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APPENDICES

A Phase 1A Brine Gathering System Incident Remediation Status Report (Keitu)
B Conceptual Water Balance Model and Fate Assessment Report (WWE)

EXHIBITS

A Monitoring and Sampling Locations
B Testing Laboratory Quality Assurance Manuals
C Crestwood's Quality Assurance Organization Chart

1.0 PURPOSE

This report was prepared in response to the July 2014 produced water incident that occurred on Crestwood Midstream Partners, LP's ("Crestwood") Phase 1A pipeline along Turnuey Ridge Road in eastern McKenzie County, North Dakota (the "Incident"). The goal of this report is to develop a Remediation Plan ("Plan") that can be implemented to establish and meet defined soil and water quality objectives. This Plan has been incorporated into an Administrative Order of Consent (the "Consent Order") between Crestwood and the U.S. Environmental Protection Agency ("EPA"), entered into and filed with EPA's Region 8 Hearing Clerk on April 24, 2017. The Plan is effective upon the date approved by the EPA.

This Plan provides specific guidance for: (i) ongoing and proposed future sampling and analysis of groundwater, perched water, surface water, soils and vegetation from specific locations associated with the produced water Incident; and (ii) required mitigation and/or restoration efforts to achieve the goals and objectives set forth herein. This report includes: (i) background on the events associated with the Incident (see Section 2.0), including Crestwood's initial response; (ii) the history of Crestwood's monitoring activities, which began on July 9–10, 2014, and continue to the present; (iii) specific details regarding the current and proposed surface water, perched water, groundwater, soils, and vegetation sampling and monitoring at locations associated with the produced water flow path (see Section 3.0); (iv) specific details regarding surface water, perched water, groundwater, soil, and vegetation mitigation and/or restoration to achieve the goals and objectives set forth herein (see Section 3.0); (v) quality assurance (see Section 4.0); (vi) data assessment and evaluations (see Section 5.0); and (vii) data management and communication (see Section 6.0).

Exhibit A provides a general overview of the area affected by the Incident beginning at the location of the Phase 1A pipeline failure, and continuing southwest along Turnuey Ridge Road to a location where produced water traveled westward down a ravine into an unnamed drainage and then northward toward Lake Sakakawea, where an estimated 250 barrels of produced water reached Lake Sakakawea. Sampling locations are also identified on Exhibit A. The sample locations depicted on Exhibit A include existing surface water and soil monitoring locations, as well as future perched water, groundwater and surface flow monitoring locations. Details about each of these locations relative to sampling, monitoring, and evaluation are discussed and analyzed herein.

2.0 BACKGROUND

To provide a foundation for the Plan, Section 2.0 provides the background of the Incident including the extent, response, initial and ongoing sampling and monitoring history, and regulatory drivers and guidelines for cleanup. Section 2.0 also reviews studies conducted to better understand the fate and likely distribution of the produced water from the Incident in the environment.

2.1 The Incident

In early July 2014, a pipe failure resulted in the unintended spill of produced water from a location along the Phase 1A pipeline of Crestwood's brine gathering system in North Dakota. Approximately 26,000 barrels or 1.1 million gallons (MG) of produced water were involved in the Incident, which began at a location approximately one mile south of Bear Den Bay (a part of Lake Sakakawea) and adjacent to Turnuey Ridge Road in McKenzie County (see Exhibit A), within the exterior boundaries of the Fort Berthold Reservation.

The following timeline provides the sequence of events associated with the Incident.

- July 3–7, 2014:
  - Episodic spill of produced water to the surrounding soils from the Phase 1A pipeline. During this time, rain was observed near the location of the Incident.
- July 7–8, 2014:
  - Identification of the Incident and commencement of initial response.
- July 8–11, 2014:
  - Development and implementation of a plan to collect produced water, and flush fresh water along a portion of the flow path to a fluid collection and withdrawal location at Dam 1 (see Exhibit A).

2.1.2 Flow path

A site inspection on July 8, 2014, identified the location of the Incident as 47°47’04"N and 102°38’40"W or in the SE¼ of the NE¼ of Section 24, Township 150 North, Range 94 West of the 5th Principal Meridian, North Dakota. The Incident resulted in produced water pooling at the surface adjacent to the Phase 1A pipeline. Thereafter, the produced water followed the surface topography, primarily in a southwesterly direction along the north side of Turnuey Ridge Road. The fluids subsequently moved westward away from Turnuey Ridge Road and down a ravine, and into an unnamed creek that flows northward into Lake Sakakawea. The total distance of the flow path from the location of the pipe failure to Lake Sakakawea, including through numerous beaver ponds and dams (some intact and active, some intact and silted in, and some previously breached), was approximately 7,400 feet. At the time of the Incident, fresh water was present in the beaver dam ponds and within the unnamed creek. The 7,400-foot flow path from the pipe failure to Lake Sakakawea was comprised of approximately 2,250 feet of overland flow, approximately 2,650 feet of channel flow, and 2,500 feet of flow through ponds. From the location of the pipe failure, produced water also moved northeasterly adjacent to Turnuey Ridge Road for approximately 450 feet but was constrained.

2.2 Monitoring and Mitigation History

Following identification of the Incident, Crestwood immediately engaged in numerous remediation efforts to reduce the effects on the unnamed drainage and Lake Sakakawea. The following actions were performed by Crestwood between July 8 and October 1, 2014:

- Approximately 1,510 barrels of produced water were removed by a vacuum truck before reaching the unnamed creek and disposed of off-site.
- 1.1 MG of fresh water was flushed into the ravine along the flow path.
- Berms were constructed within the ravine receiving the fresh water to guide the flow and to minimize erosion impacts on the downslope portion of the drainage.

- The downstream beaver dam (Dam 1) was outfitted with temporary plastic sheeting and sandbags to minimize losses and used as a collection and pumping point for withdrawal and disposal of produced water and flush water.
- Booms were placed near the inlet to Bear Den Bay from the unnamed drainage and near the intake station for Mandaree's drinking water supply.
- Between the location of the pipe failure and the unnamed creek drainage, a calcium based soil amendment (BIO-CAL) was applied and tilled into the soil.
- Some soil was excavated, removed, and replaced with soil approved by the Mandan, Hidatsa, and Arikara Tribes ("MHA Nation") in the immediate vicinity of the pipe failure.
- Flax hay and alfalfa hay were applied in multiple areas to increase organic content and increase permeability.
- Citric acid, calcium carbonate and calcium sulfate were also added to soil in some areas to release the sodium from the soil particles and to promote the downward movement of the water-soluble sodium.
- In the steeper wooded areas, citric acid and calcium carbonate were added to the soil as an in-situ soil treatment. Dead vegetation was removed and chipped with resulting wood mulch mixed into the top layer of soil by tilling. Erosion control techniques, including the installation of rock check dams, straw waddles, and straw matting, were applied to this area as well.
- Impacted areas along the flow path were seeded and fenced off to prevent cattle from grazing, and to prevent soil compaction.
- Crestwood identified and sampled more than 20 locations for soil and water quality, primarily focused on pH, chloride, and electrical conductivity (EC) (see Sections 2.2.1 and 2.2.2). Surface water sampling started immediately after the Incident was discovered, with daily sampling continuing until September 27, 2014, and weekly

sampling continuing until October 14, 2014. Moreover, extra sampling points at discrete locations were identified and sampled following significant rain events.

- Crestwood gathered soil samples from 20 locations along the flow path for parameters including benzene, toluene, ethylbenzene, and xylenes (BTEX); gasoline range organics (GRO); and diesel range organics (DRO). BTEX, GRO and DRO sampling found concentration levels requiring remediation only in the hilltop vicinity very near the initial pipe failure. These soils were excavated, hauled away, and disposed of off-site. No additional sampling locations along the flow path found BTEX, GRO, or DRO concentration levels requiring further sampling or remediation.

- Water samples were obtained for select metals analysis from seven locations.

- A botanical field survey was performed by Keitu Engineers and Consultants, Inc. (Keitu) on September 22, 2014, to inventory the vegetative cover of the affected drainage and to identify plant species.

- Fluids collected at Dam 1 were pumped to temporary storage tanks, and subsequently disposed of off-site for approximately four months.

In addition, Crestwood has performed and continues to perform the following activities to prevent or mitigate future incidents from Crestwood's North Dakota produced water gathering system:

- Inspected all valve cans to ensure correct positioning over pipeline segments.

- Removed air release valves to eliminate connections similar to the one in close proximity to the Incident pipe failure.

- Installed thirty-nine additional check valves.[1]

[1] Check values only permit fluid to flow through a pipeline in one direction; thereby, preventing backflow and reducing the severity of a release.

- Installed Flexsteel in all new produced water pipeline segments.
- Hydrostatically tested specific pipeline segments.
- Biweekly aerial patrols of the gathering system to check for potential incidents.
- Daily monitoring of the gathering system by field operators (many of whom traverse the entire gathering system more than once each day) to monitor and look for potential incidents.
- Developed and implemented new training and operational policies and procedures for staff and personnel, including required training exercises and courses.
- Created and installed a remote monitoring system that measures the volume and pressure of produced water at different points, and that transmits data to computer terminals at Crestwood's Keene, North Dakota facility approximately every twenty minutes.
- Decreased maximum operating pressures.
- Evaluated the impact of decreasing maximum allowable operating pressures.
- Retained a nationally known consultant to assess the extent of hypothetical produced water incidents to prioritize potential mitigation efforts.
- Retained a nationally known engineering firm to prepare a conceptual water balance model and fate assessment to evaluate the movement and distribution of produced water associated with the Incident.
- Continued quarterly soil and chloride sampling at established locations along the flow path.

Figure 2.2-1 provides a general timeline of events including various response and remediation activities.

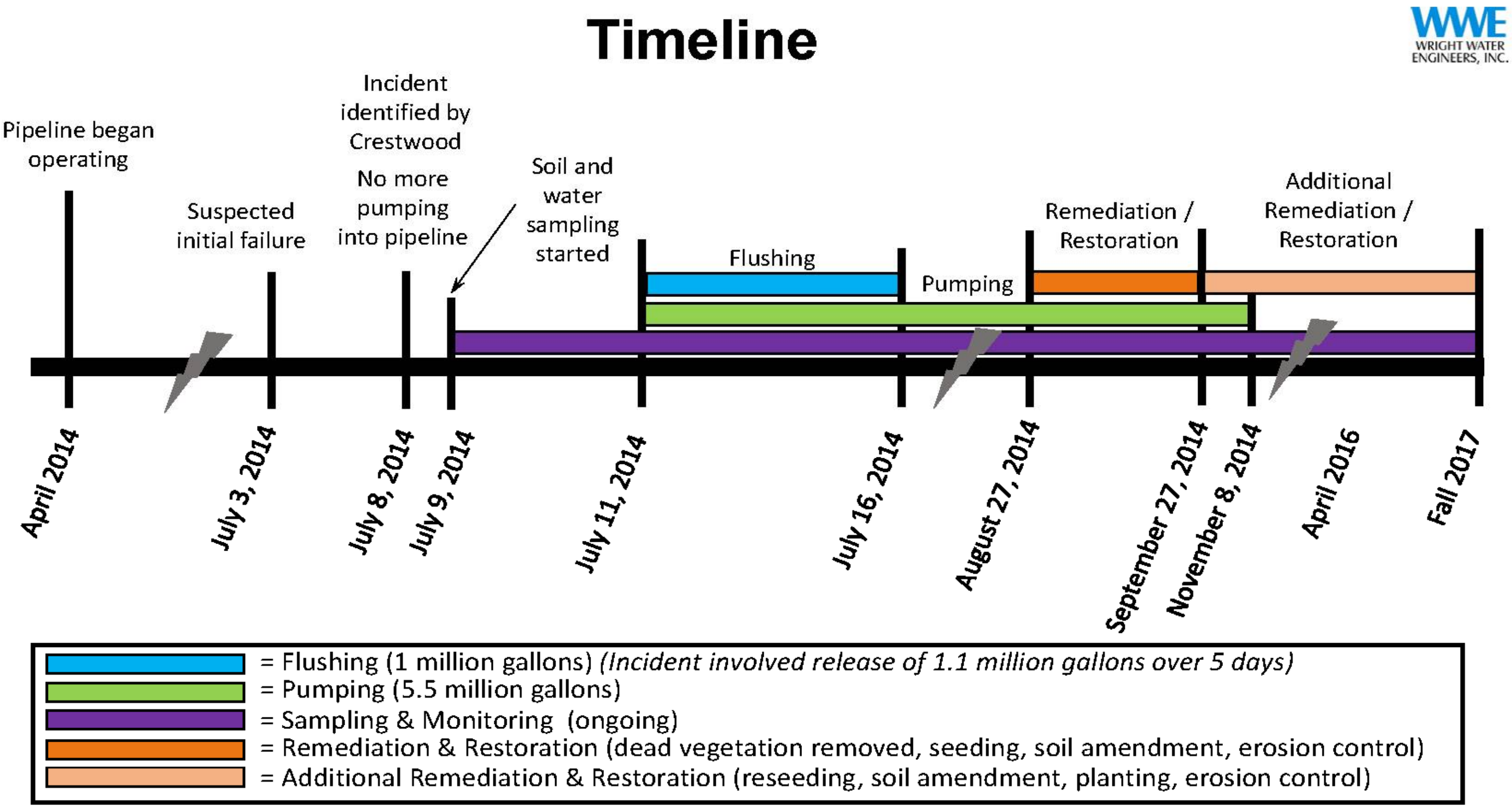


Figure 2.2-1 Timeline of Events- Crestwood July 2014 Phase 1A Pipeline Incident

2.2.2 Sampling Locations

From July 9 through October 2014, soil and water samples were collected from nearly 30 locations along the flow path associated with the Incident. Thereafter, soil and water samples have been collected quarterly from more than 20 locations as shown on Exhibit A. Samples have been analyzed for multiple parameters with particular focus on chloride, consistent with applicable guidance documents.

2.2.3 Data Collected

Surface water samples have been collected from locations within the unnamed drainage, Bear Den Bay and Lake Sakakawea with emphasis on pH, EC, chloride, calcium, and nitrates. Soil samples, originally collected to a depth of 18 inches, and most recently to 60 inches in some places, have also focused on chloride levels to monitor the natural attenuation process. Other constituents analyzed in soil samples included pH, sodium adsorption ratio (SAR) and calcium.

Laboratory results from surface water samples obtained by Crestwood found chloride levels following the Incident ranged from a high of 76,500 mg/L at the S5 – Tree Pond location to as low of 74.2 mg/L at the S16 location within Bear Den Bay (see Figure 3.2.1-1). Laboratory results from samples obtained on July 20, 2016 show chloride levels between 10,400 mg/L at the S5 - Tree Pond location and 8.4 mg/L at Bear Den Bay (Bay location). The Mandaree drinking water intake location on Lake Sakakawea was sampled more than 50 times with a maximum recorded chloride level of 12.9 mg/L on August 2, 2014.

In addition to the samples collected and laboratory data obtained, several site visits of the area subject to the Incident have been performed by multiple entities and stakeholders, including, but not limited to: (i) Crestwood representative and WWE staff on August 14, 2015; (ii) EPA personnel on October 19-23, 2015; and (iii) WWE staff, EPA personnel, and Crestwood representatives on September 20, 2016. Early laboratory data was also discussed and evaluated during a meeting in Lakewood, Colorado on January 22, 2016, and attended by representatives from: (i) Crestwood; (ii) EPA; (iii) the MHA Nation; (iv) U.S. Department of the Interior, Bureau of Indian Affairs (“BIA”); and (v) U.S. Army Corps. of Engineers (“USACE”). More detailed laboratory data, and certain aspects of this Plan were also discussed during a Technical

Stakeholder Meeting in Bismarck, North Dakota, on September 19, 2016, and attended by representatives from: (i) Crestwood; (ii) EPA; (iii) the MHA Nation; (iv) BIA; and (v) USACE.

2.3 Existing Keitu Monitoring and Sampling Plan

Shortly after identification of the Incident, Crestwood hired Keitu to assist in the initial response (including sampling and monitoring) and later to develop a remediation and sampling plan for the Incident area. This Plan has been the roadmap for ongoing sampling and monitoring activities since May 2015, and includes quarterly activities through Fall 2017. This Plan entitled *Phase 1A Brine Gathering System Incident Remediation Status Report*, and dated June 2015, provides details regarding the initial response, and subsequent implementation of a sampling program. A summary of these activities is provided at the beginning of Section 2.2.

2.4 Regulatory Guidance

Federal regulatory guidance for surface water quality is provided by EPA through the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA). Under the CWA, the EPA sets both mandatory standards and recommended guidelines for the discharge of pollutants into waters of the U.S. and, under the SDWA, sets standards for drinking water quality to ensure human health and safety. EPA water quality criteria apply to the unnamed creek associated with the Incident, which is located within the exterior boundaries of the Fort Berthold Indian Reservation, North Dakota.

In North Dakota, regulatory guidance for discharges to surface water is provided by the *Standards of Quality for Waters of the State* (SQW), which use both the CWA and SDWA as guidance (State Administrative Code, Chapter 33-16-02.1). The SQW establishes contaminant limits based upon a water body's use classifications (see Section 2.4.1), and State policy is to maintain or improve the quality of the waters of the State and to protect existing uses. The SQW contaminant limits have been set at levels that are consistent with the protection of public health and environmental resources including resident fish, wildlife and all other biota. Reasonable methods are required to be used to control and prevent pollution of State waters.

The State of North Dakota has produced two guidance documents specific to the assessment and remediation of saltwater/hydrocarbon releases. One guidance document is specific to saltwater/hydrocarbon impacts to soil, and the second guidance document is specific to the assessment and cleanup of areas impacts by a saltwater release. Section 2.4.2 provides additional details regarding these documents.

2.4.1 Stream Classifications

North Dakota beneficial use classifications are generally defined by both quality requirements for the intended uses (i.e., drinking water, recreation, aquatic life, irrigation, stock watering, etc.) and the frequency of flow within a stream (Table 2.4.1-1). The aquatic life criteria are the same for all classes of streams, and the human health value for Class I, IA, and II streams is higher than for Class III streams because the former are potential drinking water sources and the latter has health values specified only for physical contact (not ingestion). Maximum contaminant limits vary depending on the stream class only for a small number of constituents including chlorides, sodium, sulfate and pH. North Dakota's beneficial use classification for a Class I stream is applicable to Lake Sakakawea, which is a transboundary water.

Table 2.4.1-1 North Dakota Stream Classifications

Stream Class	Class Description/Designated Uses
I	Suitable for the propagation or protection, or both, of resident fish species and other aquatic biota and for swimming, boating, other water recreation, irrigation, stock watering and wildlife without injurious effects. After treatment, the water quality shall meet requirements of the department for municipal or domestic use.

(§§ 33-16-02.1, 2001)

Lake Sakakawea is considered a Class I stream. Table 2.4.1-2 summarizes standards of interest for Class I streams.

Table 2.4.1-2 North Dakota Class I Stream Standards of Interest

Requirements of Use Classifications for Lake Sakakawea

	Lake Sakakawea		
Beneficial Use Classification	Class 1 Lakes/Reservoirs		
Description	Cold water fishery. Waters capable of supporting growth of cold water fish species (e.g. salmonids) and associated aquatic biota.		
Numeric Standard	The beneficial uses and parameter limitations designated for Class I streams apply to all classified lakes/reservoirs (standards can be revised for a specific parameter with background studies/information). Lakes/reservoirs should be suitable for the propagation or protection, or both, of resident fish species and other aquatic biota, swimming, boating, other water recreation, irrigation, stock watering, and wildlife. After treatment, water quality shall meet requirements for municipal or domestic use.		
Pollutants	**Aquatic Life Value**		**Human Health Value (ug/L) [4]**
Chlorides (total)	100 mg/L (30-day arithmetic average)		
Sulfates (as SO_4)	250 mg/L (30-day arithmetic average)		
	Acute (ug/L)	**Chronic (ug/L)**	
Cadmium	2.1 [1,2]	0.27 [1,2]	5 [3]
Chromium (III)	1800 [1,2]	86 [1,2]	100 (total) [3]
Chromium (VI)	16	11	100 (total) [3]
Copper	14 [1,2]	9.3 [1,2]	1000
Lead	82 [1]	3.2 [1]	15 [3]
Mercury	1.7	0.012	0.050
Nickel	470 [1,2]	52 [1,2]	100
Selenium	20	5	50 [3]
Silver	3.8 [1,2]		
Zinc	120 [1,2]	120 [1,2]	7,400
Benzene			2.2
Toluene			1,000 [3]
Ethylbenzene			530
Xylene			10,000 [3]

[1] Hardness dependent criteria. Value given is an example only and is based on a CaCO3 hardness of 100 mg/L. Criteria for each case must be calculated using the following formula:

For the Criterion Maximum Concentration (CMC):
Cadmium CMC = $e^{(1.0166[\ln (hardness)] - 3.9240)}$
Chromum (III) CMC = $e^{(0.8190[\ln (hardness)] +3.7256)}$
Copper CMC = $e^{(0.9422[\ln (hardness)] - 1.7000)}$
Lead CMC = $e^{(1.2730[\ln (hardness)] - 1.4600)}$
Nickel CMC = $e^{(0.8460[\ln (hardness)] +2.2550)}$
Silver CMC = $e^{(1.7200[\ln (hardness)] - 6.5900)}$
Zinc CMC = $e^{(0.8473[\ln (hardness)] +0.8840)}$

CMC = Criterion Continuous Concentration (acute exposure value)
The threshold value at or below which there should be no unacceptable effects to freshwater aquatic organisms and their uses if the one-hour concentration does not exceed that CMC value more than once every three years on the average.

For the Criterion Continuous Concentration (CCC):

Cadmium CMC = $e^{(0.7409[\ln (hardness)] - 4.7190)}$
Chromium (III) CMC = $e^{(0.8190[\ln (hardness)] +0.6848)}$
Copper CMC = $e^{(0.8545[\ln (hardness)] - 1.7020)}$
Lead CMC = e($^{1.2730[\ln (hardness)] - 4.7050)}$
Nickel CMC = $e^{(0.8460[\ln (hardness)] +0.0584)}$
Silver No CCC criterion for silver
Zinc CMC = $e^{(0.8473[\ln (hardness)] +0.8840)}$

CCC = Criterion Continuous Concentration (chronic exposure value)
The threshold value at or below which there should be no unacceptable effects to freshwater aquatic organisms and their uses if the four-day concentration does not exceed that CCC value more than once every three years on the average.

[2] Hardness values shall be no greater than 400 mg/L. For waters with hardness concentrations greater than 400 mg/L. The actual ambient hardness may be used where a site-specific water effect ratio has been determined consistent with the Environmental Protection Agency's water effect ratio procedure.

[3] Safe Drinking Water Act (MCL).

[4] Based on two routes of exposure - Ingestion of contaminated aquatic organisms and drinking water.

2.4.2 Lake/Reservoir Classifications

North Dakota also distinguishes five different classifications of lakes and reservoirs within the beneficial uses and parameter limits designated for Class I streams. Therefore, contaminant limits in all of North Dakota's classified lakes and reservoirs, including Lake Sakakawea, are the same. Table 2.4.1-2 summarizes standards of interest for Class I lakes and reservoirs in general, and Lake Sakakawea specifically.

2.4.3 Remediation Guidelines

Two documents have been developed by North Dakota state agencies as guides for the remediation of areas impacted by a saltwater/hydrocarbon release. The first is a September 2016 report by the North Dakota Department of Health (NDDoH), Environmental Health Section, entitled *Guidelines for the Assessment and Cleanup of Saltwater Releases*. This report focuses on the initial Incident response, how to perform a site assessment, steps to evaluate potential remediation options, and monitoring and reporting. It was prepared with a focus on mitigation of sodium and chloride; however, total petroleum hydrocarbons (TPH) are also addressed, as hydrocarbons may potentially be present in produced water releases. This document primarily provides guidance on monitoring and does not describe remediation processes.

The second guidance document, distributed by the North Dakota Industrial Commission (NDIC), is *A Guide for Remediation of Salt/Hydrocarbon Impacted Soil*. This is primarily a field guide that provides specific technical guidance regarding the restoration of spill-impacted soil and does not include guidance on spill cleanup standards.

2.5 Conceptual Water Balance Model

In November 2015, Crestwood retained Wright Water Engineers, Inc. (WWE) to develop a conceptual model to assess the fate of produced water associated with the Incident, including the nature of storage and infiltration along the Incident flow path. One aspect of particular interest was the distribution of the fluids along the flow path. The model was created using information from aerial maps of the Incident area, reports from personnel that were present in the weeks following the Incident, and measured concentrations of chloride in samples obtained soon after the Incident. The time period represented by the model begins on July 3, 2014, (the initial day of the Incident), and continues through July 9, 2014 (the day samples were first collected). This model is conceptual in nature and does not account for the fate of the chloride after flushing and pumping, which began on July 11, 2014.

A volumetric and chloride mass balance approach was employed to model the fate of the dissolved chloride in the fluid. The distribution of fluids was considered to include: 1) soils beneath the flow path from the point of the pipe failure to the unnamed creek (S6 – Coulee Start); 2) ponded fluids along Turnuey Ridge Road that were hauled away during the initial hours of clean up; 3) soils along the unnamed creek channel both above and below the beaver dams; 4) the beaver ponds; 5) surface water flow; 6) the evaporation from surface water features; and 7) Lake Sakakawea. Two chloride concentration calibration points were used in this conceptual model. The first was at Dam 1, representing the concentration in water detained in the lower most downstream beaver pond and pumped offsite for disposal. The second was at the Creek to Bay monitoring station representing the concentration in water that continued downstream in the unnamed creek and into Lake Sakakawea.

Numerous parameters were needed as inputs to the model for the 7-day period. Actual field data for many of these parameters were not available; therefore, values were assumed based on judgment and experience. The geometry of the affected area was established using Keitu's initial field work transferred into an electronic format using GIS. Various flow path reaches were given designations of "A" through "E" as shown on Exhibit A. Soils information was assumed based on typical parameters for the region, and precipitation data was extrapolated based on published records from a weather station at Keene (approximately 15 miles away). Other input parameter assumptions and rationale are summarized in Table 2.5-1.

Table 2.5-1 Assumptions and Rationale for Input Parameters for the Components of the Conceptual Water Balance and Chloride Mass Balance Model

Component of Water Balance	Rationale and Assumptions
Incident Volume	Provided in Keitu Report.
Chloride Concentration of Incident	From typical produced water data.
Fluid that ponded along Turnuey Ridge Road and was initially pumped to tanks for offsite disposal	A 17,000 ft^2 area was delineated on map based on first-hand observations and assumed to have a depth of 0.5 ft. This entire volume was assumed to have been disposed of offsite.
Infiltration in areas A, B, C and E	The surface area of areas A, B, C and E is 143,900 ft^2. Assumed a 5-foot infiltration depth and 15% void space.
Base flow from 750 acre watershed above the Incident point into the unnamed drainage	Assumes 13,000 gallons per day of chloride-free water flowing in drainage channel based on average surface flow observations by Keitu.
Infiltration between S6-Coulee Start and the beaver ponds	18,000 ft^2 with 0.3 inch per hour infiltration rate.
Water that entered the beaver ponds	Total Incident volume minus volume pumped and disposed offsite and volume lost to infiltration above beaver ponds.
Storage (constant throughout time period)	Product of delineated surface area of beaver ponds and their assumed depths.
Water leaving beaver ponds Dam 1.	Water that enters the beaver pond minus water that evaporates and infiltrates out of the beaver ponds.
Evaporation	2 inches over 36,500 ft^2. Method used to calculate evaporation was TR-34 for Williston, ND.
Infiltration beneath the beaver ponds	36,500 ft^2 with 0.1 inch per hour infiltration rate.
Infiltration between the beaver ponds and Lake Sakakawea	20,000 ft^2 with 0.3 inch per hour infiltration rate.
Water entering Lake Sakakawea	Volume of water leaving the beaver ponds minus the volume of water infiltrated in stream channel below the beaver ponds.

Input and output information specific to the Volumetric and Chloride Mass Balance Model are visually represented in Figure 2.5-1. This figure, in conjunction with Table 2.5-2, represents key aspects of the hydrologic mass balance model and the corresponding chloride concentration and distribution of fluids. Specific components in the model (labeled A through J) are described in Table 2.5-2

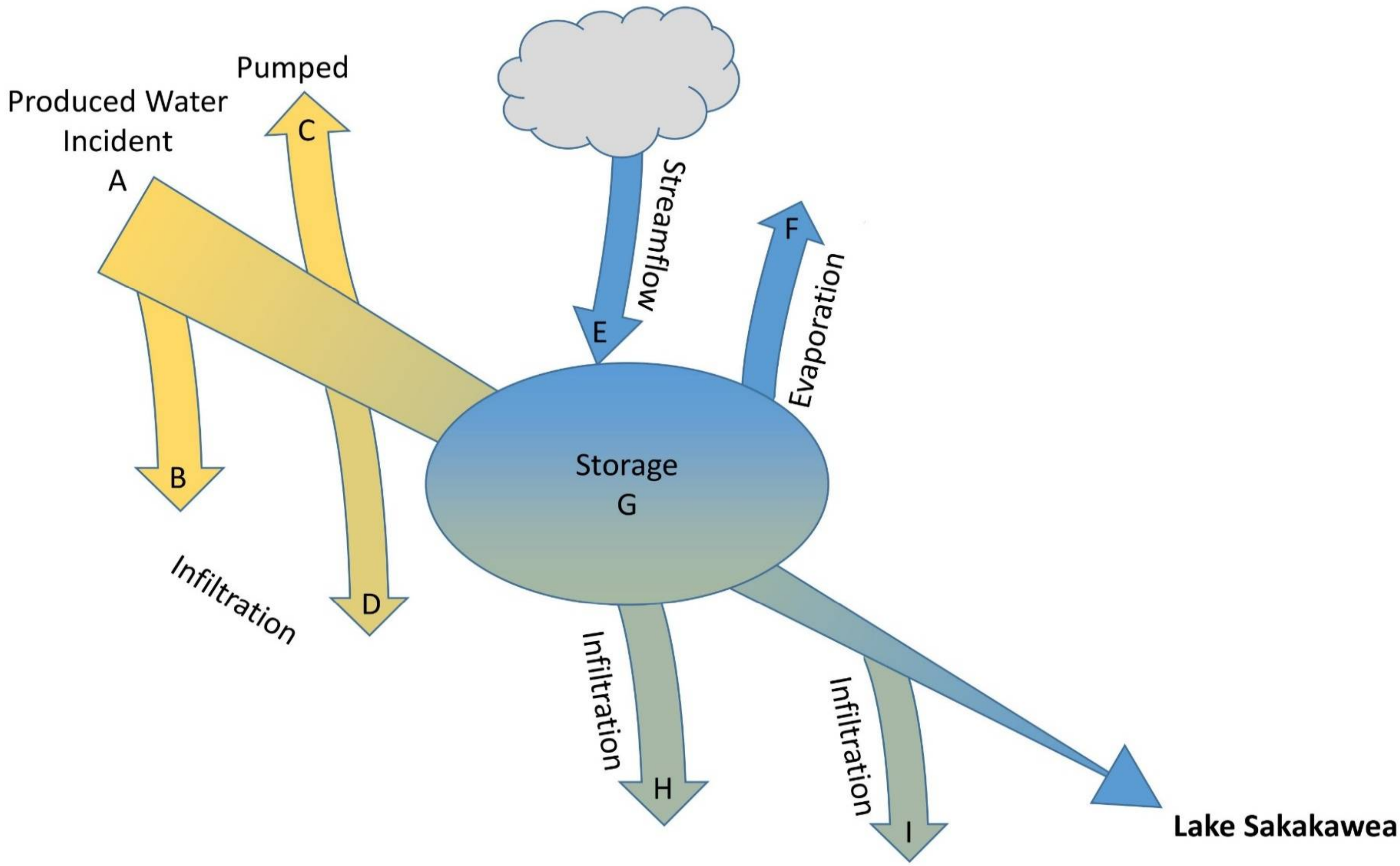


Figure 2.5-1 Conceptual Diagram of Inputs and Outputs to Volumetric and Chloride Mass Balance Model for July 3 to July 9, 2014

Table 2.5-2 provides a summary of the results from the conceptual model. The model shows that the largest proportion (74%) of the Incident fluids (and chloride mass) infiltrated into the soils up-gradient of the S6 – Coulee Start station. Per the conceptual model, 6% of the Incident fluid was removed from the system via pumping from surface ponding along Turnuey Ridge Road and about 10% was retained in the beaver ponds. An additional 9% of the Incident fluid infiltrated into soils along the unnamed drainage both above and below the beaver ponds. The remaining chloride, approximately 1% of the Incident volume, reached Lake Sakakawea at Bear Den Bay.

Table 2.5-2 Results from Volumetric and Chloride Mass Balance Conceptual Model

		Volume (MG)	**Concentration (mg/L)**	**Fate of Chloride on July 9 (bbls)**	**Percent of Produced Water**
A	Produced Water (26,000 bbls)	1.1	87,600	—	—
B	Infiltration above S6 – Coulee Start	0.81	87,600	19,220	74%
C	Pumped out from ponding above Turnuey Ridge Road	0.06	87,600	1,510	6%
D	Infiltration in channel between S6-Coulee Start and the beaver ponds	0.08	62,000	1,280	5%
E	Streamflow	0.09	0	0	
F	Evaporation	0.04	0	0	
G	Storage	0.36	0	2,610	10%
H,I	Infiltration downstream and beneath beaver ponds	0.14	26,600	980	4%
J	**Entering Lake Sakakawea**	**0.06**	**26,600**	**250**	**~1%**

3.0 SAMPLING, MONITORING AND MITIGATION PLAN

This section of the report discusses sampling and monitoring to be performed at previously-established and future locations for groundwater, perched water, surface water, soils and vegetation as represented in Exhibit A. Each of the sampling areas are addressed individually and include a discussion of physical location; parameters to be analyzed; sampling frequency and duration; and the equipment needed to obtain the samples. With respect to two surface water sampling locations, and as appropriate, this section addresses specific goals and objectives; and mitigation and/or restoration procedures.

3.1 Perched Water and Groundwater

For purposes of this Plan "groundwater" is considered any water source located below the top of the consolidated geologic strata or bedrock (i.e., within the Sentinel Butte Formation or the underlying Tongue River Formation), and not perched water sources located above the bedrock. This Plan contemplates that perched water is that water found below the ground surface but above the Sentinel Butte Formation bedrock surface. This perched water is transient and of insufficient quantity and reliability to be used for drinking water or other uses. Groundwater within the Sentinel Butte Formation is also limited as a reliable source for domestic and irrigation uses, particularly in the subject area. As a result, the only known reliable groundwater supply for beneficial uses is from the regional aquifer within the Tongue River Formation located at or below the fluctuating elevation of Lake Sakakawea, and not from perched water found above the bedrock surface or the Sentinel Butte Formation.

As of the date of EPA's approval of the Consent Order, no groundwater or perched water sampling locations have been established in the unnamed drainage or along the Incident flow path. Conceptual water balance modeling by WWE suggests that a large percentage of the Incident fluids are located in the unconsolidated materials beneath the fluid flow path (likely as perched water) between the point of the pipe failure and the unnamed drainage channel. EPA and Crestwood have identified locations for five monitoring wells to assess groundwater and perched water conditions (see Exhibit A and Figure 3.1.1-1). Specific details about the sampling and monitoring program associated with the five monitoring wells are provided below.

3.1.1 Physical Locations

The purpose of the monitoring wells is to characterize the near surface hydrogeology, groundwater and perched water chemistry, and the potential nexus between perched water, groundwater, the unnamed creek, and Lake Sakakawea, if any.

Two of the monitoring wells (GW-1 and GW-2) will monitor both the perched water above the bedrock surface and the groundwater located within the upper portion of the bedrock strata. Three additional monitoring wells (PW-1, PW-2 and PW-3) are to be completed above the bedrock surface to assess perched water conditions only. These three wells are located along the ravine connecting Turnuey Ridge Road with the unnamed drainage.

Monitoring wells GW-1 and GW-2 are a pair of monitoring wells. Each pair will include: (i) one well completed to the top of the bedrock surface to assess perched water conditions; and (ii) a second well that penetrates the bedrock and monitors groundwater. This pair of monitoring wells will be used to assess whether perched water is located above the bedrock, and to what degree it may be migrating vertically. This Plan expects to confirm that there is no vertical migration between the perched water above the bedrock surface, and the groundwater within the Sentinel Butte Formation and/or the underlying Tongue River Formation.

As shown on Figure 3.1.1-1, the two monitoring well pairs will be located northwest of Turnuey Ridge Road on relatively flat ground before the topography drops off to the northwest into the unnamed drainage. Assuming ready access to these locations, the following key elements of the two monitoring well pairs are anticipated (see Figure 3.1.1-2):

- Drilling method—auger or other mechanism as necessary. Construction should exclude or limit the use of fluids downhole if possible.

- Drilled Depth—to be determined based on the first bedrock surface encountered. It is anticipated that one of each well pair will be completed at or immediately above the bedrock surface to monitor perched water conditions, and quality within the unconsolidated materials above the bedrock surface. The second of each well pair will be completed at a greater depth. The second of each well pair will be completed when:

- Saturated materials are encountered within the first 20 feet below the bedrock surface to assess groundwater conditions and obtain samples for chemical analysis; or

- 20 feet of continuous unsaturated bedrock materials, including but not limited to fine-grained materials such as claystone, siltstone or shale, are encountered below the bedrock surface; thereby, indicating the lack of a direct hydrologic connection between the perched water in the unconsolidated materials and the groundwater.

Each of the paired wells will be independent of the other to ensure that there is no manmade hydrologic connection.

- Lithology — Lithologic information is to be observed and logged by a professional geologist capable of identifying characteristics such as material type, grain size, color, plasticity, relative permeability, moisture content, etc. It will be important to develop a vertical profile of materials encountered at each location.

- Borehole/Casing diameter and type—The borehole diameter will be selected to allow for the placement of at least 4-inch inside diameter (I.D.) casing as needed for installation of a water level monitoring device and water quality sampling equipment. Selected casing is to be factory perforated PVC with 0.010-inch openings (10-slot) in the saturated interval only. The remainder of the casing will be without perforations and of similar diameter. The entire casing string is to extend three feet above the surface and be topped with a removable cap.

- Annular space—the area between the casing and borehole wall is to be filled with select #10/20 gravel pack comprised of silica sand to a height approximately one foot above the screened interval. The remainder of the annular space will be filled with a neat cement grout to the surface and mounded around the casing and steel surface enclosure so as to prevent surface water from flowing toward or into the monitoring well.

- Enclosure—a steel surface enclosure will be installed around each PVC casing as a protection. Each enclosure will include a hinged and lockable cap, and will be seated in cement.

As shown on Figure 3.1.1-1, three perched water monitoring wells will be located within the ravine between Turnuey Ridge Road and the unnamed drainages. The steep topography of the westernmost location may make it difficult to allow access for a drilling rig. As a result, these wells will be shallow (approximately less than 10 to 15 feet, or where the first saturation zone is encountered) and installed using a push method or by hand auger. Assuming ready access, the following key construction elements are anticipated (see Figure 3.1.1-3):

- Drilling method—Hand auger or direct push or track mounted push probe. Construction methods should exclude the use of fluids if at all possible.

- Drilled depth—Ten to 15 feet (to be determined based on conditions of the unconsolidated materials, existing perched water, and underlying bedrock surface as identified according to drilling difficulty and cutting evaluation). The well depths should not be deeper than the bedrock surface under any conditions.

- Borehole diameter—Four inches to allow for the installation of 2-inch I.D. prepacked screen and casing.

- Casing diameter and type—Two-inch I.D. screen (prepacked with filter material) and casing to allow for installation of a water level monitoring device and sampling equipment. The prepacked screen is to be factory perforated PVC with 0.010-inch openings (10-slot) in the saturated interval only. The remainder of the casing will be of the same diameter but without perforations and prepacked filter material. The entire casing string is to extend to three feet above the surface and be topped with a removable cap.

- Annular space—The area between the casing and borehole wall will be filled with #20/40 sand included with the prepacked screen. The remainder of the annular space above the screened interval will be filled with a neat cement grout and mounded around the casing and steel surface enclosure so as to prevent surface water from flowing toward or into the monitoring well.

- Enclosure—A steel surface enclosure, as considered appropriate, will be installed around the PVC casing as a protection. Each enclosure will include a hinged and lockable cap, and will be seated in cement.
- Lithology—Lithologic information is to be observed and logged by a professional geologist capable of identifying characteristics such as material type, grain size, color, plasticity, relative permeability, moisture content, etc. It will be important to develop a vertical profile of materials encountered at each location.

Each of the five monitoring wells (i.e., GW-1, GW-2, PW-1, PW-2 and PW-3) is to be surveyed relative to a common datum and geographic location (i.e., latitude and longitude) such that an elevation above mean sea level can be associated with both ground surface and top of casing. All subsequent measurements regarding the depth to water at these locations are to be designated relative to a specified measurement point (i.e., ground surface or top of casing) and the established surveyed elevations and geographic coordinates.

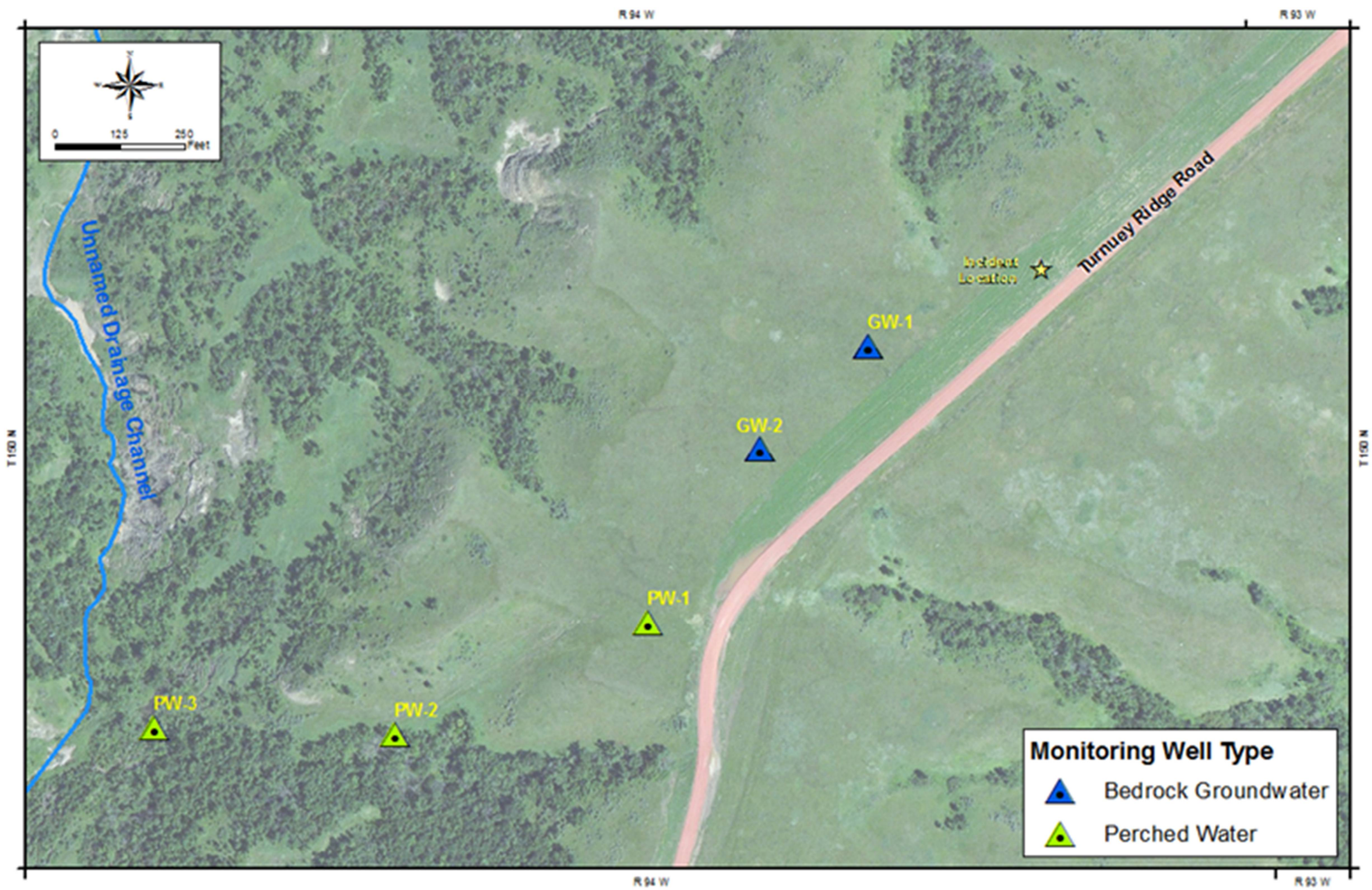
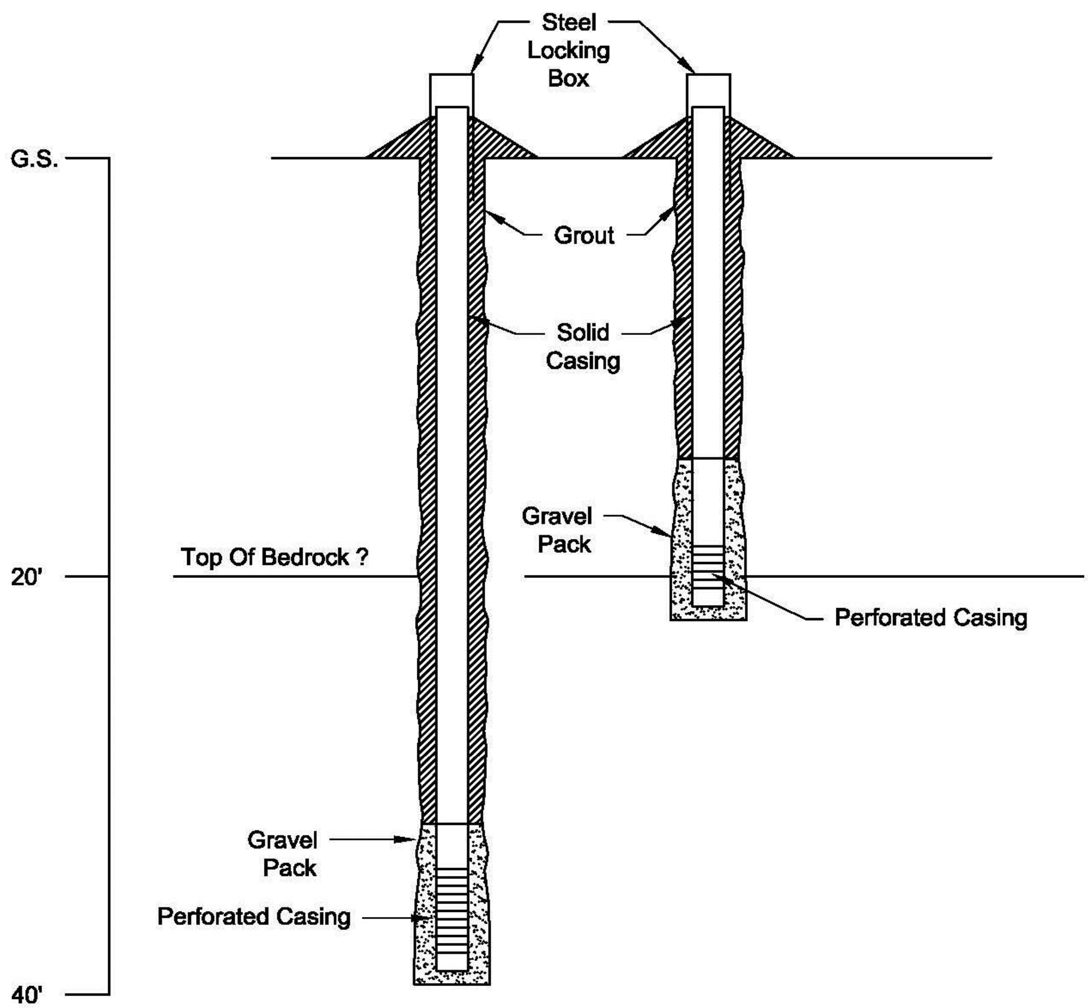


Figure 3.1.1-1 Proposed Monitoring Well Locations

Figure 3.1.1-2 Proposed Paired Bedrock Groundwater Monitoring Well Schematic



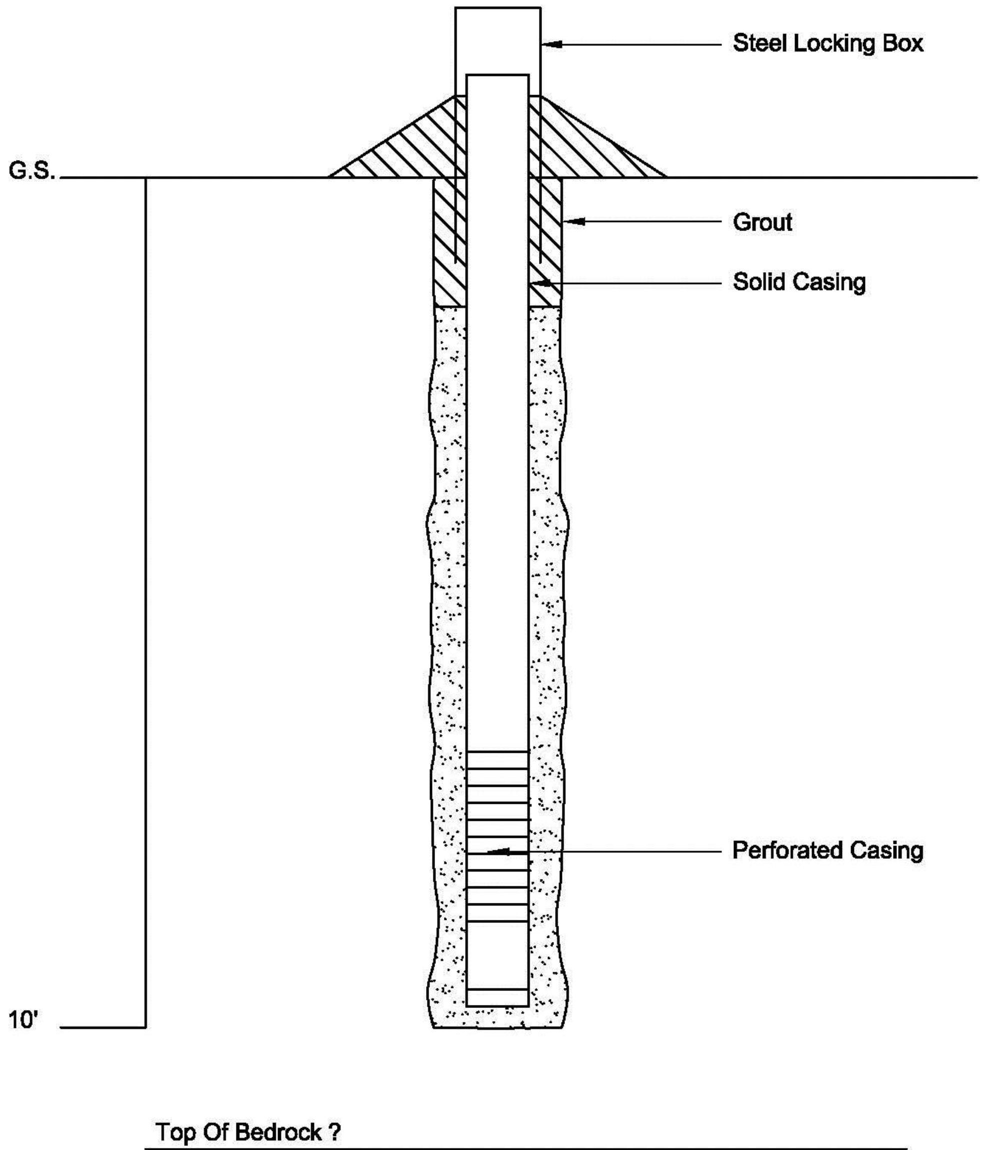


Figure 3.1.1-3 Proposed Perched Water Monitoring Well Schematic

3.1.2 Chemical Analysis

Each of the monitoring wells is to be sampled on a monthly basis for the first year. Winter sampling may be difficult due to access, but efforts will be made to obtain no less than four samples during the first calendar year after the monitoring wells are fully installed and capable of procuring appropriate samples. Thereafter, Crestwood may seek approval from EPA as appropriate for a reduction in monitoring frequency and/or parameters to be analyzed after assessment of the first-year laboratory results (see also Section 3.1.3). Samples obtained from each of the five monitoring wells will be submitted to a qualified water quality laboratory for the following parameters:

pH (field measurement)	Gross alpha and gross beta (additional parameters if needed)[2]
EC (field measurement)	Diesel Range Organics (DRO)
Temperature (field measurement)	Mercury
Chloride	Barium
Nitrates	Copper
Calcium	Arsenic
Sodium	Lead
Magnesium	Thallium
BTEX (benzene, toluene, ethylbenzene and xylene)	Gasoline Range Organics (GRO)
Zinc	Beryllium
Chromium	Selenium
Bromide	Boron

[2] Crestwood will obtain a gross alpha and gross beta sample at each monitoring well during the first monthly sampling event. In the event the initial laboratory results for gross alpha are above 15 pCi/L, Crestwood will obtain another sample within the first year of this Plan for laboratory analysis of Radium 226 and 228. Likewise, if the initial laboratory results for gross beta are above 50 pCi/L, Crestwood will obtain another sample within the first year for beta emitter speciation. Gross alpha and gross beta laboratory results generally include both a: (i) reported value; and (ii) margin in the form of a plus (+) or minus (-) value. For purposes of this Plan, the reported value, not the reported value as potentially modified by the margin, shall be the laboratory result applicable to the gross alpha threshold set forth herein. For example, if Crestwood obtains a 7 pCi/L laboratory result for gross alpha with a margin of (+/-) 2, the value applicable to this Plan shall be the reported value of seven (7), and not the reported value plus (+) or minus (-) the margin. If initial laboratory results for gross alpha and gross beta do not exceed 15 pCi/L for gross alpha or 50 pCi/L for gross beta, Crestwood may discontinue gross alpha or gross beta sampling.

Sampling should be performed in accordance with protocols established by the EPA, U.S. Geological Survey (USGS), and/or the American Society for Testing and Materials (ASTM). Quality assurance and chain-of-custody protocols should be followed in accordance with the Quality Assurance Project Plan of this report (see Section 4.0).

3.1.3 Sampling Duration and Frequency

Sampling for the parameters outlined in Section 3.1.2 will be conducted monthly. Winter sampling may be difficult due to access, but efforts will be made to obtain no less than four samples during the first calendar year after the monitoring wells are fully installed and capable of procuring appropriate samples.

3.1.4 First Year Goals and Objectives

In late 2016, Crestwood attempted to determine the depth of the bedrock surface underlying the S5 – Tree Pond surface water sampling location. Utilizing a hand auger, Crestwood drilled a borehole in close proximity to the S5 – Tree Pond surface water sampling location. Crestwood's borehole reached a total depth of approximately twelve (12) feet, and no bedrock surface was encountered. Crestwood ceased drilling to greater depths because the borehole became unstable. This leads Crestwood to believe that the bedrock surface underlying the S5 – Tree Pond is at least ten (10) feet below the bottom of the S5 – Tree Pond surface water, which is approximately three (3) feet deep.

Beginning in February 2017, Crestwood will begin to seek a temporary easement from the MHA Nation and the BIA authorizing Crestwood to locate, drill, and complete the five monitoring wells described in Section 3.1.1 herein. Crestwood will take all reasonable efforts to have the five monitoring wells fully installed and capable of procuring samples no later than May 30, 2017. EPA understands and agrees that Crestwood's ability to locate the five proposed monitoring wells is outside of Crestwood's control and subject to the MHA Nation's and BIA's approval. In the event action or inaction by the MHA Nation or BIA prohibits Crestwood from completing installation of the five monitoring wells by May 30, 2017, Crestwood shall either seek an extension of the timeframes from the EPA or notice the EPA of a force majeure event, and adhere to the process according to Section XII of the Consent Order to prevent violation of this Plan or the Consent Order.

After Crestwood has installed the five monitoring wells, Crestwood shall seek a longer duration and non-temporary easement from the MHA Nation and BIA for the five monitoring wells, and Crestwood's ingress and egress to the same. Crestwood will take all reasonable efforts to obtain an extended-duration easement no later than December 31, 2017. In the event Crestwood is not able to obtain an extended-duration easement from the MHA Nation and/or BIA within the agreed-upon timeframe, Crestwood shall either seek an extension of the timeframe from the EPA, or notify the EPA of a force majeure event and adhere to the process according to Section XII of the Consent Order to prevent violation of this Plan or the Consent Order.

No later than May 30, 2017, Crestwood shall install best management practices around the S5 – Tree Pond to prevent surface water from entering. Should a force majeure event delay or negate the installation of best management practices, Crestwood shall notify the EPA of a force majeure event and adhere to the process according to Section XII of the Consent Order to prevent violation of this Plan or the Consent Order. EPA acknowledges that best management practices cannot prevent all water from exiting the S5 – Tree Pond. Crestwood's obligation shall be to install and maintain best management practices, and to prevent water from entering the S5 – Tree Pond.

Prior to December 31, 2017, and upon evaluation of the data obtained from the first year of perched water and groundwater sampling, Crestwood will provide a recommendation for future sampling frequency with clearly defined goals and objectives. If approved by EPA, Crestwood may choose to install additional monitoring wells should Crestwood believe the data collected at the five proposed locations during the first-year warrants further investigation.

3.1.5 Future Mitigation and/or Restoration Plan

Not later than January 31, 2018, Crestwood shall submit a subsequent report and future recommendations to EPA summarizing: (i) the laboratory results of Crestwood's monitoring; (ii) Crestwood's efforts to characterize the extent of fluids associated with the Incident in the subsurface; (iii) the direction of fluid movement within the soils and larger drainage; and (iv) the associated implications (the "Future Plan"). Crestwood's proposed Future Plan, if appropriate and scientifically warranted based on Crestwood's evaluation of the first year of monitoring results, will include any proposed mitigation and/or restoration, as well as any necessary or warranted mitigation and/or restoration of the S5 – Tree Pond. In the event any mitigation and/or restoration of the groundwater or S5 – Tree Pond is scientifically warranted based on Crestwood's evaluation of the first year of monitoring results, Crestwood will take all reasonable efforts to implement the mitigation and/or restoration proposed in the Future Plan no later than May 30, 2018. Crestwood's ability to implement any necessary and warranted mitigation and/or restoration is subject to the MHA Nation and BIA's approval. In the event Crestwood cannot obtain the MHA Nation's or BIA's approval, Crestwood shall either seek an extension of the timeframes from the EPA or notify the EPA of a force majeure event and adhere to the process according to Section XII of the Consent Order to prevent violation of this Plan or the Consent Order.

Crestwood shall not implement the proposed Future Plan without EPA's concurrence and approval.

3.1.6 Monitoring Equipment

Equipment required for sampling of the monitoring wells may include low volume pumps, bailers and tubing to provide access to and removal of samples from below the surface. Such equipment should be appropriately decontaminated between each sampling event and to the degree possible. Equipment should be specifically dedicated to each well so as to eliminate the potential for cross-contamination. Other equipment needs will include the following:

EC meter	Keys for locking caps
pH meter	Data recording device[3]
Thermometer	Dedicated pumps, bailers and tubing for sample extraction
Sample bottles (appropriate for analytes to be	Power source if pumping equipment used

[3] At both GW-1 and GW-2 Crestwood shall install and monitor for the first year a water level logger, which records the perched water level at each location daily.

tested)	
Water level indicator	

3.2 Surface Water

Surface water sampling has occurred at numerous locations along the Incident flow path since July 9, 2014. This section of the report provides an explanation of where surface water samples have and will continue to be collected, along with the nature of the field and laboratory chemical analyses and related information. This is followed by sampling duration and frequency, as well as goals and objectives for two specific sampling locations. This section concludes with comments concerning the nature of the equipment necessary for surface water monitoring.

Please note that many of the topics typically addressed in surface water monitoring plans are covered in Section 4.0, QAPP. These topics include data quality objectives, elements of proper sample collection, quality control samples, split samples, interpretation of laboratory results, and others.

The proposed surface water monitoring program described below builds upon surface water samples collected since the Incident occurred in early July 2014 (the first surface water samples were collected on July 9–10, 2014), and was developed with consideration for field observations by Keitu, Crestwood and WWE staff, and conversations with EPA representatives who have also conducted site inspections of the Incident area. Surface water samples will continue to be collected at most of the monitoring stations that were established in early July 2014, but with the addition of field parameters (i.e., pH, EC, temperature and others), along with a recording Weather Station and water level loggers (alternatively referred to as water level sensors or pressure transducers) at three locations to better understand the hydrology of the roughly 800-acre watershed.

3.2.1 Physical Locations

As shown on Figure 3.2.1-1, and Exhibit A attached hereto, surface water samples will be collected at eleven locations identical to those established by Crestwood and Keitu in early July 2014. The original stations were retained for continuity, and to facilitate data evaluation over the entire sampling and monitoring period. The nomenclature of the stations has not changed, and proceeding from upstream to downstream, the surface water monitoring stations are as follows:

- BK1 – This background monitoring location is located at 47.78159°, -102.65263°.

- BK2 – This background monitoring location is located at 47.78249°, -102.65185°.

- S5 – Tree Pond—This surface water monitoring location is in an area of substantial ponding and infiltration of produced water. This is the uppermost location in the watershed where it is practical to collect a surface water sample. The approximate GPS coordinates of S5 - Tree Pond are 47.78261°, -102.65117°. Sampling information collected from this location since the Incident has consistently shown high chloride levels; although the chloride levels at this location have decreased since first sampled on July 10, 2014. As a result, and discussed in Section 3.1.4 herein, Crestwood shall install best management practices in an effort to prevent surface water from entering or escaping the confines of the larger S5 – Tree Pond water body.

- S6 – Coulee Start—This station represents the entry point of the produced water into the channelized flow of the unnamed drainage and is located approximately 300 feet downstream from the S5 - Tree Pond station. The approximate GPS coordinates of S6 – Coulee Start are 47.78299°, -102.65154°.

- S9 – Beaver Dam 1—This is the most upstream beaver pond in the unnamed drainage. Water quality samples will continue to be collected at this location, with the addition of a staff gage to be placed on the bank of the channel along with a water level logger that will provide real time water depth data in the channel. This addition will allow development of hydrographs (flow vs. time) for the S9 - Beaver Dam 1 sampling location. Coupled with rainfall data (see precipitation gage location on Exhibit A), this will provide a better hydrologic understanding of the watershed. The exact location of the staff gage and water level logger, secured to the channel bottom, will be determined in the field. The approximate GPS coordinates of S9 - Beaver Dam 1 are 47.78482°, -102.65168°.

- Creek 1—The Creek 1 monitoring station is located approximately midway along the beaver pond reach. The approximate GPS coordinates of Creek 1 are 47.78794°, -102.64986°.

- Dam 1a—This sampling location is in the lower reach of the beaver ponds. The approximate GPS coordinates of Dam 1a are 47.78998°, -102.64861°.

- Dam 1—This monitoring location is at the most downstream and largest beaver pond in the system. It is from this pond that water was pumped up to the Turnuey Ridge Road shortly after the Incident occurred. Water quality samples will continue to be collected at the same location with the addition of a staff gage and recording water level logger installed a short distance downstream where there is channelized flow, as a means to provide real time hydrologic data. The approximate coordinates of the Dam 1 sample collection station are 47.79055°, -102.64812°. The coordinates of the staff gage and water level logger will be determined in the field when the precise location is established.

- S11—This station is located approximately midway between the Dam 1 and Creek to Bay stations. The approximate GPS coordinates are 47.79326°, -102.64743°.

- Creek to Bay—This monitoring location is the most downstream location in the unnamed drainage channel upstream of Lake Sakakawea. This location is sufficiently upstream to ensure that the sample is representative of streamflow rather than water in Lake Sakakawea. Water quality samples will continue to be collected at this location with the addition of a staff gage and water level logger installed at either this exact location or a nearby location that is more conductive to water level monitoring. The approximate GPS coordinates of the sampling station are 47.79559°, -102.64702°. The precise GPS coordinates of the staff gage and level logger will be determined in the field after they are located.

- Lake 1—This station is intended to provide water quality data for the reservoir. This station will not be a fixed location. Instead, on every occasion when a sample is collected, the sampling team will measure a distance of approximately 10 feet from the mouth of the unnamed drainage channel streamflow into the reservoir, where the sample will be collected from approximately 1–2 feet beneath the water surface. The 10 feet distance is to be determined each time using a tape, rope or laser range finder device. A variable location is necessary because there are significant fluctuations in the lake level through the calendar year based on a multitude of factors. As a result, it is not feasible to specify fixed GPS coordinates for the Lake 1 station. However, coordinates shall be collected with a portable GPS unit every time the sample is collected. This sample should be collected manually by reaching into the water and opening the sampling container approximately 1–2 feet below the surface of the water.

To summarize, surface water samples will be collected at eleven stations, ten of which are in the unnamed drainage channel while the ninth (Lake 1), will be located approximately 10 feet into Lake Sakakawea. Three of the stations, S9 – Beaver Dam 1, Dam 1, and Creek to Bay will have flow monitoring capabilities including a staff gage (to be read manually during every sampling event) and a continuous, recording water level sensor (pressure transducer). Data from the water level sensors will be downloaded once a month when sampling occurs. Between observations of water levels of the staff gages and via the pressure transducers, hydrographs will be obtained for three different locations along the stream channel and analyzed in the context of rainfall data to be collected by a recording Weather Station located near Turnuey Ridge Road. Exact GPS locations of all of these locations will be determined in the field when the locations are established.

By sampling at eleven separate locations, including two separate background locations, and monitoring flow at three different locations, surface water quality and flow variation over the full length of the unnamed drainage affected by the Incident will be determined. As noted earlier, because the surface water monitoring stations are at or near locations originally established in July 2014, continuity in the water quality data record will be maintained. It will be feasible to determine if the downward trends evident at many of the surface water monitoring stations will continue. By gathering flow data, with sufficient time, it should be feasible to determine if there is a relationship between chloride concentrations and flows. For example, if prolonged wet periods cause chloride concentrations currently residing in the soils to migrate back to the channel, by having concurrent levels of chloride and flow, the chloride loading to the unnamed drainage channel and to Lake Sakakawea can be determined. In short, the stations described above will provide a comprehensive representation of water quality and streamflow variation in the affected watershed.

At all of the monitoring stations described above, grab samples will be collected in accordance with standard surface water monitoring protocols and guidelines prepared by the EPA, USGS, and/or ASTM. Streamflow data using both the staff gages and water level loggers will be gathered and analyzed in accordance with recommendations of the U.S. Bureau of Remediation (USBR) in its standard reference *Water Measurement Manual*.

As mentioned in Section 3.2.4, if feasible (based on weather forecasts and the availability of personnel to access the site at necessary times), samples during wet weather (active runoff) will be collected (estimated 3-5 times per year). Wet weather samples can be "composite" rather than "grab" at the discretion of the sampler to reflect a wider range of runoff conditions if feasible. For example, if the sampling party is at a station for 15 minutes, three samples at five minute intervals can be collected, mixed together, and then poured into laboratory sample bottles provided by the laboratory. Composite sampling procedures should be described on sampling forms, in photographs or video, or in field books. Samplers should maintain records of composite sampling procedures employed and such procedures should be periodically reviewed.

Samples will be collected from that area of the channel where flows are well mixed, and below the surface (to avoid materials floating on the surface).

Other significant aspects of the establishment and operation of the surface water monitoring stations include:

- Spikes of rebar will serve as surveyed monuments for each of the stream stations, and staff gages will be established at the three stations noted above. Locations for the monuments, staff gages and water level loggers will be field surveyed. At the stations with the loggers and staff gages, the channel cross sections will be surveyed and the channel bottom profile will be surveyed upstream and downstream from the section to enable establishment of a rating curve (a graph that will relate water depth to measured rate of flow). The rating curves will be developed using hydraulic calculations. In the event future monitoring is merited, at the start of each future monitoring year, and if warranted based on field observations, the monuments, staff gages and channel characteristics will be resurveyed if necessary. If the positions and locations of the staff gages and level loggers have changed due to ice thrust, flood flows, or for other reasons, the measuring instruments will be repositioned. Similarly, if the channel geometry changes significantly, new rating curves will be developed.

- The water level loggers will be installed at approximately the base of each staff gage at the applicable stations, provided that these locations are suitable. These sensors will measure the depth of water at the locations and record measurements every five minutes. These data will facilitate development of hydrographs at each location. The sensors will be suitably fixed to the channel bottom, so that they do not wash away in high flows.

- The Weather Station will be established in an easily accessed location near Turnuey Ridge Road. The Weather Station will monitor precipitation, and will include a stand roughly 8–10 feet above the ground, and will consist of a tipping bucket rain gage capable of recording precipitation during non-winter months. The Weather Station will also monitor: (i) atmospheric pressure, which will consist of a barologger that will record atmospheric pressure to enable calculations of water depths at the relevant monitoring stations; (ii) temperature; (iii) relative humidity; and (iv) wind speed and direction.

- Exact locations for the staff gages and water level loggers will be determined in the field, and will be situated on representative channel reaches where the flow is relatively uniform.

Over the course of the monitoring program, field conditions may indicate that it is desirable to obtain surface water samples for diagnostic purposes at additional locations. For example, a large landslide may create a new significant discharge into the unnamed drainage that may be considered appropriate for sampling. In the event new surface water monitoring stations are deemed appropriate, the locations will be named in a logical manner, assigned GPS coordinates, and shown on an updated Exhibit A. If Crestwood establishes a new surface water monitoring station, Crestwood will provide documentation regarding its rationale for the creation, parameters to be monitored (if different from those listed in 3.2.2, below), and the anticipated duration of monitoring. It is important to emphasize that such stations will be diagnostic in nature, and will not involve regulatory compliance unless previously established monitoring locations are lost and need to be replaced. As the surface water monitoring program evolves, it may also be appropriate to discontinue one or more monitoring stations. In such cases, Crestwood will provide EPA details concerning Crestwood's rational for the determination, and may discontinue monitoring at the identified station upon approval by EPA.

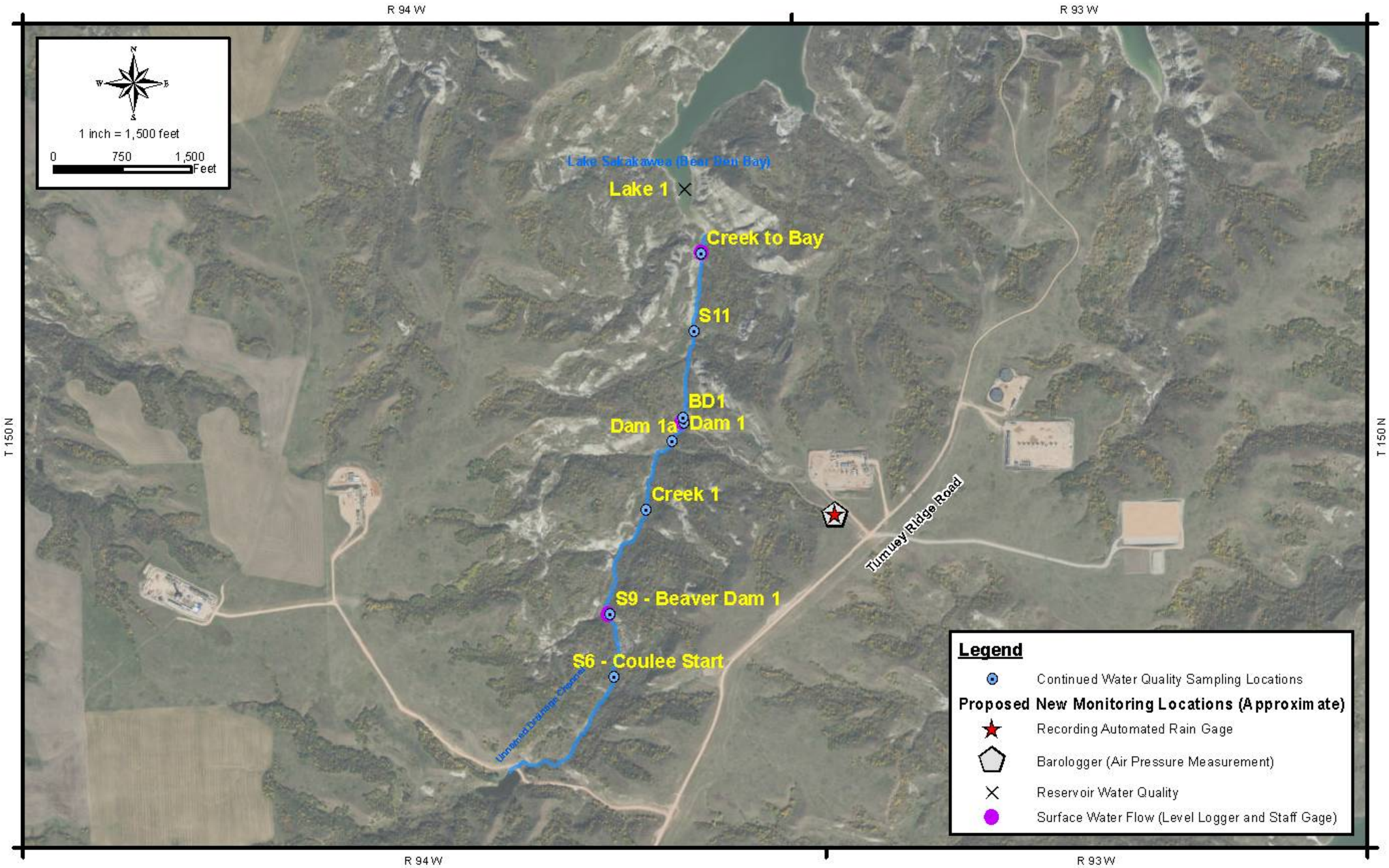


Figure 3.2.1-1 Proposed Surface Water Monitoring Locations

3.2.2 Chemical Analysis and Other Data Collection

The following field parameters will be gathered at the eleven monitoring stations on each sampling occasion when water depths are sufficient to obtain a sample without disturbing sediment from the channel bottom:

- Electrical Conductivity (EC) (with a meter)
- Water temperature (with a thermometer)
- pH (with a meter)
- Written description of visual characteristics of water (e.g., "clear with no observable sediment transport")
- Depth of flow (from staff gage) and rough estimate of surface velocity, as measured with stop watch and cork or other floating object
- Where relevant, download data from water level sensors and Weather Station
- Any notes regarding instrument performance and maintenance performed per users manuals.

In addition to collecting field data for the parameters described above, the following laboratory data will be obtained for surface water samples (again without disturbing sediment from the channel bottom):

Hardness	Sodium
Chloride	Nitrate
pH	Total Suspended Solids (TSS)
Calcium	EC and Total Dissolved Solids (TDS)
Magnesium	

Laboratory/test methods and detection limits are discussed in Section 4.0. Data will be collected via both field measurements and laboratory measurements. At each of the monitoring locations, field personnel will gather real time data for water temperature, pH and EC. Note that field data and laboratory data collected for EC, TDS, and chloride may allow development of a relationship between chloride, EC, and TDS which could prove useful as the monitoring program evolves.

In general, samples will be collected at each monitoring station using the following methodology:

1. At each sampling location, an approximate 1-liter glass or HDPE sample collection container is rinsed with distilled water. The container is then filled and emptied three times with water from the sample location.
2. The field personnel conducting sample collections stand downstream of the monitoring locations to reduce the potential of disturbing bottom sediment at the sample location and extend the sample collection container upstream to collect the sample.
3. The sample collection container is placed below the water surface and is filled with water from the sample location and transferred to the relevant sample bottles that have been provided by the previously selected testing laboratory.
4. The sample bottles are labeled with monitoring station locations, sample time and date, and placed on ice in a cooler.
5. A photograph of the water quality monitoring station and sample is taken. It will be especially important to photo-document and describe wet weather sampling procedures and conditions.
6. The sample at Lake 1, will be taken approximately 10 feet into Lake Sakakawea, and may require the use of a small boat.
7. After a set of samples has been collected from all nine monitoring stations, the cooler is to be delivered with a completed chain of custody form to the previously selected testing laboratory within the laboratory-specified hold time. Crestwood and EPA recognize, however, that the laboratory-specified hold time for pH testing is limited, and that the hold-time for pH will be exceeded in all instances. Nonetheless, pH will still be recorded at each location (with a meter), and reliance will be placed on pH data collected in the field.

When collecting stream samples, care must be taken to avoid disrupting sediment from the channel bottom. It is necessary to collect samples from the water column that does not include sediment bottom material. In addition, during winter months, if there is an ice cover on the channel, samples should not be collected because they will not be representative. The concern is that in the course of breaking through ice, it is likely that channel bottom sediment will be entrained into the very shallow flow, thereby introducing too much inaccuracy into the sample. It should be feasible to collect samples in the late autumn/early winter and late winter/early spring where there is little ice that would affect sampling conditions.

At each surface flow monitoring location the visual characteristics of the water should be noted (such as "slow and steady, clear base flow"). Water depth should be read on each staff gage, photographed, and water level sensor data downloaded. The flow width and average depth should be measured. Similarly, an approximate estimate of surface velocity (for example, "cork traveled eight feet in four seconds so surface velocity equals two ft/sec") in the channel should be recorded.

A field data form will be used for recording observations of appropriate field parameters, along with other standard information such as:

1. Names of people in the field monitoring party;
2. Date;
3. Weather when sampling occurs;
4. General characterization of weather and flow conditions leading up to site inspections over the previous week and month;
5. Members of other organizations participating in this sampling and whether or not split samples were collected;
6. Chain of custody form number;
7. General observations of the watershed such as the development of recent landslides that may be affecting flow conditions in the stream, appearance of new springs or seeps, changes in vegetation that are readily apparent, changes in the nature of the channel or others of this kind;
8. If samples collected during wet weather conditions were grab or composite;
9. Brief description of conditions of level loggers, and Weather Station;

10. Brief description of procedure for locating the Lake 1 station, approximately 10 feet into Lake Sakakawea; and
11. Other factors that may be relevant to the nature of the surface flows quantity or quality.

3.2.3 Flow and Precipitation Data Download and Equipment Maintenance

During each site visit, data will be downloaded from the flow measurement stations, the atmospheric pressure monitoring station, and the precipitation monitoring station. As applicable, the data will be analyzed and used to develop site-specific hydrographs, precipitation graphs, and a precipitation streamflow relationship. Prior to downloading data, each station will be inspected to evaluate condition (e.g., if water level sensor is in appropriate location and has not been tampered with). Following the data download, necessary routine maintenance will occur (e.g., cleaning debris out of the tipping bucket rain gauge or replacing depleted batteries). As the data are evaluated, depth measurements from the staff gages or hand-measured depths will be compared against water level sensor depths to check for approximate agreement. If there are significant differences for any given water, it should be tested and recalibrated or, if necessary, replaced.

3.2.4 Schedule

Crestwood will collect surface water data monthly for one calendar year. 90 days prior to the end of the first anniversary of EPA's approval of this Plan, Crestwood will submit to EPA for review and approval a proposal either to modify or discontinue sampling, if appropriate, or to continue sampling for an additional timeframe. Crestwood will implement this proposed plan upon approval by EPA. If additional surface water sampling is required after the first calendar year, Crestwood may at any time propose to cease surface water sampling beyond the first calendar year if Crestwood believes a cessation of surface water sampling is warranted based on the data acquired. Crestwood shall not cease surface water sampling without first obtaining EPA's approval.

In general, samples will be collected in the middle of each month, on Monday through Friday. In addition, when feasible given accurate weather forecasts and Crestwood staff availability, "wet weather" samples will be collected when there has been roughly 0.5 inches of rain or more, as measured at the to be installed Weather Station, in the previous 24 hours through either grab or manual composite sampling. Rapid snowmelt (especially in the spring and fall) can also provide good conditions for sampling. When the National Weather Service and other local forecasting organizations predict significant rainfall, Crestwood will prepare to collect wet weather samples. The decision to conduct wet weather sampling will be based on an evaluation of proximate National Weather Service rain stations, staff or contractor availability, and the number of previous wet weather sampling events during the month (no need for more than one per month). When wet weather sampling occurs (likely no more than 3–5 times per year), the same basic field and laboratory procedures described above will be utilized. Extra sampling containers from the laboratory should be maintained by Crestwood to capture wet weather or snowmelt samples. During wet weather site visits, Crestwood will take photographs or video where possible to document site conditions.

As discussed in Section 4.0, field and laboratory surface water quality and flow data will be regularly evaluated, and if anomalies are apparent, re-sampling will occur as soon as practical.

3.2.5 Surface Water Goals and Objectives

At no point during the effective period of the Consent Order shall chloride exceed 230 mg/L at Crestwood's Creek to Bay monitoring station or 100 mg/L at the Lake 1 monitoring station (collectively, the "goals and objectives).

3.2.6 Mitigation and/or Restoration

As described in Section 5.0 herein, the first year of the program will focus on data collection and interpretation. In addition, Crestwood will take the following action should chloride concentrations exceed the surface water goals and objectives described in Section 3.2.5 herein. In the event an individual sample exceeds the goals and objectives, Crestwood will provide notice to the EPA within 7 days of an individual sample exceeding the goals and objectives. Crestwood will collect one or more weekly samples at the Creek to Bay and Lake 1 monitoring stations for four additional consecutive weeks. Within 30 days following the receipt of laboratory data from the final weekly sample, Crestwood must determine and provide written notice to EPA explaining whether the 30-day average of the chloride concentrations exceeds the goals and objectives at one or both of these locations. As part of this notice, Crestwood may demonstrate that a source other than the Incident caused the contamination or that the elevated chloride in an individual sample is an artifact caused by an error in sampling, analysis or natural variation in the perched water or groundwater. If Crestwood determines that the 30-day average exceeds the goals and objectives at one or both of these locations, Crestwood shall submit a Mitigation and Restoration Plan at the same time as the notice for EPA's review and approval. The Mitigation and Restoration Plan shall include proposed additional monitoring that may be needed to characterize chloride conditions, corrective actions to reduce chloride concentrations, and/or proposed alternate chloride standards resulting from additional site characterization and data analysis. The Mitigation and Restoration Plan shall be developed with the goal of defining the potential cause of elevated chloride concentrations and reducing chloride concentrations at either the Creek to Bay and/or the Lake 1 monitoring stations to meet the goals and objectives. Following approval of the Mitigation and Restoration Plan by EPA, Crestwood shall implement this Plan.

Within 90 days of the first anniversary of EPA's approval of this Plan, Crestwood shall submit to EPA a report summarizing the laboratory results of its surface water monitoring, and describing Crestwood's efforts to characterize the extent of fluids associated with the Incident in surface water, and the associated implications. This report shall include recommendations, as appropriate, for: (i) additional monitoring; (ii) additional or modified treatment, mitigation or restoration of surface water necessary to address the impacts to surface water; or (iii) cessation of monitoring activity. Crestwood will implement any such recommendations after approval by EPA.

3.2.7 Equipment

Table 3.2.6-1 summarizes the necessary equipment for both normal weather and wet weather surface water sampling, including many of the major components of installing the water level sensors, and automated Weather Station.

Table 3.2.6-1 Surface Water Sampling Equipment

Type/Nature of Equipment	Manufacturer and Product Identifier
Field GPS unit	
50-foot measuring tape	
Recording tipping bucket rain gage	Teledyne ISCO 674 Rain Gauge
	Stratus RG202 Long Term Professional Rain and Snow Gauge
Hand level, rod, yard stick	
Metal staff gages along with necessary support components such as fence posts, or other suitable materials to anchor gages in place in channel	
18-inch-long pieces of rebar to serve as monuments at each station, and to serve as anchors for steel cable to connect to loggers	1/2" X 18" Rebar 10/Bundle (BN)
Water level loggers (or staff gages and measured flow channel cross-sections) for three stations	3001 Levelogger Edge LT M5, F15 - 16.4 ft., 5 m
	3001 DataGrabber for Levelogger
	3001 DR to Optical Adaptor for Levelogger
	3001 Standard Comm. Package (USB) for Levelogger
	Alternate – Pre-printed metal staff gage affixed to a metal post and driven into the channel bottom
Portable EC meter	HI98129 pH/EC/TDS Tester (low range)
Portable pH meter	HI98129 pH/EC/TDS Tester (low range)
Thermometer	HI98129 pH/EC/TDS Tester (low range)
Fishing “floats” for measuring surface flow velocities	
Stop watch	
Stand for rain gage (concrete base and wood or steel structure to support height of 8–10 ft.)	
Digital camera with video capabilities	
Steel cable for anchoring level loggers	
Field maps and other relevant documents and scale for measuring distances	
Other standard field equipment (appropriate clothing, first aid, communications (cell phone, radio, etc.) sunscreen, insect repellent, water, food, duct tape, backup batteries, “Leatherman” or equivalent tool, etc.)	
Laptop Computer (to download data from level loggers and rain gage)	

Note: Crestwood will obtain a suitable sampling boat, anchor and life vests; boat will be secured and locked onshore between sampling events.

3.3 Soils

Monitoring of soils and water began immediately after the Incident was identified, and was continued daily, then monthly, and now quarterly. The June 2015 report by Keitu outlines the specific sampling and monitoring locations as well as constituents that are analyzed each quarter. The following subsections describe methods for future soil sampling and monitoring efforts.

3.3.1 Physical Location and Chemical Analysis

Samples will be obtained by boring to the desired sample depth using a hand or mechanized auger. Once the desired sample depth is reached, a sample will be collected with the auger and transferred to a sample-dedicated disposable pail and homogenized with a trowel. Adhering to laboratory-specified volume and weight requirements, grab samples will be transferred directly to sample storage and transport containers provided or specified by the laboratory conducting the analysis.

Sampling locations will include the sites identified on Table 3.3.1-1 and shown on Exhibit A. Precise sampling locations will be selected in the field, and GPS coordinates will then be assigned. Surface soil samples will be collected at all listed locations. Subsurface soil samples will be collected at locations identified in bold in Table 3.3.1-1. Subsurface soil samples for quarterly parameters will be obtained from a single boring. For laboratory analysis, these samples will be separated into 6-inch sections down to 24 inches and then at 1-foot intervals thereafter to a total depth of five feet (or until bedrock is encountered). Each section will be homogenized for laboratory analysis.

Table 3.3.1-1 Sampling Locations and Parameters

Sampling Location/ID Number		
E – East	S8a	**Creek 1**
E – West	**S8b**	Dam 2
S1 – Release Location	S8c	Dam 1a
A – East	**S3 – Toe Slope**	Dam 1
S2 – Road Ditch	S4-Trees	**BD 1**
S7a	S5 – Tree Pond	S11
S7b	**S6 – Coulee Start**	Creek to Bay
S7c	**S9 – Beaver Dam 1**	S13-Bay
BK2	**BKS10**	**BKBWC**
Quarterly Sampling Parameters:		
pH, Conductivity, Chloride, Calcium, Magnesium, Sodium (calculated: SAR and EC), and select parameters based on the first 2017 sampling results		
First 2017 Soil Samples (0-6″ and 6-12" only):		
Pollutant Scan--BTEX, Mercury, Barium, Copper, Antimony, Arsenic, Beryllium, Cadmium, Chromium, Selenium, Lead, Zinc, Thallium, Radionuclides (gross alpha and gross beta)[4]		

During the first year of monitoring, all soil samples shall be sent to a laboratory that will run analyses for pH, conductivity, and chloride, as well as calcium, magnesium and sodium to calculate the SAR and EC. The first soil sampling event in 2017 will also include a pollutant scan of the parameters listed in Table 3.3.1-1. If laboratory results from the first 2017 soil sampling event for gross alpha and gross beta are greater than the maximum background levels from the BK-2, S10-BK, or BWC-BK locations, Crestwood shall sample the following quarter for Radium 226 and 228. After one year of quarterly sample collection and analysis, if a site consistently has a calculated SAR of less than 15 and an EC less than 6 decisiemens per meter (dS/m) to a depth of five feet (or greatest depth achievable), that site will no longer be sampled.

3.3.2 Sampling Duration and Frequency

Quarterly soil samples will be taken for one year, after which Crestwood will evaluate the initial monitoring data to determine and submit to EPA for approval proposed future sampling

[4] Crestwood shall also collect three background soil samples identified as **BK2, BKS10**, and **BKBWC** in Table 3.3.1-1 for Radionuclides (gross alpha and gross beta). The three background samples are approximately located at: (i) **BK2 –** 47.78249°, -102.65185°; (ii) **BKS10 –** 47.78671°, -102.65228°; and (iii) **BKBWC –** 47.79587°, -102.64897°. Radionuclides sampling at the three background locations will be obtained from a single boring. For laboratory analysis, the three background samples will be separated into six inch (6") sections down to twelve inches (12"). Each section will be homogenized for laboratory analysis.

frequencies and locations. For the first 2017 soil sampling event, if soil laboratory analyzed values from the zero to twelve inch (0-12") core samples are below approved remediation standard thresholds, future monitoring for those parameters will not be required. For purposes of this Plan, the approved remediation standard thresholds shall be the following:

As	Ba	Cd	Cr	Cu	Hg	Na	Pb	Se	Zn
mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	wt. %	mg/Kg	mg/Kg	mg/Kg
13.10	953.00	0.90	64.00	39.10	0.09	1.35	21.20	0.90	102.00[5]

If one of these parameters is found to be present in the first 2017 zero to twelve inch (0-12") soil sampling sections at concentrations exceeding the approved remediation standard thresholds, that parameter shall continue to be included in the quarterly sampling analysis at the sampling location where the concentration exceeds the approved remediation standard thresholds, as well as the two sampling locations immediately adjacent (above and below) to the location that exceeded the approved remediation standard thresholds.

3.3.3 Soil Goals and Objectives

As stated above, soils must meet the following Sodium Adsorption Ration (SAR) and Electrical Conductivity (EC) that are accepted agricultural soil values for non-sodic and non-saline soils:

i) SAR of less than 15 to a depth of five feet (or greatest depth achievable) from the soil surface. SAR is the relation between soluble sodium and soluble divalent cations, which can be used to predict the exchangeable sodium fraction of soil equilibrated with a given solution. SAR is defined where concentrations, denoted by brackets, are expressed in mmoles per liter: SAR = [sodium] / [calcium +magnesium] $^{1/2}$; and

[5] From Smith, D.B. Cannon, W.F. Woodruff, L.G. Solano, Federico, Kilburn, J.E. and Fey, D.L. 2013, Geochemical and mineralogical data for soils of the conterminous United States: U.S. Geological Survey Data Series 801, 19p., http://pubs.usgs.gov/ds/801/.

ii) EC of less than 6 decisiemens per meter (dS/m) to a depth of five feet (or the greatest depth achievable) from the soil surface. EC is the conductivity of electricity through water or an extract of soil, which is commonly used to estimate the soluble salt content in solution.

3.3.3.1 Soil Chemistry Mitigation Efforts Already Implemented

Following the Incident, flax straw hay was applied to the soils in areas A, B and E (see Exhibit A for locations). This straw was applied at a thickness of 18 inches and crimped into the soil to three feet deep. The straw placement was intended to promote water retention and provide pathways for the chloride to move downward past the root zone of plants. Alfalfa hay was also applied to the soil to increase organic matter content, enhance the leaching capability of the top layer of soil, and to reduce surface ponding of rainfall.

At Area A, soil in the immediate vicinity of the Incident was excavated and disposed of off-site. These excavated areas were backfilled to pre-Incident elevations with Tribal approved soil. Additionally, a calcium based soil amendment (BIO-CAL) was applied throughout Area A. This soil amendment provided calcium for plants' uptake and as needed to mobilize nutrients in the soil to increase plant survival (http://www.midwesternbioag.com/product/bio-cal/). Other powdered calcium and citric acid amendments were added to the impacted area at rates exceeding the recommended agriculture rate. Citric acid promotes sodium displacement. Chlorides remain in solution and are 'easily' removed. The sodium needs displacement by calcium and magnesium to move sodium into solution; therefore, migrating sodium out of the root zone. This allows chlorides to migrate into deeper portions of the soil. These chemical additions were provided to improve the soil environment and promote vegetative growth.

3.3.3.2 Future Soil Chemistry Mitigation Actions

Within 90 days of the first anniversary of the effective date of this Plan, Crestwood shall submit to EPA a report summarizing the laboratory results of its soil monitoring. This report shall include a recommendation, as appropriate, for any additional monitoring, or any mitigation or restoration of soils necessary to address the impacts to soils associated with the Incident. Crestwood shall implement any recommended mitigation or restoration once approved by EPA.

3.3.4 Soil Sampling Equipment

The following Table 3.3.4-1 provides a list of equipment and descriptions of use as needed to conduct appropriate soil sampling.

Table 3.3.4-1 Soil Sampling Equipment

Equipment	Description
Thin-walled tube sampler	Metal or Teflon tube used to recover relatively undisturbed soil samples. Augers are available at various depths, and soil cores may range in length from 6 inches to 24 inches.
Soil augers	Various models of soil augers are acceptable and selection of the specific brand and make of tool will be recommended by the contractor implementing the field work.
Trowels	For extruding the soil sample from the auger.
Collection containers	For storing soil sample.
Gloves	To prevent cross-contamination of samples. Should be disposable and powderless.
Sampling flags or a handheld GPS	Used for identifying soil sampling locations.
Field notebook	Used to record progress of sampling effort and record field observations and conditions during sampling.
Three-ring binder	To store necessary forms used to record and track samples collected at the site. Binders will contain the Field Data Sheet, Site Diagram, Chain-of-Custody documents, and sample labels.
Permanent pen	Used to label sample containers and for documentation in field logbooks and on data sheets.
Measuring tape	Used to measure the length of core in the soil coring device.
Trash bag	Used to dispose of gloves and any other non-hazardous waste generated during sampling.

3.4 Vegetation

The Incident resulted in visible adverse impacts to the vegetation along a portion of its flow path toward and within the unnamed drainage channel. In response, Keitu provided observations about the impacts to site vegetation through a botanical survey and tree and shrub inventory included in its June 2015 report (see Appendix A). The botanical survey was conducted adjacent to the flow path to assess the dominant plant species within each section of the Incident area, and the tree and shrub inventory documented the number of trees and shrubs that were impacted. Five distinct remediation areas (Areas A – E) were established to account for unique plant communities, slopes, and soil characteristics throughout the affected area (see Exhibit A).

3.4.1 Mitigation and Restoration

Vegetation and soil remediation practices were implemented at Areas A, B, C and E beginning in 2014. Vegetation within Area D did not sustain the same level of damage as the other areas. As a result, and based on the difficulty in accessing locations within Area D, Keitu determined that revegetation and remediation of Area D with equipment had the potential to cause more harm than good and that monitoring was a more appropriate response. The botanical survey was conducted on September 22, 2014, and will continue to serve as a guide for the development of seed mixes to be used in the remediation areas. The tree and shrub inventory will be used as the standard for replanting native trees and shrubs in Areas C and D, where trees were present prior to the Incident.

3.4.1.1 Previous Restoration

As of April 2016, site revegetation has included seeding Areas A, B, C, and E using alkali-tolerant dryland seed mixes. The following practices have been employed in Areas A, B, C, and E in an attempt to ensure the success of this process:

(1) Application and crimping of flax straw hay into the soil to allow the soil to retain moisture and provide a channel for chloride to more readily leach past the root zone.
(2) Application of alfalfa hay to increase the organic matter in the soil and provide a channel for chloride to more readily leach past the root zone.
(3) Application of powdered citric acid, calcium carbonate and calcium sulfate to promote the movement of sodium below the root zone.
(4) Seeding areas with a dry land alkali-resistant seed mix to reduce runoff and erosion.
(5) Application of several erosion control techniques including erosion control blankets, rock check dams and fiber rolls to reduce erosion potential. A fence was built to prevent cattle from entering the area.

The following practices have also been employed in Area C:

(1) Removal or chipping of dead trees and shrubs. Wood chips have been tilled back into the soil to a depth of six inches.

(2) Hand-application of powdered citric acid and calcium carbonate to promote the movement of sodium below the root zone.
(3) Seeding areas with a dry land alkali-resistant seed mix to reduce runoff and erosion.
(4) Application of several erosion control techniques including rock check dams and fiber rolls to reduce erosion potential.
(5) A fence was built to prevent cattle from entering the area.

3.4.1.2 Forbs and Grasses Planting Plan

The forbs and grasses planting plan largely adheres to the revegetation plan included in the Keitu report. Namely, all disturbed areas have been reseeded with an interim nature grass seed mix that is enhanced to promote water retention and soils stability. As reseeded areas become established, Crestwood will overseed with native, non-GMO, medicinal herbs and plants, including purple cone flower (*Echinacea purpurea*), western yarrow (*Achillea millefolium*), blackeyed susan (*Rudbeckia hirta*), prairie coneflower (*Ratibida columnifera*) and white sagebrush (*Artemisia ludoviciana*).

3.4.1.3 Tree and Shrub Planting Plan

Similar to the June 2015 Keitu report, this Plan recommends replanting at least twice the number of trees and shrubs which were impacted by the Incident. (see Table 3.4.1.3-1). This replanting shall begin when soils in the upper 36 inches have been remediated or have chloride and SAR values that are supportive of the intended plantings.

Table 3.4.1.3-1 Tree and Shrub Species to be Replanted

Tree and Shrub Species			
Scientific Name	**Common Name**	**Number Lost**	**Number of Plants to be replanted**
Fraxinus pennsylvanica	Green Ash	165	330
Juniperus scopulorum	Rocky Mountain Juniper	3	6
Quercus macrocarpa	Bur Oak	6	12
Ulmus Americana	American Elm	18	36

3.4.2 Monitoring Duration and Frequency

Additional restoration practices will be predicated on the survival of the trees and shrubs that will be planted and the success of the revegetation efforts. Vegetation regrowth assessment will occur each fall and spring through at least Fall 2020 to quantify the regrowth of warm and cool weather species. Monitoring will be performed by a qualified biologist who will visit the Incident site to assess site coverage by native plants using an accepted vegetation density measurement method (e.g., point-intercept, density quadrats, photographic monitoring, etc.) as determined by the biologist. The biologist will also make qualitative and quantitative observations about any non-native plant species or invasive weeds that are present. Finally, the biologist will count the trees and shrubs planted to calculate a tree and shrub survival rate.

While reseeding has already taken place, active monitoring of growth should guide decisions to engage in additional seeding in the future. Should vegetation regrowth cease or fall below expected rates, adaptive management will be used to identify the cause and most practical action.

3.4.2.1 Integrated Weed Management Plan

As part of the ongoing site remediation, integrated weed management techniques will continue to be implemented. These techniques have included rapid seeding and soil treatment following the Incident, the use of appropriate seed mixes and regular site observations. Should Crestwood determine that reseeding needs to be performed in the future certified weed-free mulch and native seed mixes previously approved by the MHA Nation will be implemented. If invasive weeds are identified, responsive management actions may include the use of biological, mechanical and/or chemical weed removal methods.

3.4.3 Vegetation Goals and Objectives

Upon restoration completion, areas impacted by the Incident will be stabilized with native grasses and forbs that provide 70% or more of original coverage. Restoration shall be considered successful if at least 3-years after all shrubs and trees were planted, the survival rate is equal to the number of trees and shrubs impacted by the unintended release.

In the event 70% or more of the original native grasses and forbs, and the equal number of trees and shrubs impacted by the Incident are not present three-years after the effective date of this

Plan, Crestwood will submit to EPA within 90 days of such anniversary a plan for any appropriate corrective action. Crestwood will implement such plan upon approval by EPA.

4.0 QUALITY ASSURANCE PROJECT PLAN (QAPP)

This QAPP provides the technical details and associated QA/QC procedures for the site-specific Sampling, Monitoring and Mitigation Plan described in Section 3.0. If conditions or requirements change during sampling and monitoring operations, the QAPP may be revised, and any revision will be submitted to EPA for approval.

4.1 Data Quality Objectives

The overall objective of this Plan is to restore the Incident site, flow path, and affected resources to their pre-Incident usage standards of supporting grazing and other similar uses. A second objective is to evaluate the extent and observable effects the Incident may have caused to surface water, perched water, groundwater, soils and vegetation in the affected environment. Finally a third objective is to reduce potential future discharges of chloride to the unnamed drainage and/or Lake Sakakawea from soils, groundwater and/or surface water. These objectives are best met when collected data are reliable, and adhere to minimum quality requirements, as addressed in the QAPP.

These objectives will be achieved by collecting and analyzing water and soil samples, vegetation, and surface flows as described in Section 3.0. EPA-approved methods will be used for the collection and analysis of the analytes listed in Table 4.1-1.

Table 4.1-1 Analytes to Be Measured, with Appropriate Methods, in Surface Water, Perched Water, Groundwater, and Soil Samples.

Sample Group	Analyte	Appropriate Methods[1]	Notes, if applicable
Surface Water	pH	EPA 150.1	
	Chloride	EPA 6500	
	Calcium	EPA 200.7	For calculating SAR and hardness
	Magnesium	EPA 200.8	For calculating SAR and hardness
	Sodium	EPA 200.7	For calculating SAR
	Sodium Adsorption Ratio (SAR)	Calculated	
	Hardness	Calculated	
	Nitrate/Nitrite	EPA 350.1; EPA 353.1	
	TDS	SM 2540C	
	TSS	EPA 160.1; SM 2540D	
Perched Water and Groundwater	pH	EPA 150.1	
	Chloride	EPA 140.4; EPA 325.2; EPA 6500	
	Calcium	EPA 200.7	For calculating SAR and hardness
	Magnesium	EPA 200.8	For calculating SAR and hardness
	Sodium	EPA 200.7	For calculating SAR
	SAR	Calculated	
	Hardness	Calculated	
	Nitrate/Nitrite	EPA 350.1; EPA 353.1	
	BTEX (Benzene, Toluene, Ethylbenzene, Xylenes)	EPA 602	
	Metals (total) Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury Selenium, Thallium, Zinc	For all metals except mercury: EPA 200.8; EPA 6020 For Mercury only: EPA 245.1	
	EC	EPA 120.1	
	DRO	EPA 8015D; EPA 3550C; EPA 8270D	
	GRO	EPA 8015D; EPA 5035; EPA8260B	
	Radionuclides	Gross alpha/beta: EPA 900	

Table 4.1-1 Analytes to Be Measured, with Appropriate Methods, in Surface Water, Perched Water, Groundwater, and Soil Samples.[6]

Sample Group	Analyte	Appropriate Methods[1]	Notes, if applicable
Soils	pH	EPA 150.1	All soil samples.
	EC	120.1 USEPA	
	Chloride	EPA 140.4; EPA 325.2;EPA 6500	
	Calcium	EPA 200.7	
	Magnesium	EPA 200.8	
	Sodium	EPA 200.7	
	Sodium Adsorption Ratio	Calculated	
	BTEX (Benzene, Toluene, Ethylbenzene, Xylenes)	EPA 602 for screening. If detected, confirm analytes using EPA 624 (GCMS).	Soil samples collected in 2016 from depth zones 0 to 6 inches and 6 to 12 inches shall include the analytes to the left as well as those above.
	Metals (total) Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury Selenium, Thallium, Zinc	For all metals except mercury: EPA 200.8; EPA 6020 For mercury only: EPA 245.1	
	Radionuclides (See radionuclide note for monitoring wells above.)	Gross alpha/beta: EPA 900	
	Percent soil moisture	ASTM D2216 or approved soil moisture probe.	

[1] The methods listed provide acceptable MDLs, PQLs, accuracy, and precision. Other methods may be used when preferred by the chosen laboratory if warranted to give equivalent results.

4.1.1 Site Specific Data Generation and Acquisition

The site-specific guidelines for data generation and acquisition include selecting sampling locations, sampling frequencies, dates/timeframes, sample size and frequency and location of QC samples. These guidelines, discussed in Section 3.0, are generally based on knowledge of the features and conditions under investigation and on professional judgment. Additionally, in the

[6] Attached hereto as Exhibit B are the two quality assurance manuals utilized by Crestwood's chosen testing laboratory, Pace Analytical Services Inc. Exhibit B consists of two quality assurance manuals because one laboratory location will be utilized to perform the vast majority of the laboratory analysis required herein; however, a second laboratory will need to be utilized for the gross alpha and gross beta laboratory analysis. Therefore, Exhibit B consists of: (i) Billings, Montana location Quality Assurance Manual – Quality Assurance/Quality Control Policies and Procedures effective December 11, 2015; and (ii) Greensburg, Pennsylvania location Quality Assurance Manual – Quality Assurance/Quality Control Policies and Procedures effective March 10, 2017. Crestwood shall provide the EPA with copies of the testing laboratory's then current and operative quality assurance manual no later than January 31st of each year this Plan remains in effect.

case of surface water, soils and vegetation continuity, the monitoring program at many of the stations is the same as established in July 2014 to maintain continuity. The guidelines were developed to ensure that data collected for fulfilling the objectives of this project are appropriate and reliable and of sufficient quality to fulfill the project goals and objectives.

4.2 Sampling Methods

Methods of sample collection, preservation and handling used in determining water quality as a part of this QAPP shall be in accordance with methods described in the following references or otherwise approved by EPA, USGS, ASTM, or USBR (in the case of streamflow monitoring). However, site conditions or project-specific data collection objectives may necessitate the use of alternative field procedures not included in the standard operating procedures (SOPs) in these referenced sources. The use of field methods other than those presented in the SOPs will be submitted to EPA for approval. References to be utilized in this monitoring program include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act*, 40 CFR Part 136 or any test procedure approved or accepted by EPA using procedures provided in 40 CFR Parts 136.3(d), 136.4, and 136.5;
- *Standard Methods for the Examination of Water and Wastewater*, latest edition, American Public Health Association;
- *Methods for Chemical Analysis of Water and Waste*, and other methods published by EPA Office of Research and Development or Office of Water;
- *Techniques of Water Resource Investigations* of the USGS;
- *Annual Book of American Society for Testing and Materials (ASTM) Standards*. Volumes 11.01 and 11.02, Water (I) and (II), latest edition, ASTM International;
- *Federal Register*, latest methods published for monitoring pursuant to Resource Conservation and Recovery Act regulations;

- *National Handbook of Recommended Methods for Water-Data Acquisition*, latest edition, prepared cooperatively by agencies of the U.S. government under the sponsorship of the USGS; and
- *Federal Register*, latest methods published for monitoring pursuant to the Safe Drinking Water Act regulations.

In addition, to the SOPs articulated in the above referenced sources, Crestwood's general sampling and field testing procedure shall consist of the following:

- Performing an equipment and supplies check, which shall include ensuring that all:
  - Sample collection containers and preservatives are accounted for;
  - Sampling tools are decontaminated and in proper working order; and
  - Field instruments are within the manufacturer's recommended calibration timeframe.
- Testing field instruments prior to sampling with a known standard solution.
- When collecting a soil sample, Crestwood shall:
  - Rinse the sample collection containers with distilled water;
  - Utilize a soil auger to collect the pertinent soil sample;
  - Extrude the soil sample from the auger into a bucket;
  - Homogenize the soil sample; and
  - Place the soil sample into a laboratory supplied sample container.
- When collecting a surface water sample, Crestwood shall:
  - Rinse the sample collection containers with distilled water, and subsequently triple rinse the sample collection containers with collection water prior to obtaining a surface water sample;
  - Place the sample collection container below the water surface to fill the sample collection container with water from the pertinent sample location;
  - Transfer the collected water sample to the applicable sample container provided by the previously selected testing laboratory;

  - Label the testing laboratory provided sample container with the monitoring station location, sample time, and date; and
  - Place the testing laboratory provided sample container on ice in an appropriate cooler.

- Utilize field instruments/meter-gauges to collect field water quality data, and record such data in Crestwood's field log.
- Decontaminate equipment employing a brush to remove any visible materials, and triple rinsing equipment with distilled water.
- Record any additional notes in the field log.
- Takes photos to assist in documenting relevant conditions.

4.2.2 Sample Handling Procedures and Holding Times

Sample container materials, preservatives and holding times are shown in Table 4.2.1-1. Each sample container must have a sample label affixed to the container. Each sample label must be legibly written with indelible (i.e., waterproof) ink. The information that is written on the sample label must match the information on the Chain of Custody (COC) form (see also Section 4.3.3). All necessary preservatives for sample containers will be provided by the laboratory in advance of field sampling.

Table 4.2.1-1 Sample Container Materials, Preservatives and Holding Times

Parameter	Sample Containers	Preservatives	Max. Holding Time
Dissolved Metals	Amber HDPE plastic	Filtered 0.45 µm, acidified using HNO3 to pH< 2, Cool <6°C	180 days (Hg only 28 days)
Total Metals	Amber HDPE plastic	Unfiltered, acidified using HNO3 to pH< 2, Cool <6°C	180 days (Hg only 28 days)
Nitrate/Nitrite	Amber HDPE plastic	H2SO4, pH<2; refrigerate <6°Cdo not freeze	28 days
Total Dissolved Solids3 (TDS)	HDPE Amber plastic	Cool <6°C	7 days
Total Suspended Solids (TSS)	HDPE Amber plastic	Cool <6°C	7 days
Radium 226 (aqueous)	HDPE Amber plastic	HNO3	6 months
Radium 228(aqueous)	HDPE Amber plastic	HNO3	6 months
Gross alpha/beta (aqueous)	HDPE Amber plastic	HNO3	6 months
Diesel Range Organics (DRO)	HDPE Amber plastic	HCl, pH<2; refrigerate <6°C	7 days until extraction, 40 days after extraction
Gasoline range organics(GRO)	HDPE Amber plastic	No Headspace HCl, pH<2; refrigerate <6°C	14 days
Chloride	60 mL plastic/1	Refrigerate<6°C	28 days
BTEX	Glass with fluoropolymer lined septum 120 mL (3-40mL)	HCl to pH < 2; < 6°C, do not freeze	14 days

4.3 Quality Assurance Measures

All personnel who collect environmental data must have experience with the monitoring procedures presented in this Plan, be familiar with these quality assurance practices and collect data in accordance with the procedures described below. Attached hereto as Exhibit C is an organizational chart identifying the individuals and entities responsible for collecting pertinent field data, analyzing/testing such data, and overseeing the quality assurances set forth in this Section 4.0.[7] Field QC samples will include field/equipment blanks, trip blanks, and temperature blanks.

[7] In the event the organizational chart attached hereto as Exhibit C undergoes modification at Crestwood's discretion, Crestwood shall provide the EPA with a revised and updated organizational chart within thirty (30) days of such modification.

4.3.1 Blanks and Duplicates

A blank sample is prepared to be free of the analytes of interest and is processed and handled at the sampling site in the same manner as environmental samples. Blanks are intended to help identify contaminants that are artifacts of the sampling procedure. There are several types of blank samples, each serving a distinct quality assurance purpose:

- A field blank is a sample of analyte-free water opened in the field and exposed to the same sampling conditions as the environmental samples collected at each sampling site. Field blanks are transferred from one clean container to another, passed through automatic equipment, or otherwise exposed to environmental conditions at the sampling site. They are then preserved and shipped to the laboratory with field samples. For dissolved metal samples that involve field filtration through a 0.45 micrometer (µm) filter, the field blank is processed as a sample through a new disposable filter setup and then preserved. This also serves as an equipment blank (see below).

  At a minimum, the field blank container is opened at the sampling site and exposed to the air for approximately the same time as the environmental samples, to identify any airborne contaminants of interest. It is then capped, labeled, and sent to the laboratory with the other samples. One field blank should be collected per sampling day or per 20 samples (whichever is greater).

  Field blanks are treated as regular samples in all respects, including exposure to sampling station conditions, storage, preservation and filtration, if applicable. The purpose of these samples is to determine if any of these conditions or processes can cause sample contamination. They help to assure that artifacts are recognizable and are not mistaken as real data.

- A trip blank is a sample of analyte-free water that is taken from the laboratory to the sampling site and transported back to the laboratory without having been opened and exposed to the sampling environment. A trip blank should be prepared for each type of container and preservative used to collect environmental samples. Trip blanks are used to identify potential contamination from the container and preservative during transportation, handling, and storage and analysis rather than during sample collection and processing.

Trip blanks are prepared by the analytical laboratory using deionized, distilled water with preservative added as required for each environmental sample. One trip blank for each type of analyte/preservative/container should be in each ice chest. They are transported, unopened, to the field with other sample containers, handled like environmental samples and shipped to the laboratory for analysis with the collected samples.

- An equipment blank is made by rinsing sampling equipment with analyte-free water after a sample has been collected and the equipment cleaned for reuse, but before resampling. Equipment blanks, sometimes referred to as "rinsate blanks," are used to document adequate decontamination of the sampling equipment. This is especially important with automatic sampling equipment or equipment used for splitting, transferring or otherwise handling environmental samples. One equipment blank should be collected per sampling day or per 20 samples (whichever is greater).

- A temperature blank is a small sample bottle filled with analyte-free water that is placed in each cooler. Upon arrival at the laboratory, the temperature of this vial is measured to assure that proper refrigeration of samples has been maintained during storage and transportation. The temperature is recorded but the blank is not analyzed and does not measure introduced contamination. One temperature blank should be in the transport cooler.

- A field duplicate is a duplicate environmental sample taken at the same time under identical circumstances to assess field sampling precision and homogeneity. Each sample is treated identically throughout field and laboratory analytical procedures. Field duplicates should be collected at a frequency of one for every 20 samples or per day (whichever is greater).

4.3.2 Interpreting the Data from Blank Samples

Blank samples are analyzed in the lab to evaluate the presence or absence of measurable contamination. Qualifier codes are assigned codes to data points that, based on the blank samples, may have been contaminated. Qualifier codes indicate to the data user that chemicals were detected in the associated blank and that the sample results may have been contaminated. Depending on the relative magnitude of blank contamination, affected data points may have to be corrected or rejected.

If a chemical is not measured in the blank at a concentration greater than or equal to the sample-specific Method Detection Limit (MDL); use the MDL times the dilution factor if the sample was diluted for analysis), no blank validation code is assigned. If a chemical is measured in the blank at a concentration greater than or equal to the MDL then all results for that chemical in samples obtained after the last blank with a result less than the MDL will be reviewed and a validation code of "B1" or "RB1" will be assigned according to Table 4.3.3-1.

Table 4.3.3-1 Blank Validation codes

Concentration in Blank	Data Point Flag	Corrective Action
Blank conc. < MDL	none	None
Blank conc. ≥ MDL and ≥ 5% of Sample conc.	CSBl	Data point flagged, corrected by subtracting blank conc. identified as suspect, and used with caution.
Blank conc. ≥ MDL and < 5% of Sample Concentration	CBl	Data point flagged and corrected by subtracting blank concentration.
Blank conc. ≥ MDL and Sample Concentration < MDL	RBl	Data point flagged and rejected.

4.3.3 Chain of Custody

A formal chain of custody is required. The receiving laboratory shall acknowledge receipt of the samples by date stamping the submittal forms and providing copies of the stamped forms to the person delivering the samples.

5.0 DATA ASSESSMENT AND EVALUATION

Building upon the Consent Order and the cited national guidance from EPA, this Plan is intended to be a living document. By allowing the Plan, and the sampling, monitoring, mitigation and restoration requirements set forth therein, to be modified or discontinued based on the continuous collection and assessment of groundwater, perched water, surface water, soil and vegetative data, the goals and objectives of the Plan will be met and the Incident site, flow path and affected resources ultimately restored to their pre-Incident usage condition.

Significant surface water, soil and vegetative data already has been collected. Treatment, mitigation, or corrective action shall commence as outlined herein. At the end of one year, and following Crestwood's submittal of its groundwater, perched water, surface water and soils reports, EPA and Crestwood will meet to review the data, and Crestwood's recommendations to continue, modify or discontinue monitoring, restoration, and mitigation.

At the outset of this Plan, no groundwater or perched water data in the vicinity of the Incident flow path or in the unnamed drainage has been collected and evaluated. By including a perched water and groundwater sampling and monitoring program in this Plan, including the locations for five monitoring well locations, EPA and Crestwood will be able to determine whether and to what extent the large percentage of Incident fluids located in the unconsolidated materials beneath the fluid flow path are contributing to the high chloride levels at the upper monitoring stations in the unnamed drainage.

In one year, it will be feasible for representatives of EPA and Crestwood to discuss the laboratory results from the data collection effort, and for Crestwood to suggest any additional perched water, groundwater and/or surface water remediation proposals, as necessary and appropriate. Permitting the parties to gather and interpret another year of information will also enable the parties to further discuss future monitoring program modifications, conditions under which additional monitoring and mitigation can end, and other topics, should such discussion be necessary.

This Plan encompasses two numeric action levels for chloride at two surface water monitoring stations. Specifically, if a measured concentration for chloride at the Lake 1 station exceeds 100 mg/L, and/or the measured concentration for chloride at the Creek to Bay station (see Exhibit A) exceeds 230 mg/L, Crestwood will: (i) immediately notify EPA; (ii) perform four consecutive weekly resamples; (iii) and within 30 days following the receipt of laboratory data from the final weekly sample, notify EPA of the cause and submit to EPA for approval a plan for any recommended mitigation or corrective action if the 30-day average exceeds the goals and objectives at one or both of the sampling locations.

6.0 DATA MANAGEMENT AND COMMUNICATION

This Plan was written with the expectation that regular communication between EPA and Crestwood will occur, along with dissemination of laboratory results for surface water, perched water, groundwater, soils and vegetation that are obtained by each party. Consistent with the Consent Order, Crestwood will assume lead responsibility for disseminating the field data to EPA, the MHA Nation, the Corps and BIA, including in electronic format when available. Crestwood will maintain and keep current a database for collected data. The database will be accessible by EPA via inquiry though Crestwood. Requests for information will be processed by Crestwood in a timely manner. The database should be set up to readily accept new field observations, data, questions and suggestions. Crestwood will assign a staff member to regularly manage the database and provide responses, as appropriate. Consistent with the Consent Order, Crestwood will provide quarterly data monitoring reports to EPA, the MHA Nation, the Corps and BIA. Initially, it is expected that the first quarterly report would include the first three months of field and laboratory data, and be provided to EPA, the MHA Nation, the Corps and BIA within four weeks of the quarter's end. The first year and quarterly data monitoring reports will include field data forms, laboratory water quality reports, summary statistics of collected data, and site observations relevant to the post-Incident monitoring and remediation efforts.

This Plan recognizes that it may be necessary to modify this Plan as field investigations move forward and the database grows. If either Crestwood or EPA wishes to propose a modification, the party should notify the other in accordance with Section VII of the Consent Order. In the event a dispute arises between Crestwood and EPA concerning whether a modification to this Plan is appropriate, the parties agree to adjudicate their dispute pursuant to Section X of the Consent Order. However, prior to initiating the dispute resolution provisions outlined in the Consent Order, Crestwood and EPA agree to attempt to resolve any dispute amicably in the first instance by meeting in person.

In addition, if there is the need for a group teleconference, Crestwood will arrange for this to occur promptly, so that monitoring can reflect any immediately necessary changes (this will be especially relevant for surface water sampling, which will be performed monthly or more frequently relative to wet weather conditions).

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