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 March 30, 2021

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
SSL – statistically significant level
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 is a coal combustion residuals (CCR) impoundment at the Plant and 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

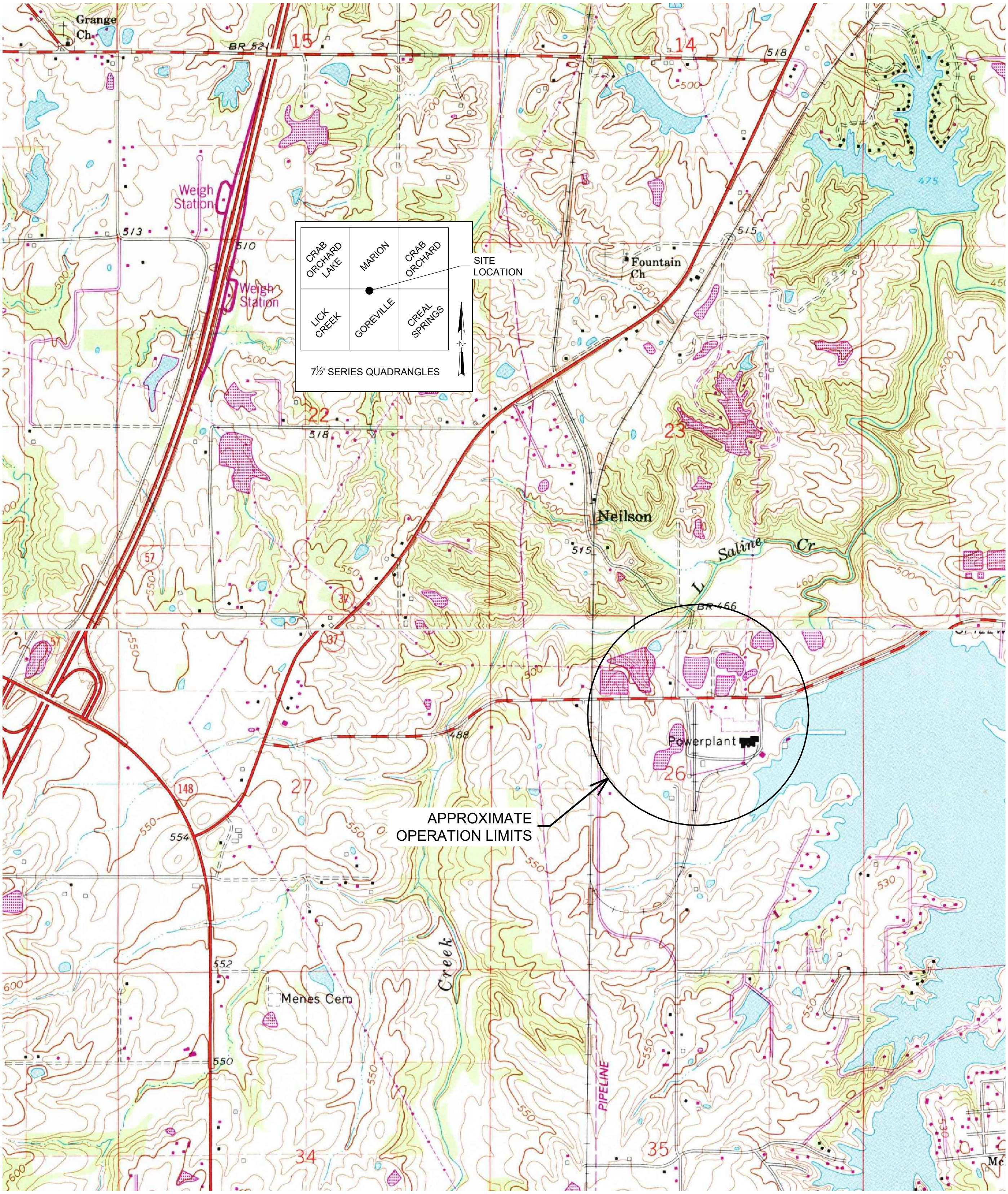
2.1 Site Hydrogeology

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 (< 1×10^{-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. At the request of Illinois EPA, compliance will be evaluated against the Class I: Potable Resource Groundwater standards. Groundwater in the rest of the explored Bedrock Unit is Class I: Potable Resource Groundwater.



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
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FIGURE NO. 2

The following reasons are used for these classifications:

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,
2. Although 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 use associated with any of the operations at the Marion Power Plant. Additionally, given existing groundwater data and because 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 Appendix IV constituents.

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. An additional map, showing the location of each direct push boring, its bottom elevation, and the top of bedrock elevation (assumed to be the bottom of Emery Pond) is also included in Appendix C.

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)], as applicable. Parameters with only one exceedance at a well are treated as a false positive result or not a confirmed exceedance† (e.g., Chromium, Lithium, etc.) assuming a 95% confidence limit and observable data trends.

2.2.1 Part 257, Appendix III Parameters

2.2.1a 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 background water quality 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.

† The alternative source demonstration in 40 CFR 257.94(e)(2) allows for the evaluation of natural variation in groundwater quality. Should a re-sample show the previous result was not statistically significant, then that result is a false positive or not a confirmed exceedance.

2.2.1b 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 background water quality 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.

2.2.1c 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 background water quality 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 concentrations below the Class I and Class II Standards.

2.2.1d 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 background water quality limit 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 background water quality limit are found at EP-3, EP-4, DP2g, and DP2h. The Emery Pond had a pH concentration of 7.77 SU.

2.2.1e 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 background water quality limit 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).

2.2.1f 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 background water quality limit 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.

2.2.2 Part 257, Appendix IV Parameters

2.2.2a 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.

2.2.2b 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 intermittently had concentrations above the Site's GPS of 0.015 mg/L (twice since the end of 2016, but these were not confirmed exceedances that would establish an SSL of the GPS). 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.

2.2.2c 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 been detected during the background monitoring period above the Site's GPS but has not been observed at an SSL above the 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.

2.2.2d 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.

2.2.2e 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), but Cadmium has been reported above the GPS (0.005 mg/L) once (not a confirmed exceedance that would establish an SSL above the GPS). 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.

2.2.2f 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 had been detected during the background monitoring period above the Site's GPS but has not been observed at an SSL above the GPS. 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.

2.2.3 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.

2.2.3a 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.

2.2.3b 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.

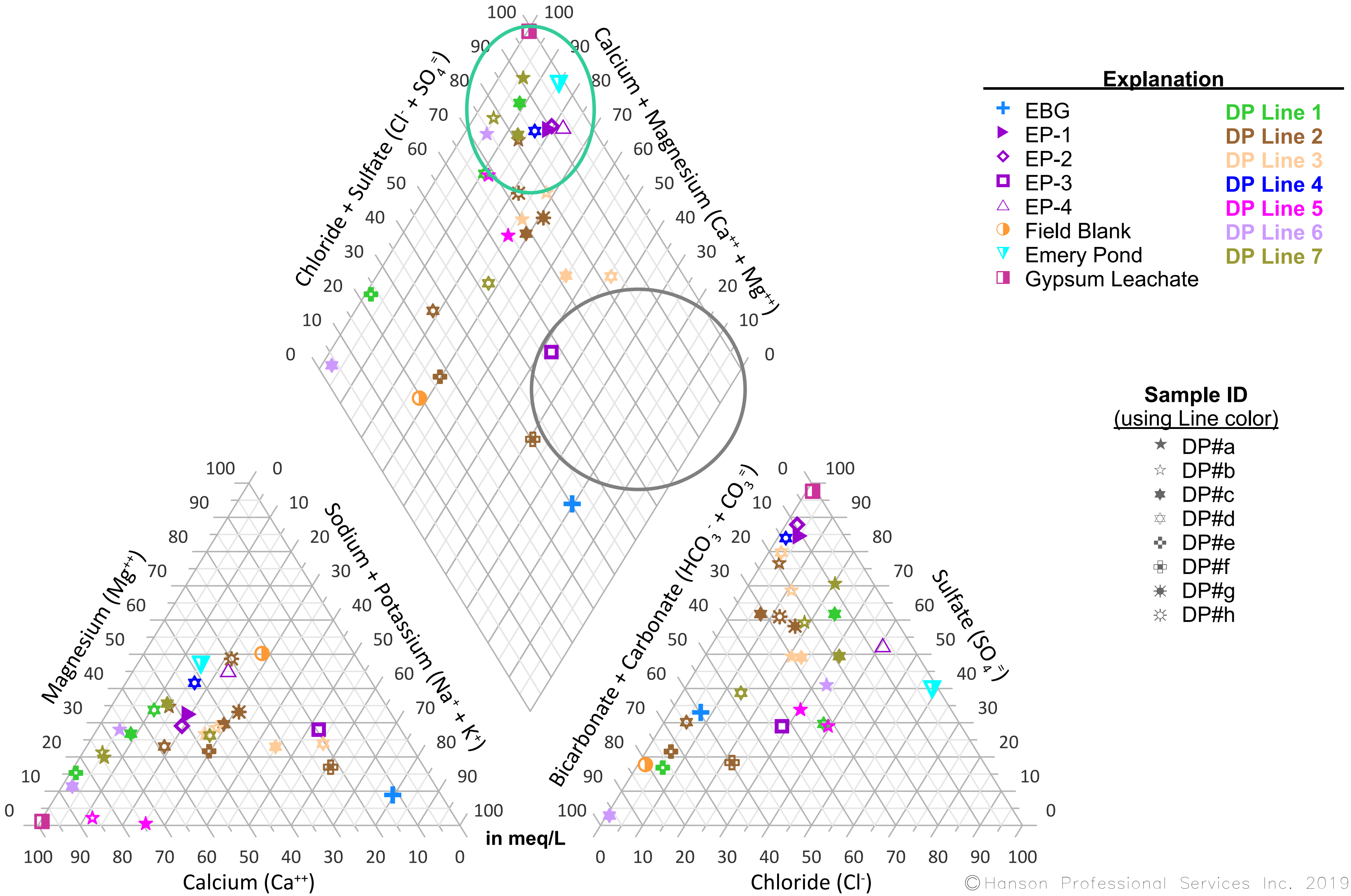
2.2.3c Zinc

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.

2.3 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.



Possible CCR Waters

Scrubber (gypsum) impacted waters

Ash (leachate and ponds) impacted waters

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Emery Pond Piper (Tri-linear) Diagram

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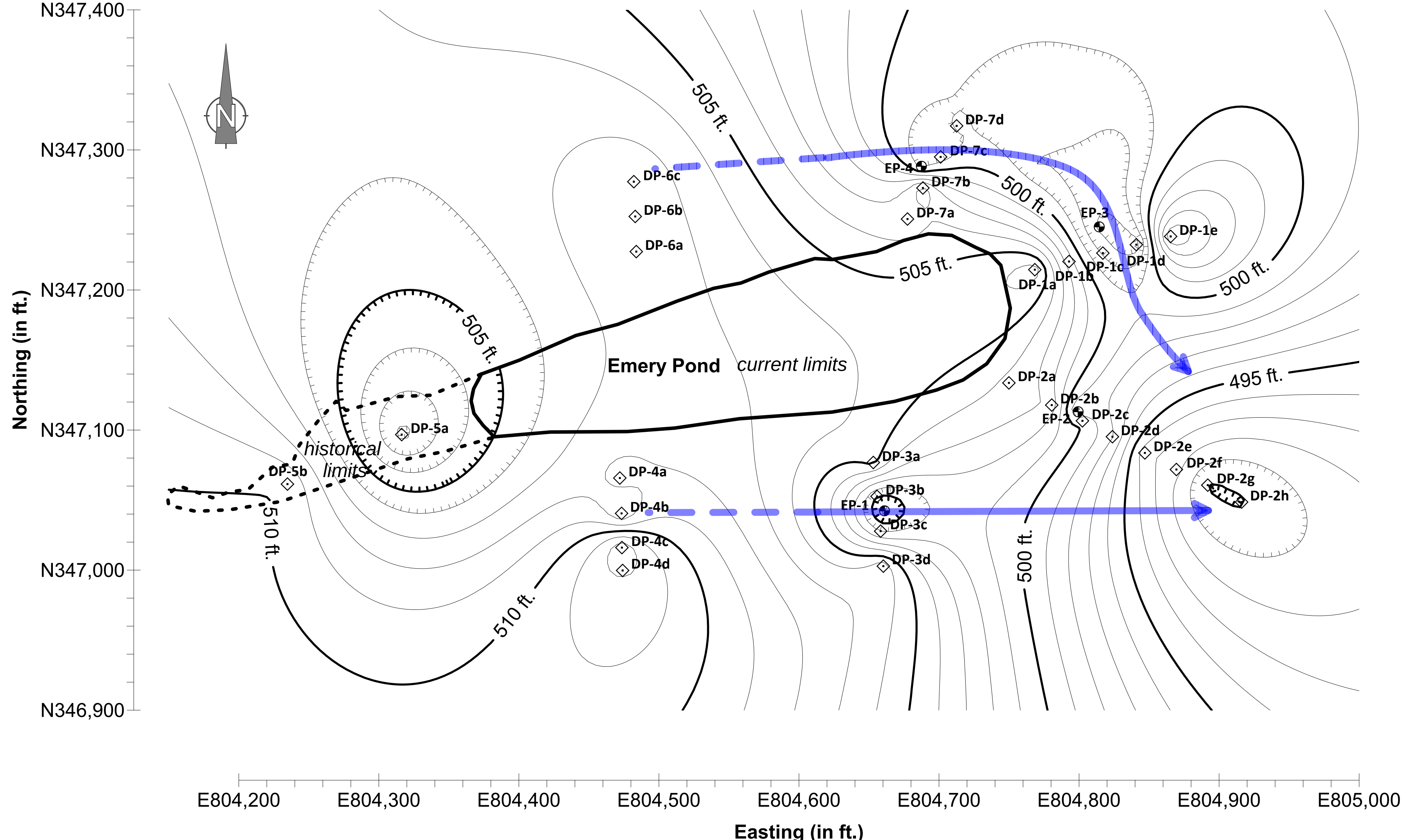
FIGURE 3



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

2.4 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).
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 reduces 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. Assessment of Corrective Measures

3.1 Corrective Measures Alternatives

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 as applied to remedy options is discussed in this Section and Sections 4 and 5, and is summarized in Table 4, Table 5, and Table 6. 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.

The assessment of corrective measures must include an analysis of the effectiveness of potential corrective measures in meeting the requirements and objectives of the remedy as described under § 257.97, including at least the following:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;
- The time required to begin and complete the remedy;
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

Corrective Measures under review are the following techniques:

Do nothing	Close in Place	Clean Close	Barrier Wall	
Monitored Natural Attenuation		Pump and Treat	Pump Station	Retrofit

The next subsection will discuss each of these alternatives.

3.1.1 Do Nothing

Performing no further action at Emery Pond is a potential corrective measure. It takes no time to implement or complete. However, it does nothing to reduce impacts, control exposure, or limit residual contamination. It also opens the owner to additional scrutiny by Federal and State regulators as well as third-party intervention.

This remedy is not protective of human health, nor does it provide a clear path to attaining the GPS or controlling releases. The CCR is not removed or managed. Because of this, there is an exposure potential.

3.1.2 Close in Place

Leaving the CCR in place and providing an isolating cover system is one of the more commonly used remedy alternatives, especially for larger impoundments. This requires construction of a final cover system that restricts the amount of water infiltration into the CCR and thereby limits the amount of leachate generated. Implementation requires a specialty contractor for the placement and welding of a geosynthetic liner and a regular dirt contractor for placement of the recompacted soil liner and vegetative soil later. The time required to install the cover system varies by the size of the project. For Emery Pond, installation would take between 6-8 weeks. This project would require a new construction permit from Illinois EPA Bureau of Water, which would add 90+ days to the schedule. A construction permit under the proposed Part 845 regulations is not needed if completed prior to July 2021. A down side to close in place is loss, or at least reduction, of storm water storage, which is the primary future function of the new Storm Water Basin.

This potential corrective measure is limited in effectiveness because the potential future groundwater contact with the CCR could prevent attaining the GPS.

3.1.3 Clean Close

Removal of CCR from the Emery Pond is perhaps the most effective and efficient corrective measure for this small pond. The small size of Emery Pond makes this remedy more cost effective, practical, and efficient than at larger ponds, where transposition and disposal of huge amounts of CCR may take months or more, be impractical and create additional concerns and risks. Clean closure will remove CCR and thus any future impact to groundwater. Excavation of bottom sediments in Emery Pond and the removal of the Gypsum Loadout Area and CCR beneath the loadout area will have an immediate benefit to the Site groundwater. CCR will be transported offsite to a solid waste disposal facility in accordance with the proposed Part 845 regulations. Implementation of the plan and removal of CCR should be limited to a 4- to 6-week timeframe. At this time, no additional permitting should be needed (a water pollution control permit has already been received for the work, no additional NPDES permitting should be required, as discussed below, and a construction permit under the proposed Part 845 regulations is not needed, if closure is completed prior to July 2021), but there will be disposal fees associated with disposal of the CCR in a State permitted facility.

3.1.4 Barrier Wall

Barrier walls have been used for some time to protect groundwater from contaminated sources that are too large or too dangerous to economically remove. The most common type of barrier wall is a bentonite slurry wall, where an excavation is made, and a high-solids bentonite slurry is pumped into the excavation. The excavation is extended as bentonite slurry is added. There are some problems with barrier wall systems. First, they can be expensive to construct, with prices in the millions of dollars for even fractions of mile long walls. Secondly, the precipitation that lands within the confines of the wall must be managed to not overtop the barrier or cause additional releases of contaminants to the environment. Overtopping would be a concern for a slurry wall here because it would likely be adjacent to Lake of Egypt and raise the potential for exposure to the contaminants of concern in the lake. Third, a barrier wall likely provides the most return when CCR is left in place and where the CCR could continue to cause groundwater impacts. In that case, the barrier wall may mitigate such impacts. However, when the source CCR is removed, which would occur with the clean close option, a barrier wall provides far less benefit, especially if there is no identified groundwater receptor at risk. This is true for Emery Pond, as discussed in this report. Evidence indicates that even without a slurry wall, current groundwater is not impacting the surface waters of Lake of Egypt (see Section 6.3).

Another issue with constructing a slurry wall around Emery Pond are the underground utilities and foundations associated with the power plant. Utilities (electrical, water, sewer, fuel, etc.) would almost certainly have to be relocated or terminated before construction of the wall could begin with potential interruption to plant operations. Furthermore, excavations adjacent to a large existing structure (i.e., Unit 4 smoke stack) could cause foundation instability. Additional geotechnical investigations would need to be done to establish safe excavation practices prior to any slurry wall construction. Excluding any additional investigations or utility relocations, Hanson estimates an 8- to 12-week installation timeline for slurry wall construction, assuming it could be constructed at this location.

3.1.5 Pump and Treat

As with barrier walls, pump and treat systems have been implemented as a corrective action for decades. Either vertical well points or horizontal trenches can be used to collect groundwater. Although treatment for metals can be straightforward, treating anion contamination can be time consuming and expensive. For example, chloride and sulfate treatment must be done with reverse osmosis (RO). RO uses a semi-permeable membrane to remove many of the dissolved solids in groundwater. This process is slow, expensive, and still generates a waste water stream that could require additional treatment or disposal.

Although horizontal trenches may be more efficient, as noted above, subsurface conditions or utilities may prevent installation of a trench system. The use of well points to collect groundwater also has limits, especially in low hydraulic conductivity soils. The low hydraulic conductivity causes rapid drawdown at the well points with reduced zones of capture. Permitting for this system would require modifying the Site's NPDES permit to allow discharge of the collected groundwater or any treated groundwater. As is true for barrier walls, pump and treat systems typically provide far less benefit when CCR is removed, especially when there are no identified at-risk groundwater receptors. Time for installation could range from 4- to 8-weeks, depending on the system used.

3.1.6 Pump Station

Since the new Stormwater Basin's purpose was to manage storm water, the closure of Emery Pond causes the need to replace that storm water collection function. A pump station is a potential alternative to a new storm water detention basin. This measure must be implemented with either the clean close or close in place options. The pump station could conceptually replace a detention basin with a cistern or sump. The smaller storm water collection volume would require that a larger pump, sized for the appropriate precipitation event (or storm) be used to control flow and prevent storm water discharges directly to Lake of Egypt. With the larger capacity pump, a larger discharge pipe may also be required to get storm water routed through the NPDES discharge system. Storm water would then continue to be discharged via the pond system to NPDES Outfall 002. This option would require a change to the currently planned and permitted construction of the new Stormwater Basin, causing substantial additional delay in the work and no meaningful corrective action benefit. The benefits and limitations of the clean close and close in place options have been previously discussed.

3.1.7 Retrofit

A retrofit of the Emery Pond to a CCR compliant impoundment was also considered. A retrofit would include excavating the CCR present in Emery Pond and the FGD load out area and decontaminating the area, which would remove CCR and its likelihood to impact groundwater. The composite liner system would protect groundwater from future CCR impacts and the impoundment could continue to provide storm water detention. Additionally, a final cover system would need to be placed at the Gypsum Loadout Area after removal of the bed ash found there. This system would take more time than just lining or covering Emery Pond, likely 8- to 10-weeks. Removal of CCR would also require proper transportation and disposal at a State permitted facility. A Bureau of Water construction permit would also be needed and may require an Illinois Department of Natural Resources dam permit. However, because Unit 4 shut down in October 2020, a new CCR surface impoundment is no longer needed.

3.1.8 Monitored Natural Attenuation

Monitored Natural Attenuation (MNA) can work as a corrective measure for both organic and inorganic parameters. “Attenuation processes include ions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants” (US EPA, 2015b). As noted by US EPA (2012), MNA works best when the source of contamination has been removed. Natural processes will, over time, remove or attenuate the small amounts of contaminants left in the soil and groundwater.

One or more of the MNA processes will be involved with the return to Class I groundwater standard for the inorganic constituents that show exceedances of Class I standards and Federal CCR rule standards. Dilution and dispersion were incorporated into the contaminant transport model used to assess Emery Pond (Hanson, 2020a), but none of the current site investigations or the contaminant transport modeling have looked at any of the “reactive” attenuation processes (e.g., sorption, chemical reaction, etc.) that could enhance clean up times. Further, that modeling shows that attaining the Part 257 GPS for Arsenic and Cobalt (the only two Appendix IV parameters with SSLs above the GPS) occurs much quicker. Table 3 lists the time to compliance at each of the downgradient monitoring wells. Note that Cobalt, at the various compliance points does not have exceedances after clean closure is achieved. MNA is an effective process here when paired with active source removal principally due to the small size of Emery Pond and the short duration of the CCR exposure (beginning 2007/08 with the construction of the Gypsum Loadout Area).

Table 3. Time to Reach Compliance at Monitoring Locations

Well ID	Arsenic SSL (time in years)	Arsenic Class I (time in years)	Cobalt SSL (time in years)	Cobalt Class I (time in years)
EP-1	8	2	n/a	n/a
EP-2	10	8	n/a	n/a
EP-3	n/a	n/a	n/a	n/a
EP-4	1	n/a	n/a	n/a

4. Evaluation of Potential Remedies

From the list of remedial option presented in the previous section, several of the more viable alternatives will be discussed here and in the next Section. Based on 40 CFR 257.97, remedies must:

- Be protective of human health and the environment;
- Attain the groundwater protection standard as specified pursuant to § 257.95(h);
- Control the source(s) of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems;
- Comply with standards for management of wastes as specified in § 257.98(d).

Based on the Site hydrogeology, effectiveness, identified risks, and constructability of the closure alternative, SIPC selected three options to further evaluate as part of the Groundwater Protection Evaluation: Closure by Removal with backfill, Closure by Removal with Composite Liner System, Closure by Removal with Composite Liner System and Perimeter Drain, and MNA. All these options meet the needs of the selection criteria for the following reasons:

- Protective of human health and the environment – removal of the CCR removes any probability of future releases from the source of contamination above the GPS. A barrier wall or additional pump and treat system is not warranted because this remedy removes the source, thus eliminating any future releases to be treated by a barrier wall or pump and treat system, and there are no identified at-risk groundwater receptors. Further a barrier wall or pump and treat system would require considerably more time to obtain approval and then construct and would substantially raise costs without any material demonstrated benefit.
- Attain the groundwater standards – Over time, with source removal and monitored natural attenuation, groundwater concentrations are predicted to timely return to below Site background concentrations, Federal GPS (40 CFR 257.95(h)), and the Illinois Class I groundwater standards (35 IAC 620.410) based on model results. Indeed, that modeling predicts that GPS for the exceeded Part 257 constituents should be achieved within 7 years, as mentioned above.
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible – Clean closure removes the physical CCR material within the limits of Emery Pond, including the Gypsum Loadout Area.
- Comply with standards for management of wastes per 257.98(d) – Wastes removed as part of the clean closure will be managed, transported, and disposed of pursuant to RCRA requirements.

5. Corrective Action and Selected Remedy

This Corrective Action and Selected Remedy is submitted to address the groundwater exceedances identified in Section 2, above. 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 4 assessed options. These alternatives are consistent with the federal CCR rule and should lead to timely compliance with the Illinois Part 620 groundwater quality standards and the Part 257 GPS.

5.1 Selected Remedy

SIPC proposes to close Emery Pond and the adjacent Gypsum Loadout Area by removal, construct a CCR-compliant composite liner system in the footprint of the existing Emery Pond to continue the storm water management function, construct a perimeter drain at the toe of the liner system to protect the liner from external hydrostatic pressure with the additional benefit of recovering contaminated groundwater, continue to monitor the natural attenuation of contaminants in groundwater, and establish 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.

5.1.1 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 to visually clean levels. Clean closure (removal of any CCR materials) will be visually confirmed and certified by a Professional Engineer prior to continued construction activities. The CCR removal is expected to remove the source of the observed groundwater impacts at the Site, allowing groundwater to improve while the requested GMZ is in effect.

5.1.2 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 the former Emery Pond, which 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.

5.1.3 Perimeter Drain System

Additionally, the installation of the perimeter toe drain around the base of the basin liner system provides protection from hydraulic (hydrostatic) pressures to the liner system and further affords for collection of groundwater in the vicinity of the new basin. The collected groundwater would be discharged to the new basin and routed to NPDES Outfall 002, which is currently permitted to discharge the types of constituents that would be present in the groundwater. Section 3.9 of the Closure Plan (submitted with this Plan) contains a complete description of the perimeter toe drain and IEPA has issued SIPC a construction permit for the work, which suggests that no additional NPDES permitting is required. However, a confirming question with supporting information concerning NPDES permitting is currently pending with Bureau of Water.

5.1.4 Monitored Natural Attenuation

MNA (dilution and dispersion) will be used to aid in returning groundwater to below the Illinois Class I standards and Federal CCR rule standards. With the removal of the CCR at Emery Pond, MNA functions as a finishing or polishing step in the timely return of groundwater compliance.

5.2 Long- and Short-Term Effectiveness, Protectiveness, and Certainty

The selected remedy provides the best combination of corrective measures to address the long- and short-term effectiveness, protectiveness, and certainty of reaching and maintaining the GPS and Class I groundwater standards.

5.2.1 Magnitude of Reduction of Existing Risks

Removal of the CCR from the Emery Pond and vicinity is the best alternative for reducing risk by allowing the material to be disposed of in a permitted landfill facility that meets the current Illinois landfill rules (35 IAC 810-815). Further protections are included due to the facility's composite liner, leachate collection, and final cover requirement. The added benefit of the perimeter drain will also lower risk with the removal of a currently impacted groundwater.

5.2.2 Magnitude of Residual Risks, Likelihood of Further CCR Releases

As noted in Section 5.2.1, removal prevents further CCR releases from Emery Pond.

5.2.3 Type and Degree of Long-Term Management Required

Long term management of the selected remedy should be nominal. There are operation and management (O & M) needs, including perimeter drain pump maintenance and/or replacement and protection of the geomembrane component of the composite liner system.

However, the O & M costs associated with a close in place and treatment solution would be much greater. Operating a Pump and Treat system or managing precipitation falling within a slurry wall (this water could pick up contamination from contact with the in place CCR) would require further management, create additional risks and concerns (as discussed above) and cost much more than simply removing the CCR and allowing natural attenuation to aid with cleanup.

Groundwater monitoring wells will need to be maintained and repaired/replaced, as needed.

5.2.4 Short-term Risks to the Community or the Environment During Implementation

Potential short-term risks to the removal of the CCR include fugitive dust from storage and loading the dry CCR for transport and the actual transport of the CCR to the permitted disposal facility. Fugitive dust controls will follow the requirements of 40 CFR 257.80 and the proposed 35 IAC 845.500.

Loading CCR for transport will only occur within the Site boundaries, limiting community exposure. Transportation of the CCR will follow the requirements of the proposed 35 IAC 845.740.

5.2.5 Time Until Full Protection is Achieved

Hanson's Groundwater Protection Evaluation indicates that all GPS and Class I groundwater standards will be reached in approximately 27 years, and some will take less time. Further meeting the Part 257 GPS for arsenic and cobalt (only two parameters with an established SSL of the GPS) is predicted to occur much quicker, with arsenic modeled to reach the GPS in approximately 7 years and cobalt never causing a GPS compliance issue at the nearest potential groundwater receptor, the edge of Lake of Egypt.

5.2.6 Potential for Exposure of Human and Environmental Receptors to Remaining CCR

With clean closure there will be no remaining wastes. Groundwater is not used by the Plant, but nominal amounts of groundwater will be collected (estimated to be approximately 600 gallons per day) by the perimeter drain system and discharged to the Storm Water Basin and eventually NPDES Outfall 002. CCR transported to the permitted disposal facility will be entombed and eventually covered with a composite liner system preventing future exposure. The permitted off-site landfill's leachate collection system will restrict potential migration of contaminants to groundwater.

5.2.7 Long-Term Reliability of the Engineering and Institutional Controls

Long-term reliability of the selected remedy is excellent provided routine O & M is performed. Clean closure of the Emery Pond removes continued impacts to groundwater by CCR. Groundwater, as modeled, should return to compliance with Class I standards three years before the end of the 30-year post-closure care period, and compliance with the Part 257 GPS much faster than that.

5.2.8 Potential Need for Replacement of the Remedy

The primary remedy is the removal of CCR from the Emery Pond. Although there are other components to the selected remedy that could need replacement, they are primarily present to continue the use of the impoundment for storm water management, and do not present an exposure potential to CCR. Proper O & M will also defer the need for replacement of parts of the selected remedy.

5.3 Source Control Effectiveness

The selected remedy for Emery Pond does not rely on a source control as the primary mitigation method. New releases of CCR around Emery Pond, with the closure of Unit 4, are unlikely.

5.3.1 The Extent to Which Containment Practices Will Reduce Further Releases

As previously noted, there will be no CCR containment associated with the selected remedy.

5.3.2 Extent to Which Treatment Technologies May be Used

Although there is some groundwater collection associated with the selected remedy, discharge of those waters is controlled by the Site NPDES permit. The only additional treatment technology used is natural attenuation, in conjunction with source removal.

5.4 Implementing Selected Remedy

This section looks at the ease and operational reliability of implementation of the remedy and includes consideration of regulatory requirements and necessary resource for implementation.

5.4.1 Degree of Difficulty Associated with Constructing the Technology

CCR excavation and construction of the perimeter drain and composite liner system are common construction activities. The installation of the geomembrane does require a specialized contractor, but primarily for the equipment needed to make water-tight connections between the geomembrane panels and the remaining water control structures needed for storm water management.

The small size of the Emery Pond also reduces the difficulty and time needed for the closure activity and any risks or concerns that might otherwise be associated with CCR removal, transport, and off-site disposal.

5.4.2 Expected Operational Reliability of Technologies

Composite liner systems have been used at municipal solid waste landfills for over 30 years. With proper construction techniques and third-party construction quality assurance inspections, the selected remedy should perform reliably for as long as the Plant will need to control storm water. Of course, this would include any required O & M to maintain pumps and repair any damages.

Table 4. 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	No	n/a
Close in Place	• 40 CFR 257 compliant	• Loss of storm water storage	Somewhat	No	Some	No	Yes
Clean close	• 40 CFR 257 compliant	• Loss of storm water storage	Protective	Yes	Yes	Yes	Yes
Barrier wall	• Containment of COCs	• Still an unlined CCR impoundment • Working around buried utilities	Protective	Yes	Yes	No	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	No	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
Retrofit	• 40 CFR 257 compliant Removes COC source	• Pond unusable during construction • Requires CCR removal • Requires dam permit • New compliant unit no longer needed with shutdown of Unit 4	Protective	Yes	Yes	Yes	Yes

Table 5. 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
Barrier 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
Retrofit	Protective	Yes	Yes	Yes	Yes	Low	Fall 2020	Low	Low	Unlikely

Table 6. 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
Barrier 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
Retrofit	Clean close existing pond	Good	Water Treatment & Dam permits	Geosynthetics	None

5.4.3 Need to Coordinate and Obtain Necessary Approvals / Permits from Other Agencies

SIPC has been working with Bureau of Water to obtain the needed Water Treatment Device permit (35 IAC 309, Subpart B) and any NPDES permitting (35 IAC 309, Subpart A) that might be required for the selected remedy. The construction permit for the water treatment device was issued by Bureau of Water on October 16, 2020. Pursuant to submissions that have been made to Illinois EPA, the proposed remedy adds no new wastewater constituents to the currently permitted discharge and should not adversely impact any receiving water. Indeed, with the recent closure of Unit 4, all CCR from the facility will be managed dry and waste water discharges associated with the Site and facility will decrease. Accordingly, the proposed action should be covered under the facility's current NPDES permit, as suggested by the issued construction permit. Illinois EPA has not informed SIPC that this position is incorrect, and SIPC must proceed with the proposed action immediately to achieve timely closure under the federal CCR rule.

Additionally, the Illinois Department of Natural Resources dam permit re-classified the Emery Pond Dam as a Class III dam on December 16, 2020.

5.4.4 Availability of Necessary Equipment and Specialists

Excavation and recompacted soil placement are common earth work activities done by many contractors with the needed earthmoving equipment and trained operators. Drainage systems, like the perimeter drain, are also common construction activities. The water-tight placement of the geomembrane is the only specialty task associated with the selected remedy. Although specialized, there are several trained installation companies. Many of these installers are associated with the geomembrane manufacturing companies.

5.5 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.

5.5.1 Timetable

Active corrective action activities were proposed to coincide with the closure of Unit 4 in fall 2020. See Hanson's (2020b) Closure Plan for details. That timetable has been delayed given the need to work with Illinois EPA to obtain approval of these and related plans and reports with Illinois EPA. However, some work has begun, and the remainder must proceed in the very near future to timely close Emery Pond under the federal CCR rule.

Illinois EPA has requested that SIPC address permitting with respect to certain elements of the selected remedy described above. A 35 IAC 302, Subpart B construction permit for the work, including the new, non-CCR Storm Water Basin (that replaces Emery Pond) was issued by Illinois EPA Bureau of Water on October 16, 2020. In addition, SIPC earlier submitted a permit modification for its current NPDES permit. However, in light of the subsequent closure of Unit 4, and attendant reductions in wastewater discharges, and because the remedial action for this small pond would not cause the discharge of any new or different constituents and would not adversely impact any receiving water, SIPC believes that the proposed remedial action is covered under its current NPDES permit, which is also supported by the terms of the issued construction permit. SIPC has been waiting for months for Illinois EPA to provide a further clarifying response, and SIPC respectfully asks once again for Illinois EPA's immediate concurrence that no further NPDES permit action is needed so that SIPC may timely complete closure of Emery Pond.

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 6, below.

6. Application for a Groundwater Management Zone (GMZ)

6.1 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.

6.2 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, 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 the 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.

Table 7. 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.

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

HANSON
Hanson Professional Services Inc.

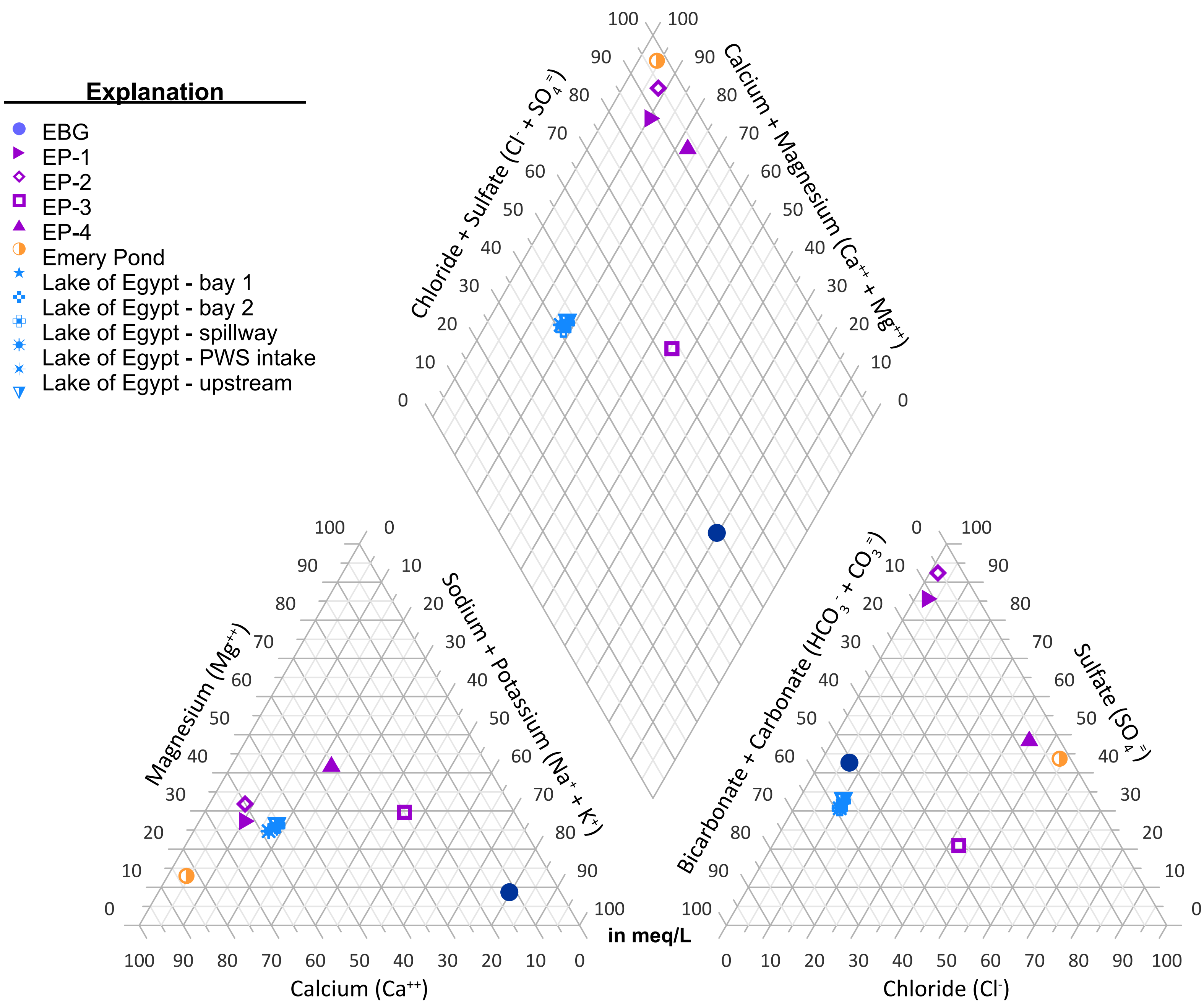
LAKE OF EGYPT SAMPLE LOCATION MAP

EMERY POND – MARION POWER PLANT
SOUTHERN ILLINOIS POWER COOPERATIVE
MARION, WILLIAMSON COUNTY, ILLINOIS

HANSON NO. 18E0022B

FIGURE 5

FIGURE 6. June 2020 Piper (Tri-linear) Diagram



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6.3 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 and 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. Meeting the Part 257 GPS for Arsenic and Cobalt occurs much quicker. Table 3 lists the time to compliance at each of the downgradient monitoring wells.

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 7 and 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.

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.

7. 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). Only assessment monitoring for Cobalt and Arsenic yielded SSLs of GPS exceedances. 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 the Site.

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 all COC concentration levels to drop below Class I: Potable Resource limits is approximately 27 years after closure by removal. Meeting the GPS for Arsenic and Cobalt (SSL of GPS) occurs much quicker, with Arsenic modeled to reach the GPS in approximately 7 years and Cobalt never modeled to cause a GPS compliance issue at the modeled compliance point adjacent to Lake of Egypt.

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.

8. 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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Date: 30 March 2021

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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)

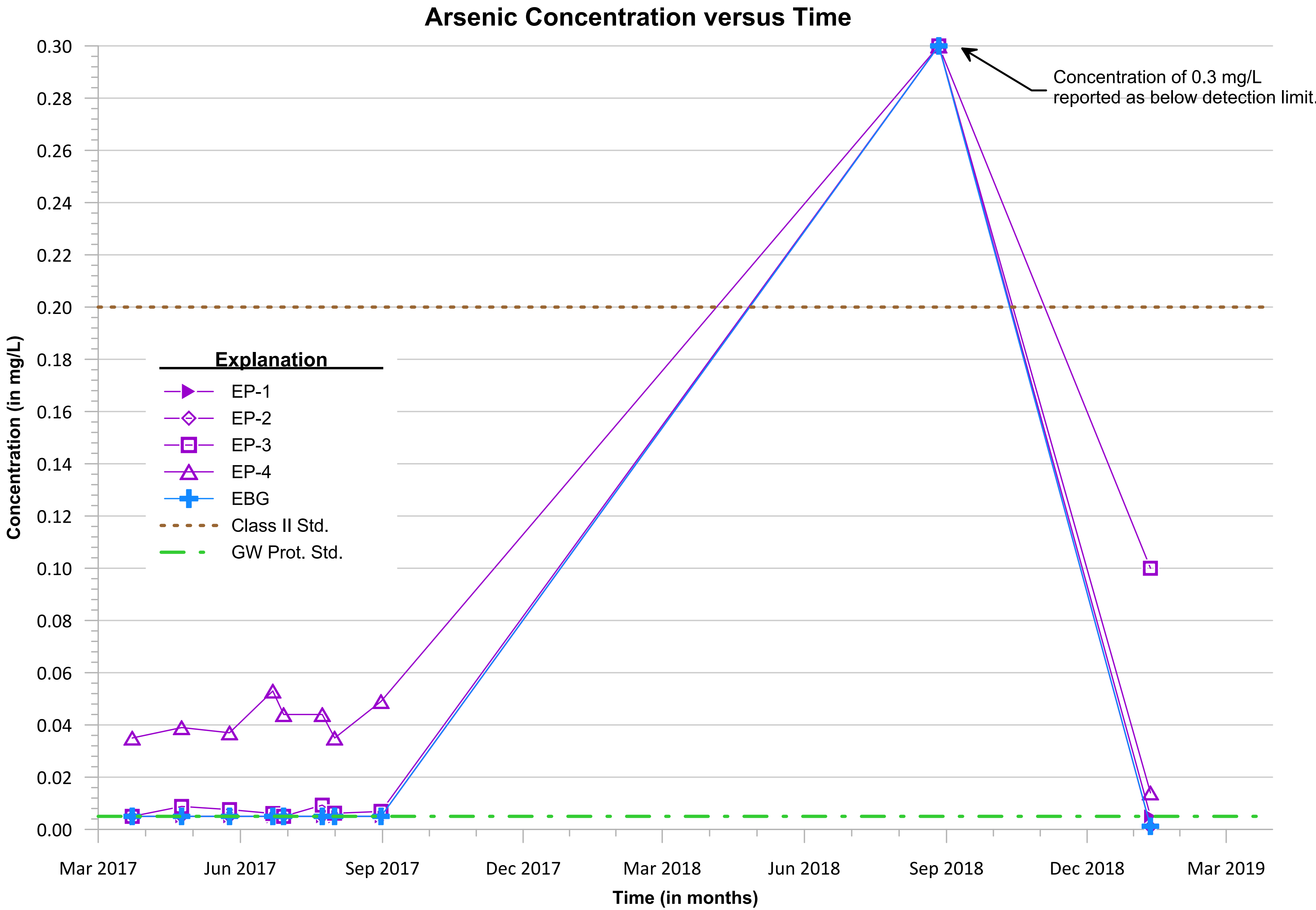
PARAMETER NAME	UNITS	Class II Std	No. of Exceedances	DP5b	DP6a	DP6b	DP6c	EP-4	DP7a	DP7b	DP7c	DP7d	Emery Pond	Gypsum
Conductivity	µmhos/cm			6020.	5160.		3380.		4000.	3580.	3210.	2470.	9630.	
pH	SU	6.5 - 9.0	9	10.6	6.48		7.11	6.07	6.51	6.61	6.44	6.66	7.77	
Temperature	°C			9.9	6.3		5.8	16.	9.7	7.6	9.8	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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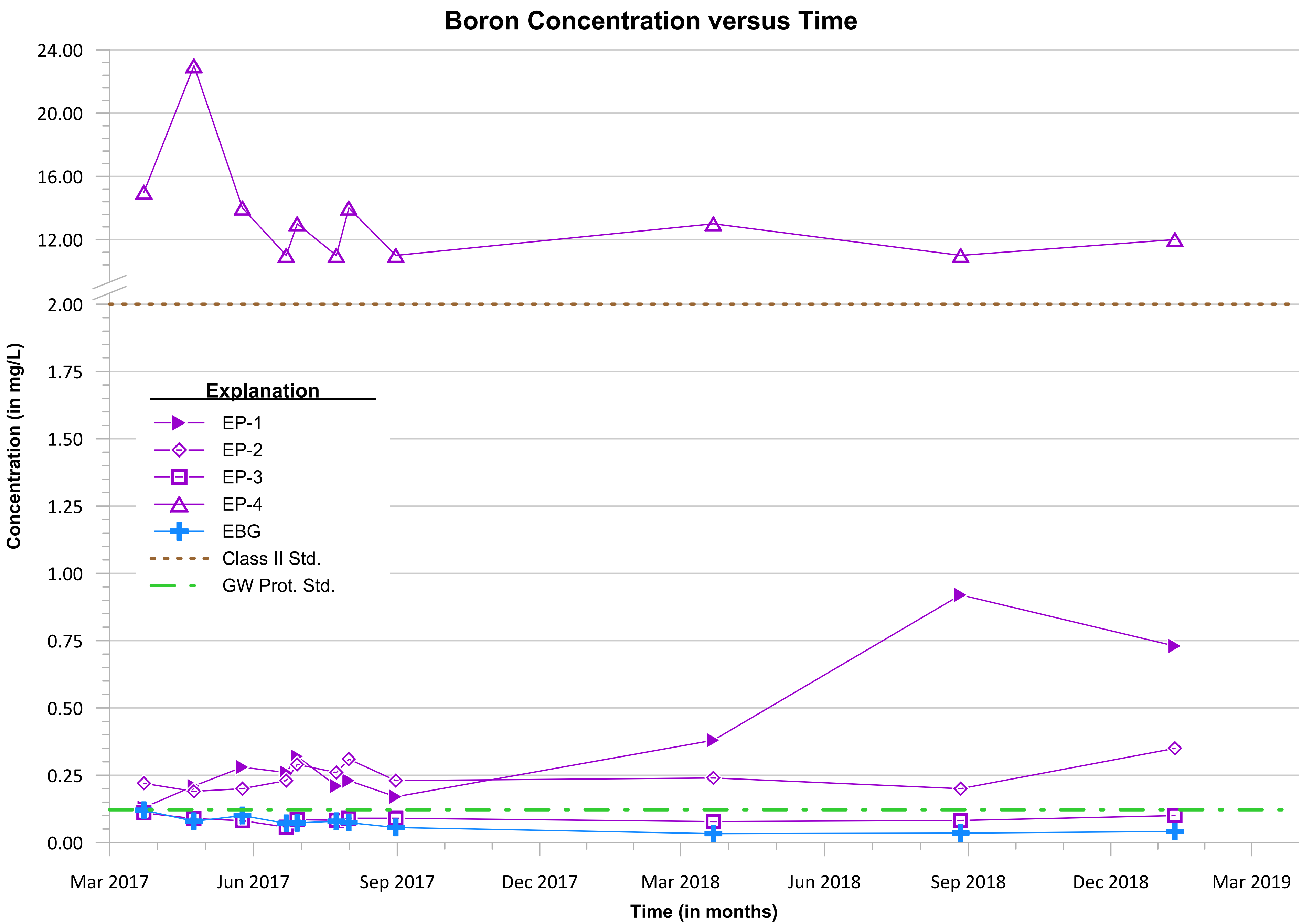

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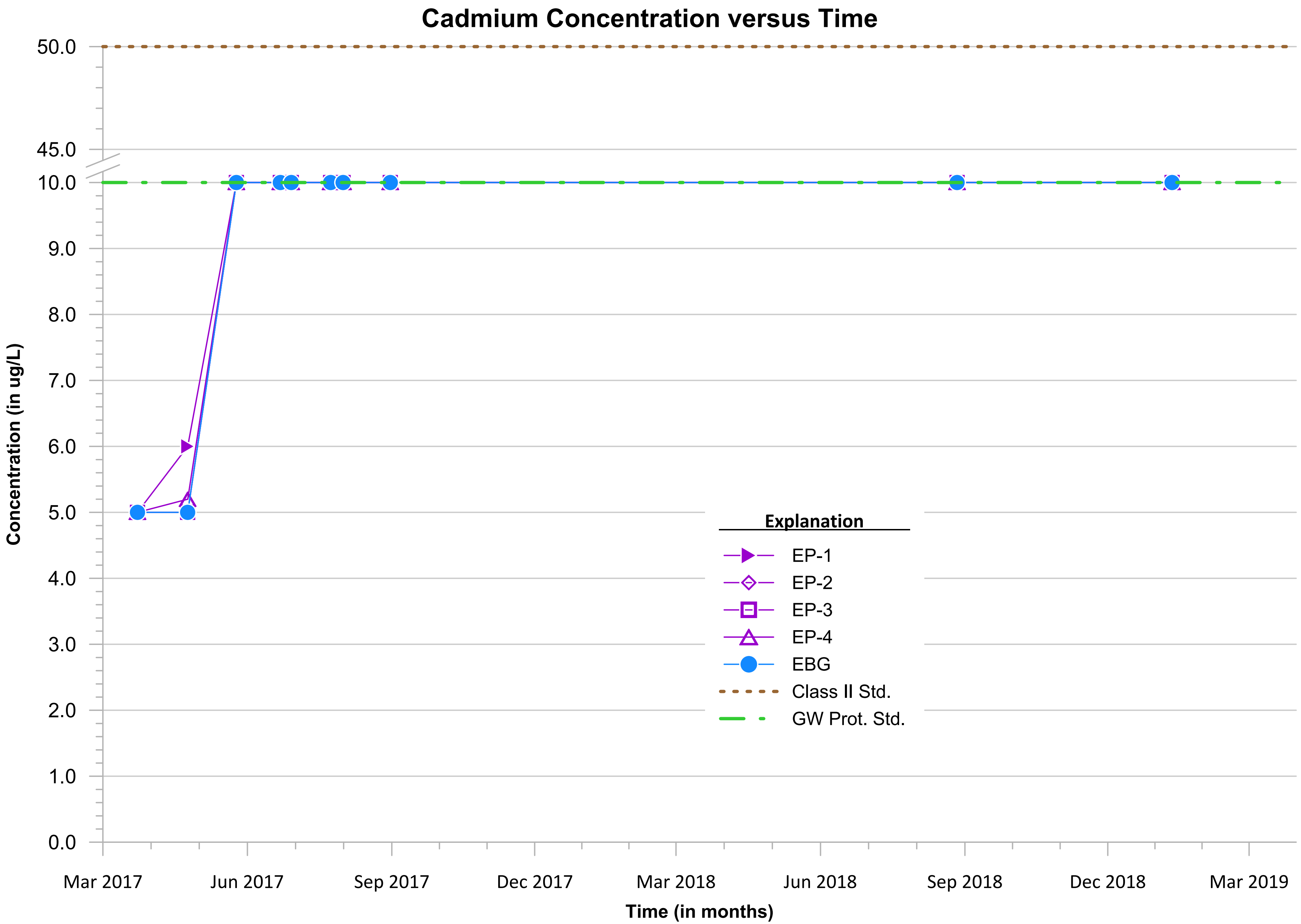

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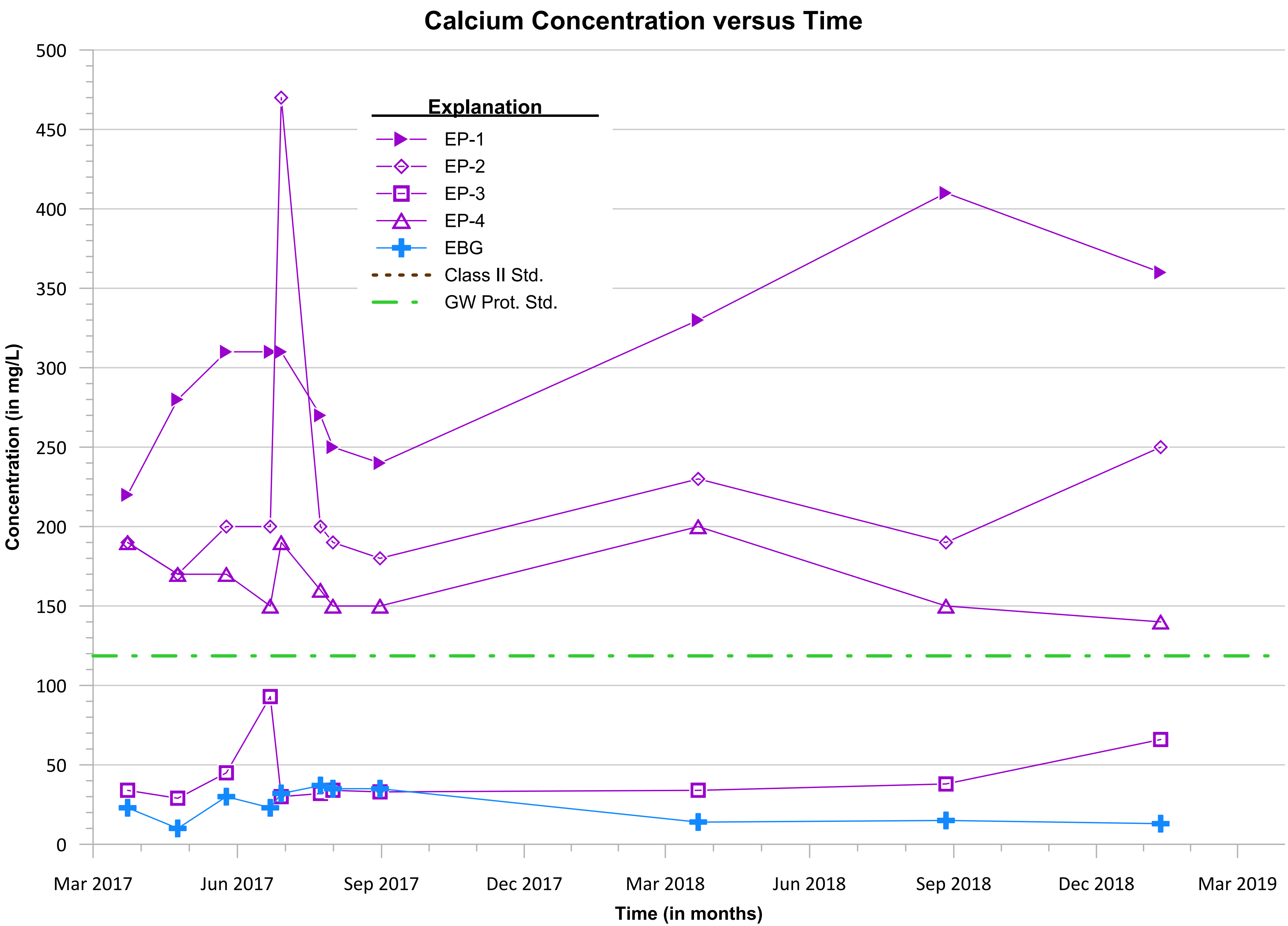

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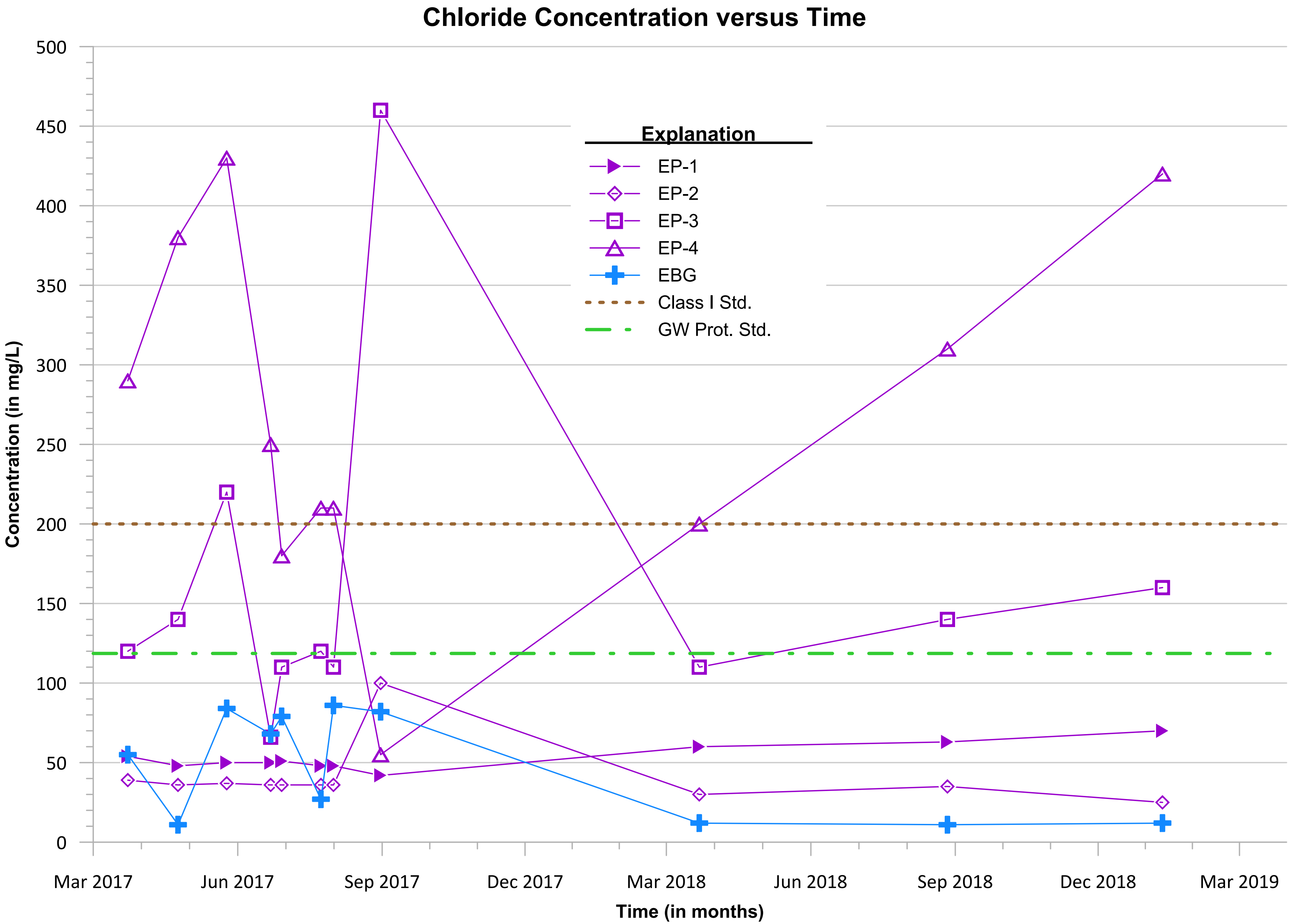
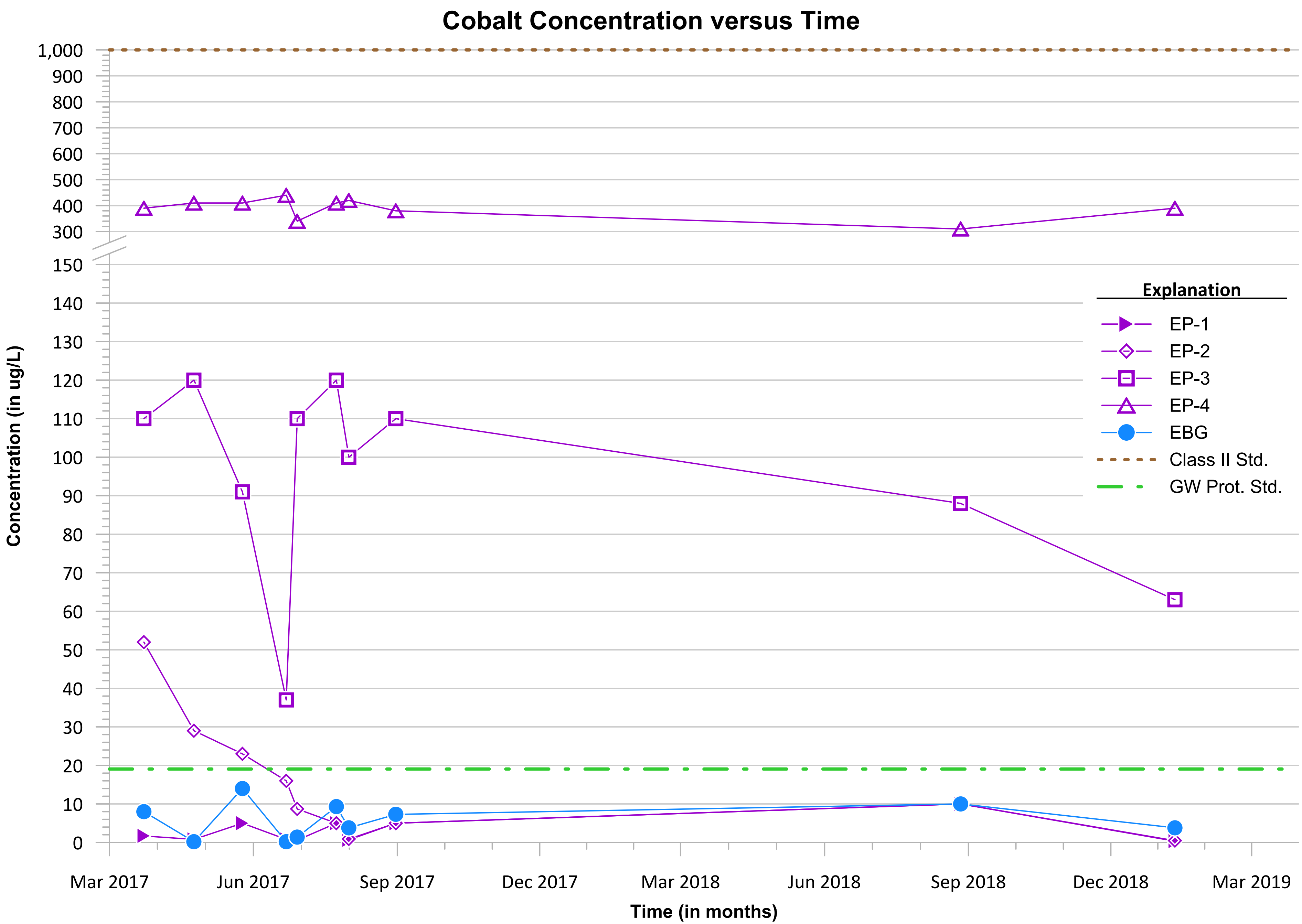

Chloride Concentration versus Time
Concentration (in mg/L)
500
450
400
350
300
250
200
150
100
50
0
Explanation
EP-1
EP-2
EP-3
EP-4
EBG
Class I Std.
GW Prot. Std.
Mar 2017
Jun 2017
Sep 2017
Dec 2017
Mar 2018
Jun 2018
Sep 2018
Dec 2018
Mar 2019
Time (in months)



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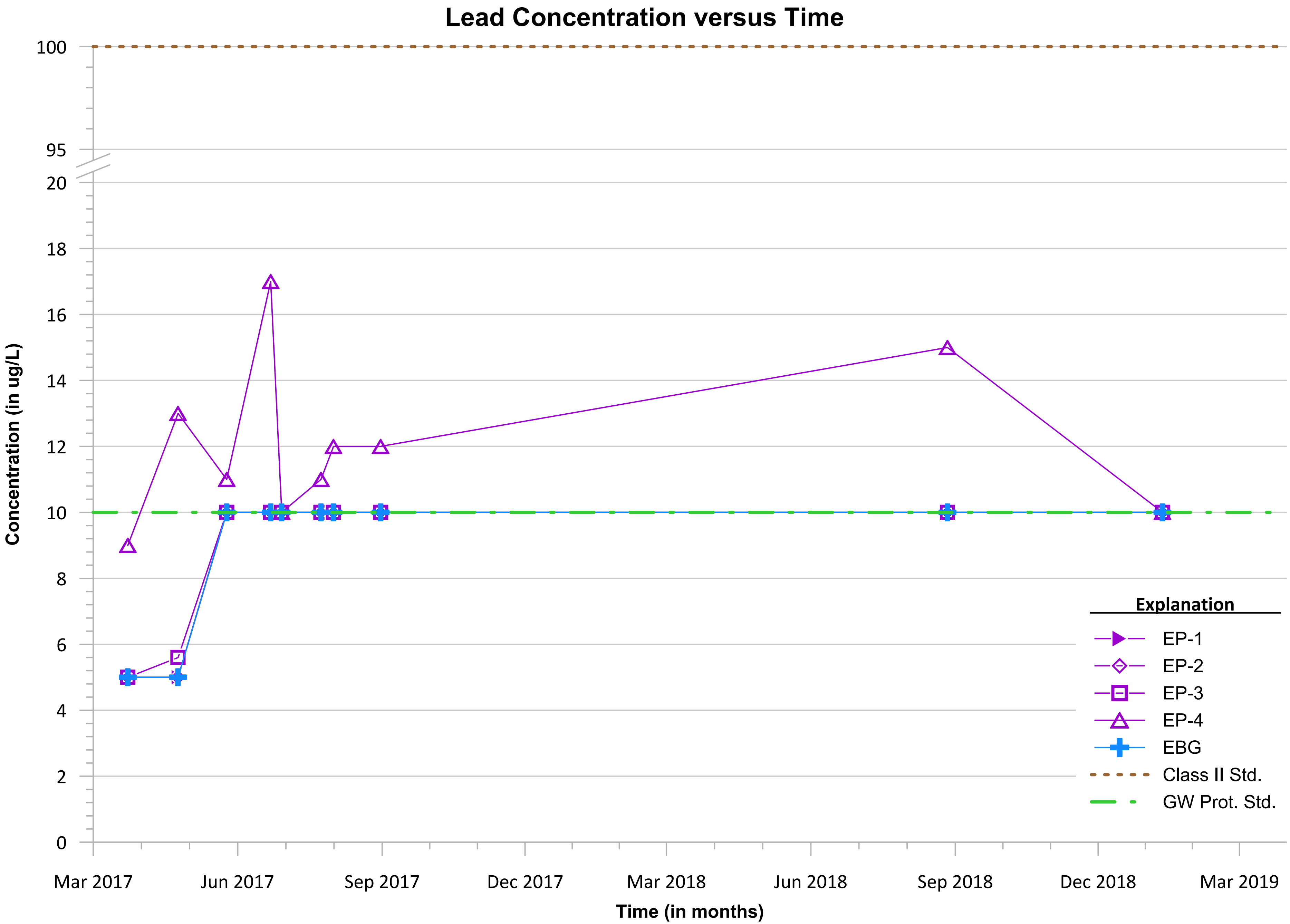

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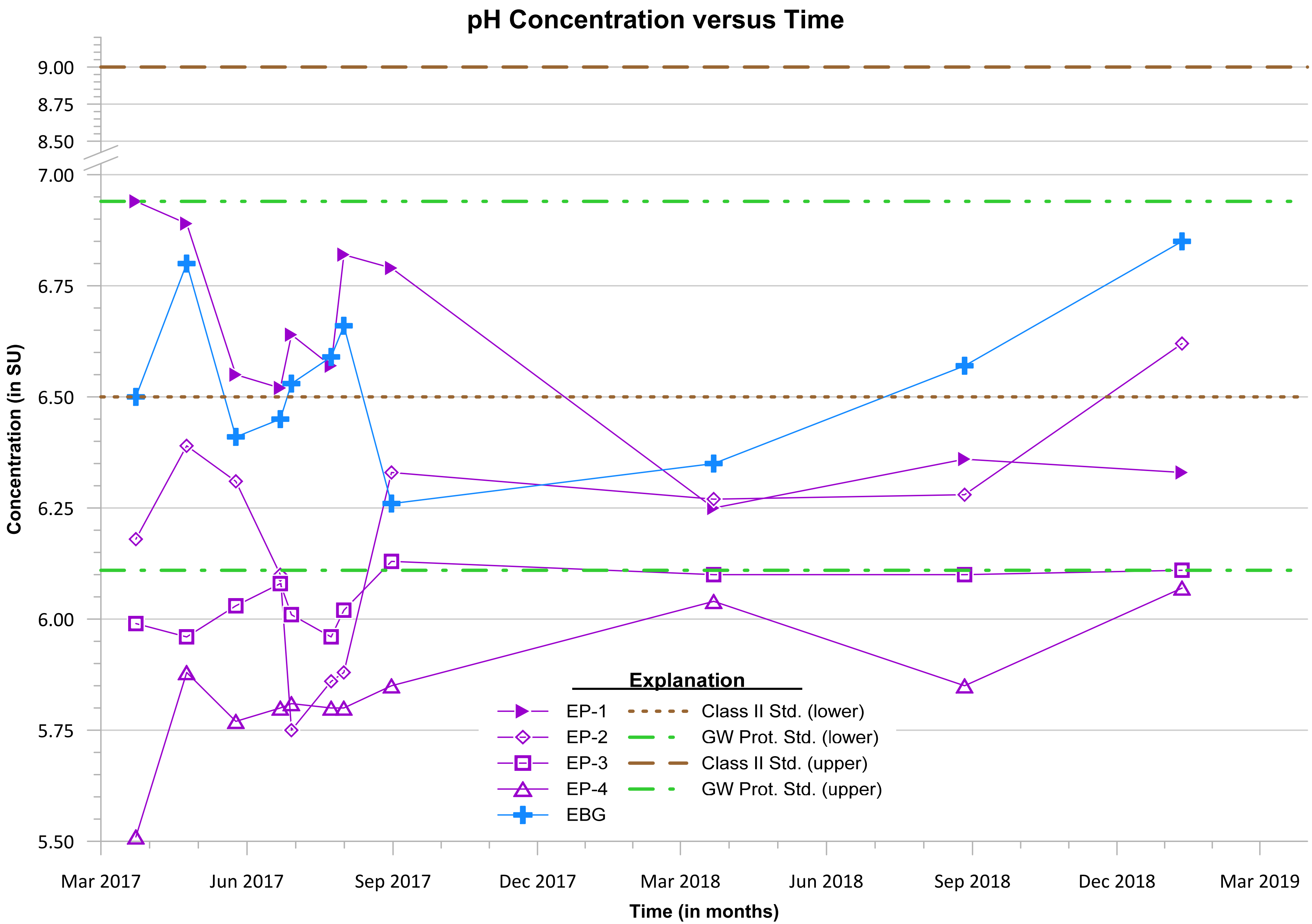

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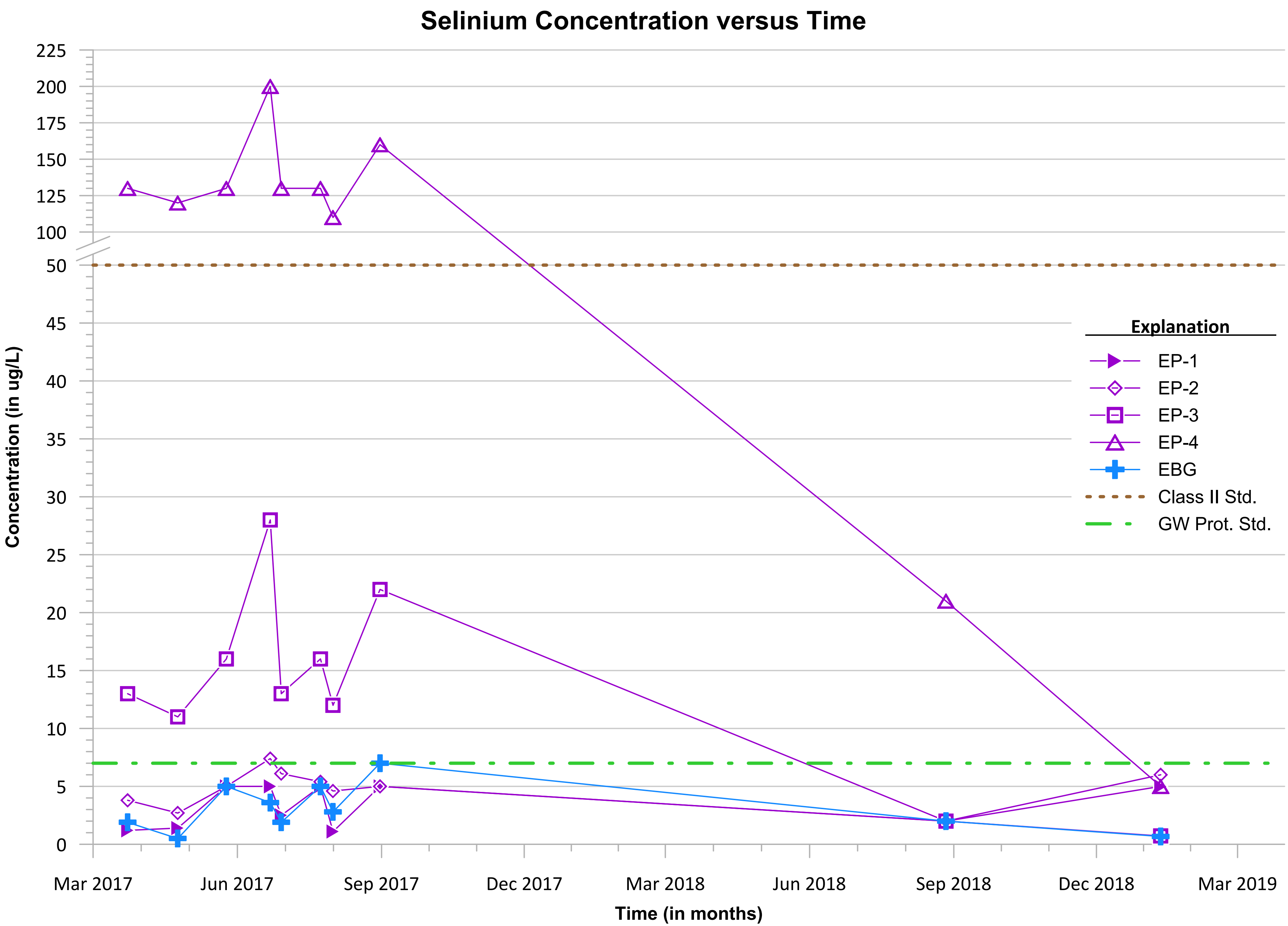

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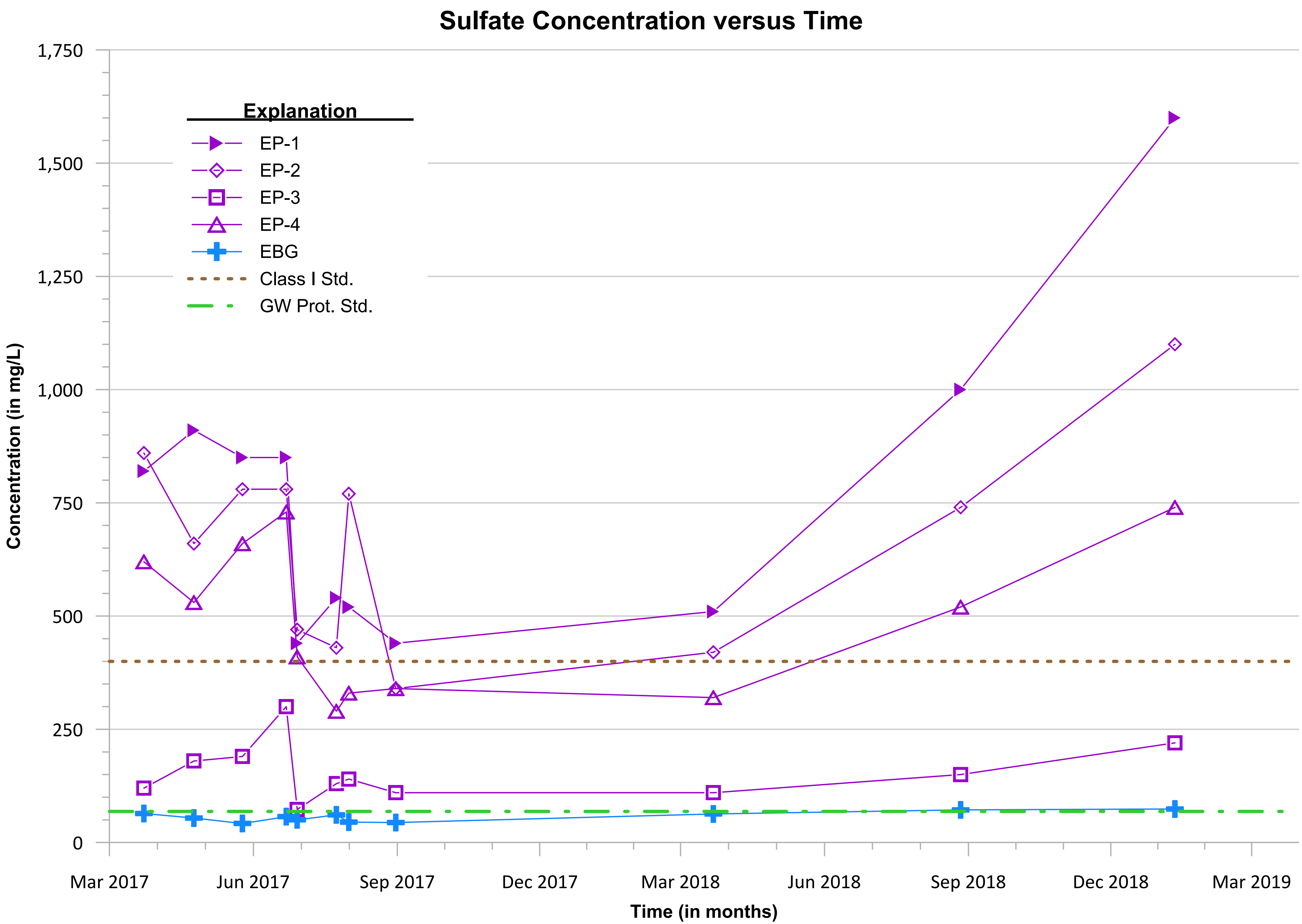

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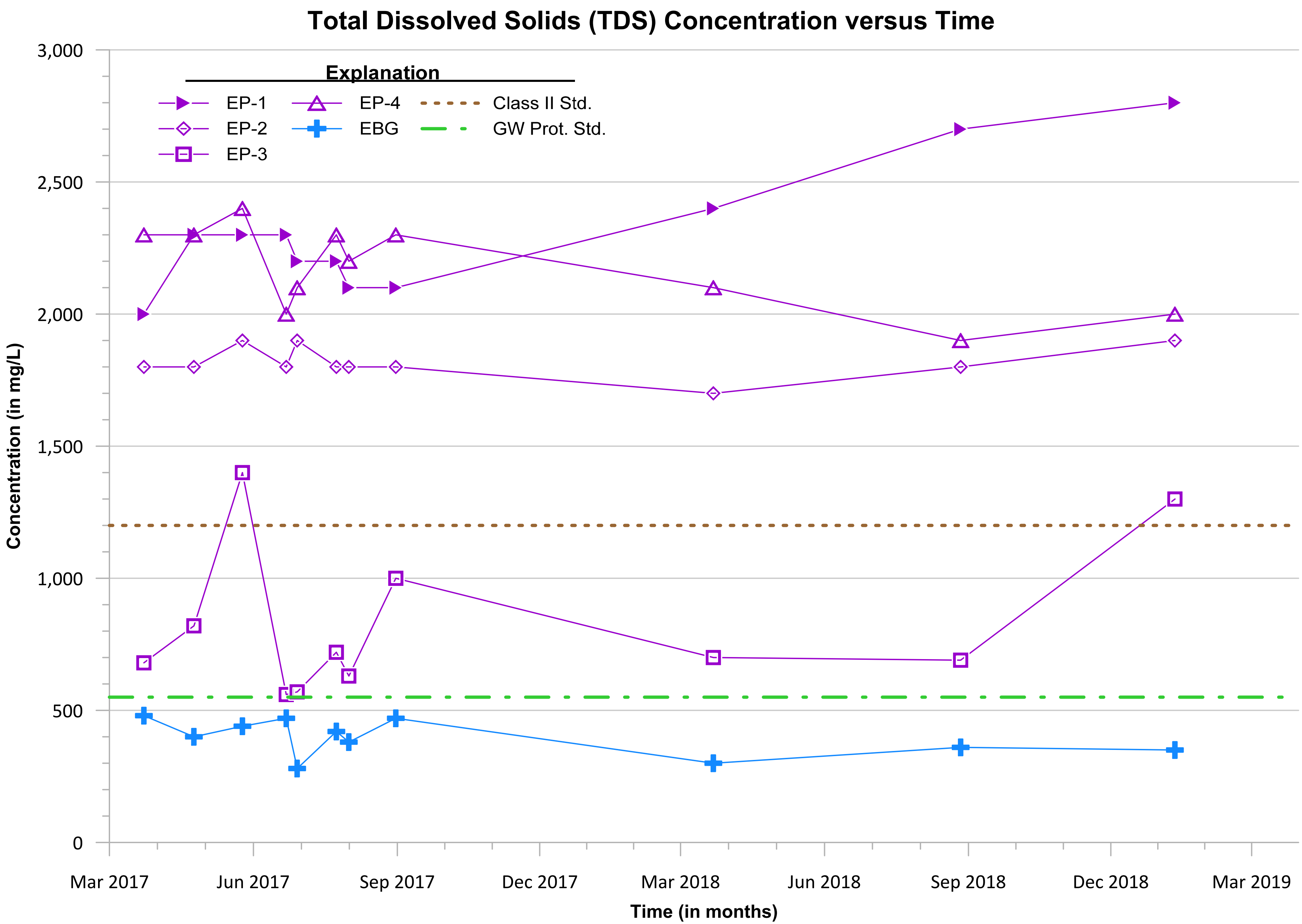

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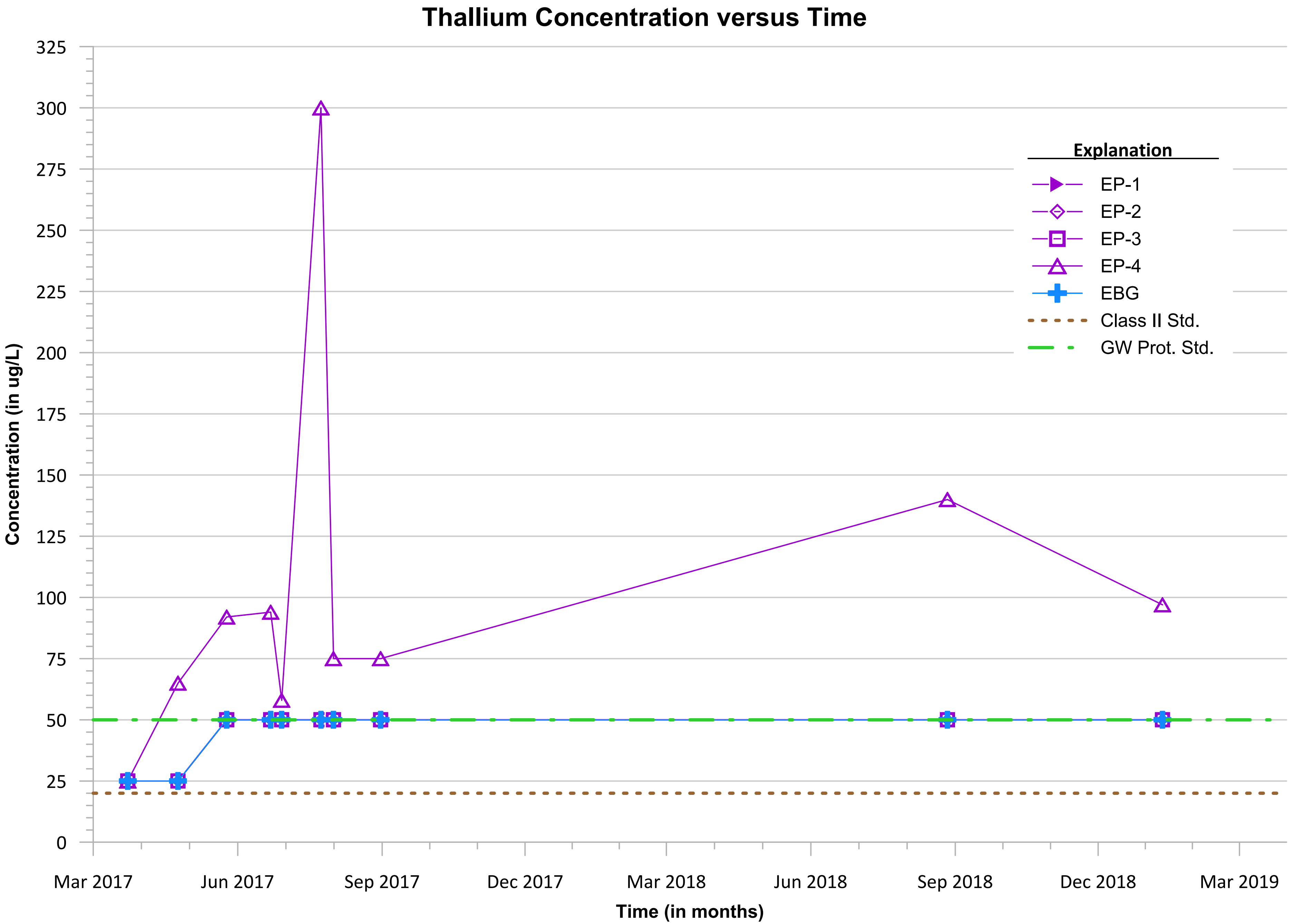

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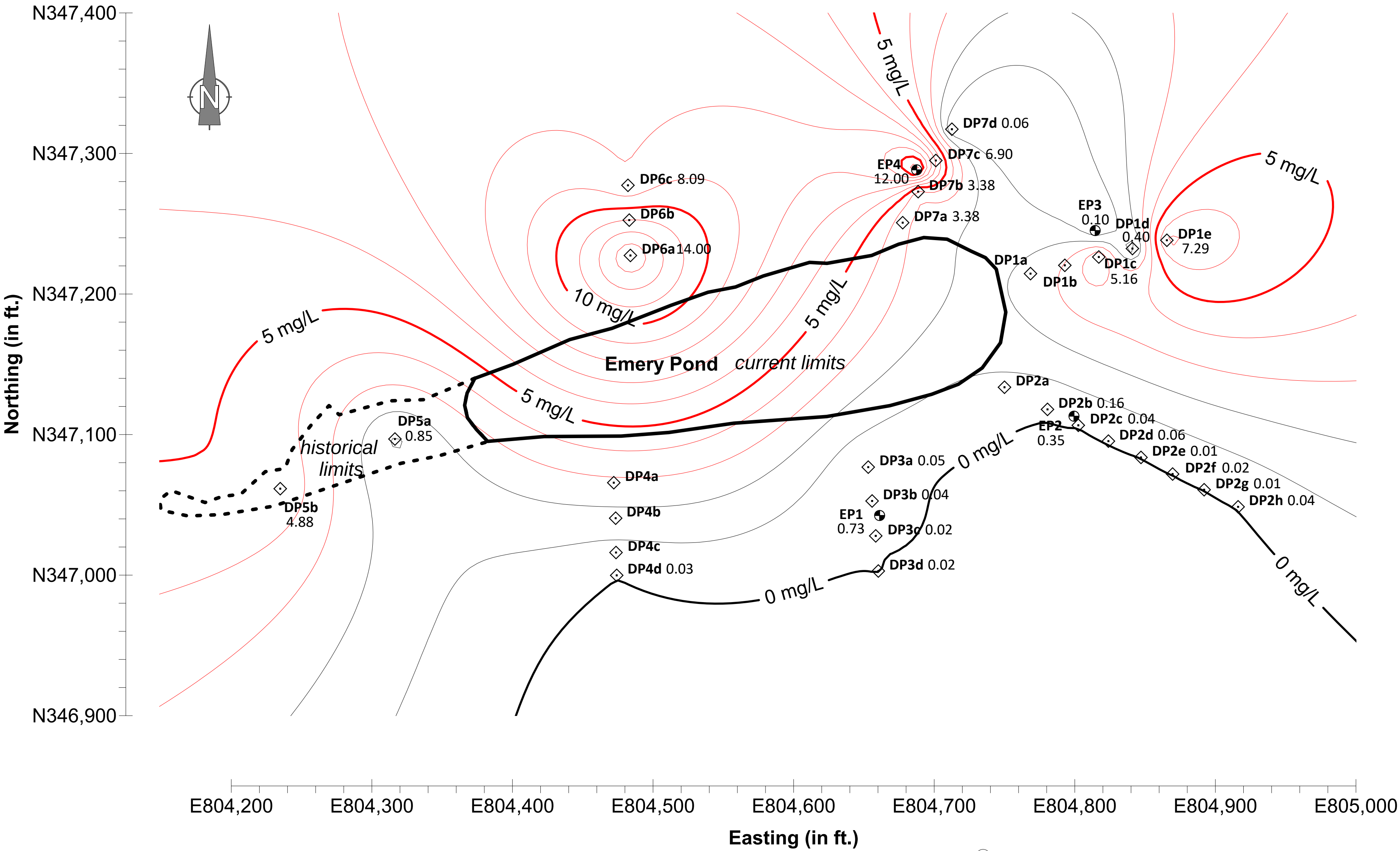
Appendix C

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.

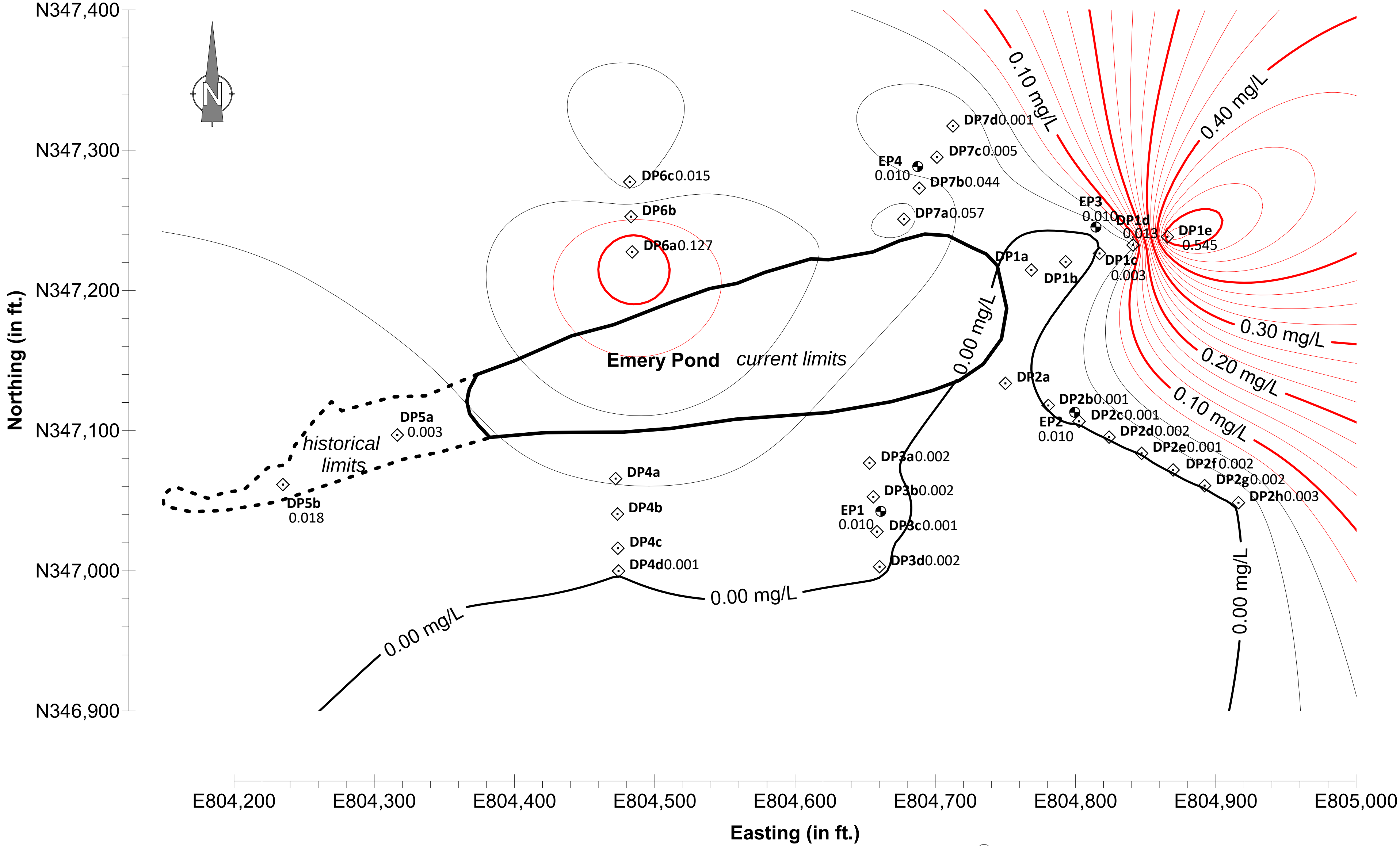
HANSON
Hanson Professional Services Inc.

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.

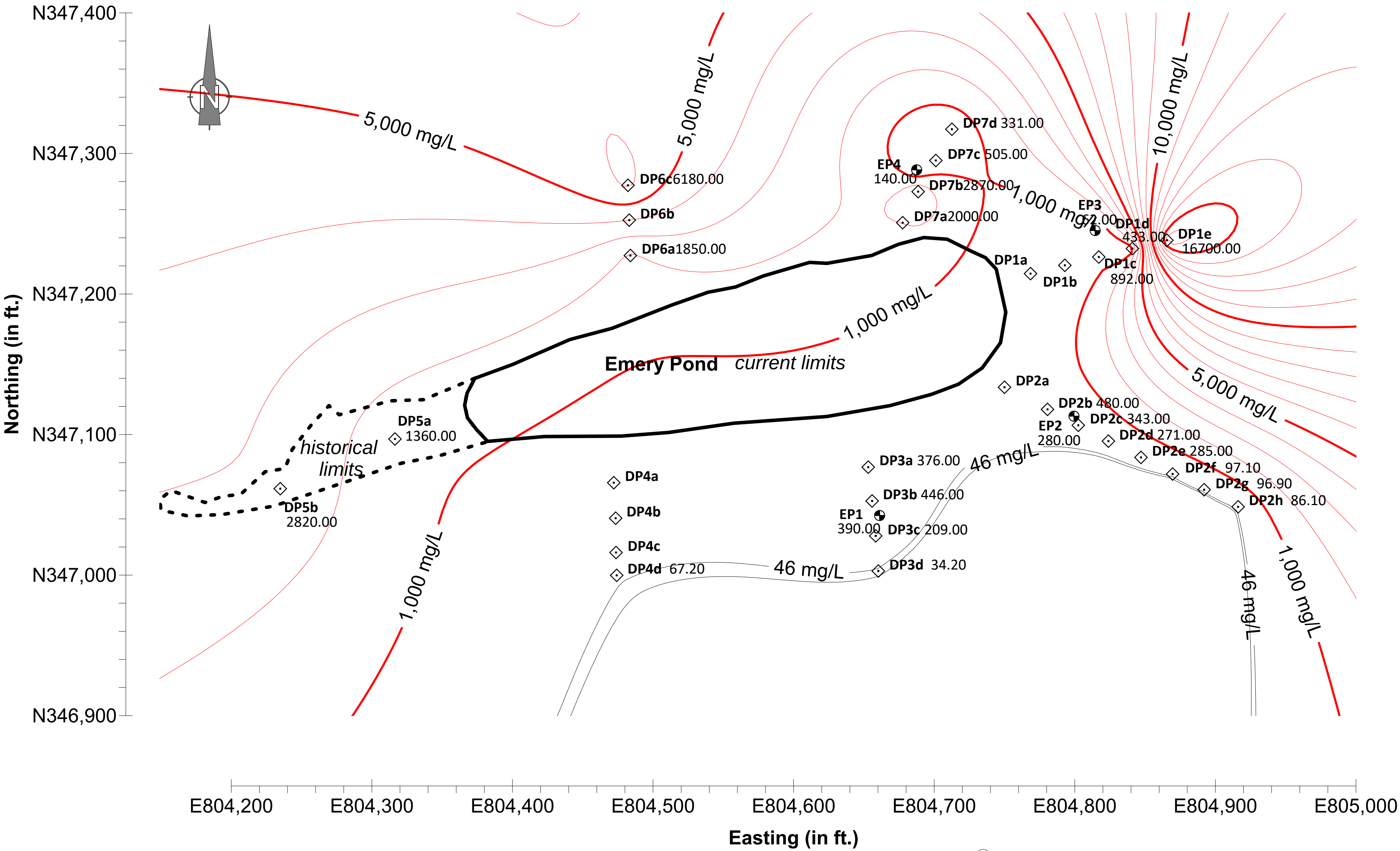
HANSON
Hanson Professional Services Inc.

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

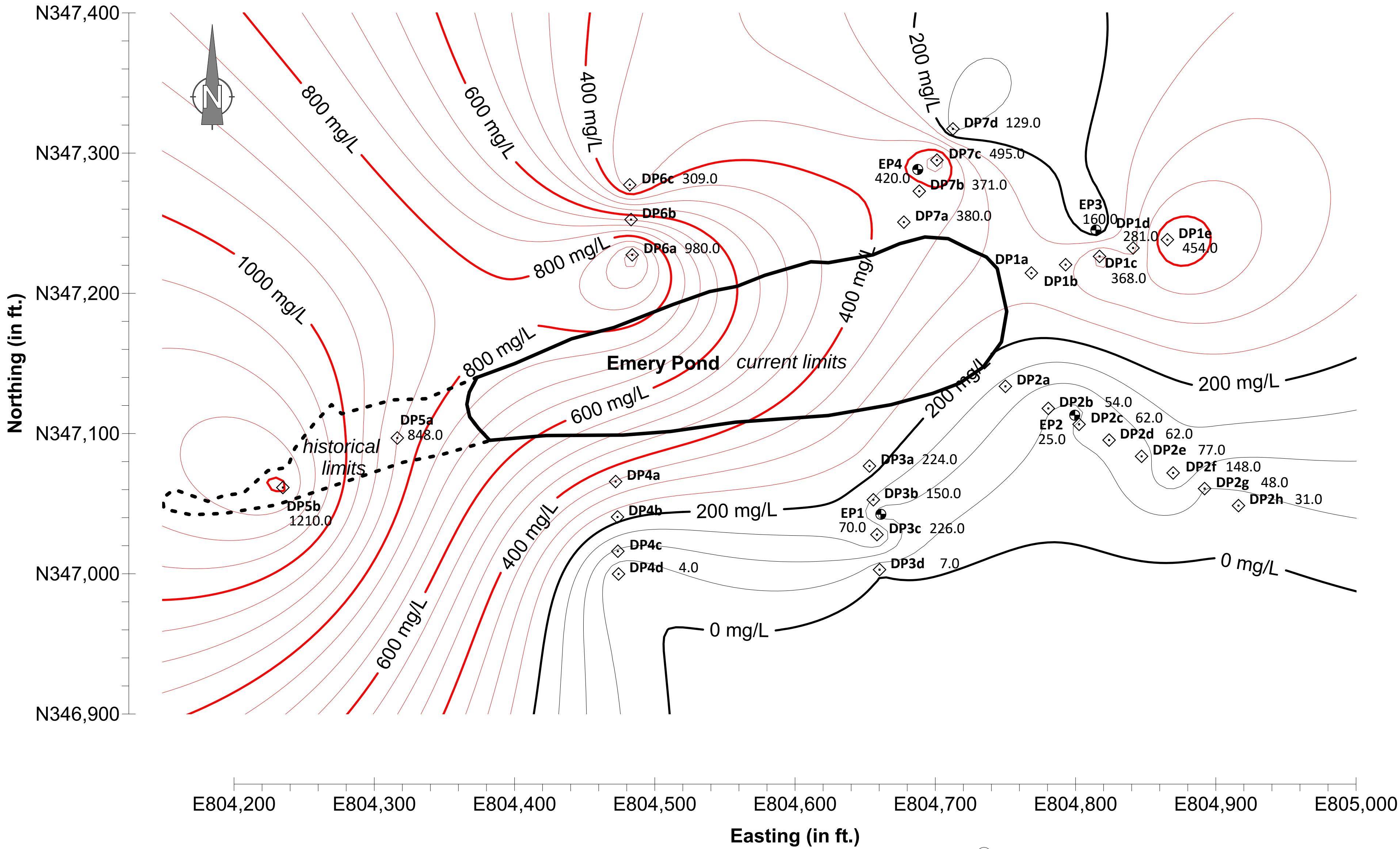
NOTE: Red contours above the GW Protection Std. (46.304 mg/L)

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.

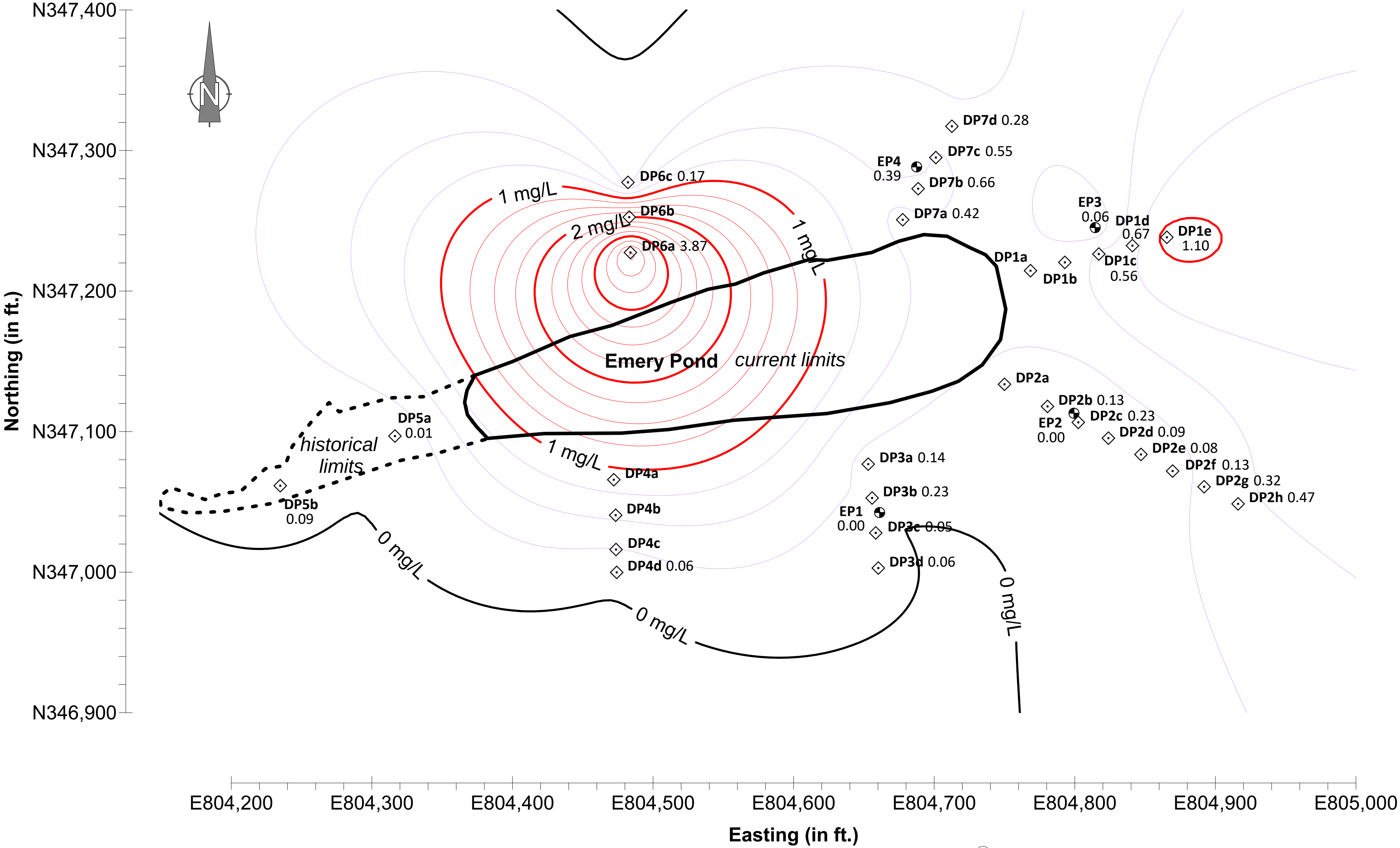
HANSON
Hanson Professional Services Inc.

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.

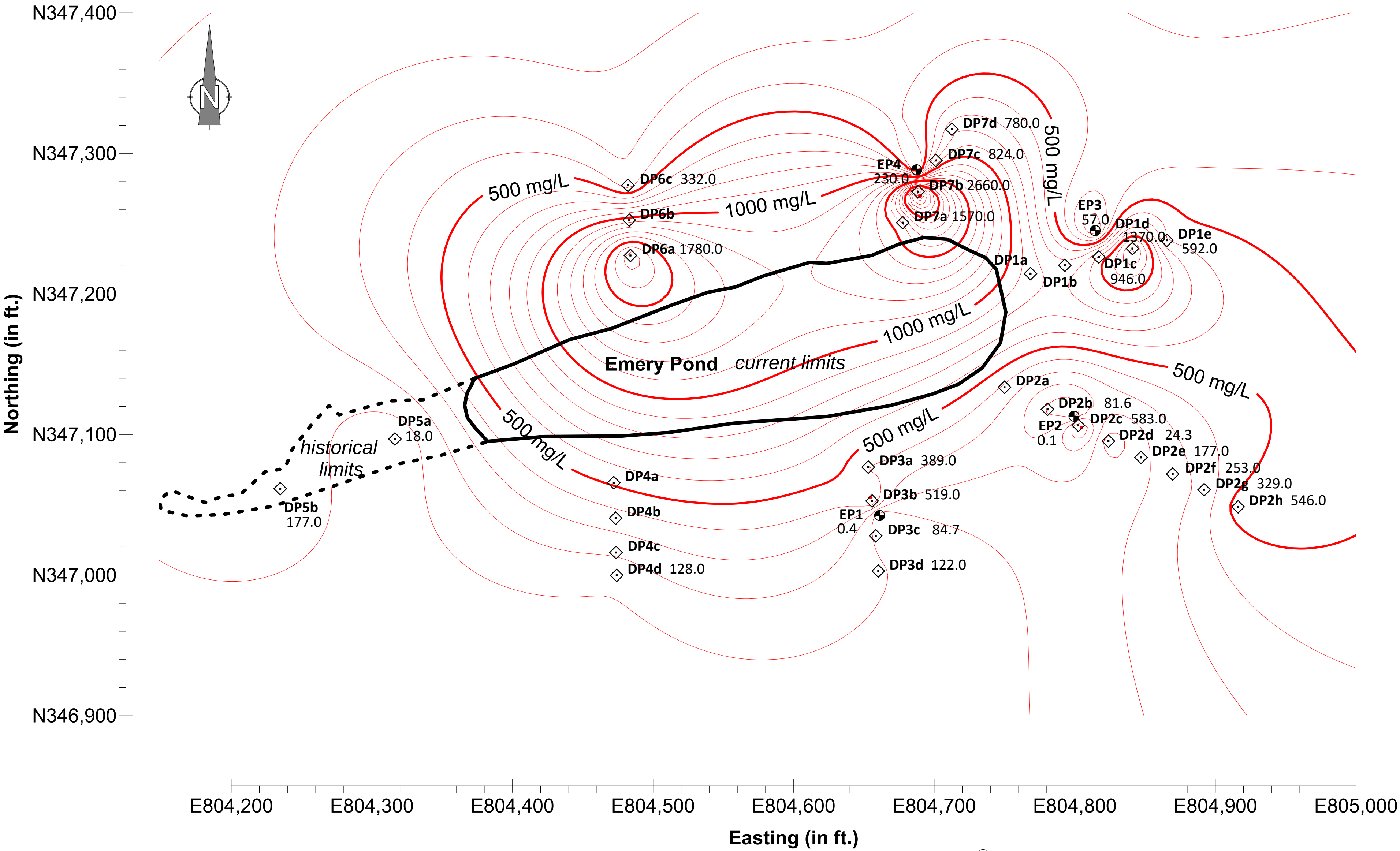
HANSON
Hanson Professional Services Inc.

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.

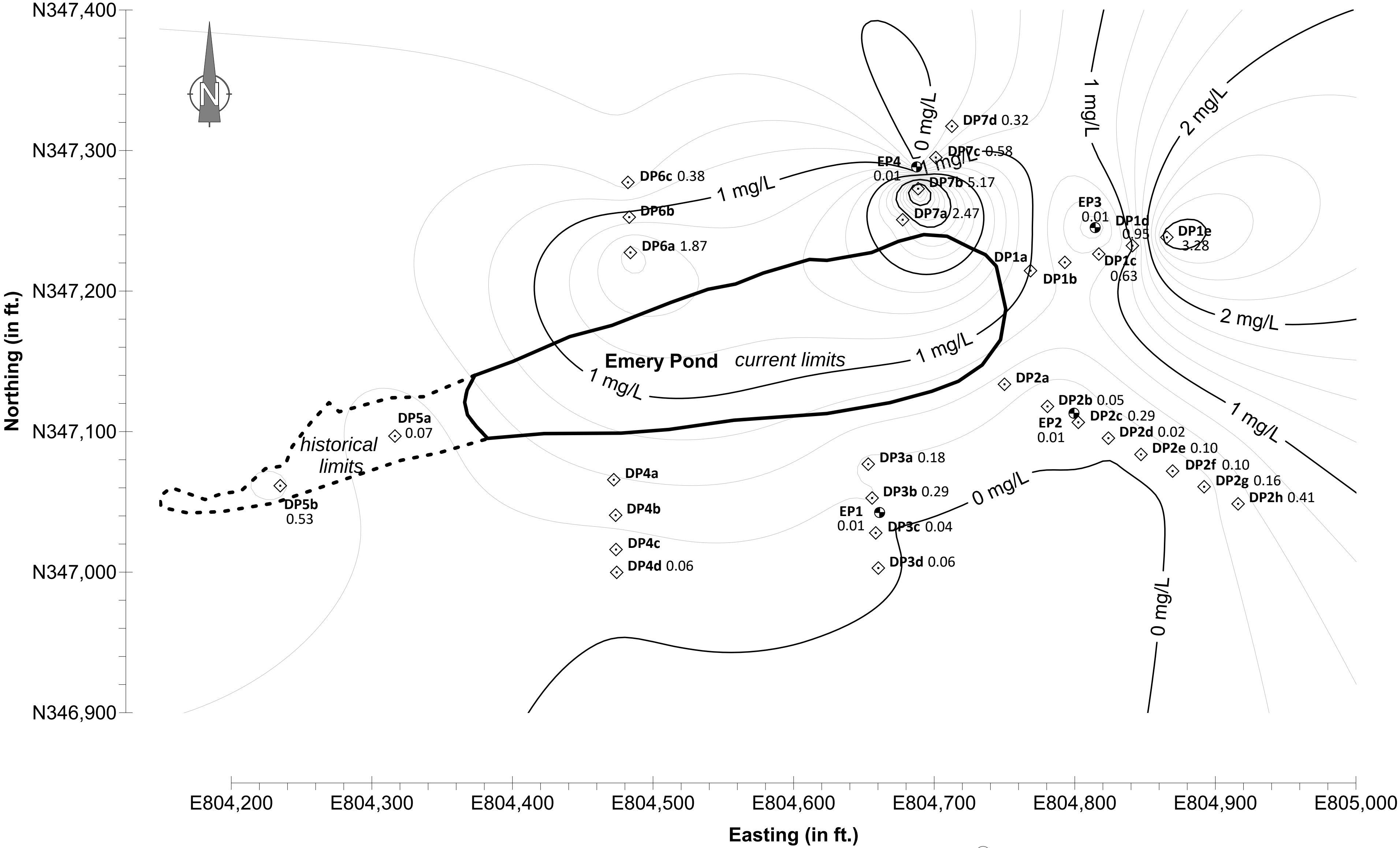
HANSON
Hanson Professional Services Inc.

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.

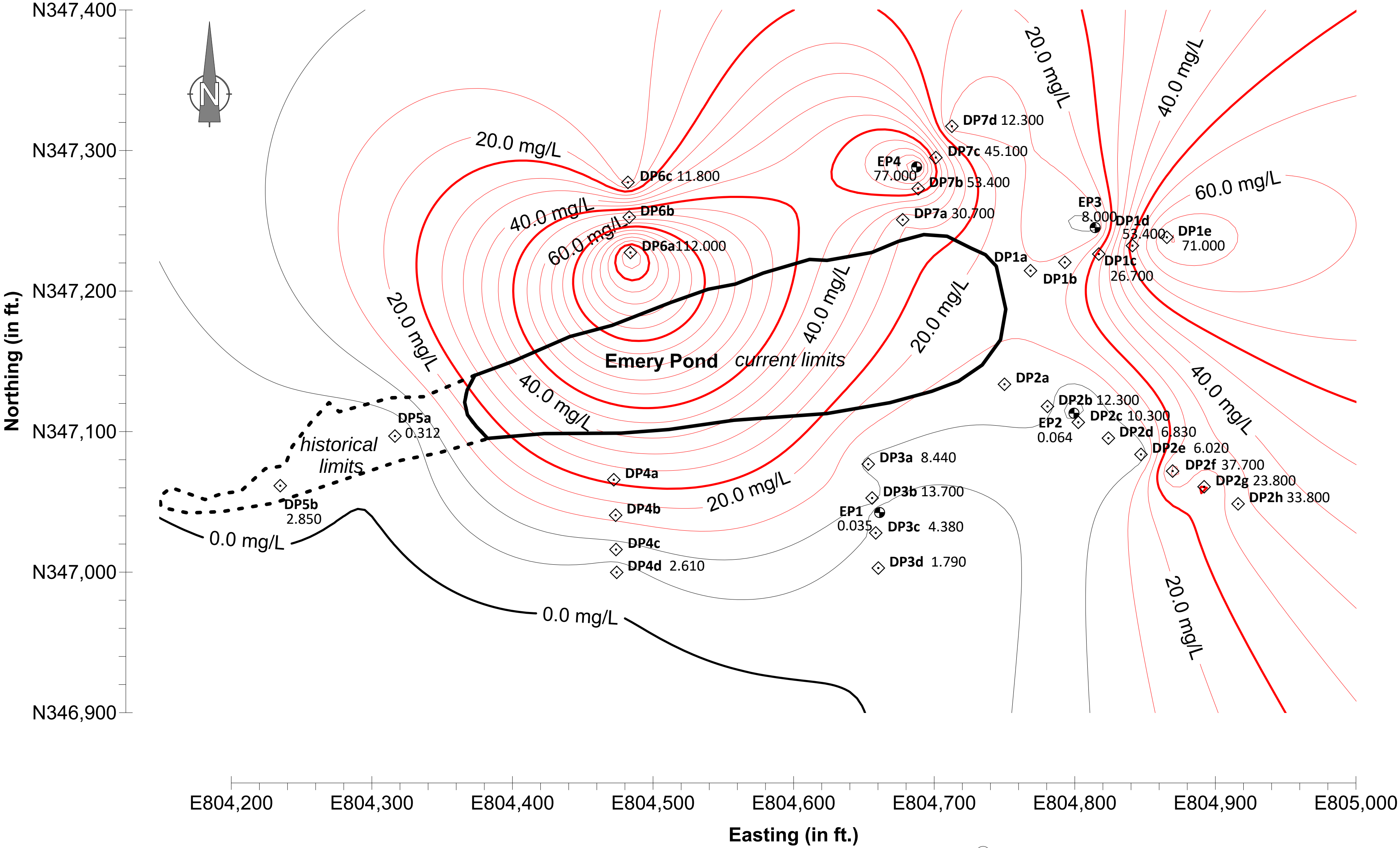
HANSON
Hanson Professional Services Inc.

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

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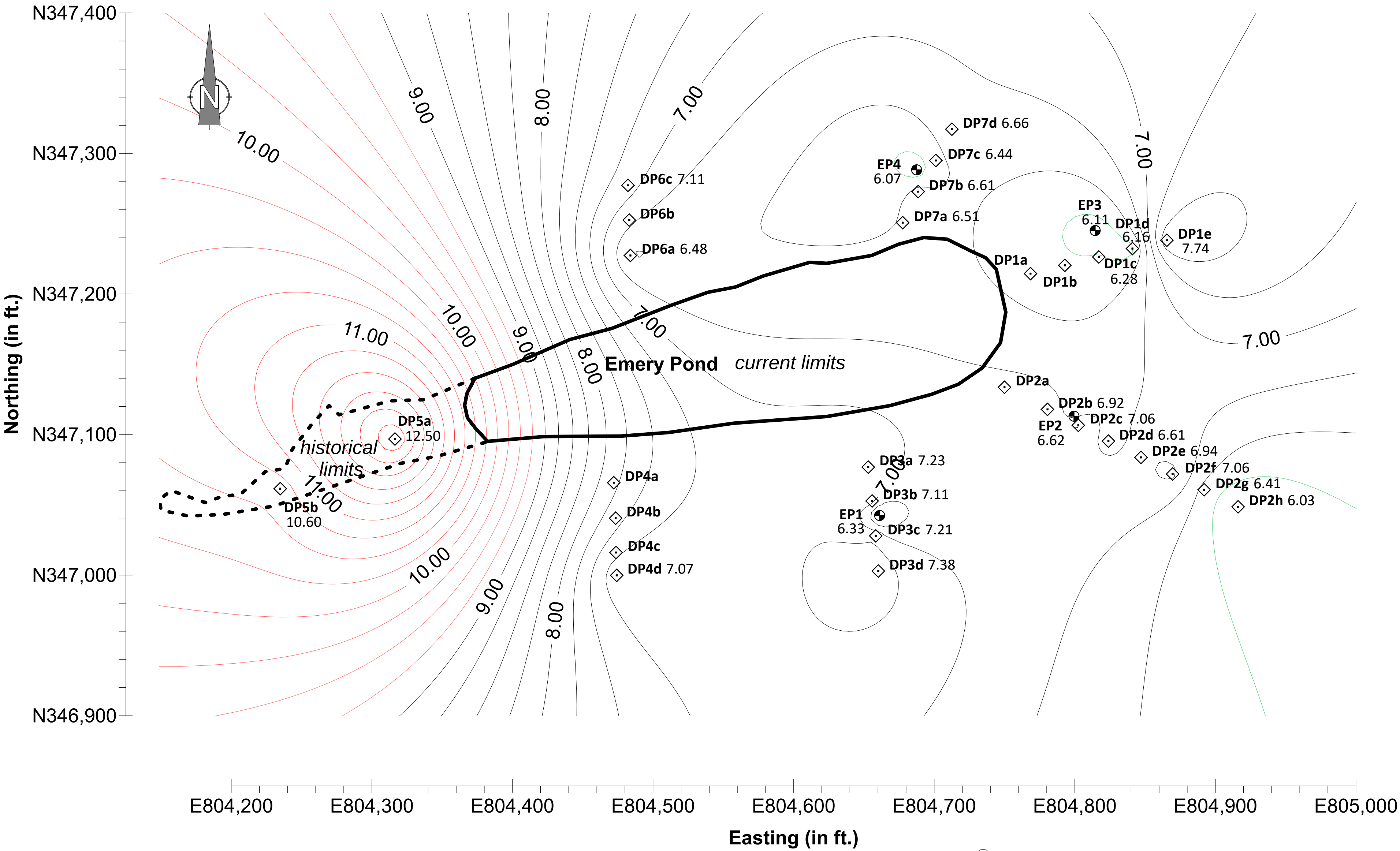


EXPLANATION

- 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

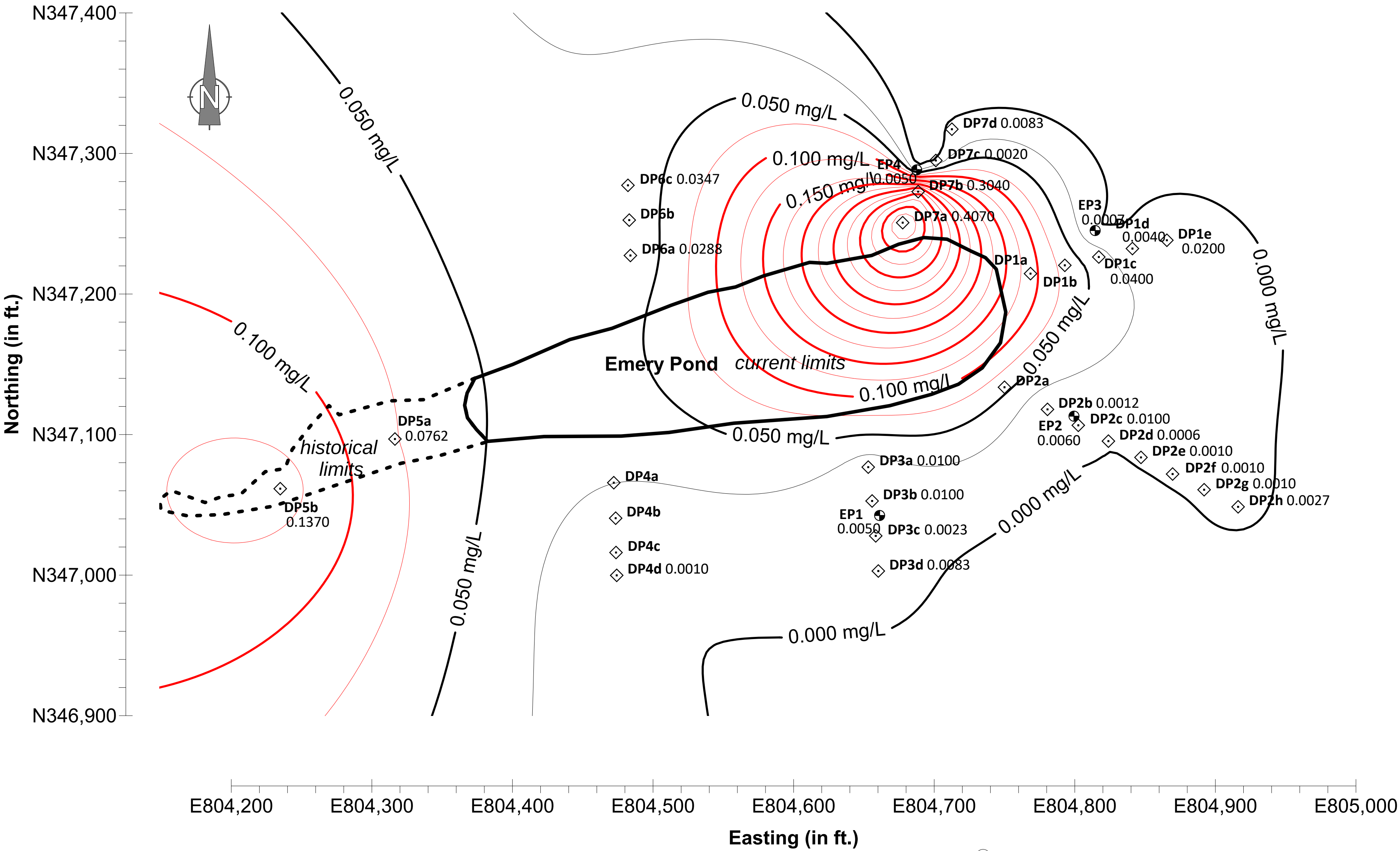
0 ft. 100 ft. 200 ft. 300 ft.

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.

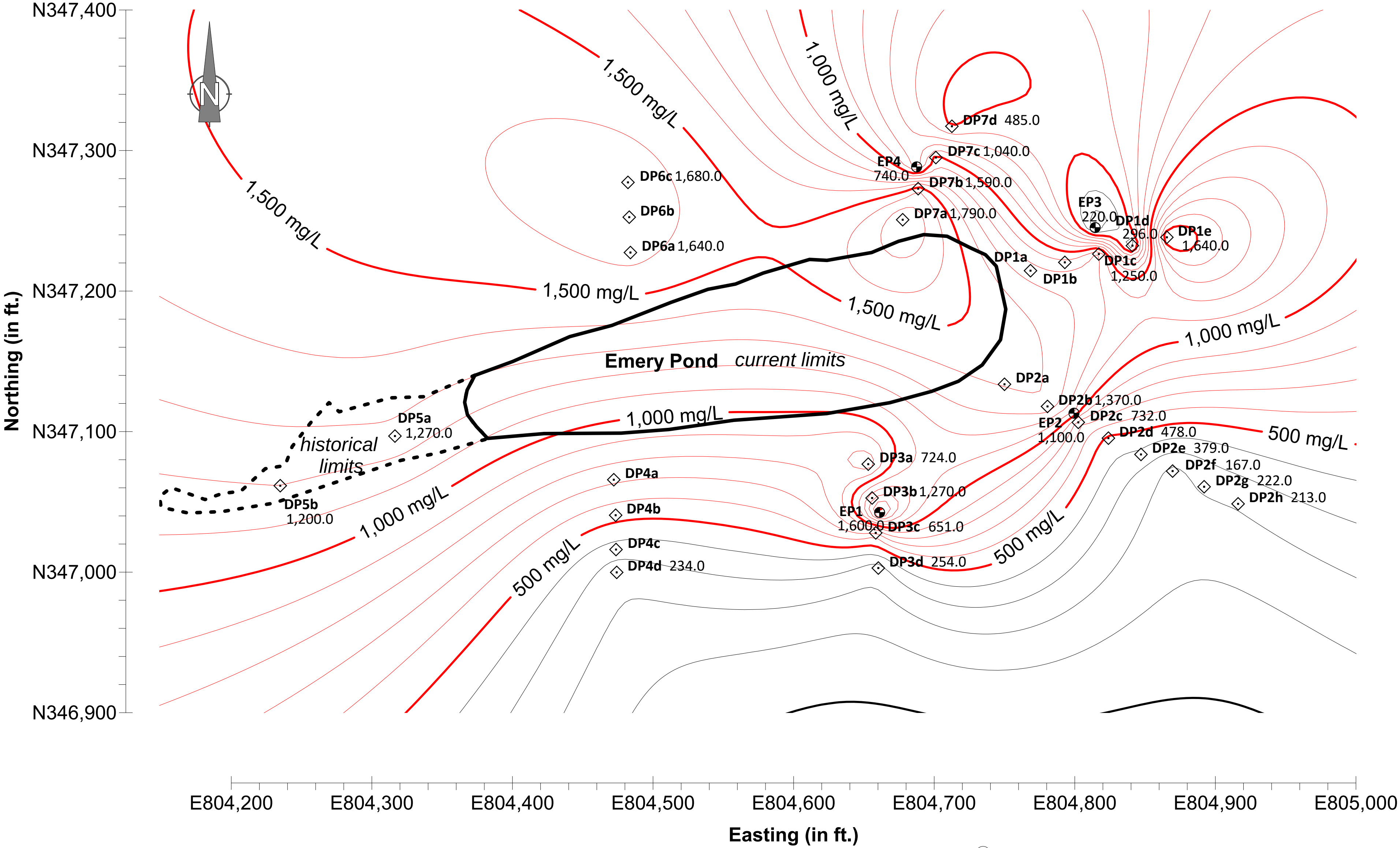
HANSON
Hanson Professional Services Inc.

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

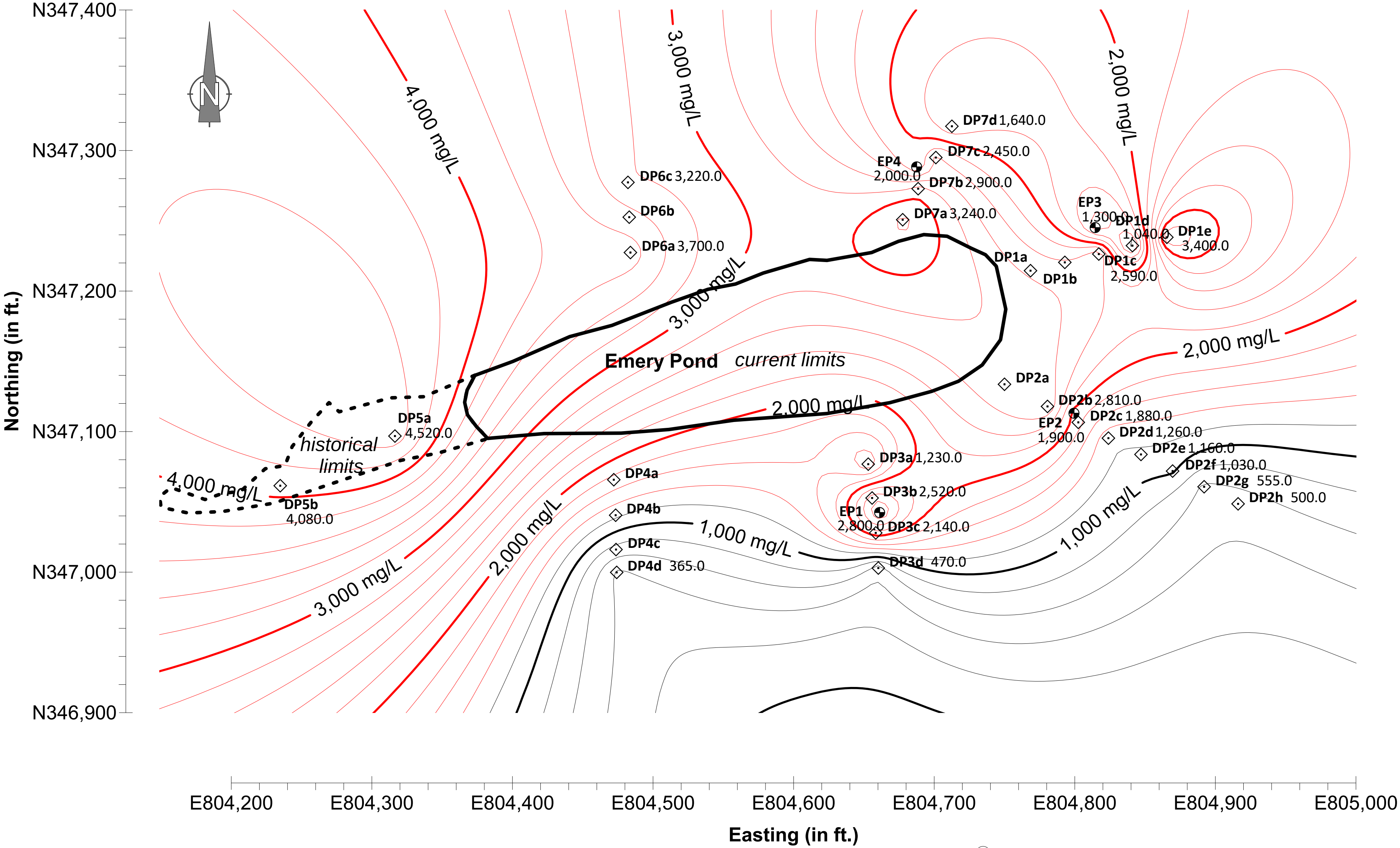
0 ft. 100 ft. 200 ft. 300 ft.

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.

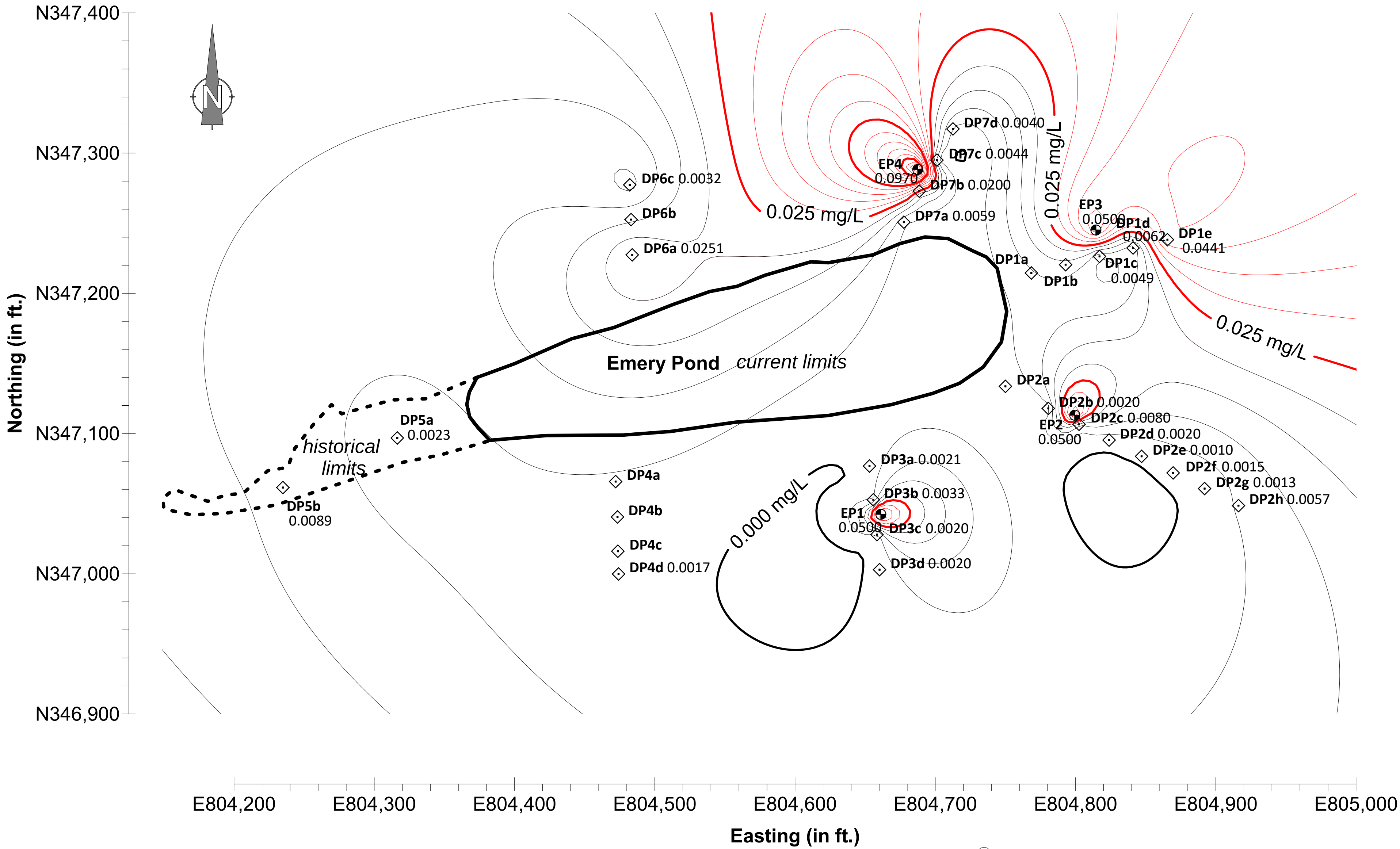
HANSON
Hanson Professional Services Inc.

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.

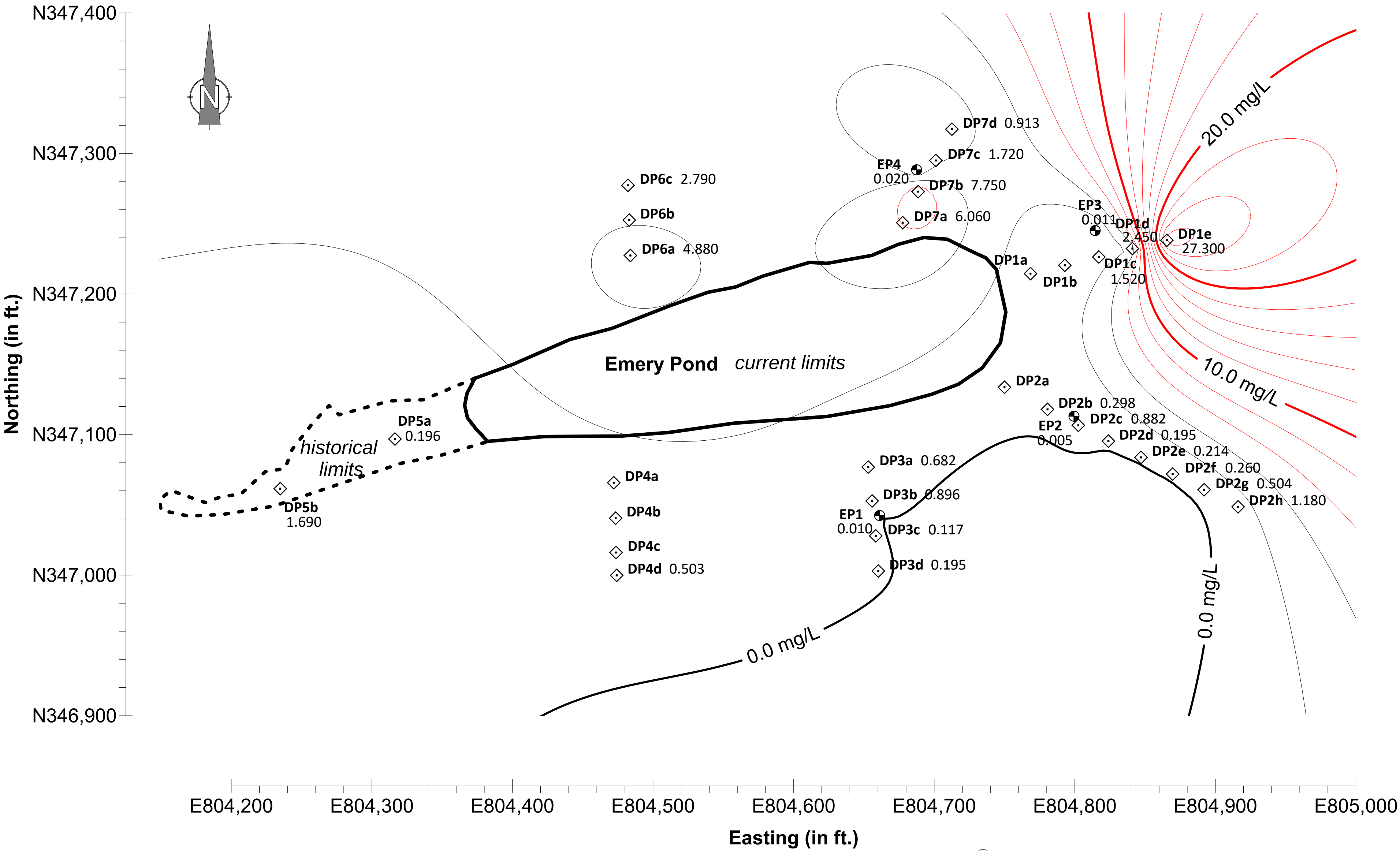
HANSON
Hanson Professional Services Inc.

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.

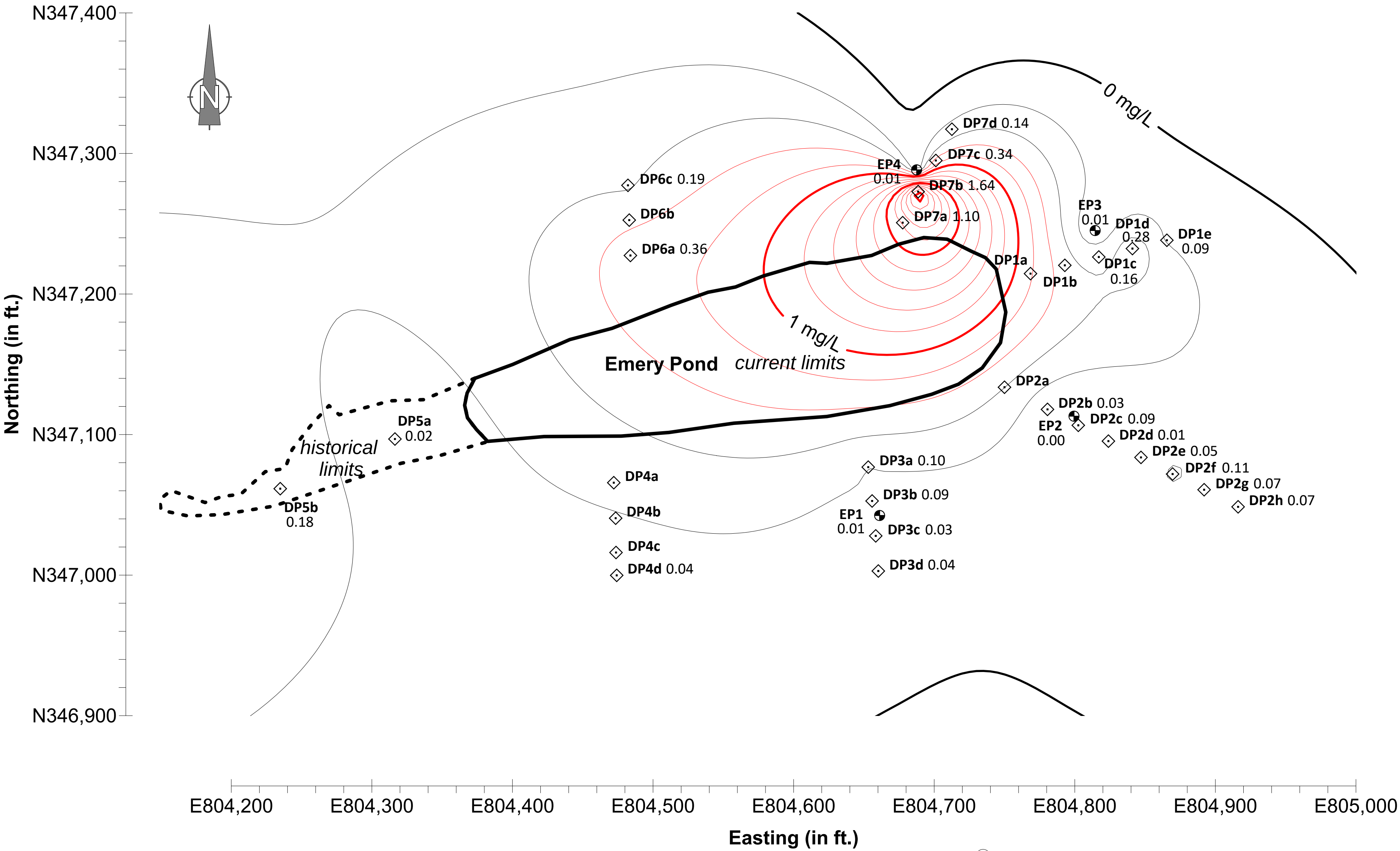
HANSON
Hanson Professional Services Inc.

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

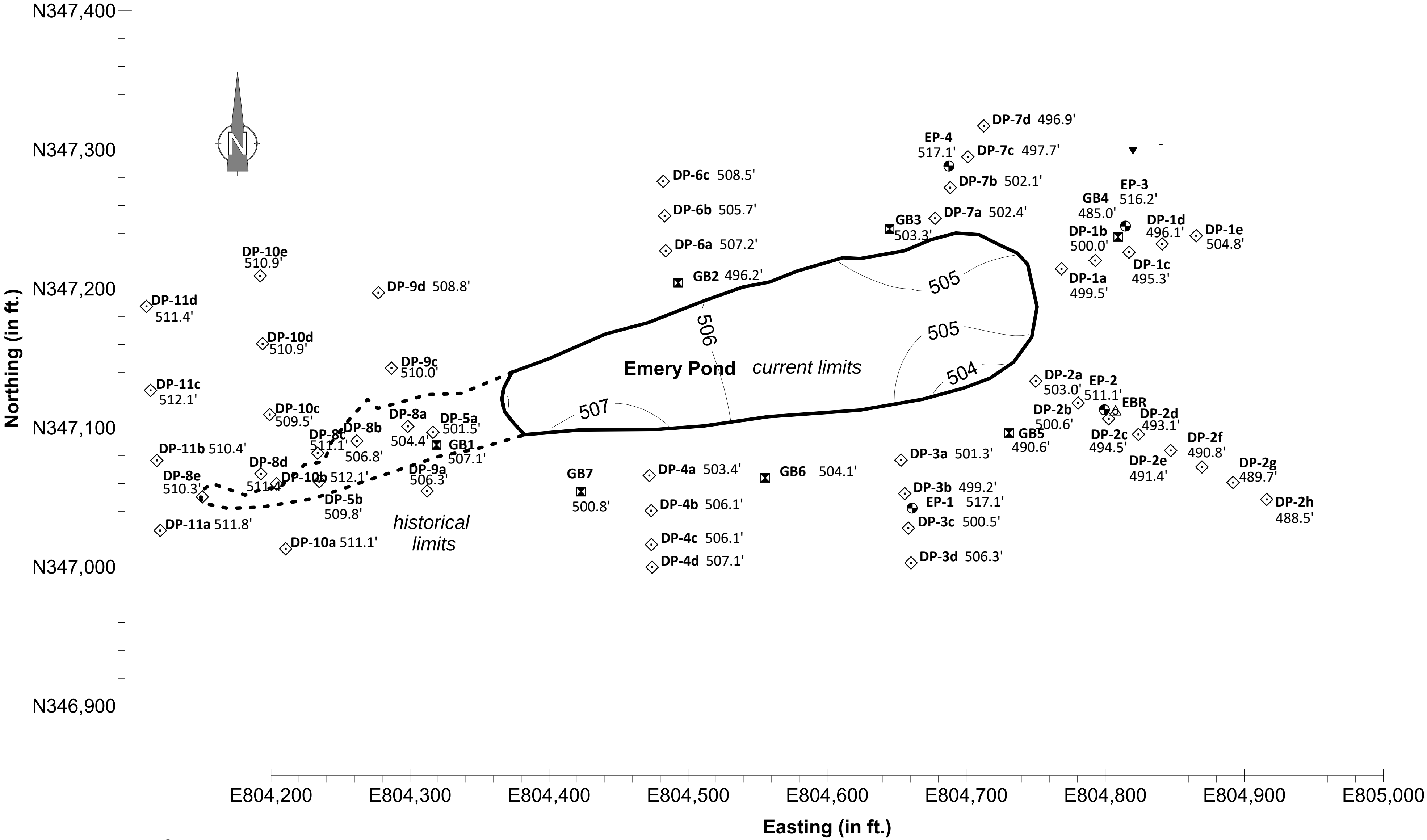
0 ft. 100 ft. 200 ft. 300 ft.

HANSON
Hanson Professional Services Inc.

Arsenic Concentration Isopleth Map

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A | FIGURE C-15



EXPLANATION

- Monitoring Well
- Direct Push Boring
- Bedrock Boring

Contour Interval = 1 foot

SCALE: 1 inch equals 100 feet

0 ft. 30 ft. 61 ft. 91 ft.

Borehole Bottom Relative to Emery Pond Bottom

HANSON

Hanson Professional Services Inc.

EMERY POND
MARION POWER PLANT
WILLIAMSON CO., ILLINOIS

HANSON NO. 18E0022A FIGURE C-16

I:\18jobs\18E0022A\Admin\15-Field-Laboratory Data\BoreholeBtm_20210318.srf

Appendix D

Groundwater Management Zone Plat and Description

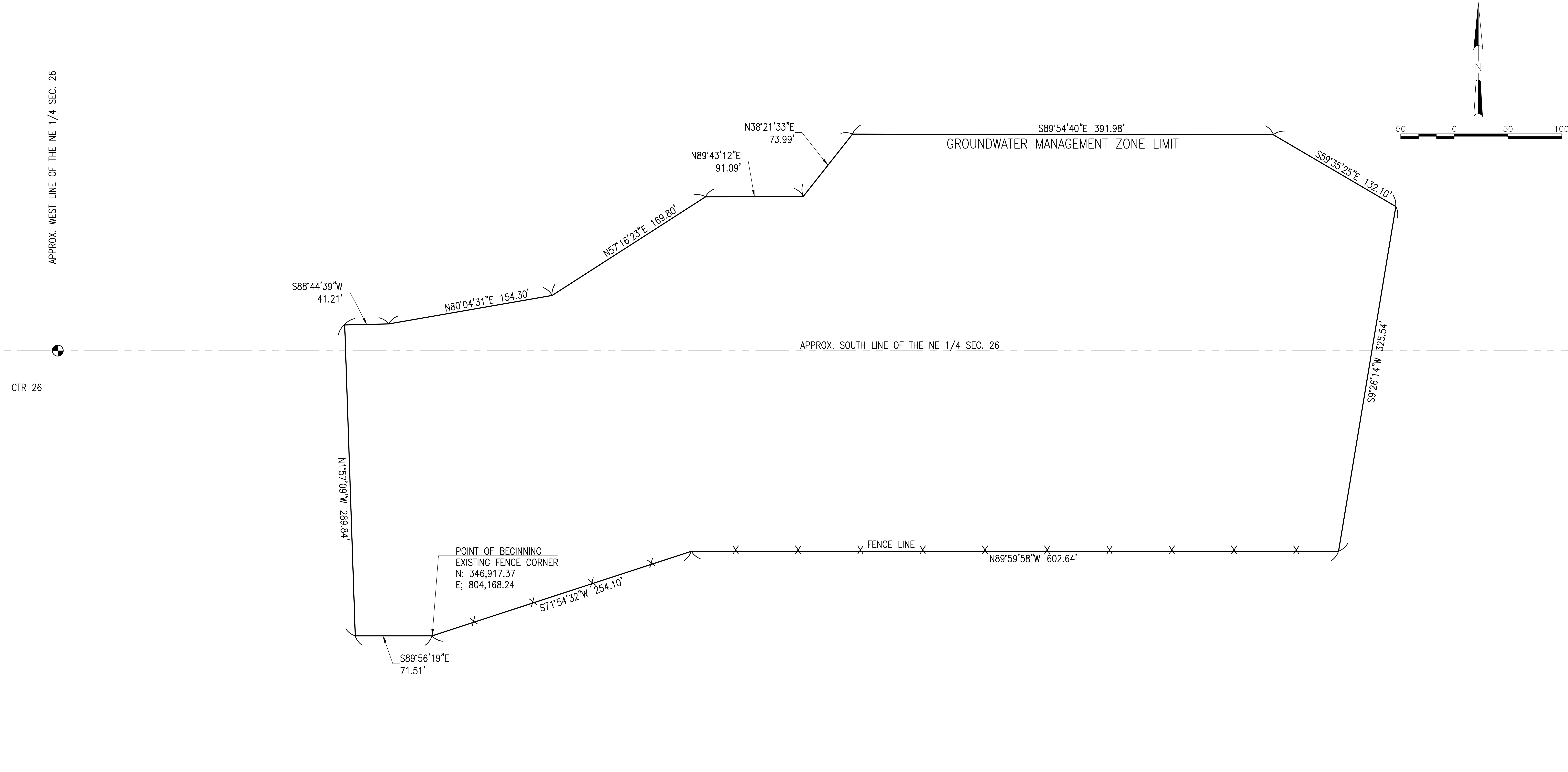
Groundwater Management Zone (GMZ) Limit

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
- FENCE LINE

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.

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.

MAR 26, 2019 12:41 PM PADGE01941
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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

Phone: (217) 788-2450
Fax: (217) 788-2503
www.hanson-inc.com
Offices Nationwide

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Hanson Professional Services Inc.
7625 N University St., Suite 200
Peoria, IL 61614
Illinois Licensed Professional Design Firm #184-001084

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.

   SIPC does not generate, store, or treat hazardous wastes. Solid waste generator numbers are listed in Part I. 7., below.

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

      Illinois EPA Water (Construct/Operate) – 2020-EA-65428

   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.

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	Donald L Bulley
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	Donald R Culley
Facility Name	Signature of Owner/Operator
11543 Lake Egypt Road, Marion, IL 62959	***Southern Illinois Power Cooperative***
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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 8 years after *the clean closure is completed. The 8-year period is needed for total Arsenic to reach 0.01 mg/L at the downgradient edge of the former CCR impoundment.

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 40 CFR 257 Appendix III and Appendix IV parameter will help determine 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	Donald L Cullen
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***
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