
DRAFT PRELIMINARY CONCEPTUAL RESTORATION PLAN

BUTTE AREA ONE



Prepared for:



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Materials Subject to FRE 408

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Cover: Tailings at Parrot operation, ca 1906. From *Hugh Magone v. Colorado Smelting and Refining Co., et.al* records. Magone sued for damages because the piles of tailings from the ore concentrator and smelter operated by Anaconda polluted the waters of the Deer Lodge River and his farm in Deer Lodge Valley. Citing the economic benefit of the mines and smelters to the region, the Master of the Chancery said the plaintiff ought to have known the water was polluted and refused to award monetary damages.

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1. INTRODUCTION

1.1. Background and Purpose

In 1983, the State of Montana filed a lawsuit in federal District Court against the Atlantic Richfield Co. (ARCO) for injuries to the natural resources in the Upper Clark Fork River Basin (UCFRB), which extends from Butte to Milltown. The *Montana v. ARCO* lawsuit, brought under federal and state Superfund laws, sought damages from ARCO, contending that decades of mining and smelting in the Butte and Anaconda areas had greatly harmed natural resources in the basin and deprived Montanans of their use.

The State settled *Montana v. ARCO* through a series of settlement agreements, or consent decrees, completed and approved by the Court in 1999, 2005 and 2008. One of the three injured areas in the UCFRB covered under the 2008 settlement agreement was the Butte Area One injured groundwater and surface water site.

The 2008 *Montana v. ARCO* Consent Decree allocated \$28.1 million, plus interest, to restore, replace or acquire the equivalent of the injured groundwater and surface water of Butte Area One (BAO). Governor Schweitzer created the Butte Natural Resource Damage Restoration Council (BNRC) to give the citizens of Butte a strong voice on how this fund should be spent. The nine member volunteer council, with assistance from the Montana Natural Resource Damage Program (NRDP), developed the 2012 Butte Area One Final Restoration Plan (2012 BAO Plan) to guide the expenditure of these funds. The 2012 BAO Plan built on the 2007 Butte Area One Draft Conceptual Restoration Plan, attached to the 2008 *Montana v. ARCO* Consent Decree.

A major component of the 2012 BAO Plan is the restoration of the historic Upper Silver Bow Creek Corridor.¹ The 2012 BAO Plan calls for removal of mine wastes

¹ By definition, restoration can include remedy. However, the 2012 BAO Plan stated:

At this time a Consent Decree finalizing the remedial actions for Butte Priority Soils Operable Unit has not been reached, however, in keeping with their goal, the BNRC has produced this restoration plan in time for the Governor's consideration. Since the final Butte Priority Soils Operable Unit remedy plan is unknown, this restoration plan is not as specific as the council had desired. Instead, it offers enough flexibility that it should complement the future remedy and not take its place.

The State's goal is successful negotiation of a Butte Priority Soils Operable Unit (BPSOU) consent decree. Nevertheless, should BPSOU consent decree negotiations fail, NRDP would then discuss options with the BNRC as well as the public, consistent with Section 6 of the 2012 BAO Plan, regarding expenditures of the historic Upper Silver Bow Creek corridor funding. Such

left in place along the historic floodplain of Silver Bow Creek through BAO. The 2012 BAO Plan identifies these wastes, which include the Parrot Tailings, Diggings East, Northside Tailings and other isolated areas of mine wastes in the Blacktail and Upper Silver Bow Creek floodplains, as the primary sources supplying inorganic contaminants to the alluvial groundwater and surface water resources within the historic Silver Bow Creek corridor. The 2012 BAO Plan noted that leaving these wastes in place was by far the greatest concern expressed by the majority of the citizens that responded during the public solicitation process. The 2012 BAO Plan also noted:

The restoration of the Upper Silver Bow Creek corridor, as provided above, will become part of a more definitive restoration plan that will be developed by the NRDP before the ongoing BPSOU [Butte Priority Soils Operable Unit] Consent Decree negotiations are concluded. That plan will be funded with up to a \$10 million allocation provided for in this section and, it is envisioned, from other funding sources. The more definitive plan, whether or not other sources are found to contribute to its funding, shall be treated as a “significant, substantial change” in this BAO Restoration Plan for the purposes of Section 6 [Restoration Plan Implementation], below, and will be subject to the same review and public comment steps before its final approval by the Governor as provided for in Section 6.

Consistent with the 2012 BAO Plan, this draft Preliminary Conceptual Restoration Plan (PCRP) is the first step towards a more definitive plan to describe the restoration of the historic Upper Silver Bow Creek corridor.

1.2. Role of the BNRC and Public

This draft PCRP describes preliminary conceptual restoration approaches for restoration of the Upper Silver Bow Creek corridor. NRDP is now seeking input by the BNRC, public, and other stakeholders on these approaches through November 26, 2014. NRDP will consider this input prior to issuance of a final PCRP, anticipated to be issued December 2014.

discussions would focus on those actions which complement, rather than replace, future remedy actions deemed necessary by the State to protect groundwater and surface water resources. As the State may advocate, absent a consent decree and further funding, that further actions similar to those considered in this document are necessary to protect groundwater and surface water resources as part of remedy, complementary actions may or may not include actions similar to those considered in this document.

The State retains and reserves all rights and authorities, including, but not limited to, those related to the BPSOU Record of Decision and BPSOU potentially responsible parties. This includes, but is not limited to, the groundwater and surface water components of the BPSOU Record of Decision remedy.

The final PCRCP, though preliminary, will provide direction to NRDP in the development of a revised and updated draft Conceptual Restoration Plan. Consistent with Section 6 of the 2012 BAO Plan, NRDP will continue to apprise BNRC members and the public on the continuing development of the draft Conceptual Restoration Plan(s), to the extent permissible under consent decree negotiations requirements of confidentiality. NRDP will also continue its work with all interested entities as it develops the draft Conceptual Restoration Plan(s).

The draft Conceptual Restoration Plan(s) would be attached upon lodging to a BPSOU consent decree. Prior to consent decree lodging, the draft Conceptual Restoration Plan(s) would be subject to consideration of the input of the Trustee Restoration Council, the BNRC, NRDP, and the public, consistent with Section 6 of the 2012 BAO Plan.

The draft Conceptual Restoration Plan(s) would also be subject to public comment upon lodging. Similarly to the 2007 Butte Area One Draft Conceptual Restoration Plan, the State, with the Governor as Trustee, would reserve its right to withdraw from or withhold its consent to the consent decree if the comments regarding the Conceptual Restoration Plan disclose facts or considerations which indicate that the plan is inappropriate, improper, or inadequate.

The State requires that any consent decree resulting from the BPSOU consent decree negotiations be fair, reasonable, in the public interest, and consistent with the goals of CERCLA. This includes the appropriate coordination of remedy implementation with State restoration requirements, and the inclusion of additional appropriate funding sources for the plan.

Should the consent decree be approved, NRDP would proceed to the next phase, which is refinement and validation of the Conceptual Restoration Plan with additional field data, analyses and surveys. This would lead to the final design phase, which would provide detailed design drawings and information adequate to implement the projects. Restoration implementation would then follow design. NRDP anticipates that the time from entry to restoration completion would take several years.

The State's goal is successful negotiation of a BPSOU consent decree. However, should BPSOU consent decree negotiations fail, NRDP would then discuss options with the BNRC as well as the public, consistent with Section 6 of the 2012 BAO Plan, regarding expenditures of the historic Upper Silver Bow Creek corridor funding. Such discussions would focus on those actions which complement, rather than replace, future remedy actions deemed necessary by the State to protect groundwater and surface water resources.

1.3. Butte Area One Overview

The deposition of wastes within the City of Butte from mining and mineral-processing operations has resulted in injury to groundwater and surface water resources of the Silver Bow Creek watershed.

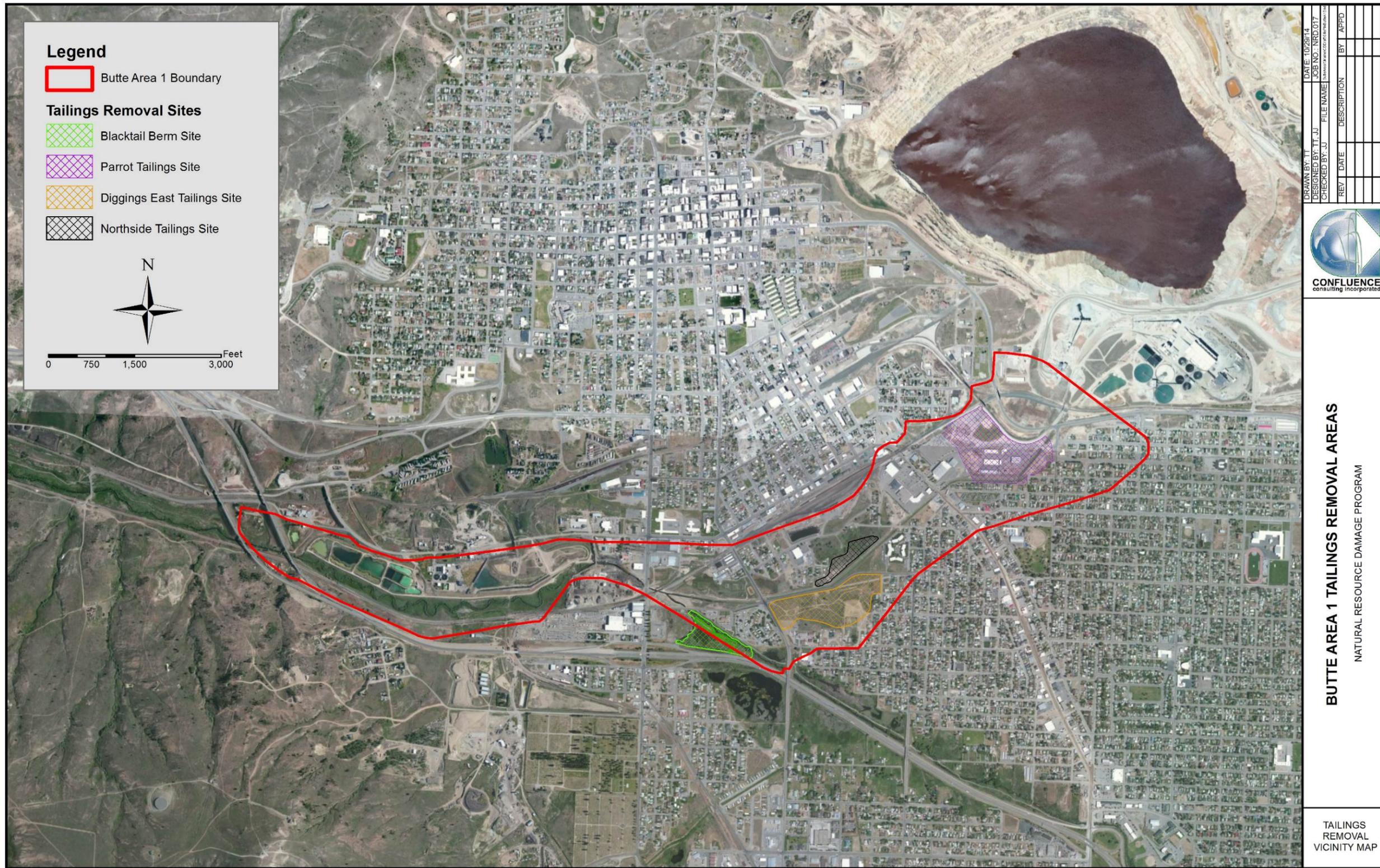
The identified injured alluvial groundwater and surface water within Butte is located in the south central portion of the Butte Priority Soils Operable Unit, referred to as Butte Area One (BAO). The BAO is depicted in the red-outlined area on Figure 1. Many of the wastes in BAO are associated with five facilities – the Parrot Smelter, the Metro Storm Drain (MSD), the Butte Reduction Works, the Colorado Smelter, and the Berkeley Pit. The Metro Sub-drain is a tile drain system located directly under the MSD, constructed to collect shallow near drain contaminated groundwater.

Injury to groundwater in BAO has been demonstrated by the occurrence of concentrations of inorganic contaminants (including cadmium, zinc, iron, lead, copper, arsenic, and sulfate) that exceed State water quality standards in the alluvial aquifer. The areal extent of the known contamination above these standards in the alluvial aquifer is approximately one square mile.

The concentration of copper in Parrot Tailings area groundwater can exceed 1,000,000 parts per billion (ppb). Similarly, the concentration of zinc and cadmium can exceed 500,000 ppb and 2,000 ppb respectively. These extremely high concentrations are rivaled in the Upper Clark Fork River Basin only by the leach pad operations at the active mining site in Butte. The concentration of copper in the Parrot Tailings area groundwater can be as much as fifteen times greater than Berkeley Pit water contaminant concentrations.

In the Diggings East and Northside Tailings areas, some samples from the original soil horizon (organic silt) on which these wastes were deposited contain in excess of 2% copper and 2% zinc. A total mass of over 3,000,000 pounds of copper and 7,000,000 pounds of zinc are estimated to be contained in the unsaturated zone in these areas.

Figure 1 Butte Area One Overview.



At the Blacktail Creek berm area, which forms the bank of the Blacktail Creek floodplain, NRDP's initial limited investigation showed elevated contaminant concentrations, with copper and zinc concentrations typically ranging from 5,000,000 to 10,000,000 ppb.

These tailings and wastes will continue to release hazardous substances to groundwater, and potentially surface water, in the historic Upper Silver Bow Creek area for many centuries, if not thousands of years.

1.4. Conceptual Restoration Plan Objectives

The objectives for removing the mine wastes left in place are set forth in the 2012 BAO Plan, and will guide the development of the PCRCP and the draft Conceptual Restoration Plan(s). The objectives are:

- to eliminate known sources of inorganic contamination to alluvial groundwater and surface water;
- to restore the area to a beneficial end use;
- to enhance the area riparian corridors; and
- to improve the quality of the fishery in Blacktail and Upper Silver Bow Creeks.

1.5. PCRCP Content and Scope

The expectations of the PCRCP are to:

- Further, and be consistent with the 2012 BAO Plan;
- Lead to development of a draft Conceptual Restoration Plan that would not adversely impact the remedy in significant ways;
- Remain consistent with natural resource damage provisions and other applicable requirements;
- Identify likely removal areas and waste types, and estimate waste volumes;
- Take into account the potential and current needs for wet weather management and catch basins;
- Identify land access and ownership;
- Identify potential end land use;
- Identify data or information gaps and describe plans to address them;
- Include a preliminary general schedule; and
- Reasonably balance any conflicting needs.

To support these purposes, the document is organized into the following sections:

- Section 1. Introduction. Provides project background, descriptions of the project area setting and resources that are important relative to restoration potential.
- Section 2. Parrot Tailings. Provides descriptions of anticipated excavation of tailings/impacted materials and proposed potential end land use for the area.
- Section 3. Diggings East and Northside Tailings. Provides descriptions of the anticipated excavation of tailings/impacted materials and proposed end land use alternatives for the area.
- Section 4. Blacktail Berm. Provides descriptions of the anticipated excavation of tailings/impacted materials and proposed end land use alternatives for the Blacktail Berm and associated wetland areas.
- Section 5. Summary Cost Estimates of PCRPs Alternatives. Provides summary cost estimates of the alternatives.
- Section 6. Data and Analysis Needs. Provides an assessment of data gaps.
- Section 7. References.

1.6. Assumptions

In order to better illustrate PCRPs options and encourage further dialogue, the draft PCRPs includes preliminary assumptions and estimates, with certain assumptions yet to be borne out. For example, the PCRPs assumes landowner acceptance and legal access to removal and repository properties, though NRDP discussions with landowners have been very preliminary to date. The PCRPs also includes assumptions in discussions of future end land use, though discussions with interested stakeholders have been preliminary. All assumptions and estimates made in the draft PCRPs will be further developed and advanced through discussion and input following issuance of this draft PCRPs.

1.7. PCRPs Schedule

- NRDP is distributing this draft PCRPs, including initial input to date, on Wednesday, November 5, 2014.
- NRDP is seeking further written input on this draft PCRPs from all interested parties, stakeholders, and the public through Wednesday, November 26, 2014.
- NRDP plans to issue a final PCRPs by December 17, 2014.

2. PARROT TAILINGS PROJECT

2.1. Tailings/Contaminated Materials Removal

2.1.1. Removal Activities

For the purposes of this draft PCRP, tailings and contaminated soils within the Parrot Tailings complex were characterized from 44 bore log records previously compiled for MBMG Open File Report #590 (MBMG 2010). Boring locations and identifiers are presented on Figure 2.

The typical profile of materials expressed in the bore holes within the Parrot Tailings area includes a layer of tailings from one half to more than twelve feet thick (average 4.8') that is underlain by a layer of native, organic rich soils (average 2.1' thick) that have become contaminated by leaching from the tailings above. These contaminated materials are buried beneath one to more than twenty feet (average 12.6') of non-tailings overburden materials, including waste rock and smelter slag. The vertical extent of the tailings and contaminated materials removal assumed by this draft PCRP for the Parrot Tailings area would include removal of tailings, removal of contaminated, organic rich "black clays" from beneath tailings deposits, and removal of any intervening soil horizons between tailings and the contaminated, organic rich "black clays". Overburden materials - including clean soil, waste rock, and slag - would be respoiled on site.

The horizontal extent of the tailings and contaminated materials removal for the Parrot Tailings complex assumed by this draft PCRP is as used in the Final Focused Feasibility Study for the Metro Storm Drain, Butte Priority Soils Operable Unit (EPA 2004) for the Total Removal Option, with the following infrastructure-protection related adjustments:

1. Removal would not be performed beneath or beyond the railways that bound the northeast and northwest sides of the current Civic Center Parking lot/Ball field area north of Civic Center Road. Removing tailings from beneath and between the rail bed and ballast, elevated rail embankment, and roadways is expected to be cost prohibitive.
2. Removal would not be performed beneath the footprint of the Metro Storm Drain (MSD). It is assumed that most of the tailings and contaminated materials that may have been present in this area would have been removed during the construction of the MSD and MSD sub-drain construction, and that disturbing the remedy infrastructure to get at the tailings that may remain would not be warranted.

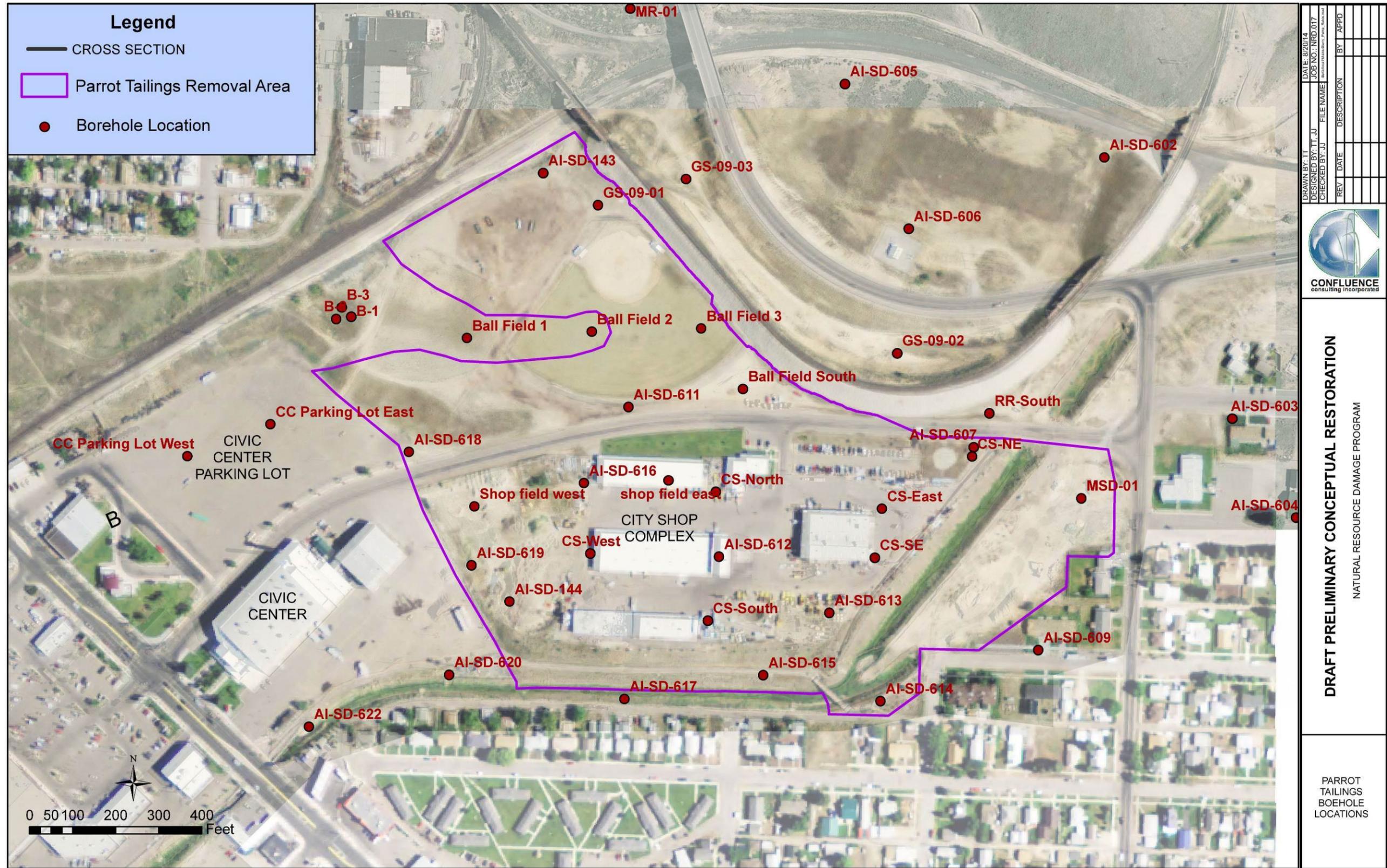


Figure 2 Borehole locations, Parrot Tailings Project Area

3. Removal would not be performed beneath the Civic Center building or its associated paved parking areas north and south of Civic Center road. Boreholes in this area typically show no tailings or thin (less than 1' thick) tailings, some of which have already been removed in the course of maintenance activities on Civic Center facilities. Disturbing the substantial Civic Center infrastructure, as well as City utilities (water, sewer, and storm sewer including a Hydro Dynamic Device) to get at the tailings that may remain would not be warranted.
4. Removal activities would not take place in areas where borings show no presence of tailings or contaminated materials. Five boreholes in the northeast of the Parrot Tailings complex (B-1 to B-3, Ball Field 1 & 2) indicate fill with slag and other overburden, but an absence of tailings and contaminated materials. The area in the vicinity of these boreholes was excluded from the tailings and contaminated removal area.

Accounting for these adjustments, the tailings and contaminated materials removal area is presented on Figure 3. This area is further subdivided into primary and secondary removal areas. The bulk of removal activities would take place in the primary removal area, which encompasses the current ball field area north of Civic Center road, and the City Shop Complex south of Civic Center road. Limited, if any, removal activities would be performed in the secondary removal area, southeast of the MSD in the area of the current City park that houses the Texas Avenue Hydro Dynamic Device (HDD). Borings indicate limited tailings impacts in this area, much of which has likely been removed during construction of the existing storm sewer, HDD, and City park. Limited additional removal in this area would be considered, provided that it could be achieved cost effectively without endangering this infrastructure.

The Parrot Tailings removal area encompasses approximately 33 acres. From within this area, approximately 270,000 cubic yards of tailings and contaminated materials are assumed to be removed and disposed of off-site. To access those wastes, approximately 675,000 cubic yards of overburden would need to be excavated and replaced on-site. Existing conditions cross-sections displaying the layering of wastes and overburden for cross-sections A and B from Figure 3 are presented on Figure 4 and Figure 5, respectively. Land ownership of the Parrot Tailings project footprint and surrounding areas, from Montana Cadastral, is presented on Figure 6.

Removal of the Parrot Tailings would require demolition and removal of the City Shop Complex, which would be relocated off-site per the desires of Butte Silver-Bow. Tailings removal would also require demolition and removal of the existing ball field.

Within the footprint of the removal are several utilities, including electric, water, sanitary sewer and storm water lines. Utilities associated with the current City

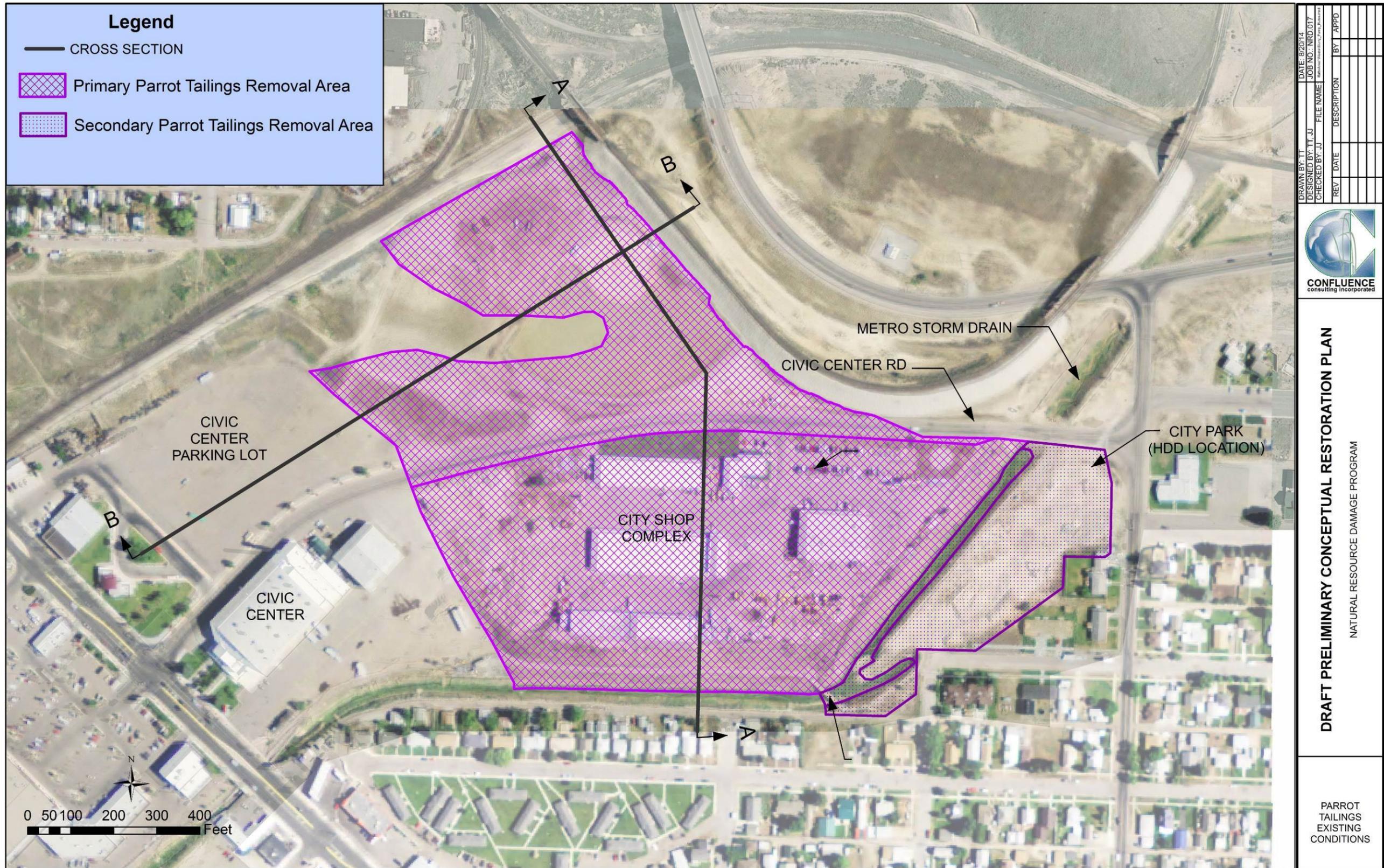


Figure 3 Parrot Tailings Project Area Existing Conditions

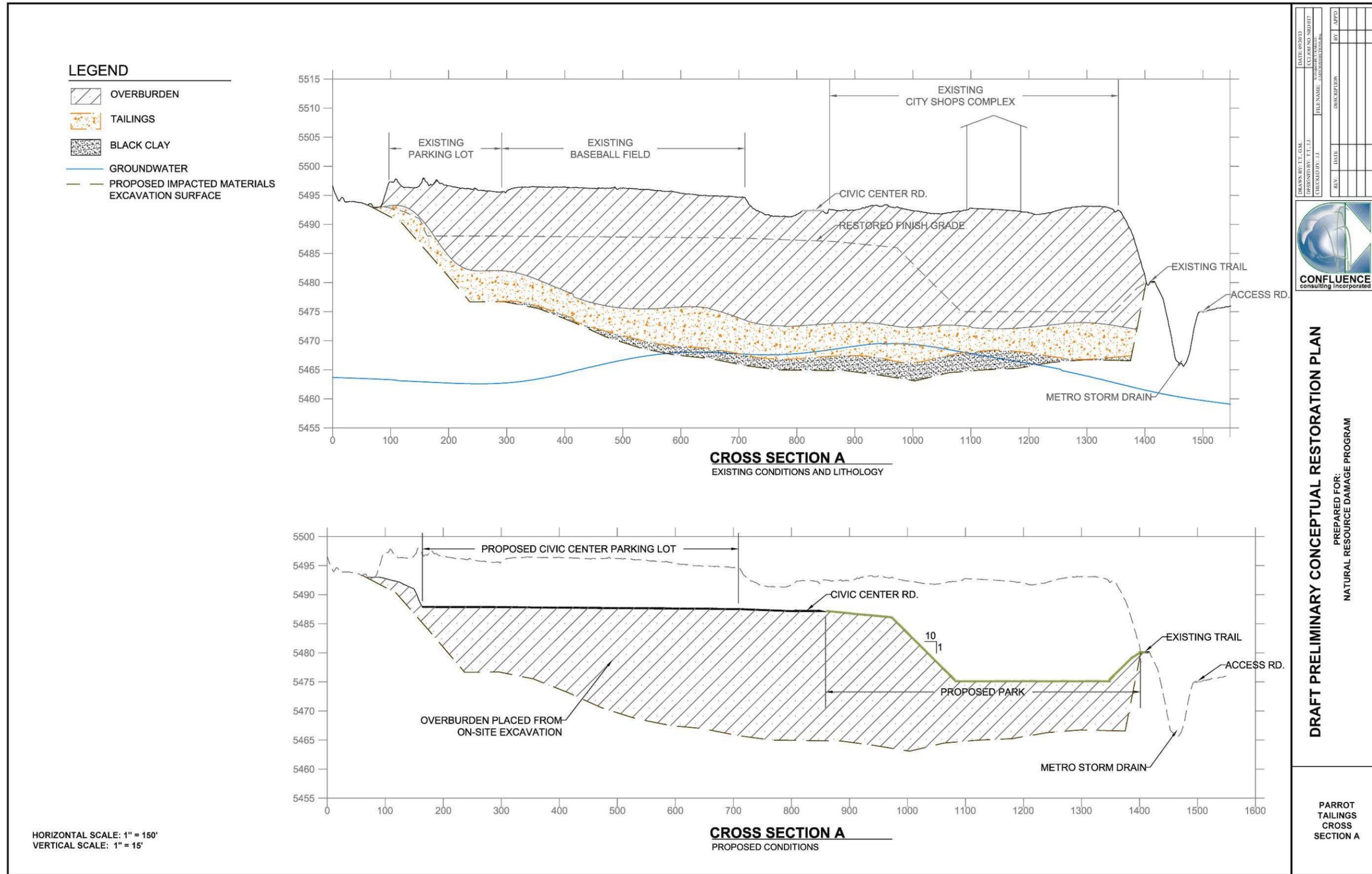


Figure 4 Parrot Tailings Project Area Cross Sections, Section A

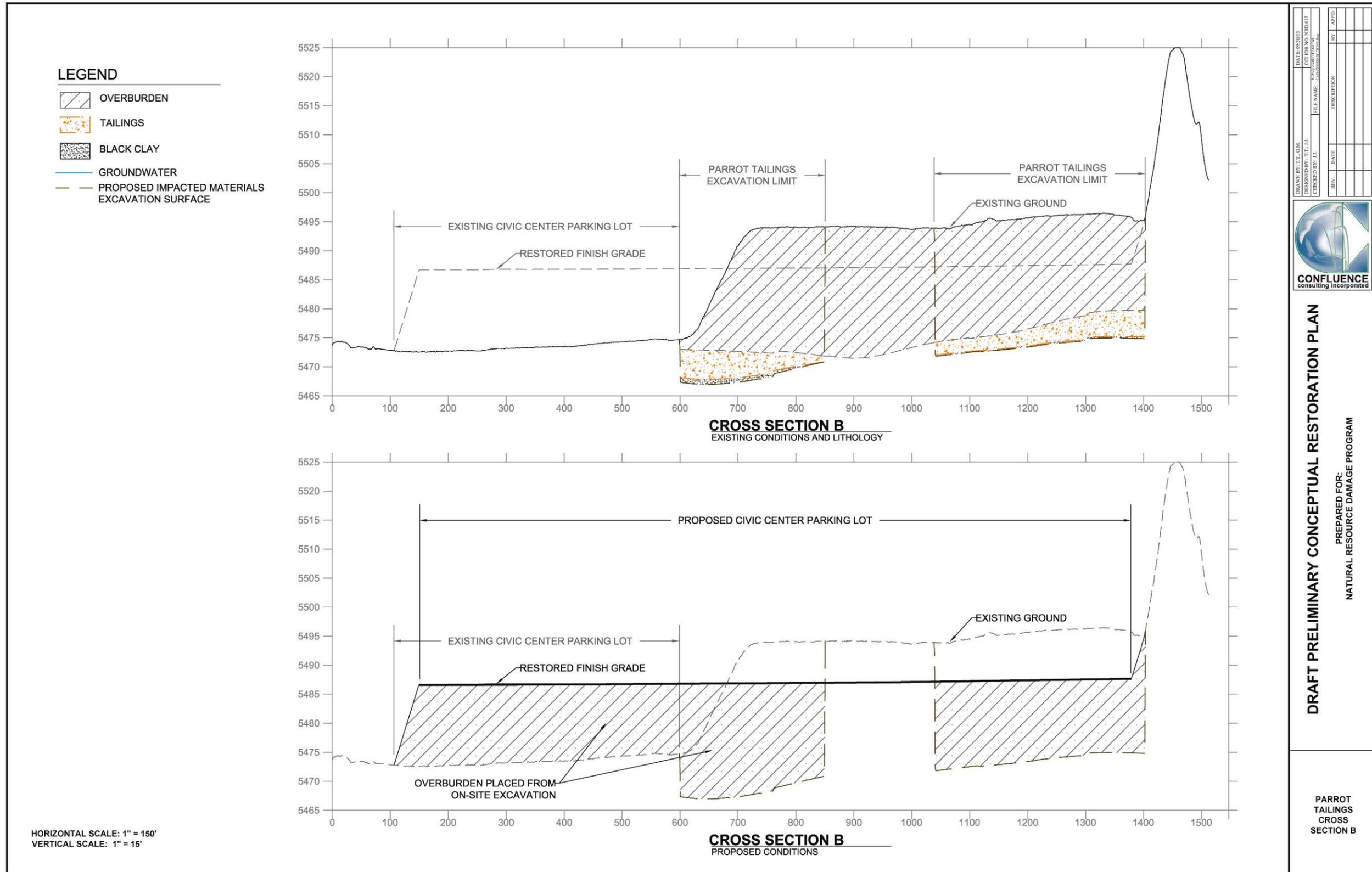


Figure 5 Parrot Tailings Project Area Cross Sections, Section B

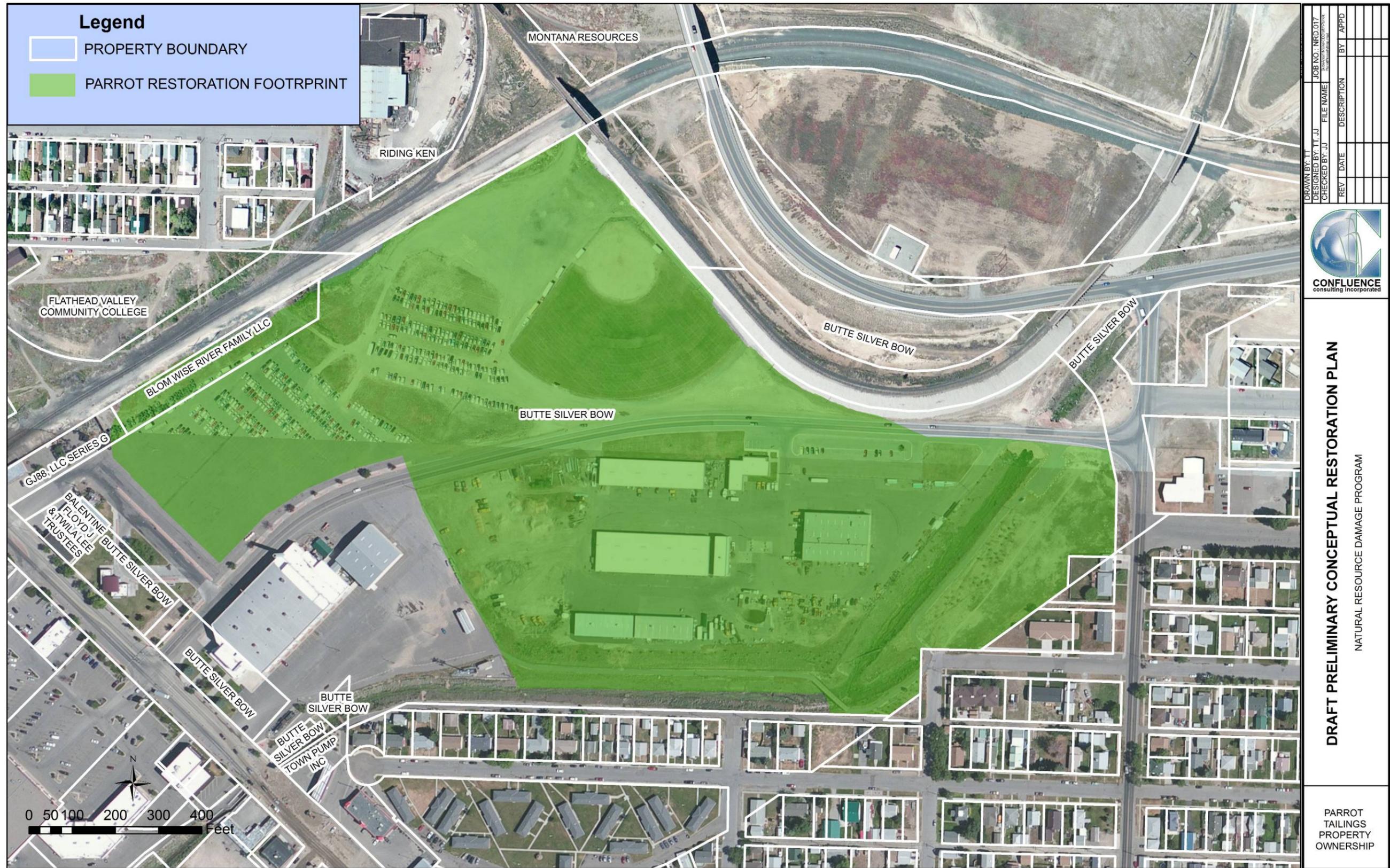


Figure 6 Parrot Tailings Project Area Property Ownership

Shop Complex are expected to be removed and replaced only if deemed necessary to serve elements of the restoration. Utilities that transit the site, including the storm sewer line, are expected to be retained or replaced. The two HDDs would be left undisturbed, and maintenance access maintained. The Metro Storm Drain and MSD sub-drain are excluded from the removal area, and would not be expected to be disturbed by removal activities. Civic Center road would be closed during the removal action, demolished to remove tailings beneath, and replaced on its current alignment.

It is anticipated that dewatering may be necessary to accomplish some of the tailings/contaminated materials removal and restoration backfill activities. Dewatering needs were estimated by comparing the groundwater elevation recorded in the borehole logs used for determining the contaminated materials excavation. The results of this comparison (approximately 9 acres of saturated materials, inundated to an average depth of approximately 2 feet) is presented on Figure 7. Assuming a 20% porosity of these contaminated materials would equal a dewatering rate of less than 120 gallons/minute for a week.

It is noted however, that the borehole logs in question predate the installation of the MSD, during a period of generally wetter climatology. Groundwater conditions at the time of restoration implementation are expected to be different and more data would need to be collected for further analysis. For the purposes of this draft PCRP and its costing assumptions, the original borehole data based inundation was used as a conservative assumption.

2.1.2. Transport and Disposal Options

Two transport methods, truck haul and slurry pipeline, might be used to remove the tailings and contaminated materials from the Parrot Tailings project area to a permanent repository. Truck haul is generally more expensive, and may utilize public streets which increases the risk to public safety from potential vehicle accidents. Transport by slurry pipeline is generally less expensive and eliminates potential noise, dust and the possibility of vehicle accidents associated with haul trucks, but does require significant quantities of water to operate. Provision for handling the contaminated decant water would have to be made at the repository location, effectively preventing the use of a slurry pipeline for transport to some potential repository locations. As a permanent repository location for the Parrot Tailings waste materials remains unknown at this time, this PCRP assumes for costing purposes that tailings and contaminated materials would be transported from the site by street legal haul trucks to a repository location not more than 2.5 miles from the site.

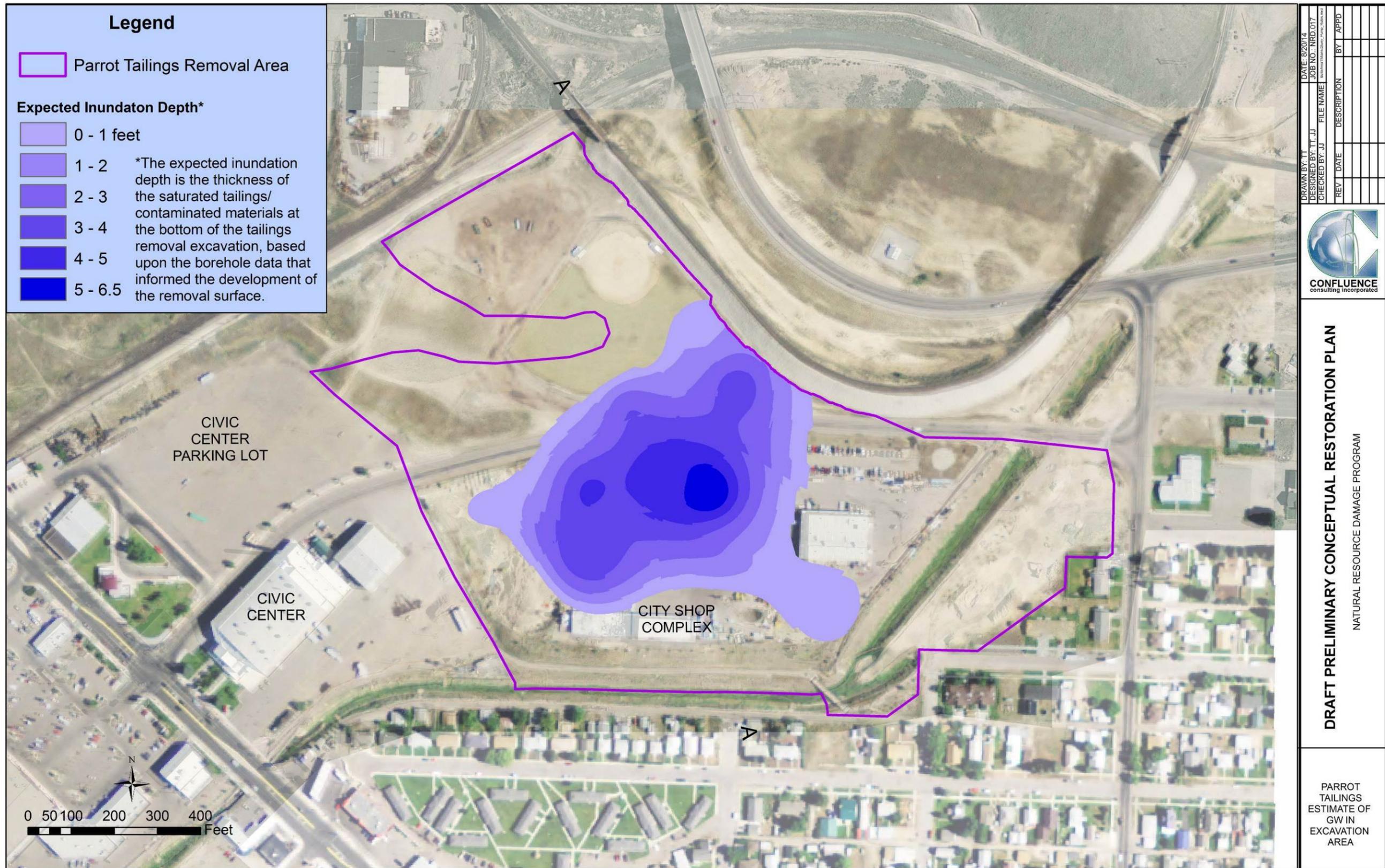


Figure 7 Parrot Tailings Project Area – Borehole log Based Estimate of Groundwater Saturated Contaminated Materials within the Expected Excavation Area

Repository location and transport method will be addressed in the draft Conceptual Restoration Plan. NRDP will continue its work with all interested entities in the development of the draft Conceptual Restoration Plan.

2.1.3. Removal costs

Removal includes the removal of tailings and contaminated materials from the Parrot Tailings using scrapers and excavators, and hauling the tailings to a repository. The tailings removal will require demolition of the existing city shops complex of office and shop buildings, fuel tanks and paved parking areas. The overburden will be excavated and placed on site to the finish grade. The tailings will be capped and revegetated. The total cost for this removal option is approximately \$10.8 million.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
SITE DEMOLITION				
Shop	363,000	CF	\$0.39	\$139,871
Office	125,000	CF	\$0.39	\$48,165
Vehicle Storage (small)	259,200	CF	\$0.19	\$49,937
Vehicle Storage (large)	421,200	CF	\$0.19	\$81,148
Wash Building	55,440	CF	\$0.39	\$21,362
New Bus Barn	114,048	CF	\$0.19	\$21,972
Old Bus Barn	114,048	CF	\$0.19	\$21,972
Pavement Removal	50,336	SY	\$5.68	\$285,959
6' Fence Removal	2,630	LF	\$3.57	\$9,380
Fuel Island	1	LS	\$9,000	\$9,000
Buried 1,500 gal Tanks	2	EA	\$7,415	\$14,830
Misc. Demolition/Removal	1	LS	\$20,000	\$20,000
			Sub Total	\$723,598
			Design/Engineer Fees 15%	\$108,540
TAILINGS REMOVAL - PARROT				
Stock Pile Topsoil	4,741	CY	\$0.86	\$4,066
Overburden Removal & Replacement	670,894	CY	\$3.00	\$2,015,458
Compact Overburden For Parking Lot and Structures	346,900	CY	\$0.74	\$257,053
Tailings + Organic Clays Dig and Haul	267,173	CY	\$12.07	\$3,223,757
Strip Topsoil at Repository	13,371	CY	\$0.86	\$11,467
Spread Tailings in Repository	267,173	CY	\$3.84	\$1,025,816
Spread Topsoil at Repository	13,371	CY	\$0.86	\$11,467
Revegetate Repository	8.29	Acre	\$1,540.00	\$12,763
Cap Tailings	8.29	Acre	\$30,000.00	\$248,628
Dewatering Site	1	LS	\$113,104.00	\$113,104
Erosion Control	1	LS	\$5,000.00	\$5,000
			TAILINGS REMOVAL SUBTOTAL	\$6,928,580
			Design/Engineer Fees 15%	\$1,039,286.99
TOTAL PROJECT COST BEFORE CONTINGENCIES				\$8,800,005
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$8,800,005	\$220,000
Performance Bond	0.90%		\$8,800,005	\$79,200
Insurance	0.85%		\$8,800,005	\$74,800
Testing/Environmental	2.00%		\$8,800,005	\$176,000
			Sub Total	\$550,000
TOTAL DESIGN/CONSTRUCTION				\$9,350,005
Contingency @15%				\$1,402,501
TOTAL PROJECT COST				\$10,752,506

Table 1 Parrot Tailings Removal Costs

2.2. Resultant Restoration and End Land Use

One potential end land use alternative for the Parrot Tailings area is shown on Figure 8. This PCRCP alternative is intended to address a Butte Silver Bow desire for an expansion of the utility of the Civic Center and nearby areas.

2.2.1. End Land Use Considerations

Butte-Silver Bow has expressed a strong interest in having the restoration of the Parrot Tailings area include expanded parking for the Civic Center north of Civic Center Road (CCR), and a park space south of the CCR. Butte-Silver Bow has also expressed a desire that the park space south of CCR not be raised far above the level of the MSD, as the current City Shop complex is now. Instead, Butte-Silver Bow has envisioned a park space that more gradually slopes from Civic Center road down to the trail that runs atop the berm of the MSD.

The PCRCP option approximately doubles the area available for parking lot construction north of Civic Center Road. Restoration would fund replacement of paving for the 425 current parking spaces, and provide sufficient well graded and compacted base sufficient for a minimum 425 additional spaces that could be developed by Butte-Silver Bow. South of Civic Center Road, the PCRCP provides a gently rolling, 13.75 acre park space with a quarter mile of walking paths that connect to the existing footpath atop the MSD.

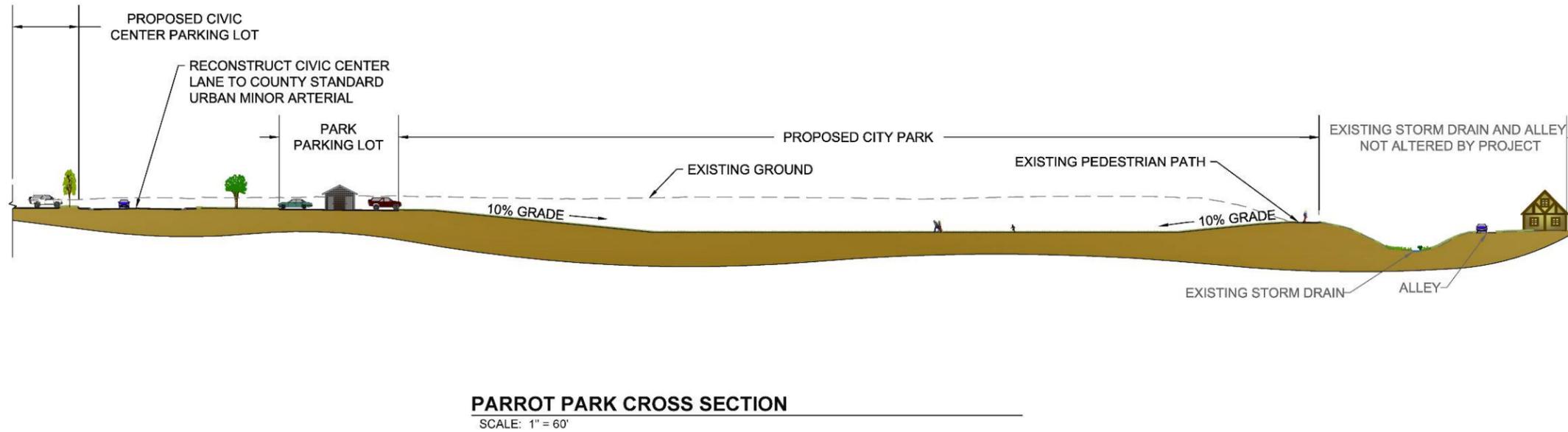
Achieving the lower final grade for the park space south of Civic Center Road while still spoiling the Parrot overburden on-site would require raising the average grade of the area north of Civic Center road. Placing all of the relocated overburden within the footprint of the tailings excavation north of Civic Center road would raise its elevation substantially from the current condition, complicating the design of a contiguous parking lot space and potentially requiring Civic Center road to be reconstructed even higher than its current elevation. To avoid these circumstances, the PCRCP option instead places much of the relocated overburden within the footprint of the current Civic Center parking lot, providing for a single level parking lot space, and allowing lower elevations for the rest of the site.

Overall, the PCRCP option:

- lowers the crest of Civic Center Road by four feet
- lowers the elevation of the current Parrot waste pile north of Civic Center road (i.e. the ball field area) by 6-8 feet
- raises the elevation of the current Civic Center parking lot by 10-12 feet
- lowers the base elevation of the current City Shop Complex area by 17 feet, putting the average elevation of the resulting park on par with the existing greenway trail that runs along the MSD.



Figure 8 Parrot Tailings Project Area, PCRPA Alternative



DATE: 09/30/13	FILENAME: CONCEPTUAL			
DESIGNED BY: T.L. J.J.	CHECKED BY: J.J.			
REV.	DATE	DESCRIPTION	BY	APPD



DRAFT PRELIMINARY CONCEPTUAL RESTORATION PLAN

PARROT TAILINGS PARK CROSS SECTION

Figure 9 Parrot Tailings Project Area, PCRPs Restoration Cross section at 1:1

Conceptual cross-sections illustrating the surface of the parking lot and City park facilities with respect to cross sections A and B from Figure 8 are presented on Figure 4 and Figure 5. Note that Figure 4 and Figure 5 are engineering cross sections, drawn with a substantial vertical exaggeration (10:1) to facilitate interpretation of the tailings, overburden, and other lithologic features. Figure 4 thus does not accurately depict the final configuration of the park option. Figure 9 presents that portion of cross section A that transects the park, drawn to a 1:1 scale that better conveys what the park space would look like on the ground.

Total relief across the width of the proposed park area would be 12 feet, providing visual interest and recreational opportunity. All slopes would be held to 10:1 or shallower for negotiability by the public, and the proposed trails would meet ADA accessibility guidelines.

The PCRPP park option is intended to provide an interesting, multi-use space. The flat bottom of the “bowl” is large enough to accommodate a regulation football field or FIFA soccer pitch.

The option would balance cut and fill across the site, provide for positive drainage of surface water for delivery to the MSD, and relocate a large percentage of the overburden material north of CCR, where it would be placed under a low permeability paved parking lot. The MSD, MSD sub-drain, and the substantial utility infrastructure buried adjacent to the MSD beneath the existing footpath would remain undisturbed by this PCRPP option.

The area east of the MSD, in the vicinity of the current City park and the location of the storm sewer system’s Texas Avenue Hydro Dynamic Device, would be expected to receive minimal work – principally removal of small tailings deposits that may have not been addressed by previous work.

2.2.2. Resultant Restoration and End Land Use Costs

The cost estimate for the resultant restoration option of the Parrot Tailings site includes the cost of reconstruction of the city shops complex and baseball field at other sites in Butte. These new sites have not been proposed or selected but the estimate includes the cost of purchasing land. Major components of the restorations of the Parrot Tailings site include; construction of an expanded Civic Center Parking Lot footprint, importing and placing topsoil, replacement of water, sewer, and stormwater pipelines, and construction of Civic Center Road. Primary placement of overburden to regrade the site is included in the removal cost estimation. As shown in Table 2, the cost for the Parrot Tailings project option is estimated to be \$12.5 million. Taken together with the removal cost (Table 1), the total project cost is estimated to be \$23.2 million.

Draft Preliminary Conceptual Restoration Plan - Butte Area One

ITEM	QUANTITY	UNIT	UNIT PRICE	CITY COST INDEX	UNIT PRICE	Reference #	Referenced Location	TOTAL PRICE
RELOCATE/RECONSTRUCT BLDGS								
Shop	16,500	SF			\$127.85	3	Added Inflation	\$2,109,509
Office	4,694	SF			\$130.03	3	Added Inflation	\$610,382
Vehicle Storage (cold storage)	14,400	SF			\$63.38	3	Added Inflation	\$912,646
Vehicle Storage (warm storage)	23,400	SF			\$63.38	3	Added Inflation	\$1,483,049
Wash Building	2,520	SF			\$81.95	3	Added Inflation	\$206,525
New Bus Barn	1	LS			\$418,954.81	3	Added Inflation	\$418,955
Old Bus Barn	1	LS			\$418,954.81	3	Added Inflation	\$418,955
Pavement	2,793	SY	\$36.20	0.988	\$35.77	1	6.13; 0200, 32 11 23.23 0100, 31 23 23	\$99,893
Fencing	2,630	LF			\$28.00	1	32 31' 13.20; 0200	\$73,640
Fuel Island, Tanks	1	LS			\$87,418.16	1	Added Inflation	\$87,418
Rebuilding Ball fields	1	LS			\$218,545.40	Estimated	Added Inflation	\$218,545
Landscaping	1	LS			\$25,000.00	2	Estimated	\$25,000
Sub Total								\$6,664,518
Misc. Costs								
Misc. Site Work	1	LS			\$21,854.54		Added inflation	\$21,855
Purchase Land For New Buildings	20	ACRES			\$10,927.27		Added inflation	\$218,545
Sub Total								\$240,400
PARROT TAILINGS RESTORATION								
Spread Topsoil (On Site Source)	4,741	CY			\$0.86	2	Table 1.1	\$4,077
Import and Place Topsoil	19,459	CY			\$33.70	2	Table 10	\$655,701
Construct Civic Center Road	1,408	LF			\$314.74	2	Table 20	\$443,159
Construct Parking Lot	429	CARS	\$2,320.00	0.988	\$2,292.16	1	RS Means g2020 214.1990	\$983,337
Construct Trails (6' Wide Gravel)	1,500	LF			\$5.77	2	Table 13	\$8,657
Install New Water Main (6" PVC)	500	LF			\$21.30	1	RS Means 2014 G3010 122.5410	\$10,652
Install New Sewer Main (6" PVC)	500	LF			\$17.25	1	Table 23	\$8,627
Replace Storm Drain (36" CMP)	1,003	LF			\$91.23	2	Table 21	\$91,505
Install Power Lines	1	LS			\$5,000.00	2	Estimate	\$5,000
Revegetation	15	ACRES			\$1,540.00	2	Table 14	\$23,100
Irrigation System	15	ACRES	\$6,162.16	0.988	\$6,088.22	2	RS Means 32 84 23.10 0100	\$91,323
Erosion Control	1	EA			\$5,000.00	1	RS Means	\$5,000
Sub Total								\$2,330,137
TOTAL PROJECT COST BEFORE CONTINGENCIES								
								\$9,235,055
PROJECT STARTUP/ENVIRONMENTAL								
Mobilization	1.00%				\$9,235,055			\$92,351
Performance Bond	0.90%				\$9,235,055			\$83,115
Insurance	0.09%				\$9,235,055			\$7,850
Testing/Environmental	0.20%				\$9,235,055			\$18,470
Design/Engineer Fees 15%	15.00%				\$9,235,055			\$1,385,258
Sub Total								\$1,587,044
TOTAL DESIGN/CONSTRUCTION								
								\$10,822,099
Contingency @15%								\$1,623,315
TOTAL PROJECT COST								
								\$12,445,414

Table 2 Parrot Tailings Restoration Costs

3. DIGGINGS EAST AND NORTHSIDE TAILINGS PROJECT

3.1. Tailings/Contaminated Materials Removal

3.1.1. Removal Actions

For the purposes of this draft PCRP, tailings and contaminated soils within the Diggings East and Northside Tailings (DENST) areas were characterized from 38 (Diggings East) and 10 (Northside Tailings) bore log records previously compiled for the report *Final Draft Version Tailings/Impacted Sediment Delineation of the Diggings East, Blacktail Berm, and Northside Tailings Areas* (NRDP 2014). Boring locations and identifiers are presented in Figure 10.

The typical profile of materials expressed in the bore holes within the Diggings East area includes a layer of tailings from one inch to more than five feet thick (average 1.9') that is often underlain by a layer of native, organic rich soils (average 1.6' thick) that have become impacted by contaminants leached from the tailings deposited above. Beneath the tailings and contaminated organic soil horizon are alluvial sands that extend below the water table to comprise the aquifer substrate. Some of the tailings deposits are exposed at the surface, but most are buried beneath a layer of generally unimpacted landfill material as much as seven feet thick (sample average 4.6'), consisting mostly of demolition debris.

The vertical profile of materials expressed in the bore holes within the Northside Tailings area is very similar to that of the Diggings East area, with the exception of the landfill overburden, which is absent from the Northside Tailings area.

The removal criterion for the Diggings East and Northside Tailings area assumed for this PCRP is based upon the sampled concentration of six contaminants. To each of the six contaminants (As, Cd, Cu, Hg, Pb, and Zn), the tailings/contaminated sediment screening criterion from the Streamside Tailings Operable Unit (SSTOU) was applied. A sample that exceeded the SSTOU screening concentration for more than two of the six contaminants was determined to be contaminated material.

The vertical extent of the tailings and contaminated materials removal assumed by this draft PCRP for the Diggings East and Northside Tailings areas is informed by the fact that within Diggings East, translocation of contaminants into the alluvial sands near the water table was noted at a majority of the sample locations with tailings. For this reason, the tailings/contaminated materials removal on both the Diggings East and Northside Tailings would include removal of tailings and any materials beneath (including contaminated, organic rich "black clays", any intervening soil horizons between tailings and the "black clays", and dry alluvial sands beneath the "black clays") down to the groundwater elevation. This PCRP assumes that the landfill overburden materials (wood, concrete,

bricks, asphalt pavement, etc.) within Diggings East would be removed from the site if they overlay tailings/contaminated materials deposits, even if the landfill materials themselves are not contaminated. Removal of landfill materials from areas without underlying tailings is not contemplated by this draft PCRCP.

The assumption that all Diggings East landfill materials overlying tailings will be removed from the site is made for three primary reasons:

1. Though the great majority of the Diggings East landfill material is uncontaminated by the associated tailings deposits, some of the samples of this material did return contaminant values that exceeded the concentration based removal criteria. Those materials would likely need to be isolated in a repository, and would not be appropriate fill for groundwater contact wetlands. Pending a more comprehensive characterization of the landfill material to determine the proportion that is suitable for wetland fill, the conservative costing assumption is that all of the landfill materials would be removed from the site and placed in a repository.
2. Among the restoration options for the Diggings East and Northside Tailings project areas is the restoration of the substantial wetland complex present prior to the injury. Accomplishing this requires removal of substantial quantities of fill material from the site to lower its average elevation, provide groundwater contact, and reestablish wetland hydrology to the site.
3. Taking into account the potential and current needs for wet weather management and potential stormwater basins, the Diggings East and Northside Tailings PCRCP alternatives avoid creating high fill areas that would interfere with the placement and storage volume of potential catch basins.

Removing the more than estimated 180,000 cubic yards of the landfill materials from the Diggings East project area to a repository would incur a substantial cost. However, if it is determined that the landfill materials are suitable for use as wetland fill, then some of those materials could be used to meet a portion of the backfill requirements for the Diggings East, Northside Tailings, and Blacktail Berm area restorations, offsetting both the cost of the landfill materials removal as well as the backfill purchase and importation cost for those projects. Blacktail Berm PCRCP alternatives 1 and 2 would require a minimum 100,000 cubic yards of backfill, while the Northside Tailings area under alternative 2 would require a minimum of 38,000 cubic yards, allowing the majority of Diggings East landfill materials to be economically relocated for those alternatives.

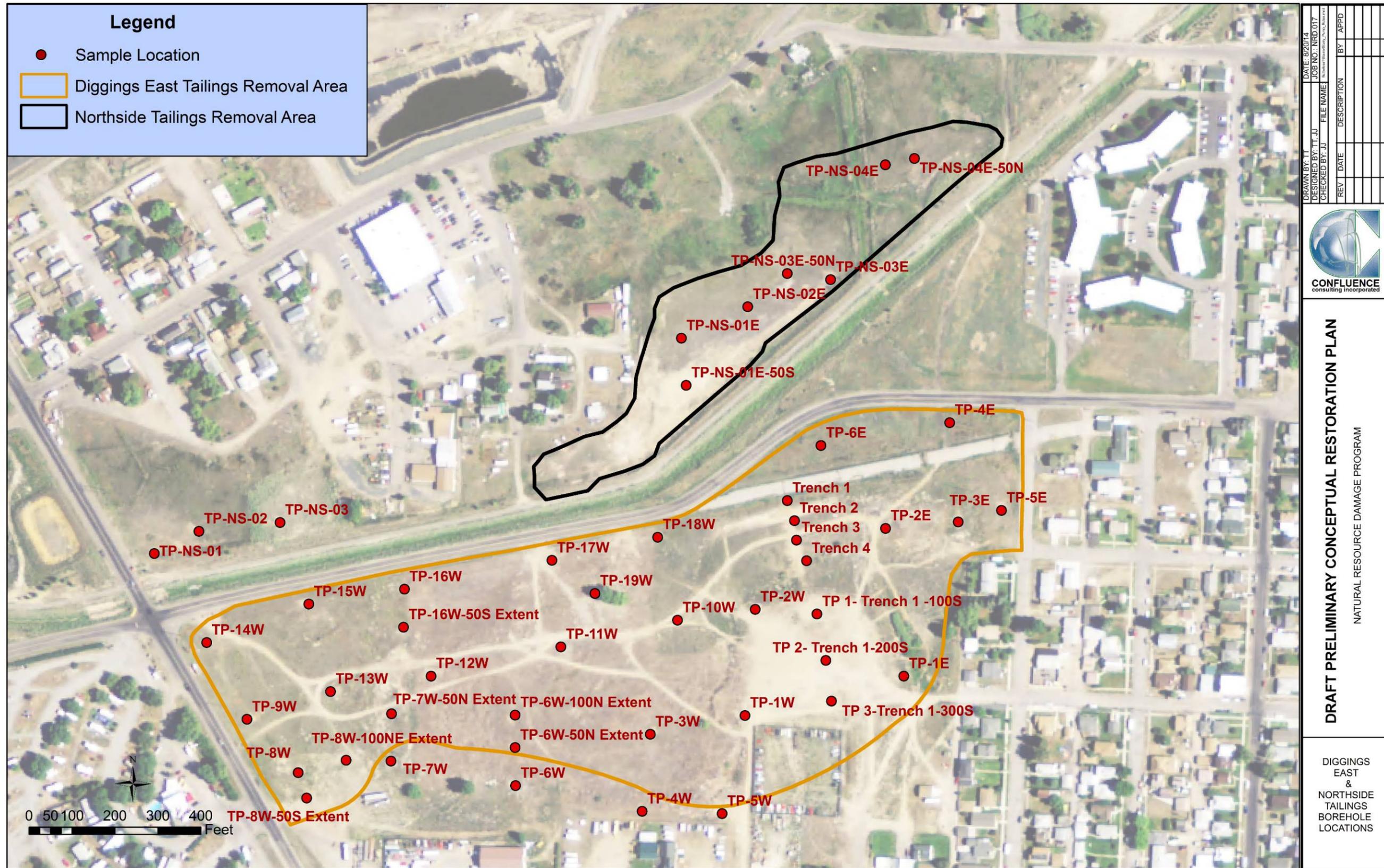


Figure 10 Diggings East and Northside Tailings Project Area, Borehole Locations

The horizontal extent of the Diggings East and Northside Tailings areas tailings and contaminated materials removal assumed by this PCRP is as presented in the report *Final Draft Version Tailings/Impacted Sediment Delineation of the Diggings East, Blacktail Berm, and Northside Tailings Areas* (MBMG 2014). Those bounds are generally similar to those used in the Final Focused Feasibility study for the Metro Storm Drain, Butte Priority Soils Operable Unit (EPA 2004) for the Total Removal Option, with the following adjustments:

- The removal area on Diggings East was extended to the south across the width of the site, to capture the area represented by those sample locations that failed the concentration based screening criterion for one or more lithologic units.
- The southwest “tail” of the Northside Tailings removal area was truncated, to reflect the fact that two of the three samples taken in that area passed the screening criterion for all lithologic units, and that the one sample location that failed the screening (TP-NS-01E) did so only in the very thin (less than 5”) tailings unit observed at this location. Given the proximity of this area to homes and other infrastructure, a removal action does not appear warranted by one isolated tailings deposit with relatively low contaminants values that does not appear to be leaching contaminants to lower units.

Accounting for these adjustments, the tailings and contaminated materials removal area for Diggings East and Northside Tailings assumed by this draft PCRP is presented on Figure 11.

The Diggings East removal area encompasses approximately 24 acres. From within this area, approximately 163,000 cubic yards of tailings and contaminated materials is assumed to be removed and disposed off-site. To access those wastes, approximately 182,000 cubic yards of landfill material overburden would need to be excavated and removed from the site. The Northside Tailings area encompasses approximately 5.5 acres, and the removal action is assumed to entail approximately 56,000 cubic yards of tailings and contaminated material. Surface ownership within the Diggings East and Northside Tailings project footprint and surrounding areas, from Montana Cadastral, is presented on Figure 15.

Existing conditions cross sections displaying the layering of wastes and overburden for cross sections A, B, and C from Figure 10 are presented on Figures Figure 12, Figure 13, and Figure 14 respectively.

Within the footprint of the removal area are several utilities, including electric power lines, a city water main, a sanitary sewer line and storm sewer lines. These utilities are expected to be retained or replaced. It is assumed for purposes of the draft PCRP that removal of any tailings that may exist beneath George Street is unnecessary. If tailings are present beneath George Street and need to be removed, the PCRP option would not change, but additional removal and restoration cost would be incurred.

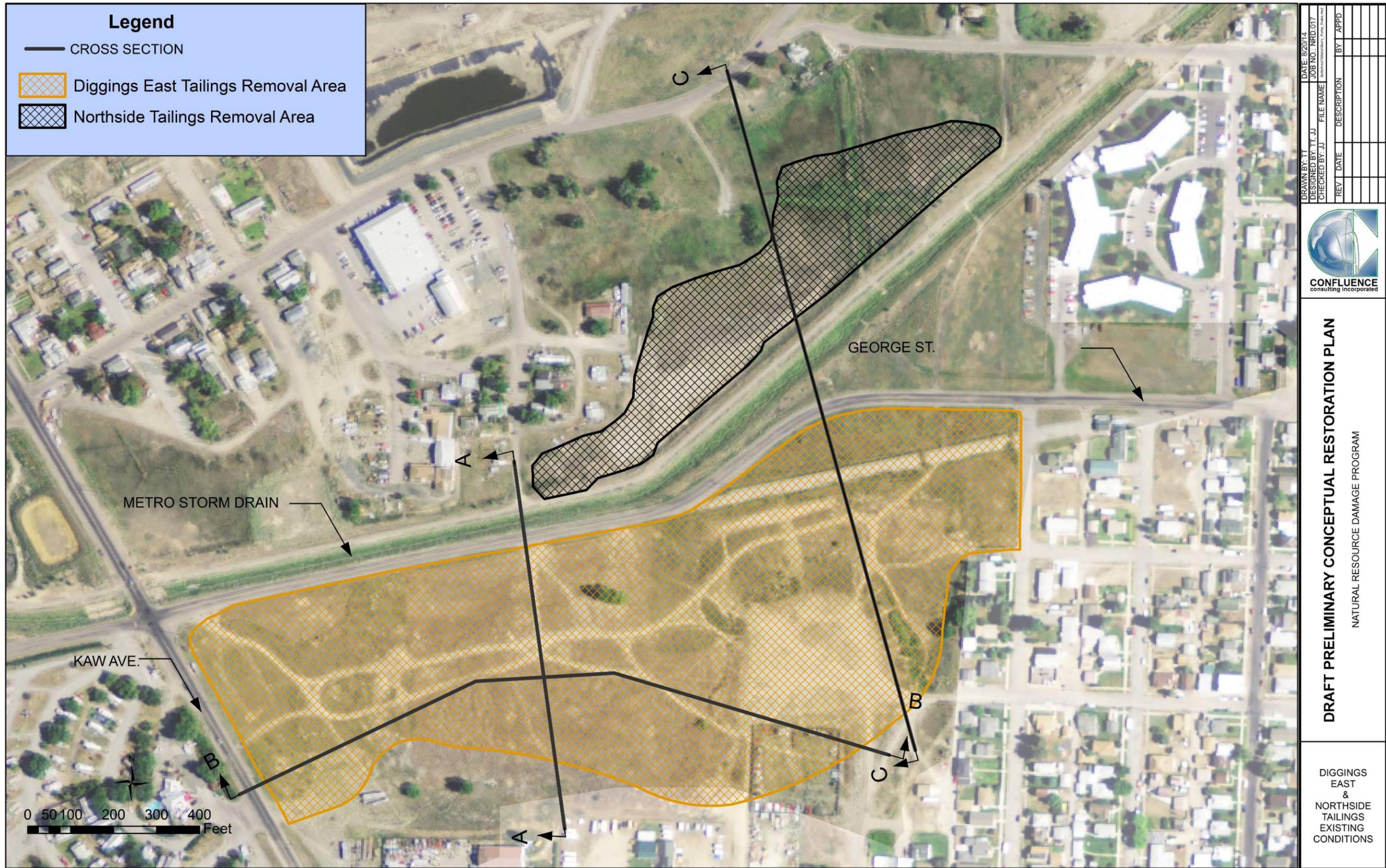


Figure 11 Diggings East and Northside Tailings Project Area, Existing Conditions

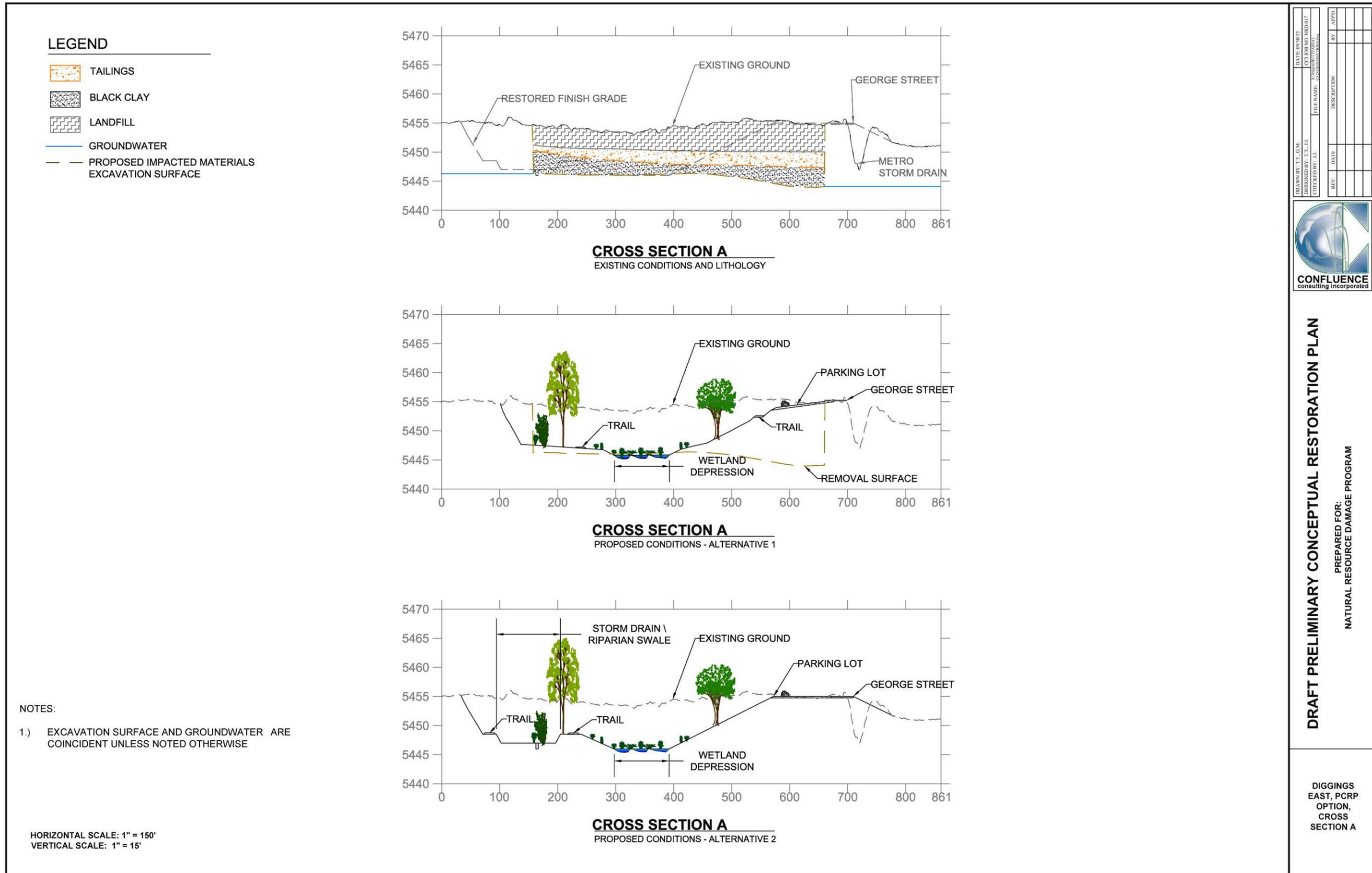


Figure 12 Diggings East and Northside Tailings Project Area, PCRPP Option Cross Sections, Section A

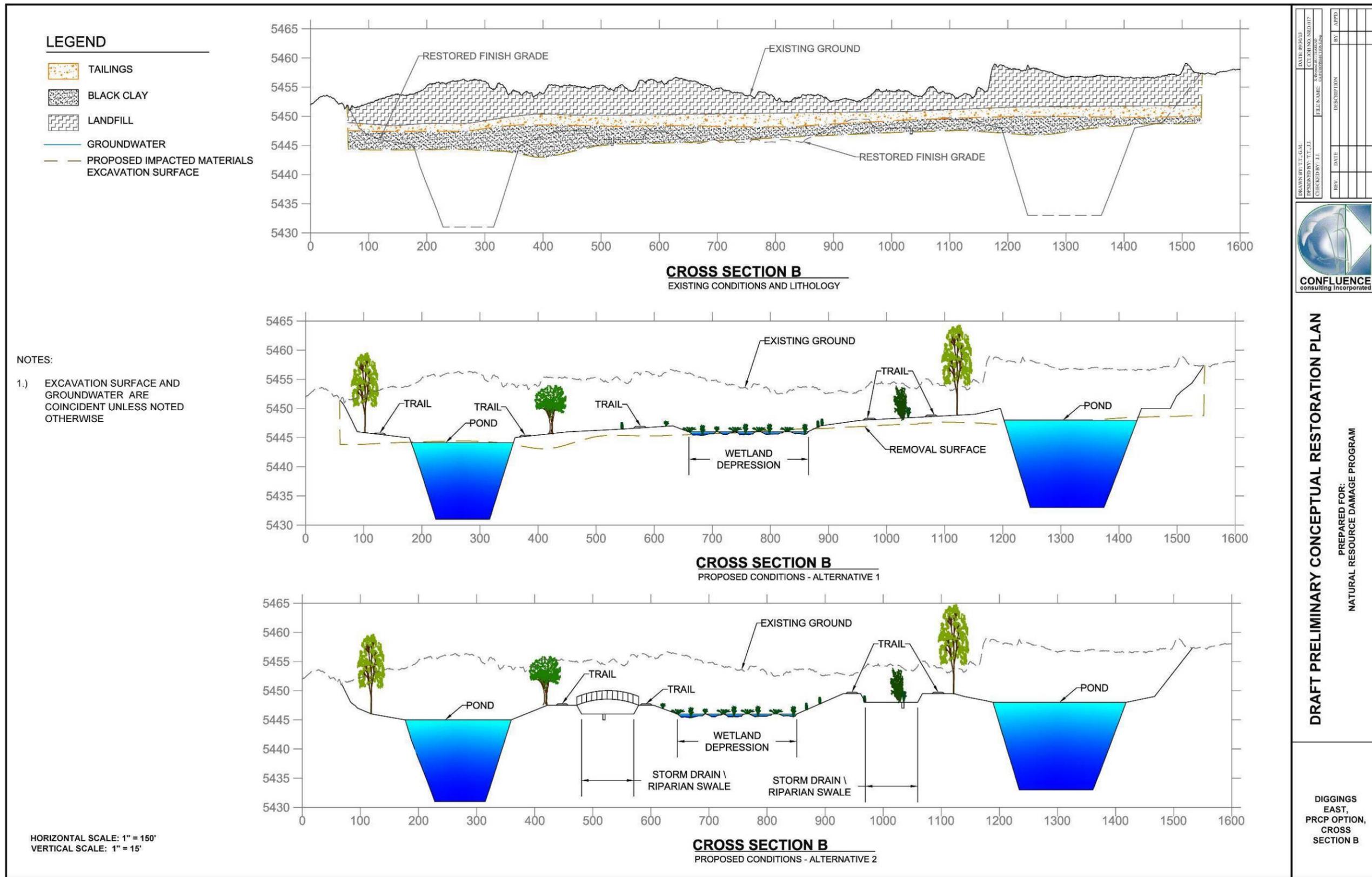


Figure 13 Diggings East and Northside Tailings Project Area, PRCP Option Cross Sections, Section B

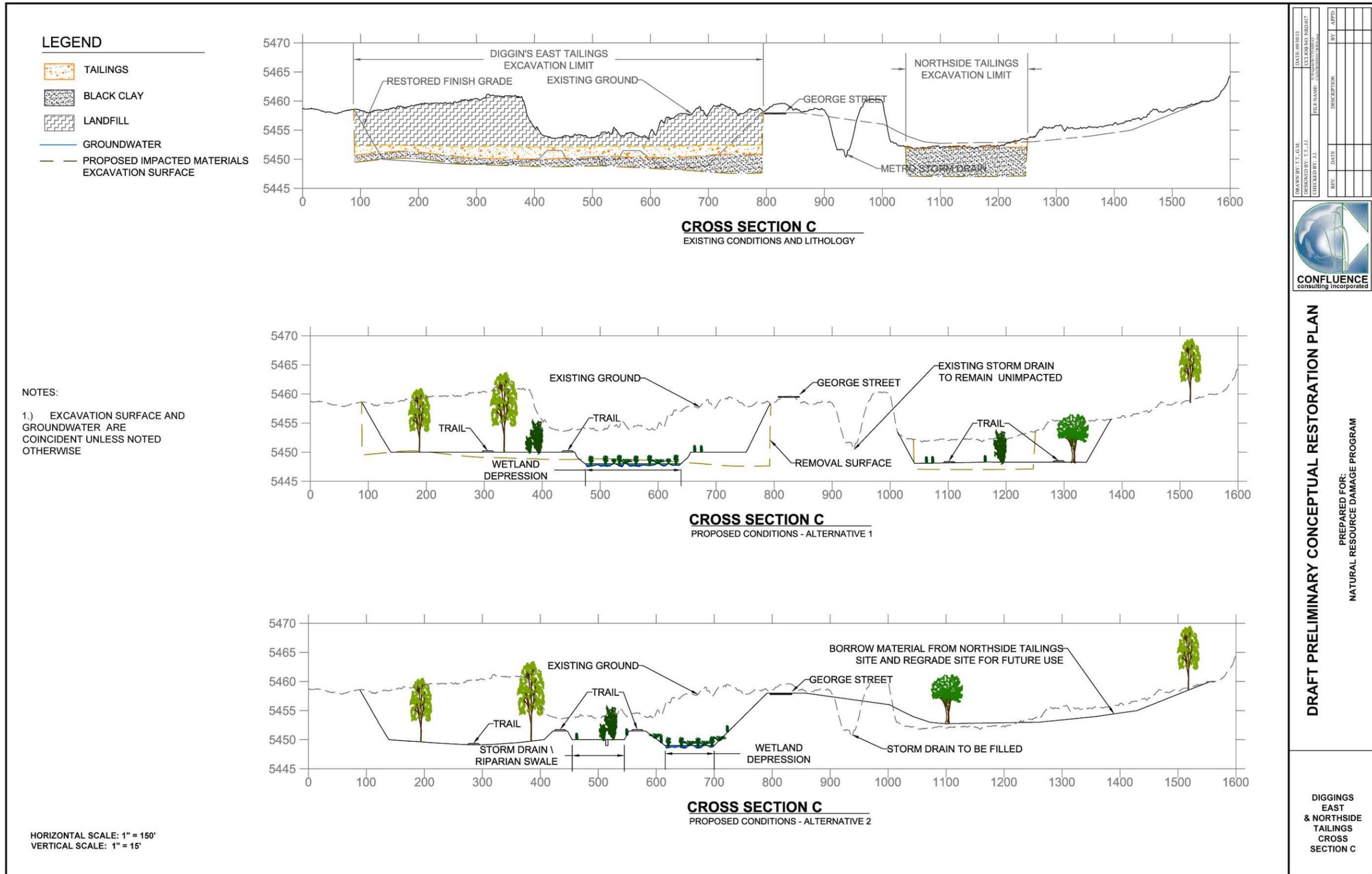


Figure 14 Diggings East and Northside Tailings Project Area, PRCP Option Cross Sections, Section C

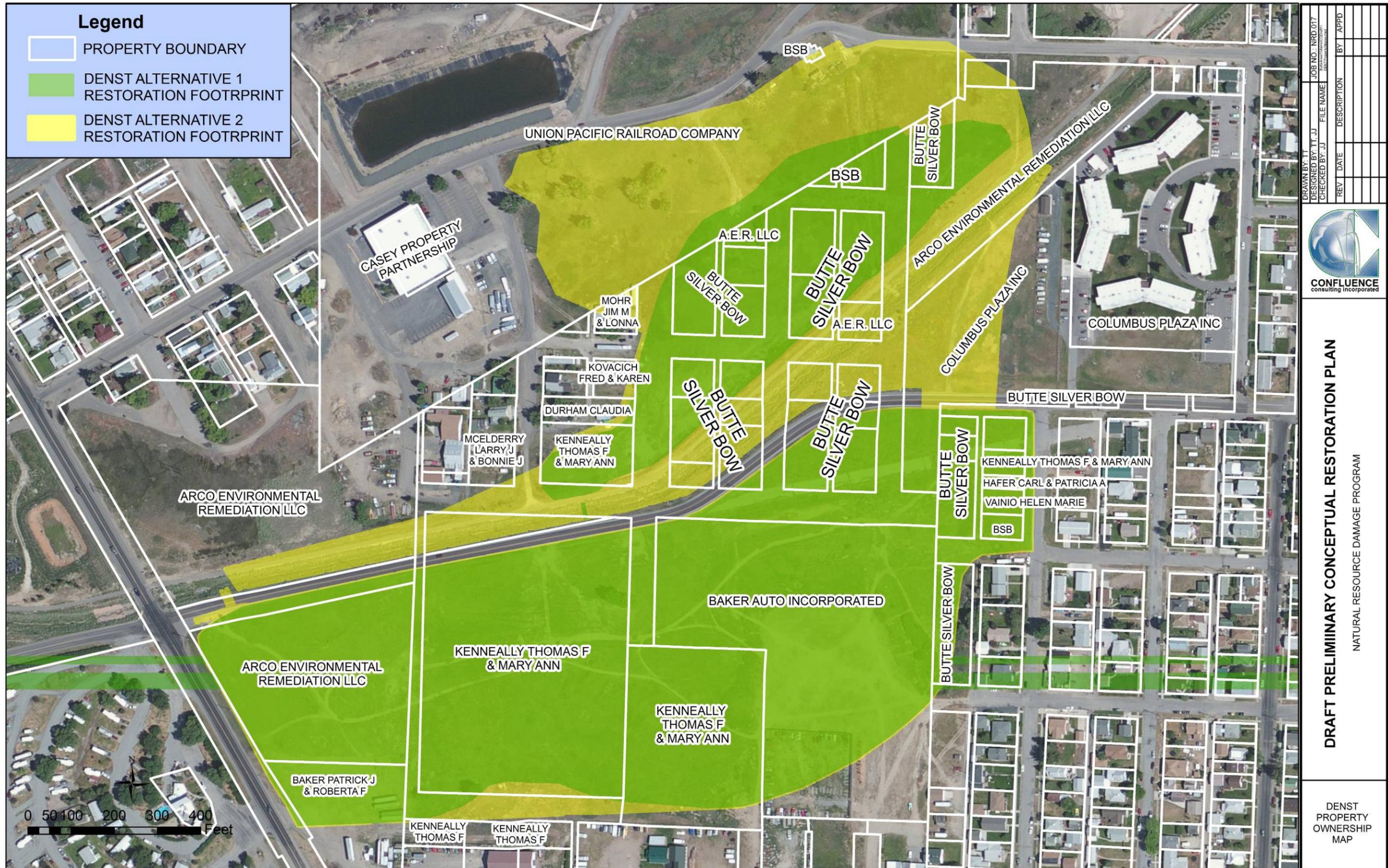


Figure 15 Diggings East and Northside Tailings Project Area, Property Ownership.

3.1.2. Transport and Disposal Options

As with the Parrot Tailings project area, two transport methods, truck haul and slurry pipeline, could be used to remove the tailings and contaminated materials from the Diggings East and Northside Tailings project areas to a permanent repository, but for this PCRP, only the truck haul option to a nearby repository location is evaluated.

Repository location and transport method will be addressed in the draft Conceptual Restoration Plan. NRDP will continue its work with all interested entities in the development of the draft Conceptual Restoration Plan.

3.1.3. Removal costs

Removal includes the removal of tailings, contaminated materials, and landfill wastes from Diggings' East and Northside Tailings, and hauling to a repository. The wastes from each site will be removed using excavators and on-road haul trucks to transport and spread tailings at the repository. The wastes will be capped and revegetated. The total cost for this removal is approximately \$7.6 million. Itemized costs are presented on Table 3 below.

3.2. Resultant Restoration and End Land Use

Two PCRP restoration alternatives are presented for the Diggings East and Northside Tailings area. Alternative 1 would perform a minimalist backfill and regrade of the tailings/contaminated materials excavations, resulting in wetland parklands in both areas, reserving the northern area for BPSOU Record of Decision wet weather retention/detention basins. Alternative 2 would reroute the current MSD surface drain south of George Street into wide riparian swale, providing complex wetland habitat and park space south of George Street, while the area north of George Street would be reserved for BPSOU Record of Decision wet weather retention / detention basins.

Both alternatives assume available acreage could be employed for BPSOU Record of Decision wet weather retention/detention basins and other stormwater features. NRDP notes and acknowledges the importance of addressing the effect of wet weather events on surface water resources.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
TAILINGS REMOVAL - DIGGINGS EAST				
Landfill - Excavate and Haul	181,635	CY	\$8.92	\$1,619,520
Tailings + Organic Clays Dig and Haul	161,832	CY	\$10.61	\$1,717,797
Strip Topsoil at Repository	17,189	CY	\$0.86	\$14,742
Spread Landfill in Repository	181,635	CY	\$3.32	\$602,612
Spread Tailings in Repository	161,832	CY	\$3.95	\$639,180
Spread Topsoil at Repository	17,189	CY	\$0.86	\$14,742
Revegetate Repository	10.65	Acre	\$1,540.00	\$16,408
Erosion Control	1	LS	\$5,000.00	\$5,000
Sub Total				\$4,630,000
TAILINGS REMOVAL - NORTHSIDE TAILINGS				
Stock Pile Topsoil	10,400	CY	\$0.86	\$8,919
Tailings + Organic Clays Dig and Haul	45,600	CY	\$11.51	\$525,019
Strip Topsoil at Repository	2,803	CY	\$0.86	\$2,404
Spread Tailings in Repository	45,600	CY	\$3.95	\$180,106
Spread Topsoil at Repository	2,803	CY	\$0.86	\$2,404
Revegetate Repository	1.74	Acre	\$1,540.00	\$2,675
Cap Tailings	1.74	Acre	\$30,000.00	\$52,113
Erosion Control	1	LS	\$3,000.00	\$3,000
Sub Total				\$776,640
TAILINGS REMOVAL SUBTOTAL				\$5,406,640
Design/Engineer Fees 15%				\$810,996.01
TOTAL PROJECT COST BEFORE CONTINGENCIES				\$6,217,636
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$6,217,636	\$155,441
Performance Bond	0.90%		\$6,217,636	\$55,959
Insurance	0.85%		\$6,217,636	\$52,850
Testing/Environmental	2.00%		\$6,217,636	\$124,353
Sub Total				\$388,602
TOTAL DESIGN/CONSTRUCTION				\$6,606,238
Contingency @15%				\$990,936
TOTAL PROJECT COST				\$7,597,174

Table 3 Diggings East and Northside Tailings, Removal Costs

3.2.1. Alternative 1 End Land Use Considerations

Figure 16 presents the first PCRPs alternative for post-tailings removal restoration of the Diggings East and Northside Tailings area. Conceptual cross sections for Alternative 1 for cross sections A, B, and C from Figure 16 are presented on Figures Figure 12, Figure 13, and Figure 14 respectively.

Under this alternative, only limited areas would be backfilled to an elevation resulting in consistently dry land conditions. These would include a parking area

situated on the south side of George Street to provide convenient public access, two areas on the north side of George Street that would need to be backfilled to protect buried utility infrastructure, and within the footprint of the trail system so as to provide year round access.

This PRCP alternative assumes the balance of the site would be restored as a wetland park complex featuring three wetland types:

- **Sub-irrigated wetland** – The majority of the area of the park, would be backfilled such that all areas would be within one foot of ground water during the wetter season of the year. As groundwater level fluctuates, for much of the year these areas would be drier than the other wetland types.
- **Depressional wetlands** – several areas throughout the park would receive limited backfill, or a shallow over-excavation to provide consistently wetter conditions to provide a diversity of wetland habitat.
- **Open water wetlands** – two ponds totaling 2.2 acres would be excavated to a depth of 20 feet. These would provide open water wetland habitat for waterfowl.

These three wetland types could be moved or altered to accommodate storm water or other concerns.

Approximately 25 acres of wetland habitat types would result from this draft PCRCP option, a substantial increase over the 3-4 acres of wetlands that are currently present in the Diggings East and Northside Tailings area, and would be much closer to wetland habitat conditions which existed prior to tailings disposal. Connecting these wetland habitats to each other and to the existing greenway trail that runs the length of the MSD would be a 1.5 mile network of walking/biking trails, providing recreational access to the restored parklands. Included in the trail system would be a footbridge over the MSD, which by its depth and inaccessibility would otherwise isolate the south side park area from the larger trail system.

Alternative 1 would maintain the MSD surface drain and the MSD sub-drain in their current configuration and function. Under this alternative, the current East Buffalo storm water ditch would be replaced with a buried culvert that would report to the MSD. All other current storm water delivery to the MSD would be maintained or similarly replaced. The wetland elements of this alternative are all groundwater fed features. As such, there would be no increase in local groundwater level attendant to this option.

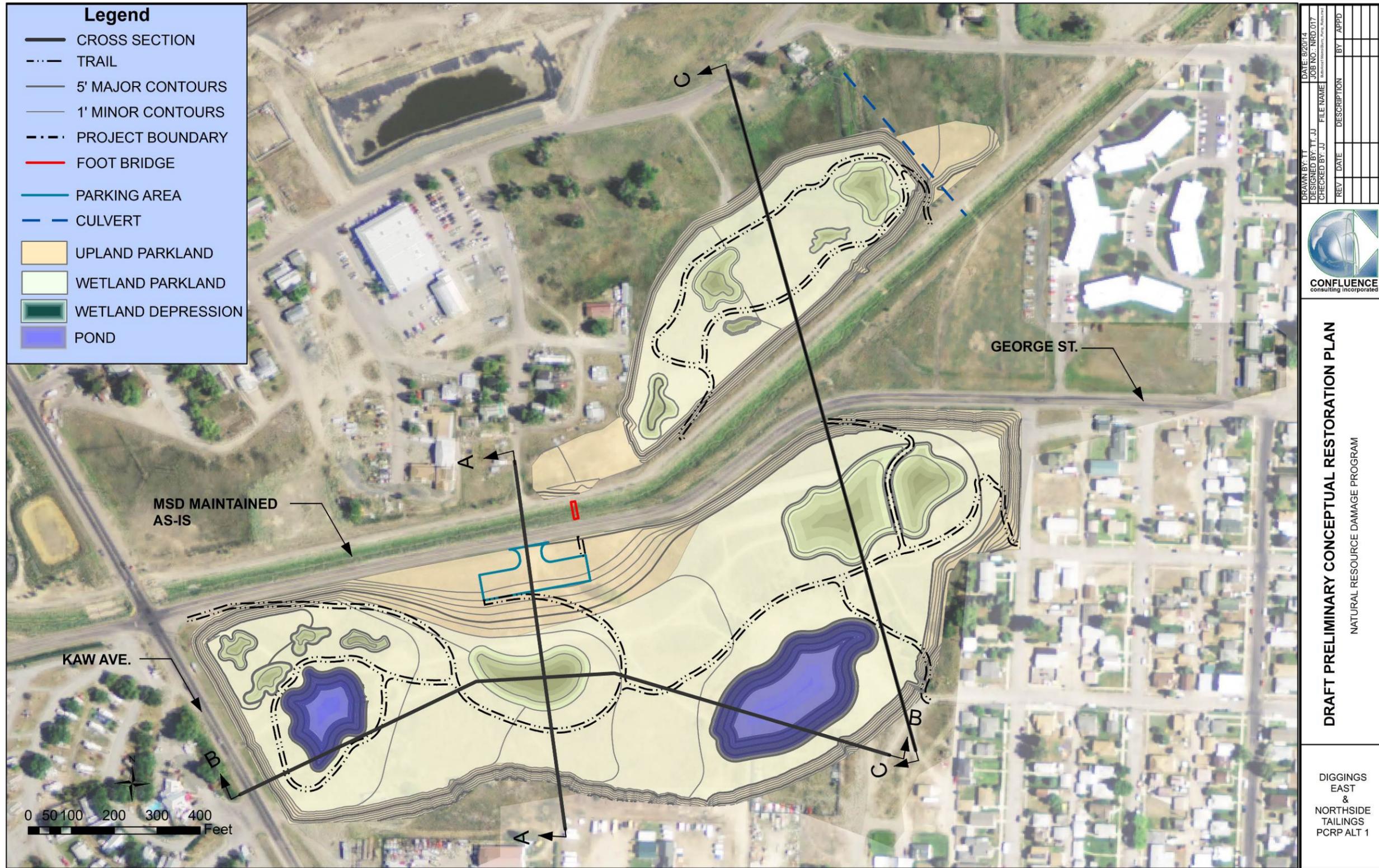


Figure 16 Diggings East and Northside Tailings Project Area, PCR Alternative 1

3.2.2. Alternative 2 End Land Use Considerations

The second PCRP alternative for post-tailings removal restoration of the Diggings East and Northside Tailings area is presented on Figure 17. Conceptual cross sections for Alternative 2 for cross sections A, B, and C from Figure 17 are presented on Figures Figure 12, Figure 13, and Figure 14 respectively.

Under this alternative, the current MSD surface water conveyance through the Northside Tailings area would be decommissioned, and its flow rerouted into a wider, more sinuous riparian/wetland swale feature south of George Street through the former Diggings East area. The current “steep and deep” MSD surface drainage ditch presents an imposing visual and physical access barrier that bisects the available open space north of George Street, greatly reducing the utility of this space to the community. This reconstructed portion of the MSD would be expected to meet all performance specifications and storm water design flows of the current MSD. Replacing that feature with a wider, shallower swale of equivalent storm water conveyance capacity is expected to result in a much more aesthetically pleasing and physically accessible storm water channel with greatly improved environmental functions and recreational value, while maintaining or enhancing the performance of the MSD as a remedy element. A typical cross section of the riparian/wetland swale feature is provided on Figure 18.

In addition to the riparian/wetland swale, this PCRP option of the Diggings East area south of George Street would include a mix of mostly wetland and some upland habitats accessible from a mile or more of walking/biking trails that would also serve to connect the neighborhood to the east to the existing MSD trail.

Although the riparian/wetland swale would be generally accessible to park users under this alternative, two footbridges would be added to connect the trails on the north and south banks of the swale to provide “dry feet” access during the wet season and ADA compliant access to the entire park year round.

This PCRP alternative assumes the wetland habitats in the southside park would be of four primary types:

- **Surface water fed** – within the lined riparian swale, there would be no connection to groundwater. Hydrologic support for vegetation would come from direct precipitation and from the storm water carried by the swale. As these would be episodic and vary in quantity, one would expect a gradient from wetland to more upland type vegetation communities to develop within the swale, with wetter types predominating near the pilot channel and more extensively during wetter years.

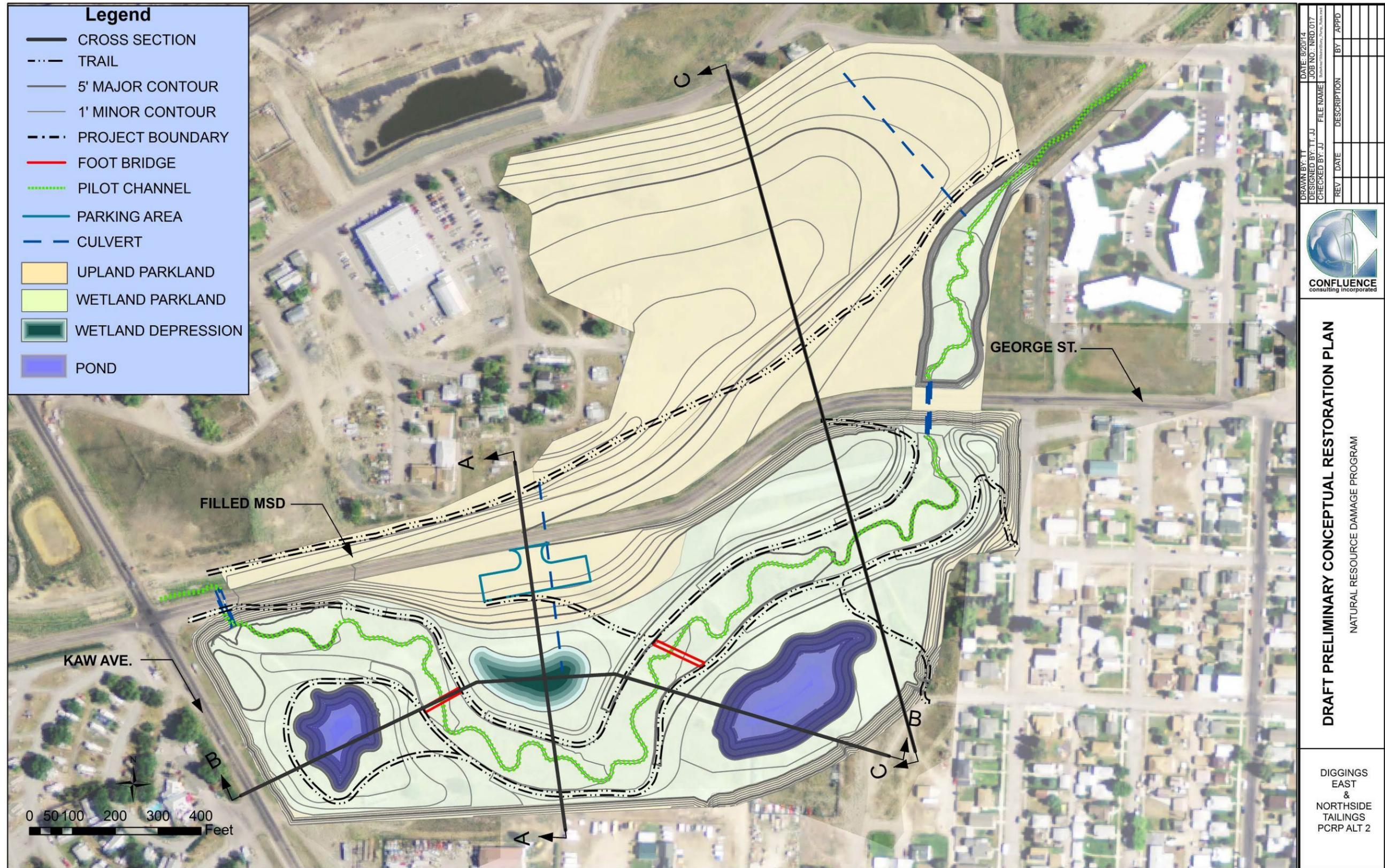


Figure 17 Diggings East and Northside Tailings Project Area, PCRPP Alternative 2

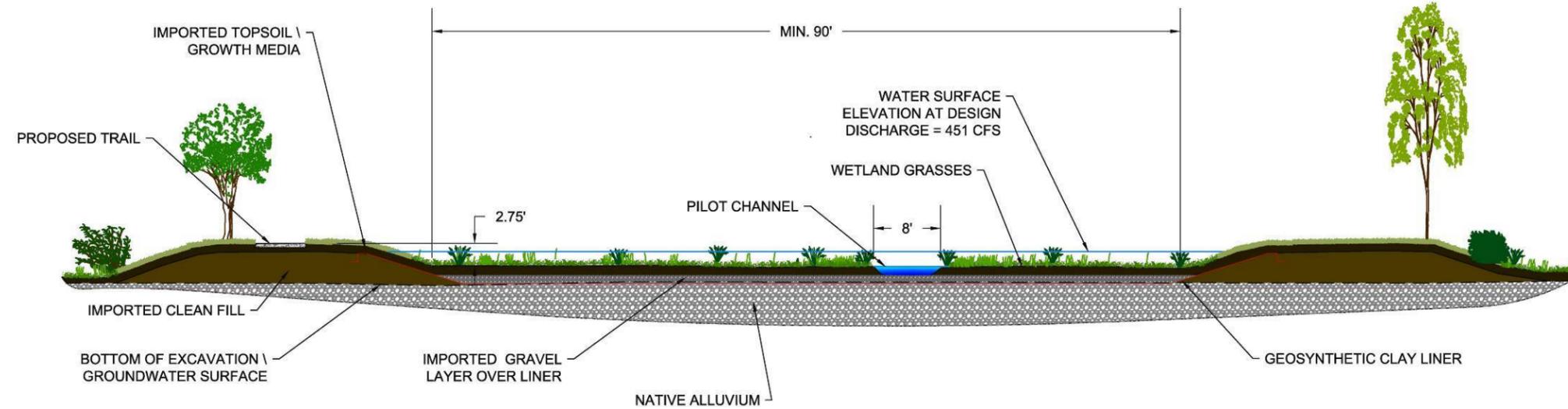
- **Sub-irrigated wetland** – The majority of the area of the park outside of the riparian/wetland swale would be backfilled such that all areas would be within one foot of ground water during the wetter season of the year. As groundwater level fluctuates, for much of the year these areas would be drier than the other wetland types.
- **Depressional wetland** – one area in the center of the wetland complex would receive a shallow over-excavation to provide consistently wetter conditions to provide a diversity of wetland habitat. This groundwater connected wetland would also receive runoff from the now clean upland parkland north of George Street via a culvert. Only direct precipitation to the upland park would report to this wetland – all offsite storm water would continue to report to the riparian/wetland swale for conveyance off the site.

As the direct precipitation to the Northside Tailings area currently infiltrates to groundwater via extensive wetlands in that area, and given that this groundwater connected wetland would be further removed from the MSD sub-drain than those existing wetlands currently are, it is not anticipated that recharge from this wetland would increase loading to the MSD sub-drain under this alternative. However, if more detailed analysis indicates a potential loading to the MSD sub-drain is likely, the recharge function of this groundwater connected wetland could be removed by rerouting the surface drainage from the upland park directly to the riparian/wetland swale for conveyance offsite.

- **Open water wetlands** – two groundwater fed ponds totaling 2.2 acres would be excavated to a depth of 20 feet. These are expected to provide open water wetland habitat for waterfowl, and if stocked would provide a fishery for the community.

North of George Street, the PCRCP alternative assumes an unstructured, upland open space that would be contiguous from Kaw Avenue on the southwest to Casey Street on the northeast. Many potential community uses could be accommodated in this space or it could be maintained as an upland open space counterpart to the wetland park south of George Street.

Under this PCRCP alternative, the decommissioned portion of the existing MSD surface drain would be filled and regarded to become an integral part of the contiguous parkland north of George Street. The current MSD sub-drain would be left undisturbed to continue its function as a component of the remedy. Maintenance access to the MSD sub-drain would be maintained by extending existing manholes to the new surface elevation.



RIPARIAN / WETLAND SWALE RECONFIGURATION OF STORM DRAIN TYPICAL CROSS SECTION
 SCALE: 1" = 15'

DATE: 06/01/13	BY: JPD
DESIGNED BY: T.L.J.	DESCRIPTION:
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DRAFT PRELIMINARY CONCEPTUAL RESTORATION PLAN

DIGGIN'S EAST AND NORTH SIDE TAILINGS RIPARIAN/WETLAND SWALE CROSS SECTION

Figure 18 Diggings East and Northside Tailings Project Area, Typical Cross Section Riparian/Wetland Swale

All current storm water conveyance to the MSD surface drain, including that carried by the existing East Buffalo storm water ditch, would be redirected to the riparian swale, which would be constructed to carry the design flow of the current MSD (i.e. the 25 year, 24 hour storm event as defined by a Type II rainfall distribution – approximately 450 cfs at Kaw Avenue). The riparian swale would be lined its full width and length to match the permeability performance of the current MSD surface drain to prevent communication with groundwater and water loading to the MSD sub-drain. Removing the MSD from its current position atop the MSD-sub-drain to a location 300-700 feet distant, increasing the lined area of the MSD, and increasing evapotranspiration across the site via open water and greatly expanded wetland area would all be expected to further reduce loading to the MSD sub-drain, improving the performance of this remedy component.

Within the context of this alternative, future incorporation of sedimentation/surface water detention basins could be achieved:

- at the location of the proposed ponds south of George street. Lined wetland basins instead of groundwater ponds could be constructed. Line basins would necessarily be shallower than the proposed ponds, but might be deepened by raising overall fill level of the site or by berming the basins;
- within the proposed swale, above George Street. This would require water control structures and additional road protection, and may benefit from widening for additional capacity;
- by reconfiguring the proposed upland park north of George Street to include a lined basin (fed by rerouting the city storm water line through the basin to a lower connection with MSD and/or overflow from swale). This location would offer the greatest capacity; and / or
- below the terminus of the swale, on the ARCO property to the northeast of the corner of George St. and Kaw avenue.

3.2.3. Resultant Restoration and End Land Use Costs

Diggings East Alternative 1 - Cost Estimate for Diggings East Restoration (Construction of Wetland Complex without Relocating Storm Drain)

The cost estimate for this PCRCP alternative at Diggings East includes the construction of a wetland complex while maintaining the Metro Storm Drain in its current location. The primary expenses include: excavation of ponds, placement of fill around the perimeter of the site, and the importing of topsoil throughout the site. The total cost for this PCRCP option is \$3.1 million.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
DIGGINS EAST RESTORATION				
Site Excavation	18,337	CY	\$4.20	\$77,087
Pond 1 Excavation	9,035	CY	\$4.20	\$37,982
Pond 2 Excavation	26,908	CY	\$4.20	\$113,119
Import and Place Topsoil	33,835	CY	\$33.70	\$1,140,099
Place Fill (On Site Source)	49,155	CY	\$12.29	\$604,123
Construct Parking Lot	50	CARS	\$1,407.90	\$70,395
Construct Trails (6' Wide Gravel)	4,818	LF	\$5.77	\$27,805
Install New Water Main (8" PVC)	600	LF	\$34.98	\$20,985
Dewatering	1	LS	\$91,792.00	\$91,792
Revegetation	21	ACRES	\$2,279.12	\$47,798
Erosion Control	1	EA	\$5,000.00	\$5,000
Sub Total				\$2,236,185
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$2,236,185	\$55,905
Performance Bond	0.90%		\$2,236,185	\$20,126
Insurance	0.09%		\$2,236,185	\$1,901
Testing/Environmental	0.20%		\$2,236,185	\$4,472
Design/Engineer Fees 15%	15.00%		\$2,236,185	\$335,428
Sub Total				\$417,831
TOTAL DESIGN/CONSTRUCTION				
				\$2,654,017
Contingency @15%				\$398,102
TOTAL PROJECT COST				
				\$3,052,119

Table 4 Diggings East Restoration Cost, Alternative 1

Northside Tailings Alternative 1 - Cost Estimate for Northside Tailings Restoration (Construction of wetlands in Tailings Removal Area)

The cost estimate for this restoration alternative at Northside Tailings includes the construction of shallow wetland habitat within the tailings excavation at the site. The site was conceptually designed to balance cut/fill, not requiring importing of fill material. The southwest and northwest corners of the site will be filled to provide cover for sewer and storm sewer pipelines. The primary costs for this restoration option are; cut and placing fill in the northeast and southwest corners of the site, and the construction of a bridge across the Metro Storm Drain to provide access to the site. The total cost for this restoration option is \$0.5 million.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
NORTHSIDE TAILINGS RESTORATION				
Strip Topsoil and Stockpile	1,271	CY	\$0.86	\$1,093
Install Drain Pipes (3 - 24" HDPE)	440	LF	\$75.58	\$33,256
Install Drain Pipe Across George St. (1 - 24" HDPE)	450	LF	\$25.19	\$11,337
Install New Water Main (8" PVC)	400	LF	\$34.98	\$13,990
Cut and Place Fill (sloped Banks)	1,012	CY	\$4.67	\$4,731
Cut and Place Fill (southwest and northeast corners)	9,815	CY	\$10.72	\$105,219
Place (Topsoil)	11,670	CY	\$0.86	\$10,036
Dewatering	1	LS	\$13,520.00	\$13,520
Construct Pedestrian Bridge / Walkway	1	EA	\$112,157.76	\$112,158
Construct Trails (6' Wide Gravel)	2,050	LF	\$5.77	\$11,831
Erosion Control	1	LS	\$3,000.00	\$3,000
Revegetate	7	ACRE	\$3,254.20	\$23,540
Sub Total				\$343,710
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$343,710	\$8,593
Performance Bond	0.90%		\$343,710	\$3,093
Insurance	0.09%		\$343,710	\$292
Testing/Environmental	0.20%		\$343,710	\$687
Design/Engineer Fees 15%	15.00%		\$343,710	\$51,557
Sub Total				\$64,222
TOTAL DESIGN/CONSTRUCTION				
				\$407,933
Contingency @15%				\$61,190
TOTAL PROJECT COST				\$469,123

Table 5 Northside Tailings Restoration Cost, Alternative 1

Combining the removal and resultant restoration costs for both Diggings East and Northside Tailings, the total project cost for Alternative 1 would be approximately \$11 million. As detailed in Section 3.1.1, concurrent restoration with Alternative 1 or 2 from the Blacktail Berm Restoration as presented in this PCRCP may allow balancing of cut and fill between the projects, resulting in substantial cost savings to both.

Diggings East Alternative 2 - Cost Estimate for Diggings East Restoration (Construction of a Wetland Complex and Relocating Storm Drain)

The cost estimate for this restoration alternative at Diggings East includes the construction of a wetland complex and the relocation of the Metro Storm Drain through the site. The primary expenses for the restoration of the site include; the construction of the relocated Metro Storm Drain, placement of fill from on-site excavation, and the importing of topsoil throughout the site. The total cost for this restoration option is \$4.9 million.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
DIGGINGS EAST RESTORATION				
Spread Topsoil (On Site Source)	11,572	CY	\$0.86	\$9,952
Import and Place Topsoil	37,438	CY	\$33.70	\$1,261,526
Place Fill (On Site Source)	59,600	CY	\$12.29	\$732,496
Site Excavation	32,959	CY	\$4.20	\$138,557
Floodplain Excavation North of George St.	12,040	CY	\$4.20	\$50,615
Pond 1 Excavation	9,035	CY	\$4.20	\$37,982
Pond 2 Excavation	26,908	CY	\$4.20	\$113,119
Construct Storm Drain \ Riparian Swale	3,830	LF	\$143.03	\$547,792
Install Upstream Culvert Crossings Across George St. (2 - 88" x 54" Concrete Culverts)	270	LF	\$500.09	\$135,023
Install Downstream Culvert Crossing Across George St. (2 - 88" x 54" Concrete Culverts)	190	LF	\$506.81	\$96,294
Construct Parking Lot	50	CARS	\$1,407.90	\$70,395
Construct Pedestrian Bridge / Walkway	2	EA	\$112,157.76	\$224,316
Construct Trails (6' Wide Gravel)	6,137	LF	\$5.77	\$35,417
Install New Water Main (8" PVC)	645	LF	\$34.98	\$22,559
Install Risers for Sub-Drain	1	EA	\$2,000.00	\$2,000
Dewatering	1	LS	\$91,792.00	\$91,792
Revegetation	30	ACRES	\$2,279.12	\$69,236
Erosion Control	1	EA	\$5,000.00	\$5,000
Sub Total				\$3,644,070
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$3,644,070	\$91,102
Performance Bond	0.90%		\$3,644,070	\$32,797
Insurance	0.09%		\$3,644,070	\$3,097
Testing/Environmental	0.20%		\$3,644,070	\$7,288
Design/Engineer Fees 15%	15.00%		\$3,644,070	\$546,611
Sub Total				\$680,895
TOTAL DESIGN/CONSTRUCTION				
				\$4,324,965
Contingency @15%				\$648,745
TOTAL PROJECT COST				
				\$4,973,709

Table 6 Diggings East Restoration Cost, Alternative 2

Northside Tailings Alternative 2 - Cost Estimate for Northside Tailings Restoration (Restore Site to an Upland Field)

The cost estimation for this restoration alternative at Northside Tailings includes the construction of an upland site to be utilized for future needs of the city. The primary expense of this restoration option is importing of fill material needed to provide a finished grade surface suitable for future use. The total cost for this restoration option is \$1.3 million.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
NORTHSIDE TAILINGS RESTORATION				
Strip Topsoil and Stockpile	11,560	CY	\$0.86	\$9,942
Import and Place Fill	37,931	CY	\$22.15	\$840,255
Install Drain Pipes (3 - 24" HDPE)	440	LF	\$75.58	\$33,256
Install Drain Pipe Across George St. (1 - 24" HDPE)	450	LF	\$25.19	\$11,337
Install New Water Main (8" PVC)	400	LF	\$34.98	\$13,990
Place (Topsoil)	21,960	CY	\$0.86	\$18,886
Dewatering	1	LS	\$13,520.00	\$13,520
Erosion Control	1	LS	\$3,000.00	\$3,000
Revegetate	14	ACRE	\$1,540.00	\$21,355
Sub Total				\$965,542
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$965,542	\$24,139
Performance Bond	0.90%		\$965,542	\$8,690
Insurance	0.09%		\$965,542	\$821
Testing/Environmental	0.20%		\$965,542	\$1,931
Design/Engineer Fees 15%	15.00%		\$965,542	\$144,831
Sub Total				\$180,411
TOTAL DESIGN/CONSTRUCTION				\$1,145,953
Contingency @15%				\$171,893
TOTAL PROJECT COST				\$1,317,846

Table 7 Northside Tailings Restoration Cost, Alternative 2

Combining the removal and resultant restoration costs for both Diggings East and Northside Tailings, the total project cost for Diggings East and Northside Tailings Alternative 2 would be approximately \$13.8 million. As with Alternative 1, concurrent restoration with Alternative 1 or 2 from the Blacktail Berm Restoration as presented in this PCRP may allow balancing of cut and fill between the projects, resulting in substantial cost savings to both.

4. BLACKTAIL BERM PROJECT

4.1. Tailings/Contaminated Materials Removal

4.1.1. Removal Actions

Data characterizing tailings/contaminated materials in the vicinity of the Blacktail berm are limited. Five locations, all within the 1.2 acre footprint of the berm, were sampled for the report *Final Draft Version Tailings/Impacted Sediment Delineation of the Diggings East, Blacktail Berm, and Northside Tailings Areas* (MBMG 2014). Boring locations and identifiers are presented in Figure 19. Surface ownership within the Diggings East and Northside Tailings project footprint and surrounding areas, from Montana Cadastral, is presented on Figure 20.

All boring results documented one or more layers within or beneath the berm that failed the concentration-based criterion for removal of contaminated materials established for the Diggings East and Northside Tailings areas (see Section 3.1.1). As in the other BAO tailings areas, the highest concentration of COCs was often found in an organic silt layer at a depth of 8-12 feet below the current ground surface that underlies visually identified tailings and overlies clean material beneath. Therefore the removal scenario assumption for the Blacktail berm in the draft PCRCP is removal of the footprint of the berm to the base of that organic silt layer (average 10 feet BGS).

A second Blacktail berm option includes addressing the additional tailings and other contaminated materials in the 9.3 acres of wetland behind the berm. These materials are saturated and are potentially affecting the quality of groundwater and surface water in Blacktail Creek. In addition, erosion or a failure of the berm could release these sediments to Blacktail Creek directly, imperiling Silver Bow Creek. This option would remove these materials as well, using the same removal criterion as applied to the other BAO units: removal to the bottom of the original organic silt/clay soil horizon (approximately 10 feet BGS).

4.1.2. Transport and Disposal Options

As discussed in Section 2.1.2 for the Parrot Tailings project area, two transport methods, truck haul and slurry pipeline, could be used to remove the tailings and contaminated materials from the Diggings East and Northside Tailings project areas to a permanent repository, but for this PCRCP, only the truck haul option to a nearby repository location is evaluated.

Repository location and transport method will be addressed in the draft Conceptual Restoration Plan. NRDP will continue its work with all interested entities in the development of the draft Conceptual Restoration Plan.

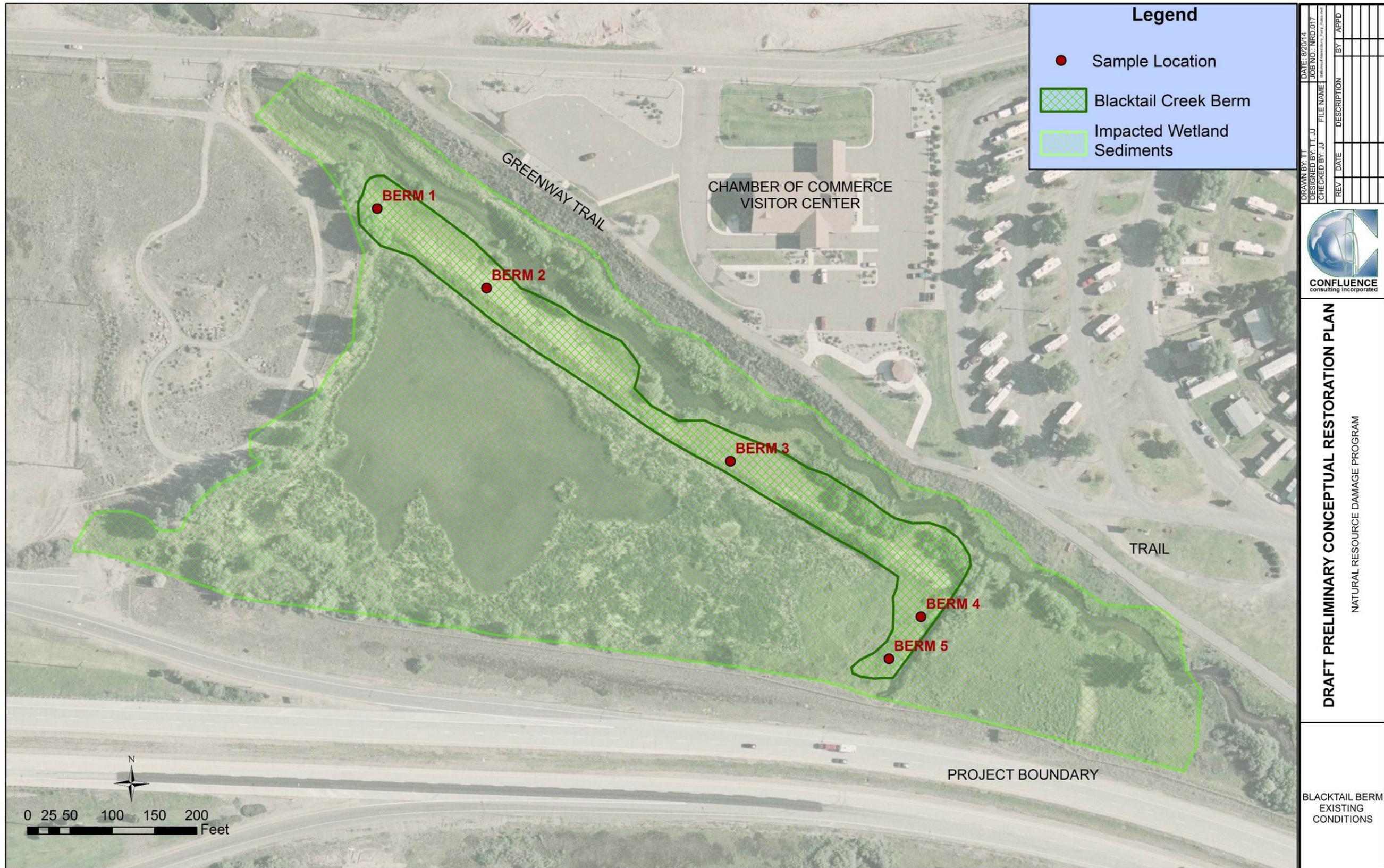


Figure 19 Blacktail Berm Project Area, Borehole Locations



Figure 20 Blacktail BERM Project Area, Property Ownership

4.1.3. Removal Costs

Scenario A - Cost Estimate for Tailings and Contaminated Materials Removal at Blacktail Berm Site (9.3 Acre Site Wide Removal to Bottom of Black Silt Layer (10') and Hauling to a Repository)

This option includes the removal of tailings and contaminated materials from the Blacktail berm site. The extent of the removal includes all wetlands within the site and removal to the depth of the black silt layer, approximately 10 feet below existing grade. The tailings will be removed with excavators and hauled to a repository with on-road haul trucks. The tailings will be capped and revegetated. The total cost for this removal option is approximately \$2.9 million.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
TAILINGS REMOVAL - BLACKTAIL BERM COMPLEX (Haul to Repository)				
Tailings + Organic Clays Dig and Haul	138,636	CY	\$9.72	\$1,346,977
Strip Topsoil at Repository	6,938	CY	\$0.86	\$5,950
Spread Tailings in Repository	138,636	CY	\$3.95	\$547,566
Spread Topsoil at Repository	6,938	CY	\$0.86	\$5,950
Revegetate Repository	4.30	Acre	\$1,540.00	\$6,623
Cap Tailings	4.30	Acre	\$30,000.00	\$129,014
Dewatering Site	1	LS	\$61,533.75	\$61,534
Erosion Control	1	LS	\$5,000.00	\$5,000
TAILINGS REMOVAL SUBTOTAL				\$2,108,614
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$2,108,614	\$52,715
Performance Bond	0.90%		\$2,108,614	\$18,978
Insurance	0.85%		\$2,108,614	\$17,923
Testing/Environmental	2.00%		\$2,108,614	\$42,172
Design/Engineer Fees 15%	15.00%		\$2,108,614	\$316,292
Sub Total				\$448,080
TOTAL DESIGN/CONSTRUCTION				
				\$2,556,694
Contingency @15%				\$383,504
TOTAL PROJECT COST				
				\$2,940,198

Table 8 Blacktail Berm Removal Cost, Scenario A

Scenario B - Cost Estimate for Tailings and Contaminated Materials Removal at Blacktail Berm Site (Removal of Berm Only to Bottom of Black Silt Layer (10') and Hauling to a Repository)

This option includes the removal of tailings and organic clays from the Blacktail berm site. The extent of the removal area includes the Blacktail berm adjacent to Blacktail Creek and removal to the depth of the black silt layer, approximately 10 feet below existing grade. The tailings and contaminated materials will be removed with excavators and hauled to a repository with on-road haul trucks. The tailings will be capped and revegetated. The total cost for this removal option is approximately \$0.7 million.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
TAILINGS REMOVAL - BLACKTAIL BERM COMPLEX (Haul to Repository)				
Tailings + Organic Clays Dig and Haul	34,908	CY	\$9.72	\$339,162
Strip Topsoil at Repository	1,747	CY	\$0.86	\$1,498
Spread Tailings in Repository	34,908	CY	\$3.95	\$137,874
Spread Topsoil at Repository	1,747	CY	\$0.86	\$1,498
Revegetate Repository	1.08	Acre	\$1,540.00	\$1,668
Cap Tailings	1.08	Acre	\$30,000.00	\$32,485
Dewatering Site	1	LS	\$12,459.75	\$12,460
Erosion Control	1	LS	\$2,500.00	\$2,500
TAILINGS REMOVAL SUBTOTAL				\$529,146
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$529,146	\$13,229
Performance Bond	0.90%		\$529,146	\$4,762
Insurance	0.85%		\$529,146	\$4,498
Testing/Environmental	2.00%		\$529,146	\$10,583
Design/Engineer Fees 15%	15.00%		\$529,146	\$79,372
Sub Total				\$112,443
TOTAL DESIGN/CONSTRUCTION				
				\$641,589
Contingency @15%				\$96,238
TOTAL PROJECT COST				\$737,828

Table 9 Blacktail Berm Removal Cost, Scenario B

4.2. Resultant Restoration and End Land Uses

Four PCRPs alternatives are assumed for the Blacktail Berm area:

4.2.1. Alternative 1 End Land Use Considerations

Alternative 1 is the “stream only” alternative. It would begin from the post-excavation surface of a site wide, bottom of silt/clay removal scenario (removal Scenario A). The site would then be restored with a relocated Blacktail Creek channel and floodplain constructed from clean fill. A walking/bike trail that connects to the existing MSD /greenway trail to the existing park trail network via a footbridge would provide recreation access to the site. The reconstructed stream is expected to provide increased stream length and habitat complexity to Blacktail Creek, and may offer some groundwater loading reduction to the MSD sub-drain. The finished grade of the Blacktail Creek floodplain could be kept low to encourage wetland development, or raised to provide drier parkland. The stream, trail and parkland elements of this PCRPs alternative are presented on Figure 21. A conceptual cross section of this alternative through section A from Figure 21 is presented on Figure 22.

4.2.2. Alternative 2 End Land Use Considerations

The Skyline Sportsman’s Association and other members of the community have expressed a desire to have a kids’ fishing pond at the Blacktail Berm location. This Alternative 2 would expand on the “stream only” aspect of Alternative 1, and include a 2.3 acre, 20 foot deep pond along with the stream channel relocation, reconstructed Blacktail Creek floodplain, and recreation trail elements. The proposed pond configuration is presented on Figure 23. A conceptual cross section of this PCRPs alternative through section A from Figure 23 is presented on Figure 22.

4.2.3. Alternative 3 End Land Use Considerations

Alternative 3 (Figure 24) represents the minimum, isolated response to the problem of a Blacktail Berm constructed from tailings and other contaminated materials threatening the water quality of Blacktail Creek. As shown on Figure 25, this minimum, isolated response removes the existing berm, removes the contaminated material beneath the berm down to the base of the historic soil horizon (approx. 10’ depth), then backfills the excavation and reconstructs the berm using clean fill material.

The minimum response leaves behind substantial quantities of the same contaminated material from which the berm was constructed, in the adjacent wetland. It relies on the berm to protect Blacktail Creek in perpetuity, and leaves contaminated material in contact with surface water and groundwater. The minimum response foregoes opportunities to improve Blacktail Creek alignment and habitat, and to create additional recreational uses for this site.

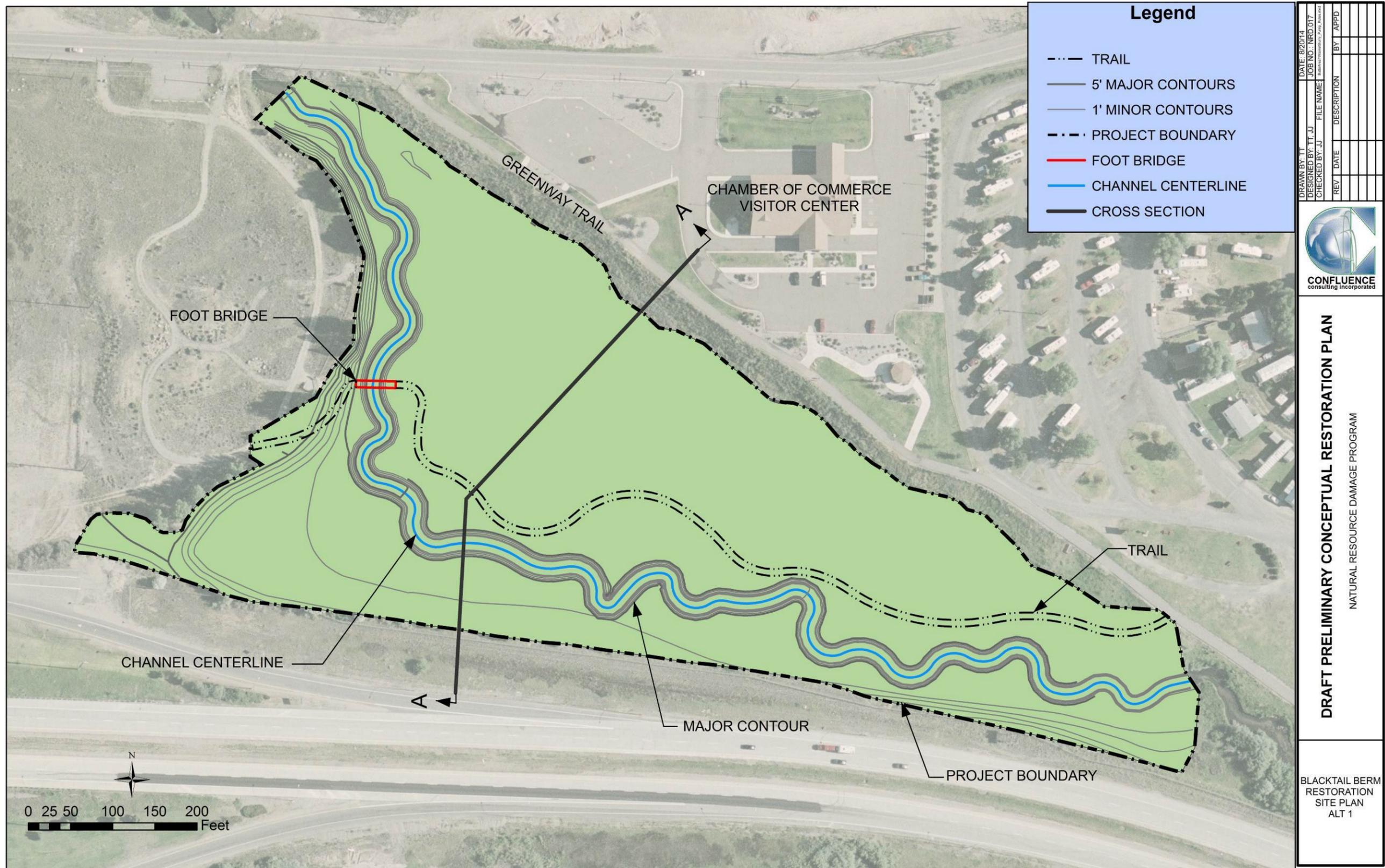


Figure 21 Blacktail Berm PCR Alternative 1

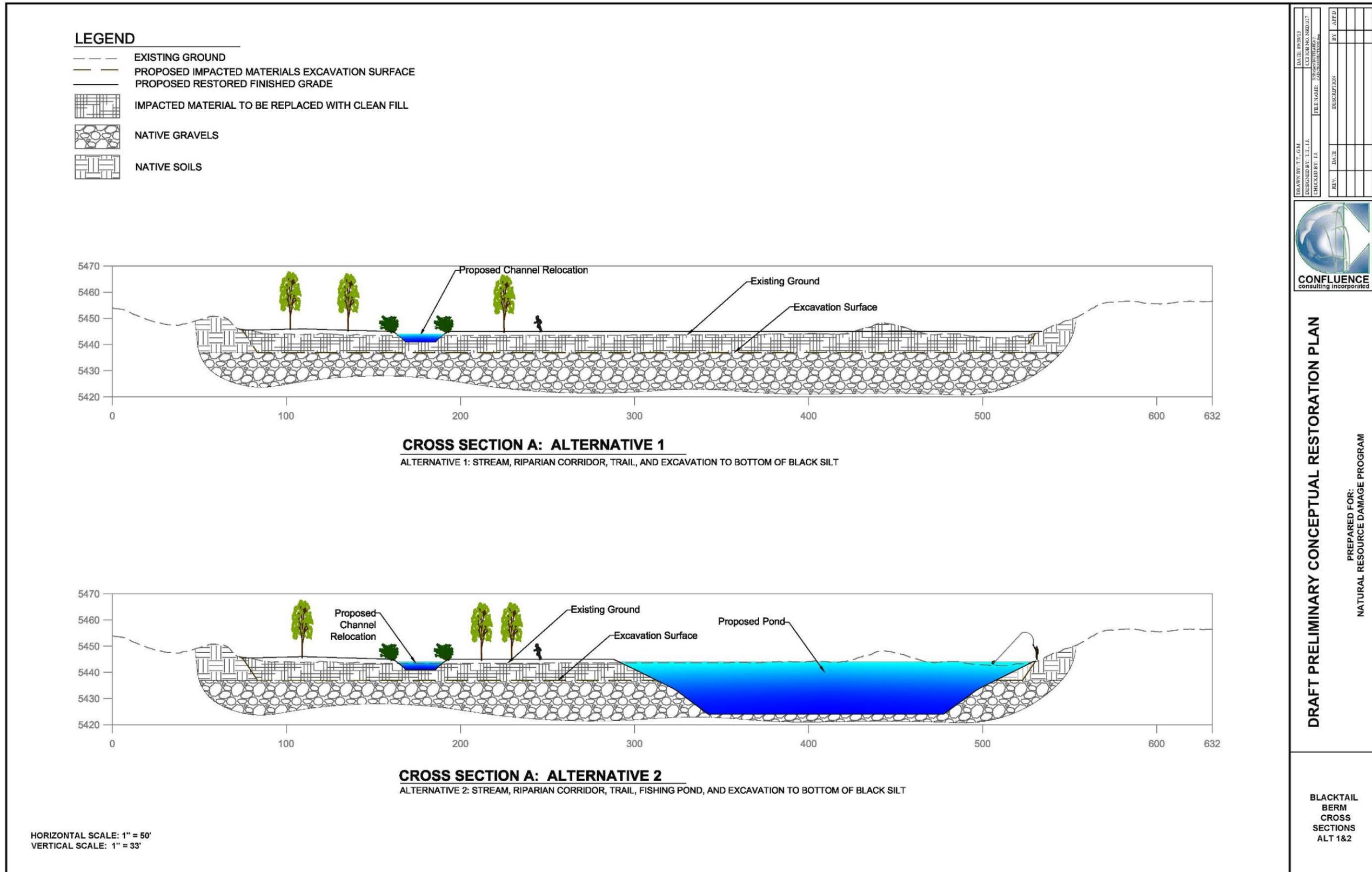


Figure 22 Blacktail Berm Restoration Conceptual Cross Sections, Alternatives 1 and 2.

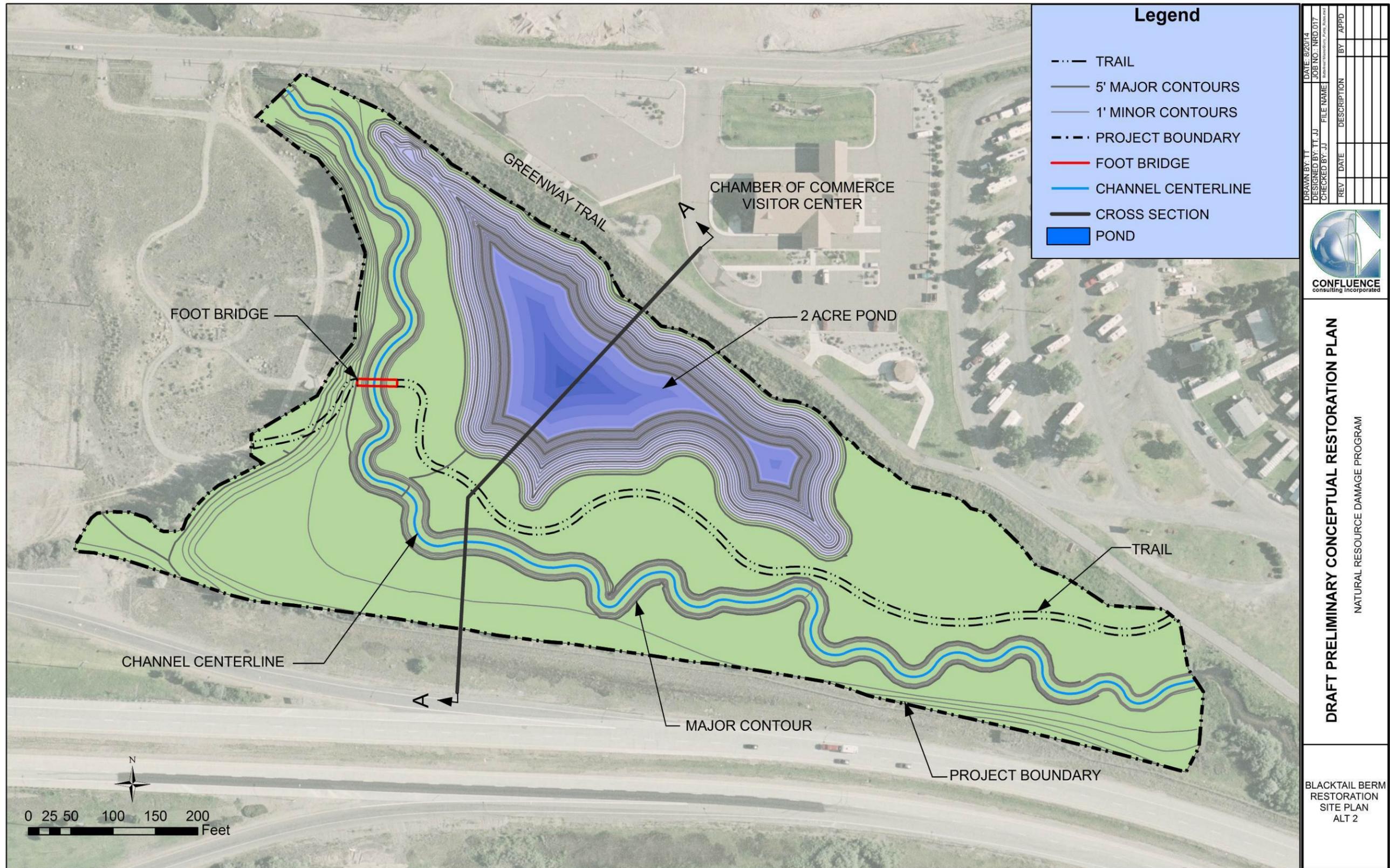


Figure 23 Blacktail Berm PCR Alternative 2

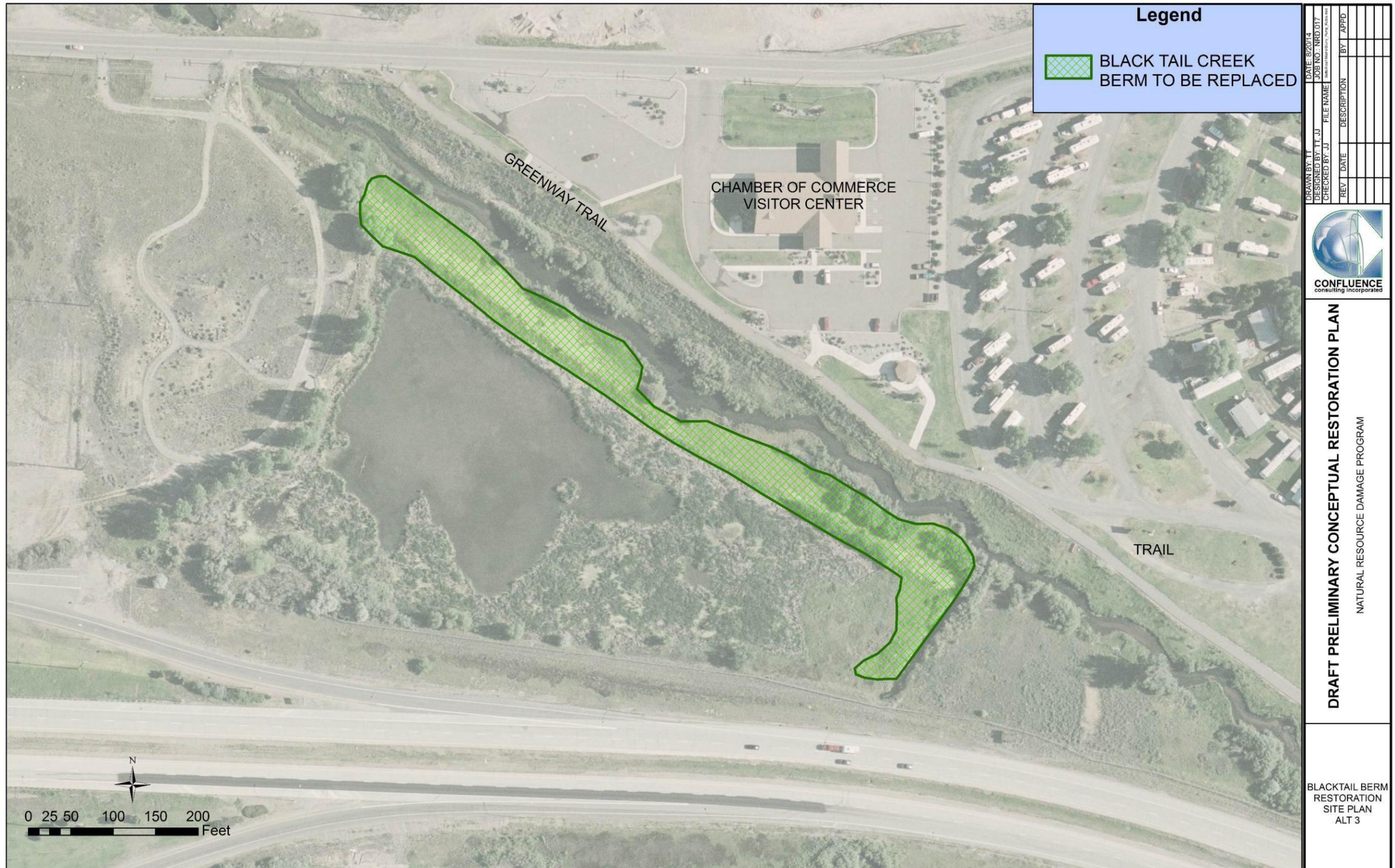


Figure 24 Blacktail Berm PCRP Alternative 3

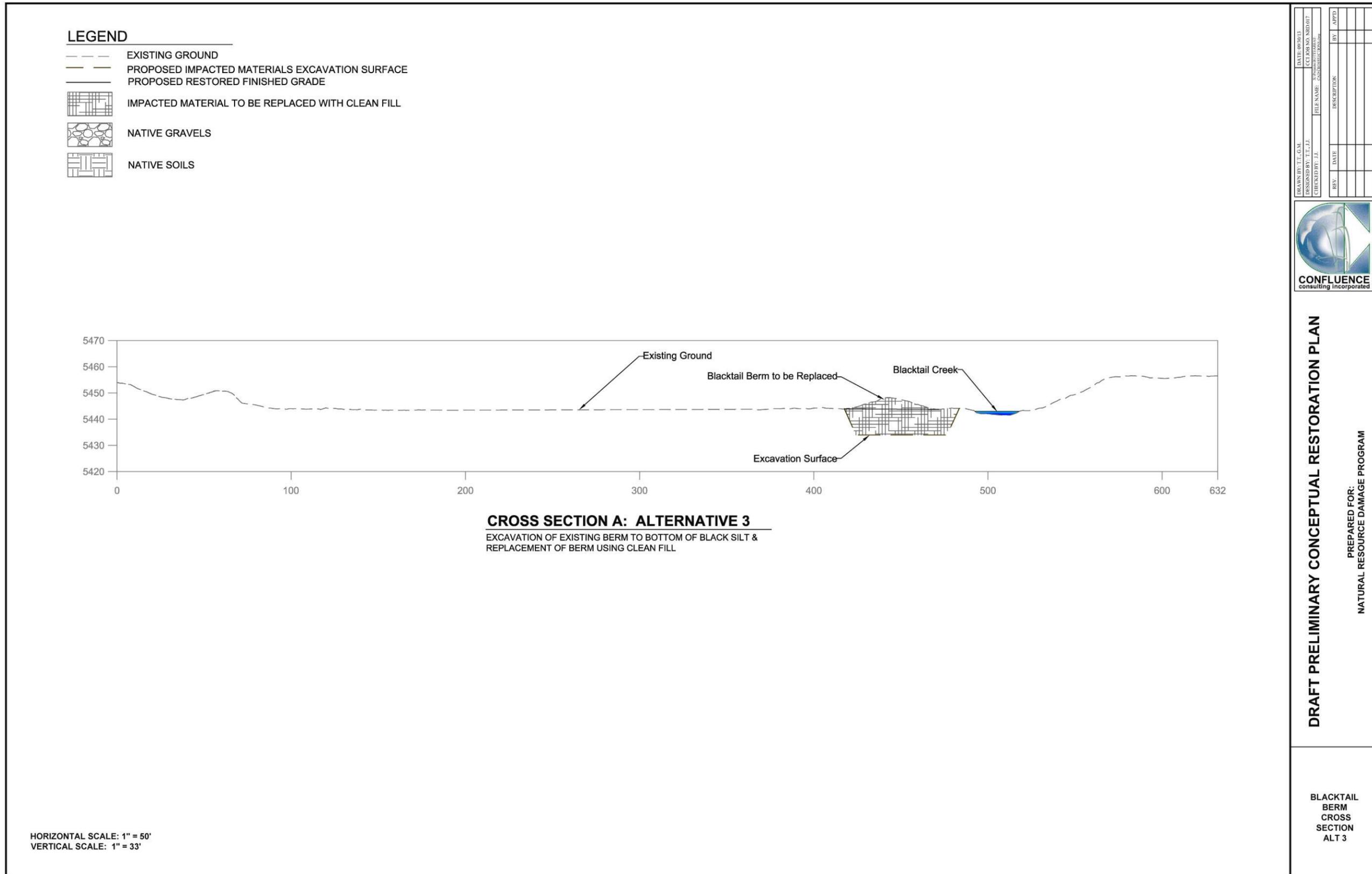


Figure 25 Blacktail Berm Restoration Conceptual Cross Sections, Alternative 3

Alternative 2 - Backfill from Bottom of Contaminated Silt Excavation, Relocate Blacktail Creek Channel, Excavate Pond, add Recreation Elements

The cost estimation for this PCRP alternative at the Blacktail Berm site includes constructing a new channel to reroute Blacktail Creek through the south side of the site as well as a pond. This option would require filling the site from an excavation of depth of approximately 10' to a suitable elevation to prevent a perched channel. The primary expense for this option is the importing of fill and topsoil to bring the site up to grade, as well as the construction of a pond. The total cost for this option is \$3.2 million. The lower cost than Alternative 1 reflects the lesser amount of backfill required due to the presence of the pond.

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
BLACKTAIL BERM RESTORATION RESTORATION				
Import and Place Topsoil	9,601	CY	\$33.70	\$323,516
Import and Place Fill	67,928	CY	\$22.15	\$1,504,764
Construct Pedestrian Bridge / Walkway	1	EA	\$56,600.00	\$56,600
Construct Trails (6' Wide Gravel)	1,084	LF	\$5.77	\$6,256
Excavate Pond #1	29,139	CY	\$4.20	\$122,497
Construct Channel	1,820	LF	\$130.74	\$237,944
Dewatering	1	LS	\$69,035.25	\$69,035
Erosion Control	1	LS	\$5,000.00	\$5,000
Revegetation	6.0	ACRES	\$5,698.35	\$33,911
Sub Total				\$2,359,523
PROJECT STARTUP/ENVIRONMENTAL				
Mobilization	2.50%		\$2,359,523	\$58,988
Performance Bond	0.90%		\$2,359,523	\$21,236
Insurance	0.09%		\$2,359,523	\$2,006
Testing/Environmental	0.20%		\$2,359,523	\$4,719
Design/Engineer Fees 15%	15.00%		\$2,359,523	\$353,928
Sub Total				\$440,877
TOTAL DESIGN/CONSTRUCTION				
				\$2,800,400
Contingency @15%				\$420,060
TOTAL PROJECT COST				
				\$3,220,460

Table 11 Blacktail Creek Restoration Project costs, Alternative 2

Taken together with the removal cost (Table 8) the total project cost for Alternative 1 would be approximately \$6.1 million. As with Alternative 1, the largest single cost item is the importation and placement of backfill to restore the site to grade. The same substantial cost savings attendant to the concurrent restoration of the Blacktail Berm, Diggings East and Northside Tailings area (which produce excess material) would apply to Alternative 2.

5. COST ESTIMATES OF PCRPs ALTERNATIVES

Site	Removal (million)	Restoration (million)	Total (million)
Parrot Tailings	\$10.8	\$12.5 ¹	\$23.3
Northside Diggings			
Alternative 1	\$0.0 ²	\$0.5	\$0.5
Alternative 2	\$0.0 ²	\$1.3	\$1.3
Diggings East			
Alternative 1	\$7.6	\$3.1	\$10.7
Alternative 2	\$7.6	\$5.0	\$12.6
Blacktail Berm			
Scenario A			
Alternative 1	\$2.9	\$3.9	\$6.8
Alternative 2	\$2.9	\$3.2	\$6.1
Scenario B			
Alternative 3	\$0.7	\$1.1	\$1.8
Subtotals =	\$19.1 to \$21.3	\$17.2 to \$22.7	
		Total =	\$36.3 to \$44.0M
1 - Restoration estimate includes approximately \$7.4M to relocate and reconstruct BSB shops 2 - Northside Diggings removal costs included in Diggings East removal cost estimate			

Table 13 Summary Cost Estimates

6. SUMMARY OF DATA AND ANALYSIS NEEDS

Progressing beyond the PCRP to a draft Conceptual Restoration Plan and ultimately a Final Design and Bid Package to perform the work would require some additional data and analyses to inform those designs.

6.1.1. BAO Sitewide

A hydrogeologic analysis may need to be performed to quantify any potential effects of these removal actions on groundwater flow volumes to the Metro Sub-drain. All indications are that the combination of activities outlined in this draft PCRP will reduce the amount of water reporting to the MSD Sub-drain and that the water quality will be much improved additional analysis may be necessary.

The adequacy of the current monitoring network versus O&M needs should be assessed to determine if additional monitoring locations (principally monitoring wells) are needed, and to determine what monitoring infrastructure currently within the proposed project areas would need to be maintained or replaced during implementation.

Concomitant to the assessment of the monitoring network generally should be an assessment of the specific construction baseline and ongoing monitoring activities necessary to evaluate the effectiveness of the restoration actions as compared to the remedy on ground and surface water hydrologic effects on groundwater elevation and flow characteristics, vegetation success, etc.

Concern that proposed restoration would increase the quantity of water delivered to the MSD sub-drain should be addressed by a hydrologic analysis to determine the probable increase or decrease in flow to the MSD sub-drain expected from restoration elements.

At all sites, near surface aquifer should be characterized (groundwater elevation, permeability, etc.) to quantify construction dewatering needs.

6.1.2. Parrot Tailings

Additional borings and/or rehabilitation of existing lithology data should be conducted to refine the characterization of tailings and other contaminated materials to better define the removal area and depths. Of particular interest would be the margins of the proposed removal area to the west and southeast, and the “finger” of apparently tailings free material in the vicinity of the ball field. Vertically, some additional borings should be completed to confirm the operating assumption that the black silt/clay material beneath areas without tailings need not be removed.

6.1.3. Diggings East and Northside Tailings

Additional borings should be completed to refine the characterization of tailings and other contaminated materials to better define removal area and depths. Of particular interest would be the area beneath George Street and the outer margins of the two proposed removal areas. Vertically, sufficient data to assess the extent of alluvial impacts and their potential effects on post restoration groundwater quality (especially in the proposed ponds) should be collected.

An analysis of expected post-restoration water quality in near surface or exposed groundwater should be performed to confirm the appropriateness of restoration elements such as groundwater contact wetlands and groundwater ponds.

6.1.4. Blacktail Berm

Additional borings should be completed to refine the characterization of tailings and other contaminated materials to better define removal area and depths. Of particular interest would be the wetland area behind the current Blacktail Berm, extending south to I-90 and east to Lexington Avenue. Vertically, sufficient data to assess the extent of alluvial impacts and their potential effects on post restoration groundwater quality (especially in the proposed pond) should be collected.

An analysis of expected post-restoration water quality in exposed groundwater should be performed to confirm the appropriateness the proposed pond and to determine the depth of material removal required to provide adequate water quality to support it.

7. REFERENCES

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