Groundwater Remediation System
Draft Interim Action Plan
Former Frank Wear Cleaners Site
Yakima, Washington

Prepared by Hart Crowser
Under Direction and Contract with
Washington State
Department of Ecology

March 28, 2013
17800-23/Task 6

WASHINGTON STATE DEPARTMENT OF ECOLOGY

HARTCROWSER

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ACRONYMS AND ABBREVIATIONS

AOC	area of concern
bgs	below ground surface
cDCE	cis-dichloroethene
CUL	cleanup level
CWCMH	Central Washington Comprehensive Mental Health
cVOCs	chlorinated volatile organic compounds
DNAPL	dense, non-aqueous-phase liquid
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
FS	Feasibility Study
GAC	Granular Activated Carbon
HSP	Health and Safety Plan
HVAC	Heating, Ventilation, and Air Conditioning
IAP	Interim Action Plan
MCL	Maximum Contaminant Level
MTCA	Model Toxics Control Act
Mg/kg	milligrams per kilogram
OMMP	Operation, Maintenance, and Monitoring Plan
PCE	perchloroethene (also known as tetrachloroethene)
RI	Remedial Investigation
SVE	soil vapor extraction
TCE	trichloroethene
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
$\mu g/m^3$	micrograms per cubic meter
UST	underground storage tank
VC	vinyl chloride
VOCs	volatile organic compounds
WAC	Washington Administrative Code
YRRA	Yakima Railroad Area

GROUNDWATER REMEDIATION SYSTEM
DRAFT INTERIM ACTION PLAN
FORMER FRANK WEAR CLEANERS SITE
YAKIMA, WASHINGTON

1.0 INTRODUCTION

This document provides a draft Interim Action Plan (IAP) for the remediation of chlorinated volatile organic compounds (cVOCs), primarily tetrachloroethylene (PCE), in soil and groundwater at the former Frank Wear Cleaners in Yakima, Washington (Figure 1). The Site is defined as the area located in the City of Yakima where contaminants released at the property parcel 181324-41442 have come to be located. For purposes of this IAP, the Site includes all areas that may be affected by contaminants originating from the former Frank Wear Cleaners, including off-property parcels affected by on-property source areas. The Site is a sub-facility of the larger Yakima Railroad Area (YRRA), a study area established by the Washington State Department of Ecology (Ecology) to investigate area-wide groundwater contamination. The property boundary is shown on Figure 2.

1.1 Purpose

This draft IAP was prepared under the direction of the Ecology's Toxics Cleanup Program and developed in accordance with Ecology's *Model Toxics Control Act Cleanup Regulation* (MTCA), Chapter 173-340-380 of the Washington Administrative Code (WAC) to present the selected interim action for the Frank Wear Cleaners Site to be conducted by Ecology. The selected interim action for the Site as described in this IAP includes enhanced *in situ* groundwater treatment through bioremediation, natural attenuation, institutional controls, and compliance monitoring.

The proposed interim action was selected in accordance with the MTCA criteria for the selection of cleanup actions in WAC 173-340-360. Accordingly, the selected interim action will meet the minimum requirements for cleanup actions of WAC 173-340-360(2). Specifically, the interim action will:

- Protect human health and the environment;
- Comply with cleanup standards;
- Comply with applicable state and federal laws;
- Provide for compliance monitoring;
- Use a permanent solution to the maximum extent practicable;

- Provide for a reasonable restoration time frame;
- Use a permanent groundwater cleanup action to achieve the cleanup levels for groundwater established in WAC 173-340-720 at the standard points of compliance; and
- Use institutional controls when required by WAC 173-340-440.

1.2 Public Participation and Final Interim Action Plan

Ecology is providing public notice and opportunity for comment on this draft interim action plan as required in WAC 173-340-600(13). After review and consideration of comments received during the public comment period, Ecology will issue a final interim action plan and publish its availability in the *Site Register*.

1.3 Interim Action Plan Content Requirements

The general requirements for interim action plan contents are specified in WAC 173-340-430. This IAP was prepared to address these requirements and includes the following elements:

- A description of the planned interim action (Sections 4.3 and 5.1);
- A description of existing site conditions and summary of available data (Section 2.0);
- Rationale for selecting the preferred alternative (Section 4.3);
- A summary of other interim action alternatives evaluated (Sections 4.1 and 4.2);
- Cleanup standards for hazardous substances and media of concern (Section 3.0);
- Schedule for the planned implementation of the interim action (Section 6.0);
- Institutional controls (Section 5.1.4);
- Applicable state and federal laws (Section 5.3);
- Preliminary determination of compliance with MTCA remedy selection criteria (Section 5.2);
- For containment measures, the types, levels, and amounts of hazardous substances remaining on the Site, and measures to prevent migration and contact (Not applicable to the Site-selected interim action);
- Compliance monitoring plan (Sections 5.1.3 and 6.0);

- Health and safety plan (Sections 5.1.3 and 6.0); and
- A sampling and analysis plan (Section 5.1.3).

1.4 Interim Action Plan Organization

A description of subsequent sections of this IAP and the topics discussed are as follows:

- **Section 2.0 – Site Background, History, and Environmental Conditions**; includes the Site location and description, geologic and hydrogeologic setting, historical operations and nature of contamination, previous environmental investigations and interim cleanup actions, summary of groundwater monitoring results, recent soil vapor investigation and interim cleanup action, and recent data gap investigation and results.
- **Section 3.0 – Cleanup Standards, Areas of Concern, and Points of Compliance**; identifies cleanup levels established for the Site, areas of concern based on soil and groundwater contamination, and points of compliance for soil and groundwater at the Site.
- **Section 4.0 – Alternatives Development and Evaluation**; presents a summary of the remedial action alternatives that were developed and evaluated in the Feasibility Study (FS), summary of the selected interim action and rationale for selection, and an updated evaluation of the selected interim action;
- **Section 5.0 – Selected Interim Action**; presents a description of the selected interim action; how the selected interim action satisfies MTCA criteria, including the threshold requirements, use of permanent solutions to the maximum extent practicable, and providing a reasonable restoration time frame; compliance with applicable local, state, and federal laws; and completion of cleanup.
- **Section 6.0 – Interim Action Implementation Schedule**; presents the implementation schedule for the interim action.
- **Section 7.0 – Ecology Periodic Reviews**; describes the periodic reviews to be conducted by Ecology to ensure the selected interim action remains protective of human health and the environment.
- **Section 8.0 – References**; presents listing of references cited throughout this IAP.

2.0 SITE BACKGROUND, HISTORY, AND ENVIRONMENTAL CONDITIONS

Background project information including the Site location and description, geologic information, past Site operations, nature of contamination, previous environmental investigation activities and interim cleanup actions, groundwater monitoring and environmental conditions are described in the following subsections.

2.1 Site Location and Description

The Site is located at 106 South Third Avenue, Yakima, Washington (Figure 1). The assigned Ecology Facility Site ID number for this Site is 444 and the Cleanup Site ID number is 4194. The former Frank Wear property is now a vacant gravel lot and zoned within the Central Business District. The property is 0.16 acres in size and located within the northeast quarter of the southeast quarter of Section 24, Township 13 North, and Range 18 East of the Willamette Meridian, Yakima County, Washington. The property is bounded to the north by an asphalt parking lot, an alley and businesses to the west, a children's daycare facility (Buckle My Shoe Early Learning Center) to the south, and by South 3rd Avenue to the east (Figure 2). South of the children's daycare facility is a former boat dealership property, now occupied by the Central Washington Comprehensive Mental Health facility (CWCMH), which extends south to West Walnut Street. Figure 2 provides a Site Plan view of the current Site layout and adjacent properties.

The Site formerly consisted of a retail dry cleaning facility, operated by Frank Wear Cleaners. During the period of operation, the facility included a dry cleaning building with an attached boiler room, a gravel parking lot on the west portion of the property, a paved parking lot on the north portion of the property, and a detached equipment storage shed located along the western property boundary adjacent to the alley. Figure 2 shows the locations of the former structures that were in use during the active operations of the dry cleaner. The dry cleaning building was removed in 2000, as a part of an interim action performed at the Site.

The Frank Wear Site is part of the larger YRRA (Facility Site ID number 500 and Cleanup Site ID number 3632), a study area established by Ecology to investigate area-wide groundwater contamination. The YRRA consists of approximately 6 square miles of numerous contaminated small sites with commingled PCE plumes centered along the Burlington Northern-Santa Fe Railroad.

2.2 Geology and Hydrogeology

The Site's shallow upper aquifer is unconfined and consists of unconsolidated alluvium, primarily coarse-grained sands, gravels, and cobbles with occasional

interbedded lenses of clay and silt; and the Thorp Gravel, primarily highly weathered, poorly cemented, coarse sands and gravels. This alluvium extends from approximately 10 to 80 feet below ground surface (bgs) and is representative of the alluvium that blankets most of the Yakima Valley floor. Below this material is the Upper Ellensburg Formation, which consists of alluvial and volcanic mudslide deposits (lahar) that have been semi-consolidated. The Upper Ellensburg Formation overlies basalt bedrock (Columbia River Basalts) and interbedded Ellensburg Formation, and is present from 50 to 1,600 feet bgs. The upper member of the Upper Ellensburg Formation is the principle water source for the Ahtanum-Moxee Basin.

Site groundwater elevations fluctuate seasonally as a result of localized recharge created from irrigation canals. During the winter months (January through March), the shallow groundwater table at the Site is typically present at approximately 20 to 25 feet bgs with the groundwater flow direction toward the south. Irrigation ditches throughout the Yakima area are charged from late March through early October each year, raising the water table to between 12 to 18 feet bgs and changing the flow direction toward the east-southeast through the autumn months. Groundwater horizontal gradients at the Site range from 0.008 foot/foot (winter) to 0.025 foot/foot (through autumn). Vertical gradients calculated from recent data are downward and range from 0.069 to 0.091 foot/foot. Groundwater velocities within the alluvial aquifer have been estimated to be approximately 240 feet per year during the winter.

Two aquifers have been identified at the study Site: a deep drinking water aquifer and a shallow water table aquifer. The interconnection between these aquifers has not been directly investigated. The aquifers are believed to be separated by a sequence of discontinuous, but thick and gradational low permeability layers.

2.3 Historical Operations and Nature of Contamination

The Frank Wear Site was a dry cleaning business from the early 1940s to 2000. The use of the Site prior to 1940 is unknown. The business was owned and operated by the Frank Wear family from the early 1940s to 1980. The dry cleaning operations primarily used Stoddard solvent as the dry cleaning fluid. However, sometime during the 1970s, the business began using PCE as the dry cleaning solvent. Spent PCE from the dry cleaning operations was reclaimed using a distillation unit. Sludges or still bottoms from the reclamation process were reportedly deposited on the property for dust abatement. Overflow from the dry cleaning machine was also periodically discharged to a catch basin or overflow tray located outside the southwest corner of the building.

Occasionally, the catch basin would overflow, potentially causing spills of the PCE-contaminated liquids to the ground surface. Leaks and spills from the dry cleaning machines and associated equipment would have collected in floor drains and these floor drains may have carried PCE-contaminated wastewaters out to the west end of the building. In 1989, the owner reportedly removed a 500-gallon gasoline underground storage tank (UST) and a 1,000-gallon heating oil UST.

Based on releases, the Site has been identified as one source of chlorinated volatile organic compounds (cVOCs) within the broader YRRA plume.

2.4 Previous Environmental Investigations and Interim Cleanup Actions

Ecology first inspected the Site in 1985 due to complaints of sludges being disposed in the back parking lot. Subsequent site inspections by Ecology in 1987 and 1989 detected PCE in soil. Soil samples collected during the 1989 UST excavations contained PCE up to 10 milligrams per kilogram (mg/kg) at depths to 12 feet bgs.

A remedial investigation (RI) of the Site was performed during 1995. A 25-point soil vapor survey was completed on the Site in January 1995, and PCE was detected in every sample ranging from 7 to 727 micrograms per liter (µg/L) of air. The dry cleaner building was still present during the soil vapor sampling (the building was demolished in 2000 and concrete floor removed in 2001) so soil vapor sampling did not include areas under the building. These results suggested two main sources of the PCE; one beneath the northeast corner of the property near a plumbing access trench, and the other at the northwest corner of the former building near the former heating oil UST. However, because sampling did not occur under the building, PCE sources within or around (or due north) of the building footprint are suspected to be more significant than those sources indicated by this soil vapor study.

During the RI, four shallow monitoring wells were installed and screened from 10 to 35 feet bgs. In September 1995, 610 tons of soil was excavated from 3 to 12 feet bgs from the former heating oil UST area with the extent based on confirmation soil sampling.

A five-well ozone sparging system intermittently operated during 1997 and 1998 with inconclusive results. In 2000, the Frank Wear building was demolished and in 2001, an additional 432 tons of soil were removed from within the building

footprint. In 2005, four of the five original 4-inch diameter ozone sparging wells were converted to monitoring wells and five new additional 2-inch diameter monitoring wells were installed at the Site. Locations of the 14 monitoring wells installed prior to 2012 are shown on Figure 2.

2.5 Summary of Groundwater Monitoring Results

The Site's monitoring well network currently consists of 24 on- and off-property wells (Figure 2). Twenty one of these wells are shallow wells installed at depths of approximately 35 feet bgs to monitor conditions in the shallow alluvial aquifer. Three wells are deep wells installed to approximately 90 feet bgs to monitor vertical migration to the deeper zones of the surficial aquifer.

Fourteen of the monitoring wells were installed between 1995 and 2005 and were intermittently monitored by various parties through 2005. Ecology conducted quarterly monitoring in these 14 wells from July 2005 through 2007, and resumed quarterly monitoring in April 2012. Ten new wells were installed and sampled in June 2012. All of the monitoring wells were sampled in September 2012, December 2012, and March 2013.

Results of the June 2012 and December 2012 groundwater monitoring events are illustrated on Figure 3 and Figure 4, respectively. Figure 4 shows that PCE concentrations up to 44,000 µg/L remain in groundwater beneath the Site (MW-10) and remain elevated at downgradient locations from the Frank Wear property along West Walnut Street (270 µg/L in MW-4) and along South Third Avenue (170 µg/L in MW-24). Other cVOCs that were detected in the 2012 groundwater monitoring events included chloroform, *cis*-1,2-dichlorothene (cDCE); trichloroethene (TCE); and 1,1,1,2-tetrachloroethane.

Historically, PCE concentrations were detected up to 43,500 µg/L in monitoring well MW-10 on the property within the footprint of the former dry cleaning building. Groundwater samples from monitoring wells SPW-12, SPW-13, and SPW-15 in both previous and recent monitoring events have had high concentrations of PCE. Off-property monitoring wells MW-3 and MW-4 along West Walnut Street historically have had high concentrations of PCE in groundwater when the groundwater flow direction was primarily to the south. MW-3 had a PCE concentration of greater than 1,500 µg/L in the April 2006 and April 2007 monitoring events, and MW-4 had a PCE concentration of 1,900 µg/L in the April 2012 monitoring event.

2.6 Recent Soil Vapor Investigation and Interim Cleanup Action

In July 2011, Ecology became aware that a day care center operated on the Site. A review of existing groundwater data indicated that PCE vapors might enter the building and create a potential health risk to children. Two rounds of indoor air monitoring were performed at the Buckle My Shoe Early Learning Center, located at 108 South Third Avenue in Yakima in September and October 2011. The results of the indoor air sampling indicated PCE vapors were present in the building and have impacted indoor air quality (Kennedy/Jenks Consultants, 2011). Based on these results, Ecology determined an interim cleanup action was needed to reduce the concentration of PCE vapors in the building and treat the contamination below the building.

A soil vapor extraction (SVE) system was installed in April 2012 as a mitigation and interim cleanup measure. The soil vapor extraction system captures and removes PCE vapors before they enter the building. This lowers the indoor air PCE levels and reduces the mass of PCE in the soil. Ecology performs periodic air monitoring to confirm that the soil vapor extraction system is working as expected.

2.7 Recent Data Gap Investigation and Results

Ecology recently completed a Data Gap Investigation to address data gaps with respect to delineating cVOC contamination in soil and groundwater at the Site. The FS completed for the Site in 2007 identified *in situ* bioremediation as the presumed preferred groundwater remedy for the Site (Hart Crowser 2007). In order to successfully develop and execute this *in situ* bioremediation approach, shallow cVOC plume delineation and baseline bioremediation assessments were necessary to finalize a design. The specific objectives of this data gap investigation included multi-depth soil characterization; shallow cVOC plume delineation; deep groundwater zone contamination characterization; and baseline bioremediation evaluation.

The Data Gap Investigation was completed from March through June 2012 and included the installation of eight exploratory borings with the collection of soil and groundwater samples; installation of seven new shallow wells (35 feet bgs) and three new deep monitoring wells (90 feet bgs); and sampling of the new and existing monitoring wells (24 wells total). The investigation results are highlighted below:

- Field observations and sampling of soil collected during the soil exploratory borings and monitoring well installations suggest PCE migration to depths between 40 and 60 feet below ground at and near the Frank Wear property.

- Results of the groundwater monitoring for shallow wells indicate the horizontal extent of the PCE contamination extends from the Frank Wear property to the downgradient wells MW-24 and MW-21 (Figure 3). The highest detected PCE concentration in groundwater during the April 2012 sampling event was at MW-9, located off-property to the south near the children's daycare center, indicating that some of the PCE mass may have migrated to the south from the high-concentration source areas around MW-10. MW-4 also had high concentrations of PCE, possibly indicating mass migration. The recent groundwater monitoring results from December 2012 show that the highest PCE concentrations were at MW-10 and SPW-15, indicating that significant PCE mass remains in former source areas (Figure 4).

- With the exception of the MW-1, MW-6, and SPW-14 wells, groundwater samples from all of the Site shallow monitoring wells exceeded the MTCA Method B Cleanup Level for PCE of 5.0 micrograms per liter (µg/L).

- PCE was detected in the on-property deep well MW-18, suggesting vertical migration at depth. However, PCE was not detected in the downgradient deep well MW-19, indicating off-site migration in the deeper zone does not appear to be occurring.

- The bioremediation data assessment indicates the subsurface conditions are favorable for an enhanced *in situ* bioremediation groundwater remedy. The bioremediation remedy utilizing a reductive dechlorination process is anticipated to be the most effective in reducing PCE concentrations to below cleanup levels.

- The proposed groundwater remedy using enhanced *in situ* bioremediation with a recirculation system to deliver amendment as described in the FS is still appropriate for the Frank Wear Site. It appears the most effective operation of a recirculation system may be during periods of high water during the irrigation season to more effectively target the contaminants that are vertically distributed throughout the soil matrix and shallow aquifer.

3.0 CLEANUP STANDARDS, AREAS OF CONCERN, AND POINTS OF COMPLIANCE

Cleanup standards, as defined in WAC 173-340-700, for the Site include establishing cleanup levels and points of compliance at which the cleanup levels will be attained for the Site. The cleanup standards have been established for the

Site in accordance with MTCA (WAC 173-340-700 through 173-340-760) and are presented in the following sections. This section also describes the areas of concern (AOC) for soil and groundwater contamination. These areas of concern were established during the FS for purposes of determining the targeted areas where the remedial alternatives would be applied.

3.1 Cleanup Levels

Cleanup levels in general are derived from the lowest contaminant concentration that is protective of human or ecological health from MTCA Method B, state surface water quality criteria (WAC 173-201A), Clean Water Act Section 304, or the National Toxics Rule (40 CFR 131) criteria. For the Frank Wear Site, Ecology established the cleanup levels (CULs) for the cVOC contaminants of concern in indoor air, soil, and groundwater at the Site primarily based on MTCA Method B criteria. These CULs for indoor air, soil, and groundwater are provided in Table 1.

The indoor air CULs were determined using MTCA Standard Method B criteria for air (WAC 173-340-750(3)). The soil CULs were determined using the fixed three-phase partitioning model (WAC 173-340-747(4)) and site-specific soil fraction of organic carbon data to calculate the soil concentration that is protective of groundwater. The groundwater CULs were established for the protection of the groundwater as a drinking water source and based on the MTCA Method B cleanup levels, with the exception of the CUL for PCE, which is a site-specific level established for the Site and is based on the federal maximum contaminant level (MCL) standard for drinking water. The AOCs where soil and groundwater contaminants exceed these CULs are described in detail below.

3.2 Areas of Concern

3.2.1 Air Areas of Concern

Existing data from the Site indicate soil and groundwater have been impacted by PCE from the dry cleaning operations at the site. The PCE-impacted groundwater appears to extend below the adjacent Buckle My Shoe Early Learning Center building, providing the potential for vapor intrusion into this building and at downgradient properties. In September and October 2011, a vapor intrusion study was performed to evaluate whether vapor intrusion is occurring at the childcare center (Kennedy/Jenks Consultants, 2011). Air sampling in September 2011 consisted of the collection of four 24-hour indoor air samples from within the childcare center, two 24-hour ambient air samples

from outside and upwind of the building, and three subslab soil vapor samples from beneath the concrete slab. The September 2011 indoor air samples were collected under expected worse case conditions [i.e., windows and doors shut, heating, ventilation and air conditioning (HVAC) system turned off, etc.]. Ambient, indoor air, and subslab vapor samples were analyzed for volatile organic compounds (VOCs) using U.S. Environmental Protection Agency (EPA) Method TO-15 with selected compounds analyzed in selective ion monitoring (SIM) mode.

A second round of indoor air samples was conducted in October 2011, and included the collection of 12-hour ambient indoor air samples under normal building operating conditions (i.e., building is ventilated with ceiling fans, HVAC system is running, etc.). Results of the vapor intrusion study are as follows:

- For the September 2011 sampling event, PCE was detected in indoor air vapor samples ranging from 5.7 to 6.6 micrograms per cubic meter (µg/m^3), above the Model Toxics Control Act (MTCA) Method B cleanup level of 0.42 µg/m^3. PCE concentrations in October 2011 indoor air samples were similar to those measured during the first sampling event. PCE was not detected in ambient air samples.

- PCE was detected in subslab vapor samples at concentrations ranging from 3,600 to 50,000 µg/m^3, above the MTCA Method B cleanup level of 4.2 µg/m^3.

Based on these results, the air areas of concern include both the indoor and subslab areas of the Buckle My Shoe Early Learning Center building.

3.2.2 Soil Areas of Concern

Recent soil sampling completed during the 2012 Data Gap Investigation shows that both on-property and off-property areas contain soils with concentrations of PCE above the established CUL of 19.6 micrograms per kilogram (µg/kg). Soil samples were collected from soil borings at various depths, ranging from 16 feet to 35 feet, depending upon field screening results. Soil samples were also collected during the installation of three deep monitoring wells from various depths, ranging from 16.5 feet to 93 feet, depending upon field screening results.

For the on-property area, soils exceeded the PCE CUL to depths of approximately 40 feet bgs within the footprint of the former dry cleaning building. For the off-property areas, soils were found impacted above the PCE CUL to depths of

approximately 30 feet bgs in a boring installed south of West Walnut Street, and to depths of approximately 40 feet bgs in the CWCMH facility parking lot. Soil samples from an upgradient boring location near West Chestnut Avenue also exceeded the PCE CUL to depths of approximately 35 feet bgs. These results indicate that soil contamination extends vertically into the smear zone (the area between the high and low water table elevations) as well as into the upper portion of the saturated zone (shallow water table aquifer).

The results of soil sampling conducted before 2012 through site characterizations and post-excavation confirmation sampling did not identify any areas where contaminants exceeded their respective CULs. However, the 2007 FS developed and evaluated an alternative that addressed potential source area soils as an AOC due to concerns that high concentrations of PCE remained in the soil, either as residual contamination sorbed to the soil mass or as a dense, non-aqueous-phase liquid (DNAPL), acting as a continuing source of the PCE in groundwater.

3.2.3 Groundwater Areas of Concern

An evaluation of the 2012 groundwater monitoring data indicates that PCE concentrations have exceeded the CUL of 5.0 µg/L in at least 20 of the Site's 21 shallow monitoring wells. Monitoring well MW-6 is the only shallow monitoring wells where PCE concentrations do not exceed the CUL. The deep well MW-18 contained concentrations of PCE above the CUL in the third quarter of 2012. No other contaminant exceeded their CUL in the shallow or deep wells indicating that PCE remains the primary contaminant of concern at Site.

The groundwater plume as defined by the 5.0 µg/L PCE CUL currently extends beyond the property boundaries to the east and south. The full extent of the plume beyond the current Site monitoring well network is unknown and potentially influenced by contributions from other sources in the YRRA.

The groundwater AOC targeted for remediation includes those areas where PCE concentrations are the highest and where remediation can more cost-effectively address contaminant mass. These areas include the Frank Wear property, as well as the children's daycare facility and the CWCMH properties to the south. The AOC is therefore, defined as the area from the northern edge of the Frank Wear property south to the south side of West Walnut Street, and is bounded by the alley to the west and South Third Avenue to the east (see Figure 4). The total area occupied by the AOC is approximately 51,000 square feet. Of that total, the Frank Wear property occupies approximately 8,800 square feet.

The vertical extent of the contaminant plume based on the recent Data Gap Investigation is estimated to be approximately 40 feet bgs. Assuming an average thickness of the plume of 40 feet and a porosity of 0.35, the volume of impacted groundwater beneath the Frank Wear property is approximately 1 million gallons. The total groundwater volume within the groundwater AOC is estimated to be approximately 5.3 million gallons.

3.3 Points of Compliance

This IAP has established points of compliance for soil (WAC 173-340-740(6)) and groundwater (WAC 173-340-720 (8)) at the Site. These are described in the following sections.

3.3.1 Air Points of Compliance

The point of compliance for air is throughout the Site (WAC 173-340-750 (6)).

3.3.2 Soil Points of Compliance

The point of compliance for soil is the soil overlying groundwater throughout the property for the protection of groundwater and ambient air, and from the ground surface to a depth of 15 feet bgs for the protection of human health based on direct contact exposure.

3.3.3 Groundwater Points of Compliance

The point of compliance for groundwater is the standard point of compliance per WAC 173-340-720 (8)(a) & (b), which is established throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by Site contaminants. The CULs will be attained in all groundwater from the point of compliance to the outer boundary of the Site plume.

4.0 ALTERNATIVES DEVELOPMENT AND EVALUATION

Ecology completed an FS for the Frank Wear Cleaners Site in July 2007 for the purpose of developing and evaluating various cleanup action alternatives that would reduce or mitigate current and potential future risks to human health and the environment associated with contamination in soils and groundwater at the Site (Hart Crowser 2007). The FS identified an *in situ* bioremediation alternative

as the selected cleanup action because it satisfied the minimum MTCA selection criteria, and was the most technically feasible and least-costly option for addressing the Site contamination. A summary of the remedial action alternatives developed in the FS, description of the evaluation of alternatives, summary of the selected interim action and the rationale for its selection, and an evaluation of the selected interim action are provided in the following sections.

4.1 Summary of Remedial Alternatives

The following remedial alternatives were developed and evaluated in the FS based on direction from Ecology:

- Alternative 1 — Containment with and without Groundwater Treatment;
- Alternative 2 — *In Situ* Treatment with and without Natural Attenuation; and
- Alternative 3 — Source Control and Treatment.

The development of these alternatives included an initial step of identifying and screening potential remedial technologies for soil and groundwater. A broad range of technologies were initially identified, then screened based on technical practicability, effectiveness, and cost.

4.1.1 Alternative 1 – Containment With and Without Groundwater Treatment

This alternative consisted of the installation of a barrier wall to prevent, or to retard and treat, contaminated groundwater flowing from the Frank Wear property to adjoining properties. The barrier wall system was to be operational until the contaminant concentrations were low enough that natural attenuation would further reduce the concentrations to below the groundwater CULs.

Several variations of Alternative 1 were developed based on different types and configurations of barrier walls, and groundwater extraction and treatment requirements. All variations of Alternative 1 included institutional controls and compliance monitoring.

4.1.2 Alternative 2 – *In Situ* Treatment

Alternative 2 involved *in situ* treatment of soil and groundwater impacted by PCE and other cVOCs. This alternative considered the following combinations of remedial technologies and delivery methods:

- Alternative 2A – Air sparging and soil vapor extraction combined with ozone injection;
- Alternative 2B – Bioremediation through application of nutrients and chemical substrates;
  - Variation 1 – Delivery through permanent injection wells;
  - Variation 2 – Delivery via a groundwater recirculation system;
- Alternative 2C – Chemical oxidation using permanganate;
  - Variation 1a – Delivery through permanent injection wells;
  - Variation 1b – Injection through temporary borings; and
  - Variation 2 – Delivery via a groundwater recirculation system.

The *in situ* treatment options described in Alternative 2 would be implemented to treat property-specific impacted soil and groundwater. Treatment would extend to neighboring properties either incidentally due to groundwater flow, or by conceptual design requirements to install treatment system infrastructure on the neighboring properties. *In situ* treatment would continue until it is determined that the maximum practicable amount of contamination has been removed. The various *in situ* treatment options could be applied as stand-alone actions or in successive combination with each other as a treatment train. *In situ* treatment could also be coupled with Alternatives 1 or 3. All variations of Alternative 2 included institutional controls and compliance monitoring.

4.1.3 Alternative 3 – Source Control and Treatment

Alternative 3A considered the further characterization, excavation, removal, and disposal of contaminated soil from the Frank Wear property. A variation of this, Alternative 3B, considered follow-up *in situ* soil treatment subsequent to excavation of most of the contaminated soil. All variations of Alternative 3 included institutional controls and compliance monitoring.

The intent of this alternative was to remove the remaining sources of contaminants in soil on the Frank Wear property. Based on past characterization, removals, and groundwater monitoring, contamination appeared to be distributed between the west end of the property, and under and to the north of the former building. The high concentrations of PCE in groundwater in wells MW-10, SP-12, and SP-13 indicated possible residual contamination acting as a source in these areas. The purpose of this alternative was to address residual contamination that was potentially missed by previous removal actions.

4.2 Evaluation of Alternatives

The remedial alternatives were evaluated using the cleanup action selection criteria specified in MTCA regulation (WAC 173-340-360). The purpose of the evaluation was to identify the advantages and disadvantages of each alternative, and determine and select the alternative that most closely satisfies the MTCA criteria. The specific criteria are all considered important, but they are grouped into three sets of criteria that are weighted differently in the decision-making process. These criteria are:

- Threshold requirements:
  - Protect human health and the environment;
  - Comply with cleanup standards (WAC 173-340-700 through 173-340-760);
  - Comply with applicable state and federal laws (WAC 173-340-710); and
  - Provide for compliance monitoring (WAC 173-340-410 and 173-340-720 through 173-340-760).
- Other requirements:
  - Use permanent solutions to the maximum practical extent. If a disproportional cost analysis is used, then evaluate:
    - Protectiveness;
    - Permanence;
    - Cost;
    - Effectiveness over the long term;
    - Management of short-term risks;
    - Technical and administrative implementability; and
    - Consideration of public concerns.
  - Provide a reasonable restoration time frame.

An alternative must meet all of the threshold criteria to be eligible for selection as a Site remedy. The expected performance of each alternative was assessed to identify its ability to comply with cleanup standards and applicable state and federal laws. If the alternative was considered to comply, the subsequent evaluation of the alternative was based on the remaining eight evaluation factors. The alternative that most closely satisfied all of these criteria was selected as interim action for the Site.

4.3 Summary of Selected Interim Action and Rationale for Selection

Based on the evaluation of all of the alternatives, a variation of Alternative 2B involving *in situ* bioremediation using a groundwater recirculation system with a

soluble remediation substrate (amendment) and soil vapor extraction provided the lowest cost alternative that was protective and satisfied the MTCA evaluation criteria described above. Other components of the selected alternative include natural attenuation, compliance monitoring, and institutional controls.

In this alternative, groundwater is continuously extracted from downgradient extraction wells, amended with substrate consisting of electron donors and nutrients to promote biological degradation of the contaminants, and reinjected into the subsurface at upgradient injection wells to create a recirculation cell. *In situ* bioremediation is a well-established remediation technology that is effective in reducing contaminant mass and concentrations in soil and groundwater through the conversion and destruction of cVOC contaminants, and desorption of contaminants bound to the soil. Substrate delivery via recirculation provides an effective and flexible option for ensuring treatment of contaminants throughout the treatment zone.

The *in situ* bioremediation alternative using groundwater recirculation directly reduces the quantity, toxicity, and volume of contaminants in soil and groundwater by either removing the contaminants from the subsurface or by destroying the contaminant mass in place. Because this alternative results in substantial destruction of contaminants *in situ*, it provided greater protection of human health and the environment, greater permanence, better effectiveness over the long term, and shorter restoration time frames when compared to Alternatives 1 and 3. The *in situ* bioremediation alternative using groundwater recirculation was the least costly of all the alternatives.

The SVE system was installed in April 2012 as an interim cleanup action designed to mitigate vapor intrusion into Site buildings and remove VOC mass from the subsurface. The implementation of the SVE system is consistent with the selected *in situ* bioremediation groundwater alternative and will augment the groundwater cleanup action and enhance the remediation timeframe through the removal of VOCs from the vadose zone.

4.4 Updated Evaluation of Selected Interim Action

The objectives of the recently-completed Data Gap Investigation included delineating the shallow cVOC groundwater plume and assessing baseline bioremediation conditions to further develop the technical details of the *in situ* bioremediation alternative. The Data Gap Investigation confirmed that the proposed groundwater remedy using enhanced *in situ* bioremediation with a recirculation system to deliver amendment as described in the FS is still appropriate for the Frank Wear Site. The bioremediation data assessment indicated that subsurface conditions are favorable for an enhanced *in situ*

bioremediation groundwater remedy and that the bioremediation remedy utilizing a reductive dechlorination process is anticipated to be effective in reducing PCE concentrations to below CULs.

The proposed *in situ* bioremediation alternative using a groundwater recirculation system as presented in the FS was further developed based on the information obtained from the Data Gap Investigation. A description of this alternative with these new developments is provided in Section 5.1.

An updated cost estimate based on the new details of the proposed alternative was completed. The total estimated cost for this alternative, including capital and long-term compliance monitoring costs, ranged from $768,700 for an equipment lease option to $804,900 for an equipment purchase option. These revised costs are comparable to the FS cost estimate for this alternative, and are still less than all other alternatives evaluated in the FS.

5.0 SELECTED INTERIM ACTION

The selected interim action for the Site includes enhanced *in situ* bioremediation using groundwater recirculation, natural attenuation, compliance monitoring, and institutional controls; in combination with soil vapor extraction.

A description of the selected interim action components, including the *in situ* bioremediation, natural attenuation, compliance monitoring, and institutional controls; how the selected interim action satisfies MTCA criteria, including the threshold requirements, permanent solutions, and the restoration time frame; compliance with applicable local, state, and federal laws; and completion of cleanup are provided in the following sections.

5.1 Interim Action Description

The selected interim action includes several components which are described below.

5.1.1 *In Situ* Bioremediation Using Groundwater Recirculation System

The *in situ* bioremediation groundwater recirculation system is the primary component for the Frank Wear Site interim action. The current assumptions and system parameters are based on the recent results of the Data Gap Investigation and quarterly groundwater monitoring completed at the Site in 2012.

The key component for the *in situ* bioremediation approach is a groundwater recirculation system. For this alternative, 10 new wells are installed for the recirculation system and two of the existing monitoring wells would be converted to extraction/injection wells. A conceptual design of the recirculation system for the Site is shown on Figure 5.

The recirculation system will continually extract groundwater from downgradient extraction wells and convey it to a remediation building where it is amended with a substrate consisting of electron donors and nutrients that stimulate the reductive dechlorination process. Reductive dechlorination sequentially converts PCE to TCE, cDCE, and vinyl chloride (VC), and eventually to ethene and ethane gas, end products that are essentially harmless and easily broken down by other indigenous bacteria. The amended groundwater is injected into upgradient wells to create a recirculation cell. This approach results in the fastest and best contact between amendments and contaminants, captures reinjected amendments, provides downgradient hydraulic control, and accelerates Site cleanup. This approach also is an effective method for addressing contaminant sources under buildings, such as the adjacent children's daycare center.

At the Frank Wear Site two recirculation treatment areas would be created. The first recirculation treatment area would consist of four new extraction wells installed to the south of the children's daycare center building, covered parking area, and garage (Figure 5). Groundwater is extracted from these four wells, pumped to the remediation building, amended, and injected into four new injection wells installed to the north (upgradient) of the Frank Wear property. To address the high levels of PCE at the north property boundary, such as the levels found in SPW-12 (2,300 µg/L), the injection wells will be installed approximately 40 feet to the north of the property boundary to allow amendment to be recirculated through this contaminated area.

The new extraction/injection wells are installed to 45 feet below ground surface to address contamination found in the deeper portions of the shallow aquifer. The amendment initially consists of complex lactates that act as a surfactant to remove PCE sorbed to the soil matrix and at the same time provide a carbon source (electron donors) needed for the reductive dechlorination process. This step is followed by additional electron donor additions, nutrients, and surfactants until the PCE and degradation products have been treated to acceptable levels. It is estimated that the recirculation system in the first treatment area would operate for approximately 12 months based on the area of contamination, estimated electron acceptor/contaminant mass, and existing oxidative state of the aquifer.

At the completion of operating the first recirculation treatment area, the second recirculation treatment area will become operational. The second recirculation treatment area consists of four extraction wells (two new and two existing wells (MW-3 and MW-4)) along the south side of the CWCMH building and West Walnut Street (Figure 5). Groundwater is extracted from these four wells, pumped to the remediation building, amended and injected into the four wells immediately south of the children's daycare center building (originally used for extraction wells in the first recirculation treatment area). Complex lactates are recirculated to remove PCE sorbed to the soil matrix and provide electron donors needed for reductive dechlorination. This step is followed by additional electron donor additions until the PCE and degradation products have been treated to acceptable levels. This treatment area would operate approximately 12 months, assuming adequate groundwater volume are extracted and reinjected at the Site.

5.1.2 Natural Attenuation

WAC 173-340-370 expects that natural attenuation of hazardous substances may be appropriate where source control has been conducted to the maximum extent practicable and where there is evidence that natural biodegradation or chemical degradation is occurring and will continue to occur at a reasonable rate at the Site.

Natural attenuation is a component of the selected interim action and will be implemented after the operation of the groundwater recirculation system. The operation of the groundwater recirculation system with amendment addition will create reductive conditions in the subsurface that are favorable to the natural attenuation of cVOC contaminants. These reductive subsurface conditions are anticipated to be maintained for at least a year or more after the recirculation system is turned off through the consumption of residual amendment and the decay of subsurface biomass built up during the recirculation period. These reducing conditions in the subsurface promote further reduction of the contaminants through the natural attenuation process.

5.1.3 Compliance Monitoring

Compliance monitoring is a component of the selected interim action and is planned in accordance with WAC 173-340-410. Compliance monitoring will include protection, performance, and confirmational monitoring as described below.

Protection Monitoring. Protection monitoring will be performed to confirm that human health and the environment are adequately protected during the

construction phase and operation and maintenance period of the interim action. Protection monitoring will be addressed through the development of Health and Safety Plans (HSP) for each of the construction and operation and maintenance phases. Each HSP will be developed in accordance with WAC 173-340-810 and include a monitoring plan for anticipated chemical and/or physical hazards associated with the work.

Performance Monitoring. To confirm that the interim action has attained cleanup standards and other performance standards performance monitoring will be performed. An Operation, Maintenance, and Monitoring Plan (OMMP) will be developed during the remedial design phase to include the performance monitoring requirements. The OMMP will describe planned monitoring and discuss the duration and frequency of monitoring activities, the trigger for contingency response actions, and the rationale for terminating monitoring. The OMMP will include a Sampling and Analysis Plan meeting the requirements of WAC 173-340-820 to describe the sample collection, handling, and analysis procedures to be used for all planned sampling.

Performance monitoring of the bioremediation process is anticipated to be performed for a duration of 36 months from the recirculation system startup to evaluate effectiveness of the treatment process in attaining cleanup standards. Monitoring will likely include sampling key wells for cVOCs, nitrate, sulfate, and methane, ethane and ethane parameters to evaluate the effective of the bioremediation processes.

Confirmational Monitoring. Confirmational monitoring will be performed to confirm the long-term effectiveness of the interim action once performance standards have been obtained. Confirmational monitoring requirements will be included in the OMMP.

Post-treatment compliance monitoring will be implemented for a minimum period of 2 years following the treatment performance monitoring period to ensure treatment goals are being attained. Monitoring includes semi-annual sampling of all 25 Site wells for cVOCs, nitrate, and sulfates.

5.1.4 Institutional Controls

One or more institutional controls will be required per WAC 173-340-440 to limit activities on the property that may interfere with the integrity of the interim action or that may result in exposure to hazardous substances. A restrictive covenant will be placed on the properties within the AOC to prohibit activities on the properties that may interfere with the operation, maintenance, and

monitoring of the groundwater recirculation system. The covenant will be recorded prior to installation of the recirculation system described in this IAP.

5.1.5 Soil Vapor Extraction System

The SVE system consists of a network of five vapor extraction wells, piping, a vacuum blower, and granular activated carbon (GAC) treatment units for extracted vapor. Treated vapors are discharged to the atmosphere. The SVE system components including the extraction wells, piping, vacuum blower and associated equipment, and the GAC treatment units are described in detail in the Final Soil Vapor Extraction System Interim Action Plan (Kennedy/Jenks, 2012). This report includes figures showing locations of the wells, piping layout, equipment building, and treatment units.

5.2 Satisfaction of MTCA Criteria

The selected interim action satisfies the MTCA criteria in WAC 173-340-360 for the selection of cleanup actions. Ecology has determined that the selected interim action is protective of human health and the environment, complies with cleanup standards, complies with federal and state requirements that are applicable or relevant and appropriate, and provides for compliance monitoring.

A discussion of how the selected interim action meets the specific MTCA minimum requirements is provided below.

5.2.1 Threshold Requirements

It has been determined through the FS evaluation that the selected interim action meets the threshold requirements of WAC 173-340-360(2)(a). Specifically, the selected interim action will:

(i) Protect human health and the environment;

(ii) Comply with cleanup standards;

(iii) Comply with applicable state and federal laws; and

(iv) Provide for compliance monitoring

5.2.2 Permanent Solutions

The selected interim action also meets the regulatory requirements for a "permanent solution to the maximum extent practicable" per WAC 173-340-360 (2)(b)(i). Specifically, the proposed interim action includes the following

components, which together meet this MTCA requirement: (1) removal of the source through *in situ* treatment; (2) minimization of the potential for ingestion of groundwater by institutional controls; and (3) elimination of greater overall threat to human health and the environment by treatment of impacted groundwater.

The determination of whether the interim action uses permanent solutions to the maximum extent practicable was completed during the FS in accordance with WAC 173-340-360(3). The selected interim action is considered to be a "permanent solution to the maximum extent practicable" because it (1) protects human health and the environment; (2) provides high degree of reduction of the contaminant mobility and volume; (3) provides for long-term and short-term remediation effectiveness; (4) manages short-term risks; and (5) can be implemented with consideration given to the restrictions imposed by existing structures and subsurface conditions. The selected alternative has incorporated prevention or minimization of present or future releases by treating the contaminant source in soil and groundwater, treating impacted groundwater, and monitoring the effectiveness of natural attenuation on the remaining impacted soil and groundwater.

Based on evaluation of these factors, and the specific subsurface soil and groundwater conditions existing at the Site, the soil vapor extraction and *in situ* bioremediation alternative using a groundwater recirculation system with amendment injections, natural attenuation, compliance monitoring, and institutional controls is considered to be the most permanent to the maximum extent practicable of all the alternatives evaluated.

5.2.3 Restoration Time Frame

As required by WAC 173-340-360(2)(b)(ii), a cleanup action shall provide for a reasonable restoration time frame by considering the following factors specified in WAC 173-340-360(4)(b):

(i) Potential risks posed by the Site to human health and the environment;

(ii) Practicability of achieving a shorter restoration time frame;

(iii) Current uses of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site;

(iv) Potential future uses of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site;

(v) Availability of alternative water supplies;

(vi) Effectiveness and reliability of institutional controls;

(vii) Ability to control and monitor migration of contamination;

(viii) Toxicity of the hazardous substances; and

(ix) Natural processes which reduce concentrations of the hazardous substances.

The proposed interim action takes into consideration all of the factors listed above. Any potential risk has been addressed through the use of institutional controls to prevent ingestion of groundwater during the reasonable restoration time frame, which has been estimated as 3 to 5 years. There is no practical remediation option which would result in a shorter time frame. The effectiveness of the institutional controls in the IAP will be evaluated, at minimum, every 5 years. A long-term monitoring plan will be developed to monitor the migration of contamination and demonstrate the effectiveness of *in situ* bioremediation and natural attenuation for the off-Property groundwater plume attributable to the Site. The toxicity of PCE contamination is well understood, *in situ* treatment processes are effective, and combined with monitored natural attenuation will be effective in reducing concentrations of cVOCs in groundwater to attain the CULs.

The expected performance of the *in situ* bioremediation alternative in attaining Site CULs within the AOC, and within a reasonable time frame is high. Based on experiences at other sites with similar geology and contaminant concentrations, it was estimated that this alternative would have a probability of 95 percent or more in attaining the CULs within a 3 to 5 year period. Although *in situ* bioremediation is a proven technology, its overall performance with respect to the degree of cleanup and remediation time frame will be a function of the Site geology and the ability to distribute amendment throughout the treatment zone, and the presence of residual or unknown sources of contaminants.

5.3 Compliance with Applicable Local, State, and Federal Laws

In accordance with WAC 173-340-710, the following local, state, and federal laws and requirements were identified as being applicable to the selected interim action:

- Underground injection control wells will be registered through Ecology for the injection of amendments into the groundwater as part of the operation of the groundwater recirculation system.
- City of Yakima Right of Way and Street Break permits will be required for the installation of new recirculation system wells and associated piping in the right of way locations, such as along West Walnut Street.

5.4 Completion of Interim Action

As previously described, the groundwater recirculation is estimated to operate for a period of 24 months, with performance monitoring occurring during this period and one additional year after the system is turned off to monitor changes in subsurface conditions. Confirmation monitoring will then be performed for an estimated 2 years following performance monitoring to verify that CULs have been attained. It is assumed that treatment goals will be met and maintained within 5 years of the recirculation system startup. Site closure will occur in Year 5 and include final reporting, system decommissioning, and well decommissioning. Well decommissioning may involve only some of the Site monitoring wells as some Site wells may be used for the YRRA area-wide monitoring program.

This interim action will be deemed complete when all components of the remedy, including institutional controls, are implemented and compliance with the CULs have been achieved with a minimum of 2 years of confirmation samples demonstrating attainment and maintenance of selected CULs at the points of compliance.

Following completion of the interim action, Ecology shall provide public notice and an opportunity for public comment prior to removing the Site from the Hazardous Sites List in accordance with WAC 173-340-330 (4), unless Ecology becomes aware of circumstances at the Site that present a previously unknown threat to human health and the environment.

6.0 INTERIM ACTION IMPLEMENTATION SCHEDULE

This interim action will be implemented in accordance with WAC 173-340-400. After the public comment period and issuance of the final interim action plan, remedial action plans and specifications will be developed for the selected interim action. These plans and specifications will be prepared for inclusion into bid documents for the Public Works bid process to select a construction contractor. After completion of the Public Works bid solicitation process and issuance of a contract to the selected contractor, the construction and installation of the groundwater recirculation system will begin.

The estimated schedule for the interim action design, construction, operation, and monitoring is summarized below:

■ Preparation of Remedial Action Plans and Specifications	November 2012 – April 2013
■ Public Work Bid Solicitation and Contracting Process	April – June 2013
■ Preparation of Health and Safety Plans for Construction and Operation and Maintenance Phases	April – June 2013
■ Preparation of Operation, Maintenance, and Monitoring Plan (OMMP)	April – June 2013
■ Construction and Installation of the Groundwater Recirculation System	July – August 2013
■ Groundwater Recirculation System Startup	August – September 2013
■ Groundwater Recirculation System Operation	September 2013 to May 2015
■ Performance Monitoring	September 2013 to May 2016
■ Confirmation Monitoring	September 2016 to May 2018

7.0 ECOLOGY PERIODIC REVIEWS

Periodic reviews will be conducted by Ecology to assess post-interim action site conditions and monitoring data in accordance with requirements of WAC 173-340-420 to assure that human health and the environment are adequately protected. Results of groundwater monitoring and other inspection and monitoring data obtained pursuant to the OMMP and other activities will be reviewed at a minimum of every 5 years. The overall efficacy and progress of remediation may be assessed at more frequent intervals, such as following annual monitoring. Notice of periodic reviews for public comment will be provided as deemed necessary.

Several review criteria are listed under WAC 173-340-420 to evaluate overall remedy effectiveness including engineered and institutional controls, new scientific information regarding hazardous substances, and new legal and regulatory requirements. These review criteria further consider Site and resource

use, availability and practicability of more permanent remedies, and new and improved analytical techniques.

These review findings will be used to assess the OMMP strategies, determine whether modifications are appropriate, and/or identify potential corrective actions. The scope and extent of revisions to the OMMP, and potentially to this IAP, will be determined based on results of the 5-year reviews.

8.0 REFERENCES

Hart Crowser, 2007. Feasibility Study Report, Frank Wear, Yakima, Washington. July 31, 2007.

Hart Crowser, 2012. Data Gap Investigation Report, Frank Wear Site, Yakima, Washington. September 18, 2012.

Kennedy/Jenks Consultants, 2011. Vapor Intrusion Study Report, Former Frank Wear Cleaners Site. November 4, 2011.

Kennedy/Jenks Consultants, 2012. Final Soil Vapor Extraction Interim Action Plan, Former Frank Wear Cleaners Site, Yakima, Washington. March 13, 2012.

Washington Administrative Code, Chapter 173-340, Model Toxics Control Act, Updated November 12, 2007.

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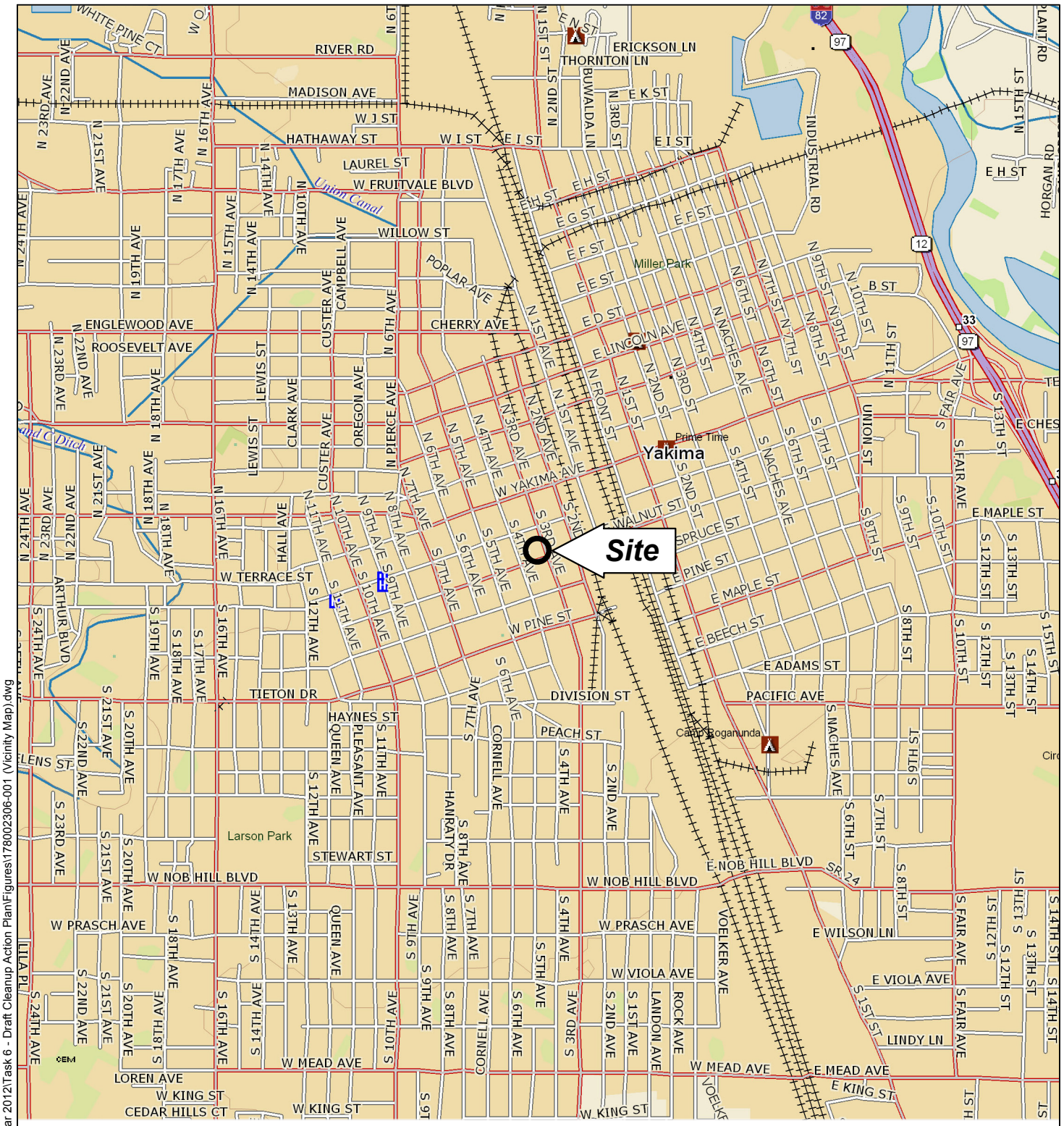
Table 1 – MTCA Method B Cleanup Levels (CULs)
Former Frank Wear Cleaners Site
Yakima, Washington

Chemical Group	Contaminant of Concern	Indoor Air CUL in $\mu g/m^3$	Soil CUL in µg/kg	Groundwater CUL in µg/L
VOC	Perchloroethylene (PCE)	0.42	19.6	5.0*
VOC	Chloroform	0.11	717	7.17
VOC	cis-1,2-dichloroethene	16	8,000	80
VOC	Trichloroethene (TCE)	0.1	398	3.98
VOC	1,1,1-trichloroethane	4,800	720,000	7,200
VOC	1,1,1,2-tetrachloroethane	0.34	168	1.68
VOC	1,2-dichlorobenzene	64	72,000	720
VOC	Chlorobenzene	8	16,000	160
VOC	1,2-dichloroethane	0.096	48.1	0.481
VOC	trans-1,3-dichloropropene	NA	24.3	0.243

* This is not a MTCA Method B Groundwater Cleanup Level, but a site-specific one.

NA = Not Established
$\mu g/m^3$ = micrograms per cubic meter
µg/kg = micrograms per kilogram
µg/L = micrograms per liter



Source: DeLorme Topo USA®.

Frank Wear Site
Yakima, Washington

Vicinity Map

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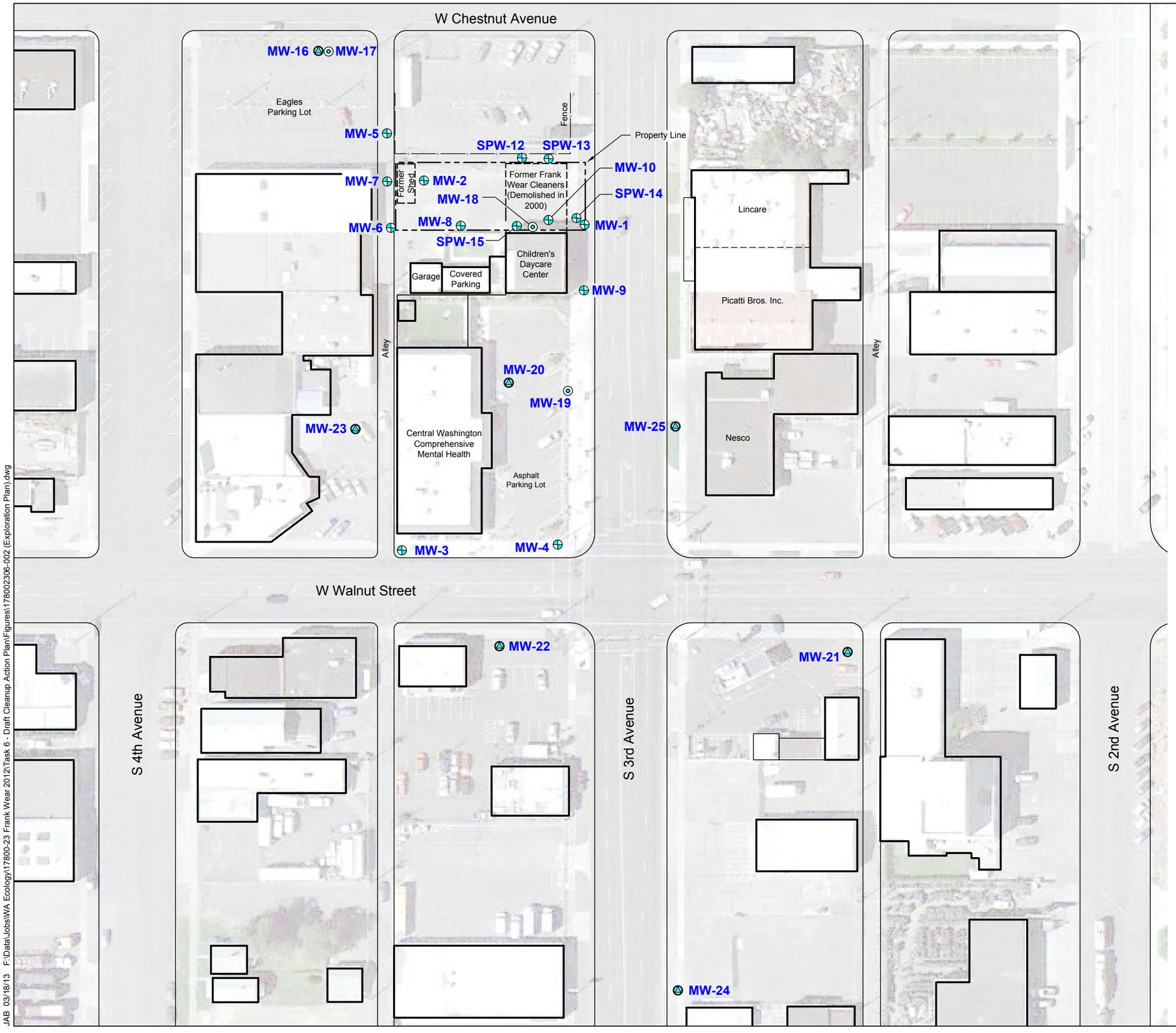
Figure
1

JAB 03/18/13 F:\Data\Jobs\WA Ecology\17800-23 Frank Wear 2012\Task 6 - Draft Cleanup Action Plan\Figures\178002306-001 (Vicinity Map).dwg



MW-5 Monitoring Well Location and Number - Pre-2012

MW-16 Shallow Monitoring Well Location and Number (35 ft.) - 2012

MW-17 Deep Monitoring Well Location and Number (90 ft.) - 2012

Source: Maxim 1995 PCE Concentration Plan, aerial photograph, site reconnaissance in July 2007, City of Yakima GIS.

Frank Wear Site
Yakima, Washington

Site Plan

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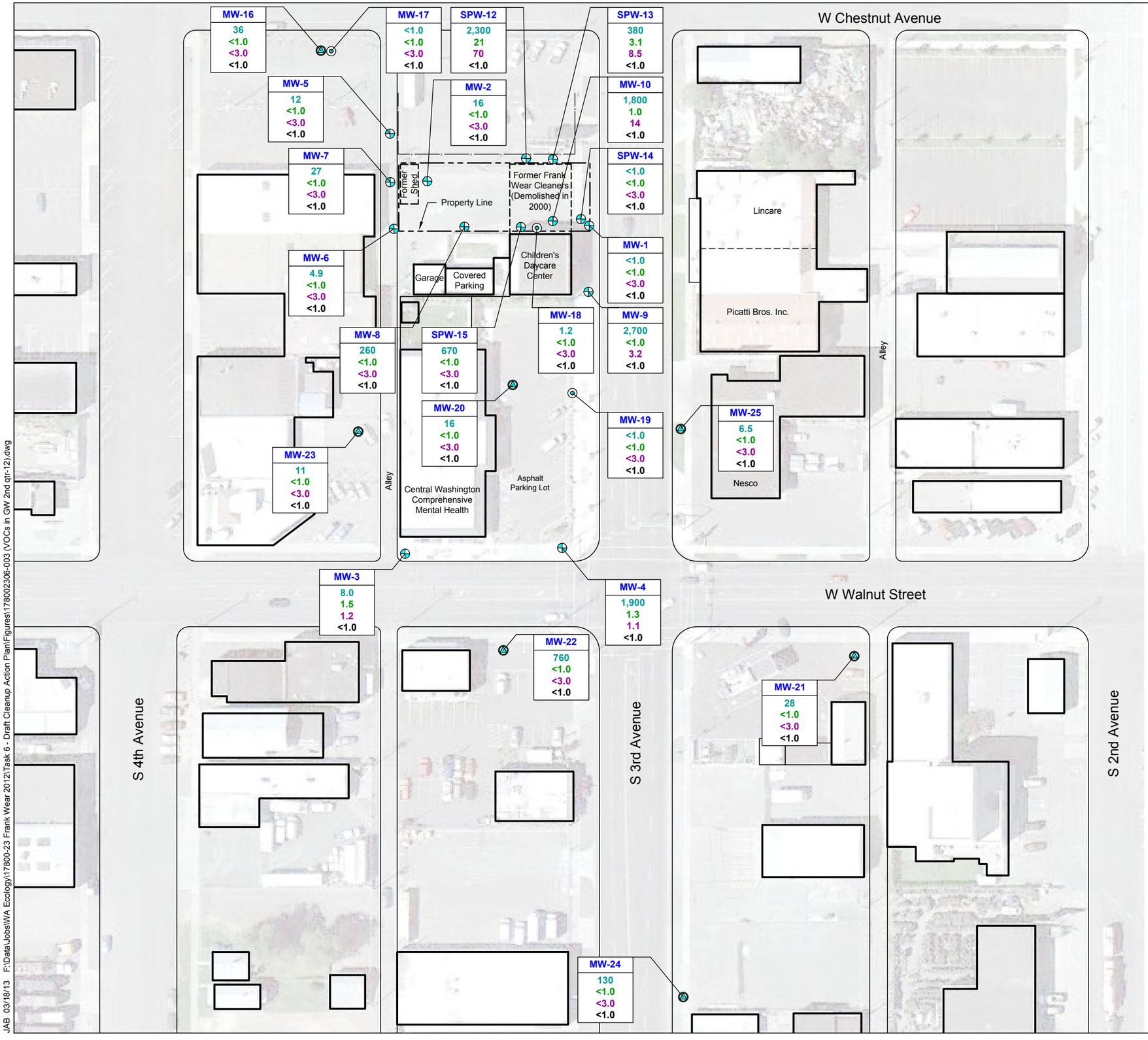
Figure **2**

JAB 03/18/13 F:\Data\Jobs\WA Ecology\17800-23 Frank Wear 2012\Task 6 - Draft Cleanup Action Plan\Figures\178002306-002 (Exploration Plan).dwg



MW-5 Monitoring Well Location and Number - Pre-2012

MW-16 Shallow Monitoring Well Location and Number (35 ft.) - 2012

MW-17 Deep Monitoring Well Location and Number (90 ft.) - 2012

Chlorinated VOC Concentrations in Groundwater:
(Concentrations Shown in µg/L)

SPW-15	Sample Identification
670	Tetrachloroethene (PCE)
<1.0	Trichloroethene (TCE)
<3.0	Total Dichloroethene (DCE)
<1.0	Vinyl Chloride (VC)

N

0 80 160

Approximate Scale in Feet

Source: Maxim 1995 PCE Concentration Plan, aerial photograph, site reconnaissance in July 2007, City of Yakima GIS.

Frank Wear Site
Yakima, Washington

Chlorinated VOCs in Groundwater - Second Quarter 2012

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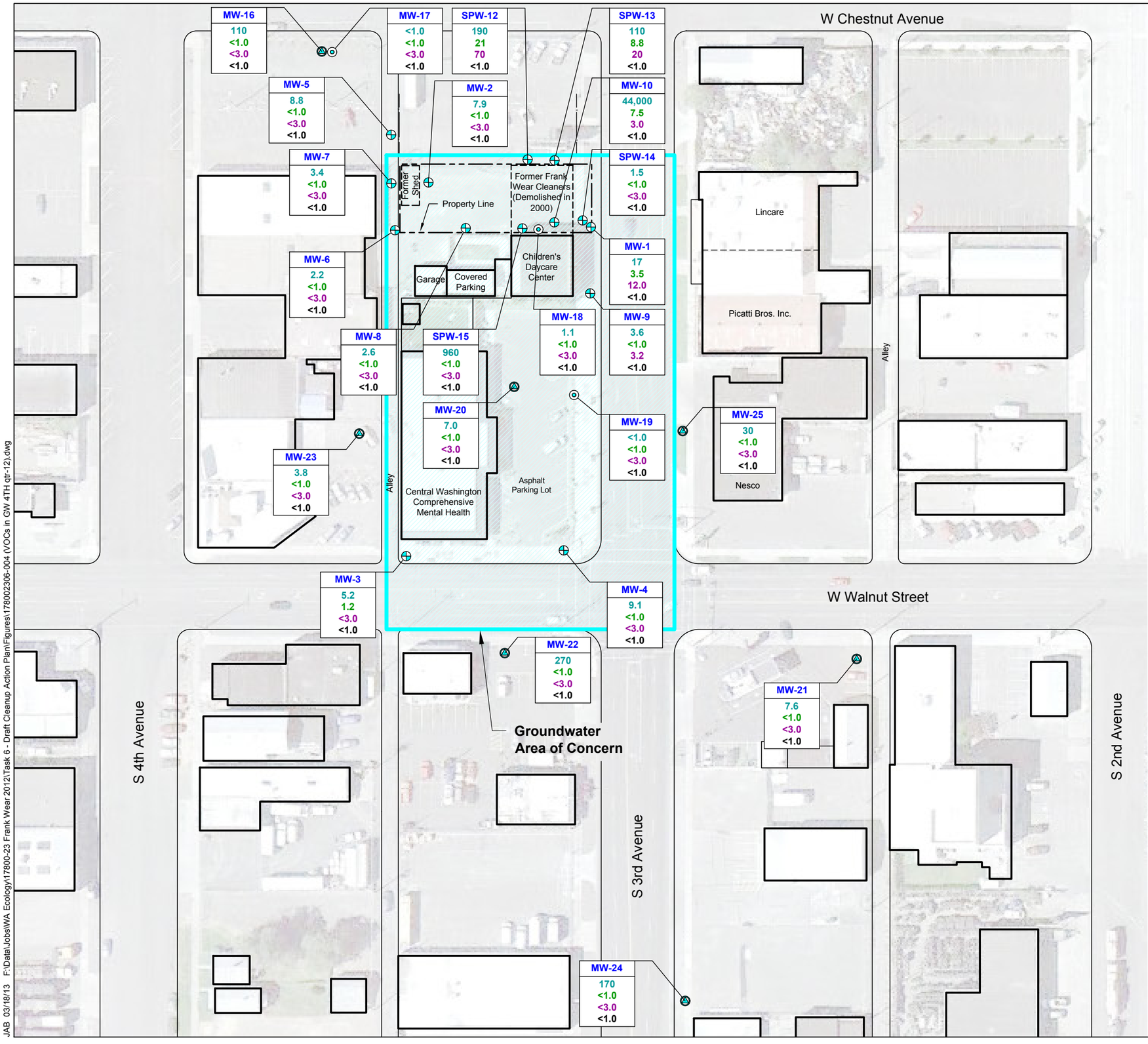
Figure 3

JAB 03/18/13 F:\Data\Jobs\WA Ecology\17800-23 Frank Wear 2012\Task 6 - Draft Cleanup Action Plan\Figures\178002306-003 (VOCs in GW 2nd qtr-12).dwg



MW-5 Monitoring Well Location and Number - Pre-2012

MW-16 Shallow Monitoring Well Location and Number (35 ft.) - 2012

MW-17 Deep Monitoring Well Location and Number (90 ft.) - 2012

Chlorinated VOC Concentrations in Groundwater:
(Concentrations Shown in µg/L)

SPW-15	Sample Identification
960	Tetrachloroethene (PCE)
<1.0	Trichloroethene (TCE)
<3.0	Total Dichloroethene (DCE)
<1.0	Vinyl Chloride (VC)

N

0 80 160

Approximate Scale in Feet

Source: Maxim 1995 PCE Concentration Plan, aerial photograph, site reconnaissance in July 2007, City of Yakima GIS.

Frank Wear Site
Yakima, Washington

Chlorinated VOCs in Groundwater - Fourth Quarter 2012

17800-23 3/13

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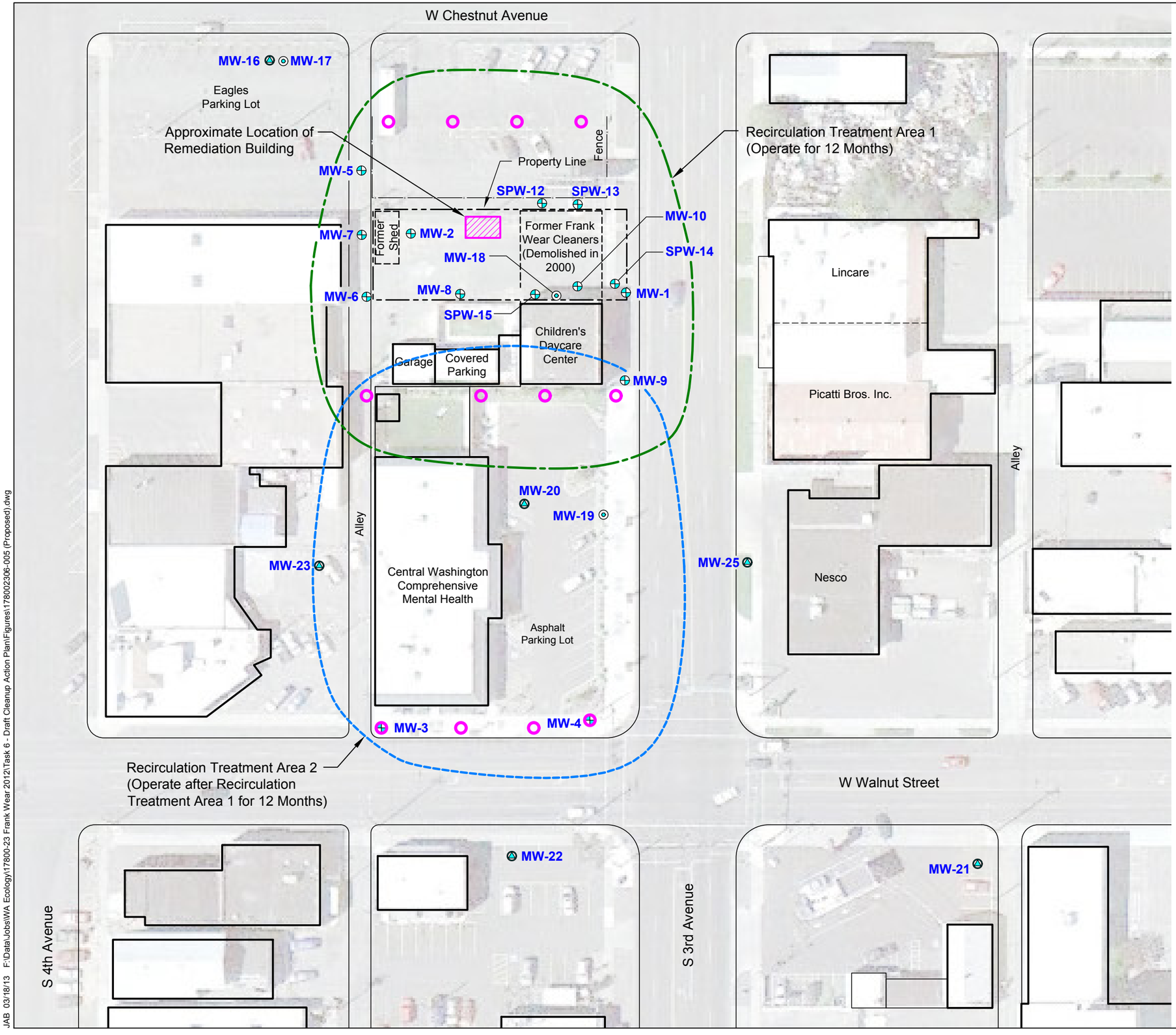
Figure **4**

JAB 03/18/13 F:\Data\Jobs\WA Ecology\17800-23 Frank Wear 2012\Task 6 - Draft Cleanup Action Plan\Figures\178002306-004 (VOCs in GW 4TH qtr-12).dwg



Proposed Injection/Extraction Well for Recirculation System

MW-5 Monitoring Well Location and Number - Pre-2012

MW-16 Shallow Monitoring Well Location and Number (35 ft.) - 2012

MW-17 Deep Monitoring Well Location and Number (90 ft.) - 2012

N

0 60 120

Approximate Scale in Feet

Source: Maxim 1995 PCE Concentration Plan, aerial photograph, site reconnaissance in July 2007, City of Yakima GIS.

Frank Wear Site
Yakima, Washington

Groundwater Recirculation System Conceptual Plan

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Figure 5

JAB 03/18/13 F:\Data\Jobs\WA Ecology\17800-23 Frank Wear 2012\Task 6 - Draft Cleanup Action Plan\Figures\178002306-005 (Proposed).dwg