MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	10-gpm WBA System

Project No. 05337008.0000	
By T.D. & C.R.	Ckd: Y.W. & T.V.
Date 12/20/11	Date: 12/22/11

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
CO2 Feed System	1	LS	$ 80,000	$ 80,000	Quote from TOMCO; 1.5 lb/hr PSF and (2) 380 lb cylinders
CO2 Feed Water Pump	2	EA	$ 7,177	$ 14,354	Quote from ITT; centrifugal; 2 gpm @ 80 psi; 1 duty/1 stdby
Static Mixer	1	EA	$ 330	$ 330	Quotes from Komax & EWS; 1-inch
Bag Filters	2	EA	$ 1,800	$ 3,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
Ion Exchange Equipment	1	LS	$ 7,400	$ 7,400	Quotes from Siemens; incl. first fill of resin
Backwash Waste Tank	1	EA	$ 7,700	$ 7,700	Quotes from Core-Rosion; 2,000 gal
Discharge Pumps	2	EA	$ 4,832	$ 9,664	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
Booster Pump	2	EA	$ 6,079	$ 12,158	Quote from Cortech, 10 gpm @ 15 ft; 1 duty/1 stdby
Aeration Equipment	1	LS	$ 42,000	$ 42,000	Quote from Siemens for an aluminum forced draft aerator (65 gpm), including blower, air distribution tray, and piping etc.
Exhaust Blowers	2	EA	$ 34,874	$ 69,748	Quote from EWS; 53 SCFM @ 2 psi; 1 duty/ 1 stdby
Off-Gas Treatment	1	LS	$ 4,000	$ 4,000	Cost from Glendale and quote from TIGG; 54 SCFM; (2) adsorbers in series; plus $2,800 for one heater
Subtotal				$ 251,000	Rounded up to $1000
Equipment Installation Cost	30%			$ 75,300	Including tax, freight, installation and manufacturer services.
Equipment Concrete Pads	29	CY	$ 1,250	$ 35,967	
Subtotal (Installed Equipment Costs)				$ 363,000	Rounded up to $1000
General Requirements	7.5%			$ 27,225	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%			$ 18,150	Excavation, backfill, and fill required to construct project
Site Improvements	5%			$ 18,150	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			$ 55,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			$ 55,000	PLC and SCADA equipment to control
Total Direct Costs				$ 537,000	Rounded up to $1000
Contractor's Overhead and Profit	20%			$ 107,400	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				$ 644,000	Rounded up to $1000
Project Level Allowance (contingency)	20%			$ 128,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			$ 128,800	Includes permits, legal fees and engineering fees for design and construction
Project Total				$ 902,000	
Low Estimate				$ 631,000	-30%
High Estimate				$ 1,353,000	+50%

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2011 dollars.
3. Costs for land or easements are not included.

MALCOLM PIRNIE | ARCADIS
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OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	100-gpm WBA System

Project No. 05337008.0000	
By T.D. & C.R.	Ckd: Y.W. & T.V.
Date 12/20/11	Date: 12/22/11

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
CO2 Feed System	1	LS	$ 160,000	$ 160,000	Quote from TOMCO; 15 lb/hr PSF and 6 ton storage
CO2 Feed Water Pump	2	EA	$ 7,177	$ 14,354	Quote from ITT; centrifugal; 15 gpm @ 80 psi; 1 duty/1 stdby
Static Mixer	1	EA	$ 850	$ 850	Quotes from Komax & EWS; 3-inch
Bag Filters	2	EA	$ 4,300	$ 8,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
Ion Exchange Equipment	1	LS	$ 93,000	$ 93,000	Quotes from Siemens; incl. first fill of resin
Backwash Waste Tank	1	EA	$ 52,000	$ 52,000	Quotes from Superior & BH; 19,000 gal
Discharge Pumps	2	EA	$ 4,832	$ 9,664	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
Booster Pump	2	EA	$ 7,716	$ 15,432	Quote from ITT, 100 gpm @ 15 ft; 1 duty/1 stdby
Aeration Equipment	1	LS	$ 42,000	$ 42,000	Quote from Siemens for an aluminum forced draft aerator (65 gpm), including blower, air distribution tray, and piping etc.
Exhaust Blowers	2	EA	$ 34,753	$ 69,505	Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby
Off-Gas Treatment	1	LS	$ 11,000	$ 11,000	Quote from TIGG; 270 SCFM; (2) adsorbers in series with one heater
Subtotal				$ 477,000	Rounded up to $1000
Equipment Installation Cost	30%			$ 143,100	Including tax, freight, installation and manufacturer services.
Equipment Concrete Pad	56	CY	$ 1,250	$ 70,525	
Subtotal (Installed Equipment Costs)				$ 691,000	Rounded up to $1000
General Requirements	7.5%			$ 51,825	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%			$ 34,550	Excavation, backfill, and fill required to construct project
Site Improvements	5%			$ 34,550	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			$ 104,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			$ 104,000	PLC and SCADA equipment to control
Total Direct Costs				$ 1,020,000	Rounded up to $1000
Contractor's Overhead and Profit	20%			$ 204,000	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				$ 1,224,000	Rounded up to $1000
Project Level Allowance (contingency)	20%			$ 244,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			$ 244,800	Includes permits, legal fees and engineering fees for design and construction
Project Total				$ 1,714,000	
Low Estimate				$ 1,200,000	-30%
High Estimate				$ 2,571,000	+50%

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2011 dollars.
3. Costs for land or easements are not included.

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OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	500-gpm WBA System

Project No. 05337008.0000	
By T.D. & C.R.	Ckd: Y.W. & T.V.
Date 12/20/11	Date: 12/22/11

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
CO2 Feed System	1	LS	$ 190,000	$ 190,000	Quote from TOMCO; 75 lb/hr PSF and 14 ton storage
CO2 Feed Water Pump	2	EA	$ 7,608	$ 15,216	Quote from ITT; centrifugal; 75 gpm @ 80 psi; 1 duty/1 stdby
Static Mixers	1	EA	$ 2,200	$ 2,200	Quotes from Komax & EWS; 8-inch
Bag Filters	2	EA	$ 1,800	$ 3,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
Ion Exchange Equipment	1	LS	$ 400,000	$ 400,000	Quotes from Siemens and Calgon; incl. first fill of resin
Backwash Waste Tank	1	EA	$ 100,000	$ 100,000	Quotes from Superior & BH; 95,000 gal
Discharge Pumps	2	EA	$ 4,832	$ 9,664	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
Booster Pump	2	EA	$ 10,923	$ 21,846	Quote from ITT, 500 gpm @ 15 ft; 1 duty/1 stdby
Aeration Equipment	1	LS	$ 47,000	$ 47,000	Quote from Siemens for an aluminum forced draft aerator (500 gpm), including blower, air distribution tray, and piping etc.
Exhaust Blowers	2	EA	$ 54,237	$ 108,474	Quotes from EWS & Yardley; 1,500 SCFM @ 5 psi; 1 duty/ 1 stdby
Off-Gas Treatment	1	LS	$ 27,000	$ 27,000	Quote from TIGG; 1,500 SCFM; (2) adsorbers in series with one heater
Subtotal				$ 925,000	Rounded up to $1000
Equipment Installation Cost	30%			$ 277,500	Including tax, freight, installation and manufacturer services.
Equipment Concrete Pad	159	CY	$ 1,250	$ 199,058	
Subtotal (Installed Equipment Costs)				$ 1,402,000	Rounded up to $1000
General Requirements	7.5%			$ 105,150	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%			$ 70,100	Excavation, backfill, and fill required to construct project
Site Improvements	5%			$ 70,100	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			$ 211,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			$ 211,000	PLC and SCADA equipment to control
Total Direct Costs				$ 2,069,000	Rounded up to $1000
Contractor's Overhead and Profit	20%			$ 413,800	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				$ 2,483,000	Rounded up to $1000
Project Level Allowance (contingency)	20%			$ 496,600	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			$ 496,600	Includes permits, legal fees and engineering fees for design and construction
Project Total				$ 3,477,000	
Low Estimate				$ 2,434,000	-30%
High Estimate				$ 5,216,000	+50%

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2011 dollars.
3. Costs for land or easements are not included.

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OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	2000-gpm WBA System

Project No. 05337008.0000	
By T.D. & C.R.	Ckd: Y.W. & T.V.
Date 12/20/11	Date: 12/22/11

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
CO2 Feed System	1	LS	$ 280,000	$ 280,000	Quote from TOMCO; 300 lb/hr and 50 ton storage
CO2 Feed Water Pump	2	EA	$ 8,705	$ 17,410	Quote from ITT; centrifugal; 305 gpm @ 80 psi; 1 duty/1 stdby
Static Mixer	1	EA	$ 4,200	$ 4,200	Quotes from Komax & EWS; 14-inch
Bag Filters	2	EA	$ 1,800	$ 3,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
Ion Exchange Equipment	1	LS	$ 1,300,000	$ 1,300,000	Quotes from Siemens and Calgon; incl. first fill of resin
Backwash Waste Tank	1	EA	$ 150,000	$ 150,000	Quotes from Superior & BH; 189,000 gal
Discharge Pumps	2	EA	$ 4,832	$ 9,664	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
Booster Pump	2	EA	$ 23,902	$ 47,804	Quote from Cortech, 2,000 gpm @ 15 ft; 1 duty/1 stdby
Aeration Equipment	1	LS	$ 71,000	$ 71,000	Quote from Siemens for an aluminum forced draft aerator (2000 gpm), including blower, air distribution tray, and piping etc.
Exhaust Blowers	2	EA	$ 135,000	$ 270,000	Quote from Yardley; 6,000 SCFM @ 5 psi; 1 duty/ 1 stdby
Off-Gas Treatment	1	LS	$ 95,000	$ 95,000	Quote from TIGG; 6,000 SCFM; (2) adsorbers in series with two 12kW heaters
Subtotal				$ 2,249,000	Rounded up to $1000
Equipment Installation Cost	30%			$ 674,700	Including tax, freight, installation and manufacturer services.
Equipment Concrete Pad	264	CY	$ 1,250	$ 330,388	
Subtotal (Installed Equipment Costs)				$ 3,255,000	Rounded up to $1000
General Requirements	7.5%			$ 244,125	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%			$ 162,750	Excavation, backfill, and fill required to construct project
Site Improvements	5%			$ 162,750	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			$ 489,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			$ 489,000	PLC and SCADA equipment to control
Total Direct Costs				$ 4,803,000	Rounded up to $1000
Contractor's Overhead and Profit	20%			$ 960,600	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				$ 5,764,000	Rounded up to $1000
Project Level Allowance (contingency)	20%			$ 1,152,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			$ 1,152,800	Includes permits, legal fees and engineering fees for design and construction
Project Total				$ 8,070,000	
Low Estimate				$ 5,649,000	-30%
High Estimate				$ 12,105,000	+50%

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2011 dollars.
3. Costs for land or easements are not included.

Estimated WBA Lab and Field Analytical Costs

Flow Rate (gpm) 10
Number of lead/lag trains 2

	Lab																	Field		
Sample Location	**Cr(VI)**	**Total Cr**	**Alkalinity**	**Turbidity**	**Sulfate**	**Nitrate**	**Phosphate**	**Total Iron**	**Silica**	**Uranium (water)**	**Uranium (solids)**	**Nitrosamines**	**BNA SVOC**	**Aldehydes/ Ketones**	**Bac-T (E. coli, T coli and HPC)**	**TCLP (Metals)**	**CA WET (Metals)**	**pH**	**Temperature**	**Conductivity**
Raw	1	1	1												1			4	4	
After pH reduction	4	4	1	1	1	1	1	1	1	1		At start-up	At start-up	At start-up	1			s	s	1
Lead vessel 50% port [1]	8	8																		
Lead vessel effluent [1]	8	8								1		At start-up	At start-up	At start-up				4	4	
Lag vessel 50% port [1]	8	8																		
Lag vessel effluent [1]	8	8								1		At start-up and monthly thereafter	At start-up and monthly thereafter	At start-up and monthly thereafter	4			4	4	
Combined IX effluent after pH increase	4	4	1	1	1	1	1	1	1						4			Continuous	Continuous	
Resin in lead vessel [1, 2]											2									
Spent resin as residuals											At disposal					At disposal	At disposal			
Resin flush water as residuals [3]														At disposal [4]						
Sum of samples (# per month)	41	41	3	2	2	2	2	2	2	3	2.2	2.3	2.3	2.8	10	0.2	0.2	12	12	1
MWH Quotes ($/sample)	$75	$15	$15		$15	$15	$15	$15	$15	25	125	400	400	200	45		350			
Test America Quotes ($/sample)	$30	$12	$15	$13	$15	$15	$15	$12	$12	20		330	165	215	70	240	492			
Unit cost ($/sample)	$53	$14	$15	$13	$15	$15	$15	$14	$14	$23	$125	$365	$283	$208	$58	$240	$421			
Sample analysis cost ($/year)	$25,830	$6,642	$540	$312	$360	$360	$360	$324	$324	$810	$3,225	$10,074	$7,797	$6,848	$6,900	$432	$758			
Annual shipping fee	$1,560	One shipment per week, $30 per shipment.																		
Sum of lab analysis cost ($/year)	$73,455	Average of two quotes, plus shipment.																		
Field meters	$2,000	portable pH and conductivity meter																		
Field analytical cost (without labor)	$1,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	$74,455	Including lab and field analysis costs; not including labor and field meters																		

1. If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.
2. A composite of top, middle and bottom resin bed layers
3. Other analyses might be required by the sewer discharge permit.
4. Three samples are estimated to be collected per resin changeout event for resin flush water disposal.

BNA SVOC - base, neutral, acid semi-volatile organic compounds

"Continuous" indicates the parameter(s) will be monitored by an online meter.

Estimated WBA Lab and Field Analytical Costs

Flow Rate (gpm) 100
Number of lead/lag trains 1

	Lab																	Field		
Sample Location	**Cr(VI)**	**Total Cr**	**Alkalinity**	**Turbidity**	**Sulfate**	**Nitrate**	**Phosphate**	**Total Iron**	**Silica**	**Uranium (water)**	**Uranium (solids)**	**Nitrosamines**	**BNA SVOC**	**Aldehydes/ Ketones**	**Bac-T (E. coli, T coli and HPC)**	**TCLP (Metals)**	**CA WET (Metals)**	**pH**	**Temperature**	**Conductivity**
Raw	1	1	1												1			4	4	
After pH reduction	4	4	1	1	1	1	1	1	1	1		At start-up	At start-up	At start-up	1			s	s	1
Lead vessel 50% port [1]	4	4																		
Lead vessel effluent [1]	4	4								1		At start-up	At start-up	At start-up				4	4	
Lag vessel 50% port [1]	4	4																		
Lag vessel effluent [1]	4	4								1		At start-up and monthly thereafter	At start-up and monthly thereafter	At start-up and monthly thereafter	4			4	4	
Combined IX effluent after pH increase	4	4	1	1	1	1	1	1	1						4			Continuous	Continuous	
Resin in lead vessel [1, 2]											1									
Spent resin as residuals											At disposal					At disposal	At disposal			
Resin flush water as residuals [3]														[4]						
Sum of samples (# per month)	25	25	3	2	2	2	2	2	2	3	1.2	1.4	1.4	1.9	10	0.2	0.2	12	12	1
MWH Quotes ($/sample)	$75	$15	$15		$15	$15	$15	$15	$15	25	125	400	400	200	45		350			
Test America Quotes ($/sample)	$30	$12	$15	$13	$15	$15	$15	$12	$12	20		330	165	215	70	240	492			
Unit cost ($/sample)	$53	$14	$15	$13	$15	$15	$15	$14	$14	$23	$125	$365	$283	$208	$58	$240	$421			
Sample analysis cost ($/year)	$15,750	$4,050	$540	$312	$360	$360	$360	$324	$324	$810	$1,763	$5,913	$4,577	$4,669	$6,900	$504	$884			
Annual shipping fee	$1,560	One shipment per week, $30 per shipment.																		
Sum of lab analysis cost ($/year)	$49,959	Average of two quotes, plus shipment.																		
Field meters	$2,000	portable pH and conductivity meter																		
Field analytical cost (without labor)	$1,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	$50,959	Including lab and field analysis costs; not including labor and field meters																		

1. If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.
2. A composite of top, middle and bottom resin bed layers
3. Other analyses might be required by the sewer discharge permit.
4. Three samples are estimated to be collected per resin changeout event for resin flush water disposal.

BNA SVOC - base, neutral, acid semi-volatile organic compounds

"Continuous" indicates the parameter(s) will be monitored by an online meter.

Estimated WBA Lab and Field Analytical Costs

Flow Rate (gpm) 500
Number of lead/lag trains 1

	Lab																	Field		
Sample Location	**Cr(VI)**	**Total Cr**	**Alkalinity**	**Turbidity**	**Sulfate**	**Nitrate**	**Phosphate**	**Total Iron**	**Silica**	**Uranium (water)**	**Uranium (solids)**	**Nitrosamines**	**BNA SVOC**	**Aldehydes/ Ketones**	**Bac-T (E. coli, T coli and HPC)**	**TCLP (Metals)**	**CA WET (Metals)**	**pH**	**Temperature**	**Conductivity**
Raw	1	1	1												1			4	4	
After pH reduction	4	4	1	1	1	1	1	1	1	1		At start-up	At start-up	At start-up	1			s	s	1
Lead vessel 50% port [1]	4	4																		
Lead vessel effluent [1]	4	4								1		At start-up	At start-up	At start-up				4	4	
Lag vessel 50% port [1]	4	4																		
Lag vessel effluent [1]	4	4								1		At start-up and monthly thereafter	At start-up and monthly thereafter	At start-up and monthly thereafter	4			4	4	
Combined IX effluent after pH increase	4	4	1	1	1	1	1	1	1						4			Continuous	Continuous	
Resin in lead vessel [1, 2]											1									
Spent resin as residuals											At disposal					At disposal	At disposal			
Resin flush water as residuals [3]														[4]						
Sum of samples (# per month)	25	25	3	2	2	2	2	2	2	3	1.2	1.4	1.4	1.9	10	0.2	0.2	12	12	1
MWH Quotes ($/sample)	$75	$15	$15		$15	$15	$15	$15	$15	25	125	400	400	200	45		350			
Test America Quotes ($/sample)	$30	$12	$15	$13	$15	$15	$15	$12	$12	20		330	165	215	70	240	492			
Unit cost ($/sample)	$53	$14	$15	$13	$15	$15	$15	$14	$14	$23	$125	$365	$283	$208	$58	$240	$421			
Sample analysis cost ($/year)	$15,750	$4,050	$540	$312	$360	$360	$360	$324	$324	$810	$1,763	$5,913	$4,577	$4,669	$6,900	$504	$884			
Annual shipping fee	$1,560	One shipment per week, $30 per shipment.																		
Sum of lab analysis cost ($/year)	$49,959	Average of two quotes, plus shipment.																		
Field meters	$2,000	portable pH and conductivity meter																		
Field analytical cost (without labor)	$1,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	$50,959	Including lab and field analysis costs; not including labor and field meters																		

1. If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.
2. A composite of top, middle and bottom resin bed layers
3. Other analyses might be required by the sewer discharge permit.
4. Three samples are estimated to be collected per resin changeout event for resin flush water disposal.

BNA SVOC - base, neutral, acid semi-volatile organic compounds

"Continuous" indicates the parameter(s) will be monitored by an online meter.

Estimated WBA Lab and Field Analytical Costs

Flow Rate (gpm) 2,000
Number of lead/lag trains 2

	Lab																	Field		
Sample Location	**Cr(VI)**	**Total Cr**	**Alkalinity**	**Turbidity**	**Sulfate**	**Nitrate**	**Phosphate**	**Total Iron**	**Silica**	**Uranium (water)**	**Uranium (solids)**	**Nitrosamines**	**BNA SVOC**	**Aldehydes/ Ketones**	**Bac-T (E. coli, T coli and HPC)**	**TCLP (Metals)**	**CA WET (Metals)**	**pH**	**Temperature**	**Conductivity**
Raw	1	1	1												1			4	4	
After pH reduction	4	4	1	1	1	1	1	1	1	1		At start-up	At start-up	At start-up	1			s	s	1
Lead vessel 50% port [1]	8	8																		
Lead vessel effluent [1]	8	8								1		At start-up	At start-up	At start-up				4	4	
Lag vessel 50% port [1]	8	8																		
Lag vessel effluent [1]	8	8								1		At start-up and monthly thereafter	At start-up and monthly thereafter	At start-up and monthly thereafter	4			4	4	
Combined IX effluent after pH increase	4	4	1	1	1	1	1	1	1						4			Continuous	Continuous	
Resin in lead vessel [1, 2]											2									
Spent resin as residuals											At disposal					At disposal	At disposal			
Resin flush water as residuals [3]														At disposal [4]						
Sum of samples (# per month)	41	41	3	2	2	2	2	2	2	3	4.2	2.4	2.4	2.9	10	0.2	0.2	12	12	1
MWH Quotes ($/sample)	$75	$15	$15		$15	$15	$15	$15	$15	25	125	400	400	200	45		350			
Test America Quotes ($/sample)	$30	$12	$15	$13	$15	$15	$15	$12	$12	20		330	165	215	70	240	492			
Unit cost ($/sample)	$53	$14	$15	$13	$15	$15	$15	$14	$14	$23	$125	$365	$283	$208	$58	$240	$421			
Sample analysis cost ($/year)	$25,830	$6,642	$540	$312	$360	$360	$360	$324	$324	$810	$6,263	$10,293	$7,967	$7,159	$6,900	$504	$884			
Annual shipping fee	$1,560	One shipment per week, $30 per shipment.																		
Sum of lab analysis cost ($/year)	$77,391	Average of two quotes, plus shipment.																		
Field meters	$2,000	portable pH and conductivity meter																		
Field analytical cost (without labor)	$1,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	$78,391	Including lab and field analysis costs; not including labor and field meters																		

1. If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.
2. A composite of top, middle and bottom resin bed layers
3. Other analyses might be required by the sewer discharge permit.
4. Three samples are estimated to be collected per resin changeout event for resin flush water disposal.

BNA SVOC - base, neutral, acid semi-volatile organic compounds

"Continuous" indicates the parameter(s) will be monitored by an online meter.

Estimated WBA O&M Costs

(Resin Replacement and Spent Resin Disposal Based on Cr(VI) Treatment Target)

WBA System Size = 10 gpm

Potential Cr(VI) MCL (ppb)	Electricity*	Chemicals	VPGAC Replacement	Resin Replacement (Fresh Resin)	Spent Resin & Wastewater Disposal	Labor	Other Consumables (Bag Filters)	Maintenance and Spare Parts	Lab and Field Analysis &	Annual O&M
1	$ 6,000	$ 920	$ 1,300	$ 6,000	$ 5,400	$ 50,000	$ 60	$ 3,630	$ 74,000	$ 147,000
2	$ 6,000	$ 920	$ 1,300	$ 5,300	$ 5,200	$ 50,000	$ 60	$ 3,630	$ 74,000	$ 146,000
5	$ 6,000	$ 920	$ 1,300	$ 4,600	$ 5,000	$ 50,000	$ 60	$ 3,630	$ 74,000	$ 146,000
10	$ 6,000	$ 920	$ 1,300	$ 3,300	$ 4,600	$ 50,000	$ 60	$ 3,630	$ 74,000	$ 144,000
25	$ 6,000	$ 920	$ 1,300	$ 1,300	$ 4,000	$ 50,000	$ 60	$ 3,630	$ 74,000	$ 141,000

* Electricity includes approximately $200 per year for aeration off-gas treatment.
& Lab and field analysis does not include cost for aeration off-gas analysis.

WBA System Size = 100 gpm

Potential Cr(VI) MCL (ppb)	Electricity*	Chemicals	VPGAC Replacement	Resin Replacement (Fresh Resin)	Spent Resin & Wastewater Disposal	Labor	Other Consumables (Bag Filters)	Maintenance and Spare Parts	Lab and Field Analysis &	Annual O&M
1	$ 12,400	$ 9,200	$ 11,800	$ 30,146	$ 21,600	$ 50,000	$ 130	$ 6,900	$ 51,000	$ 193,000
2	$ 12,400	$ 9,200	$ 11,800	$ 24,700	$ 18,300	$ 50,000	$ 130	$ 6,900	$ 51,000	$ 184,000
5	$ 12,400	$ 9,200	$ 11,800	$ 21,900	$ 16,700	$ 50,000	$ 130	$ 6,900	$ 51,000	$ 180,000
10	$ 12,400	$ 9,200	$ 11,800	$ 13,700	$ 11,800	$ 50,000	$ 130	$ 6,900	$ 51,000	$ 167,000
25	$ 12,400	$ 9,200	$ 11,800	$ 8,200	$ 8,500	$ 50,000	$ 130	$ 6,900	$ 51,000	$ 158,000

* Electricity includes approximately $700 per year for aeration off-gas treatment.
& Lab and field analysis does not include cost for aeration off-gas analysis.

WBA System Size = 500 gpm

Potential Cr(VI) MCL (ppb)	Electricity*	Chemicals	VPGAC Replacement	Resin Replacement (Fresh Resin)	Spent Resin & Wastewater Disposal	Labor	Other Consumables (Bag Filters)	Maintenance and Spare Parts	Lab and Field Analysis &	Annual O&M
1	$ 60,500	$ 46,100	$ 49,500	$ 156,400	$ 109,100	$ 50,000	$ 510	$ 14,000	$ 51,000	$ 537,000
2	$ 60,500	$ 46,100	$ 49,500	$ 128,000	$ 89,900	$ 50,000	$ 510	$ 14,000	$ 51,000	$ 490,000
5	$ 60,500	$ 46,100	$ 49,500	$ 113,800	$ 80,300	$ 50,000	$ 510	$ 14,000	$ 51,000	$ 466,000
10	$ 60,500	$ 46,100	$ 49,500	$ 71,100	$ 51,500	$ 50,000	$ 510	$ 14,000	$ 51,000	$ 394,000
25	$ 60,500	$ 46,100	$ 49,500	$ 42,700	$ 32,300	$ 50,000	$ 510	$ 14,000	$ 51,000	$ 347,000

* Electricity includes approximately $11,000 per year for aeration off-gas treatment.
& Lab and field analysis does not include cost for aeration off-gas analysis.

WBA System Size = 2,000 gpm

Potential Cr(VI) MCL (ppb)	Electricity*	Chemicals	VPGAC Replacement	Resin Replacement (Fresh Resin)	Spent Resin & Wastewater Disposal	Labor	Other Consumables (Bag Filters)	Maintenance and Spare Parts	Lab and Field Analysis &	Annual O&M
1	$ 194,800	$ 184,200	$ 168,500	$ 523,900	$ 363,900	$ 50,000	$ 1,500	$ 32,600	$ 78,000	$ 1,597,000
2	$ 194,800	$ 184,200	$ 168,500	$ 428,700	$ 298,500	$ 50,000	$ 1,500	$ 32,600	$ 78,000	$ 1,437,000
5	$ 194,800	$ 184,200	$ 168,500	$ 381,000	$ 265,500	$ 50,000	$ 1,500	$ 32,600	$ 78,000	$ 1,356,000
10	$ 194,800	$ 184,200	$ 168,500	$ 238,100	$ 167,200	$ 50,000	$ 1,500	$ 32,600	$ 78,000	$ 1,115,000
25	$ 194,800	$ 184,200	$ 168,500	$ 142,900	$ 101,700	$ 50,000	$ 1,500	$ 32,600	$ 78,000	$ 954,000

* Electricity includes approximately $21,000 per year for aeration off-gas treatment.
& Lab and field analysis does not include cost for aeration off-gas analysis.

Estimated WBA O&M Costs

(Resin Replacement and Spent Resin Disposal Based on Cr(VI) Treatment Target)

Annual O&M Summary

WBA System Size (gpm)	Potential Cr(VI) MCL, ppb				
	1	2	5	10	25
10	$ 147,000	$ 146,000	$ 146,000	$ 144,000	$ 141,000
100	$ 193,000	$ 184,000	$ 180,000	$ 167,000	$ 158,000
500	$ 537,000	$ 490,000	$ 466,000	$ 394,000	$ 347,000
2,000	$ 1,597,000	$ 1,437,000	$ 1,356,000	$ 1,115,000	$ 954,000

Net Present Value for 20 Years (Rounded to two significant figures)

WBA System Size (gpm)	Potential Cr(VI) MCL, ppb				
	1	2	5	10	25
10	$ 2,500,000	$ 2,400,000	$ 2,400,000	$ 2,400,000	$ 2,400,000
100	$ 3,200,000	$ 3,100,000	$ 3,000,000	$ 2,800,000	$ 2,800,000
500	$ 9,000,000	$ 8,200,000	$ 7,800,000	$ 6,600,000	$ 5,800,000
2,000	$ 27,000,000	$ 24,000,000	$ 23,000,000	$ 19,000,000	$ 16,000,000

20-year NPV O&M based on 2.5% inflation and a 4.5% discount rate.

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	100-gpm RCF System

Project No. 05337008.0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.
Date 12/9/11	Date: 1/18/12

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
$FeSO_4$ Feed System					
Storage Tank	1	EA	$ 2,700	$ 2,700	Quotes from Ryan Herco & Core-Rosion; 100 gal PE, outdoor, incl. seismic
Metering Pumps	2	EA	$ 3,100	$ 6,200	Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/ 1 stdby
Static Mixers	1	EA	$ 900	$ 900	Quotes from Komax & EWS; 3-inch
Reduction Tanks					
Tanks	3	EA	$ 5,100	$ 15,300	Quotes from Core-Rosion & Ryan Herco; 1,700 gal PE, outdoor, incl. seismic
Mixers	3	EA	$ 4,700	$ 14,100	Quotes from Core-Rosion & EWS; G = 60 per second
Aeration System					
Tank	1	EA	$ 3,600	$ 3,600	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic
Diffusers	1	LS	$ 400	$ 400	Based on previous project experience
Supply Blowers	2	EA	$ 30,300	$ 60,600	Quote from EWS; 53 SCFM @ 4 psi; 1 duty/ 1 stdby; incl. accessories
Exhaust Blowers	2	EA	$ 34,900	$ 69,800	Quote from EWS; 53 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories
Off-Gas Treatment	1	LS	$ 4,000	$ 4,000	Cost from Glendale and quotes from TIGG; 54 SCFM; (2) adsorbers in series with one heater
Polymer Mixing Tank					
Rapid Mixing Tank	1	EA	$ 3,600	$ 3,600	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic
Mixer	1	EA	$ 3,700	$ 3,700	Quotes from Core-Rosion & EWS; G = 170 per second
Filters					
Filter Equipment (Pressure Filters)	1	LS	$ 280,000	$ 280,000	Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf, (2) 6.5 ft dia VPF, 1 duty/ 1 stdby
Filter Drawdown Transfer Pump	2	EA	$ 5,600	$ 11,200	Quotes from DTI and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby
Pumps					
Filter Feed Pumps (Progressive Cavity)	2	EA	$ 12,000	$ 24,000	Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby
Polymer Feed Systems					
Polymer Feed System (Coagulant Aid)	1	LS	$ 28,000	$ 28,000	Quotes from Siemens & C.P. Crowley
Polymer Feed System (Solids Settling Aid)	1	LS	$ 11,000	$ 11,000	Quotes from Siemens & C.P. Crowley
Filtrate Tank for Backwash	1	EA	$ 26,200	$ 26,200	Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic
Backwash Pumps	2	EA	$ 8,900	$ 17,800	Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby
Residuals Treatment System					
Gravity Thickener	2	EA	$ 32,000	$ 64,000	Quote from Plastic-Mart for 13,000-gallon cone bottom tank with stand.
Flo-Trend SludgeMate Container	2	EA	$ 14,200	$ 28,400	Quote from Flo-Trend for 6-CY SludgeMate container.
Pumps	1	LS	$ 10,000	$ 10,000	Includes all sludge pumps and recycle pumps, one duty and one standby.
Subtotal				$ 686,000	Rounded up to $1000
Equipment Installation Cost	30%			$ 206,000	Including tax, freight, installation and manufacturer services.
Chemical Storage Containment	2	CY	$ 1,250	$ 2,500	
Equipment Concrete Pads	69	CY	$ 1,250	$ 86,250	
Subtotal (Installed Equipment Costs)				$ 981,000	Rounded up to $1000
General Requirements	7.5%			$ 73,575	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%			$ 49,050	Excavation, backfill, and fill required to construct project
Site Improvements	5%			$ 49,050	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			$ 148,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			$ 148,000	PLC and SCADA equipment to control
Total Direct Costs				$ 1,449,000	Rounded up to $1000

OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	100-gpm RCF System

Project No. 05337008.0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.
Date 12/9/11	Date: 1/18/12

Contractor's Overhead and Profit	20%			$ 289,800	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				$ 1,739,000	Rounded up to $1000
Project Level Allowance (contingency)	20%			$ 347,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			$ 347,800	Includes permits, legal fees and engineering fees for design and construction
Project Total				$ 2,435,000	
Low Estimate				$ 1,705,000	-30%
High Estimate				$ 3,653,000	+50%

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2011 dollars.
3. Costs for land or easements are not included.

MALCOLM PIRNIE | ARCADIS
The Water Division of ARCADIS

OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	500-gpm RCF System

Project No. 05337008.0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.
Date 12/9/11	Date: 1/18/12

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
$FeSO_4$ Feed System					
Storage Tank	1	EA	$ 3,300	$ 3,300	Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic
Metering Pumps	2	EA	$ 3,100	$ 6,200	Quotes from C.P. Crowley & HTP; 1.3 gph; 1 duty/ 1 stdby
Static Mixers	1	EA	$ 2,200	$ 2,200	Quotes from Komax & EWS; 8-inch
Reduction Tanks					
Tanks	3	EA	$ 20,000	$ 60,000	Quotes from Core-Rosion & Ryan Herco; 8,000 gal PE, outdoor, incl. seismic
Mixers	3	EA	$ 8,800	$ 26,400	Quotes from Core-Rosion & EWS; G = 60 per second
Aeration System					
Tanks	1	EA	$ 6,300	$ 6,300	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic
Diffusers	1	LS	$ 2,000	$ 2,000	Based on previous project experience
Supply Blowers	2	EA	$ 46,300	$ 92,600	Quote from EWS; 267 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessories
Exhaust Blowers	2	EA	$ 34,800	$ 69,600	Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories
Off-Gas Treatment	1	LS	$ 15,100	$ 15,100	Quotes from Calgon and TIGG; 270 SCFM; (2) adsorbers in series with one heater
Polymer Mixing Tank					
Rapid Mixing Tank	1	EA	$ 6,700	$ 6,700	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic
Mixers	1	EA	$ 4,400	$ 4,400	Quotes from Core-Rosion & EWS; G = 170 per second
Filters					
Filter Equipment (Pressure Filters)	1	LS	$ 465,000	$ 465,000	Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf; Coombs-Hopkins filters, 10' x 24' (4 cells, 3 duty/ 1 stdby); Layne filters, (2) 8" x 22', 1 duty/ 1 stdby
Filter Drawdown Transfer Pump	2	EA	$ 4,800	$ 9,600	Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby
Pumps					
Filter Feed Pumps (Progressive Cavity)	2	EA	$ 38,000	$ 76,000	Quotes from Cortech & Flow-Systems; 500 gpm @ 70 ft; 1 duty/ 1 stdby
Polymer Feed Systems					
Polymer Feed Systems (Coagulant Aid)	1	LS	$ 10,500	$ 10,500	Quotes from Siemens & C.P. Crowley
Polymer Feed Systems (Solids Settling Aid)	1	LS	$ 11,400	$ 11,400	Quotes from Siemens & C.P. Crowley
Filtrate Tank for Backwash	1	EA	$ 40,000	$ 40,000	Quotes from Superior; 22,000 gal; 15 ft dia x 16 ft height
Backwash Pumps	2	EA	$ 14,300	$ 28,600	Quotes from ITT & Cortech; 1,050 gpm @ 50 ft; 1 duty/ 1stdby
Residuals Treatment System					
Equalization Tank	1	EA	$ 121,000	$ 121,154	Adjusted installed costs from RS Means for 90,000-gal tank, which was divided by 1.3 to exclude installation cost (assuming a installation cost of 30%).
Plate Settler	1	EA	$ 59,000	$ 59,000	Quote from Meurer Research, Inc. and Parkson for a system handles a 26-gpm sludge flow.
Flo-Trend SludgeMate Container	3	EA	$ 25,900	$ 77,700	Quote from Flo-Trend for 15-CY SludgeMate container.
Pumps	1	LS	$ 15,000	$ 15,000	Includes all sludge pumps and recycle pumps, one duty and one standby.
Subtotal				$ 1,209,000	Rounded up to $1000
Equipment Installation Cost	30%			$ 363,000	Including tax, freight, installation and manufacturer services.
Chemical Storage Containment	6	CY	$ 1,250	$ 7,500	
Equipment Concrete Pads	166	CY	$ 1,250	$ 207,500	
Subtotal (Installed Equipment Costs)				$ 1,787,000	Rounded up to $1000
General Requirements	7.5%			$ 134,025	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%			$ 89,350	Excavation, backfill, and fill required to construct project
Site Improvements	5%			$ 89,350	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			$ 269,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			$ 269,000	PLC and SCADA equipment to control
Total Direct Costs				$ 2,638,000	Rounded up to $1000

MALCOLM PIRNIE | ARCADIS
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OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	500-gpm RCF System

Project No. 05337008.0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.
Date 12/9/11	Date: 1/18/12

Contractor's Overhead and Profit	20%			$ 527,600	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				$ 3,166,000	Rounded up to $1000
Project Level Allowance (contingency)	20%			$ 633,200	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			$ 633,200	Includes permits, legal fees and engineering fees for design and construction
Project Total				$ 4,433,000	
Low Estimate				$ 3,103,000	-30%
High Estimate				$ 6,650,000	+50%

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2011 dollars.
3. Costs for land or easements are not included.

OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	2000-gpm RCF System

Project No. 05337008.0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.
Date 12/9/11	Date: 1/18/12

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
$FeSO_4$ Feed System					
Storage Tank	1	EA	$ 5,900	$ 5,900	Quotes from Core-Rosion & Ryan Herco; 2,000 gal PE, outdoor, incl. seismic
Metering Pumps	2	EA	$ 6,000	$ 12,000	Quotes from C.P. Crowley & HTP; 5 gph
Static Mixers	1	EA	$ 4,200	$ 4,200	Quotes from Komax & EWS; 14-inch
Reduction Tanks					
Mixers	3	EA	$ 23,500	$ 70,500	Quotes from Core-Rosion & EWS; G = 60 per second
Aeration System					
Diffuser	1	LS	$ 8,000	$ 8,000	Based on previous project experience and conversation w/ Brian Bubela
Supply Blowers	2	EA	$ 74,800	$ 149,600	Quote from EWS; 1,070 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessaories
Exhaust Blowers	2	EA	$ 58,500	$ 117,000	Quote from EWS; 1,070 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessaories
Off-Gas Treatment	1	LS	$ 25,300	$ 25,300	Quotes from Calgon & TIGG; 1070 SCFM; (2) adsorbers in series with one heater
Polymer Mixing Tanks					
Mixers	1	EA	$ 17,000	$ 17,000	Quotes from Core-Rosion & EWS; G = 170 per second
Filters					
Filter Equipment (Pressure Filters)	1	LS	$ 984,000	$ 984,000	Quotes from Tonka & Layne, including media; 3 gpm/sf; Tonka filters, (2) 10' x 42', 4 cells per filter, 3 duty / 1 stdby; Layne filters, (4) 10' x 24', 3 duty/ 1 stdby
Filter Drawdown Transfer Pump	2	EA	$ 5,000	$ 10,000	Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby
Pumps					
Filter Feed Pumps (Progressive Cavity)	3	EA	$ 55,000	$ 165,000	Quotes from Cortech & Flow-Systems; 1,000 gpm @ 70 ft; 2 duty/ 1 stdby
Polymer Feed Systems					
Polymer Feed Systems (Coagulant Aid)	1	LS	$ 10,500	$ 10,500	Quotes from Siemens & C.P. Crowley
Polymer Feed Systems (Solids Settling Aid)	1	LS	$ 11,400	$ 11,400	Quotes from Siemens & C.P. Crowley
Filtrate Tank for Backwash	1	EA	$ 50,000	$ 50,000	Quotes from Superior; 30,250 gal; 18 ft dia x 16 ft height
Backwash Pumps	2	EA	$ 21,500	$ 43,000	Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stdby
Residuals Treatment System					
Equalization Tank	1	EA	$ 137,000	$ 137,385	Adjusted installed costs from RS Means for 280,000-gal tank, which was divided by 1.3 to exclude installation cost (assuming a installation cost of 30%).
Plate Settler	1	EA	$ 78,000	$ 78,000	Quote from Meurer Research, Inc. and Parkson for a system handles a 88-gpm sludge flow.
Flo-Trend SludgeMate Container	3	EA	$ 38,400	$ 115,200	Quote from Flo-Trend for 40-CY SludgeMate container.
Pumps	1	LS	$ 22,000	$ 22,000	Includes sludge pumps and recycle pumps for equalization tank and plate settlers, one duty and one standby.
Subtotal				$ 2,036,000	Rounded up to $1000
Equipment Installation Cost (30% of Equipment)	30%			$ 611,000	Including tax, freight, installation and manufacturer services.
Reduction Tanks					25 ft x 75 ft tank, including 3 sub-tanks with shared walls
Slab	140	CY	$ 700	$ 98,000	Based on 2 ft slab or wall
Walls	155	CY	$ 800	$ 124,000	Based on 2 ft slab or wall; and 2 ft freeboard
Elevated Slab	140	CY	$ 1,100	$ 154,000	Based on 2 ft slab or wall
Aeration Tanks					15 ft x 15 ft tank
Slab	17	CY	$ 700	$ 11,900	Based on 2 ft slab or wall
Walls	35	CY	$ 800	$ 28,000	Based on 2 ft slab or wall; and 2 ft freeboard
Elevated Slab	17	CY	$ 1,100	$ 18,700	Based on 2 ft slab or wall

OPINION OF PROBABLE PROJECT COST

Client	City of Glendale
Project	Phase III Demonstration Testing for Cr(VI) Treatment
Item	2000-gpm RCF System

Project No. 05337008.0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.
Date 12/9/11	Date: 1/18/12

Rapid Mixing Tanks					15 ft x 15 ft tank
Slab	17	CY	$ 700	$ 11,900	Based on 2 ft slab or wall
Walls	35	CY	$ 800	$ 28,000	Based on 2 ft slab or wall; and 2 ft freeboard
Elevated Slab	17	CY	$ 1,100	$ 18,700	Based on 2 ft slab or wall
Chemical Storage Containment	16	CY	$ 1,250	$ 20,000	
Equipment Concrete Pads	291	CY	$ 1,250	$ 363,750	
Subtotal (Installed Equipment Costs)				$ 3,524,000	Rounded up to $1000
General Requirements	7.5%			$ 264,300	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%			$ 176,200	Excavation, backfill, and fill required to construct project
Site Improvements	5%			$ 176,200	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			$ 529,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			$ 529,000	PLC and SCADA equipment to control
Total Direct Costs				$ 5,199,000	Rounded up to $1000
Contractor's Overhead and Profit	20%			$ 1,039,800	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				$ 6,238,800	
Project Level Allowance (contingency)	20%			$ 1,247,760	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			$ 1,247,760	Includes permits, legal fees and engineering fees for design and construction
Project Total				$ 8,735,000	
Low Estimate				$ 6,115,000	-30%
High Estimate				$ 13,103,000	+50%

Notes:

1. This opinion of probable cost is based on AACE Class 5 estimate guidelines. The high and low estimates fall into the acceptable range. These estimates are generally used to compare alternatives.
2. Opinion of Probable Cost in 2011 dollars.
3. Costs for land or easements are not included.

Estimated RCF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 100
Number of Duty Filters 1

	Lab									Field					
Sample Location	**Total Fe**	**Cr(VI)**	**Total Cr**	**TSS**	**Silica**	**VOCs**	**Bac-T (E. Coli, T. Coli and HPC)**	**TCLP (Metals)**	**CA WET (Metals)**	**Cr(VI)***	**Ferrous**	**Total Fe**	**Turbidity**	**pH**	**Temperature**
Raw	1	4	4		1					4	1	1	1	4	4
After ferrous addition											4	4		continuous	continuous
After 1st reduction tank											4	4		4	
After 2nd reduction tank											1	1		4	
After 3rd reduction tank		4				1					4	4		4	4
Aeration off gas (raw)						1									
Aeration off gas (after first VPGAC)						1									
Aeration off gas (after 2nd VPGAC)						1									
Filter feed (after rapid mixing)				4		1								4	4
Filter effluent	4	4	4							4	4	4	continuous	1	1
Spent filter backwash	1	1	1	1											
Supernatant from thickener	1	1	1	1			4			1	1	1	1	1	1
Thickened sludge				1											
Filtrate from dewatering container	1	1	1	1			4			1	1	1	1	1	1
Dewatered solid residuals								At disposal	At disposal						
Number of samples per month^	8	15	11	8	1	5	8	1	1	10	20	20	3	23	15
Unit cost ($/sample)	$ 14	$ 53	$ 14	$ 15	$ 14	$ 110	$ 58	$ 240	$ 421						
Sample analysis Cost ($/year)	$ 1,296	$ 9,450	$ 1,782	$ 1,440	$ 162	$ 6,600	$ 5,520	$ 2,880	$ 5,052						
Shipping fee ($/year)	$ 1,560	One shipment per week, $30 per shipment													
Sum of lab analysis cost ($/year)	$ 35,742	Sample analysis plus shipping fee													
Field meters	$ 6,000	Hach Dr 3800, portable pH meter and turbidity meter													
Field analysis cost	$ 2,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis													
Total analysis cost	$ 37,742	Including lab and field analysis costs; not including labor and field meters													

* Only if influent Cr(VI) is greater than 10 ppb, which is the method detection limit for field analysis (Hach Method).
Continuous monitoring indicates analyzed by online meter(s).
^ Assume TCLP and CA WET residuals analysis occur once a month, which is a conservative estimate.
TSS - total suspended solids; VOCs - volatile organic compounds; TCLP - toxicity characteristic leaching procedure; CA WET - California waste extraction test; VPGAC - vapor phase granular activated carbon

Estimated RCF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 500
Number of Duty Filter Cells 3

	Lab									Field					
Sample Location	**Total Fe**	**Cr(VI)**	**Total Cr**	**TSS**	**Silica**	**VOCs**	**Bac-T (E. Coli, T. Coli and HPC)**	**TCLP (Metals)**	**CA WET (Metals)**	**Cr(VI)***	**Ferrous**	**Total Fe**	**Turbidity**	**pH**	**Temperature**
Raw	1	4	4		1					4	1	1	1	4	4
After ferrous addition											4	4		continuous	continuous
After 1st reduction tank											4	4		4	
After 2nd reduction tank											1	1		4	
After 3rd reduction tank		4				1					4	4		4	4
Aeration off gas (raw)						1									
Aeration off gas (after first VPGAC)						1									
Aeration off gas (after 2nd VPGAC)						1									
Filter feed (after rapid mixing)				4		1								4	4
Filter effluent from each cell	4	4	4							4	4	4	continuous	1	1
Spent filter backwash	1	1	1	1											
Supernatant from thickener	1	1	1	1			4			1	1	1	1	1	1
Thickened sludge				1											
Filtrate from dewatering container	1	1	1	1			4			1	1	1	1	1	1
Dewatered solid residuals								At disposal	At disposal						
Number of samples per month^	16	23	19	8	1	5	8	1.5	1.5	18	28	28	3	25	17
Unit cost ($/sample)	$ 14	$ 53	$ 14	$ 15	$ 14	$ 110	$ 58	$ 240	$ 421						
Sample analysis Cost ($/year)	$ 2,592	$ 14,490	$ 3,078	$ 1,440	$ 162	$ 6,600	$ 5,520	$ 4,320	$ 7,578						
Shipping fee ($/year)	$ 1,560	One shipment per week, $30 per shipment													
Sum of lab analysis cost ($/year)	$ 47,340	Sample analysis plus shipping fee													
Field meters	$ 6,000	Hach Dr 3800, portable pH meter and turbidity meter													
Field analysis cost	$ 3,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis													
Total analysis cost	$ 50,340	Including lab and field analysis costs; not including labor and field meters													

* Only if influent Cr(VI) is greater than 10 ppb, which is the method detection limit for field analysis (Hach Method).
Continuous monitoring indicates analyzed by online meter(s).
^ Assume TCLP and CA WET residuals analysis occur three times every two months, which is a conservative estimate.
TSS - total suspended solids; VOCs - volatile organic compounds; TCLP - toxicity characteristic leaching procedure; CA WET - California waste extraction test; VPGAC - vapor phase granular activated carbon

Estimated RCF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 2,000
Number of Duty Filter Cells 9

	Lab									Field					
Sample Location	**Total Fe**	**Cr(VI)**	**Total Cr**	**TSS**	**Silica**	**VOCs**	**Bac-T (E. Coli, T. Coli and HPC)**	**TCLP (Metals)**	**CA WET (Metals)**	**Cr(VI)***	**Ferrous**	**Total Fe**	**Turbidity**	**pH**	**Temperature**
Raw	1	4	4		1					4	1	1	1	4	4
After ferrous addition											4	4		continuous	continuous
After 1st reduction tank											4	4		4	
After 2nd reduction tank											1	1		4	
After 3rd reduction tank		4				1					4	4		4	4
Aeration off gas (raw)						1									
Aeration off gas (after first VPGAC)						1									
Aeration off gas (after 2nd VPGAC)						1									
Filter feed (after rapid mixing)				4		1								4	4
Filter effluent from each cell	4	4	4							4	4	4	continuous	1	1
Spent filter backwash	1	1	1	1											
Supernatant from thickener	1	1	1	1			4			1	1	1	1	1	1
Thickened sludge				1											
Filtrate from dewatering container	1	1	1	1			4			1	1	1	1	1	1
Dewatered solid residuals								At disposal	At disposal						
Number of samples per month^	40	47	43	8	1	5	8	2	2	42	52	52	3	31	23
Unit cost ($/sample)	$ 14	$ 53	$ 14	$ 15	$ 14	$ 110	$ 58	$ 240	$ 421						
Sample analysis Cost ($/year)	$ 6,480	$ 29,610	$ 6,966	$ 1,440	$ 162	$ 6,600	$ 5,520	$ 5,760	$ 10,104						
Shipping fee ($/year)	$ 1,560	One shipment per week, $30 per shipment													
Sum of lab analysis cost ($/year)	$ 74,202	Sample analysis plus shipping fee													
Field meters	$ 6,000	Hach Dr 3800, portable pH meter and turbidity meter													
Field analysis cost	$ 5,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis													
Total analysis cost	$ 79,202	Including lab and field analysis costs; not including labor and field meters													

* Only if influent Cr(VI) is greater than 10 ppb, which is the method detection limit for field analysis (Hach Method).
Continuous monitoring indicates analyzed by online meter(s).
^ Assume TCLP and CA WET residuals analysis occur twice every two months, which is a conservative estimate.
TSS - total suspended solids; VOCs - volatile organic compounds; TCLP - toxicity characteristic leaching procedure; CA WET - California waste extraction test; VPGAC - vapor phase granular activated carbon

Estimated RCF O&M Costs

RCF System Size = 100 gpm

Influent Cr(VI) Concentration (ppb)	Residuals Disposal	Chemicals	Labor	VPGAC Replacement	Filter Media Replacement	Maintenance and Spare Parts	Electricity*	Lab and Field Analysis &	Annual O&M
5	$ 5,600	$ 1,600	$ 161,000	$ 1,200	$ 600	$ 9,800	$ 36,700	$ 37,700	$ 254,000
10	$ 10,600	$ 2,600	$ 161,000	$ 1,200	$ 600	$ 9,800	$ 36,700	$ 37,700	$ 260,000
25	$ 17,300	$ 4,000	$ 161,000	$ 1,200	$ 600	$ 9,800	$ 36,700	$ 37,700	$ 268,000
50	$ 34,000	$ 7,300	$ 161,000	$ 1,200	$ 600	$ 9,800	$ 36,700	$ 37,700	$ 288,000

* Electricity includes approximately $200 per year for aeration off-gas treatment.
& Lab and field analysis includes approximately $4,000 per year for aeration off-gas analysis.

RCF System Size = 500 gpm

Influent Cr(VI) Concentration (ppb)	Residuals Disposal	Chemicals	Labor	VPGAC Replacement	Filter Media Replacement	Maintenance and Spare Parts	Electricity*	Lab and Field Analysis &	Annual O&M
5	$ 27,900	$ 7,900	$ 233,000	$ 21,600	$ 2,500	$ 17,900	$ 99,000	$ 50,300	$ 460,000
10	$ 52,800	$ 13,000	$ 233,000	$ 21,600	$ 2,500	$ 17,900	$ 99,000	$ 50,300	$ 490,000
25	$ 86,400	$ 19,800	$ 233,000	$ 21,600	$ 2,500	$ 17,900	$ 99,000	$ 50,300	$ 531,000
50	$ 169,800	$ 36,700	$ 233,000	$ 21,600	$ 2,500	$ 17,900	$ 99,000	$ 50,300	$ 631,000

* Electricity includes approximately $700 for aeration off-gas treatment.
& Lab and field analysis includes approximately $4,000 per year for aeration off-gas analysis.

RCF System Size = 2,000 gpm

Influent Cr(VI) Concentration (ppb)	Residuals Disposal	Chemicals	Labor	VPGAC Replacement	Filter Media Replacement	Maintenance and Spare Parts	Electricity*	Lab and Field Analysis &	Annual O&M
5	$ 111,500	$ 31,600	$ 377,000	$ 60,000	$ 6,100	$ 35,200	$ 176,500	$ 79,200	$ 877,000
10	$ 211,100	$ 52,000	$ 377,000	$ 60,000	$ 6,100	$ 35,200	$ 176,500	$ 79,200	$ 997,000
25	$ 345,500	$ 79,000	$ 377,000	$ 60,000	$ 6,100	$ 35,200	$ 176,500	$ 79,200	$ 1,159,000
50	$ 679,200	$ 146,700	$ 377,000	$ 60,000	$ 6,100	$ 35,200	$ 176,500	$ 79,200	$ 1,560,000

* Electricity includes approximately $2,800 for aeration off-gas treatment.
& Lab and field analysis includes approximately $4,000 per year for aeration off-gas analysis.

Annual O&M Summary

RCF System Size (gpm)	Influent Cr(VI) Concentration, ppb			
	5	10	25	50
100	$ 254,000	$ 260,000	$ 268,000	$ 288,000
500	$ 460,000	$ 490,000	$ 531,000	$ 631,000
2,000	$ 877,000	$ 997,000	$ 1,159,000	$ 1,560,000

Net Present Value for 20 Years (Rounded to two significant figures)

RCF System Size (gpm)	Influent Cr(VI) Concentration, ppb			
	5	10	25	50
100	$ 4,300,000	$ 4,400,000	$ 4,500,000	$ 4,800,000
500	$ 7,700,000	$ 8,200,000	$ 8,900,000	$ 11,000,000
2,000	$ 15,000,000	$ 17,000,000	$ 19,000,000	$ 26,000,000

20-year NPV O&M based on 2.5% inflation and a 4.5% discount rate