November 16, 2020

Southern Illinois Power Cooperative (SIPC) is posting the Corrective Action Report, the Groundwater Monitoring Report, and the Closure Plan in draft form. While these reports represent the best possible information available at the time of posting, all three reports are under review by the Illinois Environmental Protection Agency and are being or will be updated as necessary.

DRAFT

Emery Pond

Corrective Action and Selected Remedy Plan, Including GMZ Petition

Marion Power Plant
Southern Illinois Power Cooperative
Marion, Williamson County, Illinois

March 29, 2019
revised October 29, 2020

HANSON
Engineering | Planning | Allied Services

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Abbreviations

BGS – below ground surface
CAP – Correction Action Plan
CCR – Coal Combustion Residuals
CFR – Code of Federal Regulations
COC – Contaminant of Concern
EPA – Environmental Protection Agency
GMZ – Groundwater Management Zone
GPS – groundwater protection standard [after 40 CFR 257.95(h)]
IAC – Illinois Administrative Code
NELAP – National Environmental Laboratory Accreditation Program
mg/L – milligram per liter
ug/L – micrograms per liter

1. Introduction

Marion Power Plant (Plant) is owned and operated by the Southern Illinois Power Cooperative (SIPC). The Emery Pond, a coal combustion residuals (CCR) impoundment at the Plant, has functioned from the late-1980's to the present as a storm water storage structure for drainage from the adjacent Plant area, including the more recent Gypsum Loadout Area. The Emery Pond and adjacent Gypsum Loadout Area are referred to in this Plan as the Site.

This Plan outlines the selection of a remedy to address the 35 IAC Part 620 exceedances due to the Site alleged in Illinois EPA's Violation Notice No. 6364 issued on July 3, 2018, and any additional detected Part 620 exceedances attributable to the Site, as further described below. The selected remedy for impacted groundwater is also consistent with the federal CCR rule, including 40 CFR 257.97 and 40 CFR 257.98. The remedy selected in this plan includes both active remedial actions, including the removal of CCR from the Site, and a request for a groundwater management zone (GMZ) for a limited time to allow the active corrective action to achieve relevant Part 620 groundwater quality standards. As discussed further below, the impacted groundwater has not measurably impacted nearby surface waters, specifically Lake of Egypt, and no such impact is expected during the requested GMZ period.

Figure 1 shows the Site location on a USGS Topographic Map and Figure 2 depicts the Emery Pond and other features/units at the Site.

2. Groundwater Impacts

2.1 Site Hydrogeology

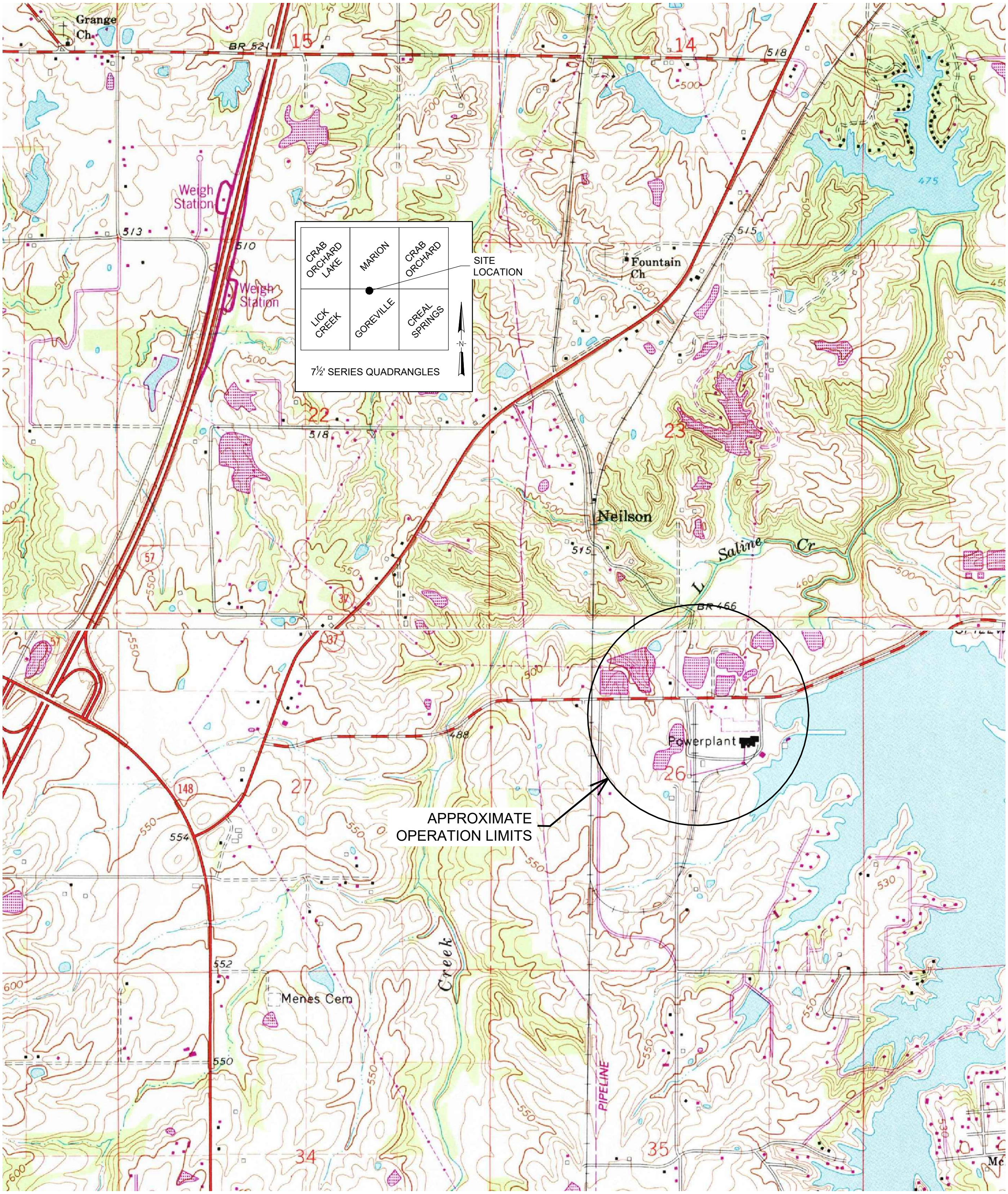
The site is located in the Shawnee Hills Section within the Interior Low Plateaus (physiographic) Province (Leighton et al., 1948). Site geology consists of glacially derived deposits of the Illinoisan Stage overlying Pennsylvanian Age bedrock. Table 1 list the hydro- and litho-stratigraphic units with their descriptions located within 50 feet of the surface at the Site (Willman et al, 1995 and Berg & Kempton, 1988).

Table 1. Site Geologic/Hydrogeologic Units

Litho-stratigraphic Unit	Hydro-stratigraphic Unit	Lithologic Description
Peoria/Roxana Silt	Unlithified Unit	light yellow tan to gray, fine sandy silt
Glasford Formation (undifferentiated)		silty/sandy diamictons with thin lenticular bodies of silt, sand, and gravel
Caseyville Formation	Bedrock Unit	primarily sandstone with shales

The current groundwater monitoring wells for the Site are all screened at the Unlithified/Bedrock Units interface. This zone has relatively low hydraulic conductivity (< $1x10^{-4}$ cm/s) and only a few feet (5-10 ft.) of saturated thickness. Because of this low hydraulic conductivity, groundwater in the Unlithified Unit and upper portion of the Bedrock Unit (approximately the upper 11 ft.) is classified as Class II: General Resource Groundwater Groundwater in the rest of the explored Bedrock Unit is Class I: Potable Resource Groundwater.

The following reasons are used for these classifications:



SCALE

2,000 0 2,000 4,000

1 inch = 2,000 feet Contour interval = 10 feet

Approximate Site Location: n½ of Section 26; T10S., R2E.

SITE LOCATION MAP

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE 1

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EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

SCALE: 1 inch equals 60 feet

0 ft. 60 ft. 120 ft. 180 ft. 240 ft.

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Site Features Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A FIGURE NO. 2

The Unlithified Unit is classified as Class II groundwater because:

1. The Unit does not contain a sand, gravel, or sand & gravel deposit greater than 5 ft. thick, and
2. The slug test results (see Hanson, 2019a and 2019b) are less than 1 x 10^{-4} cm/s.

The upper (approximately 11 ft.) of the Bedrock Unit is classified as Class II groundwater because:

1. The Unit contains less than 10 ft. of sandstone,
2. The Unit contains less than 15 ft. of fractured carbonate rock, and
3. The packer test results (see Hanson, 2019a) are less than 1 x 10^{-4} cm/s.

The lower Bedrock Unit is classified as Class I groundwater because:

1. The Unit has two continuous segments of sandstone that exceed 10 ft. in thickness, although
2. The packer test results (see Hanson, 2019a) are less than 1 x 10^{-4} cm/s.

Although groundwater is present in the Unlithified and upper/lower Bedrock Units, there is no groundwater used associated with any of the operations at the Marion Power Plant. Additionally, since SIPC owns the property immediately surrounding the Marion Power Plant and Lake of Egypt, there is no off-site migration of groundwater. The nearest water well is located at the Lake of Egypt County Club, approximately 2,500 feet south southeast from Emery Pond and is screened from 65-90 feet below ground surface. This water well is also located on SIPC property.

For the purposes of the Emery Pond corrective action and closure work, SIPC has agreed to monitor and conduct corrective action for the purpose of achieving compliance with Class I groundwater quality standards.

2.2 Groundwater Monitoring History

Five monitoring wells were installed to meet the monitoring requirements of the US EPA's CCR Rule, background well EBG and downgradient wells EP-1, EP-2, EP-3, and EP-4 (see Figure 2). Groundwater monitoring at the Site has been ongoing since evaluation of background water quality began in 2017, consistent with 40 CFR 257.90. SIPC conducted detection monitoring in compliance with the CCR Rule (40 CFR 257.94). The results of detection monitoring triggered assessment monitoring (40 CFR 257.95) in 2018 for two Appendix IV constituents, arsenic and cobalt.

The Illinois EPA issued Violation Notice No. 6364 on July 3, 2018. This notice alleged the exceedances of the Class I: Potable Use Groundwater Standards (35 IAC 620.410) summarized in Table 2. As identified in the Hydrogeologic Investigation Report (Hanson, 2019a) and Hydrogeologic Investigation Addendum (Hanson, 2019b), groundwater at the Site has been classified as Class II: General Resource Groundwater (35 IAC 620.240) in the Unlithified Unit and the upper (approx. 11 ft.). of the Bedrock Unit.

Table 2. Exceedances of the Class I: Potable Resource GW Standards

Parameter	Class I Std.	Units	EP-1	EP-2	EP-3	EP-4
Arsenic	0.010	mg/L				X
Boron	2.0	mg/L				X
Cadmium	0.005	mg/L	X			X
Chloride	200	mg/L			X	
Lead	0.0075	mg/L				X
pH	6.5 – 9.0	SU		X	X	X
Selenium	0.050	mg/L				X
Sulfate	400	mg/L	X	X		X
TDS	1,200	mg/L	X	X	X	
Thallium	0.002	mg/L				X

An extent of contamination study was performed in February 2019. The isopleth maps showing the results of that study are in Appendix C. Seven (7) linear sets of borings were drilled (direct push method) in a radial pattern around the Site at approximately 25 ft. intervals outward from the Emery Pond (see Figure 2). Groundwater samples were collected at each boring and analyzed for total analytes of the Class I inorganic parameter list. During sample collection, several borings were found to be either dry or were unable to produce sufficient volume of water for sampling. These borings were: DP1a, DP1b, DP2a, DP4a, DP4b, DP4c, and DP6b.

Appendix A contains the tabulated groundwater data and Appendix B and Appendix C contain the graphical groundwater data for the COCs identified and discussed below. While Hanson contends that the groundwater relevant to the Site is Class II under Part 620, it recognizes Illinois EPA's allegations of Class I standards. Accordingly, the below evaluations of Site water quality compare groundwater investigation results to both the Class I and Class II Part 620 groundwater standards and/or the Site Groundwater Protection Standards (GPS) under the federal CCR rule [40 CFR 257.95(h)]. Parameters with only one exceedance at a well are treated as a false positive exceedance result (e.g., Chromium, Lithium, etc.) assuming a 95% confidence limit and observable data trends.

2.2.1 Arsenic

Arsenic (CAS# 7440-38-2) concentrations have not exceeded the 35 IAC 620.420 Class II Standard (0.2 mg/L) but did exceed and Class I Standard (0.01 mg/L) at EP-4. Arsenic has exceeded the Site's GPS at EP-3 and EP-4. The Arsenic concentration in the Emery Pond water sample was only 0.0025 mg/L and the gypsum leachate was <0.01 mg/L. The Arsenic Concentration Map (in Appendix C) shows the pattern of elevated Arsenic concentrations at the Site.

2.2.2 Boron

Boron (CAS# 7440-42-8) concentrations exceeded the 35 IAC 620.410 Class I and Class II Standard (2.0 mg/L) at EP-4 since the well was first sampled. Boron has exceeded the Site's GPS at EP-1, EP-2, and EP-4. Boron had a high concentration in the Emery Pond water sample (72 mg/L). The Boron Concentration Map (in Appendix C) shows the pattern of elevated Boron concentrations at the Site. Note that high concentrations were observed in Line 6 (DP6a and DP6c) in Line 7 (DP7c), in EP-4, and Line 1 (DP1c and DP1e). Migration of Boron does not appear to be to the south of the Emery Pond.

2.2.3 Calcium

Calcium (CAS# 7440-70-2) does not have a 35 IAC 620 Class I or Class II Standard. However, Calcium has exceeded the Site's GPS at EP-1, EP-2, and EP-4. The Calcium Concentration Map (in Appendix C) shows the pattern of elevated Calcium concentrations at the Site. Emery Pond water had a Calcium concentration of 899 mg/L, while the gypsum leachate extract had a concentration of 629 mg/L. Calcium concentrations along the south-side of the Emery Pond are generally lower than the pond water or gypsum (in the low- to mid-hundreds). Along the north-side of the pond, concentrations are much higher (exceeding the pond and gypsum concentrations), with an extreme value at DP1e of 16,700 mg/L.

2.2.4 Chloride

Chloride (CAS# 7782-50-5) concentrations exceeded the 35 IAC 620 Class I and Class II groundwater standard (200 mg/L) at EP-4. Chloride has exceeded the Site's GPS at EP-4 and intermittently at EP-3. The Chloride Concentration Map (in Appendix C) shows the pattern of elevated Chloride concentrations at the Site. Emery Pond had a Chloride concentration of 2190 mg/L. The isopleth map shows high concentrations at DP5a, DP5b, DP6a, DP7c, and EP4. Again, the south-side of the Emery Pond generally has concentration below the Class I and Class II Standards.

2.2.5 Lead

Lead (CAS# 7439-92-1) concentrations have not exceeded the 35 IAC 620 Class II Standard (0.1 mg/L) at any of the monitoring wells but did exceed the Class I Standard at EP-4. Lead has also exceeded the Site's GPS at EP-4. The Lead concentration in the Emery Pond water sample was only 0.0026 mg/L and the gypsum leachate was <0.0075 mg/L. The Lead Concentration Map (in Appendix C) shows the elevated Lead concentrations around EP-4.

2.2.6 pH

pH (CAS# 13967-14-1) has concentrations below the 35 IAC 620 Class I and Class II (lower) groundwater standard (6.5 SU) at EP-4, EP-3, and intermittently at EP-2. pH falls below the Site's lower GPS at EP-4, EP-3, and intermittently at EP-2. The pH Concentration Map (in Appendix C) shows the pattern of pH concentrations at the Site. The pH Isopleth Map shows the historic area of the Emery Pond with pH levels above both the upper-Class II Standard and the upper GPS at DP5a and DP5b. Conversely, pH levels below the lower Class II Standard and lower GPS are found at EP-3, EP-4, DP2g, and DP2h. The Emery Pond had a pH concentration of 7.77 SU.

2.2.7 Selenium

Selenium (CAS# 7782-49-2) concentrations exceeded the 35 IAC 620 Class I and Class II Standard (0.05 mg/L) at EP-4 since the well was first sampled. Selenium has also exceeded the Site's GPS at EP-3 and EP-4. The Selenium concentration in the Emery Pond water sample was only 0.082 mg/L and the gypsum leachate was <0.0462 mg/L. The Selenium Concentration Map (in Appendix C) shows the pattern of elevated Selenium concentrations around the Site.

2.2.8 Sulfate

Sulfate (CAS# 14996-02-2) concentrations have consistently exceeded the 35 IAC 620 Class I and Class II groundwater standard (400 mg/L) at EP-1, EP-2, and EP-4. Sulfate has exceeded the Site's GPS at all four downgradient monitoring wells and upgradient well, EBG for the past two rounds. The Emery Pond had a concentration of 2,000 mg/L and the gypsum leachate had a concentration of 1,350 mg/L. The Sulfate Concentration Map (in Appendix C) shows the pattern of elevated Sulfate concentrations at the

Site. Several exploration lines have concentrations that are higher at further distances from the Emery Pond than those closer (see Line 1, Line 3, and Line 6).

2.2.9 Total Dissolved Solids (TDS)

TDS (CAS# 10-05-2) concentrations have consistently exceeded the 35 IAC 620 Class I and Class II groundwater standard (1,200 mg/L) at EP-1, EP-2, and EP-4 and intermittently at EP-3. TDS has also exceeded the Site's GPS at all four downgradient monitoring wells. The TDS Concentration Map (in Appendix C) shows the pattern of elevated TDS concentrations at the Site. This isopleth map displays a similar pattern as Sulfate, whereby some exploration lines have higher concentrations at distance from the Emery Pond. TDS concentrations in the Emery Pond were 6,540 mg/L and the gypsum leachate was 2,140 mg/L.

2.2.10 Cobalt

Cobalt (CAS# 7440-48-4) concentrations have not exceeded the 35 IAC 620 Class I or Class II groundwater standards (1.0 mg/L). However, Cobalt has exceeded the Site's GPS at EP-2, EP-3, and EP-4. The Cobalt Concentration Map (in Appendix C) shows the pattern of elevated Cobalt concentrations at the Site. Note that there are two extent borings with high Cobalt, DP1e and DP6a. Both have concentrations above the Emery Pond water and gypsum leachate, 0.145 mg/L and <0.005 mg/L, respectively. No obvious source for these exceedances exists and there is also no apparent connection between the two borings.

2.2.11 Cadmium

Cadmium (CAS# 7440-43-9) concentrations have not exceeded the 35 IAC 620.410 Class II: General Resource groundwater standard (0.05 mg/L), nor has it exceeded the GPS (0.01 mg/L). However, the laboratory reporting limit for Cadmium is higher than the Class I: Potable Resource groundwater standard. Note that there are two extent borings with high Cadmium, DP1e and DP6a. Both have concentrations above the Emery Pond water and gypsum leachate, 0.019 mg/L and <0.002 mg/L, respectively. No obvious source for these Class II exceedances exists and there is also no apparent connection between the two borings.

2.2.12 Thallium

Thallium (CAS# 7440-28-0) concentrations may have exceeded the 35 IAC 620 Class I and Class II: groundwater standard (0.002 and 0.02 mg/L, respectively) at all the monitoring wells, because the laboratory performing the analyses had a reporting limit of 0.050 mg/L. However, Thallium has exceeded the Site's GPS at EP-4. The Thallium Concentration Map (in Appendix C) shows the pattern of elevated Thallium concentrations at the Site. Note that both the Emery Pond and gypsum leachate have concentrations at or below 0.002 mg/L. Therefore, it is unlikely that the Thallium exceedances are related to a release from the Site.

2.3 Other 35 IAC 620 Exceedances

The February 2019 investigation identified three other parameters that exceeded the Class I and Class II groundwater standards – Iron, Manganese, and Zinc.

2.3.1 Iron

Iron (CAS# 7439-89-6) concentrations were observed above the Class I and Class II groundwater standard (5.0 mg/L) during the extent investigation. Iron exceedances were observed at all the extent borings plus EP-3 and EP-4. The background monitoring well, EBG, had an Iron concentration that almost reached the Class II Standard (EBG Iron = 4.4 mg/L), but the Emery Pond and gypsum leachate samples had Iron concentrations of 0.899 and 0.0719 mg/L. This implies that Iron is naturally occurring at these elevated concentrations, likely related to the residual iron in the bedrock and RedOx conditions at the Site.

2.3.2 Manganese

Manganese (CAS# 7439-96-5) concentrations were observed above the Class I and Class II groundwater standards (0.150 mg/L and 10.0 mg/L, respectively) during the extent investigation. Manganese exceedances were observed at many of the extent borings plus EP-4. The Emery Pond and gypsum leachate samples had Manganese concentrations of 4.56 and 0.0444 mg/L, respectively. This implies that Manganese, like Iron, at these observed concentrations are naturally occurring, and not related to a release at the Site.

2.3.3 Zinc

Zinc (CAS# 7439-66-6) concentrations were observed above the Class II General Resource groundwater standard (5.0 mg/L) during the extent investigation. Zinc exceedances were observed at three extent borings, DP1e, DP7a, and DP7b. The Emery Pond and gypsum leachate samples had Zinc concentrations of 0.215 and <0.01 mg/L, respectively. The low source water concentrations indicate that these exceedances are not related to a release at the Site.

2.4 Major Cation and Anion Geochemistry

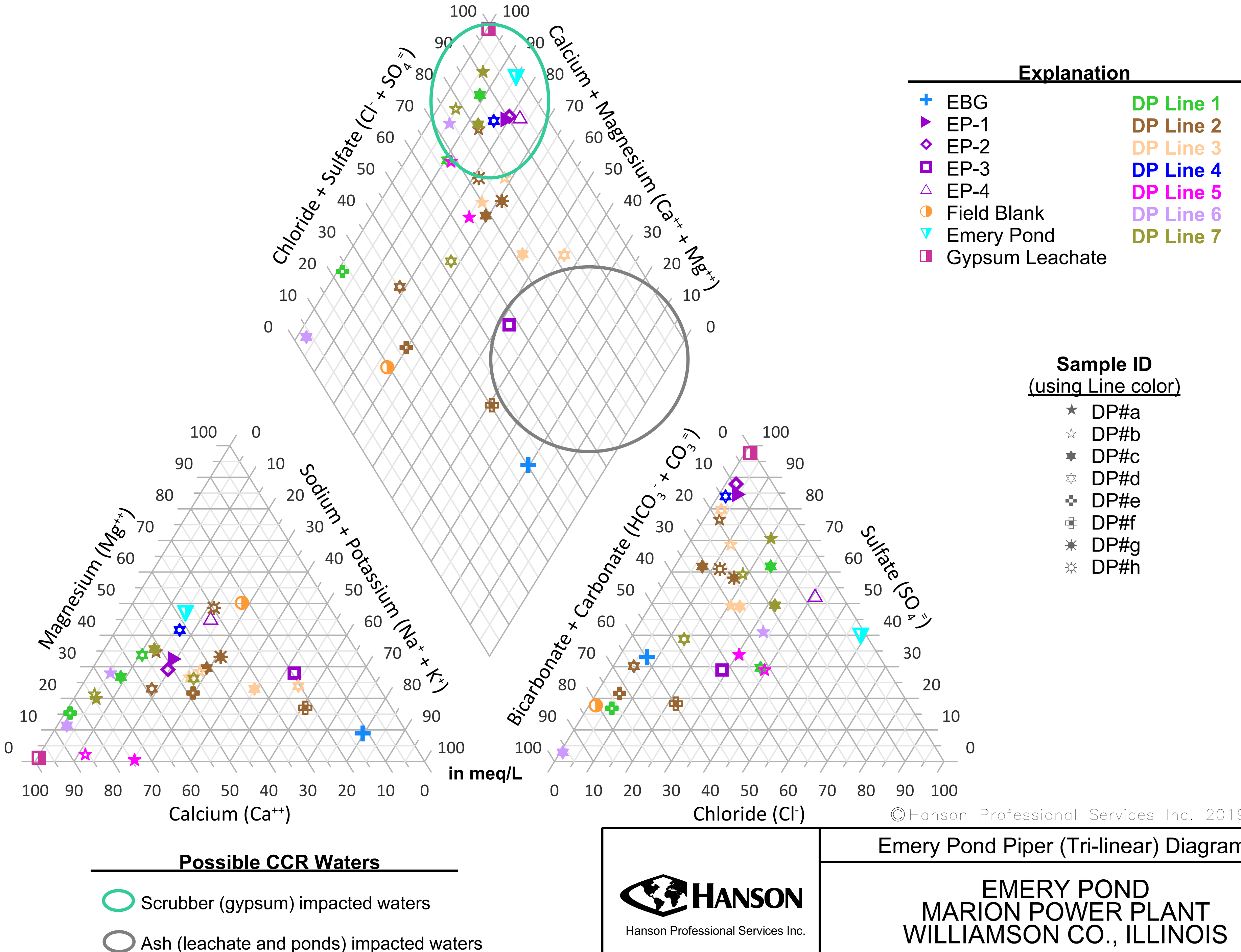
Figure 3 presents the major cation and anion data from the Emery Pond monitoring wells, investigation borings, and potential source water samples. Also shown are ellipses representing possible CCR source waters. Many of the sample results lie in the area identified as Calcium-Chloride type waters. Note that the gypsum leachate sample lies at the apex of this area and is further delineated by the possible scrubber (gypsum) impacted water ellipse. Three of the five monitoring wells also lie in this area (EP-1, EP-2, and EP-4).

The other two monitoring wells (EP-3 and upgradient well, EBG), lie within or near the other CCR source water ellipse. This area to the right of the diamond is identified as Sodium-Chloride type waters and is more indicative of ash impacted waters (either ash leachate or pond water). The investigation borings identified between the two ellipses are likely indicative of mixing of water types from the background waters to the impacted waters. The conclusion drawn from the cation/anion geochemistry is that gypsum is impacting the Emery Pond monitoring system.

2.5 Groundwater Monitoring Observations

Several overall trends can be observed in the graphs and maps found in Appendix B and Appendix C, including:

1. Several investigation borings have higher concentrations at points further from the Emery Pond than those borings that are closer (e.g., Boron at DP1e and DP7c and Sulfate at DP3b and DP6c). Hanson believes that groundwater flow is controlled by the bedrock topography and the amount and type of fill materials that appear to have been used along the north and east side of the Emery Pond (see Figure 4 for flow paths).



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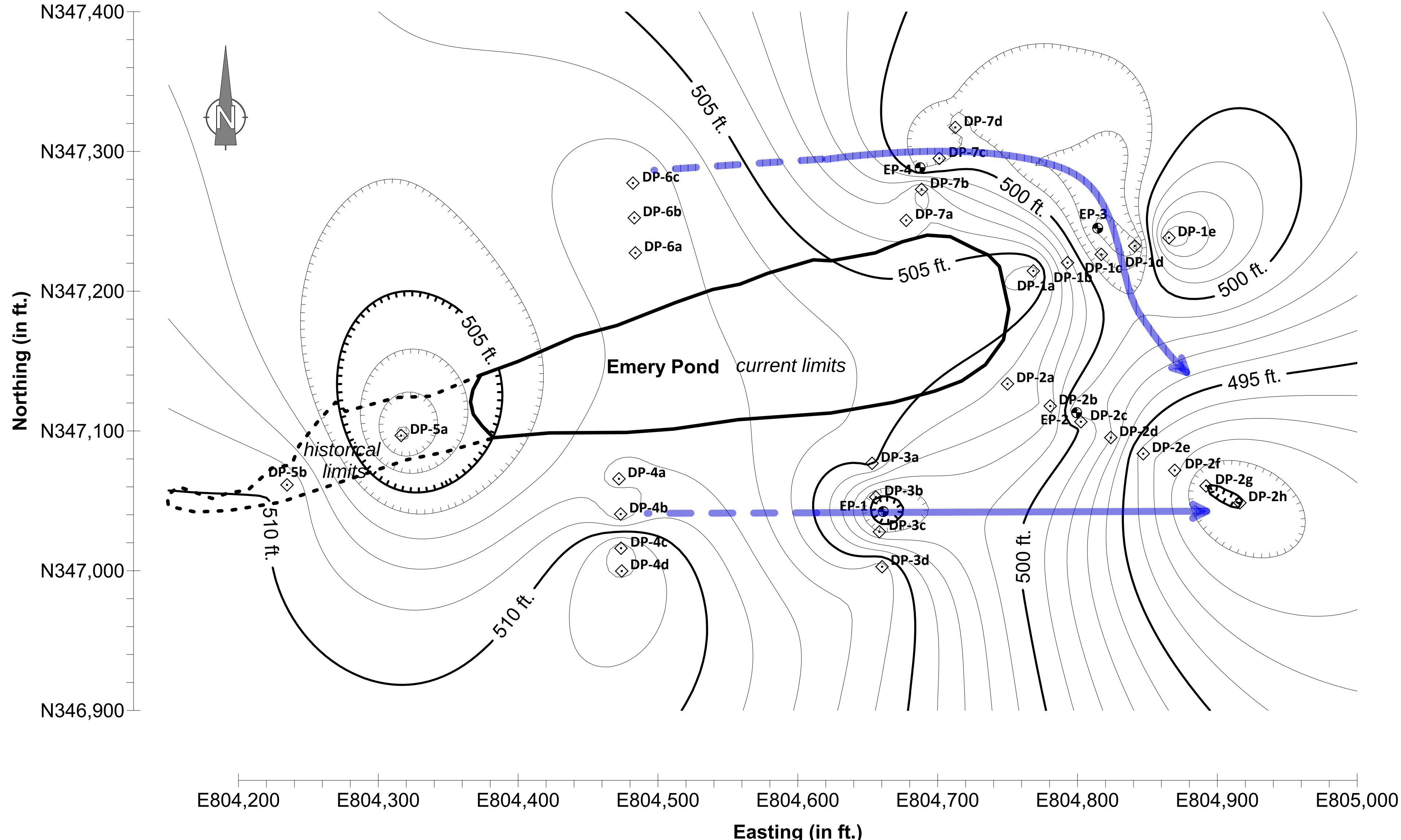
Emery Pond Piper (Tri-linear) Diagram

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE 3



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

Contour Interval = 1 foot
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

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Preferential Flow Paths (Bedrock Surface)

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A FIGURE 4

2. Increasing concentration trends can be observed in several wells for many COCs. The most notable is Sulfate, which has had three consecutive increases in concentration over the past four sampling events. Even EBG has seen concentration increases, although to a lesser degree.

   Note that the Groundwater Protection Evaluation model also shows increasing concentrations prior to the implementation of clean closure. In fact, the model shows concentrations continuing to increase for 2-3 years after CCR removal activities are complete, but then reductions over time.

3. pH levels vary dramatically across the Site, from over 10 SU in the bottom ash fill beneath the Gypsum Loadout Area to just above 6 SU at select points east of the Emery Pond. Hanson is unsure of the mechanism that is buffering the pH levels from one side of the Site to the other.

3. Corrective Action and Selected Remedy

This Corrective Action and Selected Remedy is submitted to address the groundwater exceedances identified in Section 2, above. As part of the Corrective Action Plan, SIPC proposes to close Emery Pond and the adjacent Gypsum Loadout Area by removal, construct a CCR-compliant composite liner system with perimeter drain, and establish of a Groundwater Management Zone (GMZ) pursuant to 35 IAC 620.250(a)(2) to address any Part 620 exceedances due to the Site, including those alleged in Illinois EPA's 2018 Violation Notice.

3.1 Assessment of Corrective Measures

An Assessment of Corrective Measures (ACM) is required by 40 CFR 257.96. This requires an evaluation of the available options to mitigating groundwater impacts at the Site. An evaluation addressing the requirements of 257.96 and 257.97 is summarized in Table 3, Table 4, and Table 5. This evaluation also supports the selected remedy as an adequate and appropriate remedy to address any Part 620 exceedances due to the Site, including those alleged in Illinois EPA's 2018 Violation Notice.

3.2 Proposed Corrective Action

Hanson (2020b) proposes to mitigate any groundwater impacts due to the Emery Pond CCR impoundment and adjacent Gypsum Loadout Area by using multiple alternatives from the Table 3 alternatives. These alternatives are consistent with the federal CCR rule and should lead to timely compliance with the Part 620 groundwater quality standards.

3.2.1 CCR Removal

Hanson (2020b) proposes to remove the CCR from the current footprint of the Emery Pond and any additional CCR located at and beneath the Gypsum Loadout Area. Clean closure (removal of any CCR materials) will be visually confirmed prior to continued construction activities. The CCR removal is expected to remove the source of groundwater monitoring well impacts at the Site, allowing groundwater to improve while the requested GMZ is in effect.

3.2.2 Construction of a CCR Rule Compliant Liner

After removal of the CCR from the current footprint of Emery Pond, a new storm water basin will be constructed within the footprint of then former Emery Pond, which basin will include a CCR Rule compliant composite liner system and a perimeter drainage system located beneath the outside toe of the liner system (Hanson, 2020b). The liner system is not required by the federal CCR rule because regulated CCR is not expected to be discharged to the new basin following CCR removal from the existing pond. However, the liner will be added as a conservative, protective measure at significant expense, and it should eliminate any discharges to groundwater from the new basin. Additionally, the installation of the perimeter toe drain around the base of the basin liner system provides protection from hydraulic pressures to the liner system and provides for collection of groundwater in the vicinity of the new basin. Section 3.9 of the Closure Plan (submitted with this Plan) contains a complete description of the perimeter toe drain.

3.3 Groundwater Monitoring Plan

Groundwater monitoring will continue at the Site. Groundwater monitoring proposed with respect to the Part 620 groundwater standards is detailed in Hanson's (2020c) Groundwater Monitoring Plan that accompanies this Plan. Additionally, assessment monitoring in accordance with 40 CFR 257 will continue. Thus, future monitoring will include both monitoring required by the federal CCR rule, which may be implemented by an Illinois rule once adopted and monitoring proposed to address Part 620 groundwater standard compliance.

3.3.1 Timetable

Active corrective action activities are proposed to coincide with an outage at the Plant in fall 2020. Options listed in Table 3 with earlier dates do not require the outage. See Hanson's (2020b) Closure Plan for details.

Illinois EPA has requested that SIPC obtain certain new or updated permits with respect to certain active remedies described above. Accordingly, SIPC has submitted a permit modification for its NPDES permit and it is currently undergoing review at Illinois EPA Bureau of Water. A 35 IAC 302, Subpart B construction permit application for the new Storm Water Basin (that replaces Emery Pond) is also undergoing review with Illinois EPA Bureau of Water.

In addition to the proposed active remedies, SIPC is also requesting a GMZ and proposing future groundwater monitoring, including to assess the ameliorative impacts of CCR source removal with dispersive and diffusive flux of COCs over time. The duration and scope of the requested GMZ is described in Section 4, below.

4. Application for a Groundwater Management Zone (GMZ)

4.1 Technical Support Documentation

A previously submitted Hydrogeologic Investigation Report (Hanson, 2019a) and Hydrogeologic Investigation Addendum (Hanson, 2019b), as well as an updated Closure Plan (Hanson, 2020b), Groundwater Monitoring Plan (Hanson, 2020c), and Groundwater Protection Evaluation (Hanson, 2020a) submitted with this Plan, support this Plan and GMZ Application. These documents provide descriptions of the site geology, hydrogeology, closure methods, and groundwater monitoring.

4.2 Groundwater Management Zone

As part of this Plan, SIPC requests establishment of a Groundwater Management Zone (GMZ) pursuant to 35 IAC Part 620. As provided in 35 IAC 620.250(a)(2), a GMZ may be established for sites at which the owner or operator undertakes "an adequate corrective action in a timely and appropriate manner and provides a written confirmation to the Agency." A GMZ is defined as "a three-dimensional region containing groundwater being managed to mitigate impairment caused by the release of contaminants from a site." SIPC plans to undertake in the very near future active corrective actions, including CCR removal from the Site and installation of a liner in the new basin, as well as prospective groundwater monitoring to assess the ameliorative impacts of CCR source removal and dispersive and diffusive flux of COCs over time. This corrective action is both timely, considering the ongoing negotiations between Illinois EPA and SIPC in connection with the earlier issued violation notice and federal CCR rule requirements, and adequate to address any groundwater impacts to the Site. Further, as described below, recent investigations confirm that any groundwater impacts are not causing any measurable impact to nearby surface waters.

The horizontal extent of the proposed GMZ is depicted in the Plat found in Appendix D, and contains approximately 7.5 acres. The GMZ does not extend beyond the Plant boundaries. A description of the platted area is also found in Appendix D. Vertically, the GMZ is bounded by the ground surface down to bottom of the upper (weathered) portion of the Bedrock Unit. Hanson has identified this depth as approximately 21.5 ft. BGS at bedrock boring, EBR, or an approximate elevation of 489 ft. The parameters to be covered by the GMZ include the following: Arsenic, Boron, Calcium, Chloride, pH, Sulfate, Selenium, Total Dissolved Solids, Cobalt, Thallium, Iron, Lead, Manganese, and Zinc. Pursuant to the modeling referenced below, the GMZ's expected duration is 27 years.

The Notice of Adequate Corrective Action forms are included in Appendix E.

4.3 Environmental Impact of Proposed Corrective Action

Implementation of this Plan and establishment of the GMZ will have a positive environmental impact. The removal of existing CCR materials and installation of a new CCR Rule compliant liner in the new storm water basin will reduce the impact from the COCs at the Site. The GMZ will remain in place until the groundwater meets applicable Part 620 water quality standards, as established through proposed monitoring.

The Groundwater Protection Evaluation (Hanson, 2020a) submitted herewith assesses groundwater flow and contaminant transport utilizing the USGS MODFLOW groundwater flow model (McDonald and Harbaugh, 1988) and MT3D contaminant transport model (Zheng, 1990) incorporated into the pre- and post-processor software, Processing Modflow X (Simcore, 2020), to evaluate some of the corrective measures options for Emery Pond and determine the time needed for contaminant concentrations to fall below Class I: Potable Resource groundwater standards (35 IAC 620.410). After selecting the CCR removal with Liner with Drain scenario as the appropriate remedy, each of the contaminants of concern were modeled using a worst-case source concentration (maximum observed concentration from various potential sources). Based on these evaluations, it was found that total Boron took the longest to achieve Class I compliance, with concentrations at a compliance point located adjacent to Lake of Egypt returning to below Class I limits at 27 years.

Section 5 of the Groundwater Protection Evaluation (Hanson, 2020a) used calculated surface water concentrations, based on mass flux discharges from groundwater to the General Head Boundary (representing Lake of Egypt), to show no predicted surface water standard exceedances due to any groundwater impacts from the Site.

To substantiate this prediction, samples were collected in June 2020 from Lake of Egypt and analyzed for the COCs. Results are presented in Table 6. Sample locations are shown on Figure 6. Analytical results showed no appreciable differences in analyte concentrations between the five lake samples taken adjacent to Emery Pond and other more distant locations. The Piper diagram (Figure 6) also shows the lake samples clustered with no apparent groundwater mixing trends. In addition, no surface water quality standard exceedances were observed.

Table 3. Corrective Measures Options

Potential Remedies	Pros	Cons	Human Health	Attain GPS	Control Release	Material Removal	Manage RCRA Wastes
Do nothing	• Inexpensive	• Liability	No	No	No	n/a	n/a
Close in Place	• 40 CFR 257 compliant	• Loss of storm water storage	Somewhat	No	Some	n/a	Yes
Clean close	• 40 CFR 257 compliant	• Loss of storm water storage	Protective	Yes	Yes	Yes	Yes
Slurry wall	• Containment of COCs	• Still an unlined CCR impoundment • Working around buried utilities	Protective	Yes	Yes	n/a	n/a
Pump and Treat	• Removal of COCs	• Still an unlined CCR impoundment • Low hydraulic conductivity causes narrow capture zones at wells	Protective	Unk	Unk	n/a	n/a
Pump Station	• No dam or dam permit • Smaller footprint	• Increased O & M • Additional measures to control CCR	Protective	Yes	Unk	n/a	Yes
New Location	• 40 CFR 257 compliant	• Pond unusable during construction • May require dam permit	Protective	Yes	Yes	No	No
Retrofit	• 40 CFR 257 compliant Removes COC source	• Pond unusable during construction • Requires CCR removal • Requires dam permit	Protective	Yes	Yes	Yes	Yes

Table 4. Long and Short-term Effectiveness of Options

Potential Remedies	Reduce Existing Risk	Residual Risk	Long-term Management			Short-term Risk	Completion Date	Potential Receptor Exposure	Long-term Reliability	Need to Replace
			Monitoring	Operation	Maintenance					
Do nothing	No	No	No	n/a	n/a	High	Immediately	High	Low	Likely
Close in Place	Somewhat	No	Some	n/a	Yes	Moderate	Fall 2020	Low	Moderate	Possibly
Clean close	Protective	Yes	Yes	Yes	Yes	Low	Fall 2020	Low	Low	Unlikely
Slurry wall	Protective	Yes	Yes	n/a	n/a	Moderate	Fall 2019	Low	Moderate	Possibly
Pump and Treat	Protective	Unk	Unk	n/a	n/a	Moderate	Fall 2019	Moderate	Moderate	Possibly
Pump Station	Protective	Yes	Unk	n/a	Yes	Low	Fall 2020	Low	Low	Unlikely
New Location	Protective	No	Yes	Yes	Yes	Low	Fall 2020	Low	Low	Unlikely
Retrofit	Protective	Yes	Yes	Yes	Yes	Low	Fall 2020	Low	Low	Unlikely

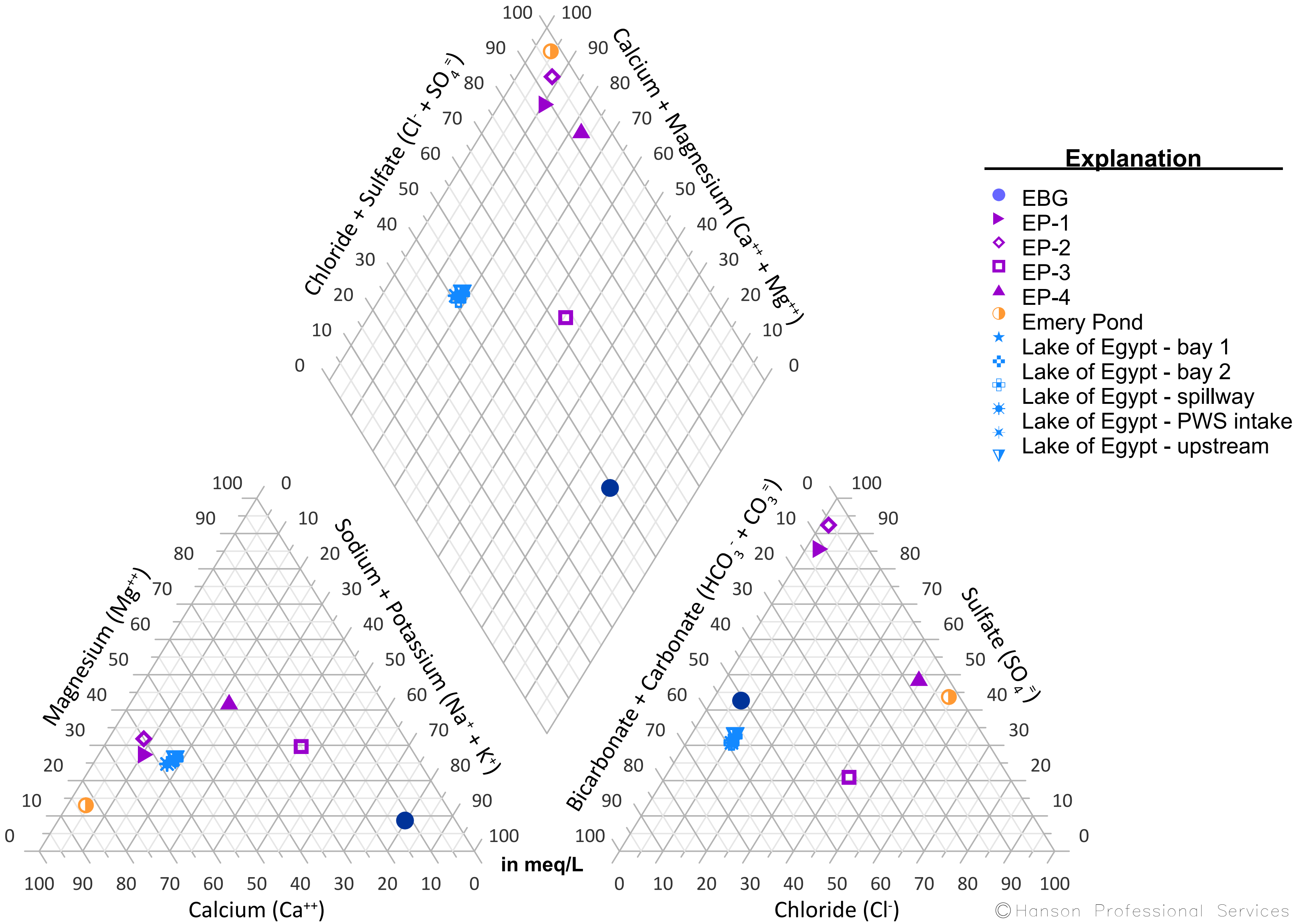
Table 5. Implementation of Options

Potential Remedies	Construction Difficulties	Operational Reliability	Permits & Approvals	Specialty Equip./Eng.	Availability Treatment, Disposal, & Storage
Do nothing	None	n/a	None	None	None
Close in Place	Nothing major	Good	None	None	None
Clean close	Nothing major	Good	None	None	Need disposal site
Slurry wall	Excavation & buried utilities	Good	None	Specialty Contractor	Unknown fill
Pump and Treat	Drilling & well installation	Good	NPDES	Drilling & Pumps	GW discharges
Pump Station	Drilled shafts	Good	Water Treatment permit	Drilling Contractor	Just like pond
New Location	Clean close existing pond	Good	Water Treatment & Dam permits	Geosynthetics	None
Retrofit	Clean close existing pond	Good	Water Treatment & Dam permits	Geosynthetics	None

Illinois EPA has questioned if plant operations and the number of operating units could influence surface water quality. To limit how the calculated results could be interpreted, Hanson (2020a) chose to limit the mixing zone used in the surface water mixing calculations. The bay mixing area shown in Figure 5 does not reach the cooling water intake structure, and therefore groundwater/surface water interactions, based on the calculations in the Groundwater Protection Evaluation, should not be influenced by plant operations.

Table 6. Lake of Egypt Sample Analytical Results

PARAMETER NAME	UNITS	LE-b1	LE-b2	LE-d	LE-in	LE-u
pH (field)	SU	7.09	7.25	7.07	6.57	7.19
Specific Conductivity	µS/cm	139.4	137.1	144.2	173.5	136.2
Temperature	°C	28.2	28.6	28.7	26.7	28.
Dissolved Oxygen	mg/L	5.06	6.21	6.22	4.71	5.65
Oxidation/Reduction Potential	mV	+171.4	+184.7	+172.5	+231.4	+186.7
Turbidity	NTU	3.53	2.88	2.55	4.45	2.54
Arsenic, total	µg/L	<25.	<25.	<25.	<25.	<25.
Barium, total	µg/L	2.52	2.65	2.27	2.34	2.51
Bicarbonate, total	mg/L	38.	38.	39.	39.	38.
Boron, total	µg/L	<20.	<20.	<20.	<20.	<20.
Cadmium, total	µg/L	<1.	<1.	<1.	<1.	<1.
Calcium, total	mg/L	14.1	14.1	13.7	15.4	14.1
Carbonate, total	mg/L	0.	0.	0.	0.	0.
Chloride, total	mg/L	<4.	4.	<4.	<4.	<4.
Chromium, total	µg/L	<5.	<5.	<5.	<5.	<5.
Cobalt, total	µg/L	<5.	<5.	<5.	<5.	<5.
Copper, total	µg/L	<5.	<5.	<5.	<5.	5.6
Fluoride, total	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron, total	mg/L	0.077	0.076	0.056	0.099	0.057
Lead, total	µg/L	<1.	<1.	<1.	<1.	<1.
Magnesium, total	mg/L	3.97	3.98	3.92	3.96	3.97
Manganese, total	µg/L	395.	423.	236.	250.	371.
Mercury, total	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Nickel, total	µg/L	<5.	<5.	<5.	<5.	<5.
Nitrogen, Ammonia, total	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrogen, Nitrate, total	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen, Nitrite, total	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus, total (as P)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium, total	mg/L	1.96	2.	1.94	1.94	2.
Selenium, total	µg/L	<1.	<1.	<1.	<1.	<1.
Silver, total	µg/L	<1.	<1.	<1.	<1.	<1.
Sodium, total	mg/L	4.11	4.16	4.03	4.03	4.13
Sulfate, total	mg/L	16.	17.	16.	16.	17.
Thallium, total	µg/L	<2.	<2.	<2.	<2.	<2.
Total Dissolved Solids	mg/L	60.	56.	44.	56.	46.
Total Suspended Solids	mg/L	<6.	<6.	<6.	<6.	<6.
Zinc, total	µg/L	<10.	<10.	<10.	<10.	<10.



HANSON
Hanson Professional Services Inc.

Lake of Egypt Piper (Tri-linear) Diagram

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A | FIGURE 6

I:\18jobs\18E0022A\Admin\14-Reports\CAP\FIG_5LakeSampleMap_20200717.srf

Revised 7/17/2020 – added Bay Mixing Area and label to figure.

HANSON Hanson Professional Services Inc.	LAKE OF EGYPT SAMPLE LOCATION MAP
	EMERY POND – MARION POWER PLANT SOUTHERN ILLINOIS POWER COOPERATIVE MARION, WILLIAMSON COUNTY, ILLINOIS
	HANSON NO. 18E0022B FIGURE 5

5. Conclusion

Hanson has reviewed the available groundwater data at the Marion Power Plant's Emery Pond and has found concentrations of Arsenic, Boron, Calcium, Chloride, Lead, pH, Sulfate, Thallium, and TDS, above the Class I: Potable Resource Groundwater Standards (35 IAC 620.410) and Class II: General Use Groundwater Standards (35 IAC 620.420). Hanson also found concentrations of Iron, Manganese, and Zinc that were above the Class I and Class II Standards, but the exceedances do not appear attributable to the Site. Hanson believes that groundwater concentrations of Arsenic, Boron, Calcium, Chloride, Cobalt, Lead, pH, Sulfate, Thallium, and TDS, found above the Class I or Class II Standards are the result of pond and contact water migration from Emery Pond and Gypsum Loadout Area.

This Plan proposes to address and mitigate the release of contaminants and resulting groundwater impacts by clean closing the Emery Pond and Gypsum Loadout Area. A new Storm Water Basin will be constructed within the footprint of the current Emery Pond and the Gypsum Loadout Area will be filled with clean earthen materials that meet the requirements of the applicable state and/or federal regulation. By removing the sources of the groundwater impacts, the concentration of contaminants will be reduced over time, as indicated by Hanson's (2020a) contaminant transport modeling. Time for COC concentration levels to drop below Class I: Potable Resource limits is approximately 27 years after closure by removal.

Groundwater monitoring, as required by the CCR Rule will continue after clean closure. Additional groundwater monitoring proposed as part of this Corrective Action and request for a GMZ, is detailed in Hanson's (2020c) Groundwater Monitoring Plan. Prospective groundwater monitoring will assess the expected ameliorative impacts of the corrective actions proposed in this Plan.

6. Licensed Professional Signature/Seal

The geological work product contained in this document has been prepared under my personal supervision and has been prepared and administered in accordance with the standards of reasonable professional skill and diligence.

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Seal:

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ILLINOIS

Expires 31 March 2021

Signature: ______________________ Date: 29 October 2020

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Appendix A

Tabulated Groundwater Monitoring Results

TABLE A-1. Analytical Data for Emery Pond (2017-2018)

			Appendix III Constituents													Appendix IV Constituents															
Analyte Name			Boron		Calcium		Chloride		Fluoride		pH	Sulfate		TDS		Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Fluoride	
Units			mg/L		mg/L		mg/L		mg/L		S.U.	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Downgradient Wells	EP-01	03/23/17	0.13		220.		54.		0.5	U	6.94	820.		2000.		0.0004	J	0.005	U	0.045		0.0002	U	0.005	U	0.005	U	0.0017	J	0.5	U
		04/24/17	0.21		280.		54.		0.5	U	6.89	910.		2300.	H1	0.0002	U	0.005	U	0.04		0.0002	U	0.006		0.005	U	0.0008	J	0.5	U
		05/25/17	0.28		310.		48.		0.5	U	6.55	850.		2300.		0.005	U	0.005	U	0.041		0.005	U	0.01	U	0.01	U	0.005	U	0.5	U
		06/22/17	0.26		310.		50.		0.5	U	6.52	850.		2300.		0.0006	J	0.005	U	0.032		0.0002	U	0.01	U	0.01	U	0.0008	J	0.5	U
		06/29/17	0.32		310.		50.		0.5	U	6.64	440.		2200.		0.001	J	0.005	U	0.033		0.0002	U	0.01	U	0.01	U	0.0006	J	0.5	U
		07/24/17	0.21		270.		51.		0.5	U	6.57	540.		2200.		0.005	U	0.005	U	0.029		0.005	U	0.01	U	0.01	U	0.005	U	0.5	U
		08/01/17	0.23		250.		48.		0.5	U	6.82	520.		2100.		0.0002	U	0.005	U	0.028		0.0002	U	0.01	U	0.01	U	0.0007	J	0.5	U
		08/31/17	0.17		240.		48.		0.5	U	6.79	440.		2100.		0.005	U	0.005	U	0.026		0.005	U	0.01	U	0.01	U	0.005	U	0.5	U
		03/22/18	0.38		330.		60.		0.5	U	6.25	510.		2400.																	
		08/27/18	0.92		410.		63.		0.5	U	6.36	1000.		2700.		0.012	U	0.3	U	0.023	U	0.008	U	0.01	U	0.01	U	0.01	U	0.05	U
	EP-02	03/23/17	0.22		190.		42.		0.5	U	6.18	860.		1800.		0.0003	J	0.005	U	0.039		0.0002	U	0.005	U	0.005	U	0.052		0.5	U
		04/24/17	0.19		170.		39.		0.5	U	6.39	660.		1800.	H1	0.0002	U	0.005	U	0.035		0.0002	U	0.005	U	0.005	U	0.029		0.5	U
		05/25/17	0.2		200.		36.		0.5	U	6.31	780.		1900.		0.005	U	0.005	U	0.038		0.005	U	0.01	U	0.01	U	0.023		0.5	U
		06/22/17	0.23		200.		37.		0.5	U	6.1	780.		1800.		0.0004	J	0.005	U	0.03		0.0002	U	0.01	U	0.01	U	0.016		0.5	U
		06/29/17	0.29		470.		36.		0.5	U	5.75	470.		1900.		0.0007	J	0.005	U	0.029		0.0002	U	0.01	U	0.01	U	0.0087		0.5	U
		07/24/17	0.26		200.		36.		0.5	U	5.86	430.		1800.		0.005	U	0.005	U	0.025		0.005	U	0.01	U	0.01	U	0.005	U	0.5	U
		08/01/17	0.31		190.		36.		0.5	U	5.88	770.		1800.		0.0002	U	0.005	U	0.025		0.0002	U	0.01	U	0.01	U	0.0009	J	0.5	U
		08/31/17	0.23		180.		36.		0.5	U	6.33	340.		1800.		0.005	U	0.005	U	0.025		0.005	U	0.01	U	0.01	U	0.005	U	0.5	U
		03/22/18	0.24		230.		30.		0.5	U	6.27	420.		1700.																	
		08/27/18	0.2		190.		35.		0.5	U	6.28	740.		1800.		0.012	U	0.3	U	0.018		0.008	U	0.01	U	0.01	U	0.01	U	0.5	U
	EP-03	03/23/17	0.11		34.		100.		0.5	U	5.99	120.		680.		0.0002	J	0.005	U	0.072		0.0002	U	0.005	U	0.005	U	0.11		0.5	U
		04/24/17	0.089		29.		120.		0.5	U	5.96	180.		820.	H1	0.0002	U	0.0088		0.059		0.0002	U	0.005	U	0.005	U	0.12		0.5	U
		05/25/17	0.081		45.		140.		0.5	U	6.03	190.		1400.		0.005	U	0.0076		0.059		0.005	U	0.01	U	0.01	U	0.091		0.5	U
		06/22/17	0.057		93.		220.		0.5	U	6.08	300.		560.		0.0003	J	0.0061		0.061		0.0002	U	0.01	U	0.01	U	0.037		0.5	U
		06/29/17	0.085		30.		66.		0.5	U	6.01	73.		570.		0.0009	J	0.005	U	0.065		0.0002	U	0.01	U	0.01	U	0.11		0.5	U
		07/24/17	0.083		32.		110.		0.5	U	5.96	130.		720.		0.005	U	0.0093		0.064		0.005	U	0.01	U	0.01	U	0.12		0.5	U
		08/01/17	0.09		34.		120.		0.5	U	6.02	140.		630.		0.0002	U	0.0062		0.057		0.0002	U	0.01	U	0.01	U	0.1		0.5	U
		08/31/17	0.09		33.		110.		0.5	U	6.13	110.		1000.		0.005	U	0.0069		0.058		0.005	U	0.01	U	0.01	U	0.11		0.5	U
		03/22/18	0.078		34.		110.		0.5	U	6.1	110.		700.																	
		08/27/18	0.082		38.		140.		0.5	U	6.1	150.		690.		0.012	U	0.3	U	0.064		0.008	U	0.01	U	0.01	U	0.088		0.5	U
	EP-04	03/23/17	15.	D	190.		460.		0.5	U	5.51	620.		2300.		0.0003	J	0.035		0.035		0.0002	U	0.005	U	0.005	U	0.39		0.5	U
		04/24/17	23.	D	170.		290.		0.5	U	5.88	530.		2300.	H1	0.0002	U	0.039		0.026		0.0002	U	0.0052		0.005	U	0.41		0.5	U
		05/25/17	14.	D	170.		380.		0.5	U	5.77	660.		2400.		0.005	U	0.037		0.028		0.005	U	0.01	U	0.01	U	0.41		0.5	U
		06/22/17	11.	D	150.		430.		0.5	U	5.8	730.		2000.		0.0003	J	0.053		0.029		0.0002	U	0.01	U	0.01	U	0.44		0.5	U
		06/29/17	13.	D	190.		250.		0.5	U	5.81	410.		2100.		0.0005	J	0.044		0.037		0.0002	U	0.01	U	0.01	U	0.34		0.5	U
		07/24/17	11.	D	160.		180.		0.5	U	5.8	290.		2300.		0.005	U	0.044		0.026		0.005	U	0.01	U	0.01	U	0.41		0.5	U
		08/01/17	14.	D	150.		210.		0.5	U	5.8	330.		2200.		0.0002	U	0.035		0.031		0.0002	U	0.01	U	0.01	U	0.42		0.5	U
		08/31/17	11.	D	150.		210.		0.5	U	5.85	340.		2300.		0.005	U	0.049		0.023		0.005	U	0.01	U	0.01	U	0.38		0.5	U
		03/22/18	13.		200.		200.		0.5	U	6.04	320.		2100.																	
		08/27/18	11.		150.		310.		0.5	U	5.85	520.		1900.		0.012	U	0.3	U	0.023		0.008	U	0.01	U	0.011		0.31		0.5	U
Upgradient Wells	EBG	03/23/17	0.12		23.		55.		0.5	U	6.5	64.		480.		0.0006	J	0.005	U	0.13		0.0003	J	0.005	U	0.006	U	0.008		0.5	U
		04/24/17	0.079		10.		11.		0.5	U	6.8	54.		400.	H1	0.0009	J	0.005	U	0.029		0.0002	U	0.005	U	0.005	U	0.0002	J	0.5	U
		05/25/17	0.1		30.		84.		0.5	U	6.41	42.		440.		0.005	U	0.005	U	0.17		0.005	U	0.01	U	0.01	U	0.014		0.5	U
		06/22/17	0.071		23.		68.		0.5	U	6.45	57.		470.		0.0007	J	0.005	U	0.049		0.0002	U	0.01	U	0.01	U	0.0002	J	0.5	U
		06/29/17	0.073		32.		79.		0.5	U	6.53	50.		280.		0.0014	J	0.005	U	0.086		0.0002	U	0.01	U	0.01	U	0.0014	J	0.5	U
		07/24/17	0.079		37.		27.	M2	0.64	M1	6.59	61.	M2	420.		0.005	U	0.005	U	0.19		0.005	U	0.01	U	0.01	U	0.0093		0.64	M1
		08/01/17	0.074		35.	M3	86.		0.5	U	6.66	45.		380.		0.0002	J	0.005	U	0.18		0.0002	U	0.01	U	0.01	U	0.0038	J	0.5	U
		08/31/17	0.056		35.		82.		0.5	U	6.26	44.		470.		0.005	U	0.005	U	0.16		0.005	U	0.01	U	0.01	U	0.0073		0.5	U
		03/22/18	0.033		14.		12.		0.53		6.35	63.		300.																	
		08/27/18	0.035		15.		16.		0.55		6.57	72.		360.		0.012	U	0.3	U	0.091		0.008	U	0.01	U	0.01	U	0.01	U	0.5	U
GPS Upper Limit			0.1216		46.304		118.631		0.64		6.94	68.6063		550.253		0.005		0.005		0.2491		0.005		0.01		0.01		0.0191		0.64	
GPS Lower Limit											6.11																				

TABLE A-1. Analytical Data for Emery Pond (2017-2018)

Appendix IV Constituents																				
Lead		Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium 226* (pCi/L)			Radium 228* (pCi/L)			Radium 226+228 (pCi/L)		
mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		Result	Uncertainty		Result	Uncertainty		Result	Uncertainty	
0.005	U	0.024	J	0.0002	U	0.0028	J	0.0012	J	0.025	U	0.603	±0.277		0.0552	±0.431	U	0.6582	±0.708	U
0.005	U	0.028	J	0.0002	U	0.0016	J	0.0014	J	0.025	U	0.223	±0.196		0.496	±0.298		0.719	±0.494	
0.01	U	0.1	U	0.0002	U	0.005	U	0.005	U	0.025	U	0.805	±0.22		0.555	±0.448		1.36	±0.668	
0.01	U	0.032	J	0.0002	U	0.0008	J	0.005	J	0.05	U	0.313	±0.176		0.496	±0.245		0.809	±0.421	
0.01	U	0.029	J	0.0002	U	0.0018	J	0.0025	J	0.05	U	0.139	±0.129		0.0387	±0.323	U	0.1777	±0.452	U
0.01	U	0.1	U	0.0002	U	0.005	U	0.005	U	0.05	U	0.16			-0.27			-0.11		
0.01	U	0.024	J	0.0002	U	0.0019	J	0.0011	J	0.05	U	0.38			1.04			1.42		
0.01	U	0.1	U	0.0002	U	0.005	U	0.005	U	0.05	U	0.24			1.15			1.39		
0.01	U	0.1	U	0.0002	U	0.005	U	0.002	U	0.05	U	0.453	±0.384		0.992	±0.899		1.445	±1.283	
0.005	U	0.018	J	0.0002	U	0.0015	J	0.0038	J	0.025	U	0.187	±0.259	U	0.853	±0.396		1.04	±0.655	
0.005	U	0.015	J	0.0002	U	0.0017	J	0.0027	J	0.025	U	0.341	±0.194		0.55	±0.298		0.891	±0.492	
0.01	U	0.1	U	0.0002	U	0.005	U	0.005	U	0.05	U	0.37	±0.15		0.609	±0.224		0.979	±0.374	
0.01	U	0.02	JU	0.0002	U	0.0003	J	0.0074		0.05	U	0.197	±0.142		-0.127	±0.359	U	0.07	±0.501	U
0.01	U	0.025	J	0.0002	U	0.0006	J	0.0061		0.05	U	1.9	±0.416		0.458	±0.303		2.358	±0.719	
0.01	U	0.1	U	0.0002	U	0.005	U	0.0054		0.05	U	0.08			0.4			0.48		
0.01	U	0.021	J	0.0002	U	0.0008	J	0.0046	J	0.05	U	0.14			1.35			1.49		
0.01	U	0.1	U	0.0002	U	0.005	U	0.005	U	0.05	U	0.08			0.64			0.72		
0.01	U	0.1	U	0.0002	U	0.005	U	0.002	U	0.05	U	0.	±0.3	U	0.443	±0.322		0.443	±0.622	U
0.005	U	0.003	U	0.0002	U	0.0004	J	0.013		0.025	U	1.64	±0.517		0.438	±0.471	U	2.078	±0.988	
0.0056	U	0.0095	J	0.0002	U	0.0005	J	0.011		0.025	U	0.338	±0.285		0.0622	±0.587	U	0.4002	±0.872	U
0.01	U	0.1	U	0.0002	U	0.005	U	0.016		0.05	U	0.177	±0.327	U	0.126	±0.485	U	0.303	±0.812	U
0.01	U	0.12		0.0002	U	0.0002	U	0.028		0.05	U	0.355	±0.178		0.42	±0.259		0.775	±0.437	
0.01	U	0.012	J	0.0002	U	0.0002	U	0.013		0.05	U	0.317	±0.178		0.397	±0.364		0.714	±0.542	
0.01	U	0.1	U	0.0002	U	0.005	U	0.016		0.05	U	0.19			0.77			0.96		
0.01	U	0.028	j	0.0002	U	0.0005	J	0.012		0.05	U	0.46			2.42			2.88		
0.01	U	0.1	U	0.0002	U	0.005	U	0.022		0.05	U	0.41			0.77			1.18		
0.01	U	0.1	U	0.0002	U	0.005	U	0.002	U	0.05	U	0.679	±0.682	U	0.717	±0.403		1.396	±1.085	
0.009		0.0044	J	0.0002	U	0.0009	J	0.13		0.025	U	1.1	±0.489		0.442	±0.442		1.542	±0.931	
0.013		0.0062	J	0.0002	U	0.0011	J	0.12		0.065		0.715	±0.399		1.92	±0.406		2.635	±0.805	
0.011		0.1	U	0.0002	U	0.005	U	0.13		0.092		1.	±0.142		0.633	±0.36		1.633	±0.502	
0.017		0.0047	J	0.0002	U	0.0002	U	0.2		0.094		0.18	±0.13		0.897	±0.354		1.077	±0.484	
0.01	U	0.0063	J	0.0002	U	0.0006	J	0.13		0.058		0.219	±0.172		0.49	±0.32		0.709	±0.492	
0.011		0.1	U	0.0002	U	0.005	U	0.13		0.3		0.3			0.44			0.74		
0.012		0.0053	J	0.0002	U	0.001	J	0.11		0.075		0.15			0.96			1.11		
0.012		0.1	U	0.0002	U	0.005	U	0.16		0.075		0.33			2.14			2.47		
0.015		0.1	U	0.0002	U	0.005	U	0.021		0.14		0.262	±0.364	U	0.79	±0.384		1.052	±0.748	
0.005	U	0.0046	J	0.0002	U	0.0034	J	0.0019	J	0.025	U	0.878	±0.42		1.06	±0.33		1.938	±0.75	
0.005	U	0.0074	J	0.0002	U	0.0043	J	0.0005	U	0.025	U	1.17	±0.205		0.353	±0.416	U	1.523	±0.621	
0.01	U	0.1	U	0.0002	U	0.005	U	0.005	U	0.05	U	0.0457	±0.278	U	0.864	±0.289		0.9097	±0.567	
0.01	U	0.028	J	0.0002	U	0.0017	J	0.0036	J	0.05	U	0.262	±0.189		0.0695	±0.21	U	0.3315	±0.399	U
0.01	U	0.059	J	0.0002	U	0.0016	J	0.0019	J	0.05	U	0.245	±0.199		0.371	±0.289		0.616	±0.488	
0.01	U	0.1	U	0.0002	U	0.005	U	0.005	U	0.05	U	0.43			0.98			1.41		
0.01	U	0.082	J	0.0002	U	0.0024	J	0.0028	J	0.05	U	0.28			1.24			1.52		
0.01	U	0.1	U	0.0002	U	0.005	U	0.007		0.05	U	0.77			2.22			2.99		
0.01	U	0.1	U	0.0002	U	0.005	U	0.002	U	0.05	U	0.933	±0.543		0.447	±0.378		1.38	±0.921	
0.01		**0.1**		**0.0002**		**0.005**		**0.007**		**0.05**		**1.2076**			**2.7454**			**4.0038**		

(shaded) Statistically significant increase (SSI) over baseline sampling using well specific and parameter specific statistical limits.

TDS = Total Dissolved Solids
NA = Not Analyzed
mg/L = milligrams per liter
S.U. = Standard Units
pCi/L = picoCurie/liter
D = Dilution
J = The analyte was positively identified, but the quantitation was 'below The RL.
U = analyte analyzed for but not detected
* = "U" flag for radionuclides is not detected above the minimum detectable concentration which differs from similar flag for aqueous results.
M1 = Matrix Spike recovery outside Control Limits due to sample matrix interference; biased high.
M2 = Matrix Spike recovery outside Control Limits due to sample Matrix interference; biased low
M3 = Analyte in the parent sample for the Matrix Spike was >4x the concentration of the spike solution which renders the spike amount insignificant. Matrix spike recoveries do not impact the quality of the parent sample data for this analyte.
H1 = Sample received outside of holding time for these analyses.

TABLE A-2. Extent of Contamination Study Results (2019)

PARAMETER NAME	UNITS	Class II Std	No. of Exceedances	EBG	EP-3	DP1a	DP1b	DP1c	DP1d	DP1e	EP-2	DP2a	DP2b	DP2c	DP2d	DP2e
Conductivity	µmhos/cm							3420.	1560.	4080.			3230.	2560.	1750.	1760.
pH	SU	6.5 - 9.0	9	6.85	6.11			6.28	6.16	7.74	6.62		6.92	7.06	6.61	6.94
Temperature	°C			8.9	17.2			11.8	8.9	5.6	13.5		13.3	12.8	13.3	12.2
Alkalinity, Bicarbonate, total	mg/L			160.	400.			350.	410.	9500.	140.		440.	470.	1300.	1620.
Alkalinity, Carbonate, total	mg/L			<5.	<5.			0.	0.	0.	<5.		0.	0.	0.	0.
Antimony, total	mg/L	0.024	0	<0.001	<0.001			<0.002	0.001	0.0008	<0.001		0.0011	<0.004	0.0008	0.001
Arsenic, total	mg/L	0.2	5	<0.0012	0.0068			0.163	0.28	0.0884	<0.001		0.0325	0.0941	0.012	0.0546
Barium, total	mg/L	2.	11	0.064	0.036			5.5	5.86	2.05	<0.01		0.316	2.9	0.276	0.78
Beryllium, total	mg/L	0.5	0	<0.0004	<0.001			0.0265	0.0345	0.0258	<0.001		0.0027	0.0245	0.001	0.0049
Boron, total	mg/L	2.	10	0.041	<0.1			5.16	0.404	7.29	0.35		0.157	<0.04	0.0627	0.013
Cadmium, total	mg/L	0.05	3	<0.01	<0.01			0.0032	0.0125	0.545	<0.01		0.0012	0.0012	0.0016	0.0007
Calcium, total	mg/L			13.	62.			892.	433.	16700.	280.		480.	343.	271.	285.
Chloride, total	mg/L	200.	14	12.	160.			368.	281.	454.	25.		54.	62.	62.	77.
Chromium, total	mg/L	1.	4	<0.01	<0.01			0.785	1.11	<0.015	<0.01		0.0839	0.606	0.0232	0.168
Cobalt, total	mg/L	1.	2	<0.0038	0.063			0.56	0.668	1.1	0.0005		0.131	0.225	0.0927	0.0806
Copper, total	mg/L	0.65	6	<0.0045	0.0012			0.552	0.936	2.32	0.0007		0.0541	0.341	0.0269	0.0714
Cyanide, total	mg/L	0.6	0	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Fluoride, total	mg/L	4.	1	<0.5	<0.5			0.23	0.1	1.02	<0.5		0.49	0.3	0.49	0.26
Iron, total	mg/L	5.	25	4.4	57.			946.	1370.	592.	0.15		81.6	583.	24.3	177.
Lead, total	mg/L	0.1	15	<0.01	<0.01			0.632	0.949	3.28	<0.01		0.053	0.29	0.0239	0.0979
Magnesium, total	mg/L			6.1	54.			224.	159.	1860.	96.		195.	149.	64.6	77.
Manganese, total	mg/L	10.	16	0.65	8.			26.7	53.4	71.	0.064		12.3	10.3	6.83	6.02
Mercury, total	mg/L	0.01	2	<0.0002	<0.0002			0.0012	0.0015	0.0184	<0.0002		0.0001	0.0009	<0.0002	0.0001
Nickel, total	mg/L	2.	2	<0.0049	0.016			0.617	0.747	2.04	0.0061		0.201	0.367	0.115	0.115
Nitrogen, Nitrate, total	mg/L	100.	0	0.68	<0.11			0.084	0.052	0.551	1.		0.154	0.065	0.036	0.039
Potassium, total	mg/L			6.2	3.3			25.1	37.6	75.7	4.5		7.92	17.6	3.86	8.59
Selenium, total	mg/L	0.05	5	<0.0068	0.0007			<0.04	<0.004	<0.02	0.006		0.0012	<0.01	0.0006	<0.001
Silver, total	mg/L		0	<0.001	<0.001			<0.014	<0.014	<0.035	<0.001		<0.007	<0.014	<0.007	<0.007
Sodium, total	mg/L			100.	190.			122.	73.	262.	120.		142.	269.	95.6	195.
Sulfate, total	mg/L	400.	21	74.	220.			1250.	296.	1640.	1100.		1370.	732.	478.	379.
Thallium, total	mg/L	0.02	3	<0.05	<0.05			0.0049	0.0062	0.0441	<0.05		<0.002	<0.008	<0.002	0.001
Total Dissolved Solids (TDS)	mg/L	1200.	22	350.	1300.			2590.	1040.	3400.	1900.		2810.	1880.	1260.	1160.
Vanadium, total	mg/L	0.1	20	<0.0079	0.0012			1.1	1.52	<0.01	0.0011		0.111	0.822	0.0398	0.211
Zinc, total	mg/L	5.	3	<0.021	0.011			1.52	2.45	27.3	0.0049		0.298	0.882	0.195	0.214

CCR (Appendix III or IV) parameter =	*Lead, total*
Upgradient monitoring well =	**EBG**
Downgradient monitoring well =	**EP-3**
Extent investigation boring =	**DP2c**
Concentration exceeds Class II Std. =	65.
Insuficient water to sample =	

Some CCR parameters (Lithium, Molybdenum, & Radium 226/228) do not have Class II GW Standards

TABLE A-2. Extent of Contamination Study Results (2019)

PARAMETER NAME	UNITS	Class II Std	No. of Exceedances	DP2f	DP2g	DP2h	EP-1	DP3a	DP3b	DP3c	DP3d	DP4a	DP4b	DP4c	DP4d	DP5a
Conductivity	µmhos/cm			1630.	869.	733.		1980.	3320.	3060.	672.				512.	8540.
pH	SU	6.5 - 9.0	9	7.06	6.41	6.03	6.33	7.23	7.11	7.21	7.38				7.07	12.5
Temperature	°C			12.8	12.5	12.2	13.9	10.7	12.1	12.9	10.7				8.8	13.8
Alkalinity, Bicarbonate, total	mg/L			690.	120.	120.	240.	560.	480.	470.	70.				50.	n/a
Alkalinity, Carbonate, total	mg/L			0.	0.	0.	<5.	0.	0.	0.	0.				0.	840.
Antimony, total	mg/L	0.024	0	0.0009	0.0049	<0.004	<0.005	<0.002	<0.004	0.0008	0.0006				0.0009	0.0027
Arsenic, total	mg/L	0.2	5	0.11	0.07	0.0681	<0.005	0.0989	0.0882	0.0281	0.0355				0.043	0.0214
Barium, total	mg/L	2.	11	4.87	1.68	3.41	<0.01	2.2	2.83	0.641	0.589				0.91	0.288
Beryllium, total	mg/L	0.5	0	0.006	0.0082	0.0207	<0.005	0.0128	0.018	0.0023	0.0036				0.0043	0.003
Boron, total	mg/L	2.	10	<0.02	0.014	<0.04	0.73	0.054	<0.04	<0.02	<0.02				0.0324	0.854
Cadmium, total	mg/L	0.05	3	0.0024	<0.002	0.0025	<0.01	0.0019	0.0023	0.0008	<0.002				0.0005	0.0031
Calcium, total	mg/L			97.1	96.9	86.1	390.	376.	446.	209.	34.2				67.2	1360.
Chloride, total	mg/L	200.	14	148.	48.	31.	70.	224.	150.	226.	7.				4.	848.
Chromium, total	mg/L	1.	4	0.155	0.274	0.574	<0.01	0.395	0.473	0.0754	0.138				0.108	0.0345
Cobalt, total	mg/L	1.	2	0.127	0.321	0.466	0.0004	0.136	0.225	0.0454	0.0594				0.0587	0.0089
Copper, total	mg/L	0.65	6	0.0901	0.208	0.604	0.0009	0.246	0.31	0.0369	0.0657				0.0982	0.0455
Cyanide, total	mg/L	0.6	0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.005	<0.005
Fluoride, total	mg/L	4.	1	0.38	0.44	0.14	<0.5	0.58	0.32	0.23	0.18				0.18	0.05
Iron, total	mg/L	5.	25	253.	329.	546.	0.44	389.	519.	84.7	122.				128.	18.
Lead, total	mg/L	0.1	15	0.0956	0.157	0.414	<0.01	0.183	0.289	0.037	0.0593				0.0621	0.0676
Magnesium, total	mg/L			45.2	54.4	85.2	160.	129.	177.	90.3	24.2				40.3	5.16
Manganese, total	mg/L	10.	16	37.7	23.8	33.8	0.035	8.44	13.7	4.38	1.79				2.61	0.312
Mercury, total	mg/L	0.01	2	0.0001	0.0006	0.0017	<0.0002	0.0007	0.0008	0.0001	0.0002				0.0002	0.0007
Nickel, total	mg/L	2.	2	0.225	0.236	0.449	0.0066	0.329	0.404	0.0728	0.0931				0.127	0.0415
Nitrogen, Nitrate, total	mg/L	100.	0	0.035	0.023	0.059	<0.11	0.112	0.079	0.068	1.1				0.113	0.341
Potassium, total	mg/L			5.93	18.9	17.6	4.6	11.6	15.2	4.95	4.5				6.13	545.
Selenium, total	mg/L	0.05	5	<0.001	<0.001	0.0027	<0.005	<0.01	<0.01	0.0023	0.0083				<0.001	0.0762
Silver, total	mg/L		0	<0.007	<0.007	<0.007	<0.001	<0.007	<0.007	<0.007	<0.007				<0.007	<0.007
Sodium, total	mg/L			303.	85.4	61.1	180.	234.	322.	331.	104.				26.3	211.
Sulfate, total	mg/L	400.	21	167.	222.	213.	1600.	724.	1270.	651.	254.				234.	1270.
Thallium, total	mg/L	0.02	3	0.0015	0.0013	0.0057	<0.05	0.0021	0.0033	<0.002	<0.002				0.0017	0.0023
Total Dissolved Solids (TDS)	mg/L	1200.	22	1030.	555.	500.	2800.	1230.	2520.	2140.	470.				365.	4520.
Vanadium, total	mg/L	0.1	20	0.31	0.397	0.727	<0.025	0.415	0.602	0.0902	0.166				0.175	0.178
Zinc, total	mg/L	5.	3	0.26	0.504	1.18	<0.01	0.682	0.896	0.117	0.195				0.503	0.196

CCR (Appendix III or IV) parameter =	*Lead, total*
Upgradient monitoring well =	EBG
Downgradient monitoring well =	EP-3
Extent investigation boring =	DP2c
Concentration exceeds Class II Std. =	65.
Insuficient water to sample =	

Some CCR parameters (Lithium, Molybdenum, & Radium 226/228) do not have Class II GW Standards

TABLE A-2. Extent of Contamination Study Results (2019)

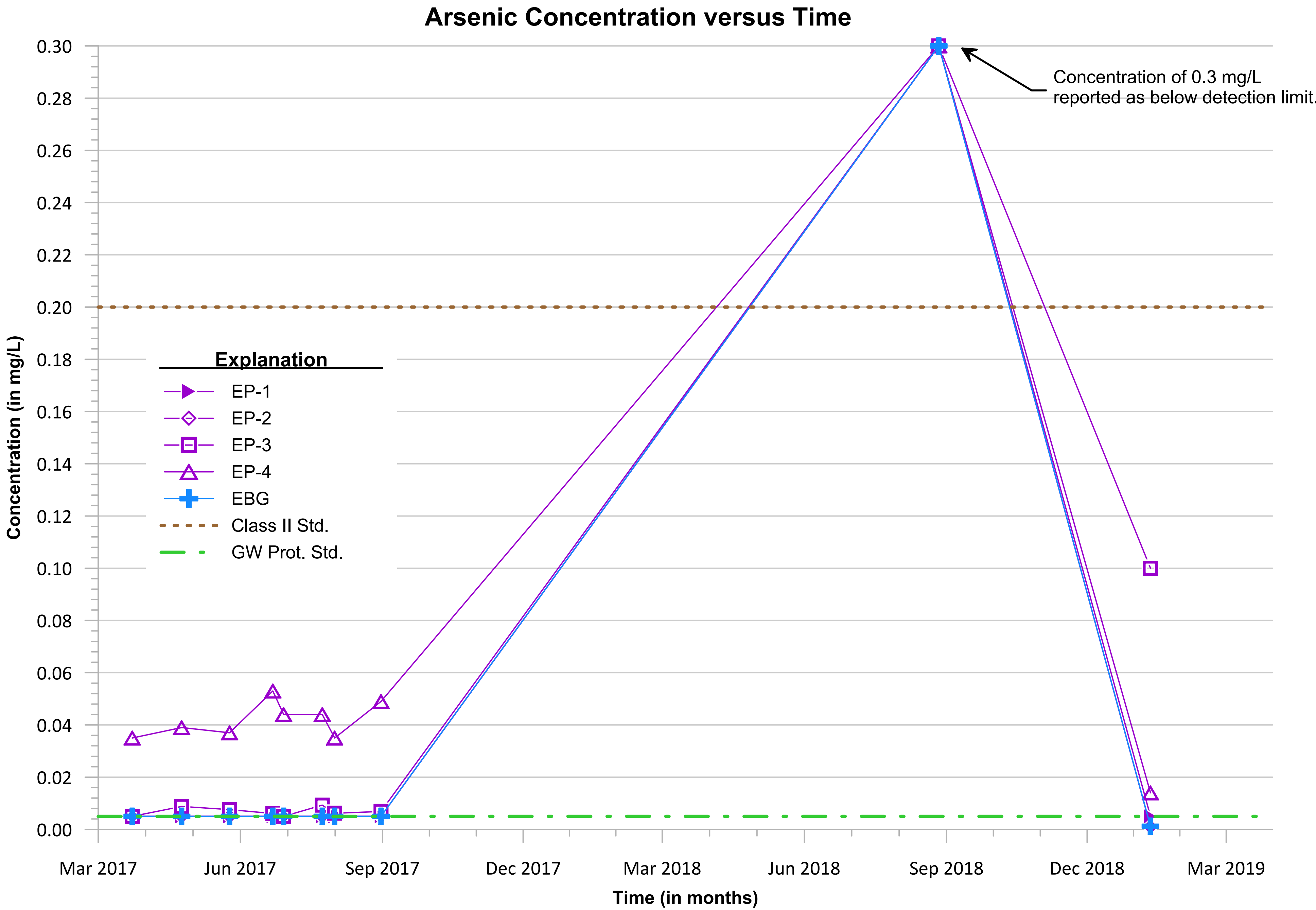
PARAMETER NAME	UNITS	Class II Std	No. of Exceedances	DP5b	DP6a	DP6b	DP6c	EP-4	DP7a	DP7b	DP7c	DP7d	Emery Pond	Gypsum
Conductivity	µmhos/cm			6020.	5160.		3380.		4000.	3580.	3210.	2470.	9630.	
pH	SU	6.5 - 9.0	9	10.6	6.48		7.11	6.07	6.51	6.61	6.44	6.66	7.77	
Temperature	°C			9.9	6.3		5.8	16.	9.7	7.6	9.8	8.9	17.3	
Alkalinity, Bicarbonate, total	mg/L			1260.	1320.		72700.	110.	294.	750.	500.	754.	100.	16.
Alkalinity, Carbonate, total	mg/L			200.	0.		0.	<5.	0.	0.	0.	0.	0.	0.
Antimony, total	mg/L	0.024	0	0.0096	<0.01		0.0018	<0.005	<0.004	<0.01	<0.002	<0.01	0.0007	<0.001
Arsenic, total	mg/L	0.2	5	0.181	0.359		0.188	0.014	1.1	1.64	0.339	0.14	0.0025	<0.01
Barium, total	mg/L	2.	11	1.32	3.22		1.48	0.024	1.49	1.59	2.84	2.46	0.121	0.0111
Beryllium, total	mg/L	0.5	0	0.019	0.083		0.0091	<0.005	0.037	0.06	0.0171	0.0226	<0.0005	<0.0005
Boron, total	mg/L	2.	10	4.88	14.		8.09	12.	3.38	3.38	6.9	0.06	72.7	0.498
Cadmium, total	mg/L	0.05	3	0.018	0.127		0.0147	<0.01	0.0565	0.044	0.0053	0.0005	0.019	<0.002
Calcium, total	mg/L			2820.	1850.		6180.	140.	2000.	2870.	505.	331.	899.	629.
Chloride, total	mg/L	200.	14	1210.	980.		309.	420.	380.	371.	495.	129.	2190.	15.
Chromium, total	mg/L	1.	4	0.328	1.52		0.702	<0.01	1.39	1.95	0.457	0.681	0.0075	0.0149
Cobalt, total	mg/L	1.	2	0.0895	3.87		0.173	0.39	0.421	0.658	0.547	0.281	0.0149	<0.005
Copper, total	mg/L	0.65	6	0.325	1.43		1.1	0.0016	2.12	3.27	0.48	0.292	0.0077	<0.005
Cyanide, total	mg/L	0.6	0	<0.005	<0.005		<0.025	<0.005	<0.005	0.003	0.004	<0.005	0.183	<0.005
Fluoride, total	mg/L	4.	1	0.15	0.21		2.26	<0.5	1.26	0.3	0.14	0.43	17.1	1.67
Iron, total	mg/L	5.	25	177.	1780.		332.	230.	1570.	2660.	824.	780.	0.899	0.0719
Lead, total	mg/L	0.1	15	0.527	1.87		0.375	<0.01	2.47	5.17	0.583	0.319	0.0026	<0.0075
Magnesium, total	mg/L			42.1	470.		495.	120.	322.	499.	211.	114.	673.	4.45
Manganese, total	mg/L	10.	16	2.85	112.		11.8	77.	30.7	53.4	45.1	12.3	4.56	0.0444
Mercury, total	mg/L	0.01	2	0.0129	0.0078		0.0014	<0.0002	0.0099	0.0069	0.0006	0.0005	0.0004	<0.0002
Nickel, total	mg/L	2.	2	0.348	2.23		0.513	0.056	1.45	1.45	0.476	0.39	0.118	0.01
Nitrogen, Nitrate, total	mg/L	100.	0	0.235	0.336		0.334	<0.11	0.122	0.033	0.185	<0.05	4.86	<0.05
Potassium, total	mg/L			488.	61.5		20.4	2.7	51.9	66.2	18.	15.	8.66	0.11
Selenium, total	mg/L	0.05	5	0.137	0.0288		0.0347	<0.005	0.407	0.304	<0.002	0.0083	0.082	0.0462
Silver, total	mg/L		0	<0.007	<0.07		<0.035	<0.001	<0.014	<0.035	<0.014	<0.007	<0.007	<0.007
Sodium, total	mg/L			158.	136.		189.	110.	149.	169.	134.	218.	408.	2.68
Sulfate, total	mg/L	400.	21	1200.	1640.		1680.	740.	1790.	1590.	1040.	485.	2000.	1350.
Thallium, total	mg/L	0.02	3	0.0089	0.0251		0.0032	0.097	0.0059	<0.02	0.0044	<0.004	0.002	<0.002
Total Dissolved Solids (TDS)	mg/L	1200.	22	4080.	3700.		3220.	2000.	3240.	2900.	2450.	1640.	6540.	2140.
Vanadium, total	mg/L	0.1	20	1.01	2.47		0.508	<0.025	1.59	2.34	0.761	0.659	0.0161	<0.01
Zinc, total	mg/L	5.	3	1.69	4.88		2.79	0.02	6.06	7.75	1.72	0.913	0.215	<0.01

CCR (Appendix III or IV) parameter =	*Lead, total*
Upgradient monitoring well =	**EBG**
Downgradient monitoring well =	**EP-3**
Extent investigation boring =	**DP2c**
Concentration exceeds Class II Std. =	65.
Insuficient water to sample =	

Some CCR parameters (Lithium, Molybdenum, & Radium 226/228) do not have Class II GW Standards

Appendix B

Graphical Groundwater Monitoring Results



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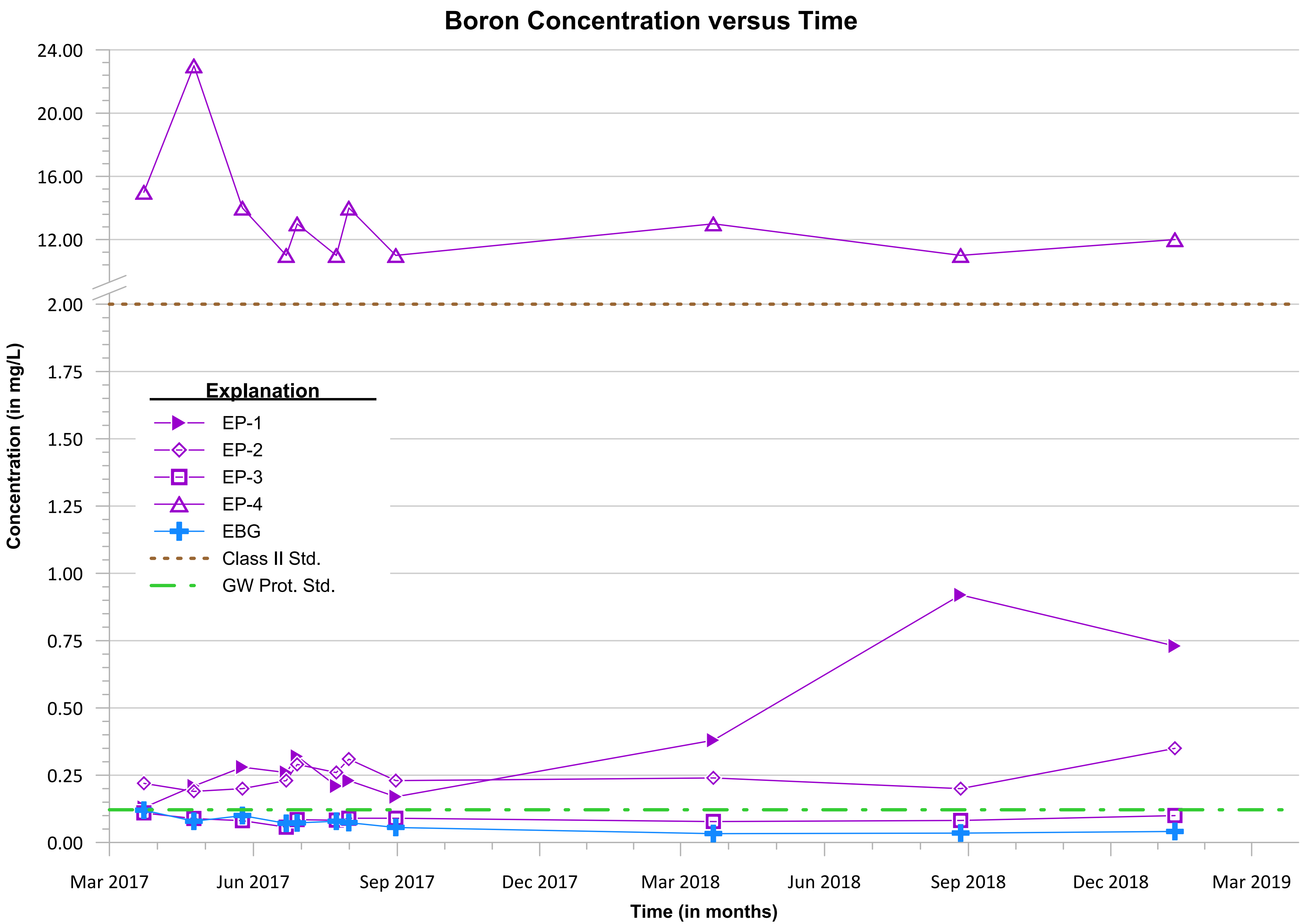

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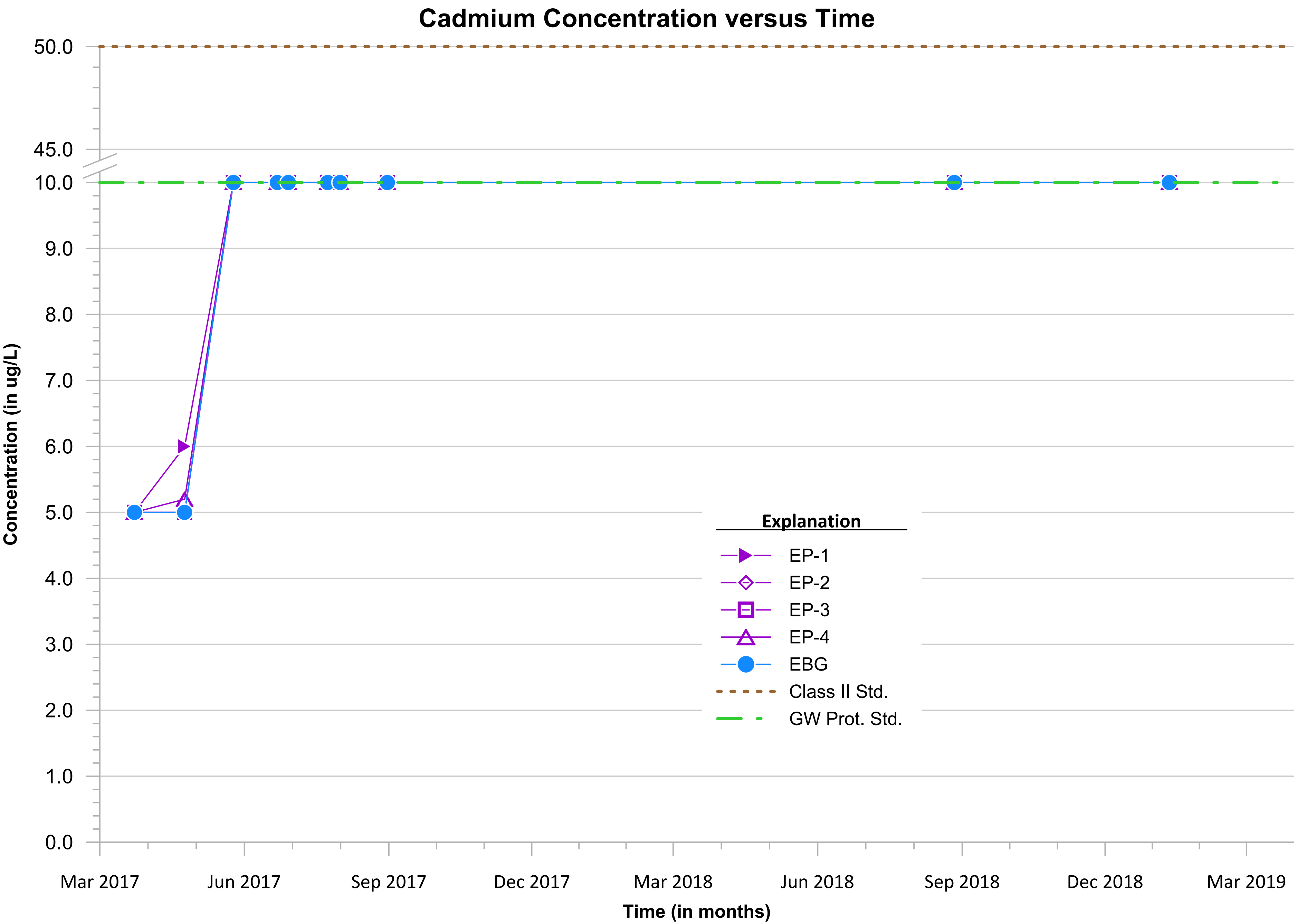

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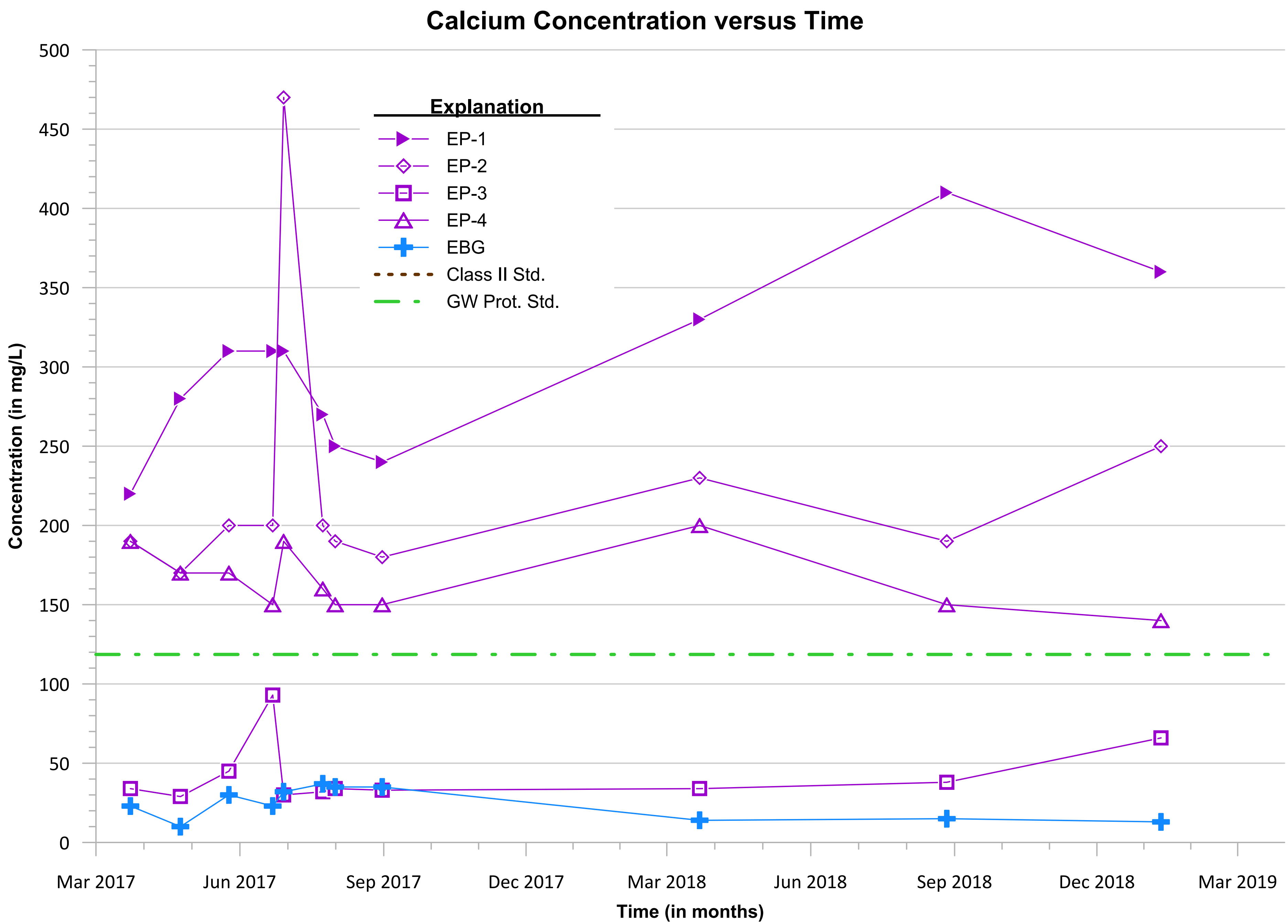

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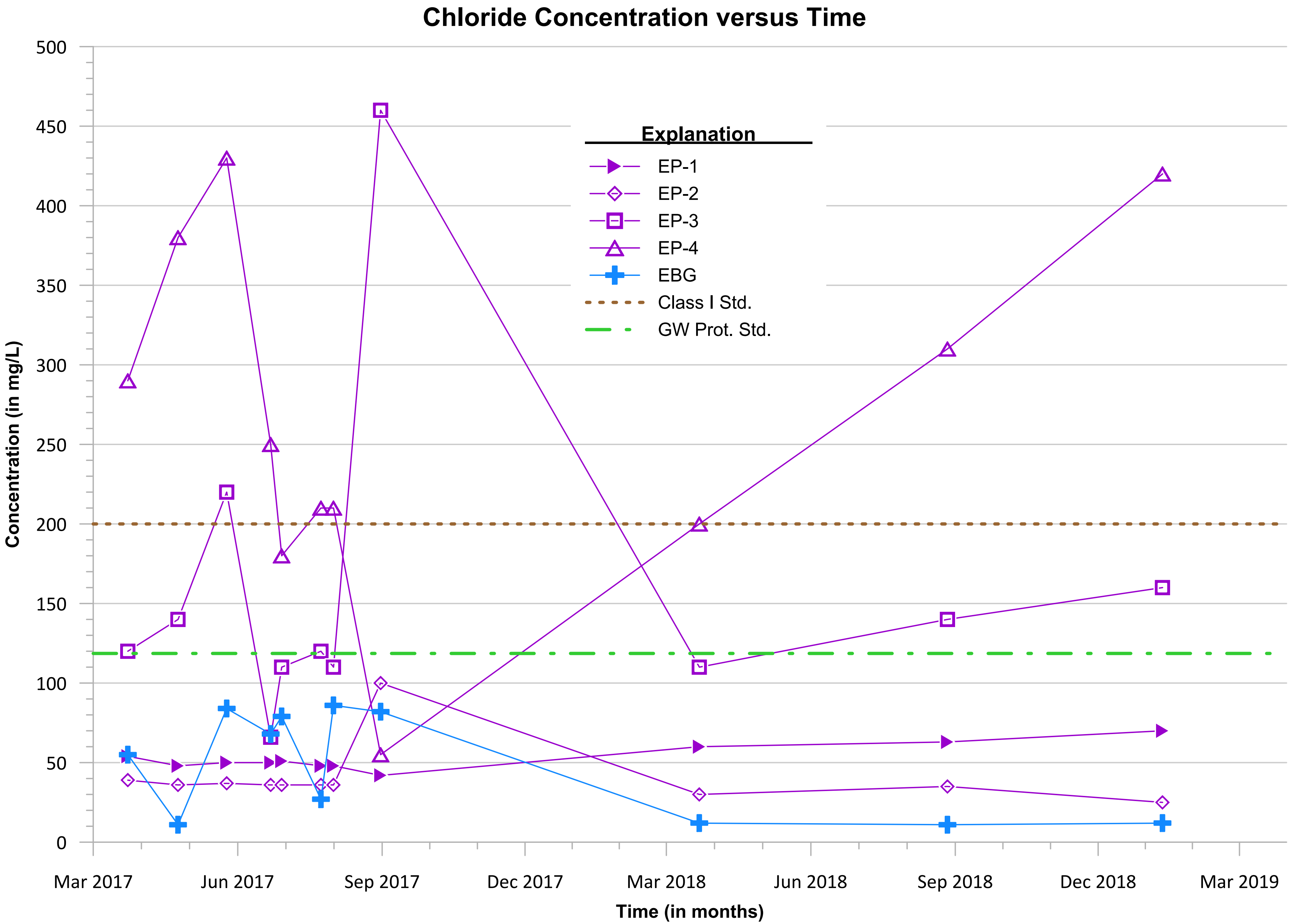

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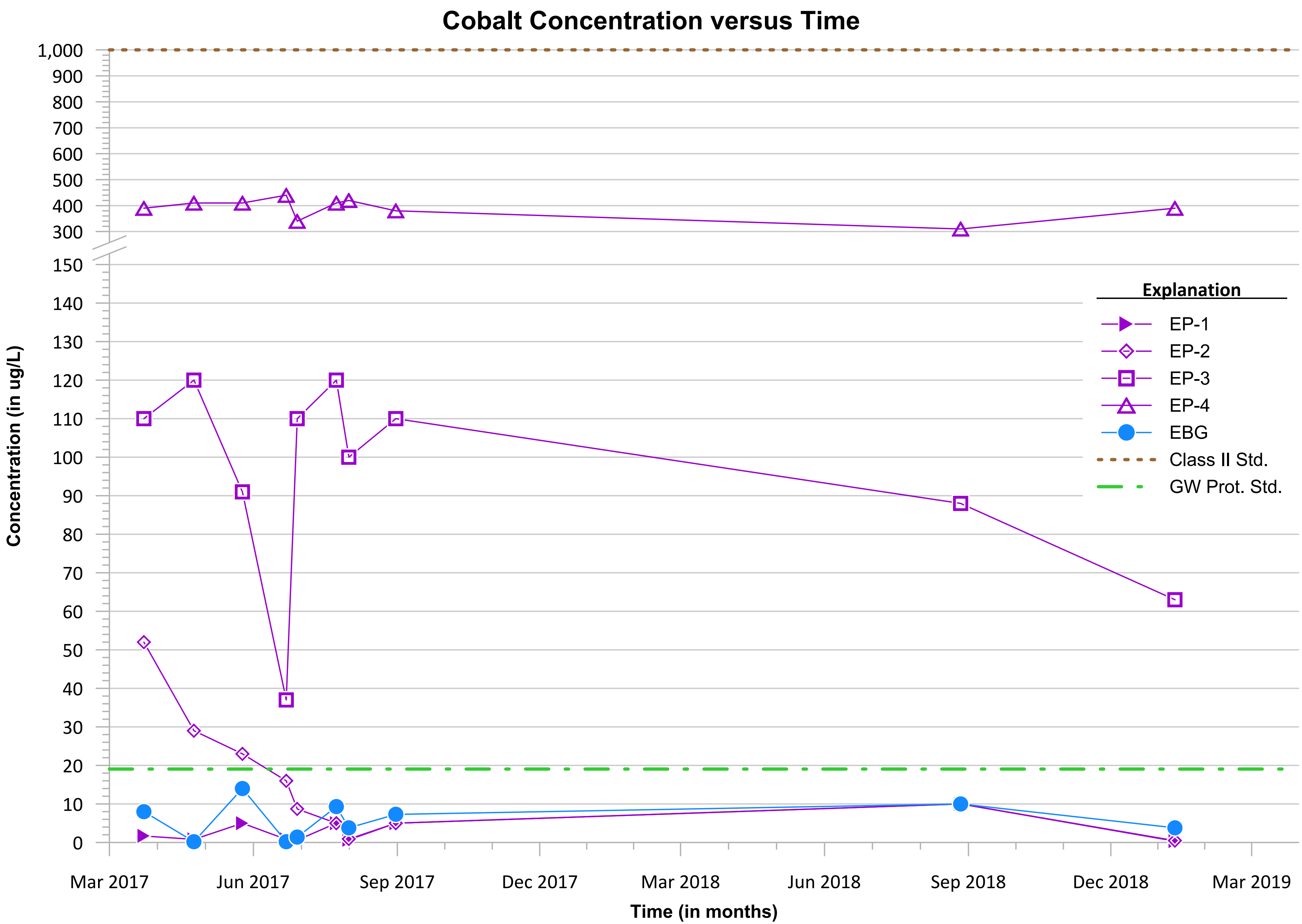

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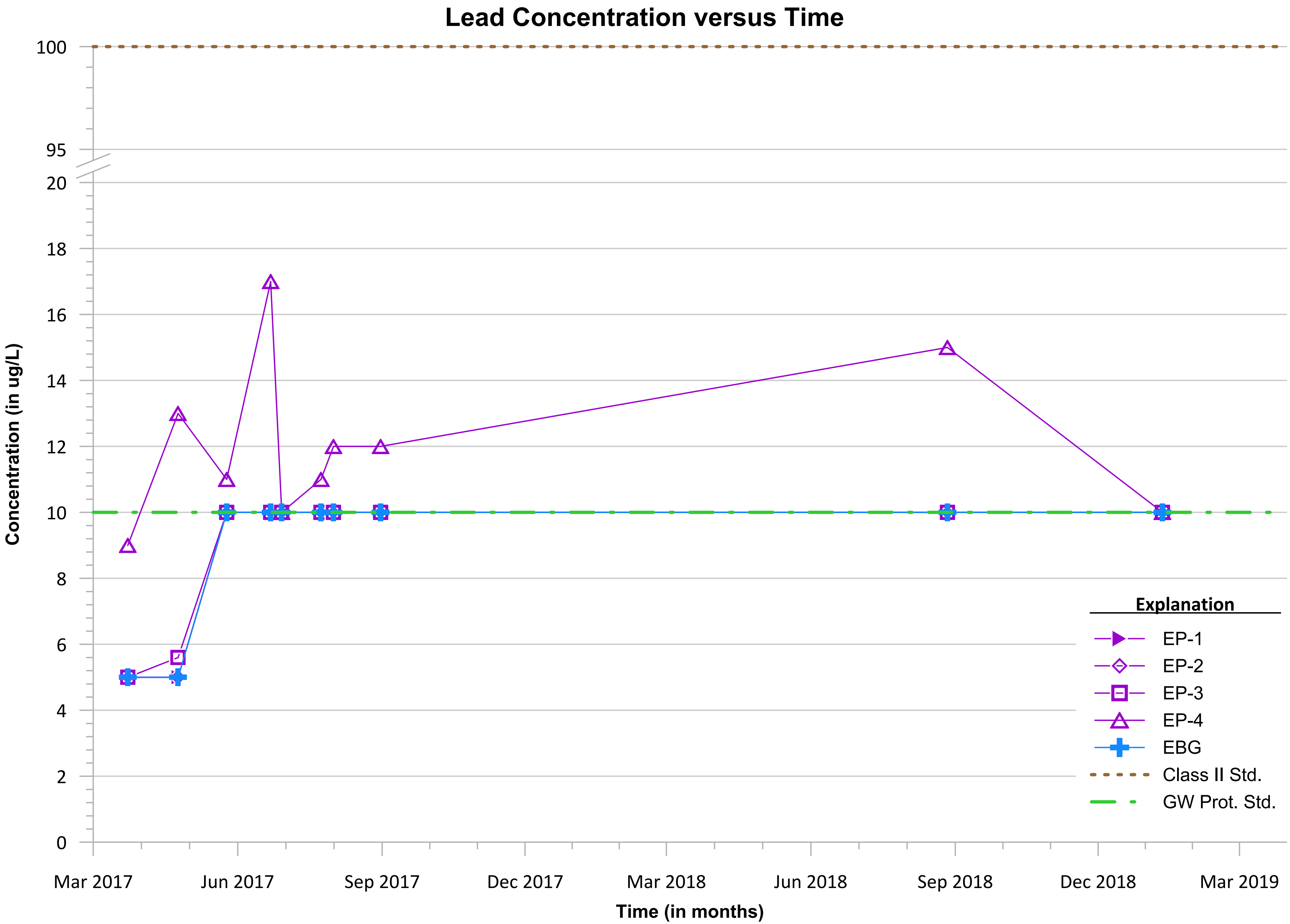

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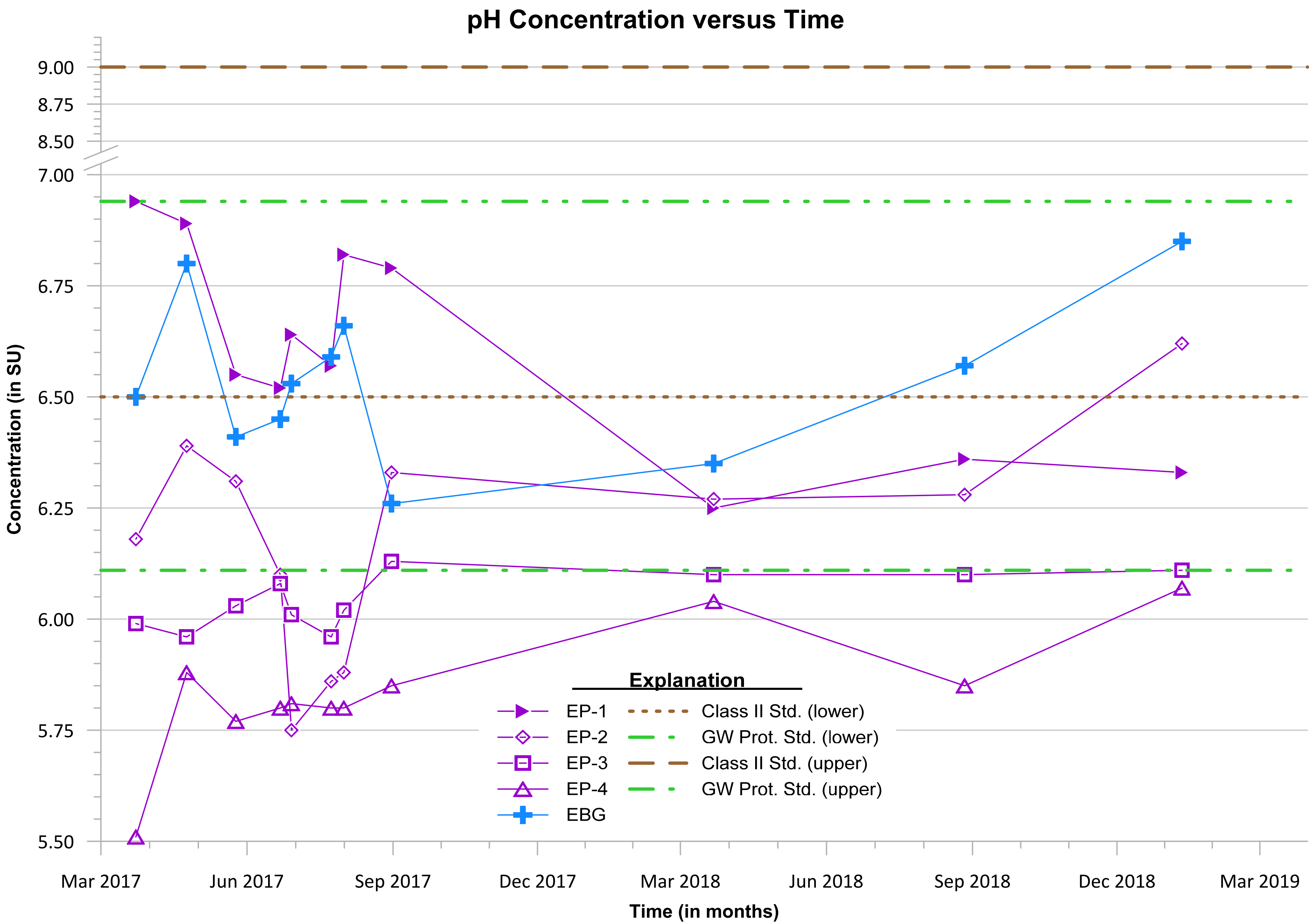

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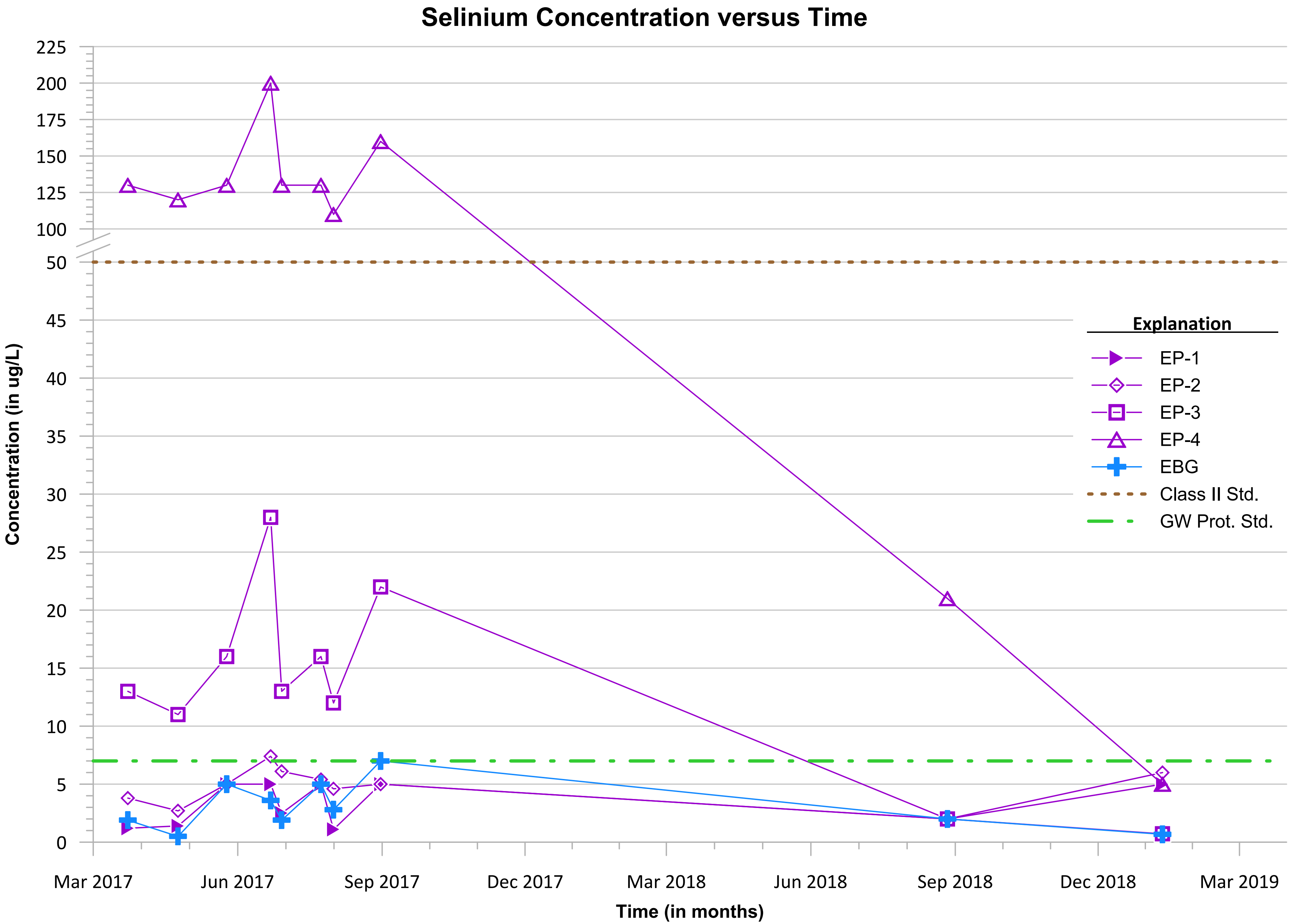

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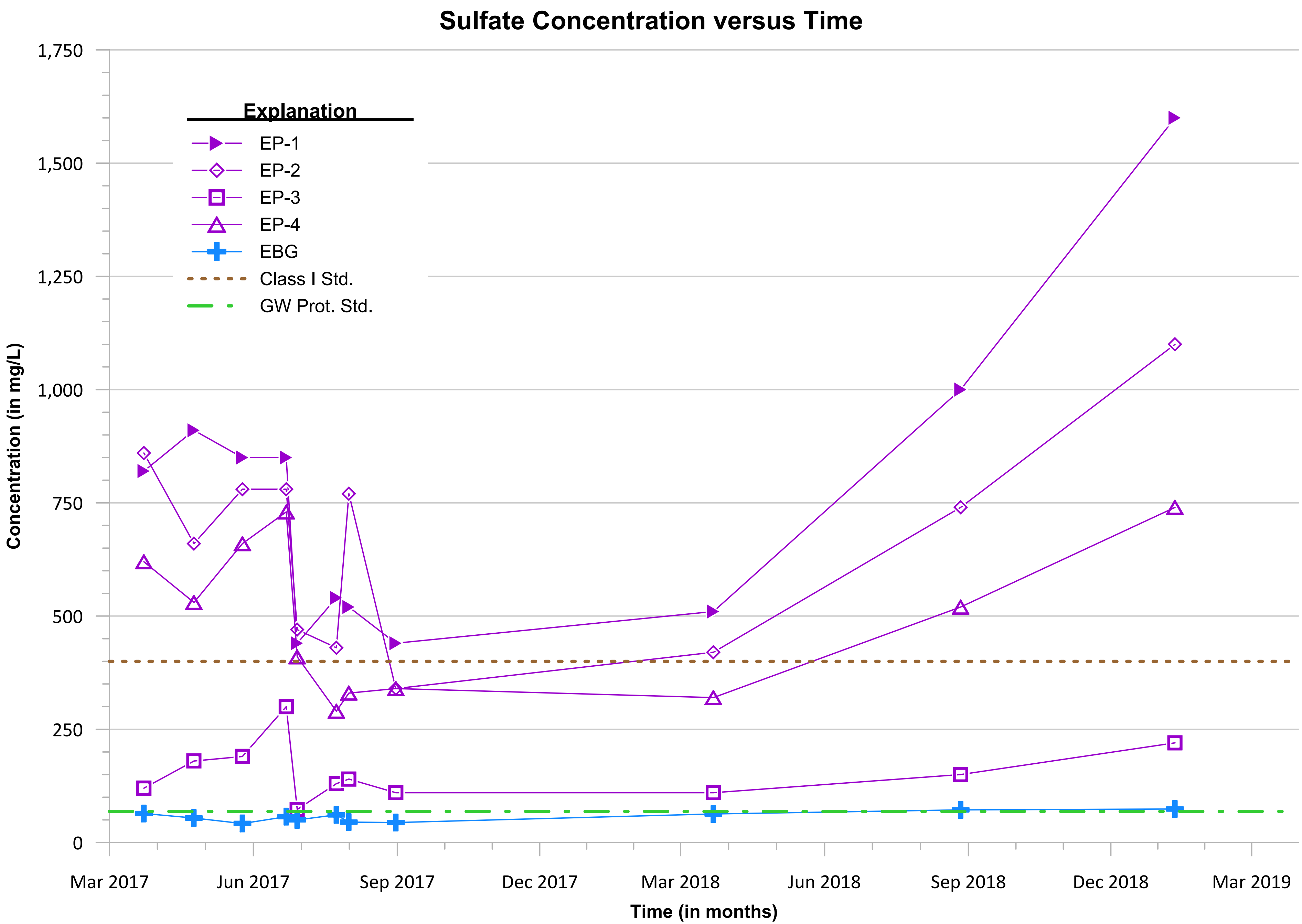

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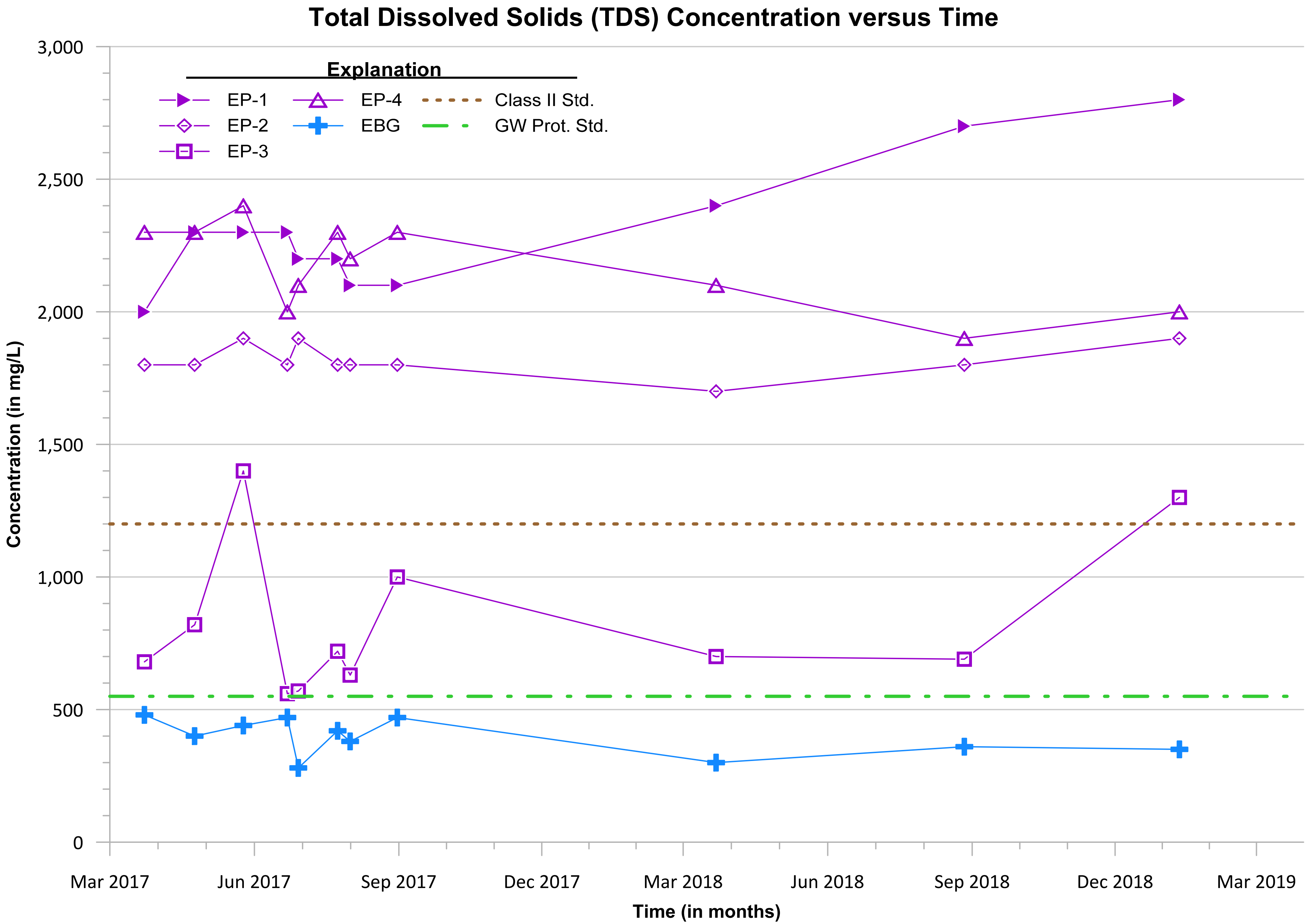

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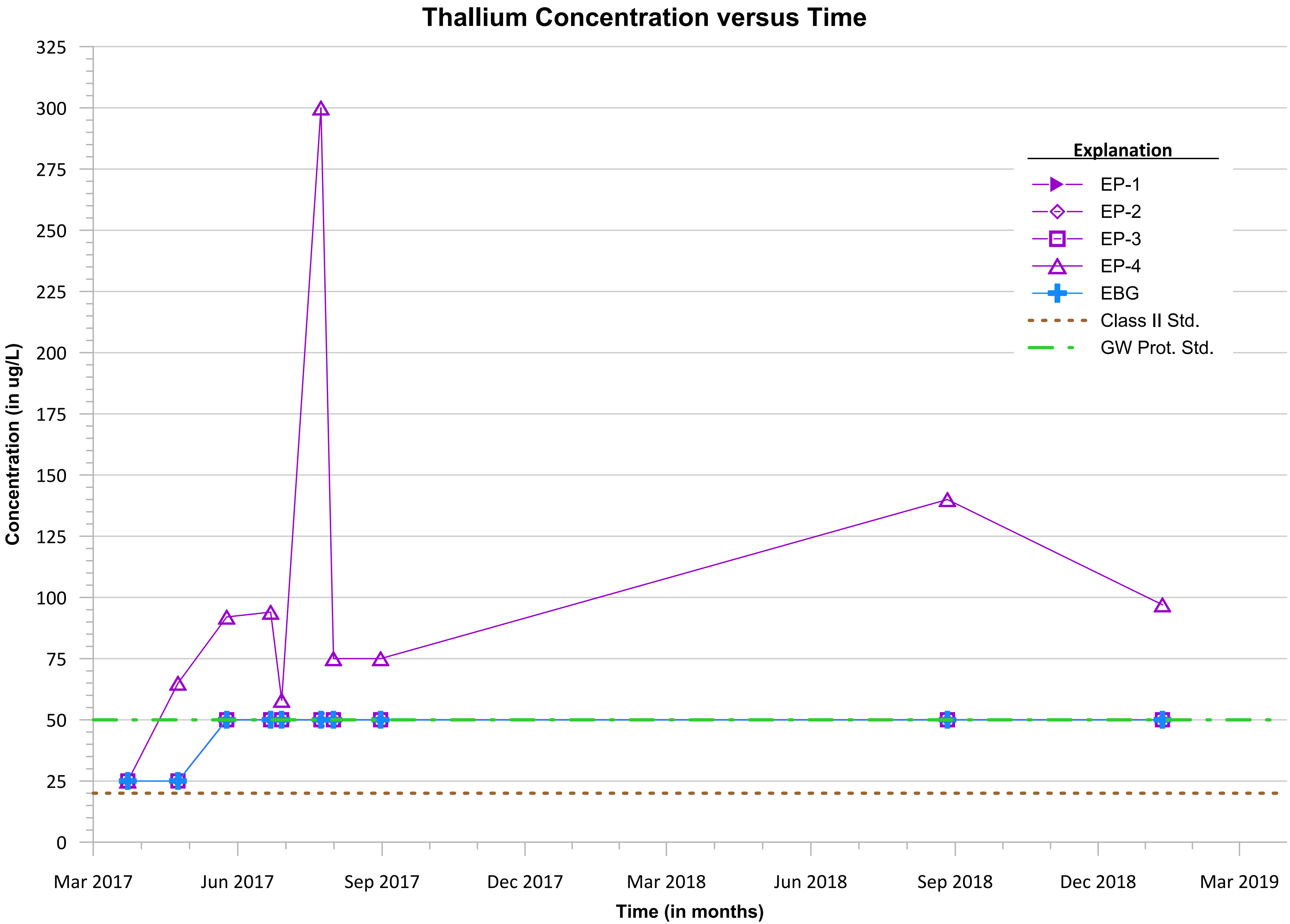

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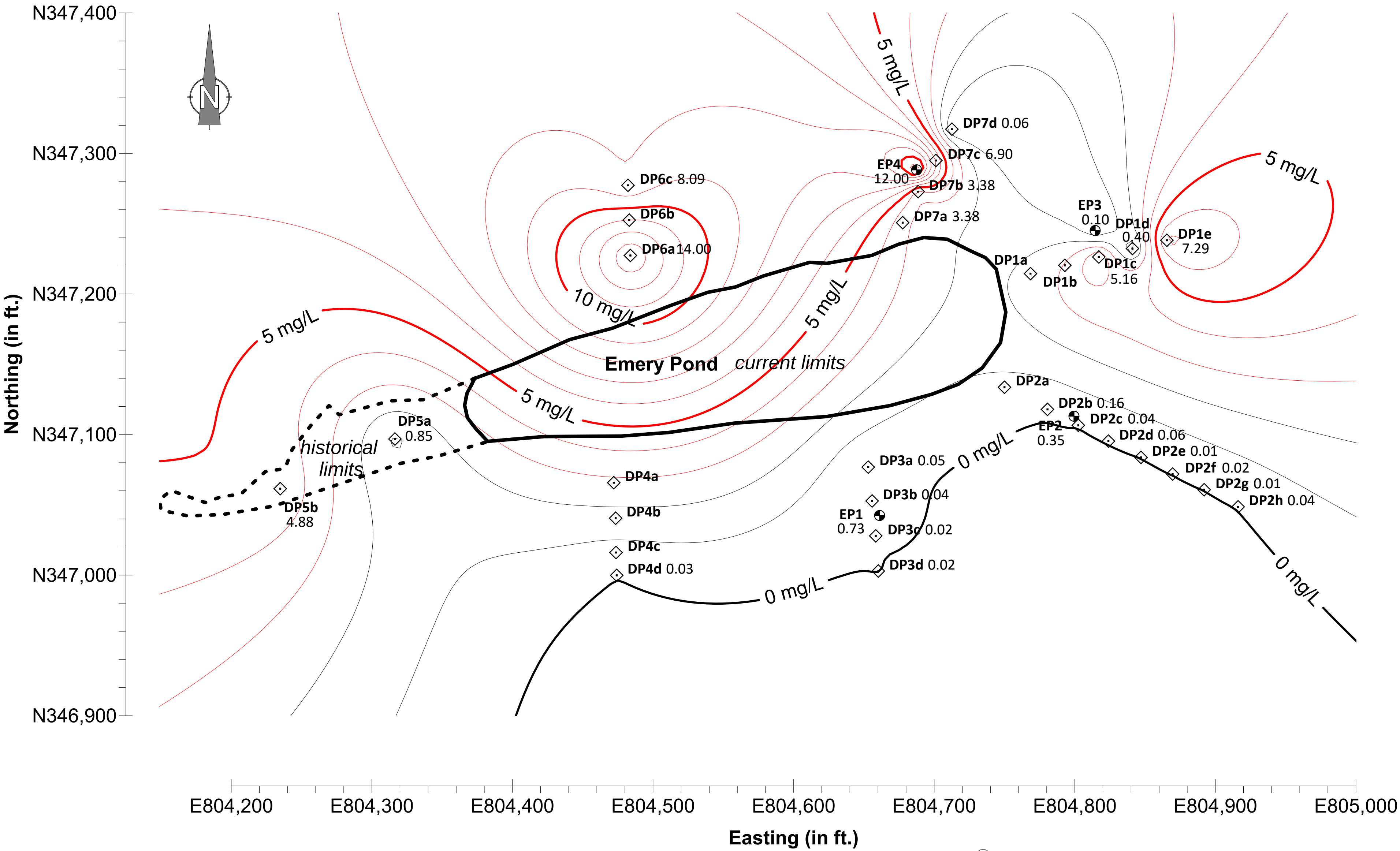
Appendix C

Extent of Impacted Groundwater Isopleth Maps



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (2.0 mg/L)

Contour Interval = 1 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

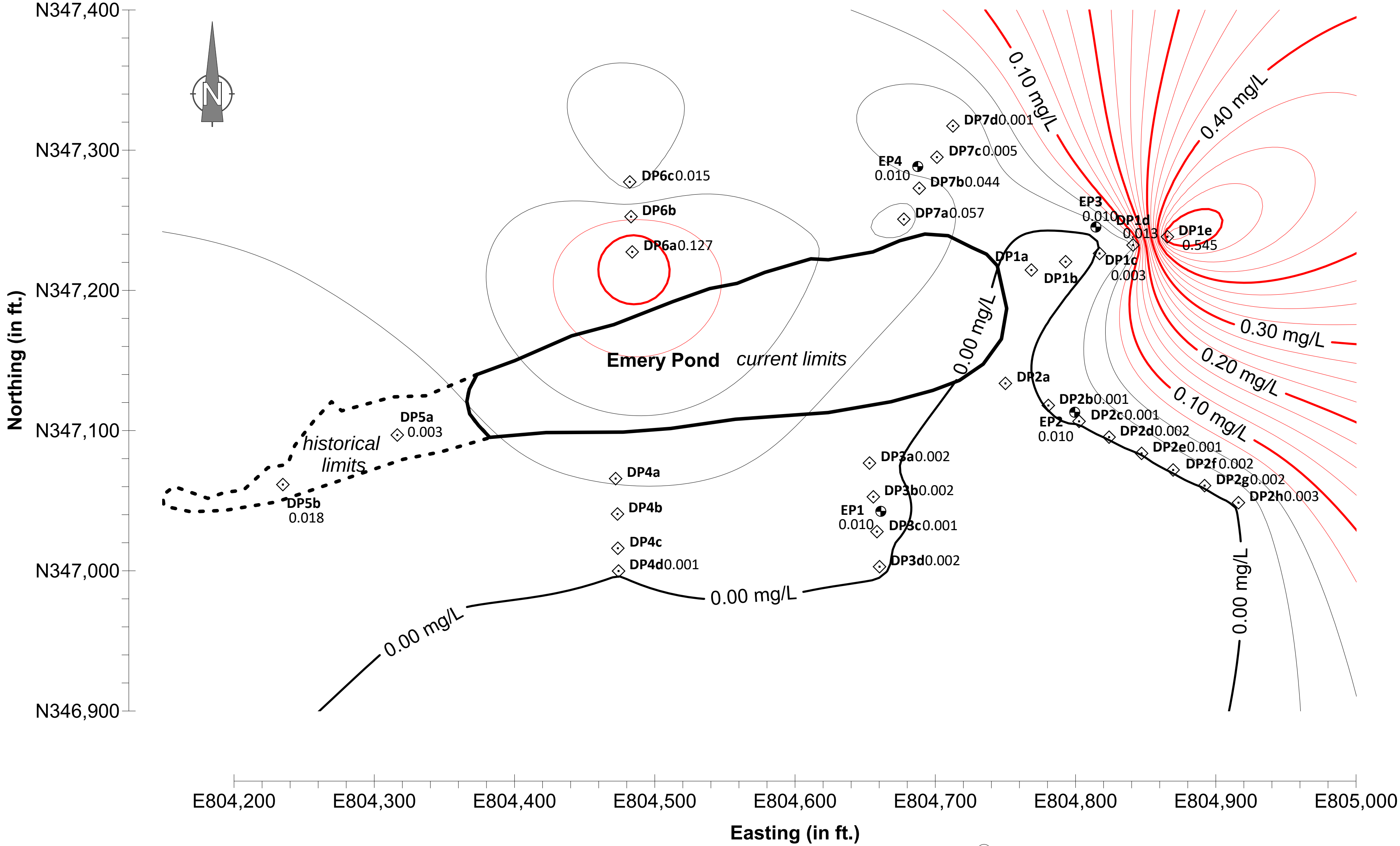
HANSON
Hanson Professional Services Inc.

Boron Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-1



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (0.05 mg/L)

Contour Interval = 1 mg/L
SCALE: 1 inch equals 100 feet

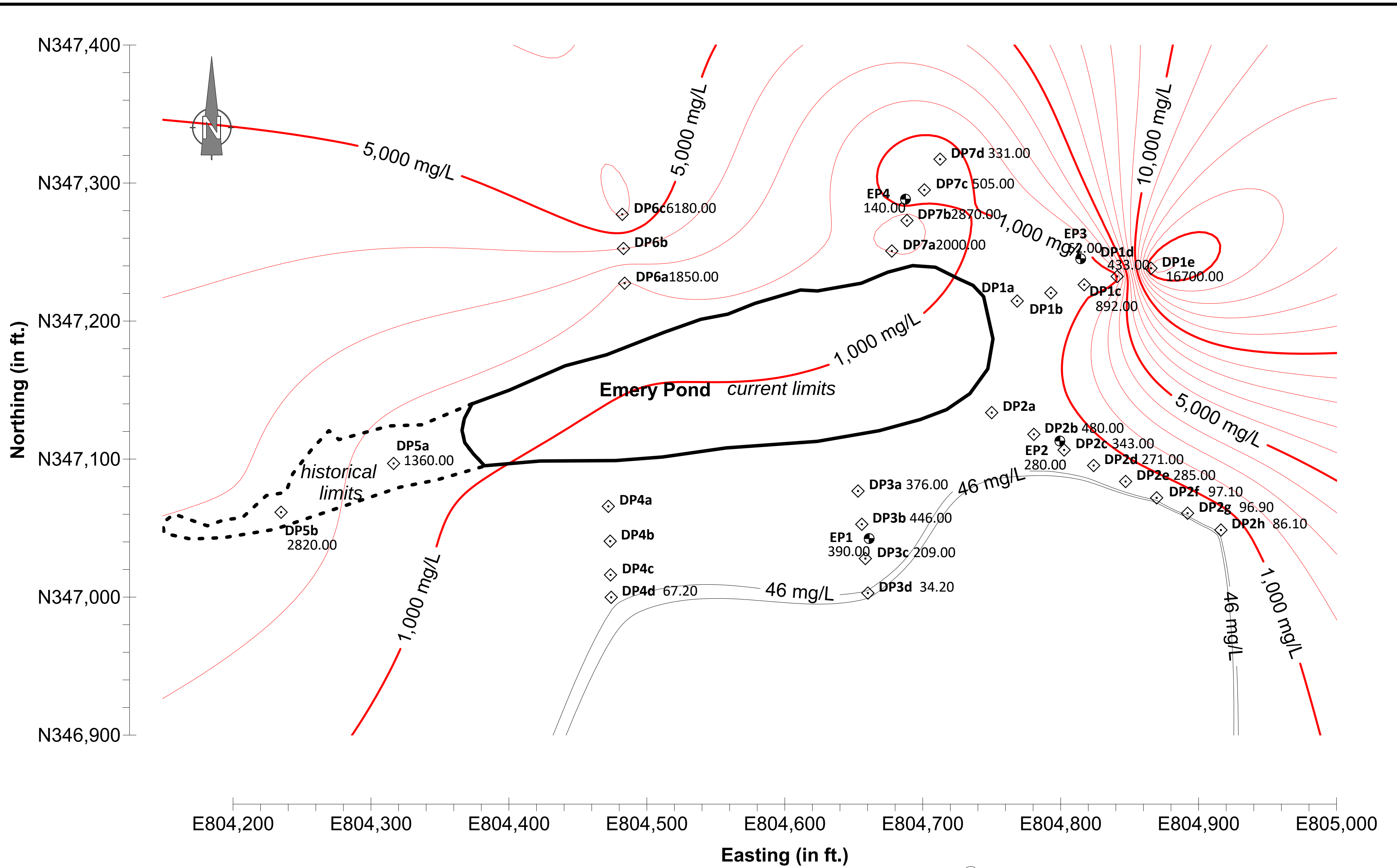
0 ft. 100 ft. 200 ft. 300 ft.

HANSON
Hanson Professional Services Inc.

Cadmium Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A FIGURE C-2



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above the GW Protection Std. (46.304 mg/L)

Contour Interval = 1 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

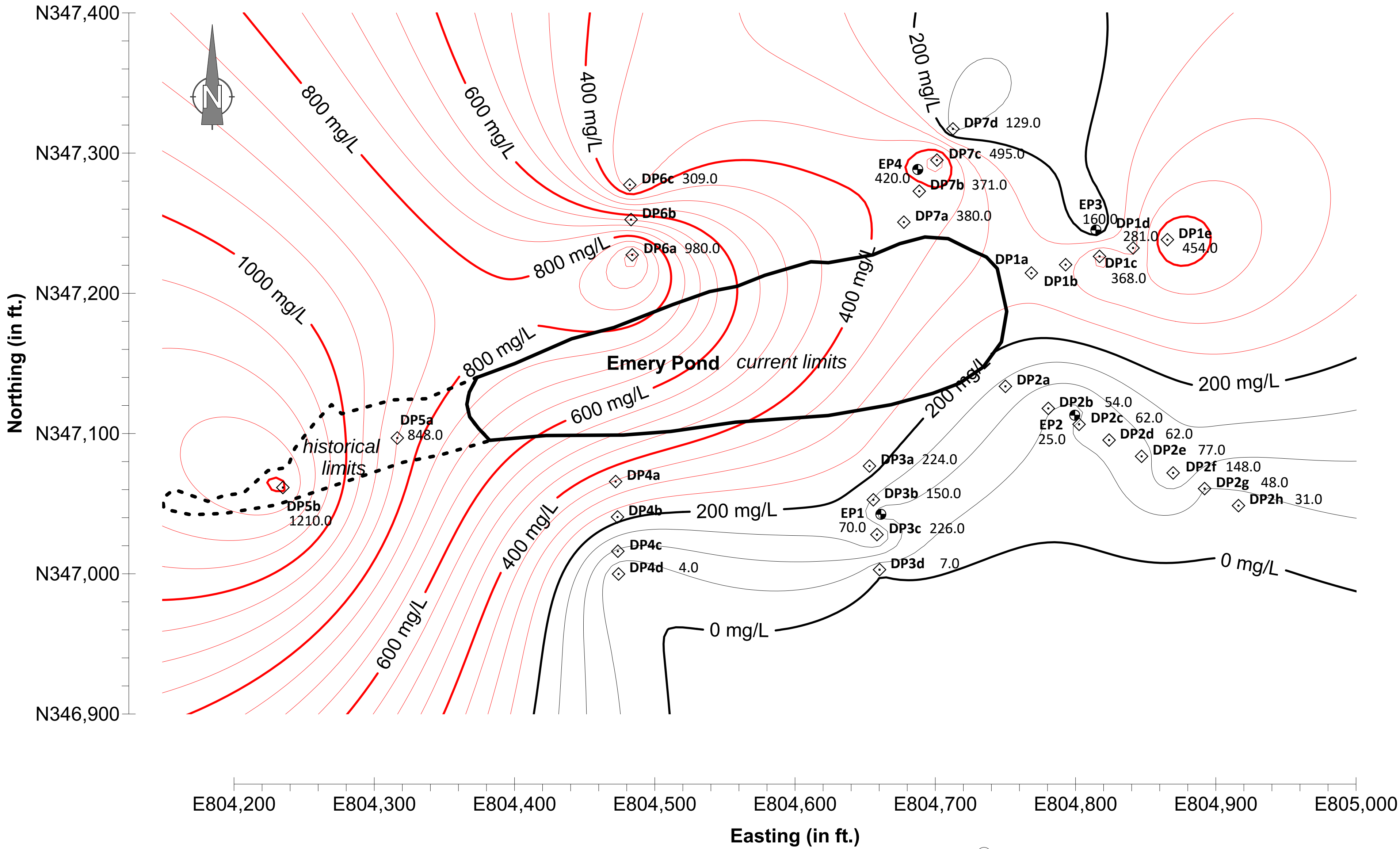
HANSON
Hanson Professional Services Inc.

Calcium Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-3



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (200 mg/L)

Contour Interval = 50 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

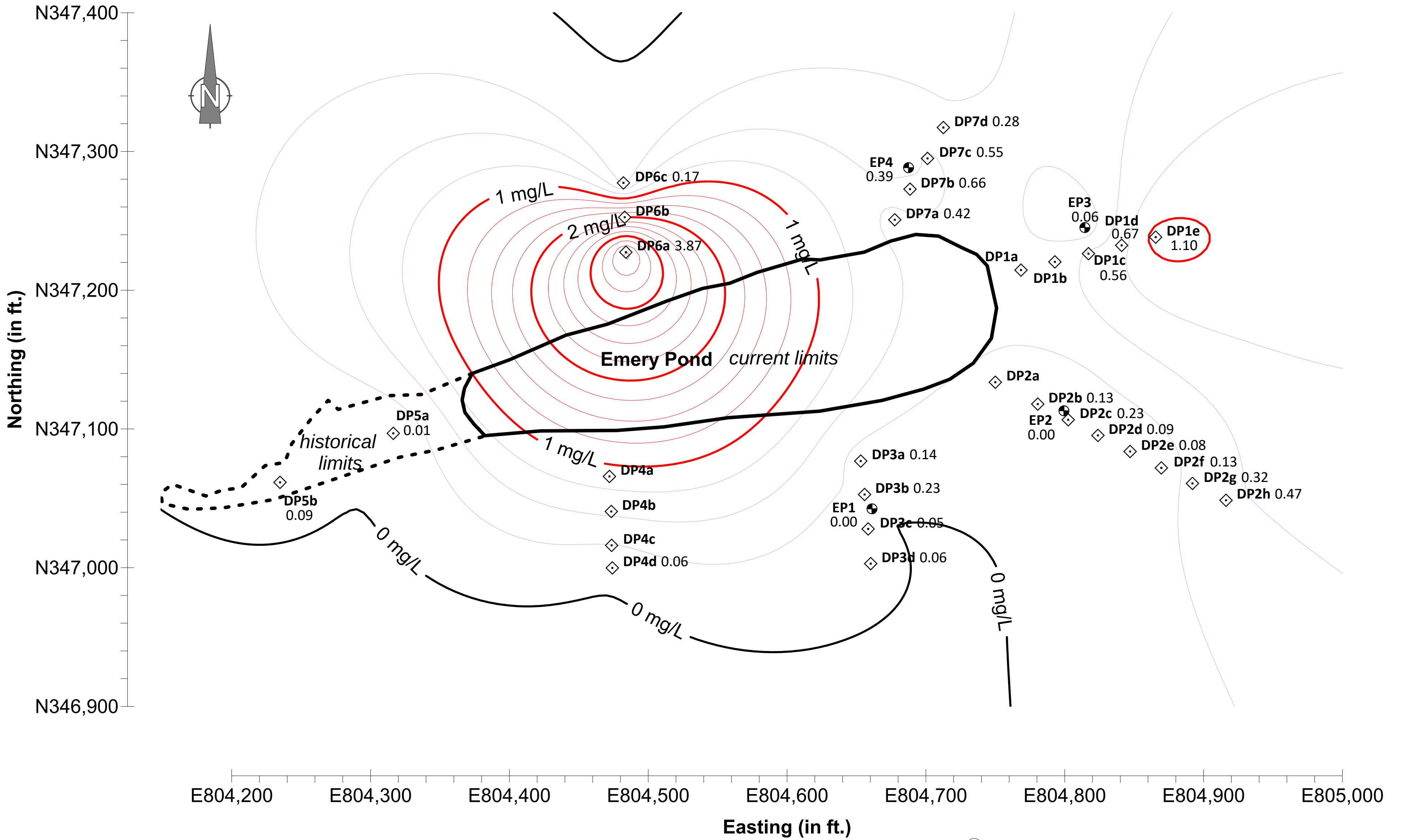
HANSON
Hanson Professional Services Inc.

Chloride Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-4



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Purple contours above the GW Protection Std. (0.0191 mg/L) and Red contours are above the Class II Standard (1.0 mg/L).

Contour Interval = 1 mg/L
SCALE: 1 inch equals 100 feet

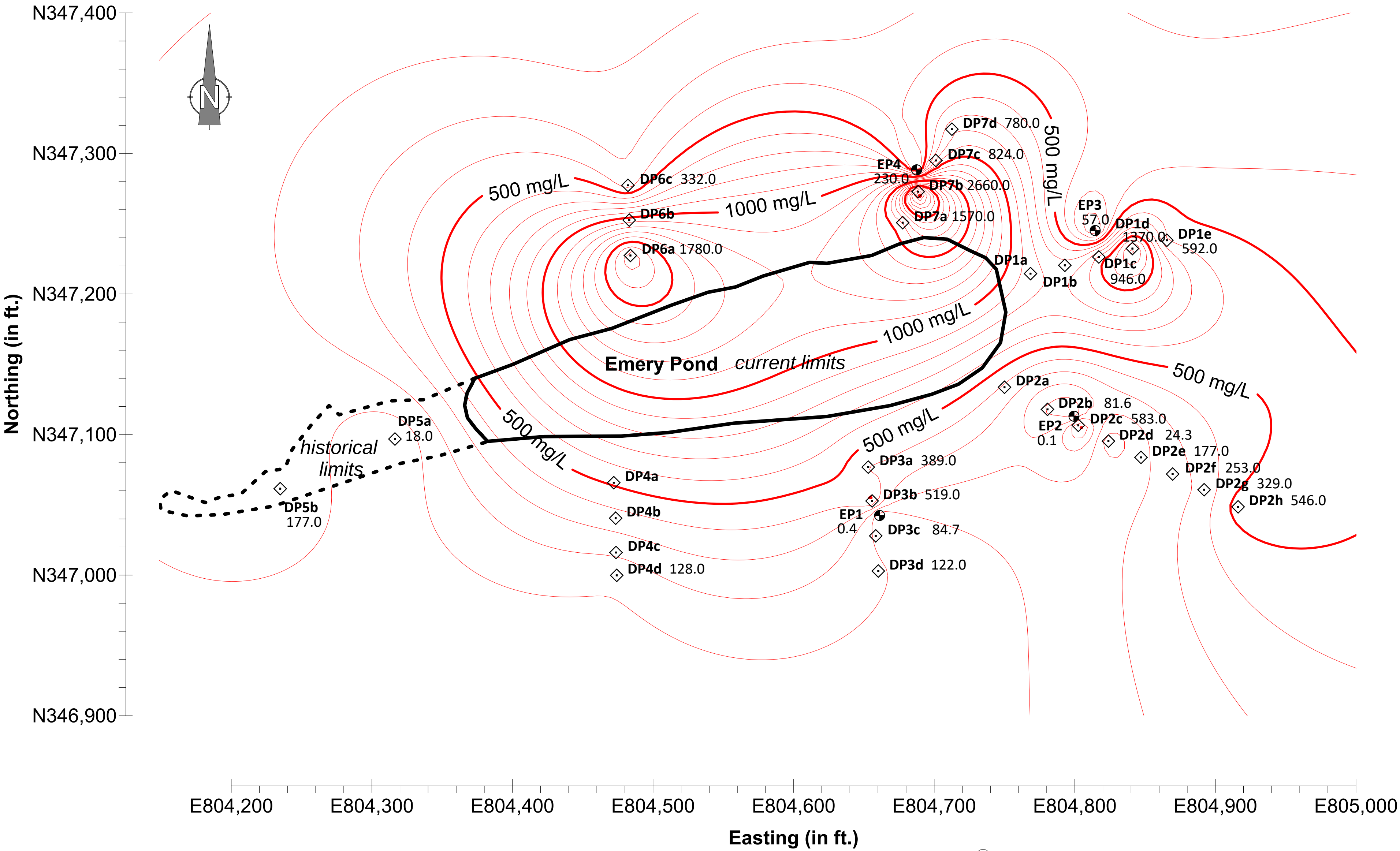
0 ft. 100 ft. 200 ft. 300 ft.

HANSON
Hanson Professional Services Inc.

Cobalt Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A FIGURE C-5



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (5.0 mg/L)

Contour Interval = 50 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

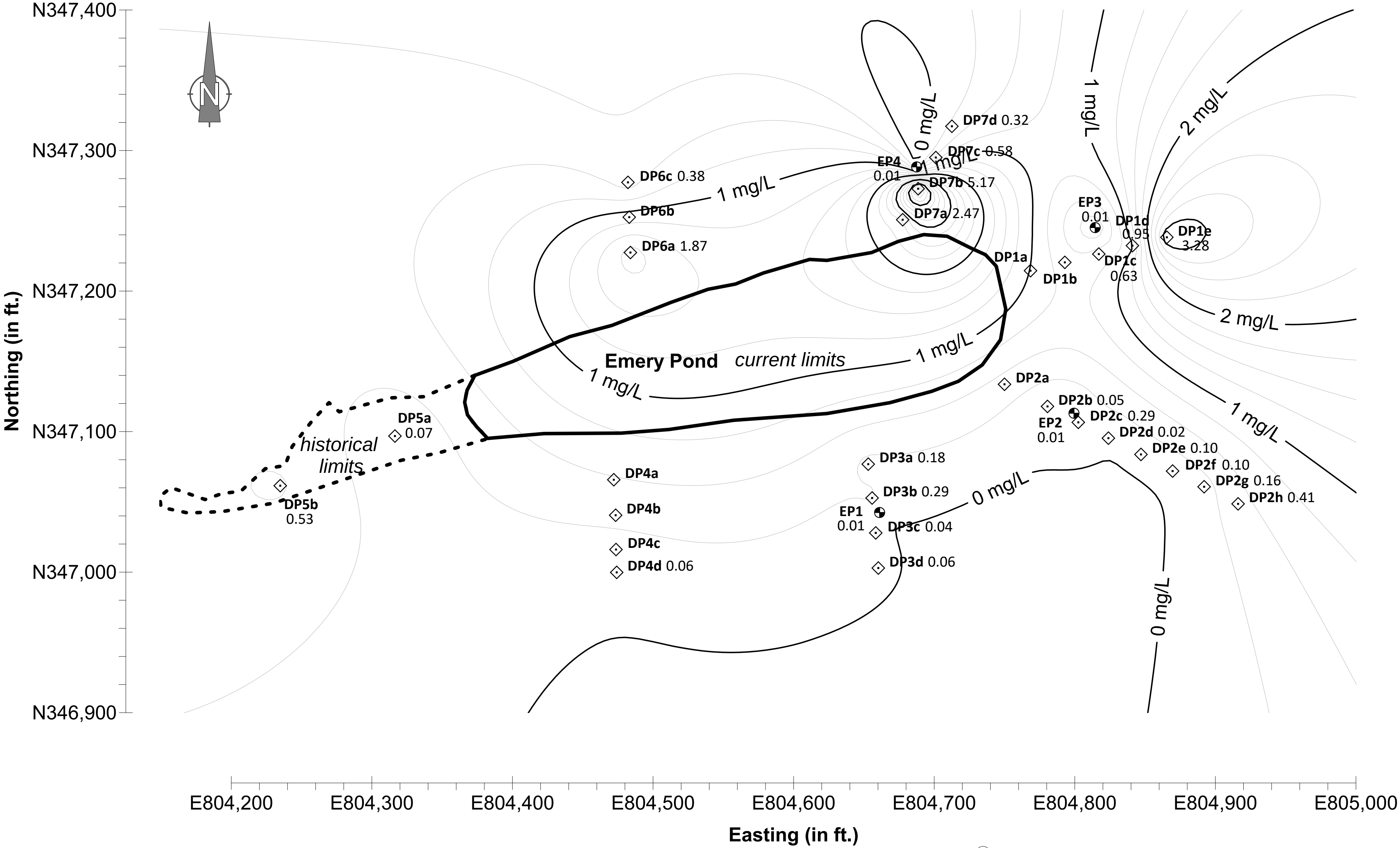
HANSON
Hanson Professional Services Inc.

Iron Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-6



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

Contour Interval = 0.25 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

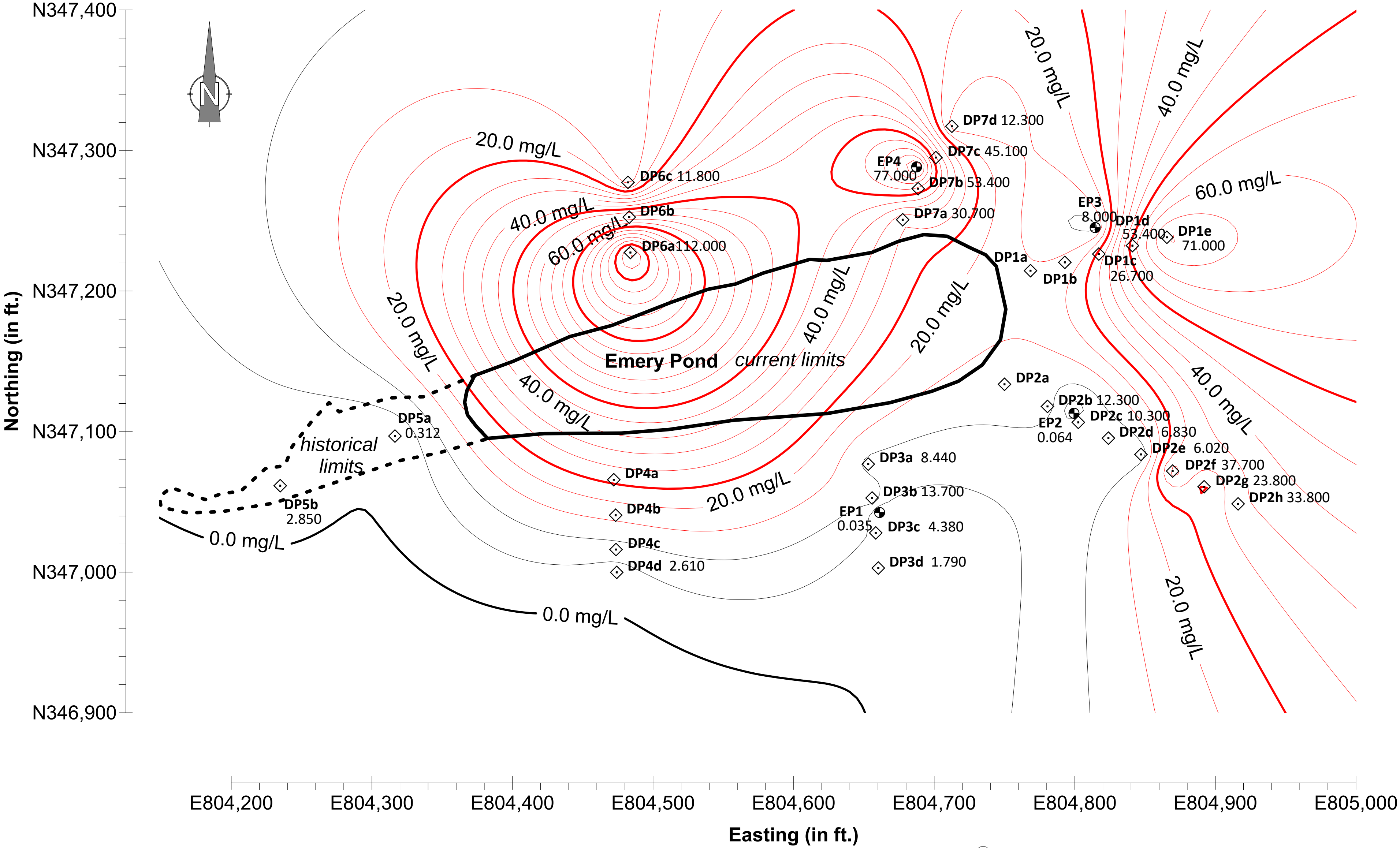
HANSON
Hanson Professional Services Inc.

Lead Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-7



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (10.0 mg/L)

Contour Interval = 1 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

HANSON
Hanson Professional Services Inc.

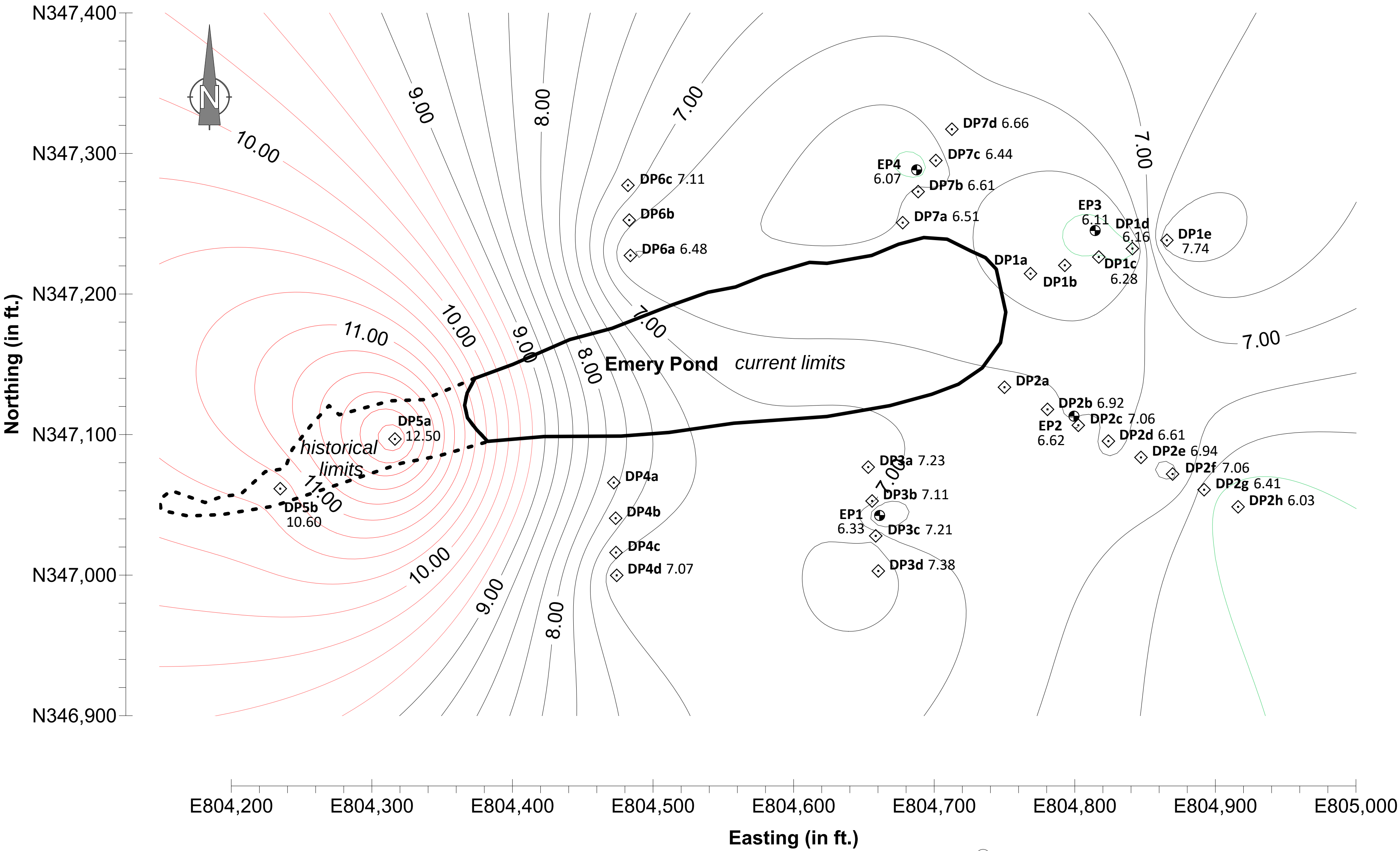
Manganese Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-8

I:\18jobs\18E0022A\Admin\15-Field-Laboratory Data\ManganeseConc_20190319.srf



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Green contours below lower GW Std. and red contours above upper GW Std.

Contour Interval = 0.25 SU
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

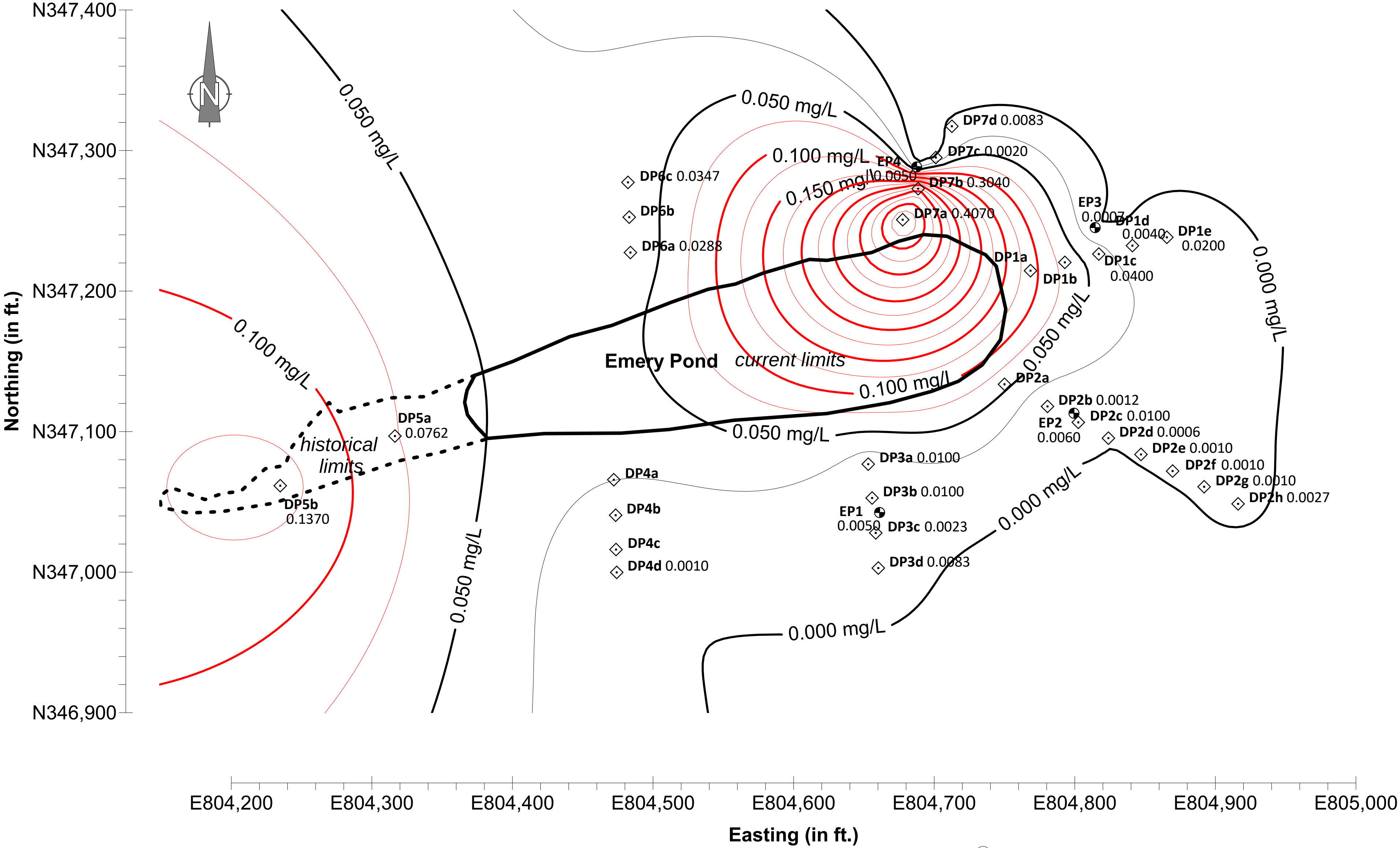
HANSON
Hanson Professional Services Inc.

pH Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-9



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (0.05 mg/L)

Contour Interval = 0.025 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

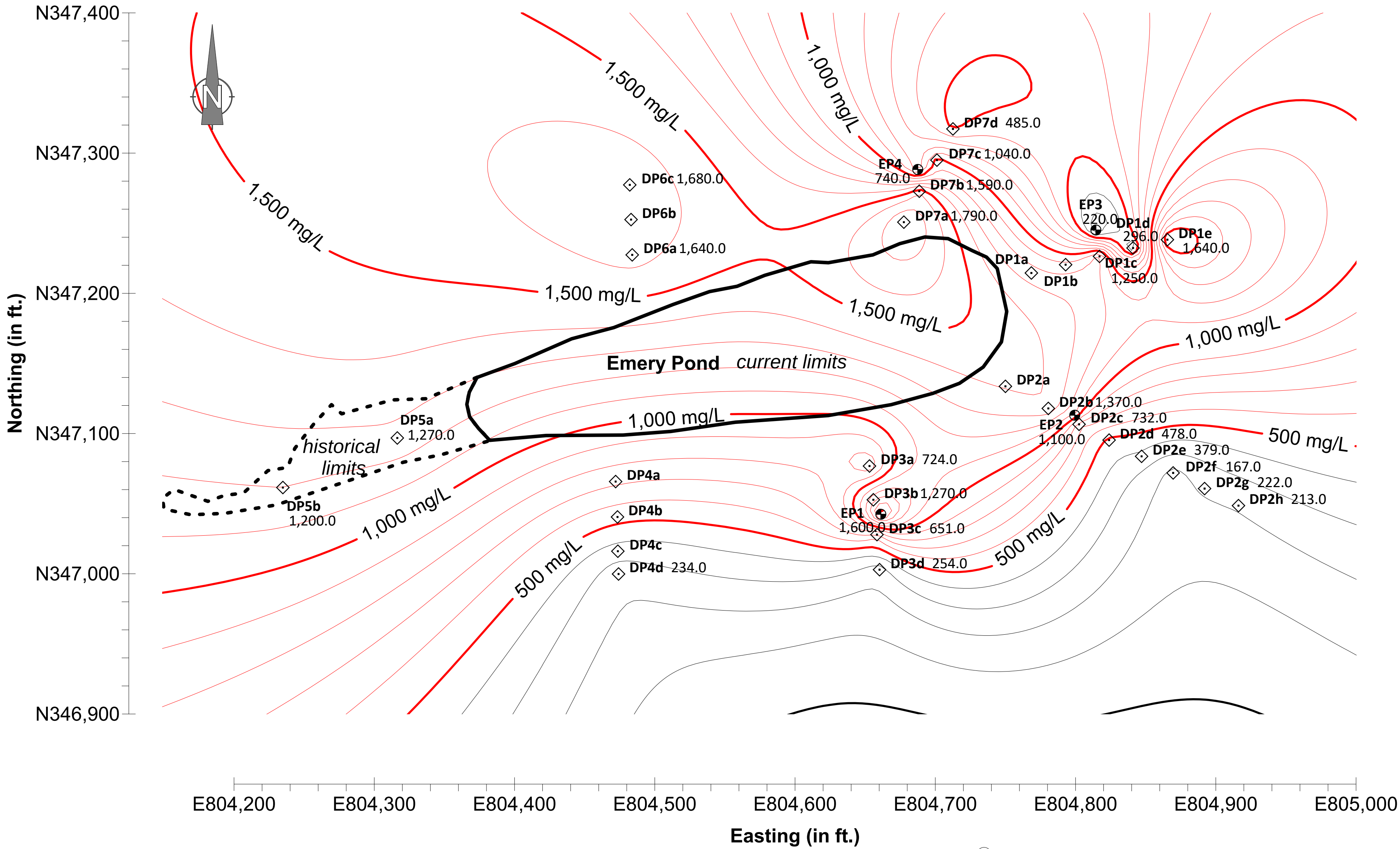
HANSON
Hanson Professional Services Inc.

Selenium Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-10



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (400 mg/L)

Contour Interval = 100 mg/L
SCALE: 1 inch equals 100 feet

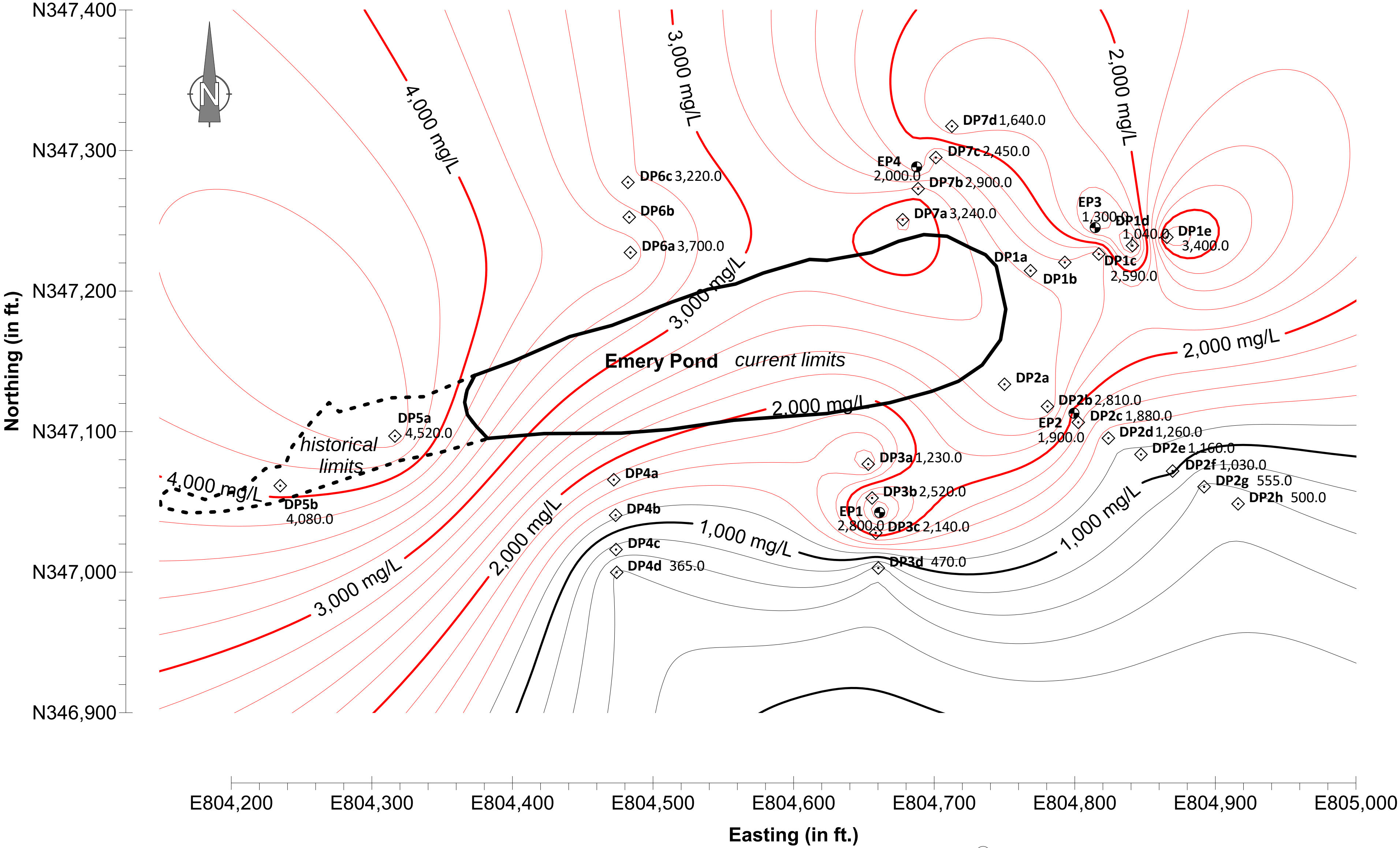
0 ft. 100 ft. 200 ft. 300 ft.

HANSON
Hanson Professional Services Inc.

Sulfate Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A FIGURE C-11



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

Contour Interval = 200 mg/L
SCALE: 1 inch equals 100 feet

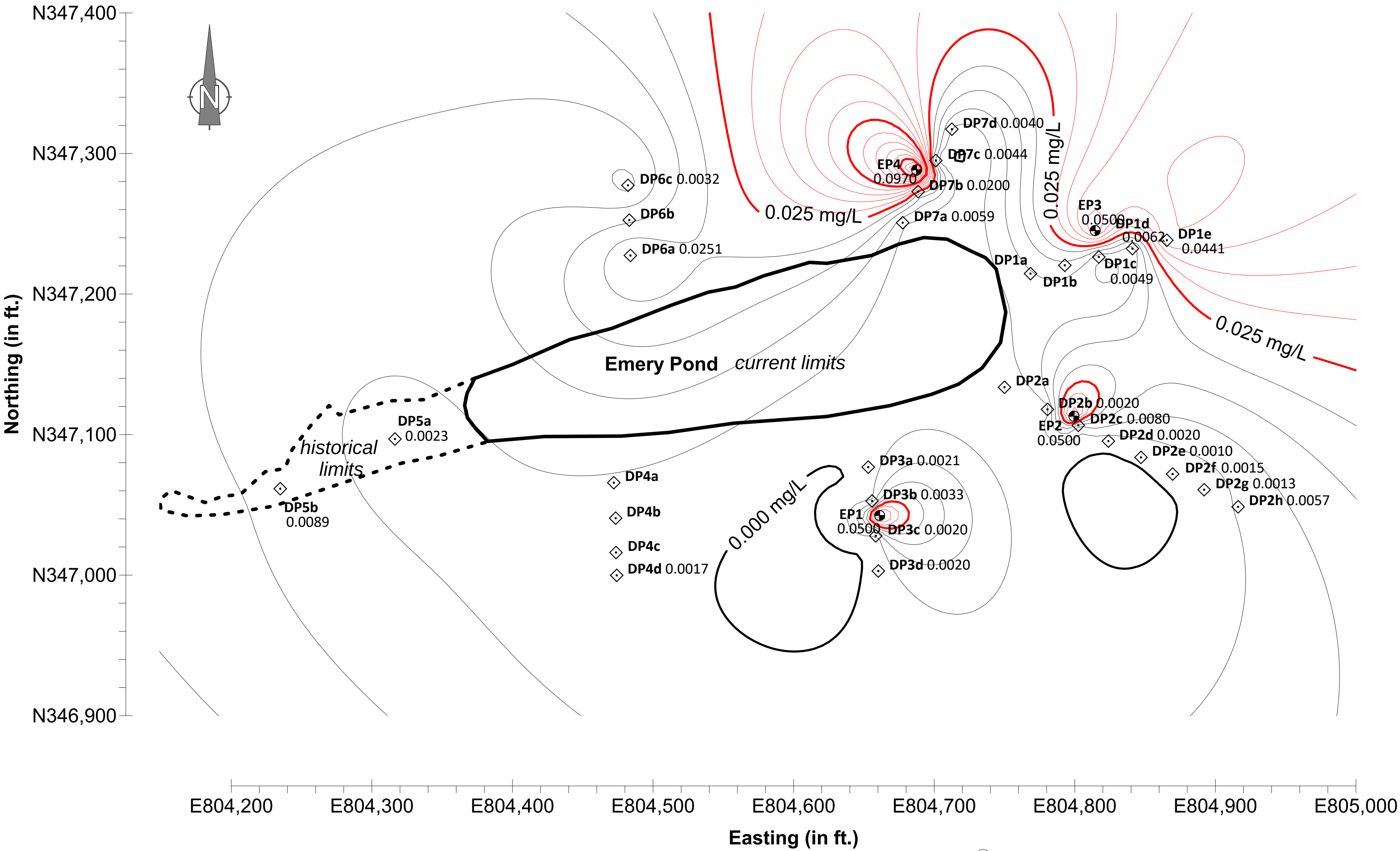
0 ft. 100 ft. 200 ft. 300 ft.

HANSON
Hanson Professional Services Inc.

Total Dissolved Solids Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A | FIGURE C-12



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (0.02 mg/L)
Microbac Laboratory detection limit was 0.05 mg/L.

Contour Interval = 0.005 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

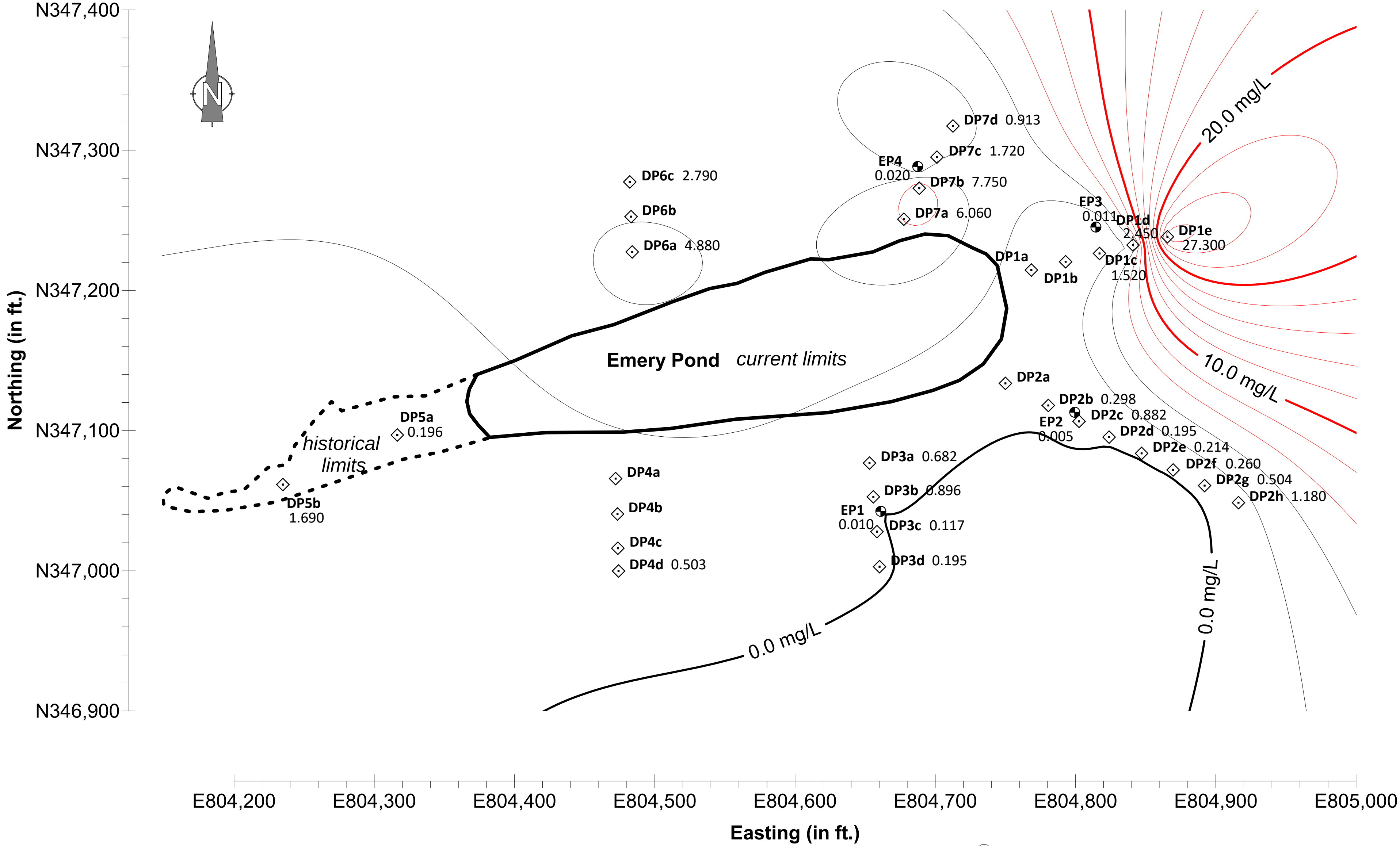
HANSON
Hanson Professional Services Inc.

Thallium Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-13



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (5.0 mg/L)

Contour Interval = 1 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

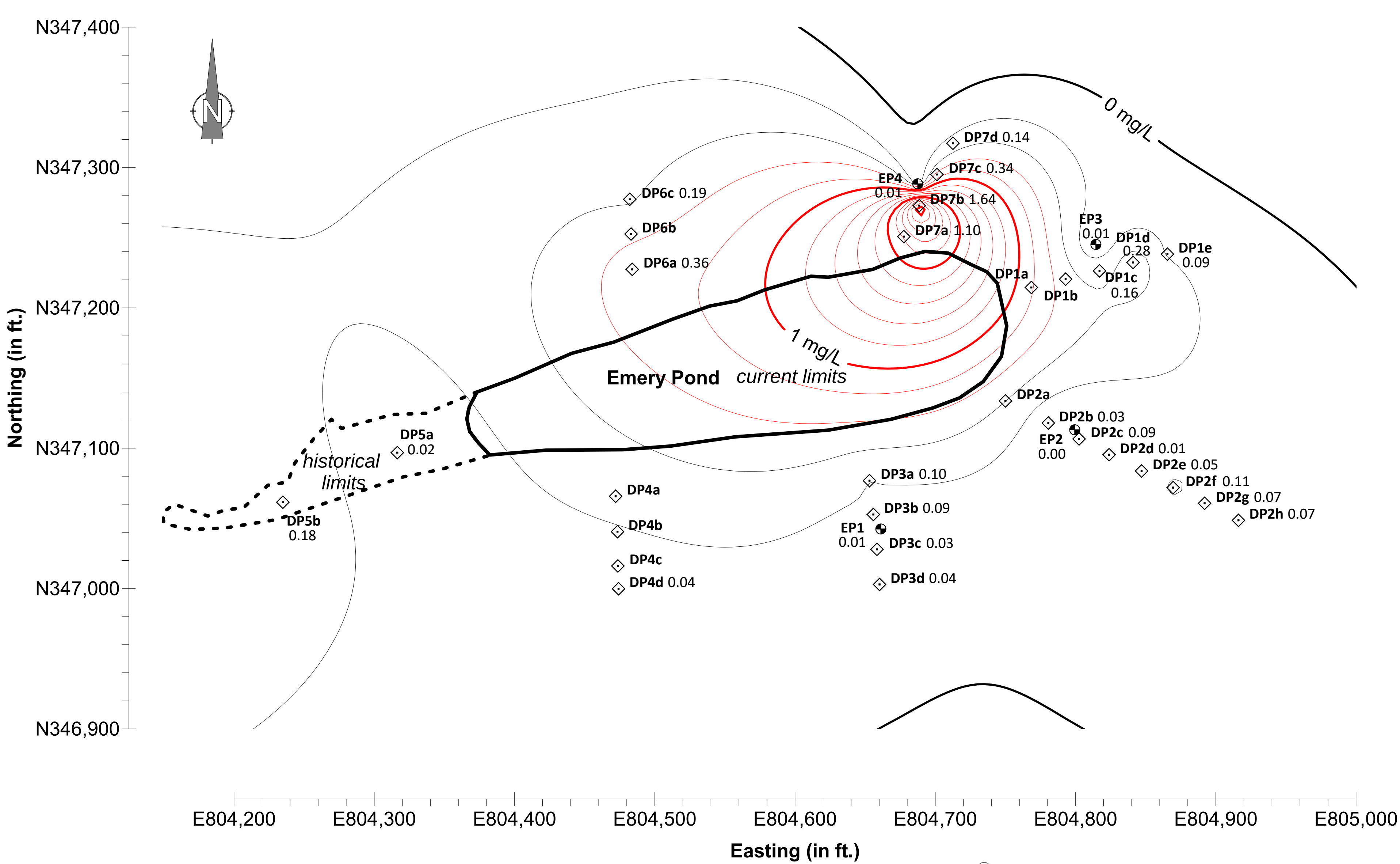
HANSON
Hanson Professional Services Inc.

Zinc Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A

FIGURE C-14



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

NOTE: Red contours above Class II GW Std. (0.2 mg/L)

Contour Interval = 1 mg/L
SCALE: 1 inch equals 100 feet

0 ft. 100 ft. 200 ft. 300 ft.

HANSON
Hanson Professional Services Inc.

Arsenic Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A FIGURE C-15

Appendix D

Groundwater Management Zone Plat and Description

HANSON

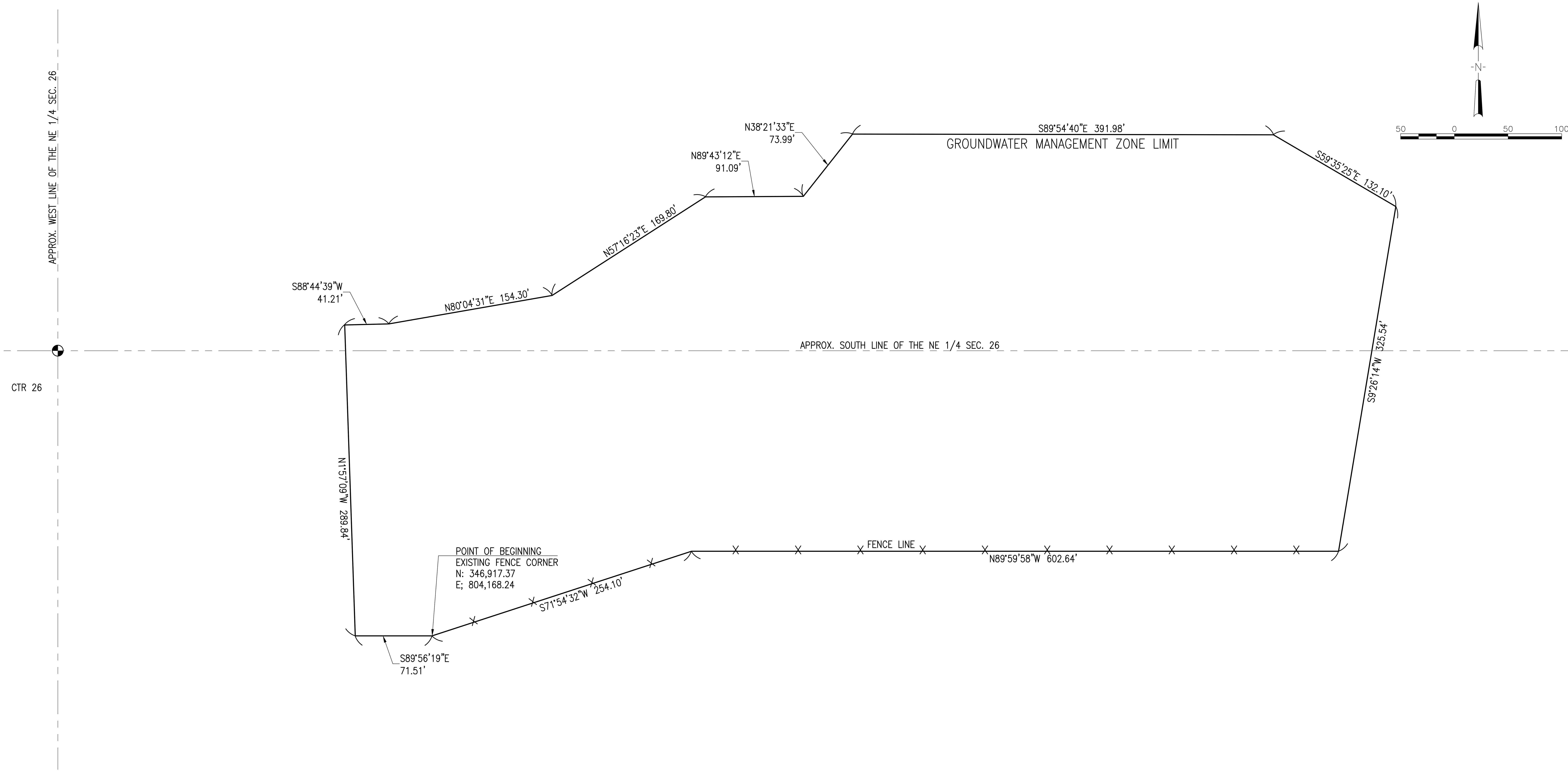
Groundwater Management Zone (GMZ) Limit

LEGAL DESCRIPTION

Part of Parcel 10-2 “A” of the Southern Illinois Power Co-Operative Lake of Egypt area property boundary, being part of the East Half of Section 26, Township 10 South, Range 2 East, Third Principal Meridian, Williamson County, Illinois, more particularly described as follows:

Beginning at a fence corner having an Illinois State Plane Coordinate of Northing 346,917.37 and Easting 804,168.24 (North American Datum of 1983, East Zone), thence on a grid bearing of N 89°-56'-19" W a distance of 71.51 feet; thence N 01°-57'-09" W a distance of 289.84; thence N 88°-44'-39" E a distance of 41.21 feet; thence N 80°-04'-31" E a distance of 154.30 feet; thence N 57°-16'-23" E a distance of 169.80 feet; thence N 89°-43'-12" E a distance of 91.09 feet; thence N 38°-21'-33" E a distance of 73.99 feet; thence S 89°-54'-40" E a distance of 391.98 feet; thence S 59°-35'-25" E a distance of 132.10 feet; thence S 09°-26'-14" W a distance of 325.54 feet; thence N 89°-59'-58" W a distance of 602.64 feet; thence S 71°-54'-32" W a distance of 254.10 feet to the POINT OF BEGINNING.

Containing 7.545 Acres, more or less.



LEGEND

- PARCEL LINE
- SECTION LINE
- X — FENCE LINE

LEGAL DESCRIPTION

Part of Parcel 10-2 "A" of the Southern Illinois Power Co-Operative Lake of Egypt area property boundary, being part of the East Half of Section 26, Township 10 South, Range 2 East, Third Principal Meridian, Williamson County, Illinois, more particularly described as follows:

Beginning at a fence corner having an Illinois State Plane Coordinate of Northing 346,917.37 and Easting 804,168.24 (North American Datum of 1983, East Zone), thence on a grid bearing of N 89°-56'-19" W a distance of 71.51 feet; thence N 01°-57'-09" W a distance of 289.84; thence N 88°-44'-39" E a distance of 41.21 feet; thence N 80°-04'-31" E a distance of 154.30 feet; thence N 57°-16'-23" E a distance of 169.80 feet; thence N 89°-43'-12" E a distance of 91.09 feet; thence N 38°-21'-33" E a distance of 73.99 feet; thence S 89°-54'-40" E a distance of 391.98 feet; thence S 59°-35'-25" E a distance of 132.10 feet; thence S 09°-26'-14" W a distance of 325.54 feet; thence N 89°-59'-58" W a distance of 602.64 feet; thence S 71°-54'-32" W a distance of 254.10 feet to the POINT OF BEGINNING.

Containing 7.545 Acres, more or less.

State of Illinois)
SS
County of Williamson)

We, Hanson Professional Services Inc., Professional Design Firm No. 184-001084, do hereby certify that this is a true and correct representation of an exhibit made for the Southern Illinois Power Co-operative.

Dated, this 26 day of March, 2019.

By: Gary C. Rogers
Gary C. Rogers
Illinois Professional Land Surveyor No. 2957
License Expires 11-30-2020

GARY C ROGERS 035-2957 PROFESSIONAL LAND SURVEYOR STATE OF ILLINOIS SPRINGFIELD, IL.

NOTE:
BASIS OF BEARING ILLINOIS STATE PLANE NORTH AMERICAN DATUM OF 1983, EAST ZONE.

MAR 26, 2019 12:41 PM PADGE01941
I:\18JOBS\18E0022A\CAD\SURVEY\SHEET\C-PROP.DWG

REVISION | DATE

Hanson No. 18E0022A
Filename C-PROP.DWG
Scale 1"=50'
Date 03/26/2019

LAYOUT	GCR	03/26/2019
DRAWN	WTP	03/26/2019
REVIEWED	GCR	03/26/2019

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GROUNDWATER MANAGEMENT ZONE (GMZ) BOUNDARY EXHIBIT

SOUTHERN ILLINOIS POWER CO-OPERATIVE

C1

1 of 1 sheets

Appendix E

Confirmation of an Adequate Corrective Action Forms

Title 35, Illinois Admin. Code, Part 620 – APPENDIX D
Confirmation of an Adequate Corrective Action Pursuant to 35 Ill. Adm. Code 620.250(a)(2)

Pursuant to 35 Ill. Adm. Code 620.250(a) if an owner or operator provides a written confirmation to the Agency that an adequate corrective action, equivalent to a corrective action process approved by the Agency, is being undertaken in a timely and appropriate manner, then a groundwater management zone may be established as a three-dimensional region containing groundwater being managed to mitigate impairment caused by the release of contaminants from a site. This document provides the form in which the written confirmation is to be submitted to the Agency.

Note 1. Parts I and II are to be submitted to IEPA at the time that the facility claims the alternative groundwater standards. Part III is to be submitted at the completion of the site investigation. At the completion of the corrective process, a final report is to be filed which includes the confirmation statement included in Part IV.

Note 2. The issuance of a permit by IEPA's Division of Air Pollution Control or Water Pollution Control for a treatment system does not imply that the Agency has approved the corrective action process.

Note 3. If the facility is conducting a cleanup of a unit which is subject to the requirements of the Resource Conservation and Recovery Act (RCRA) or the 35 Ill. Adm. Code 731 regulations for Underground Storage Tanks, this confirmation process is not applicable and cannot be used.

Note 4. If the answers to any of these questions require explanation or clarification, provide such in an attachment to this document.

Part I. Facility Information

Facility Name	***Southern Illinois Power Cooperative Marion Power Plant***
Facility Address	***11543 Lake Egypt Road, Marion, IL 62959***
County	***Williamson***
Standard Industrial Code (SIC)	***4911***

1. Provide a general description of the type of industry, products manufactured, raw materials used, location and size of the facility.

   Electric power generation and coal combustion residual (CCR) handling. The Emery Pond is an approx. 1-acre CCR Impoundment located within the Marion Power Plant which encompasses approximately 350 acres at the northwest shore of Lake of Egypt.

2. What specific units (operating or closed) are present at the facility which are or were used to manage waste, hazardous waste, hazardous substances, or petroleum?

	YES	NO
Landfill	X	
Surface Impoundment	X	
Land Treatment		X
Spray Irrigation		X
Waste Pile		X
Incinerator		X
Storage Tank (above ground)	X	
Storage Tank (underground)		X
Container Storage Area		X
Injection Well		X
Water Treatment Units	X	
Septic Tanks		X
French Drains		X
Transfer Station		X
Other Units (please describe)		
______________________		

2. Provide an extract from a USGS topographic or county map showing the location of the site and a more detailed scaled map of the facility with each waste management unit identified in Question 2 or known/suspected source clearly identified. Map scale must be specified, and the location of the facility must be provided with respect to Township, Range and Section.

   The Plant is in the north half of Section 26, Tier 10 South, Range 2 East, of the 3rd PM. Figure 1 has the facility located on a USGS topographic map (7½ minute). Figure 2 shows a scaled map of the Site.

4. Has the facility ever conducted operations which involved the generation, manufacture, processing, transportation, treatment, storage, or handling of "hazardous substances" as defined by the Illinois Environmental Protection Act? Yes ☒ No ☐
   If the answer to this question is "yes" generally describe these operations.

   Chlorine – prior to 1/1/2015, SIPC utilized Liquefied Chlorine Gas to control biofouling in its plant condenser circulating cooling water. Since 1/1/2015, SIPC has used Sodium Hypochlorite Solution (Bleach) to control biofouling.

   Ammonia – Anhydrous Ammonia is utilized on Units 123 and 4 for NOx emission control.

5. Has the facility generated, stored, or treated hazardous waste as defined by the Resource Conservation and Recovery Act? Yes ☐ No ☒
   If the answer to this question is "yes" generally describe these operations.

6. Has the facility conducted operations which involved the processing, storage, or handling of petroleum? Yes ☒ No ☐
   If the answer to this question is "yes" generally describe these operations.

   #2 fuel oil is used for coal handling equipment operations and boiler startup fuel for Units 123 & 4.

7. Has the facility ever held any of the following permits?

   a. Permits for any waste storage, waste treatment or waste disposal operation. Yes ☒ No ☐
      If the answer to this question is "yes", identify the IEPA permit numbers.

      Illinois EPA Land (Solid Waste Generator) – 1990555005

      US EPA Land (Solid Waste Generator) – ILD 007813900

   b. Interim Status under the Resources Conservation and Recovery Act (filing of a RCRA Part A application). Yes ☐ No ☒
      If the answer to this question is "yes", attach a copy of the last approved Part A application.

   c. RCRA Part B Permits. Yes ☐ No ☒
      If the answer to this question is "yes", identify the permit log number.

8. Has the facility ever conducted the closure of a RCRA hazardous waste management unit? Yes ☐ No ☒

9. Have any of the following State or federal government actions taken place for a release at the facility?

   a. Written notification regarding known, suspected, or alleged contamination on or emanating from the property (e.g., a Notice pursuant to Section 4(q) of the Environment Protection Act)? Yes ☒ No ☐
      If the to this question is "yes", identify the caption and date of issuance.

      Illinois EPA issued Violation Notice No. W-2018-00041 (ID No. 6364) on July 3, 2018.

   b. Consent Decree or Order under RCRA, CERCLA, EPAct Section 22.2 (State Superfund), or EPAct Section 21(f) (State RCRA). Yes ☐ No ☒

c. If either of Items a. or b. were answered by checking "yes", is the notice, order, or decree still in effect? Yes ☒ No ☐

10. What groundwater classification will the facility be subject to at the completion of the remediation?

    Class I ☒ Class II ☒ Class III ☐ Class IV ☐
    If more than one Class applies, please explain.

    Class II groundwater in the Unlithified Unit and upper Bedrock Unit (to a depth of approx. 21.5 ft. BGS at EBR or approx. elevation of 489 ft.) and Class I groundwater in the remaining (identified) Bedrock Unit (where sandstone is thicker than 10 ft.).

11. Describe the circumstances which the release to groundwater was identified.

    Through the monitoring well installation and water sampling guidelines listed in 40 CFR 257.90 Subpart (e).

Based on my inquiry of those persons directly responsible for gathering the information, I certify that the information submitted is, to the best of my knowledge and belief, true and accurate.

Marion Power Station	
Facility Name	Signature of Owner/Operator
11543 Lake Egypt Road, Marion, IL 62959	***Southern Illinois Power Cooperative***
Location of Facility	Name of Owner/Operator
1990555005	***July 24, 2020***
Illinois EPA Identification Number	Date

PART II: Release Information

1. Identify the chemical constituents release to the groundwater. Attach additional documents, as necessary.

Chemical Description	Chemical Abstract No.
Arsenic	***7440-38-2***
Boron	***7440-42-8***
Calcium	***14808-79-8***
Chloride	***7782-50-5***
Cobalt	***7440-48-4***
Iron	***7439-89-6***
Lead	***7439-92-1***
Manganese	***7439-96-5***
pH	***13967-14-1***
Selenium	***7782-49-2***
Sulfate	***14808-79-8***
Thallium	***7440-28-0***
Total Dissolved Solids	***10-05-2***
Zinc	***7440-66-6***

1. Describe how the site will be investigated to determine the source or sources of the release.

   The Emery Pond has been investigated as described in the Hydrogeologic Investigation Report (Hanson, 2019a) and subsequent Hydrogeologic Investigation Addendum (Hanson, 2019b).

2. Describe how the site will be investigated to determine the source or sources of the release.

   The investigation is documented in the Hydrogeologic Investigation Report (Hanson, 2019a).

3. Describe how groundwater will be monitored to determine the rate and extent of the release.

   A study of the extent of contamination is included as part of the Hydrogeologic Investigation Report (Hanson, 2019a) and this Corrective Action and Selected Remedy Plan. The monitoring network to monitor the rate and extent of the release is described in the Groundwater Monitoring Plan (Hanson, 2020c).

4. Has the release been contained on-site at the facility?

   Migration of CCR constituents is limited by Lake of Egypt, which acts as a groundwater discharge area and hydraulic barrier.

5. Describe the groundwater monitoring network and groundwater and soil sampling protocols in place at the facility.

   The groundwater monitoring network and sampling protocols are described in the Groundwater Monitoring Plan (Hanson, 2020c).

6. Provide the schedule for investigation and monitoring.

   The site investigation is complete and groundwater monitoring will continue for the regulatory/permitted frequency and monitoring period as described in the Groundwater Monitoring Plan Section 4.2: Sampling Schedule (Hanson, 2020c).

7. Describe the laboratory quality assurance program utilized for the investigation.

   All quality control criteria applicable to the test methods employed for this project have been satisfactorily met and are in accordance with the National Environmental Laboratory Accreditation Program (NELAP) unless noted.

8. Provide a summary of the results of available soil testing and groundwater monitoring associated with the release at the facility. The summary or results should provide the following information: dates of sampling; types of samples taken (soil or water); locations and depths of samples; sampling and analytical methods; analytical laboratories used; chemical constituents for which analyses were performed; analytical detection limits; and concentrations of chemical constituents in ppm (levels below detection should be identified as "ND").

   A narrative summary of the results of groundwater monitoring is discussed in Section 2.1: Groundwater Monitoring History of this report. Analytical data summary tables are available in Appendix A of this report and graphs are available in Appendix B of this report.

Based on my inquiry of those persons directly responsible for gathering the information, I certify that the information submitted is, to the best of knowledge and belief, true and accurate and confirm that the actions identified herein will be undertaken in accordance with the schedule set forth herein.

Marion Power Station	
Facility Name	Signature of Owner/Operator
11543 Lake Egypt Road, Marion, IL 62959	***Southern Illinois Power Cooperative***
Location of Facility	Name of Owner/Operator
1990555005	***July 24, 2020***
Illinois EPA Identification Number	Date

Part III: Remedy Selection Information

1. Describe the selected remedy.

   The selected remedy consists of:

   1. ***clean close the current Emery Pond,***
   2. ***clean close the Gypsum Loadout Area and historical portion of the Emery Pond***
   3. ***backfill the Gypsum Loadout Area with clean soil,***
   4. ***construct a new, storm water basin with a CCR compliant composite liner,***
   5. ***add a perimeter drain beneath the outboard toe of the liner for liner protection and to augment groundwater collection, and***
   6. ***use a Groundwater Management Zone (GMZ) during the return to compliance.***

2. Describe other remedies which were considered and why they were rejected.

   Additional mitigation for major cation/anion contaminants is difficult and expensive. Secondary containments (such as slurry walls) are also expensive.

3. Will waste, contaminated soil, or contaminated groundwater be removed from the site in the course of this remediation? Yes ☒ No ☐
   If the answer to this question is "yes", where will the contaminated material be taken?

   Any material removed during the clean closure activities will be taken to a permitted disposal facility (Illinois EPA or DNR Permit) after any needed pre-disposal testing.

4. Describe how the selected remedy will accomplish the maximum practical restoration of beneficial use of groundwater.

   A new, composite liner system (recompacted soil with HDPE) will limit contaminant migration from the new pond and the perimeter drain will aid in collecting impacted groundwater. Groundwater quality will improve over time as identified in the Groundwater Protection Evaluation (Hanson, 2020a).

5. Describe how the selected remedy will minimize any threat to public health or the environment.

   Clean closure of the Emery Pond and Gypsum *Loadout* Area will limit any new or continuing groundwater impacts. The perimeter toe drain will assist with removal of currently impacted groundwater.

6. Describe how the selected remedy will result in compliance with the applicable groundwater standards.

   The* Groundwater Protection Evaluation (Hanson, 2020a) indicates that water quality will meet the Class I: Potable Resource groundwater standard in approximately 27 years after *the clean closure is completed. The 27-year period is needed for total Boron to reach 2.0 mg/L at the downgradient compliance point.

7. Provide a schedule for design, construction, and operation of the remedy, including dates for the start and completion.

   A schedule for the remedies is included in Appendix C of the Closure Plan (Hanson, 2020b).

8. Describe how the remedy will be operated and maintained.

   The new pond liner and cover systems will be installed using a quality assurance (QA) program. The pond will be operated in such a way as to reduce the likelihood of any liner damage.

9. Have any of the following permits been issued for the remediation?

   a. Construction or Operating permit from the Division of Water Pollution Control. Yes ☐ No ☒

      But a construction/operating permit application is currently under review with Illinois EPA Bureau of Water.

   b. Land treatment permit from the Division of Water Pollution Control. Yes ☐ No ☒
      If the answer to this question is "yes", identify the permit number.

   c. Construction or Operating permit from the Division of Air Pollution Control. Yes ☐ No ☒
      If the answer to this question is "yes", identify the permit number.

10. How will groundwater at the facility be monitored following completion of the remedy to ensure that the groundwater standards have been attained?

    Quarterly monitoring of the Contaminants of Concern and annual monitoring of the 35 IAC 620.240 remaining inorganic parameters will provide the mechanism to show compliance over time. Assessment monitoring under 40 CFR 257 will also continue.

Based on my inquiry of those persons directly responsible for gathering the information, I certify that the information submitted is, to the best of my knowledge and belief, true and accurate and confirm that the actions identified herein will be undertaken in accordance with the schedule set forth herein.

Marion Power Station	
Facility Name	Signature of Owner/Operator
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