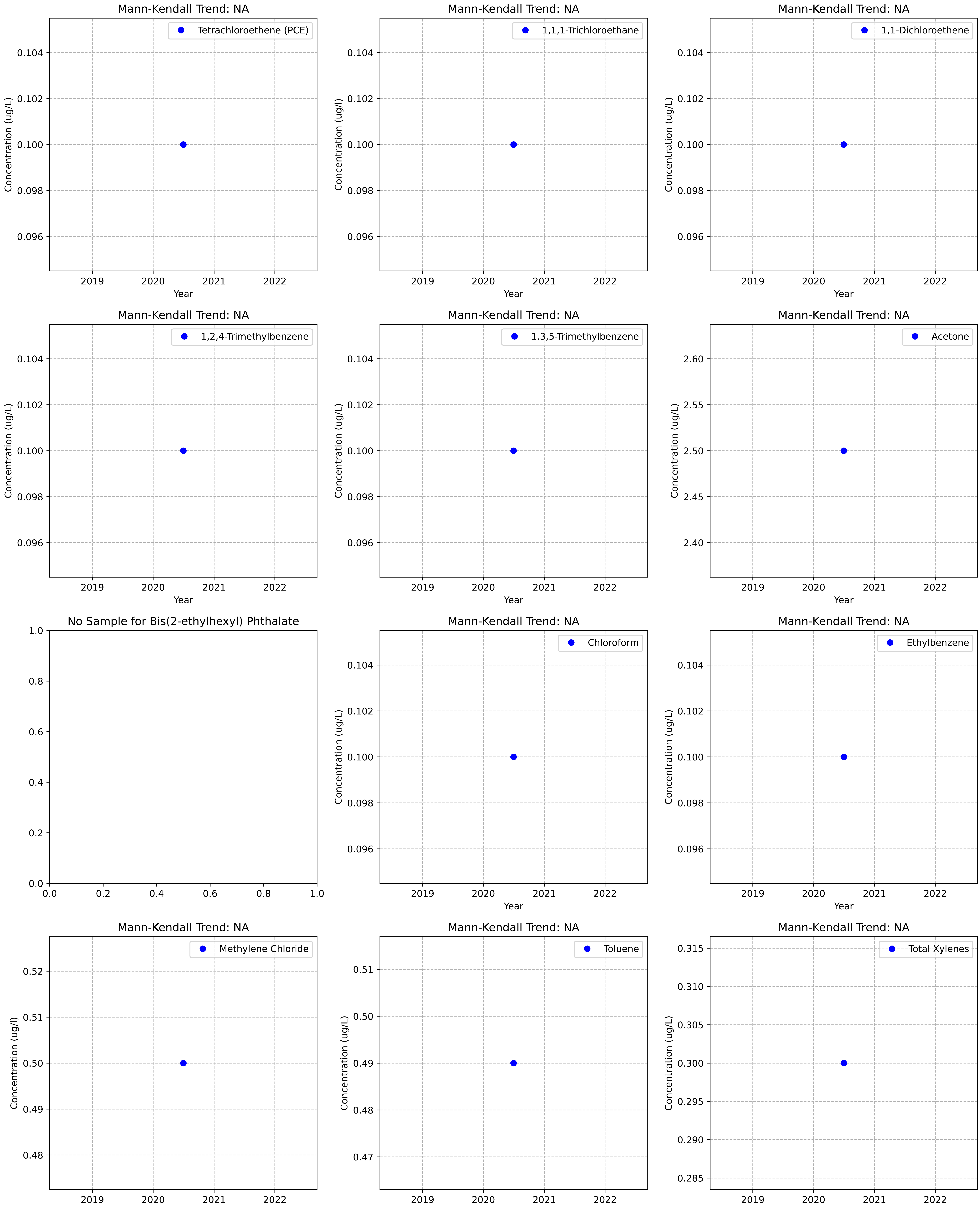


Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.62)
Exponential Fit (R²=0.57)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

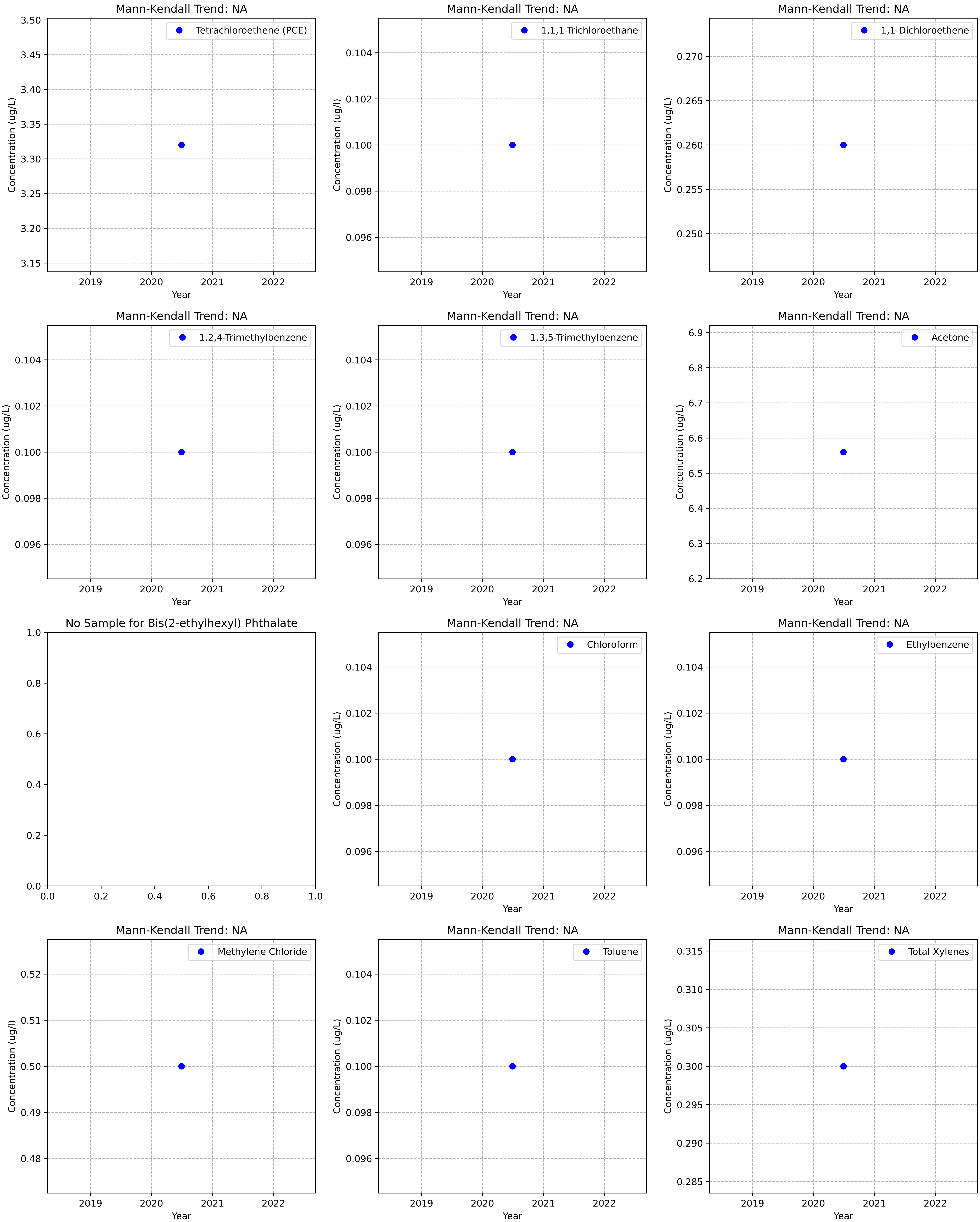
MW-72b


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
No Sample for 1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
No Sample for Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
No Sample for Toluene
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

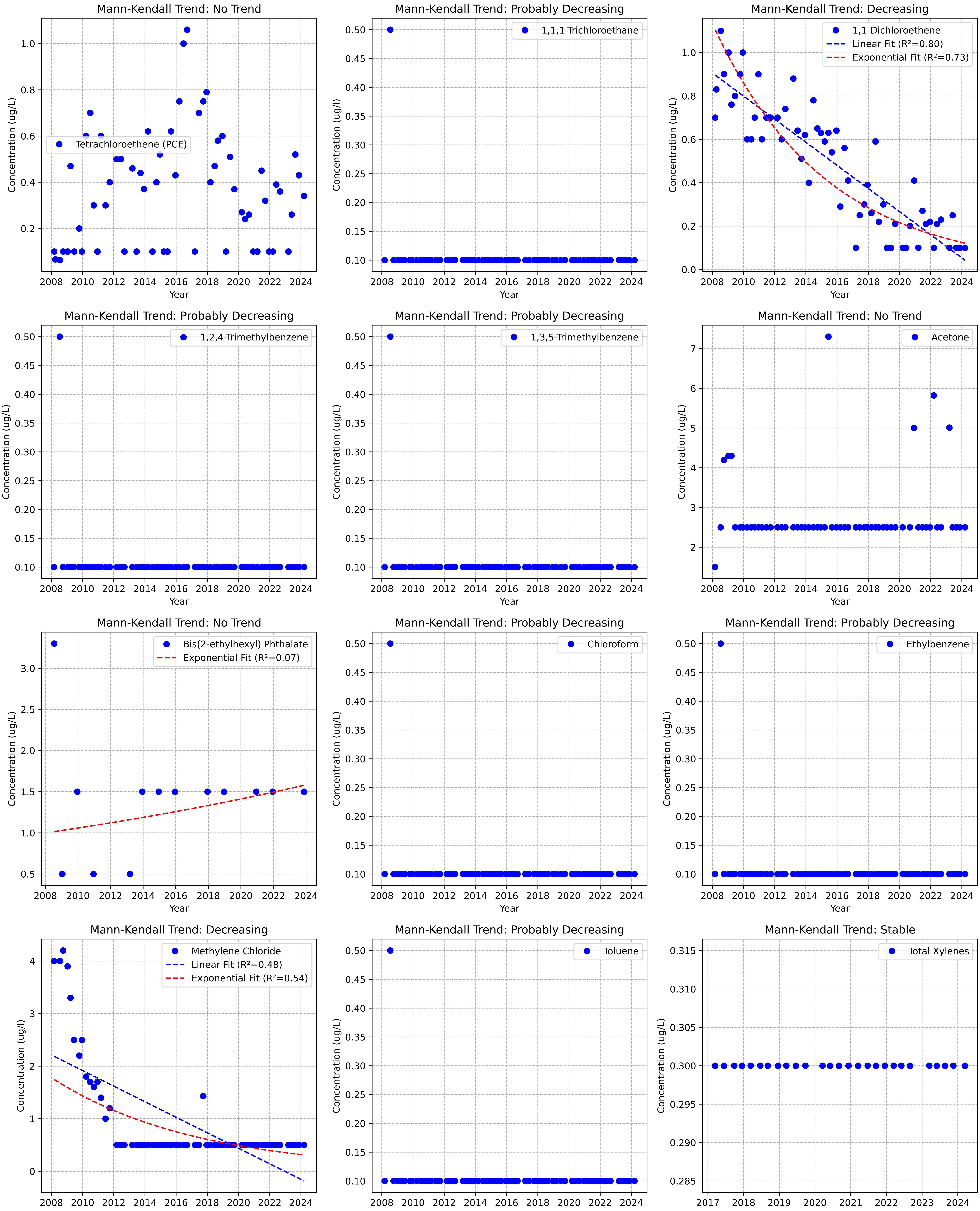
MW-74b

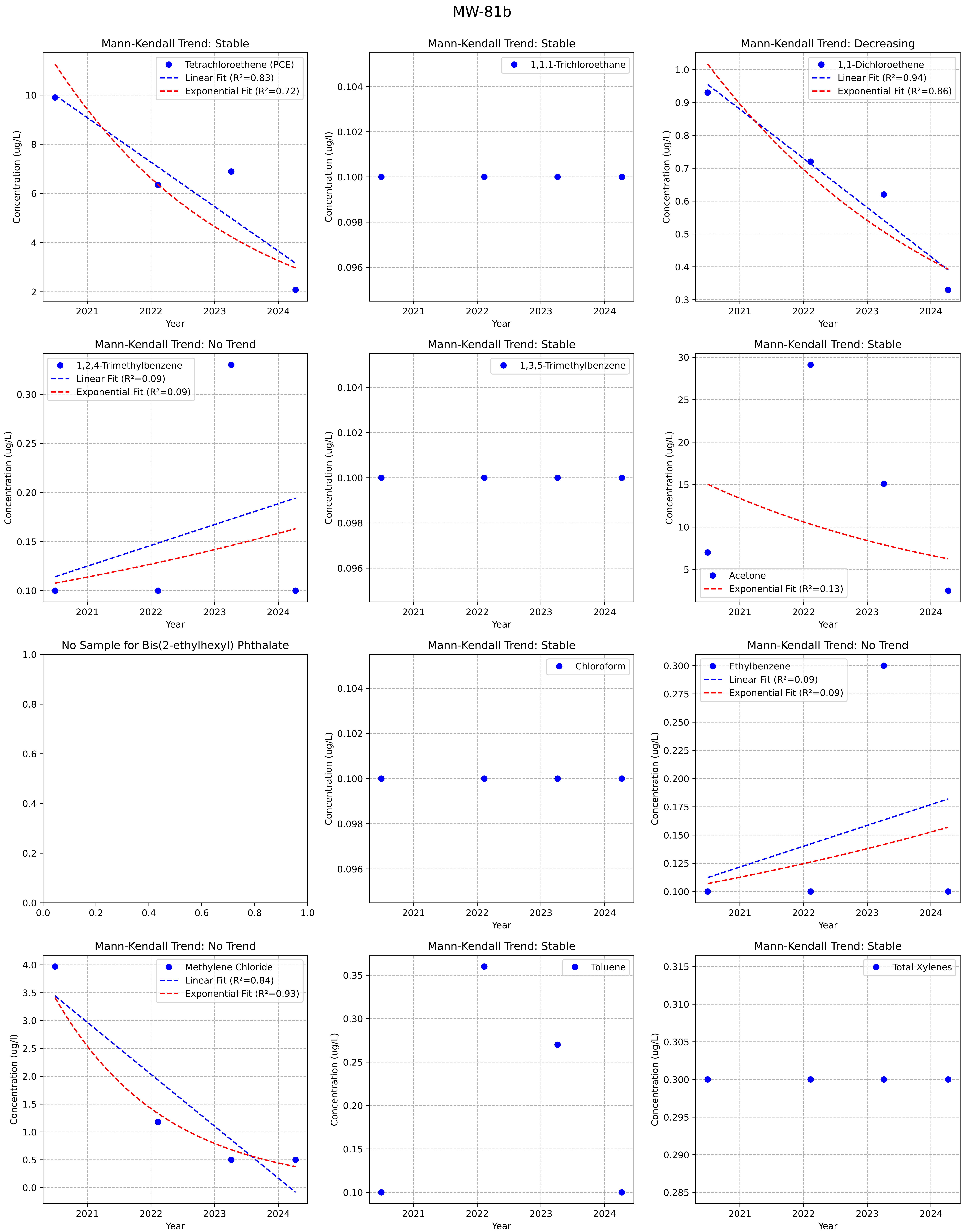

Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

MW-78b

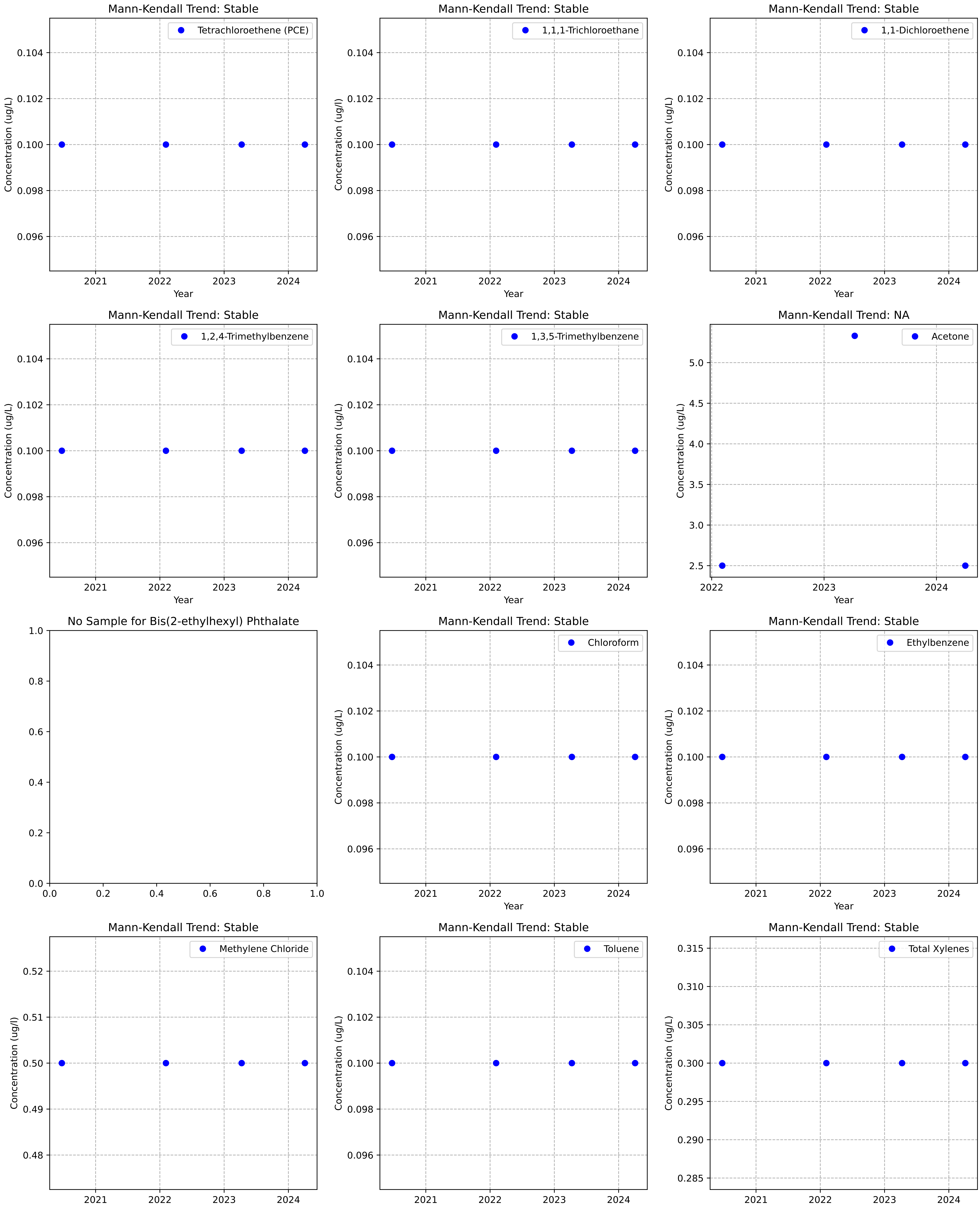

Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

MW-7b

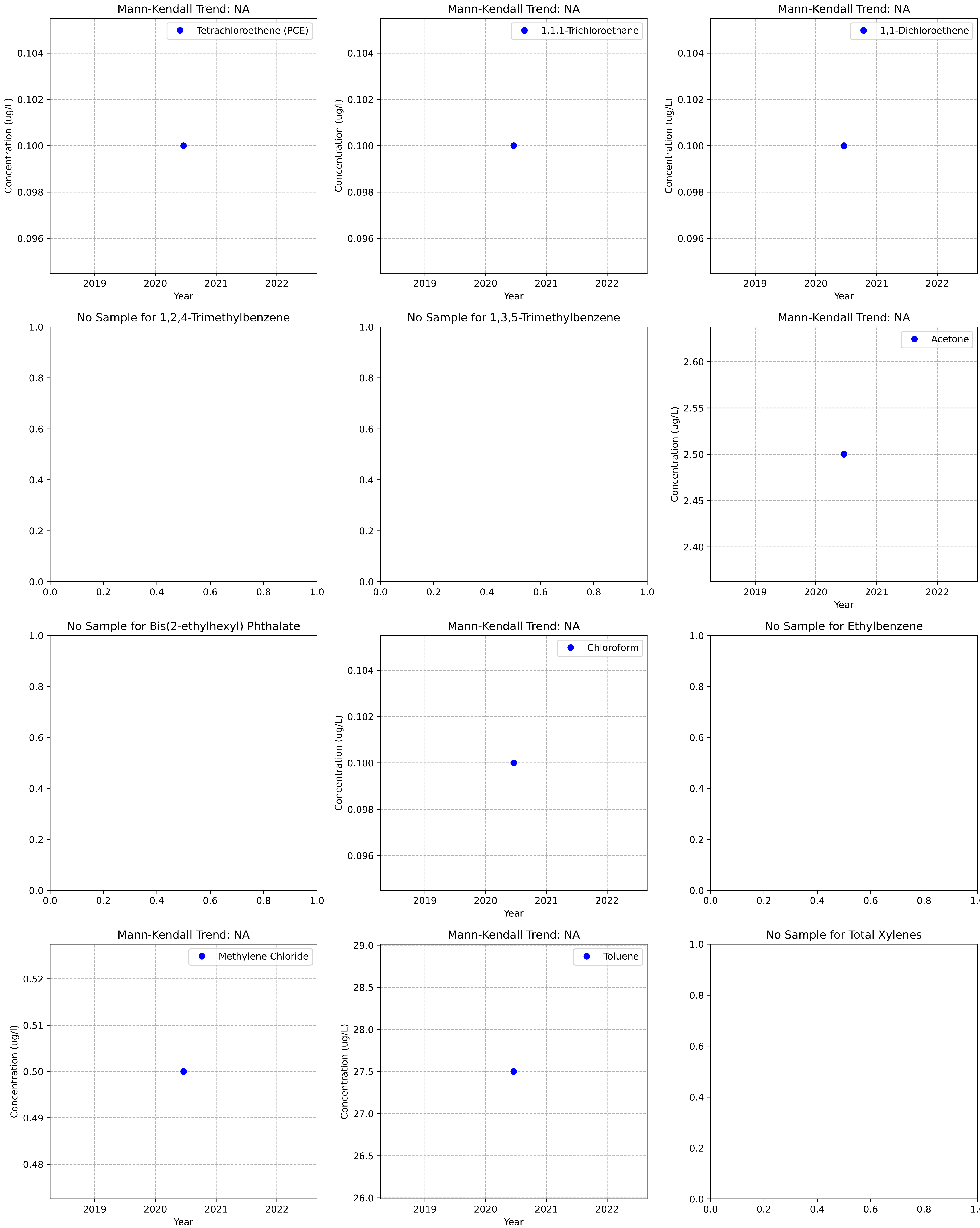

Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Mann-Kendall Trend: Probably Decreasing
1,1,1-Trichloroethane
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.80)
Exponential Fit (R²=0.73)
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Mann-Kendall Trend: No Trend
Acetone
Mann-Kendall Trend: No Trend
Bis(2-ethylhexyl) Phthalate
Exponential Fit (R²=0.07)
Mann-Kendall Trend: Probably Decreasing
Chloroform
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Mann-Kendall Trend: Decreasing
Methylene Chloride
Linear Fit (R²=0.48)
Exponential Fit (R²=0.54)
Mann-Kendall Trend: Probably Decreasing
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year


MW-81b
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Linear Fit (R²=0.83)
Exponential Fit (R²=0.72)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.94)
Exponential Fit (R²=0.86)
Mann-Kendall Trend: No Trend
1,2,4-Trimethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Exponential Fit (R²=0.13)
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: No Trend
Ethylbenzene
Linear Fit (R²=0.09)
Exponential Fit (R²=0.09)
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.84)
Exponential Fit (R²=0.93)
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-82b

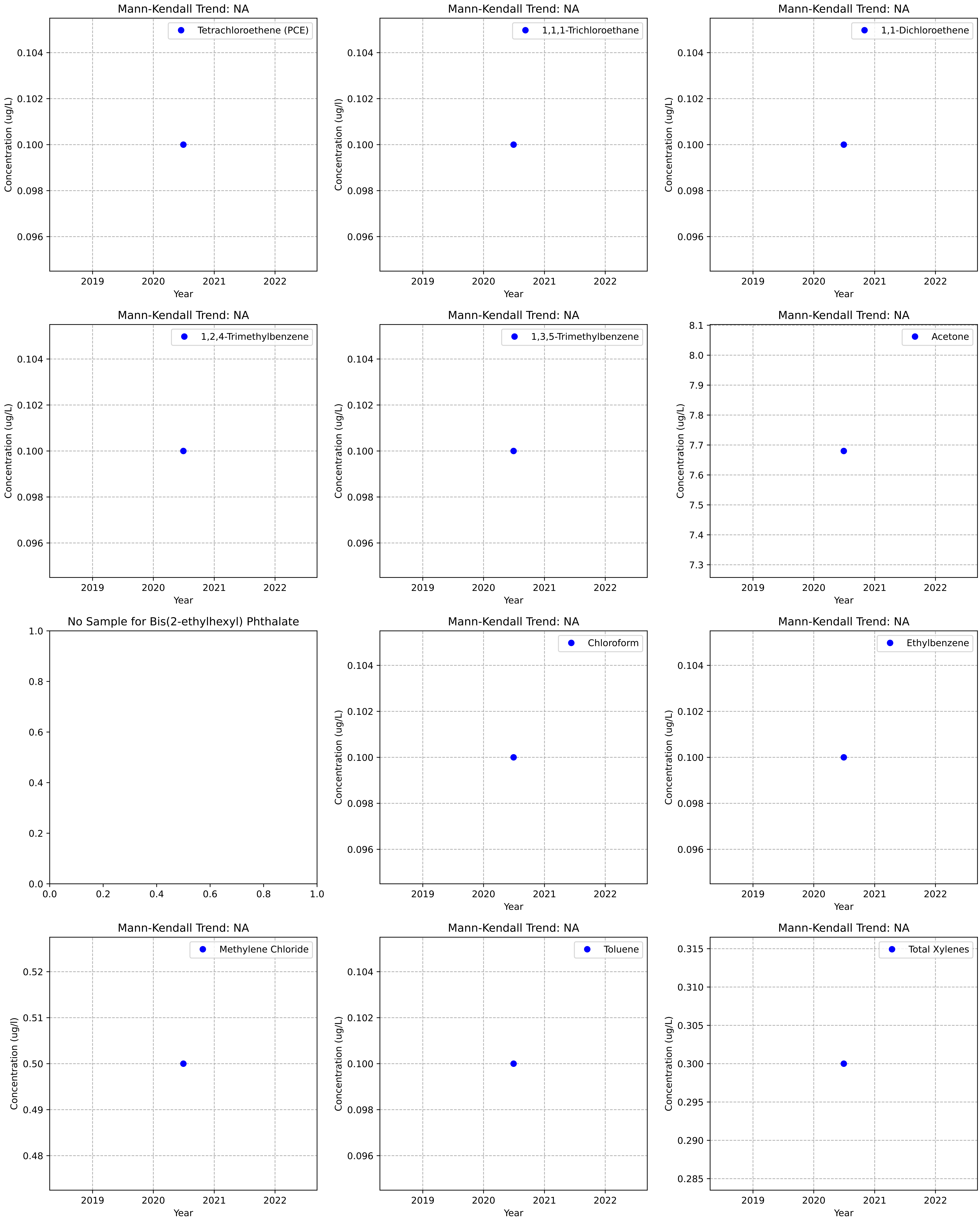

Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2021
2022
2023
2024

MW-86b

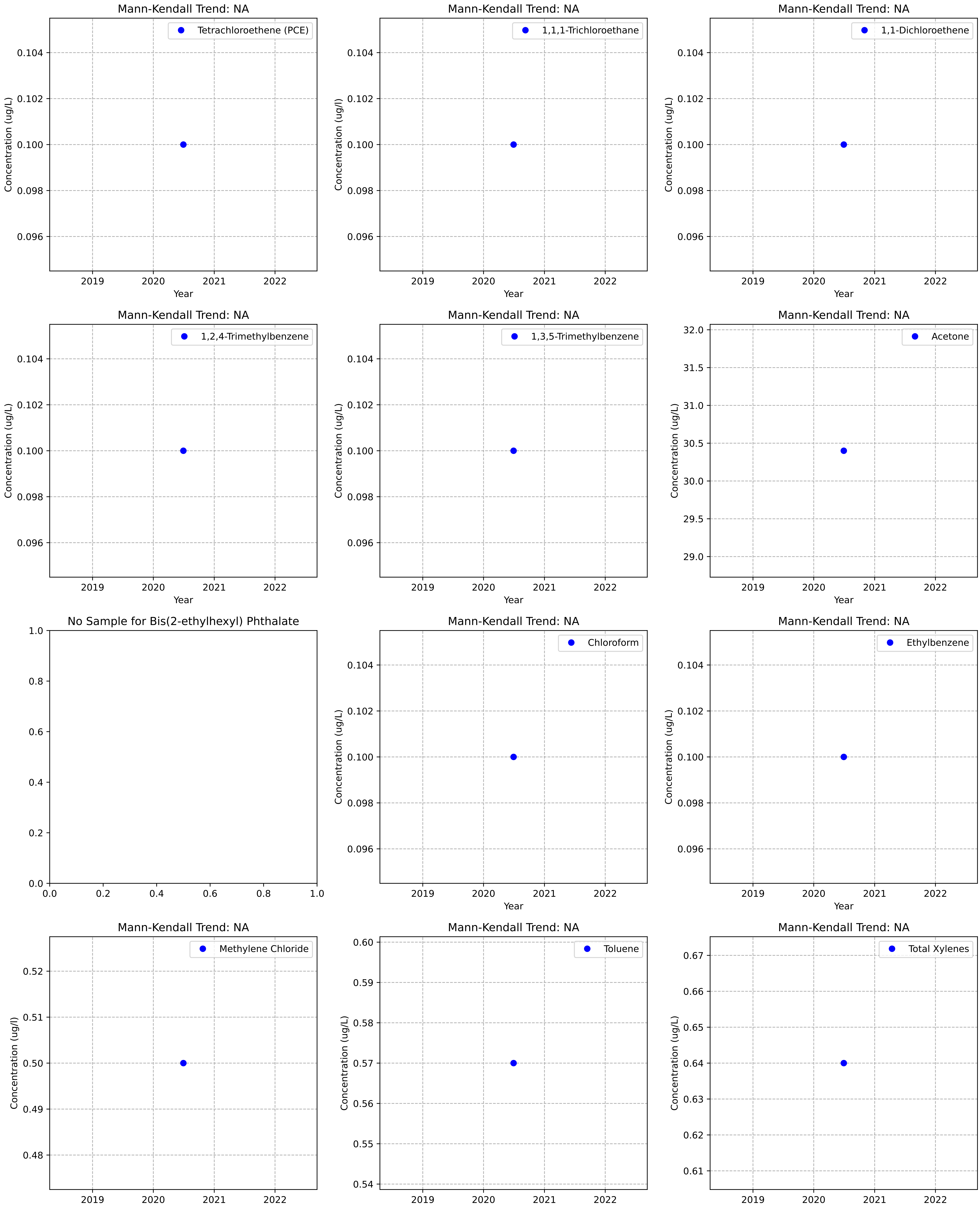


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
1,1-Dichloroethene
Concentration (ug/L)
Year
No Sample for 1,2,4-Trimethylbenzene
No Sample for 1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Concentration (ug/L)
Year
No Sample for Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
Toluene
Concentration (ug/L)
Year
No Sample for Total Xylenes

MW-89b

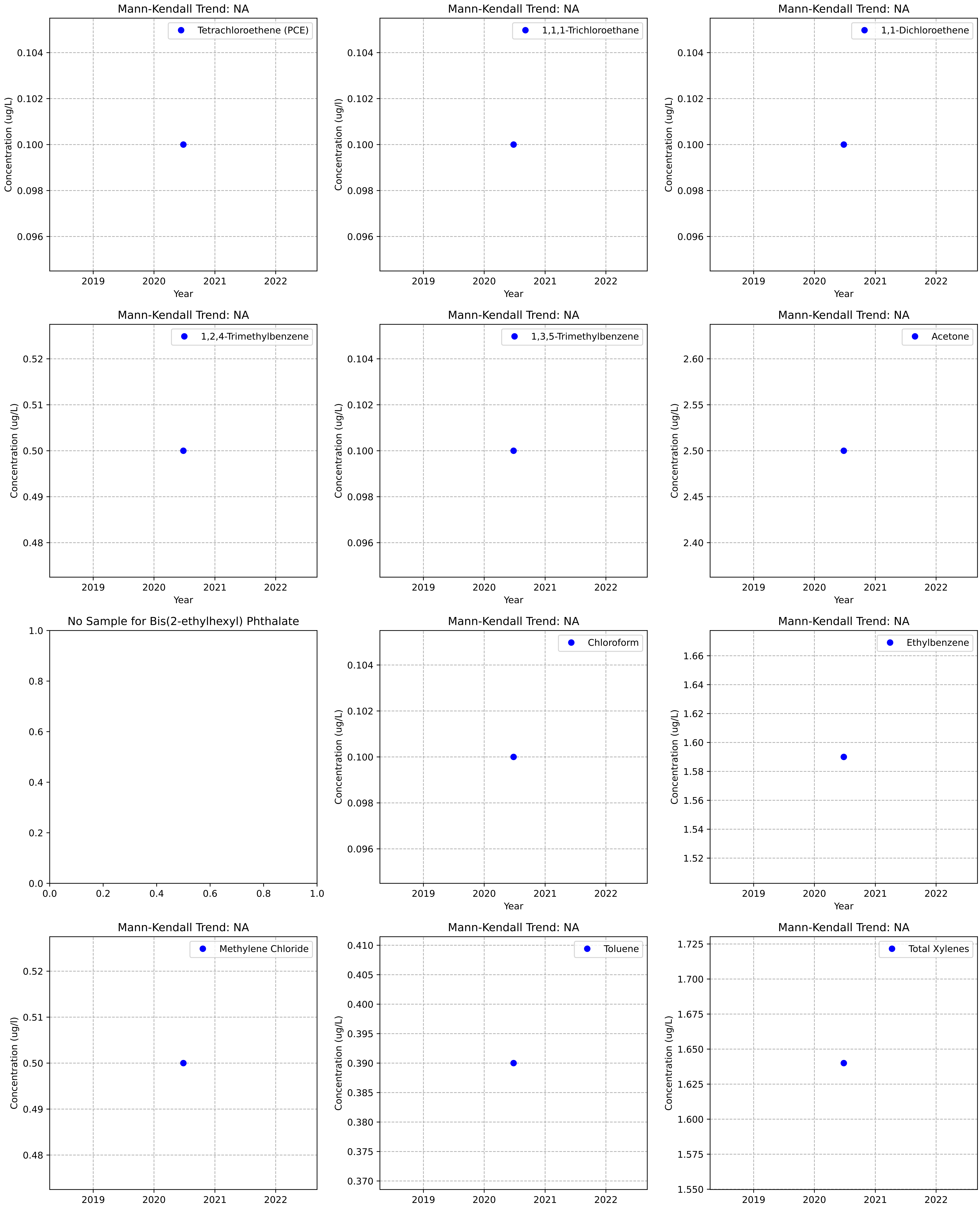

Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
1,1-Dichloroethene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Acetone
Concentration (ug/L)
Year
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Ethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: NA
Toluene
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Year

MW-93b



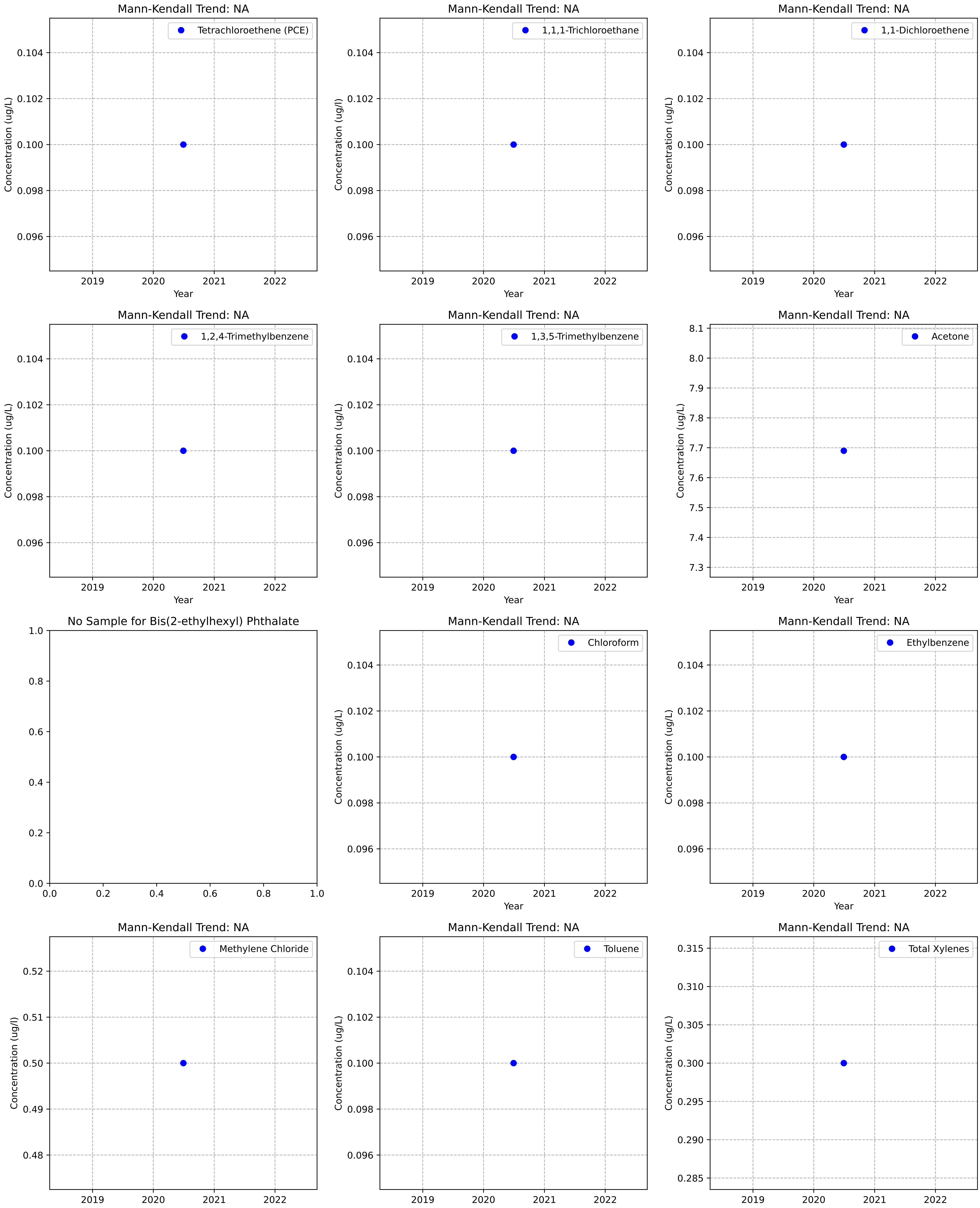
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-96b



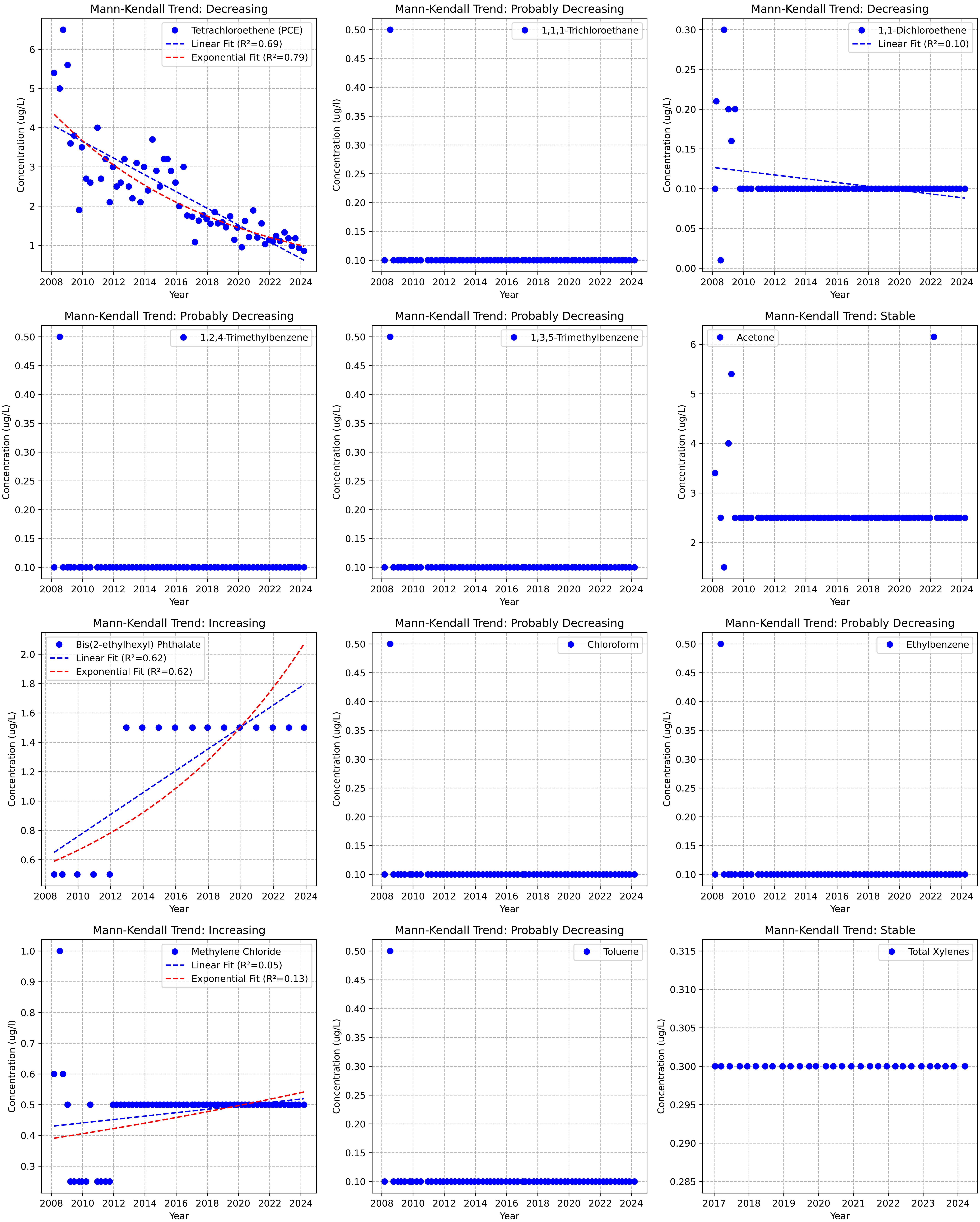
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year
2019
2020
2021
2022

MW-97b



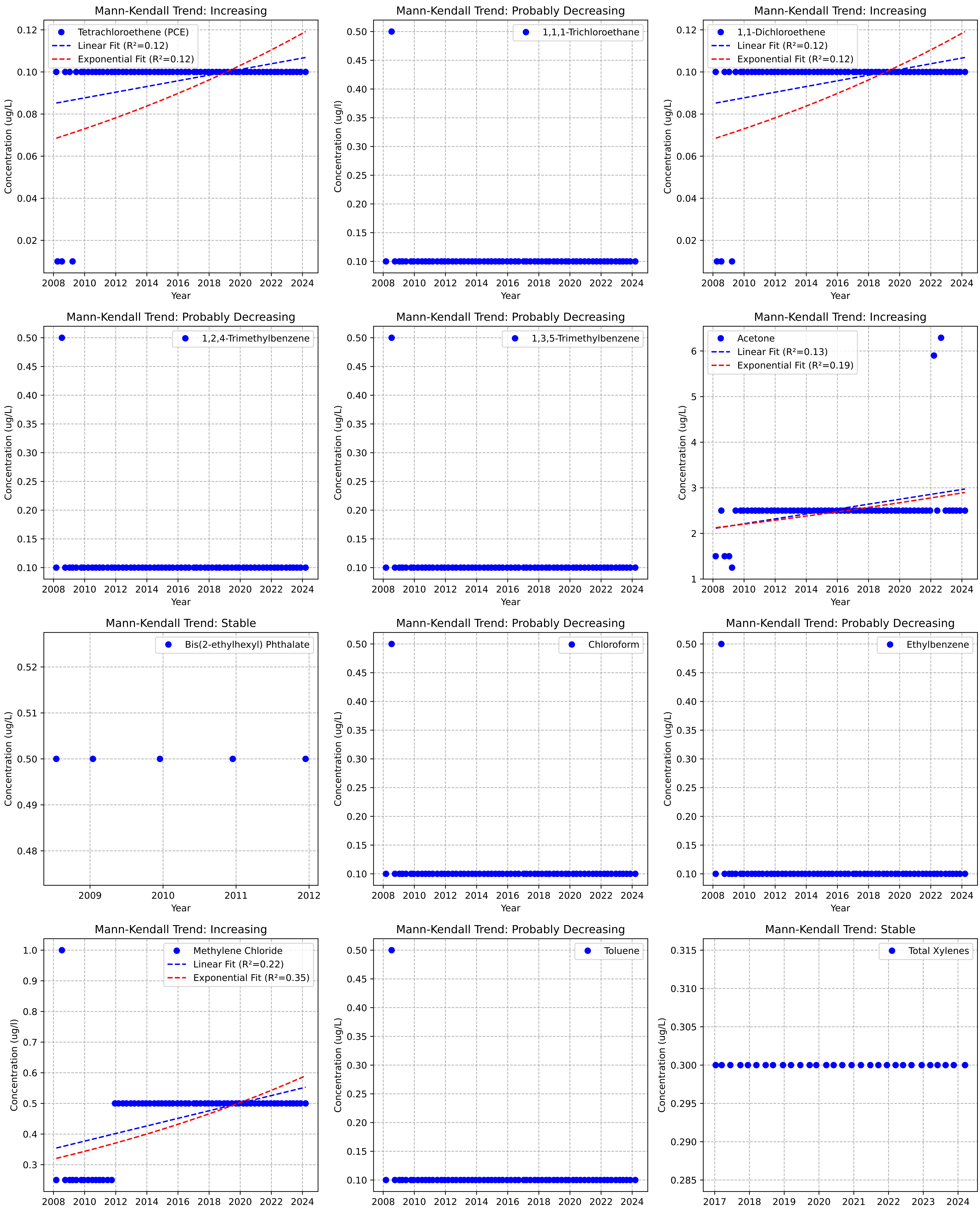
Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-9b

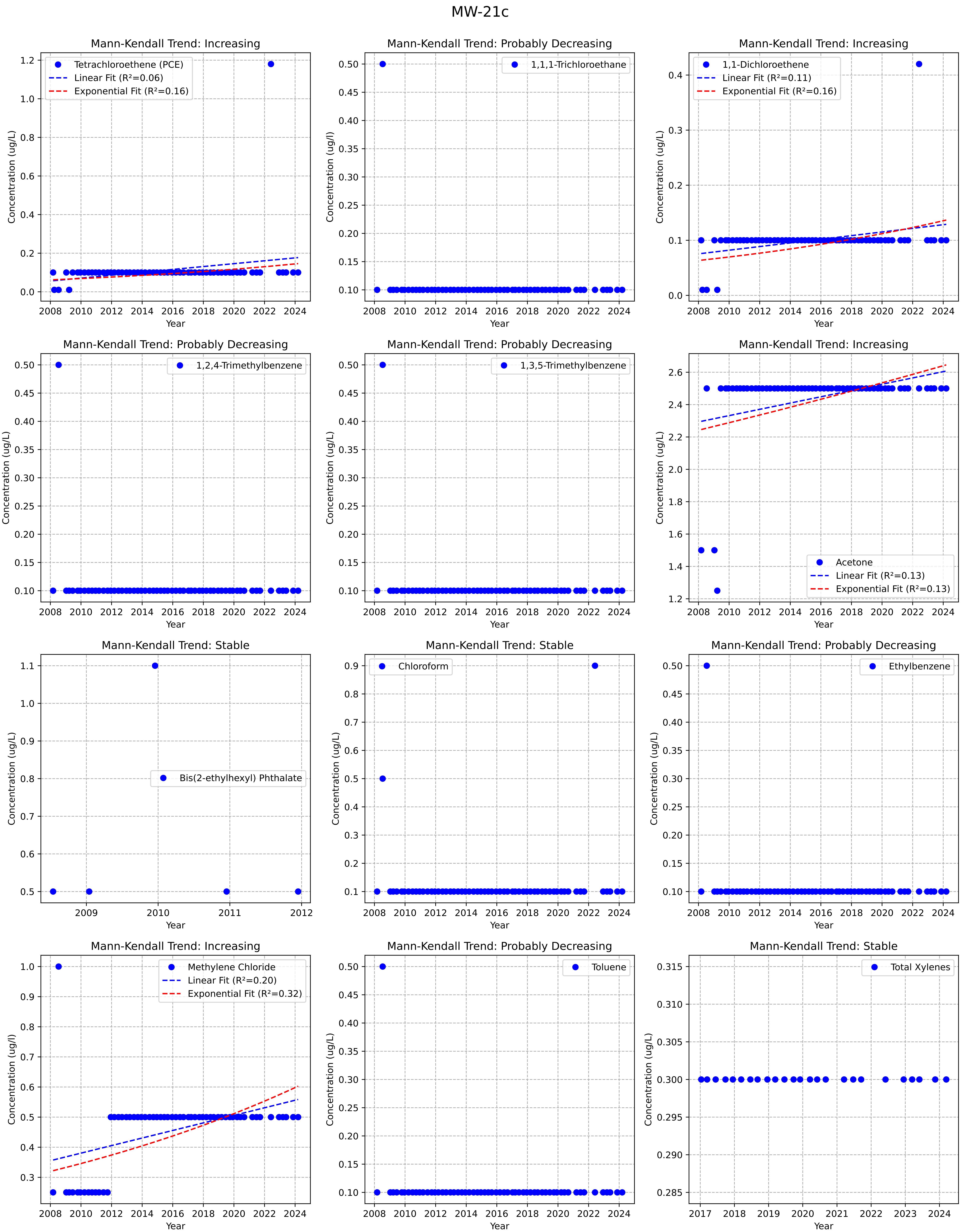

Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.69)
Exponential Fit (R²=0.79)
Mann-Kendall Trend: Probably Decreasing
1,1,1-Trichloroethane
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.10)
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: Increasing
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.62)
Exponential Fit (R²=0.62)
Mann-Kendall Trend: Probably Decreasing
Chloroform
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.05)
Exponential Fit (R²=0.13)
Mann-Kendall Trend: Probably Decreasing
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

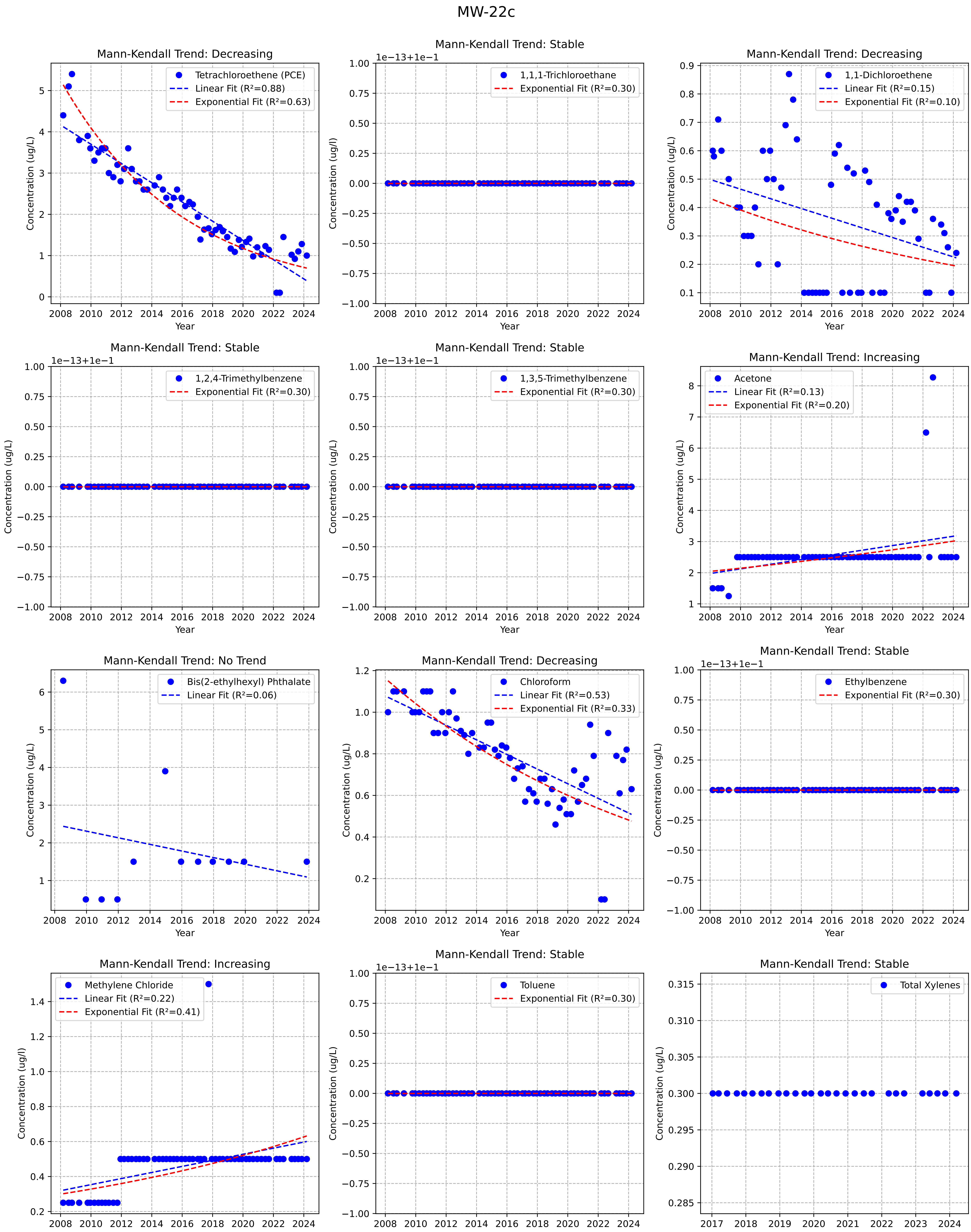
D4. Concentration time series plots of additional parameters for Interflow Aquifer wells, including Mann-Kendall statistics, linear regression, and exponential fit R^2 values

MW-20c

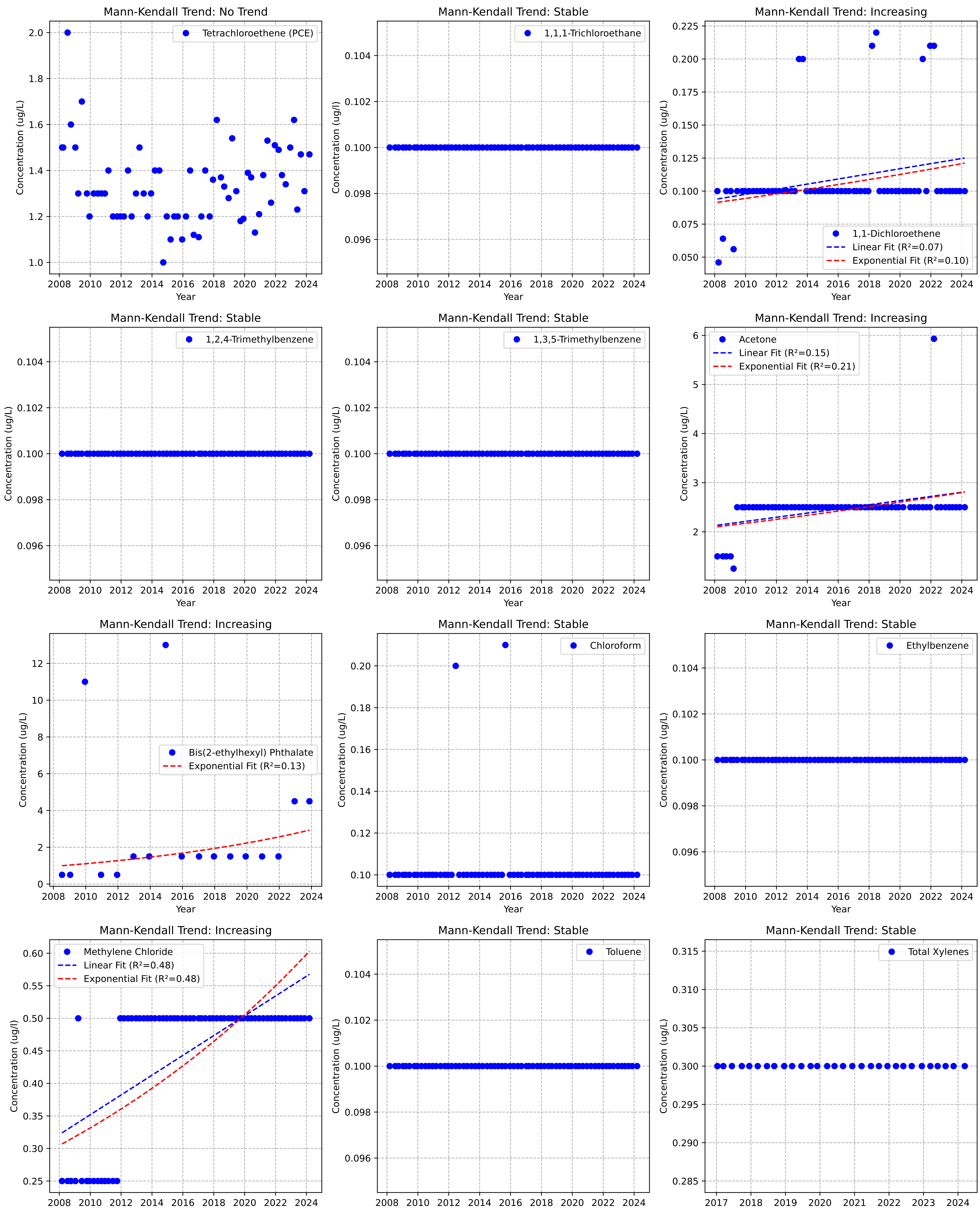


Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
Mann-Kendall Trend: Probably Decreasing
1,1,1-Trichloroethane
Mann-Kendall Trend: Increasing
1,1-Dichloroethene
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Increasing
Acetone
Linear Fit (R²=0.13)
Exponential Fit (R²=0.19)
Mann-Kendall Trend: Stable
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Probably Decreasing
Chloroform
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.22)
Exponential Fit (R²=0.35)
Mann-Kendall Trend: Probably Decreasing
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

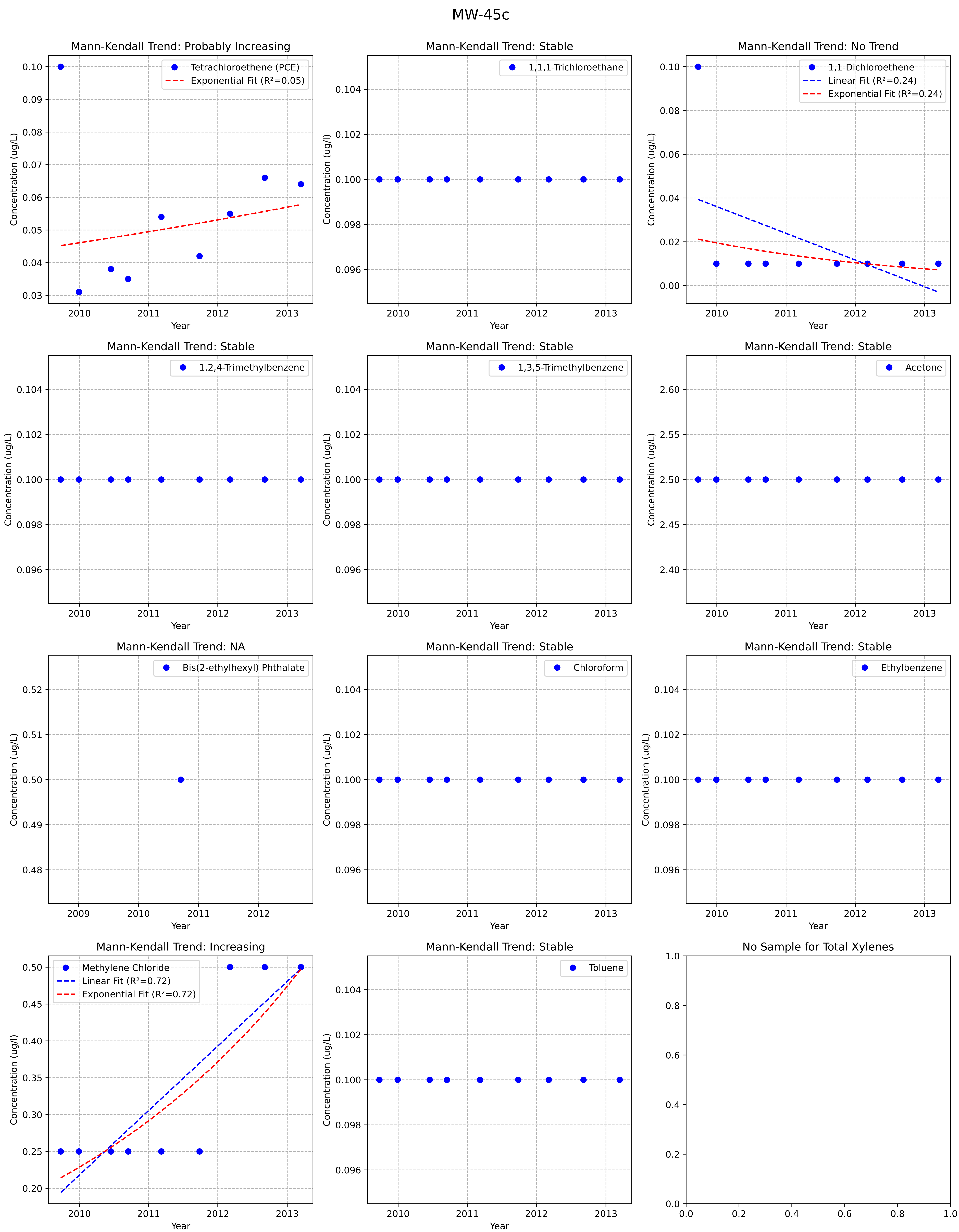

MW-21c
Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.06)
Exponential Fit (R²=0.16)
Mann-Kendall Trend: Probably Decreasing
1,1,1-Trichloroethane
Mann-Kendall Trend: Increasing
1,1-Dichloroethene
Linear Fit (R²=0.11)
Exponential Fit (R²=0.16)
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Increasing
Acetone
Linear Fit (R²=0.13)
Exponential Fit (R²=0.13)
Mann-Kendall Trend: Stable
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.20)
Exponential Fit (R²=0.32)
Mann-Kendall Trend: Probably Decreasing
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

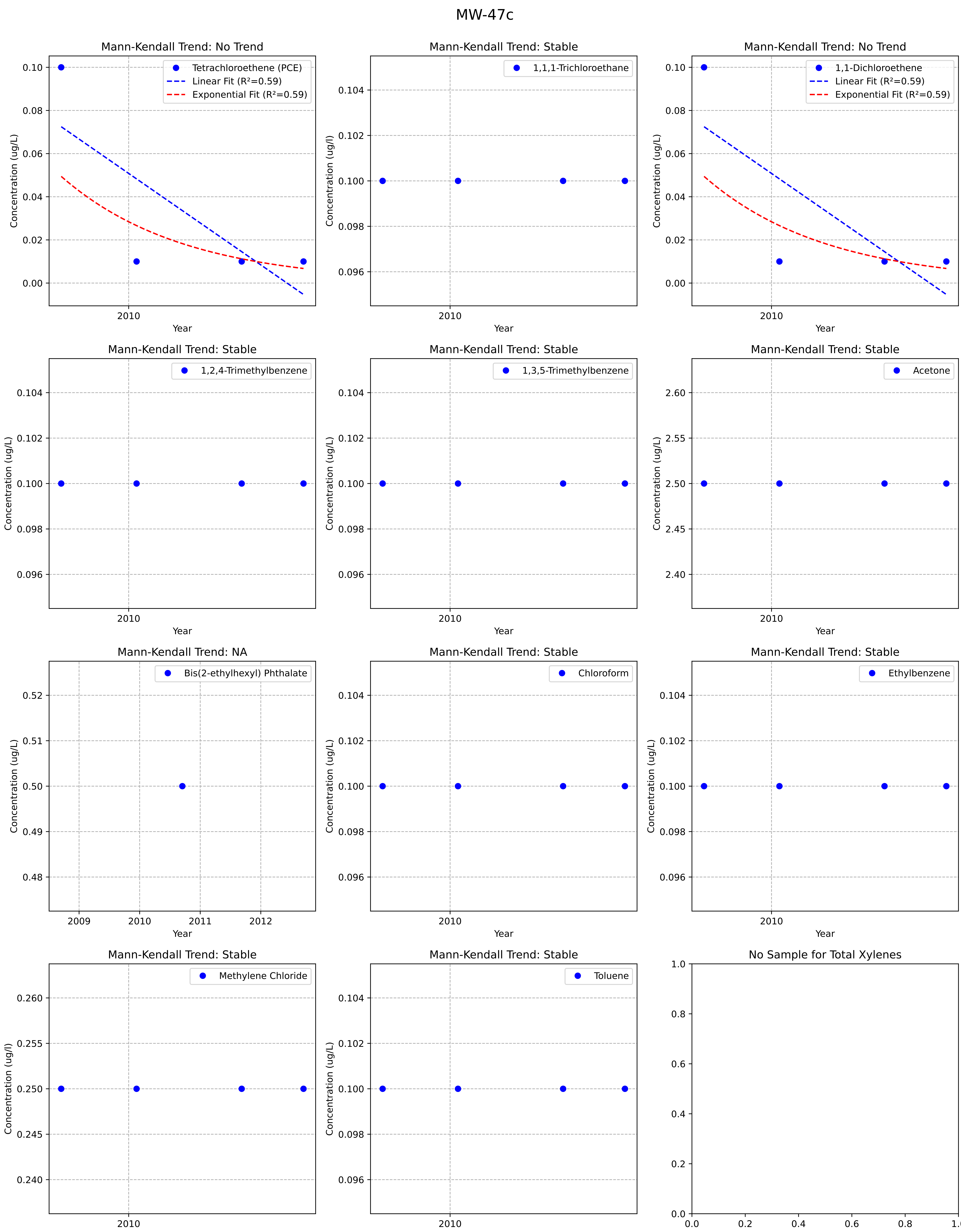

MW-22c
Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.88)
Exponential Fit (R²=0.63)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Exponential Fit (R²=0.30)
Mann-Kendall Trend: Decreasing
1,1-Dichloroethene
Linear Fit (R²=0.15)
Exponential Fit (R²=0.10)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Exponential Fit (R²=0.30)
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Exponential Fit (R²=0.30)
Mann-Kendall Trend: Increasing
Acetone
Linear Fit (R²=0.13)
Exponential Fit (R²=0.20)
Mann-Kendall Trend: No Trend
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.06)
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.53)
Exponential Fit (R²=0.33)
Mann-Kendall Trend: Stable
Ethylbenzene
Exponential Fit (R²=0.30)
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.22)
Exponential Fit (R²=0.41)
Mann-Kendall Trend: Stable
Toluene
Exponential Fit (R²=0.30)
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

MW-2c

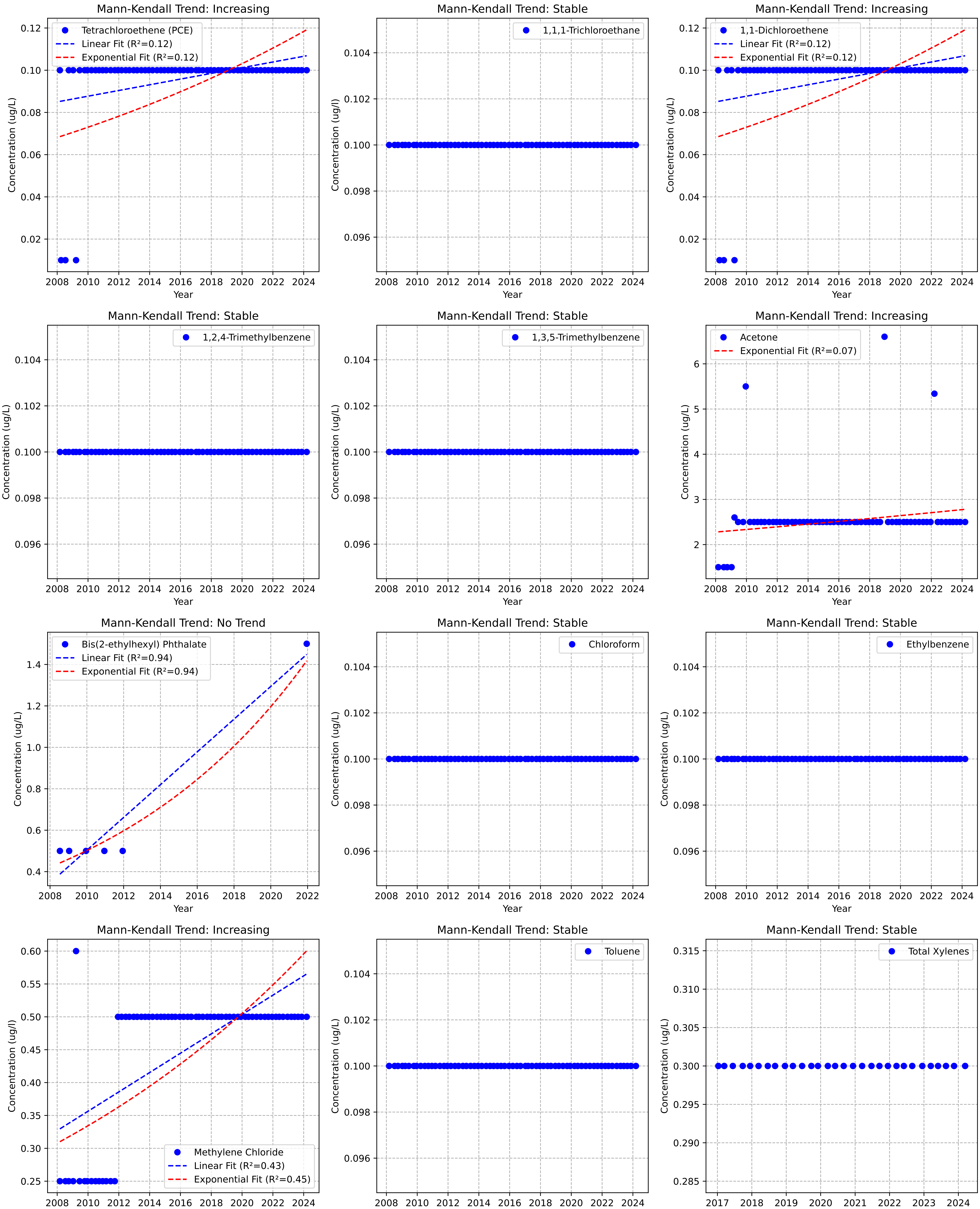


Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Increasing
1,1-Dichloroethene
Linear Fit (R^2=0.07)
Exponential Fit (R^2=0.10)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Increasing
Acetone
Linear Fit (R^2=0.15)
Exponential Fit (R^2=0.21)
Mann-Kendall Trend: Increasing
Bis(2-ethylhexyl) Phthalate
Exponential Fit (R^2=0.13)
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R^2=0.48)
Exponential Fit (R^2=0.48)
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

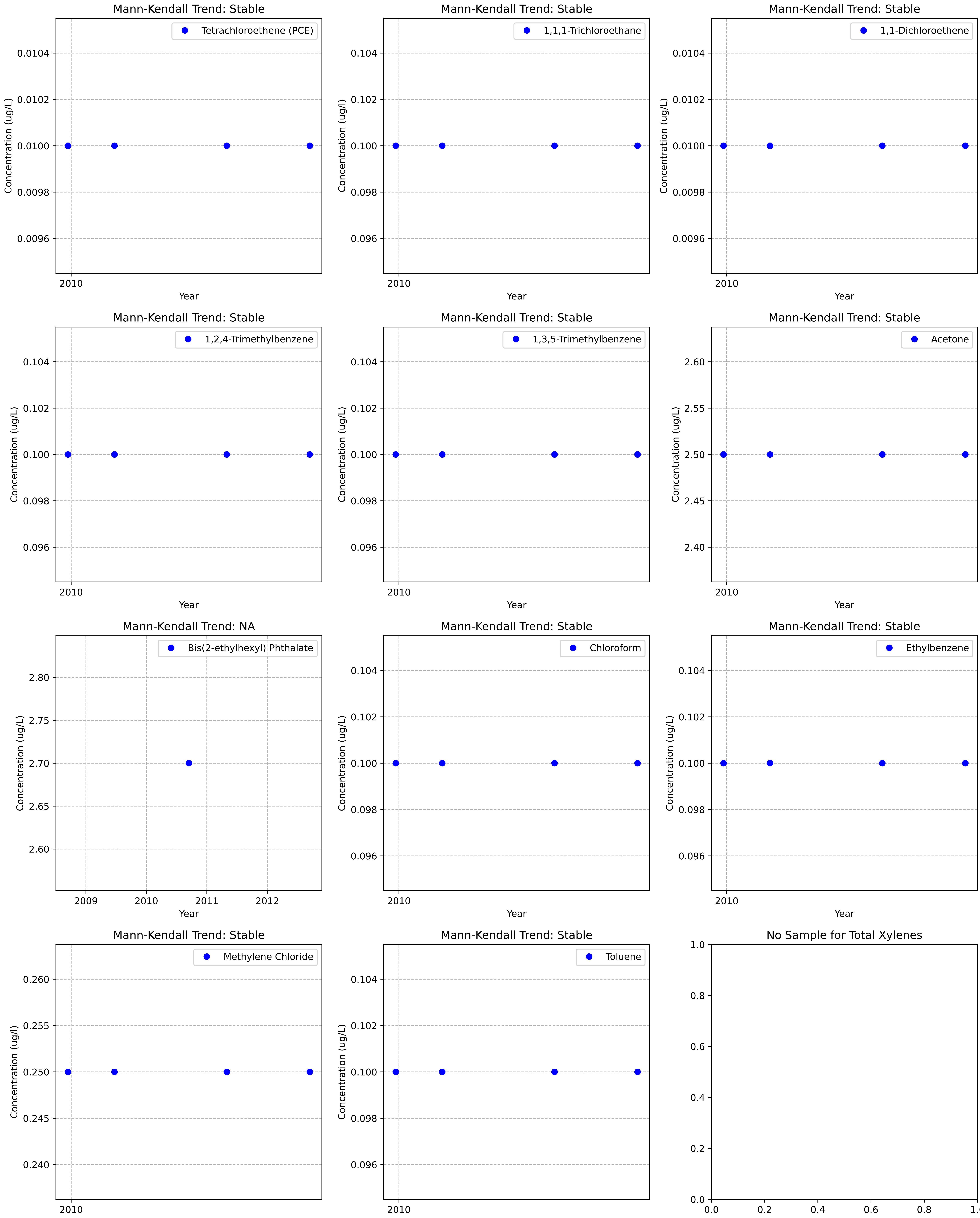

MW-45c
Mann-Kendall Trend: Probably Increasing
Tetrachloroethene (PCE)
Exponential Fit (R²=0.05)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.24)
Exponential Fit (R²=0.24)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.72)
Exponential Fit (R²=0.72)
Mann-Kendall Trend: Stable
Toluene
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year


MW-47c
Mann-Kendall Trend: No Trend
Tetrachloroethene (PCE)
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Linear Fit (R²=0.59)
Exponential Fit (R²=0.59)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

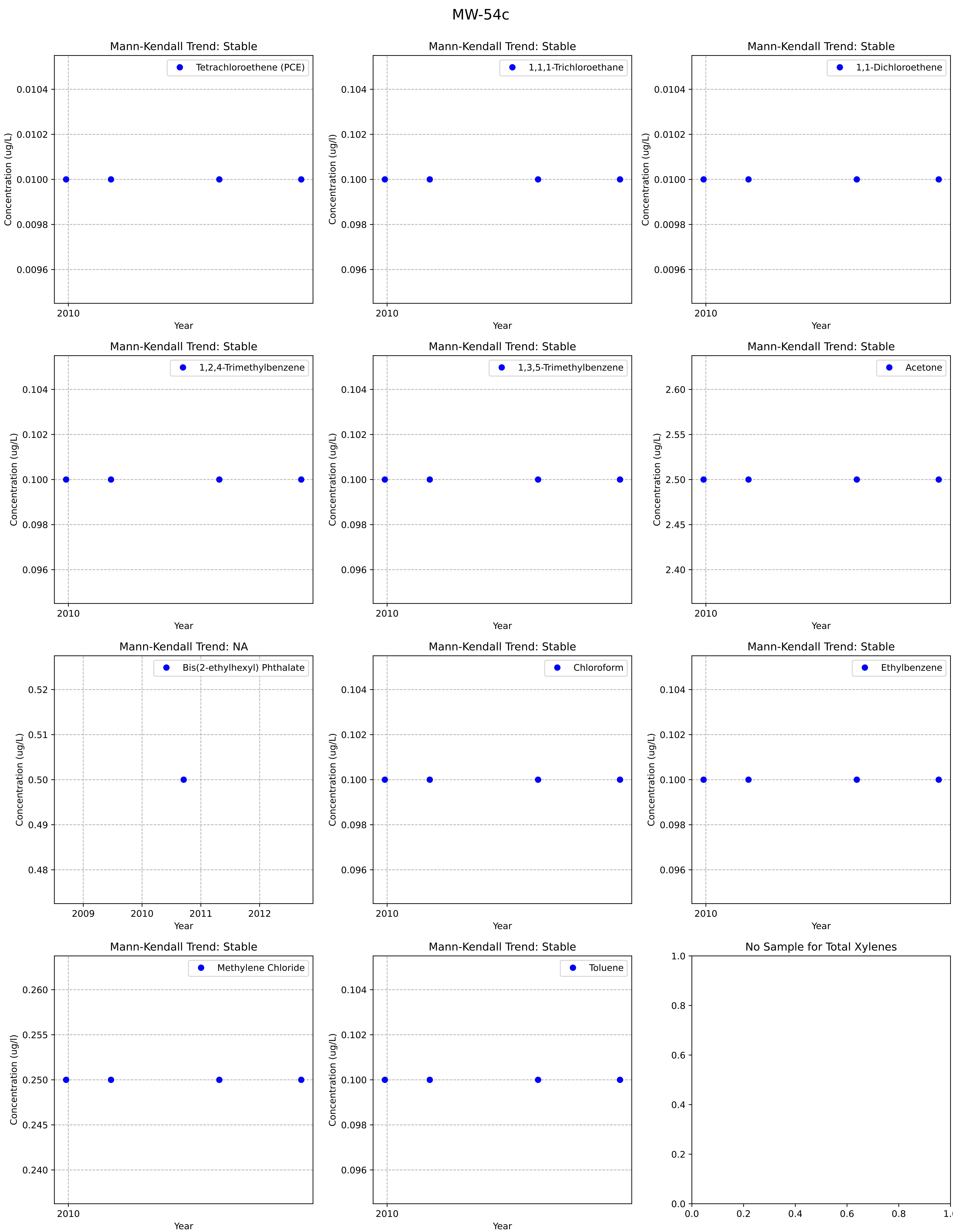
MW-4c


Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Increasing
1,1-Dichloroethene
Linear Fit (R²=0.12)
Exponential Fit (R²=0.12)
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Increasing
Acetone
Exponential Fit (R²=0.07)
Mann-Kendall Trend: No Trend
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.94)
Exponential Fit (R²=0.94)
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.43)
Exponential Fit (R²=0.45)
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

MW-50c

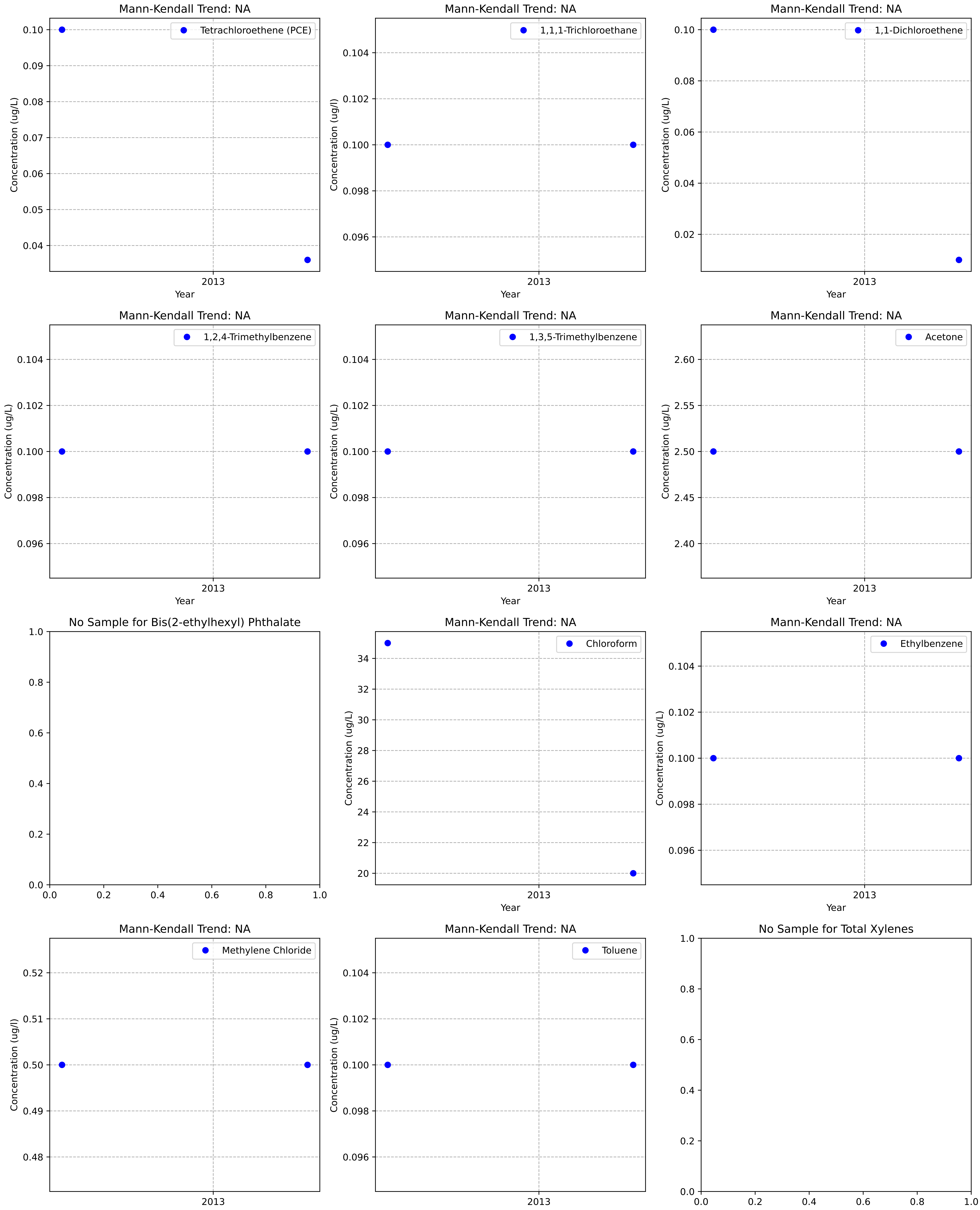


Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: Stable
Methylene Chloride
Mann-Kendall Trend: Stable
Toluene
No Sample for Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year


MW-54c
Mann-Kendall Trend: Stable
Tetrachloroethene (PCE)
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Acetone
Concentration (ug/L)
Year
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Chloroform
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Ethylbenzene
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Methylene Chloride
Concentration (ug/l)
Year
Mann-Kendall Trend: Stable
Toluene
Concentration (ug/L)
Year
No Sample for Total Xylenes

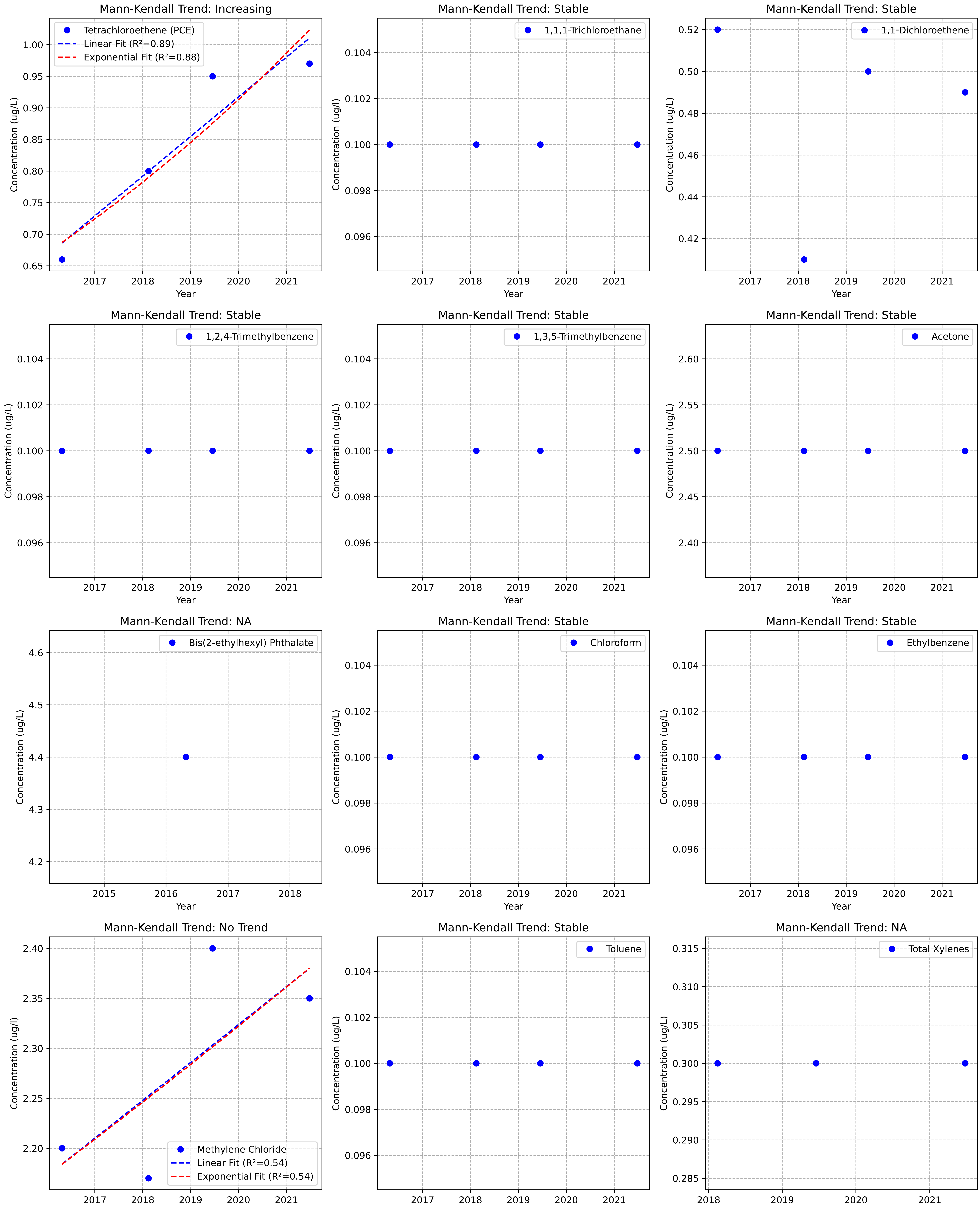
No Data for MW-55c
No Sample for Tetrachloroethene (PCE)
No Sample for 1,1,1-Trichloroethane
No Sample for 1,1-Dichloroethene
No Sample for 1,2,4-Trimethylbenzene
No Sample for 1,3,5-Trimethylbenzene
No Sample for Acetone
No Sample for Bis(2-ethylhexyl) Phthalate
No Sample for Chloroform
No Sample for Ethylbenzene
No Sample for Methylene Chloride
No Sample for Toluene
No Sample for Total Xylenes

MW-56c

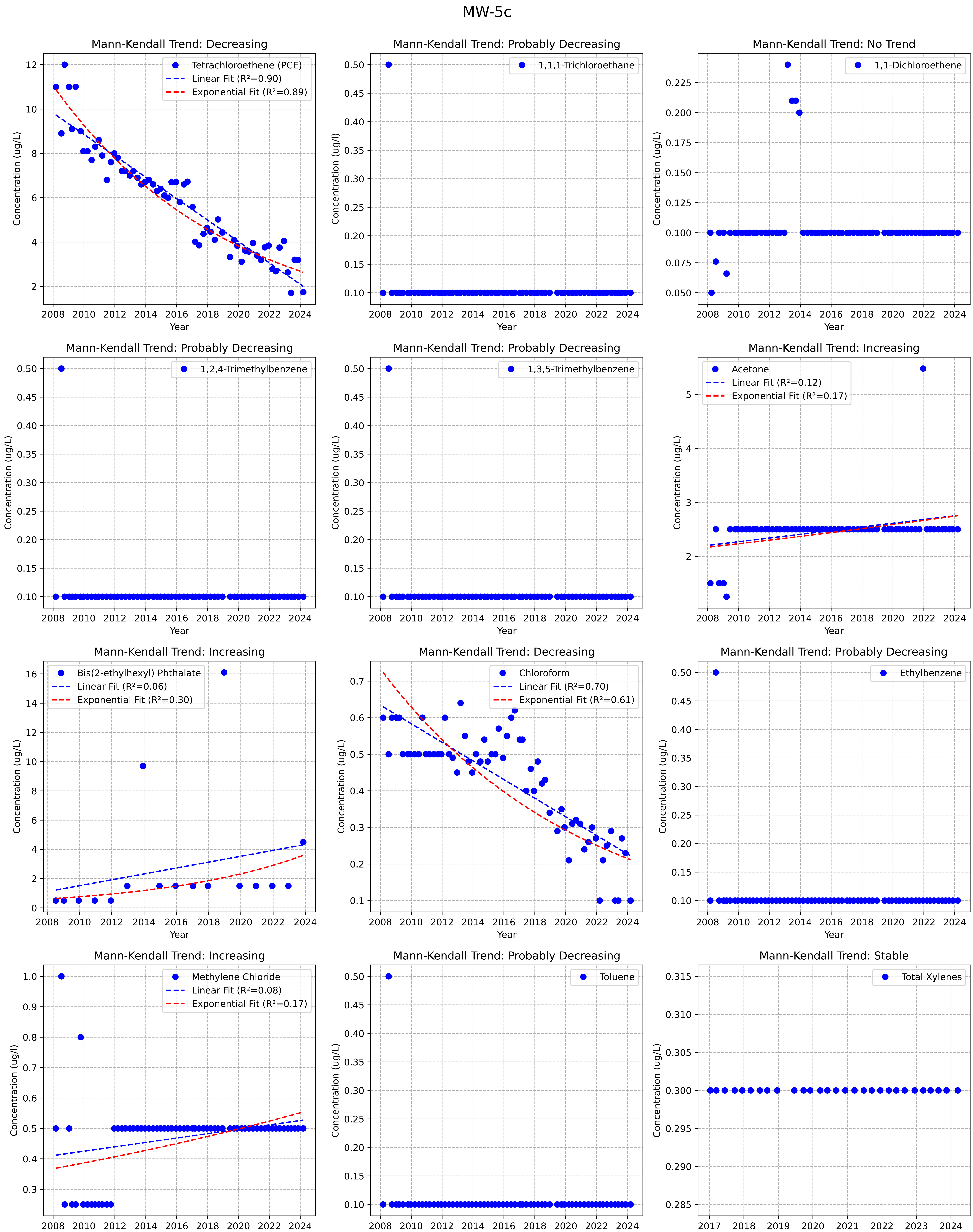


Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Concentration (ug/L)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
2013
Year
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Concentration (ug/l)
0.104
0.102
0.100
0.098
0.096
2013
Year
Mann-Kendall Trend: NA
1,1-Dichloroethene
Concentration (ug/L)
0.10
0.08
0.06
0.04
0.02
2013
Year
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2013
Year
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2013
Year
Mann-Kendall Trend: NA
Acetone
Concentration (ug/L)
2.60
2.55
2.50
2.45
2.40
2013
Year
No Sample for Bis(2-ethylhexyl) Phthalate
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Chloroform
Concentration (ug/L)
34
32
30
28
26
24
22
20
2013
Year
Mann-Kendall Trend: NA
Ethylbenzene
Concentration (ug/L)
0.104
0.102
0.100
0.098
0.096
2013
Year
Mann-Kendall Trend: NA
Methylene Chloride
Concentration (ug/l)
0.52
0.51
0.50
0.49
0.48
2013
Year
Mann-Kendall Trend: NA
Toluene
Concentration (ug/l)
0.104
0.102
0.100
0.098
0.096
2013
Year
No Sample for Total Xylenes
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

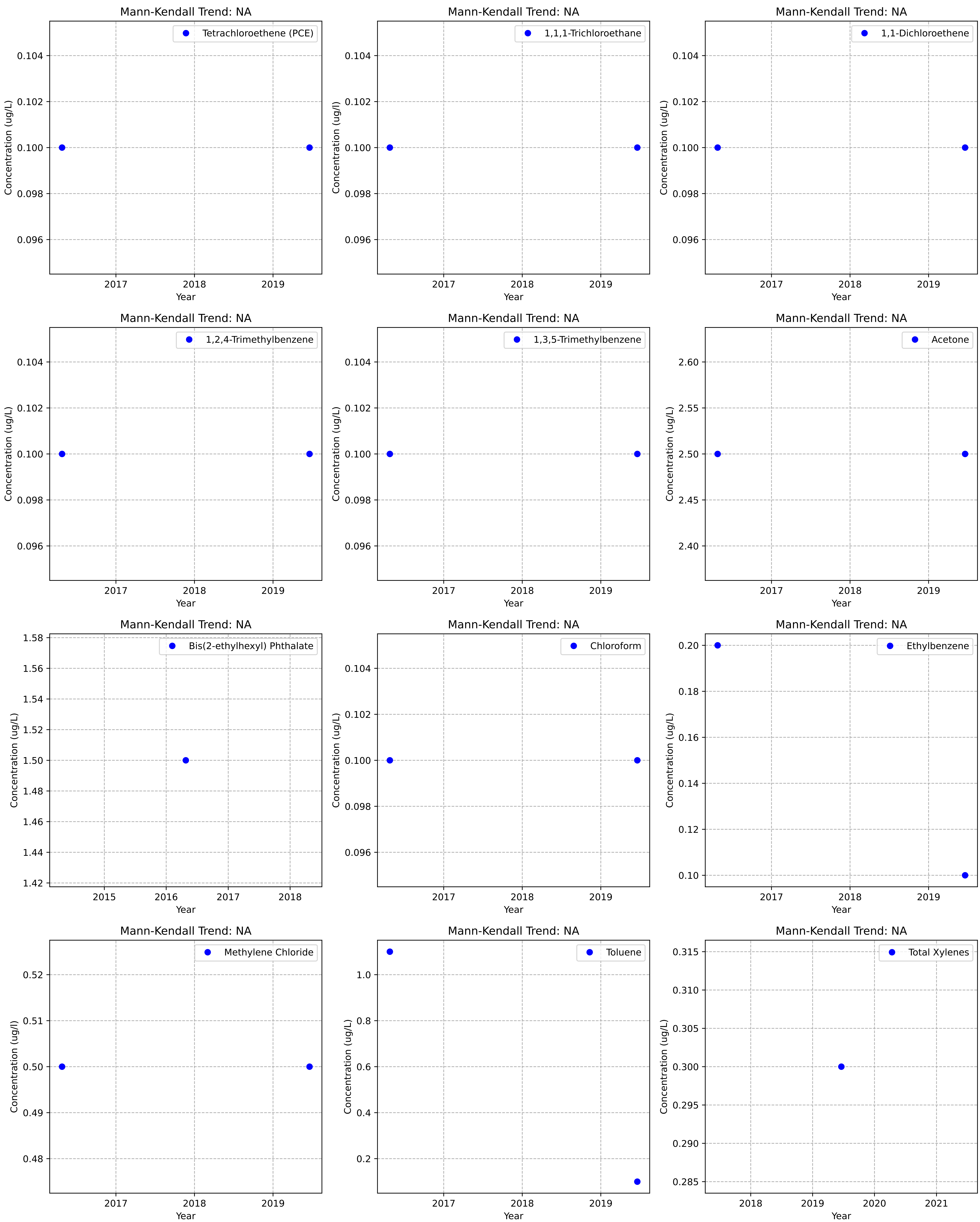
MW-58c

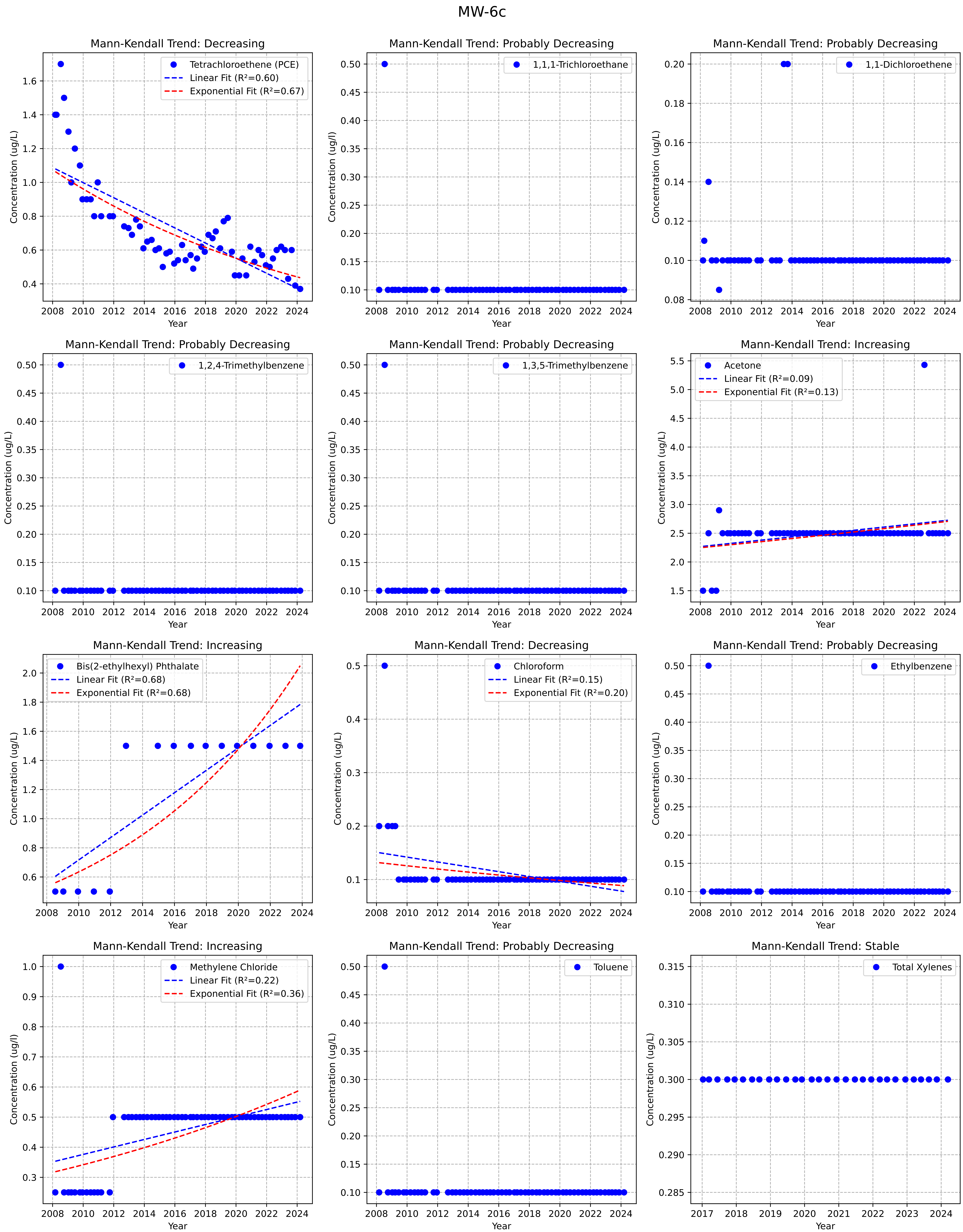


Mann-Kendall Trend: Increasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.89)
Exponential Fit (R²=0.88)
Mann-Kendall Trend: Stable
1,1,1-Trichloroethane
Mann-Kendall Trend: Stable
1,1-Dichloroethene
Mann-Kendall Trend: Stable
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Stable
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Stable
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: Stable
Chloroform
Mann-Kendall Trend: Stable
Ethylbenzene
Mann-Kendall Trend: No Trend
Methylene Chloride
Linear Fit (R²=0.54)
Exponential Fit (R²=0.54)
Mann-Kendall Trend: Stable
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year

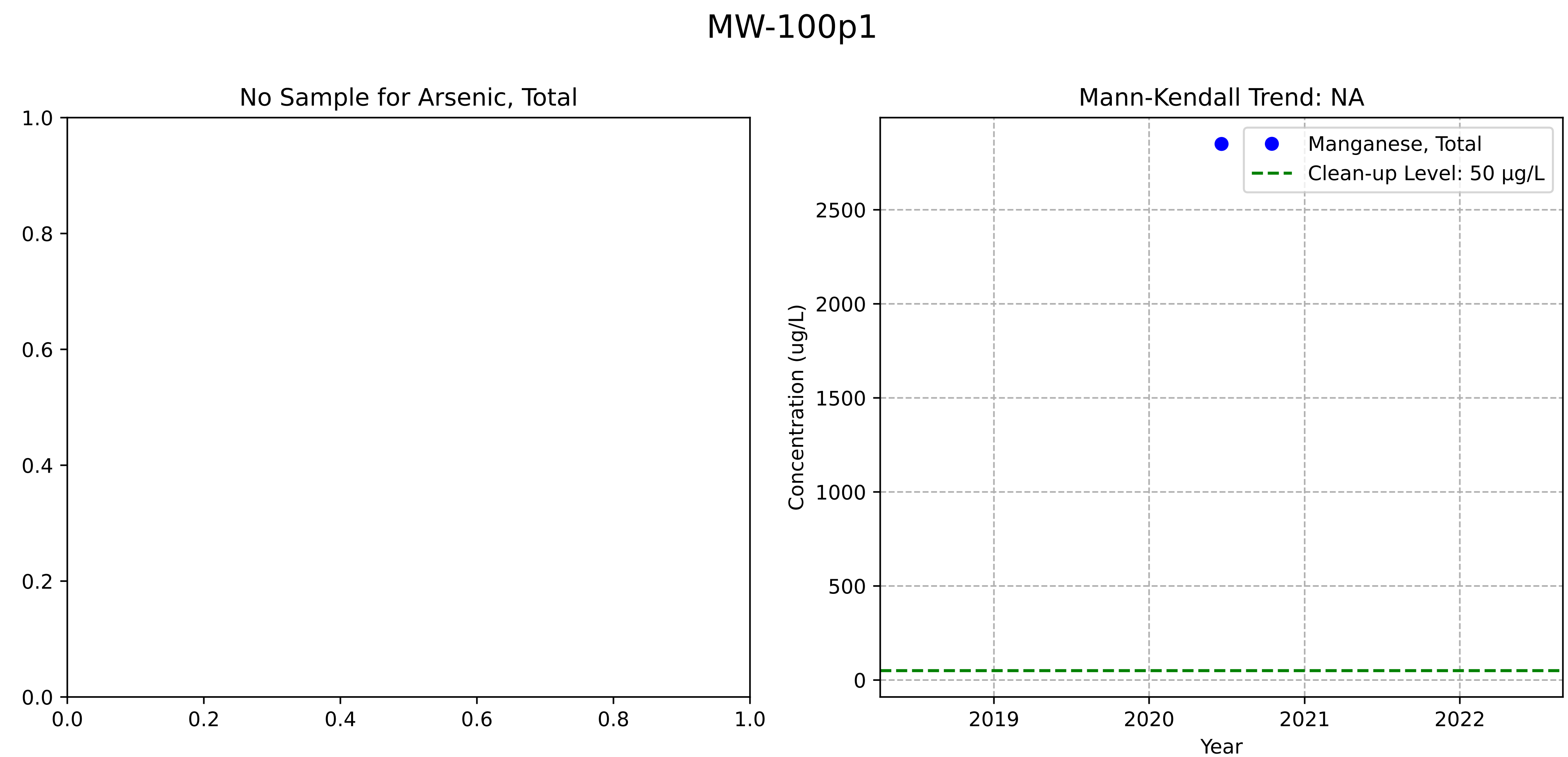

MW-5c
Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.90)
Exponential Fit (R²=0.89)
Mann-Kendall Trend: Probably Decreasing
1,1,1-Trichloroethane
Mann-Kendall Trend: No Trend
1,1-Dichloroethene
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Increasing
Acetone
Linear Fit (R²=0.12)
Exponential Fit (R²=0.17)
Mann-Kendall Trend: Increasing
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.06)
Exponential Fit (R²=0.30)
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.70)
Exponential Fit (R²=0.61)
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.08)
Exponential Fit (R²=0.17)
Mann-Kendall Trend: Probably Decreasing
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

MW-62c

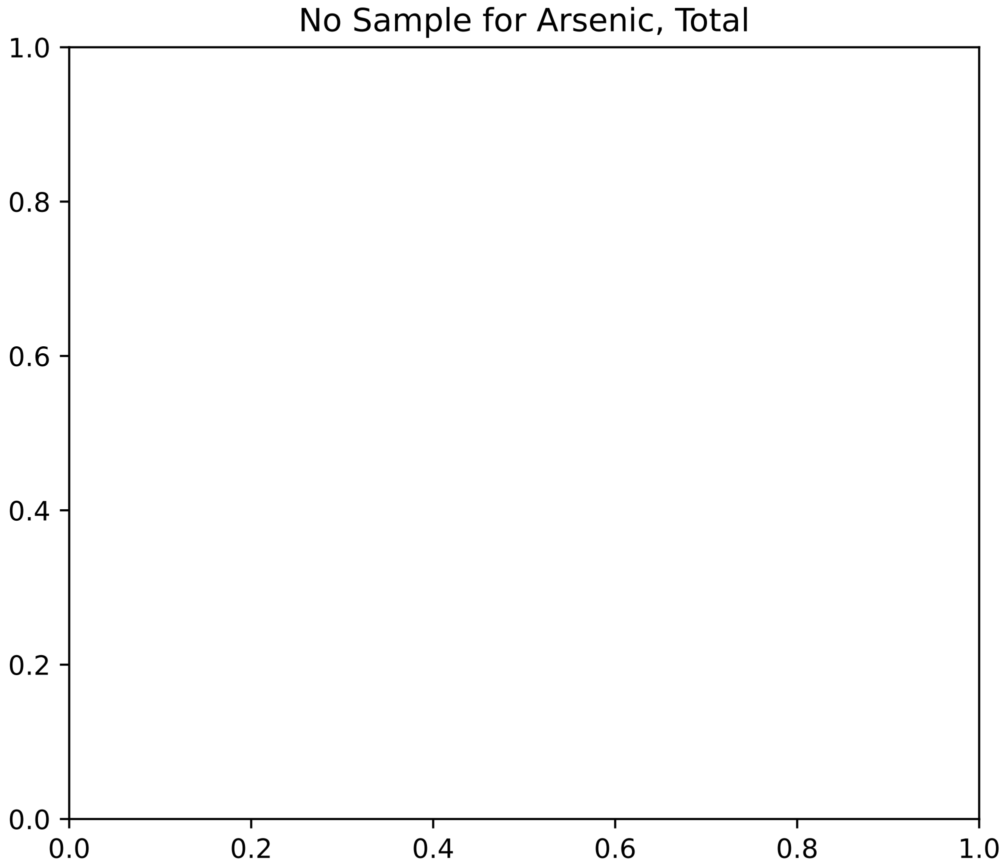

Mann-Kendall Trend: NA
Tetrachloroethene (PCE)
Mann-Kendall Trend: NA
1,1,1-Trichloroethane
Mann-Kendall Trend: NA
1,1-Dichloroethene
Mann-Kendall Trend: NA
1,2,4-Trimethylbenzene
Mann-Kendall Trend: NA
1,3,5-Trimethylbenzene
Mann-Kendall Trend: NA
Acetone
Mann-Kendall Trend: NA
Bis(2-ethylhexyl) Phthalate
Mann-Kendall Trend: NA
Chloroform
Mann-Kendall Trend: NA
Ethylbenzene
Mann-Kendall Trend: NA
Methylene Chloride
Mann-Kendall Trend: NA
Toluene
Mann-Kendall Trend: NA
Total Xylenes
Concentration (ug/L)
Concentration (ug/l)
Year


MW-6c
Mann-Kendall Trend: Decreasing
Tetrachloroethene (PCE)
Linear Fit (R²=0.60)
Exponential Fit (R²=0.67)
Mann-Kendall Trend: Probably Decreasing
1,1,1-Trichloroethane
Mann-Kendall Trend: Probably Decreasing
1,1-Dichloroethene
Mann-Kendall Trend: Probably Decreasing
1,2,4-Trimethylbenzene
Mann-Kendall Trend: Probably Decreasing
1,3,5-Trimethylbenzene
Mann-Kendall Trend: Increasing
Acetone
Linear Fit (R²=0.09)
Exponential Fit (R²=0.13)
Mann-Kendall Trend: Increasing
Bis(2-ethylhexyl) Phthalate
Linear Fit (R²=0.68)
Exponential Fit (R²=0.68)
Mann-Kendall Trend: Decreasing
Chloroform
Linear Fit (R²=0.15)
Exponential Fit (R²=0.20)
Mann-Kendall Trend: Probably Decreasing
Ethylbenzene
Mann-Kendall Trend: Increasing
Methylene Chloride
Linear Fit (R²=0.22)
Exponential Fit (R²=0.36)
Mann-Kendall Trend: Probably Decreasing
Toluene
Mann-Kendall Trend: Stable
Total Xylenes
Concentration (ug/L)
Year

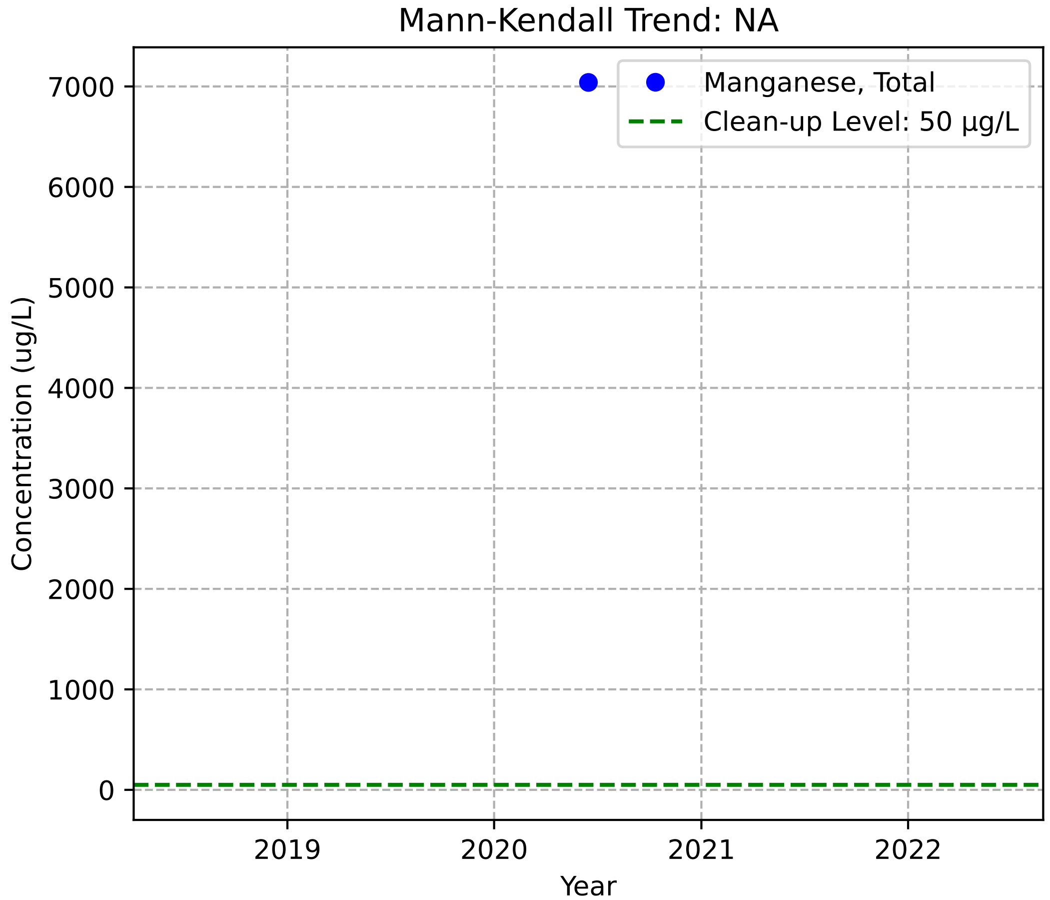
D5. Concentration time series plots of total arsenic and manganese including Mann-Kendall statistics, linear regression, and exponential fit R^2 values


MW-100p1
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
2500
2000
1500
1000
500
0
2019
2020
2021
2022
Year

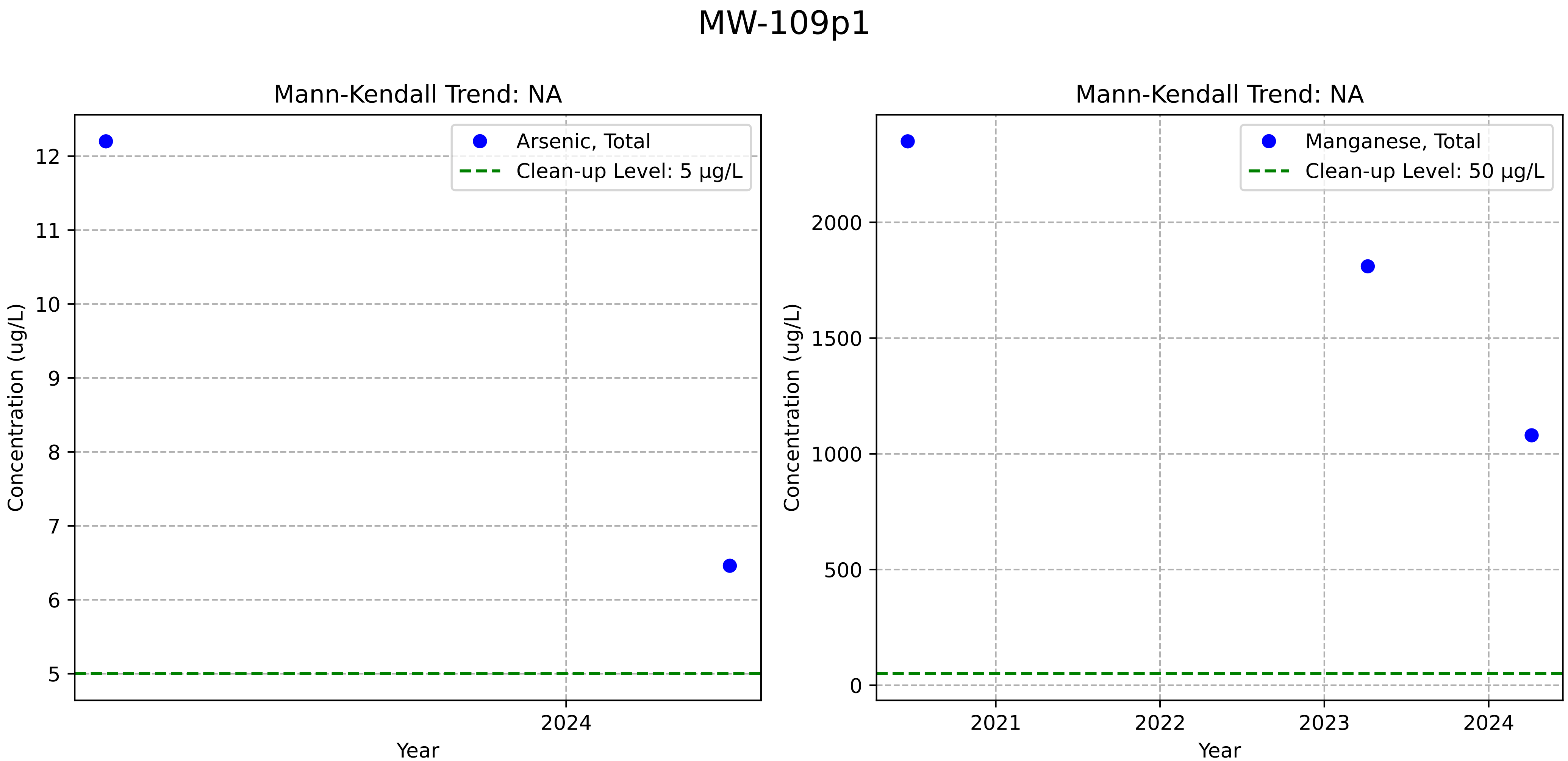
MW-104p1



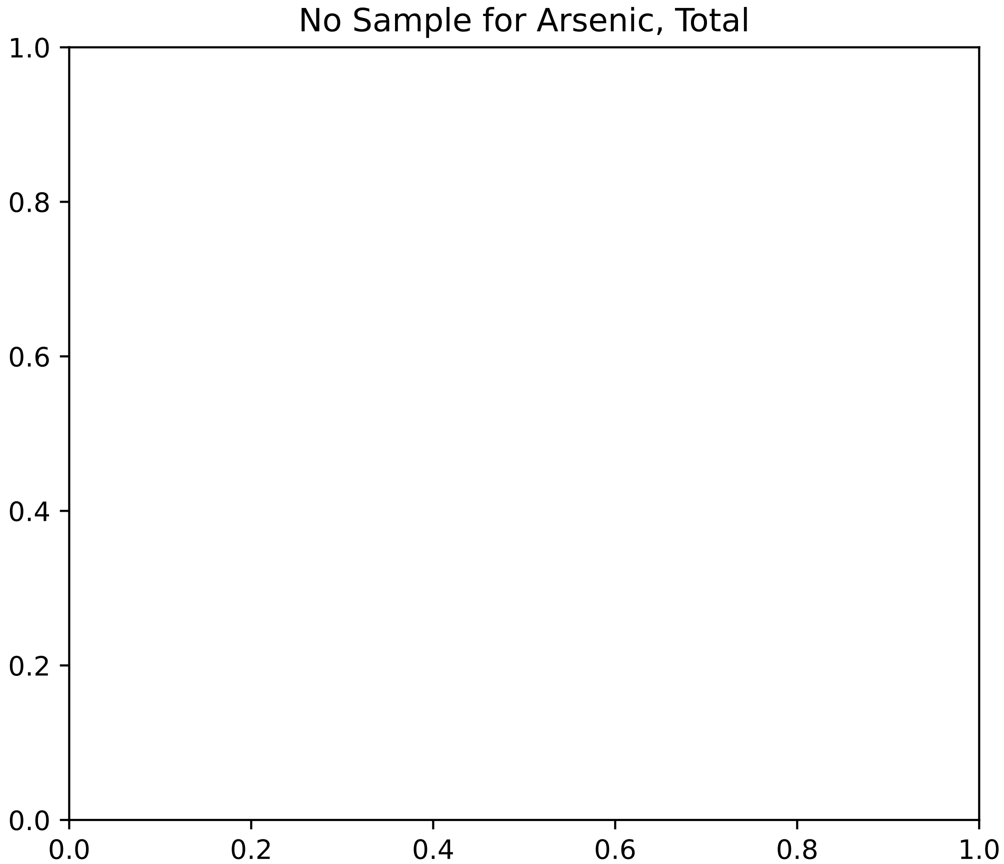
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



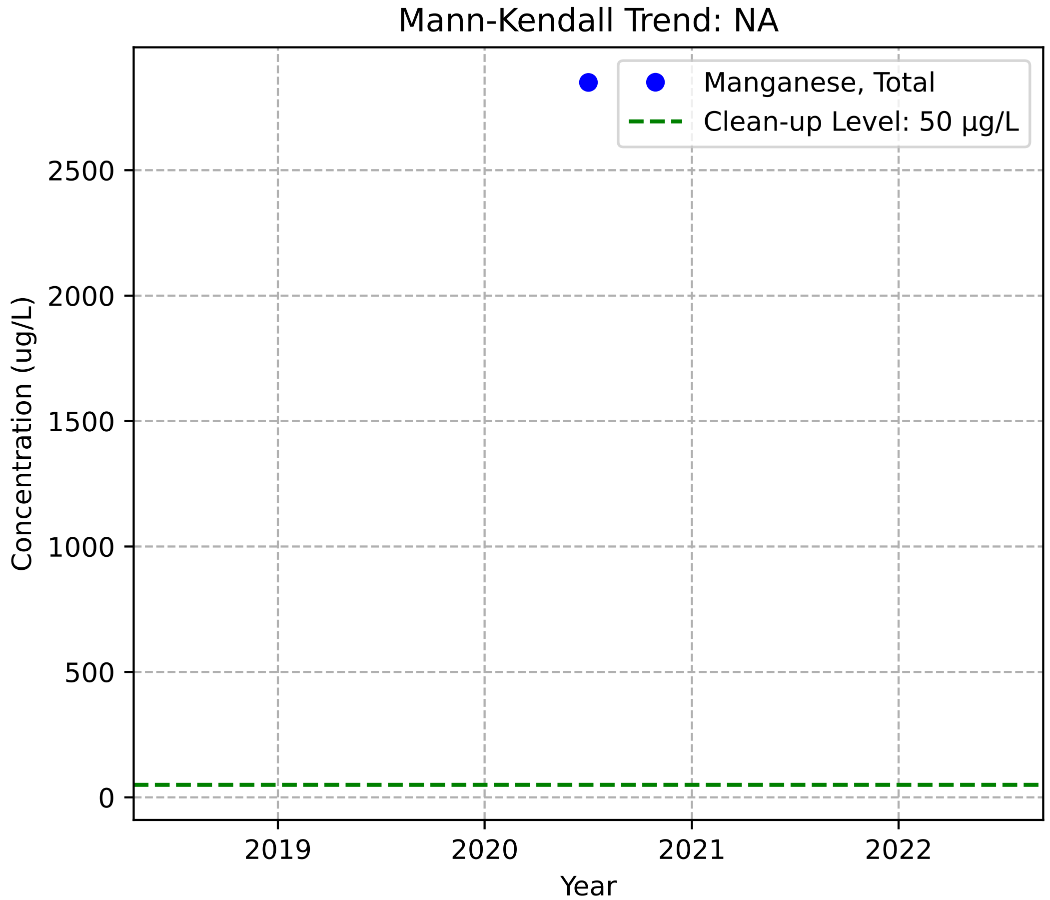
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 μg/L
Concentration (ug/L)
7000
6000
5000
4000
3000
2000
1000
0
2019
2020
2021
2022
Year


MW-109p1
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
2024
5
6
7
8
9
10
11
12
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024
0
500
1000
1500
2000

MW-110p1

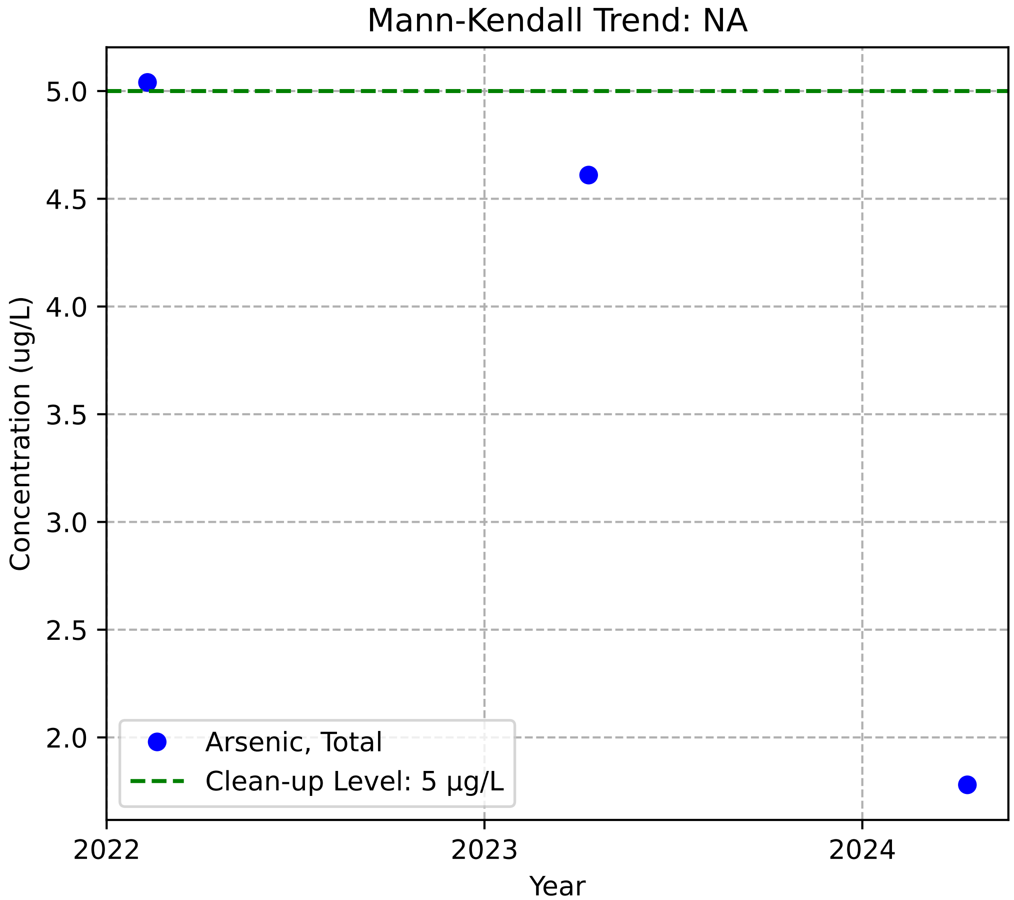


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

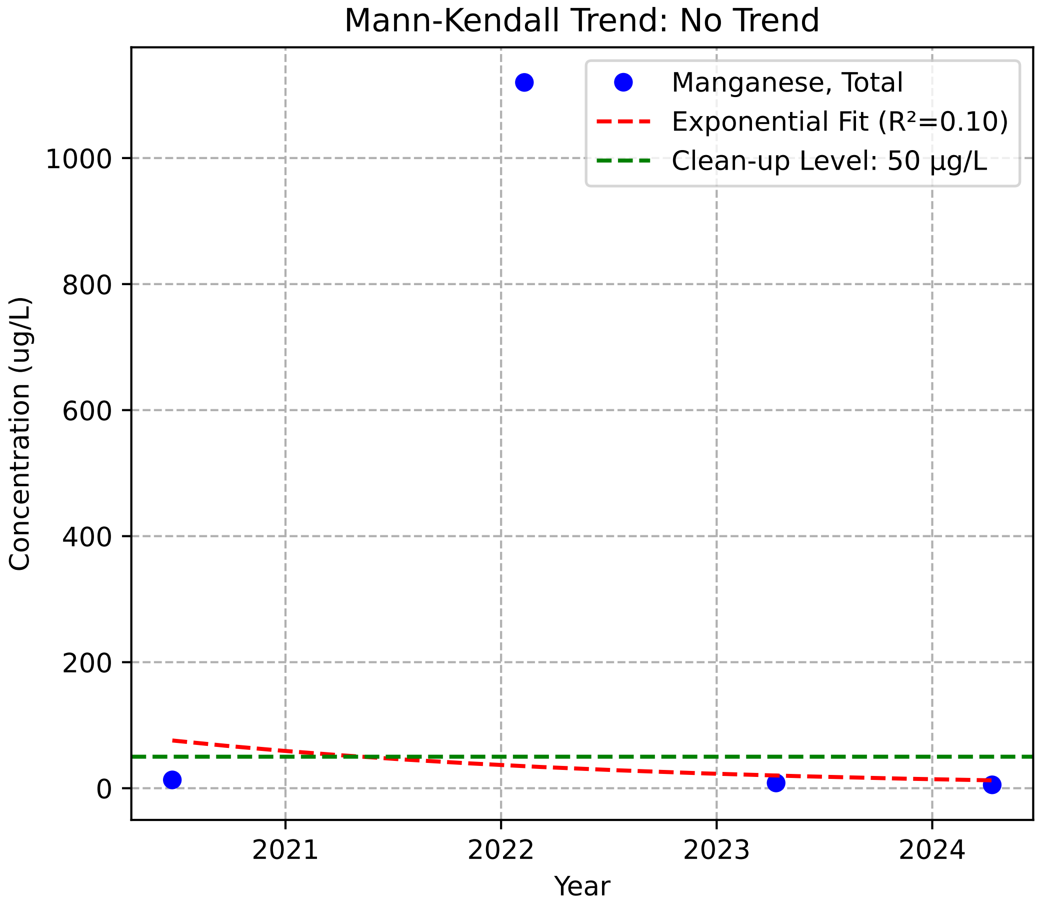


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
2500
2000
1500
1000
500
0
2019
2020
2021
2022
Year

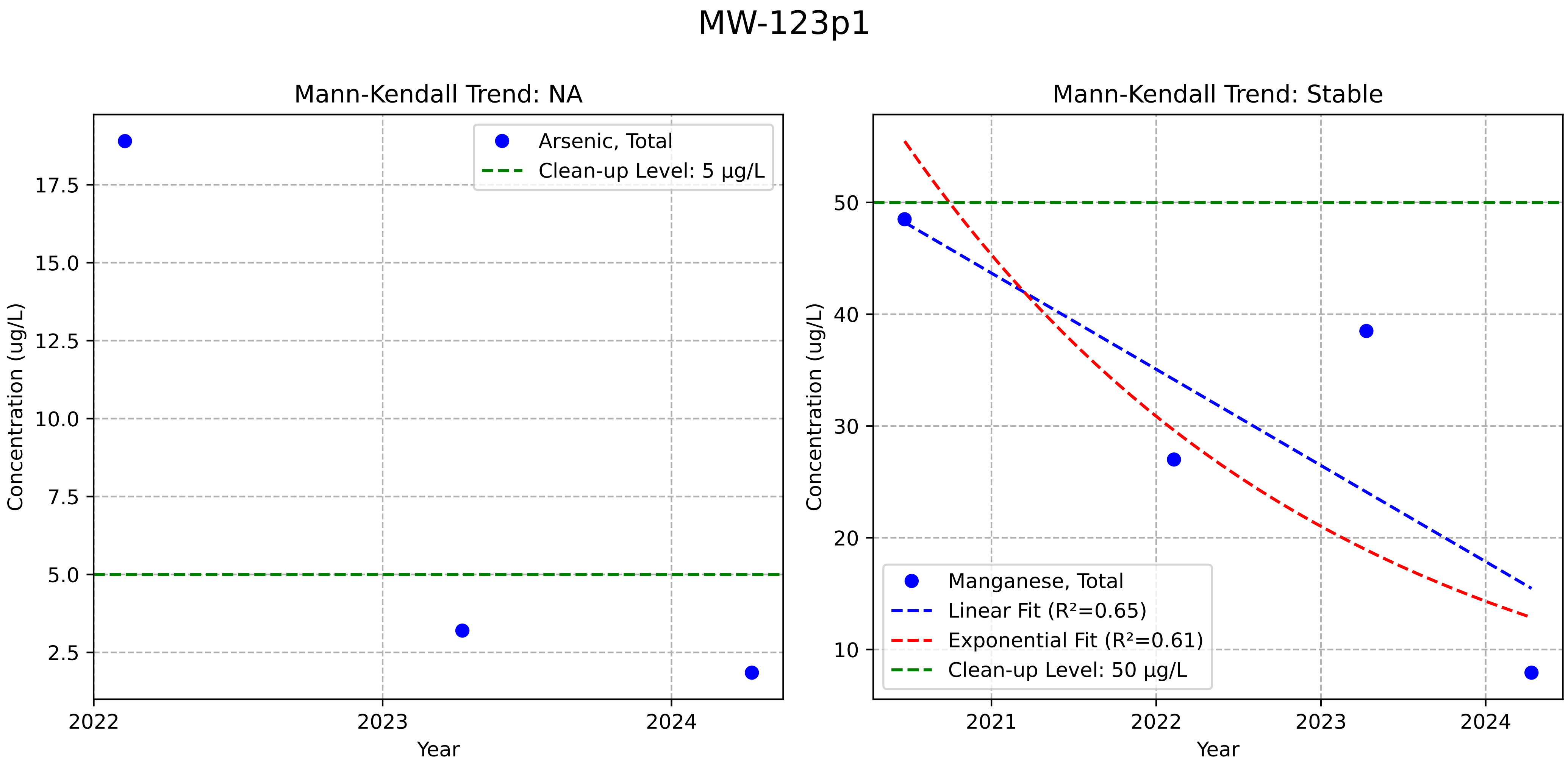
MW-117p1



Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
Arsenic, Total
Clean-up Level: 5 µg/L
2022
2023
2024
Year

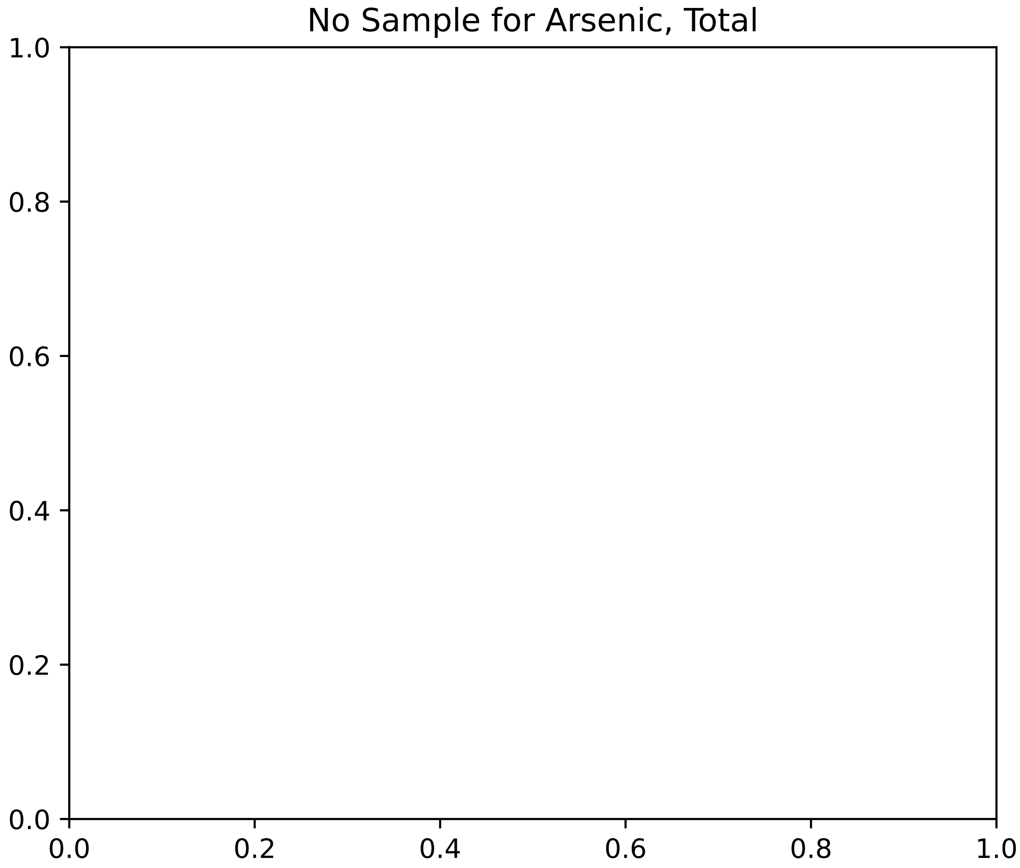


Mann-Kendall Trend: No Trend
Concentration (ug/L)
1000
800
600
400
200
0
Manganese, Total
Exponential Fit (R²=0.10)
Clean-up Level: 50 µg/L
2021
2022
2023
2024
Year

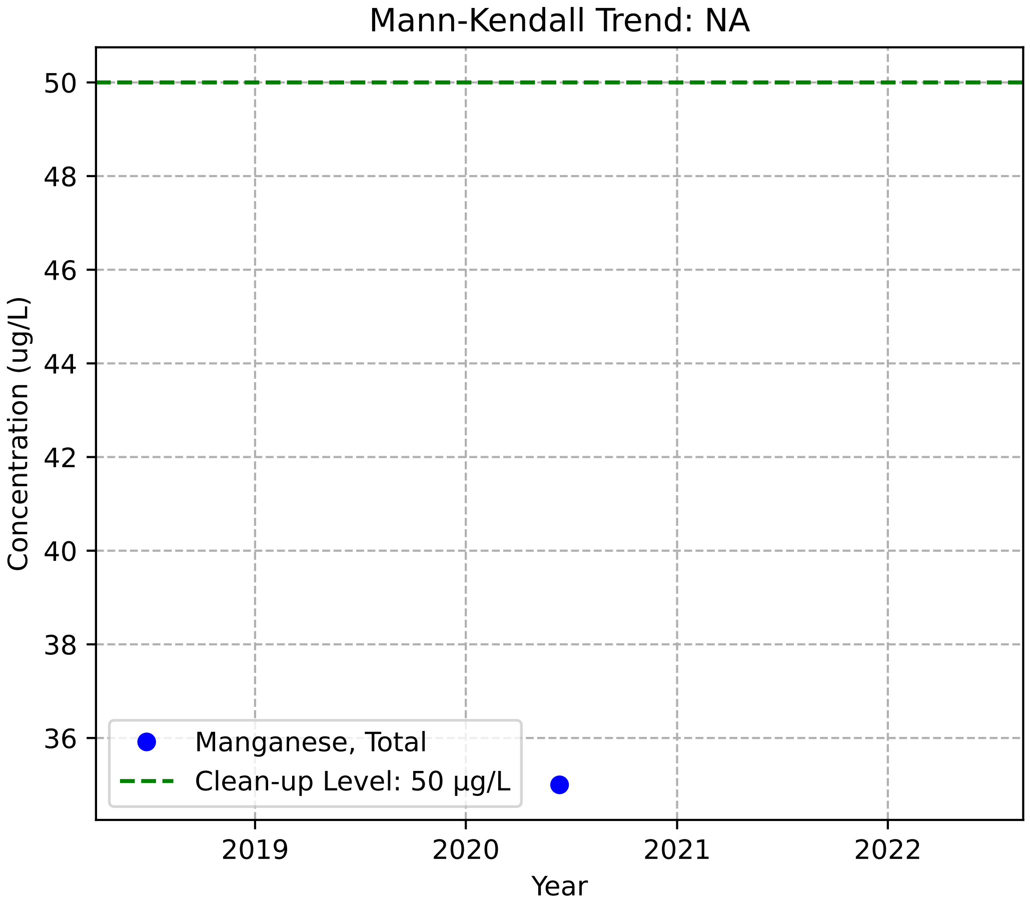


MW-123p1
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.65)
Exponential Fit (R²=0.61)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

MW-127p1

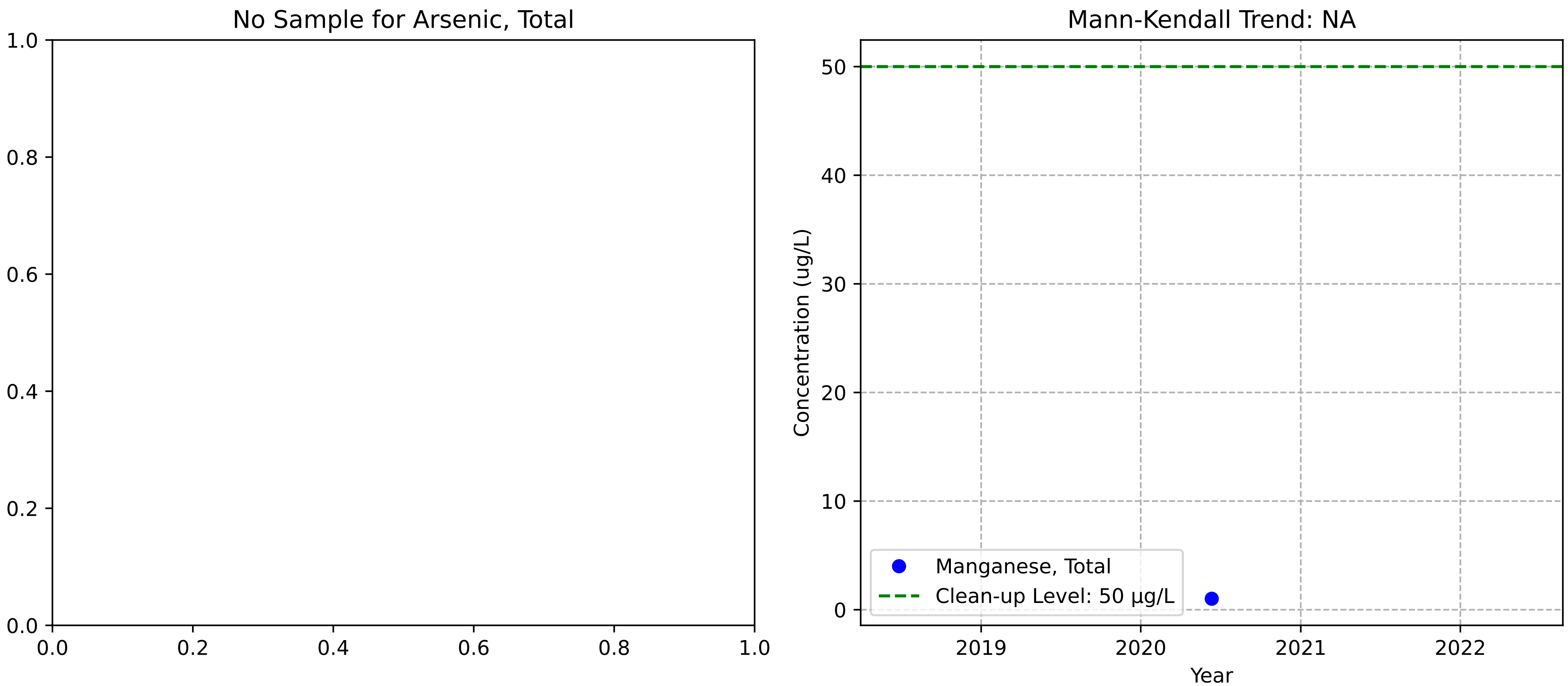


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



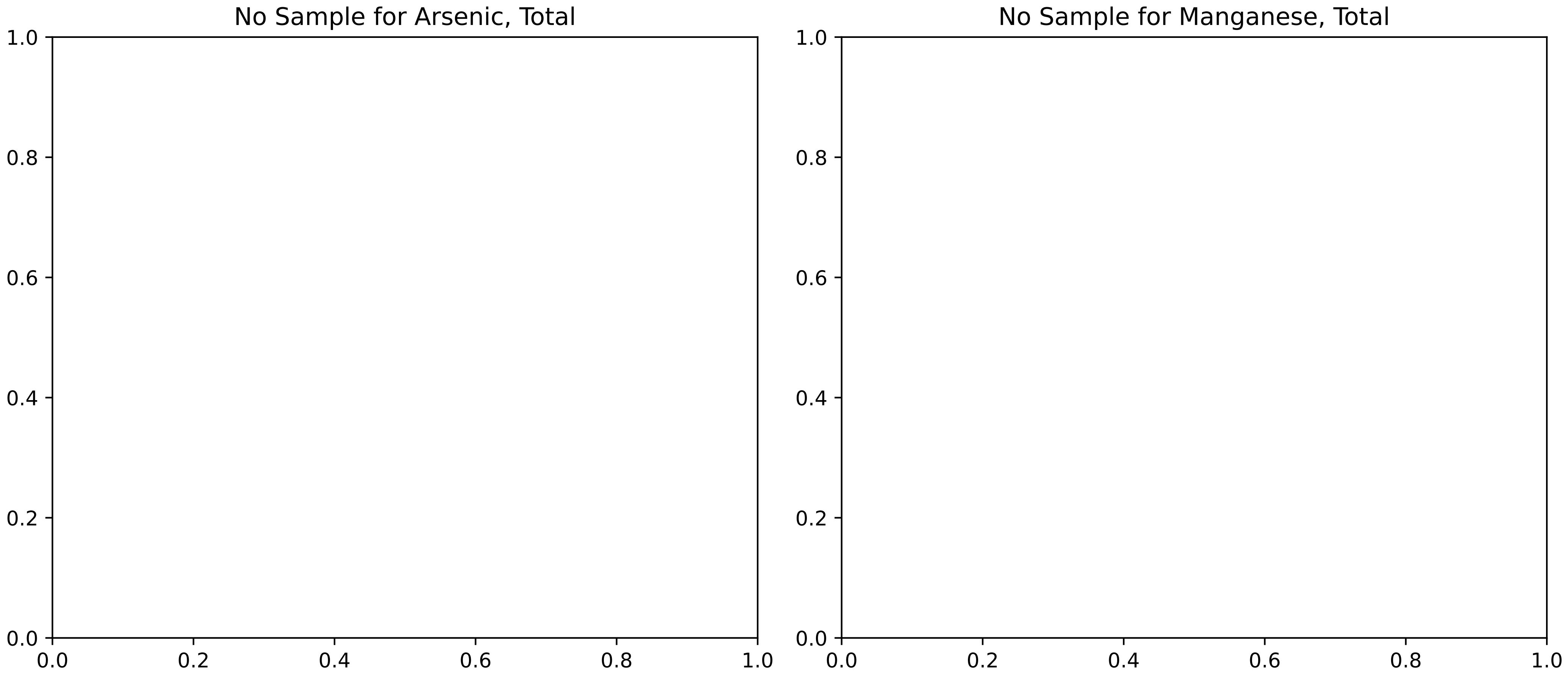
Mann-Kendall Trend: NA
Concentration (ug/L)
50
48
46
44
42
40
38
36
2019
2020
2021
2022
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-129p1



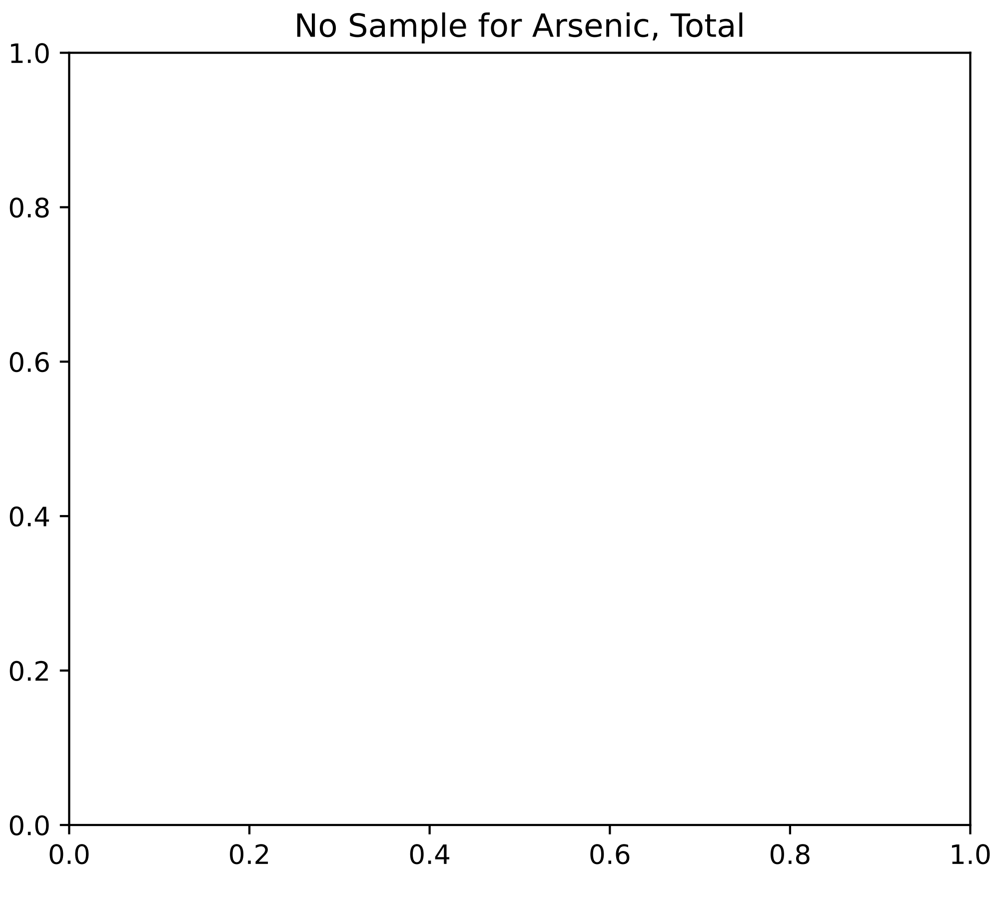
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Concentration (ug/L)
50
40
30
20
10
0
2019
2020
2021
2022
Year
Manganese, Total
Clean-up Level: 50 µg/L

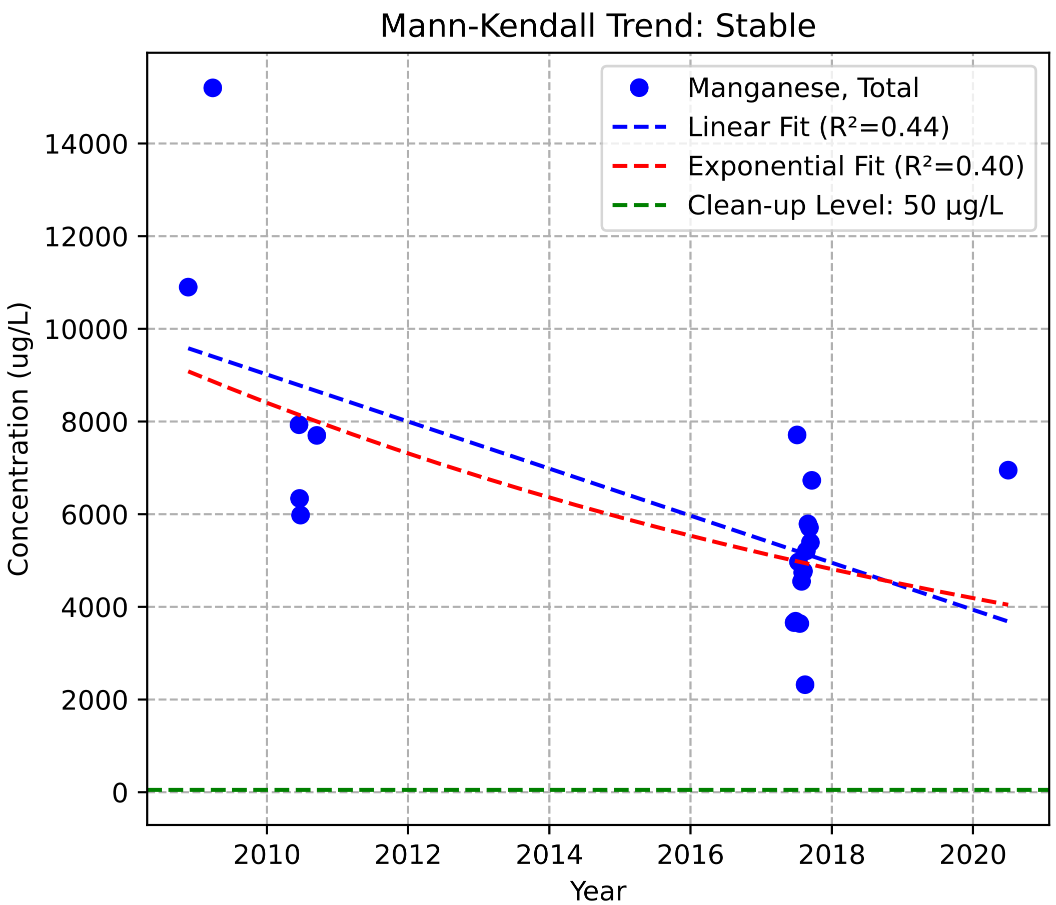
MW-137p1

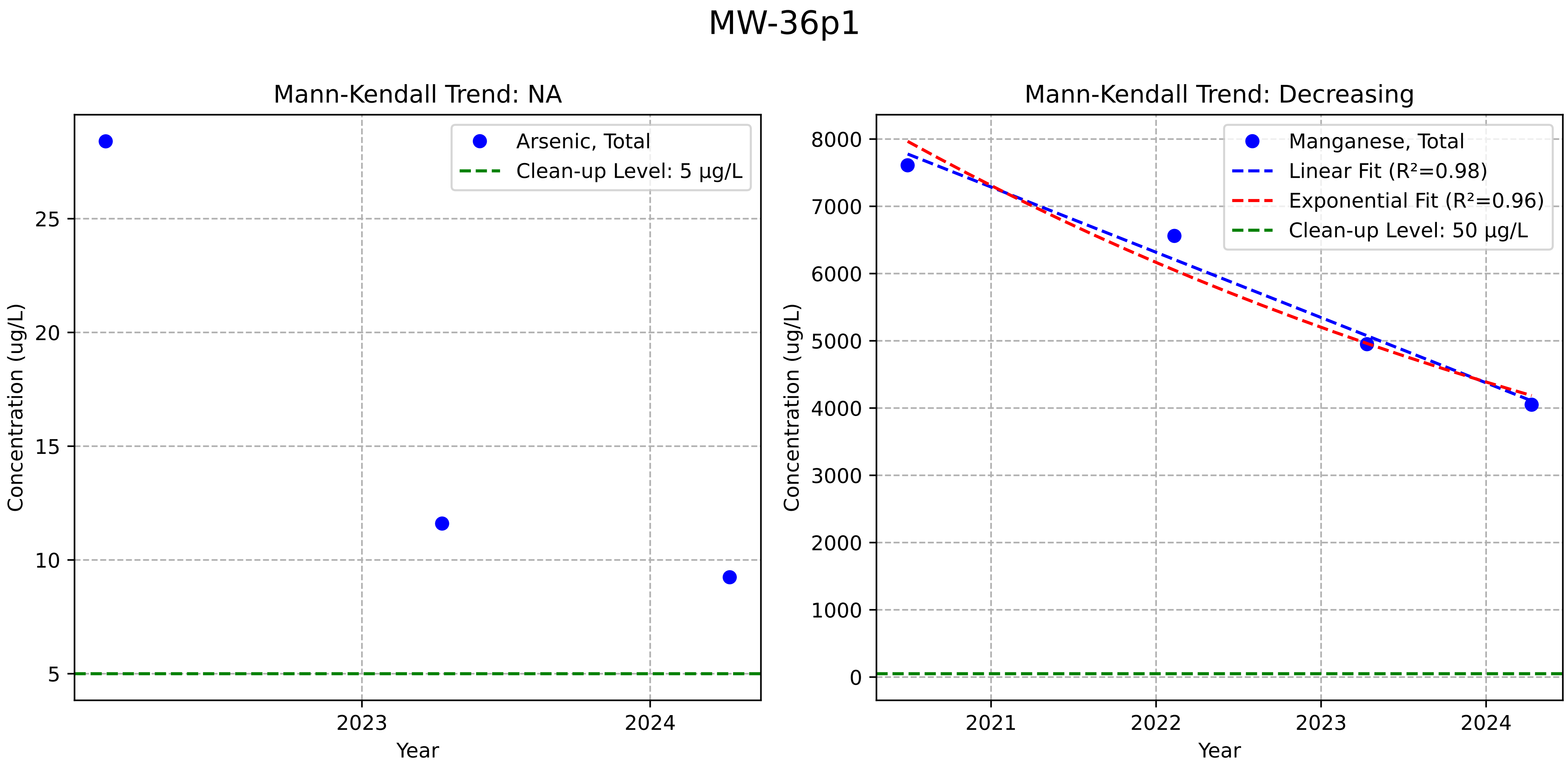


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

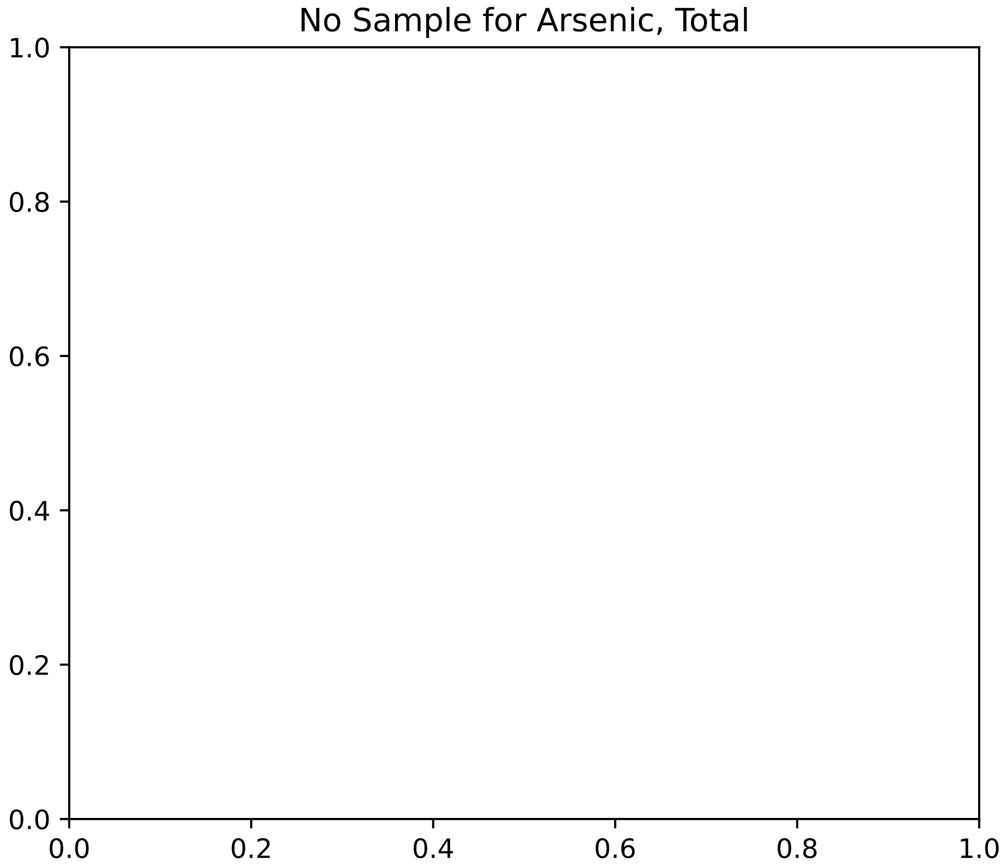
MW-34p1


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

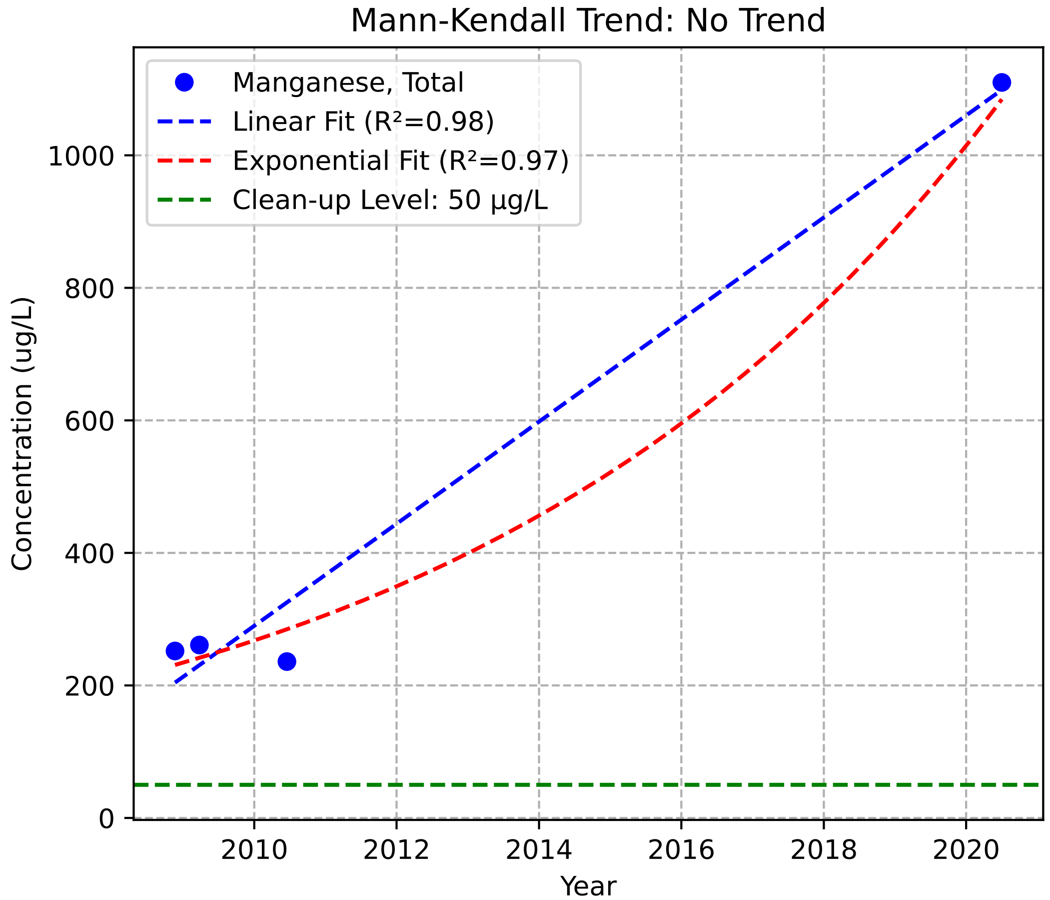

Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.44)
Exponential Fit (R²=0.40)
Clean-up Level: 50 µg/L
Concentration (ug/L)
14000
12000
10000
8000
6000
4000
2000
0
2010
2012
2014
2016
2018
2020
Year


MW-36p1
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
25
20
15
10
5
2023
2024
Year
Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.98)
Exponential Fit (R²=0.96)
Clean-up Level: 50 µg/L
Concentration (ug/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
2021
2022
2023
2024
Year

MW-37p1

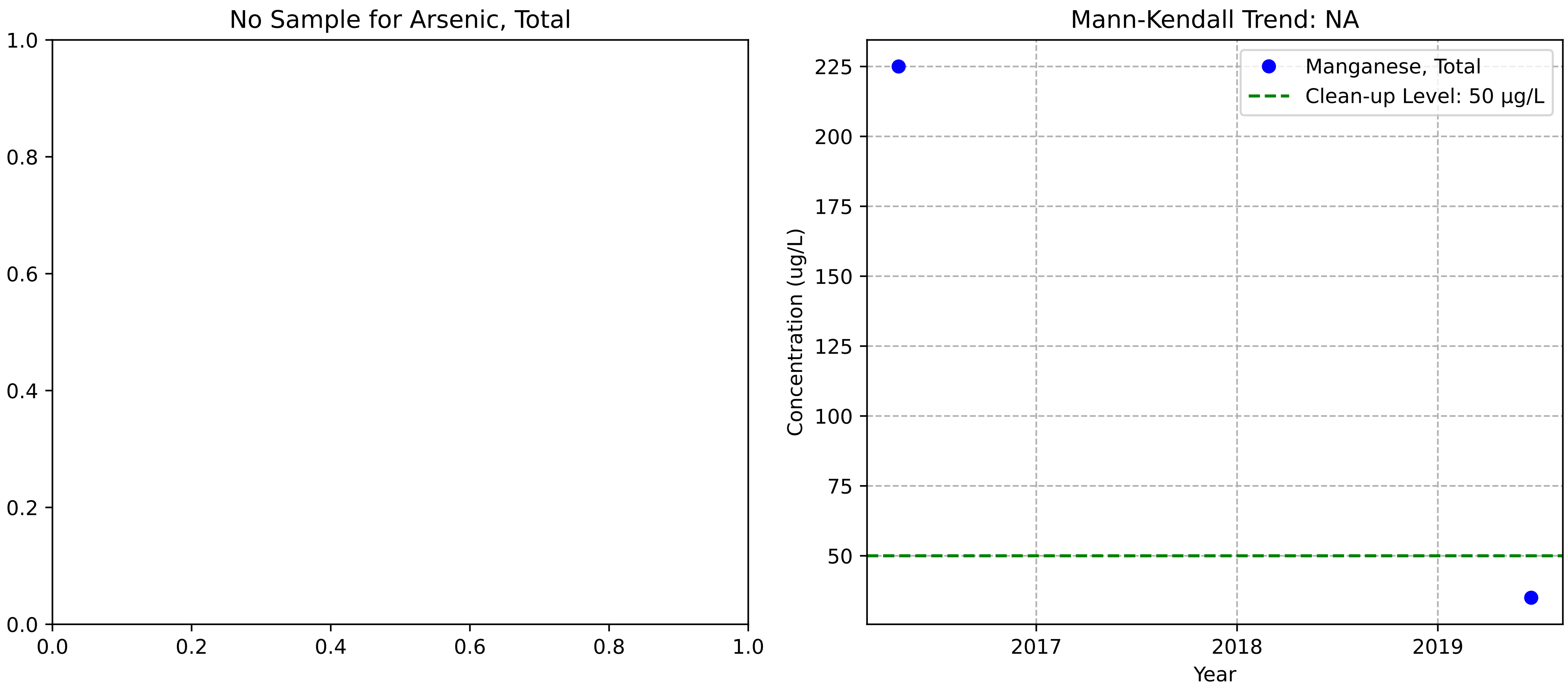


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

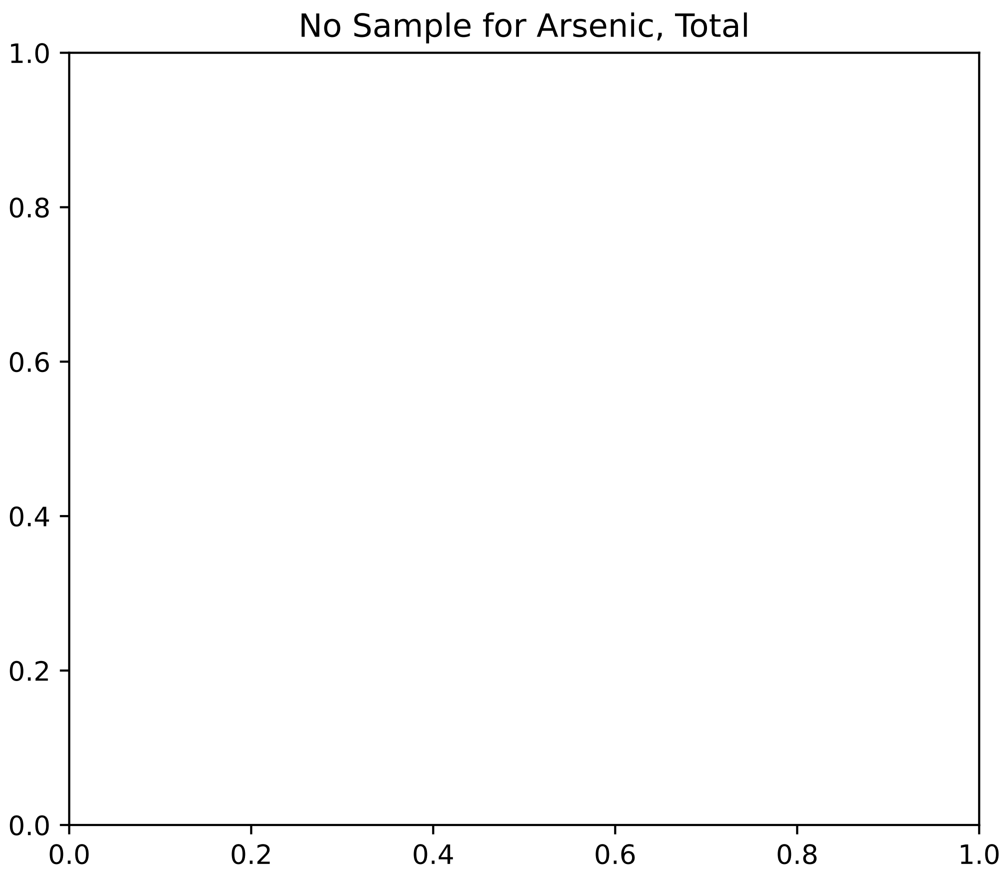


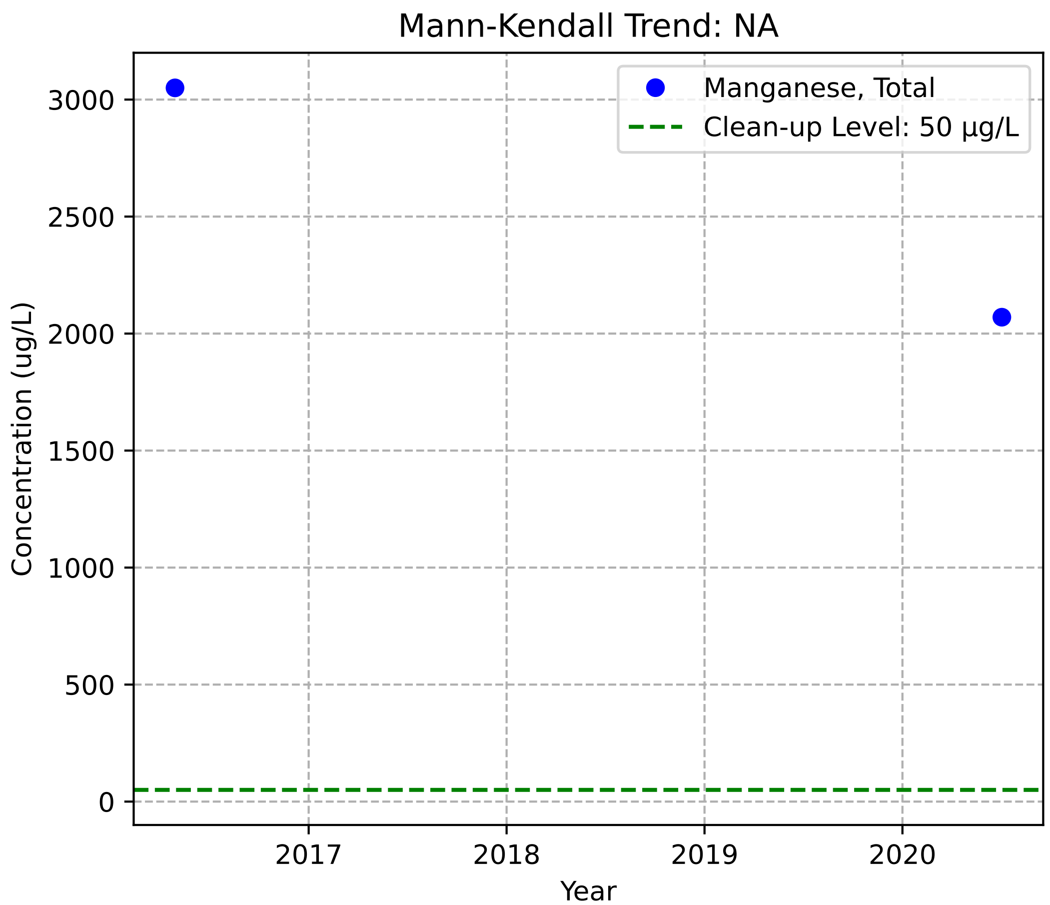
Mann-Kendall Trend: No Trend
Manganese, Total
Linear Fit (R²=0.98)
Exponential Fit (R²=0.97)
Clean-up Level: 50 µg/L
Concentration (ug/L)
1000
800
600
400
200
0
2010
2012
2014
2016
2018
2020
Year

MW-61p1

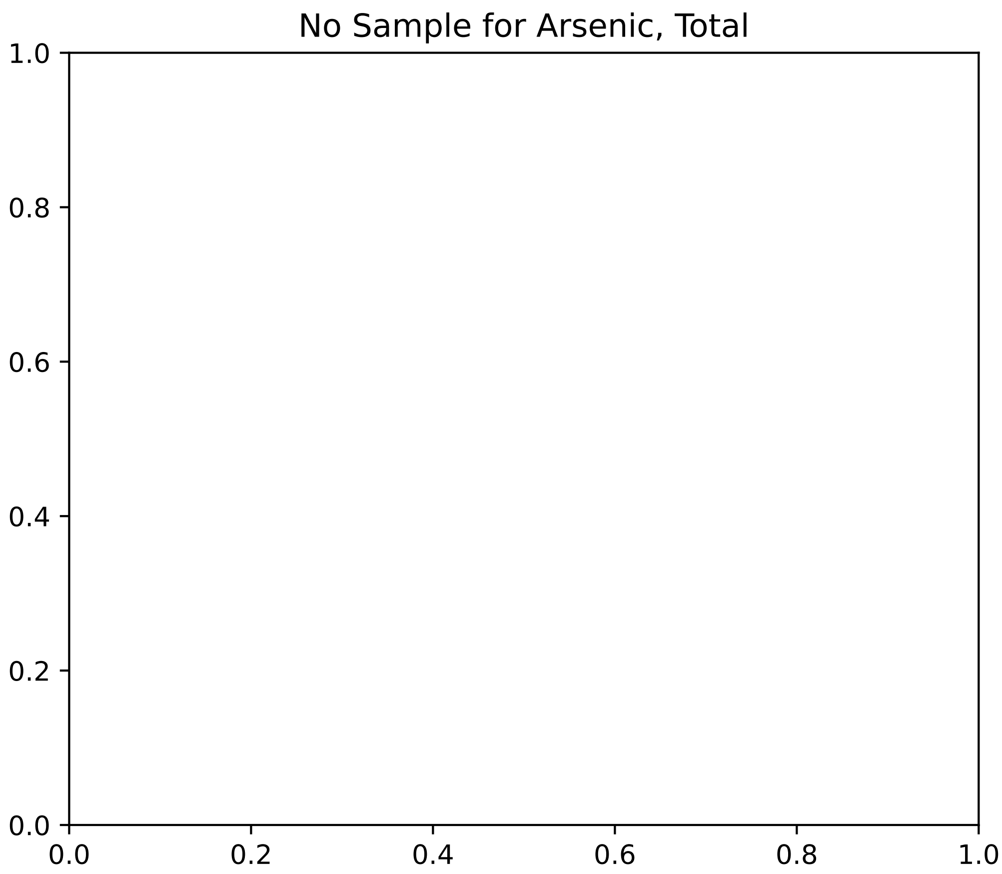

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
225
200
175
150
125
100
75
50
2017
2018
2019
Year

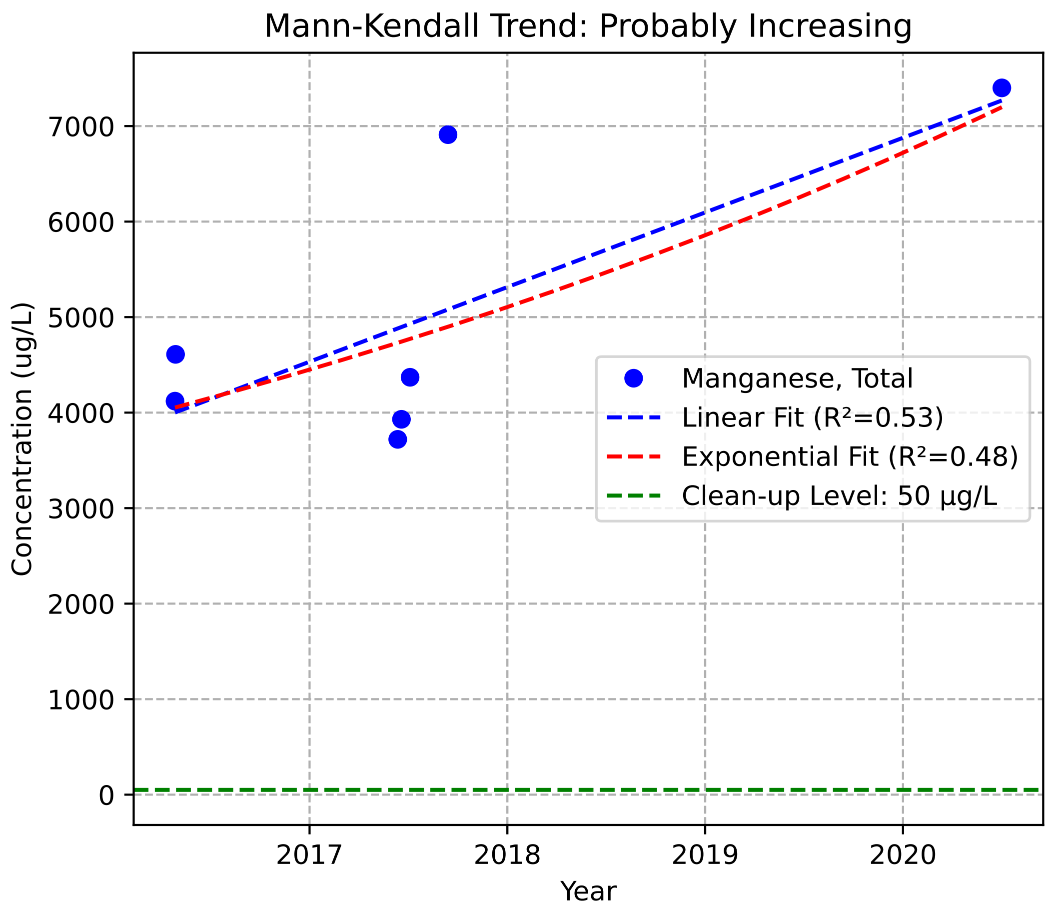
MW-64p1


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

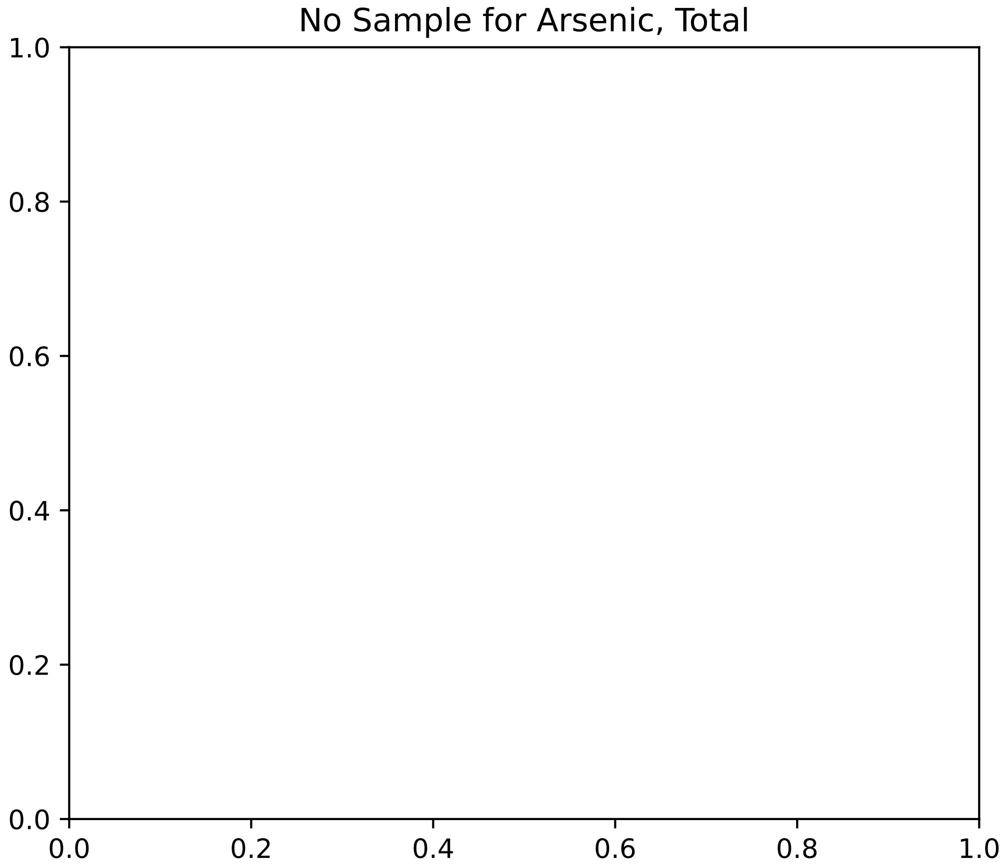

Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
3000
2500
2000
1500
1000
500
0
2017
2018
2019
2020
Year

MW-65p1

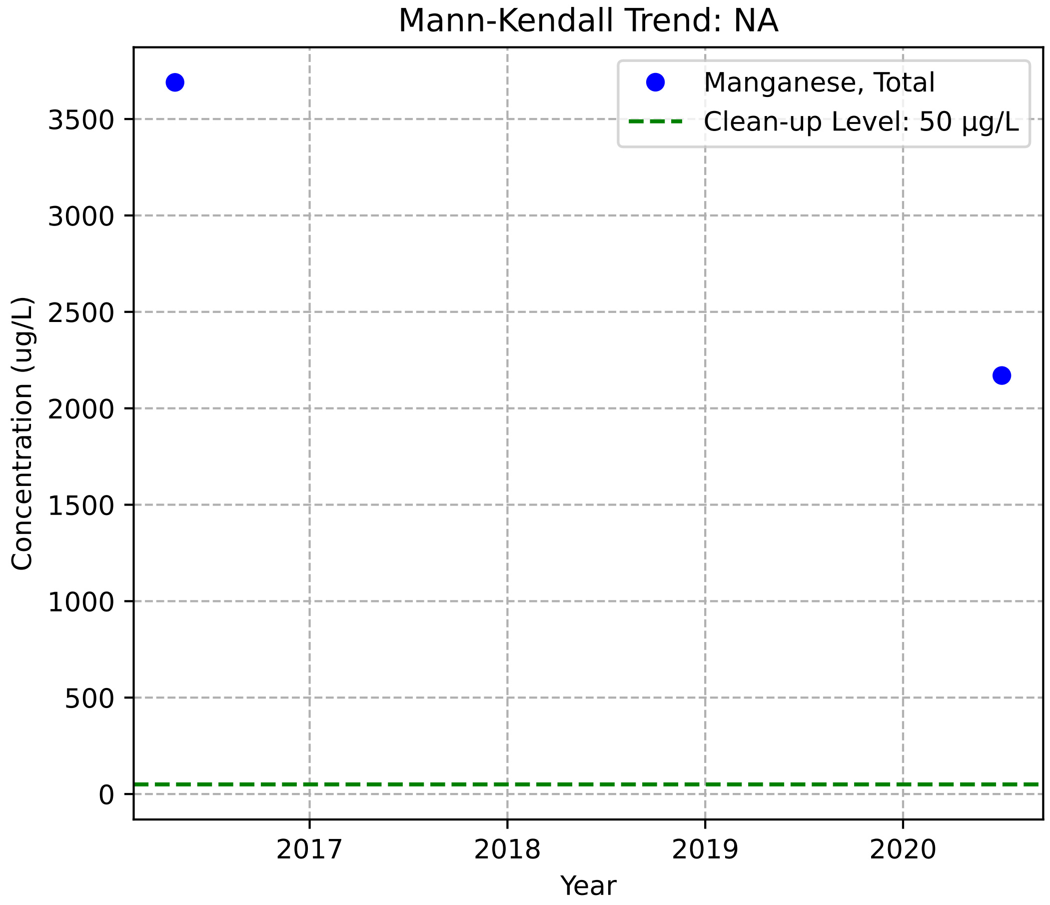

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Mann-Kendall Trend: Probably Increasing
Concentration (ug/L)
7000
6000
5000
4000
3000
2000
1000
0
2017
2018
2019
2020
Year
Manganese, Total
Linear Fit (R²=0.53)
Exponential Fit (R²=0.48)
Clean-up Level: 50 µg/L

MW-66p1

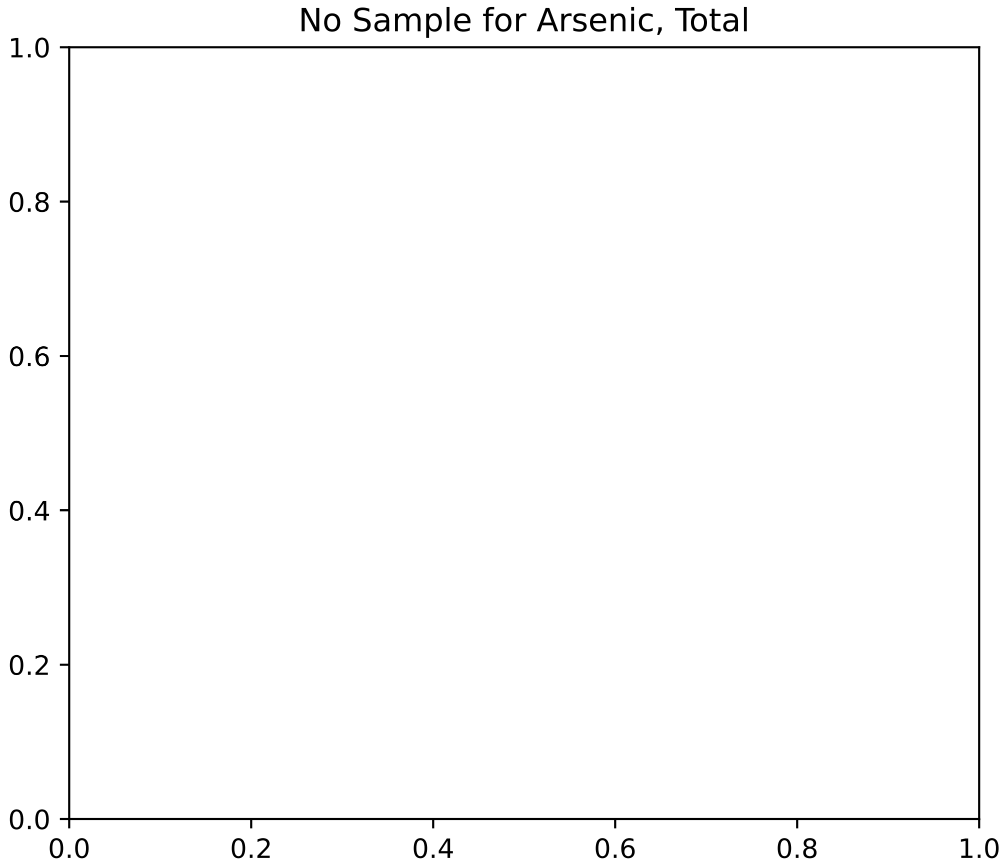


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

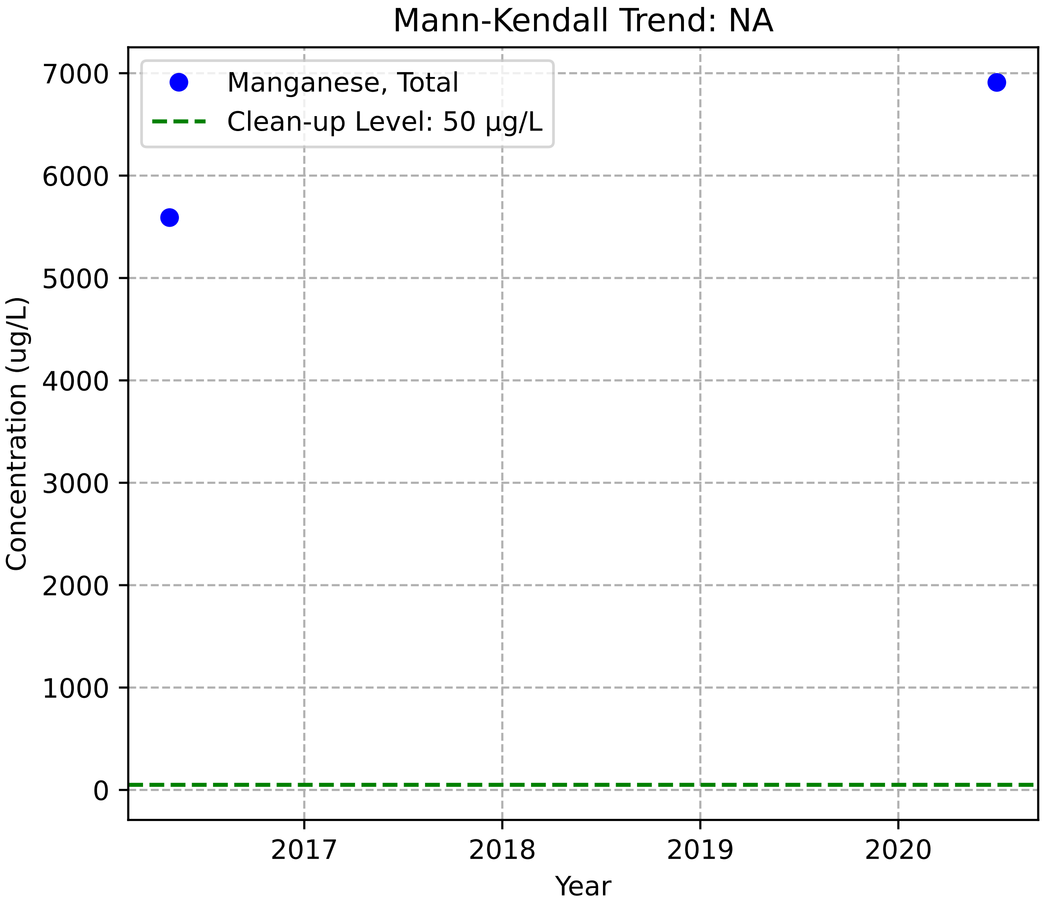


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
3500
3000
2500
2000
1500
1000
500
0
2017
2018
2019
2020
Year

MW-67p1

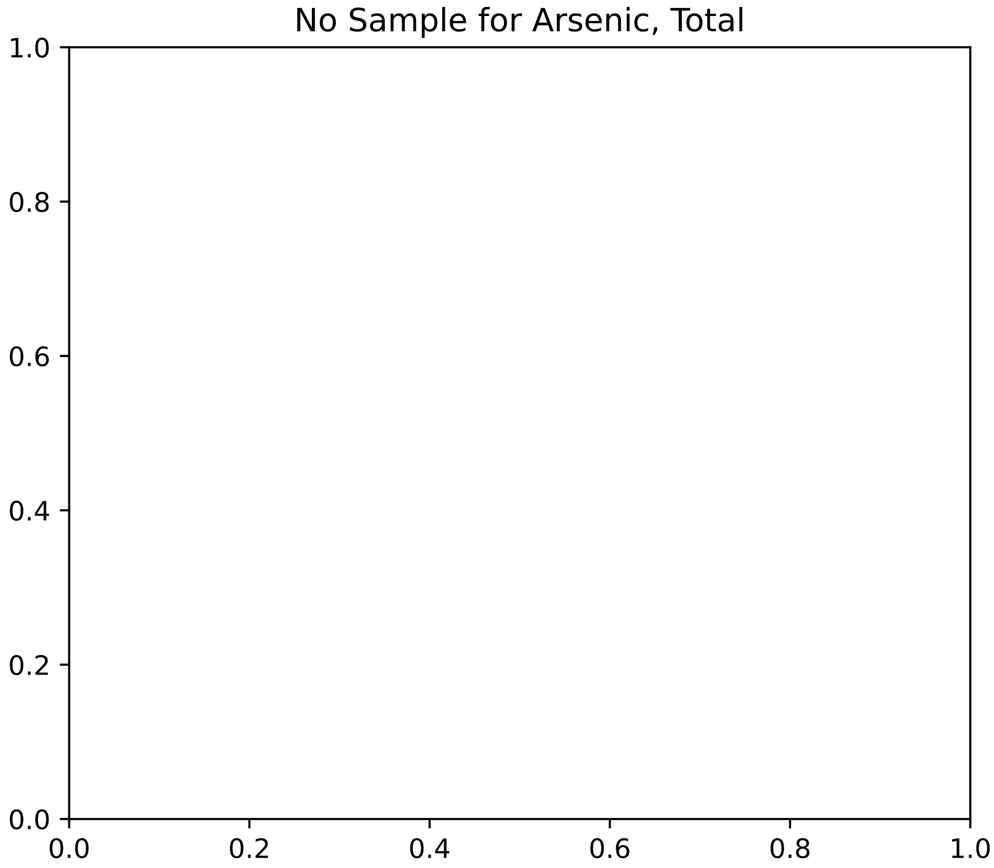


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

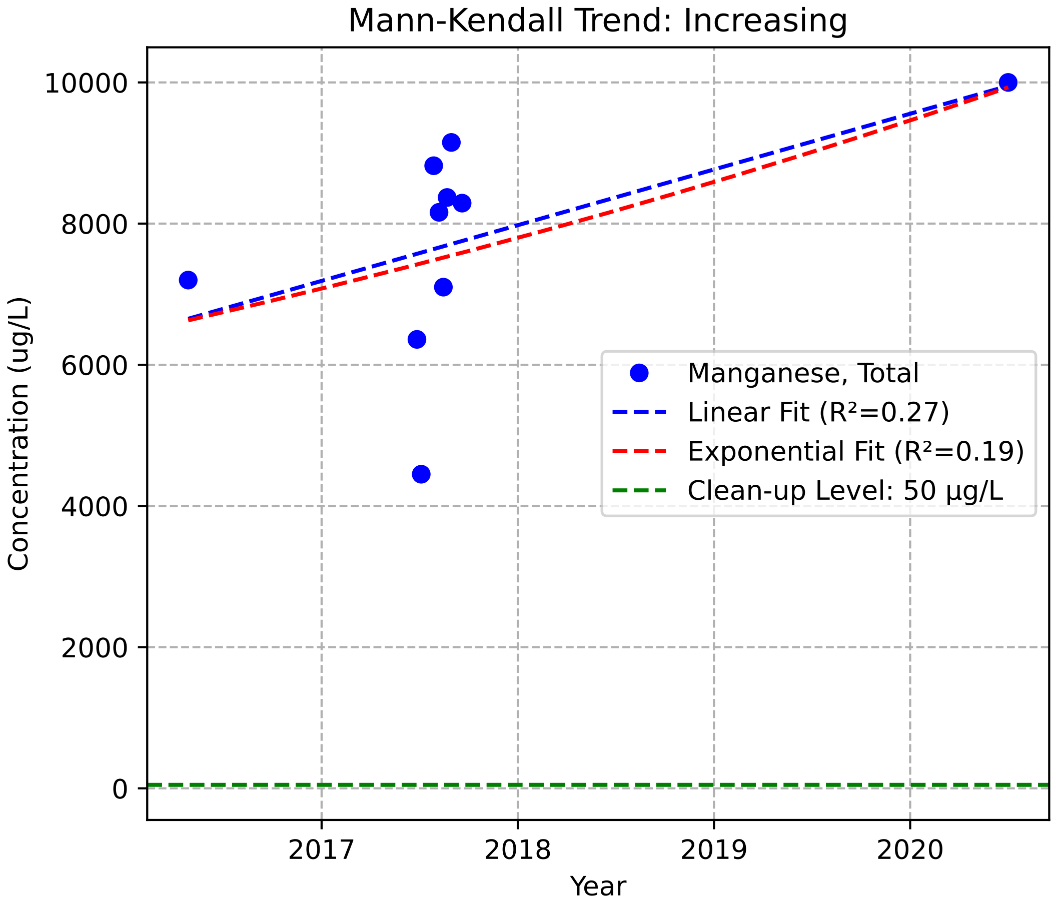


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
7000
6000
5000
4000
3000
2000
1000
0
2017
2018
2019
2020
Year

MW-68p1

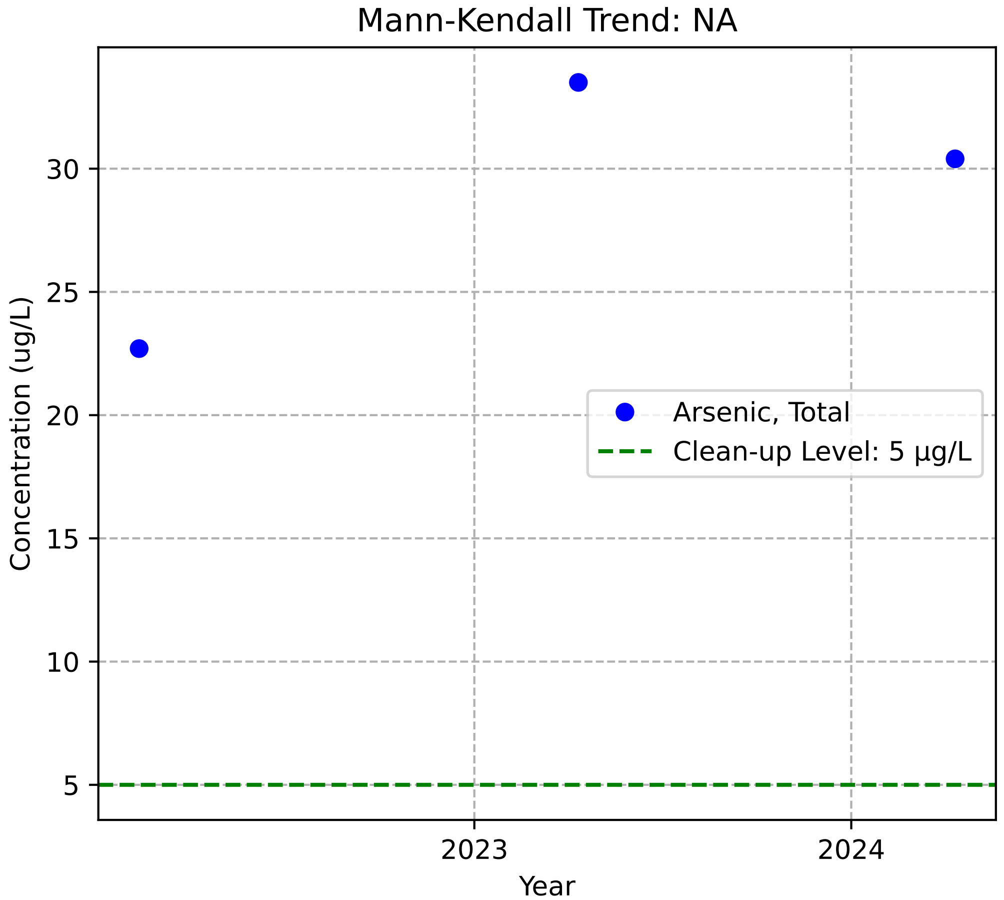


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

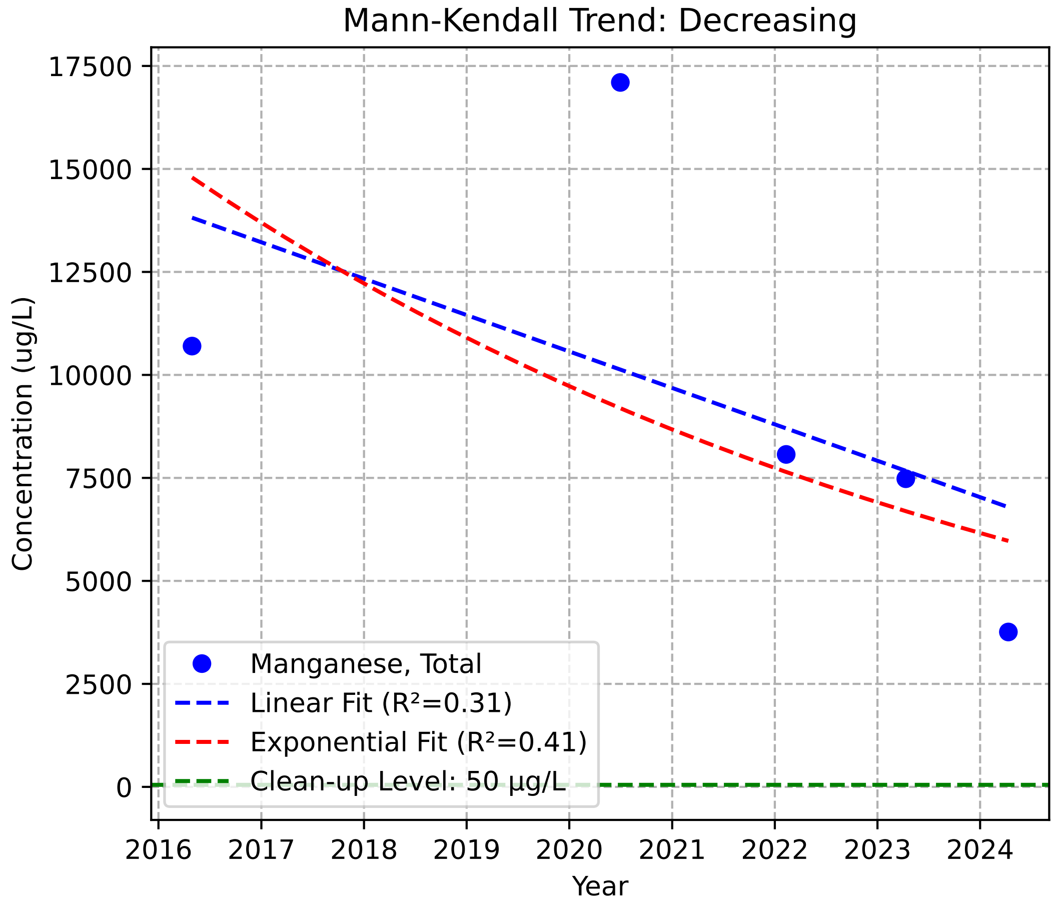


Mann-Kendall Trend: Increasing
Concentration (ug/L)
10000
8000
6000
4000
2000
0
2017
2018
2019
2020
Year
Manganese, Total
Linear Fit (R²=0.27)
Exponential Fit (R²=0.19)
Clean-up Level: 50 µg/L

MW-69p1

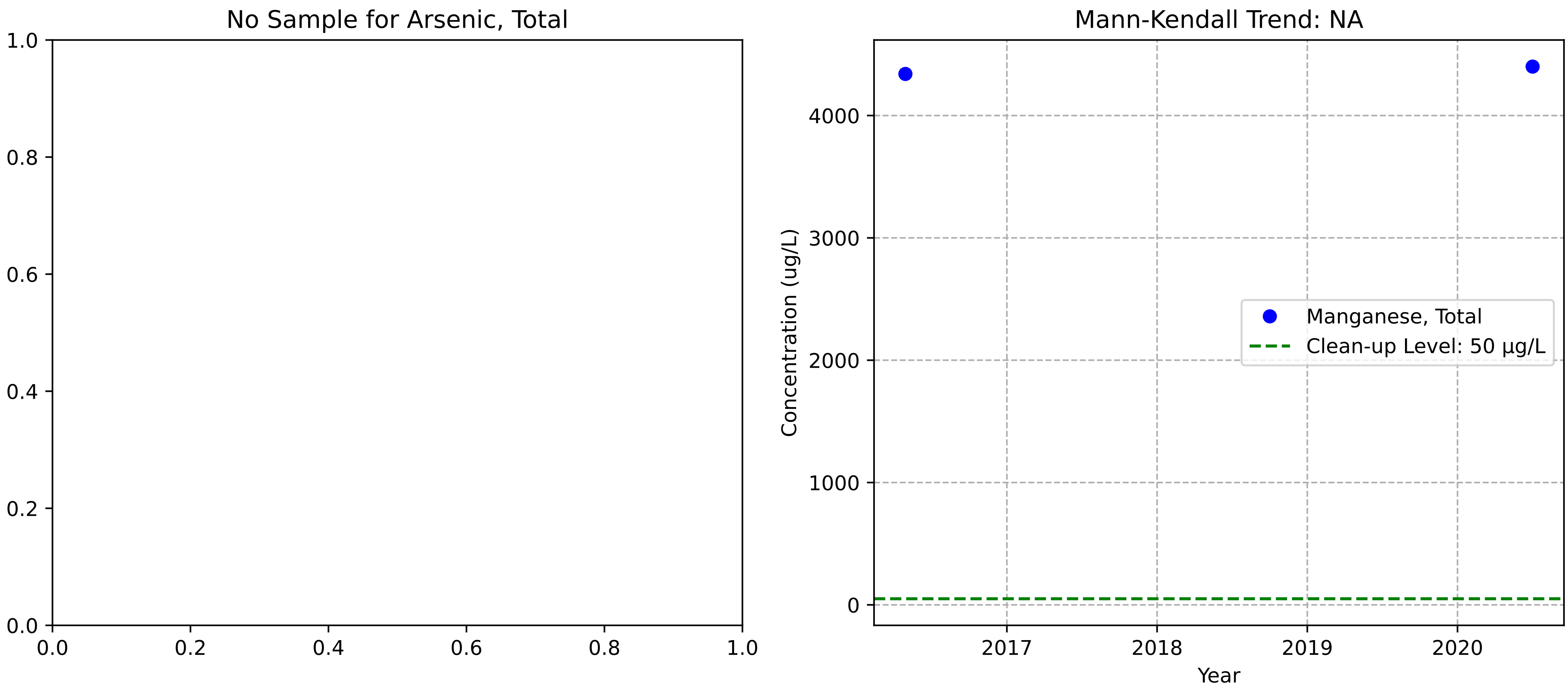


Mann-Kendall Trend: NA
Concentration (ug/L)
Year
2023
2024
5
10
15
20
25
30
Arsenic, Total
Clean-up Level: 5 µg/L

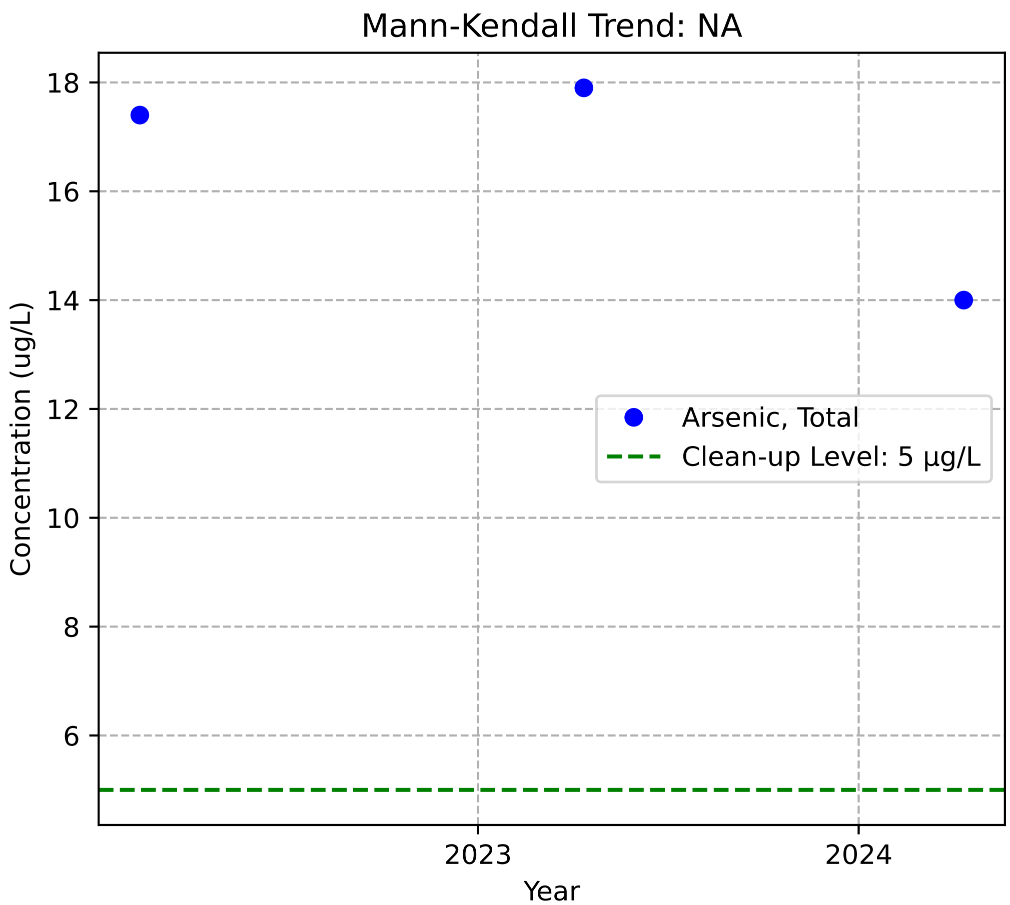


Mann-Kendall Trend: Decreasing
Concentration (ug/L)
Year
2016
2017
2018
2019
2020
2021
2022
2023
2024
0
2500
5000
7500
10000
12500
15000
17500
Manganese, Total
Linear Fit (R²=0.31)
Exponential Fit (R²=0.41)
Clean-up Level: 50 µg/L

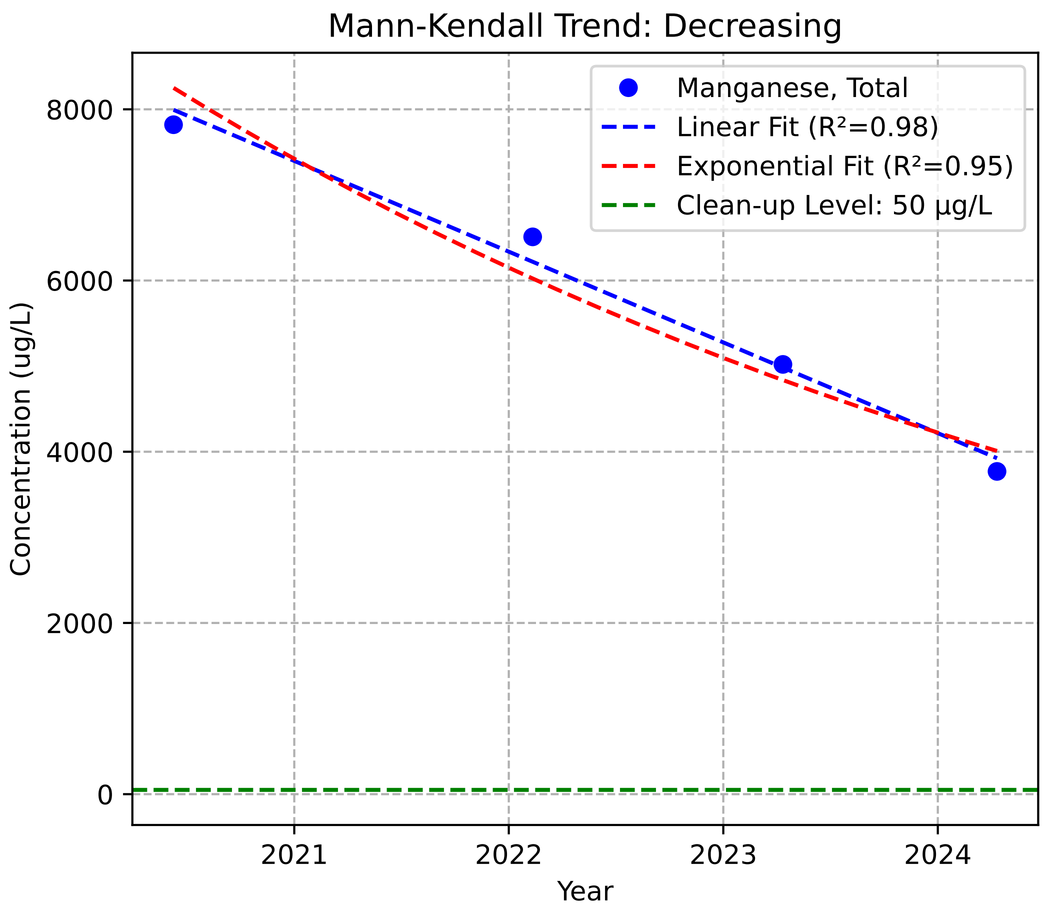
MW-70p1


No Sample for Arsenic, Total
Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-83p1

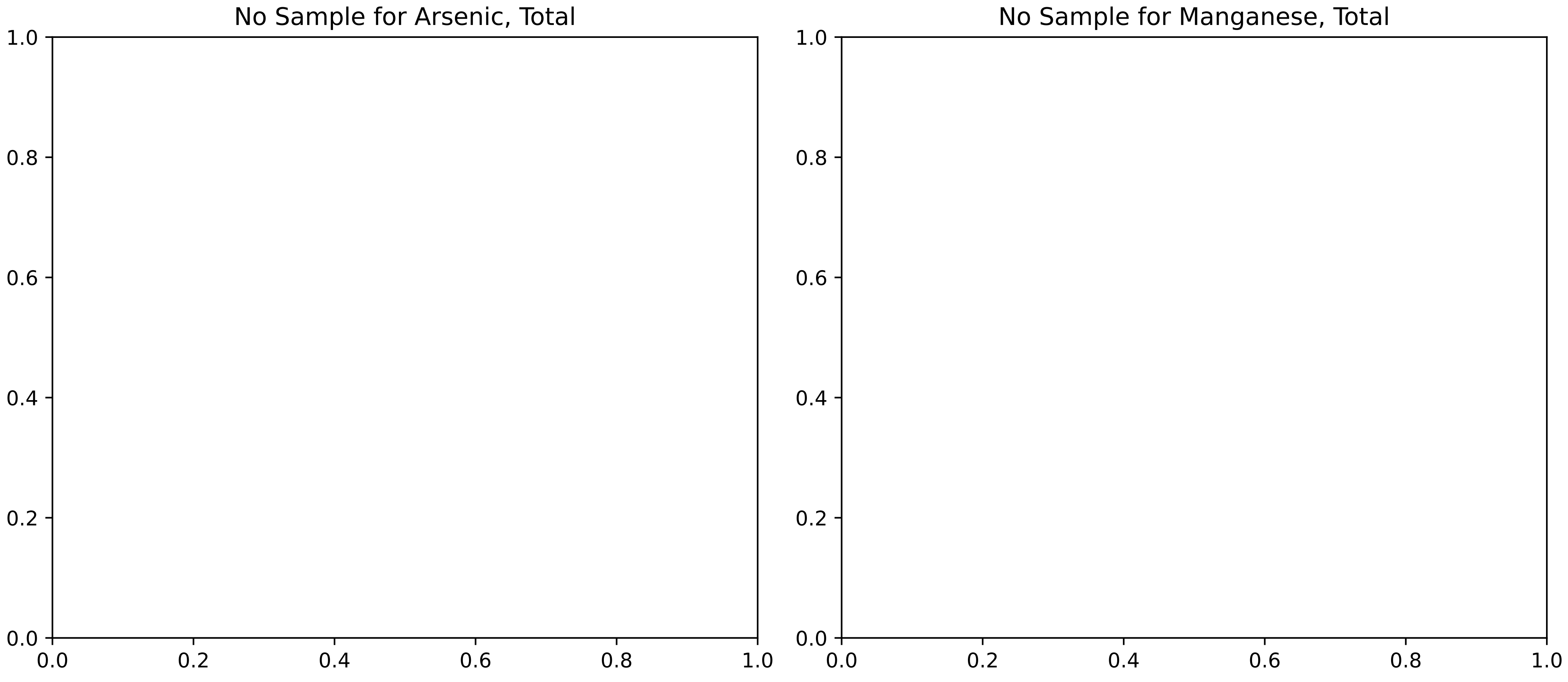


Mann-Kendall Trend: NA
18
16
14
12
10
8
6
Concentration (ug/L)
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L



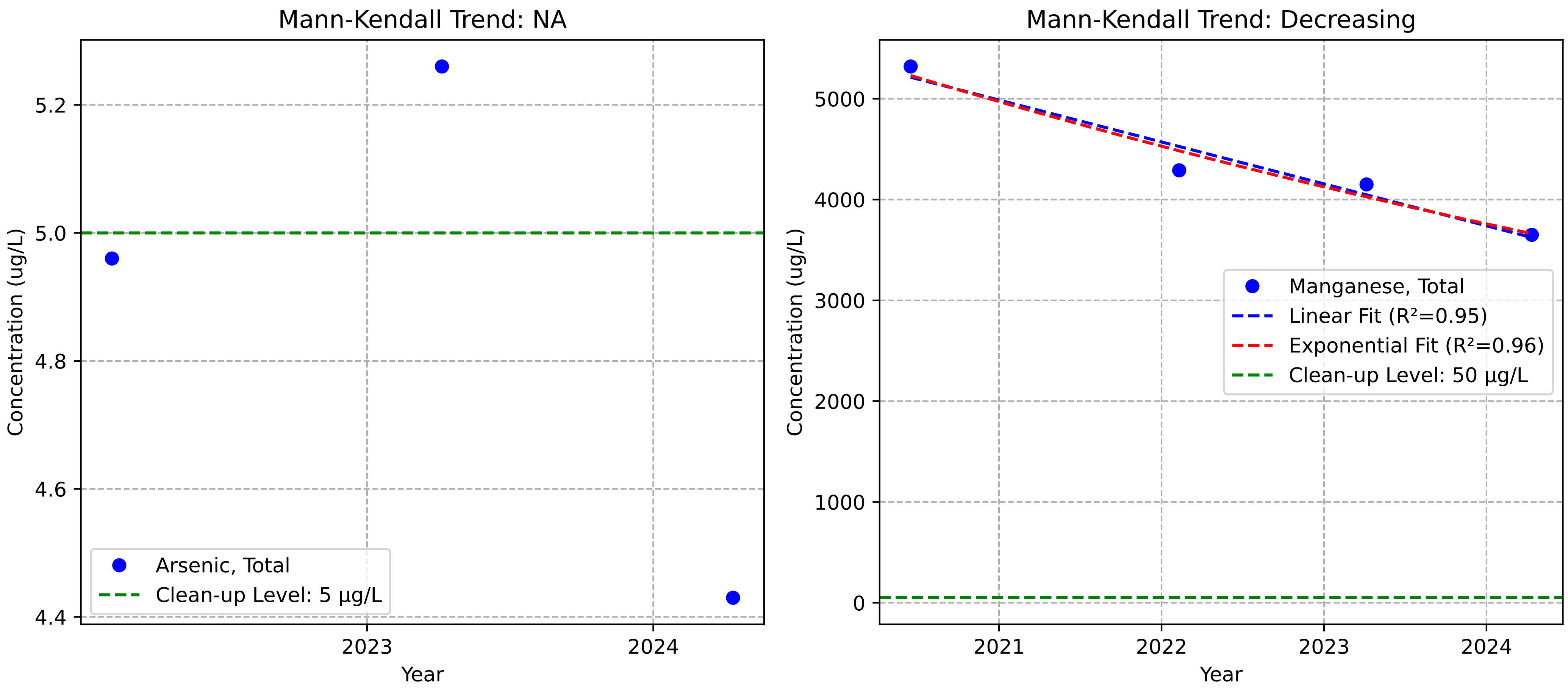
Mann-Kendall Trend: Decreasing
8000
6000
4000
2000
0
Concentration (ug/L)
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.98)
Exponential Fit (R²=0.95)
Clean-up Level: 50 µg/L

MW-84p1



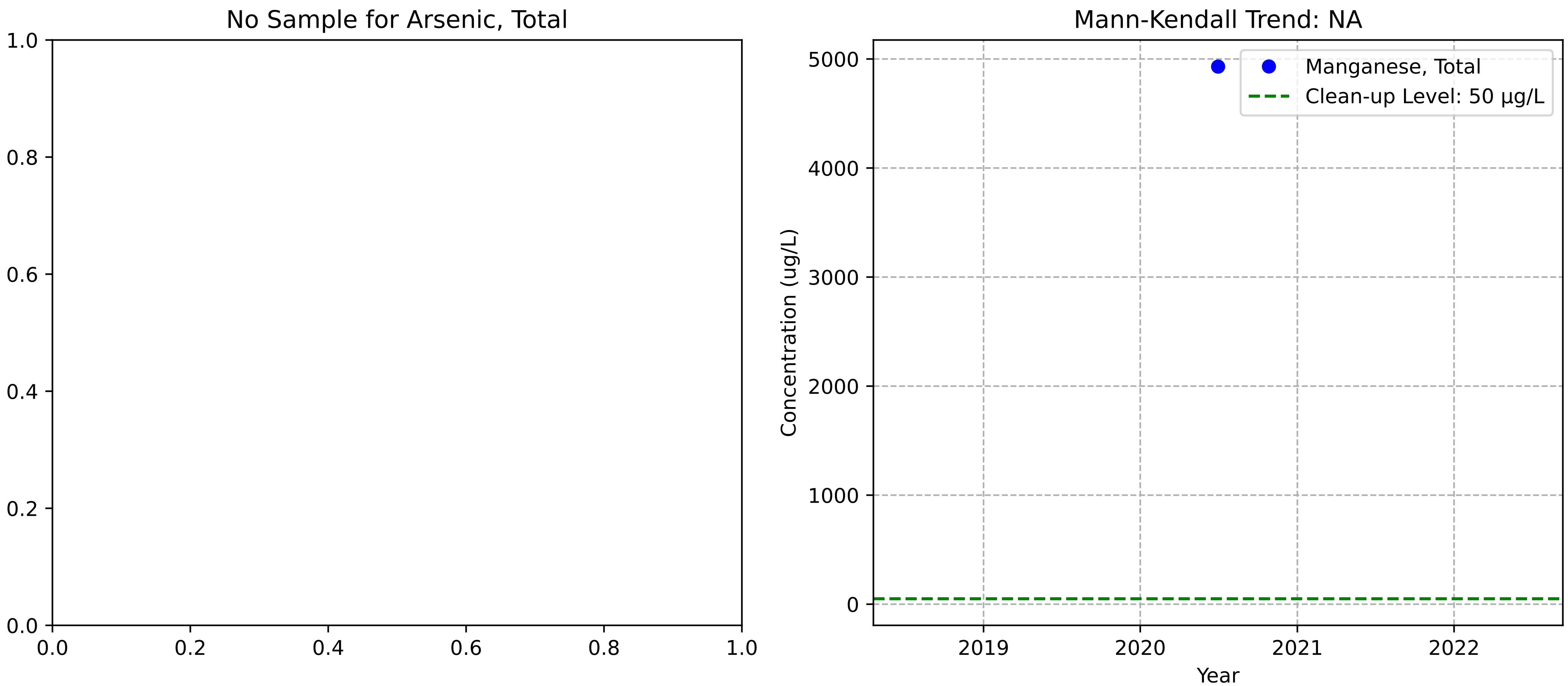
No Sample for Arsenic, Total
No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0

MW-85p1



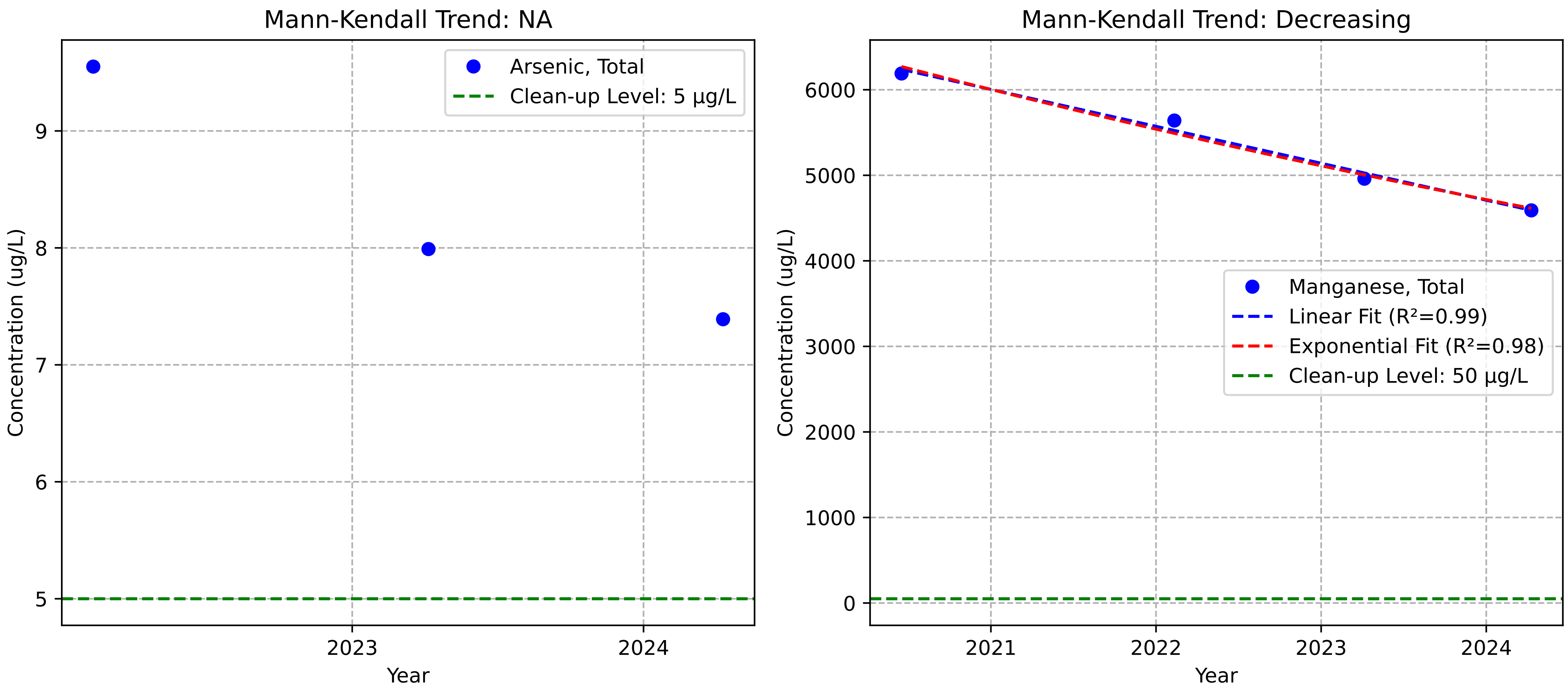
Mann-Kendall Trend: NA
Concentration (ug/L)
5.2
5.0
4.8
4.6
4.4
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Concentration (ug/L)
5000
4000
3000
2000
1000
0
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.95)
Exponential Fit (R²=0.96)
Clean-up Level: 50 µg/L

MW-90p1

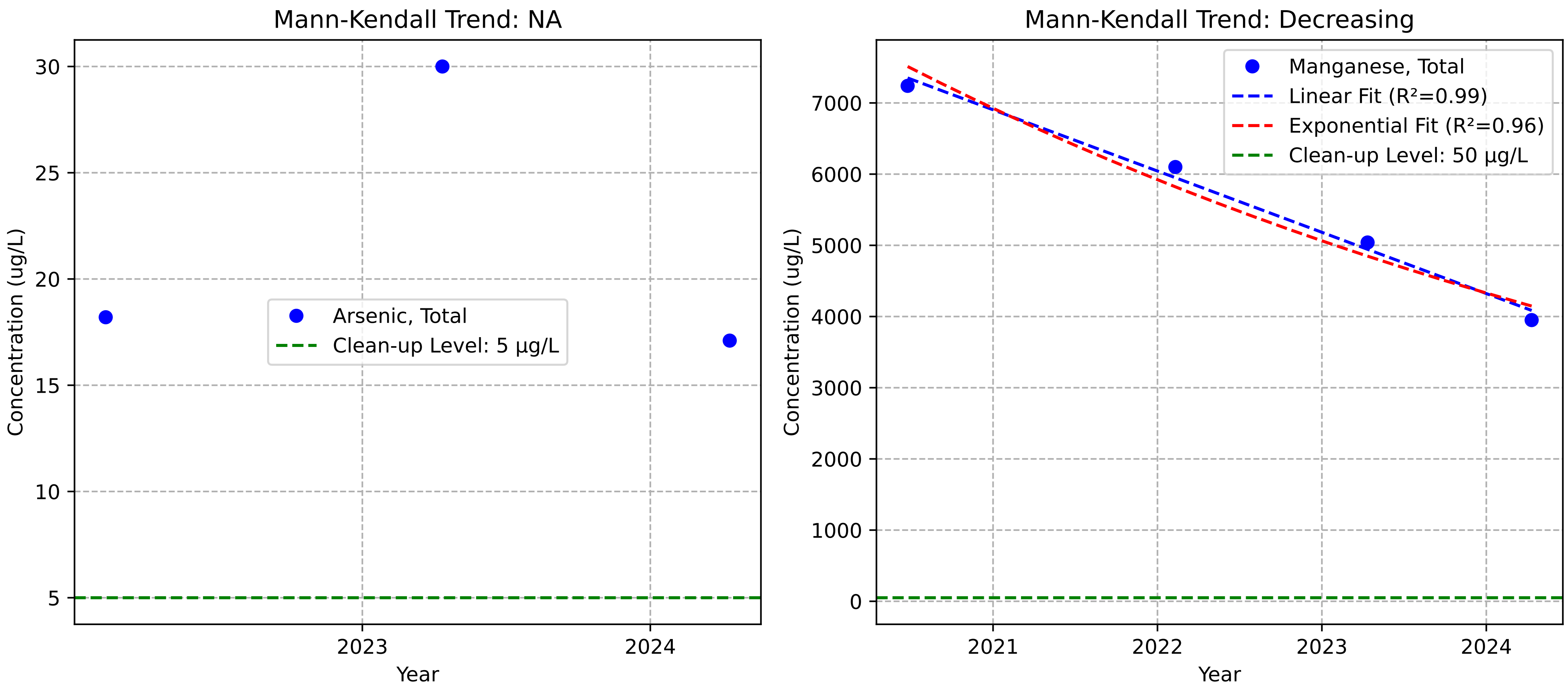


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Concentration (ug/L)
5000
4000
3000
2000
1000
0
2019
2020
2021
2022
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-92p1

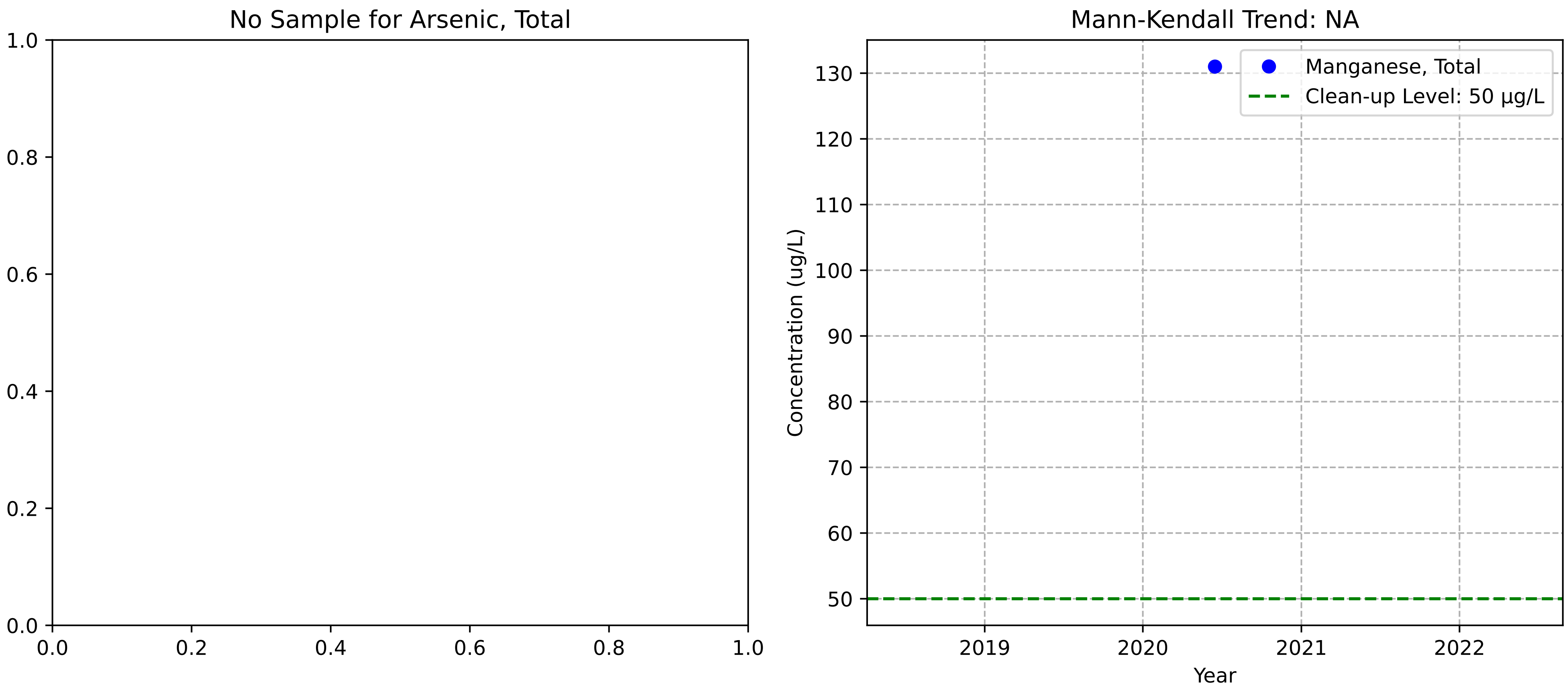

Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
9
8
7
6
5
2023
2024
Year
Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.99)
Exponential Fit (R²=0.98)
Clean-up Level: 50 µg/L
Concentration (ug/L)
6000
5000
4000
3000
2000
1000
0
2021
2022
2023
2024
Year

MW-95p1

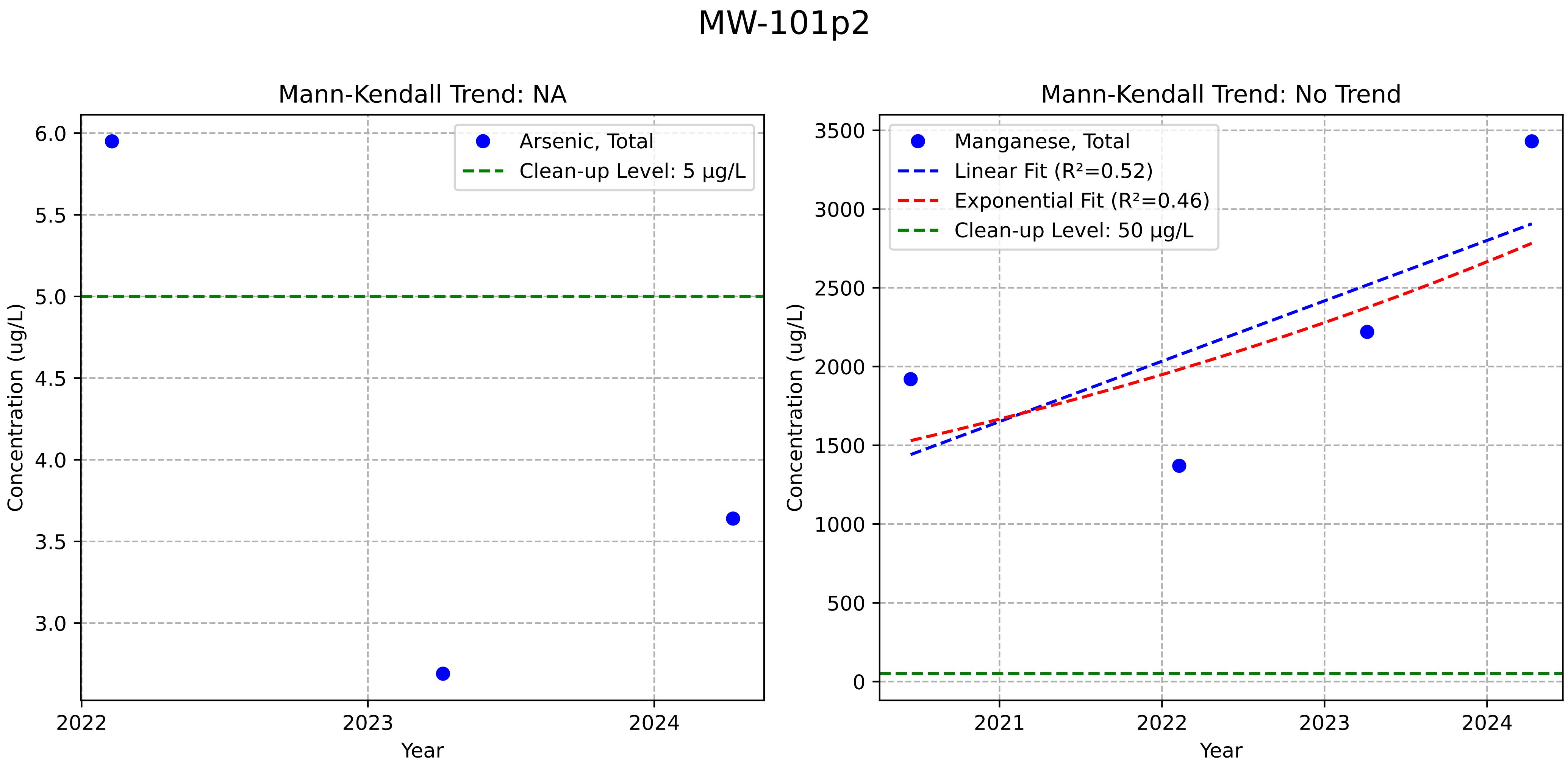


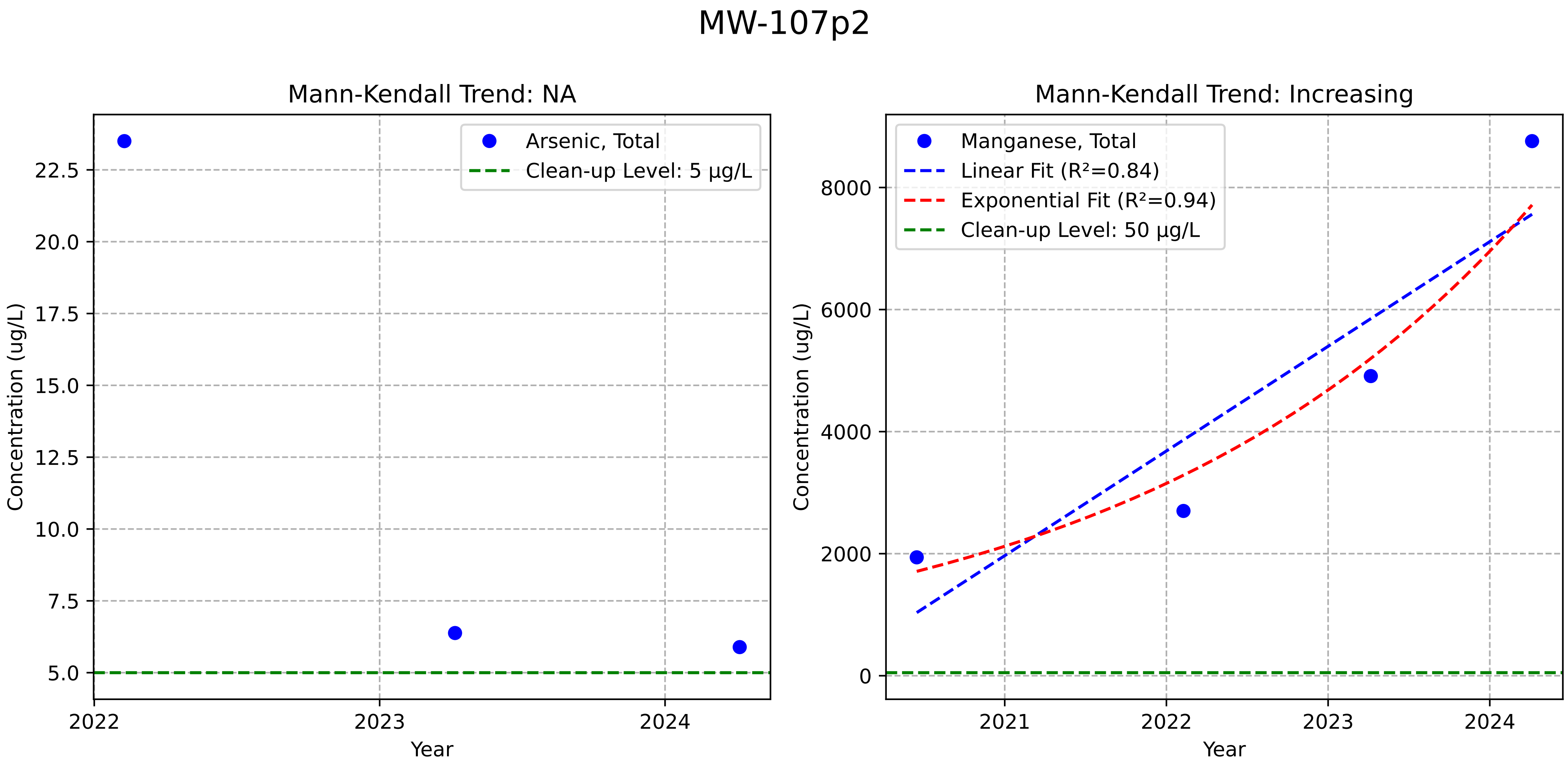
Mann-Kendall Trend: NA
30
25
20
15
10
5
2023
2024
Year
Concentration (ug/L)
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
7000
6000
5000
4000
3000
2000
1000
0
2021
2022
2023
2024
Year
Concentration (ug/L)
Manganese, Total
Linear Fit (R²=0.99)
Exponential Fit (R²=0.96)
Clean-up Level: 50 µg/L

MW-98p1

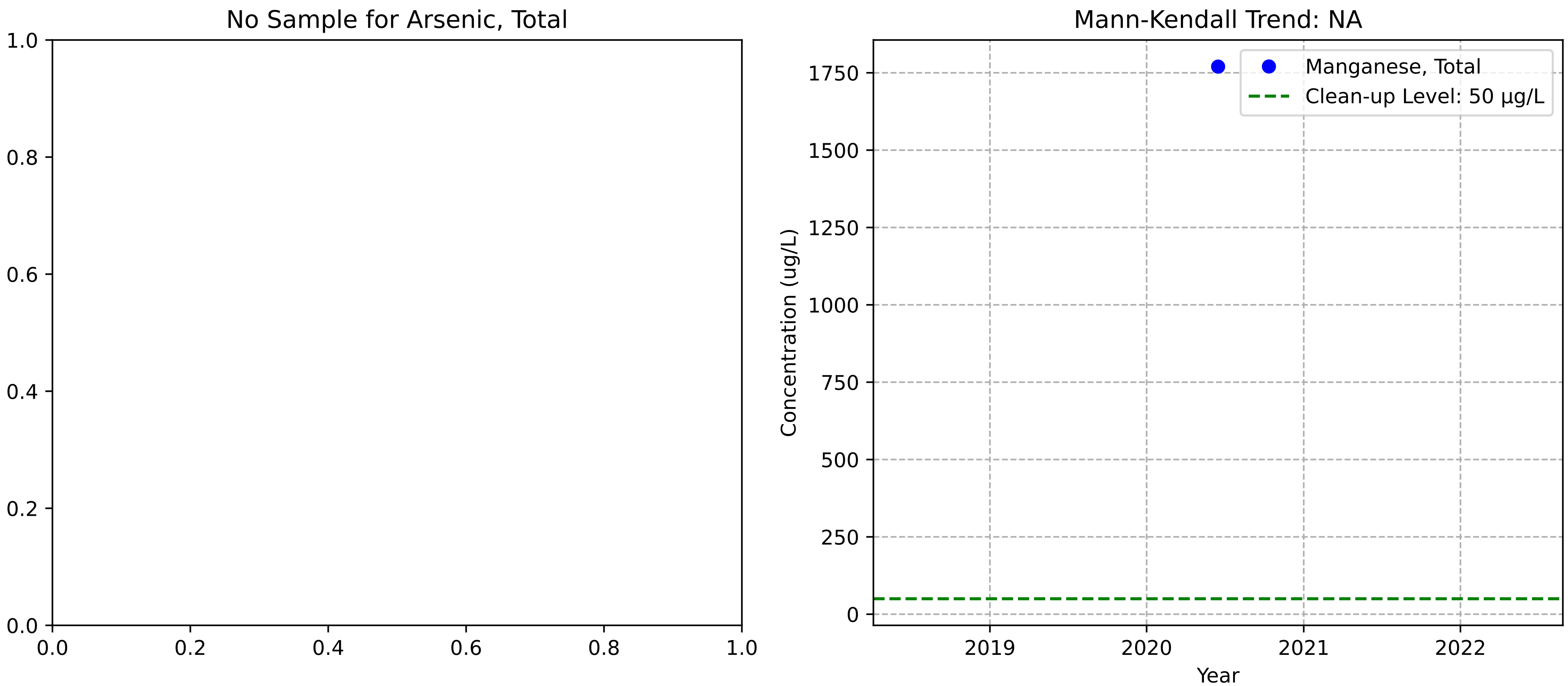


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
130
120
110
100
90
80
70
60
50
2019
2020
2021
2022
Year


MW-101p2
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2022
2023
2024
Mann-Kendall Trend: No Trend
Manganese, Total
Linear Fit (R²=0.52)
Exponential Fit (R²=0.46)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
3500
3000
2500
2000
1500
1000
500
0
2021
2022
2023
2024

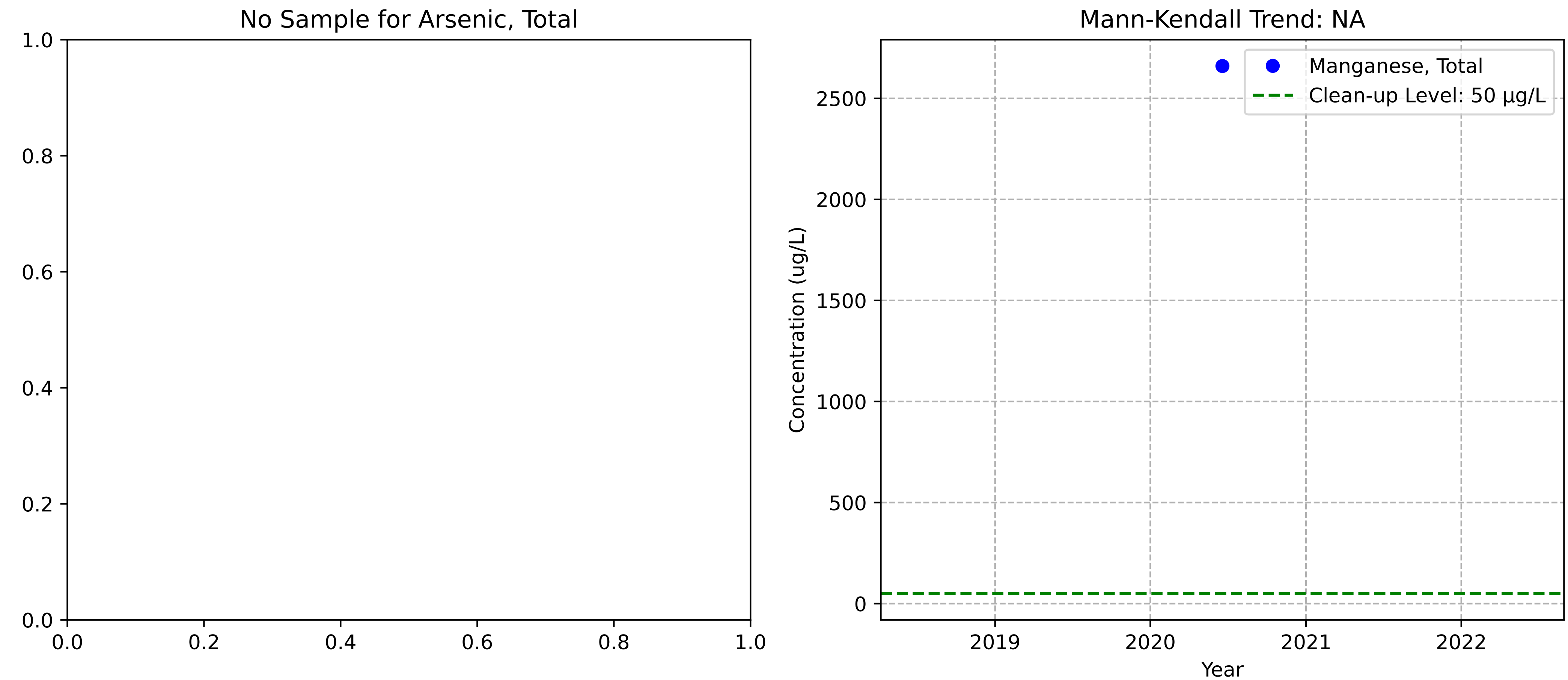

MW-107p2
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2022
2023
2024
Mann-Kendall Trend: Increasing
Manganese, Total
Linear Fit (R²=0.84)
Exponential Fit (R²=0.94)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
8000
6000
4000
2000
0
2021
2022
2023
2024

MW-108p2

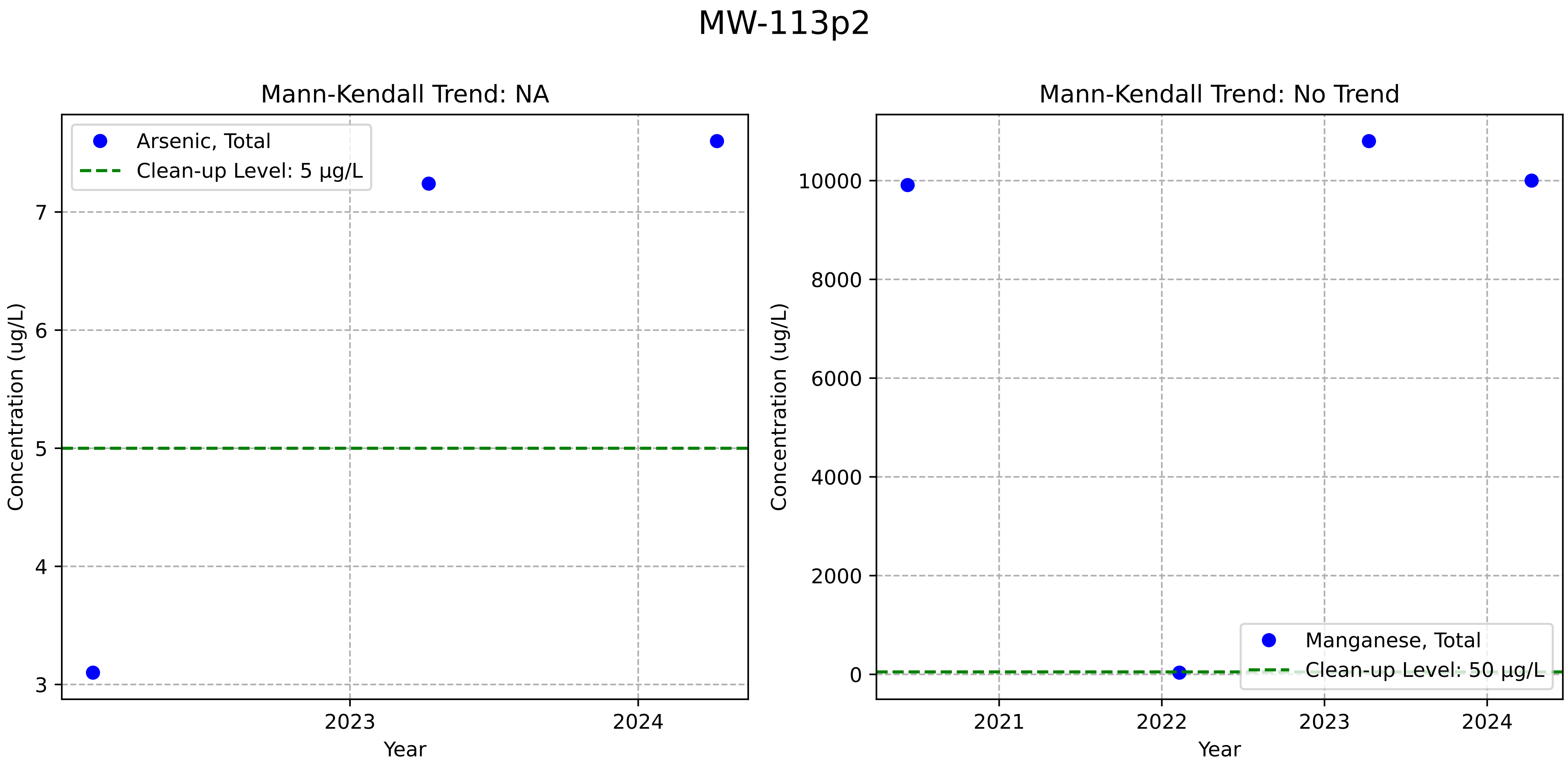


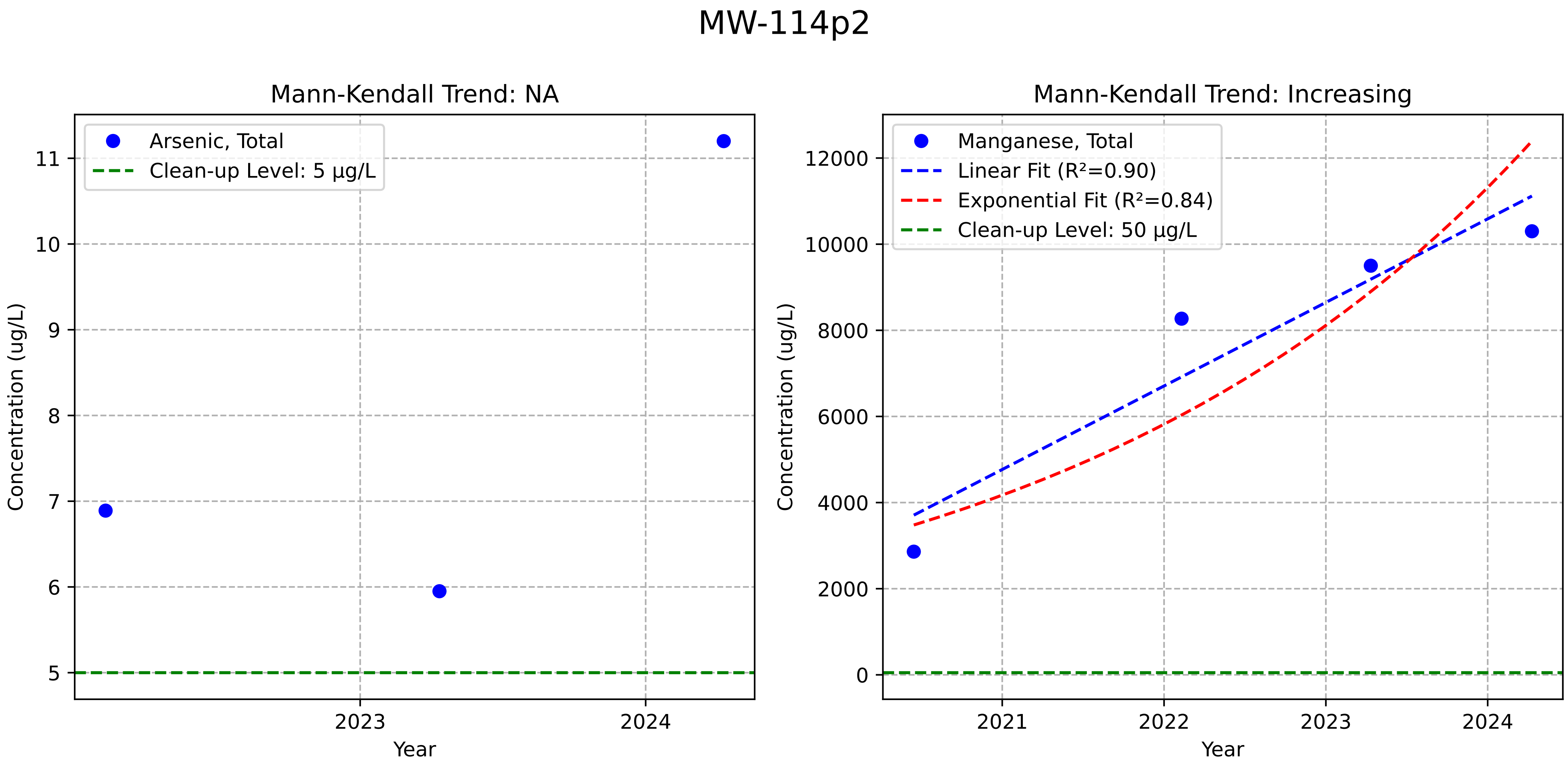
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
1750
1500
1250
1000
750
500
250
0
2019
2020
2021
2022
Year

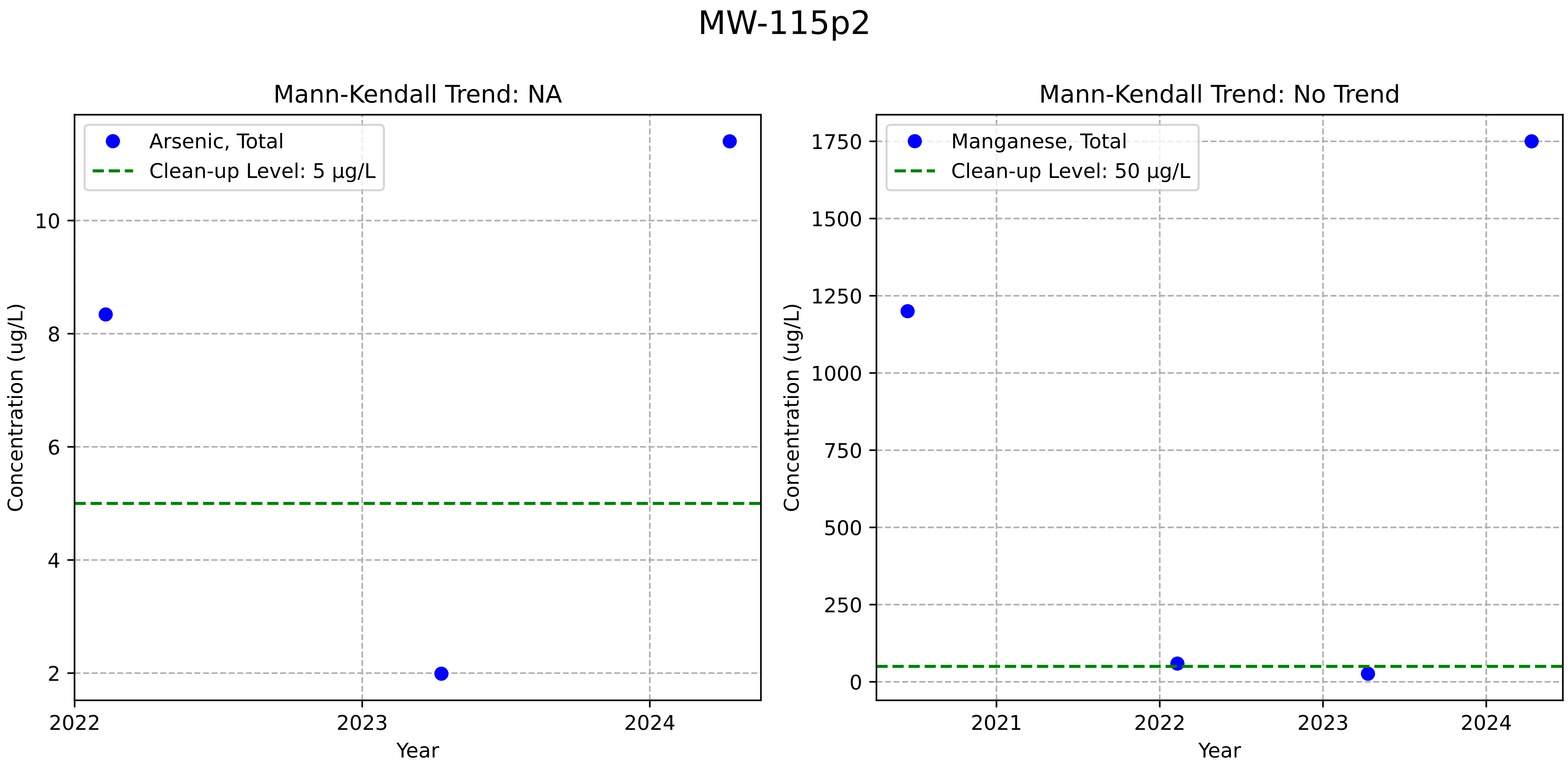
MW-112p2



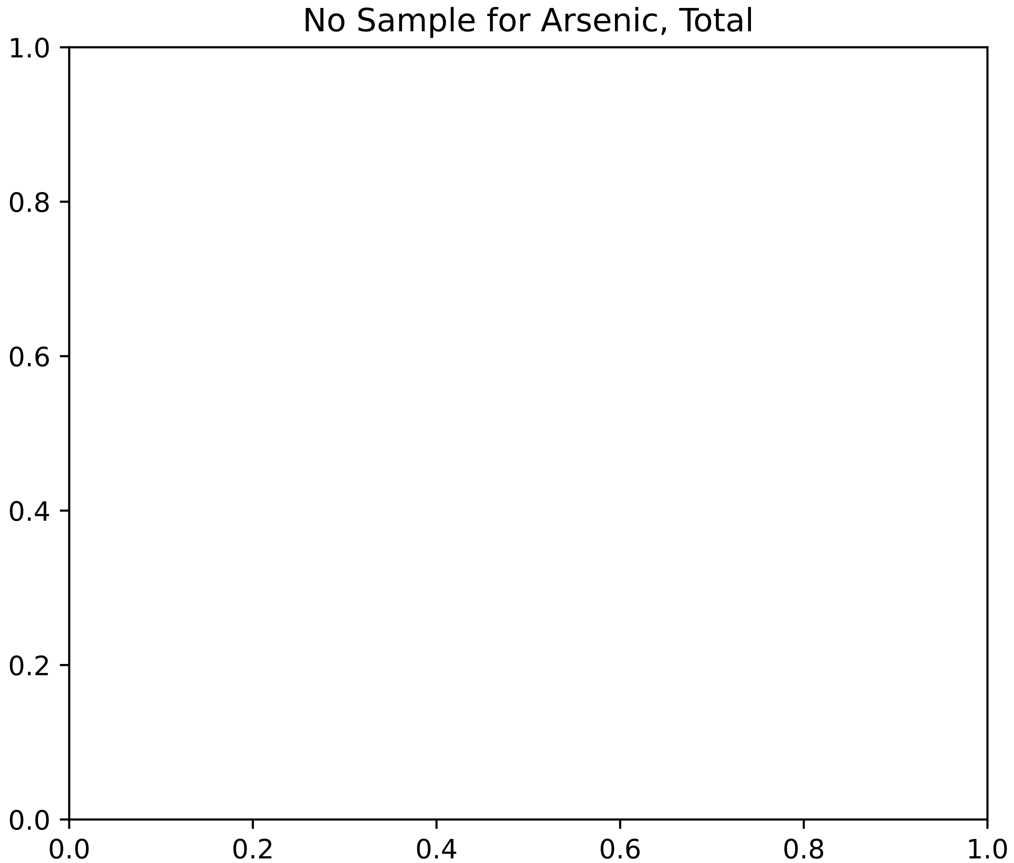
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
2500
2000
1500
1000
500
0
2019
2020
2021
2022
Year


MW-113p2
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
7
6
5
4
3
2023
2024
Year
Mann-Kendall Trend: No Trend
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
10000
8000
6000
4000
2000
0
2021
2022
2023
2024
Year

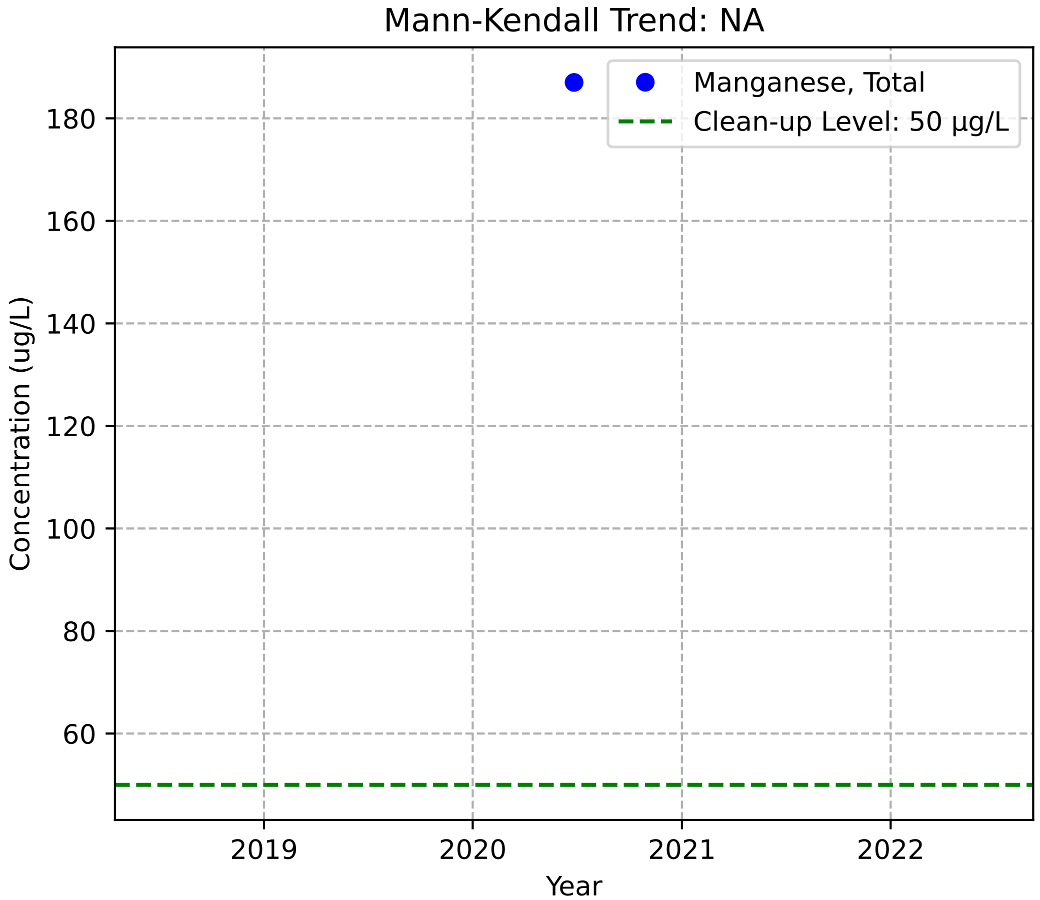

MW-114p2
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Increasing
Manganese, Total
Linear Fit (R²=0.90)
Exponential Fit (R²=0.84)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year


MW-115p2
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
10
8
6
4
2
2022
2023
2024
Year
Mann-Kendall Trend: No Trend
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
1750
1500
1250
1000
750
500
250
0
2021
2022
2023
2024
Year

MW-118p2

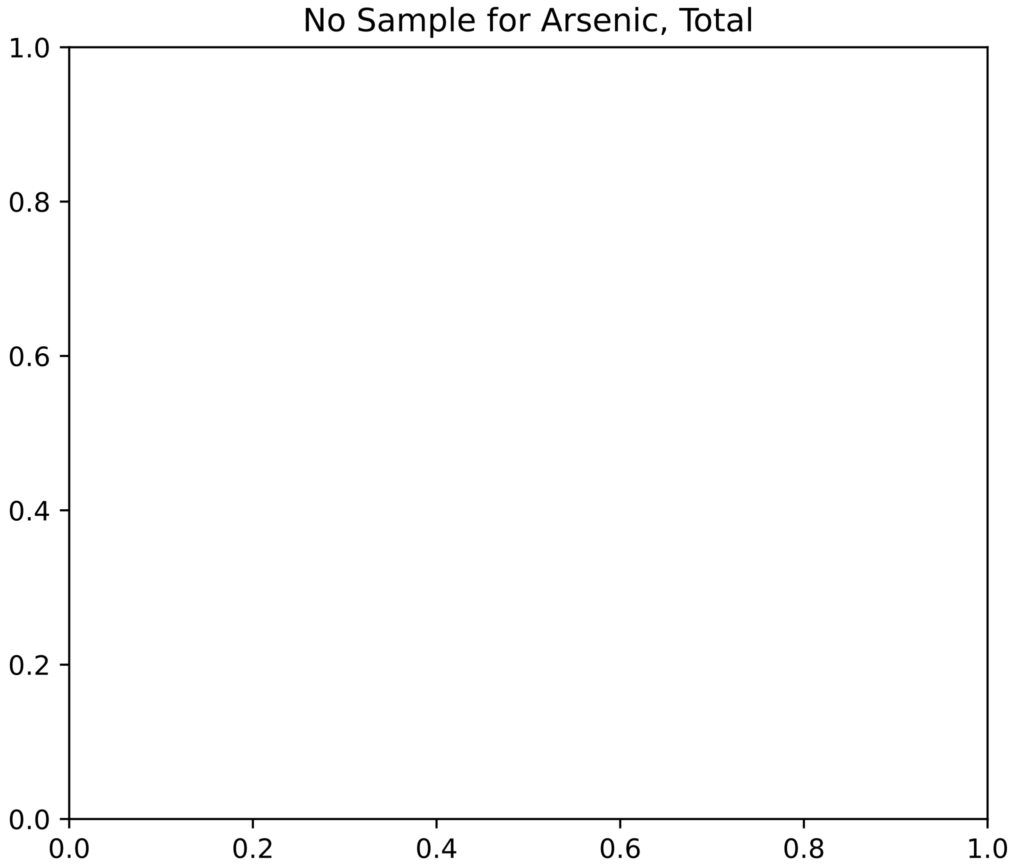


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

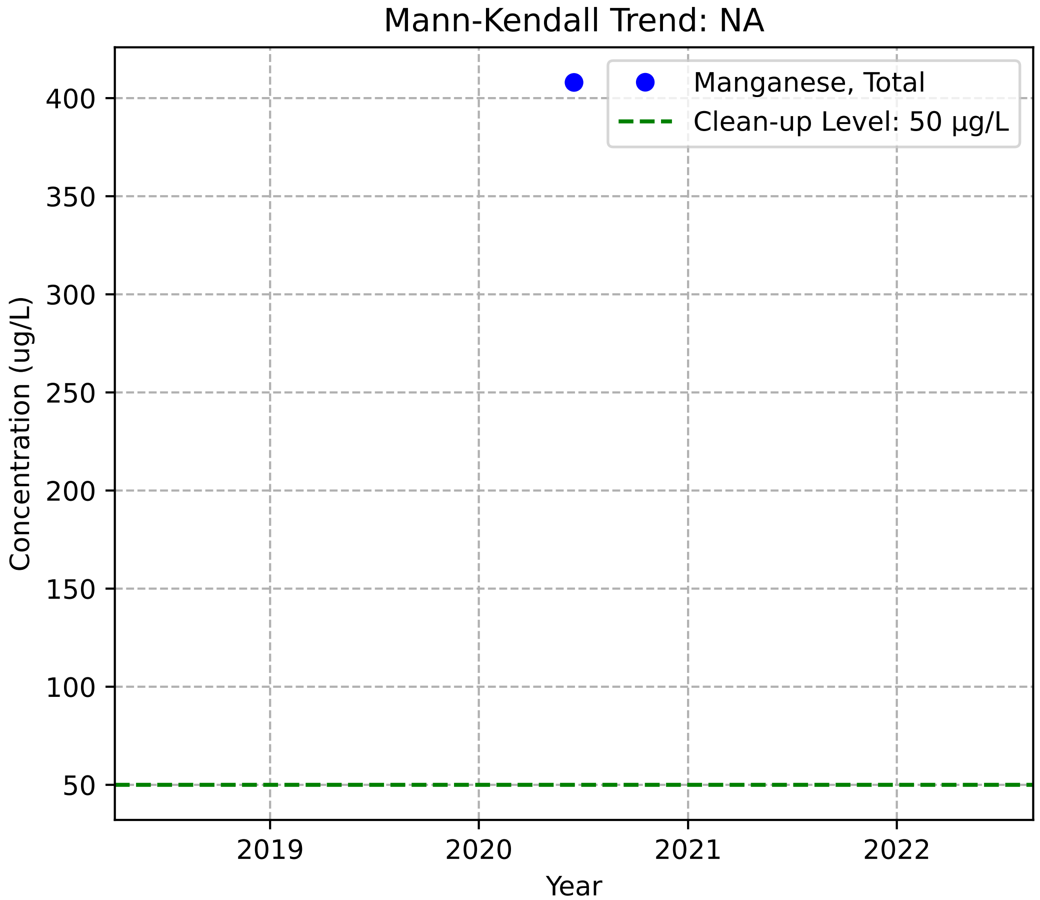


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
180
160
140
120
100
80
60
2019
2020
2021
2022
Year

MW-122p2

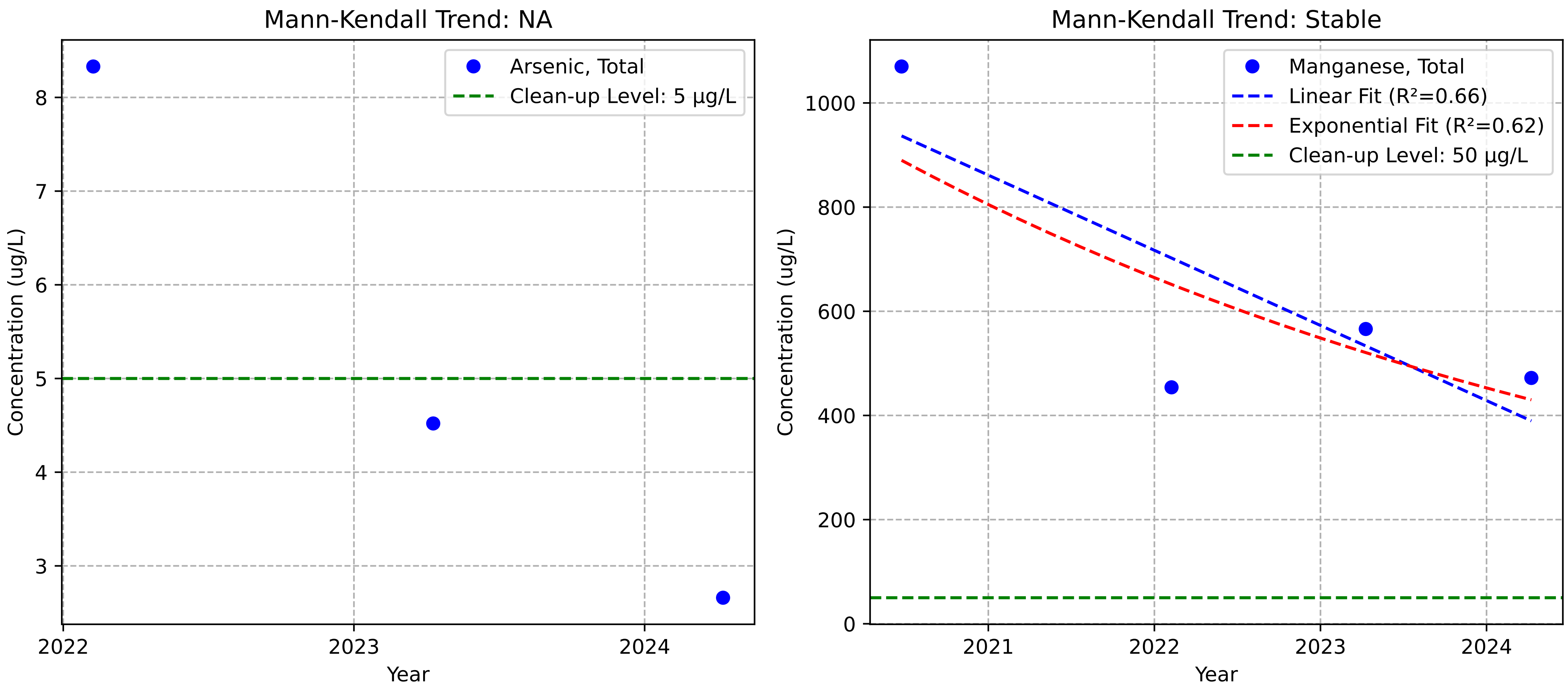


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



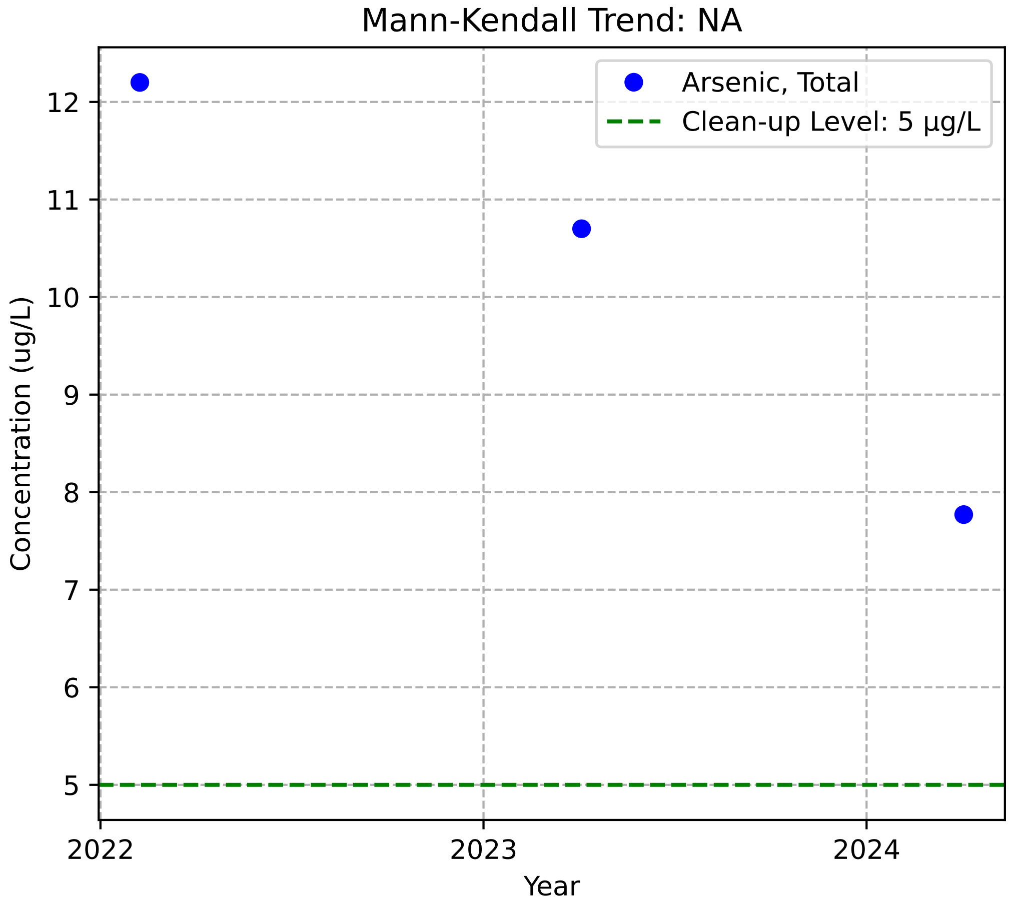
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
400
350
300
250
200
150
100
50
2019
2020
2021
2022
Year

MW-124p2

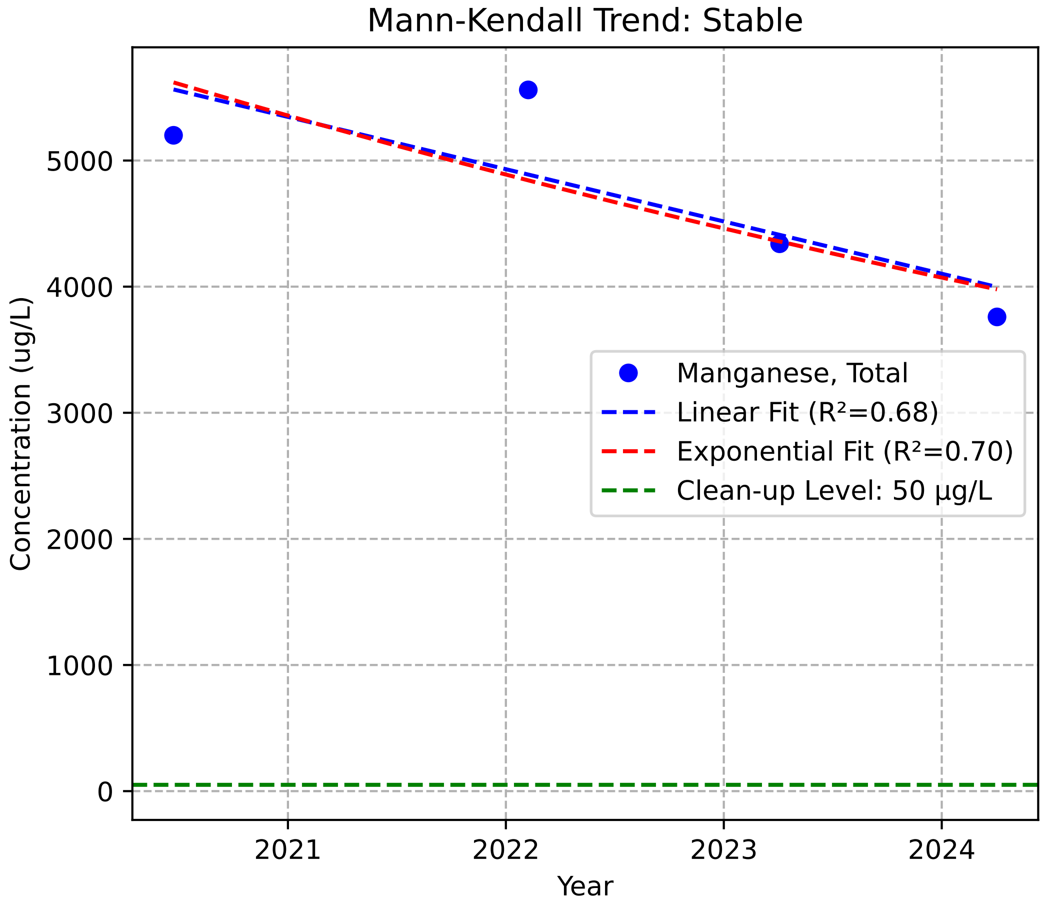


Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
8
7
6
5
4
3
2022
2023
2024
Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.66)
Exponential Fit (R²=0.62)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
1000
800
600
400
200
0
2021
2022
2023
2024

MW-125p2

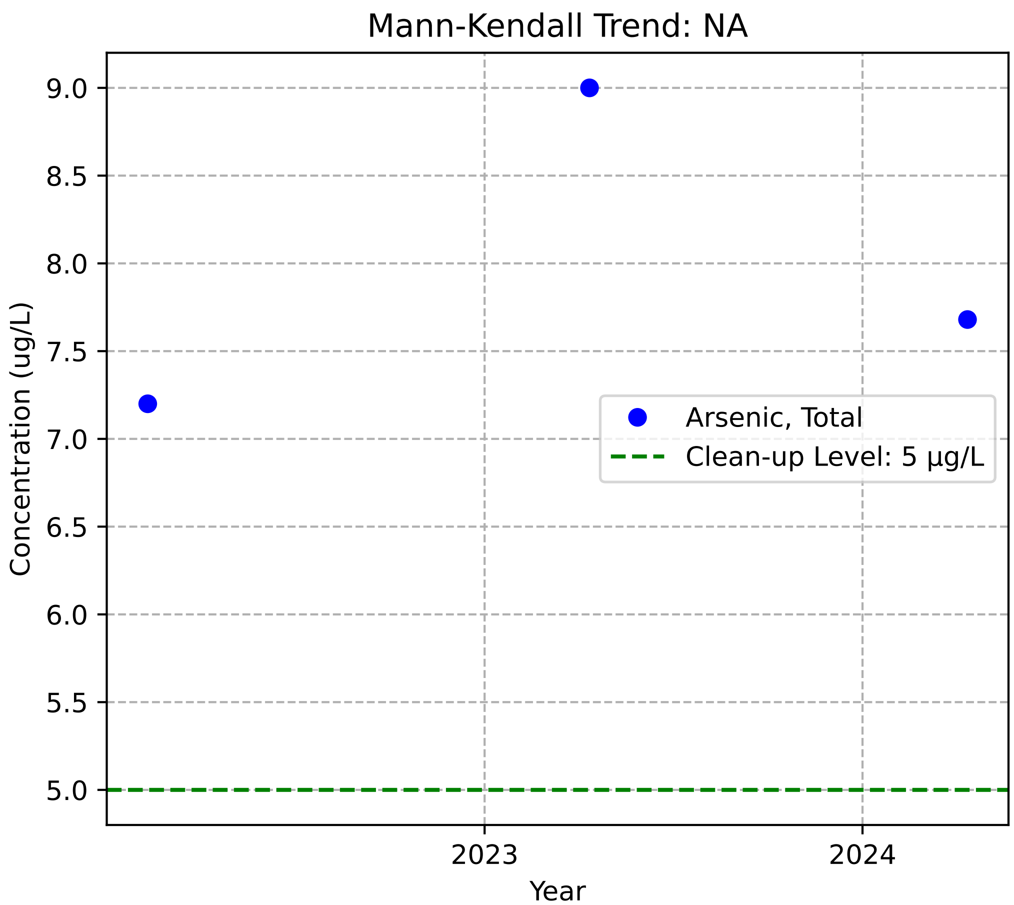


Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
12
11
10
9
8
7
6
5
2022
2023
2024

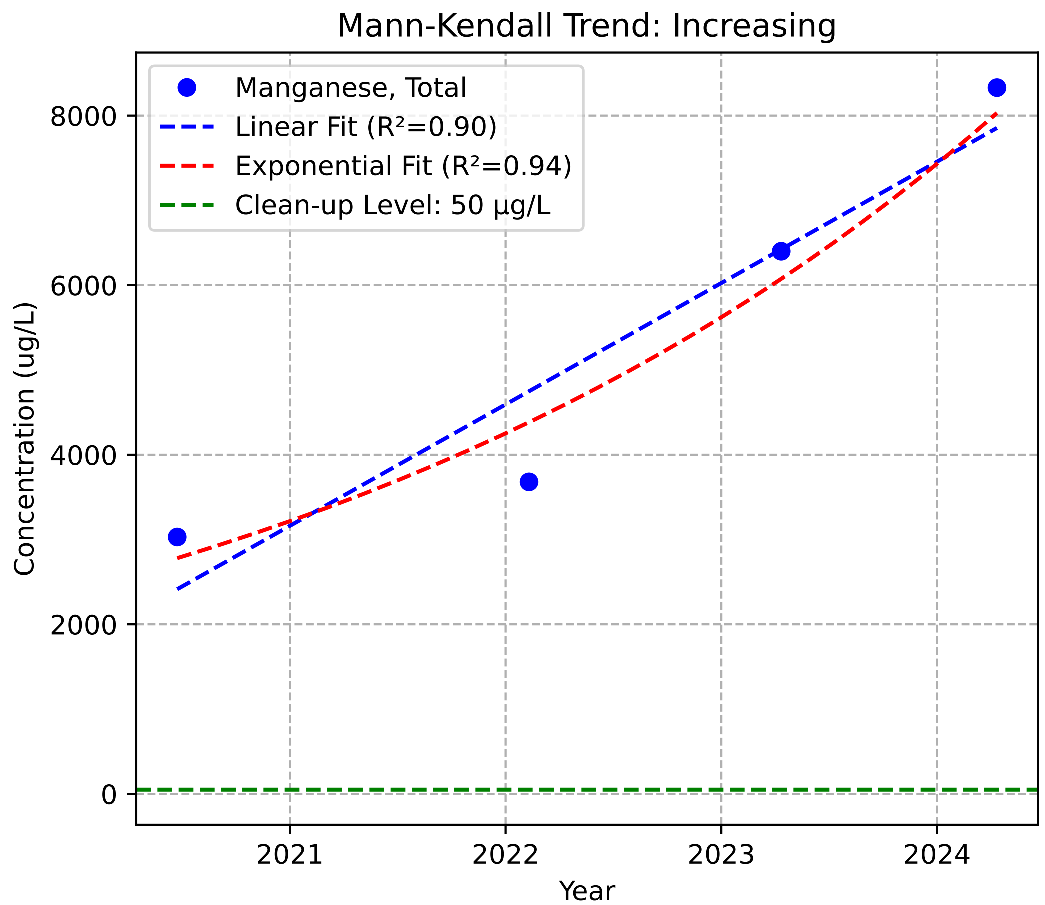


Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.68)
Exponential Fit (R²=0.70)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
5000
4000
3000
2000
1000
0
2021
2022
2023
2024

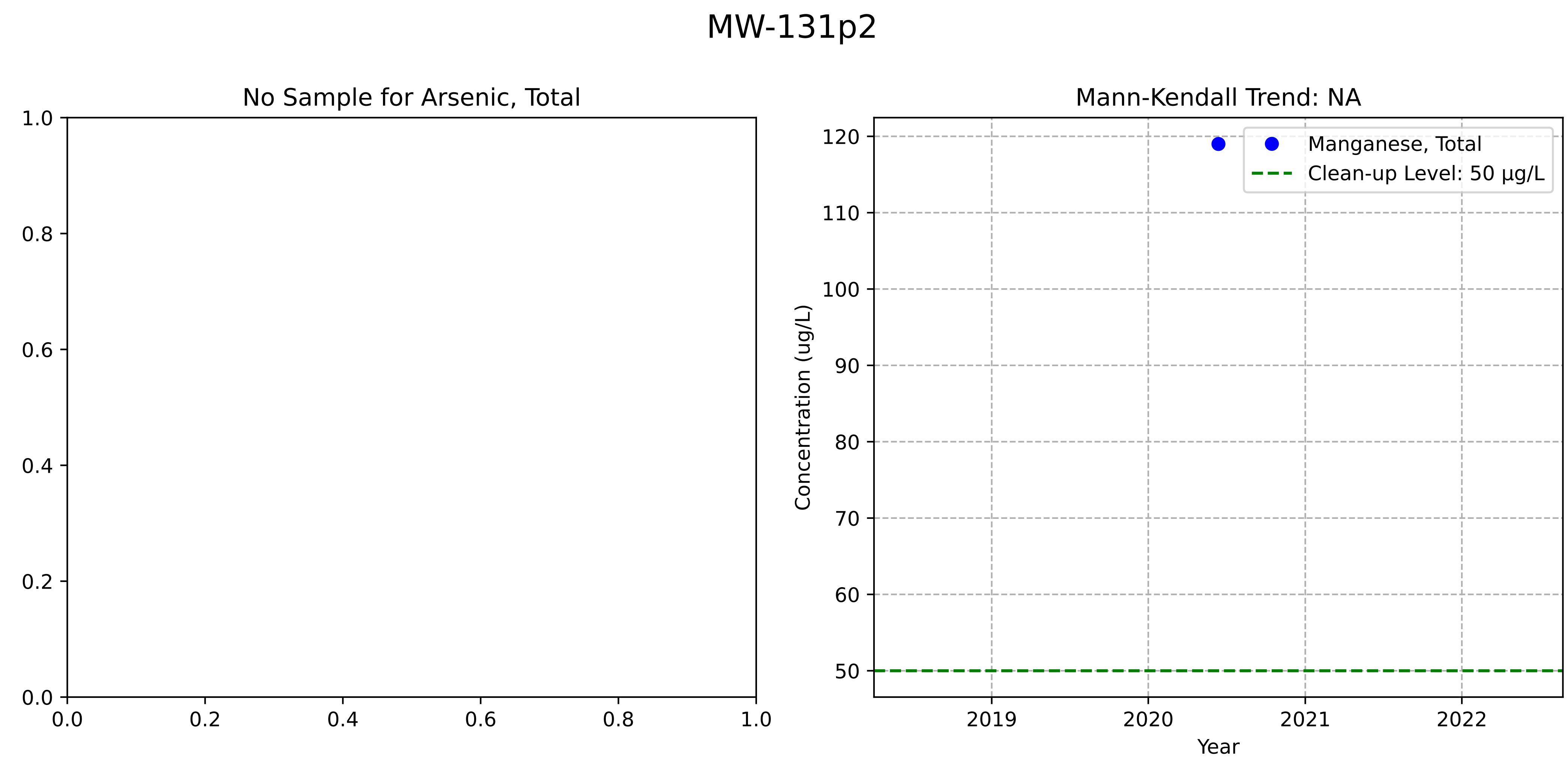
MW-126p2



Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
2023
2024

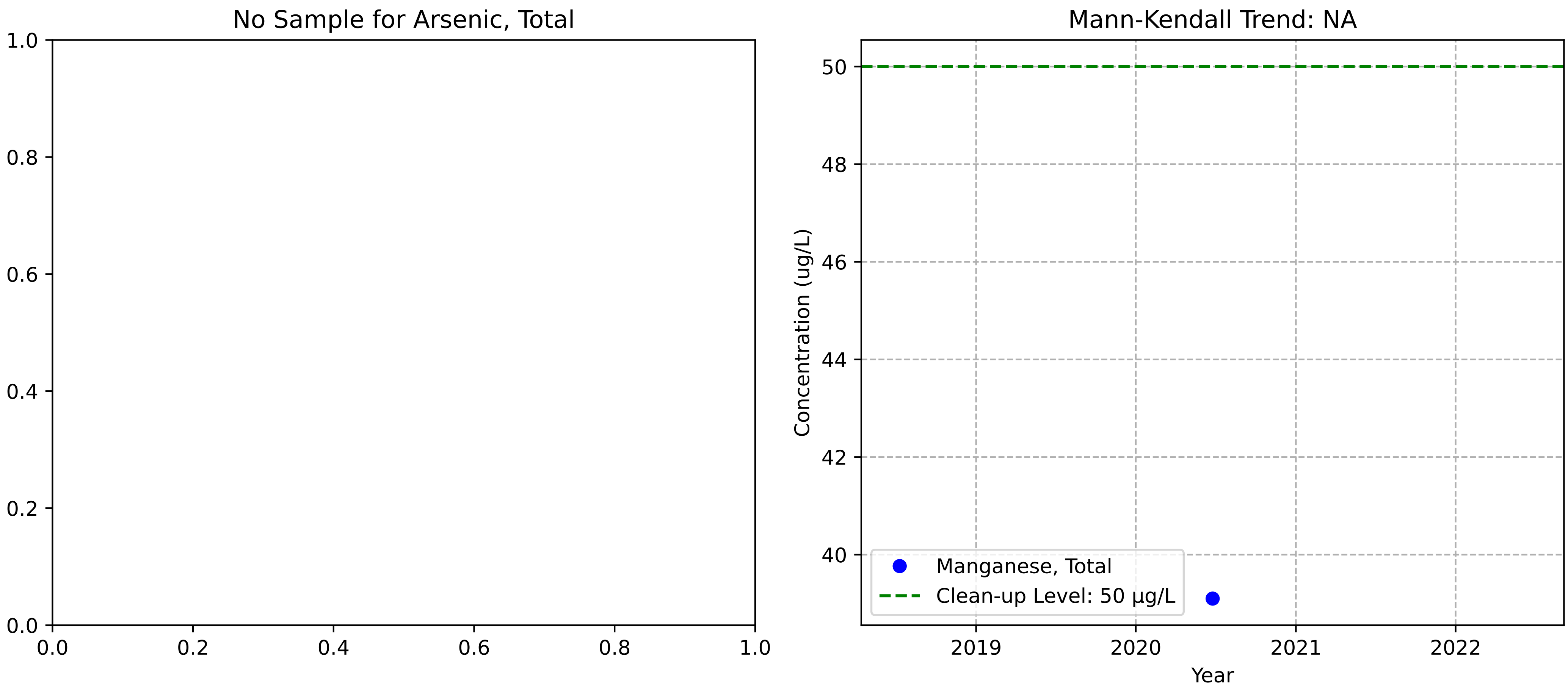


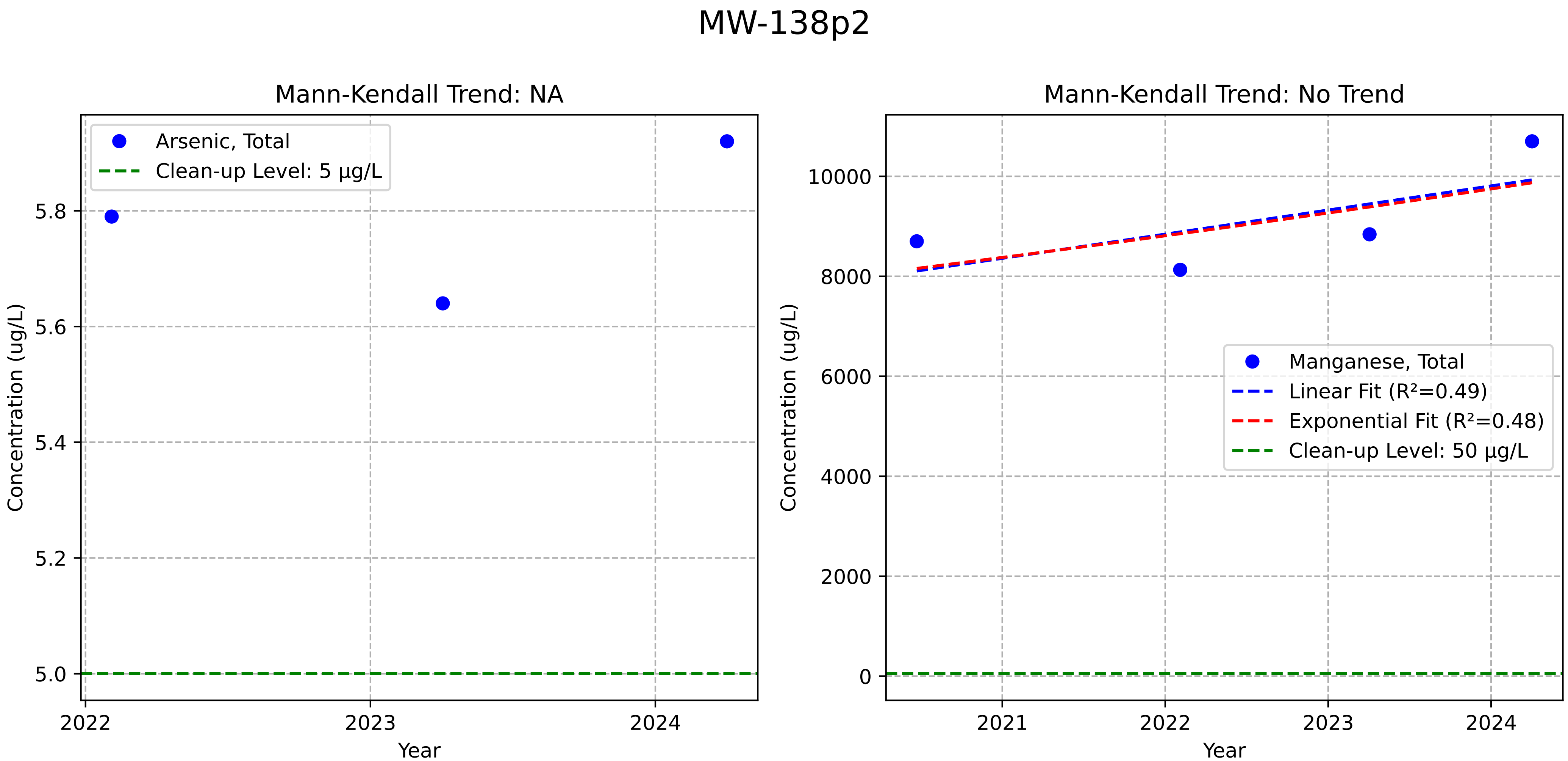
Mann-Kendall Trend: Increasing
Manganese, Total
Linear Fit (R²=0.90)
Exponential Fit (R²=0.94)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
8000
6000
4000
2000
0
2021
2022
2023
2024



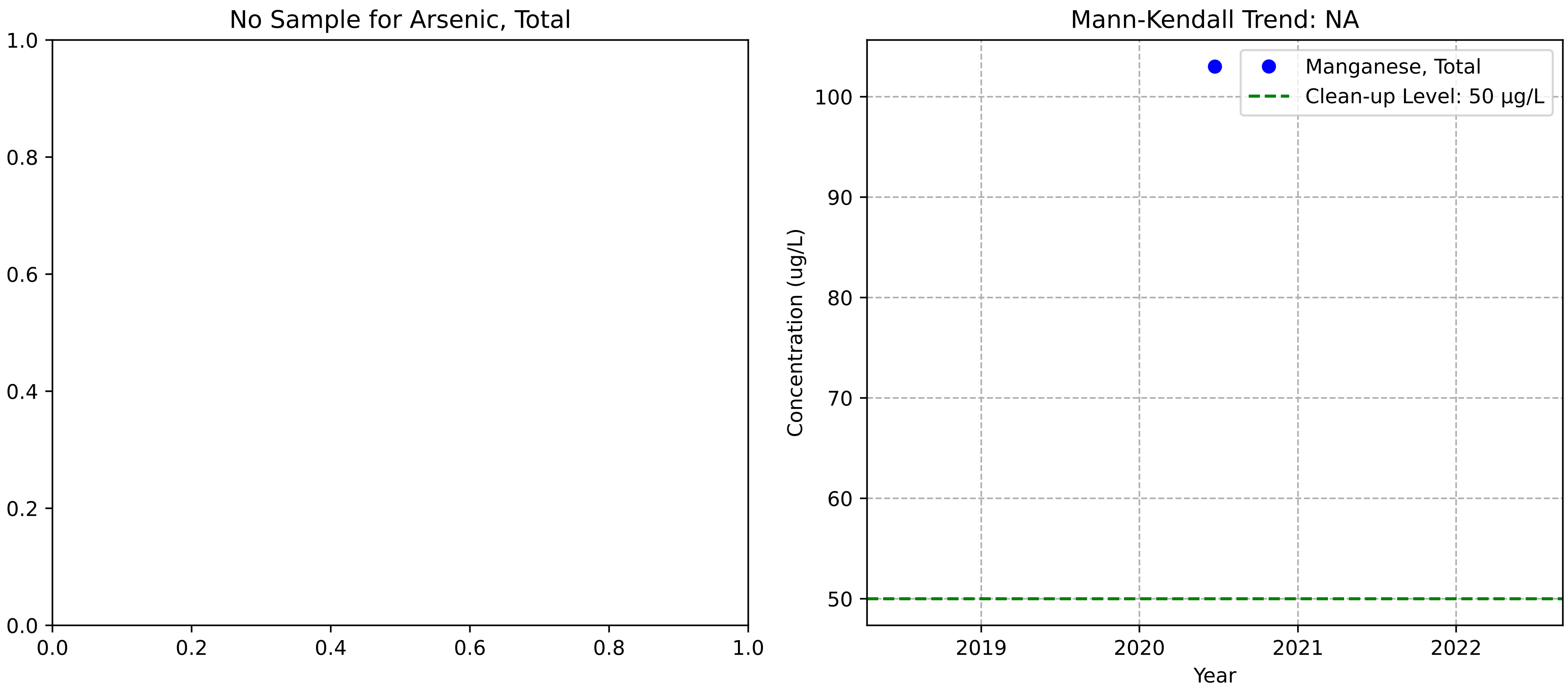
MW-131p2
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
120
110
100
90
80
70
60
50
2019
2020
2021
2022
Year

MW-136p2

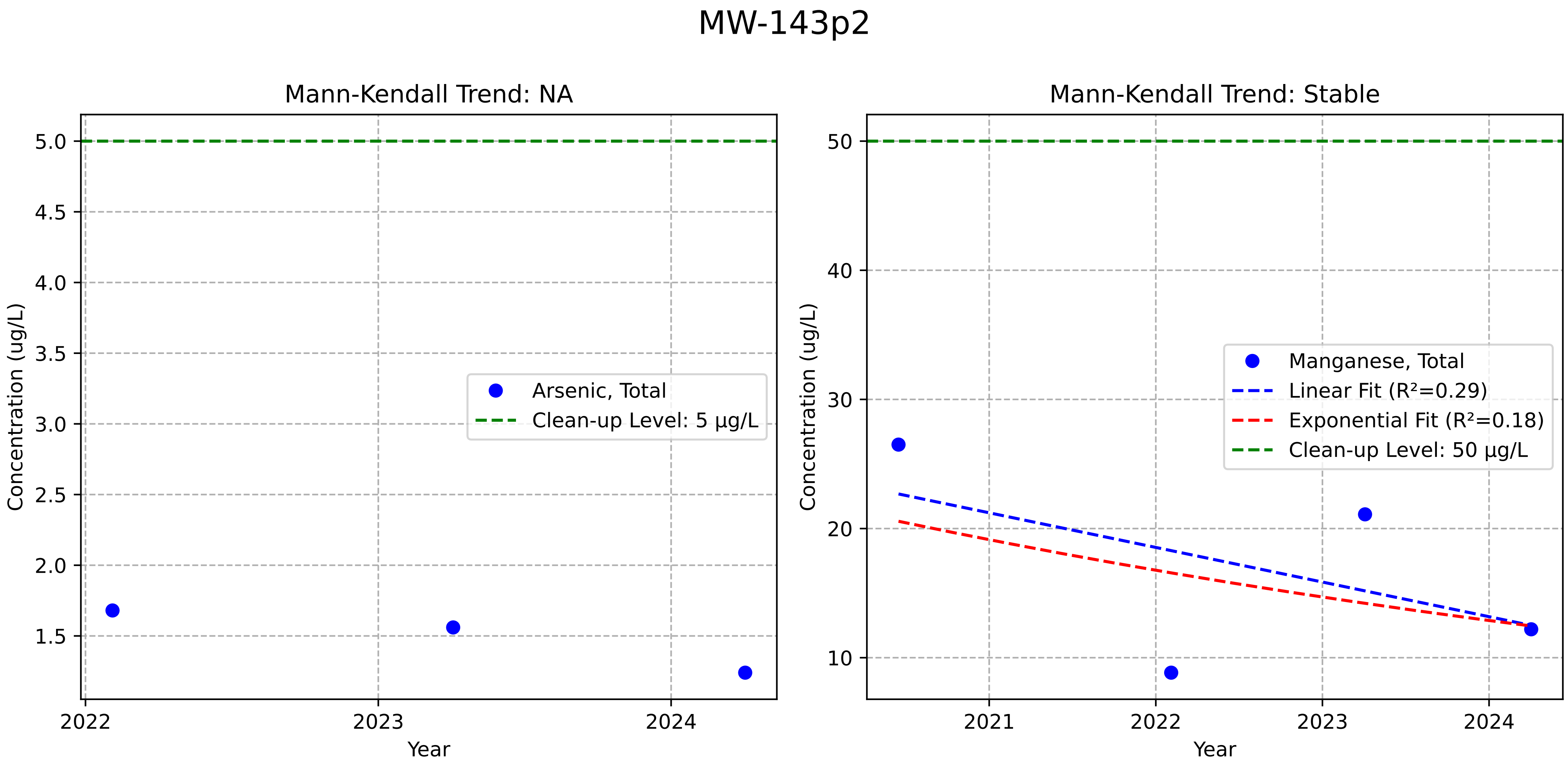

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Concentration (ug/L)
50
48
46
44
42
40
2019
2020
2021
2022
Year
Manganese, Total
Clean-up Level: 50 µg/L


MW-138p2
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 μg/L
Concentration (ug/L)
5.0
5.2
5.4
5.6
5.8
2022
2023
2024
Year
Mann-Kendall Trend: No Trend
Manganese, Total
Linear Fit (R²=0.49)
Exponential Fit (R²=0.48)
Clean-up Level: 50 μg/L
Concentration (ug/L)
0
2000
4000
6000
8000
10000
2021
2022
2023
2024
Year

MW-141p2

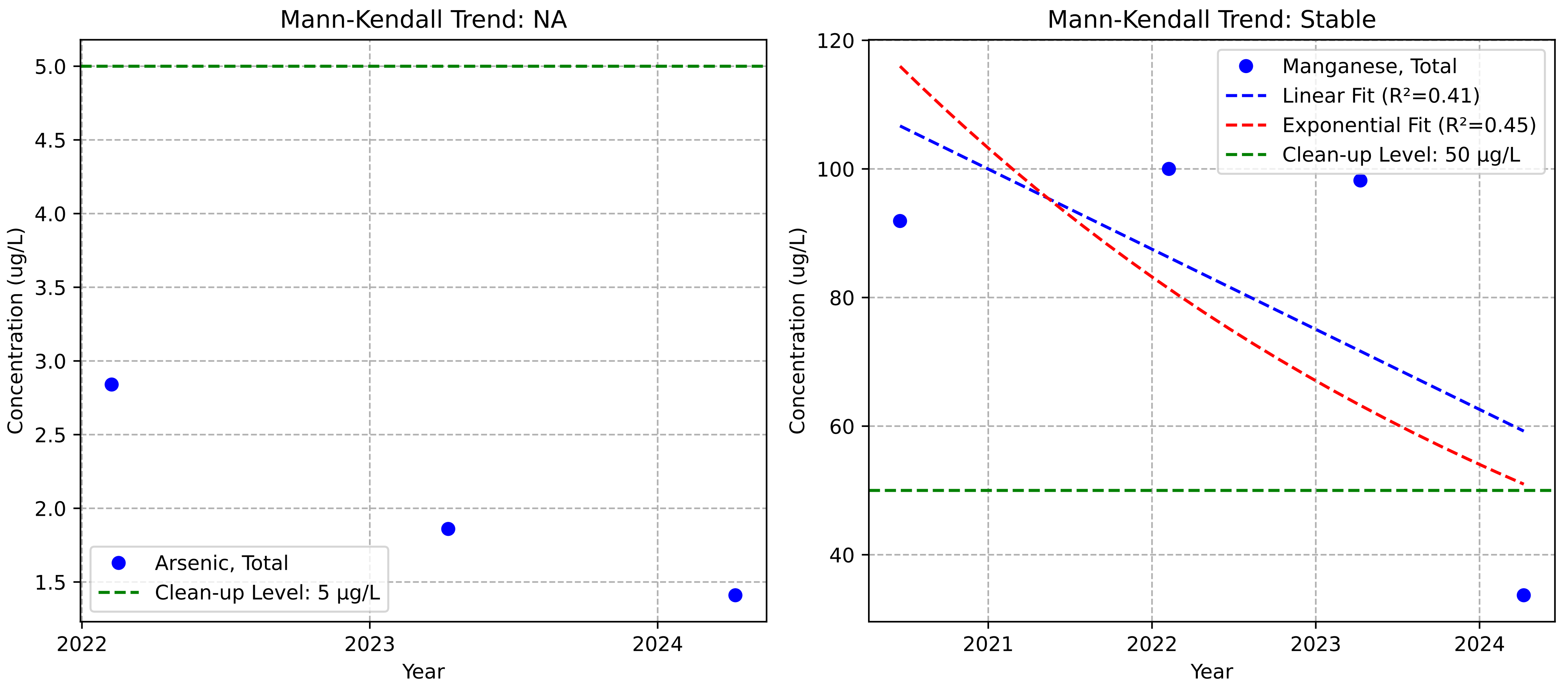


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
100
90
80
70
60
50
2019
2020
2021
2022
Year

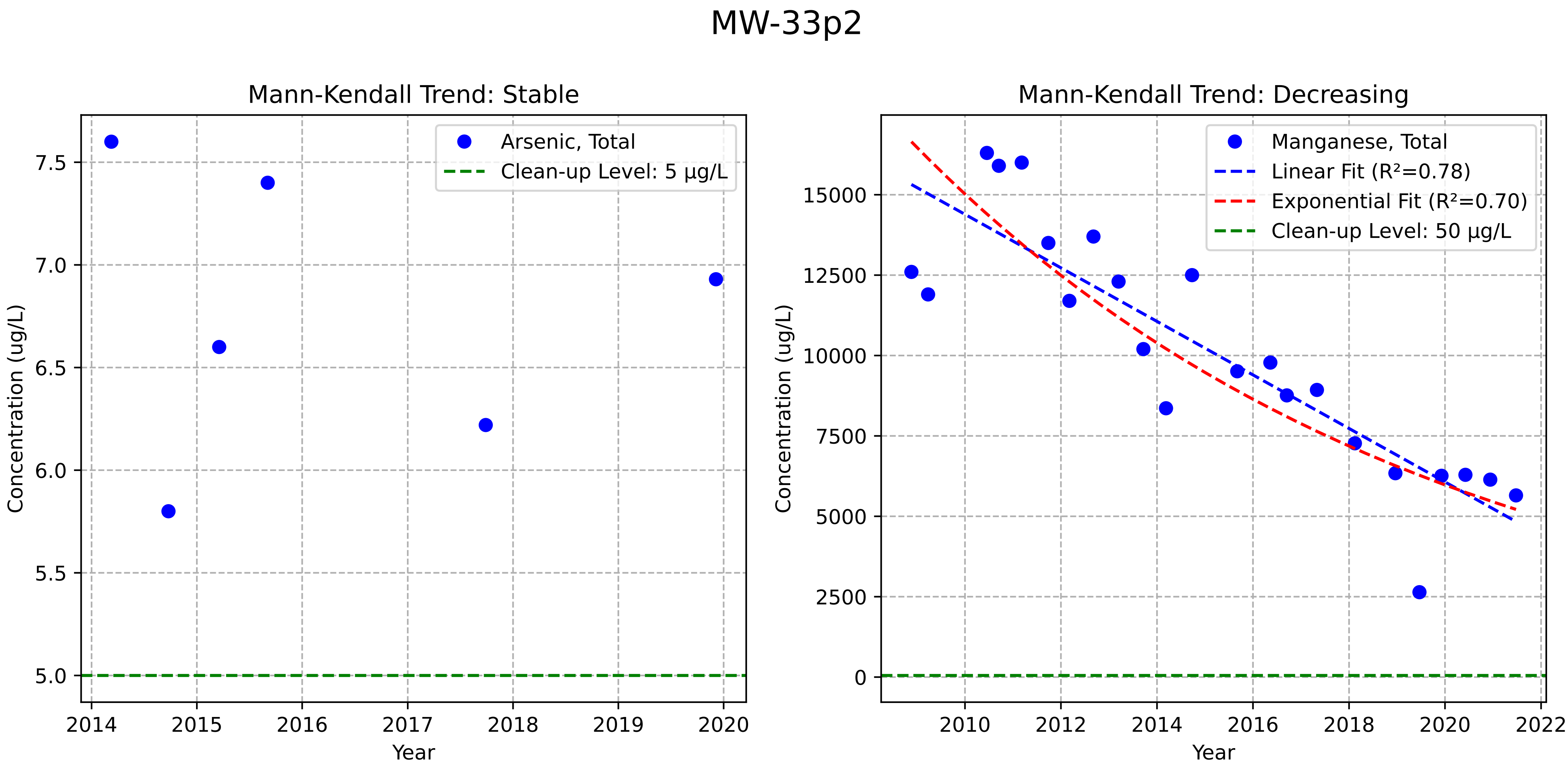


MW-143p2
Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
2022
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Concentration (ug/L)
50
40
30
20
10
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.29)
Exponential Fit (R²=0.18)
Clean-up Level: 50 µg/L

MW-147p2

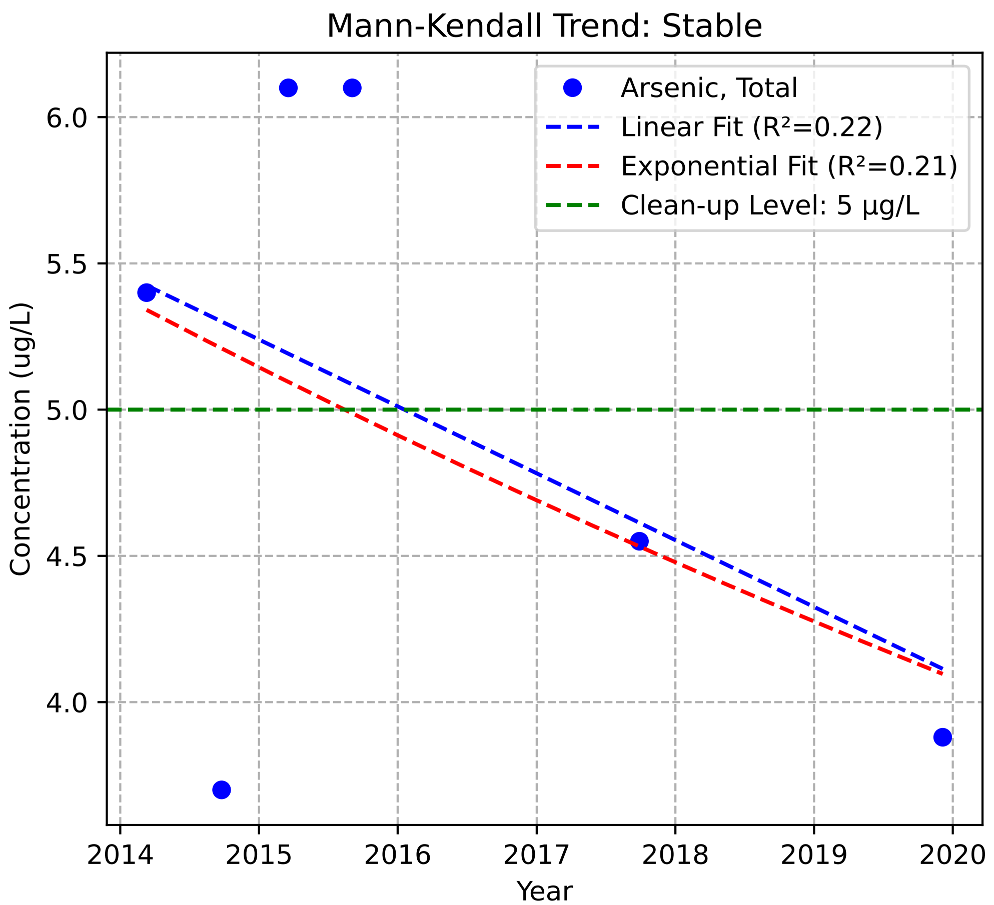


Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
2022
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Concentration (ug/L)
120
100
80
60
40
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.41)
Exponential Fit (R²=0.45)
Clean-up Level: 50 µg/L

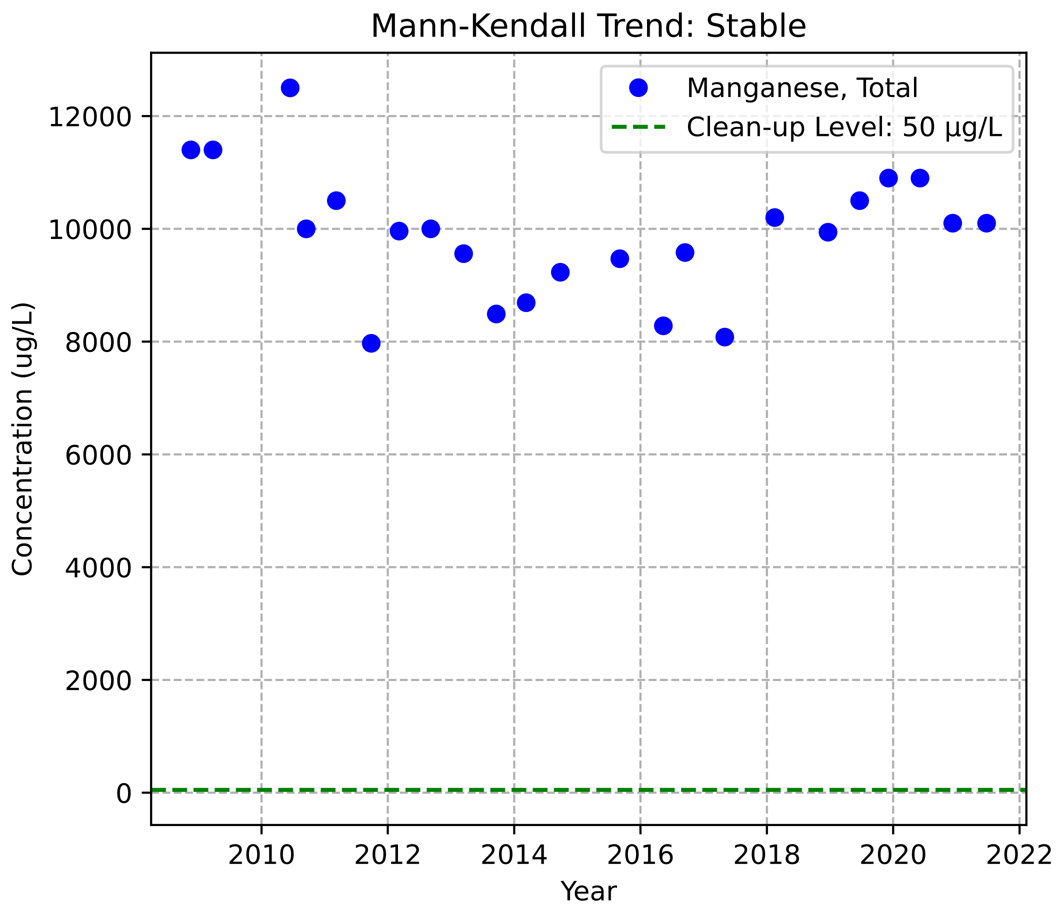


MW-33p2
Mann-Kendall Trend: Stable
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.78)
Exponential Fit (R²=0.70)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

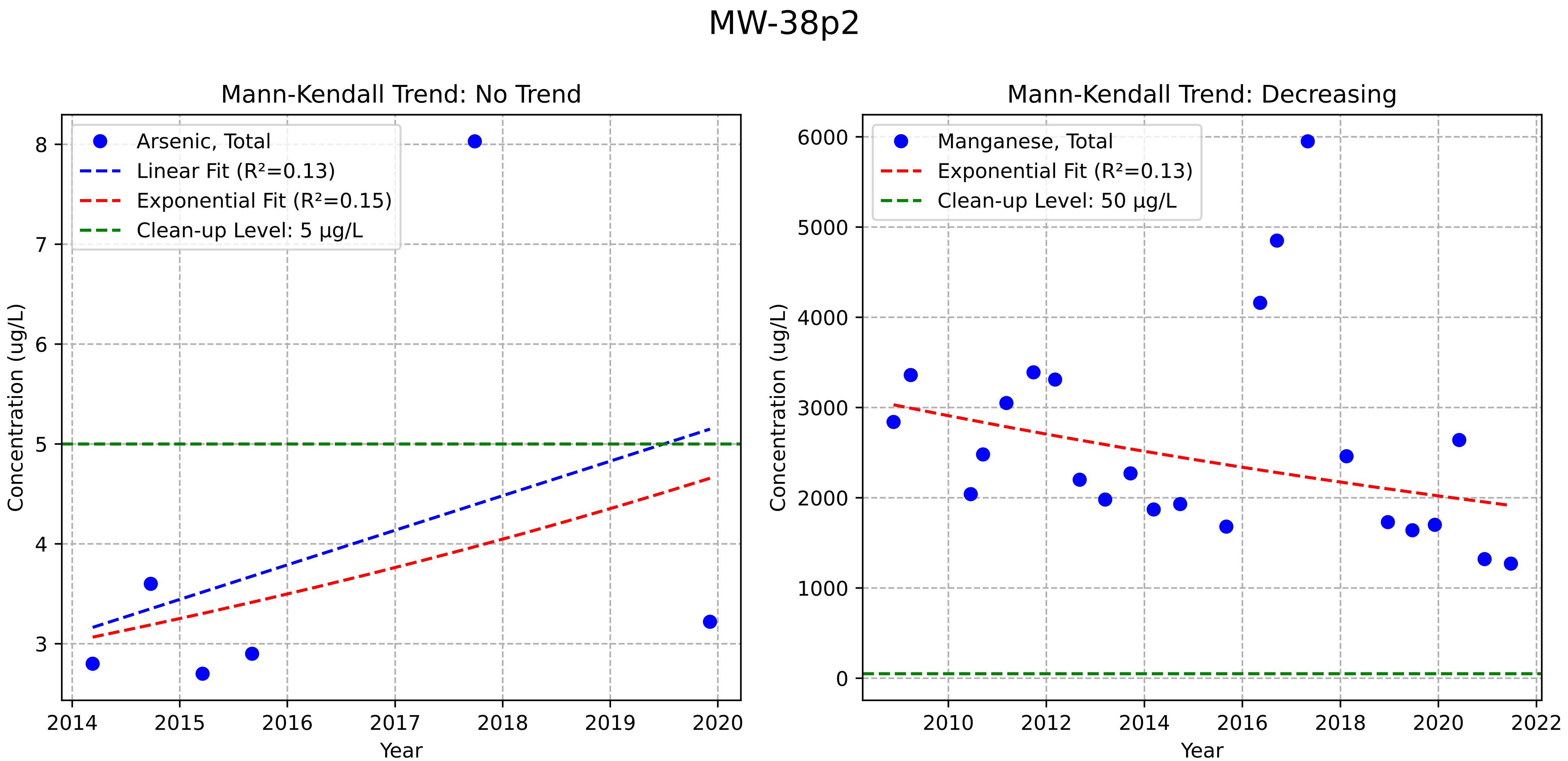
MW-35p2



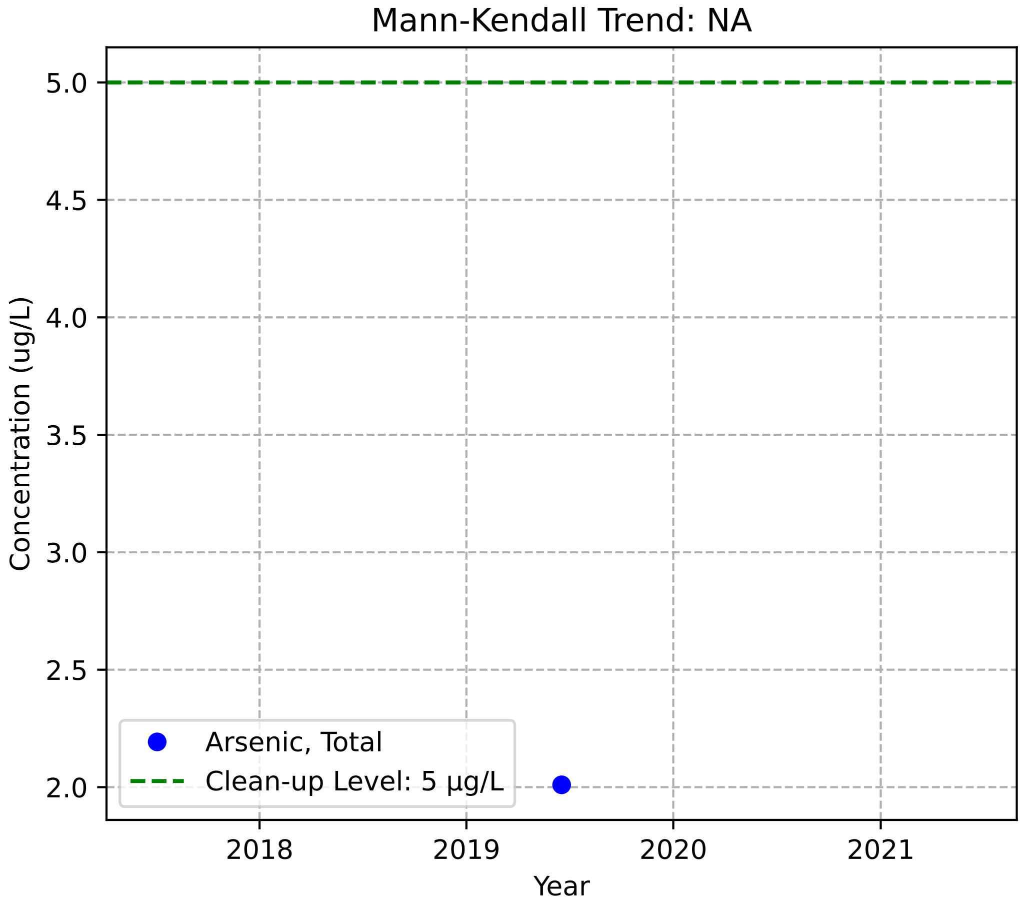
Mann-Kendall Trend: Stable
Arsenic, Total
Linear Fit (R²=0.22)
Exponential Fit (R²=0.21)
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
6.0
5.5
5.0
4.5
4.0
2014
2015
2016
2017
2018
2019
2020



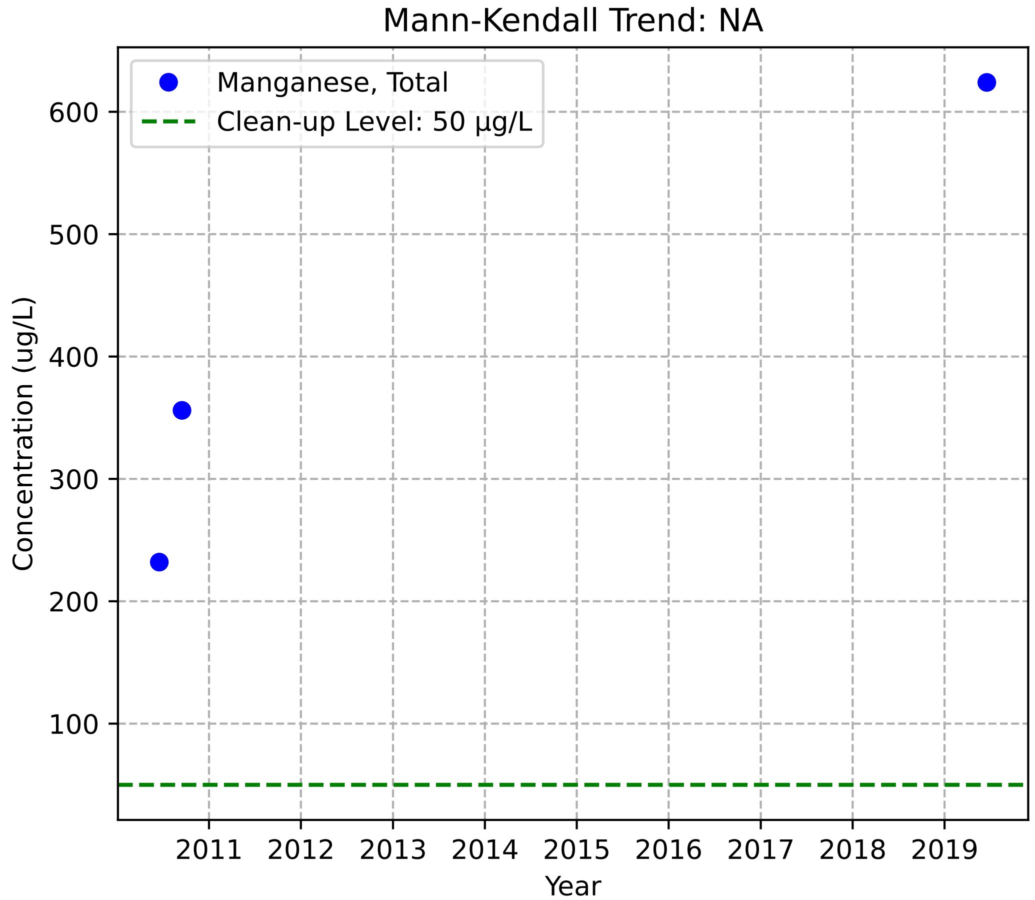
Mann-Kendall Trend: Stable
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
12000
10000
8000
6000
4000
2000
0
2010
2012
2014
2016
2018
2020
2022


MW-38p2
Mann-Kendall Trend: No Trend
Arsenic, Total
Linear Fit (R²=0.13)
Exponential Fit (R²=0.15)
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Manganese, Total
Exponential Fit (R²=0.13)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

MW-39p2

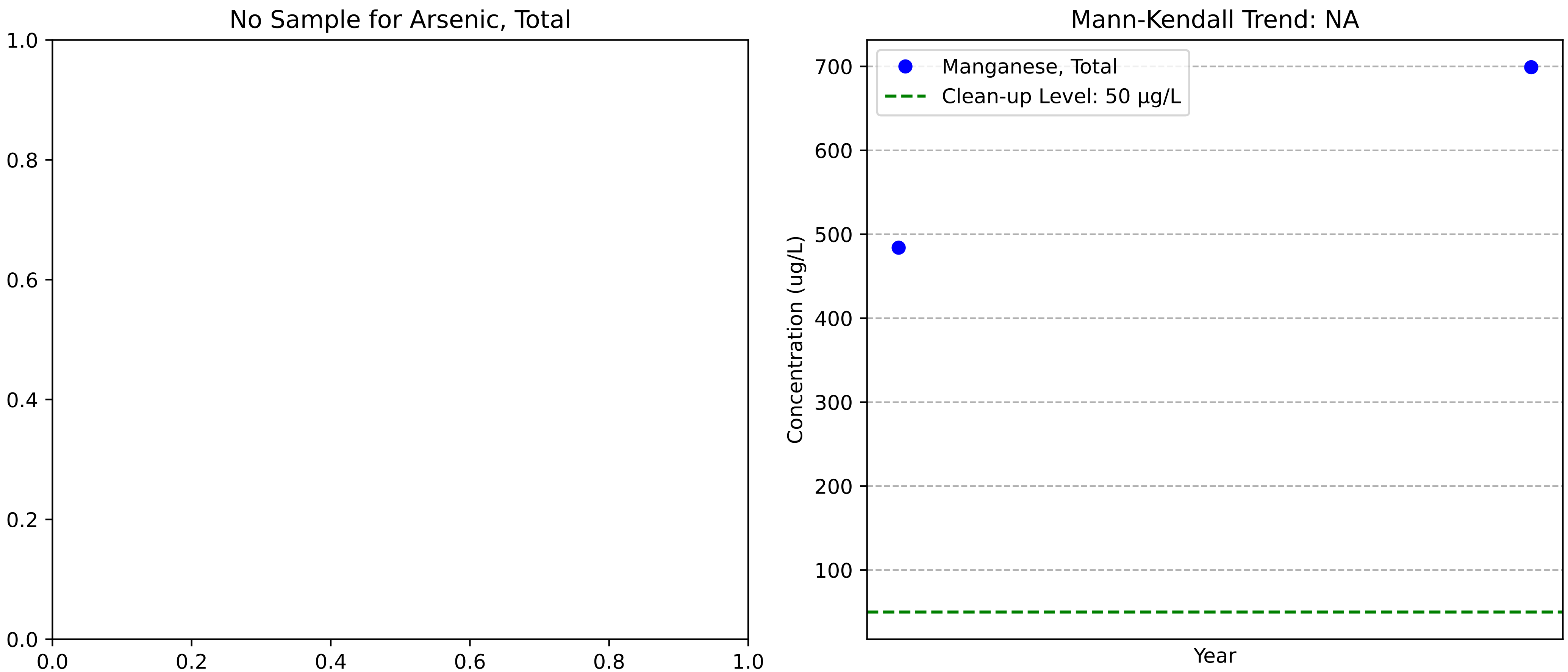


Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L
5.0
4.5
4.0
3.5
3.0
2.5
2.0
2018
2019
2020
2021

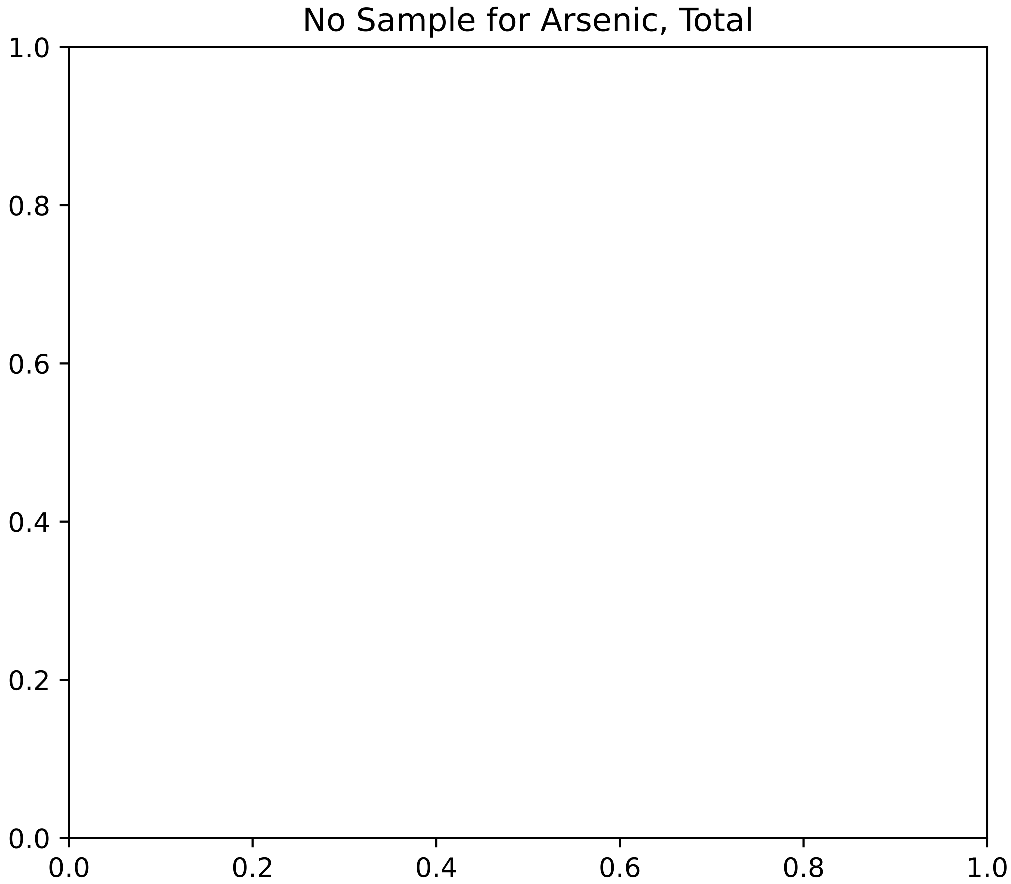


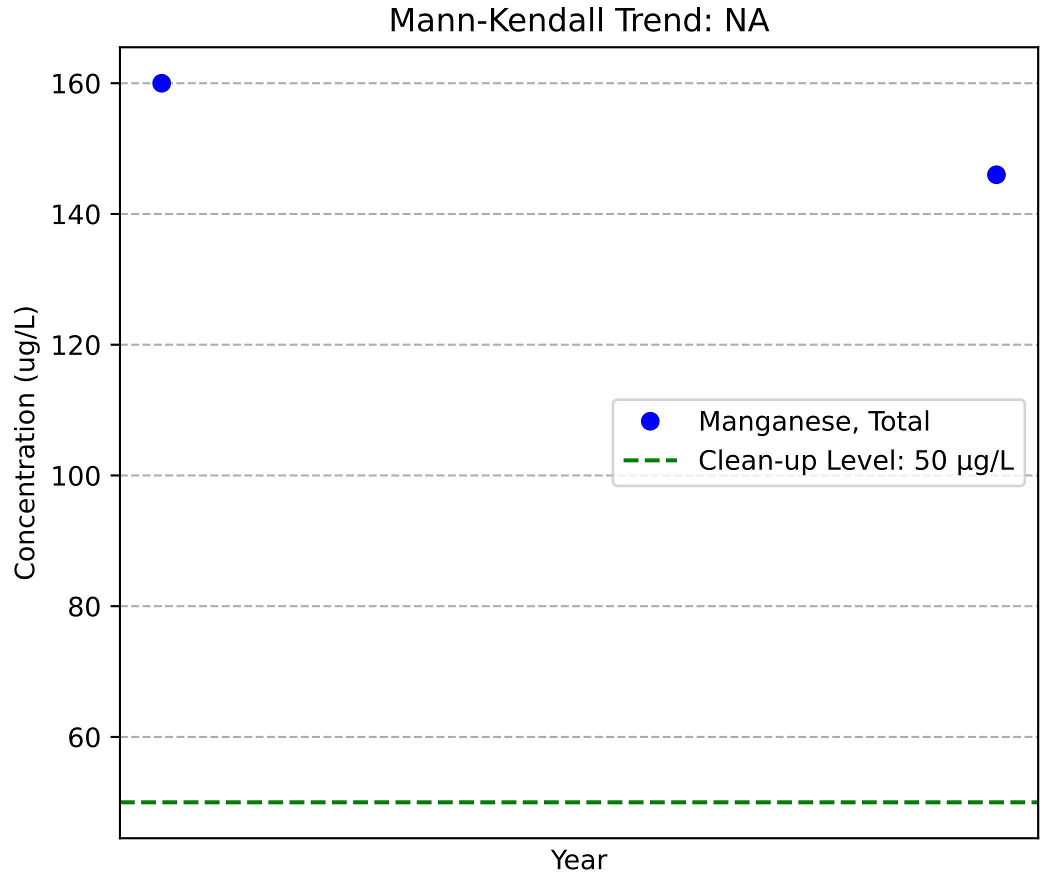
Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Manganese, Total
Clean-up Level: 50 µg/L
600
500
400
300
200
100
2011
2012
2013
2014
2015
2016
2017
2018
2019

MW-40p2

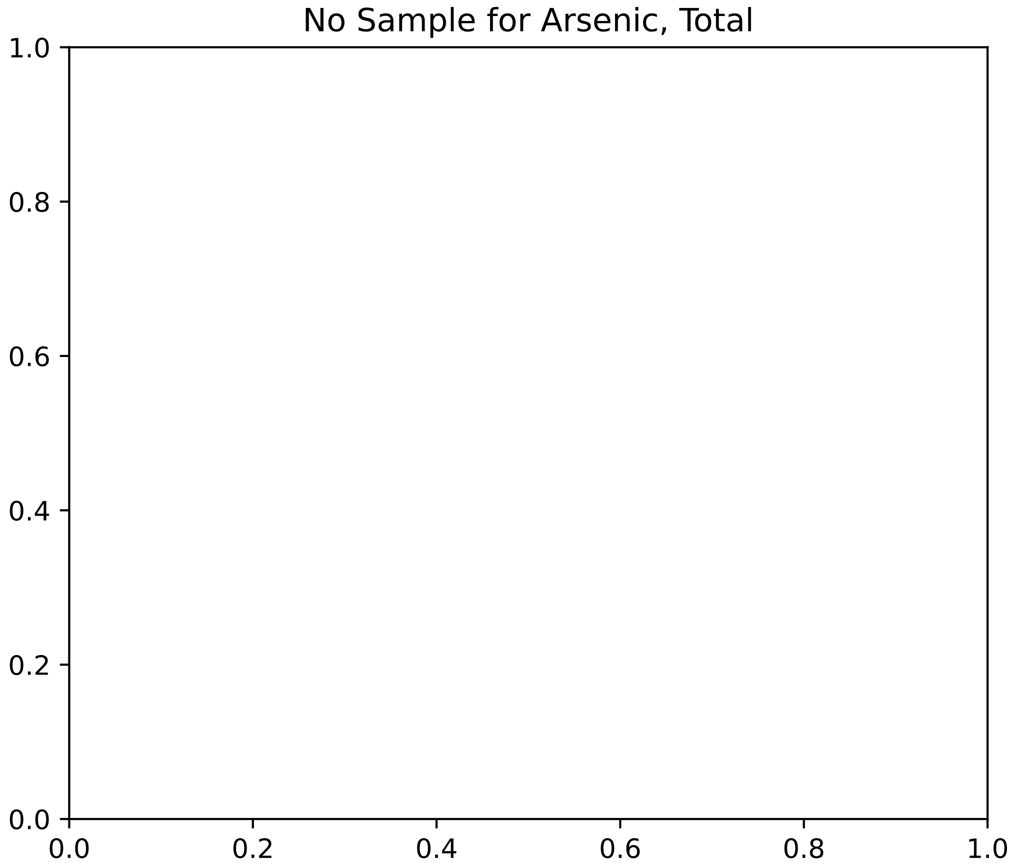

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
700
600
500
400
300
200
100
Concentration (ug/L)
Year

MW-43p2

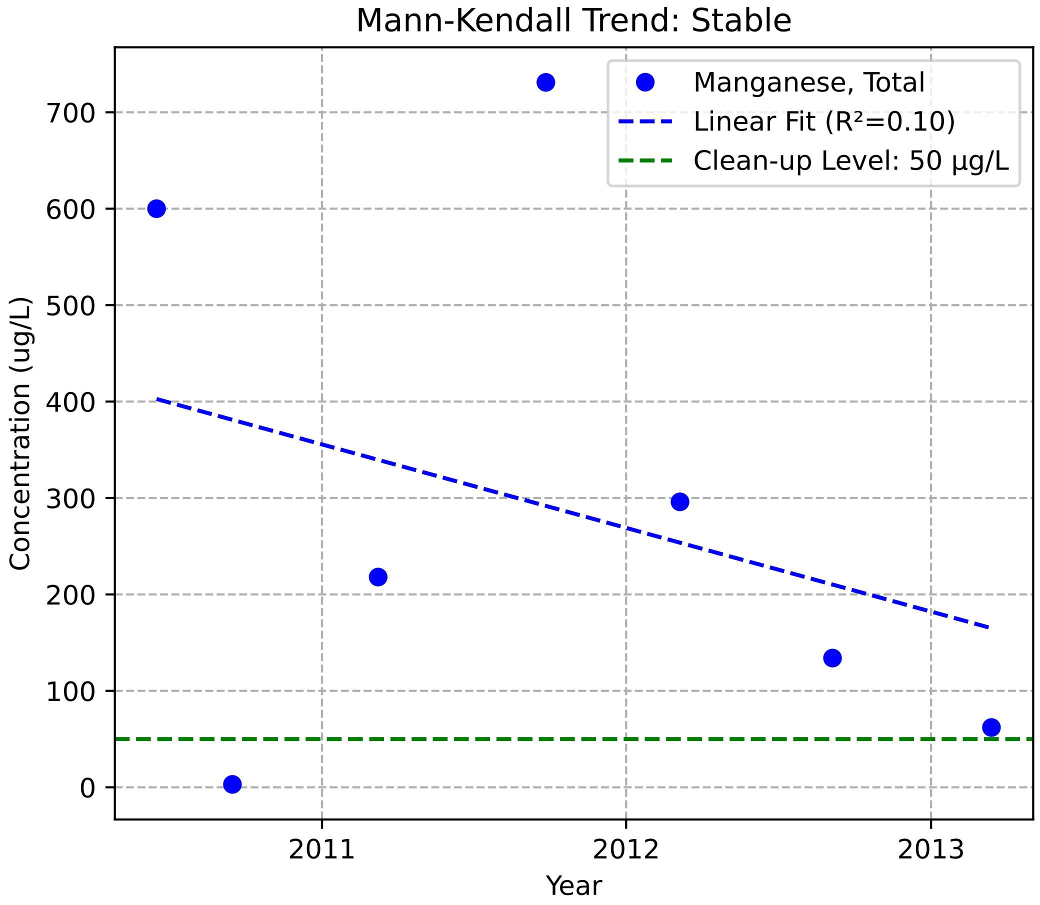

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Mann-Kendall Trend: NA
Concentration (ug/L)
160
140
120
100
80
60
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-46p2

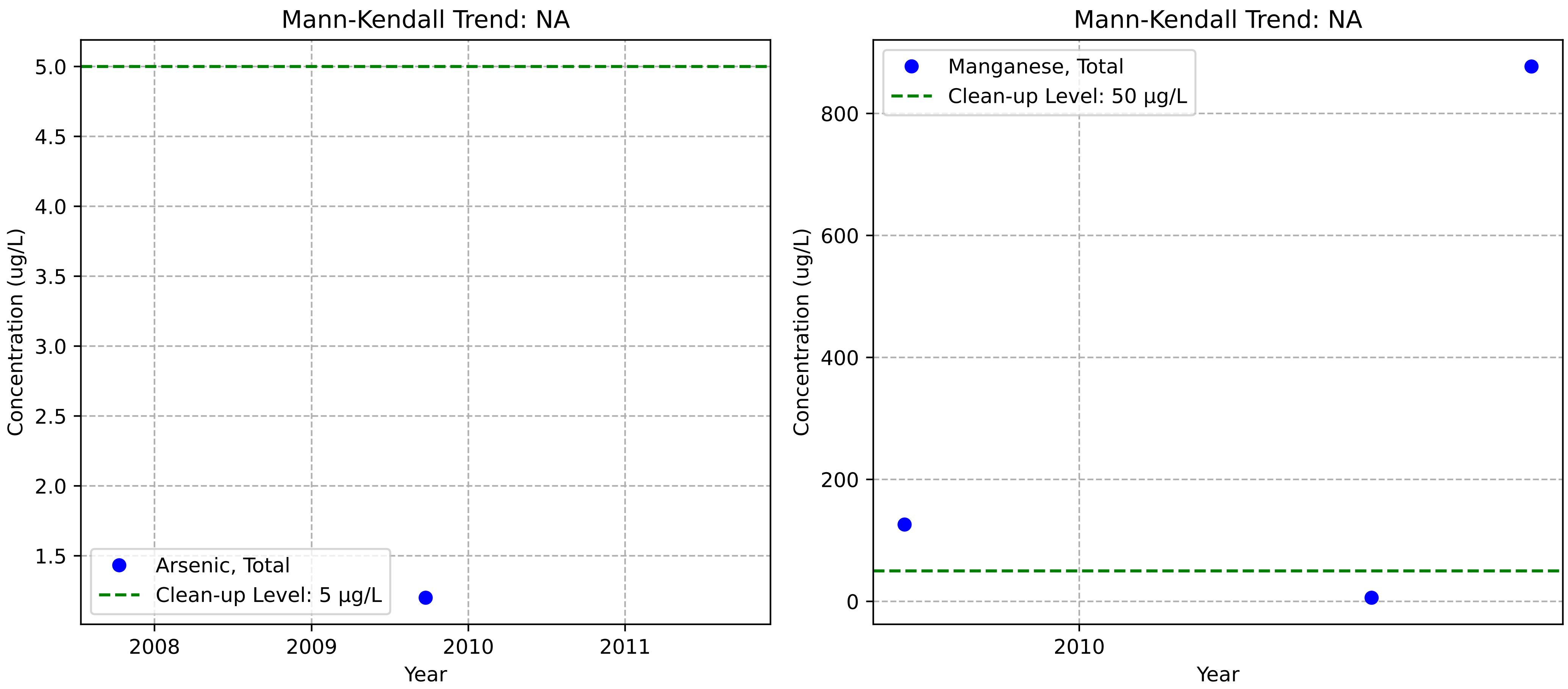


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



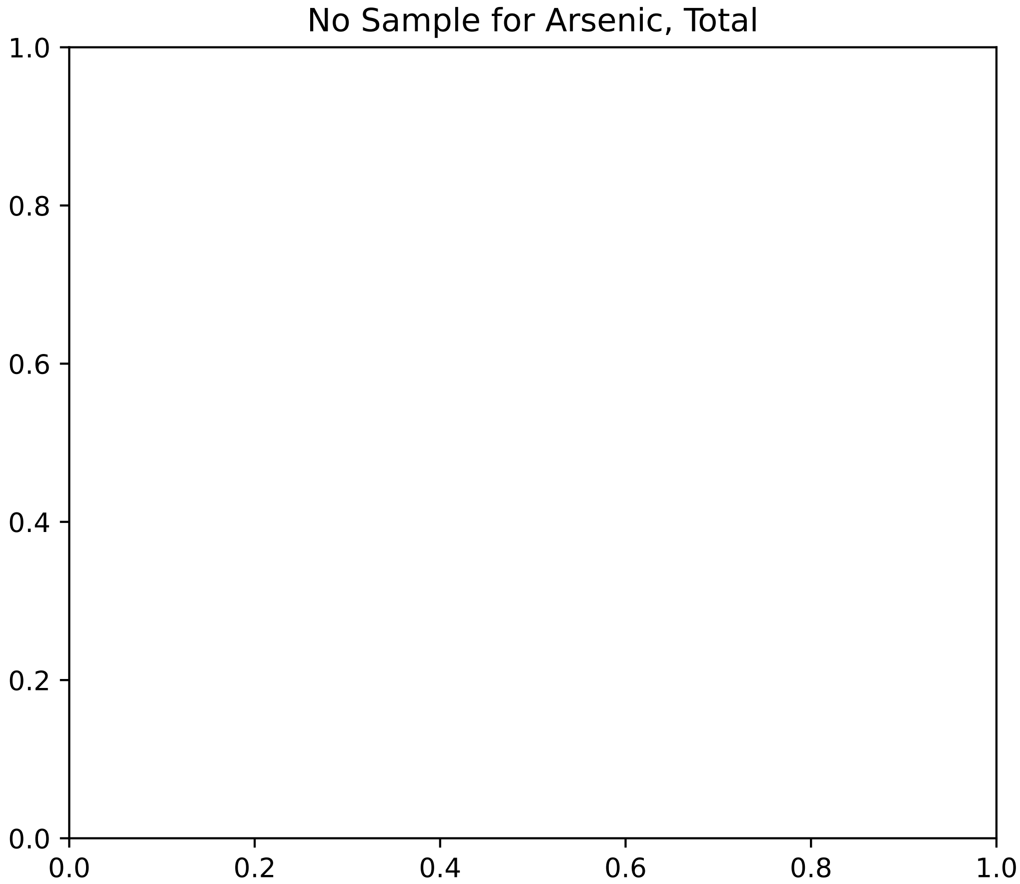
Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.10)
Clean-up Level: 50 µg/L
Concentration (ug/L)
700
600
500
400
300
200
100
0
2011
2012
2013
Year

MW-49p2

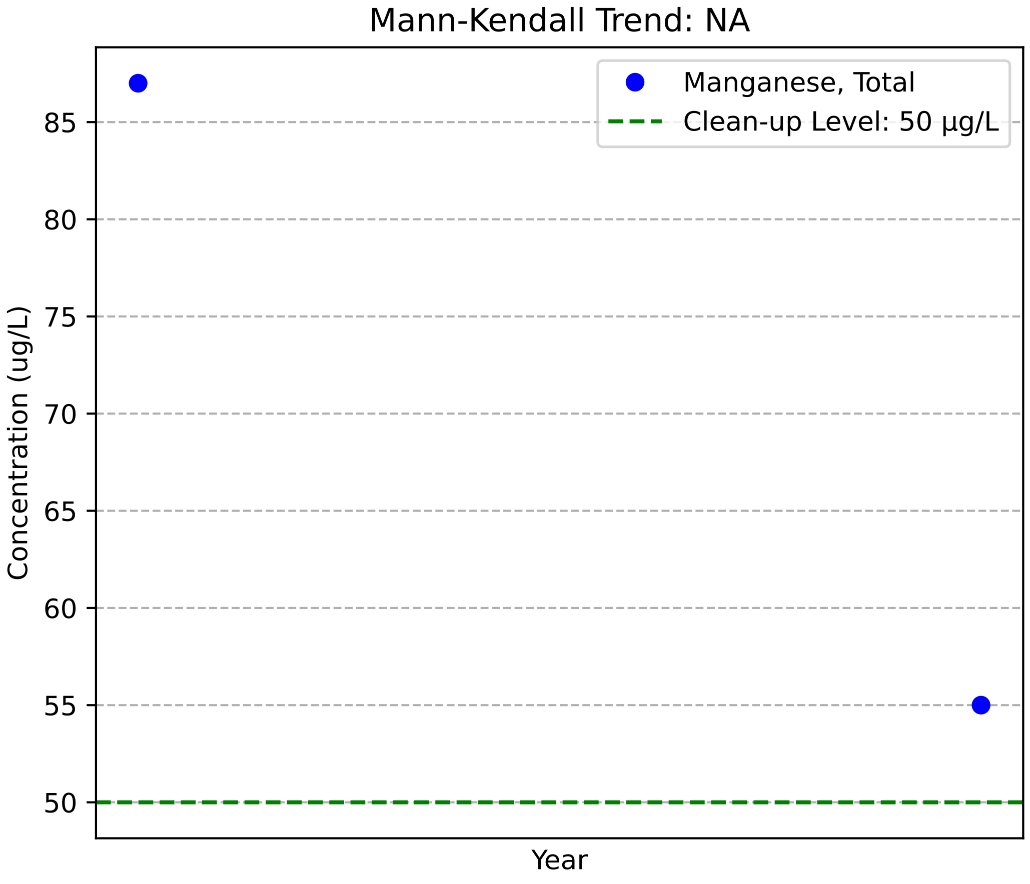


Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
2008
2009
2010
2011
Year
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
800
600
400
200
0
2010
Year

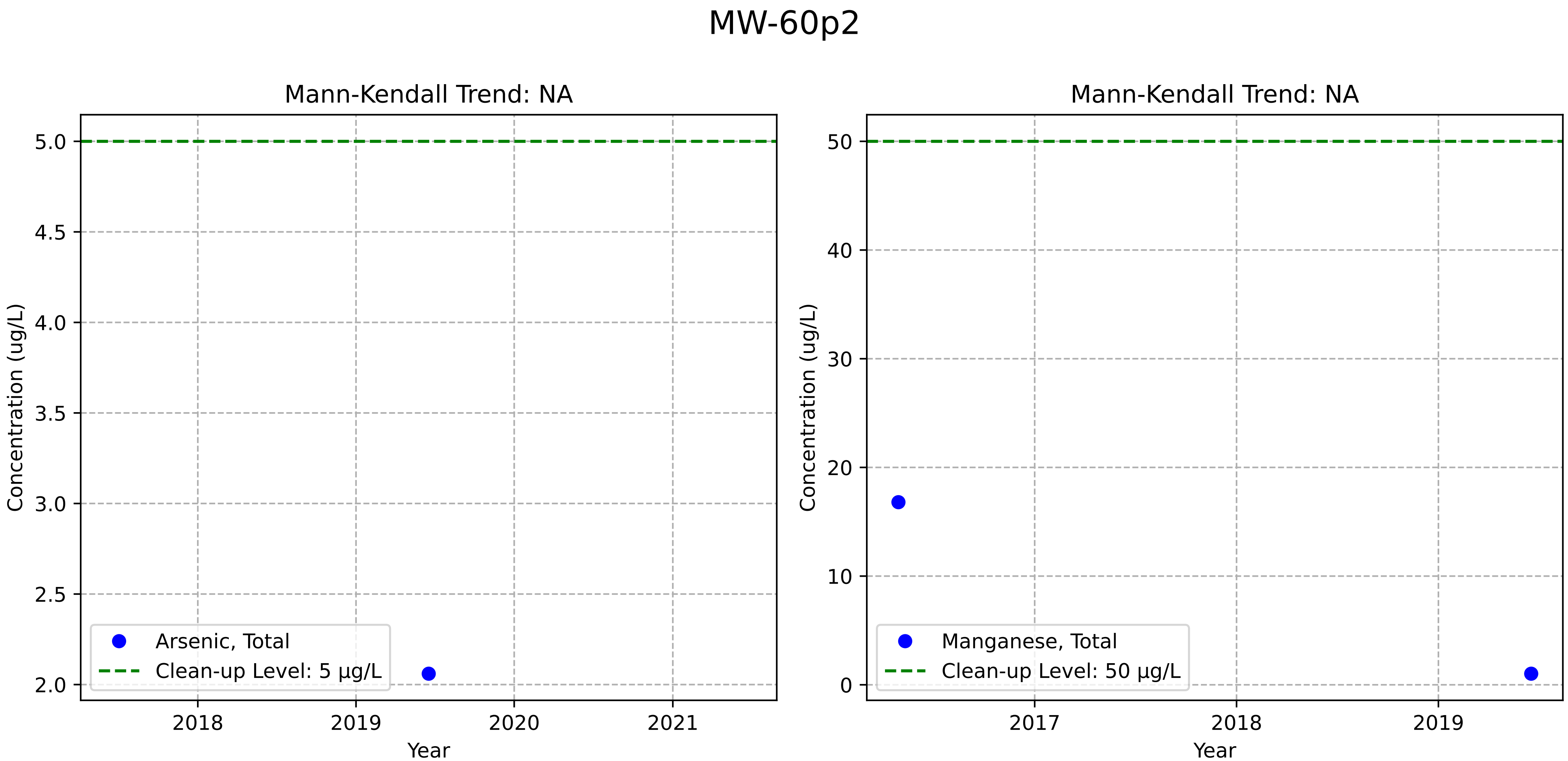
MW-52p2



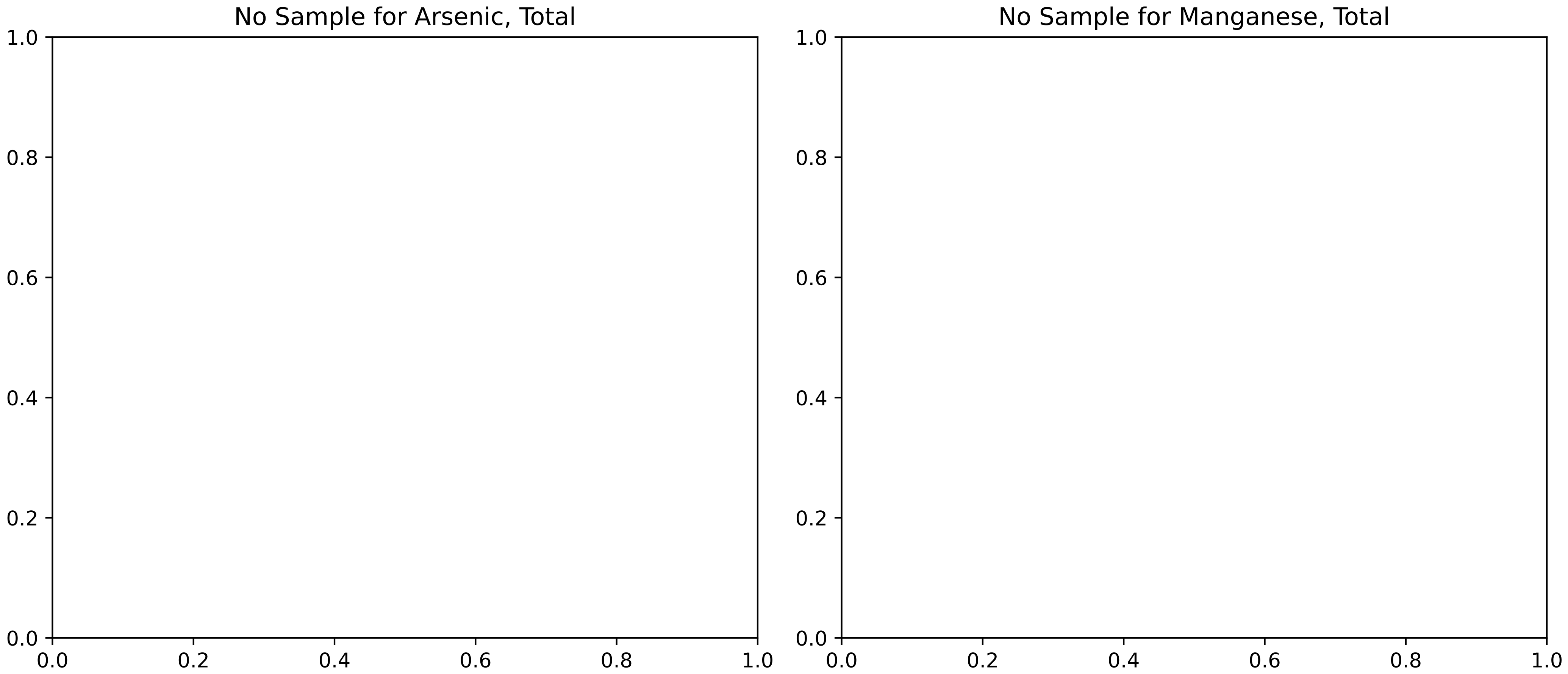
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
85
80
75
70
65
60
55
50
Year

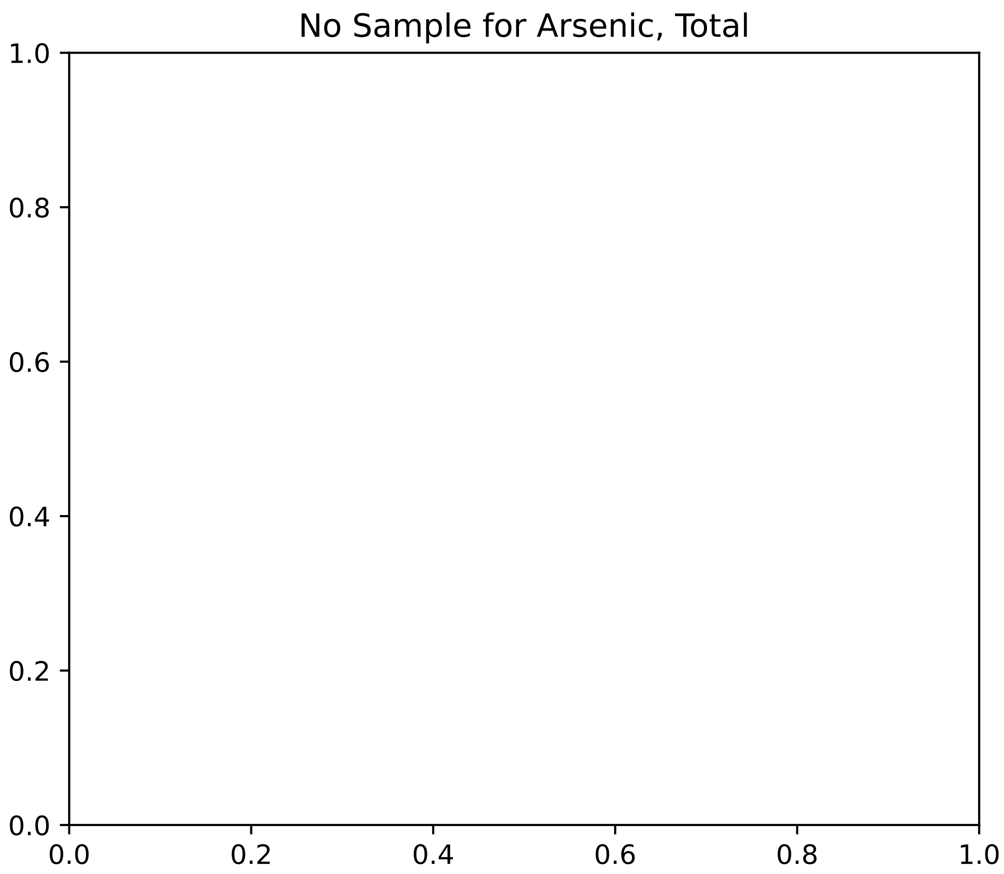

MW-60p2
Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
2018
2019
2020
2021
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: NA
Concentration (ug/L)
50
40
30
20
10
0
2017
2018
2019
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-73p2

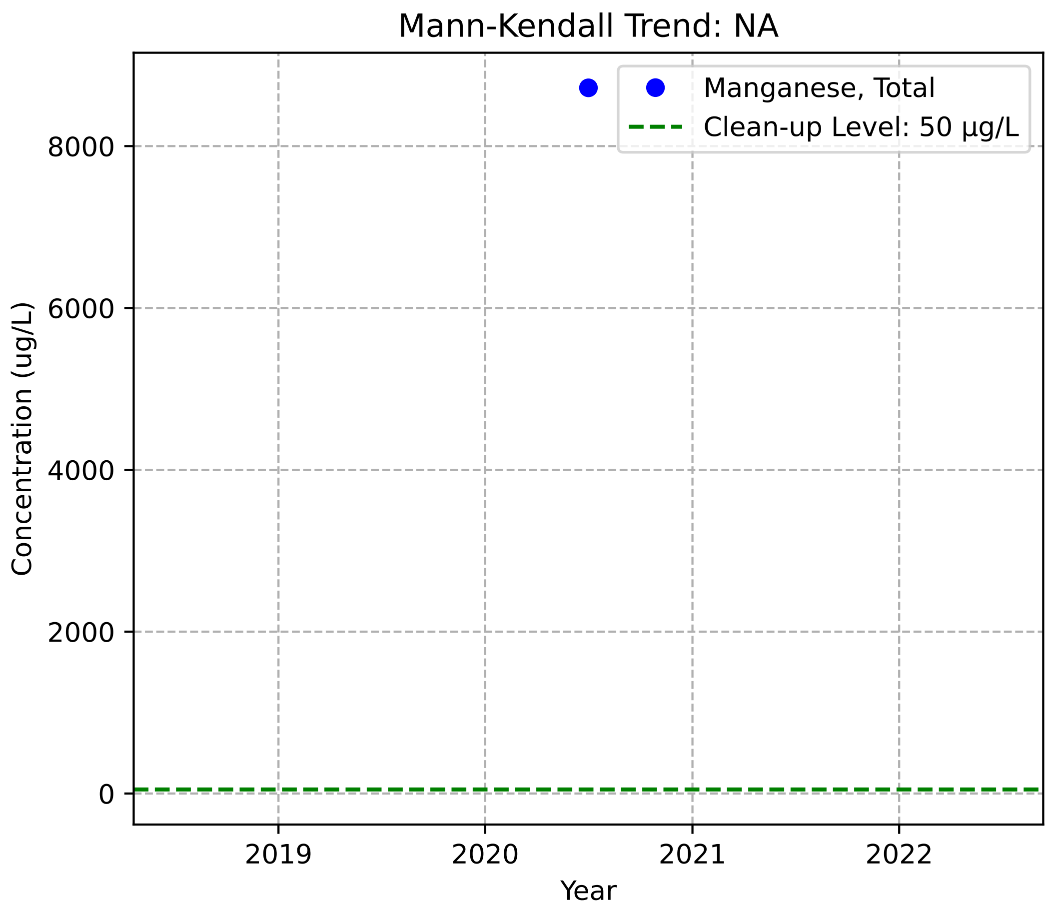


No Sample for Arsenic, Total
No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

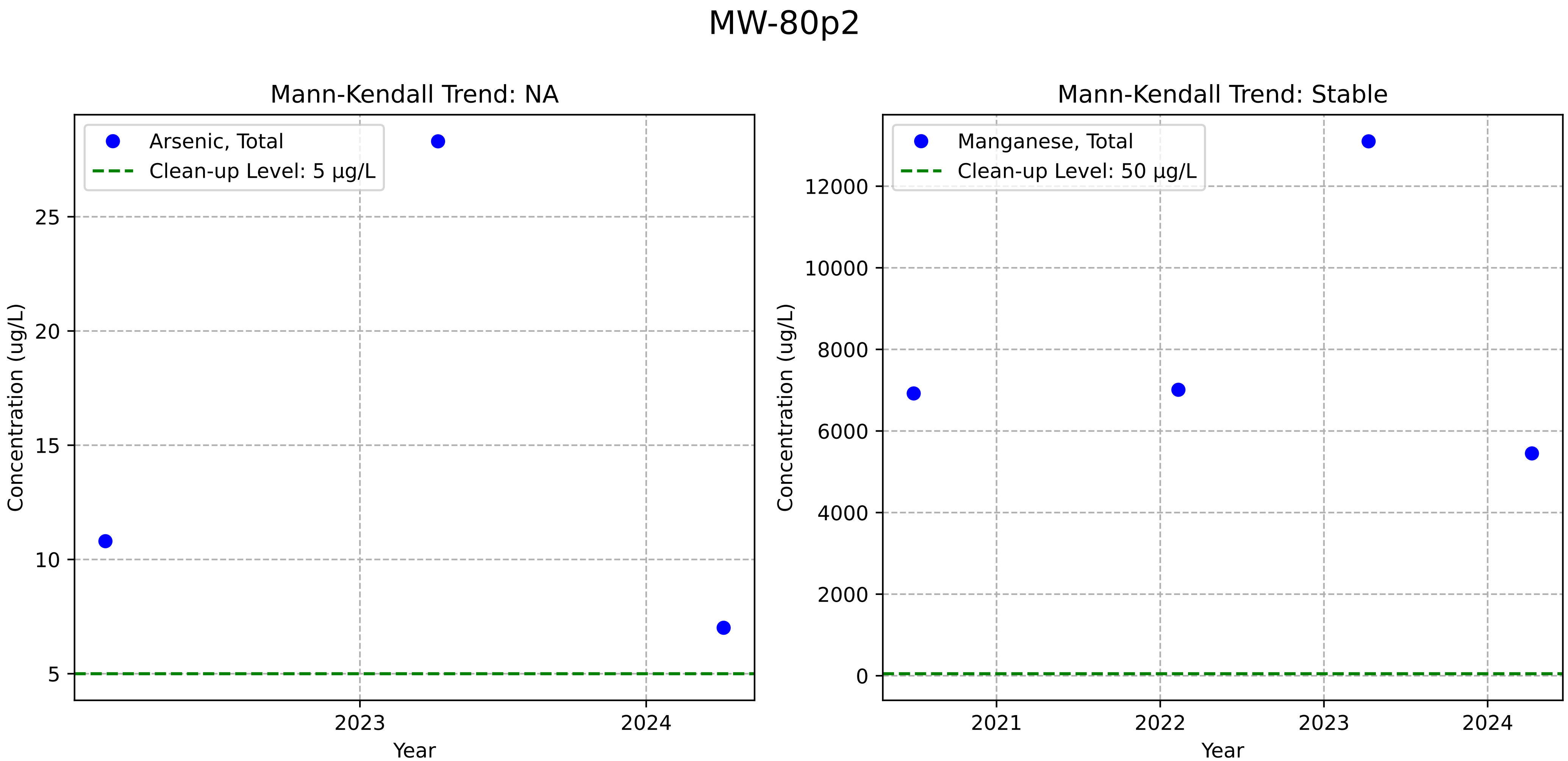
MW-76p2



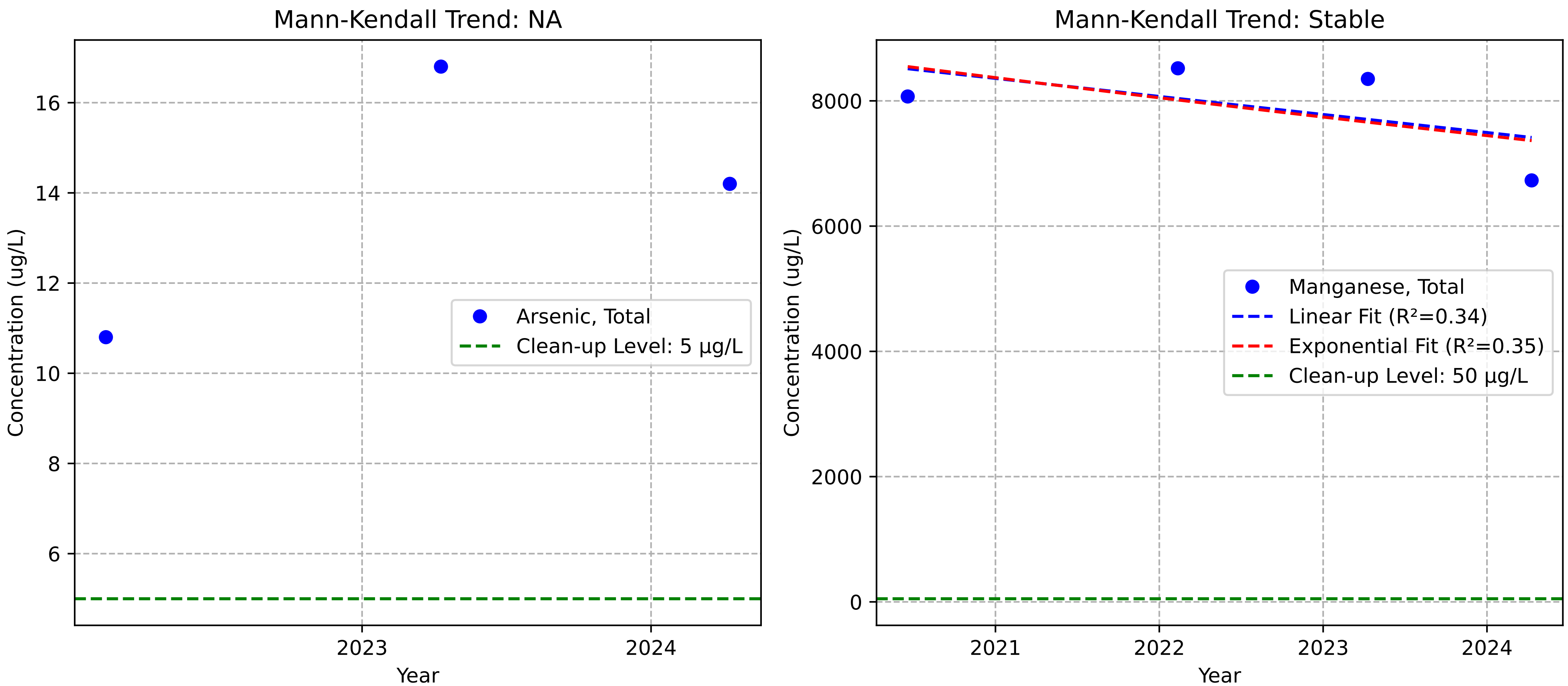
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



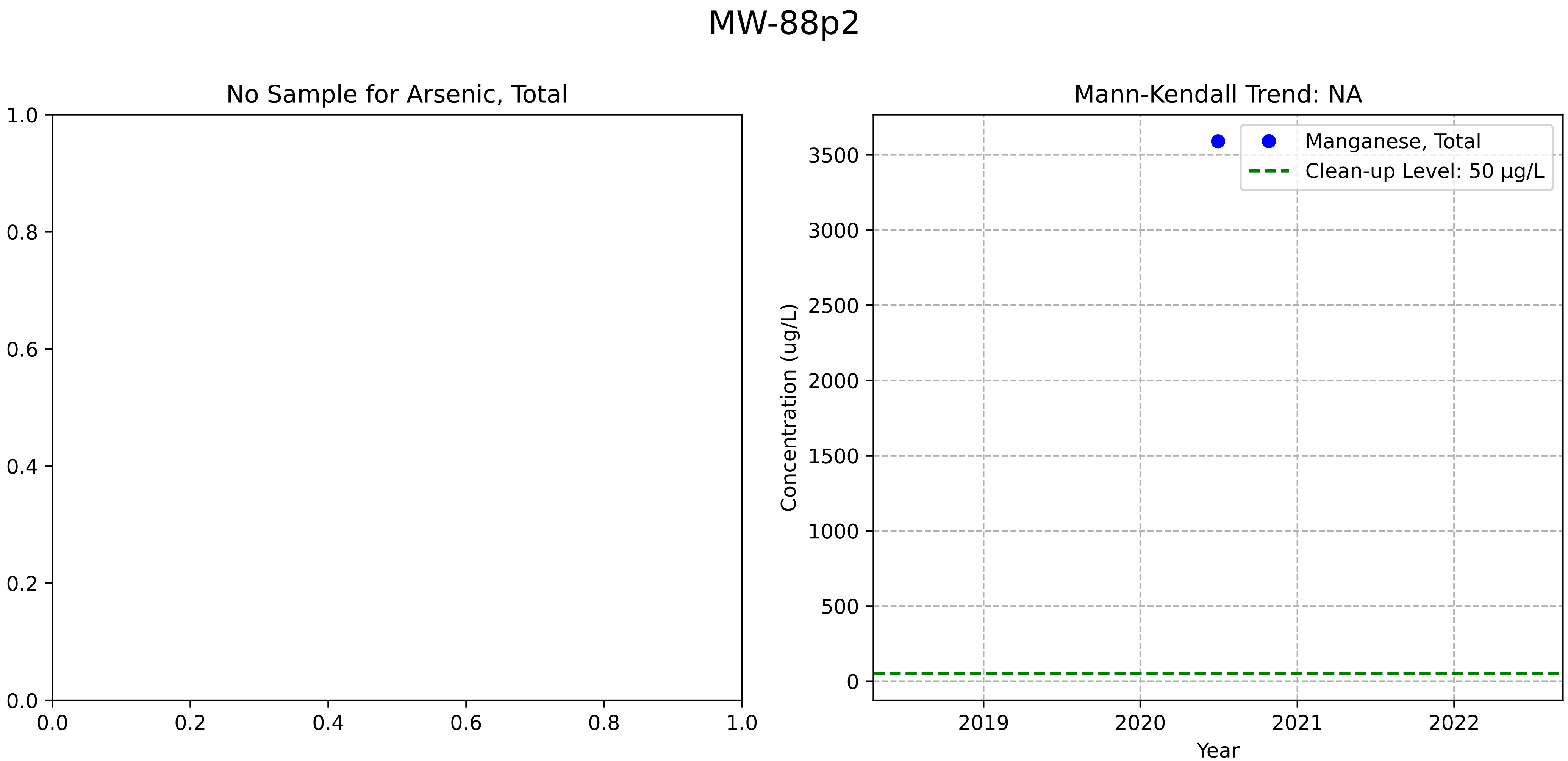
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
8000
6000
4000
2000
0
2019
2020
2021
2022
Year


MW-80p2
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
25
20
15
10
5
2023
2024
Year
Mann-Kendall Trend: Stable
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
12000
10000
8000
6000
4000
2000
0
2021
2022
2023
2024
Year

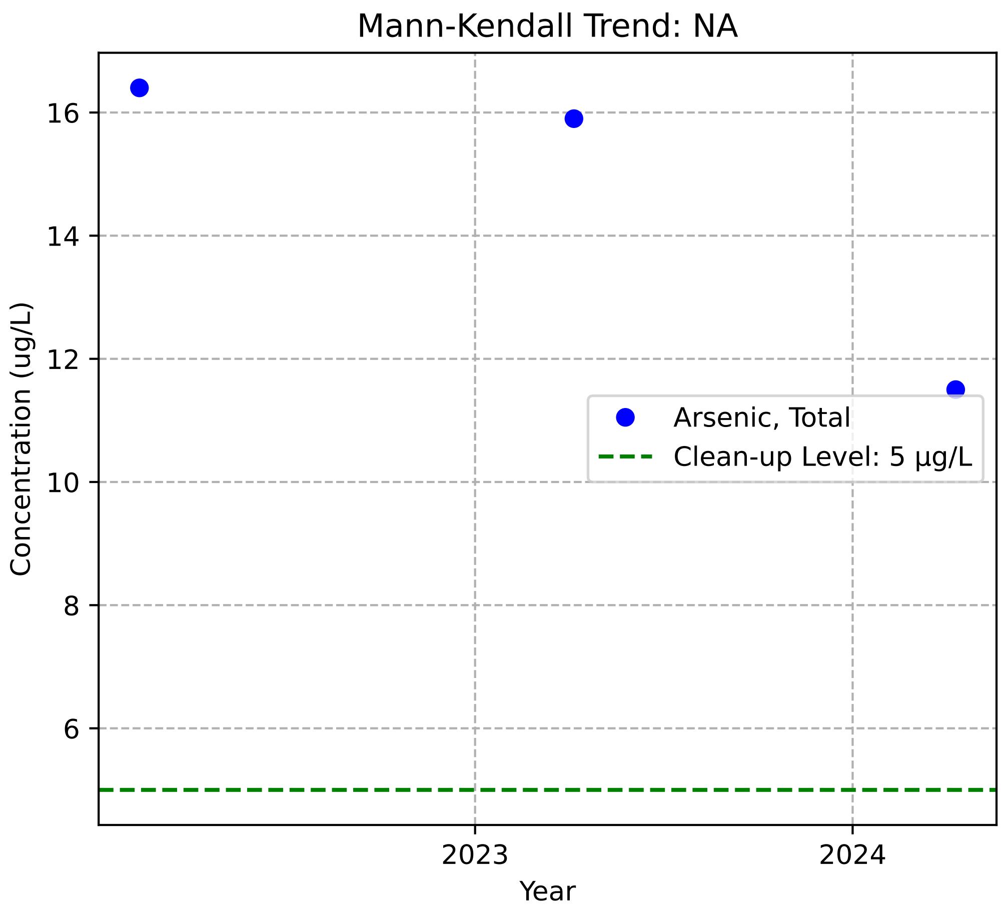
MW-87p2



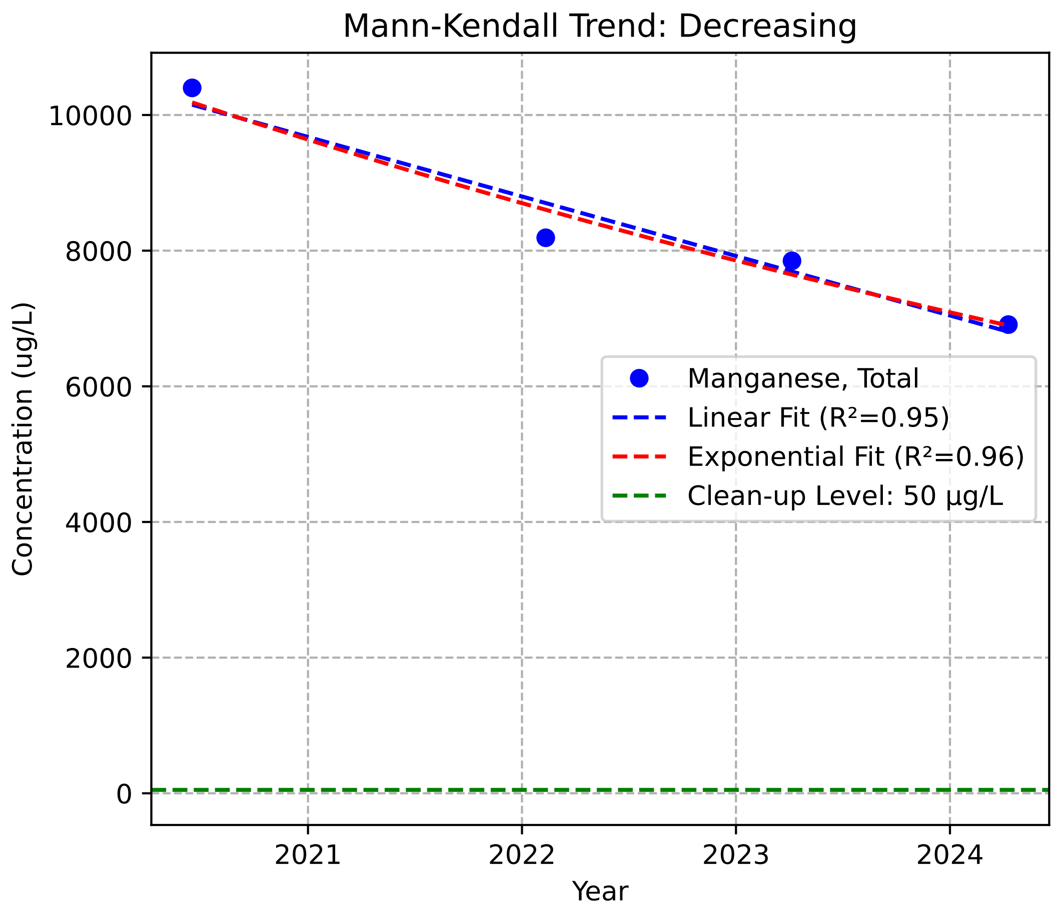
Mann-Kendall Trend: NA
Concentration (ug/L)
16
14
12
10
8
6
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Concentration (ug/L)
8000
6000
4000
2000
0
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.34)
Exponential Fit (R²=0.35)
Clean-up Level: 50 µg/L


MW-88p2
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
3500
3000
2500
2000
1500
1000
500
0
2019
2020
2021
2022
Year

MW-91p2

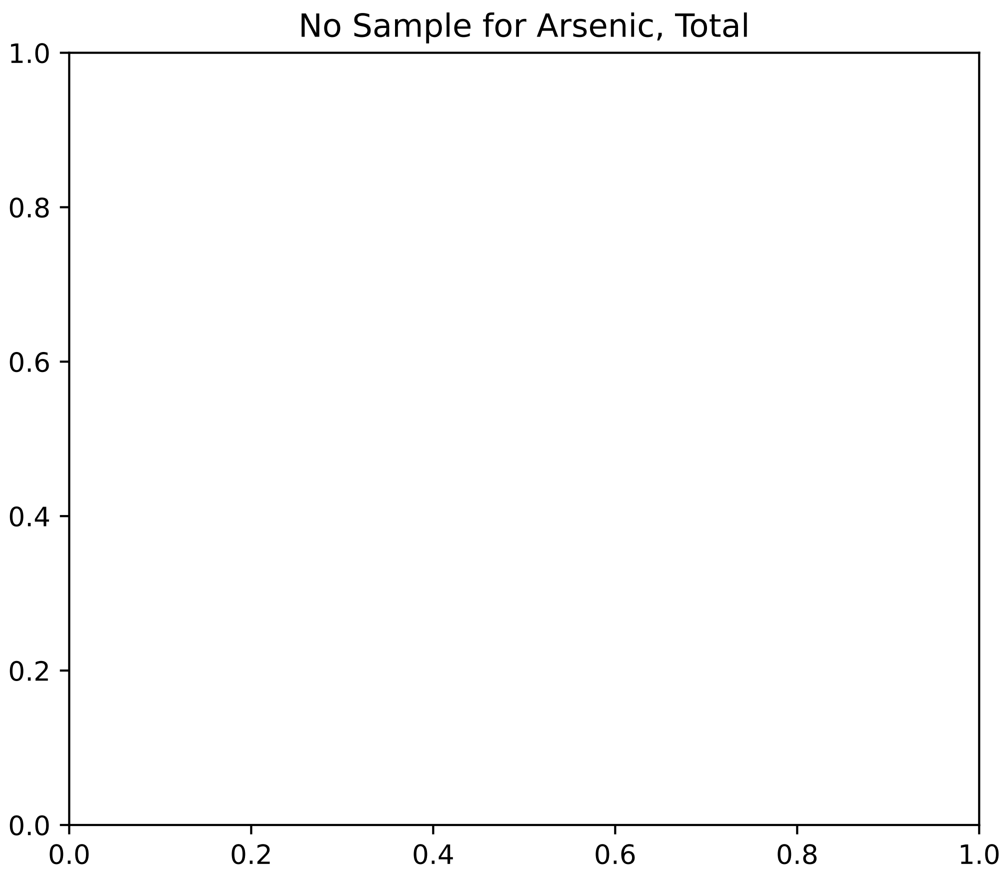


Mann-Kendall Trend: NA
Concentration (ug/L)
16
14
12
10
8
6
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L

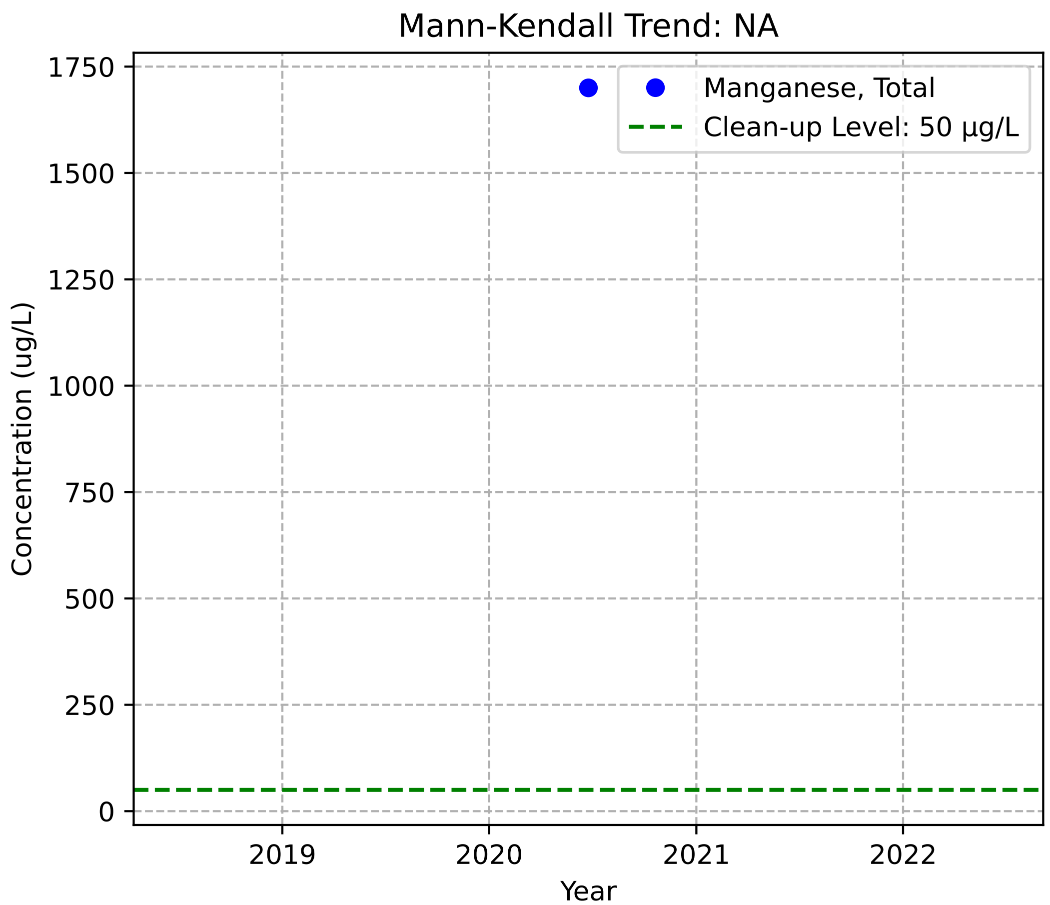


Mann-Kendall Trend: Decreasing
Concentration (ug/L)
10000
8000
6000
4000
2000
0
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.95)
Exponential Fit (R²=0.96)
Clean-up Level: 50 µg/L

MW-94p2

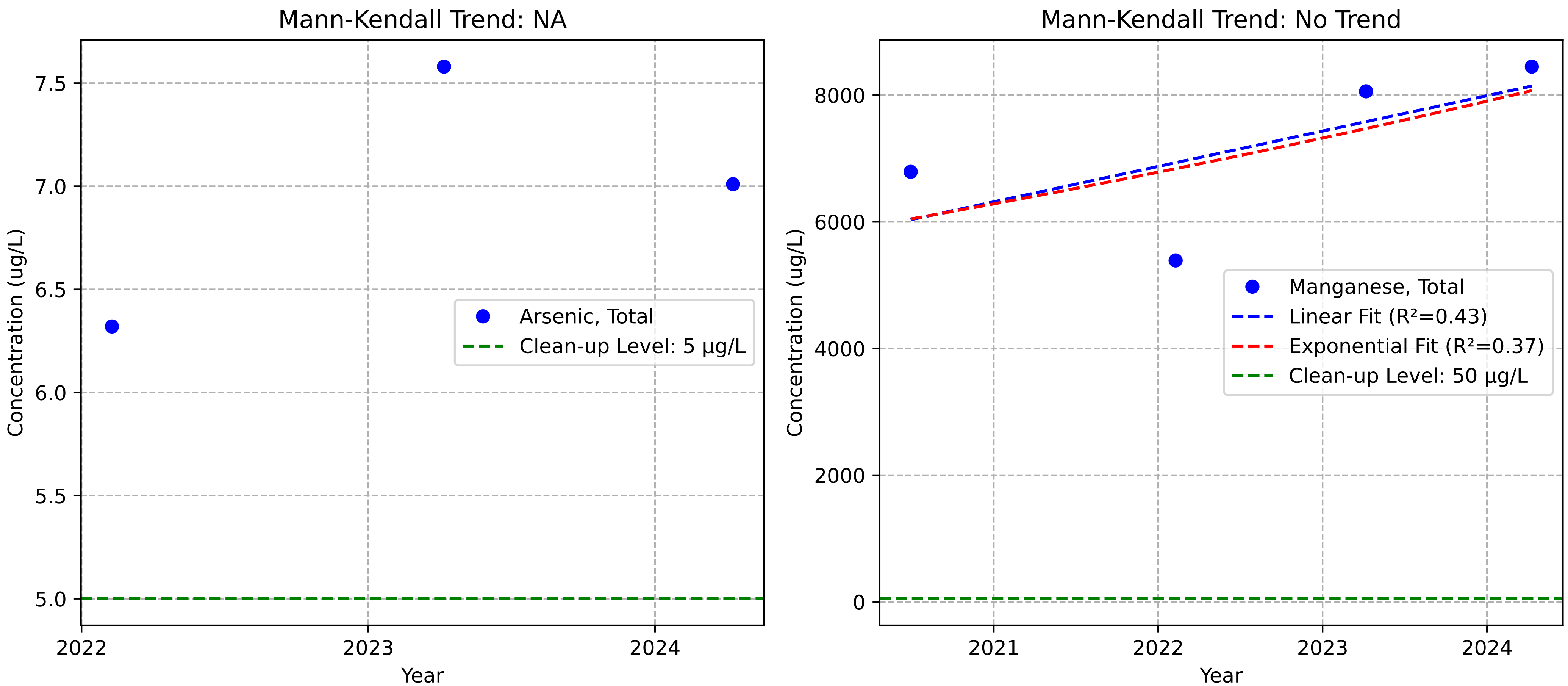


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

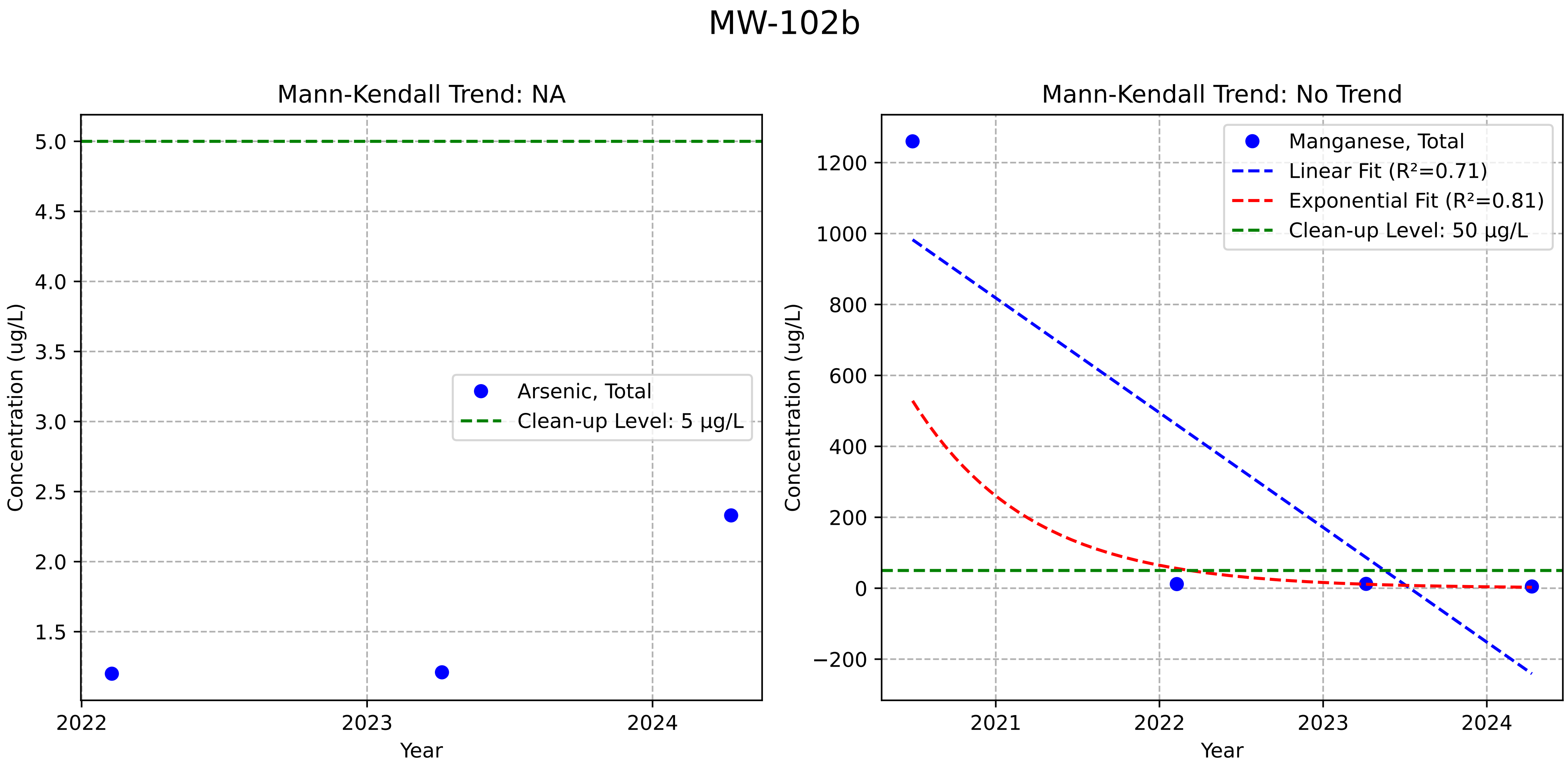


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
1750
1500
1250
1000
750
500
250
0
2019
2020
2021
2022
Year

MW-99p2

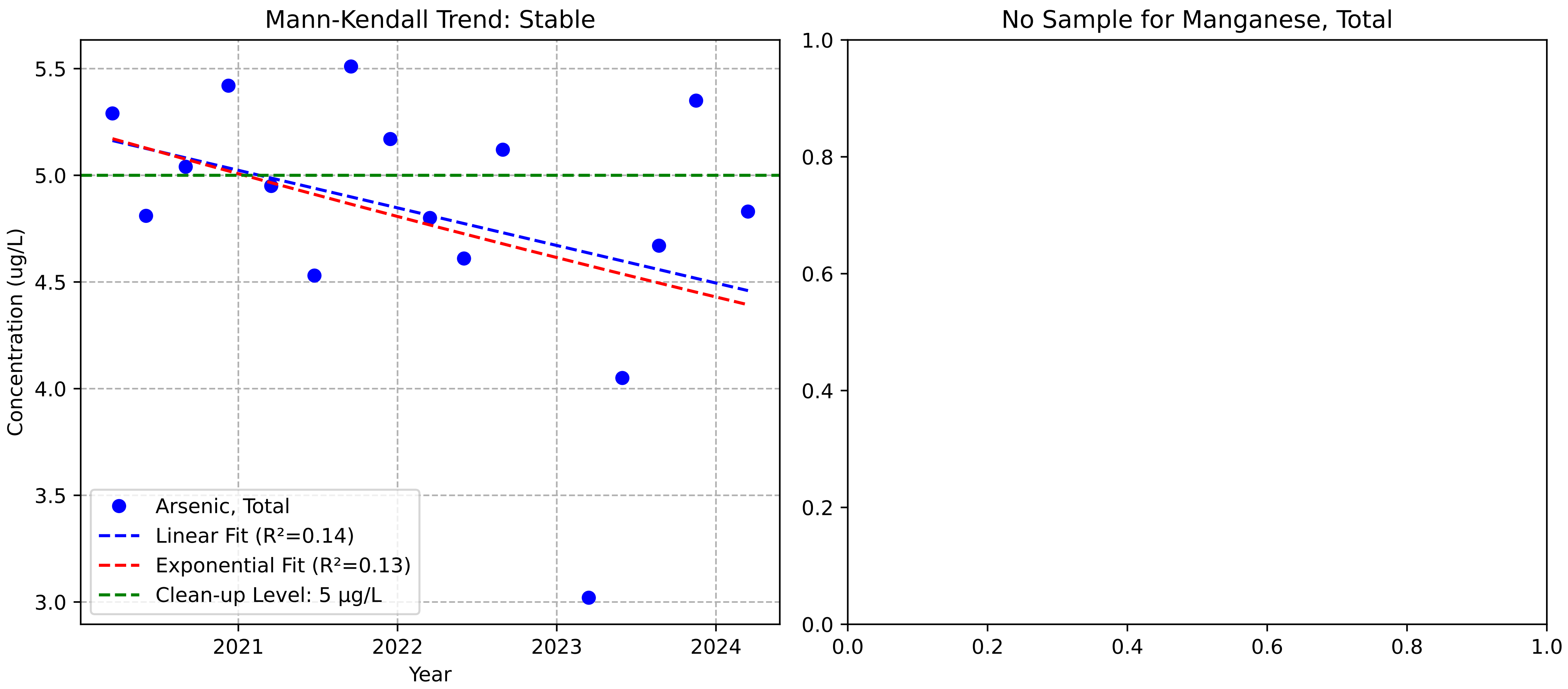


Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.43)
Exponential Fit (R²=0.37)
Clean-up Level: 50 µg/L



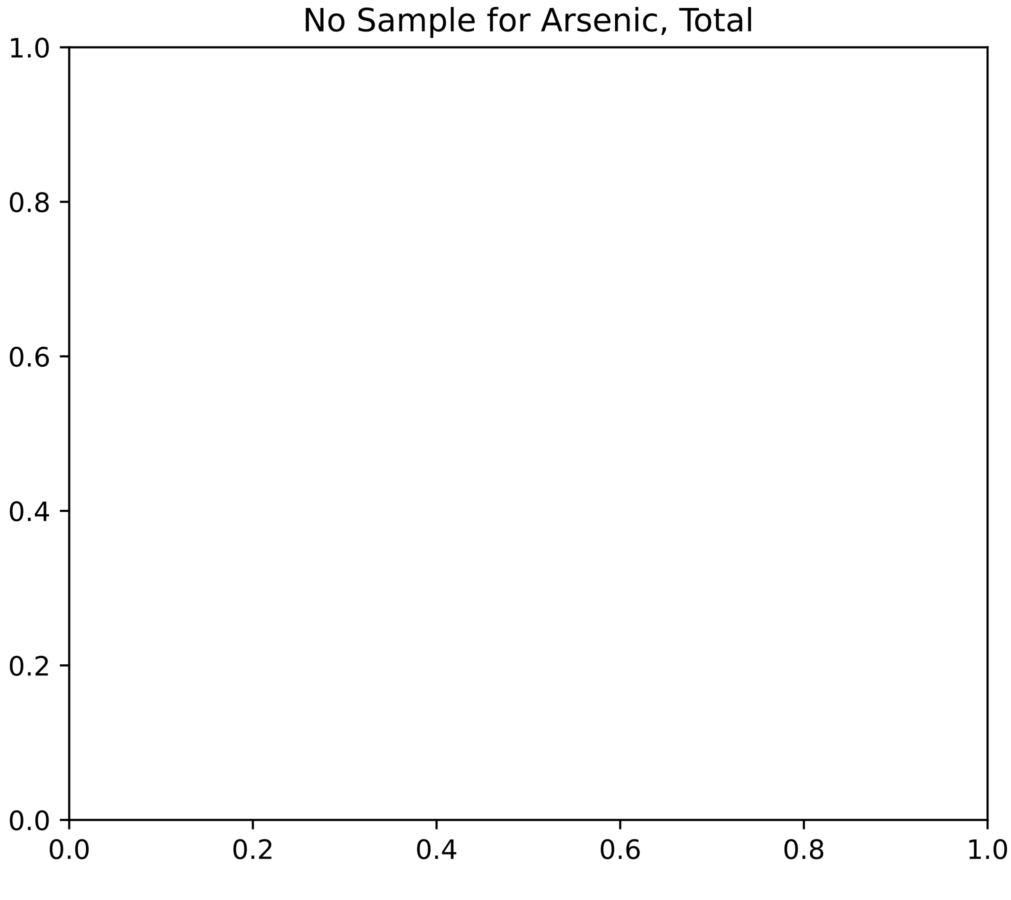
MW-102b
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Manganese, Total
Linear Fit (R²=0.71)
Exponential Fit (R²=0.81)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

MW-103b

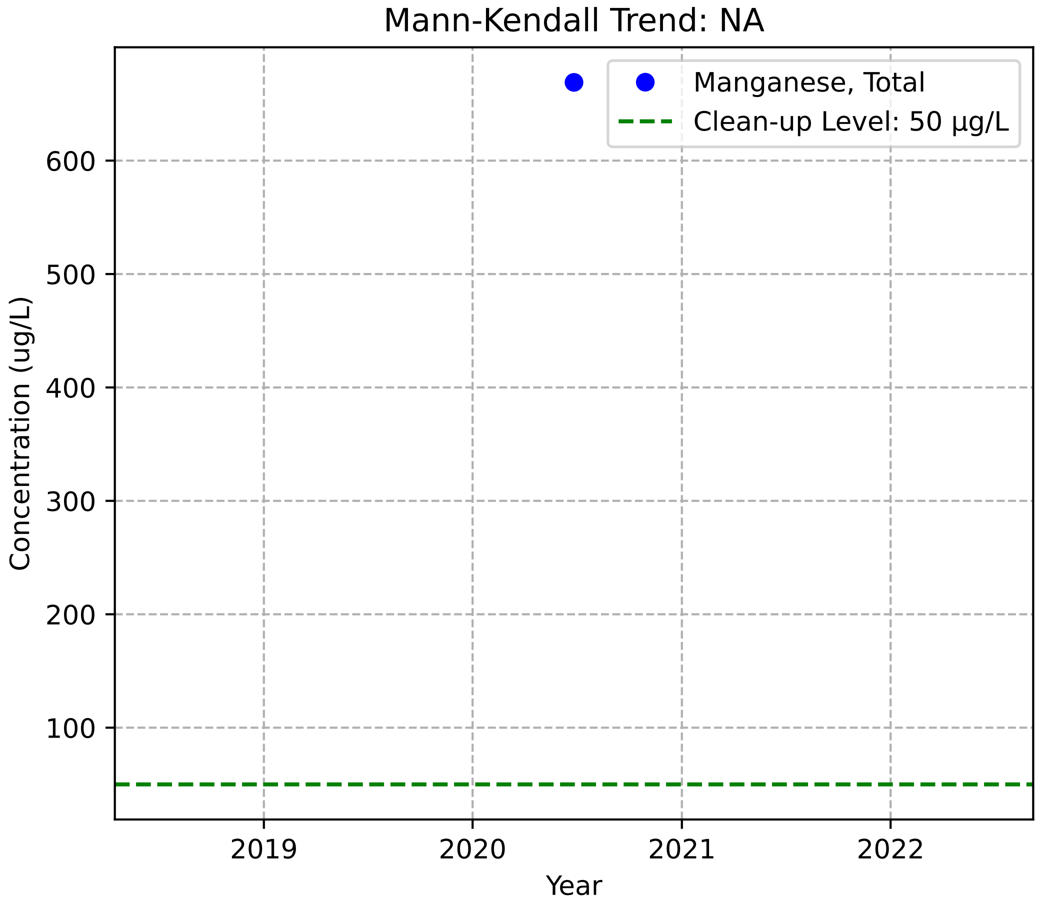


Mann-Kendall Trend: Stable
Concentration (ug/L)
Year
5.5
5.0
4.5
4.0
3.5
3.0
2021
2022
2023
2024
Arsenic, Total
Linear Fit (R²=0.14)
Exponential Fit (R²=0.13)
Clean-up Level: 5 µg/L
No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0

MW-105b

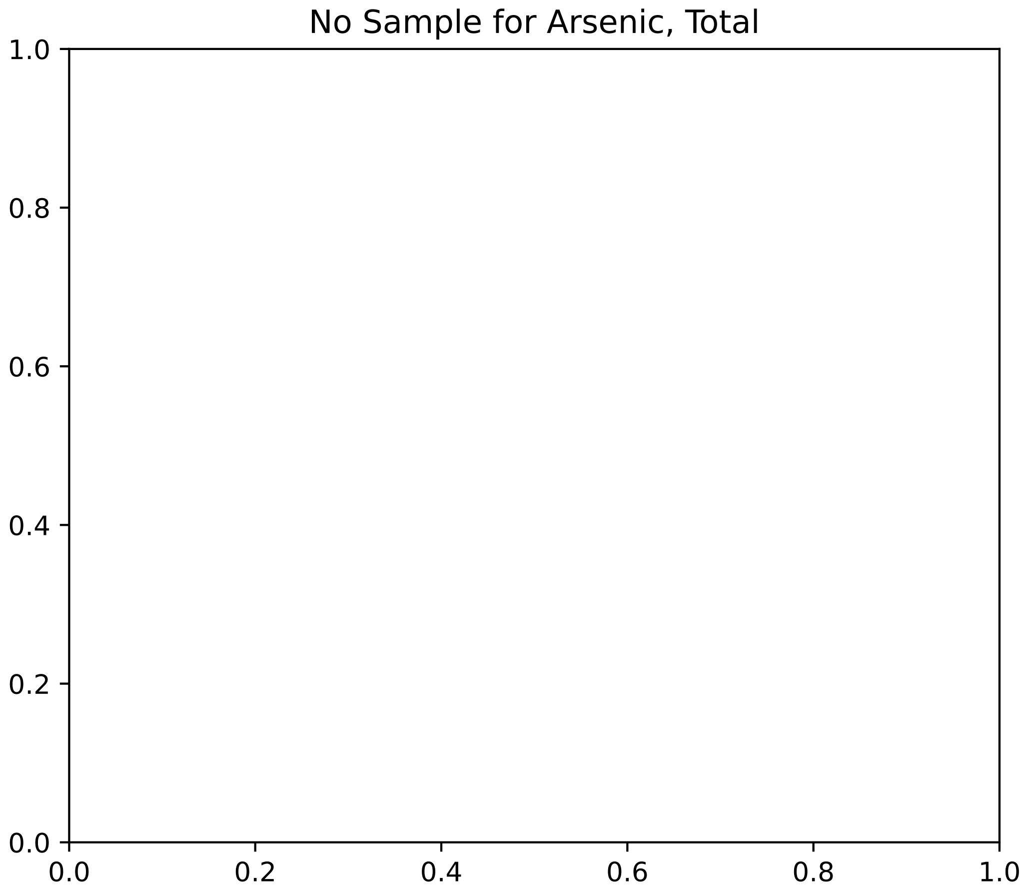


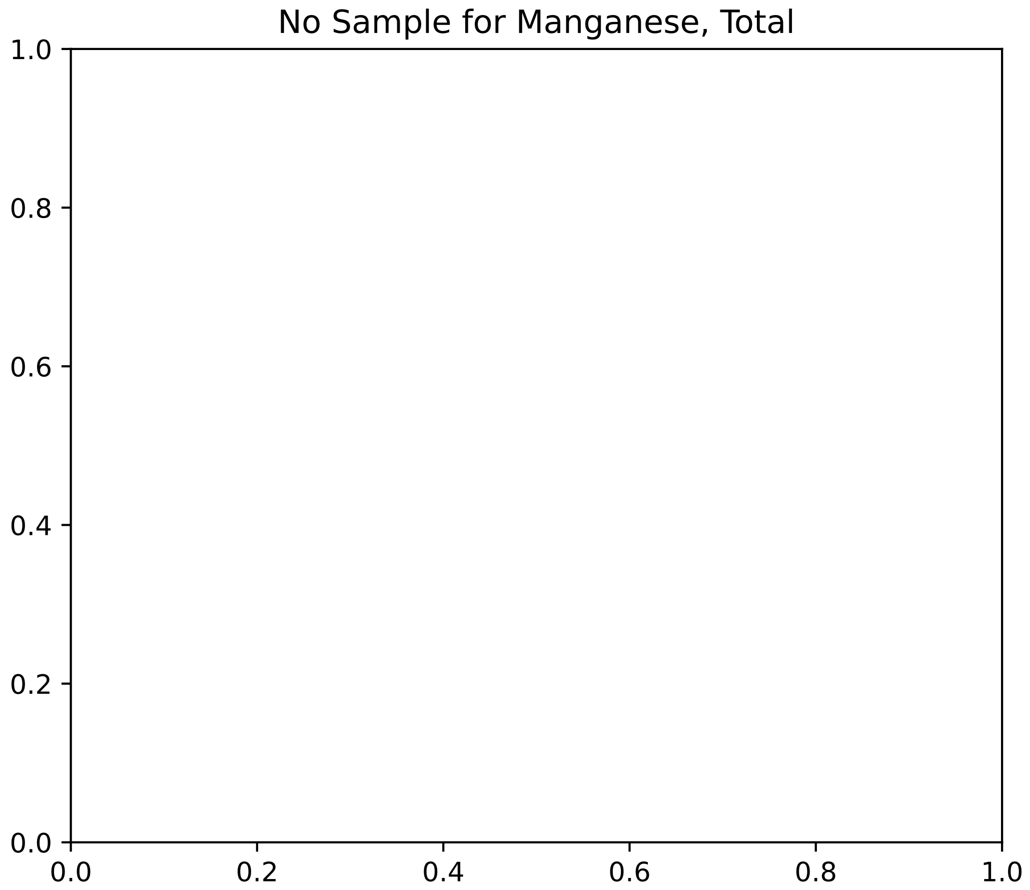
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

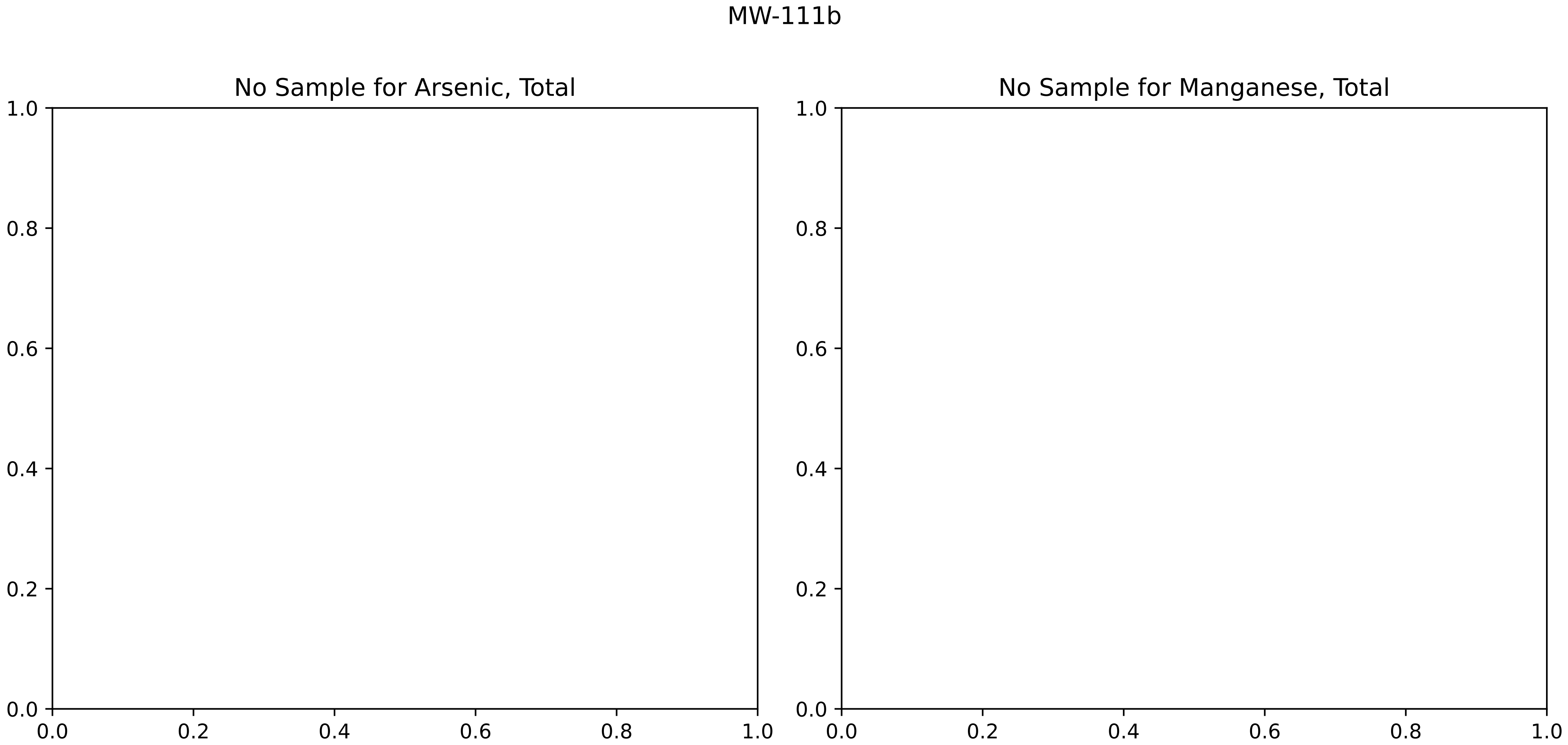


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
600
500
400
300
200
100
2019
2020
2021
2022
Year

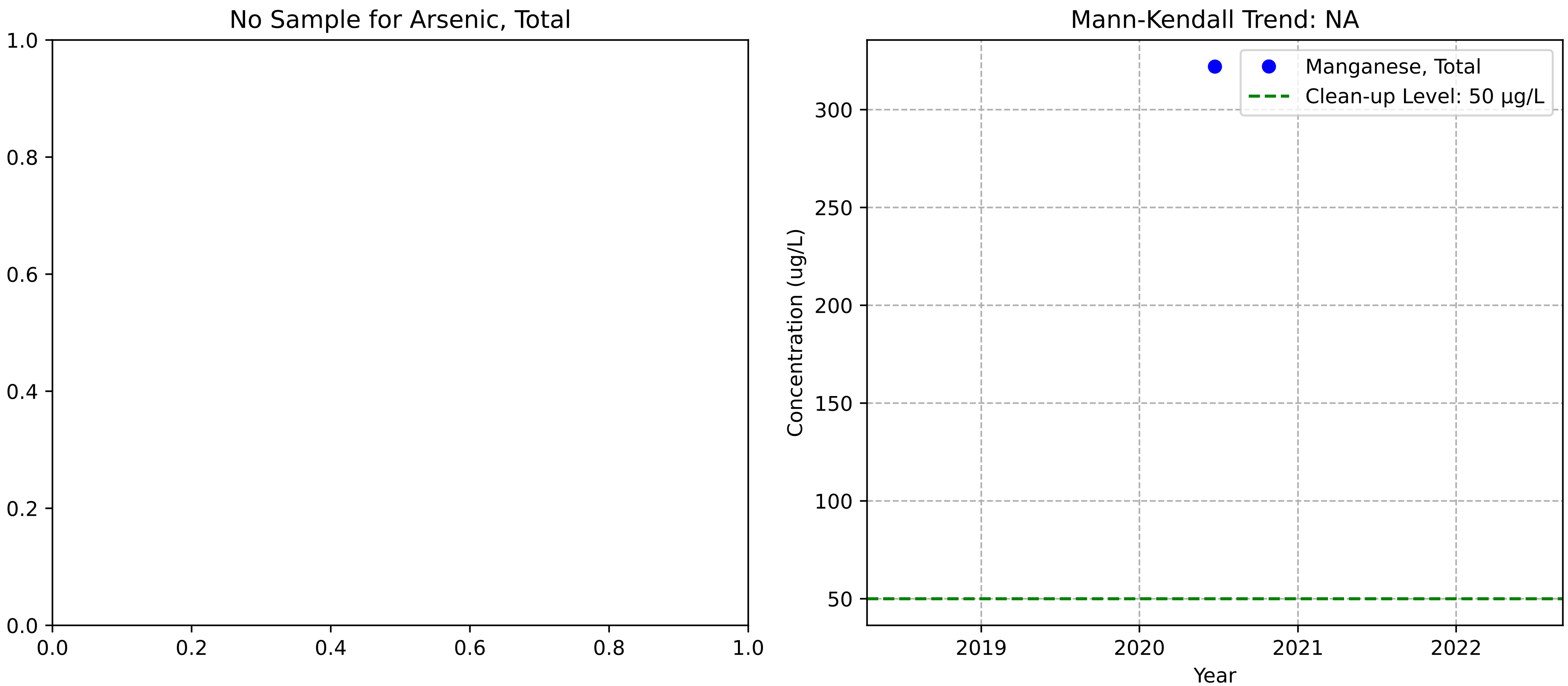
MW-106b


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

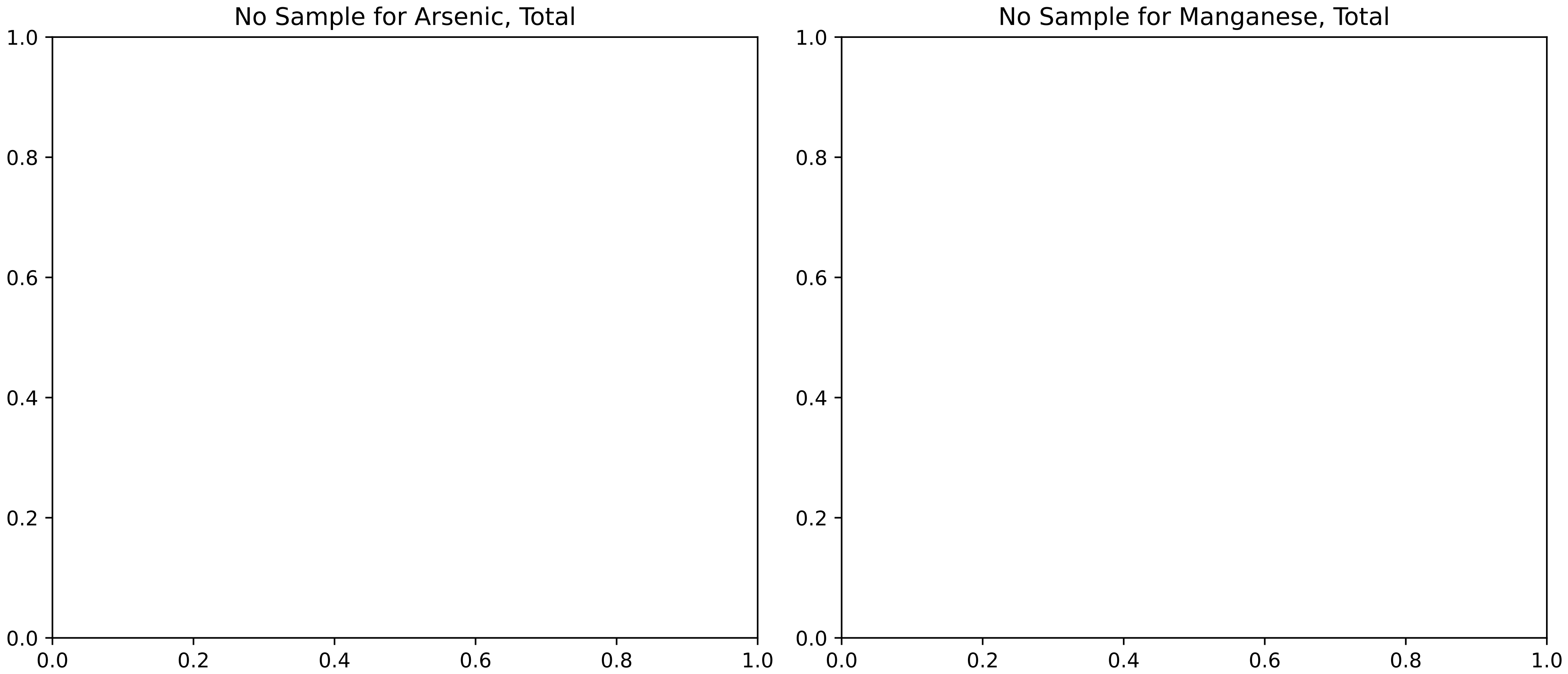

MW-111b
No Sample for Arsenic, Total
No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0

MW-116b

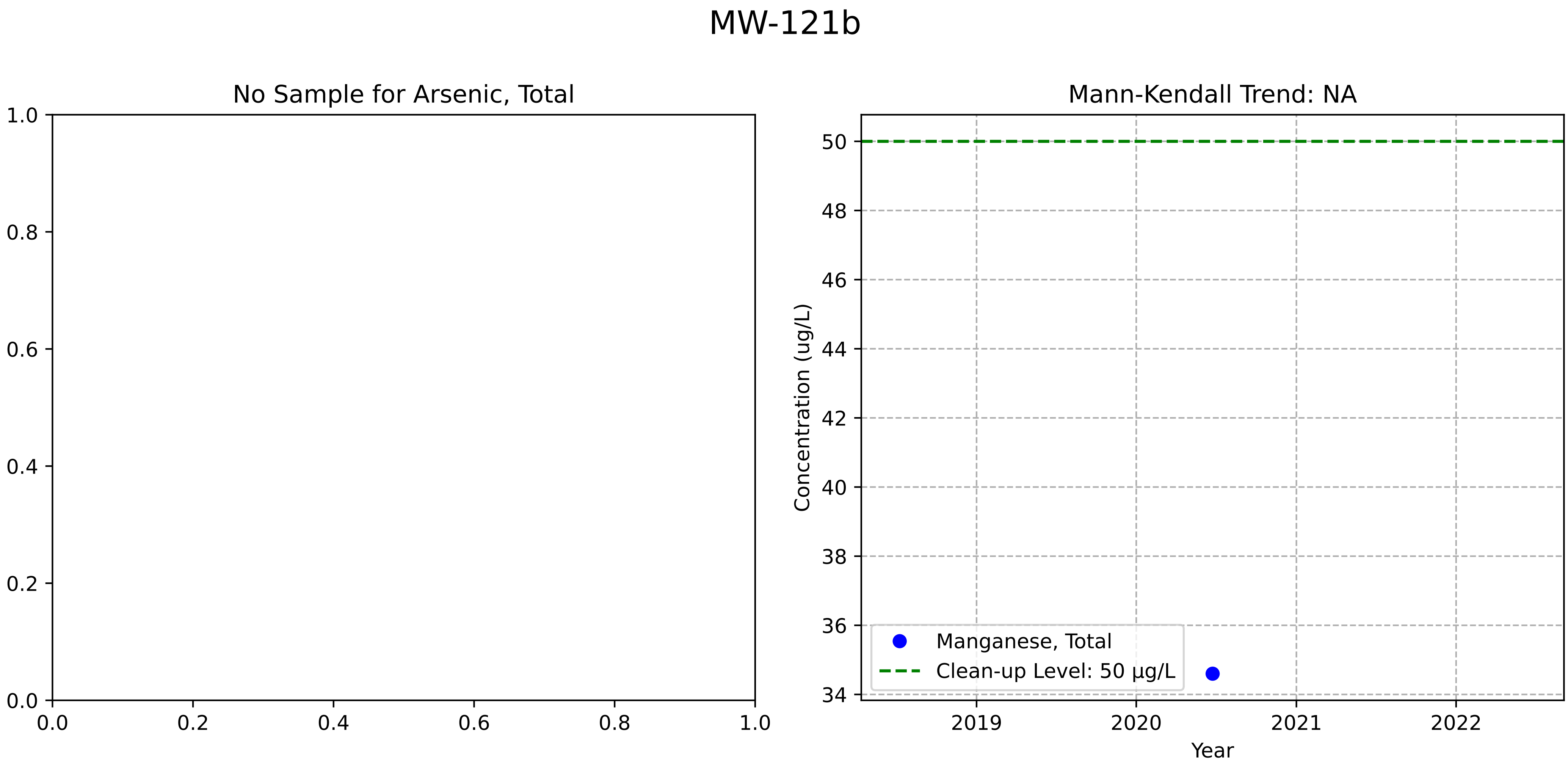


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
300
250
200
150
100
50
2019
2020
2021
2022
Year

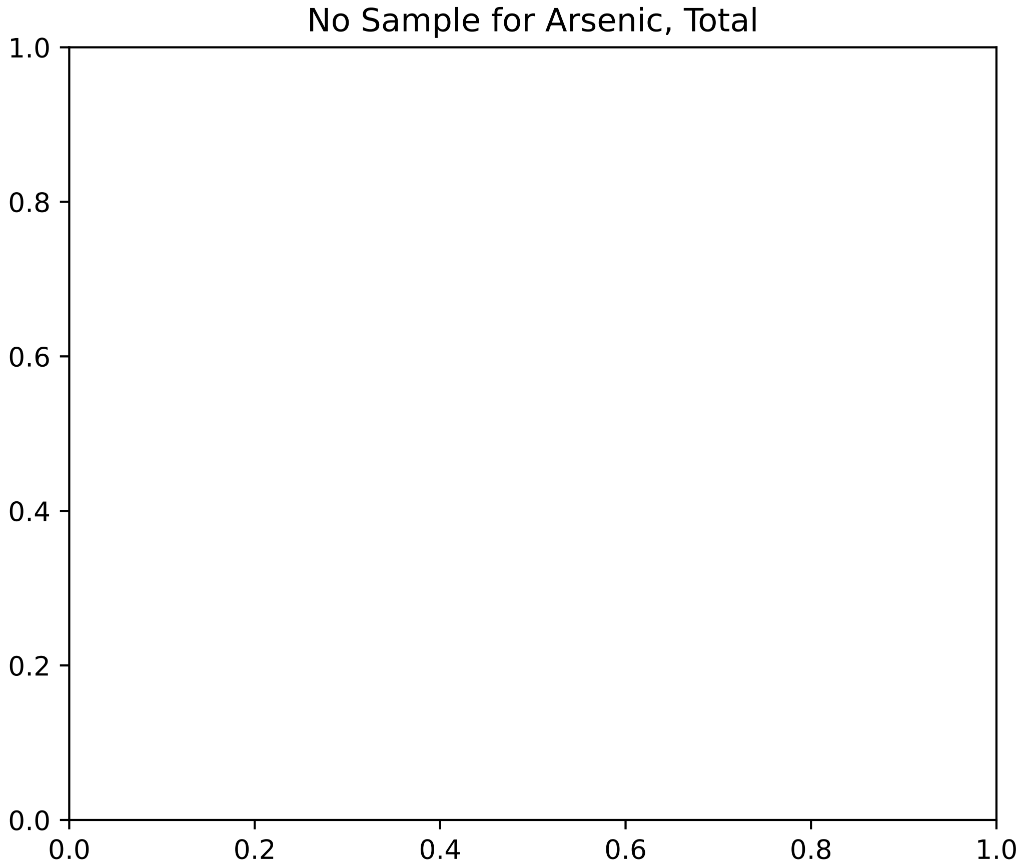
MW-119b

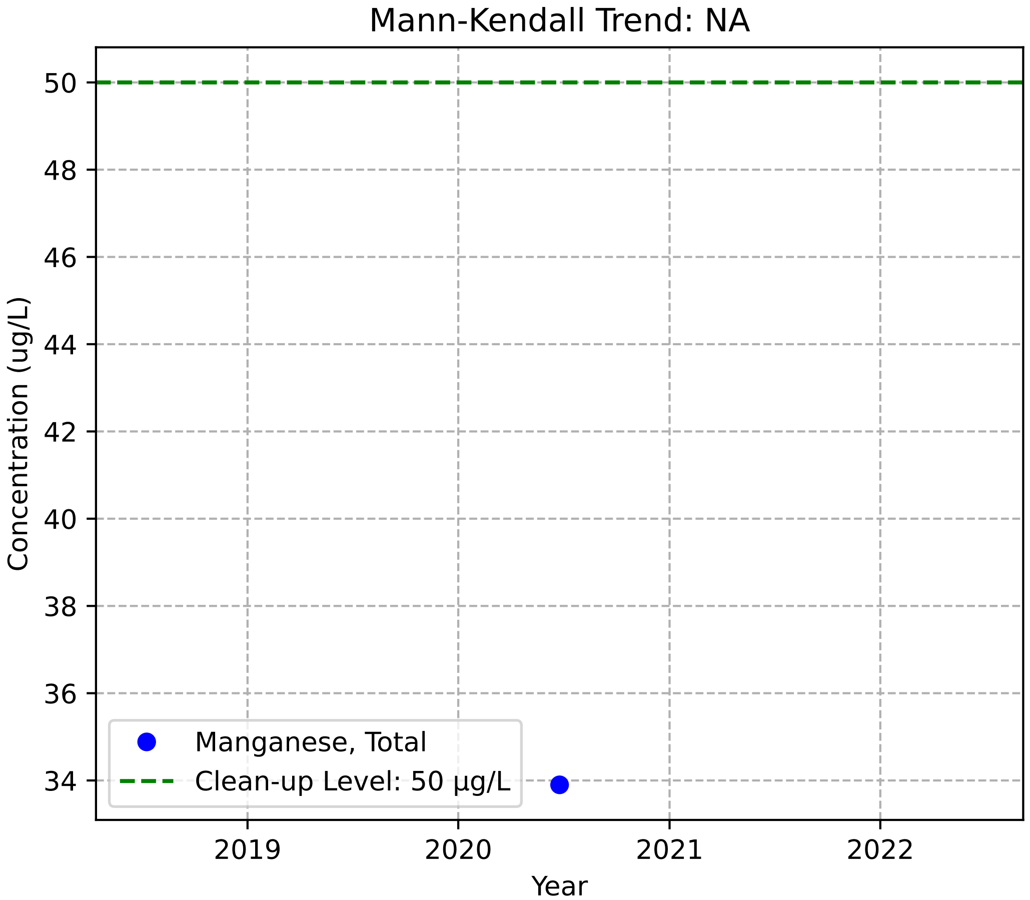


No Sample for Arsenic, Total
No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0

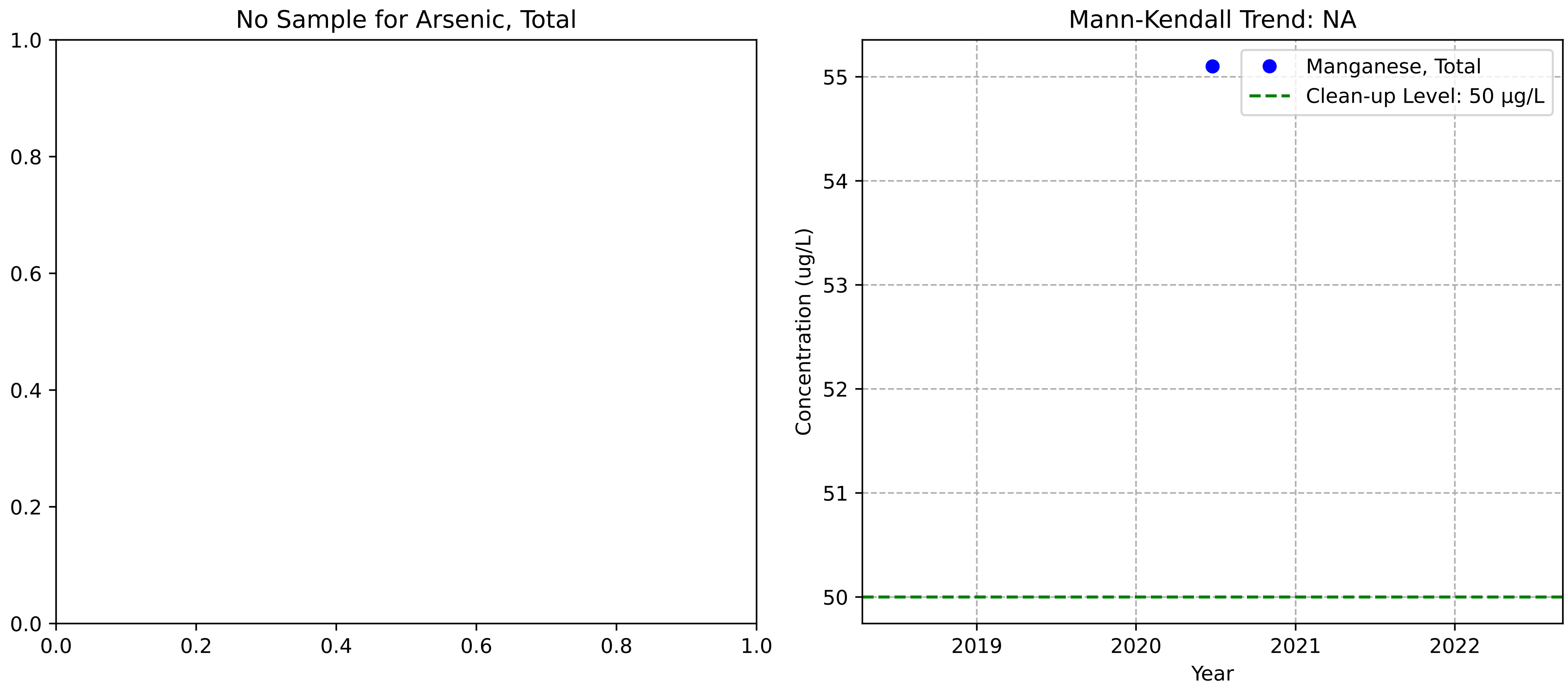

MW-121b
No Sample for Arsenic, Total
Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-128b

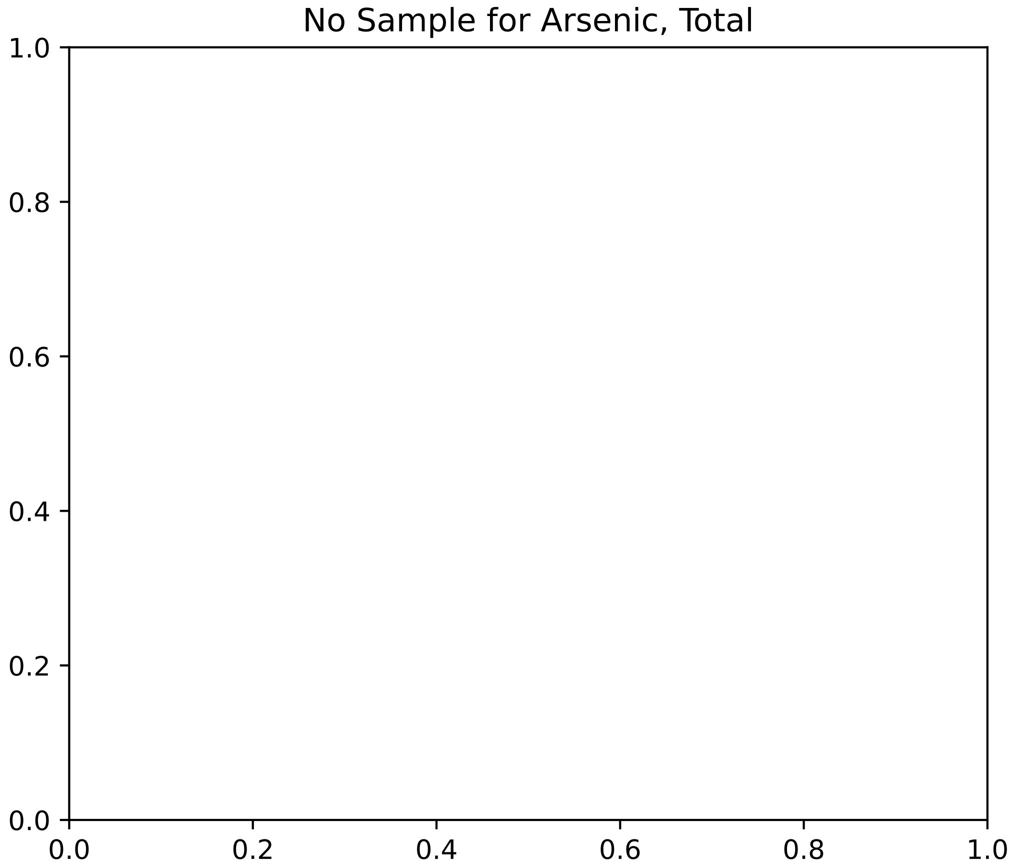

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

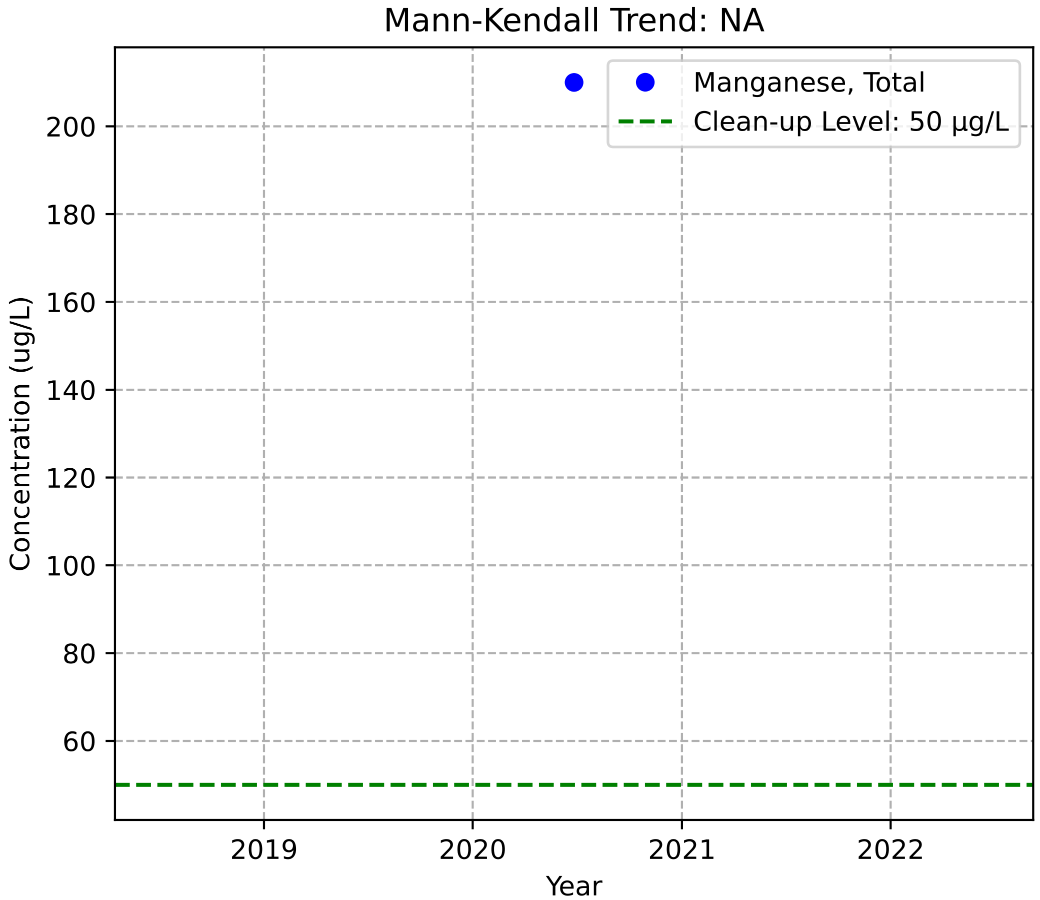

Mann-Kendall Trend: NA
Concentration (ug/L)
50
48
46
44
42
40
38
36
34
2019
2020
2021
2022
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-130b

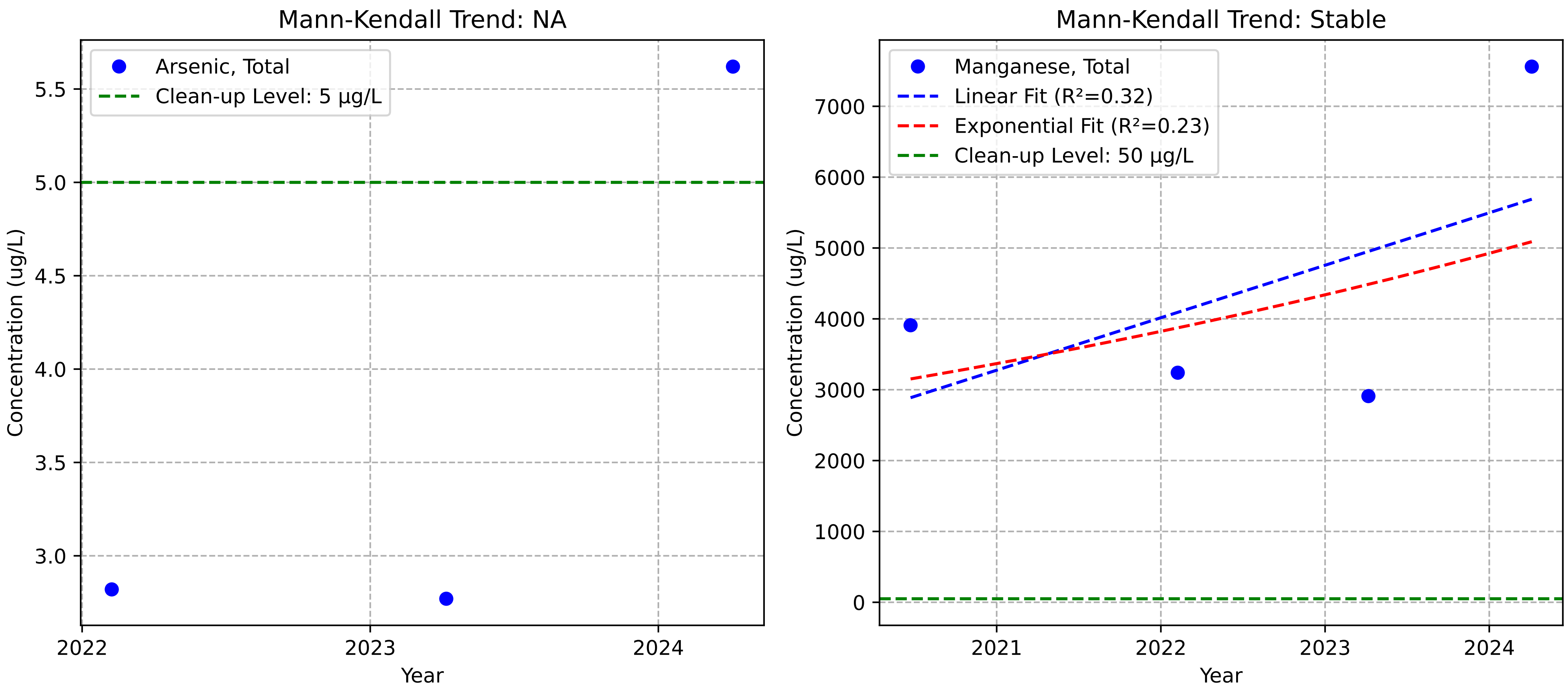

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
55
54
53
52
51
50
2019
2020
2021
2022
Year

MW-132b


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

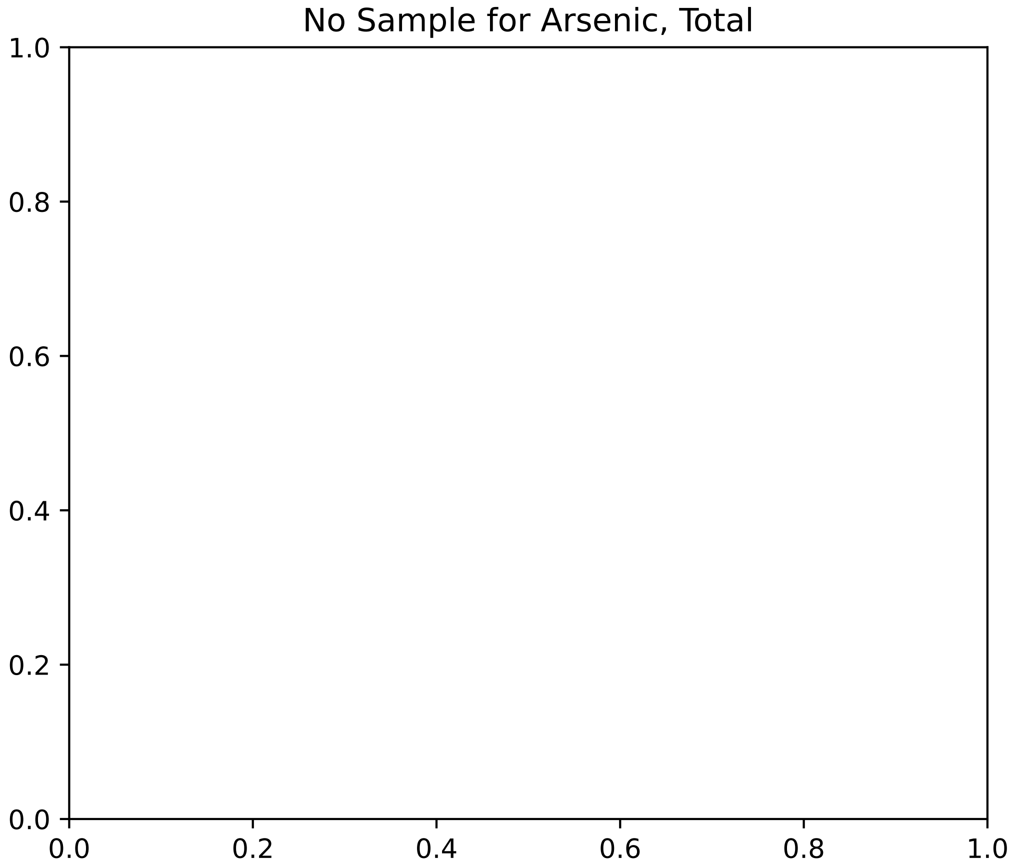

Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
200
180
160
140
120
100
80
60
2019
2020
2021
2022
Year

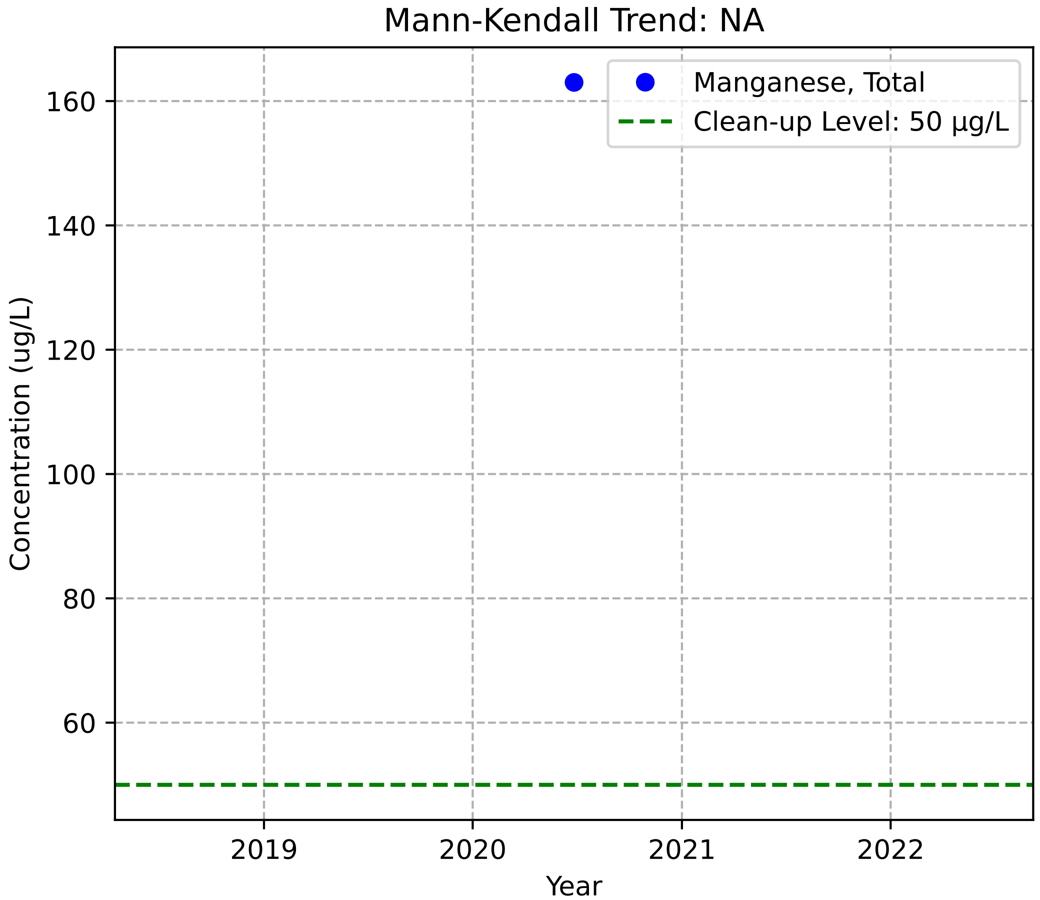
MW-133b



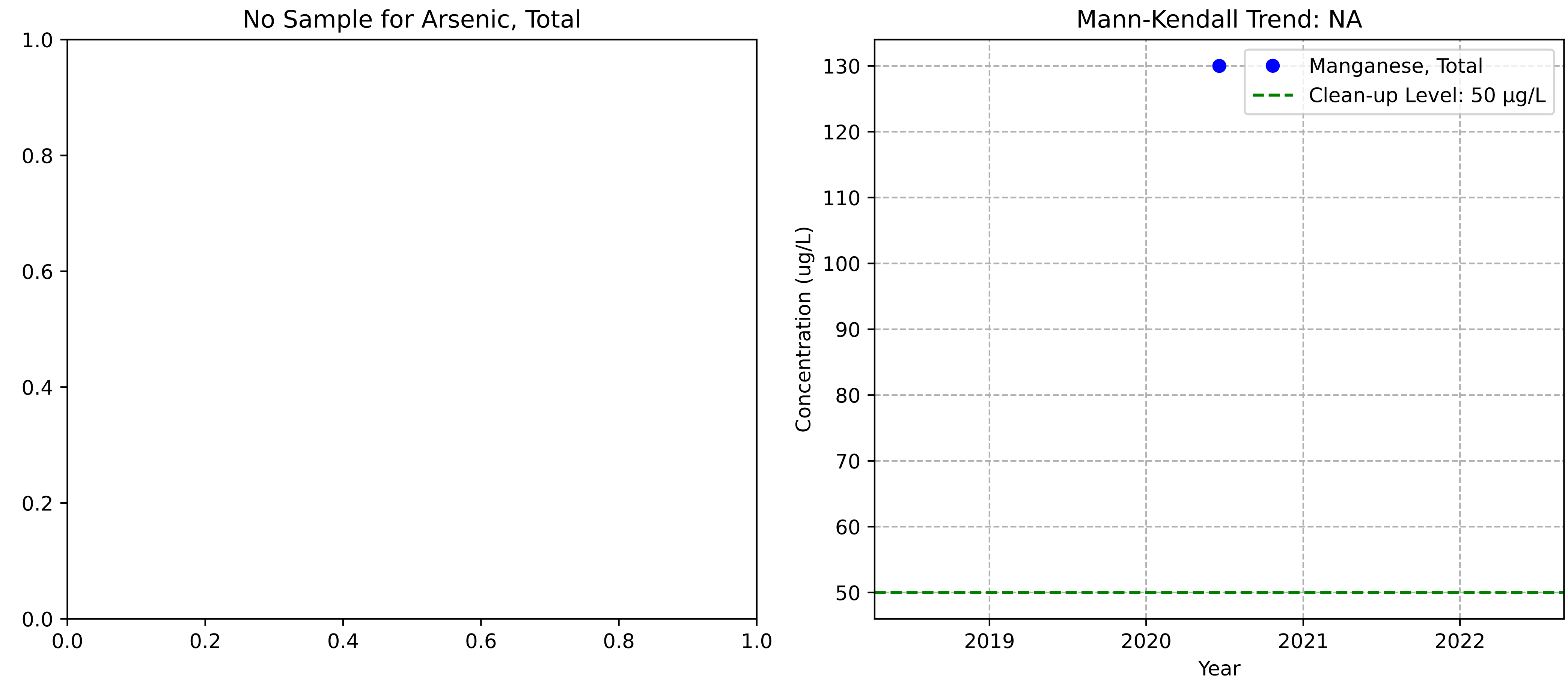
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
5.5
5.0
4.5
4.0
3.5
3.0
2022
2023
2024
Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.32)
Exponential Fit (R²=0.23)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
7000
6000
5000
4000
3000
2000
1000
0
2021
2022
2023
2024

MW-135b

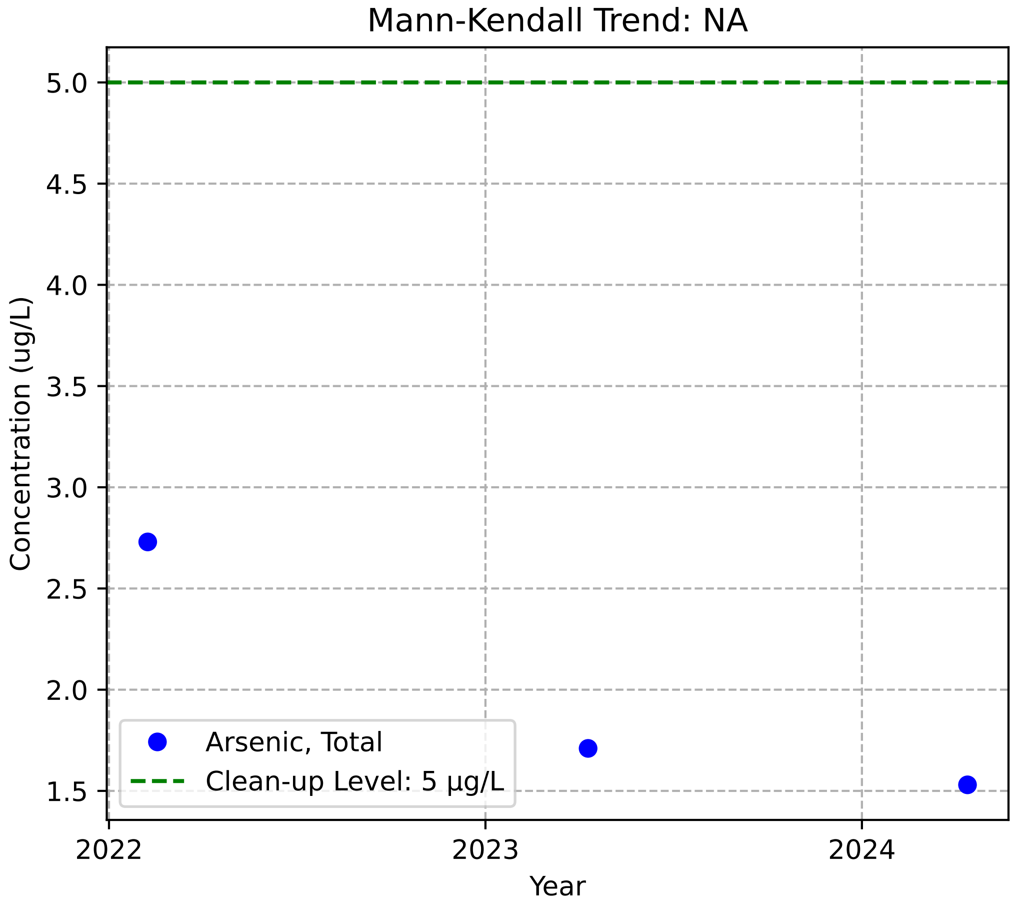

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
160
140
120
100
80
60
2019
2020
2021
2022
Year

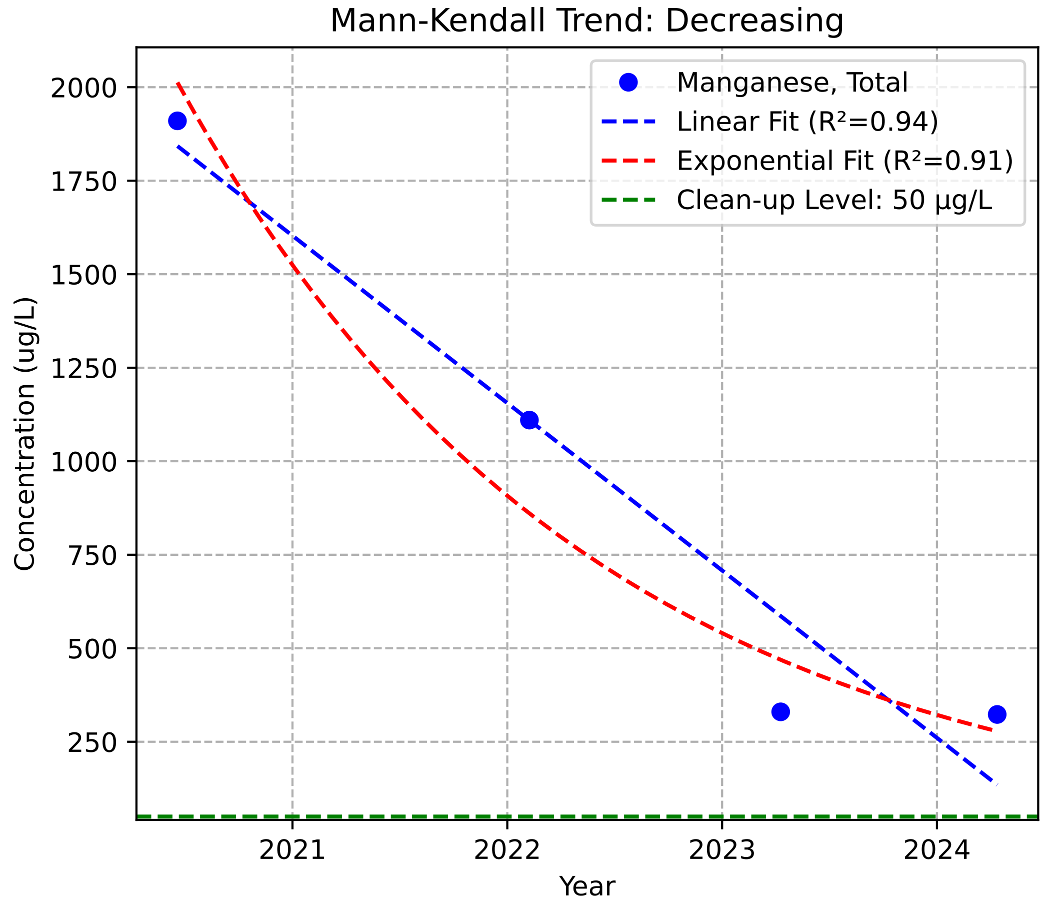
MW-139b


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
130
120
110
100
90
80
70
60
50
2019
2020
2021
2022
Year

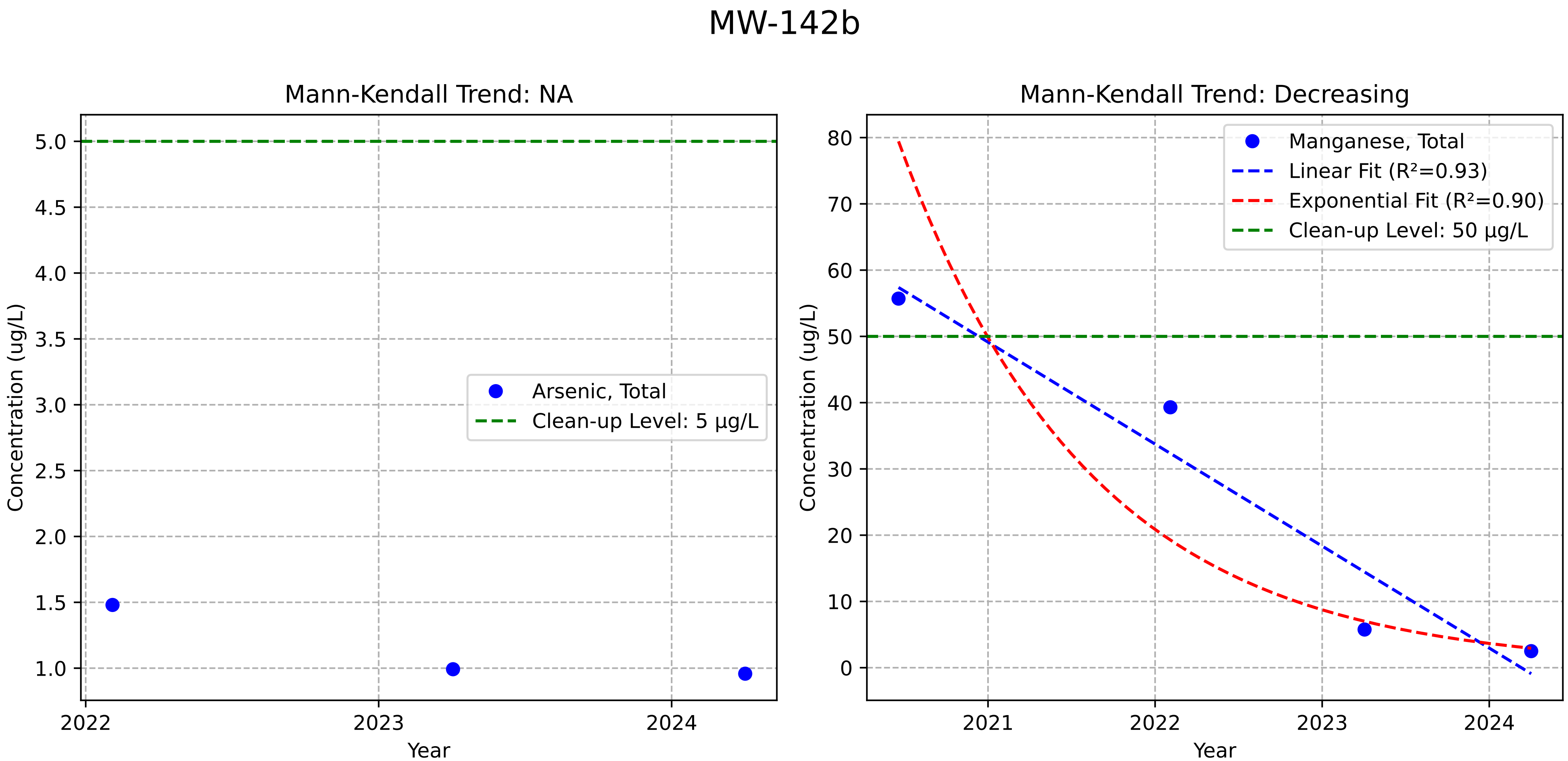
MW-140b

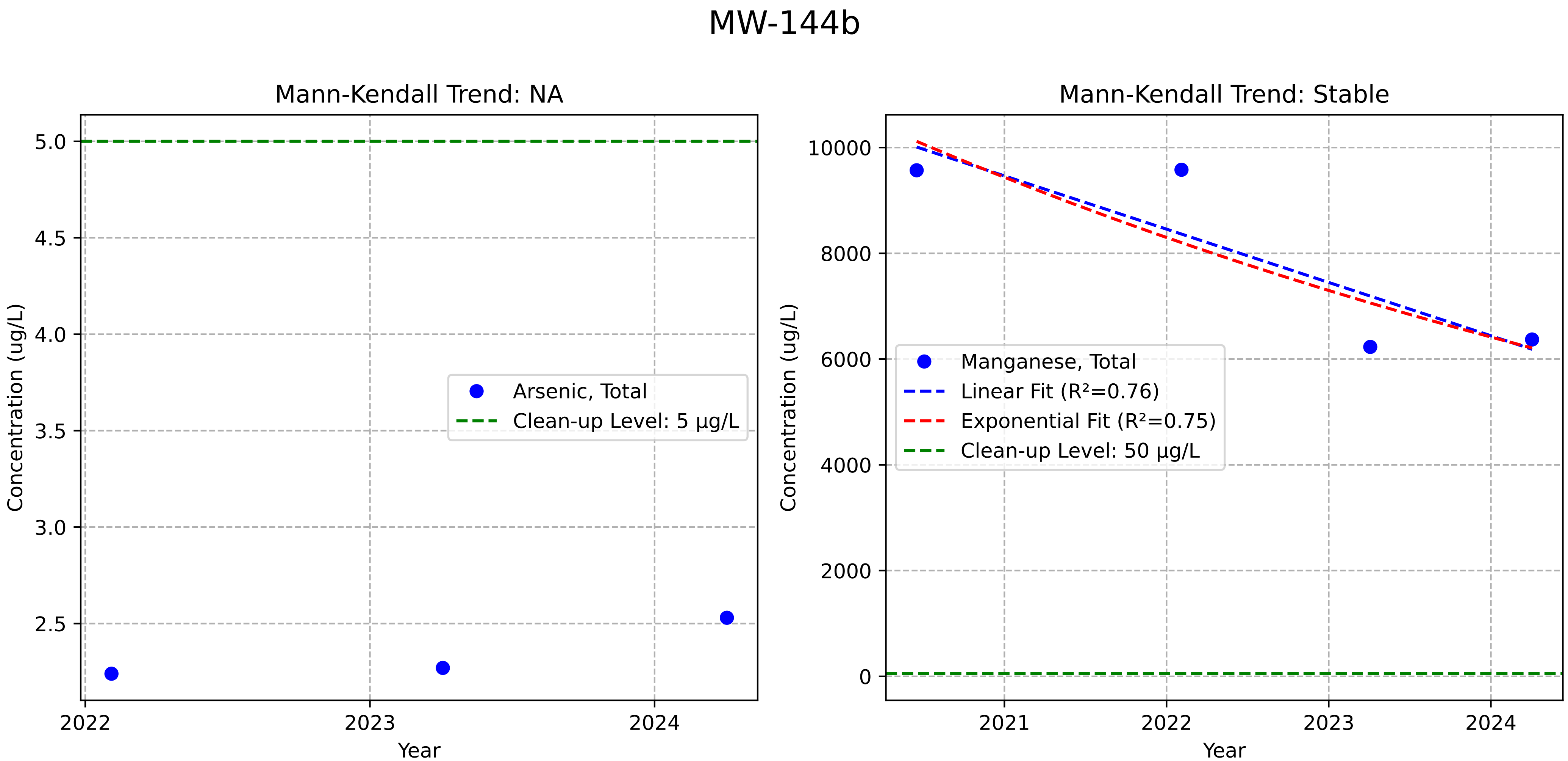


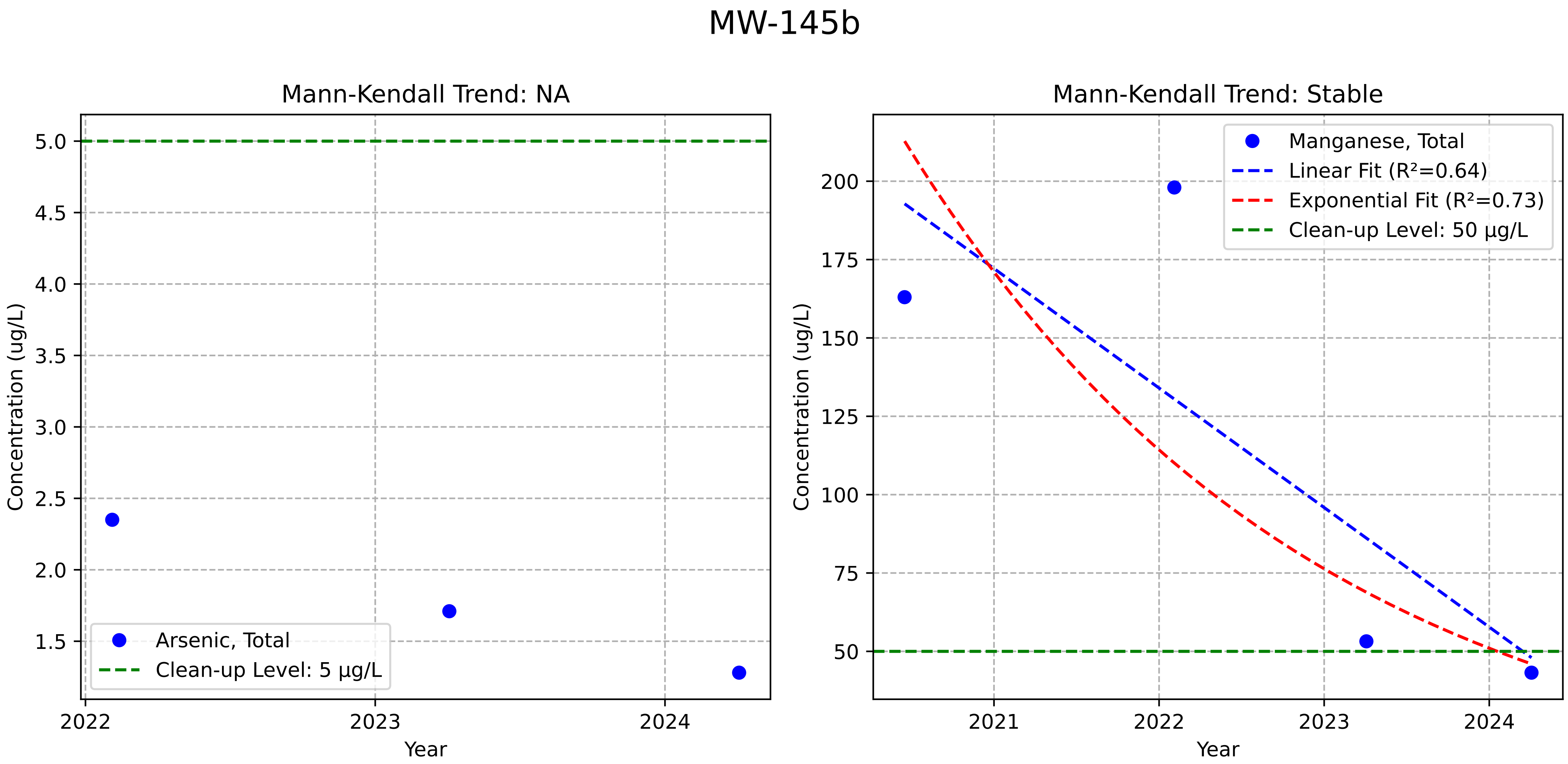
Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 μg/L
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
2022
2023
2024



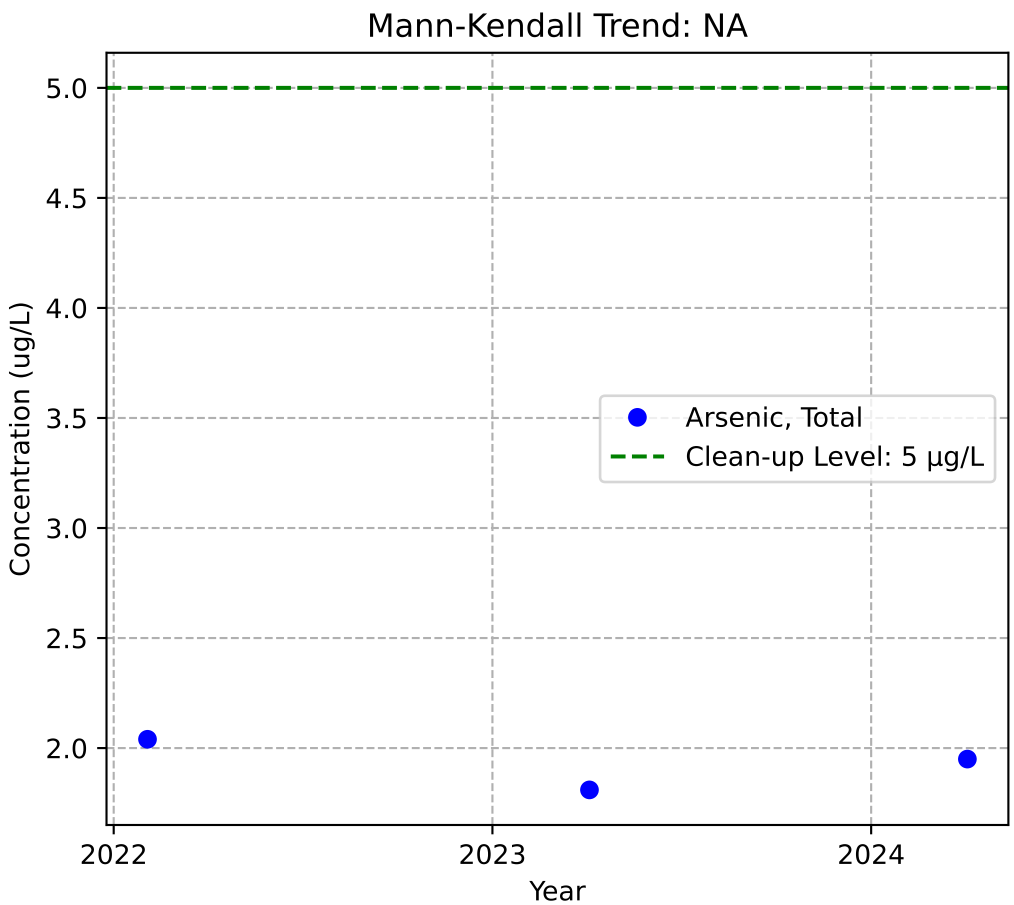
Mann-Kendall Trend: Decreasing
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.94)
Exponential Fit (R²=0.91)
Clean-up Level: 50 μg/L
2000
1750
1500
1250
1000
750
500
250
2021
2022
2023
2024


MW-142b
Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.93)
Exponential Fit (R²=0.90)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

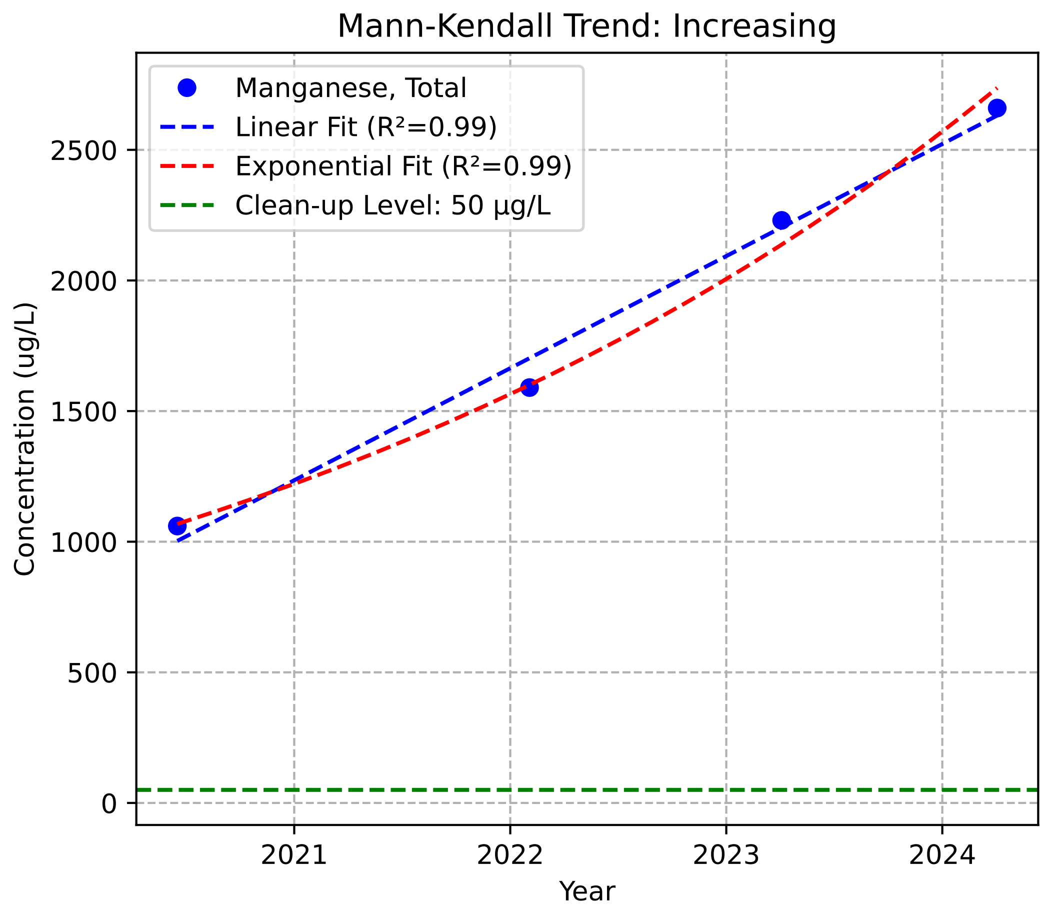

MW-144b
Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2022
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 μg/L
Mann-Kendall Trend: Stable
Concentration (ug/L)
10000
8000
6000
4000
2000
0
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.76)
Exponential Fit (R²=0.75)
Clean-up Level: 50 μg/L


MW-145b
Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.64)
Exponential Fit (R²=0.73)
Clean-up Level: 50 µg/L

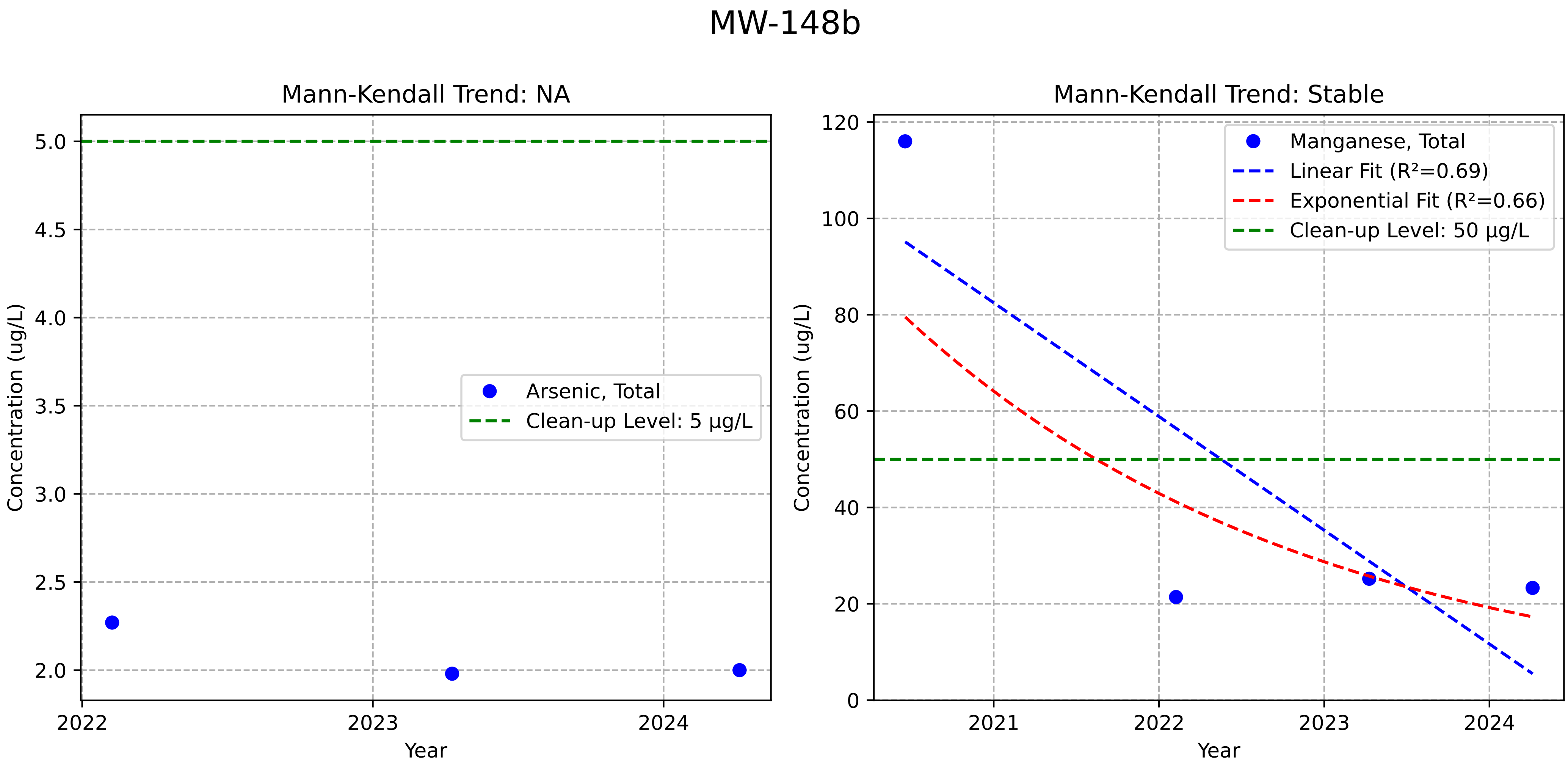
MW-146b



Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
2022
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L

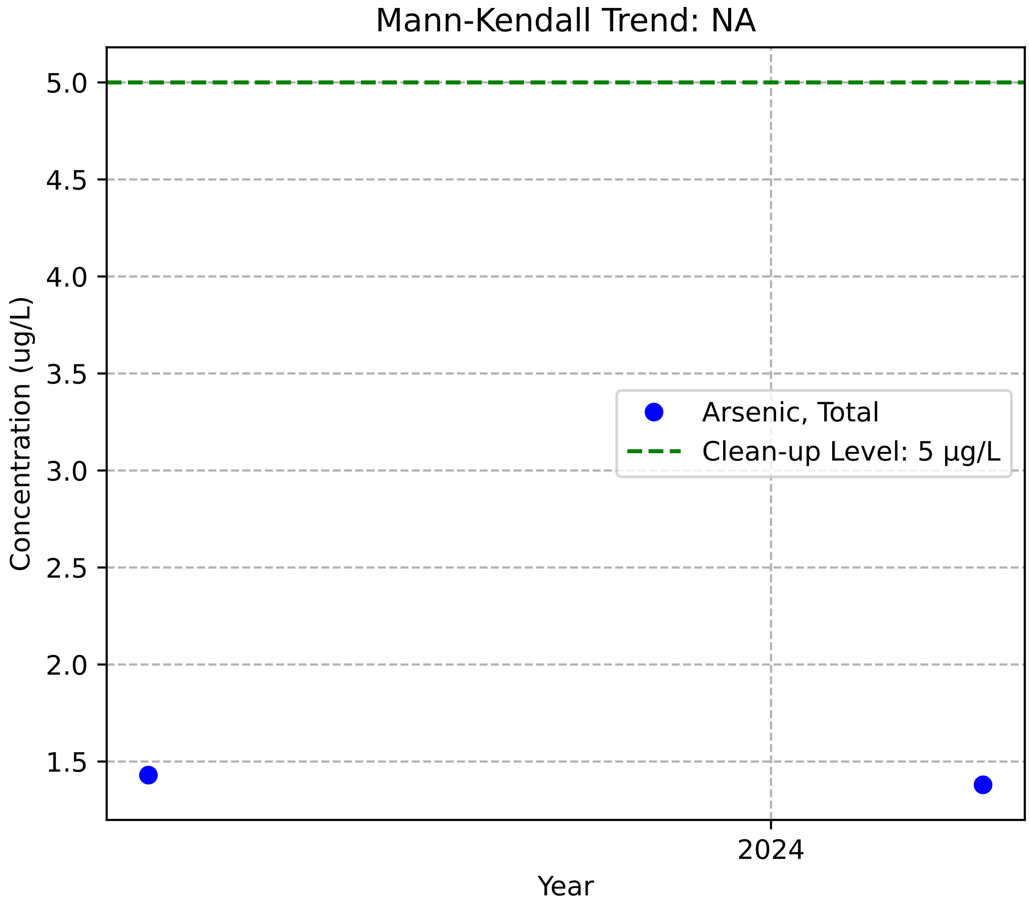


Mann-Kendall Trend: Increasing
Concentration (ug/L)
2500
2000
1500
1000
500
0
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.99)
Exponential Fit (R²=0.99)
Clean-up Level: 50 µg/L

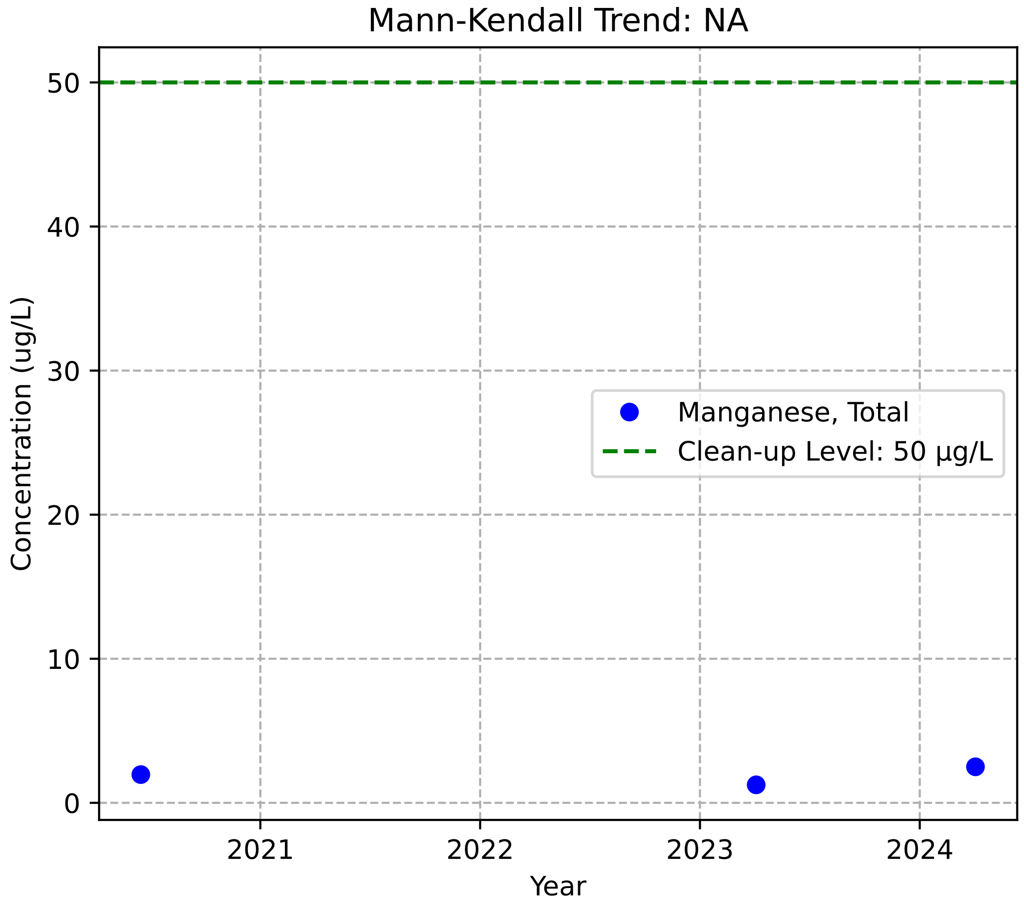


MW-148b
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
2022
2023
2024
Mann-Kendall Trend: Stable
Manganese, Total
Linear Fit (R²=0.69)
Exponential Fit (R²=0.66)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
2021
2022
2023
2024

MW-149b

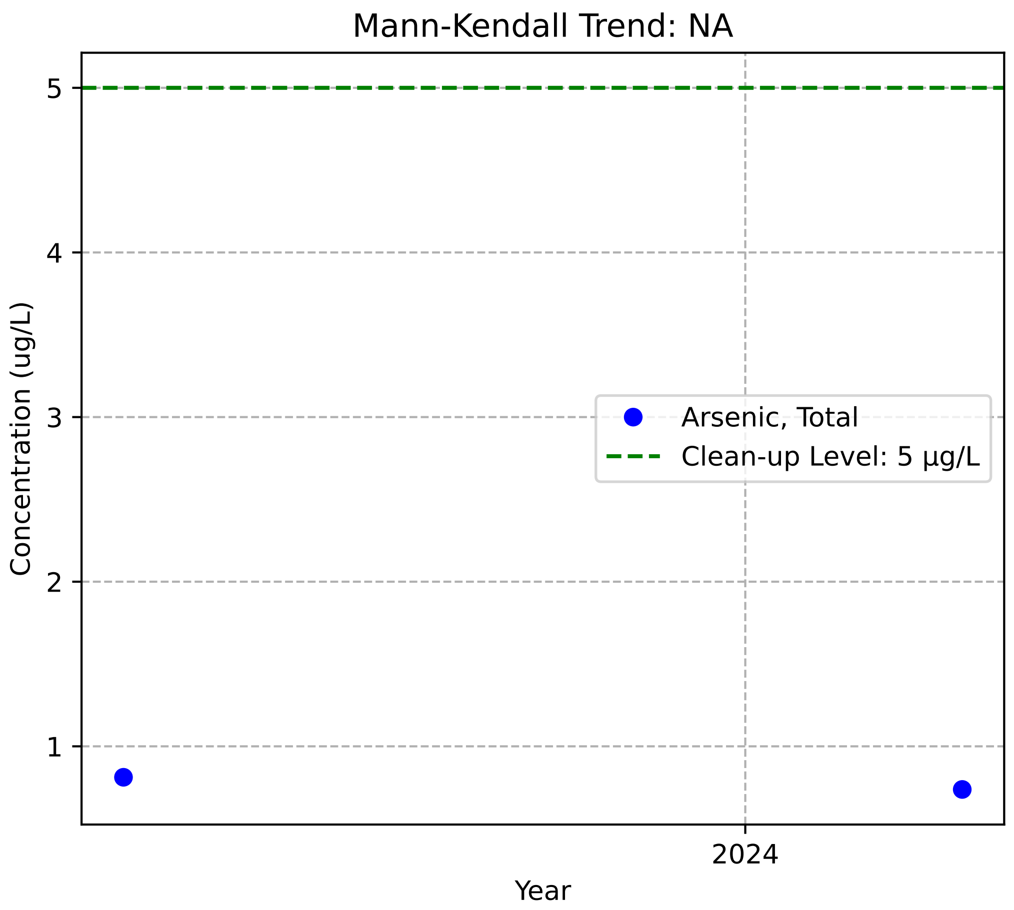


Mann-Kendall Trend: NA
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
Concentration (ug/L)
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L

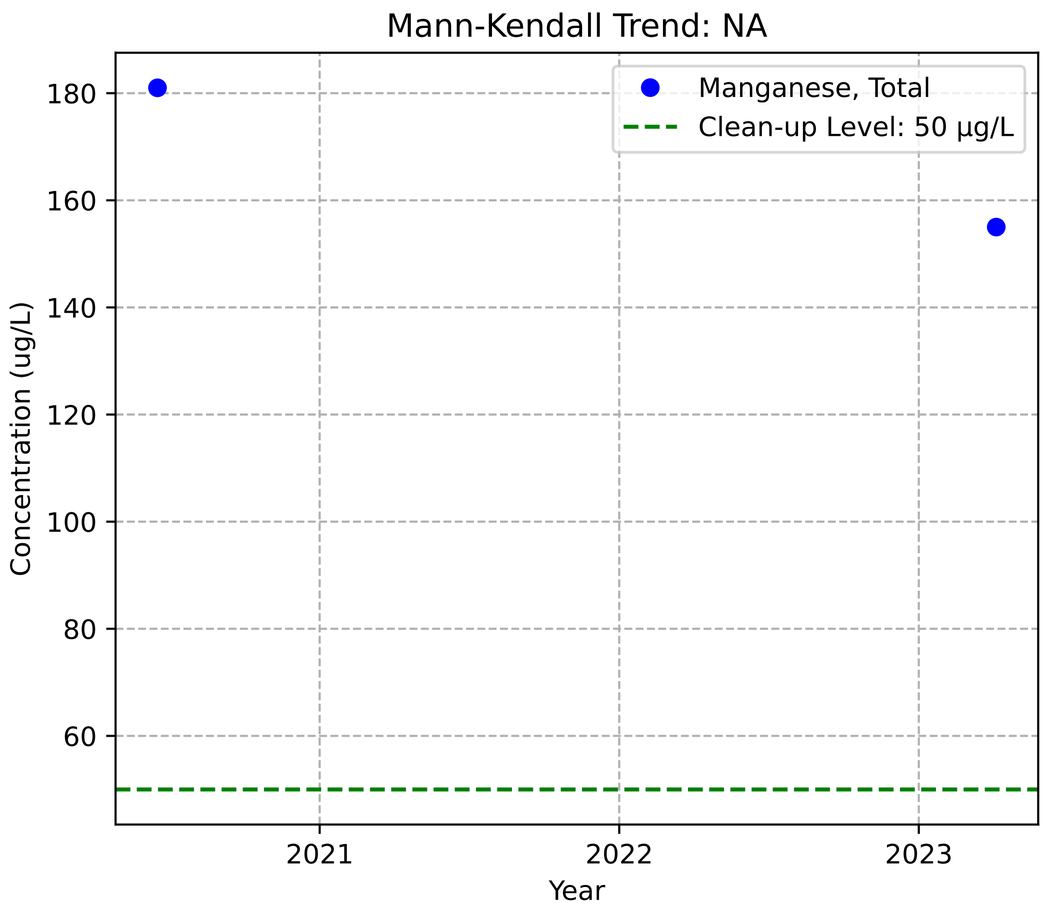


Mann-Kendall Trend: NA
50
40
30
20
10
0
Concentration (ug/L)
2021
2022
2023
2024
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-150b

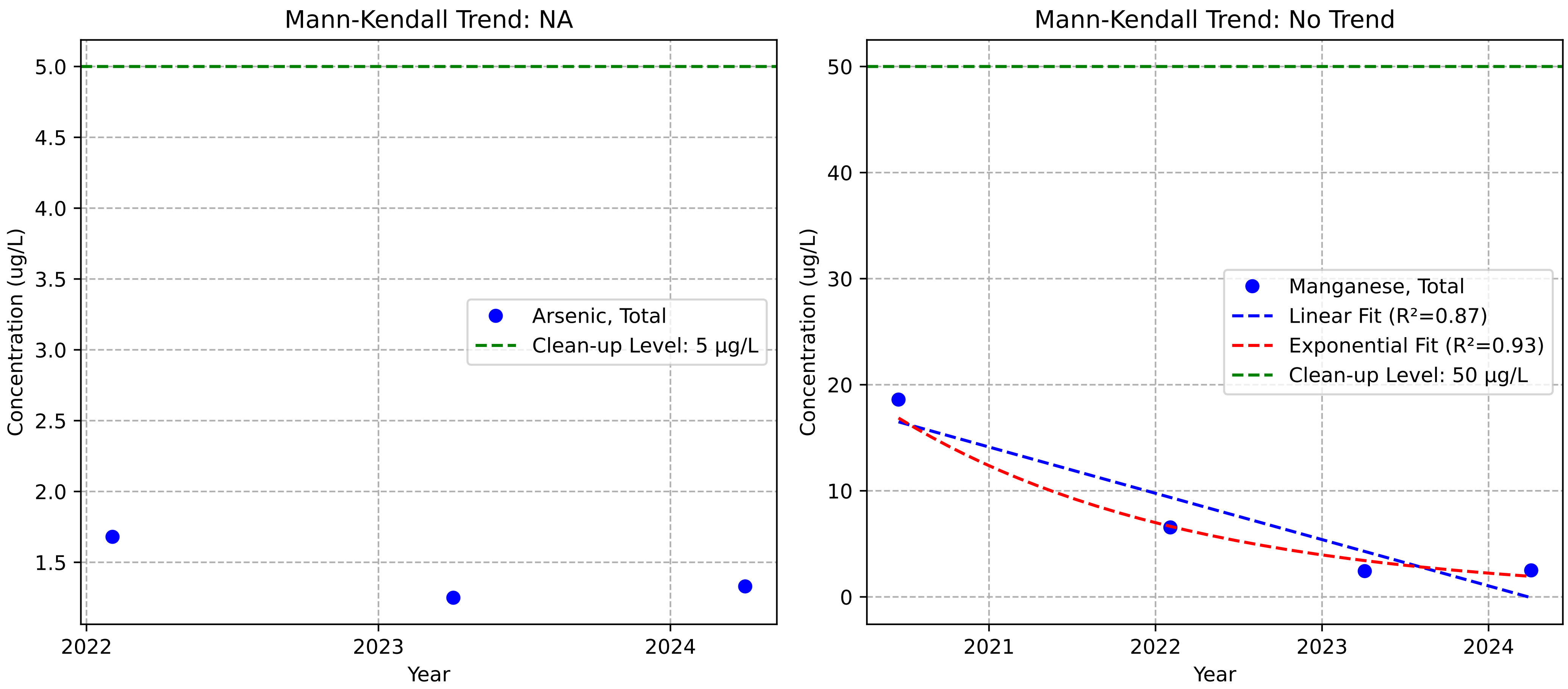


Mann-Kendall Trend: NA
5
4
3
2
1
Concentration (ug/L)
Arsenic, Total
Clean-up Level: 5 µg/L
2024
Year



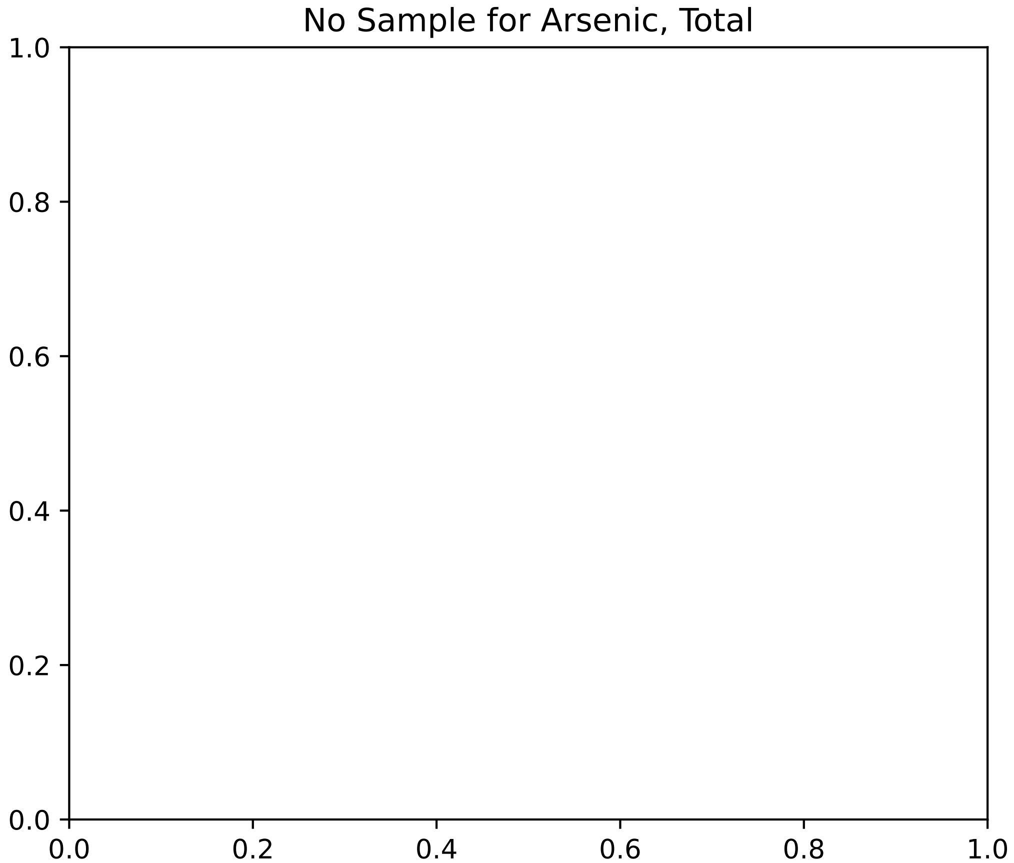
Mann-Kendall Trend: NA
180
160
140
120
100
80
60
Concentration (ug/L)
Manganese, Total
Clean-up Level: 50 µg/L
2021
2022
2023
Year

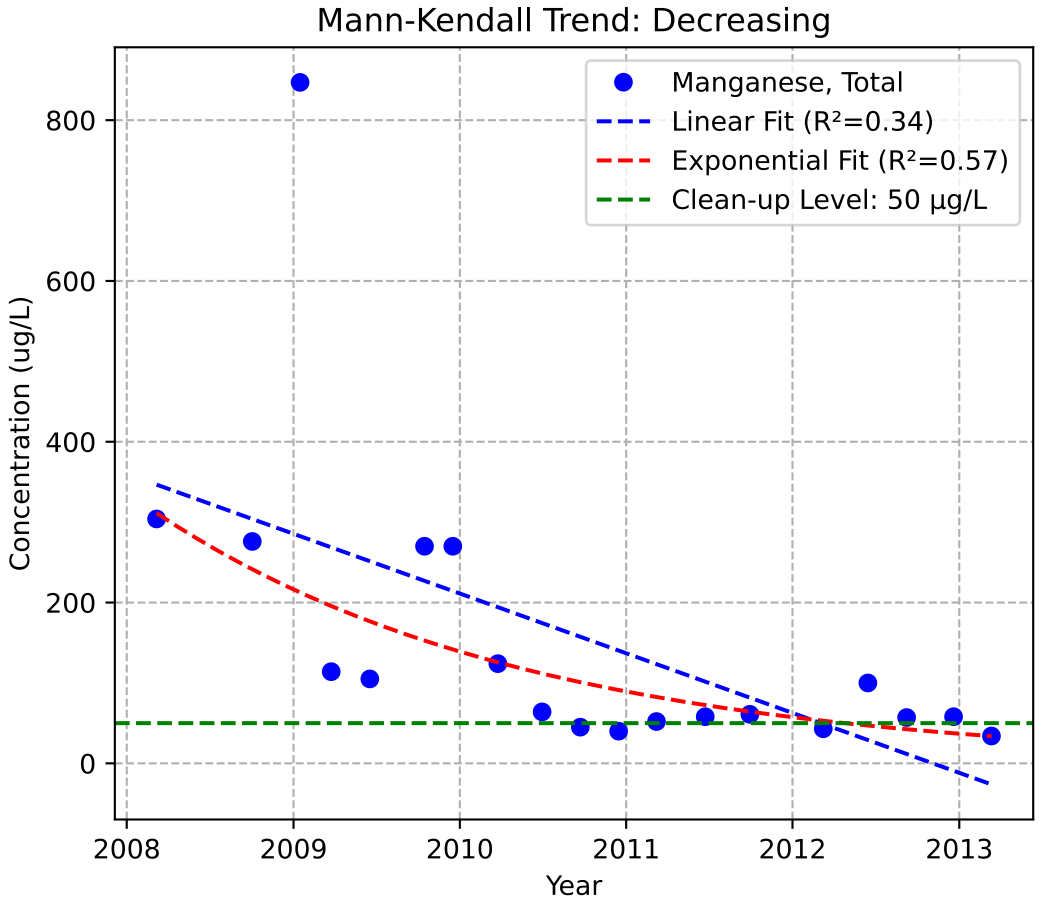
MW-151b



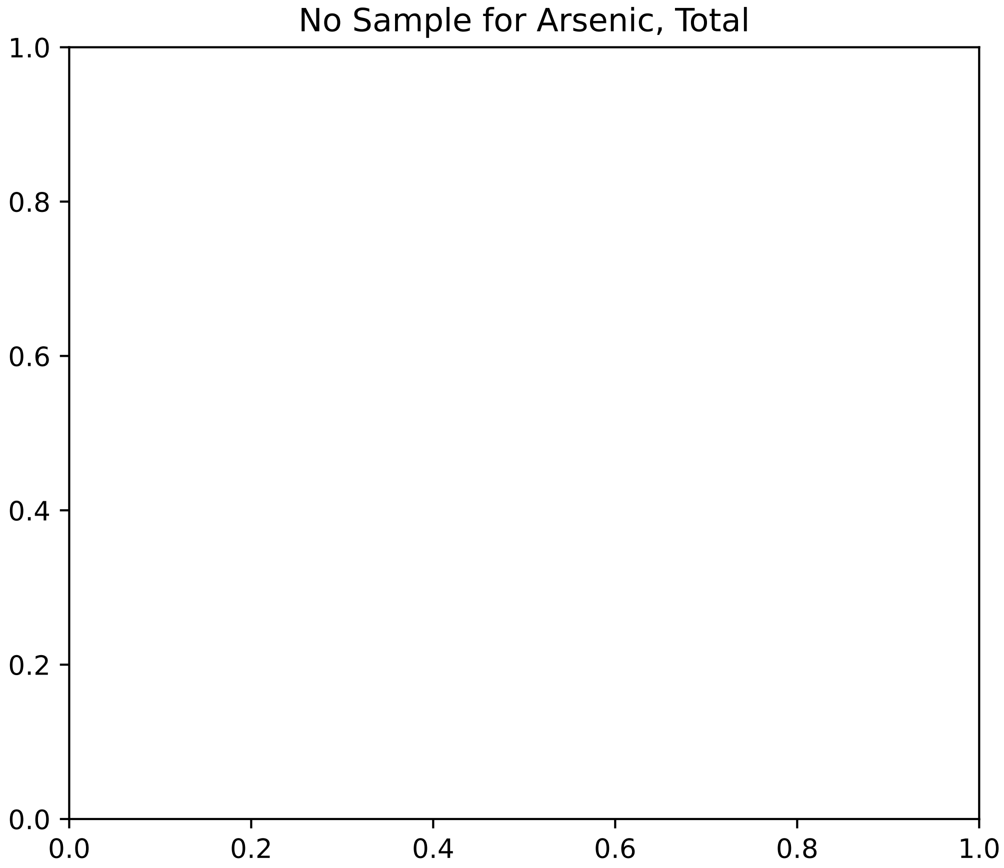
Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.87)
Exponential Fit (R²=0.93)
Clean-up Level: 50 µg/L

MW-19b

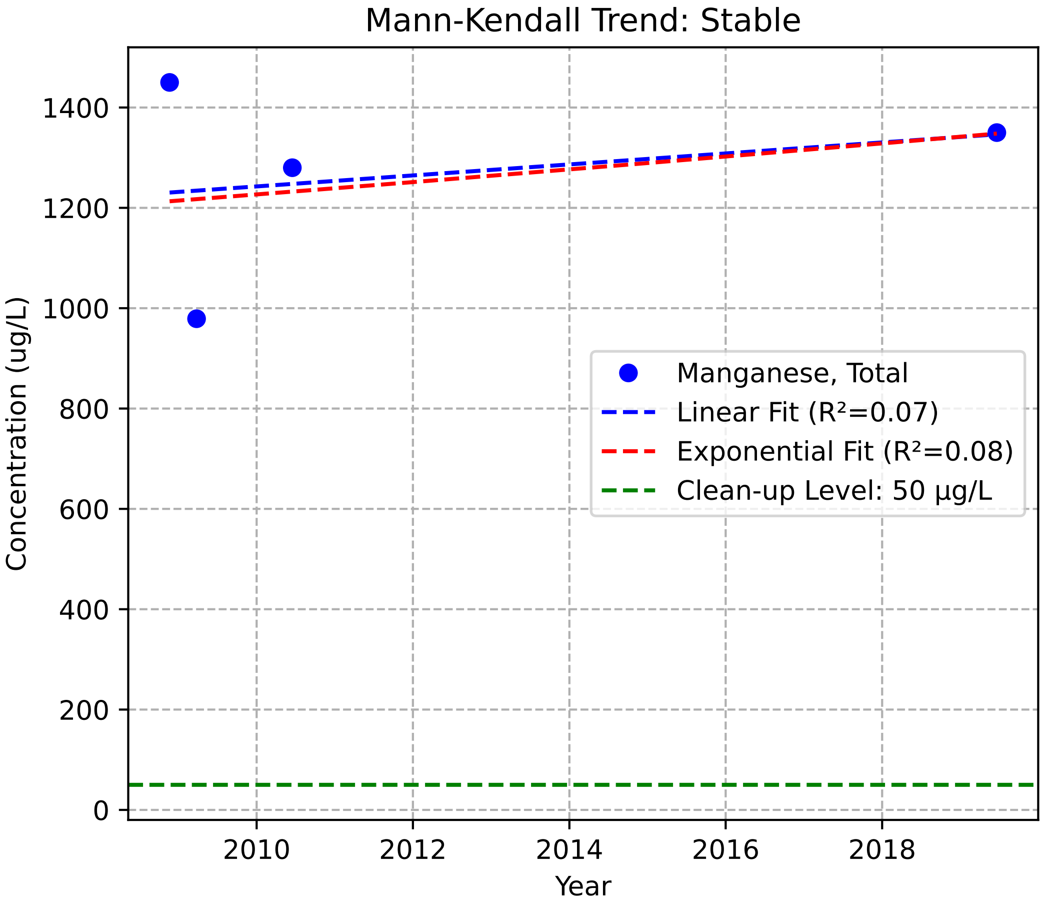

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.34)
Exponential Fit (R²=0.57)
Clean-up Level: 50 µg/L
Concentration (ug/L)
800
600
400
200
0
2008
2009
2010
2011
2012
2013
Year

MW-29b

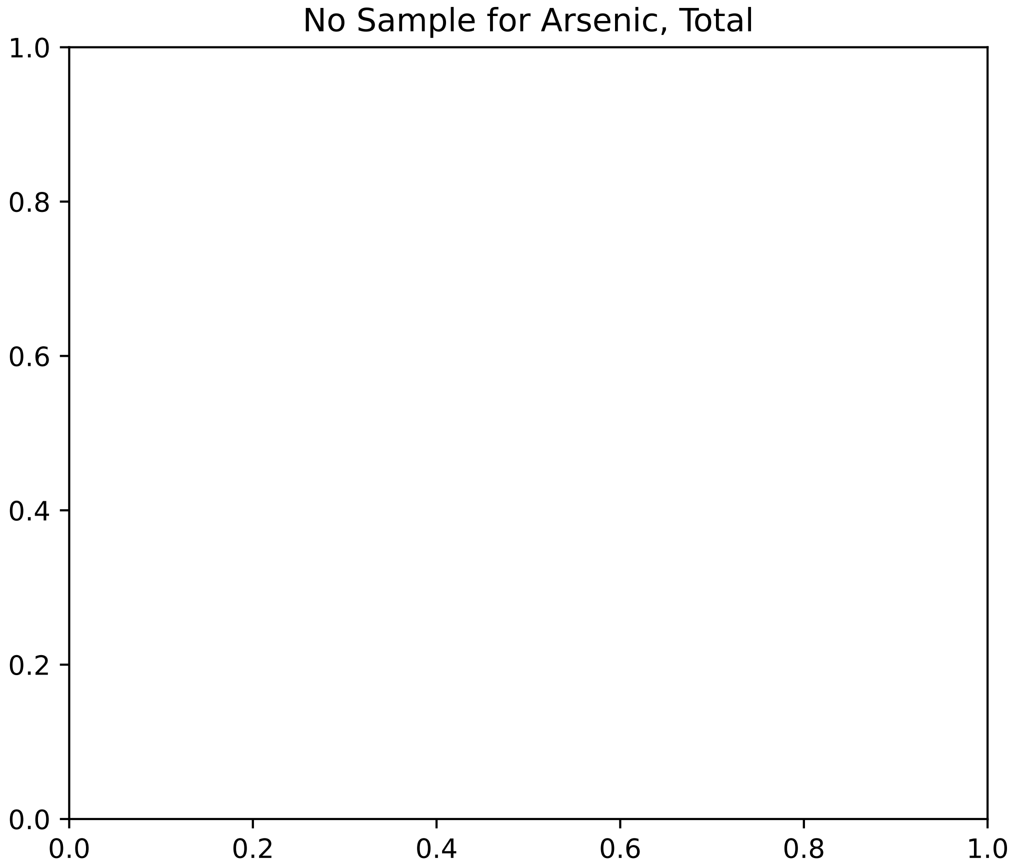


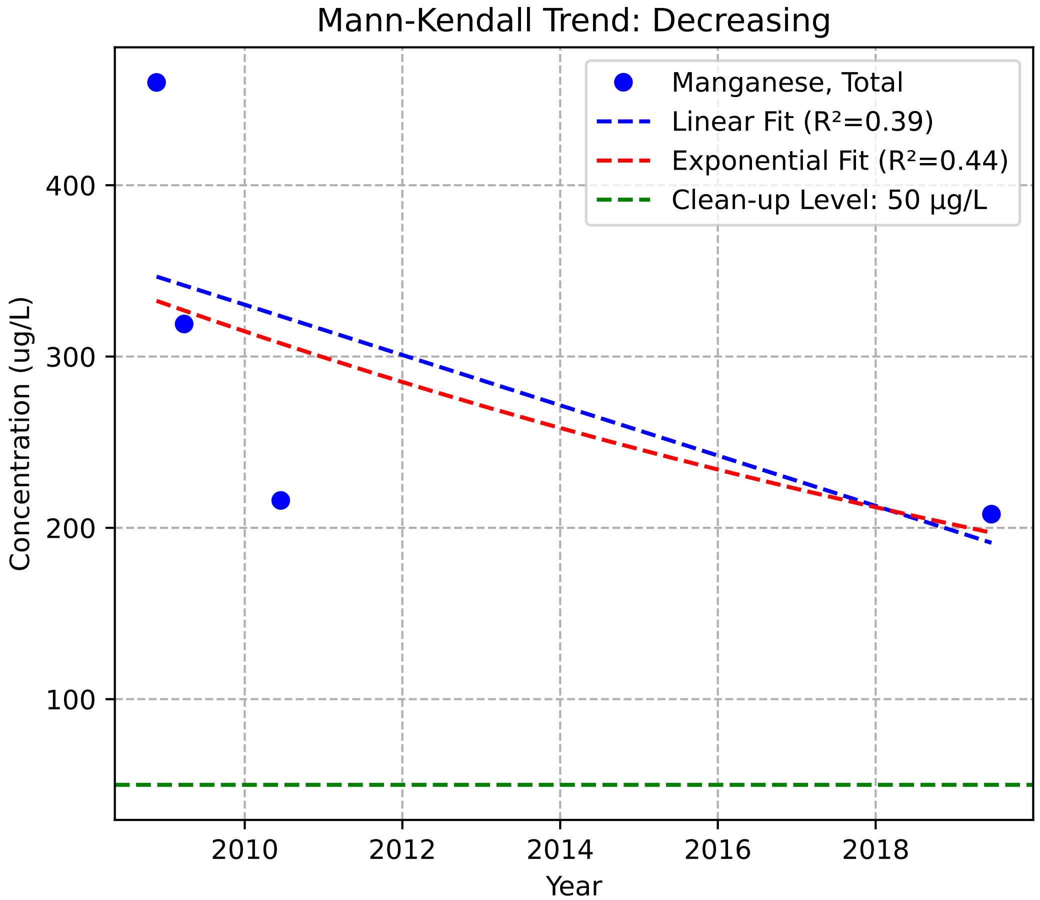
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



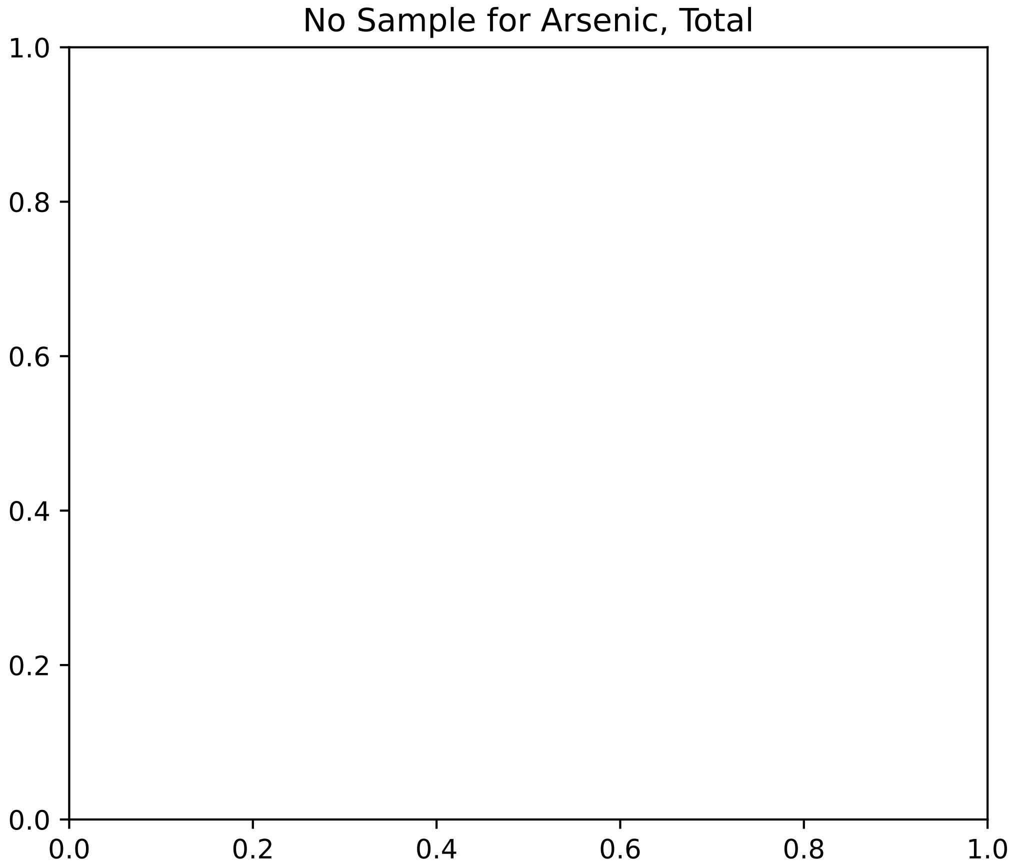
Mann-Kendall Trend: Stable
Concentration (ug/L)
1400
1200
1000
800
600
400
200
0
2010
2012
2014
2016
2018
Year
Manganese, Total
Linear Fit (R²=0.07)
Exponential Fit (R²=0.08)
Clean-up Level: 50 µg/L

MW-30b

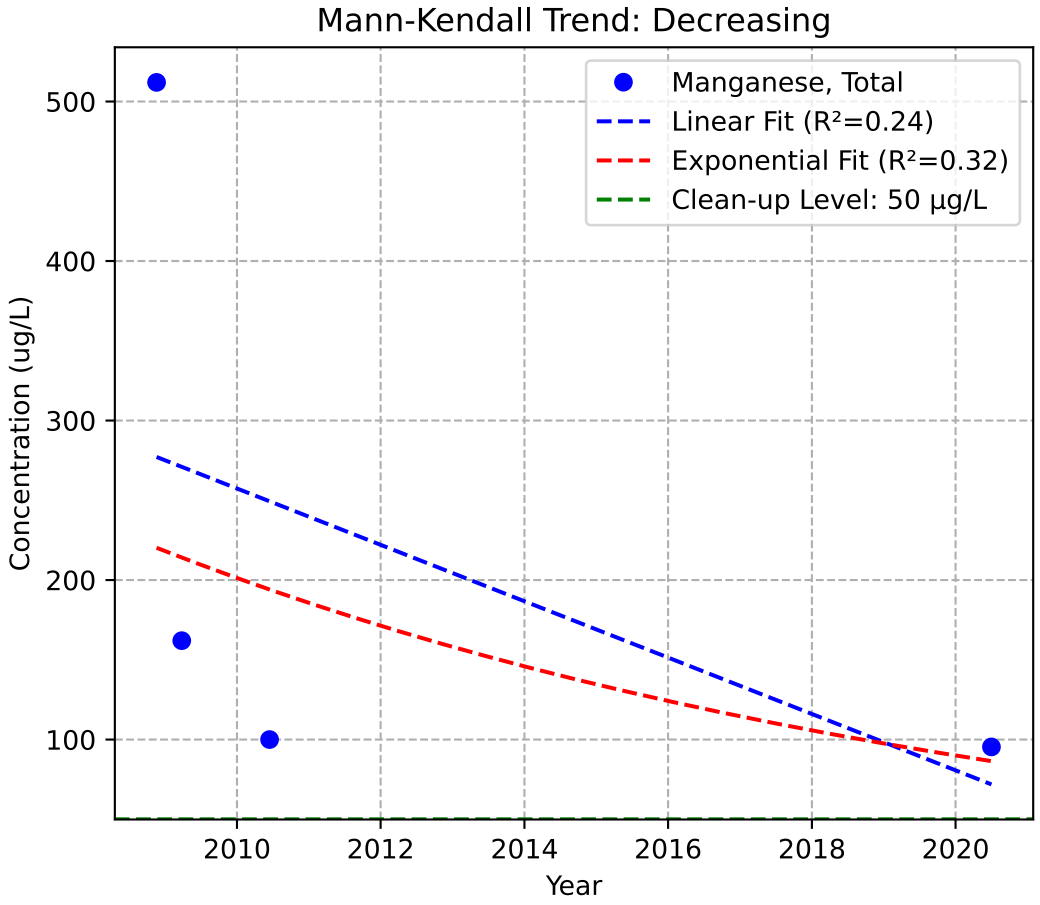

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.39)
Exponential Fit (R²=0.44)
Clean-up Level: 50 µg/L
Concentration (ug/L)
400
300
200
100
2010
2012
2014
2016
2018
Year

MW-31b

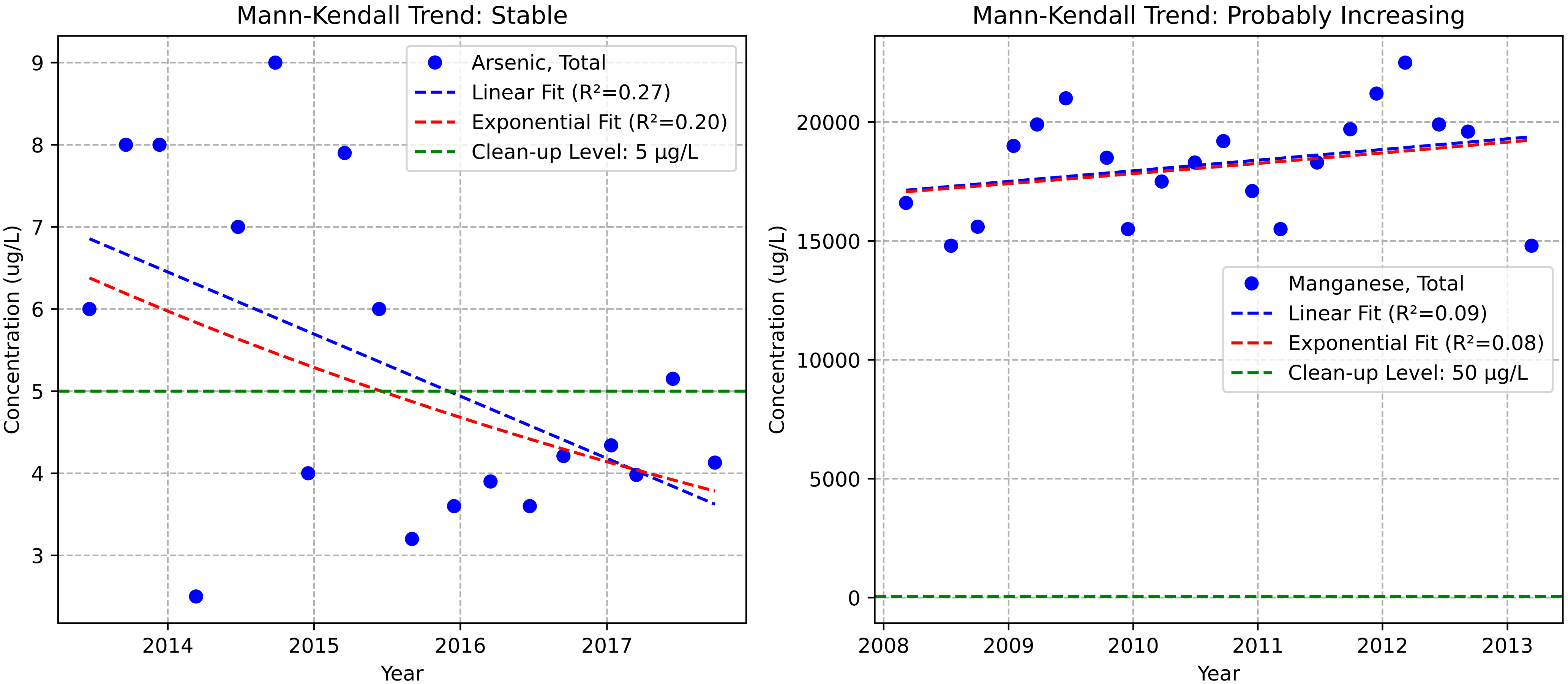


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

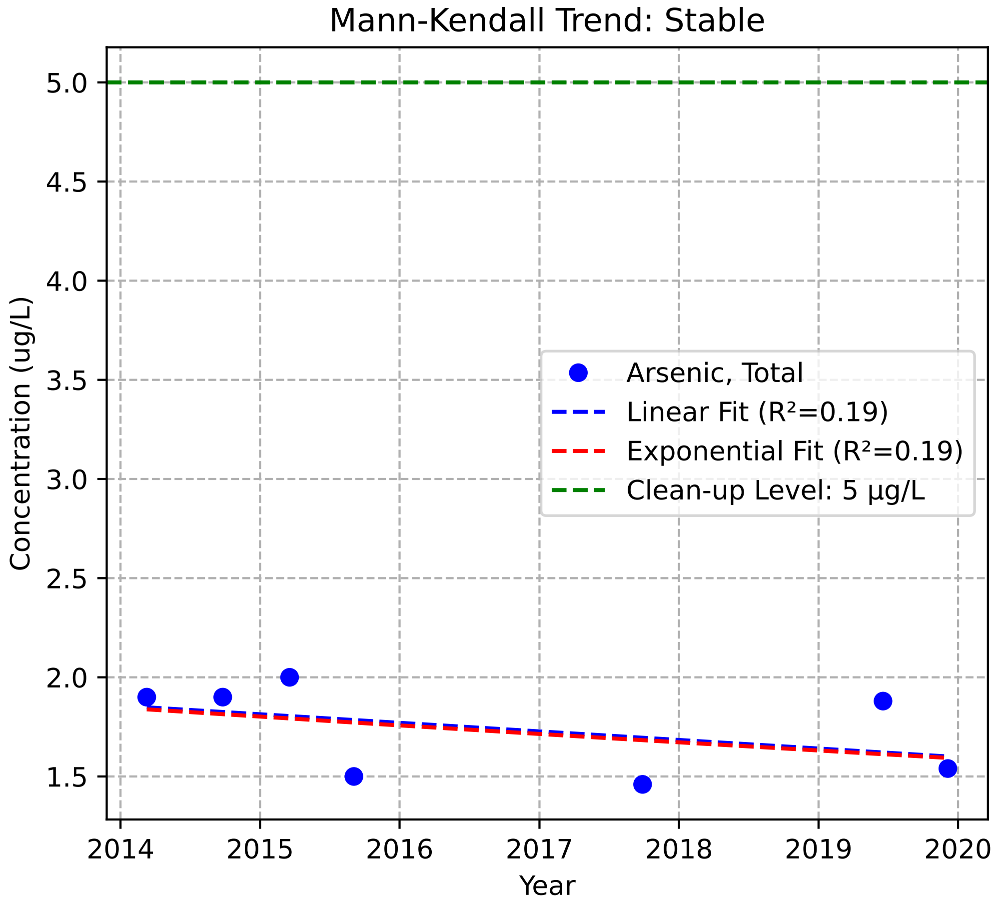


Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.24)
Exponential Fit (R²=0.32)
Clean-up Level: 50 µg/L
Concentration (ug/L)
500
400
300
200
100
2010
2012
2014
2016
2018
2020
Year

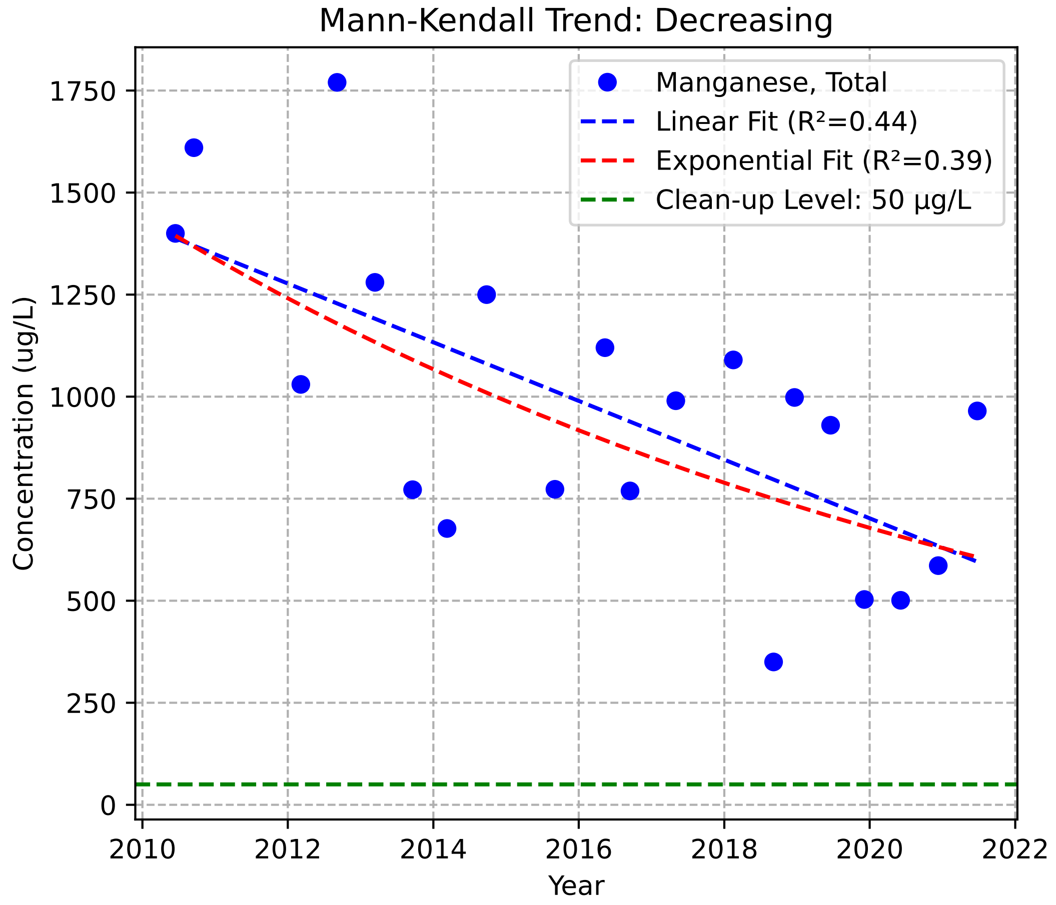
MW-3b


Mann-Kendall Trend: Stable
Arsenic, Total
Linear Fit (R²=0.27)
Exponential Fit (R²=0.20)
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
2014
2015
2016
2017
3
4
5
6
7
8
9
Mann-Kendall Trend: Probably Increasing
Manganese, Total
Linear Fit (R²=0.09)
Exponential Fit (R²=0.08)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year
2008
2009
2010
2011
2012
2013
0
5000
10000
15000
20000

MW-42b

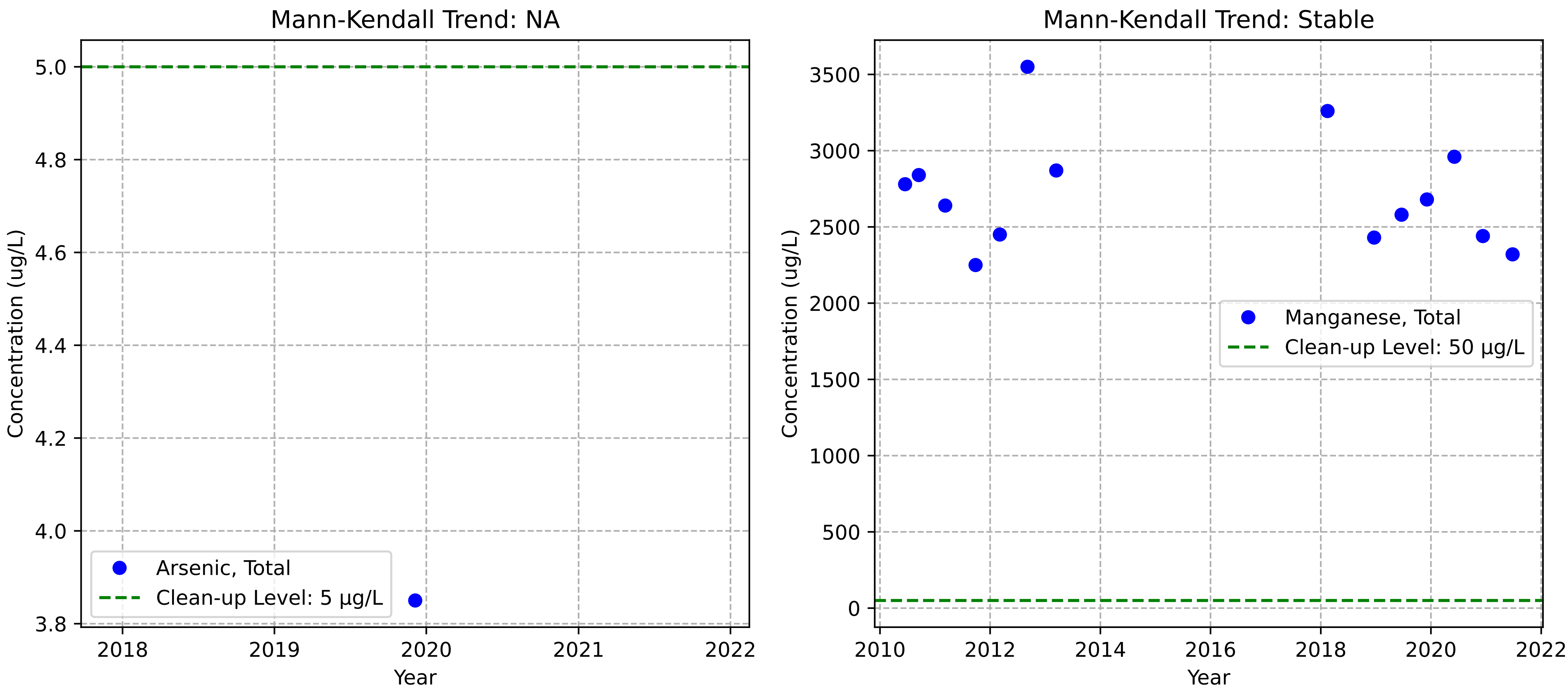


Mann-Kendall Trend: Stable
Arsenic, Total
Linear Fit (R²=0.19)
Exponential Fit (R²=0.19)
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year

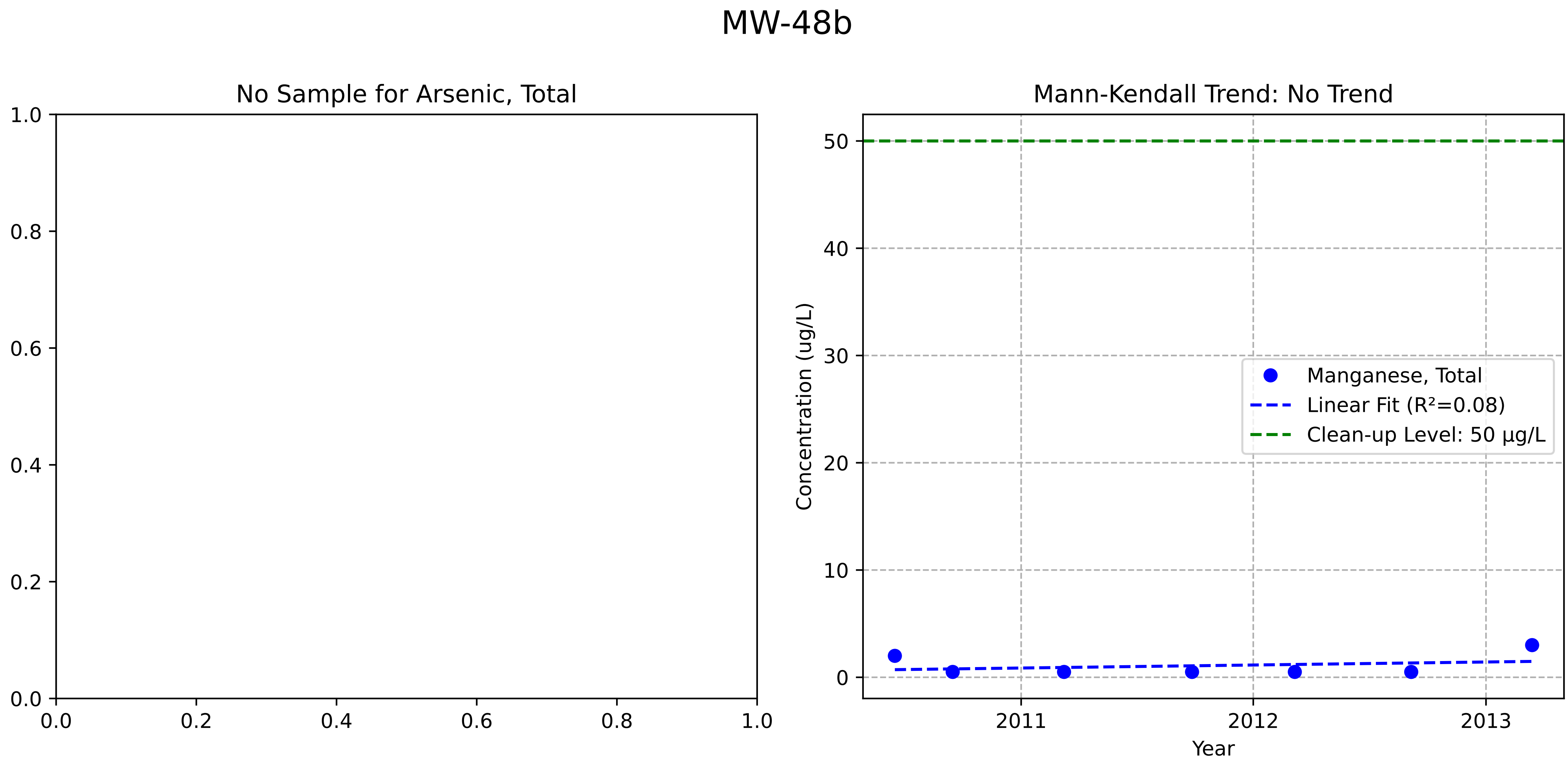


Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.44)
Exponential Fit (R²=0.39)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

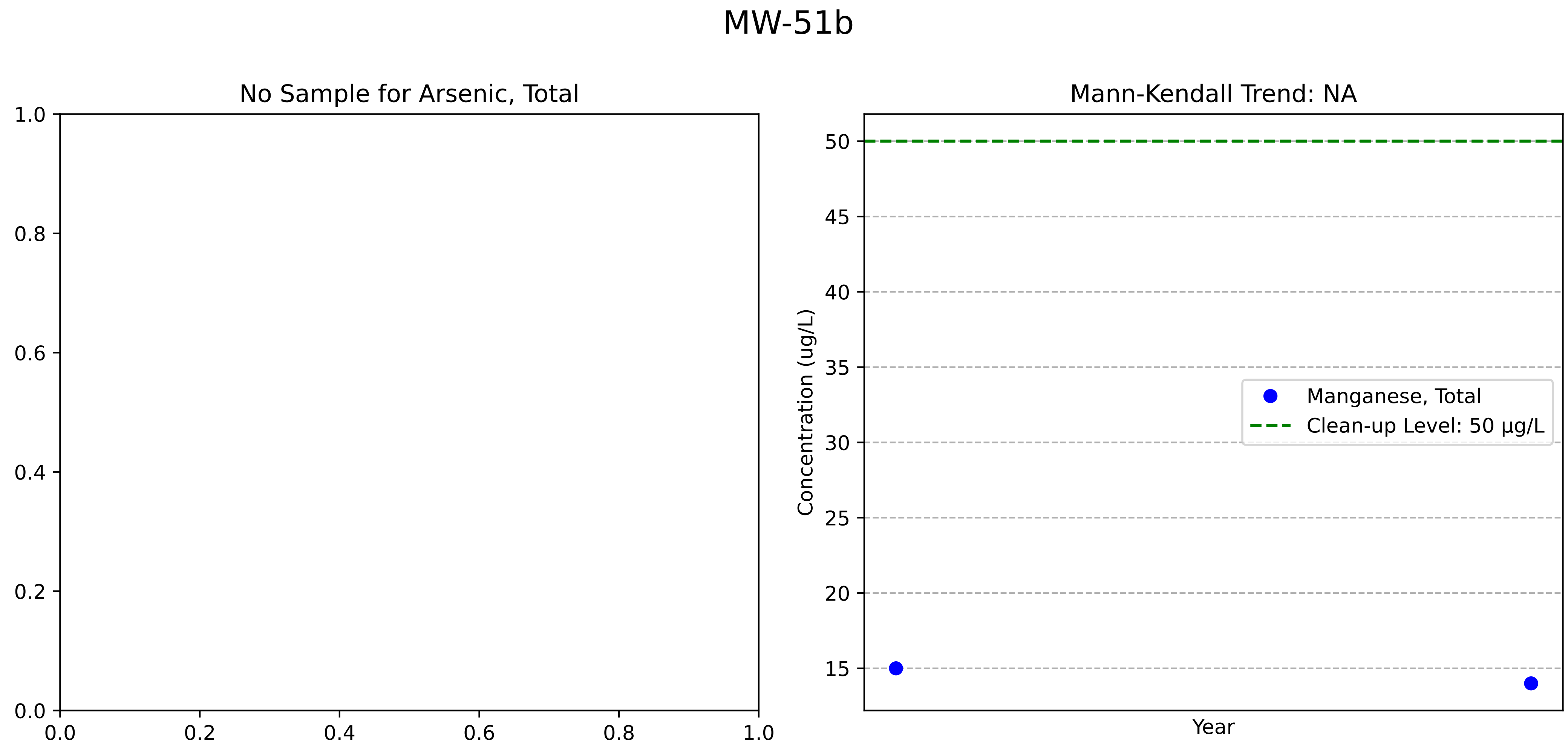
MW-44b



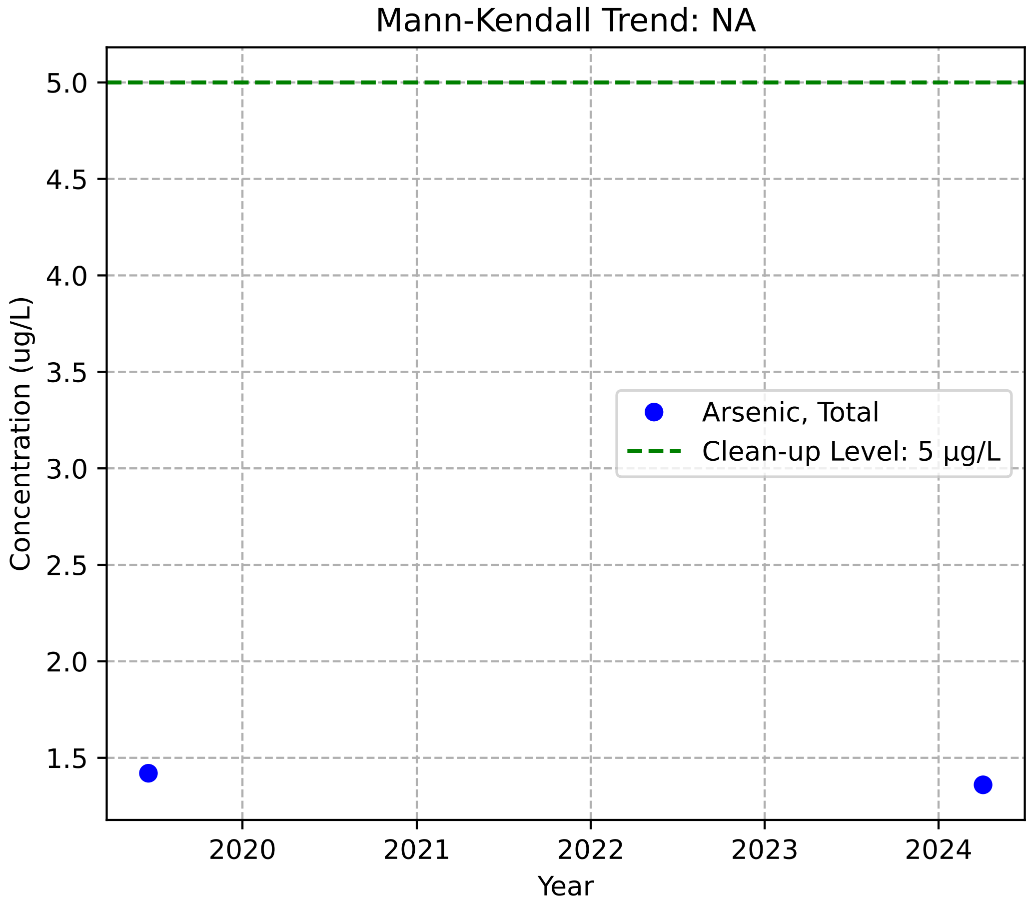
Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.8
4.6
4.4
4.2
4.0
3.8
2018
2019
2020
2021
2022
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Stable
Concentration (ug/L)
3500
3000
2500
2000
1500
1000
500
0
2010
2012
2014
2016
2018
2020
2022
Year
Manganese, Total
Clean-up Level: 50 µg/L



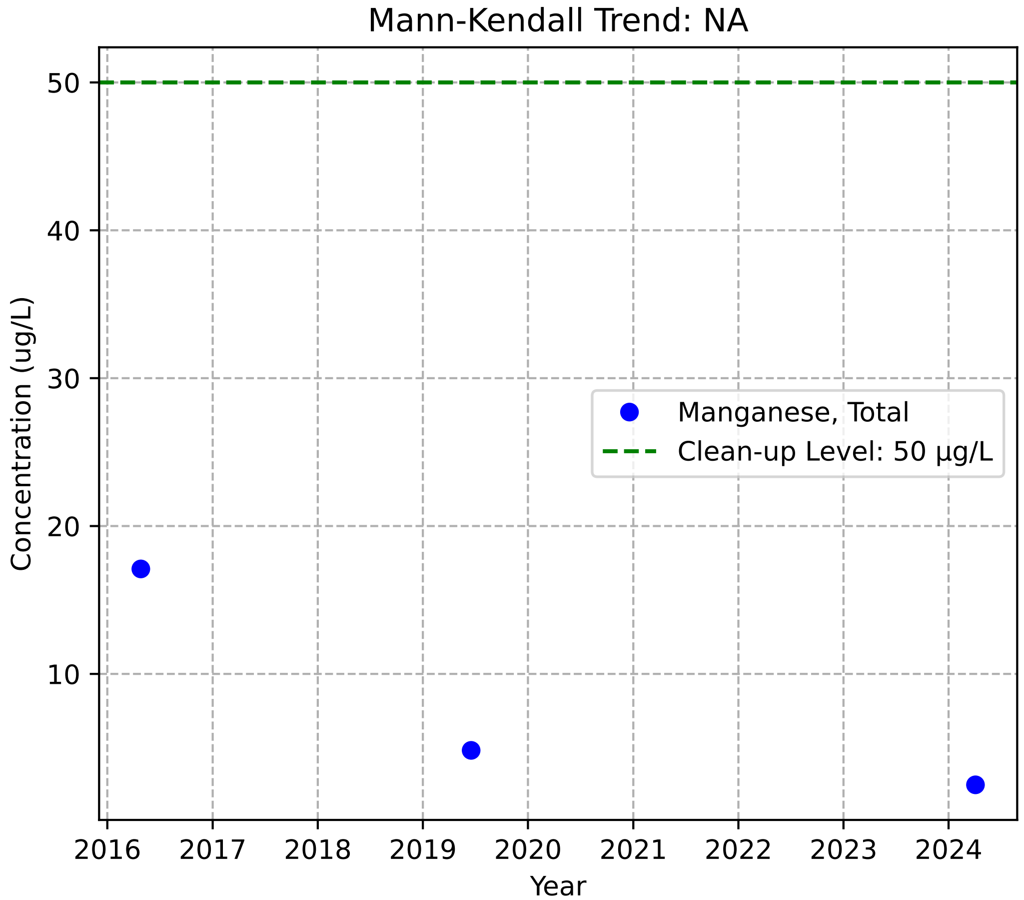
MW-48b
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: No Trend
Concentration (ug/L)
50
40
30
20
10
0
2011
2012
2013
Year
Manganese, Total
Linear Fit (R²=0.08)
Clean-up Level: 50 µg/L


MW-51b
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Concentration (ug/L)
50
45
40
35
30
25
20
15
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-57b

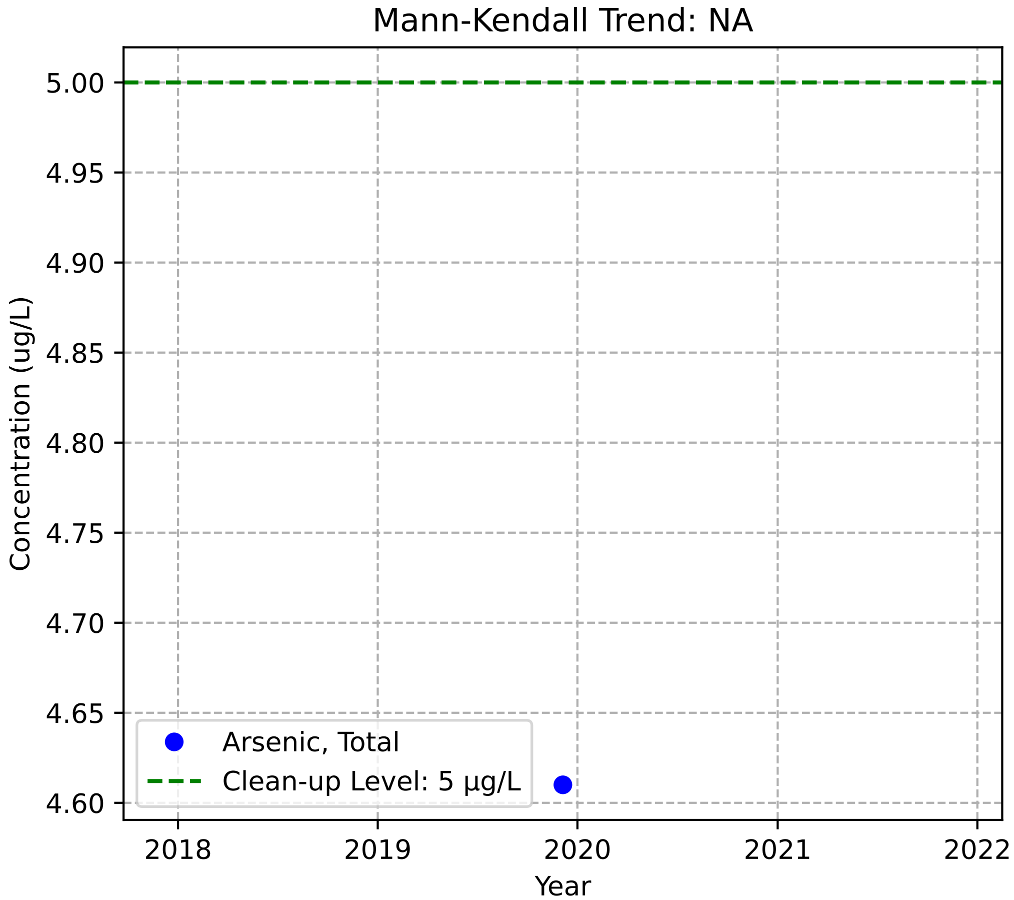


Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year

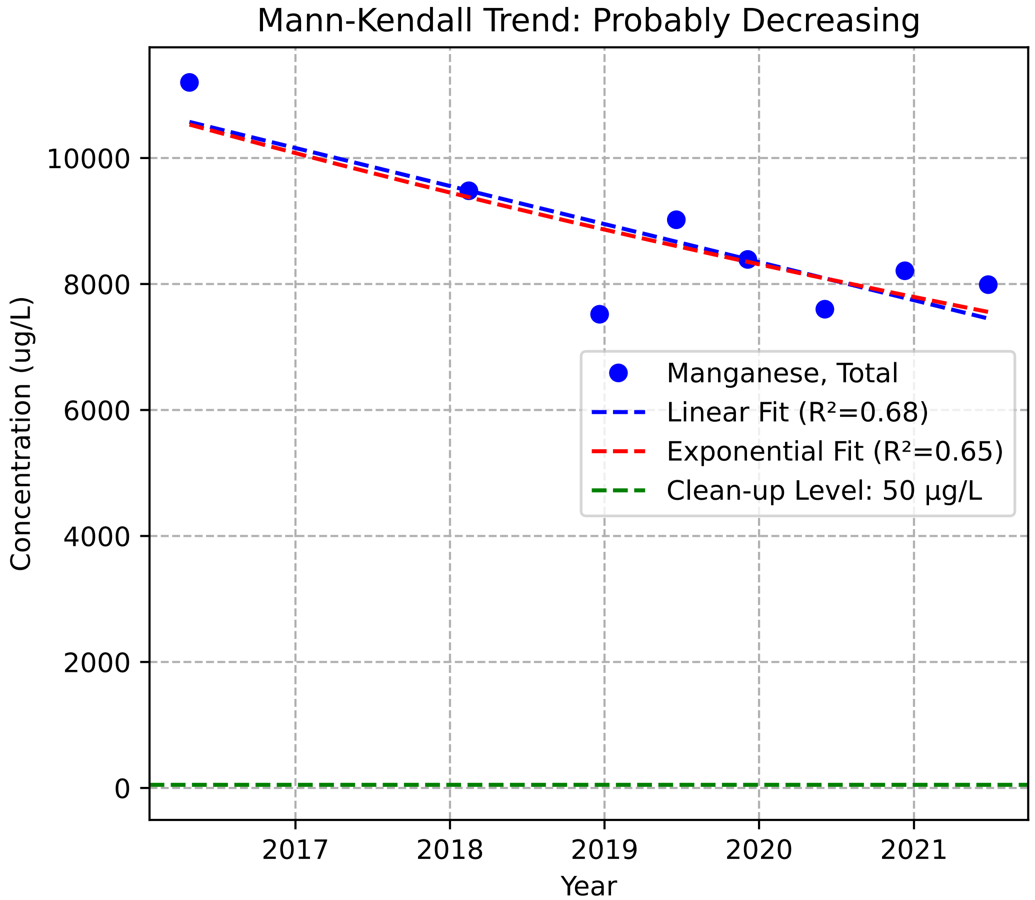


Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

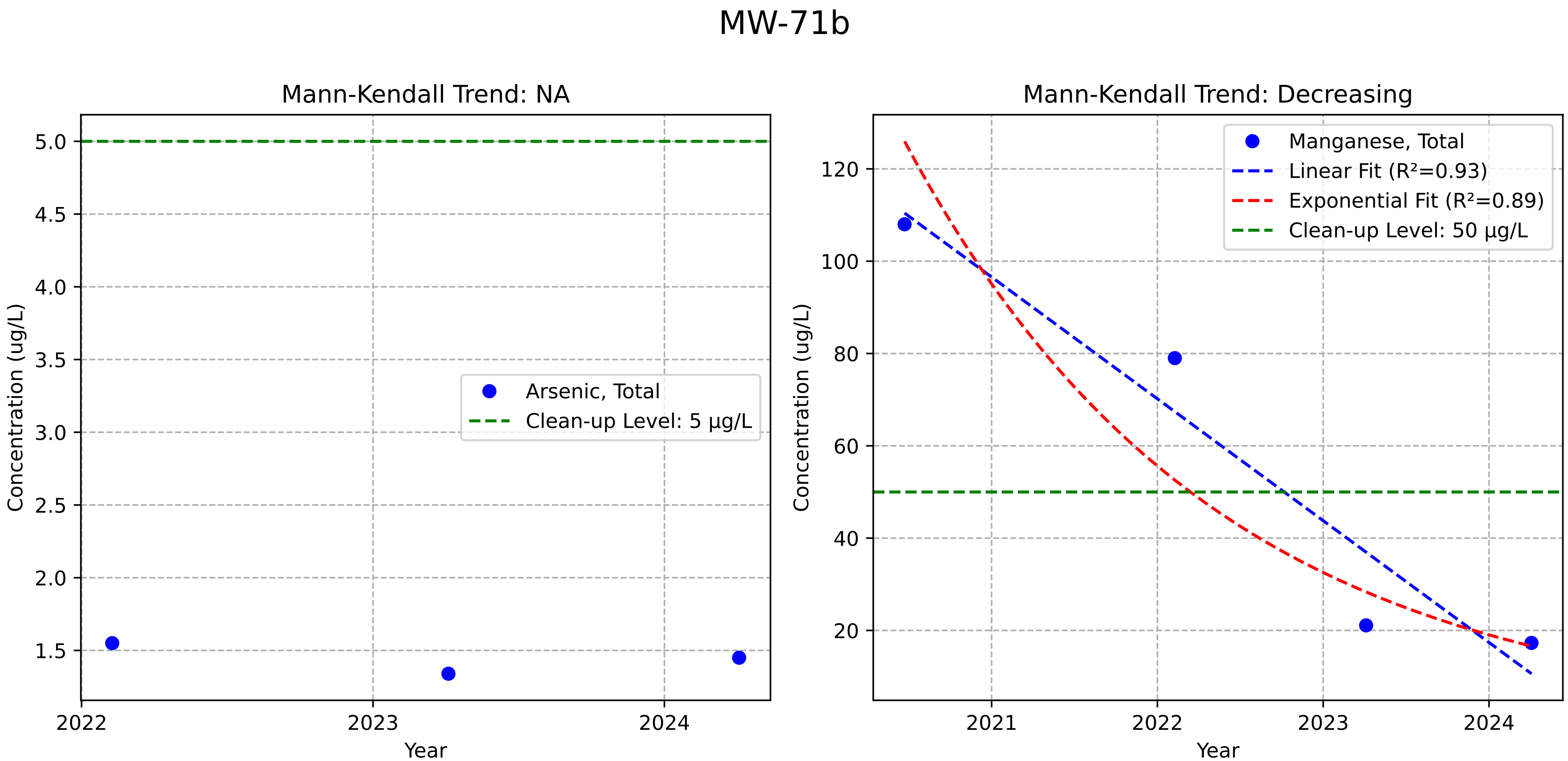
MW-63b

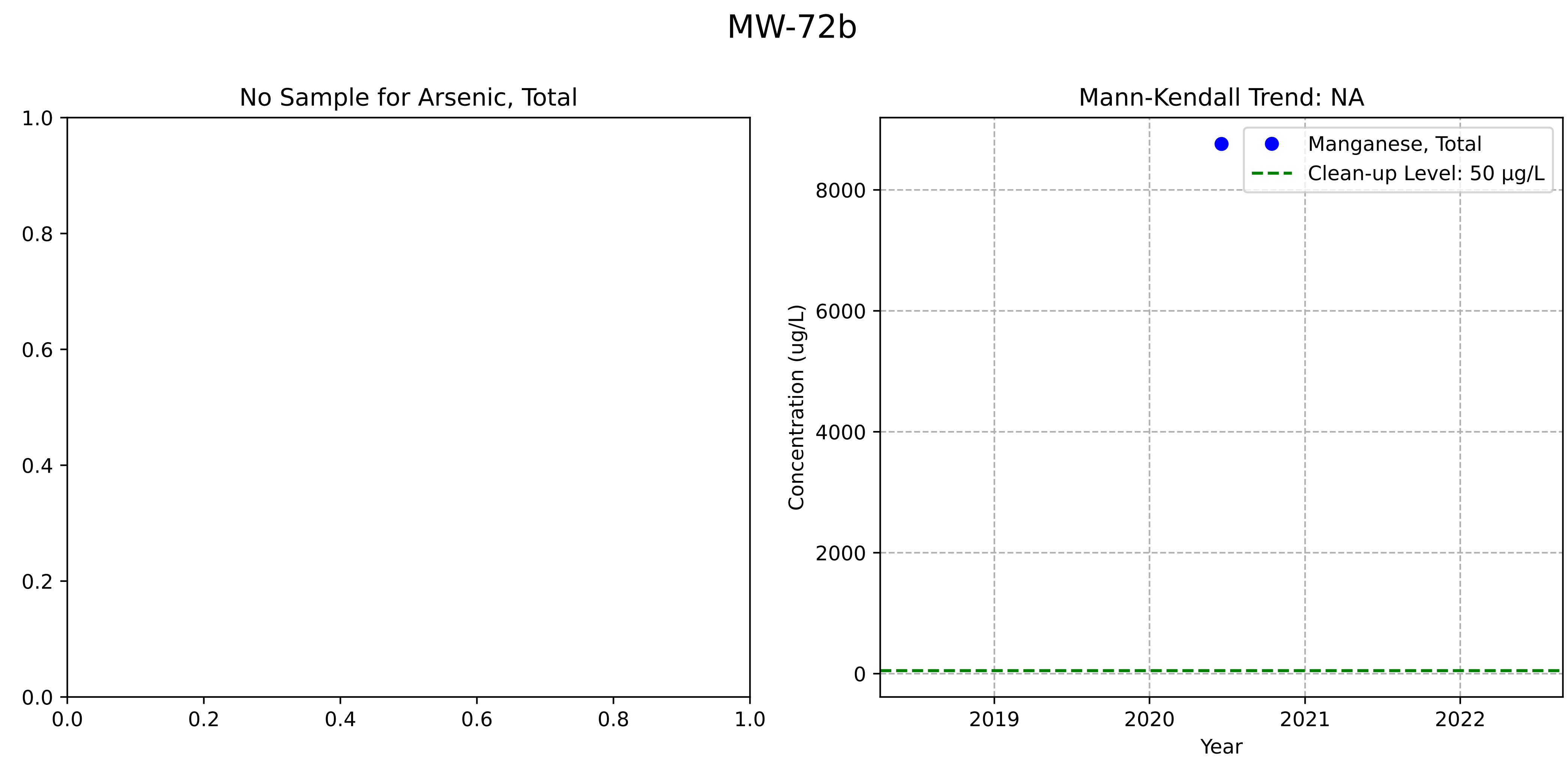


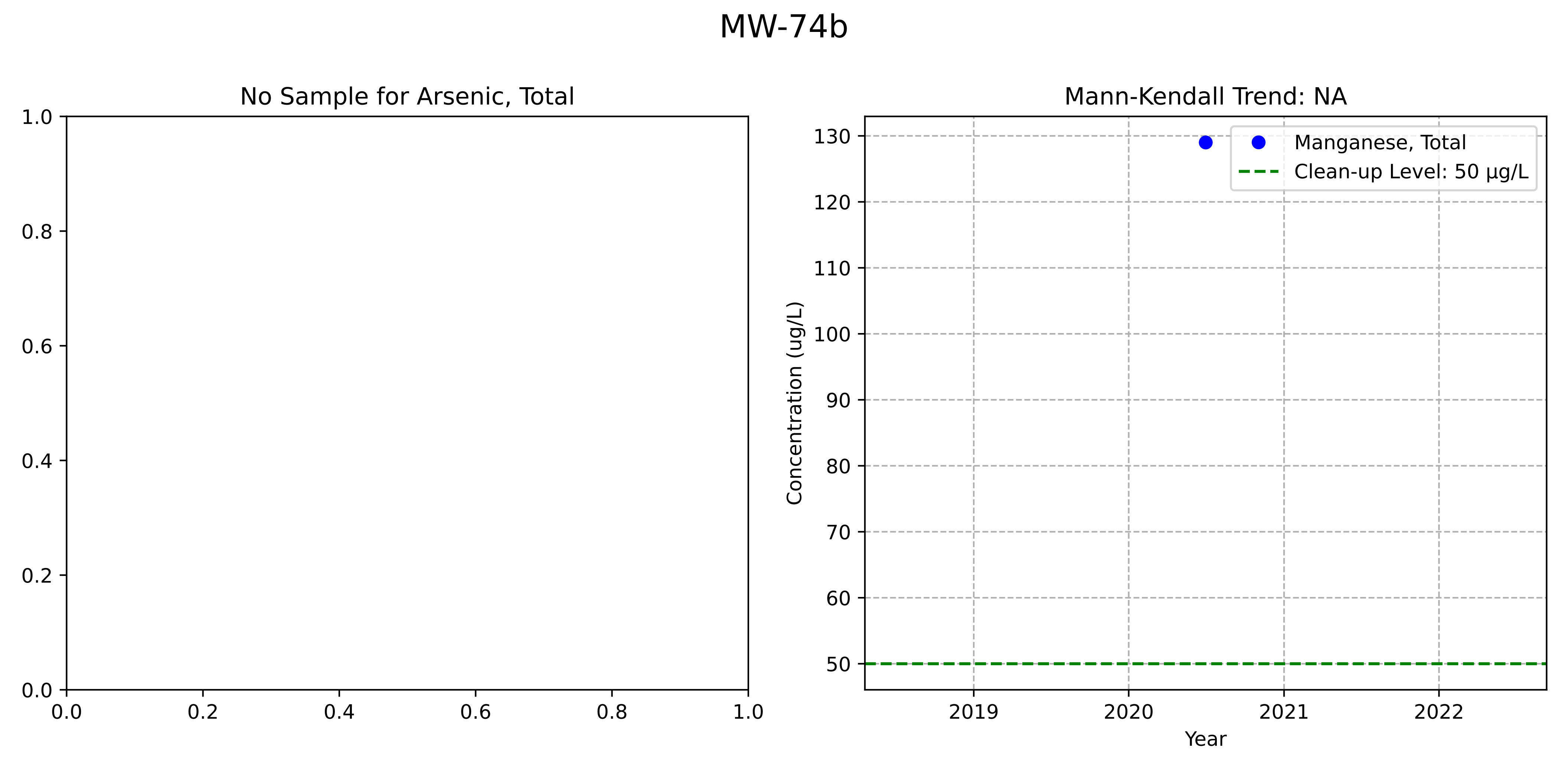
Mann-Kendall Trend: NA
Concentration (ug/L)
5.00
4.95
4.90
4.85
4.80
4.75
4.70
4.65
4.60
2018
2019
2020
2021
2022
Year
Arsenic, Total
Clean-up Level: 5 µg/L



Mann-Kendall Trend: Probably Decreasing
Concentration (ug/L)
10000
8000
6000
4000
2000
0
2017
2018
2019
2020
2021
Year
Manganese, Total
Linear Fit (R²=0.68)
Exponential Fit (R²=0.65)
Clean-up Level: 50 µg/L

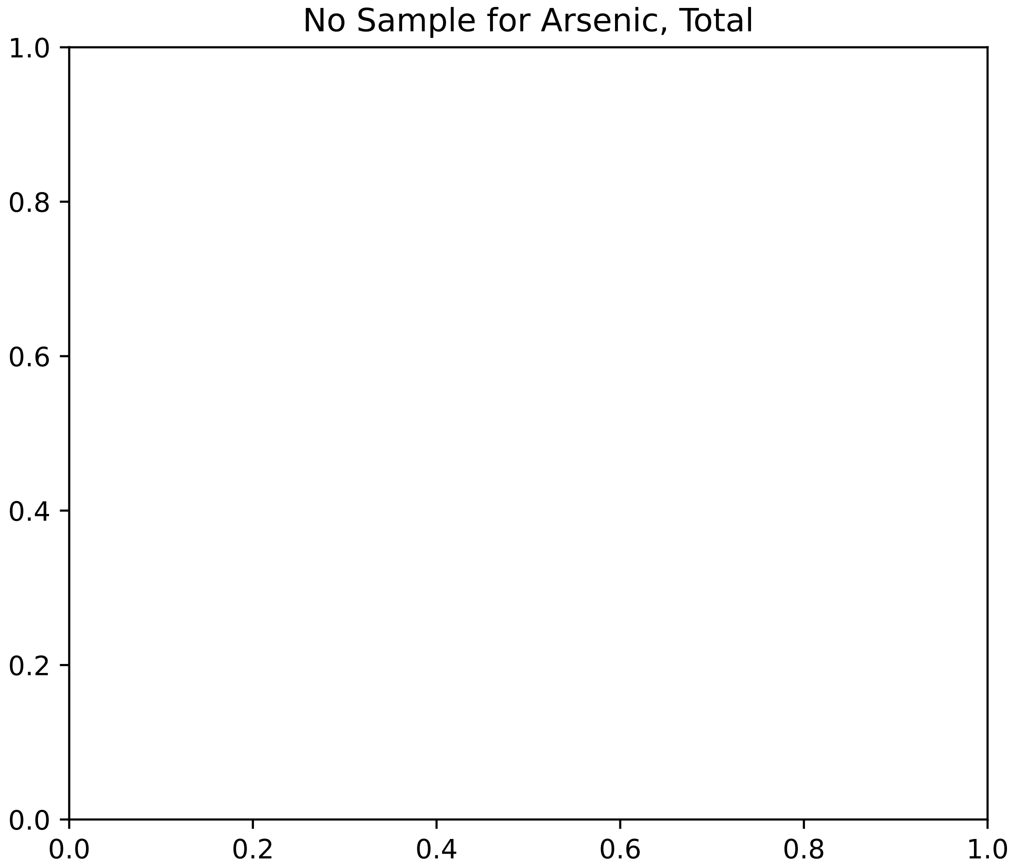

MW-71b
Mann-Kendall Trend: NA
Concentration (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
2022
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Decreasing
Concentration (ug/L)
120
100
80
60
40
20
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.93)
Exponential Fit (R²=0.89)
Clean-up Level: 50 µg/L


MW-72b
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
8000
6000
4000
2000
0
2019
2020
2021
2022
Year

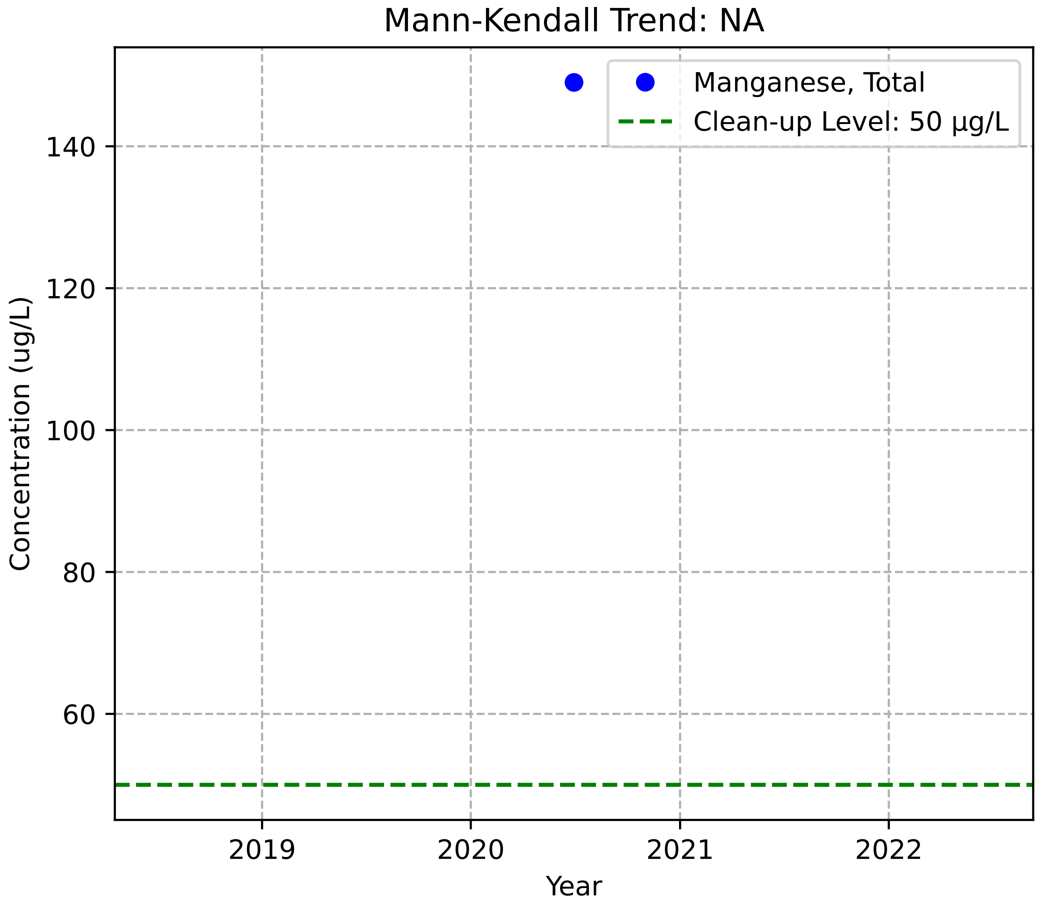


MW-74b
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
130
120
110
100
90
80
70
60
50
2019
2020
2021
2022
Year

MW-78b

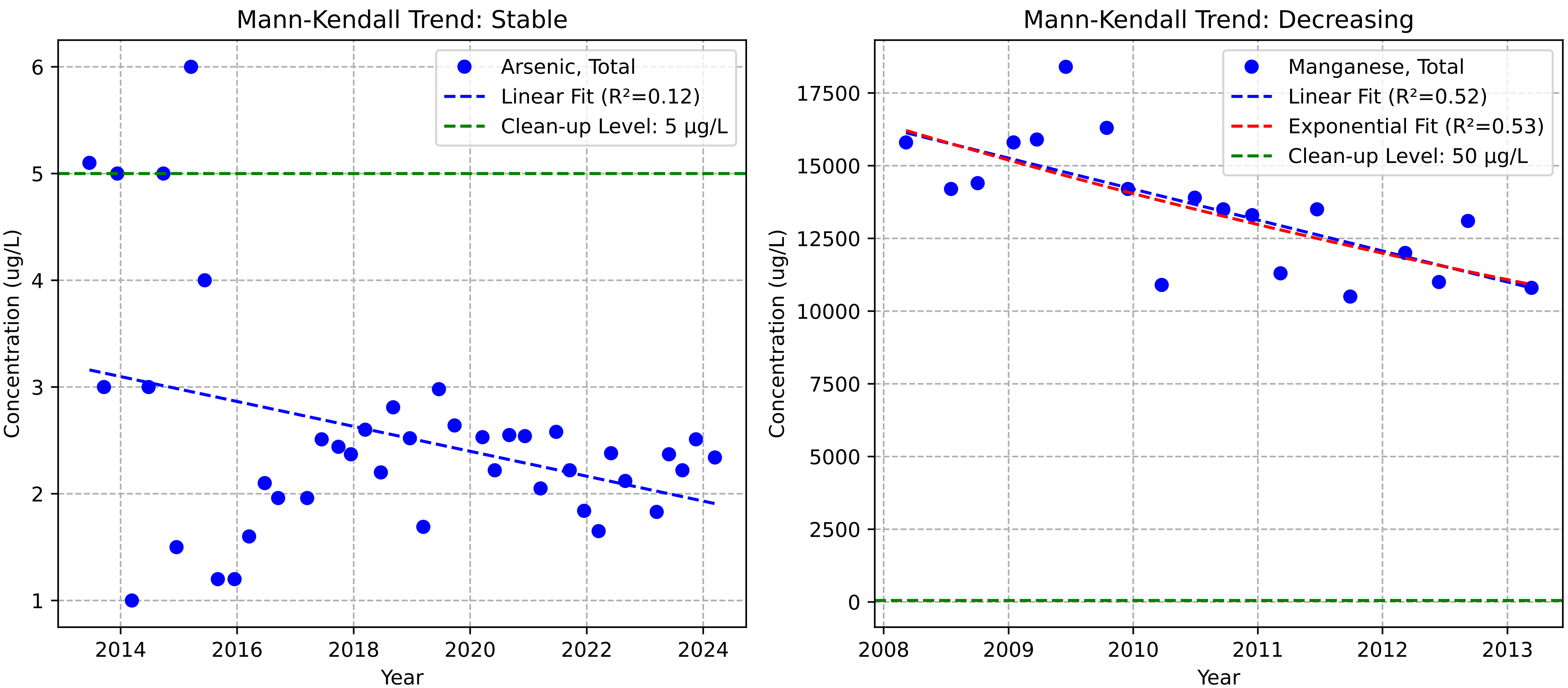


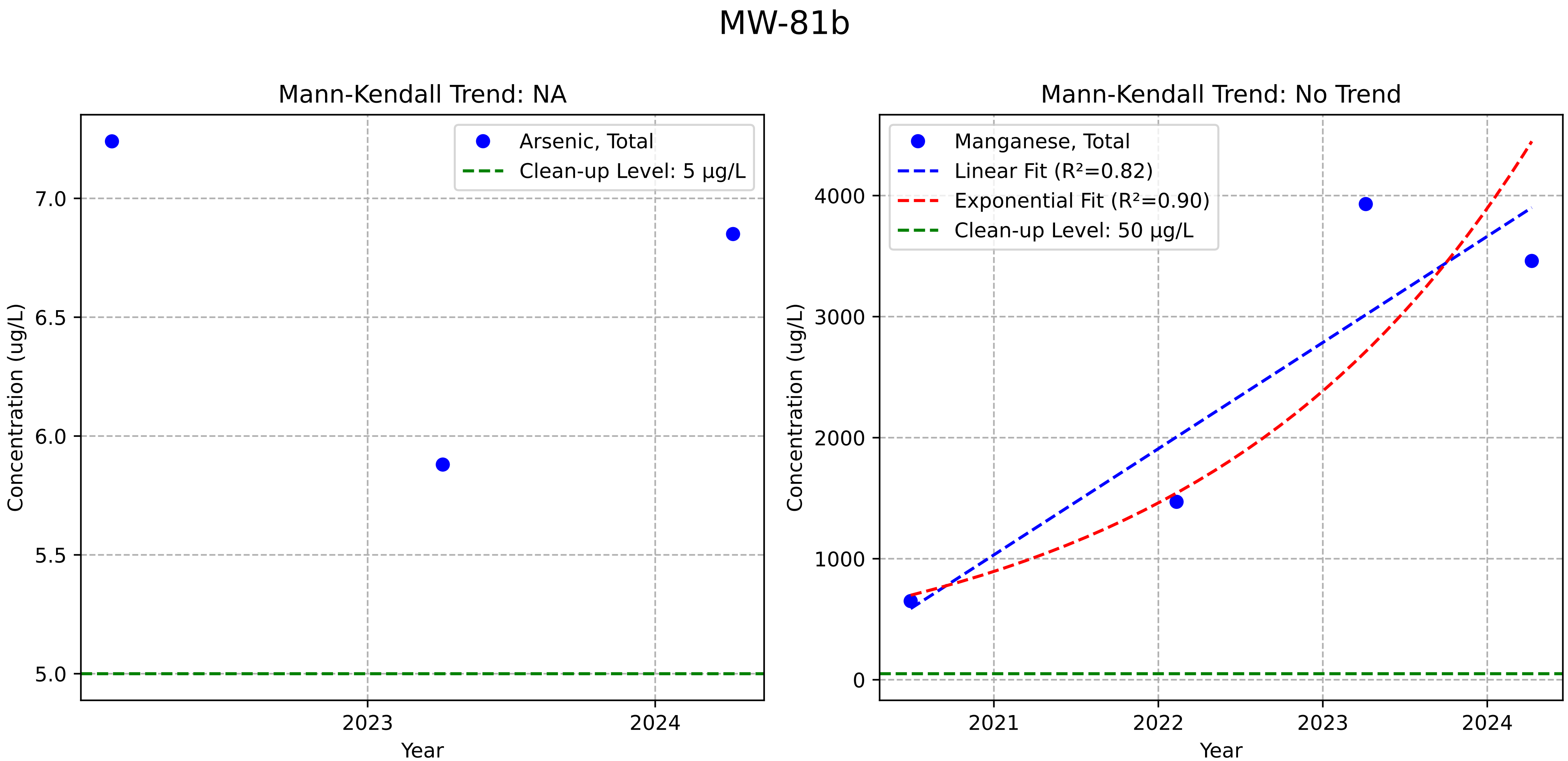
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0



Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
140
120
100
80
60
2019
2020
2021
2022
Year

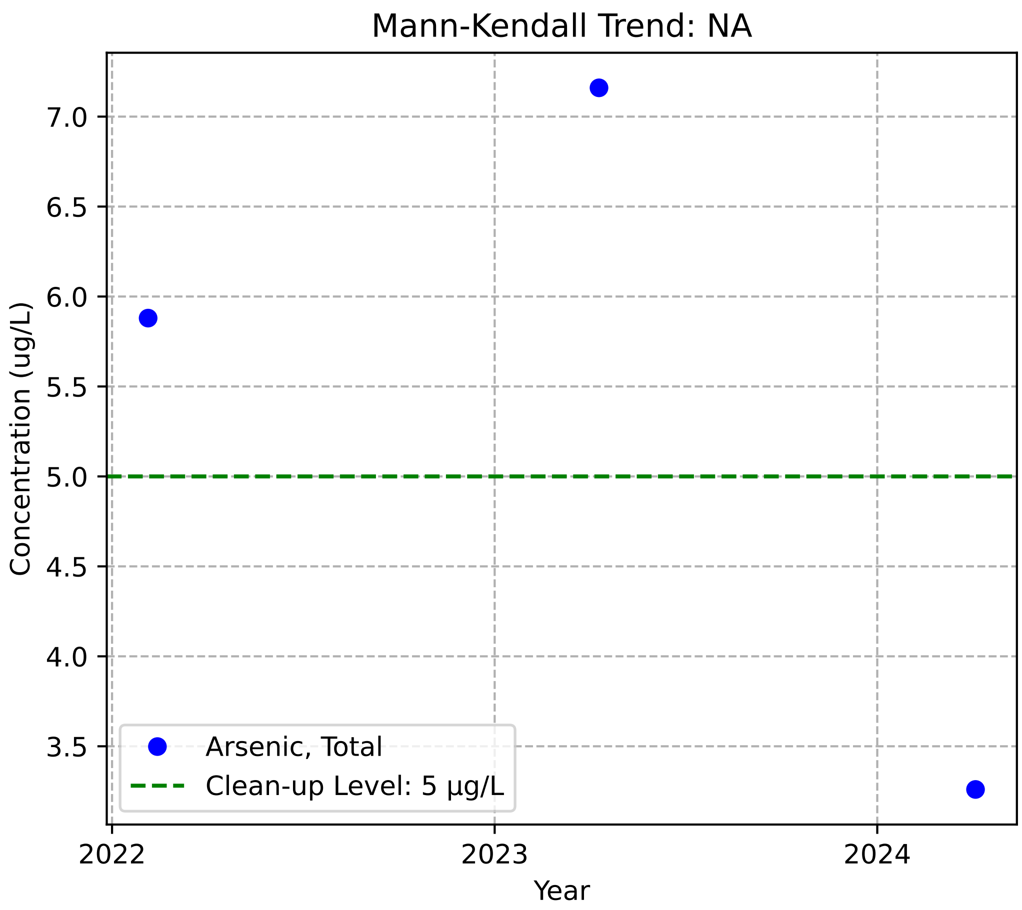
MW-7b


Mann-Kendall Trend: Stable
Arsenic, Total
Linear Fit (R²=0.12)
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.52)
Exponential Fit (R²=0.53)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

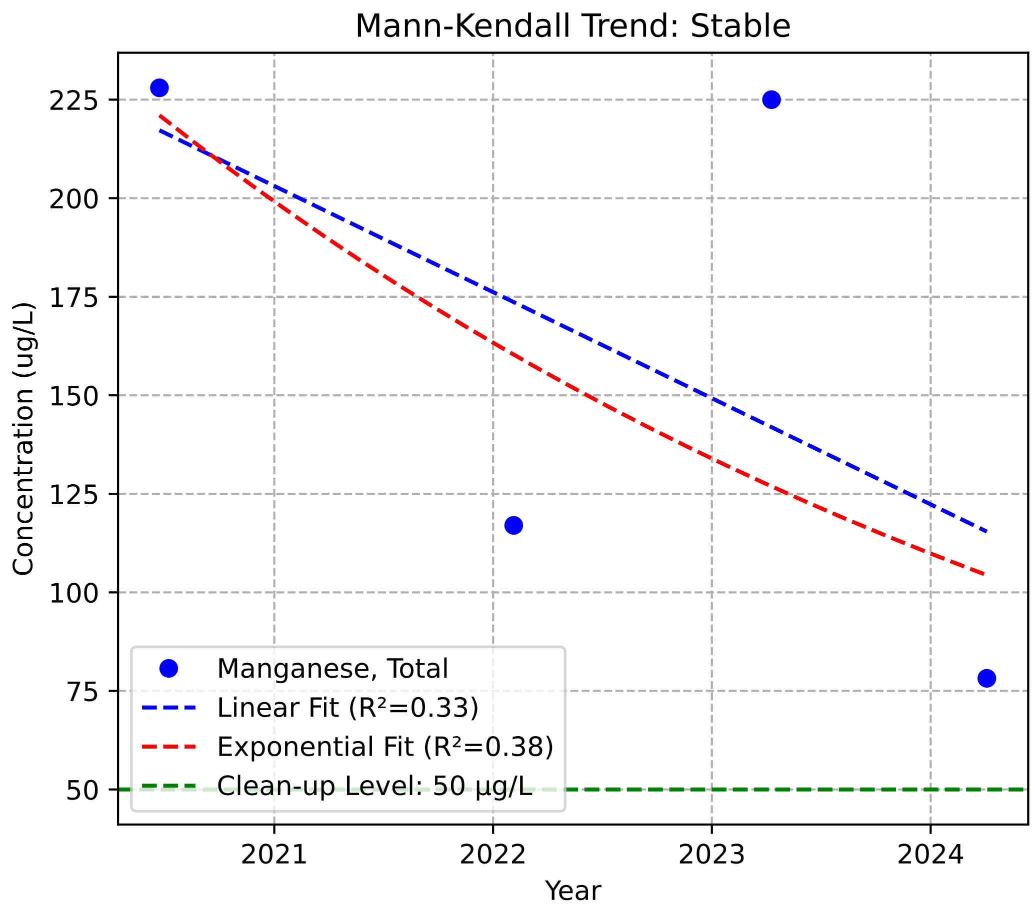


MW-81b
Mann-Kendall Trend: NA
Arsenic, Total
Clean-up Level: 5 µg/L
Concentration (ug/L)
7.0
6.5
6.0
5.5
5.0
2023
2024
Year
Mann-Kendall Trend: No Trend
Manganese, Total
Linear Fit (R²=0.82)
Exponential Fit (R²=0.90)
Clean-up Level: 50 µg/L
Concentration (ug/L)
4000
3000
2000
1000
0
2021
2022
2023
2024
Year

MW-82b

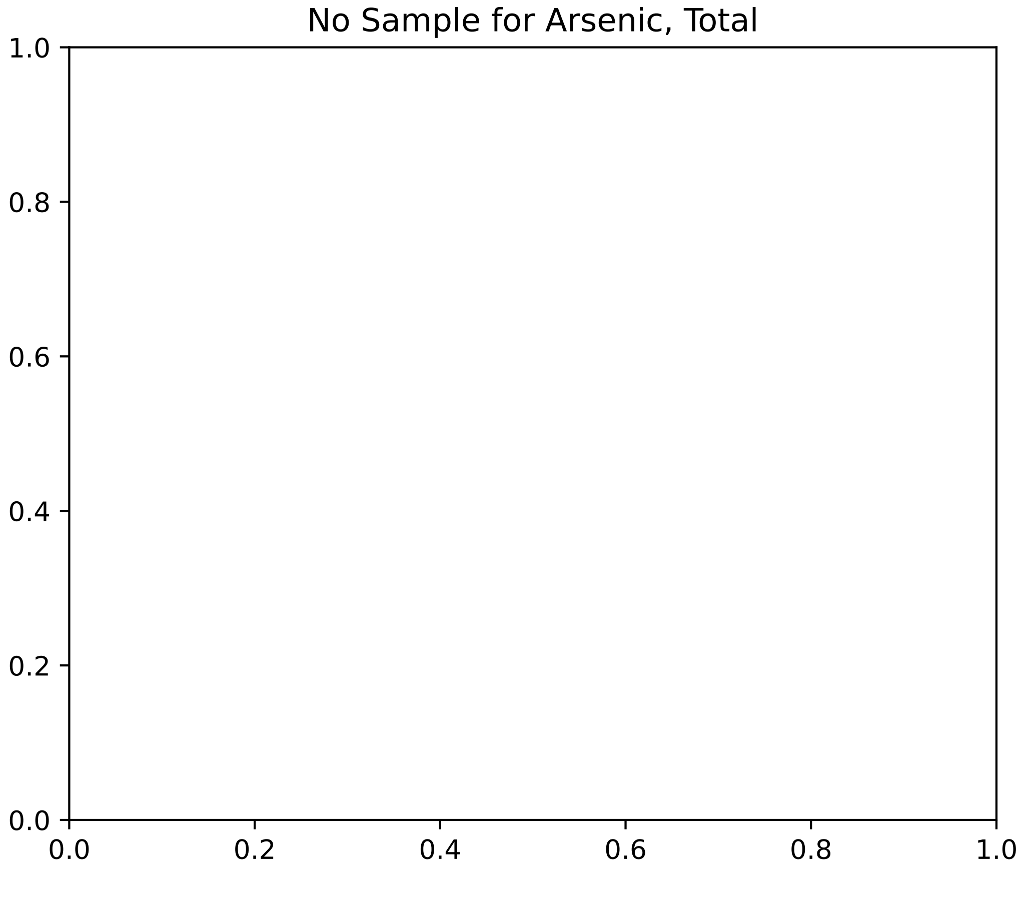


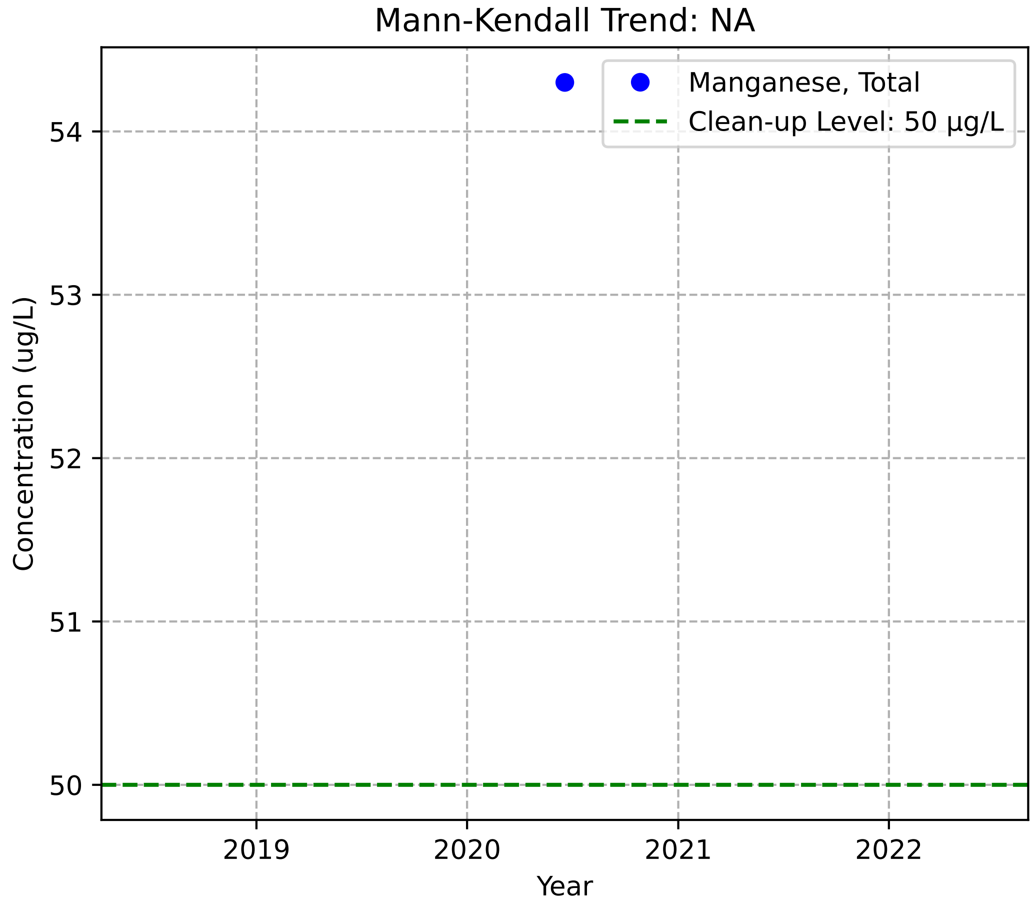
Mann-Kendall Trend: NA
Concentration (ug/L)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
2022
2023
2024
Year
Arsenic, Total
Clean-up Level: 5 µg/L



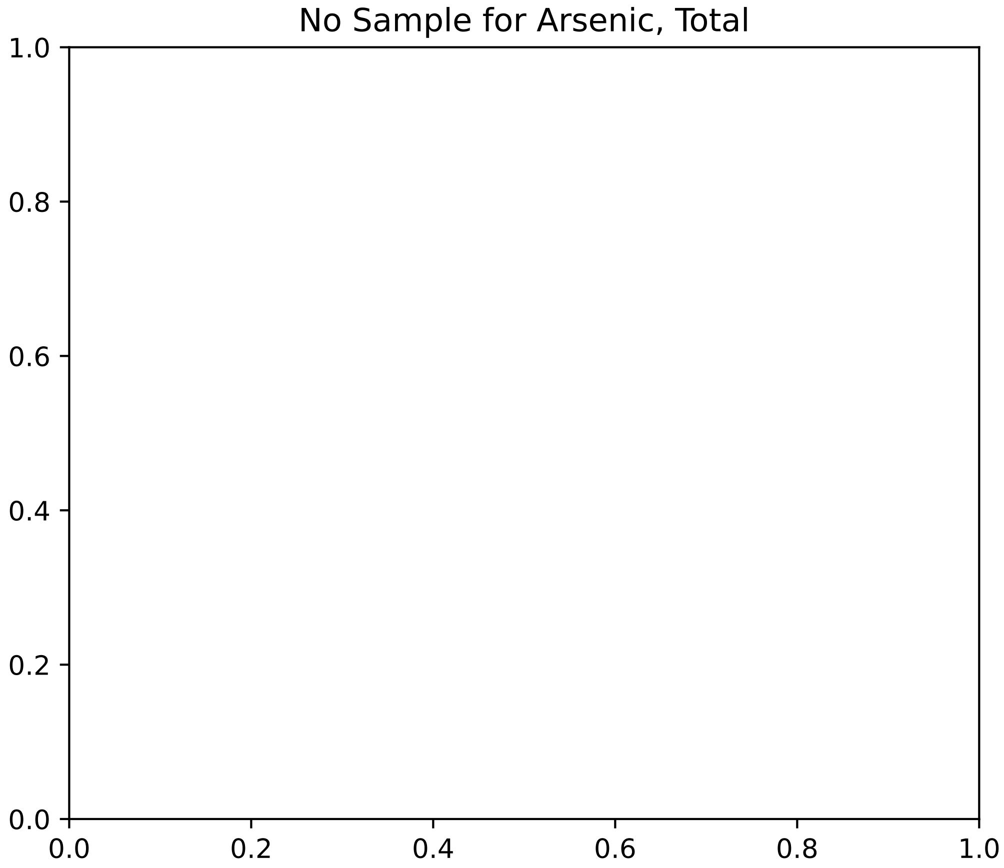
Mann-Kendall Trend: Stable
Concentration (ug/L)
225
200
175
150
125
100
75
50
2021
2022
2023
2024
Year
Manganese, Total
Linear Fit (R²=0.33)
Exponential Fit (R²=0.38)
Clean-up Level: 50 µg/L

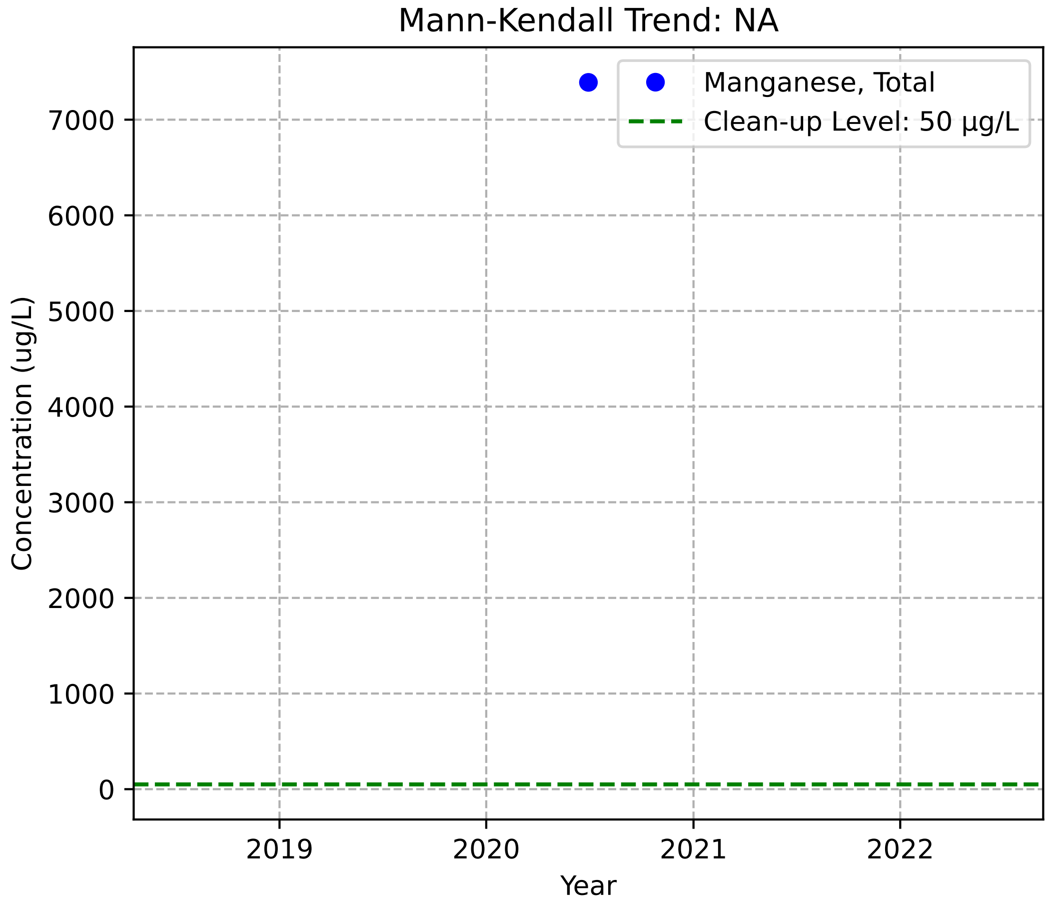
MW-86b


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

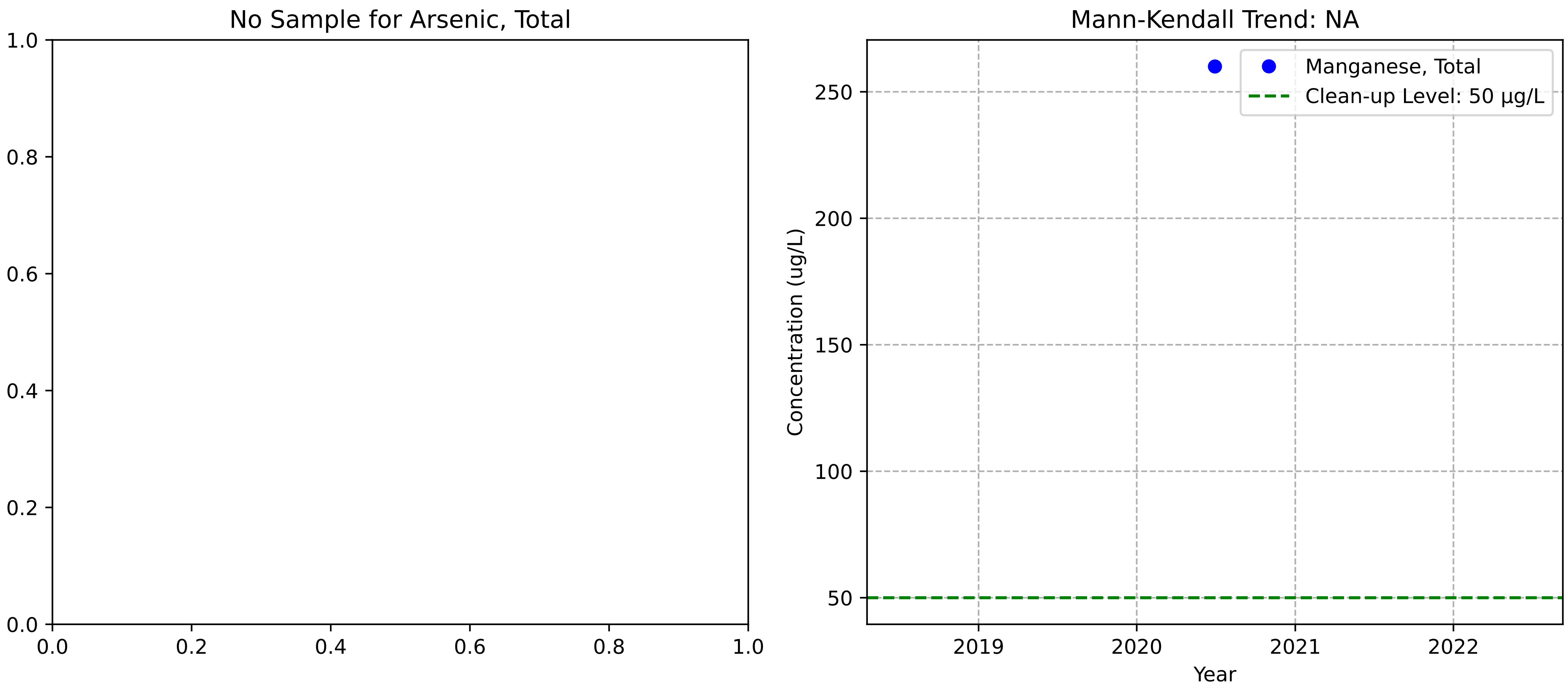

Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
54
53
52
51
50
2019
2020
2021
2022
Year

MW-89b


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

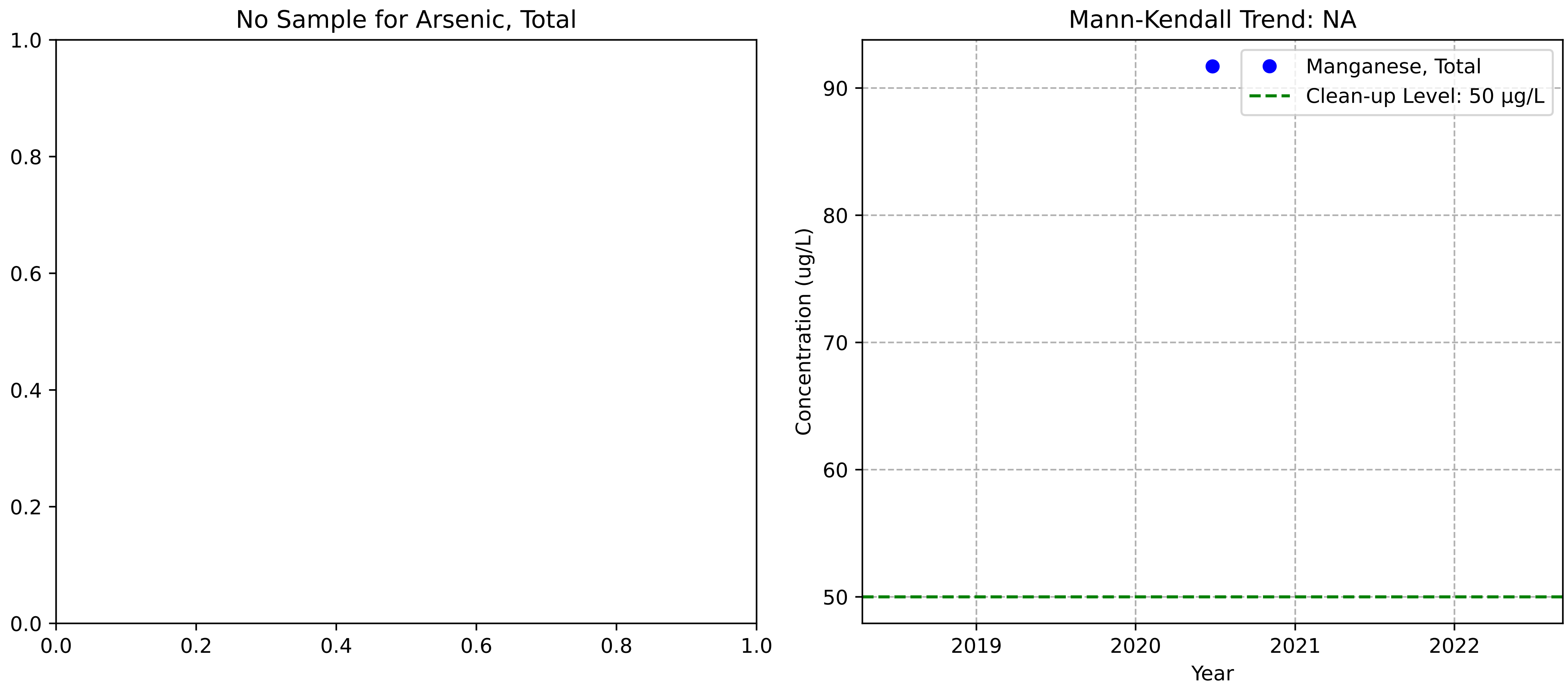

Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
7000
6000
5000
4000
3000
2000
1000
0
2019
2020
2021
2022
Year

MW-93b

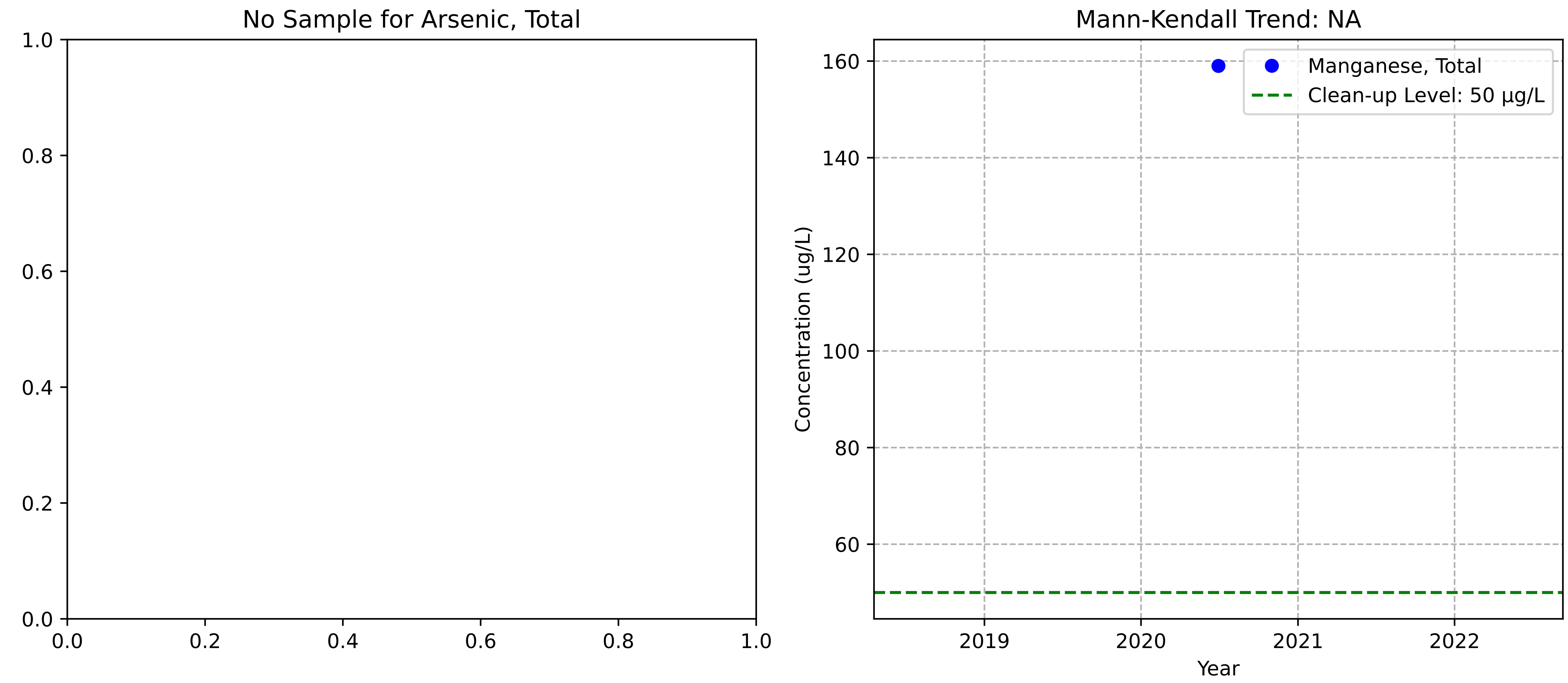


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
250
200
150
100
50
2019
2020
2021
2022
Year

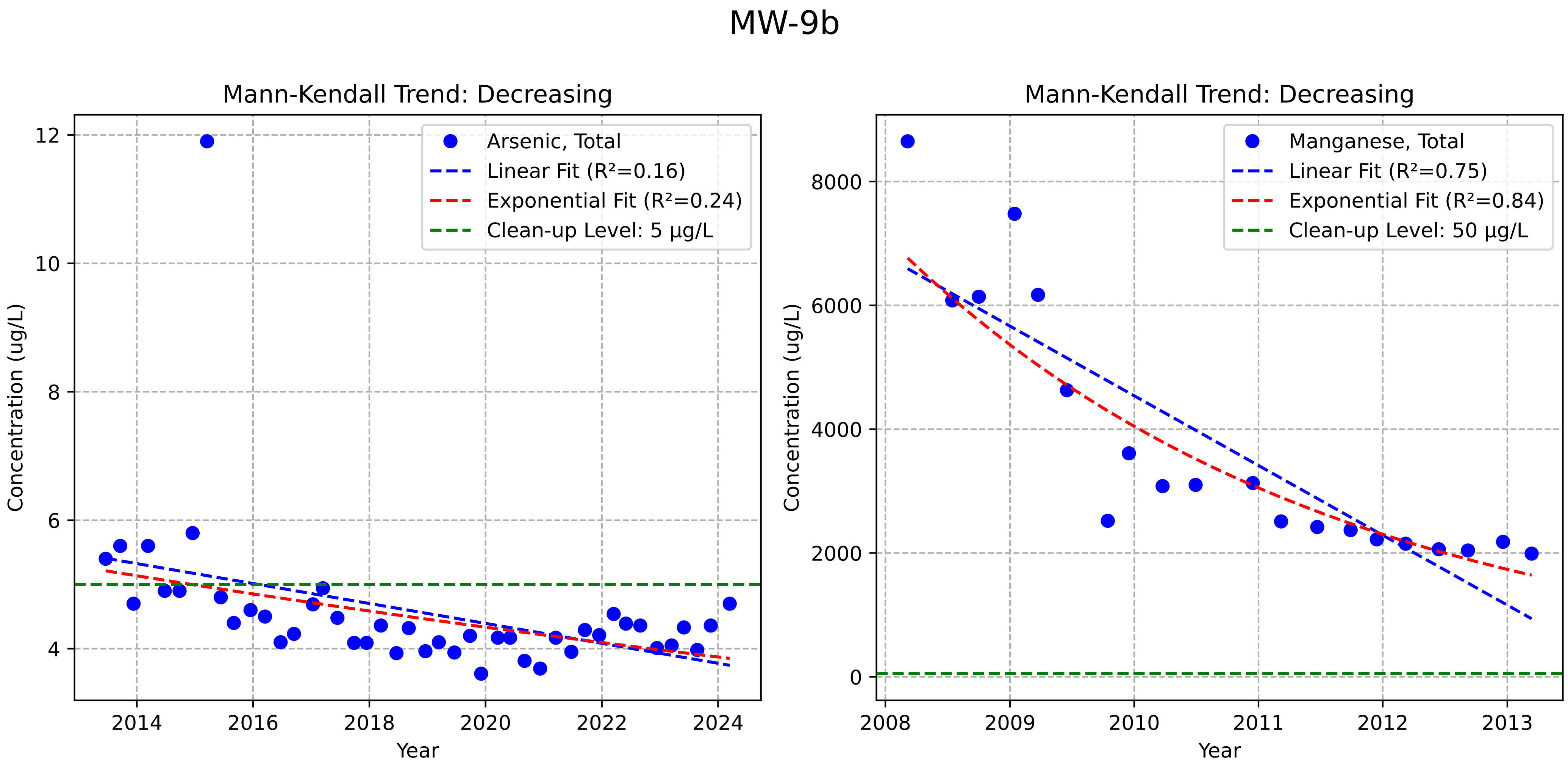
MW-96b


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
90
80
70
60
50
2019
2020
2021
2022
Year

MW-97b

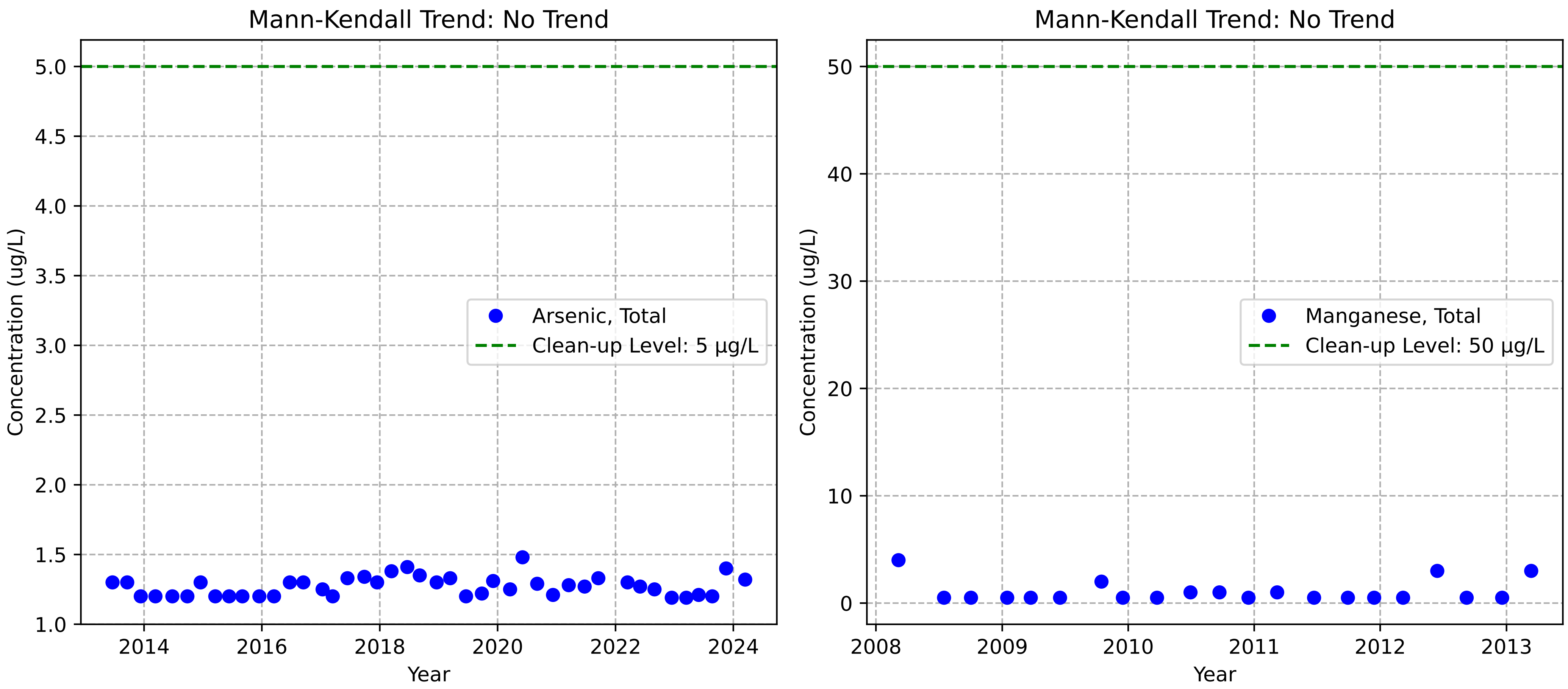


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
160
140
120
100
80
60
2019
2020
2021
2022
Year

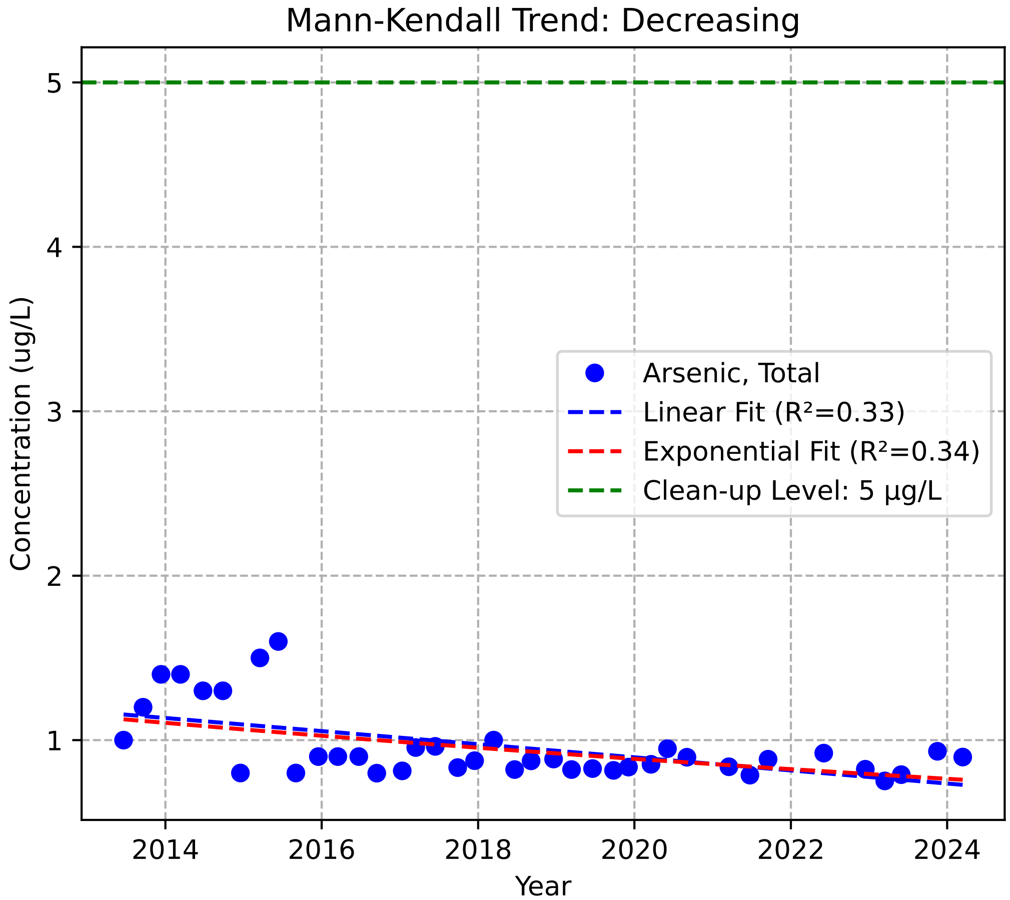


MW-9b
Mann-Kendall Trend: Decreasing
Arsenic, Total
Linear Fit (R²=0.16)
Exponential Fit (R²=0.24)
Clean-up Level: 5 µg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: Decreasing
Manganese, Total
Linear Fit (R²=0.75)
Exponential Fit (R²=0.84)
Clean-up Level: 50 µg/L
Concentration (ug/L)
Year

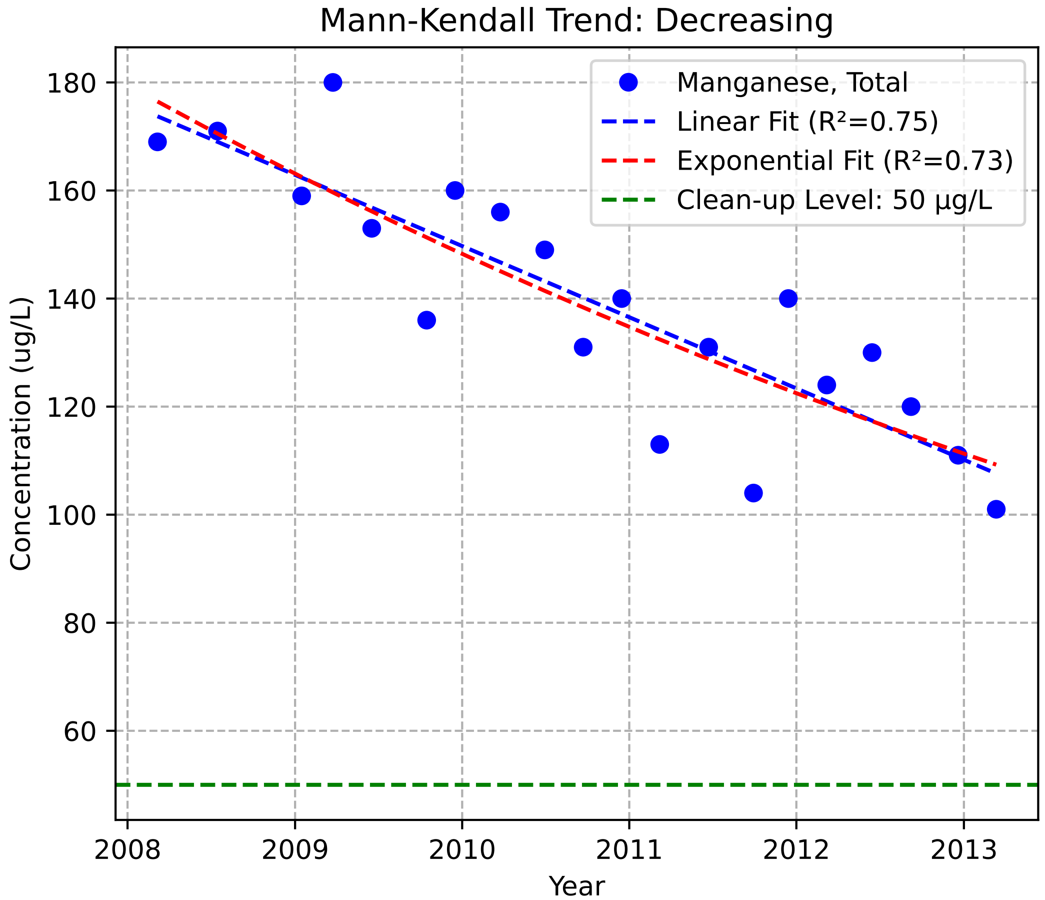
MW-20c


Mann-Kendall Trend: No Trend
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: No Trend
Concentration (ug/L)
Year
Manganese, Total
Clean-up Level: 50 µg/L

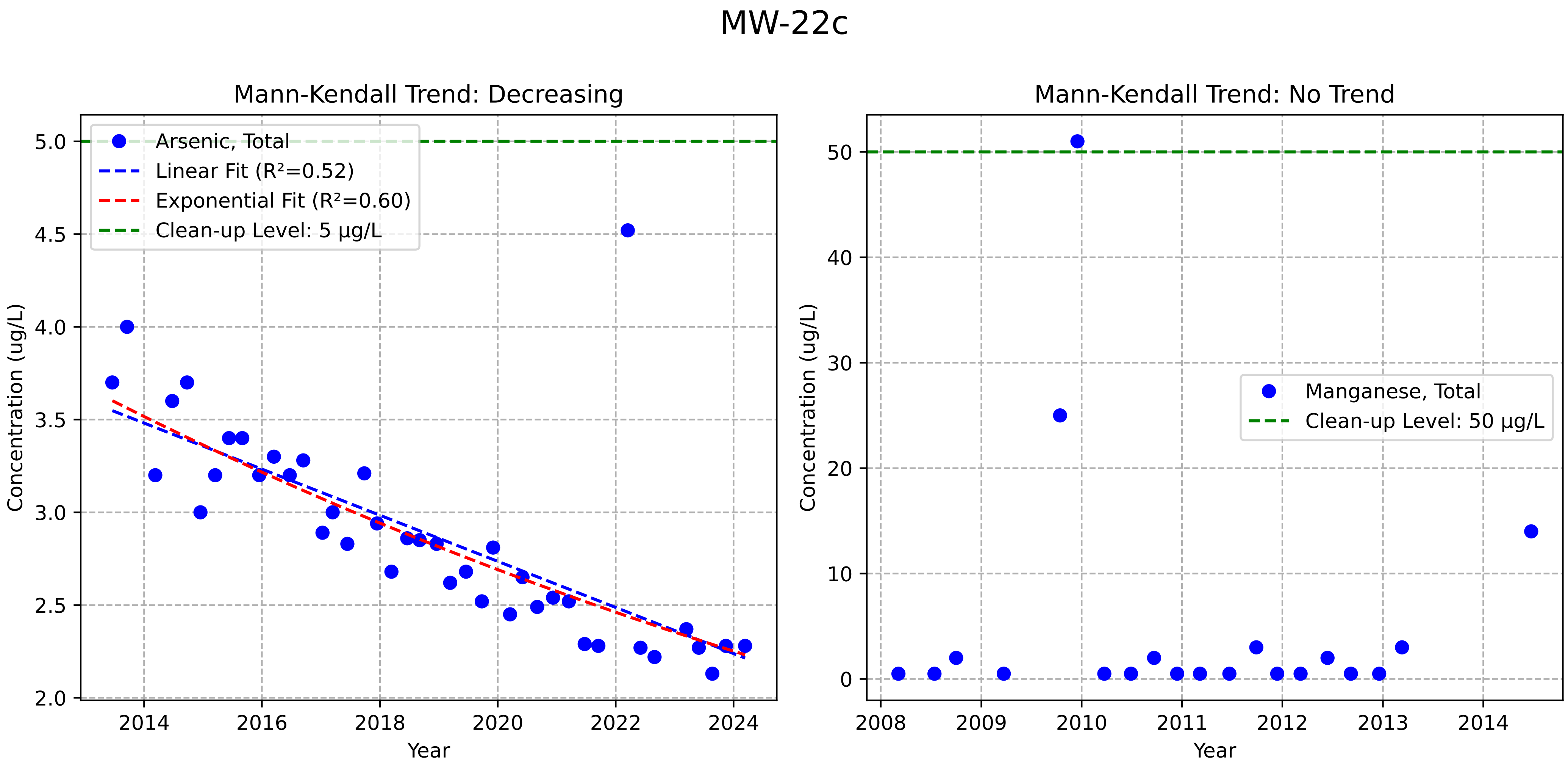
MW-21c



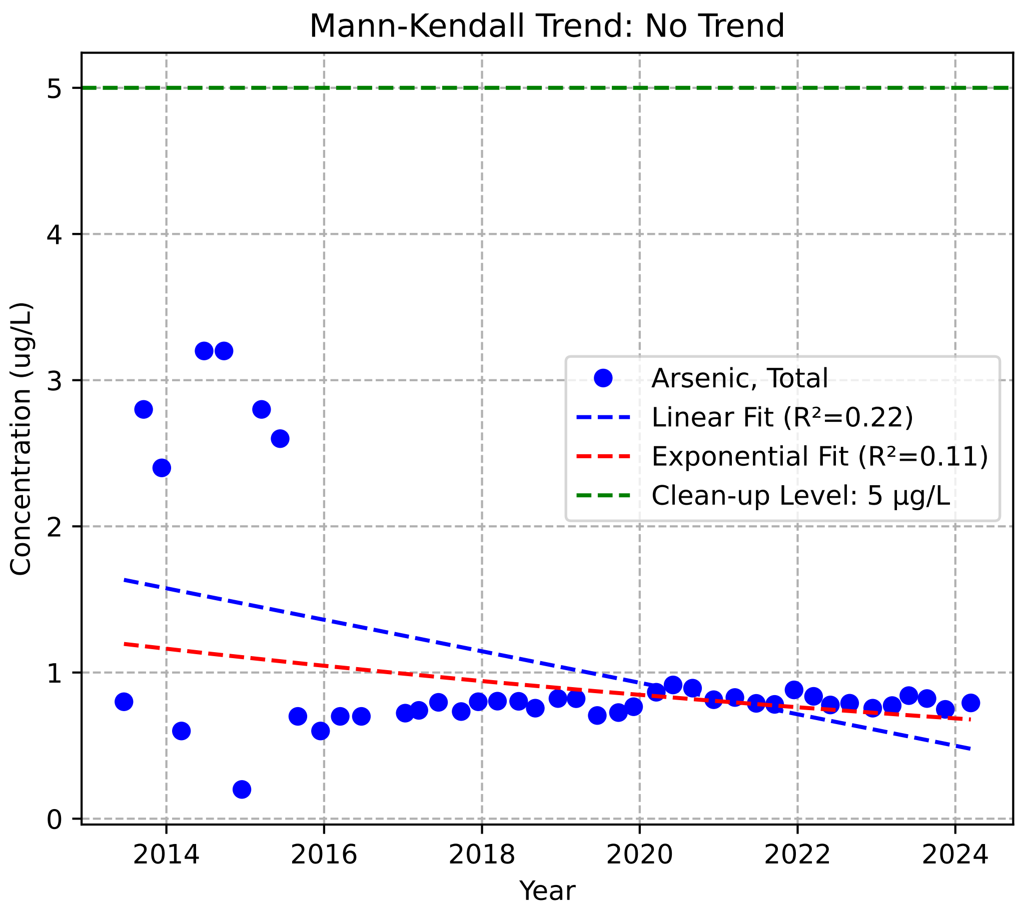
Mann-Kendall Trend: Decreasing
Concentration (ug/L)
Year
Arsenic, Total
Linear Fit (R²=0.33)
Exponential Fit (R²=0.34)
Clean-up Level: 5 μg/L



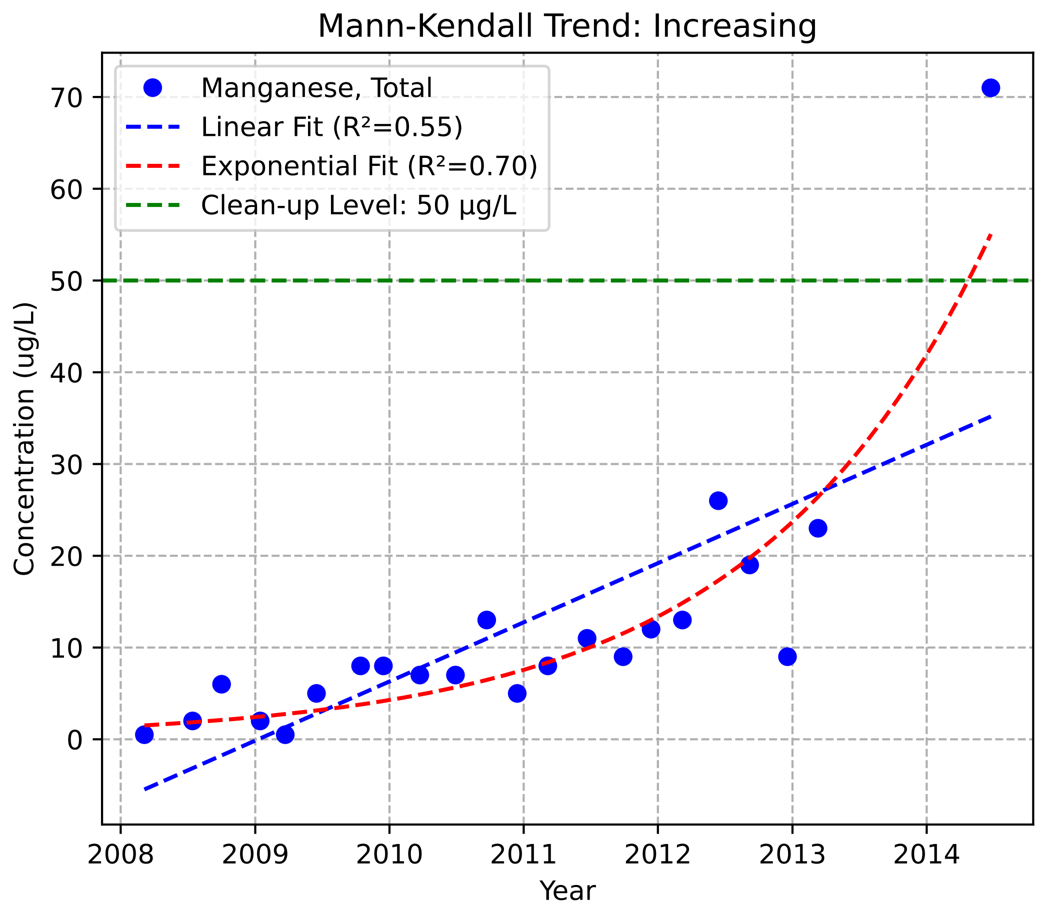
Mann-Kendall Trend: Decreasing
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.75)
Exponential Fit (R²=0.73)
Clean-up Level: 50 μg/L


MW-22c
Mann-Kendall Trend: Decreasing
Arsenic, Total
Linear Fit (R²=0.52)
Exponential Fit (R²=0.60)
Clean-up Level: 5 μg/L
Concentration (ug/L)
Year
Mann-Kendall Trend: No Trend
Manganese, Total
Clean-up Level: 50 μg/L
Concentration (ug/L)
Year

MW-2c

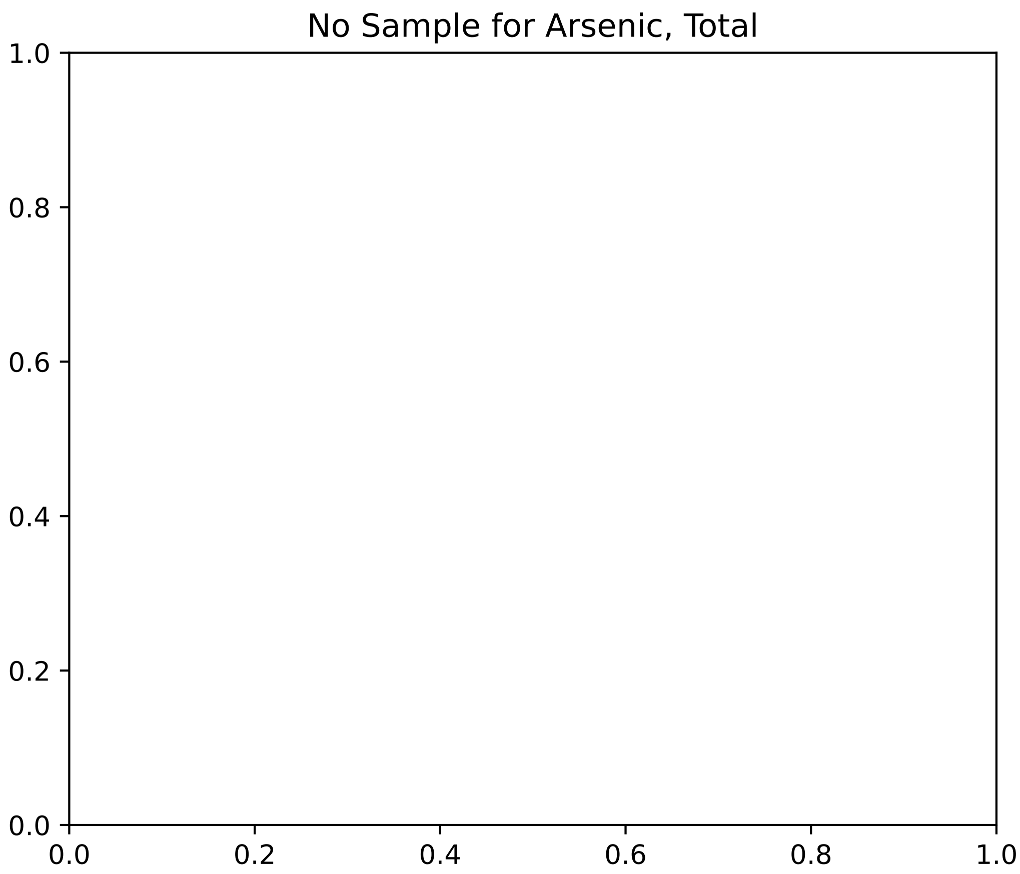


Mann-Kendall Trend: No Trend
Concentration (ug/L)
Year
Arsenic, Total
Linear Fit (R²=0.22)
Exponential Fit (R²=0.11)
Clean-up Level: 5 µg/L

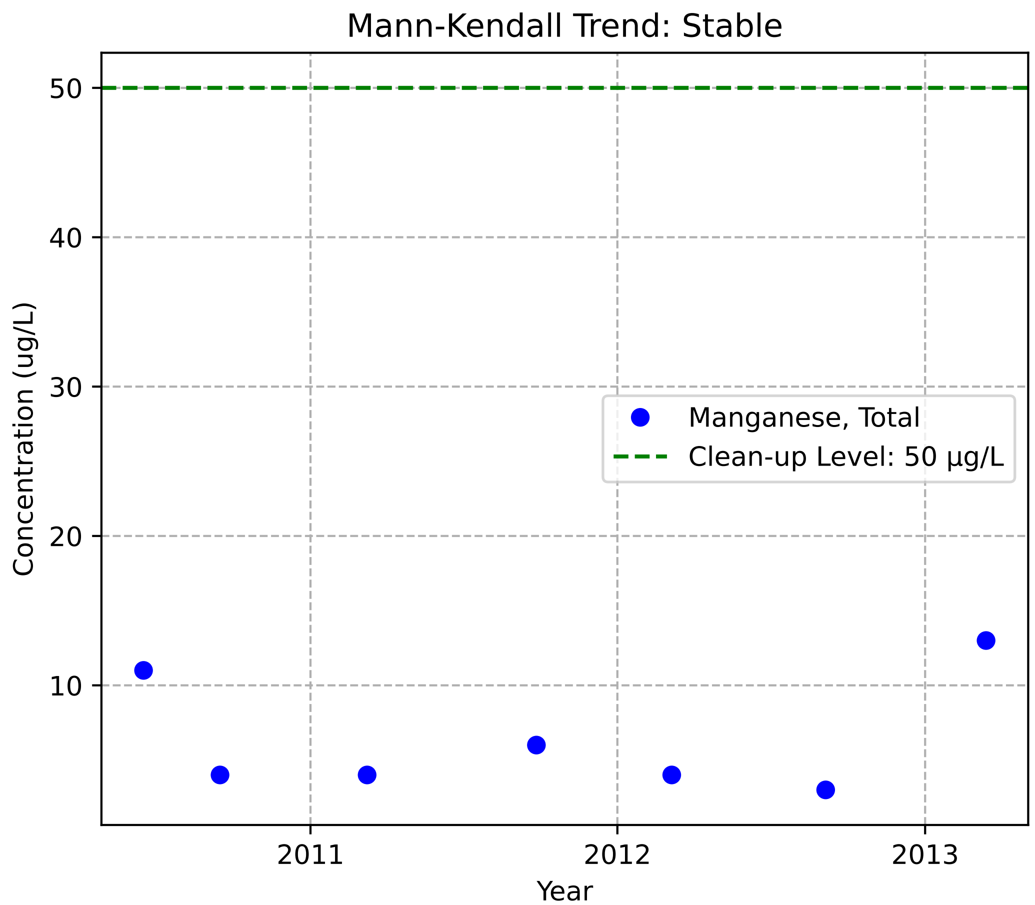


Mann-Kendall Trend: Increasing
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.55)
Exponential Fit (R²=0.70)
Clean-up Level: 50 µg/L

MW-45c

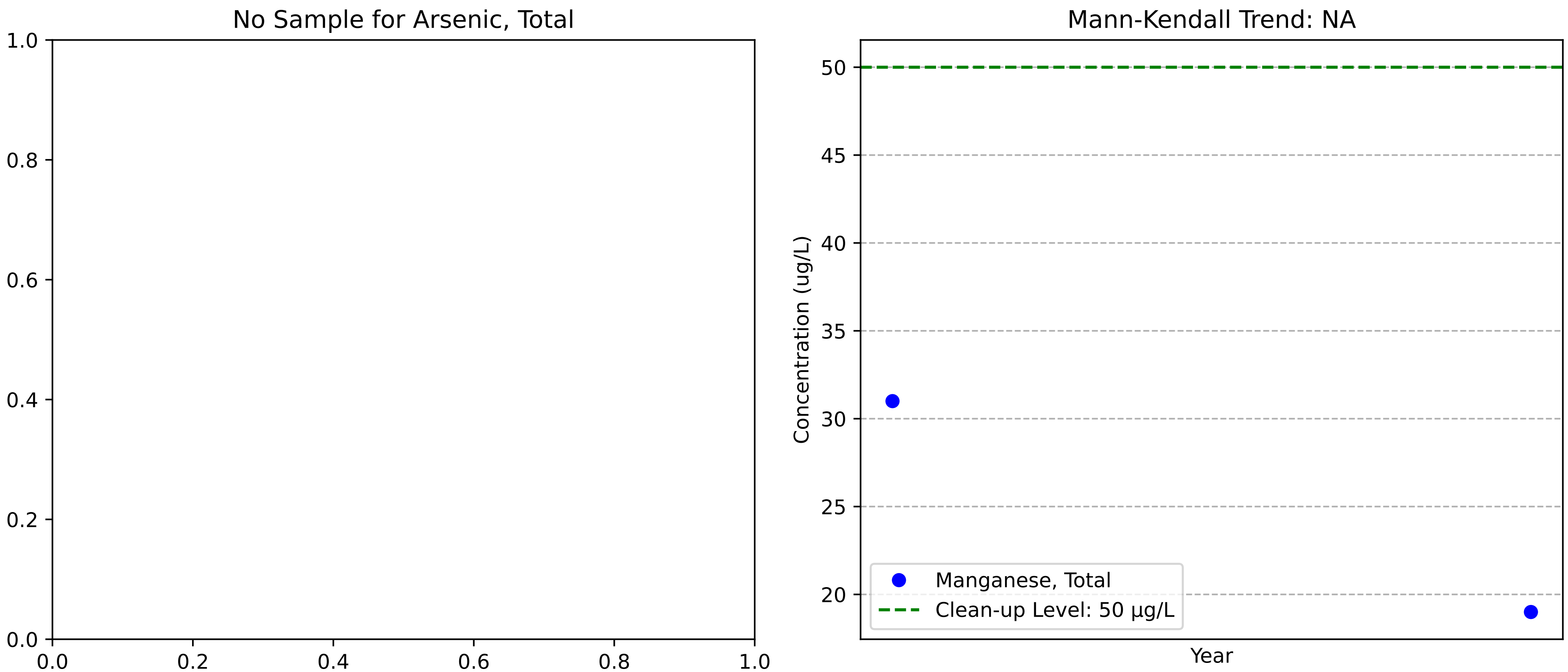


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

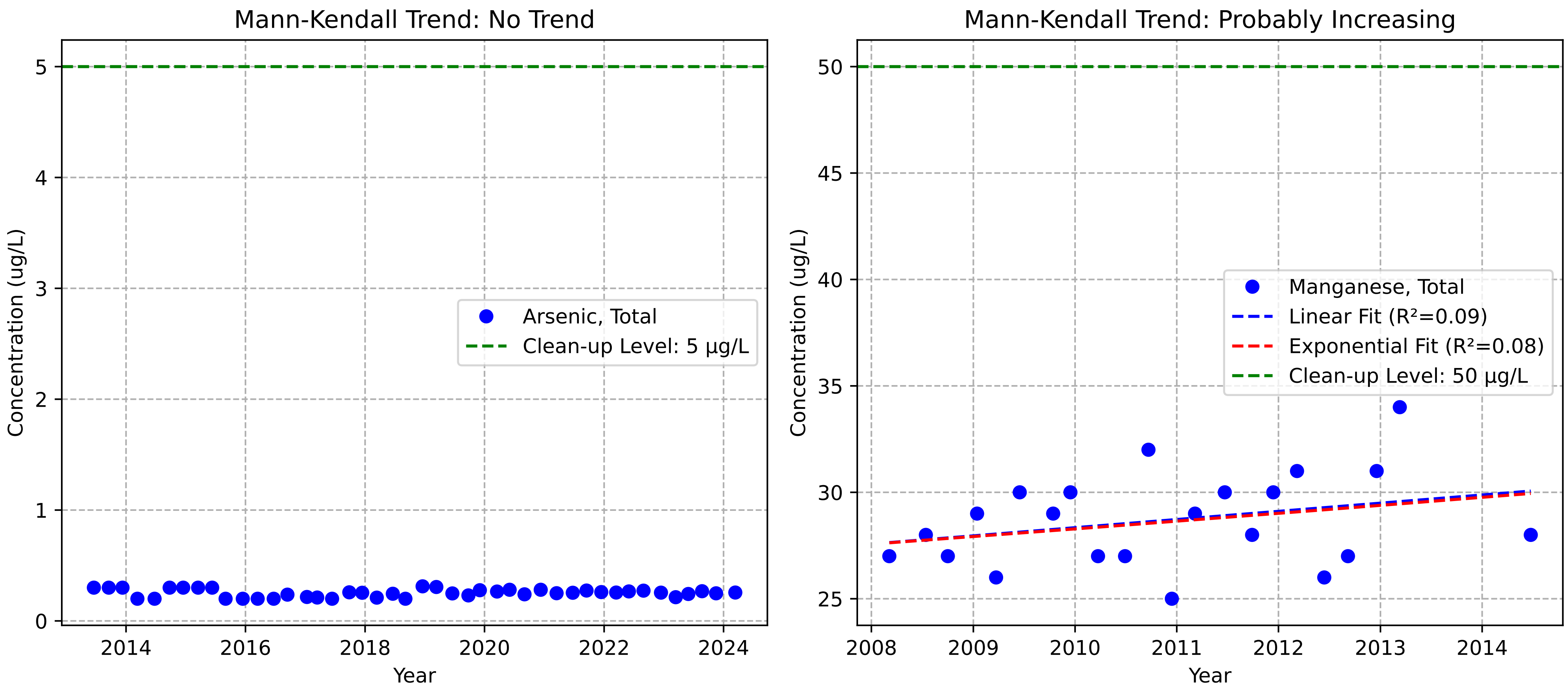


Mann-Kendall Trend: Stable
Concentration (ug/L)
50
40
30
20
10
2011
2012
2013
Year
Manganese, Total
Clean-up Level: 50 µg/L

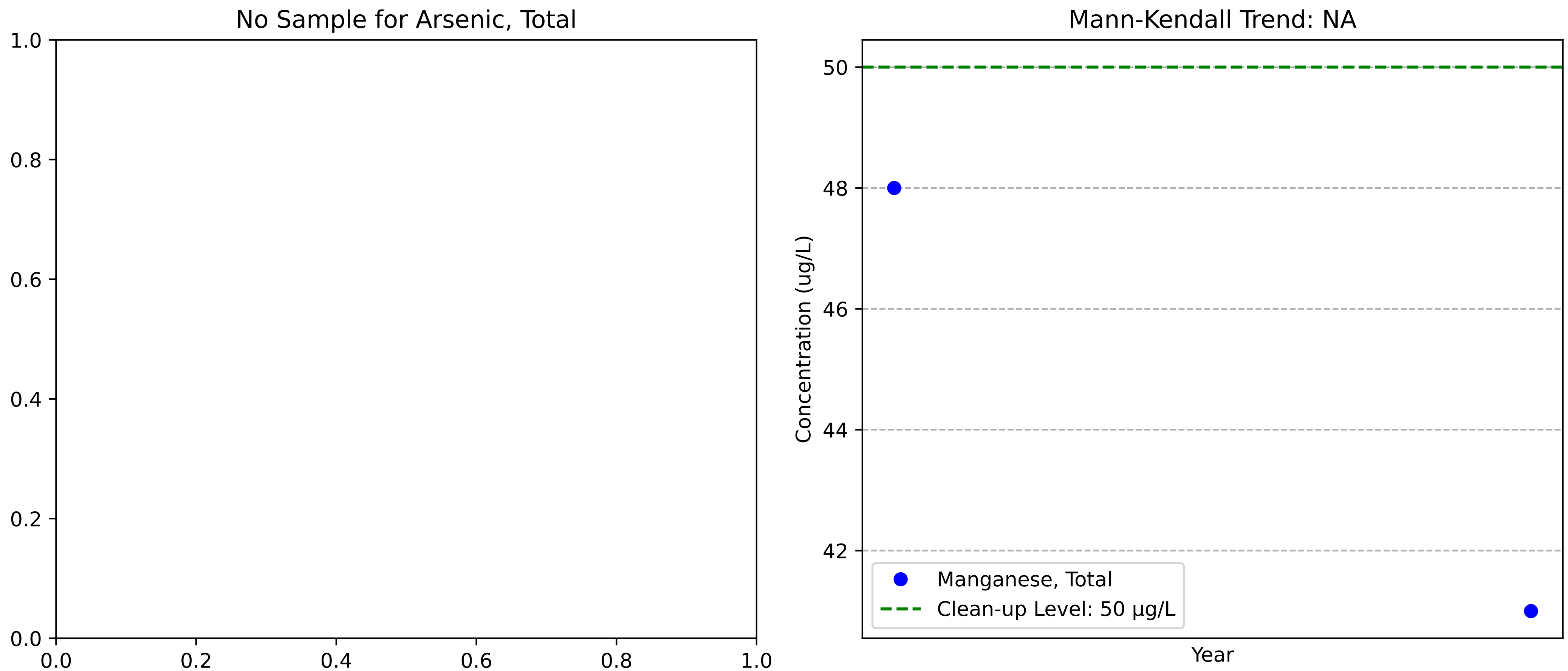
MW-47c

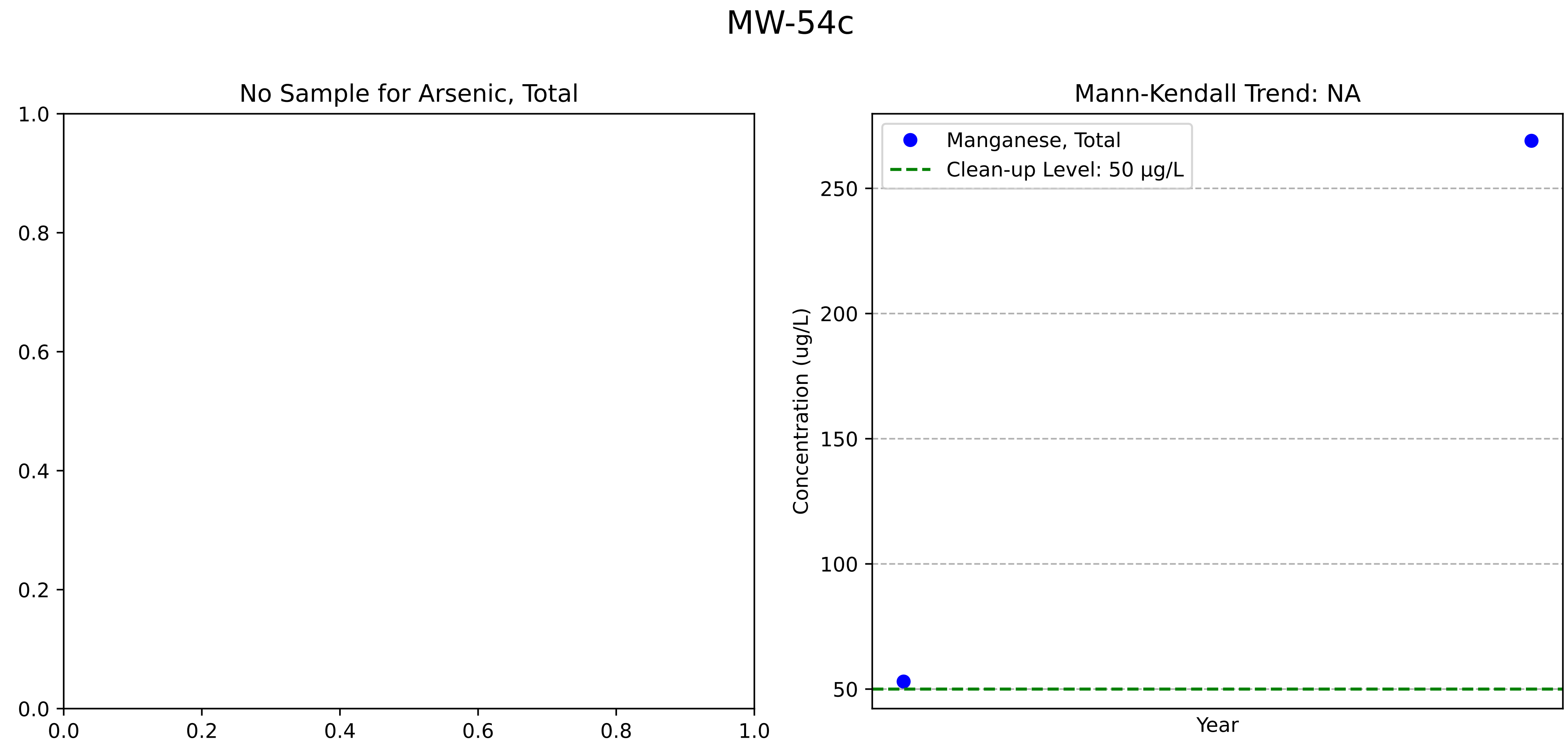

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Concentration (ug/L)
50
45
40
35
30
25
20
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-4c

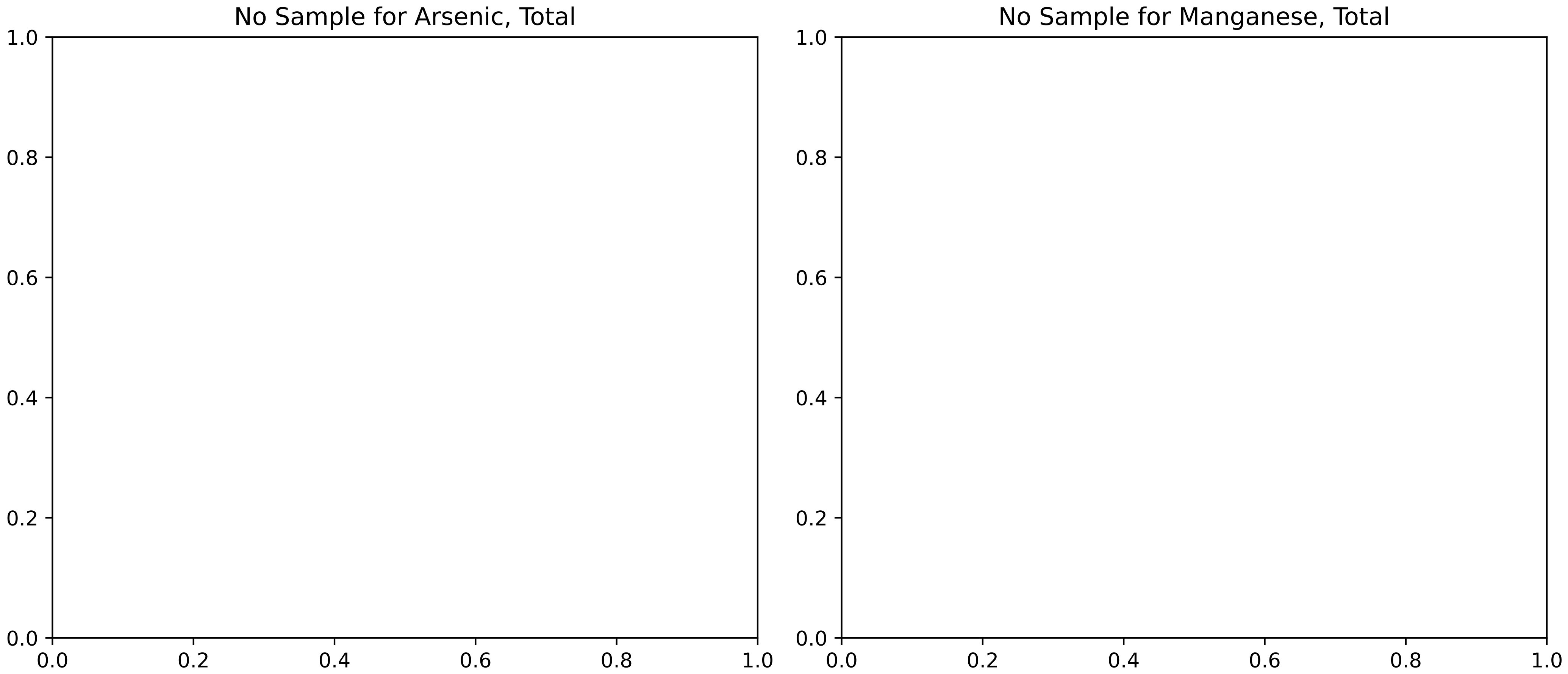

Mann-Kendall Trend: No Trend
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Probably Increasing
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.09)
Exponential Fit (R²=0.08)
Clean-up Level: 50 µg/L

MW-50c

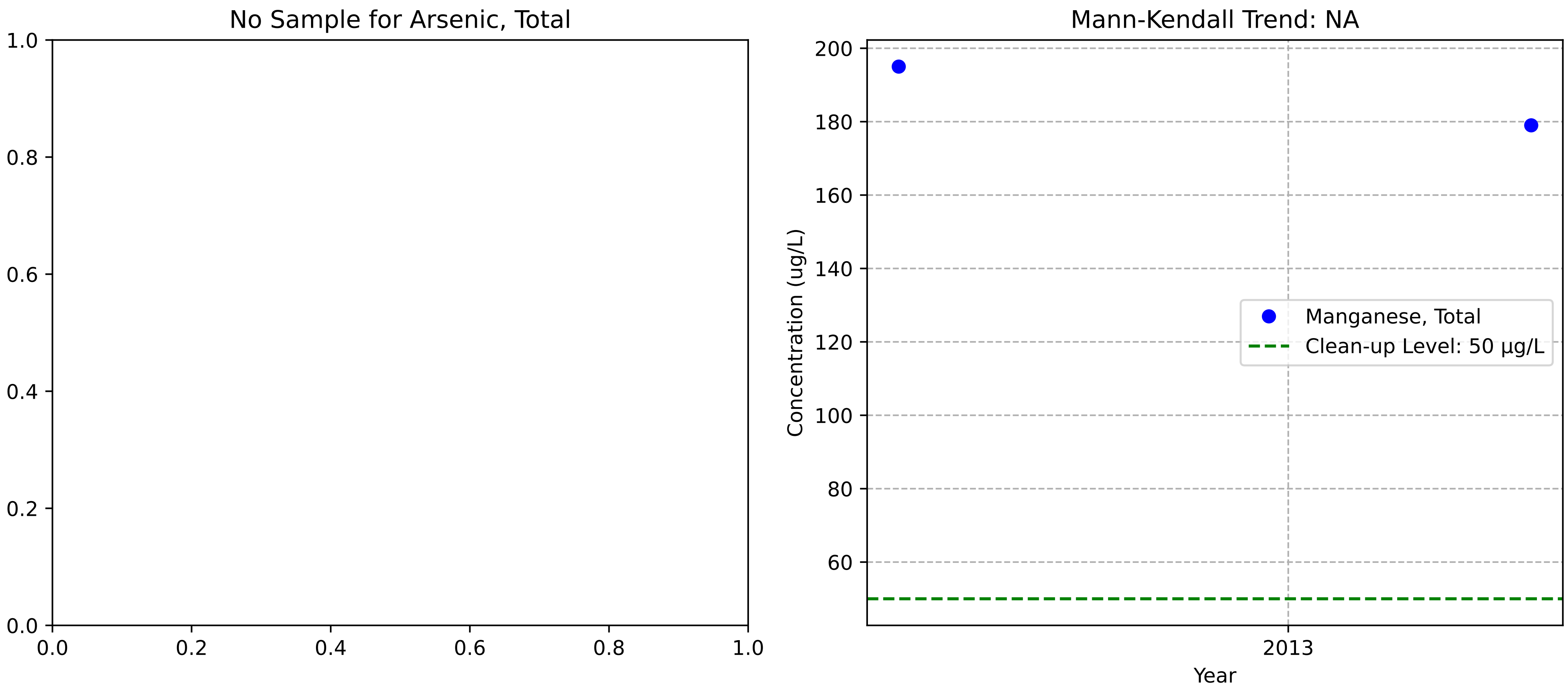

No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Concentration (ug/L)
50
48
46
44
42
Year
Manganese, Total
Clean-up Level: 50 µg/L


MW-54c
No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 µg/L
Concentration (ug/L)
250
200
150
100
50
Year

MW-55c

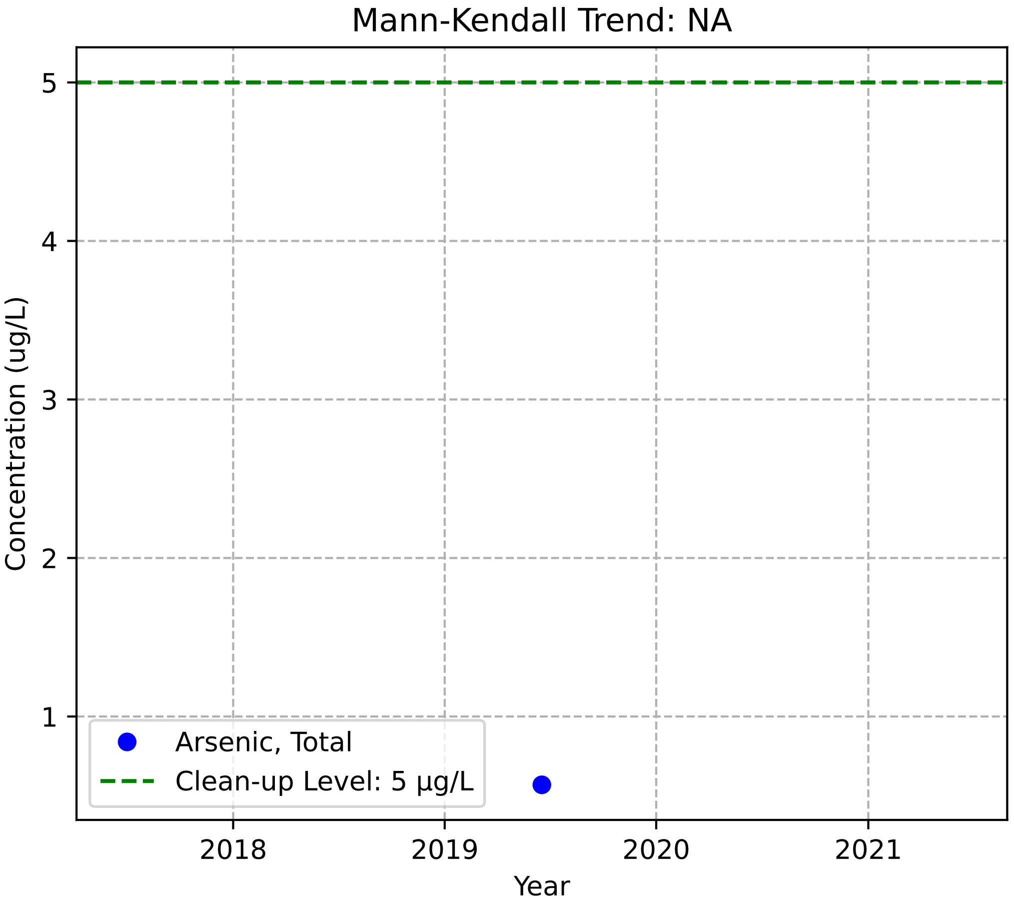

No Sample for Arsenic, Total
No Sample for Manganese, Total
1.0
0.8
0.6
0.4
0.2
0.0

MW-56c

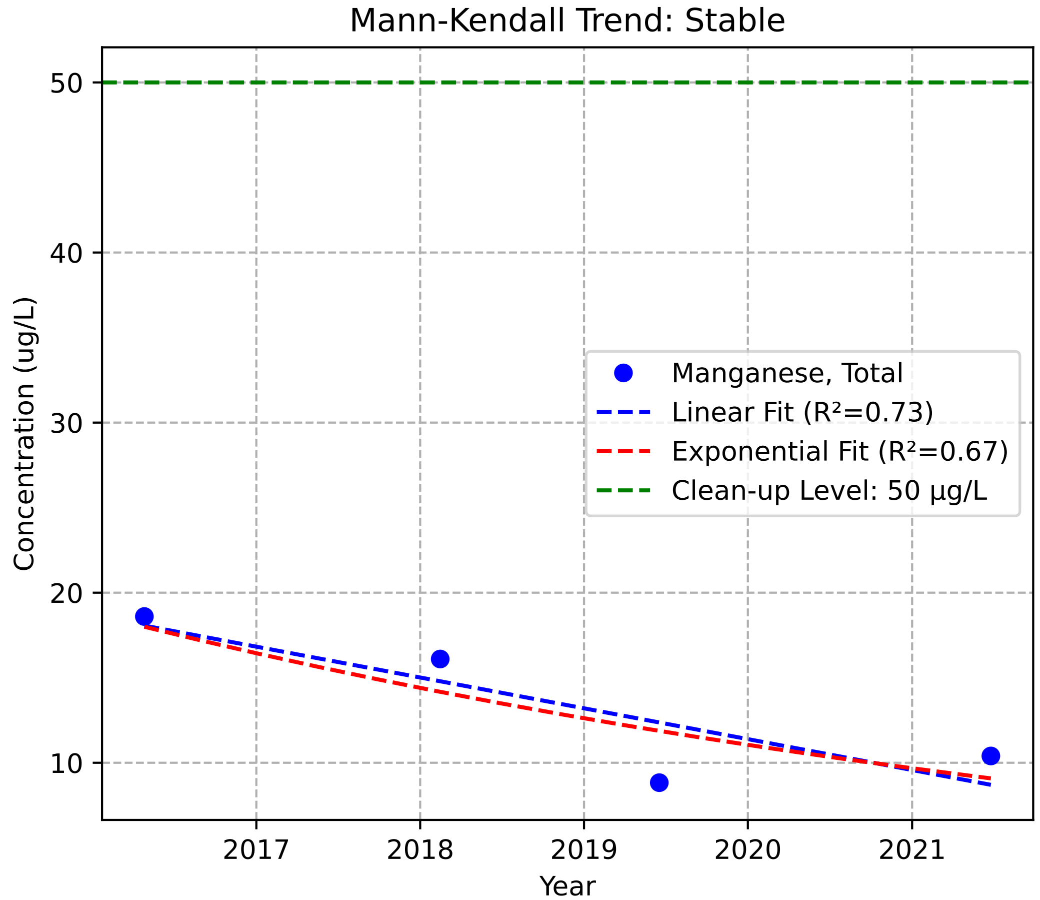


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Concentration (ug/L)
200
180
160
140
120
100
80
60
2013
Year
Manganese, Total
Clean-up Level: 50 µg/L

MW-58c

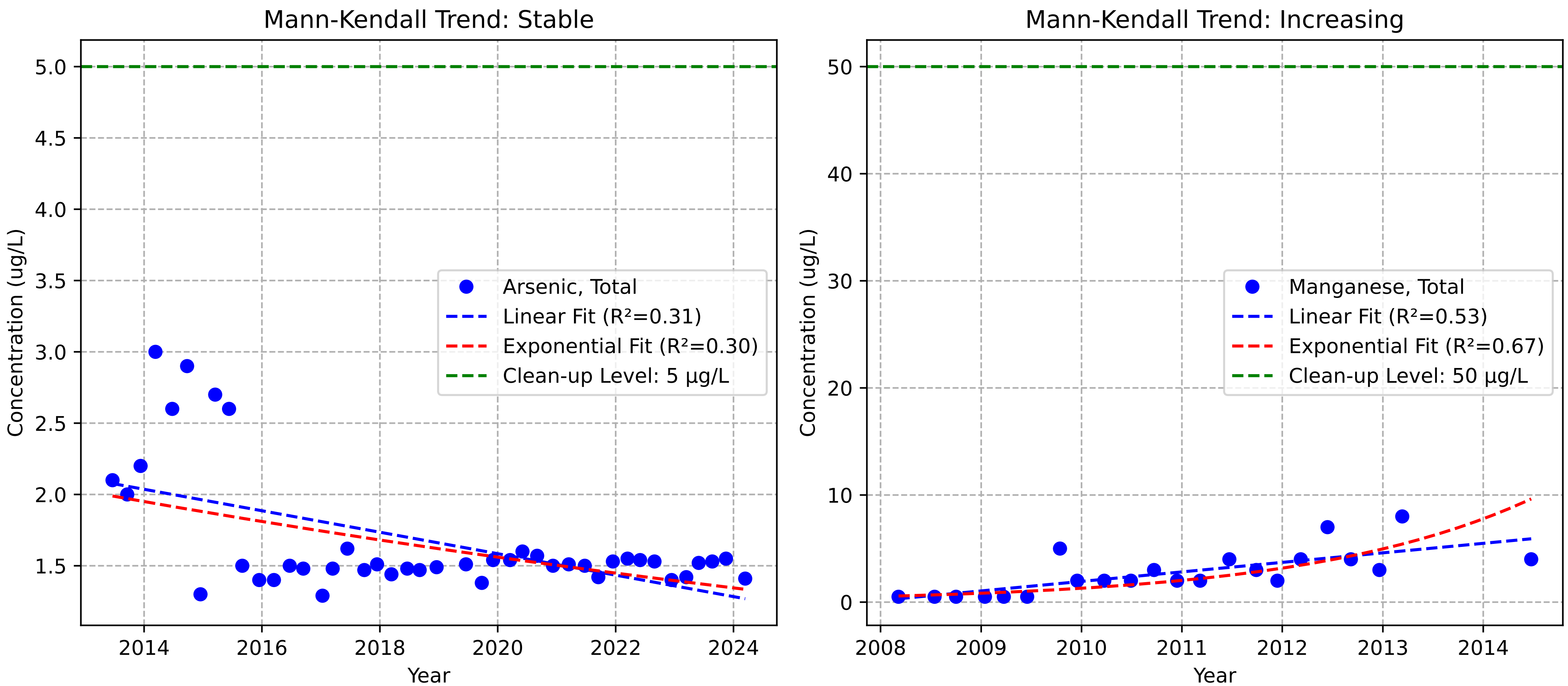


Mann-Kendall Trend: NA
Concentration (ug/L)
Year
Arsenic, Total
Clean-up Level: 5 µg/L



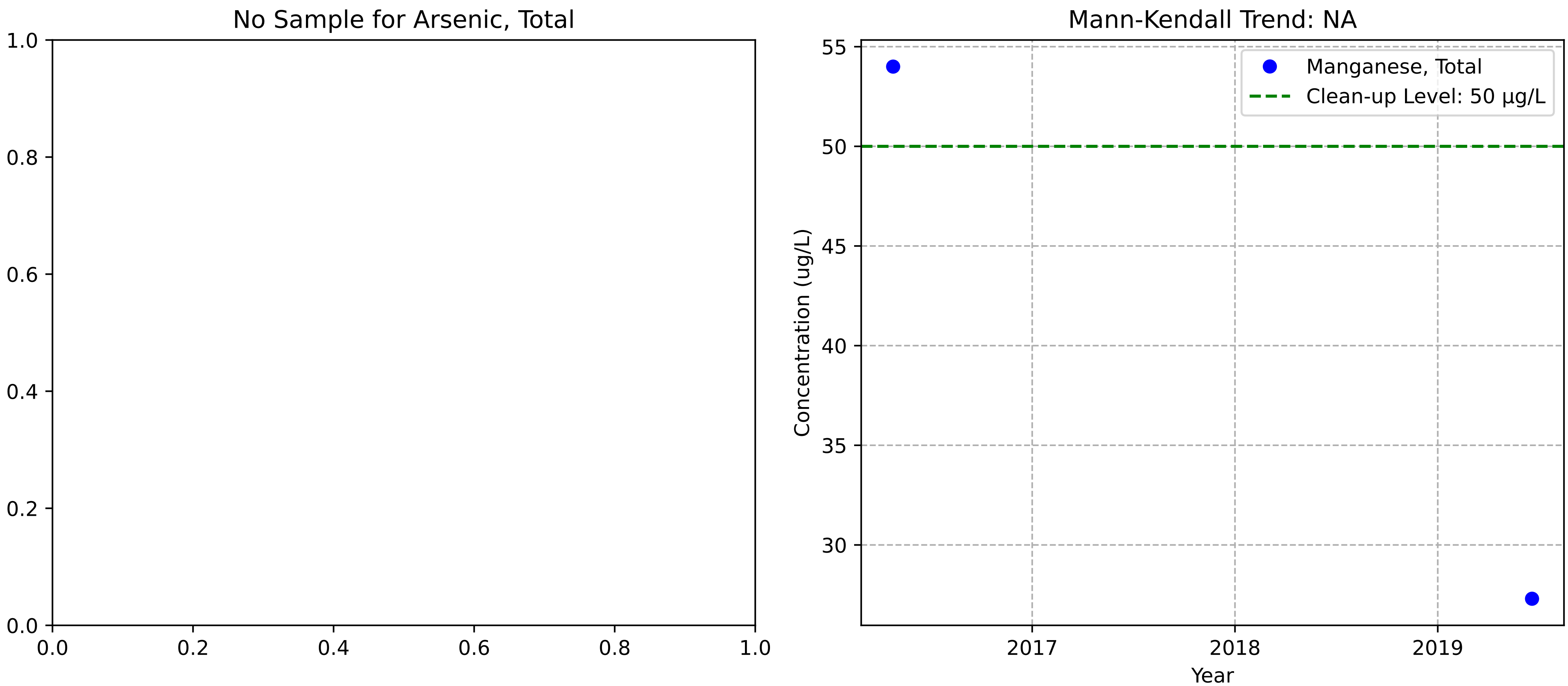
Mann-Kendall Trend: Stable
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.73)
Exponential Fit (R²=0.67)
Clean-up Level: 50 µg/L

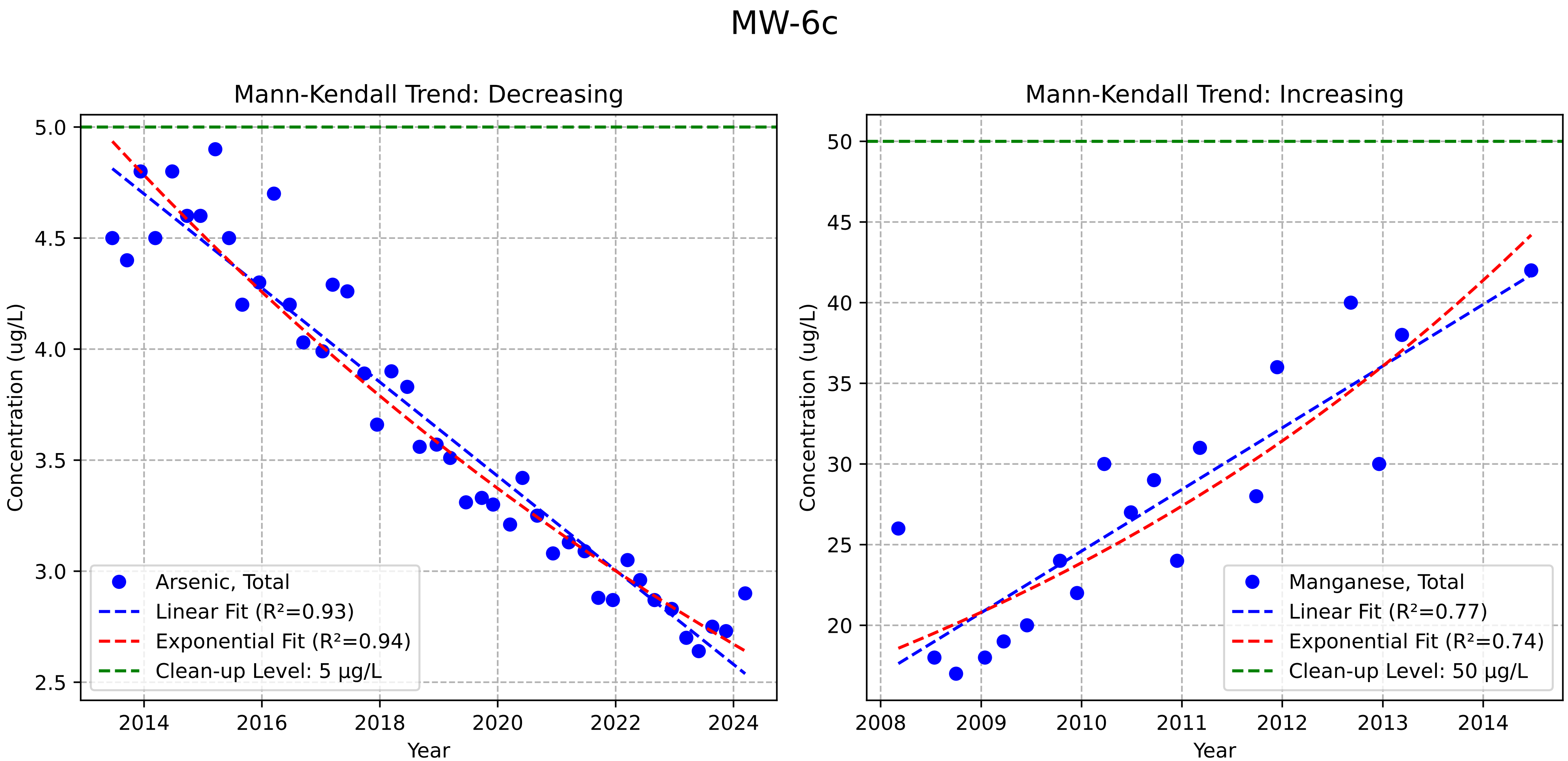
MW-5c



Mann-Kendall Trend: Stable
Concentration (ug/L)
Year
Arsenic, Total
Linear Fit (R²=0.31)
Exponential Fit (R²=0.30)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.53)
Exponential Fit (R²=0.67)
Clean-up Level: 50 µg/L

MW-62c


No Sample for Arsenic, Total
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Mann-Kendall Trend: NA
Manganese, Total
Clean-up Level: 50 μg/L
Concentration (ug/L)
55
50
45
40
35
30
2017
2018
2019
Year


MW-6c
Mann-Kendall Trend: Decreasing
Concentration (ug/L)
Year
Arsenic, Total
Linear Fit (R²=0.93)
Exponential Fit (R²=0.94)
Clean-up Level: 5 µg/L
Mann-Kendall Trend: Increasing
Concentration (ug/L)
Year
Manganese, Total
Linear Fit (R²=0.77)
Exponential Fit (R²=0.74)
Clean-up Level: 50 µg/L

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Appendix D

Site-Specific Health and Safety Plan

Site-Specific Health and Safety Plan – Ephrata Landfill: Expanded MPE Pilot Test Interim Action Workplan

Prepared for
Grant County

October 2024

Parametrix

Site-Specific Health and Safety Plan – Ephrata Landfill: Expanded MPE Pilot Test Interim Action Workplan

Prepared for

Grant County
124 Enterprise Street SE
Ephrata, WA 98823

Prepared by

Parametrix
719 2nd Avenue, Suite 200
Seattle, WA 98104
T. 206.394.3700 F. 1.206.649.6353
www.parametrix.com

October 30, 2024 | 553-1860-014

Citation

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Plan – Ephrata Landfill: Expanded MPE Pilot Test
Interim Action Workplan.
Prepared for Grant County
by Parametrix, Seattle, Washington.
October 30, 2024.

Site-Specific Health and Safety Plan – Ephrata Landfill: Expanded MPE Pilot Test Interim Action Workplan

The material and data contained in this document were prepared under the supervision and direction of the undersigned.

Margaret Spence
Senior Consultant

Brian Pippin
Senior Consultant

Contents

Contents (continued)

Contents (continued)

FIGURES

TABLES

ATTACHMENTS

Acronyms and Abbreviations

CFR	Code of Federal Regulations
CO_2	carbon dioxide
EPA	U.S. Environmental Protection Agency
H_2S	hydrogen sulfide
HASP	health and safety plan
HSC	health and safety coordinator
JHA	job hazard analysis
LTT	liquid treatment train
MPE	multi-phase extraction
NAPL	non-aqueous phase liquid
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
SSO	site safety officer
VTT	vapor treatment train

1. Nearest Facilities for Emergency and Non-Emergency Medical Care

1.1 Nearest Hospital/Emergency Medical Center

Columbia Basin Hospital

200 Nat Washington Way, Ephrata, WA 98823

Phone: 509-754-4631

Distance: 5 miles

Travel Time: 9 minutes

1.1.1 Route to Hospital from Site

See map in Attachment A.

1.1.1.1 Driving Directions to Hospital from Site

1. Follow C 1 and Road 12 NW to Dodson Road NW
2. Turn left onto Dodson Road NW
3. Continue on A Street SE to Columbia Basin Hospital

See campus map for the emergency entrance in Attachment A.

1.2 Nearest Facility for Non-Emergency Medical Care

Medical care for injuries that do not require 911, such as stitches for minor cuts, can be provided at the following location during hours of operation:

Confluence Health- Ephrata Clinic

314 Basin St SW, Ephrata, WA 98823

Phone: 509-754-7186

Hours of Operation: Monday to Friday, 7:30 a.m. to 5:00 p.m.

Distance: 4 miles

Travel Time: 8 minutes

1.3 Emergency Phone Numbers

In the event of an emergency, call 911. For non-emergency matters and whom to inform after an emergency event, see Table 1 below.

Table 1. Contacts for Non-Emergency Matters and Emergency Events

Site Contact	Contact No. 911
Brian Pippin Project Manager	Cell: 425-681-3602
Jason Collings Solid Waste Supervisor	Phone: 509-750-3351 Cell: 509-754-4319
Andy Booth Interim Grant County Public Works Director	Phone: 509-754-6082 Cell: 509-760-4668

Alternate contacts:

- Dwight Miller, Principal-in-Charge, phone: 206-394-3644, mobile: 425-941-1823.
- Melisa Peyton, Health and Safety Coordinator, phone: 253-604-6678, cell: 253-229-7894.

2. Plan Summary

This health and safety plan (HASP) was developed to describe the procedures and practices necessary for protecting the health and safety of Parametrix employees conducting activities at the Ephrata Landfill cleanup site. Other employers, including contractors and subcontractors, will be required to develop and implement their own HASPs to manage the health and safety of their personnel.

Parametrix personnel conducting activities at the site are responsible for understanding and adhering to this HASP. Before fieldwork begins, a site safety officer (SSO) who is familiar with health and safety procedures and with the site will be designated. The SSO will generally be the most experienced person on site. Safety issues should be communicated first to the SSO, then the project manager and Parametrix's health and safety coordinator (HSC) as needed to resolve the issue.

All contractors and subcontractors have the primary responsibility for the safety of their own personnel on the site. All personnel on the site have "stop work" authority if they observe conditions that they believe create an imminent danger.

If Parametrix employees work on the site for more than 1 year, this HASP will be reviewed at least annually. The plan will be updated as necessary to ensure that it reflects the known hazards, conditions, and requirements associated with the site.

Parametrix personnel who will be working on the site are required to read and understand this HASP. Parametrix personnel working on site for the first time and following any formal HASP update must sign the Personnel Acknowledgment Sheet (see Section 17), certifying that they have read and that they understand this HASP and agree to abide by it.

3. Key Project Personnel

Key project personnel are listed in Table 2 below.

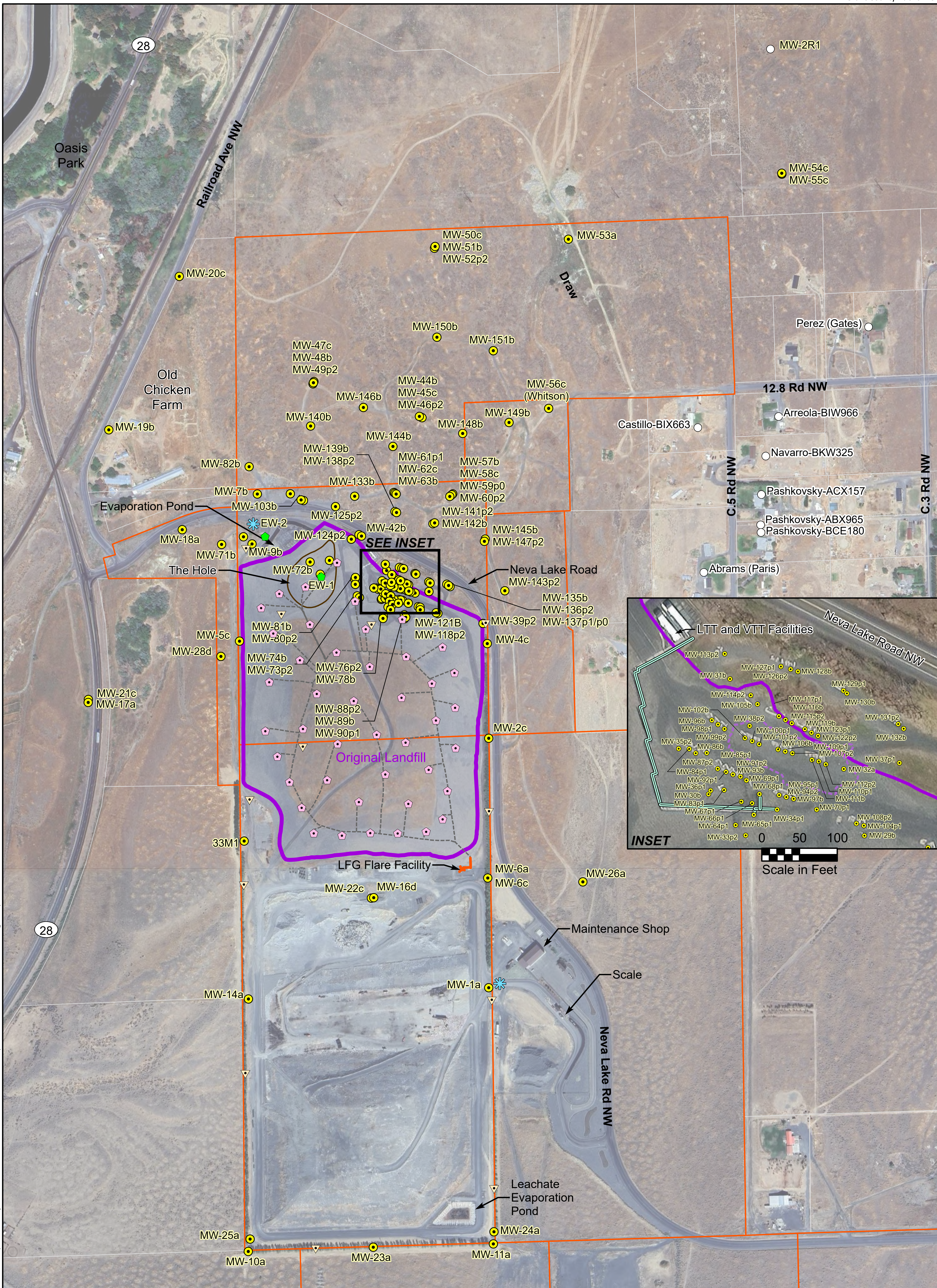
Table 2. Key Project Personnel

Name	Responsibility	Phone #1	Phone #2	Email
Parametrix				
Dwight Miller	Principal in Charge, Principal Consultant	206-410-6446	425-9411823	dmiller@parametrix.com
Brian Pippin	Project Manager, Senior Project Engineer	425-681-3602	206-394-3634	bpippin@parametrix.com
Mike Brady	Field Personnel, Senior Hydrogeologist	206-604-8570	206-519-5781	MBrady@parametrix.com
Sally Nguyen	Field Personnel, Hydrogeologist I	206-395-7367		SNguyen@parametrix.com
Tiffany Neier	Project Support, Project Engineer	206-696-2895	206-394-3671	TNeier@parametrix.com
Drew Norton	Field Personnel, Engineer IV	614-557-5988	206-394-3710	DNorton@parametrix.com
Shira DeGrood	Project Support, Senior Scientist	971-351-7968		sdegrood@parametrix.com
Katie Burke	Field Personnel, Hydrogeologist I	503-416-6075		kburke@parametrix.com
Scott Swedberg	Field Personnel, Engineer II	206-410-6446	206-410-6446	sswedberg@parametrix.com
Walter Havey	Construction Observation, Environmental Technician III	360-731-3032		wharvey@parametrix.com
Other Staff	To be determined			
Melisa Peyton	Health and Safety Coordinator	253-604-6678	253-2297894	mpeyton@parametrix.com
Prime Contractor	**To be determined through public works bidding**			

4. Site Description and Background

4.1 Type of Site

The site, or project area, is located on a portion of the Ephrata Landfill (Figure 1). In 2008, approximately 2,300 buried hazardous waste drums were removed from the site. Grant County requested that Parametrix lead restart and seasonal operation of the multi-phase extraction (MPE) system on the site, followed by construction observation when the system is expanded, then seasonal operation and monitoring of the expanded MPE system. This HASP focuses on construction observation and seasonal operation and monitoring of the expanded MPE system. Work conducted by Parametrix will predominately occur in the northern portion of the Ephrata Landfill, around the MPE system.



Parametrix

- Monitoring Well
- Extraction Well
- Other Well
- Existing MPE Pipe
- Gated Entrance

Landfill Gas System

- Landfill Gas Piping
- Flare Facility
- Gas Extraction Well
- Gas Probe

- County-owned Parcel
- Original Landfill

N

0 250 500

Scale in Feet

2021 Google Earth Aerial Photo

Figure 1-1
Ephrata Landfill
Site Map

4.2 Building/Structures

The Ephrata landfill is a fully fenced facility. Structures proximate to and within the site include an office/storage building, a pretreatment facility, and an evaporation pond.

4.3 Topography

Parametrix personnel will be working in and around the vapor treatment train (VTT) and liquid treatment train (LTT) containers and support building. The VTT, LTT, and support building are in a generally flat area of crushed rock surfacing material. Parametrix personnel will also be working on the landfill, which is sloped and uneven terrain. Roads and paths are crushed rock surfacing material. The landfill surface is covered with well-graded loose cobble about 3 to 6 inches in diameter.

4.4 Geologic/Hydrologic Setting

The Ephrata landfill is situated within the Columbia Plateau region of the Pacific Northwest, which is characterized by its basaltic lava flows and sedimentary deposits. Groundwater is present in the region, with aquifers contained within the porous layers of basalt and sedimentary deposits.

4.5 Site Status

The Grant County Regional Landfill, which is immediately south of the Ephrata Landfill, is active and open to the public. The project area is signed off limits from the Regional Landfill roads, although there are no physical barriers such as gates.

4.6 Site History

This is Parametrix's project Phase 9 (Amendment Nine) of a site cleanup of the old Ephrata Landfill under the Model Toxics Control Act. Completed interim actions include the removal of more than 2,317 buried hazardous waste drums (2008), capping the landfill (2009), and MPE pilot testing and removal of soil contaminated with arsenic (2016 to 2018). Parametrix is the engineering lead, and Mott MacDonald (formerly Pacific Groundwater Group) is the hydrogeology lead. This work is required under the terms of Agreed Order No. DE 3810 Amendment No. 3 between the Washington State Department of Ecology and Grant County.

5. Hazard Evaluation

5.1 Site Tasks and Operations

Parametrix has completed job hazard analyses (JHAs) for specific tasks that likely could be completed on the site, depending on the scope of work (Section 5.3). The following list generally summarizes planned tasks and operations:

- Working near heavy equipment.
- Working around excavations.

- Working under or near overhead loads.
- Working near traffic.
- Groundwater sampling.
- Collecting VTT and LTT samples.
- Monitoring and sampling non-aqueous phase liquids (NAPL).
- Working around electrically powered equipment and controls.

The control measures that field personnel must use to eliminate or minimize these hazards, such as air monitoring, personal protective equipment (PPE), and decontamination procedures, are detailed in the JHAs and in subsequent sections of this plan.

5.2 Chemical Hazard Evaluation

Chemicals of potential concern at the site and corresponding action levels are summarized in Section 5.2.1 and Attachment B. Wildfire smoke is discussed in Section 5.2.2 and Attachment C.

5.2.1 Landfill Gases and Chemical Hazards

Landfill work can potentially lead to exposure to gases like methane, carbon dioxide, and vinyl chloride. Hydrogen sulfide is encountered on occasion, especially in an actively decomposing moist environment. These gases may be encountered during excavation and other disturbance of landfill refuse.

Methane is a naturally occurring gas often found in decomposing landfills. It is lighter than air, flammable, and generally considered nontoxic at lower concentrations. If concentrations are high enough, as with any gas, methane can be asphyxiating. The lower explosive limit for methane is 5% by volume in air (50,000 ppm).

Carbon dioxide (CO_2) is generated through decomposition, and asphyxiating levels can be measured in active landfill piping systems. CO_2 is nontoxic but asphyxiating at high concentrations (several thousand ppm). Generally, in indoor office environments, it is desirable to maintain CO_2 levels below 1,000 ppm to maintain occupant comfort. Normal outdoor concentrations of CO_2 are around 300 ppm.

Vinyl chloride is often formed from decomposition of synthetic materials and can be encountered at municipal solid waste landfills. It is carcinogenic, very light in air, and dissipates very quickly. Consequently, it can be difficult, if not impossible, to measure in ambient air, thus reducing its chance of inhalation. Vinyl chloride, like the other gases, can be found in active landfill cells via the piping system or during excavation on an active cell or face. Vinyl chloride is also one of several volatile organic compounds found in the P1 zone immediately south of the former buried drums. The recommended exposure limits for vinyl chloride are 1 ppm averaged over a 10-hour period during a 40-hour workweek.

Hydrogen sulfide (H_2S) can be formed from anaerobic bacterial action and is sometimes measured in landfill piping. It is corrosive, thought to cause heart problems, and can be asphyxiating at high concentrations (several hundred ppm). The recommended exposure limit for H_2S is 10 ppm averaged over a 10-hour period during a 40-hour workweek and a ceiling limit of 15 ppm, which should not be exceeded at any time. The immediately dangerous to life and health value is 100 ppm. A problem with H_2S is its ability to temporarily paralyze the olfactory nerves, making it impossible to sense at high concentrations.

Personnel exposure to landfill gas is possible during sampling activities or if pipes break or equipment fails in such a way as to release landfill gas. Volatilization of organic compounds could occur in wells, piping, tanks, and equipment during pumping and treatment activities.

Arsenic occurs naturally in some Eastern Washington rock and soil and has been detected in soil and groundwater samples associated with this site. The principal route of exposure of arsenic at the site is from accidental ingestion of groundwater. Threshold limit values for employee exposure to arsenic are listed in Attachment B.

Chemicals in groundwater: In addition to vinyl chloride, there is potential for exposure to other organic chemicals during field sampling. Threshold limit values for employee exposure to potential organic chemicals are listed in Attachment B. Any of these chemicals can affect the body if inhaled or swallowed or if contact occurs with the eyes or skin. The principal route of exposure at the site is from inhalation and skin contact.

5.2.2 Wildfire Smoke

Although there are many hazardous chemicals in wildfire smoke, the main harmful pollutant for people who are not close to the fire is "particulate matter," the tiny particles suspended in the air. These tiny particles can reach the deepest parts of the lungs and can be absorbed into the body. The U.S. Environmental Protection Agency (EPA) has determined that particulate matter may cause or worsen cardiovascular disease, respiratory disease, cancer, and can harm the nervous system. A JHA for wildfire smoke can be found in Attachment C.

5.3 Physical Hazards

The specific physical hazards and associated controls for work on the site are described in the JHAs for the specific tasks likely to be completed on the site. The control measures that field personnel must use to eliminate or minimize these hazards are detailed in the JHAs below and in the relevant sections of this plan.

5.3.1 Working near Heavy Equipment

The JHA for working near heavy equipment is provided in Table 3.

Table 3. JHA for Working near Heavy Equipment

Job/Task Description		
Employees will conduct work such as construction observation and operation and monitoring of the expanded MPE system. This will require work near heavy equipment, construction operations, and MPE system equipment.		
Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Bodily harm or death	Heavy equipment operating on-site creating a potential for site workers to be struck, crushed, or impacted by moving parts	Stay a safe distance from equipment and maintain eye contact with equipment operators. Wear a safety vest for enhanced visibility.
Eye injury	Construction debris (e.g., soil) coming into contact with eyes	Wear eye protection with side shields.
Head injury	Heavy equipment and/or tools impacting the head	Wear a hard hat.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Penetration of feet	Sharp objects that could be stepped on; large objects falling on feet	Wear steel-toe boots with steel shank.
Hearing loss	Noise generated by heavy equipment/machinery	Wear hearing protection such as earplugs or earmuffs.
Injury to bystanders	Pedestrians in the locality of work	Use cones and caution tape to cordon off the immediate work area. Watch for and escort pedestrians away from the work area. Pause work if necessary.
Hand injury	Pinch points	Wear protective gloves whenever possible. Avoid placing hands near operating equipment.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
None	None specific to this JHA. Chemical hazards related to the site are described in Section 5.2 and Attachment B.	None.

Additional Control Measures and Guidance
Engineering Controls: No engineering controls are specified.
General Safe-Work Practices and Guidance: ▪ Personnel should stay upwind and out of the impact area of the heavy equipment if feasible. ▪ Cones, barrier tape, or other equivalent methods will be used to establish the impact area if feasible. ▪ Work conducted in the impact area must be coordinated with the equipment operator using pre-established methods of communication, such as direct eye contact, hand signals, and/or verbal communication.
Personal Protective Equipment: Hard hat, steel-toe work boots with steel shank, high-visibility safety vest or outer garment, safety glasses with side shields, nitrile gloves, and hearing protection (i.e., earplugs or earmuffs).

5.3.2 Working Around Excavations

The JHA for working around excavations is provided in Table 4.

Table 4. JHA for Working Around Excavations

Job/Task Description
Employees will conduct work such as construction observation. This will require occasional work near excavations.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Bodily harm or death	Possible to fall into open excavation from heights.	Stay a safe distance from the excavation area. Signs, cones, barrier tape, or other equivalent methods will be used to mark open excavations.
Eye injury	Construction debris (e.g., soil) coming into contact with eyes.	Wear eye protection with side shields.
Head injury	Possible to fall into open excavation from heights.	Stay a safe distance from excavation area. Signs, cones, barrier tape, or other equivalent methods will be used to mark open excavations.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Chemical	None specific to this JHA, unless contact made with contaminated materials.	If necessary, see Section 5.2 and Attachment B for applicable chemical hazards.
Biological	No unique source of biological hazards warranting specific controls.	None.

Additional Control Measures and Guidance
Engineering Controls: No engineering controls are specified.
General Safe-Work Practices and Guidance: ▪ Personnel will stay out of excavations at all times. ▪ If heavy equipment is being operated, the JHA for working around heavy equipment will be referenced. ▪ Signs, cones, barrier tape, or other equivalent methods will be used to mark open excavations if feasible. ▪ Any work that must be conducted near excavations will be conducted using a buddy system.
Personal Protective Equipment: Hard hat, work boots, high-visibility vest, safety glasses with side shields, hearing protection (i.e., earplugs or earmuffs) and nitrile gloves if handling potentially impacted media.

5.3.3 Working Under or near Overhead Loads

The JHA for working under or near overhead loads is provided in Table 5.

Table 5. JHA for Working Under or near Overhead Loads

Job/Task Description
Employees will conduct work such as construction observation and operation and monitoring of the expanded MPE system. This will require work under or near overhead loads.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Bodily harm or death	Heavy equipment operating on site and overhead treatment system equipment creates a potential for site workers to be struck, crushed, or impacted by overhead loads.	Stay a safe distance from equipment and maintain eye contact with equipment operators. Wear a safety vest for enhanced visibility.
Head injury	Debris from vehicles carrying overhead loads moving on or around site and overhead treatment system equipment.	Hard hat.
Foot injury	Large or heavy objects falling on feet.	Wear steel-toe boots with steel shank.
Eye injury	Debris, chemicals, or splashes coming into contact with eyes.	Wear eye protection with side shields.
Hand injury	Pinch points.	Wear protective gloves whenever possible. Avoid placing hands near operating equipment.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Slips, trips, and falls	Ice, plastic sheeting, uneven ground.	Use caution when walking on plastic sheeting and uneven ground and in general when snowy and/or icy conditions exist. Sidestep/step over hazards on the ground. Avoid walking on steep slopes.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
None	None specific to this JHA. Chemical hazards related to the site are described in Section 5.2 and Attachment B.	None.

Additional Control Measures and Guidance
Engineering Controls: No engineering controls are specified.
General Safe-Work Practices and Guidance: ▪ Personnel should stay out of the impact area of the heavy equipment if feasible. ▪ Cones, barrier tape, or other equivalent methods will be used to establish the impact area if feasible. ▪ Work conducted in the impact area must be coordinated with the equipment operator using pre-established methods of communication, such as direct eye contact, hand signals, and/or verbal communication.
Personal Protective Equipment: Hard hat, steel-toe work boots with steel shank, high-visibility safety vest or outer garment, safety glasses with side shields, nitrile gloves, and hearing protection (i.e., earplugs or earmuffs).

5.3.4 Working near Traffic

The JHA for working near traffic is provided in Table 6.

Table 6. JHA for Working near Traffic

Job/Task Description
Employees will conduct work such as construction observation and operation and monitoring of the expanded MPE system. This will require work near heavy equipment and vehicles entering and exiting the site.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Bodily injury	Vehicles moving on or around site.	Wear a reflective safety vest for enhanced visibility. Use cones and/or barriers to designate traffic patterns.
Eye injury	Debris (e.g., soil) contacting eyes due to vehicle movement.	Wear eye protection with side shields.
Head injury	Vehicles moving on or around site.	Wear a hard hat.
Foot injury	Vehicles moving on or around site.	Wear steel-toe boots with steel shank.
Hearing loss	Noise generated by vehicles moving on or around site.	Wear hearing protection, such as earplugs or earmuffs.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
None	None specific to this JHA. Chemical hazards related to the site are described in Section 5.2 and Attachment B.	None.

Additional Control Measures and Guidance
Engineering Controls: No engineering controls specified.
General Safe-Work Practices and Guidance: ▪ Personnel will stay upwind and out of heavy traffic areas if feasible. ▪ Cones, signage, barrier tape, or other equivalent methods will be used to establish traffic-control patterns if feasible. ▪ Personnel should monitor traffic hazards before entering locations with potential vehicle movement.
Personal Protective Equipment: Hard hat, steel-toe work boots with steel shank, high-visibility safety vest or outer garment, safety glasses with side shields, nitrile gloves, and hearing protection (i.e., earplugs or earmuffs).

5.3.5 Collecting Groundwater and Vapor Samples

The JHA for collecting groundwater and vapor samples is provided in Table 7.

Table 7. JHA for Collecting Groundwater and Vapor Samples

Job/Task Description		
Employees will conduct work such as collecting groundwater and vapor samples.		
Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Heat/cold/ sunburn	Weather.	Wear sunscreen on exposed skin. Stop work if an employee feels symptoms of dehydration, overheating, or heat stroke. Move to a shaded area and consume water. During cold conditions, wear adequate clothing to reduce the potential for hypothermia.
Eye injury	Construction debris and splashes (e.g., soil and water) coming into contact with eyes.	Wear eye protection with side shields.
Physical stress	Heavy lifting of equipment and bailing water.	Use proper lifting techniques and take breaks and rest as needed.
Accidents with equipment/tools	Sample-collection equipment/tools.	Use only appropriate equipment for its intended use. Secure equipment in vehicle with netting or straps. Do not leave loose.
Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Chemical	Personnel performing tasks may come into direct contact with contaminated groundwater.	If necessary, see Section 5.2 and Attachment B for applicable chemical hazards. The personal protective equipment described below should be used during groundwater sampling to minimize direct contact with groundwater.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Biological—animals	Biting or stinging insects, spiders, snakes, and livestock.	When necessary, use bug repellent. Use snake chaps or shin guards when grass is above the ankle. Use a bar to clear spiders and/or snakes from objects and/or vegetation.

Additional Control Measures and Guidance
Engineering Controls: No engineering controls are specified.
Chemical or Biological Concerns Specific to this JHA: None.
General Safe-Work Practices and Guidance: ▪ Do not eat or drink in the immediate area where sampling is being conducted. ▪ Wash hands and face before eating or drinking. ▪ Dispose of used nitrile gloves in an appropriate container. ▪ Avoid working with breathing zone directly above the opening of the well casing. When possible, work upwind of the well casing. ▪ If work is conducted in or near traffic areas, wear high-visibility vests. Use cones, flagging, or other devices to mark out the work area. ▪ Always carry a cellular phone while working in remote areas.
Personal Protective Equipment: Hard hat, work boots, high-visibility vest, safety glasses with side shields, and disposable nitrile gloves. Avoid direct contact with groundwater.

5.3.6 Collecting VTT and LTT Samples

The JHA for collecting VTT and LTT samples is provided in Table 8.

Table 8. JHA for Collecting VTT and LTT Samples

Job/Task Description
Employees will conduct work such as collecting samples from the VTT and LTT.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Eye injury	Construction debris coming into contact with eyes.	Wear eye protection with side shields.
Physical stress	Heavy lifting of sampling equipment, compressed gas cylinders, sample coolers; kneeling on hard or gravel surfaces.	Use proper bending/lifting techniques by bending and lifting with legs and not with back. Do not twist at the waist when turning. Use buddy system for heavy objects. Use kneepads or a kneeling pad. Take breaks and rest as needed.
Accidents with equipment/tools	Sample-collection equipment/tools.	Verify that you have the appropriate equipment/tools for your tasks. Use equipment/tools as intended by the manufacturer. Stow tools in vehicle properly; use appropriate cases and bags. Secure equipment in vehicle with netting and straps. Do not leave loose. Doing so can cause property damage or serious injuries to others or self.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Chemical	Chemical hazards related to the site are described in Section 5.2 and Attachment B.	If necessary, see Section 5.2 and Attachment B for applicable chemical hazards. Wear the appropriate personal protective equipment, including nitrile gloves, during sampling to prevent direct contact with contaminants in soil. If appropriate, use of a half-face respirator may be necessary.
Biological—animals	Spiders and rodents.	Use nitrile gloves and a mask when working in enclosed areas where rodent droppings are present. Do not touch mouth, eyes, nose, or open wounds when working near rodent droppings.

Additional Control Measures and Guidance
Engineering Controls: No engineering controls are specified.
General Safe-Work Practices and Guidance: ▪ Always wear nitrile gloves when handling samples and sampling equipment. ▪ Do not eat or drink in the immediate area where sampling is conducted. ▪ Wash hands and face before eating or drinking. ▪ Used nitrile gloves should be disposed of in a container labeled for disposable items. ▪ During transport and use, properly secure compressed gas cylinders. ▪ Attach regulator and hose to compressed gas cylinder in appropriate manner. ▪ Grasp or secure hose when in use. Do not allow to whip. ▪ Employees should use caution when working around rodent droppings. If possible, use a shop vac to remove rodent droppings before commencing work. ▪ Secure equipment in vehicle with netting or straps; do not leave loose.
Personal Protective Equipment: Hard hat (if overhead hazard is present), work boots (if working near heavy equipment), high-visibility vest, safety glasses, disposable nitrile gloves, hearing protection (i.e., earplugs or earmuffs) as needed, and respiratory protection if necessary.

5.3.7 Monitoring and Sampling Non-Aqueous Phase Liquids

The JHA for monitoring and sampling NAPL is provided in Table 9.

Table 9. JHA for Monitoring and Sampling NAPL

Job/Task Description
Employees will conduct work such as collecting NAPL thickness measurements and samples.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Heat/cold/sunburn	Weather.	Wear sunscreen on exposed skin. Stop work if an employee feels symptoms of dehydration, overheating, or heat stroke. Move to a shaded area and consume water. During cold conditions, wear adequate clothing to reduce the potential for hypothermia.
Impact—eyes	Debris and splashes; opening pressurized wells.	Wear eye protection.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Physical stress	Heavy lifting of equipment, purge water/NAPL, and sample coolers; kneeling on hard or gravel surfaces.	Use proper lifting techniques by bending and lifting with legs and not the back. Do not twist at the waist when turning. Use buddy system for heavy objects. Take breaks and rest as needed.
Accidents with equipment/tools	Sample-collection equipment/tools.	Verify you have the appropriate equipment/tools for your tasks. Use equipment/tools as intended by the manufacturer. Stow tools in vehicle properly; use appropriate cases and bags. Secure equipment in vehicle with netting and straps. Do not leave loose. It can cause property damage or serious injuries to others or yourself.
Slips, trips, and falls	Ice, plastic sheeting, uneven ground.	Use caution when walking on plastic sheeting and uneven ground and in general when snowy and/or icy conditions exist. Avoid stepping in open well monuments. Sidestep/step over hazards on the ground.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Biological—animals	Stinging insects, spiders, snakes, deer, rodents, and vegetation (e.g., blackberry bushes).	When necessary, use bug repellent. Insect nests should never be disturbed. If necessary, long pants and a long-sleeved shirt should be worn while on the site. Employees who are allergic to stings should not work in areas where there is a high risk of being stung. Check well vaults and security lids for insects; use caution when opening. Western diamondback rattlesnakes inhabit the region and have been seen on site.
Chemical	Chemical hazards related to the site are described in Section 5.2 and Attachment B.	If necessary, see Section 5.2 and Attachment B for applicable chemical hazards.

Additional Control Measures and Guidance
Engineering Controls: Electric and/or pneumatic fans can be used to abate nuisance odors when working indoors or outdoors. Fans can also be used when air monitoring action levels have been exceeded.
General Safe-Work Practices and Guidance: ▪ Do not eat or drink in the immediate area where NAPL monitoring/sampling is being conducted. ▪ Wash hands and face before eating or drinking. ▪ Dispose of used nitrile gloves in appropriate container/manner. ▪ Avoid working with the breathing zone directly above the opening of the well casing. When possible, work upwind of the well casing. ▪ Keep face away from monument when removing well cap. ▪ Use plastic garbage bags or plastic sheeting to cover the work area. It is preferable to roll/berm the edges to catch any drips/spills. If raining, work underneath a rain canopy. ▪ When removing a dedicated bladder pump from a well, secure air/discharge lines to hose reel with a clamp prior to removal. Turn hose reel slowly to avoid splatter/spray. ▪ Avoid splashing/splattering NAPL or otherwise coming into direct contact with NAPL. If direct contact occurs, remove NAPL with a paper towel and immediately wash the affected area thoroughly with soap and water. ▪ Use caution when pulling up bailers full of NAPL, because NAPL-coated string and bailers can become slippery. Avoid jarring NAPL-coated string and bailers, as splattering can occur. Put lids on sample jars ASAP to avoid spilling. ▪ When pouring NAPL (or NAPL/groundwater mixture) from a bailer into a bucket, watch for fluid leaking from the back end (bottom) of the bailer. Consider setting up paper towels/sorbent pads or a second bucket to catch any leaks. Make sure to conduct all NAPL-related activities over plastic sheeting. ▪ Do not operate vehicle when wearing Tyvek that may have NAPL on it. ▪ If work is conducted in or near traffic areas, wear high-visibility vests and use cones, flagging, or other devices to mark out the work area. ▪ Clean monitoring and sampling equipment appropriately, using distilled water and Simple Green (or another detergent).
Personal Protective Equipment: Hard hat (when working around heavy equipment, including drill rigs), work boots (steel-toed when working around heavy equipment, including drill rigs), high-visibility vest (optional if wearing Tyvek), safety glasses, disposable nitrile gloves (multiple layers recommended), hearing protection (i.e., earplugs or earmuffs) as needed. This site falls under the purview of Parametrix's voluntary respirator program. All field personnel should have their respirator available near the work area and don the respirator at their own discretion. Confined space entry is neither expected nor allowed. Chemical-resistant Tyvek (yellow/coated) is strongly recommended.

5.3.8 Working Around Electrically Powered Equipment and Controls

The JHA for working around electrically powered equipment and controls is provided in Table 10.

Table 10. JHA for Working Around Electrically Powered Equipment and Controls

Job/Task Description
Employees will conduct work such as construction observation and operation and monitoring of the expanded MPE system. This will require work with or near electrically powered equipment and work near the construction of electrical systems.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Accidents with equipment/tools	Sample-collection equipment/tools.	Verify that you have the appropriate equipment/tools for your tasks. Use equipment/tools as intended by the manufacturer.

Physical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Bodily harm or death from electric shock, electrocution	Working around and touching equipment.	Stay a safe distance from equipment or outlets. Do not approach or touch equipment that does not appear to be in working order. Avoid generating static electricity. Remove tools and other metals from body.
Head injury	Debris from equipment.	Hard hat.
Foot injury	Sharp objects that could be stepped on, or large or heavy objects falling on feet.	Wear steel-toe boots with steel shank.
Noise	Noise generated by equipment at site.	Wear proper ear protection such as earplugs or earmuffs during high-noise tasks.
Eye injury	Debris, chemicals, or splashes coming into contact with eyes; pressurized wells or sampling ports.	Wear eye protection with side shields.
Hand injury	Pinch points.	Wear protective gloves whenever possible. Avoid placing hands near operating equipment.
Heat/cold/sunburn	Weather.	Wear sunscreen on exposed skin. Stop work if an employee feels symptoms of dehydration, overheating, or heat stroke. Move to a shaded area and consume water. During cold conditions, wear adequate clothing to reduce the potential for hypothermia.
Slips, trips, and falls	Ice, plastic sheeting, uneven ground, wet floors.	Use caution when walking on plastic sheeting and uneven ground and in general when snowy and/or icy conditions exist. Avoid stepping in open well monuments. Sidestep/step over hazards on the ground. Avoid walking on steep slopes. Clean up any standing water in treatment containers.

Biological and Chemical Hazards		
Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
None	None specific to this JHA. Chemical hazards related to the site are described in Section 5.2 and Attachment B.	None.

Additional Control Measures and Guidance
Engineering Controls: No engineering controls are specified.
General Safe-Work Practices and Guidance: ▪ Visually inspect electrically powered equipment prior to operating to confirm equipment is in working order. Contact SSO to arrange for evaluation/repair if necessary. ▪ Avoid wet areas when working around or touching electrically powered equipment or controls. ▪ Avoid wearing wool, nylon, or other synthetic clothing that could generate static electricity. ▪ Consider wearing rubber boots when working with electrically powered equipment. ▪ Any work near electrically powered equipment or controls will be conducted using a buddy system. ▪ Only licensed electricians are allowed to remove junction box covers, switch plates, panel face plates, and similar enclosures.
Personal Protective Equipment: Hard hat, steel-toe work boots with steel shank, safety glasses with side shields, nitrile gloves, and hearing protection (i.e., earplugs or earmuffs).

6. Health and Safety Training

Parametrix personnel performing construction observation, monitoring, sampling, and system operations on-site must have completed training consistent with the hazardous waste operations and emergency response requirements in 29 Code of Federal Regulations (CFR) 1910.120(e). The training will include:

- Identity of site safety and health personnel.
- Safety and health hazards identified on the site.
- Proper use of required PPE.
- Safe work practices required on the site (e.g., fall protection, confined space entry procedures, hot work permits, and general safety rules).
- Safe use of engineering controls and equipment on the site.
- Medical surveillance requirements, including the recognition of signs and symptoms that might indicate overexposure to hazards.
- The site emergency response plan/spill containment plan.

The HSC will oversee training for site personnel. Training records, including an outline, sign-offs, and competency records, will be maintained by the HSC.

7. Safety Equipment

7.1 Personal Protective Equipment

PPE must be worn by individuals on the site to protect against physical hazards. PPE required on the site is modified Level D, which consists of:

- Hard hat.
- High-visibility vest.
- Work boots.
- Safety glasses with side shields.
- Nitrile gloves or equivalent when handling known or potentially impacted media.
- Work gloves (if handling materials that might have sharp edges, protrusions, or splinters).

Additional PPE may be necessary for specific tasks with additional hazards. The SSO will be responsible for designating additional PPE for specific tasks. Depending on the activity, additional PPE may include:

- Hearing protection (during high-noise tasks).
- Chemical-resistant clothing (e.g., Tyvek coveralls).
- Chemical-resistant boots.
- Chemical-resistant goggles.
- Chemical-resistant gloves.

- Face shield.
- Respiratory protection.

Additional PPE may be required if workers discover unexpected contamination. Characteristics of unexpected contamination could include unusual odors, discolored media, a visible sheen, etc. The SSO and, if necessary, the HSC will be contacted as soon as possible after the discovery of unexpected contamination, and the SSO and/or the HSC will determine the need for additional controls and/or training.

PPE used at the site must meet the requirements of recognized consensus standards (e.g., American National Standards Institute and National Institute for Occupational Safety and Health [NIOSH]), and respiratory protection shall comply with the requirements set forth in 29 CFR 1910.134.

Project personnel are not permitted to reduce the level of specified PPE without approval from the SSO or the HSC.

7.2 Safety Equipment

The SSO will be responsible for ensuring that the following safety equipment is available on-site and is properly inspected and maintained:

- Soap and water for decontamination.
- Caution tape, traffic cones, and/or barriers.
- First-aid kit.
- Fire extinguisher.
- Fluids for hydration (e.g., drinking water or sports drink).

7.3 Air Monitoring Equipment

The following air monitoring equipment will be immediately available to identify site conditions that may require additional controls. See Section 5.2.1 and Attachment B for specified action levels.

- 4-gas personal air monitor.
- Landtec SEM5000 portable methane detector.
- Landtec GEM5000 landfill gas meter.

7.4 Communications Equipment

Parametrix personnel should have a mobile phone or a radio available in case of emergency.

8. Decontamination Procedures

Parametrix employees will not ordinarily need to establish or work in exclusion or contaminant reduction zones. Communicate with the SSO or project manager at least 1 week in advance of establishing or working in such a zone so the necessary controls can be established and PPE and decontamination equipment provided. Monitoring, sample collection, and VTT and LTT system operations areas are not categorized as exclusion or contaminant reduction zones. Any PPE and supplies used during ordinary sampling and monitoring activities will be disposed of in labeled drums. Partial decontamination procedures should be followed as applicable after routine monitoring, sampling, and operations.

8.1 Partial Decontamination Procedure

Parametrix employees will implement the following partial decontamination procedures when exiting the exclusion zone but remaining on the site.

- Wash and rinse boots and outer gloves in containers in the contamination-reduction zone.
- Inspect Tyvek suit for stains, rips, or tears. If the suit is contaminated, full decontamination will be performed as described in Section 8.2 if the suit is to be used again. If the suit is damaged, it should not be reused.
- Remove outer gloves. Inspect and discard in a container labeled for disposable items if ripped or damaged.
- Remove respirator, if worn, and clean with premoistened alcohol wipes. Discard used cartridges at the frequency dictated by the SSO.
- Wash hands and face with soap and water.

8.2 Full Decontamination Procedures

Parametrix employees will follow the full decontamination procedures listed below when exiting the exclusion zone and leaving the site (e.g., at the end of the work shift).

- Wash and rinse boots and outer gloves in containers in the contamination-reduction zone.
- Remove outer gloves and Tyvek suit and deposit in a container labeled for disposable items.
- Remove respirator and discard used cartridges at the frequency dictated by the SSO.
- Wash and rinse respirator in a “respirators only” decontamination container.
- Remove work boots and put on street shoes. Place work boots in a plastic bag or container for later reuse.
- Remove inner gloves and deposit in a container labeled for disposable items.
- Wash hands and face with soap and water.
- Shower as soon after the work shift as practicable.

9. Medical Surveillance

Work on this project should generally not exceed thresholds for medical surveillance in 29 CFR 1910.120(f). Each Parametrix employee should monitor their total amount of work performed on all hazardous sites and evaluate potential exposure accordingly. Parametrix will ensure that its employees who meet the following criteria are enrolled in a medical surveillance program consistent with 29 CFR 1910.120(f):

- The employees are, or may be, exposed to hazardous substances or health hazards at or above established permissible exposure limits for 30 or more days per year.
- The employees are required to wear a respirator for 30 or more days per year.

- Parametrix employees who exhibit signs or symptoms consistent with overexposure to site contaminants will be offered medical surveillance consistent with Washington Administrative Code 296-843-21005.

Parametrix will ensure that its employees who are authorized to wear respirators are medically evaluated consistent with the respiratory protection standard (29 CFR 1910.134). The HSC or administrative designee (e.g., human resources manager) will maintain medical evaluation records.

The planned activities on this project fall within purview of Parametrix's voluntary respirator use program.

10. Air Monitoring

Based on site conditions, air monitoring is not anticipated; however, air monitoring equipment will be immediately available in case workers encounter conditions that indicate the presence of unexpected contamination, such as unusual odors, discolored media, or a visible sheen. If such conditions are discovered, workers will exit the area and contact the SSO and, as needed, the HSC. If necessary, Parametrix will use the air monitoring equipment to evaluate the conditions and determine whether additional controls and/or training are required. Action levels are provided in Attachment B.

Air monitoring, if conducted, must be performed by individuals familiar with the calibration, use, and care of the required instruments. Measurements shall be documented, and the records should include the following information:

- The name of the person conducting the measurements.
- The identity of workers, if any, who have exposure indicated by measurement result.
- Information about the instrument (e.g., type, make, model, and serial number).
- The location of the measurement.
- The measurement date and start/stop time.
- Conditions represented by the measurement, including applicable activities, work practices, weather conditions, site conditions, and controls in place.
- Measurement results.
- Other relevant observations or notes.

10.1 Air Monitoring Action Levels

If air monitoring is conducted, the results will be compared to the action levels provided in Attachment B. The air monitoring action levels are established to comply with Occupational Safety and Health Administration (OSHA) permissible exposure levels, American Conference of Governmental Industrial Hygienists threshold limit values, and the NIOSH recommendations for the chemicals that may be encountered on the site. The action levels are also adjusted for the relative response of common photoionization detection instruments to motor-fuel vapors.

10.2 Explosion Hazard Action Levels

Parametrix employees working on-site will take measurements when working near known or suspected sources of explosive gases or vapors. The instrument alarm should be set to sound at 10% of the lower explosive limit. When measurements exceed this level, Parametrix employees on site will:

1. Extinguish ignition sources and shut down powered equipment in the work area.
2. Move personnel at least 100 feet away from the work area.
3. Contact the SSO and the HSC.
4. At the instruction of the HSC and after waiting 15 minutes for explosive gases to dissipate, the SSO may use the combustible gas meter to approach the worksite to measure combustible gases in the work area. The SSO shall not enter (or allow any personnel to enter) any area where the combustible gas meter readings exceed the explosivity action level, nor shall the SSO approach if there is a potential for fire or explosion.
5. The SSO may authorize personnel to reenter the work area after the source of the combustible gases has been identified and controlled.

10.3 Instrument Calibrations

Instruments shall be calibrated consistent with manufacturers' recommendations. Calibrations shall be coordinated by the SSO. Calibration and monitoring records shall be maintained by the SSO and/or the project manager.

11. Site Control Measures

Access to the site will be controlled as part of the site preparation. Control measures may include fencing, gates, and signs limiting access to everyone except authorized personnel. Parametrix requires the buddy system if personnel conduct operations that may involve exposure to site hazards. The buddy system may involve working with non-Parametrix personnel. Some low-hazard tasks, such as groundwater monitoring on familiar sites, may not require use of the buddy system. Contact the SSO and HSC if there are questions regarding the buddy system on the site.

12. Emergency Response/Spill Containment/ Confined Space

Parametrix employees on-site will follow the emergency response, spill response, and confined space procedures described in the Parametrix's Health and Safety Manual. Incidents will be documented on the incident report form included with Attachment D.

13. Pre-Entry Briefing

Parametrix employees on-site will conduct pre-entry briefings (e.g., tailgate meetings) before starting work on the site and/or as the scope of work changes throughout the project to ensure that employees are familiar with the HASP and that the plan is being followed. Attendance and discussion topics will be documented on sign-in sheets, which will be maintained by the SSO.

14. Construction and Safety Coordination

The prime contractor for construction of the expanded MPE system will be selected by Grant County through public works bidding. Once selected, the contractor will be responsible for providing Parametrix with the contractor's HASP. The contractor is responsible for implementing the contractor's HASP and keeping Parametrix informed of site hazards that could affect Parametrix personnel.

While at the construction site, Parametrix is required to comply with the contractor's HASP and this HASP. A Parametrix construction observer will attend the contractor's preconstruction safety meeting, which will cover the contractor's HASP, including on-site emergency response procedures, potential hazards, and mitigation measures. The meeting will also review the hazards associated with the specific operations and staff assignments.

The SSO will make a copy of this HASP and the Contractor's HASP available at the construction site for Parametrix construction observers and guests. It is the responsibility of these members to review this HASP and follow its guidelines.

15. Periodic Evaluation

The project manager or designee will evaluate the effectiveness of this HASP. As part of the evaluation, the project manager or designee will track ongoing health and safety feedback from field personnel working on the project. This feedback will be reviewed and incorporated into either immediate or annual updates of the HASP. HASPs will be reviewed and updated at least annually. Updating the plan as necessary ensures that it reflects the known hazards, conditions, and requirements associated with the site. Parametrix will maintain periodic evaluation records and will track all HASP revisions.

16. Safe Work Practices

The following safe work practices are provided to supplement the other information included with this HASP.

1. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited in areas with potentially contaminated materials.

2. Field personnel will, whenever practicable, remain upwind of drilling rigs, open excavations, and other site-disturbing activities.

3. Subsurface work shall not be performed at any location until the area has been confirmed by a utility-locator firm to be free of underground utilities or other obstructions.

17. Acknowledgment

Parametrix cannot guarantee the health or safety of any person entering the site. Because of the potentially hazardous nature of visits to active sites, it is not possible to discover, evaluate, and provide protection against all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at the site. The health and safety guidelines in this plan were prepared specifically for the site and should not be used on any other site without prior evaluation by trained health and safety personnel.

Parametrix personnel who will work at the site are to read, understand, and agree to comply with the specific practices and guidelines described in this HASP regarding field safety and health hazards.

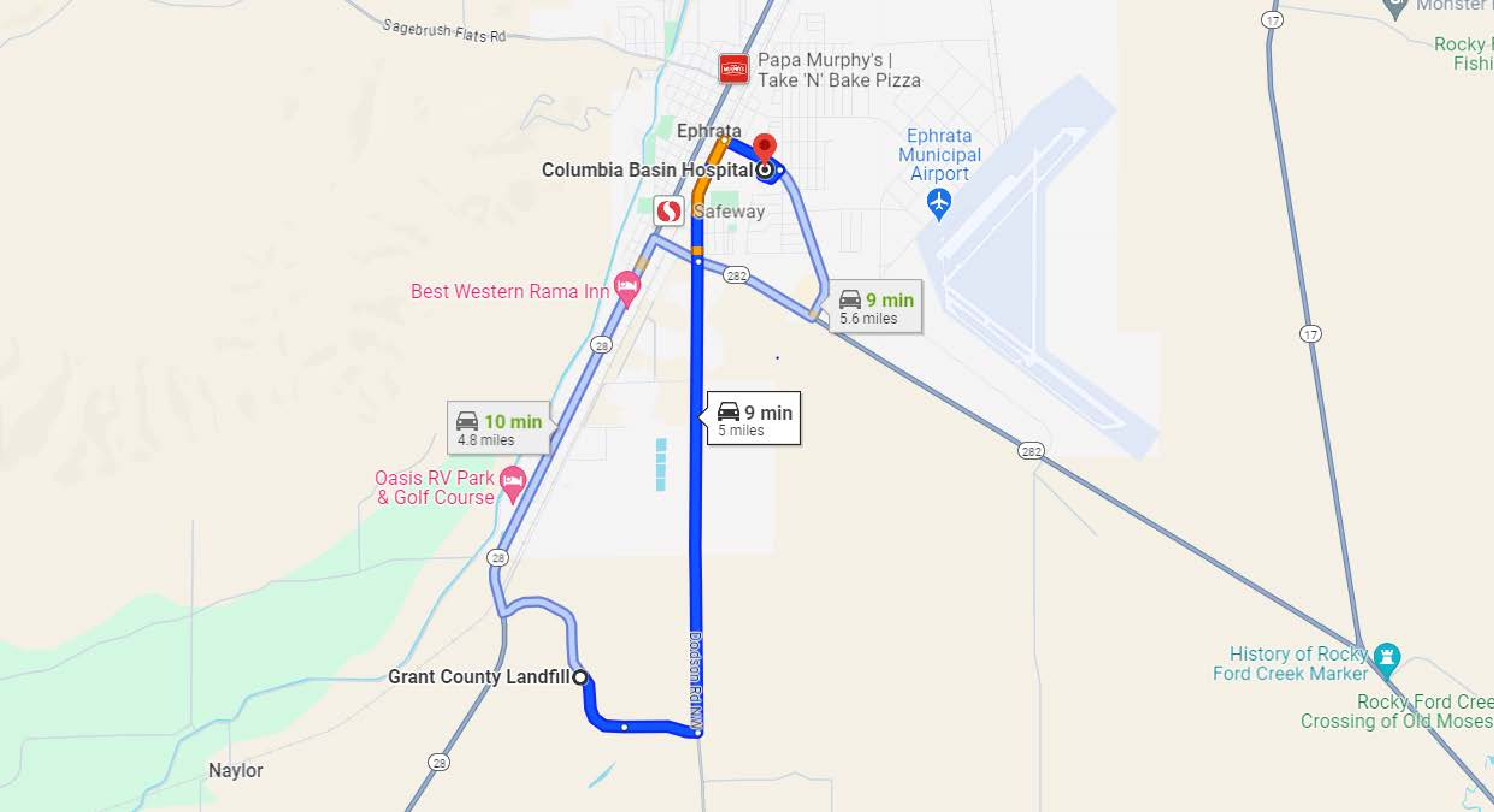
This HASP has been developed for the exclusive use of Parametrix personnel. Parametrix may make this plan available for review by contracted or subcontracted personnel for information only. This plan does not cover the activities performed by employees of any other employer on the site. All contracted or subcontracted personnel are responsible for implementing their own health and safety program, including generating and using their own plan.

I have read, and I understand this HASP and all attachments and agree to comply with the requirements described herein:

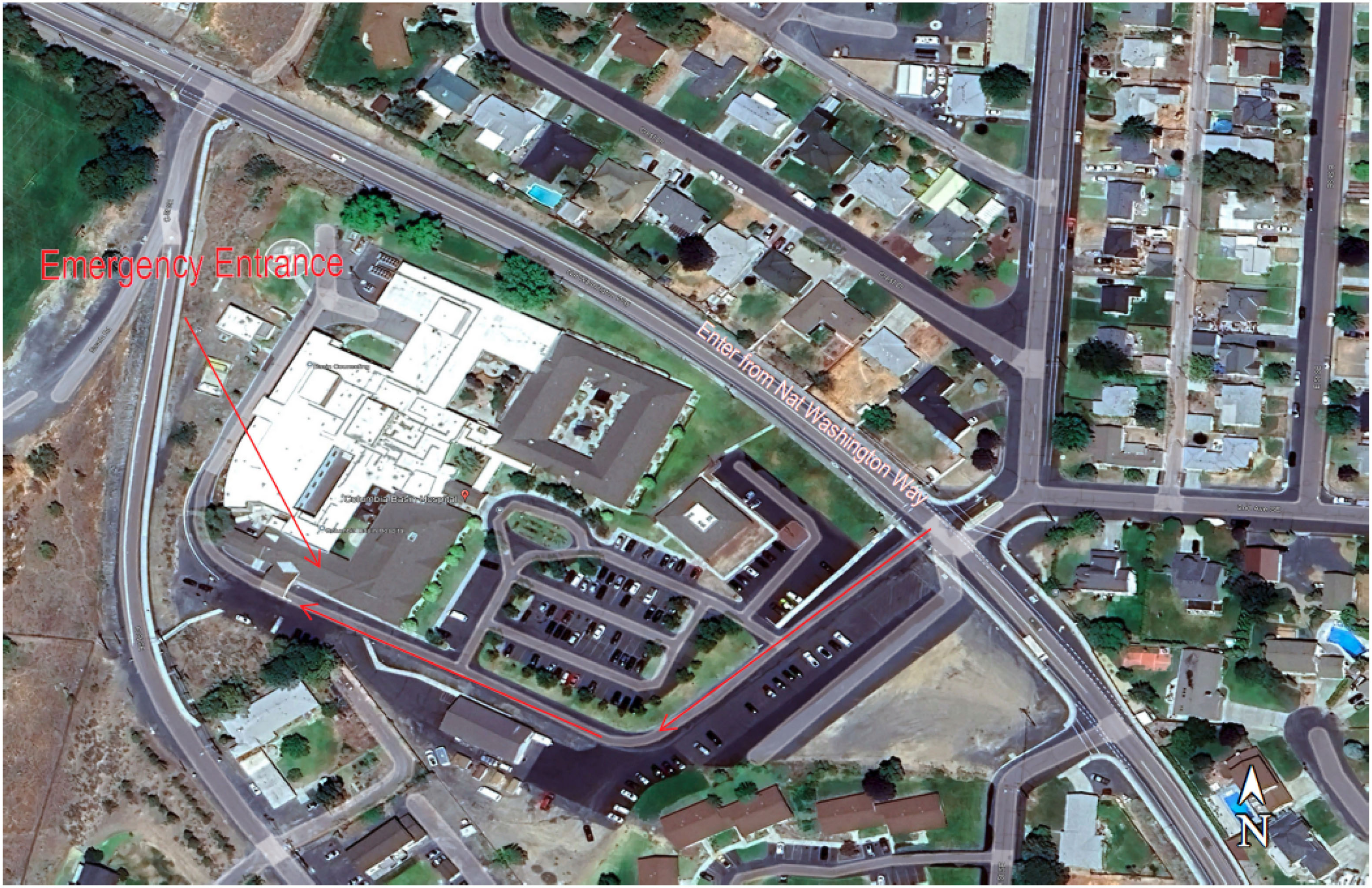
Name	Title	Date

Attachment A

Map to Hospital



Sagebrush Flats Rd
Papa Murphy's | Take 'N' Bake Pizza
Ephrata
Columbia Basin Hospital
Ephrata Municipal Airport
Safeway
Best Western Rama Inn
282
9 min
5.6 miles
28
10 min
4.8 miles
9 min
5 miles
Oasis RV Park & Golf Course
17
Dodson Rd NW
Grant County Landfill
Naylor
History of Rocky Ford Creek Marker



Hospital Campus Map Indicating Emergency Entrance

Attachment B

Chemicals of Potential Concern

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
Arsenic	Metal: Silver-gray or tin-white, brittle, odorless solid.	OSHA PEL = TWA 0.010 mg/m^3 NIOSH = Ca C 0.002 mg/m^3	- *Exposure Routes* Inhalation, skin absorption, skin and/or eye contact, ingestion - *Symptoms* Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, resp irritation, hyperpigmentation of skin, [potential occupational carcinogen]
1,2-Dichloroethane (EDC)	Colorless liquid with a pleasant, chloroform-like odor.	OSHA PEL = TWA 50 ppm, C 100 ppm	- *Exposure Routes* Inhalation, ingestion, skin absorption, skin and/or eye contact - *Symptoms* Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]
1,1-Dichloroethane	Colorless, oily liquid with a chloroform-like odor.	OSHA PEL = TWA 100 ppm	- *Exposure Routes* Inhalation, ingestion, skin and/or eye contact - *Symptoms* Irritation skin; central nervous system depression; liver, kidney, lung damage
1,1,1-Trichloroethane	Colorless liquid with a mild, chloroform-like odor.	OSHA PEL = TWA 350 ppm	- *Exposure Routes* Inhalation, ingestion, skin and/or eye contact - *Symptoms* Irritation eyes, skin; headache; lassitude; central nervous system depression; poor equilibrium; dermatitis; cardiac arrhythmias; liver damage
Chloroethane	Colorless gas or liquid (below 54°F) with a pungent, ether-like odor.	OSHA PEL = TWA 1000 ppm	*Exposure Routes* Inhalation, skin absorption (liquid), ingestion (liquid), skin and/or eye contact - *Symptoms* Incoordination, inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
Tetrachloroethene (PCE)	Colorless liquid with a mild, chloroform-like odor.	OSHA PEL = TWA 100 ppm, C 200 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]
Trichloroethene (TCE)	Colorless liquid (unless dyed blue) with a chloroform-like odor.	OSHA PEL = TWA 100 ppm, C 200 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]
1,1-Dichloroethene	Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor.	OSHA PEL None	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]
cis-1,2-Dichloroethene	No data available	No data available	No data available
trans-1,2-Dichloroethene	No data available	No data available	No data available
Vinyl Chloride	Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations.	OSHA PEL = TWA 1 ppm, C 5 ppm	- ***Exposure Routes*** Inhalation, skin, and/or eye contact (liquid) - ***Symptoms*** Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
Chloromethane	Colorless gas with a faint, sweet odor which is not noticeable at dangerous concentrations.	OSHA PEL = TWA 100 ppm, C 200 ppm	- ***Exposure Routes*** Inhalation, skin and/or eye contact (liquid) - ***Symptoms*** Dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects; [potential occupational carcinogen]
Dichloromethane (Methylene Chloride)	Colorless liquid with a chloroform-like odor. [Note: A gas above 104°F.]	OSHA PEL = TWA 25 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential occupational carcinogen]
Trichlorofluoromethane	Colorless to water-white, nearly odorless liquid or gas (above 75°F).	OSHA PEL = TWA 1000 ppm	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Incoordination, tremor; dermatitis; cardiac arrhythmias, cardiac arrest; asphyxia; liquid: frostbite
1,2-Dichloropropane	Colorless liquid with a chloroform-like odor. [pesticide]	OSHA PEL = TWA 75 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, respiratory system; drowsiness, dizziness; liver, kidney damage; in animals: central nervous system depression; [potential occupational carcinogen]
Benzene	Colorless to light-yellow liquid with an aromatic odor. [Note: A solid below 42°F.]	OSHA PEL = TWA 1 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
Toluene	Colorless liquid with a sweet, pungent, benzene-like odor.	OSHA PEL = TWA 200 ppm, C 300 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage
Ethyl benzene	Colorless liquid with an aromatic odor.	OSHA PEL = TWA 100 ppm	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma
Xylene (m, p, o)	Colorless liquid with an aromatic odor.	OSHA PEL = TWA 100 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis
Styrene (vinyl benzene)	Colorless to yellow, oily liquid with a sweet, floral odor.	OSHA PEL = TWA 100 ppm, C 200 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, nose, respiratory system; headache; lassitude; confusion; malaise; drowsy; unsteady gait; narcosis; dermatitis; possible liver injury; reproductive effects
1,2-Dichlorobenzene	Colorless to pale-yellow liquid with a pleasant, aromatic odor.	OSHA PEL = C 50 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, nose; liver, kidney damage; skin blisters

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
1,4-Dichlorobenzene	Colorless or white crystalline solid with a mothball-like odor. [insecticide]	OSHA PEL = TWA 75 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Eye irritation, swelling periorbital (situated around the eye); profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; in animals: liver, kidney injury; [potential occupational carcinogen]
1,2,4-Trichlorobenzene	Colorless liquid or crystalline solid (below 63°F) with an aromatic odor.	OSHA PEL = TWA None NIOSH = C 5 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** - Eye irritation; skin; mucous membrane; liver and kidney damage in animals; possible teratogenic effects.
1,3,5-Trimethylbenzene	Clear, colorless liquid with a distinctive, aromatic odor.	OSHA PEL = TWA None NIOSH = 25 ppm	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, nose, throat and respiratory system; bronchitis; hypochromic anemia; headache; drowsiness; lassitude; dizziness; nausea; incoordination; vomiting; confusion; chemical pneumontitis (aspiration liquid).
1,2,4-Trimethybenzene	Clear, colorless liquid with a distinctive, aromatic odor.	OSHA PEL = TWA None NIOSH = 25 ppm	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, nose, throat and respiratory system; bronchitis; hypochromic anemia; headache; drowsiness; lassitude; dizziness; nausea; incoordination; vomiting; confusion; chemical pneumontitis (aspiration liquid).
n-Propylbenzene	No data available	No data available	No data available
n-Butylbenzene	No data available	No data available	No data available

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
Phenol	Colorless to light pink, crystalline solid with a sweet, acrid odor. [Note: phenol liquefied by mixing with about 8% water]	OSHA PEL = TWA 5 ppm (19 mg/m_3) [skin]	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Itching, irritation, reddening skin; hepatitis; hemolytic anemia, abdominal cramps; tachycardia; kidney damage; skin photophobia sensitization.
2-Methylphenol (cresol-o)	White crystals with a sweet, tarry odor. [Note: A liquid above 88°F]	OSHA PEL = TWA 5 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, and mucous membrane; central nervous system effects; confusion; depression; respiratory failure; dyspnea (breathing difficulty); irregular rapid respiration; weak pulse; eye and skin burns; dermatitis; lung, liver, kidney, pancreas damage.
4-Methylphenol (cresol-p)	Crystalline solid with a sweet, tarry odor. [Note: A liquid above 95°F]	OSHA PEL = TWA 5 ppm	- ***Exposure Routes*** Inhalation, skin absorption, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, skin, and mucous membrane; central nervous system effects; confusion; depression; respiratory failure; dyspnea (breathing difficulty); irregular rapid respiration; weak pulse; eye and skin burns; dermatitis; lung, liver, kidney, pancreas damage.
2,4-Dimethylphenol	No data available	No data available	No data available
Benzoic Acid	No data available	No data available	No data available
Benzyl Alcohol	No data available	No data available	No data available
Isophorone	Colorless to white liquid with a peppermint-like odor.	OSHA PEL = TWA 25 ppm	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, nose, throat; headache; nausea; dizziness; lassitude (weakness, exhaustion); malaise; narcosis; dermatitis; kidney and liver damage in animals.

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
Acetone	Colorless liquid with a fragrant, mint-like odor	OSHA PEL = TWA 1000 ppm	- *Exposure Routes* - Inhalation, ingestion, skin and/or eye contact - *Symptoms* Irritation eyes, nose, throat; headache; dizziness; central nervous system depression; dermatitis.
2-Butanone (MEK)	Colorless liquid with a moderately sharp, fragrant, mint- or acetone-like odor.	OSHA PEL = TWA 200 ppm	- *Exposure Routes* - Inhalation, ingestion, skin and/or eye contact - *Symptoms* Irritation eyes, skin, nose; headache; dizziness; vomiting; dermatitis.
Hexone (MIBK)	Colorless liquid with a pleasant odor.	OSHA PEL = TWA 100 ppm	- *Exposure Routes* - Inhalation, ingestion, skin and/or eye contact - *Symptoms* Irritation eyes, skin, nose; headache; narcosis; coma; dermatitis; liver and kidney damage in animals.
2-Hexanone (MBK)	Colorless liquid with an acetone-like odor.	OSHA PEL = TWA 100 ppm	- *Exposure Routes* - Inhalation, ingestion, skin absorption; skin and/or eye contact - *Symptoms* Irritation eyes, nose; peripheral neuropathy; lassitude; paresthesia; dermatitis; headache; drowsiness.
Naphthalene	Colorless to brown solid with an odor of mothballs. [Note: shipped as a molten solid]	OSHA = TWA 10 ppm	- *Exposure Routes* - Inhalation, ingestion, skin absorption; skin and/or eye contact - *Symptoms* Irritation eyes; headache; confusion; excitement; malaise; nausea; vomiting; abdominal pain; irritated bladder; profuse sweat; jaundice; hematuria (blood in urine); renal shutdown; dermatitis; optical neuritis; corneal damage.

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
1-Methylnaphthalene	No Data Available	No Data Available	No Data Available
2-Methylnaphthalene	No Data Available	No Data Available	No Data Available
Bis(2-ethylhexyl) Phthalate	Colorless, oily liquid with a slight odor.	OSHA PEL = TWA 5 mg/m³	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation eyes, mucous membrane; in animals: liver damage; teratogenic effects; [potential occupational carcinogen]
Dimethylphthalate	Colorless, oily liquid with a slight, aromatic odor [Note: A solid below 42°F]	OSHA = TWA 5 mg/m³	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation to eyes, upper respiratory system; stomach pain.
Diethylphthalate	Colorless to water-shite, oily liquid with a very slight, aromatic odor [pesticide]	OSHA = TWA None NIOSH 5 mg/m³	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation to eyes, skin, nose, and throat; headache; dizziness; nausea; lacrimation (discharge of tears); possible polyneur; vestibular dysfunction; pain, numbness, lassitude, and spasms in arms and legs; reproductive effects in animals.
Di-n-Butylphthalate (DBP-)	Colorless to faint-yellow, oily liquid with a slight, aromatic odor.	OSHA = TWA 5 mg/m³	- ***Exposure Routes*** Inhalation, ingestion, skin and/or eye contact - ***Symptoms*** Irritation to eyes, upper respiratory system and stomach.
Butylbenzylphthalate	No Data Available	No Data Available	No Data Available
Di-n-Octyl phthalate	No Data Available	No Data Available	No Data Available
N-nitrosodiphenylamine	No Data Available	No Data Available	No Data Available
Aroclor 1242 (PCB)	Colorless to light-colored, viscous liquid with a mild, hydrocarbon odor.	OSHA = TWA 0.5 mg/m_3 [skin]	- ***Exposure Routes*** - Inhalation, ingestion, skin absorption; skin and/or eye contact - ***Symptoms*** Irritation eyes; chloracne; liver damage; reproductive effects; [potential occupational carcinogen]

Attachment B: Chemicals Detected in Media Samples at the Site

Chemical	Physical/Chemical Characteristics	Regulatory Standards	Exposure Routes/Systems
Aroclor 1260 (PCB)	No Data Available	No Data Available	No Data Available

C = Ceiling Limit.
Ca = Carcinogen.
OSHA = Occupational Safety and Health Administration.
NIOSH = National Institute for Occupational Safety and Health.
TWA = Time Weighted Average (8-hour during 40-hour week).

Attachment C

Job Hazard Analysis- Wildfire Smoke

Job Hazard Analysis: Outdoor Work During Wildfires

Project Number: 553-1960-014	**Location/Site Where Task/Operation Performed:** Ephrata Landfill
Date Prepared: 8/28/2024	**Employee Preparing this JHA:** Amber Bailey, Senior Scientist
Date Reviewed:8/30/2024	**Employee Reviewing and Certifying this JHA:** Brian Pippin

Job/Task Description
This job hazard analysis (JHA) describes hazards related to outdoor work during wildfire season and required safe-work practices where ambient air quality has been degraded.

Relevant Standard Operating Procedures	
☐ Hazard Communication	☐ Fall Protection
☐ Noise and Hearing Conservation	☒ Selection and Use of Personal Protective Equipment
☐ Working Near Traffic	☐ Underground Utility Locate and Emergency Response During a Utility Strike

Wildfire Smoke Standard Operating Procedure

Review the Air Quality Index (AQI) locally. For Washington, the current AQI can be reviewed at the following sources:
https://www.airnow.gov/
https://enviwa.ecology.wa.gov/home/map
https://www.iqair.com/us/air-quality-map

For evaluation of air quality at the site we will be using the Soap Lake station, if available.
https://www.iqair.com/us/usa/washington/soap-lake/soap-lake-4th-ave-se

Physical Hazards

Hazard/Risk	Source of Hazard/Risk	Hazard/Risk Mitigation
Smoke/Particulates inhalation **AQI above 72**	Wildfires	Reduce, reschedule, or relocate work with less smoke if possible. Use enclosed buildings or vehicles where the air is filtered, if possible. Reduce work intensity or increase resting periods.
Smoke/Particulates inhalation **AQI above 101**	Wildfires	Follow the steps above. Voluntary N95/KN95 respirators may be worn
Smoke/Particulates inhalation **AQI above 300**	Wildfires	Follow the steps above. Voluntary use of N95/KN95 respirators highly recommended but not required.
Smoke/Particulates inhalation **AQI above 849**	Wildfires	Stop work or wear a P100 half-face or full-face respirator. Note: Use of a P100 requires a medical evaluation and fit testing in accordance with the respiratory protection program.
Smoke/Particulates visual effects **AQI above 150**	Wildfires	Voluntary foam sealed eye protection goggles and eyewear may be worn when working outdoors, ANSI dust/splash protection rated.

Additional Control Measures and Guidance
Engineering Controls: Limit the time outdoors. If work is to be scheduled during a known wildfire smoke event, consider rescheduling the work until the air quality resumes a lower AQI. Note: Sensitivity of individual may vary greatly.
Personal Protective Equipment (PPE): See HASP ☐ Safety shoes/boots with safety toe and shank ☐ Hard hat ☐ High-visibility traffic safety vest ☒ Safety glasses ☐ Work gloves ☐ Disposable nitrile gloves ☐ Hearing protection (i.e., earplugs or earmuffs) ☒ N95/KN95 Respirators ☒ P100 half face/full face respirators for individuals that have completed respirator fit tests and have medical clearance

The following summarizes the U.S. Air Quality Index

Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Below is the overall Wildfire Smoke Response Plan.

Wildfire Smoke Response Plan

Ephrata Landfill
553-1860-014

Introduction

Wildfire smoke is a health hazard for our employees when present in a work area. This wildfire smoke plan includes our policies and procedures related to protecting our employees from exposure to wildfire smoke. This plan was created to meet the Washington State workplace wildfire smoke regulations (Chapter 296-820 WAC and WAC 296-307-09805 through 09860 for agriculture).

The specific jobs and tasks at our workplace covered under this wildfire smoke plan include:

- Working near heavy equipment.
- Working around excavations.
- Working under or near overhead loads.
- Working near traffic.
- Collecting groundwater samples.
- Collecting VTT and LTT samples.
- Monitoring and sampling non-aqueous phase liquids (NAPL).
- Working around electrically powered equipment and controls.

Health Effects and Adverse Symptoms of Wildfire Smoke

Although there are many hazardous chemicals in wildfire smoke, the main harmful pollutant for people who are not close to the fire is "particulate matter," the tiny particles suspended in the air.

These tiny particles can reach the deepest parts of the lungs and can be absorbed into the body. The U.S. Environmental Protection Agency (EPA) has determined that particulate matter may cause or worsen cardiovascular disease, respiratory disease, cancer, and can harm the nervous system.

Exposure to particulate matter in wildfire smoke can cause a wide range of symptoms including (but not limited to):

Respiratory:

- Cough
- Difficulty breathing
- Wheezing
- Shortness of breath
- Asthma attack
- Runny nose
- Sore throat

- Sinus pain or pressure
- Phlegm.

Cardiovascular:

- Chest pain or discomfort
- Fast or irregular heartbeat
- Feeling weak, light-headed, faint, or dizzy
- Pain or discomfort in the jaw, neck, or back.

Symptoms concerning for a stroke:

- Sudden numbness or weakness in the face, arm, or leg, especially on one side of the body
- Sudden confusion, trouble speaking, or difficulty understanding speech
- Sudden trouble seeing in one or both eyes
- Sudden trouble walking, dizziness, loss of balance, or lack of coordination
- Sudden severe headache with no known cause.
- Headache, scratchy or irritated eyes, fatigue or tiredness, or nausea or vomiting.

Symptoms requiring immediate medical attention can include, but is not limited to:

Symptoms that can lead to a heart attack, such as:

- Chest pain or discomfort
- Feeling weak, light-headed, faint, or dizzy
- Pain or discomfort in the jaw, neck, or back
- Pain or discomfort in one or both arms or shoulders
- Shortness of breath, especially if accompanied by chest discomfort

Symptoms that can lead to a stroke, such as:

- Sudden numbness or weakness in the face, arm, or leg, especially on one side of the body
- Sudden confusion, trouble speaking, or difficulty understanding speech
- Sudden trouble seeing in one or both eyes
- Sudden trouble walking, dizziness, loss of balance, or lack of coordination
- Sudden severe headache with no known cause
- Wheezing, difficulty breathing, or shortness of breath
- Asthma attacks
- Nausea or vomiting
- Any symptom that is concerning or per a health care providers advice.

Our employees may follow medical advice they have been given or seek medical attention for any symptoms they may experience that are potentially related to wildfire smoke exposure, regardless of the severity. Parametrix will not retaliate against our employees for seeking medical attention or following medical advice they have been given.

Additionally, sensitive groups are more at risk of experiencing the adverse health effects of wildfire smoke. These sensitive groups can include:

- Outdoor workers.
- Smokers.
- Workers under 18 or over 65 years old.
- People with respiratory infections, like colds. Conditions can include pneumonia, acute bronchitis, bronchiolitis, colds, flus, or those recovering from COVID-19.
- People with certain medical conditions like lung diseases, heart or circulatory problems, diabetes, pregnancy, and other conditions. Conditions can include asthma, COPD, bronchitis, emphysema, irregular heartbeat, congestive heart failure, coronary artery disease, angina, those who have had a heart attack or stroke, and those with medical conditions that can be worsened by exposure to wildfire smoke as determined by a medical provider.
- Tribal and indigenous people.
- People with low income.

Wildfire smoke is a serious work-related hazard for exposed outdoor workers. It is important to notify the project manager and site safety officer (SSO) when an employee is experiencing symptoms of wildfire smoke exposure so management can respond appropriately. Our employees must watch for symptoms of wildfire smoke exposure as a sign to reduce exposure. Wildfire smoke can harm healthy people. Smoke can harm someone even if they are exposed over a short period or a long period. The wildfire smoke rule is designed to limit the harm to employees from wildfire smoke.

By law, we will **not** retaliate against our employees for:

- Reporting symptoms,
- Seeking medical attention,
- Following medical advice they have been given,
- Or for filing a workers' compensation claim.

Note: Our employees have the right to file a workers' compensation claim to have their symptoms or any work-related injury evaluated. Labor and Industries (L&I) workers' compensation is in part funded by employee salaries and is separate from personal health insurance. In most cases, L&I will pay for an initial medical evaluation, even if the claim is denied. If the claim is allowed, the workers' compensation system will cover medical bills directly related to our employees' condition and partial wage replacement benefits if our employee cannot work.

Identification of Harmful Wildfire Smoke Exposures

The main pollutant in smoke is the small particles in the air called fine particulate matter, also called $PM_{2.5}$. $PM_{2.5}$ measurements are reported in two ways:

- As micrograms per cubic meter ($\mu g/m^3$), or
- NowCast AQI for $PM_{2.5}$, which is an index produced by the EPA to communicate general air quality based on $PM_{2.5}$. AQI stands for "air quality index."

The wildfire smoke regulations require employers look at hourly $PM_{2.5}$ averages, which is reported as "Current $PM_{2.5}$." NowCast Air Quality Index (AQI) for $PM_{2.5}$ can also be used, which is a unitless index which uses $PM_{2.5}$ data averaged over the past 3 to 12 hours. The EPA updated how the Air Quality

Index relates to $PM_{2.5}$ on May 6, 2024, and L&I rules will be updated to reflect those changes. The levels of smoke and particulate matter in the air which require action are not changing.

The SSO will determine employee exposure to current $PM_{2.5}$, to protect the health of our workers. We will use one of these sites to determine employee exposure to the current $PM_{2.5}$:

https://www.airnow.gov/
https://enviwa.ecology.wa.gov/home/map
https://www.iqair.com/us/air-quality-map

Summary of the Wildfire Smoke Rule Requirements

The following table summarizes the key requirements of the rule. See the wildfire smoke rules for more details. The EPA updated how the Air Quality Index relates to $PM_{2.5}$ on May 6, 2024, and L&I rules will be updated to reflect those changes. The levels of smoke and particulate matter in the air which require action are not changing.

Current $PM_{2.5}$	NowCast Air Quality Index for $PM_{2.5}$	Requirements at Current $PM_{2.5}$ Level
0.0–20.4 µg/m³	0–71	▪ Prepare a written wildfire smoke response plan. ▪ Provide wildfire smoke training to employees. ▪ Watch the $PM_{2.5}$ conditions and forecasts. ▪ Prepare a two-way communication system and notify employees of $PM_{2.5}$ conditions. ▪ Make provisions for prompt medical attention and permit that medical attention without retaliation.
20.5–35.4 µg/m³	72–100	All of the above and: ▪ Notify employees of PM2.5 conditions and forecasts. ▪ Ensure only trained employees work outdoors. ▪ Consider implementing exposure controls. ▪ Consider providing voluntary use respirators.
35.5–250.4 µg/m³	101–350	All of the above and: ▪ Implement exposure controls. ▪ Make N95 respirators available for voluntary use.
250.5–500.3 µg/m³	351–848	All of the above and: ▪ Ensure workers experiencing symptoms requiring immediate medical attention be moved to a location that ensures sufficient clean air. ▪ Directly distribute N95 respirators to employees for voluntary use.
500.4–554.9 µg/m³	849–956	All of the above and: ▪ Implement a complete required use respiratory protection program, including fit-testing, medical evaluations, requiring employees to be clean-shaven, and requiring the use of particulate respirators.
555 µg/m³ or more	957 or more	All of the above and: ▪ Require respirators with an assigned protection factor (APF) of 25 or more. N95 respirators are not sufficient at this level of smoke.

Wildfire Smoke Hazard Communication for Our Employees

We will communicate wildfire smoke hazards to our employees when the air quality is at or above 20.5 µg/m³ of $PM_{2.5}$ (AQI 72). Additionally, we encourage our employees to monitor the air quality where they are working and to notify their supervisor when the air quality is above 20.5 µg/m³ (AQI 69 or AQI 72 after May 6. 2024).

We will inform our employees of the following:

- When at least two consecutive current $PM_{2.5}$ readings are 20.5 µg/m³ (AQI 72) or more.
- When the current $PM_{2.5}$ reaches 35.5 (AQI 101), 250.5 (AQI 351), 500.4 (AQI 849), and/or 555 µg/m³ (AQI 957) or more.
- What available protective measures are available to employees to reduce their wildfire smoke exposures at each level.

Current air quality levels will be texted, emailed, or verbally communicated to field personnel.

We will not punish employees who show signs of injury or illness that may potentially be due to wildfire smoke exposure for reporting those symptoms, seeking medical attention, or following medical advice they have been given.

All employees should notify the SSO of any health effects so that proper mitigation measures can be implemented or so that medical evaluations can be completed.

Employee and Supervisor Training

We train all covered workers and supervisors with wildfire smoke training. Supervisors will complete additional training.

The site-specific HASP provides the training protocols required for on-site field work. Additionally, employees can see the company Health and Safety manual for further information.

Responding to Wildfire Smoke Exposure Symptoms

We require that our employees inform the SSO and the health and safety coordinator if they experience symptoms of wildfire smoke exposure. This is so we can monitor these employees to determine whether medical attention is necessary.

Our employees may seek medical attention or follow medical advice they have been given for symptoms potentially related to wildfire smoke exposure. We will not retaliate against those employees for seeking medical attention or following medical advice they have been given.

When employees are experiencing health symptoms related to wildfire smoke, follow the site-specific HASP including:

- Stop work, contact your supervisor and the SSO.
- Take breaks.
- Call 911 related to emergencies.
- Rotation of personnel.

Where the current $PM_{2.5}$ is 250.5 μg/m^3 (AQI 351) or more, we will ensure workers experiencing adverse symptoms requiring medical attention be moved to a location that ensures sufficient clean air. We will move these workers to:

- A vehicle with a sufficient air filtration mechanism.

Employees exhibiting wildfire smoke exposure symptoms will be monitored by the SSO. Employees should have regular check-ins with the other Parametrix personnel on-site, if present, to ensure the health and safety of employees.

This includes evaluation of recovery, when to seek medical attention, and shifting work schedules to ensure exposure is mitigated for the employee.

Controlling Employee Exposures to Wildfire Smoke

We care about the health of our employees and will implement these methods to protect our employees from wildfire smoke:

When the current $PM_{2.5}$ is 35.5 μg/m^3 (AQI 101,) or more, we will implement these exposure controls:

- Use vehicles where the air is adequately filtered.
- Changing work schedules to a time with a lower ambient air concentration of $PM_{2.5}$.
- Avoiding, or reducing work that creates additional dust, fumes, or smoke.
- Reducing work intensity.
- Providing additional rest periods.
- Provide N95/KN95 respirators for voluntary use.

When the current $PM_{2.5}$ is 500.4 μg/m^3 (AQI 849,) or more, we will implement these exposure controls:

Stop work, or

- Use a P100 half-mask or full-face respirator, this requires a medical evaluation and fit testing in accordance with the respiratory protection program.

Respirator Use for Wildfire Smoke

When the current $PM_{2.5}$ is 35.5 μg/m^3 (AQI 101) or more, we will make NIOSH approved N95 (or KN95) respirators available at no cost to all employees, and we will encourage employees to use the respirators, but they are optional. Respirator use can be beneficial even when the current $PM_{2.5}$ is less than 35.5 μg/m^3 (AQI 101).

When the current $PM_{2.5}$ is 500.4 μg/m^3 (AQI 849) or more, Parametrix will stop work. Continued work at 500.4 μg/m^3 (AQI 849) or above will require personnel to enroll in a complete respiratory protection program (including fit-tests and respirator medical evaluations) in accordance with the Washington State Respirator Standard, WAC 296-842 because National Institute for Occupational Safety and Health (NIOSH) approved air purifying respirators must be worn, either half-face piece or full-face air purifying respirator with P100 filters.

The respiratory protection program includes fit tests and respirator medical evaluations. The Parametrix Health and Safety Plan and Respiratory Protection Program have further details on medical evaluations, training, and fit testing for P100 air purifying respirators.

Attachment D

Incident Report Form

INCIDENT REPORT FORM

Project Name:			
Incident Date/Time:			
Incident Location:			
Contractor Involved:			
Employee Involved:			
Describe the Injury or Illness in Detail and Indicate the Part of Body Affected:			
Describe Accident and Task Being Performed When Accident Occurred:			
Was Medical Treatment Required?	☐ Yes ☐ No ☐ Unknown	**Number of Work Days missed:**	
Equipment Involved:	☐ Yes ☐ No ☐ Unknown List Equipment:		
Property Damaged:			
Witness(es): Name, Company, and Contact Information			
Notification Date and Time:			
Photos:	☐ Yes ☐ No (Attach photos if available)		
Completed by: ______________________		Date: __________	

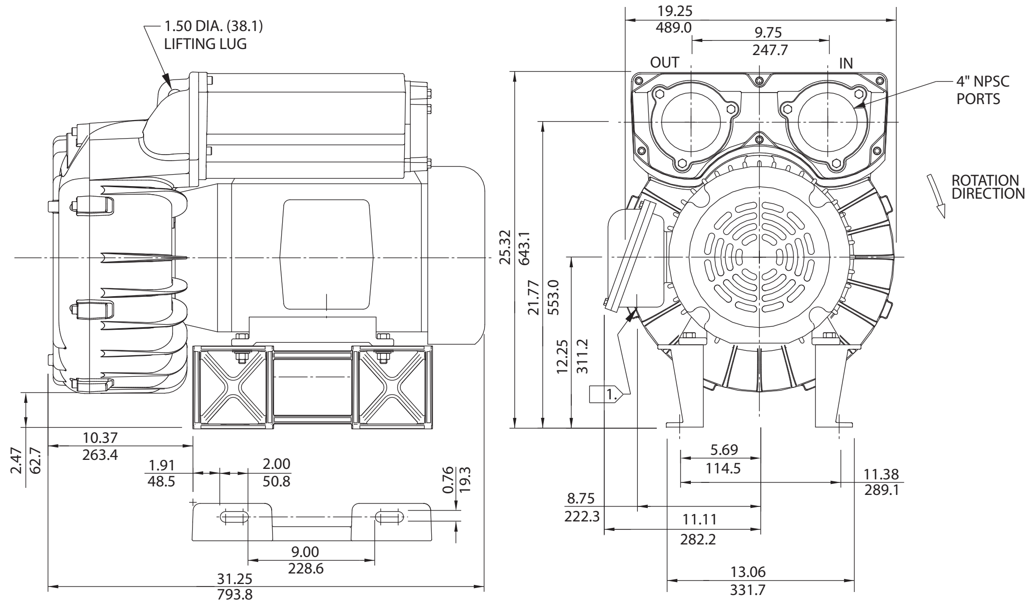
Appendix E

Catalog Cutsheets

EN 979 & CP 979

ROTRON®

20.0 HP Sealed Regenerative w/Explosion-Proof Motor



IN / MM

NOTES

1. TERMINAL BOX CONNECTOR HOLE 1 1/4" NPT FEMALE THREAD.
2. DRAWING NOT TO SCALE, CONTACT FACTORY FOR SCALE CAD DRAWING.
3. CONTACT FACTORY FOR BLOWER MODEL LENGTHS NOT SHOWN.

		Part/Model Number		
		EN979BK72WL	EN979BK86WL	CP979GB72WLR
Specification	**Units**	080724	082277	081778
Motor Enclosure - Shaft Mtl.	-	20	20	20
Horsepower	-	Explosion-proof-CS	Explosion-proof-CS	Chem XP-SS
Phase - Frequency Voltage	-	Three-60 hz	Three-60 hz	Three-60 hz
Motor Nameplate Amps	AC	230/460	575	230/460
Max. Blower Amps	Amps (A)	46/23	18.4	46/23
Locked Rotor Amps	Amps (A)	60/30	24	60/30
Service Factor	Amps (A)	334/167	118	334/167
Starter Size	-	3/2	2	3/2
Thermal Protection	-	1.0	1.0	1.0
XP Motor Class - Group	-	Class B - Pilot Duty	Class B - Pilot Duty	Class B - Pilot Duty
	-	I-D, II-F&G	I-D, II-F&G	I-D, II-F&G
Shipping Weight	Lbs	533	533	533
	Kg	241.8	241.8	241.8

Voltage - ROTRON motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

Operating Temperatures - Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

Maximum Blower Amps - Corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

XP Motor Class - Group - See Explosive Atmosphere Classification Chart in Section I

AMETEK DYNAMIC FLUID SOLUTIONS
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Customer Service Fax: +1 215.256.1338
www.ametekdfs.com

AMETEK®
PRECISION MOTION CONTROL
DYNAMIC FLUID SOLUTIONS

ROTRON®

Environmental / Chemical Processing Blowers

EN 979 & CP 979

20.0 HP Sealed Regenerative w/Explosion-Proof Motor

FEATURES

- Manufactured in the USA - ISO 9001 and NAFTA compliant
- Maximum flow: 1100 SCFM
- Maximum pressure: 90 IWG
- Maximum vacuum: 90 IWG
- Standard motor: 20 HP, explosion-proof
- Cast aluminum blower housing, impeller , cover & manifold; cast iron flanges (threaded); teflon® lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

MOTOR OPTIONS

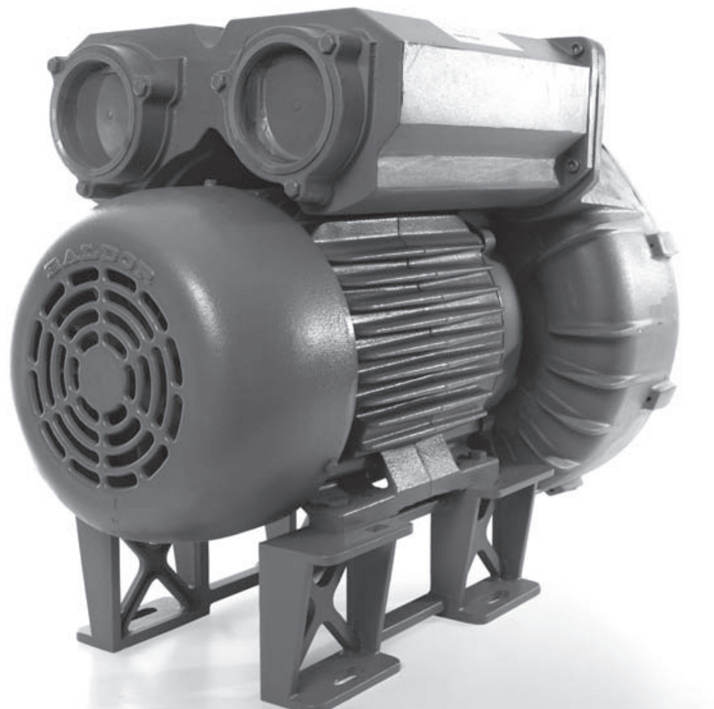
- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS

- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

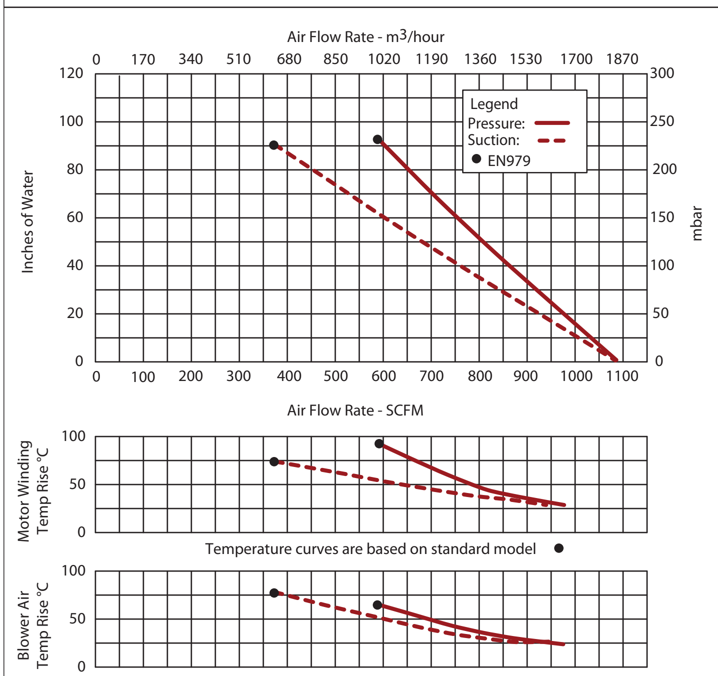
ACCESSORIES

- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges, & relief valves
- Switches - air flow, pressure, vacuum, or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

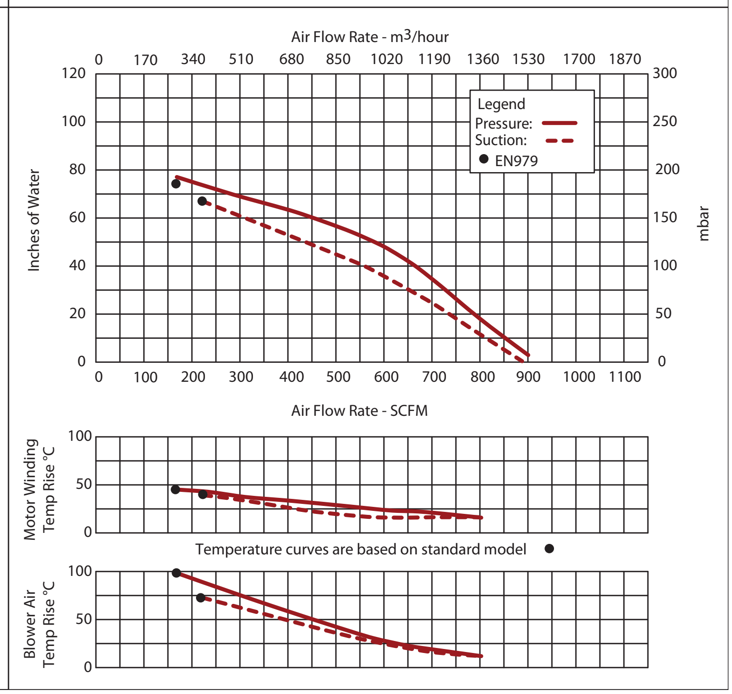


Blower Performance at Standard Conditions

60 Hz



50 Hz



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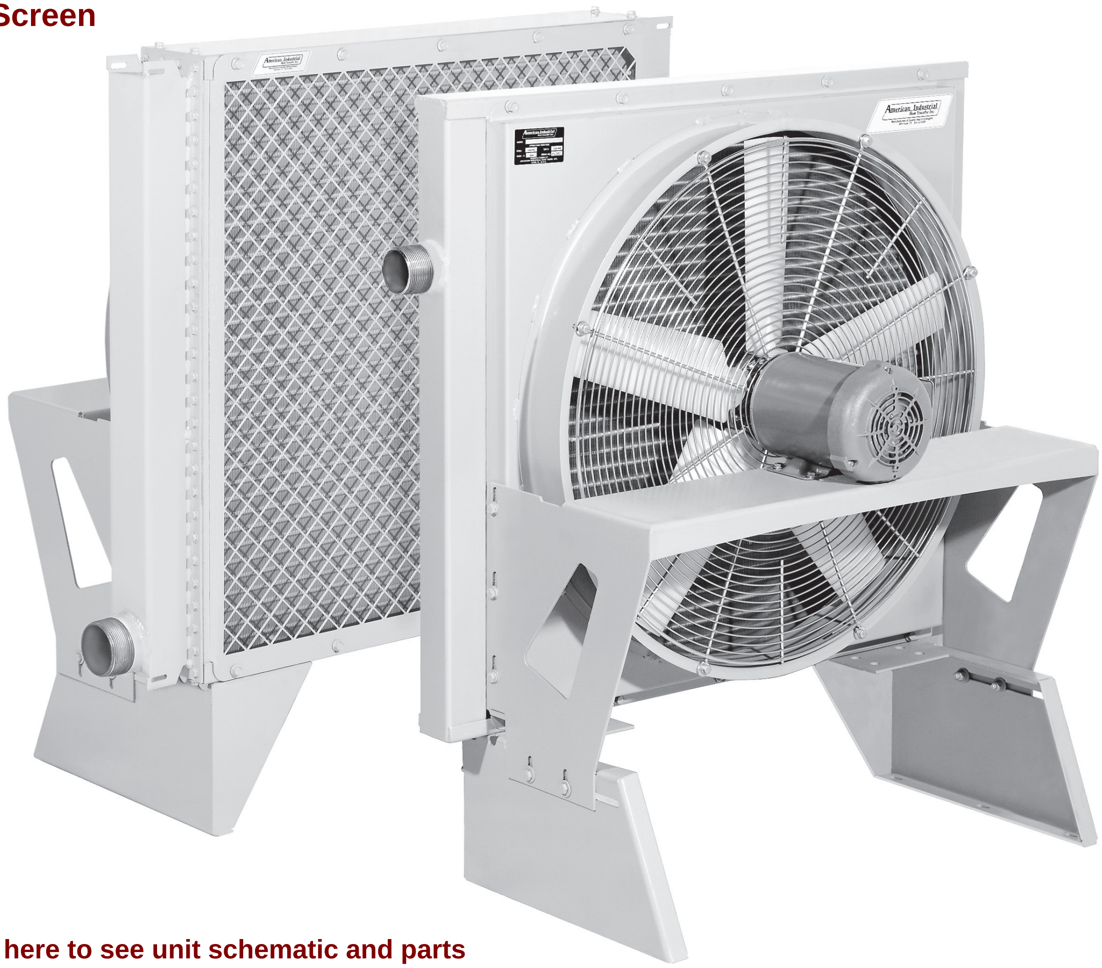
DYNAMIC FLUID SOLUTIONS

Fit to Screen



Click here to see unit schematic and parts

AIR COOLED

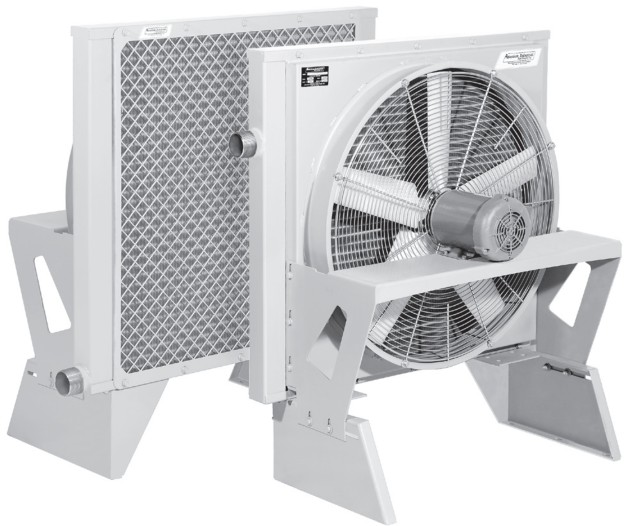
AFTERCOOLERS

For Compressed Gas or Vapor

- Computer Selection.
- Low pressure drop available.
- Standard ports NPT, optional ANSI flange.
- Operating temperature of 300° F & pressure of 300PSI.
- Custom designs to fit your needs.
- Cools: Air, Compressors, Blowers, Steam vapors, Pneumatic systems, Vapor recovery systems etc...

note: AIHTI reserves the right to make reasonable design changes without notice.

ACA - 3181 through ACA - 4362



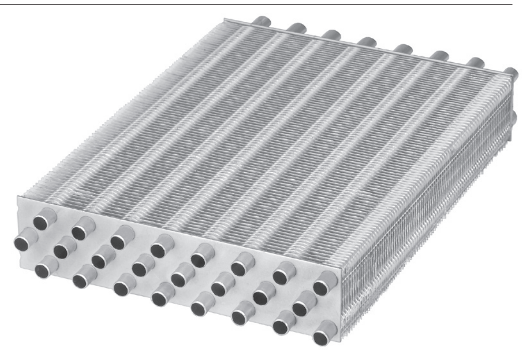
Brazed Core Construction

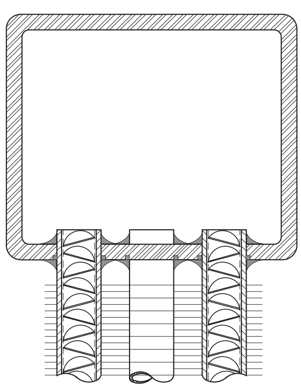
Air coolers are an essential part of any compressed air system, by cooling the air, and condensing water vapor into a liquid state for removal. When air is compressed, the compression induces heat into both the air and the water entrained in the air.

The American Industrial ACA series heat exchanger cools air with air, making it a simple inexpensive way to cool when compared to other water-cooled or refrigerant cooled systems. The unique compact brazed fin/tube design provides efficient cooling and low maintenance under the warmest environmental conditions. By using an ACA series air-cooled after cooler, machine tools will recieve cooler dryer air, provide longer trouble free life, experience less down time, and be cost effective to operate on a continuous basis.

SUPERIOR COOLING FINS

Copper tubes are mechanically bonded to highly efficient aluminum cooling fins. Die-formed fin collars provide a durable precision fit for maximum heat transfer. Custom fin design forces air to become turbulent and carry heat away more efficiently than old flat fin designs.





TANKS

State-of-the-art high temperature brazing method insures permanent bond and positive contact of tube to manifold, eliminating leaks and providing maximum service life.

CONSTRUCTION MATERIALS & RATINGS

Standard Construction Materials		Standard Unit Ratings	
Tubes	Copper	Operating Pressure	150 psig
Fins	Aluminum	Operating Temperature	400 °F
Cabinet & Pipes	Steel	Consult factory for optional materials and ratings.	
Fan Guard	Zinc Plated Steel		
Manifolds	Steel		

note: AIHTI reserves the right to make reasonable design changes without notice.

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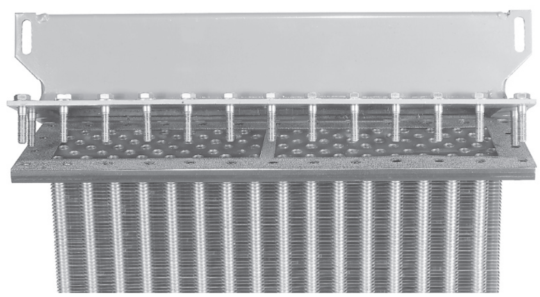
ACA - 6301 through ACA 6602

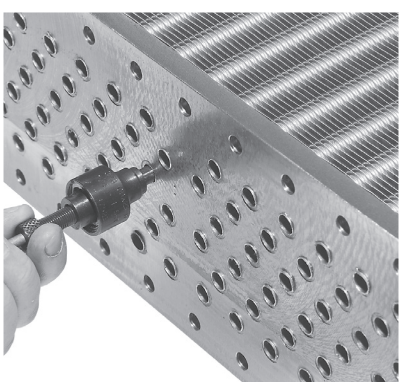
Serviceable Core® Construction

Air coolers are an essential part of any compressed air system, by cooling the air, and condensing water vapor into a liquid state for removal. When air is compressed, the compression induces heat into both the air and the water entrained in the air.
The American Industrial ACA series heat exchanger cools air with air, making it a simple inexpensive way to cool when compared to other water-cooled or refrigerant cooled systems. The unique compact *serviceable core®* design provides efficient cooling and low maintenance under the warmest environmental conditions. By using an ACA series air-cooled after cooler, machine tools will recieve cooler dryer air, provide longer trouble free life, experience less down time, and be cost effective to operate on a continuous basis.

SERVICEABLE CORE®

Core covers disassemble for easy access and cleaning. Repairable design for applications that require limited down time or in the event of a mishap requiring repair. Roller expanded tube to tube-sheet joint. 100% mechanical bond. Positive gasket seal is field replaceable for field maintenance or repair.





SUPERIOR COOLING FINS

Copper tubes are mechanically bonded to highly efficient aluminum cooling fins. Die-formed fin collars provide a durable precision fit for maximum heat transfer. Custom fin design forces air to become turbulent and carry heat away more efficiently than old flat fin designs.

Standard Construction Materials		Standard Unit Ratings	
Tubes	Copper	Operating Pressure	150 psig
Fins	Aluminum	Operating Temperature	400 °F
Cabinet & Pipes	Steel	Consult factory for optional materials and ratings.	
Fan Guard	Zinc Plated Steel		
Manifolds	Steel		

note: AIHTI reserves the right to make reasonable design changes without notice.

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ACA Series *selection*

Compressed Air

Normally air compressors have airflow rates based upon the horsepower. Rotary Screw compressors normally discharge air at 180 ^{o}f - 200 ^{o}f, prior to after-cooling. Reciprocating compressors normally discharge air at 250 ^{o}f - 275 ^{o}f, prior to after-cooling. Compressors are rated in CFM or cubic feet per minute of free air at inlet conditions. For practical purpose we will use sea level at 68 ^{o}f and 36% relative humidity as a norm. Altitude, differing ambient conditions with respect to temperature and humidity will all affect heat exchanger performance to a degree. Moisture content in air actually increases the Btu/hr load requirement for cooling air by adding an additional condensing load to the gas load requirement. As air rapidly cools, moisture in the compressed air stream will condense and separate into droplets, the more humidity present the more condensation will occur.

Sizing

The performance curves provided are for air. However, gases other than air may be applied to this cooler with respect to compatibility by applying a correction factor. Please take time to check the operating specifications thoroughly for material compatibility, pressure, and size before applying an American Industrial heat exchanger into your system.

Terms

Approach Temperature is the desired outlet temperature of the compressed gas minus the inlet ambient air temperature of the external air flowing over the coil.
SCFM (Standard Cubic Feet per Minute)
A cubic foot of air at 68 ^{o}f, 14.696 psia, & 36% relative humidity, per minute.
CFM (Cubic Feet per Minute)
Air at inlet atmospheric conditions.
ACFM (Actual Cubic Feet per Minute)
Air at current pressure, temperature, & humidity conditions without reference to a standard.

To Determine the Heat Load

If the heat load (Btu/hr) is unknown a value can be calculated based upon system operational requirements. To properly calculate the heat load (Btu/hr) to be rejected, several items must be known with certainty (see below).

- Flow rate SCFM (standard cubic feet pr minute)
- Type of gas and its makeup.
- System inlet pressure to the heat exchanger.
- Ambient temperature where the heat exchanger will be located (hotest condition).
- Temperature of the gas at the heat exchanger inlet.
- Temperature of the gas desired at heat exchanger outlet.
- Maximum acceptable pressure loss or cooled gas.

Using The Chart

American Industrial has created a quick reference chart for selecting ACA heat exchangers for Rotary Screw compressors (see page 214) [This chart offers basic information based upon compressor horsepower and average airflow rates. To properly use the chart, select the compressor horsepower at the left or the air flow rate. Next select the approach to ambient that is desired. Where the two columns intersect is shown the proper ACA model number.]

Using The Graphs

American Industrial provides performance graphs for ease of model selection. The following calculation examples (page 213), illustrate formulas to determine model selection sizes. It should be noted that there are some assumptions made when applying the basic principles for calculation in the formula. Altitude, humidity, materials, pressures, etc... all contribute to the final selection. Contact American Industrial for more detailed calculation.

Selection

The selection process is important, many considerations should be made when selecting a heat exchanger. Once the proper Fs requirement is calculated, it is time to apply the data to the graph and make a selection.
1) Find the Flow rate in SCFM located at the bottom of the graph. Follow the graph line up until it matches the calculated Fs from your calculations. If the point falls just above one of the model graphed lines, select the next larger size. If the point is on a line select it as your choice.
2) Check carefully the pressure differential. Units with operating pressures from 70+ psig will have no greater than 2.0 psid within the published flow range. For lower inlet pressure see the pressure drop curves for more detail.
3) Calculate a Nozzle size using the nozzle size calculation to verify your selection has the proper port sizes for your required inlet pressure.

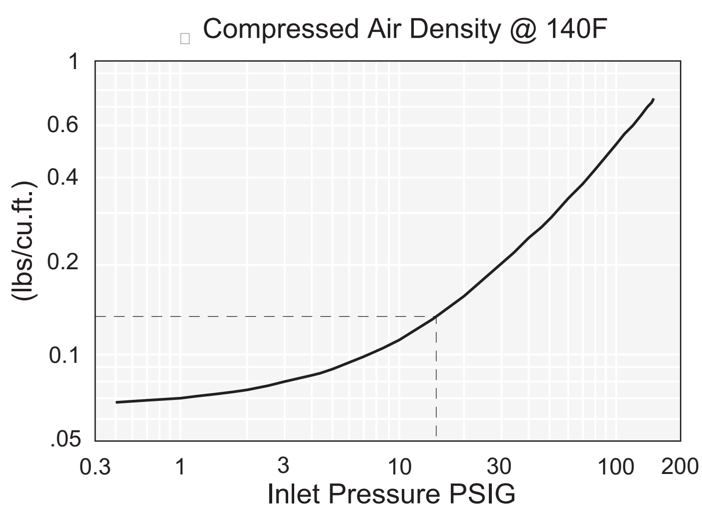
Formula: Nozzle Calculation

$$\text{Nozzle Size} = \sqrt{\frac{\left[\frac{(\text{SCFM} \times 4.512)}{(270{,}000 \times d)} \times 144\right]}{.7854}}$$

All numbers in equation are constants except for SCFM and (d) "density".

Example:
Flow rate = 200 SCFM
Pressure = 15 psig
Density = (d) from Compressed Air Density Graph

$$\sqrt{\frac{\left[\frac{(200 \times 4.512)}{(270{,}000 \times .14)} \times 144\right]}{.7854}} = 2.09\text{" or (2" Nozzle)}$$



note: AIHTI reserves the right to make reasonable design changes without notice.

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Examples: (Note: All air flow rates must be converted to SCFM)

Application 1 Air Rotary Screw Compressor

Determine the heat load "Q" =Btu/hr

$Q = [SCFM \times CF \times (T_1 - T_2)]$ or $[350 \times 1.13 \times 105^o] = 41{,}528$ Btu/hr

T_1 = Inlet gas temperature: 200ºf

T_2 = Outlet gas temperature: Ambient + 10ºf= (95ºf)

T_a = Ambient temperature: 85ºf

Determine the $Fs = \frac{Btu/hr}{T_2 - T_a}$ or $\frac{41{,}528}{10}$ = **4,153 Fs** Refer to graph example on page 215

Airflow rate: 350 SCFM

PSIG = Operating Pressure 100 psig

CF = Correction factor: 1.13

CF = (.0753 x S x C x60) or (.0753 x 1.0 x .25 x 60) = 1.13

S = Specific gravity with air being 1.0

C = Specific heat (Btu/Lb ºf): .25

Model Selection - ACA-4362

$$\sqrt{\frac{\left[\frac{(350 \times 4.512)}{(270{,}000 \times .50)} \times 144\right]}{.7854}} = 1.46\text{" or (1.5" minimum nozzle)}$$

Application 2 Methane Gas

Determine the heat load "Q" = Btu/hr

$Q = [SCFM \times CF \times (T_1 - T_2)]$ or $[500 \times 1.428 \times 210^o] = 149{,}940$ Btu/hr

T_1 = Inlet gas temperature: 300ºf

T_2 = Outlet gas temperature: 90ºf

T_a = Ambient temperature: 60ºf

Determine the $Fs = \frac{Btu/hr}{T_2 - T_a}$ or $\frac{149{,}940}{30}$ = **4,998 Fs** Refer to graph example on page 215

Gas flow rate: 500 SCFM

PSIG = Operating pressure: 150 psig

CF = Correction factor: 1.428

CF = (.0753 x S x C x 60) or (.0753 x .55 x .575 x 60) = 1.428

S = Specific gravity with air being 1.0: .55

C = Specific heat (Btu/Lb ºf)

Model Selection - ACA-6421

$$\sqrt{\frac{\left[\frac{(500 \times 4.512)}{(270{,}000 \times .74)} \times 144\right]}{.7854}} = 1.44\text{" or (1.5" minimum nozzle)}$$

Application 3 Low Pressure Blower

Determine the heat load "Q" = Btu/hr

$Q = [SCFM \times CF \times (T_1 - T_2)]$ or $[76 \times 1.13 \times 150^o] = 12{,}882$ Btu/hr

T_1 = Inlet gas temperature: 250ºf

T_2 = Outlet gas temperature: 100ºf

T_a = Ambient temperature: 90ºf

Determine the $Fs = \frac{Btu/hr}{T_2 - T_a}$ or $\frac{12{,}882}{10}$ = **1,288 Fs** Refer to graph example on page 215

CF = Correction Factor: 1.13

PSIG = Operating pressure: 2 psig

Airflow rate: 90 ACFM

To Convert ACFM to SCFM $= \frac{ACFM \times (PSIG + 14.7) \times 528}{(T_1 + 460) \times 14.7} = \frac{90 \times 16.7 \times 528}{710 \times 14.7} = 76$ SCFM

S = Specific gravity with air being 1.0

C = Specific heat (Btu/lb ºf): .25

△P = 5" water column or less (example pg. 220)

Model Selection - ACA-3302

$$\sqrt{\frac{\left[\frac{(76 \times 4.512)}{(270{,}000 \times .075)} \times 144\right]}{.7854}} = 1.76\text{" or (2.0" minimum nozzle)}$$

Pressure Drop (see page 220 for graphs)

Since gas is compressible the density of the gas changes from one temperature or pressure to the next. While the mass flow rate may not change, the pressure differential across the heat exchanger will change dramatically from high (70-125 psig) to low (1-5 psig) pressure. A low pressure condition requires larger carrying lines to move flow than does the same gas rate under a higher pressure. At lower pressures the differential pressure across the heat exchanger can be quite high compared to the same flow rate at a higher pressure. For that reason it is suggested that the pressure differential graphs on page 220 be consulted prior to making your final selection.

The ACA series heat exchanger is designed to be easily modified to accept larger port sizes in the event your system pressure requires larger nozzles. Consult our engineering department for more exacting information regarding pressure differential issues.

note: AIHTI reserves the right to make reasonable design changes without notice.

ROTARY SCREW COMPRESSORS

(200°F @125 PSI & 36% relative humidity)

Compressor Horse Power (HP)	Average Air Discharge Cubic feet per minute (SCFM)	Model Size Selection *Approach Temperature °F ($T_2 - T_a$)			
		5°F	10°F	15°F	20°F
15	60	ACA - 3302	ACA - 3242	ACA - 3242	ACA - 3182
20	80	ACA - 3302	ACA - 3242	ACA - 3242	ACA - 3182
30	130	ACA - 3362	ACA - 3302	ACA - 3242	ACA - 3242
40	165	ACA - 3362	ACA - 3302	ACA - 3302	ACA - 3242
60	250	ACA - 4362	ACA - 3362	ACA - 3302	ACA - 3302
75	350	ACA - 6362	ACA - 4362	ACA - 3362	ACA - 3302
100	470	ACA - 6362	ACA - 6362	ACA - 3362	ACA - 3362
125	590	ACA - 6422	ACA - 6362	ACA - 4362	ACA - 3362
150	710	ACA - 6422	ACA - 6362	ACA - 6362	ACA - 4362
200	945	ACA - 6482	ACA - 6422	ACA - 6362	ACA - 6362
250	1160	ACA - 6482	ACA - 6422	ACA - 6362	ACA - 6362
300	1450	ACA - 6542	ACA - 6482	ACA - 6422	ACA - 6362
350	1630	ACA - 6542	ACA - 6482	ACA - 6422	ACA - 6362
400	1830	ACA - 6602	ACA - 6482	ACA - 6422	ACA - 6422
500	2150	ACA - 6602	ACA - 6542	ACA - 6482	ACA - 6422

***Approach Temperature**
the desired outlet temperature of the compressed gas minus the inlet ambient air temperature of the external air flowing over the coil.

T_2 - Outlet gas temperature

T_a - Ambient temperature

Example of a model:

ACA - 3242 - 3 - __ -____ - ____

Model
ACA

Size

Number of Passes
1P = 1 pass
2P = 2 pass

Drive Type
N = no motor
1 = single phase
3 = three phase
1EXP = single phase
3EXP = three phase
5 = 575 Volt

Connections
Blank = NPT
A = ANSI 150#RF Flange

Tubing
Blank = Copper
U = 90/10 Cu Ni
C = Carbon Steel

Coating
Blank = Enamel (standard)
G = Galvanize (cabinet)
T = Heresite (core)
X = Epoxy (core & cabinet)

Using the performance graphs (page 215)

The Flow vs. Fs graph is calculated based upon SCFM units.

To convert volumetric Actual Cubic Feet per Minute (ACFM) into Standard Cubic Feet per Minute (SCFM) see page 213 application 3.

To select a model, locate the flow rate in SCFM located at the bottom of the graph. Proceed upward on the graph until the SCFM flow rate intersects with the calculated Fs. The curve closest, on or above the intersection point is the proper selection.

Using the one pass graph or two-pass graph depends upon pressure differential, flow, and performance requirements. The actual surface area for one or two pass units is the same. However, the airflow velocity in the tubes increases with the number of passes giving slightly higher pressure differentials and better cooling performance.

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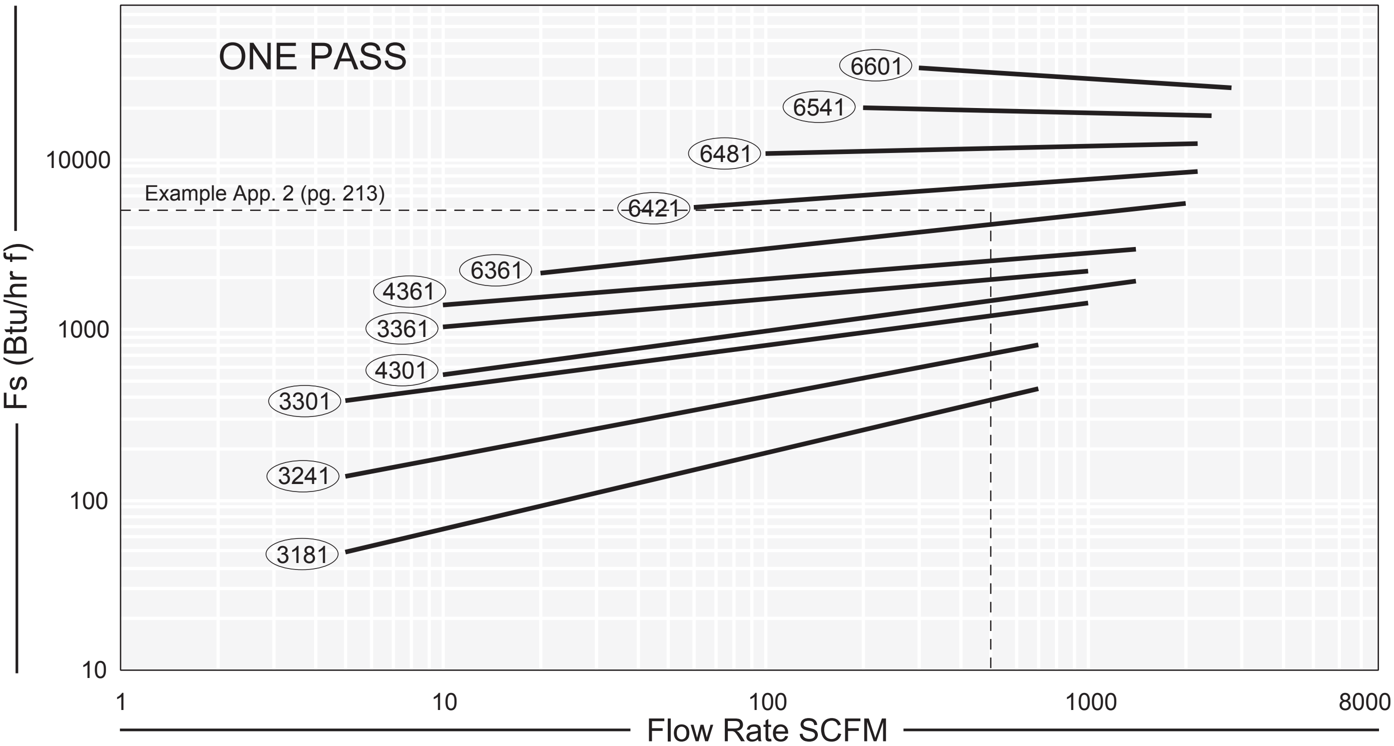

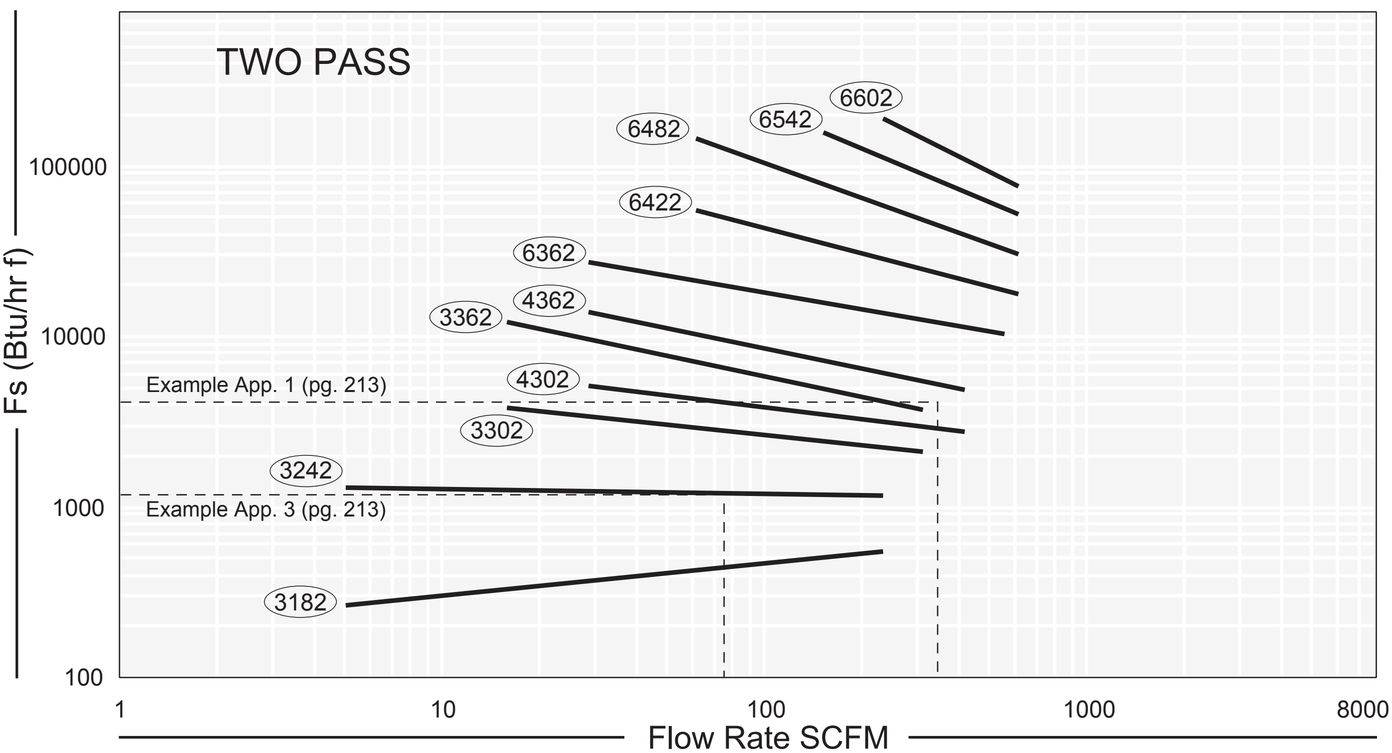

Example

Application #3 (p.5)

$$Fs = \frac{\text{Heat Load (Btu/hr)}}{\text{Process exiting temperature } (T_2) \text{ from cooler} - \text{Ambient air entering the cooler } (T_a)}$$

SCFM = 76
ÐPSI required = 5" H2O
Model selection = ACA-6421-3
Fs = 1,288 Nozzle check (p.4) = 3.10 or 3"NPT

note: AIHTI reserves the right to make reasonable design changes without notice.

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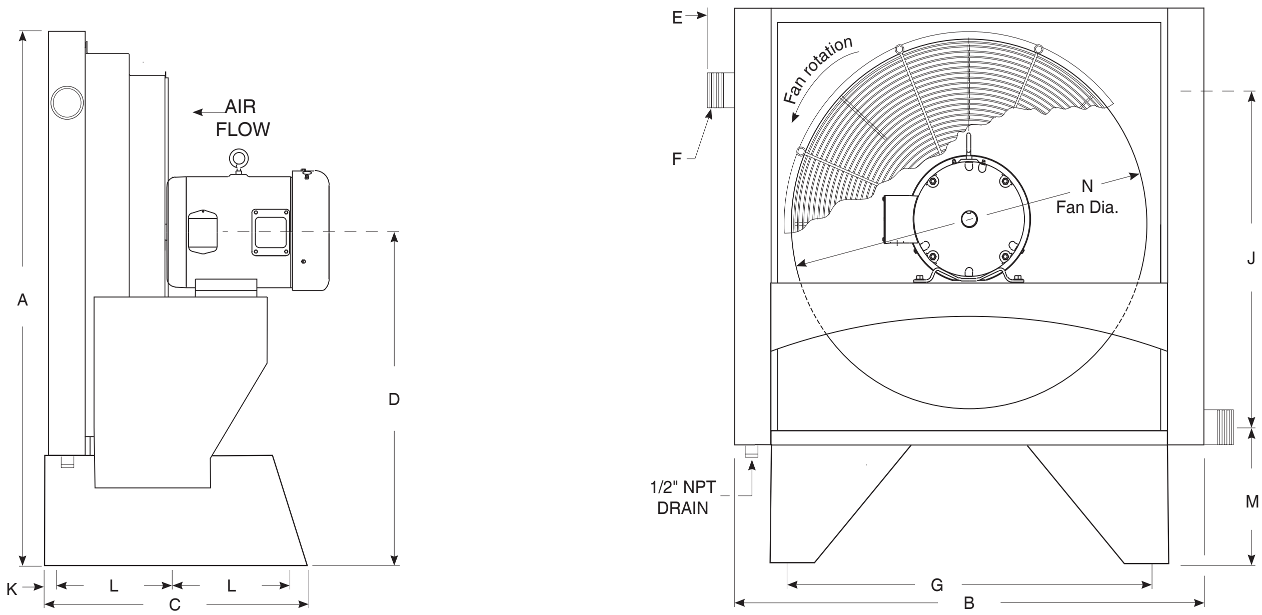
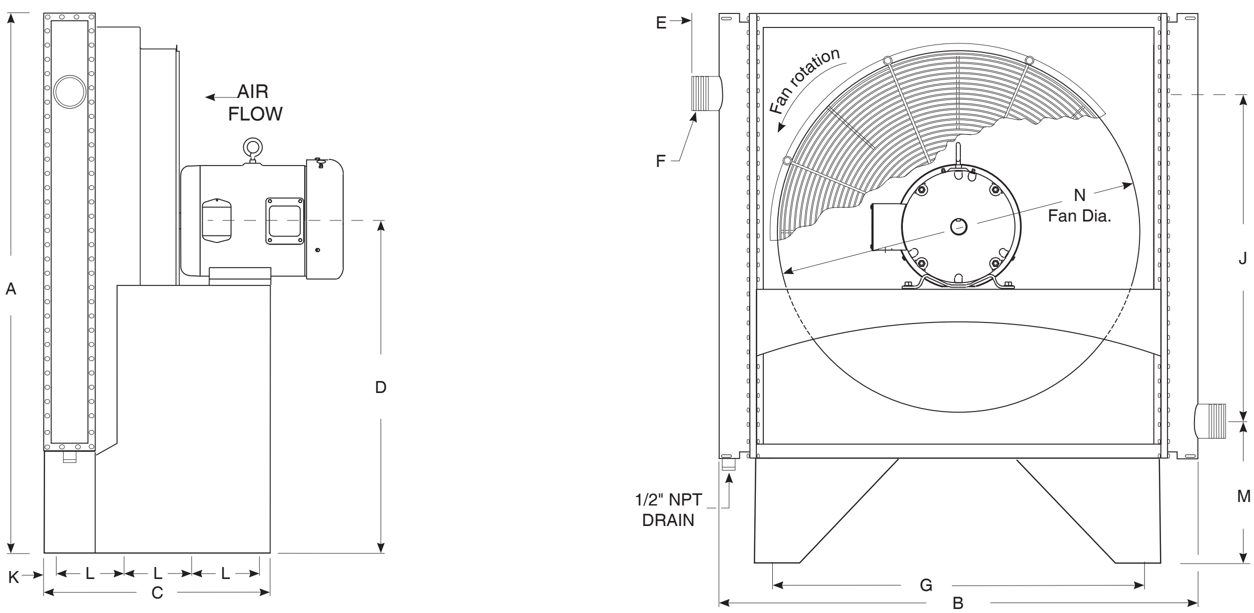
ACA Series *dimensions*



ACA - 3181 through ACA - 4361



ACA - 6301 through ACA - 6601

DIMENSIONS (inches)												
Model	A	B	C	D	E	F NPT	G	J	K	L	M	N
ACA - 3181	30.6	23.0	19.8	20.25	2.5	1.5	16.3	12.98	1.5	8.38	11.93	14.0
ACA - 3241	36.6	29.0	19.8	23.25	2.5	1.5	22.3	17.48	1.5	8.38	11.93	22.0
ACA - 3301	42.6	35.0	19.8	26.25	2.5	2.0	28.3	21.75	1.5	8.38	12.15	28.0
ACA - 4301	42.6	36.0	19.8	26.25	2.5	2.5	28.3	21.55	1.5	8.38	12.35	28.0
ACA - 6301	42.6	38.8	19.8	26.25	2.5	3.0	28.3	21.07	1.5	8.38	12.98	28.0
ACA - 3361	48.6	41.0	19.8	29.25	2.5	2.0	34.3	26.25	1.5	8.38	12.15	32.0
ACA - 4361	48.6	42.0	19.8	29.25	2.5	2.5	34.4	26.05	1.5	8.38	12.35	32.0
ACA - 6361	48.5	43.9	19.8	29.25	2.5	3.0	34.3	26.0	1.5	8.38	12.7	32.0
ACA - 6421	54.5	50.8	27.36	32.25	2.5	4.0	40.3	29.4	2.0	6.75	13.3	36.0
ACA - 6481	60.6	56.8	27.36	35.25	2.5	4.0	46.3	34.1	2.0	6.75	13.3	42.0
ACA - 6541	66.6	62.8	28.83	38.25	2.5	4.0	52.3	38.6	2.0	6.75	13.3	48.0
ACA - 6601	72.4	67.9	30.6	41.25	2.5	4.0	58.3	43.05	2.0	6.75	13.3	48.0

note: AIHTI reserves the right to make reasonable design changes without notice.

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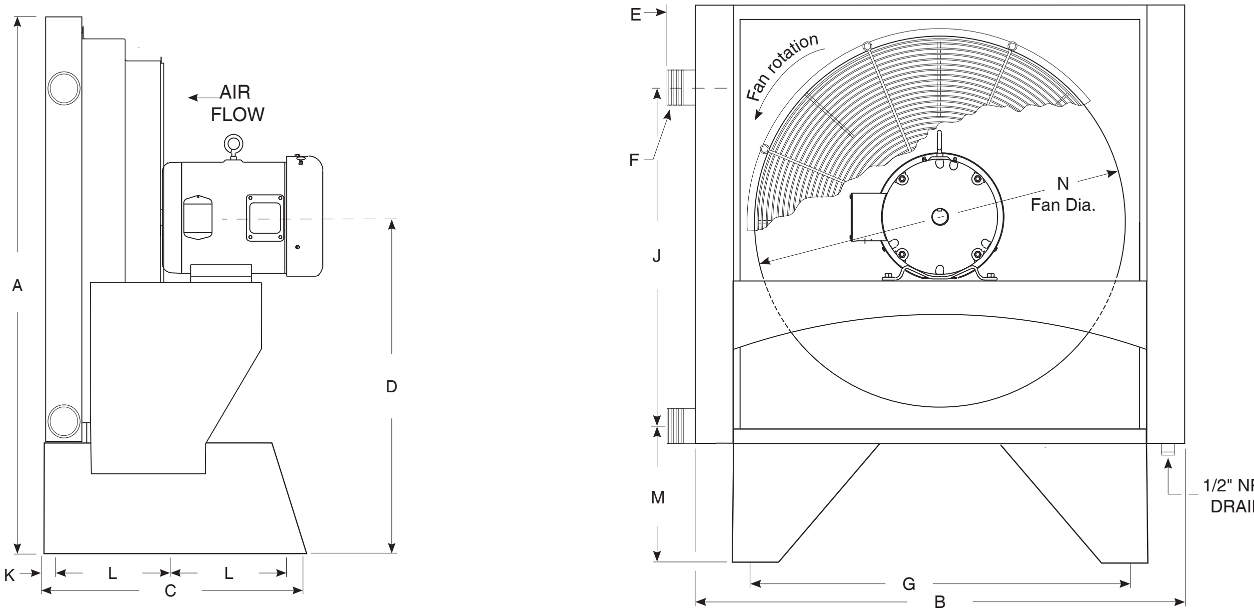
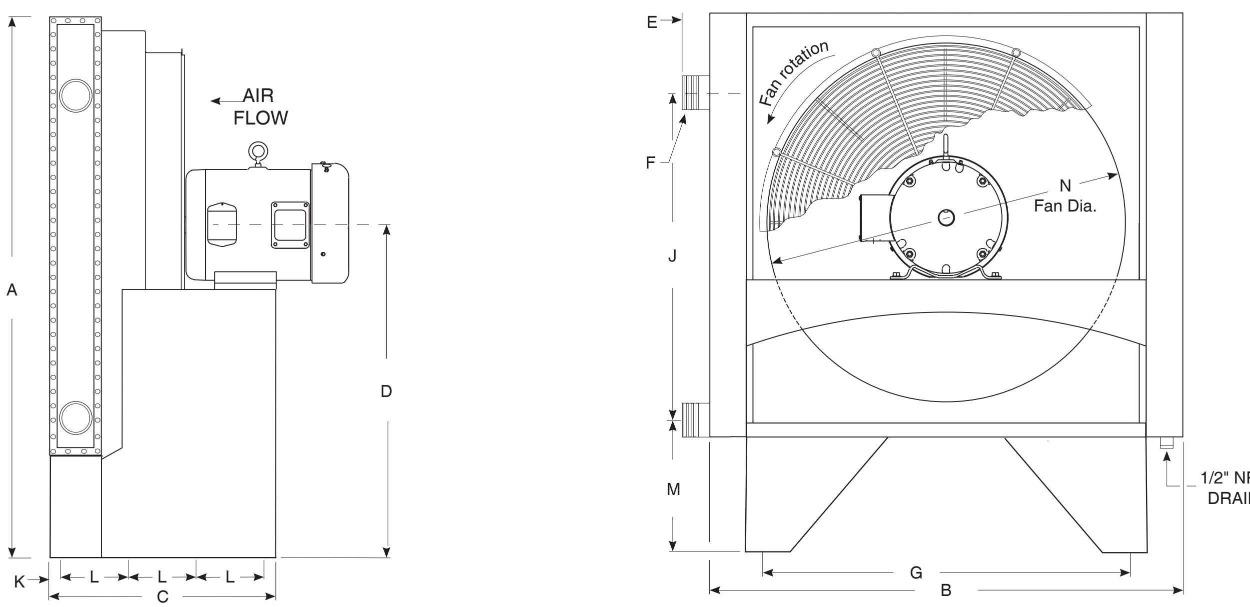


ACA - 3182 through ACA - 4362



ACA - 6302 through ACA - 6602

DIMENSIONS (inches)													
Model	A	B	C	D	E	F NPT	G	J	K	L	M	N
ACA - 3182	30.6	23.0	19.8	20.25	2.5	1.5	16.3	12.98	1.5	8.38	11.93	14.0
ACA - 3242	36.6	29.0	19.8	23.25	2.5	1.5	22.3	17.48	1.5	8.38	11.93	22.0
ACA - 3302	42.6	35.0	19.8	26.25	2.5	2.0	28.3	21.75	1.5	8.38	12.15	28.0
ACA - 4302	42.6	36.0	19.8	26.25	2.5	2.5	28.3	21.55	1.5	8.38	12.35	28.0
ACA - 6302	42.6	38.8	19.8	26.25	2.5	3.0	28.3	21.07	1.5	8.38	12.98	28.0
ACA - 3362	48.6	41.0	19.8	29.25	2.5	2.0	34.3	26.25	1.5	8.38	12.15	32.0
ACA - 4362	48.6	42.0	19.8	29.25	2.5	2.5	34.4	26.05	1.5	8.38	12.35	32.0
ACA - 6362	48.5	43.9	19.8	29.25	2.5	3.0	34.3	26.0	1.5	8.38	12.7	32.0
ACA - 6422	54.5	50.8	27.36	32.25	2.5	4.0	40.3	29.4	2.0	6.75	13.3	36.0
ACA - 6482	60.6	56.8	27.36	35.25	2.5	4.0	46.3	34.1	2.0	6.75	13.3	42.0
ACA - 6542	66.6	62.8	28.83	38.25	2.5	4.0	52.3	38.6	2.0	6.75	13.3	48.0
ACA - 6602	72.4	67.9	30.6	41.25	2.5	4.0	58.3	43.05	2.0	6.75	13.3	48.0

note: AIHTI reserves the right to make reasonable design changes without notice.

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ELECTRIC MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2- 1	.25	1	60-50	115/230 - 90/190	1725-1440	48	TEFC	3.2/1.6/2.8-1.4	1.15	NO
ACA- 3181/2 -3	.25	3	60-50	208 - 230/460 - 190/380	1725-1440	48	TEFC	1.3/.65/1.1-.55	1.15	NO
ACA- 3241/2 -1	.25	1	60-50	115/230 - 90/190	1140-950	56	TEFC	6.8/3.1-3.4	1.15	NO
ACA- 3241/2 -3	.25	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	1.7/2.0/1.0	1.15	NO
ACA- 3301/2 -1	.5	1	60-50	115/230 - 90/190	1140-950	56	TEFC	9.6/4.7-4.8/10.4/5.2	1.15	NO
ACA- 3301/2 -3	.5	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	2.4-2.7/1.35-2.5/1.25	1.15	NO
ACA- 4301/2 -1	.5	1	60-50	115/230 - 90/190	1140-950	56	TEFC	9.6/4.7-4.8/10.4/5.2	1.15	NO
ACA- 4301/2 -3	.5	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	2.4-2.7/1.35-2.5/1.25	1.15	NO
ACA- 6301/2 -3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 3361/2 -3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 4361/2- 3	1.0	3	60-50	208 - 230/460 - 190/380	1140-950	56	TEFC	4/2-3.7/1.85	1.15	NO
ACA- 6361/2 -3	3.0	3	60-50	208 - 230/460 - 190/380	1725-1440	182T	TEFC	8.4-6.8/3.4	1.15	NO
ACA- 6421/2 -3	5.0	3	60-50	208 - 230/460 - 190/380	1140-950	213T	TEFC	8.2-7.6/3.8	1.15	NO
ACA- 6481/2 -3	5.0	3	60-50	208 - 230/460 - 190/380	1140-950	213T	TEFC	14.0/7.0	1.15	NO
ACA- 6541/2 -3	7.5	3	60-50	208 - 230/460 - 190/380	1140-950	254T	TEFC	20.4/10.2	1.15	NO
ACA- 6601/2 -3	10	3	60-50	208 - 230/460 - 190/380	1140-950	256T	TEFC	28.0/14.0	1.15	NO

ELECTRIC MOTOR NOTES:

1) Motor electrical ratings are an approximate guide and may vary between motor manufacturers. Consult ratings on motor data plate prior to installation and operation.

2) Explosion proof, high temperature, severe duty, chemical, IEC, Canadian Standards Association, and Underwriters Laboratory recognized motors are available upon request.

3) American Industrial reserves the right to enact changes to motor brand, type and ratings regarding horsepower, RPM,FLA,and service factor for standard products without notice. All specific requirements will be honored without change.

4) Fan rotation is clockwise when facing the motor shaft.

5) The above motors contain factory lubricated shielded ball bearings (no additional lubrication is required).

6) **Abbreviation Index**
TEFC...........................Totally Enclosed, Fan Cooled
EXP.............................Explosion Proof

CLASS I,DIV.1, GROUP D or CLASS II,DIV.2, GROUP F & G EXPLOSION PROOF MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2 -1	.25	1	60	115/230	1725	48	EXP	5.8/2.8	1.0	YES
ACA- 3181/2 -3	.25	3	60	208-230/460	1725	48	EXP	1.4-1.3/.65	1.0	YES
ACA- 3241/2 -3	.33	1	60	115/230	1140	56	EXP	7.8/3.5	1.0	YES
ACA- 3241/2 -1	.33	3	60	208-230/460	1140	56	EXP	1.18-1.6/8	1.0	YES
ACA- 3301/2 -3	.75	1	60	115/230	1140	56	EXP	9.4/4.8	1.0	YES
ACA- 3301/2 -1	.75	3	60	208-230/460	1140	56	EXP	2.5-2.4/1.2	1.0	YES
ACA- 4301/2 -3	.75	1	60	115/230	1140	56	EXP	9.4/4.8	1.0	YES
ACA- 4301/2 -1	.75	3	60	208-230/460	1140	56	EXP	2.5-2.4/1.2	1.0	YES
ACA- 6301/2 -1	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.0	YES
ACA- 3361/2 -3	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.0	YES
ACA- 4361/2 -3	1.0	3	60	230/460	1140	56	EXP	3.8/1.9	1.15	YES
ACA- 6361/2 -3	3	3	60	230/460	1725	182	EXP	8.8/4.4	1.15	YES
ACA- 6421/2 -3	5	3	60	230/460	1160	215	EXP	15.0-13.8/6.9	1.15	YES
ACA- 6481/2 -3	5	3	60	230/460	1160	215	EXP	15.0-13.8/6.9	1.15	YES
ACA- 6541/2 -3	7.5	3	60	230/460	1160	256	EXP	21.6-20.4/10.2	1.15	YES
ACA- 6601/2 -3	10	3	60	230/460	1160	256	EXP	29-26/13	1.15	YES

NOTE: Basic electric drive units are supplied with one of the corresponding above listed motors.

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575 VOLT ELECTRIC MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
ACA- 3181/2 -5	1/3	3	60	575	1725	56	TEFC	.52 .56	1.15	NO
ACA- 3241/2 -5	1/3	3	60	575	1140	56	TEFC	.52 .56	1.15	NO
ACA- 3301/2 -5	1/2	3	60	575	1140	56	TEFC	1.08	1.15	NO
ACA- 4301/2 -5	1/2	3	60	575	1140	56	TEFC	1.08	1.15	NO
ACA- 6301/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA- 3361/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA- 4361/2 -5	1	3	60	575	1140	56	TEFC	1.6	1.15	NO
ACA- 6361/2 -5	3	3	60	575	1725	182T	TEFC	3.3	1.15	NO
ACA- 6421/2 -5	5	3	60	575	1140	213T	TEFC	5.9	1.15	NO
ACA- 6481/2 -5	5	3	60	575	1140	213T	TEFC	5.9	1.15	NO
ACA- 6541/2 -5	7.5	3	60	575	1140	254T	TEFC	8.0	1.15	NO
ACA- 6601/2 -5	10	3	60	575	1140	256T	TEFC	10.5	1.15	NO

COMMON DATA

Model	Air Flow		Sound Level	Weight		Serviceable
	CFM	m^3/s	dB(A) @ 7ft	w/ motor	w/o motor	Core
ACA-3181/2	1550	0.731	72	131	111	NO
ACA-3241/2	2900	1.36	76	154	134	NO
ACA-3301/2	4450	2.10	76	184	160	NO
ACA-4301/2	4450	2.10	76	211	187	NO
ACA-6301/2	4450	2.10	76	343	305	YES
ACA-3361/2	6350	2.99	79	243	205	NO
ACA-4361/2	6350	2.99	79	289	251	NO
ACA-6361/2	10500	4.95	91	402	342	YES
ACA-6421/2	14300	6.75	87	636	443	YES
ACA-6481/2	18700	8.82	88	753	560	YES
ACA-6541/2	23350	11.02	91	938	691	YES
ACA-6601/2	29300	13.83	91	1104	835	YES

NOTES:

TEFC = Totally Enclosed, Fan Cooled

To estimate the sound level at distances other than 7 feet (2.1 meters) from the cooler, add 6 db for each halving of distance, or substract 6 db for each doubling of the distance.

Example:
The Sound Level of the ACA-3181/2 is 72 dB at 7ft. At 3.5ft (7ft x 0.5 = 3.5ft) the sound level is 66 dB (72dB - 6dB = 66dB). At 14ft (7ft x 2 = 14ft) the sound level is 78dB (72dB + 6dB = 78dB).

Pressure Drop Graphs (see page 220)

Each graph represents a specific pressure drop at differing flow rates and inlet pressures. The four graphs for each model series size represents the more popular milestone pressure differentials commonly applied.

To use the graphs for selection purposes follw the steps below.

1) Locate the operating pressure at the bottom of the desired pressure drop chart.
2) Locate the flow rate in SCFM at the left end of the chart.
3) Follow the "Pressure" line vertically and the "Flow" line horizontally until they cross, note the location.
4) The curve on, or closest above will be exact or less pressure drop than requested and suitable for the application.
5) There may be several units shown above the intersection point, all of which will produce less than the desired pressure drop at the required flow.

Example: Application 3 Low Pressure Blower

Flow = 76 SCFM
Operating pressure = 2 PSIG
Initial selection from graph page 215 = ACA-3302
Desired pressure drop = 5" H2O or less. (USE the "Pressure Drop 5" H20" curves page 220)
From the pressure drop graph, page 220. Acceptable choice - ACA-3302 is on the line, ACA-3242 is well below the line. The ACA-3302 meets the pressure drop requirement, but exceeds the capacity requirement. However, even though the ACA-3242 exceeds 5" of water pressure drop, other considerations should be made prior to selection such as unit physical size, cost, availability, and port size.

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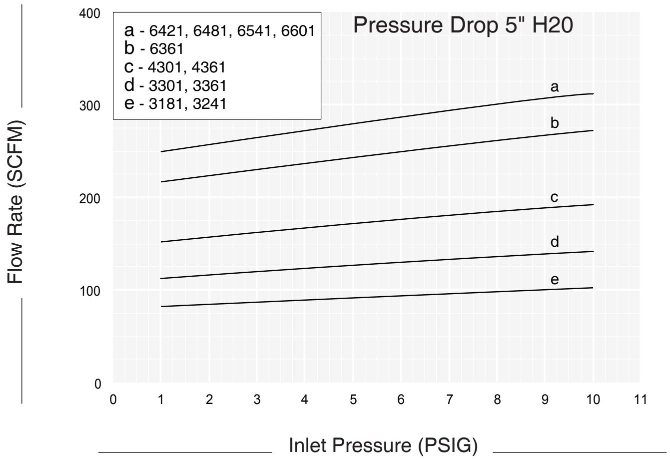
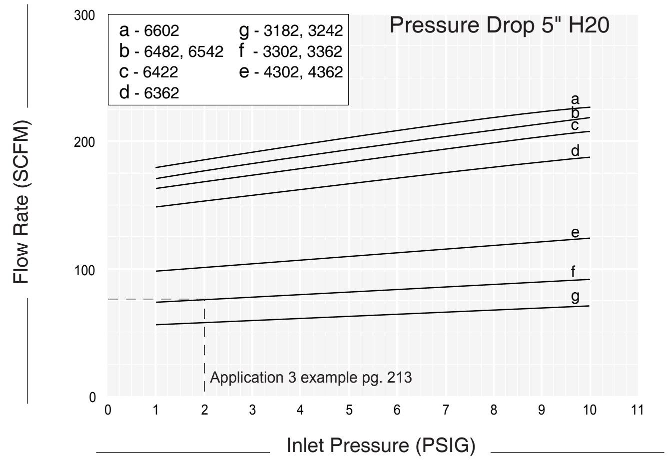
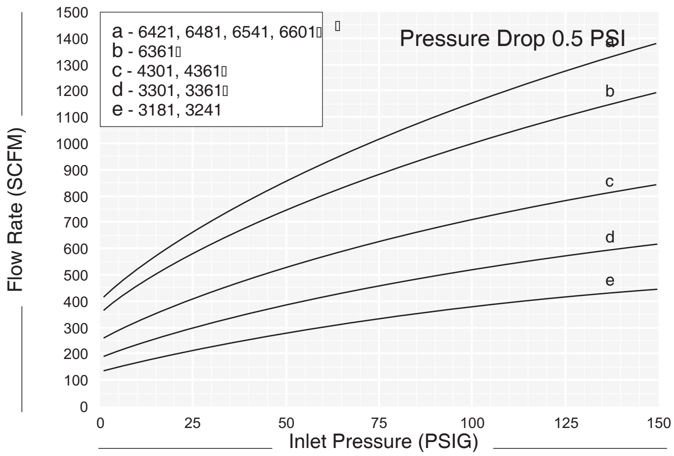
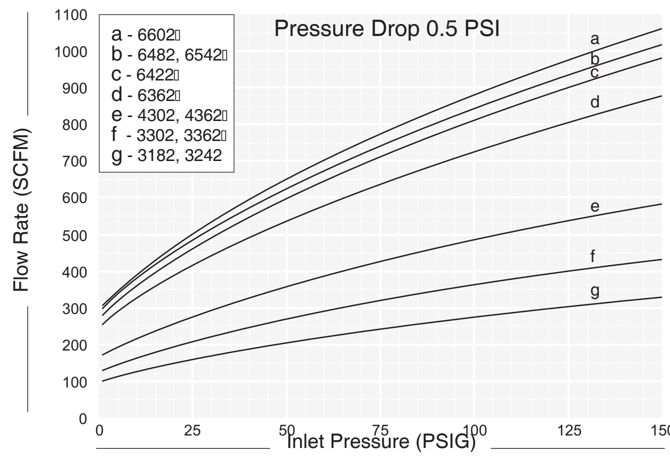
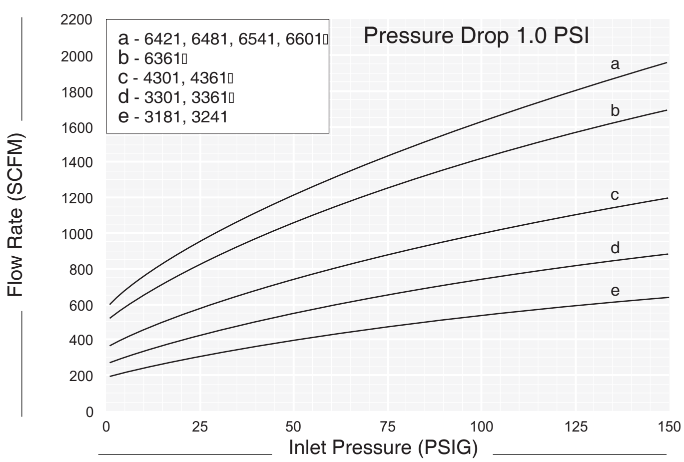
ACA Series *pressure drop graphs*

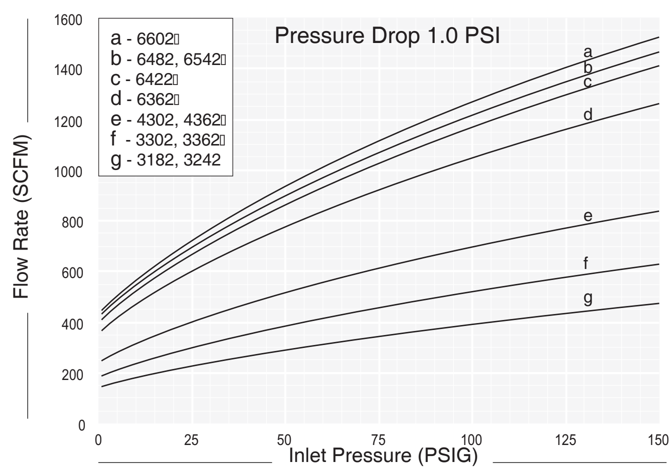


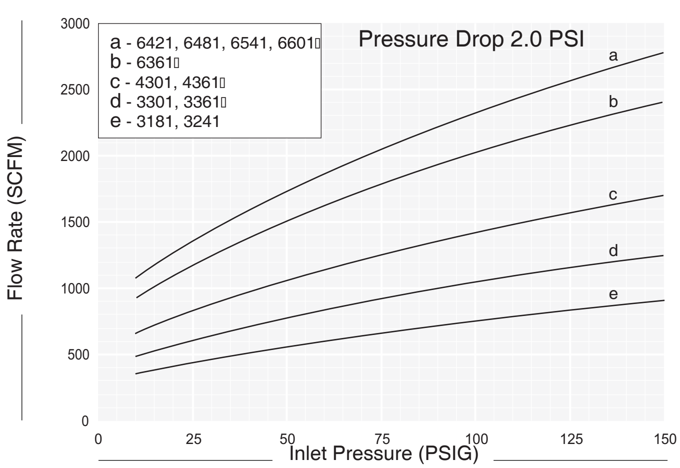


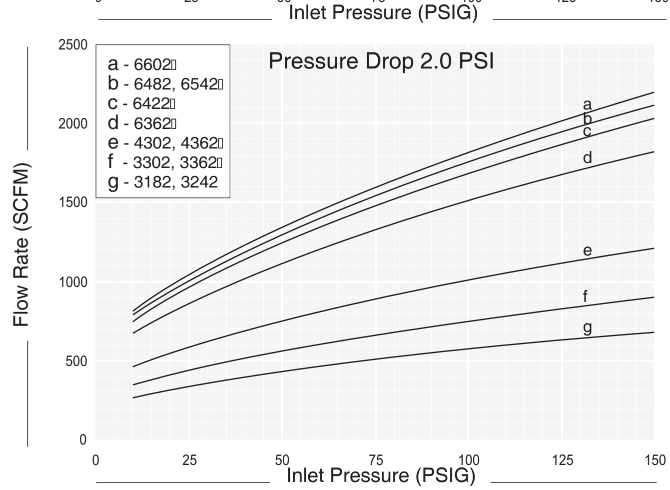












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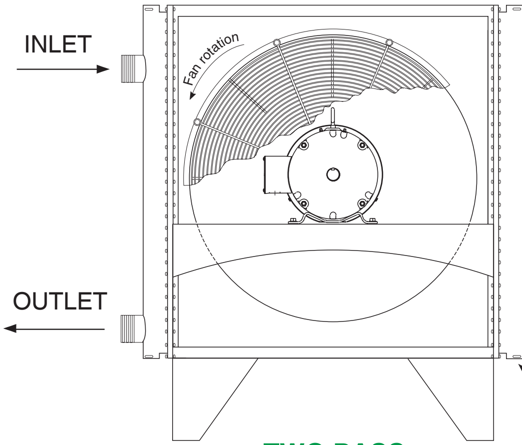
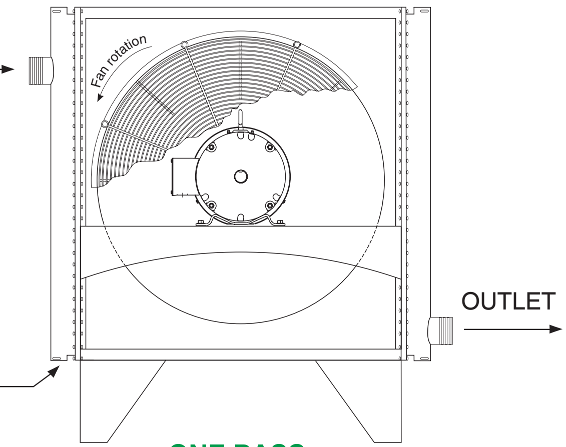
PIPING HOOK UP





Receiving:

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person and mark it on the receiving bill before accepting the freight. Make sure that the core and fan are not damaged. Rotate the fan blade to make sure that it moves freely. The published weight information located in this brochure is approximate. True shipment weights are determined at the time of shipping and may vary. Approximate weight information published herein is for engineering approximation purposes and should not be used for exact shipping weight. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturers warranty.*

b) When handling the ACA heat exchanger, special care should be taken to avoid damage to the core and fan. All units are shipped with wood skids for easy forklift handling

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warrantee it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

Installation:

a) American Industrial recommends that the equipment supplied should be installed by qualified personal who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any ACA series cooler. If the system pressure or temperature does not fall within the parameters on ACA rating tag located on the heat exchanger, contact our factory prior to installation or operation.

b) In order for the heat exchanger to properly function, installation should be made with minimum airflow obstruction distance of not less than twenty (20) inches on both fan intake and exiting side of the heat exchanger.

c) Process piping should be as indicated above with the process flow entering into the upper port and exiting out the lower port (see illustration). This configuration will allow for condensate moisture to drain completely from the equipment. It is recommended that an air separator or automatic drip leg be applied to the outlet side of the heat exchanger to trap any moisture that develops.

d) Flow line sizes should be sized to handle the appropriate flow to meet the system pressure drop requirements. If the nozzle size of the heat exchanger is smaller than the process line size an increased pressure differential at the heat exchanger may occur.

e) ACA series coolers are produced with both brazed ACA-3181 through ACA-4362, and serviceable core® ACA-6301 through ACA-6602 style coils. A brazed construction coil does not allow internal tube access. A serviceable core® will allow full accessibility to the internal tubes for cleaning and maintenance. ACA series coolers are rated for 150 PSIG working pressure, and a 400°f working temperature.

f) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warrantee coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

note: AIHTI reserves the right to make reasonable design changes without notice.

 355 American Industrial Drive LaCrosse, VA 23950 tel: 434-757-1800 fax: 434-757-1810 email: sales@aihti.com

g) Electric motors should be connected only to supply source of the same characteristics as indicated on the electric motor information plate. Prior to starting, verify that the motor and fan spin freely without obstruction. Check carefully that the fan turns in the correct rotation direction normally counter clockwise from the motor side (fan direction arrow). Failure to operate the fan in the proper direction could reduce performance or cause serious damage to the heat exchanger or other components. Fan blades should be rechecked for tightness after the first 100 hours of operation.

Maintenance

Regular maintenance intervals based upon the surrounding and operational conditions should be maintained to verify equipment performance and to prevent premature component failure. Since some of the components such as, motors, fans, load adapters, etc... are not manufactured by American Industrial maintenance requirements provided by the manufacture must be followed.

a) Inspect the entire heat exchanger and motor/fan assembly for loosened bolts, loose connections, broken components, rust spots, corrosion, fin/coil clogging, or external leakage. Make immediate repairs to all affected areas prior to restarting and operating the heat exchanger or its components.

b) Heat exchangers operating in oily or dusty environments will often need to have the coil cooling fins cleaned. Oily or clogged fins should be cleaned by carefully brushing the fins and tubes with water or a non-aggressive degreasing agent mixture (Note: Cleaning agents that are not compatible with copper, brass, aluminum, steel or stainless steel should not be used). A compressed air or a water stream can be used to dislodge dirt and clean the coil further. Any external dirt or oil on the electric motor and fan assembly should be removed. Caution: Be sure to disconnect the electric motor from its power source prior to doing any maintenance.

c) In most cases it is not necessary to internally flush the coil. In circumstances where the coil has become plugged or has a substantial buildup of material, flushing the coil with water or a solvent may be done. Flushing solvents should be non-aggressive suitable for the materials of construction. Serviceable Core® models can be disassembled and inspected or cleaned if required.

d) Most low horsepower electric motors do not require any additional lubrication. However, larger motors must be lubricated with good quality grease as specified by the manufacture at least once every 6-9 months or as directed by the manufacture. T.E.F.C. air ventilation slots should be inspected and cleaned regularly to prevent clogging and starving the motor of cooling air. To maintain the electric motor properly see the manufactures requirements and specifications.

e) Fan blades should be cleaned and inspected for tightness during the regular maintenance schedule when handling a fan blade care must be given to avoid bending or striking any of the blades. Fan blades are factory balanced and will not operate properly if damaged or unbalanced. Damaged fan blades can cause excessive vibration and severe damage to the heat exchanger or drive motor.

Replace any damaged fan with an American industrial suggested replacement.

f) ACA heat exchanger cabinets are constructed using 7ga. through 18ga. steel that may be bent back into position if damaged. Parts that are not repairable can be purchased through American Industrial.

g) Coil fins that become flattened can be combed back into position. This process may require removal of the coil from the cabinet.

h) It is not advisable to attempt repairs to brazed joints of a brazed construction coil unless it will be done by an expert in silver solder brazing. Brazed coils are heated uniformly during the original manufacturing process to prevent weak zones from occurring. Uncontrolled reheating of the coil may result in weakening of the tube joints surrounding the repair area. In many instances brazed units that are repaired will not hold up as well to the rigors of the system as will a new coil. American Industrial will not warranty or be responsible for any repairs done by unauthorized sources. Manipulation in any way other than normal application will void the manufactures warranty.

i) Units containing a Serviceable Core® have bolted manifold covers that can be removed for cleaning or repair purposes.

Servicing Sequence

American Industrial has gone to great lengths to provide components that are repairable. If the ACA unit requires internal cleaning or attention the following steps will explain what must be done to access the internal tubes. Be sure to order gasket kits or repair parts prior to removal and disassembly to minimize down time.

a) To clean the internal tubes first remove all connection pipes from the unit.

b) Be sure the unit is drained of all water etc...

c) Place the ACA unit in an area that it can be accessed from all sides.

d) Remove the manifold cover bolts and hardware and place them into a secure place.

e) The manifold covers are tightly compressed and may need some prying to separate them from the gasket, physically remove the cover assemblies from both sides.

f) The tubes are now accessible for cleaning. We suggest a mild water-soluble degreaser be used with a brush. Tubing I.D. is .325 a plastic bristle brush on a rod will work best for cleaning the tubes. Steel brushes should be avoided since the steel is harder than the copper tubing and may heavily score the tubes if used.

g) If there are any leaking tubes you may plug them be forcing a soft metal plug into the hole and tapping it tight. You may in some cases weld the leaking tube shut however, care should be taken since excessive heat may cause surrounding tube joints to loosen and leak.

note: AIHTI reserves the right to make reasonable design changes without notice.

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Solinst®

More Info | Instructions | Get Quote

Quick Start Guide

Levelogger 5 Series

Get Quote

High Quality Groundwater and Surface Water Monitoring Instrumentation

Installing the Software

To begin using your Levelogger, download the newest version of Levelogger Software and User Guide by visiting: www.solinst.com/downloads/

Installing the Hardware

Connect your datalogger to a computer using either the Optical Reader (Desktop Reader 5 or Field Reader 5) or PC Interface Cable.

Desktop Reader 5

Field Reader 5

Optical Readers

L5 Direct Read Cable

PC Interface Cable

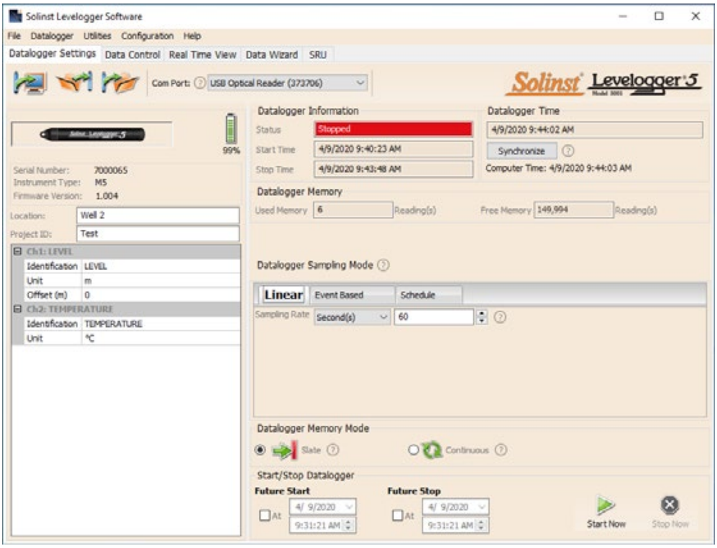
Programming the Levelogger

Note: Ensure the Levelogger is operating with the latest firmware, and that you are using the latest software. Visit the Solinst website (www.solinst.com/downloads/) or use the update notifications in the software for assistance. If older Levelogger versions are used, refer to our Compatibility Chart on the Downloads page.

1. Connect the Levelogger to the communications device and start the software.
2. Select the appropriate Com Port for the connected communications device from the centre drop-down menu.
3. Click the 'Retrieve Settings from Levelogger' icon. This will retrieve and display information about the connected datalogger, and any current programmed settings.

4. You can now customize the Levelogger including your Project ID, Location, Sampling Mode and Rate, and Future Stop and Start times.

Tip: If a number of Leveloggers are to be programmed with identical inputs, clicking the 'Save Default Settings' icon will create a template.



Datalogger Settings Window

Note: Clicking on the (?) in the software will provide you with a short explanation of that feature, e.g. Com Port, Slate Mode, Time Synchronization, etc.

Rainlogger 5 Programming

The Rainfall Calibration Constant 'value' of the tipping bucket rain gauge used with the Rainlogger is required when programming the Rainlogger 5. Consult the Levelogger User Guide for more information on programming the Rainlogger 5.

Levelogger 5 LTC Calibration

Before deploying your Levelogger 5 LTC, be sure to calibrate the instrument. To begin calibration, open the 'Conductivity Cal' tab and follow the steps provided. Consult the Levelogger User Guide for more information, or view the LTC Calibration Video on our YouTube Channel: https://www.youtube.com/user/SolinstCanadaLtd

Starting and Stopping the Levelogger

Note: Levelogger 5 Junior and Rainlogger 5 do not have the Future Stop function.

1. If desired, enter a Future Start and/or Future Stop Time. To start logging immediately, do not fill in a future start time and click the 'Start Now' icon.

Note: When the 'Start' icon is selected, a window will pop-up to indicate how much memory is available. Selecting "Yes" ignores the message and starts the datalogger immediately. Selecting "No" gives you the chance to access the 'Data Control' tab to download and/or delete data files using the 'Download and Delete Files' option, to free-up memory.

2. When "Yes" is selected, all settings are applied to the Levelogger and it will start logging at the specified time.
3. To stop the Levelogger immediately, click the 'Stop Now' icon.

Tip: The 'future start' and 'future stop' options are ideal for synchronizing the data collection of multiple Leveloggers and Barologgers.

Downloading and Working with Data

1. Click the 'Data Control' tab to access the 'Data Control' window. This window is laid out in three sections: Levelogger settings, tabular data, and graphical data.
2. To download the data from a connected Levelogger, select the 'Download Data from Levelogger' icon. There are four options for downloading data. They are: All Data, Append Download, Partial Download and Download and Delete Files. The data will be presented in both tabular and graphical format.

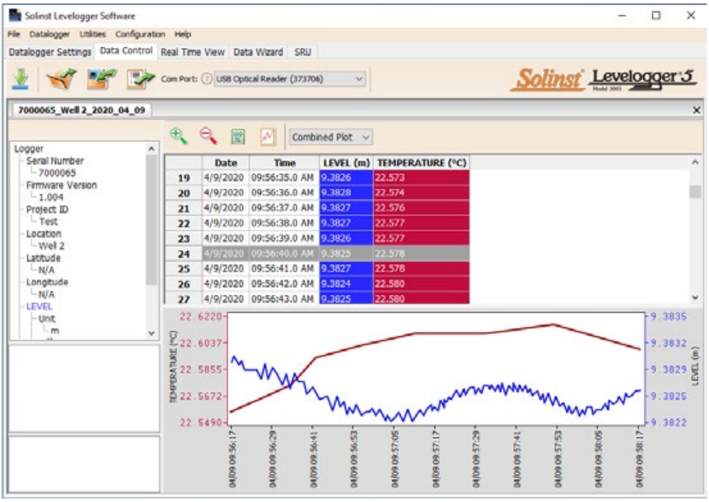
Note: The default directory for downloaded and saved data is in the 'Data' folder: <C:\Program\Files\Solinst\Levelogger 4_6\Data>. Data is saved as a .xle data file.

3. To save data, click the 'Save Data' icon and input desired name for the saved file.
4. To export the file for use in other software, click the 'Export' icon. The file can be exported to a *.csv or *.xml file.

Note: To change the default directory for downloaded data, use the 'Configuration' menu at the top of the software window. Select 'Application Settings' and input or navigate to a different folder destination. Click 'OK'.

Tip: The *.csv and *.xml file formats are supported and can be imported by most spreadsheet and database programs.

The data graph can be exported to a *.bmp file or a *.png file by clicking File > Export >Graph.



Data Control Window

DataGrabber 5

Connect a DataGrabber 5 to an in-field Levelogger via an L5 Direct Read Cable or L5 Threaded or Slip Fit Adaptor, and transfer data to a USB key.

Solinst Readout Unit (SRU)

Connect an SRU to an in-field Levelogger via an L5 Direct Read Cable or L5 Threaded or Slip Fit Adaptor to display instant water level readings, Levelogger status, save a real-time logging session, and download data to the SRU memory.

Real Time View

Real Time View provides on-screen measurement as data is being recorded by the connected datalogger. A view rate is set independently of the logging period of the Levelogger and does not interfere with internal logging taking place. To take a reading at any specific time, click and that reading will be added to the displayed data. The data can be exported and saved.

Compensate the Data

Click the 'Data Wizard' tab to open the 'Data Wizard' window. In this window the 'Wizard' will guide you through Barometric Compensation, Manual Data Adjustments, and Parameter Adjustments on your open data files. There are two convenient options; Basic or Advanced compensation. This allows you to choose just one, two, or all three types of compensation. Multiple Levelogger files can be barometrically compensated at once, using one open Barologger file.

Tip: 'Manual Data Adjustment' allows you to use manual water level measurements to adjust your data to depth to water readings.

Levelogger Field Measurement

Levelogger 5 Ranges

Each model of Levelogger is rated for a specific submergence depth (Table 1). The choice of model largely depends on the accuracy of the water level required and the submergence depth. The selection, however, should be based on the maximum anticipated water level fluctuation.

Model	Submergence Depth	Accuracy
Barologger	Air only	± 0.05 kPa
M5	5 m (16.4 ft.)	± 0.3 cm (0.010 ft.)
M10	10 m (32.8 ft.)	± 0.5 cm (0.016 ft.)
M20	20 m (65.6 ft.)	± 1 cm (0.032 ft.)
M30	30 m (98.4 ft.)	± 1.5 cm (0.064 ft.)
M100	100 m (328.1 ft.)	± 5 cm (0.164 ft.)
M200	200 m (656.2 ft.)	± 10 cm (0.328 ft.)

Table 1 – Levelogger 5 Ranges

Measurement Fundamentals

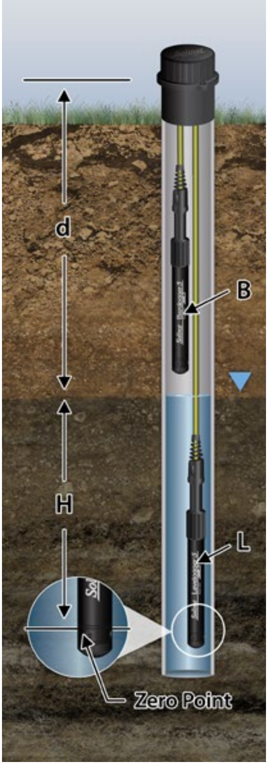
Leveloggers **(L)** measure the total pressure acting on a transducer at their zero point/sensor. The total pressure is caused by the column of water lying above the Levelogger pressure sensor AND the barometric (atmospheric) pressure acting on the water surface. To compensate for barometric pressure fluctuations and get true height of water column measurements **(H)**, a Barologger **(B)** is required, i.e.:

Levelogger Reading (L) – Barologger Reading (B)
=
Height of Water Column (H)

Verifying Readings

The best recommendation is to compare barometrically compensated Levelogger data **(H)** with a manually measured depth to water level value **(d)** (using a Water Level Meter).

Tip: To adjust all readings in your Levelogger file to depth to water below a well casing **(d)**, record a manual water level measurement using a water level meter. This reading should correspond in date and time with an actual Levelogger recording. Use this as a reference datum in the Manual Data Adjustment option in the Levelogger Software Data Wizard.



Note: The Levelogger 5 can withstand over-pressurization of 2 times the intended range, e.g. a Model M10 can accommodate a fluctuation of 20 meters or 60 feet and still record pressure. However, over-range accuracy is not guaranteed.

A single Barologger 5 can be used to compensate all Leveloggers on site, within a 30 km/20 mile radius and with every 300 m (1000 ft.) change in elevation. Ensure that your Barologger will start logging within at least 3 hours of your Levelogger start time.

Levelogger Field Notes

Tip: It is recommended to take a manual water level measurement before installing a Levelogger, shortly after installation, periodically during your monitoring interval, and at the end of your measurement period. Use these measurements to verify Levelogger readings, and for data adjustments later on. Ensure you take manual readings as close in time as possible to a scheduled Levelogger reading.

Before Deployment

Before deployment, make sure you do the following:

- Program your Levelogger, using Levelogger Software, with the correct project identification, memory mode, sampling regime, time, etc.

Note: It is useful to synchronize the times of all Leveloggers and Barologgers being used for the same project.

- Set a future start time, or start the Levelogger if deploying on a wireline/Kevlar cord (Leveloggers can be started after deployment if using an L5 Direct Read Cable)
- Determine borehole depth to ensure the Levelogger does not touch the bottom of the well (avoid submergence in sediment)
- Determine the minimum and maximum expected water levels, as Leveloggers must remain submerged for the entire monitoring period, and Barologgers must not be submerged
- Use a Solinst Model 101 or 102 Water Level Meter to take a manual depth to water measurement that will be used to verify Levelogger readings

Note: If you are using an old style Direct Read Cable with a Levelogger 5 Series datalogger, you will need to use an L5–Edge DRC Adaptor.

Wireline/Cord Deployment

Direct Read Deployment

Deployment

- Deploy your Levelogger and Barologger using an L5 Direct Read Cable for down-well communication, or use an inexpensive wireline or Kevlar cord.

> **Note:** For information on other types of installations, see the latest [Levelogger User Guide](#).

- Install the Barologger in a similar thermal environment as the Levelogger
- The Barologger should be suspended beyond the frost line and deep enough to avoid large temperature fluctuations
- Ensure the Barologger location is vented to atmosphere

After Deployment

After deployment, make sure you do the following:

- Take a manual depth to water measurement after the well has stabilized (approximately 10 minutes)
- Take another manual depth to water measurement just before removing the Levelogger from the well

Well Caps

The Model 3001 2" (or 4" with Adaptor) Well Cap Assembly provides a secure method of installing your Levelogger using wireline/Kevlar cord or L5 Direct Read Cables. A Support Hanger Bracket is available for supporting and organizing down well wires or cords, or for coiling extra L5 Direct Read Cable lengths.

In-field Communication

If you have installed your Levelogger using wireline/Kevlar cord, you can communicate with your Levelogger via a Field Reader 5 or Desktop Reader 5 and Levelogger Software on a laptop PC.

If you have installed your Levelogger using an L5 Direct Read Cable, you can communicate with your Levelogger via a PC Interface Cable and Levelogger Software on a laptop PC, using a Levelogger 5 App Interface and the Solinst Levelogger App on your mobile device, or connect an SRU or a DataGrabber 5, without removing the Levelogger from the well.

Field Reader 5

Desktop Reader 5

PC Interface Cable

Levelogger 5 App Interface

SRU

DataGrabber 5

Note: An L5 Threaded or Slip Fit Adaptor can be used to directly connect a Levelogger to a Levelogger 5 App Interface, SRU or DataGrabber 5.

Solinst®

Maintenance

As with any monitoring project, you should select the proper equipment and determine a maintenance schedule based on the environment specific to your application.

Maintenance tips include:

- Inspect regularly, and replace the o-ring at the optical end of the Levelogger if damaged
- Clean the optical eye of the Levelogger with a clean, soft cloth or cotton swab
- Rinse the Levelogger body using a mild, non-residual, non-abrasive household cleaner
- Use a very soft-plastic bristled brush, if needed, to clean the Levelogger body
- Do not insert any object through the circulation holes at the sensor end of the Levelogger
- See the Levelogger User Guide Maintenance Section if simple household cleaners are not sufficient for certain issues, such as hard water build up
- Clean Levelogger 5 LTC conductivity sensor pins before calibration and before/after deployment—see the Solinst Levelogger User Guide
- Stop the Levelogger from recording before storing
- Store Leveloggers with the installation cap on and in the case they were originally provided in
- Store Leveloggers in above-freezing conditions
- Read our Technical Bulletin "Ensuring Proper Use and Maintenance of Leveloggers"

Note: A Solinst Biofoul Screen can be used to protect the Levelogger 5 from biofouling on the pressure sensor, and the conductivity cell of a Levelogger 5 LTC.

Note: All Leveloggers should be deployed and stored with the installation cap or L5 Direct Read Cable attached. This prevents unnecessary battery drainage and protects the optical eye.

Troubleshooting Guide

Levelogger Software:

1. You must have administrator privileges to install software on a computer.
2. The Windows 10 Operating System supports Levelogger Software.

Communication Errors:

"Port Cannot Open", "Check Com Port"

1. Reason: Software was started before USB device was connected to computer.
   Solution: Restart computer, connect USB device, start software.
2. Reason: Incorrect Com Port is selected in Com Port selection menu.
   Solution: Check the Com Port location for the installed device, by accessing the 'Device Manager' (through the Control Panel), and selecting the "Ports" section. This will state the Com Port the device is installed on.
3. Reason: Another device shares the same Com Port or is causing a communication conflict.
   Solution: Ensure that software for PDA or other devices, which automatically synchronize, are disabled. Ask your system administrator for assistance.

"Communication Time-Out", "Communication Error"

1. Reason: Levelogger, Direct Read Cable, or communications device has failed.
   Solution: a) Narrow down the failure by using a different Levelogger, Direct Read Cable, or another communications device.
   b) Clean the optical eye/lens on the Levelogger and Optical Reader (Desktop Reader 5 or Field Reader 5), or L5 Direct Read Cable, with a soft cloth.
   c) Check that the communication cable is connected to the same Com Port that is chosen in the upper middle of the Levelogger Software window.
   d) Try using a different computer, to see if this is the cause of the problem.
   e) If using a laptop (especially in conjunction with a Direct Read Cable) your Com Port may not be powered adequately to receive/transmit data. Try using a desktop computer to test this.
   f) If problem persists, contact Solinst.

Frequently Asked Questions

(Also see https://www.solinst.com/products/dataloggers-and-telemetry/3001-levelogger-series/levelogger-faq/levelogger-faq.php)

How can I protect my Levelogger from corrosive or marine environments?

The Levelogger 5 and Levelogger 5 LTC have a corrosion resistant coating. In harsher chemical environments, you can protect the Levelogger using a thick membrane balloon (e.g. helium) filled with non-corrosive/non-toxic fluid (tap water). As pressure changes, the fluid encasing the dataloggers will transmit the pressure differential to the datalogger's pressure transducer, without exposing it to corrosive conditions. Continual monitoring is recommended to assess the effectiveness of the protection at your site.

How do I install my Levelogger in a surface water application?

For installations within rivers, streams, wetlands, lakes and watershed or drainage basin monitoring, the shallow pressure range (M5) Levelogger 5 or Levelogger 5 Junior should be considered. For installation in streams or rivers, stilling wells can be constructed which shield the instrument from the water turbulence. Alternatively, Leveloggers can be lowered into a protective pipe or casing and then attached to a permanent fixture such as a bridge, pier or hand driven marker/rod.

How do I protect my Levelogger from freezing?

To avoid icing/freezing and transducer damage, the easiest method is to lower the transducer to a point in the water column below the frost line or ice formation depth. In water bodies such as shallow streams, wetlands or ponds where icing/freezing may penetrate to the bottom, install the Levelogger in a vented stilling well imbedded into the bottom of the water body beyond the frost line.

If this is not possible, place the Levelogger inside a thick membrane balloon filled with a non-toxic, non-corrosive anti-freeze solution or saltwater solution. Place the balloon in a section of perforated, 30 mm (1.25") ID pipe and install the datalogger in the monitored water. The antifreeze solution will protect the Levelogger from ice expansion at the pressure transducer, yet transmit any pressure and temperature fluctuations that occur.

How do I protect my Levelogger from biofouling?

Use the Solinst Model 3001 Biofoul Screen.

Is Levelogger maintenance required?

Yes, consult the Solinst Technical Bulletin "Ensuring Proper Use and Maintenance of Leveloggers" to maintain the long life of your instrument, based on the monitoring environment specific to your application.

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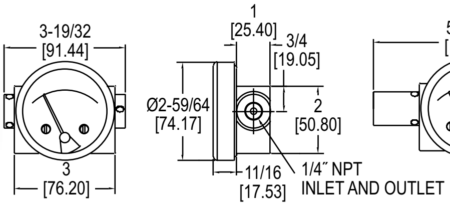
Dwyer

SERIES DTFW & DTFA

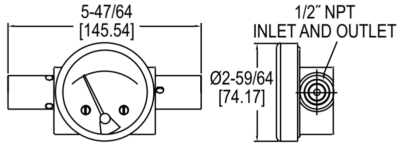
VARIABLE-AREA FLOWMETERS

In-Line Mounting, Gas, Liquids and Oils

DTFW

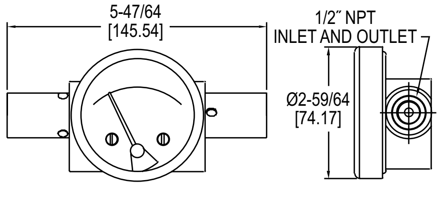


1/4˝ NPT connection

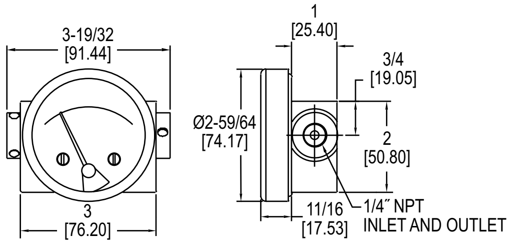


1/2˝ NPT connection

DTFA



1/2˝ NPT process connection



1/4˝ NPT connection

The **Series DTFW Variable-Area Flowmeters** for Liquids and Oils measure water or oil flow rates with ± 2% of full-scale accuracy at a competitive price. Available in 1/4˝, 1/2˝ and 1˝ connections for a wide variety of applications and comes calibrated for horizontal in line mounting.

The **Series DTFA Variable-Area Flowmeters** for Gases measures gas flow rates with ±5% of full-scale accuracy at an affordable price. Available in either 1/4˝ or 1/2˝ NPT connections and comes pre-calibrated for horizontal in-line mounting.

BENEFITS/FEATURES

- Durable metal construction ensures great reliability and the strength to withstand system pressures of up to 3000 psig (200 bar).
- Shatter proof construction, unlike glass tube variable area flowmeters, yields long operation life
- Preform precisely in high temperature, high vibration, shock-prone environments

APPLICATIONS

- Monitoring pressure drop across filters or strainers
- Flow scale based on differential pressure
- Liquid level given pressure differential between bottom and top of tank
- Hydraulic equipment
- Oil and gas equipment
- Heat exchangers
- Backflow prevention

SPECIFICATIONS

Service: DTFW: Compatible liquids; DTFA: Compatible gases.
Wetted Materials: Body: 316 SS, brass or aluminum; Spring: 302 SS or PTFE-coated; Range spring: 302 SS; Magnet: PTFE-coated; Metering cone: Acetal or PTFE; Seals: Buna.
Temperature Limits: -40 to 200°F (-40 to 93°C).
Pressure Limit: DTFW-3S: 1500 psig (100 bar); All other DTFW models: 3000 psig (200 bar); DTFA: 3000 psig (200 bar).
Accuracy: Liquid/oil calibration: ±2% FS; Air calibration: ±5% FS.
Repeatability: ±1% FS.
Size: Diameter dial face 2.5˝ (63.5 mm).
Process Connection: See model chart.
Weight: DTFW-1B and 1S: 3 lb (1.36 kg); DTFW-2B and 2S: 5 lb (2.27 kg); DTFW-3S: 10 lb (4.54 kg); DTFA-1A: 3 lb (1.36 kg); DTFA-2A: 5 lb (2.27 kg).

MODEL CHART

Model	Range GPM Water	Connection NPT	Body	Metering Cone	Model	Range GPM Water	Connection NPT	Body	Metering Cone
DTFW-1B-1W	0 to 1	1/4˝	Brass	Acetal	**DTFW-2B-8W**	0 to 8	1/2˝	Brass	Acetal
DTFW-1B-2W	0 to 2	1/4˝	Brass	Acetal	**DTFW-2B-10W**	0 to 10	1/2˝	Brass	Acetal
DTFW-1B-3W	0 to 3	1/4˝	Brass	Acetal	**DTFW-2S-1W**	0 to 1	1/2˝	SS	Acetal
DTFW-1B-4W	0 to 4	1/4˝	Brass	Acetal	**DTFW-2S-2W**	0 to 2	1/2˝	SS	Acetal
DTFW-1B-5W	0 to 5	1/4˝	Brass	Acetal	**DTFW-2S-3W**	0 to 3	1/2˝	SS	Acetal
DTFW-1S-1W	0 to 1	1/4˝	SS	Acetal	**DTFW-2S-4W**	0 to 4	1/2˝	SS	Acetal
DTFW-1S-2W	0 to 2	1/4˝	SS	Acetal	**DTFW-2S-5W**	0 to 5	1/2˝	SS	Acetal
DTFW-1S-3W	0 to 3	1/4˝	SS	Acetal	**DTFW-2S-8W**	0 to 8	1/2˝	SS	Acetal
DTFW-1S-4W	0 to 4	1/4˝	SS	Acetal	**DTFW-2S-10W**	0 to 10	1/2˝	SS	Acetal
DTFW-1S-5W	0 to 5	1/4˝	SS	Acetal	**DTFW-3S-10W**	0 to 10	1˝	SS	PTFE
DTFW-2B-1W	0 to 1	1/2˝	Brass	Acetal	**DTFW-3S-15W**	0 to 15	1˝	SS	PTFE
DTFW-2B-2W	0 to 2	1/2˝	Brass	Acetal	**DTFW-3S-20W**	0 to 20	1˝	SS	PTFE
DTFW-2B-3W	0 to 3	1/2˝	Brass	Acetal	**DTFW-3S-25W**	0 to 25	1˝	SS	PTFE
DTFW-2B-4W	0 to 4	1/2˝	Brass	Acetal	**DTFW-3S-30W**	0 to 30	1˝	SS	PTFE
DTFW-2B-5W	0 to 5	1/2˝	Brass	Acetal					

Note: Not available in 1/4˝ or 1/2˝ SS.

MODEL CHART

Model	Range, SCFM	Body	Connection
DTFA-1A-10A	1.5 to 10	Aluminum	1/4˝ NPT
DTFA-1A-15A	2.0 to 15	Aluminum	1/4˝ NPT
DTFA-1A-20A	3.0 to 20	Aluminum	1/4˝ NPT
DTFA-1A-25A	3.0 to 25	Aluminum	1/4˝ NPT
DTFA-2A-30A	3.0 to 30	Aluminum	1/2˝ NPT
DTFA-2A-40A	4.0 to 40	Aluminum	1/2˝ NPT
DTFA-2A-50A	4.0 to 50	Aluminum	1/2˝ NPT
DTFA-2A-75A	5.0 to 75	Aluminum	1/2˝ NPT
DTFA-2A-100A	10.0 to 100	Aluminum	1/2˝ NPT

USA: California Proposition 65
⚠**WARNING:** This product can expose you to chemicals including Lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Dwyer®

SERIES 2000 | MAGNEHELIC® DIFFERENTIAL PRESSURE GAGES

Standard Magnehelic® gage

High Accuracy Magnehelic® gage
Shown with optional -SS bezel

BENEFITS/FEATURES

- **Easy to read gage through undistorted plastic face permits viewing from far away**
- **Patented design provides quick response to pressure changes means no delay in assessing critical situations**
- **Durable and rugged housing and high-quality components combine to provide long service life and minimized down-time**

APPLICATIONS

- Filter monitoring
- Air velocity with Dwyer® pitot tube
- Blower vacuum monitoring
- Fan pressure indication
- Duct, room, or building pressures
- Clean room positive pressure indication

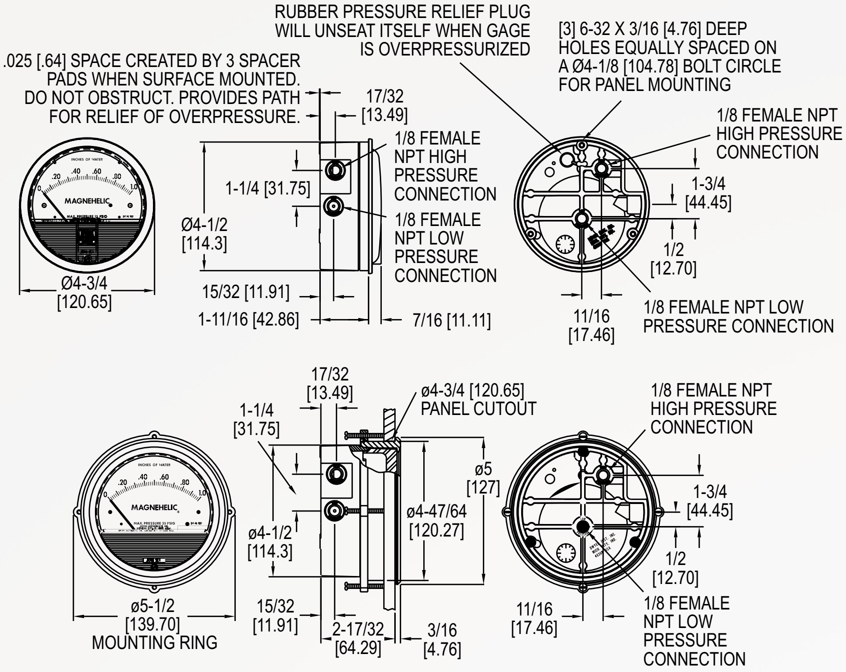
DESCRIPTION

Select the **Series 2000 Magnehelic® Differential Pressure Gages** for a versatile low differential pressure gauge with a wide choice of 81 models and 27 options to choose from. Using Dwyer's simple, frictionless Magnehelic® gage movement, it quickly indicates air or noncorrosive gas pressures - either positive, negative (vacuum) or differential. The design resists shock, vibration, over-pressures and is weatherproof to IP67.

GAGE SPECIFICATIONS

Service	Air and non-combustible, compatible gases (natural gas option available). **Note:** May be used with hydrogen. Order a Buna-N diaphragm. Pressures must be less than 35 psi.
Wetted Materials	Consult factory.
Housing	Die cast aluminum case and bezel, with acrylic cover, exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy	±2% of FS (±3% on -0, -100 Pa, -125 PA, -10 mm and ±4% on -00, -60 Pa, -6 mm ranges), throughout range at 70°F (21.1°C).
Pressure Limits	20 in Hg to 15 psig (-0.677 bar to 1.034 bar); MP option; 35 psig (2.41 bar), HP option; 80 psig (5.52 bar).
Enclosure Rating	IP67.
Overpressure	Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. See Overpressure Protection note on catalog page.
Temperature Limits	20 to 140°F (-6.67 to 60°C). -20°F (-28°C) with low temperature option.
Size	4″ (101.6 mm) diameter dial face.
Mounting Orientation	Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections	1/8″ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight	1 lb 2 oz (510 g); MP and HP 2 lb 2 oz (963 g).
Standard Accessories	Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapters and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for three adapters in MP and HP gage accessories).
Compliance	Meets the technical requirements of EU Directive 2011/65/EU (RoHS II). **Note:** -SP models not RoHS approved.
Note: For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Options page.	

DIMENSIONS



HOW TO ORDER

Use the **bold** characters from the chart below to construct a product code.

2002 **-ASF**

SERIES

(in w.c./mm w.c.)
2000-00: 0-0.25 in w.c.
2000-00N: 0.5-0-0.2 in w.c.
2000-0: 0-0.5 in w.c.
2001: 0-1 in w.c.
2002: 0-2 in w.c.
2003: 0-3 in w.c.
2004: 0-4 in w.c.
2006: 0-6 in w.c.
2010: 0-10 in w.c.
2000-6MM: 0-6 mm w.c.
2000-50MM: 0-50 mm w.c.
2300-12MM: 6-0-6 mm w.c.

(Pa)
2000-60NPA: 10-0-50 Pa
2000-60PA: 0-60 Pa
2000-100PA: 0-100 Pa
2000-125PA: 0-125 Pa
2000-250PA: 0-250 Pa
2000-300PA: 0-300 Pa
2000-500PA: 0-500 Pa
2300-60PA: 30-0-30 Pa
2300-100PA: 50-0-50 Pa
2300-120PA: 60-0-60 Pa

(kPa)
2000-1KPA: 0-1 kPa
2000-1.5KPA: 0-1.5 kPa
2000-2KPA: 0-2 kPa
2000-3KPA: 0-3 kPa

OPTIONS

-ASF: Adjustable signal flag
-AHU1: Mounting plate
-AHU2: Mounting plate with A-481 accessory kit
-BUNA: Buna-N elastomers
-CB: Chrome bezel
-FC: Factory calibration
-HA: High accuracy
-M: Mirrored scale overlay
-SB: 304 SS bezel
-SS: Brushed 304 SS bezel

Note: Only our most popular models and options are listed. For additional available models, please visit:
https://www.dwyer-inst.com/Product/Pressure/DifferentialPressure/Gages/Series2000

ACCESSORIES

Model	Description
A-320-A	Enclosure for Series 2000 Magnehelic® gages, DM-2000 differential pressure transmitter, 4-9/16″ (115.89 mm)
A-464	Flush Mount kit for Magnehelic® gages
A-610	Pipe mounting kit for 1-1/4″ to 2″ pipe. 5.6″ x 4.6″ x 1.4″, 1.0 lb
A-300	Flat aluminum bracket for flush mounting Magnehelic® gage. 6.8″ x 6.0″ x .1″, .35 lb
A-299	Mounting bracket flush mount Magnehelic® gage in bracket. Bracket is then surface mounted. Steel with gray hammertone epoxy finish. 6.3″ x 7.7″ x 4.0″, 1.30 lb

DWYER INSTRUMENTS, LLC

Printed in U.S.A. 11/22

DS-2000 Rev. 2

Enviro-Equipment Inc.
10120 Industrial Drive
Pineville NC 28134
www.enviroequipment.com

STOCK #1806

Carbonair 2,000lb Vapor Phase Carbon Vessel
Model GPC20R
2000 CFM MAX
Approx 2,000 Pound GAC Capacity
6” Flanged Inlet / Outlet
False Bottom Design

Enviro-Equipment Inc.
10120 Industrial Drive
Pineville NC 28134
www.enviroequipment.com

Call: 1.877.759.8143

CARBONAIR

Home Equipment Rentals Equipment for Sale Services About Carbonair Careers Contact Us

Products For Sale: Vapor Phase Carbon Vessels

Carbonair's GPC Series vapor phase carbon vessels are designed to provide an efficient and economical means to reduce VOC concentrations, corrosive gases, toxic vapors, and to control odor. Carbonair's GPC Series Vapor Phase Carbon Vessels can be filled with several types of granular activated carbons and other specialty media for a variety of applications.

Carbonair's GPC Series vapor phase carbon vessels are constructed of high quality steel and treated with corrosion resistant paint inside and out. The GPC Series is designed to provide the most efficient use of the granular activated carbon in the bed and to provide the lowest pressure drop possible in order to minimize back pressure on blowers and other equipment. Some vessels use slotted plastic pipe to distribute the air flow across the carbon bed. This tends to create excessive back pressure and can cause channeling of the carbon bed, causing the waste of some of the carbon in the bed and premature breakthrough. Carbonair GPC vessels employ a carbon bed supported on a screened grate above a plenum. The air stream enters the vessel through the plenum where it is evenly distributed across the entire cross section of the carbon bed, providing the lowest pressure drop and most efficient use of the carbon. Click here for specifications for our GPC Drum Series, GPC Round Series, and GPC Series of vapor phase carbon filters.

Vapor Phase Carbon Vessel Specifications; <1000 cfm

Model	GPC 3	GPC 3H	GPC 5R	GPC 7R	GPC 13R
Dimensions	24.5″ OD x 36.5″ H	24.5″ OD x 36.5″ H	30″ OD x 5'7″ H	3'2″ OD x 7′ H	4′ OD x 7′ H
Bed Area (Square Feet)	2.7	2.7	4.91	7.07	12.57<
Nominal Flow Rate (cfm)	100	270	400	500	800
Carbon Capacity (pounds)	200	180	500	1,000	1,500
Fittings	2″ NPT	4″ NPT	4-1/2″ nozzle	6-5/8″ nozzle	8-5/8″ nozzle
Empty Weight (pounds)	65	65	550	790	1,090
Operating Weight (pounds)	265	265	1,050	1,790	2,590<

Vapor Phase Carbon Vessel Specifications; >1000 cfm

Model	GPC 20R	GPC 28R	GPC 50R	GPC 70	GPC 120

Dimensions	5′ OD x 7′ H	6′ OD x 7’3″ H	8′ OD x 7′ H	16′ L x 5′ W x 8’6″ H	16’6″ L x 8′ W x 8’6″ H
Bed Area (Square Feet)	19.63	28.30	50.27	69.80	120.00
Nominal Flow Rate (cfm)	2,000	2,500	4,000	7,000	12,000
Carbon Capacity (pounds)	2,000	3,000	5,000	10,000	13,500
Fittings	8-5/8″ nozzle	8-5/8″ nozzle	12-3/4″ nozzle	12-3/4″ nozzle	12-3/4″ nozzle
Empty Weight (pounds)	1,425	1,795	3,970	5,850	9,250
Operating Weight (pounds)	3,425	4,795	8,970	15,850	22,750

Applications

We offer full service application support, from equipment sizing, carbon usage modeling, activated carbon analysis, on-site carbon change-out, filter exchange and spent carbon recycling. Typical applications include:

- VOC control from SVE systems and air strippers
- NESHAPS emissions control
- Wastewater, product storage tank and similar vents
- Odor and H2S control

Standard Features

- Galvanized steel drum (GPC 3, 3H)
- Two 4″ PVC connections (GPC 3, 3H)
- Baked enamel exterior (GPC 3, 3H)
- PVC internals (GPC 3, 3H)
- Welded steel construction.
- Forkliftable tubes
- Epoxy coated interior & exterior
- One condensation drain
- FRP grate with screen
- Nozzle connections

Optional Components

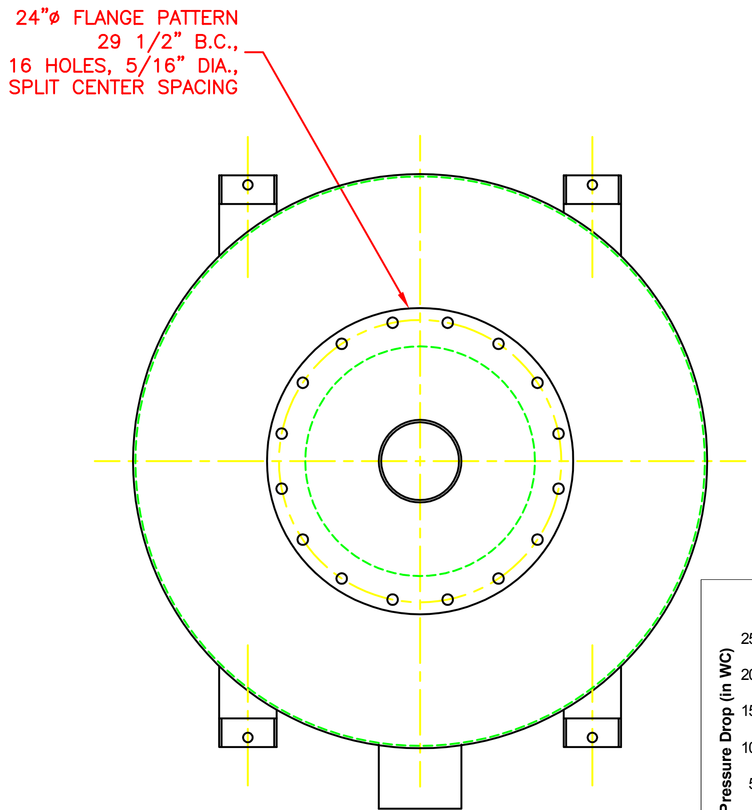
- Blowers Humidity control
- Influent/effluent ducting
- Discharge stack
- Additional sampling ports and valves
- Vapor monitors

More Products:

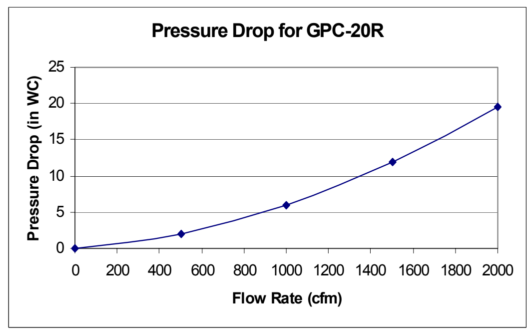
STAT Low Profile Air Strippers for Rent
STAT Low Profile Air Strippers for Sale
Liquid Phase Carbon Vessels for Rent
Liquid Phase Carbon Vessels for Sale
Liquid Phase Carbon and Specialty Media
Vapor Phase Carbon Vessels for Rent
Vapor Phase Carbon and Specialty Media

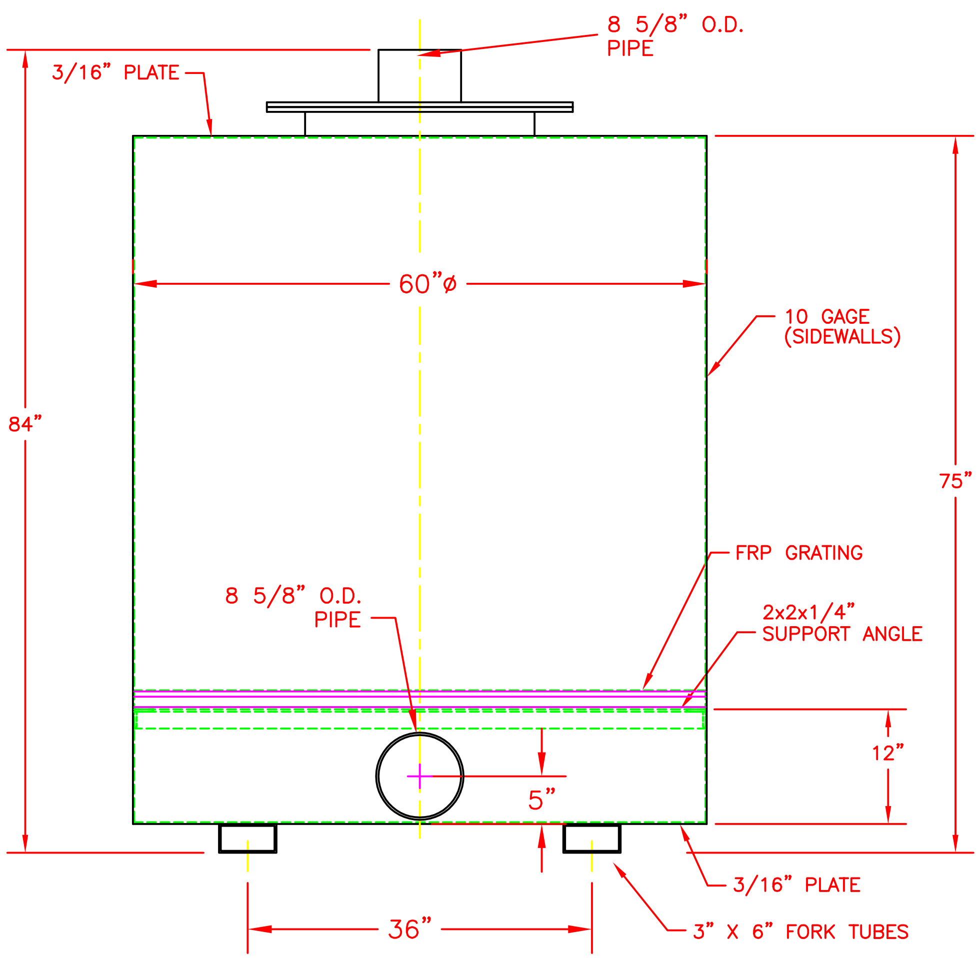
Request A Quote

Carbon Adsorber – Vapor Phase
GPC–20R



PLAN VIEW





ELEVATION

Sales Drawing #156000
03/22/05

Appendix F

Proposed System Drawings

SYMBOL SPECIFICATION

INSTRUMENT TYPE

FE	FLOW ELEMENT
FIT	FLOW INDICATING TRANSMITTER
LRT	LEVEL RECORDING TRANSDUCER
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
LSL	LEVEL SWITCH LOW
LT	LEVEL TRANSMITTER
M	MOTOR, METER
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATING TRANSMITTER
PRT	PRESSURE RECORDING TRANSDUCER
PS	PRESSURE SWITCH
PSH	PRESSURE SWITCH HIGH
SV	SOLENOID VALVE
TI	TEMPERATURE INDICATOR
TSH	TEMPERATURE SWITCH HIGH

INSTRUMENTATION CONTROLS AND EQUIPMENT

- PUMP
- BLOWER
- CHEMICAL METERING PUMP
- DIAPHRAGM PUMP
- TANK (CLOSED TOP)
- MOTOR
- INTERLOCK
- HANDS, OFF, AUTO
- DISCONNECT SWITCH, UNFUSED
- DISCONNECT SWITCH, FUSED
- POSITIVE DISPLACEMENT PUMP
- TANK (CLOSED TOP)

INSTRUMENT IDENTIFICATION

SIGNAL TO MCP
LSH
INSTRUMENT TYPE
###
LOOP NUMBER

PIPE MATERIAL

- HAND CONTROL
- BLOWDOWN
- GATE VALVE
- CLOSED VALVE
- GLOBE VALVE
- CHECK VALVE
- TRU UNION BALL/CHECK VALVE
- PLUG
- BALL VALVE
- TRUE UNION BALL VALVE
- BUTTERFLY OR DAMPER
- NEEDLE VALVE
- DIAPHRAGM VALVE
- THREE WAY VALVE
- ELECTRIC CONTROL GATE
- ELECTRIC BUTTERFLY OR DAMPER
- BLEED OR PURGE CONNECTION
- AIR RELEASE VALVE
- SOLENOID VALVE
- VACUUM RELIEF VALVE
- PRESSURE RELIEF VALVE
- ANTI–SIPHON VALVE
- FOOT VALVE
- HARD PIPE (PRIMARY)
- HARD PIPE (SECONDARY)
- FLEXIBLE PIPE
- INSULATED PIPE
- CROSS OVER
- FLANGED CONNECTION
- SCREWED CONNECTION
- UNION
- COUPLING
- EXPANSION JOINT/SLEEVE
- METER
- HOSE CONNECTION
- ROTAMETER
- CLEANOUT
- STRAINER
- PLUG
- PIPE CAP
- SLIP UPDRAFT VENT CAP
- ELBOW – TURNED UP
- ELBOW – TURNED DOWN
- ELBOW – 90°
- ELBOW – 45°
- ELBOW – LONG RADIUS
- REDUCING ELBOW
- QUICK CONNECT COUPLING
- BUSHING
- REDUCER (CONCENTRIC)
- TEE – REDUCING
- TEE – OUTLET UP
- TEE – OUTLET DOWN
- TEE
- SAMPLE PORT
- REGULATOR
- FLOW CONTROL VALVE (NONADJUSTABLE)
- FLOW CONTROL VALVE (ADJUSTABLE)
- SPECTACLE FLANGE
- ORIFICE
- VACUUM AND FLOW GAUGE

PIPE MATERIAL

CARBON STEEL

CS1	CARBON STEEL – SCHEDULE 5
CS2	CARBON STEEL – SCHEDULE 10
CS3	CARBON STEEL – SCHEDULE 40
CS4	CARBON STEEL – SCHEDULE 80
CS5	GALVANIZED CARBON STEEL – SCHEDULE 40
CS6	CARBON STEEL, POLYPROPYLENE LINED

COPPER

CO1	TYPE K COPPER
CO2	TYPE L COPPER

DUCTILE IRON

DI1	DUCTILE CAST IRON
DI2	DUCTILE CAST IRON
DI3	DUCTILE CAST IRON

FIBERGLASS

F1	FIBERGLASS PIPE (POLYTHREAD WITH INNER LINER)
F2	FIBERGLASS PIPE (GREENTHREAD)
F3	FIBERGLASS PIPE (FIBERCAST – CENTRICAST PLUS RB2530)
F4	FIBERGLASS PIPE (VINYL ESTER RESIN)
F5	FIBERGLASS PIPE (POLYTHREAD WITHOUT VINYL ESTER LINER)
F6	FIBERGLASS PIPE (CUSTOM MANUFACTURED POLYESTER)
F7	FIBERGLASS PIPE (FIBERCAST – CENTRICAST CC III–EP)

PLASTIC

PVC1	PVC PIPE – SCH 40
PVC2	PVC PIPE – SCH 80
PVC3	PVC PIPE – SDR21
PVC4	PVC PIPE – SDR26
PVC5	PVC PIPE – SDR35
PVC6	PVC C900 PIPE – DR 14
PVC7	PVC C900 PIPE – DR 18
PVC8	PVC C900 PIPE – DR 25
PVC9	PVC C900 PIPE – DR 14
PVC10	PVC C900 PIPE – DR 18
PVC11	PVC C900 PIPE – DR 21
PVC12	PVC C900 PIPE – DR 25
PVC13	PVC C900 PIPE – DR 32.5
PVC14	DRAIN WASTE VENT
CPVC	CPVC PIPE – SCH 80
TT1	TEFLON TUBING (CHEMICAL SERVICE)

CAST IRON

CI1	CAST IRON DRAIN

HDPE

PE1	HIGH DENSITY POLYETHYLENE PIPE – SDR 7
PE2	HIGH DENSITY POLYETHYLENE PIPE – SDR 9
PE3	HIGH DENSITY POLYETHYLENE PIPE – SDR 11
PE4	HIGH DENSITY POLYETHYLENE PIPE – SDR 13.5
PE5	HIGH DENSITY POLYETHYLENE PIPE – SDR 15.5
PE6	HIGH DENSITY POLYETHYLENE PIPE – SDR 17
PE7	HIGH DENSITY POLYETHYLENE PIPE – SDR 19
PE8	HIGH DENSITY POLYETHYLENE PIPE – SDR 21
PE9	HIGH DENSITY POLYETHYLENE PIPE – SDR 26
PE10	HIGH DENSITY POLYETHYLENE PIPE – SDR 32.5
PE11	POLYETHYLENE TUBING

STAINLESS STEEL

SS1	STAINLESS STEEL T–304L – SCHEDULE 5
SS2	STAINLESS STEEL T–304L – SCHEDULE 10
SS3	STAINLESS STEEL T–304L – SCHEDULE 40
SS4	STAINLESS STEEL T–304L – SCHEDULE 80
SS5	STAINLESS STEEL T–316L – SCHEDULE 5
SS6	STAINLESS STEEL T–316L – SCHEDULE 10
SS7	STAINLESS STEEL T–316L – SCHEDULE 40
SS8	STAINLESS STEEL T–316L – SCHEDULE 80

NOTE: PIPE MATERIALS SHOWN SHADED NOT USED

SECTION AND DETAIL DESIGNATIONS:

DETAIL CALLOUT:

1
C2
INDICATES DETAIL NUMBER
INDICATES DRAWING WHERE DETAIL IS SHOWN

A
C2
INDICATES SECTION LETTER
INDICATES DRAWING WHERE SECTION IS SHOWN

A
–
DETAIL OR SECTION APPEARS ON THE SAME SHEET

SECTION AND DETAIL DESIGNATION:

INDICATES DETAIL NUMBER
DETAIL
1
C1
NO SCALE
INDICATES DRAWING WHERE DETAIL IS REFERED TO

INDICATES SECTION LETTER
SECTION
A
C1
NO SCALE
INDICATES DRAWING WHERE DETAIL IS REFERED TO

PIPE DESIGNATIONS:

EXAMPLE SYMBOL:

PIPE SIZE
3"-PVC2-VAE
SERVICE FLOW STREAM
MATERIAL TYPE

PROCESS ABBREVIATIONS:

A/C	AIR CONDITIONING
ACFM	ACTUAL CUBIC FEET PER MINUTE
AIR	AIR, ATMOSPHERIC PRESSURE
BGS	BELOW GROUND SURFACE
BR	REDUCING BALL VALVE
CO	CONDENSATE, CLEAN OUT
CP	CONTROL POINT
CS	CARBON STEEL
D	DRAIN, DISCHARGE
DIA	DIAMETER
EL	ELEVATION
FB	FREEBOARD
FT	FEET
GALV	GALVANIZED
GW	GROUNDWATER
HDPE	HIGH DENSITY POLYETHYLENE
HG	MERCURY
HOA	HAND OFF AUTO
HP	HORSE POWER
I/O	INLET/OUTLET
KO	KNOCKOUT
LFG	LANDFILL GAS
LTT	LIQUID TREATMENT TRAIN
MAX	MAXIMUM
MCP	MASTER CONTROL PANEL
MIN	MINIMUM
MPE	MULTI PHASE EXTRACTION
MW	MONITORING WELL
NIC	NOT IN CONTRACT
NPT	NATIONAL PIPE THREAD
OC	ON CENTER
OD	OUTSIDE DIAMETER
OP	OVERHEAD POWER
OWS	OIL WATER SEPARATOR
P&ID	PIPING AND INSTRUMENTATION DIAGRAM
PE	POLYETHYLENE
PP	POWER POLE
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
ROW	RIGHT–OF–WAY
SCH	SCHEDULE
SP	SAMPLE PORT
SS	STAINLESS STEEL
T	TELEPHONE
TBD	TO BE DETERMINED
TYP	TYPICAL
V	VENT
VAE	VACUUM ASSISTED EXTRACTION
VFD	VARIABLE FREQUENCY DRIVE
VTT	VAPOR TREATMENT TRAIN
W	WATER
W/	WITH
WS	WATER SURFACE

NOT FOR CONSTRUCTION

PRELIMINARY

REVISIONS	DATE	BY	
			DESIGNED J. STOLLE
			DRAWN N. CHRISTENSEN
			CHECKED –
			APPROVED B. PIPPIN

ONE INCH AT FULL SCALE, IF NOT, SCALE ACCORDINGLY
FILE NAME PS1860014–M1–M2
JOB No. 553–1860–014
DATE JANUARY 2025

Parametrix
719 2nd Avenue, Suite 200 • Seattle, WA 98104
Ph: 206.394.3700

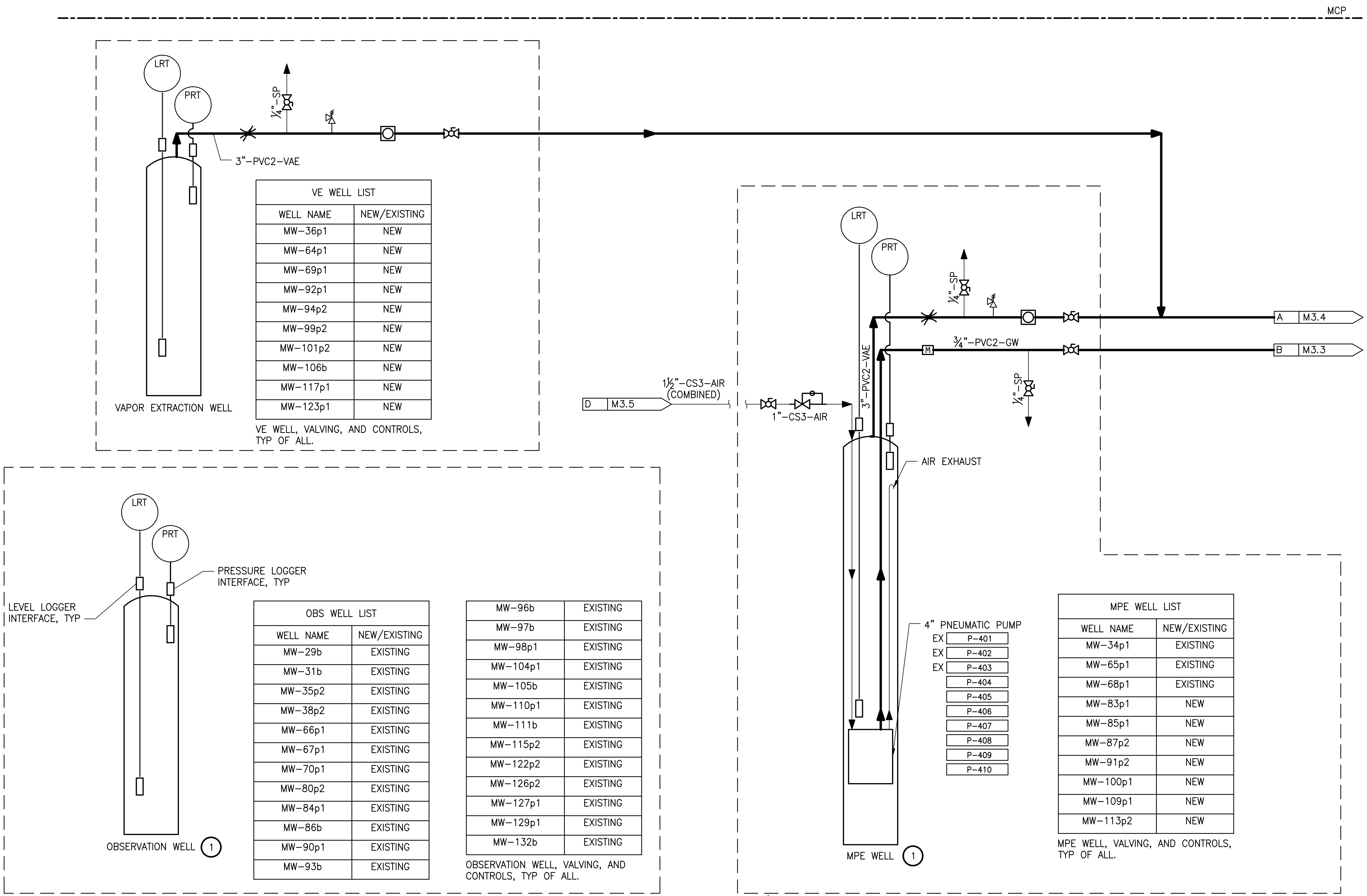
PROJECT NAME
EPHRATA LANDFILL
MULTI PHASE EXTRACTION SYSTEM EXPANSION
EPHRATA, WASHINGTON

MECHANICAL LEGEND, NOTES AND ABBREVATIONS

DRAWING NO.
X OF X
M3.1

NOTES:

(1) WELL EQUIPMENT SHALL BE INSTALLED IN EXISTING WELLS.



VE WELL LIST	
WELL NAME	NEW/EXISTING
MW–36p1	NEW
MW–64p1	NEW
MW–69p1	NEW
MW–92p1	NEW
MW–94p2	NEW
MW–99p2	NEW
MW–101p2	NEW
MW–106b	NEW
MW–117p1	NEW
MW–123p1	NEW

OBS WELL LIST	
WELL NAME	NEW/EXISTING
MW–29b	EXISTING
MW–31b	EXISTING
MW–35p2	EXISTING
MW–38p2	EXISTING
MW–66p1	EXISTING
MW–67p1	EXISTING
MW–70p1	EXISTING
MW–80p2	EXISTING
MW–84p1	EXISTING
MW–86b	EXISTING
MW–90p1	EXISTING
MW–93b	EXISTING
MW–96b	EXISTING
MW–97b	EXISTING
MW–98p1	EXISTING
MW–104p1	EXISTING
MW–105b	EXISTING
MW–110p1	EXISTING
MW–111b	EXISTING
MW–115p2	EXISTING
MW–122p2	EXISTING
MW–126p2	EXISTING
MW–127p1	EXISTING
MW–129p1	EXISTING
MW–132b	EXISTING

MPE WELL LIST	
WELL NAME	NEW/EXISTING
MW–34p1	EXISTING
MW–65p1	EXISTING
MW–68p1	EXISTING
MW–83p1	NEW
MW–85p1	NEW
MW–87p2	NEW
MW–91p2	NEW
MW–100p1	NEW
MW–109p1	NEW
MW–113p2	NEW

NOT FOR CONSTRUCTION

PRELIMINARY

REVISIONS	DATE	BY	
			DESIGNED J. STOLLE
			DRAWN N. CHRISTENSEN
			CHECKED –
			APPROVED B. PIPPIN

ONE INCH AT FULL SCALE, IF NOT, SCALE ACCORDINGLY
FILE NAME PS1860014–M3.1–3.3
JOB No. 553–1860–014
DATE JANUARY 2025

Parametrix
719 2nd Avenue, Suite 200 • Seattle, WA 98104
Ph: 206.394.3700

PROJECT NAME
EPHRATA LANDFILL
MULTI PHASE EXTRACTION SYSTEM EXPANSION
EPHRATA, WASHINGTON

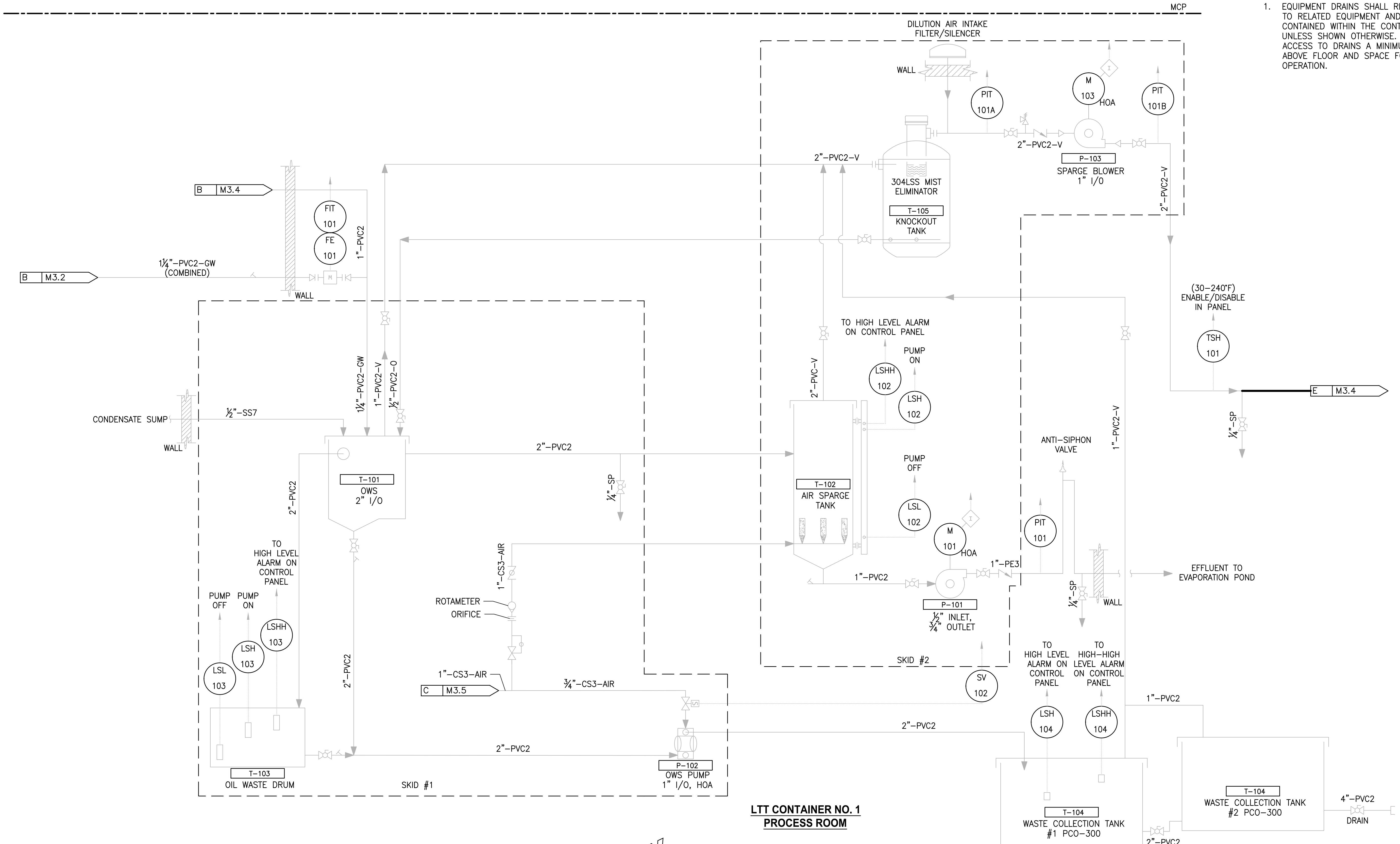
PROCESS FLOW DIAGRAM

DRAWING NO. X OF X

M3.2

NOTES:

1. EQUIPMENT DRAINS SHALL REMAIN LOCAL TO RELATED EQUIPMENT AND SHALL BE CONTAINED WITHIN THE CONTAINER, UNLESS SHOWN OTHERWISE. PROVIDE ACCESS TO DRAINS A MINIMUM 6" ABOVE FLOOR AND SPACE FOR MANUAL OPERATION.



PRELIMINARY

NOT FOR CONSTRUCTION

REVISIONS	DATE	BY	
			DESIGNED J. STOLLE
			DRAWN N. CHRISTENSEN
			CHECKED –
			APPROVED B. PIPPIN

ONE INCH AT FULL SCALE, IF NOT, SCALE ACCORDINGLY
FILE NAME PS1860014-M3.1-3.3
JOB No. 553-1860-014
DATE JANUARY 2025

Parametrix
719 2nd Avenue, Suite 200 • Seattle, WA 98104
Ph: 206.394.3700

PROJECT NAME
EPHRATA LANDFILL MULTI PHASE EXTRACTION SYSTEM EXPANSION
EPHRATA, WASHINGTON

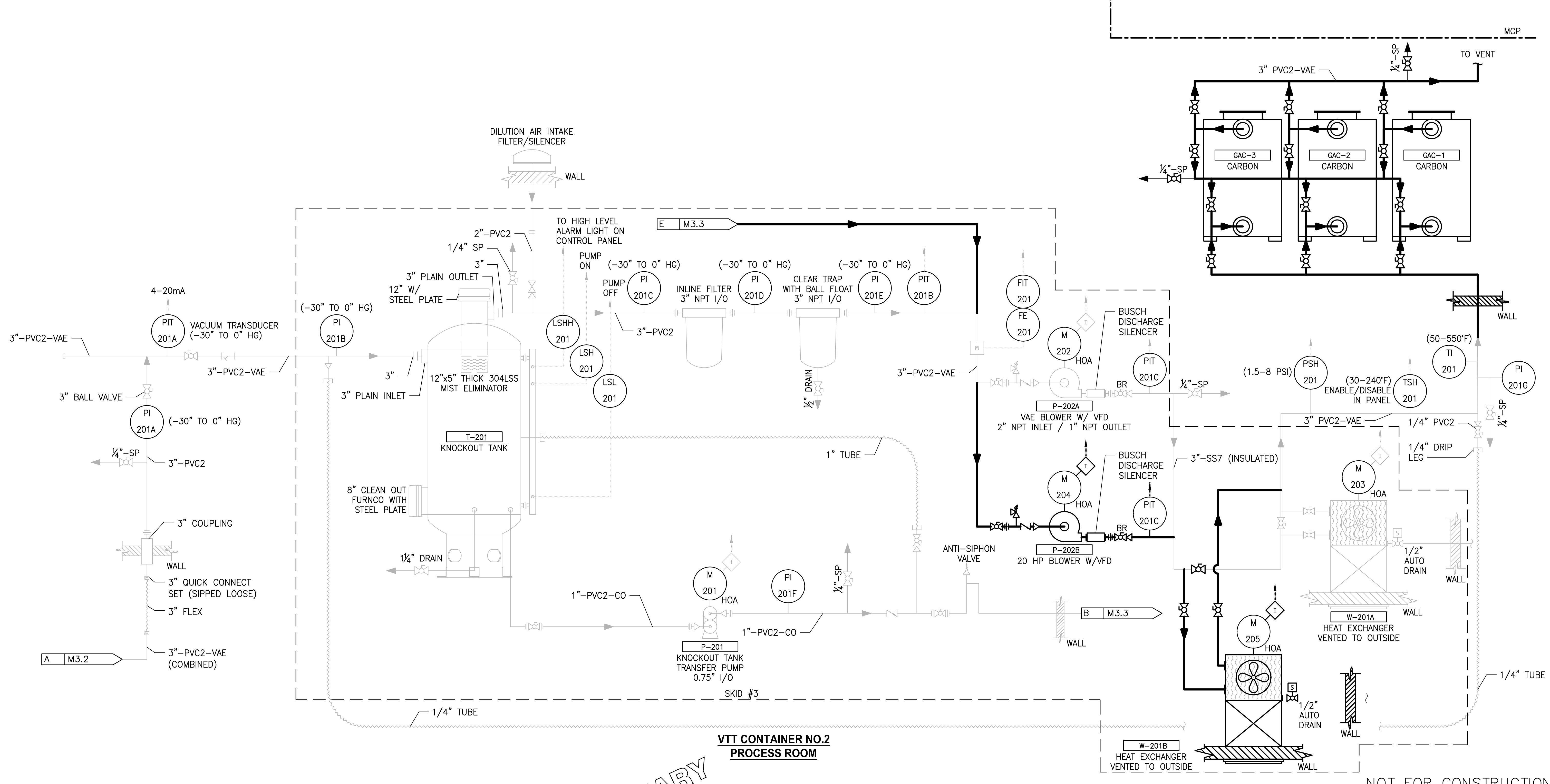
PROCESS FLOW DIAGRAM

DRAWING NO. X OF X
M3.3

LAYOUT: M3.3 PATH: U:\PSO\Projects\Clients\1860-HellerEhrmanWhite\553-1860-014 Ephrata LF RI-FS Ph9\99Svcs\CADD\DWG PLOTTED BY: StolJoc DATE: Monday, January 27, 2025 9:50:39 AM

NOTES:

1. EQUIPMENT DRAINS SHALL REMAIN LOCAL TO RELATED EQUIPMENT AND SHALL BE CONTAINED WITHIN THE CONTAINER, UNLESS SHOWN OTHERWISE PROVIDE ACCESS TO DRAINS. A MINIMUM 6" ABOVE FLOOR AND SPACE FOR MANUAL OPERATION.
2. VTT EQUIPMENT, PIPING AND COMPONENTS SHALL BE RATED FOR VACUUM UP TO 30" HG.



NOT FOR CONSTRUCTION

PRELIMINARY

REVISIONS	DATE	BY	
			DESIGNED J. STOLLE
			DRAWN N. CHRISTENSEN
			CHECKED –
			APPROVED B. PIPPIN

ONE INCH AT FULL SCALE, IF NOT, SCALE ACCORDINGLY
FILE NAME PS1860014–M3.1–3.3
JOB No. 553–1860–014
DATE JANUARY 2025

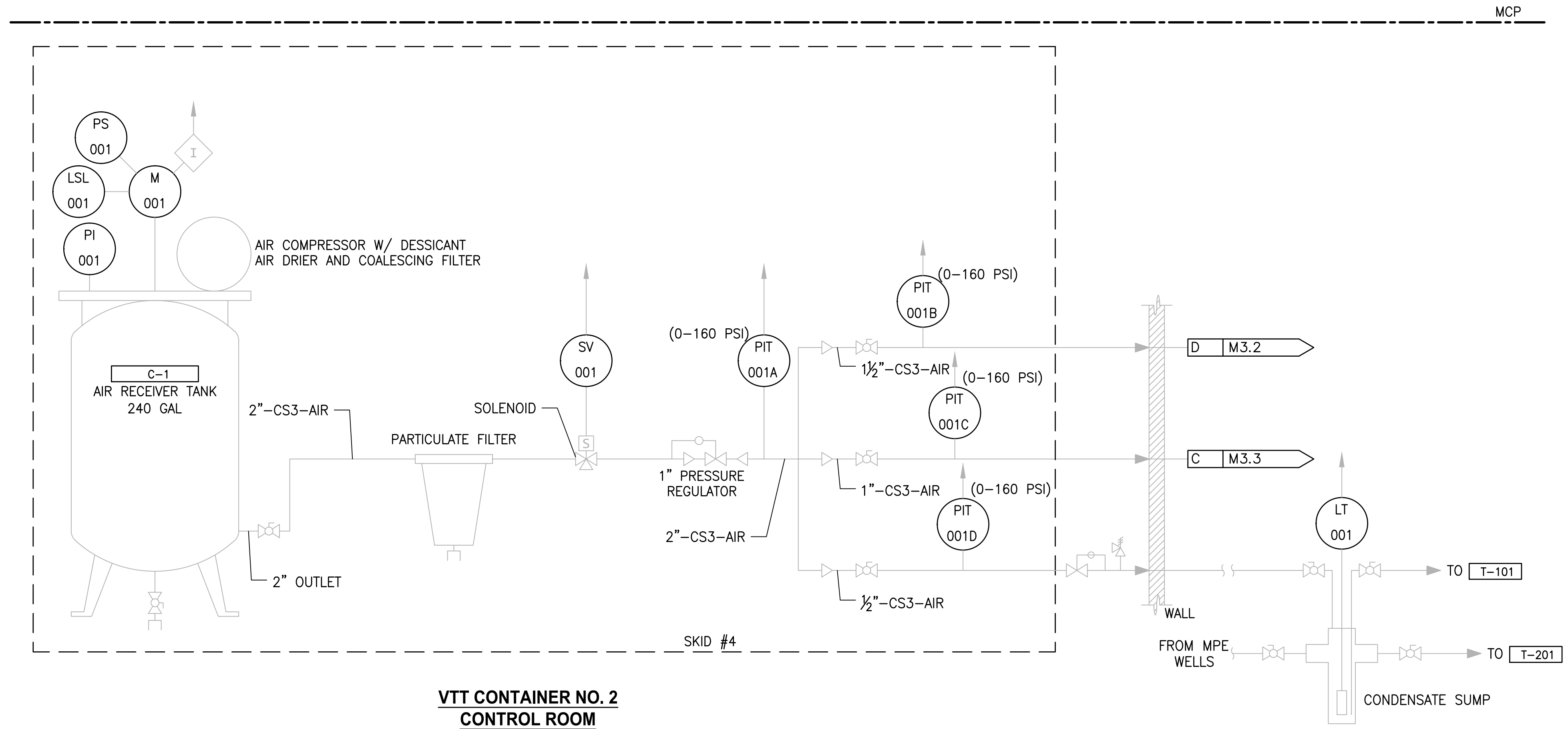
Parametrix
719 2nd Avenue, Suite 200 • Seattle, WA 98104
Ph: 206.394.3700

PROJECT NAME
EPHRATA LANDFILL
MULTI PHASE EXTRACTION SYSTEM EXPANSION
EPHRATA, WASHINGTON

PROCESS FLOW DIAGRAM

DRAWING NO. X OF X
M3.4

PATH: U:\PSO\Projects\Clients\1860–HellerEhrmanWhite\553–1860–014 Ephrata LF RI–FS Ph9\99Svcs\CADD\DWG PLOTTED BY: StolJoc DATE: Monday, January 27, 2025 9:51:42 AM
LAYOUT: M3.4



VTT CONTAINER NO. 2
CONTROL ROOM

NOTES:

1. CONDENSATE PUMP CONNECTIONS TO UPSTREAM/DOWNSTREAM PROCESS NOT SHOWN FOR CLARITY.

NOT FOR CONSTRUCTION

PRELIMINARY

REVISIONS	DATE	BY	
			DESIGNED J. STOLLE
			DRAWN N. CHRISTENSEN
			CHECKED –
			APPROVED B. PIPPIN

ONE INCH AT FULL SCALE, IF NOT, SCALE ACCORDINGLY
FILE NAME PS1860014-M3.1-3.3
JOB No. 553-1860-014
DATE JANUARY 2025

Parametrix
719 2nd Avenue, Suite 200 • Seattle, WA 98104
Ph: 206.394.3700

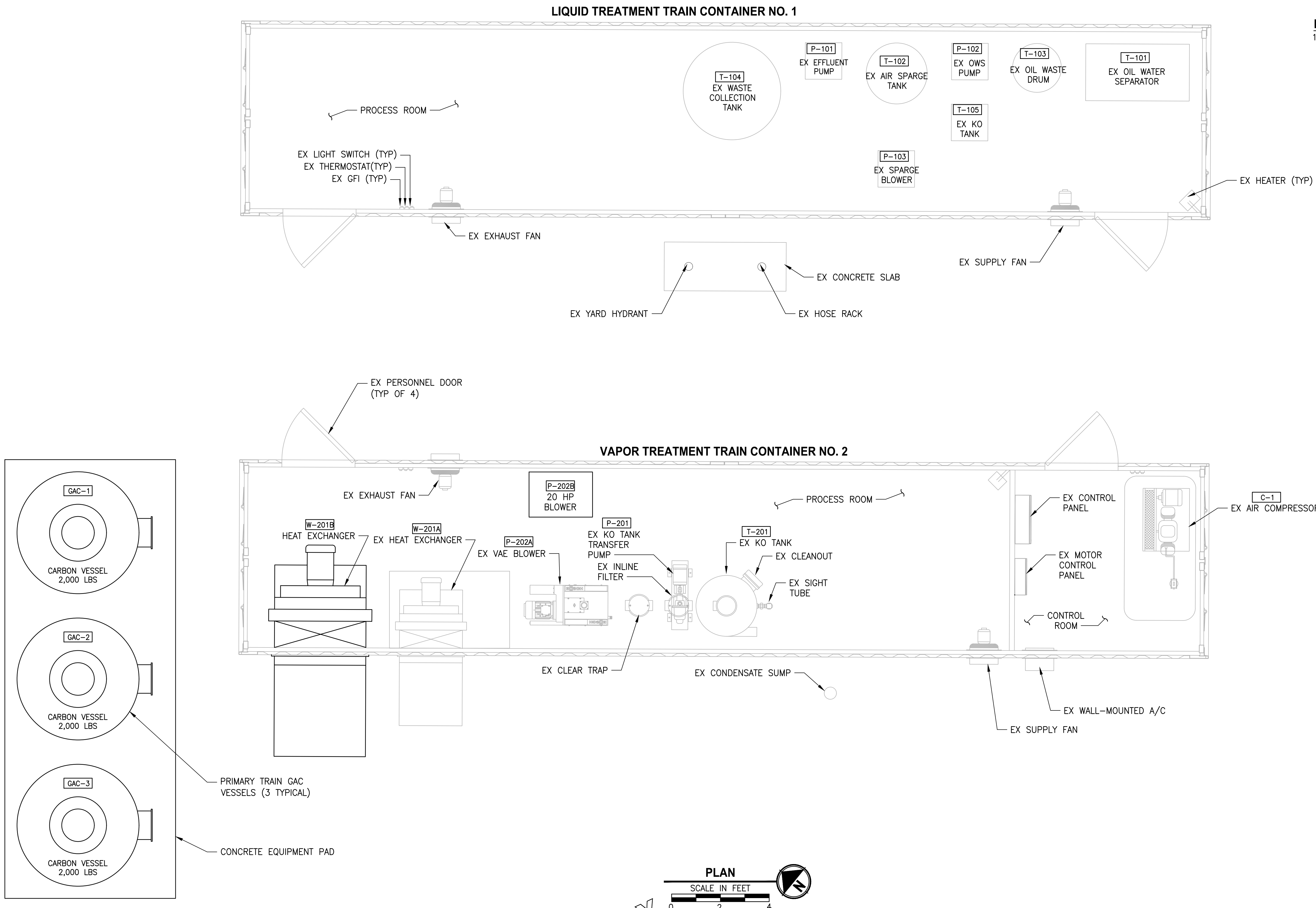
PROJECT NAME
EPHRATA LANDFILL
MULTI PHASE EXTRACTION SYSTEM EXPANSION
EPHRATA, WASHINGTON

PROCESS FLOW DIAGRAM

DRAWING NO. X OF X
M3.5

NOTES:

1. EXISTING 500 LB GAC VESSELS TO BE REMOVED AND STORED ONSITE.



PRELIMINARY

NOT FOR CONSTRUCTION

REVISIONS	DATE	BY

DESIGNED J. STOLLE
DRAWN N. CHRISTENSEN
CHECKED –
APPROVED B. PIPPIN

ONE INCH AT FULL SCALE, IF NOT, SCALE ACCORDINGLY
FILE NAME PS1860014-M4
JOB No. 553-1860-014
DATE JANUARY 2025

Parametrix
719 2nd Avenue, Suite 200 • Seattle, WA 98104
Ph: 206.394.3700

PROJECT NAME
EPHRATA LANDFILL
MULTI PHASE EXTRACTION SYSTEM EXPANSION
EPHRATA, WASHINGTON

CONTAINER LAYOUT

DRAWING NO. X OF X

M4.0

LAYOUT: M4.0
PATH: \\parametrix.com\pmx\PSO\Projects\Clients\1860-HellerEhrmanWhite\553-1860-014 Ephrata LF RI-FS Ph9\99Svcs\CADD\DWG PLOTTED BY: StolJoc DATE: Monday, January 27, 2025 9:49:36 AM

Appendix G

Groundwater Extraction Estimates

Appendix G Groundwater Extraction Estimate

Station ID	Unit	Bore ID	Well Dia. (in)	Bore Dia. @ Scrn (in)[1]	T_pre2019.T ft2/dy	T_2020.T ft2/dy	FH Coop T (ft2/dy)	RH Coop T (ft2/dy)	Avg. T (ft2/dy)	Est. Yield	Yield Rank	Individual Pump Test T (ft2/dy)	T (Q/dd)	T (slug)	Slug: (QQ/dd)
MW-109p1	P1	B-109	6	13.375		1366.4	1366.4	0	1366.4	High	1		70	1366.4	19.5
MW-100p1	P1	B-100	6	13.375		176.6	161.1	192	176.6	High	1		High	176.6	
MW-83p1	P1	B-83	6	13.375		122.5	200	45	122.5	Low	5		62	122.5	2
MW-85p1	P1	B-85	6	9.875		13.7	13.5	13.8	13.7	Moderate to High	2		10.6	13.7	1.3
MW-34p1	P1		4		51	51									
MW-65p1	P1		4		50	50									
MW-68p1	P1		4		20	20									
MW-113p2	P2	B-113	6	10.625		40.6	51.7	29.5	40.6	Moderate	3	30.8	31	40.6	1.3
MW-91p2	P2	B-91	6	9.875		29.6	40.4	18.9	29.6	Moderate to High	2		1	29.6	29.6
MW-87p2	P2	B-87	6	9.875		24	24.2	23.8	24	Moderate to High	2	7	7	24	3.4

Station ID	Storage (gal)	Aquifer (gal)	Aquifer: Storage	Pump Time (min)	Calc Purge Volume, 3 casings (gal)	Pumped Volume (gal)	Avg Sample Pump Rate (gpm)	Notes	Est. Initial Pump Rate (gpm)[2]	Est. 1st Month Avg. Pump Rate (gpm)[2]	Est. Long Term Avg. Pump Rate (gpm)[2]	Est. Initial Air @ 0.9 scf/gal (scfm)	Est. 1st Month Air @ 0.9 scf/gal (scfm)	Est. Long Term Air @ 0.9 scf/gal (scfm)	Sequence
MW-109p1	0.8	22.2	27.6	59	36	23	0.4	In drum backfill and fairly productive	6.16	1.54	0.51	5.54	1.39	0.46	1
MW-100p1	0	13.7	308.6	41	16	13.75	0.3	In drum backfill and very productive. Steady DD level at 0.4 gpm	6.16	1.54	0.51	5.54	1.39	0.46	1
MW-83p1	1.4	17.6	12.7	31	11	19	0.6		0.6	0.3	0.10	0.54	0.27	0.09	1
MW-85p1	3.8	11.2	2.9	53	26	15	0.3	Fairly productive	0.87	0.29	0.10	0.78	0.26	0.09	1
MW-34p1									2.31	0.77	0.26	2.08	0.69	0.23	1
MW-65p1									0.87	0.29	0.10	0.78	0.26	0.09	1
MW-68p1									0.08	0.04	0.01	0.07	0.04	0.01	1
MW-113p2	1.9	10.1	5.3	34	28	12	0.4		0.6	0.3	0.10	0.54	0.27	0.09	2
MW-91p2	17.5	3.5	0.2	111	37	21	0.2	Pumped dry and recovered 8 feet over night (Moderate)	0.87	0.29	0.10	0.78	0.26	0.09	2
MW-87p2	2.7	13.3	5	100	38	16	0.2	Fairly productive	0.87	0.29	0.10	0.78	0.26	0.09	2
								Total	**19.4**	**5.7**	**1.9**	**17.5**	**5.1**	**1.7**	

[1]MW-100p1 - Screen set at transition from 13 3/8-in to 9 7/8-in borehole.

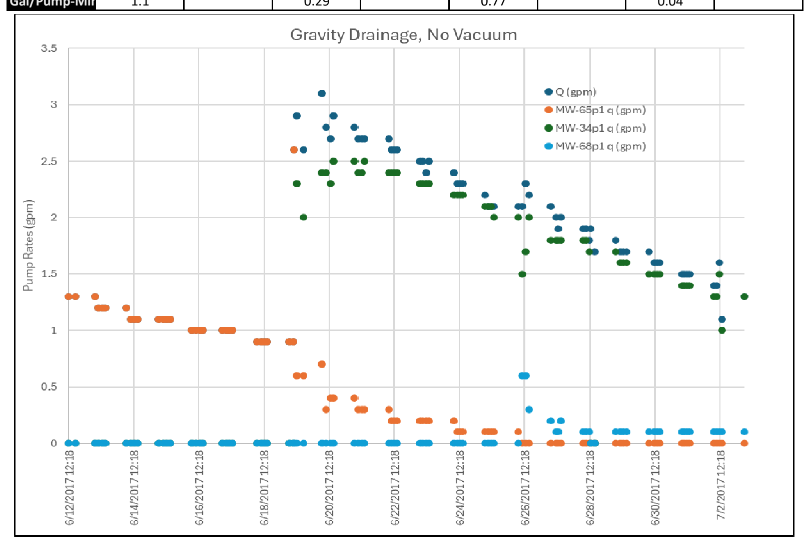
[2]In 2017 pump rates fell off quickly after local groundwater was depleted, likely due to recharge constraints. Estimates reflect this observation, calculated transmissivity, and notes.

RH - rising head
FH - falling head
B&R - Bouwer & Rice
Coop - Cooper et al

Convert SCF to ACF			
17.5	scf	14.7	psig
4	acf	65	psig

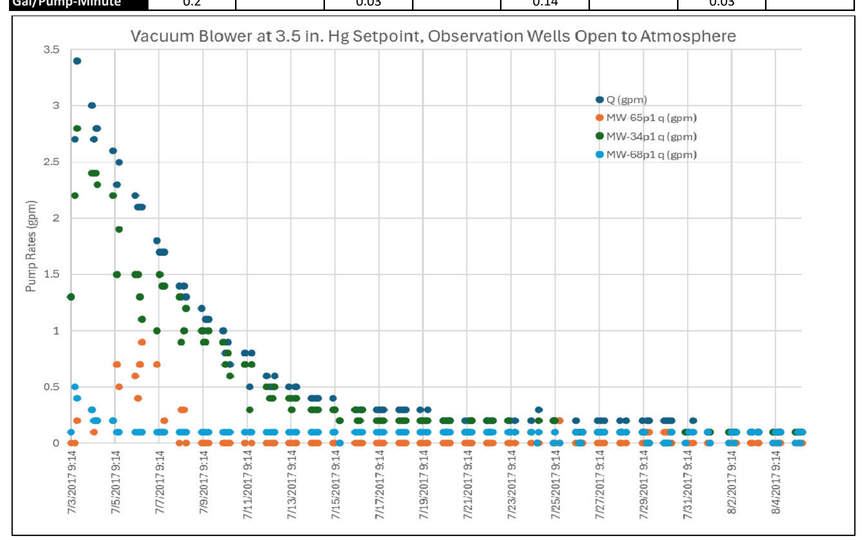
Gravity Drainage, No Vacuum Start 6/12/17 End 7/3/17

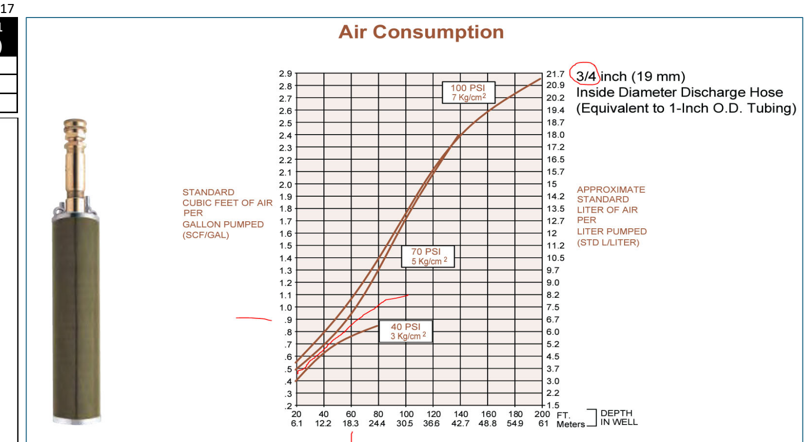
	FIT-101 (cum. gal)	Q (gpm)	MW-65p1 q (gpm)	MW-65p1 (cum. gal)	MW-34p1 q (gpm)	MW-34p1 (cum. gal)	MW-68p1 q (gpm)	MW-68p1 (cum. gal)
Total, Average	52959	1.8	0.7	13331	1.9	37866	0.1	1369
Pump Hours	825.2		331		330.1		164.1	
Gal/Pump-Mir	1.1		0.29		0.77		0.04	

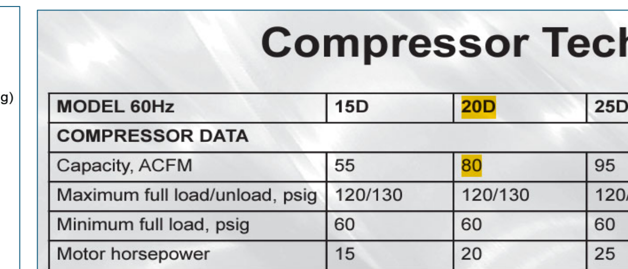


Vacuum Blower at 3.5 in. Hg Setpoint, Observation Wells Open to Atmosphere Start 7/3/17 End 8/5/17

	FIT-101 (cum. gal)	Q (gpm)	MW-65p1 q (gpm)	MW-65p1 (cum. gal)	MW-34p1 q (gpm)	MW-34p1 (cum. gal)	MW-68p1 q (gpm)	MW-68p1 (cum. gal)
Total, Average	28858	0.6	0.1	2895	0.5	21957	0.1	3959
Pump Hours	2390.7		796.9		796.9		796.9	
Gal/Pump-Minute	0.2		0.03		0.14		0.03	






Compressor Techi

MODEL 60Hz	15D	20D	25D4
COMPRESSOR DATA			
Capacity, ACFM	55	80	95
Maximum full load/unload, psig	120/130	120/130	120/13
Minimum full load, psig	60	60	60
Motor horsepower	15	20	25

Appendix H

Soil Vapor Extraction Estimates

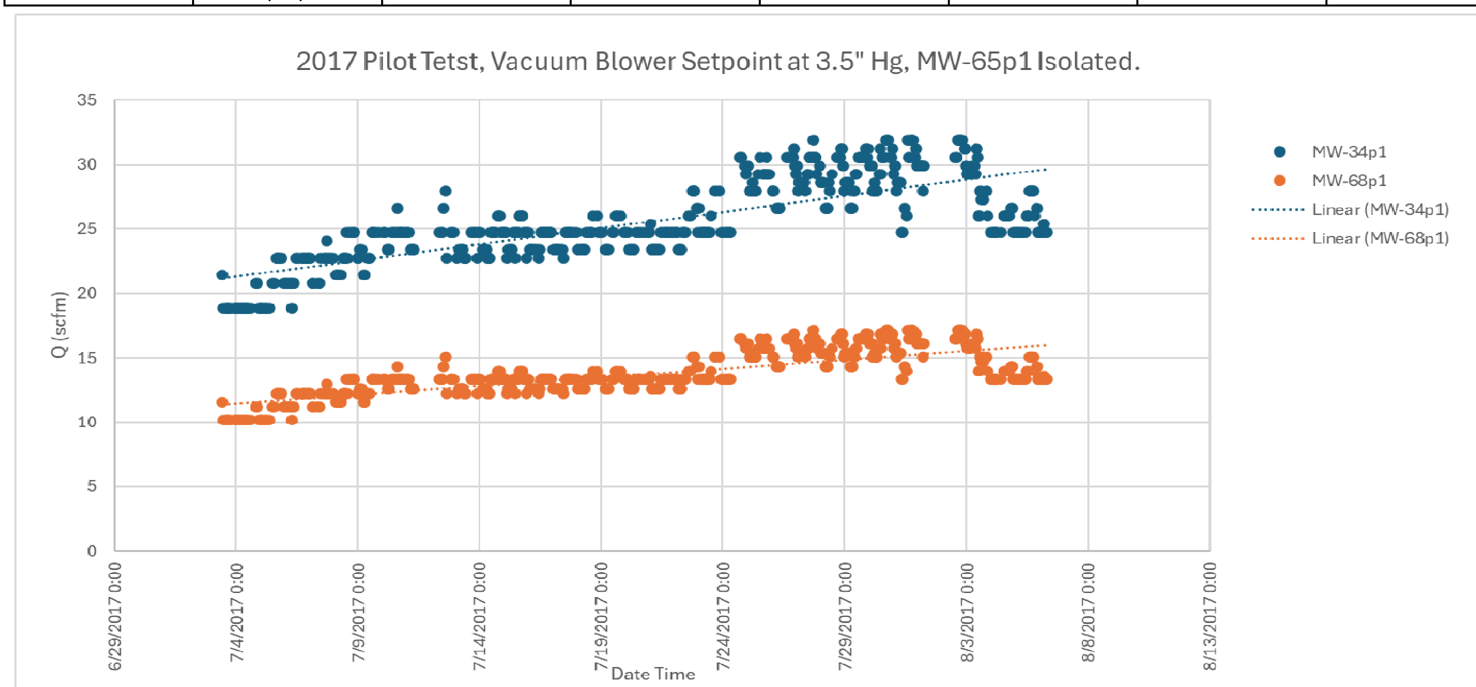
Appendix H Soil Vapor Extraction Rate Estimate for Expanded MPE at 3.5 in. Hg. Nominal Blower Vacuum

Station ID	Status	Unit	Type	Dia. (in)	Zone Factor[1]	Low Q (scfm)	High Q (scfm)
MW-34p1	Existing	P1	MPE	4	1	10	32
MW-36p1	New	P1	VE	4	1	10	32
MW-64p1	New	P1	VE	4	1	10	32
MW-65p1	Existing	P1	MPE	4	1	10	32
MW-68p1	Existing	P1	MPE	4	1	10	32
MW-69p1	New	P1	VE	4	1	10	32
MW-83p1	New	P1	MPE	6	1	10	32
MW-85p1	New	P1	MPE	6	1	10	32
MW-87p2	New	P2	MPE	6	0.6	6	19.2
MW-91p2	New	P2	MPE	6	0.6	6	19.2
MW-92p1	New	P1	VE	6	1	10	32
MW-94p2	New	P2	VE	6	0.6	6	19.2
MW-99p2	New	P2	VE	6	0.6	6	19.2
MW-100p1	New	P1	MPE	6	1	10	32
MW-101p2	New	P2	VE	6	0.6	6	19.2
MW-106b	New	Roza	VE	6	0.3	3	9.6
MW-109p1	New	P1	MPE	6	1	10	32
MW-113p2	New	P2	MPE	6	0.6	6	19.2
MW-117p1	New	P1	VE	6	1	10	32
MW-123p1	New	P1	VE	6	1	10	32
Total						**169**	**541**

[1]Assumes less connectivity to ambient air in the P2 zone and Roza aquifer compared to the P1 zone.

2017 Pilot Tetst, Vacuum Blower Setpoint at 3.5" Hg, MW-65p1 Isolated.

Stat	Date	Blower Vacuum (in. Hg. Gage)	VTT Flow (scfm)	MW-34p1 P (in. Hg abs.)	MW-34p1 Est. Q (scfm)	MW-68p1 P (in. Hg abs.)	MW-68p1 Est. Q (scfm)
Mean	---	3.7	39.3	25.1	25.6	25.1	13.8
Min	07/03/17	3.1	29	24.5	18.9	24.5	10.2
Max	08/06/17	3.9	49	25.8	31.9	25.7	17.2



Appendix I

LTT & VTT Record Drawings

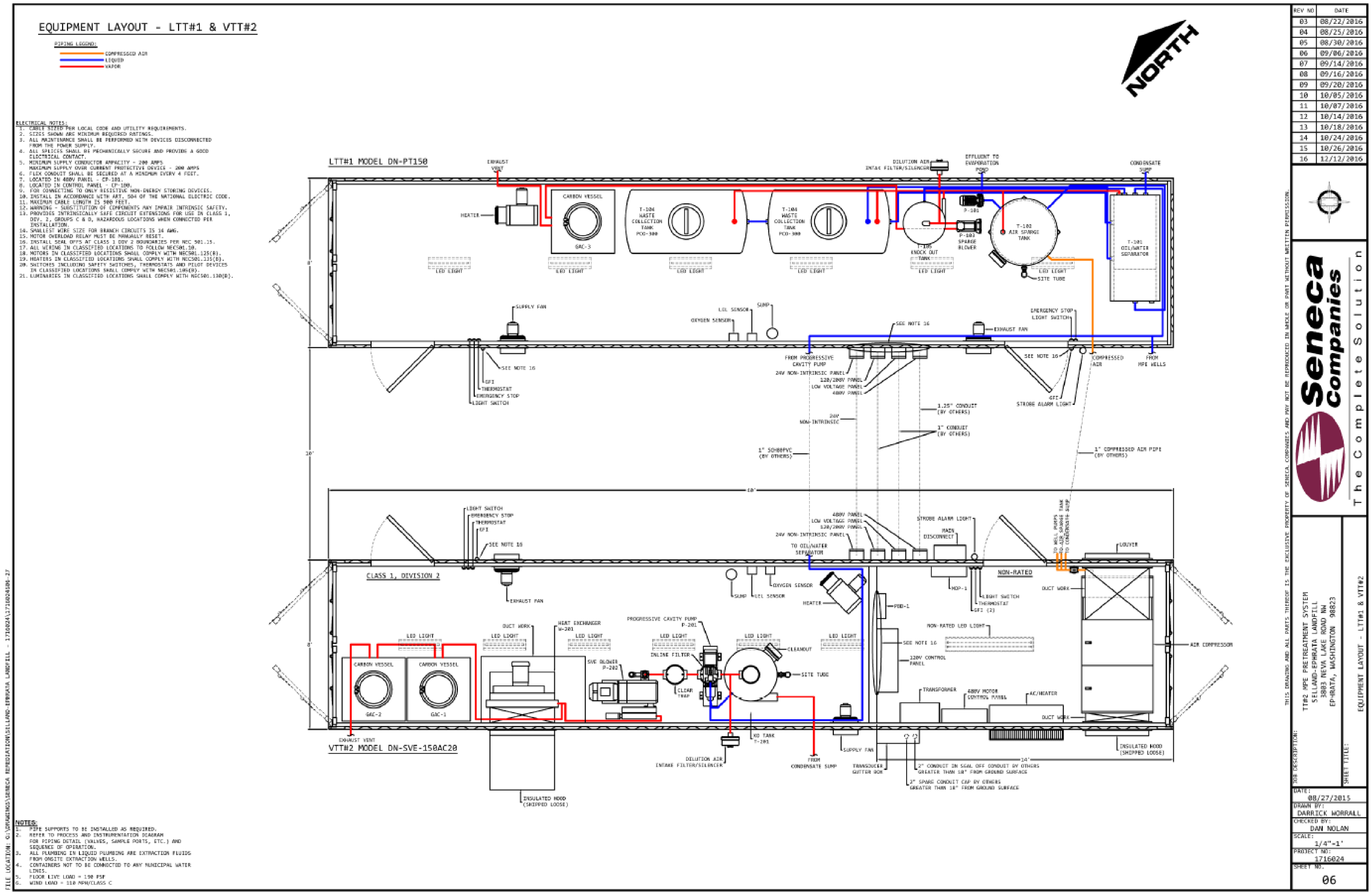


Figure I-1 Existing LTT and VTT Equipment Layout

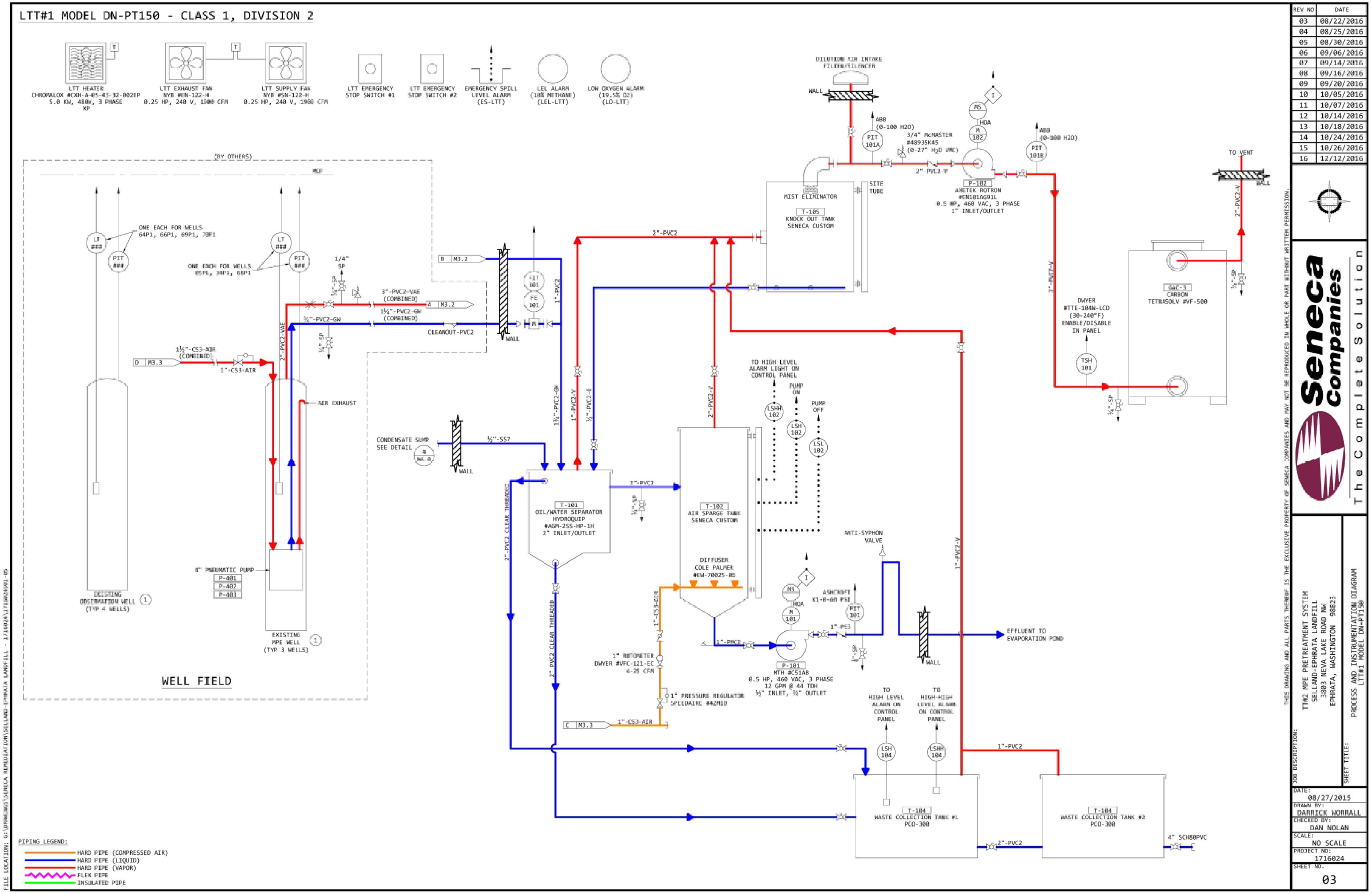


Figure I-2 Existing LTT Flow Diagram

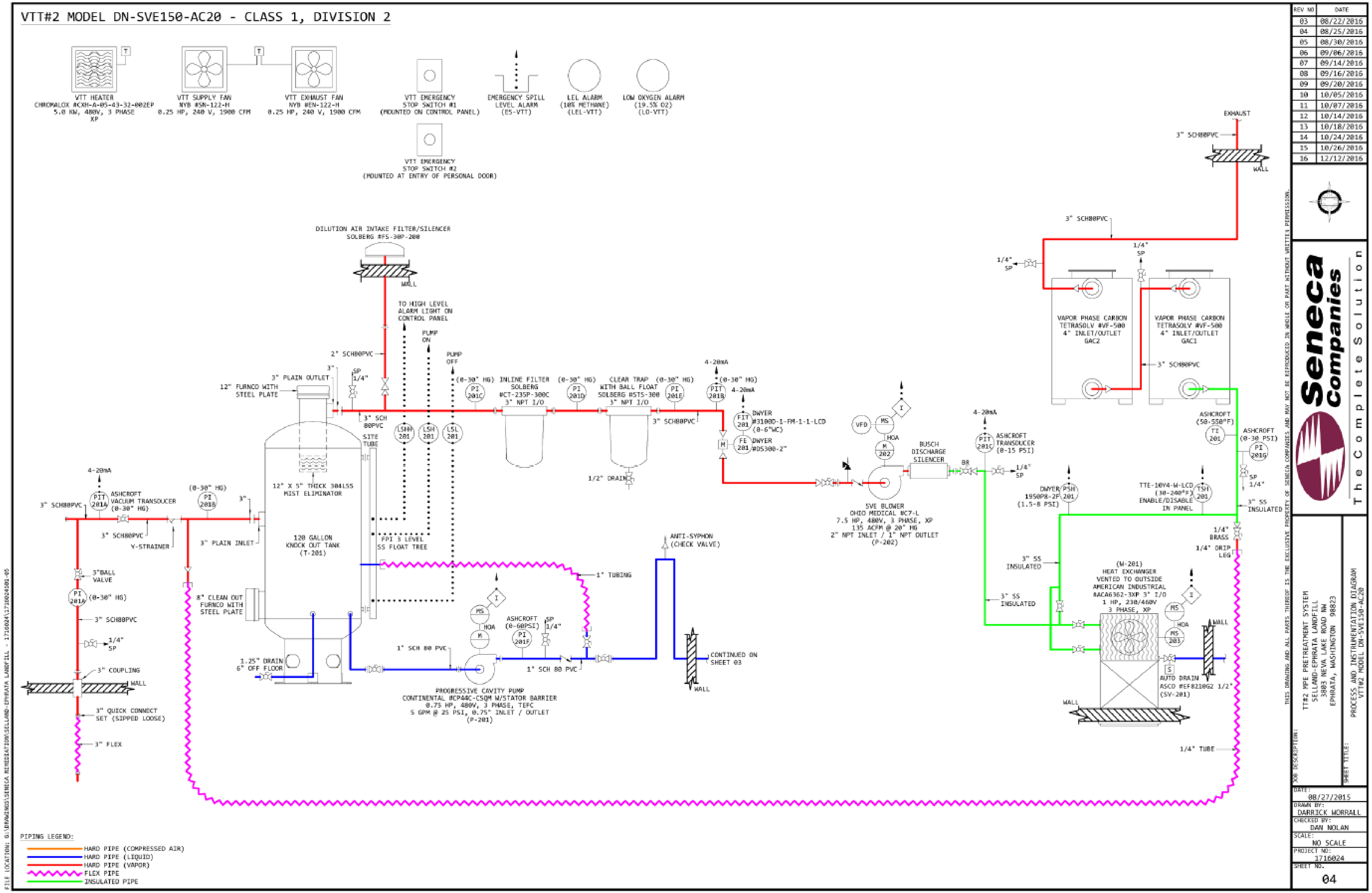


Figure I-3 Existing VTT Flow Diagram

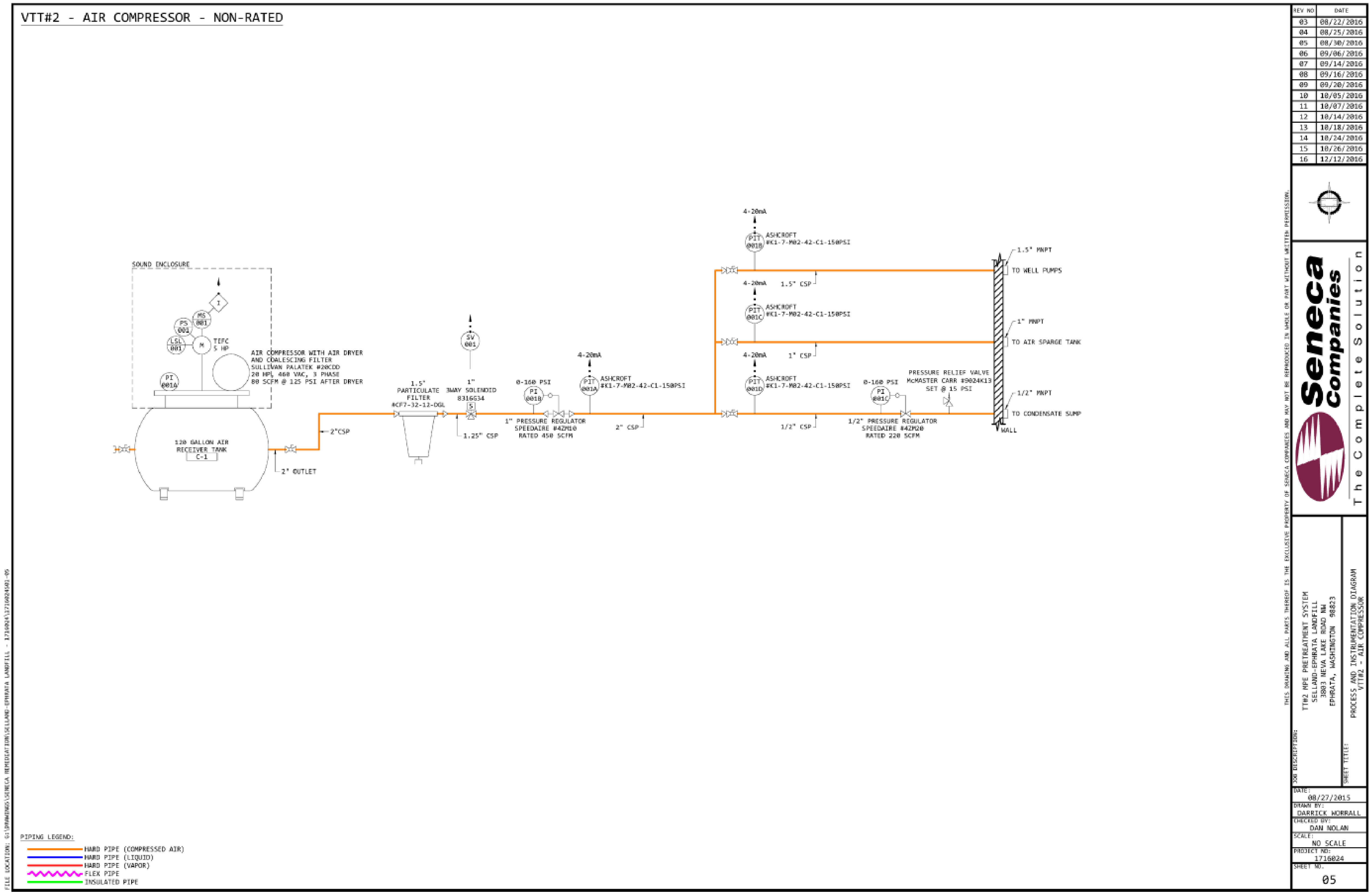


Figure I-4 Air Compressor Flow Diagram

Appendix J

MPE Pilot Test Expansion Cost Estimate

Ephrata Landfill

MPE Pilot Test Expansion Cost Estimate

Engineer's Opinion of Probable Cost for Preliminary Design

PREPARED: N. Christensen
CHECKED: J. Stolle

DATE: 1/27/2025

NO.	QUANTITY	UNIT	DESCRIPTION	UNIT COST	TOTAL
			PREPARATION		
	1	LS	MOBILIZATION	$113,200	**$113,200**
				SUBTOTAL	**$113,200**
			STRUCTURAL		
	3	EA	GAC Filter Foundation	$5,000.00	$15,000
				SUBTOTAL	**$15,000**
			CIVIL		
	1	LS	Site Health and Safety	$3,800.00	$3,800
	1	LS	Stormwater Control Improvements	$25,000.00	$25,000
	8	EA	Existing Well Pump Field Testing	$1,000.00	$8,000
	1	LS	Hydraulic and Air Testing of Existing piping	$5,000.00	$5,000
	65	EA	Pipe Supports @ 10' lengths	$1,200	$78,000
	650	LF	Well Disch. Line - Pipe, stainless steel, butt weld, 1-1/4" diameter, schedule 10, type 304, includes weld joir	$29	$18,590
	650	LF	Vacuum Line - Pipe, stainless steel, butt weld, 2" diameter, schedule 10, type 304, includes weld joint	$39	$25,090
	650	LF	Compressed Air - Pipe, steel, black, threaded, 1-1/2" diameter, schedule 40, Spec. A-53,	$13	$8,580
	10	EA	Valve - Air and Vacuum Relief Valve 1"	$3,000	$30,000
	10	EA	Drainage Tap 1"	$1,500	$15,000
	1	FA	Well appurtenances replacement	$15,000	$15,000
				SUBTOTAL	**$232,060**
			MECHANICAL		
	1	LS	General Contractor markup for mechanical installation	$31,150	$31,150
	10	EA	MPE Well Pump, caps and ancillary equipment	$18,000	$180,000
	10	EA	VE Well caps and ancillary equipment	$3,000	$30,000
	1	LS	Modifications to the existing LTT piping and valving.	$7,500	$7,500
	1	EA	Regenerative Blower	$29,000	$29,000
	1	EA	Heat Exchanger	$20,000	$20,000
	1	LS	Modifications to the existing VTT piping and valving.	$25,000	$25,000
	1	LS	Existing LTT System Field Testing and Cleaning	$10,000	$10,000
	1	LS	Existing VTT System Field Testing and Cleaning	$10,000	$10,000
	1	FA	Equipment, gaskets, and appurtenances replacement	$25,000	$25,000
	3	EA	2,000 lb GAC Vessel	$18,000	$54,000
	1	LS	GAC Vessel Start up carbon fill	$4,500	$4,500
				SUBTOTAL	**$426,150**
			ELECTRICAL AND CONTROLS		
	1	EA	WORK / MATERIAL DESCRIPTION TO INCL. CONTRACTOR OH&P	$10,479	$10,479
	1	EA	General Contractor markup for electrical sub	$238,200	$238,200
	1	LS	Existing LTT System Instrumentation Testing	$3,000	$3,000
	1	LS	Existing VTT System Instrumentation Testing	$3,000	$3,000
	1	FA	Instrumentation and appurtenances replacement	$15,000	$15,000
				SUBTOTAL	**$269,700**

	SUBTOTAL CONSTRUCTION		**$1,056,110**
	OVERHEAD & PROFIT	10%	$105,611
	SALES TAX	8.2%	$95,261
	TOTAL CONSTRUCTION BASELINE		**$1,256,982**
	CONTINGENCY	-30%	50%
	TOTAL CONSTRUCTION RANGE	**$879,887**	**$1,885,473**

Appendix K

Air Emissions Estimates

Appendix K Air Emissions Estimate

Groundwater Rate	MW-100p1	MW-109p1	MW-113p2	MW-34p1	MW-65p1	MW-68p1	MW-83p1	MW-85p1	MW-87p2	MW-91p2	Total (gal/AP)	Averaging Period (AP)
Est. Initial Pump Rate (gpm)	6.16	6.16	0.6	2.31	0.87	0.08	0.6	0.87	0.87	0.87	27921.6	24-hr
Est. 1st Month Avg. Pump Rate (gpm)	1.54	1.54	0.3	0.77	0.29	0.04	0.3	0.29	0.29	0.29	---	year[1]
Est. Long Term Avg. Pump Rate (gpm)	0.51	0.51	0.1	0.26	0.1	0.01	0.1	0.1	0.1	0.1	743754.24	
24-hr flow weighting	0.318	0.318	0.031	0.119	0.045	0.004	0.031	0.045	0.045	0.045	1.00	24-hr
Annual flow weighting	0.271	0.271	0.053	0.137	0.052	0.006	0.053	0.052	0.052	0.052	1.00	year[1]

	Latest Groundwater Analytical Result (µg/L)																			
Toxic Air Pollutant	6/9/20	4/1/24	4/1/24	6/9/20	6/9/20	6/9/20	4/1/24	4/1/24	4/1/24	4/1/24	FWAC[2] (µg/L)	Averaging Period (AP)	ASIL (µg/m3)	Pretreated FWAC[2, 3, 4] (µg/m3)	Pretreated FWAC > ASIL?	SQER (lb/AP)	De Minimis (lb/AP)	Pretreated Loading[3, 4] (lb/AP)	Pretreated Loading > SQER?	Pretreated Loading > De Minimis?
1,1,1-Trichloroethane	0.27	182	11.9			0.82				2.98	50.2	year	0.14	581	Yes	22	1.1	6.0448E-02	No	No
1,1-Dichloroethane	1.47	137	219	13.5	1.82	61.5	195	25.2	8.85	37.7	62	24-hr	40000	717	No	3000	150	2.8027E-03	No	No
1,1-Dichloroethene		40.7									12.9	24-hr	40000	149	No	3000	150	5.8315E-04	No	No
1,2,4-Trimethylbenzene	0.32		493	59.8	25.8	209	299	27.1	282	199	56.6	24-hr	60	655	Yes	4.4	0.22	2.5586E-03	No	No
1,2-Dichlorobenzene			35.9	31.8	16.6	51.4			15.9	16.4	9.1	year	0.091	105	Yes	15	0.74	1.0958E-02	No	No
1,2-Dichloropropane	0.24	3.48	11.2	0.42		8.76				3.66	1.9	year	0.25	22	Yes	41	2	2.2879E-03	No	No
1,3,5-Trimethylbenzene			106	17.3	2.89	15.3	50.7		92.4	69.3	14.4	24-hr	60	167	Yes	4.4	0.22	6.5096E-04	No	No
1,3-Dichlorobenzene				3.13	1.28	3.67					0.5	year	0.091	6	Yes	15	0.74	6.0207E-04	No	No
1,4-Dichlorobenzene	0.59		24.8	11.1	11.1	21.8		2.32	18.7	13.8	5.5	year	0.091	64	Yes	15	0.74	6.6228E-03	No	No
2-Hexanone						8.06					0.03	24-hr	30	0	No	2.2	0.11	1.3562E-06	No	No
Benzene	0.3		9.96	3.22	5.74	8.22				5.35	1.7	year	0.13	20	Yes	21	1	2.0470E-03	No	No
Bromobenzene			2.59	0.54	0.74	3.82					0.2	24-hr	60	2	No	4.4	0.22	9.0411E-06	No	No
Chlorobenzene	0.21		11	1	9.12	5.43			18.3	12.7	2.4	24-hr	1000	28	No	74	3.7	1.0849E-04	No	No
Chloroethane	0.21	12.2	151		5.94	10.5	26.9	3.23	40	25	16.7	year	60	193	Yes	9800	490	2.0109E-02	No	No
Chloromethane				1.07							0.1	year	60	1	No	9800	490	1.2041E-04	No	No
Ethylbenzene	0.5		1160	81.9	82.5	341	737	96.5	568	414	174.3	year	0.4	2017	Yes	65	3.2	2.0988E-01	No	No
Naphthalene			92	16.6	9.18	13.5	61.2	5.54	49.5	44.8	16.1	year	0.029	186	Yes	4.8	0.24	1.9387E-02	No	No
Toluene			2240	12.8	5.04	498	2730	286		984	215	24-hr	5000	2488	No	370	19	9.7191E-03	No	No
trans-1,2-Dichloroethene				0.48	0.47	0.74					0.1	24-hr	810	1	No	60	3	4.5205E-06	No	No
Trichloroethene (TCE)	0.25	1.79		0.32		0.39					0.6	year	0.21	7	Yes	34	1.7	7.2249E-04	No	No
Vinyl Chloride	0.523	7.53	25.4	2.13	1.01	4.84	2.53	5.14	1.84	19.3	5.4	year	0.11	62	Yes	18	0.92	6.5024E-03	No	No
Xylene (mixture)			1705	70.8	33.37	237.4	1894	106.8	959.4	977	214.4	24-hr	220	2481	Yes	16	0.82	9.6920E-03	No	No

[1]Based on seasonal operation from April through October, first month estimate combined with 6 months at the long term average rate.

[2]FWAC - Flow Weighted Average Concentration.

[3]Applying 80.6% VOC removal rate in the LTT during the 2017 pilot test (Parametrix 2018).

[4]Assuming the TAP mass during a 24-hour initial pumping period dissipates into ambient air one meter high above the evaporation pond water surface.

Conversions

(min/mo)	43776	minute/month
(lb/ug)	2.2046E-09	pound/microgram
(L/gal)	3.78541	liter/gallon