Former Acme Power Plant

WDEQ/VRP Site #58.220

PS #0793

Surface Water and Groundwater Interaction Study

Prepared for:

Wyoming Department of Environmental Quality

Voluntary Remediation Program

WWC ENGINEERING

June 2021

FORMER ACME POWER PLANT
WDEQ/VRP SITE #58.220 (PS #0793)
SURFACE WATER AND GROUNDWATER INTERACTION STUDY

Prepared for:	Voluntary Remediation Program Solid and Hazardous Waste Division Wyoming Department of Environmental Quality 200 West 17th Street, 2nd Floor Cheyenne, WY 82002
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1.0 INTRODUCTION

Wyoming Department of Environmental Quality/Voluntary Remediation Program (WDEQ/VRP) contracted WWC Engineering (WWC) to conduct a surface water and groundwater interaction study (the Study) at the Former Acme Power Plant (VRP Site #58.220). The location of the Former Acme Power Plant (the Plant) in relation to Sheridan, Wyoming is shown on Figure 1.

The Plant was used as a coal-fired power plant from 1910 to 1976. As a power plant, water from the Tongue River was diverted into the cooling tunnel underneath the Plant to condense steam. Once the water condensed the steam, it was returned to the cooling tunnel and, subsequently, the Tongue River. The proximity of the Plant to the Tongue River is depicted in Figure 2. The process of condensing steam utilizing the cooling tunnel is depicted in the Wyoming State Engineer's Office (SEO) document P50590.0E for a non-consumptive industrial water right (provided in Attachment A).

The sheet pile weir was placed in the river channel to raise the water elevation of the Tongue River for diversion through the Plant cooling tunnel. Though it is unknown if the weir was constructed as early as the Plant, it is assumed the sheet pile weir has been in place since nearly the beginning of Plant construction. Photograph B-1 (Attachment B) depicts the cooling tunnel excavation in 1910. Photograph B-2 depicts the rear of the Plant in 1947 where the weir and headgate structure to the cooling tunnel are clearly identifiable. Photograph B-3 shows the operational Plant and functional weir in 1973.

Since operations ceased at the Plant, the condition of the weir has deteriorated. The current condition of the weir is shown in Photograph B-4 (June 2021). The inlet and outlet of the cooling tunnel have mostly filled with silt. Photograph B-5 shows the current condition of the cooling tunnel inlet. Photograph B-6 shows the cooling tunnel outlet in relation to the inlet. As shown in the photos, static water is typically present in the cooling tunnel. Photograph B-7 and B-8 show the sedimentation at the cooling tunnel inlet and outlet, respectively.

The Study was solicited under Professional Services (PS) Contract #0793. The scope of work (SOW) included a topographic survey of the Plant cooling tunnel headgate, weir structure, and the adjacent Tongue River channel; installation of three transducers to develop hourly water level hydrographs from December 2020 through June 2021; and collection of three river sediment samples within the river and near the weir structure for chemical analysis since the tunnel could provide a pathway for contamination to be transported from the Plant. The following Study examines the current relationship between the weir, the cooling tunnel, the Tongue River, and groundwater.

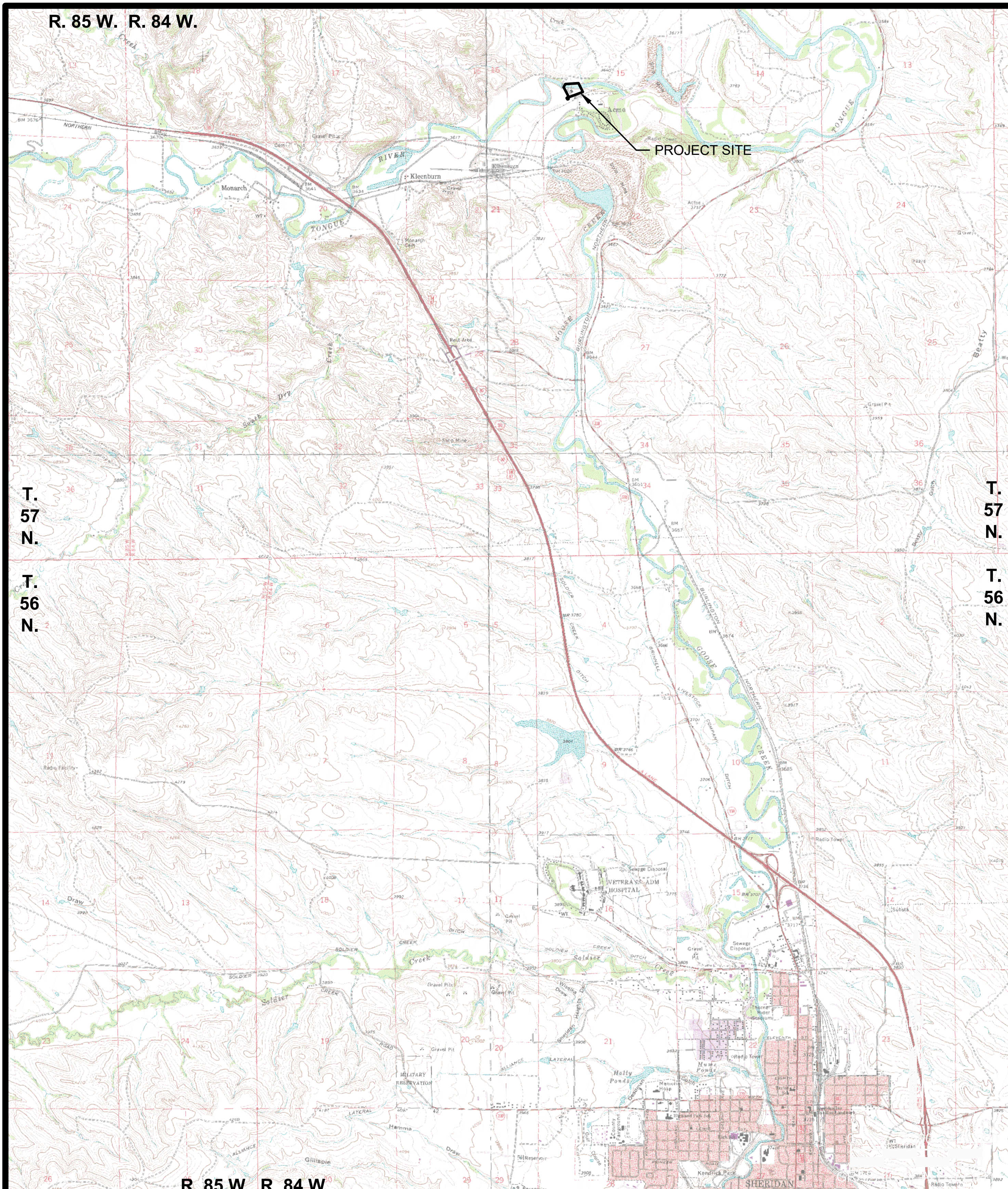

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FIGURE 1. PROJECT SITE IN RELATION TO SHERIDAN, WYOMING

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FIGURE 2. PROXIMITY OF PLANT IN RELATION TO TONGUE RIVER

2.0 SURVEY OF TUNNEL HEADGATE, WEIR, AND TOPOGRAPHY OF RIVER

To evaluate the current elevation differences of the weir and the cooling tunnel inlet and outlet, elevations were collected with a total station and survey-grade GPS. A profile view along the weir and tunnel outlet and inlet is shown in Figure 3 (A-A'). As shown in the profile view, the current elevations of the weir in the center of the river are approximately the same as the elevation of the sediment built up directly in front of the tunnel outlet (approximately 3596.61 feet above mean sea level [ft amsl]). The sediment in front of the tunnel inlet is slightly higher at 3597.10 ft amsl. Sediment and debris have built up along the south riverbank to an elevation of approximately 3598.25 ft amsl. Therefore, the river elevation must rise to at least 3598.25 ft amsl at the weir to reach and flood the cooling tunnel.

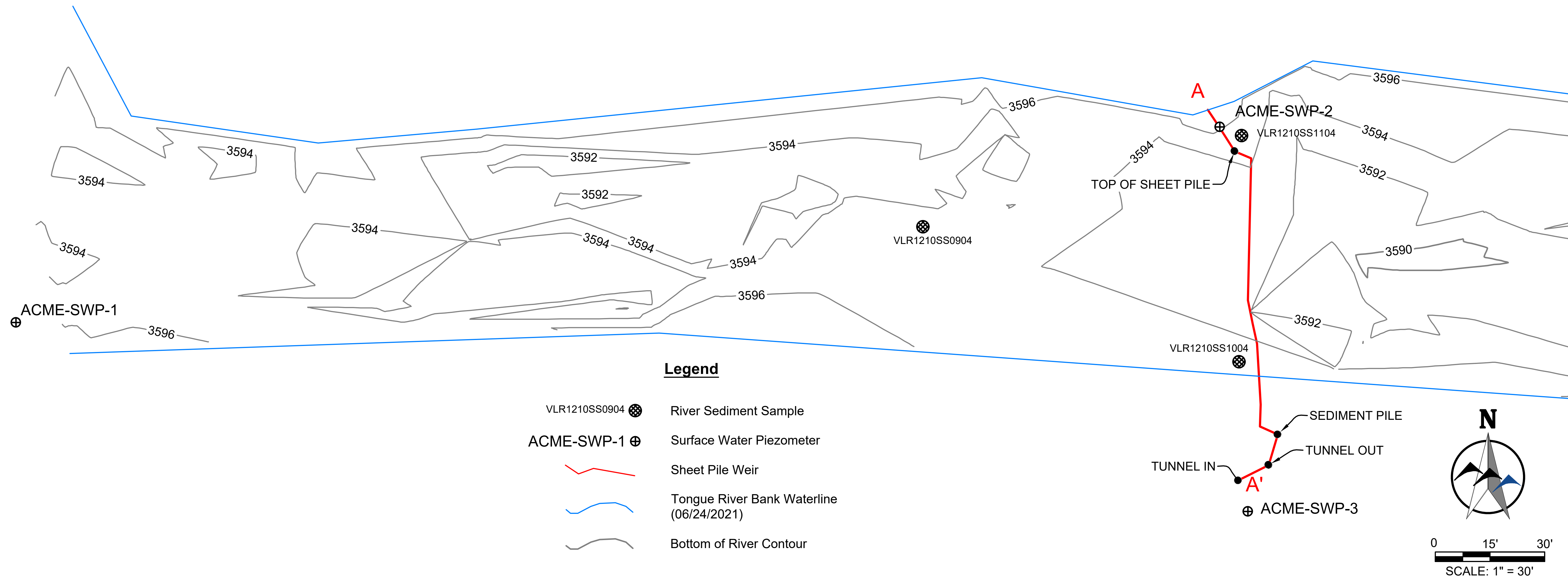
A bathymetric survey of the river channel was completed from approximately the upstream Property boundary to the downstream Property boundary (the approximate Property boundary is depicted in Figure 2). The bathymetric survey was utilized to develop topographic contours of the riverbed. As shown by the topographic contours in Figure 3, sediment has accumulated behind the weir mostly along the northern bank. This may correlate to the higher elevations of the weir towards the northern bank. A deeper channel has developed along the southern bank, which may correlate to the low spot in the weir at approximately station 0+65 to 0+70 (shown in the profile view of Figure 3). A hole has developed just downstream of the weir due to the hydraulic jump.

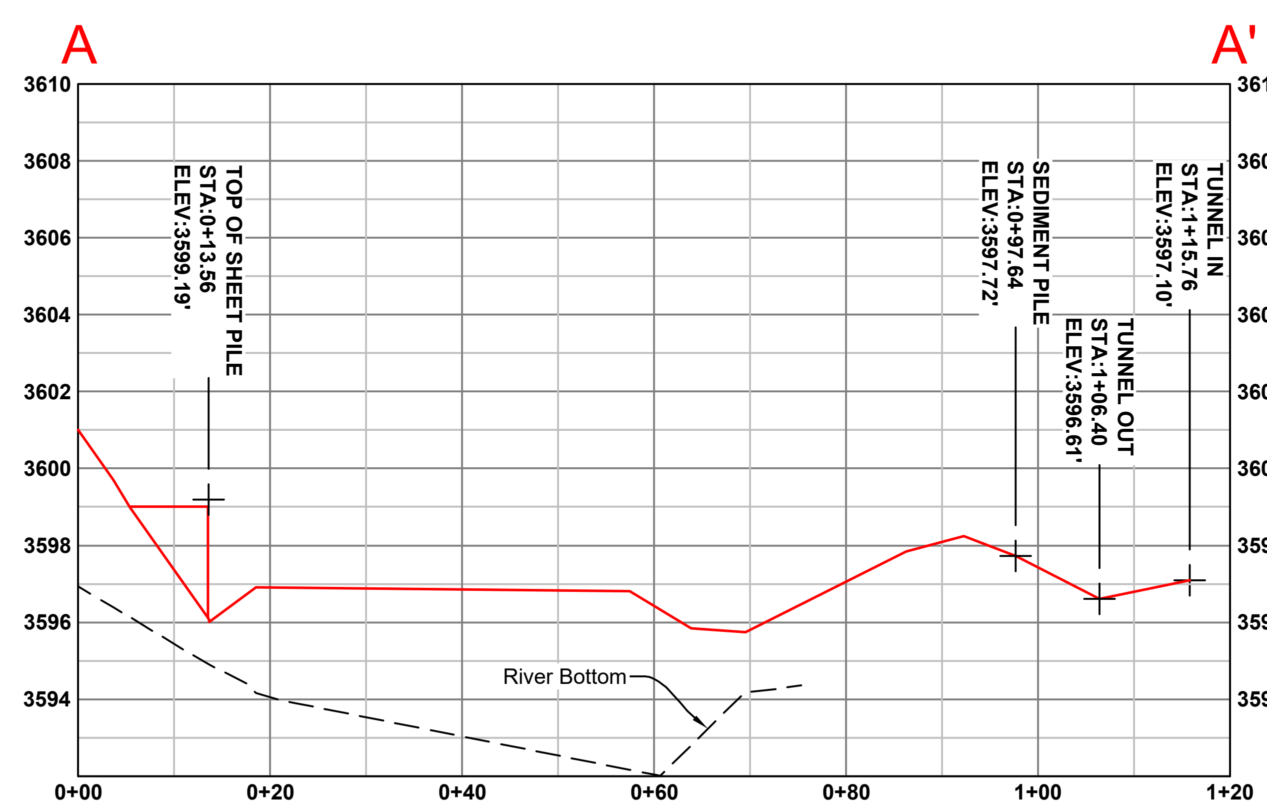
3.0 SURFACE WATER HYDROGRAPHS

Three surface water piezometers (ACME-SWP-1, ACME-SWP-2, and ACME-SWP-3) were installed in the Tongue River to collect water level measurements. The water levels were measured using Heron Instruments, Inc. dipperLog Nano vented transducers. The transducers were set to collect pressure readings on hourly intervals. The pressure readings were correlated to water depths. Continuous hydrographs were then developed based on the hourly water level readings. The piezometer locations are shown in Figure 3 and summarized in Table 1.

Table 1. Surface Water Piezometer Locations

Piezometer	Northing (WY83EC ft)	Easting (WY83EC ft)	Top of Casing Elevation (ft amsl)	Description of Location
ACME-SWP-1	1936610.52	1401440.87	3609.79	Upstream at bridge near south bank
ACME-SWP-2	1936665.79	1401769.79	3602.13	Downstream side of weir near north bank
ACME-SWP-3	1936558.73	1401778.73	3608.43	Stagnant water inside cooling tunnel





NO.	REVISION	BY	DATE

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WDEQ/VRP
Former Acme Power Plant Surface Water and Groundwater Interaction Study
FIGURE 3. TONGUE RIVER TOPOGRAPHY AND WEIR PROFILE
Sheridan County, Wyoming

DESIGNED BY: LMR
DRAWN BY: RAV
CHECKED BY: LMR
DATE: ----

SHEET
1 OF 1

Upon analyzing the pressure data from the transducers, ACME-SWP-1 and ACME-SWP-2 froze between mid-December 2020 and mid-March 2021. The data for these months from these transducers were not usable. The maximum water elevation in ACME-SWP-1 was approximately 3600 ft amsl in May 2021. The maximum water elevation in ACME-SWP-2 was approximately 3698 ft amsl, 2 feet lower on the downstream side of the weir.

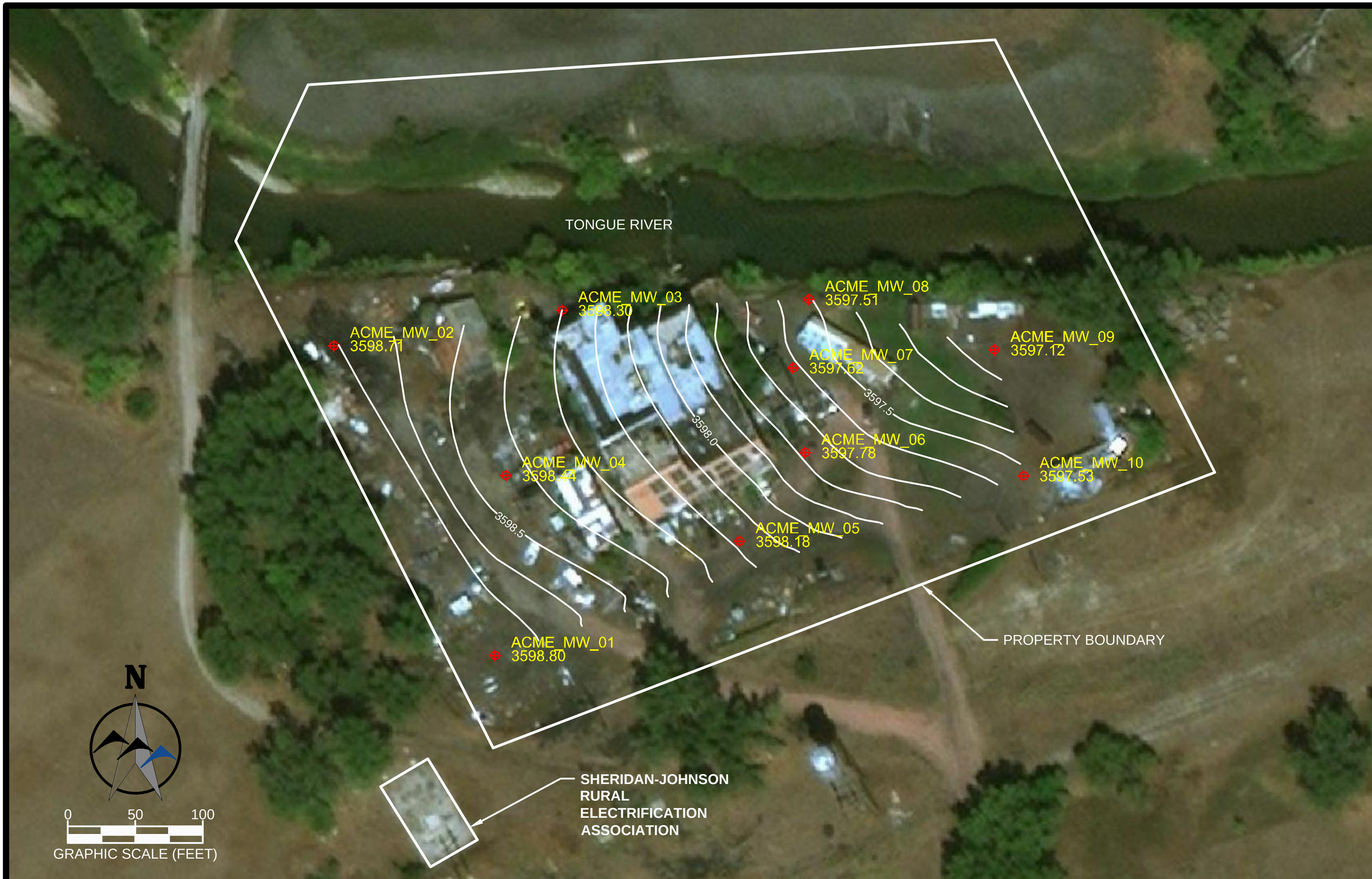
The water did not freeze in the ACME-SWP-3 piezometer in the cooling tunnel. All data were usable. The water elevations ranged between 3597 ft amsl and 3599 ft amsl. The water level does not appear to spike in the spring in response to surface water runoff as drastically as the surface water levels in the Tongue River. The surface water hydrographs are provided in Attachment C.

Surface water hydrographs were compared to the ongoing groundwater hydrographs developed as a portion of site assessment activities under EPA Site Assessment Grant BF96845801. Ten monitor wells were installed as a component of site assessment activities. Groundwater samples were collected from all ten wells on a quarterly basis. Hourly water level measurements were obtained, and groundwater hydrographs were developed, for five of the ten monitor wells (ACME-MW-03, ACME-MW-04, ACME-MW-05, ACME-MW-07, and ACME-MW-09). Figure 4 shows the locations of the monitor wells in relation to the Plant. Additionally, the June 2020 potentiometric surface is depicted in Figure 4. The June 2020 potentiometric surface developed from the monitor wells is approximately 3598.0 ft amsl near the mouth of the cooling tunnel. This correlates to the measured water levels in the ACME-SWP-3 piezometer in May and June 2021.

Continuous groundwater level hydrographs from December 2019 to May 2021 are provided in Attachment D. As shown by Figure 4, the two nearest wells and hydrographs of the five to the cooling tunnel (and ACME-SWP-3) are ACME-MW-03 and ACME-MW-07. The water levels in ACME-MW-03 range between 3598 ft amsl and 3599 ft amsl in May 2021. The water levels in ACME-MW-07 range between 3597 ft amsl and 3598 ft amsl in May 2021. The water levels in ACME-SWP-3 range between 3597.5 ft amsl and 3598.5 ft amsl in May 2021. This correlates to the potentiometric surface since ACME-SWP-3 is between ACME-MW-03 (upgradient) and ACME-MW-07 (downgradient).

Based on the following evidence from monitoring water levels, WWC believes that the stagnant water in the cooling tunnel is derived from groundwater:

1. Water in the cooling tunnel did not freeze during the winter months even though it is relatively shallow and isolated from the Tongue River.
2. The water levels in the cooling tunnel correlate to the potentiometric surface developed from groundwater monitoring wells.



POTENTIOMETRIC SURFACE

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FIGURE 4. JUNE 2020 POTENTIOMETRIC SURFACE AND MONITOR WELL LOCATIONS

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4.0 RIVER SEDIMENT SAMPLING

River sediment samples were collected from the Tongue River to assess the chemical constituents and potential contamination. The sediment samples were collected to supplement river sediment data obtained during site assessment activities under EPA Site Assessment Grant BF96845801 (WWC 2021). Eight river sediment samples were collected along the south bank of the Tongue River during site assessment. All sediment samples were collected above the Tongue River waterline. Contamination was detected near the inlet and outlet of the cooling tunnel. Due to this, it was determined that sediment samples should be collected near the weir. Since the additional sediment samples were meant to supplement site assessment data, the naming convention and lab analyses were based on those used during site assessment (WWC 2021). The primary sampling difference was that the sediment samples collected for the Study were collected below the water surface. Table 2 summarizes the sediment sample locations. These locations are depicted on Figure 3.

Table 2. River Sediment Sample Locations

Sample Name	Northing (WY83EC ft)	Easting (WY83EC ft)	Description of Location
VLR1210SS0904	1936757.0	1402112.8	Upstream of weir in sand bar
VLR1210SS1004	1936749.7	1402148.5	Upstream of weir near south bank
VLR1210SS1104	1936778.7	1402149.7	Downstream of weir near north bank

The same lab analyses used for site assessment were also used for the analytical samples collected for the Study. Table 3 summarizes the laboratory analyses. The analytical results are provided in the laboratory report in Attachment E.

The laboratory analytical results were compared to WDEQ/VRP cleanup levels for residential soil and migration to groundwater. The comparisons to WDEQ/VRP cleanup levels are provided in Attachment F. Table 4 and Table 5 summarize the exceedances of residential and migration to groundwater cleanup levels, respectively. Tables 4 and 5 exclude the analytes for which the method detection limits were greater than the cleanup levels, unless there was a detection of an analyte above the method detection limit in one of the three samples. The statewide background concentrations for arsenic, lead, and selenium were used for comparison (WDEQ/VRP 2015).

The three analytes that exceeded residential soil cleanup levels (arsenic, iron, and manganese) are likely naturally occurring. Based on the site assessment results, iron and manganese are especially high in concentration, even in upgradient samples from the Plant. However, the contaminant of concern (COC) analysis completed for site assessment determined that arsenic and iron are COCs for sediment at the Plant (WWC 2021).

Table 3. River Sediment Sample Locations

EPA Method	**Reasoning for Analysis**
EPA 8015M DRO+ORO	Comparison of analyte concentrations to previous sediment analyses
EPA 8015M GRO	Comparison of analyte concentrations to previous sediment analyses
EPA 8270 SVOCs	Comparison of analyte concentrations to previous sediment analyses
EPA 8270 SIM PAHs	Comparison of analyte concentrations to previous sediment analyses
EPA 8260 VOCs	Comparison of analyte concentrations to previous sediment analyses
EPA 8082 PCBs	Comparison of analyte concentrations to previous sediment analyses
EPA 6010 Metals	Comparison of analyte concentrations to previous sediment analyses
EPA 7471B Mercury	Comparison of analyte concentrations to previous sediment analyses
EPA 8151A Pentachlorophenol (only)	Comparison of analyte concentrations to previous sediment analyses

Table 4. Residential Soil Cleanup Level Exceedances

Analyte	**Residential Soil Cleanup Level (mg/kg)[1]**	**ACME-SS-09 VLR1210SS0904**	**ACME-SS-10 VLR1210SS1004**	**ACME-SS-11 VLR1210SS1104**
Arsenic	12[2]	8.2	**28.8**	**15.3**
Iron	55,000	**79,100**	**158,000**	**155,000**
Manganese	1,800	693	**2,680**	**2,540**

[1]Bold values exceed WDEQ/VRP cleanup levels.
[2]Statewide background concentration (WDEQ/VRP 2015).

As shown in Table 5, additional analytes exceeded migration to groundwater cleanup levels. Several of these included metals, which may be naturally occurring. The only analytes in Table 5 identified as COCs during site assessment are arsenic and iron (WWC 2021). However, tetrachloroethene (PCE) was detected in sediment samples as well as surface water samples collected from the cooling tunnel at sampling location ACME-SW-02 (WWC 2021). This indicates that the low-level detections of PCE in the river sediment samples near the weir may have been transported from the cooling tunnel.

Table 5. Migration to Groundwater Cleanup Level Exceedances

Analyte	Migration to Groundwater Cleanup Level (mg/kg)[1]	ACME-SS-09 VLR1210SS0904	ACME-SS-10 VLR1210SS1004	ACME-SS-11 VLR1210SS1104
Antimony	0.27	<0.47	<2.1	**2.8J**
Arsenic	12[2]	8.2	**28.8**	**15.3**
Barium	82.6	**634**	**132**	**203**
Cobalt	0.453	**10.1**	**20.2**	**17.5**
Iron	7.59	**79,100**	**158,000**	**155,000**
Manganese	3.265	**693**	**2,680**	**2,540**
Mercury	0.105	**0.13**	<0.0090	<0.0088
Tetrachloroethene	0.0021	<0.00170	**0.00309J**	**0.00234J**

[1]Bold values exceed WDEQ/VRP cleanup levels.
[2]Statewide background concentration (WDEQ/VRP 2015).

5.0 CONCLUSIONS

WWC completed the Study to evaluate the interaction between surface water and groundwater at the Site. In particular, WWC assessed the relationship and impacts that the Plant cooling tunnel and weir have on groundwater and the Tongue River. To assess these impacts, WWC completed the following SOW:

1. Completed a topographic survey of the weir, cooling tunnel, and river channel.
2. Collected and evaluated long-term water level measurement from surface water piezometers and groundwater monitor wells.
3. Collected river sediment samples near the weir for chemical analysis.

Based on the results of the SOW, as discussed in this Study, WWC has made the following conclusions:

- The current elevations of the cooling tunnel inlet and outlet are approximately the same elevation as the top of most of the weir; therefore, the Tongue River could reach elevations that would flood the cooling tunnel.

- Sediment and debris have accumulated along the south bank in front of the cooling tunnel. The sediment and debris likely provide the only protection from the Tongue River flooding the cooling tunnel.

- Sediment has accumulated behind the weir, as evidenced by the riverbed topography. The depth of accumulated sediment may be as much as 2-3 feet.

- A hole has developed immediately downstream of the weir due to the hydraulic jump. based on the measured water elevations in May and June 2021 at the weir (up to 3598 ft amsl), the depth of water downstream of the weir may be as much as 8-10 feet during spring runoff.

- Measurement of surface water levels along the river determined that the difference in the Tongue River water elevation between the bridge upstream and at the weir is approximately 1-2 feet.

- The water elevation in the cooling tunnel tends to be approximately 1 foot higher than the water elevation at the weir. The water elevation in the cooling tunnel also does not fluctuate as drastically in the spring. Water temperatures in the cooling tunnel did not decrease below freezing. Water elevations in the cooling tunnel correlate to potentiometric surfaces developed from groundwater monitoring. Therefore, the water in the cooling tunnel is likely derived from groundwater.

- High concentrations of iron and manganese in the river sediments are likely naturally occurring.

- Low-level detections of PCE in river sediments near the weir are likely from contamination transport from the tunnel based on sampling results from site assessment (WWC 2021).

6.0 REFERENCES

WWC Engineering (WWC), 2021, Site Assessment Final Report: Former Acme Power Plant VRP #58.220 (PS #0807) EPA Site Assessment Grant BF96845801.

Wyoming Department of Environmental Quality, Voluntary Remediation Program (WDEQ/VRP), 2018, Fact Sheet 12D, Soil and Groundwater Cleanup Level Tables, October 2018.

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