Coal Combustion Residual Closure Analysis

Cost and Jobs Associated with Different Closure Alternatives

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1. Introduction

1.1 Background and problem statement

This report provides an analysis of closure and cleanup of coal combustion residuals located at three coal-fired steam electric generating stations in the U.S., evaluating the benefits, cost, and direct job creation under two differing closure plans for each facility. The power stations evaluated include Michigan City Generating Station (MCGS), Indiana; Grainger Generating Station, South Carolina; and Colstrip Steam Electric Station, Montana.

Coal combustion residuals (CCR) are generated from the combustion of coal and include fly ash and bottom ash, boiler slag, and flue gas desulfurization materials. CCR is historically one of the largest industrial waste streams generated in the U.S. The U.S. Environmental Protection Agency (EPA) estimated in 2012 that over 470 coal-fired electric utilities burn over 800 million tons of coal, generating approximately 110 million tons of CCR annually in the U.S.[1] CCR disposal was not federally regulated until promulgation of the federal CCR Rule (40 CFR Part 257, Subpart D) in 2015. Prior to this, disposal of CCR was commonly only regulated by states permitting the power station facility. Given the lack of regulatory standards for constructing CCR disposal areas and monitoring CCR waste, both the construction and condition of CCR waste units and pollution caused by the CCR were widely unreported until recently.

Historically much of the CCR generated has been disposed of in unlined or poorly lined surface impoundments often referred to as coal ash "ponds." CCR surface impoundments hold a mixture of CCR and process water by design, because CCR is commonly managed as a slurry at power stations to allow it to be piped to typically unlined basins. Where power stations were constructed adjacent to rivers and lakes for access to cooling water, the surface impoundments were often also sited adjacent to those rivers and lakes. It is also common for impoundments near those surface waters to be located in the floodplain and/or in areas of shallow groundwater.

Groundwater pollution is common from unlined and poorly-lined surface impoundments as shown in the groundwater quality analytical data that have been required to be collected since the federal CCR rule came into effect (40 CFR § 257.90). Contact between groundwater and CCR provides one mechanism that leaches contaminants from CCR to groundwater. Seepage of both CCR slurry process water and precipitation in the impoundment provides another mechanism by which CCR leachate may impact groundwaters. CCR leachate is commonly high in arsenic, boron, lithium, cobalt, manganese, molybdenum, sulfate, and other chemical elements[2] that are either toxic or otherwise render water unusable for drinking because of salinity and taste. CCR-contaminated groundwater may flow to drinking water wells or pollute nearby surface water.

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[1] EPA, 2015. 40 CFR Parts 257 and 261 [EPA–HQ–RCRA–2009–0640; FRL–9919–44– OSWER] RIN–2050–AE81. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities. Federal Register / Vol. 80, No. 74 / Friday, April 17, 2015 / Rules and Regulations.

[2] See for instance 40 CFR Appendix III to Part 257 - Constituents for Detection Monitoring and Appendix IV to Part 257 - Constituents for Assessment Monitoring.

In addition to disposal in surface impoundments, other common CCR management practices include beneficial reuse and landfill disposal. CCR disposal in engineered landfills constructed under the standards found at §257.70 for new and laterally expanded landfills typically provides superior environmental protection to surface impoundments because the CCR is drained and stored relatively dry and because the landfills have liners, leachate collection systems, and are constructed above the water table.[3] A substantial volume of CCR is also beneficially reused as a raw material in products such as concrete or drywall. CCR reused in these types of applications is "encapsulated," meaning it is bound with other materials that limit the exposure to and leaching potential of contaminants contained in the CCR.

At each of the three power stations evaluated in this report, CCR was disposed of in unlined surface impoundments that are in contact with groundwater. Each site also has documented groundwater pollution resulting from leaching of the CCR by both groundwater contact and seepage from the impoundments. As stated previously, impact to groundwater where CCR is stored in unlined or inadequately-lined surface impoundments is a common situation. As such the three sites evaluated here are representative of CCR disposal and contamination issues prevalent in the U.S.

Regulatory agencies in the U.S. and the public are faced with evaluating electric power industry plans to address groundwater pollution and choose appropriate closure methods for surface impoundments at hundreds of power stations nationwide. The number of impoundments undergoing closure has significantly increased in recent years as electric utilities have retired coal-fired power stations because they are uneconomical to operate due to a combination of competition from power generated from renewables and cheap natural gas and due to the cost required to retrofit coal-fired power stations to comply with current environmental regulations. In addition, due to requirements in the 2015 federal CCR rule, most coal ash surface impoundments (including all unlined impoundments and those whose bases are located within five feet of groundwater) must initiate closure by April 2021, unless they receive a specific extension to operate from EPA. The result is that decisions are being made today that will determine the long-term human and environmental risks as well as permanence of the closure methods used for surface impoundments.

The closure method used for a CCR surface impoundment determines to a large degree whether or not the source of pollution to groundwater is eliminated. The electric power industry has shown a preference for cap-in-place closure of CCR impoundments because it is relatively easy to implement as well as relatively low cost. Cap-in-place involves dewatering the impoundment of its surface liquid and then grading the top of the CCR to provide drainage and installing a low permeability over-liner or "cap" typically made of a combination of plastic "geomembrane" and soil and drainage layers. Cap-in-place eliminates most of the precipitation percolation leaching of contaminants from the CCR but does not prevent leaching by groundwater contact with CCR underneath the cap if the ash in the impoundment is in contact with the aquifer. Cap-in-place may also leave CCR surface impoundments vulnerable to catastrophic failure due to floods or cap failure during extreme storms. The risk of impoundment failure is exacerbated by the fact that impoundments are commonly constructed adjacent to surface water features and in floodways. Several high-profile, catastrophic surface impoundment failures have

[3] These are some of the ideal criteria for building a CCR-compliant landfill. However, it is important to note that not all landfills have these safeguards, and EPA has grandfathered existing unlined landfills.

occurred, for instance the 2008 Kingston Fossil Plant spill in Tennessee and 2014 Dan River coal ash spill in North Carolina.

Other common closure methods for surface impoundments include excavation and removal of CCR either to a CCR landfill or to be beneficiated to produce raw materials for reuse; both are commonly referred to as “clean closure.” Removal of CCR to landfills or the beneficial reuse market typically mitigates both the source of groundwater pollution and risk of catastrophic release from impoundment dike failure due to floods or other extreme events.

1.2 Study goals and objectives

The goal of the analysis presented in this report is to evaluate the site conditions at the three power stations studied, focusing on the extent and sources of groundwater contamination, and assessing the status and construction of impoundments or other waste units that store CCR at the site. In this evaluation we identify which CCR waste units are likely to pose an ongoing risk of groundwater pollution, catastrophic failure, or other long-term risk.

For each of the three power stations studied we then compare two different closure and groundwater corrective action alternatives as follows:

Alternative 1: minimal removal/cap-in-place closure plan
In the first closure alternative for each power station facility, most of the CCR is left in the surface impoundments in which it was originally disposed. Long-term groundwater monitoring is needed to ensure that contaminants do not spread or present unacceptable risk to humans or the environment. There may also be a need for long-term controls or remediation to address groundwater pollution.

Alternative 2: comprehensive cleanup and closure plan
The second alternative for each power station facility represents a high-level cleanup that excavates CCR and other contaminated materials from existing impoundments if they are in contact with groundwater or pose a long-term threat to water quality. Excavated CCR is transported and disposed of in federally compliant CCR landfills or used beneficially. This alternative is designed to eliminate the source of pollution to groundwater and surface water. There may be a need for long-term controls or remediation to address residual groundwater pollution. Typically, comprehensive cleanup provides a permanent and effective remedy of the source of groundwater contamination.

Both CCR waste unit closure (capping, removal, etc.) and groundwater corrective action needs are considered for each alternative; for simplicity we will refer to both of these as “closure” in the discussion of cost and jobs created. The relative benefits and drawbacks to the two closure alternatives are evaluated. The direct cost of each closure alternative is estimated, and the potential jobs created during closure and post-closure construction and related activities are evaluated. The cost and jobs are of interest because power stations often provide significant employment and tax base to communities located near power stations, and when the power station is retired, the economic impact to the community can be devastating. The closure and cleanup activities can provide an economic engine for these communities at exactly the time when the jobs and expenditures for power generation cease.

1.3 Report organization

The report is organized as follows:

> **Section 1** provides an introductory background of CCR disposal issues and a summary of the goals and objectives and methods of this study.
>
> **Sections 2, 3, and 4** provide discussion and results of the closure analysis for each power station. The section for each power station begins with a site overview of the power station facility, a summary of existing extent of contamination and special considerations therein, a description of the two closure plan alternatives evaluated, and cost and jobs analysis results. Results are described for each power station in each section as follows:
>
> **Section 2** Grainger Generating Station, South Carolina.
>
> **Section 3** Michigan City Generating Station, Indiana.
>
> For the Michigan City Generating Station we also provide a separate report in Attachment 3 describing potential redevelopment options and a roadmap that a grassroots community advocacy group could take to defining a preferred redevelopment option.
>
> **Section 4** Colstrip Steam Electric Station, Montana.
>
> **Section 5** provides references cited.

Tables are provided in Attachment 1. Large format figures are provided in Attachment 2. Several smaller graphics are included in the text below.

1.4 Methods used to estimate cost and jobs

We conducted an analysis to quantify the direct cost and job creation for two closure alternatives for each facility. Our analysis included developing cost and job schedules that illustrate capital and operation and maintenance (O&M) expenditures and construction and O&M related jobs over the course of the cleanup and post-closure timeline, depending on the nature of the proposed alternative. Methods used to estimate cost and jobs for each project component are described in the 'Cost analysis' and 'Jobs analysis' subsections and tables included in Sections 2, 3, and 4 below. In general, we developed independent capital and O&M costs for each closure plan alternative, except for Grainger Station, Alternative 2. Clean Closure (Santee Cooper's completed cleanup), where total capital costs provided by Santee Cooper were used. Jobs quantified as part of this analysis are denoted as Full-Time Employee, or FTE, which represents the number of jobs per position per year. Our analysis was conducted under a set of assumptions made based on the data available for each site and the scope of the analysis, which was limited to direct costs and jobs. Cost and jobs indirectly linked to a particular cleanup effort (e.g., service industry costs or jobs catering to the cleanup workforce, rental equipment suppliers, etc.) were not considered as part of this evaluation.

We limited our cost and jobs analysis to the type and quantity of contaminants and waste identified in the site closure plans and the site characterization and investigative reports completed by the plant pursuant to state or federal requirements. No estimates were made for handling of additional contaminants that may be discovered during closure activities (e.g., asbestos, PCBs, fuel tanks and hydrocarbon-contaminated soil, or other hazardous material) and which is not described in the closure plan. Our analysis was also limited to site closure and land reclamation, focusing on the economic benefits of more comprehensive cleanup and closure. Any reclamation activities evaluated as part of the analysis were limited to grading and revegetation and did not include detailed reuse and redevelopment plans or institutional controls needed for specific reuse options. Plant decommissioning (building removal, demolition, salvage net costs, etc.) was not part of the evaluation.

Our analysis used a variety of methods and sources to quantify the capital costs and jobs associated with a particular cleanup effort. Fundamentally, our analysis used the material quantities for a particular activity (cubic yards of material excavated or dredged, gallons of water pumped, area of surface impoundment capped, etc.) combined with production rates and operational costs of a particular piece of equipment and labor rates to determine cost. Similar to the development of costs, the number of jobs were determined on a per-unit area or volume basis based on production rates of equipment and other references such as contractor quotes and assumptions. Some jobs, particularly annual O&M jobs, were determined on a cost-basis based on the median salary of a particular job position with additional inflation to account for taxes, benefits, space, and materials to better represent a full-time position. The types of jobs produced are categorized as skilled labor, unskilled labor, and professional. A specific list of jobs and roles would be developed prior to actual cleanup of a facility, but our analysis provides a representative comparison between cleanup alternatives. The results of the analysis, along with references, background information, calculation methodology, and assumptions for the cost and jobs are contained in the tables attached to this report.

2. Grainger Generating Station

2.1 Site overview

Grainger Generating Station was a former coal-fired power station located in the community of Conway, South Carolina. Constructed in 1966, the power plant had two units with an operating capacity of 170 megawatts. The plant operated until 2012 when it was retired by owner/operator Santee Cooper because it was uneconomical to comply with the new federal EPA Mercury and Air Toxics Standards (MATS). Santee Cooper is a state-owned electric and water utility, South Carolina’s largest power producer.

Figure 2-1 shows the layout of the facility while it was still operating in 2005. The Grainger facility was constructed adjacent to the Waccamaw River for use as cooling water. Coal ash produced at the plant was either beneficially reused (concrete/cement market) or stored in two 40-acre unlined surface impoundments constructed within the floodplain of the river. At the time the plant was decommissioned the ash ponds contained 1,750,000 tons (approximately 1,500,000 cubic yards) of coal ash.

Initially, Santee Cooper proposed a cap-in-place closure plan that would have provided some level of erosion protection with a concrete “vault” and cap for the CCR impoundments. There was significant public opposition to cap-in-place closure, including an official resolution by the Conway City Council opposing the plan and requesting excavation and removal. Several environmental groups, including Waccamaw Riverkeeper, the Coastal Conservation League, and the Southern Environmental Law Center, also sued to prevent cap-in-place. Santee Cooper reevaluated closure by excavation as well as their liabilities if capping in place. The various litigants reached a settlement requiring excavation and disposal of the coal ash by a combination of beneficial reuse in the concrete/cement market and disposal at a Class 3 landfill, at minimum, or a landfill having even more stringent controls. The settlement also required Santee Cooper to remove 1-foot of soil that underlaid the unlined impoundments. The closure plan, approved by S.C. Department of Health and Environmental Control (SC DHEC), included these elements and restoration of the impoundment area as a backwater wetland. Closure construction began in 2014 with excavating CCR from Pond 1, with a requirement to complete construction by 2023.

During the closure construction period, the site experienced several extreme weather events including the two highest-ever recorded floods of the Waccamaw River during hurricanes Matthew in October 2016 and Florence in September 2018. These events required a rapid and complex emergency response by Santee Cooper and made clear the long-term risk of catastrophic failure if the impoundments had been left capped in place. Emergency response actions during Hurricane Florence included construction of temporary dikes, silt fences, floating booms, and an emergency "AquaDam" completely surrounding Pond 2. Santee Cooper's response required having over 50 portable diesel pumps which were used to flood Pond 2 to equalize hydraulic pressure by pumping river water into the impoundment, in order to prevent dike failure and erosion of CCR. As the river levels rose, the pumping operations had to be moved to mobile barges because of a lack of dry land. Additionally, Santee Cooper had five hundred 1.5-ton bags of gravel ready to be airlifted by helicopter onto sections of the dike should failure begin to occur.

After Florence, water in Pond 1 in the area with remaining contaminated soil and all of Pond 2 had to be drained and the water treated to the degree possible. The last load of CCR was removed from Pond 2 in May 2019 and the last load of contaminated soil removed May 2020.

2.2 Contamination summary and cleanup considerations

The Grainger CCR impoundments created two significant environmental risks, one was presence of groundwater contamination, the most highly contaminated of which flows from the ponds towards the river, the second was the risk of catastrophic failure of the impoundments during a flood or other severe weather.

We did not review detailed site contaminant characterization data for the Grainger site because it has already undergone clean closure. Several National Pollutant Discharge Elimination System (NPDES) groundwater monitoring records were made available to us showing that arsenic was the primary contaminant of concern, which is common for CCR impacted groundwater. NPDES monitoring records[4] show arsenic contaminated groundwater between the impoundments and Waccamaw River at levels

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[4] Santee Cooper, 2018. Letter to S.C. Department of Health and Environmental Control Re: Santee Cooper Grainger Station – NPDES Permit #SC0001104 NPDES Groundwater and Surface Water Semi-annual Report for 2018. November 26, 2018; Santee Cooper, 2013. Letter to S.C. Department of Health and Environmental Control Re: Santee Cooper Grainger Station – NPDES Permit #SC0001104 NPDES Groundwater and Surface Water Semi-annual and Compliance Report for 2013. November 22, 2013.
Santee Cooper, 2019. Letter to S.C. Department of Health and Environmental Control Re: Santee Cooper Grainger Station – NPDES Permit #SC0001104 NPDES Groundwater and Surface Water Semi-annual Report for 2019. May 19, 2019.
Santee Cooper, 2020. Letter to S.C. Department of Health and Environmental Control Re: Santee Cooper Grainger Station – NPDES Permit #SC0001104 NPDES Groundwater and Surface Water Semi-annual Report for 2020. May 28, 2020.

between 6 and 337 times the federal human health maximum contaminant level (MCL). Sulfate and total dissolved solids (TDS), which are also commonly associated with CCR leachate, were also elevated in groundwater. This groundwater discharges directly to the Waccamaw River. The SC DHEC determined the arsenic contamination violated the S.C. Pollution Control Act. More recent NPDES reports show arsenic concentrations dramatically decreasing following removal of the CCR.

Groundwater contamination would have continued under a cap-in-place closure because the CCR would have remained saturated because the CCR in the impoundment was in continuous contact with groundwater. River flood events also cause periodic rise in the groundwater into the impoundments; the river may likewise rise into the impoundment during floods. The rise and fall of groundwater within the impoundments would have increased the leaching of contaminants from the coal ash into groundwater. Flow of contaminated groundwater into the river could potentially lead to accumulation of contaminants such as arsenic in sediment in the river channel owing to geochemical changes in the water as it flows into the river, although we do not know if data exist to show that this was occurring.

Under a cap-in-place closure, the potential would always exist for catastrophic failure of the CCR in the impoundments into surface water because they were located immediately adjacent to the Waccamaw River. The river is subject to frequent flooding from intense rainfall, especially during hurricanes. The perimeter dikes of Pond 1 and 2 were 15 and 13 feet above mean sea level, respectively[5]. For comparison, Hurricane Florence produced a flood stage of over 21 feet. The site also is a poor candidate for capping because the caps could easily be compromised by flooding either by damage from flood waters or debris. Additionally, the cap could float during rapid increases in river stage releasing CCR into the flood. Future flooding would have also caused reoccurring saturation and leaching of CCR if it had been capped in place.

The location of the Grainger impoundments presented an important consideration for closure design. The impoundments were poorly sited to begin with, both in contact with groundwater and adjacent to a river subject to frequent flooding. It is lucky that the impoundments survived their over 50-year lifespan. Cap-in-place closure would have presented a long-term risk to groundwater and potentially to aquatic life in the Waccamaw River. Additionally, the impoundments presented a very significant long-term risk of catastrophic failure during extreme weather. These risks created a significant long-term liability and maintenance cost for the caps, erosion controls, and emergency preparedness. Santee Cooper understood these risks and made the decision to remove the ponds.

2.3 Description of closure plan alternatives

Alternative 1. Cap-in-place

This closure plan would cap in place the CCR located in Pond 1 and 2. The major elements of the closure and post-closure plan include the following:

- Active CCR dewatering and surface water management,
- Construction of federal CCR Rule compliant cover system over 80 acres of Pond 1 and 2,
- Long-term monitoring of groundwater,
- Long-term cap maintenance,

[5] Santee Cooper, 2014. Amended Closure Plan Wastewater Ash Ponds Grainger Generating Station Conway, South Carolina. Prepared by Geosyntec Consultants, January 2014.

- Long-term surface water management.

This alternative does not exactly follow Santee Cooper's initial closure plan proposal because construction drawings for that proposal were not made available. However, this alternative provides a similar function with final cover systems provided for the entire acreage of Pond 1 and 2 as well as long-term surface water management and erosion control.

The caps for this alternative are a federal CCR Rule-compliant cover system that include 18-inches of vegetated soil, a geocomposite drainage layer, 60-mil textured HDPE impermeable geomembrane, and 8-oz non-woven geotextile cushion over graded CCR.

Because the alternative does not remove CCR and underlying contaminated soil, which is one source of groundwater pollution (the other source being process water that was formerly held within the impoundment), it is assumed that groundwater will remain contaminated above water quality standards long-term. In this alternative there is no active treatment for groundwater. Our cost and jobs analyses assume that cap-in-place closure would rely primarily on monitored natural attenuation for groundwater pollutants and long-term groundwater monitoring is required to show that the groundwater contaminant plume is stable and not expanding towards human or environmental receptors. The most recent data available (described in Section 2.2) indicate the groundwater arsenic plume was located within the ponds and in between the ponds and Waccamaw River. A monitored natural attenuation approach to groundwater contamination may require institutional controls such as deed restrictions that would prevent the withdrawal and use of contaminated groundwater and prevent other activities that would affect the contaminant plume. Our cost and jobs analysis includes 30-years of post-closure groundwater monitoring, cap maintenance, and surface water management for the Pond 1 and 2 impoundments.

Alternative 2. Clean Closure (Santee Cooper's completed cleanup)

This is the complete removal closure plan completed by Santee Cooper, with construction beginning in 2014 and lasting until 2020. The major elements of the closure and post-closure plan include the following:

- Active CCR dewatering, surface water management, and water treatment,
- Excavation and removal of all CCR (1,458,000 cubic yards),
- Excavation and removal minimum 1-foot underlying soil (391,000 cubic yards),
- CCR transportation and disposal in cement/concrete reuse market or landfill,
- Soil disposed of for use as daily cover at county landfills,
- Reclamation of ponds into wetlands.

This alternative includes excavation and removal of all CCR and a minimum 1 foot of underlying soil in the ponds. Excavated CCR was disposed off-site, with about 82% being beneficially used in the concrete/cement market. Santee Cooper reported that the CCR was beneficially reused if the secondary market had capacity to accept the volume of material being produced by excavation and if costs for beneficiating and transporting to the reuse market were break-even or better than the cost of landfilling. The remaining CCR (18%) was disposed of in Santee Cooper's existing CCR landfill at Cross Generating Station, Pineville, S.C., located approximately 90 miles from Grainger.

Removal of a minimum of 1-foot of the soil underlying the CCR also generated a large volume of material for disposal. Santee Cooper was able to make arrangements with numerous county sanitary/municipal solid waste landfills to accept most of the soil for reuse as daily landfill cover. A small portion of the soil was also accepted for use by the concrete/cement market.

After excavation was completed, the native soils remaining in the excavated area and the pond dikes were sampled to ensure that levels of contaminants were lower than U.S. EPA Region 4 ecological sediment threshold screening levels or risk-based concentrations determined from a site risk evaluation (Santee Cooper and Haley and Aldrich 2020). The pond areas were then restored to a semi-natural backwater area and wetland by grading the area, creating islands for forest habitat, and then breaching the impoundment dike.

There is no active remedy for groundwater in this alternative. We assume groundwater will clean up now that the source of contamination has been removed. The most recent groundwater data we reviewed shows that concentrations of arsenic in groundwater have dropped significantly as of April 2020 but remained significantly elevated in several wells. We assume in our cost and jobs analyses that two years of post-closure groundwater monitoring will be conducted.

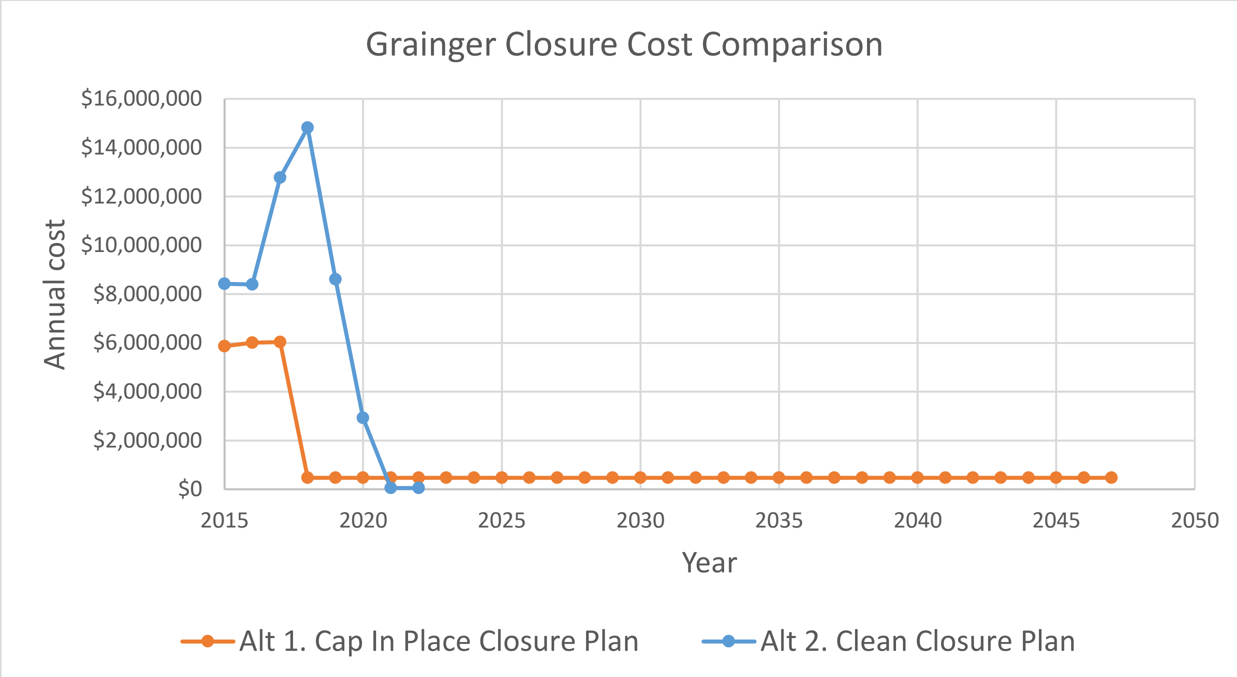
2.4 Cost analysis

Cost Summary

The table below summarizes the estimated total capital cost for each alternative and the annual long-term post-closure care operation and maintenance (O&M) cost. Capital costs are inclusive of all construction activities, disposal cost, construction-related infrastructure and equipment, reclamation and revegetation, engineering design, planning, and project management.

Alternative	**Closure plan and groundwater corrective action summary**	**Total estimated capital cost**	**Long-term O&M annual cost**
1. Cap-in-place	Construction of cap with vegetative cover, active CCR dewatering and surface water management. Long-term monitoring of groundwater, cap maintenance, and storm water management.	$23,705,000	$469,000
2. Clean Closure (Santee Cooper's completed cleanup)	CCR and soil removal, transportation to landfill or beneficial reuse market, active CCR dewatering and surface water management, and reclamation of ponds into wetlands.	$62,612,000	$0

Table 2-1 provides an annual cost comparison of the two closure alternatives for the Grainger Generating Station. The following graphic shows the sum of the total capital cost and total annual O&M cost for the two alternatives from Table 2-1.



Clean Closure, which Santee Cooper has already completed, is roughly three times more expensive up front due to the costs associated with CCR removal, trucking, and disposal but long-term O&M costs are nil because the former impoundments are completely cleaned of CCR and restored to natural wetlands. Cap-in-place requires $469,000 annual long-term O&M to maintain the cap and provide stormwater management for these impoundments, which are located in an area of subject to hurricanes and frequent flooding.

Detailed Cost Tables

Unlike the other alternatives described in this report, post-construction total capital costs for this alternative were provided by the utility. Santee Cooper's capital cost as provided to us do not specifically itemize how expenditures were spent. Therefore, we developed independent cost estimates for specific project components to itemize those costs. Our total capital cost for this alternative was prepared to match the total capital cost provided by Santee Cooper. This was done by calibrating CCR disposal costs (which were not reported) such that the total capital cost in our cost estimate matches Santee Cooper's reported total. The 25% contingency applied to the other alternatives was not applied to this alternative because the total capital cost is known.

Table 2-2 provides cost calculations and detailed annual accounting of the project elements included in Alternative 1 Cap-in-place.

Table 2-3 provides cost calculations and detailed annual accounting of the project elements included in Alternative 2 Clean Closure.

Table 2-7 provides the references we used in developing the cost estimates.

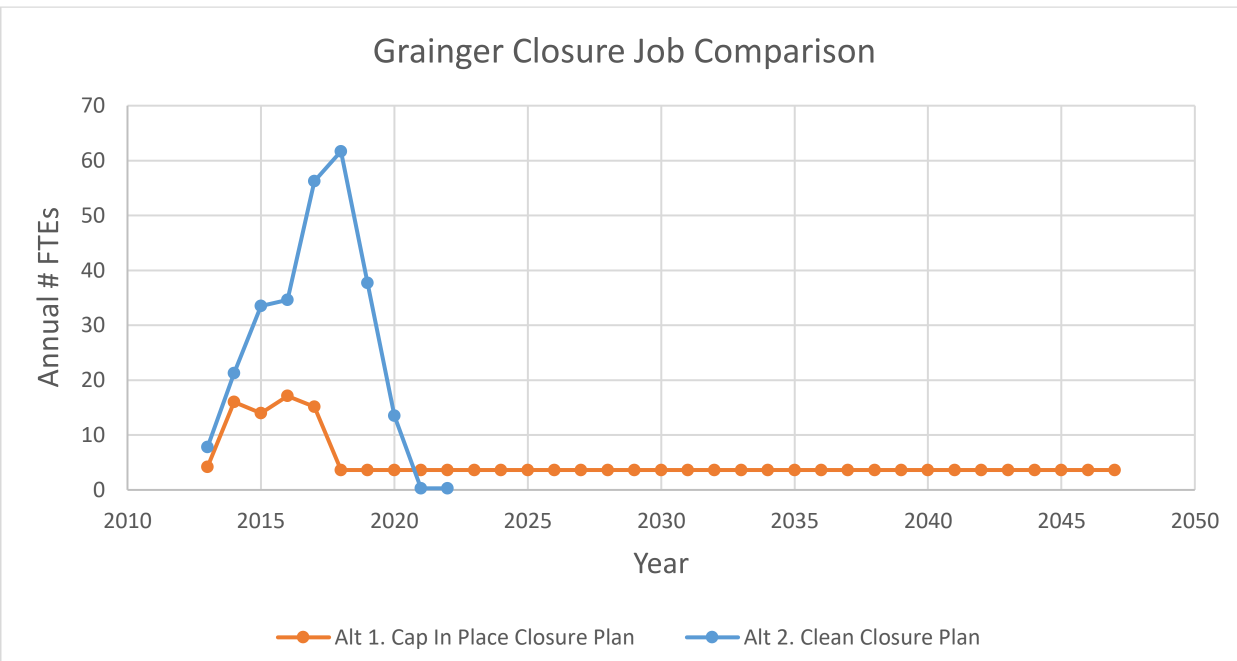
2.5 Jobs analysis

Jobs Summary

The table below summarizes the estimated total job creation (full time equivalent, FTE) for each alternative and the annual long-term post-closure care operation and maintenance (O&M) FTEs.

Alternative	Short description	Closure and corrective action FTE	Long-term O&M FTE
1. Cap-in-place	Construction of cap with vegetative cover, active CCR dewatering and surface water management. Long-term monitoring of groundwater, cap maintenance, and storm water management.	57	3.6
2. Clean Closure (Santee Cooper's completed cleanup)	CCR and soil removal, transportation to landfill or beneficial reuse market, active CCR dewatering and surface water management, and reclamation of ponds into wetlands.	266	0

Table 2-4 provides an annual comparison of the estimated jobs created for the two alternatives for the Grainger Generating Station. The following graphic shows the sum of the total construction FTE and total annual O&M FTE for the two alternatives from Table 2-4.



Clean Closure, which Santee Cooper has already completed, creates more jobs during closure and corrective action construction due to the large volume of CCR that is excavated, the need for significant storm water controls and water treatment during construction, trucking, and engineering, planning, and project management. There are no long-term O&M jobs associated with clean closure because the site has no remaining CCR needing maintenance or monitoring. Cap-in-place creates a few long-term jobs because of maintenance, monitoring, and storm water management that would be required for the impoundments.

Detailed Job Tables

Table 2-5 provides job calculations and detailed annual accounting of job types included in Alternative 1 Cap in place.

Table 2-6 provides job calculations and detailed annual accounting of job types included in Alternative 2 Clean Closure.

3. Michigan City Generating Station

3.1 Site overview

Michigan City Generating Station is a coal and natural gas-fired power station located in Michigan City, Indiana on the shore of Lake Michigan. Figure 3-1 shows the current facility layout. The site has an extensive history of industrial use. Beginning in the late 1800s, sand was mined from one of the largest sand dunes in the Midwest, which was located at the site. Land use transitioned to a shipping depot where docks connected boats to railroad. Shipping activities included operation and maintenance of locomotives, cranes, conveyors, trucks, and other heavy equipment. The Northern Indiana Public Service Company (NIPSCO) purchased the property in 1928 and constructed the first power generation plant in 1931; disposal of CCR onsite began at that time. The shoreline of Lake Michigan and Trail Creek were extensively modified, by construction of sheet piling in the lake and along Trail Creek followed by filling of the former beaches and lake area behind the piling with CCR and other materials to make made land.

Much of the early history of coal ash management was not documented to our knowledge. The 1952 airphoto (Figure 3-2) shows the generating plant located on made land extending into Lake Michigan. Extensive sheet piling had been installed prior to 1952 to create a large CCR surface impoundment adjacent to the lake. NIPSCO reports that the large impoundment shown in Figure 3-2 received CCR from 1932 to approximately 1972[6]. Airphotos show that by 1961 the surface impoundment had mostly filled with CCR (Figure 3-3), and additional fill had been placed to the southwest behind sheet piling along the lakeshore. Both airphotos and borehole logs prepared by NIPSCO show that the fill and made land contains CCR over much of its area. The approximate extent of CCR fill is shown in Figure 3-3, which we determined from borehole logs and historic airphotos.

The filled impoundment created additional ground for expansion of the generating, ash handling, and pollution control equipment at the facility. In the 1970s the large surface impoundment behind the lakefront sheet piling was reworked to construct the five ash settling ponds for fly ash and boiler slag that exist today as well as a water treatment pond called the Final Pond. These ponds are shown in Figure 3-1; all of these features are unlined. After the new settling ponds were constructed, CCR was managed by collecting ash and regularly transporting and disposing the accumulated ash off site, because there was no space to accommodate additional CCR disposal. The five settling ponds were

[6] Golder, 2018. RCRA Facility Investigation Report Northern Indiana Public Service Company Michigan City Generating Station Michigan City, Indiana EPA ID NO.: IND000715375. Golder Associates Inc., December 2018.

discontinued from use following recent pollution control modifications to the plant and today contain CCR.

NIPSCO plans to close the Michigan City Generating Station in 2028 and has issued a closure plan[7] to Indiana Department of Environmental Management (IDEM).

3.2 Contamination summary and cleanup considerations

NIPSCO has provided some data on the physical and chemical properties of the CCR fill that is located in the area of the former lakefront impoundment and in other areas where fill was placed, but the analysis lacks depth of detail and is inconclusive. A RCRA Facility Investigation[8] included drilled borings to evaluate the composition of the CCR fill; this was done by logging borehole lithology and performing microscopy on a relatively small number of boring samples. Contaminant leachability of select boring samples was tested using the Synthetic Precipitation Leaching Procedure (SPLP). However, the SPLP test is inappropriate to use to predict leachability at the site because the test does not represent the alkaline conditions typically associated with CCR pore water. Other leachability tests that are considered superior for testing CCR, such as the Leaching Environmental Assessment Framework (LEAF)[9] were not used at the site.

The lack of data describing the contaminant properties of the CCR fill in the former impoundment and other fill is a significant data gap. The RCRA Facility Investigation portrays the composition of the historic fill at the site as having only a limited proportion of CCR. But the airphotos show otherwise, with the impoundment clearly being filled with CCR during the 1950s and 1960s. There is no clear explanation why CCR would have been removed from the former impoundment and clean fill brought in its place. For the purposes of our analysis, we assume that the fill is CCR, which if excavated requires disposal in a manner consistent with the federal CCR Rule.

Sheet piling that separates the buried CCR at the site from Lake Michigan and Trail Creek is aging and is expected to have a limited lifespan. The oldest sheet piling dates to the 1930s and should be expected to have reduced structural strength already. The sheet piling holds back approximately two million cubic yards of fill containing CCR that is at risk of catastrophic release to surface water if the piling were to fail from continued deterioration or flooding. NIPSCO's closure plan does not provide any information on how the sheet piling will be maintained in perpetuity to protect Lake Michigan and Trail Creek, something that will be necessary under a closure that leaves CCR in place.

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[7] Wood Environment & Infrastructure Solutions, Inc., 2018. NIPSCO Michigan City Generating Station Surface Impoundment Closures (CCR Final Rule and RCRA Regulated) Closure Application. Prepared for Northern Indiana Public Service Company, December 2018.

[8] Golder, RCRA Facility Investigation Report and Wood Environment & Infrastructure Solutions, Inc., 2018. Additional Field Studies Report To Support Corrective Measures Michigan City Generating Station. Prepared for Northern Indiana Public Service Company, December 2018.

[9] Kosson, D., F. Sanchez, P. Kariher, L.H. Turner, R. Delapp, P. Seignette. 2009. Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data. EPA-600/R-09/151 December 2009 and Kosson, D.S., H.A. van der Sloot, A.C. Garrabrants and P.F.A.B. Seignette. 2014. Leaching Test Relationships, Laboratory-to-Field Comparisons and Recommendations for Leaching Evaluation using Leaching Environmental Assessment Framework (LEAF). EPA-600/R-14/061 October 2014.

The groundwater under the current CCR management area and in the area of the Final Pond is impacted by arsenic, boron, and selenium. Arsenic is the most acute groundwater pollutant, with levels up to 50 times the human health maximum contaminant level (MCL). The arsenic plume has highest concentration near the Final Pond, which is an unlined water treatment pond. Groundwater at the site flows towards Trail Creek and Lake Michigan. The fate of contaminants in groundwater leaving the site have not been characterized so it is unknown if the groundwater is impacting lake or creek sediment or surface water. The potential impacts to aquatic life, including fish which are consumed by humans, has not been investigated.

The source of the groundwater arsenic plume has not been clearly identified as to whether it is related to CCR disposed of in the five ash settling ponds, which would be removed under NIPSCO's closure plan, or CCR in the former large lakefront impoundment, which would not be removed, or water managed in the Final Pond. The RCRA Facility Investigation[10] makes the nebulous conclusion that groundwater impacts are "influenced by a combination of factors including the presence of sources (e.g., historical releases from active and inactive impoundments awaiting closure, historical fill), depth to groundwater/saturated thickness of the fill materials, vertical gradients and depth of the underlying clay aquitard, and groundwater flow influenced by the sheet pile(s)." If the CCR in the former impoundment shown in Figure 3-2 or other CCR fill placed on the site is a significant source of contamination to groundwater, it would not be removed under NIPSCO's closure plan and groundwater pollution will remain a long-term issue.

3.3 Description of closure plan alternatives

Alternative 1. NIPSCO Closure (utility-proposed closure plan)[11]

This is the partial removal closure plan proposed by NIPSCO[12]. The major elements of the closure and post-closure plan include the following:

- Excavation and removal of 190,200 cubic yards of CCR from the five ash settling ponds,
- Off-site CCR disposal at R.M. Schahfer Generating Station Landfill in Wheatfield, Indiana,
- Backfilling and revegetating of removal areas with soil to limit infiltration,
- 2 years of groundwater monitoring after CCR removal followed by a groundwater Corrective Measures Study,
- Long-term monitoring of groundwater,
- Long-term vegetation maintenance,
- Long-term surface water management.

This alternative would remove CCR from the five ash settling ponds built in the early 1970s (shown in Figure 3-1). This alternative does not cap or otherwise provide contaminant controls for the large volume of CCR fill that was disposed of at the site between 1932 and 1972 (outlined in Figure 3-3). The five settling ponds are no longer part of plant operations, therefore excavation and removal of the CCR was initially proposed to be completed by 2022, prior to plant closure. NIPSCO has since updated the

[10] Golder, RCRA Facility Investigation Report.
[11] NIPSCO Closure is referred to as "Leave-in-place closure plan" in the accompanying white paper.
[12] Wood, NIPSCO Michigan City Generating Station Surface Impoundment Closures.

schedule such that removal actions would not be completed until 2024. For the purposes of our cost and job analysis we follow the initial closure plan.

The closure plan delays assessment of corrective action, which is required at the site for groundwater contamination, until 2 years after the removal of the five ash settling ponds is complete. The proposed postponement of corrective action may violate the federal CCR rule's requirement to determine corrective measures "as soon as feasible" and initiate such measures "within a reasonable period of time," but is included for our analysis because it is NIPSCO's proposal. Groundwater monitoring is proposed to be conducted during the 2-year period following closure, then water quality trends would be evaluated, and a Corrective Measures Study completed to determine if active measures (e.g., pump and treat or a permeable reactive barrier) are necessary for groundwater. Because the potential groundwater remedy is speculative at this point, we assume that under the proposed partial removal groundwater contamination above water quality standards will remain after closure. In the cost and jobs analysis we assume that future groundwater corrective measures include 30-years groundwater monitoring and institutional controls such as deed restrictions that will prevent the withdrawal and use of contaminated groundwater and prevent other activities that could affect the contaminant plume. This alternative also includes post-closure vegetation maintenance for the backfilled area and surface water management for the entire site.

Alternative 2. Clean Closure

This alternative would provide for full removal of all CCR at the facility. The major elements of the closure and post-closure plan include the following:

- Excavation of CCR from the five ash settling ponds and all underlying CCR fill (2,023,000 cubic yards total),
- Dewatering of CCR from below the water table by stockpiling and passive draining,
- Off-site CCR disposal at R.M. Schahfer Generating Station Landfill in Wheatfield, Indiana,
- Grading of the excavation area to create a smooth shoreline and upland area,
- Import of 6" of topsoil into graded upland areas,
- Removal of all sheet piling and riprap along Lake Michigan and within excavation area,
- Reinforcement of Trail Creek sheet piling with riprap to maintain storm protection,
- Long-term monitoring of groundwater at a reduced monitoring network of five wells,
- Long-term vegetation maintenance,
- Long-term surface water management.

This alternative removes CCR from the five settling ponds built in the early 1970s (shown in Figure 3-1), which are included in Alternative 1, but also removes all other CCR fill (outlined in Figure 3-3). CCR would be excavated by a combination of excavators and shore-based dredging.

To determine the CCR excavation volume we reviewed borehole logs provided in the RCRA Facility Investigation[13] for the presence and depth of CCR and reviewed the extent of CCR shown in the historical airphotos. We created an excavation surface that includes the deepest CCR identified in borehole logs. The depth of this excavation surface was cross-checked against depth of CCR fill reported in the RCRA Facility Investigation. We calculated the volume of wet CCR requiring dewatering by

[13] Golder, RCRA Facility Investigation Report and Wood, Additional Field Studies Report.

calculating the CCR volume below the August 2018 water table reported in the RCRA Facility Investigation.

The excavation project would be completed in phases to allow areas that are not used in current power station operations to be excavated before plant closure and areas under the power generation area to be excavated after plant closure beginning in 2029. CCR under the Final Pond would be excavated last to allow the pond to continue to be used for water treatment until the construction project is nearly complete.

Restoration features included in this alternative are shown in Figure 3-4. Dry land within the excavation would be graded to create a restored Lake Michigan shoreline and upland area. The upland area would receive 6-inches of topsoil and revegetation. This alternative does not include importing sand for the shoreline; instead we assume that sand will be transported to the site by natural shoreline processes over a number of years.

The double sheet piling and riprap along the Lake Michigan shoreline will provide a barrier between the construction activities and lake to minimize offsite impacts to water quality and would be removed after excavation, grading, and revegetation are complete.

We assume that the source of groundwater pollution will be removed under this alternative because all CCR would be removed. Some residual groundwater contamination could remain following removal. This alternative includes monitoring groundwater at five wells for 30-years to ensure that any remaining groundwater pollution is not migrating off site and contaminant plumes are dissipating.

Post-closure operation & maintenance for this alternative includes vegetation management and storm water control for the site.

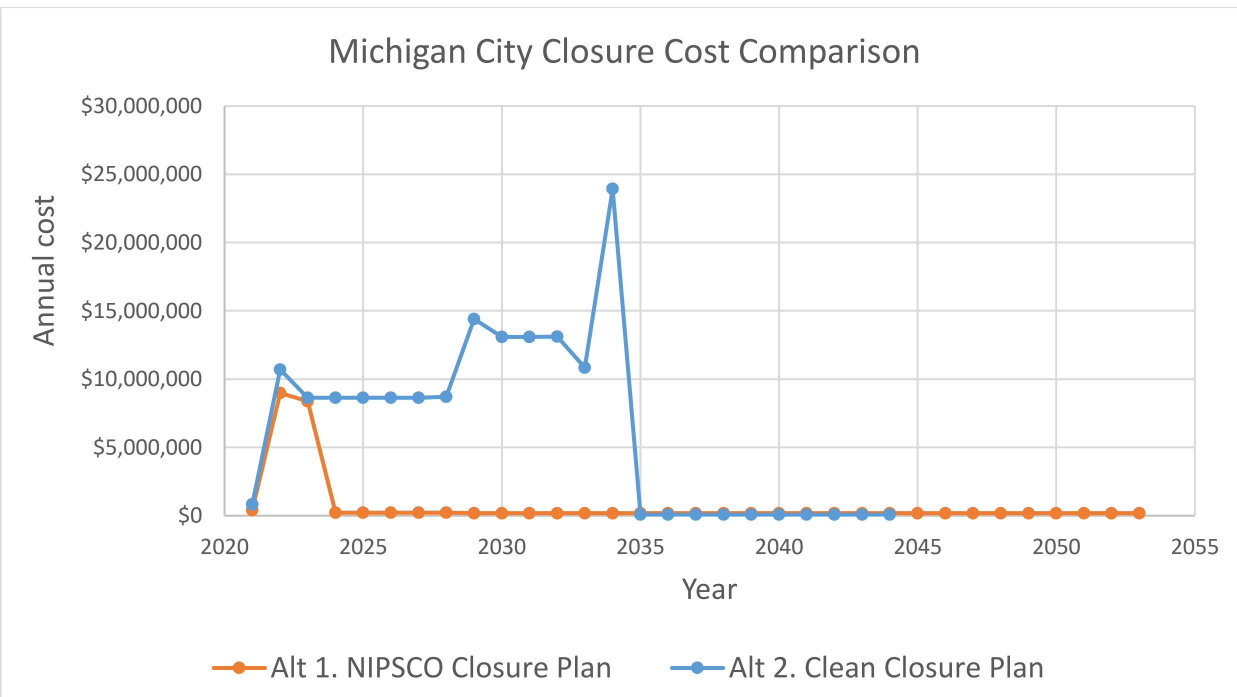
3.4 Cost analysis

Cost Summary

The table below summarizes the estimated total capital cost for each alternative and the annual long-term post-closure care operation and maintenance (O&M) cost. Capital costs are inclusive of all construction activities, disposal cost, construction-related infrastructure and equipment, reclamation and revegetation, engineering design, planning, and project management.

Alternative	Closure plan and groundwater corrective action summary	Total estimated capital cost	Long-term O&M annual cost
1. NIPSCO Closure	Excavation of CCR from the five settling ponds built in the early 1970s and off-site disposal at R.M. Schahfer Generating Station (RMSGS) CCR Landfill. Backfill excavation with soil. CCR in former lakefront impoundment and fill will be left in place without cap or controls. Long-term monitoring of groundwater, vegetation maintenance, and storm water management.	$17,576,000	$190,000
2. Clean Closure	Excavation, dredging, and dewatering of all CCR for off-site transportation and disposal at the RMSGS CCR Landfill. Site grading and revegetation. Removal of sheet piling and riprap along Lake Michigan shoreline. Limited long-term monitoring of groundwater, vegetation maintenance, and storm water management.	$151,481,000	$92,000

Table 3-1 provides an annual cost comparison of the two closure alternatives for the Michigan City Generating Station. The following graphic shows the sum of the total capital cost and total annual O&M cost for the two alternatives from Table 3-1.



Alternative 2 Clean Closure is significantly more expensive up front because the excavation would remove an estimated 2,023,000 cubic yards of CCR versus the NIPSCO Closure proposal that would

remove only 190,200 cubic yards. Clean Closure is also a phased construction process of extended time because excavation of CCR fill located under the power generation area and water treatment pond must wait until after plant shut down in 2028.

NIPSCO Closure leaves an estimated 1,832,800 cubic yards of CCR in place in with portions in contact with groundwater and without a cap or other controls. Long-term O&M costs are higher for the NIPSCO Closure because groundwater is expected to remain contaminated, requiring extensive long-term monitoring. Additionally, the NIPSCO Closure requires more expensive long-term O&M including storm water management for the entire site, including the CCR fill left in place.

NIPSCO Closure proposes to monitor groundwater for two years after the proposed partial removal is completed before selecting a corrective action for groundwater. Active groundwater remediation measures may be needed, which would be in addition to the costs we have evaluated. NIPSCO has identified monitored natural attenuation (MNA), a permeable reactive barrier (PRB), and pump and treat as possible alternatives; although they indicate pump and treat is undesirable because it would require expensive water treatment. Our cost and jobs analyses assume that MNA will be their selected alternative because it is least expensive and because it is commonly proposed by the power industry as a groundwater corrective action for CCR pollution. If a PRB or pump and treat are required for groundwater it could be anticipated to cost on the order of $200,000 to $500,000 additional per year during the post-closure period, with capital costs potentially on the order of $1 million.

Additionally, NIPSCO Closure will require long-term maintenance of the sheet piling to protect the CCR fill left at the site from release into surface water. This is an additional expense that is not included in NIPSCO's proposed closure plan.

Detailed Cost Tables

Table 3-2 provides cost calculations and detailed annual accounting of the project elements included in Alternative 1 NIPSCO Closure

Table 3-3 provides cost calculations and detailed annual accounting of the project elements included in Alternative 2 Clean Closure.

Table 3-7 provides the references we used in developing the cost estimates.

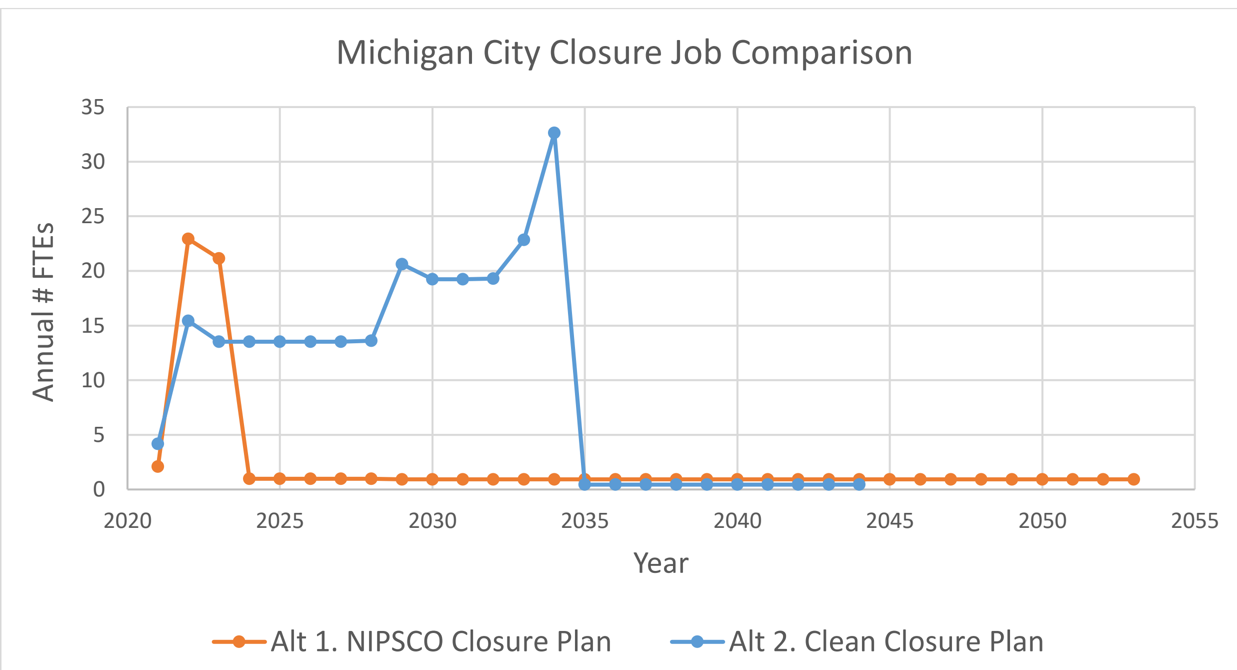
3.5 Jobs analysis

Jobs Summary

The table below summarizes the estimated total job creation (full time equivalent, FTE) for each alternative and the annual long-term post-closure care operation and maintenance (O&M) FTEs.

Alternative	Closure plan and groundwater corrective action summary	Closure and corrective action FTE	Long-term O&M FTE
1. NIPSCO Closure	Excavation of CCR from the five settling ponds built in the early 1970s and off-site disposal at R.M. Schahfer Generating Station (RMSGS) CCR Landfill. Backfill excavation with soil. CCR in former lakefront impoundment and fill will be left in place without cap or controls. Long-term monitoring of groundwater, vegetation maintenance, and storm water management.	46	0.9
2. Clean Closure	Excavation, dredging, and dewatering of all CCR for off-site transportation and disposal at the RMSGS CCR Landfill. Site grading and revegetation. Removal of sheet piling and riprap along Lake Michigan shoreline. Limited long-term monitoring of groundwater, vegetation maintenance, and storm water management.	234	0.4

Table 3-4 provides an annual comparison of the estimated jobs created for the two alternatives for the Michigan City Generating Station. The following graphic shows the sum of the total construction FTE and total annual O&M FTE for the two alternatives from Table 3-4.



Alternative 2 Clean Closure creates more jobs for a longer duration during closure and corrective action construction due to the large volume of CCR that is excavated, trucking, sheet piling removal, lake shore restoration, and engineering, planning, and project management.

Long-term O&M FTEs associated with both alternatives are limited. Clean Closure requires less long-term FTEs because the site has no remaining CCR fill needing O&M and groundwater monitoring of any residual groundwater contamination is from a limited number of wells. NIPSCO Closure requires approximately double the long-term O&M FTE because long-term groundwater contamination is expected to remain a significant issue requiring more extensive monitoring. Additionally, the CCR fill left in place will require more extensive storm water management.

Detailed Job Tables

Table 3-5 provides job calculations and detailed annual accounting of job types included in Alternative 1 NIPSCO Closure.

Table 3-6 provides job calculations and detailed annual accounting of job types included in Alternative 2 Clean Closure.

3.6 Evaluation of potential redevelopment options

Economic gains are possible through clean closure and complete environmental cleanup at the NIPSCO Michigan City Generating Station facility followed by reuse of the site. Options for redevelopment and reuse of the site will be limited if the site is not fully remediated. The older CCR fill which would remain under NIPSCO's proposed closure plan would limit how the site can be reused or built upon. Additionally, the site would be an environmental liability due to the large volume of CCR which remains, the aging sheet piling, and the need for perpetual protection of Lake Michigan and Trail Creek from the fill. Potential new property owners would be unlikely to assume that liability.

The jobs and revenue created by closure and cleanup activities eventually end, but environmental protection lasts in perpetuity. Continued short-term economic gains are possible through site redevelopment. The gains are related to construction jobs and capital investment, similar to the economic gains from closure construction, groundwater corrective action, and long-term O&M. Long-term economic gains are possible by targeting jobs creation as part of the redevelopment planning process. Other factors should be considered in the reuse planning process including community needs, environmental justice, lake ecology, among other considerations to select the preferred reuse redevelopment plan. Attachment 3 (Appendix D) presents a separate report, *Reuse Planning and Economic Opportunities for the Michigan City, Indiana Power Generation Facility*. The report provides an overview of the reuse planning process; case studies; challenges to reuse planning; and a matrix useful to compare redevelopment alternatives, relative costs, and local economic gains possible with various reuse alternatives for the generating station property following clean closure.

4. Colstrip Steam Electric Station

4.1 Site overview

Colstrip Steam Electric Station is a coal-fired power station located in Colstrip, Montana in the southeastern part of the state. Figure 4-1 shows the current facility layout. The power plant had four generating units. Construction of Units 1 and 2 began in 1972, and they came online in the mid-1970s, Unit 3 in 1983, and Unit 4 in 1985. When fully operating, Colstrip's generating capacity of 2,094 megawatts was the second largest in the Western U.S., providing power to a large area of the Northwestern U.S.

The Colstrip Plant is co-owned by Talen Montana, LLC (Talen), PacifiCorp, Puget Sound Energy, Inc., Portland General Electric Company, Avista Corporation, and NorthWestern Corporation. Talen is the current operator of the Plant, having taken over operations from PPL Montana in 2015.

Unlike the other power station facilities evaluated in this report, Colstrip was built near the coal source and far away from the supply of cooling water. The plant is located in the heart of Powder River Basin coal country, literally constructed on top of reclaimed strip mines and surrounded by the active Rosebud Mine which supplies the plant. Cooling water is piped 30 miles from the Yellowstone River and is stored in a nearby reservoir named Castle Rock Lake.

Coal combustion residuals (CCR) produced over the years are contained in two very large surface impoundment complexes, the Units 1&2 Stage I Evaporation Pond and Stage II Evaporation Pond, and the Units 3&4 Effluent Holding Pond. Separate CCR ponds and bottom ash dewatering areas are also located adjacent to the power plant. These three sites, which we refer to as the SOEP-STEP pond complex, EHP pond complex, and Plant Site pond complex, are shown in Figures 4-2, 4-3, and 4-4.

The scale of the pond complexes at all three sites is enormous, with a total of 38 million cubic yards of CCR disposed of in 20 individual ponds or cells that combined cover over 700 acres. In addition to coal ash ponds, each site also has water management ponds that store process water from the coal ash slurry system and contaminated groundwater pumped from the groundwater capture system. There are also smaller cells containing brine solids from the water treatment system.

The power station process water and scrubber water management system were designed to be closed loop, meaning the ponds were designed to minimize water loss, pond water is recycled into the plant, and the plant has no permitted discharge. The CCR impoundments vary from unlined in the oldest impoundments, to double-lined with synthetic liners and leachate collection in recent overfill cells. The SOEP-STEP pond complex was designed with engineered dams keyed into bedrock to limit seepage loss. The EHP complex uses two dams and is surrounded with a cutoff wall constructed of bentonite-amended concrete which is keyed into bedrock. The dams and cutoff wall at both pond complexes were mostly effective at limiting the horizontal migration of pond seepage but instead directed the seepage downward towards groundwater.

Despite the closed-loop design, the ponds have leaked CCR leachate and process water for decades, with seepage contaminating local aquifers and creeks. Montana Department of Environmental Quality (DEQ) became involved and reached an Administrative Order on Consent (AOC) with the operator to address environmental impacts from the coal ash ponds and other wastes. The power station operators also settled civil damage claims made by neighboring water users, wherein water wells used for drinking water and livestock are reported to have been impacted. The plant operator constructed an elaborate system of groundwater capture wells and trenches to limit the spread of contaminated groundwater and to pump it back into the plant water circuit. Captured water is treated to improve its quality to that required in the various plant operations. The operator has also upgraded the coal ash slurry system and pond liners to reduce seepage of CCR contaminants to groundwater. Still seepage remains a significant problem.

The steps taken to lessen seepage and the groundwater capture system have generally prevented further spread of contamination but have not been effective in restoring water quality to meet water quality standards in aquifers underlying and near the CCR ponds. Additionally, the capture system has needed to be expanded to chase portions of the plume not captured by previous measures. Another limitation with the steps taken so far is if the capture system were shut down, contamination would resume spreading in groundwater and area creeks. Talen is in the process of submitting remedy (corrective action) and closure proposals for the three sites for approval with DEQ. Given the complexity of the site and the extensive impacts to groundwater, there have been numerous iterations of remedy evaluation and proposals as Talen attempts to reach agreement with DEQ. Most recently Talen invoked a dispute resolution process because they do not agree with DEQ's selected full removal/clean closure remedy for the SOEP-STEP pond complex.

The power station has struggled economically in recent years, owing to aging infrastructure, new environmental regulations requiring upgrades, and competition from other energy sources in the electricity market. Units 1&2 were shut down in 2020 for economic reasons. The Units 1&2 owners had previously agreed to close those generating units no later than July 1, 2022 in two separate consent decrees with environmental groups who had litigated over violations of the Montana Water Quality Act and Federal Clean Air Act. Units 3&4 are slated to operate after a transition to dry coal ash management for what is expected to be years to decades.

4.2 Contamination summary and cleanup considerations

Impoundment closure and groundwater cleanup at the Colstrip facility must consider the risk of contamination to both human, ecological, and livestock receptors that drink groundwater or impacted surface water. These receptors are located a short distance downgradient in the direction of groundwater flow from the pond complexes. Groundwater contaminants include boron, sulfate, cobalt, lithium, selenium, manganese, and possibly radium. The plant operators have already installed extensive groundwater capture and water treatment systems at all three pond complexes to provide hydraulic controls and prevent the spread of contaminated groundwater over an area of several square miles. Long-term use of these capture systems will be needed with any alternative because groundwater cannot be cleaned up quickly. It is also important that closure of CCR impoundments adequately removes the source of contamination to groundwater so that the groundwater capture and water treatment system can eventually be turned off.

The hydrogeologic conditions at the Colstrip facility present a unique and difficult situation for remedying groundwater. The area aquifers are naturally low flow because the area is semi-arid and much of the geology underlying the CCR ponds is of low permeability. The low flow nature of the natural groundwater system means there is limited clean groundwater available for dilution; this is the opposite of conditions typical of surface impoundments constructed along major rivers. Despite being low flow, contaminated seepage from the impoundments has made it far into the aquifers because the hydraulic pressure head caused by the depth of pond water functions to force seepage into the aquifer. The situation is difficult to remedy because now that the contamination is present in the aquifer to significant depth and areal extent it is very challenging to get the contamination out of the aquifer via capture or flushing with clean water.

Colstrip is unique among the three power station facilities examined in this report in that the plant operator has provided an extensive evaluation of potential groundwater remedy technologies applicable to the site. They have also modeled groundwater flow and contaminant fate and transport to predict the effect of potential corrective measures such as capture, flushing, and source removal. Using the computer modeling it is estimated that groundwater capture and water treatment will be needed for 30-years, which is a significant part of the site cleanup and closure cost. Even with this lengthy period of active groundwater remediation some residual groundwater contamination is predicted to remain afterwards that may require either institutional controls (e.g., deed restrictions on use or withdrawal of groundwater, or a state-certified controlled groundwater area) or further corrective action technologies. This illustrates just how challenging it is to remedy groundwater at the Colstrip facility. The groundwater corrective measures that appear most suitable for the site have been identified and costed by Talen to calculate financial assurance, which is required by the Administrative Order on Consent (AOC) with Montana DEQ. Therefore, the cost and job impact of groundwater cleanup can be included in the alternatives evaluated in this report.

Another challenge that needs to be addressed in the groundwater remedy and pond closure is groundwater contact with CCR impoundments. The design and construction of some of the impoundments has exacerbated shallow groundwater contacting CCR. The two main dams at the SOEP-STEP are keyed into bedrock with grout curtains that are designed to contain pond leachate and seepage. However, an unwanted side effect of that design is the dams limit groundwater flow in the alluvium and shallowest bedrock underlying the ponds. The effect is to back up groundwater, raising the water table to where it saturates and flows through CCR in the unlined impoundments and is in contact with single layer plastic liners in the lined impoundments. The result is that capping the impoundments alone will not prevent groundwater from continuing to leach contaminants. There is also the likelihood for increased CCR leaching far into the future as the plastic liners slowly degrade.

Several ponds at the Plant site present a long-term risk to groundwater as well. There are currently lined CCR impoundments at the Plant site wherein the pond leachate collection system collects groundwater, not just leachate from the CCR. It is standard design practice for impoundments or landfills with leachate collection systems to be built above the water table and it is not clear why these impoundments are now sitting within the water table.

The EHP pond complex does not appear to have the same risk for long-term groundwater contact. Although the EHP pond complex is currently hydraulically connected to groundwater, this appears to be because of the large quantity of seepage that has drained from the ponds over the years. The EHP pond complex is more hydrologically isolated from regional groundwater flow than the ponds at the SOEP-STEP and Plant sites. Therefore, excavation of coal ash from the impoundments may not be necessary to protect groundwater at the EHP.

Another challenge to groundwater cleanup and impoundment closure at the Colstrip pond complexes is residual pore water in the ponds. The CCR impoundments were managed wet for most of their history with open process water overlying saturated CCR in the ponds. Although the plant operator has altered water management in recent years to limit the amount of water in the ponds, the impoundments still contain significant amounts of contaminated water which if left unaddressed will cause contaminated seepage for years to come. A closure plan that actively dewaters or captures the seepage in the ponds will benefit groundwater cleanup.

The oldest impoundment at the Colstrip facility, Units 1&2 SOEP, was previously closed in 2002 using an evaporation cap. Because the evaporation cap does not include an impermeable layer such as compacted clay or a synthetic liner, it is leaky, which causes leaching of the underlying CCR by precipitation. The SOEP also has groundwater flowing through its lower portions as described previously. A closure plan that eliminates the leaching of CCR in the SOEP will benefit groundwater cleanup.

4.3 Description of closure plan alternatives

Alternative 1. Talen Proposal

This alternative is the initial proposal by plant operator Talen. The proposal would use cap-in-place with active groundwater capture, flushing, and treatment. Through several iterations of remedy evaluation and comment from Montana DEQ, Talen has changed their preferred closure and remedy plan to include much more significant dewatering of CCR in order to reduce contaminated seepage, and more significant excavation of CCR that contacts groundwater. Regardless, Talen's first proposal is the subject of this example alternative because it represents a typical initial closure proposal by the power industry.

The major elements of the closure and post-closure plan include the following:

- Cap-in-place of active CCR ponds (34,078,000 cubic yards of CCR) with Federal CCR Rule compliant cover system (451 acres of cap),
- Units 1&2 SOEP (3,791,000 cubic yards of CCR) will remain with existing 114-acre evaporation cap,
- Conversion to dry storage for new CCR disposal at the Units 3&4 EHP in 2023,
- Groundwater corrective action using 30 years of capture and treatment combined with in situ flushing with clean water to increase the recovery of contaminants.
- Increased water treatment with a new reverse osmosis (RO) water treatment system treating a maximum of 1,000 gallons per minute.

Talen's initial closure plans and post-closure plan are detailed in a large number of documents[14]. The various plans were distilled into the single alternative described here and in a closure and cleanup alternatives analysis performed for Northern Plains Resource Council by KirK Engineering[15].

In our cost and jobs analysis, construction under this closure plan is assumed to begin in 2017 according to Talen's original proposed schedule. Under this alternative the pond complexes at Colstrip will continue to be used for disposal of CCR until the generating units are shut down; although individual ponds within the pond complex are capped in place when they are no longer actively used for disposal. Units 1&2 were assumed to shut down in 2022 in this analysis although Units 1&2 shut down in Jan 2020. This schedule change does not affect the overall progression of cost and jobs, only the year various construction activities are started and completed. Units 3&4 we assume to shut down in 2040; although that date is also subject to change based on the electricity market. There are therefore two periods of concentrated closure construction activity when each pair of generating units is shut down.

This alternative relies almost completely on cap-in-place closure. The only area that would be excavated is the small volume that remains of the Former Units 1&2 Bottom Ash Ponds located at the Plant Site, which has already been partly excavated in the past. The contents of this former pond will be placed at the SOEP-STEP pond complex and capped in place. All new caps are Federal CCR Rule-compliant cover systems that include 18-inches of vegetated soil, a geocomposite drainage layer, 60-mil textured HDPE impermeable geomembrane, and 8-oz non-woven geotextile cushion over graded CCR. The Units 1&2 SOEP, which is the original impoundment that was previously closed in 2002, will not be modified and will have the existing evaporation cap (24-inches of vegetated soil overlying a capillary break layer of 12-inch porcelanite/coal clinker).

The groundwater remedy under this alternative includes continued operation of the groundwater capture and treatment system with addition of new capture wells to target portions of the aquifer

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[14] Geosyntec Consultants 2016. Written Closure Plan per Requirement on 40 CFR §257.102 Existing Impoundments Colstrip Steam Electric Station. Report prepared for Talen Montana, LLC, October 2016; and,
Geosyntec Consultants 2016. Written Post-Closure Plan per Requirement on 40 CFR §257.104 Existing Impoundments Colstrip Steam Electric Station. Report prepared for Talen Montana, LLC, October 2016; and,
Geosyntec Consultants 2016. Written Closure Plan per Requirement on 40 CFR §257.102 J Cell Colstrip Steam Electric Station. Report prepared for Talen Montana, LLC, July 2016; and,
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Geosyntec Consultants 2018. Colstrip wastewater facility closure plan: Plant site. Report prepared for Talen Energy, LLC, January 2018; and,
Geosyntec Consultants 2018. Colstrip wastewater facility closure plan: Units 1 & 2 Stage I & II Evaporation Pond Site. Report prepared for Talen Energy, LLC, January 2018; and,
Geosyntec Consultants 2018. Colstrip wastewater facility closure plan: Units 3 & 4 Effluent Holding Pond Site. Report prepared for Talen Energy, LLC, January 2018; and,
Geosyntec Consultants 2018. Remedy evaluation report: Units 1 & 2 Stage I and II Evaporation Ponds. Report prepared for Talen Montana, LLC, May 2018.

[15] KirK Engineering, 2018. POWER Cleanup Jobs Study Remediation Alternatives Analysis. KirK Engineering & Natural Resources, Inc. prepared for Northern Plains Resource Council, December 31, 2018. Report commissioned by the Montana Department of Labor and Industry. https://northernplains.org/cleanup-jobs-study-research/.

where the groundwater flow modeling predicts it would benefit the cleanup timeframe. This alternative also uses in situ flushing, wherein wells will be constructed to inject clean water at locations where the groundwater flow modeling predicts it would benefit the cleanup timeframe.

This alternative includes changes to water management in the ponds that are active in plant operations to reduce pond seepage. Management of both process water and captured groundwater has been transitioning to storage in new impoundment ponds with composite liners and underdrain collection systems; additionally, the EHP will be converted to dry CCR storage in 2023. Forced evaporation is also used to reduce the water inventory to shorten the time that ponds continue to produce seepage to groundwater.

This alternative does not include active pore water dewatering of the CCR impoundments, instead relying on saturated CCR in the pond complexes to slowly drain by gravity, with capture of the contaminated water once it has seeped into groundwater by continued operation of the capture well system.

Alternative 2. NPRC's Doing It Right Proposal

This alternative was proposed as an alternative to Talen's proposal by Northern Plains Resource Council (NPRC), a grassroots conservation and family agriculture advocacy group based in Montana. The alternative includes excavation and removal of those CCR impoundments that have the greatest potential to continue to impact groundwater long-term. The impoundments that are predicted to be safely above the water table after closure completion are proposed to be capped in place.

The major elements of the closure and post-closure plan include the following:

- Excavation and removal of 8,679,000 cubic yards of CCR in ponds which are in contact with groundwater,
- Construction of two new Federal CCR Rule-compliant landfills for disposal of excavated CCR,
- Cap-in-place of CCR in ponds which are not in contact with groundwater (29,210,000 cubic yards of CCR total) with Federal CCR Rule compliant cover system (approximately 311 acres of cap),
- Conversion to dry storage for new CCR disposal at the Units 3&4 EHP in 2023,
- Active dewatering of CCR pore water (1,369,400,000 gallons total) prior to excavation of ponds and to reduce contaminated seepage from ponds capped in place,
- Groundwater corrective action using 30-years of capture and water treatment combined with in situ flushing with clean water to increase the recovery of contaminants,
- Construction of two new double lined water storage ponds with leachate collection to store dewatering flows and captured groundwater,
- Increased water treatment with a new reverse osmosis (RO) water treatment system with solar powered brine concentrators, treating a maximum of 1,450 gallons per minute.

This alternative is based on NPRC's *Doing it Right II* report[16]. NPRC performed the *Doing it Right* study to highlight the specific environmental and economic benefits of coal ash cleanup at the Colstrip Steam

[16] NPRC, 2019. Doing it Right II: Job creation through Colstrip cleanup. Northern Plains Resource Council, April 2019. https://northernplains.org/colstrip-jobs-study-2/.

Electric Station. NPRC's *Doing it Right Proposal* is based on an engineering analysis[17] we developed as part of the Colstrip POWER Cleanup Jobs Study that was commissioned by the Montana Department of Labor and Industry. The *Doing it Right Proposal* is a combination of the Contaminant Source Control Alternative 2 and Water Treatment Alternative 2 described in that engineering analysis.

This alternative provides for excavation and removal of the Units 1&2 SOEP-STEP ponds that are in contact with groundwater. The STEP D cell would not be excavated because it is above groundwater and is constructed with a composite liner and leachate collection and generally meets Federal CCR Rule standards. At the Plant Site, both ponds that are in contact with groundwater and ponds not in contact with groundwater would be excavated and removed. The decision to excavate and consolidate the Plant Site ponds that are not in contact with groundwater is based on the relatively low volume of CCR present in those ponds and the determination that it is safer and easier in the long-term to manage that CCR in a single landfill rather than individual waste units. The landfill would be constructed at the Plant Site regardless to accept CCR from ponds that are in contact with groundwater. The Units 3&4 EHP pond complex would be capped in place after actively dewatering the ponds to reduce future contaminated seepage to groundwater.

Excavated CCR, residual brine waste, and contaminated soil will be removed to two new CCR landfills constructed to Federal CCR Rule standards. The CCR landfill locations are based on a preliminary siting analysis with one located northwest of the SOEP-STEP site and one located at the Plant Site. Both chosen locations allow for easy access and short transportation using trucks once roads are constructed. We have included the costs and jobs from construction, filling, capping, annual operation and maintenance of the new landfills within our cost and jobs analysis.

For the ponds that are not in contact with groundwater, this alternative follows Alternative 1 Talen Proposal wherein the ponds are capped with Federal CCR Rule-compliant cover systems. Unlike Alternative 1, this alternative provides complete dewatering of the CCR in the ponds before they are capped to eliminate pond seepage significantly faster.

The Units 1&2 Cooling Tower Blowdown Ponds at the Plant Site will be converted to water storage ponds to store the large quantity of water anticipated from dewatering of the CCR ponds and groundwater capture. The proposed CCR dewatering would involve installation of extraction wells at the SOEP-STEP and Plant Site pond complexes. At the EHP Site dewatering will use the existing underdrain combined with perimeter wells located in the native rock below the pond bottom. The proposed dewatering wells will help to eliminate CCR leachate seepage, which is the pathway of contaminant transport from CCR to groundwater, in a shorter time.

This alternative includes the same groundwater capture and in situ flushing remedy proposed by Talen in Alternative 1. It also includes the same water management changes proposed for Alternative 1 to reduce pond water volume and seepage.

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[17] KirK Engineering, POWER Cleanup Jobs Study Remediation Alternatives Analysis.

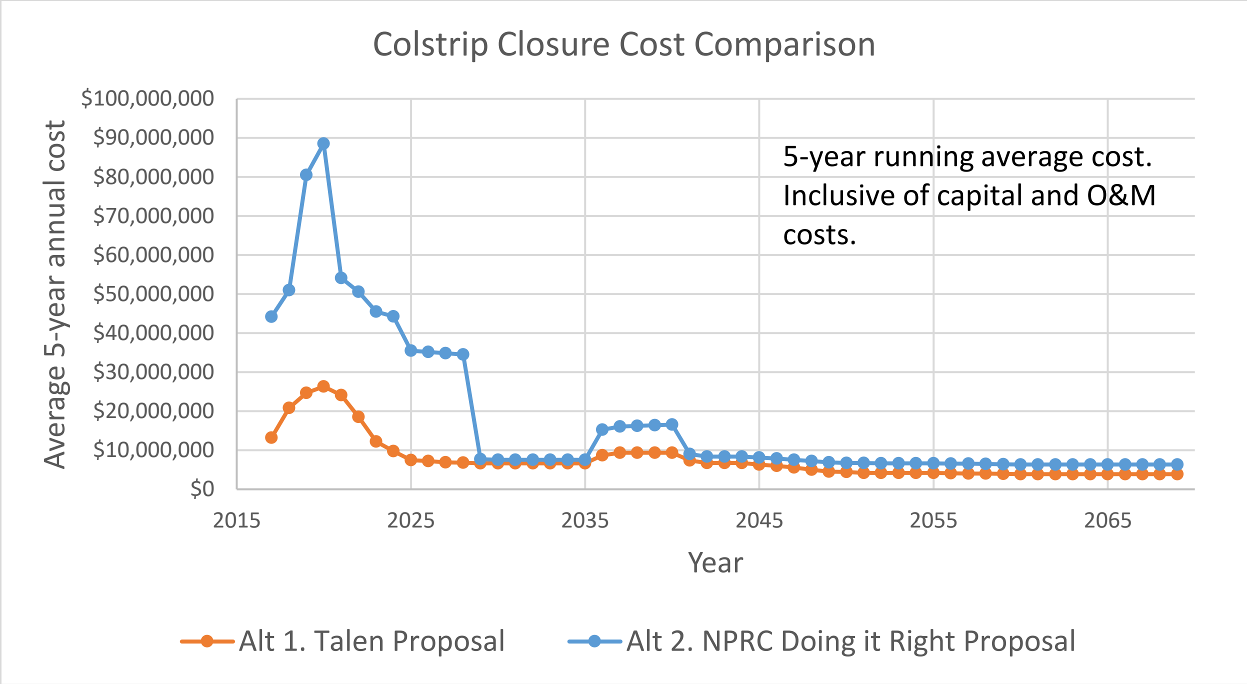
4.4 Cost analysis

Cost Summary

The table below summarizes the estimated total capital cost for each alternative and the annual long-term post-closure care operation and maintenance (O&M) cost. Capital costs are inclusive of all construction activities, disposal cost, infrastructure and equipment, reclamation and revegetation, engineering design, planning, and project management.

Alternative	Closure plan and groundwater corrective action summary	Total estimated capital cost	Long-term O&M annual cost
1. Talen Proposal	Cap-in-place of all CCR ponds (37,889,000 cubic yards of CCR). Groundwater corrective action using 30 years of capture and treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.	$126,581,000	$3,876,000
2. NPRC's Doing It Right Proposal	Removal of 8,679,000 cubic yards of CCR in ponds which are in contact with groundwater to two new CCR landfills. Cap-in-place of 29,210,000 cubic yards CCR in ponds which are not in contact with groundwater. Active dewatering of CCR pore water. Groundwater corrective action using 30 years of capture and water treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.	$593,990,000	$6,348,000

Table 4-1 provides an annual cost comparison of the two closure alternatives for the Colstrip Steam Electric Station. Total capital cost includes closure, groundwater remedy, and water treatment capital construction costs. Total annual O&M cost includes closure O&M, O&M of the new CCR landfills, groundwater remedy O&M, water treatment operation, and groundwater monitoring. The following graphic shows the sum of the total capital cost and total annual O&M cost for the two alternatives from Table 4-1.



A five-year running average of costs is shown in the graphic because the actual project schedule is unknown and will likely change as the project is undertaken due to project complexity.

Alternative 2, NPRC's *Doing it Right Proposal*, is significantly more expensive because it will remove all CCR in ponds that are in contact with groundwater. Costs associated with removal include construction of two new federally compliant CCR landfills that would be constructed for disposal of excavated CCR. Additionally, NPRC's *Doing it Right Proposal* includes aggressive dewatering of leachate in the CCR impoundments to eliminate seepage from the ponds that continues to contaminate groundwater. These additional expenses are incurred to provide better and permanent protection of water quality.

Both Colstrip alternatives require expensive ongoing O&M. These costly annual post-closure care expenses are due to the size of impoundments and landfills that must be maintained in perpetuity. Both impoundment and landfill caps must be maintained to provide assurance that they are virtually impermeable and the CCR will not be rewetted by precipitation and storm runoff. Our cost calculation for Alternative 2 assumes 10% of the cover system requires repair maintenance per year. This is an average; in reality the cap will require little maintenance some years and other years will require extensive repair. The cover system also has a finite lifespan, and the cost of replacing the cover is prorated into the yearly annual cost. Long-term O&M also includes water treatment that is also expensive.

The long-term O&M cost for Alternative 2 is more expensive than Alternative 1. One reason for this is because collecting leachate is more expensive and labor intensive than letting it leach to groundwater. Alternative 2 includes two CCR landfills where the leachate collection system must be maintained and leachate disposed of. In contrast, leachate from the impoundments capped in place under Alternative 1 would pass through to groundwater because the capped impoundments are either unlined or lined without leachate collection systems. Another reason the long-term O&M cost for Alternative 2 is more than Alternative 1 is because they are calculated differently. For Alternative 1 we use Talen's published costs in their post-closure plans and Master Plan Summary. Whereas for Alternative 2 we calculate the costs using the methods described in Section 1.4. There may be incentives for Talen to report low estimates for long-term post-closure costs, whereas our costs are conservative and relatively higher. Regardless, either alternative for Colstrip continues to require expensive O&M, because all CCR will be capped under either alternative whether capped in-place in an impoundment or in a new CCR landfill.

Detailed Cost Tables

Due to the complexity of the Colstrip closure and groundwater cleanup, cost and jobs analyses were performed differently than at the Grainger and Michigan City generating stations. For Colstrip we have calculated cost and job creation for closure and groundwater remedy construction by individual project element (pond closed, landfill constructed, etc.), without consideration of the specific schedule for each project element. We then constructed a project schedule for the cost and job analyses that follows an assumed project timeline. We also calculated cost and jobs independently for water treatment and groundwater monitoring. Because of this there are layout differences in the detailed cost tables for Colstrip versus the two other power stations in this study.

We also do not provide detailed cost calculations for Alternative 1 Talen Proposal because those costs were provided by Talen in the closure and post-closure plan documents previously cited as well as Talen's Master Plan Summary Report Update[18] and those documents do not show calculation details.

Table 4-2 provides a detailed annual accounting of the closure and groundwater remedy costs included in Alternative 1 Talen Proposal.

Table 4-3 provides a detailed annual accounting of the closure and groundwater remedy costs included in Alternative 2 NPRC's *Doing It Right Proposal*.

Table 4-4 provides detailed cost calculations for the closure and groundwater remedy included in Alternative 2 NPRC's *Doing It Right Proposal*.

Table 4-8 provides the references we used in developing the cost estimates.

Table 4-9 provides cost and job calculations for water treatment included in Alternative 1 Talen Proposal.

Table 4-10 provides cost and job calculations for water treatment included in Alternative 2 NPRC's *Doing It Right Proposal*.

Table 4-11 provides cost and job calculations for groundwater monitoring. Groundwater monitoring requirements are assumed to be the same for both Alternative 1 and Alternative 2.

[18] Geosyntec Consultants 2016, September. Master Plan Summary Report Update Colstrip Steam Electric Station. Report prepared for Talen Montana, LLC.

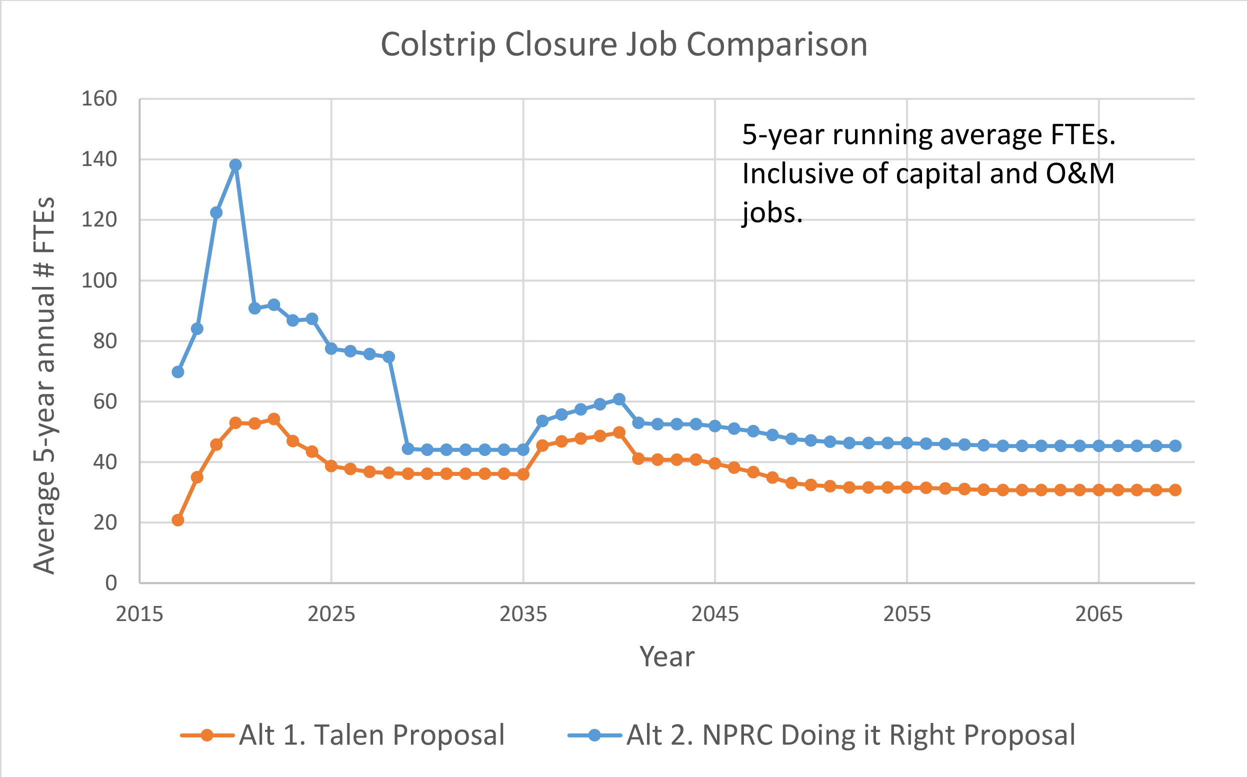
4.5 Jobs analysis

Jobs Summary

The table below summarizes the estimated total job creation (full time equivalent, FTE) for each alternative and the annual long-term post-closure care operation and maintenance (O&M) FTEs. The closure and corrective action FTEs are spread over a number of years.

Alternative	**Closure plan and groundwater corrective action summary**	**Closure and corrective action FTE**	**Long-term O&M FTE**
1. Talen Proposal	Cap-in-place of all CCR ponds (37,889,000 cubic yards of CCR). Groundwater corrective action using 30-years of capture and treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.	183	31
2. NPRC's Doing It Right Proposal	Removal of 8,679,000 cubic yards of CCR in ponds which are in contact with groundwater to two new CCR landfills. Cap-in-place of 29,210,000 cubic yards CCR in ponds which are not in contact with groundwater. Active dewatering of CCR pore water. Groundwater corrective action using 30-years of capture and water treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.	734	48

Table 4-5 provides an annual comparison of the estimated jobs created for the two alternatives for the Colstrip Steam Electric Station. The following graphic shows the sum of the total construction FTE and total annual O&M FTE for the two alternatives from Table 4-5.



A five-year running average of jobs is shown in the graphic because the actual project schedule is unknown and will likely change as the project is undertaken due to project complexity.

Alternative 2 NPRC's *Doing it Right Proposal* creates many more jobs during closure construction due to the large volume of CCR that is excavated, dewatering work, construction of the new landfills and water storage ponds, trucking, and engineering, planning, and project management.

There are two employment peaks, one beginning with initial closure and groundwater remediation activities in 2018 with closure activities peaking after assumed closure of the Units 1&2 generating plant in 2022. The second employment peak occurs in 2040 with assumed closure of the Units 3&4 generating plant. Long-term O&M FTEs associated with both alternatives are significant for the reasons discussed in the cost analyses for these alternatives in section 4.4.

Detailed Job Tables

Similar to cost, the Colstrip job calculations were performed by project element due to project complexity; the project element costs were then applied to an assumed project timeline to create the job schedule. For Alternative 1 Talen Proposal, we develop detailed job calculations that are based on the activities performed and are independent of Talen's cost estimates.

Table 4-6 provides detailed job calculations including the job types included in Alternative 1 Talen Proposal. The schedule for these jobs is shown in Table 4-5.

Table 4-7 provides detailed job calculations including the job types included in Alternative 2 NPRC's Doing it Right Proposal. The schedule of job creation is shown in Table 4-5.

Table 4-9 provides cost and job calculations for water treatment included in Alternative 1 Talen Proposal.

Table 4-10 provides cost and job calculations for water treatment included in Alternative 2 NPRC's Doing It Right Proposal.

Table 4-11 provides cost and job calculations for groundwater monitoring. Groundwater monitoring requirements are assumed to be the same for both Alternative 1 and Alternative 2.

Attachment 1. Tables

Table 2-1: Grainger Cost Comparison

Year	Alternative 1. Cap In Place			Alternative 2. Clean Closure		
	Closure Plan	Total Capital Cost	Total Annual O&M Cost	Clean Closure Remedy	Total Capital Cost	Total Annual O&M Cost
2013	Construction of cap with vegetative cover, active construction dewatering and surface water management. Long term monitoring of groundwater, cap maintenance, and storm water management.	$ 873,361	$ 16,263	CCR and soil removal, transportation to landfill or beneficial reuse market, active construction dewatering and surface water management, and reclamation of ponds into wetlands.	$ 1,369,407	$ 16,263
2014		$ 6,033,103	$ 158,723		$ 5,402,823	$ 16,263
2015		$ 5,597,412	$ 265,733		$ 8,398,608	$ 16,263
2016		$ 5,639,195	$ 367,523		$ 8,383,762	$ 16,263
2017		$ 5,562,151	$ 469,313		$ 12,752,452	$ 16,263
2018			$ 469,313		$ 14,804,125	$ 16,263
2019			$ 469,313		$ 8,591,836	$ 16,263
2020			$ 469,313		$ 2,908,826	$ 16,263
2021			$ 469,313			$ 51,713
2022			$ 469,313			$ 51,713
2023			$ 469,313			
2024			$ 469,313			
2025			$ 469,313			
2026			$ 469,313			
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2043			$ 469,313			
2044			$ 469,313			
2045			$ 469,313			
2046			$ 469,313			
2047			$ 469,313			
	Total cost	$ 23,705,222	$ 15,356,938		$ 62,611,839	$ 233,531

Cap In Place Closure Remedy Matrix								Capital Cost						
								Site Work						Dewatering
								Surveying			Site Preparation and Clearing			
Year	CCR Removed From GGS (Ton)	CCR Removed From GGS (CY)	Soil Removed from GGS (Tons)	Soil Removed from GGS (CY)	Total Pond Surface Area (acres)	Closure Activities	Cover Type	Area (Acre)	Unit Cost ($/Acre)	Cost	Area (Acre)	Unit Cost ($/Acre)	Cost	Cost ($)
2013					80		Federal CCR Rule Compliant Cover System	80	$ 1,000	$ 80,000				
2014						Construction of cover system with vegetative cover, active construction dewatering and surface water management. Long term monitoring of groundwater, cap maintenance, and storm water management.					41	$ 6,500	$ 266,500	$ 231,065
2015								41	$ 1,000	$ 41,000				$ 147,207
2016											39	$ 6,500	$ 253,500	$ 190,946
2017								39	$ 1,000	$ 39,000				$ 147,207
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Notes		Based on Bulk Density of 1.2 Ton/CY		Based on Bulk Density of 1.2 Ton/CY	Pond 1 (41 Ac) Pond 2 (39 Ac)			Unit cost based on contractor quote			Assumes 100% of the pond area requires clearing, grubbing, and site preparation, which incorporates immediate surroundings.			Dewatering costs derived from assumed pumping rates and supplier quotes
References											1			

Table 2-2: Grainger Alternative 1 Cap In Place Cost Calculations

	Capital Cost														
	Excavation						Disposal/Reuse Transportation						Soil Sampling		
	CCR Excavation			Soil Excavation			Soil and CCR Transportation			CCR Disposal					
Year	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Weight (Tons)	Unit Cost ($/ton)	Cost ($)	Weight (Tons)	Unit Cost ($/ton)	Cost ($)	Samples	$/Sample	Cost ($)
2013															
2014															
2015															
2016															
2017															
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Notes							Transportation rates provided by Santee Cooper			Disposal rate estimates provided by Santee Cooper			Assumes engineering construction oversight collects the samples		
References	2			2			2								

Table 2-2: Grainger Alternative 1 Cap In Place Cost Calculations

	Capital Cost									
	Cover System Installation			Reclamation	Dust Control				Construction Erosion Control	
	Federal CCR Rule Compliant Cover System			Wetland Construction	Water Truck					
Year	**Area (Acre)**	**Unit Cost ($/Acre)**	**Cost ($)**	**Cost ($)**	**Area (Acre)**	**Time (Days)**	**Unit Cost ($/Acre-Day)**	**Cost ($)**	**Area (Acre)**	**Cost ($)**
2013										
2014	20.5		$ 4,500,351		20	86		$ 129,000.00	41	$ 39,115.93
2015	20.5	Cost = ((($170,144 x Area)+$36,207) x 1.5)-($72,600 x Area)+($25,000 x Area)+($9,264 x Area))	$ 4,500,351		20	86	$ 75.00	$ 129,000.00	41	$ 39,115.93
2016	19.5		$ 4,283,471		20	86		$ 129,000.00	39	$ 38,390.59
2017	19.5		$ 4,283,471		20	86		$ 129,000.00	39	$ 38,390.59
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Notes	Cover system cost includes 6" erosion layer, 12" of earthen material, geocomposite layer, runoff system, 60-mil HDPE, and geotextile cushion.				Assume water trucks spray application costs $75/acre day and dust control is working days for 4 months out of the year (86 working days). Assumes 25% of the site is under construction at any one time and requires dust control				Assume 25% of the site is under construction at any one time and requires erosion control. Assumes on site construction laborers conduct the installation, inspections, and maintenance work items.	
References	2,3				4,8					

Table 2-2: Grainger Alternative 1 Cap In Place Cost Calculations

	Capital Cost										
	Direct Capital					Project Startup/Construction Management/ Health and Safety					
Year	Direct Capital Total	Contingency	Discount Rate	Area Cost Factor	Total Direct Capital Cost	Engineering/Design/Management/Planning	Construction Management/Health and Safety (5%)	Mobilization (1%)	Demobilization (1%)	Total PM Cost	Total Capital Cost
2013	$ 80,000				$ 82,400.00	$ 689,840.00		$ 101,121		$ 790,961	**$ 873,361**
2014	$ 5,166,031				$ 5,321,011.93	$ 344,920.00	$ 266,051	$ 101,121		$ 712,091	**$ 6,033,103**
2015	$ 4,856,674	25%	7%	-15%	$ 5,002,373.74	$ 344,920.00	$ 250,119			$ 595,039	**$ 5,597,412**
2016	$ 4,895,307				$ 5,042,166.62	$ 344,920.00	$ 252,108			$ 597,028	**$ 5,639,195**
2017	$ 4,637,068				$ 4,776,180.23	$ 344,920.00	$ 238,809		$ 202,241	$ 785,970	**$ 5,562,151**
2018											
2019											
2020											
2021											
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Notes						Assumes prevailing wage salary for engineers with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assumes four full time engineers, planners, managers, etc. during 2013 for initial design and planning and two full time employees for every subsequent year.		Assume mobilization occurs in 2013/2014. 1% of total direction capital cost.	Assume demobilization occurs in 2021		
References		5	7	6		7	7,6	1			

Table 2-2: Grainger Alternative 1 Cap In Place Cost Calculations

	Operation & Maintenance and Post Closure Care Cost												
	Groundwater Monitoring	Impoundment Inspections	Wetland Monitoring	Cover System Misc Maint & Repairs			Surface Water Management			Direct O&M Total ($/yr)	Project Management (6%)	Contingency (10%)	Total Annual Post-Closure Care O&M Cost
Year	Unit Cost	Cost ($/yr)	Cost ($/yr)	Area (Acre)	Unit Cost	Cost ($/yr)	Area (Acre)	Unit Cost	Cost ($/yr)				
2013	$ 14,020				Cost = ($3,500 x Area)	$ -		Cost = ($1,000 x Area)	$ -	**$ 14,020**	**$ 841**	**$ 1,402**	**$ 16,263**
2014	$ 14,020	$ 30,560.00		21		$ 71,750	21		$ 20,500	**$ 136,830**	**$ 8,210**	**$ 13,683**	**$ 158,723**
2015	$ 14,020	$ 30,560.00		41		$ 143,500	41		$ 41,000	**$ 229,080**	**$ 13,745**	**$ 22,908**	**$ 265,733**
2016	$ 14,020	$ 30,560.00		61		$ 211,750	61		$ 60,500	**$ 316,830**	**$ 19,010**	**$ 31,683**	**$ 367,523**
2017	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2018	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2019	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2020	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2021	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2022	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2023	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2024	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2025	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2026	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2027	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2028	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2029	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2030	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2031	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2032	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2033	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2034	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2035	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2036	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2037	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2038	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2039	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2040	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2041	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2042	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2043	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2044	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2045	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2046	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
2047	$ 14,020	$ 30,560.00		80		$ 280,000	80		$ 80,000	**$ 404,580**	**$ 24,275**	**$ 40,458**	**$ 469,313**
Notes	Assumes Groundwater Monitoring performed by an Environmental Scientist per the requirements of the NPDES permit. Cost includes labor, laboratory, travel, and data analysis/reporting.	Assumes 25% FTE Environmental Scientist salary with an increase of 100% to account for taxes, benefits, space, equipment, and materials.	Assumes 25% FTE Environmental Scientist salary with an increase of 100% to account for taxes, benefits, space, equipment, and materials.	Unit cost derived from references on a per acre basis, assuming 10% of cover system is repaired per year			Unit cost derived from references on a per acre basis. Includes surface water collection system operation and maintenance, sediment basin maintenance and repair, cleanout, sampling, and analysis.						
References				9, 12, 13			10, 11, 16,14				12	12	

Table 2-3: Grainger Alternative 2 Clean Closure Cost Calculations

Clean Closure Remedy Matrix								Capital Cost		
								Site Work		
								Surveying		
Year	CCR Removed From GGS (Ton)	CCR Removed From GGS (CY)	Soil Removed from GGS (Tons)	Soil Removed from GGS (CY)	Total Pond Surface Area (acres)	Closure Activities	Cover Type	Area (Acre)	Unit Cost ($/Acre)	Cost
2013					80		NA	80	$ 1,000	$ 80,000
2014	164,144	136,787				Active construction dewatering and CCR removal and transportation to landfill or beneficial reuse market.				
2015	284,390	236,992								
2016	269,370	224,475	17,056	14,213		Active construction dewatering, CCR and soil removal and transportation to landfill or beneficial reuse market.				
2017	420,560	350,466	42,145	35,121						
2018	479,075	399,230	57,838	48,198				41		$ 41,000
2019	132,083	110,069	260,505	217,088						
2020			91,942	76,618		Active construction dewatering, soil removal and transportation to landfill, and reclamation of ponds into wetlands.		39		$ 39,000
2021										
2022										
		Based on Bulk Density of 1.2 Ton/CY		Based on Bulk Density of 1.2 Ton/CY	Pond 1 (41 Ac) Pond 2 (39 Ac)	Active construction dewatering and surface water management, CCR removal, CCR transportation to designated disposal location, and reclamation of ponds into wetlands.		Unit cost based on contractor quote. Includes initial site surveying and closure surveying of each pond.		

Table 2-3: Grainger Alternative 2 Clean Closure Cost Calculations

	Capital Cost												
	Site Work			Dewatering	Excavation						Disposal/Reuse Transportation		
	Site Preparation and Clearing				CCR Excavation			Soil Excavation			Soil and CCR Transportation		
Year	Area (Acre)	Unit Cost ($/Acre)	Cost	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Weight (Tons)	Unit Cost ($/ton)	Cost ($)
2013	$ 41	$ 6,500	$ 266,500		-	Cost = ($5.99 x CY)+$560		-	Cost = ($5.99 x CY)+$560		-	Varies by destination	$ -
2014				$ 240,675	136,787		$ 1,361,056	-			164,144		$ 3,121,038
2015				$ 263,803	236,992		$ 2,357,431	-			284,390		$ 5,405,672
2016				$ 275,368	224,475		$ 2,232,975	14,213		$ 142,259	286,426		$ 5,445,015
2017	$ 39	$ 6,500	$ 253,500	$ 286,932	350,466		$ 3,485,758	35,121		$ 350,154	462,705		$ 8,150,185
2018				$ 523,201	399,230		$ 3,970,628	48,198		$ 480,184	536,913		$ 9,648,957
2019				$ 460,329	110,069		$ 1,095,393	217,088		$ 2,159,520	392,589		$ 5,396,372
2020				$ 213,037	-			76,618		$ 762,778	91,942		$ 945,396
2021					-			-					
2022													
	Assumes 100% of the pond area requires clearing, grubbing, and site preparation, which incorporates immediate surroundings.			Dewatering costs derived from assumed pumping rates and supplier quotes							Transportation rates provided by Santee Cooper		
	1				2			2			2		

Table 2-3: Grainger Alternative 2 Clean Closure Cost Calculations

	Capital Cost									
	Disposal/Reuse Transportation			Soil Sampling			Cap Installation			Reclamation
	CCR Disposal						Type IV Cap			Wetland Construction
Year	Weight (Tons)	Unit Cost ($/ton)	Cost ($)	Samples	$/Sample	Cost ($)	Area (Acre)	Unit Cost ($/Acre)	Cost ($)	Cost ($)
2013	-	Varies by destination	$ -		$368/Pond 1 Sample and $270/Pond 2 Sample			Cost = ((($170,144 x Area)+$36,207) x 1.5)-($72,600 x Area)+($25,000 x Area)+($9,264 x Area))		
2014	164,144		$ 945,179							
2015	284,390		$ 1,638,540							
2016	269,370		$ 1,551,704							
2017	420,560		$ 2,443,312							
2018	479,075		$ 2,791,092	54		$ 19,872				
2019	132,083		$ 760,565	49		$ 17,543				
2020	-		$ -	32		$ 8,648				$ 315,000
2021	-									
2022										
	Specific disposal rates were not provided by Santee Cooper. Disposal unit costs were derived so that the total expenditures match those reported by Santee Cooper.			Assumes engineering construction oversight collects the samples				Cap cost includes 6" erosion layer, 12" of earthen material, geocomposite layer, runoff system, 60-mil HDPE, and geotextile cushion.		Estimate provided by Santee Cooper
								2,3		

Table 2-3: Grainger Alternative 2 Clean Closure Cost Calculations

	Capital Cost										
	Dust Control				Construction Erosion Control		Direct Capital				
	Water Truck										
Year	**Area (Acre)**	**Time (Days)**	**Unit Cost ($/Acre-Day)**	**Cost ($)**	**Area (Acre)**	**Cost ($)**	**Direct Capital Total**	**Contingency**	**Discount Rate**	**Area Cost Factor**	**Total Direct Capital Cost**
2013	20	86		$ 129,000.00	41	$ 39,115.93	$ 514,616				$ 401,400.43
2014	20	86		$ 129,000.00	41	$ 39,115.93	$ 5,836,064				$ 4,552,130.25
2015	20	86		$ 129,000.00	41	$ 39,115.93	$ 9,833,563				$ 7,670,178.99
2016	20	86		$ 129,000.00	41	$ 39,115.93	$ 9,815,436				$ 7,656,039.88
2017	20	86		$ 129,000.00	80	$ 50,772.49	$ 15,149,612				$ 11,816,697.25
2018	20	86	$ 75.00	$ 129,000.00	80	$ 50,772.49	$ 17,654,707		7%	-15%	$ 13,770,671.26
2019	20	86		$ 129,000.00	80	$ 50,772.49	$ 10,069,494				$ 7,854,205.35
2020	20	86		$ 129,000.00	39	$ 38,390.59	$ 2,451,249				$ 1,911,974.36
2021											
2022											
	Assume water trucks spray application costs $75/acre day and dust control is working days for 4 months out of the year (86 working days). Assumes 25% of the site is under construction at any one time and requires dust control				Assume 25% of the site is under construction at any one time and requires erosion control. Assumes on site construction laborers conduct the installation, inspections, and maintenance work items.			No contingency was applied since total capital costs were provided by Santee Cooper.			
	4,8								7	6	

Table 2-3: Grainger Alternative 2 Clean Closure Cost Calculations

	Capital Cost					
	Project Startup/Construction Management/ Health and Safety					
Year	Engineering/Design/Management/Planning	Construction Management/Health and Safety (5%)	Mobilization (1%)	Demobilization (1%)	Total PM Cost	Total Capital Cost
2013	$ 689,840.00		$ 278,166		$ 968,006	**$ 1,369,407**
2014	$ 344,920.00	$ 227,607	$ 278,166		$ 850,693	**$ 5,402,823**
2015	$ 344,920.00	$ 383,509			$ 728,429	**$ 8,398,608**
2016	$ 344,920.00	$ 382,802			$ 727,722	**$ 8,383,762**
2017	$ 344,920.00	$ 590,835			$ 935,755	**$ 12,752,452**
2018	$ 344,920.00	$ 688,534			$ 1,033,454	**$ 14,804,125**
2019	$ 344,920.00	$ 392,710			$ 737,630	**$ 8,591,836**
2020	$ 344,920.00	$ 95,599		$ 556,333	$ 996,852	**$ 2,908,826**
2021						
2022						
	Assumes prevailing wage salary for engineers with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assumes four full time engineers, planners, managers, etc. during 2013 for initial design and planning and two full time employees for every subsequent year.		Assume mobilization occurs in 2013/2014. 1% of total direction capital cost.	Assume demobilization occurs in 2021		
	7	7,5	1			

Table 2-3: Grainger Alternative 2 Clean Closure Cost Calculations

	Operation & Maintenance and Post Closure Care Cost									
	Groundwater Monitoring	Impoundment Inspections	Wetland Monitoring	Type IV Cap Misc Maint & Repairs			Surface Water Management			Direct O&M Total ($/yr)
Year	Cost ($/yr)	Cost ($/yr)	Cost ($/yr)	Area (Acre)	Unit Cost	Cost ($/yr)	Area (Acre)	Unit Cost	Cost ($/yr)	
2013	$ 14,020				Cost = ($3,500 x Area)	$ -		$ 1,000	$ -	**$ 14,020**
2014	$ 14,020					$ -			$ -	**$ 14,020**
2015	$ 14,020					$ -			$ -	**$ 14,020**
2016	$ 14,020					$ -			$ -	**$ 14,020**
2017	$ 14,020					$ -			$ -	**$ 14,020**
2018	$ 14,020					$ -				**$ 14,020**
2019	$ 14,020					$ -				**$ 14,020**
2020	$ 14,020					$ -				**$ 14,020**
2021	$ 14,020		$ 30,560.00			$ -				**$ 44,580**
2022	$ 14,020		$ 30,560.00			$ -				**$ 44,580**
	Assumes Groundwater Monitoring performed by an Environmental Scientist per the requirements of the NPDES permit. Cost includes labor, laboratory, travel, and data analysis/reporting.	Assumes 25% FTE Environmental Scientist salary with an increase of 100%.	Assumes 25% FTE Environmental Scientist salary with an increase of 100%.	Unit cost derived from references on a per acre basis, assuming 10% of cover system is repaired per year			Unit cost derived from references on a per acre basis. Includes surface water collection system operation and maintenance, sediment basin maintenance and repair, cleanout, sampling, and analysis.			
				9, 12, 13			10, 11, 16,14			

Table 2-3: Grainger Alternative 2 Clean Closure Cost Calculations

Year	Operation & Maintenance and Post Closure Care Cost		
	Project Management (6%)	Contingency (10%)	Total Annual O&M + Post-Closure Care Cost
2013	$ 841	$ 1,402	$ 16,263
2014	$ 841	$ 1,402	$ 16,263
2015	$ 841	$ 1,402	$ 16,263
2016	$ 841	$ 1,402	$ 16,263
2017	$ 841	$ 1,402	$ 16,263
2018	$ 841	$ 1,402	$ 16,263
2019	$ 841	$ 1,402	$ 16,263
2020	$ 841	$ 1,402	$ 16,263
2021	$ 2,675	$ 4,458	$ 51,713
2022	$ 2,675	$ 4,458	$ 51,713
	12	12	

Table 2-4: Grainger Jobs Comparison

Year	Alternative 1. Cap In Place			Alternative 2. Clean Closure		
	Closure Plan	Total Construction FTE	Total Annual O&M FTE	Closure Plan	Total Construction FTE	Total Annual O&M FTE
2013	Active construction dewatering and surface water management, construction of Federal CCR Rule compliant cover system with vegetative cover, and long term monitoring of groundwater.	4	0	Active construction dewatering and surface water management, CCR removal, CCR transportation to designated disposal location, and reclamation of ponds into wetlands	8	
2014		15	1.2		21	
2015		12	2.0		33	
2016		14	2.8		35	
2017		12	3.6		56	
2018			3.6		62	
2019			3.6		38	
2020			3.6		14	
2021			3.6			0.3
2022			3.6			0.3
2023			3.6			
2024			3.6			
2025			3.6			
2026			3.6			
2027			3.6			
2028			3.6			
2029			3.6			
2030			3.6			
2031			3.6			
2032			3.6			
2033			3.6			
2034			3.6			
2035			3.6			
2036			3.6			
2037			3.6			
2038			3.6			
2039			3.6			
2040			3.6			
2041			3.6			
2042			3.6			
2043			3.6			
2044			3.6			
2045			3.6			
2046			3.6			
2047			3.6			
	Total FTE	57			266	

Table 2-5: Grainger Alternative 1 Cap in Place Jobs Calculations

Cap In Place Remedy Matrix								Construction Job Calculations								
								Surveying					Site Preparation and Clearing			
Year	**CCR Removed From GGS (Ton)**	**CCR Removed From GGS (CY)**	**Soil Removed from GGS (Tons)**	**Soil Removed from GGS (CY)**	**Total Pond Surface Area (acres)**	**Closure Activities**	**Cover Type**	**Area (Acres)**	**Rate (acre/day)**	**Surveying Duration (Days)**	**Professional Land Surveyor FTE**	**PLS Assistant FTE**	**Area (Acre)**	**Dozer Operator FTE**	**Heavy Machinery Mechanic FTE**	**Construction Laborer FTE**
2013					80		Federal CCR Rule Compliant Cover System	80	8	10	0.1	0.04				
2014						Construction of cover system with vegetative cover, active construction dewatering and surface water management. Long term monitoring of groundwater, cap maintenance, and storm water management.							41	0.8	0.2	1.7
2015								41	8	5	0.04	0.02				
2016													39	0.8	0.2	1.6
2017								39	8	5	0.04	0.02				
2018																
2019																
2020																
2021																
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2044																
2045																
2046																
2047																
Notes		Based on Bulk Density of 1.2 Ton/CY		Based on Bulk Density of 1.2 Ton/CY	Pond 1 (41 Ac) Pond 2 (39 Ac)				Contractor Quote		Assumes two-person surveying team which includes 1 PLS and assistant per team. Additionally one PLS for data processing and drafting. Calculated based on a 261-day working year.			Calculated based on a production rate of a CAT D6T Dozer.	Assumes 2 mechanics per 10 operators	Assumes 2 construction laborers per dozer

Table 2-5: Grainger Alternative 1 Cap in Place Jobs Calculations

	Construction Job Calculations											
	Excavation					Dust Control				Disposal/Reuse Transportation		
Year	Excavation Volume (CY)	Excavator Operator FTE	Dozer/Front End Loader Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Acres	Water Truck Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Tons of Material Transported Offsite	Truck Driver FTE	Truck Mechanic FTE
2013												
2014						20	0.5	0.1	0.1			
2015						20	0.5	0.1	0.1			
2016						20	0.5	0.1	0.1			
2017						20	0.5	0.1	0.1			
2018												
2019												
2020												
2021												
2022												
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2046												
2047												
Notes		Calculated based on production rate of a Cat 349F Excavator. Assumes 261 working days per year and 8 hour work days. Assumes half of CCR and soil is temporarily stockpiled on site for dewatering/conditioning and is double handled.	Calculated based on a production rate of a CAT D6T Dozer. Production rates applied to temporarily stockpiled material on site.	2 mechanics per 10 operators	1 construction laborer per 5 heavy equipment operators			Assumes 2 mechanics per 10 operators	Assumes 1 construction laborer per 5 heavy equipment operators	Assumes trucks carrying an average payload of 23.7 tons per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantities of materials shipped per year and final destination.		Assume 1 mechanic per 10 vehicles

Table 2-5: Grainger Alternative 1 Cap in Place Jobs Calculations

	Construction Job Calculations										Construction Job Totals Summary			
	Federal CCR Rule Compliant Cover System									Wetland Construction	Skilled Laborer FTE			Unskilled Laborer
Year	Cover System Area (Acres)	Earthen Material Volume (CY)	Topsoil Material Volume (CY)]	Dump Truck Operator FTE	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Liner Installation, Surface Water Runoff Collection Installation Laborer FTE	Construction Laborer FTE	Skilled Laborer FTE	Heavy Equipment Operator FTE	Commercial Truck Driver FTE	
2013											0.0	0.0	0.0	0.0
2014	20.5	33,073	16,544	1.8	1.27	1.27	0.869	0.9	2.4		3.6	3.8	1.8	2.7
2015	20.5	33,073	16,544	1.8	1.27	1.27	0.869	0.9	2.4		3.4	3.0	1.8	1.0
2016	19.5	31,460	15,737	1.7	1.21	1.21	0.827	0.8	2.3		3.4	3.7	1.7	2.5
2017	19.5	31,460	15,737	1.7	1.21	1.21	0.827	0.8	2.3		3.3	2.9	1.7	0.9
2018														
2019														
2020														
2021														
2022														
2023														
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2026														
2027														
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2041														
2042														
2043														
2044														
2045														
2046														
2047														
Notes		12" of Earthen Material equates to 1613.33 CY per Acre	6" of Earthen Material equates to 807 CY per Acre	Assumes trucks carrying an average payload of 15 CY of fill per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantities of materials shipped to site per year. Assumes a load time, unload time, and travel time of 1.5 hours.	Based on production rate of a CAT D6T with a 50% efficiency applied and assumed four passes per unit operation.	Assume 1 roller per dozer	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators.	Assume 21-worker crew can install 1 acre of HDPE liner and geocomposite liner per day plus 10 workers to construct the surface water runoff system.	Assumes crew of four working for two weeks in 2018 and 2020 to prepare the wetland soil and seed mix.	Includes PLS assistants, pump and conveyance system installers, heavy machinery mechanics, liner installers, surface runoff collection installers.	Includes water truck drivers, excavator operators, dozer operators, drum compactor operators.	Includes dump truck drivers.	Includes unskilled laborers to assist with construction efforts.

Table 2-5: Grainger Alternative 1 Cap in Place Jobs Calculations

	Construction Job Totals Summary					Post Closure O&M Job Calculations							
	Professional				Total Construction-Related Jobs FTE	Groundwater Monitoring	Wetland Monitoring	Impoundment Inspections	Cover System Maintenance		Surface/Storm Water Management	Project Management	Total Annual O&M Jobs FTE
Year	Professional Land Surveyor FTE	Construction Manager FTE	Health/Safety Manager FTE	Engineer/Planner/Estimator/Designer/Management FTE		Environmental Scientist FTE	Environmental Scientist FTE	Environmental Scientist FTE	Heavy Equipment Operator FTE	Construction Laborer FTE	Construction Laborer FTE	Engineer/Project Manager FTE	
2013	0.08	0.0	0.0	4.0	4.1	0.04		0.00	0.00	0.00	0.00	0.00	0.0
2014	0.00	0.5	0.5	2.0	14.9	0.04		0.25	0.17	0.36	0.29	0.05	1.2
2015	0.04	0.4	0.4	2.0	12.0	0.04		0.25	0.34	0.71	0.58	0.08	2.0
2016	0.00	0.5	0.5	2.0	14.3	0.04		0.25	0.50	1.05	0.86	0.11	2.8
2017	0.04	0.4	0.4	2.0	11.5	0.04		0.25	0.66	1.39	1.14	0.14	3.6
2018						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2019						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2020						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2021						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2022						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2023						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2024						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2025						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2026						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2027						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2028						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2029						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2030						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2031						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2032						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2033						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2034						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2035						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2036						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2037						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2038						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2039						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2040						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2041						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2042						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2043						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2044						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2045						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2046						0.04		0.25	0.66	1.39	1.14	0.14	3.6
2047						0.04		0.25	0.66	1.39	1.14	0.14	3.6
Notes		Assumes 1 construction manager per 20 employees	Assumes 1 health/safety manager per 20 employees	Assumes four full time engineers, planners, managers, etc. during 2013 for initial design and planning and two full time employees for every subsequent year.		Assumes groundwater monitoring continues per NPDES permit requirements. Estimated contract cost for sampling labor, travel, data analysis and reporting.	Assume 25% Environmental Scientist FTE per year to complete wetland monitoring	FTE based on salary of an Environmental Scientist ($61,120/yr) with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of inspection budget consists of labor.	FTE based on salary of heavy equipment operator ($35,110) and salary of a construction laborer ($33,650) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor and there is two construction laborers for every heavy equipment operator.		FTE based on salary of an construction laborer ($33,650/yr) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Maintenance includes cleanout and repair of water conveyance structures, down chutes, sediment basins, and outfalls.	Assumes prevailing wage salary of $86,230/yr with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of budget consists of labor.	

Table 2-6: Grainger Alternative 2 Clean Closure Jobs Calculations

Clean Closure Remedy Matrix							
Year	**CCR Removed From GGS (Ton)**	**CCR Removed From GGS (CY)**	**Soil Removed from GGS (Tons)**	**Soil Removed from GGS (CY)**	**Total Pond Surface Area (acres)**	**Closure Activities**	**Cover Type**
2013					80		
2014	164,144	136,787				Active construction dewatering and CCR removal and transportation to	
2015	284,390	236,992					
2016	269,370	224,475	17,056	14,213		Active construction dewatering, CCR and soil removal and transportation to landfill or beneficial reuse market.	
2017	420,560	350,466	42,145	35,121			
2018	479,075	399,230	57,838	48,198			
2019	132,083	110,069	260,505	217,088			
2020			91,942	76,618		Active construction dewatering, soil removal and transportation to landfill, and reclamation of ponds into wetlands.	
2021							
2022							
Notes		Based on Bulk Density of 1.2 Ton/CY		Based on Bulk Density of 1.2 Ton/CY	Pond 1 (41 Ac) Pond 2 (39 Ac)		

Table 2-6: Grainger Alternative 2 Clean Closure Jobs Calculations

	Construction Job Calculations													
	Surveying					Site Preparation and Clearing				Excavation				
Year	Area (Acres)	Rate (acre/day)	Surveying Duration (Days)	Professional Land Surveyor FTE	PLS Assistant FTE	Area (Acre)	Dozer Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Excavation Volume (CY)	Excavator Operator FTE	Dozer/Front End Loader Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
2013	80	8	10	0.1	0.04	41	0.8	0.17	1.69					
2014										136,787	1.6	0.3	0.4	0.4
2015										236,992	2.8	0.6	0.7	0.7
2016										238,688	2.9	0.6	0.7	0.7
2017						39	0.8	0.16	1.61	385,588	4.6	0.9	1.1	1.1
2018	41	8	5	0.04	0.02					447,428	5.4	1.1	1.3	1.3
2019										327,157	3.9	0.8	0.9	0.9
2020	39	8	5	0.04	0.02					76,618	0.9	0.2	0.2	0.2
2021														
2022														
Notes		Contractor Quote		Assumes two-person surveying team which includes 1 PLS and assistant per team. Additionally one PLS for data processing and drafting. Calculated based on a 261-day working year.			Calculated based on a production rate of a CAT D6T Dozer.	Assumes 2 mechanics per 10 operators	Assumes 2 construction laborers per dozer		Calculated based on production rate of a Cat 349F Excavator. Assumes 261 working days per year and 8 hour work days. Assumes half of CCR and soil is temporarily stockpiled on site for dewatering/conditio	Calculated based on a production rate of a CAT D6T Dozer. Production rates applied to temporarily stockpiled material on site.	Assumes 2 mechanics per 10 operators	Assumes 1 construction laborer per 5 heavy equipment operators

Table 2-6: Grainger Alternative 2 Clean Closure Jobs Calculations

	Construction Job Calculations													
	Dust Control				Disposal/Reuse Transportation			Federal CCR Rule Compliant Cover System						
Year	Acres	Water Truck Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Tons of Material Transported Offsite	Truck Driver FTE	Truck Mechanic FTE	Cover System Area (Acres)	Earthen Material Volume (CY)	Topsoil Material Volume (CY)]	Dump Truck Operator FTE	Articulated Truck Operator FTE	Dozer Operator FTE
2013	20	0.5	0.1	0.1									
2014	20	0.5	0.1	0.1	164,144	14	1.4						
2015	20	0.5	0.1	0.1	284,390	23	2.3						
2016	20	0.5	0.1	0.1	286,426	24	2.4						
2017	20	0.5	0.1	0.1	462,705	38	3.8						
2018	20	0.5	0.1	0.1	536,913	44	4.4						
2019	20	0.5	0.1	0.1	392,589	25	2.5						
2020	20	0.5	0.1	0.1	91,942	8	0.8						
2021													
2022													
Notes			Assumes 2 mechanics per 10 operators	Assumes 1 construction laborer per 5 heavy equipment operators	Assumes trucks carrying an average payload of 23.7 tons per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantities of materials transported per year and distance of travel.		Assume 1 mechanic per 10 vehicles		12" of Earthen Material equates to 1613.33 CY per Acre	6" of Earthen Material equates to 807 CY per Acre	Assumes trucks carrying an average payload of 15 CY of fill per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantities of materials shipped to site per year. Assumes a	Based on production rate of a CAT D6T with a 50% efficiency applied and assumed four passes per unit operation.	Assume 1 roller per dozer

Table 2-6: Grainger Alternative 2 Clean Closure Jobs Calculations

	Construction Job Totals Summary						
	Federal CCR Rule Compliant Cover System			Wetland Construction	Skilled Laborer FTE		
Year	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Construction Laborer FTE	Skilled Laborer FTE	Heavy Equipment Operator FTE	Commercial Truck Driver FTE
2013					0.3	1.3	0.0
2014					1.9	2.4	14.0
2015					3.1	3.9	23.0
2016					3.2	3.9	24.0
2017					5.2	6.8	38.0
2018				0.16	5.8	6.9	44.0
2019					3.5	5.2	25.0
2020				0.16	1.1	1.6	8.0
2021							
2022							
Notes	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators.	Assume 21-worker crew can install 1 acre of HDPE liner and geocomposite liner per day plus 10 workers to construct the surface water runoff system.	Assumes crew of four working for two weeks in 2018 and 2020 to prepare the wetland soil and seed mix.	Includes PLS assistants, pump and conveyance system installers, heavy machinery mechanics, liner installers, surface runoff collection installers.	Includes water truck drivers, excavator operators, dozer operators, drum compactor operators.	Includes dump truck drivers.

Table 2-6: Grainger Alternative 2 Clean Closure Jobs Calculations

	Construction Job Totals Summary					
		Professional				
Year	Unskilled Laborer	Professional Land Surveyor FTE	Construction Manager FTE	Health/Safety Manager FTE	Engineer/Planner/Estimator/Designer/Management FTE	Total Construction-Related Jobs FTE
2013	1.8	0.08	0.2	0.2	4.0	7.8
2014	0.5	0.00	0.2	0.2	2.0	21.3
2015	0.8	0.00	0.4	0.4	2.0	33.5
2016	0.8	0.00	0.4	0.4	2.0	34.6
2017	2.8	0.00	0.7	0.7	2.0	56.3
2018	1.5	0.04	0.7	0.7	2.0	61.7
2019	1.0	0.00	0.5	0.5	2.0	37.7
2020	0.5	0.04	0.2	0.2	2.0	13.5
2021						0.0
2022						0.0
Notes	Includes unskilled laborers to assist with construction efforts.		Assumes 1 construction manager per 20 employees	Assumes 1 health/safety manager per 20 employees	Assumes four full time engineers, planners, managers, etc. during 2013 for initial design and planning and two full time employees for every subsequent year.	

Table 2-6: Grainger Alternative 2 Clean Closure Jobs Calculations

	Post Closure O&M Job Calculations							Post Closure O&M Job Totals
	Groundwater Monitoring	Wetland Monitoring	Impoundment Inspections	Cover System Maintenance		Surface/Storm Water Management	Project Management	
Year	Environmental Scientist FTE	Environmental Scientist FTE	Environmental Scientist FTE	Heavy Equipment Operator FTE	Construction Laborer FTE	Construction Laborer FTE	Engineer/Project Manager FTE	Total Annual O&M Jobs FTE
2013	0.04							0.04
2014	0.04							0.04
2015	0.04							0.04
2016	0.04							0.04
2017	0.04							0.04
2018	0.04							0.04
2019	0.04							0.04
2020	0.04							0.04
2021	0.04	0.25						0.29
2022	0.04	0.25						0.29
Notes	Assumes groundwater monitoring continues per NPDES permit requirements. Estimated contract cost for sampling labor, travel, data analysis and reporting.	Assume 25% Environmental Scientist FTE per year to complete wetland monitoring	FTE based on salary of an Environmental Scientist ($61,120/yr) with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of inspection budget consists of labor.	FTE based on salary of heavy equipment operator ($35,110) and salary of a construction laborer ($33,650) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor and there is two construction laborers for every heavy equipment operator.		FTE based on salary of an construction laborer ($33,650/yr) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Maintenance includes cleanout and repair of water conveyance structures, down chutes, sediment basins, and outfalls.	Assumes prevailing wage salary of $86,230/yr with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of budget consists of labor.	

Table 2-7: Grainger Cost References

Ref. #	Citation
1	Casmalia Resources Site Steering Committee. 2016. *Casmalia Resources Superfund Site: Final Feasibility Study.* Prepared for USEPA, Region 9.
2	United States Environmental Protection Agency. September 2004. *Interim Measures Cost Compendium.*
3	https://foresternetwork.com/weekly/msw-management-weekly/landfill-management/landfill-economics-part-ii-getting-down-to-business-part-i/
4	Johnson, E., Olson, C., 2009 *Best Practices for Dust Control on Aggregate Roads,* Minnesota Department of Transportation Office, Maplewood, Minnesota.
5	United States Department of Energy. March 1997. Cost Estimating Guide. DOE G 430.1-1
6	United States Department of Defense. June 2018. Unified Facilities Criteria - DoD Facilities Pricing Guide. UFC 3-701-01
7	United States Environmental Protection Agency. July 2001. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002
8	Sierra Research, Inc. 2003. *Final BACM Technological and Economic Feasibility Analysis.* San Joaquin Valley Unified Air Pollution Control District. Sacramento, CA.
9	Golder Associates Inc.2016. *Post Closure Care Plant - Clover Power Station Stage 3 Ash Landfill - Permit #556.* Prepared for Dominion - Clover Power Station.
10	CB&I Environmental & Infrastructure, Inc. 2016. *Post Closure Plan - Lawrence Energy Center - Industrial Landfill #0847.* Prepared for Westar Energy. Lawrence, Kansas.
11	Environmental Management Services, Inc. 2016. *Coal Combustion Residuals (CCR) Landfill Closure and Post-Closure Plan.* Prepared for South Mississippi Electric Power Association. Purvis, Mississippi.
12	Gai Consultants. 2016. *Post-Closure Care Plan Upper (East) Pond CCR Closure* . Chesterfield County, Virginia. Prepared for Virginia Electric Power Company.
13	Andrews Engineering, Inc. 2016. *Closure, Post-Closure Plans for Coal Combustion Residual Unit 2 Landfill.* Springfield, Sangamon County, Illinois. Prepared for City, Water, Light & Power.
14	Garrett & Moore. 2016. *Post-Closure Plan for the Williams Station Class III Landfill.* Berkely County, South Carolina. Prepared for SCANA, Inc.

Table 3-1: Michigan City Cost Comparison

Year	Alternative 1. NIPSCO Closure			Alternative 2. Clean Closure		
	Closure Plan	Total Capital Cost	Total Annual O&M Cost	Closure Plan	Total Capital Cost	Total Annual O&M Cost
2021	Excavation of CCR from the five settling basins built in the early 1970's and off-site disposal at R.M. Schahfer Generating Station (RMSGS) CCR Landfill. Backfill excavation with soil. CCR in former lakefront impoundment and fill will be left in place without cap or controls. Long term monitoring of groundwater, vegetation maintenance, and storm water management.	$ 345,860	$ 65,525	Excavation, dredging, and dewatering of all CCR for off-site transportation and disposal at the RMSGS CCR Landfill. Site grading and revegetation. Removal of sheet piling and riprap along Lake Michigan shoreline. Limited long term monitoring of groundwater, vegetation maintenance, and storm water management.	$ 770,631	$ 65,525
2022		$ 8,921,572	$ 65,525		$ 10,626,233	$ 65,525
2023		$ 8,308,700	$ 65,525		$ 8,625,716	$ 16,381
2024			$ 222,285		$ 8,625,716	$ 16,381
2025			$ 222,285		$ 8,625,716	$ 16,381
2026			$ 222,285		$ 8,625,716	$ 16,381
2027			$ 222,285		$ 8,625,716	$ 16,381
2028			$ 222,285		$ 8,682,556	$ 16,381
2029			$ 190,200		$ 14,380,905	$ 16,381
2030			$ 190,200		$ 13,062,478	$ 16,381
2031			$ 190,200		$ 13,062,478	$ 16,381
2032			$ 190,200		$ 13,100,471	$ 16,381
2033			$ 190,200		$ 10,831,294	$ 16,381
2034			$ 190,200		$ 23,835,462	$ 91,553
2035			$ 190,200			$ 91,553
2036			$ 190,200			$ 91,553
2037			$ 190,200			$ 91,553
2038			$ 190,200			$ 91,553
2039			$ 190,200			$ 91,553
2040			$ 190,200			$ 91,553
2041			$ 190,200			$ 91,553
2042			$ 190,200			$ 91,553
2043			$ 190,200			$ 91,553
2044			$ 190,200			$ 91,553
2045			$ 190,200			
2046			$ 190,200			
2047			$ 190,200			
2048			$ 190,200			
2049			$ 190,200			
2050			$ 190,200			
2051			$ 190,200			
2052			$ 190,200			
2053			$ 190,200			
	Total cost	$ 17,576,132	$ 6,062,995		$ 151,481,089	$ 1,318,329

NIPSCO Closure Remedy Matrix							
Year	**Material Removed Above GW Level (CY)**	**Material Removed Below GW Level (CY)**	**Excavation Area/Phase**	**Area (Acres)**	**Fill Volume (CY)**	**Topsoil Volume (CY)**	**Closure Activities**
2021							
2022	95,008	8,592	Primary Settling Pond 1; Secondary Settling Pond 1	4.3	83,316	3,468	Excavation of CCR from the five settling ponds built in the early 1970's, trucking, and off-site disposal at R.M. Schahfer Generating Station (RMSGS) CCR Landfill. Backfill excavation with clean soil.
2023	49,118	37,482	Primary Settling Pond 2; Secondary Settling Pond 2; Boiler Slag Pond	7.1	71,566	5,726	
2024							
2025							
2026							
2027							
2028							
2029							
2030							
2031							
2032							
2033							
2034							
2035							
2036							
2037							
2038							
2039							
2040							
2041							
2042							
2043							
2044							
2045							
2046							
2047							
2048							
2049							
2050							
2051							
2052							
2053							
Notes							
References							

Table 3-2: Michigan City Alternative 1 NIPSCO Closure Cost Calculations

	Capital Cost												
	Site Work						Dewatering	Excavation and Dredging					
	Surveying			Site Preparation and Clearing				CCR Excavation Above GW			CCR Excavation Below GW		
Year	Area (Acre)	Unit Cost ($/Acre)	Cost	Area (Acre)	Unit Cost ($/Acre)	Cost	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)
2021	11.4		$ 11,400										
2022	4.3		$ 4,300	4.3		$ 27,950		95,008		$ 989,166	8,592		$ 434,538
2023	7.1		$ 7,100	7.1		$ 46,150		49,118		$ 514,580	37,482		$ 1,164,535
2024													
2025													
2026													
2027													
2028													
2029													
2030													
2031													
2032													
2033													
2034													
2035													
2036		$ 1,000			$ 6,500				Cost = (($6.23 x CY)+$3,983) x 1.66			Cost = ((($1350.2 x (CY)^0.557) + ((5.99 x CY)+$560)) x 1.66	
2037													
2038													
2039													
2040													
2041													
2042													
2043													
2044													
2045													
2046													
2047													
2048													
2049													
2050													
2051													
2052													
2053													
Notes	Unit cost based on contractor quote			Assumes 100% of the pond area requires clearing, grubbing, and site preparation, which incorporates immediate surroundings.			Assume Excavated or dredged CCR will be dewatered passively by stockpiling CCR to drain before loading for transportation and disposal. Costs are included in excavation/dredging.						
References				1				2			2		

Table 3-2: Michigan City Alternative 1 NIPSCO Closure Cost Calculations

	Capital Cost										
	Excavation and Dredging			Sheet Piling and Riprap Removal							
	CCR Dredging			Sheet Piling Removal				Riprap Removal			
Year	Volume (CY)	Unit Cost (\$/CY)	Cost (\$)	Sheet Piling Length (LF)	Sheet Piling Area (ft^2)	Unit Cost (\$ft^2)	Cost (\$)	Riprap Length (LF)	Riprap Volume (CY)	Unit Cost (\$ft^2)	Cost (\$)
2021											
2022											
2023											
2024											
2025											
2026											
2027											
2028											
2029											
2030											
2031											
2032											
2033											
2034											
2035											
2036		Cost = ((\$3.02603448275862 x CY + ((5.99 x CY) + \$560))) x 1.66									
2037											
2038											
2039											
2040											
2041											
2042											
2043											
2044											
2045											
2046											
2047											
2048											
2049											
2050											
2051											
2052											
2053											
Notes											
References											

Table 3-2: Michigan City Alternative 1 NIPSCO Closure Cost Calculations

	Capital Cost											
	Transportation/Disposal							Backfill/Grading/Vegetation				
	CCR Transportation and Disposal			Sheet Piling Transportation				Backfill Placement and Compaction			Grading/Vegetation	
Year	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Sheet Piling Length (LF)	Sheet Piling Weight (tons)	Unit Cost ($/ton)	Cost ($)	Fill Volume (CY)	Topsoil Volume (CY)	Cost ($)	Area	Cost ($)
2021												
2022	103,600		$ 4,040,509					83,316	3,468	$ 1,457,988	$ 4.3	$ 41,893
2023	86,600		$ 3,377,491					71,566	5,726	$ 1,285,334	$ 7.1	$ 69,172
2024												
2025												
2026												
2027												
2028												
2029												
2030												
2031												
2032												
2033												
2034												
2035												
2036		$ 39.00										
2037												
2038												
2039												
2040												
2041												
2042												
2043												
2044												
2045												
2046												
2047												
2048												
2049												
2050												
2051												
2052												
2053												
Notes	Transportation rates provided by NIPSCO Closure Report at a rate of $19/CY. Assume a disposal rate/airspace cost of $20/CY.							Assume NIPSCO reported costs for importing and compacting fill ($17/CY) and topsoil ($12/CY)			Grading cost ($3,209/acre) based on production rate of D10T2 Dozer with a daily equipment use labor costs. Seeding cost is $6,534/acre per NIPSCO Closure Plan.	
References	19							19			1,9,11,12,15, 19	

Table 3-2: Michigan City Alternative 1 NIPSCO Closure Cost Calculations

	Capital Cost										
	Dust Control				Construction Erosion Control		Direct Capital				
	Water Truck										
Year	Area (Acre)	Time (Days)	Unit Cost ($/Acre-Day)	Cost ($)	Area (Acre)	Cost ($)	Direct Capital Total	Contingency	Discount Rate	Area Cost Factor	Total Direct Capital Cost
2021							$ 11,400				$ 12,540.00
2022	31.5	183	$ 75.00	$ 432,337.50	4.3	$ 14,500.03	$ 7,443,180	25%	7%	-8%	$ 8,187,498.49
2023	31.5	183		$ 432,337.50	7.1	$ 15,855.39	$ 6,912,555				$ 7,603,810.97
2024											
2025											
2026											
2027											
2028											
2029											
2030											
2031											
2032											
2033											
2034											
2035											
2036											
2037											
2038											
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2044											
2045											
2046											
2047											
2048											
2049											
2050											
2051											
2052											
2053											
Notes	Assume water trucks spray application costs $75/acre day and dust control is conducted during half the year. Assumes 25% of the entire property requires dust control on any given day.				Assumes on site construction laborers conduct the installation, inspections, and maintenance work items.						
References	4,8				16			5	7	6	

Table 3-2: Michigan City Alternative 1 NIPSCO Closure Cost Calculations

	Capital Cost					
	Project Startup/Construction Management/ Health and Safety					
Year	Engineering/Design/Management/ Planning	Construction Management/Health and Safety (5%)	Mobilization (1%)	Demobilization (1%)	Total PM Cost	Total Capital Cost
2021	$ 333,320.00				$ 333,320	**$ 345,860**
2022	$ 166,660.00	$ 409,375	$ 158,038		$ 734,073	**$ 8,921,572**
2023	$ 166,660.00	$ 380,191		$ 158,038	$ 704,889	**$ 8,308,700**
2024						
2025						
2026						
2027						
2028						
2029						
2030						
2031						
2032						
2033						
2034						
2035						
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2042						
2043						
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2050						
2051						
2052						
2053						
Notes	Assumes prevailing wage salary for engineers with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assumes two full time engineers, planners, managers, etc. during 2021 for initial design and planning and one full time employees for every subsequent year.		Assume mobilization occurs in 2022. 1% of total direct capital cost.	Assume demobilization occurs in 2023. 1% of total direct capital cost.		
References	7	7,6	1			

	Operation & Maintenance and Post Closure Care Cost										
	Groundwater Monitoring	Semi-Annual Inspections	Final Cover and Vegetation Management		Surface/Storm Water Management						
Year	Unit Cost	Cost ($/yr)	Area (Acre)	Cost ($/yr)	Area (Acre)	Unit Cost ($/acre)	Cost ($/yr)	Direct O&M Total ($/yr)	Project Management (6%)	Contingency (10%)	Total Annual Post-Closure Care O&M Cost
2021	$ 56,487							**$ 56,487**	**$ 3,389**	**$ 5,649**	**$ 65,525**
2022	$ 56,487							**$ 56,487**	**$ 3,389**	**$ 5,649**	**$ 65,525**
2023	$ 56,487							**$ 56,487**	**$ 3,389**	**$ 5,649**	**$ 65,525**
2024	$ 56,487	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 191,625**	**$ 11,498**	**$ 19,163**	**$ 222,285**
2025	$ 56,487	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 191,625**	**$ 11,498**	**$ 19,163**	**$ 222,285**
2026	$ 56,487	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 191,625**	**$ 11,498**	**$ 19,163**	**$ 222,285**
2027	$ 56,487	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 191,625**	**$ 11,498**	**$ 19,163**	**$ 222,285**
2028	$ 56,487	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 191,625**	**$ 11,498**	**$ 19,163**	**$ 222,285**
2029	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2030	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2031	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2032	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2033	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2034	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2035	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2036	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0	$1,000	$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2037	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2038	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2039	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2040	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2041	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2042	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2043	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2044	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2045	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2046	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2047	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2048	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2049	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2050	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2051	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2052	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
2053	$ 28,827	$ 3,920.00	11.4	$ 5,219	126.0		$ 126,000	**$ 163,965**	**$ 9,838**	**$ 16,397**	**$ 190,200**
Notes	Assumes NIPSCO reported costs for groundwater monitoring and well maintenance, replacement, and repair. Assumes 20 wells sampled semiannually until 2028 when sampling frequency will likely be reduced to one sample per well annually.	Assumes NIPSCO reported costs for semi-annual inspections and reporting.	Assumes NIPSCO reported costs for vegetation control (mowing), maintenance of access control & benchmarks, maintenance of backfill and topsoil, and maintenance of vegetation.		Unit cost derived from references on a per acre basis. Includes stormwater/surface water system operation and maintenance, sediment basin maintenance and repair, cleanout, sampling, and analysis. Assumes half the property area requires surface water/stormwater management.						
References	19	19	19		10, 11, 16,14				12	12	

Table 3-3: Michigan City Alternative 2 Clean Closure Cost Calculations

Clean Closure Remedy Matrix						
Year	**Material Removed Above GW Level (CY)**	**Material Removed Below GW Level (CY)**	**Excavation Area/Phase**	**Area (Acres)**	**Fill Volume (CY)**	**Topsoil Volume (CY)**
2021						
2022	75,500	43,501	CCR Management Area	49.2		
2023	75,500	43,501				
2024	75,500	43,501				
2025	75,500	43,501				
2026	75,500	43,501				
2027	75,500	43,501				
2028	75,500	43,501				
2029	95,211	92,935	Power Generation Area	32.89511019		
2030	95,211	92,935				
2031	95,211	92,935				
2032	95,211	92,935				
2033		140,548	Final Pond	9.9	9,481	36,663
2034		296,744	Shoreline	2.5		
2035						
2036						
2037						
2038						
2039						
2040						
2041						
2042						
2043						
2044						
Notes					2 ft of subbase materials required for temporary road between sheet pilings to grant access for construction equipment.	Assume 6" of topsoil required for disturbed upland areas following excavation.
References						

Table 3-3: Michigan City Alternative 2 Clean Closure Cost Calculations

	Clean Closure Remedy Matrix	Capital Cost						
		Site Work						Dewatering
		Surveying			Site Preparation and Clearing			
Year	Closure Activities	Area (Acre)	Unit Cost ($/Acre)	Cost	Area (Acre)	Unit Cost ($/Acre)	Cost	Cost ($)
2021		95		$ 94,537				
2022	Excavation of all underlying CCR materials for off-site transportation and disposal at the RMSGS Landfill.				49.2		$ 319,877	
2023								
2024								
2025								
2026								
2027								
2028		49.2		$ 49,212				
2029	Excavation of underlying CCR materials for off-site transportation and disposal at the RMSGS Landfill.				32.9		$ 213,818	
2030								
2031								
2032		33		$ 32,895				
2033	Dredging of CRR from below Final Pond for off-site transportation and disposal at the RMSGS Landfill; backfill, grade, and vegetate upland areas; and construction of temporary road between sheet pilings for construction equipment access along shoreline.	9.9	$ 1,000	$ 9,930		$ 6,500		
2034	Removal of sheet pile and riprap and excavation, transportation, and disposal of underlying fill material along the shoreline.	2.5		$ 2,500				
2035								
2036								
2037								
2038								
2039								
2040								
2041								
2042								
2043								
2044								
Notes		Unit cost based on contractor quote. Includes initial site surveying and hydrographic surveying of each phase area following complete excavation.			Assumes 100% of the excavation area requires clearing, grubbing, and site preparation, which incorporates immediate surroundings.			Assume Excavated or dredged CCR will be dewatered passively by stockpiling CCR to drain before loading for transportation and disposal. Costs are included in excavation/dredging.
References					1			

Table 3-3: Michigan City Alternative 2 Clean Closure Cost Calculations

	Capital Cost												
	Excavation and Dredging									Sheet Piling and Riprap Removal			
	CCR Excavation Above GW			CCR Excavation Below GW			CCR Dredging			Sheet Piling Removal			
Year	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Sheet Piling Length (LF)	Sheet Piling Area (ft^2)	Unit Cost ($\$/ft^2$)	Cost ($)
2021													
2022	75,500		$ 787,421	43,501		$ 1,292,791				1,010	30,300		$ 217,536
2023	75,500		$ 787,421	43,501		$ 1,292,791							
2024	75,500		$ 787,421	43,501		$ 1,292,791							
2025	75,500		$ 787,421	43,501		$ 1,292,791							
2026	75,500		$ 787,421	43,501		$ 1,292,791							
2027	75,500		$ 787,421	43,501		$ 1,292,791							
2028	75,500		$ 787,421	43,501		$ 1,292,791							
2029	95,211		$ 991,260	92,935		$ 2,236,556				4,130	123,901		$ 889,539
2030	95,211		$ 991,260	92,935		$ 2,236,556							
2031	95,211		$ 991,260	92,935		$ 2,236,556							
2032	95,211		$ 991,260	92,935		$ 2,236,556							
2033		Cost = (($6.23 x CY)+$3,983) x 1.66			Cost = ((($1350.2 x (CY)^0.557) + ((5.99 x CY)+$560)) x 1.66		140,548	Cost = (($3.02603448275862 x CY) + ((5.99 x CY) + $560))) x 1.66	$ 2,104,458			$7.18	
2034				296,744		$ 5,455,510				6,032	180,960		$ 1,299,188
2035													
2036													
2037													
2038													
2039													
2040													
2041													
2042													
2043													
2044													
Notes				Costs assumes initial excavation of saturated material that is stockpiled and allowed to drain before loaded into trucks for transport and disposal.			Includes equipment and labor costs for shore-based dredging using a crane and 3 CY clamshell bucket and stockpiling material prior to loading, transportation, and disposal. Assume dredged material is stockpiled to allow for passive dewatering before loading for transport.			Assumes a type PZ-27 pile with an average height of 30 ft. Includes equipment and labor costs for shore-based sheet piling extraction using a crane, extractor, and compressor. Assumes a production rate of 800 SF/day. Assume excavated riprap will be used elsewhere on the property or surrounding areas.			
References	2			2			2, 15, 17			15,18			

Table 3-3: Michigan City Alternative 2 Clean Closure Cost Calculations

	Capital Cost													
	Sheet Piling and Riprap Removal				Transportation/Disposal							Backfill/Grading/Vegetation		
	Riprap Removal				CCR Transportation and Disposal			Sheet Piling Transportation and Disposal				Backfill Placement and Compaction		
Year	Riprap Length (LF)	Riprap Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Sheet Piling Length (LF)	Sheet Piling Weight (tons)	Unit Cost ($/ton)	Cost ($)	Fill Volume (CY)	Topsoil Volume (CY)	Cost ($)
2021														
2022					119,001		$ 4,641,181	1,010	409		$ 9,327			
2023					119,001		$ 4,641,181							
2024					119,001		$ 4,641,181							
2025					119,001		$ 4,641,181							
2026					119,001		$ 4,641,181							
2027					119,001		$ 4,641,181							
2028					119,001		$ 4,641,181							
2029					188,145		$ 7,337,863	4,130	1,673		$ 38,139			
2030					188,145		$ 7,337,863							
2031					188,145		$ 7,337,863							
2032					188,145		$ 7,337,863							
2033			$14.1		140,548	$39.00	$ 5,481,520			$22.80		9,481	36,663	$ 601,140
2034	3,142	23,251		$ 327,321	296,744		$ 11,573,334	6,032	2,443		$ 55,703			
2035														
2036														
2037														
2038														
2039														
2040														
2041														
2042														
2043														
2044														
Notes	Assumes riprap is 20 ft in height with a 1:1 slope. Includes equipment and labor costs for shore-based riprap removal using a crane with a 3 CY clamshell bucket. Assumes a production rate of 200 CY/day. Assume riprap used elsewhere on the property or surrounding areas.				Transportation rates provided by NIPSCO Closure Report at a rate of $19/CY. Assume a disposal rate/airspace cost of $20/CY.			Assumes NIPSCO transportation rates on a per unit weight basis and sheet piling is recycled with a net zero disposal cost. 1 LF of PZ-27 sheet piling equates to 0.41 tons.				Assume NIPSCO reported costs for importing and compacting fill ($17/CY). Assumes import of subbase materials for temporary road construction along shoreline and 6" of topsoil for upland areas.		
References	15,18				19			15,18				19		

Table 3-3: Michigan City Alternative 2 Clean Closure Cost Calculations

	Capital Cost												
	Backfill/Grading/Vegetation		Dust Control				Construction Erosion Control		Direct Capital				
	Grading/Vegetation		Water Truck						Direct Capital Total	Contingency	Discount Rate	Area Cost Factor	Total Direct Capital Cost
Year	Area	Cost ($)	Area (Acre)	Time (Days)	Unit Cost ($/Acre-Day)	Cost ($)	Area (Acre)	Cost ($)					
2021									$ 94,537				$ 103,990.84
2022			31.5	183		$ 432,337.50	49.2	$ 25,833.60	$ 7,726,304				$ 8,498,934.19
2023			31.5	183		$ 432,337.50	49.2	$ 25,833.60	$ 7,179,564				$ 7,897,520.19
2024			31.5	183		$ 432,337.50	49.2	$ 25,833.60	$ 7,179,564				$ 7,897,520.19
2025			31.5	183		$ 432,337.50	49.2	$ 25,833.60	$ 7,179,564				$ 7,897,520.19
2026			31.5	183		$ 432,337.50	49.2	$ 25,833.60	$ 7,179,564				$ 7,897,520.19
2027			31.5	183		$ 432,337.50	49.2	$ 25,833.60	$ 7,179,564				$ 7,897,520.19
2028			31.5	183		$ 432,337.50	49.2	$ 25,833.60	$ 7,228,776				$ 7,951,653.17
2029			31.5	183		$ 432,337.50	32.9	$ 22,898.56	$ 12,162,412				$ 13,378,652.84
2030			31.5	183		$ 432,337.50	32.9	$ 22,898.56	$ 11,020,916				$ 12,123,007.19
2031			31.5	183		$ 432,337.50	32.9	$ 22,898.56	$ 11,020,916				$ 12,123,007.19
2032			31.5	183		$ 432,337.50	32.9	$ 22,898.56	$ 11,053,811				$ 12,159,191.81
2033	45.45	$ 442,798	31.5	183	$ 75.00	$ 432,337.50	9.9	$ 16,971.53	$ 9,089,155	25%	7%	-8%	$ 9,998,070.31
2034			31.5	183		$ 432,337.50	9.9	$ 16,971.53	$ 19,162,865				$ 21,079,151.41
2035													
2036													
2037													
2038													
2039													
2040													
2041													
2042													
2043													
2044													
Notes	Grading cost ($3,209/acre) based on production rate of D10T2 Dozer with a daily equipment use labor costs. Seeding cost is $6,534/acre per NIPSCO Closure Plan. Assumes grading and vegetation of upland excavated areas.		Assume water trucks spray application costs $75/acre day and dust control is conducted during half the year. Assumes 25% of the entire property requires dust control on any given day.				Assumes on site construction laborers conduct the installation, inspections, and maintenance work items.						
References	1,9,11,12,15, 19		4,8							5	7	6	

Table 3-3: Michigan City Alternative 2 Clean Closure Cost Calculations

	Capital Cost					
	Project Startup/Construction Management/ Health and Safety					
Year	Engineering/Design/Management/ Planning	Construction Management/Health and Safety (5%)	Mobilization (1%)	Demobilization (1%)	Total PM Cost	Total Capital Cost
2021	$ 666,640.00				$ 666,640	**$ 770,631**
2022	$ 333,320.00	$ 424,947	$ 1,369,033		$ 2,127,299	**$ 10,626,233**
2023	$ 333,320.00	$ 394,876			$ 728,196	**$ 8,625,716**
2024	$ 333,320.00	$ 394,876			$ 728,196	**$ 8,625,716**
2025	$ 333,320.00	$ 394,876			$ 728,196	**$ 8,625,716**
2026	$ 333,320.00	$ 394,876			$ 728,196	**$ 8,625,716**
2027	$ 333,320.00	$ 394,876			$ 728,196	**$ 8,625,716**
2028	$ 333,320.00	$ 397,583			$ 730,903	**$ 8,682,556**
2029	$ 333,320.00	$ 668,933			$ 1,002,253	**$ 14,380,905**
2030	$ 333,320.00	$ 606,150			$ 939,470	**$ 13,062,478**
2031	$ 333,320.00	$ 606,150			$ 939,470	**$ 13,062,478**
2032	$ 333,320.00	$ 607,960			$ 941,280	**$ 13,100,471**
2033	$ 333,320.00	$ 499,904			$ 833,224	**$ 10,831,294**
2034	$ 333,320.00	$ 1,053,958		$ 1,369,033	$ 2,756,310	**$ 23,835,462**
2035						
2036						
2037						
2038						
2039						
2040						
2041						
2042						
2043						
2044						
Notes	Assumes prevailing wage salary for engineers with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assumes four full time engineers, planners, managers, etc. during 2021 for initial design and planning and one full time employees for every subsequent year.		Assume mobilization occurs in 2022. 1% of total direction capital cost.	Assume demobilization occurs in 2034		
References	7	7,5	1			

Table 3-3: Michigan City Alternative 2 Clean Closure Cost Calculations

	Operation & Maintenance and Post Closure Care Cost										
	Groundwater Monitoring	Semi-Annual Inspections	Final Cover and Vegetation Management		Surface/Storm Water Management			Direct O&M Total ($/yr)	Project Management (6%)	Contingency (10%)	Total Annual Post-Closure Care O&M Cost
Year	Cost ($/yr)	Cost ($/yr)	Area (Acre)	Cost ($/yr)	Area (Acre)	Unit Cost ($/acre)	Cost ($/yr)				
2021	$ 56,487							$ 56,487	$ 3,389	$ 5,649	$ 65,525
2022	$ 56,487							$ 56,487	$ 3,389	$ 5,649	$ 65,525
2023	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2024	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2025	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2026	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2027	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2028	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2029	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2030	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2031	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2032	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2033	$ 14,122							$ 14,122	$ 847	$ 1,412	$ 16,381
2034	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2035	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2036	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2037	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2038	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2039	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5	$1,000	$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2040	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2041	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2042	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2043	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
2044	$ 14,122	$ 3,920.00	45.5	$ 15,434	45.5		$ 45,450	$ 78,925	$ 4,736	$ 7,893	$ 91,553
Notes	Assumes NIPSCO costs for groundwater monitoring and well maintenance, replacement, and repair. Assumes NIPSCO monitoring plan of 20 wells in 2021 and 2022 followed by 5 wells sampled semiannually until 2044.	Assumes NIPSCO reported costs for semi-annual inspections and reporting.	Assumes NIPSCO reported costs for vegetation control (mowing), maintenance of access control & benchmarks, maintenance of backfill and topsoil, and maintenance of vegetation.		Unit cost derived from references on a per acre basis. Includes stormwater/surface water system operation and maintenance, sediment basin maintenance and repair, cleanout, sampling, and analysis. Assumes upland areas require surface water/stormwater management.						
References	19	19	19		10, 11, 16,14				12	12	

Table 3-4: Michigan City Jobs Comparison

Year	Alternative 1. NIPSCO Closure			Alternative 2. Clean Closure		
	Closure Plan	Total Construction FTE	Total Annual O&M FTE	Closure Plan	Total Construction FTE	Total Annual O&M FTE
2021	Excavation of CCR from the five settling basins built in the early 1970's and off-site disposal at R.M. Schahfer Generating Station (RMSGS) CCR Landfill. Backfill excavation with soil. CCR in former lakefront impoundment and fill will be left in place without cap or controls. Long term monitoring of groundwater, vegetation maintenance, and storm water management.	2	0.1	Excavation, dredging, and dewatering of all CCR for off-site transportation and disposal at the RMSGS CCR Landfill. Site grading and revegetation. Removal of sheet piling and riprap along Lake Michigan shoreline. Limited long term monitoring of groundwater, vegetation maintenance, and storm water management.	4.1	0.08
2022		23	0.1		15	0.08
2023		21	0.1		14	0.02
2024			1		14	0.02
2025			1		14	0.02
2026			1		14	0.02
2027			1		14	0.02
2028			1		14	0.02
2029			1		21	0.02
2030			1		19	0.02
2031			1		19	0.02
2032			1		19	0.02
2033			1		23	0.02
2034			1		32	0.44
2035			1			0.44
2036			1			0.44
2037			1			0.44
2038			1			0.44
2039			1			0.44
2040			1			0.44
2041			1			0.44
2042			1			0.44
2043			1			0.44
2044			1			0.44
2045			1			
2046			1			
2047			1			
2048			1			
2049			1			
2050			1			
2051			1			
2052			1			
2053			1			
	Total FTE	46			234	

Table 3-5: Michigan City Alternative 1 NIPSCO Closure Jobs Calculations

Clean Closure Remedy Matrix								Construction Job Calculations				
								Surveying				
Year	**Material Removed Above GW Level (CY)**	**Material Removed Below GW Level (CY)**	**Excavation Area/Phase**	**Area (Acres)**	**Fill (CY)**	**Topsoil (CY)**	**Closure Activities**	**Area (Acres)**	**Rate (acre/day)**	**Surveying Duration (Days)**	**Professional Land Surveyor FTE**	**PLS Assistant FTE**
2021								11.4	8	1.4	0.0	0.01
2022	95,008	8,592	Primary Settling Pond 1; Secondary Settling Pond 1	4.3	83,316	3,468	Excavation of CCR from the five settling ponds built in the early 1970's, trucking, and off-site disposal at R.M. Schahfer Generating Station (RMSGS) CCR Landfill. Backfill excavation with clean soil.	4.3	9	0.5	0.0	0.00
2023	49,118	37,482	Primary Settling Pond 2; Secondary Settling Pond 2; Boiler Slag Pond	7.1	71,566	5,726		7.1	10	0.7	0.0	0.00
2024												
2025												
2026												
2027												
2028												
2029												
2030												
2031												
2032												
2033												
2034												
2035												
2036												
2037												
2038												
2039												
2040												
2041												
2042												
2043												
2044												
2045												
2046												
2047												
2048												
2049												
2050												
2051												
2052												
2053												
Notes									Contractor Quote		Assumes two-person surveying team which includes 1 PLS and assistant per team. Additionally one PLS for data processing and drafting. Calculated based on a 261-day working year.	

Table 3-5: Michigan City Alternative 1 NIPSCO Closure Jobs Calculations

	Construction Job Calculations									
	Site Preparation and Clearing				Excavation					
Year	Area (Acre)	Dozer Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Excavation Volume Above GW (CY)	Excavation Volume Below GW (CY)	Excavator Operator FTE	Dozer Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
2021										
2022	4.3	0.0	0.01	0.09	95,008	8,592	0.9	0.0	0.2	0.2
2023	7.1	0.1	0.01	0.15	49,118	37,482	1.0	0.1	0.2	0.2
2024										
2025										
2026										
2027										
2028										
2029										
2030										
2031										
2032										
2033										
2034										
2035										
2036										
2037										
2038										
2039										
2040										
2041										
2042										
2043										
2044										
2045										
2046										
2047										
2048										
2049										
2050										
2051										
2052										
2053										
Notes		Calculated based on a production rate of a CAT D6T Dozer. Calculated based on a production rate of a CAT D6T Dozer. Assume 1 ft depth.	Assumes 2 mechanics per 10 operators	Assumes 2 construction laborers per dozer			Calculated based on production rate of a Cat 349F Excavator. Assumes 261 working days per year and 8 hour work days. Assumes CCR excavated below GW table is double handled to account for dewatering.	Calculated based on a production rate of a CAT D6T Dozer. Production rates applied to temporarily stockpiled material on site.	Assumes 2 mechanics per 10 operators	Assumes 1 construction laborer per 5 heavy equipment operators

Table 3-5: Michigan City Alternative 1 NIPSCO Closure Jobs Calculations

	Construction Job Calculations													
	Dredging						Sheet Piling Removal				Riprap Removal			
Year	Dredging Volume (CY)	Crane Operator FTE	Excavator Operator FTE	Dozer/Front End Loader Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Sheet Piling Area (ft^2)	Crane Operator FTE	Pile Driver FTE	Heavy Machinery Mechanic FTE	Riprap Volume (CY)	Crane Operator FTE	Construction Laborer FTE	Heavy Machinery Mechanic FTE
2021														
2022														
2023														
2024														
2025														
2026														
2027														
2028														
2029														
2030														
2031														
2032														
2033														
2034														
2035														
2036														
2037														
2038														
2039														
2040														
2041														
2042														
2043														
2044														
2045														
2046														
2047														
2048														
2049														
2050														
2051														
2052														
2053														
Notes		Assumes production rate of 960 CY per day	Calculated based on production rate of a Cat 349F Excavator. Assumes 261 working days per year and 8 hour work days. Assumes CCR excavated below GW table is double handled to account for dewatering.	Calculated based on a production rate of a CAT D6T Dozer. Production rates applied to temporarily stockpiled material on site.	Assumes 1 mechanics per 5 operators	Assumes 1 construction laborer per 5 excavator and dozer operators and 1 laborers per crane operator		Assumes a production rate of 800 SF of sheet piling removed per day.	Assumes four pile drivers per crane operator.	Assumes 1 mechanics per 5 operators		Assumes a production rate of 200 CY of riprap removed per day.	Assumes two laborers per crane operator	Assumes 1 mechanics per 5 operators

Table 3-5: Michigan City Alternative 1 NIPSCO Closure Jobs Calculations

	Construction Job Calculations														
	CCR Transportation			Sheet Piling Transportation			Fill Transportation			Backfill Placement/Grading/Compaction					
Year	CY of Material Transported Offsite	Truck Driver FTE	Truck Mechanic FTE	Sheet Piling Removed (tons)	Truck Driver FTE	Truck Mechanic FTE	Fill Volume (CY)	Truck Driver FTE	Truck Mechanic FTE	Grading Area (Acres)	Fill Volume (CY)	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
2021															
2022	103,600	5.0	0.5				86,784	3.3	0.3	4.3	86,784	2.2	2.22	0.887	0.9
2023	86,600	4.1	0.4				77,292	3.0	0.3	7.1	77,292	2.0	1.97	0.790	0.8
2024															
2025															
2026															
2027															
2028															
2029															
2030															
2031															
2032															
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2046															
2047															
2048															
2049															
2050															
2051															
2052															
2053															
Notes	Assumes trucks carrying an average payload of 20 CY per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantity of material transported per year and distance of travel.		Assume 1 mechanic per 10 vehicles	Assumes trucks carrying an average payload of 24 tons per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantity of material transported per year and distance of travel.		Assume 1 mechanic per 10 vehicles	Assumes trucks carrying an average payload of 15 CY per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantity of material transported per year and distance of travel.		Assume 1 mechanic per 10 vehicles			Based on production rate of a CAT D6T with a 50% efficiency applied and assumed four passes per unit operation.	Assume 1 roller per dozer	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators.

Table 3-5: Michigan City Alternative 1 NIPSCO Closure Jobs Calculations

	Construction Job Calculations					Construction Job Totals Summary								
	Dust Control					Skilled Laborer FTE			Laborer FTE	Professional				Total Construction-Related Jobs FTE
Year	**Acres**	**Days**	**Truck Driver FTE**	**Heavy Machinery Mechanic FTE**	**Construction Laborer FTE**	**Skilled Laborer FTE**	**Heavy Equipment Operator FTE**	**Commercial Truck Driver FTE**		**Professional Land Surveyor FTE**	**Construction Manager FTE**	**Health/Safety Manager FTE**	**Engineer/Planner/Estimator/Designer/Management FTE**	
2021										0.01			2	2.0
2022	31.5	183	2.2	0.4	0.4	2.4	5.4	10.5	1.6	0.004	1.0	1.0	1	22.8
2023	31.5	183	2.2	0.4	0.4	2.2	5.1	9.3	1.6	0.01	0.9	0.9	1	21.1
2024														
2025														
2026														
2027														
2028														
2029														
2030														
2031														
2032														
2033														
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2047														
2048														
2049														
2050														
2051														
2052														
2053														
Notes				Assumes 2 mechanics per 10 operators	Assumes 1 construction laborer per 5 heavy equipment operators	Includes PLS assistants, pump and conveyance system installers, heavy machinery mechanics, liner installers, surface runoff collection installers.	Includes water truck drivers, excavator operators, dozer operators, drum compactor operators.	Includes dump truck drivers.	Includes unskilled laborers to assist with construction efforts.		Assumes 1 construction manager per 20 employees	Assumes 1 health/safety manager per 20 employees	Assumes two full time engineers, planners, managers, etc. during 2021 for initial design and planning and one full time employees for every subsequent year.	

Table 3-5: Michigan City Alternative 1 NIPSCO Closure Jobs Calculations

	Post Closure O&M Job Calculations					Post Closure O&M Job Totals
	Groundwater Monitoring	Semi-Annual Inspections	Final Cover and Vegetation Management	Surface/Storm Water Management	Project Management	Total Annual O&M Jobs FTE
Year	Environmental Scientist FTE	Environmental Scientist FTE	Construction Laborer FTE	Construction Laborer FTE	Engineer/Project Manager FTE	
2021	0.08					0.08
2022	0.08					0.08
2023	0.08					0.08
2024	0.08	0.02	0.03	0.78	0.07	0.98
2025	0.08	0.02	0.03	0.78	0.07	0.98
2026	0.08	0.02	0.03	0.78	0.07	0.98
2027	0.08	0.02	0.03	0.78	0.07	0.98
2028	0.08	0.02	0.03	0.78	0.07	0.98
2029	0.04	0.02	0.03	0.78	0.06	0.93
2030	0.04	0.02	0.03	0.78	0.06	0.93
2031	0.04	0.02	0.03	0.78	0.06	0.93
2032	0.04	0.02	0.03	0.78	0.06	0.93
2033	0.04	0.02	0.03	0.78	0.06	0.93
2034	0.04	0.02	0.03	0.78	0.06	0.93
2035	0.04	0.02	0.03	0.78	0.06	0.93
2036	0.04	0.02	0.03	0.78	0.06	0.93
2037	0.04	0.02	0.03	0.78	0.06	0.93
2038	0.04	0.02	0.03	0.78	0.06	0.93
2039	0.04	0.02	0.03	0.78	0.06	0.93
2040	0.04	0.02	0.03	0.78	0.06	0.93
2041	0.04	0.02	0.03	0.78	0.06	0.93
2042	0.04	0.02	0.03	0.78	0.06	0.93
2043	0.04	0.02	0.03	0.78	0.06	0.93
2044	0.04	0.02	0.03	0.78	0.06	0.93
2045	0.04	0.02	0.03	0.78	0.06	0.93
2046	0.04	0.02	0.03	0.78	0.06	0.93
2047	0.04	0.02	0.03	0.78	0.06	0.93
2048	0.04	0.02	0.03	0.78	0.06	0.93
2049	0.04	0.02	0.03	0.78	0.06	0.93
2050	0.04	0.02	0.03	0.78	0.06	0.93
2051	0.04	0.02	0.03	0.78	0.06	0.93
2052	0.04	0.02	0.03	0.78	0.06	0.93
2053	0.04	0.02	0.03	0.78	0.06	0.93
Notes	Assumes NIPSCO's hourly labor rate and sampling frequency. Assumes NIPSCO reported costs for groundwater monitoring and well maintenance, replacement, and repair. Assumes 20 wells sampled semiannually until 2028 when sampling frequency will likely be reduced to one sample per well annually.	Assumes NIPSCO reported labor to complete semi-annual inspections.	FTE based on salary of heavy equipment operator and salary of a construction laborer with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor.	FTE based on salary of an construction laborer with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Maintenance includes cleanout and repair of water conveyance structures, down chutes, sediment basins, and outfalls.	Assumes prevailing wage salary with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of budget consists of labor.	

Clean Closure Remedy Matrix

Year	Material Removed Above GW Level (CY)	Material Removed Below GW Level (CY)	Excavation Area/Phase	Area (Acres)	Fill (CY)	Topsoil (CY)	Closure Activities
2021							
2022	75,500	43,501	CCR Management Area	49.2			Excavation of all underlying CCR materials for off-site transportation and disposal at the RMSGS Landfill.
2023	75,500	43,501					
2024	75,500	43,501					
2025	75,500	43,501					
2026	75,500	43,501					
2027	75,500	43,501					
2028	75,500	43,501					
2029	95,211	92,935	Power Generation Area	32.9			Excavation of underlying CCR materials for off-site transportation and disposal at the RMSGS Landfill.
2030	95,211	92,935					
2031	95,211	92,935					
2032	95,211	92,935					
2033		140,548	Final Pond	9.9	9,481	36,663	Dredging of CRR from below Final Pond for off-site transportation and disposal at the RMSGS Landfill; backfill, grade, and vegetate upland areas; and construction of temporary road between sheet pilings for construction equipment access along shoreline.
2034		296,744	Shoreline	2.9			Removal of sheet pile and riprap and excavation, transportation, and disposal of underlying fill material along the shoreline.
2035							
2036							
2037							
2038							
2039							
2040							
2041							
2042							
2043							
2044							
Notes							

Table 3-6: Michigan City Alternative 2 Clean Closure Jobs Calculations

	Construction Job Calculations														
	Surveying					Site Preparation and Clearing				Excavation					
Year	Area (Acres)	Rate (acre/day)	Surveying Duration (Days)	Professional Land Surveyor FTE	PLS Assistant FTE	Area (Acre)	Dozer Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Excavation Volume Above GW (CY)	Excavation Volume Below GW (CY)	Excavator Operator FTE	Dozer Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
2021	94.5	8	11.8	0.1	0.05										
2022						49	0.5	0.10	1.01	75,500	43,501	1.3	0.1	0.3	0.3
2023										75,500	43,501	1.3	0.1	0.3	0.3
2024										75,500	43,501	1.3	0.1	0.3	0.3
2025										75,500	43,501	1.3	0.1	0.3	0.3
2026										75,500	43,501	1.3	0.1	0.3	0.3
2027										75,500	43,501	1.3	0.1	0.3	0.3
2028	49.2	8	6	0.05	0.02					75,500	43,501	1.3	0.1	0.3	0.3
2029						33	0.3	0.07	0.68	95,211	92,935	2.2	0.3	0.5	0.5
2030										95,211	92,935	2.2	0.3	0.5	0.5
2031										95,211	92,935	2.2	0.3	0.5	0.5
2032	32.9	8	4.1	0.03	0.02					95,211	92,935	2.2	0.3	0.5	0.5
2033	9.9	8	1.2	0.01	0.005										
2034	2.5	8	0.31	0.002	0.001						296,744	4.7	0.9	1.1	1.1
2035															
2036															
2037															
2038															
2039															
2040															
2041															
2042															
2043															
2044															
Notes		Contractor Quote		Assumes two-person surveying team which includes 1 PLS and assistant per team. Additionally one PLS for data processing and drafting. Calculated based on a 261-day working year.			Calculated based on a production rate of a CAT D6T Dozer. Assume 1 ft depth.	Assumes 2 mechanics per 10 operators	Assumes 2 construction laborers per dozer			Calculated based on production rate of a Cat 349F Excavator. Assumes 261 working days per year and 8 hour work days. Assumes CCR excavated below GW table is double handled to account for dewatering.	Calculated based on a production rate of a CAT D6T Dozer. Production rates applied to temporarily stockpiled material on site.	Assumes 2 mechanics per 10 operators	Assumes 1 construction laborer per 5 heavy equipment operators

Table 3-6: Michigan City Alternative 2 Clean Closure Jobs Calculations

	Construction Job Calculations													
	Dredging						**Sheet Piling Removal**				**Riprap Removal**			
Year	**Dredging Volume (CY)**	**Crane Operator FTE**	**Excavator Operator FTE**	**Dozer Operator FTE**	**Heavy Machinery Mechanic FTE**	**Construction Laborer FTE**	**Sheet Piling Area (ft^2)**	**Crane Operator FTE**	**Pile Driver FTE**	**Heavy Machinery Mechanic FTE**	**Riprap Volume (CY)**	**Crane Operator FTE**	**Construction Laborer FTE**	**Heavy Machinery Mechanic FTE**
2021														
2022							1,010	0.005	0.02	0.001				
2023														
2024														
2025														
2026														
2027														
2028														
2029							4,130	0.020	0.1	0.004				
2030														
2031														
2032														
2033	140,548	0.6	1.1	0.4	0.4	0.9								
2034							6,032	0.029	0.1	0.006	23,251	0.4	0.891	0.09
2035														
2036														
2037														
2038														
2039														
2040														
2041														
2042														
2043														
2044														
Notes		Assumes production rate of 960 CY per day	Calculated based on production rate of a Cat 349F Excavator. Assumes 261 working days per year and 8 hour work days. Assumes CCR excavated below GW table is double handled to account for dewatering.	Calculated based on a production rate of a CAT D6T Dozer. Production rates applied to temporarily stockpiled material on site.	Assumes 1 mechanics per 5 operators	Assumes 1 construction laborer per 5 excavator and dozer operators and 1 laborers per crane operator		Assumes a production rate of 800 SF of sheet piling removed per day.	Assumes four pile drivers per crane operator.	Assumes 1 mechanics per 5 operators		Assumes a production rate of 200 CY of riprap removed per day.	Assumes two laborers per crane operator	Assumes 1 mechanics per 5 operators

Table 3-6: Michigan City Alternative 2 Clean Closure Jobs Calculations

	Construction Job Calculations														
	CCR Transportation			**Sheet Piling Transportation**			**Fill Transportation**			**Backfill Placement/Grading/Compaction**					
Year	**CY of Material Transported Offsite**	**Truck Driver FTE**	**Truck Mechanic FTE**	**Sheet Piling Removed (tons)**	**Truck Driver FTE**	**Truck Mechanic FTE**	**Fill Volume (CY)**	**Truck Driver FTE**	**Truck Mechanic FTE**	**Grading Area (Acres)**	**Fill Volume (CY)**	**Dozer Operator FTE**	**Drum Compactor Operator FTE**	**Heavy Machinery Mechanic FTE**	**Construction Laborer FTE**
2021															
2022	119,001	5.7	0.6	409	0.02	0.0									
2023	119,001	5.7	0.6												
2024	119,001	5.7	0.6												
2025	119,001	5.7	0.6												
2026	119,001	5.7	0.6												
2027	119,001	5.7	0.6												
2028	119,001	5.7	0.6												
2029	188,145	9.0	0.9	1673	0.06	0.0									
2030	188,145	9.0	0.9												
2031	188,145	9.0	0.9												
2032	188,145	9.0	0.9												
2033	140,548	6.7	0.7				46,144	2.36	0.24	45	46,144	1.2	1.2	0.5	0.5
2034	296,744	14.2	1.4	2443	0.09	0.0									
2035															
2036															
2037															
2038															
2039															
2040															
2041															
2042															
2043															
2044															
Notes	Assumes trucks carrying an average payload of 20 CY per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantity of material transported per year and distance of travel.		Assume 1 mechanic per 10 vehicles	Assumes trucks carrying an average payload of 24 tons per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantity of material transported per year and distance of travel.		Assume 1 mechanic per 10 vehicles	Assumes trucks carrying an average payload of 15 CY per trip and transportation occurs 261 days per year. Quantity of FTEs calculated based on quantity of material transported per year and distance of travel.		Assume 1 mechanic per 10 vehicles			Based on production rate of a CAT D6T with a 50% efficiency applied and assumed four passes per unit operation.	Assume 1 roller per dozer	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators.

Table 3-6: Michigan City Alternative 2 Clean Closure Jobs Calculations

	Construction Job Calculations					Construction Job Totals Summary								
	Dust Control					Skilled Laborer FTE			Laborer FTE	Professional				Total Construction-Related Jobs FTE
Year	Acres	Days	Truck Driver FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Skilled Laborer FTE	Heavy Equipment Operator FTE	Commercial Truck Driver FTE		Professional Land Surveyor FTE	Construction Manager FTE	Health/Safety Manager FTE	Engineer/Planner/Estimator/Designer/Management FTE	
2021										0.09			4.0	4.1
2022	32	183	2.2	0.4	0.4	1.4	1.9	7.9	1.7		0.7	0.7	1.0	15.3
2023	32	183	2.2	0.4	0.4	1.3	1.4	7.9	0.7		0.6	0.6	1.0	13.5
2024	32	183	2.2	0.4	0.4	1.3	1.4	7.9	0.7		0.6	0.6	1.0	13.5
2025	32	183	2.2	0.4	0.4	1.3	1.4	7.9	0.7		0.6	0.6	1.0	13.5
2026	32	183	2.2	0.4	0.4	1.3	1.4	7.9	0.7		0.6	0.6	1.0	13.5
2027	32	183	2.2	0.4	0.4	1.3	1.4	7.9	0.7		0.6	0.6	1.0	13.5
2028	32	183	2.2	0.4	0.4	1.3	1.4	7.9	0.7	0.05	0.6	0.6	1.0	13.6
2029	32	183	2.2	0.4	0.4	2.0	2.9	11.3	1.6		0.9	0.9	1.0	20.6
2030	32	183	2.2	0.4	0.4	1.9	2.5	11.2	0.9		0.8	0.8	1.0	19.2
2031	32	183	2.2	0.4	0.4	1.9	2.5	11.2	0.9		0.8	0.8	1.0	19.2
2032	32	183	2.2	0.4	0.4	1.9	2.5	11.2	0.9	0.03	0.8	0.8	1.0	19.3
2033	32	183	2.2	0.4	0.4	2.3	4.5	11.3	1.8		1.0	1.0	1.0	22.8
2034	32	183	2.2	0.4	0.4	3.2	6.2	16.5	2.5		1.4	1.4	1.0	32.2
2035														
2036														
2037														
2038														
2039														
2040														
2041														
2042														
2043														
2044														
Notes				Assumes 2 mechanics per 10 operators	Assumes 1 construction laborer per 5 heavy equipment operators	Includes PLS assistants, pump and conveyance system installers, heavy machinery mechanics, liner installers, surface runoff collection installers.	Includes water truck drivers, excavator operators, dozer operators, drum compactor operators.	Includes dump truck drivers.	Includes unskilled laborers to assist with construction efforts.		Assumes 1 construction manager per 20 employees	Assumes 1 health/safety manager per 20 employees	Assumes 4 full time engineers, planners, managers, etc. during 2021 for initial design and planning and one full time employees for every subsequent year.	

Table 3-6: Michigan City Alternative 2 Clean Closure Jobs Calculations

	Post Closure O&M Job Calculations					Post Closure O&M Job Totals
	Groundwater Monitoring	Semi-Annual Inspections	Final Cover and Vegetation Management	Surface/Storm Water Management	Project Management	
Year	Environmental Scientist FTE	Environmental Scientist FTE	Laborer FTE	Laborer FTE	Engineer/Project Manager FTE	Total Annual O&M Jobs FTE
2021	0.08					0.08
2022	0.08					0.08
2023	0.02					0.02
2024	0.02					0.02
2025	0.02					0.02
2026	0.02					0.02
2027	0.02					0.02
2028	0.02					0.02
2029	0.02					0.02
2030	0.02					0.02
2031	0.02					0.02
2032	0.02					0.02
2033	0.02					0.02
2034	0.02	0.02	0.1	0.28	0.03	0.44
2035	0.02	0.02	0.1	0.28	0.03	0.44
2036	0.02	0.02	0.1	0.28	0.03	0.44
2037	0.02	0.02	0.1	0.28	0.03	0.44
2038	0.02	0.02	0.1	0.28	0.03	0.44
2039	0.02	0.02	0.1	0.28	0.03	0.44
2040	0.02	0.02	0.1	0.28	0.03	0.44
2041	0.02	0.02	0.1	0.28	0.03	0.44
2042	0.02	0.02	0.1	0.28	0.03	0.44
2043	0.02	0.02	0.1	0.28	0.03	0.44
2044	0.02	0.02	0.1	0.28	0.03	0.44
Notes	Assumes NIPSCO's reported hourly labor rate. Assumes NIPSCO monitoring plan of 20 wells in 2021 and 2022 followed by 5 wells sampled semiannually until 2044.	FTE based on salary of an Environmental Scientist with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of inspection budget consists of labor.	FTE based on salary of heavy equipment operator and salary of a construction laborer with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor and there is two construction laborers for every heavy equipment operator.	FTE based on salary of an construction laborer with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Maintenance includes cleanout and repair of water conveyance structures, down chutes, sediment basins, and outfalls.	Assumes prevailing wage salary with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of budget consists of labor.	

Table 3-7: Michigan City Cost References

Ref. #	Citation
1	Casmalia Resources Site Steering Committee. 2016. *Casmalia Resources Superfund Site: Final Feasibility Study.* Prepared for USEPA, Region 9.
2	United States Environmental Protection Agency. September 2004. *Interim Measures Cost Compendium.*
3	*https://foresternetwork.com/weekly/msw-management-weekly/landfill-management/landfill-economics-part-ii-getting-down-to-business-part-i/*
4	Johnson, E., Olson, C., 2009 *Best Practices for Dust Control on Aggregate Roads,* Minnesota Department of Transportation Office, Maplewood, Minnesota.
5	United States Department of Energy. March 1997. *Cost Estimating Guide* . DOE G 430.1-1
6	United States Department of Defense. June 2018. *Unified Facilities Criteria - DoD Facilities Pricing Guide* . UFC 3-701-01
7	United States Environmental Protection Agency. July 2001. *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* . EPA 540-R-00-002
8	Sierra Research, Inc. 2003. *Final BACM Technological and Economic Feasibility Analysis.* San Joaquin Valley Unified Air Pollution Control District. Sacramento, CA.
9	Golder Associates Inc.2016. *Post Closure Care Plant - Clover Power Station Stage 3 Ash Landfill - Permit #556.* Prepared for Dominion - Clover Power Station.
10	CB&I Environmental & Infrastructure, Inc. 2016. *Post Closure Plan - Lawrence Energy Center - Industrial Landfill #0847.* Prepared for Westar Energy. Lawrence, Kansas.
11	Environmental Management Services, Inc. 2016. *Coal Combustion Residuals (CCR) Landfill Closure and Post-Closure Plan.* Prepared for South Mississippi Electric Power Association. Purvis, Mississippi.
12	Gai Consultants. 2016. *Post-Closure Care Plan Upper (East) Pond CCR Closure* . Chesterfield County, Virginia. Prepared for Virginia Electric Power Company.
13	Andrews Engineering, Inc. 2016. *Closure, Post-Closure Plans for Coal Combustion Residual Unit 2 Landfill.* Springfield, Sangamon County, Illinois. Prepared for City, Water, Light & Power.
14	Garrett & Moore. 2016. *Post-Closure Plan for the Williams Station Class III Landfill.* Berkely County, South Carolina. Prepared for SCANA, Inc.
15	United States Department of Agriculture. March 2012. *Cost Estimating Guide for Road Construction.*
16	United States Environmental Protection Agency. 2016. *Erosion Control Alternatives Cost Calculator*
17	Moffatt & Nichol. August 2008. *Capitol Lake Alternatives Analysis - Dredging and Disposal*
18	United States Environmental Protection Agency. March 1976. *Cost Estimating Methodology for Once-Through Cooling Water Discharge Modifications* . EPA 600/2-76-078
19	Wood Environment & Infrastructure Solutions, Inc. 2018. *Surface Impoundment Closures (CCR Final Rule and RCRA Regulated) Closure Application.* Michigan City Generating Station. Northern Indiana Public Service Company, Merrillville, Indiana.

Table 4-1: Colstrip Cost Comparison

Year	Alternative 1. Talen Proposal			Alternative 2. NPRC's Doing It Right Proposal		
	Closure Plan	Total Capital Cost	Total Annual O&M Cost	Closure Plan	Total Capital Cost	Total Annual O&M Cost
2016	Cap in place of all CCR ponds (37,889,000 cubic yards of CCR). Groundwater corrective action using 30-years of capture and treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.	$ -	$ -	Removal of 8,679,000 cubic yards of CCR in ponds which are in contact with groundwater to two new CCR landfills. Cap-in-place of 29,210,000 cubic yards CCR in ponds which are not in contact with groundwater. Active dewatering of CCR pore water. Groundwater corrective action using 30-years of capture and water treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.	$ -	$ -
2017		$ 843,760	$ 129,000		$ 843,760	$ 129,000
2018		$ -	$ 129,000		$ -	$ 129,000
2019		$ 9,490,180	$ 375,000		$ 12,003,716	$ 129,000
2020		$ 14,857,000	$ 4,240,000		$ 174,006,211	$ 7,137,584
2021		$ 31,595,000	$ 4,540,000		$ 18,798,200	$ 7,878,665
2022		$ 34,122,100	$ 4,608,000		$ 27,357,447	$ 7,329,334
2023		$ 11,700,800	$ 7,932,000		$ 140,570,060	$ 7,453,220
2024		$ 9,806,300	$ 8,202,000		$ 43,555,688	$ 8,465,069
2025		$ -	$ 8,202,000		$ -	$ 9,114,844
2026		$ -	$ 8,202,000		$ -	$ 9,114,844
2027		$ -	$ 7,213,000		$ -	$ 9,114,844
2028		$ -	$ 7,213,000		$ 133,812,804	$ 8,116,645
2029		$ -	$ 6,687,000		$ -	$ 8,116,645
2030		$ -	$ 6,687,000		$ -	$ 7,565,915
2031		$ -	$ 6,687,000		$ -	$ 7,565,915
2032		$ -	$ 6,687,000		$ -	$ 7,565,915
2033		$ -	$ 6,687,000		$ -	$ 7,565,915
2034		$ -	$ 6,687,000		$ -	$ 7,565,915
2035		$ -	$ 6,687,000		$ -	$ 7,565,915
2036		$ -	$ 6,687,000		$ -	$ 7,565,915
2037		$ -	$ 6,687,000		$ -	$ 7,565,915
2038		$ -	$ 6,687,000		$ -	$ 7,565,915
2039		$ -	$ 6,422,000		$ -	$ 7,565,915
2040		$ 10,147,140	$ 6,694,000		$ 39,578,594	$ 6,515,915
2041		$ 3,268,800	$ 6,694,000		$ 3,463,227	$ 8,014,661
2042		$ -	$ 6,694,000		$ -	$ 8,375,133
2043		$ -	$ 6,694,000		$ -	$ 8,375,133
2044		$ -	$ 6,694,000		$ -	$ 8,375,133
2045		$ -	$ 6,694,000		$ -	$ 8,375,133
2046		$ -	$ 6,694,000		$ -	$ 8,375,133
2047		$ -	$ 6,694,000		$ -	$ 8,375,133
2048		$ -	$ 6,694,000		$ -	$ 8,375,133
2049		$ -	$ 4,726,000		$ -	$ 7,197,790
2050		$ 750,000	$ 4,426,000		$ -	$ 6,897,790
2051		$ -	$ 4,426,000		$ -	$ 6,897,790
2052		$ -	$ 4,176,000		$ -	$ 6,647,790
2053		$ -	$ 4,176,000		$ -	$ 6,647,790
2054		$ -	$ 4,176,000		$ -	$ 6,647,790
2055		$ -	$ 4,176,000		$ -	$ 6,647,790
2056		$ -	$ 4,176,000		$ -	$ 6,647,790
2057		$ -	$ 4,176,000		$ -	$ 6,647,790
2058		$ -	$ 4,176,000		$ -	$ 6,647,790
2059		$ -	$ 4,176,000		$ -	$ 6,647,790
2060		$ -	$ 3,876,000		$ -	$ 6,347,790
2061		$ -	$ 3,876,000		$ -	$ 6,347,790
2062		$ -	$ 3,876,000		$ -	$ 6,347,790
2063		$ -	$ 3,876,000		$ -	$ 6,347,790
2064		$ -	$ 3,876,000		$ -	$ 6,347,790
2065		$ -	$ 3,876,000		$ -	$ 6,347,790
2066		$ -	$ 3,876,000		$ -	$ 6,347,790
2067		$ -	$ 3,876,000		$ -	$ 6,347,790
2068		$ -	$ 3,876,000		$ -	$ 6,347,790
2069		$ -	$ 3,876,000		$ -	$ 6,347,790
	Total cost	$ 126,581,080	$ 280,269,000	Total cost	$ 593,989,707	$ 368,697,937

Table 4-2: Colstrip Alternative 1 Talen Cost Schedule

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Annual Capital Cost	O&M	Total Annual O&M	Total Annual Cost
2016						$ -	$ -			$ -
2017	EHP	Design and Close EHP A Cell (including New Clearwell)	$ 47,760	$ 796,000	EHP Closure plan (assume 6% design cost)	$ 843,760	$ 843,760	$ 129,000	$ 129,000.00	$ 972,760
2018						$ -	$ -		$ 129,000.00	$ 129,000
2019	Plant	Design and Close Former Units 1&2 A Pond	$ 159,000	$ 3,657,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 3,816,000	$ 9,490,180	$ 28,000	$ 375,000.00	$ 9,865,180
2019	EHP	Design and Close EHP B Cell	$ 321,180	$ 5,353,000	EHP Closure plan (assume 6% design cost)	$ 5,674,180		$ 218,000		
2020	STEP	Design and Close STEP A Cell	$ 300,000	$ 8,600,000	SOEP-STEP RER	$ 8,900,000	$ 14,857,000	$ 85,000	$ 590,000.00	$ 15,447,000
2020	Plant	Design and Close Units 3&4 Bottom Ash Pond with Clearwell	$ 204,000	$ 4,692,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 4,896,000		$ 30,000		
2020	SOEP-STEP	Design and install horizontal capture well - beneath SOEP Main Dam	$ 72,000	$ 989,000	SOEP-STEP RER	$ 1,061,000		$ 100,000		
2021	Plant	Design and Construct Units 1&2 Capture Well Storage Pond at Plant Site	$ 150,000	$ 1,710,000	SOEP-STEP RER	$ 1,860,000	$ 5,555,000	$ 300,000	$ 890,000.00	$ 6,445,000
2021	SOEP-STEP	Design and install vertical or angled capture wells (SOEP-STEP)	$ 32,000	$ 448,000	SOEP-STEP RER	$ 480,000				
2021	SOEP-STEP	Design and install vertical or angled injection wells (SOEP-STEP)	$ 88,000	$ 1,232,000	SOEP-STEP RER	$ 1,320,000				
2021	SOEP-STEP	Design and install in situ flushing system (SOEP-STEP)	$ 200,000	$ 1,695,000	SOEP-STEP RER	$ 1,895,000				
2022	SOEP-STEP	Design and Close STEP Old Clearwell	$ 300,000	$ 2,300,000	SOEP-STEP RER	$ 2,600,000	$ 26,122,100	$ 22,000	$ 1,458,000.00	$ 27,580,100
2022	SOEP-STEP	Design and Close STEP E Cell	$ 300,000	$ 9,500,000	SOEP-STEP RER	$ 9,800,000		$ 94,000		
2022	Plant	Design and Close Units 1&2 Bottom Ash Ponds and Clearwell	$ 120,000	$ 2,760,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 2,880,000		$ 16,000		
2022	EHP	Design and Close EHP D/E Cells	$ 391,020	$ 6,517,000	EHP Closure plan (assume 6% design cost)	$ 6,908,020.00		$ 220,000.00		
2022	Plant	Design and install 50 New Vertical Injection Wells (Plant Site)	$ 70,380	$ 1,618,740	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,689,120.00		$ 216,000.00		
2022	Plant	Design and install 3 New Vertical Capture Wells in Alluvium (Plant Site)	$ 4,440	$ 102,120	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 106,560.00				
2022	Plant	Install 2 New Horizontal Capture Wells (Plant Site)	$ 87,660	$ 2,016,180	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 2,103,840.00				
2022	Plant	Convert 4 Existing Capture Wells to Injection Wells (Plant Site)	$ 1,440	$ 33,120	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 34,560.00				

Table 4-2: Colstrip Alternative 1 Talen Cost Schedule

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Annual Capital Cost	O&M	Total Annual O&M	Total Annual Cost
2023	SOEP-STEP	Design and Close STEP D Cell	$ 300,000	$ 5,300,000	SOEP-STEP RER	$ 5,600,000.00	$ 11,700,800.00	$ 52,000.00	$ 1,534,000.00	$ 13,234,800
	Plant	Design and Close Units 1&2 B Fly ash Pond	$ 177,000	$ 4,071,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 4,248,000		$ 24,000		
	SOEP-STEP	Prepare STEP B Cell for Post-Closure Stormwater Management Pond	$ -	$ 500,000	SOEP-STEP RER	$ 500,000		NA		
	SOEP-STEP	Decommission Units 1&2 Scrubber Pipline/North 1AD Drain Pond	$ -	$ 100,000	SOEP-STEP RER	$ 100,000		NA		
	Plant	Close North Pond of Units 1&2 Cooling Tower Blowdown	$ 52,200	$ 1,200,600	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,252,800		NA		
2024	EHP	Design and Construct Closure for EHP J-1 Cell	$ 480,900	$ 8,015,000	EHP Closure plan (assume 6% design cost)	$ 8,495,900	$ 9,806,300	$ 320,000	$ 1,854,000.00	$ 11,660,300
	Plant	Close South Pond of Units 1&2 Cooling Tower Blowdown	$ 54,600	$ 1,255,800	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,310,400		NA		
2025									$ 1,854,000.00	$ 1,854,000.00
2026									$ 1,854,000.00	$ 1,854,000.00
2027									$ 1,854,000.00	$ 1,854,000.00
2028									$ 1,854,000.00	$ 1,854,000.00
2029									$ 1,854,000.00	$ 1,854,000.00
2030									$ 1,854,000.00	$ 1,854,000.00
2031									$ 1,854,000.00	$ 1,854,000.00
2032									$ 1,854,000.00	$ 1,854,000.00
2033									$ 1,854,000.00	$ 1,854,000.00
2034									$ 1,854,000.00	$ 1,854,000.00
2035									$ 1,854,000.00	$ 1,854,000.00
2036									$ 1,854,000.00	$ 1,854,000.00
2037									$ 1,854,000.00	$ 1,854,000.00
2038									$ 1,854,000.00	$ 1,854,000.00
2039									$ 1,854,000.00	$ 1,854,000.00
2040	EHP	Design and close EHP C Cell	$ 455,220	$ 7,587,000	EHP Closure plan (assume 6% design cost)	$ 8,042,220	$ 10,147,140	$ 420,000	$ 3,176,000.00	$ 13,323,140.00
	EHP	Design and close EHP G Cell	$ 103,920	$ 1,732,000	EHP Closure plan (assume 6% design cost)	$ 1,835,920		$ 290,000		
	EHP	Design and close EHP New Clearwell	$ -	$ -	Included in A Cell per EHP Closure Plan	$ -				
	EHP	Dewater and prepare EHP F Cell for stormwater management	$ -	$ 113,000	EHP Closure plan	$ 113,000		$ 332,000		
	EHP	Dewater and prepare EHP H Cell for stormwater management	$ -	$ 113,000	EHP Closure plan	$ 113,000		$ 280,000		
	EHP	Close Units 3&4 Scrubber-EHP Pipeline and Drain Pits #3 and #5		$ 43,000	EHP Closure plan	$ 43,000		NA		

Table 4-2: Colstrip Alternative 1 Talen Cost Schedule

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Annual Capital Cost	O&M	Total Annual O&M	Total Annual Cost
	Plant	Close Units 3&4 North Plant Area Drain	$ 13,200	$ 303,600	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 316,800		NA		
	Plant	Close Units 3&4 Wash Tray Pond	$ 42,000	$ 966,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,008,000		NA		
2041	Plant	Close Units 3&4 Scrubber Drain Collection (DC Pond)	$ 31,200	$ 717,600	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 748,800	$ 3,268,800	NA	$ 3,176,000.00	$ 6,444,800.00
	Plant	Close Units 1-4 Sediment Retention Pond (Thompson Lake)	$ 46,800	$ 1,076,400	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,123,200		NA		
	Plant	Close Units 1-4 North Plant Sediment Retention Pond	$ 3,000	$ 69,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 72,000		NA		
2042									$ 3,176,000.00	$ 3,176,000.00
2043									$ 3,176,000.00	$ 3,176,000.00
2044									$ 3,176,000.00	$ 3,176,000.00
2045									$ 3,176,000.00	$ 3,176,000.00
2046									$ 3,176,000.00	$ 3,176,000.00
2047									$ 3,176,000.00	$ 3,176,000.00
2048									$ 3,176,000.00	$ 3,176,000.00
2049									$ 3,176,000.00	$ 3,176,000.00
2050	SOEP-STEP	Close Units 1&2 Capture Well Storage Pond at Plant Site	$ -	$ 750,000	SOEP-STEP RER	$ 750,000	$ 750,000	NA	$ 3,176,000.00	$ 3,926,000.00
2051									$ 3,176,000.00	$ 3,176,000.00
2052									$ 3,176,000.00	$ 3,176,000.00
2053									$ 3,176,000.00	$ 3,176,000.00
2054									$ 3,176,000.00	$ 3,176,000.00
2055									$ 3,176,000.00	$ 3,176,000.00
2056									$ 3,176,000.00	$ 3,176,000.00
2057									$ 3,176,000.00	$ 3,176,000.00
2058									$ 3,176,000.00	$ 3,176,000.00
2059									$ 3,176,000.00	$ 3,176,000.00
2060									$ 3,176,000.00	$ 3,176,000.00
2061									$ 3,176,000.00	$ 3,176,000.00
2062									$ 3,176,000.00	$ 3,176,000.00
2063									$ 3,176,000.00	$ 3,176,000.00
2064									$ 3,176,000.00	$ 3,176,000.00
2065									$ 3,176,000.00	$ 3,176,000.00
2066									$ 3,176,000.00	$ 3,176,000.00
2067									$ 3,176,000.00	$ 3,176,000.00
2068									$ 3,176,000.00	$ 3,176,000.00
2069									$ 3,176,000.00	$ 3,176,000.00
Notes									Total Annual O&M represents the total cost of O&M each year. As each remedy is completed, new O&M expenses will be required each year for operation and maintenance of that particular remedy	Total Annual Cost represents the total amount of capital and O&M that will be spent in a given year.

Table 4-3: Colstrip Alternative 2 NPRC Doing It Right Cost Schedule (water treatment and groundwater monitoring cost schedules are separate)

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Capital Cost	Dewatering O&M	Total Annual Dewatering O&M	O&M	Total Annual O&M	Total Annual Cost
2016						$ -						$ -
2017	EHP	A Cell (South Portion) Closed and Post Closure O&M Initiated	$ 47,760	$ 796,000	EHP Closure plan (assume 6% design cost)	$ 843,760	$ 843,760			$ 129,000	$ 129,000.00	$ 972,760.00
2018						$ -					$ 129,000.00	$ 129,000.00
2019	EHP	Design and Close B Cell (Clearwell)			KirK Eng. Alternative 1	$ 12,003,716	$ 12,003,716				$ 129,000.00	$ 12,132,716.06
2020	SOEP-STEP	Dewater Units 1&2 Stage I Evaporation Pond					$ 158,346,211	$ 33,402	$ 290,751		$ 672,804	$ 159,019,015
	SOEP-STEP	Dewater Units 1&2 STEP Cell A						$ 99,342				
	SOEP-STEP	Close Units 1&2 STEP Cell D			KirK Eng. Alternative 1	$ 7,935,675						
	SOEP-STEP	Dewater Units 1&2 STEP Old Clearwell						$ 16,881				
	EHP	Install Dewatering Wells Around A Cell's (South Portion) Perimeter			KirK Eng. Alternative 1	$ 36,387						
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater C Cell						$ 8,801				
	EHP	Dewater D/E Cell						$ 8,306				
	EHP	Dewater F Cell						$ 8,261				
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
	EHP	Begin Post Closure O&M on B Cell (Clearwell)								$ 443,804		
	Plant	Dewater Units 1&2 Flyash A Pond						$ 31,962				
	Plant	Dewater Units 1&2 Flyash B Pond						$ 32,430				
	Plant	Design and Close D4 Pond			KirK Eng. Alternative 1	$ 688,403						
	Plant	Cooling Tower Blowdown Pond C North - Install Liner and leachate collection system for future stormwater management			KirK Eng. Alternative 1	$ 1,792,020						
	Plant	Cooling Tower Blowdown Pond C South - Install Liner and leachate collection system for future stormwater management			KirK Eng. Alternative 1	$ 1,881,621						
	SOEP-STEP	Design and Construct Proposed CCR Landfill			KirK Eng. Alternative 1	$ 112,622,973						
	Plant	Design and Construct Proposed CCR Landfill			KirK Eng. Alternative 1	$ 32,328,133						
	SOEP-STEP	Design and install horizontal capture well - beneath SOEP Main Dam	$ 72,000	$ 989,000	SOEP-STEP RER	$ 1,061,000				$ 100,000		

Table 4-3: Colstrip Alternative 2 NPRC Doing It Right Cost Schedule (water treatment and groundwater monitoring cost schedules are separate)

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Capital Cost	Dewatering O&M	Total Annual Dewatering O&M	O&M	Total Annual O&M	Total Annual Cost
2021	SOEP-STEP	Dewater Units 1&2 Stage I Evaporation Pond					$ 3,695,000	$ 33,402	$ 282,311		$ 1,413,885	$ 5,108,885
	SOEP-STEP	Dewater Units 1&2 STEP Cell A						$ 99,342				
	SOEP-STEP	Begin Post Closure for Units 1&2 STEP Cell D								$ 292,456		
	SOEP-STEP	Dewater Units 1&2 STEP Old Clearwell						$ 8,441				
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater C Cell						$ 8,801				
	EHP	Dewater D/E Cell						$ 8,306				
	EHP	Dewater F Cell						$ 8,261				
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
	Plant	Dewater Units 1&2 Flyash A Pond						$ 31,962				
	Plant	Dewater Units 1&2 Flyash B Pond						$ 32,430				
	Plant	Begin post closure on Cooling Tower Blowdown Pond C North								$ 72,500		
	Plant	Begin post closure on Cooling Tower Blowdown Pond C North								$ 76,125		
	SOEP-STEP	Design and install vertical or angled capture wells (SOEP-STEP)	$ 32,000	$ 448,000	SOEP-STEP RER	$ 480,000						
	SOEP-STEP	Design and install vertical or angled injection wells (SOEP-STEP)	$ 88,000	$ 1,232,000	SOEP-STEP RER	$ 1,320,000				$ 300,000		
	SOEP-STEP	Design and install in situ flushing system (SOEP-STEP)	$ 200,000	$ 1,695,000	SOEP-STEP RER	$ 1,895,000						
2022	SOEP-STEP	Dewater Units 1&2 Stage I Evaporation Pond					$ 27,357,447	$ 33,402	$ 357,375		$ 1,629,885	$ 28,987,332
	SOEP-STEP	Dewater Units 1&2 STEP Cell A						$ 99,342				
	SOEP-STEP	Dewater Units 1&2 STEP Cell E						$ 83,505				
	SOEP-STEP	Design and Close Units 1&2 STEP Old Clearwell			KirK Eng. Alternative 1	$ 11,313,198						
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater C Cell						$ 8,801				
	EHP	Dewater D/E Cell						$ 8,306				
	EHP	Dewater F Cell						$ 8,261				
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
	EHP	Design and Close D/E Cell			Kirk Eng. Alternative 1	$ 12,110,168						
	Plant	Dewater Units 1&2 Flyash A Pond						$ 31,962				
	Plant	Dewater Units 1&2 Flyash B Pond						$ 32,430				
	Plant	Design and install 50 New Vertical Injection Wells (Plant Site)	$ 70,380	$ 1,618,740	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,689,120				$ 216,000		
	Plant	Design and install 3 New Vertical Capture Wells in Alluvium (Plant Site)	$ 4,440	$ 102,120	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 106,560						
	Plant	Install 2 New Horizontal Capture Wells (Plant Site)	$ 87,660	$ 2,016,180	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 2,103,840						
	Plant	Convert 4 Existing Capture Wells to Injection Wells (Plant Site)	$ 1,440	$ 33,120	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 34,560						

Table 4-3: Colstrip Alternative 2 NPRC Doing It Right Cost Schedule (water treatment and groundwater monitoring cost schedules are separate)

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Capital Cost	Dewatering O&M	Total Annual Dewatering O&M	O&M	Total Annual O&M	Total Annual Cost
	SOEP-STEP	Design and Close Units 1&2 Stage I Evaporation Pond (SOEP)			KirK Eng. Alternative 1	$ 136,120,925						
	SOEP-STEP	Dewater Units 1&2 STEP Cell A						$ 99,342.0				
	SOEP-STEP	Dewater Units 1&2 STEP Cell E						$ 83,505.0				
	SOEP-STEP	Begin Post-Closure O&M for Units 1&2 STEP Old Clearwell								$ -		
	EHP	Dewater A Cell (South portion)						$ 8,080.5				
	EHP	Dewater C Cell						$ 8,800.5				
	EHP	Dewater D/E Cell						$ 8,305.5				
	EHP	Dewater F Cell						$ 8,260.5				
	EHP	Dewater G Cell						$ 17,241.0				
2023	EHP	Dewater H Cell					$ 140,570,060.5	$ 8,085.0	$ 314,291		$ 1,812,228	$ 142,382,288.31
	EHP	Dewater J Cell						$ 17,961.0				
	EHP	Begin Post Closure O&M on D/E Cell								$ 182,342.7		
	Plant	Dewater Units 1&2 Flyash A Pond						$ 28,765.8				
	Plant	Dewater Units 1&2 Flyash B Pond						$ 25,944.0				
	Plant	Design and Close Units 1&2 Bottom Ash Pond			KirK Eng. Alternative 1	$ 1,171,059						
	Plant	Design and Close Units 3&4 Bottom Ash Pond Area			KirK Eng. Alternative 1	$ 1,948,011						
	Plant	Design and Close Former Units 1&2 Bottom Ash Ponds			KirK Eng. Alternative 1	$ 730,065						
	SOEP-STEP	Prepare STEP B Cell for Post-Closure Stormwater Management Pond			SOEP-STEP RER	$ 500,000						
	SOEP-STEP	Decommission Units 1&2 Scrubber Pipline/North 1AD Drain Pond	$ -	$ 100,000	SOEP-STEP RER	$ 100,000				NA		
	SOEP-STEP	Begin Post-Closure O&M for Units 1&2 Stage I Evaporation Pond (SOEP)								$ 8,662		
	SOEP-STEP	Dewater Units 1&2 STEP Cell A						$ 99,342				
	SOEP-STEP	Dewater Units 1&2 STEP Cell E						$ 83,505				
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater C Cell						$ 8,801				
	EHP	Dewater D/E Cell						$ 8,306				
2024	EHP	Dewater F Cell					$ 43,555,688	$ 8,261	$ 259,581		$ 2,874,077	$ 46,429,765
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
	EHP	Design and Close J Cell			KirK Eng. Alternative 1	$ 17,683,832						
	Plant	Design and Close Units 1&2 Flyash A Pond			KirK Eng. Alternative 1	$ 14,354,335						
	Plant	Design and Close Units 1&2 Flyash B Pond			KirK Eng. Alternative 1	$ 11,517,521						
	SOEP-STEP	Begin Post-Closure O&M for the Proposed CCR Landfill								$ 1,053,187		
	SOEP-STEP	Dewater Units 1&2 STEP Cell A						$ 99,342				
	SOEP-STEP	Dewater Units 1&2 STEP Cell E						$ 83,505				
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater C Cell						$ 8,801				
	EHP	Dewater D/E Cell						$ 8,306				
2025	EHP	Dewater F Cell					$ -	$ 8,261	$ 259,581		$ 3,523,852	$ 3,523,852
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
	EHP	Begin Post Closure O&M for EHP J Cell								$ 649,775		
	Plant	Begin Post-Closure O&M for Units 1&2 Flyash A Pond								$ -		
	Plant	Begin Post-Closure O&M for Design and Close Units 1&2 Flyash B Pond								$ -		

Table 4-3: Colstrip Alternative 2 NPRC Doing It Right Cost Schedule (water treatment and groundwater monitoring cost schedules are separate)

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Capital Cost	Dewatering O&M	Total Annual Dewatering O&M	O&M	Total Annual O&M	Total Annual Cost
2026	SOEP-STEP	Dewater Units 1&2 STEP Cell A					$ -	$ 99,342	$ 259,581		$ 3,523,852	$ 3,523,852
	SOEP-STEP	Dewater Units 1&2 STEP Cell E						$ 83,505				
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater C Cell						$ 8,801				
	EHP	Dewater D/E Cell						$ 8,306				
	EHP	Dewater F Cell						$ 8,261				
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
2027	SOEP-STEP	Dewater Units 1&2 STEP Cell A					$ -	$ 79,474	$ 231,362		$ 3,523,852	$ 3,523,852
	SOEP-STEP	Dewater Units 1&2 STEP Cell E						$ 75,155				
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater C Cell						$ 8,801				
	EHP	Dewater D/E Cell						$ 8,306				
	EHP	Dewater F Cell						$ 8,261				
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
2028	SOEP-STEP	Design and Close Units 1&2 STEP Cell A			KirK Eng. Alternative 1	$ 76,970,508	$ 133,812,804		$ 67,934		$ 3,523,852	$ 137,336,656
	SOEP-STEP	Design and Close Units 1&2 STEP Cell E			KirK Eng. Alternative 1	$ 56,842,296						
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater D/E Cell						$ 8,306				
	EHP	Dewater F Cell						$ 8,261				
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
2029	SOEP-STEP	Begin Post-Closure on Units 1&2 STEP Cell A					$ -		$ 67,934	$ -	$ 3,523,852	$ 3,523,852
	SOEP-STEP	Begin Post-Closure on Units 1&2 STEP Cell E								$ -		
	EHP	Dewater A Cell (South portion)						$ 8,081				
	EHP	Dewater D/E Cell						$ 8,306				
	EHP	Dewater F Cell						$ 8,261				
	EHP	Dewater G Cell						$ 17,241				
	EHP	Dewater H Cell						$ 8,085				
	EHP	Dewater J Cell						$ 17,961				
2030											$ 3,523,852	$ 3,523,852
2031											$ 3,523,852	$ 3,523,852
2032											$ 3,523,852	$ 3,523,852
2033											$ 3,523,852	$ 3,523,852
2034											$ 3,523,852	$ 3,523,852
2035											$ 3,523,852	$ 3,523,852
2036											$ 3,523,852	$ 3,523,852
2037											$ 3,523,852	$ 3,523,852
2038											$ 3,523,852	$ 3,523,852
2039											$ 3,523,852	$ 3,523,852

Table 4-3: Colstrip Alternative 2 NPRC Doing It Right Cost Schedule (water treatment and groundwater monitoring cost schedules are separate)

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Capital Cost	Dewatering O&M	Total Annual Dewatering O&M	O&M	Total Annual O&M	Total Annual Cost
	EHP	Design and Close Units 3&4 Scrubber-EHP Pipeline and Drain Pits #3 and #5		$ 43,000	EHP Closure plan	$ 43,000				NA		
	EHP	Design and Close EHP C Cell			Kirk Eng. Alternative 1	$ 23,078,087						
2040	EHP	Design and Close EHP G Cell			Kirk Eng. Alternative 1	$ 16,034,279	$ 39,578,594				$ 3,523,852	$ 43,102,445
	EHP	Design and Close New Clearwell			Cost included in A Cell	$ -						
	EHP	Design and Close F Cell			Kirk Eng. Alternative 1	$ 43,500						
	EHP	Design and Close H Cell			Kirk Eng. Alternative 1	$ 379,728						
	Plant	Design and Close Units 1&2 CCR Solids Collection Basin			KirK Eng. Alternative 1	$ 194,427						
	Plant	Close Units 3&4 North Plant Area Drain	$ 13,200	$ 303,600	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 316,800				NA		
	Plant	Close Units 3&4 Wash Tray Pond	$ 42,000	$ 966,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,008,000				NA		
2041	Plant	Close Units 3&4 Scrubber Drain Collection (DC Pond)	$ 31,200	$ 717,600	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 748,800	$ 3,463,227			NA	$ 5,022,597	$ 8,485,824
	Plant	Close Units 1-4 Sediment Retention Pond (Thompson Lake)	$ 46,800	$ 1,076,400	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 1,123,200				NA		
	Plant	Close Units 1-4 North Plant Sediment Retention Pond	$ 3,000	$ 69,000	Plant Site RER (assuming 6% design and 25% contingency + 5% project mgt + 8% construction mgt = 38% construction overhead)	$ 72,000				NA		
	EHP	Begin Post-Closure on C Cell								$ 852,332		
	EHP	Begin Post-Closure on G Cell								$ 589,463		
	EHP	Begin Post-Closure on New Clearwell								$ -		
	EHP	Begin Post-Closure on F Cell								$ 30,902		
	EHP	Begin Post-Closure on H Cell								$ 26,048		
2042	Plant	Begin Post Closure O&M on the Proposed CCR Landfill								$ 360,472	$ 5,383,070	$ 5,383,070
2043											$ 5,383,070	$ 5,383,070
2044											$ 5,383,070	$ 5,383,070
2045											$ 5,383,070	$ 5,383,070
2046											$ 5,383,070	$ 5,383,070
2047											$ 5,383,070	$ 5,383,070
2048											$ 5,383,070	$ 5,383,070
2049											$ 5,383,070	$ 5,383,070
2050											$ 5,383,070	$ 5,383,070
2051											$ 5,383,070	$ 5,383,070

Table 4-3: Colstrip Alternative 2 NPRC Doing It Right Cost Schedule (water treatment and groundwater monitoring cost schedules are separate)

Year	Location	Construction Activities	Design Cost Cost	Construction Cost	Cost Source	Capital Cost	Total Capital Cost	Dewatering O&M	Total Annual Dewatering O&M	O&M	Total Annual O&M	Total Annual Cost
2052											$ 5,383,070	$ 5,383,070
2053											$ 5,383,070	$ 5,383,070
2054											$ 5,383,070	$ 5,383,070
2055											$ 5,383,070	$ 5,383,070
2056											$ 5,383,070	$ 5,383,070
2057											$ 5,383,070	$ 5,383,070
2058											$ 5,383,070	$ 5,383,070
2059											$ 5,383,070	$ 5,383,070
2060											$ 5,383,070	$ 5,383,070
2061											$ 5,383,070	$ 5,383,070
2062											$ 5,383,070	$ 5,383,070
2063											$ 5,383,070	$ 5,383,070
2064											$ 5,383,070	$ 5,383,070
2065											$ 5,383,070	$ 5,383,070
2066											$ 5,383,070	$ 5,383,070
2067											$ 5,383,070	$ 5,383,070
2068											$ 5,383,070	$ 5,383,070
2069											$ 5,383,070	$ 5,383,070
Notes											Total Annual O&M represents the total cost of O&M each year. As each remedy is completed, new O&M expenses will be required each year for operation and maintenance of that particular remedy	Total Annual Cost represents the total amount of capital and O&M that will be spent in a given year.

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

Pond Info Summary								Closure and Groundwater Remedy Matrix			
Location	**Wastewater Facility**	**Total Volume CCR and Contaminated Media**	**Individual Pond Surface Area (acres)**	**Approximate pond depth (calculated)**	**Saturated thickness (calculated)**	**Saturated CCR volume, calculated (acft)**	**Pore water volume (acft)**	**Closure Activities**	**Removal Volumes (acft)**	**Dewatering Volume for Removal or ISS Treatment (acft)**	**ISS Encapsulated Volume (acft)**
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	2350	114	60	32	153	77	CCR removal to new repository. Construct liner system and sump to manage stormwater.	2350	77	-
SOEP / STEP	Units 1&2 STEP Cell A	1330	42.1	52	47	1202	601	CCR removal to new repository.	1330	601	-
SOEP / STEP	Units 1&2 STEP Cell D	621	25.7	38	33.5	124	62	Cap in place per Talen plan or never fill with CCR if not needed.			-
SOEP / STEP	Units 1&2 STEP Cell E	976	46.8	60	55.7	758	379	CCR removal to new repository.	976	379	-
SOEP / STEP	Units 1&2 STEP Old Clearwell	193	10.9	70	61.4	39	19	CCR removal to new repository.	193	19	-
EHP	A Cell (South portion)	775	23.1	30	0	0	0	Same as Talen's plan. Completed in 2017. Capital cost listed here includes installation of dewatering wells.			-
EHP	A Cell (North portion-New Clearwell)	755	22.5	25	0	0	0	Use for future storm water management per Talen plan.			-
EHP	B Cell (Clearwell)	1360	39	90	33	1287	644	Enhanced dewatering to reduce seepage; cap in place per Talen plan.			-
EHP	C Cell	4420	74.9	110	92	207	103	Enhanced dewatering to reduce seepage; cap in place per Talen plan.			-
EHP	D/E Cell	1530	39.2	55	9	353	176	Enhanced dewatering to reduce seepage; cap in place per Talen plan.			-
EHP	F Cell	520	59.2	50	0	0	0	Use for future storm water management per Talen plan.			-
EHP	G Cell	1870	51.8	90	42	508	254	Enhanced dewatering to reduce seepage; cap in place per Talen plan.			-
EHP	H Cell	552.6	49.9	31	35	552.6	276	Enhanced dewatering to reduce seepage; use for future storm water management per Talen plan.			-
EHP	J Cell	5702	57.1	130	82	2851	1,426	Enhanced dewatering to reduce seepage; cap in place per Talen plan.			-
Plant	Units 1&2 Flyash A Pond	245	14	20	14.5	203	102	CCR removal to new repository.	245	102	-
Plant	Units 1&2 Flyash B Pond	196	10	33	24	196	98	CCR removal to new repository.	196	98	-
Plant	Units 1&2 Bottom Ash Pond	24	4	6	Not reported	24	12	CCR removal to new repository.	24	12	-
Plant	D4 Pond	12.5	7	2	Not reported	0	0	Contaminant removal to new repository.	12.5	0	-
Plant	Units 3&4 Bottom Ash Pond Area	38	12.8	3	5	64	32	CCR removal to new repository.	38	32	-
Plant	Units 1&2 CCR Solids Collection Basin	2.6	neglible	NA	Not reported	2.6	1	CCR removal to new repository.	2.6	1	-
Plant	Former Units 1&2 Bottom Ash Ponds	12.5	9.5	1	Not reported	6.25	3	CCR removal to new repository.	12.5	3	-
Plant	Cooling Tower Blowdown Pond C North		10	20				Retrofit for storage of CCR dewatering flows.			-
Plant	Cooling Tower Blowdown Pond C South		10.5	20				Retrofit for storage of CCR dewatering flows.			-
SOEP / STEP	Proposed CCR Landfill		97					Construct landfill to hold CCR excavated from SOEP/STEP Site and cap in place.			-
Plant	Proposed CCR Landfill		33.2					Construct landfill to hold CCR excavated from Plant Site and cap in place.			-
Notes											
References											

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Remedy Matrix								
Location	**Wastewater Facility**	**Final Cover Type**	**Cover acreage for cap in place (acres)**	**General reclamation after pond removal (acres)**	**Enhanced CCR Dewatering Volume (acft)**	**# dewatering wells**	**Flow per well (gpm)**	**Total dewatering rate (gpm)**	**Dewatering time (years)**	**Notes**
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)			114		4	4	16	3.0	Use wells for dewatering.
SOEP / STEP	Units 1&2 STEP Cell A			42.1		12	4	48	7.8	Use wells for dewatering.
SOEP / STEP	Units 1&2 STEP Cell D	IV	25.7							Cell D has liner which meets CCR Rule. Use leachate collection system to collect slow drainage of CCR.
SOEP / STEP	Units 1&2 STEP Cell E			46.8		10	4	40	5.9	Use wells for dewatering.
SOEP / STEP	Units 1&2 STEP Old Clearwell			10.9		2	4	8	1.5	Use wells for dewatering.
EHP	A Cell (South portion)	IV	23.1			1	20	20	10.0	Dewatering wells installed on pond perimeter for dewatering clinker and native geology. Use EHP underdrain for pond dewatering. Dewatering time assumed at 10 years. Capital costs listed here only include installation of dewatering wells in 2020 since the pond was closed in 2017.
EHP	A Cell (North portion-New Clearwell)	No additional cap								
EHP	B Cell (Clearwell)	IV	39		644					
EHP	C Cell	IV	74.9		103	1	187	187	8.0	This is a proxy for the EHP underdrain which dewaters the base of the EHP. Assume 8 years based on pond saturated volume.
EHP	D/E Cell	IV	39.2		176	1	20	20	10.0	Dewatering wells installed on pond perimeter for dewatering clinker and native geology. Use EHP underdrain for pond dewatering. Dewatering time assumed at 10 years.
EHP	F Cell	No additional cap				1	20	20	10.0	Dewatering wells installed on pond perimeter for dewatering clinker and native geology. Use EHP underdrain for pond dewatering. Dewatering time assumed at 10 years.
EHP	G Cell	IV	51.8		254	2	20	40	10.0	Dewatering wells installed on pond perimeter for dewatering clinker and native geology. Use EHP underdrain for pond dewatering. Dewatering time assumed at 10 years.
EHP	H Cell	No additional cap			276	1	20	20	10.0	Dewatering wells installed on pond perimeter for dewatering clinker and native geology. Use EHP underdrain for pond dewatering. Dewatering time assumed at 10 years.
EHP	J Cell	IV	57.1		1,426	2	20	40	10.0	Dewatering wells installed on pond perimeter for dewatering clinker and native geology. Use EHP underdrain for pond dewatering. Dewatering time assumed at 10 years.
Plant	Units 1&2 Flyash A Pond			14		4	4	16	3.9	Use wells or wellpoints for dewatering.
Plant	Units 1&2 Flyash B Pond			10		4	4	16	3.8	Use wells or wellpoints for dewatering.
Plant	Units 1&2 Bottom Ash Pond			4					0.5	Assume small dewatering volume can be handled with a sump.
Plant	D4 Pond			7						
Plant	Units 3&4 Bottom Ash Pond Area			12.8					0.5	Assume small dewatering volume can be handled with a sump.
Plant	Units 1&2 CCR Solids Collection Basin			neglible					0.5	Assume small dewatering volume can be handled with a sump.
Plant	Former Units 1&2 Bottom Ash Ponds			9.5					0.5	Assume small dewatering volume can be handled with a sump.
Plant	Cooling Tower Blowdown Pond C North			10						
Plant	Cooling Tower Blowdown Pond C South			10.5						
SOEP / STEP	Proposed CCR Landfill	IV	97							
Plant	Proposed CCR Landfill	IV	33.2							
Notes										
References										

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Misc. Information			Proposed Pond Info					Capital Cost: Site Work					
										Surveying			Clearing and Grubbing		
Location	Wastewater Facility	Dewatering Well Depth (ft)	Remedy Duration (yrs)	Pond Perimeter (ft)	Proposed Pond Constructed Berm Volume (CY)	Proposed Pond Area (Acre)	Proposed Pond Depth (ft)	Proposed Pond Capacity (CY)	Proposed Pond Excavation Volume (CY)	Area (Acre)	Unit Cost ($/Acre)	Cost	Area (Acre)	Unit Cost ($/Acre)	Cost
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	60	1							114.0	$ 1,000	$ 114,000	$ -	$ 6,500	$ -
SOEP / STEP	Units 1&2 STEP Cell A	52	1							42.1		$ 42,100	$ -	$ 6,500	$ -
SOEP / STEP	Units 1&2 STEP Cell D	FALSE	1							25.7		$ 25,700	$ -	$ 6,500	$ -
SOEP / STEP	Units 1&2 STEP Cell E	60	1							46.8		$ 46,800	$ -	$ 6,500	$ -
SOEP / STEP	Units 1&2 STEP Old Clearwell	70	1							10.9		$ 10,900	$ -	$ 6,500	$ -
EHP	A Cell (South portion)	30	1								$ 1,000			$ 6,500	
EHP	A Cell (North portion-New Clearwell)	FALSE	1									$ -	$ -	$ 6,500	$ -
EHP	B Cell (Clearwell)	FALSE	1							39.0		$ 39,000	$ -	$ 6,500	$ -
EHP	C Cell	110	1							74.9		$ 74,900	$ -	$ 6,500	$ -
EHP	D/E Cell	55	1							39.2		$ 39,200	$ -	$ 6,500	$ -
EHP	F Cell	50	1									$ -	$ -	$ 6,500	$ -
EHP	G Cell	90	1							51.8		$ 51,800	$ -	$ 6,500	$ -
EHP	H Cell	31	1							49.9		$ 49,900	$ -	$ 6,500	$ -
EHP	J Cell	130	1							57.1		$ 57,100	$ -	$ 6,500	$ -
Plant	Units 1&2 Flyash A Pond	20	1							14.0	$ 1,000	$ 14,000	$ -	$ 6,500	$ -
Plant	Units 1&2 Flyash B Pond	33	1							10.0		$ 10,000	$ -	$ 6,500	$ -
Plant	Units 1&2 Bottom Ash Pond	6	1							4.0		$ 4,000	$ -	$ 6,500	$ -
Plant	D4 Pond	FALSE	1							7.0		$ 7,000	$ -	$ 6,500	$ -
Plant	Units 3&4 Bottom Ash Pond Area	3	1							12.8		$ 12,800	$ -	$ 6,500	$ -
Plant	Units 1&2 CCR Solids Collection Basin	NA	1									$ -	$ -	$ 6,500	$ -
Plant	Former Units 1&2 Bottom Ash Ponds	1	1							9.5		$ 9,500	$ -	$ 6,500	$ -
Plant	Cooling Tower Blowdown Pond C North	FALSE	1							10.0		$ 10,000	$ -	$ 6,501	$ -
Plant	Cooling Tower Blowdown Pond C South	FALSE	1							10.5		$ 10,500	$ -	$ 6,502	$ -
SOEP / STEP	Proposed CCR Landfill		1		1,362,773	97	60	7,921,150	2,669,021	97	$ 1,000	$ 97,000	$ 97	$ 6,500	$ 630,500
Plant	Proposed CCR Landfill		1		56,730	33.2	20	973,554	818,896	33.2		$ 33,200	$ 33	$ 6,500	$ 215,800
Notes					Berm volume, area, depth, capacity, and required excavation determined by design using Carlson Civil Software						Unit cost based on contractor quote				
References														1	

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Capital Cost											
		Dewatering			Excavation/Backfill								
		Extraction Well (10 GPM)			Excavation (1' Depth)			Excavation (5' Depth)			Excavation (10' Depth)		
Location	Wastewater Facility	Well Depth (ft)	Unit Cost Per Well ($/Depth)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	60	Cost (Per Well) = ($172 x GW Depth) + $12,436	$ 136,536		Cost = ($5.71 x CY)+$			Cost = ($5.78 x CY)+$			Total Cost = ($6.35 x cy)+$6,099	
SOEP / STEP	Units 1&2 STEP Cell A	52		$ 384,840									
SOEP / STEP	Units 1&2 STEP Cell D			$ -									
SOEP / STEP	Units 1&2 STEP Cell E	60		$ 341,340									
SOEP / STEP	Units 1&2 STEP Old Clearwell	70		$ 73,428									
EHP	A Cell (South portion)	30	Cost (Per Well) = ($172 x GW Depth) + $12,436	$ 26,394		Cost = ($5.71 x CY)+$809			Cost = ($5.78 x CY)+$2,056			Total Cost = ($6.35 x cy)+$6,099	
EHP	A Cell (North portion-New Clearwell)			$ -									
EHP	B Cell (Clearwell)			$ -									
EHP	C Cell	110		$ 67,980									
EHP	D/E Cell	55		$ 32,844									
EHP	F Cell	50		$ 31,554									
EHP	G Cell	90		$ 83,748									
EHP	H Cell	31		$ 26,523									
EHP	J Cell	130		$ 104,388									
Plant	Units 1&2 Flyash A Pond	20	Cost (Per Well) = ($172 x GW Depth) + $12,436	$ 95,256		Cost = ($5.71 x CY)+$809			Cost = ($5.78 x CY)+$2,056			Total Cost = ($6.35 x cy)+$6,	
Plant	Units 1&2 Flyash B Pond	33		$ 108,672									
Plant	Units 1&2 Bottom Ash Pond	6		$ -				38,720		$ 338,786			
Plant	D4 Pond			$ -	20,167		$ 173,941						
Plant	Units 3&4 Bottom Ash Pond Area	3		$ -	61,307		$ 526,304						
Plant	Units 1&2 CCR Solids Collection Basin			$ -			FALSE						
Plant	Former Units 1&2 Bottom Ash Ponds	1		$ -	20,167		$ 173,941						
Plant	Cooling Tower Blowdown Pond C North			$ -									
Plant	Cooling Tower Blowdown Pond C South			$ -									
SOEP / STEP	Proposed CCR Landfill		Cost (Per Well) = ($172 x GW Depth) + $12,436			Cost = ($5.71 x CY)+$809			Cost = ($5.78 x CY)+$2,056			Total Cost = ($6.35 x cy)+$6,099	
Plant	Proposed CCR Landfill												
Notes													
References			2			2			2			2	

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Capital Cost											
		Excavation/Backfill									In-Situ Stabilization/Solidification		
		Excavation (20' Depth)			BackFill			Perimeter Berm Construction			Bottom Liner		
Location	Wastewater Facility	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Volume (CY)	Unit Cost ($/CY)	Cost ($)
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	3,791,325.5	Cost = $13.648xCY)+$33,69 9	$ 51,777,709.42	3,791,326	Cost = $7.96 x CY	$ 45,268,426	$ -	$ 8	$ -		$ 45	$ -
SOEP / STEP	Units 1&2 STEP Cell A	2,145,728.9		$ 29,318,607.03	2,145,729		$ 25,620,003	$ -		$ -			$ -
SOEP / STEP	Units 1&2 STEP Cell D	-			-			$ -		$ -			$ -
SOEP / STEP	Units 1&2 STEP Cell E	1,574,610.1		$ 21,523,977.37	1,574,610		$ 18,800,844	$ -		$ -			$ -
SOEP / STEP	Units 1&2 STEP Old Clearwell	311,372.7		$ 4,283,313.47	311,373		$ 3,717,790	$ -		$ -			$ -
EHP	A Cell (South portion)		Cost = $13.648xCY)+$33,699			Cost = $7.96 x CY			$ 8			$ 45	
EHP	A Cell (North portion-New Clearwell)	-			-			$ -		$ -			$ -
EHP	B Cell (Clearwell)	-			-			$ -		$ -			$ -
EHP	C Cell	-			-			$ -		$ -			$ -
EHP	D/E Cell	-			-			$ -		$ -			$ -
EHP	F Cell	-			-			$ -		$ -			$ -
EHP	G Cell	-			-			$ -		$ -			$ -
EHP	H Cell	-			-			$ -		$ -			$ -
EHP	J Cell	-			-			$ -		$ -			$ -
Plant	Units 1&2 Flyash A Pond	395,265.9	Cost = $13.648xCY)+$33,699	$ 5,428,287.32	395,266	Cost = $7.96 x CY	$ 4,719,474	$ -	$ 8	$ -		$ 45	$ -
Plant	Units 1&2 Flyash B Pond	316,212.7		$ 4,349,369.66	316,213		$ 3,775,579	$ -		$ -			$ -
Plant	Units 1&2 Bottom Ash Pond				38,720		$ 462,316	$ -		$ -			$ -
Plant	D4 Pond				20,167		$ 240,790	$ -		$ -			$ -
Plant	Units 3&4 Bottom Ash Pond Area				61,307		$ 732,000	$ -		$ -			$ -
Plant	Units 1&2 CCR Solids Collection Basin	4,194.7		$ 90,947.69	4,195		$ 50,084	$ -		$ -			$ -
Plant	Former Units 1&2 Bottom Ash Ponds				20,167		$ 240,790	$ -		$ -			$ -
Plant	Cooling Tower Blowdown Pond C North												$ -
Plant	Cooling Tower Blowdown Pond C South												$ -
SOEP / STEP	Proposed CCR Landfill	2,669,021	Cost = $13.648xCY)+$33,699	$ 36,460,497.61		Cost = $7.96 x CY		1,362,773	$ 8	$ 10,902,184			0
Plant	Proposed CCR Landfill	818,896		$ 11,209,991.61				56,730		$ 453,840			$ -
Notes					Backfill includes trucking and depositing CCR material from excavated ponds into proposed landfill repositories.								
References			2			2			3			4	

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Capital Cost								
		In-Situ Stabilization/Solidification			Cover System Installation					
		Perimeter Liner			Federal CCR Rule Compliant Cover System			Federal CCR Rule Compliant Liner System		
Location	Wastewater Facility	Volume (CY)	Unit Cost ($/CY)	Cost ($)	Area (Acre)	Unit Cost ($/Acre)	Cost ($)	Area (Acre)	Unit Cost ($/Acre)	Cost ($)
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)		$ 45	$ -	0.0	Cost = $170,144 x Area)+$36,207) x 1.5)-($72,600 x Area)+($25,000 x Area))		1.32	Cost = ($29,500 X Area X 2)+($56,000 X Area)+($10,000 X Area)+$12,771	$ 177,771.00
SOEP / STEP	Units 1&2 STEP Cell A			$ -	0.0					$ -
SOEP / STEP	Units 1&2 STEP Cell D			$ -	25.7		$ 5,628,127			$ -
SOEP / STEP	Units 1&2 STEP Cell E			$ -	0.0					$ -
SOEP / STEP	Units 1&2 STEP Old Clearwell			$ -	0.0					$ -
EHP	A Cell (South portion)		$ 45			Cost = $170,144 x Area)+$36,207) x 1.5)-($72,600 x Area)+($25,000 x Area))				
EHP	A Cell (North portion-New Clearwell)			$ -	0.0					$ -
EHP	B Cell (Clearwell)			$ -	39.0		$ 8,512,631			$ -
EHP	C Cell			$ -	74.9		$ 16,298,623			$ -
EHP	D/E Cell			$ -	39.2		$ 8,556,007			$ -
EHP	F Cell			$ -	0.0					$ -
EHP	G Cell			$ -	51.8		$ 11,288,695			$ -
EHP	H Cell			$ -	0.0					$ -
EHP	J Cell			$ -	57.1		$ 12,438,159			$ -
Plant	Units 1&2 Flyash A Pond		$ 45	$ -	0.0	Cost = $170,144 x Area)+$36,207) x 1.5)-($72,600 x Area)+($25,000 x Area))			Cost = ($29,500 X Area X 2)+($56,000 X Area)+($10,000 X Area)	$ -
Plant	Units 1&2 Flyash B Pond			$ -	0.0					$ -
Plant	Units 1&2 Bottom Ash Pond			$ -	0.0					$ -
Plant	D4 Pond			$ -	0.0					$ -
Plant	Units 3&4 Bottom Ash Pond Area			$ -	0.0					$ -
Plant	Units 1&2 CCR Solids Collection Basin			$ -	0.0					$ -
Plant	Former Units 1&2 Bottom Ash Ponds			$ -	0.0					$ -
Plant	Cooling Tower Blowdown Pond C North			$ -				10		$ 1,250,000.00
Plant	Cooling Tower Blowdown Pond C South			$ -				10.5		$ 1,312,500.00
SOEP / STEP	Proposed CCR Landfill			0	97.0	Cost = $170,144 x Area)+$36,207) x 1.5)-($72,600 x Area)+($25,000 x Area))	$ 21,091,671	97	Cost = ($29,500 X Area X 2)+($56,000 X Area)+($10,000 X Area)	$ 12,125,000.00
Plant	Proposed CCR Landfill			$ -	33.2		$ 7,254,727	33.2		$ 4,150,000.00
Notes						Federal CCR Rule compliant cover system cost includes 6" erosion layer, 12" of earthen material, geocomposite layer, runoff system, 60-mil HDPE, and geotextile cushion.			Liner system includes two layers of 60-mil textured HDPE, 2' of geocomposite drainage layer (sand/aggregate),geosynthetic liner, and leachate collection system.	
References			4			2,3			2,3	

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Capital Cost						
		Reclamation			Dust Control			
		Grading/Hydroseeding			Water Truck			
Location	Wastewater Facility	Area (Acre)	Unit Cost ($/Acre)	Cost ($)	Area (Acre)	Time (Days)	Unit Cost ($/Acre-Day)	Cost ($)
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	114	$ 7,100	$ 809,400	28.5	130.5	$ 75	$ 454,678.31
SOEP / STEP	Units 1&2 STEP Cell A	42.1		$ 298,910	10.5	130.5		$ 167,911.90
SOEP / STEP	Units 1&2 STEP Cell D				6.4	130.5		$ 102,502.04
SOEP / STEP	Units 1&2 STEP Cell E	46.8		$ 332,280	11.7	130.5		$ 186,657.41
SOEP / STEP	Units 1&2 STEP Old Clearwell	10.9		$ 77,390	2.7	130.5		$ 43,473.63
EHP	A Cell (South portion)		$ 7,100				$ 75	
EHP	A Cell (North portion-New Clearwell)				0.0	130.5		$ -
EHP	B Cell (Clearwell)				9.8	130.5		$ 155,547.84
EHP	C Cell				18.7	130.5		$ 298,731.63
EHP	D/E Cell				9.8	130.5		$ 156,345.53
EHP	F Cell				0.0	130.5		$ -
EHP	G Cell				13.0	130.5		$ 206,599.44
EHP	H Cell				12.5	130.5		$ 199,021.47
EHP	J Cell				14.3	130.5		$ 227,738.00
Plant	Units 1&2 Flyash A Pond	14	$ 7,100	$ 99,400	3.5	130.5	$ 75	$ 55,837.69
Plant	Units 1&2 Flyash B Pond	10		$ 71,000	2.5	130.5		$ 39,884.06
Plant	Units 1&2 Bottom Ash Pond	4		$ 28,400	1.0	130.5		$ 15,953.63
Plant	D4 Pond	7		$ 49,700	1.8	130.5		$ 27,918.84
Plant	Units 3&4 Bottom Ash Pond Area	12.8		$ 90,880	3.2	130.5		$ 51,051.60
Plant	Units 1&2 CCR Solids Collection Basin					130.5		$ -
Plant	Former Units 1&2 Bottom Ash Ponds	9.5		$ 67,450	2.4	130.5		$ 37,889.86
Plant	Cooling Tower Blowdown Pond C North				2.5	130.5		$ 39,884.06
Plant	Cooling Tower Blowdown Pond C South				2.6	130.5		$ 41,878.27
SOEP / STEP	Proposed CCR Landfill				24.3	130.5	$ 75.00	$ 386,875.41
Plant	Proposed CCR Landfill				8.3	130.5		$ 132,415.09
Notes		Grading cost based on production rate of D10T2 Dozer with a daily equipment cost of $5,000 per day and labor cost of $1,000 per day based on median heavy equipment operator salary. Seeding cost is $3,300/acre.					Assume water trucks spray application costs $75/acre day and dust control is required half of the year (261 working days).	
References		1, 11, 13, 14, 20					5,10	

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Capital Cost									
		Direct Capital					Project Startup/Construction Management/ Health and Safety				
Location	Wastewater Facility	Direct Capital Total	Contingency	Discount Rate	Area Cost Factor	Total Direct Capital Cost	Engineering/Design/ Management (6%)	Construction Management/ Health and Safety (5%)	Mobilization/Demobilization (2%)	Total PM Cost	Total Capital Cost (2018$)
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	$ 98,738,521				$ 120,460,996	$ 7,227,660	$ 6,023,050	$ 2,409,220	$ 15,659,929	$ 136,120,925
SOEP / STEP	Units 1&2 STEP Cell A	$ 55,832,372				$ 68,115,494	$ 4,086,930	$ 3,405,775	$ 1,362,310	$ 8,855,014	$ 76,970,508
SOEP / STEP	Units 1&2 STEP Cell D	$ 5,756,329	25%	7%	4%	$ 7,022,721	$ 421,363	$ 351,136	$ 140,454	$ 912,954	$ 7,935,675
SOEP / STEP	Units 1&2 STEP Cell E	$ 41,231,899				$ 50,302,917	$ 3,018,175	$ 2,515,146	$ 1,006,058	$ 6,539,379	$ 56,842,296
SOEP / STEP	Units 1&2 STEP Old Clearwell	$ 8,206,295				$ 10,011,680	$ 600,701	$ 500,584	$ 200,234	$ 1,301,518	$ 11,313,198
EHP	A Cell (South portion)	$ 26,394				$ 32,201	$ 1,932	$ 1,610	$ 644	$ 4,186	$ 36,387
EHP	A Cell (North portion-New Clearwell)	$ -				$ -	$ -	$ -	$ -	$ -	$ -
EHP	B Cell (Clearwell)	$ 8,707,178				$ 10,622,758	$ 637,365	$ 531,138	$ 212,455	$ 1,380,958	$ 12,003,716
EHP	C Cell	$ 16,740,234				$ 20,423,086	$ 1,225,385	$ 1,021,154	$ 408,462	$ 2,655,001	$ 23,078,087
EHP	D/E Cell	$ 8,784,396	25%	7%	4%	$ 10,716,963	$ 643,018	$ 535,848	$ 214,339	$ 1,393,205	$ 12,110,168
EHP	F Cell	$ 31,554				$ 38,496	$ 2,310	$ 1,925	$ 770	$ 5,004	$ 43,500
EHP	G Cell	$ 11,630,842				$ 14,189,627	$ 851,378	$ 709,481	$ 283,793	$ 1,844,652	$ 16,034,279
EHP	H Cell	$ 275,444				$ 336,042	$ 20,163	$ 16,802	$ 6,721	$ 43,685	$ 379,728
EHP	J Cell	$ 12,827,384				$ 15,649,409	$ 938,965	$ 782,470	$ 312,988	$ 2,034,423	$ 17,683,832
Plant	Units 1&2 Flyash A Pond	$ 10,412,255				$ 12,702,951	$ 762,177	$ 635,148	$ 254,059	$ 1,651,384	$ 14,354,335
Plant	Units 1&2 Flyash B Pond	$ 8,354,505				$ 10,192,496	$ 611,550	$ 509,625	$ 203,850	$ 1,325,025	$ 11,517,521
Plant	Units 1&2 Bottom Ash Pond	$ 849,455				$ 1,036,335	$ 62,180	$ 51,817	$ 20,727	$ 134,724	$ 1,171,059
Plant	D4 Pond	$ 499,349				$ 609,206	$ 36,552	$ 30,460	$ 12,184	$ 79,197	$ 688,403
Plant	Units 3&4 Bottom Ash Pond Area	$ 1,413,036	25%	7%	4%	$ 1,723,904	$ 103,434	$ 86,195	$ 34,478	$ 224,107	$ 1,948,011
Plant	Units 1&2 CCR Solids Collection Basin	$ 141,032				$ 172,059	$ 10,324	$ 8,603	$ 3,441	$ 22,368	$ 194,427
Plant	Former Units 1&2 Bottom Ash Ponds	$ 529,570				$ 646,075	$ 38,765	$ 32,304	$ 12,922	$ 83,990	$ 730,065
Plant	Cooling Tower Blowdown Pond C North	$ 1,299,884				$ 1,585,859	$ 95,152	$ 79,293	$ 31,717	$ 206,162	$ 1,792,020
Plant	Cooling Tower Blowdown Pond C South	$ 1,364,878				$ 1,665,151	$ 99,909	$ 83,258	$ 33,303	$ 216,470	$ 1,881,621
SOEP / STEP	Proposed CCR Landfill	$ 81,693,728	25%	7%	4%	$ 99,666,348	$ 5,979,981	$ 4,983,317	$ 1,993,327	$ 12,956,625	$ 112,622,973
Plant	Proposed CCR Landfill	$ 23,449,973				$ 28,608,967	$ 1,716,538	$ 1,430,448	$ 572,179	$ 3,719,166	$ 32,328,133
Notes											Capital Costs are represented in 2018$ by applying RSMeans cost Index by each construction activity by reference year.
References			6	8	7		8	8,6	1		

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Dewatering O&M				Post Closure O&M					
		Extraction Well (10 GPM)				General Inspections			Cover System Misc Maint & Repairs		
Location	**Wastewater Facility**	**Well Depth (ft)**	**Well Depth (ft)**	**Unit Cost Per Well ($/Depth)**	**Cost ($/yr)**	**Area (Acre)**	**Unit Cost ($/Acre)**	**Cost ($/yr)**	**Area (Acre)**	**Unit Cost**	**Cost ($/yr)**
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	60	4	Cost (Per Well) = ($6 x GW Depth) + $5,207	$ 33,402	0.0	$ 60	$ -	0	Cost = ($3,500 x Area)	FALSE
SOEP / STEP	Units 1&2 STEP Cell A	52	12		$ 99,342	0.0		$ -	0		FALSE
SOEP / STEP	Units 1&2 STEP Cell D	0	0		$ -	25.7		$ 1,542.00	26		$ 89,950
SOEP / STEP	Units 1&2 STEP Cell E	60	10		$ 83,505	0.0		$ -	0		FALSE
SOEP / STEP	Units 1&2 STEP Old Clearwell	70	2		$ 16,881	0.0		$ -	0		FALSE
EHP	A Cell (South portion)	30	1	Cost (Per Well) = ($6 x GW Depth) + $5,207	$ 8,081		$ 60	$ -	0	Cost = ($3,500 x Area)	
EHP	A Cell (North portion-New Clearwell)	0	0		$ -						
EHP	B Cell (Clearwell)	0	0		$ -	39.0		$ 2,340.00	39		$ 136,500
EHP	C Cell	110	1		$ 8,801	74.9		$ 4,494.00	75		$ 262,150
EHP	D/E Cell	55	1		$ 8,306	39.2		$ 2,352.00	39		$ 137,200
EHP	F Cell	50	1		$ 8,261	0.0		$ -	0		FALSE
EHP	G Cell	90	2		$ 17,241	51.8		$ 3,108.00	52		$ 181,300
EHP	H Cell	31	1		$ 8,085	0.0		$ -	0		FALSE
EHP	J Cell	130	2		$ 17,961	57.1		$ 3,426.00	57		$ 199,850
Plant	Units 1&2 Flyash A Pond	20	4	Cost (Per Well) = ($6 x GW Depth) + $5,207	$ 31,962	0.0	$ 60	$ -	0	Cost = ($3,500 x Area)	FALSE
Plant	Units 1&2 Flyash B Pond	33	4		$ 32,430	0.0		$ -	0		FALSE
Plant	Units 1&2 Bottom Ash Pond	6	0		$ -	0.0		$ -	0		FALSE
Plant	D4 Pond	0	0		$ -	0.0		$ -	0		FALSE
Plant	Units 3&4 Bottom Ash Pond Area	3	0		$ -	0.0		$ -	0		FALSE
Plant	Units 1&2 CCR Solids Collection Basin	0	0		$ -	0.0		$ -	0		FALSE
Plant	Former Units 1&2 Bottom Ash Ponds	1	0		$ -	0.0		$ -	0		FALSE
Plant	Cooling Tower Blowdown Pond C North	0	0		$ -	0.0		$ -	0		FALSE
Plant	Cooling Tower Blowdown Pond C South	0	0		$ -	0.0		$ -	0		FALSE
SOEP / STEP	Proposed CCR Landfill		0	Cost (Per Well) = ($6 x GW Depth) + $5,207		97.0	$ 60.00	$ 5,820.00	97.0	Cost = ($3,500 x Area)	$ 339,500
Plant	Proposed CCR Landfill		0			33.2		$ 1,992.00	33.2		$ 116,200
Notes									assumes 10% of cover system repaired/maintained per year. Unit cost derived from references on a per acre basis.		
References				2			11			11, 14, 15	

Table 4-4: Colstrip Alternative 2 NPRC Doing It Right Cost Calculations

		Post Closure O&M									
		Collection System/Capture Well System Mai			Surface water/Stormwater Management						
Location	Wastewater Facility	Area (Acre)	Unit Cost ($/Acre)	Cost ($/yr)	Area (Acre)	Unit Cost ($/Acre)	Cost ($/yr)	Direct O&M Total ($/yr)	Project Management (6%)	Contingency (10%)	Total Annual Post-Closure Care O&M Cost
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	1.32	$ 5,800	$ 6,873	1.32	$ 450	$ 594	$ 7,467	$ 448	$ 747	**$ 8,662**
SOEP / STEP	Units 1&2 STEP Cell A			$ -			$ -	$ -	$ -	$ -	**$ -**
SOEP / STEP	Units 1&2 STEP Cell D	25.7	$ 5,800	$ 149,060	25.7		$ 11,565	$ 252,117	$ 15,127	$ 25,212	**$ 292,456**
SOEP / STEP	Units 1&2 STEP Cell E			$ -			$ -	$ -	$ -	$ -	**$ -**
SOEP / STEP	Units 1&2 STEP Old Clearwell			$ -			$ -	$ -	$ -	$ -	**$ -**
EHP	A Cell (South portion)		$ 5,800			$ 450					**$ 129,000**
EHP	A Cell (North portion-New Clearwell)										
EHP	B Cell (Clearwell)	39.0		$ 226,200	39.0		$ 17,550	$ 382,590	$ 22,955	$ 38,259	**$ 443,804**
EHP	C Cell	74.9		$ 434,420	74.9		$ 33,705	$ 734,769	$ 44,086	$ 73,477	**$ 852,332**
EHP	D/E Cell			$ -	39.2		$ 17,640	$ 157,192	$ 9,432	$ 15,719	**$ 182,343**
EHP	F Cell			$ -	59.2		$ 26,640	$ 26,640	$ 1,598	$ 2,664	**$ 30,902**
EHP	G Cell	51.8		$ 300,440	51.8		$ 23,310	$ 508,158	$ 30,489	$ 50,816	**$ 589,463**
EHP	H Cell			$ -	49.9		$ 22,455	$ 22,455	$ 1,347	$ 2,246	**$ 26,048**
EHP	J Cell	57.1		$ 331,180	57.1		$ 25,695	$ 560,151	$ 33,609	$ 56,015	**$ 649,775**
Plant	Units 1&2 Flyash A Pond		$ 5,800	$ -		$ 450	$ -	$ -	$ -	$ -	**$ -**
Plant	Units 1&2 Flyash B Pond			$ -			$ -	$ -	$ -	$ -	**$ -**
Plant	Units 1&2 Bottom Ash Pond			$ -			$ -	$ -	$ -	$ -	**$ -**
Plant	D4 Pond			$ -			$ -	$ -	$ -	$ -	**$ -**
Plant	Units 3&4 Bottom Ash Pond Area			$ -			$ -	$ -	$ -	$ -	**$ -**
Plant	Units 1&2 CCR Solids Collection Basin			$ -			$ -	$ -	$ -	$ -	**$ -**
Plant	Former Units 1&2 Bottom Ash Ponds	0.0		$ -			$ -	$ -	$ -	$ -	**$ -**
Plant	Cooling Tower Blowdown Pond C North	10.0		$ 58,000	10.0		$ 4,500	$ 62,500	$ 3,750	$ 6,250	**$ 72,500**
Plant	Cooling Tower Blowdown Pond C South	10.5		$ 60,900	10.5		$ 4,725	$ 65,625	$ 3,938	$ 6,563	**$ 76,125**
SOEP / STEP	Proposed CCR Landfill	97.0	$ 5,800.00	$ 562,600	97.0	$ 450	$ 43,650	$ 907,920	$ 54,475	$ 90,792	**$ 1,053,187**
Plant	Proposed CCR Landfill	33.2		$ 192,560	33.2		$ 14,940	$ 310,752	$ 18,645	$ 31,075	**$ 360,472**
Notes		Unit cost derived from references on a per acre basis.			Unit cost derived from references on a per acre basis.						
References			11, 12, 13, 17			12, 13, 16,18			12	12	

Table 4-5: Colstrip Jobs Comparison

Year	Alternative 1. Talen Proposal			Alternative 2. NPRC's Doing It Right Proposal		
	Closure Plan	Total Construction FTE	Total Annual O&M FTE	Closure Plan	Total Construction FTE	Total Annual O&M FTE
2016	Cap in place of all CCR ponds (37,889,000 cubic yards of CCR). Groundwater corrective action using 30-years of capture and treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.			Removal of 8,679,000 cubic yards of CCR in ponds which are in contact with groundwater to two new CCR landfills. Cap-in-place of 29,210,000 cubic yards CCR in ponds which are not in contact with groundwater. Active dewatering of CCR pore water. Groundwater corrective action using 30-years of capture and water treatment combined with in situ flushing. Additional groundwater remedy and/or institutional controls may be needed and will be evaluated as work progresses.		
2017		2	1		2	1
2018			1			1
2019		20	4		14	1
2020		21	21		257	29
2021		11	23		8	35
2022		47	27		40	34
2023		17	38		158	35
2024		19	41		51	44
2025			41			49
2026			41			49
2027			38			49
2028			38		150	46
2029			36			46
2030			36			44
2031			36			44
2032			36			44
2033			36			44
2034			36			44
2035			36			44
2036			36			44
2037			36			44
2038			36			44
2039			35			44
2040		43	41		51	41
2041		2	41		2	53
2042			41			56
2043			41			56
2044			41			56
2045			41			56
2046			41			56
2047			41			56
2048			41			56
2049			35			52
2050			34			51
2051			34			51
2052			32			49
2053			32			49
2054			32			49
2055			32			49
2056			32			49
2057			32			49
2058			32			49
2059			32			49
2060			31			48
2061			31			48
2062			31			48
2063			31			48
2064			31			48
2065			31			48
2066			31			48
2067			31			48
2068			31			48
2069			31			48
	Total FTE	183		Total FTE	734	

Table 4-6: Colstrip Alternative 1 Talen Jobs Calculations

Closure and Groundwater Remedy Matrix				Construction Job Calculations															
				Surveying					Dewatering							Dust Control			
Location	Wastewater Facility	Closure Activities	Remedy Duration (Yrs)	Area (Acres)	Rate (acre/day)	Surveying Duration (Days)	Professional Land Surveyor FTE	PLS Assistant FTE	Number of Wells	Well Drilling Rate (#Wells/ week)	Total Well Drilling Duration (Weeks)	Certified Well Driller FTE	Laborer - Well Drilling Assistant FTE	Laborer - Pump Installer FTE	Laborer - Conveyance System Installer FTE	Acres	Water Truck Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	None. Use existing engineered ET cap.	1																
SOEP / STEP	Units 1&2 STEP Cell A	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	42.1	8	5.2625	0.06	0.04								42.10	0.65	0.129	0.129
SOEP / STEP	Units 1&2 STEP Cell D	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary. Pond slowly drains into leachate collection system.	1	25.7	8	3.2125	0.04	0.02								25.70	0.39	0.079	0.079
SOEP / STEP	Units 1&2 STEP Cell E	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	46.8	8	5.85	0.07	0.04								46.80	0.72	0.143	0.143
SOEP / STEP	Units 1&2 STEP Old Clearwell	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	10.9	8	1.3625	0.02	0.01								10.90	0.17	0.033	0.033
SOEP / STEP	STEP B Cell	Continue to use as Clearwell. When there is no longer need to store decant water it will be dewatered, the liner cleaned, and used for stormwater management. Assumed to be dewatered and dry post closure.	1																
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam		1																
SOEP / STEP	Vertical or angled capture wells		1																
SOEP / STEP	Vertical or angled capture wells		1																
SOEP / STEP	In-Situ Flushing System		1																
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond	CCR material, water, and liner will be removed to the active EHP cell. Area graded and reclaimed with veg.	1	16.8	8	2.1	0.02	0.02											
EHP	A Cell (South portion)	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	25.6	8	4	0.06	0.04								45.60	0.70	0.140	0.140
EHP	A Cell (North portion-New Clearwell)	Existing Type III cap over CCR stays. Dewater cell and use for future storm water mgt.	1																
EHP	B Cell (Clearwell)	Existing Type I cover over CCR stays. Type IV final cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	39	8	4.9	0.06	0.04								39.00	0.60	0.120	3.000
EHP	C Cell	Type II cap over CCR planned for 2023, then overfill until full and Type IV cap.	1	74.9	8	9.4	0.11	0.07								74.90	1.15	0.230	0.230
EHP	D/E Cell	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	39.2	8	4.9	0.06	0.04								39.20	0.60	0.120	0.120
EHP	F Cell	Existing RPP composite liner system and liquid collection system stays. Final closure is dewater cell and use for future storm water mgt and captured groundwater storage.	1	59.2	8	7.4	0.09	0.06								59.20	0.91	0.181	0.181
EHP	G Cell	Type II cap over CCR planned for 2019, then overfill until full and Type IV cap.	1	51.8	8	6.5	0.07	0.05								51.80	0.79	0.159	0.159
EHP	H Cell	Existing double-RPP liner and liquid collection system stays. Final closure is dewater cell and use for future storm water mgt.	1	49.9	8	6.2	0.07	0.05								49.90	0.76	0.153	0.153
EHP	J Cell	Existing Type II cap over CCR, then overfill until full and Type IV cap.	1	57.1	8	7.1	0.08	0.05								57.10	0.88	0.175	0.175
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5	CCR material, water, and liner will be removed to the active EHP cell. Area graded and reclaimed with veg.	1	0.75	8	0.09	0.001	0.00								0.75	0.01	0.002	0.002
Plant	Units 1&2 Flyash A Pond	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary. Evaluate dewatering potential, but not part of current plan.	1	14	8	1.75	0.02	0.01								14.00	0.21	0.043	0.043
Plant	Units 1&2 Flyash B Pond	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	10	8	1.25	0.01	0.01								10.00	0.15	0.031	0.031
Plant	Units 1&2 Bottom Ash Pond	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	4	8	0.5	0.01	0.00								4.00	0.06	0.012	0.012
Plant	D4 Pond	None. Previously closed per MDEQ approval	1																
Plant	Units 3&4 Bottom Ash Pond Area	Type IV cap. Geocomposite drainage layer and/or a geotextile cushion if necessary.	1	12.8	8	1.6	0.02	0.01								12.80	0.20	0.039	0.039
Plant	Units 1&2 CCR Solids Collection Basin	None given.	1																
Plant	Former Units 1&2 Bottom Ash Ponds	Finish excavation of CCR, sample soil underneath to determine if it needs to be removed. Area will be used for new Groundwater Capture Well Storage Pond.	1	9.5	8	1.2	0.01	0.01								9.50	0.15	0.029	0.029
Plant	Cooling Tower Blowdown Pond C North	Water will be removed. Soil sampling will be conducted beneath the pond after water is removed. Area graded and reclaimed with vegetation.	1	10	8	1.3	0.01	0.01								10.00	0.15	0.031	0.031
Plant	Cooling Tower Blowdown Pond C South	Water will be removed. Soil sampling will be conducted beneath the pond after water is removed. Area graded and reclaimed with vegetation.	1	10.5	8	1.3	0.02	0.01								10.50	0.16	0.032	0.032
Plant	Construct 50 New Vertical Injection Wells		1						50	1	50	1.00	1.00	2.00	4.00				
Plant	Construct 3 New Vertical Capture Wells in Alluvium		1						3	1	3	0.06	0.06	0.12	0.24				
Plant	Construct 2 New Horizontal Capture Wells		1						2	1	2	0.04	0.04	0.08	0.16				
Plant	Convert 4 Existing Capture Wells to Injection Wells		1						4	1	4	0.08	0.08	0.16	0.32				
Plant	Units 3&4 North Plant Area Drain	Remove water and liner. Area graded and reclaimed with veg.	1	1	8	0.125	0.00	0.0010								1	0.02	0.003	0.003
Plant	Units 3&4 Wash Tray Pond	Remove water. Area graded and reclaimed with veg.	1	8	8	1	0.01	0.0077								8	0.12	0.025	0.025
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)	Remove water. Area graded and reclaimed with veg.	1	6	8	0.75	0.01	0.0057								6	0.09	0.018	0.018
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)	Remove water and liner. Area graded and reclaimed with veg.	1	3.6	8	0.45	0.01	0.0034								3.6	0.06	0.011	0.011
Plant	Units 1-4 North Plant Sediment Retention Pond	Remove water and liner. Area graded and reclaimed with veg.	1	1.2	8	0.15	0.00	0.0011								1.2	0.02	0.004	0.004
Notes/Assumptions					Contractor Quote		Assumes two-person surveying team which includes 1 PLS and assistant per team. Additionally one PLS for data processing and drafting. Calculated based on a 261-day working year.			Assumed		Assumes 1 certified well driller, 1 laborer to assist with drilling, two laborers to install pumps, and 4 laborers to install piping and conveyance system. Calculated based on a 50-week working year.							

Table 4-6: Colstrip Alternative 1 Talen Jobs Calculations

		Construction Job Calculations																					
		Excavation/Backfill							In-Situ Stabilization/Solidification				Federal CCR Rule Compliant Cover System										
Location	Wastewater Facility	Excavation Volume (CY)	Excavator Operator FTE	Articulated Truck Operator FTE	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	ISS Volume (ISS)	Auger Operator FTE	Auger Assistant Laborer FTE	Cement/Mix Truck Operator	Cap Area (Acres)	Cap Construction Duration (Years)	Earthen Material Volume (CY)	Topsoil Material Volume (CY)]	Excavator Operator FTE	Articulated Truck Operator FTE	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Liner Installation, Surface Water Runoff Collection Installation Laborer FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)																						
SOEP / STEP	Units 1&2 STEP Cell A												42	1	67,921	33,975	0.13	1.00	0.13	0.125	0.275	0.3	5.0
SOEP / STEP	Units 1&2 STEP Cell D												26	1	41,463	20,740	0.08	0.61	0.08	0.076	0.168	0.2	3.1
SOEP / STEP	Units 1&2 STEP Cell E												47	1	75,504	37,768	0.14	1.11	0.14	0.139	0.306	0.3	5.6
SOEP / STEP	Units 1&2 STEP Old Clearwell												11	1	17,585	8,796	0.03	0.26	0.03	0.032	0.071	0.1	1.3
SOEP / STEP	STEP B Cell																						
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam																						
SOEP / STEP	Vertical or angled capture wells																						
SOEP / STEP	Vertical or angled capture wells																						
SOEP / STEP	In-Situ Flushing System																						
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond																						
EHP	A Cell (South portion)												0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
EHP	A Cell (North portion-New Clearwell)																						
EHP	B Cell (Clearwell)												39	1	62,920	31,473	0.12	0.93	0.12	0.116	0.255	0.3	4.6
EHP	C Cell												75	1	120,838	60,444	0.22	1.78	0.22	0.223	0.490	0.5	8.9
EHP	D/E Cell												39	1	63,243	31,634	0.12	0.93	0.12	0.117	0.256	0.3	4.7
EHP	F Cell																						
EHP	G Cell												52	1	83,570	41,803	0.15	1.23	0.15	0.154	0.339	0.3	6.2
EHP	H Cell																						
EHP	J Cell												57	1	92,121	46,080	0.17	1.36	0.17	0.170	0.373	0.4	6.8
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5																						
Plant	Units 1&2 Flyash A Pond												14	1	22,587	11,298	0.04	0.33	0.04	0.042	0.092	0.1	1.7
Plant	Units 1&2 Flyash B Pond												10	1	16,133	8,070	0.03	0.24	0.03	0.030	0.065	0.1	1.2
Plant	Units 1&2 Bottom Ash Pond												4	1	6,453	3,228	0.01	0.10	0.01	0.012	0.026	0.0	0.5
Plant	D4 Pond																						
Plant	Units 3&4 Bottom Ash Pond Area												13	1	20,651	10,330	0.04	0.30	0.04	0.038	0.084	0.1	1.5
Plant	Units 1&2 CCR Solids Collection Basin																						
Plant	Former Units 1&2 Bottom Ash Ponds	20,167	0.025	0.198	0.025	0.0	0.054	0.054															
Plant	Cooling Tower Blowdown Pond C North																						
Plant	Cooling Tower Blowdown Pond C South																						
Plant	Construct 50 New Vertical Injection Wells																						
Plant	Construct 3 New Vertical Capture Wells in Alluvium																						
Plant	Construct 2 New Horizontal Capture Wells																						
Plant	Convert 4 Existing Capture Wells to Injection Wells																						
Plant	Units 3&4 North Plant Area Drain																						
Plant	Units 3&4 Wash Tray Pond																						
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)																						
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)																						
Plant	Units 1-4 North Plant Sediment Retention Pond																						
Notes/Assumptions			Calculated based on production rate of a Cat 374F Excavator. Assumes 261 working days per year and 8 hour work days.	Calculated based on a tailgate struck capacity of a CAT 745C with a cycle time of 15 minutes	Calculated based on a production rate of a CAT D10T2 Dozer with a average dozing distance of 400'	Calculated based on a production rate of a CAT CS79 B Roller	2 mechanics per 10 operators	1 construction laborer per 5 heavy equipment operators		Assume a production rate of 600 CY/day and 261 working days per year.	Assumes 2 laborers per drill rig	Assumes one cement/mix truck operator per drill rig.			12" of Earthen Material equates to 1613.33 CY per Acre	6" of Earthen Material 807 CY per Acre	Calculated based on production rate of a Cat 374F Excavator. Assumes 261 working days per year and 8 hour work days. Excavator needed to harvest clean on-site fill	Calculated based on a tailgate struck capacity of a CAT 745C with a cycle time of 15 minutes	Calculated based on a production rate of a CAT CS79 B Roller	Calculated based on a production rate of a CAT D10T2 Dozer.	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators.	Assume 21-worker crew can install 1 acre of HDPE liner and geocomposite liner per day plus 10 workers to construct the surface water runoff system.

Construction Job Calculations

Location	Wastewater Facility	Federal CCR Rule Compliant Liner System							Reclamation			
		Liner Area (acre)	Liner Construction Duration (Years)	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Liner Installation, Leachate Collection Laborer FTE	Area (acre)	Dozer Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)											
SOEP / STEP	Units 1&2 STEP Cell A											
SOEP / STEP	Units 1&2 STEP Cell D											
SOEP / STEP	Units 1&2 STEP Cell E											
SOEP / STEP	Units 1&2 STEP Old Clearwell											
SOEP / STEP	STEP B Cell											
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam											
SOEP / STEP	Vertical or angled capture wells											
SOEP / STEP	Vertical or angled capture wells											
SOEP / STEP	In-Situ Flushing System											
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond								16.80	0.06	0.01	0.1
EHP	A Cell (South portion)											
EHP	A Cell (North portion-New Clearwell)											
EHP	B Cell (Clearwell)											
EHP	C Cell											
EHP	D/E Cell											
EHP	F Cell											
EHP	G Cell											
EHP	H Cell											
EHP	J Cell											
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5								0.75	0.003	0.001	0.006
Plant	Units 1&2 Flyash A Pond											
Plant	Units 1&2 Flyash B Pond											
Plant	Units 1&2 Bottom Ash Pond											
Plant	D4 Pond											
Plant	Units 3&4 Bottom Ash Pond Area											
Plant	Units 1&2 CCR Solids Collection Basin											
Plant	Former Units 1&2 Bottom Ash Ponds	9.5	1	0.035	0.009	0.009	0.009	1.13				
Plant	Cooling Tower Blowdown Pond C North								10.00	0.04	0.01	0.1
Plant	Cooling Tower Blowdown Pond C South								10.50	0.04	0.01	0.1
Plant	Construct 50 New Vertical Injection Wells											
Plant	Construct 3 New Vertical Capture Wells in Alluvium											
Plant	Construct 2 New Horizontal Capture Wells											
Plant	Convert 4 Existing Capture Wells to Injection Wells											
Plant	Units 3&4 North Plant Area Drain								1.00	0.004	0.001	0.01
Plant	Units 3&4 Wash Tray Pond								8.00	0.03	0.01	0.1
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)								6.00	0.02	0.004	0.1
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)								3.60	0.01	0.003	0.03
Plant	Units 1-4 North Plant Sediment Retention Pond								1.20	0.004	0.001	0.01
Notes/Assumptions				Assume 1' depth of grading per area. Calculated based on production rate of D10T2 Dozer.	Assume 1' depth per area requires compaction. Calculated based on a production rate of a CAT D10T2 Dozer.		Assume 1 construction laborer per 2 heavy equipment operators.	Assume 21-worker crew can install 1 acre of HDPE liner (double layer) per day plus 10 workers to construct the leachate collection system.		Assume 2' depth of grading per area. Calculated based on production rate of D10T2 Dozer.	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators. Assume 1 laborer can hydroseed 0.5 acres per day.

Table 4-6: Colstrip Alternative 1 Talen Jobs Calculations

		Construction Job Totals Summary								
		Skilled Labor			Unskilled Labor	Professional				
Location	Wastewater Facility	Certified Well Driller FTE	Skilled Laborer FTE	Heavy Equipment Operator FTE	Construction Laborer FTE	Professional Land Surveyor FTE	Construction Manager FTE	Health/Safety Manager FTE	Engineer/Planner/Estimator/Designer/Management FTE	Total Construction Jobs FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)									
SOEP / STEP	Units 1&2 STEP Cell A	0.0	7	2.5	0.5	0.1	1.0	1.0	1.5	13.4
SOEP / STEP	Units 1&2 STEP Cell D	0.0	4	1.5	0.3	0.05	0.6	0.6	1.5	8.8
SOEP / STEP	Units 1&2 STEP Cell E	0.0	8	2.8	0.6	0.1	1.1	1.1	1.5	14.7
SOEP / STEP	Units 1&2 STEP Old Clearwell	0.0	2	0.7	0.1	0.02	0.3	0.3	1.5	4.6
SOEP / STEP	STEP B Cell								1.5	1.5
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam	0.0	0	1	1.0	0.00	0.2	0.2	0.4	2.8
SOEP / STEP	Vertical or angled capture wells	0.0	0	1	1.0	0.00	0.2	0.2	0.2	2.0
SOEP / STEP	Vertical or angled capture wells	0.0	0	1	1.0	0.00	0.2	0.2	0.4	2.8
SOEP / STEP	In-Situ Flushing System	0.0	0	1	1.0	0.00	0.2	0.2	1.0	3.4
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond	0.0	0.04	0.08	0.2	0.03	0.0	0.0	1.5	1.9
EHP	A Cell (South portion)	0.00	0	0.9	0.2	0.08	0.1	0.1	0.24	1.9
EHP	A Cell (North portion-New Clearwell)									
EHP	B Cell (Clearwell)	0	6	2.3	4.1	0.1	1	1	1.6	16.9
EHP	C Cell	0.00	12	4.5	0.9	0.1	2	2	2.3	23.4
EHP	D/E Cell	0.00	6	2.4	0.5	0.1	1	1	2.0	13.0
EHP	F Cell	0.00	0	1.1	0.2	0.1	0.2	0.2		2.1
EHP	G Cell	0.0	8	3.1	0.6	0.1	1	1	0.5	15.2
EHP	H Cell	0.00	0	1.0	0.2	0.1	0.1	0.1		1.8
EHP	J Cell	0.0	9	3.4	0.7	0.1	1	1	2.4	18.5
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5		0.004	0.018	0.011	0.001	0.003	0.003		0.04
Plant	Units 1&2 Flyash A Pond	0.0	2	0.8	0.2	0.03	0	0	0.14	4
Plant	Units 1&2 Flyash B Pond	0.0	2	0.6	0.1	0.02	0	0	0.8850	4
Plant	Units 1&2 Bottom Ash Pond	0	1	0.2	0.0	0.01	0.1	0.1	0.6000	2
Plant	D4 Pond		0							
Plant	Units 3&4 Bottom Ash Pond Area	0	2	0.8	0.2	0.02	0.3	0.3	1.0200	5
Plant	Units 1&2 CCR Solids Collection Basin		0							
Plant	Former Units 1&2 Bottom Ash Ponds	0	2	0.6	0.1	0.02	0.2	0.2	0.6000	3
Plant	Cooling Tower Blowdown Pond C North	0	0.06	0.24	0.1	0.02	0.0	0.0	0.2610	1
Plant	Cooling Tower Blowdown Pond C South	0	0.06	0.25	0.2	0.02	0.0	0.0	0.3230	1
Plant	Construct 50 New Vertical Injection Wells		9				0.9	0.9	0.35	10.9
Plant	Construct 3 New Vertical Capture Wells in Alluvium		1				0.1	0.1	0.02	0.7
Plant	Construct 2 New Horizontal Capture Wells		0				0.04	0.04	0.44	0.9
Plant	Convert 4 Existing Capture Wells to Injection Wells		1				0.1	0.1	0.01	0.8
Plant	Units 3&4 North Plant Area Drain		0.01	0.02	0.01	0.002	0.005	0.005	0.07	0.1
Plant	Units 3&4 Wash Tray Pond		0.05	0.19	0.1	0.01	0.04	0.04	0.21	0.6
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)		0.04	0.14	0.1	0.01	0.03	0.03	0.16	0.5
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)		0.02	0.09	0.1	0.01	0.02	0.02	0.23	0.4
Plant	Units 1-4 North Plant Sediment Retention Pond		0.01	0.03	0.02	0.002	0.01	0.01	0.02	0.1
Notes/Assumptions		25% contingency applied	Includes PLS assistants, well drilling assistants, pump and conveyance system installers, heavy machinery mechanics auger assistant laborers, liner installers, surface runoff collection installers, and leachate collection system installers. 25% contingency applied.	Includes Excavator operators, truck drivers, dozer operators, drum compactor operators, auger operators, and cement truck drivers. 25% contingency applied.	Includes unskilled laborers to assist with construction efforts 25% contingency applied.	25% contingency applied	Assumes 1 construction manager per 10 employees	Assumes 1 health/safety manager per 10 employees	Assumes median salary of $100,000/yr with an increase of 100% to account for taxes, benefits, space, equipment, and materials.	

Table 4-6: Colstrip Alternative 1 Talen Jobs Calculations

		Post Closure O&M Job Calculations							
		Dewatering	Inspections	Leachate Collection System/Capture Well System Maintenance	Cap Maintenance		Surface/Storm Water Management	Project Management	
Location	**Wastewater Facility**	**Skilled Laborer FTE**	**Environmental Scientist FTE**	**Environmental Technician FTE**	**Heavy Equipment Operator FTE**	**Construction Laborer FTE**	**Construction Laborer FTE**	**Engineer/Project Manager FTE**	**Total Annual O&M Jobs FTE**
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)								
SOEP / STEP	Units 1&2 STEP Cell A		0.01		0.2	0.6	0.1	0.03	0.9
SOEP / STEP	Units 1&2 STEP Cell D		0.00	0.2	0.0	0.1	0.0	0.02	0.5
SOEP / STEP	Units 1&2 STEP Cell E		0.01		0.2	0.6	0.1	0.04	1.0
SOEP / STEP	Units 1&2 STEP Old Clearwell		0.00		0.0	0.1	0.0	0.01	0.2
SOEP / STEP	STEP B Cell								NA
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam			0.8	0.1			0.04	0.9
SOEP / STEP	Vertical or angled capture wells			1.2	0.1			0.04	1.3
SOEP / STEP	Vertical or angled capture wells			1.2	0.1			0.04	1.3
SOEP / STEP	In-Situ Flushing System				0.1			0.04	NA
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond								NA
EHP	A Cell (South portion)		0.02		0.3	0.9	0.2	0.05	1.4
EHP	A Cell (North portion-New Clearwell)								
EHP	B Cell (Clearwell)		0.03		0.5	1.5	0.3	0.08	2.3
EHP	C Cell		0.06		0.9	2.8	0.5	0.16	4.5
EHP	D/E Cell		0.03		0.5	1.5	0.3	0.08	2.3
EHP	F Cell						0.4	0.01	0.4
EHP	G Cell		0.04		0.6	1.9	0.4	0.11	3.1
EHP	H Cell						0.4	0.11	0.5
EHP	J Cell		0.05		0.7	2.1	0.4	0.12	3.4
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5								NA
Plant	Units 1&2 Flyash A Pond		0.00		0.1	0.2	0.0	0.01	0.3
Plant	Units 1&2 Flyash B Pond		0.00		0.1	0.2	0.0	0.01	0.3
Plant	Units 1&2 Bottom Ash Pond		0.00		0.0	0.1	0.0	0.01	0.2
Plant	D4 Pond								0.0
Plant	Units 3&4 Bottom Ash Pond Area		0.00		0.1	0.2	0.0	0.01	0.3
Plant	Units 1&2 CCR Solids Collection Basin								NA
Plant	Former Units 1&2 Bottom Ash Ponds								NA
Plant	Cooling Tower Blowdown Pond C North								NA
Plant	Cooling Tower Blowdown Pond C South								NA
Plant	Construct 50 New Vertical Injection Wells			0.4				0.08	0.5
Plant	Construct 3 New Vertical Capture Wells in Alluvium			0.4				0.08	0.5
Plant	Construct 2 New Horizontal Capture Wells			0.4				0.08	0.5
Plant	Convert 4 Existing Capture Wells to Injection Wells			0.4				0.08	0.5
Plant	Units 3&4 North Plant Area Drain								NA
Plant	Units 3&4 Wash Tray Pond								NA
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)								NA
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)								NA
Plant	Units 1-4 North Plant Sediment Retention Pond								NA
Notes/Assumptions		2 skilled laborer to service wells and pumps and 2 to service the conveyance system.	FTE based on median salary of an Environmental Scientist ($63,000/yr) with an increase of 100% to account for taxes, benefits, space, equipment, and materials. 25% contingency applied. Assume 100% of inspection budget consists of labor.	FTE based on median salary of an environmental technician ($40,580/yr) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Leachate collection maintenance and operation consists of cleaning, pump replacement and repair, flushing of collection and conveyance system, maintenance of collection and conveyance system.	FTE based on median salary of heavy equipment operator ($42,000) and median salary of a construction worker ($27,000) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor and there is two construction laborers for every heavy equipment operator.		FTE based on median salary of an construction laborer ($27,000/yr) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Maintenance includes cleanout and repair of water conveyance structures, down chutes, sediment basins, and outfalls.	Assumes median salary of $100,000/yr with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of budget consists of labor.	

Table 4-7: Colstrip Alternative 2 NPRC Doing It Right Jobs Calculations

Closure and Groundwater Remedy Matrix				Construction Job Calculations															
				Surveying					Dewatering							Dust Control			
Location	Wastewater Facility	Closure Activities	Remedy Duration (Yrs)	Area (Acres)	Rate (acre/day)	Surveying Duration (Days)	Professional Land Surveyor FTE	PLS Assistant FTE	Number of Wells	Well Drilling Rate (#Wells/ week)	Total Well Drilling Duration (Weeks)	Certified Well Driller FTE	Laborer - Well Drilling Assistant FTE	Laborer - Pump Installer FTE	Laborer - Conveyance System Installer FTE	Acres	Water Truck Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	CCR removal to new repository. Construct liner system and sump to manage stormwater.	1	114	8	14.25	0.16	0.1092	4	1	4	0.08	0.08	0.16	0.32	114.00	1.75	0.349	0.349
SOEP / STEP	Units 1&2 STEP Cell A	CCR removal to new repository.	1	42.1	8	5.2625	0.06	0.0403	12	1	12	0.24	0.24	0.48	0.96	42.10	0.65	0.129	0.129
SOEP / STEP	Units 1&2 STEP Cell D	Cap in place per Talen plan or never fill with CCR if not needed.	1	25.7	8	3.2125	0.04	0.0246	0	1	0	0.00	0.00	0.00	0.00	25.70	0.39	0.079	0.079
SOEP / STEP	Units 1&2 STEP Cell E	CCR removal to new repository.	1	46.8	8	5.85	0.07	0.0448	10	1	10	0.20	0.20	0.40	0.80	46.80	0.72	0.143	0.143
SOEP / STEP	Units 1&2 STEP Old Clearwell	CCR removal to new repository.	1	10.9	8	1.3625	0.02	0.0104	2	1	2	0.04	0.04	0.08	0.16	10.90	0.17	0.033	0.033
SOEP / STEP	STEP B Cell	Same as Talen's plan.	1																
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam	Same as Talen's plan.	1																
SOEP / STEP	Vertical or angled capture wells	Same as Talen's plan.	1																
SOEP / STEP	Vertical or angled capture wells	Same as Talen's plan.	1																
SOEP / STEP	In-Situ Flushing System	Same as Talen's plan.	1																
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond	Same as Talen's plan.	1																
EHP	A Cell (South portion)	Same as Talen's plan. Completed in 2017.	1						1	1	1	0.02	0.02	0.04	0.08				
EHP	A Cell (North portion-New Clearwell)	Use for future storm water management per Talen plan.	1																
EHP	B Cell (Clearwell)	Enhanced dewatering to reduce seepage; cap in place per Talen plan.	1	39	8	4.875	0.06	0.0374	0	1	0	0.00	0.00	0.00	0.00	39.00	0.60	0.120	0.120
EHP	C Cell	Enhanced dewatering to reduce seepage; cap in place per Talen plan.	1	74.9	8	9.3625	0.11	0.0717	1	1	1	0.02	0.02	0.04	0.08	74.90	1.15	0.230	0.230
EHP	D/E Cell	Enhanced dewatering to reduce seepage; cap in place per Talen plan.	1	39.2	8	4.9	0.06	0.0375	1	1	1	0.02	0.02	0.04	0.08	39.20	0.60	0.120	0.120
EHP	F Cell	Use for future storm water management per Talen plan.	1	59.2	8	7.4	0.09	0.0567	1	1	1	0.02	0.02	0.04	0.08	59.20	0.91	0.181	0.181
EHP	G Cell	Enhanced dewatering to reduce seepage; cap in place per Talen plan.	1	51.8	8	6.475	0.07	0.0496	2	1	2	0.04	0.04	0.08	0.16	51.80	0.79	0.159	0.159
EHP	H Cell	Enhanced dewatering to reduce seepage; use for future storm water management per Talen plan.	1	49.9	8	6.2375	0.07	0.0478	1	1	1	0.02	0.02	0.04	0.08	49.90	0.76	0.153	0.153
EHP	J Cell	Enhanced dewatering to reduce seepage; cap in place per Talen plan.	1	57.1	8	7.1375	0.08	0.0547	2	1	2	0.04	0.04	0.08	0.16	57.10	0.88	0.175	0.175
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5	Same as Talen's plan.	1																
Plant	Units 1&2 Flyash A Pond	CCR removal to new repository.	1	14	8	1.75	0.02	0.0134	4	1	4	0.08	0.08	0.16	0.32	14.00	0.21	0.043	0.043
Plant	Units 1&2 Flyash B Pond	CCR removal to new repository.	1	10	8	1.25	0.01	0.0096	4	1	4	0.08	0.08	0.16	0.32	10.00	0.15	0.031	0.031
Plant	Units 1&2 Bottom Ash Pond	CCR removal to new repository.	1	4	8	0.5	0.01	0.0038	0	1	0	0.00	0.00	0.00	0.00	4.00	0.06	0.012	0.012
Plant	D4 Pond	Contaminant removal to new repository.	1	7	8	0.875	0.01	0.0067	0	1	0	0.00	0.00	0.00	0.00	7.00	0.11	0.021	0.021
Plant	Units 3&4 Bottom Ash Pond Area	CCR removal to new repository.	1	12.8	8	1.6	0.02	0.0123	0	1	0	0.00	0.00	0.00	0.00	12.80	0.20	0.039	0.039
Plant	Units 1&2 CCR Solids Collection Basin	CCR removal to new repository.	1	neglible	8				0	1	0	0.00	0.00	0.00	0.00	neglible		0.000	0.000
Plant	Former Units 1&2 Bottom Ash Ponds	CCR removal to new repository.	1	9.5	8	1.1875	0.01	0.0091	0	1	0	0.00	0.00	0.00	0.00	9.50	0.15	0.029	0.029
Plant	Cooling Tower Blowdown Pond C North	Retrofit for storage of CCR dewatering flows.	1	10	8	1.25	0.01	0.0096	0	1	0	0.00	0.00	0.00	0.00	10.00	0.15	0.031	0.031
Plant	Cooling Tower Blowdown Pond C South	Retrofit for storage of CCR dewatering flows.	1	10.5	8	1.3125	0.02	0.0101	0	1	0	0.00	0.00	0.00	0.00	10.50	0.16	0.032	0.032
Plant	Construct 50 New Vertical Injection Wells	Same as Talen's plan.	1																
Plant	Construct 3 New Vertical Capture Wells in Alluvium	Same as Talen's plan.	1																
Plant	Construct 2 New Horizontal Capture Wells	Same as Talen's plan.	1																
Plant	Convert 4 Existing Capture Wells to Injection Wells	Same as Talen's plan.	1																
Plant	Units 3&4 North Plant Area Drain	Same as Talen's plan.	1																
Plant	Units 3&4 Wash Tray Pond	Same as Talen's plan.	1																
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)	Same as Talen's plan.	1																
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)	Same as Talen's plan.	1																
Plant	Units 1-4 North Plant Sediment Retention Pond	Same as Talen's plan.	1																
SOEP / STEP	Proposed CCR Landfill	Construct landfill to hold CCR excavated from SOEP/STEP Site and cap in place.	1	97	8	12.125	0.14	0.0929	0	1	0	0.00	0.00	0.00	0.00	97.00	1.49	0.297	0.297
Plant	Proposed CCR Landfill	Construct landfill to hold CCR excavated from Plant Site and cap in place.	1	33.2	8	4.15	0.05	0.0318	0	1	0	0.00	0.00	0.00	0.00	33.20	0.51	0.102	0.102
Notes/Assumptions					Contractor Quote		Assumes two-person surveying team which includes 1 PLS and assistant per team. Additionally one PLS for data processing and drafting. Calculated based on a 261-day working year.			Assumed		Assumes 1 certified well driller, 1 laborer to assist with drilling, two laborers to install pumps, and 4 laborers to install piping and conveyance system. Calculated based on a 50-week working year.							

		Construction Job Calculations																						
		Excavation/Backfill							In-Situ Stabilization/Solidification				Federal CCR Rule Compliant Cover System											
Location	Wastewater Facility	Excavation Volume (CY)	Excavator Operator FTE	Articulated Truck Operator FTE	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	ISS Volume (ISS)	Auger Operator FTE	Auger Assistant Laborer FTE	Cement/Mix Truck Operator	Cap Area (Acres)	Cap Construction Duration (Years)	Earthen Material Volume (CY)	Topsoil Material Volume (CY)]	Excavator Operator FTE	Articulated Truck Operator FTE	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Liner Installation, Surface Water Runoff Collection Installation Laborer FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	3,791,326	4.656	37.247	4.656	4.7	10.243	10.243	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
SOEP / STEP	Units 1&2 STEP Cell A	2,145,729	2.635	21.080	2.635	2.6	5.797	5.797	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
SOEP / STEP	Units 1&2 STEP Cell D	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	26	1	41,463	20,740	0.08	0.61	0.08	0.076	0.168	0.2	3.1
SOEP / STEP	Units 1&2 STEP Cell E	1,574,610	1.934	15.469	1.934	1.9	4.254	4.254	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
SOEP / STEP	Units 1&2 STEP Old Clearwell	311,373	0.382	3.059	0.382	0.4	0.841	0.841	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
SOEP / STEP	STEP B Cell																						
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam																						
SOEP / STEP	Vertical or angled capture wells																						
SOEP / STEP	Vertical or angled capture wells																						
SOEP / STEP	In-Situ Flushing System																						
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond																						
EHP	A Cell (South portion)																						
EHP	A Cell (North portion-New Clearwell)																						
EHP	B Cell (Clearwell)	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	39	1	62,920	31,473	0.12	0.93	0.12	0.116	0.255	0.3	4.6
EHP	C Cell	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	75	1	120,838	60,444	0.22	1.78	0.22	0.223	0.490	0.5	8.9
EHP	D/E Cell	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	39	1	63,243	31,634	0.12	0.93	0.12	0.117	0.256	0.3	4.7
EHP	F Cell	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
EHP	G Cell	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	52	1	83,570	41,803	0.15	1.23	0.15	0.154	0.339	0.3	6.2
EHP	H Cell	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
EHP	J Cell	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	57	1	92,121	46,080	0.17	1.36	0.17	0.170	0.373	0.4	6.8
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5																						
Plant	Units 1&2 Flyash A Pond	395,266	0.485	3.883	0.485	0.5	1.068	1.068	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Units 1&2 Flyash B Pond	316,213	0.388	3.107	0.388	0.4	0.854	0.854	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Units 1&2 Bottom Ash Pond	38,720	0.048	0.380	0.048	0.0	0.105	0.105	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	D4 Pond	20,167	0.025	0.198	0.025	0.0	0.054	0.054	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Units 3&4 Bottom Ash Pond Area	61,307	0.075	0.602	0.075	0.1	0.166	0.166	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Units 1&2 CCR Solids Collection Basin	4,195	0.005	0.041	0.005	0.0	0.011	0.011	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Former Units 1&2 Bottom Ash Ponds	20,167	0.025	0.198	0.025	0.0	0.054	0.054	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Cooling Tower Blowdown Pond C North	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Cooling Tower Blowdown Pond C South	-	0.000	0.000	0.000	0.0	0.000	0.000	-	0.0	0.0	0.0	0	1	-	-	0.00	0.00	0.00	0.000	0.000	0.0	0.0
Plant	Construct 50 New Vertical Injection Wells																						
Plant	Construct 3 New Vertical Capture Wells in Alluvium																						
Plant	Construct 2 New Horizontal Capture Wells																						
Plant	Convert 4 Existing Capture Wells to Injection Wells																						
Plant	Units 3&4 North Plant Area Drain																						
Plant	Units 3&4 Wash Tray Pond																						
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)																						
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)																						
Plant	Units 1-4 North Plant Sediment Retention Pond																						
SOEP / STEP	Proposed CCR Landfill	4,031,794	4.951	39.609	4.951	5.0	10.892	10.892	-	0.0	0.0	0.0	97	1	156,493	78,279	0.29	2.31	0.29	0.288	0.634	0.6	11.5
Plant	Proposed CCR Landfill	875,626	1.075	8.602	1.075	1.1	2.366	2.366	-	0.0	0.0	0.0	33	1	53,563	26,792	0.10	0.79	0.10	0.099	0.217	0.2	3.9
			Calculated based on production rate of a Cat 374F Excavator. Assumes 261 working days per year and 8 hour work days.	Calculated based on a tailgate struck capacity of a CAT 745C with a cycle time of 15 minutes	Calculated based on a production rate of a CAT D10T2 Dozer with a average dozing distance of 400'	Calculated based on a production rate of a CAT CS79 B Roller	2 mechanics per 10 operators	1 construction laborer per 5 heavy equipment operators		Assume a production rate of 600 CY/day and 261 working days per year.	Assumes 2 laborers per drill rig	Assumes one cement/mix truck operator per drill rig.			12" of Earthen Material equates to 1613.33 CY per Acre	6" of Earthen Material 807 CY per Acre	Calculated based on production rate of a Cat 374F Excavator. Assumes 261 working days per year and 8 hour work days. Excavator needed to harvest clean on-site fill	Calculated based on a tailgate struck capacity of a CAT 745C with a cycle time of 15 minutes	Calculated based on a production rate of a CAT CS79 B Roller	Calculated based on a production rate of a CAT D10T2 Dozer.	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators.	Assume 21-worker crew can install 1 acre of HDPE liner and geocomposite liner per day plus 10 workers to construct the surface water runoff system.

Table 4-7: Colstrip Alternative 2 NPRC Doing It Right Jobs Calculations

		Construction Job Calculations										
		Federal CCR Rule Compliant Liner System							Reclamation			
Location	Wastewater Facility	Liner Area (acre)	Liner Construction Duration (Years)	Dozer Operator FTE	Drum Compactor Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE	Liner Installation, Leachate Collection Laborer FTE	Area (acre)	Dozer Operator FTE	Heavy Machinery Mechanic FTE	Construction Laborer FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	1.32	1	0.005	0.001	0.001	0.001	0.16	114	0.42	0.08	1
SOEP / STEP	Units 1&2 STEP Cell A	0	1	0.000	0.000	0.000	0.000	0.00	42.1	0.15	0.03	0.4
SOEP / STEP	Units 1&2 STEP Cell D	0	1	0.000	0.000	0.000	0.000	0.00				
SOEP / STEP	Units 1&2 STEP Cell E	0	1	0.000	0.000	0.000	0.000	0.00	46.8	0.17	0.03	0.4
SOEP / STEP	Units 1&2 STEP Old Clearwell	0	1	0.000	0.000	0.000	0.000	0.00	10.9	0.04	0.01	0.1
SOEP / STEP	STEP B Cell											
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam											
SOEP / STEP	Vertical or angled capture wells											
SOEP / STEP	Vertical or angled capture wells											
SOEP / STEP	In-Situ Flushing System											
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond											
EHP	A Cell (South portion)											
EHP	A Cell (North portion-New Clearwell)											
EHP	B Cell (Clearwell)	0	1	0.000	0.000	0.000	0.000	0.00				
EHP	C Cell	0	1	0.000	0.000	0.000	0.000	0.00				
EHP	D/E Cell	0	1	0.000	0.000	0.000	0.000	0.00				
EHP	F Cell	0	1	0.000	0.000	0.000	0.000	0.00				
EHP	G Cell	0	1	0.000	0.000	0.000	0.000	0.00				
EHP	H Cell	0	1	0.000	0.000	0.000	0.000	0.00				
EHP	J Cell	0	1	0.000	0.000	0.000	0.000	0.00				
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5											
Plant	Units 1&2 Flyash A Pond	0	1	0.000	0.000	0.000	0.000	0.00	14	0.05	0.01	0.1
Plant	Units 1&2 Flyash B Pond	0	1	0.000	0.000	0.000	0.000	0.00	10	0.04	0.01	0.1
Plant	Units 1&2 Bottom Ash Pond	0	1	0.000	0.000	0.000	0.000	0.00	4	0.01	0.00	0.03
Plant	D4 Pond	0	1	0.000	0.000	0.000	0.000	0.00	7	0.03	0.01	0.1
Plant	Units 3&4 Bottom Ash Pond Area	0	1	0.000	0.000	0.000	0.000	0.00	12.8	0.05	0.01	0.1
Plant	Units 1&2 CCR Solids Collection Basin	0	1	0.000	0.000	0.000	0.000	0.00				
Plant	Former Units 1&2 Bottom Ash Ponds	0	1	0.000	0.000	0.000	0.000	0.00	9.5	0.03	0.01	0.1
Plant	Cooling Tower Blowdown Pond C North	10	1	0.018	0.010	0.006	0.006	1.19				
Plant	Cooling Tower Blowdown Pond C South	10.5	1	0.019	0.010	0.006	0.006	1.25				
Plant	Construct 50 New Vertical Injection Wells											
Plant	Construct 3 New Vertical Capture Wells in Alluvium											
Plant	Construct 2 New Horizontal Capture Wells											
Plant	Convert 4 Existing Capture Wells to Injection Wells											
Plant	Units 3&4 North Plant Area Drain											
Plant	Units 3&4 Wash Tray Pond											
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)											
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)											
Plant	Units 1-4 North Plant Sediment Retention Pond											
SOEP / STEP	Proposed CCR Landfill	97	1	0.177	0.096	0.055	0.055	11.52				
Plant	Proposed CCR Landfill	33.2	1	0.061	0.033	0.019	0.019	3.94				
				Assume 1' depth of grading per area. Calculated based on production rate of D10T2 Dozer.	Assume 1' depth per area requires compaction. Calculated based on a production rate of a CAT D10T2 Dozer.		Assume 1 construction laborer per 5 heavy equipment operators.	Assume 21-worker crew can install 1 acre of HDPE liner (double layer) per day plus 10 workers to construct the leachate collection system.		Assume 2' depth of grading per area. Calculated based on production rate of D10T2 Dozer.	Assume 2 mechanics per 10 operators	Assume 1 construction laborer per 5 heavy equipment operators. Assume 1 laborer can hydroseed 0.5 acres per day.

Construction Job Totals Summary

Location	Wastewater Facility	Skilled Labor: Certified Well Driller FTE	Skilled Labor: Skilled Laborer FTE	Skilled Labor: Heavy Equipment Operator FTE	Unskilled Labor: Construction Laborer FTE	Professional: Professional Land Surveyor FTE	Professional: Construction Manager FTE	Professional: Health/Safety Manager FTE	Professional: Engineer/Planner/Estimator/Designer/Management FTE	Total Construction Jobs FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)	0.1	14	66	13	0.2	9	9	36	149
SOEP / STEP	Units 1&2 STEP Cell A	0.3	10	37	7.4	0.1	5	5	20	86
SOEP / STEP	Units 1&2 STEP Cell D	0.0	4	1.5	0.3	0.05	1	1	2	9
SOEP / STEP	Units 1&2 STEP Cell E	0.3	7	27	5.5	0.1	4	4	15	64
SOEP / STEP	Units 1&2 STEP Old Clearwell	0.1	1	5	1.1	0.02	1	1	3	13
SOEP / STEP	STEP B Cell	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam	0.0	0.0	1.0	1.0	0.0	0.2	0.2	0.4	2.8
SOEP / STEP	Vertical or angled capture wells	0.0	0.0	0.5	1.0	0.0	0.2	0.2	0.2	2.0
SOEP / STEP	Vertical or angled capture wells	0.0	0.0	1.0	1.0	0.0	0.2	0.2	0.4	2.8
SOEP / STEP	In-Situ Flushing System	0.0	0.0	1.0	1.0	0.0	0.2	0.2	1.0	3.4
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond	0.0	0.0	0.1	0.2	0.0	0.0	0.0	1.5	1.9
EHP	A Cell (South portion)	0.00	0.2	1	0.2	0.1	0.1	0.1	0.2	1.9
EHP	A Cell (North portion-New Clearwell)									
EHP	B Cell (Clearwell)	0	6	2.3	0.5	0.1	1	1	3	14
EHP	C Cell	0.03	12	4.5	0.9	0.1	2	2	6	28
EHP	D/E Cell	0.03	7	2.4	0.5	0.1	1	1	3	15
EHP	F Cell	0.03	0	1.1	0.2	0.1	0.2	0.2	0	2
EHP	G Cell	0.1	9	3.1	0.6	0.1	1	1	4	19
EHP	H Cell	0.03	0	1.0	0.2	0.1	0.2	0.2	0	2
EHP	J Cell	0.1	10	3.4	0.7	0.1	1	1	5	21
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5	0.00000	0.00446	0.01780	0.01074	0.00135	0.00343	0.00343	0.00000	0.04121
Plant	Units 1&2 Flyash A Pond	0.1	2	6.9	1.4	0.03	1	1	4	16
Plant	Units 1&2 Flyash B Pond	0.1	2	5.5	1.1	0.02	1	1	3	13
Plant	Units 1&2 Bottom Ash Pond	0	0	0.7	0.1	0.01	0.1	0.1	0	1.6
Plant	D4 Pond	0	0	0.5	0.1	0.01	0.1	0.1	0	1.0
Plant	Units 3&4 Bottom Ash Pond Area	0	0	1.3	0.3	0.02	0.2	0.2	1	2.7
Plant	Units 1&2 CCR Solids Collection Basin	0	0	0.1	0.01	0	0.01	0.01	0	0.2
Plant	Former Units 1&2 Bottom Ash Ponds	0	0	0.5	0.1	0.02	0.1	0.1	0	1.1
Plant	Cooling Tower Blowdown Pond C North	0	2	0.2	0.0	0.02	0.2	0.2	0.5	2.7
Plant	Cooling Tower Blowdown Pond C South	0	2	0.2	0.0	0.02	0.2	0.2	0.5	2.8
Plant	Construct 50 New Vertical Injection Wells	0.0	8.8	0.0	0.0	0.0	0.9	0.9	0.4	10.9
Plant	Construct 3 New Vertical Capture Wells in Alluvium	0.0	0.5	0.0	0.0	0.0	0.1	0.1	0.0	0.7
Plant	Construct 2 New Horizontal Capture Wells	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.9
Plant	Convert 4 Existing Capture Wells to Injection Wells	0.0	0.7	0.0	0.0	0.0	0.1	0.1	0.0	0.8
Plant	Units 3&4 North Plant Area Drain	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Plant	Units 3&4 Wash Tray Pond	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.6
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.5
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.4
Plant	Units 1-4 North Plant Sediment Retention Pond	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
SOEP / STEP	Proposed CCR Landfill	0	44	74.2	15	0.2	13	13	30	190
Plant	Proposed CCR Landfill	0	13	16.9	3.4	0.1	3	3	9	49
		25% contingency applied	Includes PLS assistants, well drilling assistants, pump and conveyance system installers, heavy machinery mechanics auger assistant laborers, liner installers, surface runoff collection installers, and leachate collection system installers. 25% contingency applied.	Includes Excavator operators, truck drivers, dozer operators, drum compactor operators, auger operators, and cement truck drivers. 25% contingency applied.	Includes unskilled laborers to assist with construction efforts 25% contingency applied.	25% contingency applied	Assumes 1 construction manager per 10 employees	Assumes 1 health/safety manager per 10 employees	Assumes median salary of $100,000/yr with an increase of 100% to account for taxes, benefits, space, equipment, and materials.	

Table 4-7: Colstrip Alternative 2 NPRC Doing It Right Jobs Calculations

		Post Closure O&M Job Calculations							
		Dewatering	Inspections	Leachate Collection System/Capture Well System Maintenance	Cap Maintenance		Surface/Storm Water Management	Project Management	
Location	Wastewater Facility	Skilled Laborer FTE	Environmental Scientist FTE	Environmental Technician FTE	Heavy Equipment Operator FTE	Construction Laborer FTE	Construction Laborer FTE	Engineer/Project Manager FTE	Total Annual O&M Jobs FTE
SOEP / STEP	Units 1&2 Stage I Evaporation Pond (SOEP)		0	0.05	0.0	0.0	0.007	0.003	0.06
SOEP / STEP	Units 1&2 STEP Cell A		0	0.00	0.0	0.0	0.00	0.00	0
SOEP / STEP	Units 1&2 STEP Cell D		0.02	1.15	0.2	0.7	0.13	0.09	2
SOEP / STEP	Units 1&2 STEP Cell E		0	0.00	0.0	0.0	0.00	0	0
SOEP / STEP	Units 1&2 STEP Old Clearwell		0.000	0.00	0.0	0.0	0.00	0	0.0
SOEP / STEP	STEP B Cell								NA
SOEP / STEP	Horizontal Capture Well - Beneath SOEP Main Dam			0.77	0.1			0.04	0.9
SOEP / STEP	Vertical or angled capture wells			1.16	0.1			0.04	1.3
SOEP / STEP	Vertical or angled capture wells			1.16	0.1			0.04	1.3
SOEP / STEP	In-Situ Flushing System				0.1			0.04	NA
SOEP / STEP	Decommission Units 1&2 Scrubber Pipeline/North 1AD Drain Pond								NA
EHP	A Cell (South portion)		0.02		0.28	0.87	0.16	0.05	1.4
EHP	A Cell (North portion-New Clearwell)								
EHP	B Cell (Clearwell)		0.02	1.74	0.3	1.1	0.2	0.14	4
EHP	C Cell	4	0.04	3.35	0.7	2.0	0.4	0.28	7
EHP	D/E Cell		0.02	0	0.3	1.1	0.2	0.06	2
EHP	F Cell		0	0	0.0	0.0	0.3	0.01	0.3
EHP	G Cell		0.03	2.31	0.4	1.4	0.3	0.19	5
EHP	H Cell		0	0	0.0	0.0	0.3	0.01	0.3
EHP	J Cell		0.03	2.55	0.5	1.5	0.3	0.21	5
EHP	Units 3&4 Scrubber EHP Pipeline and Drain Pits #3 and #5								
Plant	Units 1&2 Flyash A Pond		0	0	0.0	0.0	0.0	0.0	0.0
Plant	Units 1&2 Flyash B Pond		0	0	0.0	0.0	0.0	0.0	0.0
Plant	Units 1&2 Bottom Ash Pond		0	0	0.0	0.0	0.0	0.0	0
Plant	D4 Pond		0	0	0.0	0.0	0.0	0.0	0
Plant	Units 3&4 Bottom Ash Pond Area		0	0	0.0	0.0	0.0	0.0	0
Plant	Units 1&2 CCR Solids Collection Basin		0	0	0.0	0.0	0.0	0.0	0
Plant	Former Units 1&2 Bottom Ash Ponds		0	0	0.0	0.0	0.0	0.0	0
Plant	Cooling Tower Blowdown Pond C North		0	0.45	0.0	0.0	0.1	0.02	0.5
Plant	Cooling Tower Blowdown Pond C South		0	0.47	0.0	0.0	0.1	0.02	0.5
Plant	Construct 50 New Vertical Injection Wells			0.4				0.08	0.5
Plant	Construct 3 New Vertical Capture Wells in Alluvium			0.4				0.08	0.5
Plant	Construct 2 New Horizontal Capture Wells			0.4				0.08	0.5
Plant	Convert 4 Existing Capture Wells to Injection Wells			0.4				0.08	0.5
Plant	Units 3&4 North Plant Area Drain								
Plant	Units 3&4 Wash Tray Pond								
Plant	Units 3&4 Scrubber Drain Collection (DC Pond)								
Plant	Units 1-4 Sediment Retention Pond (Thompson Lake)								
Plant	Units 1-4 North Plant Sediment Retention Pond								
SOEP / STEP	Proposed CCR Landfill		0.06	4.3	0.8	2.6	0.5	0.3	9
Plant	Proposed CCR Landfill		0.02	1.5	0.3	0.9	0.2	0.1	3
		Assume 2 skilled laborer to service wells and pumps and 2 to service the conveyance system.	FTE based on median salary of an Environmental Scientist ($63,000/yr) with an increase of 100% to account for taxes, benefits, space, equipment, and materials. 25% contingency applied. Assume 100% of inspection budget consists of labor.	FTE based on median salary of an environmental technician ($40,580/yr) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Leachate collection maintenance and operation consists of cleaning, pump replacement and repair, flushing of collection and conveyance system, maintenance of collection and conveyance system.	FTE based on median salary of heavy equipment operator ($42,000) and median salary of a construction worker ($27,000) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor and there is two construction laborers for every heavy equipment operator.		FTE based on median salary of an construction laborer ($27,000/yr) with an increase of 100% to account for taxes, benefits, and space. Assume 50% of maintenance budget consists of labor. Maintenance includes cleanout and repair of water conveyance structures, down chutes, sediment basins, and outfalls.	Assumes median salary of $100,000/yr with an increase of 100% to account for taxes, benefits, space, equipment, and materials. Assume 100% of budget consists of labor.	

Table 4-8: Colstrip Cost References

Ref. #	Citation
1	Casmalia Resources Site Steering Committee. 2016. *Casmalia Resources Superfund Site: Final Feasibility Study.* Prepared for USEPA, Region 9.
2	United States Environmental Protection Agency. September 2004. *Interim Measures Cost Compendium.*
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5	Johnson, E., Olson, C., 2009 *Best Practices for Dust Control on Aggregate Roads,* Minnesota Department of Transportation Office, Maplewood, Minnesota.
6	United States Department of Energy. March 1997. Cost Estimating Guide. DOE G 430.1-1
7	United States Department of Defense. June 2018. Unified Facilities Criteria - DoD Facilities Pricing Guide. UFC 3-701-01
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16	American Power Service Corporation 2016. *Closure Plan - Gavin Residual Waste Landfill. Cheshire, Ohio.* Prepared for AEP Generation Resources - Gavin Plant.
17	CB&I Environmental & Infrastructure, Inc. 2016. *Closure and Post-Closure Care Plan, NRG Indian River Generating Station, Indian River Landfill Phase II.* Dagsboro, Delaware. Prepared for Indian River Power LLC.
18	Garrett & Moore. 2016. *Post-Closure Plan for the Williams Station Class III Landfill.* Berkely County, South Carolina. Prepared for SCANA, Inc.
19	The Gordian Group. 2018. *Historical Cost Index. Http://info.thegordiangroup.com/RSMeans.html*
20	https://www.rentalyard.com/listings/construction-equipment/for-rent/list/category/1026/dozers-crawler/manufacturer/caterpillar/model-group/d10
21	USDA Forest Service. 2008. Meyers Landfill Remedial Design.

Table 4-9. Colstrip Alternative 1 Water Treatment Cost and Job Calculations

	Annual cost			Annual	Estimated		
Year	SOEP-STEP site[1]	EHP site[1]	Total	labor cost[2]	# of jobs[3]	Capital[4]	Notes
2020	$1,000,000	$2,000,000	$3,000,000	$900,000	9.4		
2021	$1,000,000	$2,000,000	$3,000,000	$900,000	9.4	$26,040,000	Install CWTS and BCC
2022	$500,000	$2,000,000	$2,500,000	$750,000	7.8	$8,000,000	Construct BCC disposal area
2023	$3,748,000	$2,000,000	$5,748,000	$1,724,400	18.0		
2024	$3,748,000	$2,000,000	$5,748,000	$1,724,400	18.0		
2025	$3,748,000	$2,000,000	$5,748,000	$1,724,400	18.0		
2026	$3,748,000	$2,000,000	$5,748,000	$1,724,400	18.0		
2027	$2,759,000	$2,000,000	$4,759,000	$1,427,700	14.9		
2028	$2,759,000	$2,000,000	$4,759,000	$1,427,700	14.9		
2029	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2030	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2031	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2032	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2033	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2034	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2035	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2036	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2037	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2038	$2,233,000	$2,000,000	$4,233,000	$1,269,900	13.3		
2039	$1,968,000	$2,000,000	$3,968,000	$1,190,400	12.4		
2040	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2041	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2042	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2043	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2044	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2045	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2046	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2047	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2048	$1,968,000	$1,000,000	$2,968,000	$890,400	9.3		
2049	$0	$1,000,000	$1,000,000	$300,000	3.1		
2050	$0	$700,000	$700,000	$210,000	2.2		
2051	$0	$700,000	$700,000	$210,000	2.2		
2052	$0	$700,000	$700,000	$210,000	2.2		
2053	$0	$700,000	$700,000	$210,000	2.2		
2054	$0	$700,000	$700,000	$210,000	2.2		
2055	$0	$700,000	$700,000	$210,000	2.2		
2056	$0	$700,000	$700,000	$210,000	2.2		
2057	$0	$700,000	$700,000	$210,000	2.2		
2058	$0	$700,000	$700,000	$210,000	2.2		
2059	$0	$700,000	$700,000	$210,000	2.2		
2060	$0	$400,000	$400,000	$120,000	1.3		
2061	$0	$400,000	$400,000	$120,000	1.3		
2062	$0	$400,000	$400,000	$120,000	1.3		
2063	$0	$400,000	$400,000	$120,000	1.3		
2064	$0	$400,000	$400,000	$120,000	1.3		
2065	$0	$400,000	$400,000	$120,000	1.3		
2066	$0	$400,000	$400,000	$120,000	1.3		
2067	$0	$400,000	$400,000	$120,000	1.3		
2068	$0	$400,000	$400,000	$120,000	1.3		
2069	$0	$400,000	$400,000	$120,000	1.3		
Total			**$126,020,000**		**7.9**	**$34,040,000**	

1) From Master Plan Summary Report Update, Sept. 2016

2) Cost attributed to labor: 30%

3) Price of 1 FTE: $95,680

Based on: Wage rate of $23/hr (service contract rate for WT operator in Rosebud County, Montana)

Total cost of $46/hr including benefits

2080 hrs/yr

4) From Table 7-6 of Plant Site Remedy Evaluation Report

Notes: Capital, monitoring, and O&M costs provided in Talen documents cited in report.

CWTS = Capture Well Treatment System; BCC = Brine Concentrator/Crystallizer

Table 4-10. Colstrip Alternative 2 Water Treatment Cost and Job Calculations

	SM annual cost[1]				Combined	CWTS	Estimated # of jobs				
Year	Labor/parts[1]	Electricity[2,3]	SM total	CWTS[4]	Total	Labor cost[5]	SM[6]	CWTS[7]	Total	Capital cost[4]	Notes
2020	$307,070	$915,729	$1,222,798	$4,591,981	$5,814,779	$1,377,594	3.1	14.4	17.5	$15,660,000	Install Solar Multiple system
2021	$307,070	$915,729	$1,222,798	$4,591,981	$5,814,779	$1,377,594	3.1	14.4	17.5	$15,103,200	Install CWTS
2022	$307,070	$915,729	$1,222,798	$3,826,651	$5,049,449	$1,147,995	3.1	12.0	15.1		
2023	$343,029	$1,022,963	$1,365,992	$3,625,000	$4,990,992	$1,087,500	3.5	11.4	14.8		
2024	$343,029	$1,022,963	$1,365,992	$3,625,000	$4,990,992	$1,087,500	3.5	11.4	14.8		
2025	$343,029	$1,022,963	$1,365,992	$3,625,000	$4,990,992	$1,087,500	3.5	11.4	14.8		
2026	$343,029	$1,022,963	$1,365,992	$3,625,000	$4,990,992	$1,087,500	3.5	11.4	14.8		
2027	$343,029	$1,022,963	$1,365,992	$3,625,000	$4,990,992	$1,087,500	3.5	11.4	14.8		
2028	$274,423	$818,371	$1,092,794	$2,900,000	$3,992,794	$870,000	2.8	9.1	11.9		
2029	$274,423	$818,371	$1,092,794	$2,900,000	$3,992,794	$870,000	2.8	9.1	11.9		
2030	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2031	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2032	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2033	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2034	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2035	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2036	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2037	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2038	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2039	$236,571	$705,492	$942,063	$2,500,000	$3,442,063	$750,000	2.4	7.8	10.2		
2040	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2041	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2042	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2043	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2044	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2045	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2046	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2047	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2048	$236,571	$705,492	$942,063	$1,500,000	$2,442,063	$450,000	2.4	4.7	7.1		
2049	$66,477	$198,243	$264,720	$1,000,000	$1,264,720	$300,000	0.7	3.1	3.8		
2050	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2051	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2052	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2053	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2054	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2055	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2056	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2057	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2058	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2059	$66,477	$198,243	$264,720	$700,000	$964,720	$210,000	0.7	2.2	2.9		
2060	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2061	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2062	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2063	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2064	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2065	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2066	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2067	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2068	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
2069	$66,477	$198,243	$264,720	$400,000	$664,720	$120,000	0.7	1.3	1.9		
Total			**$36,142,263**	**$87,435,613**	**$123,577,877**				**7.3**	**$30,763,200**	

1) Solar Multiple estimate; adjusted for flow rate and total wage rate of $46/hr

2) Electricity cost = 0.05 $/kWh

3) Electricity usage = 391,940 kWh/yr/module

4) CWTS O&M and capital costs are scaled-up to accommodate dewatering flow

5) Cost attributed to labor: 30%

6) Based on 1 person per 15 modules

7) Price of 1 FTE: $95,680

Based on: Wage rate of $23/hr (service contract rate for WT operator in Rosebud County, Montana)
Total cost of $46/hr including benefits
2080 hrs/yr

Notes: Capital, monitoring, and O&M costs provided in Talen documents referenced in Section

CWTS = Reverse Osmosis Capture Well Treatment System; Solar Multiple system used for brine concentration.

Table 4-11. Colstrip Groundwater Monitoring Cost and Jobs Calculations

		Annual cost			Annual	Estimated
Year	Plant site[1]	SOEP-STEP site[2]	EHP site[2]	Total	Labor cost[3]	# of jobs[4]
2020	$100,000	$200,000	$350,000	$650,000	$390,000	5.2
2021	$100,000	$200,000	$350,000	$650,000	$390,000	5.2
2022	$100,000	$200,000	$350,000	$650,000	$390,000	5.2
2023	$100,000	$200,000	$350,000	$650,000	$390,000	5.2
2024	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2025	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2026	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2027	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2028	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2029	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2030	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2031	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2032	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2033	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2034	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2035	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2036	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2037	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2038	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2039	$100,000	$150,000	$350,000	$600,000	$360,000	4.8
2040	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2041	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2042	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2043	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2044	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2045	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2046	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2047	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2048	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2049	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2050	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2051	$100,000	$150,000	$300,000	$550,000	$330,000	4.4
2052	$0	$0	$300,000	$300,000	$180,000	2.4
2053	$0	$0	$300,000	$300,000	$180,000	2.4
2054	$0	$0	$300,000	$300,000	$180,000	2.4
2055	$0	$0	$300,000	$300,000	$180,000	2.4
2056	$0	$0	$300,000	$300,000	$180,000	2.4
2057	$0	$0	$300,000	$300,000	$180,000	2.4
2058	$0	$0	$300,000	$300,000	$180,000	2.4
2059	$0	$0	$300,000	$300,000	$180,000	2.4
2060	$0	$0	$300,000	$300,000	$180,000	2.4
2061	$0	$0	$300,000	$300,000	$180,000	2.4
2062	$0	$0	$300,000	$300,000	$180,000	2.4
2063	$0	$0	$300,000	$300,000	$180,000	2.4
2064	$0	$0	$300,000	$300,000	$180,000	2.4
2065	$0	$0	$300,000	$300,000	$180,000	2.4
2066	$0	$0	$300,000	$300,000	$180,000	2.4
2067	$0	$0	$300,000	$300,000	$180,000	2.4
2068	$0	$0	$300,000	$300,000	$180,000	2.4
2069	$0	$0	$300,000	$300,000	$180,000	2.4
2070	$0	$0	$300,000	$300,000	$180,000	2.4
Total				**$23,850,000**	**$14,310,000**	**3.8**
1) From 2017 Annual Plan and 5-Year Plan (referenced in Table 7-6 of						
Plant Site Remedy Evaluation Report)						
2) From Master Plan Summary Report Update, Sept. 2016						
3) Cost attributed to labor:			60%			
4) Price of 1 FTE:			$74,880			
	Based on:	Wage rate of $18/hr (service contract rate for envir. technician				
		in Rosebud County, Montana)				
		Total cost of $36/hr including benefits				
		2080 hrs/yr				

Attachment 2. Large format figures

Figure 2-1. Grainger Generating Station prior to decomissioning and CCR removal

Airphoto background is 2005.

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Checked by:	Scott Payne, PhD
Date:	1/28/2021
Sheet No.	1

Figure 3-1. Michigan City Generating Station current site layout

0 250 500 1,000 1,500 Feet

Background airphoto is 6/6/2020.

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Figure 3-2. Michigan City Generating Station in 1952

0 250 500 1,000 1,500 Feet

Background airphoto is 3/29/1952

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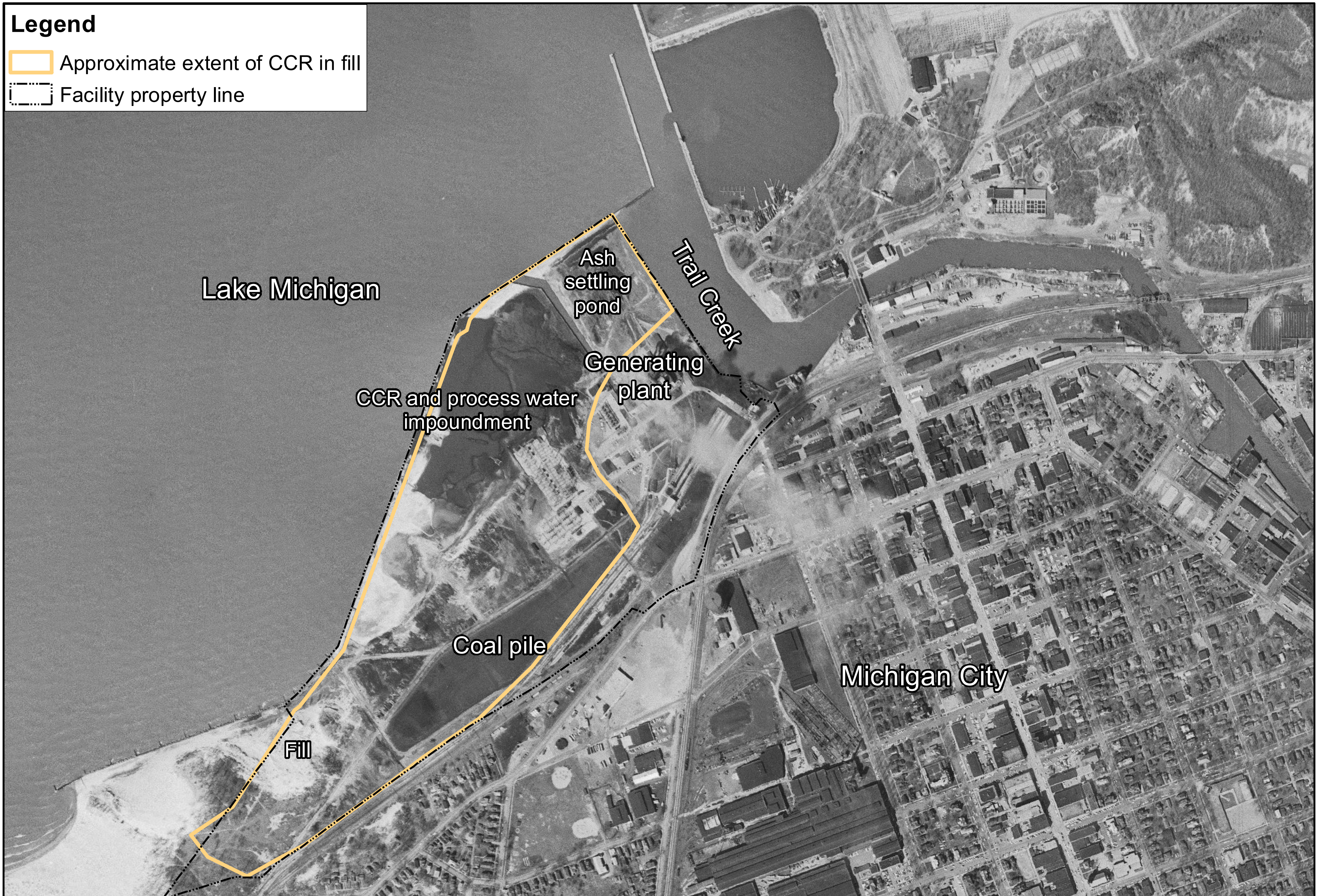

Figure 3-3. Michigan City Generating Station in 1961

Background airphoto is 3/29/1961
Extent of CCR in fill determined from boring logs in RCRA Facility Investigation (Golder 2018, Wood 2018b)

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Figure 3-4. Michigan City Generating Station Alternative 2 restoration areas

Background airphoto is 6/6/2020.

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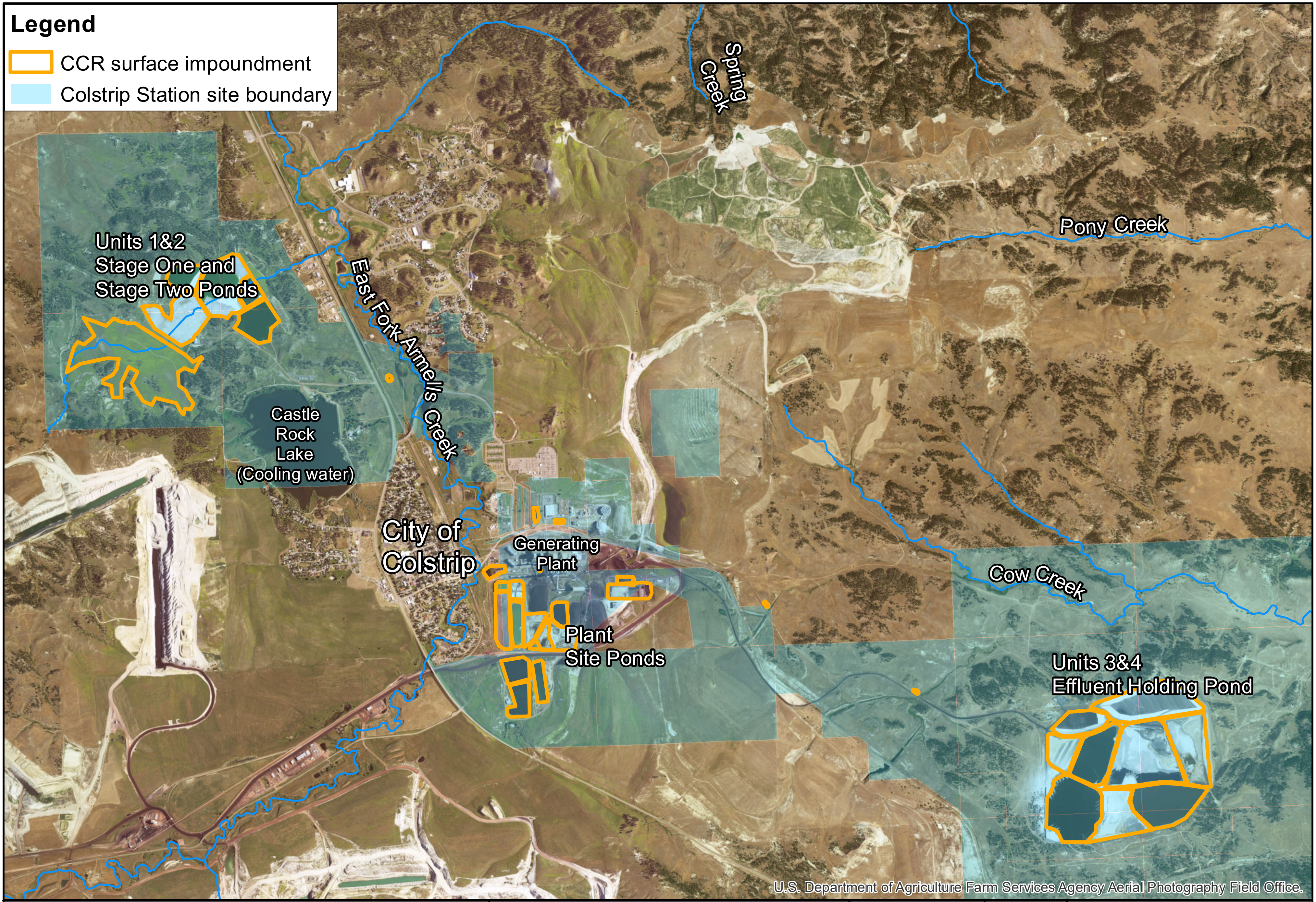

Figure 4-1. Colstrip Steam Electric Plant current site layout

0 0.5 1 Miles

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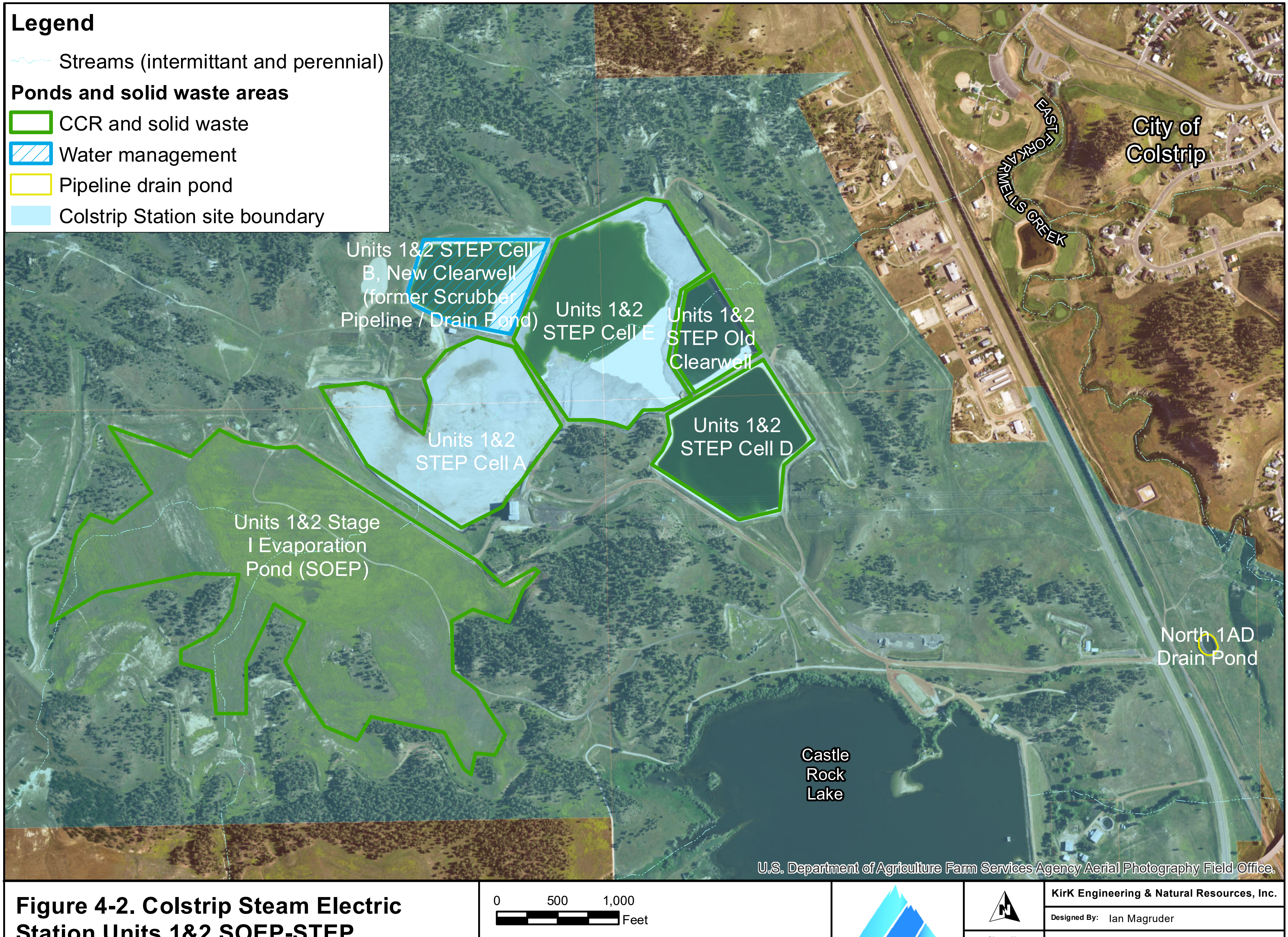

Figure 4-2. Colstrip Steam Electric Station Units 1&2 SOEP-STEP Pond Complex

Pond end use is shown. Some CCR ponds are currently used for water management.

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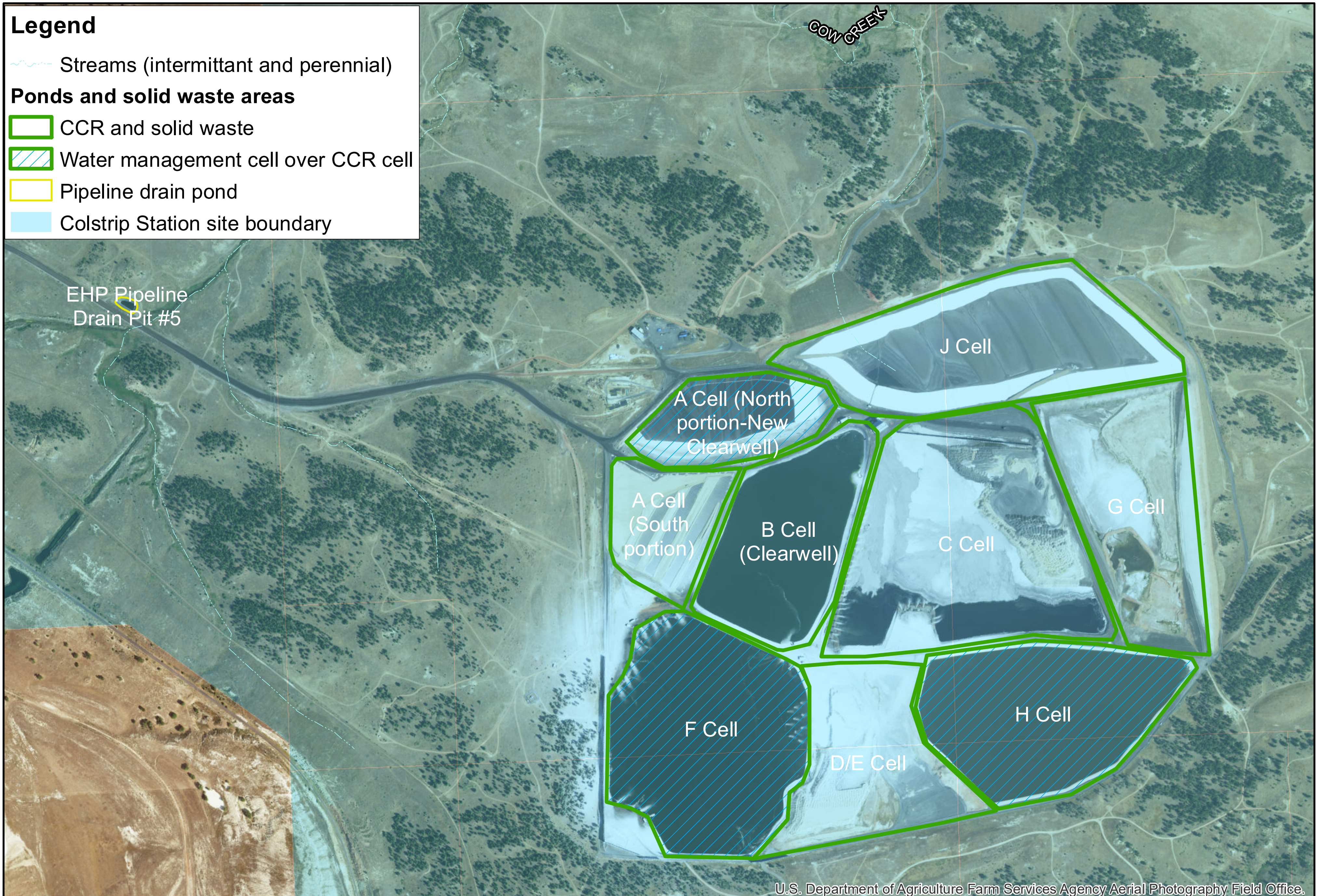

Figure 4-3. Colstrip Steam Electric Station Units 3&4 EHP Pond Complex

Pond end use is shown. Some CCR ponds are currently used for water management.

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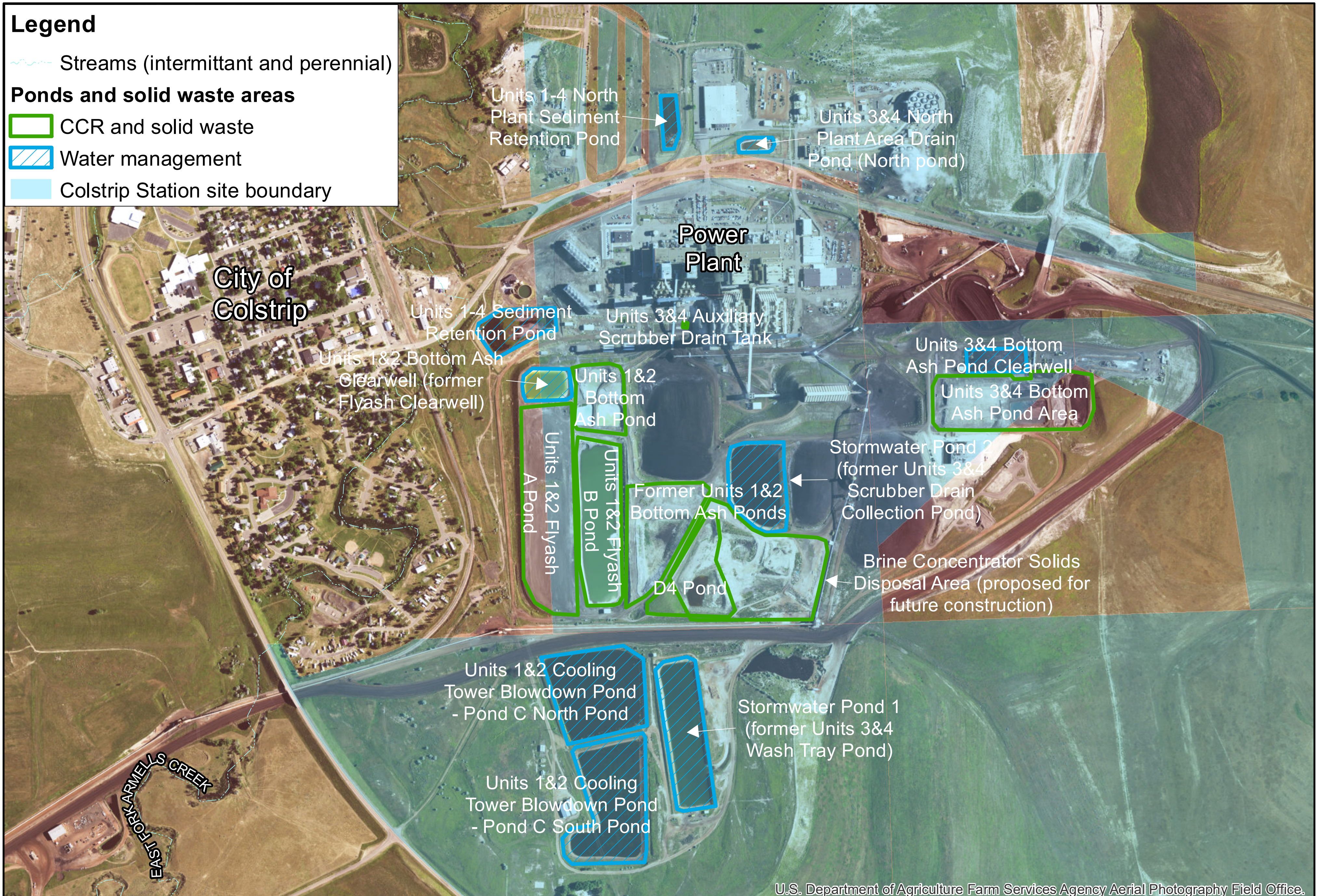

Figure 4-4. Colstrip Steam Electric Plant Site Pond Complex

0 500 1,000 Feet

Pond end use is shown. Some CCR ponds are currently used for water management.

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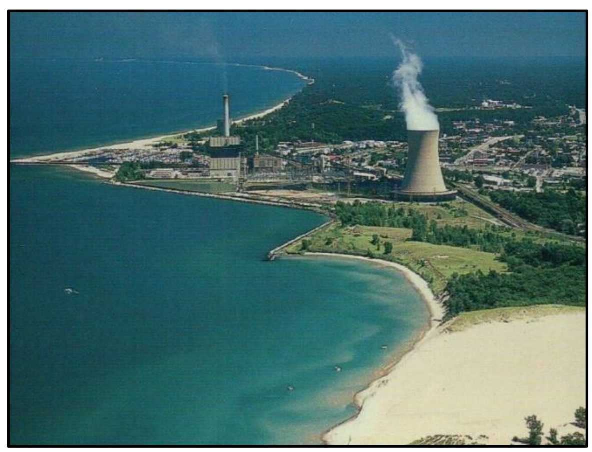
REUSE AND ECONOMICS IMPACTS
NIPSCO POWER GENERATION FACILITY
MICHIGAN CITY, IN

APRIL 20, 2021



KIRK ENGINEERING & NATURAL RESOURCES, INC.

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1. Introduction

The energy market in the United States is changing with growing community and economic pressures, and coal-fired power plants across the country are shutting down (Delta Institute 2018). Cleanup, demolition, and reclamation of coal-fired power plants will accelerate over the next decade as renewable energy development grows, and carbon dioxide emissions are reduced to counter the impacts of climate change. This supplemental report is part of the economic impact analysis of "Clean Closure" at the Michigan City NIPSCO facility described in KirK Engineering (2021).

The creation of jobs and revenue linked to facility closure and environmental cleanup will eventually end, but environmental protection lasts in perpetuity. Continued short-term economic gains are possible through redevelopment. Similar to the economic benefits of closure and environmental cleanup, these gains are related to construction jobs and capital investment. Long-term economic gains are possible by targeting jobs creation as part of the redevelopment planning process. Other factors should be considered in the redevelopment planning process including community needs, environmental justice, ecological value, and other considerations needed to select a preferred redevelopment plan.

NIPSCO's Michigan City Generating Station is located within the Michigan City municipal boundary and governed under local zoning ordinances for planning purposes. The facility is located on the shores of Lake Michigan next to Indiana Dunes National Park and Michigan City's Washington City Beach Park. Reuse opportunities on the shores of Lake Michigan are rare, which means the opportunity garners local interest and out-of-area developers. Redevelopment at the site offers an excellent opportunity for a community-led redevelopment plan. A community-led redevelopment plan considers redevelopment alternatives that, for example, mitigate legacy economic and health impacts residents endured living next to a coal-fired power plant for over 100 years, ensure environmental justice is linked to redevelopment, generate revenue for the city and local businesses, and enhance quality of life for city residents. Environmental justice in this case means residual contaminants are adequately remediated so that any future reuse of the site is possible, and the redevelopment plan is not limited because of environmental restrictions.

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (https://www.epa.gov/environmentaljustice). Environmental justice is achieved when everyone enjoys the same degree of protection from environmental and health hazards, and there is equal access to the decision-making process to having a healthy environment where Michigan City residents live, learn, and work. A well planned and complete cleanup achieves a healthy environment that benefits the entire community. A community-led redevelopment plan achieves a better place for Michigan City residents to live, learn, and work.

Reuse and economic revitalization of contaminated sites is not new. The U.S. EPA Brownfields program was created in 1995 to aid states, counties, and local governments in identifying, planning, and remediating contaminated sites for economic and recreational gain. The program is designed to empower states, communities, and other stakeholders to work together to prevent, assess, safely remediate, and sustainably reuse contaminated sites. For most Brownfields sites, the property is abandoned, left by the owner, or the responsible party for the cleanup is out of business, which is not the case for NIPSCO. However, the community planning ideals are apt for applying them to the NIPSCO facility. Like the Brownfields program, a key goal of reuse is having the local community embrace and lead reuse planning and consider economic, recreational, housing, and community needs at the site. Without a locally-led reuse plan, outside interest groups or organizations may acquire the site, targeting profit over community needs, and avoid mitigating legacy economic disparities and addressing environmental justice.

2. Case Studies

The following case studies are examples of community planning and redevelopment success stories. The case studies were selected based on the proposed redevelopment end use or process used to engage a community in the redevelopment process. They also serve as examples to incentivize Michigan City residents to lead redevelopment at the NIPSCO facility.

2.1 Developing a Multiuse Reuse Plan - Shenango Coke Plant

The Shenango Coke Plant, owned by DTE Energy and located on Pennsylvania's Neville Island, closed in January 2016 following years of environmental violations and community protest. In 2019, a number of local and regional concerned parties formed the Shenango Reimagined Advisory Council (Council) to better understand the needs and desires of the community for redevelopment and explore options for reuse (Delta Institute 2020). The Council decided that the end reuse must be feasible given local and regional market realities, have a positive economic benefit for the Neville Township, and not create environmental or health consequences for Neville or surrounding communities.

The re-visioning process identified seven Guiding Principles for reuse important to the community and redevelopment of the site. The process also identified 20 reuse ideas that align with the Guiding Principles and market forces. Together these elements form a conceptual regional model for commercial and industrial redevelopment expressed with site renderings (Figure 1).

Figure 1. Existing conditions and proposed reuse rendering. Source: Delta Institute 2020.

Redevelopment of the former Shenango Site has the potential to economically and environmentally impact over 18,000 residents of the Neville Township and the four northern boroughs combined and up to 70,000 Pennsylvania residents living within a three-mile radius of the Site (Delta Institute 2020). The planning process yielded a community plan that can be implemented to bolster economic development, improve environmental outcomes, and expand revenue opportunities for the municipality.

2.2 Economic Development – Navy Fleet and Industrial Supply Center

The Fleet and Industrial Supply Center, Oakland was a war-time supply facility operated by the U.S. Navy in Oakland, California. During World War II, it was a major source of supplies and war materials for ships operating in the Pacific (https://en.wikipedia.org/wiki/Fleet_and_Industrial_Supply_Center,_Oakland).

The Depot had its origin in 1940 when the Navy bought 500 acres of wetlands from the city of Oakland for $1.00. The Navy developed the land and populated it with large warehouses. It opened on December 15, 1941 and quickly began a decades-long expansion. In the late 1940s it was renamed Naval Supply Center, Oakland; later it was renamed Fleet and Industrial Supply Center, Oakland. During the Cold War, it was one of the Navy's most important supply facilities. The site was environmentally contaminated due to past activities. The 1995 Base Realignment and Closure Commission recommended that the Center be closed. The based was closed in 1998, and in 1999, the Navy transferred the entire 531-acre property to the Port of Oakland, a division of the City of Oakland. The new owner redeveloped the remediated facility into an expanded area of their intermodal freight transport marine terminal, railroad, and truck cargo facilities. A portion of the supply depot was developed into Middle Harbor Shoreline Park in 2003. The buildings were removed, and environmental restoration created new wetlands for wildlife (Figure 2).

Figure 2. Existing conditions and the former naval supply center. Source: Google Maps and Aerialachrives.com

In many respects, redevelopment at the former Navy facility can be called an economic success story. The project demonstrates how a municipality can lead reuse of a once contaminated military base and convert it into a marine terminal and waterfront park. The civilian and military personal that worked for the Navy were replaced with Port of Oakland employees. Local jobs were created as part of the reuse plan and revenue continues to be generated for the city by operating the marine terminal. Other reuses, such as low-income housing, were discussed but not adopted by the city or pursued by the Navy. Middle Harbor Shoreline Park was eventually constructed to provide wetland habitat and ensure area residents had access to San Francisco Bay. Park construction helped quell objection to the preferred reuse alternative of a marine terminal. The economic opportunities from an expanded marine terminal quickly eliminated other possible reuse alternatives. While not a community-led redevelopment effort, the preferred reuse demonstrates how an industrial site can be redeveloped to boost and support a municipal economy.

2.3 Community-Led Ecological and Recreational Reuse – Milltown Dam Removal

For 100 years, Milltown Dam near Missoula, Montana blocked the confluence of the Clark Fork and Blackfoot rivers, trapping toxic sediments that washed down from mines in Butte, Montana. The sediments impacted local drinking water wells, the fishery, and riparian habitat. Between Milltown Dam and headwaters of Silver Bow Creek in Butte, the site is the largest Superfund complex in the nation.

The removal of Milltown Dam at the confluence of the Clark Fork and Blackfoot rivers near Missoula is one of the greatest restoration success stories in the West (https://clarkfork.org/our-work/what-we-do/restore-the-best/confluence/). A local nonprofit group, Clark Fork Coalition, spearheaded a decades-long, collaborative effort to list the Clark Fork River as a Superfund site, clean up a century's worth of mine waste, remove the dam, and reunite two rivers. The former dam and reservoir area are now a restored floodplain, and the confluence of the Clark Fork and Blackfoot are open for recreation and fish migration (Figure 3).

Figure 3. Milltown Dam before and after dam removal. Source: clarkforkcoalition.org

The dam was built in 1905 to generate power. A possible reuse alternative that was considered was to leave the dam in place, continue generating renewable energy, and remove sediments built up behind the dam. Instead, dam removal became the preferred solution based on a culmination of two decades of studies, proposed plans, lobbying, campaigning, and public input. Eventually a final plan to remove the ageing dam and the copper and arsenic-laden sediment behind it was selected (https://clarkfork.org/reflections-on-milltown-dam/). Community support for removal was overwhelming, pressuring decision makers to remove the dam and accelerate remediation. Removal and restoration construction was completed many years before upstream headwaters were cleaned up, which continue to undergo cleanup today.

The plan for the redevelopment of the Milltown area included creation of a state park and trail system connecting the surrounding communities. In 2007, a conceptual design for the park was created in cooperation by the Milltown Superfund Redevelopment Working Group; the Montana Department of Fish, Wildlife, and Parks; the National Park Service Rivers and Trails Program; and the Idaho-Montana Chapter of the American Society of Landscape Architects, exemplifying the need for partnerships for site redevelopment. In 2009, a grant proposal for the initial park development was submitted to the Montana Natural Resource Damage Program and funded to complete the construction.

Following the removal of the dam and mining waste, native fish including endangered bull trout navigate upstream, and the two rivers flow free. This reuse success story emphasizes the importance and need for community-led reuse plans at contaminated sites. Without a determined community, public demands, and partnership, the former Milltown Dam could still be in place today.

2.4 Affordable Housing Development – Washington Courtyards

In 1996, the Avenue Community Development Corporation (ACDC) in Houston, Texas, conducted a door-to-door survey of the Washington Avenue area that identified affordable housing as a critical need. In response, ACDC contracted to purchase a 2.76-acre brownfield at 2505 Washington Avenue for housing development in December 1997. Three years later, a ribbon-cutting ceremony commemorated the development of Washington Courtyards, a 74-unit, mixed-income building (Schopp 2003).

The site previously housed a municipal greenhouse, an automobile sale/repair shop, a truck parts storage facility, and a used car dealership. ACDC used a U.S. EPA Brownfields Program grant to conduct a Phase I & II environmental site assessment and identified four areas within a quarter mile of the site where leaking petroleum storage tanks and contaminated soil were removed in 1989. In 1998, tests from monitoring wells revealed low levels of lead, arsenic, and chromium contamination in the soil and groundwater, which were below the action levels under the Texas Risk Reduction Program. The state issued a final certificate of completion for the site, enabling site development to proceed through numerous alliances of private, public, and community agencies (Figure 4, Schopp 2003).

Residential redevelopment raises several sociopolitical issues. Constructing affordable housing on former contaminated sites can trigger equity concerns because low-income people, if given a choice, might not wish to live there. However, remediating and redeveloping these types of properties as affordable housing can create an asset for low-income communities and encourage other commercial and residential investment nearby (Schopp 2003).

Figure 4. Washington Courtyards redevelopment. Source: Schopp 2003.

2505 Washington Avenue before redevelopment

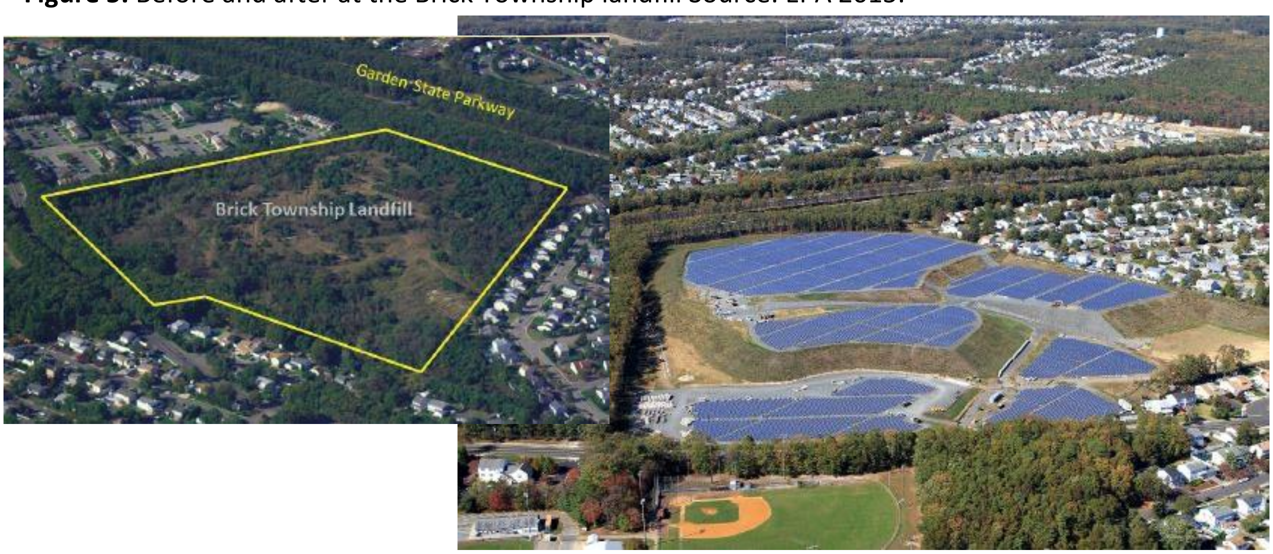
Washington Courtyards after redevelopment

Promoting residential reuse at market prices raises still other concerns about contributing to gentrification, which can push out existing residents who can no longer afford the rising taxes and rents in their community as property values increase. Such social justice concerns are particularly strong where market-priced housing projects have been sited on former contaminated sites near highly desirable waterfront areas (Schopp 2003).

2.5 Light Industrial Development – Brick Township

The Brick Township Landfill Superfund site is located in Brick Township, New Jersey. The Brick Township was responsible for an expensive landfill closure. The town's leaders started thinking creatively about how the site could help generate revenue to defray the cost to taxpayers (EPA 2015). They considered redevelopment of the area from building a medical office park to an indoor firing range for area police departments. In the end, they decided on a solar power facility large enough to supply all electricity needed by nearby township government buildings and community parks (Figure 5). When it was clear the township could not hire a single team to coordinate the cleanup and redevelopment construction, the township stepped up to coordinate the project by assembling a public-private partnership.

Figure 5. Before and after at the Brick Township landfill Source: EPA 2015.



The landfill began operations in the late 1940s and operated for more than 30 years as a disposal site for mixed wastes. An unknown number of 55-gallon drums were disposed of at the landfill containing engine oil, lubricants, automatic transmission fluid, antifreeze, resin, pesticides, and herbicides. A total of 63 million gallons of septic wastes were also disposed of in the landfill between 1969 and 1979. Brick Township purchased the landfill property in 1973 and closed operations in 1979. EPA placed the landfill on the Superfund program's National Priorities List in 1983. Contaminants from the landfill leached into groundwater, soil and sediment affecting about 470 acres of groundwater (EPA 2015).

In 1992, state officials ordered the township to construct an impermeable cap on the landfill. The township asked the state to allow an alternative remedy (monitored natural attenuation). The state agreed at the time that an impermeable cap was not needed; but it was later found that this less stringent remedy was not reducing contaminant levels quickly enough. EPA's risk assessment found that the levels of arsenic, chromium, mercury and vinyl chloride in the site's groundwater would pose a risk to human health if people consumed it. After multiple sampling events, EPA selected a final remedy in 2008, which included constructing an impermeable landfill cap and institutional controls to restrict the use of groundwater (EPA 2015).

Through the public-private redevelopment partnership, the township was able to leverage resources needed to create a 7-megawatt solar facility (EPA 2015). Brick Township installed the landfill cap in 2013 and in 2014 the solar developer installed the site's 24,000 solar panels. The solar facility is connected to the regional electric grid. The solar facility started producing electricity in October 2014 and by May 2015, the solar facility had generated over 3 million kilowatt-hours of power, offsetting as much carbon dioxide as 60,000 trees (EPA 2015).

Members of the collaborative project team learned several lessons during the project, and they suggest communities consider the following for similar projects:

- Integrating cleanup and reuse was crucial to the success of the project. By selecting a desired reuse prior to designing the cap, the design engineers were able to adjust the cap's design to optimize it for the solar panel construction.
- Having an experienced solar developer is crucial. Make sure the solar contractor has experience with similar projects.
- Environmental cleanup companies and solar developers operate in separate industries; they may not want to team up together on a combined contract.
- Make an extra effort to inform the public about the project, using a variety of methods. Putting in extra effort up front can help avoid misunderstandings down the road.

2.6 Unique Reuse Opportunities – Petrified Forest Expansion

The NIPSCO facility location offers unique and innovative reuse possibilities. The Lake Michigan shoreline and proximity of the Indiana Dunes National Park provide redevelopment alternatives that are not normally possible at closing facilities. The Indiana Dunes National Park typically has over two million visitors annually (https://www.statista.com/statistics/254018/number-of-visitors-to-the-indiana-dunes-national-lakeshore/). Michigan City can target redevelopment that capitalizes on National Park visitation.

National parks have limited authorized acreage they can manage, but National Parks can be expanded through executive order and new laws. Funding from the Land and Water Conservation Fund (LWCF), a federal land protection program that receives significant revenue from the development of federally-owned offshore oil and gas rights, can be used to fund National Park expansion and renovation. The following case study demonstrates this type of land redevelopment at a National Park.

On December 3, 2004, President George W. Bush signed the Petrified Forest Expansion Act into law, more than doubling the authorized acreage of the park. The Act provided the authority for the National Park Service to acquire approximately 125,000 acres of private and State lands from willing sellers and transfer Bureau of Land Management (BLM) lands into the new boundary for the Park.

On May 18, 2007, the BLM transferred administrative jurisdiction of approximately 15,228 acres of public lands to the National Park Service. The funds for acquisition of lands came through LWCF, and no taxpayer dollars were used to support the transfer. As part of the transfer process, the Petrified Forest National Park competed for LWCF funds with other worthy projects across the National Park Service.

Using this funding approach, the former Paulsell Ranch was purchased from the Hatch family, adding 25,876 acres primarily to the eastern portion of the park. In January of 2013, the Conservation Fund, in partnership with the National Parks Conservation Association, purchased the 4,265-acre McCauley Ranch on the park's behalf. On December 26, 2013, the National Park Service purchased the ranch from The Conservation Fund. On August 30, 2016, a 7,629-acre portion of the NZ Milky Ranch in the southeastern portion of the park expansion was purchased by the National Park Service. Including several smaller parcels not highlighted above, the park has acquired over 53,000 acres since 2007, mostly in the eastern expansion area, and is leasing another 25,000 acres from the State.

Through partnerships with local, county, State of Indiana, and federal agencies and private stakeholders, it’s possible that a similar process can be implemented at the NIPSCO facility, expanding Indiana Dunes National Park. The Michigan City business economy would benefit if the former NIPSCO facility could be redeveloped in part by the Park Service and merge it with other redevelopment alternatives that support local business development. For example, reuse alternatives could include a Climate Change Resource Education Center, or an overnight visitor campground owned and managed by Michigan City. Through partnering with the Nation Park Service, LWCF funds can be targeted for redevelopment to avoid or limit use of taxpayer funds. LWCF funds are an appropriate funding source because they are collected from the fossil fuel industry and would be used to redevelop a former coal-fired facility responsible for decades of greenhouse gas emissions, and in particular carbon dioxide.

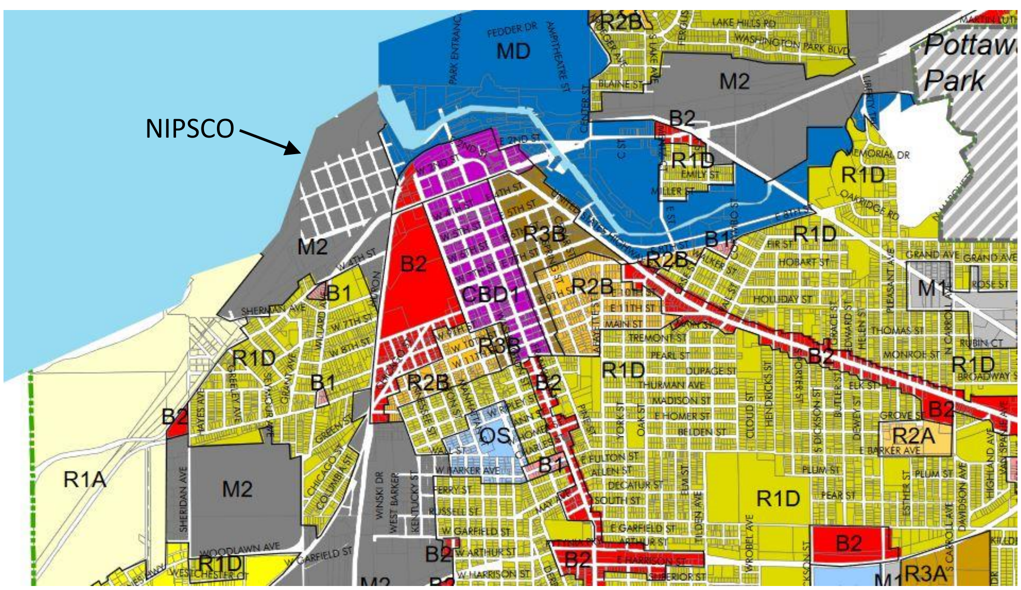
3. Challenges, Strategic Planning, and Engineering

Closing the NIPSCO power generation facility is several years away. The complete cleanup of the site and demolition of the power generation facilities must be planned and executed. It may be possible to retain some of the existing power generation facilities, such as the cooling tower; however, funds are needed to maintain and eventually remove legacy structures if they become a hazard. It may be possible to collect demolition funds from the owner at closing and use the funds in the future for demolition. Reuse planning should not be delayed until cleanup is completed. The sooner the community and local leadership establish a placeholder on redevelopment, the more likely it is to realize local redevelopment goals. A placeholder on redevelopment could take the form of an agreement or memorandum of understanding between NIPSCO and a coalition of interest groups, community leaders, elected municipal leaders, planners, and volunteers. The agreement would outline the process to exchange reuse ideas, adopt a process to select a final redevelopment plan, estimate costs, and address administrative needs, such as zoning changes. Outside interests in Lake Michigan shoreline development is almost certain. There will be competing redevelopment interests that likely are driven by profiteering versus local community needs.

Planning funds are needed to create a community board or council, identify key agency and stakeholder memberships, and develop a vision and actionable goals that support redevelopment once cleanup and demolition are completed. The source of funding for planning may be through local funds if available, state or federal government grants, or potentially nonprofit organizations providing in-kind support or funding. Michigan City may benefit from receiving in-kind support service, grant writing services, or outside reuse facilitation services needed to begin the reuse planning process.

Michigan City has a legal and vested interest in reuse because the power generation facility is located within city limits. For over 175 years, the city has invested local resources in the development and operation of city services, roads, and utilities. The city has a vested interest ensuring major changes within the city limits, such as a closing power plant, are well planned and reuse benefits residents, housing, and businesses. The city also has a vested interest in community planning and assuring citizen representation in a reuse selection process. To accomplish this, the city has legal authority over zoning, subdivision, annexation, infrastructure development, and community planning per local ordinance. Zoning at the NIPSCO facility is currently zoned as Heavy Industrial (M2). North of the site is zoned the Marina District (MD) and south of the site is R1A, or Single Family Residential (Figure 6). Michigan City can and should identify and recommend the best possible zoning designation before environmental cleanup is completed to meet the community planning, growth, and economic objectives.

Figure 6. NIPSCO facility zoning Heavy Industrial (M2).



The city can decide to retain the industrial zoning designation for electrical generation or other beneficial industrial uses, or it can be changed to recreational, residential, commercial, or multiple-use after cleanup. While processes exist for developers and outside interests to petition to change zoning designations, Michigan City can rely on a community-led planning effort to identify rezoning based on community needs and desires. This can be achieved through preparation of a Growth Policy or

Comprehensive Plan. This process can occur in the redevelopment planning phase to prevent reuses that may not be compatible with the best interests and needs of the community.

Another responsibility Michigan City leads is transportation and access to the NIPSCO facility. The facility is located across a major highway and railroad corridor. Railroad corridors are significant barriers to expanded local access. Generally, the number of railroad crossings are limited for safety reasons and there are high costs associated with modifying access through these types of corridors. Alternatively, the railroad corridor could be removed if there is no longer a need for rail traffic in this area.

Assuming the railroad corridor must remain in place, the existing access points may limit easy and nearby residential access to a redeveloped site, such as a park or commercial business area. Expanding access may be desirable to provide local residents with better access to the area, such as an elevated foot traffic bridge over the railroad corridor to a waterfront recreation area or park system. A redevelopment plan must consider transportation needs assuming enhanced access to a recreation area is desired. Other considerations include plans for parking, walking trails, interior roads, public water, public sewer, and stormwater infrastructure, all of which require civil engineering services and agency review.

4. Reuse Alternatives

A reuse plan for the NIPSCO power generation facility does not currently exist. Limited information from area residents, community leaders, and nonprofit organizations identify ideas for reuse and for what not to develop. However, no official group or government agency is leading redevelopment for the NIPSCO facility. In the absence of a reuse plan, a range of possible reuses are discussed here and serve as talking points to foster local input, creative reuse ideas, and garner interest in pursuing a formal reuse planning effort.

The following facility reuse matrix identifies 22 example reuses at the NIPSCO facility once cleanup is completed. The redevelopment alternatives range from no action, a recreational beach and park, marina, commercial development, low-income residential development, renewable power generation facility, industrial reuse, and possibly expanding Indiana Dunes National Park. It is difficult to conclude which, if any, of the identified reuse ideas have merit in terms of truly benefiting Michigan City residents from an economic, environmental justice, housing, quality of life, and other perspectives. A formal public input, planning, and review process is needed to sort, discuss, and prioritize redevelopment at the plant site.

The matrix is set up to list possible reuse alternatives, identify new ones, and discuss the pros and cons of each reuse. It also serves as tool to consider eliminating some redevelopment alternatives. For example, local input suggests there is no desire for constructing condominiums after cleanup. This reuse was kept in the matrix to serve as a reminder that it was not formally dismissed under the official reuse selection process and private interest groups may pursue redevelopment in the absence of a community-led reuse plan. A desire for no private development can be articulated in the guiding principles of the community redevelopment plan.

The matrix provides qualitative indicators of cost as low, moderate, high, and very high designations. These indicators suggest the cost of required construction after the cleanup is completed. This cost may include demolishing industrial infrastructure, adding more fill and sand for beach reconstruction, protecting the break wall so it lasts in perpetuity for a marina, engineering permitting services, road construction, utility infrastructure construction, landscaping, building/home construction, commercial facilities, industrial facilities, and whatever else may be needed to achieve turnkey redevelopment.

For the purposes of discussion, costs are broken into four categories. These are not precise or representative cost estimates but serve as way to compare relative cost between redevelopment alternatives. Actual costs cannot be prepared until more details are available for reuse alternatives.

Low:	< $1 million
Moderate:	< $40 million
High:	< $80 million
Very High:	> $80 million

The difficulty in implementing a reuse plan, identifying possible leadership roles, and technical feasibility are described in the matrix. Both the difficulty, such a being able to setup a public and private partnership, and technical feasibility, such as being able to address all engineering needs, shed light on the challenges for each alternative. Similarly, the likely beneficiaries from reuse are identified, possible issues identified once reuse is constructed, and the relative local economic impact is provided. These criteria offer subjective perspectives on reuse that are subject to change pending redevelopment discussions.

All of the reuse plans are expensive with the exception of no action. Under the no action alternative, Michigan City would likely lose significant tax revenue as it offers only limited to no benefits to residents. Private reuse plans are also not necessarily expensive to the community because they are funded with private venture capital. These types of developments may add to the tax base, replacing at least some of the lost tax revenue from the power plant. However, they also may have limited contributions to local businesses and offer no benefits to residents because of economic inequalities related to, for example, construction of upper-end condominiums. A locally led reuse plan can consider reuses that account for a variety of guiding principles that lead to redevelopment and alternatives that target the needs and desires of Michigan City residents.

Notable reuses in the matrix include low-income lakefront housing and public beach funded through government housing programs; expanding Indiana Dunes National Park through LWCF, executive order, and partnering with Michigan City; building an RV park and campground with a public beach to generate local revenue from visitors camping next to the Park; and generating renewable energy from a solar farm with a public beach.

Other development options have different economic and public benefits. All of them are similarly difficult to fund and implement without public funding or private venture capital. Nonetheless, a well-organized and determined community-led council can find ways to plan and implement the preferred redevelopment alternative. The plan will require adequate outreach, partnering, and stakeholder support. The reuse plan should use site renderings needed to garner public support and fundraising (Figure 7). The preferred alternative can target one focused redevelopment option, such as expanding Indiana Dunes National Park, or propose multiple land uses involving, for example, public beach recreation, commercial development, and low-income residential housing.

5. Economic Gains, Job Creation, and Quality of Life

The economic gains from a complete environmental cleanup for Michigan City are quantified in the Coal Ash Remediation Cost and Job Analysis report. While significant, these gains are considered temporary. Redevelopment, depending on the preferred plan, will likely have similar construction-related economic gains for Michigan City. The economic gains cannot be quantified until a specific plan is adopted. After one or more reuse alternatives are adopted, it is possible to estimate the number of jobs created, capital investment required to construct the alternative, and quantify long-term economic gains.

Qualitatively, the number of jobs created from redevelopment can be discussed early in the planning process and used to compare alternatives. These types of temporary construction jobs last from a few years to generally less than a decade, but they are worthy of analysis because they are potentially a major investment within the Michigan City limits.

Reuse also has a long-term economic benefit that lasts decades and potentially in perpetuity. For example, constructing a private marina or a Michigan City-owned and operated campground at the former facility can increase the local tax base (in the case of the marina) or increase municipal revenue (in the case of a municipal campground selling overnight RV campsites). Both reuses provide temporary short-term construction jobs and long-term employment at the new facility. The long-term economic gains are significant and after decades of operation the benefits should exceed the local economic gains of the original construction activity.

As part of reuse planning, analysis of jobs creation and economic gains must be balanced with other community needs. For example, the reuse plan can prioritize improving quality of life for Michigan City residents and address environmental justice. These types of reuses may include restoring a natural lakeshore for public access or building waterfront affordable housing. The economic benefits for these alternatives may be less but could be considered reasonable following guiding principles that rely on multiple reuse goals vs. a singular goal of economic gain.

Future work on behalf of Michigan City residents is needed to assess the economic benefits in terms of construction jobs, long-term economic gains, and meeting community needs. Economic gains in the matrix are described as: none, limited, some, or significant for each alternative. These descriptors are useful to compare alternatives but offer no monetary level of economic benefit. The descriptors suggest if there is a potential economic contribution to Michigan City as increased tax base, jobs, business development opportunities, or reduced housing costs. Future work should quantify these possible economic gains for targeted redevelopment alternatives as a means to assist reuse planning and decision making.

Michigan City Power Plant Reuse Matrix - Post Cleanup

Possible Reuse	Land Use	ID	Alternatives	Cost	Source of Funding	Difficulty	Leadership	Feasibility	Beneficiaries	Issues	Economic Gains
No action	**Remediated Site No Land Use / No Access**	**1**	None	Low	NIPSCO	Low	NIPSCO	Low	None	Poor aesthetics, no reuse, lost revenue	None
Restored Natural Lakeshore	**Recreation**	**2a**	MI City ownership	Moderate	NIPSCO, local/federal government, private	Moderate	Local	High	Benefits local community and some visitors	Limited local access across highway and RR tracks	Significant local
		2b	MI City & NPS lakeshore partnership	Moderate	Local/federal government, NIPSCO, LWCF	High	Local & NPS	Moderate	Benefits broader community and lake ecology	Limited local access across highway and RR tracks	Limited local
		2c	NPS ownership, expand park & possible limited ownership	Moderate	LWCF, NIPSCO, Local government	High	NPS & Local	Moderate	Visitors, limited local community, and lake ecology	Limited local access across highway and RR tracks	Limited local
Multiuse Lakeshore with no Housing (and Natural or Modified/Fortified lakeshore)	**Recreation & Commercial**	**3a**	Unknown mixed recreation with limited commercial	High	Local government, private, NIPSCO	High	Private and local government	High	Benefits local community but also visitors	Limited local access across highway and RR tracks	Some local
		3b	Small marina & park with some public beach	Moderate	Private, local government, NIPSCO	High	Private and local government	Moderate	Benefits local community and visitors	Existing lakeshore left in place and fortified, limited local access	Some local
		3c	Large marina	Moderate	Private, local government, NIPSCO	High	Private and local government	High	Benefits visitors, limited local community	Existing lakeshore left in place and fortified, limited local access	Limited local
		3d	RV park / campground and public beach	Moderate	Private or local government, NIPSCO	Moderate	Private or local government	High	Benefits visitors, limited local community	Limited local access	Significant local (campers visiting NPS)
		3e	Museum, public beach	Very high	Private, local government, NIPSCO	Very high	Private and local government	Low	Benefits visitors, limited local community	Limited local access	Limited local
		3f	Athletic park / center / ball fields	Moderate to high	Local government, NIPSCO	High	Local government	Moderate	Benefits local community and some visitors	Limited local access	Limited local
		3g	Outdoor concert venue	Very high	Private, local government, NIPSCO	Very high	Private and local government	Low	Benefits visitors and some local community	Limited local access, loud music	Some local
		3h	Three par golf course	High	Private	Very high	Private	Low	Benefits visitors and some local community	Possible limited local interest	Limited local
		3i	Combination & other possible recreation/commercial uses	Very High	Private, local government, NIPSCO	Very high	Private and local government	Moderate	Benefits local community and visitors	Limited local access	Some local
Office space and sales	**Commercial**	**4**	Office / retail / other	High	Private	Very high	Private	High	Visitors, area community and limited local community	Limited local access	Some local
Housing & Multiuse Commercial with possible Lakeshore	**Residential, Limited Commercial, and**	**5a**	Individual homes	High	Private	Moderate	Private	High	Visitors, new residents, and limited local community	Increased home values	Some local

Reuse and Economic Impacts – NIPSCO Power Generation Facility

Possible Reuse	Land Use	ID	Alternatives	Cost	Source of Funding	Difficulty	Leadership	Feasibility	Beneficiaries	Issues	Economic Gains
Recreation	**Lakeshore Recreation**	**5b**	Condominiums	High	Private	Moderate	Private	High	Visitors, new residents, limited local community	Increased home values	Some local
		5c	Public beach, commercial and townhouse development	High	Private, local government, NIPSCO	Moderate	Private and local government	High	Visitors, new residents, and limited local community	Increased home values	Some local
		5d	Public beach, low income lakeshore housing	Moderate to high	Federal government, local/county government, NIPSCO	High	Local government	Moderate	Local community	None	Significant local
Power Generation	**Industrial**	**6**	Solar energy & possible a public beach	High	Private and/or NIPSCO	Moderate	Private Renewable possible local government	High	Limited local community	Poor aesthetics, area limited to developing 5 to 10 MW solar power based on available acreage	Some local
Transportation	**Industrial**	**7a**	Rail without Marine	Very high	Private	Very high	Private without possible local government	Moderate	Local and area community	Noise, pollution, poor aesthetics	Some local
		7b	Marine and rail	Very high	Private	Very high	Private and possible local government	Low	Local and area community	Existing lakeshore left in place and fortified	Some local
Manufacturing	**Industrial**	**8**	TBD	Very high	Private	Very high	Private	Low	Local and area community	Noise, pollution, poor aesthetics	Significant local

Exhibit 7. Example Reuse Plan
NIPSCO Power Generation Facility
Representative Reuse Scenario

0 0.125 0.25 Miles

KirK Inc.
Engineering & Natural Resources

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Date:	2/9/2021
Other info:	

Sheet No. 1

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