



Groundwater Remedy Selection Report

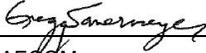
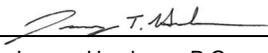
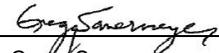
Laramie River Station, Wheatland, WY

Basin Electric Power Cooperative

Project number: 60632474

July, 2020

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position

Distribution List

# Hard Copies	PDF Required	Association / Company Name
	yes	Kevin Solie / Basin Electric Power Cooperative

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Table of Contents

List of Acronyms	5
Remedy Selection Certification.....	6
1. Introduction	7
Background	7
2. Remedy Description	9
3. Compliance with Corrective Measures Objectives.....	10
Protection of human health and the environment.....	10
Attain groundwater protection standards	10
Control the source of releases	10
Remove contaminated material from the environment	10
Comply with standards for management of wastes	11
4. Corrective Action Program Implementation	12
5. References.....	13

Figures

Figure 1-1 Site Location Map

Figure 1-2 LRS CCR Monitoring Well Network

Figure 2-1 Typical Groundwater Extraction Well

Figure 2-2 Approximate Location of Groundwater Extraction Wells

List of Acronyms

ACM	Assessment of Corrective Measures
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
FGD	flue gas desulfurization
gpm	gallons per minute
GWPS	groundwater protection standard
LRS	Laramie River Station
RCRA	Resource Conservation and Recovery Act
SSL	statistically significant level

Remedy Selection Certification

Basin Electric Power Cooperative Laramie River Station, CCR Surface Impoundment Bottom Ash Pond 1

AECOM ("Consultant") has been retained by Basin Electric Power Cooperative to certify whether the selected groundwater remedy presented herein for the Laramie River Station Bottom Ash Pond 1 coal combustion residuals (CCR) surface impoundment meets the requirements of Chapter 40 of the Code of Federal Regulations (CFR) § 257.97.

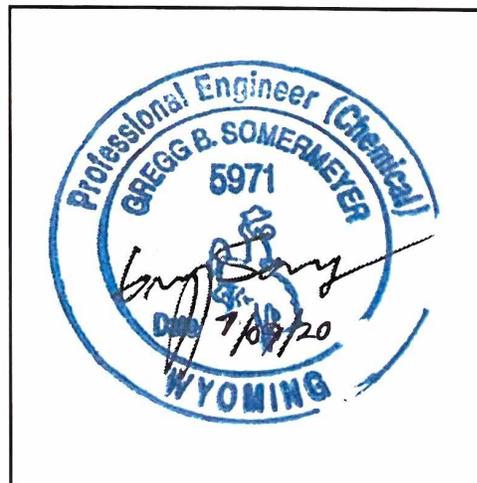
LIMITATIONS

The signature of Consultant's authorized representative on this document represents that to the best of Consultant's knowledge, information, and belief in the exercise of its professional judgment, it is Consultant's professional opinion that the aforementioned information is accurate as of the date of such signature. Any opinion or decisions by Consultant are made on the basis of Consultant's experience, qualifications, and professional judgment and are not to be construed as warranties or guaranties. In addition, opinions relating to environmental, geologic, and geotechnical conditions or other estimates are based on available data, and actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

CERTIFICATION

I, Gregg Somermeyer, being a Registered Professional Engineer in the State of Wyoming, certify to the best of my knowledge, information, and belief, that the remedy selected by Basin Electric for the CCR unit that is the subject of this certification meets the requirements of 40 CFR § 257.97, and that this certification is true and correct and has been prepared in accordance with generally accepted good engineering practices.

SIGNATURE: Gregg Somermeyer
DATE: July 9, 2020



1. Introduction

Laramie River Station (LRS) is a coal-fired power plant located near Wheatland Wyoming owned by the Missouri Basin Power Project (**Figure 1-1**). Basin Electric Power Cooperative (Basin Electric), operating agent of LRS, has selected a remedy to address groundwater impacts associated with Bottom Ash Pond 1 at LRS. This report, prepared by AECOM Technical Services, Inc. (AECOM), describes the selected remedy and how it meets the standards specified in the federal Coal Combustion Residuals (CCR) Rule (40 CFR Part 257, Subpart D).

Background

LRS is located east of Wheatland, Wyoming in Platte County (**Figure 1-1**). LRS has three generating units with a total power output capacity of 1,710 megawatts (MW):

- Unit 1, which began operating in 1980;
- Unit 2, which began operating in 1981; and
- Unit 3, which began operating in 1982.

The CCR Rule establishes standards for the disposal of CCR in landfills and surface impoundments (CCR units). CCR produced at LRS includes fly ash, bottom ash, and flue gas desulfurization (FGD) waste, which is disposed onsite in the following units/multi-units:

- Bottom Ash Pond 1
- Bottom Ash Pond 2, Bottom Ash Pond 3, Ash Landfill (multi-unit)
- Emergency Holding Ponds (multi-unit)

40 CFR §§ 257.90 through 257.98 specify groundwater monitoring and corrective action requirements for CCR units/multi-units. The groundwater monitoring provisions required the installation of a system of monitoring wells at LRS (**Figure 1-2**), periodic sampling of these wells, and analysis of the resulting data to evaluate whether hazardous constituents are present above background levels. The CCR Rule requires initiating a corrective action process if any hazardous constituents listed in Appendix IV of 40 CFR Part 257, which cannot be attributed to an alternative source, are found to exceed groundwater protection standards (GWPSs) at statistically significant levels (SSLs).

LRS groundwater monitoring data indicate that GWPSs for the two CCR multi-units have not been exceeded. Assessment monitoring of Bottom Ash Pond 1 in 2018 (AECOM 2018a) identified lithium and molybdenum at SSLs above GWPSs. The SSLs required additional groundwater characterization of Bottom Ash Pond 1 per 40 CFR § 257.95(g)(1) to evaluate the nature and extent of groundwater exceeding GWPSs and support selection and implementation of a remedy to attain GWPSs. The additional characterization activities were performed by AECOM in the spring of 2019 and documented in a report to Basin Electric (AECOM 2019a). Characterization involved installation of four additional monitoring wells, one of which was installed at the downgradient property boundary as required by 40 CFR § 257.95(g)(1)(iii).

The SSLs of lithium and molybdenum also triggered CCR Rule requirements for the assessment, selection and implementation of corrective measures to prevent further releases of hazardous constituents, remediate any releases and restore the affected area. Basin completed an Assessment of Corrective Measures (ACM) in 2019 (AECOM 2019b) per the requirements of 40 CFR § 257.96. The ACM focused on identifying and evaluating groundwater corrective measures to address the dissolved lithium and molybdenum in groundwater downgradient of Bottom Ash Pond 1.

Potentially applicable corrective measures were identified based on the nature and extent of groundwater impacts and site-specific geological and hydrogeological characteristics. The following corrective measures, to be used singly or in combination, were identified for screening to achieve the corrective action objectives:

- Natural attenuation
- Groundwater extraction (e.g., using pumping wells), followed by:

- Surface discharge of extracted groundwater with prior treatment if necessary,
- Underground injection of extracted groundwater, or
- On-site reuse or disposal of extracted groundwater
- In-situ treatment
- Long-term monitoring.

Applying the screening criteria of effectiveness, technical implementability and relative cost to the corrective measures described above eliminated in-situ treatment from further consideration. The effectiveness of in-situ treatment for the target constituents is currently unknown and would have to be verified; it was therefore determined the technology would be difficult and costly to construct and maintain. Accordingly, in-situ treatment was removed from further consideration as a potential corrective action technology.

Natural attenuation, groundwater extraction, and long-term monitoring are proven effective, easily implementable and often cost-effective corrective measures, and were retained and assembled into the following two corrective measures alternatives for further detailed evaluation:

- Alternative A: Natural Attenuation and Long-Term Monitoring
- Alternative B: Groundwater Extraction, Onsite Reuse or Disposal, and Long-Term Monitoring

These two alternatives were evaluated against the requirements specified in 40 §§ CFR 257.96 and 257.97, broadly categorized under the criterion of effectiveness, implementability, and cost. The results of the ACM, including an evaluation of Alternatives A and B, were presented in the ACM report (AECOM, 2019b) which was posted to Basin Electric's publicly accessible website. The two alternatives were also presented at a public meeting held on January 30, 2020 in Wheatland Wyoming. A 30-day public comment period started on January 30, 2020 and ended on February 29, 2020. No comments were received during the 30-day period following the public meeting.

Based on the results of the ACM, Basin Electric has elected to implement Alternative B: Groundwater Extraction, Onsite Reuse or Disposal, and Long-Term Monitoring to meet the remedy requirements of the CCR Rule. This alternative involves the use of proven, reliable groundwater pumping technology and is expected to restore the underlying aquifer faster than Alternative A, which would rely on natural attenuation to reduce lithium and molybdenum concentrations. This Groundwater Remedy Selection Report documents the selected remedy as it will be implemented at LRS and describes how the corrective measures will achieve the objectives listed in 40 CFR § 257.97(b).

Basin Electric is in the process of retrofitting Bottom Ash Pond 1 in accordance with § 257.102 (criteria for conducting the closure or retrofit of CCR units). Because the retrofit will effectively remove the source of GWPS exceedances, the selected remedy focuses on implementing groundwater corrective measures to address the dissolved lithium and molybdenum in groundwater downgradient of Bottom Ash Pond 1.

2. Remedy Description

The remedy selected by Basin Electric will consist of installing and operating groundwater extraction wells to recover groundwater downgradient of Bottom Ash Pond 1 for onsite reuse or disposal. The remedy will also include long-term groundwater monitoring. Each extraction well will be installed in the bedrock (sandstone) aquifer downgradient of Bottom Ash Pond 1 and will be equipped with a dedicated submersible pump. The number and location of recovery wells will be chosen to capture the impacted groundwater and prevent it from flowing beyond the property boundary. **Figure 2-1** illustrates a typical groundwater extraction well.

AECOM performed groundwater flow modeling to support design of the selected remedy to capture the dissolved lithium and molybdenum downgradient of Bottom Ash Pond 1. AECOM set up and calibrated a site-specific flow model using GFLOW, a stepwise groundwater flow modeling system developed by Haitjema Software. GFLOW models steady state flow in a single heterogeneous aquifer based on the analytic element method, and uses particle tracking to simulate movement of groundwater particles. Using the calibrated GFLOW model, three recovery wells installed downgradient of Bottom Ash Pond 1, each pumping at a rate of 13 gallons per minute (gpm), is expected to effectively capture the plume of dissolved lithium and molybdenum. **Figure 2-2** shows the approximate locations of the three idealized wells. The optimal number of extraction wells, placement, and pumping rate will be finalized during detailed design prior to construction.

Groundwater would be pumped from the extraction wells to the LRS makeup water pond or one of the existing CCR impoundments. If used for makeup water, the groundwater would not require treatment because of the relatively low rate of extraction compared to incoming makeup water from Grayrocks Reservoir.

Long-term groundwater monitoring will be conducted to demonstrate hydraulic containment and to track the decline of lithium and molybdenum concentrations over time based on closure of the unit and extraction of the remaining impacted water. Monitoring will be performed on a semi-annual basis as required for ongoing Assessment Monitoring, and will include measurement of groundwater elevations, sampling of approximately six monitoring wells and the combined stream of extracted groundwater, and laboratory analysis for Appendix IV constituents.

The remediation timeframes for groundwater extraction to attain GWPSs were estimated using SourceDK Remediation Timeframe Decision Support System. The timeframes to attain GWPSs for lithium and molybdenum were calculated to be approximately 2.4 years and 2.1 years, respectively after completion of the pond closure and performance of groundwater extraction.

In accordance with 40 CFR § 257.98(c), the remedy will be considered complete when the GWPSs have been achieved at all points within the plume beyond the compliance monitoring wells, concentrations at the compliance monitoring wells have not statistically exceeded the GWPSs for a period of three consecutive years, and all actions of the selected remedy are complete. Once these criteria are satisfied, the corrective action (groundwater extraction) can be discontinued and the unit can return to semiannual Assessment Monitoring.

3. Compliance with Corrective Measures Objectives

This chapter discusses how the selected corrective measures will achieve the following objectives listed in 40 CFR § 257.97(b):

- Be protective of human health and the environment;
- Attain the groundwater protection standards as specified pursuant to 40 CFR § 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; and
- Comply with standards for management of wastes as specified in 40 CFR § 257.98(d).

Protection of human health and the environment

The overall goal of the remedy is to protect human health and the environment. By recovering impacted groundwater downgradient of Bottom Ash Pond 1 and returning it to one of the ash ponds or utilizing it as makeup water, the remedy will prevent migration offsite and potential exposure to human and ecological receptors, thereby protecting human health and the environment. The corrective measures will be implemented using equipment and procedures to protect workers health and safety and prevent releases of hazardous constituents to the environment. The remedy will be constructed and operated in accordance with Occupational Safety and Health Act standards for worker protection. Overall, the selected remedy should be protective of human health and the environment in both the short-term (during implementation and operation) and long-term (after operation of the corrective measures ceases).

Attain groundwater protection standards

The corrective measures will attain the GWPS identified pursuant to 40 CFR § 257.95(h), thereby reducing existing risks to acceptable levels. The remedy will involve pumping groundwater containing lithium and molybdenum above the GWPSs until natural recharge of the aquifer reduces dissolved concentrations to below GWPSs. By retrofitting Bottom Ash Pond 1, further releases of Appendix IV constituents will be prevented, and concentrations of lithium and molybdenum will remain below GWPSs after operation of the pumping system is discontinued. Basin Electric will continue to implement the CCR groundwater monitoring program at LRS following remedy implementation to ensure that the remedy remains effective over the long-term.

Control the source of releases

The remedy, including retrofit of the unit, will eliminate the source of releases of constituents in Appendix IV to this part into the environment. Basin Electric plans to retrofit Bottom Ash Pond 1 with a liner system that meets the requirements in 40 CFR § 257.71 for surface impoundments. This will effectively control the source of previous releases, prevent further releases of lithium, molybdenum, and other Appendix IV constituents, and minimize residual risks following implementation of the remedy.

Remove contaminated material from the environment

The corrective measures will 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. Groundwater extraction is a proven, reliable technology that is relatively easy to construct using readily available materials and equipment. The corrective measures will effectively remove dissolved lithium and molybdenum from the aquifer. The remedy will be designed and operated to intercept and extract impacted groundwater until concentrations downgradient of Bottom Ash Pond 1 are reduced to below GWPSs. Extracted groundwater will be recycled or discharged to one of the existing bottom ash ponds and will not be discharged offsite. Implementation of the corrective measures will involve drilling several pumping wells and installing conveyance piping. There are no sensitive ecosystems in the vicinity of where the groundwater pumping system will be installed. Therefore, remedy implementation and operation will not disturb or impact any sensitive ecosystems.

Comply with standards for management of wastes

Finally, the selected remedy will be implemented in a manner designed to comply with federal Resource Conservation and Recovery Act (RCRA) standards for management of wastes as required in 40 CFR § 257.98(d). No hazardous wastes are expected to be generated during remedy implementation and operation. Any non-hazardous wastes that are generated will be disposed in the permitted onsite landfill or transported to offsite licensed waste management facilities for recycling or disposal in accordance with federal, state and local rules and regulations. Short-term risks to the community or the environment associated with drilling of the groundwater recovery wells and transportation and disposal of any resulting waste materials will be minimal.

4. Corrective Action Program Implementation

Basin Electric will implement the remedy in accordance with 40 CFR § 257.98 requirements for corrective action programs. Basin Electric will initiate remedial activities, starting with design and contracting for construction of system components (extraction wells, pumps, piping, and metering), within 90 days of selecting this remedy. Remedial activities will be completed within a reasonable period of time given the hydrogeological characteristics of the facility in the vicinity of Bottom Ash Pond 1. Construction of the groundwater extraction system and associated piping will be coordinated with the retrofit of Bottom Ash Pond 1. Groundwater system design activities will commence within 90 days of remedy selection. Basin Electric anticipates that drilling of the recovery wells and installation of the extraction pumps, controls and discharge piping will occur in late 2020 or the first half of 2021, depending on weather conditions and completion of Bottom Ash Pond 1 retrofit activities.

Basin Electric will establish and implement a corrective action groundwater monitoring program per 40 CFR § 257.98(a)(1). The monitoring program will meet or exceed the requirements of the LRS CCR Assessment Monitoring Program, document the effectiveness of the remedy, and monitor progress towards meeting the applicable GWPSs for lithium and molybdenum. The corrective measures will be conducted until groundwater quality downgradient of Bottom Ash Pond 1 consistently complies with the GWPSs for three consecutive years using the statistical procedures and performance standards in 40 CFR § 257.93(f) and (g).

The timeframe for achieving GWPSs will be a function of the hydrogeological characteristics of the facility, which affect the pumping rates and capture zone of the groundwater recovery system. As stated in Chapter 2, the timeframe to attain GWPSs for both lithium and molybdenum is estimated to be less than three years. The potential risks to human health and the environment from exposure to contamination during remedy implementation and operation will be minimal.

Basin Electric will continue to prepare annual groundwater monitoring and corrective action reports during remedy implementation, operation, and monitoring. Each annual report will be prepared no later than January 31 for the previous calendar year. The annual reports will document the status of the groundwater monitoring and corrective action program for the preceding calendar year, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year.

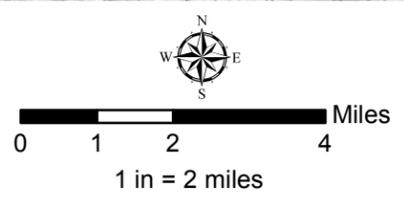
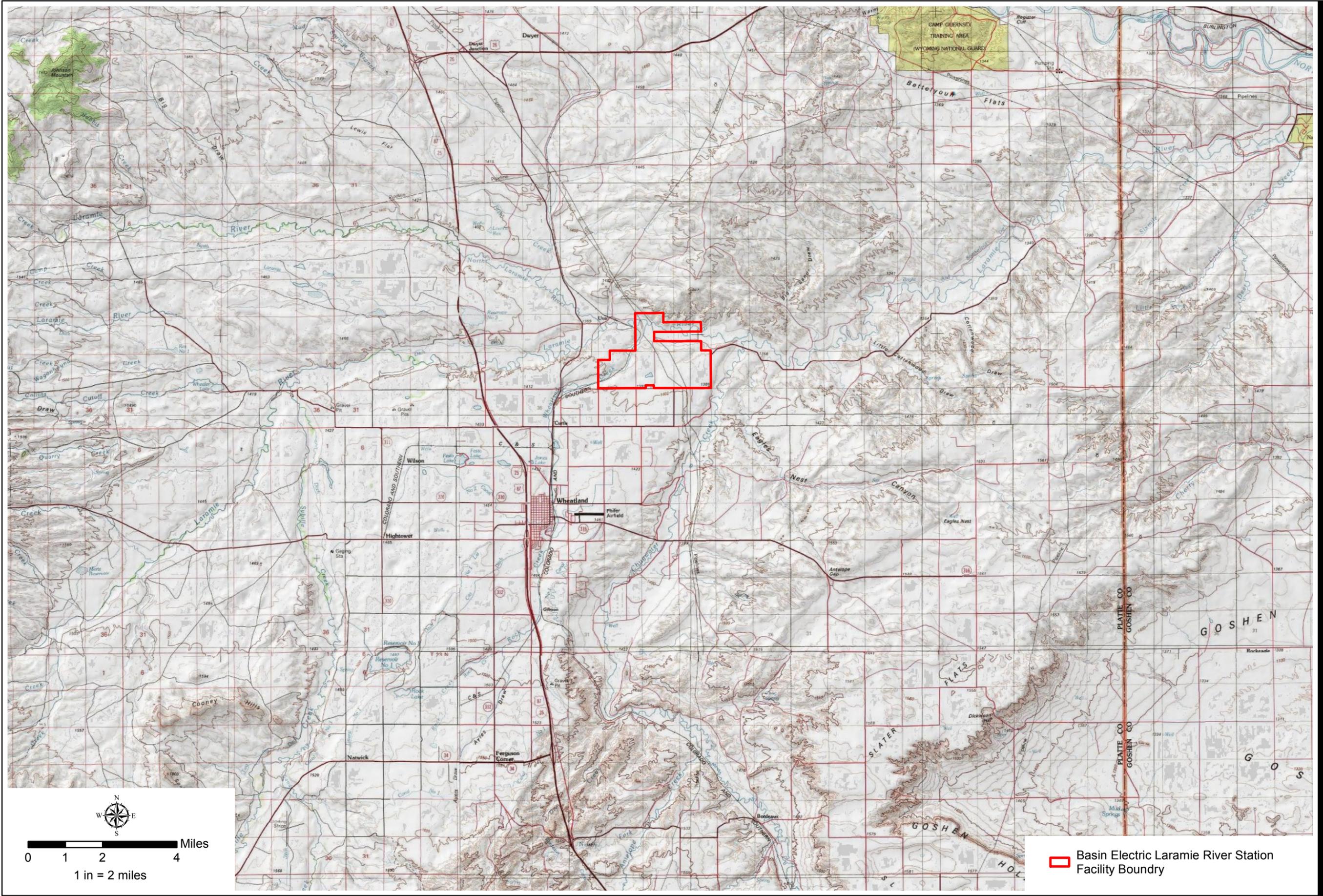
Once the remedy is complete, Basin Electric will prepare a notification as required by 40 CFR §257.106(h)(10) and obtain a certification from a qualified professional engineer or applicable permitting authority that the remedy has been completed in compliance with the requirements of § 257.98(c).

5. References

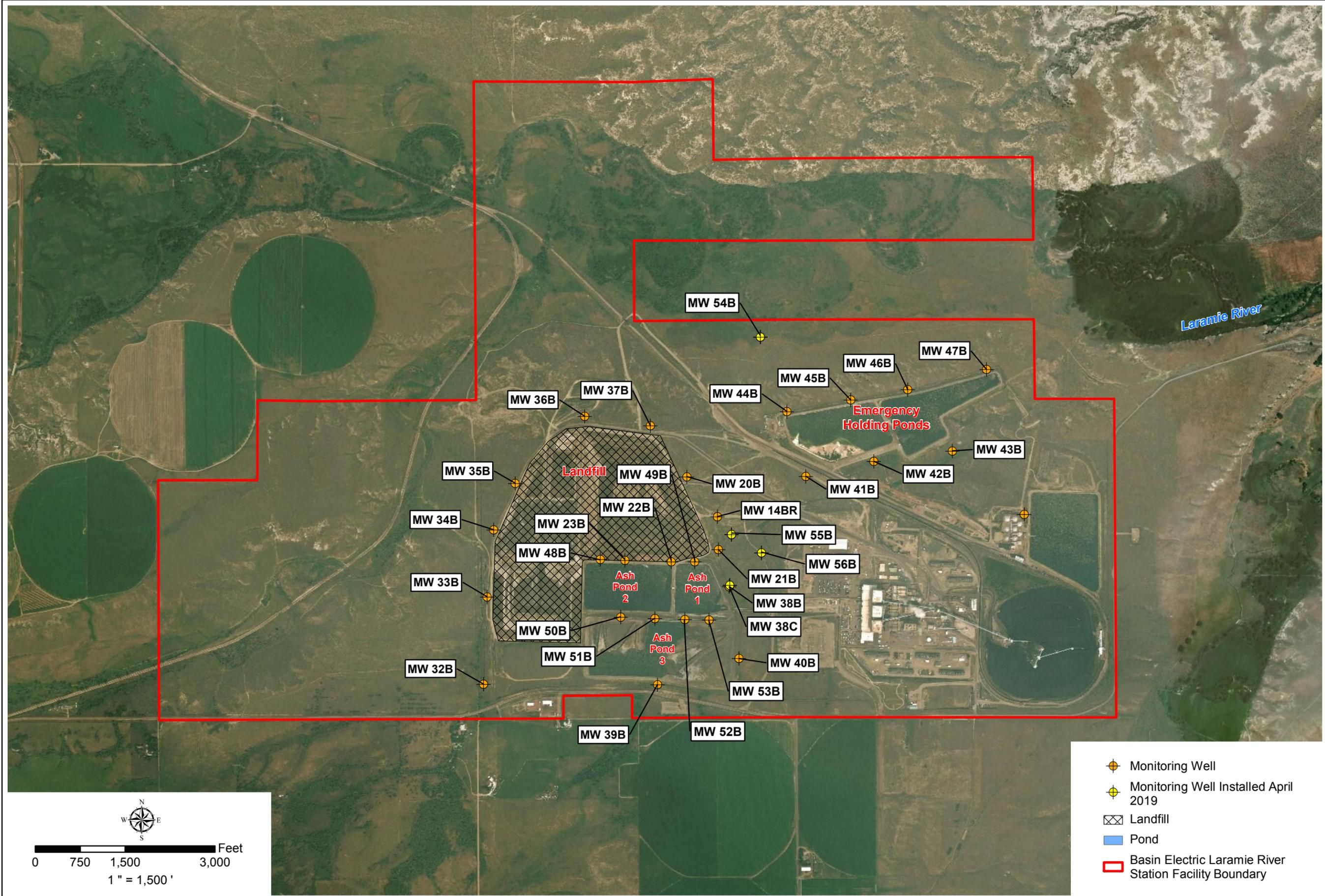
AECOM. 2019a. Groundwater Characterization Report, Laramie River Station, Wheatland, Wyoming. Basin Electric Power Cooperative. July 2019.

AECOM. 2019b. Assessment of Corrective Measures, Laramie River Station, Wheatland, Wyoming. Basin Electric Power Cooperative. August 2019.

Figures



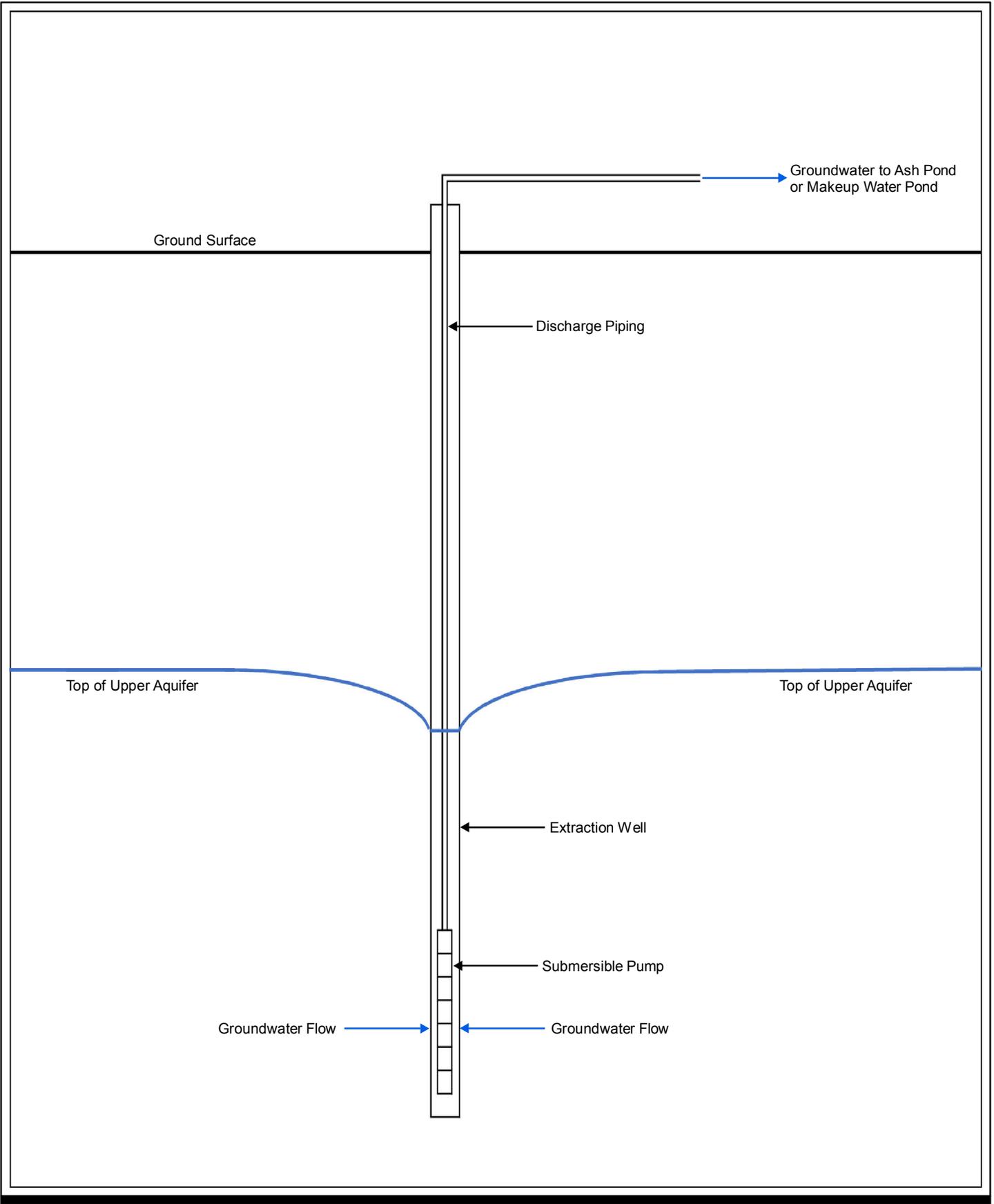
 Basin Electric Laramie River Station Facility Boundary



0 750 1,500 3,000 Feet
1" = 1,500'

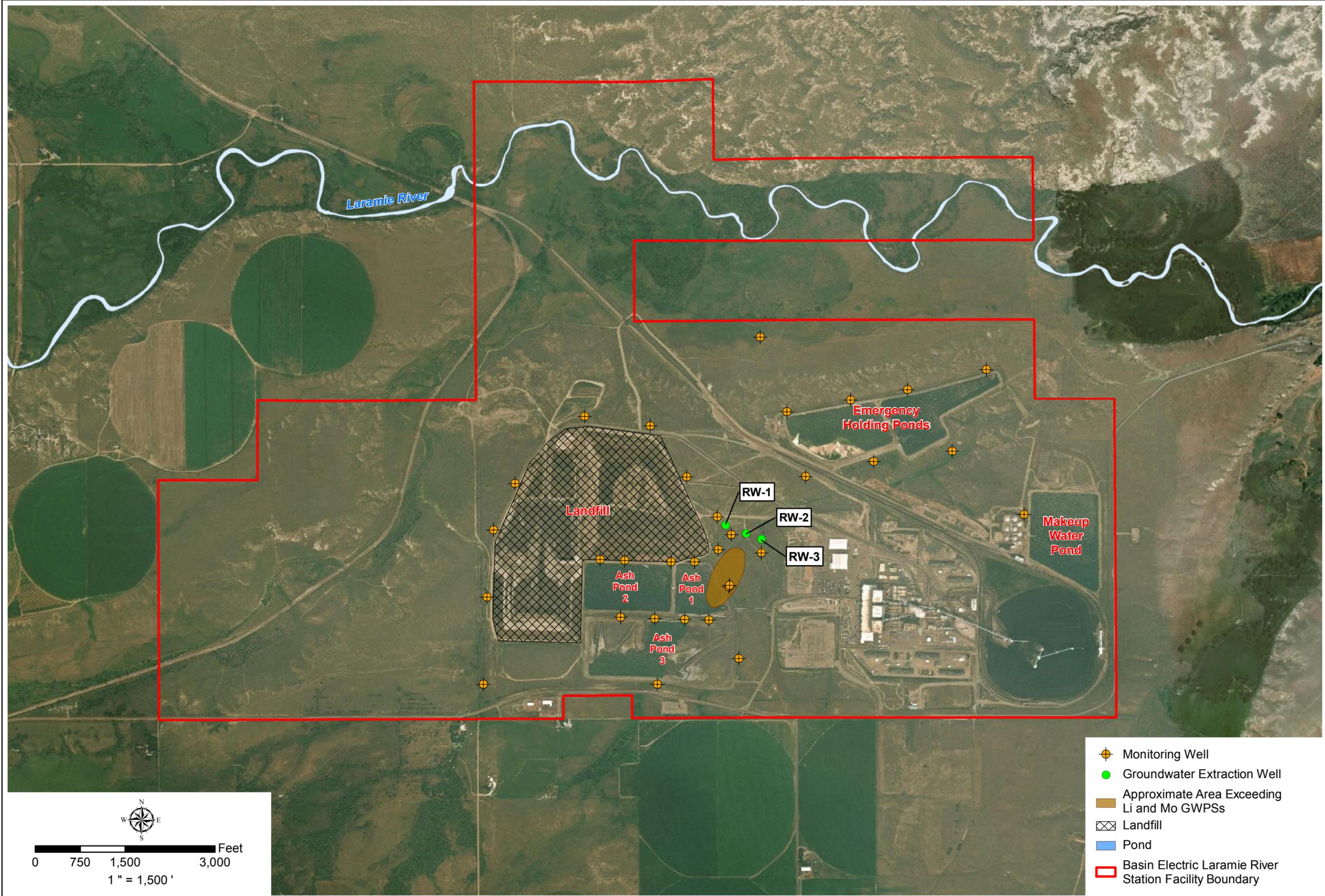
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- Monitoring Well Installed April 2019
- Landfill
- Pond
- Basin Electric Laramie River Station Facility Boundary

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Basin Electric
Laramie River Station
Platte County, Wyoming
Project No.: 60506860 Date: 05/20/2020

Typical Groundwater Extraction Well



0 750 1,500 3,000 Feet
1" = 1,500'

- Monitoring Well
- Groundwater Extraction Well
- Approximate Area Exceeding Li and Mo GWPPS
- Landfill
- Pond
- Basin Electric Laramie River Station Facility Boundary

Approximate Location of Groundwater Extraction Wells

