Groundwater Sampling and Analysis Plan

WEC Temporary Ash Disposal Area

Public Power Generation Agency/
Hastings Utilities/City of Hastings, Nebraska

Gerald T. Whelan Energy Center

Hastings, Nebraska

Revised: August 6, 2021

GROUNDWATER SAMPLING AND ANALYSIS PLAN
WEC TEMPORARY ASH DISPOSAL AREA

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SECTION 1.0
INTRODUCTION

On April 17, 2015, the U.S. Environmental Protection Agency (EPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA). The rule – effective on October 19, 2015 – applies to electric utilities and independent power producers that fall within North American Industry Classification System (NAICS) code 221112, and the facility produces or stores CCR materials in surface impoundments or landfills. This regulation applies to the Gerald T. Whelan Energy Center (WEC). The CCR rule required the following groundwater monitoring requirements by October 17, 2017:

- Install groundwater monitoring system that consists of sufficient number of wells at appropriate locations and depths, based on site-specific technical information, to yield groundwater samples from the uppermost aquifer that:
    - Accurately represent the quality of both background groundwater, and groundwater passing the boundary of the CCR unit
    - Monitor potential contaminant pathways
- Develop a sampling and analysis program
- Collect a minimum of eight (8) independent samples before October 17, 2017 from each monitoring well in the detection monitoring program and analyze for constituents in Appendix III and IV (§257.90(b)(iii) and §257.94(b))
- Begin semi-annual sampling in 4th quarter 2017 and evaluating groundwater monitoring data for Statistically Significant Increases (SSI's) over background levels for constituents in Appendix III

The CCR rule required an Annual Groundwater Monitoring and Corrective Action Report no later than January 31, 2018 for existing CCR surface impoundments and landfills, and annually thereafter. The Nebraska Department of Environment and Energy (NDEE) and Title 132 require semi-annual sampling of groundwater monitoring wells with semi-annual reports.

City of Hastings Utilities has been conducting groundwater monitoring at the WEC since 2001, when the initial monitoring wells were installed. This Groundwater Sampling and Analysis Plan (Groundwater SAP) is revised to comply with the requirements of the federal CCR rule, identify the monitoring well system for groundwater monitoring based on site-specific hydrogeology, and address the concerns of the NDEE based on historic sampling and analysis.

In August 2013, the NDEE issued a revised guidance document for Ground Water Monitoring Program for Municipal Solid Waste Disposal Areas. This guidance document is intended to assist permitted solid waste disposal areas in addressing the groundwater monitoring requirements of NDEE Title 132 – Integrated Solid Waste Management Regulations, Chapter 7, Ground Water Monitoring and Remedial Action. The requirements apply to all solid waste disposal areas accepting municipal solid waste, industrial waste, delisted waste and fossil fuel combustion ash. The sampling and analysis procedures, reporting, and statistical methods described herein are compatible with the guidance document.

This Groundwater SAP is organized into the following sections and related information:

- Section 1.0 Introduction – Discussion of the monitoring system;
- Section 2.0 Sampling and Analysis Procedures – Discussion of field procedures to be followed during sampling activities and anticipated health and safety conditions while sampling; Discussion of procedures to be followed during handling and shipping of groundwater samples; Presentation of parameters to be analyzed and frequency of sampling and analysis;
- Section 3.0 Reporting Requirements – Discussion of the format for data reports, documentation;
- Section 4.0 Statistical Methods – Discussion of methods for statistical analysis, and subsequent actions to be initiated based on analytical results;
- Section 5.0 Assessment Monitoring – Discussion of requirements if assessment monitoring occurs.

1.1 Facility

The Whelan Energy Center is located in Adams County, Nebraska, approximately two miles east of Hastings, Nebraska. WEC Temporary Ash Disposal Area serves the two (2) fossil fuel combustion units of the Whelan Energy Center. City of Hastings Utilities owns and operates Unit No. 1 (WEC1); Public Power Generation Agency (PPGA) owns Unit No. 2 (WEC2) while City of Hastings Utilities is the operating agent for PPGA. The WEC Temporary Ash Disposal Area is an existing CCR surface impoundment of approximately 23.2 acres that has historically received CCR for disposal/storage and is permitted with the State of Nebraska (NDEE ID #58048, Program ID – IWM NE0204129). WEC Temporary Ash Disposal Area continues to receive CCR for disposal/storage. This Groundwater SAP is specific to the WEC Temporary Ash Disposal Area.

NDEE will be notified in writing by City of Hastings Utilities personnel of any changes made in or to sampling equipment, monitoring wells, or other work practices that will materially affect the accuracy of the sampling and analysis plan in accordance with NDEE Title 132, Chapter 7, Section 003.01A. This Groundwater SAP, as part of the approved fossil fuel combustion ash disposal area permit renewal application, will be placed in the operating record in accordance with NDEE Title 132 Chapter 7 Section 003.01A.

1.2 Site Hydrogeology Summary

The groundwater monitoring system is based on the Hydrogeologic Characterization (Permit – Appendix K) and Supplemental Hydrogeologic Characterization (Permit – Appendix L).

1.2.1 Geology

The near surface unconsolidated geology at the WEC site consists of:

- 55 to 80 feet of brown clay and lean clay (loess) at the surface,
- Underlain by 30 to 40 feet of fine to medium grained sand and silty clay, and
- Underlain by fine to coarse alluvial sand and gravel (with minor clay lenses) of Pliocene/Pleistocene age starting at approximately 90 feet below ground surface (bgs) to a total depth of approximately 240 feet bgs.

1.2.2 Uppermost Aquifer

The uppermost aquifer under the WEC Temporary Ash Disposal Area is the unconsolidated Pliocene/Pleistocene alluvial aquifer. This aquifer is considered to be unconfined in the area near the WEC. This aquifer consists of a generally coarsening downward sequence of clay, silt, sand, and gravel with a total saturated thickness of approximately 120 to 135 feet (HDR, 2011). In general, this alluvial aquifer consists of highly transmissive sand and gravel interspersed with discontinuous clay layers. Underlying the Pliocene/Pleistocene alluvial aquifer is Cretaceous-age relatively impermeable bedrock that forms the base of the aquifer (HDR, 2010).

1.2.3 Hydraulic Gradient

The regional hydraulic gradient near Hastings is approximately south 70 degrees east at approximately 0.002 feet per foot (ft/ft) (HDR, 2011). Hydraulic gradient at the WEC Temporary Ash Disposal Area as determined by water levels collected immediately after installation of the first five (5) monitoring wells was to the southeast at an average gradient of 0.003 (ft/ft), which is similar to the regional groundwater direction. Subsequent monitoring has indicated a groundwater flow direction towards the east and northeast (towards WEC production wells). Hydraulic gradient and flow direction beneath the WEC Temporary Ash Disposal Area does not appear consistent throughout the observed monitoring history (2001 – 2021):

- 2001 to 2005: Groundwater flow direction is to the east northeast towards WEC Well C, with a gradient across the site of approximately 0.003 ft/ft.
- 2005 to late-2007: Water levels at MW-5 dropped two feet, while water levels at the other monitoring wells rose three to five feet resulting in a shift in groundwater direction to the northwest. Gradient across the site is approximately 0.003 ft/ft.
- Late-2007 to 2015: Groundwater flow direction returns to the north northeast towards WEC Well C, however gradient has increased to closer to 0.004 to 0.005 ft/ft.
- 2015 to 2021: Groundwater flow direction is to the northeast. Gradient across the site is approximately 0.004 ft/ft.

The changes in groundwater gradient could be due to drought conditions and the effects of local high-capacity production wells.

1.2.4 Hydraulic Conductivity

Aquifer tests performed near the City of Hastings indicated the hydraulic conductivity of sand and gravel in the uppermost aquifer ranges from 0.067 to 0.081 cm/sec (HDR, 2010). Slugs test performed at the WEC monitoring wells indicated a range of 0.009 to 0.053 cm/sec (HDR, 2011). The lower hydraulic conductivities seen at the monitoring wells may reflect their completion higher up in the Pliocene/Pleistocene alluvial aquifer, and the coarsening downward grain size.

1.2.5 Groundwater Flow Velocity

Horizontal flow velocity was calculated for the groundwater beneath the WEC Temporary Ash Disposal Area based on hydraulic conductivity determined from slug tests at the monitoring wells and assuming an effective porosity of 26 to 38 percent for sand and gravel. Results indicated a horizontal flow velocity between 0.2 and 1.7 feet per day (HDR, 2011). This

compares favorably with the average rate of groundwater movement in Adams County estimated to range from 0.5 to 2 feet per day (HDR, 2010).

1.2.6 Water Level Decline

Water levels collected at the WEC monitoring wells since 2001 show decline of as much as five feet in groundwater level beneath the site. This decline since 2001 is reflected regionally in groundwater level data at other wells in the Hastings area (USGS, 2015). It should be noted that in one (1) well located six miles to the west with a long-term record, groundwater level declined approximately 18 feet between predevelopment in 1940 and 1981. Water levels then recovered nine feet between 1981 and 2001, before declining seven feet between 2001 and 2015. Depth to groundwater in the vicinity of the WEC Temporary Ash Disposal Area has historically been 105 to 115 feet bgs. More recent depths to groundwater have been approximately 115 to 140 feet bgs. Groundwater levels remained relatively stable between 2015 and 2021.

1.3 Groundwater Monitoring System

Based on the groundwater flow to the east, southeasterly and northeasterly direction, the groundwater monitoring system network for the WEC Temporary Ash Disposal Area is described below:

- Upgradient/Background Wells: MW-5B, MW-6, and MW-9
- Downgradient Wells: MW-1, MW-2B, MW-3R (cross-gradient), MW-4B (cross-gradient), MW-7 and MW-8 (cross-gradient)
- Water Levels Only: MW-2, MW-4, and MW-5

The monitoring well locations are shown in Figure 1 (attached). The replacement well MW-5B and new background well (MW-9) were installed to help re-establish the quality of background groundwater that has not been affected by a CCR unit, as required by the CCR rule, for the Appendix III and IV constituents. Existing MW-6, along with MW-5B and MW-9, are used to establish the background groundwater quality for the WEC Temporary Ash Disposal Area starting with the sampling of each well for CCR rule Appendix III and IV constituents.

Monitoring well MW-2B is a deeper well and screened interval to monitor for vertical downward migration of potential contaminants due to the influence of continuously pumping Well C.

Monitoring well MW-1 currently has less than 14 feet of its 30-foot screen submerged in the upper aquifer and used as an alternative to MW-2 for collection of water quality samples at the northeast corner of the WEC Temporary Ash Disposal Area. MW-2 has not had sufficient water levels for sampling since 2014.

Monitoring well MW-4B is a replacement well for MW-4 which has not had sufficient water levels for sampling since 2014.

Groundwater monitoring wells MW-1, MW-2, MW-4, MW-5 and MW-6 are constructed of 2-inch-diameter, schedule 40 PVC, flush threaded riser pipe, and machine slotted 10-slot (0.010-inch) screen. Groundwater monitoring wells MW-3R, MW-2B, MW-4B, MW-5B, MW-7, MW-8, and MW-9 are constructed with 4-inch diameter casing. The monitoring wells are screened in the upper level of the aquifer. All wells except for MW-1 have a 10-foot screen. The surface completion for each well consists of a steel protective casing, concrete apron, and protective

bollards/posts. Table 1 below provides the status of each well in the groundwater monitoring system for the WEC Temporary Ash Disposal Area. Soil boring and well construction logs for the groundwater monitoring wells are presented in Attachment 2 of this plan.

Table 1
WEC Temporary Ash Disposal Area
Groundwater Monitoring Well System

Monitoring Well	Date Installed	Well Screen Depth (feet bgs)[1]	Well Depth (feet from TOC)[2]	Top of Casing Elevation[5, 6]	Gradient
Detection/Assessment Monitoring Program					
MW-5B	10/11/2016	122	123.95	1899.84 1897.21 (g)	Background / Upgradient
MW-6	10/5/2004	110	113.18	1896.88 1893.54 (g)	Background / Upgradient
MW-9	10/10/2016	117	119.22	1897.11 1894.31 (g)	Background / Upgradient
MW-1[3, 4]	7/28/1999	137	139.25	1903.16 1900.68 (g)	Downgradient
MW-2B (deep well)	10/17/2016	160	162.36	1903.46 1900.60 (g)	Downgradient / Crossgradient
MW-3R	1/29/2011	121.5	123.97	1900.76 1897.98 (g)	Downgradient
MW-4B[5]	10/18/2016	119	121.33	1897.55 1894.69 (g)	Downgradient / Crossgradient
MW-7	10/7/2016	127	129.09	1901.79 1899.14 (g)	Downgradient
MW-8	10/19/2016	127	129.31	1903.93 1901.05 (g)	Downgradient / Crossgradient
Water Levels Only					
MW-2[3]	10/22/2001	124	126.25	1903.18 1900.93 (g)	Downgradient
MW-4[3,5]	10/24/2001	115	119.02	1899.21 1895.19 (g)	Downgradient / Crossgradient
MW-5	10/25/2001	116	117.30	1898.90 1897.60 (g)	Upgradient
Abandoned Wells					
MW-3	Installed 2001 (Abandoned 2011)				

Notes:

(1) Depth from ground surface to bottom of installed well. Actual boring depth may be deeper.
(2) Depth from top of casing to bottom of installed well.
(3) Monitoring wells MW-1, MW-2, and MW-4 top of casing and ground surface raised higher than original installation due to WEC2 construction activity.
(4) Monitoring well MW-1 was installed with 30-foot screen (see Permit-Appendix K).
(5) Elevations for monitoring network wells were most recently surveyed as of July 23, 2019. (g) – ground surface elevation at monitoring wells.
(6) Elevations for water level only wells surveyed by JEO Consulting Group, Inc. August 17, 2016.

SECTION 2.0
SAMPLING AND ANALYSIS PROCEDURES

The sampling and analysis procedures presented in this section provide a reliable and consistent means of obtaining groundwater samples at the Site.

2.1 General Considerations

This Plan has been developed for use in the absence of constituents of concern. If there is a known or suspected presence of constituents of concern in the work area, a health and safety plan, in accordance with Occupational Safety and Health Administration (OSHA) 1910.120, will be developed and implemented prior to additional fieldwork.

2.1.1 Order of Sampling

The order of sampling each well will proceed from the upgradient monitoring wells to the downgradient monitoring wells and, within the latter group, from the least to most contaminated well if detectable concentrations of contaminants have been present in historical samples. The order of sampling of each well will proceed from the background/upgradient monitoring wells (MW-5B, MW-9, MW-6) to downgradient monitoring wells MW-4B, MW-3R, MW-7, MW-1, MW-2B and MW-8. The order of sampling downgradient wells may be adjusted as additional samples are obtained.

2.1.2 Sampling Personnel

City of Hastings Utilities will ensure that at all times, either in-house or contracted personnel who sample groundwater from WEC monitoring wells or take groundwater elevation measurements will be a licensed Water Well Monitoring Technician or work under a certified pump installation contractor/supervisor as defined in Nebraska Department of Health and Human Services (DHHS) regulations Title 178, Chapter 10 (dated 6/7/2011). The certified technician will have successfully completed an examination that tests the technician's knowledge about the following:

- Minimum standards for water wells
- Water pumps and pumping equipment
- Geologic characteristics of the State of Nebraska
- Water Well Standards Contractors' and Licensing Act, and rules and regulations adopted pursuant to the act
- Water sampling practices/techniques
- Measuring groundwater levels

This Groundwater SAP requires field-sampling personnel to conduct activities adjacent to an active CCR surface impoundment. Precautions will be taken while on-site to avoid risk of injury. Additional health and safety plans may be required if additional groundwater degradation is subsequently detected.

All sampling activities will be conducted in Level D personal protective equipment (e.g., safety glasses, steel-toe boots, nitrile gloves). If conditions warrant an upgrade in level of protection,

work will cease and the City of Hastings Utilities Environmental Supervisor will be contacted immediately.

2.2 Well Inspection

2.2.1 Sampling Equipment

The monitoring wells will be equipped with dedicated pump for low-flow sampling. All instrumentation will be calibrated as per the manufacturer's specifications. Field analytical instruments include pH, conductivity, dissolved oxygen, and other parameters depending upon the water quality meter used. Each instrument will be calibrated as per manufacturers' specifications.

The Table 2 below provides a sample list of equipment to be utilized during monitoring events. This list may be adjusted as necessary immediately prior to sampling events if sampling needs and equipment changes.

Table 2
Sample Field Equipment Checklist

1. Sample Data Sheets 2. Well Volume Sheets 3. Labels 4. Sample containers/coolers packs – ice 5. 500 ml beaker and bucket to determine sample flow rate 6. Tools – wrenches, socket set 7. Chain of Custody Forms 8. Groundwater SAP (this plan) 9. Keys for monitoring wells locks	10. Black marker and extra fine point sample marker 11. Previous sample event sheets 12. Tape 13. Pump controller/compressor 14. Multi-probe flowcell 15. Turbidimeter, multi-meter for stabilization parameters 16. Static water level indicator

2.2.2 Well Inspections

Each well will be inspected for construction defects, damage, labeling, security, and any outstanding issues noted in the Field Notes on the Groundwater Monitoring Sampling Collection Field Log (Attachment 1). Any damage or defect noted during the inspection will be noted on the field log for each well and all necessary repairs made within 60 days of discovery.

2.2.3 Water Levels

Static groundwater level measurements will be taken at all monitoring wells specified in Table 3 below prior to conducting the groundwater monitoring event. The water levels for all wells need to be recorded prior to purging. Groundwater elevation measurements will be taken to the nearest 0.01 foot from a defined point on the edge of the casing. Field notes for all wells listed below will be included in the semi-annual monitoring reports to NDEE.

Table 3
Wells for Groundwater Level Measurements

Network Monitoring Wells	Static Groundwater Levels (only)
MW-5B	MW-2
MW-9	MW-4
MW-6	MW-5
MW-4B	
MW-3R	
MW-7	
MW-1	
MW-2B	
MW-8	

An electronic water level indicator is used to determine static water level measurements. As low flow sampling is used, the volume of water in the casing is not applicable and, therefore, will not be calculated prior to sampling. The water elevations provide information on the groundwater gradients, which are used to predict groundwater flow directions and velocities. The following procedure will be used to record groundwater levels in the wells:

- The well location and number will be recorded.
- The measurement reference point (MRP) is the top of the inner PVC casing (measured on the north side if a survey mark is not present).
- Decontaminate the probe and lower clean probe into the well to the water surface. (The probe will emit an audible and or visual signal upon contact with the water surface.)
- The distance from the MRP to the water surface to the nearest 0.01 foot on the probe reel will be recorded on the well sampling log.

Note: It is assumed the depth of the monitoring wells does not change upon installation. The pumps will be removed and the depth of the well will be measured and recorded periodically, but only when a pump is pulled for maintenance purposes or at least biennially.

Water levels will be documented on a Field Note sheet and submitted along with groundwater data. A groundwater contour map will be developed based on data obtained in the field.

If the water level in monitoring well MW-1 is equal to or greater than 20 feet above bottom of well, then one or more samples will be obtained from MW-1 to represent across the 30-foot well screen.

- One sample from lowest 10 feet of well screen.
- One sample from 10 feet to 20 feet of well screen.
- If water level greater than 20 feet above bottom of well, then one sample from upper 10 feet of well screen.

2.3 Well Purging

WEC Temporary Ash Disposal Area monitoring wells will be equipped with dedicated pumps for low-flow sampling; therefore, three well volumes will not be purged prior to sampling. The purging rate at each monitoring well will be dependent upon the well yield. However, City of

Hastings Utilities will attempt to purge each monitoring well at a purge rate range of 100 to 600 ml/min, with a maximum removal rate not to exceed 1,000 ml/min. The actual purge rate for a well will be based on the observed drawdown during pumping. City of Hastings Utilities will attempt to set the pumping rate such that the drawdown is less than 0.5 feet during well purging. If an acceptable purging rate has not been established at a monitoring well to limit drawdown as much as possible, the water level should be monitored on a periodic basis with an electronic water level indicator during the purging process. The purging rate will be estimated by discharging purge water into a container of known volume for a specified period of time. The well purging data will be recorded on the field log (Attachment 1).

Samples will be collected after purged groundwater indicates that it has stabilized using the following parameters as indicators:

- pH
- Specific conductance (conductivity)
- Temperature

Dissolved oxygen, turbidity and redox potential (Eh) are optional to monitor.

Instrumentation will be calibrated in accordance with manufacturers' specifications prior to each sampling event. Calibration results will be recorded in the sampling log. Stabilization will be correlated with purge flow rates and time. Stabilization is considered to have occurred for three (3) consecutive readings with respect to the stabilization ranges listed below. The parameters will be measured with an inline flow cell that can allow for readings to be recorded continuously. However, City of Hastings Utilities proposes measuring the parameters at a time interval of 1 to 5 minutes, depending on the purging rate and the volume of the flow cell, with a minimum of one flow cell volume between readings.

Table 4
Stabilization Parameters

Stabilization Parameter	Stabilization Range
pH	10% or 0.2 units, whichever is greater
Conductivity	10% or 0.02 mS/cm, whichever is greater
Temperature	10% or 1°C, whichever is greater
DO (Optional)	10% or 0.2 mg/l, whichever is greater
Turbidity (Optional)	25 NTUs or less

With low flow sampling, it is not necessary to purge three (3) well volumes of groundwater prior to sampling. Samples will be taken after the groundwater data indicates stabilization. The amount of water purged prior to parameter stabilization will vary with well diameter but could typically be less than one half of a well volume. For any slowly recovering wells, the well will be sampled when sufficient volume of groundwater has re-entered the well.

The controller instrumentation used in conjunction with field parameter monitoring instruments detects stabilization and allows for very low flow rates. This purging technique should minimize the mobilization of solids and sediments not normally found in groundwater under natural flow conditions.

If multiple samples are required to be obtained from monitoring well MW-1 (see water level discussion in 2.2.3), then adequate time must be allowed between samples for the monitoring well to recover, prior to raising the dedicated pump and purging for the next sample.

2.4 Sample Collection and Field Determinations

The wells will be sampled immediately after purging. In accordance with the new U.S. Environmental Protection Agency (EPA) Final Rule for the regulation and management of Coal Combustion Residuals under the Resource Conservation and Recovery Act (RCRA), a minimum of eight (8) independent samples of Appendix III and IV constituents from each monitoring well in the detection monitoring program were collected before October 17, 2017. The constituents of CCR rule Appendix III and IV are listed in Table 5 below.

Table 5
Appendix III and IV to 40 CFR Part 257

Appendix III Constituents for Detection Monitoring	Appendix IV Constituents for Assessment Monitoring
• Boron • Calcium • Chloride • Fluoride • pH • Sulfate • Total dissolved solids (TDS)	• Antimony • Arsenic • Barium • Beryllium • Cadmium • Chromium • Cobalt • Fluoride • Lead • Lithium • Mercury • Molybdenum • Selenium • Thallium • Radium 226 and 228 combined

Thereafter, groundwater samples of Appendix III constituents have been collected from all the three (3) background/upgradient monitoring wells and the six (6) downgradient/crossgradient groundwater monitoring wells on a semi-annual basis (twice per year) as required by the CCR rule and NDEE Title 132. The detection monitoring program for the WEC Temporary Ash Disposal Area is described below.

- WEC Temporary Ash Disposal Area monitoring wells conducted eight (8) rounds of sampling and analysis for Appendix III and IV constituents, prior to October 2017 deadline in compliance with the CCR rule. A minimum of 30 days were maintained between sampling events. The following wells were sampled during the eight (8) rounds: upgradient wells MW-5B, MW-6, and MW-9, and downgradient wells MW-1, MW-2B, MW-3R, MW-4B, MW-7, and MW-8. Wells were sampled in the order specified above in Section 2.1.1.

    - With installation of the new replacement wells, upgradient/background monitoring wells and downgradient wells into the detection monitoring program, background levels will be re-established for Appendix III and IV constituents.
- For Appendix IV constituents, a groundwater protection standard (GWPS) was set. The GWPS must be the U.S. EPA Maximum Contaminant Level (MCL) or the background concentration level for the detected constituents, whichever is higher.
- After the initial eight (8) rounds of sampling were completed in compliance with the CCR rule, semi-annual sampling has continued for constituents listed in Appendix III from the monitoring wells in the detection monitoring program. Statistical analysis began after the initial eight (8) rounds of sampling were completed. See Section 4.0 for statistical analysis procedures.

Assessment monitoring is required whenever a SSI over background has been detected for one or more of the constituents listed in CCR rule Appendix III. Per the CCR rule, assessment monitoring will sample the wells for Appendix IV constituents. See Section 5.0 for assessment monitoring program procedures. The site has been in the assessment monitoring program since 2018.

The following in-situ groundwater data will be submitted along with analytical results. This data includes:

- Groundwater elevation
- pH
- specific conductance (conductivity)
- temperature
- color
- odor
- turbidity (optional)
- dissolved oxygen (optional)

Low flow sampling techniques will minimize aeration of groundwater samples.

Samples will only be collected after instrumentation indicates stabilization. As stated in Section 2.3, experience indicates that collection pump rates range from 100 to 1,000 ml/minute and will vary based on the well and stabilization parameters. Pump rates for sampling will not exceed purge flow rates.

2.5 Sample Preservation and Handling

Samples will be collected in appropriate containers and preserved in accordance with the latest required methodologies. The laboratory will be required to provide the required preservatives in labeled containers designated for each specific analysis. Sample containers will be prepared by the contract laboratory in accordance with USEPA's "Test Methods for Evaluating Solid Waste" (USEPA Document # SW-846) prior to sample collection. Samples are to be placed in a plastic or glass container and cooled to 4°C as soon as possible after they are collected. Sample preservatives, containers, and holding times are summarized in the Table 6 below.

Table 6
Sample Parameters, Preservatives, Containers, and Holding Times

Chemical Group / SW-846 Method	Preservative	Container/Minimum Sample Size	Maximum Holding Time
Metals	HNO_3 pH<2 Cool <4°C	500 ml plastic	6 months, 28 days for mercury
Sulfate	Cool <4°C	500 ml plastic	28 days
Total Dissolved Solids (TDS)	Cool <4°C	500 ml plastic	7 days
Combined Radium (Radium 226 + 228)	HNO_3 pH<2 Cool <4°C	2 – 1,000 ml plastic	6 months

Only containers provided by the contract laboratory will be used. The groundwater samples will be placed in a cooler (with ice) for storage and shipment to be cooled to a temperature of <4°C as soon as possible after samples are collected. The conditions should be maintained during storage and shipment of the groundwater samples. The temperature of the samples will be noted upon completion of sampling on the chain of custody and again upon arrival at the contract laboratory.

Samples will be labeled with minimum following information:

- Sample number and location
- Facility name
- Type of analysis to be conducted
- Date and time of sampling
- Sampler's name
- Method of preservation

A sample label and shipping record example can be found in Attachment 1 of this SAP.

Duplicate samples will be submitted to the laboratory as blind samples (i.e., not labeled as a duplicate sample, duplicate location number, or duplicate sample number) so the analyses can be used as a quality control check of the precision of the lab results. The sample ID should be "disguised", so the sample appears to be a normal sample from a monitoring well. The sample ID used for duplicates (and all samples) shall be recorded in the field logs.

2.6 Chain-of-Custody Control

The chain-of-custody form shall include at least the following information:

1. Sample ID number for each monitoring well sample enclosed
2. The date and time of collection for each sample
3. Media sampled (e.g., groundwater)
4. Sample type (composite/grab)
5. Identification of sampling location/well
6. Number of sample containers
7. Parameters requested for analysis
8. Printed name and signature of collector

9. Signature of person involved in chain of possession and times
10. Inclusive dates of possession with time in 24-hour notation
11. Internal temperature of shipping container when samples are removed at laboratory
12. Remarks to note preservative, turn-around, etc. and to relay other information to laboratory
13. Condition of samples (bubbles, cracks, leakage, unlabeled, frozen, etc.)
14. Signature of person relinquishing samples
15. Date and time samples were relinquished
16. Signature of person receiving samples
17. Date and time samples were received
18. Shipping company information
19. Appropriate invoice information

A copy of a sample chain of custody is included in Attachment 1. The information in the chain of custody will be completed by the laboratory upon receiving the samples or by any other person(s) who accept(s) the sample during transport.

A copy of the chain of custody will be submitted with the analytical results. This document provides constant and accurate information on the samples until they are analyzed, and proper disposal is completed.

2.7 Analytical Procedures

Laboratory analyses for the metals will be total concentrations on unfiltered samples. As a general rule, filtering of samples will not be performed; however, if turbidity measurements remain high, filtered samples may be taken for comparison purposes to be analyzed for dissolved metals. A 0.45-micron filter will be used when collecting groundwater samples for dissolved metals analyses.

Table 7
List of Analytes, Methods, and Reporting Limits for Network Monitoring (Appendix III) Constituents

Analyte	Method
Boron	EPA 6020A
Calcium	EPA 6020A
Chloride	EPA 9056A
Fluoride	EPA 9056A
pH	Field
Sulfate	EPA 9056A
Total Dissolved Solids (TDS)	SM-2540C

City of Hastings Utilities will ensure that its contract laboratory analyzes for metals in accordance with the table above or current approved method(s). Laboratory analytical data will include method detection limit (MDLs) for each analyte.

Assessment monitoring is required whenever a SSI over background has been detected for one or more of the constituents listed in CCR rule Appendix III. Per the CCR rule, assessment

monitoring will sample the wells for Appendix IV constituents. See Section 5.0 for assessment monitoring program procedures.

Table 8
List of Analytes, Methods, and Reporting Limits for Assessment Monitoring (Appendix IV) Constituents

Analyte	Method
Antimony	6020A
Arsenic	6020A
Barium	6020A
Beryllium	6020A
Cadmium	6020A
Chromium	6020A
Lead	6020A
Lithium	6010A
Mercury	7470A - Mercury (CVAA)
Molybdenum	6020A
Selenium	6020A
Thallium	6020A
Radium 226 and 228 combined	EPA 903.0 for Radium 226 and EPA 904.0 for Radium 228

2.8 Quality Assurance/Quality Control (QA/QC)

Sampling personnel will ensure that QA/QC samples for field duplicates and blind samples as required. A minimum of one field duplicate sample should be collected for every 10 samples. Nine (9) wells will be sampled for the WEC Temporary Ash Disposal Area monitoring program; therefore, one (1) duplicate sample will be collected. The duplicate will be collected from one of the following wells: MW-3R, MW-4B, MW-7, or MW-8. QA/QC requirements, including numbers of required field duplicates, field blanks, rinse blanks, and trip blanks are summarized in Table 9 below.

Table 9
Groundwater Sampling Summary(1)

Matrix	Laboratory Parameters	Samples(2)	Duplicate(3)	FB	RB(4)
Groundwater	Appendix III	9	1	1	-
Groundwater	Appendix IV	9	1	1	-

Notes:
FB = Field Blank
RB = Rinsate Blank

(1) The following determinations will be performed in the field at the time of sample collection: groundwater elevation, pH, conductivity, turbidity, and temperature. Dissolve oxygen and redox potential are optional.
(2) Number of samples may vary based on actual number of monitoring wells at time of sampling activities. One sample per well is anticipated; 9 wells will be in the monitoring system. An additional sample from MW-1 (in the top half of 30-foot screen) may be required depending upon water level.
(3) Duplicate samples to be collected at a minimum frequency of one in every 10 samples.
(4) Required when non-dedicated sampling equipment is used.
(5) Trip blanks are not required at this time since sampling does not include volatile organic compounds.

Each monitoring well is equipped with dedicated low-flow pump, which eliminate/minimize cross contamination. The flow cell and field parameter instrument probes are the only non-dedicated sampling equipment that comes in contact with groundwater. New sample tubing or dedicated tubing is used for every sample; thus, cross contamination cannot occur. An equipment rinsate blank and trip blank will not be collected as long as this process is used.

The laboratory is responsible for assuring the quality of all results obtained in the laboratory. The analytical laboratory report will include a complete summary of quality control sample results.

Laboratory QA/QC activities will include the use of method blanks, matrix spike/matrix spike duplicate, and surrogate spikes in accordance with the requirements of the methods presented in Section 2.7. Data from QA/QC samples (e.g., blanks, surrogates, spiked samples) will be used as a measure of performance (e.g., accuracy and precision) and as an indicator of potential sources of cross-contamination but will not be used to alter or correct analytical data. The analytical laboratory must report the method blank, laboratory control and duplicate control sample, surrogate, and matrix spike/matrix spike duplicate QA/QC data with the groundwater monitoring analytical results to enable the data to be partially validated. The laboratory will be required to provide a discussion of any problems encountered during the analysis and reporting process.

The laboratory shall be responsible for maintaining an appropriate health and safety program for all laboratory activities.

SECTION 3.0
REPORTING REQUIREMENTS

Reporting requirements comply with NDEE Title 132 and federal CCR rule.

3.1 NDEE Reporting

NDEE requires semi-annual reports to be submitted each calendar year, as such groundwater monitoring is conducted semi-annually. Reports for NDEE will be submitted by August 1 and February 1 of each year for the first and second semi-annual sampling events, respectively. The semi-annual report due February 1 may be combined with the annual report required by the CCR rule (see Section 3.2 below), unless NDEE requests a separate semi-annual report. The City of Hastings Utilities will contact NDEE in writing in the event that it cannot meet this reporting requirement and will propose an alternative date of submission. Groundwater monitoring reports will include the following:

1. Field notes for each well
2. Summary of current groundwater analytical results
3. Site map with monitoring wells locations, groundwater elevations, aquifer groundwater contours, groundwater flow direction, and estimated velocity
4. Laboratory analytical reports (including QA/QC data) and chain of custody
5. Statistical analysis

Groundwater monitoring reports submitted to the NDEE will include a hard copy and digital copy (PDFs/Excel files) of the information above.

A blank Field Log sheet is included in Attachment 1. The purpose of the field log is to provide a record of the field activities performed. The logs will allow documentation of the following information:

1. Monitoring well number/identification
2. Sample # with date and time of sampling
3. Weather
4. Sampler name(s)
5. Instrument calibrations
6. Wellhead inspection
7. Depth to static water level
8. Depth to bottom of casing
9. Volume of water purged
10. Water level measuring equipment used
11. Purge equipment used
12. Sampling equipment used
13. Pump rate during sample collection
14. Purge parameters
15. Well pumped to dryness
16. Method of sample preservation
17. Unusual occurrences
18. In-situ sampling of field parameters during sample collection

Semi-annual reports will be submitted to NDEE at the following address.

NDEE
Integrated Waste Division
P.O. Box 98922
245 Fallbrook Blvd.
Lincoln, NE 68521-8922

3.2 CCR Rule Reporting

The CCR rule requires an Annual Groundwater Monitoring and Corrective Action Report no later than January 31, 2018, and annually by January 31 thereafter, to be placed in the facility operating record and posted to the CCR website. Notification of availability of this annual report will be submitted to the NDEE.

SECTION 4.0
STATISTICAL METHODS

Pursuant to the NDEE Title 132, Chapter 7, the facility must develop a program to address the selection of statistical methods to be certified by a Qualified Professional Engineer. HDR has prepared a Statistical Selection Report to certify that the statistical methods selected for evaluating the groundwater monitoring data at the WEC Temporary Ash Disposal Area are appropriate under the requirements of NDEE Title 132, Chapter 7, Section 003.07.

NDEE Title 132 Chapter 7, Section 003.07 includes a list of statistical methods from which to choose for evaluating the groundwater monitoring data from solid waste management areas. The options include:

- A parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method shall include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.
- An analysis of variance (ANOVA) based on ranks followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method shall include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.
- A tolerance or prediction interval procedure in which an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.
- A control chart approach that gives control limits for each constituent.
- Another statistical test method that meets the performance standards of this chapter.

As groundwater monitoring progresses, the use of the selected statistical method will be subject to ongoing review. City of Hastings Utilities reserves the right to use other statistical tests in place of, or in addition to, the methods specified in this Groundwater SAP and the Statistical Selection Report if such methods are better suited for analysis of future results and consistent with regulatory requirements. Additionally, modifications to this Groundwater SAP and the Statistical Selection Report may occur if future revisions or amendments are made to the NDEE Title 132, Chapter 7 rules. If test methods are changed, this Groundwater SAP and the Statistical Selection Report will be revised, as appropriate, and its certification updated. Changes to these statistical tests and/or the Groundwater SAP will not occur without approval of the NDEE.

The goal of the statistical analysis is to provide a quantified means to evaluate whether a CCR management unit has released contaminants into the groundwater. Following the collection of groundwater monitoring data, detected constituents will be statistically evaluated. The SANITAS™ for Groundwater Statistical Software will be used to conduct statistical analysis of groundwater analytical data collected for the WEC Temporary Ash Disposal Area. However, if during the period of the groundwater monitoring program at the WEC Temporary Ash Disposal Area, an updated or equivalent comprehensive statistical software program is available or may become available, WEC reserves the right to change software packages.

The following sections describe the method(s) that will be implemented for evaluating the groundwater monitoring data at the WEC Temporary Ash Disposal Area. The method(s) described herein will be implemented in accordance with the EPA's Unified Guidance Document (EPA 2009).

4.1 Preliminary Data Review

Data for each sampling and analysis event will be reviewed for outliers and trends. The review will include evaluations utilizing time series plots, box-whisker plots, Sen's Slope/Mann-Kendall trend test, and Outlier screening. If the data is determined to be an outlier, the data point may be replaced with a corrected value, discarded from statistical calculations, or left "as is" in the database. In accordance with Title 132 Chapter 7, Section 002.04A1, data will be evaluated, as necessary, for seasonal and spatial variability using the procedures previously mentioned.

Statistical analysis will be completed in accordance with the data's distribution type, normal/ parametric or non-normal/non-parametric. The Shapiro-Wilk test for normality will be performed for each combination of well and constituent. During the normality test, non-detect (ND) values are identified as a function of percent ND. If the percentage of NDs is less than 15 percent, the ND value will be replaced with one-half of the laboratory reporting limit. If the percent of NDs is 50 percent or higher, a non-parameter test will be used in lieu of parametric testing. Analytical results between the reporting limit and method detection limit (i.e. "J-flagged" values) will be entered into the database if provided by the laboratory but will not be considered statistically significant detections.

Duplicate samples are collected in the field as part of the facility's QA/QC program. Results from these samples will be used strictly for QA/QC evaluation and will not be used for statistical analysis.

4.2 Outliers

Based on EPA guidance, an evaluation for removal of an outlier will be done only if an observation seems particularly high (several orders of magnitude) compared to the remainder of the data set. If a sample value is suspect, then an outlier test will be performed. Mathematical calculations will be performed to test whether individual data points are outliers.

An outlier should not be excluded from the data set unless a specific reason for the abnormal value can be determined. Explanations for the potential outlier could include lab instrument failure, field collection problems, or data entry errors. An outlier could also occur naturally as a result of temporal variability in the data or the result of other alterations to local groundwater, such as groundwater identified to be under the influence of surface water that results in an alteration of natural groundwater quality. The Qualified Professional Engineer will evaluate an outlier and determine if it should be removed or included in the data set.

4.3 Evaluating Statistically Significant Increases (SSIs)

Under the Detection and Assessment Monitoring programs of Title 132, Chapter 7, 003.09B, monitoring results will be statistically compared to background levels through interwell statistical methods to determine if there is a SSI above background concentrations. Based on the Site's existing groundwater monitoring system and hydrogeological data, the Site is well suited for interwell analysis.

Interwell upper prediction limits (UPLs) will be used to statistically evaluate SSIs over background for the Detection and Assessment Monitoring constituents. The formulation of the prediction limit may vary with the particulars of the test to be made and the characteristics of the data involved such as the type of distribution, the sample size, presence of NDs, and level of skewness; but for illustration, under normal distribution assumptions with no NDs, the formula for the prediction limit for 1 future or independent observation is:

$$UPL = \bar{x} + ks$$

Where:

- $\bar{x}$ = mean concentration of the background dataset
- s = standard deviation of the background dataset
- k = multiplier based on the characteristics of the Site and the statistical test

Values for k are chosen to maintain a site-wide false positive rate (SWFPR) less than 10 percent, as recommended by the Unified Guidance, and depends on the following:

- Number of wells;
- Number of constituents being evaluated;
- Size of the background dataset;
- Retesting regime; and
- Whether intrawell or interwell comparisons are being used.

Values for k are listed in Tables 19-1, 19-2, 19-10, and 19-11 in Appendix D of the Unified Guidance (EPA, 2009). If the k value that precisely matches Site conditions does not appear in these tables, it can be estimated using the provided values by linear interpolation. Parametric or non-parametric UPLs may be utilized depending on the distribution of the data.

4.4 Background Data

The background data set currently is comprised of at least nine (9) rounds of groundwater data collected from three (3) upgradient wells (MW-5B, MW-6 and MW-9) in the groundwater monitoring system from November 2016 through November 2020. Upgradient data are defined by data pooled from MW-5B, MW-6, and MW-9. As recommended in the Unified Guidance, background values should be updated every four (4) to eight (8) measurements (i.e., every two [2] to four [4] years if samples are collected semi-annually). New background data will be evaluated against the existing background dataset, as appropriate. If the new background data does not indicate a statistically significant difference, the new data should be combined with the existing background data to calculate an updated UPL. Increasing the background dataset will increase the power of subsequent statistical tests. If the new background data does indicate a significant difference between the two (2) populations, the data should be reviewed to evaluate the cause of the difference. In the absence of evidence of a release, the new dataset should be considered more representative of present-day groundwater conditions and used for background.

4.5 Verification Sampling

A "1 of-2" retesting plan will be used on individual sample results. The 1-of-2 retesting plan as defined in the EPA Unified Guidance concludes that an SSI has occurred when two (2) out of two (2) consecutive sample results exceed the prediction limit, while no SSI is concluded if 1-of-2 is below the limit. Verification resampling will be collected within 30 days of the constituents being initially detected above its limit. The results of the verification resampling will be incorporated into the database for statistical analysis. The prediction limit for each constituent will be recalculated semi-annually.

In the event a confirmed "2-of-2" SSI over background is identified for any of the Detection Monitoring parameters, either an alternate source demonstration will be completed within 90 days or assessment monitoring will be initiated. If the alternate source demonstration concludes that the SSI resulted from a source other than the CCR unit or from error or natural variability, then assessment monitoring is not initiated. Otherwise, assessment monitoring is then initiated within 30 days of the completion of the alternate source demonstration. Refer to Section 5.0 of this plan.

Notification of a new SSI with be sent to the NDEE within 14 days of determination in compliance with Title 132, Chapter 7, 004.03A. If the NDEE revises Title 132 requirements for fossil fuel combustion ash disposal areas, these timelines will be adjusted to match any revised requirements. Assessment monitoring was initiated at the site in 2018.

SECTION 5.0
ASSESSMENT MONITORING

Assessment monitoring will be initiated when a verified SSI by a specific chemical constituent occurs during the course of detection monitoring, and if alternate sources for the exceeded constituent are ruled out. Upon commencement of assessment monitoring, a groundwater sample must be collected from each well in the detection monitoring program pursuant to the CCR rule. Assessment monitoring steps are summarized below.

- If SSI occurs in a downgradient well for an Appendix III constituent and a successful demonstration is not made, then initiate assessment monitoring.
- Within 90 days of triggering an assessment monitoring program, and annually thereafter, sample and analyze the groundwater for all constituents listed in Appendix IV. Collect at least one (1) sample from each well in the monitoring network.
- Within 90 days of obtaining the results, and on at least a semi-annual basis thereafter, re-sample all wells, conduct analyses for all parameters in Appendix III and for those constituents in Appendix IV that are detected. Collect at least one (1) sample from each well in the monitoring network.
- If Appendix III and IV constituents are shown to be at or below background values for two (2) consecutive sampling events, sampling will return to detection monitoring.
- If Appendix III and IV constituents are shown to be above background levels but below GWPS, continue assessment monitoring (i.e. sampling of Appendix III constituents and detected Appendix IV constituents).
- If Appendix IV constituents are detected at statistically significant levels (SSLs) above GWPS, then
    - Within 90 days, complete a demonstration that a source other than the CCR unit caused the contamination, or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. If a successful demonstration is made, continue assessment monitoring.
    - If a successful demonstration is not made and therefore, an assessment of corrective measures is required, then the WEC Temporary Ash Disposal Area (as an unlined CCR surface impoundment) is subject to the requirements under 40 CFR 257.101(a) to retrofit or close. Within six (6) months of making such determination, City of Hastings Utilities must cease placing CCR and non-CCR waste streams into the unlined CCR surface impoundment and either retrofit or close the CCR unit.

Notifications of assessment monitoring and returning to detection monitoring, in accordance with the CCR rule, will be completed.

5.1 Establishing Groundwater Protection Standards

Under the assessment monitoring program, GWPSs should be determined for Assessment Monitoring constituents in accordance with NDEE Title 132 Chapter 7, Section 005.08. The GWPS shall be defined as the following:

- The U.S. EPA MCL for constituents for which an MCL has been established;
- the background concentration for constituents for which an MCL has not been established, or
- the background concentration for constituents for which the background level is higher than the U.S. EPA MCL established.

5.2 Evaluating Statistically Significant Levels (SSLs)

If constituents are detected as SSLs above the GWPS, the following actions are required to be taken by the owner:

- Place a notification in the operating record identifying the GWPS exceedances.
- Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected in accordance with NDEE Title 118 – Ground Water Quality Standards and Use Classification, Chapter 10 – Remedial Action Provisions for Point Source Ground Water Pollution Occurrences.
- Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination.
- Within 90 days:
    - Prepare an alternative source determination for the exceedance, or
    - Initiate an assessment of corrective measures in accordance with NDEE Title 118 Chapter 10.

If concentrations of all Detection and Assessment Monitoring constituents at the monitoring network locations continue to be above background concentrations but below the applicable GWPS, assessment monitoring will continue. Annual reports and current status of WEC Temporary Ash Disposal Area groundwater monitoring program can be found through the City of Hastings website to the Hastings Utilities webpage and link to the CCR Rule Compliance Data and Information.

Attachment 1
Sample Forms

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Attachment 2
Groundwater Monitoring Wells Construction and Boring Logs

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