ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

U.S. EPA Brownfield Cleanup Grant
Cooperative Agreement (CA) # 4B-00E03568-0
USEPA Revolving Loan Fund CA #4B-00E03232
Indiana Brownfields Program Site No. 4200507
USEPA ACRES ID 226781

Former Advance Plating Facility
1005 East Sumner Avenue
Indianapolis, Marion County, Indiana
May 14, 2024

This Analysis of Brownfield Cleanup Alternatives (ABCA) was cooperatively prepared by the City of Indianapolis (City) and Industrial Waste Management Consulting Group, LLC (IWM Consulting) as a requirement for utilizing United States Environmental Protection Agency (U.S. EPA) grant monies to remediate a brownfield. Specifically, this project utilizes funds from a U.S. EPA Cleanup Grant awarded to the City and supplemental funds supplied by the City and the Indiana Finance Authority through a U.S. EPA Revolving Loan Fund grant. The Former Advance Plating Facility (U.S. EPA ACRES ID: 226781 and Indiana Brownfield Site ID: 4200507), located at 1005 East Sumner Avenue in Indianapolis, Marion County, Indiana (Site), is currently an unoccupied former industrial facility which was occupied from about 1914 through 2009. The Site location is illustrated on **Figure 1**. The Site is irregular in shape and consists of a single parcel containing a total of approximately 2.9 acres and was most recently developed with a 21,722 square-foot industrial structure and a 5,250 square-foot detached warehouse building, which is located southeast of the main structure. The buildings were located on the northern 1/3 of the property and a paved parking lot is located immediately around the former buildings. The remainder of the Site supports vegetative cover (weeds, trees, bushes, and grass).

Former Site operations included canning, soap manufacturing, pattern storage, and metal plating involving oils, solvents, degreasers, metals, and plating chemicals. These operations at the Site are believed to be the primary source of chlorinated volatile organic compounds (cVOCs), cyanide, and metals contamination in soils and groundwater at the Site. This ABCA presents remedial alternatives considered to mitigate potential exposure to contaminated soil and groundwater associated with the historical release(s). Site redevelopment plans include the expansion of a neighboring business for use as a truck and equipment maintenance facility, which will provide temporary construction jobs and six new permanent jobs.

The City Indianapolis, Department of Metropolitan Development, acquired the property on March 3, 2021 and will be the property owner when implementing the work activities discussed in this ABCA.

Site Details

Site Name:	Former Advance Plating Facility 1005 East Sumner Avenue Indianapolis, Marion County, Indiana 46227
Property Owner:	City of Indianapolis 200 E. Washington Street, Suite 2042 Indianapolis, Indiana 46204

Site Representative: Ms. Margarette Webb
City of Indianapolis
200 E. Washington Street, Suite 2042
Indianapolis, Indiana 46204

Summary of Previous Site Activities

Site History

Based on standard historical sources, previous Phase I Environmental Site Assessments (ESA) discovered the Site was used as a cannery in 1914, residential purposes in the 1930's, soap manufacturing in the 1940's and 1950's, a manufacturing warehouse in the 1960's, and Advance Plating Works from the 1970's through 2009. The Site was abandoned by 2010. From February to March 2012, the U.S. EPA conducted emergency hazardous waste removal activities at the Site. The fire department responded to numerous fires for the main structure between 2016 and 2021. Both buildings were razed by the City of Indianapolis in March/April 2022 due to the dilapidated and unsafe condition of the buildings. The building foundations (concrete slabs) and paved parking lot still remain at the Site. The remainder of the Site supports vegetative cover (weeds, trees, bushes, and grass). Aerial photographs indicate historical dumping has occurred at least on the southern portion of the property.

Previous Environmental Assessments/Environmental Investigations

The Office Furniture Mart (OFM) facility is located approximately 0.1 miles northeast of the Site. Investigation into cVOCs released from the OFM property historically resulted in the installation of monitoring wells and soil borings on the Advance Plating property. Additional soil borings were subsequently installed on-Site as part of the Site investigation completed on behalf of the City of Indianapolis. As such, environmental conditions at the Site were assessed via numerous investigations completed between 2014 and 2020. Key Site features are illustrated on **Figures 2** and **3**. Historical environmental assessments and investigations of the Site were documented in the following reports, which are summarized below. Please refer to **Figure 4** for historical sampling locations

OFFICE FURNITURE MART REPORTS:

- *Remediation Work Plan, Environmental Forensic Investigations Inc., July 26, 2016.*
- *Further Site Investigation and 2Q20 Groundwater Monitoring Report, EnviroForensics, LLC, June 29, 2020.*
- *2Q21 Groundwater Monitoring Report, EnviroForensics, LLC, July 15, 2021*
- *2022 Annual Groundwater Monitoring Report, EnviroForensics, LLC, December 15, 2023.*

FORMER ADVANCE PLATING FACILITY REPORTS:

- *Phase I Environmental Site Assessment, IWM Consulting, October 5, 2015.*
- *Phase II Environmental Site Assessment, IWM Consulting, March 27, 2017.*
- *Asbestos Inspection and Lead Paint Survey, IWM Consulting, July 2, 2020.*
- *Phase I Environmental Site Assessment, IWM Consulting, July 9, 2020.*
- *Per- and Polyfluoroalkyl Substances (PFAS) Groundwater Investigation Report, IWM Consulting, July 10, 2020.*
- *Further Site Investigation Assessment Report, IWM Consulting, October 8, 2020.*

- *UST Closure Report, Heartland Environmental Associates, February 16, 2021.*
- *Phase I Environmental Site Assessment, IWM Consulting, January 26, 2021.*
- *Waste Audit Monitoring Report, IWM Consulting, April 25, 2022. This report provides a summary of demolition activities including asbestos abatement, waste segregation/ disposal, and outlines future environmental concerns that should be considered prior to redevelopment.*

Historical Report Summary

The aforementioned historical reports are only briefly summarized below. For more details, please refer to the referenced reports.

From October 2014 through February 2016 under the OFM investigation, EnviroForensics advanced 13 direct push borings (T2-1 through T2-6 and T3-1 through T3-7) at the Advance Plating property with soil and grab groundwater samples collected from each boring. Shallow monitoring wells MW-20, MW-22, MW-25, and MW-27 were also installed at the Site, and sub-slab vapor samples were collected from beneath the floor of the main on-Site building.

From April 2016 through October 2022, EnviroForensics conducted over twenty (20) groundwater monitoring events for the OFM facility. Concentrations of trichloroethene (TCE) consistently exceeded the applicable state guidelines (Remediation Closure Guide [RCG]) in place at the time. Specifically, the dissolved TCE concentrations exceeded the RCG Commercial/Industrial vapor exposure (VE) groundwater screening level (GWSL) at MW-20 and MW-22. Degradation daughter products have also periodically been detected at MW-22. Concentrations of cVOCs were not detected at MW-25, while TCE concentrations were more variable at MW-27 and ranged from non-detect to concentrations exceeding RCG Commercial/Industrial VE GWSLs. Since MW-22 is hydraulically upgradient from any potential onsite source areas, it a clear that a chlorinated solvent plume is migrating on-Site from the upgradient OFM property. However, based on the Site sub-slab vapor and soil/groundwater analytical results, EnviroForensics concluded there may be an additional TCE source area on the Advance Plating property.

IWM Consulting's 2015, 2017, 2020, and 2021 Phase I ESAs identified numerous Recognized Environmental Conditions (RECs) pertaining to historical on-Site operations, on-Site migration of an upgradient (off-Site) solvent plume, an existing underground storage tank (UST), and known on-Site soil/groundwater/soil vapor issues.

In January 2017, IWM Consulting personnel collected water samples from three (3) interior sumps, and advanced eleven (11) soil borings (AP-GP1 through AP-GP12 with AP-GP6 not installed due to interior obstructions) for the purposes of obtaining near-surface and subsurface soil samples and groundwater samples. A geophysical survey identified two (2) anomalies along the southwest side of the main building which were interpreted to be an existing UST and associated vent line.

In August 2020, eleven (11) additional soil borings (AP-GP13 to AP-GP23) were installed as part of a Further Site Investigation (FSI) to further assess previously identified areas with elevated TCE concentrations and the suspect UST location. A UST approximately 12,000-gallons in size was confirmed to be present south of the Site building. The UST was subsequently removed on January 14, 2021.

IWM Consulting's investigations confirmed high concentrations of adsorbed TCE was present in the vicinity of AP-GP8, AP-GP13, and AP-GP18. When comparing the results to the state regulatory guidelines in place at the time (RCG), soil concentrations in excess of the RCG Industrial/Commercial Direct Contact Screening Levels (IDCSLs) extend northward past AP-GP13, eastward towards AP-GP19, westward past AP-GP17, and southwestward past AP-GP17 and AP-GP18. The full extent of this contaminant plume is not delineated, especially to the west and southwest, but sampling locations were limited at the time of the investigation due to the presence of the collapsing building. Additional conclusions included:

- The magnitude of TCE concentrations inside the Site structure is not vertically continuous. This scenario is best observed at AP-GP13 and AP-GP18, which are located within the northern portion of the main building. Specifically, both sampling locations had TCE concentrations (AP-GP13: 35.4 mg/kg; AP-GP18: 52.1 mg/kg) above RCG IDCSL within the top one (1) foot of the boring, then TCE concentrations decreased to levels (AP-GP13: 0.15 mg/kg; AP-GP18: 0.78 mg/kg) less than RCG Migration to Groundwater Screening Level (MTGSL) by 2-4 feet below ground surface (BGS). The TCE concentrations then subsequently increased near the groundwater interface (~11-12 feet BGS) at AP-GP13 (17 mg/kg) and AP-GP18 (76 mg/kg). The presence of a relatively clean sampling interval between the near surface sampling interval and the deeper sampling interval suggests the deeper TCE concentrations were likely influenced from TCE spills upgradient of AP-GP13 (possibly Office Furniture Mart) and AP-GP18 (suspect near surface spill around AP-GP8, which exhibited a TCE concentration of 122 mg/kg from 2-4 feet BGS).
- Analytical results from AP-GP3 and AP-GP22 indicated elevated adsorbed TCE concentrations were also observed south of the UST, along the southern portion of the main Site structure. However, concentrations in excess of the RCG Residential Direct Contact Screening Level (RDCSL) were not detected in this area shallower than ten (10) feet depth and the highest concentrations were detected within or immediately above the water bearing zone in these areas, which suggests that the contaminants may have migrated to this area via groundwater movement from an upgradient location, as opposed to a surface spill. Analytical data obtained from the base and sidewalls of the UST during the closure activities further support this conclusion since no TCE exceedances were documented during the closure activities, thus the UST does not appear to be source either. Due to limited sampling, and/or limited depth of sampling in this area, the full extent of this contaminant plume is not well delineated in any direction. It is also possible that some of the contaminants have migrated to AP-GP22 via an upgradient offsite source (Office Furniture Mart) since MW-22 is hydraulically upgradient from AP-GP22 and is known to have both soil and groundwater TCE impacts.
- Based on all available data (including results from the nearby Office Furniture Mart investigation), concentrations of TCE in soil exceed the RCG IDCSL to a minimum depth of twelve (12) feet BGS, exceed the RCG RDCSL to a minimum depth of sixteen (16) feet BGS, and exceed the RCG MTGSL to a minimum depth of twenty (20) feet BGS.
- Arsenic was historically detected in multiple samples in excess of the RCG RDCSL (9.5 mg/kg), but less than the corresponding RCG IDCSL (30 mg/kg). Native Indiana soils often have naturally occurring arsenic concentrations in excess of the aforementioned RDCSL but below the RCG IDCSL. However, the highest arsenic concentrations were found within the shallow cinders/fill material beneath the northwestern portion of the Site, and as such, these concentrations are not believed to be indicative of naturally occurring background concentrations. Consequently, this material will require additional

characterization if it is disturbed and needs to be transported off-Site during future redevelopment activities.

- Groundwater flow direction, based on historical investigations, is directed to the southwest.
- Analytical results confirm the presence high adsorbed TCE concentrations (> RCG IDCSL) in the northern portion of the main Site structure and the full lateral extent of TCE above RCG IDCSL has not been defined west/southwest of AP-GP8, AP-GP17, and AP-GP18; however, sufficient data exists to develop this ABCA and implement an appropriate remediation program at the Site.
- The maximum observed soil and groundwater concentrations of TCE are high enough such that if the soil/groundwater is removed, it may be considered a Characteristic Hazardous Waste based on the Toxicity Characteristic as specified in the "D-List" of 40 CFR 261.24. The concentrations presented on the D-List are based on Toxicity Characteristic Leaching Procedure (TCLP) analytical results (SW-846 Method 1311). As this method is predicated on a 20-fold dilution of a solid sample, the general rule of thumb is if the actual solid waste concentration of a contaminant is less than 20 times the D-List concentration, then the waste cannot be hazardous. If the soil concentration is 20 times the D-List concentration or more, then a TCLP test should be run. For this reason, TCLP analysis of a representative portion the in-situ soil will likely be required by the landfill prior to acceptance of this waste stream as non-hazardous material. If the in-situ soil samples indicate TCLP exceedances, then the soil can be conditioned in-situ and retested for TCLP to document the soil conditions are no longer characteristically hazardous. If the TCLP concentrations cannot be reduced to non-hazardous levels, the soil would have to be disposed of as a hazardous waste.
- The UST at the Site was emptied (3,300 gallons of hazardous fluid and 1,500 gallons of non-hazardous residual tank bottoms) and properly closed/removed in January 2021.
- South of the former main building, adsorbed TCE has been detected adjacent to the UST – which may either be the source of the TCE, or the UST and associated piping run backfill may have acted as a preferential migration pathway for a TCE source further upgradient. However, adsorbed TCE was only detected in one (1) UST base sample and at concentrations significantly less than the adjacent soil boring sampled. Based on this information, it appears that the UST was not a significant source of the TCE detected around/adjacent to the UST and an upgradient source area may be the primary or at least a contributing source of the elevated TCE found in AP-GP22.
- Historical arsenic concentrations exceeded the RCG RDCSL in some of the samples collected from shallow cinder fill. Consequently, any encountered shallow cinder fill material should be properly characterized prior to excavating/removing the material from the Site.
- The former structures on the Site were razed in March/April 2022 but the building slabs were left in place to minimize rainwater infiltration.
- Due to the presence of cyanide in multiple historical soil samples, any future remediation activities involving soil/groundwater removal with documented concentrations of cyanide will require acquisition of a contained-in determination, or any cyanide-containing waste will need to be classified as hazardous.
- Sub-slab vapor samples obtained from beneath the northern building slab exhibited TCE concentrations in excess of the calculated sub-slab Commercial/Industrial VE screening level. Dissolved TCE concentrations in excess of the RCG Commercial/Industrial VE GWSL were also historically present in groundwater at the Site. If the property is re-developed for either residential or commercial/industrial use, then vapor intrusion is a possible exposure pathway. Consequently, if a structure is constructed directly over or

within 50 to 100 feet of a known TCE exceedance, then the developer should pre-emptively install a vapor mitigation system or conduct additional vapor intrusion sampling to rule out this potential exposure pathway prior to occupation of the new building.

- Elevated concentrations of total metals were historically found in the water present in two (2) sumps inside the building. The fluid (1,031 gallons) within the sumps were removed and properly disposed offsite during the building demolition activities. The sumps were then covered with plywood or metal plates and then covered with gravel. This approach minimizes immediate access to these sumps while reducing future costs associated with properly removing and decommissioning these sumps in the future.
- Dissolved concentrations of hexavalent chromium historically exceeded the RCG Residential Tap GWSL at AP-GP10. However, additional assessment inside the building was not feasible at the time of the investigations due to the collapsing nature of the building. Additional hexavalent chromium sampling under the chrome plating area in the northwest quarter of the building should be considered now that the building has been razed.

In addition to the foregoing, a June 2020 investigation identified friable asbestos and lead based paint in the main building. Asbestos abatement and building (all onsite structures) demolition activities occurred between March 21 and April 25, 2022. The friable asbestos was properly abated prior to the demolition activities and any lead painted surfaces were properly disposed at a landfill. The onsite historical water supply well was also properly abandoned by a licensed well driller.

The foundation for both buildings remained in place to limit rainwater infiltration into the subsurface beneath the building footprints. The fluids (1,031 gallons) within the sumps were removed and disposed offsite as hazardous waste, along with one roll-off box of concrete (top covering of the two (2) underground historical plating bath vaults) that was impacted with chromium and cyanide. Additional stained concrete is present at the Site and will require removal, characterization, and disposal offsite in the future when the remaining portion of the vaults and sump pits are removed and when the building foundation is removed. This will need to occur prior to Site redevelopment or as part of the Site redevelopment activities. Based upon visual observations (staining) and results obtained during the building demolition activities, this material will likely need to be disposed as categorically listed (F008) hazardous waste.

Summary of Site Characterization

The following summary of Site conditions is supported by historical and recent Site investigations.

1. The Site is located in the southeast ¼ of Section 25, Township 15 North, Range 3 East in Marion County as shown on **Figure 1**. The Site consists of 2.9 acres and was historically improved with a manufacturing building and a separate storage building. The two (2) buildings contained approximately 19,550 and 5,200 square feet of floor space, respectively. Both structures were razed in March/April 2022 but the foundations were left in place. The remainder of the Site supports vegetative cover (weeds, bushes, and grass) or asphalt (parking lot). Properties in the immediate Site vicinity include a senior community, SealMaster (paving), Kennedy Tank, Moore Restoration (water damage), and automotive sales.

2. Based on standard historical sources, the Site has been developed since at least 1914. Occupants of the Site included a cannery, residences, a soap manufacturing company, a pattern warehouse, and a metal plating facility (Advance Plating). Advance Plating abandoned the Site in 2009, leaving numerous containers of chemicals and/or waste at the Site. From February 27 to March 12, 2012, the U.S. EPA conducted an emergency removal of the abandoned materials/waste. The Site has remained unoccupied since that time. As a consequence of several fires at the Site between 2016 and 2022, the buildings were razed in March/April 2022 but the presence of the collapsing buildings hindered the historical investigations completed at the Site between 2017-2020.

3. The nearest surface water feature to the Site is Highland Creek, located approximately 500 feet southwest (downgradient) from the Site. No surface water features are located on or adjacent to the Site. The Site is not located within the 100- or 500-year flood plains.

4. Previous environmental investigations conducted at the Site indicate shallow groundwater beneath the Site is present in saturated poorly to well graded sands at depths of approximately 8 to 12 feet BGS. Static water levels within temporary groundwater sampling points were encountered between approximately 2 and 6 feet below the top of casing. The piezometers were not surveyed. However, shallow groundwater flow beneath the Site appears to be to the west or southwest based on historical OFM gauging data. Depth to water in the permanent monitoring wells installed on-Site as part of the OFM investigation has historically been around 5 to 9 feet below top of casing. However, only one of the four monitoring wells has a flush-mount surface completion. The other three are completed with a stickup. According to the Indiana Maps website (http://maps.indiana.edu) the nearest located well is about 550 feet south of the Site, and the nearest estimated well location is about 650 feet east of the Site. However, OFM documentation indicates an old supply well inside the Site building was historically sampled. The onsite supply well was abandoned by a licensed well driller on April 15, 2022. According to IDEM, the Site is not located within a regulated wellhead protection area.

5. Previous environmental assessments conducted at the Site between 2017 and 2020 identified arsenic and VOCs in the soils on the Site at concentrations exceeding their respective RCG Residential Soil MTGSLs, RDCSLs, IDCSLs, and/or Excavation Direct Contact Screening Levels (EXDCSLs). TCE was the only chemical detected at concentrations in excess of the RCG IDCSL of EXDCSL. The investigations also identified several VOCs and hexavalent chromium (only 1 location) in the groundwater beneath the Site at concentrations exceeding their respective RCG Commercial/Industrial VE GWSLs, Residential VE GWSLs, and/or Residential Tap GWSLs. Dissolved concentrations of additional metals (antimony and nickel) were present in excess of Residential Tap GWSLs in the water accumulated in a sump located in the main structure but this water was subsequently removed in 2022 during the building demolition activities. Soil gas concentrations have also been detected (as part of the OFM investigation) exceeding the calculated RCG Commercial/Industrial sub slab VE screening level for TCE. Concentrations of tetrachloroethene (PCE) and chloroform in sub-slab samples also exceeded the calculated RCG Residential VE screening levels.

6. Soil and groundwater samples gathered during the course of the OFM investigation indicate significant groundwater concentrations of TCE are consistently present upgradient from the Site building in the right-of-way for E. Sumner Avenue (MW-13)

and the northeast portion of the Site property (MW-22). Concentrations of TCE from the OFM release are known to affect multiple saturated zones, and TCE concentrations from the OFM release are present in excess of 50 feet below ground surface on and near the OFM property itself. Site assessment work performed for the Former Advance Plating Site has obtained groundwater samples from the first-encountered groundwater zone (~12 feet BGS), with the maximum boring depth being 16 feet BGS. Consequently, the borings did not penetrate into the deeper zones which may be impacted by the OFM release. However, borings advanced on the Site during the historical OFM site investigations obtained samples from a maximum depth of 27 feet BGS, which exhibited VOC concentrations at depths as deep as 27 feet BGS but the majority of the points indicated the VOCs did not extend beyond 21 feet BGS. The remedial actions proposed in this ABCA are intended to address the shallow (0-20 feet BGS) adsorbed and dissolved impacts at the Site. However, following completion of any proposed remedial activities, additional TCE contamination (at deeper intervals and in areas further upgradient of the remediation areas) may remain beneath or downgradient of the Site, or may migrate onto the Site in the future, from the OFM release.

Remedial Action Objectives

Environmental conditions at the Site and current land use suggest the following human exposure routes represent potential risks for the indicated media and potentially exposed populations:

1. Direct contact with impacted surface soil, subsurface soil, or groundwater by on-Site workers, Site occupants, or future construction workers performing maintenance or excavation;

2. Ingestion of groundwater by future users of water wells which might be drilled at the Site or in the immediate vicinity of the Site, within the areas exhibiting VOC and/or metal impacts above the IDEM RCG Residential Tap GWSLs; and,

3. Inhalation of vapors by potential users of future structures on the Site and potentially occupants of nearby structures which are in close proximity to the Site (within 50-100 feet of the known cVOC impacts above the RCG Residential and/or Commercial/ Industrial VE GWSL) and which have not yet been evaluated.

Four (4) aspects of the Site are identified as needing corrective action based on the results of previous Site investigations. The IDEM RCG was in place during all of the previous investigations but IDEM transitioned to the Risk based Closure Guide (R2) in March 2022, which provides the framework for characterizing a release, evaluating risk, and when necessary, selecting appropriate remedies to minimize risk and to mitigate any potentially complete exposure pathways. The R2 provides numeric values in the form of published levels (PLs) for the relevant exposure routes and land uses. Land use at the Site is currently zoned commercial/industrial, and is expected to remain so for the foreseeable future. Assuming an Environmental Restrictive Covenant (ERC) restricting water and land use is instituted as a partial corrective action alternative, then remedial efforts will not be necessary for groundwater concentrations which exceed only a R2 Groundwater Published Level (GWPL) or soil concentrations which only exceed a R2 Residential Soil Published Level (RSPL). Even with the ERC restrictions for groundwater usage, groundwater remediation may be necessary in order to reduce the contaminant concentrations to levels less that do not pose a threat to downgradient off-site properties and to minimize the possibility of the dissolved contaminants volatilizing at high concentrations, creating a potential inhalation risk via vapor intrusion. Remediating the source area in the soil, even if it is below the applicable PL, will assist in reducing the dissolved contaminant concentrations and accelerate natural attenuation processes at the Site and downgradient of the Site since the source area will no longer be leaching into the underlying shallow groundwater table.

Unless all of the impacted soil above the applicable PL is actively remediated, the ERC should also incorporate the requirement for development of a Soil Management Plan (SMP), which will provide instructions on how to safely handle and properly characterize any disturbed soil during redevelopment activities and provide instructions on how to properly relocate or dispose of the soil at an offsite location. These protective steps are necessary since shallow soil (0-10 feet BGS) located in various locations throughout the Site have exhibited the presence of adsorbed contaminants of concern at varying concentrations.

Given the documented soil gas and groundwater concentrations, the ERC should also require active vapor mitigation activities or further evaluation of the potential VI exposure pathway prior to any newly constructed buildings being occupied. Soil, groundwater, and/or vapor media exceeding applicable PLs include the following:

1. Surface, and near surface, soil media to depths of up to two (2) feet BGS that exceed one (1) or more R2 Commercial/Industrial Soil PL (CSPL) or Excavation Soil PL (XSPL).

2. Subsurface soil media at depths of up to thirteen (13) feet BGS that exceed one (1) or more R2 CSPL or XSPL.

3. Groundwater media at depths of ranging between approximately 5 to 14 feet BGS that exceed one (1) or more R2 GWPL.

4. Subsurface soil vapor media which exceed one (1) or more R2 Commercial/Industrial Exterior Soil Gas or Sub-slab Vapor PLs.

The objective is to implement a focused remedial program which targets the areas of the Site which exhibit the highest VOC impacts and to remediate the above referenced media to levels at or below the applicable R2 PLs. Areas of soil impacts which only exceed the R2 Residential Soil PL (if applicable), can be managed in-situ through use of an ERC. However, active soil remediation activities are warranted in areas that exceed an R2 CSPL or XSPL.

In summary, the proposed corrective actions will incorporate both active remediation and use of institutional controls (ERC) in order to adequately address any potential exposure pathways and to make the Site redevelopment ready. A summary of the corrective action objectives per media type is as follows:

Soil: R2 CSPL or XSPL (if IDEM has not established a CSPL)
Groundwater: R2 GWSL at the downgradient Property line
Soil Gas: R2 Commercial/Industrial Vapor PL onsite and at the downgradient Property line.

In addition to the proposed remediation work activities, three (3) additional tasks should be completed prior to redeveloping the Site:

- Characterization and disposal of the stained concrete building foundation, sump pits, and underground plating bath vaults and potentially any limited areas of underlying media/debris subject to transmission of contaminants through the concrete.
- During any future redevelopment activities, any shallow cinder fill encountered should be properly characterized prior to excavating/removing/relocating and should be handled in accordance with SMP.
- Although this RWP is treating the groundwater beneath the formerly inaccessible (collapsing) portion of the main warehouse building (northwest corner), additional assessment in this area could assist with planning when redeveloping this area of the Site, specifically how to handle any shallow soil disturbed during the redevelopment activities.

Analysis of Remedial Alternatives

The remedial action alternatives considered were evaluated using the following criteria:

(1) Effectiveness

a. The degree to which the toxicity, mobility, and volume of the contamination is expected to be reduced.
b. The degree to which a remedial action option, if implemented, will protect public health, safety and welfare and the environment over time.
c. Taking into account any adverse impacts on public health, safety and welfare and the environment which may be posed during the construction and implementation period until case closure.

(2) Implementability

a. The technical feasibility of constructing and implementing the remedial action option at the Site or facility.
b. The availability of materials, equipment, technologies and services needed to conduct the remedial action option.
c. The administrative feasibility of the remedial action option, including activities and time needed to obtain any necessary licenses, permits or approvals; the presence of any federal or state, threatened or endangered species; and the technical feasibility of recycling, treatment, engineering controls, disposal or naturally occurring biodegradation; and the expected time frame needed to achieve the necessary restoration.

(3) Cost

a. The following types of costs are generally associated with the remedial alternatives:
    - Capital costs, including both direct and indirect costs; Initial costs, including design and testing costs.
    - Annual operation and maintenance costs.

Summary of Remedial Alternatives: Soil

1. Alternative 1 – No Action.

2. Alternative 2 – (partial alternative) – Environmental Restrictive Covenant (ERC).

3. Alternative 3 – Targeted Excavation and Non-hazardous Disposal Following In-situ Soil Conditioning as Necessary.

4. Alternative 4 – Targeted Excavation and Hazardous Disposal.

Remedial Alternatives: Soil

1. ***Soil Alternative 1 – No Action****:* If no action is taken at the Site, the impacted surface and near-surface soil will remain on the Site and it will impede and complicate redevelopment of the Site and present a potential exposure risk to future occupants or construction workers. Additionally, if the Site is not secured, it is possible the general public could come into direct contact with the impacted surface soils, thus creating a potential environmental, health, and welfare liability for the City. This option is considered the least environmentally protective and the impacts to the environment (soil and groundwater) will likely continue for decades to come.

    a. **Effectiveness** – None: This option does not decrease the toxicity, mobility, or volume of the contamination and does not protect human health, safety, welfare, or the environment.
    b. **Implementability** – Easy: There are no required actions or technology necessary to implement this option.
    c. **Cost** – None: This option does not require ongoing operation, maintenance, or management costs. Any costs incurred would be in the form of loss of potential income from redevelopment.

2. ***Soil Alternative 2 (partial alternative) – ERC:*** ERCs are a type of institutional control which are used to apply land use restrictions to properties. First encountered groundwater beneath the Site appears to be impacted by a release of chlorinated VOCs. Public water supply is available to the Site, and current zoning is Site is commercial/industrial. IDEM has not established R2 RSPLs or CSPLs for any of the chlorinated VOCs detected at the Site that historically exceeded the RCG RDCSL or RCG IDCSLs but have established R2 XSPLs for each of the VOC constituents. One historical sampling location (AP-GP8) exhibited a TCE concentration in excess of the R2 XSPL. Development of an ERC which requires a Site-specific SMP prior to any excavation activities will protect future occupants and construction workers at the Site. The ERC may also require a protective barrier (building foundation, parking lot, 2-foot soil cap, etc.) in any areas which exceed the R2 XSPL and prohibit groundwater extraction (except for monitoring/remediation purposes). The groundwater restriction would effectively eliminate the R2 GWPL exposure pathway. Please note that if single family residential homes are constructed at the Site, all of the soil for each residential lot must meet the R2 RSPL, if applicable, to a depth of 10 feet BGS, thus active remediation will be required in those areas with documented exceedances since the protective barrier option is no longer a viable institutional control. Selection of one of the other remedial alternatives would be necessary to address the remaining exposure pathways.

    a. **Effectiveness** – Moderate: This option would not decrease the toxicity, mobility, or volume of the contamination, but would protect human health, safety, or welfare by eliminating/minimizing potential exposure pathways. While adherence to the restrictions of an ERC would prevent the potential exposure pathways from being completed, all of the contaminants still remain in place and it is possible that subsurface conditions (i.e., vertical and/or lateral extent of contamination) or regulatory guidelines may change over time, identifying potential exposure pathways not currently considered.

b. **Implementability** – Easy to Moderate: Once a draft ERC is approved by the concerned parties, it would simply need to be recorded with the deed. However, each subsequent property owner and/or tenant needs to be aware of the ERC and they must follow the ERC in order for this remedial approach to be effective.
c. **Cost** – Low: This option would require preparation time and recording costs for a legal document – the ERC. Typically, an ERC may be worded in a manner which would require the property owner to periodically certify property use still complies with the terms of the ERC. In this event, there would be a minor compliance cost on an on-going basis, but that would be the responsibility of the Site tenant/owner. If new buildings are constructed in the future over soil impacted areas, and soil is disturbed during the construction activities, costs would be incurred by the property owner/developer during redevelopment of the Site. These costs pertain to developing/implementing a SMP. The estimated cost to prepare and record the ERC is $15,000, but costs borne by the future property owner/developer during redevelopment activities cannot be calculated since these costs are dependent upon the finalized redevelopment plans.

3. ***Soil Alternative 3 – Targeted Soil Excavation and Non-hazardous Disposal Following In-situ Soil Conditioning as Necessary*****:** The advantage of targeted excavation and disposal is that it expeditiously addresses the environmental concerns with respect to the hazardous substances adsorbed to the subsurface soil and removes the impacted soil from the Site. The excavation can focus on a suspected source area or only on areas with the highest contaminant concentrations. Soil source removal alleviates any long-term effects with managing soil contamination migration to groundwater and subsequent groundwater impacts. In addition, removal of shallow impacted soil would have a positive effect on the near surface (i.e. sub-slab) soil vapor concentrations. This remedial approach does not include excavation of impacted soil which may be present off-Site. Based on historical analytical data obtained to date and the depth of the documented impacts, IWM Consulting proposes to conduct targeted soil excavation activities along the northcentral portion of the main building, with the excavation encompassing approximately 2,120 square feet and extending to a maximum depth of 13 feet. Confirmation base and sidewall samples will be obtained prior to backfilling the excavation area.

   A review of historical documents contained in the VFC indicate the Site generated eight characteristic wastes (D001-ignitable, D002-corrosive, D003-reactive, D005-barium, D006-cadmium, D007-chromium, D008-lead, and D009-selenium). In addition, as per annual reports and EPA response documents, the Site generated two F-listed wastes: F006 (wastewater treatment sludges from electroplating operations) and F008 (plating bath residues from electroplating operations where cyanide is used). Consequently, although TCE concentrations may be considered a characteristic hazardous waste (based on potential for TCLP results to exceed the D-Listing toxicity threshold), TCE is not a listed hazardous waste at this Site.

   This is an important distinction. If TCE were a listed hazardous waste at this Site, then all TCE soil concentrations would have to be less than the RCG IDCSL (19 mg/kg, which is still applicable for "contained-in" evaluation purposes) in order to meet a "contained-in" designation, which would allow non-hazardous disposal of the TCE impacted media. However, since TCE is not a listed waste, any TCE soil concentration which passes a TCLP test (and is less than 60 mg/kg), could be direct loaded into trucks as a non-hazardous waste without any in-situ pre-treatment. This would greatly reduce the costs associated with in-situ soil conditioning prior to excavation.

Concentrations of TCE in soil at the Site do exceed the 20-fold dilution rule of thumb for the toxicity characteristic of hazardous waste. So, in order to dispose of the cVOC-impacted Site soils at an off-Site Subtitle D landfill as a non-hazardous solid waste, either TCLP analysis, or additional treatment (followed by confirmation analyses) will be required to render the soils non-hazardous. Even if the TCLP analytical results are less than the applicable TCLP hazardous level, the total TCE concentration must be less than 60 mg/kg to be accepted at the landfill. Any additional sampling necessary for waste characterization and landfill profile approval purposes will need to be conducted prior to initiating an excavation and supplemental borings may be installed to further define the lateral extent of TCE impacts in the vicinity of historical soil borings AP-GP8, AP-GP17, and AP-GP18.

Without TCLP analysis, all TCE concentrations in excess of 10 mg/kg must be assumed to be hazardous (Scenario 1). This would result in an approximate remedial volume of 2,750 tons of TCE-impacted soil (which would be hazardous waste if excavated) and not tested further, and an additional approximate 1,100 tons of clean overburden, if two excavations (northern and southern) are completed at the Site. However, only the northern excavation exhibits a TCE concentration in excess of the R2 XSPL, which is the only area that will be addressed under this ABCA. The estimated volume to be removed in the vicinity of AP-GP8 is 1,710 tons of TCE impacted soil and 225 tons of clean overburden.

Historical experience has indicated soils impacted with TCE at concentrations as high as 100 mg/kg may be characteristically non-hazardous, primarily dependent on soil characteristics. For the purposes of estimating, IWM Consulting will assume TCLP sampling is conducted, and any TCE concentration over 50 mg/kg will be hazardous (Scenario 2). This would result in a hazardous volume of about 500 tons (needing in-situ conditioning), a non-hazardous volume of about 1,310 tons (not requiring in-situ soil conditioning), and an overburden of about 225 tons (for stockpiling and re-use). The approximate 100-ton discrepancy between the treatment/disposal volumes of Scenario 1 and Scenario 2 of this Soil Alternative is due to the difference in volume of soil which would need to be conditioned in-situ. The addition of remedial amendments to degrade concentrations and then dry out and stabilize the soil will increase the weight of the conditioned soil. Consequently, the greater treatment volume under Scenario 1 results in more remedial amendments (oxidizers, water, lime, etc.), which in turn results in a greater final tonnage. Please refer to **Figure 5** for the estimated footprint of the potential TCE excavation cell.

The estimated tonnages listed above are subject to change depending on the results of additional delineation and post-demolition waste characterization (TCLP) sampling and the actual moisture content of the soil during the excavation activities.

Following waste characterization sampling (TCLP) and potential further delineation of the TCE in this area of the Site, soils with TCE concentrations in excess of the Federal D-list concentration for TCE (0.5 mg/L) will be conditioned in-situ with a chemical oxidant (PersulfOx or sodium persulfate, hydrogen peroxide, and water) in order to quickly decrease the cVOC concentrations to levels that reduce the leachability of the contaminants in the soil to non-hazardous levels (<0.5 mg/L for TCE). The in-situ conditioning activities will occur at depths up to about 13 feet BGS (based on current data) in approximate 2-foot intervals. The soil and oxidant (including any necessary amendments) will be mixed in-situ, below grade, with a hydraulic excavator. Following receipt of laboratory results for confirmation soil samples, application of agricultural lime (or similar product) will be used to dry and reduce the pH of the conditioned soil for off-Site disposal. After the non-hazardous soils have been excavated and disposed, the process will be repeated for each subsequent deeper treatment interval.

If the soil conditioning is successful, the soils can be disposed of as non-hazardous solid waste instead of as hazardous waste. Surface and near-surface soils which have not been impacted will be stockpiled on-Site and used as backfill following excavation and disposal activities.

Regardless of the hazardous/non-hazardous status of the soil based on TCE concentrations, cyanide is a listed waste at this Site, and historical analytical results show cyanide concentrations are present under the building footprint (in the potential TCE excavation area). All known cyanide concentrations do not exceed the RCG IDCSL (150 mg/kg), and as such, would be eligible for a "contained-in" designation. So, although documented non-hazardous TCE concentrations could be direct loaded into trucks, the potential presence of cyanide (at any concentration) will force the non-hazardous TCE concentrations to be loaded into roll-off boxes, and each box will need to be tested for cyanide and short list cVOCs prior to transportation offsite for disposal. Each roll-off box with cyanide concentrations less than the RCG IDCSL (and TCE concentrations less than the TCLP dilution rule of 20) could then be transported offsite for non-hazardous disposal, while each roll-off box with a cyanide concentration in excess of the RCG IDCSL would need to be transported offsite for hazardous disposal. The cost estimate listed below assumes no roll-off boxes fail a cyanide test. The costs for disposal of each roll-off box with hazardous contents would increase the estimated price of this remedial option by about $2,500 per load (assuming a 14.5-ton load and local disposal).

Current data does not indicate significant soil impact is present below the anticipated maximum depth of the excavation (13 feet BGS), which is at or below the underlying shallow groundwater table. But, continued migration from the known off-Site source (OFM) is expected. In order to help address future migration issues, and in preparation for the expected groundwater treatment, a suitable volume of zero valent iron (ZVI) will be mixed with the soil at the base of the excavation. This is consistent with the in-situ injection approach which is expected to be utilized for groundwater remediation. The ZVI should assist in preparing the subsurface environment for the groundwater remediation and in reducing cVOCs located immediately beneath or adjacent to the base of the cVOC excavation, or which migrate from off-Site in the future – provided that it is in contact with the saturated interval. In this event, the material would be applied and thoroughly mixed with the soil at the base of the excavation using the bucket of the excavator.

Although a remedial excavation would be designed to remove the on-Site contaminants in excess of a target threshold, it would not necessarily address future migration of contaminants from the known upgradient off-Site source (OFM). Migration of such contaminants in the future could cause a potential indoor air exposure problem if a new structure is constructed at the Site. This could be exacerbated by placement of granular fill in the excavation area. Granular fill may be necessary in the event of significant water influx to the excavation area. However, clay backfill is strongly recommended over the top of any granular fill which must be used. Even after the targeted excavation activities and installation of clay backfill, it is anticipated vapor mitigation will be necessary for any new structure constructed at the Site or additional exterior soil gas sampling will be required within the footprint of the new building to further evaluate and rule out this potential exposure pathway.

In addition, due to the anticipated use of clay for backfill (at least for shallower fill), the size of the anticipated excavation area, and the nature of the work, the fill material is not anticipated to be compacted in a manner suitable for siting a new structure. As such, any structure placed over the excavation area will need to consider optimal compaction issues prior to installing structural components, or potential destructive settling could occur after a structural load is placed on the fill.

a. **Effectiveness –** High: This method minimizes the long-term leaching potential of the most highly impacted soil at the Site by removing sorbed contaminants and also minimizes potential future direct contact risks with impacted soil or groundwater and vapors. This approach should also result in reduced dissolved cVOC concentrations once the highest Site contaminants have been removed from the subsurface.
b. **Implementability** – Easy to Moderate: The Site is currently vacant and the building is anticipated to be removed prior to initiating the excavation activities so no operations would be interrupted. However, cleaner soil will have to be segregated from the soil being removed from the Site in order to be reused as backfill post-excavation, and any soil exhibiting characteristically hazardous conditions (based upon pre-excavation TCLP results) will have to be conditioned in-situ to reach non-hazardous TCLP levels. The work activities will take approximately three (3) weeks to complete once the contractors have mobilized to the Site.
c. **Cost** – High: Costs would include soil disposal, in-situ mixing of soil with a chemical oxidant as necessary to reduce TCE TCLP concentrations less than 0.5 mg/L, confirmation analyses, application of ZVI to the base of the excavation areas, imported backfill material, and compaction of imported backfill material. Based on the assumptions listed above (500-tons of soil to be conditioned to non-hazardous levels in-situ prior to excavation and disposal, 1,810 tons of non-hazardous soil – subject to load-by-load confirmation analysis, and 250 tons of overburden), IWM Consulting has estimated the cost of implementing this remedial alternative to be approximately $595,000. If pre-excavation TCLP testing indicates a greater portion of the soil needs to be conditioned, that would increase the costs by roughly $100 per additional ton of soil to be conditioned or an extra $150 per additional ton if the material would need to be disposed as hazardous (if already containerized).

Soil Alternative 4 – Targeted Excavation and Hazardous Disposal: This alternative is essentially the same as Soil Alternative 3, except all of the soil targeted for excavation and removal would be tested in advance for additional analytical parameters as required by the landfill. This soil would then be direct-loaded and hauled for disposal as hazardous waste as opposed to requesting a “contained-in” designation and sampling every load of soil prior to transportation offsite to the designated disposal facility. This approach allows for the implemented soil remediation activities to be completed in a more expeditious manner.

However, disposal requirements essentially create two separate levels of hazardous waste. Concentrations which meet the ten times land disposal restriction (10x LDR) can be disposed of in a properly licensed hazardous waste landfill. Concentrations in excess of the 10x LDR must be incinerated prior to disposal. Incineration is a much more expensive disposal option. For TCE, the 10x LDR is 60 mg/kg. Consequently, any soil which exceeds 60 mg/kg for TCE will be conditioned in-situ (see Soil Alternative 3, above, for more details regarding in-situ soil conditioning) to reduce TCE concentrations to less than 60 mg/kg. Conditioned soil will then be re-sampled to verify concentrations meet 10x LDR requirements prior to excavation, hauling and hazardous disposal.

For the purposes of estimating, it is assumed a total of 1,810 tons of soil will be hauled for hazardous disposal. Of this, an estimated 500 tons of TCE impacted soil will be conditioned in-situ in order to meet the 10x LDR requirement. Other than verification of the final concentrations for the conditioned volume, no additional analysis will be conducted on this excavated soil during the excavation phase. However, confirmation sidewall/floor samples will still be collected. It should be noted the 10x LDR for cyanide (300 mg/kg) is much higher than any historically observed concentrations at the Site, and as such, no in-situ conditioning will be necessary for cyanide concentrations in order to meet the 10x LDR threshold.

Surface and near-surface soils which have not been impacted (estimated at 225 tons) with TCE concentrations greater than 10 mg/kg, will be temporarily stockpiled on-Site and will be re-used as backfill following excavation and disposal activities. The estimated tonnages listed above are subject to change depending on the results of additional delineation (if conducted) and waste characterization sampling.

Just as with Soil Alternative #3, continued migration from the known off-Site source (OFM) is expected. In order to help address future migration issues, and to prepare the subsurface for the expected groundwater treatment, a suitable volume of ZVI will be thoroughly mixed with the soil at the base of the excavation area using the bucket of the excavator. Also, clay backfill will be utilized to the extent practical. As the size of the excavation area will preclude optimal compaction, any structure placed over the excavation area will need to consider optimal compaction issues prior to installing structural components.

a. **Effectiveness** – High: This method minimizes the long-term leaching potential of the most highly impacted soil at the Site by removing sorbed contaminants and also minimizes potential future direct contact risks with impacted soil or groundwater and vapors. This approach should also result in reduced dissolved cVOC concentrations once the highest Site contaminants have been removed from the subsurface.
b. **Implementability** – Easy to Moderate: The Site is currently vacant and the building is anticipated to be removed prior to initiating the excavation activities so no operations would be interrupted. However, cleaner soil will have to be segregated from the soil being removed from the Site in order to be reused as backfill post-excavation. The work activities will take approximately two (2) weeks to complete once the contractors have mobilized to the Site.
c. **Cost** – High: Costs would include hazardous soil disposal, analytical testing, application of ZVI to the base of the excavation areas, imported backfill material, and compaction of imported backfill material. Based on the assumptions listed above (1,810 tons of soil to be hauled/disposed as hazardous waste inclusive of 500 tons conditioned in-situ to allow land disposal), IWM Consulting has estimated the cost of implementing this remedial alternative to be approximately

$605,000. The results of the waste characterization sampling activities may alter this estimate.

<u>Summary of Remedial Alternatives: Groundwater</u>

1. Alternative 1 – No Action.

2. Alternative 2 – (partial alternative) – ERC

3. Alternative 3 – Limited In-situ Injections (Permeable Reactive Barriers).

4. Alternative 4 – Plume-wide In-situ Injections with Up and Downgradient PRBs

<u>Remedial Alternatives: Groundwater</u>

1. ***Groundwater Alternative 1 – No Action:*** If no action is taken at the Site, the impacted groundwater will remain on the Site which could complicate or impede future Site development. The dissolved plume could also migrate offsite over time and may result in complications arising from third party claims. This option is considered the least environmentally protective and the impacts to the environment may continue for decades to come. This option also would fail to address potential exposure to impacted groundwater and/or vapors emanating from the chlorinated VOC impacted groundwater both on-Site and potentially for downgradient receptors.

    a. **Effectiveness** – None: This option does not decrease the toxicity, mobility, or volume of the contamination and does not protect human health, safety, welfare, or the environment.
    b. **Implementability** – Easy: There are no required actions or technology necessary to implement this option.
    c. **Cost** – None: This option does not require ongoing operation, maintenance, or management costs. Any deficit incurred would be in the form of loss of potential income from redevelopment, or increased cost of re-development.

2. ***Groundwater Alternative 2 (partial alternative) – ERC:*** As discussed earlier, development of an ERC prohibiting groundwater extraction (except for monitoring/remediation purposes) would effectively eliminate the Residential Tap GWPL ingestion exposure pathway. The ERC would also need to provide stipulations regarding additional evaluation of onsite potential VI exposure pathways or require the installation of a vapor mitigation system if soil gas still exceeds the R2 Commercial Vapor PL. Selection of one of the other remedial alternatives would be necessary to address the remaining potential exposure pathways.

    a. **Effectiveness** – Moderate: Please refer to Soil Alternative 2 above for more details.
    b. **Implementability** – Easy: Please refer to Soil Alternative 2 above for more details.
    c. **Cost** – Low: Please refer to Soil Alternative 2 above for more details.

3. ***Groundwater Alternative 3 – Limited In-situ Injections (Permeable Reactive Barriers):*** Permeable reactive barriers (PRBs) consist of a subsurface area with an added remedial amendment which reacts with contaminants in the groundwater as groundwater migrates

through the barrier area. As such, PRBs are typically a linear feature-oriented perpendicular to groundwater flow direction, or a barrier feature at least partly surrounding a sensitive area or inaccessible source area. The PRBs can be constructed by a variety of methods, including trench excavation and backfill, permanent injection wells, and direct push injections.

The groundwater corrective action goals are to reduce the dissolved chlorinated VOC concentrations in the core of the plume in order to promote a stable to shrinking plume and to reach the R2 GWSL at the downgradient property boundary.

Excavated trenches and direct push injections typically will dose the subject area with enough remedial amendments to degrade the chemicals present in the PRB area, and the mass of contaminants which are expected to migrate through the PRB for a certain period of time in the future. Permanent injection wells (or an injection network) may be utilized if the mass of contaminants is expected to quickly overwhelm the volume of remedial amendments which can be emplaced at one time.

Trenches may utilize a granular (permeable) backfill mixed with the remedial substance. Injection wells may be installed in a granular trench or native materials. Direct push injections are installed in whatever in-situ materials are present. Differing subsurface lithologies, the contaminant suite, and concentrations may call for a variety of approaches.

The advantage of PRBs are the relative ease of installation and low up-front cost by comparison with any whole-plume treatment method. The main disadvantage of PRBs is the time necessary to achieve plume-wide remedial goals (and corresponding increased monitoring time and costs). PRBs by themselves (unless coupled with extraction and/or injection wells) rely on the natural speed of groundwater flow to bring the contaminants into contact with the remedial amendments. Depending on the number of PRBs installed, it may take some time for impacted groundwater to reach a barrier. Hence, if short-term cost is of paramount importance, and length of remedial time is not an issue, then PRBs would be a good option.

For this project, PRBs would be installed via direct push injections. At a minimum, an upgradient and downgradient PRB would be installed which would be separated by up to about 180 feet in the direction of groundwater flow. This would address TCE concentrations migrating on-Site from the hydraulically upgradient OFM release as well as comingled TCE concentrations from the OFM release and Advance Plating which appear to be migrating off-Site (based on data obtained from historical OFM investigations).

Information contained in the historical OFM files includes slug test results from MW-13 (near the upgradient property line for the Site), along with estimates of soil bulk density (2.65), organic carbon/water partition coefficient for TCE (86), fraction organic carbon (0.2%), effective porosity (25%), and OFM plume-wide gradient (0.0022). Using the hydraulic conductivity calculated for MW-13 (1.56E-4 feet per second), along with a gradient specific to the Advance Plating Site (0.0025), and the remaining values listed for OFM, results in an average linear groundwater flow velocity of about 50 feet per year and a solute-front velocity of about 11-12 feet per year.

For the sake of remedial planning, if an average TCE solute front velocity of 11.5 feet per year is utilized, then a transit time between PRBs can be estimated. If only two PRBs are installed (upgradient and downgradient) it would take about 16 years for TCE-impacted groundwater on the downgradient side of the upgradient PRB to reach the downgradient PRB, and it would take more years for TCE concentrations between the two barriers to reach default screening levels.

If a third PRB is added between the two barriers, it would decrease the solute-front transit time between PRBs to about eight (8) years. While it may take more time to affect a complete reduction of TCE concentrations between the PRBs, adding a third PRB should at least cut eight (8) years off of any subsequent monitoring and maintenance. Please refer to **Figure 6** for the location of the potential PRBs.

IWM Consulting anticipates the PRBs would utilize PlumeStop Liquid Activated Carbon® (PlumeStop) and sulfidated micro-ZVI (S-MZVI™). PlumeStop is a colloidal form of activated carbon with a surface treatment that allows the material to move more readily through the soil pores, increasing the sorption surface of the PlumeStop since it is thoroughly distributed throughout the sub-surface. PlumeStop will result in immediate reductions in the dissolved cVOC concentrations since the contaminants will adsorb to the carbon. Once the contaminants are concentrated on the surface of the carbon, the contaminants could be readily destroyed by the supplemental S-MZVI™.

S-MZVI™ is a colloidal, sulfidated zero-valent iron product which is suspended in glycerol using proprietary environmentally acceptable dispersants. This product provides reactivity with chlorinated hydrocarbons (such as TCE and PCE) and generates beta-elimination of chlorinated compounds, which bypasses the formation of cis-1,2-DCE and vinyl chloride. Instead, this abiotic degradation process results in the production of ethenes and ethanes. The passivation technique of sulfidation of the zero valent iron will also increase the stability of the S-MZVI™ and provide long-term [designed to last at least ten (10) years] of chlorinated hydrocarbon degradation.

As such, a three (3) PRB approach to groundwater remediation would consist of the following:

- Upgradient PRB (~300 feet in length) with 60 injection locations along the north and east property lines. Each injection location is assumed to have about a 3.5-foot radius of influence. In general, the injection depth would be from 10 to 20 feet BGS. The upgradient PRB would cover about 2,100 square feet and use 23,600 pounds of PlumeStop and 2,000 pounds of S-MZVI™.
- Intermediate PRB (~220 feet long) with 44 injection locations covering about 1,540 square feet total. In general, the injection depths would be from 10 to 20 feet BGS. This PRB would utilize 17,600 pounds of PlumeStop and 2,000 pounds of S-MZVI™.
- Downgradient PRB (~210 feet long) with 42 injection locations along the western property line covering about 1,470 square feet total. In general, the injection depth would also be from 10 to 20 feet BGS. This PRB would utilize 16,800 pounds of PlumeStop and 2,000 pounds of S-MZVI™.

a. **Effectiveness** – Moderate: This method chemically degrades contaminants as they come in contact with the barrier(s). Depending on the number and location of barriers, it may take years to affect the entire groundwater plume.

b. **Implementability** – Easy to Moderate: The Site is currently vacant, so no operations would be interrupted. The remedial chemicals, injection equipment and drill rig would need to be secured on-Site for the duration of the work. The work activities are anticipated to take approximately two (2) to three (3) weeks to complete once the contractors have mobilized to the Site. Although the application phase would be less time-consuming than a plume-wide treatment, this option would typically require a longer post-treatment monitoring period.

c. **Cost** – Moderate: Costs would include injectate, injection equipment, drill rig, etc. By comparison with plume-wide treatment, a higher portion of the total lifetime PRB costs are shifted to the post-treatment monitoring phase. IWM Consulting has estimated the up-front cost of implementing this remedial alternative is approximately **$550,000.** The cost of installation of permanent monitoring wells (7 wells) and ongoing monitoring of the 7 new wells and 3 existing OFM wells (baseline + up to 7 years of additional monitoring/reporting) adds an additional **$75,000** for the first-year post-injection with an additional **$40,000** per year in ongoing monitoring costs. The estimated cost to petition for Site closure and abandon the monitoring wells once closure has been issued is approximately **$20,000**. Altogether, the well installation, seven (7) years of monitoring, and well abandonment add an additional **$335,000** to the implementation phase of Groundwater Alternative 3, making the total estimated cost of implementation **$885,000**. The exact number of years for post injection monitoring will be dependent on the dissolved contaminant concentrations observed and any long-term trends documented during the monitoring activities. Consequently, this is an estimate only based on information known at this time.

4. ***Groundwater Alternative 4 – Plume-wide In-situ Injections with Up and Downgradient PRBs –*** Plume-wide injections are very similar to PRBs, except the whole plume is covered with injection points. This can significantly increase the implementation costs relative to PRBs, but it eliminates the wait time (and additional associated monitoring) necessary to achieve contact between the remedial substance and the chemical-of-concern. Another advantage of plume-wide injections is the added number of injection points allow for an increase in the mass of remedial amendments which can be emplaced at one time. As such, plume-wide injections have a lower chance of being overwhelmed by continued migration/leaching of the contaminants and pro-actively treats areas where the lateral extent of VOCs have not been fully defined. Incorporating both upgradient and downgradient PRBs also provides an extra level of protection along the property boundaries, further minimizing the chance for an upgradient source re-impacting an in-situ treatment area and minimizing the possibility of off-site migration of dissolved VOCs while the interior site-wide injection activities are working through the remediation process. Please refer to **Figure 7** for the location of the site wide injections and PRBs.

   Plume-wide injections and PRBs would be installed via direct push drill rig, and would consist of the following:

   - Separation of the Site into two (2) separate treatment areas, upgradient treatment Area A and central/downgradient Treatment Area B.
   - Installation of one upgradient PRB (~300 feet in length) with 60 injection locations along the north and east property lines. Each injection location is assumed to have about a 3.5-foot radius of influence. In general, the injection depth would be from 10 to 20 feet BGS. The upgradient PRB would cover about

2,100 square feet and use 23,600 pounds of PlumeStop and 2,000 pounds of S-MZVI™. This PRB will remediate contaminants migrating onto the Site from the hydraulically upgradient source (OFM).

- Installation of one downgradient PRB (~210 feet long) with 42 injection locations along the western property line covering about 1,470 square feet total. In general, the injection depth would also be from 10 to 20 feet BGS. This PRB would utilize 16,800 pounds of PlumeStop and 2,000 pounds of S-MZVI™. This PRB will provide a treatment barrier along the hydraulically downgradient edge of the Site.
- Installation of 99 injection points into upgradient Treatment Area A, which is designed to remediate contaminants detected in the northeaster portion of the Site that have already migrated onto the Site from the hydraulically upgradient source (OFM). Each injection location is assumed to have about a 3.5-foot radius of influence. In general, the injection depth would be from 10 to 20 feet BGS. Upgradient Treatment Area A would cover about 17,200 square feet and use 6,000 pounds of 3-D Microemulsion (3-DME), 4,500 pounds of S-MZVI™, and 37 liters of Bio-Dechlor Inoculum Plus (BDI Plus).
- Installation of 216 injection points into central/downgradient Treatment Area B, which is designed to remediate the area of the Site where the VOCs from the suspected on-Site source area and the hydraulically upgradient source (OFM) are comingled. Each injection location is assumed to have about a 3.5-foot radius of influence. In general, the injection depth would be from 10 to 20 feet BGS. Treatment Area B would cover about 35,100 square feet and use 12,000 pounds of 3-DME, 9,000 pounds of S-MZVI™, and 79 liters of BDI Plus.

a. **Effectiveness** – Good to High: This method chemically degrades contaminants in-situ and works best at addressing dissolved phase contamination. Plume-wide injections would also address a higher contaminant mass, and decrease concentrations over the entire injection area more quickly than isolated PRBs. However, variations in lithology and soil chemistry could still result in an inadequate decrease in contaminant concentrations – at least on a localized basis, if the contaminant mass is higher than what is anticipated or if the injectants are not able to be effectively distributed throughout the subsurface.

b. **Implementability** – Easy to Moderate: The Site is currently vacant, so no operations would be interrupted. The remedial chemicals, injection equipment and drill rig would need to be secured on-Site for the duration of the work. The work activities are anticipated to take between 4 and 5 weeks to complete once the contractors have mobilized to the Site. The application phase would be more time-consuming than PRBs alone, but this option should shave years off the post-treatment monitoring period.

c. **Cost** – Moderate to High: Costs would include injectate, injection equipment, drill rig, etc. Costs for plume-wide treatment and limited PRBs are more front-end loaded than only PRBs. IWM Consulting has estimated the cost of implementing this remedial alternative is approximately **$865,000**. The cost of installation of permanent monitoring wells (7 wells) and ongoing monitoring of the 7 new wells and 3 existing OFM wells (baseline + up to 3 years of additional monitoring/reporting) adds an additional **$75,000** for the first-year post-injection with an additional **$40,000** per year in ongoing monitoring/reporting costs. The estimated cost to petition for Site closure and abandon the monitoring wells once closure has been issued is approximately **$20,000**. Altogether, the well installation, three (3) years of monitoring, and well abandonment add an additional **$175,000** to the implementation phase of Groundwater Alternative 4, making the total estimated cost of implementation **$1,040,000**. The exact number of years for post injection monitoring will be dependent on the dissolved contaminant concentrations observed and any short-term trends documented during the monitoring activities. Consequently, this is an estimate only based on information known at this time.

Remedial Alternatives with Respect to Climate Fluctuation Conditions

An evaluation of several climate fluctuation consequences (e.g., sea level changes, increased frequency and intensity of flooding and/or extreme weather events, etc.) indicates that the Site is not likely to be materially affected by such conditions.

Recommendation for Site Remedy

The most feasible and appropriate cleanup alternative is Soil Alternative 4 (Targeted Excavation and Hazardous Disposal) along with Groundwater Alternative 4 (Site Wide Injections with Upgradient and Downgradient PRBs). An ERC restricting land use to non-residential and prohibiting groundwater extraction (except for assessment and remediation purposes) should also be instituted on the Site. The total estimated combined cost to implement Soil Alternative 4 and Groundwater Alternative 4 is approximately **$1,645,000** plus supplemental administrative reporting requirements for an additional **$10,000**.

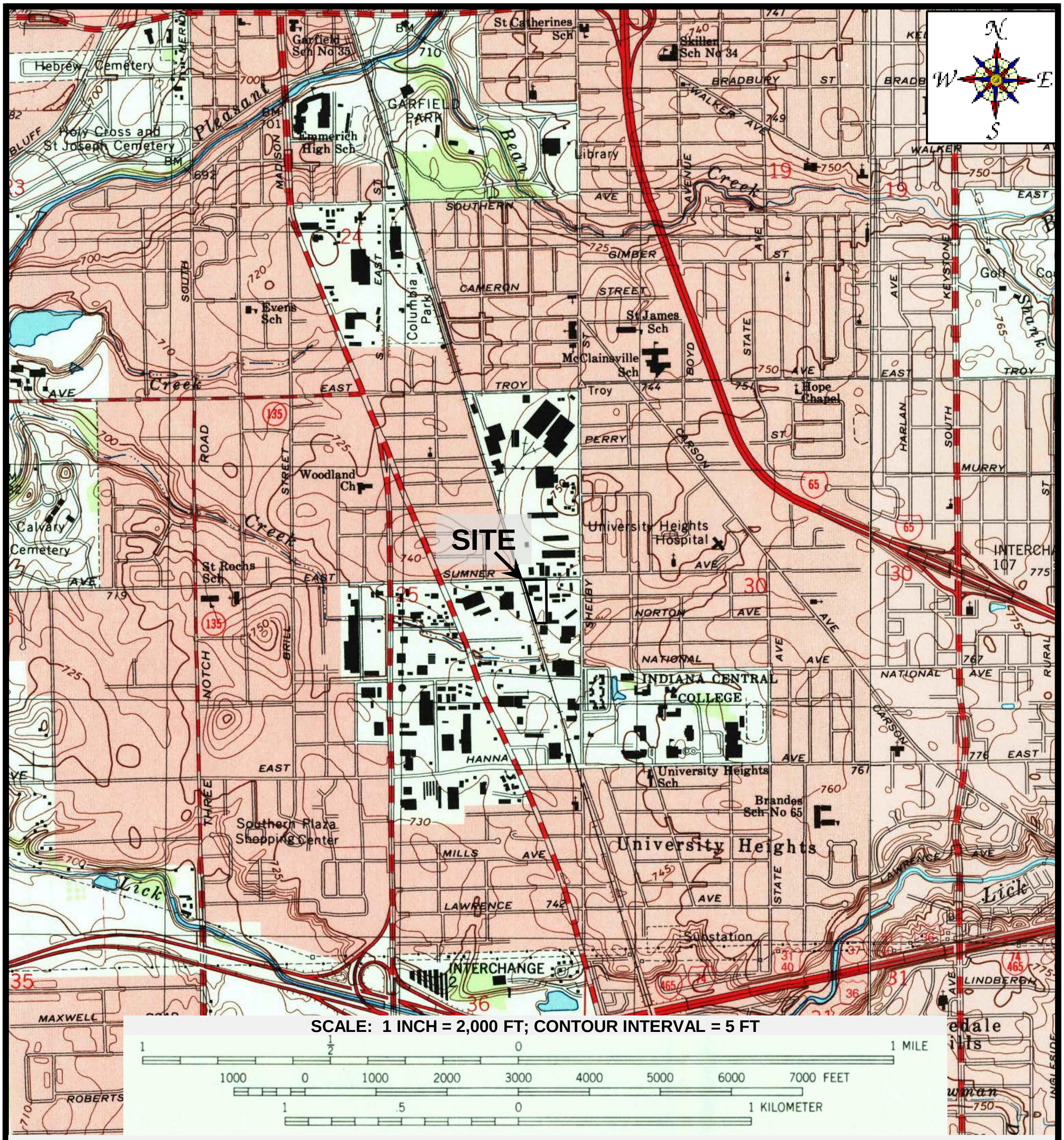
This remedial approach immediately remediates and/or removes areas with the highest contaminant concentrations in soil and groundwater, and expeditiously minimizes potential exposure pathways. The approach promotes redevelopment of the Site by cleaning up the Site soils to levels below R2 XSPL, and expeditiously cleaning up the first encountered groundwater to R2 GWPLs at the downgradient property line, and the selected approach consists of the most health protective options for future Site occupants and construction workers. It also provides the quickest path to regulatory closure and Site redevelopment. Implementing Soil Alternative 4 is also the greener soil remediation approach when compared to Soil Alternative 3, since it minimizes vehicle and equipment emissions by requiring less trips to the landfill (~ 85 truckloads as opposed to 125 roll-off boxes) and less time on-site time (by at least 5 days) for the excavation equipment.

However, migration from the off-Site TCE source (OFM) may continue to impact the Site once the upgradient PRB has been exhausted if further remediation does not occur by a third party for the Office Furniture Mart plume north of Sumner Avenue. Due to the potential for vapor encroachment, if a structure is constructed directly over or within 50-100 feet of a known TCE soil gas exceedance, then a future developer should pre-emptively install a vapor mitigation system or conduct additional vapor intrusion sampling to rule out this potential exposure pathway prior to occupancy of the new building.

Decision Document

A decision document will be issued at the close of the public comment period with additional details on the selected alternative for Site remedy. The decision document will serve as a notice to proceed with federally funded remediation activities and will be available in the local information repository for public review, along with this Site ABCA and other Site-related documents.

FIGURES



SOURCE: MAYWOOD, INDIANA, USGS TOPOGRAPHIC QUADRANGLE MAP, 1998

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Project	Task	Size	Date
IN23109	01	A	12/5/2016

FIGURE 1

Site Location Map
Former Advance Plating Facility
1005 E. Sumner Avenue
Indianapolis, Indiana

CLIENT

THE CITY OF INDIANAPOLIS
INDIANAPOLIS, INDIANA

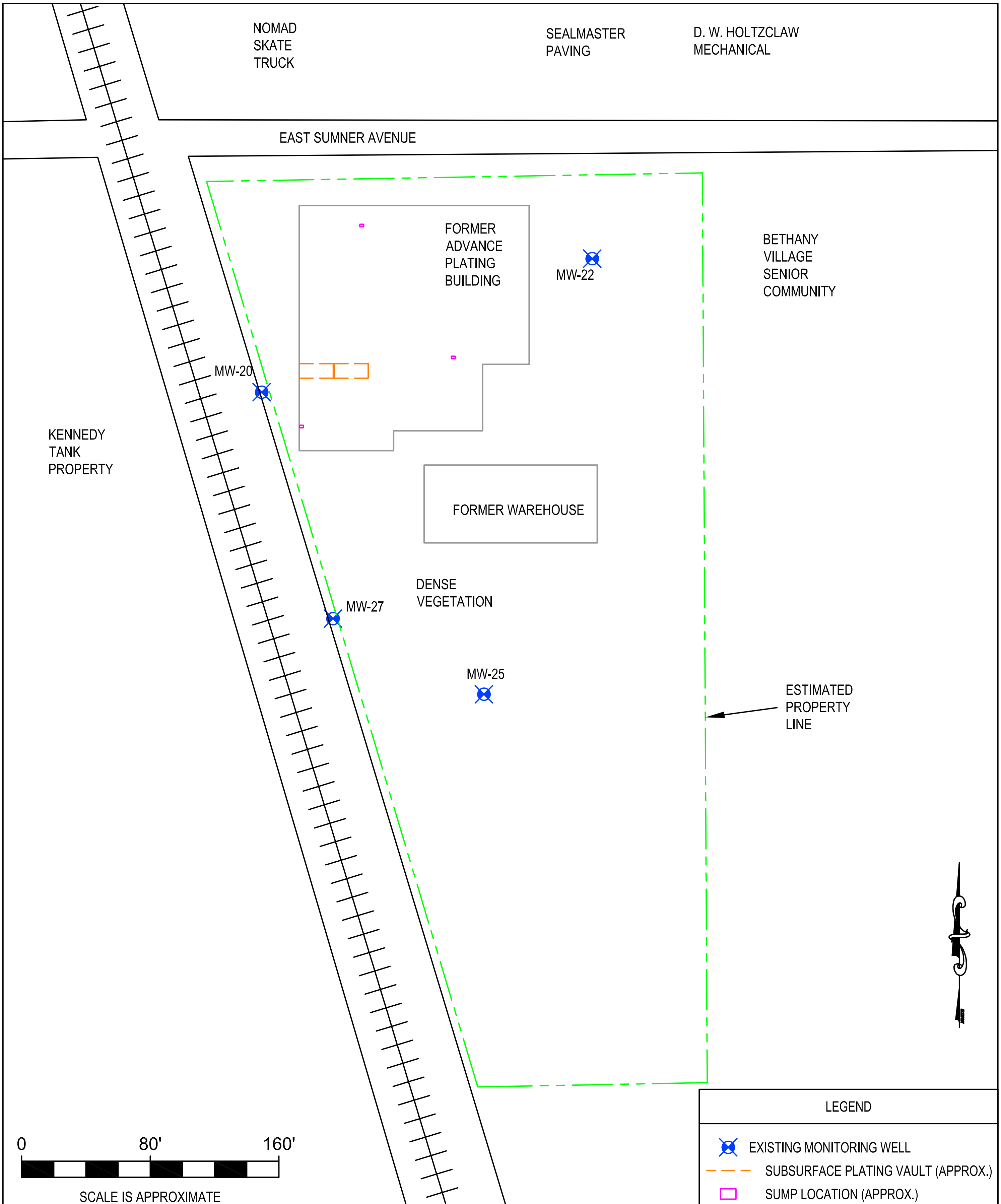

FIGURE 2
SITE MAP

DRAWN BY: WEA
DATE: 3/21/17
REVISED: 4/18/24
IN23109
#Figure 1 - Site Map.dwg

FORMER ADVANCE PLATING FACILITY
1005 EAST SUMNER AVENUE
INDIANAPOLIS, INDIANA

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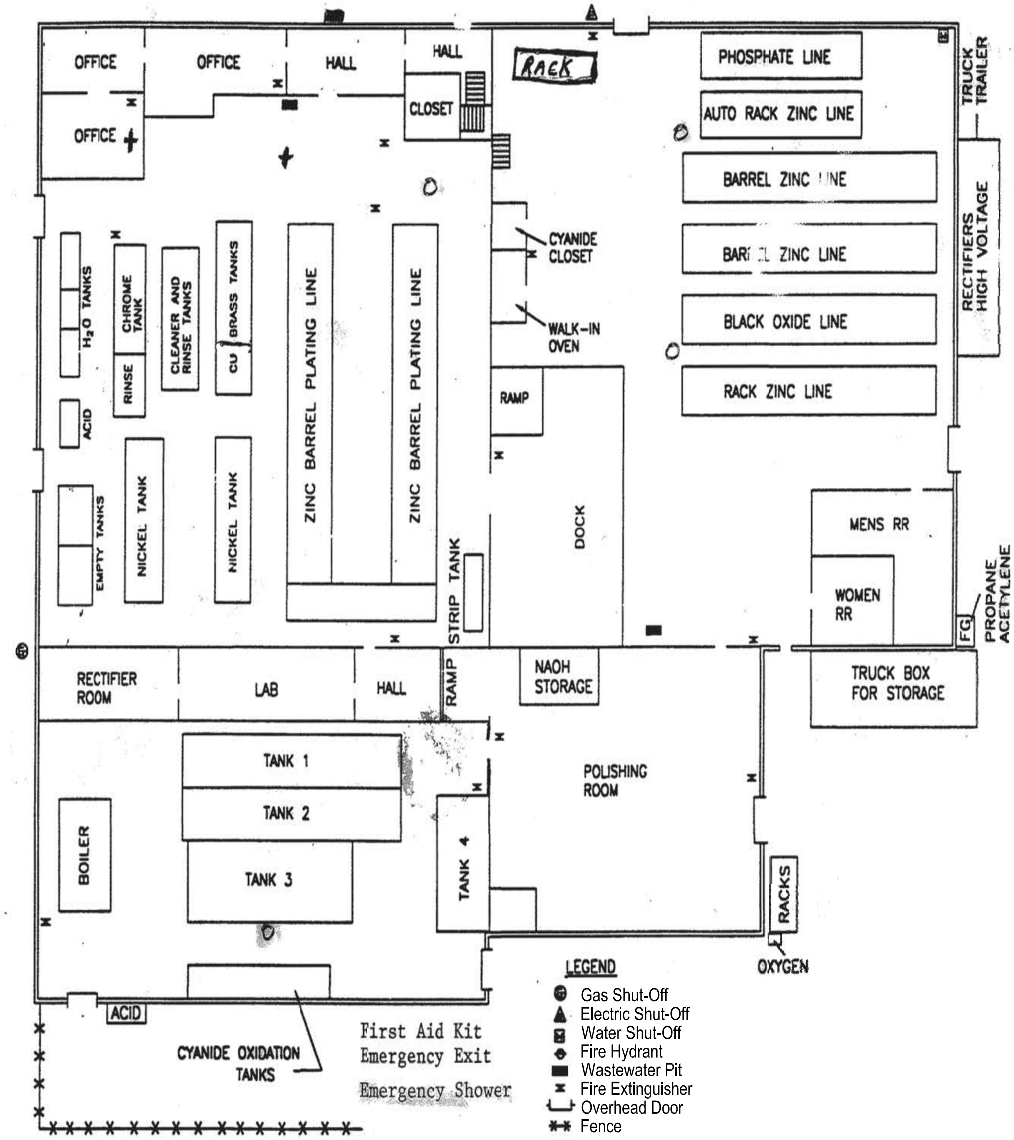
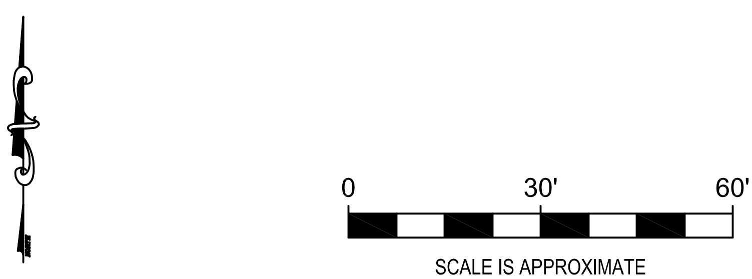
FIRST FLOOR





LEGEND

WASTEWATER SUMP

FIGURE 3 HISTORICAL BUILDING LAYOUT	DRAWN BY: WEA DATE: 11/29/16 REVISED: 4/18/24 IN23109 #Figure 3 Historical...dwg	FORMER ADVANCE PLATING FACILITY 1005 EAST SUMNER AVENUE INDIANAPOLIS, INDIANA	IWM CONSULTING GROUP

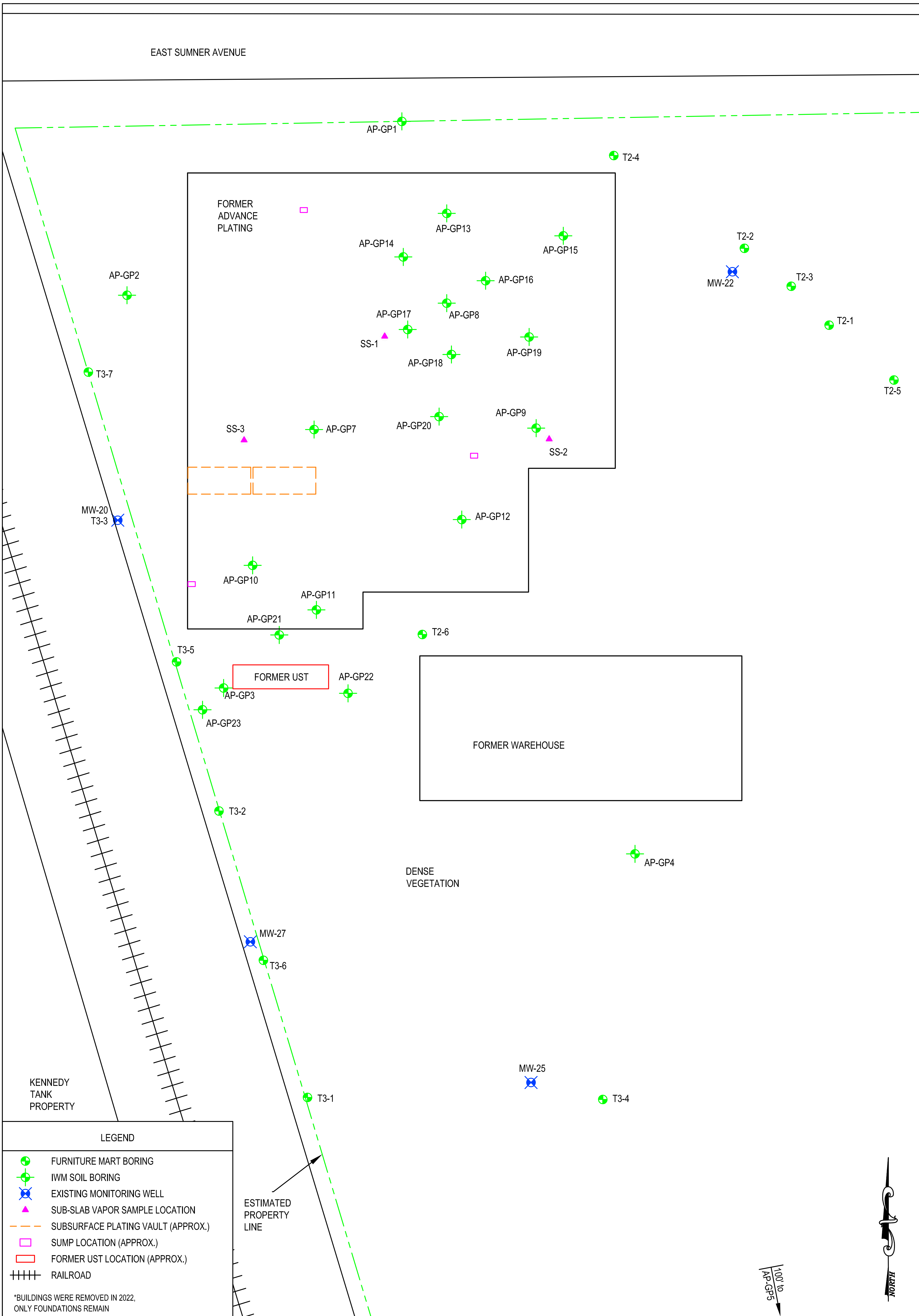


FIGURE 4

HISTORICAL SAMPLE LOCATIONS

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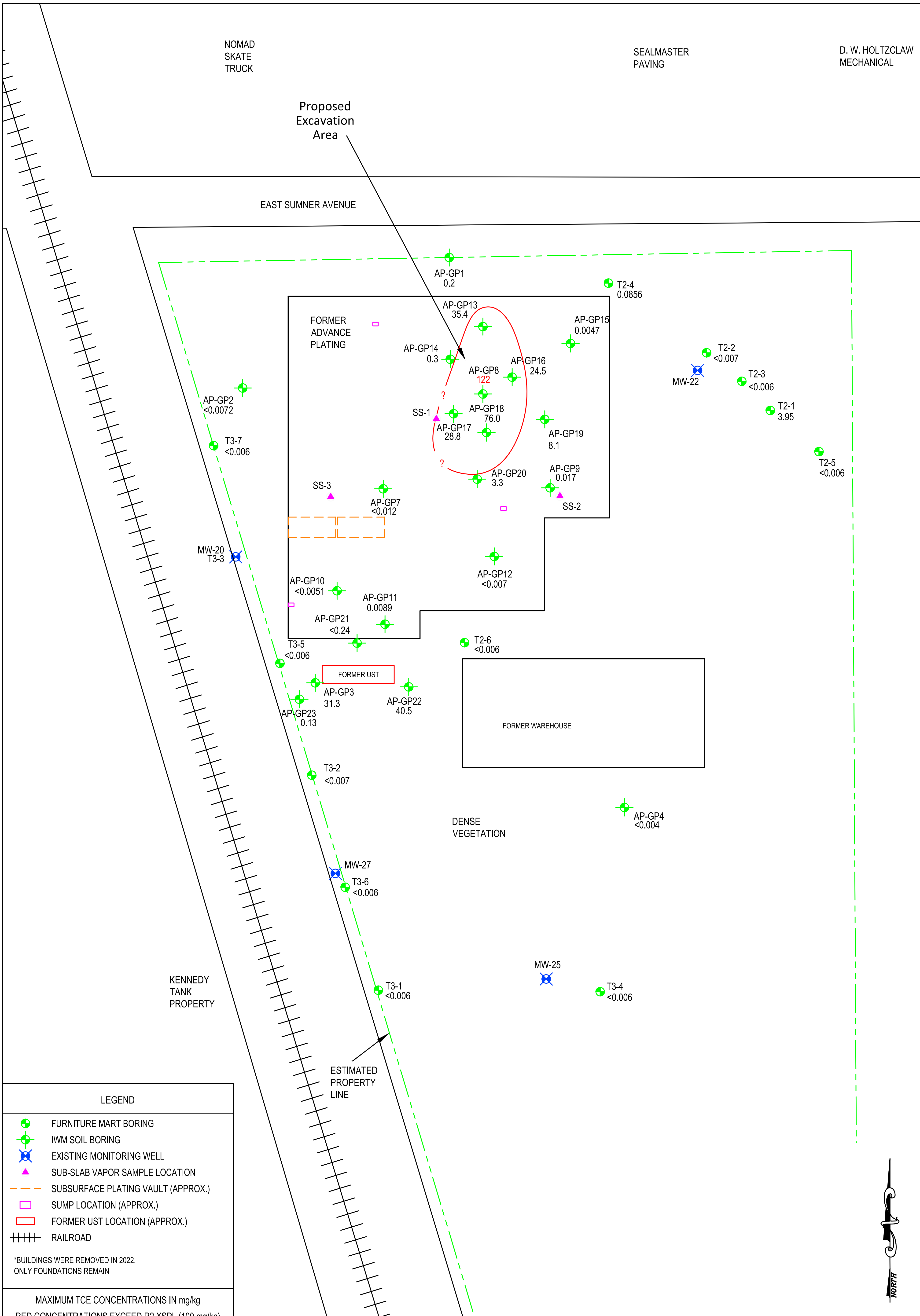

0' 40' 80'

FIGURE 5

ESTIMATED OVER-EXCAVATION

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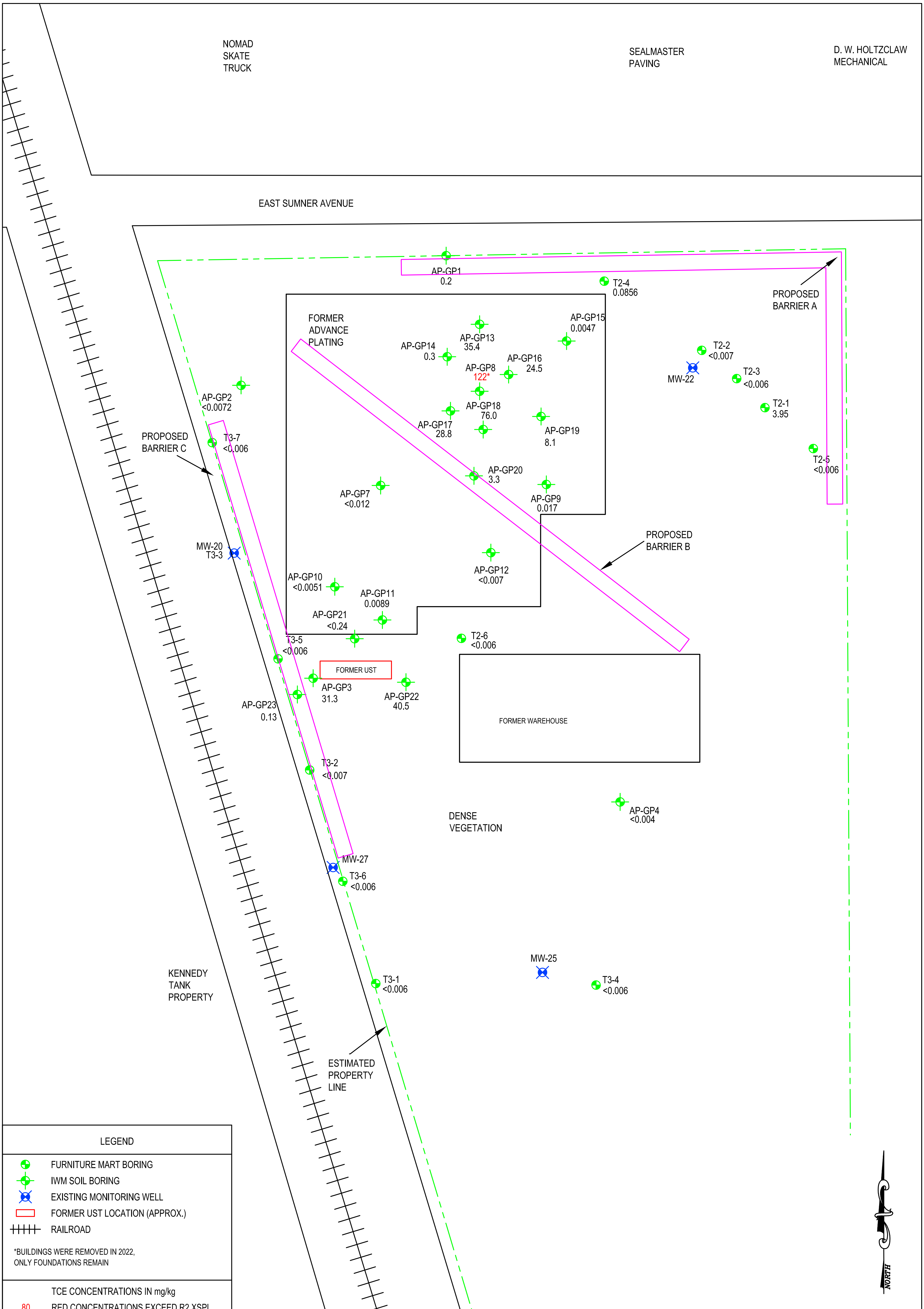

0' 40' 80'

FIGURE 6

PROPOSED PRBs

(GROUNDWATER ALTERNATIVE 3)

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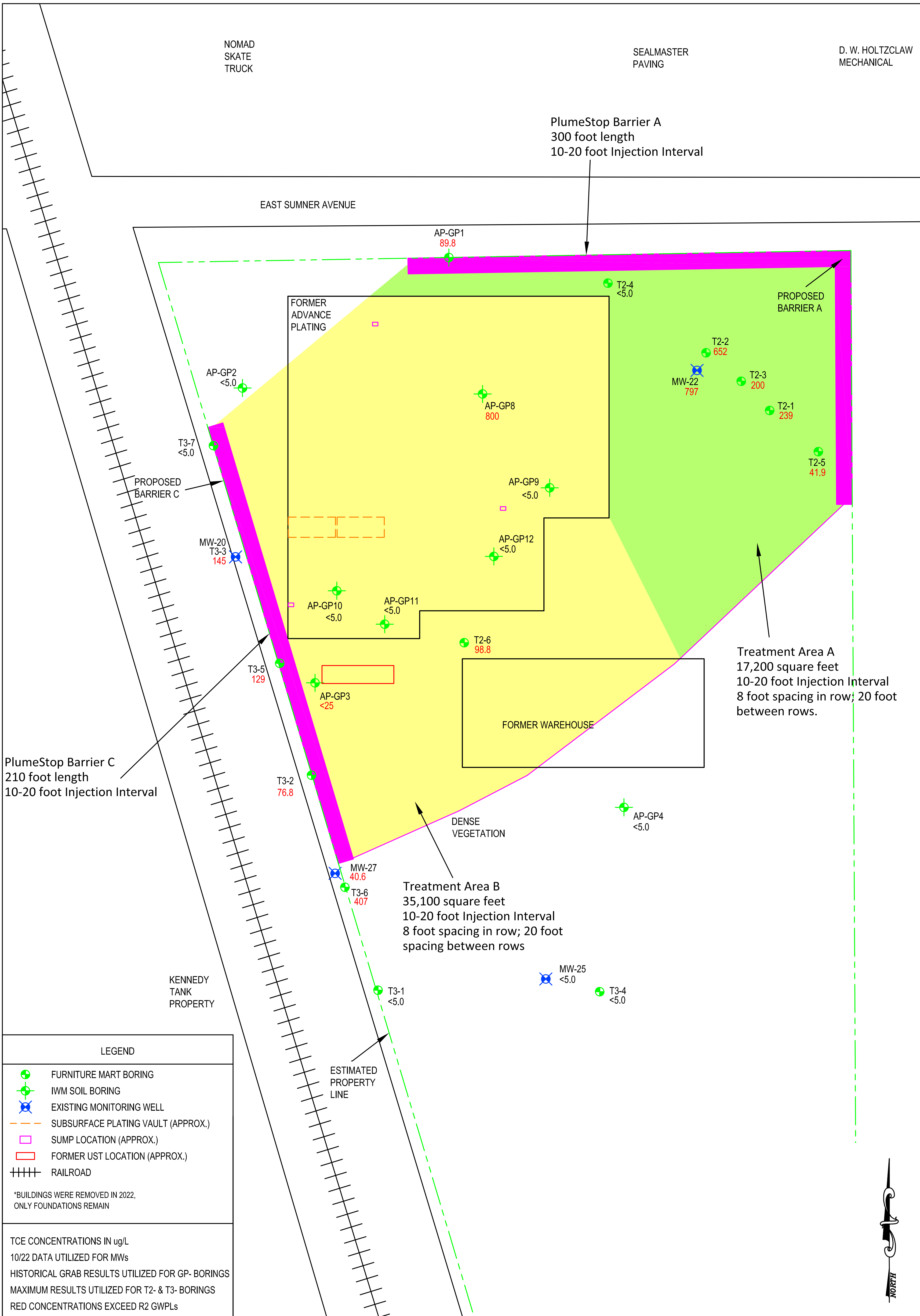

FIGURE 7

PROPOSED PRB AND PLUME-WIDE INJECTION AREAS

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