Precision National Plating Services, Inc.

SUPPLEMENTAL IN SITU CHEMICAL REDUCTION WORK PLAN - 2020

Docket No. CERC-03-2012-0031DC

Precision National Plating Services, Inc.
198 Ackerly Road
Clarks Summit, Pennsylvania 18411

August 2020

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August 2020

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1 INTRODUCTION

Arcadis U.S., Inc. (Arcadis) is submitting this Supplemental In Situ Chemical Reduction Work Plan (Work Plan) on behalf of Precision National Plating Services, Inc. (Precision). This Work Plan has been prepared as an addendum to the Response Action Plan prepared by Precision as Respondent to Docket No. CERC-03-2012-0031DC for the former Precision facility located at 198 Ackerly Road in Clarks Summit, Lackawanna County, Pennsylvania (the Site). The work described herein will be performed in accordance with the 2012 Administrative Settlement Agreement and Order on Consent for Removal Response Action (Settlement Agreement) entered by the United States Environmental Protection Agency (EPA) and Precision. The Settlement Agreement was executed pursuant to the Action Memorandum (2011 Action Memo) issued by the Director of the Hazardous Site Cleanup Division of EPA Region 3 which selected the response action for addressing chromium contamination at the Site.

Based on the Findings of Fact and Conclusions of Law presented in the Settlement Agreement, EPA determined that an actual and/or threatened release of hazardous substances from the Site may present an imminent and substantial endangerment to the public health or welfare or the environment. Therefore, EPA determined that the Work outlined in the Settlement Agreement is necessary to protect the public health and welfare and the environment. Because there is a threat to public health or welfare or the environment, EPA determined that a removal action is appropriate to abate, minimize, stabilize, mitigate or eliminate the release or threat of release of hazardous substances at or from the Site.

All work to be performed at the Site will be consistent with the National Oil and Hazardous Substances Pollution Contingency Plan, as amended (NCP), 40 C.F.R. Part 300 and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The general objectives of the work conducted pursuant to the Settlement Agreement are to conduct a removal action, as defined in Section 101(23) of CERCLA, 42 U.S.C. § 9601(23), to abate, mitigate and/or eliminate the release or threat of release of hazardous substances at the Site by preventing the migration of hazardous substances from the Site through the treatment of contaminated groundwater. The supplemental In Situ Chemical Reduction activities described herein are designed to meet these general objectives.

2 BACKGROUND

2.1 Site Setting

The Precision Site is located at 198 Ackerly Road, Clarks Summit, in Lackawanna County, Pennsylvania, which is approximately 10 miles north of Scranton, Pennsylvania. The majority of the Site is located within Waverly Township (formerly Abington Township) and a portion of the Site is located within Glenburn Township. The location of the Site is shown on Figure 1. The total property measures 46 acres. Approximately five acres were used for site operations and the balance remained undeveloped and largely wooded. A 45,000 square foot operations building was the principal structure on site. This building was demolished in 2000. Portions of the concrete slab floor of the building remain. The Site layout is illustrated on Figure 2.

The Site is located near a topographic high in the area with an average elevation of 1,190 feet above mean sea level (msl). Topography slopes down to the north and west of the site toward Ackerly Creek at a gradient of approximately 660 feet per mile. Ackerly Creek, a perennial stream that flows from southeast to northwest before joining a tributary and flowing northwest to Glenburn Pond, is located approximately 800 feet northwest of the former Site operations area. Residential properties are located north, east, and west of the Site. To the south is undeveloped land.

The geology beneath the Site consists of two primary lithologies, the unconsolidated glacial overburden and the consolidated bedrock. The overburden generally consists of silts and silty sands with some interbedded sands. One of these sand lenses occurs in the area of groundwater monitoring well OMW-13 and extends from the area beneath the lagoon treatment shed northward to beneath the former lagoon where the sand lens pinches out.

The consolidated bedrock is a sandstone with interbedded siltstone and shale. At the top of the hill, a siltstone and shale unit is present at approximately 20 to 30 feet bgs in the vicinity of the former building slab. The unit projects out the slope of the hill. The bedrock has both primary and secondary (joints and fractures) porosity. Since there is a calcareous cement present throughout the formation much of the primary porosity has been sealed up. A significant amount of porosity was assigned to the fractures due to the presence of some intensely fractured zones especially in the vicinity of wells SB-2008-4 (SB-4) and SB-2008-7 (SB-7) to SB-2008-11 (SB-11) and SB-2008-12 (SB-12).

There are also sporadic vuggy zones present throughout the formation. These vuggy zones, when present, represent a preferential pathway for the accumulation and transport of impacted groundwater. The vuggy zones are discontinuous and are generally not connected. However, a vuggy zone is present in the area from SB-2007-H (SB-H) and SB-2007E (SB-E) to SB-2008-9 (SB-9) and SB-2008-8 (SB-8) at an elevation of approximately 1,175 feet above msl. There is a second vuggy zone that occurs from SB-2008-6 (SB-6) to SB-2008-5 (SB-5) and extends under the former lagoon and occurs at an elevation of approximately 1,140 feet above msl.

There are three primary hydrogeologic zones of concern beneath the Site. The uppermost zone is the overburden groundwater which occurs within the unconsolidated glacial deposits. This is generally the first groundwater encountered beneath the Site. The second zone is the shallow bedrock groundwater. The shallow bedrock groundwater occurs below the glacial sediments and bedrock surface, within the shallow bedrock. The shallow bedrock groundwater is perched above the siltstone/shale layer and contains the highest concentrations of hexavalent chromium. The third zone of concern represents the unconfined water table within the intermediate bedrock which occurs at a depth of 60 to 80 feet below the ground surface. The deep bedrock groundwater is not considered to be a zone of concern, although it is monitored along with the other zones.

2.2 Site History

The Site began operation as a chromium electroplating facility for locomotive crankshafts in 1956. This operation continued when Precision bought the facility in 1971. Precision operated an industrial component reconditioning facility on site from 1971 until 1999. Site operations ceased in April 1999. Shortly thereafter, the process equipment used for plating operations was decontaminated and either sold or properly disposed offsite. With U.S. EPA oversight and approval from Abington Township, the former plating building was demolished in the fall of 2000.

Based on historical investigations conducted to date, the hazardous substances at the Site are total chromium and hexavalent chromium; however, hexavalent chromium is the primary constituent of concern at the Site. Hexavalent chromium and total chromium in the soil and groundwater at the Site may be related to historical site activities and incidents that occurred between 1958 and 1987 as summarized in the 2012 Response Action Plan (RAP).

In September of 1991, EPA and Precision entered into an Administrative Order by Consent, Docket No. III-90-057-DC, which required Precision to provide an alternate water supply to one residence located on Arch Avenue. Precision complied with this Order and replaced the well late in 1991. Precision installed another well on Arch Avenue in the fall of 1993 to be used as an alternate source of drinking water for three residents.

On August 22, 1995, EPA and Precision entered into an Administrative Order by Consent for Removal Response Action (1995 AOC), Docket No. III-94-32-DC, which required Precision to perform an Engineering Evaluation/Cost Analysis (EE/CA) to characterize the nature and extent of contamination at the Site. The EE/CA, which was approved with reservations by EPA in 1997, was designed to gather sufficient information to identify and evaluate removal alternatives to ensure that any actions taken would protect public health, welfare, and the environment in accordance with 40 C.F.R. § 300.415(b)(4).

On April 22, 1998, the Director of the Hazardous Site Cleanup Division of EPA signed an Action Memorandum (1998 Action Memo), which determined that a threat to public health, welfare, and/or the environment exists due to the actual or threatened release of hazardous substances from the Site and set forth the requirements for the Removal Action at the Site. Supported by this Action Memo, on April 24, 1998, EPA issued Precision a Unilateral Administrative Order, Docket No. III-98-069-DC (1998 Order) which required Precision to conduct the Removal Action at the Site. In accordance with this AO and with input from the U.S. EPA, PADEP, and the local townships, Precision developed a RAP that detailed the following Site activities:

- Residential well monitoring;
- Residential soil sampling;
- Long-term ground water monitoring;
- Ecological risk assessment; and
- Collection and treatment of the four groundwater seeps, out of the eight identified, that exceeded the Pennsylvania Drinking Water Standard for hexavalent chromium.

The investigation and remediation activities completed at the Site from 1998 through May 2012 were conducted pursuant to the requirements of the 1998 Order. A summary of the activities was provided in the 2012 RAP.

On March 25, 2010, EPA issued an EE/CA Approval Memorandum, approving the drafting of an EE/CA document. EPA subsequently drafted a second EE/CA (2011 EE/CA) to present the final response alternatives for the Site. A public meeting was conducted on December 7, 2010 to present the response alternatives for the Site to the community and to solicit public comments as required by Section

300.820(a) of the NCP. The preferred alternative presented was continuation of the contaminant source area treatment using an in situ chemical injection system, continuation of the collection and treatment of groundwater seeps, as well as long-term monitoring and institutional controls (ICs) that will prevent exposure of residents to contaminated groundwater and surface water. EPA finalized the 2011 EE/CA on September 1, 2011.

On September 9, 2011, the Director of the Hazardous Site Cleanup Division approved an Action Memorandum (2011 Action Memo) selecting the response action for addressing chromium contamination at the Site. Supported by this Action Memo, on March 22, 2012, EPA and Precision entered an Administrative Settlement Agreement and Order on Consent for Removal Response Action, Docket No. CERC-03-2012-0031DC (2012 Settlement Agreement) which required Precision to conduct the Removal Action at the Site. In accordance with this Administrative Settlement, Precision developed the 2012 Response Action Plan (2012 RAP) that detailed the following Site activities:

- Collection and treatment of the existing groundwater seeps that exceeded the Pennsylvania Drinking Water Standard for hexavalent chromium and total chromium;
- Treatment of chromium-contaminated overburden and shallow bedrock with in-situ chemical reduction to prevent high levels of hexavalent chromium from leaching into groundwater;
- Semiannual ground water monitoring;
- Semiannual residential well monitoring;
- Quarterly surface water monitoring (later modified to biannually in November 2019); and
- Implementation of institutional controls to prevent the use of groundwater within the contaminated plume for drinking water until the MCL for total chromium is achieved.

Following the requirements of the 2012 RAP, Precision injected approximately 126,140 gallons of diluted calcium polysulfide solution (1% to 2%) between September and November 2012 into the overburden, shallow bedrock, and weathered bedrock source areas, downgradient wells in the former lagoon area, and along the Trolley Tracks to treat contaminated groundwater. Between September and November 2013, Precision injected approximately 115,735 gallons of diluted calcium polysulfide solution (1% to 2%) into the overburden, shallow bedrock, and weathered bedrock source areas and downgradient wells in the former lagoon area and along the Trolley Tracks to treat contaminated groundwater.

Semiannual groundwater monitoring, semiannual residential well monitoring, and quarterly surface water monitoring have been ongoing since 2012 as outlined in the 2012 Settlement Agreement and approved in the 2012 RAP. The results of the semiannual monitoring in 2013 and early 2014 indicated that the source areas impacted with hexavalent chromium had been greatly reduced in size as a result of the prior in situ chemical reduction activities, and excess unreacted calcium polysulfide solution persisted in many of the groundwater monitoring wells. Therefore, Precision continued monitoring the groundwater and surface water concentrations of hexavalent chromium and total chromium through 2014 and the first half of 2015. The extended monitoring period allowed longer-term observation of the trends in groundwater and surface water concentrations and a more precise evaluation of residual contaminant source areas before proposing additional remediation.

During the semiannual groundwater monitoring event completed in April 2015, elevated concentrations of hexavalent chromium were identified south of the former building slab in intermediate bedrock monitoring well MW-C. Historically, hexavalent chromium has generally not been detected at elevated concentrations in this well. Based on this change in conditions, Precision initiated the installation of new bedrock monitoring wells in the vicinity of MW-C and modified MW-C from May through September 2015 to further delineate impacts to groundwater in this area. The locations of the wells are illustrated on Figure 2.

With the exception of the area surrounding MW-C, the highest remaining hexavalent chromium concentrations in the groundwater in 2013 and 2014 had been observed in the wells near Ackerly Creek, mainly in the shallow bedrock aquifer. During the April 2014 semiannual groundwater sampling event, hexavalent chromium was detected at concentrations in the three shallow bedrock wells located along the southern (upgradient) side of Ackerly Creek. The highest of these results was 952 ug/L in MW-9S. In September 2014, Arcadis installed three deeper wells (MW-9IA, MW-9IB, and MW-9D) to delineate these impacts vertically and to evaluate whether hexavalent chromium from the intermediate or deep aquifers was discharging into Ackerly Creek. During the installation of bedrock well MW-9I, a geophysical survey of the boring was completed to identify major water-producing fractures and significant bedrock features. The key zones identified in the geophysical survey were then sampled separately using an inflatable packer assembly. The findings of the geophysical survey and the results of the packer testing were evaluated to select the final depths and screen intervals for each of the two nested wells constructed within the MW-9I boring (MW-9IA and MW-9IB).

In the April 2015 semiannual sampling event, hexavalent chromium was detected in MW-C at a concentration of 9,390 ug/L. After further investigation and confirmatory sampling of MW-C, it was determined that hexavalent chromium impacts needed further delineation in areas to the south of the original plant area. On May 28, 2015, bedrock well MW-22 was installed approximately 10 feet to the north (downgradient) of MW-C. Subsequently, packer testing was performed on MW-22 at various intervals to investigate the hexavalent chromium concentrations in the groundwater at specific intervals across significant fractures to determine which were most directly impacting the well. After laboratory results indicated high concentrations of hexavalent chromium in multiple intervals, it was determined that further delineation was required.

Precision installed seventeen shallow and intermediate bedrock monitoring wells (MW-23, MW-24, MW-25, MW-26S, MW-26I, MW-27S, MW-27I, MW-28S, MW-28I, MW-29, MW-30, MW-31S, MW-31I, MW-32S, MW-32I, MW-33S, and MW-33I) in August 2015 to delineate the hexavalent chromium impacts identified in MW-C and MW-22. Furthermore, wells MW-C and MW-22 were modified to create couplet wells screened at shallow and intermediate depths (MW-CS and MW-CI, MW-22S and MW-22I). The depths of the wells, lengths of polyvinyl chloride (PVC) casing, and open boreholes were dependent on the observations made during the drilling activities and geophysical testing, including the depths at which major fractures were identified. Some of the boring locations were also adjusted based on Site conditions, access constraints, and field observations identified during the performance of the investigation activities. All of the newly installed and modified wells were constructed of PVC casing with the capability of attaching a flange to enable injection into these bedrock wells as necessary.

In August 2015, Precision installed a group of five shallow bedrock monitoring wells (MW-23, MW-24, MW-25, MW-30, and MW-29) located in an arc extending from the eastern edge of the former building slab to the open field approximately 100 feet west of the slab. These five wells were constructed as 4-inch diameter wells with 15 to 25 feet of open hole intervals. The total depths of the five wells range from 33 feet to 46 feet and serve as delineation wells for the shallow bedrock. All of the newly installed wells were constructed of PVC casing with the capability of attaching a flange to enable injections.

The sixth round of supplemental bedrock injection activities was completed between September and November 2015. Precision injected approximately 63,470 gallons of dilute calcium polysulfide solution (1% to 2%) into the overburden, shallow bedrock, and weathered bedrock source areas, downgradient wells in the former lagoon area, and along the Trolley Tracks to treat contaminated groundwater.

Following the 2015 injection activities, monitoring of the groundwater during semi-annual events and supplemental sampling activities indicated that the source areas beneath the building slab had been effectively treated. The results of the semiannual monitoring in 2016 and early 2017 indicated that the source areas impacted with hexavalent chromium had been greatly reduced in size as a result of the prior in situ chemical reduction activities, and excess unreacted calcium polysulfide solution persisted in many of the groundwater monitoring wells. Therefore, Precision elected to continue monitoring the groundwater and surface water concentrations of hexavalent chromium and total chromium through 2017 and the first half of 2018.

In December 2017, Precision installed six clusters of wells upgradient from the stream wells and downgradient from the wells located on the trolley tracks. Each cluster consisted of an overburden, shallow, intermediate, and deep bedrock well. The clusters were spaced to cover an injection influence area upgradient of the existing stream wells. The overburden wells, OMW-38 through OMW-43, extended to the top of bedrock, approximately 10 feet below grade, and were constructed with 4-inch PVC well screen from approximately 3 feet to 10 feet below grade. The shallow bedrock wells, MW-38s through MW-43s, were installed into competent bedrock with an open 4-inch borehole from approximately 15 to 25 feet below grade. The intermediate bedrock wells, MW-38I through MW-43I, were installed into competent bedrock with an open 4-inch borehole from approximately 30 to 40 feet below grade. The deep bedrock wells, MW-38D through MW-43D, were installed into competent bedrock with an open 4-inch borehole from approximately 55 to 65 feet below grade. All of the newly installed wells were constructed of PVC casing with the capability of attaching a flange to enable injections.

In August 2018, an additional well couplet was installed east of the OMW/MW-38 well cluster. An overburden well, OMW-44, was installed to a depth of 12 feet below ground surface (bgs). The well was installed using 2-inch PVC and screened from 9 feet bgs to 12 feet bgs. A shallow bedrock well, MW-44s was installed to a depth of 25 feet bgs. The well was constructed using 2-inch PVC and screened from 15 feet bgs to 25 feet bgs. Each of newly installed wells were constructed of PVC casing with the capability of attaching a flange to enable injections.

The seventh round of supplemental bedrock injection activities was completed between July and November 2018. Precision injected approximately 48,935 gallons of dilute calcium polysulfide solution (1% to 3%) into the overburden, shallow bedrock, and weathered bedrock source areas, downgradient wells in the former lagoon area, along the Trolley Tracks, and the wells upgradient of the stream to treat contaminated groundwater.

Following the 2018 injection activities, monitoring of the groundwater during semi-annual events and supplemental sampling activities indicated that the source areas beneath the building slab had been effectively treated. In addition, sampling of Ackerly Creek from October 2016 through July 2019 demonstrated that the concentrations of hexavalent chromium in the surface water had decreased and remained below EPA's Water Quality Criterion Continuous Concentration of 11 ug/L. Based on these results, EPA issued an Amendment to the 2012 Settlement Agreement reducing the sampling frequency of Ackerly Creek from quarterly to biannually.

The results of the semiannual groundwater monitoring in 2019 and the first half of 2020 indicated that the source areas impacted with hexavalent chromium had been greatly reduced in size and concentration as a result of the prior in situ chemical reduction activities, and excess unreacted calcium polysulfide solution was present in several of the groundwater monitoring wells. Based on the recent results, Precision has elected to perform supplemental injection activities to address the residual hexavalent chromium concentrations remaining in the groundwater at the Site. The proposed plans are presented in this work plan.

3 SUPPLEMENTAL OVERBURDEN AND BEDROCK GROUNDWATER INVESTIGATION ACTIVITIES

3.1 Comprehensive Site Wide Groundwater Sampling

During the April 2020 semiannual groundwater sampling event, samples were collected from all of the wells on site to determine the concentrations of total and hexavalent chromium in the wells. The groundwater samples were collected using low-flow purging procedures unless water levels were insufficient to purge, in which case a grab sample was collected. The samples were collected in laboratory-supplied sample bottles and submitted to an EPA/PADEP-approved laboratory for analysis for the presence of total and hexavalent chromium.

Analytical results from this sampling indicated that hexavalent chromium concentrations are present at levels above 100 ug/L in the groundwater within the overburden, shallow, and intermediate bedrock units. Three distinct areas around the Site were identified with concentrations above 100 ug/L. The areas were located along Ackerly Creek and just upgradient, in the former lagoon, and one location along the paper road. The area along Ackerly Creek and just upgradient of the creek had hexavalent chromium concentrations within the overburden ranging from 114 ug/L in OMW-15 to 323 ug/L in OMW-40. The shallow bedrock had hexavalent chromium concentrations ranging from 146 ug/L in MW-43S to 322 ug/L in MW-14S. The intermediate bedrock had hexavalent chromium concentrations ranging from 113 ug/L in MW-9IA to 384 ug/L in MW-40I. Sampling of the wells in the lagoon area identified concentrations in both the overburden and shallow bedrock aquifers at levels above 100 ug/L. The overburden had hexavalent chromium concentrations ranging from 136 ug/L in the Lagoon Seep to 335 ug/L in OMW-32. Hexavalent chromium was only found in MW-21S in the shallow bedrock at a concentration of 346 ug/L. Along the paper road hexavalent chromium was detected in the overburden aquifer at OMW-30 at a concentration of 499 ug/L.

Following the April 2020 semiannual monitoring event, the data was evaluated to determine the extent of hexavalent and total chromium concentrations in each zone and to select the locations of injection activities to treat the remaining hexavalent chromium concentrations in this area. In addition, select wells from each groundwater monitoring zone may be selected for future sampling along with the existing monitoring wells that are monitored as part of the semi-annual sampling program. The results from the monitoring wells that are selected for future periodic monitoring will be used to evaluate the effectiveness of treatment activities and to determine if the requirements of the Settlement Agreement are being achieved.

Based on the recent monitoring well sampling activities, a report will be prepared to summarize the activities including the description of the monitoring wells, the field monitoring data, and an evaluation of the groundwater quality. The report will be submitted under separate cover.

3.2 Proposed Well Installations

During the injection activities, the potential installation of additional overburden and shallow bedrock wells will be evaluated to supplement the monitoring and injection activities. Based on the April 2020 groundwater sampling results, the installation of six overburden and shallow bedrock well couplets will be evaluated during the injection activities. The potential well installation areas are illustrated on Figure 13 and include two locations between the Trolley Tracks and the MW-38 to MW-44 well clusters, three locations between the MW-38 to MW-44 well clusters and Ackerly Creek, and one location west of the MW-43 well cluster. The installation of the wells will depend on access with a drill rig and the field observations during the initial injection activities. The exact location of the proposed wells will be determined in the field based on land elevation, accessibility, and current field conditions observed during the startup of the proposed injection activities outlined below. The wells will be installed as applicable to maximize the effectiveness of the injection activities.

The overburden wells will extend to the top of bedrock, approximately 10 feet below grade, and will be constructed with 4-inch PVC well screen from approximately 3 feet to 10 feet below grade. The wells will be completed with a standard stick-up, lockable, protective monitoring well casing composed of steel. A diagram of the typical overburden well construction is provided as Figure 10.

The shallow bedrock wells will be installed into competent bedrock with an open 4-inch borehole from approximately 15 to 25 feet below grade. The boring for the well will extend into the shallow bedrock approximately 5 feet using air rotary drilling techniques and a 4-inch schedule 40 PVC casing will be grouted into the bedrock to provide a seal from the overburden groundwater. The boring will be extended as a 4-inch diameter open hole from approximately 15 to 25 feet into the competent bedrock. The wells will be completed with a standard stick-up, lockable, protective monitoring well casing composed of steel. A diagram of the typical shallow bedrock well construction is provided as Figure 11.

As with the previous well installation activities, the well heads will be finished such that a flange or expandable well plug may be attached to enable injections. Approximately one to two weeks after installation, the new wells will be sampled using low-flow purging and sampling techniques. The samples will be collected in laboratory-supplied sample bottles and submitted to an EPA/PADEP-approved laboratory for analysis for the presence of total and hexavalent chromium.

4 IN SITU CHEMICAL REDUCTION OF HEXAVALENT CHROMIUM IN OVERBURDEN AND BEDROCK

The proposed supplemental bedrock chemical injection activities are designed to treat the remaining hexavalent chromium concentrations in the overburden and bedrock units in the Ackerly Creek area, the former lagoon area, and the paper road area as a follow-up to the previous chemical injection activities completed from 2008 through 2018. In general, the remedial strategy of treating the hexavalent chromium by ISCR with calcium polysulfide (CaSx) will be implemented as outlined herein. The Work Plan follows the general procedures previously submitted and approved by EPA for the previous injection activities conducted in 2008, 2009, 2010, 2011, 2012, 2013, 2015, and 2018 and includes the flexibility for on-site changes in design parameters including, but not limited to, location of injection points, calcium polysulfide concentrations, calcium polysulfide volumes, injection techniques, follow-up injection chemicals and other site-specific variables depending upon actual Site conditions. If modifications to the injection plan outlined below are necessary during implementation, Precision or Arcadis will notify the EPA onsite representative of the modifications.

The remediation strategy follows from the same interpretation of site characteristics as updated based on recent investigation results, remedial alternative selection, and feasibility study that were performed in preparation for the first phase of bedrock injection activities completed in 2008/2009 and the source area overburden soil injection activities completed in 2006. The strategy incorporates the results of the supplemental investigation activities completed from 2007 through 2020.

From August 2008 to January 2009, the initial phase of shallow bedrock injection activities was completed at the Site. Calcium polysulfide was injected into the shallow bedrock through 25 injection points/wells. During the injection activities, approximately 150,000 gallons of a 1% to 2% solution of percent calcium polysulfide were injected into the shallow bedrock. The quarterly monitoring activities following the injection activities indicated an overall decrease in both hexavalent chromium and total chromium concentrations in the monitoring wells, influents to the treatment systems, and Ackerly Creek. The results indicated that the hexavalent chromium concentrations had been effectively treated by the CaSx injections. However, the surface water quality standard of 11 ug/l of hexavalent chromium had not been achieved in Ackerly Creek.

A second phase of the shallow bedrock injection activities was completed at the Site from October 2010 to December 2010. Calcium polysulfide was injected into the overburden and shallow bedrock through 37 injection points/wells. During the second phase of injection activities, approximately 50,000 gallons of dilute (1% to 2%) calcium polysulfide solution were injected into the overburden and shallow bedrock.

A third phase of the shallow bedrock injection activities was completed at the Site from October 2011 to November 2011. Calcium polysulfide was injected into the overburden and shallow bedrock through 48 injection points/wells. During this phase of injection activities, approximately 63,300 gallons of diluted calcium polysulfide solution was injected into the overburden and shallow bedrock.

Similarly, between September and November 2012, Precision injected approximately 126,140 gallons of dilute calcium polysulfide solution (1% to 2%) into the overburden, shallow bedrock, and weathered bedrock source areas, downgradient wells in the former lagoon area, and along the Trolley Tracks to treat contaminated groundwater.

The fifth phase of supplemental bedrock injection activities was completed between September and November 2013. Precision injected approximately 115,735 gallons of dilute calcium polysulfide solution (1% to 2%) into the overburden, shallow bedrock, and weathered bedrock source areas, downgradient wells in the former lagoon area, and along the Trolley Tracks to treat contaminated groundwater.

Following the injection activities, monitoring of the groundwater during semi-annual events and supplemental sampling activities indicated that the source areas beneath the building slab had been effectively treated. The results of the semiannual monitoring in 2013 and early 2014 indicated that the source areas impacted with hexavalent chromium had been greatly reduced in size. Precision continued monitoring the groundwater and surface water concentrations of hexavalent chromium and total chromium through 2014 and the first half of 2015.

The first semiannual groundwater monitoring event completed in 2015 indicated that total chromium and hexavalent chromium concentrations were still present in wells downgradient of the building slab in the former lagoon area and upgradient of Ackerly Creek. Although hexavalent chromium concentrations were still present at levels above 100 ug/L in the overburden and shallow bedrock, the concentrations and areas impacted had been reduced considerably since the initial injection activities in 2008/2009 as depicted in Figures 3a, 3b, 4a, and 4b, indicating that the CaSx injection activities had been successful in reducing the hexavalent chromium concentrations. To address the remaining concentrations identified during the supplemental investigation activities, additional injection activities were conducted in 2015.

The sixth phase of supplemental bedrock injection activities was completed between September and November 2015. Precision injected approximately 63,470 gallons of dilute calcium polysulfide solution (1% to 2%) into the overburden, shallow bedrock, and weathered bedrock source areas, downgradient wells in the former lagoon area, and along the Trolley Tracks to treat contaminated groundwater.

Following the 2015 injection activities, monitoring of the groundwater during semi-annual events and supplemental sampling activities indicated that the source areas beneath the building slab had been effectively treated. The results of the semiannual monitoring in 2016 and early 2017 indicated that the source areas impacted with hexavalent chromium had been greatly reduced in size as a result of the prior in situ chemical reduction activities, and excess unreacted calcium polysulfide solution persisted in many of the groundwater monitoring wells. Therefore, Precision continued monitoring the groundwater and surface water concentrations of hexavalent chromium and total chromium through 2017 and the first half of 2018.

The seventh phase of supplemental bedrock injection activities was completed between July and November 2018. Precision injected approximately 48,935 gallons of dilute calcium polysulfide solution (1% to 3%) into the overburden, shallow bedrock, and weathered bedrock source areas, downgradient wells in the former lagoon area, along the Trolley Tracks, and downgradient of the Trolley Tracks to treat contaminated groundwater.

Following the 2018 injection activities, monitoring of the groundwater during semi-annual events and supplemental sampling activities indicated that the source areas beneath the building slab had been effectively treated. The results of the semiannual monitoring in 2019 and early 2020 indicated that the source areas impacted with hexavalent chromium had been greatly reduced in size as a result of the prior in situ chemical reduction activities, and excess unreacted calcium polysulfide solution persisted in many of the groundwater monitoring wells. Therefore, Precision continued monitoring the groundwater and surface water concentrations of hexavalent chromium and total chromium through 2019 and the first half of 2020.

The laboratory results from the first semiannual groundwater monitoring event completed in 2020 determined that total chromium and hexavalent chromium concentrations were still present in wells downgradient of the building slab in the former lagoon area and paper road area and upgradient of Ackerly Creek. Although hexavalent chromium concentrations were still present at levels above 100 ug/l in the overburden and shallow bedrock, the concentrations and areas impacted had been reduced considerably since the initial injection activities in 2008/2009 and further injection activities as depicted in Figures 3b, 4b, and 5b, indicating that the CaSx injection activities had been successful in reducing the hexavalent chromium concentrations. To address the remaining concentrations identified during the recent investigation activities, additional injection activities are proposed as presented in this Work Plan.

4.1 Investigation Results

The groundwater, surface water, and seep monitoring activities following the 2018 injection activities indicated a further trend of the overall decrease in both hexavalent chromium and total chromium concentrations in the monitoring wells, influents to the treatment systems, and Ackerly Creek. The results indicated that the prior CaSx injection activities have effectively treated the hexavalent chromium concentrations in the overburden and shallow bedrock. However, the data indicate that residual concentrations of hexavalent chromium are present in the overburden, weathered rock and shallow bedrock in the areas located along Ackerly Creek and just upgradient, in the former lagoon, and one location along the paper road.

The existing injection points and other monitoring locations not typically included in the quarterly and semi-annual monitoring program were sampled in April 2020 for hexavalent chromium to evaluate conditions following the 2018 injection activities. These results were evaluated with the semi-annual monitoring data from October 2019 to determine areas for future injection activities.

A historical overview of the hexavalent chromium concentrations in each of the overburden, shallow bedrock, and intermediate bedrock groundwater monitoring zones from the April sampling events from 2008 through 2019 are provided as Figures 3a through 5b. The sample results for the April 2020 semi-annual monitoring event are summarized on Figures 6 through 9. The results indicate that the source areas beneath the former building slab have been effectively treated. Residual concentrations are still present to the north of the Site along Ackerly Creek, in the former lagoon area and in one location along the paper road. To address the remaining concentrations identified in the recent investigation activities and as directed by the 2012 Settlement Agreement, additional injection activities are proposed. The proposed activities are presented in this work plan.

4.2 Remedial Approach

As presented in the May 2008 Proposed Shallow Bedrock In Situ Chemical Reduction Work Plan, Precision evaluated several cleanup alternatives to mitigate the discharges to Ackerly Creek as part of the Remedial Action Plan (RAP) for the 2006 ISCR. Precision's evaluation showed that ISCR with CaSx would be the most effective way to remediate source area soils and overburden groundwater at the Site. With EPA’s approval, Precision employed ISCR with CaSx to convert the hexavalent chromium in the soils and groundwater to the less toxic, more stable and less leachable trivalent form of chromium.

In the 2008 Work Plan, in situ chemical reduction was identified as the most practical and effective remediation method for the treatment of the remaining sources in the shallow bedrock and weathered rock. The selection of this remedial approach was based on a review and update of the remedial alternatives evaluated by Precision in the Focused Feasibility Study completed in 2005 and approved by EPA. Five remediation methodologies previously were considered: excavation and off-site disposal, a funnel and gate system, a permeable reactive barrier, capping and installation of a slurry wall, and in situ chemical reduction. Most of the remediation methodologies considered would be difficult to implement at the Precision Site and are more suited to treatment of near-surface soil rather than bedrock. The results of the previous injection activities confirmed the effectiveness of the ISCR method as the source area was reduced significantly and the concentrations in the Lagoon Seep, Lagoon and Seep Shed Treatment System influents, and Ackerly Creek have decreased considerably. The concentrations in Ackerly Creek have been below the EPA's Water Quality Criterion Continuous Concentration of 11 ug/l of hexavalent chromium for more than four years. Using in situ chemical reduction, both contaminated bedrock and groundwater can be treated.

Precision used the same remedial approach for the shallow bedrock injection activities in 2008/2009, 2010, 2011, 2012, 2013, 2015 and 2018, and the results have confirmed the effectiveness of this method for reducing the hexavalent chromium concentrations in the shallow bedrock and associated groundwater beneath the Site. The proposed injection activities for 2020 will again use CaSx for the reduction of hexavalent chromium based on the evaluation of potential reducing agents and the results of the previous injection activities that confirmed the effectiveness of CaSx as the reducing agent. Any source material remaining after the treatment can be addressed with additional rounds of injection.

The reduction of hexavalent chromium to trivalent chromium with CaSx proceeds as shown in the following simplified equation.

$$2\,CrO_4^{-2} + 3\,CaS_5 + 10\,H^+ \rightarrow 2\,Cr(OH)_3 + 15S + 3\,Ca^{+2} + 2\,H_2O$$

The treatment process is not intended to reduce the total chromium concentrations at the Site.

The following provides a summary of the proposed current site remediation approach to address the residual hexavalent chromium concentrations in the bedrock and groundwater:

- Use ISCR with CaSx to treat the residual concentrations in the overburden and shallow bedrock groundwater.
- Monitor Ackerly Creek, the groundwater seeps, and groundwater to determine the effectiveness of the treatment.
- If monitoring results indicate hexavalent chromium concentrations remain above 100 ug/L in the groundwater, it may be necessary to perform additional monitoring and/or additional treatment with CaSx at a similar or higher concentration or another reducing agent depending on how the concentrations have decreased over time.

4.3 Calcium Polysulfide Injection

As presented in the May 2008 Proposed Shallow Bedrock In Situ Chemical Reduction Work Plan, Precision evaluated several cleanup alternatives to mitigate the discharges to Ackerly Creek as part of the Remedial Action Plan (RAP) for the 2006 ISCR. Precision's evaluation showed that ISCR with CaSx would be the most effective way to clean up source area soils and overburden groundwater at the Site.

With EPA's approval, Precision employed ISCR with CaSx in 2008/2009, 2010, 2011, 2012, 2013, 2015 and 2018 to convert the hexavalent chromium in the groundwater to the less toxic, more stable and less leachable trivalent form of chromium. Additional injection activities are proposed for 2020. Precision proposes to complete the injections with two main target areas: 1) the shallow bedrock and overburden groundwater downgradient of the Site, between the Trolley Tracks and Ackerly Creek; and 2) pockets of residual hexavalent chromium in the overburden and shallow bedrock beneath the former lagoon area and one location along the paper road. The implementation of the injections is described in the following sections.

4.3.1 Material Storage and Concentration

The CaSx solution will be delivered to the Site in approximately 300-gallon totes at a concentration of 29 percent. A maximum of six totes will be delivered at a time. The material will be stored in the totes on site. Secondary containment will be provided for the totes. If smaller quantities of CaSx solution are determined to be needed towards the end of the proposed injection activities, then deliveries of 55-gallon drums of CaSx may occur. Drums of CaSx will be stored within the on-site containment area.

All valves on the totes will be locked shut when not in use to prevent any accidental discharge of CaSx. Only authorized personnel will have keys to the valves. The Site fence will remain locked during non-working hours to prevent vandalism that could result in a discharge of CaSx. Spill cleanup supplies such as absorbent pads, drums, and pumps will be on site to clean up any spills that occur. Emergency response contacts are included in the Health and Safety Plan (HASP) and prominently displayed inside the on-site treatment shed that is used as the Site office. These emergency response contacts include the following:

1) Arcadis and Precision contacts (Lawrence Brunt and Kevin Quinn)
2) PADEP contact (Donald Rood)
3) EPA contact (Ann DiDonato)
4) Hospital
5) Police/Fire Department

The HASP is discussed further in Sections 4.3.4.4 and 10 of this work plan.

In preparation for injection into the shallow bedrock, the concentrated CaSx feed stock will be blended with water from the on-site production well to create a 1 percent to 5 percent CaSx solution as was prepared for the previous injection activities at the Site. The blending will occur by pre-mixing the solution in two 2,500-gallon polyethylene mixing storage tanks. Secondary containment will be provided for the mixing storage tanks.

4.3.2 Injection Method/System Design

The supplemental injection activities will utilize the existing wells that have been installed in the overburden, shallow bedrock, and intermediate bedrock. During the injection activities, the potential installation of additional wells as discussed in Section 3.2 will be evaluated to supplement the monitoring and injection activities. The selection of the injection points and the CaSx concentrations will be determined by Precision based on the hexavalent chromium groundwater concentrations and field observations during the activities to maximize the effectiveness of the injection activities. During previous investigation activities, bedrock was encountered at approximately 20 feet below the surface of the slab and approximately 10 feet below ground surface to the north of the slab and on the southern side of the lagoon area. The injection wells were constructed such that they generally extended between 10 and 15 feet into bedrock at each location. The depths are designed to intersect the impacted groundwater within the shallow bedrock. In addition, the existing and any supplemental overburden wells installed during the injection activities will be utilized for monitoring and injection activities for the targeted zones within the overburden.

The wells that will be used for injection will be fitted with well head caps to allow for injection under pressure and monitoring of flow, pressure and concentrations, as necessary. A diagram of the typical injection well construction is included as Figure 12.

The injection system is designed to inject the appropriate amount of CaSx solution under pressure into the bedrock and overburden groundwater. The system will use make-up water from the on-site production well and mix it with the 29 percent CaSx feedstock to achieve the desired injection concentration. The water from the production well has been previously sampled and analyzed for hexavalent chromium and total chromium and approved for use in the injection activities. The CaSx solution will then be injected through a manifold system in up to ten wells at a time using gravity or plastic air-diaphragm pumps and centrifugal pumps with pressures up to a maximum of 60 pounds per square inch (psi). The injection flow rate in each well is anticipated to be approximately one to two gallons per minute.

As with the prior bedrock injection activities, the CaSx solution will be injected into the overburden and bedrock via pumping or delivered by gravity through a manifold system into injection wells installed in the contaminated areas. The metering diaphragm pumps and associated injection manifold apparatus will be housed in a trailer located on site to protect the equipment from the elements. The centrifugal pumps and their distribution manifold will be located in the containment area adjacent to the above ground mixing tanks. The gravity feed manifold will be located adjacent to the wells being injected. Based on the previous injection activities, it has been determined that injection through a manifold system under pressure for injection points to the south of the on-Site injection trailer (upgradient) and by gravity feeding for the downgradient wells will be appropriate methods for delivery of the calcium polysulfide solution.

As the CaSx solution is introduced into the injection points, the surrounding wells will be used as monitoring points. Groundwater levels, pH, and distance/time of CaSx progression from the injection points will be monitored in these locations. The monitoring points will also include the Seep Shed Treatment System (including associated seeps), Ackerly Creek, and select existing bedrock and overburden monitoring wells at the Site, along the paper road to the north, along the Trolley Tracks, and along the southern bank of Ackerly Creek. The proposed monitoring locations, parameters, and frequency are summarized in Table 2.

For the additional injection activities in 2020, Precision proposes to complete the injections with two main target areas: 1) the shallow bedrock and overburden groundwater downgradient of the Site, between the Trolley Tracks and Ackerly Creek; and 2) pockets of residual hexavalent chromium in the overburden and shallow bedrock beneath the former lagoon area and along the paper road. The implementation of the injections is described in the following sections.

To target the impacted shallow bedrock and overburden groundwater downgradient of the Site, between the Trolley Tracks and Ackerly Creek that are impacting the surface water of the creek, Precision intends to begin injecting into the shallow bedrock and intermediate bedrock wells MW-12S and MW-12I located along the path between the Site and the Trolley Tracks. At the same time, CaSx will be injected into the shallow bedrock and intermediate bedrock wells in the center portion of the Trolley Track (MW-16S, AGM-3S, AGM-3I, and MW-17S) followed by the overburden wells paired with these bedrock locations (OMW-27, OMW-28, and OMW-29). During these initial injection activities, the well clusters MW-38 through MW-44 will be monitored to determine influence, and the quantity and concentration of CaSx will be adjusted accordingly. The concentrations of CaSx solution may be increased up to 5 percent in the center high concentration zones to maximize the chemical reduction activity.

The monitoring wells just south of Ackerly Creek, including MW-9S, MW-9IA and MW-9IB, MW-14S, MW-15S, and OMW-15 will be monitored during this phase of injections for chemical influence. Similar to the previous injection activities, the CaSx solution will be injected into the bedrock aquifer first and then overburden aquifer injections will follow. Due to the significant difference in elevation between the chemical storage area and injection trailer on the Site and these downgradient wells, all injections will be performed by gravity feeding with the use of pressure reducing valves as necessary. Injection personnel will be on hand at the injection points at all times during the injection into the Trolley Track wells to secure the area, monitor injection pressures, and check for any surfacing chemical. The proposed injection wells and proposed performance monitoring locations and air monitoring locations to be used during this injection phase are illustrated on Figure 13.

In the second phase of the proposed injections, Precision plans to inject CaSx into overburden and shallow bedrock locations within the former lagoon area and paper road. The proposed injection points will include as necessary, but not be limited to, OMW-6, OMW-30, SB-6, and SB-10. Due to the difference in elevation between the chemical storage area and injection trailer on the Site and these downgradient wells, all injections will be performed by gravity feeding with the use of pressure reducing valves as necessary. During the injection activities, the surrounding points will be monitored to determine influence, and the quantity and concentration of CaSx will be adjusted accordingly. The overburden injection points are illustrated on Figure 13.

4.3.3 Injection Concentration, Frequency, Depth, and Volume

The CaSx feedstock will be diluted to concentrations ranging from one to five percent solution using make-up water obtained from the on-site production well. The diluted CaSx solution will then be injected into the injection points to treat the overburden and shallow bedrock beneath the Site. This concentration range is based on the existing hexavalent chromium levels in the shallow bedrock and groundwater. The areas where the hexavalent chromium concentrations in the overburden, shallow bedrock, and intermediate bedrock groundwater exceed 100 ug/l are illustrated on Figures 6 through 8.

Based on the 2012, 2013, 2015 and 2018 injection volumes and most recent groundwater sampling results, Precision anticipates injecting similar volumes of CaSx in 2020 as in 2018. Approximately 2,000 gallons of 29% solution will be diluted and injected into the bedrock and 350 gallons of 29% solution will be diluted and injected in the overburden. The actual injection volumes will be determined in the field based on the onsite monitoring activities and the actual injection concentrations also will be determined in the field based on the onsite monitoring activities and will range from 1% to 5% CaSx. The injection system is designed to inject the CaSx solution in up to ten wells at the same time with pressures up to 60 psi. The injection flow rate in each well is anticipated to be approximately one to two gallons per minute. Confirmation sampling with analysis for hexavalent chromium will be performed in select monitoring wells and Ackerly Creek at the completion of the injection activities.

4.3.4 Permit Requirements

Since remedial activities will be conducted under CERCLA, Precision will not be required to obtain permits, but will comply with the substantive requirements for various permits as they have with previous remedial activities. The following is a list of permit requirements that have been considered:

- Erosion and Sedimentation control requirements for site disturbance;
- Underground Injection Control (UIC) requirements for injection into groundwater (EPA); and
- Local building permits and work ordinances.

4.3.4.1 Erosion and Sediment Control

Precision will not be disturbing any significant soil areas as part of these remedial activities. The development and implementation of erosion and sediment control measures are not necessary at this time.

4.3.4.2 Underground Injection Control

As discussed and presented in the previous injection workplans and 2012 RAP, Precision will be injecting CaSx into and above groundwater. Property owners (or their consultants) are required to contact EPA Region 3 and obtain approval from EPA before injecting or placing remediation materials or treated water into or above the groundwater under the UIC Program. The EPA UIC Program requires the submission of site/facility information typically provided in a remediation plan (name, location, address, site contact person, etc.). Information required by the UIC program includes the number and location (latitude and longitude) of the remediation wells, the extent of contamination and contaminants being treated, the remediation materials proposed for use and method of introduction into the groundwater, and the identification and location of all drinking water wells within a ¼-mile radius of the contaminated area being treated. The name of the PADEP contact (site Project Manager) and the PADEP Region Office should also be included. The approval by EPA for a remediation project typically constitutes a Rule Authorization Letter for a Class V well.

For this project, EPA approval of the work plan will be considered approval for injecting the CaSx. For the Precision remediation, the locations of the remediation well points are shown on Figure 13. The substantive information required by the UIC program with applicable background information is included as Appendix A.

Due to the proximity and continuing use of two potable wells located approximately 0.25 mile to the north of the Site, the frequency of sampling of these residential wells will be increased to monthly once injection of calcium polysulfide begins. The samples will be analyzed for hexavalent chromium, total chromium, sulfate, sulfides, and pH. Preliminary lab results will be shared with the EPA as they are available. This increased sampling frequency will continue for one month following the injections. After that time, the sampling interval will return to semiannual.

4.3.4.3 Local Permits and Work Ordinances

In order to limit the impact of noise and traffic on the surrounding area, work will be limited to the hours of 7:30 am to 7:30 pm, Monday through Friday. Saturday work, if necessary, will be limited to 8:00 am to 4:30 pm. No work will be permitted on Sundays.

4.3.4.4 Health and Safety

Precision will continue to follow the site-specific Health and Safety Plan (HASP) that was prepared in 2006 and updated on March 29, 2007, September 16, 2011, January 28, 2015, May 12, 2015, April 4, 2017, and most recently on April 6, 2020 in order to meet the requirements of the Occupational Health and Safety Act (OSHA) CFR 1910.120. The HASP, in addition to the standard requirements, will address the safe handling and injection of CaSx and other site-specific contingencies. The HASP also includes procedures for the air and odor monitoring plan described below to ensure that there are no impacts to off-site personnel and further described in the Standard Operating Procedure for Hydrogen Sulfide Perimeter Air Monitoring Activities prepared by Arcadis and dated July 31, 2008. Dust monitoring and mitigation will be performed if any off-site migration of dust is detected, but dust generation is not expected as a result of the remedial activities.

4.3.5 Air Monitoring

When calcium polysulfide comes into contact with acids or acidic materials or is diluted with water, hydrogen sulfide (H_2S) gas is produced. Hydrogen sulfide gas is colorless, and, at elevated concentrations, can be toxic and flammable. It has a characteristic rotten egg odor. The odor alone cannot be used as an indicator of exposure to hydrogen sulfide, since hydrogen sulfide can be detected at very low levels [odor threshold of 0.5 parts per billion (ppb)] that are not harmful to health and the sense of smell can become rapidly fatigued (i.e., reduced) with continued exposure. The recommended exposure limit developed by the National Institute for Occupational Safety and Health (NIOSH) for H_2S is 10,000 ppb (time-weighted average concentrations for up to a 10-hour workday). The maximum permissible exposure limit established by the OSHA for H_2S is 20,000 ppb (time-weighted concentration not to be exceeded during any 8-hour work shift).

The CaSx injection activities will primarily be performed in areas with exposed surface soil (e.g. south of slab, along Trolley Tracks and along Ackerly Creek). Based on the depths of the treatment zones within the overburden and bedrock groundwater, the anticipated low injection flow rates (approximately one to two gallons per minute in each well), and the observations of the prior bedrock injection activities, Precision anticipates minimal surfacing of calcium polysulfide. With little opportunity for exposure to air, rainwater, and sunlight, hydrogen sulfide generation should be minimal.

For the protection of the workers on Site and the nearest residents and to comply with the 2012 Settlement Agreement, Section 8.3(g), H_2S concentrations will be monitored surrounding the exclusion zone and at the Site perimeter. The H_2S concentrations will be compared to the ambient air action level for the general population of 30 ppb established by ATSDR for the previous injection activities. This concentration is two orders of magnitude below the level of known health effects and is based on long term exposure.

H_2S ambient air action level	30 ppb

If an H_2S reading of 30 ppb or greater is identified on-Site, additional monitoring will be conducted at the Site perimeter (along the fence line) and along Arch Avenue to ensure that the hydrogen sulfide is not affecting the residences downgradient of the Site. If the H_2S concentrations at the Site perimeter or along Arch Avenue exceed 30 ppb, injection activities will be stopped temporarily until the source of the release can be located and mitigated. The mitigation measures may include reducing the emission rate of hydrogen sulfide at the point source and implementing air plume suppression techniques at the Site boundary.

4.3.5.1 Exclusion Zone Monitoring

As described in the HASP and Addendum for Calcium Polysulfide Injection Activities previously prepared by Arcadis, exclusion zone real-time ambient air monitoring will be conducted as necessary by Arcadis during all work activities within the exclusion zone. The Exclusion Zone real-time ambient air monitoring details and action levels are summarized in Table 1 of the HASP. For hydrogen sulfide, the monitoring will be performed and evaluated relative to the NIOSH and OSHA acceptable exposure limits of 10,000 ppb and 20,000 ppb, respectively.

A handheld Jerome 631-X Hydrogen Sulfide Analyzer with a detection limit of 3 ppb will be used to obtain H_2S measurements at locations surrounding the current injection area periodically throughout the workday. Readings will continue for one hour after the injection work ends each day. In the event of any calcium polysulfide spill or surfacing, additional monitoring will occur surrounding the exposed calcium polysulfide. During the third phase of the proposed injections, which will include injection of calcium polysulfide into the overburden and shallow bedrock in the former lagoon area, the frequency of visual inspection of the lagoon and French drain collection sumps and air monitoring will be increased as necessary. If calcium polysulfide is visually identified in the French Drain sump, the pump will be shut off temporarily to inhibit the agitation and exposure of the chemical to air and water which could lead to the generation of hydrogen sulfide gas. The approximate locations for the exclusion zone monitoring are shown on Figure 13.

4.3.5.2 Perimeter Air Monitoring

As requested by EPA with respect to the prior remediation, perimeter air monitoring will be conducted to confirm that fugitive emissions, if any, of H_2S leaving the Site are below action levels for residential neighborhoods (30 ppb). The perimeter monitoring will be performed continuously on the property boundary of the Precision National Plating Services Site prior to the residential areas along Arch Avenue and along the southern bank of Ackerly Creek prior to the South Abington Little League fields. The electronic monitoring stations will collect perimeter air monitoring data 24 hours a day. Additional monitoring will be performed manually with hand-held instruments periodically during the workday at locations surrounding the current work zone. The manual monitoring will be limited to the typical workday (approximately 8:00 am to 6:00 pm) while calcium polysulfide is being injected and continue for approximately one hour after the injection work ends each day. Manual monitoring along Arch Avenue will be performed at the beginning, at the end, and periodically during each workday, approximately once every three hours.

The electronic monitoring stations will consist of Jerome 651 stationary units, which include a Jerome 631-X Hydrogen Sulfide Analyzer with a detection limit of 3 ppb. The Jerome Analyzers will be programmed to record real time data on 10-minute intervals 24 hours per day. The data will be transmitted from the analyzers to a computer at the Site via radio modem, so it can be evaluated and saved electronically for future use. The electronic monitoring stations will be programmed to provide an alert via email and/or SMS text message (i.e., cellular phone text message) to the appropriate Site persons if there is a detection of H_2S above the 30-ppb action level. The perimeter monitoring units will also record meteorological data to document current conditions each day during the injection activities. As a supplement to the data being recorded electronically, the analyzers will be checked periodically, and manual measurements will be recorded.

The electronic monitoring stations will be installed at three locations to collect perimeter air monitoring data. Air monitoring data will be collected at a fixed monitoring location on the northern property boundary between the Site and the residences located along Arch Avenue. A second monitoring station will be installed along the southern bank of Ackerly Creek, between the injection area and the South Abington Little League fields. These locations will provide air monitoring data to evaluate any potential impacts to the residences in the area throughout the remediation activities. The approximate locations of the perimeter air monitoring stations are shown on Figure 13.

A handheld Jerome 631-X Hydrogen Sulfide Analyzer with a detection limit of 3 ppb will be available on site for manual readings in the event of a calcium polysulfide spill or surfacing of material. Surfacing is not anticipated since the treatment zone is below grade within the groundwater and the injection flow rate will be very low.

4.3.6 Performance Monitoring

All performance monitoring of the groundwater, surface water, groundwater seeps, and residential wells on and in the vicinity of the Precision Site will be completed in accordance with the requirements set forth in Section 10 of the 2012 Settlement Agreement. All sample analyses will be performed by a laboratory which has a documented Quality Assurance Program that complies with the U.S. EPA guidance document QAMS-005/80, “Interim Guidelines and Specifications for Preparing QA Project Plans” and has been approved by the PADEP Laboratory Accreditation Program as meeting the requirements of the National Environmental Laboratory Accreditation Program (NELAP) for the analysis methods to be used and matrices to be sampled.

4.3.6.1 Groundwater Monitoring

Precision will continue monitoring the groundwater, surface water, and seeps on a semi-annual basis in accordance with the existing monitoring plan and to comply with the 2012 Settlement Agreement, Section 8.3(e). To supplement these activities, a round of groundwater and surface water samples will also be collected approximately one month following the completion of the injection activities. During the post-injection sampling event, select injection points and other locations not typically monitored during the semi-annual events will also be sampled.

The results of the sampling events will be evaluated to determine the need for additional monitoring and/or additional rounds of injections with calcium polysulfide or another suitable reducing agent. The evaluation of the data will be performed following the injection event and based on the results, Precision may elect to perform additional injection activities prior to the completion of the monitoring.

During the injection activities, the potential influence of the CaSx on the groundwater at the Site will be monitored at several permanent wells surrounding the injection area. Continuous monitoring probes will be installed in locations downgradient of the injection wells and in the collection sump in the Seep Shed. By monitoring the pH, dissolved oxygen, oxidation-reduction potential (ORP) and specific conductance of the groundwater, the movement of the calcium polysulfide through the bedrock aquifer and the creation of the desired reducing environment will be tracked. These field parameters will also be measured at additional groundwater and surface water locations on a periodic or as-needed basis throughout the injections. Also, sulfide and sulfate analysis will be added to the monthly sampling schedule for both the Lagoon and the Seep Shed Treatment Systems.

Due to the proximity and continuing use of two potable wells located approximately 0.25 mile to the north of the Site, these residential wells will be sampled twice a month once injection of calcium polysulfide begins. The samples will be analyzed for hexavalent chromium, total chromium, sulfate, sulfides, and pH. This increased sampling frequency will continue for one month following the injections. After that time, the sampling interval will return to semiannual.

The proposed monitoring locations, parameters, and frequency are summarized in Table 2.

4.3.6.2 Surface Water Monitoring

Precision will continue monitoring the surface water locations in Ackerly Creek on a semiannual basis in accordance with the existing monitoring plan. During the injection activities, the creek will be monitored for influence from the CaSx injections. Samples from several locations between and including SW-14 and SW-15 will be screened in the field for pH and ORP with a multi-parameter meter on a weekly basis. A sample of surface water from each of the locations also will be screened for sulfides with a Hach test kit on a bi-weekly basis. Upgradient location SW-16 will also be field screened for pH, ORP, and sulfides every 2 weeks to provide background data. An additional sample from each of the screened locations will be sent to the laboratory monthly for hexavalent chromium, sulfate, and sulfide analysis. Precision anticipates that the routine semiannual surface water monitoring event planned for January 2021 will also serve as the post-injection surface water monitoring event. The proposed monitoring locations, parameters, and frequency are summarized in Table 2.

4.3.6.3 Monitoring of Treatment Systems

During the historical Site investigations, eight groundwater seeps had been observed in the vicinity of the Site. The seeps were generally only present during times of significant precipitation events. The seeps generally occurred where there were abrupt changes in the bedrock surface. For groundwater flowing through the bedrock, when the bedrock surface drops off, the groundwater is then discharged into the overburden and has the potential to seep out.

Historically, the eight seeps located downgradient of the site along Ackerly Creek were sampled for hexavalent chromium. Of the eight seeps, the Bathtub Seep, Cinderblock Seep, Trolley Track Seep, and Arch Avenue dug well contained higher concentrations of hexavalent chromium. Historically, the hexavalent chromium concentrations observed in the seeps have been consistent with ground water concentrations seen in the vicinity of the seeps.

Two water treatment systems are located at the Precision site to address the seeps identified. The first and largest treatment system is the Lagoon Treatment System which collects water from the former lagoon area and seeps that discharge in this area. The second treatment system is the Seep Shed Treatment System that collects water from the Trolley Track Seep, Bathtub Seep and Cinderblock Seep located upgradient of Ackerly Creek. Precision will continue to operate the two water treatment systems on Site during the shallow bedrock remediation activities as approved in the 2012 RAP. Calcium polysulfide, and the reducing environment it creates, can negatively impact the resin in the treatment systems. Therefore, Precision will conduct additional monitoring of the treatment systems during the proposed injection activities.

Lagoon Treatment System

During the proposed supplemental injection activities, the Lagoon Treatment System will continue to be operated and monitored in accordance with Section 8.3 of the Settlement Agreement and as approved in the 2012 RAP. To ensure that the treatment resin maintains its efficacy, the pH of the lagoon influent will be screened periodically during the injection activities. Also, the water collecting in the lagoon area will be visually inspected for the presence of CaSx daily. During the third phase of the proposed injections, which will include injection of calcium polysulfide into the overburden and shallow bedrock in the former lagoon area, the frequency of visual inspection of the lagoon and French drain collection sumps will be increased as necessary. If at any time the concentration of CaSx or the pH becomes too high for the effective operation of the treatment systems, the systems will be shut down and any collected water will be contained for analysis and proper treatment.

To demonstrate the continued effective operation of the Lagoon treatment system, the monthly sampling of the Lagoon Treatment System will continue and will include analysis of the influent for sulfate and sulfide during the injection activities. Following this monitoring, the sampling will return to the regular sampling parameters at monthly intervals.

Seep Shed Treatment System

The Seep Shed Treatment System receives water from collection systems installed at the Trolley Track Seep, Bathtub Seep, and Cinderblock Seep. The Seep Shed Treatment System will continue to operate in accordance with Section 8.3 of the Settlement Agreement and as approved in the 2012 RAP. Additional monitoring will be implemented during times of on-Site in situ chemical reduction activities. The collection sump of the Seep Shed will have a probe installed for continuous monitoring of temperature, pH, dissolved oxygen, and specific conductance for the duration of the injection activities. Also, the water collecting in the Seep Shed sump will be visually inspected for the presence of CaSx daily. If at any time the concentration of CaSx or the pH becomes too high for the effective operation of the treatment system, the system will be shut down and any collected water will be contained for analysis and proper treatment.

To demonstrate the continued effective operation of the treatment system, the monthly sampling of the Seep Shed Treatment System will continue and will include analysis of the influent for sulfate and sulfide during the injection activities. Following this monitoring, the sampling will return to the regular sampling parameters at monthly intervals.

4.3.7 Reporting

Following the supplemental ISCR activities, a report will be prepared to summarize the activities described above including the volume of material injected, the field monitoring data, and an initial evaluation of the effects of the treatment. Groundwater monitoring will be initiated at the completion of the ISCR activities as described above; the results of the post-injection groundwater monitoring will also be summarized in this report. The report will summarize the data, evaluate the effectiveness of the treatment activities, and recommend any further actions to complete the objectives of the Settlement Agreement.

5 SEMIANNUAL GROUNDWATER MONITORING

5.1 Monitoring Well Sampling Locations and Methodology

As approved in the 2012 RAP, semiannual monitoring of groundwater wells on and surrounding the Precision Site will be continued to evaluate hexavalent chromium and total chromium concentrations. The list of locations to be monitored will include wells in the overburden unconsolidated aquifer as well as the shallow, intermediate, and deep bedrock zones. The wells have been selected to monitor the distribution of hexavalent and total chromium concentrations across the Site and downgradient to the Creek. The wells will be monitored to determine if the requirements of the Settlement Agreement are being achieved. The locations, construction details, and depths of each well to be sampled as approved in the 2012 RAP and updated in 2016 are presented in Table 1. This sampling list will be updated to include select wells from the group of wells installed in December 2017 and during the 2018 field activities once the characterization of the wells has been completed and based on connectivity between wells that is anticipated to be observed during the proposed bedrock injection activities. Sampling will be performed in accordance with Section 10 of the 2012 Settlement Agreement and the Quality Assurance/Quality Control Monitoring and Sampling Plan included in the 2012 RAP, which is based on the Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling prepared by U.S. EPA Region II dated March 26, 1998.

5.2 Sampling Parameters

As required by the Settlement Agreement and approved in the 2012 RAP, the groundwater samples collected will be analyzed by an EPA/PADEP-approved laboratory for hexavalent chromium via U.S. EPA Method SW846 7196A and for total chromium by U.S. EPA Method 200.7.

5.3 Reporting

The analytical results of the semi-annual groundwater monitoring conducted pursuant to the Settlement Agreement will be presented in the quarterly progress reports as required by paragraph 8.7 of the Settlement Agreement. Semi-annual groundwater reports that summarize the monitoring results and provide an evaluation of the groundwater quality and effectiveness of the remedial actions will also be prepared and submitted to EPA.

6 SURFACE WATER MONITORING

6.1 Surface Water Sampling Locations and Methodology

The EPA has selected Ackerly Creek as an endpoint for monitoring the contamination status and progress of the Removal Action at the Precision Site. As approved in the 2012 RAP and subsequently amended, Precision will continue to monitor select locations in Ackerly Creek on a semiannual basis. The locations to be sampled are listed in Table 1.

Samples will be collected in laboratory-supplied clean sampling jars with the proper preservatives as necessary. All samples will be shipped in coolers to an EPA/PADEP-approved laboratory under proper chain-of-custody procedures.

6.2 Sampling Parameters

As required by the Settlement Agreement, the surface water samples collected will be analyzed by an EPA/PADEP-approved laboratory for hexavalent chromium via U.S. EPA Method SW 846 7196A and for total chromium by U.S. EPA Method 200.7. Additional monitoring of Ackerly Creek will be conducted during the in situ chemical reduction activities; parameters may include hexavalent chromium, sulfate, sulfide, and water quality indicators such as pH.

6.3 Reporting

The analytical results of the semiannual surface water monitoring conducted pursuant to the Settlement Agreement will be presented in the quarterly progress reports as required by paragraph 8.7 of the Settlement Agreement. Semiannual groundwater reports that summarize the monitoring results and provide an evaluation of the groundwater and surface water quality and effectiveness of the remedial actions will also be prepared and submitted to EPA.

7 POTABLE WELL SAMPLING

7.1 Potable Well Sampling Locations and Methodology

Residential potable wells in the vicinity of the Precision Site will be sampled semi-annually as put forth in paragraph 8.3 of the Settlement Agreement. The locations, construction details, and depths of each well to be sampled are presented in Table 1. In addition, during the in situ chemical reduction activities, the residential wells will be monitored with increased frequency and for additional parameters.

Samples will be collected in laboratory-supplied clean sampling jars with the proper preservatives as necessary. All samples will be shipped in coolers to an EPA/PADEP-approved laboratory under proper chain-of-custody procedures.

7.2 Sampling Parameters

As required by the Settlement Agreement, the potable well samples collected will be analyzed by an EPA/PADEP-approved laboratory for hexavalent chromium via U.S. EPA Method SW846 7196A and for total chromium by U.S. EPA Method 200.7. During the in situ chemical reduction activities, the residential wells will be monitored with increased frequency and additional parameters, including sulfate and sulfide, will be added to the monitoring.

7.3 Reporting

The analytical results of the potable well monitoring conducted pursuant to the Settlement Agreement will be presented in the quarterly progress reports as required by paragraph 8.7 of the Settlement Agreement. Semiannual groundwater reports that summarize the monitoring results and provide an evaluation of the groundwater and surface water quality and effectiveness of the remedial actions will also be prepared and submitted to EPA.

8 REPORTING

8.1 Quarterly Progress Reports

All reports and related documents prepared pursuant to the Settlement Agreement will be submitted by e-mail and/or overnight mail to the EPA Project Coordinator as specified in paragraph 8.8 of the Settlement Agreement. As stated in paragraph 8.9 of the Settlement Agreement, all reports and plans submitted to EPA to satisfy the requirements of the Settlement Agreement are subject to EPA approval and, once approved, will be incorporated into the Settlement Agreement.

8.2 In Situ Chemical Reduction Reports

In addition to the progress reports specified in paragraph 8.7 of the Settlement Agreement, Precision will prepare and submit reports to the EPA documenting the additional investigation and in situ chemical reduction activities described above.

All reports and related documents will be submitted by e-mail and/or overnight mail to the EPA Project Coordinator as specified in paragraph 8.8 of the Settlement Agreement. As stated in paragraph 8.9 of the Settlement Agreement, all reports and plans submitted to EPA to satisfy the requirements of the Settlement Agreement are subject to EPA approval and, once approved, will be incorporated into the Settlement Agreement.

9 QUALITY ASSURANCE/QUALITY CONTROL MONITORING AND SAMPLING PLAN

The Quality Assurance/Quality Control Monitoring and Sampling Plan that was prepared for the activities approved in the 2012 RAP will also be implemented for the activities described in this Work Plan. A copy is included in Appendix B.

10 SITE-SPECIFIC HEALTH AND SAFETY PLAN

All proposed field activities will be conducted in accordance with the Arcadis Site-specific Health and Safety Plan (HASP) maintained onsite and at Arcadis' Hillsborough, New Jersey office. Precision will continue to follow the site-specific Health and Safety Plan (HASP) that was prepared in 2006 and updated on March 29, 2007, September 16, 2011, January 28, 2015, May 12, 2015, April 4, 2017 and most recently on April 6, 2020 in order to meet the requirements of the Occupational Health and Safety Act (OSHA) CFR 1910.120. The April 2020 update included an addendum to address the COVID-19 issues associated with performing the field activities. The HASP, in addition to the standard requirements, addresses the safe handling and injection of CaSx and other site-specific contingencies. The HASP also includes procedures for the air and odor monitoring plan described above to ensure that there are no impacts to off-site personnel and further described in the Standard Operating Procedure for Hydrogen Sulfide Perimeter Air Monitoring Activities prepared by Arcadis and dated July 31, 2008. The HASP will be updated to cover additional work when required.

11 SCHEDULE FOR COMPLETION OF REMOVAL RESPONSE ACTION

The activities proposed in this Work Plan will be implemented following EPA approval. It is anticipated that EPA will review and approve the Work Plan such that injection activities can be initiated the week of August 17, 2020 and continue to November 2020 depending on weather and the progress of the injection activities.

TABLES

Table 1
Ground Water, Surface Water, and Seep Monitoring Locations
Precision National Plating Services, Inc. - Clarks Summit, PA

Sample ID	Location	Installation Date	Monitoring Zone	Post-Treatment Analysis	Number of Sample bottles required	Well Diameter (inches)	Well Construction	Total Depth (ft bgs)	Depth of Casing (ft bgs)	Significant Water Producing Zones (ft bgs)	Monitoring Interval (ft		Sampling Point (ft btoc)	Top of Bedrock (ft bgs)
											Top	Bottom		
AGM-2S	Trolly Track near Michaelangelo's	12/22/1998	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	130	17	115	17	130	117	7
AGM-2I	Trolly Track near Michaelangelo's	12/29/1998	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	190	150	171,183,186,190	150	190	173	7
AGM-3S	Trolly Track near trail to Seep Shed	12/30/1998	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	110	18	110	18	110	107	9
AGM-3I	Trolly Track near trail to Seep Shed	1/5/1999	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	200	130	177-180	130	200	179	9
AGM-4S	Trolly Tracks near Arch Avenue	1/6/1999	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	90	18	70	18	90	72	8
AGM-4I	Trolly Tracks near Arch Avenue	1/8/1999	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	147	110	127	110	147	130	8
MW-8S	End of Arch Avenue near Trolly Track	7/28/2008	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	40	30	ND	30	40	35	10
AGM-5S	Ballfield near turn in Ackerly Creek	12/21/1998	Overburden	Hex Chrome, Total Chromium	2	4	Open Borehole	19	9	ND	9	19	17	19
AGM-5I	Ballfield near turn in Ackerly Creek	12/18/1998	Bedrock	Hex Chrome, Total Chromium	2	4	Artesian	100	27	94	27	100	94	19
MW-3S ^	Precision (upgradient of former encapsulation vault)	1/30/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	85	65	74-76, 82	65	85	76	ND
MW-3D ^	Precision (upgradient of former encapsulation vault)	1/30/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	126	110	117	110	126	119	ND
MW-4S	Precision (at front of former building)	10/31/2002	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	195	185	190	185	195	188	ND
MW-4D	Precision (at front of former building)	10/31/2002	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	335	325	330	325	335	328	ND
MW-AS ^	Precision (downgradient of former encapsulation vault)	1/30/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	90	70	83	70	90	83	1
MW-AD ^	Precision (downgradient of former encapsulation vault)	1/30/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	152	127	130, 150	127	152	142	1
MW-BS ^	Precision (adjacent to former lagoon)	1/30/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	90	70	ND	70	90	82	28.5
MW-BD ^	Precision (adjacent to former lagoon)	1/30/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	128	110	110-116, 126	110	128	121	28.5
MW-C	Precision (upgradient of former building)	6/24/1991	Bedrock	Hex Chrome, Total Chromium	2	6	Open Borehole	191	25	ND	25	191	138	1
MW-9S	Ackerly Creek, south bank	5/5/2010	Bedrock	Hex Chrome, Total Chromium	2	2	Open Borehole	30	20		20	30	25	15
MW-10S	Paper Road, north of Site (west, closer to power line easement)	5/12/2010	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	43	28		28	43	35	23
MW-10I	Paper Road, north of Site (west, closer to power line easement)	5/7/2010	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	100	85		85	100	93	23
MW-11S	Paper Road, north of Site (east, closer to Ackerly Road)	9/26/2011	Bedrock	Hex Chrome, Total Chromium	2	2	Open Borehole	43	27		27	43	35	25
MW-11I	Paper Road, north of Site (east, closer to Ackerly Road)	8/2012	Bedrock	Hex Chrome, Total Chromium	2	2	Open Borehole	105	85		85	105	95	25
MW-12S	Precision (northwest, between former Plant Area and Trolly Track)	9/26/2011	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	30	20		20	30	25	18
MW-12I	Precision (northwest, between former Plant Area and Trolly Track)	9/27/2011	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	100	85		85	100	93	72
MW-14S	Ackerly Creek, south bank near ruin and bridge	9/28/2011	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	24	14		14	24	19	12
MW-15S	Ackerly Creek, south bank near SW-14BC2	8/2012	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	25	15		15	25	20	13
MW-21S	Precision (Lagoon area, along southern fence)	8/2012	Bedrock	Hex Chrome, Total Chromium	2	4	Open Borehole	21.5	11.5		11.5	21.5	16.5	10
Res-1	Arch Avenue residential well	1991**	Bedrock	Hex Chrome, Total Chromium	2	6	Residential Spigot	178	150	ND	150	178	ND	ND
Res-2	Ackerly Road residential well	1979**	Bedrock	Hex Chrome, Total Chromium	2	ND	Residential Spigot	147	85	ND	85	147	ND	ND
OMW-2	Precision (near NW corner of building slab)	9/25/2003	Overburden	Hex Chrome, Total Chromium	2	2	PVC	13	8	11	8	13	12	13
OMW-3	Precision (in the former lagoon)	9/30/2005	Overburden	Hex Chrome, Total Chromium	2	2	PVC	6.5	1.5	6	1.5	6.5	6	6.5
OMW-4	Precision (downgradient of OMW-2)	9/22/2003	Overburden	Hex Chrome, Total Chromium	2	2	PVC	13	8	11.32	8	13	12	13
OMW-6	Precision (adjacent to former lagoon)	9/29/2003	Overburden	Hex Chrome, Total Chromium	2	2	PVC	14	9	12	9	14	13	14
OMW-11	Precision (on building slab near NE corner and MW-4)	9/24/2003	Overburden	Hex Chrome, Total Chromium	2	2	PVC	21	16	18.2	16	21	19	21
OMW-13	Precision (outside main entrance along fence line)	9/26/2003	Overburden	Hex Chrome, Total Chromium	2	2	PVC	19	14	16.6	14	19	17	20
OMW-14	End of Arch Avenue near Trolly Track	7/28/2008	Overburden	Hex Chrome, Total Chromium	2	2	PVC/Screen	10	4	ND	4	10	7	10
OMW-15	Ackerly Creek, south bank	5/5/2010	Overburden	Hex Chrome, Total Chromium	2	2	PVC	10	3	7	3	10	8	15
OMW-16	Paper Road, north of Site (west, closer to power line easement)	5/6/2010	Overburden	Hex Chrome, Total Chromium	2	2	PVC	24	14	17.8	14	24	19	24
OMW-17	Paper Road, north of Site (east, closer to Ackerly Road)	5/12/2010	Overburden	Hex Chrome, Total Chromium	2	2	PVC	27.5	12.5	17.8	12.5	27.5	20	27.5
OMW-18	Precision (main entrance along Ackerly Road)	5/3/2010	Overburden	Hex Chrome, Total Chromium	2	2	PVC	15	5	10	5	15	11	15
OMW-23	Precision (northwest, between former Plant Area and Trolly Track)	9/25/2011	Overburden	Hex Chrome, Total Chromium	2	2	PVC/Screen	18	8		8	18	13	18
OMW-24	Ackerly Creek, south bank near ruin and bridge	9/27/2011	Overburden	Hex Chrome, Total Chromium	2	2	PVC/Screen	10	0		0	10	5	10
OMW-25	Ackerly Creek, south bank near SW-14BC2	TBD	Overburden	Hex Chrome, Total Chromium	2	2	PVC/Screen	TBD	TBD		TBD	TBD	TBD	TBD
OMW-26	Trolly Track, near AGM-4S and AGM-4I	8/22/2012	Overburden	Hex Chrome, Total Chromium	2	2	PVC/Screen	11	4		4	11	8	11
OMW-28	Trolly Track, near AGM-3S and AGM-3I	8/20/2012	Overburden	Hex Chrome, Total Chromium	2	2	PVC/Screen	10.5	3.5		3.5	10.5	7.5	10.5
MW-B01S ^	Precision (in former building area - EPA Well)	1/29/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	90	80	88	80	90	86	28
MW-B01D ^	Precision (in former building area - EPA Well)	1/30/2009	Bedrock	Hex Chrome, Total Chromium	2	2	PVC/Screen	121	111	114	111	121	117	28
SB-2008-1	Precision (East of former building)	6/4/2008	Bedrock	Hex Chrome, Total Chromium	2	2	Open Borehole	32 (50)	22 (19.5)	ND	22 (19.5)	32 (50)	29 (45)	19.5
SB-2008-2	Precision (South of former Rectifier Room)	6/4/2008	Bedrock	Hex Chrome, Total Chromium	2	2	Open Borehole	47	13	ND	13	47	42	13
SB-2008-6	Precison (Lagoon Area)	3/12/2008	Bedrock	Hex Chrome, Total Chromium	2	2	Open Borehole	30/34	24		24	34	29	30
SB-2008-10	Precision (Lagoon Area, along southern fence)	3/17/2008	Overburden	Hex Chrome, Total Chromium	2	2	PVC/Screen	15.5	10	ND	10	15	14	15.5
Lagoon System Influent	Lagoon Treatment System Inlet		Seeps	Hex Chrome, TAL Metals	2									
Lagoon Post Lead	Lagoon Treatment System - Effluent of Lead Tank		Seeps	Hex Chrome, Total Chromium	2									
Lagoon System Effluent	Lagoon Treatment System Outlet		Seeps	Hex Chrome, TAL Metals	2									
Seep Shed Influent	Seep Shed System Inlet		Seeps	Hex Chrome, Total Chrome	2									
Seep Shed Mid	Seep Shed System - Between Resin Tanks		Seeps	Hex Chrome, Total Chromium	2									
Seep Shed Effluent	Seep Shed System Outlet		Seeps	Hex Chrome, Total Chrome	2									
SW-10	Ackerly Creek (downgradient of confluence with unnamed tributary)		Surface Water	Hex Chrome, Total Chromium	2									
SW-14	Ackerly Creek (upgradient of confluence with unnamed tributary)		Surface Water	Hex Chrome, Total Chromium	2									
SW-14BC2	Ackerly Creek		Surface Water	Hex Chrome, Total Chromium	2									
SW-14DE	Ackerly Creek		Surface Water	Hex Chrome, Total Chromium	2									
SW-14G	Ackerly Creek (50' downstream of SW-15)		Surface Water	Hex Chrome, Total Chromium	2									
SW-15	Ackerly Creek (upgradient of bridge near Seep Shed)		Surface Water	Hex Chrome, Total Chromium	2									
SW-16	Ackerly Creek (upgradient of Ackerly Road bridge)		Surface Water	Hex Chrome, Total Chromium	2									
BRP-1	Brace's Pond (Michaelangelo's Restaurant 894 Old State Road)		Surface Water	Hex Chrome, Total Chromium	2									
SWALE-U	Ackerly Road drainage ditch, south of lagoon gate		Surface Water	Hex Chrome, Total Chromium	2									
SWALE-M	Ackerly Road drainage ditch, corner of fence by French Drain Sump		Surface Water	Hex Chrome, Total Chromium	2									
SWALE-D	Ackerly Road drainage ditch, utility pole north of lagoon		Surface Water	Hex Chrome, Total Chromium	2									

Notes:

ft bgs	Feet below ground surface
ft btoc	Feet below top of casing
ft msl	Feet above mean sea level
ND	No Data available
**	Exact date not known
(#)	Former depth; well has been modified after initial installation
^	Modified well installed within former well location in order to monitor discrete zones.
TBD	To be determined when proposed well is installed

Note: Proposed monitoring locations have been updated based on recent samplng results and well installation activities.

Table 2
2020 ISCR Field Monitoring Locations
Precision National Plating Services, Inc. - Clarks Summit, PA

Sample ID	Location	Monitoring Zone	Field Monitoring During Treatment	Frequency of Monitoring	Laboratory Analysis During Treatment	Frequency of Sampling
Bedrock Wells						
AGM-4S	Trolly Tracks near Arch Avenue	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-9S	Adjacent to Ackerly Creek	Bedrock	pH, ORP, Conductivity	Continuous (Phases 1&2)		
MW-14S	Adjacent to Ackerly Creek, near ruin	Bedrock	pH, ORP, Conductivity	Continuous (All Phases)		
MW-15S	Adjacent to Ackerly Creek	Bedrock	pH, ORP, Conductivity	Weekly (All Phases)		
MW-38S	Between Trolley Tracks and Ackerly Creek, south of Seep Shed	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-39S	Between Trolley Tracks and Ackerly Creek, south of Seep Shed	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-40S	Between Trolley Tracks and Ackerly Creek	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-41S	Between Trolley Tracks and Ackerly Creek	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-41I	Between Trolley Tracks and Ackerly Creek	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-42S	Between Trolley Tracks and Ackerly Creek	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-43S	Between Trolley Tracks and Ackerly Creek	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-44S	Between Trolley Tracks and Ackerly Creek, south of Seep Shed	Bedrock	pH, ORP, Conductivity	Weekly (Phase 1)		
MW-11S	Along Paper Road	Bedrock	pH, ORP, Conductivity	Weekly (Phase 3)		
MW-18S	Along Paper Road	Bedrock	pH, ORP, Conductivity	Weekly (Phase 3)		
MW-AS	Precision, northwest of former Plant area	Bedrock	pH, ORP, Conductivity	Weekly (Phase 3)		
MW-BS	Precision (Lagoon area)	Bedrock	pH, ORP, Conductivity	Daily (Phase 3)		
Overburden Wells						
OMW-3	Precision (Lagoon Area)	Overburden	pH, ORP, Conductivity	Daily (Phase 3)		
OMW-5	Precision, northwest of former Plant area	Overburden	pH, ORP, Conductivity	Daily (Phase 3)		
OMW-15	Adjacent to Ackerly Creek	Overburden	pH, ORP, Conductivity	Continuous (Phases 1, 2, & 3)		
OMW-17	Along Paper Road	Overburden	pH, ORP, Conductivity	Weekly (Phase 3)		
OMW-24	Adjacent to Ackerly Creek, near ruin	Overburden	pH, ORP, Conductivity	Continuous (Phases 1, 2, & 3)		
OMW-25	Adjacent to Ackerly Creek	Overburden	pH, ORP, Conductivity	Weekly (Phases 1, 2, & 3)		
OMW-38	Between Trolley Tracks and Ackerly Creek, south of Seep Shed	Overburden	pH, ORP, Conductivity	Weekly (Phase 1)		
OMW-39	Between Trolley Tracks and Ackerly Creek, south of Seep Shed	Overburden	pH, ORP, Conductivity	Weekly (Phase 1)		
OMW-40	Between Trolley Tracks and Ackerly Creek	Overburden	pH, ORP, Conductivity	Weekly (Phase 1)		
OMW-41	Between Trolley Tracks and Ackerly Creek	Overburden	pH, ORP, Conductivity	Weekly (Phase 1)		
OMW-42	Between Trolley Tracks and Ackerly Creek	Overburden	pH, ORP, Conductivity	Weekly (Phase 1)		
OMW-43	Between Trolley Tracks and Ackerly Creek	Overburden	pH, ORP, Conductivity	Weekly (Phase 1)		
OMW-44	Between Trolley Tracks and Ackerly Creek, south of Seep Shed	Overburden	pH, ORP, Conductivity	Weekly (Phase 1)		
OMW-30	Along Paper Road	Overburden	pH, ORP, Conductivity	Weekly (Phase 3)		
OMW-32	Precision (Lagoon Area)	Overburden	pH, ORP, Conductivity	Continuous (Phase 3)		
Residential Wells						
Res-1	Arch Avenue Residential well	Bedrock	pH	Monthly	Hex Chrome, Total Chrome, Sulfide, Sulfate	Monthly
Res-2	Ackerly Road Residential Well	Bedrock	pH	Monthly	Hex Chrome, Total Chrome, Sulfide, Sulfate	Monthly
Treatment Systems						
Lagoon System Influent	Lagoon Treatment System Inlet	Seeps	pH, ORP, Conductivity	Weekly	Hex Chrome, TAL Metals, Sulfide, Sulfate	Monthly
Lagoon Post Lead	Lagoon Treatment System - Effluent of Lead Tank	Seeps			Hex Chrome, Total Chrome	Monthly
Lagoon System Effluent	Lagoon Treatment System Outlet	Seeps			Hex Chrome, TAL Metals	Monthly
Seep Shed Influent	Seep Shed System Inlet	Seeps	pH, ORP, Cond./Sulfide	Continuous (Phases 1,2,&3)/We	Hex Chrome, Total Chrome, Sulfide, Sulfate	Monthly
Seep Shed Mid	Seep Shed System - Between Resin Tanks	Seeps			Hex Chrome, Total Chrome	Monthly
Seep Shed Effluent	Seep Shed System Outlet	Seeps			Hex Chrome, Total Chrome	Monthly
Surface Water						
SW-14	Ackerly Creek (upgradient of confluence with unnamed tributary)	Surface Water	pH, ORP, Cond., Sulfide	Biweekly	Hex Chrome, Sulfate, Sulfide	Monthly
SW-14BC2	Ackerly Creek (near MW-15S)	Surface Water	pH, ORP, Cond., Sulfide	Biweekly	Hex Chrome, Sulfate, Sulfide	Monthly
SW-14DE	Ackerly Creek (near MW-9S & OMW-15)	Surface Water	pH, ORP, Cond., Sulfide	Biweekly	Hex Chrome, Sulfate, Sulfide	Monthly
SW-14G	Ackerly Creek (between OMW-15 and bridge)	Surface Water	pH, ORP, Cond., Sulfide	Biweekly	Hex Chrome, Sulfate, Sulfide	Monthly
SW-15	Ackerly Creek (upgradient of bridge near Seep Shed)	Surface Water	pH, ORP, Cond., Sulfide	Biweekly	Hex Chrome, Sulfate, Sulfide	Monthly
SW-16	Ackerly Creek (upgradient of Ackerly Road bridge)	Surface Water	pH, ORP, Cond., Sulfide	Biweekly	Hex Chrome, Sulfate, Sulfide	Monthly

FIGURES

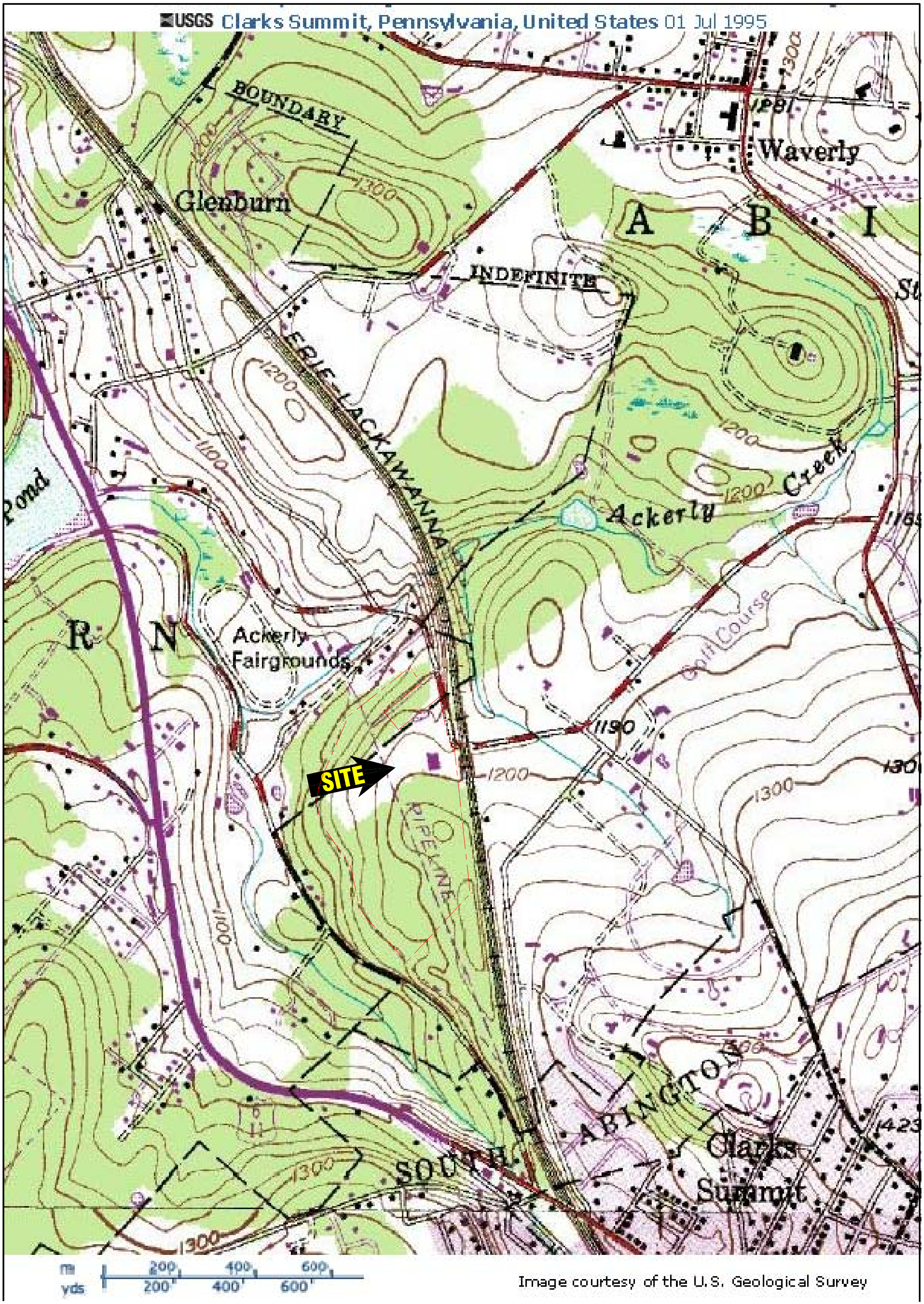

Image courtesy of the U.S. Geological Survey

ARCADIS

ARCADIS U.S., INC.

PRECISION NATIONAL PLATING SERVICES, INC. ● 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA
RESPONSE ACTION PLAN

SITE LOCATION MAP

ARCADIS Project No.
BB014215.0005.00011

Date
05/25/2012

ARCADIS
35 COLUMBIA ROAD
BRANCHBURG, NEW JERSEY
TEL. 908.526.1000

1

CITY: BRANCHBURG DIV/GROUP: ENVCAD DB: S.IRWIN PM: L.BRUNT TM: L.BRUNT LAYOUT: 1 SAVED: 7/30/2012 5:14 PM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---
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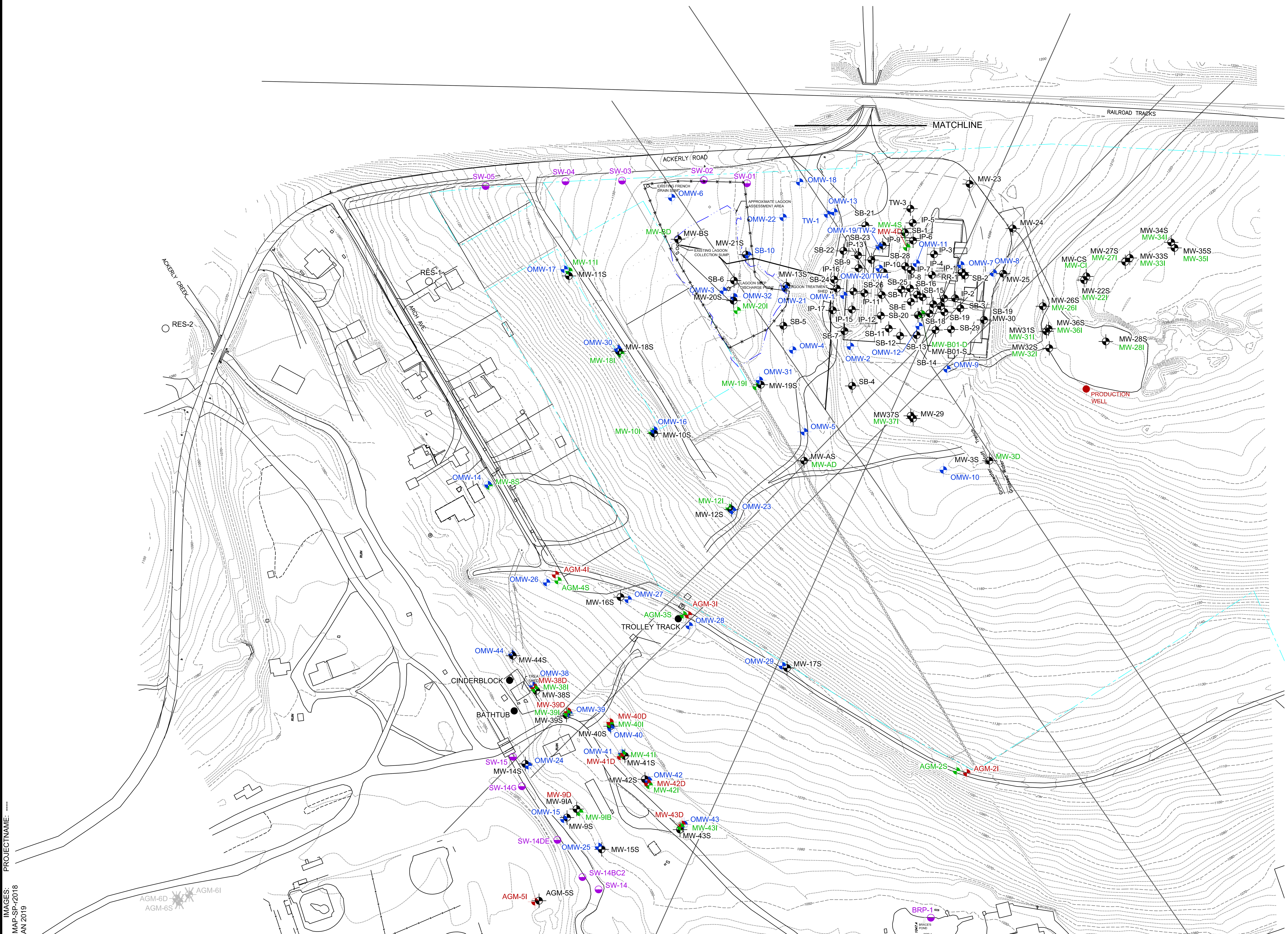
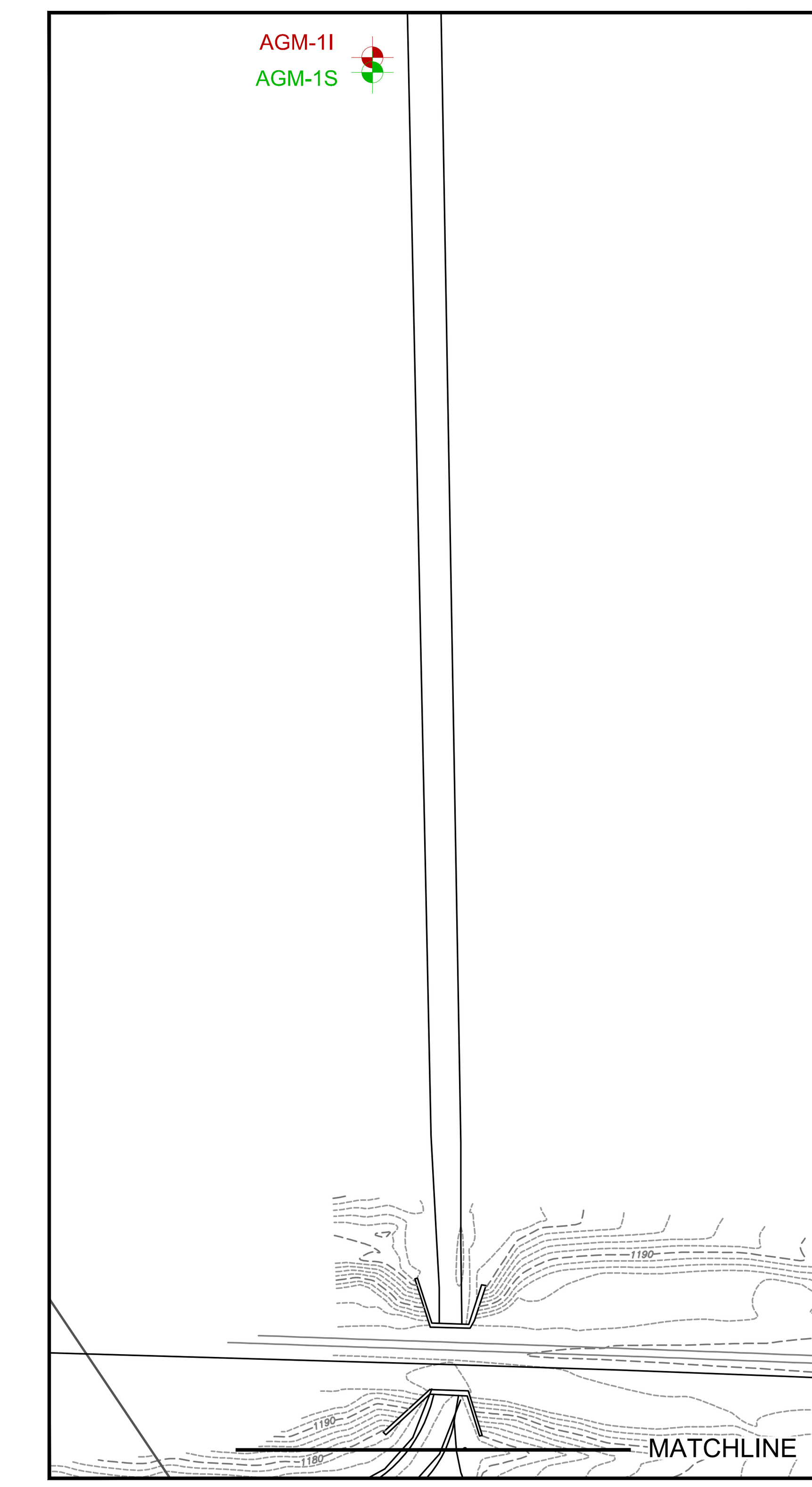
XREFS: IMAGES: TOPO.jpg PROJECTNAME: ---



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- FRACTURE TRACE (FROM R.E. WRIGHT, 1978)
- DEEP BEDROCK MONITORING WELL
- INTERMEDIATE BEDROCK MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- OVERBURDEN MONITORING WELL
- SURFACE WATER SAMPLE LOCATION
- PRODUCTION WELL
- FORMER/ABANDONED MONITORING WELL
- SEEP
- RES-1 RESIDENTIAL POTABLE WELL



NOTES:

1. MONITORING WELLS MW-AS/AD, MW-BS/BD, MW-3S/3D, MW-9IA/9D, MW-B01S/B01D, MW-26, MW-27, MW-28, MW-31, MW-32 & MW-33 ARE NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)

2. MW-C AND MW-22 ARE CONVERTED WELLS, NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)

3. WELL LOCATIONS FROM DPK SURVEYING.

4. MAP DATUM: PENNSYLVANIA STATE PLANE, NORTH, NAD83, FEET.

CITY: MANCHESTER CT DIV/GROUP: ENVCAD DB: T.HALLIWELL PM: L.BRUNT TM: L.BRUNT
C:\Users\PPHaliw\OneDrive - ARCADIS\BIM 360 Docs\PRECISION NATIONAL PLATING SERVICES INC\2019\B0014215.2019\01-DWG\BM-Fig1-Site Plan rev Jan 2019.dwg LAYOUT: 1 SAVED: 1/17/2019 8:54 AM ACADVER: 21.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: THERMORETEC
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XREFS: IMAGES: PROJECTNAME: ----
X-BASEMAP-SEP-2018
X-TTL-JAN 2019

100' 0 100' 200'
Graphic Scale

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

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Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr. LGB
Designed by LGB	Drawn by TPH	Checked by SWI

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.
NEW JERSEY ENGINEERING CERTIFICATE OF AUTHORIZATION NUMBER 24GA27939600

PRECISION NATIONAL PLATING SERVICES, INC. ● 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

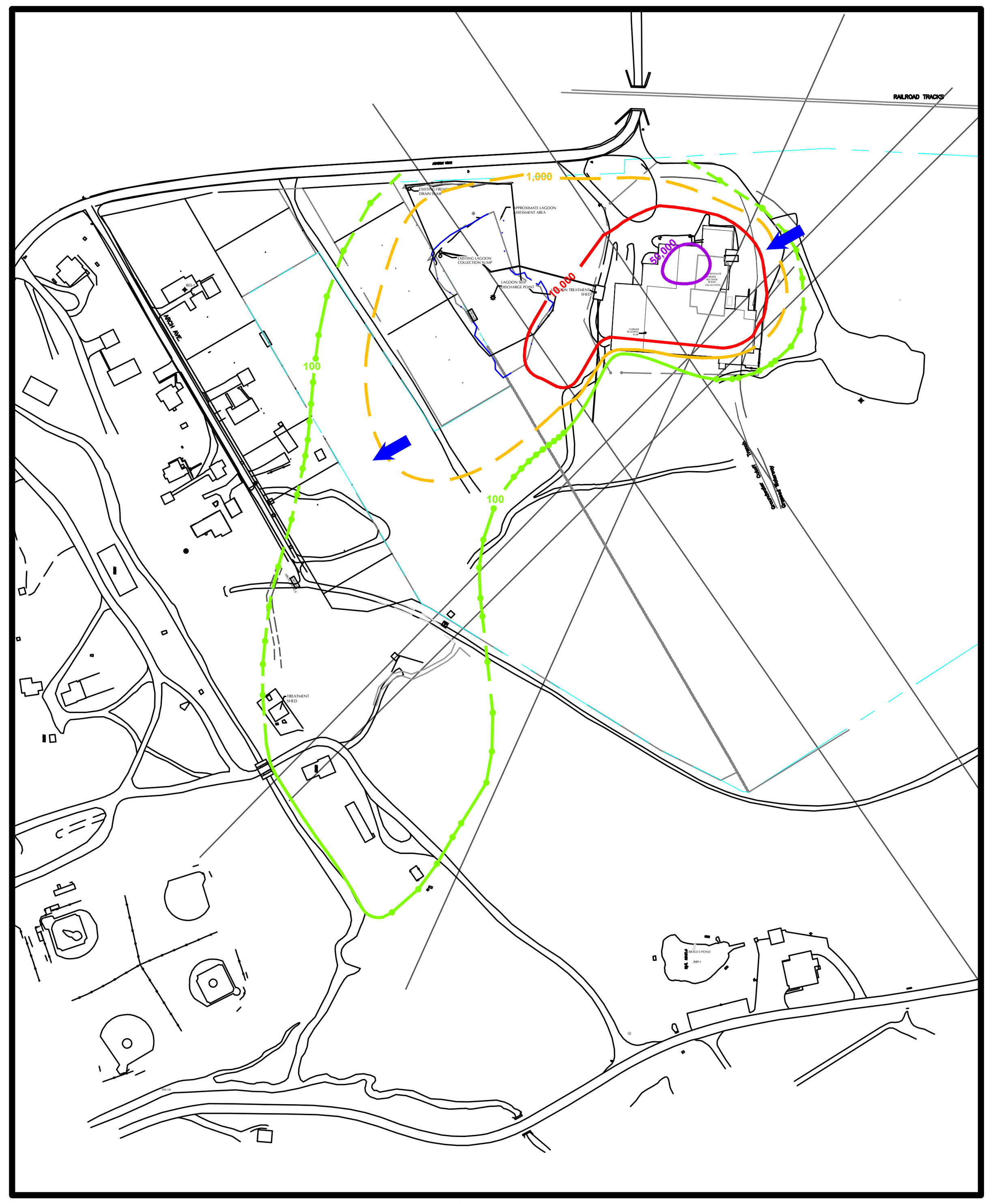
SITE PLAN

ARCADIS Project No.
BB014215.2018.00015

Date
JANUARY 2019

ARCADIS
1 HARVARD WAY, SUITE 5
HILLSBOROUGH, NJ 08844
TEL. 908.685.7845

2



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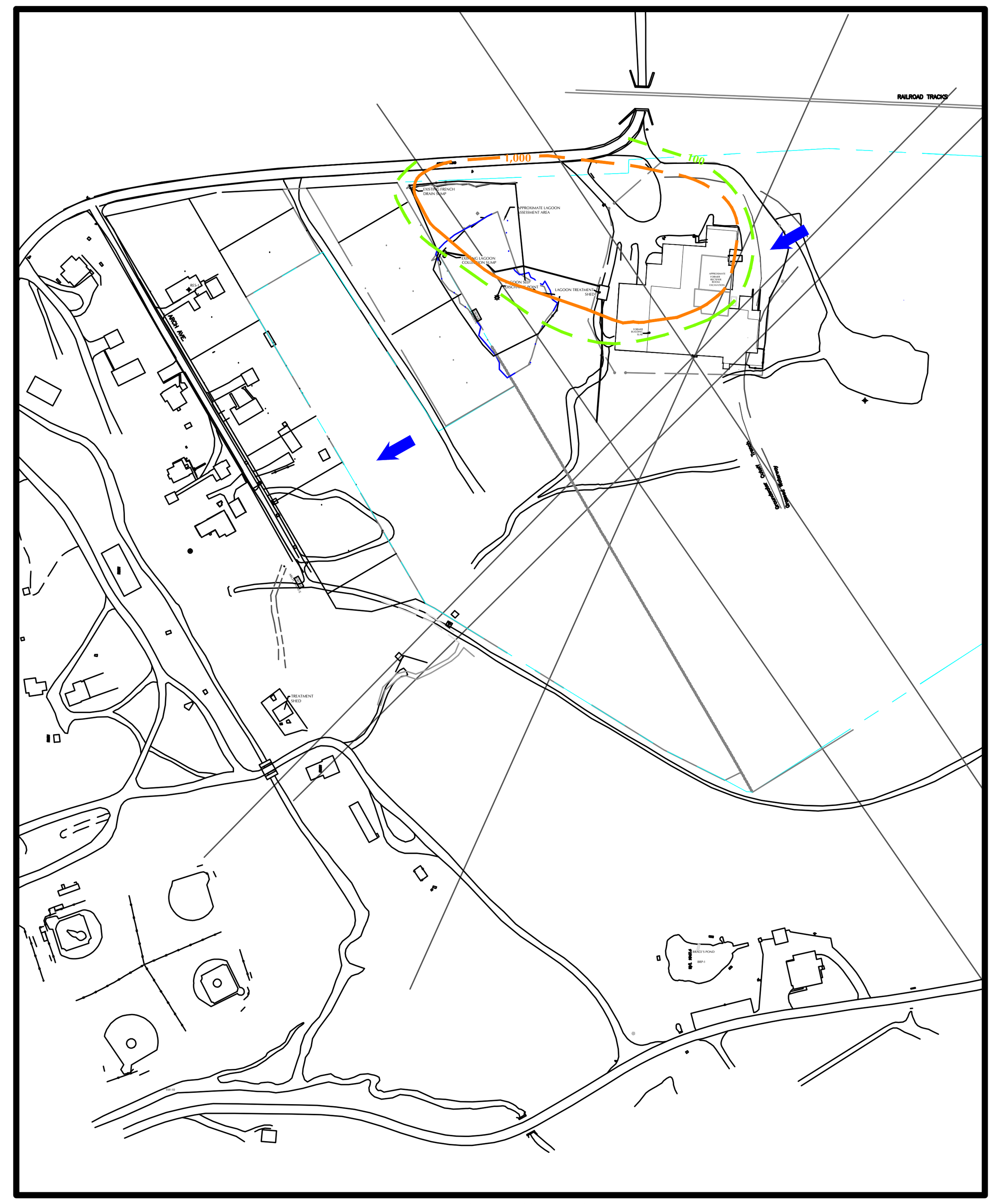

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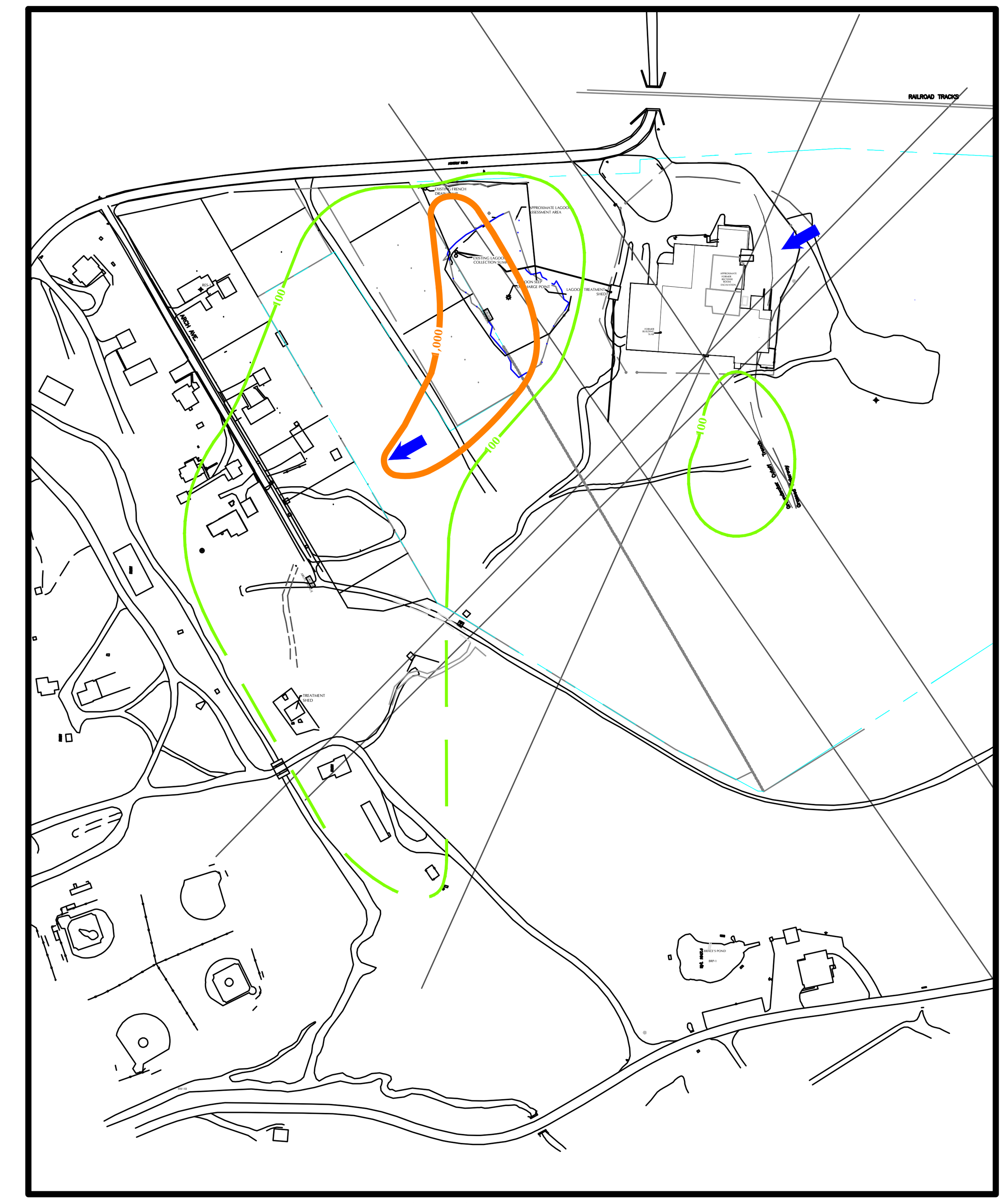


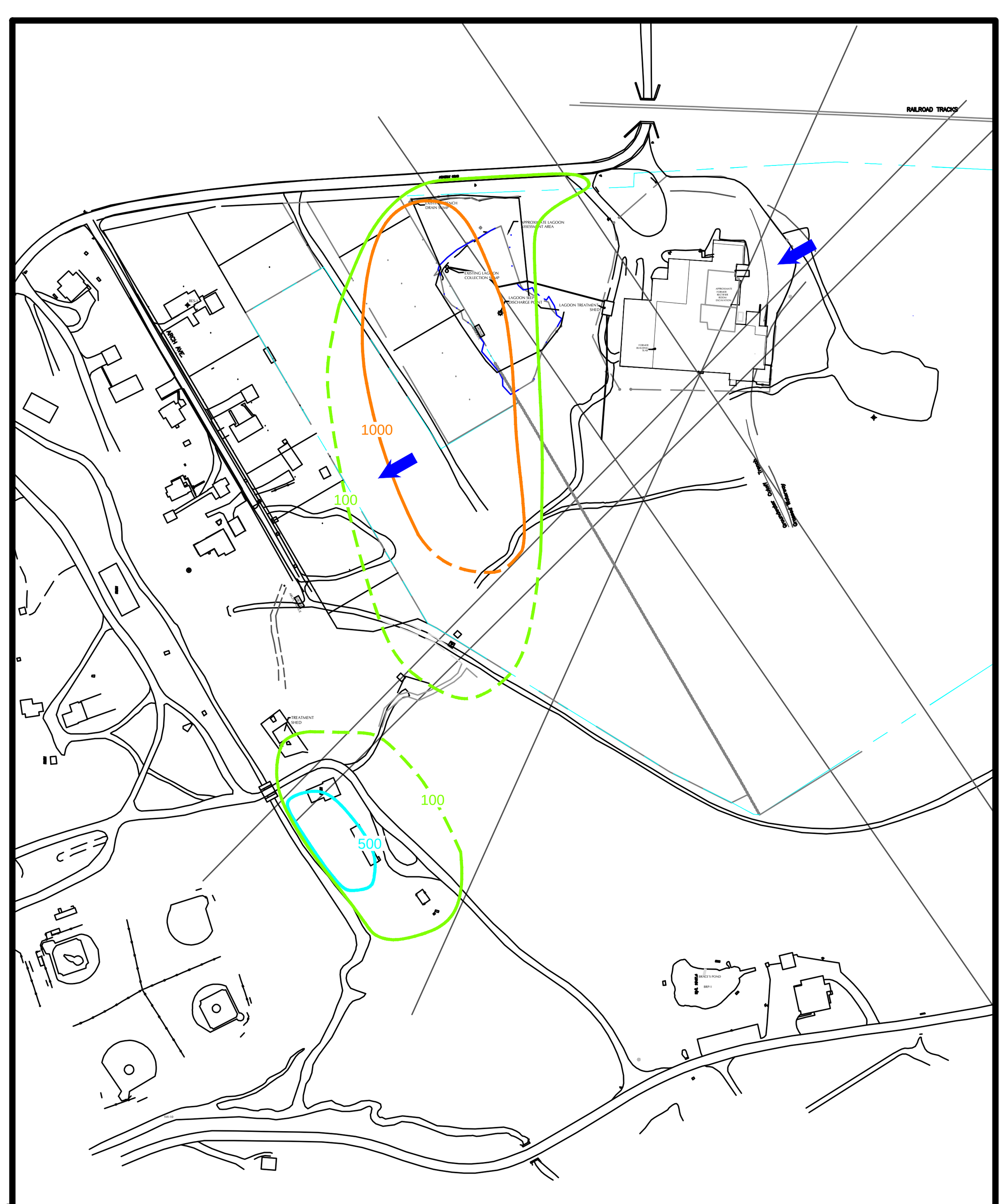
2011

LEGEND:

APPROXIMATE PROPERTY BOUNDARY
PATH/TRAIL
FENCE
GROUNDWATER INTERCEPTOR TRENCH
GROUNDWATER FLOW DIRECTION

HEXAVALENT CHROMIUM ISOCONCENTRATION CONTOURS:
(DASHED WHERE INFERRED)

50,000
10,000
1,000
500
100



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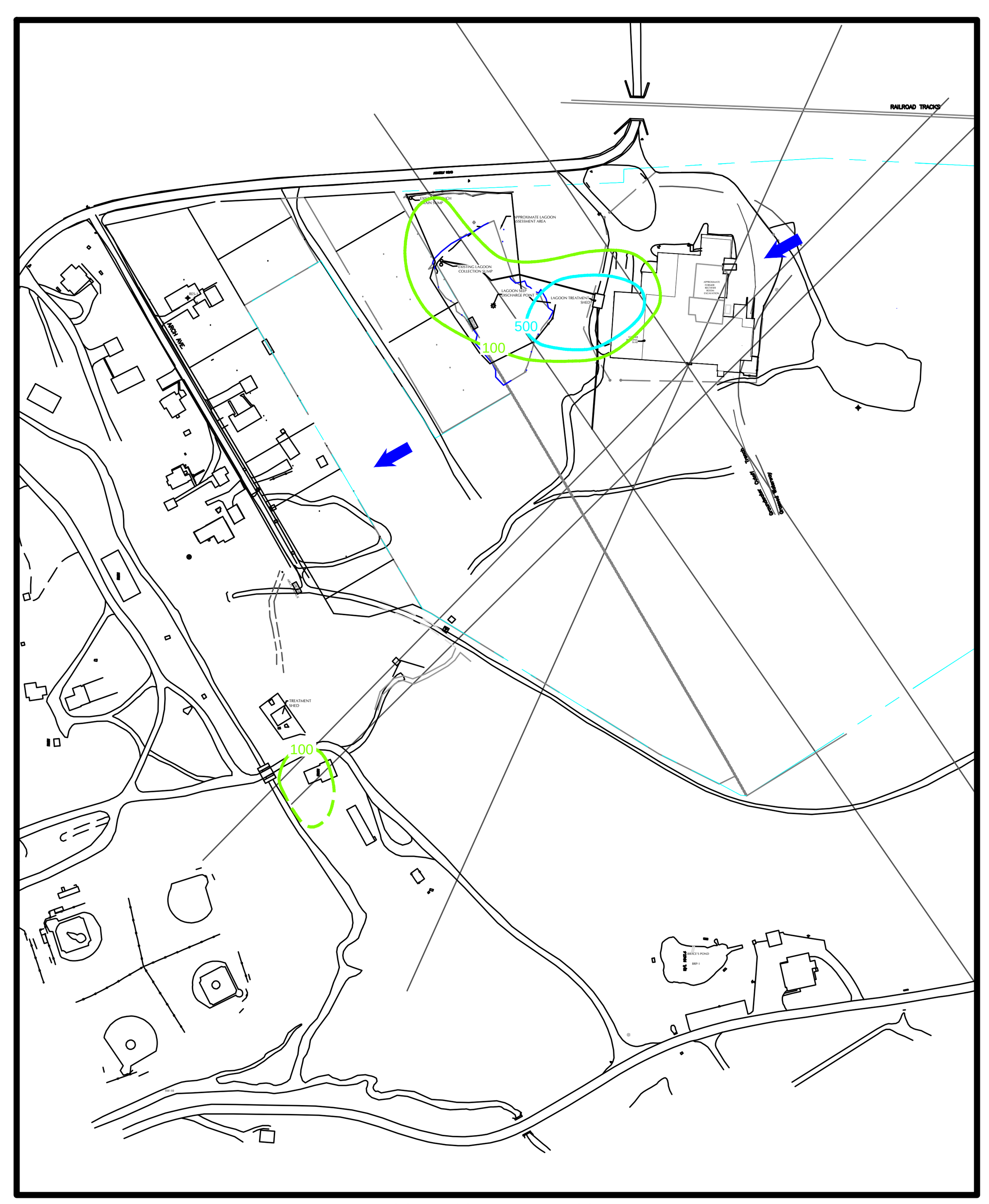

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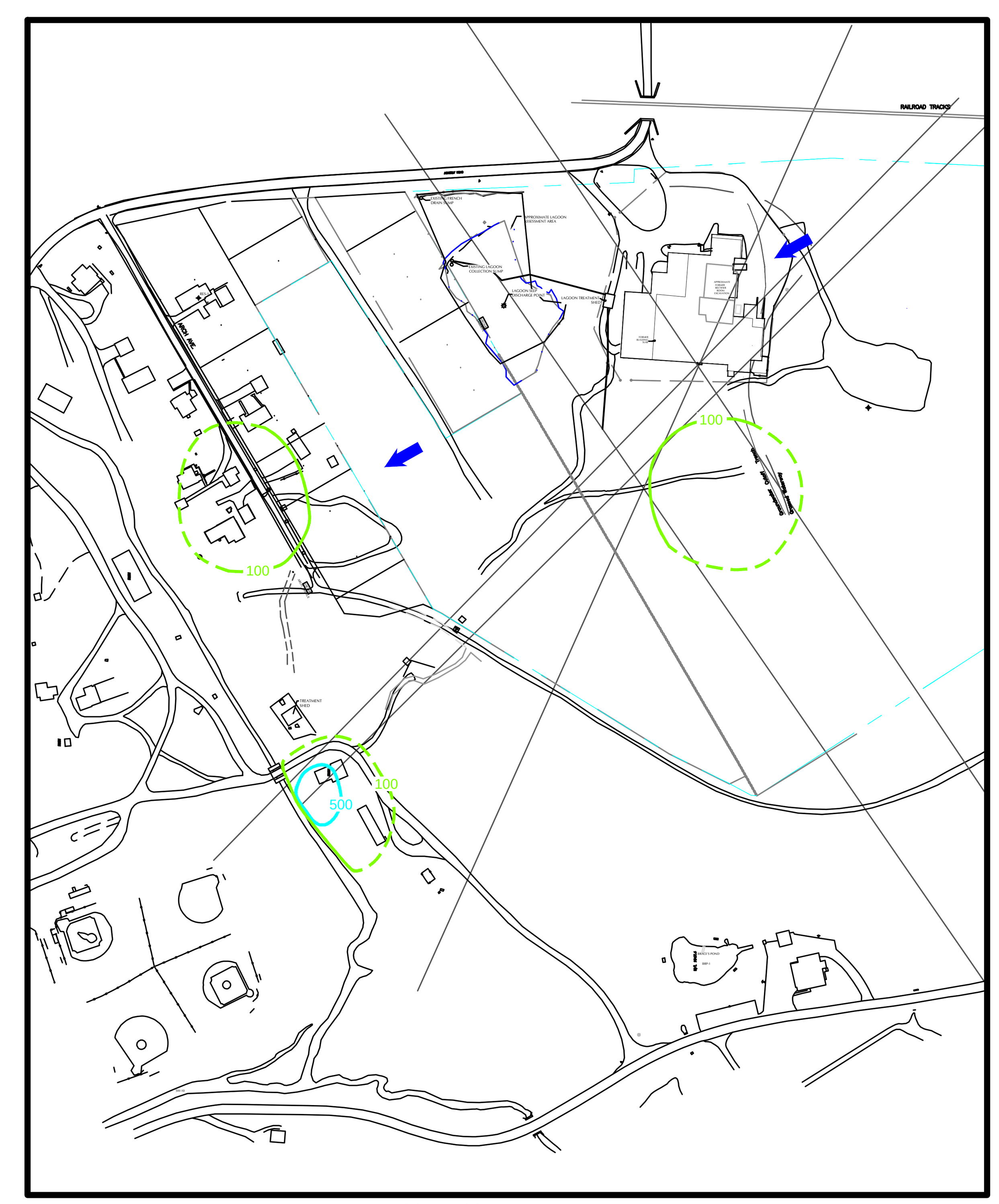

2014

250' 0 250' 500'
SCALE

PRECISION NATIONAL PLATING SERVICES, INC.
198 ACKERLY ROAD
CLARKS SUMMIT, PENNSYLVANIA

HEXAVALENT CHROMIUM CONCENTRATIONS IN GROUNDWATER-OVERBURDEN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
3A

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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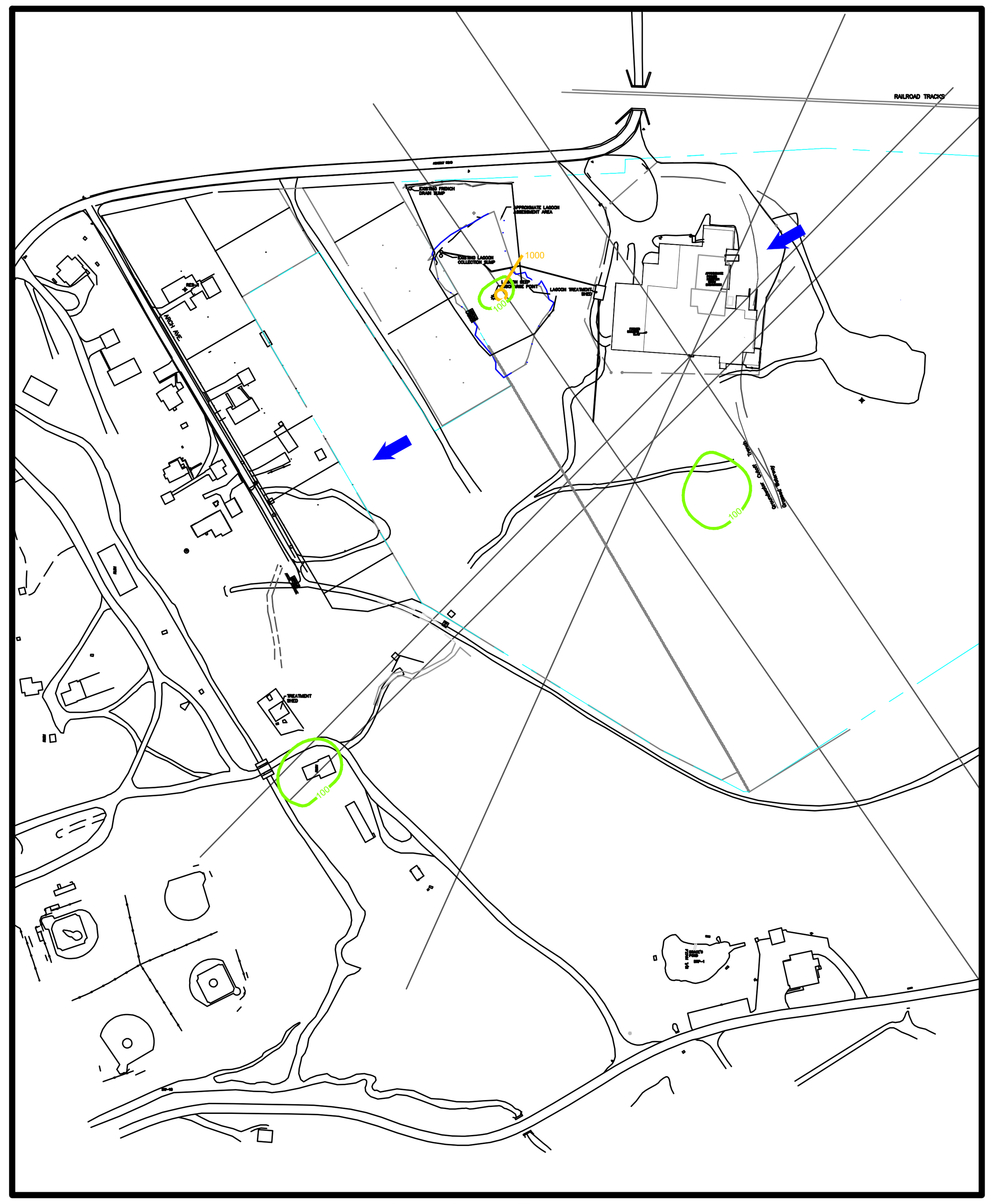

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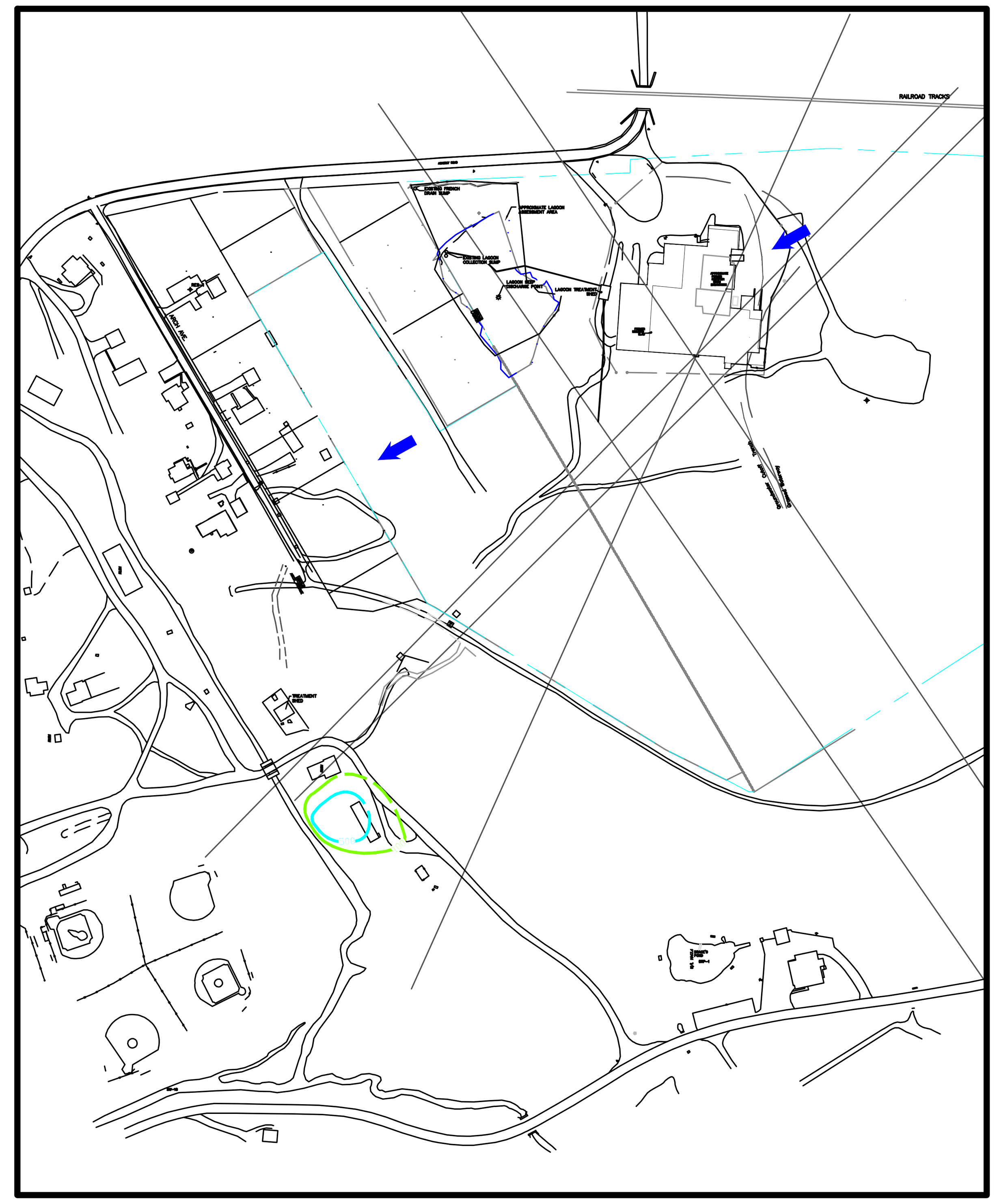

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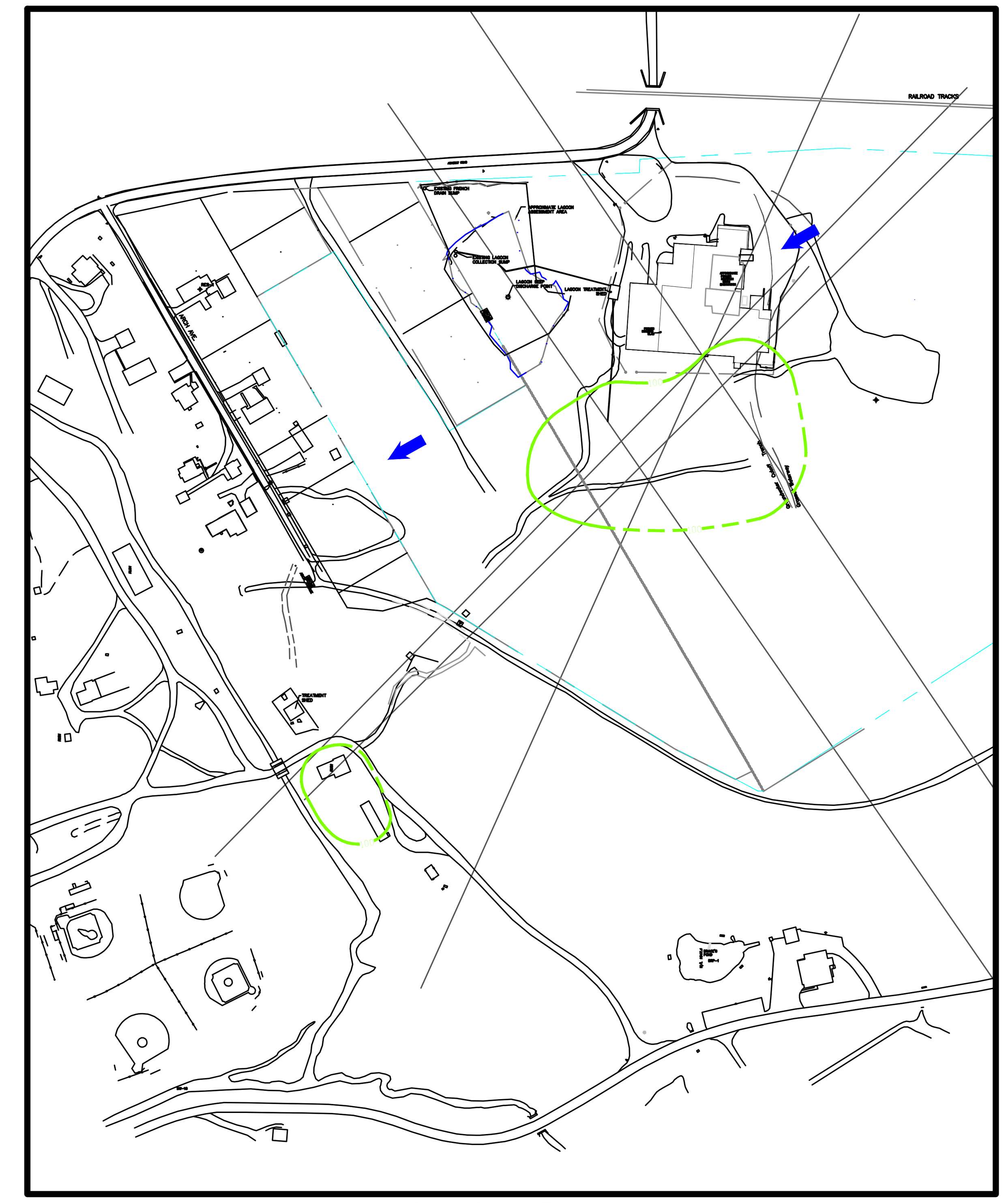
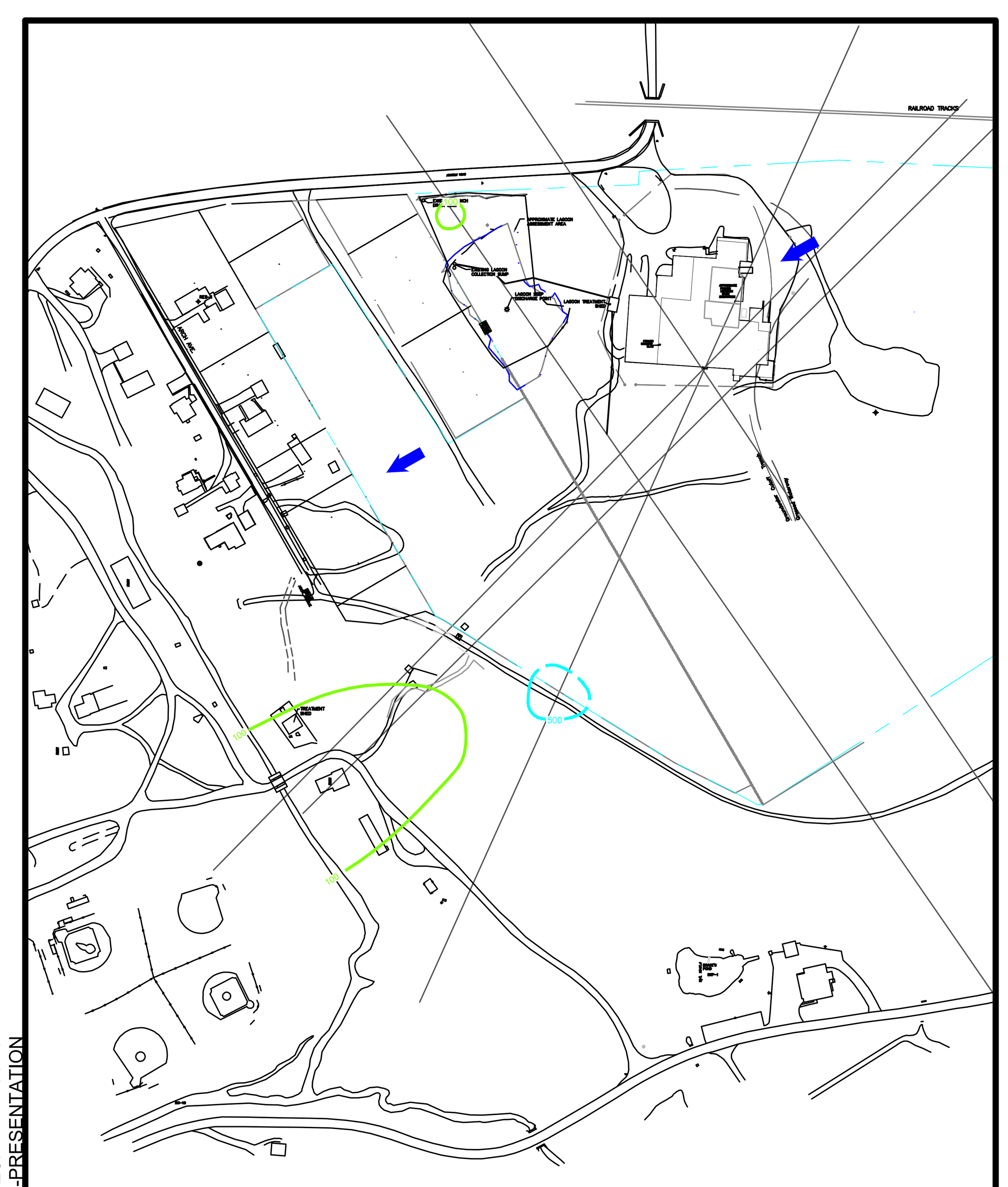
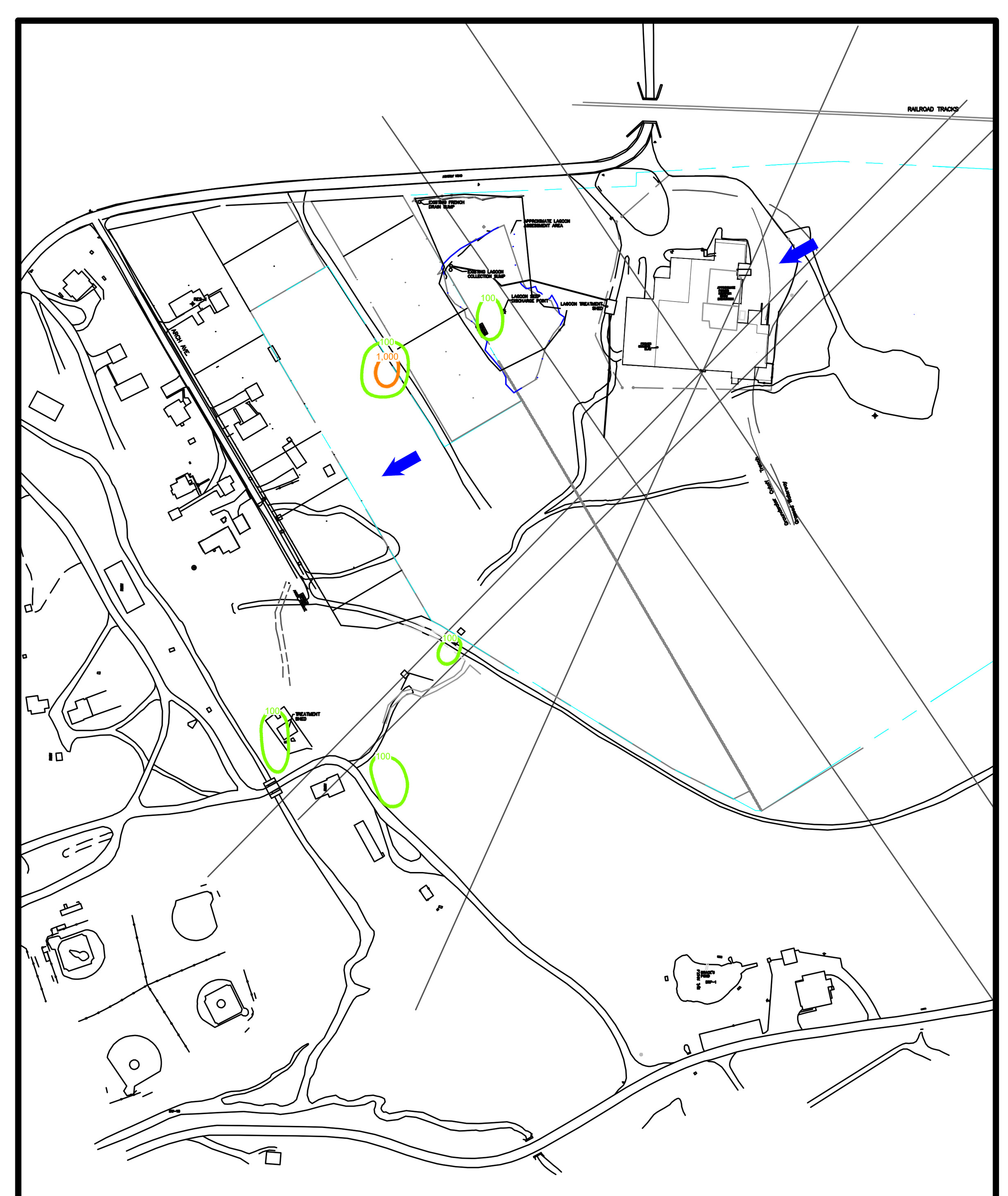


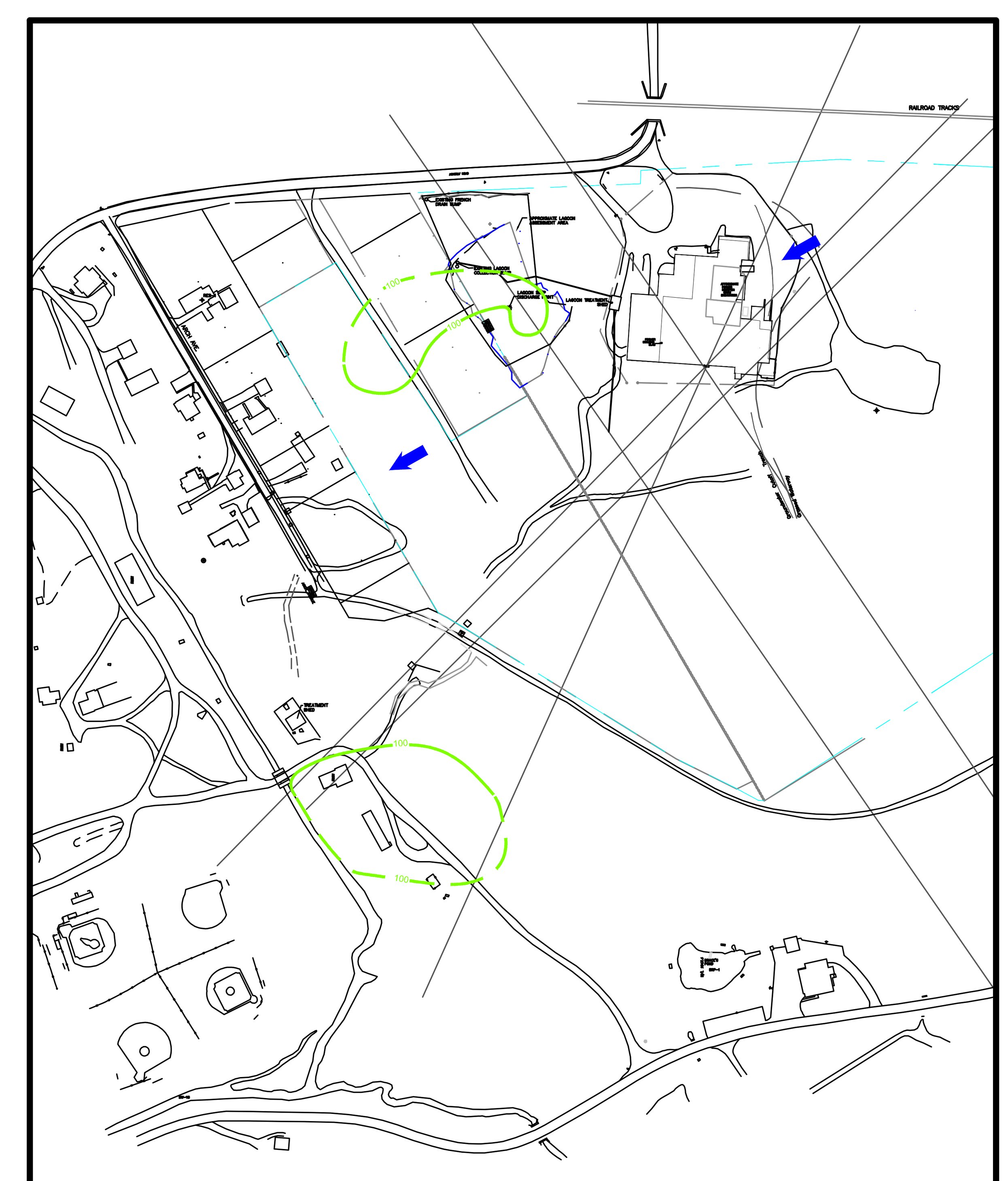
2017



2018



2019



2020

LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- GROUNDWATER FLOW DIRECTION

HEXAVALENT CHROMIUM ISOCONCENTRATION CONTOURS:
(DASHED WHERE INFERRED)

- 50,000
- 10,000
- 1,000
- 500
- 100

250' 0 250' 500'
SCALE

PRECISION NATIONAL PLATING SERVICES, INC.
198 ACKERLY ROAD
CLARKS SUMMIT, PENNSYLVANIA

HEXAVALENT CHROMIUM CONCENTRATIONS IN GROUNDWATER-OVERBURDEN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
3B

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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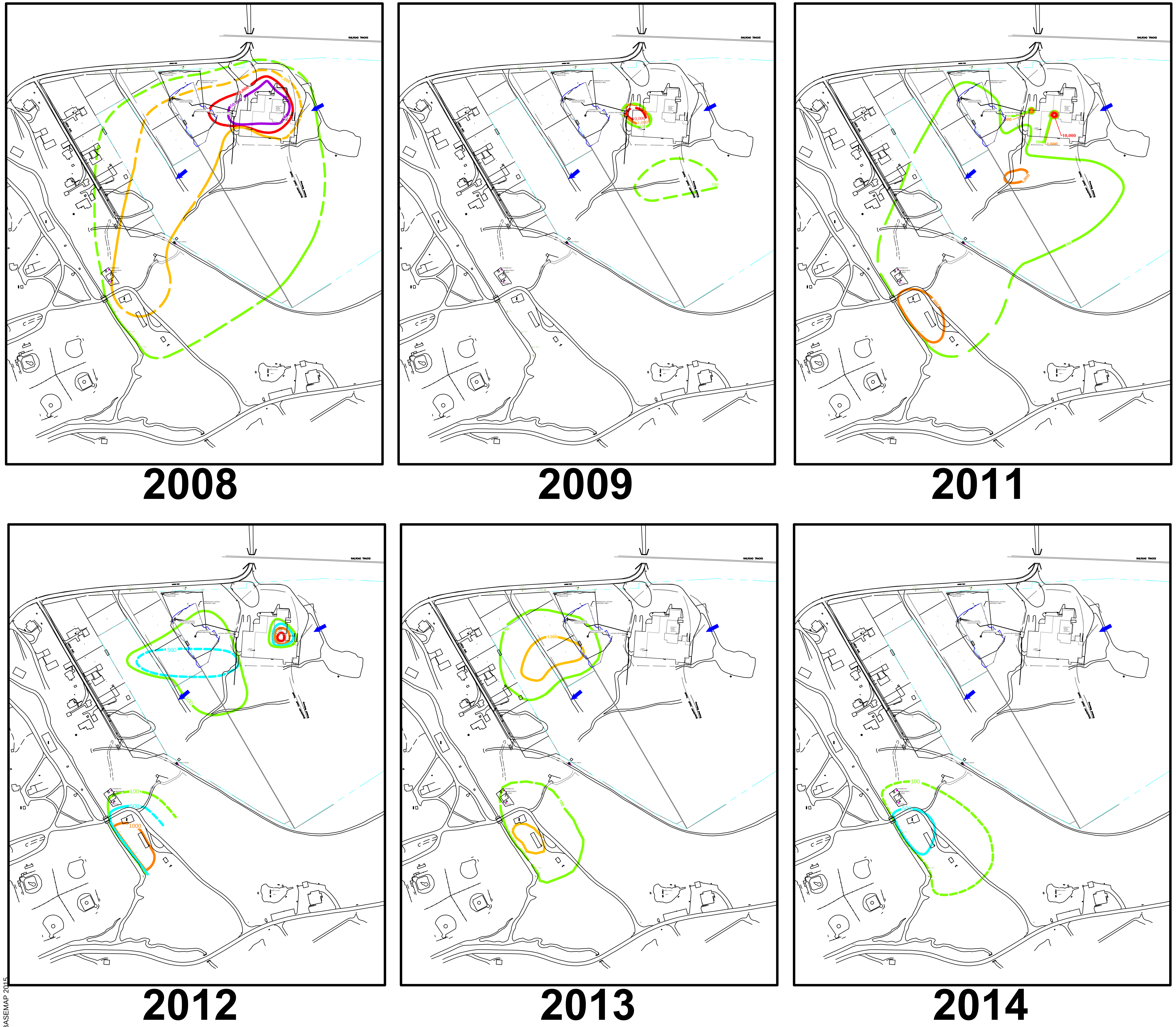


LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- GROUNDWATER FLOW DIRECTION

HEXAVALENT CHROMIUM ISOCONCENTRATION CONTOURS:
(DASHED WHERE INFERRED)

- 50,000
- 10,000
- 1,000
- 500
- 100

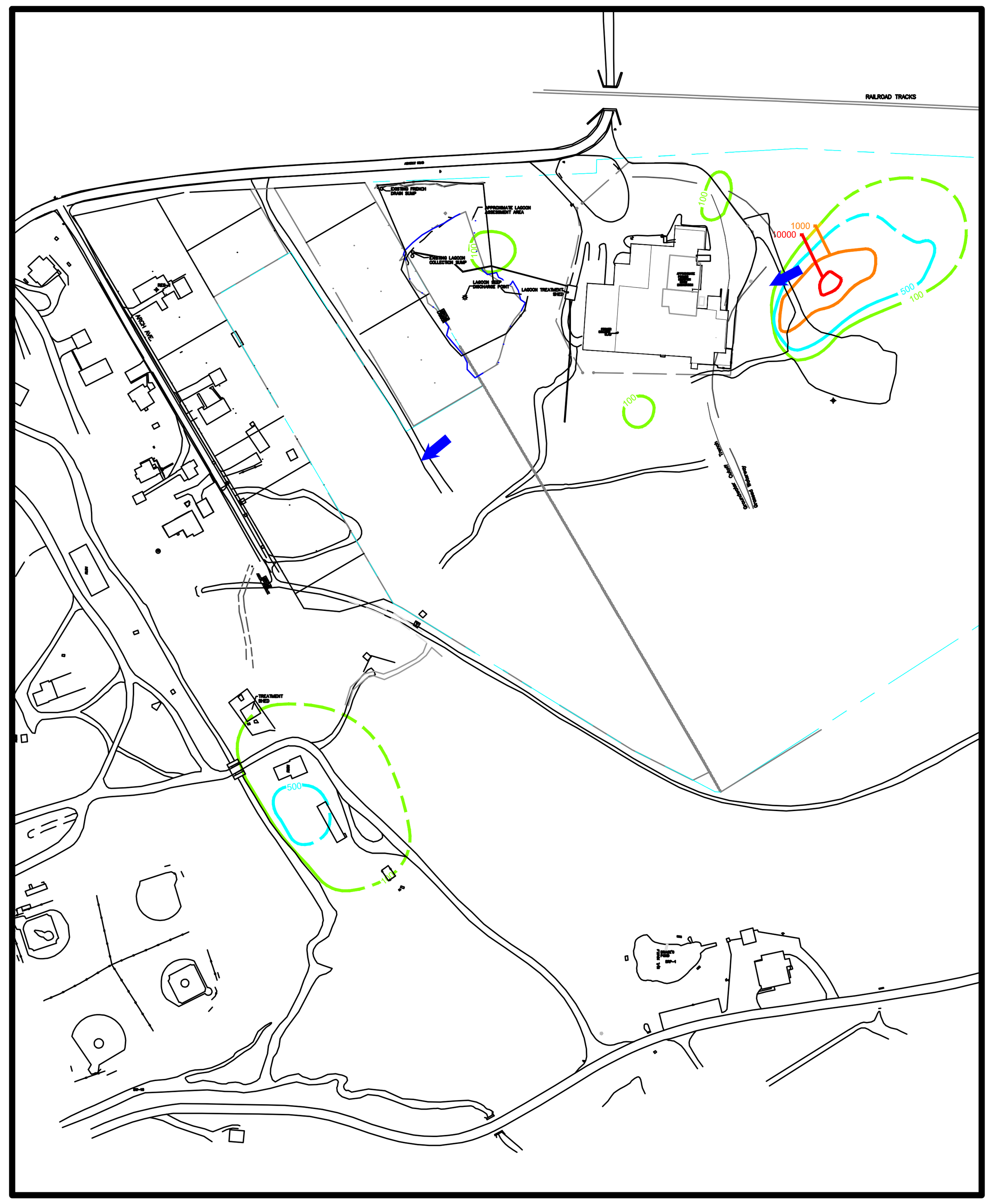
250' 0 250' 500'
SCALE

PRECISION NATIONAL PLATING SERVICES, INC.
198 ACKERLY ROAD
CLARKS SUMMIT, PENNSYLVANIA

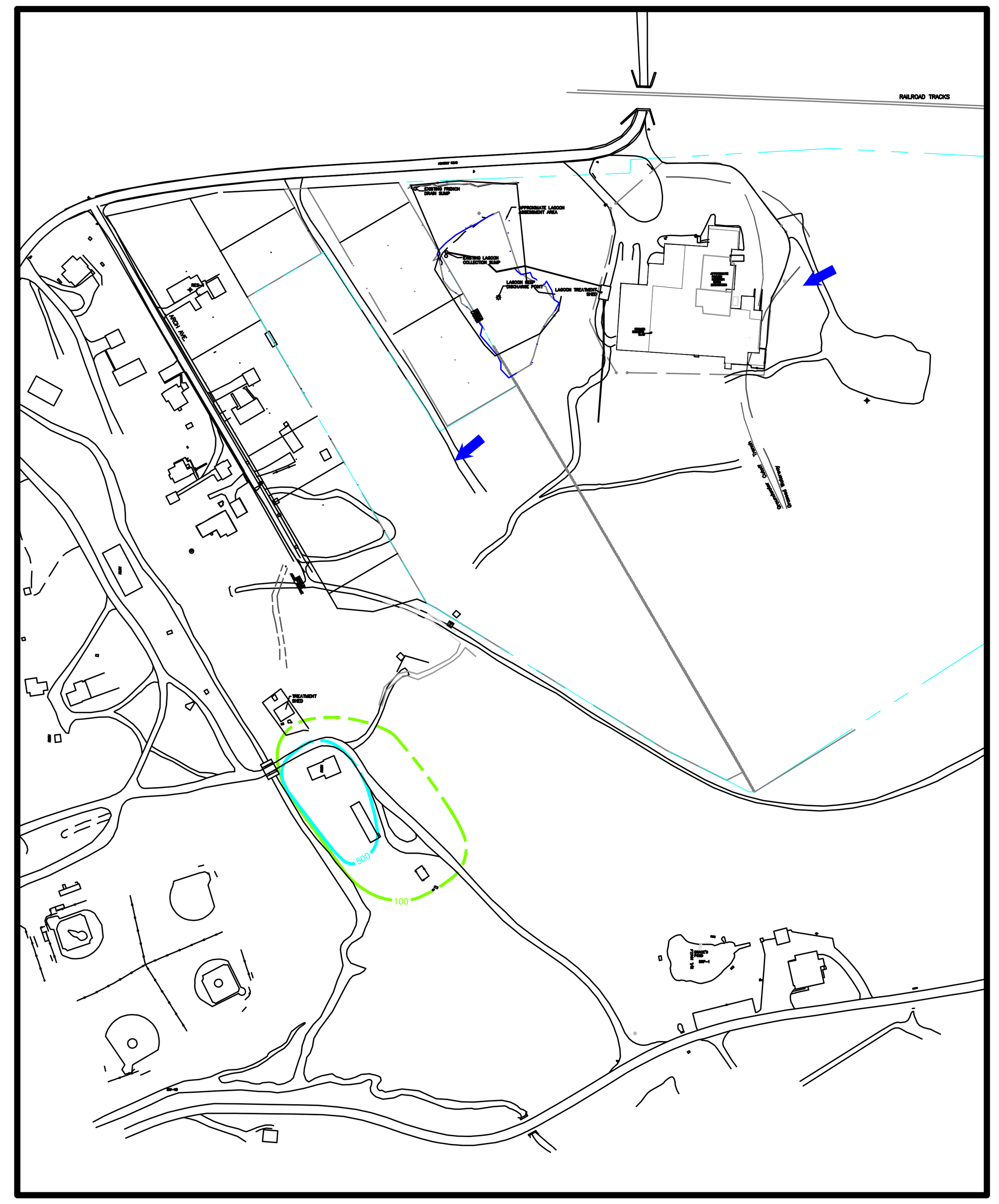
HEXAVALENT CHROMIUM CONCENTRATIONS IN GROUNDWATER-SHALLOW BEDROCK

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4A



2015



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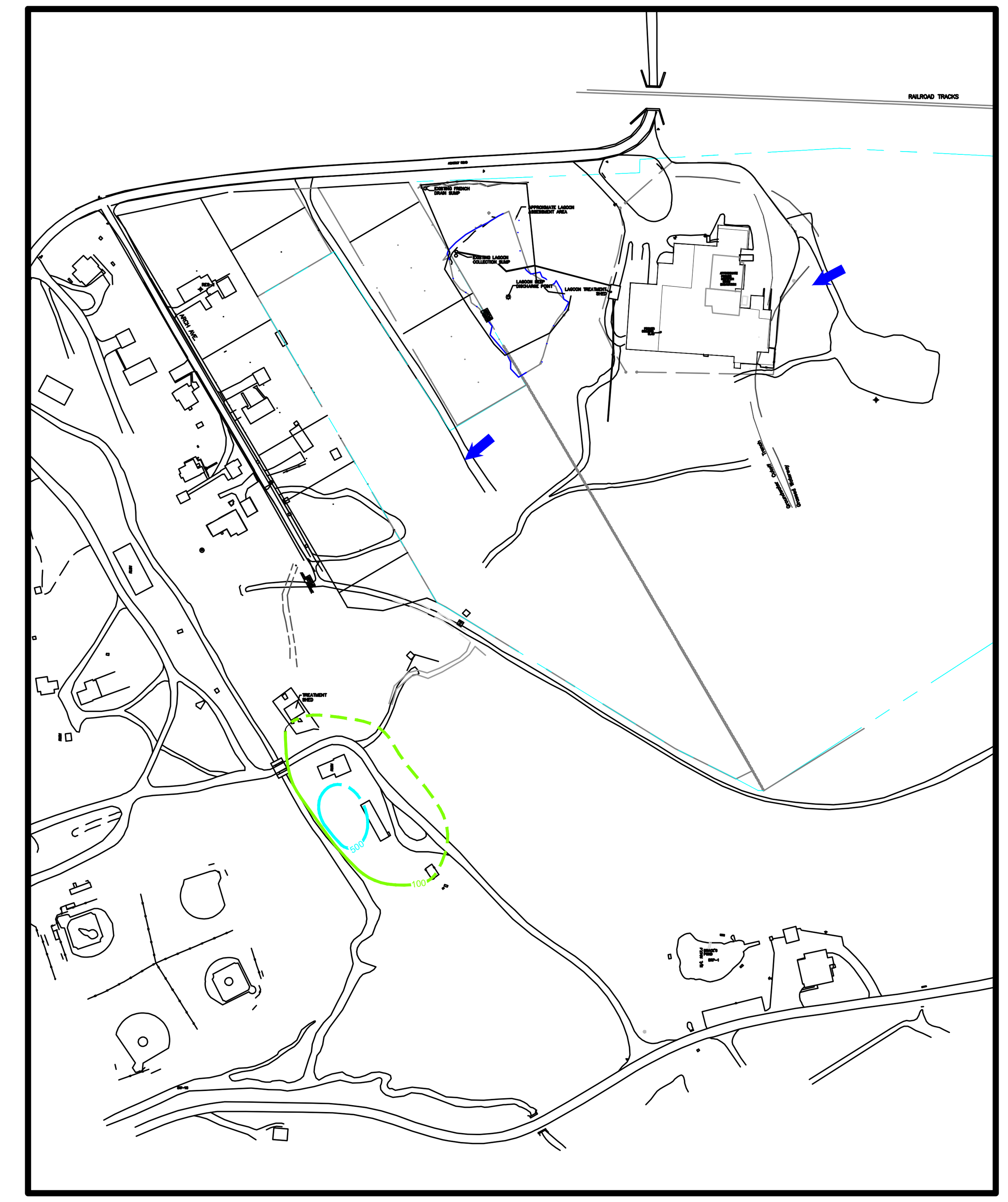
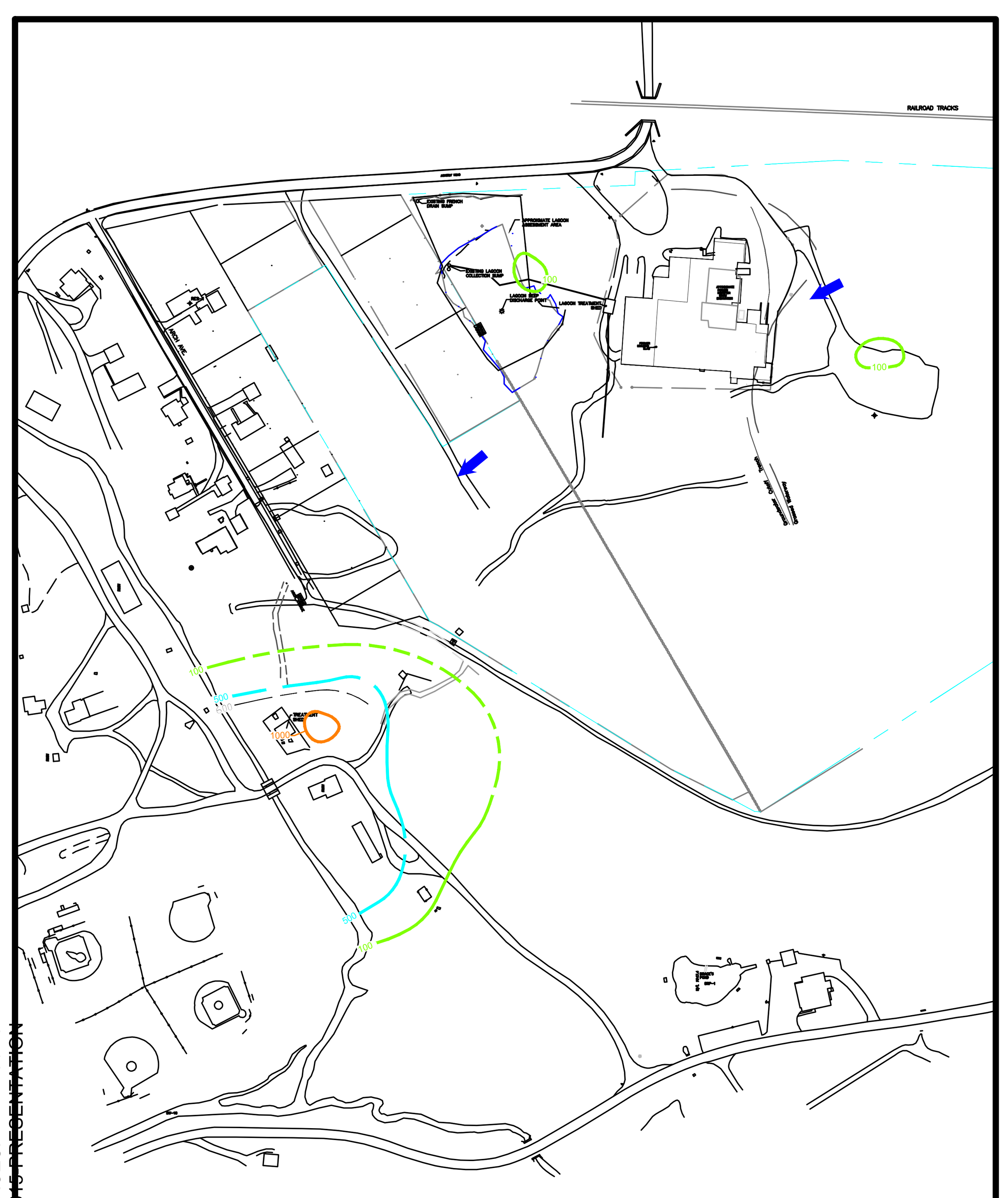
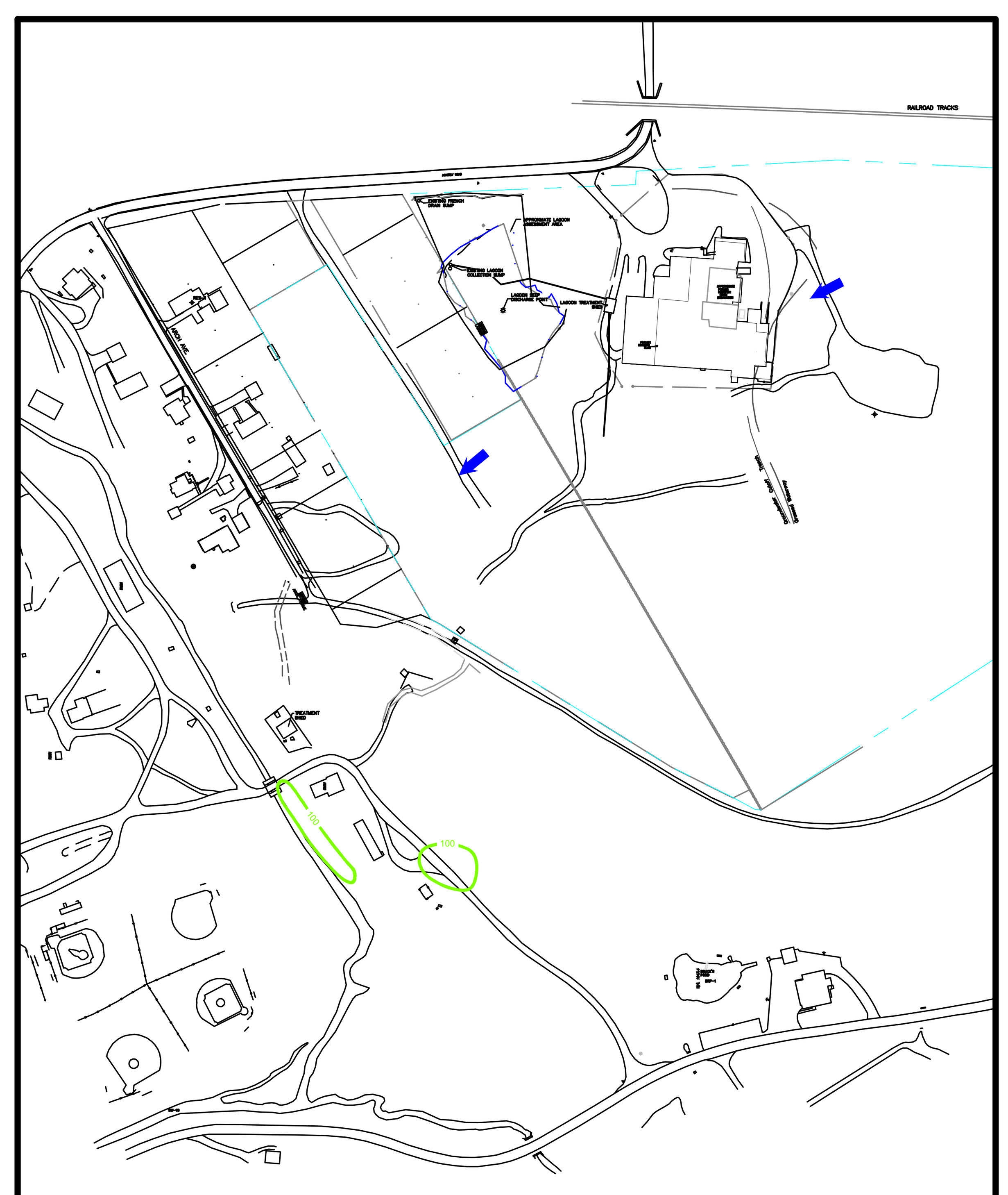


2017



2018



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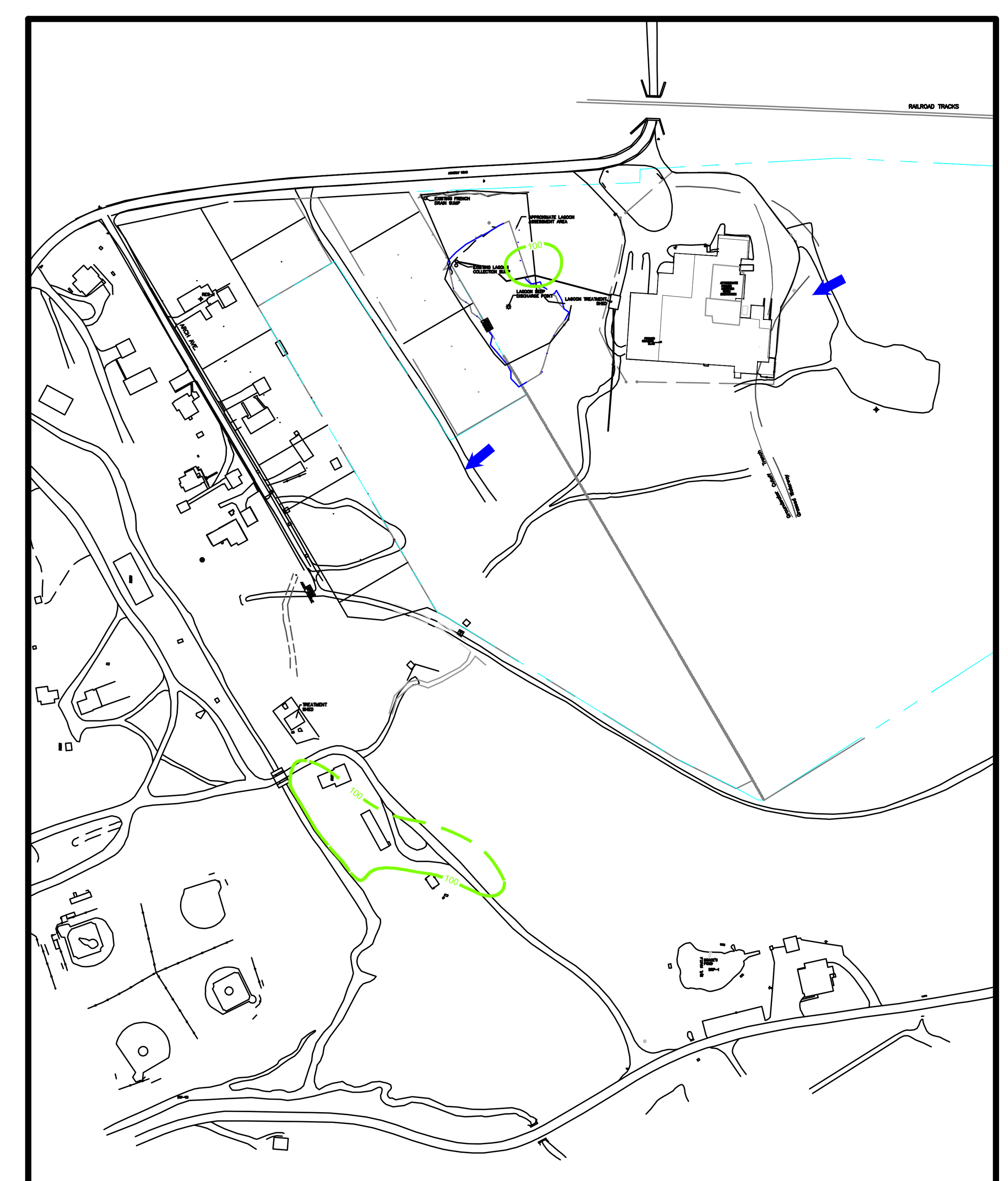


2020

LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- GROUNDWATER FLOW DIRECTION

HEXAVALENT CHROMIUM ISOCONCENTRATION CONTOURS:
(DASHED WHERE INFERRED)

- 50,000
- 10,000
- 1,000
- 500
- 100

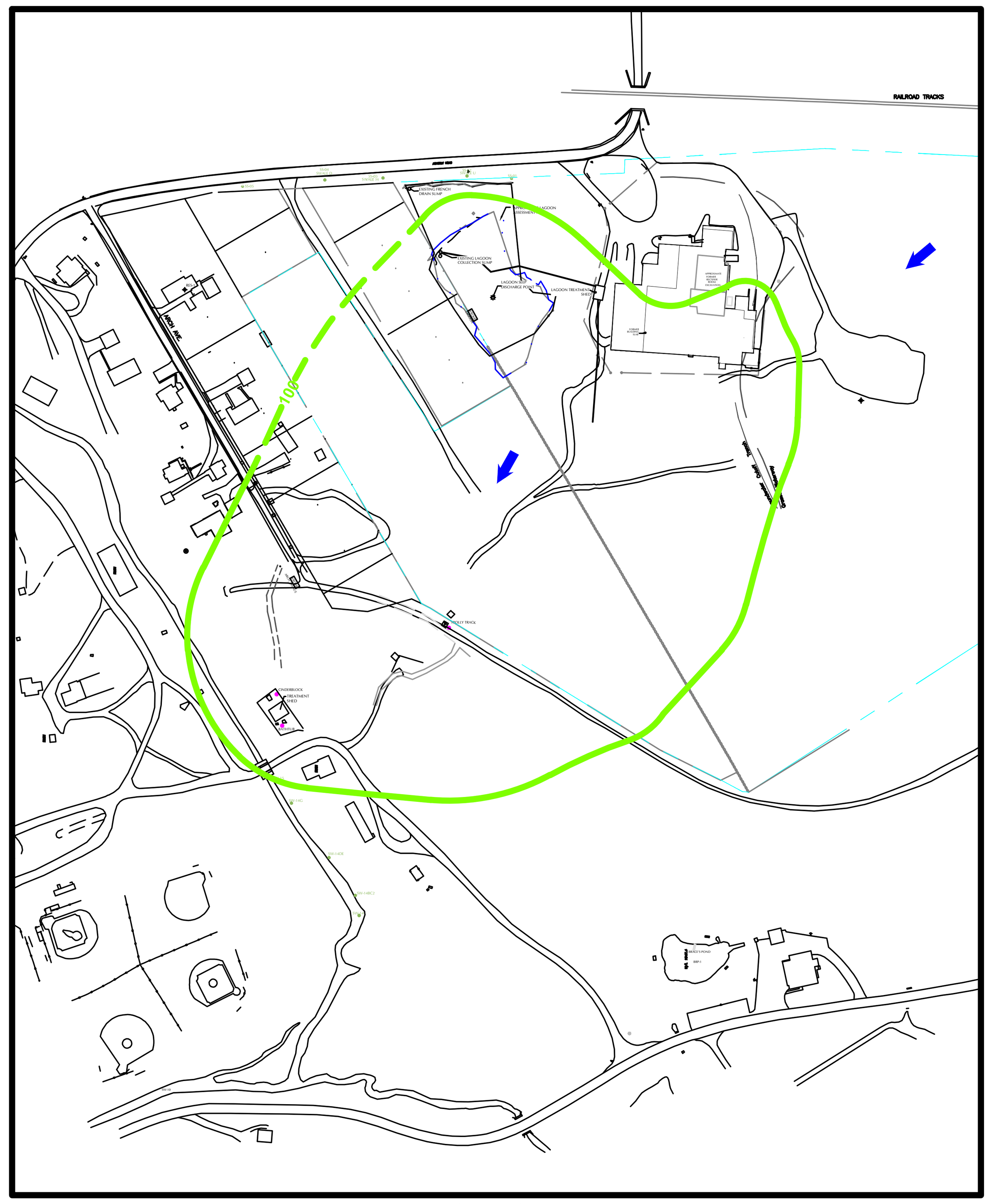
250' 0 250' 500'
SCALE

PRECISION NATIONAL PLATING SERVICES, INC.
198 ACKERLY ROAD
CLARKS SUMMIT, PENNSYLVANIA

HEXAVALENT CHROMIUM CONCENTRATIONS IN GROUNDWATER-SHALLOW BEDROCK

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4B



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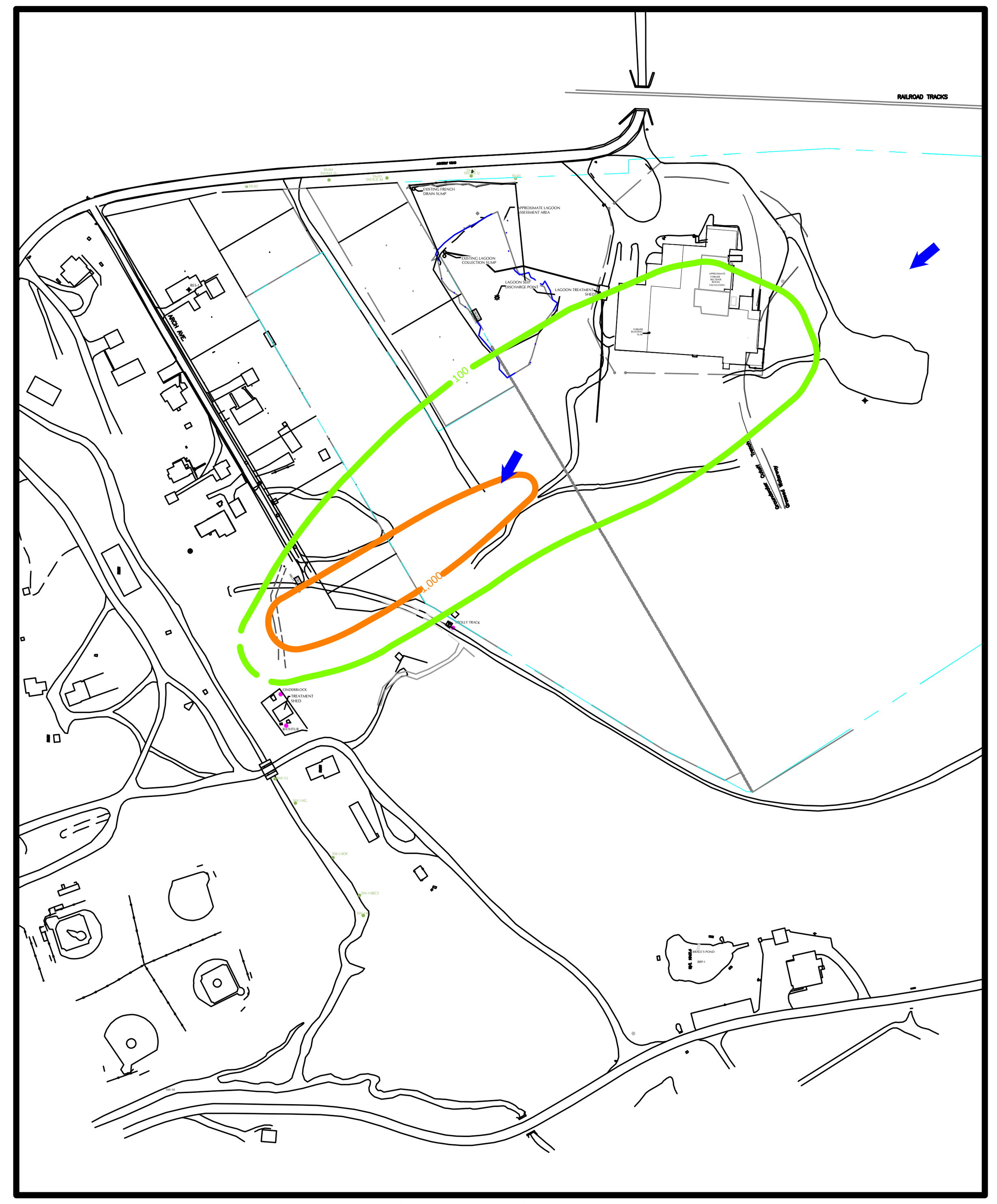

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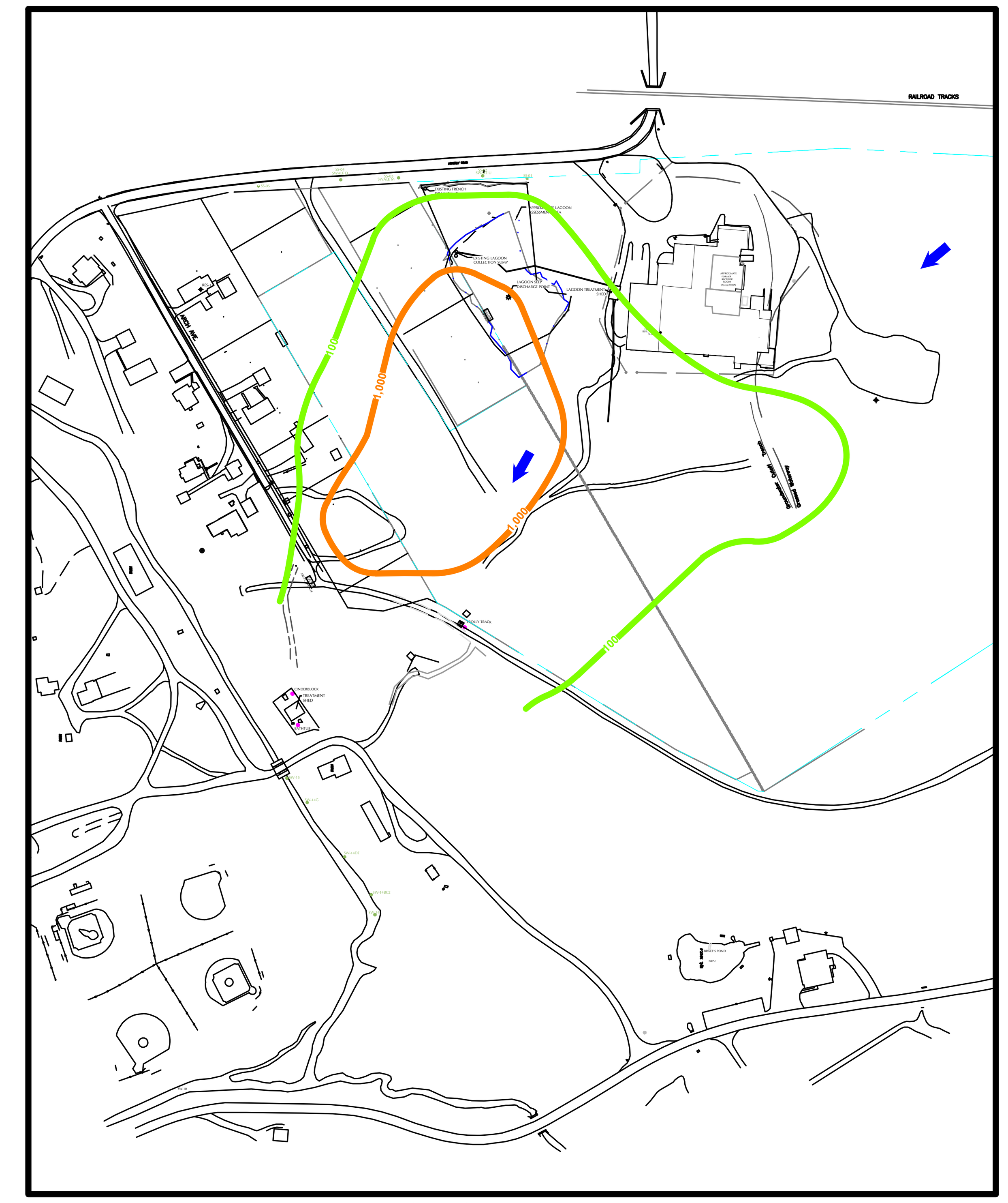

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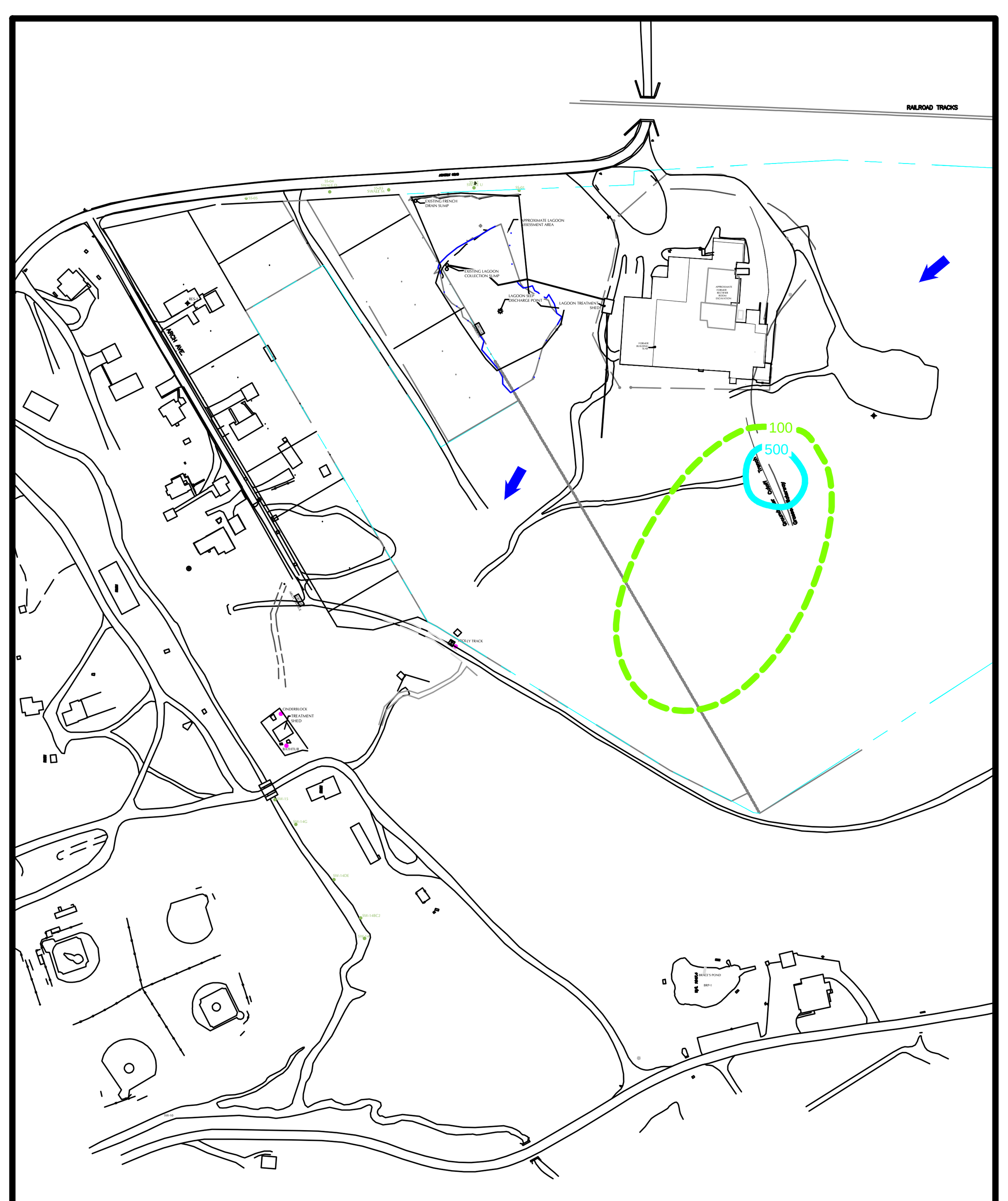

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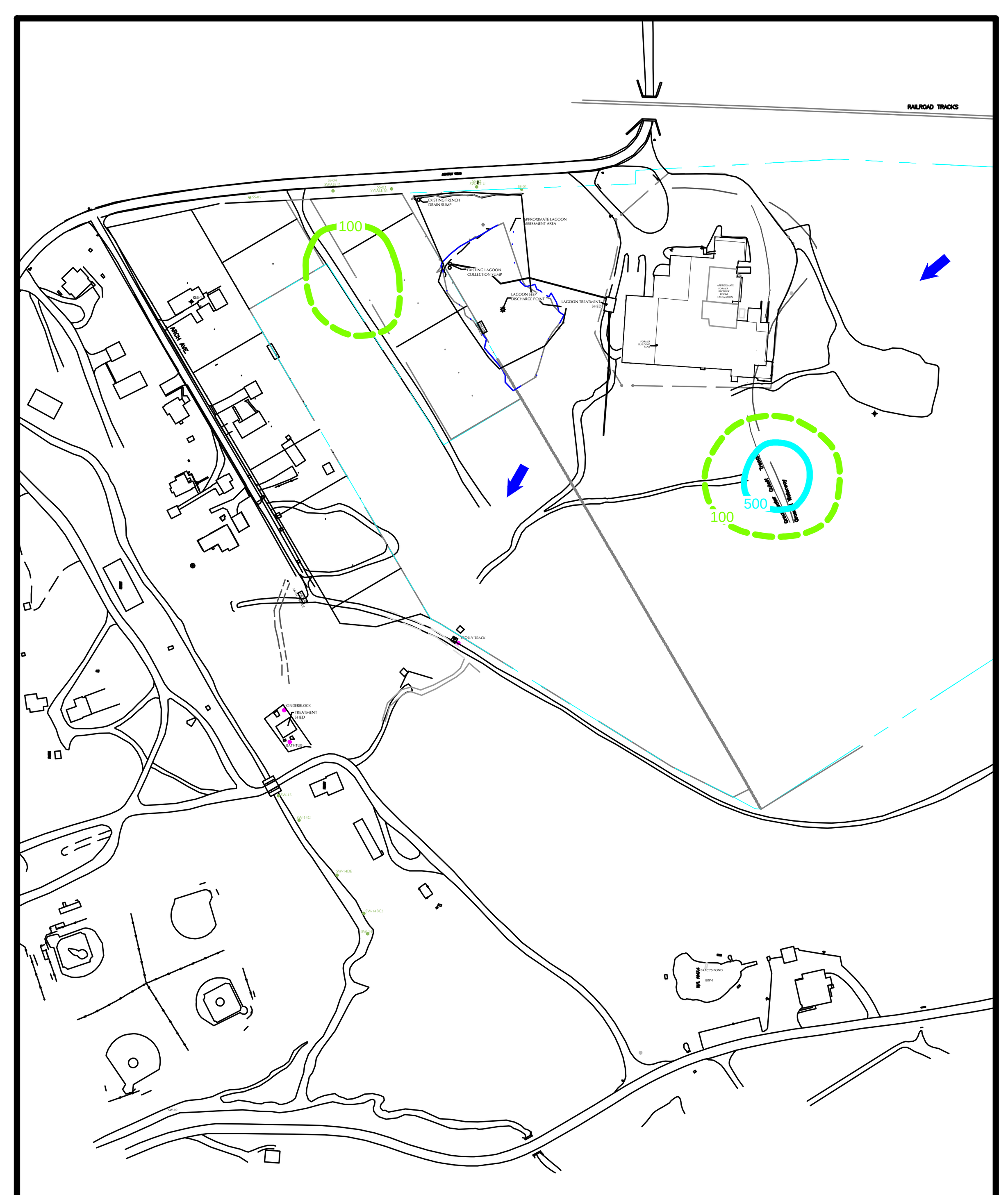

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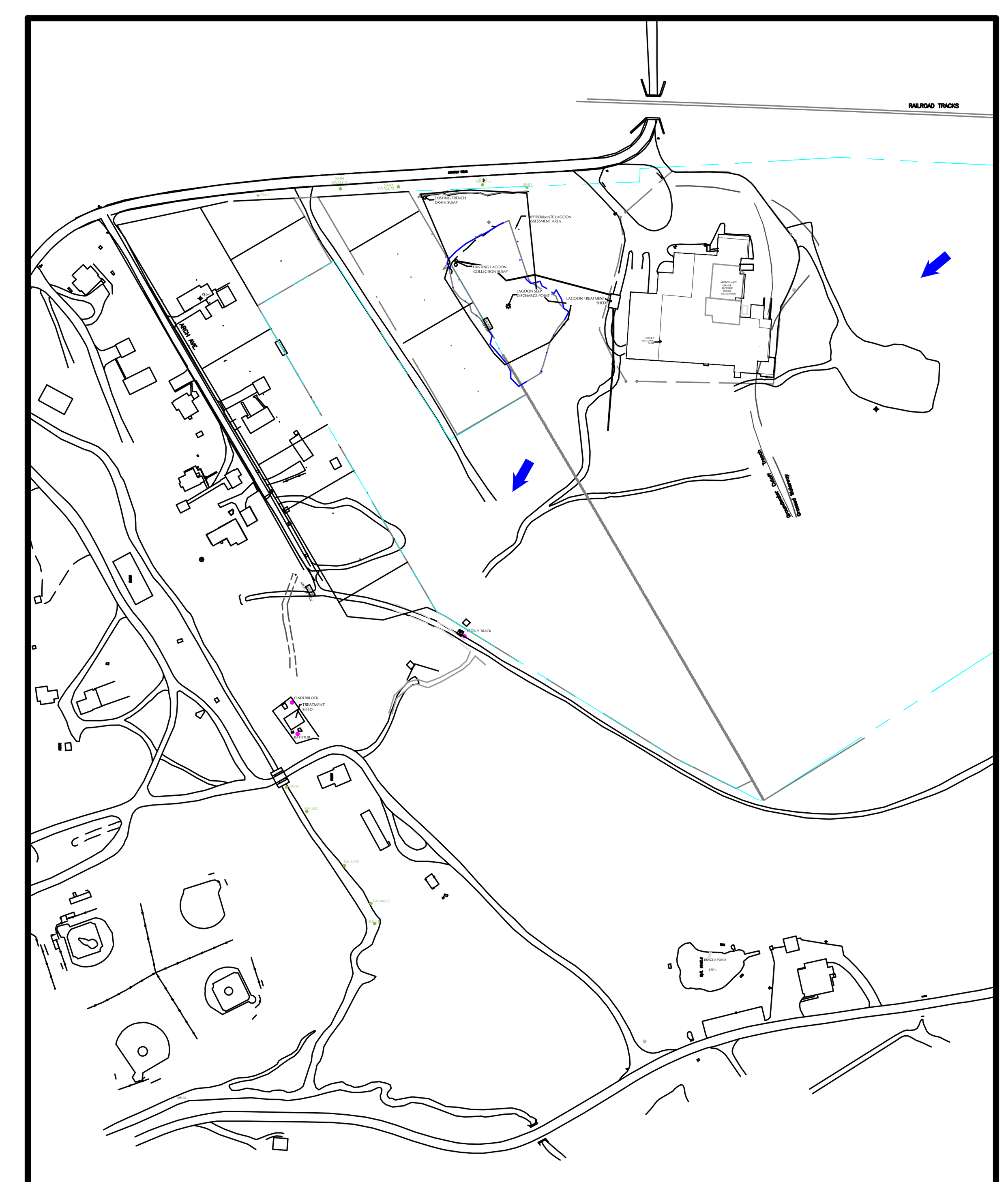


2014

LEGEND:

APPROXIMATE PROPERTY BOUNDARY
PATH/TRAIL
FENCE
GROUNDWATER INTERCEPTOR TRENCH
GROUNDWATER FLOW DIRECTION

HEXAVALENT CHROMIUM ISOCONCENTRATION CONTOURS:
(DASHED WHERE INFERRED)

50,000
10,000
1,000
500
100

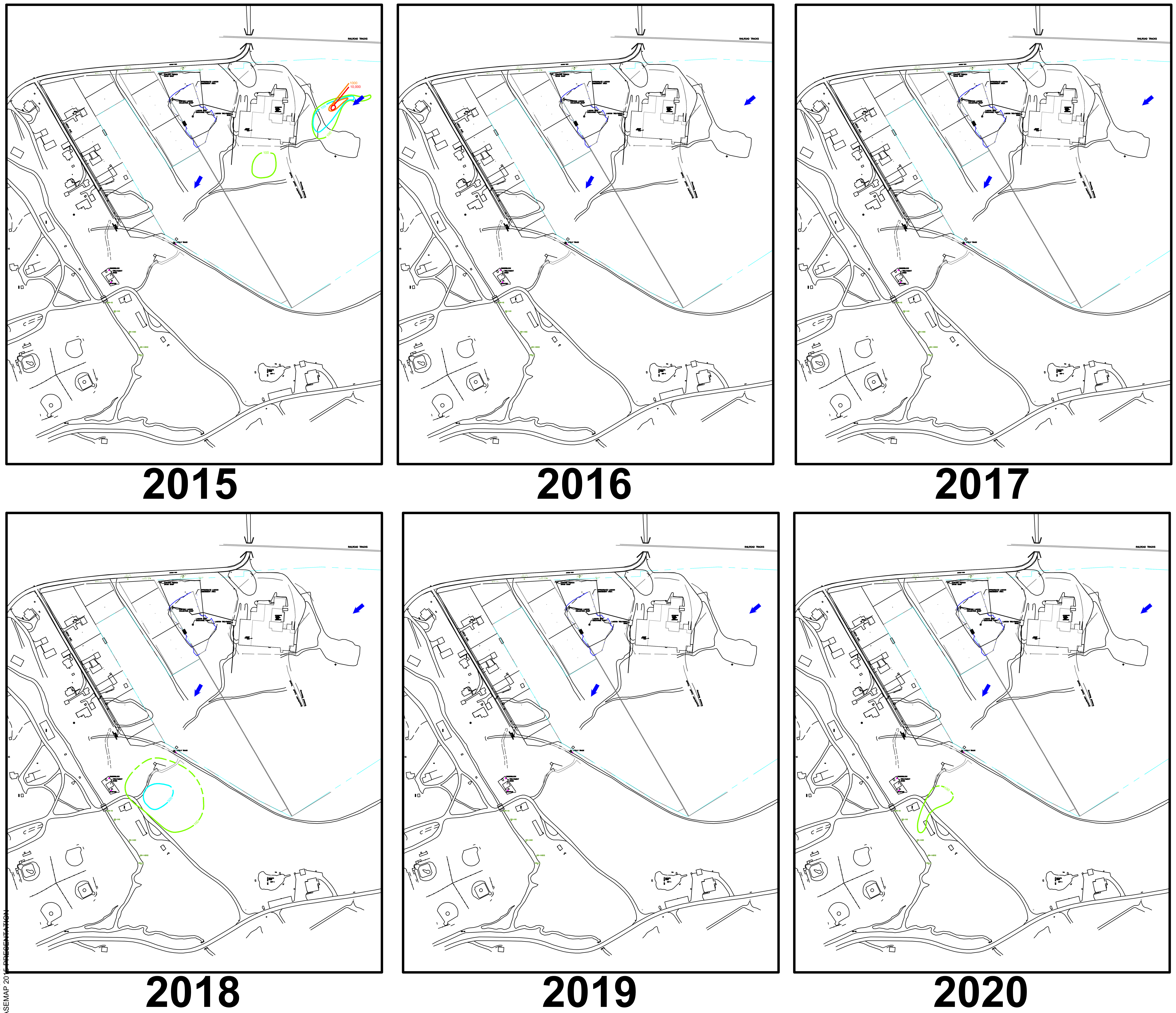
250' 0 250' 500'
SCALE

PRECISION NATIONAL PLATING SERVICES, INC.
198 ACKERLY ROAD
CLARKS SUMMIT, PENNSYLVANIA

HEXAVALENT CHROMIUM CONCENTRATIONS IN GROUNDWATER-INTERMEDIATE BEDROCK

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5A



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- GROUNDWATER FLOW DIRECTION

HEXAVALENT CHROMIUM ISOCONCENTRATION CONTOURS:
(DASHED WHERE INFERRED)

- 50,000
- 10,000
- 1,000
- 500
- 100

250' 0 250' 500'
SCALE

PRECISION NATIONAL PLATING SERVICES, INC.
198 ACKERLY ROAD
CLARKS SUMMIT, PENNSYLVANIA

HEXAVALENT CHROMIUM CONCENTRATIONS IN GROUNDWATER-INTERMEDIATE BEDROCK

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5B

CITY: MANCHESTER CT DIV/GROUP: ENVCAD DB: T.HALLIWELL PM: L.BRUNT TM: L.BRUNT
C:\Users\PHalliwell\BIM 360\Arcadis\ANA - PRECISION NATIONAL PLATING SERVICES INC\Project Files\2020\30003895\01-DWG\GW-HC-OVB-APRIL 2020.dwg LAYOUT: 1 SAVED: 6/2/2020 2:22 PM ACADVER: 23.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: THERMORETEC STANDARD.CTB
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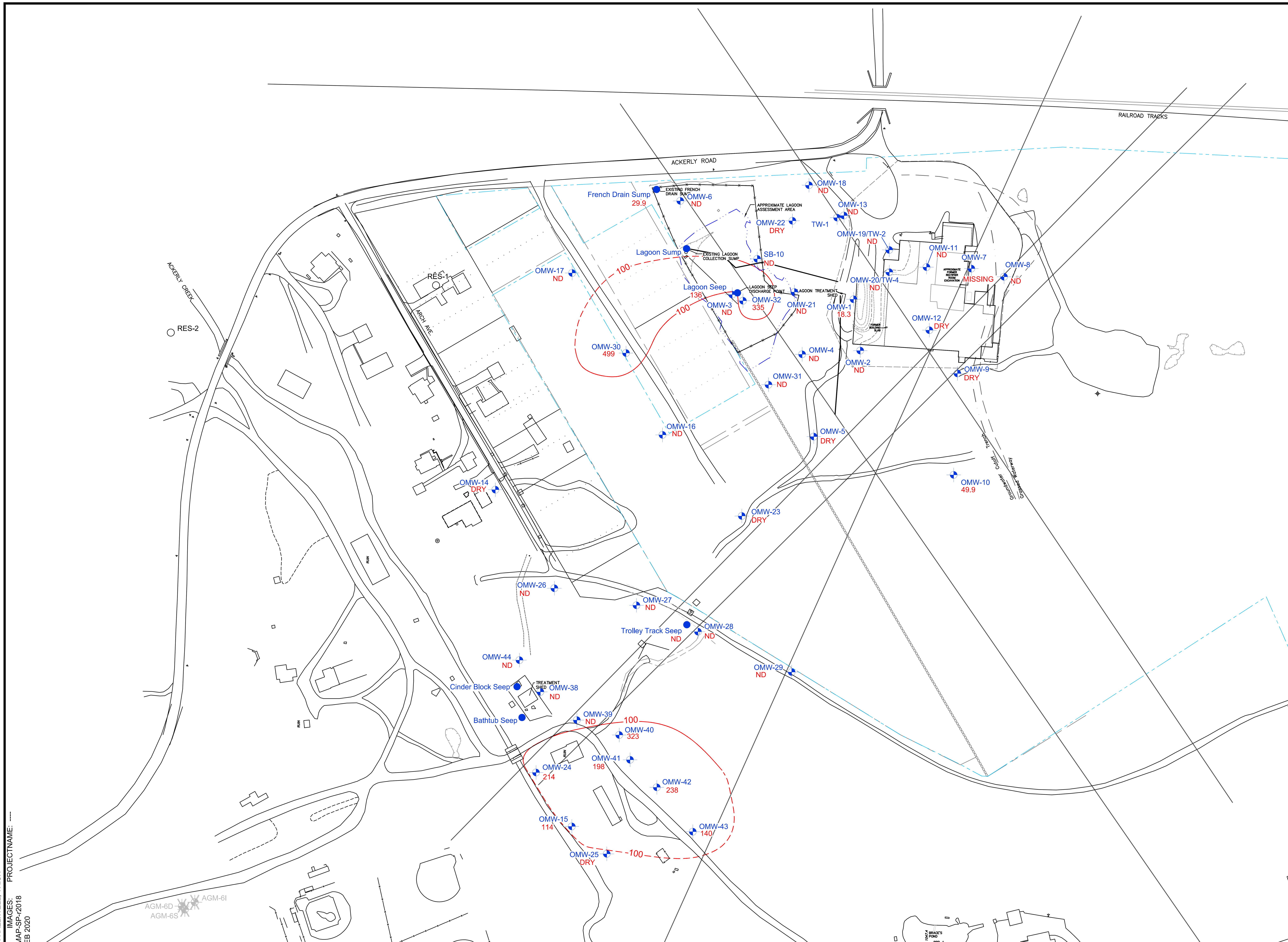
XREFS: IMAGES: PROJECTNAME: ----
X-BASEMAP-SP-2018
X-TTL-FEB 2020



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- FRACTURE TRACE (FROM R.E. WRIGHT, 1978)
- OVERBURDEN MONITORING WELL
- FORMER/ABANDONED MONITORING WELL
- SEEP
- RES-1 ○ RESIDENTIAL POTABLE WELL
- 29.9 HEXAVALENT CHROMIUM CONCENTRATIONS
- MISSING UNABLE TO LOCATE WELL OMW-7
- ND NON DETECT
- DRY WELL WAS DRY AT TIME OF SAMPLING
- 100 HEXAVALENT CHROMIUM ISOPLETH (DASHED WHERE INFERRED)

NOTES:

1. MONITORING WELLS MW-AS/AD, MW-BS/BD, MW-3S/3D, MW-9IA/9D, MW-B01S/B01D, MW-26, MW-27, MW-28, MW-31, MW-32 & MW-33 ARE NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)
2. MW-C AND MW-22 ARE CONVERTED WELLS, NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)
3. WELL LOCATIONS FROM DPK SURVEYING.
4. MAP DATUM: PENNSYLVANIA STATE PLANE, NORTH, NAD83, FEET.

Graphic Scale: 0 — 100' — 200'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr. LGB
Designed by LGB	Drawn by TPH	Checked by SWI

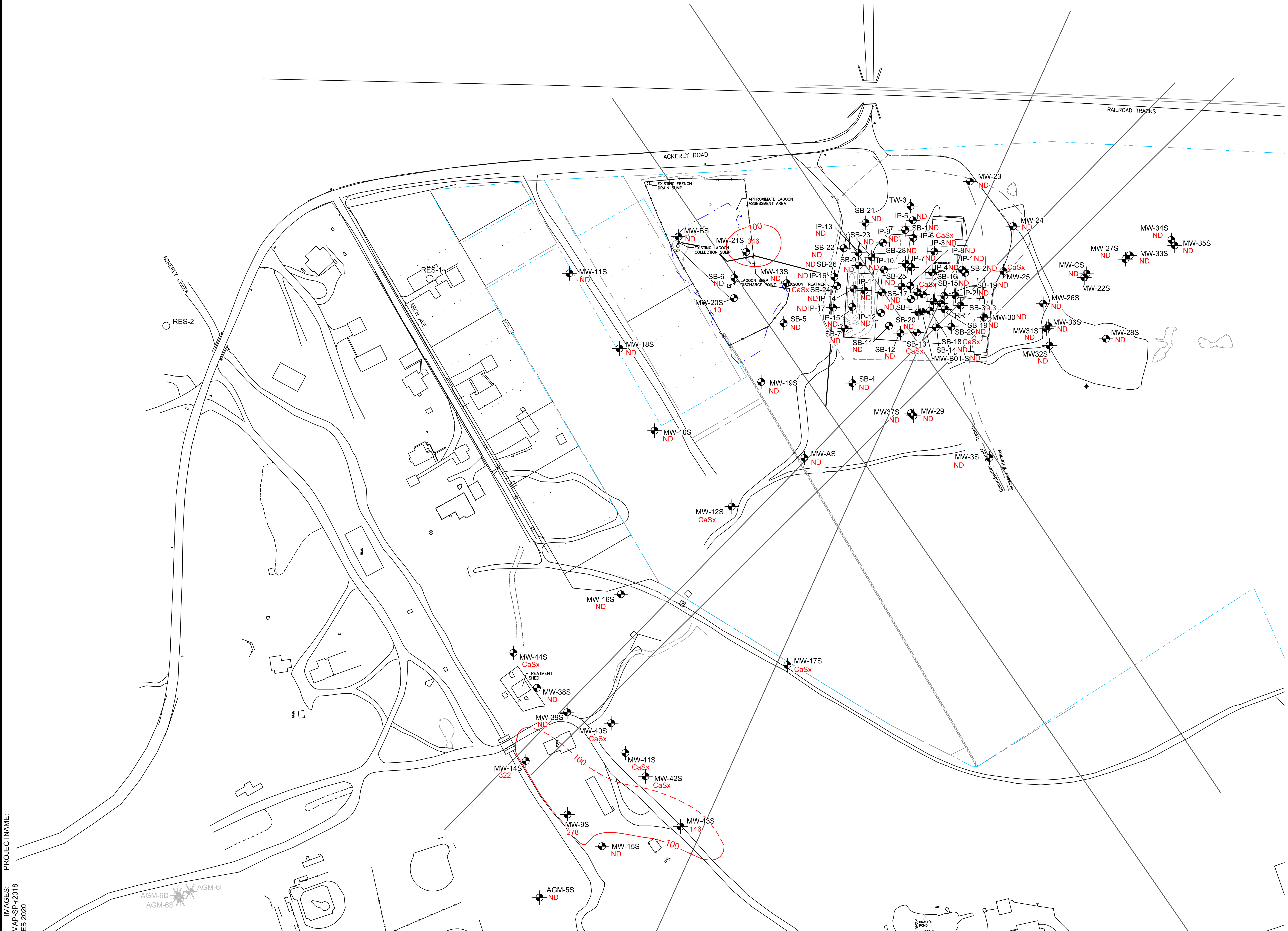
ARCADIS Design & Consultancy for natural and built assets
ARCADIS U.S., INC.
NEW JERSEY ENGINEERING CERTIFICATE OF AUTHORIZATION NUMBER 24GA27939600

PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

APRIL 2020 HEXAVALENT CHROMIUM OVERBURDEN GROUNDWATER ISOPLETHS

ARCADIS Project No. 30003895
Date FEBRUARY 2020
ARCADIS
1 HARVARD WAY, SUITE 5
HILLSBOROUGH, NJ 08844
TEL. 908.685.7845

6



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- FRACTURE TRACE (FROM R.E. WRIGHT, 1978)
- SHALLOW BEDROCK MONITORING WELL
- FORMER/ABANDONED MONITORING WELL
- RES-1 ○ RESIDENTIAL POTABLE WELL
- 16.9 HEXAVALENT CHROMIUM CONCENTRATIONS
- CaSx CALCIUM POLYSULFIDE
- ND NON DETECT
- J ESTIMATED VALUE
- 100 HEXAVALENT CHROMIUM ISOPLETH (DASHED WHERE INFERRED)

NOTES:

1. MONITORING WELLS MW-AS/AD, MW-BS/BD, MW-3S/3D, MW-9IA/9D, MW-B01S/B01D, MW-26, MW-27, MW-28, MW-31, MW-32 & MW-33 ARE NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)

2. MW-C AND MW-22 ARE CONVERTED WELLS, NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)

3. WELL LOCATIONS FROM DPK SURVEYING.

4. MAP DATUM: PENNSYLVANIA STATE PLANE, NORTH, NAD83, FEET.

CITY: MANCHESTER CT DIV/GROUP: ENVCAD DB: T.HALLIWELL PM: L.BRUNT TM: L.BRUNT
PLOTSTYLETABLE: THERMORETEC STANDARD.CTB

XREFS: X-BASEMAP-SP-2018 X-TTL-FEB 2020 IMAGES: PROJECTNAME: ----

0 100' 200'
Graphic Scale

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REPRODUCED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr. LGB
Designed by LGB	Drawn by TPH	Checked by SWI

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.
NEW JERSEY ENGINEERING CERTIFICATE OF AUTHORIZATION NUMBER 24GA27939600

PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

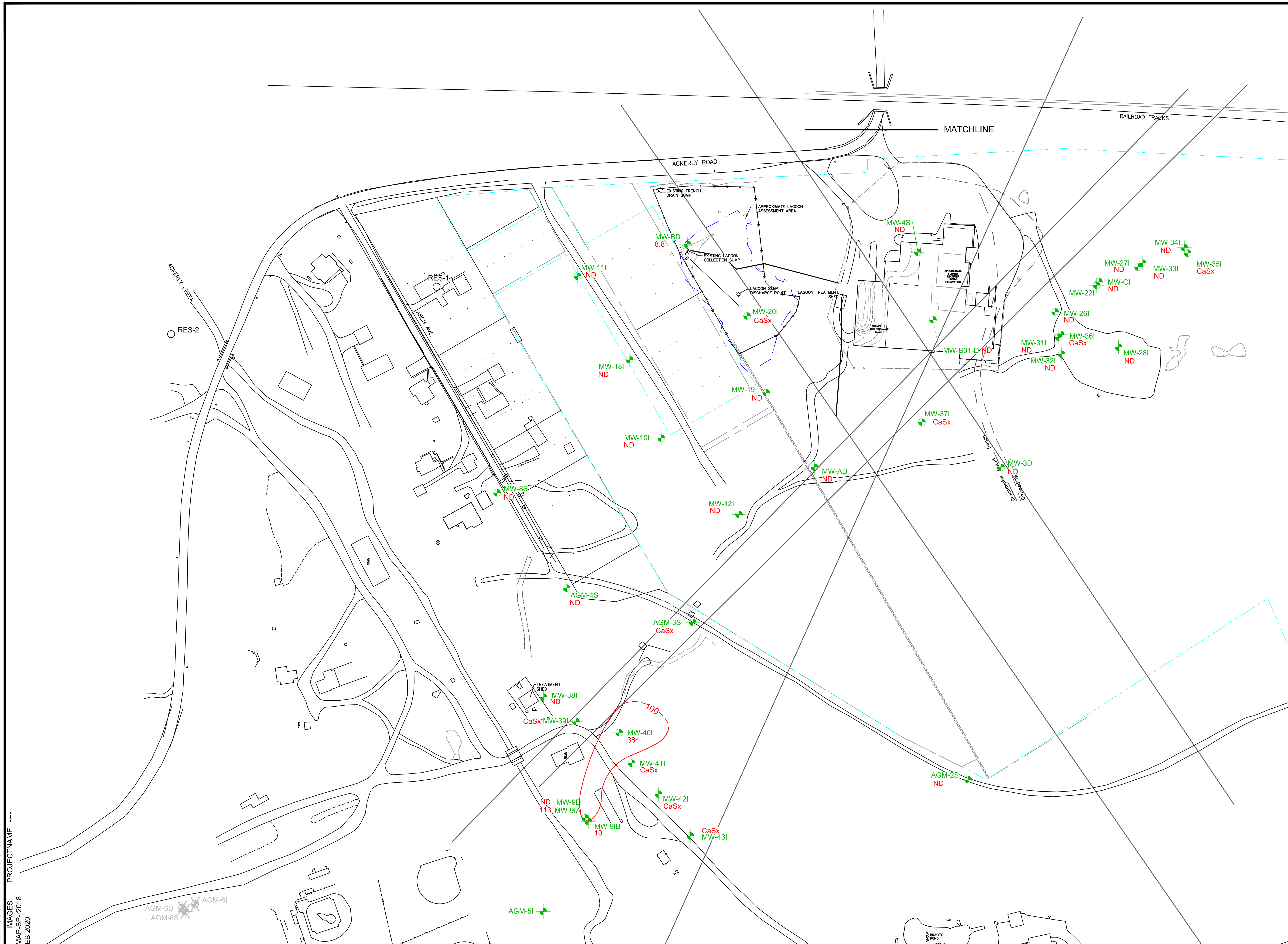
APRIL 2020 HEXAVALENT CHROMIUM SHALLOW BEDROCK GROUNDWATER ISOPLETHS

ARCADIS Project No. 30003895

Date FEBRUARY 2020

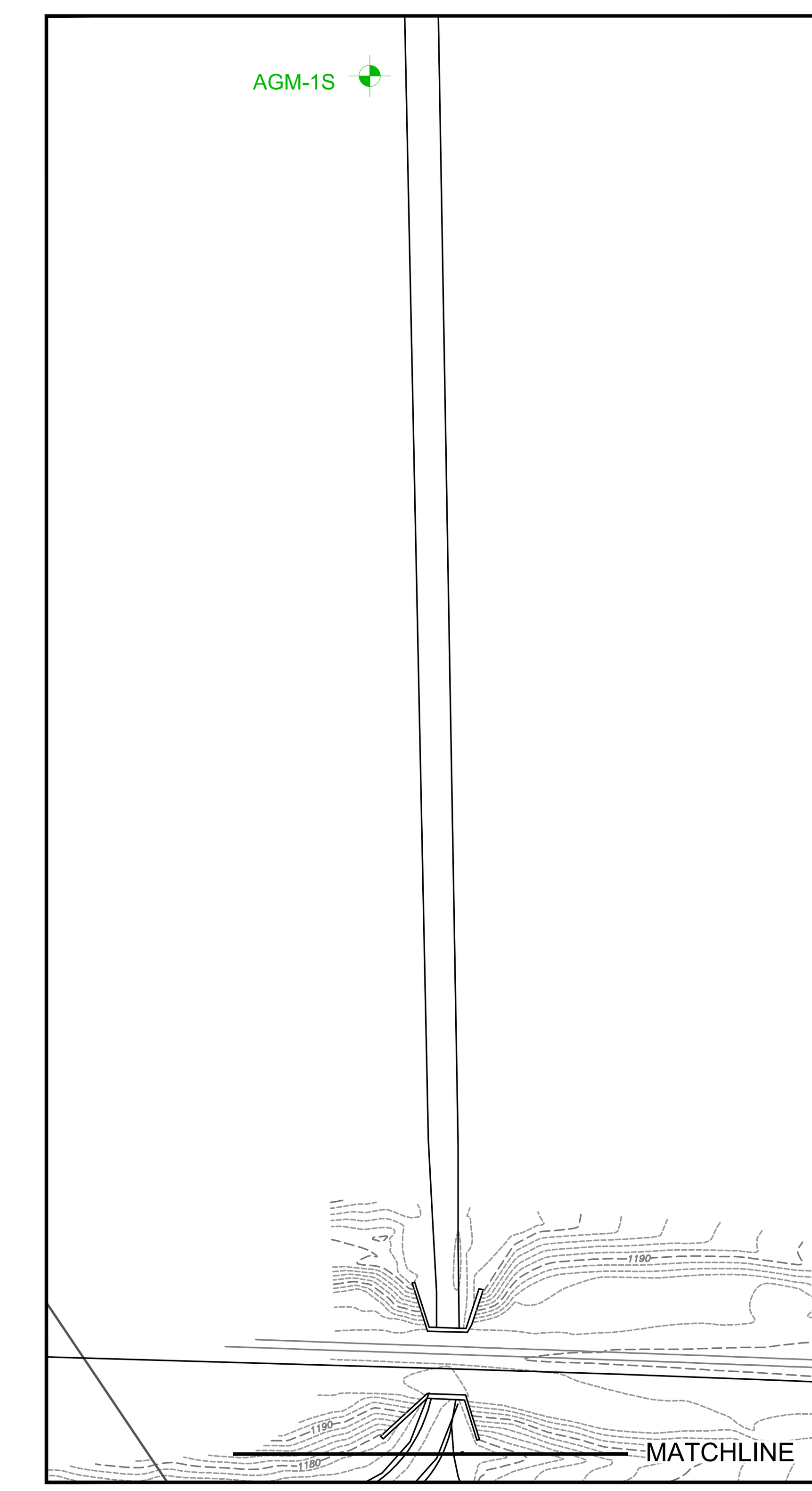
ARCADIS
1 HARVARD WAY, SUITE 5
HILLSBOROUGH, NJ 08844
TEL. 908.685.7845

7



LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- FRACTURE TRACE (FROM R.E. WRIGHT, 1978)
- INTERMEDIATE BEDROCK MONITORING WELL
- FORMER/ABANDONED MONITORING WELL
- RES-1 ○ RESIDENTIAL POTABLE WELL
- 8.8 HEXAVALENT CHROMIUM CONCENTRATIONS
- CaSx CALCIUM POLYSULFIDE
- ND NON DETECT
- 100 HEXAVALENT CHROMIUM ISOPLETH (DASHED WHERE INFERRED)



NOTES:

1. MONITORING WELLS MW-AS/AD, MW-BS/BD, MW-3S/3D, MW-9IA/9D, MW-B01S/B01D, MW-26, MW-27, MW-28, MW-31, MW-32 & MW-33 ARE NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)
2. MW-C AND MW-22 ARE CONVERTED WELLS, NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)
3. WELL LOCATIONS FROM DPK SURVEYING.
4. MAP DATUM: PENNSYLVANIA STATE PLANE, NORTH, NAD83, FEET.

CITY: MANCHESTER CT DIV/GROUP: ENVCAD DB: T.HALLIWELL PM: L.BRUNT TM: L.BRUNT
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XREFS: IMAGES: PROJECTNAME: ----
X-BASEMAP-SP-2018
X-TTL-FEB 2020

0 100' 200'
Graphic Scale

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr. LGB
Designed by LGB	Drawn by TPH	Checked by SWI

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.
NEW JERSEY ENGINEERING CERTIFICATE OF AUTHORIZATION NUMBER 24GA27939600

PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

APRIL 2020 HEXAVALENT CHROMIUM INTERMEDIATE BEDROCK GROUNDWATER ISOPLETHS

ARCADIS Project No. 30003895

Date APRIL 2020

ARCADIS
1 HARVARD WAY, SUITE 5
HILLSBOROUGH, NJ 08844
TEL. 908.685.7845

8

CITY: MANCHESTER CT DIV/GROUP: ENVCAD DB: T.HALLIWELL PM: L.BRUNT TM: L.BRUNT
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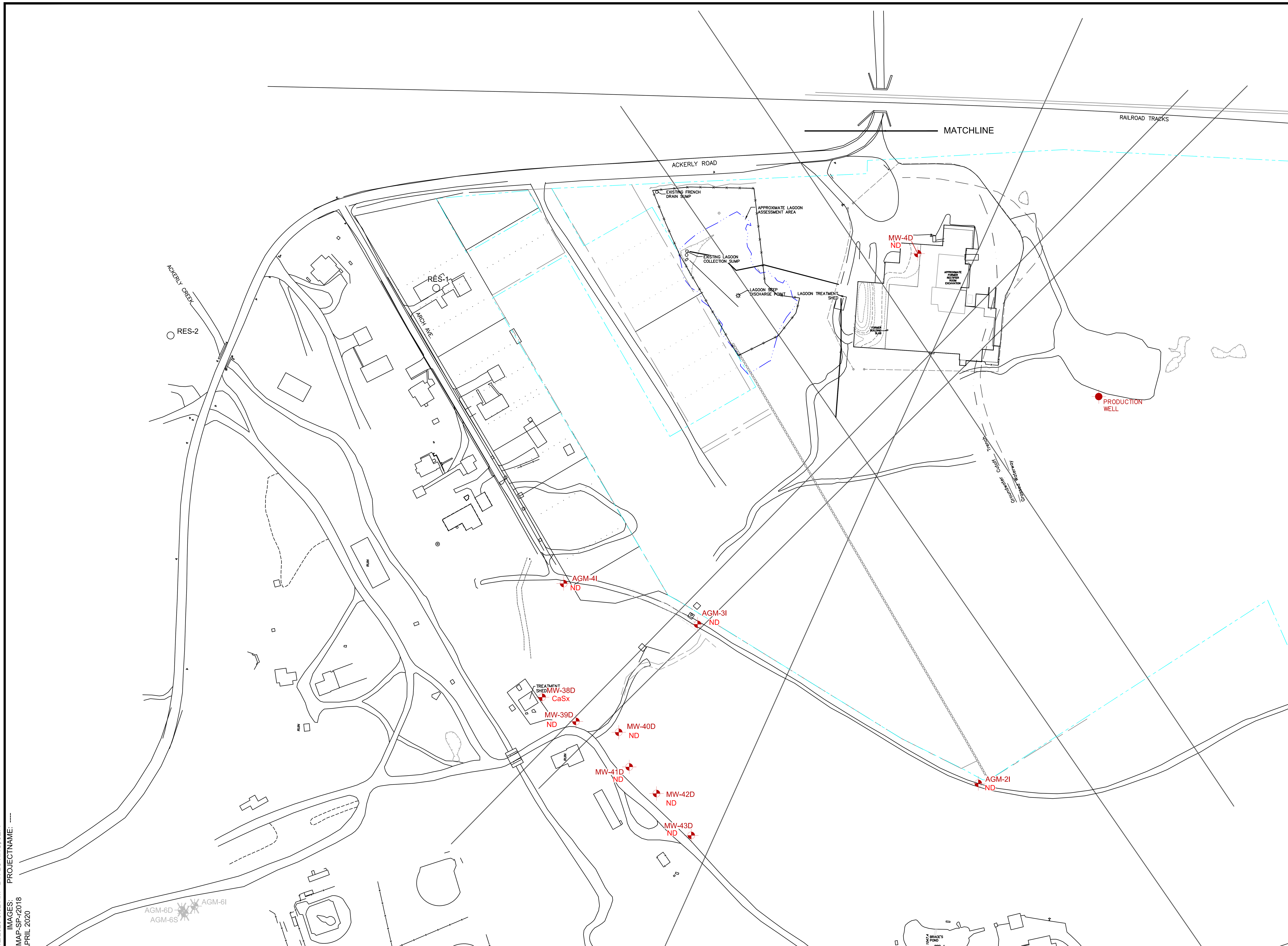
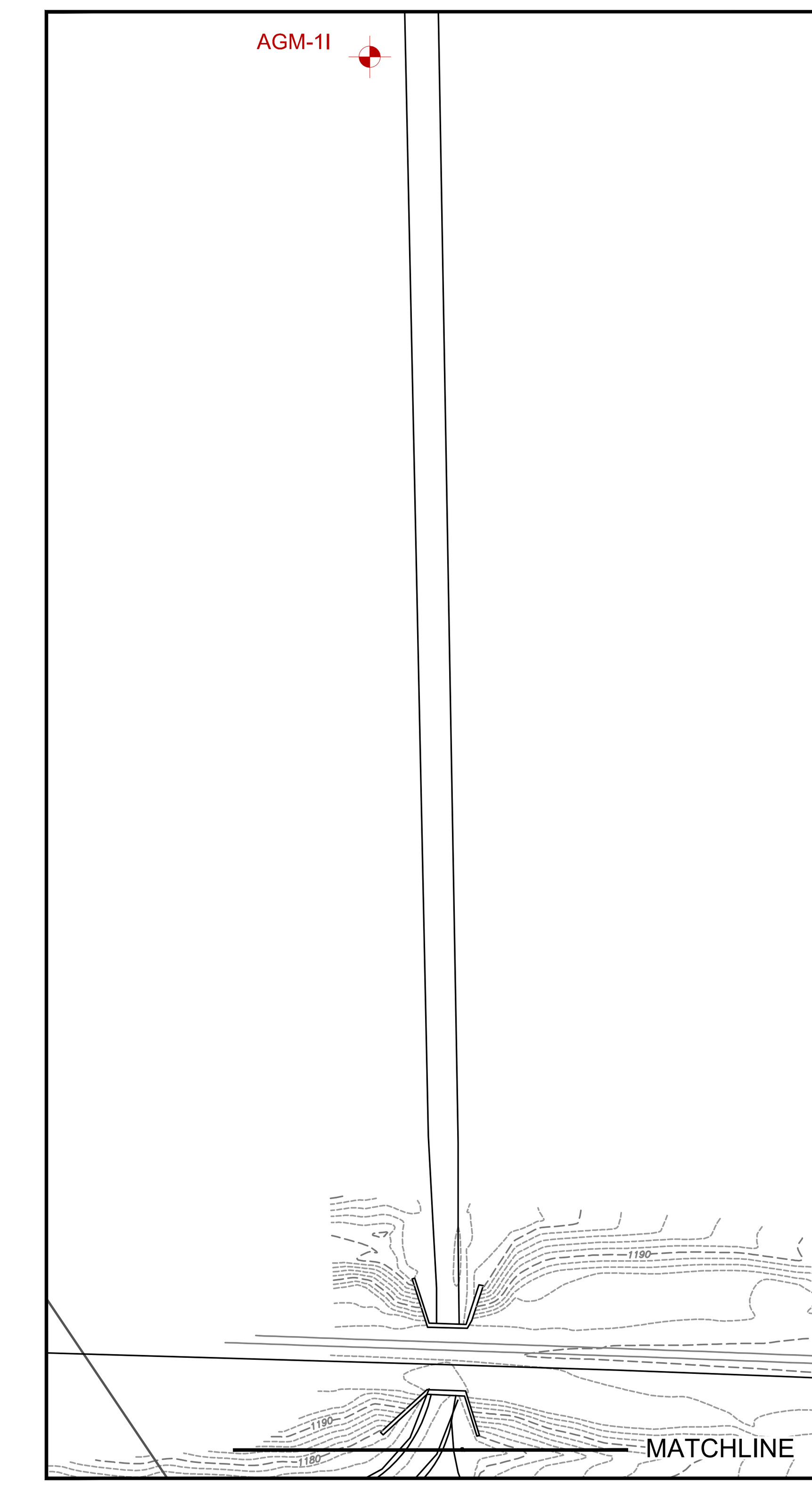


LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- PATH/TRAIL
- FENCE
- GROUNDWATER INTERCEPTOR TRENCH
- FRACTURE TRACE (FROM R.E. WRIGHT, 1978)
- DEEP BEDROCK MONITORING WELL
- FORMER/ABANDONED MONITORING WELL
- RES-1 RESIDENTIAL POTABLE WELL
- CaSx CALCIUM POLYSULFIDE
- ND NON DETECT



NOTES:

1. MONITORING WELLS MW-AS/AD, MW-BS/BD, MW-3S/3D, MW-9IA/9D, MW-B01S/B01D, MW-26, MW-27, MW-28, MW-31, MW-32 & MW-33 ARE NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)

2. MW-C AND MW-22 ARE CONVERTED WELLS, NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)

3. WELL LOCATIONS FROM DPK SURVEYING.

4. MAP DATUM: PENNSYLVANIA STATE PLANE, NORTH, NAD83, FEET.

Graphic Scale: 0 — 100' — 200'

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Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr. LGB
Designed by LGB	Drawn by TPH	Checked by SWI

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.
NEW JERSEY ENGINEERING CERTIFICATE OF AUTHORIZATION NUMBER 24GA27939600

PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

APRIL 2020 HEXAVALENT CHROMIUM DEEP BEDROCK GROUNDWATER ISOPLETHS

ARCADIS Project No. 30003895

Date APRIL 2020

ARCADIS
1 HARVARD WAY, SUITE 5
HILLSBOROUGH, NJ 08844
TEL. 908.685.7845

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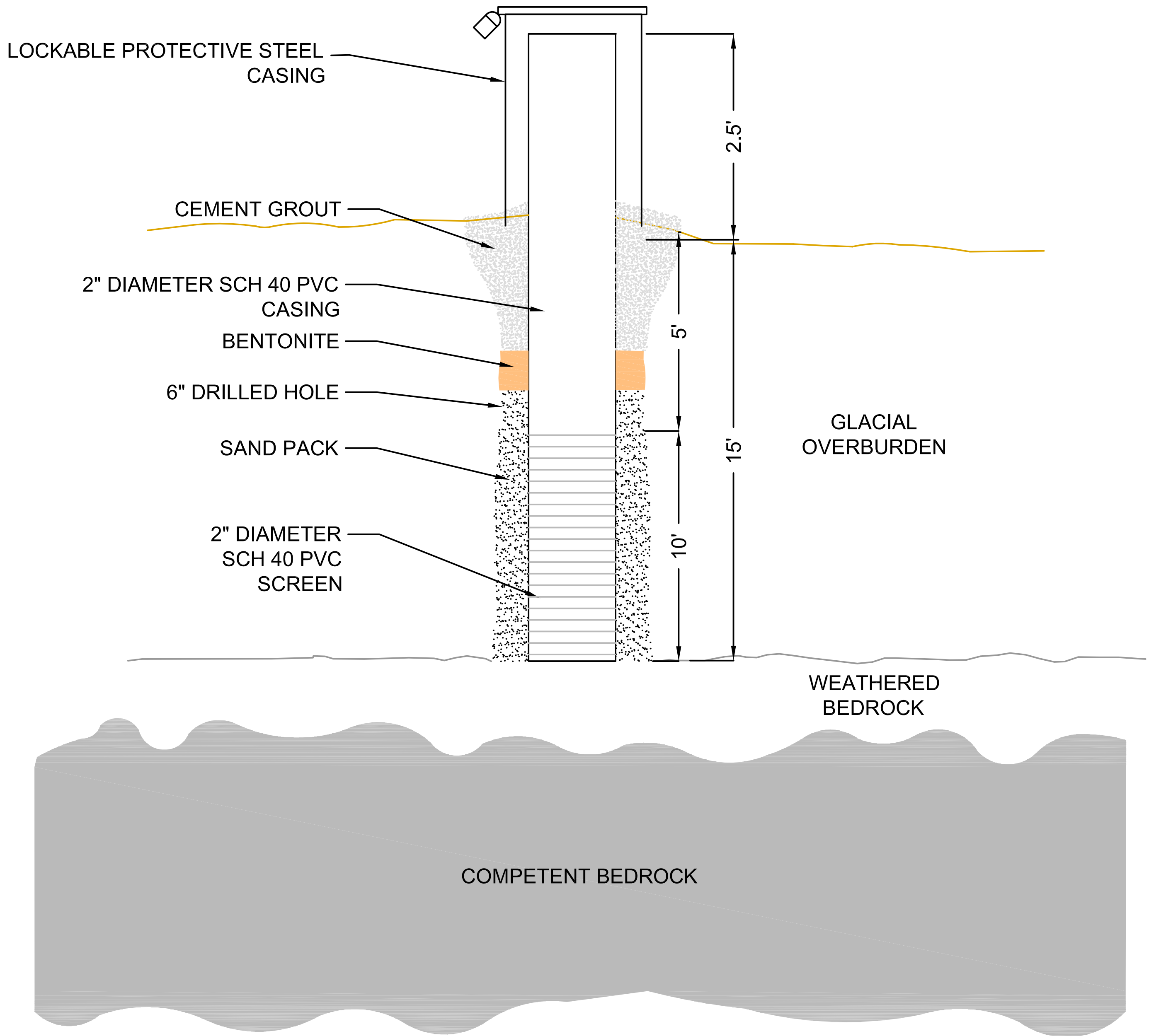

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PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA
RESPONSE ACTION PLAN

TYPICAL OVERBURDEN WELL CONSTRUCTION

ARCADIS Project No.
BB014215.0005.00011

Date
05/25/2012

ARCADIS
35 COLUMBIA ROAD
BRANCHBURG, NEW JERSEY
TEL. 908.526.1000

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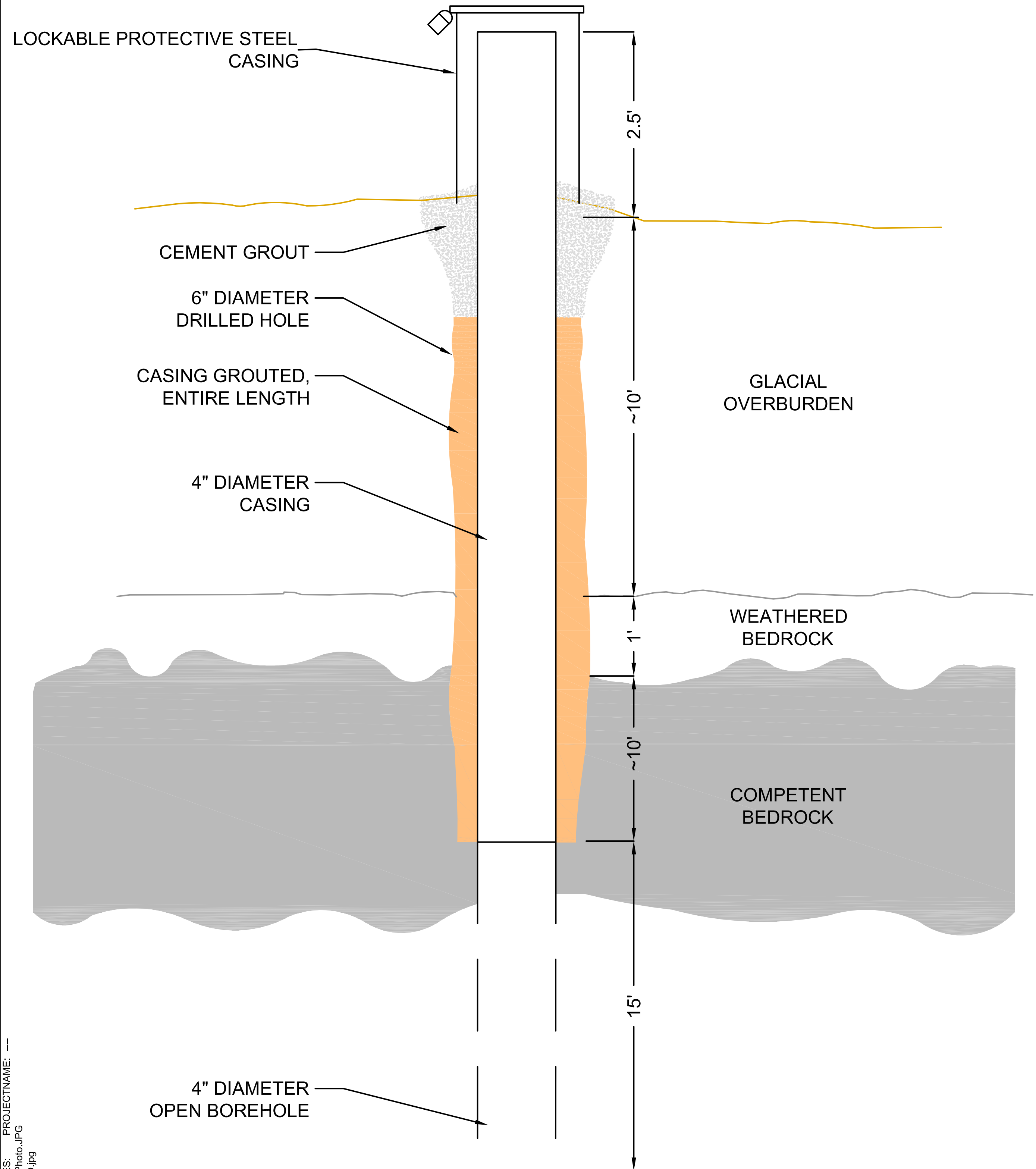

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ARCADIS U.S., INC.

PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

RESPONSE ACTION PLAN

TYPICAL SHALLOW BEDROCK WELL CONSTRUCTION

ARCADIS Project No.
BB014215.0005.00011

Date
05/25/2012

ARCADIS
35 COLUMBIA ROAD
BRANCHBURG, NEW JERSEY
TEL. 908.526.1000

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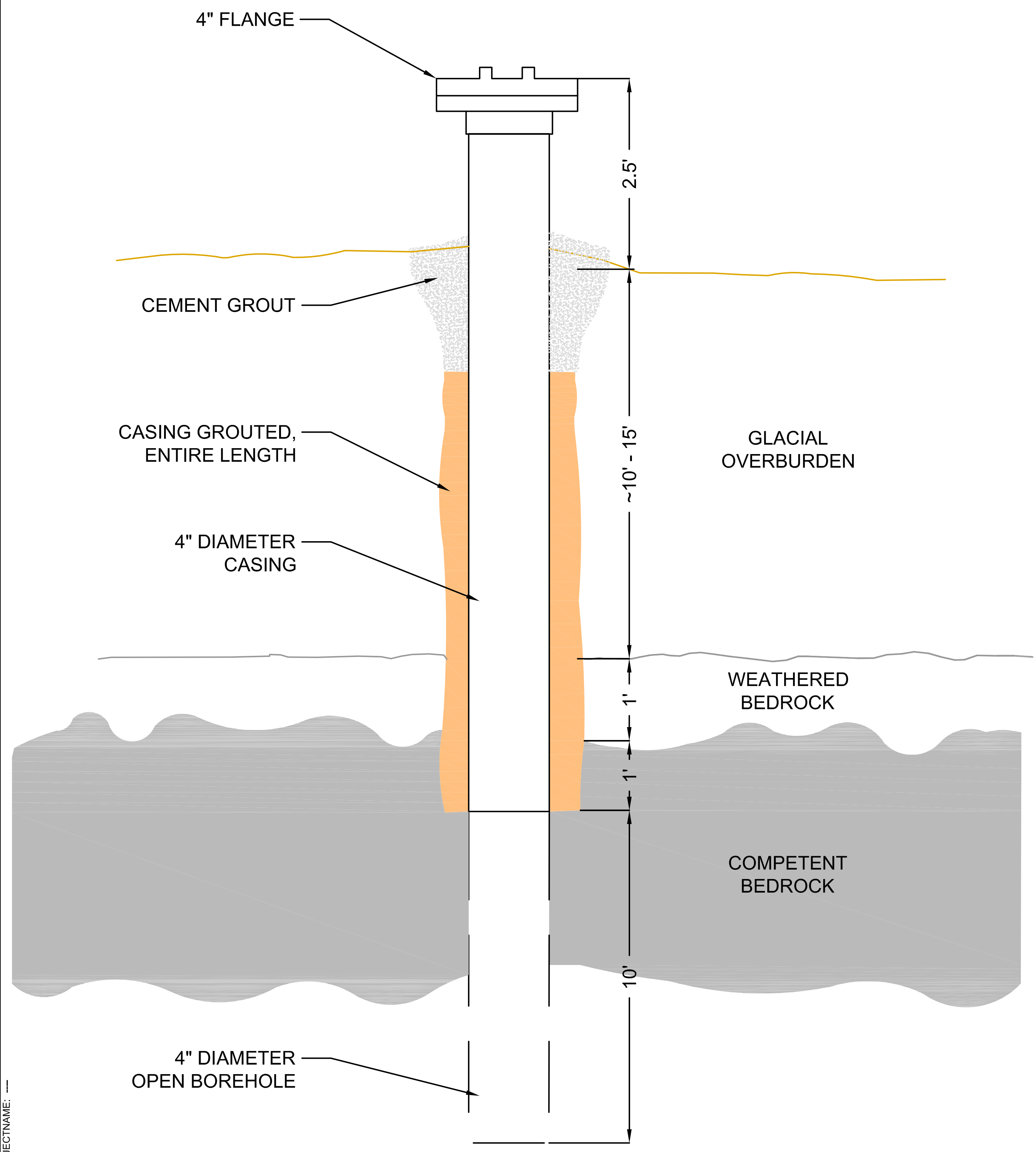

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ARCADIS U.S., INC.

PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

RESPONSE ACTION PLAN

TYPICAL INJECTION WELL CONSTRUCTION

ARCADIS Project No.
BB014215.0005.00011

Date
05/25/2012

ARCADIS
35 COLUMBIA ROAD
BRANCHBURG, NEW JERSEY
TEL. 908.526.1000

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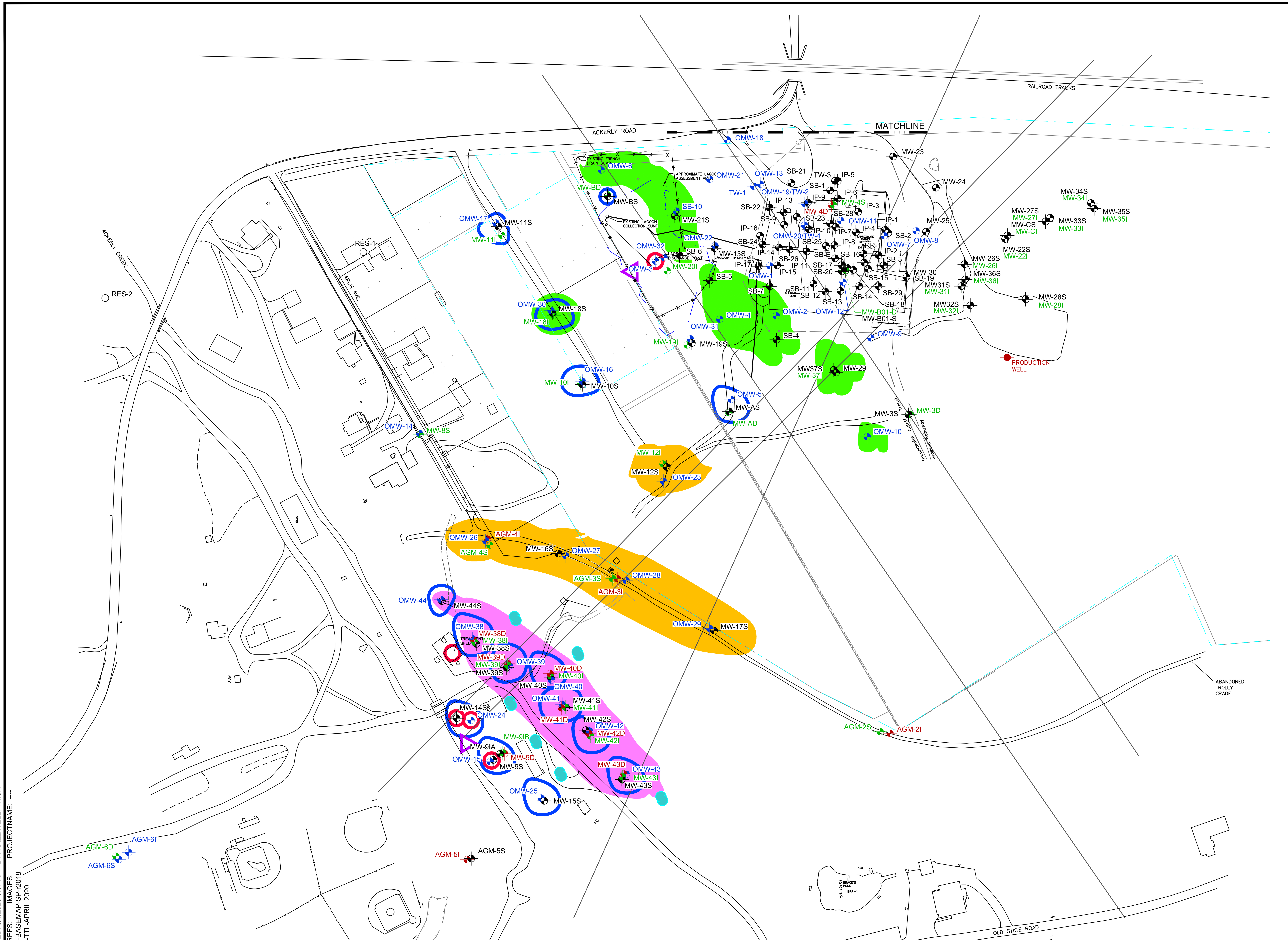

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- DEEP BEDROCK MONITORING WELL
- INTERMEDIATE BEDROCK MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- OVERBURDEN MONITORING WELL
- PROPOSED INJECTION LOCATION - PHASE 1
- PROPOSED INJECTION LOCATION - PHASE 2
- PROPOSED INJECTION LOCATION - PHASE 3
- PROPOSED YSI MONITORING LOCATION
- PROPOSED JEROME MONITORING LOCATION
- PROPOSED GROUNDWATER FIELD MONITORING LOCATION
- POTENTIAL SUPPLEMENTAL OVERBURDEN AND SHALLOW BEDROCK WELL LOCATIONS

NOTES:

1. MONITORING WELLS MW-26, MW-27, MW-28, MW-31, MW-32 & MW-33 ARE NESTED BEDROCK WELLS WITH TWO PVC WELLS IN EACH BORE HOLE (SHALLOW AND INTERMEDIATE BEDROCK)

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Professional Engineer's Name		
Professional Engineer's No.		
State	Date Signed	Project Mgr. LGB
Designed by LGB	Drawn by TPH	Checked by SWI

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.
NEW JERSEY ENGINEERING CERTIFICATE OF AUTHORIZATION NUMBER 24GA27939600

PRECISION NATIONAL PLATING SERVICES, INC. • 198 ACKERLY ROAD, CLARKS SUMMIT, PENNSYLVANIA

PROPOSED INJECTION AND MONITORING LOCATIONS

ARCADIS Project No.
30003895

Date
APRIL 2020

ARCADIS
1 HARVARD WAY, SUITE 5
HILLSBOROUGH, NJ 08844
TEL. 908.685.7845

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APPENDIX A

Underground Injection Control Information

Underground Injection Control Information	
Site Name	**Precision National Plating Services, Inc. Site**
Site Address	198 Ackerly Road Clarks Summit, Pennsylvania 18411
Site Owner/Site Contact	Precision National Plating Services, Inc. P.O. Box 8588 Tarrytown, NY 10591-8588 Local Contact: Kevin Quinn, Esq. Hourigan Kluger and Quinn, P.C. 600 Third Ave. Kingston, PA 570-287-3000
Regulatory Authority	2012 Administrative Settlement Agreement and Order on Consent for Removal Response Action under the CERCLA Removal Authority and subsequent requirements from the United States Environmental Protection Agency (USEPA) to mitigate hexavalent chromium discharges to Ackerly Creek.
Regulatory Contact	Ann L. DiDonato On-Scene Coordinator Eastern Response Branch USEPA Region III 1650 Arch St. (3HS31) Philadelphia, PA 19103-2029 Office: 215-814-3311 Cell: 215-287-8157
PADEP Contact/Regional Office	Donald G. Rood Licensed Professional Geologist PADEP-Northeastern Pennsylvania Office Two Public Square Wilkes Barre, PA 18701-1915 570-826-5449
Number and Location of Well Points (including Latitude and Longitude)	Approximately 90 monitoring/injection wells have been installed at the site and surrounding areas for the proposed injection activities. The locations of existing wells/injection points and proposed wells are shown on Figure 13 of the 2020 Work Plan.

Underground Injection Control Information

Site Name	Precision National Plating Services, Inc. Site
	The site is located in Waverly Township (formerly Abington Township), Lackawanna County, Pennsylvania at the following coordinates: Latitude 41° 30' 49.31"N, Longitude 75° 42' 56.54"W
Site Contaminants/Extent of Contamination	The groundwater in the overburden and shallow bedrock beneath the Site is impacted by hexavalent chromium. The extent of the hexavalent chromium source areas are shown on Figures 6 through 9 of the 2020 Work Plan.
Remediation Materials	The impacted groundwater in the overburden and shallow bedrock will be treated in situ with 29% calcium polysulfide (CaSx) diluted to a 1%-5% solution.
Method of Introduction	The calcium polysulfide will be pumped into the well points using an injection system. The 29% CaSx feedstock will be stored in totes. The CaSx feedstock will be mixed with water in two 2,500-gallon polyethylene day tanks to create the desired injection concentrations. The injection system is designed to pump the mixture into the impacted areas under pressure. The system will inject the CaSx solution in up to 10 wells at the same time at pressures up to 60 psi.
Drinking Water Wells within ¼ mile of the Contaminated Area	Under the direction of the USEPA, Precision sampled all residential wells within a mile of the site in 1999 and has been conducting an ongoing ground water monitoring program that consists of routine sampling of 34 bedrock monitoring and two residential wells within ¼ mile of the site. Neither of these sampling programs has identified any chromium impacts in either the drinking water wells or the deeper bedrock monitoring wells. The monitoring programs will continue throughout and after the injection activities. The CaSx injection will occur in the overburden and shallow bedrock ground water. Based on the fact that there has been no chromium impacts in the deep bedrock/drinking water aquifer, it is extremely unlikely that there will be any CaSx impacts to the deep bedrock aquifer or to nearby wells. In addition, previous injection activities had no adverse effects on the bedrock/drinking water aquifer.

APPENDIX B

Quality Assurance/Quality Control Monitoring and Sampling Plan

Imagine the result

Precision National Plating Services, Inc.

Quality Assurance Project Plan and Field Sampling Plan

Precision National Plating Services, Inc.
198 Ackerly Road
Clarks Summit, Pennsylvania 18411

July 30, 2012

ARCADIS

Quality Assurance Project Plan and Field Sampling Plan

Precision National Plating Services, Inc.
198 Ackerly Road
Clarks Summit, Pennsylvania 18411

Prepared for:

Precision National Plating Services, Inc.
120 White Plains Road
Tarrytown, New York 10591

Prepared by:

ARCADIS U.S., Inc.
35 Columbia Road
Branchburg, New Jersey 08876
Tel 908 526 1000
Fax 908 526 7886

Our Ref.:

BB014215.0005.00011

Date:

July 30, 2012

Table of Contents

1. Introduction

ARCADIS U.S., Inc. (ARCADIS) has prepared this Quality Assurance Project Plan and Field Sampling Plan (QAPP/FSP) on behalf of Precision National Plating Services, Inc. (Precision) for the implementation of the 2012 Response Action Plan (RAP). The RAP was prepared and submitted to the United States Environmental Protection Agency (EPA) by Precision as Respondent to Docket No. CERC-03-2012-0031DC for the former Precision facility located at 198 Ackerly Road in Clarks Summit, Lackawanna County, Pennsylvania (the Site). The Response Action will be performed in accordance with the 2012 Administrative Settlement Agreement and Order on Consent for Removal Response Action (Settlement Agreement) entered by EPA and Precision. The Settlement Agreement was executed to address chromium contamination at the Site.

Based on the Findings of Fact and Conclusions of Law presented in the Settlement Agreement, EPA determined that an actual and/or threatened release of hazardous substances from the Site may present an imminent and substantial endangerment to the public health or welfare or the environment. Therefore, the Work outlined in the Settlement Agreement is necessary to protect the public health and welfare and the environment. Because there is a threat to public health or welfare or the environment, EPA determined that a removal action is appropriate to abate, minimize, stabilize, mitigate or eliminate the release or threat of release of hazardous substances at or from the Site. The general objectives of the work conducted pursuant to the Settlement Agreement are to conduct a removal action, as defined in Section 101(23) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601(23), to abate, mitigate and/or eliminate the release or threat of release of hazardous substances at the Site by preventing the migration of hazardous substances from the Site through the treatment of contaminated groundwater. The activities described in the RAP to meet these objectives include the installation of overburden, shallow bedrock, and intermediate bedrock monitoring wells, sampling of monitoring wells, residential wells, and surface water locations, in situ chemical reduction by injection of calcium polysulfide, operation and monitoring of two on-Site seep collection and treatment systems, and the evaluation and implementation of institutional controls to limit the use of groundwater within the contaminated plume.

All work to be performed at the Site will be consistent with the National Oil and Hazardous Substances Pollution Contingency Plan, as amended (NCP), 40 C.F.R. Part 300 and the CERCLA.

2. General Field Procedures

2.1 Field Documentation

Field activities will be documented in a Site log book and on appropriate field data forms. The collection and handling of all samples will be carefully recorded on appropriate chain of custody forms to document the integrity of each sample from the time the sampling personnel enter the Site through sample collection and shipment to the laboratory. Field forms that will be used for record-keeping at the Precision Site include, but are not limited to:

- Daily Tailgate Meeting Forms/Sign-in Logs
- Well Purge Forms
- Soil Boring/Well Construction Logs
- Field Sampling/Measurement Logs
- Chain of Custody Forms
- Air Monitoring Forms

2.1.1 Daily Tailgate Meeting Forms/Sign-in Logs

Daily tailgate meeting forms and sign-in logs will be used to document the personnel on-Site each day to conduct and/or oversee the Work outlined in the RAP. The daily tailgate meeting forms will also document the discussions of Site conditions, the work to be performed, health and safety protocols, any incidents that may occur, and any changes to the Site procedures or Health and Safety Plan (HSP). The forms will be maintained in a secure place on-Site along with the HSP.

2.1.2 Well Purge Forms

Well purge forms will be used to document all well sampling activities. In addition to general project information, the well purge forms will include the date and time of sampling, static water level in the well, well purge method and volume, field observations of the water and well conditions, water quality parameters recorded during well purging and sampling, results of any field analyses performed on the water sample, sampling method and materials used, and sampling personnel.

2.1.3 Soil Boring/Well Construction Logs

During the installation of soil borings or new wells, the field personnel will prepare a soil boring/well construction log for each boring/well location. In addition to general project information, the soil boring/well construction log will document the date of installation, method of drilling and well installation, total depth of drilling and depth at which bedrock is encountered, the date, time, and depth at which any samples are collected, first encountered and stabilized water levels in the boring/well, field observations, physical appearance of the soil and rock, results of any field analyses performed on the soil or water from the boring, sampling method and materials used, and boring/well installation and sampling personnel.

2.1.4 Field Sampling/Measurement Logs

For all other field sampling or monitoring where a purge form or soil boring/well construction log is not applicable, including daily monitoring during in situ chemical reduction activities and routine monitoring of the on-Site treatment systems, a field sampling or measurement log will be completed. The field sampling or measurement log will document the date and time of sampling or measurement, sampling method and materials used, the static water level in the boring/well if applicable, field observations, physical appearance of the samples, results of any field analyses performed on the soil or water samples, and sampling personnel.

2.1.5 Chain of Custody Forms

All samples collected at the Precision Site for laboratory analysis will be documented using proper chain of custody procedures. Sample labels will be completed by field sampling personnel and will be affixed to sample containers at the time of sampling. The sample labels and chain of custody forms will document the Site name, sample identification, the date and time of sampling, any sample preservatives, the required analyses to be performed on the soil or water sample, and sampling personnel. The chain of custody form will be completed in the field before the sampling team leaves the Site.

The sampling personnel will be responsible for maintaining custody of the samples until they are delivered to the carrier or the laboratory. The chain of custody form will then be signed by the field personnel and custody formally relinquished to the carrier or the laboratory. Samples will be kept in a secure location with access restricted to authorized personnel.

2.2 Health and Safety

All Site activities will be conducted according to the Site-specific Health and Safety Plan (HSP) that was prepared in 2006 and updated in March 29, 2007 and September 16, 2011 in order to meet the requirements of the Occupational Health and Safety Act (OSHA) CFR 1910.120. The HSP will be kept on-Site in the Lagoon Treatment System shed. The HSP will be updated as necessary to reflect changes in Site conditions, new activities to be performed, or new procedures to improve health and safety performance. All personnel working at the Site will be required to read and understand the requirements of the HSP. The appropriate personal protective equipment required for all Site activities is presented in the HSP. At a minimum, for all sampling and decontamination activities, Site personnel will wear steel-toed boots, gloves and safety glasses.

2.3 Sample Collection and Preservation

2.3.1 Sampling Equipment

All sampling equipment will be made of sturdy materials that will be thoroughly cleaned and decontaminated prior to use at the Site and after use at each sampling location. All reusable equipment that comes in contact with sample media will be decontaminated by scrubbing with a laboratory-grade detergent and water, thoroughly rinsing with tap water, and thoroughly rinsing with distilled/deionized water. Submersible pumps will be submerged and run for a short period of time in the laboratory-grade detergent and then in clean tap water to ensure internal decontamination. If field instruments come in contact with the sample media, they will be decontaminated by wiping off excess soil, water, or sediment with a clean paper towel and then rinsing with distilled/deionized water. For sampling equipment that cannot be easily or thoroughly decontaminated, such as polyethylene tubing and bailers, disposable, dedicated equipment will be selected for single use at each sampling location.

2.3.2 Sample Containers and Preservation

Prior to implementation of the field sampling program, the laboratory will be contacted to verify sample handling and preservation requirements. Samples will be collected in laboratory-supplied, clean sample containers of appropriate material and volume for the desired analyses. Soil samples will be collected in unpreserved, glass jars with Teflon-lined lids. Water samples for hexavalent chromium or sulfate analysis will be collected in unpreserved plastic bottles of at least 250 milliliter (mL) volume. Water samples for total chromium or other metals analysis will be collected in 500-mL plastic bottles with sufficient nitric acid (HNO3) preservative to reduce the pH of the sample to less than 2 standard pH units. Water samples for sulfide analysis will be collected in 500-mL plastic bottles preserved with sodium hydroxide and zinc acetate.

All samples will be preserved at approximately 4° Celsius in a sealed cooler during transport to the laboratory for analysis. Ice or other frozen media that cannot impact the samples will be used to keep the samples cold during shipping. The specific type of sample preservation will be recorded on the chain of custody form, the sample labels, and field sampling documentation.

2.4 Field Analyses and Measurements

Measurements for temperature, pH, specific conductance, oxidation/reduction potential, and dissolved oxygen for groundwater samples will be made in the field at the time of purging and sampling. Measurements of pH and temperature will also be collected at the time of the monthly performance monitoring of the treatment systems. During the in situ injection activities, continuous measurements of pH, temperature, specific conductance, and oxidation/reduction potential will be collected from strategic monitoring locations at the Site to monitor the progress of the injections. The instruments used to collect the field analytical data will depend on the type of sampling or monitoring being completed. During well sampling, field analytical parameters will be measured using a multi-parameter water quality meter with a flow-through cell, such as a Horiba U-53 or similar model meter. The meter will be calibrated each morning prior to sampling according to the manufacturer's specifications. All field parameters will be recorded on a well purge form or other appropriate field data log. The continuous field parameter monitoring during the injection activities will be performed using a YSI 600xl or similar model probe. The probe will be calibrated according to manufacturer's specifications prior to deployment. Data from the continuous monitoring probes will be downloaded daily to an on-Site computer.

A hand-held pH, temperature, and conductivity meter will be used to collect field analytical parameters during the monthly treatment system sampling, surface water sampling, and monitoring of the on-Site seeps and water collection sumps. Approximately 250 mL of sample will be placed in a clean, unpreserved container, and then the probe will be inserted into the sample and gently swirled to allow the reading to stabilize before recording the measurement. Additional monitoring during injection activities or well installation may also include the use of disposable pH measurement strips.

Field analyses for hexavalent chromium in soil or water and sulfide in water may be performed as necessary on-Site using the appropriate Hach test kits with colorimetric methods. Field personnel will follow the manufacturer's instructions for performing field tests with these kits.

2.5 Disposal Procedures

All refuse generated at the Site will be disposed properly off-Site. All disposable sampling supplies will be collected and disposed properly off-Site. Drill cuttings and soil generated by soil boring/well installation activities will be used to backfill the boring locations or spread in the vicinity of the boring location. Purge water evacuated during the installation of new wells or sampling of monitoring wells will be collected and treated in the on-Site treatment systems before being discharged. Any wastewater or sludge generated by the in situ chemical reduction with calcium polysulfide will be containerized and disposed off-Site in accordance with Federal, State, and local regulations. The spent resins from the on-Site treatment systems will be shipped off-Site for regeneration or proper disposal in accordance with Federal, State, and local regulations.

3. Well Installation

To assess the residual chromium concentrations, evaluate potential contaminant pathways, and identify potential remedial actions, Precision is proposing additional investigation of the overburden, shallow bedrock and intermediate bedrock groundwater in the areas downgradient of the former building slab towards Ackerly Creek. Based on the existing data and the current Site conceptual model, Precision is proposing the installation of six shallow bedrock monitoring wells, four intermediate bedrock monitoring wells and six overburden monitoring wells. In addition, Precision is currently evaluating borehole geophysics information for the bedrock wells along the Trolley Tracks and will be proposing modifications to these wells in a separate work plan. The locations of the proposed wells are illustrated on Figure 9 of the RAP.

The depths of the wells, polyvinyl chloride (PVC) casing and open boreholes will be dependent on the observations made during the drilling activities including the depths at which major fractures are identified. Some of the boring locations also may be adjusted based on Site conditions, access constraints, and field observations identified during the performance of the investigation activities. The wells will be installed by a Pennsylvania-licensed well driller. Upon completion, the wells will be surveyed by a Pennsylvania-licensed land surveyor to determine their location and elevation.

All downhole equipment (e.g., submersible pumps) that will be used to develop or purge groundwater monitoring wells will be thoroughly cleaned before each use to prevent the possibility of cross-contamination between wells. The pump will be cleaned on the outside with a solution of laboratory grade glassware detergent and potable water, followed by a potable water rinse and distilled/deionized water rinse. The inside of the pump will be cleaned by pouring a detergent solution and potable water through the intake valve and draining the solution through the discharge valve, followed by a thorough rinsing with potable and distilled water.

3.1 Overburden Monitoring Wells

ARCADIS will contract with a Pennsylvania-licensed well driller to install the six proposed overburden wells. The wells will be installed by advancing a 6-inch diameter borehole to the top of competent bedrock using a drill rig equipped with a hollow-stem auger (HSA). Upon encountering bedrock refusal, the well will be constructed as a single-cased well with 2-inch diameter schedule 40 PVC casing with 0.020-slot PVC screen installed across the water table as encountered in each area. The PVC riser will extend above the screened interval to 2 to 3 feet above the ground surface. The six overburden wells will be finished such that they may be used as injection points during calcium polysulfide injection activities.

Based on previous drilling data from these portions of the Site, it is anticipated that bedrock will be encountered at depths of approximately 10 to 20 feet bgs. Therefore, the screened intervals are anticipated to range from 5 to 20 feet bgs. A sand pack will be installed around the well screen and the remaining annulus above the screen will be grouted with a cement/bentonite mixture to the surface. The well will be completed with a standard stick-up, lockable, protective monitoring well casing composed of steel. Following installation and development, the new wells will be sampled for hexavalent chromium and total chromium. The locations of the proposed wells are depicted on Figure 9 of the RAP. A diagram depicting the proposed well construction is provided as Figure 10 of the RAP.

3.2 Shallow Bedrock Monitoring Wells

The borings for the six proposed wells will be extended into the shallow bedrock approximately 1 to 3 feet using air rotary drilling techniques and a 4-inch schedule 40 PVC casing will be grouted into the bedrock to provide a seal from the overburden groundwater. The boring will then be extended as a 4-inch diameter open hole approximately 15 to 20 feet into the competent bedrock. It is anticipated that the wells will be installed to total depths of approximately 25 to 40 feet bgs. After completion, groundwater samples will be collected and analyzed for total and hexavalent chromium. The wells will be finished such that they can be used as injection points during calcium polysulfide injection activities.

Each shallow bedrock well will be completed to seal off the overburden groundwater such that if the well is selected for future injection activities, the seal will prevent the injection solution from short- circuiting and rising to the surface. To convert the wells into injection points, the wells will be fitted with PVC well head caps to allow for injection under pressure using the existing on-Site injection system. Diagrams depicting typical shallow bedrock well and injection point construction are provided as Figures 11 and 13 of the RAP, respectively.

3.3 Intermediate Bedrock Monitoring Wells

Based on access to the desired installation locations, the proposed intermediate bedrock monitoring wells will be installed in one of two manners. For the first option, the borings for the proposed wells will be extended into the intermediate bedrock approximately 85 feet using air rotary drilling techniques and a 4-inch schedule 40 PVC casing will be grouted into the bedrock to provide a seal from the overburden groundwater. The boring will then be extended as a 4-inch diameter open hole approximately 15 to 20 feet into the competent bedrock. Alternatively, the intermediate bedrock wells will be installed by drilling a 6-inch diameter borehole into the bedrock to a depth of approximately 100 feet. A 2-inch diameter PVC casing with 0.020-slot PVC well screen will be set into the borehole. The well screen will extend from approximately 85 to 100 feet bgs. The PVC riser will extend from the top of the well screen to approximately 2 to 3 feet above ground surface. A sand pack will be installed around the well screen and the remaining annulus above the screen will be grouted with a cement/bentonite mixture to the surface. The wells will be completed with a standard stick-up, lockable, protective monitoring well casing composed of steel.

It is anticipated that the wells will be installed to total depths of approximately 100 feet bgs. After completion, groundwater samples will be collected and analyzed for total and hexavalent chromium.

Each intermediate bedrock well will be completed to seal off the overburden groundwater such that if the well is selected for future injection activities, the seal will prevent the injection solution from short-circuiting and rising to the surface. To convert the wells into injection points, the wells will be fitted with PVC well head caps to allow for injection under pressure using the existing on-Site injection system. Diagrams depicting typical intermediate bedrock well and injection point construction are provided as Figures 12 and 13 of the RAP, respectively.

4. Water Sampling Procedures

4.1 Monitoring Well Sampling Methodology

Monitoring wells on and surrounding the Precision Site will be sampled semi-annually to evaluate hexavalent chromium and total chromium concentrations. The list of locations to be monitored will include wells in the overburden unconsolidated aquifer as well as the shallow, intermediate, and deep bedrock layers. The wells have been selected to monitor the distribution of hexavalent and total chromium concentrations across the Site and downgradient to the Creek. The wells will be monitored to determine if the requirements of the Settlement Agreement are being achieved. The locations, construction details, and depths of each well to be sampled are presented in Table 1 of the RAP. Sampling will be performed in accordance with the procedures outlined in this QAPP/FSP, which is based on the Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling prepared by U.S. EPA Region II dated March 26, 1998.

4.1.1 Sampling Procedure

The static water level in each well will be measured prior to sampling and recorded on individual well purge forms so that groundwater elevations may be calculated and groundwater contour maps produced for each sampling event. The monitoring wells will be purged using a stainless steel submersible pump with flow controller. Wells will be purged using the slow purge technique according to the EPA guidance, minimizing drawdown in the well. During the purging process, water quality indicators including pH, temperature, dissolved oxygen concentration, oxidation/reduction potential, specific conductance, and turbidity will be measured with a properly calibrated multi-parameter water quality meter outfitted with a flow-through cell and recorded on field forms. If there is insufficient water volume in the well to accomplish purging and stabilization of water quality parameters, a grab sample will be collected with a dedicated disposable bailer and the conditions of sampling will be noted on the field form.

Samples will be collected directly from the pump discharge tubing in laboratory-supplied clean sampling containers with the proper preservatives as necessary. All samples will be shipped in coolers to a certified laboratory under proper chain-of-custody procedures.

4.1.2 Sampling Parameters

As required by the Settlement Agreement, the groundwater samples collected will be analyzed by an EPA/PADEP certified laboratory for hexavalent chromium via U.S. EPA Method SW846 7196A and for total chromium by U.S. EPA Method 200.7.

4.2 Potable Well Sampling Methodology

Residential potable wells in the vicinity of the Precision Site will be sampled semi-annually as put forth in paragraph 8.3 of the Settlement Agreement. The locations, construction details, and depths of each well to be sampled are presented in Table 1 of the RAP. In addition, during the in situ chemical reduction activities, the residential wells will be monitored with increased frequency and for additional parameters.

4.2.1 Sampling Procedure

Potable well samples are to be collected from a water tap prior to any treatment devices. Prior to sampling, the aerator will be removed, the cold water tap will be turned on and the water will be allowed to flush for approximately five minutes. Samples will be collected in laboratory-supplied clean sampling jars with the proper preservatives as necessary. All samples will be shipped in coolers to a certified laboratory under proper chain-of-custody procedures.

4.2.2 Sampling Parameters

As required by the Settlement Agreement, the potable well samples collected will be analyzed by an EPA/PADEP certified laboratory for hexavalent chromium via U.S. EPA Method SW 846 7196A and for total chromium by U.S. EPA Method 200.7. During the in situ chemical reduction activities, the residential wells will be monitored with increased frequency and additional parameters, including sulfate and sulfide, will be added to the monitoring.

4.3 Surface Water Sampling Methodology

The EPA has selected Ackerly Creek as an endpoint for monitoring the contamination status and progress of the Removal Action at the Precision Site. Pursuant to the Settlement Agreement, Precision will monitor select locations in Ackerly Creek on a quarterly basis. Three locations in the drainage swale along Ackerly road will also be sampled semiannually. The locations to be sampled are listed in Table 1 of the RAP.

4.3.1 Sampling Procedure

Surface water samples will be collected as grab samples in laboratory-supplied clean sampling jars with the proper preservatives as necessary. The samples collected from each of the Ackerly Road drainage swale locations will be collected in clean, unpreserved containers. Every effort will be made to prevent leaf debris and other solids from entering the sample containers. The samples will then be allowed to rest so additional organic debris and sediments may settle. The water samples will then be decanted into new unpreserved and nitric acid-preserved sample containers as necessary. If the drainage swale water is especially turbid and sediments and debris cannot be kept out of the samples, additional sample volume may be collected in clean, unpreserved containers from the drainage swale locations and filtration by the laboratory prior to analysis will be requested. All samples will be shipped in coolers to a certified laboratory under proper chain-of-custody procedures.

4.3.2 Sampling Parameters

As required by the Settlement Agreement, the surface water samples collected will be analyzed by an EPA/PADEP certified laboratory for hexavalent chromium via U.S. EPA Method SW846 7196A and for total chromium by U.S. EPA Method 200.7. Additional monitoring of Ackerly Creek will be conducted during the in situ chemical reduction activities; parameters may include sulfate, sulfide, and water quality indicators such as pH.

4.4 Treatment System Sampling Methodology

The Lagoon Treatment System and Seep Shed Treatment System will be monitored on a monthly basis. Samples will be collected from the influent and effluent and analyzed for hexavalent chromium and total chromium to evaluate the effectiveness of each treatment system. In addition, samples will be collected between the SIR-700 and SIR-300 resin vessels and analyzed for hexavalent chromium and total chromium respectively, to evaluate the removal efficiency of the units and determine when the resin needs to be changed.

The systems will continue to operate in accordance with Section 8.3 of the Settlement Agreement. .

4.4.1 Sampling Procedure

Samples of the influent, effluent, and midpoint of the treatment systems will be collected while the treatment system is in operation. Grab samples will be collected in laboratory-supplied clean sampling jars with the proper preservatives as necessary. All samples will be shipped in coolers to a certified laboratory under proper chain-of-custody procedures. Field parameters including pH and temperature will be measured and recorded for the influent of the Lagoon Treatment System and Seep Shed Treatment System at the time of sampling. The flow rate and volume totalizer reading for each system will also be recorded on the field form at the time of sampling.

4.4.2 Sampling Parameters

As required by the Settlement Agreement, the samples collected from the treatment systems will be analyzed by an EPA/PADEP certified laboratory for hexavalent chromium via U.S. EPA Method SW846 7196A and for total chromium by U.S. EPA Method 200.7. During the in situ chemical reduction activities, the treatment systems will be monitored with increased frequency and additional parameters, including sulfate and sulfide, may be added to the monitoring.

5. Air Monitoring

When calcium polysulfide comes into contact with acids or acidic materials or is diluted with water, hydrogen sulfide (H_2S) gas is produced. Hydrogen sulfide gas is colorless, and at elevated concentrations can be toxic and flammable. It has a characteristic rotten egg odor. The odor alone cannot be used as an indicator of exposure to hydrogen sulfide, since hydrogen sulfide can be detected at very low levels [odor threshold of 0.5 parts per billion (ppb)] that are not harmful to health and the sense of smell can become rapidly fatigued (i.e., reduced) with continued exposure. The recommended exposure limit developed by the National Institute for Occupational Safety and Health (NIOSH) for H_2S is 10,000 ppb (time-weighted average concentrations for up to a 10-hour work day). The maximum permissible exposure limit established by the OSHA for H_2S is 20,000 ppb (time-weighted concentration not to be exceeded during any 8-hour work shift).

The CaSx injection activities will be performed in two general types of areas: areas below asphalt or concrete pavement (i.e., building slab) and areas with exposed surface soil (i.e., north of slab). Based on the depths of the treatment zones within the overburden and shallow bedrock groundwater, the anticipated low injection flow rates (approximately one to two gallons per minute in each well), and the observations of the prior bedrock injection activities, Precision anticipates minimal surfacing of calcium polysulfide. With little opportunity for exposure to air, rainwater, and sunlight, hydrogen sulfide generation should be minimal.

For the protection of the workers on Site and the nearest residents and to comply with the 2012 Settlement Agreement, Section 8.3(g), H_2S concentrations will be monitored surrounding the exclusion zone and at the Site perimeter. The H_2S concentrations will be compared to the ambient air action level for the general population of 30 ppb established by ATSDR for the previous injection activities. This concentration is two orders of magnitude below known health effects and is based on long term exposure.

H_2S ambient air action level	30 ppb

If a H_2S reading of 30 ppb or greater is identified at the Site, additional monitoring will be conducted at the Site perimeter (along the fence line) and along Arch Avenue to ensure that the hydrogen sulfide is not affecting the residences downgradient of the Site. If the H_2S concentrations leaving the Site boundary or along Arch Avenue exceed 30 ppb, injection activities will be stopped temporarily until the source of the release can be located and mitigated. The mitigation measures may include reducing the emission rate of hydrogen sulfide at the point source and implementing air plume suppression techniques at the Site boundary.

5.1 Exclusion Zone Monitoring

As described in the HSP and Addendum for Calcium Polysulfide Injection Activities previously prepared by ARCADIS, continuous exclusion zone real-time ambient air monitoring will be conducted as necessary by ARCADIS during all work activities within the exclusion zone. The Exclusion Zone real-time ambient air monitoring details and action levels are summarized in Table 1 of the HSP. For hydrogen sulfide, the monitoring will be performed and evaluated relative to the NIOSH and OSHA acceptable exposure limits of 10,000 ppb and 20,000 ppb, respectively.

A handheld Jerome 631-X Hydrogen Sulfide Analyzer with a detection limit of 3 ppb will be used to obtain hourly H_2S measurements at locations surrounding the current injection area. Readings will continue for one hour after the injection work ends each day. In the event of any calcium polysulfide spill or surfacing, additional monitoring will occur surrounding the exposed calcium polysulfide. The sensor of the Jerome 631-X will be thermally regenerated at the beginning and end of each work day according to the manufacturer's specifications. The analyzer will be properly zeroed in a clean air (no H_2S) environment prior to collecting measurements. The approximate locations for the exclusion zone monitoring are shown on Figure 14 of the RAP.

5.2 Perimeter Air Monitoring

As requested by EPA with respect to the prior remediation, perimeter air monitoring will be conducted to confirm that fugitive emissions, if any, of H_2S leaving the Site are below action levels for residential neighborhoods (30 ppb). The perimeter monitoring will be performed on the property boundary of the Precision Site prior to the residential areas and along Arch Avenue. The monitoring will be performed manually with hand-held instruments during the work day, as well as continuously electronically with monitoring stations installed on the Site boundary and along Arch Avenue. The manual monitoring will be limited to the typical work day (approximately 8:00 am to 6:00 pm) while calcium polysulfide is being injected and continue for one hour after the injection work ends each day. Manual monitoring along Arch Avenue will be performed every two hours during the work day. The sensor of the Jerome 631-X will be thermally regenerated at the beginning and end of each work day according to the manufacturer's specifications. The analyzer will be properly zeroed in a clean air (no H2S) environment prior to collecting measurements. The electronic monitoring stations will collect perimeter air monitoring data 24 hours a day.

The electronic monitoring stations will consist of Jerome 651 stationary units, which include a Jerome 631-X Hydrogen Sulfide Analyzer with a detection limit of 3 ppb. The Jerome Analyzers will be programmed to record real time data on 10-minute intervals 24 hours per day. The data will be transmitted from the analyzers to a computer via radio modem, so it can be evaluated and saved electronically for future use. The electronic monitoring stations will be programmed to provide an alert via email and/or SMS text message (i.e., cellular phone text message) to the appropriate Site personnel if there is a detection of H_2S above the 30 ppb action level. The Jerome 651 will be programmed to thermally regenerate the sensor in the early morning of each work day according to the manufacturer's specifications. The analyzer will be automatically zeroed immediately following sensor regeneration and prior to collecting measurements. The perimeter monitoring units will also record meteorological data to document current conditions each day during the injection activities. As a supplement to the data being recorded electronically, the analyzers will be checked periodically and manual measurements will be recorded.

The electronic monitoring stations will be installed at two locations to collect perimeter air monitoring data. Air monitoring data will be collected at a fixed monitoring location on the northern property boundary between the Site and the residences located along Arch Avenue. In addition, a fixed monitoring station will be located at the end of Arch

Avenue near the Trolley Tracks. These locations will provide air monitoring data to evaluate any potential impacts to the residences in the area throughout the remediation activities. The approximate locations of the perimeter air monitoring stations are shown on Figure 14 of the RAP.

A handheld Jerome 631-X Hydrogen Sulfide Analyzer with a detection limit of 3 ppb will be available on site for manual readings in the event of a calcium polysulfide spill or surfacing of material. Surfacing is not anticipated since the treatment zone is below grade within the groundwater and the injection flow rate will be very low.

6. Quality Assurance Project Plan

All sampling completed as part of the RAP activities will be performed using proper field techniques and sample handling such that the precision, accuracy, representativeness, comparability, and completeness of the collected data are known, documented, and adequate to satisfy the data quality objectives (DQOs) of the Site work. In addition, Precision will consult with EPA prior to all sampling and data collection activities outlined in the RAP. The collection and analysis of samples and data collected for the Site will be conducted in accordance with the following documents:

- "EPA NEIC Policies and Procedures Manual" (EPA Document 330/9-78-001-R), EPA, revised November 1984;
- "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (QAMS-005/80), EPA, December 1980; and
- "QA/QC Guidance for Removal Activities" (EPA/540/G-90/004), EPA, April 1990.
- "U.S. EPA National Functional Guidelines for Inorganic Superfund Data Review" (U.S. EPA-540-R-10-011), January 2010.

6.1 Scope of Work

The scope of work consists of monitoring well installation, in situ calcium polysulfide injections, monitoring well sampling, residential well sampling, surface water sampling, treatment system operation, maintenance, and sampling, and evaluation and implementation of institutional controls to limit groundwater use. Detailed procedures for conducting the scope of work are provided in the RAP. The scope of work will be performed in accordance with the 2012 Settlement Agreement.

6.2 Data Quality Objectives

Data obtained during the implementation of the RAP will be used to determine and monitor the extent of the hexavalent chromium and total chromium in groundwater in the vicinity of the Site. The goals of the RAP are to address the issues outlined in the 2012 Settlement Agreement.

In order to best utilize the data generated during the implementation of the RAP, data quality objectives (DQOs) must be developed that relate the extent and quality of data to be gathered to the ultimate objective of the work. DQOs are qualitative and quantitative goals for precision, accuracy, reproducibility, comparability, and completeness specified for each data set. DQOs are based on the concept that different data uses require different levels of data quality. DQOs are defined with respect to the types, numbers, and locations of samples that will be collected, and the quality assurance levels associated with their analysis. The DQOs and quality assurance levels required for the work conducted according to the RAP will be guided by the above-listed EPA documents.

All analyses will be performed by a laboratory which has a documented Quality Assurance Program in compliance with EPA guidance document QAMS-005/80. Laboratory analyses of samples collected at the Precision Site will be performed following standard EPA methods. The laboratory will make every effort to achieve quantitation limits as low as practicable and will report estimated concentration values at less than the reporting limit by flagging the value with a “J”. All data packages provided by the certified laboratory will consist of Level IV deliverables.

6.3 Quality Assurance/Quality Control

The overall Quality Assurance (QA) objective is to develop and implement procedures for field measurements, sampling, and analytical testing that will provide data of known quality that is consistent with the intended use of the information. This section defines the objectives by 1) describing the use of the data; 2) specifying the applicable QC effort (field checks and analytical support levels); and 3) defining the QC objectives (data quality acceptance criteria).

6.3.1 Data Usage and Requirements

The field measurements and laboratory analyses will be used in support of the removal action at the Site and in determining the need for further remedial actions. The data to be collected range from qualitative information based on field observations to quantitative laboratory analyses.

6.3.2 Level of Quality Control Effort

The sampling personnel will use several types of QA/QC samples to ensure and document the integrity of the sampling procedures, laboratory sample handling procedures, and the validity of the measurement data. Field replicate samples will be collected to evaluate the reproducibility of the sampling technique. Replicate samples will be collected as needed and will be given a coded identity on the sample label and chain of custody form, so as to be a “blind” replicate to the laboratory. The actual sampling location will be recorded on the well purge form or other field sampling form.

If needed, field blanks will be collected using analyte-free water and identical clean sample bottles provided by the laboratory. Field blanks will be prepared to determine if cross-contamination has occurred during sampling. Field blanks will be handled and preserved in the same manner as field samples. The field blank will be analyzed for the same parameters as the associated samples.

All field samples and QC samples will be transported daily to the laboratory by ARCADIS personnel or shipped via courier or overnight delivery (FedEx). All blanks and samples will be maintained at 4°C while stored on-Site and while in transit.

The laboratory will follow standard QC procedures to provide data of known and defensible quality. The data quality elements that will be checked and documented include precision, accuracy, reproducibility, comparability, and completeness as described below.

6.3.2.1 Precision

Measurements of data precision are necessary to demonstrate the reproducibility of the analytical data. Precision of the sample data will be determined from the analyses of laboratory duplicates and field duplicates. Laboratory duplicates will be analyzed at a frequency of one per 20 samples per matrix. Laboratory precision requirements are set by the analytical methods used.

6.3.2.2 Accuracy

Accuracy is the relationship of the reported data to the "true" value. The accuracy of the methods used for the analyses of the samples will be evaluated through the use of calibration standards, matrix spike (MS) analyses, and laboratory control samples (LCS). MS samples will be analyzed at a frequency of one per 20 samples per matrix. Laboratory accuracy requirements are determined by the analytical methods used.

6.3.2.3 Representativeness

The sampling procedures employed during the implementation of the RAP are designed to provide data that are representative of actual conditions at the sampling location. Considerations for evaluating the representativeness of the data include, but are not limited to: the sampling location; the methods used to obtain the sample; and the appropriateness of the analytical method to the type of sample obtained. All field sampling activities will be performed following the procedures described in the RAP and this QAPP/FSP.

6.3.2.4 Comparability

Comparability expresses the confidence with which one data set can be compared with another data set. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the analytical data, as documented in this QAPP/FSP, are expected to provide comparable data. The new analytical data, however, may not be directly comparable to some existing historical data based on differences in procedures and QA objectives.

6.3.2.5 Completeness

Completeness is a measure of the amount of data obtained from a specific measurement that is judged to be valid as compared to the total amount of data collected. The validity of the collected data will be evaluated using the guidelines in the EPA guidance documents listed above. The laboratory should provide data that meet QC acceptance criteria for 90 percent or more of the requested determinations. If the percent completion limits are not met, the laboratory may be required to re-analyze samples or resampling may be required.

6.3.3 Quality Control Objective

The purpose of the Quality Control (QC) check samples is to determine if the data are of acceptable quality. Several different types of QC check samples will be analyzed and the results will be compared to data quality acceptance criteria and/or QC control limits that are specified for each analytical method. The laboratory will routinely run QC samples in accordance with the protocols and frequencies specified in the analytical methods used. The QC check samples include:

- Method blank samples,
- Preparation blanks,
- Initial and continuing calibration blanks,
- Initial and continuing calibration verification samples;
- Matrix Spikes/Analytical Spikes;
- Duplicate samples; and
- Laboratory control samples.

The specific types and frequencies of QC checks which will be performed in support of each test method, the calibration procedures for each instrument, and the QC control limits and/or data quality acceptance will be determined by the laboratory and verified during the review of the laboratory analytical report. Criteria for each of the types of QC check samples are set by the analytical method used.

6.3.4 Sampling Procedure

Samples will be collected according to the procedures provided in the RAP and this QAPP/FSP. All samples will be shipped or delivered to the laboratory within 24 hours of the time of sample collection. Preservation, container type, and holding time requirements for the parameters to be analyzed are determined by the specific analytical method to be used.

6.3.5 Sample Custody

A chain of custody record will be maintained for each sample collected and will provide an accurate written record that can be used to trace the possession of samples from collection through analysis and reporting. Sample bottles to be used for the work in support of the RAP will be clean, laboratory-supplied sampling containers appropriate for the matrix and analytes chosen.

The procedures that will be followed to provide chain of custody in the field from sample collection through shipment to the laboratory are specified in this QAPP/FSP. The procedures that will be used to continue the chain of custody for each sample from its arrival at the laboratory through analysis and reporting will be performed according to the laboratory QAPP. The laboratory sample custody procedures must conform to EPA guidelines. The laboratory will retain the project samples until the holding times are exceeded, or until permission to discard is received.

6.3.6 Calibration Procedures

The calibration procedures for field instrumentation are discussed in this QAPP/FSP. The calibration procedures for laboratory instrumentation will be performed in accordance with those specified by the analytical method to be used and the laboratory QAPP.

6.3.7 Analytical Procedures

The methods to be followed for the analysis of hexavalent chromium are found in U.S. EPA SW846 7196A and for total chromium and Target Analyte List Metals in U.S. EPA 200.7. The analysis for sulfate will follow U.S. EPA method D516-90, 02. The analysis of sulfide will follow Standard Method SM4500 S2E. The types and frequencies of QC checks will be those specified in the analytical methods and described in Section 6.3.2 above.

6.3.8 Data Reduction, Validation, and Reporting

All data collected during the implementation of the RAP, including field and laboratory results, will be reduced, reviewed, summarized, and reported. The reduction of the field data will consist of summarizing the raw field data, which may be presented in the form of tables, logs, illustrations, and graphs as appropriate. The analytical data from the laboratory will be reduced to appropriate forms and summarized as appropriate in the form of tables, illustrations, and graphs. All data will be maintained at the ARCADIS office until acceptance of final reports.

The sample data collected will be screened for completeness and technical compliance. All data packages provided by the laboratory will consist of Level IV deliverables. A Level IV data review of each laboratory report will be performed, which will include:

- Checking to see if the chain of custody form was filled out properly and if the samples were logged properly;
- Checking to verify the correct parameters were analyzed using the methods identified in the RAP and this QAPP/FSP;
- Checking to verify that the holding times were met for each parameter analyzed;
- Reviewing the blank results;
- Checking calibration records;
- Checking matrix spike/analytical spike analyses;
- Checking duplicate sample analyses;
- Checking laboratory control sample and standard analyses.

If the data appear suspect, specific data of concern will be investigated. On the basis of this review, the data validator will make judgments and comments on the quality and limitations of the data. The data validator will prepare documentation of his/her review and conclusions to summarize any overall deficiencies that require attention. General laboratory performance will also be assessed by the data validator. During the validation, the data validator may qualify sample results as estimated. In most cases, estimated results will meet project DQOs. However, if in the judgment of the data validator, the result does not meet the project DQOs, it will be clearly stated in the validation memorandum.

The data validator will inform the Project Coordinator of data quality and limitations, and assist in interacting with the laboratory to correct any data omissions and/or deficiencies. The laboratory may be required to rerun or resubmit data depending on the extent of the deficiencies and importance in meeting the DQOs within the overall context of the work.

The reviewed laboratory data will be reduced and tabulated for inclusion in the quarterly progress reports specified in paragraph 8.7 of the Settlement Agreement, additional reports that Precision will prepare and submit to the EPA documenting the additional investigation and in situ chemical reduction activities described in Sections 4 and 5 of the RAP, and the Final Report that Precision will submit to the EPA when it concludes it has completed the implementation of this RAP and addressed the items in paragraph 8.3 of the Settlement Agreement. The tabulated format will be designed to facilitate comparison and evaluation of the data. Field measurements, including well construction details, water level measurements, and other field analyses, will be similarly tabulated for inclusion in the reports submitted to the EPA to facilitate the comparison and evaluation of the data.

6.3.9 Internal Quality Control

The QA/QC samples collected, including field replicates and field blanks, will be used to ensure and document the integrity of the sampling procedures and the validity of the measurement data. The QA/QC sample results will be compared to acceptance criteria, and documentation will be performed showing that these criteria have been met. Any samples that are not in conformance with the QC criteria will be identified and reanalyzed by the laboratory, if appropriate.

Two types of quality assurance mechanisms are used to ensure the laboratory production of analytical data of known and documented quality: analytical method QC and program QA. The internal QC procedures for the analytical services on samples to be provided are specified in the analytical methods and the laboratory QAPP. These specifications include the types of control samples required (sample spikes, surrogate spikes, reference samples, controls, blanks), the frequency of each control, the compounds to be used for sample spikes and surrogate spikes, and the quality control acceptance criteria. The laboratory will be responsible for documenting that both initial and ongoing instrument and analytical QC criteria are met in each package. This information will be included in the case narrative of the data packages generated by the laboratory and will be evaluated during the review performed by ARCADIS.

6.3.10 Preventive Maintenance

ARCADIS has an established program for the maintenance of field equipment to ensure the availability of equipment in good working order when it is needed. An inventory of equipment including model number, serial number, calibration records, and maintenance records is kept for each field instrument. Equipment manuals are also kept with all field instruments. Field personnel are responsible for calibration, operation, and cleaning of all field instruments according to manufacturer's specifications when the equipment is used in the field.

The laboratory also follows a well-defined program to prevent the failure of laboratory equipment and instrumentation. This preventive maintenance program is described in the laboratory QAPP.

6.3.11 Data Assessment Procedures

Both field- and laboratory-generated data will be assessed for precision, accuracy, representativeness, comparability, and completeness. Both qualitative and quantitative procedures will be used for these assessments. The criterion for field measurements will be that the measurements were taken properly using calibrated instruments. Assessment of the sampling data with respect to field performance will be based on the criteria that the samples were properly collected and handled. Field QC check samples will also be considered in assessing the representativeness and comparability of the samples collected. The Project Coordinator will have overall responsibility for data assessment and integration of that assessment into data use and interpretation.

The QC acceptance criteria prescribed for each test method are presented in the laboratory QAPP. Rigorous QA/QC procedures will be followed for the collection of samples. The sampling protocols will be strictly adhered to in order to maintain consistency in sampling.

6.3.12 Corrective Actions

The QA/QC program contained in this QAPP/FSP will enable problems to be identified, controlled, and corrected. Potential problems may involve non-conformance with the standard operating procedures (SOPs) and/or analytical procedures established for the work, or other unforeseen difficulties. Any persons identifying an unacceptable condition will notify the Project Coordinator. The Project Coordinator will be responsible for developing and initiating appropriate corrective action and verifying that the corrective action has been effective. For laboratory analysis, both the identified deviations and corrective actions will be documented.

Corrective actions may include repeating measurements, resampling and/or reanalysis of samples, and amending or adjusting project procedures. If warranted by the severity of the problem, the EPA Project Coordinator will be notified. Additional work, which is dependent upon an unacceptable activity, will not be performed until the problem has been corrected.

6.3.13 Quality Assurance Reports

During each data review, the data validator will make judgments and comments on the quality and limitations of the data. The data validator will prepare documentation of his/her review and conclusions to summarize any overall deficiencies that require attention. General laboratory performance will also be assessed by the data validator. During the validation, the data validator may qualify sample results as estimated. In most cases, estimated results will meet project DQOs. However, if in the judgment of the data validator, the result does not meet the project DQOs, it will be clearly stated in the validation memorandum. This documentation of the review of analytical data and any other documentation of QA/QC evaluation will be included in the quarterly progress reports specified in paragraph 8.7 of the Settlement Agreement, additional reports that Precision will prepare and submit to the EPA documenting the additional investigation and in situ chemical reduction activities described in Sections 4 and 5 of the RAP, and the Final Report that Precision will submit to the EPA when it concludes it has completed the implementation of this RAP and addressed the items in paragraph 8.3 of the Settlement Agreement.

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