Documentation of Estimated CTP Expansion and Water Treatment Costs Presented in the Draft Final FFS Report for the Upper Basin of the Coeur d'Alene River, Bunker Hill Superfund Site

PREPARED FOR: Bill Adams/EPA Region 10

PREPARED BY: Rebecca Maco/CH2M HILL
Michelle Zaehring/CH2M HILL

COPY TO: Gary Hickman/CH2M HILL
Jim Stefanoff/CH2M HILL
Joan Stoupa/CH2M HILL
Brian Tracy/CH2M HILL

DATE: July 20, 2012

1.0 Introduction

The purpose of this Technical Memorandum (TM) is to provide documentation of the estimated costs required to upgrade, expand, operate, and maintain the Bunker Hill Central Treatment Plant (CTP) and associated mine water systems and sludge disposal cell, located in Kellogg, Idaho, for treatment of additional waters as part of Alternative 3+(d) presented in the *Draft Final Focused Feasibility Study* [FFS] *Report, Upper Basin of the Coeur d'Alene River, Bunker Hill Mining and Metallurgical Complex Superfund Site* (CH2M HILL, 2010b).

Currently, the CTP primarily treats acid mine drainage (AMD) from the Bunker Hill Mine, as well as a relatively small (compared to AMD) quantity of water collected at the Principal Threat Materials (PTM) cell, the lead Smelter Closure Area, and the smelter closure cover toe drain. This water is conveyed by the Sweeney Area gravity pipeline to the lined pond, and then pumped to the CTP. The CTP also treats a small volume of stormwater and groundwater collected by the mine yard storm drain system; this water is collected in storm drains and conveyed to the lined pond in an older high-density polyethylene (HDPE) pipeline that enters the east end of the pond. Alternative 3+(d) in the Draft Final FFS Report included upgrading and expanding the CTP to treat additional waters from Operable Unit 2 (OU 2) and the Upper Basin portion of OU 3. This TM therefore is a companion document to the *Technical Memorandum: CTP Expansion of Other OU 2 and OU 3 Waters* (CH2M HILL, 2010a) that was provided as Attachment D-1 in the Draft Final FFS Report.

The historical background of the CTP has been previously documented in the aforementioned 2010 TM and in the 2001 *Record of Decision Amendment, Non-Populated Areas Operable Unit, Bunker Hill Mining and Metallurgical Complex, Shoshone County, Idaho* (referred to herein as the Mine Water ROD Amendment; U.S. Environmental Protection Agency

[EPA], 2001). The Mine Water ROD Amendment addressed one portion of OU 2 and selected a final remedy for managing AMD from the Bunker Hill Mine, including improvements needed at the CTP. The design of improvements needed to expand the CTP's capacity for treating additional waters from OU 2 and the Upper Basin portion of OU 3 must take into account the CTP's treatment of its current and future inflows, particularly Bunker Hill Mine AMD. It has been a basic assumption that Bunker Hill Mine AMD would continue to be treated at the CTP. If this changes, the costing information provided in this TM will need to be updated.

The estimated costs associated with expansion of the CTP are presented in Section 2.0, including the capital and operations and maintenance (O&M) cost estimates included in Alternative 3+(d) in the 2010 Draft Final FFS Report (Sections 2.1 through 2.3 in this TM) and estimated costs for management of the sludge formed during water treatment at the CTP (Section 2.4). Section 3.0 summarizes the total estimated costs for CTP expansion based on the combined costs for treatment of Bunker Hill Mine AMD, treatment of other waters from OU 2 and the Upper Basin portion of OU 3, and sludge management. Section 4.0 provides the full references for the documents cited in this TM.

2.0 Cost Estimates

Order-of-magnitude cost opinions were developed for expanding the CTP to various maximum capacities for treatment of additional waters from OU 2 and the Upper Basin portion of OU 3. These opinions were developed using the capital and O&M cost estimates that were prepared for the Bunker Hill Mine Water Remedial Investigation/Feasibility Study (RI/FS) (CH2M HILL, 2001), and modifying these estimates for maximum capacities of 2,500, 5,000, 10,000, 15,000, and 20,000 gallons per minute (gpm) (Tables A1-1 through A1-5 in Attachment 1, respectively). These costs were then escalated to 2009 dollars and used to develop a capital cost curve and an O&M cost curve relating cost to capacity (Attachment 2). The development of the capital and O&M cost estimates is further described in the sections below.

The cost opinions are considered to be order-of-magnitude, with an expected accuracy of plus 50 percent to minus 30 percent. Estimated capital and operating costs were derived from vendor quotes, cost estimating manuals, historical operating budgets, and similar projects. Costs are for comparative purposes only. Net present value (NPV) costs are based on 30 years of operation at a 7 percent interest rate. As noted above, the order-of-magnitude cost opinions are in 2009 dollars. They have been prepared for guidance in project evaluation and should be carefully reviewed before making specific financial decisions or establishing final project budgets. The actual costs are expected to vary from the costs shown here based on actual labor and material costs, competitive market conditions, final project scope, and other variable factors.

The following sections discuss the CTP capital and O&M cost estimates and how those estimates were used in the Draft Final FFS Report (CH2M HILL, 2010b), as well as cost estimates for management of sludge generated during treatment at the CTP.

2.1 CTP Expansion Capital Cost Estimates

The capital cost estimates shown in Figure A2-1 in Attachment 2 are quite linear with respect to capacity, as was expected, because the size of the required upgrades (particularly the filters) is proportional to flow. The capital costs represent the total costs to upgrade the existing CTP to the desired capacity. The largest single capital-cost component is the addition of media filters, which are sized based on flow (gpm) per media filter surface area (square feet). Thus, increasing the treatment capacity from 2,500 to 20,000 gpm requires eight times the area of filters. The next largest capital cost is associated with constructing the neutralization/oxidation reactors. These are sized using treatment residence time, which is also proportional to flow.

2.2 CTP Expansion O&M Cost Estimates

The basis for the annual O&M cost estimate for treatment of Bunker Hill AMD at the CTP is the current cost incurred by EPA for O&M of the CTP and associated mine water systems, including the Kellogg Tunnel portal collection system, the AMD pipelines, and the lined pond and pump station. Annual O&M cost estimates for treatment of additional waters begin with these current costs and add additional costs for power and O&M of new equipment and other upgrades, and increased chemical usage (lime and polymer).

Comparison of Figures A2-1 and A2-2 in Attachment 2 shows that while the capital cost required to construct 20,000 gpm of capacity is about five times that required to provide 2,500 gpm capacity, the annual O&M cost increases by only about two times. This is because once the CTP's treatment capacity is available, the incremental cost, on a per-gallon basis, to treat additional water is relatively low. At lower flows the O&M cost per gallon will be slightly higher. This can be observed in the two O&M cost curves in Figure A2-2, for flow from 1,500 to 2,499 gpm and from 2,500 to 20,000 gpm. Little additional operational labor is required, and the increased lime and polymer consumption is also relatively low because of the much more dilute nature of the other OU 2/OU 3 waters as compared to Bunker Hill Mine water.

2.3 Derivation of Unit Cost Equations Used in the 2010 Draft Final FFS Report

As discussed above, cost estimates for CTP expansion at various flow rates (Attachment 1) were used to develop cost curves depicting cost as a function of flow rate (Attachment 2). From these curves, unit cost equations for water treatment at the CTP were derived for use in the Draft Final FFS Report (CH2M HILL, 2010b). The unit cost equations allowed for water treatment costs to be allocated to specific sites based on the flow rate of water to be treated. This section documents the derivation of these unit cost equations.

2.3.1 Derivation of Unit Cost Equation for Capital Costs

As shown in Figure A2-1 in Attachment 2, the equation for the capital cost curve is:

$$Y = 1391.6Q + 3326476.8$$

where Y is the estimated total (direct plus indirect) capital cost for CTP upgrades for a design flow of Q in gallons per minute. This equation is applicable to design flows between 2,500 and 20,000 gpm. The cost estimates provided in Attachment 1, Tables A1-1 through A1-5, indicate that indirect costs are estimated to be 107 percent of the direct capital costs.

Therefore, direct and indirect capital costs were broken out on that basis in the Draft Final FFS Report.

The CTP cost estimates in the Draft Final FFS Report are based on the assumption that the upgrades to the CTP called for in the 2001 Mine Water ROD Amendment for treatment of Bunker Hill Mine water would be complete prior to the addition of other OU 2 and OU 3 waters for treatment. The design flow for the CTP after implementation of those upgrades would be 2,500 gpm if the mitigations were implemented to reduce flows to the CTP. The design flow to the CTP would be 5,000 gpm if these mitigations were not implemented. Conceptually, the three-step process used to estimate CTP costs in the FFS consisted of the following:

1. Use the above equation to estimate the capital costs for the total flow at the CTP (FFS design flow rate plus Bunker Hill Mine water design flow rate), Q + 2,500.
2. Use the same equation to estimate capital costs for the Bunker Hill Mine water (2,500 gpm).
3. Subtract (2) from (1) above to arrive at the estimated cost of CTP upgrades for only the "other" OU 2 and OU 3 waters.

Mathematically, this three-step process can be described and simplified as follows, where m and b are used to represent the constants in the capital cost curve equation (m=1391.6 and b=3326476.8):

$Y_{total} = m(Q+2500)+b$ (Step 1 above)

$Y_{BH\text{-}AMD} = m(2500) + b$ (Step 2 above)

$Y_{OtherWaters} = Y_{total} - Y_{BH\text{-}AMD} = m(Q+2500)+b – [m(2500)+b]$ (Step 3 above)

Simplifying…

$$Y_{OtherWaters} = mQ + 2500m + b – 2500m - b$$

$$Y_{OtherWaters} = mQ = 1391.6Q$$

For the purposes of the FFS, this capital cost was broken down into direct and indirect components. As shown in the capacity-specific estimates in Attachment 1, Tables A1-1 through A1-5, indirect costs consist of indirect markups for consistently 107 percent of direct capital costs. An equation describing direct capital costs can then be developed as follows:

$$Y_{total}=1391.6Q = \text{direct} + \text{indirect} = xQ + (1.07)xQ = (2.07)xQ$$

Solve for x and find that x=672. Therefore, the total direct capital costs can be described as:

$$Y_{direct}= xQ = 672Q$$

The unit cost equation for DIRECT CAPITAL COSTS used in the FFS is then:

$$Y_{Direct,OtherWaters} = 672Q$$

where Q is the maximum (design) flow rate in gpm.

2.3.2 Annual Operation and Maintenance Costs

The equation for the annual O&M cost curve based on the capacity-specific estimates in Attachment 1, Tables A1-6 through A1-11, and presented in Figure A2-2 in Attachment 2, is:

$$Y=82.11Q + 1004308.16$$

where Y is the estimated annual O&M cost for treatment of a given flow Q. This equation is applicable to annual average flows between 2,500 and 20,000 gpm.

Though not applicable to CTP expansion cost estimates, note that for annual average flows between 1,500 and 2,499 gpm (which represent the range of Bunker Hill AMD flows currently being treated at the CTP), the equation for the annual O&M cost curve (as shown in Figure A2-2) is:

$$Y = 49.333Q + 1,077,718$$

The same three-step process applied above to capital cost estimation in the FFS is applied to O&M cost estimation such that the estimated annual O&M cost, at a given flow Q and excluding the O&M costs for the Bunker Hill Mine water, is described as:

$$Y_{OtherWaters} =82.11Q$$

For the purposes of the FFS, it was necessary to also calculate the 30-year NPV of the O&M costs. Given a depreciation rate of 7 percent, the 30-year NPV of O&M costs was calculated by multiplying the annual O&M cost by a factor of 12.409.

Therefore, the unit cost equation used to estimate the 30-year NPV of O&M costs is:

$$Y_{OtherWaters} = (82.11*12.409)Q = 1019Q$$

where Q is the annual average flow rate in gpm.

2.4 Sludge Management Cost Estimates

The volume of sludge formed during treatment at the CTP is a function of the water chemistry of the incoming water. For many of the additional water sources from OU 3, very few water chemistry data exist with which to estimate sludge volumes resulting from treatment at the CTP. Therefore, estimates of future sludge volumes are subject to significant uncertainty at this time. Prior to the design of CTP upgrades and expansion, additional water chemistry data should be collected on all water sources to be treated at the CTP so that these estimates can be refined.

The general chemistry parameters known as "lime demand" and "solids formed" are useful for estimating sludge volumes for treatment. Lime demand and solids formed data provide an indication of the lime required to treat a unit volume of water and the quantity of sludge produced during treatment. Lime demand and solids formed tests were conducted on samples taken from a limited number of adit discharges and seeps in the Upper Basin during the 2008 High-Flow and Low-Flow Surface Water Study (CH2M HILL, 2009). Lime demand and solids formed tests were performed for nine of the 34 water sources included for treatment at the CTP in Alternative 3+(d) in the Draft Final FFS Report (CH2M HILL, 2010b). For those water sources where data were not available, it was assumed that the results of tests conducted on other water sources within that drainage were representative.

Table 2-1[1] lists the water sources planned for treatment at the CTP and, for each source, either the measured or assumed values for lime demand and solids formed that form the basis for the overall estimate of solids formed, which is 1.44 pounds per 1,000 gallons of water treated (lb/1000 gal). This value includes Bunker Hill Mine Water and additional waters from OU 2 and OU 3. Based on this rate of solids formed, the estimated volume of sludge requiring disposal each year would be 13,800 cubic yards (cy/yr) if Alternative 3+(d) were fully implemented. The derivation of this estimate is presented in Table 2-2.

The sludge disposal cost estimate includes two parts: the cost to close the existing sludge disposal cell, and the cost to build a new sludge disposal cell. Both of these costs are based on the estimated volume of sludge that will be produced at the CTP when Alternative 3+(d) is fully implemented. These costs are presented in Table 2-3, and the basis of these costs is described in the sections below.

In the future, alternative sludge management options such as metals recovery may become economically viable and should be considered. Because no viable metals recovery options have been identified at this time, the cost estimates for sludge management assume continued disposal in a lined cell.

2.4.1 Existing Sludge Disposal Cell Closure Cost Estimate

Under current operating conditions (treating only the current inflows, with the CTP operating in low-density sludge mode), the existing unlined sludge disposal cell on top of the Central Impoundment Area (CIA) will reach capacity in about 8.5 years. This estimate is based on the latest data available for sludge level in the pond collected by plant operators, measured pond volume, and the rate at which that level has been rising each year. As described above, when Alternative 3+(d) is fully implemented, the CTP will produce an estimated 13,800 cubic yards per year of sludge from the treatment of the combined Bunker Hill Mine AMD and other waters from OU 2 and OU 3, assuming operation in HDS mode. At that rate, the existing sludge disposal cell would be filled in about 3 years. The actual time until the existing capacity is reached will depend on the implementation schedule of the remedy selected (i.e., how quickly additional flows are added to the CTP). When filled, the existing unlined disposal cell will be capped with a low-permeability liner similar to the areas of the CIA that have already been capped. The estimated cost to close the existing sludge disposal cell is $1,500,000; using a 7 percent interest rate and assuming the pond will be filled up and closure will begin in 3 years, this equals an NPV cost of $1,230,000.

2.4.2 New Sludge Disposal Cell Cost Estimate

Unless a more economical disposal option is identified, a new lined disposal cell will be constructed atop the CIA at the southeast end near the CTP. Although the 2001 Mine Water ROD Amendment specified construction of a 10-year cell, a longer-term cell having more capacity may be more cost-effective and will be considered during design. The new cell will be lined with a polyvinyl chloride (PVC) or HDPE (or equivalent) low-permeability liner system. A drainage system will be installed to collect water that drains from the sludge. This water will be piped to the lined pond or CTP for treatment. In the Draft Final FFS Report

[1] Tables 2-1 through 2-3 and Table 3-1 are presented following Section 4.0 of this TM, preceding the attachments.

(CH2M HILL, 2010b), costs were developed for constructing a new lined disposal cell having a 30-year capacity.

Capital, annual O&M, and 30-year NPV O&M sludge disposal cell costs were developed based on the estimated sludge produced by Alternative 3+(d), 13,800 cubic yards per year. At this sludge production rate, the storage volume required for a 30-year capacity is 414,000 cubic yards. As noted above, there is significant uncertainty associated with the estimated sludge production rate, and thus with the estimated capacity and cost of the sludge disposal cell, due to the limited availability of water quality data.

2.4.3 Allocation of Sludge Disposal Cell Costs

Sludge management costs were allocated between Bunker Hill Mine AMD and other OU 2 and OU 3 waters based on the percentage of estimated total solids formed. This estimate was made using the data presented in Table 2-1 for each water source. Based on this analysis, Bunker Hill Mine AMD will be responsible for 48 percent of the costs, OU 3 waters for 19 percent, and OU 2 waters for 33 percent. Table 2-3 shows this cost allocation. As noted above, water quality data are not available for all water sources and, for roughly half of the water sources to be treated, the water chemistry had to be assumed based on the measured water quality of other water sources within the Upper Basin that were assumed to be similar in nature. Therefore, there is significant uncertainty associated with these allocations at this time.

3.0 Summary of Estimated CTP Expansion and Water Treatment Costs

Table 3-1 presents the total estimated costs for CTP expansion and water treatment based on the combined costs for treatment of Bunker Hill Mine AMD, treatment of other waters from OU 2 and the Upper Basin portion of OU 3, and sludge management.

It should be noted that Table 3-1 does not include costs for the passive, onsite treatment systems included for some water sources in Alternative 3+(d) in the Draft Final FFS Report (CH2M HILL, 2010b). Nor does it include costs for collecting and conveying any new water to the CTP or installing the effluent pipeline from the CTP directly to the South Fork of the Coeur d'Alene River (SFCDR), as were included in Alternative 3+(d) in the Draft Final FFS Report.

4.0 References

CH2M HILL. April 2001. *Bunker Hill Mine Water Management Remedial Instruction/Feasibility Study* (RI/FS). Prepared for U.S. Environmental Protection Agency Region 10.

CH2M HILL. October 2006. *Canyon Creek Phase II Treatability Study, Draft Report*. Prepared for U.S. Environmental Protection Agency Region 10.

CH2M HILL. June 2009. *2008 High-Flow and Low-Flow Surface Water Study Report, Upper Basin of the South Fork Coeur d'Alene River*. Prepared for U.S. Environmental Protection Agency Region 10.

CH2M HILL. January 14, 2010 (2010a). *Technical Memorandum: CTP Expansion of Other OU 2 and OU 3 Waters.* Prepared for U.S. Environmental Protection Agency Region 10.

CH2M HILL. July 2010 (2010b). *Draft Final Focused Feasibility Study Report, Upper Basin of the Coeur d'Alene River, Bunker Hill Mining and Metallurgical Complex Superfund Site.* Prepared for U.S. Environmental Protection Agency Region 10.

U.S. Environmental Protection Agency (EPA). December 2001. *EPA Superfund Record of Decision Amendment, Non-Populated Areas Operable Unit, Bunker Hill Mining and Metallurgical Complex, Shoshone County, Idaho*.

Tables

TABLE 2-1
Measured and Assumed Lime Demand and Solids Formed Data
Documentation of Estimated CTP Expansion and Water Treatment Costs Presented in the Draft Final FFS Report for the Upper Basin of the Coeur d'Alene River

Site ID	Watershed	Source Type	Average Flow (gpm)	Lime Demand (mg/L)	Solids Formed (mg/L)
BUR067	Canyon Creek	Adit Drainage	709	50	100.3
BUR088	Canyon Creek	Adit Drainage	45	45	62
BUR096	Canyon Creek	Adit Drainage	4	45	62
BUR097	Canyon Creek	Adit Drainage	646	25	5.3
BUR098	Canyon Creek	Adit Drainage	880	40	101.1
BUR099	Canyon Creek	Adit Drainage	45	45	62
BUR107	Canyon Creek	Adit Drainage	45	45	62
BUR112	Canyon Creek	Adit Drainage	45	45	62
BUR121	Canyon Creek	Adit Drainage	507	18	3.0
BUR129	Canyon Creek	Adit Drainage	45	45	62
BUR190	Canyon Creek	Adit Drainage	162	45	62
KLE040	SFCDR	Groundwater	598	50	65
KLE048	SFCDR	Groundwater	598	50	65
KLE049	SFCDR	Groundwater	598	50	65
LOK011	Upper SFCDR	Adit Drainage	2,580	10	10
MUL012	Upper SFCDR	Adit Drainage	193	45	62
MUL014	Upper SFCDR	Adit Drainage	817	45	62
MUL019	Upper SFCDR	Adit Drainage	530	45	62
MUL020	Upper SFCDR	Groundwater	9	50	65
MUL037	Upper SFCDR	Groundwater	9	50	65
MUL058	Upper SFCDR	Groundwater	9	50	65
OSB039	Ninemile Creek	Adit Drainage	3	45	62
OSB065	SFCDR	Groundwater	598	50	65
OSB088	Ninemile Creek	Adit Drainage	3	20	0.5
OSB089	Ninemile Creek	Adit Drainage	9	130	248.5
OSB119	SFCDR	Groundwater	22	50	65
OSB120	SFCDR	Groundwater	598	50	65
WAL001	SFCDR	Groundwater	18	50	65
WAL002	SFCDR	Adit Drainage	0	50	65
WAL004	SFCDR	Groundwater	598	50	65
WAL011	Canyon Creek	Adit Drainage	45	45	62
WAL020	Mainstem SFCDR	Adit Drainage	45	50	65
Woodland Park	Canyon Creek	Groundwater	539	66	47.0
Subtotal - OU 3 Waters for Treatment at CTP			**11,551**		
Other OU 2 Waters	SFCDR	Groundwater	3,905	200	263.0
Bunker Hill Mine Water	SFCDR	Mine Water	1,300	984	995.2
OU 3 Waters			11,551		
Other OU 2 Waters			3,905		
Bunker Hill Mine Water			1,300		
Total Flow to CTP, Alternative 3+(d)			16,800		
Flow Weighted Average LD/SF (mg/L)				148	173
Flow Weighted Average LD/SF (lb/1,000 gal)				1.24	1.44

Notes:

Highlighted lime demand/solids formed data are actual data. Remaining values for other waters are assumed.

CTP = Central Treatment Plant
gpm = gallons per minute
lb/1,000 gal = pounds per 1,000 gallons
LD = lime demand
mg/L = milligrams per liter
OU = Operable Unit
SF = solids formed

TABLE 2-2
Derivation of Estimated Annual Sludge Production Rate, Alternative 3+(d)
Documentation of Estimated CTP Expansion and Water Treatment Costs Presented in the Draft Final FFS Report for the Upper Basin of the Coeur d'Alene River

Item			Notes
A	Flow Weighted Average Solids Formed (lb/1000 gal)	1.44	From Table 2-1
B	Average Flow to CTP (gpm)	16,800	From Table 2-1
C	Solids Formed (lb/day)	34,850	Multiply A*B, convert units
D	Specific Gravity	3	Based on Treatability Study Results (CH2M HILL, 2006)
E	Thickener Underflow Sludge % Solids (% by weight)	18	Typical % solids assuming HDS operation
F	Mass Sludge Sent to Bed (lb/day)	193,610	Divide C by E
G	Mass of Water Sent to Bed (lb/day)	158,760	F minus C
H	Volume of Solids Sent to Bed (cy/day)	6.90	Divide C by D, convert units
I	Volume of Water Sent to Bed (cy/day)	94	G, divide by density of water, convert units
J	Total Sludge Volume Sent to Bed (cy/day)	101	H plus I
K	Final Sludge % Solids in Bed (% by weight)	40	Typical % solids in settled sludge
L	Mass Sludge Remaining (lb/day)	87,125	C divided by K
M	Mass of Water Remaining (lb/day)	52,275	L minus C
N	Volume of Water Remaining (cy/day)	31	M, divide by density of water, convert units
O	Final Sludge Volume (cy/day)	38	N plus H
P	**Estimated Annual Sludge Production Rate, Alternative 3+(d) (cy/yr)**	**13,800**	

Notes:

% by weight = percent by weight
CTP = Central Treatment Plant
cy/day = cubic yards per day
cy/yr = cubic yards per year
gpm = gallons per minute
lb/day = pounds per day
lb/1000 gal = pounds per 1,000 gallons

TABLE 2-3
Estimated Sludge Disposal Cell Costs and Allocation to Bunker Hill Mine AMD and Other Waters from OU 2 and OU 3 Based on Percent Solids Contributed
Documentation of Estimated CTP Expansion and Water Treatment Costs Presented in the Draft Final FFS Report for the Upper Basin of the Coeur d'Alene River

	% Allocation	Dewatered Sludge Produced (cy/year)	New Sludge Disposal Cell Capacity [1] (cy)	Capital Cost	Closure of Existing Sludge Disposal Cell (years)	NPV Cost for Closure of Existing Sludge Disposal Cell	Annual O&M Cost for New Sludge Disposal Cell	O&M Cost (30-Year NPV)	Total 30-Year NPV
Total	100%	13,800	414,000	$ 6,100,000	3	$ 1,230,000	$ 32,000	$ 397,000	**$ 7,730,000**
Bunker Hill Mine AMD	48%	6,600		$ 2,940,000		$ 590,000	$ 15,000	$ 190,000	**$ 3,720,000**
OU 3 Waters (Alternative 3+)	19%	2,600		$ 1,140,000		$ 230,000	$ 6,000	$ 70,000	**$ 1,450,000**
OU 2 Waters (Alternative d)	33%	4,600		$ 2,020,000		$ 410,000	$ 11,000	$ 130,000	**$ 2,560,000**

Notes:

[1] Assumes 30-year sludge storage capacity.

AMD = acid mine drainage
cy = cubic yards
NPV = net present value
O&M = operations and maintenance
OU = Operable Unit

TABLE 3-1
Estimated Costs for Water Treatment at the Expanded CTP, including Treatment of Bunker Hill Mine Water
Documentation of Estimated CTP Expansion and Water Treatment Costs Presented in the Draft Final FFS Report for the Upper Basin of the Coeur d'Alene River

Operable Unit	Remedial Actions	Average Flow Rate[a] (gpm)	Maximum Flow Rate[a] (gpm)	Total Capital Cost	O&M Cost (30-Year NPV)	O&M Cost (Annual Average)	Total Cost (30-Year NPV)
OU 3 (Upper Basin Portion)							
	Treatment at CTP[b]	11,500	18,800	$26,150,000	$11,720,000	$940,000	$37,870,000
	Sludge Disposal Cell (apportioned cost, see Table 2-3)	--	--	$1,140,000	$70,000	$6,000	$1,450,000
	OU 3 TOTAL			**$27,300,000**	**$11,800,000**	**$950,000**	**$39,300,000**
OU 2							
	Treatment at CTP[b]	3,900	4,400	$6,120,000	$3,980,000	$320,000	$10,100,000
	Sludge Disposal Cell (apportioned cost, see Table 2-3)	--	--	$2,020,000	$130,000	$10,000	$2,560,000
	OU 2 TOTAL			**$8,100,000**	**$4,100,000**	**$330,000**	**$12,700,000**
TOTALS FOR OUs 2 AND 3		**15,400**	**23,200**	**$35,400,000**	**$15,900,000**	**$1,300,000**	**$52,000,000**
BUNKER HILL MINE AMD							
	Treatment at CTP[b,c]	1,300	2,500	$6,430,000	$14,270,000	$1,150,000	$20,700,000
	Sludge Disposal Cell (apportioned cost, see Table 2-3)	--	--	$2,940,000	$190,000	$15,000	$3,720,000
	BUNKER HILL MINE AMD TOTAL			**$9,370,000**	**$14,460,000**	**$1,165,000**	**$24,420,000**
TOTALS FOR OUs 2 AND 3 AND BUNKER HILL MINE AMD		**16,700**	**25,700**	**$44,800,000**	**$30,400,000**	**$2,500,000**	**$76,400,000**

Notes:

[a]From Table 7-13 in the Draft Final Focused Feasibility Study Report for the Upper Basin of the Coeur d'Alene River (CH2M HILL, 2010b).
b"Treatment at CTP" capital costs include upgrade and expansion costs for treatment of additional waters. O&M costs reflect the incremental cost for O&M of the CTP due to additional water.
[c]If the West Fork Diversion is constructed, the maximum flow is 2,500 gpm. If not, the maximum flow is 5,000 gpm.

AMD = acid mine drainage; CTP = Central Treatment Plant; gpm = gallons per minute
NPV = net present value; O&M = operations and maintenance; OU = Operable Unit

The above costs are presented rounded to three significant figures.
The above cost opinion is a feasibility-study-level estimate with a nominal accuracy of +50 percent to -30 percent (+50/-30%).
The above cost opinion is in 2009 dollars and does not include future escalation. The order-of-magnitude cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Attachment 1

Attachment 1, Table A1-1

Bunker Hill CTP
Upgrade Existing CTP to Treat 2,500 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
HDS				**The Following Costs are in Year 2000 Dollars. See Escalation Factor at Bottom.**
Sitework/Yard Piping				
Fencing	1,000	LF	$10,000	allowance
Gravel Surfacing & Misc	1	LS	$25,000	allowance
Connections & Relocations of Existing Piping	1	LS	$30,000	allowance
Reactor A (Sludge Conditioning Tank)				
Earthwork & Concrete for Slab	1	LS	$19,872	apx 50cy @ $400/cy
Elevated Platform for Reactor A&B	1	LS	$60,000	asm 40x20 @ $75/sf high level and to support reactor A
Paint	1	LS	$10,000	allowance for subcontract
Sludge Conditioning Tank, 2500gal FRP	1	EA	$42,695	quote + 5% infla. + 5%frt + 10%mu
Mixer, 3hp	1	EA	$13,803	quote + 5% infla. + 5%frt + 10%mu
Inlet Piping, 24" SDR 15.5	120	LF	$23,242	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Inlet Piping, 18" SDR 15.5	120	LF	$17,634	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Valves, vaults, etc	1	LS	$50,000	allowance
Reactor B (Neutralization/Oxidation System)				
Distribution Piping, 24" HDPE	170	LF	$32,926	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Retaining Wall to Accommodate New Tank	450	SF	$11,250	45'x 8'H + 2' below grade, CIP cantelever
Earthwork for Retaining Wall	1	LS	$6,814	
Earthwork & Concrete for Slab	1	LS	$65,578	apx 165cy @ $400/cy
Paint	1	LS	$50,000	allowance for subcontract
Aeration Tank (Reactor B), 75,000gal Steel Tank	1	EA	$56,250	revised to $.75/gal
Submerged Turbine Aerator/Mixer	1	EA	$73,520	use same a 5000gpm estimate
Positive Displacement Blower	1	EA	$13,205	
Pipe Supports, Hangers, etc	1	LS	$2,500	allowance
Automated Polymer Make-up & Feed System				
Earthwork & Concrete for Slab	1	LS	$0	in bldg
Paint	1	LS	$5,000	allowance for subcontract
Polymer Make-up System	2	EA	$20,433	
Polymer Make-up Tank, 2000gal	1	EA	$3,974	
Mixer	2	EA	$4,674	corrected hours
Transfer Pump, 20gpm	2	EA	$6,548	corrected hours
Polymer Feed Tank, 2000gal	1	EA	$3,974	
Variable Speed Gear Pump, 1gpm	2	EA	$8,421	

Attachment 1, Table A1-1

Bunker Hill CTP
Upgrade Existing CTP to Treat 2,500 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Piping to Feed Point	100	LF	$1,990	
Thickener				
Clean & Decommission Existing Floc System	1	LS	$1,775	
Replace Weir	0	LS	$0	quote + frt & markup=$19/lf & allow for removal & replacement
Groundwater Test & Empty Tank	0	LS	$0	allowance
Replace Thickener Rake System Complete	0	LS	$0	quote + frt & markup
E-DUC Feed & Floc System & Center Well Mods	1	LS	$45,934	quote + frt & markup + add'l parts for mods
Surface Prep & Coat	0	LS	$0	allowance for interior walls & mechanism
Sludge Wasting & Recycle Pumps				
Earthwork & Concrete for Slab	0	LS	$0	apx 200cy @ $400/cy
Remove Existing Pumps	1	LS	$2,474	
Paint	1	LS	$20,000	allowance for subcontract
Sludge Recycle Pump, 400gpm	2	EA	$29,234	new cost for smaller pump
Sludge Recycle Pump, 800gpm	1	EA	$22,048	new cost for smaller pump
Sludge Waste Pump, 400gpm, 200' tdh	1	EA	$26,380	new cost for larger pump
Sludge Recycle Piping, 8" DI	150	LF	$10,271	including ftgs, valves, etc, revised cost
Sludge Wasting Piping, 6" DI	0	LF	$0	including ftgs, valves, etc, revised cost
I&C and Electrical				
Total I&C	1	LS	$41,371	use 5% of above
New Magnetic Flowmeter in Existing Vault	1	EA	$10,269	24"
Parshall Flume @ Effluent	1	EA	$3,037	12"
Electrical	1	LS	$70,568	use 8% of above
Existing Plant Demolition				
Earthwork	1	LS	$7,314	
Concrete Slab & Footings	100	CY	$25,536	assume 18" avg thickness to account for ftgs, etc
Relocate Existing Filtration Bldg, etc	1	LS	$34,071	60' x 30' x 10' eave ht metal bldg-remove contents, dismantle & re-erect
Repairs, Touchup, etc	1	LS	$5,000	allowance for some painting, sealants, doors, etc
Water	1	LS	$4,235	sink, emer. Shower, hose bibbs, piping & service
Sanitary	1	LS	$1,917	toilet, piping & service
Drains	1	LS	$2,117	
HVAC	1	LS	$1,617	reinstall unit heaters
Electrical	1	LS	$4,933	reinstall, fixtures, panels, wiring, etc

Attachment 1, Table A1-1

Bunker Hill CTP
Upgrade Existing CTP to Treat 2,500 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Tertiary Media Filters				
HDS Pump Station Complete	1	LS	$70,000	cost by DAH
Water Reuse Pump Station Complete	1	LS	$30,000	cost by DAH
Distribution Piping	500	LF	$17,500	4" plastic, below grade
Media Filter System	1	LS	$566,834	quote=430000 + 10% frt + 10% mu & 100hrs to install
Liquid Polymer System	0	LS	$0	Not required per JS 11/28/2000
Backwash Pumping Complete	1	LS	$133,461	Bob York spreadsheet + 10% OH&P, scaled to 2500gpm + escalation to 2(
Dirty Backwash Storage Tank, 30,000gal	1	EA	$22,500	$.75/gal
Dirty Backwash Storage Tank Mixer	1	EA	$3,737	allowance
Dirty Backwash Return Pump	1	EA	$13,885	allowance
Clean Backwash Supply Tank, 30,000gal	1	EA	$22,500	$.75/gal
Clean Backwash Supply Pump	1	EA	$13,885	
Building Complete	1	LS	$318,750	85'x 50 @ $75/sf
Electrical/I&C	1	LS	$0	included
Mechanical	1	LS	$0	included
Backflow Preventer	1	EA	$10,000	allowance
Distribution Piping	1,000	LF	$23,000	2" plastic
Paint	1	LS	$5,000	misc painting allowance
Total DIRECT Capital Costs			**$2,290,458**	
MISC. ALLOWANCE	**10%**		**$229,046**	
SUBTOTAL			**$2,519,504**	
CONTINGENCY	**25%**		**$629,876**	
SUBTOTAL			**$3,149,380**	
MOBILIZATION	**15%**		**$472,407**	
CONSTRUCTION TOTAL			**$3,621,787**	
SALES TAX ON MATERIALS	**5.0%**		**$100,163**	
ENGINEERING AND SUPPORT	**20%**		**$724,357**	
CONSTRUCTION MANAGEMENT	**8%**		**$289,743**	
CAPITAL TOTAL (Direct+Indirect) (Yr 2000 Dollars)			**$4,740,000**	**Year 2000 Dollars**
Escalate from Yr 2000 to Yr 2009 Dollars (factor of 1.358)			**$6,440,000**	**Year 2009 Dollars**

Attachment 1, Table A1-1

Bunker Hill CTP
Upgrade Existing CTP to Treat 2,500 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments

Notes:

Misc. Allowance markup is to include items known to exist but cannot be quantified at this time.
Contingency is for scope changes that are presently unforeseen.
Mobilization includes bonds, insurance, temporary facilities, health & safety, demobilization, etc.

The order of magnitude cost opinion shown has been prepared for guidance in project evaluation at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Attachment 1, Table A1-2

Bunker Hill CTP
Upgrade Existing CTP to Treat 5,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
HDS				**The Following Costs are in Year 2000 Dollars. See Escalation Factor at Bottom.**
Sitework/Yard Piping				
Fencing	1,000	LF	$10,000	allowance
Gravel Surfacing & Misc	1	LS	$30,000	allowance
Connections & Relocations of Existing Piping	1	LS	$30,000	allowance
Reactor A (Sludge Conditioning Tank)				
Earthwork & Concrete for Slab	1	LS	$19,872	apx 50cy @ $400/cy
Elevated Platform for Reactor A&B	1	LS	$60,000	asm 40x20 @ $75/sf high level and to support reactor A
Paint	1	LS	$10,000	allowance for subcontract
Sludge Conditioning Tank, 2500gal FRP	1	EA	$42,695	quote + 5% infla. + 5%frt + 10%mu
Mixer, 3hp	1	EA	$13,803	quote + 5% infla. + 5%frt + 10%mu
Inlet Piping, 24" SDR 15.5	120	LF	$23,242	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Inlet Piping, 18" SDR 15.5	120	LF	$17,634	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Valves, vaults, etc	1	LS	$50,000	allowance
Reactor B (Neutralization/Oxidation System)				
Distribution Piping, 24" HDPE	85	LF	$16,463	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Retaining Wall to Accommodate New Tanks	225	SF	$5,625	90'x 8'H + 2' below grade, CIP cantelever
Earthwork for Retaining Wall	1	LS	$13,629	
Earthwork & Concrete for Slab	1	LS	$95,337	apx 450cy @ $400/cy
Paint	2	LS	$100,000	allowance for subcontract
Aeration Tank (Reactor B), (2) 75000 gal Steel Tank	2	EA	$112,500	$0.75/gal
Submerged Turbine Aerator/Mixer	2	EA	$130,583	
Positive Displacement Blower	2	EA	$23,031	
Pipe Supports, Hangers, etc	1	LS	$5,000	allowance
Automated Polymer Make-up & Feed System				
Earthwork & Concrete for Slab	1	LS	$0	in bldg
Paint	1	LS	$5,000	allowance for subcontract
Polymer Make-up System	2	EA	$20,433	
Polymer Make-up Tank, 2000gal	1	EA	$3,974	
Mixer	2	EA	$4,674	corrected hours
Transfer Pump, 20gpm	2	EA	$6,548	corrected hours
Polymer Feed Tank, 2000gal	1	EA	$3,974	

Attachment 1, Table A1-2

Bunker Hill CTP
Upgrade Existing CTP to Treat 5,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Variable Speed Gear Pump, 1gpm	2	EA	$8,421	
Piping to Feed Point	100	LF	$1,990	
Thickener				
Clean & Decommission Existing Floc System	1	LS	$1,775	
Replace Weir	1	LS	$28,905	
E-DUC Feed & Floc System & Hydraulic Mods	1	LS	$32,334	
Sludge Wasting & Recycle Pumps				
Earthwork & Concrete for Slab	0	LS	$0	apx 200cy @ $400/cy
Remove Existing Pumps	1	LS	$2,474	
Paint	1	LS	$20,000	
Sludge Recycle Pump, 400gpm	2	EA	$29,234	
Sludge Recycle Pump, 800gpm	1	EA	$22,048	
Sludge Waste Pump, 400gpm, 200' tdh	1	EA	$26,380	
Sludge Recycle Piping, 8" DI	150	LF	$10,271	including ftgs, valves, etc, revised cost
Sludge Wasting Piping, 6" DI	0	LF	$0	including ftgs, valves, etc, revised cost
I&C and Electrical				
Total I&C	1	LS	$51,892	use 5% of above
New Magnetic Flowmeter in Existing Vault	1	EA	$10,269	24"
Parshall Flume @ Effluent	1	EA	$5,537	
Electrical	1	LS	$88,444	use 8% of above
Existing Plant Demolition				
Remove Reactor A	1	LS	$2,810	
Remove Aeration Basin, Ret Wall, Stairs, etc	1	LS	$127,768	6000cy @ 200cy/hr
Remove Flocculation Basin	1	LS	$18,734	allow 40hrs
Remove Associated Piping	1	LS	$1,873	
Remove Associated Electrical	1	LS	$1,873	
Regrade Area	1	LS	$1,704	
Connections & Relocations of Existing Piping	1	LS	$5,000	allowance
Earthwork	1	LS	$7,314	
Concrete Slab & Footings	100	CY	$25,536	assume 18" avg thickness to account for ftgs, etc
Relocate Existing Filtration Bldg, etc	1	LS	$34,071	60' x 30' x 10' eave ht metal bldg-remove contents, dismantle & re-erect
Repairs, Touchup, etc	1	LS	$5,000	allowance for some painting, sealants, doors, etc

Attachment 1, Table A1-2

Bunker Hill CTP
Upgrade Existing CTP to Treat 5,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Water	1	LS	$4,235	sink, emer. Shower, hose bibbs, piping & service
Drains	1	LS	$2,117	
Electrical	1	LS	$4,933	reinstall, fixtures, panels, wiring, etc
Tertiary Media Filters				
Filter Pump Station Complete	1	LS	$106,100	
Water Reuse Pump Station Complete	1	LS	$30,000	cost by DAH
Distribution Piping	500	LF	$17,500	4" plastic, below grade
Media Filter System	2	LS	$1,133,668	quote=430000 + 10% frt + 10% mu & 100hrs to install
Liquid Polymer System	0	LS	$0	Not required as per JS 11/28/2000
Backwash Pumping Complete	1	LS	$190,677	
Dirty Backwash Storage Tank	1	EA	$45,000	$.75/gal
Dirty Backwash Storage Tank Mixer	1	EA	$5,182	allowance
Dirty Backwash Return Pump	1	EA	$20,080	allowance
Clean Backwash Supply Tank	1	EA	$45,000	$.75/gal
Clean Backwash Supply Pump	1	EA	$20,080	
Building Complete	1	LS	$637,500	$75/sf
Electrical/I&C	1	LS	$0	included
Mechanical	1	LS	$0	included
Backflow Preventer	1	EA	$10,000	allowance
Distribution Piping	2,000	LF	$46,000	2" plastic
Paint	1	LS	$10,000	misc painting allowance
Total DIRECT Capital Costs			**$3,753,745**	
MISC. ALLOWANCE	**10%**		**$375,375**	
SUBTOTAL			**$4,129,120**	
CONTINGENCY	**25%**		**$1,032,280**	
SUBTOTAL			**$5,161,400**	
MOBILIZATION	**15%**		**$774,210**	
CONSTRUCTION TOTAL			**$5,935,610**	
SALES TAX ON MATERIALS	**5.0%**		**$163,300**	
ENGINEERING AND SUPPORT	**20%**		**$1,187,122**	
CONSTRUCTION MANAGEMENT	**8%**		**$474,849**	
CAPITAL TOTAL (Direct+Indirect) (Yr 2000 Dollars)			**$7,760,000**	**Year 2000 Dollars**
Escalate from Yr 2000 to Yr 2009 Dollars (factor of 1.358)			**$10,500,000**	**Year 2009 Dollars**

Attachment 1, Table A1-2

Bunker Hill CTP
Upgrade Existing CTP to Treat 5,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments

Notes:

Misc. Allowance markup is to include items known to exist but cannot be quantified at this time.
Contingency is for scope changes that are presently unforeseen.
Mobilization includes bonds, insurance, temporary facilities, health & safety, demobilization, etc.

The order of magnitude cost opinion shown has been prepared for guidance in project evaluation at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Attachment 1, Table A1-3

Bunker Hill CTP
Upgrade Existing CTP to Treat 10,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
HDS				**The Following Costs are in Year 2000 Dollars. See Escalation Factor at Bottom.**
Sitework/Yard Piping				
Fencing	1,000	LF	$10,000	allowance
Gravel Surfacing & Misc	1	LS	$35,000	allowance
Connections & Relocations of Existing Piping	1	LS	$30,000	allowance
Reactor A (Sludge Conditioning Tank)				
Earthwork & Concrete for Slab	1	LS	$19,872	apx 50cy @ $400/cy
Elevated Platform for Reactor A&B	1	LS	$60,000	asm 40x20 @ $75/sf high level and to support reactor A
Paint	1	LS	$10,000	allowance for subcontract
Sludge Conditioning Tank, 2500gal FRP	1	EA	$42,695	quote + 5% infla. + 5%frt + 10%mu
Mixer, 3hp	1	EA	$13,803	quote + 5% infla. + 5%frt + 10%mu
Inlet Piping, 24" SDR 15.5	120	LF	$23,242	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Inlet Piping, 18" SDR 15.5	120	LF	$17,634	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Valves, vaults, etc	1	LS	$50,000	allowance
Reactor B (Neutralization/Oxidation System)				
Distribution Piping, 24" HDPE	170	LF	$32,926	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Retaining Wall to Accommodate New Tanks	450	SF	$11,250	90'x 8'H + 2' below grade, CIP cantelever
Earthwork for Retaining Wall	1	LS	$13,629	
Earthwork & Concrete for Slab	1	LS	$123,174	apx 450cy @ $400/cy
Paint	2	LS	$151,572	allowance for subcontract
Aeration Tank (Reactor B), 150,000 gal Steel Tank	2	EA	$225,000	$0.75/gal
Submerged Turbine Aerator/Mixer	2	EA	$197,926	
Positive Displacement Blower	2	EA	$32,010	
Pipe Supports, Hangers, etc	1	LS	$10,000	allowance
Automated Polymer Make-up & Feed System				
Earthwork & Concrete for Slab	1	LS	$0	in bldg
Paint	1	LS	$5,000	allowance for subcontract
Polymer Make-up System	2	EA	$20,433	
Polymer Make-up Tank, 2000gal	1	EA	$3,974	
Mixer	2	EA	$4,674	corrected hours
Transfer Pump, 20gpm	2	EA	$6,548	corrected hours
Polymer Feed Tank, 2000gal	1	EA	$3,974	
Variable Speed Gear Pump, 1gpm	2	EA	$8,421	

Attachment 1, Table A1-3

Bunker Hill CTP
Upgrade Existing CTP to Treat 10,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Piping to Feed Point	100	LF	$1,990	
Thickener				
Clean & Decommission Existing Floc System	1	LS	$1,775	
Replace Weir	1	LS	$43,010	
E-DUC Feed & Floc System & Hydraulic Mods	1	LS	$45,934	
Sludge Wasting & Recycle Pumps				
Remove Existing Pumps	1	LS	$2,474	
Paint	1	LS	$20,000	
Sludge Recycle Pump, 400gpm	2	EA	$29,234	
Sludge Recycle Pump, 800gpm	1	EA	$22,048	
Sludge Waste Pump, 400gpm, 200' tdh	1	EA	$26,380	
Sludge Recycle Piping, 8" DI	150	LF	$10,271	including ftgs, valves, etc, revised cost
Sludge Wasting Piping, 6" DI	0	LF	$0	including ftgs, valves, etc, revised cost
I&C and Electrical				
Total I&C	1	LS	$68,294	use 5% of above
New Magnetic Flowmeter in Existing Vault	1	EA	$10,269	24"
Parshall Flume @ Effluent	1	EA	$5,537	
Electrical	1	LS	$115,998	use 8% of above
Existing Plant Demolition				
Remove Reactor A	1	LS	$2,810	
Remove Aeration Basin, Ret Wall, Stairs, etc	1	LS	$127,768	6000cy @ 200cy/hr
Remove Flocculation Basin	1	LS	$18,734	allow 40hrs
Remove Associated Piping	1	LS	$1,873	
Remove Associated Electrical	1	LS	$1,873	
Regrade Area	1	LS	$1,704	
Connections & Relocations of Existing Piping	1	LS	$5,000	allowance
Earthwork	1	LS	$7,314	
Concrete Slab & Footings	100	CY	$25,536	assume 18" avg thickness to account for ftgs, etc
Relocate Existing Filtration Bldg, etc	1	LS	$34,071	60' x 30' x 10' eave ht metal bldg-remove contents, dismantle & re-erect
Repairs, Touchup, etc	1	LS	$5,000	allowance for some painting, sealants, doors, etc
Water	1	LS	$4,235	sink, emer. Shower, hose bibbs, piping & service

Attachment 1, Table A1-3

Bunker Hill CTP
Upgrade Existing CTP to Treat 10,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Drains	1	LS	$2,117	
Electrical	1	LS	$4,933	reinstall, fixtures, panels, wiring, etc
Tertiary Media Filters				
Filter Pump Station Complete	1	LS	$160,818	
Water Reuse Pump Station Complete	1	LS	$30,000	cost by DAH
Distribution Piping	500	LF	$17,500	4" plastic, below grade
Media Filter System	4	LS	$2,267,336	quote=430000 + 10% frt + 10% mu & 100hrs to install
Liquid Polymer System	0	LS	$0	Not required as per JS 11/28/2000
Backwash Pumping Complete	1	LS	$289,013	
Dirty Backwash Storage Tank	1	EA	$90,000	$.75/gal
Dirty Backwash Storage Tank Mixer	1	EA	$7,371	allowance
Dirty Backwash Return Pump	1	EA	$29,470	allowance
Clean Backwash Supply Tank	1	EA	$90,000	$.75/gal
Clean Backwash Supply Pump	1	EA	$29,470	
Building$_{Com}$ plete	1	LS	$1,275,000	$75/sf
Electrical/I&C	1	LS	$0	included
Mechanical	1	LS	$0	included
Backflow Preventer	1	EA	$10,000	allowance
Distribution Piping	4,000	LF	$92,000	2" plastic
Paint	1	LS	$20,000	misc painting allowance
Total DIRECT Capital Costs			**$6,216,915**	
MISC. ALLOWANCE	**10%**		**$621,691**	
SUBTOTAL			**$6,838,606**	
CONTINGENCY	**25%**		**$1,709,652**	
SUBTOTAL			**$8,548,258**	
MOBILIZATION	**15%**		**$1,282,239**	
CONSTRUCTION TOTAL			**$9,830,496**	
SALES TAX ON MATERIALS	**5.0%**		**$279,921**	
ENGINEERING AND SUPPORT	**20%**		**$1,966,099**	
CONSTRUCTION MANAGEMENT	**8%**		**$786,440**	
CAPITAL TOTAL (Direct+Indirect) (Yr 2000 Dollars)			**$12,900,000**	**Year 2000 Dollars**
Escalate from Yr 2000 to Yr 2009 Dollars (factor of 1.358)			**$17,500,000**	**Year 2009 Dollars**

Attachment 1, Table A1-3

Bunker Hill CTP
Upgrade Existing CTP to Treat 10,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments

Notes:

Misc. Allowance markup is to include items known to exist but cannot be quantified at this time.
Contingency is for scope changes that are presently unforeseen.
Mobilization includes bonds, insurance, temporary facilities, health & safety, demobilization, etc.

The order of magnitude cost opinion shown has been prepared for guidance in project evaluation at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Attachment 1, Table A1-4

Bunker Hill CTP
Upgrade Existing CTP to Treat 15,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
HDS				**The Following Costs are in Year 2000 Dollars. See Escalation Factor at Bottom.**
Sitework/Yard Piping				
Fencing	1,000	LF	$10,000	allowance
Gravel Surfacing & Misc	1	LS	$40,000	allowance
Connections & Relocations of Existing Piping	1	LS	$30,000	allowance
Reactor A (Sludge Conditioning Tank)				
Earthwork & Concrete for Slab	1	LS	$19,872	apx 50cy @ $400/cy
Elevated Platform for Reactor A&B	1	LS	$60,000	asm 40x20 @ $75/sf high level and to support reactor A
Paint	1	LS	$10,000	allowance for subcontract
Sludge Conditioning Tank, 2500gal FRP	1	EA	$42,695	quote + 5% infla. + 5%frt + 10%mu
Mixer, 3hp	1	EA	$13,803	quote + 5% infla. + 5%frt + 10%mu
Inlet Piping, 24" SDR 15.5	120	LF	$23,242	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Inlet Piping, 18" SDR 15.5	120	LF	$17,634	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Valves, vaults, etc	1	LS	$50,000	allowance
Reactor B (Neutralization/Oxidation System)				
Distribution Piping, 24" HDPE	261	LF	$50,487	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Retaining Wall to Accommodate New Tanks	690	SF	$17,250	90'x 8'H + 2' below grade, CIP cantelever
Earthwork for Retaining Wall	1	LS	$13,629	
Earthwork & Concrete for Slab	1	LS	$151,011	apx 450cy @ $400/cy
Paint	2	LS	$195,884	allowance for subcontract
Aeration Tank (Reactor B), 230,000 gal Steel Tank	2	EA	$345,000	$0.75/gal
Submerged Turbine Aerator/Mixer	2	EA	$255,791	
Positive Displacement Blower	2	EA	$39,726	
Pipe Supports, Hangers, etc	1	LS	$15,000	allowance
Automated Polymer Make-up & Feed System				
Earthwork & Concrete for Slab	1	LS	$0	in bldg
Paint	1	LS	$5,000	allowance for subcontract
Polymer Make-up System	2	EA	$20,433	
Polymer Make-up Tank, 2000gal	1	EA	$3,974	
Mixer	2	EA	$4,674	corrected hours
Transfer Pump, 20gpm	2	EA	$6,548	corrected hours
Polymer Feed Tank, 2000gal	1	EA	$3,974	

Attachment 1, Table A1-4

Bunker Hill CTP
Upgrade Existing CTP to Treat 15,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Variable Speed Gear Pump, 1gpm	2	EA	$8,421	
Piping to Feed Point	100	LF	$1,990	
Thickener				
Clean & Decommission Existing Floc System	1	LS	$1,775	
Replace Weir	1	LS	$57,115	
E-DUC Feed & Floc System & Hydraulic Mods	1	LS	$59,534	
Surface Prep & Coat	0	LS	$0	allowance for interior walls & mechanism
Sludge Wasting & Recycle Pumps				
Remove Existing Pumps	1	LS	$2,474	
Paint	1	LS	$20,000	
Sludge Recycle Pump, 400gpm	2	EA	$29,234	
Sludge Recycle Pump, 800gpm	1	EA	$22,048	
Sludge Waste Pump, 400gpm, 200' tdh	1	EA	$26,380	
Sludge Recycle Piping, 8" DI	150	LF	$10,271	including ftgs, valves, etc, revised cost
Sludge Wasting Piping, 6" DI	0	LF	$0	including ftgs, valves, etc, revised cost
I&C and Electrical				
Total I&C	1	LS	$84,243	use 5% of above
New Magnetic Flowmeter in Existing Vault	1	EA	$10,269	24"
Parshall Flume @ Effluent	1	EA	$5,537	
Electrical	1	LS	$142,793	use 8% of above
Existing Plant Demolition				
Remove Reactor A	1	LS	$2,810	
Remove Aeration Basin, Ret Wall, Stairs, etc	1	LS	$127,768	6000cy @ 200cy/hr
Remove Flocculation Basin	1	LS	$18,734	allow 40hrs
Remove Associated Piping	1	LS	$1,873	
Remove Associated Electrical	1	LS	$1,873	
Regrade Area	1	LS	$1,704	
Connections & Relocations of Existing Piping	1	LS	$5,000	allowance
Earthwork	1	LS	$7,314	
Concrete Slab & Footings	100	CY	$25,536	assume 18" avg thickness to account for ftgs, etc
Relocate Existing Filtration Bldg, etc	1	LS	$34,071	60' x 30' x 10' eave ht metal bldg-remove contents, dismantle & re-erect
Repairs, Touchup, etc	1	LS	$5,000	allowance for some painting, sealants, doors, etc

Attachment 1, Table A1-4

Bunker Hill CTP
Upgrade Existing CTP to Treat 15,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Water	1	LS	$4,235	sink, emer. Shower, hose bibbs, piping & service
Drains	1	LS	$2,117	
Electrical	1	LS	$4,933	reinstall, fixtures, panels, wiring, etc
Tertiary Media Filters				
Filter Pump Station Complete	1	LS	$205,111	
Water Reuse Pump Station Complete	1	LS	$30,000	cost by DAH
Distribution Piping	500	LF	$17,500	4" plastic, below grade
Media Filter System	6	LS	$3,401,004	quote=430000 + 10% frt + 10% mu & 100hrs to install
Liquid Polymer System	0	LS	$0	Not required as per JS 11/28/2000
Backwash Pumping Complete	1	LS	$368,614	
Dirty Backwash Storage Tank	1	EA	$135,000	$.75/gal
Dirty Backwash Storage Tank Mixer	1	EA	$9,143	allowance
Dirty Backwash Return Pump	1	EA	$37,070	allowance
Clean Backwash Supply Tank	1	EA	$135,000	$.75/gal
Clean Backwash Supply Pump	1	EA	$37,070	
Building Complete	1	LS	$1,912,500	$75/sf
Electrical/I&C	1	LS	$0	included
Mechanical	1	LS	$0	included
Backflow Preventer	1	EA	$10,000	allowance
Distribution Piping	6,000	LF	$138,000	2" plastic
Paint	1	LS	$30,000	misc painting allowance
Total DIRECT Capital Costs			**$8,636,692**	
MISC. ALLOWANCE	**10%**		**$863,669**	
SUBTOTAL			**$9,500,361**	
CONTINGENCY	**25%**		**$2,375,090**	
SUBTOTAL			**$11,875,451**	
MOBILIZATION	**15%**		**$1,781,318**	
CONSTRUCTION TOTAL			**$13,656,769**	
SALES TAX ON MATERIALS	**5.0%**		**$394,342**	
ENGINEERING AND SUPPORT	**20%**		**$2,731,354**	
CONSTRUCTION MANAGEMENT	**8%**		**$1,092,542**	
CAPITAL TOTAL (Direct+Indirect) (Yr 2000 Dollars)			**$17,900,000**	**Year 2000 Dollars**
Escalate from Yr 2000 to Yr 2009 Dollars (factor of 1.358)			**$24,300,000**	**Year 2009 Dollars**

Attachment 1, Table A1-4

Bunker Hill CTP
Upgrade Existing CTP to Treat 15,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments

Notes:

Misc. Allowance markup is to include items known to exist but cannot be quantified at this time.
Contingency is for scope changes that are presently unforeseen.
Mobilization includes bonds, insurance, temporary facilities, health & safety, demobilization, etc.

The order of magnitude cost opinion shown has been prepared for guidance in project evaluation at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Attachment 1, Table A1-5

Bunker Hill CTP
Upgrade Existing CTP to Treat 20,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
HDS				**The Following Costs are in Year 2000 Dollars. See Escalation Factor at Bottom.**
Sitework/Yard Piping				
Fencing	1,000	LF	$10,000	allowance
Gravel Surfacing & Misc	1	LS	$45,000	allowance
Connections & Relocations of Existing Piping	1	LS	$30,000	allowance
Reactor A (Sludge Conditioning Tank)				
Earthwork & Concrete for Slab	1	LS	$19,872	apx 50cy @ $400/cy
Elevated Platform for Reactor A&B	1	LS	$60,000	asm 40x20 @ $75/sf high level and to support reactor A
Paint	1	LS	$10,000	allowance for subcontract
Sludge Conditioning Tank, 2500gal FRP	1	EA	$42,695	quote + 5% infla. + 5%frt + 10%mu
Mixer, 3hp	1	EA	$13,803	quote + 5% infla. + 5%frt + 10%mu
Inlet Piping, 24" SDR 15.5	120	LF	$23,242	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Inlet Piping, 18" SDR 15.5	120	LF	$17,634	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Valves, vaults, etc	1	LS	$50,000	allowance
Reactor B (Neutralization/Oxidation System)				
Distribution Piping, 24" HDPE	340	LF	$65,853	constrained schedule & access w/obstacles, ftgs, valves, connections, etc
Retaining Wall to Accommodate New Tanks	900	SF	$22,500	90'x 8'H + 2' below grade, CIP cantelever
Earthwork for Retaining Wall	1	LS	$13,629	
Earthwork & Concrete for Slab	1	LS	$178,848	apx 450cy @ $400/cy
Paint	2	LS	$229,740	allowance for subcontract
Aeration Tank (Reactor B), 300,000gal Steel Tank	2	EA	$450,000	$0.75/gal
Submerged Turbine Aerator/Mixer	2	EA	$300,000	
Positive Displacement Blower	2	EA	$45,620	
Pipe Supports, Hangers, etc	1	LS	$20,000	allowance
Automated Polymer Make-up & Feed System				
Earthwork & Concrete for Slab	1	LS	$0	in bldg
Paint	1	LS	$5,000	allowance for subcontract
Polymer Make-up System	2	EA	$20,433	
Polymer Make-up Tank, 2000gal	1	EA	$3,974	
Mixer	2	EA	$4,674	corrected hours
Transfer Pump, 20gpm	2	EA	$6,548	corrected hours
Polymer Feed Tank, 2000gal	1	EA	$3,974	

Attachment 1, Table A1-5

Bunker Hill CTP
Upgrade Existing CTP to Treat 20,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Variable Speed Gear Pump, 1gpm	2	EA	$8,421	
Piping to Feed Point	100	LF	$1,990	
Thickener				
Clean & Decommission Existing Floc System	1	LS	$1,775	
Replace Weir	1	LS	$71,040	
E-DUC Feed & Floc System & Hydraulic Mods	1	LS	$73,134	
Sludge Wasting & Recycle Pumps				
Remove Existing Pumps	1	LS	$2,474	
Paint	1	LS	$20,000	
Sludge Recycle Pump, 400gpm	2	EA	$29,234	
Sludge Recycle Pump, 800gpm	1	EA	$22,048	
Sludge Waste Pump, 400gpm, 200' tdh	1	EA	$26,380	
Sludge Recycle Piping, 8" DI	150	LF	$10,271	including ftgs, valves, etc, revised cost
Sludge Wasting Piping, 6" DI	0	LF	$0	including ftgs, valves, etc, revised cost
I&C and Electrical				
Total I&C	1	LS	$97,990	use 5% of above
New Magnetic Flowmeter in Existing Vault	1	EA	$10,269	24"
Parshall Flume @ Effluent	1	EA	$5,537	
Electrical	1	LS	$165,888	use 8% of above
Existing Plant Demolition				
Remove Reactor A	1	LS	$2,810	
Remove Aeration Basin, Ret Wall, Stairs, etc	1	LS	$127,768	6000cy @ 200cy/hr
Remove Flocculation Basin	1	LS	$18,734	allow 40hrs
Remove Associated Piping	1	LS	$1,873	
Remove Associated Electrical	1	LS	$1,873	
Regrade Area	1	LS	$1,704	
Connections & Relocations of Existing Piping	1	LS	$5,000	allowance
Earthwork	1	LS	$7,314	
Concrete Slab & Footings	100	CY	$25,536	assume 18" avg thickness to account for ftgs, etc
Relocate Existing Filtration Bldg, etc	1	LS	$34,071	60' x 30' x 10' eave ht metal bldg-remove contents, dismantle & re-erect
Repairs, Touchup, etc	1	LS	$5,000	allowance for some painting, sealants, doors, etc

Attachment 1, Table A1-5

Bunker Hill CTP
Upgrade Existing CTP to Treat 20,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments
Water	1	LS	$4,235	sink, emer. Shower, hose bibbs, piping & service
Drains	1	LS	$2,117	
Electrical	1	LS	$4,933	reinstall, fixtures, panels, wiring, etc
Tertiary Media Filters				
Filter Pump Station Complete	1	LS	$243,600	
Water Reuse Pump Station Complete	1	LS	$30,000	cost by DAH
Distribution Piping	500	LF	$17,500	4" plastic, below grade
Media Filter System	8	LS	$4,534,673	quote=430000 + 10% frt + 10% mu & 100hrs to install
Liquid Polymer System	0	LS	$0	Not required as per JS 11/28/2000
Backwash Pumping Complete	1	LS	$464,445	
Dirty Backwash Storage Tank	1	EA	$180,000	$.75/gal
Dirty Backwash Storage Tank Mixer	1	EA	$10,683	allowance
Dirty Backwash Return Pump	1	EA	$43,675	allowance
Clean Backwash Supply Tank	1	EA	$180,000	$.75/gal
Clean Backwash Supply Pump	1	EA	$43,675	
Building Complete	1	LS	$2,550,000	$75/sf
Electrical/I&C	1	LS	$0	included
Mechanical	1	LS	$0	included
Backflow Preventer	1	EA	$10,000	allowance
Distribution Piping	8,000	LF	$184,000	2" plastic
Paint	1	LS	$40,000	misc painting allowance
Total DIRECT Capital Costs			**$11,014,708**	
MISC. ALLOWANCE	**10%**		**$1,101,471**	
SUBTOTAL			**$12,116,179**	
CONTINGENCY	**25%**		**$3,029,045**	
SUBTOTAL			**$15,145,223**	
MOBILIZATION	**15%**		**$2,271,783**	
CONSTRUCTION TOTAL			**$17,417,007**	
SALES TAX ON MATERIALS	**5.0%**		**$506,736**	
ENGINEERING AND SUPPORT	**20%**		**$3,483,401**	
CONSTRUCTION MANAGEMENT	**8%**		**$1,393,361**	
CAPITAL TOTAL (Direct+Indirect) (Yr 2000 Dollars)			**$22,800,000**	**Year 2000 Dollars**
Escalate from Yr 2000 to Yr 2009 Dollars (factor of 1.358)			**$31,000,000**	**Year 2009 Dollars**

Attachment 1, Table A1-5

Bunker Hill CTP
Upgrade Existing CTP to Treat 20,000 gpm

Order of Magnitude Cost Opinion

Description	Quantity	Unit	Direct Capital Unit Cost	Comments

Notes:

Misc. Allowance markup is to include items known to exist but cannot be quantified at this time.
Contingency is for scope changes that are presently unforeseen.
Mobilization includes bonds, insurance, temporary facilities, health & safety, demobilization, etc.

The order of magnitude cost opinion shown has been prepared for guidance in project evaluation at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Attachment 1, Table A1-6

Bunker Hill CTP
1,500 gpm O&M Cost Estimate
Based on 1,500 gpm of Bunker Hill Mine Water Only

O & M COST ESTIMATE DETAILS

Description	Quantity	Unit	Material Unit Cost	Labor Unit Cost	Equip Unit Cost	Total Cost	Comments
Annual Costs							
Operation and Maintenance Costs for Existing CTP	1	YR	Included	Included	Included	$834,000	Bid price to operate existing CTP for 2006
Add'l. Equipment O&M Costs at 2%	1	YR	Included	Included	Included	$68,430	Assume 2% of capital costs after allowance
Additional Lime	0	tons/yr	$205	NA	NA	$0	Lime cost from Ferguson (2006 price)
Additional Polymer	0	lbs/yr	$2.75	NA	NA	$0	Polymer cost from Ferguson (2006 price)
Additional Power	94	KW	$0.07	NA	NA	$57,334	Assumes 125 additional Hp
					Subtotal	$959,764	
Contingency	10%					$95,976	
Allowance	10%					$95,976	
Total Annual Cost						**$1,151,717**	**In 2009 dollars**
NPV of Annual O&M Costs (30 years @ 7%)						**$14,300,000**	**In 2009 dollars**

Attachment 1, Table A1-7

Bunker Hill CTP
2,500 gpm O&M Cost Estimate
Based on 1,500 gpm of Bunker Hill Mine Water and 1,000 gpm of Woodland Park Quality Groundwater

O & M COST ESTIMATE DETAILS

Description	Quantity	Unit	Material Unit Cost	Labor Unit Cost	Equip Unit Cost	Total Cost	Comments
Annual Costs							
Operation and Maintenance Costs for Existing CTP	1	YR	Included	Included	Included	$834,000	Bid price to operate existing CTP for 2006
Add'l. Equipment O&M Costs at 2%	1	YR	Included	Included	Included	$68,430	Assume 2% of capital costs after allowance
Additional Lime	120	tons/yr	$205	NA	NA	$24,600	Lime cost from Ferguson (2006 price)
Additional Polymer	500	lbs/yr	$2.75	NA	NA	$1,375	Polymer cost from Ferguson (2006 price)
Additional Power	118	KW	$0.07	NA	NA	$72,470	Assumes 158 additional Hp
					Subtotal	$1,000,875	
Contingency	10%					$100,088	
Allowance	10%					$100,088	
Total Annual Cost						**$1,201,050**	**In 2009 dollars**
NPV of Annual O&M Costs (30 years @ 7%)						**$14,900,000**	**In 2009 dollars**

Attachment 1, Table A1-8

Bunker Hill CTP
5,000 gpm O&M Cost Estimate
Based on 1,500 gpm of Bunker Hill Mine Water and 3,500 gpm of Woodland Park Quality Groundwater

O & M COST ESTIMATE DETAILS

Description	Quantity	Unit	Material Unit Cost	Labor Unit Cost	Equip Unit Cost	Total Cost	Comments
Annual Costs							
Operation and Maintenance Costs for Existing CTP	1	YR	Included	Included	Included	$834,000	Bid price to operate existing CTP for 2006
Add'l. Equipment O&M Costs at 2%	1	YR	Included	Included	Included	$112,147	Assume 2% of capital costs after allowance
Additional Lime	400	tons/yr	$205	NA	NA	$82,000	Lime cost from Ferguson (2006 price)
Additional Polymer	4,000	lbs/yr	$2.75	NA	NA	$11,000	Polymer cost from Ferguson (2006 price)
Additional Power	237	KW	$0.07	NA	NA	$145,400	Assumes 317 additional Hp
					Subtotal	$1,184,546	
Contingency	10%					$118,455	
Allowance	10%					$118,455	
Total Annual Cost						**$1,421,456**	**In 2009 dollars**
NPV of Annual O&M Costs (30 years @ 7%)						**$17,600,000**	**In 2009 dollars**

Attachment 1, Table A1-9

Bunker Hill CTP
10,000 gpm O&M Cost Estimate
Based on 1,500 gpm of Bunker Hill Mine Water and 8,500 gpm of Woodland Park Quality Ground Water

O & M COST ESTIMATE DETAILS

Description	Quantity	Unit	Material Unit Cost	Labor Unit Cost	Equip Unit Cost	Total Cost	Comments
Annual Costs							
Operation and Maintenance Costs for Existing CTP	1	YR	Included	Included	Included	$834,000	Bid price to operate existing CTP for 2006
Add'l. Equipment O&M Costs at 2%	1	YR	Included	Included	Included	$185,737	Assume 2% of capital costs after allowance
Additional Lime	980	tons/yr	$205	NA	NA	$200,900	Lime cost from Ferguson (2006 price)
Additional Polymer	4,200	lbs/yr	$2.75	NA	NA	$11,550	Polymer cost from Ferguson (2006 price)
Additional Power	473	KW	$0.07	NA	NA	$290,340	Assumes 633 additional Hp
					Subtotal	$1,522,527	
Contingency	10%					$152,253	
Allowance	10%					$152,253	
Total Annual Cost						**$1,827,032**	**In 2009 dollars**
NPV of Annual O&M Costs (30 years @ 7%)						**$22,700,000**	**In 2009 dollars**

Attachment 1, Table A1-10

Bunker Hill CTP
15,000 gpm O&M Cost Estimate
Based on 1,500 gpm of Bunker Hill Mine Water and 13,500 gpm of Woodland Park Quality Ground Water

O & M COST ESTIMATE DETAILS

Description	Quantity	Unit	Material Unit Cost	Labor Unit Cost	Equip Unit Cost	Total Cost	Comments
Annual Costs							
Operation and Maintenance Costs for Existing CTP	1	YR	Included	Included	Included	$834,000	Bid price to operate existing CTP for 2006
Add'l. Equipment O&M Costs at 2%	1	YR	Included	Included	Included	$258,030	Assume 2% of capital costs after allowance
Additional Lime	1,550	tons/yr	$205	NA	NA	$317,750	Lime cost from Ferguson (2006 price)
Additional Polymer	6,800	lbs/yr	$2.75	NA	NA	$18,700	Polymer cost from Ferguson (2006 price)
Additional Power	718	KW	$0.07	NA	NA	$440,327	Assumes 960 additional Hp
					Subtotal	$1,868,806	
Contingency	10%					$186,881	
Allowance	10%					$186,881	
Total Annual Cost						**$2,242,568**	**In 2009 dollars**
NPV of Annual O&M Costs (30 years @ 7%)						**$27,800,000**	**In 2009 dollars**

Attachment 1, Table A1-11

Bunker Hill CTP
20,000 gpm O&M Cost Estimate
Based on 1,500 gpm of Bunker Hill Mine Water and 18,500 gpm of Woodland Park Quality Groundweater

O & M COST ESTIMATE DETAILS

Description	Quantity	Unit	Total Cost	Comments
Annual Costs				
Operation and Maintenance Costs for Existing CTP	1	YR	$834,000	Bid price to operate existing CTP for 2006
Add'l. Equipment O&M Costs at 2%	1	YR	$329,075	Assume 2% of capital costs after allowance
Additional Lime	2,100	tons/yr	$430,500	Lime cost from Ferguson (2006 price)
Additional Polymer	9,200	lbs/yr	$25,300	Polymer cost from Ferguson (2006 price)
Additional Power	948	KW	$581,139	Assumes 1,267 additional Hp
			$2,200,015	
Contingency	10%		$220,001	
Allowance	10%		$220,001	
Total Annual Cost			**$2,640,018**	**In 2009 dollars**
NPV of Annual O&M Costs (30 years @ 7%)			**$32,800,000**	**In 2009 dollars**

$ WWDFK P HQW

Figure A2-1: CTP Upgrade and Expansion Total Capital (Direct + Indirect) Cost Estimates (Y) as a Function of Flow Rate (Q)

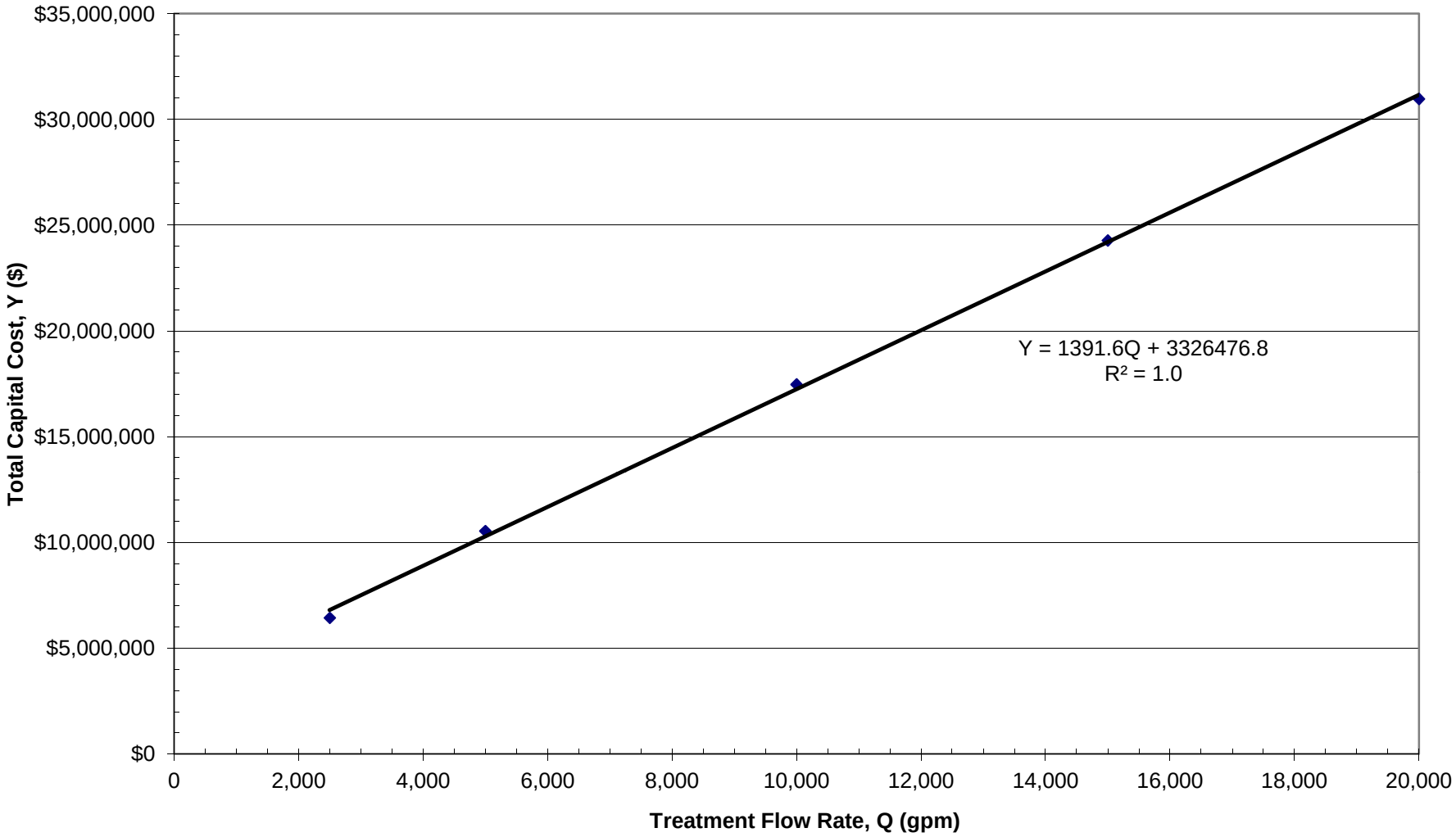

Figure A2-2: CTP Upgrade and Expansion O&M Cost Estimates (Y) as a Function of Flow Rate (Q)