**Five-Year Periodic Review**

Bee-Jay Scales Site
Sunnyside, WA  98944



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# Sign-off Sheet

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# 1.0    Introduction

Stantec Consulting Services Inc. (Stantec) is submitting this Five-Year Periodic Review to the Washington Department of Ecology (Ecology) for the Bee-Jay Scales Site (the Site), on behalf of Chevron Environmental Management Company (CEMC) and Remediation Management Services Company (RMSC) on behalf of Chevron Chemical Company and American Oil Company (Amoco), respectively. This Five-Year Periodic Review has been prepared as required by Consent Decree No. 132017660 between Ecology, Chevron Chemical Company, and Amoco (Ecology, 2013a) and under the provisions of the Washington State Model Toxics Control Act (MTCA) Washington Administrative Code (WAC) 173-340 (WAC, 2007). The objective of the periodic review is to determine whether human health and the environment are being protected based on the factors established in WAC 173-340-420(4). Those factors are:

- The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the Site;

- New scientific information for individual hazardous substances or mixtures present at the Site;

- New applicable state and federal laws for hazardous substances present at the Site;

- Current and projected Site use;

- Availability and practicability of higher preference technologies; and

- The availability of improved analytical techniques to evaluate compliance with cleanup levels (CULs).

This Five-Year Periodic Review covers the period of 2020 through 2024. The previous Five-Year Periodic Review was submitted December 16, 2019 (Stantec, 2019c).

## 2.0 Summary of Site Conditions

### 2.1 SITE DESCRIPTION AND HISTORY

The Site is located in the City of Sunnyside (City), within Yakima County, Washington, and includes the two parcels where contaminants were historically released and the parcels where those contaminants have come to be located. The Site location is shown on **Figure 1**.

The two parcels where contaminants were historically released include the southern portions of Parcel No. 22102522014, located at 110 North 1st Street and owned by Bee-Jay Scales, Inc. (BJS), and Parcel No. 22102522015, located at 301 Warehouse Avenue and owned by Western General Land, LLC (WGL) (shown on **Figure 2**; note that only the last six digits of the parcel numbers are shown). The BJS parcel is approximately 3.0 acres in size. Three businesses currently operate at the parcel: Sandy Farms, a local trucking company; Sanleco, Inc., an interstate trucking company with a tractor-trailer repair garage; and Bee-Jay Scales, a commercial scale operation. The WGL parcel is approximately 0.9 acres in size and is currently used to park semi-trucks and trailers as well as store other equipment used by the food processing facility to the east.

The BJS and WGL parcels and the surrounding area have been the location of agricultural warehouses, lumber yards, coal storage, and railroad transportation activities since approximately 1906. Portions of these two parcels were owned by the Northern Pacific Railroad Company from 1906 until 1989 when the Glacier Park Company purchased them. An agricultural distribution facility operated at the BJS parcel from the 1960s through at least 1986. This facility consisted of buildings and aboveground storage tanks (ASTs), and was operated by at least two separate companies: Laneger Agricultural Services and Valley Agricultural, Inc. The ASTs have since been removed from the parcel. Documentation also indicates that Amoco, now part of BP, leased portions of the parcels from Northern Pacific Railroad Company between 1965 and 1972. A lagoon was constructed by Valley Agricultural, Inc. in the early 1980s to collect water from the washdown of farm chemical applicator vehicles.

The western portion of Lot 10 was purchased by Chevron Chemical Company in 1981 and sold to BJS in 1987. BJS purchased additional portions of Lots 10 and 11 in 1995 and 1996. Lots 10 and 11 are referenced in the Summary of Ownership included as Appendix B of the *Remedial Investigation/Feasibility Study Work Plan* (CH2M Hill, 2003). The exact locations and boundaries of Lots 10 and 11 are unknown based on available information.

Hickenbottom & Sons, Inc. leased the WGL parcel from the Northern Pacific Railroad Company beginning in 1961 and purchased portions of Lots 10 and 11 in 1992. The WGL parcel was previously used as pastureland; since 1961, it has been used for food packing, storage, and a transportation business. The parcel was purchased by WGL in 2010.

The BJS and WGL parcels were historically divided into six main study areas throughout the environmental investigation and assessment process. Those six study areas are shown on **Figure 2**.

On the BJS property, material is spilling out of the east wall of the Former Fertilizer Building and accumulating on the ground surface outside of the building. This was documented in letters submitted to Ecology on November 7, 2014, and November 1, 2019. Similar photos to document the condition were taken in August 2022 and can be provided to Ecology upon request. Material in and around the Former Fertilizer Building was sampled November 19, 2014 and chemicals associated with fertilizer that may impact the Site remedy were detected, including ammonia, nitrate, sulfate, pentachlorophenol, 2,4-DB, p,p-DDE, p,p-DDT, and other pesticide/polychlorinated biphenyl (PCB) constituents. The BJS property owner is responsible for addressing this continual release.

Historical releases from activities on the BJS and WGL parcels have impacted the groundwater at those parcels and have extended down-gradient to affect several additional parcels. The following parcels were affected by the contaminant groundwater plumes as defined by the *Groundwater Remedy Engineering Design Report* (GW EDR) dated November 15, 2016 (Stantec, 2016), and are considered part of the Site:

- Parcel 22102522016 is located adjacent to the WGL parcel to the east and is owned by Northwest American Land LLC. The parcel is approximately 1.8 acres in size and contains a fruit processing facility.

- Parcel 22102522904 is located south of the BJS and WGL parcels and is owned by Burlington Northern Santa Fe Railway Company (BNSF). This parcel is approximately 1.5 acres in size and adjacent to the railroad right-of-way (ROW).

- Parcel 221025225559 is located south of the railroad ROW and is owned by Milne Fruit Products Inc. (MFP) & MFP Holdings Inc. (previously owned by Valley Processing Inc.). The parcel is approximately 3.8 acres in size and contains a fruit processing facility.

- Parcels 22102523416, 22102523418, 22102523419, 22102523420, 22102523421, 22102523437, 22102523438, 22102523439, 22102523440, and 22102523441 comprise the northeast portion of the triangular area bordered by Blaine Avenue to the north, S. 3rd Street to the east, a railroad spur to the south and S. 1st Street to the west. The parcels combined have an area of approximately 1.5 acres and are owned by MFP (previously owned by Mary Ann Bliesner). These parcels are used as transportation parking associated with the local fruit processing facilities.

- Parcel 22102523901 coincides with the location of a large structure located south of Blaine Avenue. The parcel is owned by MFP & MFP Holdings Inc. and occupies an area of 0.21 acres. The building appears to contain a fruit processing facility.

- Parcel 22102523417 is a square parcel 0.13 acres in size located at the southwest corner of Blaine Avenue and S. 3rd Street. The parcel is owned by Sunnyside Zero Storage LLC (previously owned by George and Evelyn Johnson) and is used as transportation parking.

The Site layout, including parcel numbers, monitoring well locations and other important features, is shown on **Figure 2**.

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## 2.2     CLEANUP LEVELS AND POINTS OF COMPLIANCE

### 2.2.1     Soil Cleanup Levels

CULs have been established for two constituents for soil at the Site as identified in the Corrective Action Plan (CAP) dated March 8, 2013 (Ecology, 2013b). A nitrate CUL of 220 milligrams per kilogram (mg/kg) has been established by MTCA modified Method B for the protection of groundwater using Site-specific leaching tests pursuant to WAC 173-340-747(3)(d). Site-specific testing has established that Site soils with nitrate concentrations below the CUL should not leach to groundwater above the groundwater nitrate CUL. The ammonia CUL of 385 mg/kg has been established based on MTCA Method B for protection against acute vapor health effects for a construction worker.

### 2.2.2     Soil Point of Compliance

The point of compliance (POC) for soil is the soil overlying groundwater within the BJS and WGL parcels (Ecology, 2013b).

### 2.2.3     Groundwater Cleanup Levels

Site-specific CULs for groundwater constituents have been developed from a combination of primary maximum contaminant levels (MCLs), standard MTCA Method A CULs, and standard and modified MTCA Method B CULs. When primary MCLs have been developed for Site groundwater constituents, they are set as the CUL. If no MCL has been established, modified MTCA Method B CULs are generally used. In cases where modified MTCA Method B CULs have not been developed, standard MTCA Method A or Method B CULs are used.

Though nitrate in groundwater above the MCL of 10 milligrams per liter (mg/L) is the main driver, CULs have been established for 24 constituents for groundwater at the Site. The constituents, CULs, and basis for the CUL are shown in **Table 1**. Per WAC 173-340-703, when defining cleanup requirements at a site that is contaminated with a large number of hazardous substances, some of those substances may be eliminated from consideration where those substances contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances shall serve as indicator hazardous substances (IHSs) for purposes of defining cleanup requirements.

Twelve groundwater IHSs have been identified from the 24 groundwater constituents with CULs based on the remedial investigation and feasibility study process completed for the Site. The 12 Site groundwater IHSs were identified in the CAP dated March 8, 2013 (Ecology, 2013b) and are shown in **bold** in **Table 1**. Only the IHSs will be used to monitor compliance with the Site cleanup requirements.

### 2.2.4     Groundwater Point of Compliance

The POC for Site groundwater constituents is defined in the CAP as monitoring wells MW-4R, MW-5R, MW-6, MW-12R, and all monitoring wells, including those to be constructed as part of the remedial action, that are located down-gradient of those wells (generally to the south and southeast). The POC includes groundwater from the POC to the outer boundary of the Site plume. This plume is considered to apply to

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groundwater that has migrated from the BJS and WGL parcels, and any other sources would need to be considered separately. The following monitoring wells were determined to meet the CAP POC definition in the *Groundwater Remedy Compliance Monitoring Plan* (GW CMP; Stantec, 2019a): MW-4R, MW-5R, MW-6, MW-9, MW-12R, MW-13, MW-16, MW-19. In addition, wells MW-21, MW-23, and MW-24 were installed between October 2019 and March 2022 and are considered groundwater POCs.

## 2.3    CLEANUP ACTIONS

The CAP, dated March 8, 2013 and prepared for the Site by Ecology (Ecology, 2013b), contains both soil and groundwater cleanup objectives. The selected cleanup action includes a combination of the removal of contaminated soil overlying groundwater, in-situ bioremediation of the Site groundwater plume via injection wells and/or vertical barrier wall treatment system(s), natural attenuation of the groundwater and soil contamination to meet the CULs at the defined POCs, and institutional controls (ICs) to protect against the use of groundwater by the public.

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## 3.0    PERIODIC REVIEW

### 3.1    ASSESSMENT OF CLEANUP ACTIONS

#### 3.1.1    Previously Completed Cleanup Actions

As documented in the previous Five-Year Periodic Review (Stantec, 2019c), contaminated soils exceeding the nitrate and ammonia CULs and located above groundwater were excavated from the BJS and WGL parcels in 2014. The extent of contaminated soil was determined based on soil assessment activities completed in 2003 and 2004. Additional soil assessment activities were completed in 2013 and 2014 to delineate the limits of soil contamination prior to the initiation of excavation activities. Each excavation was then designed to extend to a confirmation soil sample location not exceeding the soil CULs or to a property boundary or building location. Completed excavation extents were then confirmed by survey.

A total of eight excavations were completed in 2014 to depths ranging from 4.75 feet below ground surface (bgs) to 11 feet bgs, with approximately 6,605 cubic yards of contaminated soil transported under manifest for off-site disposal to the Waste Management Columbia Ridge Landfill in Arlington, Oregon. Full details regarding the shallow soil excavation activities can be found in the *Shallow Soil Excavation As-Built Completion Report,* dated April 23, 2015 (Stantec, 2015).

#### 3.1.2    Ongoing Cleanup Actions

#### 3.1.2.1    In-Situ Bioremediation of Groundwater

Planning for the implementation of in-situ bioremediation of the Site groundwater has been underway since 2015. The final version of the GW EDR was submitted to Ecology on November 15, 2016 (Stantec, 2016). Ecology approved the revised GW EDR on February 22, 2017. The final versions of the *Groundwater Remedy Construction Plans and Specifications* (GW CPS) and GW CMP were submitted to Ecology on May 1, 2019 (Stantec, 2019b and 2019a, respectively). Ecology approved the revised GW CPS and GW CMP on August 21, 2019.

A two-phased approach to the installation and implementation of the enhanced in-situ bioremediation (EISB) system was established in the GW CPS (Stantec, 2019b), with data obtained during Phase I used to refine the Phase II implementation. Between October and December 2019, ten Phase I EISB injection wells, three observation wells, and one monitoring well (MW-21) were installed and developed, and soil sampling and testing were implemented to provide additional analytical, geotechnical, and hydrogeological data.

In the Phase I EISB, a total of approximately 79,100 gallons of injection solution (consisting of water mixed with approximately 18,100 pounds of sodium acetate and approximately 3,500 grams of sodium triphosphate) were injected to the ten Phase I injection wells over the course of three stages between June and August 2020. Four quarterly post-injection groundwater monitoring events were conducted in September 2020, November 2020, February 2021, and May 2021 to monitor the response to the Phase I

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groundwater remedy implementation and gather additional data specific to EISB injection operating parameters during implementation across a greater portion of the Site groundwater plume.

The *Groundwater Remedy Phase I As-Built and Documentation Report* (GW Remedy Phase I Report) was first submitted to Ecology for review on July 30, 2021. Ecology comments on the GW Remedy Phase I Report were received on December 27, 2021. The revised GW Remedy Phase I Report and a response to comments were submitted to Ecology on February 18, 2022 (Stantec, 2022), and summarized Phase I injection well installation, Phase I data collection, the implementation of the Phase I EISB injection, and the subsequent quarterly EISB performance monitoring events. The GW Remedy Phase I Report also recommended design changes to be implemented for Phase II.

These design specifications were incorporated into the Phase II EISB, which was completed with the objective to augment Phase I treatment through the installation of additional EISB injection wells within the Site groundwater plume to create continuous groundwater treatment zones consistent with the overall groundwater cleanup objectives of the 2013 CAP. In February and March 2022, forty Phase II EISB injection wells and three groundwater monitoring wells (MW-22, MW-23, and MW-24) were installed and developed.

The Phase II EISB injection was conducted in three stages:

- During the first stage, from July 27 to August 18, 2022, a total of approximately 60,026 gallons of injection solution with 12,000 pounds of sodium acetate and 54 pounds of sodium triphosphate was injected to ten wells (IW-2-2, IW-2-5 through IW-2-7, IW-3-2, and IW-3-16 through IW-3-20);

- During the second stage, from September 15 to 29, 2022, a total of approximately 54,541 gallons of injection solution with 10,800 pounds of sodium acetate and 48.6 pounds of sodium triphosphate was injected through System A to nine wells (IW-4-1 through IW-4-3 and IW-4-5 through IW-4-10) and a total of approximately 48,011 gallons of injection solution with 9,600 pounds of sodium acetate and 43.2 pounds of sodium triphosphate was injected through System B to eight wells (IW-4-4 and IW-4-11 through IW-4-17); and

- During the third stage, from October 13 to 27, 2022, a total of approximately 60,157 gallons of injection solution with 11,950 pounds of sodium acetate and 54 pounds of sodium triphosphate was injected through System A to ten wells (IW-2-3, IW-2-4, IW-3-1, and IW-3-9 through IW-3-15) and a total of approximately 59,780 gallons of injection solution with 12,000 pounds of sodium acetate and 54 pounds of sodium triphosphate was injected through System B to ten wells (IW-1-1 through IW-1-4 and IW-3-3 through IW-3-8).

Following Phase II injection, quarterly EISB groundwater remedy performance monitoring events were conducted in December 2022, March 2023, May 2023, August 2023, and December 2023 to monitor the response to the Phase II groundwater remedy implementation.

The *Groundwater Remedy Phase II As-Built and Documentation Report* (GW Remedy Phase II Report) was submitted to Ecology for review on November 22, 2024 (Stantec, 2024), and summarized Phase II

injection well installation, the implementation of the Phase II EISB injection, the subsequent quarterly EISB performance monitoring events, and a modeling update.

Following the Phase II injection, EISB conditions were indicated in at least one quarterly event at five of the six expected monitoring wells in the immediate treatment zones. The lack of EISB conditions following the Phase II injection event at MW-4R may indicate that the injection failed to achieve the target injection radius of 10 feet at this location.

Significant decreases in nitrate were observed in MW-5R, MW-21, MW-22, and MW-23 during Phase II EISB performance monitoring, with nitrate concentration reductions between approximately 69% to over 99% at these locations. Nitrate concentrations remained relatively stable at MW-4R and MW-12R after the Phase II injection and may be a result of the monitoring well location relative to the injection wells. Overall, the nitrate plume area decreased by approximately 32%.

Dinoseb concentrations generally show a similar response as nitrate at each of the immediate treatment zone locations. Phase II EISB performance monitoring showed decreases in dinoseb concentrations ranging from approximately 26% to over 99%. Overall, the dinoseb plume area decreased by approximately 28%.

The EISB groundwater remedy was not designed to directly remediate the 1,2-DCP plume at the Site. Increases in 1,2-DCP concentrations were indicated near the source area and decreases in the downgradient portion of the plume. It is noted that the wells indicating increasing 1,2-DCP concentrations are located within the combined nitrate/ammonia plume while those with decreasing concentrations are located outside of the ammonia plume but still in the nitrate plume. Overall, the 1,2-DCP plume area decreased by approximately 12.3%.

Expected short-term increases in metals concentrations were observed in the immediate treatment zones, correlated to EISB conditions and inversely related to nitrate and dinoseb concentrations. As a result, significant increases in metal concentrations were observed during the Phase II EISB performance monitoring at MW-5R, MW-21, MW-22, and MW-23. However, arsenic concentrations have decreased at many monitoring well locations despite EISB conditions associated with the groundwater remedy. The Phase II EISB performance monitoring data support that metal concentrations generally decrease to or below pre-treatment concentrations with the transition out of EISB conditions.

Ammonia is commingled with nitrate at the up-gradient portion of the groundwater plume with ammonia concentrations exceeding 100 mg/L at MW-3, MW-4R, MW-9, and MW-12R. Site data support that ammonia may be acting as an ongoing source of nitrate. At MW-4R and MW-12R, Phase II EISB performance monitoring nitrate reductions averaged approximately 29%, while when ammonia concentrations were less than 100 mg/L (at MW-5R, MW-21, MW-22, and MW-23), nitrate reductions averaged approximately 90%.

The relationship between nitrate, nitrite, biochemical oxygen demand (BOD), and phosphorus in the Phase II EISB performance monitoring indicates that phosphorus may be limiting the denitrification of nitrate in some portions of the treatment zones. Instances where both nitrate and BOD were elevated but phosphorus concentrations were low may indicate that phosphorus is a limiting nutrient to denitrification

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and frequently corresponded to spikes in nitrite concentrations which can indicate the incomplete denitrification of nitrate.

Neither EISB conditions nor significant decreases in nitrate concentrations have been observed in locations downgradient of the IW Lines at monitoring wells MW-3, MW-9, MW-16, and MW-24. However, significant reductions in dinoseb concentrations have been indicated at downgradient monitoring wells MW-3, MW-9, and MW-16 with an average decrease of 72%. Treatment responses of dinoseb may be indicated downgradient from the IW Lines before nitrate responses because, unlike nitrate with ammonia, there are no known reactions that would reconstitute it.

The Site-wide groundwater model was updated and recalibrated with data through the Phase II EISB performance monitoring.

- The nitrate reactive transport model was updated to incorporate details of the Phase II injection and nitrate concentrations were added as transient concentration targets to the model. Compared to the 2021 model results, the revised simulation shows more rapid expansion of the extent of the acetate treatment zone resulting in reduced nitrate plume sizes. These changes are attributed to the updated simulation of the remedy to include the Phase I injections as well as the Phase II injections. The changes are also attributed to the time between the start of the Phase I injections and the end of the Phase II injections which allow for more dispersion and advective transport to have occurred by the end of the injection period.

- For 1,2-DCP, updated values for 1,2-DCP were interpolated to a grid which was used as the initial concentrations in an updated forward simulation of 1,2-DCP. Compared to the 2021 modeling results, for the simulation using a 3.5-year half-life, the plume is still simulated to be depleted within 30 years although the plume extends further south at 5 and 15 years. Similarly, for the simulation using a 14.1-year half-life, the plume is predicted to extend further to the southeast compared to the 2021 modeling results.

- For dinoseb, review of groundwater sampling results indicates that the acetate is treating the dinoseb plume. Additional time for the acetate treatment zone to expand and for ongoing sampling to occur will facilitate further evaluation of the dinoseb transport model.

Although it is early in the modeled post-injection period, at select wells there appeared to be earlier rebound in nitrate concentrations in the Phase II EISB performance monitoring versus simulated nitrate concentrations; this may be attributable to ammonia nitrification which could not be factored into the model.

Based on the Phase II EISB groundwater remedy performance monitoring data and conclusions made in the GW Remedy Phase II Report (Stantec, 2024), it is recommended that the project remain in post-EISB groundwater remedy performance monitoring through at least 2026.

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### 3.1.2.2   Natural Attenuation of Groundwater

Groundwater monitoring has been conducted either quarterly or semi-annually since the issuance of the Consent Decree, and since 2020 has generally been semi-annual other than the periods of quarterly EISB performance monitoring that followed the Phase I and Phase II groundwater remedy injection events. The Site is currently following the semi-annual post-EISB groundwater remedy performance monitoring program. Groundwater monitoring data through September 2024 have been analyzed to provide an update to the IHS plume distributions and trends at the Site as part of this periodic review.

<u>**Groundwater Concentration and Trend Analysis**</u>

The IHS groundwater concentrations from the period of 2022 through 2024 (from up to nine sampling events) were analyzed and, when sufficient data were available, the 3-year 95 percent (%) upper confidence limit (UCL95) concentration was calculated using ProUCL version 5.2 (United States Environmental Protection Agency [EPA], 2022) to help define the areas exceeding the CULs for the selected time period per the GW CMP (Stantec, 2019a). These UCL95 concentrations are presented in **Table 2**. The ProUCL software outputs are provided for each applicable monitoring well in **Appendix A**. Since the purpose of this trend analysis is to evaluate natural attenuation, results for select analytes (nitrate, nitrite, arsenic, iron, manganese, dinoseb, etc.) that are affected by the EISB groundwater remedy were excluded from the sample set for the sampling events when EISB conditions were assessed to be present in the well. In some cases, the calculated UCL95 concentration exceeds the maximum concentration for the analyte due to small sample set size; this is noted in **Table 2**. In cases where there were insufficient data to calculate the 3-year UCL95 concentration due to data distribution or the small data set sample size, the maximum concentration is shown in **Table 2**.

In addition, for applicable IHSs and monitoring well locations, a trend analysis was performed using the Ecology Package A, Natural Attenuation Analysis Tool Package (Ecology, 2005). The trend analysis was only performed for IHSs that were detected and had exceeded their CUL at least once in the last five years and was completed using the maximum amount (16) of monitoring events, if available. The trend analysis outputs are provided for each applicable monitoring well in **Appendix B**.

**Table 2** summarizes the status (UCL95 concentration and trend) of analyzed IHSs at each of the monitoring wells for the period of 2022 through 2024. The status of the groundwater concentrations for each IHS is further summarized below.

**Nitrate and Nitrite**

The nitrate 3-year UCL95 concentration (or maximum concentration if a UCL95 could not be calculated) exceeds the CUL of 10 mg/L at 13 of the 23 monitoring well locations (MW-1, MW-3, MW-4R, MW-8, MW-9, MW-12R, MW-13, MW-15, MW-16, MW-21, MW-22, MW-23, and MW-24). The nitrate 3-year UCL95 concentrations and estimated plume extents are shown on **Figure 3**. Note that UCL95 concentrations were calculated at each monitoring well for nitrate, even when the nitrate concentrations didn't exceed the CUL; these nitrate UCL95 concentrations are shown in **Table 2** and on **Figure 3**. The calculated concentration trends for each monitoring well with a UCL95 concentration above the CUL indicate stable trends at seven wells (MW-3, MW-9, MW-12R, MW-15, MW-16, MW-23, and MW-24),

decreasing trends at five wells (MW-4R, MW-8, MW-13, MW-21, and MW-22), and an increasing trend at one well (MW-1). Additional monitoring well locations (MW-5R, MW-6, and MW-11) were defined as within the nitrate plume in the previous Five-Year Periodic Review (Stantec, 2019c); these locations currently have 3-year nitrate UCL95 concentrations below the CUL. MW-5R is under EISB conditions and MW-6 and MW-11 indicate decreasing trends.

Collectively, it is difficult to draw a single conclusion from the collective trend analysis throughout the nitrate plume, though overall stable to decreasing nitrate trends are observed. Generally, the wells in the western and northern portions of the nitrate plume (MW-4R, MW-8, MW-13, MW-21, and MW-22) show a decreasing trend, while wells within the central and eastern portions (MW-3, MW-9, MW-12R, MW-15, MW-16, MW-23, and MW-24) show a stable trend. This supports that the nitrate plume is generally stable with some decreasing concentrations and that significant nitrate plume migration is not occurring. Cross-gradient well MW-1 in the northern portion of the Site and outside of the primary nitrate plume area indicates an increasing nitrate concentration trend; however, the UCL95 concentration exceedance of the CUL is due to a nitrate concentration slightly above the CUL observed during first half 2023. The source of that concentration increase is not clear.

The nitrite UCL95 concentration exceeds the CUL of 1 mg/L at three (MW-16, MW-21, and MW-22) of the 23 monitoring well locations; these three wells are within the current nitrate plume. The nitrite concentration trend is decreasing at MW-16 and undetermined at MW-21 and MW-22. As discussed in the GW Remedy Phase II Report, the presence of nitrite may be a result of the incomplete denitrification of nitrate or the incomplete nitrification of ammonia depending on the oxidation-reduction conditions present.

**Dinoseb**

The dinoseb 3-year UCL95 concentration (or maximum concentration if a UCL95 could not be calculated) exceeds the CUL of 0.007 mg/L at six (MW-3, MW-4R, MW-9, MW-12R, MW-16, and MW-23) of the 13 monitoring well locations where dinoseb was analyzed. The dinoseb 3-year UCL95 concentrations and estimated plume extents are shown on **Figure 4**. Monitoring wells defined as within the dinoseb plume in the previous Five-Year Periodic Review (Stantec, 2019c) remain within the plume extents. The calculated dinoseb concentration trends for each monitoring well with a UCL95 concentration above the CUL indicate an increasing trend at one well (MW-16), a stable trend at one well (MW-23), and decreasing trends at four wells (MW-3, MW-4R, MW-9, and MW-12R). The decreasing trends are primarily observed in the source area wells. The Site data indicate the dinoseb plume is generally shrinking.

**2,4-D**

2,4-D has not been detected above the CUL of 0.07 mg/L during the 2022 through 2024 monitoring events in any sample collected from the 13 monitoring wells where it was analyzed.

**1,2-Dichloropropane**

The 1,2-dichloropropane (1,2-DCP) 3-year UCL95 concentration (or maximum concentration if a UCL95 could not be calculated) exceeds the CUL of 0.005 mg/L at seven (MW-4R, MW-9, MW-12R, MW-16, MW-19, MW-23, and MW-24) of the 13 monitoring well locations where 1,2-DCP was analyzed. The

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1,2-DCP 3-year UCL95 concentrations and estimated plume extents are shown on **Figure 5**. Five of the seven locations (MW-4R, MW-12R, MW-19, MW-23, and MW-24) show stable concentration trends while MW-9 indicates an increasing concentration trend and MW-16 indicates a decreasing concentration trend. Overall, the 1,2-DCP plume is considered stable.

**Benzene and Chlorobenzene**

The 3-year UCL95 concentrations for both benzene and chlorobenzene exceed the CULs of 0.005 mg/L and 0.1 mg/L, respectively, at one (MW-12R) of the 13 monitoring well locations where they were analyzed. Both the benzene and chlorobenzene concentrations at MW-12R indicate stable trends.

**2-Methylnaphthalene**

2-Methylnaphthalene has not been detected above the CUL of 0.032 mg/L during the 2022 through 2024 monitoring events in any sample collected from the 13 monitoring wells where it was analyzed.

**TPH-Gx**

TPH-Gx has not been analyzed at the Site since 2008.

**Arsenic, Iron, and Manganese**

Total arsenic, iron, and manganese were analyzed in samples collected during the last nine monitoring events in only nine selected wells of the 23 Site monitoring wells as part of the EISB and post-EISB performance monitoring. These metals were analyzed in samples collected semi-annually in all 23 Site monitoring wells between 2022 and 2024 as part of the post-EISB groundwater monitoring. Therefore, the number of analytical results per well for total arsenic, iron, and manganese varies from four to nine.

The total arsenic 3-year UCL95 concentration (or maximum concentrations if a UCL95 could not be calculated) exceeds the CUL of 0.01 mg/L at 18 monitoring well locations (MW-1, MW-4R, MW-6, MW-7, MW-8, MW-10, MW-11, MW-12R, MW-13, MW-14, MW-15, MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, and MW-23). The arsenic 3-year UCL95 concentrations and estimated plume extents are shown on **Figure 6**. The Site-wide arsenic concentrations from September 2024 were input to ProUCL to calculate a Site-wide UCL95 of 0.0347 mg/L (output included in **Appendix A**), which was below the Site-wide arsenic remediation level (RL) of 0.04 mg/L for the Site as defined in the GW EDR (Stantec, 2016).

Arsenic concentrations do not follow a similar distribution to the other Site IHSs. Total arsenic UCL95 concentrations exceeding the CUL were present: 1) in up-gradient, source area, and down-gradient wells in the west, central, and east/southeast portions of the Site (MW-4R, MW-6, MW-8, MW-10, MW-11, MW-12R, MW-14, MW-15, MW-17, and MW-23); 2) in two wells in the northern portion of the Site (MW-1 and MW-7); and 3) in five wells at the southeast extent of the Site (MW-13, MW-16, MW-18, MW-19, and MW-20). Total arsenic concentrations in down-gradient and cross-gradient wells MW-3, MW-9, MW-21, MW-22, and MW-24 were below the CUL, defining the separation of the Site arsenic plume boundaries. Arsenic concentration trends are largely stable (at eight wells: MW-4R, MW-6, MW-7, MW-8, MW-13, MW-15, MW-20, and MW-21) or decreasing (at seven wells: MW-10, MW-11, MW-12R, MW-14, MW-16, MW-18, and MW-19), with increasing trends indicated at three wells (MW-1, MW-17, and MW-23).

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Total iron has not been detected above the CUL of 11 mg/L during the 2022 through 2024 monitoring events in any sample collected from the 15 monitoring wells where it was analyzed.

The total manganese 3-year UCL95 concentration exceeds the CUL of 0.75 mg/L at eight monitoring well locations (MW-3, MW-11, MW-12R, MW-16, MW-19, MW-21, MW-22, and MW-23). Total manganese concentration trends are stable (MW-3, MW-12R, MW-16, MW-19, MW-21, and MW-22) or undetermined (MW-11 and MW-23).

### 3.1.2.3   Institutional Controls

The Consent Decree and CAP require a good faith effort to implement ICs in the form of restrictive covenants with the owners of the affected Site parcels. The purpose of a restrictive covenant is to prohibit activities that may interfere with a cleanup action or other measures necessary to assure the integrity of the cleanup action and to protect human health and the environment.

As detailed in the GW CPS, Stantec is working with CEMC and RMSC to draft restrictive covenants for review using the Ecology Environmental Covenant for MTCA Sites template and to identify parties that would need to sign the restrictive covenant for each applicable Site parcel.

## 3.2   NEW SCIENTIFIC INFORMATION FOR INDIVIDUAL HAZARDOUS SUBSTANCES OR MIXTURES PRESENT AT THE SITE

Chemical-specific changes to the Ecology Cleanup Levels and Risk Calculation (CLARC) tool were reviewed for the 12 Site IHSs (Ecology, 2024) and are summarized in this section.

The manganese Modified MTCA Method B CUL was adjusted from 2.24 mg/L in the Ecology 2015 CLARC table to 0.75 mg/L in the 2019 CLARC table. The manganese CUL has been updated in **Table 1**.

In July 2022, Ecology added chemical-specific values from the Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles for benzene.

In July 2024, Ecology filled in effects information for 52 chemicals that had both oral and inhalation noncancer toxicity criteria, including arsenic, chlorobenzene, and 1,2-DCP. For these chemicals, the IRIS toxicity source already had noncancer effects information, and Ecology added the information for the non-IRIS source.

Though not one of the IHSs, a CUL is included in **Table 1** for 2,4-DB. It should be noted that in July 2022 Ecology removed 2,4-DB from CLARC based on updates from EPA's Office of Pesticide Programs. There is no longer toxicity data for this pesticide.

## 3.3   NEW APPLICABLE STATE AND FEDERAL LAWS FOR HAZARDOUS SUBSTANCES PRESENT AT THE SITE

The groundwater cleanup at the Site is governed by MTCA and all other applicable, relevant and appropriate requirements (ARAR) as detailed in the GW EDR. No changes to MTCA or other ARARs

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identified in the GW EDR were identified which would substantively affect the implementation of the remediation of the Site.

## 3.4    CURRENT AND PROJECTED SITE USE

The Site is located in an industrial and food manufacturing area and the parcels comprising the Site contain food processing facilities or open staging areas for food transportation vehicles and containers. In addition, the Site includes a railroad ROW and several city street ROWs. The use of Site parcels has remained relatively unchanged and there are no known changes planned for the parcels comprising the Site; however, all Site parcels are third-party owned.

## 3.5    AVAILABILITY AND PRACTICABILITY OF HIGHER PREFERENCE TECHNOLOGIES

The remedy that has been or is currently being implemented at the Site includes removal of contaminated soil overlying groundwater, in-situ bioremediation of the Site groundwater plume via injection wells, natural attenuation of the groundwater and soil contamination, and ICs to protect against the use of groundwater by the public.

The groundwater remedy for the Site, utilizing EISB via injection wells, was selected because of access limitations resulting from the current land use of the Site parcels. The groundwater remedy was implemented in a two-phase approach to confirm the design parameters of the selected remedy in Phase I prior to the full-scale implementation in Phase II. Based on the Phase II EISB groundwater remedy performance monitoring data and conclusions in the GW Remedy Phase II Report (Stantec, 2024), it is recommended the project remain in post-EISB groundwater remedy performance monitoring through at least 2026. The semi-annual groundwater monitoring data collected during the post-EISB performance monitoring period will improve understanding of the following:

- Residual treatment capacity of the Phase II injection;

- Ammonia-nitrate interaction at the Site;

- Acetate consumption within the Site aquifer; and

- Phosphorus consumption and migration within the Site aquifer.

The post-EISB groundwater remedy performance monitoring data collected through 2026 will be used to develop a plan for any additional active groundwater remedy actions or recommendations for continued post-EISB monitoring. Any additional active groundwater remedy actions would most likely utilize the existing injection wells unless land use changes allow additional access.

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### 3.6 AVAILABILITY OF IMPROVED ANALYTICAL TECHNIQUES TO EVALUATE COMPLIANCE WITH CLEANUP LEVELS

In March 2024, the analytical method used for ammonia testing was changed from SM4500NH3-D to EPA Method 350.1. From an analytical standpoint, SM4500NH3-D is an older methodology and not very efficient. EPA Method 350.1 provides a lower detection limit.

## 4.0    Conclusions

The following conclusions have been made as a result of this periodic review:

- The groundwater remedy has been implemented per the plans and specifications as approved by Ecology on August 21, 2019.

  o  In the Phase I EISB, a total of approximately 79,100 gallons of injection solution (consisting of water mixed with approximately 18,100 pounds of sodium acetate and approximately 3,500 grams of sodium triphosphate) were injected to the ten Phase I injection wells over the course of three stages between June and August 2020.

  o  Four quarterly post-injection groundwater monitoring events were conducted in September 2020, November 2020, February 2021, and May 2021 to monitor the response to the Phase I groundwater remedy implementation.

  o  The Phase II EISB injection was conducted in three stages between July and October 2022. A total of approximately 282,515 gallons of injection solution with 56,350 pounds of sodium acetate and 253.8 pounds of sodium triphosphate was injected to the 47 injection wells.

  o  Five quarterly post-injection groundwater remedy performance monitoring events were conducted in December 2022, March 2023, May 2023, August 2023, and December 2023 to monitor the response to the Phase II groundwater remedy implementation.

  o  Conclusions regarding the Phase II EISB groundwater remedy performance are provided in the GW Remedy Phase II Report (Stantec, 2024). Based on the conclusions, it is recommended that the project remain in post-EISB groundwater remedy performance monitoring through at least 2026.

- The groundwater monitoring program has continued to monitor the distribution and natural attenuation of IHSs in the groundwater.

  o  Nitrate concentrations remain above the CUL in the 13 monitoring wells in the source and downgradient areas with decreasing or stable trends observed in all source area and downgradient plume monitoring wells; however, cross-gradient well MW-1 indicates an increasing trend. Wells MW-5R, MW-6, and MW-11, previously defined as within the nitrate plume in the previous Five-Year Periodic Review (Stantec, 2019c), currently have 3-year nitrate UCL95 concentrations below the CUL and are either under EISB conditions or indicate decreasing trends. Generally, the wells in the western and northern portions of the nitrate plume show a decreasing trend, while wells within the central and eastern portions show a stable trend. This supports that significant nitrate plume migration is not occurring.

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- o Nitrite concentrations exceed the CUL at three wells (MW-16, MW-21, and MW-22). The nitrite concentration trend is decreasing at MW-16 and undetermined at MW-21 and MW-22.

- o Dinoseb concentrations remain above the CUL in the source and downgradient areas with decreasing trends in wells MW-3, MW-4R, MW-9, and MW-12R, an increasing trend in MW-16, and a stable trend at MW-23. The decreasing trends are primarily observed in the source area wells. The Site data indicate the dinoseb plume is generally shrinking.

- o 1,2-DCP concentrations remain above the CUL in the source and downgradient areas, with stable trends in five wells (MW-4R, MW-12R, MW-19, MW-23, and MW-24). MW-9 indicates an increasing concentration trend and MW-16 indicates a decreasing concentration trend. Overall, the 1,2-DCP plume is considered stable.

- o Benzene and chlorobenzene are only above the CUL in source area well MW-12R, and both indicate stable trends.

- o Arsenic concentrations remain above the CUL in the source, downgradient, and up-gradient areas with stable or decreasing trends in 15 of the 18 monitoring wells exceeding the CUL. The Site-wide arsenic UCL95 concentration for September 2024 was 0.0347 mg/L, which is below the arsenic Site-wide RL of 0.04 mg/L.

- o Manganese concentrations exceed the CUL at eight wells (MW-3, MW-11, MW-12R, MW-16, MW-19, MW-21, MW-22, and MW-23). Manganese concentration trends are stable or undetermined.

- All Site parcels are within the City limits and are on municipal water supply from the City. No new structures have been constructed on Site parcels since the implementation of the Site Consent Decree and CAP. ICs in the form of restrictive covenants are being pursued for Site parcels to further protect human health and the environment.

- A release of a material continues to occur at the Former Fertilizer Building of the BJS property. This was previously documented in letters submitted to Ecology in November 2014 and November 2019. Similar photos to document the condition were taken in August 2022 and can be provided to Ecology upon request. The BJS property owner is responsible for addressing this release.

Based on the general conclusions contained within the periodic review for this period, human health and the environment are being protected based on the factors established in WAC 173-340-420(4).

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# 5.0    References

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**TABLES**

**Table 1**
**Groundwater Cleanup Levels**
Bee-Jay Scales Site
Sunnyside, Washington

| Analyte | Groundwater Cleanup Level (mg/L) | Source |
|---|---|---|
| 1,2,3-Trichloropropane | 0.00001 | Modified MTCA Method B |
| 1,2,4-Trimethylbenzene | 0.4 | Modified MTCA Method B |
| **1,2-Dichloropropane** | 0.005 | Primary MCL |
| 1,3,5-Trimethylbenzene | 0.4 | Modified MTCA Method B |
| **2-Methylnaphthalene** | 0.032 | Modified MTCA Method B |
| 2,4,5-T | 0.16 | Modified MTCA Method B |
| 2,4,5-TP | 0.05 | Primary MCL |
| **2,4-D** | 0.07 | Primary MCL |
| 2,4-DB | 0.128 | Modified MTCA Method B |
| **Arsenic** | 0.01 | Primary MCL |
| **Benzene** | 0.005 | Primary MCL |
| **Chlorobenzene** | 0.1 | Primary MCL |
| Dicamba | 0.48 | Modified MTCA Method B |
| **Dinoseb** | 0.007 | Primary MCL |
| Ethylbenzene | 0.7 | Primary MCL |
| **Iron** | 11 | Modified MTCA Method B |
| **Manganese**[1] | 0.75 | Standard MTCA Method B |
| Naphthalene | 0.16 | Modified MTCA Method B |
| **Nitrate Nitrogen** | 10 | Primary MCL |
| **Nitrite Nitrogen** | 1 | Primary MCL |
| Pentachlorophenol | 0.001 | Primary MCL |
| Toluene | 1 | Primary MCL |
| **TPH-Gx** | 0.8 | Standard MTCA Method A |
| Xylenes | 10 | Primary MCL |

**Notes:**

2,4,5-T = 2,4,5-Trichlorophenoxyacetic acid

2,4,5-TP = 2(2,4,5-Trichlorophenoxy)propionic acid

2,4-D = 2,4-Dichlorophenoxyacetic acid

2,4-DB = 4-(2,4-Dichlorophenoxy)butyric acid

TPH-Gx = Total petroleum hydrocarbons in the gasoline range

mg/L = milligrams per liter
MCL = Maximum Contaminant Level
MTCA = Model Toxics Control Act
**Bold analytes** are indicator hazardous substances (IHSs).

[1] The manganese cleanup level was adjusted from 2.2 mg/L to 0.75 mg/L in 2019.

**Table 2**
**Summary of Indicator Hazardous Substance Concentrations and Trends in Site Groundwater (2022-2024)**
Bee-Jay Scales Site
Sunnyside, Washington

| Monitoring Well ID | Well Designation | Total # Sampling Events / # Sampling Events Under MNA Conditions | IHS | CUL (mg/L) | # Times Detected Conc. ≥ CUL / # Events IHS Was Analyzed | 3-Year UCL95[1] (mg/L) | 3-Year UCL95 / CUL Status[1] | Trend[1,2] |
|---|---|---|---|---|---|---|---|---|
| MW-1 | Up- or Cross-Gradient | 6 / 6 | Nitrate | 10 | 1 / 6 | 10.2 | Above | Increasing |
| | | | Nitrite | 1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Arsenic | 0.01 | 4 / 4 | 0.012[c] | Above | Increasing |
| MW-3 | In Plume | 8 / 8 | Nitrate | 10 | 8 / 8 | 368.2 | Above | Stable |
| | | | Nitrite | 1 | 0 / 8 | 0.48 | Below | Decreasing |
| | | | Arsenic | 0.01 | 0 / 8 | 0.0086 | Below | Decreasing |
| | | | Iron | 11 | 0 / 8 | 0.39 | Below | NA[e] |
| | | | Manganese | 0.75 | 8 / 8 | 2.32 | Above | Stable |
| | | | 2,4-D | 0.07 | 0 / 8 | 0.00038 | Below | NA[e] |
| | | | Dinoseb | 0.007 | 5 / 8 | 0.023 | Above | Decreasing |
| | | | Benzene | 0.005 | 0 / 8 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 8 | 0.012 | Below | NA[e] |
| | | | 1,2-DCP | 0.005 | 0 / 8 | 0.0014 | Below | NA[e] |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 8 | NA[b] | NA[b] | NA[b] |
| MW-4R | POC | 9 / 9 | Nitrate | 10 | 9 / 9 | 212.9 | Above | Decreasing |
| | | | Nitrite | 1 | 0 / 9 | 0.087 | Below | NA[e] |
| | | | Arsenic | 0.01 | 8 / 9 | 0.013 | Above | Stable |
| | | | Iron | 11 | 0 / 9 | 0.13 | Below | NA[e] |
| | | | Manganese | 0.75 | 0 / 9 | 0.48 | Below | NA[e] |
| | | | 2,4-D | 0.07 | 0 / 9 | 0.00028 | Below | NA[e] |
| | | | Dinoseb | 0.007 | 9 / 9 | 0.033 | Above | Decreasing |
| | | | Benzene | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 9 | 0.00054 | Below | NA[e] |
| | | | 1,2-DCP | 0.005 | 8 / 9 | 0.0066 | Above | Stable |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| MW-5R | POC | 9 / 0 | Nitrate | 10 | 0 / 9 | NA[a,b] | NA[a,b] | NA[a,b] |
| | | | Nitrite | 1 | 1 / 9 | NA[a,b] | NA[a,b] | NA[a,b] |
| | | | Arsenic | 0.01 | 8 / 9 | NA[a,b] | NA[a,b] | NA[a,b] |
| | | | Iron | 11 | 0 / 9 | NA[a,b] | NA[a,b] | NA[a,b] |
| | | | Manganese | 0.75 | 2 / 9 | NA[a,b] | NA[a,b] | NA[a,b] |
| | | | 2,4-D | 0.07 | 0 / 9 | NA[a,b] | NA[a,b] | NA[a,b] |
| | | | Dinoseb | 0.007 | 0 / 9 | NA[a,b] | NA[a,b] | NA[a,b] |
| | | | Benzene | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| MW-6 | POC | 4 / 4 | Nitrate | 10 | 0 / 4 | 6.9[c] | Below | Decreasing |
| | | | Nitrite | 1 | 0 / 4 | NC (0.048 J)[d] | Below | NA[e] |
| | | | Arsenic | 0.01 | 4 / 4 | NC (0.026)[d] | Above | Stable |
| | | | Iron | 11 | 0 / 3 | NC (0.10 J)[d] | Below | NA[e] |
| | | | Manganese | 0.75 | 0 / 3 | 0.39[c] | Below | NA[e] |
| MW-7 | Up- or Cross-Gradient | 6 / 6 | Nitrate | 10 | 0 / 6 | 5.8 | Below | Stable |
| | | | Nitrite | 1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Arsenic | 0.01 | 4 / 4 | 0.014 | Above | Stable |
| MW-8 | In Plume | 6 / 6 | Nitrate | 10 | 6 / 6 | 48.5 | Above | Decreasing |
| | | | Nitrite | 1 | 0 / 6 | NC (0.082)[d] | Below | NA[e] |
| | | | Arsenic | 0.01 | 4 / 4 | 0.012 | Above | Stable |
| | | | Iron | 11 | 0 / 4 | NC (0.090)[d] | Below | NA[e] |
| | | | Manganese | 0.75 | 0 / 4 | 0.68[c] | Below | NA[e] |

| Monitoring Well ID | Well Designation | Total # Sampling Events / # Sampling Events Under MNA Conditions | IHS | CUL (mg/L) | # Times Detected Conc. ≥ CUL / # Events IHS Was Analyzed | 3-Year UCL95[1] (mg/L) | 3-Year UCL95 / CUL Status[1] | Trend[1,2] |
|---|---|---|---|---|---|---|---|---|
| MW-9 | In Plume | 6 / 6 | Nitrate | 10 | 6 / 6 | 328.9 | Above | Stable |
| | | | Nitrite | 1 | 0 / 6 | NC (0.081)[d] | Below | NA[e] |
| | | | Arsenic | 0.01 | 0 / 6 | 0.0082 | Below | NA[e] |
| | | | Iron | 11 | 0 / 4 | NC (0.19)[d] | Below | NA[e] |
| | | | Manganese | 0.75 | 0 / 4 | 0.073 | Below | NA[e] |
| | | | 2,4-D | 0.07 | 0 / 4 | NA[b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 3 / 6 | 0.1 | Above | Decreasing |
| | | | Benzene | 0.005 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 6 | 0.0009 | Below | NA[e] |
| | | | 1,2-DCP | 0.005 | 6 / 6 | 0.067 | Above | Increasing |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| MW-10 | Up-Gradient | 6 / 6 | Nitrate | 10 | 0 / 6 | 5.7 | Below | Stable |
| | | | Nitrite | 1 | 0 / 6 | 0.088 | Below | NA[e] |
| | | | Arsenic | 0.01 | 6 / 6 | 0.020 | Above | Decreasing |
| MW-11 | Up-Gradient | 6 / 6 | Nitrate | 10 | 0 / 6 | 5.7 | Below | Decreasing |
| | | | Nitrite | 1 | 0 / 6 | 0.056 | Below | NA[e] |
| | | | Arsenic | 0.01 | 6 / 6 | 0.035 | Above | Decreasing |
| | | | Iron | 11 | 0 / 4 | NC (0.028 J)[d] | Below | NA[e] |
| | | | Manganese | 0.75 | 2 / 4 | 2.8 | Above | Undetermined |
| MW-12R | POC | 9 / 8 | Nitrate | 10 | 9 / 9 | 377.8[a] | Above | Stable |
| | | | Nitrite | 1 | 0 / 9 | NC (0.13)[a,d] | Below | NA[e] |
| | | | Arsenic | 0.01 | 8 / 9 | 0.034[a] | Above | Decreasing |
| | | | Iron | 11 | 0 / 9 | 0.11[a] | Below | NA[e] |
| | | | Manganese | 0.75 | 9 / 9 | 1.4 | Above | Stable |
| | | | 2,4-D | 0.07 | 0 / 9 | 0.002 | Below | NA[e] |
| | | | Dinoseb | 0.007 | 8 / 9 | 1.18[a] | Above | Decreasing |
| | | | Benzene | 0.005 | 9 / 9 | 0.017 | Above | Stable |
| | | | Chlorobenzene | 0.1 | 9 / 9 | 0.25 | Above | Stable |
| | | | 1,2-DCP | 0.005 | 9 / 9 | 1.3 | Above | Stable |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NC (0.025)[d] | Below | NA[e] |
| MW-13 | POC | 9 / 9 | Nitrate | 10 | 9 / 9 | 23.1 | Above | Decreasing |
| | | | Nitrite | 1 | 0 / 9 | 0.054 | Below | NA[e] |
| | | | Arsenic | 0.01 | 9 / 9 | 0.014 | Above | Stable |
| | | | Iron | 11 | 0 / 9 | 0.079 | Below | NA[e] |
| | | | Manganese | 0.75 | 1 / 9 | 0.66 | Below | Stable |
| | | | 2,4-D | 0.07 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 0 / 9 | 0.0024 | Below | NA[e] |
| | | | Benzene | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| MW-14 | Boundary | 6 / 6 | Nitrate | 10 | 0 / 6 | 1.8 | Below | Decreasing |
| | | | Nitrite | 1 | 0 / 6 | 0.11 | Below | NA[e] |
| | | | Arsenic | 0.01 | 0 / 4 | 0.011[c] | Above | Decreasing |
| MW-15 | Boundary | 6 / 6 | Nitrate | 10 | 1 / 6 | NC (12)[d] | Above | Stable |
| | | | Nitrite | 1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Arsenic | 0.01 | 6 / 6 | NC (0.015)[d] | Above | Stable |
| | | | 2,4-D | 0.07 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Benzene | 0.005 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 6 | NA[b] | NA[b] | NA[b] |

| Monitoring Well ID | Well Designation | Total # Sampling Events / # Sampling Events Under MNA Conditions | IHS | CUL (mg/L) | # Times Detected Conc. ≥ CUL / # Events IHS Was Analyzed | 3-Year UCL95[1] (mg/L) | 3-Year UCL95 / CUL Status[1] | Trend[1,2] |
|---|---|---|---|---|---|---|---|---|
| MW-16 | POC | 6 / 6 | Nitrate | 10 | 6 / 6 | 109.5 | Above | Stable |
| | | | Nitrite | 1 | 2 / 6 | 1.34 | Above | Decreasing |
| | | | Arsenic | 0.01 | 1 / 4 | 0.018 | Above | Decreasing |
| | | | Iron | 11 | 0 / 4 | 1.41 | Below | NA[e] |
| | | | Manganese | 0.75 | 3 / 4 | 1.74[c] | Above | Stable |
| | | | 2,4-D | 0.07 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 4 / 6 | 0.032 | Above | Increasing |
| | | | Benzene | 0.005 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 6 / 6 | 0.15 | Above | Decreasing |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| MW-17 | Boundary | 6 / 6 | Nitrate | 10 | 0 / 6 | 4.3 | Below | Stable |
| | | | Nitrite | 1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Arsenic | 0.01 | 2 / 4 | 0.012 | Above | Increasing |
| MW-18 | Boundary | 6 / 6 | Nitrate | 10 | 0 / 6 | NC (8.8)[d] | Below | Stable |
| | | | Nitrite | 1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Arsenic | 0.01 | 6 / 6 | 0.018 | Above | Decreasing |
| MW-19 | POC | 6 / 6 | Nitrate | 10 | 1 / 6 | 9.3 | Below | Stable |
| | | | Nitrite | 1 | 0 / 6 | 0.19 | Below | NA[e] |
| | | | Arsenic | 0.01 | 5 / 6 | 0.027 | Above | Decreasing |
| | | | Iron | 11 | 0 / 4 | NC (3.7)[d] | Below | NA[e] |
| | | | Manganese | 0.75 | 1 / 4 | 0.84 | Above | Stable |
| | | | 2,4-D | 0.07 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 0 / 6 | NC (0.00043 J)[d] | Below | NA[e] |
| | | | Benzene | 0.005 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 5 / 6 | 0.030 | Above | Stable |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| MW-20 | Boundary | 6 / 6 | Nitrate | 10 | 0 / 6 | NC (7.0)[d] | Below | Stable |
| | | | Nitrite | 1 | 0 / 6 | NA[b] | NA[b] | NA[b] |
| | | | Arsenic | 0.01 | 6 / 6 | 0.020 | Above | Stable |
| MW-21 | POC | 9 / 8 | Nitrate | 10 | 8 / 9 | 84.4[a] | Above | Decreasing |
| | | | Nitrite | 1 | 5 / 9 | 2.6[a] | Above | Undetermined |
| | | | Arsenic | 0.01 | 2 / 9 | NC (0.032)[a,d] | Above | Stable |
| | | | Iron | 11 | 0 / 9 | 0.33[a] | Below | NA[e] |
| | | | Manganese | 0.75 | 9 / 9 | 2.42[a] | Above | Stable |
| | | | 2,4-D | 0.07 | 0 / 9 | NA[a,b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 0 / 9 | NA[a,b] | NA[b] | NA[b] |
| | | | Benzene | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 0 / 9 | 0.00069 | Below | NA[e] |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| MW-22 | In Plume | 9 / 7 | Nitrate | 10 | 4 / 9 | 48.0[a] | Above | Decreasing |
| | | | Nitrite | 1 | 4 / 9 | 4.4[a] | Above | Undetermined |
| | | | Arsenic | 0.01 | 3 / 9 | 0.0097[a] | Below | Undetermined |
| | | | Iron | 11 | 0 / 9 | 0.87[a] | Below | NA[e] |
| | | | Manganese | 0.75 | 7 / 9 | 4.26[a] | Above | Stable |
| | | | 2,4-D | 0.07 | 0 / 9 | NC (0.0047)[a,d] | Below | NA[e] |
| | | | Dinoseb | 0.007 | 0 / 9 | NC (0.00051 J)[a,d] | Below | NA[e] |
| | | | Benzene | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NC (0.0024 J)[d] | Below | NA[e] |

**Table 2**
**Summary of Indicator Hazardous Substance Concentrations and Trends in Site Groundwater (2022-2024)**
Bee-Jay Scales Site
Sunnyside, Washington

| Monitoring Well ID | Well Designation | Total # Sampling Events / # Sampling Events Under MNA Conditions | IHS | CUL (mg/L) | # Times Detected Conc. ≥ CUL / # Events IHS Was Analyzed | 3-Year UCL95[1] (mg/L) | 3-Year UCL95 / CUL Status[1] | Trend[1,2] |
|---|---|---|---|---|---|---|---|---|
| MW-23 | POC | 9 / 4 | Nitrate | 10 | 7 / 9 | 179.3[a,c] | Above | Stable |
| | | | Nitrite | 1 | 2 / 9 | 0.92[a,c] | Below | Undetermined |
| | | | Arsenic | 0.01 | 6 / 9 | 0.012[a] | Above | Increasing |
| | | | Iron | 11 | 0 / 9 | 0.26[a,c] | Below | NA[e] |
| | | | Manganese | 0.75 | 5 / 9 | 1.24[a,c] | Above | Undetermined |
| | | | 2,4-D | 0.07 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 4 / 9 | 0.017[a] | Above | Stable |
| | | | Benzene | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 9 / 9 | 0.17 | Above | Stable |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| MW-24 | POC | 9 / 9 | Nitrate | 10 | 8 / 9 | 39.6 | Above | Stable |
| | | | Nitrite | 1 | 0 / 9 | 0.037 | Below | NA[e] |
| | | | Arsenic | 0.01 | 0 / 9 | 0.0083 | Below | NA[e] |
| | | | Iron | 11 | 0 / 9 | 0.14 | Below | NA[e] |
| | | | Manganese | 0.75 | 0 / 9 | 0.013 | Below | NA[e] |
| | | | 2,4-D | 0.07 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Dinoseb | 0.007 | 0 / 9 | 0.0043 | Below | NA[e] |
| | | | Benzene | 0.005 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | Chlorobenzene | 0.1 | 0 / 9 | NA[b] | NA[b] | NA[b] |
| | | | 1,2-DCP | 0.005 | 9 / 9 | NC (0.29)[d] | Above | Stable |
| | | | 2-Methylnaphthalene | 0.032 | 0 / 9 | NA[b] | NA[b] | NA[b] |

**Notes:**

[1] Results for nitrate, nitrite, dinoseb, arsenic, iron, and manganese from sampling events under EISB conditions are excluded from UCL95 calculations and trend analysis. Significant figures for UCL95 calculations have been rounded in some cases.

[2] Mann-Kendall trend analysis applied to the last 16 sampling events, as applicable; expanding plume is considered increasing trend and shrinking plume is considered decreasing trend.

[a] Sample results were excluded from the data set when EISB conditions were present during one or more sampling events.

[b] Of the data set, there are insufficient data available (non-detect, excluded under EISB conditions, etc.) to calculate a 3-year UCL95 or analyze trends.

[c] Calculated 3-year UCL95 exceeds maximum concentration during the timeframe due to small data set sample size.

[d] 3-year UCL95 value could not be calculated due to data distribution or small sample size of the dataset; therefore, the maximum concentration over the 3-year period is shown.

[e] Trend analysis was only performed for IHSs that were detected <u>and</u> had exceeded their CUL at least once in the last five years, with the exception of nitrate. All nitrate trend analysis results are included.

MNA = monitored natural attenuation

IHS = indicator hazardous substance

CUL = Cleanup Level

mg/L = milligrams per liter

UCL95 = 95% Upper Confidence Limit

NA = Not applicable

NC = Not calculated

2,4-D = 2,4-Dichlorophenoxyacetic acid

1,2-DCP = 1,2-Dichloropropane

POC = Point of Compliance

**FIGURES**

23  W WOODIN RD        E WOODIN RD  24

FAIRVIEW AVE        BECKN[...]

N 1ST ST

WOODS RD

ROUSE RD

NORTH AVE

W YAKIMA VALLEY HWY

750  WAREHOUSE AVE

SITE

BLAINE AVE        SUNNYSIDE

DECATUR AVE

W EDISON RD

S 7TH ST

E EDISON AVE

NW CRESCENT AVE

750

S 5TH ST

PO
F

26

800

MAYHEW ST

CRESCENT AVE

25

S 8TH ST

S 9TH ST

H

S 11TH ST

[...]MBIA AVE

SUNNYSIDE AVE

E GRANT AVE

6TH ST

W GRANDVIEW AVE

E HARRISON AVE

S 4TH

10TH ST

Harrison Hill

[...]RRICK AVE

N

WASHINGTON

| 1 | 1/2 | 0 | | 1 |
SCALE IN MILES

1000  0  1000  2000  3000  4000  5000  6000  7000
SCALE IN FEET

REFERENCE:  USGS 7.5 MINUTE QUADRANGLE;
SUNNYSIDE, WASHINGTON; 2020

| Stantec | FOR:<br>BEE-JAY SCALES SITE<br>SUNNYSIDE, WASHINGTON | SITE LOCATION MAP | FIGURE:<br>1 |
|---|---|---|---|
| | JOB NUMBER:<br>182604043/182604044 | DRAWN BY:<br>JO | CHECKED BY:<br>EB | APPROVED BY:<br>MK | DATE:<br>1/8/25 |

WAREHOUSE AVENUE

#22503

AREA 5-
NORTH AREA

CARPORT

MW-7

MW-1

AREA 4 -
SUSPECTED
HISTORIC
WASHDOWN
AREA

#22496

BLDG.

#22014
(BEE-JAY SCALES
[BJS] PARCEL)

#22015
(WESTERN GENERAL
LAND [WGL] PARCEL)

#22016

AREA 6-
HICKENBOTTOM
PROPERTY

BLDG.

IW-2-2

IW-2-7

BUILDING

AREA 2 - DRY
FERTILIZER AREA

MW-22

AREA 1 - LIQUID
FERTILIZER PLANT AND
TRUCK WASH AREA

MW-8

IW-2-6

MW-3

IW-1-4

IW-2-5

IW-2-1

MW-10

IW-1-3

FORMER FERTILIZER BUILDING

IW-2-4

AREA 3 - DRUM
STORAGE AREA

IW-1-2

FORMER
LAGOON

IW-2-3

MW-11

IW-1-1

MW-3-19

MW-3-20

MW-5R

IW-3-1

MW-4R

MW-12R

MW-6

IW-3-2

IW-3-18

CENTER OF NORTH
RAIL FOR RAILROAD
SIDE TRACK

MW-15

BURLINGTON NORTHERN SANTA FE (BNSF)
RIGHT-OF-WAY

#22904

MW-9

MW-14

IW-4-1

MW-21

IW-4-3

IW-4-4

MW-23

IW-4-5

IW-4-6

IW-4-2

IW-4-9

IW-4-10

IW-4-11

IW-4-12

IW-4-13

IW-4-14

IW-4-15

IW-4-16

IW-4-17

MW-17

IW-4-7

IW-4-8

BUILDING

#22559

MW-24

MILNE FRUIT
PRODUCTS BUILDING

MW-16

APPROXIMATE
TRUCK SCALE
LOCATION

IW-5-1

MW-13

IW-5-2

BLAINE AVENUE

MW-18

N. 1ST STREET

S. 3RD STREET

#23447

#23443

BUILDING

#23441

#23416

#23417

#23902

BUILDING

BUILDING

#23901

#23440

#23903

#23418

#23439

#23419

MW-20

#23446

#23442

#23438

MW-19

#23420

#23437

#23421

#23436

#23422

#23423

BUILDING

N

0          80          160

APPROXIMATE SCALE IN FEET

**LEGEND**

| | |
|---|---|
| ———— | SITE BOUNDARY (APPROXIMATE) |
| —‧—‧— | PARCEL BOUNDARY (APPROXIMATE) |
| #22503 | PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN) |
| #22014 | SITE PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN) |
| ///// | BUILDING |
| —‧‧— | BUILDING OVERHANG |
| ×–×–× | CHAIN LINK FENCE |
| ++++++ | RAILROAD |
| ◑ | MONITORING WELL (INSTALLED PRIOR TO 2017) |
| ◕ | MONITORING WELL (INSTALLED 2019 OR LATER) |
| ◉ | PHASE I EISB INJECTION WELL |
| ○ | PHASE II EISB INJECTION WELL |
| ⊗ | PHASE I & PHASE II EISB INJECTION WELL |

**Stantec**

FOR:

BEE-JAY SCALES SITE
SUNNYSIDE, WASHINGTON

SITE PLAN

FIGURE:

2

JOB NUMBER:
182604043/182604044

DRAWN BY:
JO

CHECKED BY:
EB

APPROVED BY:
MK

DATE:
1/8/25

No warranty is made by Stantec, Inc. as to the accuracy, reliability, or completeness of these data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed electronically, and may be updated without notification. Any reproduction may result in a loss of scale and or information.

**Figure 3** — NITRATE ISOCONCENTRATION MAP - 3-YEAR UCL95 2022-2024

Map labels (as shown):

WAREHOUSE AVENUE

#22503
#22496
BLDG.
CARPORT

AREA 4 - SUSPECTED HISTORIC WASHDOWN AREA
AREA 5 - NORTH AREA
AREA 2 - DRY FERTILIZER AREA
AREA 3 - DRUM STORAGE AREA
AREA 1 - LIQUID FERTILIZER PLANT AND TRUCK WASH AREA
AREA 6 - HICKENBOTTOM PROPERTY

#22014 (BEE-JAY SCALES [BJS] PARCEL)
#22015 (WESTERN GENERAL LAND [WGL] PARCEL)
#22016

BUILDING

FORMER FERTILIZER BUILDING
FORMER LAGOON
BLDG.

MW-7 (5.8)
MW-1 (10.2)
MW-22 (48.0)***
MW-8 (48.5)
MW-3 (368.2)
MW-10 (5.7)
MW-11 (5.7)
MW-5R (NA)***
MW-6 (6.9)*
MW-4R (212.9)
MW-12R (377.8)***
MW-15 (12)**

CENTER OF NORTH RAIL FOR RAILROAD SIDE TRACK

BURLINGTON NORTHERN SANTA FE (BNSF) RIGHT-OF-WAY

#22904
MW-9 (328.9)
MW-21 (84.4)***
MW-23 (179.3)*/***
MW-17 (4.3)
MW-14 (1.8)

N. 1ST STREET

MILNE FRUIT PRODUCTS BUILDING
BUILDING
#22559
MW-24 (39.6)
MW-16 (109.5)

APPROXIMATE TRUCK SCALE LOCATION

MW-13 (23.1)
BLAINE AVENUE
MW-18 (8.8)**

#23447
#23443
#23902
BUILDING
BUILDING
#23442
#23441
#23416
#23417
#23901
#23440
#23418
#23419
#23439
#23438
MW-19 (9.3)
#23420
#23437
#23421
#23436
#23422
#23423

S. 3RD STREET
BUILDING
MW-20 (7.0)**

N

**LEGEND**

— SITE BOUNDARY (APPROXIMATE)
— PARCEL BOUNDARY (APPROXIMATE)
#22503 — PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN)
— BUILDING
— BUILDING OVERHANG
—x—x— CHAIN LINK FENCE
++++++ RAILROAD
◑ MONITORING WELL (INSTALLED PRIOR TO 2017)
◑ MONITORING WELL (INSTALLED 2019 OR LATER)
(10.2) NITRATE CONCENTRATION 3-YEAR 95% UPPER CONFIDENCE LIMIT (UCL95) 2022-2024
(NA) NOT ANALYZED OR NOT APPLICABLE
* CALCULATED UCL95 EXCEEDS MAXIMUM CONCENTRATION DUE TO SMALL SAMPLE SET SIZE
** INSUFFICIENT DETECTED VALUES TO CALCULATE UCL95; MAXIMUM DETECTED VALUE SHOWN
*** NITRATE RESULTS WERE EXCLUDED WHEN EISB CONDITIONS WERE PRESENT DURING ONE OR MORE EVENTS
— CONTOURS FOR SITE-SPECIFIC NITRATE PLUME 3-YEAR UCL95 2022-2024; DASHED WHERE INFERRED

**NOTE**
ALL CONCENTRATIONS IN MILLIGRAMS PER LITER (mg/L)
SITE-SPECIFIC CLEANUP LEVEL IS 10 mg/L
EISB = ENHANCED IN-SITU BIOREMEDIATION

0  80  160
APPROXIMATE SCALE IN FEET

**Stantec**

FOR: BEE-JAY SCALES SITE SUNNYSIDE, WASHINGTON

NITRATE ISOCONCENTRATION MAP - 3-YEAR UCL95 2022-2024

FIGURE: 3

JOB NUMBER: 182604043/182604044
DRAWN BY: JO
CHECKED BY: EB
APPROVED BY: MK
DATE: 1/23/25

WAREHOUSE AVENUE

#22503

#22496
BLDG.

CARPORT

AREA 5-
NORTH AREA

MW-7
(NA)*

MW-1
(NA)*

AREA 4 -
SUSPECTED
HISTORIC
WASHDOWN
AREA

#22014
(BEE-JAY SCALES
[BJS] PARCEL)

#22015
(WESTERN GENERAL
LAND [WGL] PARCEL)

AREA 6-
HICKENBOTTOM
PROPERTY

#22016

BUILDING

BLDG.

AREA 2 - DRY
FERTILIZER AREA

MW-22
(0.00051 J)**/***

AREA 1 - LIQUID
FERTILIZER PLANT AND
TRUCK WASH AREA

MW-8
(NA)*

0.007

MW-3
(0.023)

0.07

MW-10
(NA)*

FORMER FERTILIZER BUILDING

FORMER
LAGOON

0.7

MW-12R
(1.18)***

AREA 3 - DRUM
STORAGE AREA

MW-11
(NA)*

MW-5R
(NA)***

MW-4R
(0.033)

MW-6
(NA)*

CENTER OF NORTH
RAIL FOR RAILROAD
SIDE TRACK

MW-15
(ND<0.00032)

BURLINGTON NORTHERN SANTA FE (BNSF)
RIGHT-OF-WAY

#22904

MW-9
(0.1)

MW-14
(NA)*

MW-21
(ND<0.00033)***

MW-23
(0.017)***

MW-17
(NA)*

N. 1ST STREET

BUILDING

MILNE FRUIT
PRODUCTS BUILDING

#22559

MW-24
(0.0043)

MW-16
(0.032)

0.007

APPROXIMATE
TRUCK SCALE
LOCATION

MW-13
(0.0024)

BLAINE AVENUE

MW-18
(NA)*

#23447

#23443

#23902
BUILDING

BUILDING

#23441

BUILDING

#23901

#23416

#23417

S. 3RD STREET

BUILDING

#23440

#23418

BUILDING

#23442

#23439

#23419

MW-20
(NA)*

#23438

MW-19
(0.00043 J)**

#23420

#23437

#23421

#23436

#23422

#23423

N

LEGEND

— SITE BOUNDARY (APPROXIMATE)

— · — PARCEL BOUNDARY (APPROXIMATE)

#22503    PARCEL ID NUMBER (221025 PRECEDES
ALL PARCEL NUMBERS AND IS NOT SHOWN)

BUILDING

BUILDING OVERHANG

—x—x— CHAIN LINK FENCE

++++++ RAILROAD

MONITORING WELL (INSTALLED PRIOR TO 2017)

MONITORING WELL (INSTALLED 2019 OR LATER)

(0.023)    DINOSEB CONCENTRATION 3-YEAR 95% UPPER
CONFIDENCE LIMIT (UCL95) 2022-2024

(NA)    NOT ANALYZED OR NOT APPLICABLE

(ND<)    NO DETECTED VALUES TO CALCULATE UCL95;
MAXIMUM METHOD DETECTION LIMIT SHOWN

*    NOT ANALYZED

**    INSUFFICIENT DETECTED VALUES TO CALCULATE UCL95;
MAXIMUM DETECTED VALUE SHOWN

***    DINOSEB RESULTS WERE EXCLUDED WHEN EISB CONDITIONS
WERE PRESENT DURING ONE OR MORE EVENTS

CONTOURS FOR SITE-SPECIFIC DINOSEB PLUME
3-YEAR UCL95 2022-2024; DASHED WHERE INFERRED

NOTE
ALL CONCENTRATIONS IN
MILLIGRAMS PER LITER (mg/L)
J = ESTIMATED
SITE-SPECIFIC CLEANUP LEVEL IS 0.007 mg/L
EISB = ENHANCED IN-SITU BIOREMEDIATION

0    80    160
APPROXIMATE SCALE IN FEET

Stantec

FOR:
BEE-JAY SCALES SITE
SUNNYSIDE, WASHINGTON

DINOSEB ISOCONCENTRATION MAP -
3-YEAR UCL95
2022-2024

FIGURE:
4

JOB NUMBER:
182604043/182604044

DRAWN BY:
JO

CHECKED BY:
EB

APPROVED BY:
MK

DATE:
1/23/25

WAREHOUSE AVENUE

#22503

AREA 5 -
NORTH AREA

MW-7
(NA)*

MW-1
(NA)*

#22014
(BEE-JAY SCALES
[BJS] PARCEL)

#22015
(WESTERN GENERAL
LAND [WGL] PARCEL)

CARPORT

AREA 4 -
SUSPECTED
HISTORIC
WASHDOWN
AREA

#22496

BLDG.

AREA 6 -
HICKENBOTTOM
PROPERTY

#22016

BUILDING

BLDG.

AREA 2 - DRY
FERTILIZER AREA

MW-22
(ND<0.0003)

AREA 1 - LIQUID
FERTILIZER PLANT AND
TRUCK WASH AREA

MW-8
(NA)*

MW-3
(0.0014)

0.005

MW-10
(NA)*

AREA 3 - DRUM
STORAGE AREA

FORMER FERTILIZER BUILDING

FORMER
LAGOON

0.05

0.5

MW-12R
(1.3)

MW-11
(NA)*

MW-5R
(ND<0.003)

MW-4R
(0.0066)

MW-6
(NA)*

CENTER OF NORTH
RAIL FOR RAILROAD
SIDE TRACK

BURLINGTON NORTHERN SANTA FE (BNSF)
RIGHT-OF-WAY

MW-15
(ND<0.0003)

N. 1ST STREET

#22904

MW-9
(0.067)

MW-14
(NA)*

MW-21
(0.00069)

MW-23
(0.17)

MW-17
(NA)*

BUILDING

MILNE FRUIT
PRODUCTS BUILDING

#22559

MW-24
(0.29)**

MW-16
(0.15)

APPROXIMATE
TRUCK SCALE
LOCATION

MW-13
(ND<0.0003)

BLAINE AVENUE

MW-18
(NA)*

#23447

#23443

#23902
BUILDING

BUILDING

BUILDING

#23441

#23416

#23417

S. 3RD STREET

BUILDING

#23901

0.05

0.005

#23440

#23418

BUILDING

#23439

#23419

MW-20
(NA)*

#23442

#23438

MW-19
(0.030)

#23420

#23437

#23421

#23436

#23422

#23423

N

LEGEND

SITE BOUNDARY (APPROXIMATE)

PARCEL BOUNDARY (APPROXIMATE)

#22503  PARCEL ID NUMBER (221025 PRECEDES
ALL PARCEL NUMBERS AND IS NOT SHOWN)

BUILDING

BUILDING OVERHANG

CHAIN LINK FENCE

RAILROAD

MONITORING WELL (INSTALLED PRIOR TO 2017)

MONITORING WELL (INSTALLED 2019 OR LATER)

(0.00143)  1,2-DICHLOROPROPANE CONCENTRATION 3-YEAR
95% UPPER CONFIDENCE LIMIT (UCL95) 2022-2024

(NA)  NOT ANALYZED OR NOT APPLICABLE

(ND<)  NO DETECTED VALUES TO CALCULATE UCL95;
MAXIMUM METHOD DETECTION LIMIT SHOWN

*  NOT ANALYZED

**  INSUFFICIENT DETECTED VALUES TO CALCULATE UCL95;
MAXIMUM DETECTED VALUE SHOWN

CONTOURS FOR SITE-SPECIFIC 1,2-DICHLOROPROPANE PLUME
3-YEAR UCL95 2022-2024; DASHED WHERE INFERRED

NOTE
ALL CONCENTRATIONS IN
MILLIGRAMS PER LITER (mg/L)
SITE-SPECIFIC CLEANUP LEVEL IS 0.005 mg/L

0        80        160
APPROXIMATE SCALE IN FEET

Stantec

FOR:
BEE-JAY SCALES SITE
SUNNYSIDE, WASHINGTON

1,2-DICHLOROPROPANE
ISOCONCENTRATION MAP -
3-YEAR UCL95
2022-2024

FIGURE:
5

JOB NUMBER:
182604043/182604044

DRAWN BY:
JO

CHECKED BY:
EB

APPROVED BY:
MK

DATE:
1/23/25

FILEPATH:\\Us0257-ppfss01\shared_projects\182604043\02_correspondence\regulators\periodic_review\second_periodic_review\figures\dwg_182604043_per-review_2024.dwg|JOpalekOpsahl|Jan 23, 2025 at 11:11|Layout: fig5_dcp

Figure 6 — Arsenic Isoconcentration Map - 3-Year UCL95 2022-2024

**WAREHOUSE AVENUE**

0.01

MW-7
(0.014)

MW-1
(0.012)*

AREA 5-
NORTH AREA

#22503

#22014
(BEE-JAY SCALES
[BJS] PARCEL)

#22015
(WESTERN GENERAL
LAND [WGL] PARCEL)

#22016

CARPORT

AREA 4 -
SUSPECTED
HISTORIC
WASHDOWN
AREA

AREA 6-
HICKENBOTTOM
PROPERTY

#22496

BLDG.

BLDG.

BUILDING

AREA 1 - LIQUID
FERTILIZER PLANT AND
TRUCK WASH AREA

0.01

MW-22
(0.0097)***

MW-8
(0.012)

MW-3
(0.0086)

AREA 2 - DRY
FERTILIZER AREA

MW-10
(0.020)

0.01

AREA 3 - DRUM
STORAGE AREA

FORMER FERTILIZER BUILDING

FORMER
LAGOON

MW-11
(0.035)

MW-5R
(NA)***

MW-4R
(0.013)

MW-12R
(0.034)***

MW-15
(0.015)**

MW-6
(0.026)**

CENTER OF NORTH
RAIL FOR RAILROAD
SIDE TRACK

**BURLINGTON NORTHERN SANTA FE (BNSF)
RIGHT-OF-WAY**

0.01

#22904

MW-9
(0.0082)

MW-21
(0.032)**/***

MW-23
(0.012)***

MW-17
(0.012)

MW-14
(0.011)*

**N. 1ST STREET**

BUILDING

MILNE FRUIT
PRODUCTS BUILDING

#22559

MW-24
(0.0083)

MW-16
(0.018)

0.01

APPROXIMATE
TRUCK SCALE
LOCATION

MW-13
(0.014)

**BLAINE AVENUE**

MW-18
(0.018)

#23447

#23443

#23902

BUILDING

BUILDING

BUILDING

#23901

#23441

#23416

#23417

#23440

#23418

BUILDING

**S. 3RD STREET**

BUILDING

#23442

#23439

#23438

MW-19
(0.027)

#23419

#23420

MW-20
(0.020)

#23437

#23421

#23436

#23422

#23423

N

## LEGEND

| Symbol | Description |
|---|---|
| — (red) | SITE BOUNDARY (APPROXIMATE) |
| — ·· — | PARCEL BOUNDARY (APPROXIMATE) |
| #22503 | PARCEL ID NUMBER (221025 PRECEDES ALL PARCEL NUMBERS AND IS NOT SHOWN) |
| | BUILDING |
| - - - | BUILDING OVERHANG |
| ×—×—× | CHAIN LINK FENCE |
| +++++ | RAILROAD |
| ⊕ | MONITORING WELL (INSTALLED PRIOR TO 2017) |
| ⊕ | MONITORING WELL (INSTALLED 2019 OR LATER) |
| (0.012) | ARSENIC CONCENTRATION 3-YEAR 95% UPPER CONFIDENCE LIMIT (UCL95) 2022-2024 |
| (NA) | NOT ANALYZED OR NOT APPLICABLE |
| * | CALCULATED UCL95 EXCEEDS MAXIMUM CONCENTRATION DUE TO SMALL SAMPLE SET SIZE |
| ** | INSUFFICIENT DETECTED VALUES TO CALCULATE UCL95; MAXIMUM DETECTED VALUE SHOWN |
| *** | ARSENIC RESULTS WERE EXCLUDED WHEN EISB CONDITIONS WERE PRESENT DURING ONE OR MORE EVENTS |
| — (purple) | CONTOURS FOR SITE-SPECIFIC ARSENIC PLUME 3-YEAR UCL95 2022-2024; DASHED WHERE INFERRED |

## NOTE

ALL CONCENTRATIONS IN
MILLIGRAMS PER LITER (mg/L)

SITE-SPECIFIC CLEANUP LEVEL IS 0.01 mg/L

EISB = ENHANCED IN-SITU BIOREMEDIATION

0    80    160

APPROXIMATE SCALE IN FEET

No warranty is made by Stantec, Inc. as to the accuracy, reliability, or completeness of these data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed electronically, and may be updated without notification. Any reproduction may result in a loss of scale and or information.

**Stantec**

FOR:
BEE-JAY SCALES SITE
SUNNYSIDE, WASHINGTON

ARSENIC ISOCONCENTRATION MAP -
3-YEAR UCL95
2022-2024

FIGURE:
**6**

| JOB NUMBER: | DRAWN BY: | CHECKED BY: | APPROVED BY: | DATE: |
|---|---|---|---|---|
| 182604043/182604044 | JO | EB | MK | 1/23/25 |

**APPENDIX A**
**Groundwater Concentration ProUCL Software Outputs**

| UCL Statistics for Uncensored Full Data Sets | | |
|---|---|---|
| | | |
| **User Selected Options** | | |
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:02:15 PM | |
| From File | mw01_3year_data.xls | |
| Full Precision | OFF | |
| Confidence Coefficient | 95% | |
| Number of Bootstrap Operations | 2000 | |

**Nitrate - MW-1**

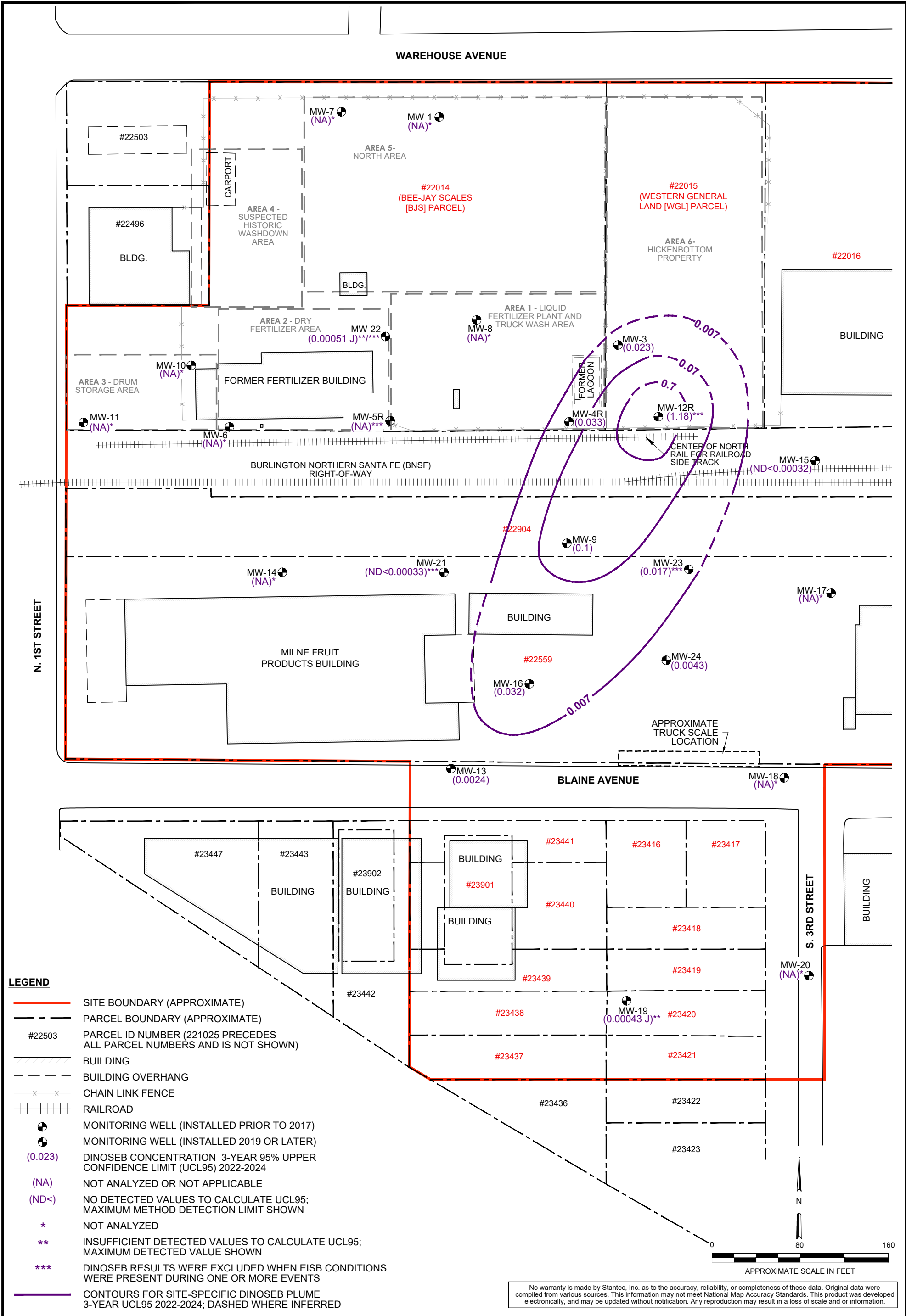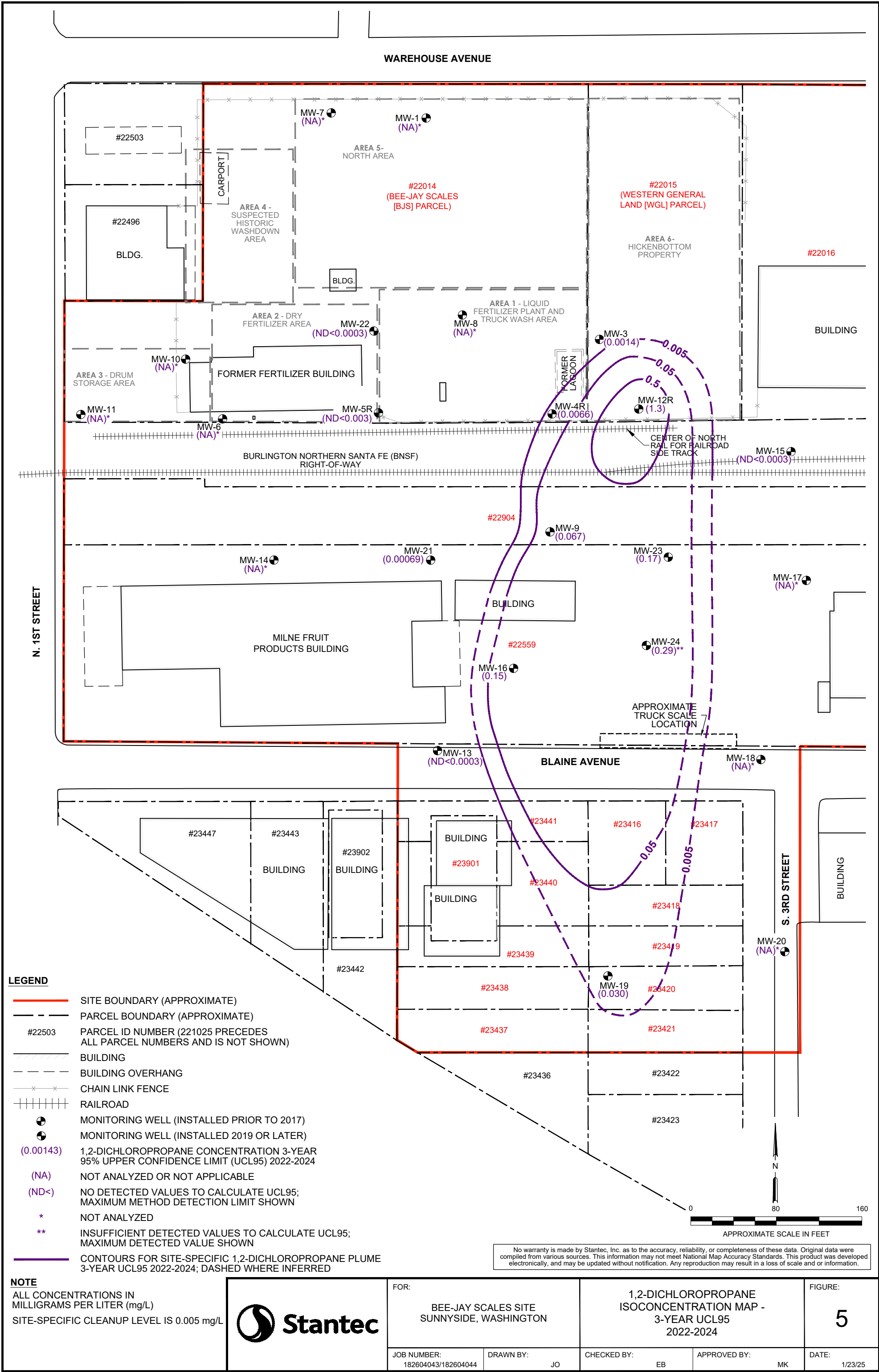| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 | |
| | | Number of Missing Observations | 0 | |
| Minimum | 6.4 | Mean | 8.667 | |
| Maximum | 12 | Median | 8.4 | |
| SD | 1.859 | Std. Error of Mean | 0.759 | |
| Coefficient of Variation | 0.214 | Skewness | 1.155 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.906 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.262 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 10.2 | 95% Adjusted-CLT UCL (Chen-1995) | 10.3 |
| | | 95% Modified-t UCL (Johnson-1978) | 10.26 |

| Gamma GOF Test | | |
|---|---|---|
| A-D Test Statistic | 0.337 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.697 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.229 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 27.94 | | k star (bias corrected MLE) | 14.08 |
| Theta hat (MLE) | 0.31 | | Theta star (bias corrected MLE) | 0.616 |
| nu hat (MLE) | 335.2 | | nu star (bias corrected) | 168.9 |
| MLE Mean (bias corrected) | 8.667 | | MLE Sd (bias corrected) | 2.31 |
| | | | Approximate Chi Square Value (0.05) | 139.9 |
| Adjusted Level of Significance | 0.0122 | | Adjusted Chi Square Value | 130.3 |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 10.47 | | 95% Adjusted Gamma UCL | 11.24 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.946 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.226 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 1.856 | | Mean of logged Data | 2.141 |
| Maximum of Logged Data | 2.485 | | SD of logged Data | 0.205 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 10.52 | | 90% Chebyshev (MVUE) UCL | 10.84 |
| 95% Chebyshev (MVUE) UCL | 11.83 | | 97.5% Chebyshev (MVUE) UCL | 13.2 |
| 99% Chebyshev (MVUE) UCL | 15.88 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| **Data appear to follow a Discernible Distribution** |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 9.915 | | 95% BCA Bootstrap UCL | 10.1 |
| 95% Standard Bootstrap UCL | 9.816 | | 95% Bootstrap-t UCL | 10.88 |
| 95% Hall's Bootstrap UCL | 17.92 | | 95% Percentile Bootstrap UCL | 9.833 |
| 90% Chebyshev(Mean, Sd) UCL | 10.94 | | 95% Chebyshev(Mean, Sd) UCL | 11.97 |
| 97.5% Chebyshev(Mean, Sd) UCL | 13.41 | | 99% Chebyshev(Mean, Sd) UCL | 16.22 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 10.2 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Arsenic - MW-1**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 2 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.011 | Mean | 0.0115 |
| Maximum | 0.012 | Median | 0.0115 |
| SD | 5.7735E-4 | Std. Error of Mean | 2.8868E-4 |
| Coefficient of Variation | 0.0502 | Skewness | 0 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.731 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.307 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0122 | 95% Adjusted-CLT UCL (Chen-1995) | 0.012 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0122 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.719 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.657 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.341 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.394 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 528.7 | k star (bias corrected MLE) | 132.3 |
| Theta hat (MLE) | 2.1753E-5 | Theta star (bias corrected MLE) | 8.6902E-5 |
| nu hat (MLE) | 4229 | nu star (bias corrected) | 1059 |
| MLE Mean (bias corrected) | 0.0115 | MLE Sd (bias corrected) | 9.9969E-4 |
| | | Approximate Chi Square Value (0.05) | 984.1 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| 95% Approximate Gamma UCL | 0.0124 | 95% Adjusted Gamma UCL | N/A |
|---|---|---|---|

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.731 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.307 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Approximate Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.51 | Mean of logged Data | -4.466 |
| Maximum of Logged Data | -4.423 | SD of logged Data | 0.0502 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.0124 |
| 95% Chebyshev (MVUE) UCL | 0.0128 | 97.5% Chebyshev (MVUE) UCL | 0.0133 |
| 99% Chebyshev (MVUE) UCL | 0.0144 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.012 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0124 | 95% Chebyshev(Mean, Sd) UCL | 0.0128 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0133 | 99% Chebyshev(Mean, Sd) UCL | 0.0144 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0122 | | |
| **Recommended UCL exceeds the maximum observation** | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

| UCL Statistics for Data Sets with Non-Detects | |
|---|---|
| | |
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:04:50 PM |
| From File | mw03_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-3**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 180 | Mean | 307.5 |
| Maximum | 410 | Median | 345 |
| SD | 90.67 | Std. Error of Mean | 32.06 |
| Coefficient of Variation | 0.295 | Skewness | -0.539 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.872 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.265 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |
| Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 368.2 | 95% Adjusted-CLT UCL (Chen-1995) | 353.7 |
| | | 95% Modified-t UCL (Johnson-1978) | 367.2 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.63 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.715 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.297 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.294 | Data Not Gamma Distributed at 5% Significance Level | |
| Detected data follow Appr. Gamma Distribution at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 11.53 | | k star (bias corrected MLE) | 7.29 |
| Theta hat (MLE) | 26.67 | | Theta star (bias corrected MLE) | 42.18 |
| nu hat (MLE) | 184.5 | | nu star (bias corrected) | 116.6 |
| MLE Mean (bias corrected) | 307.5 | | MLE Sd (bias corrected) | 113.9 |
| | | | Approximate Chi Square Value (0.05) | 92.71 |
| Adjusted Level of Significance | 0.0195 | | Adjusted Chi Square Value | 87.32 |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 386.9 | | 95% Adjusted Gamma UCL | 410.8 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.843 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.295 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 5.193 | | Mean of logged Data | 5.684 |
| Maximum of Logged Data | 6.016 | | SD of logged Data | 0.329 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 402.8 | | 90% Chebyshev (MVUE) UCL | 416.4 |
| 95% Chebyshev (MVUE) UCL | 465.3 | | 97.5% Chebyshev (MVUE) UCL | 533.2 |
| 99% Chebyshev (MVUE) UCL | 666.6 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| **Data appear to follow a Discernible Distribution** |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 360.2 | | 95% BCA Bootstrap UCL | 350 |
| 95% Standard Bootstrap UCL | 356.5 | | 95% Bootstrap-t UCL | 360.7 |
| 95% Hall's Bootstrap UCL | 347.2 | | 95% Percentile Bootstrap UCL | 355 |
| 90% Chebyshev(Mean, Sd) UCL | 403.7 | | 95% Chebyshev(Mean, Sd) UCL | 447.2 |
| 97.5% Chebyshev(Mean, Sd) UCL | 507.7 | | 99% Chebyshev(Mean, Sd) UCL | 626.5 |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 368.2 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

**Nitrite - MW-3**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| Number of Detects | 7 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 7 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.015 | Minimum Non-Detect | 0.015 |
| Maximum Detect | 0.87 | Maximum Non-Detect | 0.015 |
| Variance Detects | 0.145 | Percent Non-Detects | 12.5% |
| Mean Detects | 0.27 | SD Detects | 0.38 |
| Median Detects | 0.033 | CV Detects | 1.408 |
| Skewness Detects | 1.184 | Kurtosis Detects | -0.77 |
| Mean of Logged Detects | -2.515 | SD of Logged Detects | 1.763 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.702 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.73 | Detected Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.328 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.35 | Detected Data appear Normal at 1% Significance Level | |
| Detected Data appear Approximate Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.238 | KM Standard Error of Mean | 0.13 |
| 90KM SD | 0.34 | 95% KM (BCA) UCL | 0.442 |
| 95% KM (t) UCL | 0.484 | 95% KM (Percentile Bootstrap) UCL | 0.442 |
| 95% KM (z) UCL | 0.452 | 95% KM Bootstrap t UCL | 1.688 |
| 90% KM Chebyshev UCL | 0.628 | 95% KM Chebyshev UCL | 0.804 |
| 97.5% KM Chebyshev UCL | 1.049 | 99% KM Chebyshev UCL | 1.53 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.718 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.75 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.31 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.327 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 0.523 | k star (bias corrected MLE) | 0.394 |
| Theta hat (MLE) | 0.516 | Theta star (bias corrected MLE) | 0.685 |
| nu hat (MLE) | 7.322 | nu star (bias corrected) | 5.518 |
| Mean (detects) | 0.27 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.01 | Mean | 0.238 |
| Maximum | 0.87 | Median | 0.029 |
| SD | 0.364 | CV | 1.532 |
| k hat (MLE) | 0.478 | k star (bias corrected MLE) | 0.382 |
| Theta hat (MLE) | 0.497 | Theta star (bias corrected MLE) | 0.622 |
| nu hat (MLE) | 7.644 | nu star (bias corrected) | 6.111 |
| Adjusted Level of Significance (β) | 0.0195 | | |
| Approximate Chi Square Value (6.11, α) | 1.697 | Adjusted Chi Square Value (6.11, β) | 1.176 |
| 95% Gamma Approximate UCL | 0.855 | 95% Gamma Adjusted UCL | 1.234 |

| Estimates of Gamma Parameters using KM Estimates | | | |
|---|---|---|---|
| Mean (KM) | 0.238 | SD (KM) | 0.34 |
| Variance (KM) | 0.116 | SE of Mean (KM) | 0.13 |
| k hat (KM) | 0.491 | k star (KM) | 0.39 |
| nu hat (KM) | 7.853 | nu star (KM) | 6.242 |
| theta hat (KM) | 0.485 | theta star (KM) | 0.61 |
| 80% gamma percentile (KM) | 0.383 | 90% gamma percentile (KM) | 0.676 |
| 95% gamma percentile (KM) | 0.998 | 99% gamma percentile (KM) | 1.811 |

| Gamma Kaplan-Meier (KM) Statistics | | | |
|---|---|---|---|
| Approximate Chi Square Value (6.24, α) | 1.765 | Adjusted Chi Square Value (6.24, β) | 1.229 |
| 95% KM Approximate Gamma UCL | 0.842 | 95% KM Adjusted Gamma UCL | 1.209 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.836 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.838 | Detected Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.266 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.28 | Detected Data appear Lognormal at 10% Significance Level |
| **Detected Data appear Approximate Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 0.236 | Mean in Log Scale | -3.047 |
| SD in Original Scale | 0.365 | SD in Log Scale | 2.219 |
| 95% t UCL (assumes normality of ROS data) | 0.481 | 95% Percentile Bootstrap UCL | 0.439 |
| 95% BCA Bootstrap UCL | 0.513 | 95% Bootstrap t UCL | 1.665 |
| 95% H-UCL (Log ROS) | 161.1 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -2.726 | KM Geo Mean | 0.0655 |
| KM SD (logged) | 1.625 | 95% Critical H Value (KM-Log) | 5.084 |
| KM Standard Error of Mean (logged) | 0.621 | 95% H-UCL (KM -Log) | 5.566 |
| KM SD (logged) | 1.625 | 95% Critical H Value (KM-Log) | 5.084 |
| KM Standard Error of Mean (logged) | 0.621 | | |

| DL/2 Statistics | | | | |
|---|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | | |
| Mean in Original Scale | 0.237 | Mean in Log Scale | -2.813 | |
| SD in Original Scale | 0.364 | SD in Log Scale | 1.836 | |
| 95% t UCL (Assumes normality) | 0.481 | 95% H-Stat UCL | 16.56 | |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

**Nonparametric Distribution Free UCL Statistics**

**Detected Data appear Approximate Normal Distributed at 1% Significance Level**

**Suggested UCL to Use**

| 95% KM (t) UCL | 0.484 | | |
|---|---|---|---|

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**

**Please verify the data were collected from random locations.**

**If the data were collected using judgmental or other non-random methods,**

**then contact a statistician to correctly calculate UCLs.**

When a data set follows an approximate distribution passing only one of the GOF tests,

it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Arsenic - MW-3 | | | | |
|---|---|---|---|---|

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0064 | Mean | 0.00774 |
| Maximum | 0.0096 | Median | 0.0072 |
| SD | 0.00132 | Std. Error of Mean | 4.6749E-4 |
| Coefficient of Variation | 0.171 | Skewness | 0.646 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.848 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.255 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.00862 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00862 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.00864 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.551 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.715 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.249 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.294 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 40.75 | k star (bias corrected MLE) | 25.55 |
| Theta hat (MLE) | 1.8988E-4 | Theta star (bias corrected MLE) | 3.0281E-4 |
| nu hat (MLE) | 652 | nu star (bias corrected) | 408.8 |
| MLE Mean (bias corrected) | 0.00774 | MLE Sd (bias corrected) | 0.00153 |
| | | Approximate Chi Square Value (0.05) | 363 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 352 |

### Assuming Gamma Distribution

| 95% Approximate Gamma UCL | 0.00872 | 95% Adjusted Gamma UCL | 0.00899 |
|---|---|---|---|

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.865 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.234 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -5.051 | Mean of logged Data | -4.874 |
| Maximum of Logged Data | -4.646 | SD of logged Data | 0.166 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.00874 | 90% Chebyshev (MVUE) UCL | 0.0091 |
| 95% Chebyshev (MVUE) UCL | 0.00972 | 97.5% Chebyshev (MVUE) UCL | 0.0106 |
| 99% Chebyshev (MVUE) UCL | 0.0123 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.00851 | 95% BCA Bootstrap UCL | 0.00855 |
| 95% Standard Bootstrap UCL | 0.00846 | 95% Bootstrap-t UCL | 0.00882 |
| 95% Hall's Bootstrap UCL | 0.00852 | 95% Percentile Bootstrap UCL | 0.00849 |
| 90% Chebyshev(Mean, Sd) UCL | 0.00914 | 95% Chebyshev(Mean, Sd) UCL | 0.00978 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0107 | 99% Chebyshev(Mean, Sd) UCL | 0.0124 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.00862 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**Iron - MW-3**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| Number of Detects | 5 | Number of Non-Detects | 3 |
| Number of Distinct Detects | 5 | Number of Distinct Non-Detects | 2 |
| Minimum Detect | 0.023 | Minimum Non-Detect | 0.02 |
| Maximum Detect | 0.99 | Maximum Non-Detect | 0.08 |
| Variance Detects | 0.183 | Percent Non-Detects | 37.5% |
| Mean Detects | 0.225 | SD Detects | 0.428 |
| Median Detects | 0.032 | CV Detects | 1.899 |
| Skewness Detects | 2.231 | Kurtosis Detects | 4.983 |
| Mean of Logged Detects | -2.755 | SD of Logged Detects | 1.57 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.577 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.686 | Detected Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.455 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.396 | Detected Data Not Normal at 1% Significance Level | |
| **Detected Data Not Normal at 1% Significance Level** | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.151 | KM Standard Error of Mean | 0.125 |
| 90KM SD | 0.317 | 95% KM (BCA) UCL | 0.388 |
| 95% KM (t) UCL | 0.389 | 95% KM (Percentile Bootstrap) UCL | 0.388 |
| 95% KM (z) UCL | 0.357 | 95% KM Bootstrap t UCL | 7.821 |
| 90% KM Chebyshev UCL | 0.527 | 95% KM Chebyshev UCL | 0.698 |
| 97.5% KM Chebyshev UCL | 0.935 | 99% KM Chebyshev UCL | 1.399 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.976 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.711 | Detected Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.422 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.372 | Detected Data Not Gamma Distributed at 5% Significance Level | |
| **Detected Data Not Gamma Distributed at 5% Significance Level** | | | |

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 0.502 | k star (bias corrected MLE) | 0.334 |
| Theta hat (MLE) | 0.448 | Theta star (bias corrected MLE) | 0.674 |
| nu hat (MLE) | 5.021 | nu star (bias corrected) | 3.342 |
| Mean (detects) | 0.225 | | |

## Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

| | | | | |
|---|---|---|---|---|
| Minimum | 0.01 | | Mean | 0.151 |
| Maximum | 0.99 | | Median | 0.029 |
| SD | 0.339 | | CV | 2.245 |
| k hat (MLE) | 0.481 | | k star (bias corrected MLE) | 0.384 |
| Theta hat (MLE) | 0.314 | | Theta star (bias corrected MLE) | 0.394 |
| nu hat (MLE) | 7.696 | | nu star (bias corrected) | 6.144 |
| Adjusted Level of Significance (β) | 0.0195 | | | |
| Approximate Chi Square Value (6.14, α) | 1.714 | | Adjusted Chi Square Value (6.14, β) | 1.189 |
| 95% Gamma Approximate UCL | 0.542 | | 95% Gamma Adjusted UCL | 0.781 |

## Estimates of Gamma Parameters using KM Estimates

| | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.151 | | SD (KM) | 0.317 |
| Variance (KM) | 0.101 | | SE of Mean (KM) | 0.125 |
| k hat (KM) | 0.227 | | k star (KM) | 0.225 |
| nu hat (KM) | 3.626 | | nu star (KM) | 3.599 |
| theta hat (KM) | 0.667 | | theta star (KM) | 0.671 |
| 80% gamma percentile (KM) | 0.21 | | 90% gamma percentile (KM) | 0.456 |
| 95% gamma percentile (KM) | 0.754 | | 99% gamma percentile (KM) | 1.559 |

## Gamma Kaplan-Meier (KM) Statistics

| | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (3.60, α) | 0.57 | | Adjusted Chi Square Value (3.60, β) | 0.339 |
| 95% KM Approximate Gamma UCL | 0.954 | | 95% KM Adjusted Gamma UCL | 1.604 |

## Lognormal GOF Test on Detected Observations Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.729 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.806 | Detected Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.337 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.319 | Detected Data Not Lognormal at 10% Significance Level |

**Detected Data Not Lognormal at 10% Significance Level**

## Lognormal ROS Statistics Using Imputed Non-Detects

| | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.148 | | Mean in Log Scale | -3.414 |
| SD in Original Scale | 0.34 | | SD in Log Scale | 1.693 |
| 95% t UCL (assumes normality of ROS data) | 0.377 | | 95% Percentile Bootstrap UCL | 0.387 |
| 95% BCA Bootstrap UCL | 0.508 | | 95% Bootstrap t UCL | 3.394 |
| 95% H-UCL (Log ROS) | 4.03 | | | |

## Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -3.095 | | KM Geo Mean | 0.0453 |
| KM SD (logged) | 1.212 | | 95% Critical H Value (KM-Log) | 3.966 |
| KM Standard Error of Mean (logged) | 0.486 | | 95% H-UCL (KM -Log) | 0.58 |
| KM SD (logged) | 1.212 | | 95% Critical H Value (KM-Log) | 3.966 |
| KM Standard Error of Mean (logged) | 0.486 | | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| **DL/2 Normal** | | **DL/2 Log-Transformed** | |
| Mean in Original Scale | 0.152 | Mean in Log Scale | -3.102 |
| SD in Original Scale | 0.339 | SD in Log Scale | 1.35 |
| 95% t UCL (Assumes normality) | 0.379 | 95% H-Stat UCL | 1.019 |
| **DL/2 is not a recommended method, provided for comparisons and historical reasons** | | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data do not follow a Discernible Distribution** | | | |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% KM (t) UCL | 0.389 | | |
| | | | |
| **The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.** | | | |
| **Please verify the data were collected from random locations.** | | | |
| **If the data were collected using judgmental or other non-random methods,** | | | |
| **then contact a statistician to correctly calculate UCLs.** | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

**Manganese - MW-3**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 1.1 | Mean | 1.863 |
| Maximum | 3.2 | Median | 1.75 |
| SD | 0.678 | Std. Error of Mean | 0.24 |
| Coefficient of Variation | 0.364 | Skewness | 1.07 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.926 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.151 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 2.317 | 95% Adjusted-CLT UCL (Chen-1995) | 2.354 |
| | | 95% Modified-t UCL (Johnson-1978) | 2.332 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.195 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.715 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.141 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.294 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 9.437 | k star (bias corrected MLE) | 5.981 |
| Theta hat (MLE) | 0.197 | Theta star (bias corrected MLE) | 0.311 |
| nu hat (MLE) | 151 | nu star (bias corrected) | 95.7 |
| MLE Mean (bias corrected) | 1.863 | MLE Sd (bias corrected) | 0.762 |
| | | Approximate Chi Square Value (0.05) | 74.14 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 69.35 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 2.404 | 95% Adjusted Gamma UCL | 2.57 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.979 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.123 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | 0.0953 | Mean of logged Data | 0.568 |
| Maximum of Logged Data | 1.163 | SD of logged Data | 0.346 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 2.473 | 90% Chebyshev (MVUE) UCL | 2.546 |
| 95% Chebyshev (MVUE) UCL | 2.857 | 97.5% Chebyshev (MVUE) UCL | 3.289 |
| 99% Chebyshev (MVUE) UCL | 4.137 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 2.257 | 95% BCA Bootstrap UCL | 2.313 |
| 95% Standard Bootstrap UCL | 2.23 | 95% Bootstrap-t UCL | 2.506 |
| 95% Hall's Bootstrap UCL | 2.581 | 95% Percentile Bootstrap UCL | 2.238 |
| 90% Chebyshev(Mean, Sd) UCL | 2.582 | 95% Chebyshev(Mean, Sd) UCL | 2.908 |
| 97.5% Chebyshev(Mean, Sd) UCL | 3.36 | 99% Chebyshev(Mean, Sd) UCL | 4.248 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 2.317 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**2,4-D - MW-3**

| | | | |
|---|---|---|---|
| **General Statistics** | | | |
| Total Number of Observations | 8 | Number of Distinct Observations | 5 |
| Number of Detects | 2 | Number of Non-Detects | 6 |
| Number of Distinct Detects | 2 | Number of Distinct Non-Detects | 3 |
| Minimum Detect | 4.3000E-4 | Minimum Non-Detect | 2.3000E-4 |
| Maximum Detect | 4.8000E-4 | Maximum Non-Detect | 2.8000E-4 |
| Variance Detects | 1.2500E-9 | Percent Non-Detects | 75% |
| Mean Detects | 4.5500E-4 | SD Detects | 3.5355E-5 |
| Median Detects | 4.5500E-4 | CV Detects | 0.0777 |
| Skewness Detects | N/A | Kurtosis Detects | N/A |
| Mean of Logged Detects | -7.697 | SD of Logged Detects | 0.0778 |

| |
|---|
| **Warning: Data set has only 2 Detected Values.** |
| **This is not enough to compute meaningful or reliable statistics and estimates.** |

| |
|---|
| **Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,** |
| **refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,** |
| **but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).** |
| **The Chebyshev UCL often results in gross overestimates of the mean.** |
| **Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.** |

| |
|---|
| **Normal GOF Test on Detects Only** |
| **Not Enough Data to Perform GOF Test** |

| | | | |
|---|---|---|---|
| **Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs** | | | |
| KM Mean | 2.8625E-4 | KM Standard Error of Mean | 4.9113E-5 |
| 90KM SD | 9.8226E-5 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 3.7930E-4 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 3.6703E-4 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 4.3359E-4 | 95% KM Chebyshev UCL | 5.0033E-4 |
| 97.5% KM Chebyshev UCL | 5.9296E-4 | 99% KM Chebyshev UCL | 7.7492E-4 |

| |
|---|
| **Gamma GOF Tests on Detected Observations Only** |
| **Not Enough Data to Perform GOF Test** |

| | | | |
|---|---|---|---|
| **Gamma Statistics on Detected Data Only** | | | |
| k hat (MLE) | 330.9 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 1.3750E-6 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 1324 | nu star (bias corrected) | N/A |
| Mean (detects) | 4.5500E-4 | | |

## Estimates of Gamma Parameters using KM Estimates

| | | | |
|---|---|---|---|
| Mean (KM) | 2.8625E-4 | SD (KM) | 9.8226E-5 |
| Variance (KM) | 9.6484E-9 | SE of Mean (KM) | 4.9113E-5 |
| k hat (KM) | 8.492 | k star (KM) | 5.391 |
| nu hat (KM) | 135.9 | nu star (KM) | 86.26 |
| theta hat (KM) | 3.3706E-5 | theta star (KM) | 5.3097E-5 |
| 80% gamma percentile (KM) | 3.8158E-4 | 90% gamma percentile (KM) | 4.5121E-4 |
| 95% gamma percentile (KM) | 5.1447E-4 | 99% gamma percentile (KM) | 6.4770E-4 |

## Gamma Kaplan-Meier (KM) Statistics

| | | | |
|---|---|---|---|
| | | Adjusted Level of Significance (β) | 0.0195 |
| Approximate Chi Square Value (86.26, α) | 65.85 | Adjusted Chi Square Value (86.26, β) | 61.35 |
| 95% KM Approximate Gamma UCL | 3.7497E-4 | 95% KM Adjusted Gamma UCL | 4.0244E-4 |

## Lognormal GOF Test on Detected Observations Only
### Not Enough Data to Perform GOF Test

## Lognormal ROS Statistics Using Imputed Non-Detects

| | | | |
|---|---|---|---|
| Mean in Original Scale | 3.4292E-4 | Mean in Log Scale | -7.998 |
| SD in Original Scale | 7.5350E-5 | SD in Log Scale | 0.208 |
| 95% t UCL (assumes normality of ROS data) | 3.9339E-4 | 95% Percentile Bootstrap UCL | 3.8640E-4 |
| 95% BCA Bootstrap UCL | 3.9178E-4 | 95% Bootstrap t UCL | 4.4107E-4 |
| 95% H-UCL (Log ROS) | 4.0045E-4 | | |

## Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| KM Mean (logged) | -8.207 | KM Geo Mean | 2.7267E-4 |
| KM SD (logged) | 0.296 | 95% Critical H Value (KM-Log) | 2.053 |
| KM Standard Error of Mean (logged) | 0.148 | 95% H-UCL (KM -Log) | 3.5845E-4 |
| KM SD (logged) | 0.296 | 95% Critical H Value (KM-Log) | 2.053 |
| KM Standard Error of Mean (logged) | 0.148 | | |

## DL/2 Statistics

| DL/2 Normal | | DL/2 Log-Transformed | |
|---|---|---|---|
| Mean in Original Scale | 2.1438E-4 | Mean in Log Scale | -8.613 |
| SD in Original Scale | 1.4934E-4 | SD in Log Scale | 0.57 |
| 95% t UCL (Assumes normality) | 3.1441E-4 | 95% H-Stat UCL | 3.6459E-4 |

### DL/2 is not a recommended method, provided for comparisons and historical reasons

## Nonparametric Distribution Free UCL Statistics
### Data do not follow a Discernible Distribution

## Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 3.7930E-4 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Dinoseb - MW-3 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 8 |
| Number of Detects | 7 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 7 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.0022 | Minimum Non-Detect | 0.0015 |
| Maximum Detect | 0.036 | Maximum Non-Detect | 0.0015 |
| Variance Detects | 1.3913E-4 | Percent Non-Detects | 12.5% |
| Mean Detects | 0.0167 | SD Detects | 0.0118 |
| Median Detects | 0.015 | CV Detects | 0.708 |
| Skewness Detects | 0.547 | Kurtosis Detects | -0.304 |
| Mean of Logged Detects | -4.405 | SD of Logged Detects | 0.966 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.96 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.73 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.169 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.35 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0148 | KM Standard Error of Mean | 0.00435 |
| 90KM SD | 0.0114 | 95% KM (BCA) UCL | 0.0214 |
| 95% KM (t) UCL | 0.023 | 95% KM (Percentile Bootstrap) UCL | 0.0213 |
| 95% KM (z) UCL | 0.0219 | 95% KM Bootstrap t UCL | 0.0255 |
| 90% KM Chebyshev UCL | 0.0278 | 95% KM Chebyshev UCL | 0.0337 |
| 97.5% KM Chebyshev UCL | 0.0419 | 99% KM Chebyshev UCL | 0.058 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.219 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.718 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.191 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.316 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 1.759 | k star (bias corrected MLE) | 1.101 |
| Theta hat (MLE) | 0.00947 | Theta star (bias corrected MLE) | 0.0151 |
| nu hat (MLE) | 24.63 | nu star (bias corrected) | 15.41 |
| Mean (detects) | 0.0167 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.0022 | Mean | 0.0158 |
| Maximum | 0.036 | Median | 0.014 |
| SD | 0.0112 | CV | 0.706 |
| k hat (MLE) | 1.91 | k star (bias corrected MLE) | 1.277 |
| Theta hat (MLE) | 0.00829 | Theta star (bias corrected MLE) | 0.0124 |
| nu hat (MLE) | 30.56 | nu star (bias corrected) | 20.43 |
| Adjusted Level of Significance (β) | 0.0195 | | |
| Approximate Chi Square Value (20.43, α) | 11.17 | Adjusted Chi Square Value (20.43, β) | 9.487 |
| 95% Gamma Approximate UCL | 0.0289 | 95% Gamma Adjusted UCL | 0.0341 |
| | | | |
| Estimates of Gamma Parameters using KM Estimates | | | |
| Mean (KM) | 0.0148 | SD (KM) | 0.0114 |
| Variance (KM) | 1.2947E-4 | SE of Mean (KM) | 0.00435 |
| k hat (KM) | 1.683 | k star (KM) | 1.135 |
| nu hat (KM) | 26.93 | nu star (KM) | 18.17 |
| theta hat (KM) | 0.00877 | theta star (KM) | 0.013 |
| 80% gamma percentile (KM) | 0.0235 | 90% gamma percentile (KM) | 0.0329 |
| 95% gamma percentile (KM) | 0.0423 | 99% gamma percentile (KM) | 0.0638 |
| | | | |
| Gamma Kaplan-Meier (KM) Statistics | | | |
| Approximate Chi Square Value (18.17, α) | 9.51 | Adjusted Chi Square Value (18.17, β) | 7.977 |
| 95% KM Approximate Gamma UCL | 0.0282 | 95% KM Adjusted Gamma UCL | 0.0336 |
| | | | |
| Lognormal GOF Test on Detected Observations Only | | | |
| Shapiro Wilk Test Statistic | 0.925 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.838 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.24 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.28 | Detected Data appear Lognormal at 10% Significance Level | |
| Detected Data appear Lognormal at 10% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |
| | | | |
| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
| Mean in Original Scale | 0.0147 | Mean in Log Scale | -4.695 |
| SD in Original Scale | 0.0122 | SD in Log Scale | 1.212 |
| 95% t UCL (assumes normality of ROS data) | 0.0229 | 95% Percentile Bootstrap UCL | 0.0217 |
| 95% BCA Bootstrap UCL | 0.0222 | 95% Bootstrap t UCL | 0.0254 |
| 95% H-UCL (Log ROS) | 0.117 | | |
| | | | |
| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
| KM Mean (logged) | -4.667 | KM Geo Mean | 0.0094 |
| KM SD (logged) | 1.087 | 95% Critical H Value (KM-Log) | 3.643 |
| KM Standard Error of Mean (logged) | 0.415 | 95% H-UCL (KM -Log) | 0.0757 |
| KM SD (logged) | 1.087 | 95% Critical H Value (KM-Log) | 3.643 |
| KM Standard Error of Mean (logged) | 0.415 | | |

| DL/2 Statistics | | | | |
|---|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | | |
| Mean in Original Scale | 0.0147 | Mean in Log Scale | -4.754 | |
| SD in Original Scale | 0.0123 | SD in Log Scale | 1.332 | |
| 95% t UCL (Assumes normality) | 0.0229 | 95% H-Stat UCL | 0.181 | |
| **DL/2 is not a recommended method, provided for comparisons and historical reasons** | | | | |
| | | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | | |
| **Detected Data appear Normal Distributed at 1% Significance Level** | | | | |
| | | | | |
| **Suggested UCL to Use** | | | | |
| 95% KM (t) UCL | 0.023 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |
| | | | | |
| | | | | |

**Chlorobenzene - MW-3**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.004 | Mean | 0.00839 |
| Maximum | 0.019 | Median | 0.00685 |
| SD | 0.0047 | Std. Error of Mean | 0.00166 |
| Coefficient of Variation | 0.561 | Skewness | 1.952 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.795 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.249 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0115 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0123 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0117 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.412 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.719 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.227 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.295 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 4.798 | k star (bias corrected MLE) | 3.082 |
| Theta hat (MLE) | 0.00175 | Theta star (bias corrected MLE) | 0.00272 |
| nu hat (MLE) | 76.76 | nu star (bias corrected) | 49.31 |
| MLE Mean (bias corrected) | 0.00839 | MLE Sd (bias corrected) | 0.00478 |
| | | Approximate Chi Square Value (0.05) | 34.19 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 31.04 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0121 | 95% Adjusted Gamma UCL | 0.0133 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.944 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.198 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -5.521 | Mean of logged Data | -4.889 |
| Maximum of Logged Data | -3.963 | SD of logged Data | 0.472 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0127 | 90% Chebyshev (MVUE) UCL | 0.0125 |
| 95% Chebyshev (MVUE) UCL | 0.0144 | 97.5% Chebyshev (MVUE) UCL | 0.017 |
| 99% Chebyshev (MVUE) UCL | 0.0222 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0111 | 95% BCA Bootstrap UCL | 0.012 |
| 95% Standard Bootstrap UCL | 0.011 | 95% Bootstrap-t UCL | 0.0148 |
| 95% Hall's Bootstrap UCL | 0.0224 | 95% Percentile Bootstrap UCL | 0.0113 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0134 | 95% Chebyshev(Mean, Sd) UCL | 0.0156 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0188 | 99% Chebyshev(Mean, Sd) UCL | 0.0249 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0115 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

**1,2-DCP - MW-3**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 5.8000E-4 | Mean | 0.00113 |
| Maximum | 0.0019 | Median | 0.0011 |
| SD | 4.4262E-4 | Std. Error of Mean | 1.5649E-4 |
| Coefficient of Variation | 0.39 | Skewness | 0.375 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.946 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.155 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.00143 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00141 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.00143 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.31 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.717 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.175 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.295 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 7.103 | k star (bias corrected MLE) | 4.523 |
| Theta hat (MLE) | 1.5961E-4 | Theta star (bias corrected MLE) | 2.5067E-4 |
| nu hat (MLE) | 113.7 | nu star (bias corrected) | 72.37 |
| MLE Mean (bias corrected) | 0.00113 | MLE Sd (bias corrected) | 5.3310E-4 |
| | | Approximate Chi Square Value (0.05) | 53.78 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 49.75 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.00153 | 95% Adjusted Gamma UCL | 0.00165 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.923 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.199 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -7.452 | Mean of logged Data | -6.854 |
| Maximum of Logged Data | -6.266 | SD of logged Data | 0.417 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.00163 | 90% Chebyshev (MVUE) UCL | 0.00164 |
| 95% Chebyshev (MVUE) UCL | 0.00187 | 97.5% Chebyshev (MVUE) UCL | 0.00219 |
| 99% Chebyshev (MVUE) UCL | 0.00282 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.00139 | 95% BCA Bootstrap UCL | 0.00137 |
| 95% Standard Bootstrap UCL | 0.00137 | 95% Bootstrap-t UCL | 0.00146 |
| 95% Hall's Bootstrap UCL | 0.00152 | 95% Percentile Bootstrap UCL | 0.00137 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0016 | 95% Chebyshev(Mean, Sd) UCL | 0.00182 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.00211 | 99% Chebyshev(Mean, Sd) UCL | 0.00269 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.00143 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:08:02 PM |
| From File | mw4r_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-4R**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 100 | Mean | 184.4 |
| Maximum | 250 | Median | 180 |
| SD | 45.86 | Std. Error of Mean | 15.29 |
| Coefficient of Variation | 0.249 | Skewness | -0.448 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.935 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.239 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 212.9 | 95% Adjusted-CLT UCL (Chen-1995) | 207.1 |
| | | 95% Modified-t UCL (Johnson-1978) | 212.5 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.478 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.721 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.272 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

## Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 15.99 | k star (bias corrected MLE) | 10.74 |
| Theta hat (MLE) | 11.53 | Theta star (bias corrected MLE) | 17.18 |
| nu hat (MLE) | 287.9 | nu star (bias corrected) | 193.2 |
| MLE Mean (bias corrected) | 184.4 | MLE Sd (bias corrected) | 56.29 |
| | | Approximate Chi Square Value (0.05) | 162.1 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 156.1 |

## Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 219.9 | 95% Adjusted Gamma UCL | 228.4 |

## Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.889 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.288 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.252 | Data Not Lognormal at 10% Significance Level |

**Data appear Approximate Lognormal at 10% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

## Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | 4.605 | Mean of logged Data | 5.186 |
| Maximum of Logged Data | 5.521 | SD of logged Data | 0.278 |

## Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 225.7 | 90% Chebyshev (MVUE) UCL | 236.5 |
| 95% Chebyshev (MVUE) UCL | 259.9 | 97.5% Chebyshev (MVUE) UCL | 292.3 |
| 99% Chebyshev (MVUE) UCL | 356 | | |

## Nonparametric Distribution Free UCL Statistics

**Data appear to follow a Discernible Distribution**

## Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 209.6 | 95% BCA Bootstrap UCL | 205.6 |
| 95% Standard Bootstrap UCL | 208.5 | 95% Bootstrap-t UCL | 213.3 |
| 95% Hall's Bootstrap UCL | 210.6 | 95% Percentile Bootstrap UCL | 207.8 |
| 90% Chebyshev(Mean, Sd) UCL | 230.3 | 95% Chebyshev(Mean, Sd) UCL | 251.1 |
| 97.5% Chebyshev(Mean, Sd) UCL | 279.9 | 99% Chebyshev(Mean, Sd) UCL | 336.5 |

## Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% Student's-t UCL | 212.9 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

| Nitrite - MW-4R | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | | 5 |
| Number of Detects | 4 | Number of Non-Detects | | 5 |
| Number of Distinct Detects | 4 | Number of Distinct Non-Detects | | 1 |
| Minimum Detect | 0.017 | Minimum Non-Detect | | 0.015 |
| Maximum Detect | 0.16 | Maximum Non-Detect | | 0.015 |
| Variance Detects | 0.0038 | Percent Non-Detects | | 55.56% |
| Mean Detects | 0.0925 | SD Detects | | 0.0616 |
| Median Detects | 0.0965 | CV Detects | | 0.666 |
| Skewness Detects | -0.312 | Kurtosis Detects | | -1.027 |
| Mean of Logged Detects | -2.661 | SD of Logged Detects | | 0.996 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.989 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.687 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.172 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.413 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0494 | KM Standard Error of Mean | 0.0202 |
| 90KM SD | 0.0524 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.087 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.0826 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.11 | 95% KM Chebyshev UCL | 0.137 |
| 97.5% KM Chebyshev UCL | 0.175 | 99% KM Chebyshev UCL | 0.25 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.312 | Anderson-Darling GOF Test | |
| 5% A-D Critical Value | 0.661 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.231 | Kolmogorov-Smirnov GOF | |
| 5% K-S Critical Value | 0.398 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 1.932 | k star (bias corrected MLE) | 0.65 |
| Theta hat (MLE) | 0.0479 | Theta star (bias corrected MLE) | 0.142 |
| nu hat (MLE) | 15.45 | nu star (bias corrected) | 5.197 |
| Mean (detects) | 0.0925 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.01 | | Mean | 0.0467 |
| Maximum | 0.16 | | Median | 0.01 |
| SD | 0.0576 | | CV | 1.234 |
| k hat (MLE) | 0.868 | | k star (bias corrected MLE) | 0.653 |
| Theta hat (MLE) | 0.0538 | | Theta star (bias corrected MLE) | 0.0715 |
| nu hat (MLE) | 15.63 | | nu star (bias corrected) | 11.75 |
| Adjusted Level of Significance (β) | 0.0231 | | | |
| Approximate Chi Square Value (11.75, α) | 5.064 | | Adjusted Chi Square Value (11.75, β) | 4.177 |
| 95% Gamma Approximate UCL | 0.108 | | 95% Gamma Adjusted UCL | N/A |
| | | | | |
| Estimates of Gamma Parameters using KM Estimates | | | | |
| Mean (KM) | 0.0494 | | SD (KM) | 0.0524 |
| Variance (KM) | 0.00275 | | SE of Mean (KM) | 0.0202 |
| k hat (KM) | 0.889 | | k star (KM) | 0.667 |
| nu hat (KM) | 16.01 | | nu star (KM) | 12.01 |
| theta hat (KM) | 0.0556 | | theta star (KM) | 0.0741 |
| 80% gamma percentile (KM) | 0.0814 | | 90% gamma percentile (KM) | 0.126 |
| 95% gamma percentile (KM) | 0.171 | | 99% gamma percentile (KM) | 0.281 |
| | | | | |
| Gamma Kaplan-Meier (KM) Statistics | | | | |
| Approximate Chi Square Value (12.01, α) | 5.231 | | Adjusted Chi Square Value (12.01, β) | 4.326 |
| 95% KM Approximate Gamma UCL | 0.113 | | 95% KM Adjusted Gamma UCL | 0.137 |
| | | | | |
| Lognormal GOF Test on Detected Observations Only | | | | |
| Shapiro Wilk Test Statistic | 0.885 | | Shapiro Wilk GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.792 | | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.268 | | Lilliefors GOF Test | |
| 10% Lilliefors Critical Value | 0.346 | | Detected Data appear Lognormal at 10% Significance Level | |
| Detected Data appear Lognormal at 10% Significance Level | | | | |
| Note GOF tests may be unreliable for small sample sizes | | | | |
| | | | | |
| Lognormal ROS Statistics Using Imputed Non-Detects | | | | |
| Mean in Original Scale | 0.0436 | | Mean in Log Scale | -4.379 |
| SD in Original Scale | 0.0598 | | SD in Log Scale | 1.883 |
| 95% t UCL (assumes normality of ROS data) | 0.0807 | | 95% Percentile Bootstrap UCL | 0.077 |
| 95% BCA Bootstrap UCL | 0.0832 | | 95% Bootstrap t UCL | 0.121 |
| 95% H-UCL (Log ROS) | 2.704 | | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -3.516 | KM Geo Mean | 0.0297 |
| KM SD (logged) | 0.957 | 95% Critical H Value (KM-Log) | 3.144 |
| KM Standard Error of Mean (logged) | 0.368 | 95% H-UCL (KM -Log) | 0.136 |
| KM SD (logged) | 0.957 | 95% Critical H Value (KM-Log) | 3.144 |
| KM Standard Error of Mean (logged) | 0.368 | | |
| | | | |
| DL/2 Statistics | | | |
| DL/2 Normal | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.0453 | Mean in Log Scale | -3.901 |
| SD in Original Scale | 0.0586 | SD in Log Scale | 1.325 |
| 95% t UCL (Assumes normality) | 0.0816 | 95% H-Stat UCL | 0.317 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | |
| | | | |
| Nonparametric Distribution Free UCL Statistics | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | |
| | | | |
| Suggested UCL to Use | | | |
| 95% KM (t) UCL | 0.087 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

## Arsenic - MW-4R

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0098 | Mean | 0.012 |
| Maximum | 0.016 | Median | 0.012 |
| SD | 0.00183 | Std. Error of Mean | 6.1050E-4 |
| Coefficient of Variation | 0.153 | Skewness | 1.233 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.866 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.273 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0131 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0133 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0132 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.525 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.721 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.254 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 51.62 | k star (bias corrected MLE) | 34.49 |
| Theta hat (MLE) | 2.3202E-4 | Theta star (bias corrected MLE) | 3.4728E-4 |
| nu hat (MLE) | 929.2 | nu star (bias corrected) | 620.8 |
| MLE Mean (bias corrected) | 0.012 | MLE Sd (bias corrected) | 0.00204 |
| | | Approximate Chi Square Value (0.05) | 564 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 552.6 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0132 | 95% Adjusted Gamma UCL | 0.0135 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.246 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.625 | Mean of logged Data | -4.434 |
| Maximum of Logged Data | -4.135 | SD of logged Data | 0.146 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0132 | 90% Chebyshev (MVUE) UCL | 0.0137 |
| 95% Chebyshev (MVUE) UCL | 0.0145 | 97.5% Chebyshev (MVUE) UCL | 0.0156 |
| 99% Chebyshev (MVUE) UCL | 0.0178 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.013 | 95% BCA Bootstrap UCL | 0.0131 |
| 95% Standard Bootstrap UCL | 0.0129 | 95% Bootstrap-t UCL | 0.0134 |
| 95% Hall's Bootstrap UCL | 0.0187 | 95% Percentile Bootstrap UCL | 0.013 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0138 | 95% Chebyshev(Mean, Sd) UCL | 0.0146 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0158 | 99% Chebyshev(Mean, Sd) UCL | 0.0181 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0131 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Iron - MW-4R**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 | |
| Number of Detects | 7 | Number of Non-Detects | 2 | |
| Number of Distinct Detects | 7 | Number of Distinct Non-Detects | 1 | |
| Minimum Detect | 0.038 | Minimum Non-Detect | 0.08 | |
| Maximum Detect | 0.2 | Maximum Non-Detect | 0.08 | |
| Variance Detects | 0.00361 | Percent Non-Detects | 22.22% | |
| Mean Detects | 0.109 | SD Detects | 0.0601 | |
| Median Detects | 0.096 | CV Detects | 0.551 | |
| Skewness Detects | 0.672 | Kurtosis Detects | -0.948 | |
| Mean of Logged Detects | -2.354 | SD of Logged Detects | 0.581 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.913 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.73 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.208 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.35 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0979 | KM Standard Error of Mean | 0.0196 |
| 90KM SD | 0.0538 | 95% KM (BCA) UCL | 0.129 |
| 95% KM (t) UCL | 0.134 | 95% KM (Percentile Bootstrap) UCL | 0.129 |
| 95% KM (z) UCL | 0.13 | 95% KM Bootstrap t UCL | 0.156 |
| 90% KM Chebyshev UCL | 0.157 | 95% KM Chebyshev UCL | 0.184 |
| 97.5% KM Chebyshev UCL | 0.221 | 99% KM Chebyshev UCL | 0.293 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.24 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.71 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.176 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.313 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 3.783 | k star (bias corrected MLE) | 2.257 |
| Theta hat (MLE) | 0.0288 | Theta star (bias corrected MLE) | 0.0483 |
| nu hat (MLE) | 52.96 | nu star (bias corrected) | 31.6 |
| Mean (detects) | 0.109 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.038 | Mean | 0.097 |
| Maximum | 0.2 | Median | 0.073 |
| SD | 0.0577 | CV | 0.595 |
| k hat (MLE) | 3.484 | k star (bias corrected MLE) | 2.397 |
| Theta hat (MLE) | 0.0278 | Theta star (bias corrected MLE) | 0.0405 |
| nu hat (MLE) | 62.72 | nu star (bias corrected) | 43.14 |
| Adjusted Level of Significance (β) | 0.0231 | | |
| Approximate Chi Square Value (43.14, α) | 29.08 | Adjusted Chi Square Value (43.14, β) | 26.67 |
| 95% Gamma Approximate UCL | 0.144 | 95% Gamma Adjusted UCL | 0.157 |
| | | | |
| Estimates of Gamma Parameters using KM Estimates | | | |
| Mean (KM) | 0.0979 | SD (KM) | 0.0538 |
| Variance (KM) | 0.00289 | SE of Mean (KM) | 0.0196 |
| k hat (KM) | 3.314 | k star (KM) | 2.283 |
| nu hat (KM) | 59.65 | nu star (KM) | 41.1 |
| theta hat (KM) | 0.0295 | theta star (KM) | 0.0429 |
| 80% gamma percentile (KM) | 0.144 | 90% gamma percentile (KM) | 0.185 |
| 95% gamma percentile (KM) | 0.223 | 99% gamma percentile (KM) | 0.307 |
| | | | |
| Gamma Kaplan-Meier (KM) Statistics | | | |
| Approximate Chi Square Value (41.10, α) | 27.41 | Adjusted Chi Square Value (41.10, β) | 25.07 |
| 95% KM Approximate Gamma UCL | 0.147 | 95% KM Adjusted Gamma UCL | 0.16 |
| | | | |
| Lognormal GOF Test on Detected Observations Only | | | |
| Shapiro Wilk Test Statistic | 0.963 | Shapiro Wilk GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.838 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.15 | Lilliefors GOF Test | |
| 10% Lilliefors Critical Value | 0.28 | Detected Data appear Lognormal at 10% Significance Level | |
| Detected Data appear Lognormal at 10% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |
| | | | |
| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
| Mean in Original Scale | 0.0974 | Mean in Log Scale | -2.473 |
| SD in Original Scale | 0.0572 | SD in Log Scale | 0.563 |
| 95% t UCL (assumes normality of ROS data) | 0.133 | 95% Percentile Bootstrap UCL | 0.129 |
| 95% BCA Bootstrap UCL | 0.132 | 95% Bootstrap t UCL | 0.16 |
| 95% H-UCL (Log ROS) | 0.158 | | |
| | | | |
| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
| KM Mean (logged) | -2.469 | KM Geo Mean | 0.0847 |
| KM SD (logged) | 0.538 | 95% Critical H Value (KM-Log) | 2.293 |
| KM Standard Error of Mean (logged) | 0.204 | 95% H-UCL (KM -Log) | 0.151 |
| KM SD (logged) | 0.538 | 95% Critical H Value (KM-Log) | 2.293 |
| KM Standard Error of Mean (logged) | 0.204 | | |

| DL/2 Statistics | | | | |
|---|---|---|---|---|
| **DL/2 Normal** | | **DL/2 Log-Transformed** | | |
| Mean in Original Scale | 0.0937 | Mean in Log Scale | -2.546 | |
| SD in Original Scale | 0.0603 | SD in Log Scale | 0.631 | |
| 95% t UCL (Assumes normality) | 0.131 | 95% H-Stat UCL | 0.167 | |
| **DL/2 is not a recommended method, provided for comparisons and historical reasons** | | | | |
| | | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | | |
| **Detected Data appear Normal Distributed at 1% Significance Level** | | | | |
| | | | | |
| **Suggested UCL to Use** | | | | |
| 95% KM (t) UCL | 0.134 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |

| Manganese - MW-4R | | | | |
|---|---|---|---|---|

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.34 | Mean | 0.421 |
| Maximum | 0.61 | Median | 0.41 |
| SD | 0.0925 | Std. Error of Mean | 0.0308 |
| Coefficient of Variation | 0.22 | Skewness | 1.312 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.835 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.283 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.478 | 95% Adjusted-CLT UCL (Chen-1995) | 0.486 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.481 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.578 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.721 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.257 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 26.07 | k star (bias corrected MLE) | 17.45 |
| Theta hat (MLE) | 0.0162 | Theta star (bias corrected MLE) | 0.0241 |
| nu hat (MLE) | 469.2 | nu star (bias corrected) | 314.1 |
| MLE Mean (bias corrected) | 0.421 | MLE Sd (bias corrected) | 0.101 |
| | | Approximate Chi Square Value (0.05) | 274.1 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 266.2 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.483 | 95% Adjusted Gamma UCL | 0.497 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.871 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.245 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -1.079 | Mean of logged Data | -0.884 |
| Maximum of Logged Data | -0.494 | SD of logged Data | 0.203 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.484 | 90% Chebyshev (MVUE) UCL | 0.506 |
| 95% Chebyshev (MVUE) UCL | 0.545 | 97.5% Chebyshev (MVUE) UCL | 0.599 |
| 99% Chebyshev (MVUE) UCL | 0.705 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.472 | 95% BCA Bootstrap UCL | 0.488 |
| 95% Standard Bootstrap UCL | 0.471 | 95% Bootstrap-t UCL | 0.539 |
| 95% Hall's Bootstrap UCL | 0.793 | 95% Percentile Bootstrap UCL | 0.474 |
| 90% Chebyshev(Mean, Sd) UCL | 0.514 | 95% Chebyshev(Mean, Sd) UCL | 0.556 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.614 | 99% Chebyshev(Mean, Sd) UCL | 0.728 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.478 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

## 2,4-D - MW-4R

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 6 |
| Number of Detects | 2 | Number of Non-Detects | 7 |
| Number of Distinct Detects | 2 | Number of Distinct Non-Detects | 4 |
| Minimum Detect | 3.0000E-4 | Minimum Non-Detect | 2.4000E-4 |
| Maximum Detect | 3.3000E-4 | Maximum Non-Detect | 2.9000E-4 |
| Variance Detects | 4.500E-10 | Percent Non-Detects | 77.78% |
| Mean Detects | 3.1500E-4 | SD Detects | 2.1213E-5 |
| Median Detects | 3.1500E-4 | CV Detects | 0.0673 |
| Skewness Detects | N/A | Kurtosis Detects | N/A |
| Mean of Logged Detects | -8.064 | SD of Logged Detects | 0.0674 |

### Warning: Data set has only 2 Detected Values.
### This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only
### Not Enough Data to Perform GOF Test

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 2.5667E-4 | KM Standard Error of Mean | 1.5072E-5 |
| 90KM SD | 3.1972E-5 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 2.8469E-4 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 2.8146E-4 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 3.0188E-4 | 95% KM Chebyshev UCL | 3.2236E-4 |
| 97.5% KM Chebyshev UCL | 3.5079E-4 | 99% KM Chebyshev UCL | 4.0663E-4 |

### Gamma GOF Tests on Detected Observations Only
### Not Enough Data to Perform GOF Test

### Gamma Statistics on Detected Data Only

| | | | |
|---|---|---|---|
| k hat (MLE) | 440.7 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 7.1483E-7 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 1763 | nu star (bias corrected) | N/A |
| Mean (detects) | 3.1500E-4 | | |

## Estimates of Gamma Parameters using KM Estimates

| | | | |
|---|---|---|---|
| Mean (KM) | 2.5667E-4 | SD (KM) | 3.1972E-5 |
| Variance (KM) | 1.0222E-9 | SE of Mean (KM) | 1.5072E-5 |
| k hat (KM) | 64.45 | k star (KM) | 43.04 |
| nu hat (KM) | 1160 | nu star (KM) | 774.7 |
| theta hat (KM) | 3.9827E-6 | theta star (KM) | 5.9637E-6 |
| 80% gamma percentile (KM) | 2.8888E-4 | 90% gamma percentile (KM) | 3.0791E-4 |
| 95% gamma percentile (KM) | 3.2423E-4 | 99% gamma percentile (KM) | 3.5634E-4 |

## Gamma Kaplan-Meier (KM) Statistics

| | | | |
|---|---|---|---|
| | | Adjusted Level of Significance ($\beta$) | 0.0231 |
| Approximate Chi Square Value (774.68, $\alpha$) | 711.1 | Adjusted Chi Square Value (774.68, $\beta$) | 698.2 |
| 95% KM Approximate Gamma UCL | 2.7962E-4 | 95% KM Adjusted Gamma UCL | 2.8478E-4 |

## Lognormal GOF Test on Detected Observations Only
### Not Enough Data to Perform GOF Test

## Lognormal ROS Statistics Using Imputed Non-Detects

| | | | |
|---|---|---|---|
| Mean in Original Scale | 2.4018E-4 | Mean in Log Scale | -8.349 |
| SD in Original Scale | 4.6120E-5 | SD in Log Scale | 0.18 |
| 95% t UCL (assumes normality of ROS data) | 2.6877E-4 | 95% Percentile Bootstrap UCL | 2.6561E-4 |
| 95% BCA Bootstrap UCL | 2.6865E-4 | 95% Bootstrap t UCL | 2.9534E-4 |
| 95% H-UCL (Log ROS) | 2.7121E-4 | | |

## Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| KM Mean (logged) | -8.275 | KM Geo Mean | 2.5489E-4 |
| KM SD (logged) | 0.115 | 95% Critical H Value (KM-Log) | 1.834 |
| KM Standard Error of Mean (logged) | 0.0541 | 95% H-UCL (KM -Log) | 2.7640E-4 |
| KM SD (logged) | 0.115 | 95% Critical H Value (KM-Log) | 1.834 |
| KM Standard Error of Mean (logged) | 0.0541 | | |

## DL/2 Statistics

| DL/2 Normal | | DL/2 Log-Transformed | |
|---|---|---|---|
| Mean in Original Scale | 1.7389E-4 | Mean in Log Scale | -8.733 |
| SD in Original Scale | 8.0846E-5 | SD in Log Scale | 0.386 |
| 95% t UCL (Assumes normality) | 2.2400E-4 | 95% H-Stat UCL | 2.3181E-4 |

### DL/2 is not a recommended method, provided for comparisons and historical reasons

## Nonparametric Distribution Free UCL Statistics
### Data do not follow a Discernible Distribution

## Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 2.8469E-4 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Dinoseb - MW-4R | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | | 8 |
| | | Number of Missing Observations | | 0 |
| Minimum | 0.0077 | Mean | | 0.0235 |
| Maximum | 0.054 | Median | | 0.021 |
| SD | 0.0158 | Std. Error of Mean | | 0.00526 |
| Coefficient of Variation | 0.672 | Skewness | | 0.799 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.891 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.191 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |
| Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
| 95% Student's-t UCL | 0.0333 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0336 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0335 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.4 | Anderson-Darling Gamma GOF Test | |
| 5% A-D Critical Value | 0.728 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.175 | Kolmogorov-Smirnov Gamma GOF Test | |
| 5% K-S Critical Value | 0.282 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 2.436 | k star (bias corrected MLE) | 1.698 |
| Theta hat (MLE) | 0.00964 | Theta star (bias corrected MLE) | 0.0138 |
| nu hat (MLE) | 43.84 | nu star (bias corrected) | 30.56 |
| MLE Mean (bias corrected) | 0.0235 | MLE Sd (bias corrected) | 0.018 |
| | | Approximate Chi Square Value (0.05) | 18.94 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 17.03 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0379 | 95% Adjusted Gamma UCL | 0.0421 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.91 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.184 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.867 | Mean of logged Data | -3.971 |
| Maximum of Logged Data | -2.919 | SD of logged Data | 0.722 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0482 | 90% Chebyshev (MVUE) UCL | 0.0412 |
| 95% Chebyshev (MVUE) UCL | 0.0491 | 97.5% Chebyshev (MVUE) UCL | 0.0601 |
| 99% Chebyshev (MVUE) UCL | 0.0817 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0321 | 95% BCA Bootstrap UCL | 0.0328 |
| 95% Standard Bootstrap UCL | 0.0315 | 95% Bootstrap-t UCL | 0.0357 |
| 95% Hall's Bootstrap UCL | 0.0335 | 95% Percentile Bootstrap UCL | 0.0317 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0393 | 95% Chebyshev(Mean, Sd) UCL | 0.0464 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0563 | 99% Chebyshev(Mean, Sd) UCL | 0.0758 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0333 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

**1,2-DCP - MW-4R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0049 | Mean | 0.00616 |
| Maximum | 0.0072 | Median | 0.006 |
| SD | 7.1259E-4 | Std. Error of Mean | 2.3753E-4 |
| Coefficient of Variation | 0.116 | Skewness | -0.286 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.973 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.142 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0066 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00652 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.00659 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.221 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.72 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.147 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 81.55 | k star (bias corrected MLE) | 54.44 |
| Theta hat (MLE) | 7.5484E-5 | Theta star (bias corrected MLE) | 1.1307E-4 |
| nu hat (MLE) | 1468 | nu star (bias corrected) | 979.9 |
| MLE Mean (bias corrected) | 0.00616 | MLE Sd (bias corrected) | 8.3428E-4 |
| | | Approximate Chi Square Value (0.05) | 908.2 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 893.6 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.00664 | 95% Adjusted Gamma UCL | 0.00675 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.963 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.14 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -5.319 | Mean of logged Data | -5.097 |
| Maximum of Logged Data | -4.934 | SD of logged Data | 0.119 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.00665 | 90% Chebyshev (MVUE) UCL | 0.00689 |
| 95% Chebyshev (MVUE) UCL | 0.00722 | 97.5% Chebyshev (MVUE) UCL | 0.00768 |
| 99% Chebyshev (MVUE) UCL | 0.00858 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.00655 | 95% BCA Bootstrap UCL | 0.00651 |
| 95% Standard Bootstrap UCL | 0.00653 | 95% Bootstrap-t UCL | 0.00659 |
| 95% Hall's Bootstrap UCL | 0.00655 | 95% Percentile Bootstrap UCL | 0.00652 |
| 90% Chebyshev(Mean, Sd) UCL | 0.00687 | 95% Chebyshev(Mean, Sd) UCL | 0.00719 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.00764 | 99% Chebyshev(Mean, Sd) UCL | 0.00852 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0066 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |
| | | | |
| | | | |

| Chlorobenzene - MW-4R | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 1 |
| Number of Detects | 7 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 5 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 3.5000E-4 | Minimum Non-Detect | 3.0000E-4 |
| Maximum Detect | 6.5000E-4 | Maximum Non-Detect | 3.0000E-4 |
| Variance Detects | 7.9905E-9 | Percent Non-Detects | 12.5% |
| Mean Detects | 4.8714E-4 | SD Detects | 8.9389E-5 |
| Median Detects | 5.0000E-4 | CV Detects | 0.183 |
| Skewness Detects | 0.547 | Kurtosis Detects | 2.346 |
| Mean of Logged Detects | -7.641 | SD of Logged Detects | 0.184 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.9 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.73 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.3 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.35 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 4.6375E-4 | KM Standard Error of Mean | 3.7849E-5 |
| 90KM SD | 9.9113E-5 | 95% KM (BCA) UCL | 5.1875E-4 |
| 95% KM (t) UCL | 5.3546E-4 | 95% KM (Percentile Bootstrap) UCL | 5.2500E-4 |
| 95% KM (z) UCL | 5.2601E-4 | 95% KM Bootstrap t UCL | 5.3029E-4 |
| 90% KM Chebyshev UCL | 5.7730E-4 | 95% KM Chebyshev UCL | 6.2873E-4 |
| 97.5% KM Chebyshev UCL | 7.0012E-4 | 99% KM Chebyshev UCL | 8.4035E-4 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.474 | Anderson-Darling GOF Test | |
| 5% A-D Critical Value | 0.707 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.274 | Kolmogorov-Smirnov GOF | |
| 5% K-S Critical Value | 0.311 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 34.92 | k star (bias corrected MLE) | 20.05 |
| Theta hat (MLE) | 1.3949E-5 | Theta star (bias corrected MLE) | 2.4295E-5 |
| nu hat (MLE) | 488.9 | nu star (bias corrected) | 280.7 |
| Mean (detects) | 4.8714E-4 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 3.5000E-4 | Mean | 0.00168 |
| Maximum | 0.01 | Median | 5.0000E-4 |
| SD | 0.00336 | CV | 2.007 |
| k hat (MLE) | 0.695 | k star (bias corrected MLE) | 0.518 |
| Theta hat (MLE) | 0.00241 | Theta star (bias corrected MLE) | 0.00324 |
| nu hat (MLE) | 11.12 | nu star (bias corrected) | 8.282 |
| Adjusted Level of Significance (β) | 0.0195 | | |
| Approximate Chi Square Value (8.28, α) | 2.899 | Adjusted Chi Square Value (8.28, β) | 2.157 |
| 95% Gamma Approximate UCL | 0.00479 | 95% Gamma Adjusted UCL | 0.00644 |

| Estimates of Gamma Parameters using KM Estimates | | | |
|---|---|---|---|
| Mean (KM) | 4.6375E-4 | SD (KM) | 9.9113E-5 |
| Variance (KM) | 9.8234E-9 | SE of Mean (KM) | 3.7849E-5 |
| k hat (KM) | 21.89 | k star (KM) | 13.77 |
| nu hat (KM) | 350.3 | nu star (KM) | 220.3 |
| theta hat (KM) | 2.1183E-5 | theta star (KM) | 3.3687E-5 |
| 80% gamma percentile (KM) | 5.6436E-4 | 90% gamma percentile (KM) | 6.2940E-4 |
| 95% gamma percentile (KM) | 6.8664E-4 | 99% gamma percentile (KM) | 8.0284E-4 |

| Gamma Kaplan-Meier (KM) Statistics | | | |
|---|---|---|---|
| Approximate Chi Square Value (220.26, α) | 186.9 | Adjusted Chi Square Value (220.26, β) | 179.1 |
| 95% KM Approximate Gamma UCL | 5.4649E-4 | 95% KM Adjusted Gamma UCL | 5.7025E-4 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.91 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.838 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.27 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.28 | Detected Data appear Lognormal at 10% Significance Level |
| Detected Data appear Lognormal at 10% Significance Level | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 4.6532E-4 | Mean in Log Scale | -7.695 |
| SD in Original Scale | 1.0323E-4 | SD in Log Scale | 0.228 |
| 95% t UCL (assumes normality of ROS data) | 5.3447E-4 | 95% Percentile Bootstrap UCL | 5.2500E-4 |
| 95% BCA Bootstrap UCL | 5.2500E-4 | 95% Bootstrap t UCL | 5.4033E-4 |
| 95% H-UCL (Log ROS) | 5.5365E-4 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -7.7 | KM Geo Mean | 4.5277E-4 |
| KM SD (logged) | 0.223 | 95% Critical H Value (KM-Log) | 1.967 |
| KM Standard Error of Mean (logged) | 0.085 | 95% H-UCL (KM -Log) | 5.4764E-4 |
| KM SD (logged) | 0.223 | 95% Critical H Value (KM-Log) | 1.967 |
| KM Standard Error of Mean (logged) | 0.085 | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | |
| Mean in Original Scale | 4.4500E-4 | Mean in Log Scale | -7.787 |
| SD in Original Scale | 1.4511E-4 | SD in Log Scale | 0.445 |
| 95% t UCL (Assumes normality) | 5.4220E-4 | 95% H-Stat UCL | 6.7100E-4 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

**Nonparametric Distribution Free UCL Statistics**

**Detected Data appear Normal Distributed at 1% Significance Level**

**Suggested UCL to Use**

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 5.3546E-4 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| UCL Statistics for Data Sets with Non-Detects | | | |
|---|---|---|---|

| User Selected Options | | | |
|---|---|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:11:07 PM | | |
| From File | mw06_3year_data.xls | | |
| Full Precision | OFF | | |
| Confidence Coefficient | 95% | | |
| Number of Bootstrap Operations | 2000 | | |

**Nitrate - MW-6**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 4.4 | Mean | 5.65 |
| Maximum | 6.8 | Median | 5.7 |
| SD | 1.063 | Std. Error of Mean | 0.532 |
| Coefficient of Variation | 0.188 | Skewness | -0.198 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.974 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.198 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |
| Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 6.901 | 95% Adjusted-CLT UCL (Chen-1995) | 6.468 |
| | | 95% Modified-t UCL (Johnson-1978) | 6.892 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.243 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.656 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.234 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.394 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 36.6 | | k star (bias corrected MLE) | 9.318 |
| Theta hat (MLE) | 0.154 | | Theta star (bias corrected MLE) | 0.606 |
| nu hat (MLE) | 292.8 | | nu star (bias corrected) | 74.54 |
| MLE Mean (bias corrected) | 5.65 | | MLE Sd (bias corrected) | 1.851 |
| | | | Approximate Chi Square Value (0.05) | 55.66 |
| Adjusted Level of Significance | N/A | | Adjusted Chi Square Value | N/A |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 7.567 | | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.968 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.21 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 1.482 | | Mean of logged Data | 1.718 |
| Maximum of Logged Data | 1.917 | | SD of logged Data | 0.193 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 7.453 | | 90% Chebyshev (MVUE) UCL | 7.282 |
| 95% Chebyshev (MVUE) UCL | 8.02 | | 97.5% Chebyshev (MVUE) UCL | 9.045 |
| 99% Chebyshev (MVUE) UCL | 11.06 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| **Data appear to follow a Discernible Distribution** |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 6.524 | | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 7.245 | | 95% Chebyshev(Mean, Sd) UCL | 7.967 |
| 97.5% Chebyshev(Mean, Sd) UCL | 8.969 | | 99% Chebyshev(Mean, Sd) UCL | 10.94 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 6.901 | | |
| **Recommended UCL exceeds the maximum observation** | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

**Arsenic - MW-6**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 2 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.025 | Mean | 0.0253 |
| Maximum | 0.026 | Median | 0.025 |
| SD | 5.0000E-4 | Std. Error of Mean | 2.5000E-4 |
| Coefficient of Variation | 0.0198 | Skewness | 2 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.63 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.687 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.441 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.413 | Data Not Normal at 1% Significance Level |
| **Data Not Normal at 1% Significance Level** | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0258 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0259 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0259 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.992 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.657 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.479 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.394 | Data Not Gamma Distributed at 5% Significance Level |
| **Data Not Gamma Distributed at 5% Significance Level** | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3445 | k star (bias corrected MLE) | 861.4 |
| Theta hat (MLE) | 7.3298E-6 | Theta star (bias corrected MLE) | 2.9314E-5 |
| nu hat (MLE) | 27559 | nu star (bias corrected) | 6891 |
| MLE Mean (bias corrected) | 0.0253 | MLE Sd (bias corrected) | 8.6033E-4 |
| | | Approximate Chi Square Value (0.05) | 6699 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.026 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.63 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.441 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -3.689 | Mean of logged Data | -3.679 |
| Maximum of Logged Data | -3.65 | SD of logged Data | 0.0196 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.026 |
| 95% Chebyshev (MVUE) UCL | 0.0263 | 97.5% Chebyshev (MVUE) UCL | 0.0268 |
| 99% Chebyshev (MVUE) UCL | 0.0277 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data do not follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0257 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.026 | 95% Chebyshev(Mean, Sd) UCL | 0.0263 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0268 | 99% Chebyshev(Mean, Sd) UCL | 0.0277 |
| | | | |
| **Suggested UCL to Use** | | | |
| Recommendation cannot be provided | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**Manganese - MW-6**

## General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 3 | Number of Distinct Observations | 3 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.041 | Mean | 0.184 |
| Maximum | 0.27 | Median | 0.24 |
| SD | 0.124 | Std. Error of Mean | 0.0719 |
| Coefficient of Variation | 0.678 | Skewness | -1.62 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

## Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.846 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.753 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.341 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.429 | Data appear Normal at 1% Significance Level |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

## Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.393 | 95% Adjusted-CLT UCL (Chen-1995) | 0.23 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.382 |

## Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.528 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.637 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.401 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.436 | Detected data appear Gamma Distributed at 5% Significance Level |

**Data Not Gamma Distributed at 5% Significance Level**

## Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.921 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 0.0956 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 11.53 | nu star (bias corrected) | N/A |
| MLE Mean (bias corrected) | N/A | MLE Sd (bias corrected) | N/A |
| | | Approximate Chi Square Value (0.05) | N/A |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

## Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | N/A | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.797 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.789 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.365 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.389 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -3.194 | Mean of logged Data | -1.977 |
| Maximum of Logged Data | -1.309 | SD of logged Data | 1.056 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 7119 | 90% Chebyshev (MVUE) UCL | 0.51 |
| 95% Chebyshev (MVUE) UCL | 0.652 | 97.5% Chebyshev (MVUE) UCL | 0.85 |
| 99% Chebyshev (MVUE) UCL | 1.239 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.302 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.399 | 95% Chebyshev(Mean, Sd) UCL | 0.497 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.632 | 99% Chebyshev(Mean, Sd) UCL | 0.899 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.393 | | |
| **Recommended UCL exceeds the maximum observation** | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |

| UCL Statistics for Uncensored Full Data Sets | | | | |
|---|---|---|---|---|

| User Selected Options | | | | |
|---|---|---|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:12:33 PM | | | |
| From File | mw07_3year_data.xls | | | |
| Full Precision | OFF | | | |
| Confidence Coefficient | 95% | | | |
| Number of Bootstrap Operations | 2000 | | | |

**Nitrate - MW-7**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 | |
| | | Number of Missing Observations | 0 | |
| Minimum | 1.6 | Mean | 4.3 | |
| Maximum | 7 | Median | 4.4 | |
| SD | 1.788 | Std. Error of Mean | 0.73 | |
| Coefficient of Variation | 0.416 | Skewness | -0.0189 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.98 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.181 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 5.771 | 95% Adjusted-CLT UCL (Chen-1995) | 5.494 |
| | | 95% Modified-t UCL (Johnson-1978) | 5.77 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.298 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.698 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.2 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.333 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 5.702 | k star (bias corrected MLE) | 2.962 |
| Theta hat (MLE) | 0.754 | Theta star (bias corrected MLE) | 1.452 |
| nu hat (MLE) | 68.43 | nu star (bias corrected) | 35.55 |
| MLE Mean (bias corrected) | 4.3 | MLE Sd (bias corrected) | 2.498 |
| | | Approximate Chi Square Value (0.05) | 22.91 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 19.33 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 6.673 | 95% Adjusted Gamma UCL | 7.909 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.909 | Shapiro Wilk Lognormal GOF Test | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.22 | Lilliefors Lognormal GOF Test | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |

**Data appear Lognormal at 10% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| Lognormal Statistics | | | |
|---|---|---|---|
| Minimum of Logged Data | 0.47 | Mean of logged Data | 1.368 |
| Maximum of Logged Data | 1.946 | SD of logged Data | 0.5 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 8.027 | 90% Chebyshev (MVUE) UCL | 7.015 |
| 95% Chebyshev (MVUE) UCL | 8.22 | 97.5% Chebyshev (MVUE) UCL | 9.893 |
| 99% Chebyshev (MVUE) UCL | 13.18 | | |

**Nonparametric Distribution Free UCL Statistics**

**Data appear to follow a Discernible Distribution**

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 5.5 | 95% BCA Bootstrap UCL | 5.467 |
| 95% Standard Bootstrap UCL | 5.406 | 95% Bootstrap-t UCL | 5.802 |
| 95% Hall's Bootstrap UCL | 5.79 | 95% Percentile Bootstrap UCL | 5.4 |
| 90% Chebyshev(Mean, Sd) UCL | 6.49 | 95% Chebyshev(Mean, Sd) UCL | 7.481 |
| 97.5% Chebyshev(Mean, Sd) UCL | 8.858 | 99% Chebyshev(Mean, Sd) UCL | 11.56 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 5.771 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

**Arsenic - MW-7**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 3 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.012 | Mean | 0.013 |
| Maximum | 0.014 | Median | 0.013 |
| SD | 8.1650E-4 | Std. Error of Mean | 4.0825E-4 |
| Coefficient of Variation | 0.0628 | Skewness | 6.585E-15 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.944 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.25 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.014 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0137 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.014 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.331 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.657 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.257 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.394 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 337.2 | k star (bias corrected MLE) | 84.46 |
| Theta hat (MLE) | 3.8557E-5 | Theta star (bias corrected MLE) | 1.5392E-4 |
| nu hat (MLE) | 2697 | nu star (bias corrected) | 675.7 |
| MLE Mean (bias corrected) | 0.013 | MLE Sd (bias corrected) | 0.00141 |
| | | Approximate Chi Square Value (0.05) | 616.4 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0143 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | | |
|---|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.944 | | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.259 | | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | | |
| | | | | |
| **Lognormal Statistics** | | | | |
| Minimum of Logged Data | -4.423 | | Mean of logged Data | -4.344 |
| Maximum of Logged Data | -4.269 | | SD of logged Data | 0.063 |
| | | | | |
| **Assuming Lognormal Distribution** | | | | |
| 95% H-UCL | N/A | | 90% Chebyshev (MVUE) UCL | 0.0142 |
| 95% Chebyshev (MVUE) UCL | 0.0148 | | 97.5% Chebyshev (MVUE) UCL | 0.0156 |
| 99% Chebyshev (MVUE) UCL | 0.0171 | | | |
| | | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | | |
| **Data appear to follow a Discernible Distribution** | | | | |
| | | | | |
| **Nonparametric Distribution Free UCLs** | | | | |
| 95% CLT UCL | 0.0137 | | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0142 | | 95% Chebyshev(Mean, Sd) UCL | 0.0148 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0155 | | 99% Chebyshev(Mean, Sd) UCL | 0.0171 |
| | | | | |
| **Suggested UCL to Use** | | | | |
| 95% Student's-t UCL | 0.014 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| User Selected Options | | |
|---|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:14:07 PM | |
| From File | mw08_3year_data.xls | |
| Full Precision | OFF | |
| Confidence Coefficient | 95% | |
| Number of Bootstrap Operations | 2000 | |

**Nitrate - MW-8**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 | |
| | | Number of Missing Observations | 0 | |
| Minimum | 16 | Mean | 35.67 | |
| Maximum | 52 | Median | 37.5 | |
| SD | 15.65 | Std. Error of Mean | 6.391 | |
| Coefficient of Variation | 0.439 | Skewness | -0.207 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.877 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.245 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 48.54 | 95% Adjusted-CLT UCL (Chen-1995) | 45.6 |
| | | 95% Modified-t UCL (Johnson-1978) | 48.45 |

| Gamma GOF Test | | |
|---|---|---|
| A-D Test Statistic | 0.438 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.698 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.276 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.333 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 5.434 | k star (bias corrected MLE) | | 2.828 |
| Theta hat (MLE) | 6.564 | Theta star (bias corrected MLE) | | 12.61 |
| nu hat (MLE) | 65.2 | nu star (bias corrected) | | 33.94 |
| MLE Mean (bias corrected) | 35.67 | MLE Sd (bias corrected) | | 21.21 |
| | | Approximate Chi Square Value (0.05) | | 21.61 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | | 18.15 |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 56 | 95% Adjusted Gamma UCL | | 66.69 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.88 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.259 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 2.773 | Mean of logged Data | | 3.479 |
| Maximum of Logged Data | 3.951 | SD of logged Data | | 0.497 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 65.81 | 90% Chebyshev (MVUE) UCL | | 57.7 |
| 95% Chebyshev (MVUE) UCL | 67.58 | 97.5% Chebyshev (MVUE) UCL | | 81.29 |
| 99% Chebyshev (MVUE) UCL | 108.2 | | | |

| Nonparametric Distribution Free UCL Statistics | | | | |
|---|---|---|---|---|
| **Data appear to follow a Discernible Distribution** | | | | |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 46.18 | 95% BCA Bootstrap UCL | | 45 |
| 95% Standard Bootstrap UCL | 45.2 | 95% Bootstrap-t UCL | | 48.46 |
| 95% Hall's Bootstrap UCL | 42.47 | 95% Percentile Bootstrap UCL | | 45.17 |
| 90% Chebyshev(Mean, Sd) UCL | 54.84 | 95% Chebyshev(Mean, Sd) UCL | | 63.52 |
| 97.5% Chebyshev(Mean, Sd) UCL | 75.58 | 99% Chebyshev(Mean, Sd) UCL | | 99.26 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 48.54 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

**Arsenic - MW-8**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | | 3 |
| | | Number of Missing Observations | | 0 |
| Minimum | 0.01 | Mean | | 0.011 |
| Maximum | 0.012 | Median | | 0.011 |
| SD | 8.1650E-4 | Std. Error of Mean | | 4.0825E-4 |
| Coefficient of Variation | 0.0742 | Skewness | | 6.585E-15 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.944 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.25 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level |

**Data appear Normal at 1% Significance Level**

Note GOF tests may be unreliable for small sample sizes

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.012 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0117 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.012 |

| Gamma GOF Test | | |
|---|---|---|
| A-D Test Statistic | 0.331 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.657 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.259 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.394 | Detected data appear Gamma Distributed at 5% Significance Level |

**Detected data appear Gamma Distributed at 5% Significance Level**

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 241.2 | k star (bias corrected MLE) | 60.46 |
| Theta hat (MLE) | 4.5612E-5 | Theta star (bias corrected MLE) | 1.8194E-4 |
| nu hat (MLE) | 1929 | nu star (bias corrected) | 483.7 |
| MLE Mean (bias corrected) | 0.011 | MLE Sd (bias corrected) | 0.00141 |
| | | Approximate Chi Square Value (0.05) | 433.7 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0123 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.944 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.261 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.605 | Mean of logged Data | -4.512 |
| Maximum of Logged Data | -4.423 | SD of logged Data | 0.0745 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.0122 |
| 95% Chebyshev (MVUE) UCL | 0.0128 | 97.5% Chebyshev (MVUE) UCL | 0.0136 |
| 99% Chebyshev (MVUE) UCL | 0.0151 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0117 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0122 | 95% Chebyshev(Mean, Sd) UCL | 0.0128 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0135 | 99% Chebyshev(Mean, Sd) UCL | 0.0151 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.012 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**Manganese - MW-8**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.19 | Mean | 0.438 |
| Maximum | 0.61 | Median | 0.475 |
| SD | 0.204 | Std. Error of Mean | 0.102 |
| Coefficient of Variation | 0.467 | Skewness | -0.502 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.874 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.287 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.678 | 95% Adjusted-CLT UCL (Chen-1995) | 0.578 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.673 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.41 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.659 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.314 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.396 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 5.051 | k star (bias corrected MLE) | 1.429 |
| Theta hat (MLE) | 0.0866 | Theta star (bias corrected MLE) | 0.306 |
| nu hat (MLE) | 40.41 | nu star (bias corrected) | 11.44 |
| MLE Mean (bias corrected) | 0.438 | MLE Sd (bias corrected) | 0.366 |
| | | Approximate Chi Square Value (0.05) | 4.858 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 1.03 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.871 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.276 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -1.661 | Mean of logged Data | -0.929 |
| Maximum of Logged Data | -0.494 | SD of logged Data | 0.552 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 1.612 | 90% Chebyshev (MVUE) UCL | 0.799 |
| 95% Chebyshev (MVUE) UCL | 0.961 | 97.5% Chebyshev (MVUE) UCL | 1.186 |
| 99% Chebyshev (MVUE) UCL | 1.627 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.605 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.744 | 95% Chebyshev(Mean, Sd) UCL | 0.883 |
| 97.5% Chebyshev(Mean, Sd) UCL | 1.075 | 99% Chebyshev(Mean, Sd) UCL | 1.453 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.678 | | |
| **Recommended UCL exceeds the maximum observation** | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| User Selected Options | | |
|---|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:15:36 PM | |
| From File | mw09_3year_data.xls | |
| Full Precision | OFF | |
| Confidence Coefficient | 95% | |
| Number of Bootstrap Operations | 2000 | |

**Nitrate - MW-9**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 66 | Mean | 242.7 |
| Maximum | 350 | Median | 255 |
| SD | 104.8 | Std. Error of Mean | 42.79 |
| Coefficient of Variation | 0.432 | Skewness | -0.936 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.924 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.175 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 328.9 | 95% Adjusted-CLT UCL (Chen-1995) | 295.6 |
| | | 95% Modified-t UCL (Johnson-1978) | 326.2 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.496 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.7 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.247 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.333 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 4.205 | k star (bias corrected MLE) | | 2.213 |
| Theta hat (MLE) | 57.71 | Theta star (bias corrected MLE) | | 109.6 |
| nu hat (MLE) | 50.46 | nu star (bias corrected) | | 26.56 |
| MLE Mean (bias corrected) | 242.7 | MLE Sd (bias corrected) | | 163.1 |
| | | Approximate Chi Square Value (0.05) | | 15.81 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | | 12.92 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 407.6 | 95% Adjusted Gamma UCL | 499 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.801 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.288 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Approximate Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | |
|---|---|---|---|
| Minimum of Logged Data | 4.19 | Mean of logged Data | 5.368 |
| Maximum of Logged Data | 5.858 | SD of logged Data | 0.618 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 585.4 | 90% Chebyshev (MVUE) UCL | 439.8 |
| 95% Chebyshev (MVUE) UCL | 525.5 | 97.5% Chebyshev (MVUE) UCL | 644.4 |
| 99% Chebyshev (MVUE) UCL | 878 | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| **Data appear to follow a Discernible Distribution** |

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 313.1 | 95% BCA Bootstrap UCL | 296.7 |
| 95% Standard Bootstrap UCL | 307.6 | 95% Bootstrap-t UCL | 313.2 |
| 95% Hall's Bootstrap UCL | 295.8 | 95% Percentile Bootstrap UCL | 305 |
| 90% Chebyshev(Mean, Sd) UCL | 371 | 95% Chebyshev(Mean, Sd) UCL | 429.2 |
| 97.5% Chebyshev(Mean, Sd) UCL | 509.9 | 99% Chebyshev(Mean, Sd) UCL | 668.4 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 328.9 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

| Nitrite - MW-9 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 3 |
| Number of Detects | 2 | Number of Non-Detects | 4 |
| Number of Distinct Detects | 2 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.02 | Minimum Non-Detect | 0.015 |
| Maximum Detect | 0.081 | Maximum Non-Detect | 0.015 |
| Variance Detects | 0.00186 | Percent Non-Detects | 66.67% |
| Mean Detects | 0.0505 | SD Detects | 0.0431 |
| Median Detects | 0.0505 | CV Detects | 0.854 |
| Skewness Detects | N/A | Kurtosis Detects | N/A |
| Mean of Logged Detects | -3.213 | SD of Logged Detects | 0.989 |

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | | |
|---|---|---|---|---|
| KM Mean | 0.0268 | KM Standard Error of Mean | 0.014 |
| 90KM SD | 0.0243 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.0551 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.0499 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.0689 | 95% KM Chebyshev UCL | 0.088 |
| 97.5% KM Chebyshev UCL | 0.114 | 99% KM Chebyshev UCL | 0.166 |

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 2.357 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 0.0214 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 9.428 | nu star (bias corrected) | N/A |
| Mean (detects) | 0.0505 | | |

## Estimates of Gamma Parameters using KM Estimates

| | | | |
|---|---|---|---|
| Mean (KM) | 0.0268 | SD (KM) | 0.0243 |
| Variance (KM) | 5.9014E-4 | SE of Mean (KM) | 0.014 |
| k hat (KM) | 1.22 | k star (KM) | 0.721 |
| nu hat (KM) | 14.64 | nu star (KM) | 8.654 |
| theta hat (KM) | 0.022 | theta star (KM) | 0.0372 |
| 80% gamma percentile (KM) | 0.0441 | 90% gamma percentile (KM) | 0.0669 |
| 95% gamma percentile (KM) | 0.0904 | 99% gamma percentile (KM) | 0.146 |

## Gamma Kaplan-Meier (KM) Statistics

| | | | |
|---|---|---|---|
| | | Adjusted Level of Significance (β) | 0.0122 |
| Approximate Chi Square Value (8.65, α) | 3.119 | Adjusted Chi Square Value (8.65, β) | 2.049 |
| 95% KM Approximate Gamma UCL | 0.0744 | 95% KM Adjusted Gamma UCL | 0.113 |

## Lognormal GOF Test on Detected Observations Only

### Not Enough Data to Perform GOF Test

## Lognormal ROS Statistics Using Imputed Non-Detects

| | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0175 | Mean in Log Scale | -6.216 |
| SD in Original Scale | 0.0321 | SD in Log Scale | 2.663 |
| 95% t UCL (assumes normality of ROS data) | 0.0438 | 95% Percentile Bootstrap UCL | 0.0409 |
| 95% BCA Bootstrap UCL | 0.0473 | 95% Bootstrap t UCL | 0.546 |
| 95% H-UCL (Log ROS) | 12253 | | |

## Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| KM Mean (logged) | -3.871 | KM Geo Mean | 0.0208 |
| KM SD (logged) | 0.616 | 95% Critical H Value (KM-Log) | 2.935 |
| KM Standard Error of Mean (logged) | 0.356 | 95% H-UCL (KM -Log) | 0.0566 |
| KM SD (logged) | 0.616 | 95% Critical H Value (KM-Log) | 2.935 |
| KM Standard Error of Mean (logged) | 0.356 | | |

## DL/2 Statistics

| DL/2 Normal | | DL/2 Log-Transformed | |
|---|---|---|---|
| Mean in Original Scale | 0.0218 | Mean in Log Scale | -4.333 |
| SD in Original Scale | 0.0294 | SD in Log Scale | 0.974 |
| 95% t UCL (Assumes normality) | 0.046 | 95% H-Stat UCL | 0.122 |

### DL/2 is not a recommended method, provided for comparisons and historical reasons

## Nonparametric Distribution Free UCL Statistics

### Data do not follow a Discernible Distribution

## Suggested UCL to Use

| | | | |
|---|---|---|---|
| Recommendation cannot be provided | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Arsenic - MW-9**

## General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.007 | Mean | 0.00745 |
| Maximum | 0.0083 | Median | 0.00725 |
| SD | 5.9161E-4 | Std. Error of Mean | 2.9580E-4 |
| Coefficient of Variation | 0.0794 | Skewness | 1.545 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

## Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.848 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.284 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

## Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.00815 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00818 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.00818 |

## Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.447 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.657 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.281 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.394 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

## Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 219.6 | k star (bias corrected MLE) | 55.06 |
| Theta hat (MLE) | 3.3930E-5 | Theta star (bias corrected MLE) | 1.3531E-4 |
| nu hat (MLE) | 1757 | nu star (bias corrected) | 440.5 |
| MLE Mean (bias corrected) | 0.00745 | MLE Sd (bias corrected) | 0.001 |
| | | Approximate Chi Square Value (0.05) | 392.8 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

## Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.00835 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.859 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.273 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.962 | Mean of logged Data | -4.902 |
| Maximum of Logged Data | -4.791 | SD of logged Data | 0.0772 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.00831 |
| 95% Chebyshev (MVUE) UCL | 0.0087 | 97.5% Chebyshev (MVUE) UCL | 0.00925 |
| 99% Chebyshev (MVUE) UCL | 0.0103 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.00794 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.00834 | 95% Chebyshev(Mean, Sd) UCL | 0.00874 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0093 | 99% Chebyshev(Mean, Sd) UCL | 0.0104 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.00815 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

| Iron - MW-9 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 3 |
| Number of Detects | 2 | Number of Non-Detects | 2 |
| Number of Distinct Detects | 2 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.15 | Minimum Non-Detect | 0.08 |
| Maximum Detect | 0.19 | Maximum Non-Detect | 0.08 |
| Variance Detects | 8.0000E-4 | Percent Non-Detects | 50% |
| Mean Detects | 0.17 | SD Detects | 0.0283 |
| Median Detects | 0.17 | CV Detects | 0.166 |
| Skewness Detects | N/A | Kurtosis Detects | N/A |
| Mean of Logged Detects | -1.779 | SD of Logged Detects | 0.167 |

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | | |
|---|---|---|---|---|
| KM Mean | 0.125 | KM Standard Error of Mean | 0.0334 |
| 90KM SD | 0.0472 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.203 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.18 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.225 | 95% KM Chebyshev UCL | 0.27 |
| 97.5% KM Chebyshev UCL | 0.333 | 99% KM Chebyshev UCL | 0.457 |

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 71.92 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 0.00236 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 287.7 | nu star (bias corrected) | N/A |
| Mean (detects) | 0.17 | | |

## Estimates of Gamma Parameters using KM Estimates

| | | | |
|---|---|---|---|
| Mean (KM) | 0.125 | SD (KM) | 0.0472 |
| Variance (KM) | 0.00223 | SE of Mean (KM) | 0.0334 |
| k hat (KM) | 7.022 | k star (KM) | 1.922 |
| nu hat (KM) | 56.18 | nu star (KM) | 15.38 |
| theta hat (KM) | 0.0178 | theta star (KM) | 0.065 |
| 80% gamma percentile (KM) | 0.188 | 90% gamma percentile (KM) | 0.245 |
| 95% gamma percentile (KM) | 0.3 | 99% gamma percentile (KM) | 0.422 |

## Gamma Kaplan-Meier (KM) Statistics

| | | | |
|---|---|---|---|
| | | Adjusted Level of Significance (β) | 0.00498 |
| Approximate Chi Square Value (15.38, α) | 7.525 | Adjusted Chi Square Value (15.38, β) | 4.803 |
| 95% KM Approximate Gamma UCL | 0.255 | 95% KM Adjusted Gamma UCL | 0.4 |

## Lognormal GOF Test on Detected Observations Only

### Not Enough Data to Perform GOF Test

## Lognormal ROS Statistics Using Imputed Non-Detects

| | | | |
|---|---|---|---|
| Mean in Original Scale | 0.131 | Mean in Log Scale | -2.087 |
| SD in Original Scale | 0.0488 | SD in Log Scale | 0.381 |
| 95% t UCL (assumes normality of ROS data) | 0.188 | 95% Percentile Bootstrap UCL | N/A |
| 95% BCA Bootstrap UCL | N/A | 95% Bootstrap t UCL | N/A |
| 95% H-UCL (Log ROS) | 0.263 | | |

## Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| KM Mean (logged) | -2.152 | KM Geo Mean | 0.116 |
| KM SD (logged) | 0.383 | 95% Critical H Value (KM-Log) | 3.1 |
| KM Standard Error of Mean (logged) | 0.271 | 95% H-UCL (KM -Log) | 0.248 |
| KM SD (logged) | 0.383 | 95% Critical H Value (KM-Log) | 3.1 |
| KM Standard Error of Mean (logged) | 0.271 | | |

## DL/2 Statistics

| DL/2 Normal | | DL/2 Log-Transformed | |
|---|---|---|---|
| Mean in Original Scale | 0.105 | Mean in Log Scale | -2.499 |
| SD in Original Scale | 0.0768 | SD in Log Scale | 0.837 |
| 95% t UCL (Assumes normality) | 0.195 | 95% H-Stat UCL | 1.783 |

### DL/2 is not a recommended method, provided for comparisons and historical reasons

## Nonparametric Distribution Free UCL Statistics

### Data do not follow a Discernible Distribution

## Suggested UCL to Use

| | | | |
|---|---|---|---|
| Recommendation cannot be provided | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Manganese - MW-9**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.034 | Mean | 0.0508 |
| Maximum | 0.078 | Median | 0.0455 |
| SD | 0.019 | Std. Error of Mean | 0.00948 |
| Coefficient of Variation | 0.374 | Skewness | 1.49 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.857 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.349 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0731 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0739 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0742 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.408 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.657 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.335 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.395 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 10.73 | k star (bias corrected MLE) | 2.849 |
| Theta hat (MLE) | 0.00473 | Theta star (bias corrected MLE) | 0.0178 |
| nu hat (MLE) | 85.85 | nu star (bias corrected) | 22.79 |
| MLE Mean (bias corrected) | 0.0508 | MLE Sd (bias corrected) | 0.0301 |
| | | Approximate Chi Square Value (0.05) | 12.94 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0894 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.915 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.308 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -3.381 | Mean of logged Data | -3.028 |
| Maximum of Logged Data | -2.551 | SD of logged Data | 0.347 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0928 | 90% Chebyshev (MVUE) UCL | 0.0767 |
| 95% Chebyshev (MVUE) UCL | 0.0885 | 97.5% Chebyshev (MVUE) UCL | 0.105 |
| 99% Chebyshev (MVUE) UCL | 0.137 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0663 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0792 | 95% Chebyshev(Mean, Sd) UCL | 0.0921 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.11 | 99% Chebyshev(Mean, Sd) UCL | 0.145 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0731 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**Dinoseb - MW-9**

| | | | |
|---|---|---|---|
| | | **General Statistics** | |
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| Number of Detects | 5 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 5 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 4.5000E-4 | Minimum Non-Detect | 3.2000E-4 |
| Maximum Detect | 0.16 | Maximum Non-Detect | 3.2000E-4 |
| Variance Detects | 0.00447 | Percent Non-Detects | 16.67% |
| Mean Detects | 0.0565 | SD Detects | 0.0668 |
| Median Detects | 0.031 | CV Detects | 1.183 |
| Skewness Detects | 1.132 | Kurtosis Detects | 0.285 |
| Mean of Logged Detects | -4.119 | SD of Logged Detects | 2.358 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| | | **Normal GOF Test on Detects Only** | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.876 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.686 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.249 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.396 | Detected Data appear Normal at 1% Significance Level | |
| | | Detected Data appear Normal at 1% Significance Level | |
| | | Note GOF tests may be unreliable for small sample sizes | |

| | | **Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs** | |
|---|---|---|---|
| KM Mean | 0.0471 | KM Standard Error of Mean | 0.0267 |
| 90KM SD | 0.0584 | 95% KM (BCA) UCL | 0.0869 |
| 95% KM (t) UCL | 0.101 | 95% KM (Percentile Bootstrap) UCL | 0.0878 |
| 95% KM (z) UCL | 0.091 | 95% KM Bootstrap t UCL | 0.199 |
| 90% KM Chebyshev UCL | 0.127 | 95% KM Chebyshev UCL | 0.163 |
| 97.5% KM Chebyshev UCL | 0.214 | 99% KM Chebyshev UCL | 0.313 |

| | | **Gamma GOF Tests on Detected Observations Only** | |
|---|---|---|---|
| A-D Test Statistic | 0.197 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.711 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.18 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.371 | Detected data appear Gamma Distributed at 5% Significance Level | |
| | | Detected data appear Gamma Distributed at 5% Significance Level | |
| | | Note GOF tests may be unreliable for small sample sizes | |

| | | **Gamma Statistics on Detected Data Only** | |
|---|---|---|---|
| k hat (MLE) | 0.509 | k star (bias corrected MLE) | 0.337 |
| Theta hat (MLE) | 0.111 | Theta star (bias corrected MLE) | 0.168 |
| nu hat (MLE) | 5.088 | nu star (bias corrected) | 3.368 |
| Mean (detects) | 0.0565 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 4.5000E-4 | Mean | 0.0487 |
| Maximum | 0.16 | Median | 0.0205 |
| SD | 0.0627 | CV | 1.287 |
| k hat (MLE) | 0.534 | k star (bias corrected MLE) | 0.378 |
| Theta hat (MLE) | 0.0914 | Theta star (bias corrected MLE) | 0.129 |
| nu hat (MLE) | 6.403 | nu star (bias corrected) | 4.535 |
| Adjusted Level of Significance (β) | 0.0122 | | |
| Approximate Chi Square Value (4.53, α) | 0.944 | Adjusted Chi Square Value (4.53, β) | 0.486 |
| 95% Gamma Approximate UCL | 0.234 | 95% Gamma Adjusted UCL | 0.455 |

| Estimates of Gamma Parameters using KM Estimates | | | |
|---|---|---|---|
| Mean (KM) | 0.0471 | SD (KM) | 0.0584 |
| Variance (KM) | 0.00342 | SE of Mean (KM) | 0.0267 |
| k hat (KM) | 0.65 | k star (KM) | 0.436 |
| nu hat (KM) | 7.802 | nu star (KM) | 5.235 |
| theta hat (KM) | 0.0725 | theta star (KM) | 0.108 |
| 80% gamma percentile (KM) | 0.0767 | 90% gamma percentile (KM) | 0.131 |
| 95% gamma percentile (KM) | 0.19 | 99% gamma percentile (KM) | 0.337 |

| Gamma Kaplan-Meier (KM) Statistics | | | |
|---|---|---|---|
| Approximate Chi Square Value (5.23, α) | 1.262 | Adjusted Chi Square Value (5.23, β) | 0.692 |
| 95% KM Approximate Gamma UCL | 0.195 | 95% KM Adjusted Gamma UCL | 0.357 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.928 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.806 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.208 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.319 | Detected Data appear Lognormal at 10% Significance Level |
| **Detected Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0471 | Mean in Log Scale | -5.098 |
| SD in Original Scale | 0.0641 | SD in Log Scale | 3.194 |
| 95% t UCL (assumes normality of ROS data) | 0.0998 | 95% Percentile Bootstrap UCL | 0.0869 |
| 95% BCA Bootstrap UCL | 0.0993 | 95% Bootstrap t UCL | 0.203 |
| 95% H-UCL (Log ROS) | 33201100 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -4.773 | KM Geo Mean | | 0.00845 |
| KM SD (logged) | 2.419 | 95% Critical H Value (KM-Log) | | 9.245 |
| KM Standard Error of Mean (logged) | 1.104 | 95% H-UCL (KM -Log) | | 3470 |
| KM SD (logged) | 2.419 | 95% Critical H Value (KM-Log) | | 9.245 |
| KM Standard Error of Mean (logged) | 1.104 | | | |
| | | | | |
| DL/2 Statistics | | | | |
| DL/2 Normal | | DL/2 Log-Transformed | | |
| Mean in Original Scale | 0.0471 | Mean in Log Scale | | -4.889 |
| SD in Original Scale | 0.064 | SD in Log Scale | | 2.83 |
| 95% t UCL (Assumes normality) | 0.0998 | 95% H-Stat UCL | | 342118 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% KM (t) UCL | 0.101 | | | |
| | | | | |
| The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner. | | | | |
| Please verify the data were collected from random locations. | | | | |
| If the data were collected using judgmental or other non-random methods, | | | | |
| then contact a statistician to correctly calculate UCLs. | | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |
| | | | | |
| | | | | |

| Chlorobenzene - MW-9 | | | | |
|---|---|---|---|---|

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 3.3000E-4 | Mean | 6.9333E-4 |
| Maximum | 0.001 | Median | 7.2500E-4 |
| SD | 2.4655E-4 | Std. Error of Mean | 1.0065E-4 |
| Coefficient of Variation | 0.356 | Skewness | -0.359 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.97 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.196 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 8.9615E-4 | 95% Adjusted-CLT UCL (Chen-1995) | 8.4314E-4 |
| | | 95% Modified-t UCL (Johnson-1978) | 8.9370E-4 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.264 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.698 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.228 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.333 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 8.133 | k star (bias corrected MLE) | 4.177 |
| Theta hat (MLE) | 8.5253E-5 | Theta star (bias corrected MLE) | 1.6597E-4 |
| nu hat (MLE) | 97.59 | nu star (bias corrected) | 50.13 |
| MLE Mean (bias corrected) | 6.9333E-4 | MLE Sd (bias corrected) | 3.3922E-4 |
| | | Approximate Chi Square Value (0.05) | 34.87 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 30.35 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 9.9668E-4 | 95% Adjusted Gamma UCL | 0.00115 |

| Lognormal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.929 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.214 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level |
| **Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |
| | | |
| **Lognormal Statistics** | | |
| Minimum of Logged Data | -8.016 | Mean of logged Data | -7.337 |
| Maximum of Logged Data | -6.908 | SD of logged Data | 0.407 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 0.0011 | 90% Chebyshev (MVUE) UCL | 0.00104 |
| 95% Chebyshev (MVUE) UCL | 0.0012 | 97.5% Chebyshev (MVUE) UCL | 0.00142 |
| 99% Chebyshev (MVUE) UCL | 0.00185 | | |

**Nonparametric Distribution Free UCL Statistics**

**Data appear to follow a Discernible Distribution**

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 8.5889E-4 | 95% BCA Bootstrap UCL | 8.4167E-4 |
| 95% Standard Bootstrap UCL | 8.4538E-4 | 95% Bootstrap-t UCL | 8.8657E-4 |
| 95% Hall's Bootstrap UCL | 8.3395E-4 | 95% Percentile Bootstrap UCL | 8.4000E-4 |
| 90% Chebyshev(Mean, Sd) UCL | 9.9529E-4 | 95% Chebyshev(Mean, Sd) UCL | 0.00113 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.00132 | 99% Chebyshev(Mean, Sd) UCL | 0.00169 |

| Suggested UCL to Use | | |
|---|---|---|
| 95% Student's-t UCL | 8.9615E-4 | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

**1,2-DCP - MW-9**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.022 | Mean | 0.0518 |
| Maximum | 0.074 | Median | 0.0535 |
| SD | 0.0184 | Std. Error of Mean | 0.00752 |
| Coefficient of Variation | 0.355 | Skewness | -0.657 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.972 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.149 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.067 | 95% Adjusted-CLT UCL (Chen-1995) | 0.062 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0667 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.313 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.698 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.198 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.333 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 7.505 | k star (bias corrected MLE) | 3.864 |
| Theta hat (MLE) | 0.00691 | Theta star (bias corrected MLE) | 0.0134 |
| nu hat (MLE) | 90.06 | nu star (bias corrected) | 46.36 |
| MLE Mean (bias corrected) | 0.0518 | MLE Sd (bias corrected) | 0.0264 |
| | | Approximate Chi Square Value (0.05) | 31.74 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 27.44 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0757 | 95% Adjusted Gamma UCL | 0.0876 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.889 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.214 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -3.817 | Mean of logged Data | -3.028 |
| Maximum of Logged Data | -2.604 | SD of logged Data | 0.434 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0862 | 90% Chebyshev (MVUE) UCL | 0.0801 |
| 95% Chebyshev (MVUE) UCL | 0.0927 | 97.5% Chebyshev (MVUE) UCL | 0.11 |
| 99% Chebyshev (MVUE) UCL | 0.145 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0642 | 95% BCA Bootstrap UCL | 0.062 |
| 95% Standard Bootstrap UCL | 0.0633 | 95% Bootstrap-t UCL | 0.0646 |
| 95% Hall's Bootstrap UCL | 0.0631 | 95% Percentile Bootstrap UCL | 0.0628 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0744 | 95% Chebyshev(Mean, Sd) UCL | 0.0846 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0988 | 99% Chebyshev(Mean, Sd) UCL | 0.127 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.067 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |
| | | | |

| UCL Statistics for Data Sets with Non-Detects | | | | |
|---|---|---|---|---|
| | | | | |
| **User Selected Options** | | | | |
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:19:07 PM | | | |
| From File | mw10_3year_data.xls | | | |
| Full Precision | OFF | | | |
| Confidence Coefficient | 95% | | | |
| Number of Bootstrap Operations | 2000 | | | |

**Nitrate - MW-10**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 | |
| | | Number of Missing Observations | 0 | |
| Minimum | 2.8 | Mean | 4.4 | |
| Maximum | 6.4 | Median | 3.9 | |
| SD | 1.541 | Std. Error of Mean | 0.629 | |
| Coefficient of Variation | 0.35 | Skewness | 0.504 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.865 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.262 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 5.668 | 95% Adjusted-CLT UCL (Chen-1995) | 5.574 |
| | | 95% Modified-t UCL (Johnson-1978) | 5.69 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.452 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.698 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.277 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 10.05 | k star (bias corrected MLE) | 5.135 | |
| Theta hat (MLE) | 0.438 | Theta star (bias corrected MLE) | 0.857 | |
| nu hat (MLE) | 120.6 | nu star (bias corrected) | 61.62 | |
| MLE Mean (bias corrected) | 4.4 | MLE Sd (bias corrected) | 1.942 | |
| | | Approximate Chi Square Value (0.05) | 44.57 | |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 39.39 | |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 6.084 | 95% Adjusted Gamma UCL | 6.884 | |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.888 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.253 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | |
|---|---|---|---|
| Minimum of Logged Data | 1.03 | Mean of logged Data | 1.431 |
| Maximum of Logged Data | 1.856 | SD of logged Data | 0.347 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 6.359 | 90% Chebyshev (MVUE) UCL | 6.265 |
| 95% Chebyshev (MVUE) UCL | 7.111 | 97.5% Chebyshev (MVUE) UCL | 8.285 |
| 99% Chebyshev (MVUE) UCL | 10.59 | | |

| Nonparametric Distribution Free UCL Statistics | | | |
|---|---|---|---|
| **Data appear to follow a Discernible Distribution** | | | |

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 5.435 | 95% BCA Bootstrap UCL | 5.417 |
| 95% Standard Bootstrap UCL | 5.335 | 95% Bootstrap-t UCL | 6.151 |
| 95% Hall's Bootstrap UCL | 5.535 | 95% Percentile Bootstrap UCL | 5.317 |
| 90% Chebyshev(Mean, Sd) UCL | 6.288 | 95% Chebyshev(Mean, Sd) UCL | 7.143 |
| 97.5% Chebyshev(Mean, Sd) UCL | 8.33 | 99% Chebyshev(Mean, Sd) UCL | 10.66 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 5.668 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Nitrite - MW-10 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| Number of Detects | 5 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 5 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.02 | Minimum Non-Detect | 0.015 |
| Maximum Detect | 0.11 | Maximum Non-Detect | 0.015 |
| Variance Detects | 0.00162 | Percent Non-Detects | 16.67% |
| Mean Detects | 0.0618 | SD Detects | 0.0402 |
| Median Detects | 0.058 | CV Detects | 0.651 |
| Skewness Detects | 0.19 | Kurtosis Detects | -2.595 |
| Mean of Logged Detects | -2.994 | SD of Logged Detects | 0.762 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.904 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.686 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.213 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.396 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.054 | KM Standard Error of Mean | 0.017 |
| 90KM SD | 0.0372 | 95% KM (BCA) UCL | 0.0805 |
| 95% KM (t) UCL | 0.0882 | 95% KM (Percentile Bootstrap) UCL | 0.0798 |
| 95% KM (z) UCL | 0.0819 | 95% KM Bootstrap t UCL | 0.0977 |
| 90% KM Chebyshev UCL | 0.105 | 95% KM Chebyshev UCL | 0.128 |
| 97.5% KM Chebyshev UCL | 0.16 | 99% KM Chebyshev UCL | 0.223 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.351 | Anderson-Darling GOF Test | |
| 5% A-D Critical Value | 0.683 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.237 | Kolmogorov-Smirnov GOF | |
| 5% K-S Critical Value | 0.36 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 2.533 | k star (bias corrected MLE) | | 1.147 |
| Theta hat (MLE) | 0.0244 | Theta star (bias corrected MLE) | | 0.0539 |
| nu hat (MLE) | 25.33 | nu star (bias corrected) | | 11.47 |
| Mean (detects) | 0.0618 | | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.01 | Mean | | 0.0532 |
| Maximum | 0.11 | Median | | 0.042 |
| SD | 0.0417 | CV | | 0.785 |
| k hat (MLE) | 1.671 | k star (bias corrected MLE) | | 0.946 |
| Theta hat (MLE) | 0.0318 | Theta star (bias corrected MLE) | | 0.0562 |
| nu hat (MLE) | 20.05 | nu star (bias corrected) | | 11.36 |
| Adjusted Level of Significance (β) | 0.0122 | | | |
| Approximate Chi Square Value (11.36, α) | 4.806 | Adjusted Chi Square Value (11.36, β) | | 3.392 |
| 95% Gamma Approximate UCL | 0.126 | 95% Gamma Adjusted UCL | | 0.178 |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.054 | SD (KM) | | 0.0372 |
| Variance (KM) | 0.00138 | SE of Mean (KM) | | 0.017 |
| k hat (KM) | 2.109 | k star (KM) | | 1.166 |
| nu hat (KM) | 25.31 | nu star (KM) | | 13.99 |
| theta hat (KM) | 0.0256 | theta star (KM) | | 0.0463 |
| 80% gamma percentile (KM) | 0.0857 | 90% gamma percentile (KM) | | 0.12 |
| 95% gamma percentile (KM) | 0.153 | 99% gamma percentile (KM) | | 0.23 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (13.99, α) | 6.565 | Adjusted Chi Square Value (13.99, β) | | 4.847 |
| 95% KM Approximate Gamma UCL | 0.115 | 95% KM Adjusted Gamma UCL | | 0.156 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.9 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.806 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.205 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.319 | Detected Data appear Lognormal at 10% Significance Level |
| **Detected Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0527 | Mean in Log Scale | -3.315 |
| SD in Original Scale | 0.0423 | SD in Log Scale | 1.04 |
| 95% t UCL (assumes normality of ROS data) | 0.0875 | 95% Percentile Bootstrap UCL | 0.0792 |
| 95% BCA Bootstrap UCL | 0.0798 | 95% Bootstrap t UCL | 0.0973 |
| 95% H-UCL (Log ROS) | 0.455 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -3.195 | KM Geo Mean | 0.041 |
| KM SD (logged) | 0.767 | 95% Critical H Value (KM-Log) | 3.375 |
| KM Standard Error of Mean (logged) | 0.35 | 95% H-UCL (KM -Log) | 0.175 |
| KM SD (logged) | 0.767 | 95% Critical H Value (KM-Log) | 3.375 |
| KM Standard Error of Mean (logged) | 0.35 | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.0528 | Mean in Log Scale | -3.31 |
| SD in Original Scale | 0.0423 | SD in Log Scale | 1.032 |
| 95% t UCL (Assumes normality) | 0.0875 | 95% H-Stat UCL | 0.44 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

**Nonparametric Distribution Free UCL Statistics**

**Detected Data appear Normal Distributed at 1% Significance Level**

**Suggested UCL to Use**

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 0.0882 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Arsenic - MW-10**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.015 | Mean | 0.0177 |
| Maximum | 0.021 | Median | 0.0175 |
| SD | 0.00234 | Std. Error of Mean | 9.5452E-4 |
| Coefficient of Variation | 0.132 | Skewness | 0.318 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.901 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.262 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0196 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0194 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0196 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.44 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.697 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.28 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 69.21 | k star (bias corrected MLE) | 34.72 |
| Theta hat (MLE) | 2.5526E-4 | Theta star (bias corrected MLE) | 5.0888E-4 |
| nu hat (MLE) | 830.5 | nu star (bias corrected) | 416.6 |
| MLE Mean (bias corrected) | 0.0177 | MLE Sd (bias corrected) | 0.003 |
| | | Approximate Chi Square Value (0.05) | 370.3 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 354.4 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0199 | 95% Adjusted Gamma UCL | 0.0208 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.903 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.257 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.2 | Mean of logged Data | -4.043 |
| Maximum of Logged Data | -3.863 | SD of logged Data | 0.132 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0199 | 90% Chebyshev (MVUE) UCL | 0.0205 |
| 95% Chebyshev (MVUE) UCL | 0.0218 | 97.5% Chebyshev (MVUE) UCL | 0.0236 |
| 99% Chebyshev (MVUE) UCL | 0.0271 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0192 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0205 | 95% Chebyshev(Mean, Sd) UCL | 0.0218 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0236 | 99% Chebyshev(Mean, Sd) UCL | 0.0272 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0196 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |

| UCL Statistics for Data Sets with Non-Detects | | | |
|---|---|---|---|
| | | | |
| User Selected Options | | | |
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:20:12 PM | | |
| From File | mw11_3year_data.xls | | |
| Full Precision | OFF | | |
| Confidence Coefficient | 95% | | |
| Number of Bootstrap Operations | 2000 | | |

**Nitrate - MW-11**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 4.6 | Mean | 5.283 |
| Maximum | 6.1 | Median | 5.4 |
| SD | 0.531 | Std. Error of Mean | 0.217 |
| Coefficient of Variation | 0.1 | Skewness | 0.236 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.912 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.254 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |
| Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 5.72 | 95% Adjusted-CLT UCL (Chen-1995) | 5.662 |
| | | 95% Modified-t UCL (Johnson-1978) | 5.723 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.429 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.696 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.273 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 119.3 | | k star (bias corrected MLE) | 59.75 |
| Theta hat (MLE) | 0.0443 | | Theta star (bias corrected MLE) | 0.0884 |
| nu hat (MLE) | 1431 | | nu star (bias corrected) | 717 |
| MLE Mean (bias corrected) | 5.283 | | MLE Sd (bias corrected) | 0.683 |
| | | | Approximate Chi Square Value (0.05) | 655.9 |
| Adjusted Level of Significance | 0.0122 | | Adjusted Chi Square Value | 634.5 |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 5.776 | | 95% Adjusted Gamma UCL | 5.97 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.914 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.269 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 1.526 | | Mean of logged Data | 1.66 |
| Maximum of Logged Data | 1.808 | | SD of logged Data | 0.1 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 5.77 | | 90% Chebyshev (MVUE) UCL | 5.933 |
| 95% Chebyshev (MVUE) UCL | 6.227 | | 97.5% Chebyshev (MVUE) UCL | 6.635 |
| 99% Chebyshev (MVUE) UCL | 7.437 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| **Data appear to follow a Discernible Distribution** |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 5.64 | | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 5.933 | | 95% Chebyshev(Mean, Sd) UCL | 6.228 |
| 97.5% Chebyshev(Mean, Sd) UCL | 6.636 | | 99% Chebyshev(Mean, Sd) UCL | 7.439 |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 5.72 | | | |

| |
|---|
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. |

**Nitrite - MW-11**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| Number of Detects | 5 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 5 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.027 | Minimum Non-Detect | 0.015 |
| Maximum Detect | 0.07 | Maximum Non-Detect | 0.015 |
| Variance Detects | 2.8180E-4 | Percent Non-Detects | 16.67% |
| Mean Detects | 0.0446 | SD Detects | 0.0168 |
| Median Detects | 0.046 | CV Detects | 0.376 |
| Skewness Detects | 0.791 | Kurtosis Detects | 0.461 |
| Mean of Logged Detects | -3.166 | SD of Logged Detects | 0.373 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.934 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.686 | Detected Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.22 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.396 | Detected Data appear Normal at 1% Significance Level |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0397 | KM Standard Error of Mean | 0.00803 |
| 90KM SD | 0.0176 | 95% KM (BCA) UCL | 0.0523 |
| 95% KM (t) UCL | 0.0558 | 95% KM (Percentile Bootstrap) UCL | 0.0523 |
| 95% KM (z) UCL | 0.0529 | 95% KM Bootstrap t UCL | 0.0567 |
| 90% KM Chebyshev UCL | 0.0638 | 95% KM Chebyshev UCL | 0.0747 |
| 97.5% KM Chebyshev UCL | 0.0898 | 99% KM Chebyshev UCL | 0.12 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.261 | **Anderson-Darling GOF Test** |
| 5% A-D Critical Value | 0.679 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.199 | **Kolmogorov-Smirnov GOF** |
| 5% K-S Critical Value | 0.358 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 9.132 | k star (bias corrected MLE) | 3.786 |
| Theta hat (MLE) | 0.00488 | Theta star (bias corrected MLE) | 0.0118 |
| nu hat (MLE) | 91.32 | nu star (bias corrected) | 37.86 |
| Mean (detects) | 0.0446 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.01 | Mean | 0.0388 |
| Maximum | 0.07 | Median | 0.039 |
| SD | 0.0206 | CV | 0.531 |
| k hat (MLE) | 3.338 | k star (bias corrected MLE) | 1.78 |
| Theta hat (MLE) | 0.0116 | Theta star (bias corrected MLE) | 0.0218 |
| nu hat (MLE) | 40.06 | nu star (bias corrected) | 21.36 |
| Adjusted Level of Significance (β) | 0.0122 | | |
| Approximate Chi Square Value (21.36, α) | 11.86 | Adjusted Chi Square Value (21.36, β) | 9.411 |
| 95% Gamma Approximate UCL | 0.0699 | 95% Gamma Adjusted UCL | 0.0881 |

| Estimates of Gamma Parameters using KM Estimates | | | |
|---|---|---|---|
| Mean (KM) | 0.0397 | SD (KM) | 0.0176 |
| Variance (KM) | 3.0956E-4 | SE of Mean (KM) | 0.00803 |
| k hat (KM) | 5.083 | k star (KM) | 2.653 |
| nu hat (KM) | 60.99 | nu star (KM) | 31.83 |
| theta hat (KM) | 0.0078 | theta star (KM) | 0.015 |
| 80% gamma percentile (KM) | 0.0574 | 90% gamma percentile (KM) | 0.0723 |
| 95% gamma percentile (KM) | 0.0863 | 99% gamma percentile (KM) | 0.117 |

| Gamma Kaplan-Meier (KM) Statistics | | | |
|---|---|---|---|
| Approximate Chi Square Value (31.83, α) | 19.94 | Adjusted Chi Square Value (31.83, β) | 16.63 |
| 95% KM Approximate Gamma UCL | 0.0633 | 95% KM Adjusted Gamma UCL | 0.0759 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.961 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.806 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.192 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.319 | Detected Data appear Lognormal at 10% Significance Level |
| **Detected Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0399 | Mean in Log Scale | -3.326 |
| SD in Original Scale | 0.019 | SD in Log Scale | 0.515 |
| 95% t UCL (assumes normality of ROS data) | 0.0555 | 95% Percentile Bootstrap UCL | 0.0518 |
| 95% BCA Bootstrap UCL | 0.0528 | 95% Bootstrap t UCL | 0.0594 |
| 95% H-UCL (Log ROS) | 0.076 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -3.338 | KM Geo Mean | 0.0355 | |
| KM SD (logged) | 0.491 | 95% Critical H Value (KM-Log) | 2.617 | |
| KM Standard Error of Mean (logged) | 0.224 | 95% H-UCL (KM -Log) | 0.0712 | |
| KM SD (logged) | 0.491 | 95% Critical H Value (KM-Log) | 2.617 | |
| KM Standard Error of Mean (logged) | 0.224 | | | |
| | | | | |
| DL/2 Statistics | | | | |
| DL/2 Normal | | DL/2 Log-Transformed | | |
| Mean in Original Scale | 0.0384 | Mean in Log Scale | -3.454 | |
| SD in Original Scale | 0.0213 | SD in Log Scale | 0.78 | |
| 95% t UCL (Assumes normality) | 0.056 | 95% H-Stat UCL | 0.141 | |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% KM (t) UCL | 0.0558 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |
| | | | | |
| | | | | |

**Arsenic - MW-11**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.023 | Mean | 0.0307 |
| Maximum | 0.038 | Median | 0.03 |
| SD | 0.00509 | Std. Error of Mean | 0.00208 |
| Coefficient of Variation | 0.166 | Skewness | -0.0649 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.974 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.205 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

Note GOF tests may be unreliable for small sample sizes

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.0349 | 95% Adjusted-CLT UCL (Chen-1995) | 0.034 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0348 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.24 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.697 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.212 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 42.4 | k star (bias corrected MLE) | 21.31 |
| Theta hat (MLE) | 7.2332E-4 | Theta star (bias corrected MLE) | 0.00144 |
| nu hat (MLE) | 508.8 | nu star (bias corrected) | 255.7 |
| MLE Mean (bias corrected) | 0.0307 | MLE Sd (bias corrected) | 0.00664 |
| | | Approximate Chi Square Value (0.05) | 219.7 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 207.6 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0357 | 95% Adjusted Gamma UCL | 0.0378 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.962 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.231 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -3.772 | Mean of logged Data | -3.496 |
| Maximum of Logged Data | -3.27 | SD of logged Data | 0.17 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0359 | 90% Chebyshev (MVUE) UCL | 0.0371 |
| 95% Chebyshev (MVUE) UCL | 0.04 | 97.5% Chebyshev (MVUE) UCL | 0.044 |
| 99% Chebyshev (MVUE) UCL | 0.0519 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0341 | 95% BCA Bootstrap UCL | 0.0335 |
| 95% Standard Bootstrap UCL | 0.0338 | 95% Bootstrap-t UCL | 0.035 |
| 95% Hall's Bootstrap UCL | 0.0359 | 95% Percentile Bootstrap UCL | 0.0338 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0369 | 95% Chebyshev(Mean, Sd) UCL | 0.0397 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0436 | 99% Chebyshev(Mean, Sd) UCL | 0.0513 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0349 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |
| | | | |

| Iron - MW-11 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 3 |
| Number of Detects | 2 | Number of Non-Detects | 2 |
| Number of Distinct Detects | 2 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.023 | Minimum Non-Detect | 0.08 |
| Maximum Detect | 0.028 | Maximum Non-Detect | 0.08 |
| Variance Detects | 1.2500E-5 | Percent Non-Detects | 50% |
| Mean Detects | 0.0255 | SD Detects | 0.00354 |
| Median Detects | 0.0255 | CV Detects | 0.139 |
| Skewness Detects | N/A | Kurtosis Detects | N/A |
| Mean of Logged Detects | -3.674 | SD of Logged Detects | 0.139 |

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | | |
|---|---|---|---|---|
| KM Mean | 0.0255 | KM Standard Error of Mean | 0.0025 |
| 90KM SD | 0.0025 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.0314 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.0296 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.033 | 95% KM Chebyshev UCL | 0.0364 |
| 97.5% KM Chebyshev UCL | 0.0411 | 99% KM Chebyshev UCL | 0.0504 |

### Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 103.7 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 2.4589E-4 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 414.8 | nu star (bias corrected) | N/A |
| Mean (detects) | 0.0255 | | |

| Estimates of Gamma Parameters using KM Estimates | | | |
|---|---|---|---|
| Mean (KM) | 0.0255 | SD (KM) | 0.0025 |
| Variance (KM) | 6.2500E-6 | SE of Mean (KM) | 0.0025 |
| k hat (KM) | 104 | k star (KM) | 26.18 |
| nu hat (KM) | 832.3 | nu star (KM) | 209.4 |
| theta hat (KM) | 2.4510E-4 | theta star (KM) | 9.7415E-4 |
| 80% gamma percentile (KM) | 0.0296 | 90% gamma percentile (KM) | 0.0321 |
| 95% gamma percentile (KM) | 0.0342 | 99% gamma percentile (KM) | 0.0385 |

| Gamma Kaplan-Meier (KM) Statistics | | | |
|---|---|---|---|
| | | Adjusted Level of Significance (β) | 0.00498 |
| Approximate Chi Square Value (209.41, α) | 176.9 | Adjusted Chi Square Value (209.41, β) | 160.4 |
| 95% KM Approximate Gamma UCL | 0.0302 | 95% KM Adjusted Gamma UCL | 0.0333 |

### Lognormal GOF Test on Detected Observations Only
### Not Enough Data to Perform GOF Test

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0255 | Mean in Log Scale | -3.674 |
| SD in Original Scale | 0.00289 | SD in Log Scale | 0.114 |
| 95% t UCL (assumes normality of ROS data) | 0.0289 | 95% Percentile Bootstrap UCL | N/A |
| 95% BCA Bootstrap UCL | N/A | 95% Bootstrap t UCL | N/A |
| 95% H-UCL (Log ROS) | 0.0296 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -3.674 | KM Geo Mean | 0.0254 |
| KM SD (logged) | 0.0984 | 95% Critical H Value (KM-Log) | N/A |
| KM Standard Error of Mean (logged) | 0.0984 | 95% H-UCL (KM -Log) | N/A |
| KM SD (logged) | 0.0984 | 95% Critical H Value (KM-Log) | N/A |
| KM Standard Error of Mean (logged) | 0.0984 | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.0328 | Mean in Log Scale | -3.446 |
| SD in Original Scale | 0.00862 | SD in Log Scale | 0.275 |
| 95% t UCL (Assumes normality) | 0.0429 | 95% H-Stat UCL | 0.0507 |

### DL/2 is not a recommended method, provided for comparisons and historical reasons

### Nonparametric Distribution Free UCL Statistics
### Data do not follow a Discernible Distribution

### Suggested UCL to Use

| | | | |
|---|---|---|---|
| Recommendation cannot be provided | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Manganese - MW-11**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 | |
| | | Number of Missing Observations | 0 | |
| Minimum | 0.041 | Mean | 1.16 | |
| Maximum | 3.2 | Median | 0.7 | |
| SD | 1.399 | Std. Error of Mean | 0.699 | |
| Coefficient of Variation | 1.206 | Skewness | 1.666 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.835 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.343 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 2.806 | 95% Adjusted-CLT UCL (Chen-1995) | 2.933 |
| | | 95% Modified-t UCL (Johnson-1978) | 2.903 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.245 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.672 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.201 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.406 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 0.714 | k star (bias corrected MLE) | 0.345 |
| Theta hat (MLE) | 1.624 | Theta star (bias corrected MLE) | 3.36 |
| nu hat (MLE) | 5.715 | nu star (bias corrected) | 2.762 |
| MLE Mean (bias corrected) | 1.16 | MLE Sd (bias corrected) | 1.975 |
| | | Approximate Chi Square Value (0.05) | 0.306 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 10.49 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.937 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.279 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -3.194 | Mean of logged Data | -0.695 |
| Maximum of Logged Data | 1.163 | SD of logged Data | 1.823 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 778217 | 90% Chebyshev (MVUE) UCL | 4.452 |
| 95% Chebyshev (MVUE) UCL | 5.834 | 97.5% Chebyshev (MVUE) UCL | 7.753 |
| 99% Chebyshev (MVUE) UCL | 11.52 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 2.311 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 3.259 | 95% Chebyshev(Mean, Sd) UCL | 4.209 |
| 97.5% Chebyshev(Mean, Sd) UCL | 5.528 | 99% Chebyshev(Mean, Sd) UCL | 8.12 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 2.806 | | |
| | | | |
| **The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.** | | | |
| **Please verify the data were collected from random locations.** | | | |
| **If the data were collected using judgmental or other non-random methods,** | | | |
| **then contact a statistician to correctly calculate UCLs.** | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |

| UCL Statistics for Data Sets with Non-Detects | |
|---|---|
| | |
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 11/18/2024 8:44:34 AM |
| From File | mw12r_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 150 | Mean | 287.5 |
| Maximum | 490 | Median | 250 |
| SD | 134.8 | Std. Error of Mean | 47.65 |
| Coefficient of Variation | 0.469 | Skewness | 0.477 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.874 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.242 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 377.8 | 95% Adjusted-CLT UCL (Chen-1995) | 374.5 |
| | | 95% Modified-t UCL (Johnson-1978) | 379.1 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.499 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.719 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.237 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.295 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 5.262 | k star (bias corrected MLE) | 3.372 |
| Theta hat (MLE) | 54.63 | Theta star (bias corrected MLE) | 85.25 |
| nu hat (MLE) | 84.2 | nu star (bias corrected) | 53.96 |
| MLE Mean (bias corrected) | 287.5 | MLE Sd (bias corrected) | 156.6 |
| | | Approximate Chi Square Value (0.05) | 38.08 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 34.74 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 407.4 | 95% Adjusted Gamma UCL | 446.6 |

## Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.884 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.212 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level |

### Data appear Lognormal at 10% Significance Level
### Note GOF tests may be unreliable for small sample sizes

## Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | 5.011 | Mean of logged Data | 5.563 |
| Maximum of Logged Data | 6.194 | SD of logged Data | 0.474 |

## Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| 95% H-UCL | 441.5 | 90% Chebyshev (MVUE) UCL | 433.2 |
| 95% Chebyshev (MVUE) UCL | 499.3 | 97.5% Chebyshev (MVUE) UCL | 591 |
| 99% Chebyshev (MVUE) UCL | 771.2 | | |

## Nonparametric Distribution Free UCL Statistics
### Data appear to follow a Discernible Distribution

## Nonparametric Distribution Free UCLs

| | | | |
|---|---|---|---|
| 95% CLT UCL | 365.9 | 95% BCA Bootstrap UCL | 366.3 |
| 95% Standard Bootstrap UCL | 361.7 | 95% Bootstrap-t UCL | 402.4 |
| 95% Hall's Bootstrap UCL | 358.5 | 95% Percentile Bootstrap UCL | 363.8 |
| 90% Chebyshev(Mean, Sd) UCL | 430.5 | 95% Chebyshev(Mean, Sd) UCL | 495.2 |
| 97.5% Chebyshev(Mean, Sd) UCL | 585.1 | 99% Chebyshev(Mean, Sd) UCL | 761.6 |

## Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% Student's-t UCL | 377.8 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

### Nitrite - MW-12R

## General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 2 |
| Number of Detects | 1 | Number of Non-Detects | 7 |
| Number of Distinct Detects | 1 | Number of Distinct Non-Detects | 1 |

### Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
### It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

### The data set for variable Nitrite was not processed!

**Arsenic - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.01 | Mean | 0.0214 |
| Maximum | 0.064 | Median | 0.014 |
| SD | 0.0182 | Std. Error of Mean | 0.00643 |
| Coefficient of Variation | 0.85 | Skewness | 2.315 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.676 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.749 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.28 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level |
| **Data appear Approximate Normal at 1% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0335 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0376 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0344 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.761 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.723 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.231 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.297 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data follow Appr. Gamma Distribution at 5% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.519 | k star (bias corrected MLE) | 1.658 |
| Theta hat (MLE) | 0.00849 | Theta star (bias corrected MLE) | 0.0129 |
| nu hat (MLE) | 40.3 | nu star (bias corrected) | 26.52 |
| MLE Mean (bias corrected) | 0.0214 | MLE Sd (bias corrected) | 0.0166 |
| | | Approximate Chi Square Value (0.05) | 15.78 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 13.73 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0359 | 95% Adjusted Gamma UCL | 0.0413 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.839 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.851 | Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.219 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level |
| **Data appear Approximate Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -4.605 | Mean of logged Data | -4.057 |
| Maximum of Logged Data | -2.749 | SD of logged Data | 0.63 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 0.0391 | | 90% Chebyshev (MVUE) UCL | 0.0344 |
| 95% Chebyshev (MVUE) UCL | 0.0407 | | 97.5% Chebyshev (MVUE) UCL | 0.0495 |
| 99% Chebyshev (MVUE) UCL | 0.0667 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 0.0319 | | 95% BCA Bootstrap UCL | 0.0386 |
| 95% Standard Bootstrap UCL | 0.0315 | | 95% Bootstrap-t UCL | 0.0624 |
| 95% Hall's Bootstrap UCL | 0.0726 | | 95% Percentile Bootstrap UCL | 0.033 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0407 | | 95% Chebyshev(Mean, Sd) UCL | 0.0494 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0615 | | 99% Chebyshev(Mean, Sd) UCL | 0.0853 |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% Student's-t UCL | 0.0335 | | | |
| | | | | |
| When a data set follows an approximate distribution passing only one of the GOF tests, | | | | |
| it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL | | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |
| | | | | |

**Iron - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 8 |
| Number of Detects | 7 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 7 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.051 | Minimum Non-Detect | 0.08 |
| Maximum Detect | 0.15 | Maximum Non-Detect | 0.08 |
| Variance Detects | 0.00129 | Percent Non-Detects | 12.5% |
| Mean Detects | 0.0884 | SD Detects | 0.0359 |
| Median Detects | 0.078 | CV Detects | 0.405 |
| Skewness Detects | 0.835 | Kurtosis Detects | -0.0526 |
| Mean of Logged Detects | -2.494 | SD of Logged Detects | 0.397 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.917 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.73 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.186 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.35 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 0.0854 | KM Standard Error of Mean | 0.0125 |
| 90KM SD | 0.0323 | 95% KM (BCA) UCL | 0.107 |
| 95% KM (t) UCL | 0.109 | 95% KM (Percentile Bootstrap) UCL | 0.106 |
| 95% KM (z) UCL | 0.106 | 95% KM Bootstrap t UCL | 0.121 |
| 90% KM Chebyshev UCL | 0.123 | 95% KM Chebyshev UCL | 0.14 |
| 97.5% KM Chebyshev UCL | 0.163 | 99% KM Chebyshev UCL | 0.21 |

### Gamma GOF Tests on Detected Observations Only

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.267 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.709 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.164 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.312 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics on Detected Data Only

| | | | |
|---|---|---|---|
| k hat (MLE) | 7.503 | k star (bias corrected MLE) | 4.383 |
| Theta hat (MLE) | 0.0118 | Theta star (bias corrected MLE) | 0.0202 |
| nu hat (MLE) | 105 | nu star (bias corrected) | 61.36 |
| Mean (detects) | 0.0884 | | |

### Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

| | | | |
|---|---|---|---|
| Minimum | 0.051 | Mean | 0.0854 |
| Maximum | 0.15 | Median | 0.077 |
| SD | 0.0343 | CV | 0.402 |
| k hat (MLE) | 7.877 | k star (bias corrected MLE) | 5.006 |
| Theta hat (MLE) | 0.0108 | Theta star (bias corrected MLE) | 0.0171 |

| | | | |
|---|---|---|---|
| nu hat (MLE) | 126 | nu star (bias corrected) | 80.1 |
| Adjusted Level of Significance (β) | 0.0195 | | |
| Approximate Chi Square Value (80.10, α) | 60.48 | Adjusted Chi Square Value (80.10, β) | 56.18 |
| 95% Gamma Approximate UCL | 0.113 | 95% Gamma Adjusted UCL | 0.122 |

### Estimates of Gamma Parameters using KM Estimates

| | | | |
|---|---|---|---|
| Mean (KM) | 0.0854 | SD (KM) | 0.0323 |
| Variance (KM) | 0.00105 | SE of Mean (KM) | 0.0125 |
| k hat (KM) | 6.975 | k star (KM) | 4.443 |
| nu hat (KM) | 111.6 | nu star (KM) | 71.09 |
| theta hat (KM) | 0.0122 | theta star (KM) | 0.0192 |
| 80% gamma percentile (KM) | 0.116 | 90% gamma percentile (KM) | 0.14 |
| 95% gamma percentile (KM) | 0.161 | 99% gamma percentile (KM) | 0.207 |

### Gamma Kaplan-Meier (KM) Statistics

| | | | |
|---|---|---|---|
| Approximate Chi Square Value (71.09, α) | 52.67 | Adjusted Chi Square Value (71.09, β) | 48.69 |
| 95% KM Approximate Gamma UCL | 0.115 | 95% KM Adjusted Gamma UCL | 0.125 |

### Lognormal GOF Test on Detected Observations Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.946 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.838 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.154 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.28 | Detected Data appear Lognormal at 10% Significance Level |

**Detected Data appear Lognormal at 10% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Lognormal ROS Statistics Using Imputed Non-Detects

| | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0854 | Mean in Log Scale | -2.526 |
| SD in Original Scale | 0.0343 | SD in Log Scale | 0.378 |
| 95% t UCL (assumes normality of ROS data) | 0.108 | 95% Percentile Bootstrap UCL | 0.105 |
| 95% BCA Bootstrap UCL | 0.108 | 95% Bootstrap t UCL | 0.126 |
| 95% H-UCL (Log ROS) | 0.117 | | |

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| KM Mean (logged) | -2.527 | KM Geo Mean | 0.0799 |
| KM SD (logged) | 0.362 | 95% Critical H Value (KM-Log) | 2.14 |
| KM Standard Error of Mean (logged) | 0.141 | 95% H-UCL (KM -Log) | 0.114 |
| KM SD (logged) | 0.362 | 95% Critical H Value (KM-Log) | 2.14 |
| KM Standard Error of Mean (logged) | 0.141 | | |

### DL/2 Statistics

| DL/2 Normal | | DL/2 Log-Transformed | |
|---|---|---|---|
| Mean in Original Scale | 0.0824 | Mean in Log Scale | -2.584 |
| SD in Original Scale | 0.0374 | SD in Log Scale | 0.448 |
| 95% t UCL (Assumes normality) | 0.107 | 95% H-Stat UCL | 0.122 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

### Nonparametric Distribution Free UCL Statistics

**Detected Data appear Normal Distributed at 1% Significance Level**

### Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 0.109 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Manganese - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.9 | Mean | 1.209 |
| Maximum | 1.8 | Median | 1.15 |
| SD | 0.321 | Std. Error of Mean | 0.113 |
| Coefficient of Variation | 0.265 | Skewness | 0.819 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.868 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.242 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 1.424 | 95% Adjusted-CLT UCL (Chen-1995) | 1.43 |
| | | 95% Modified-t UCL (Johnson-1978) | 1.429 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.529 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.716 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.253 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.294 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 17.3 | k star (bias corrected MLE) | 10.9 |
| Theta hat (MLE) | 0.0699 | Theta star (bias corrected MLE) | 0.111 |
| nu hat (MLE) | 276.8 | nu star (bias corrected) | 174.4 |
| MLE Mean (bias corrected) | 1.209 | MLE Sd (bias corrected) | 0.366 |
| | | Approximate Chi Square Value (0.05) | 144.8 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 138 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 1.455 | 95% Adjusted Gamma UCL | 1.527 |

### Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.881 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.235 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -0.105 | Mean of logged Data | 0.16 |
| Maximum of Logged Data | 0.588 | SD of logged Data | 0.255 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 1.471 | | 90% Chebyshev (MVUE) UCL | 1.535 |
| 95% Chebyshev (MVUE) UCL | 1.684 | | 97.5% Chebyshev (MVUE) UCL | 1.89 |
| 99% Chebyshev (MVUE) UCL | 2.294 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 1.395 | | 95% BCA Bootstrap UCL | 1.425 |
| 95% Standard Bootstrap UCL | 1.389 | | 95% Bootstrap-t UCL | 1.487 |
| 95% Hall's Bootstrap UCL | 1.409 | | 95% Percentile Bootstrap UCL | 1.4 |
| 90% Chebyshev(Mean, Sd) UCL | 1.549 | | 95% Chebyshev(Mean, Sd) UCL | 1.703 |
| 97.5% Chebyshev(Mean, Sd) UCL | 1.917 | | 99% Chebyshev(Mean, Sd) UCL | 2.337 |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% Student's-t UCL | 1.424 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**2,4-D - MW-12R**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 6 |
| Number of Detects | 3 | Number of Non-Detects | 6 |
| Number of Distinct Detects | 3 | Number of Distinct Non-Detects | 4 |
| Minimum Detect | 2.6000E-4 | Minimum Non-Detect | 2.4000E-4 |
| Maximum Detect | 0.0045 | Maximum Non-Detect | 0.0053 |
| Variance Detects | 5.3160E-6 | Percent Non-Detects | 66.67% |
| Mean Detects | 0.00186 | SD Detects | 0.00231 |
| Median Detects | 8.1000E-4 | CV Detects | 1.242 |
| Skewness Detects | 1.622 | Kurtosis Detects | N/A |
| Mean of Logged Detects | -6.926 | SD of Logged Detects | 1.435 |

| |
|---|
| Warning: Data set has only 3 Detected Values. |
| This is not enough to compute meaningful or reliable statistics and estimates. |

| |
|---|
| Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach, |
| refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance, |
| but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7). |
| The Chebyshev UCL often results in gross overestimates of the mean. |
| Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL. |

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.845 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.753 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.342 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.429 | Detected Data appear Normal at 1% Significance Level | |
| **Detected Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 8.4675E-4 | KM Standard Error of Mean | 6.0327E-4 |
| 90KM SD | 0.00139 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.00197 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.00184 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.00266 | 95% KM Chebyshev UCL | 0.00348 |
| 97.5% KM Chebyshev UCL | 0.00461 | 99% KM Chebyshev UCL | 0.00685 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.312 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.642 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.296 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.441 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected Data Not Gamma Distributed at 5% Significance Level** | | | |

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 0.916 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 0.00203 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 5.497 | nu star (bias corrected) | N/A |
| Mean (detects) | 0.00186 | | |

| Gamma ROS Statistics using Imputed Non-Detects | |
|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs |
| This is especially true when the sample size is small. |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates |

| | | | | |
|---|---|---|---|---|
| Minimum | 2.6000E-4 | | Mean | 0.00729 |
| Maximum | 0.01 | | Median | 0.01 |
| SD | 0.00423 | | CV | 0.581 |
| k hat (MLE) | 1.235 | | k star (bias corrected MLE) | 0.897 |
| Theta hat (MLE) | 0.0059 | | Theta star (bias corrected MLE) | 0.00812 |
| nu hat (MLE) | 22.22 | | nu star (bias corrected) | 16.15 |
| Adjusted Level of Significance (β) | 0.0231 | | | |
| Approximate Chi Square Value (16.15, α) | 8.067 | | Adjusted Chi Square Value (16.15, β) | 6.897 |
| 95% Gamma Approximate UCL | 0.0146 | | 95% Gamma Adjusted UCL | N/A |

| | | | | |
|---|---|---|---|---|
| | | Estimates of Gamma Parameters using KM Estimates | | |
| Mean (KM) | 8.4675E-4 | | SD (KM) | 0.00139 |
| Variance (KM) | 1.9410E-6 | | SE of Mean (KM) | 6.0327E-4 |
| k hat (KM) | 0.369 | | k star (KM) | 0.32 |
| nu hat (KM) | 6.649 | | nu star (KM) | 5.766 |
| theta hat (KM) | 0.00229 | | theta star (KM) | 0.00264 |
| 80% gamma percentile (KM) | 0.00132 | | 90% gamma percentile (KM) | 0.00248 |
| 95% gamma percentile (KM) | 0.00379 | | 99% gamma percentile (KM) | 0.00718 |

| | | | | |
|---|---|---|---|---|
| | | Gamma Kaplan-Meier (KM) Statistics | | |
| Approximate Chi Square Value (5.77, α) | 1.522 | | Adjusted Chi Square Value (5.77, β) | 1.11 |
| 95% KM Approximate Gamma UCL | 0.00321 | | 95% KM Adjusted Gamma UCL | 0.0044 |

| | | | |
|---|---|---|---|
| | | Lognormal GOF Test on Detected Observations Only | |
| Shapiro Wilk Test Statistic | 0.986 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.789 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.22 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.389 | Detected Data appear Lognormal at 10% Significance Level | |
| | | Detected Data appear Lognormal at 10% Significance Level | |
| | | Note GOF tests may be unreliable for small sample sizes | |

| | | | | |
|---|---|---|---|---|
| | | Lognormal ROS Statistics Using Imputed Non-Detects | | |
| Mean in Original Scale | 6.3496E-4 | | Mean in Log Scale | -9.67 |
| SD in Original Scale | 0.00147 | | SD in Log Scale | 2.351 |
| 95% t UCL (assumes normality of ROS data) | 0.00155 | | 95% Percentile Bootstrap UCL | 0.00155 |
| 95% BCA Bootstrap UCL | 0.0021 | | 95% Bootstrap t UCL | 0.0112 |
| 95% H-UCL (Log ROS) | 0.248 | | | |

| | | | | |
|---|---|---|---|---|
| | | Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | |
| KM Mean (logged) | -7.804 | | KM Geo Mean | 4.0793E-4 |
| KM SD (logged) | 0.989 | | 95% Critical H Value (KM-Log) | 3.215 |
| KM Standard Error of Mean (logged) | 0.428 | | 95% H-UCL (KM -Log) | 0.00205 |
| KM SD (logged) | 0.989 | | 95% Critical H Value (KM-Log) | 3.215 |
| KM Standard Error of Mean (logged) | 0.428 | | | |

| | | | | |
|---|---|---|---|---|
| | | DL/2 Statistics | | |
| **DL/2 Normal** | | | **DL/2 Log-Transformed** | |
| Mean in Original Scale | 9.8611E-4 | | Mean in Log Scale | -7.936 |
| SD in Original Scale | 0.00155 | | SD in Log Scale | 1.426 |
| 95% t UCL (Assumes normality) | 0.00195 | | 95% H-Stat UCL | 0.00845 |
| | | DL/2 is not a recommended method, provided for comparisons and historical reasons | | |

| | | |
|---|---|---|
| | Nonparametric Distribution Free UCL Statistics | |
| | Detected Data appear Normal Distributed at 1% Significance Level | |

| | | | |
|---|---|---|---|
| | Suggested UCL to Use | | |
| 95% KM (t) UCL | 0.00197 | | |

**Dinoseb - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0039 | Mean | 0.799 |
| Maximum | 1.8 | Median | 0.815 |
| SD | 0.574 | Std. Error of Mean | 0.203 |
| Coefficient of Variation | 0.718 | Skewness | 0.238 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.95 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.175 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level |

**Data appear Normal at 1% Significance Level**
**Note GOF tests may be unreliable for small sample sizes**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 1.183 | 95% Adjusted-CLT UCL (Chen-1995) | 1.151 |
| | | 95% Modified-t UCL (Johnson-1978) | 1.186 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.774 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.743 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.326 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.304 | Data Not Gamma Distributed at 5% Significance Level |

**Data Not Gamma Distributed at 5% Significance Level**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.798 | k star (bias corrected MLE) | 0.582 |
| Theta hat (MLE) | 1.002 | Theta star (bias corrected MLE) | 1.373 |
| nu hat (MLE) | 12.77 | nu star (bias corrected) | 9.313 |
| MLE Mean (bias corrected) | 0.799 | MLE Sd (bias corrected) | 1.048 |
| | | Approximate Chi Square Value (0.05) | 3.517 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 2.678 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 2.116 | 95% Adjusted Gamma UCL | 2.78 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.716 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.851 | Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.352 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.265 | Data Not Lognormal at 10% Significance Level |

**Data Not Lognormal at 10% Significance Level**

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -5.547 | Mean of logged Data | -0.968 |
| Maximum of Logged Data | 0.588 | SD of logged Data | 2.015 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 318.8 | | 90% Chebyshev (MVUE) UCL | 5.321 |
| 95% Chebyshev (MVUE) UCL | 6.941 | | 97.5% Chebyshev (MVUE) UCL | 9.19 |
| 99% Chebyshev (MVUE) UCL | 13.61 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| Data appear to follow a Discernible Distribution |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 1.133 | | 95% BCA Bootstrap UCL | 1.103 |
| 95% Standard Bootstrap UCL | 1.108 | | 95% Bootstrap-t UCL | 1.218 |
| 95% Hall's Bootstrap UCL | 1.232 | | 95% Percentile Bootstrap UCL | 1.097 |
| 90% Chebyshev(Mean, Sd) UCL | 1.408 | | 95% Chebyshev(Mean, Sd) UCL | 1.683 |
| 97.5% Chebyshev(Mean, Sd) UCL | 2.066 | | 99% Chebyshev(Mean, Sd) UCL | 2.817 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 1.183 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Benzene - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 9 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0056 | Mean | 0.013 |
| Maximum | 0.022 | Median | 0.013 |
| SD | 0.00579 | Std. Error of Mean | 0.00193 |
| Coefficient of Variation | 0.444 | Skewness | 0.278 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.946 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.164 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0166 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0164 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0167 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.251 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.723 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.18 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.28 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 5.346 | k star (bias corrected MLE) | 3.638 |
| Theta hat (MLE) | 0.00244 | Theta star (bias corrected MLE) | 0.00359 |
| nu hat (MLE) | 96.24 | nu star (bias corrected) | 65.49 |
| MLE Mean (bias corrected) | 0.013 | MLE Sd (bias corrected) | 0.00684 |
| | | Approximate Chi Square Value (0.05) | 47.87 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 44.71 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0178 | 95% Adjusted Gamma UCL | 0.0191 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.946 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.163 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level |
| **Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -5.185 | Mean of logged Data | -4.436 |
| Maximum of Logged Data | -3.817 | SD of logged Data | 0.479 |

| Assuming Lognormal Distribution | | | | | |
|---|---|---|---|---|---|
| 95% H-UCL | 0.0193 | | 90% Chebyshev (MVUE) UCL | 0.0195 |
| 95% Chebyshev (MVUE) UCL | 0.0223 | | 97.5% Chebyshev (MVUE) UCL | 0.0263 |
| 99% Chebyshev (MVUE) UCL | 0.0342 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| Data appear to follow a Discernible Distribution |

| Nonparametric Distribution Free UCLs | | | | | |
|---|---|---|---|---|---|
| 95% CLT UCL | 0.0162 | | 95% BCA Bootstrap UCL | 0.016 |
| 95% Standard Bootstrap UCL | 0.0161 | | 95% Bootstrap-t UCL | 0.0169 |
| 95% Hall's Bootstrap UCL | 0.0164 | | 95% Percentile Bootstrap UCL | 0.0161 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0188 | | 95% Chebyshev(Mean, Sd) UCL | 0.0215 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0251 | | 99% Chebyshev(Mean, Sd) UCL | 0.0323 |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 0.0166 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Chlorobenzene - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.12 | Mean | 0.202 |
| Maximum | 0.29 | Median | 0.2 |
| SD | 0.0689 | Std. Error of Mean | 0.023 |
| Coefficient of Variation | 0.341 | Skewness | 0.207 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.886 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.175 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.245 | 95% Adjusted-CLT UCL (Chen-1995) | 0.242 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.245 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.426 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.722 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.184 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 9.493 | k star (bias corrected MLE) | 6.403 |
| Theta hat (MLE) | 0.0213 | Theta star (bias corrected MLE) | 0.0316 |
| nu hat (MLE) | 170.9 | nu star (bias corrected) | 115.3 |
| MLE Mean (bias corrected) | 0.202 | MLE Sd (bias corrected) | 0.0799 |
| | | Approximate Chi Square Value (0.05) | 91.47 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 87.01 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.255 | 95% Adjusted Gamma UCL | 0.268 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.899 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.169 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level |
| **Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.12 | Mean of logged Data | -1.652 |
| Maximum of Logged Data | -1.238 | SD of logged Data | 0.35 |

| Assuming Lognormal Distribution | | | | | |
|---|---|---|---|---|---|
| 95% H-UCL | 0.263 | | 90% Chebyshev (MVUE) UCL | 0.274 |
| 95% Chebyshev (MVUE) UCL | 0.306 | | 97.5% Chebyshev (MVUE) UCL | 0.351 |
| 99% Chebyshev (MVUE) UCL | 0.439 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| Data appear to follow a Discernible Distribution |

| Nonparametric Distribution Free UCLs | | | | | |
|---|---|---|---|---|---|
| 95% CLT UCL | 0.24 | | 95% BCA Bootstrap UCL | 0.239 |
| 95% Standard Bootstrap UCL | 0.238 | | 95% Bootstrap-t UCL | 0.249 |
| 95% Hall's Bootstrap UCL | 0.234 | | 95% Percentile Bootstrap UCL | 0.239 |
| 90% Chebyshev(Mean, Sd) UCL | 0.271 | | 95% Chebyshev(Mean, Sd) UCL | 0.302 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.346 | | 99% Chebyshev(Mean, Sd) UCL | 0.431 |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 0.245 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**1,2-DCP - MW-12R**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.37 | Mean | 1.01 |
| Maximum | 1.9 | Median | 1.1 |
| SD | 0.486 | Std. Error of Mean | 0.162 |
| Coefficient of Variation | 0.481 | Skewness | 0.492 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.958 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.141 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 1.311 | 95% Adjusted-CLT UCL (Chen-1995) | 1.305 |
| | | 95% Modified-t UCL (Johnson-1978) | 1.316 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.219 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.724 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.189 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.28 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 4.576 | k star (bias corrected MLE) | 3.125 |
| Theta hat (MLE) | 0.221 | Theta star (bias corrected MLE) | 0.323 |
| nu hat (MLE) | 82.37 | nu star (bias corrected) | 56.24 |
| MLE Mean (bias corrected) | 1.01 | MLE Sd (bias corrected) | 0.571 |
| | | Approximate Chi Square Value (0.05) | 40.01 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 37.14 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 1.42 | 95% Adjusted Gamma UCL | 1.53 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.965 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.204 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level |
| **Data appear Lognormal at 10% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -0.994 | Mean of logged Data | -0.103 |
| Maximum of Logged Data | 0.642 | SD of logged Data | 0.522 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 1.57 | | 90% Chebyshev (MVUE) UCL | 1.556 |
| 95% Chebyshev (MVUE) UCL | 1.8 | | 97.5% Chebyshev (MVUE) UCL | 2.139 |
| 99% Chebyshev (MVUE) UCL | 2.805 | | | |

| Nonparametric Distribution Free UCL Statistics | | | | |
|---|---|---|---|---|
| Data appear to follow a Discernible Distribution | | | | |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 1.276 | | 95% BCA Bootstrap UCL | 1.269 |
| 95% Standard Bootstrap UCL | 1.261 | | 95% Bootstrap-t UCL | 1.353 |
| 95% Hall's Bootstrap UCL | 1.327 | | 95% Percentile Bootstrap UCL | 1.27 |
| 90% Chebyshev(Mean, Sd) UCL | 1.496 | | 95% Chebyshev(Mean, Sd) UCL | 1.716 |
| 97.5% Chebyshev(Mean, Sd) UCL | 2.021 | | 99% Chebyshev(Mean, Sd) UCL | 2.621 |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 1.311 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

2-Methylnaphthalene - MW-12R

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | | Number of Distinct Observations | 5 |
| Number of Detects | 1 | | Number of Non-Detects | 8 |
| Number of Distinct Detects | 1 | | Number of Distinct Non-Detects | 4 |

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2-Methylnaphthalene was not processed!

| UCL Statistics for Data Sets with Non-Detects |
|---|

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:23:57 PM |
| From File | mw13_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-13**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 16 | Mean | 20.89 |
| Maximum | 28 | Median | 21 |
| SD | 3.516 | Std. Error of Mean | 1.172 |
| Coefficient of Variation | 0.168 | Skewness | 0.695 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.933 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.179 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 23.07 | 95% Adjusted-CLT UCL (Chen-1995) | 23.11 |
| | | 95% Modified-t UCL (Johnson-1978) | 23.11 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.327 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.721 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.201 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 40.92 | | k star (bias corrected MLE) | 27.36 |
| Theta hat (MLE) | 0.51 | | Theta star (bias corrected MLE) | 0.764 |
| nu hat (MLE) | 736.6 | | nu star (bias corrected) | 492.4 |
| MLE Mean (bias corrected) | 20.89 | | MLE Sd (bias corrected) | 3.994 |
| | | | Approximate Chi Square Value (0.05) | 442 |
| Adjusted Level of Significance | 0.0231 | | Adjusted Chi Square Value | 431.9 |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 23.27 | | 95% Adjusted Gamma UCL | 23.82 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.952 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.209 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 2.773 | | Mean of logged Data | 3.027 |
| Maximum of Logged Data | 3.332 | | SD of logged Data | 0.165 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 23.35 | | 90% Chebyshev (MVUE) UCL | 24.35 |
| 95% Chebyshev (MVUE) UCL | 25.92 | | 97.5% Chebyshev (MVUE) UCL | 28.09 |
| 99% Chebyshev (MVUE) UCL | 32.37 | | | |

| Nonparametric Distribution Free UCL Statistics | | | | |
|---|---|---|---|---|
| **Data appear to follow a Discernible Distribution** | | | | |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 22.82 | | 95% BCA Bootstrap UCL | 22.89 |
| 95% Standard Bootstrap UCL | 22.74 | | 95% Bootstrap-t UCL | 23.45 |
| 95% Hall's Bootstrap UCL | 24.18 | | 95% Percentile Bootstrap UCL | 22.78 |
| 90% Chebyshev(Mean, Sd) UCL | 24.4 | | 95% Chebyshev(Mean, Sd) UCL | 26 |
| 97.5% Chebyshev(Mean, Sd) UCL | 28.21 | | 99% Chebyshev(Mean, Sd) UCL | 32.55 |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 23.07 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Nitrite - MW-13**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 7 |
| Number of Detects | 6 | Number of Non-Detects | 3 |
| Number of Distinct Detects | 6 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.018 | Minimum Non-Detect | 0.015 |
| Maximum Detect | 0.087 | Maximum Non-Detect | 0.015 |
| Variance Detects | 8.8120E-4 | Percent Non-Detects | 33.33% |
| Mean Detects | 0.046 | SD Detects | 0.0297 |
| Median Detects | 0.032 | CV Detects | 0.645 |
| Skewness Detects | 0.832 | Kurtosis Detects | -1.723 |
| Mean of Logged Detects | -3.249 | SD of Logged Detects | 0.634 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.816 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.299 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Detected Data appear Normal at 1% Significance Level | |
| Detected Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0357 | KM Standard Error of Mean | 0.00968 |
| 90KM SD | 0.0265 | 95% KM (BCA) UCL | 0.0507 |
| 95% KM (t) UCL | 0.0537 | 95% KM (Percentile Bootstrap) UCL | 0.0509 |
| 95% KM (z) UCL | 0.0516 | 95% KM Bootstrap t UCL | 0.0825 |
| 90% KM Chebyshev UCL | 0.0647 | 95% KM Chebyshev UCL | 0.0779 |
| 97.5% KM Chebyshev UCL | 0.0961 | 99% KM Chebyshev UCL | 0.132 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.506 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.701 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.254 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.334 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 3.092 | k star (bias corrected MLE) | 1.657 |
| Theta hat (MLE) | 0.0149 | Theta star (bias corrected MLE) | 0.0278 |
| nu hat (MLE) | 37.11 | nu star (bias corrected) | 19.89 |
| Mean (detects) | 0.046 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.01 | Mean | 0.034 |
| Maximum | 0.087 | Median | 0.027 |
| SD | 0.0296 | CV | 0.87 |
| k hat (MLE) | 1.71 | k star (bias corrected MLE) | 1.214 |
| Theta hat (MLE) | 0.0199 | Theta star (bias corrected MLE) | 0.028 |
| nu hat (MLE) | 30.79 | nu star (bias corrected) | 21.86 |
| Adjusted Level of Significance (β) | 0.0231 | | |
| Approximate Chi Square Value (21.86, α) | 12.23 | Adjusted Chi Square Value (21.86, β) | 10.74 |
| 95% Gamma Approximate UCL | 0.0608 | 95% Gamma Adjusted UCL | 0.0692 |

| Estimates of Gamma Parameters using KM Estimates | | | |
|---|---|---|---|
| Mean (KM) | 0.0357 | SD (KM) | 0.0265 |
| Variance (KM) | 7.0311E-4 | SE of Mean (KM) | 0.00968 |
| k hat (KM) | 1.809 | k star (KM) | 1.28 |
| nu hat (KM) | 32.57 | nu star (KM) | 23.04 |
| theta hat (KM) | 0.0197 | theta star (KM) | 0.0279 |
| 80% gamma percentile (KM) | 0.0561 | 90% gamma percentile (KM) | 0.0773 |
| 95% gamma percentile (KM) | 0.098 | 99% gamma percentile (KM) | 0.145 |

| Gamma Kaplan-Meier (KM) Statistics | | | |
|---|---|---|---|
| Approximate Chi Square Value (23.04, α) | 13.12 | Adjusted Chi Square Value (23.04, β) | 11.58 |
| 95% KM Approximate Gamma UCL | 0.0626 | 95% KM Adjusted Gamma UCL | 0.071 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.894 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.826 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.214 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.298 | Detected Data appear Lognormal at 10% Significance Level |
| **Detected Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0332 | Mean in Log Scale | -3.806 |
| SD in Original Scale | 0.0303 | SD in Log Scale | 0.994 |
| 95% t UCL (assumes normality of ROS data) | 0.052 | 95% Percentile Bootstrap UCL | 0.0496 |
| 95% BCA Bootstrap UCL | 0.0518 | 95% Bootstrap t UCL | 0.0724 |
| 95% H-UCL (Log ROS) | 0.113 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -3.566 | | KM Geo Mean | 0.0283 |
| KM SD (logged) | 0.651 | | 95% Critical H Value (KM-Log) | 2.535 |
| KM Standard Error of Mean (logged) | 0.238 | | 95% H-UCL (KM -Log) | 0.0626 |
| KM SD (logged) | 0.651 | | 95% Critical H Value (KM-Log) | 2.535 |
| KM Standard Error of Mean (logged) | 0.238 | | | |
| | | | | |
| DL/2 Statistics | | | | |
| DL/2 Normal | | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.0332 | | Mean in Log Scale | -3.797 |
| SD in Original Scale | 0.0304 | | SD in Log Scale | 0.962 |
| 95% t UCL (Assumes normality) | 0.052 | | 95% H-Stat UCL | 0.104 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% KM (t) UCL | 0.0537 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |
| | | | | |
| | | | | |

**Arsenic - MW-13**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 3 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.012 | Mean | 0.0132 |
| Maximum | 0.014 | Median | 0.013 |
| SD | 6.6667E-4 | Std. Error of Mean | 2.2222E-4 |
| Coefficient of Variation | 0.0504 | Skewness | -0.254 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.812 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.297 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**
**Note GOF tests may be unreliable for small sample sizes**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0136 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0136 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0136 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.942 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.72 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.299 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.279 | Data Not Gamma Distributed at 5% Significance Level | |

**Data Not Gamma Distributed at 5% Significance Level**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 438.6 | k star (bias corrected MLE) | 292.4 |
| Theta hat (MLE) | 3.0149E-5 | Theta star (bias corrected MLE) | 4.5213E-5 |
| nu hat (MLE) | 7894 | nu star (bias corrected) | 5264 |
| MLE Mean (bias corrected) | 0.0132 | MLE Sd (bias corrected) | 7.7318E-4 |
| | | Approximate Chi Square Value (0.05) | 5096 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 5061 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0137 | 95% Adjusted Gamma UCL | 0.0138 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.812 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.289 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.423 | Mean of logged Data | -4.327 |
| Maximum of Logged Data | -4.269 | SD of logged Data | 0.0508 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.0139 |
| 95% Chebyshev (MVUE) UCL | 0.0142 | 97.5% Chebyshev (MVUE) UCL | 0.0146 |
| 99% Chebyshev (MVUE) UCL | 0.0154 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0136 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0139 | 95% Chebyshev(Mean, Sd) UCL | 0.0142 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0146 | 99% Chebyshev(Mean, Sd) UCL | 0.0154 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0136 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

| Iron - MW-13 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | | 6 |
| Number of Detects | 4 | Number of Non-Detects | | 5 |
| Number of Distinct Detects | 4 | Number of Distinct Non-Detects | | 2 |
| Minimum Detect | 0.023 | Minimum Non-Detect | | 0.02 |
| Maximum Detect | 0.15 | Maximum Non-Detect | | 0.08 |
| Variance Detects | 0.00331 | Percent Non-Detects | | 55.56% |
| Mean Detects | 0.0778 | SD Detects | | 0.0576 |
| Median Detects | 0.069 | CV Detects | | 0.74 |
| Skewness Detects | 0.596 | Kurtosis Detects | | -1.9 |
| Mean of Logged Detects | -2.799 | SD of Logged Detects | | 0.843 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.94 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.238 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Detected Data appear Normal at 1% Significance Level | |
| Detected Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0477 | KM Standard Error of Mean | 0.0168 |
| 90KM SD | 0.0431 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.0789 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.0753 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.098 | 95% KM Chebyshev UCL | 0.121 |
| 97.5% KM Chebyshev UCL | 0.153 | 99% KM Chebyshev UCL | 0.215 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.258 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.66 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.232 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.398 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 2.194 | k star (bias corrected MLE) | 0.715 |
| Theta hat (MLE) | 0.0354 | Theta star (bias corrected MLE) | 0.109 |
| nu hat (MLE) | 17.55 | nu star (bias corrected) | 5.721 |
| Mean (detects) | 0.0778 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.01 | Mean | 0.0424 |
| Maximum | 0.15 | Median | 0.023 |
| SD | 0.0491 | CV | 1.158 |
| k hat (MLE) | 1.103 | k star (bias corrected MLE) | 0.809 |
| Theta hat (MLE) | 0.0384 | Theta star (bias corrected MLE) | 0.0524 |
| nu hat (MLE) | 19.85 | nu star (bias corrected) | 14.57 |
| Adjusted Level of Significance (β) | 0.0231 | | |
| Approximate Chi Square Value (14.57, α) | 6.961 | Adjusted Chi Square Value (14.57, β) | 5.889 |
| 95% Gamma Approximate UCL | 0.0887 | 95% Gamma Adjusted UCL | N/A |

| Estimates of Gamma Parameters using KM Estimates | | | |
|---|---|---|---|
| Mean (KM) | 0.0477 | SD (KM) | 0.0431 |
| Variance (KM) | 0.00186 | SE of Mean (KM) | 0.0168 |
| k hat (KM) | 1.222 | k star (KM) | 0.889 |
| nu hat (KM) | 22 | nu star (KM) | 16 |
| theta hat (KM) | 0.039 | theta star (KM) | 0.0536 |
| 80% gamma percentile (KM) | 0.0774 | 90% gamma percentile (KM) | 0.113 |
| 95% gamma percentile (KM) | 0.149 | 99% gamma percentile (KM) | 0.233 |

| Gamma Kaplan-Meier (KM) Statistics | | | |
|---|---|---|---|
| Approximate Chi Square Value (16.00, α) | 7.964 | Adjusted Chi Square Value (16.00, β) | 6.803 |
| 95% KM Approximate Gamma UCL | 0.0958 | 95% KM Adjusted Gamma UCL | 0.112 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.962 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.792 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.21 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.346 | Detected Data appear Lognormal at 10% Significance Level |
| **Detected Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 0.0422 | Mean in Log Scale | -3.737 |
| SD in Original Scale | 0.0493 | SD in Log Scale | 1.14 |
| 95% t UCL (assumes normality of ROS data) | 0.0728 | 95% Percentile Bootstrap UCL | 0.0702 |
| 95% BCA Bootstrap UCL | 0.0783 | 95% Bootstrap t UCL | 0.134 |
| 95% H-UCL (Log ROS) | 0.191 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -3.346 | KM Geo Mean | 0.0352 |
| KM SD (logged) | 0.715 | 95% Critical H Value (KM-Log) | 2.647 |
| KM Standard Error of Mean (logged) | 0.289 | 95% H-UCL (KM -Log) | 0.0889 |
| KM SD (logged) | 0.715 | 95% Critical H Value (KM-Log) | 2.647 |
| KM Standard Error of Mean (logged) | 0.289 | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.0501 | Mean in Log Scale | -3.34 |
| SD in Original Scale | 0.0454 | SD in Log Scale | 0.905 |
| 95% t UCL (Assumes normality) | 0.0783 | 95% H-Stat UCL | 0.141 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| Detected Data appear Normal Distributed at 1% Significance Level |

| Suggested UCL to Use | | |
|---|---|---|
| 95% KM (t) UCL | 0.0789 | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Manganese - MW-13 | | | | |
|---|---|---|---|---|

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 1 |
| Minimum | 0.2 | Mean | 0.499 |
| Maximum | 0.92 | Median | 0.445 |
| SD | 0.239 | Std. Error of Mean | 0.0846 |
| Coefficient of Variation | 0.48 | Skewness | 0.624 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.933 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.246 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.659 | 95% Adjusted-CLT UCL (Chen-1995) | 0.658 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.662 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.311 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.719 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.24 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.295 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 4.907 | k star (bias corrected MLE) | 3.15 |
| Theta hat (MLE) | 0.102 | Theta star (bias corrected MLE) | 0.158 |
| nu hat (MLE) | 78.51 | nu star (bias corrected) | 50.4 |
| MLE Mean (bias corrected) | 0.499 | MLE Sd (bias corrected) | 0.281 |
| | | Approximate Chi Square Value (0.05) | 35.1 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 31.9 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.716 | 95% Adjusted Gamma UCL | 0.788 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.951 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.211 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -1.609 | Mean of logged Data | -0.801 |
| Maximum of Logged Data | -0.0834 | SD of logged Data | 0.5 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.794 | 90% Chebyshev (MVUE) UCL | 0.768 |
| 95% Chebyshev (MVUE) UCL | 0.889 | 97.5% Chebyshev (MVUE) UCL | 1.058 |
| 99% Chebyshev (MVUE) UCL | 1.389 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.638 | 95% BCA Bootstrap UCL | 0.643 |
| 95% Standard Bootstrap UCL | 0.628 | 95% Bootstrap-t UCL | 0.679 |
| 95% Hall's Bootstrap UCL | 0.657 | 95% Percentile Bootstrap UCL | 0.63 |
| 90% Chebyshev(Mean, Sd) UCL | 0.753 | 95% Chebyshev(Mean, Sd) UCL | 0.868 |
| 97.5% Chebyshev(Mean, Sd) UCL | 1.027 | 99% Chebyshev(Mean, Sd) UCL | 1.341 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.659 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

**Dinoseb - MW-13**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 4.6000E-4 | Mean | 0.00192 |
| Maximum | 0.0032 | Median | 0.0016 |
| SD | 8.3297E-4 | Std. Error of Mean | 2.7766E-4 |
| Coefficient of Variation | 0.434 | Skewness | -0.107 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.944 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.204 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.00243 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00236 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.00243 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.499 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.724 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.257 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.28 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 4.448 | k star (bias corrected MLE) | 3.039 |
| Theta hat (MLE) | 4.3118E-4 | Theta star (bias corrected MLE) | 6.3101E-4 |
| nu hat (MLE) | 80.06 | nu star (bias corrected) | 54.71 |
| MLE Mean (bias corrected) | 0.00192 | MLE Sd (bias corrected) | 0.0011 |
| | | Approximate Chi Square Value (0.05) | 38.71 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 35.89 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.00271 | 95% Adjusted Gamma UCL | 0.00292 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.834 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.3 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -7.684 | Mean of logged Data | -6.373 |
| Maximum of Logged Data | -5.745 | SD of logged Data | 0.572 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.00325 | 90% Chebyshev (MVUE) UCL | 0.00312 |
| 95% Chebyshev (MVUE) UCL | 0.00364 | 97.5% Chebyshev (MVUE) UCL | 0.00436 |
| 99% Chebyshev (MVUE) UCL | 0.00577 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.00237 | 95% BCA Bootstrap UCL | 0.00231 |
| 95% Standard Bootstrap UCL | 0.00234 | 95% Bootstrap-t UCL | 0.00244 |
| 95% Hall's Bootstrap UCL | 0.00238 | 95% Percentile Bootstrap UCL | 0.00233 |
| 90% Chebyshev(Mean, Sd) UCL | 0.00275 | 95% Chebyshev(Mean, Sd) UCL | 0.00313 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.00365 | 99% Chebyshev(Mean, Sd) UCL | 0.00468 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.00243 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |
| | | | |

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:25:29 PM |
| From File | mw14_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-14**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 |
| Number of Detects | 5 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 4 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.21 | Minimum Non-Detect | 0.04 |
| Maximum Detect | 2 | Maximum Non-Detect | 0.04 |
| Variance Detects | 0.608 | Percent Non-Detects | 16.67% |
| Mean Detects | 1.248 | SD Detects | 0.78 |
| Median Detects | 1.7 | CV Detects | 0.625 |
| Skewness Detects | -0.654 | Kurtosis Detects | -2.225 |
| Mean of Logged Detects | -0.0537 | SD of Logged Detects | 0.959 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.861 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.686 | Detected Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.319 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.396 | Detected Data appear Normal at 1% Significance Level |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 1.047 | KM Standard Error of Mean | 0.356 |
| 90KM SD | 0.78 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 1.764 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 1.632 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 2.115 | 95% KM Chebyshev UCL | 2.598 |
| 97.5% KM Chebyshev UCL | 3.27 | 99% KM Chebyshev UCL | 4.589 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.54 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.685 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.355 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.361 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Gamma Statistics on Detected Data Only** | | | |
| k hat (MLE) | 1.967 | k star (bias corrected MLE) | 0.92 |
| Theta hat (MLE) | 0.634 | Theta star (bias corrected MLE) | 1.356 |
| nu hat (MLE) | 19.67 | nu star (bias corrected) | 9.202 |
| Mean (detects) | 1.248 | | |
| | | | |
| **Gamma ROS Statistics using Imputed Non-Detects** | | | |
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.0244 | Mean | 1.044 |
| Maximum | 2 | Median | 1.165 |
| SD | 0.858 | CV | 0.822 |
| k hat (MLE) | 0.835 | k star (bias corrected MLE) | 0.529 |
| Theta hat (MLE) | 1.25 | Theta star (bias corrected MLE) | 1.975 |
| nu hat (MLE) | 10.02 | nu star (bias corrected) | 6.345 |
| Adjusted Level of Significance (β) | 0.0122 | | |
| Approximate Chi Square Value (6.34, α) | 1.818 | Adjusted Chi Square Value (6.34, β) | 1.076 |
| 95% Gamma Approximate UCL | 3.643 | 95% Gamma Adjusted UCL | 6.154 |
| | | | |
| **Estimates of Gamma Parameters using KM Estimates** | | | |
| Mean (KM) | 1.047 | SD (KM) | 0.78 |
| Variance (KM) | 0.608 | SE of Mean (KM) | 0.356 |
| k hat (KM) | 1.801 | k star (KM) | 1.012 |
| nu hat (KM) | 21.61 | nu star (KM) | 12.14 |
| theta hat (KM) | 0.581 | theta star (KM) | 1.035 |
| 80% gamma percentile (KM) | 1.683 | 90% gamma percentile (KM) | 2.403 |
| 95% gamma percentile (KM) | 3.123 | 99% gamma percentile (KM) | 4.792 |
| | | | |
| **Gamma Kaplan-Meier (KM) Statistics** | | | |
| Approximate Chi Square Value (12.14, α) | 5.319 | Adjusted Chi Square Value (12.14, β) | 3.812 |
| 95% KM Approximate Gamma UCL | 2.389 | 95% KM Adjusted Gamma UCL | 3.333 |
| | | | |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.821 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.806 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.329 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.319 | Detected Data Not Lognormal at 10% Significance Level |
| **Detected Data appear Approximate Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |
| | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
|---|---|---|---|
| Mean in Original Scale | 1.057 | Mean in Log Scale | -0.424 |
| SD in Original Scale | 0.84 | SD in Log Scale | 1.248 |
| 95% t UCL (assumes normality of ROS data) | 1.748 | 95% Percentile Bootstrap UCL | 1.572 |
| 95% BCA Bootstrap UCL | 1.552 | 95% Bootstrap t UCL | 1.74 |
| 95% H-UCL (Log ROS) | 23.07 | | |
| | | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -0.581 | KM Geo Mean | 0.559 |
| KM SD (logged) | 1.416 | 95% Critical H Value (KM-Log) | 5.577 |
| KM Standard Error of Mean (logged) | 0.646 | 95% H-UCL (KM -Log) | 52.06 |
| KM SD (logged) | 1.416 | 95% Critical H Value (KM-Log) | 5.577 |
| KM Standard Error of Mean (logged) | 0.646 | | |
| | | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| **DL/2 Normal** | | **DL/2 Log-Transformed** | |
| Mean in Original Scale | 1.043 | Mean in Log Scale | -0.697 |
| SD in Original Scale | 0.859 | SD in Log Scale | 1.794 |
| 95% t UCL (Assumes normality) | 1.75 | 95% H-Stat UCL | 653.3 |
| **DL/2 is not a recommended method, provided for comparisons and historical reasons** | | | |
| | | | |

| Nonparametric Distribution Free UCL Statistics | |
|---|---|
| **Detected Data appear Normal Distributed at 1% Significance Level** | |
| | |

| Suggested UCL to Use | | |
|---|---|---|
| 95% KM (t) UCL | 1.764 | |
| | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Nitrite - MW-14 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 | |
| Number of Detects | 4 | Number of Non-Detects | 2 | |
| Number of Distinct Detects | 4 | Number of Distinct Non-Detects | 1 | |
| Minimum Detect | 0.022 | Minimum Non-Detect | 0.015 | |
| Maximum Detect | 0.16 | Maximum Non-Detect | 0.015 | |
| Variance Detects | 0.00409 | Percent Non-Detects | 33.33% | |
| Mean Detects | 0.0783 | SD Detects | 0.064 | |
| Median Detects | 0.0655 | CV Detects | 0.818 | |
| Skewness Detects | 0.721 | Kurtosis Detects | -1.768 | |
| Mean of Logged Detects | -2.846 | SD of Logged Detects | 0.924 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.91 | Shapiro Wilk GOF Test | |
| 1% Shapiro Wilk Critical Value | 0.687 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.26 | Lilliefors GOF Test | |
| 1% Lilliefors Critical Value | 0.413 | Detected Data appear Normal at 1% Significance Level | |
| Detected Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0572 | KM Standard Error of Mean | 0.0255 |
| 90KM SD | 0.0542 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.109 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.0992 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.134 | 95% KM Chebyshev UCL | 0.169 |
| 97.5% KM Chebyshev UCL | 0.217 | 99% KM Chebyshev UCL | 0.311 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.317 | Anderson-Darling GOF Test | |
| 5% A-D Critical Value | 0.661 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.276 | Kolmogorov-Smirnov GOF | |
| 5% K-S Critical Value | 0.398 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 1.827 | k star (bias corrected MLE) | | 0.623 |
| Theta hat (MLE) | 0.0428 | Theta star (bias corrected MLE) | | 0.126 |
| nu hat (MLE) | 14.62 | nu star (bias corrected) | | 4.987 |
| Mean (detects) | 0.0783 | | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.01 | Mean | | 0.0555 |
| Maximum | 0.16 | Median | | 0.0275 |
| SD | 0.0608 | CV | | 1.096 |
| k hat (MLE) | 1.06 | k star (bias corrected MLE) | | 0.641 |
| Theta hat (MLE) | 0.0524 | Theta star (bias corrected MLE) | | 0.0866 |
| nu hat (MLE) | 12.72 | nu star (bias corrected) | | 7.693 |
| Adjusted Level of Significance (β) | 0.0122 | | | |
| Approximate Chi Square Value (7.69, α) | 2.559 | Adjusted Chi Square Value (7.69, β) | | 1.62 |
| 95% Gamma Approximate UCL | 0.167 | 95% Gamma Adjusted UCL | | N/A |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.0572 | SD (KM) | | 0.0542 |
| Variance (KM) | 0.00294 | SE of Mean (KM) | | 0.0255 |
| k hat (KM) | 1.113 | k star (KM) | | 0.668 |
| nu hat (KM) | 13.35 | nu star (KM) | | 8.011 |
| theta hat (KM) | 0.0514 | theta star (KM) | | 0.0856 |
| 80% gamma percentile (KM) | 0.0941 | 90% gamma percentile (KM) | | 0.145 |
| 95% gamma percentile (KM) | 0.198 | 99% gamma percentile (KM) | | 0.325 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (8.01, α) | 2.741 | Adjusted Chi Square Value (8.01, β) | | 1.759 |
| 95% KM Approximate Gamma UCL | 0.167 | 95% KM Adjusted Gamma UCL | | 0.26 |

| Lognormal GOF Test on Detected Observations Only | | | | |
|---|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.933 | **Shapiro Wilk GOF Test** | | |
| 10% Shapiro Wilk Critical Value | 0.792 | Detected Data appear Lognormal at 10% Significance Level | | |
| Lilliefors Test Statistic | 0.23 | **Lilliefors GOF Test** | | |
| 10% Lilliefors Critical Value | 0.346 | Detected Data appear Lognormal at 10% Significance Level | | |
| **Detected Data appear Lognormal at 10% Significance Level** | | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | | | |
|---|---|---|---|---|---|
| Mean in Original Scale | 0.0537 | | Mean in Log Scale | -3.71 |
| SD in Original Scale | 0.0625 | | SD in Log Scale | 1.539 |
| 95% t UCL (assumes normality of ROS data) | 0.105 | | 95% Percentile Bootstrap UCL | 0.0926 |
| 95% BCA Bootstrap UCL | 0.102 | | 95% Bootstrap t UCL | 0.231 |
| 95% H-UCL (Log ROS) | 5.037 | | | |
| | | | | |
| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | | |
| KM Mean (logged) | -3.297 | | KM Geo Mean | 0.037 |
| KM SD (logged) | 0.913 | | 95% Critical H Value (KM-Log) | 3.813 |
| KM Standard Error of Mean (logged) | 0.431 | | 95% H-UCL (KM -Log) | 0.267 |
| KM SD (logged) | 0.913 | | 95% Critical H Value (KM-Log) | 3.813 |
| KM Standard Error of Mean (logged) | 0.431 | | | |
| | | | | |
| DL/2 Statistics | | | | | |
| DL/2 Normal | | | DL/2 Log-Transformed | | |
| Mean in Original Scale | 0.0547 | | Mean in Log Scale | -3.528 |
| SD in Original Scale | 0.0616 | | SD in Log Scale | 1.277 |
| 95% t UCL (Assumes normality) | 0.105 | | 95% H-Stat UCL | 1.208 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | | |
| | | | | |
| Suggested UCL to Use | | | | | |
| 95% KM (t) UCL | 0.109 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | |

**Arsenic - MW-14**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| Number of Detects | 3 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 3 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.0061 | Minimum Non-Detect | 6.8000E-4 |
| Maximum Detect | 0.01 | Maximum Non-Detect | 6.8000E-4 |
| Variance Detects | 4.0433E-6 | Percent Non-Detects | 25% |
| Mean Detects | 0.00777 | SD Detects | 0.00201 |
| Median Detects | 0.0072 | CV Detects | 0.259 |
| Skewness Detects | 1.167 | Kurtosis Detects | N/A |
| Mean of Logged Detects | -4.879 | SD of Logged Detects | 0.252 |

**Warning: Data set has only 3 Detected Values.**

**This is not enough to compute meaningful or reliable statistics and estimates.**

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.94 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.753 | Detected Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.278 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.429 | Detected Data appear Normal at 1% Significance Level |

**Detected Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 0.006 | KM Standard Error of Mean | 0.00207 |
| 90KM SD | 0.00338 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.0109 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.0094 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.0122 | 95% KM Chebyshev UCL | 0.015 |
| 97.5% KM Chebyshev UCL | 0.0189 | 99% KM Chebyshev UCL | 0.0266 |

### Gamma GOF Tests on Detected Observations Only

| | | |
|---|---|---|
| A-D Test Statistic | 0.306 | **Anderson-Darling GOF Test** |
| 5% A-D Critical Value | 0.635 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.282 | **Kolmogorov-Smirnov GOF** |
| 5% K-S Critical Value | 0.431 | Detected data appear Gamma Distributed at 5% Significance Level |

**Detected Data Not Gamma Distributed at 5% Significance Level**

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 23.4 | | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 3.3196E-4 | | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 140.4 | | nu star (bias corrected) | N/A |
| Mean (detects) | 0.00777 | | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.0061 | | Mean | 0.00833 |
| Maximum | 0.01 | | Median | 0.0086 |
| SD | 0.00199 | | CV | 0.239 |
| k hat (MLE) | 22.51 | | k star (bias corrected MLE) | 5.794 |
| Theta hat (MLE) | 3.6986E-4 | | Theta star (bias corrected MLE) | 0.00144 |
| nu hat (MLE) | 180.1 | | nu star (bias corrected) | 46.35 |
| Adjusted Level of Significance (β) | 0.00498 | | | |
| Approximate Chi Square Value (46.35, α) | 31.73 | | Adjusted Chi Square Value (46.35, β) | N/A |
| 95% Gamma Approximate UCL | 0.0122 | | 95% Gamma Adjusted UCL | N/A |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.006 | | SD (KM) | 0.00338 |
| Variance (KM) | 1.1438E-5 | | SE of Mean (KM) | 0.00207 |
| k hat (KM) | 3.142 | | k star (KM) | 0.952 |
| nu hat (KM) | 25.14 | | nu star (KM) | 7.618 |
| theta hat (KM) | 0.00191 | | theta star (KM) | 0.0063 |
| 80% gamma percentile (KM) | 0.00969 | | 90% gamma percentile (KM) | 0.014 |
| 95% gamma percentile (KM) | 0.0183 | | 99% gamma percentile (KM) | 0.0283 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (7.62, α) | 2.516 | | Adjusted Chi Square Value (7.62, β) | 1.211 |
| 95% KM Approximate Gamma UCL | 0.0182 | | 95% KM Adjusted Gamma UCL | 0.0377 |

| Lognormal GOF Test on Detected Observations Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.965 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.789 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.252 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.389 | Detected Data appear Lognormal at 10% Significance Level | |
| **Detected Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.00675 | | Mean in Log Scale | -5.058 |
| SD in Original Scale | 0.00261 | | SD in Log Scale | 0.412 |
| 95% t UCL (assumes normality of ROS data) | 0.00982 | | 95% Percentile Bootstrap UCL | N/A |
| 95% BCA Bootstrap UCL | N/A | | 95% Bootstrap t UCL | N/A |
| 95% H-UCL (Log ROS) | 0.0149 | | | |
| | | | | |
| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
| KM Mean (logged) | -5.483 | | KM Geo Mean | 0.00416 |
| KM SD (logged) | 1.06 | | 95% Critical H Value (KM-Log) | 7.052 |
| KM Standard Error of Mean (logged) | 0.649 | | 95% H-UCL (KM -Log) | 0.547 |
| KM SD (logged) | 1.06 | | 95% Critical H Value (KM-Log) | 7.052 |
| KM Standard Error of Mean (logged) | 0.649 | | | |
| | | | | |
| DL/2 Statistics | | | | |
| DL/2 Normal | | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.00591 | | Mean in Log Scale | -5.656 |
| SD in Original Scale | 0.00406 | | SD in Log Scale | 1.567 |
| 95% t UCL (Assumes normality) | 0.0107 | | 95% H-Stat UCL | 133.9 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% KM (t) UCL | 0.0109 | | | |
| Warning: Recommended UCL exceeds the maximum observation | | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| | | |
|---|---|---|
| User Selected Options | | |
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:27:21 PM | |
| From File | mw15_3year_data.xls | |
| Full Precision | OFF | |
| Confidence Coefficient | 95% | |
| Number of Bootstrap Operations | 2000 | |

**Nitrate - MW-15**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | | Number of Distinct Observations | 5 |
| | | | Number of Missing Observations | 0 |
| Minimum | 3.4 | | Mean | 5.033 |
| Maximum | 12 | | Median | 3.65 |
| SD | 3.417 | | Std. Error of Mean | 1.395 |
| Coefficient of Variation | 0.679 | | Skewness | 2.437 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.542 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.713 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.463 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.373 | Data Not Normal at 1% Significance Level |
| **Data Not Normal at 1% Significance Level** | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 7.844 | 95% Adjusted-CLT UCL (Chen-1995) | 8.811 |
| | | 95% Modified-t UCL (Johnson-1978) | 8.075 |

| Gamma GOF Test | | |
|---|---|---|
| A-D Test Statistic | 1.443 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.7 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.462 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.333 | Data Not Gamma Distributed at 5% Significance Level |
| **Data Not Gamma Distributed at 5% Significance Level** | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 4.124 | | k star (bias corrected MLE) | 2.173 |
| Theta hat (MLE) | 1.22 | | Theta star (bias corrected MLE) | 2.316 |
| nu hat (MLE) | 49.49 | | nu star (bias corrected) | 26.08 |
| MLE Mean (bias corrected) | 5.033 | | MLE Sd (bias corrected) | 3.414 |
| | | | Approximate Chi Square Value (0.05) | 15.44 |
| Adjusted Level of Significance | 0.0122 | | Adjusted Chi Square Value | 12.58 |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 8.501 | | 95% Adjusted Gamma UCL | 10.43 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.583 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.437 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 1.224 | | Mean of logged Data | 1.49 |
| Maximum of Logged Data | 2.485 | | SD of logged Data | 0.489 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 8.861 | | 90% Chebyshev (MVUE) UCL | 7.827 |
| 95% Chebyshev (MVUE) UCL | 9.155 | | 97.5% Chebyshev (MVUE) UCL | 11 |
| 99% Chebyshev (MVUE) UCL | 14.62 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| **Data do not follow a Discernible Distribution** |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 7.328 | | 95% BCA Bootstrap UCL | 7.867 |
| 95% Standard Bootstrap UCL | 7.128 | | 95% Bootstrap-t UCL | 49.74 |
| 95% Hall's Bootstrap UCL | 41.7 | | 95% Percentile Bootstrap UCL | 7.783 |
| 90% Chebyshev(Mean, Sd) UCL | 9.218 | | 95% Chebyshev(Mean, Sd) UCL | 11.11 |
| 97.5% Chebyshev(Mean, Sd) UCL | 13.74 | | 99% Chebyshev(Mean, Sd) UCL | 18.91 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| Recommendation cannot be provided | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## Arsenic - MW-15

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 2 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.014 | Mean | 0.0147 |
| Maximum | 0.015 | Median | 0.015 |
| SD | 5.1640E-4 | Std. Error of Mean | 2.1082E-4 |
| Coefficient of Variation | 0.0352 | Skewness | -0.968 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.64 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.713 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.407 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.373 | Data Not Normal at 1% Significance Level |
| **Data Not Normal at 1% Significance Level** | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0151 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0149 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0151 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 1.239 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.696 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.427 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.332 | Data Not Gamma Distributed at 5% Significance Level |
| **Data Not Gamma Distributed at 5% Significance Level** | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 953 | k star (bias corrected MLE) | 476.6 |
| Theta hat (MLE) | 1.5391E-5 | Theta star (bias corrected MLE) | 3.0774E-5 |
| nu hat (MLE) | 11436 | nu star (bias corrected) | 5719 |
| MLE Mean (bias corrected) | 0.0147 | MLE Sd (bias corrected) | 6.7183E-4 |
| | | Approximate Chi Square Value (0.05) | 5544 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 5481 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0151 | 95% Adjusted Gamma UCL | 0.0153 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.64 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.407 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.269 | Mean of logged Data | -4.223 |
| Maximum of Logged Data | -4.2 | SD of logged Data | 0.0356 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.0153 |
| 95% Chebyshev (MVUE) UCL | 0.0156 | 97.5% Chebyshev (MVUE) UCL | 0.016 |
| 99% Chebyshev (MVUE) UCL | 0.0168 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data do not follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.015 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0153 | 95% Chebyshev(Mean, Sd) UCL | 0.0156 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.016 | 99% Chebyshev(Mean, Sd) UCL | 0.0168 |
| | | | |
| **Suggested UCL to Use** | | | |
| Recommendation cannot be provided | | | |
| | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| User Selected Options | | |
|---|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:28:57 PM | |
| From File | mw16_3year_data.xls | |
| Full Precision | OFF | |
| Confidence Coefficient | 95% | |
| Number of Bootstrap Operations | 2000 | |

**Nitrate - MW-16**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | | Number of Distinct Observations | 6 |
| | | | Number of Missing Observations | 0 |
| Minimum | 13 | | Mean | 76.67 |
| Maximum | 130 | | Median | 80.5 |
| SD | 39.89 | | Std. Error of Mean | 16.29 |
| Coefficient of Variation | 0.52 | | Skewness | -0.478 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.985 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.144 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level |
| Data appear Normal at 1% Significance Level | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 109.5 | 95% Adjusted-CLT UCL (Chen-1995) | 100.1 |
| | | 95% Modified-t UCL (Johnson-1978) | 109 |

| Gamma GOF Test | | |
|---|---|---|
| A-D Test Statistic | 0.438 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.702 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.235 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.335 | Detected data appear Gamma Distributed at 5% Significance Level |
| Detected data appear Gamma Distributed at 5% Significance Level | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 2.653 | k star (bias corrected MLE) | | 1.438 |
| Theta hat (MLE) | 28.9 | Theta star (bias corrected MLE) | | 53.33 |
| nu hat (MLE) | 31.84 | nu star (bias corrected) | | 17.25 |
| MLE Mean (bias corrected) | 76.67 | MLE Sd (bias corrected) | | 63.94 |
| | | Approximate Chi Square Value (0.05) | | 8.852 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | | 6.793 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 149.4 | 95% Adjusted Gamma UCL | 194.7 |

| Lognormal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.813 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.826 | Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.287 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level |
| **Data appear Approximate Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal Statistics | | | |
|---|---|---|---|
| Minimum of Logged Data | 2.565 | Mean of logged Data | 4.139 |
| Maximum of Logged Data | 4.868 | SD of logged Data | 0.821 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 322 | 90% Chebyshev (MVUE) UCL | 164.2 |
| 95% Chebyshev (MVUE) UCL | 201.3 | 97.5% Chebyshev (MVUE) UCL | 252.8 |
| 99% Chebyshev (MVUE) UCL | 354 | | |

| Nonparametric Distribution Free UCL Statistics | |
|---|---|
| **Data appear to follow a Discernible Distribution** | |

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 103.5 | 95% BCA Bootstrap UCL | 99 |
| 95% Standard Bootstrap UCL | 101 | 95% Bootstrap-t UCL | 105.9 |
| 95% Hall's Bootstrap UCL | 102.4 | 95% Percentile Bootstrap UCL | 100.5 |
| 90% Chebyshev(Mean, Sd) UCL | 125.5 | 95% Chebyshev(Mean, Sd) UCL | 147.7 |
| 97.5% Chebyshev(Mean, Sd) UCL | 178.4 | 99% Chebyshev(Mean, Sd) UCL | 238.7 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 109.5 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

**Nitrite - MW-16**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.22 | Mean | 0.853 |
| Maximum | 1.8 | Median | 0.7 |
| SD | 0.592 | Std. Error of Mean | 0.241 |
| Coefficient of Variation | 0.693 | Skewness | 0.845 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.922 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.262 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 1.34 | 95% Adjusted-CLT UCL (Chen-1995) | 1.34 |
| | | 95% Modified-t UCL (Johnson-1978) | 1.354 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.213 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.703 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.189 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.335 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.389 | k star (bias corrected MLE) | 1.305 |
| Theta hat (MLE) | 0.357 | Theta star (bias corrected MLE) | 0.654 |
| nu hat (MLE) | 28.66 | nu star (bias corrected) | 15.66 |
| MLE Mean (bias corrected) | 0.853 | MLE Sd (bias corrected) | 0.747 |
| | | Approximate Chi Square Value (0.05) | 7.726 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 5.829 |

### Assuming Gamma Distribution

| 95% Approximate Gamma UCL | 1.73 | 95% Adjusted Gamma UCL | 2.293 |
|---|---|---|---|

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.971 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.173 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -1.514 | Mean of logged Data | -0.382 |
| Maximum of Logged Data | 0.588 | SD of logged Data | 0.765 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 2.891 | 90% Chebyshev (MVUE) UCL | 1.667 |
| 95% Chebyshev (MVUE) UCL | 2.031 | 97.5% Chebyshev (MVUE) UCL | 2.537 |
| 99% Chebyshev (MVUE) UCL | 3.529 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 1.251 | 95% BCA Bootstrap UCL | 1.302 |
| 95% Standard Bootstrap UCL | 1.22 | 95% Bootstrap-t UCL | 1.762 |
| 95% Hall's Bootstrap UCL | 4.583 | 95% Percentile Bootstrap UCL | 1.263 |
| 90% Chebyshev(Mean, Sd) UCL | 1.578 | 95% Chebyshev(Mean, Sd) UCL | 1.906 |
| 97.5% Chebyshev(Mean, Sd) UCL | 2.361 | 99% Chebyshev(Mean, Sd) UCL | 3.256 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 1.34 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**Arsenic - MW-16**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 3 |
| Number of Detects | 3 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 2 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.0061 | Minimum Non-Detect | 6.8000E-4 |
| Maximum Detect | 0.019 | Maximum Non-Detect | 6.8000E-4 |
| Variance Detects | 5.5470E-5 | Percent Non-Detects | 25% |
| Mean Detects | 0.0104 | SD Detects | 0.00745 |
| Median Detects | 0.0061 | CV Detects | 0.716 |
| Skewness Detects | 1.732 | Kurtosis Detects | N/A |
| Mean of Logged Detects | -4.721 | SD of Logged Detects | 0.656 |

### Warning: Data set has only 3 Detected Values.

### This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.75 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.753 | Detected Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.385 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.429 | Detected Data appear Normal at 1% Significance Level |

### Detected Data appear Approximate Normal at 1% Significance Level

### Note GOF tests may be unreliable for small sample sizes

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 0.00797 | KM Standard Error of Mean | 0.00413 |
| 90KM SD | 0.00674 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.0177 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.0148 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.0204 | 95% KM Chebyshev UCL | 0.026 |
| 97.5% KM Chebyshev UCL | 0.0338 | 99% KM Chebyshev UCL | 0.049 |

### Gamma GOF Tests on Detected Observations Only

| | | |
|---|---|---|
| A-D Test Statistic | 0.62 | **Anderson-Darling GOF Test** |
| 5% A-D Critical Value | 0.636 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.429 | **Kolmogorov-Smirnov GOF** |
| 5% K-S Critical Value | 0.434 | Detected data appear Gamma Distributed at 5% Significance Level |

### Detected Data Not Gamma Distributed at 5% Significance Level

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 3.388 | k star (bias corrected MLE) | | N/A |
| Theta hat (MLE) | 0.00307 | Theta star (bias corrected MLE) | | N/A |
| nu hat (MLE) | 20.33 | nu star (bias corrected) | | N/A |
| Mean (detects) | 0.0104 | | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.0061 | Mean | | 0.0103 |
| Maximum | 0.019 | Median | | 0.00805 |
| SD | 0.00608 | CV | | 0.591 |
| k hat (MLE) | 4.461 | k star (bias corrected MLE) | | 1.282 |
| Theta hat (MLE) | 0.00231 | Theta star (bias corrected MLE) | | 0.00803 |
| nu hat (MLE) | 35.69 | nu star (bias corrected) | | 10.26 |
| Adjusted Level of Significance (β) | 0.00498 | | | |
| Approximate Chi Square Value (10.26, α) | 4.102 | Adjusted Chi Square Value (10.26, β) | | N/A |
| 95% Gamma Approximate UCL | 0.0258 | 95% Gamma Adjusted UCL | | N/A |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.00797 | SD (KM) | | 0.00674 |
| Variance (KM) | 4.5450E-5 | SE of Mean (KM) | | 0.00413 |
| k hat (KM) | 1.398 | k star (KM) | | 0.516 |
| nu hat (KM) | 11.18 | nu star (KM) | | 4.129 |
| theta hat (KM) | 0.0057 | theta star (KM) | | 0.0154 |
| 80% gamma percentile (KM) | 0.0131 | 90% gamma percentile (KM) | | 0.0214 |
| 95% gamma percentile (KM) | 0.0303 | 99% gamma percentile (KM) | | 0.052 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (4.13, α) | 0.773 | Adjusted Chi Square Value (4.13, β) | | 0.251 |
| 95% KM Approximate Gamma UCL | 0.0426 | 95% KM Adjusted Gamma UCL | | 0.131 |

| Lognormal GOF Test on Detected Observations Only | | | | |
|---|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.75 | **Shapiro Wilk GOF Test** | | |
| 10% Shapiro Wilk Critical Value | 0.789 | Detected Data Not Lognormal at 10% Significance Level | | |
| Lilliefors Test Statistic | 0.385 | **Lilliefors GOF Test** | | |
| 10% Lilliefors Critical Value | 0.389 | Detected Data appear Lognormal at 10% Significance Level | | |
| Detected Data appear Approximate Lognormal at 10% Significance Level | | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.00822 | Mean in Log Scale | | -5.14 |
| SD in Original Scale | 0.00749 | SD in Log Scale | | 0.994 |
| 95% t UCL (assumes normality of ROS data) | 0.017 | 95% Percentile Bootstrap UCL | | N/A |
| 95% BCA Bootstrap UCL | N/A | 95% Bootstrap t UCL | | N/A |
| 95% H-UCL (Log ROS) | 0.433 | | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -5.364 | KM Geo Mean | 0.00468 |
| KM SD (logged) | 1.207 | 95% Critical H Value (KM-Log) | 7.987 |
| KM Standard Error of Mean (logged) | 0.739 | 95% H-UCL (KM -Log) | 2.53 |
| KM SD (logged) | 1.207 | 95% Critical H Value (KM-Log) | 7.987 |
| KM Standard Error of Mean (logged) | 0.739 | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.00789 | Mean in Log Scale | -5.537 |
| SD in Original Scale | 0.00789 | SD in Log Scale | 1.718 |
| 95% t UCL (Assumes normality) | 0.0172 | 95% H-Stat UCL | 1258 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

**Nonparametric Distribution Free UCL Statistics**

**Detected Data appear Approximate Normal Distributed at 1% Significance Level**

**Suggested UCL to Use**

| 95% KM (t) UCL | 0.0177 | | |
|---|---|---|---|

When a data set follows an approximate distribution passing only one of the GOF tests,

it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| Iron - MW-16 | | | | |
|---|---|---|---|---|

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| Number of Detects | 3 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 3 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.045 | Minimum Non-Detect | 0.08 |
| Maximum Detect | 1.6 | Maximum Non-Detect | 0.08 |
| Variance Detects | 0.796 | Percent Non-Detects | 25% |
| Mean Detects | 0.57 | SD Detects | 0.892 |
| Median Detects | 0.064 | CV Detects | 1.566 |
| Skewness Detects | 1.731 | Kurtosis Detects | N/A |
| Mean of Logged Detects | -1.793 | SD of Logged Detects | 1.968 |

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.759 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.753 | Detected Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.381 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.429 | Detected Data appear Normal at 1% Significance Level |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.441 | KM Standard Error of Mean | 0.41 |
| 90KM SD | 0.669 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 1.405 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 1.115 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 1.67 | 95% KM Chebyshev UCL | 2.227 |
| 97.5% KM Chebyshev UCL | 3 | 99% KM Chebyshev UCL | 4.519 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.53 | **Anderson-Darling GOF Test** |
| 5% A-D Critical Value | 0.65 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.411 | **Kolmogorov-Smirnov GOF** |
| 5% K-S Critical Value | 0.449 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected Data Not Gamma Distributed at 5% Significance Level

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 0.514 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 1.108 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 3.084 | nu star (bias corrected) | N/A |
| Mean (detects) | 0.57 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.0367 | Mean | 0.436 |
| Maximum | 1.6 | Median | 0.0545 |
| SD | 0.776 | CV | 1.778 |
| k hat (MLE) | 0.477 | k star (bias corrected MLE) | 0.286 |
| Theta hat (MLE) | 0.915 | Theta star (bias corrected MLE) | 1.527 |
| nu hat (MLE) | 3.815 | nu star (bias corrected) | 2.287 |
| Adjusted Level of Significance (β) | 0.00498 | | |
| Approximate Chi Square Value (2.29, α) | 0.197 | Adjusted Chi Square Value (2.29, β) | N/A |
| 95% Gamma Approximate UCL | 5.069 | 95% Gamma Adjusted UCL | N/A |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.441 | SD (KM) | 0.669 |
| Variance (KM) | 0.448 | SE of Mean (KM) | 0.41 |
| k hat (KM) | 0.434 | k star (KM) | 0.275 |
| nu hat (KM) | 3.471 | nu star (KM) | 2.201 |
| theta hat (KM) | 1.016 | theta star (KM) | 1.602 |
| 80% gamma percentile (KM) | 0.661 | 90% gamma percentile (KM) | 1.313 |
| 95% gamma percentile (KM) | 2.073 | 99% gamma percentile (KM) | 4.07 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (2.20, α) | 0.181 | Adjusted Chi Square Value (2.20, β) | 0.0475 |
| 95% KM Approximate Gamma UCL | 5.351 | 95% KM Adjusted Gamma UCL | 20.43 |

| Lognormal GOF Test on Detected Observations Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.823 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.789 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.353 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.389 | Detected Data appear Lognormal at 10% Significance Level | |
| **Detected Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.443 | Mean in Log Scale | -2.038 |
| SD in Original Scale | 0.771 | SD in Log Scale | 1.679 |
| 95% t UCL (assumes normality of ROS data) | 1.351 | 95% Percentile Bootstrap UCL | N/A |
| 95% BCA Bootstrap UCL | N/A | 95% Bootstrap t UCL | N/A |
| 95% H-UCL (Log ROS) | 23652 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | |
|---|---|---|---|
| KM Mean (logged) | -2.076 | KM Geo Mean | 0.125 |
| KM SD (logged) | 1.478 | 95% Critical H Value (KM-Log) | 9.732 |
| KM Standard Error of Mean (logged) | 0.907 | 95% H-UCL (KM -Log) | 1510 |
| KM SD (logged) | 1.478 | 95% Critical H Value (KM-Log) | 9.732 |
| KM Standard Error of Mean (logged) | 0.907 | | |

| DL/2 Statistics | | | |
|---|---|---|---|
| DL/2 Normal | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.437 | Mean in Log Scale | -2.15 |
| SD in Original Scale | 0.775 | SD in Log Scale | 1.758 |
| 95% t UCL (Assumes normality) | 1.349 | 95% H-Stat UCL | 66707 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

**Nonparametric Distribution Free UCL Statistics**

**Detected Data appear Normal Distributed at 1% Significance Level**

**Suggested UCL to Use**

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 1.405 | | |

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**

**Please verify the data were collected from random locations.**

**If the data were collected using judgmental or other non-random methods,**

**then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Manganese - MW-16**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 | |
| Number of Detects | 3 | Number of Non-Detects | 1 | |
| Number of Distinct Detects | 3 | Number of Distinct Non-Detects | 1 | |
| Minimum Detect | 0.84 | Minimum Non-Detect | 9.5000E-4 | |
| Maximum Detect | 1.5 | Maximum Non-Detect | 9.5000E-4 | |
| Variance Detects | 0.115 | Percent Non-Detects | 25% | |
| Mean Detects | 1.213 | SD Detects | 0.338 | |
| Median Detects | 1.3 | CV Detects | 0.279 | |
| Skewness Detects | -1.077 | Kurtosis Detects | N/A | |
| Mean of Logged Detects | 0.164 | SD of Logged Detects | 0.302 | |

**Warning: Data set has only 3 Detected Values.**

**This is not enough to compute meaningful or reliable statistics and estimates.**

**Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,**

**refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,**

**but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).**

**The Chebyshev UCL often results in gross overestimates of the mean.**

**Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.**

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.951 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.753 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.268 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.429 | Detected Data appear Normal at 1% Significance Level | |

**Detected Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.91 | KM Standard Error of Mean | 0.353 |
| 90KM SD | 0.577 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 1.742 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 1.491 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 1.97 | 95% KM Chebyshev UCL | 2.45 |
| 97.5% KM Chebyshev UCL | 3.117 | 99% KM Chebyshev UCL | 4.426 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.343 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.635 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.311 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.432 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected Data Not Gamma Distributed at 5% Significance Level**

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 17.48 | | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 0.0694 | | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 104.9 | | nu star (bias corrected) | N/A |
| Mean (detects) | 1.213 | | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.385 | | Mean | 1.006 |
| Maximum | 1.5 | | Median | 1.07 |
| SD | 0.498 | | CV | 0.495 |
| k hat (MLE) | 4.277 | | k star (bias corrected MLE) | 1.236 |
| Theta hat (MLE) | 0.235 | | Theta star (bias corrected MLE) | 0.814 |
| nu hat (MLE) | 34.21 | | nu star (bias corrected) | 9.887 |
| Adjusted Level of Significance (β) | 0.00498 | | | |
| Approximate Chi Square Value (9.89, α) | 3.871 | | Adjusted Chi Square Value (9.89, β) | N/A |
| 95% Gamma Approximate UCL | 2.57 | | 95% Gamma Adjusted UCL | N/A |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.91 | | SD (KM) | 0.577 |
| Variance (KM) | 0.333 | | SE of Mean (KM) | 0.353 |
| k hat (KM) | 2.489 | | k star (KM) | 0.789 |
| nu hat (KM) | 19.91 | | nu star (KM) | 6.311 |
| theta hat (KM) | 0.366 | | theta star (KM) | 1.154 |
| 80% gamma percentile (KM) | 1.489 | | 90% gamma percentile (KM) | 2.221 |
| 95% gamma percentile (KM) | 2.968 | | 99% gamma percentile (KM) | 4.733 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (6.31, α) | 1.801 | | Adjusted Chi Square Value (6.31, β) | 0.778 |
| 95% KM Approximate Gamma UCL | 3.19 | | 95% KM Adjusted Gamma UCL | 7.381 |

| Lognormal GOF Test on Detected Observations Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.921 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.789 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.294 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.389 | Detected Data appear Lognormal at 10% Significance Level | |
| **Detected Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 1.04 | | Mean in Log Scale | -0.04 |
| SD in Original Scale | 0.443 | | SD in Log Scale | 0.478 |
| 95% t UCL (assumes normality of ROS data) | 1.562 | | 95% Percentile Bootstrap UCL | N/A |
| 95% BCA Bootstrap UCL | N/A | | 95% Bootstrap t UCL | N/A |
| 95% H-UCL (Log ROS) | 2.86 | | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -1.616 | | KM Geo Mean | 0.199 |
| KM SD (logged) | 3.092 | | 95% Critical H Value (KM-Log) | 20.2 |
| KM Standard Error of Mean (logged) | 1.893 | | 95% H-UCL (KM -Log) | 1.079E+17 |
| KM SD (logged) | 3.092 | | 95% Critical H Value (KM-Log) | 20.2 |
| KM Standard Error of Mean (logged) | 1.893 | | | |

| DL/2 Statistics | | | | |
|---|---|---|---|---|
| DL/2 Normal | | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.91 | | Mean in Log Scale | -1.79 |
| SD in Original Scale | 0.666 | | SD in Log Scale | 3.916 |
| 95% t UCL (Assumes normality) | 1.694 | | 95% H-Stat UCL | 4.501E+27 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| Detected Data appear Normal Distributed at 1% Significance Level |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% KM (t) UCL | 1.742 | | | |
| Warning: Recommended UCL exceeds the maximum observation | | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Dinoseb - MW-16**

| | | | |
|---|---|---|---|
| | | | |

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0042 | Mean | 0.0191 |
| Maximum | 0.045 | Median | 0.0141 |
| SD | 0.0161 | Std. Error of Mean | 0.00657 |
| Coefficient of Variation | 0.841 | Skewness | 0.908 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.893 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.232 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.0324 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0325 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0328 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.26 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.707 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.212 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.337 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 1.637 | k star (bias corrected MLE) | 0.93 |
| Theta hat (MLE) | 0.0117 | Theta star (bias corrected MLE) | 0.0206 |
| nu hat (MLE) | 19.65 | nu star (bias corrected) | 11.16 |
| MLE Mean (bias corrected) | 0.0191 | MLE Sd (bias corrected) | 0.0198 |
| | | Approximate Chi Square Value (0.05) | 4.677 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 3.287 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0456 | 95% Adjusted Gamma UCL | 0.0649 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.954 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.165 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -5.473 | Mean of logged Data | -4.292 |
| Maximum of Logged Data | -3.101 | SD of logged Data | 0.93 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.105 | 90% Chebyshev (MVUE) UCL | 0.041 |
| 95% Chebyshev (MVUE) UCL | 0.0508 | 97.5% Chebyshev (MVUE) UCL | 0.0644 |
| 99% Chebyshev (MVUE) UCL | 0.0912 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0299 | 95% BCA Bootstrap UCL | 0.0312 |
| 95% Standard Bootstrap UCL | 0.029 | 95% Bootstrap-t UCL | 0.0401 |
| 95% Hall's Bootstrap UCL | 0.0413 | 95% Percentile Bootstrap UCL | 0.0295 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0388 | 95% Chebyshev(Mean, Sd) UCL | 0.0478 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0601 | 99% Chebyshev(Mean, Sd) UCL | 0.0845 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0324 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |

**1,2-DCP - MW-16**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.029 | Mean | 0.103 |
| Maximum | 0.18 | Median | 0.0995 |
| SD | 0.0542 | Std. Error of Mean | 0.0221 |
| Coefficient of Variation | 0.525 | Skewness | 0.1 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.983 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.172 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.148 | 95% Adjusted-CLT UCL (Chen-1995) | 0.14 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.148 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.229 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.701 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.18 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.334 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3.504 | k star (bias corrected MLE) | 1.863 |
| Theta hat (MLE) | 0.0294 | Theta star (bias corrected MLE) | 0.0554 |
| nu hat (MLE) | 42.05 | nu star (bias corrected) | 22.36 |
| MLE Mean (bias corrected) | 0.103 | MLE Sd (bias corrected) | 0.0756 |
| | | Approximate Chi Square Value (0.05) | 12.61 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 10.07 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.183 | 95% Adjusted Gamma UCL | 0.229 |

| Lognormal GOF Test | | | | |
|---|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.929 | Shapiro Wilk Lognormal GOF Test | | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | | |
| Lilliefors Test Statistic | 0.198 | Lilliefors Lognormal GOF Test | | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | | |
| Data appear Lognormal at 10% Significance Level | | | | |
| Note GOF tests may be unreliable for small sample sizes | | | | |
| | | | | |
| Lognormal Statistics | | | | |
| Minimum of Logged Data | -3.54 | Mean of logged Data | | -2.421 |
| Maximum of Logged Data | -1.715 | SD of logged Data | | 0.65 |
| | | | | |
| Assuming Lognormal Distribution | | | | |
| 95% H-UCL | 0.265 | 90% Chebyshev (MVUE) UCL | | 0.189 |
| 95% Chebyshev (MVUE) UCL | 0.227 | 97.5% Chebyshev (MVUE) UCL | | 0.28 |
| 99% Chebyshev (MVUE) UCL | 0.383 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 0.14 | 95% BCA Bootstrap UCL | | 0.139 |
| 95% Standard Bootstrap UCL | 0.137 | 95% Bootstrap-t UCL | | 0.151 |
| 95% Hall's Bootstrap UCL | 0.14 | 95% Percentile Bootstrap UCL | | 0.137 |
| 90% Chebyshev(Mean, Sd) UCL | 0.169 | 95% Chebyshev(Mean, Sd) UCL | | 0.2 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.241 | 99% Chebyshev(Mean, Sd) UCL | | 0.323 |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% Student's-t UCL | 0.148 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |

| UCL Statistics for Uncensored Full Data Sets | | | |
|---|---|---|---|

| User Selected Options | | | |
|---|---|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:34:39 PM | | |
| From File | mw17_3year_data.xls | | |
| Full Precision | OFF | | |
| Confidence Coefficient | 95% | | |
| Number of Bootstrap Operations | 2000 | | |

**Nitrate - MW-17**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 |
| | | Number of Missing Observations | 0 |
| Minimum | 3 | Mean | 3.833 |
| Maximum | 4.6 | Median | 3.8 |
| SD | 0.524 | Std. Error of Mean | 0.214 |
| Coefficient of Variation | 0.137 | Skewness | -0.232 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.948 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.233 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 4.264 | 95% Adjusted-CLT UCL (Chen-1995) | 4.164 |
| | | 95% Modified-t UCL (Johnson-1978) | 4.261 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.341 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.697 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.24 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 62.13 | | k star (bias corrected MLE) | 31.17 |
| Theta hat (MLE) | 0.0617 | | Theta star (bias corrected MLE) | 0.123 |
| nu hat (MLE) | 745.5 | | nu star (bias corrected) | 374.1 |
| MLE Mean (bias corrected) | 3.833 | | MLE Sd (bias corrected) | 0.687 |
| | | | Approximate Chi Square Value (0.05) | 330.3 |
| Adjusted Level of Significance | 0.0122 | | Adjusted Chi Square Value | 315.3 |
| | | | | |
| Assuming Gamma Distribution | | | | |
| 95% Approximate Gamma UCL | 4.342 | | 95% Adjusted Gamma UCL | 4.549 |
| | | | | |
| Lognormal GOF Test | | | | |
| Shapiro Wilk Test Statistic | 0.933 | | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.256 | | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | | |
| | | | | |
| Lognormal Statistics | | | | |
| Minimum of Logged Data | 1.099 | | Mean of logged Data | 1.336 |
| Maximum of Logged Data | 1.526 | | SD of logged Data | 0.141 |
| | | | | |
| Assuming Lognormal Distribution | | | | |
| 95% H-UCL | 4.352 | | 90% Chebyshev (MVUE) UCL | 4.494 |
| 95% Chebyshev (MVUE) UCL | 4.793 | | 97.5% Chebyshev (MVUE) UCL | 5.208 |
| 99% Chebyshev (MVUE) UCL | 6.024 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 4.185 | | 95% BCA Bootstrap UCL | 4.117 |
| 95% Standard Bootstrap UCL | 4.159 | | 95% Bootstrap-t UCL | 4.259 |
| 95% Hall's Bootstrap UCL | 4.328 | | 95% Percentile Bootstrap UCL | 4.15 |
| 90% Chebyshev(Mean, Sd) UCL | 4.475 | | 95% Chebyshev(Mean, Sd) UCL | 4.766 |
| 97.5% Chebyshev(Mean, Sd) UCL | 5.169 | | 99% Chebyshev(Mean, Sd) UCL | 5.962 |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% Student's-t UCL | 4.264 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

**Arsenic - MW-17**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0083 | Mean | 0.00973 |
| Maximum | 0.012 | Median | 0.0093 |
| SD | 0.00169 | Std. Error of Mean | 8.4397E-4 |
| Coefficient of Variation | 0.174 | Skewness | 1.037 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.902 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.247 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0117 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0116 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0118 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.34 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.656 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.28 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.394 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 46.37 | k star (bias corrected MLE) | 11.76 |
| Theta hat (MLE) | 2.0974E-4 | Theta star (bias corrected MLE) | 8.2708E-4 |
| nu hat (MLE) | 370.9 | nu star (bias corrected) | 94.07 |
| MLE Mean (bias corrected) | 0.00973 | MLE Sd (bias corrected) | 0.00284 |
| | | Approximate Chi Square Value (0.05) | 72.7 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| 95% Approximate Gamma UCL | 0.0126 | 95% Adjusted Gamma UCL | N/A |
|---|---|---|---|

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.916 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.248 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.791 | Mean of logged Data | -4.644 |
| Maximum of Logged Data | -4.423 | SD of logged Data | 0.168 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0123 | 90% Chebyshev (MVUE) UCL | 0.0122 |
| 95% Chebyshev (MVUE) UCL | 0.0133 | 97.5% Chebyshev (MVUE) UCL | 0.0148 |
| 99% Chebyshev (MVUE) UCL | 0.0178 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0111 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0123 | 95% Chebyshev(Mean, Sd) UCL | 0.0134 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.015 | 99% Chebyshev(Mean, Sd) UCL | 0.0181 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0117 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

| UCL Statistics for Uncensored Full Data Sets | | |
|---|---|---|

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:35:46 PM |
| From File | mw18_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-18**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 |
| | | Number of Missing Observations | 0 |
| Minimum | 2.8 | Mean | 4.05 |
| Maximum | 8.8 | Median | 3.05 |
| SD | 2.342 | Std. Error of Mean | 0.956 |
| Coefficient of Variation | 0.578 | Skewness | 2.38 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.594 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.41 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data Not Normal at 1% Significance Level | |
| **Data Not Normal at 1% Significance Level** | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 5.977 | 95% Adjusted-CLT UCL (Chen-1995) | 6.616 |
| | | 95% Modified-t UCL (Johnson-1978) | 6.132 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 1.183 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.698 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.382 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.333 | Data Not Gamma Distributed at 5% Significance Level | |
| **Data Not Gamma Distributed at 5% Significance Level** | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 5.348 | k star (bias corrected MLE) | 2.785 |
| Theta hat (MLE) | 0.757 | Theta star (bias corrected MLE) | 1.454 |
| nu hat (MLE) | 64.18 | nu star (bias corrected) | 33.42 |
| MLE Mean (bias corrected) | 4.05 | MLE Sd (bias corrected) | 2.427 |
| | | Approximate Chi Square Value (0.05) | 21.2 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 17.78 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 6.384 | 95% Adjusted Gamma UCL | 7.614 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.659 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.353 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |

| Lognormal Statistics | | | |
|---|---|---|---|
| Minimum of Logged Data | 1.03 | Mean of logged Data | 1.302 |
| Maximum of Logged Data | 2.175 | SD of logged Data | 0.435 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 6.567 | 90% Chebyshev (MVUE) UCL | 6.096 |
| 95% Chebyshev (MVUE) UCL | 7.056 | 97.5% Chebyshev (MVUE) UCL | 8.388 |
| 99% Chebyshev (MVUE) UCL | 11.01 | | |

| Nonparametric Distribution Free UCL Statistics | | | |
|---|---|---|---|
| **Data do not follow a Discernible Distribution** | | | |

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 5.623 | 95% BCA Bootstrap UCL | 6.117 |
| 95% Standard Bootstrap UCL | 5.488 | 95% Bootstrap-t UCL | 25.09 |
| 95% Hall's Bootstrap UCL | 19.01 | 95% Percentile Bootstrap UCL | 5.883 |
| 90% Chebyshev(Mean, Sd) UCL | 6.919 | 95% Chebyshev(Mean, Sd) UCL | 8.218 |
| 97.5% Chebyshev(Mean, Sd) UCL | 10.02 | 99% Chebyshev(Mean, Sd) UCL | 13.57 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| Recommendation cannot be provided | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

## Arsenic - MW-18

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 3 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.016 | Mean | 0.0173 |
| Maximum | 0.018 | Median | 0.0175 |
| SD | 8.1650E-4 | Std. Error of Mean | 3.3333E-4 |
| Coefficient of Variation | 0.0471 | Skewness | -0.857 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.821 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.293 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.018 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0178 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.018 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.615 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.696 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.313 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 530.4 | k star (bias corrected MLE) | 265.3 |
| Theta hat (MLE) | 3.2680E-5 | Theta star (bias corrected MLE) | 6.5332E-5 |
| nu hat (MLE) | 6365 | nu star (bias corrected) | 3184 |
| MLE Mean (bias corrected) | 0.0173 | MLE Sd (bias corrected) | 0.00106 |
| | | Approximate Chi Square Value (0.05) | 3054 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 3007 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0181 | 95% Adjusted Gamma UCL | 0.0184 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.82 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.291 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Approximate Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.135 | Mean of logged Data | -4.056 |
| Maximum of Logged Data | -4.017 | SD of logged Data | 0.0478 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.0183 |
| 95% Chebyshev (MVUE) UCL | 0.0188 | 97.5% Chebyshev (MVUE) UCL | 0.0194 |
| 99% Chebyshev (MVUE) UCL | 0.0207 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0179 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0183 | 95% Chebyshev(Mean, Sd) UCL | 0.0188 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0194 | 99% Chebyshev(Mean, Sd) UCL | 0.0206 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.018 | | |
| **Recommended UCL exceeds the maximum observation** | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |

| UCL Statistics for Data Sets with Non-Detects | | | | |
|---|---|---|---|---|
| | | | | |
| **User Selected Options** | | | | |
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:37:30 PM | | | |
| From File | mw19_3year_data.xls | | | |
| Full Precision | OFF | | | |
| Confidence Coefficient | 95% | | | |
| Number of Bootstrap Operations | 2000 | | | |

**Nitrate - MW-19**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 | |
| | | Number of Missing Observations | 0 | |
| Minimum | 0.28 | Mean | 5.28 | |
| Maximum | 13 | Median | 3.4 | |
| SD | 4.928 | Std. Error of Mean | 2.012 | |
| Coefficient of Variation | 0.933 | Skewness | 0.916 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.888 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.285 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 9.334 | 95% Adjusted-CLT UCL (Chen-1995) | 9.393 |
| | | 95% Modified-t UCL (Johnson-1978) | 9.459 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.23 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.714 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.173 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.341 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 1.043 | k star (bias corrected MLE) | 0.633 |
| Theta hat (MLE) | 5.061 | Theta star (bias corrected MLE) | 8.344 |
| nu hat (MLE) | 12.52 | nu star (bias corrected) | 7.594 |
| MLE Mean (bias corrected) | 5.28 | MLE Sd (bias corrected) | 6.637 |
| | | Approximate Chi Square Value (0.05) | 2.502 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 1.578 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 16.03 | 95% Adjusted Gamma UCL | 25.41 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.918 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.213 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Lognormal Statistics | | | |
|---|---|---|---|
| Minimum of Logged Data | -1.273 | Mean of logged Data | 1.113 |
| Maximum of Logged Data | 2.565 | SD of logged Data | 1.367 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 211.1 | 90% Chebyshev (MVUE) UCL | 16.06 |
| 95% Chebyshev (MVUE) UCL | 20.54 | 97.5% Chebyshev (MVUE) UCL | 26.76 |
| 99% Chebyshev (MVUE) UCL | 38.96 | | |

| Nonparametric Distribution Free UCL Statistics | | | |
|---|---|---|---|
| **Data appear to follow a Discernible Distribution** | | | |

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 8.589 | 95% BCA Bootstrap UCL | 8.933 |
| 95% Standard Bootstrap UCL | 8.318 | 95% Bootstrap-t UCL | 15.91 |
| 95% Hall's Bootstrap UCL | 40.37 | 95% Percentile Bootstrap UCL | 8.647 |
| 90% Chebyshev(Mean, Sd) UCL | 11.32 | 95% Chebyshev(Mean, Sd) UCL | 14.05 |
| 97.5% Chebyshev(Mean, Sd) UCL | 17.84 | 99% Chebyshev(Mean, Sd) UCL | 25.3 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 9.334 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Nitrite - MW-19**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 | |
| Number of Detects | 4 | Number of Non-Detects | 2 | |
| Number of Distinct Detects | 4 | Number of Distinct Non-Detects | 1 | |
| Minimum Detect | 0.017 | Minimum Non-Detect | 0.015 | |
| Maximum Detect | 0.32 | Maximum Non-Detect | 0.015 | |
| Variance Detects | 0.02 | Percent Non-Detects | 33.33% | |
| Mean Detects | 0.118 | SD Detects | 0.141 | |
| Median Detects | 0.067 | CV Detects | 1.2 | |
| Skewness Detects | 1.518 | Kurtosis Detects | 1.995 | |
| Mean of Logged Detects | -2.788 | SD of Logged Detects | 1.366 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.827 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.272 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Detected Data appear Normal at 1% Significance Level | |
| **Detected Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.0835 | KM Standard Error of Mean | 0.0523 |
| 90KM SD | 0.111 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.189 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.17 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.241 | 95% KM Chebyshev UCL | 0.312 |
| 97.5% KM Chebyshev UCL | 0.41 | 99% KM Chebyshev UCL | 0.604 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.344 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.668 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.293 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.403 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 0.901 | k star (bias corrected MLE) | 0.392 |
| Theta hat (MLE) | 0.131 | Theta star (bias corrected MLE) | 0.3 |
| nu hat (MLE) | 7.21 | nu star (bias corrected) | 3.136 |
| Mean (detects) | 0.118 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.01 | Mean | 0.0818 |
| Maximum | 0.32 | Median | 0.0205 |
| SD | 0.123 | CV | 1.5 |
| k hat (MLE) | 0.681 | k star (bias corrected MLE) | 0.452 |
| Theta hat (MLE) | 0.12 | Theta star (bias corrected MLE) | 0.181 |
| nu hat (MLE) | 8.175 | nu star (bias corrected) | 5.421 |
| Adjusted Level of Significance (β) | 0.0122 | | |
| Approximate Chi Square Value (5.42, α) | 1.351 | Adjusted Chi Square Value (5.42, β) | 0.752 |
| 95% Gamma Approximate UCL | 0.328 | 95% Gamma Adjusted UCL | N/A |
| | | | |
| Estimates of Gamma Parameters using KM Estimates | | | |
| Mean (KM) | 0.0835 | SD (KM) | 0.111 |
| Variance (KM) | 0.0123 | SE of Mean (KM) | 0.0523 |
| k hat (KM) | 0.565 | k star (KM) | 0.394 |
| nu hat (KM) | 6.786 | nu star (KM) | 4.726 |
| theta hat (KM) | 0.148 | theta star (KM) | 0.212 |
| 80% gamma percentile (KM) | 0.135 | 90% gamma percentile (KM) | 0.236 |
| 95% gamma percentile (KM) | 0.349 | 99% gamma percentile (KM) | 0.632 |
| | | | |
| Gamma Kaplan-Meier (KM) Statistics | | | |
| Approximate Chi Square Value (4.73, α) | 1.028 | Adjusted Chi Square Value (4.73, β) | 0.539 |
| 95% KM Approximate Gamma UCL | 0.384 | 95% KM Adjusted Gamma UCL | 0.732 |
| | | | |
| Lognormal GOF Test on Detected Observations Only | | | |
| Shapiro Wilk Test Statistic | 0.923 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.255 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Detected Data appear Lognormal at 10% Significance Level | |
| **Detected Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| Lognormal ROS Statistics Using Imputed Non-Detects | | | |
| Mean in Original Scale | 0.079 | Mean in Log Scale | -4.069 |
| SD in Original Scale | 0.125 | SD in Log Scale | 2.281 |
| 95% t UCL (assumes normality of ROS data) | 0.182 | 95% Percentile Bootstrap UCL | 0.165 |
| 95% BCA Bootstrap UCL | 0.197 | 95% Bootstrap t UCL | 0.917 |
| 95% H-UCL (Log ROS) | 1714 | | |

| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -3.258 | KM Geo Mean | | 0.0385 |
| KM SD (logged) | 1.173 | 95% Critical H Value (KM-Log) | | 4.729 |
| KM Standard Error of Mean (logged) | 0.553 | 95% H-UCL (KM -Log) | | 0.914 |
| KM SD (logged) | 1.173 | 95% Critical H Value (KM-Log) | | 4.729 |
| KM Standard Error of Mean (logged) | 0.553 | | | |
| | | | | |
| DL/2 Statistics | | | | |
| DL/2 Normal | | DL/2 Log-Transformed | | |
| Mean in Original Scale | 0.081 | Mean in Log Scale | | -3.489 |
| SD in Original Scale | 0.123 | SD in Log Scale | | 1.517 |
| 95% t UCL (Assumes normality) | 0.182 | 95% H-Stat UCL | | 5.427 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% KM (t) UCL | 0.189 | | | |
| | | | | |
| The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner. | | | | |
| Please verify the data were collected from random locations. | | | | |
| If the data were collected using judgmental or other non-random methods, | | | | |
| then contact a statistician to correctly calculate UCLs. | | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |
| | | | | |
| | | | | |

**Arsenic - MW-19**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0074 | Mean | 0.0174 |
| Maximum | 0.038 | Median | 0.012 |
| SD | 0.0116 | Std. Error of Mean | 0.00472 |
| Coefficient of Variation | 0.665 | Skewness | 1.438 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.825 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.315 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0269 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0281 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0274 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.448 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.701 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.29 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.334 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3.279 | k star (bias corrected MLE) | 1.751 |
| Theta hat (MLE) | 0.00531 | Theta star (bias corrected MLE) | 0.00994 |
| nu hat (MLE) | 39.35 | nu star (bias corrected) | 21.01 |
| MLE Mean (bias corrected) | 0.0174 | MLE Sd (bias corrected) | 0.0132 |
| | | Approximate Chi Square Value (0.05) | 11.6 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 9.18 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0315 | 95% Adjusted Gamma UCL | 0.0398 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.92 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.253 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.906 | Mean of logged Data | -4.211 |
| Maximum of Logged Data | -3.27 | SD of logged Data | 0.599 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0385 | 90% Chebyshev (MVUE) UCL | 0.0297 |
| 95% Chebyshev (MVUE) UCL | 0.0354 | 97.5% Chebyshev (MVUE) UCL | 0.0433 |
| 99% Chebyshev (MVUE) UCL | 0.0588 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0252 | 95% BCA Bootstrap UCL | 0.0268 |
| 95% Standard Bootstrap UCL | 0.0244 | 95% Bootstrap-t UCL | 0.0547 |
| 95% Hall's Bootstrap UCL | 0.0858 | 95% Percentile Bootstrap UCL | 0.0248 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0316 | 95% Chebyshev(Mean, Sd) UCL | 0.038 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0469 | 99% Chebyshev(Mean, Sd) UCL | 0.0644 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0269 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

**Iron - MW-19**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.58 | Mean | 1.373 |
| Maximum | 3.7 | Median | 0.605 |
| SD | 1.552 | Std. Error of Mean | 0.776 |
| Coefficient of Variation | 1.131 | Skewness | 2 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.637 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.438 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data Not Normal at 1% Significance Level | |
| **Data Not Normal at 1% Significance Level** | | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 3.198 | 95% Adjusted-CLT UCL (Chen-1995) | 3.478 |
| | | 95% Modified-t UCL (Johnson-1978) | 3.328 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.925 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.663 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.467 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.4 | Data Not Gamma Distributed at 5% Significance Level | |
| **Data Not Gamma Distributed at 5% Significance Level** | | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.471 | k star (bias corrected MLE) | 0.534 |
| Theta hat (MLE) | 0.933 | Theta star (bias corrected MLE) | 2.569 |
| nu hat (MLE) | 11.77 | nu star (bias corrected) | 4.275 |
| MLE Mean (bias corrected) | 1.373 | MLE Sd (bias corrected) | 1.878 |
| | | Approximate Chi Square Value (0.05) | 0.833 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 7.042 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.652 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.433 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -0.545 | Mean of logged Data | -0.0604 |
| Maximum of Logged Data | 1.308 | SD of logged Data | 0.913 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 35.87 | 90% Chebyshev (MVUE) UCL | 2.891 |
| 95% Chebyshev (MVUE) UCL | 3.628 | 97.5% Chebyshev (MVUE) UCL | 4.651 |
| 99% Chebyshev (MVUE) UCL | 6.661 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data do not follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 2.649 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 3.7 | 95% Chebyshev(Mean, Sd) UCL | 4.754 |
| 97.5% Chebyshev(Mean, Sd) UCL | 6.218 | 99% Chebyshev(Mean, Sd) UCL | 9.092 |
| | | | |
| **Suggested UCL to Use** | | | |
| Recommendation cannot be provided | | | |
| | | | |
| **The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.** | | | |
| **Please verify the data were collected from random locations.** | | | |
| **If the data were collected using judgmental or other non-random methods,** | | | |
| **then contact a statistician to correctly calculate UCLs.** | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

**Manganese - MW-19**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.17 | Mean | 0.445 |
| Maximum | 0.91 | Median | 0.35 |
| SD | 0.336 | Std. Error of Mean | 0.168 |
| Coefficient of Variation | 0.755 | Skewness | 1.227 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.889 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.239 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.84 | 95% Adjusted-CLT UCL (Chen-1995) | 0.831 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.858 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.291 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.66 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.264 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.397 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.501 | k star (bias corrected MLE) | 0.792 |
| Theta hat (MLE) | 0.178 | Theta star (bias corrected MLE) | 0.562 |
| nu hat (MLE) | 20.01 | nu star (bias corrected) | 6.335 |
| MLE Mean (bias corrected) | 0.445 | MLE Sd (bias corrected) | 0.5 |
| | | Approximate Chi Square Value (0.05) | 1.813 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 1.555 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.956 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.224 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -1.772 | Mean of logged Data | -1.023 |
| Maximum of Logged Data | -0.0943 | SD of logged Data | 0.752 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 4.389 | 90% Chebyshev (MVUE) UCL | 0.917 |
| 95% Chebyshev (MVUE) UCL | 1.133 | 97.5% Chebyshev (MVUE) UCL | 1.432 |
| 99% Chebyshev (MVUE) UCL | 2.021 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.721 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.949 | 95% Chebyshev(Mean, Sd) UCL | 1.177 |
| 97.5% Chebyshev(Mean, Sd) UCL | 1.494 | 99% Chebyshev(Mean, Sd) UCL | 2.117 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.84 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**1,2-DCP - MW-19**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0042 | Mean | 0.0204 |
| Maximum | 0.038 | Median | 0.02 |
| SD | 0.0119 | Std. Error of Mean | 0.00484 |
| Coefficient of Variation | 0.582 | Skewness | 0.201 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.989 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.144 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0301 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0288 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0302 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.235 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.702 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.184 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.335 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.656 | k star (bias corrected MLE) | 1.439 |
| Theta hat (MLE) | 0.00767 | Theta star (bias corrected MLE) | 0.0142 |
| nu hat (MLE) | 31.88 | nu star (bias corrected) | 17.27 |
| MLE Mean (bias corrected) | 0.0204 | MLE Sd (bias corrected) | 0.017 |
| | | Approximate Chi Square Value (0.05) | 8.866 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 6.805 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0397 | 95% Adjusted Gamma UCL | 0.0517 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.913 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.207 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -5.473 | Mean of logged Data | -4.094 |
| Maximum of Logged Data | -3.27 | SD of logged Data | 0.776 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.0733 | 90% Chebyshev (MVUE) UCL | 0.0413 |
| 95% Chebyshev (MVUE) UCL | 0.0504 | 97.5% Chebyshev (MVUE) UCL | 0.063 |
| 99% Chebyshev (MVUE) UCL | 0.0877 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0283 | 95% BCA Bootstrap UCL | 0.0283 |
| 95% Standard Bootstrap UCL | 0.0277 | 95% Bootstrap-t UCL | 0.0315 |
| 95% Hall's Bootstrap UCL | 0.0292 | 95% Percentile Bootstrap UCL | 0.0278 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0349 | 95% Chebyshev(Mean, Sd) UCL | 0.0415 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0506 | 99% Chebyshev(Mean, Sd) UCL | 0.0685 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0301 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

| UCL Statistics for Uncensored Full Data Sets | | |
|---|---|---|

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:38:36 PM |
| From File | mw20_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-20**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 5 |
| | | Number of Missing Observations | 0 |
| Minimum | 3.3 | Mean | 4.167 |
| Maximum | 7 | Median | 3.6 |
| SD | 1.407 | Std. Error of Mean | 0.574 |
| Coefficient of Variation | 0.338 | Skewness | 2.31 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.642 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data Not Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.38 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data Not Normal at 1% Significance Level | |
| **Data Not Normal at 1% Significance Level** | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 5.324 | 95% Adjusted-CLT UCL (Chen-1995) | 5.69 |
| | | 95% Modified-t UCL (Johnson-1978) | 5.414 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 1.043 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.698 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.357 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Data Not Gamma Distributed at 5% Significance Level | |
| **Data Not Gamma Distributed at 5% Significance Level** | | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 13.68 | | k star (bias corrected MLE) | 6.952 |
| Theta hat (MLE) | 0.305 | | Theta star (bias corrected MLE) | 0.599 |
| nu hat (MLE) | 164.2 | | nu star (bias corrected) | 83.42 |
| MLE Mean (bias corrected) | 4.167 | | MLE Sd (bias corrected) | 1.58 |
| | | | Approximate Chi Square Value (0.05) | 63.37 |
| Adjusted Level of Significance | 0.0122 | | Adjusted Chi Square Value | 57.1 |

| Assuming Gamma Distribution | | | | |
|---|---|---|---|---|
| 95% Approximate Gamma UCL | 5.485 | | 95% Adjusted Gamma UCL | 6.088 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.696 | | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.826 | | Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.339 | | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.298 | | Data Not Lognormal at 10% Significance Level |
| **Data Not Lognormal at 10% Significance Level** | | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 1.194 | | Mean of logged Data | 1.39 |
| Maximum of Logged Data | 1.946 | | SD of logged Data | 0.279 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 5.49 | | 90% Chebyshev (MVUE) UCL | 5.566 |
| 95% Chebyshev (MVUE) UCL | 6.209 | | 97.5% Chebyshev (MVUE) UCL | 7.101 |
| 99% Chebyshev (MVUE) UCL | 8.853 | | | |

| Nonparametric Distribution Free UCL Statistics | | | | |
|---|---|---|---|---|
| **Data do not follow a Discernible Distribution** | | | | |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 5.111 | | 95% BCA Bootstrap UCL | 5.367 |
| 95% Standard Bootstrap UCL | 5.042 | | 95% Bootstrap-t UCL | 11.52 |
| 95% Hall's Bootstrap UCL | 11.41 | | 95% Percentile Bootstrap UCL | 5.25 |
| 90% Chebyshev(Mean, Sd) UCL | 5.889 | | 95% Chebyshev(Mean, Sd) UCL | 6.67 |
| 97.5% Chebyshev(Mean, Sd) UCL | 7.753 | | 99% Chebyshev(Mean, Sd) UCL | 9.881 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| Recommendation cannot be provided | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Arsenic - MW-20**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 6 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.016 | Mean | 0.0183 |
| Maximum | 0.02 | Median | 0.0185 |
| SD | 0.00137 | Std. Error of Mean | 5.5777E-4 |
| Coefficient of Variation | 0.0745 | Skewness | -0.889 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.926 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.237 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.0195 | 95% Adjusted-CLT UCL (Chen-1995) | 0.019 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0194 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.371 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.696 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.238 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.332 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 208.7 | k star (bias corrected MLE) | 104.5 |
| Theta hat (MLE) | 8.7825E-5 | Theta star (bias corrected MLE) | 1.7546E-4 |
| nu hat (MLE) | 2505 | nu star (bias corrected) | 1254 |
| MLE Mean (bias corrected) | 0.0183 | MLE Sd (bias corrected) | 0.00179 |
| | | Approximate Chi Square Value (0.05) | 1173 |
| Adjusted Level of Significance | 0.0122 | Adjusted Chi Square Value | 1144 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0196 | 95% Adjusted Gamma UCL | 0.0201 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.912 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.251 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -4.135 | Mean of logged Data | -4.001 |
| Maximum of Logged Data | -3.912 | SD of logged Data | 0.0765 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | N/A | 90% Chebyshev (MVUE) UCL | 0.0201 |
| 95% Chebyshev (MVUE) UCL | 0.0208 | 97.5% Chebyshev (MVUE) UCL | 0.0219 |
| 99% Chebyshev (MVUE) UCL | 0.024 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0193 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.02 | 95% Chebyshev(Mean, Sd) UCL | 0.0208 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0218 | 99% Chebyshev(Mean, Sd) UCL | 0.0239 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.0195 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |
| | | | |

| UCL Statistics for Data Sets with Non-Detects | |
|---|---|
| | |
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.2 11/18/2024 8:46:19 AM |
| From File | mw21_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-21**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 19 | Mean | 61.5 |
| Maximum | 110 | Median | 55 |
| SD | 34.22 | Std. Error of Mean | 12.1 |
| Coefficient of Variation | 0.556 | Skewness | 0.5 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.911 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.172 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |
| Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 84.42 | 95% Adjusted-CLT UCL (Chen-1995) | 83.69 |
| | | 95% Modified-t UCL (Johnson-1978) | 84.78 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.24 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.72 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.163 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.296 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3.396 | k star (bias corrected MLE) | 2.206 |
| Theta hat (MLE) | 18.11 | Theta star (bias corrected MLE) | 27.88 |
| nu hat (MLE) | 54.33 | nu star (bias corrected) | 35.29 |
| MLE Mean (bias corrected) | 61.5 | MLE Sd (bias corrected) | 41.41 |
| | | Approximate Chi Square Value (0.05) | 22.7 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 20.18 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 95.62 | 95% Adjusted Gamma UCL | 107.5 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.943 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.15 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | 2.944 | Mean of logged Data | 3.965 |
| Maximum of Logged Data | 4.7 | SD of logged Data | 0.622 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 117.1 | 90% Chebyshev (MVUE) UCL | 103.8 |
| 95% Chebyshev (MVUE) UCL | 122.6 | 97.5% Chebyshev (MVUE) UCL | 148.8 |
| 99% Chebyshev (MVUE) UCL | 200.1 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 81.4 | 95% BCA Bootstrap UCL | 81.75 |
| 95% Standard Bootstrap UCL | 80.42 | 95% Bootstrap-t UCL | 91.35 |
| 95% Hall's Bootstrap UCL | 96.33 | 95% Percentile Bootstrap UCL | 81 |
| 90% Chebyshev(Mean, Sd) UCL | 97.8 | 95% Chebyshev(Mean, Sd) UCL | 114.2 |
| 97.5% Chebyshev(Mean, Sd) UCL | 137.1 | 99% Chebyshev(Mean, Sd) UCL | 181.9 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 84.42 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Nitrite - MW-21**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.31 | Mean | 1.611 |
| Maximum | 3.8 | Median | 0.955 |
| SD | 1.463 | Std. Error of Mean | 0.517 |
| Coefficient of Variation | 0.908 | Skewness | 0.928 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.805 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.287 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**
Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 2.591 | 95% Adjusted-CLT UCL (Chen-1995) | 2.643 |
| | | 95% Modified-t UCL (Johnson-1978) | 2.619 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.424 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.73 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.212 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.3 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.371 | k star (bias corrected MLE) | 0.94 |
| Theta hat (MLE) | 1.175 | Theta star (bias corrected MLE) | 1.714 |
| nu hat (MLE) | 21.94 | nu star (bias corrected) | 15.04 |
| MLE Mean (bias corrected) | 1.611 | MLE Sd (bias corrected) | 1.662 |
| | | Approximate Chi Square Value (0.05) | 7.293 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 5.981 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 3.324 | 95% Adjusted Gamma UCL | 4.053 |

### Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.905 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.153 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |

**Data appear Lognormal at 10% Significance Level**
Note GOF tests may be unreliable for small sample sizes

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | -1.171 | | Mean of logged Data | 0.07 |
| Maximum of Logged Data | 1.335 | | SD of logged Data | 1 |
| | | | | |
| Assuming Lognormal Distribution | | | | |
| 95% H-UCL | 6.456 | | 90% Chebyshev (MVUE) UCL | 3.394 |
| 95% Chebyshev (MVUE) UCL | 4.194 | | 97.5% Chebyshev (MVUE) UCL | 5.303 |
| 99% Chebyshev (MVUE) UCL | 7.483 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 2.462 | | 95% BCA Bootstrap UCL | 2.61 |
| 95% Standard Bootstrap UCL | 2.412 | | 95% Bootstrap-t UCL | 3.521 |
| 95% Hall's Bootstrap UCL | 2.826 | | 95% Percentile Bootstrap UCL | 2.44 |
| 90% Chebyshev(Mean, Sd) UCL | 3.163 | | 95% Chebyshev(Mean, Sd) UCL | 3.865 |
| 97.5% Chebyshev(Mean, Sd) UCL | 4.841 | | 99% Chebyshev(Mean, Sd) UCL | 6.757 |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% Student's-t UCL | 2.591 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Arsenic - MW-21**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0015 | Mean | 0.00416 |
| Maximum | 0.014 | Median | 0.0028 |
| SD | 0.00405 | Std. Error of Mean | 0.00143 |
| Coefficient of Variation | 0.973 | Skewness | 2.628 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.602 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.749 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.381 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.333 | Data Not Normal at 1% Significance Level |
| **Data Not Normal at 1% Significance Level** | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.00687 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00794 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0071 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.951 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.724 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.294 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.297 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data follow Appr. Gamma Distribution at 5% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 2.186 | k star (bias corrected MLE) | 1.45 |
| Theta hat (MLE) | 0.0019 | Theta star (bias corrected MLE) | 0.00287 |
| nu hat (MLE) | 34.98 | nu star (bias corrected) | 23.2 |
| MLE Mean (bias corrected) | 0.00416 | MLE Sd (bias corrected) | 0.00346 |
| | | Approximate Chi Square Value (0.05) | 13.24 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 11.38 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.00729 | 95% Adjusted Gamma UCL | 0.00848 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.84 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.851 | Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.242 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level |
| **Data appear Approximate Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | -6.502 | | Mean of logged Data | -5.727 |
| Maximum of Logged Data | -4.269 | | SD of logged Data | 0.661 |
| | | | | |
| Assuming Lognormal Distribution | | | | |
| 95% H-UCL | 0.00786 | | 90% Chebyshev (MVUE) UCL | 0.00672 |
| 95% Chebyshev (MVUE) UCL | 0.00798 | | 97.5% Chebyshev (MVUE) UCL | 0.00974 |
| 99% Chebyshev (MVUE) UCL | 0.0132 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 0.00652 | | 95% BCA Bootstrap UCL | 0.00835 |
| 95% Standard Bootstrap UCL | 0.00641 | | 95% Bootstrap-t UCL | 0.0158 |
| 95% Hall's Bootstrap UCL | 0.019 | | 95% Percentile Bootstrap UCL | 0.00689 |
| 90% Chebyshev(Mean, Sd) UCL | 0.00846 | | 95% Chebyshev(Mean, Sd) UCL | 0.0104 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0131 | | 99% Chebyshev(Mean, Sd) UCL | 0.0184 |
| | | | | |
| Suggested UCL to Use | | | | |
| Recommendation cannot be provided | | | | |
| | | | | |
| When a data set follows an approximate distribution passing only one of the GOF tests, | | | | |
| it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL | | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |

**Iron - MW-21**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| Number of Detects | 5 | Number of Non-Detects | 3 |
| Number of Distinct Detects | 5 | Number of Distinct Non-Detects | 2 |
| Minimum Detect | 0.042 | Minimum Non-Detect | 0.02 |
| Maximum Detect | 0.75 | Maximum Non-Detect | 0.08 |
| Variance Detects | 0.0891 | Percent Non-Detects | 37.5% |
| Mean Detects | 0.233 | SD Detects | 0.299 |
| Median Detects | 0.097 | CV Detects | 1.279 |
| Skewness Detects | 1.91 | Kurtosis Detects | 3.66 |
| Mean of Logged Detects | -2.059 | SD of Logged Detects | 1.199 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.742 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.686 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.305 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.396 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 0.158 | KM Standard Error of Mean | 0.0921 |
| 90KM SD | 0.233 | 95% KM (BCA) UCL | 0.314 |
| 95% KM (t) UCL | 0.332 | 95% KM (Percentile Bootstrap) UCL | 0.316 |
| 95% KM (z) UCL | 0.309 | 95% KM Bootstrap t UCL | 1.015 |
| 90% KM Chebyshev UCL | 0.434 | 95% KM Chebyshev UCL | 0.559 |
| 97.5% KM Chebyshev UCL | 0.733 | 99% KM Chebyshev UCL | 1.074 |

### Gamma GOF Tests on Detected Observations Only

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.415 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.692 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.252 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.365 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics on Detected Data Only

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.96 | k star (bias corrected MLE) | 0.517 |
| Theta hat (MLE) | 0.243 | Theta star (bias corrected MLE) | 0.451 |
| nu hat (MLE) | 9.597 | nu star (bias corrected) | 5.172 |
| Mean (detects) | 0.233 | | |

### Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

| | | | | |
|---|---|---|---|---|
| Minimum | 0.01 | | Mean | 0.15 |
| Maximum | 0.75 | | Median | 0.045 |
| SD | 0.254 | | CV | 1.695 |
| k hat (MLE) | 0.56 | | k star (bias corrected MLE) | 0.433 |
| Theta hat (MLE) | 0.267 | | Theta star (bias corrected MLE) | 0.345 |
| nu hat (MLE) | 8.962 | | nu star (bias corrected) | 6.935 |
| Adjusted Level of Significance (β) | 0.0195 | | | |
| Approximate Chi Square Value (6.93, α) | 2.135 | | Adjusted Chi Square Value (6.93, β) | 1.527 |
| 95% Gamma Approximate UCL | 0.486 | | 95% Gamma Adjusted UCL | 0.68 |

### Estimates of Gamma Parameters using KM Estimates

| | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.158 | | SD (KM) | 0.233 |
| Variance (KM) | 0.0542 | | SE of Mean (KM) | 0.0921 |
| k hat (KM) | 0.458 | | k star (KM) | 0.369 |
| nu hat (KM) | 7.325 | | nu star (KM) | 5.911 |
| theta hat (KM) | 0.344 | | theta star (KM) | 0.426 |
| 80% gamma percentile (KM) | 0.252 | | 90% gamma percentile (KM) | 0.451 |
| 95% gamma percentile (KM) | 0.673 | | 99% gamma percentile (KM) | 1.235 |

### Gamma Kaplan-Meier (KM) Statistics

| | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (5.91, α) | 1.595 | | Adjusted Chi Square Value (5.91, β) | 1.095 |
| 95% KM Approximate Gamma UCL | 0.584 | | 95% KM Adjusted Gamma UCL | 0.85 |

### Lognormal GOF Test on Detected Observations Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.915 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.806 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.192 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.319 | Detected Data appear Lognormal at 10% Significance Level |

**Detected Data appear Lognormal at 10% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Lognormal ROS Statistics Using Imputed Non-Detects

| | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.154 | | Mean in Log Scale | -2.828 |
| SD in Original Scale | 0.251 | | SD in Log Scale | 1.472 |
| 95% t UCL (assumes normality of ROS data) | 0.322 | | 95% Percentile Bootstrap UCL | 0.316 |
| 95% BCA Bootstrap UCL | 0.389 | | 95% Bootstrap t UCL | 1.167 |
| 95% H-UCL (Log ROS) | 2.338 | | | |

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -2.619 | | KM Geo Mean | 0.0728 |
| KM SD (logged) | 1.141 | | 95% Critical H Value (KM-Log) | 3.782 |
| KM Standard Error of Mean (logged) | 0.462 | | 95% H-UCL (KM -Log) | 0.714 |
| KM SD (logged) | 1.141 | | 95% Critical H Value (KM-Log) | 3.782 |
| KM Standard Error of Mean (logged) | 0.462 | | | |

### DL/2 Statistics

| DL/2 Normal | | | DL/2 Log-Transformed | |
|---|---|---|---|---|
| Mean in Original Scale | 0.157 | | Mean in Log Scale | -2.667 |
| SD in Original Scale | 0.249 | | SD in Log Scale | 1.307 |
| 95% t UCL (Assumes normality) | 0.324 | | 95% H-Stat UCL | 1.312 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

### Nonparametric Distribution Free UCL Statistics

**Detected Data appear Normal Distributed at 1% Significance Level**

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% KM (t) UCL | 0.332 | | |

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**

**Please verify the data were collected from random locations.**

**If the data were collected using judgmental or other non-random methods,**

**then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Manganese - MW-21**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 7 |
| | | Number of Missing Observations | 0 |
| Minimum | 1.4 | Mean | 2.038 |
| Maximum | 3.1 | Median | 1.95 |
| SD | 0.573 | Std. Error of Mean | 0.203 |
| Coefficient of Variation | 0.281 | Skewness | 0.804 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.926 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.749 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.152 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.333 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**
Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 2.421 | 95% Adjusted-CLT UCL (Chen-1995) | 2.432 |
| | | 95% Modified-t UCL (Johnson-1978) | 2.431 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.266 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.716 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.169 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.294 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 15.29 | k star (bias corrected MLE) | 9.638 |
| Theta hat (MLE) | 0.133 | Theta star (bias corrected MLE) | 0.211 |
| nu hat (MLE) | 244.6 | nu star (bias corrected) | 154.2 |
| MLE Mean (bias corrected) | 2.038 | MLE Sd (bias corrected) | 0.656 |
| | | Approximate Chi Square Value (0.05) | 126.5 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 120.2 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 2.484 | 95% Adjusted Gamma UCL | 2.615 |

### Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.953 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.851 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.153 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.265 | Data appear Lognormal at 10% Significance Level | |

**Data appear Lognormal at 10% Significance Level**
Note GOF tests may be unreliable for small sample sizes

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | 0.336 | | Mean of logged Data | 0.679 |
| Maximum of Logged Data | 1.131 | | SD of logged Data | 0.272 |
| | | | | |
| Assuming Lognormal Distribution | | | | |
| 95% H-UCL | 2.52 | | 90% Chebyshev (MVUE) UCL | 2.626 |
| 95% Chebyshev (MVUE) UCL | 2.894 | | 97.5% Chebyshev (MVUE) UCL | 3.265 |
| 99% Chebyshev (MVUE) UCL | 3.993 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 2.371 | | 95% BCA Bootstrap UCL | 2.4 |
| 95% Standard Bootstrap UCL | 2.362 | | 95% Bootstrap-t UCL | 2.56 |
| 95% Hall's Bootstrap UCL | 2.479 | | 95% Percentile Bootstrap UCL | 2.375 |
| 90% Chebyshev(Mean, Sd) UCL | 2.645 | | 95% Chebyshev(Mean, Sd) UCL | 2.921 |
| 97.5% Chebyshev(Mean, Sd) UCL | 3.303 | | 99% Chebyshev(Mean, Sd) UCL | 4.053 |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% Student's-t UCL | 2.421 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**1,2-DCP - MW-21**

## General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 3.9000E-4 | Mean | 5.8778E-4 |
| Maximum | 9.4000E-4 | Median | 5.7000E-4 |
| SD | 1.7138E-4 | Std. Error of Mean | 5.7125E-5 |
| Coefficient of Variation | 0.292 | Skewness | 0.987 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

## Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.925 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.203 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

## Assuming Normal Distribution

| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
|---|---|---|---|
| 95% Student's-t UCL | 6.9400E-4 | 95% Adjusted-CLT UCL (Chen-1995) | 7.0183E-4 |
| | | 95% Modified-t UCL (Johnson-1978) | 6.9714E-4 |

## Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.229 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.721 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.163 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

## Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 14.22 | k star (bias corrected MLE) | 9.554 |
| Theta hat (MLE) | 4.1336E-5 | Theta star (bias corrected MLE) | 6.1523E-5 |
| nu hat (MLE) | 256 | nu star (bias corrected) | 172 |
| MLE Mean (bias corrected) | 5.8778E-4 | MLE Sd (bias corrected) | 1.9016E-4 |
| | | Approximate Chi Square Value (0.05) | 142.6 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 137 |

## Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 7.0862E-4 | 95% Adjusted Gamma UCL | 7.3776E-4 |

## Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.962 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.153 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level |
| **Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal Statistics | | | | |
|---|---|---|---|---|
| Minimum of Logged Data | -7.849 | | Mean of logged Data | -7.475 |
| Maximum of Logged Data | -6.97 | | SD of logged Data | 0.28 |
| | | | | |
| Assuming Lognormal Distribution | | | | |
| 95% H-UCL | 7.1831E-4 | | 90% Chebyshev (MVUE) UCL | 7.5255E-4 |
| 95% Chebyshev (MVUE) UCL | 8.2741E-4 | | 97.5% Chebyshev (MVUE) UCL | 9.3132E-4 |
| 99% Chebyshev (MVUE) UCL | 0.00114 | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Data appear to follow a Discernible Distribution | | | | |
| | | | | |
| Nonparametric Distribution Free UCLs | | | | |
| 95% CLT UCL | 6.8174E-4 | | 95% BCA Bootstrap UCL | 6.8556E-4 |
| 95% Standard Bootstrap UCL | 6.7490E-4 | | 95% Bootstrap-t UCL | 7.2875E-4 |
| 95% Hall's Bootstrap UCL | 8.1336E-4 | | 95% Percentile Bootstrap UCL | 6.7778E-4 |
| 90% Chebyshev(Mean, Sd) UCL | 7.5915E-4 | | 95% Chebyshev(Mean, Sd) UCL | 8.3678E-4 |
| 97.5% Chebyshev(Mean, Sd) UCL | 9.4452E-4 | | 99% Chebyshev(Mean, Sd) UCL | 0.00116 |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% Student's-t UCL | 6.9400E-4 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| User Selected Options | | |
|---|---|---|
| Date/Time of Computation | ProUCL 5.2 11/18/2024 9:04:03 AM | |
| From File | mw22_3year_data.xls | |
| Full Precision | OFF | |
| Confidence Coefficient | 95% | |
| Number of Bootstrap Operations | 2000 | |

**Nitrate - MW-22**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 7 | Number of Distinct Observations | 7 | |
| | | Number of Missing Observations | 0 | |
| Minimum | 0.16 | Mean | 27.18 | |
| Maximum | 70 | Median | 17 | |
| SD | 28.38 | Std. Error of Mean | 10.73 | |
| Coefficient of Variation | 1.044 | Skewness | 1.007 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.809 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.73 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.3 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.35 | Data appear Normal at 1% Significance Level | |
| Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 48.02 | 95% Adjusted-CLT UCL (Chen-1995) | 49.18 |
| | | 95% Modified-t UCL (Johnson-1978) | 48.7 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.342 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.741 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.198 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.324 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 0.669 | k star (bias corrected MLE) | 0.477 |
| Theta hat (MLE) | 40.63 | Theta star (bias corrected MLE) | 56.93 |
| nu hat (MLE) | 9.364 | nu star (bias corrected) | 6.684 |
| MLE Mean (bias corrected) | 27.18 | MLE Sd (bias corrected) | 39.34 |
| | | Approximate Chi Square Value (0.05) | 1.999 |
| Adjusted Level of Significance | 0.0158 | Adjusted Chi Square Value | 1.319 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 90.88 | 95% Adjusted Gamma UCL | 137.8 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.819 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.838 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.291 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.28 | Data Not Lognormal at 10% Significance Level | |
| **Data Not Lognormal at 10% Significance Level** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -1.833 | Mean of logged Data | 2.393 |
| Maximum of Logged Data | 4.248 | SD of logged Data | 2.051 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 29097 | 90% Chebyshev (MVUE) UCL | 156.6 |
| 95% Chebyshev (MVUE) UCL | 204.8 | 97.5% Chebyshev (MVUE) UCL | 271.8 |
| 99% Chebyshev (MVUE) UCL | 403.3 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 44.82 | 95% BCA Bootstrap UCL | 46.43 |
| 95% Standard Bootstrap UCL | 43.74 | 95% Bootstrap-t UCL | 88.65 |
| 95% Hall's Bootstrap UCL | 199.8 | 95% Percentile Bootstrap UCL | 44.73 |
| 90% Chebyshev(Mean, Sd) UCL | 59.36 | 95% Chebyshev(Mean, Sd) UCL | 73.93 |
| 97.5% Chebyshev(Mean, Sd) UCL | 94.16 | 99% Chebyshev(Mean, Sd) UCL | 133.9 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 48.02 | | |

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**

**Please verify the data were collected from random locations.**

**If the data were collected using judgmental or other non-random methods,**

**then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Nitrite - MW-22**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 7 | | Number of Distinct Observations | 7 |
| Number of Detects | 6 | | Number of Non-Detects | 1 |
| Number of Distinct Detects | 6 | | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.056 | | Minimum Non-Detect | 0.015 |
| Maximum Detect | 7.7 | | Maximum Non-Detect | 0.015 |
| Variance Detects | 8.575 | | Percent Non-Detects | 14.29% |
| Mean Detects | 2.619 | | SD Detects | 2.928 |
| Median Detects | 1.85 | | CV Detects | 1.118 |
| Skewness Detects | 1.195 | | Kurtosis Detects | 0.991 |
| Mean of Logged Detects | -0.179 | | SD of Logged Detects | 2.16 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.879 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.713 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.224 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.373 | Detected Data appear Normal at 1% Significance Level | |
| Detected Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 2.247 | KM Standard Error of Mean | 1.092 |
| 90KM SD | 2.637 | 95% KM (BCA) UCL | 3.931 |
| 95% KM (t) UCL | 4.369 | 95% KM (Percentile Bootstrap) UCL | 3.937 |
| 95% KM (z) UCL | 4.043 | 95% KM Bootstrap t UCL | 6.24 |
| 90% KM Chebyshev UCL | 5.523 | 95% KM Chebyshev UCL | 7.007 |
| 97.5% KM Chebyshev UCL | 9.066 | 99% KM Chebyshev UCL | 13.11 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.382 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.733 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.234 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.348 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics on Detected Data Only | | | |
|---|---|---|---|
| k hat (MLE) | 0.548 | k star (bias corrected MLE) | 0.385 |
| Theta hat (MLE) | 4.776 | Theta star (bias corrected MLE) | 6.798 |
| nu hat (MLE) | 6.579 | nu star (bias corrected) | 4.623 |
| Mean (detects) | 2.619 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | |
|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | |
| This is especially true when the sample size is small. | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | |
| Minimum | 0.01 | Mean | 2.246 |
| Maximum | 7.7 | Median | 1.5 |
| SD | 2.849 | CV | 1.269 |
| k hat (MLE) | 0.405 | k star (bias corrected MLE) | 0.327 |
| Theta hat (MLE) | 5.544 | Theta star (bias corrected MLE) | 6.874 |
| nu hat (MLE) | 5.672 | nu star (bias corrected) | 4.574 |
| Adjusted Level of Significance ($\beta$) | 0.0158 | | |

| | | | |
|---|---|---|---|
| Approximate Chi Square Value (4.57, α) | 0.961 | Adjusted Chi Square Value (4.57, β) | 0.558 |
| 95% Gamma Approximate UCL | 10.69 | 95% Gamma Adjusted UCL | 18.41 |

### Estimates of Gamma Parameters using KM Estimates

| | | | |
|---|---|---|---|
| Mean (KM) | 2.247 | SD (KM) | 2.637 |
| Variance (KM) | 6.955 | SE of Mean (KM) | 1.092 |
| k hat (KM) | 0.726 | k star (KM) | 0.51 |
| nu hat (KM) | 10.16 | nu star (KM) | 7.14 |
| theta hat (KM) | 3.096 | theta star (KM) | 4.406 |
| 80% gamma percentile (KM) | 3.693 | 90% gamma percentile (KM) | 6.054 |
| 95% gamma percentile (KM) | 8.571 | 99% gamma percentile (KM) | 14.75 |

### Gamma Kaplan-Meier (KM) Statistics

| | | | |
|---|---|---|---|
| Approximate Chi Square Value (7.14, α) | 2.248 | Adjusted Chi Square Value (7.14, β) | 1.511 |
| 95% KM Approximate Gamma UCL | 7.137 | 95% KM Adjusted Gamma UCL | 10.61 |

### Lognormal GOF Test on Detected Observations Only

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.832 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.273 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Detected Data appear Lognormal at 10% Significance Level | |

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Lognormal ROS Statistics Using Imputed Non-Detects

| | | | |
|---|---|---|---|
| Mean in Original Scale | 2.245 | Mean in Log Scale | -0.911 |
| SD in Original Scale | 2.85 | SD in Log Scale | 2.764 |
| 95% t UCL (assumes normality of ROS data) | 4.339 | 95% Percentile Bootstrap UCL | 3.945 |
| 95% BCA Bootstrap UCL | 4.315 | 95% Bootstrap t UCL | 6.749 |
| 95% H-UCL (Log ROS) | 581433 | | |

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| KM Mean (logged) | -0.754 | KM Geo Mean | 0.471 |
| KM SD (logged) | 2.305 | 95% Critical H Value (KM-Log) | 7.715 |
| KM Standard Error of Mean (logged) | 0.954 | 95% H-UCL (KM -Log) | 9526 |
| KM SD (logged) | 2.305 | 95% Critical H Value (KM-Log) | 7.715 |
| KM Standard Error of Mean (logged) | 0.954 | | |

### DL/2 Statistics

| DL/2 Normal | | DL/2 Log-Transformed | |
|---|---|---|---|
| Mean in Original Scale | 2.246 | Mean in Log Scale | -0.853 |
| SD in Original Scale | 2.85 | SD in Log Scale | 2.658 |
| 95% t UCL (Assumes normality) | 4.339 | 95% H-Stat UCL | 213906 |

DL/2 is not a recommended method, provided for comparisons and historical reasons

### Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

### Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 4.369 | | |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods,

then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Arsenic - MW-22**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 7 | Number of Distinct Observations | 7 |
| Number of Detects | 6 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 6 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.0012 | Minimum Non-Detect | 6.8000E-4 |
| Maximum Detect | 0.017 | Maximum Non-Detect | 6.8000E-4 |
| Variance Detects | 3.1198E-5 | Percent Non-Detects | 14.29% |
| Mean Detects | 0.00638 | SD Detects | 0.00559 |
| Median Detects | 0.0052 | CV Detects | 0.875 |
| Skewness Detects | 1.733 | Kurtosis Detects | 3.531 |
| Mean of Logged Detects | -5.364 | SD of Logged Detects | 0.891 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.833 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.713 | Detected Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.296 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.373 | Detected Data appear Normal at 1% Significance Level |

Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 0.00557 | KM Standard Error of Mean | 0.00212 |
| 90KM SD | 0.00513 | 95% KM (BCA) UCL | 0.00947 |
| 95% KM (t) UCL | 0.00969 | 95% KM (Percentile Bootstrap) UCL | 0.00904 |
| 95% KM (z) UCL | 0.00906 | 95% KM Bootstrap t UCL | 0.0131 |
| 90% KM Chebyshev UCL | 0.0119 | 95% KM Chebyshev UCL | 0.0148 |
| 97.5% KM Chebyshev UCL | 0.0188 | 99% KM Chebyshev UCL | 0.0267 |

### Gamma GOF Tests on Detected Observations Only

| | | |
|---|---|---|
| A-D Test Statistic | 0.227 | **Anderson-Darling GOF Test** |
| 5% A-D Critical Value | 0.706 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.194 | **Kolmogorov-Smirnov GOF** |
| 5% K-S Critical Value | 0.337 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics on Detected Data Only

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.763 | k star (bias corrected MLE) | 0.993 |
| Theta hat (MLE) | 0.00362 | Theta star (bias corrected MLE) | 0.00643 |
| nu hat (MLE) | 21.16 | nu star (bias corrected) | 11.91 |
| Mean (detects) | 0.00638 | | |

### Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

| | | | | |
|---|---|---|---|---|
| Minimum | 0.0012 | | Mean | 0.0069 |
| Maximum | 0.017 | | Median | 0.0057 |
| SD | 0.00528 | | CV | 0.765 |
| k hat (MLE) | 1.942 | | k star (bias corrected MLE) | 1.205 |
| Theta hat (MLE) | 0.00355 | | Theta star (bias corrected MLE) | 0.00573 |
| nu hat (MLE) | 27.19 | | nu star (bias corrected) | 16.87 |
| Adjusted Level of Significance (β) | 0.0158 | | | |
| Approximate Chi Square Value (16.87, α) | 8.578 | | Adjusted Chi Square Value (16.87, β) | 6.87 |
| 95% Gamma Approximate UCL | 0.0136 | | 95% Gamma Adjusted UCL | 0.0169 |

### Estimates of Gamma Parameters using KM Estimates

| | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.00557 | | SD (KM) | 0.00513 |
| Variance (KM) | 2.6267E-5 | | SE of Mean (KM) | 0.00212 |
| k hat (KM) | 1.181 | | k star (KM) | 0.77 |
| nu hat (KM) | 16.53 | | nu star (KM) | 10.78 |
| theta hat (KM) | 0.00472 | | theta star (KM) | 0.00723 |
| 80% gamma percentile (KM) | 0.00912 | | 90% gamma percentile (KM) | 0.0137 |
| 95% gamma percentile (KM) | 0.0183 | | 99% gamma percentile (KM) | 0.0293 |

### Gamma Kaplan-Meier (KM) Statistics

| | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (10.78, α) | 4.433 | | Adjusted Chi Square Value (10.78, β) | 3.291 |
| 95% KM Approximate Gamma UCL | 0.0135 | | 95% KM Adjusted Gamma UCL | 0.0182 |

### Lognormal GOF Test on Detected Observations Only

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.982 | | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.826 | | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.168 | | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.298 | | Detected Data appear Lognormal at 10% Significance Level |

**Detected Data appear Lognormal at 10% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Lognormal ROS Statistics Using Imputed Non-Detects

| | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.00554 | | Mean in Log Scale | -5.683 |
| SD in Original Scale | 0.00556 | | SD in Log Scale | 1.172 |
| 95% t UCL (assumes normality of ROS data) | 0.00963 | | 95% Percentile Bootstrap UCL | 0.00909 |
| 95% BCA Bootstrap UCL | 0.0101 | | 95% Bootstrap t UCL | 0.0128 |
| 95% H-UCL (Log ROS) | 0.0504 | | | |

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -5.639 | | KM Geo Mean | 0.00356 |
| KM SD (logged) | 1.011 | | 95% Critical H Value (KM-Log) | 3.73 |
| KM Standard Error of Mean (logged) | 0.419 | | 95% H-UCL (KM -Log) | 0.0277 |
| KM SD (logged) | 1.011 | | 95% Critical H Value (KM-Log) | 3.73 |
| KM Standard Error of Mean (logged) | 0.419 | | | |

### DL/2 Statistics

| DL/2 Normal | | | DL/2 Log-Transformed | |
|---|---|---|---|---|
| Mean in Original Scale | 0.00552 | | Mean in Log Scale | -5.738 |
| SD in Original Scale | 0.00559 | | SD in Log Scale | 1.282 |
| 95% t UCL (Assumes normality) | 0.00962 | | 95% H-Stat UCL | 0.0782 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

### Nonparametric Distribution Free UCL Statistics

**Detected Data appear Normal Distributed at 1% Significance Level**

### Suggested UCL to Use

| | | | | |
|---|---|---|---|---|
| 95% KM (t) UCL | 0.00969 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Iron - MW-22**

| | | | |
|---|---|---|---|
| Total Number of Observations | 7 | Number of Distinct Observations | 7 |
| Number of Detects | 6 | Number of Non-Detects | 1 |
| Number of Distinct Detects | 6 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.087 | Minimum Non-Detect | 0.08 |
| Maximum Detect | 1.7 | Maximum Non-Detect | 0.08 |
| Variance Detects | 0.361 | Percent Non-Detects | 14.29% |
| Mean Detects | 0.506 | SD Detects | 0.601 |
| Median Detects | 0.325 | CV Detects | 1.187 |
| Skewness Detects | 2.166 | Kurtosis Detects | 4.933 |
| Mean of Logged Detects | -1.149 | SD of Logged Detects | 1.025 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.711 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.713 | Detected Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.371 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.373 | Detected Data appear Normal at 1% Significance Level |
| Detected Data appear Approximate Normal at 1% Significance Level | | |
| Note GOF tests may be unreliable for small sample sizes | | |

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 0.445 | KM Standard Error of Mean | 0.219 |
| 90KM SD | 0.529 | 95% KM (BCA) UCL | 0.863 |
| 95% KM (t) UCL | 0.871 | 95% KM (Percentile Bootstrap) UCL | 0.838 |
| 95% KM (z) UCL | 0.806 | 95% KM Bootstrap t UCL | 1.685 |
| 90% KM Chebyshev UCL | 1.103 | 95% KM Chebyshev UCL | 1.4 |
| 97.5% KM Chebyshev UCL | 1.814 | 99% KM Chebyshev UCL | 2.626 |

### Gamma GOF Tests on Detected Observations Only

| | | |
|---|---|---|
| A-D Test Statistic | 0.382 | **Anderson-Darling GOF Test** |
| 5% A-D Critical Value | 0.712 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.261 | **Kolmogorov-Smirnov GOF** |
| 5% K-S Critical Value | 0.339 | Detected data appear Gamma Distributed at 5% Significance Level |
| Detected data appear Gamma Distributed at 5% Significance Level | | |
| Note GOF tests may be unreliable for small sample sizes | | |

### Gamma Statistics on Detected Data Only

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.207 | k star (bias corrected MLE) | 0.715 |
| Theta hat (MLE) | 0.419 | Theta star (bias corrected MLE) | 0.708 |
| nu hat (MLE) | 14.48 | nu star (bias corrected) | 8.575 |
| Mean (detects) | 0.506 | | |

### Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

| | | | |
|---|---|---|---|
| Minimum | 0.01 | Mean | 0.435 |
| Maximum | 1.7 | Median | 0.26 |
| SD | 0.58 | CV | 1.332 |
| k hat (MLE) | 0.739 | k star (bias corrected MLE) | 0.518 |
| Theta hat (MLE) | 0.589 | Theta star (bias corrected MLE) | 0.841 |
| nu hat (MLE) | 10.35 | nu star (bias corrected) | 7.248 |
| Adjusted Level of Significance (β) | 0.0158 | | |

| | | | |
|---|---|---|---|
| Approximate Chi Square Value (7.25, α) | 2.308 | Adjusted Chi Square Value (7.25, β) | 1.559 |
| 95% Gamma Approximate UCL | 1.367 | 95% Gamma Adjusted UCL | 2.024 |

### Estimates of Gamma Parameters using KM Estimates

| | | | |
|---|---|---|---|
| Mean (KM) | 0.445 | SD (KM) | 0.529 |
| Variance (KM) | 0.28 | SE of Mean (KM) | 0.219 |
| k hat (KM) | 0.708 | k star (KM) | 0.5 |
| nu hat (KM) | 9.91 | nu star (KM) | 6.996 |
| theta hat (KM) | 0.629 | theta star (KM) | 0.891 |
| 80% gamma percentile (KM) | 0.731 | 90% gamma percentile (KM) | 1.205 |
| 95% gamma percentile (KM) | 1.711 | 99% gamma percentile (KM) | 2.955 |

### Gamma Kaplan-Meier (KM) Statistics

| | | | |
|---|---|---|---|
| Approximate Chi Square Value (7.00, α) | 2.169 | Adjusted Chi Square Value (7.00, β) | 1.45 |
| 95% KM Approximate Gamma UCL | 1.437 | 95% KM Adjusted Gamma UCL | 2.149 |

### Lognormal GOF Test on Detected Observations Only

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.968 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.826 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.199 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.298 | Detected Data appear Lognormal at 10% Significance Level | |

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Lognormal ROS Statistics Using Imputed Non-Detects

| | | | |
|---|---|---|---|
| Mean in Original Scale | 0.437 | Mean in Log Scale | -1.519 |
| SD in Original Scale | 0.578 | SD in Log Scale | 1.354 |
| 95% t UCL (assumes normality of ROS data) | 0.862 | 95% Percentile Bootstrap UCL | 0.83 |
| 95% BCA Bootstrap UCL | 0.931 | 95% Bootstrap t UCL | 1.614 |
| 95% H-UCL (Log ROS) | 7.518 | | |

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | |
|---|---|---|---|
| KM Mean (logged) | -1.346 | KM Geo Mean | 0.26 |
| KM SD (logged) | 0.991 | 95% Critical H Value (KM-Log) | 3.674 |
| KM Standard Error of Mean (logged) | 0.411 | 95% H-UCL (KM -Log) | 1.883 |
| KM SD (logged) | 0.991 | 95% Critical H Value (KM-Log) | 3.674 |
| KM Standard Error of Mean (logged) | 0.411 | | |

### DL/2 Statistics

| DL/2 Normal | | DL/2 Log-Transformed | |
|---|---|---|---|
| Mean in Original Scale | 0.44 | Mean in Log Scale | -1.445 |
| SD in Original Scale | 0.576 | SD in Log Scale | 1.22 |
| 95% t UCL (Assumes normality) | 0.863 | 95% H-Stat UCL | 4.299 |

DL/2 is not a recommended method, provided for comparisons and historical reasons

### Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

### Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 0.871 | | |

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods,

then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests,

it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Manganese - MW-22**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 7 | Number of Distinct Observations | 6 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.099 | Mean | 2.714 |
| Maximum | 6.2 | Median | 2.4 |
| SD | 2.106 | Std. Error of Mean | 0.796 |
| Coefficient of Variation | 0.776 | Skewness | 0.4 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.95 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.73 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.16 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.35 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 4.261 | 95% Adjusted-CLT UCL (Chen-1995) | 4.152 |
| | | 95% Modified-t UCL (Johnson-1978) | 4.281 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.416 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.727 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.265 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.319 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.047 | k star (bias corrected MLE) | 0.694 |
| Theta hat (MLE) | 2.591 | Theta star (bias corrected MLE) | 3.912 |
| nu hat (MLE) | 14.66 | nu star (bias corrected) | 9.713 |
| MLE Mean (bias corrected) | 2.714 | MLE Sd (bias corrected) | 3.258 |
| | | Approximate Chi Square Value (0.05) | 3.763 |
| Adjusted Level of Significance | 0.0158 | Adjusted Chi Square Value | 2.733 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 7.005 | 95% Adjusted Gamma UCL | 9.646 |

### Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.843 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.838 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.306 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.28 | Data Not Lognormal at 10% Significance Level | |

Data appear Approximate Lognormal at 10% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -2.313 | Mean of logged Data | 0.45 |
| Maximum of Logged Data | 1.825 | SD of logged Data | 1.454 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 90.22 | | 90% Chebyshev (MVUE) UCL | 9.347 |
| 95% Chebyshev (MVUE) UCL | 11.96 | | 97.5% Chebyshev (MVUE) UCL | 15.59 |
| 99% Chebyshev (MVUE) UCL | 22.72 | | | |

**Nonparametric Distribution Free UCL Statistics**
**Data appear to follow a Discernible Distribution**

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 4.023 | | 95% BCA Bootstrap UCL | 3.943 |
| 95% Standard Bootstrap UCL | 3.939 | | 95% Bootstrap-t UCL | 4.612 |
| 95% Hall's Bootstrap UCL | 4.372 | | 95% Percentile Bootstrap UCL | 3.914 |
| 90% Chebyshev(Mean, Sd) UCL | 5.102 | | 95% Chebyshev(Mean, Sd) UCL | 6.184 |
| 97.5% Chebyshev(Mean, Sd) UCL | 7.685 | | 99% Chebyshev(Mean, Sd) UCL | 10.63 |

| Suggested UCL to Use | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 4.261 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**2,4-D - MW-22**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | | Number of Distinct Observations | 6 |
| Number of Detects | 1 | | Number of Non-Detects | 8 |
| Number of Distinct Detects | 1 | | Number of Distinct Non-Detects | 5 |

**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**
**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**

**The data set for variable 2,4-D was not processed!**

**Dinoseb - MW-22**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 7 | | Number of Distinct Observations | 6 |
| Number of Detects | 1 | | Number of Non-Detects | 6 |
| Number of Distinct Detects | 1 | | Number of Distinct Non-Detects | 5 |

**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**
**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**

**The data set for variable Dinoseb was not processed!**

**Benzene - MW-22**

| | | | |
|---|---|---|---|
| **General Statistics** | | | |
| Total Number of Observations | 9 | Number of Distinct Observations | 1 |
| Number of Detects | 0 | Number of Non-Detects | 9 |
| Number of Distinct Detects | 0 | Number of Distinct Non-Detects | 1 |

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Benzene was not processed!

**Chlorobenzene - MW-22**

| | | | |
|---|---|---|---|
| **General Statistics** | | | |
| Total Number of Observations | 9 | Number of Distinct Observations | 1 |
| Number of Detects | 0 | Number of Non-Detects | 9 |
| Number of Distinct Detects | 0 | Number of Distinct Non-Detects | 1 |

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Chlorobenzene was not processed!

**1,2-DCP - MW-22**

| | | | |
|---|---|---|---|
| **General Statistics** | | | |
| Total Number of Observations | 9 | Number of Distinct Observations | 1 |
| Number of Detects | 0 | Number of Non-Detects | 9 |
| Number of Distinct Detects | 0 | Number of Distinct Non-Detects | 1 |

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-DCP was not processed!

**2-Methylnaphthalene - MW-22**

| | | | |
|---|---|---|---|
| **General Statistics** | | | |
| Total Number of Observations | 9 | Number of Distinct Observations | 2 |
| Number of Detects | 1 | Number of Non-Detects | 8 |
| Number of Distinct Detects | 1 | Number of Distinct Non-Detects | 1 |

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2-Methylnaphthalene was not processed!

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 11/18/2024 9:05:12 AM |
| From File | mw23_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-23**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 13 | Mean | 89.25 |
| Maximum | 160 | Median | 92 |
| SD | 76.51 | Std. Error of Mean | 38.26 |
| Coefficient of Variation | 0.857 | Skewness | -0.0501 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.826 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.286 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 179.3 | 95% Adjusted-CLT UCL (Chen-1995) | 151.2 |
| | | 95% Modified-t UCL (Johnson-1978) | 179.1 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.443 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.664 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.323 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.401 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 1.259 | k star (bias corrected MLE) | 0.481 |
| Theta hat (MLE) | 70.91 | Theta star (bias corrected MLE) | 185.4 |
| nu hat (MLE) | 10.07 | nu star (bias corrected) | 3.851 |
| MLE Mean (bias corrected) | 89.25 | MLE Sd (bias corrected) | 128.6 |
| | | Approximate Chi Square Value (0.05) | 0.664 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 517.9 | 95% Adjusted Gamma UCL | N/A |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.875 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.286 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | 2.565 | Mean of logged Data | 4.044 |
| Maximum of Logged Data | 5.075 | SD of logged Data | 1.218 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 34794 | 90% Chebyshev (MVUE) UCL | 249.7 |
| 95% Chebyshev (MVUE) UCL | 319.9 | 97.5% Chebyshev (MVUE) UCL | 417.5 |
| 99% Chebyshev (MVUE) UCL | 609 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 152.2 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 204 | 95% Chebyshev(Mean, Sd) UCL | 256 |
| 97.5% Chebyshev(Mean, Sd) UCL | 328.2 | 99% Chebyshev(Mean, Sd) UCL | 469.9 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 179.3 | | |
| **Recommended UCL exceeds the maximum observation** | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

| Nitrite - MW-23 | | | | |
|---|---|---|---|---|

### General Statistics

| | | | | |
|---|---|---|---|---|
| Total Number of Observations | 4 | | Number of Distinct Observations | 4 |
| | | | Number of Missing Observations | 0 |
| Minimum | 0.025 | | Mean | 0.411 |
| Maximum | 0.91 | | Median | 0.354 |
| SD | 0.435 | | Std. Error of Mean | 0.218 |
| Coefficient of Variation | 1.059 | | Skewness | 0.314 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.873 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.285 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |
| **Data appear Normal at 1% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.923 | 95% Adjusted-CLT UCL (Chen-1995) | 0.805 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.928 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.4 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.672 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.285 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.406 | Detected data appear Gamma Distributed at 5% Significance Level | |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.717 | k star (bias corrected MLE) | 0.346 |
| Theta hat (MLE) | 0.573 | Theta star (bias corrected MLE) | 1.187 |
| nu hat (MLE) | 5.738 | nu star (bias corrected) | 2.768 |
| MLE Mean (bias corrected) | 0.411 | MLE Sd (bias corrected) | 0.698 |
| | | Approximate Chi Square Value (0.05) | 0.307 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 3.702 | 95% Adjusted Gamma UCL | N/A |

### Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.892 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.27 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.689 | Mean of logged Data | -1.729 |
| Maximum of Logged Data | -0.0943 | SD of logged Data | 1.74 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 77374 | | 90% Chebyshev (MVUE) UCL | 1.432 |
| 95% Chebyshev (MVUE) UCL | 1.873 | | 97.5% Chebyshev (MVUE) UCL | 2.484 |
| 99% Chebyshev (MVUE) UCL | 3.685 | | | |

| Nonparametric Distribution Free UCL Statistics |
|---|
| Data appear to follow a Discernible Distribution |

| Nonparametric Distribution Free UCLs | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 0.769 | | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 1.063 | | 95% Chebyshev(Mean, Sd) UCL | 1.359 |
| 97.5% Chebyshev(Mean, Sd) UCL | 1.77 | | 99% Chebyshev(Mean, Sd) UCL | 2.576 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 0.923 | | |
| Recommended UCL exceeds the maximum observation | | | |

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**

**Please verify the data were collected from random locations.**

**If the data were collected using judgmental or other non-random methods,**

**then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Arsenic - MW-23**

## General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0056 | Mean | 0.008 |
| Maximum | 0.013 | Median | 0.0067 |
| SD | 0.00338 | Std. Error of Mean | 0.00169 |
| Coefficient of Variation | 0.423 | Skewness | 1.828 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

## Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.784 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.366 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level |

Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

## Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.012 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0124 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0122 |

## Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.53 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.658 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.359 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.395 | Detected data appear Gamma Distributed at 5% Significance Level |

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

## Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 8.941 | k star (bias corrected MLE) | 2.402 |
| Theta hat (MLE) | 8.9471E-4 | Theta star (bias corrected MLE) | 0.00333 |
| nu hat (MLE) | 71.53 | nu star (bias corrected) | 19.22 |
| MLE Mean (bias corrected) | 0.008 | MLE Sd (bias corrected) | 0.00516 |
| | | Approximate Chi Square Value (0.05) | 10.28 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

## Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.015 | 95% Adjusted Gamma UCL | N/A |

## Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.844 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.331 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level |

Data appear Lognormal at 10% Significance Level
Note GOF tests may be unreliable for small sample sizes

## Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -5.185 | Mean of logged Data | -4.885 |
| Maximum of Logged Data | -4.343 | SD of logged Data | 0.373 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 0.0157 | | 90% Chebyshev (MVUE) UCL | 0.0124 |
| 95% Chebyshev (MVUE) UCL | 0.0144 | | 97.5% Chebyshev (MVUE) UCL | 0.0171 |
| 99% Chebyshev (MVUE) UCL | 0.0226 | | | |

### Nonparametric Distribution Free UCL Statistics
### Data appear to follow a Discernible Distribution

### Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 0.0108 | | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0131 | | 95% Chebyshev(Mean, Sd) UCL | 0.0154 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0186 | | 99% Chebyshev(Mean, Sd) UCL | 0.0248 |

### Suggested UCL to Use

| | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 0.012 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Iron - MW-23**

| | | | | |
|---|---|---|---|---|
| | | **General Statistics** | | |
| Total Number of Observations | 4 | | Number of Distinct Observations | 4 |
| Number of Detects | 3 | | Number of Non-Detects | 1 |
| Number of Distinct Detects | 3 | | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.17 | | Minimum Non-Detect | 0.08 |
| Maximum Detect | 0.25 | | Maximum Non-Detect | 0.08 |
| Variance Detects | 0.00163 | | Percent Non-Detects | 25% |
| Mean Detects | 0.207 | | SD Detects | 0.0404 |
| Median Detects | 0.2 | | CV Detects | 0.196 |
| Skewness Detects | 0.722 | | Kurtosis Detects | N/A |
| Mean of Logged Detects | -1.589 | | SD of Logged Detects | 0.194 |

**Warning: Data set has only 3 Detected Values.**

**This is not enough to compute meaningful or reliable statistics and estimates.**

**Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,**
**refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,**
**but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).**
**The Chebyshev UCL often results in gross overestimates of the mean.**
**Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.**

| | | | |
|---|---|---|---|
| | | **Normal GOF Test on Detects Only** | |
| Shapiro Wilk Test Statistic | 0.98 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.753 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.232 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.429 | Detected Data appear Normal at 1% Significance Level | |

**Detected Data appear Normal at 1% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| | | | |
|---|---|---|---|
| | | **Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs** | |
| KM Mean | 0.175 | KM Standard Error of Mean | 0.0379 |
| 90KM SD | 0.0618 | 95% KM (BCA) UCL | N/A |
| 95% KM (t) UCL | 0.264 | 95% KM (Percentile Bootstrap) UCL | N/A |
| 95% KM (z) UCL | 0.237 | 95% KM Bootstrap t UCL | N/A |
| 90% KM Chebyshev UCL | 0.289 | 95% KM Chebyshev UCL | 0.34 |
| 97.5% KM Chebyshev UCL | 0.412 | 99% KM Chebyshev UCL | 0.552 |

| | | | |
|---|---|---|---|
| | | **Gamma GOF Tests on Detected Observations Only** | |
| A-D Test Statistic | 0.262 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.634 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.235 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.431 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected Data Not Gamma Distributed at 5% Significance Level**

| | | | |
|---|---|---|---|
| | | **Gamma Statistics on Detected Data Only** | |
| k hat (MLE) | 39.91 | k star (bias corrected MLE) | N/A |
| Theta hat (MLE) | 0.00518 | Theta star (bias corrected MLE) | N/A |
| nu hat (MLE) | 239.4 | nu star (bias corrected) | N/A |
| Mean (detects) | 0.207 | | |

**Gamma ROS Statistics using Imputed Non-Detects**

**GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs**

**GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)**

**For such situations, GROS method may yield incorrect values of UCLs and BTVs**

**This is especially true when the sample size is small.**

**For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates**

| | | | | |
|---|---|---|---|---|
| Minimum | 0.0995 | | Mean | 0.18 |
| Maximum | 0.25 | | Median | 0.185 |
| SD | 0.063 | | CV | 0.35 |
| k hat (MLE) | 9.53 | | k star (bias corrected MLE) | 2.549 |
| Theta hat (MLE) | 0.0189 | | Theta star (bias corrected MLE) | 0.0706 |
| nu hat (MLE) | 76.24 | | nu star (bias corrected) | 20.39 |
| Adjusted Level of Significance (β) | 0.00498 | | | |
| Approximate Chi Square Value (20.39, α) | 11.14 | | Adjusted Chi Square Value (20.39, β) | N/A |
| 95% Gamma Approximate UCL | 0.329 | | 95% Gamma Adjusted UCL | N/A |

### Estimates of Gamma Parameters using KM Estimates

| | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.175 | | SD (KM) | 0.0618 |
| Variance (KM) | 0.00383 | | SE of Mean (KM) | 0.0379 |
| k hat (KM) | 8.007 | | k star (KM) | 2.168 |
| nu hat (KM) | 64.05 | | nu star (KM) | 17.35 |
| theta hat (KM) | 0.0219 | | theta star (KM) | 0.0807 |
| 80% gamma percentile (KM) | 0.26 | | 90% gamma percentile (KM) | 0.334 |
| 95% gamma percentile (KM) | 0.405 | | 99% gamma percentile (KM) | 0.561 |

### Gamma Kaplan-Meier (KM) Statistics

| | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (17.35, α) | 8.92 | | Adjusted Chi Square Value (17.35, β) | 5.89 |
| 95% KM Approximate Gamma UCL | 0.34 | | 95% KM Adjusted Gamma UCL | 0.515 |

### Lognormal GOF Test on Detected Observations Only

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.992 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.789 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.208 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.389 | Detected Data appear Lognormal at 10% Significance Level |

**Detected Data appear Lognormal at 10% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

### Lognormal ROS Statistics Using Imputed Non-Detects

| | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.184 | | Mean in Log Scale | -1.728 |
| SD in Original Scale | 0.0556 | | SD in Log Scale | 0.319 |
| 95% t UCL (assumes normality of ROS data) | 0.25 | | 95% Percentile Bootstrap UCL | N/A |
| 95% BCA Bootstrap UCL | N/A | | 95% Bootstrap t UCL | N/A |
| 95% H-UCL (Log ROS) | 0.316 | | | |

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

| | | | | |
|---|---|---|---|---|
| KM Mean (logged) | -1.823 | | KM Geo Mean | 0.161 |
| KM SD (logged) | 0.428 | | 95% Critical H Value (KM-Log) | 3.302 |
| KM Standard Error of Mean (logged) | 0.262 | | 95% H-UCL (KM -Log) | 0.4 |
| KM SD (logged) | 0.428 | | 95% Critical H Value (KM-Log) | 3.302 |
| KM Standard Error of Mean (logged) | 0.262 | | | |

### DL/2 Statistics

| DL/2 Normal | | | DL/2 Log-Transformed | |
|---|---|---|---|---|
| Mean in Original Scale | 0.165 | | Mean in Log Scale | -1.997 |
| SD in Original Scale | 0.0896 | | SD in Log Scale | 0.83 |
| 95% t UCL (Assumes normality) | 0.27 | | 95% H-Stat UCL | 2.805 |

**DL/2 is not a recommended method, provided for comparisons and historical reasons**

### Nonparametric Distribution Free UCL Statistics

**Detected Data appear Normal Distributed at 1% Significance Level**

### Suggested UCL to Use

| | | | |
|---|---|---|---|
| 95% KM (t) UCL | 0.264 | | |

**Warning: Recommended UCL exceeds the maximum observation**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Manganese - MW-23**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.03 | Mean | 0.535 |
| Maximum | 1.2 | Median | 0.456 |
| SD | 0.597 | Std. Error of Mean | 0.299 |
| Coefficient of Variation | 1.116 | Skewness | 0.243 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.837 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.301 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 1.238 | 95% Adjusted-CLT UCL (Chen-1995) | 1.065 |
| | | 95% Modified-t UCL (Johnson-1978) | 1.244 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.589 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.678 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.339 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.409 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data appear Gamma Distributed at 5% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.564 | k star (bias corrected MLE) | 0.308 |
| Theta hat (MLE) | 0.95 | Theta star (bias corrected MLE) | 1.74 |
| nu hat (MLE) | 4.509 | nu star (bias corrected) | 2.461 |
| MLE Mean (bias corrected) | 0.535 | MLE Sd (bias corrected) | 0.965 |
| | | Approximate Chi Square Value (0.05) | 0.232 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 5.668 | 95% Adjusted Gamma UCL | N/A |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.772 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.792 | Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.304 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.346 | Data appear Lognormal at 10% Significance Level |
| **Data appear Approximate Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.507 | Mean of logged Data | -1.731 |
| Maximum of Logged Data | 0.182 | SD of logged Data | 2.035 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 8926739 | 90% Chebyshev (MVUE) UCL | 2.033 |
| 95% Chebyshev (MVUE) UCL | 2.676 | 97.5% Chebyshev (MVUE) UCL | 3.569 |
| 99% Chebyshev (MVUE) UCL | 5.323 | | |

**Nonparametric Distribution Free UCL Statistics**
**Data appear to follow a Discernible Distribution**

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 1.026 | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 1.431 | 95% Chebyshev(Mean, Sd) UCL | 1.837 |
| 97.5% Chebyshev(Mean, Sd) UCL | 2.4 | 99% Chebyshev(Mean, Sd) UCL | 3.507 |

**Suggested UCL to Use**

| | | | |
|---|---|---|---|
| 95% Student's-t UCL | 1.238 | | |

**Recommended UCL exceeds the maximum observation**

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.**
**Please verify the data were collected from random locations.**
**If the data were collected using judgmental or other non-random methods,**
**then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Dinoseb - MW-23**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 4 | Number of Distinct Observations | 4 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0013 | Mean | 0.00925 |
| Maximum | 0.017 | Median | 0.00935 |
| SD | 0.00643 | Std. Error of Mean | 0.00322 |
| Coefficient of Variation | 0.695 | Skewness | -0.092 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.976 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.687 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.216 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.413 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**
Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
|---|---|---|---|
| 95% Student's-t UCL | 0.0168 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0144 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.0168 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.391 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.662 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.324 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.399 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.643 | k star (bias corrected MLE) | 0.577 |
| Theta hat (MLE) | 0.00563 | Theta star (bias corrected MLE) | 0.016 |
| nu hat (MLE) | 13.14 | nu star (bias corrected) | 4.619 |
| MLE Mean (bias corrected) | 0.00925 | MLE Sd (bias corrected) | 0.0122 |
| | | Approximate Chi Square Value (0.05) | 0.98 |
| Adjusted Level of Significance | N/A | Adjusted Chi Square Value | N/A |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0436 | 95% Adjusted Gamma UCL | N/A |

### Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.847 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.792 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.346 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.346 | Data Not Lognormal at 10% Significance Level | |

**Data appear Approximate Lognormal at 10% Significance Level**
Note GOF tests may be unreliable for small sample sizes

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -6.645 | Mean of logged Data | -5.017 |
| Maximum of Logged Data | -4.075 | SD of logged Data | 1.123 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 1.56 | | 90% Chebyshev (MVUE) UCL | 0.0259 |
| 95% Chebyshev (MVUE) UCL | 0.0331 | | 97.5% Chebyshev (MVUE) UCL | 0.0429 |
| 99% Chebyshev (MVUE) UCL | 0.0623 | | | |

### Nonparametric Distribution Free UCL Statistics
### Data appear to follow a Discernible Distribution

### Nonparametric Distribution Free UCLs

| | | | | |
|---|---|---|---|---|
| 95% CLT UCL | 0.0145 | | 95% BCA Bootstrap UCL | N/A |
| 95% Standard Bootstrap UCL | N/A | | 95% Bootstrap-t UCL | N/A |
| 95% Hall's Bootstrap UCL | N/A | | 95% Percentile Bootstrap UCL | N/A |
| 90% Chebyshev(Mean, Sd) UCL | 0.0189 | | 95% Chebyshev(Mean, Sd) UCL | 0.0233 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0293 | | 99% Chebyshev(Mean, Sd) UCL | 0.0413 |

### Suggested UCL to Use

| | | | | |
|---|---|---|---|---|
| 95% Student's-t UCL | 0.0168 | | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

### Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
### reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

**1,2-DCP - MW-23**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.027 | Mean | 0.112 |
| Maximum | 0.24 | Median | 0.053 |
| SD | 0.0883 | Std. Error of Mean | 0.0294 |
| Coefficient of Variation | 0.787 | Skewness | 0.432 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.814 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.304 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.167 | 95% Adjusted-CLT UCL (Chen-1995) | 0.165 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.168 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.774 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.733 | Data Not Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.275 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.284 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data follow Appr. Gamma Distribution at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.651 | k star (bias corrected MLE) | 1.175 |
| Theta hat (MLE) | 0.068 | Theta star (bias corrected MLE) | 0.0955 |
| nu hat (MLE) | 29.71 | nu star (bias corrected) | 21.14 |
| MLE Mean (bias corrected) | 0.112 | MLE Sd (bias corrected) | 0.104 |
| | | Approximate Chi Square Value (0.05) | 11.7 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 10.25 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.203 | 95% Adjusted Gamma UCL | 0.232 |

### Lognormal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.844 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data Not Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.243 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |

Data appear Approximate Lognormal at 10% Significance Level
Note GOF tests may be unreliable for small sample sizes

### Lognormal Statistics

| | | | |
|---|---|---|---|
| Minimum of Logged Data | -3.612 | Mean of logged Data | -2.52 |
| Maximum of Logged Data | -1.427 | SD of logged Data | 0.894 |

| Assuming Lognormal Distribution | | | | |
|---|---|---|---|---|
| 95% H-UCL | 0.311 | | 90% Chebyshev (MVUE) UCL | 0.218 |
| 95% Chebyshev (MVUE) UCL | 0.266 | | 97.5% Chebyshev (MVUE) UCL | 0.331 |
| 99% Chebyshev (MVUE) UCL | 0.461 | | | |

### Nonparametric Distribution Free UCL Statistics
### Data appear to follow a Discernible Distribution

### Nonparametric Distribution Free UCLs

| 95% CLT UCL | 0.161 | | 95% BCA Bootstrap UCL | 0.161 |
|---|---|---|---|---|
| 95% Standard Bootstrap UCL | 0.158 | | 95% Bootstrap-t UCL | 0.176 |
| 95% Hall's Bootstrap UCL | 0.146 | | 95% Percentile Bootstrap UCL | 0.158 |
| 90% Chebyshev(Mean, Sd) UCL | 0.201 | | 95% Chebyshev(Mean, Sd) UCL | 0.241 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.296 | | 99% Chebyshev(Mean, Sd) UCL | 0.405 |

### Suggested UCL to Use

| 95% Student's-t UCL | 0.167 | | |
|---|---|---|---|

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

| UCL Statistics for Data Sets with Non-Detects | | |
|---|---|---|

| User Selected Options | |
|---|---|
| Date/Time of Computation | ProUCL 5.2 11/13/2024 2:45:45 PM |
| From File | mw24_3year_data.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Nitrate - MW-24**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 7.7 | Mean | 32.3 |
| Maximum | 51 | Median | 35 |
| SD | 11.85 | Std. Error of Mean | 3.949 |
| Coefficient of Variation | 0.367 | Skewness | -0.813 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.927 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.19 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level |
| **Data appear Normal at 1% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 39.64 | 95% Adjusted-CLT UCL (Chen-1995) | 37.65 |
| | | 95% Modified-t UCL (Johnson-1978) | 39.46 |

| Gamma GOF Test | | |
|---|---|---|
| A-D Test Statistic | 0.789 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.723 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.244 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.28 | Detected data appear Gamma Distributed at 5% Significance Level |
| **Detected data follow Appr. Gamma Distribution at 5% Significance Level** | | |
| Note GOF tests may be unreliable for small sample sizes | | |

| Gamma Statistics | | | | |
|---|---|---|---|---|
| k hat (MLE) | 5.289 | k star (bias corrected MLE) | 3.6 |
| Theta hat (MLE) | 6.107 | Theta star (bias corrected MLE) | 8.973 |
| nu hat (MLE) | 95.19 | nu star (bias corrected) | 64.8 |
| MLE Mean (bias corrected) | 32.3 | MLE Sd (bias corrected) | 17.02 |
| | | Approximate Chi Square Value (0.05) | 47.28 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 44.14 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 44.27 | 95% Adjusted Gamma UCL | 47.42 |

| Lognormal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.75 | **Shapiro Wilk Lognormal GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.859 | Data Not Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.27 | **Lilliefors Lognormal GOF Test** |
| 10% Lilliefors Critical Value | 0.252 | Data Not Lognormal at 10% Significance Level |

**Data Not Lognormal at 10% Significance Level**

| Lognormal Statistics | | | |
|---|---|---|---|
| Minimum of Logged Data | 2.041 | Mean of logged Data | 3.378 |
| Maximum of Logged Data | 3.932 | SD of logged Data | 0.542 |

| Assuming Lognormal Distribution | | | |
|---|---|---|---|
| 95% H-UCL | 52.74 | 90% Chebyshev (MVUE) UCL | 51.69 |
| 95% Chebyshev (MVUE) UCL | 60 | 97.5% Chebyshev (MVUE) UCL | 71.54 |
| 99% Chebyshev (MVUE) UCL | 94.22 | | |

**Nonparametric Distribution Free UCL Statistics**

**Data appear to follow a Discernible Distribution**

| Nonparametric Distribution Free UCLs | | | |
|---|---|---|---|
| 95% CLT UCL | 38.8 | 95% BCA Bootstrap UCL | 37.56 |
| 95% Standard Bootstrap UCL | 38.32 | 95% Bootstrap-t UCL | 38.45 |
| 95% Hall's Bootstrap UCL | 38.52 | 95% Percentile Bootstrap UCL | 38 |
| 90% Chebyshev(Mean, Sd) UCL | 44.15 | 95% Chebyshev(Mean, Sd) UCL | 49.51 |
| 97.5% Chebyshev(Mean, Sd) UCL | 56.96 | 99% Chebyshev(Mean, Sd) UCL | 71.59 |

| Suggested UCL to Use | | | |
|---|---|---|---|
| 95% Student's-t UCL | 39.64 | | |

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**

**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**

| Nitrite - MW-24 | | | | |
|---|---|---|---|---|

### General Statistics

| | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 6 | |
| Number of Detects | 5 | Number of Non-Detects | 4 | |
| Number of Distinct Detects | 5 | Number of Distinct Non-Detects | 1 | |
| Minimum Detect | 0.018 | Minimum Non-Detect | 0.015 | |
| Maximum Detect | 0.062 | Maximum Non-Detect | 0.015 | |
| Variance Detects | 3.3500E-4 | Percent Non-Detects | 44.44% | |
| Mean Detects | 0.035 | SD Detects | 0.0183 | |
| Median Detects | 0.031 | CV Detects | 0.523 | |
| Skewness Detects | 0.82 | Kurtosis Detects | -0.511 | |
| Mean of Logged Detects | -3.461 | SD of Logged Detects | 0.522 | |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test on Detects Only

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.916 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.686 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.194 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.396 | Detected Data appear Normal at 1% Significance Level | |

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

| | | | |
|---|---|---|---|
| KM Mean | 0.0261 | KM Standard Error of Mean | 0.00586 |
| 90KM SD | 0.0157 | 95% KM (BCA) UCL | 0.0351 |
| 95% KM (t) UCL | 0.037 | 95% KM (Percentile Bootstrap) UCL | 0.0352 |
| 95% KM (z) UCL | 0.0358 | 95% KM Bootstrap t UCL | 0.0416 |
| 90% KM Chebyshev UCL | 0.0437 | 95% KM Chebyshev UCL | 0.0517 |
| 97.5% KM Chebyshev UCL | 0.0627 | 99% KM Chebyshev UCL | 0.0845 |

### Gamma GOF Tests on Detected Observations Only

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.277 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.681 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.23 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.358 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 4.745 | k star (bias corrected MLE) | | 2.031 |
| Theta hat (MLE) | 0.00738 | Theta star (bias corrected MLE) | | 0.0172 |
| nu hat (MLE) | 47.45 | nu star (bias corrected) | | 20.31 |
| Mean (detects) | 0.035 | | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.01 | Mean | | 0.0239 |
| Maximum | 0.062 | Median | | 0.018 |
| SD | 0.0185 | CV | | 0.773 |
| k hat (MLE) | 2.276 | k star (bias corrected MLE) | | 1.592 |
| Theta hat (MLE) | 0.0105 | Theta star (bias corrected MLE) | | 0.015 |
| nu hat (MLE) | 40.98 | nu star (bias corrected) | | 28.65 |
| Adjusted Level of Significance ($\beta$) | 0.0231 | | | |
| Approximate Chi Square Value (28.65, $\alpha$) | 17.43 | Adjusted Chi Square Value (28.65, $\beta$) | | 15.62 |
| 95% Gamma Approximate UCL | 0.0393 | 95% Gamma Adjusted UCL | | 0.0438 |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.0261 | SD (KM) | | 0.0157 |
| Variance (KM) | 2.4765E-4 | SE of Mean (KM) | | 0.00586 |
| k hat (KM) | 2.753 | k star (KM) | | 1.909 |
| nu hat (KM) | 49.55 | nu star (KM) | | 34.37 |
| theta hat (KM) | 0.00948 | theta star (KM) | | 0.0137 |
| 80% gamma percentile (KM) | 0.0393 | 90% gamma percentile (KM) | | 0.0513 |
| 95% gamma percentile (KM) | 0.0629 | 99% gamma percentile (KM) | | 0.0885 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (34.37, $\alpha$) | 21.96 | Adjusted Chi Square Value (34.37, $\beta$) | | 19.89 |
| 95% KM Approximate Gamma UCL | 0.0409 | 95% KM Adjusted Gamma UCL | | 0.0451 |

| Lognormal GOF Test on Detected Observations Only | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.94 | **Shapiro Wilk GOF Test** |
| 10% Shapiro Wilk Critical Value | 0.806 | Detected Data appear Lognormal at 10% Significance Level |
| Lilliefors Test Statistic | 0.206 | **Lilliefors GOF Test** |
| 10% Lilliefors Critical Value | 0.319 | Detected Data appear Lognormal at 10% Significance Level |
| **Detected Data appear Lognormal at 10% Significance Level** | | |
| **Note GOF tests may be unreliable for small sample sizes** | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| Mean in Original Scale | 0.0226 | | Mean in Log Scale | -4.157 |
| SD in Original Scale | 0.0197 | | SD in Log Scale | 0.945 |
| 95% t UCL (assumes normality of ROS data) | 0.0348 | | 95% Percentile Bootstrap UCL | 0.0332 |
| 95% BCA Bootstrap UCL | 0.0349 | | 95% Bootstrap t UCL | 0.042 |
| 95% H-UCL (Log ROS) | 0.0693 | | | |
| | | | | |
| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | |
| KM Mean (logged) | -3.79 | | KM Geo Mean | 0.0226 |
| KM SD (logged) | 0.506 | | 95% Critical H Value (KM-Log) | 2.236 |
| KM Standard Error of Mean (logged) | 0.188 | | 95% H-UCL (KM -Log) | 0.0383 |
| KM SD (logged) | 0.506 | | 95% Critical H Value (KM-Log) | 2.236 |
| KM Standard Error of Mean (logged) | 0.188 | | | |
| | | | | |
| DL/2 Statistics | | | | |
| DL/2 Normal | | | DL/2 Log-Transformed | |
| Mean in Original Scale | 0.0228 | | Mean in Log Scale | -4.098 |
| SD in Original Scale | 0.0194 | | SD in Log Scale | 0.84 |
| 95% t UCL (Assumes normality) | 0.0348 | | 95% H-Stat UCL | 0.0558 |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | |
| | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | |
| | | | | |
| Suggested UCL to Use | | | | |
| 95% KM (t) UCL | 0.037 | | | |
| | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | |
| | | | | |

**Arsenic - MW-24**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.006 | Mean | 0.00768 |
| Maximum | 0.009 | Median | 0.008 |
| SD | 0.00103 | Std. Error of Mean | 3.4391E-4 |
| Coefficient of Variation | 0.134 | Skewness | -0.491 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

### Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.933 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.178 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.00832 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00818 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.00831 |

### Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.377 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.72 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.197 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.279 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 59.46 | k star (bias corrected MLE) | 39.72 |
| Theta hat (MLE) | 1.2912E-4 | Theta star (bias corrected MLE) | 1.9332E-4 |
| nu hat (MLE) | 1070 | nu star (bias corrected) | 714.9 |
| MLE Mean (bias corrected) | 0.00768 | MLE Sd (bias corrected) | 0.00122 |
| | | Approximate Chi Square Value (0.05) | 653.8 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 641.5 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.00839 | 95% Adjusted Gamma UCL | 0.00856 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.92 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.194 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -5.116 | Mean of logged Data | -4.878 |
| Maximum of Logged Data | -4.711 | SD of logged Data | 0.139 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.00842 | 90% Chebyshev (MVUE) UCL | 0.00875 |
| 95% Chebyshev (MVUE) UCL | 0.00924 | 97.5% Chebyshev (MVUE) UCL | 0.00991 |
| 99% Chebyshev (MVUE) UCL | 0.0112 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.00824 | 95% BCA Bootstrap UCL | 0.00818 |
| 95% Standard Bootstrap UCL | 0.00822 | 95% Bootstrap-t UCL | 0.00827 |
| 95% Hall's Bootstrap UCL | 0.00815 | 95% Percentile Bootstrap UCL | 0.00822 |
| 90% Chebyshev(Mean, Sd) UCL | 0.00871 | 95% Chebyshev(Mean, Sd) UCL | 0.00918 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.00983 | 99% Chebyshev(Mean, Sd) UCL | 0.0111 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.00832 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |
| | | | |

**Iron - MW-24**

| | | | |
|---|---|---|---|
| | | | |

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| Number of Detects | 7 | Number of Non-Detects | 2 |
| Number of Distinct Detects | 7 | Number of Distinct Non-Detects | 1 |
| Minimum Detect | 0.026 | Minimum Non-Detect | 0.08 |
| Maximum Detect | 0.25 | Maximum Non-Detect | 0.08 |
| Variance Detects | 0.00525 | Percent Non-Detects | 22.22% |
| Mean Detects | 0.113 | SD Detects | 0.0725 |
| Median Detects | 0.11 | CV Detects | 0.641 |
| Skewness Detects | 1.06 | Kurtosis Detects | 1.681 |
| Mean of Logged Detects | -2.377 | SD of Logged Detects | 0.723 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test on Detects Only | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.931 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.73 | Detected Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.213 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.35 | Detected Data appear Normal at 1% Significance Level | |
| Detected Data appear Normal at 1% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs | | | |
|---|---|---|---|
| KM Mean | 0.1 | KM Standard Error of Mean | 0.0238 |
| 90KM SD | 0.0648 | 95% KM (BCA) UCL | 0.14 |
| 95% KM (t) UCL | 0.144 | 95% KM (Percentile Bootstrap) UCL | 0.14 |
| 95% KM (z) UCL | 0.139 | 95% KM Bootstrap t UCL | 0.158 |
| 90% KM Chebyshev UCL | 0.171 | 95% KM Chebyshev UCL | 0.204 |
| 97.5% KM Chebyshev UCL | 0.248 | 99% KM Chebyshev UCL | 0.336 |

| Gamma GOF Tests on Detected Observations Only | | | |
|---|---|---|---|
| A-D Test Statistic | 0.182 | **Anderson-Darling GOF Test** | |
| 5% A-D Critical Value | 0.713 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.144 | **Kolmogorov-Smirnov GOF** | |
| 5% K-S Critical Value | 0.314 | Detected data appear Gamma Distributed at 5% Significance Level | |
| Detected data appear Gamma Distributed at 5% Significance Level | | | |
| Note GOF tests may be unreliable for small sample sizes | | | |

| Gamma Statistics on Detected Data Only | | | | |
|---|---|---|---|---|
| k hat (MLE) | 2.686 | k star (bias corrected MLE) | 1.63 |
| Theta hat (MLE) | 0.0421 | Theta star (bias corrected MLE) | 0.0694 |
| nu hat (MLE) | 37.6 | nu star (bias corrected) | 22.82 |
| Mean (detects) | 0.113 | | |

| Gamma ROS Statistics using Imputed Non-Detects | | | | |
|---|---|---|---|---|
| GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | |
| GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20) | | | | |
| For such situations, GROS method may yield incorrect values of UCLs and BTVs | | | | |
| This is especially true when the sample size is small. | | | | |
| For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | |
| Minimum | 0.026 | Mean | 0.0987 |
| Maximum | 0.25 | Median | 0.075 |
| SD | 0.0694 | CV | 0.703 |
| k hat (MLE) | 2.431 | k star (bias corrected MLE) | 1.695 |
| Theta hat (MLE) | 0.0406 | Theta star (bias corrected MLE) | 0.0583 |
| nu hat (MLE) | 43.75 | nu star (bias corrected) | 30.5 |
| Adjusted Level of Significance (β) | 0.0231 | | |
| Approximate Chi Square Value (30.50, α) | 18.89 | Adjusted Chi Square Value (30.50, β) | 16.99 |
| 95% Gamma Approximate UCL | 0.159 | 95% Gamma Adjusted UCL | 0.177 |

| Estimates of Gamma Parameters using KM Estimates | | | | |
|---|---|---|---|---|
| Mean (KM) | 0.1 | SD (KM) | 0.0648 |
| Variance (KM) | 0.0042 | SE of Mean (KM) | 0.0238 |
| k hat (KM) | 2.381 | k star (KM) | 1.661 |
| nu hat (KM) | 42.85 | nu star (KM) | 29.9 |
| theta hat (KM) | 0.042 | theta star (KM) | 0.0602 |
| 80% gamma percentile (KM) | 0.153 | 90% gamma percentile (KM) | 0.203 |
| 95% gamma percentile (KM) | 0.252 | 99% gamma percentile (KM) | 0.361 |

| Gamma Kaplan-Meier (KM) Statistics | | | | |
|---|---|---|---|---|
| Approximate Chi Square Value (29.90, α) | 18.42 | Adjusted Chi Square Value (29.90, β) | 16.54 |
| 95% KM Approximate Gamma UCL | 0.162 | 95% KM Adjusted Gamma UCL | 0.181 |

| Lognormal GOF Test on Detected Observations Only | | | | |
|---|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.966 | **Shapiro Wilk GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.838 | Detected Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.164 | **Lilliefors GOF Test** | |
| 10% Lilliefors Critical Value | 0.28 | Detected Data appear Lognormal at 10% Significance Level | |
| **Detected Data appear Lognormal at 10% Significance Level** | | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | | |

| Lognormal ROS Statistics Using Imputed Non-Detects | | | | | |
|---|---|---|---|---|---|
| Mean in Original Scale | 0.0989 | | Mean in Log Scale | -2.523 | |
| SD in Original Scale | 0.069 | | SD in Log Scale | 0.7 | |
| 95% t UCL (assumes normality of ROS data) | 0.142 | | 95% Percentile Bootstrap UCL | 0.137 | |
| 95% BCA Bootstrap UCL | 0.145 | | 95% Bootstrap t UCL | 0.162 | |
| 95% H-UCL (Log ROS) | 0.196 | | | | |
| | | | | | |
| Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution | | | | | |
| KM Mean (logged) | -2.518 | | KM Geo Mean | 0.0806 | |
| KM SD (logged) | 0.682 | | 95% Critical H Value (KM-Log) | 2.588 | |
| KM Standard Error of Mean (logged) | 0.265 | | 95% H-UCL (KM -Log) | 0.19 | |
| KM SD (logged) | 0.682 | | 95% Critical H Value (KM-Log) | 2.588 | |
| KM Standard Error of Mean (logged) | 0.265 | | | | |
| | | | | | |
| DL/2 Statistics | | | | | |
| DL/2 Normal | | | DL/2 Log-Transformed | | |
| Mean in Original Scale | 0.0969 | | Mean in Log Scale | -2.564 | |
| SD in Original Scale | 0.0706 | | SD in Log Scale | 0.728 | |
| 95% t UCL (Assumes normality) | 0.141 | | 95% H-Stat UCL | 0.2 | |
| DL/2 is not a recommended method, provided for comparisons and historical reasons | | | | | |
| | | | | | |
| Nonparametric Distribution Free UCL Statistics | | | | | |
| Detected Data appear Normal Distributed at 1% Significance Level | | | | | |
| | | | | | |
| Suggested UCL to Use | | | | | |
| 95% KM (t) UCL | 0.144 | | | | |
| | | | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | |
| | | | | | |
| | | | | | |

**Manganese - MW-24**

| General Statistics | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.0048 | Mean | 0.0104 |
| Maximum | 0.016 | Median | 0.011 |
| SD | 0.00417 | Std. Error of Mean | 0.00139 |
| Coefficient of Variation | 0.401 | Skewness | -0.106 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.922 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.159 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |

**Data appear Normal at 1% Significance Level**

Note GOF tests may be unreliable for small sample sizes

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.013 | 95% Adjusted-CLT UCL (Chen-1995) | 0.0126 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.013 |

| Gamma GOF Test | | | |
|---|---|---|---|
| A-D Test Statistic | 0.417 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.723 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.182 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.28 | Detected data appear Gamma Distributed at 5% Significance Level | |

**Detected data appear Gamma Distributed at 5% Significance Level**

Note GOF tests may be unreliable for small sample sizes

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 6.161 | k star (bias corrected MLE) | 4.182 |
| Theta hat (MLE) | 0.00169 | Theta star (bias corrected MLE) | 0.00249 |
| nu hat (MLE) | 110.9 | nu star (bias corrected) | 75.27 |
| MLE Mean (bias corrected) | 0.0104 | MLE Sd (bias corrected) | 0.00509 |
| | | Approximate Chi Square Value (0.05) | 56.29 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 52.84 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.0139 | 95% Adjusted Gamma UCL | 0.0148 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.896 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.206 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -5.339 | Mean of logged Data | -4.649 |
| Maximum of Logged Data | -4.135 | SD of logged Data | 0.451 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.015 | 90% Chebyshev (MVUE) UCL | 0.0152 |
| 95% Chebyshev (MVUE) UCL | 0.0174 | 97.5% Chebyshev (MVUE) UCL | 0.0204 |
| 99% Chebyshev (MVUE) UCL | 0.0263 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.0127 | 95% BCA Bootstrap UCL | 0.0124 |
| 95% Standard Bootstrap UCL | 0.0125 | 95% Bootstrap-t UCL | 0.0128 |
| 95% Hall's Bootstrap UCL | 0.0124 | 95% Percentile Bootstrap UCL | 0.0125 |
| 90% Chebyshev(Mean, Sd) UCL | 0.0146 | 95% Chebyshev(Mean, Sd) UCL | 0.0165 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.0191 | 99% Chebyshev(Mean, Sd) UCL | 0.0242 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.013 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| **Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be** | | | |
| **reliable.  Chen's and Johnson's methods provide adjustments for positvely skewed data sets.** | | | |
| | | | |
| | | | |

**Dinoseb - MW-24**

## General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | 9 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.001 | Mean | 0.00326 |
| Maximum | 0.0064 | Median | 0.0029 |
| SD | 0.00169 | Std. Error of Mean | 5.6448E-4 |
| Coefficient of Variation | 0.52 | Skewness | 0.654 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

## Normal GOF Test

| | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.959 | **Shapiro Wilk GOF Test** | |
| 1% Shapiro Wilk Critical Value | 0.764 | Data appear Normal at 1% Significance Level | |
| Lilliefors Test Statistic | 0.174 | **Lilliefors GOF Test** | |
| 1% Lilliefors Critical Value | 0.316 | Data appear Normal at 1% Significance Level | |

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

## Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 0.00431 | 95% Adjusted-CLT UCL (Chen-1995) | 0.00432 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.00433 |

## Gamma GOF Test

| | | | |
|---|---|---|---|
| A-D Test Statistic | 0.168 | **Anderson-Darling Gamma GOF Test** | |
| 5% A-D Critical Value | 0.725 | Detected data appear Gamma Distributed at 5% Significance Level | |
| K-S Test Statistic | 0.123 | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 5% K-S Critical Value | 0.281 | Detected data appear Gamma Distributed at 5% Significance Level | |

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

## Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 3.879 | k star (bias corrected MLE) | 2.66 |
| Theta hat (MLE) | 8.3924E-4 | Theta star (bias corrected MLE) | 0.00122 |
| nu hat (MLE) | 69.82 | nu star (bias corrected) | 47.88 |
| MLE Mean (bias corrected) | 0.00326 | MLE Sd (bias corrected) | 0.002 |
| | | Approximate Chi Square Value (0.05) | 33 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 30.42 |

## Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.00472 | 95% Adjusted Gamma UCL | 0.00513 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.967 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.161 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -6.908 | Mean of logged Data | -5.862 |
| Maximum of Logged Data | -5.051 | SD of logged Data | 0.576 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.00546 | 90% Chebyshev (MVUE) UCL | 0.00522 |
| 95% Chebyshev (MVUE) UCL | 0.0061 | 97.5% Chebyshev (MVUE) UCL | 0.00731 |
| 99% Chebyshev (MVUE) UCL | 0.0097 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.00418 | 95% BCA Bootstrap UCL | 0.00422 |
| 95% Standard Bootstrap UCL | 0.00412 | 95% Bootstrap-t UCL | 0.00459 |
| 95% Hall's Bootstrap UCL | 0.00505 | 95% Percentile Bootstrap UCL | 0.00412 |
| 90% Chebyshev(Mean, Sd) UCL | 0.00495 | 95% Chebyshev(Mean, Sd) UCL | 0.00572 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.00678 | 99% Chebyshev(Mean, Sd) UCL | 0.00887 |
| | | | |
| **Suggested UCL to Use** | | | |
| 95% Student's-t UCL | 0.00431 | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |
| | | | |
| | | | |

**1,2-DCP - MW-24**

| General Statistics | | | | |
|---|---|---|---|---|
| Total Number of Observations | 9 | Number of Distinct Observations | | 8 |
| | | Number of Missing Observations | | 0 |
| Minimum | 0.032 | Mean | | 0.101 |
| Maximum | 0.29 | Median | | 0.068 |
| SD | 0.0782 | Std. Error of Mean | | 0.0261 |
| Coefficient of Variation | 0.774 | Skewness | | 2.123 |

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,

refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

| Normal GOF Test | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.747 | **Shapiro Wilk GOF Test** |
| 1% Shapiro Wilk Critical Value | 0.764 | Data Not Normal at 1% Significance Level |
| Lilliefors Test Statistic | 0.319 | **Lilliefors GOF Test** |
| 1% Lilliefors Critical Value | 0.316 | Data Not Normal at 1% Significance Level |

**Data Not Normal at 1% Significance Level**

| Assuming Normal Distribution | | | |
|---|---|---|---|
| **95% Normal UCL** | | **95% UCLs (Adjusted for Skewness)** | |
| 95% Student's-t UCL | 0.149 | 95% Adjusted-CLT UCL (Chen-1995) | 0.164 |
| | | 95% Modified-t UCL (Johnson-1978) | 0.153 |

| Gamma GOF Test | | |
|---|---|---|
| A-D Test Statistic | 0.529 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.728 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.249 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.282 | Detected data appear Gamma Distributed at 5% Significance Level |

**Detected data appear Gamma Distributed at 5% Significance Level**

**Note GOF tests may be unreliable for small sample sizes**

| Gamma Statistics | | | |
|---|---|---|---|
| k hat (MLE) | 2.687 | k star (bias corrected MLE) | 1.865 |
| Theta hat (MLE) | 0.0376 | Theta star (bias corrected MLE) | 0.0542 |
| nu hat (MLE) | 48.36 | nu star (bias corrected) | 33.57 |
| MLE Mean (bias corrected) | 0.101 | MLE Sd (bias corrected) | 0.074 |
| | | Approximate Chi Square Value (0.05) | 21.32 |
| Adjusted Level of Significance | 0.0231 | Adjusted Chi Square Value | 19.29 |

| Assuming Gamma Distribution | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL | 0.159 | 95% Adjusted Gamma UCL | 0.176 |

| Lognormal GOF Test | | | |
|---|---|---|---|
| Shapiro Wilk Test Statistic | 0.943 | **Shapiro Wilk Lognormal GOF Test** | |
| 10% Shapiro Wilk Critical Value | 0.859 | Data appear Lognormal at 10% Significance Level | |
| Lilliefors Test Statistic | 0.206 | **Lilliefors Lognormal GOF Test** | |
| 10% Lilliefors Critical Value | 0.252 | Data appear Lognormal at 10% Significance Level | |
| **Data appear Lognormal at 10% Significance Level** | | | |
| **Note GOF tests may be unreliable for small sample sizes** | | | |
| | | | |
| **Lognormal Statistics** | | | |
| Minimum of Logged Data | -3.442 | Mean of logged Data | -2.49 |
| Maximum of Logged Data | -1.238 | SD of logged Data | 0.632 |
| | | | |
| **Assuming Lognormal Distribution** | | | |
| 95% H-UCL | 0.177 | 90% Chebyshev (MVUE) UCL | 0.162 |
| 95% Chebyshev (MVUE) UCL | 0.191 | 97.5% Chebyshev (MVUE) UCL | 0.231 |
| 99% Chebyshev (MVUE) UCL | 0.31 | | |
| | | | |
| **Nonparametric Distribution Free UCL Statistics** | | | |
| **Data appear to follow a Discernible Distribution** | | | |
| | | | |
| **Nonparametric Distribution Free UCLs** | | | |
| 95% CLT UCL | 0.144 | 95% BCA Bootstrap UCL | 0.165 |
| 95% Standard Bootstrap UCL | 0.141 | 95% Bootstrap-t UCL | 0.245 |
| 95% Hall's Bootstrap UCL | 0.373 | 95% Percentile Bootstrap UCL | 0.145 |
| 90% Chebyshev(Mean, Sd) UCL | 0.179 | 95% Chebyshev(Mean, Sd) UCL | 0.215 |
| 97.5% Chebyshev(Mean, Sd) UCL | 0.264 | 99% Chebyshev(Mean, Sd) UCL | 0.36 |
| | | | |
| **Suggested UCL to Use** | | | |
| Recommendation cannot be provided | | | |
| | | | |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | |
| Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. | | | |
| However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | |

**APPENDIX B**
**Trend Analysis Software Outputs**

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

| | |
|---|---|
| Site Name: | *Bee-Jay Scales* |
| Site Address: | *116 N. 1st Street, Sunnyside, WA* |
| Additional Description: | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-1** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

### 1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Arsenic | | | | |
| *#1* | 2/28/2017 | 7.1 | | | | | |
| *#2* | 9/19/2017 | 6.9 | | | | | |
| *#3* | 3/6/2018 | 2.8 | | | | | |
| *#4* | 8/30/2018 | 7.7 | | | | | |
| *#5* | 3/19/2019 | 4.9 | | | | | |
| *#6* | 8/20/2019 | 7.5 | 0.0065 | | | | |
| *#7* | 3/10/2020 | 7.3 | | | | | |
| *#8* | 8/31/2020 | 8.2 | | | | | |
| *#9* | 2/23/2021 | 7.6 | | | | | |
| *#10* | 9/14/2021 | 7 | 0.01 | | | | |
| *#11* | 3/28/2022 | 6.4 | 0.011 | | | | |
| *#12* | 7/11/2022 | 8.5 | 0.012 | | | | |
| *#13* | 3/6/2023 | 12 | | | | | |
| *#14* | 8/21/2023 | 8.3 | | | | | |
| *#15* | 3/11/2024 | 7.8 | 0.012 | | | | |
| *#16* | 9/23/2024 | 9 | 0.011 | | | | |

### 2. Mann-Kendall Non-parametric Statistical Test Results

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 99.40% | 93.20% | NA | NA | NA | NA |
| **Plume Stability?** | *Expanding* | *Expanding* | NA | NA | NA | NA |
| Coefficient of Variation? | | | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | 56 | 9 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 6 | 0 | 0 | 0 | 0 |
| Average Concentration? | 7.44 | 0.01 | NA | NA | NA | NA |
| Standard Deviation? | 1.92 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.26 | 0.20 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

### 3. Temporal Trend: Plot of Concentration vs. Sampling Time

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Expanding** |
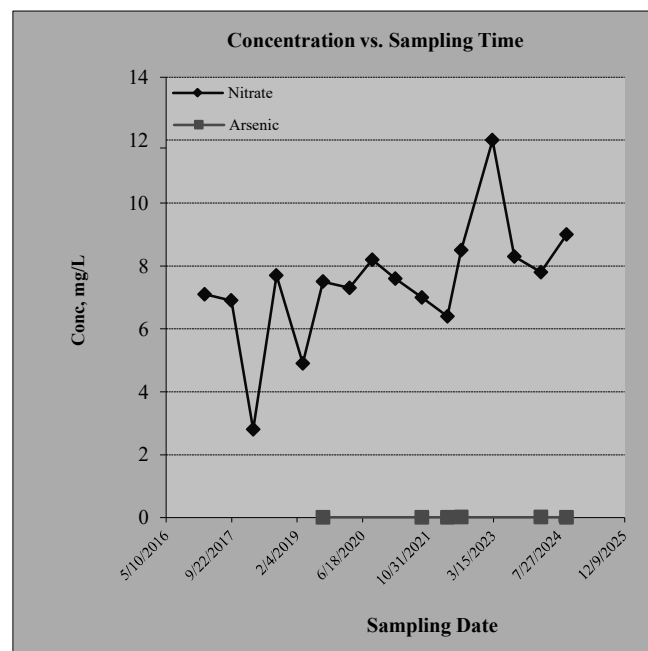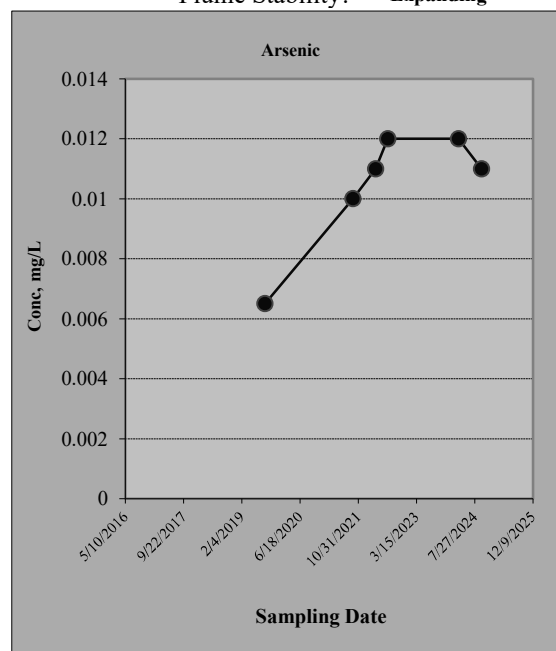
**Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)**

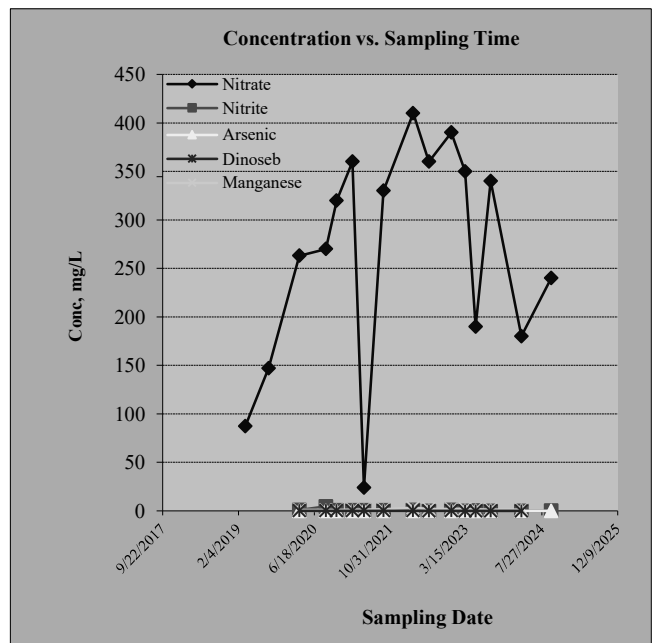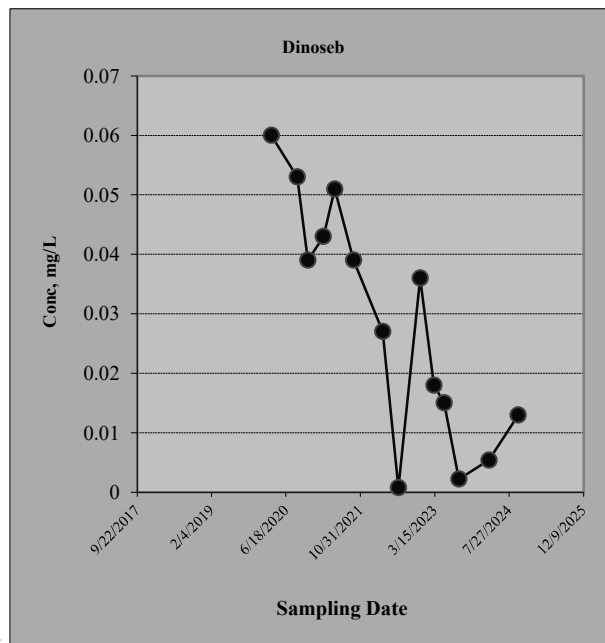| | |
|---|---|
| Site Name: | *Bee-Jay Scales* |
| Site Address: | *116 N. 1st Street, Sunnyside, WA* |
| Additional Description: | |

| | |
|---|---|
| Well (Sampling) Location? | **MW-3** |
| Level of Confidence (Decision Criteria)? | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Nitrite | Arsenic | Manganese | Dinoseb | |
| *#1* | 3/21/2019 | 87.2 | | | | | |
| *#2* | 8/22/2019 | 147 | | | | | |
| *#3* | 3/12/2020 | 263 | 1 | 0.0096 | 1.04 | 0.06 | |
| *#4* | 9/3/2020 | 270 | 4.6 | 0.011 | 0.91 | 0.053 | |
| *#5* | 11/12/2020 | 320 | 0.49 | 0.0093 | 0.95 | 0.039 | |
| *#6* | 2/25/2021 | 360 | 0.41 | 0.0081 | 1.5 | 0.043 | |
| *#7* | 5/12/2021 | 24 | 0.49 | 0.0093 | 1.5 | 0.051 | |
| *#8* | 9/17/2021 | 330 | 0.5 | 0.008 | 1.6 | 0.039 | |
| *#9* | 3/31/2022 | 410 | 0.87 | 0.007 | 3.2 | 0.027 | |
| *#10* | 7/14/2022 | 360 | 0.025 | 0.0064 | 2.1 | 0.00075 | |
| *#11* | 12/8/2022 | 390 | 0.77 | 0.0096 | 1.9 | 0.036 | |
| *#12* | 3/9/2023 | 350 | 0.017 | 0.0064 | 2.3 | 0.018 | |
| *#13* | 5/18/2023 | 190 | 0.16 | 0.0071 | 1.6 | 0.015 | |
| *#14* | 8/24/2023 | 340 | 0.0075 | 0.0085 | 1.4 | 0.0022 | |
| *#15* | 3/14/2024 | 180 | 0.015 | 0.0073 | 1.3 | 0.0054 | |
| *#16* | 9/26/2024 | 240 | 0.033 | 0.0096 | 1.1 | 0.013 | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Nitrite** | **Arsenic** | **Manganese** | **Dinoseb** | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 82.50% | 99.50% | 88.30% | 77.50% | 100.00% | NA |
| **Plume Stability?** | Stable | Shrinking | Shrinking | Stable | Shrinking | NA |
| Coefficient of Variation? | CV <= 1 | | | CV <= 1 | | n<4 |
| Mann-Kendall Statistic "S" value? | 23 | -48 | -24 | 15 | -64 | 0 |
| Number of Sampling Rounds? | 16 | 14 | 14 | 14 | 14 | 0 |
| Average Concentration? | 266.33 | 0.67 | 0.01 | 1.60 | 0.03 | NA |
| Standard Deviation? | 113.11 | 1.18 | 0.00 | 0.62 | 0.02 | NA |
| Coefficient of Variation? | 0.42 | 1.76 | 0.17 | 0.39 | 0.69 | NA |
| Blank if No Errors found | | | | | | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Dinoseb** |
| Plume Stability? | **Shrinking** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-4R** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

### 1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Nitrate | Arsenic | Dinoseb | 1,2-DCP | | |
| #1 | 8/20/2019 | 316 | 0.0147 | 0.074 | 0.007 | | |
| #2 | 3/12/2020 | 302 | 0.0169 | 0.1 | 0.006 | | |
| #3 | 9/3/2020 | | | | 0.0064 | | |
| #4 | 11/12/2020 | | | | 0.0062 | | |
| #5 | 2/25/2021 | 230 | 0.011 | 0.044 | 0.0048 | | |
| #6 | 5/12/2021 | 17 | 0.0099 | 0.059 | 0.0065 | | |
| #7 | 9/17/2021 | 350 | 0.012 | 0.028 | 0.0097 | | |
| #8 | 4/1/2022 | 250 | 0.01 | 0.021 | 0.006 | | |
| #9 | 7/14/2022 | 230 | 0.012 | 0.0079 | 0.0065 | | |
| #10 | 12/6/2022 | 180 | 0.0098 | 0.0097 | 0.0056 | | |
| #11 | 3/9/2023 | 180 | 0.012 | 0.034 | 0.0057 | | |
| #12 | 5/18/2023 | 180 | 0.011 | 0.054 | 0.006 | | |
| #13 | 8/24/2023 | 220 | 0.012 | 0.013 | 0.0072 | | |
| #14 | 12/7/2023 | 140 | 0.012 | 0.03 | 0.0068 | | |
| #15 | 3/14/2024 | 100 | 0.016 | 0.0077 | 0.0049 | | |
| #16 | 9/26/2024 | 180 | 0.013 | 0.034 | 0.0067 | | |

### 2. Mann-Kendall Non-parametric Statistical Test Results

| Hazardous Substance? | Nitrate | Arsenic | Dinoseb | 1,2-DCP | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 99.30% | 66.60% | 96.90% | 51.80% | NA | NA |
| Plume Stability? | Shrinking | Stable | Shrinking | Stable | NA | NA |
| Coefficient of Variation? | | CV <= 1 | | CV <= 1 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -46 | 10 | -36 | -2 | 0 | 0 |
| Number of Sampling Rounds? | 14 | 14 | 14 | 16 | 0 | 0 |
| Average Concentration? | 205.36 | 0.01 | 0.04 | 0.01 | NA | NA |
| Standard Deviation? | 87.42 | 0.00 | 0.03 | 0.00 | NA | NA |
| Coefficient of Variation? | 0.43 | 0.18 | 0.74 | 0.17 | NA | NA |
| Blank if No Errors found | | | | | n<4 | n<4 |

### 3. Temporal Trend: Plot of Concentration vs. Sampling Time

| | |
|---|---|
| Hazardous substance? | **Dinoseb** |
| Plume Stability? | **Shrinking** |
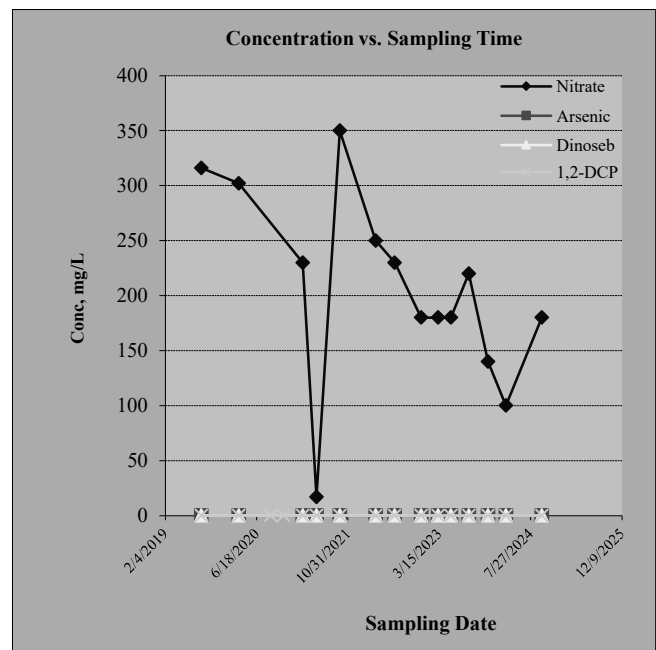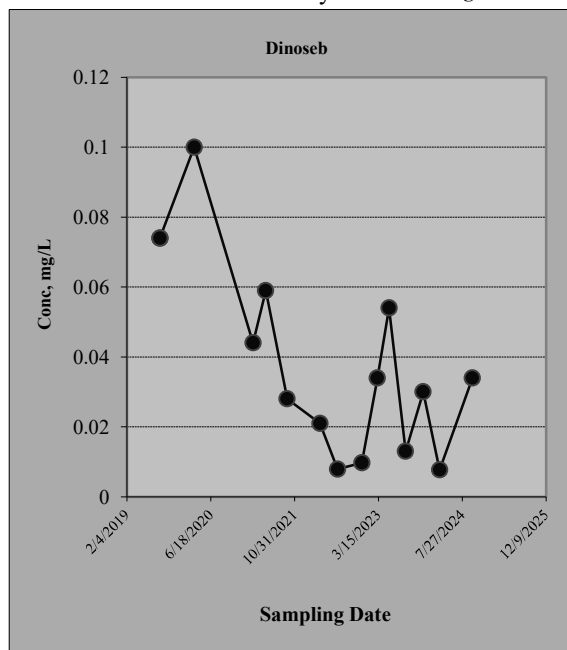
**Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)**

|  |  |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* |  |

| Well (Sampling) Location? | **MW-6** |
|---|---|
| Level of Confidence (Decision Criteria)? | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Nitrate | Arsenic |  |  |  |  |
|---|---|---|---|---|---|---|---|
| | | | | **Hazardous Substances (unit is mg/L)** | | | |
| *#1* | 2/25/2016 | 18.8 | 0.0332 | | | | |
| *#2* | 8/24/2016 | 4.9 | 0.0236 | | | | |
| *#3* | 2/28/2017 | 129 | 0.0163 | | | | |
| *#4* | 9/20/2017 | 5.8 | 0.021 | | | | |
| *#5* | 3/7/2018 | 15.1 | 0.034 | | | | |
| *#6* | 8/30/2018 | 5.5 | 0.0351 | | | | |
| *#7* | 3/20/2019 | 34.4 | 0.0258 | | | | |
| *#8* | 8/20/2019 | 5.5 | 0.0262 | | | | |
| *#9* | 3/11/2020 | 5.9 | 0.0259 | | | | |
| *#10* | 9/2/2020 | 5.3 | 0.026 | | | | |
| *#11* | 2/24/2021 | 5.6 | 0.024 | | | | |
| *#12* | 9/15/2021 | 2.6 | 0.024 | | | | |
| *#13* | 4/1/2022 | 4.4 | 0.025 | | | | |
| *#14* | 7/12/2022 | 6.8 | 0.026 | | | | |
| *#15* | 3/7/2023 | 5.2 | 0.025 | | | | |
| *#16* | 9/25/2024 | 6.2 | 0.025 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 90.30% | 55.30% | NA | NA | NA | NA |
| **Plume Stability?** | Shrinking | Stable | NA | NA | NA | NA |
| Coefficient of Variation? | | CV <= 1 | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -31 | -5 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 0 | 0 | 0 | 0 |
| Average Concentration? | 16.31 | 0.03 | NA | NA | NA | NA |
| Standard Deviation? | 31.09 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 1.91 | 0.18 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| Hazardous substance? | **Arsenic** |
|---|---|
| Plume Stability? | **Stable** |
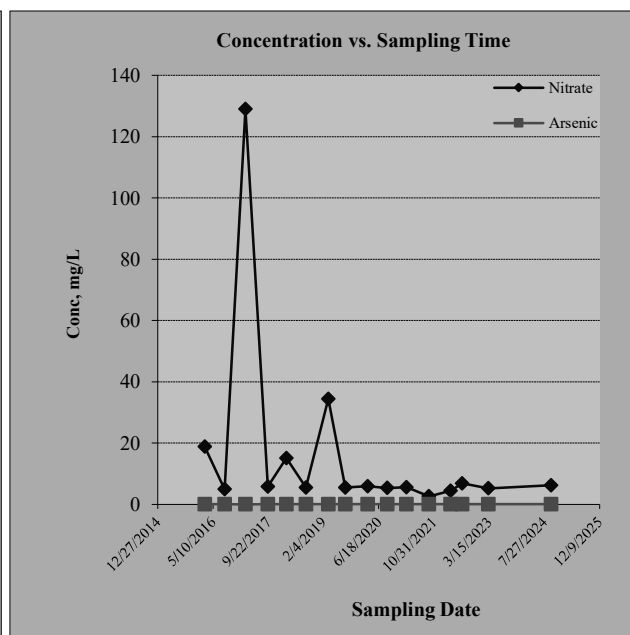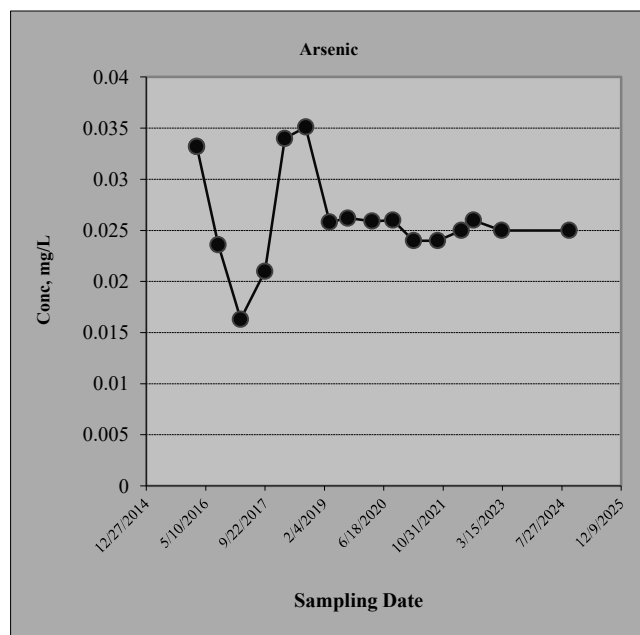
## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

| | |
|---|---|
| Site Name: | *Bee-Jay Scales* |
| Site Address: | *116 N. 1st Street, Sunnyside, WA* |
| Additional Description: | |

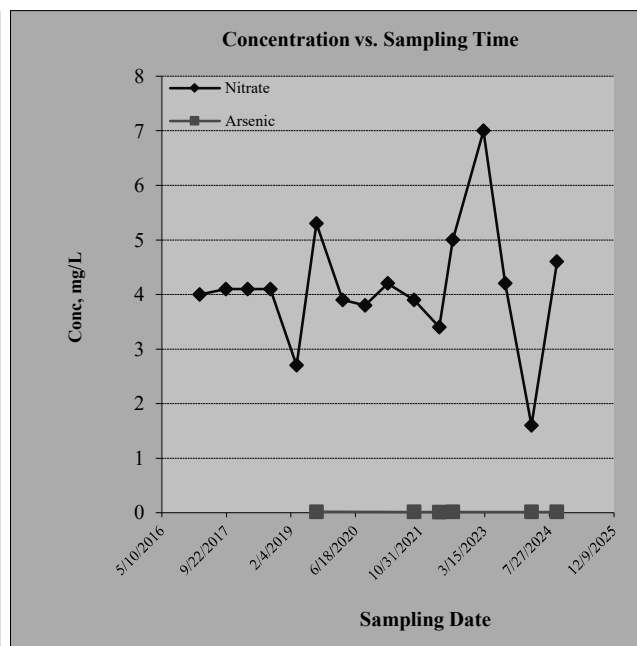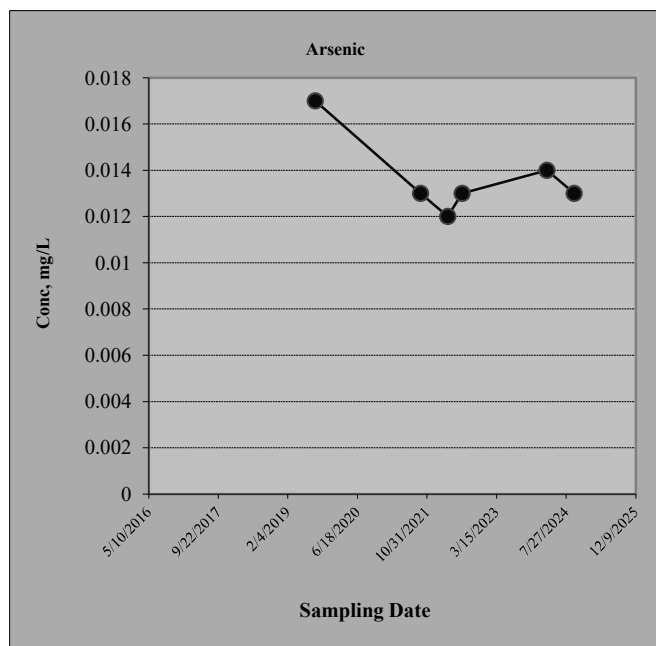| | |
|---|---|
| Well (Sampling) Location? | **MW-7** |
| Level of Confidence (Decision Criteria)? | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Nitrate | Arsenic | | | | |
|---|---|---|---|---|---|---|---|
| | | **Hazardous Substances (unit is mg/L)** | | | | | |
| *#1* | 2/28/2017 | 4 | | | | | |
| *#2* | 9/19/2017 | 4.1 | | | | | |
| *#3* | 3/6/2018 | 4.1 | | | | | |
| *#4* | 8/28/2018 | 4.1 | | | | | |
| *#5* | 3/19/2019 | 2.7 | | | | | |
| *#6* | 8/20/2019 | 5.3 | 0.017 | | | | |
| *#7* | 3/10/2020 | 3.9 | | | | | |
| *#8* | 8/31/2020 | 3.8 | | | | | |
| *#9* | 2/23/2021 | 4.2 | | | | | |
| *#10* | 9/14/2021 | 3.9 | 0.013 | | | | |
| *#11* | 3/28/2022 | 3.4 | 0.012 | | | | |
| *#12* | 7/11/2022 | 5 | 0.013 | | | | |
| *#13* | 3/6/2023 | 7 | | | | | |
| *#14* | 8/21/2023 | 4.2 | | | | | |
| *#15* | 3/11/2024 | 1.6 | 0.014 | | | | |
| *#16* | 9/23/2024 | 4.6 | 0.013 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 65.50% | 50.00% | NA | NA | NA | NA |
| Plume Stability? | Stable | Stable | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | CV <= 1 | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | 11 | -2 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 6 | 0 | 0 | 0 | 0 |
| Average Concentration? | 4.12 | 0.01 | NA | NA | NA | NA |
| Standard Deviation? | 1.15 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.28 | 0.13 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Stable** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

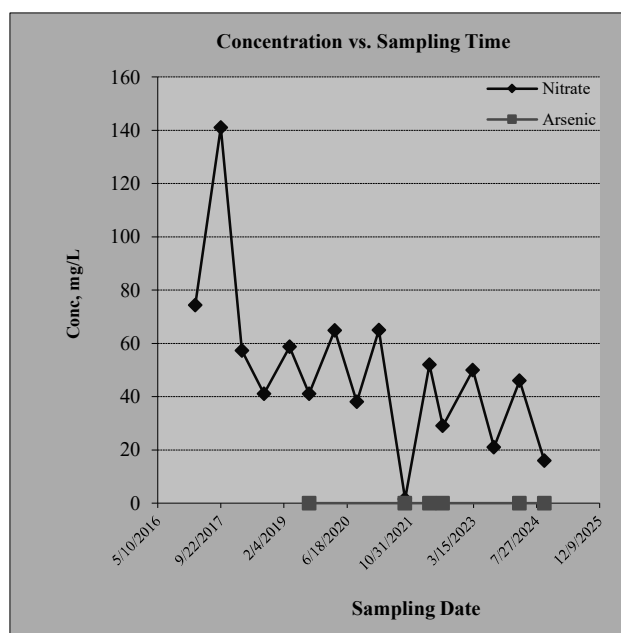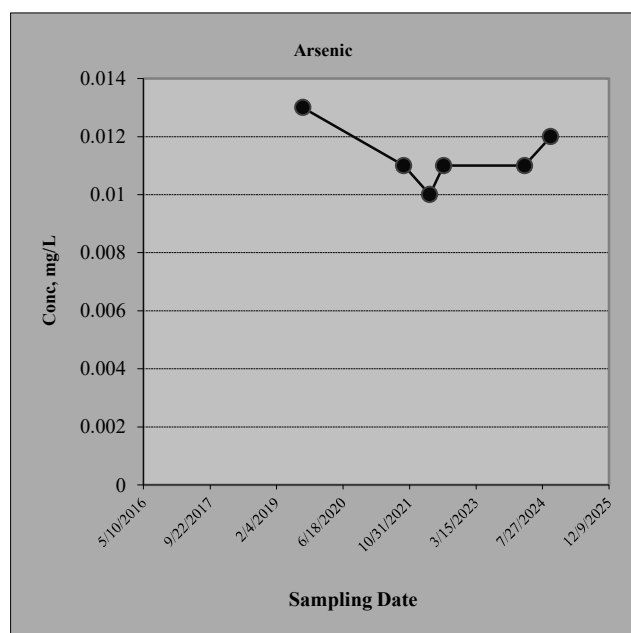| | |
|---:|:---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *110 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---:|:---:|
| **Well (Sampling) Location?** | **MW-8** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| Sampling Event | Date Sampled | Nitrate | Arsenic | | | | |
| *#1* | 3/2/2017 | 74.3 | | | | | |
| *#2* | 9/21/2017 | 141 | | | | | |
| *#3* | 3/8/2018 | 57.3 | | | | | |
| *#4* | 8/29/2018 | 41.1 | | | | | |
| *#5* | 3/20/2019 | 58.7 | | | | | |
| *#6* | 8/21/2019 | 41.1 | 0.013 | | | | |
| *#7* | 3/11/2020 | 64.9 | | | | | |
| *#8* | 9/3/2020 | 38 | | | | | |
| *#9* | 2/25/2021 | 65 | | | | | |
| *#10* | 9/17/2021 | 1.6 | 0.011 | | | | |
| *#11* | 3/31/2022 | 52 | 0.01 | | | | |
| *#12* | 7/14/2022 | 29 | 0.011 | | | | |
| *#13* | 3/9/2023 | 50 | | | | | |
| *#14* | 8/24/2023 | 21 | | | | | |
| *#15* | 3/14/2024 | 46 | 0.011 | | | | |
| *#16* | 9/26/2024 | 16 | 0.012 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| Confidence Level Calculated? | 99.40% | -500.00% | NA | NA | NA | NA |
| **Plume Stability?** | Shrinking | Stable | NA | NA | NA | NA |
| Coefficient of Variation? | | CV <= 1 | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -57 | 0 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 6 | 0 | 0 | 0 | 0 |
| Average Concentration? | 49.81 | 0.01 | NA | NA | NA | NA |
| Standard Deviation? | 31.14 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.63 | 0.09 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---:|:---:|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Stable** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

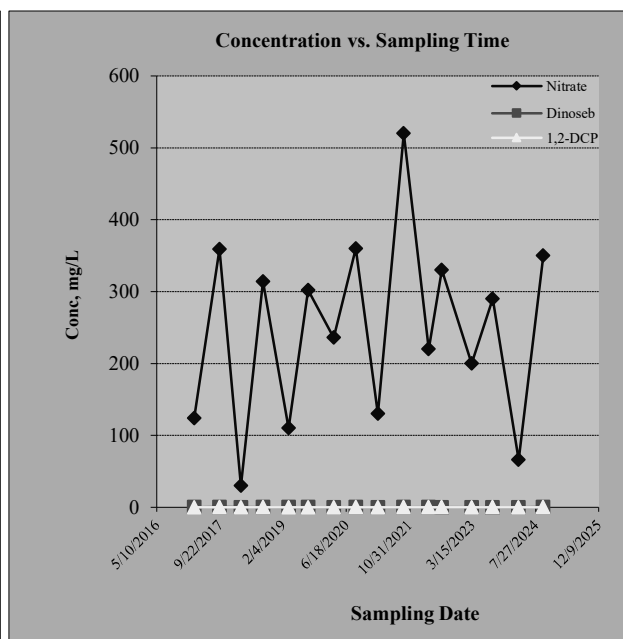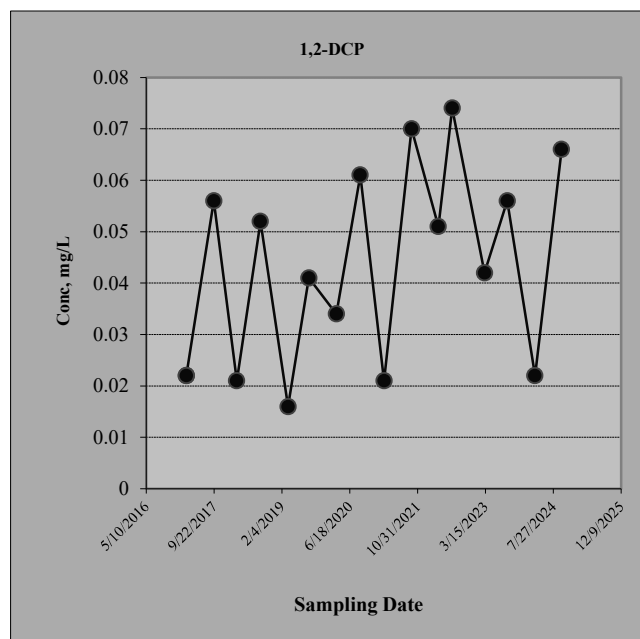| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-9** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Nitrate | Dinoseb | 1,2-DCP | | | |
| *#1* | 3/2/2017 | 124 | 0.068 | 0.022 | | | |
| *#2* | 9/20/2017 | 359 | 0.31 | 0.056 | | | |
| *#3* | 3/7/2018 | 30 | 0.0099 | 0.021 | | | |
| *#4* | 8/29/2018 | 314 | 0.1 | 0.052 | | | |
| *#5* | 3/21/2019 | 110 | 0.046 | 0.016 | | | |
| *#6* | 8/21/2019 | 302 | 0.076 | 0.041 | | | |
| *#7* | 3/11/2020 | 236 | 0.041 | 0.034 | | | |
| *#8* | 9/2/2020 | 360 | 0.1 | 0.061 | | | |
| *#9* | 2/25/2021 | 130 | 0.031 | 0.021 | | | |
| *#10* | 9/16/2021 | 520 | 0.2 | 0.07 | | | |
| *#11* | 4/1/2022 | 220 | 0.085 | 0.051 | | | |
| *#12* | 7/13/2022 | 330 | 0.006 | 0.074 | | | |
| *#13* | 3/8/2023 | 200 | 0.00016 | 0.042 | | | |
| *#14* | 8/22/2023 | 290 | 0.031 | 0.056 | | | |
| *#15* | 3/13/2024 | 66 | 0.00045 | 0.022 | | | |
| *#16* | 9/25/2024 | 350 | 0.16 | 0.066 | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Dinoseb** | **1,2-DCP** | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 65.50% | 88.60% | 90.30% | NA | NA | NA |
| **Plume Stability?** | Stable | Shrinking | *Expanding* | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | | | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | 10 | -28 | 31 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 16 | 0 | 0 | 0 |
| Average Concentration? | 246.31 | 0.08 | 0.04 | NA | NA | NA |
| Standard Deviation? | 130.94 | 0.08 | 0.02 | NA | NA | NA |
| Coefficient of Variation? | 0.53 | 1.06 | 0.44 | NA | NA | NA |
| Blank if No Errors found | | | | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **1,2-DCP** |
| Plume Stability? | **Expanding** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

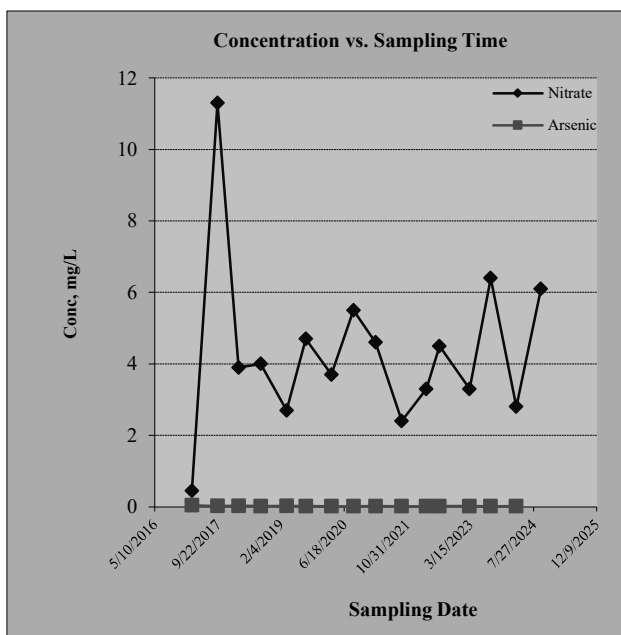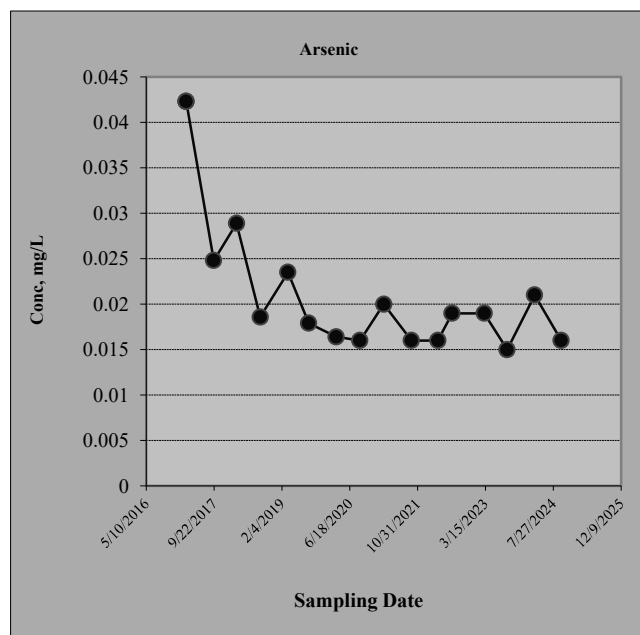| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-10** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Arsenic | | | | |
| *#1* | 2/28/2017 | 0.45 | 0.0423 | | | | |
| *#2* | 9/19/2017 | 11.3 | 0.0248 | | | | |
| *#3* | 3/6/2018 | 3.9 | 0.0289 | | | | |
| *#4* | 8/28/2018 | 4 | 0.0186 | | | | |
| *#5* | 3/20/2019 | 2.7 | 0.0235 | | | | |
| *#6* | 8/20/2019 | 4.7 | 0.0179 | | | | |
| *#7* | 3/10/2020 | 3.7 | 0.0164 | | | | |
| *#8* | 9/1/2020 | 5.5 | 0.016 | | | | |
| *#9* | 2/23/2021 | 4.6 | 0.02 | | | | |
| *#10* | 9/15/2021 | 2.4 | 0.016 | | | | |
| *#11* | 3/29/2022 | 3.3 | 0.016 | | | | |
| *#12* | 7/12/2022 | 4.5 | 0.019 | | | | |
| *#13* | 3/6/2023 | 3.3 | 0.019 | | | | |
| *#14* | 8/21/2023 | 6.4 | 0.015 | | | | |
| *#15* | 3/11/2024 | 2.8 | 0.021 | | | | |
| *#16* | 9/23/2024 | 6.1 | 0.016 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 62.20% | 99.20% | NA | NA | NA | NA |
| **Plume Stability?** | Stable | Shrinking | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | 9 | -55 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 0 | 0 | 0 | 0 |
| Average Concentration? | 4.35 | 0.02 | NA | NA | NA | NA |
| Standard Deviation? | 2.37 | 0.01 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.54 | 0.33 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Shrinking** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

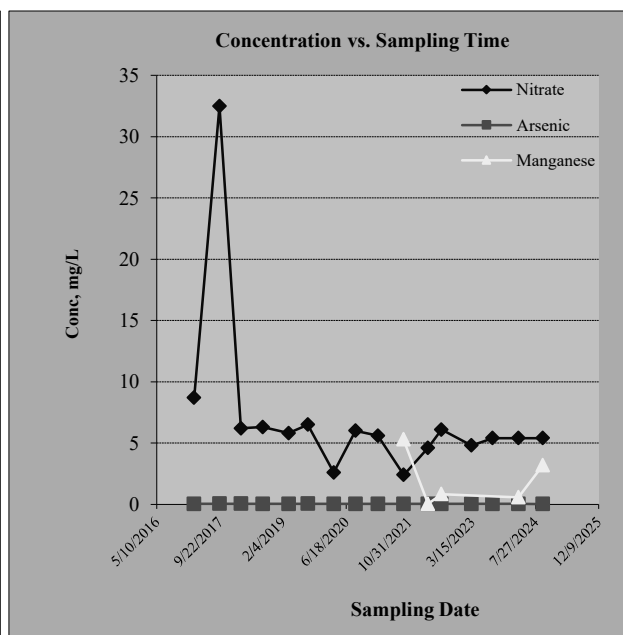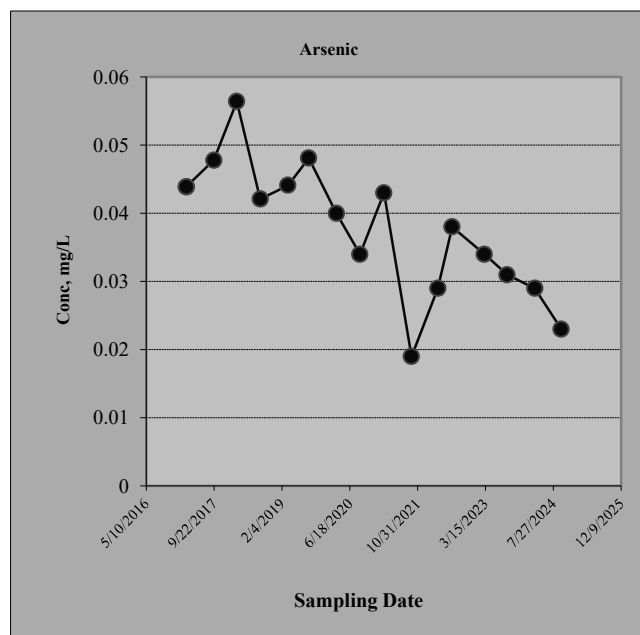| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-11** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Nitrate | Arsenic | Manganese | | | |
|---|---|---|---|---|---|---|---|
| | | | **Hazardous Substances (unit is mg/L)** | | | | |
| *#1* | 3/1/2017 | 8.7 | 0.0439 | | | | |
| *#2* | 9/20/2017 | 32.5 | 0.0478 | | | | |
| *#3* | 3/7/2018 | 6.2 | 0.0564 | | | | |
| *#4* | 8/28/2018 | 6.3 | 0.0421 | | | | |
| *#5* | 3/20/2019 | 5.8 | 0.0441 | | | | |
| *#6* | 8/20/2019 | 6.5 | 0.0481 | | | | |
| *#7* | 3/11/2020 | 2.6 | 0.04 | | | | |
| *#8* | 9/1/2020 | 6 | 0.034 | | | | |
| *#9* | 2/24/2021 | 5.6 | 0.043 | | | | |
| *#10* | 9/15/2021 | 2.4 | 0.019 | 5.3 | | | |
| *#11* | 3/28/2022 | 4.6 | 0.029 | 0.041 | | | |
| *#12* | 7/12/2022 | 6.1 | 0.038 | 0.83 | | | |
| *#13* | 3/7/2023 | 4.8 | 0.034 | | | | |
| *#14* | 8/21/2023 | 5.4 | 0.031 | | | | |
| *#15* | 3/12/2024 | 5.4 | 0.029 | 0.57 | | | |
| *#16* | 9/23/2024 | 5.4 | 0.023 | 3.2 | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | **Manganese** | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 99.20% | 100.00% | 40.80% | NA | NA | NA |
| **Plume Stability?** | Shrinking | Shrinking | Undetermined | NA | NA | NA |
| Coefficient of Variation? | | | CV > 1 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -55 | -74 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 5 | 0 | 0 | 0 |
| Average Concentration? | 7.14 | 0.04 | 1.99 | NA | NA | NA |
| Standard Deviation? | 6.92 | 0.01 | 2.21 | NA | NA | NA |
| Coefficient of Variation? | 0.97 | 0.26 | 1.11 | NA | NA | NA |
| Blank if No Errors found | | | | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Shrinking** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

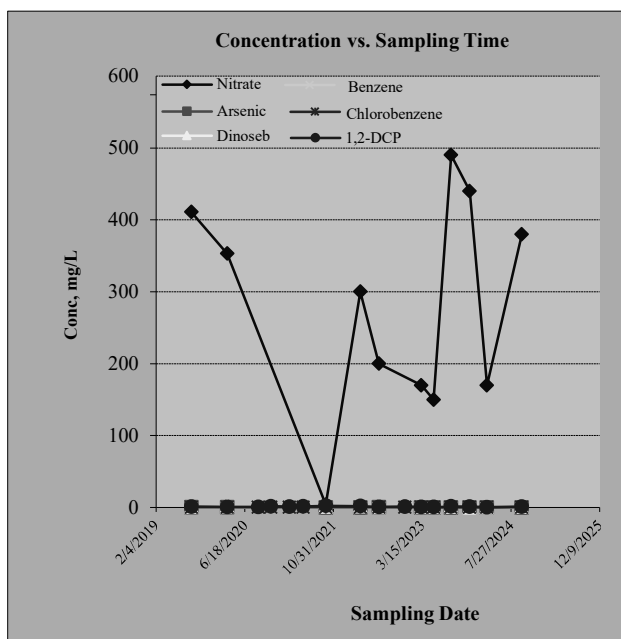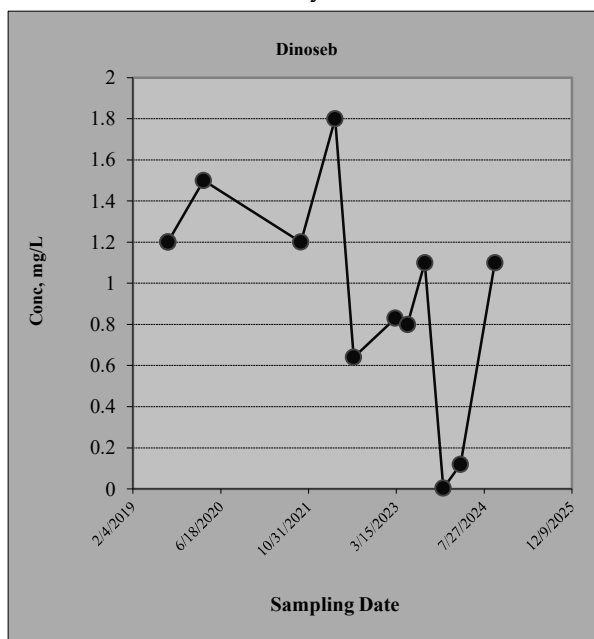| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-12R** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Nitrate | Arsenic | Dinoseb | Benzene | Chlorobenzene | 1,2-DCP |
| *#1* | 8/22/2019 | 411 | 0.0687 | 1.2 | 0.014 | 0.16 | 1.3 |
| *#2* | 3/12/2020 | 353 | 0.064 | 1.5 | 0.01 | 0.18 | 0.75 |
| *#3* | 9/3/2020 | | | | 0.011 | 0.14 | 0.89 |
| *#4* | 11/12/2020 | | | | 0.02 | 0.22 | 1.8 |
| *#5* | 2/25/2021 | | | | 0.015 | 0.17 | 1.2 |
| *#6* | 5/12/2021 | | | | 0.014 | 0.17 | 1.4 |
| *#7* | 9/17/2021 | 4 | 0.0039 | 1.2 | 0.026 | 0.29 | 2.3 |
| *#8* | 3/31/2022 | 300 | 0.011 | 1.8 | 0.022 | 0.29 | 1.9 |
| *#9* | 7/14/2022 | 200 | 0.064 | 0.64 | 0.011 | 0.16 | 0.76 |
| *#10* | 12/8/2022 | | | | 0.013 | 0.22 | 1.1 |
| *#11* | 3/9/2023 | 170 | 0.027 | 0.83 | 0.0075 | 0.14 | 0.61 |
| *#12* | 5/18/2023 | 150 | 0.02 | 0.8 | 0.0073 | 0.13 | 0.55 |
| *#13* | 8/24/2023 | 490 | 0.012 | 1.1 | 0.02 | 0.29 | 1.4 |
| *#14* | 12/7/2023 | 440 | 0.011 | 0.0039 | 0.017 | 0.27 | 1.1 |
| *#15* | 3/14/2024 | 170 | 0.016 | 0.12 | 0.0056 | 0.12 | 0.37 |
| *#16* | 9/26/2024 | 380 | 0.01 | 1.1 | 0.014 | 0.2 | 1.3 |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | **Dinoseb** | **Benzene** | **Chlorobenzene** | **1,2-DCP** |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | -1000.00% | 95.70% | 95.70% | 71.80% | 48.20% | 80.10% |
| **Plume Stability?** | Stable | Shrinking | Shrinking | Stable | Stable | Stable |
| Coefficient of Variation? | CV <= 1 | | | CV <= 1 | CV <= 1 | CV <= 1 |
| Mann-Kendall Statistic "S" value? | 0 | -23 | -23 | -15 | -1 | -21 |
| Number of Sampling Rounds? | 11 | 11 | 11 | 16 | 16 | 16 |
| Average Concentration? | 278.91 | 0.03 | 0.94 | 0.01 | 0.20 | 1.17 |
| Standard Deviation? | 150.42 | 0.02 | 0.54 | 0.01 | 0.06 | 0.52 |
| Coefficient of Variation? | 0.54 | 0.89 | 0.58 | 0.40 | 0.30 | 0.45 |
| Blank if No Errors found | | | | | | |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Dinoseb** |
| Plume Stability? | **Shrinking** |

**Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)**

|  |  |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| Well (Sampling) Location? | **MW-12R** |
|---|---|
| Level of Confidence (Decision Criteria)? | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Manganese | | | | | |
| *#1* | 3/12/2020 | 0.746 | | | | | |
| *#2* | 9/3/2020 | | | | | | |
| *#3* | 11/12/2020 | | | | | | |
| *#4* | 2/25/2021 | | | | | | |
| *#5* | 5/12/2021 | | | | | | |
| *#6* | 9/17/2021 | 1.6 | | | | | |
| *#7* | 3/31/2022 | 1.3 | | | | | |
| *#8* | 7/14/2022 | 0.93 | | | | | |
| *#9* | 12/8/2022 | | | | | | |
| *#10* | 3/9/2023 | 0.94 | | | | | |
| *#11* | 5/18/2023 | 0.9 | | | | | |
| *#12* | 8/24/2023 | 1.4 | | | | | |
| *#13* | 12/7/2023 | 1.8 | | | | | |
| *#14* | 3/14/2024 | 1 | | | | | |
| *#15* | 9/26/2024 | 1.4 | | | | | |
| *#16* | | | | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Manganese** | | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 81.00% | NA | NA | NA | NA | NA |
| **Plume Stability?** | Stable | NA | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | n<4 | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | 12 | 0 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 10 | 0 | 0 | 0 | 0 | 0 |
| Average Concentration? | 1.20 | NA | NA | NA | NA | NA |
| Standard Deviation? | 0.35 | NA | NA | NA | NA | NA |
| Coefficient of Variation? | 0.29 | NA | NA | NA | NA | NA |
| Blank if No Errors found | | n<4 | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| Hazardous substance? | **Manganese** |
|---|---|
| Plume Stability? | **Stable** |
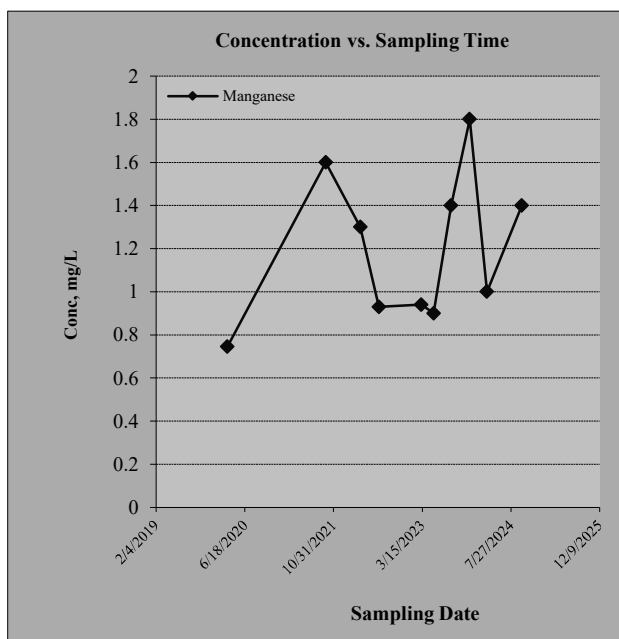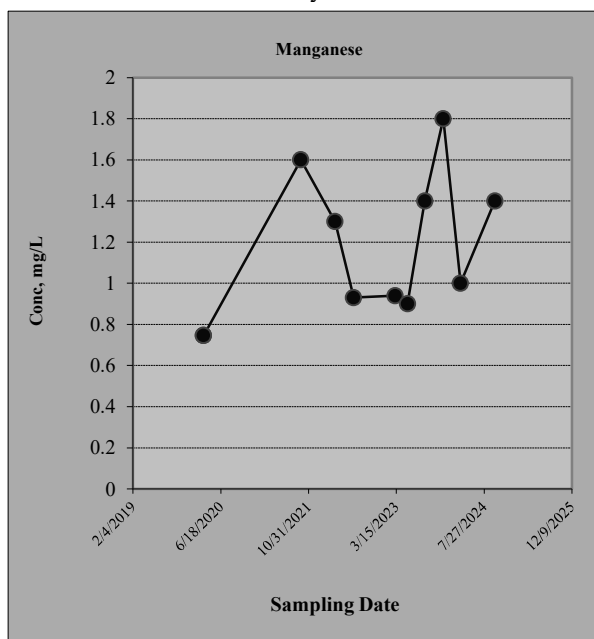
## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

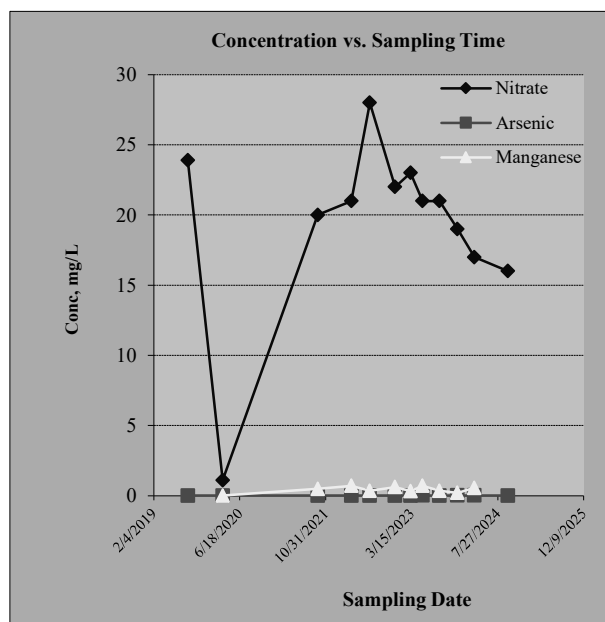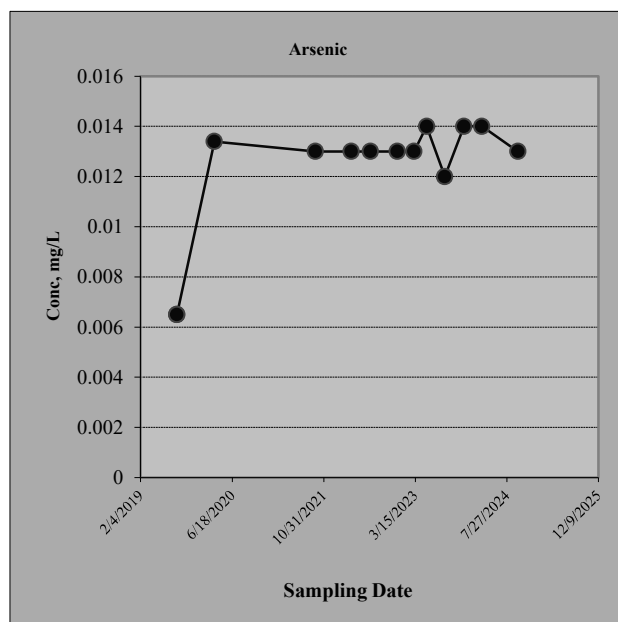| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-13** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Arsenic | Manganese | | | |
| *#1* | 8/21/2019 | 23.9 | 0.0065 | | | | |
| *#2* | 3/12/2020 | 1.1 | 0.0134 | 0.009 | | | |
| *#3* | 9/2/2020 | | | | | | |
| *#4* | 11/11/2020 | | | | | | |
| *#5* | 2/24/2021 | | | | | | |
| *#6* | 5/11/2021 | | | | | | |
| *#7* | 9/16/2021 | 20 | 0.013 | 0.48 | | | |
| *#8* | 3/30/2022 | 21 | 0.013 | 0.7 | | | |
| *#9* | 7/13/2022 | 28 | 0.013 | 0.34 | | | |
| *#10* | 12/7/2022 | 22 | 0.013 | 0.61 | | | |
| *#11* | 3/8/2023 | 23 | 0.013 | 0.33 | | | |
| *#12* | 5/16/2023 | 21 | 0.014 | 0.7 | | | |
| *#13* | 8/23/2023 | 21 | 0.012 | 0.34 | | | |
| *#14* | 12/6/2023 | 19 | 0.014 | 0.2 | | | |
| *#15* | 3/13/2024 | 17 | 0.014 | 0.55 | | | |
| *#16* | 9/25/2024 | 16 | 0.013 | 0.92 | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | **Manganese** | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 90.20% | 84.50% | 77.70% | NA | NA | NA |
| **Plume Stability?** | Shrinking | Stable | Stable | NA | NA | NA |
| Coefficient of Variation? | | CV <= 1 | CV <= 1 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -21 | 16 | 11 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 12 | 12 | 11 | 0 | 0 | 0 |
| Average Concentration? | 19.42 | 0.01 | 0.47 | NA | NA | NA |
| Standard Deviation? | 6.57 | 0.00 | 0.26 | NA | NA | NA |
| Coefficient of Variation? | 0.34 | 0.16 | 0.55 | NA | NA | NA |
| Blank if No Errors found | | | | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Stable** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

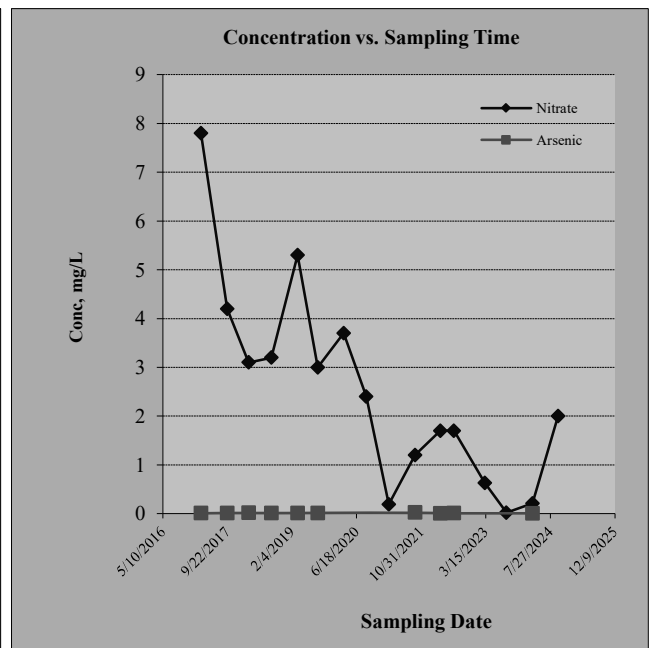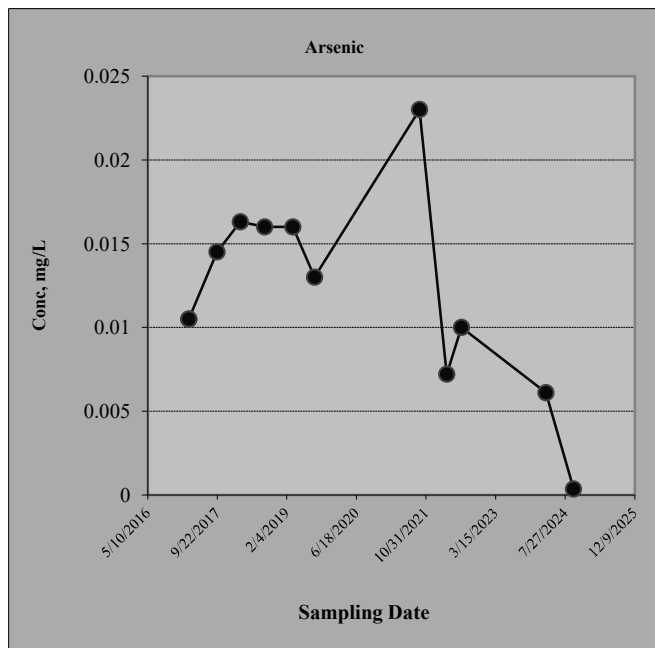| | |
|---:|:---|
| Site Name: | *Bee-Jay Scales* |
| Site Address: | *116 N. 1st Street, Sunnyside, WA* |
| Additional Description: | |

| | |
|---:|:---:|
| Well (Sampling) Location? | **MW-14** |
| Level of Confidence (Decision Criteria)? | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| Sampling Event | Date Sampled | Nitrate | Arsenic | | | | |
| *#1* | 3/2/2017 | 7.8 | 0.0105 | | | | |
| *#2* | 9/20/2017 | 4.2 | 0.0145 | | | | |
| *#3* | 3/6/2018 | 3.1 | 0.0163 | | | | |
| *#4* | 8/28/2018 | 3.2 | 0.016 | | | | |
| *#5* | 3/20/2019 | 5.3 | 0.016 | | | | |
| *#6* | 8/22/2019 | 3 | 0.013 | | | | |
| *#7* | 3/11/2020 | 3.7 | | | | | |
| *#8* | 9/1/2020 | 2.4 | | | | | |
| *#9* | 2/23/2021 | 0.19 | | | | | |
| *#10* | 9/14/2021 | 1.2 | 0.023 | | | | |
| *#11* | 3/29/2022 | 1.7 | 0.0072 | | | | |
| *#12* | 7/12/2022 | 1.7 | 0.01 | | | | |
| *#13* | 3/7/2023 | 0.63 | | | | | |
| *#14* | 8/22/2023 | 0.02 | | | | | |
| *#15* | 3/11/2024 | 0.21 | 0.0061 | | | | |
| *#16* | 9/25/2024 | 2 | 0.00034 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| Confidence Level Calculated? | 100.00% | 95.70% | NA | NA | NA | NA |
| **Plume Stability?** | Shrinking | Shrinking | NA | NA | NA | NA |
| Coefficient of Variation? | | | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -75 | -24 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 11 | 0 | 0 | 0 | 0 |
| Average Concentration? | 2.52 | 0.01 | NA | NA | NA | NA |
| Standard Deviation? | 2.08 | 0.01 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.82 | 0.51 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---:|:---:|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Shrinking** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

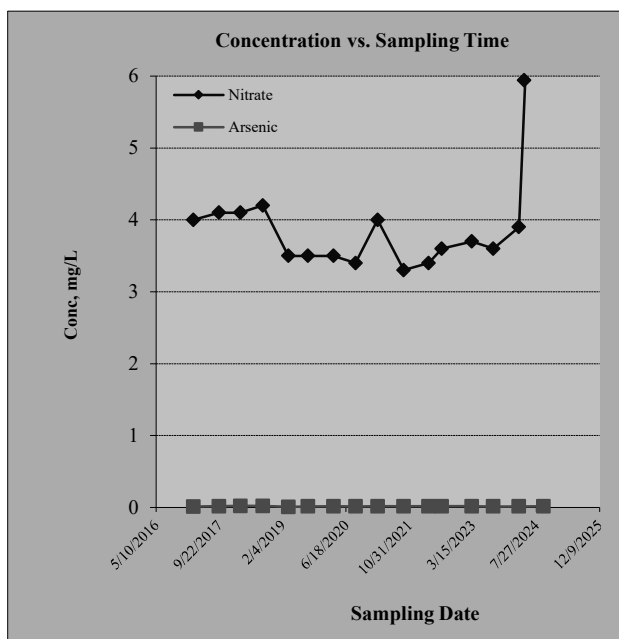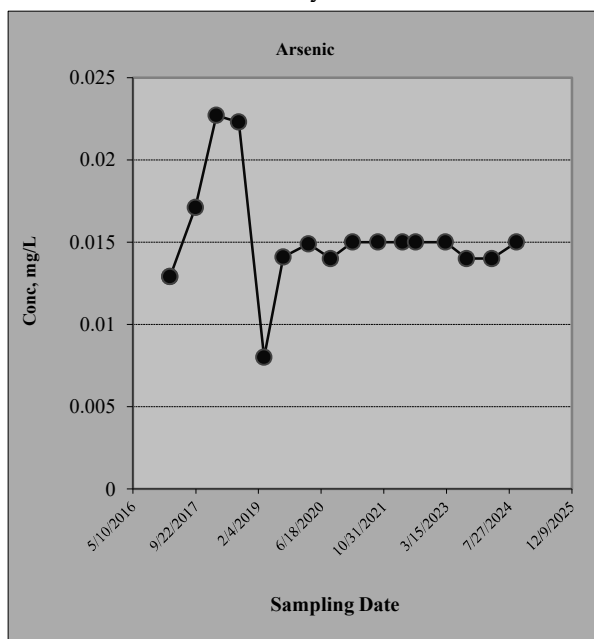| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-15** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Nitrate | Arsenic | | | | |
| *#1* | 3/1/2017 | 4 | 0.0129 | | | | |
| *#2* | 9/19/2017 | 4.1 | 0.0171 | | | | |
| *#3* | 3/6/2018 | 4.1 | 0.0227 | | | | |
| *#4* | 8/30/2018 | 4.2 | 0.0223 | | | | |
| *#5* | 3/20/2019 | 3.5 | 0.008 | | | | |
| *#6* | 8/20/2019 | 3.5 | 0.0141 | | | | |
| *#7* | 3/10/2020 | 3.5 | 0.0149 | | | | |
| *#8* | 9/1/2020 | 3.4 | 0.014 | | | | |
| *#9* | 2/23/2021 | 4 | 0.015 | | | | |
| *#10* | 9/14/2021 | 3.3 | 0.015 | | | | |
| *#11* | 3/30/2022 | 3.4 | 0.015 | | | | |
| *#12* | 7/12/2022 | 3.6 | 0.015 | | | | |
| *#13* | 3/7/2023 | 3.7 | 0.015 | | | | |
| *#14* | 8/22/2023 | 3.6 | 0.014 | | | | |
| *#15* | 3/11/2024 | 3.9 | 0.014 | | | | |
| *#16* | 9/23/2024 | 12 | 0.015 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 58.80% | 58.80% | NA | NA | NA | NA |
| **Plume Stability?** | Stable | Stable | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | CV <= 1 | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -7 | -6 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 0 | 0 | 0 | 0 |
| Average Concentration? | 4.24 | 0.02 | NA | NA | NA | NA |
| Standard Deviation? | 2.09 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.49 | 0.22 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Stable** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

|  |  |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* |  |

|  |  |
|---|---|
| **Well (Sampling) Location?** | **MW-16** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

### 1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
|  |  | Nitrate | Nitrite | Arsenic | Manganese | Dinoseb | 1,2-DCP |
| *#1* | 3/1/2017 | 116 | 3.3 |  |  | 0.0028 | 0.22 |
| *#2* | 9/20/2017 | 80.2 | 0.83 |  |  | 0.0061 | 0.14 |
| *#3* | 3/7/2018 | 128 | 2.4 |  |  | 0.014 | 0.17 |
| *#4* | 8/29/2018 | 151 | 2.6 |  |  | 0.021 | 0.2 |
| *#5* | 3/20/2019 | 57.3 | 1.3 |  |  | 0.015 | 0.15 |
| *#6* | 8/21/2019 | 89.3 | 5.8 | 0.013 |  | 0.018 | 0.15 |
| *#7* | 3/13/2020 | 145 | 1.6 |  |  | 0.054 | 0.15 |
| *#8* | 9/2/2020 |  |  |  |  |  | 0.069 |
| *#9* | 2/25/2021 |  |  |  |  |  | 0.042 |
| *#10* | 9/16/2021 | 25 | 0.98 | 0.022 | 0.92 | 0.0097 | 0.14 |
| *#11* | 3/30/2022 | 99 | 0.4 | 0.0061 | 1.3 | 0.031 | 0.14 |
| *#12* | 7/13/2022 | 57 | 1.8 | 0.019 | 0.84 | 0.0042 | 0.12 |
| *#13* | 3/9/2023 | 13 | 0.22 |  |  | 0.0064 | 0.029 |
| *#14* | 8/23/2023 | 89 | 0.71 |  |  | 0.0092 | 0.079 |
| *#15* | 3/14/2024 | 72 | 0.69 | 0.0061 | 1.5 | 0.019 | 0.071 |
| *#16* | 9/25/2024 | 130 | 1.3 | 0.00034 | 0.000475 | 0.045 | 0.18 |

### 2. Mann-Kendall Non-parametric Statistical Test Results

| Hazardous Substance? | **Nitrate** | **Nitrite** | **Arsenic** | **Manganese** | **Dinoseb** | **1,2-DCP** |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 80.60% | 96.90% | 86.40% | 59.20% | 88.30% | 99.00% |
| **Plume Stability?** | Stable | Shrinking | Shrinking | Stable | *Expanding* | Shrinking |
| Coefficient of Variation? | CV <= 1 |  |  | CV <= 1 |  |  |
| Mann-Kendall Statistic "S" value? | -17 | -36 | -8 | -2 | 23 | -52 |
| Number of Sampling Rounds? | 14 | 14 | 6 | 5 | 14 | 16 |
| Average Concentration? | 89.41 | 1.71 | 0.01 | 0.91 | 0.02 | 0.13 |
| Standard Deviation? | 42.31 | 1.47 | 0.01 | 0.58 | 0.02 | 0.06 |
| Coefficient of Variation? | 0.47 | 0.86 | 0.76 | 0.63 | 0.84 | 0.43 |
| Blank if No Errors found |  |  |  |  |  |  |

### 3. Temporal Trend: Plot of Concentration vs. Sampling Time

| | |
|---|---|
| Hazardous substance? | **1,2-DCP** |
| Plume Stability? | **Shrinking** |
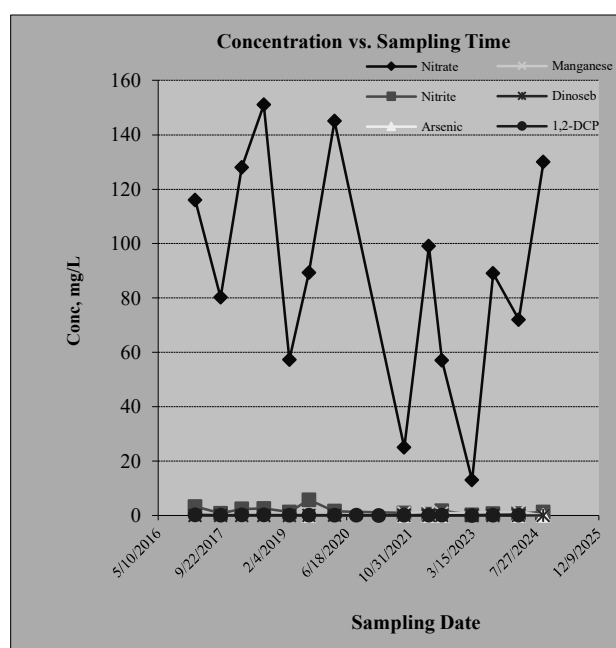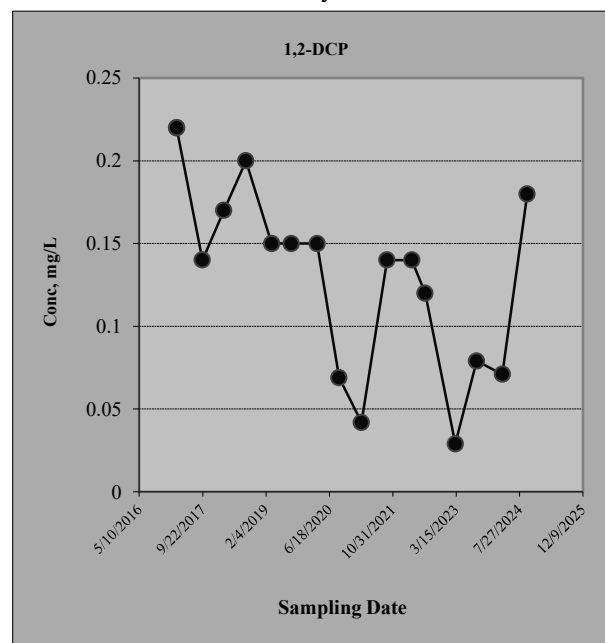
## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-17** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

### 1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Nitrate | Arsenic | | | | |
| *#1* | 2/28/2017 | 6.2 | | | | | |
| *#2* | 9/19/2017 | 3.8 | | | | | |
| *#3* | 3/7/2018 | 3.9 | | | | | |
| *#4* | 8/28/2018 | 3.5 | | | | | |
| *#5* | 3/21/2019 | 4.9 | | | | | |
| *#6* | 8/21/2019 | 3.4 | 0.0065 | | | | |
| *#7* | 3/11/2020 | 2.1 | | | | | |
| *#8* | 9/1/2020 | 3.3 | | | | | |
| *#9* | 2/24/2021 | 3.8 | | | | | |
| *#10* | 9/16/2021 | 3.6 | 0.0084 | | | | |
| *#11* | 3/29/2022 | 3 | 0.0083 | | | | |
| *#12* | 7/13/2022 | 4.1 | 0.0086 | | | | |
| *#13* | 3/8/2023 | 4.6 | | | | | |
| *#14* | 8/22/2023 | 3.8 | | | | | |
| *#15* | 3/12/2024 | 3.8 | 0.012 | | | | |
| *#16* | 9/24/2024 | 3.7 | 0.01 | | | | |

### 2. Mann-Kendall Non-parametric Statistical Test Results

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 68.70% | 97.20% | NA | NA | NA | NA |
| **Plume Stability?** | Stable | *Expanding* | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -12 | 11 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 6 | 0 | 0 | 0 | 0 |
| Average Concentration? | 3.84 | 0.01 | NA | NA | NA | NA |
| Standard Deviation? | 0.89 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.23 | 0.21 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

### 3. Temporal Trend: Plot of Concentration vs. Sampling Time

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Expanding** |
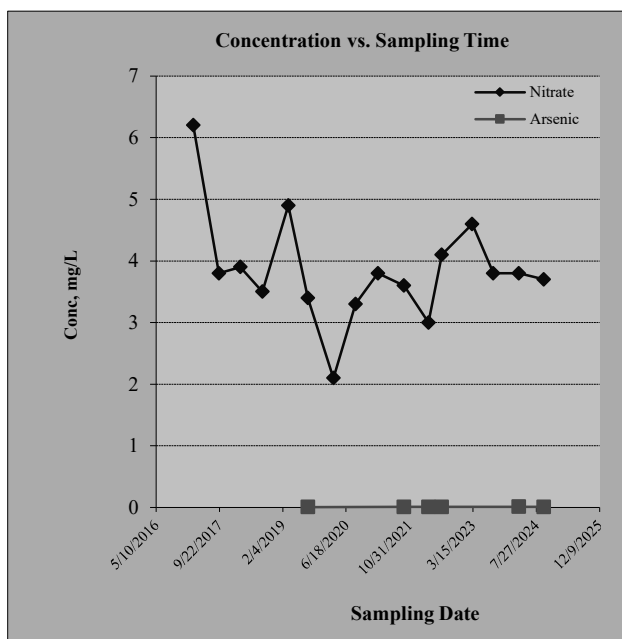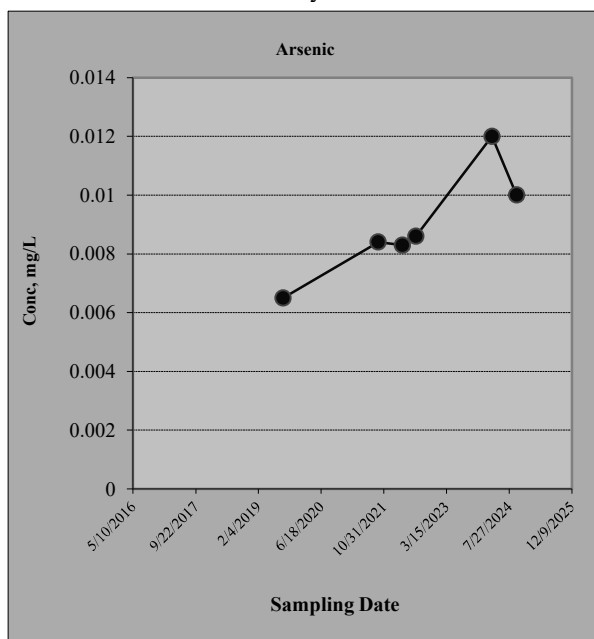
## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

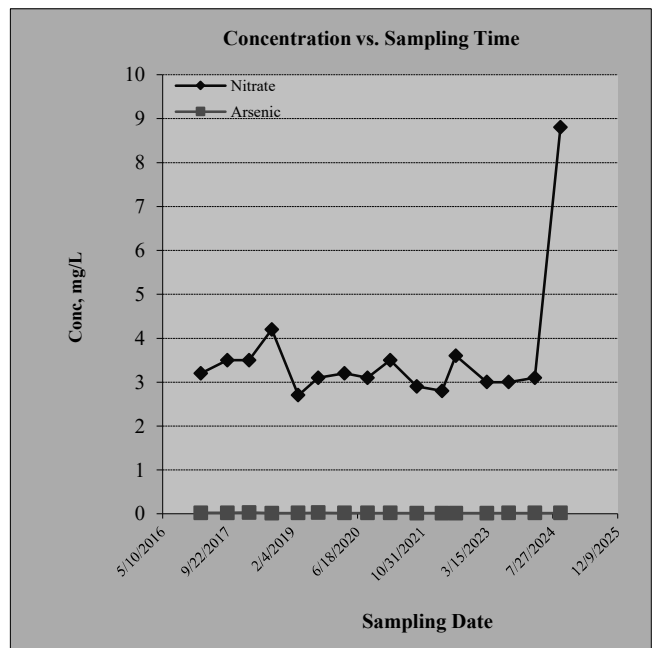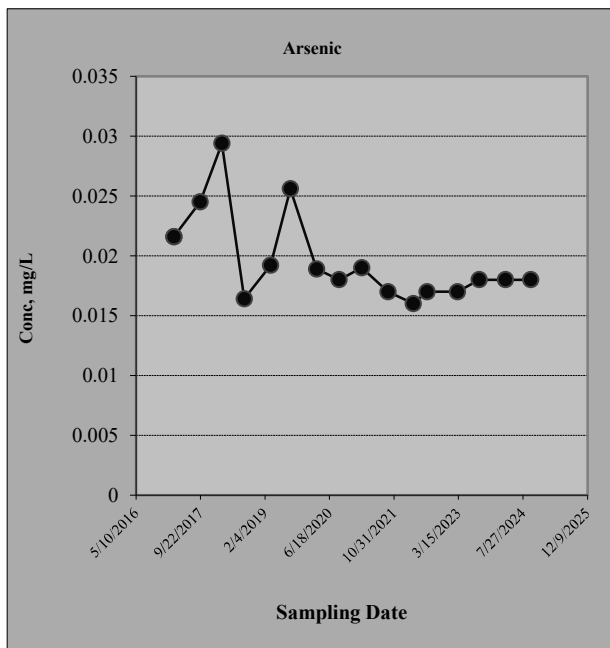| | |
|---|---|
| Site Name: | *Bee-Jay Scales* |
| Site Address: | *116 N. 1st Street, Sunnyside, WA* |
| Additional Description: | |

| | |
|---|---|
| Well (Sampling) Location? | **MW-18** |
| Level of Confidence (Decision Criteria)? | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Arsenic | | | | |
| *#1* | 2/28/2017 | 3.2 | 0.0216 | | | | |
| *#2* | 9/19/2017 | 3.5 | 0.0245 | | | | |
| *#3* | 3/6/2018 | 3.5 | 0.0294 | | | | |
| *#4* | 8/28/2018 | 4.2 | 0.0164 | | | | |
| *#5* | 3/19/2019 | 2.7 | 0.0192 | | | | |
| *#6* | 8/20/2019 | 3.1 | 0.0256 | | | | |
| *#7* | 3/10/2020 | 3.2 | 0.0189 | | | | |
| *#8* | 9/1/2020 | 3.1 | 0.018 | | | | |
| *#9* | 2/24/2021 | 3.5 | 0.019 | | | | |
| *#10* | 9/15/2021 | 2.9 | 0.017 | | | | |
| *#11* | 3/29/2022 | 2.8 | 0.016 | | | | |
| *#12* | 7/13/2022 | 3.6 | 0.017 | | | | |
| *#13* | 3/8/2023 | 3 | 0.017 | | | | |
| *#14* | 8/23/2023 | 3 | 0.018 | | | | |
| *#15* | 3/12/2024 | 3.1 | 0.018 | | | | |
| *#16* | 9/24/2024 | 8.8 | 0.018 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 62.20% | 97.40% | NA | NA | NA | NA |
| **Plume Stability?** | Stable | Shrinking | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -8 | -45 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 0 | 0 | 0 | 0 |
| Average Concentration? | 3.58 | 0.02 | NA | NA | NA | NA |
| Standard Deviation? | 1.44 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.40 | 0.19 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Shrinking** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

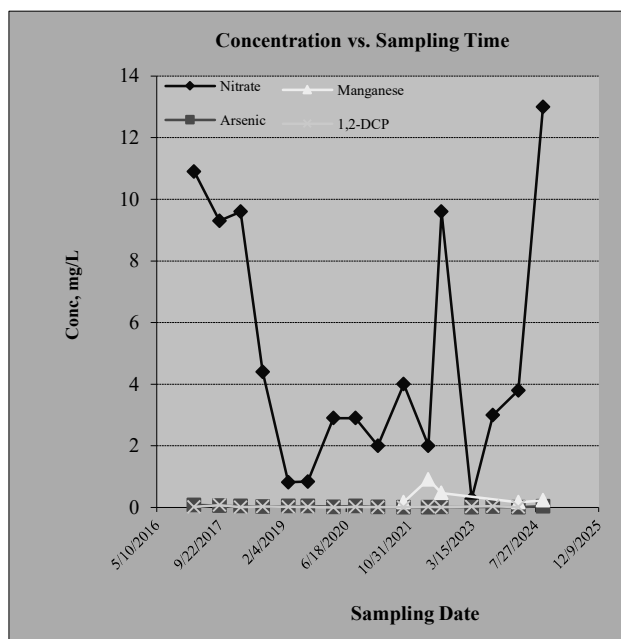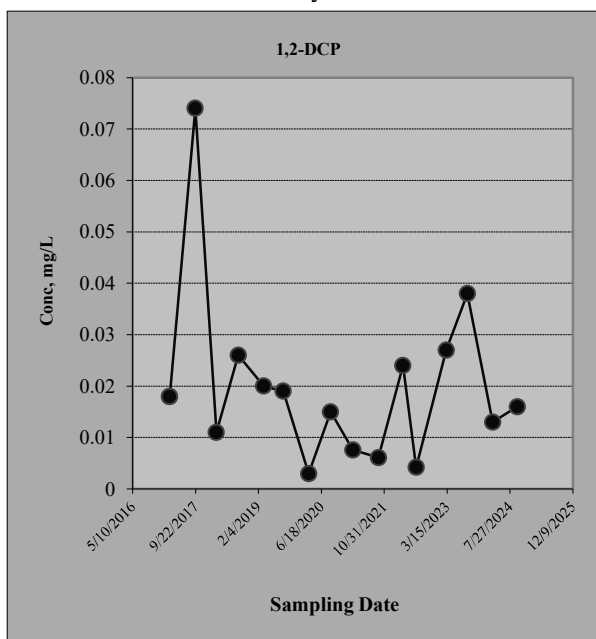| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-19** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Nitrate | Arsenic | Manganese | 1,2-DCP | | |
| *#1* | 3/1/2017 | 10.9 | 0.0833 | | 0.018 | | |
| *#2* | 9/19/2017 | 9.3 | 0.0585 | | 0.074 | | |
| *#3* | 3/6/2018 | 9.6 | 0.045 | | 0.011 | | |
| *#4* | 8/28/2018 | 4.4 | 0.0229 | | 0.026 | | |
| *#5* | 3/19/2019 | 0.82 | 0.044 | | 0.02 | | |
| *#6* | 8/20/2019 | 0.84 | 0.0446 | | 0.019 | | |
| *#7* | 3/10/2020 | 2.9 | 0.0182 | | 0.003 | | |
| *#8* | 8/31/2020 | 2.9 | 0.046 | | 0.015 | | |
| *#9* | 2/24/2021 | 2 | 0.012 | | 0.0076 | | |
| *#10* | 9/15/2021 | 4 | 0.011 | 0.17 | 0.0061 | | |
| *#11* | 3/29/2022 | 2 | 0.0074 | 0.91 | 0.024 | | |
| *#12* | 7/12/2022 | 9.6 | 0.013 | 0.47 | 0.0042 | | |
| *#13* | 3/8/2023 | 0.28 | 0.011 | | 0.027 | | |
| *#14* | 8/23/2023 | 3 | 0.024 | | 0.038 | | |
| *#15* | 3/12/2024 | 3.8 | 0.011 | 0.17 | 0.013 | | |
| *#16* | 9/24/2024 | 13 | 0.038 | 0.23 | 0.016 | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | **Manganese** | **1,2-DCP** | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 62.20% | 99.60% | 40.80% | 65.50% | NA | NA |
| **Plume Stability?** | Stable | Shrinking | Stable | Stable | NA | NA |
| Coefficient of Variation? | CV <= 1 | | CV <= 1 | CV <= 1 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -9 | -59 | -1 | -10 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 5 | 16 | 0 | 0 |
| Average Concentration? | 4.96 | 0.03 | 0.39 | 0.02 | NA | NA |
| Standard Deviation? | 4.08 | 0.02 | 0.32 | 0.02 | NA | NA |
| Coefficient of Variation? | 0.82 | 0.71 | 0.81 | 0.85 | NA | NA |
| Blank if No Errors found | | | | | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **1,2-DCP** |
| Plume Stability? | **Stable** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

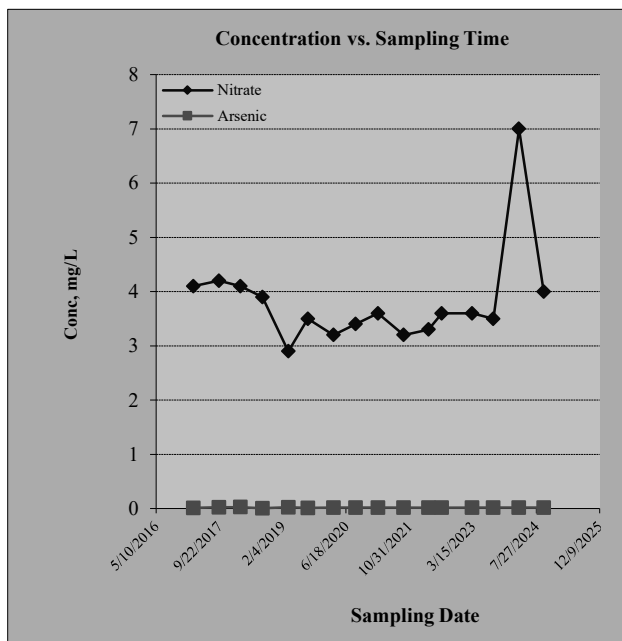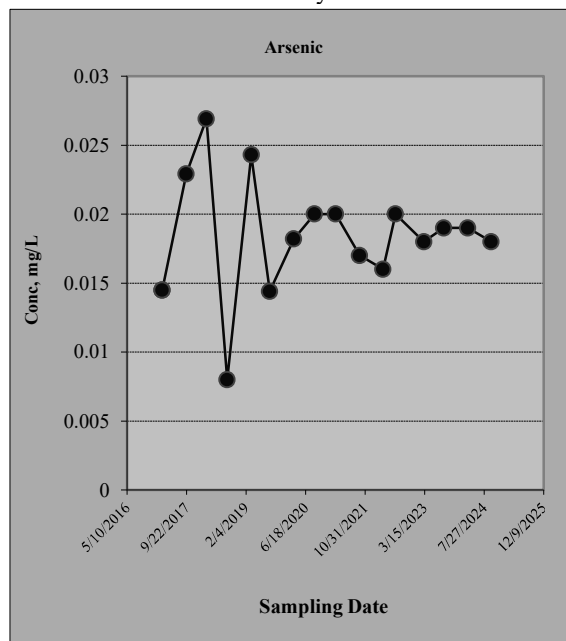| | |
|---|---|
| Site Name: | Bee-Jay Scales |
| Site Address: | 116 N. 1st Street, Sunnyside, WA |
| Additional Description: | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-20** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Arsenic | | | | |
| **#1** | 3/1/2017 | 4.1 | 0.0145 | | | | |
| **#2** | 9/19/2017 | 4.2 | 0.0229 | | | | |
| **#3** | 3/6/2018 | 4.1 | 0.0269 | | | | |
| **#4** | 8/28/2018 | 3.9 | 0.008 | | | | |
| **#5** | 3/19/2019 | 2.9 | 0.0243 | | | | |
| **#6** | 8/20/2019 | 3.5 | 0.0144 | | | | |
| **#7** | 3/10/2020 | 3.2 | 0.0182 | | | | |
| **#8** | 8/31/2020 | 3.4 | 0.02 | | | | |
| **#9** | 2/24/2021 | 3.6 | 0.02 | | | | |
| **#10** | 9/15/2021 | 3.2 | 0.017 | | | | |
| **#11** | 3/29/2022 | 3.3 | 0.016 | | | | |
| **#12** | 7/12/2022 | 3.6 | 0.02 | | | | |
| **#13** | 3/8/2023 | 3.6 | 0.018 | | | | |
| **#14** | 8/23/2023 | 3.5 | 0.019 | | | | |
| **#15** | 3/12/2024 | 7 | 0.019 | | | | |
| **#16** | 9/24/2024 | 4 | 0.018 | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Arsenic** | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 55.30% | 58.80% | NA | NA | NA | NA |
| **Plume Stability?** | Stable | Stable | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | CV <= 1 | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -4 | -7 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 16 | 16 | 0 | 0 | 0 | 0 |
| Average Concentration? | 3.82 | 0.02 | NA | NA | NA | NA |
| Standard Deviation? | 0.93 | 0.00 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.24 | 0.23 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Stable** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

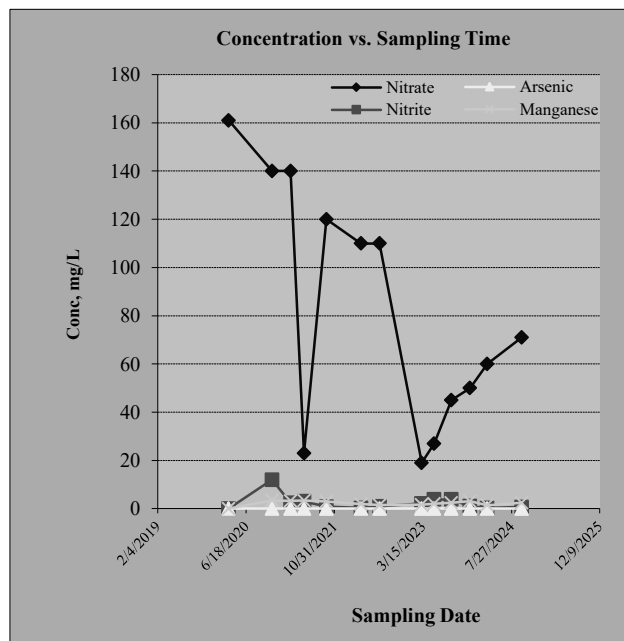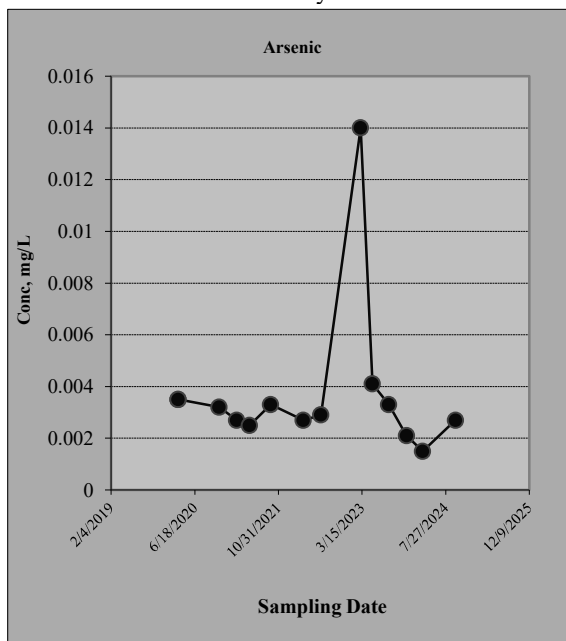| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-21** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Nitrite | Arsenic | Manganese | | |
| *#1* | 3/11/2020 | 161 | 0.0075 | 0.0035 | 0.0605 | | |
| *#2* | 9/1/2020 | | | | | | |
| *#3* | 11/11/2020 | 140 | 12 | 0.0032 | 3.4 | | |
| *#4* | 2/24/2021 | 140 | 2.4 | 0.0027 | 3.2 | | |
| *#5* | 5/11/2021 | 23 | 3 | 0.0025 | 3.3 | | |
| *#6* | 9/15/2021 | 120 | 0.77 | 0.0033 | 2.9 | | |
| *#7* | 3/29/2022 | 110 | 0.31 | 0.0027 | 1.9 | | |
| *#8* | 7/12/2022 | 110 | 0.91 | 0.0029 | 1.5 | | |
| *#9* | 12/7/2022 | | | | | | |
| *#10* | 3/7/2023 | 19 | 2.1 | 0.014 | 1.6 | | |
| *#11* | 5/16/2023 | 27 | 3.8 | 0.0041 | 2 | | |
| *#12* | 8/22/2023 | 45 | 3.8 | 0.0033 | 2.4 | | |
| *#13* | 12/6/2023 | 50 | 1 | 0.0021 | 3.1 | | |
| *#14* | 3/12/2024 | 60 | 0.31 | 0.0015 | 1.4 | | |
| *#15* | 9/24/2024 | 71 | 0.66 | 0.0027 | 2.4 | | |
| *#16* | | | | | | | |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | **Nitrate** | **Nitrite** | **Arsenic** | **Manganese** | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 96.20% | 61.70% | 81.60% | 74.50% | NA | NA |
| **Plume Stability?** | Shrinking | Undetermined | Stable | Stable | NA | NA |
| Coefficient of Variation? | | CV > 1 | CV <= 1 | CV <= 1 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -30 | -6 | -16 | -13 | 0 | 0 |
| Number of Sampling Rounds? | 13 | 13 | 13 | 13 | 0 | 0 |
| Average Concentration? | 82.77 | 2.39 | 0.00 | 2.24 | NA | NA |
| Standard Deviation? | 49.54 | 3.17 | 0.00 | 0.97 | NA | NA |
| Coefficient of Variation? | 0.60 | 1.33 | 0.85 | 0.43 | NA | NA |
| Blank if No Errors found | | | | | n<4 | n<4 |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Stable** |

## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

| | |
|---|---|
| *Site Name:* | *Bee-Jay Scales* |
| *Site Address:* | *116 N. 1st Street, Sunnyside, WA* |
| *Additional Description:* | |

| | |
|---|---|
| **Well (Sampling) Location?** | **MW-22** |
| **Level of Confidence (Decision Criteria)?** | **85%** |

### 1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | Nitrite | Arsenic | Manganese | | |
| *#1* | 3/31/2022 | 70 | 0.056 | 0.00034 | 0.5 | | |
| *#2* | 7/14/2022 | 65 | 0.057 | 0.0012 | 0.099 | | |
| *#3* | 12/6/2022 | | | | | | |
| *#4* | 3/6/2023 | 7.8 | 2.2 | 0.017 | 6.2 | | |
| *#5* | 5/17/2023 | 9.3 | 7.7 | 0.0057 | 3.8 | | |
| *#6* | 8/24/2023 | | | | | | |
| *#7* | 12/5/2023 | 17 | 4.2 | 0.0069 | 3.8 | | |
| *#8* | 3/14/2024 | 21 | 1.5 | 0.0028 | 2.4 | | |
| *#9* | 9/26/2024 | 0.16 | 0.0075 | 0.0047 | 2.2 | | |
| *#10* | | | | | | | |
| *#11* | | | | | | | |
| *#12* | | | | | | | |
| *#13* | | | | | | | |
| *#14* | | | | | | | |
| *#15* | | | | | | | |
| *#16* | | | | | | | |

### 2. Mann-Kendall Non-parametric Statistical Test Results

| | | | | | | |
|---|---|---|---|---|---|---|
| Hazardous Substance? | **Nitrate** | **Nitrite** | **Arsenic** | **Manganese** | | |
| Confidence Level Calculated? | 88.10% | 50.00% | 71.90% | -600.00% | NA | NA |
| **Plume Stability?** | Shrinking | Undetermined | Undetermined | Stable | NA | NA |
| Coefficient of Variation? | | CV > 1 | CV > 1 | CV <= 1 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -9 | 1 | 5 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 7 | 7 | 7 | 7 | 0 | 0 |
| Average Concentration? | 27.18 | 2.25 | 0.01 | 2.71 | NA | NA |
| Standard Deviation? | 28.38 | 2.85 | 0.01 | 2.11 | NA | NA |
| Coefficient of Variation? | 1.04 | 1.27 | 1.01 | 0.78 | NA | NA |
| Blank if No Errors found | | | | | n<4 | n<4 |

### 3. Temporal Trend: Plot of Concentration vs. Sampling Time

| | |
|---|---|
| Hazardous substance? | **Arsenic** |
| Plume Stability? | **Undetermined** |
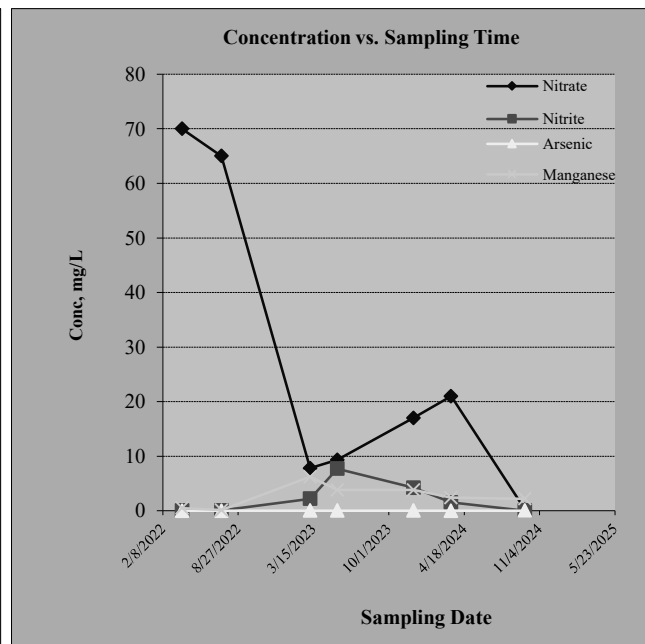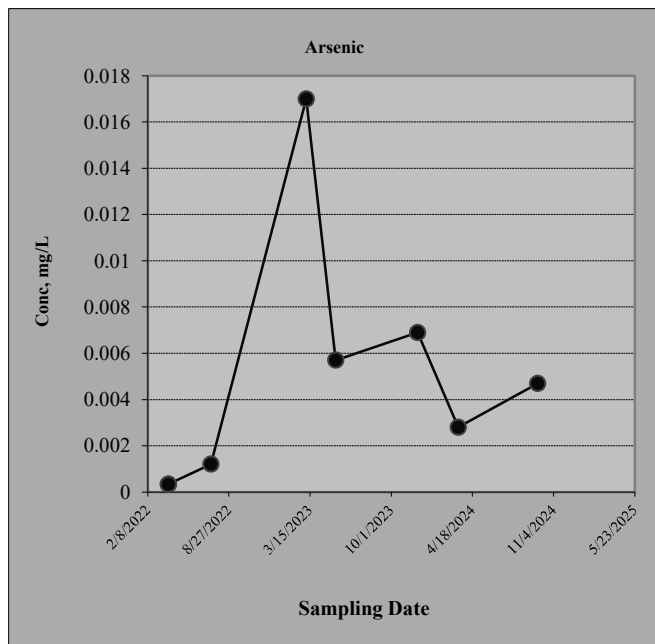
## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

|  |  |
|---|---|
| Site Name: | Bee-Jay Scales |
| Site Address: | 116 N. 1st Street, Sunnyside, WA |
| Additional Description: |  |

| Well (Sampling) Location? | MW-23 |
|---|---|
| Level of Confidence (Decision Criteria)? | 85% |

**1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.**

| Sampling Event | Date Sampled | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
|  |  | Nitrate | Nitrite | Arsenic | Manganese | Dinoseb | 1,2-DCP |
| #1 | 3/30/2022 | 150 | 0.068 | 0.0056 | 0.031 | 0.017 | 0.18 |
| #2 | 7/13/2022 | 160 | 0.025 | 0.0064 | 0.03 | 0.0013 | 0.17 |
| #3 | 12/7/2022 |  |  |  |  |  | 0.05 |
| #4 | 3/7/2023 | 34 | 0.64 | 0.007 | 0.88 | 0.0087 | 0.053 |
| #5 | 5/17/2023 | 13 | 0.91 | 0.013 | 1.2 | 0.01 | 0.035 |
| #6 | 8/22/2023 |  |  |  |  |  | 0.027 |
| #7 | 12/5/2023 |  |  |  |  |  | 0.035 |
| #8 | 3/13/2024 |  |  |  |  |  | 0.24 |
| #9 | 9/25/2024 |  |  |  |  |  | 0.22 |
| #10 |  |  |  |  |  |  |  |
| #11 |  |  |  |  |  |  |  |
| #12 |  |  |  |  |  |  |  |
| #13 |  |  |  |  |  |  |  |
| #14 |  |  |  |  |  |  |  |
| #15 |  |  |  |  |  |  |  |
| #16 |  |  |  |  |  |  |  |

**2. Mann-Kendall Non-parametric Statistical Test Results**

| Hazardous Substance? | Nitrate | Nitrite | Arsenic | Manganese | Dinoseb | 1,2-DCP |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 83.30% | 83.30% | 95.80% | 83.30% | 37.50% | 54.00% |
| Plume Stability? | Stable | Undetermined | *Expanding* | Undetermined | Stable | Stable |
| Coefficient of Variation? | CV <= 1 | CV > 1 |  | CV > 1 | CV <= 1 | CV <= 1 |
| Mann-Kendall Statistic "S" value? | -4 | 4 | 6 | 4 | 0 | -3 |
| Number of Sampling Rounds? | 4 | 4 | 4 | 4 | 4 | 9 |
| Average Concentration? | 89.25 | 0.41 | 0.01 | 0.54 | 0.01 | 0.11 |
| Standard Deviation? | 76.51 | 0.44 | 0.00 | 0.60 | 0.01 | 0.09 |
| Coefficient of Variation? | 0.86 | 1.06 | 0.42 | 1.12 | 0.70 | 0.79 |
| Blank if No Errors found |  |  |  |  |  |  |

**3. Temporal Trend: Plot of Concentration vs. Sampling Time**

| Hazardous substance? | 1,2-DCP |
|---|---|
| Plume Stability? | Stable |
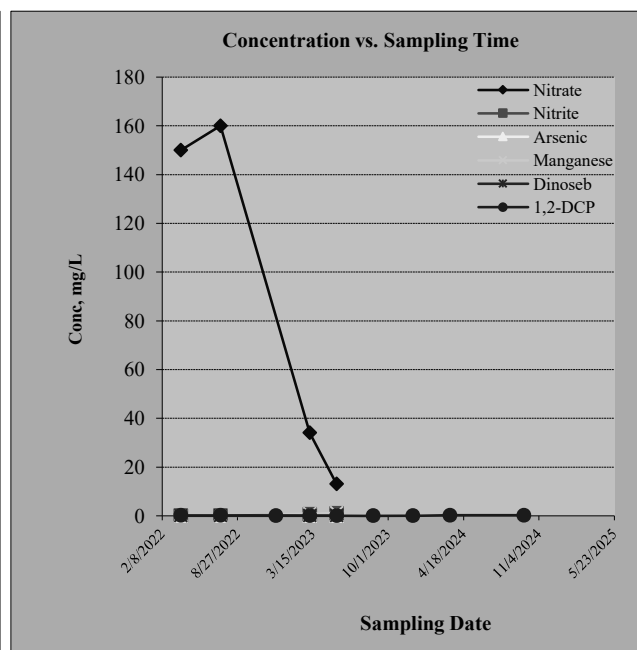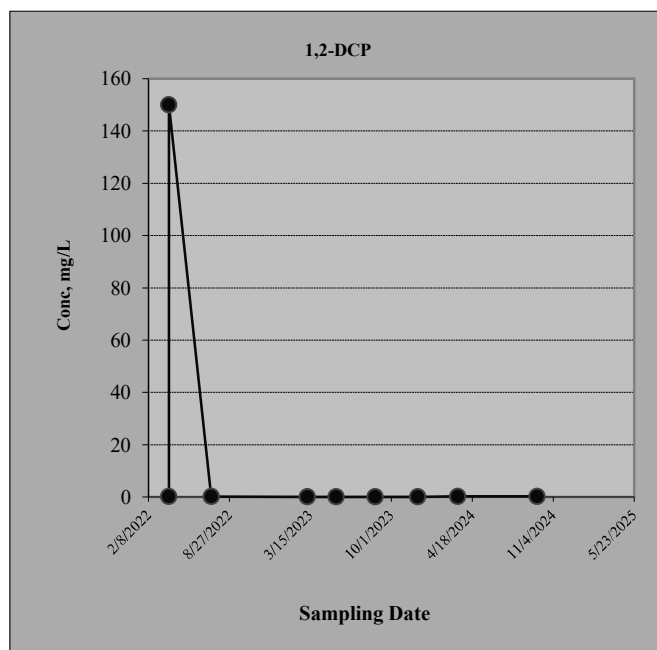
## Module1: Mann-Kendall Trend Test for Plume Stability (Non-parametric Statistical Test)

| | |
|---|---|
| Site Name: | Bee-Jay Scales |
| Site Address: | 116 N. 1st Street, Sunnyside, WA |
| Additional Description: | |

| | |
|---|---|
| Well (Sampling) Location? | MW-24 |
| Level of Confidence (Decision Criteria)? | 85% |

### 1. Monitoring Well Information: Contaminant Concentration at a well: Quarterly sampling recommended.

| | | Hazardous Substances (unit is mg/L) | | | | | |
|---|---|---|---|---|---|---|---|
| Sampling Event | Date Sampled | Nitrate | 1,2-DCP | | | | |
| #1 | 3/30/2022 | 24 | 0.066 | | | | |
| #2 | 7/13/2022 | 40 | 0.093 | | | | |
| #3 | 12/7/2022 | 35 | 0.068 | | | | |
| #4 | 3/8/2023 | 36 | 0.09 | | | | |
| #5 | 5/16/2023 | 51 | 0.15 | | | | |
| #6 | 8/23/2023 | 33 | 0.068 | | | | |
| #7 | 12/6/2023 | 29 | 0.032 | | | | |
| #8 | 3/13/2024 | 7.7 | 0.29 | | | | |
| #9 | 9/24/2024 | 35 | 0.052 | | | | |
| #10 | | | | | | | |
| #11 | | | | | | | |
| #12 | | | | | | | |
| #13 | | | | | | | |
| #14 | | | | | | | |
| #15 | | | | | | | |
| #16 | | | | | | | |

### 2. Mann-Kendall Non-parametric Statistical Test Results

| Hazardous Substance? | Nitrate | 1,2-DCP | | | | |
|---|---|---|---|---|---|---|
| Confidence Level Calculated? | 69.40% | 46.00% | NA | NA | NA | NA |
| Plume Stability? | Stable | Stable | NA | NA | NA | NA |
| Coefficient of Variation? | CV <= 1 | CV <= 1 | n<4 | n<4 | n<4 | n<4 |
| Mann-Kendall Statistic "S" value? | -7 | -1 | 0 | 0 | 0 | 0 |
| Number of Sampling Rounds? | 9 | 9 | 0 | 0 | 0 | 0 |
| Average Concentration? | 32.30 | 0.10 | NA | NA | NA | NA |
| Standard Deviation? | 11.85 | 0.08 | NA | NA | NA | NA |
| Coefficient of Variation? | 0.37 | 0.77 | NA | NA | NA | NA |
| Blank if No Errors found | | | n<4 | n<4 | n<4 | n<4 |

### 3. Temporal Trend: Plot of Concentration vs. Sampling Time

| | |
|---|---|
| Hazardous substance? | 1,2-DCP |
| Plume Stability? | Stable |