

Client
City of Glendale
Project
Phase III Demonstration Testing for
Cr(VI) Treatment

10-gpm WBA System

Item

Project No. 05337008	.0000	
By T.D. & C.R.	Ckd: Y.W. & T.V.	Updated: Y.W.
Date 12/20/11	Date: 12/22/11	Date: 12/31/12

DESCRIPTION	QTY	UNIT MEAS.	ī	UNIT COST		TOTAL COST	COMMENTS
Equipment			H				<del></del>
Equipment							
CO2 Feed System	1	LS	\$	81,600	\$	81 600	Quote from TOMCO; 1.5 lb/hr PSF and (2) 380 lb cylinders; adjusted to 2012 dollars.
CO2 Feed Water Pump	2	EA	\$	7,321	\$		Quote from ITT; centrifugal; 2 gpm @ 80 psi; 1 duty/1 stdby; adjusted to 2012 dollars.
Static Mixer	1	EA EA	\$	337	\$	337	Quotes from Komax & EWS; 1-inch; adjusted to 2012 dollars.
Static Ivilkei	<u>'</u>	LA	Ψ	337	Ψ	337	Quotes IIOIII Kolliax & EWG, 1-IIICII, aujusteu to 2012 dollais.
Bag Filters	2	EA	\$	1,800	\$	3,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; adjusted to 2012 dollars.
bay Filters		EA	Ą	1,000	φ	3,000	Quotes Iron FSI & Ryan Herco, Tudity/ T stuby, adjusted to 2012 dollars.
lan Evahanna Environant	1	LS	\$	7,600	\$	7,600	Ouston from Ciamana, incl. first fill of region adjusted to 2012 dellars
Ion Exchange Equipment	1	LS	Þ	7,600	Þ	7,600	Quotes from Siemens; incl. first fill of resin; adjusted to 2012 dollars.
	4	F.4	•	7.000	_	7.000	0 4 7 0 0 0 1 0000 4 1 1 4 14 0040 4 11
Backwash Waste Tank	1	EA	\$	7,800	\$		Quotes from Core-Rosion; 2,000 gal; adjusted to 2012 dollars.
Discharge Pumps	2	EA	\$	4,929	\$	9,857	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby; adjusted to 2012
			Ļ		_		
Booster Pump	2	EA	\$	6,201	\$	12,401	Quote from Cortech, 10 gpm @ 15 ft; 1 duty/1 stdby; adjusted to 2012 dollars.
			<u> </u>				
Aeration Equipment	1	LS	\$	42,840	\$	42,840	Quote from Siemens for an aluminum forced draft aerator (65 gpm), including blower,
Exhaust Blowers	2	EA	\$	35,571	\$	71 1/13	air distribution tray, and piping etc.; adjusted to 2012 dollars.  Quote from EWS; 53 SCFM @ 2 psi; 1 duty/ 1 stdby; adjusted to 2012 dollars.
			Ė	·	Ė		Cost from Glendale and quote from TIGG; 54 SCFM; (2) adsorbers in series; plus
Off-Gas Treatment	1	LS	\$	4,100	\$	4,100	\$2,800 for one heater; adjusted to 2012 dollars.
							. ,
Subtotal					\$	256,000	Rounded up to \$1000
					Ė	·	
Equipment Installation Cost	30%				\$	76,800	Including tax, freight, installation and manufacturer services.
Equipment instantation cost	0070				Ť	70,000	and managed and modern and managed and converse.
Equipment Concrete Pads	29	CY	\$	1.275	\$	36 686	\$1250/CY, adjusted to 2012 dollars
Equipment consists i acc		Ŭ.	Ť	.,2.0	Ť	00,000	4 1200 0 1, adjusted to 2012 dental o
Subtotal (Installed Equipment Costs)		1			\$	370 000	Rounded up to \$1000
Substituti (motamon Equipmont Socie)					Ť	0.0,000	1 total day 10 \$ 1,000
			H				Division 1 requirements, including labor supervision, field offices, temporary utilities,
General Requirements	7.5%				\$		health and safety, office supplies, clean up, photographs, survey, erosion control,
Contra resquirements	7.070				۳	21,100	coordination, testing services, and record documents
Earthwork	5%		t		\$	18 500	Excavation, backfill, and fill required to construct project
Site Improvements	5%		t		\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$		Major system piping and valves
Electrical. Instrumentation and Controls	15%		H		\$	,	PLC and SCADA equipment to control
Electrical, instramentation and controls	1070		H		Ψ	50,000	I LO and GOADA equipment to control
Total Direct Costs		l I			\$	547 000	Rounded up to \$1000
Total Direct Costs			<u> </u>		Ą	347,000	Rounded up to \$1000
			┢				Includes bonds, mobilization and demobilization, insurance, overhead and profit, and
Contractor's Overhead and Profit	20%				\$	109,400	management reserves
			H				and a gornous 10001100
Construction Total			H		\$	656 000	Rounded up to \$1000
	<del>                                     </del>		┢		<b>"</b>	000,000	10011000 ap 10 \$1000
Project Level Allowance (contingency)	20%		H		\$	131,200	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%		H		\$		Includes permits, legal fees and engineering fees for design and construction
Lingingening, Legal and Administrative	20 /0		H		φ	131,200	iniciades permits, regal rees and engineering rees for design and constituction
Project Total	<u> </u>	l 	<u> </u>		\$	919.000	
Project Total	1		┝		Þ	919,000	
			┡		_	212.25	000/
Low Estimate			<u> </u>		\$	643,000	
High Estimate					\$	1,379,000	+50%

- 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 2012 dollars.
- Costs for land or easements are not included.



Cilent
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. Updated: Y.W.											
Date 12/20/11	Date: 12/22/11	Date: 12/31/12									

DESCRIPTION	QTY	UNIT MEAS.	UNIT C	OST	TOTAL CO	ST	COMMENTS
Equipment	Q I I	JITI MLAU.	1 31411 0	501	TOTALOU	J1	COMMENTO
Equipment							
CO2 Feed System	1	LS	\$ 1	60,000	\$ 16	000	Quote from TOMCO; 15 lb/hr PSF and 6 ton storage; adjusted to 2012 dollars.
CO2 Feed System CO2 Feed Water Pump	2	EA	\$	7,321			
·	1	EA	\$		\$ 1		Quote from ITT; centrifugal; 15 gpm @ 80 psi; 1 duty/1 stdby; adjusted to 2012 dollars.
Static Mixer	1	EA	\$	867	\$	867	Quotes from Komax & EWS; 3-inch; adjusted to 2012 dollars.
D 514		F.4	•	4 400	•	0.000	Out to firm FOLD Dura Harry Adult / Antiller adicted to 0040 dellars
Bag Filters	2	EA	\$	4,400	\$	8,800	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; adjusted to 2012 dollars.
Ion Exchange Equipment	1	LS	\$	95,000	\$ 9	5,000	Quotes from Siemens; incl. first fill of resin; adjusted to 2012 dollars.
			_				
Backwash Waste Tank	1	EA		53,000	-		Quotes from Superior & BH; 19,000 gal; adjusted to 2012 dollars.
Discharge Pumps	2	EA	\$	4,929	\$	9,857	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars.
Booster Pump	2	EA	\$	7,870	\$ 1	5,741	Quote from ITT, 100 gpm @ 15 ft; 1 duty/1 stdby; adjusted to 2012 dollars.
Aeration Equipment	1	LS	\$	42,840	\$ 4	2.840	Quote from Siemens for an aluminum forced draft aerator (100 gpm), including blower,
				35.448		,	air distribution tray, and piping etc.; adjusted to 2012 dollars.
Exhaust Blowers	2	EA		,			Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby; adjusted to 2012 dollars.  Quote from TIGG; 270 SCFM; (2) adsorbers in series with one heater; adjusted to 2012
Off-Gas Treatment	1	LS	\$	11,000	\$ 1	1,000	dollars.
							dollaro.
Subtotal					\$ 48	3.000	Rounded up to \$1000
Cubiciai					<del>y</del> +0	13,000	Tourided up to \$1000
Equipment Installation Cost	30%				\$ 14	4,900	Including tax, freight, installation and manufacturer services.
Equipment installation cost	30 /6				Ş 14	4,900	including tax, height, histaliation and manufacturer services.
Equipment Concrete Pad	56	CY	\$	1.275	\$ 7	1,936	\$1250/CY, adjusted to 2012 dollars
Equipment Concrete Pad	30	Cf	à	1,275	\$ 1	1,930	\$1250/C1, adjusted to 2012 dollars
Code 4-4-1 (10-4-11-4 Foods on and Octob)					\$ 70	0.000	D
Subtotal (Installed Equipment Costs)					\$ 10	0,000	Rounded up to \$1000
							Division 4 year increases including labor conservation field offices towards willities
General Requirements	7.5%				\$ 5	2 500	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion control,
Concrai requirements	7.570				Ψ 3	,500	coordination, testing services, and record documents
Earthwork	5%				\$ 3	5.000	Excavation, backfill, and fill required to construct project
Site Improvements	5%						Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%						Major system piping and valves
Electrical, Instrumentation and Controls	15%						PLC and SCADA equipment to control
Listandar, met americane and controls	1070				<del>*</del>	.0,000	2 20 and 307 lb7 (Squipmont to Sortion
Total Direct Costs					\$ 1,03	3 000	Rounded up to \$1000
Total Direct Goods			1		Ψ 1,03	,	Tourison up to \$1000
							Includes bonds, mobilization and demobilization, insurance, overhead and profit, and
Contractor's Overhead and Profit	20%				\$ 20	6,600	management reserves
Construction Total			1		\$ 1,23	9,600	Rounded up to \$1000
CONSTRUCTION TOTAL			-		Ψ 1,23	,000	i touridou ap to y root
Project Level Allowance (contingency)	20%		-		\$ 24	7,920	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%		1				Includes permits, legal fees and engineering fees for design and construction
Engineering, Legal and Administrative	20%				φ 24	1,920	includes permits, regarilees and engineering rees for design and construction
			1				
Project Total					\$ 1,73	6,000	
Low Estimate						5,000	
High Estimate					\$ 2,60	14,000	+50%

- 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 2012 dollars.
- 3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase III Demonstration Testing for
Cr(VI) Treatment

Item
500-gpm WBA System

Project No. 05337008.0000  Rv T D & C R										
By T.D. & C.R.	Ckd: Y.W. & T.V.	Updated: Y.W.								
Date 12/20/11	Date: 12/22/11	Date: 12/31/12								

DESCRIPTION	QTY	UNIT MEAS.	LIMIT	COST	TO	TAL COST	COMMENTS
	QIT	UNIT MEAS.	UNIT	COST	10	TAL COST	COMMENTS
Equipment							
CO2 Feed System	1	LS	\$	193,800	\$	193,800	Quote from TOMCO; 75 lb/hr PSF and 14 ton storage; adjusted to 2012 dollars.
CO2 Feed Water Pump	2	EA	\$	7,760	\$	15,520	Quote from ITT; centrifugal; 75 gpm @ 80 psi; 1 duty/1 stdby; adjusted to 2012 dollars.
Static Mixers	1	EA	\$	2,244	\$	2,244	Quotes from Komax & EWS; 8-inch; adjusted to 2012 dollars.
Bag Filters	2	EA	\$	12,800	\$	25,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; adjusted to 2012 dollars.
							, , , , ,
Ion Exchange Equipment	1	LS	\$	400.000	\$	400.000	Quotes from Siemens and Calgon; incl. first fill of resin; adjusted to 2012 dollars.
			-	,	-	,	
Backwash Waste Tank	1	EA	\$	102,000	\$	102,000	Quotes from Superior & BH; 95,000 gal; adjusted to 2012 dollars.
Discharge Pumps	2	EA	\$	4,929	\$	9,857	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars.
Discharge Fullips		LA	Ψ	4,323	Ψ	9,037	Quotes from 111 & Cortect 100 gpm @ 13 ft, 1 duty/ 1 stuby, adjusted to 2012 dollars.
5 / 5		F.4	•	44.444	•	00.000	0 4 6 177 500 0 45 6 4 1 4 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Booster Pump	2	EA	\$	11,141	\$	22,283	Quote from ITT, 500 gpm @ 15 ft; 1 duty/1 stdby; adjusted to 2012 dollars.
Aeration Equipment	1	LS	\$	47,940	\$	47,940	Quote from Siemens for an aluminum forced draft aerator (500 gpm), including blower, air
	0	EA	•	FF 200	•	440.040	distribution tray, and piping etc.; adjusted to 2012 dollars.
Exhaust Blowers	2		\$	55,322	\$	110,643	Quotes from EWS & Yardley; 1,500 SCFM @ 5 psi; 1 duty/ 1 stdby; adjusted to 2012 Quote from TIGG; 1,500 SCFM; (2) adsorbers in series with one heater; adjusted to 2012
Off-Gas Treatment	1	LS	\$	28,000	\$	28,000	dollars.
							uolidi3.
Subtotal					\$	958,000	Rounded up to \$1000
Subtotal					ð	930,000	Rounded up to \$1000
	000/						
Equipment Installation Cost	30%				\$	287,400	Including tax, freight, installation and manufacturer services.
Equipment Concrete Pad	159	CY	\$	1,275	\$	203,040	\$1250/CY, adjusted to 2012 dollars
Subtotal (Installed Equipment Costs)					\$	1,449,000	Rounded up to \$1000
							Division 1 requirements, including labor supervision, field offices, temporary utilities, health
General Requirements	7.5%				\$	108,675	and safety, office supplies, clean up, photographs, survey, erosion control, coordination,
·							testing services, and record documents
Earthwork	5%				\$	72.450	Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$		Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$		PLC and SCADA equipment to control
Licotroal, matumentation and controls	13/0				Ÿ	۷۱۵,000	20 and 00/10/1 equipment to control
Total Direct Coats					•	2 420 000	Desiraded in te \$1000
Total Direct Costs					\$	2,139,000	Rounded up to \$1000
			ļ				
Contractor's Overhead and Profit	20%				\$	427,800	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and
			<del>                                     </del>		-		management reserves
			<u> </u>		_	0.50-00-	D 1 1 44000
Construction Total			ļ		\$	2,567,000	Rounded up to \$1000
			ļ				
Project Level Allowance (contingency)	20%		ļ		\$		Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$	513,400	Includes permits, legal fees and engineering fees for design and construction
Project Total					\$	3,594,000	
Low Estimate					\$	2,516,000	-30%
High Estimate					\$	5,391,000	
- ng., 20011010		l	1		¥	0,001,000	1.00%

- 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 2012 dollars.
- 3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase III Demonstration Testing for
Cr(VI) Treatment

Item
2000-gpm WBA System

Project No. 05337006.0000 By T.D. & C.R.									
By T.D. & C.R.	Ckd: Y.W. & T.V.	Updated: Y.W.							
Date 12/20/11	Date: 12/22/11	Date: 12/31/12							

Equipment								
1	DESCRIPTION	QTY	UNIT MEAS.	ι	JNIT COST		TOTAL COST	COMMENTS
CO2 Feed Water Pump	Equipment							
CO2 Feed Water Pump								
Static Mover	CO2 Feed System	1	LS	\$	280,000	\$	280,000	Quote from TOMCO; 300 lb/hr and 50 ton storage; adjusted to 2012 dollars.
Page   Filters   2	CO2 Feed Water Pump	2	EA	\$	8,879	\$	17,758	Quote from ITT; centrifugal; 305 gpm @ 80 psi; 1 duty/1 stdby; adjusted to 2012
Den Exchange Equipment  1	Static Mixer	1	EA	\$	4,284	\$	4,284	Quotes from Komax & EWS; 14-inch; adjusted to 2012 dollars.
Den Exchange Equipment  1								·
Selectary   Waste Tank	Bag Filters	2	EA	\$	29,800	\$	59,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby; adjusted to 2012 dollars.
Selectary   Waste Tank								
Selectary   Waste Tank	Ion Exchange Equipment	1	LS	\$	1,300,000	\$	1,300,000	Quotes from Siemens and Calgon; incl. first fill of resin; adjusted to 2012 dollars.
Discharge Pumps   2	3 11							
Discharge Pumps   2	Backwash Waste Tank	1	EA	\$	150,000	\$	150.000	Quotes from Superior & BH: 189.000 gal; adjusted to 2012 dollars.
Booster Pump 2 EA \$ 24,300 \$ 48,760 Duote from Cortech, 2,000 gm @ 15 ft; duty's tabley, adjusted to 2012 dollars.  Aeration Equipment 1 LS \$ 72,420 \$ 72,420 Duote from Siemens for an altunium forced draft serator (2000 gm), including blower, air distribution tray, and piping etc.; adjusted to 2012 dollars.  Diffused Significant 1 LS \$ 97,000 \$ 275,400 Duote from Yardley, 6,000 SCFM, (2) adsorbers in series with two 12kW heaters; adjusted to 2012 dollars.  Diffused Significant 1 LS \$ 97,000 \$ 97,000 Duote from Yardley, 6,000 SCFM, (2) adsorbers in series with two 12kW heaters; adjusted to 2012 dollars.  Subtotal		2	EA			_		
Aeration Equipment  1 LS \$ 72.420 \$ 72.420 Ducte from Siemens for an aluminum forced draft aerator (2000 grm), including blower, air distribution tray, and pping etc.; adjusted to 2012 dollars.  2 EA \$ 137,700 \$ 275,000 Ducte from Traditive, 10.00 SCPM, (2) pair, 1 duty! 1 stdby; adjusted to 2012 dollars.  2 Construction Total  1 LS \$ 97,000 \$ 97,000 Ducte from Traditive, 10.00 SCPM, (2) pair, 1 duty! 1 stdby; adjusted to 2012 dollars.  2 Construction Total  1 LS \$ 97,000 \$ 97,000 Ducte from Traditive, 10.00 SCPM, (2) pair, 1 duty! 1 stdby; adjusted to 2012 dollars.  2 Subtotal  2 S 2,316,000 Rounded up to \$1000  3 Subtotal  3 S 694,800 Rounded up to \$1000  3 Subtotal (Installed Equipment Costs)  5 Subtotal (Installed Equipment Costs)  5 Subtotal (Installed Equipment Costs)  5 S 1,275 \$ 336,995 \$ 1250/CY, adjusted to 2012 dollars  8 Subtotal (Installed Equipment Costs)  5 S 25,100 Rounded up to \$1000  2 Subtotal (Installed Equipment Costs)  5 S 25,100 Rounded up to \$1000  2 Subtotal (Installed Equipment Costs)  5 S 167,400 Excavation, backfill, and fill required to construct project Stitle Improvements  5 S S 167,400 Excavation, backfill, and fill required to construct project Stitle Improvements  5 S S 503,000 Rounded up to \$1000  2 S 167,000 Excavation, backfill, and fill required to construct project Stitle Improvements  5 S S 503,000 Rounded up to \$1000  2 S S 503,000 Rounded up to \$1000				_	.,,	Ť	2,221	
Aeration Equipment  1 LS \$ 72.420 \$ 72.420 Ducte from Siemens for an aluminum forced draft aerator (2000 grm), including blower, air distribution tray, and pping etc.; adjusted to 2012 dollars.  2 EA \$ 137,700 \$ 275,000 Ducte from Traditive, 10.00 SCPM, (2) pair, 1 duty! 1 stdby; adjusted to 2012 dollars.  2 Construction Total  1 LS \$ 97,000 \$ 97,000 Ducte from Traditive, 10.00 SCPM, (2) pair, 1 duty! 1 stdby; adjusted to 2012 dollars.  2 Construction Total  1 LS \$ 97,000 \$ 97,000 Ducte from Traditive, 10.00 SCPM, (2) pair, 1 duty! 1 stdby; adjusted to 2012 dollars.  2 Subtotal  2 S 2,316,000 Rounded up to \$1000  3 Subtotal  3 S 694,800 Rounded up to \$1000  3 Subtotal (Installed Equipment Costs)  5 Subtotal (Installed Equipment Costs)  5 Subtotal (Installed Equipment Costs)  5 S 1,275 \$ 336,995 \$ 1250/CY, adjusted to 2012 dollars  8 Subtotal (Installed Equipment Costs)  5 S 25,100 Rounded up to \$1000  2 Subtotal (Installed Equipment Costs)  5 S 25,100 Rounded up to \$1000  2 Subtotal (Installed Equipment Costs)  5 S 167,400 Excavation, backfill, and fill required to construct project Stitle Improvements  5 S S 167,400 Excavation, backfill, and fill required to construct project Stitle Improvements  5 S S 503,000 Rounded up to \$1000  2 S 167,000 Excavation, backfill, and fill required to construct project Stitle Improvements  5 S S 503,000 Rounded up to \$1000  2 S S 503,000 Rounded up to \$1000	Booster Pump	2	FA	\$	24 380	\$	48 760	Quote from Cortech, 2 000 gpm @ 15 ft: 1 duty/1 stdby; adjusted to 2012 dollars
Setators (appropriet comprehence of the propriet control of the propriet contr	2000.0. 1 0.1.15			Ť	21,000	Ť	10,100	Quality 1001,001, 2,000 gpm & 10 11, 1 daty 1 daty 1 daty 1 daty 1 daty 1
Setators (appropriet comprehence of the propriet control of the propriet contr								Quote from Siemens for an aluminum forced draft aerator (2000 gpm), including
Exhaust Blowers	Aeration Equipment	1	LS	\$	72,420	\$	72,420	
Subtotal Subtotal Substitute Subs	Exhaust Blowers	2	EA	\$	137,700	\$	275,400	Quote from Yardley; 6,000 SCFM @ 5 psi; 1 duty/ 1 stdby; adjusted to 2012 dollars.
Subtotal (Installation Cost Subtotal (	Off-Gas Treatment	1	LS	\$	97 000	\$	97 000	
Equipment Installation Cost 30% \$ 694,800 Including tax, freight, installation and manufacturer services.  Equipment Concrete Pad 264 CY \$ 1,275 \$ 336,995 \$ 1250/CY, adjusted to 2012 dollars  Subtotal (Installed Equipment Costs) \$ 3,348,000 Rounded up to \$1000  Subtotal (Installed Equipment Costs) \$ 251,100 Rounded up to \$1000  Farthwork 5% \$ 251,000 Rounded up to \$1000  Site Improvements 5% \$ 167,400 Roadways, curb and gutter, sidewalk and landscaping Valves. Piping, and Appurtenances 15% \$ 503,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization, insurance, overhead and profit, and management reserves  Construction Total 5 5,928,000 Rounded up to \$1000  Contractor's Overhead and Administrative 20% \$ 1,185,600 Rounded up to \$1000  Contractor Costs 5 5,928,000 Rounded up to \$1000  Contractor's Overhead and Administrative 20% \$ 1,185,600 Rounded up to \$1000  Contractor Costs 5 5,928,000 Rounded up to \$1000  Contractor Costs 6,928,000 Rounded up to \$1000  Contractor Costs 7,928,000 Rounded up to \$1000  Contractor Costs 8,928,000 Rounded up to \$1000  Contractor Costs 8,928,000 Rounded up to \$1000  Contractor Costs 8,928,000 Rounded up to \$1000  Cont	on out frounds.			_	01,000	_	0.,000	adjusted to 2012 dollars.
Equipment Installation Cost 30% \$ 694,800 Including tax, freight, installation and manufacturer services.  Equipment Concrete Pad 264 CY \$ 1,275 \$ 336,995 \$ 1250/CY, adjusted to 2012 dollars  Subtotal (Installed Equipment Costs) \$ 3,348,000 Rounded up to \$1000  Subtotal (Installed Equipment Costs) \$ 251,100 Rounded up to \$1000  Farthwork 5% \$ 251,000 Rounded up to \$1000  Site Improvements 5% \$ 167,400 Roadways, curb and gutter, sidewalk and landscaping Valves. Piping, and Appurtenances 15% \$ 503,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization, insurance, overhead and profit, and management reserves  Construction Total 5 5,928,000 Rounded up to \$1000  Contractor's Overhead and Administrative 20% \$ 1,185,600 Rounded up to \$1000  Contractor Costs 5 5,928,000 Rounded up to \$1000  Contractor's Overhead and Administrative 20% \$ 1,185,600 Rounded up to \$1000  Contractor Costs 5 5,928,000 Rounded up to \$1000  Contractor Costs 6,928,000 Rounded up to \$1000  Contractor Costs 7,928,000 Rounded up to \$1000  Contractor Costs 8,928,000 Rounded up to \$1000  Contractor Costs 8,928,000 Rounded up to \$1000  Contractor Costs 8,928,000 Rounded up to \$1000  Cont								
Equipment Concrete Pad 264 CY \$ 1,275 \$ 336,995 \$1250/CY, adjusted to 2012 dollars  Subtotal (Installed Equipment Costs) \$ 3,348,000 Rounded up to \$1000  General Requirements 7.5% \$ 251,100 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 55% \$ 167,400 Excavation, backfill, and fill required to construct project  Site Improvements 55% \$ 167,400 Excavation, backfill, and fill required to construct project  Site Improvements 55% \$ 503,000 PLC and SCADA equipment to control  Total Direct Costs \$ 4,940,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization, insurance, overhead and profit, and management reserves  Construction Total \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency) 20% \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions  Engineering, Legal and Administrative 20% \$ 1,185,600 Includes permits, legal fees and engineering fees for design and construction  Low Estimate \$ 5,810,000 30%	Subtotal					\$	2,316,000	Rounded up to \$1000
Equipment Concrete Pad 264 CY \$ 1,275 \$ 336,995 \$1250/CY, adjusted to 2012 dollars  Subtotal (Installed Equipment Costs) \$ 3,348,000 Rounded up to \$1000  General Requirements 7.5% \$ 251,100 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 55% \$ 167,400 Excavation, backfill, and fill required to construct project  Site Improvements 55% \$ 167,400 Excavation, backfill, and fill required to construct project  Site Improvements 55% \$ 503,000 PLC and SCADA equipment to control  Total Direct Costs \$ 4,940,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization, insurance, overhead and profit, and management reserves  Construction Total \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency) 20% \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions  Engineering, Legal and Administrative 20% \$ 1,185,600 Includes permits, legal fees and engineering fees for design and construction  Low Estimate \$ 5,810,000 30%								
Subtotal (Installed Equipment Costs)  \$ 3,348,000  Rounded up to \$1000  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% \$ 167,400 Excavation, backfill, and fill required to construct project  Site Improvements 5% \$ 167,400 Excavation, backfill, and fill required to construct project  Electrical, Instrumentation and Controls 15% \$ 503,000 Major system piping and valves  Electrical, Instrumentation and Controls 15% \$ 503,000 PLC and SCADA equipment to control  Total Direct Costs \$ 4,940,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization, insurance, overhead and profit, and management reserves  Construction Total \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency) 20% \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions  Engineering, Legal and Administrative 20% \$ 8,300,000  Low Estimate \$ 5,810,000 30%	Equipment Installation Cost	30%				\$	694,800	Including tax, freight, installation and manufacturer services.
Subtotal (Installed Equipment Costs)  \$ 3,348,000  Rounded up to \$1000  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% \$ 167,400 Excavation, backfill, and fill required to construct project  Site Improvements 5% \$ 167,400 Excavation, backfill, and fill required to construct project  Electrical, Instrumentation and Controls 15% \$ 503,000 Major system piping and valves  Electrical, Instrumentation and Controls 15% \$ 503,000 PLC and SCADA equipment to control  Total Direct Costs \$ 4,940,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization, insurance, overhead and profit, and management reserves  Construction Total \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency) 20% \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions  Engineering, Legal and Administrative 20% \$ 8,300,000  Low Estimate \$ 5,810,000 30%								
General Requirements 7.5% \$ 251,100 Division 1 requirements, including labor supervision, field offices, temporary utilities, coordination, testing services, and record documents Earthwork 5% \$ 167,400 Excavation, backfill, and fill required to construct project Site Improvements 5% \$ 167,400 Roadways, curb and gutter, sidewalk and landscaping Valves, Piping, and Appurtenances 15% \$ 503,000 PLC and SCADA equipment to control  Contractor's Overhead and Profit 20% \$ 988,000 Construction Total \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency) 20% \$ 1,185,600 Sudget item to cover change orders due to unforeseen conditions Engineering, Legal and Administrative 20% \$ 1,185,600 Sudget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  \$ 8,300,000  Project Total \$ 8,300,000  Project Total \$ 8,300,000  Sudget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  \$ 8,300,000  Sudget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction	Equipment Concrete Pad	264	CY	\$	1,275	\$	336,995	\$1250/CY, adjusted to 2012 dollars
General Requirements 7.5% \$ 251,100 Division 1 requirements, including labor supervision, field offices, temporary utilities, coordination, testing services, and record documents Earthwork 5% \$ 167,400 Excavation, backfill, and fill required to construct project Site Improvements 5% \$ 167,400 Roadways, curb and gutter, sidewalk and landscaping Valves, Piping, and Appurtenances 15% \$ 503,000 PLC and SCADA equipment to control  Contractor's Overhead and Profit 20% \$ 988,000 Construction Total \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency) 20% \$ 1,185,600 Sudget item to cover change orders due to unforeseen conditions Engineering, Legal and Administrative 20% \$ 1,185,600 Sudget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  \$ 8,300,000  Project Total \$ 8,300,000  Project Total \$ 8,300,000  Sudget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  \$ 8,300,000  Sudget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction								
Seneral Requirements 7.5% Size 1,100 Realth and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents  Earthwork Size 167,400 Si	Subtotal (Installed Equipment Costs)					\$	3,348,000	Rounded up to \$1000
Seneral Requirements 7.5% Size 1,100 Realth and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents  Earthwork Size 167,400 Si								
Construction Total  Signature  Construction Total  Construction To								Division 1 requirements, including labor supervision, field offices, temporary utilities,
Earthwork 5% \$ 167,400   Excavation, backfill, and fill required to construct project   Site Improvements   5%   \$ 167,400   \$ 167,400   Roadways, curb and gutter, sidewalk and landscaping   Walves, Piping, and Appurtenances   15%   \$ 503,000   Major system piping and valves   Electrical, Instrumentation and Controls   15%   \$ 503,000   PLC and SCADA equipment to control    Total Direct Costs   \$ 4,940,000   Rounded up to \$1000    Contractor's Overhead and Profit   20%   \$ 988,000   Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves    Construction Total   \$ 5,928,000   Rounded up to \$1000    Construction Total   \$ 5,928,000   Rounded up to \$1000    Engineering, Legal and Administrative   20%   \$ 1,185,600   Includes permits, legal fees and engineering fees for design and construction    Project Total   \$ 8,300,000    Project Total   \$ 8,300,000    Project Total   \$ 8,300,000    Solve Estimate   \$ 5,810,000   30%	General Requirements	7.5%				\$	251,100	
Site Improvements 5% \$ 167.400 Roadways, curb and gutter, sidewalk and landscaping Major system piping and valves Electrical, Instrumentation and Controls 15% \$ 503,000 PLC and SCADA equipment to control  Total Direct Costs \$ 4,940,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves  Construction Total \$ 5,928,000 Rounded up to \$1000  Construction Total \$ 5,928,000 Rounded up to \$1000  Construction Total \$ 1,185,600 Rounded up to \$1000  Construction Total \$ 1,185,600 Rounded up to \$1000  Construction Total \$ 5,928,000 Rounded up to \$1000  Construction Total \$ 5,928,000 Rounded up to \$1000  Construction Total \$ 5,928,000 Rounded up to \$1000  Construction Total \$ 1,185,600 Rounded up to \$1000  Construction Total Rounded Round								
Valves, Piping, and Appurtenances  15%  \$ 503,000  Major system piping and valves  PLC and SCADA equipment to control  Total Direct Costs  \$ 4,940,000  Rounded up to \$1000  Contractor's Overhead and Profit  20%  \$ 988,000  Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves  Construction Total  \$ 5,928,000  Rounded up to \$1000  Budget item to cover change orders due to unforeseen conditions  Includes permits, legal fees and engineering fees for design and construction  Project Level Allowance (contingency)  Project Total  \$ 8,300,000  S 8,300,000  S 9,000  S 1,185,600  S 1,185,600  S 9,000  S 1,185,600  S 1,185,6						_		
Electrical, Instrumentation and Controls  15%  \$ 503,000  PLC and SCADA equipment to control  Total Direct Costs  \$ 4,940,000  Rounded up to \$1000  Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves  Construction Total  \$ 5,928,000  Rounded up to \$1000  Project Level Allowance (contingency)  20%  \$ 1,185,600  Budget item to cover change orders due to unforeseen conditions  Engineering, Legal and Administrative  20%  \$ 1,185,600  Includes permits, legal fees and engineering fees for design and construction  Project Total  \$ 8,300,000  Project Total  \$ 5,810,000  30%	Site Improvements					\$	167,400	Roadways, curb and gutter, sidewalk and landscaping
Total Direct Costs \$ 4,940,000 Rounded up to \$1000  Contractor's Overhead and Profit 20% \$ 988,000 Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves  Construction Total \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency) 20% \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions Engineering, Legal and Administrative 20% \$ 1,185,600 Includes permits, legal fees and engineering fees for design and construction  Project Total \$ 8,300,000 Includes permits, legal fees and engineering fees for design and construction 30%	Valves, Piping, and Appurtenances	15%						
Contractor's Overhead and Profit  20%  \$ 988,000 Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves  Construction Total  \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency)  20%  \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  Project Total  \$ 8,300,000  Low Estimate  \$ 5,810,000 30%	Electrical, Instrumentation and Controls	15%				\$	503,000	PLC and SCADA equipment to control
Contractor's Overhead and Profit  20%  \$ 988,000 Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves  Construction Total  \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency)  20%  \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  Project Total  \$ 8,300,000  Low Estimate  \$ 5,810,000 30%								
Construction Total  Construction Total  Solution Total  Soluti	Total Direct Costs					\$	4,940,000	Rounded up to \$1000
Construction Total  Construction Total  Solution Total  Soluti								
Construction Total  \$ 5,928,000 Rounded up to \$1000  Project Level Allowance (contingency)  20%  \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions  Engineering, Legal and Administrative  20%  \$ 1,185,600 Includes permits, legal fees and engineering fees for design and construction  Project Total  \$ 8,300,000 Includes permits, legal fees and engineering fees for design and construction  3 8,300,000 Includes permits, legal fees and engineering fees for design and construction  3 8,300,000 Includes permits, legal fees and engineering fees for design and construction  3 8,300,000 Includes permits, legal fees and engineering fees for design and construction  3 8,300,000 Includes permits, legal fees and engineering fees for design and construction  3 8,300,000 Includes permits, legal fees and engineering fees for design and construction  3 9,300,000 Includes permits, legal fees and engineering fees for design and construction  4 9,300,000 Includes permits, legal fees and engineering fees for design and construction  5 9,300,000 Includes permits, legal fees and engineering fees for design and construction  4 9,300,000 Includes permits, legal fees and engineering fees for design and construction  4 9,300,000 Includes permits, legal fees and engineering fees for design and construction	Contractor's Overhead and Profit	20%				¢	088 000	
Project Level Allowance (contingency)  20%  \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  Project Total  \$ 8,300,000 Low Estimate  \$ 5,810,000  30%	Contractor's Overnead and Front	20 /0				9	900,000	management reserves
Project Level Allowance (contingency)  20%  \$ 1,185,600 Budget item to cover change orders due to unforeseen conditions Includes permits, legal fees and engineering fees for design and construction  Project Total  \$ 8,300,000 Low Estimate  \$ 5,810,000  30%						<u> </u>		
Engineering, Legal and Administrative 20% \$ 1,185,600 Includes permits, legal fees and engineering fees for design and construction  Project Total \$ 8,300,000    Low Estimate \$ 5,810,000    \$ 5,810,000    \$ 30%	Construction Total					\$	5,928,000	Rounded up to \$1000
Engineering, Legal and Administrative 20% \$ 1,185,600 Includes permits, legal fees and engineering fees for design and construction  Project Total \$ 8,300,000    Low Estimate \$ 5,810,000    \$ 5,810,000    \$ 30%								
Project Total \$ 8,300,000 Low Estimate \$ 5,810,000 -30%	Project Level Allowance (contingency)	20%				\$	1,185,600	Budget item to cover change orders due to unforeseen conditions
Low Estimate \$ 5,810,000 30%	Engineering, Legal and Administrative	20%				\$	1,185,600	Includes permits, legal fees and engineering fees for design and construction
Low Estimate \$ 5,810,000 30%								
Low Estimate \$ 5,810,000 -30%	Project Total					\$	8,300,000	
	-							
	Low Estimate					\$	5,810,000	-30%
	High Estimate					\$		

- 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 2012 dollars.
- 3. Costs for land or easements are not included.



Flow Rate (gpm) Number of lead/lag trains

Number of lead/lag trains		2																		
									L	ab									Field	
Sample Location	Cr(VI)	Total Cr	Alkalinity	Turbidity	Sulfate		Phosphat e	Total Iron	Silica	Uranium (water)	Uranium (solids)	Nitrosamine s	BNA SVOC	Aldehydes/ Ketones		TCLP (Metals)	CA WET (Metals)		Temperat ure	Conducti vity
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 <sup>1</sup>	8	8 8 At start-up and monthly and monthly thereafter thereafter 4														4	4			
Combined IX effluent after pH increase	4	4	1	1	1	1	1	1	1						4			Continuou s	Continuou s	
Resin in lead vessel 1, 2											2									
Spent resin as residuals											At disposal			A4 di		At disposal	At disposal			
Resin flush water as residuals <sup>3</sup>														At disposal						
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
Unit cost (\$/sample)	\$54	\$14	\$15	\$13	\$15	\$15	\$15	\$14	\$14	\$23	\$128	\$372	\$288	\$212	\$59	\$245	\$429			
Sample analysis cost (\$/year)	\$26,347	\$6,775	\$551	\$318	\$367	\$367	\$367	\$330	\$330	\$826	\$3,290	\$10,275	\$7,953	\$6,984	\$7,038	\$441	\$773			
Annual shipping fee	\$1,560	One ship	ment per we	ek, \$30 pe	r shipment.															
Sum of lab analysis cost (\$/year)	\$74,893 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 \$75,893 Including lab and field analysis costs; not including labor and field meters																		
Total analytical cost	\$75,893	Including	lab and field	d analysis o	costs; not in	cluding lab	or 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.

dollars.



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

Number of lead/lag trains									Li	ab									Field	
Sample Location	Cr(VI)	Total Cr	Alkalinity	Turbidity	Sulfate	Nitrate	Phosphat e	Total Iron	Silica	Uranium (water)	Uranium (solids)	Nitrosamine s	BNA SVOC	Aldehydes/ Ketones	Bac-T (E. coli, T coli and HPC)	TCLP (Metals)	CA WET (Metals)		Temperat ure	Conducti vity
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												Continuou s	Continuou s						
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
Unit cost (\$/sample)	\$54	\$14	\$15	\$13	\$15	\$15	\$15	\$14	\$14	\$23	\$128	\$372	\$288	\$212	\$59	\$245	\$429			
Sample analysis cost (\$/year)	\$16,065	\$4,131	\$551	\$318	\$367	\$367	\$367	\$330	\$330	\$826	\$1,798	\$6,031	\$4,668	\$4,762	\$7,038	\$514	\$902			
Annual shipping fee	\$1,560	One ship	ment per we	ek, \$30 pe	r shipment.															
Sum of lab analysis cost (\$/year)	\$50,927	Average	of two quote	s, plus ship	ment.				•	•										
Field meters	\$2,000	\$2,000 portable pH and conductivity meter																		
Field analytical cost (without labor)	\$1,000	\$1,000 Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	\$51,927	Including	lab and field	d analysis o	osts; not in	cluding lab	or and field	meters		-		•								

<sup>1.</sup> 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

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Costs are adjusted to 2012 dollars.



Flow Rate (gpm) Number of lead/lag trains

Number of lead/lag trains									L	ab									Field	
Sample Location	Cr(VI)	Total Cr	Alkalinity	Turbidity	Sulfate	Nitrate	Phosphat e	Total Iron	Silica	Uranium (water)	Uranium (solids)	Nitrosamine s	BNA SVOC	Aldehydes/ Ketones	Bac-T (E. coli, T coli and HPC)	TCLP (Metals)	CA WET (Metals)		Temperat ure	Conducti vity
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												Continuou s	Continuou s						
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
Unit cost (\$/sample)	\$54	\$14	\$15	\$13	\$15	\$15	\$15	\$14	\$14	\$23	\$128	\$372	\$288	\$212	\$59	\$245	\$429			
Sample analysis cost (\$/year)	\$16,065	\$4,131	\$551	\$318	\$367	\$367	\$367	\$330	\$330	\$826	\$1,798	\$6,031	\$4,668	\$4,762	\$7,038	\$514	\$902			
Annual shipping fee	\$1,560	One ship	ment per we	ek, \$30 pe	r shipment.	•										•				
Sum of lab analysis cost (\$/year)	\$50,927	Average	of two quote	s, plus ship	ment.	•										•				
Field meters	\$2,000	\$2,000 portable pH and conductivity meter																		
Field analytical cost (without labor)	\$1,000	\$1,000 Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	\$51,927	Including	lab and field	d analysis o	osts; not in	cluding lab	or and field	meters			·	-			-	·		·	·	

<sup>1.</sup> 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.

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Costs are adjusted to 2012 dollars.



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

									L	ab									Field	
Sample Location	Cr(VI)	Total Cr	Alkalinity	Turbidity	Sulfate	Nitrate	Phosphat e	Total Iron	Silica	Uranium (water)	Uranium (solids)	Nitrosamine s	BNA SVOC	Aldehydes/ Ketones	Bac-T (E. coli, T coli and HPC)	TCLP (Metals)	CA WET (Metals)	рН	Temperat ure	Conducti vity
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																		
1										4		,	At start-up and monthly					,		
Lag vessel effluent 1 Combined IX effluent after pH	8	8								1		thereafter	thereafter	thereafter	4			Continuou	4 Continuou	
increase	4	4	1	1	1	1	1	1	1						4			S	S	
Resin in lead vessel 1, 2											2									
Spent resin as residuals											At disposal					At disposal	At disposal			
Resin flush water as residuals <sup>3</sup>														At disposal						
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
Unit cost (\$/sample)	\$54	\$14	\$15	\$13	\$15	\$15	\$15	\$14	\$14	\$23	\$128	\$372	\$288	\$212	\$59	\$245	\$429			
Sample analysis cost (\$/year)	\$26,347	\$6,775	\$551	\$318	\$367	\$367	\$367	\$330	\$330	\$826	\$6,388	\$10,499	\$8,126	\$7,302	\$7,038	\$514	\$902			
Annual shipping fee	\$1,560 One shipment per week, \$30 per shipment.																			
Sum of lab analysis cost (\$/year)	\$78,907	Average	of two quote	s, plus ship	ment.															
Field meters	\$2,000 portable pH and conductivity meter																			
Field analytical cost (without labor)	\$1,000	\$1,000 Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	\$79,907	Including	lab and field	d analysis c	osts; not in	cluding lab	or 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.

Costs are adjusted to 2012 dollars.



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

#### WBA System Size = 10 gpm

	3											
					Resin	Spent Resin &			Other			
Potential Cr(VI)			VP	GAC	Replacement	Wastewater			Consumables	Maintenance	Lab and Field	
MCL (ppb)	Electricity*	Chemicals	Rep	placement	(Fresh Resin)	Disposal	Labor		(Bag Filters)	and Spare Parts	Analysis &	Annual O&M
1	\$ 6,000	\$ 94	0 \$	1,300	\$ 6,100	\$ 5,500	\$	51,000	\$ 60	\$ 3,700	\$ 76,000	\$ 151,000
2	\$ 6,000	\$ 94	0 \$	1,300	\$ 5,400	\$ 5,300	\$	51,000	\$ 60	\$ 3,700	\$ 76,000	\$ 150,000
5	\$ 6,000	\$ 94	0 \$	1,300	\$ 4,700	\$ 5,100	\$	51,000	\$ 60	\$ 3,700	\$ 76,000	\$ 149,000
10	\$ 6,000	\$ 94	0 \$	1,300	\$ 3,400	\$ 4,700	\$	51,000	\$ 60	\$ 3,700	\$ 76,000	\$ 147,000
25	\$ 6,000	\$ 94	0 \$	1,300	\$ 1,300	\$ 4,100	\$	51,000	\$ 60	\$ 3,700	\$ 76,000	\$ 144,000

<sup>\*</sup> Electricity includes approximately \$200 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

#### WBA System Size = 100 gpm

				Resin	Spent Resin &		Other			
Potential Cr(VI)			VPGAC	Replacement	Wastewater		Consumables	Maintenance	Lab and Field	
MCL (ppb)	Electricity*	Chemicals	Replacement	(Fresh Resin)	Disposal	Labor	(Bag Filters)	and Spare Parts	Analysis &	Annual O&M
1	\$ 12,600	\$ 9,400	\$ 12,000	\$ 30,748	\$ 22,000	\$ 51,000	\$ 130	\$ 7,000	\$ 52,000	\$ 197,000
2	\$ 12,600	\$ 9,400	\$ 12,000	\$ 25,200	\$ 18,700	\$ 51,000	\$ 130	\$ 7,000	\$ 52,000	\$ 188,000
5	\$ 12,600	\$ 9,400	\$ 12,000	\$ 22,400	\$ 17,000	\$ 51,000	\$ 130	\$ 7,000	\$ 52,000	\$ 184,000
10	\$ 12,600	\$ 9,400	\$ 12,000	\$ 14,000	\$ 12,000	\$ 51,000	\$ 130	\$ 7,000	\$ 52,000	\$ 170,000
25	\$ 12,600	\$ 9,400	\$ 12,000	\$ 8,400	\$ 8,700	\$ 51,000	\$ 130	\$ 7,000	\$ 52,000	\$ 161,000

<sup>\*</sup> Electricity includes approximately \$700 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

### WBA System Size = 500 gpm

				Resin	Spent Resin &		Other			
Potential Cr(VI)			VPGAC	Replacement	Wastewater		Consumables	Maintenance	Lab and Field	
MCL (ppb)	Electricity*	Chemicals	Replacement	(Fresh Resin)	Disposal	Labor	(Bag Filters)	and Spare Parts	Analysis &	Annual O&M
1	\$ 61,700	\$ 47,000	\$ 50,500	\$ 159,600	\$ 111,300	\$ 51,000	\$ 520	\$ 14,500	\$ 52,000	\$ 548,000
2	\$ 61,700	\$ 47,000	\$ 50,500	\$ 130,600	\$ 91,700	\$ 51,000	\$ 520	\$ 14,500	\$ 52,000	\$ 500,000
5	\$ 61,700	\$ 47,000	\$ 50,500	\$ 116,100	\$ 81,900	\$ 51,000	\$ 520	\$ 14,500	\$ 52,000	\$ 475,000
10	\$ 61,700	\$ 47,000	\$ 50,500	\$ 72,500	\$ 52,500	\$ 51,000	\$ 520	\$ 14,500	\$ 52,000	\$ 402,000
25	\$ 61,700	\$ 47,000	\$ 50,500	\$ 43,500	\$ 33,000	\$ 51,000	\$ 520	\$ 14,500	\$ 52,000	\$ 354,000

<sup>\*</sup> Electricity includes approximately \$11,000 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

### WBA System Size = 2,000 gpm

	,,									
				Resin	Spent Resin &		Other			
Potential Cr(VI)			VPGAC	Replacement	Wastewater		Consumables	Maintenance	Lab and Field	
MCL (ppb)	Electricity*	Chemicals	Replacement	(Fresh Resin)	Disposal	Labor	(Bag Filters)	and Spare Parts	Analysis &	Annual O&M
1	\$ 198,700	\$ 187,900	\$ 171,900	\$ 534,400	\$ 371,200	\$ 51,000	\$ 1,600	\$ 33,500	\$ 80,000	\$ 1,630,000
2	\$ 198,700	\$ 187,900	\$ 171,900	\$ 437,200	\$ 304,400	\$ 51,000	\$ 1,600	\$ 33,500	\$ 80,000	\$ 1,466,000
5	\$ 198,700	\$ 187,900	\$ 171,900	\$ 388,600	\$ 270,800	\$ 51,000	\$ 1,600	\$ 33,500	\$ 80,000	\$ 1,384,000
10	\$ 198,700	\$ 187,900	\$ 171,900	\$ 242,900	\$ 170,500	\$ 51,000	\$ 1,600	\$ 33,500	\$ 80,000	\$ 1,138,000
25	\$ 198,700	\$ 187,900	\$ 171,900	\$ 145,700	\$ 103,700	\$ 51,000	\$ 1,600	\$ 33,500	\$ 80,000	\$ 974,000

<sup>\*</sup> Electricity includes approximately \$21,000 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.



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

#### Annual O&M Summary

WBA System		Po	otei	ntial Cr(VI) MCL,	pp	b	
Size (gpm)	1	2		5		10	25
10	\$ 151,000	\$ 150,000	\$	149,000	\$	147,000	\$ 144,000
100	\$ 197,000	\$ 188,000	\$	184,000	\$	170,000	\$ 161,000
500	\$ 548,000	\$ 500,000	\$	475,000	\$	402,000	\$ 354,000
2,000	\$ 1,630,000	\$ 1,466,000	\$	1,384,000	\$	1,138,000	\$ 974,000

Costs are in 2012 dollars.

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

WBA System		Po	oten	tial Cr(VI) MCL,	ppb	)	
Size (gpm)	1	2		5		10	25
10	\$ 2,500,000	\$ 2,500,000	\$	2,500,000	\$	2,500,000	\$ 2,500,000
100	\$ 3,300,000	\$ 3,100,000	\$	3,100,000	\$	2,800,000	\$ 2,800,000
500	\$ 9,200,000	\$ 8,400,000	\$	8,000,000	\$	6,700,000	\$ 5,900,000
2,000	\$ 27,000,000	\$ 25,000,000	\$	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. Costs are in 2012 dollars.



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

#### WBA System Size = 10 gpm

					Resin	Spent	Resin &			Othe	er	Mair	ntenance				
Potential Cr(VI)				VPGAC	Replacement	Waste	water			Con	sumables	and	Spare	Lab a	nd Field		
MCL (ppb)	Electricity		Chemicals	Replacement	(Fresh Resin)	Dispos	sal	Labor		(Bag	g Filters)	Part	s	Analy	sis	Annı	ıal O&M
1	\$ 6,0	000	\$ 940	\$ 1,300	\$239,500	\$	74,800	\$	51,000	\$	60	\$	3,700	\$	76,000	\$	453,000
2	\$ 6,0	000	\$ 940	\$ 1,300	\$34,400	\$	13,900	\$	51,000	\$	60	\$	3,700	\$	76,000	\$	187,000
5	\$ 6,0	000	\$ 940	\$ 1,300	\$4,700	\$	5,100	\$	51,000	\$	60	\$	3,700	\$	76,000	\$	149,000
10	\$ 6,0	000	\$ 940	\$ 1,300	\$3,400	\$	4,700	\$	51,000	\$	60	\$	3,700	\$	76,000	\$	147,000
25	\$ 6,0	000	\$ 940	\$ 1,300	\$1,300	\$	4,100	\$	51,000	\$	60	\$	3,700	\$	76,000	\$	144,000

<sup>\*</sup> Electricity includes approximately \$200 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

#### WBA System Size = 100 gpm

						Res	sin	Spe	nt Resin &			Othe	er	Main	tenance				
Potential Cr(VI)					VPGAC	Rep	olacement	Was	stewater			Con	sumables	and :	Spare	Lab and Field			
MCL (ppb)	Electri	icity	Chemicals		Replacement	(Fre	esh Resin)	Disp	oosal	Labor		(Bag	g Filters)	Parts	3	Analysis		Ann	ual O&M
1	\$	12,600	\$ 9,40	00	\$ 12,000	\$	1,190,800	\$	714,700	\$	51,000	\$	130	\$	7,000	\$	52,000	\$	2,049,630
2	\$	12,600	\$ 9,40	00	\$ 12,000	\$	170,500	\$	105,500	\$	51,000	\$	130	\$	7,000	\$	52,000	\$	420,130
5	\$	12,600	\$ 9,40	00	\$ 12,000	\$	22,400	\$	17,000	\$	51,000	\$	130	\$	7,000	\$	52,000	\$	183,530
10	\$	12,600	\$ 9,40	00	\$ 12,000	\$	14,000	\$	12,000	\$	51,000	\$	130	\$	7,000	\$	52,000	\$	170,130
25	\$	12,600	\$ 9,40	00	\$ 12,000	\$	8,400	\$	8,700	\$	51,000	\$	130	\$	7,000	\$	52,000	\$	161,230

<sup>\*</sup> Electricity includes approximately \$700 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

### WBA System Size = 500 gpm

						Res	sin	Spe	nt Resin &			Othe	er	Main	tenance				
Potential Cr(VI)					VPGAC	Rep	placement	Was	stewater			Cons	sumables	and S	Spare	Lab and Field			
MCL (ppb)	Electric	ity	Chemicals		Replacement	(Fre	esh Resin)	Dis	oosal	Labor		(Bag	Filters)	Parts	3	Analysis		Ann	ual O&M
1	\$	61,700	\$ 47,0	000	\$ 50,500	\$	6,179,900	\$	4,168,100	\$	51,000	\$	520	\$	14,500	\$	52,000	\$	10,625,220
2	\$	61,700	\$ 47,0	000	\$ 50,500	\$	884,900	\$	600,000	\$	51,000	\$	520	\$	14,500	\$	52,000	\$	1,762,120
5	\$	61,700	\$ 47,0	000	\$ 50,500	\$	116,100	\$	81,900	\$	51,000	\$	520	\$	14,500	\$	52,000	\$	475,220
10	\$	61,700	\$ 47,0	000	\$ 50,500	\$	72,500	\$	52,600	\$	51,000	\$	520	\$	14,500	\$	52,000	\$	402,320
25	\$	61,700	\$ 47.0	000	\$ 50.500	\$	43.500	\$	33.000	\$	51.000	\$	520	\$	14,500	\$	52.000	\$	353,720

<sup>\*</sup> Electricity includes approximately \$11,000 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

### WBA System Size = 2,000 gpm

TTD/T Cyclom C	,	,000 96																
					Re	esin	Sp	ent Resin &			Oth	er	Mainte	nance				
Potential Cr(VI)				VPGAC	Re	eplacement	Wa	astewater			Cor	nsumables	and Sp	are	Lab and Field			
MCL (ppb)	Electr	icity	Chemicals	Replacement	(F	resh Resin)	Dis	sposal	Labor		(Ba	g Filters)	Parts		Analysis		Ann	ual O&M
1	\$	198,700	\$ 187,900	\$ 171,900	\$	20,695,300	\$	14,225,100	\$	51,000	\$	1,600	\$	33,500	\$	80,000	\$	35,645,000
2	\$	198,700	\$ 187,900	\$ 171,900	\$	2,963,400	\$	2,040,100	\$	51,000	\$	1,600	\$	33,500	\$	80,000	\$	5,728,100
5	\$	198,700	\$ 187,900	\$ 171,900	\$	388,600	\$	270,700	\$	51,000	\$	1,600	\$	33,500	\$	80,000	\$	1,383,900
10	\$	198,700	\$ 187,900	\$ 171,900	\$	242,900	\$	170,600	\$	51,000	\$	1,600	\$	33,500	\$	80,000	\$	1,138,100
25	\$	198,700	\$ 187,900	\$ 171,900	\$	145,700	\$	103,800	\$	51,000	\$	1,600	\$	33,500	\$	80,000	\$	974,100

<sup>\*</sup> Electricity includes approximately \$21,000 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis does not include cost for aeration off-gas analysis.



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

### Annual O&M Summary

Γ	WBA System	-	Pote	entia	al Cr(VI) MC	L,	ppb	
	Size (gpm)	1	2		5		10	25
	10	\$ 453,000	\$ 187,000	\$	149,000	\$	147,000	\$ 144,000
	100	\$ 2,049,630	\$ 420,130	\$	183,530	\$	170,130	\$ 161,230
	500	\$ 10,625,220	\$ 1,762,120	\$	475,220	\$	402,320	\$ 353,720
	2,000	\$ 35,645,000	\$ 5,728,100	\$	1,383,900	\$	1,138,100	\$ 974,100

Costs are in 2012 dollars.

### Net Present Value for 20 Years

WBA System		Pote	ential Cr(VI) MC	L, ppb	
Size (gpm)	1	2	5	10	25
10	\$ 7,600,000	\$ 3,100,000	\$ 2,500,000	\$ 2,500,000	\$ 2,500,000
100	\$ 34,300,000	\$ 7,000,000	\$ 3,100,000	\$ 2,800,000	\$ 2,800,000
500	\$ 178,000,000	\$ 30,000,000	\$ 8,000,000	\$ 7,000,000	\$ 6,000,000
2,000	\$ 597,000,000	\$ 96,000,000	\$ 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.

Costs are in 2012 dollars.



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
100-gpm RCF System
(Granular Media Filter With Recycle)

Project No. 05337008.0000						
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.				
Date 12/9/11	Date: 1/18/12	Date: 12/31/12				

DESCRIPTION	QTY	UNIT MEAS.	U	INIT COST		TOTAL COST	COMMENTS
Equipment							
FeSO₄ Feed System							
Storage Tank	1	EA	\$	2,700	\$	2,700	Quotes from Ryan Herco & Core-Rosion; 100 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/ 1 stdby; adjusted to 2012
Static Mixers	1	EA	\$	900	\$	900	dollars Quotes from Komax & EWS; 3-inch; adjusted to 2012 dollars
Reduction Tanks							
Tanks	3	EA	\$	5,200	\$	15,600	Quotes from Core-Rosion & Ryan Herco; 1,700 gal PE, outdoor, incl. seismic; ladiusted to 2012 dollars
Mixers	3	EA	\$	4,800	\$	14,400	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars
Aeration System							
Tank	1	EA	\$	3,700	\$	3,700	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars
Diffusers	1	LS	\$	400	\$	400	Based on previous project experience; adjusted to 2012 dollars
Supply Blowers	2	EA	\$	30,900	\$	61,800	Quote from EWS; 53 SCFM @ 4 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars
Exhaust Blowers	2	EA	\$	35,600	\$	71,200	Quote from EWS; 53 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars
Off-Gas Treatment	1	LS	\$	4,100	\$	4,100	Cost from Glendale and quotes from TIGG; 54 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars
Polymer Mixing Tank							
Rapid Mixing Tank	1	EA	\$	3,700	\$	3,700	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars
Mixer	1	EA	\$	3,800	\$	3,800	Quotes from Core-Rosion & EWS; G = 170 per second; adjusted to 2012 dollars
Filters							
Filter Equipment (Pressure Filters)	1	LS	\$	286,000	\$	286,000	Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf, (2) 6.5 ft dia VPF, 1 duty/ 1 stdby; adjusted to 2012 dollars
Filter Drawdown Transfer Pump	2	EA	\$	5,700	\$	11,400	Quotes from DTI and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars
Pumps							
Filter Feed Pumps (Progressive Cavity)	2	EA	\$	13,000	\$	26,000	Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars
Polymer Feed Systems							
Polymer Feed System (Coagulant Aid)	1	LS	\$	28,000		28,000	Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars
Polymer Feed System (Solids Settling Aid)	1	LS	\$	11,000	\$	11,000	Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars
Filtrate Tank for Backwash	1	EA	\$	26,700	\$	26,700	Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; ladjusted to 2012 dollars
Backwash Pumps	2	EA	\$	9,000	\$	18,000	Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars
Residuals Treatment System					_		
Gravity Thickener	2	EA	\$	33,000	\$	66,000	Quote from Plastic-Mart for 13,000-gallon cone bottom tank with stand; adjusted to 2012 dollars
Flo-Trend SludgeMate Container	2	EA	\$	14,500	\$	29,000	Quote from Flo-Trend for 6-CY SludgeMate container; adjusted to 2012 dollars
Pumps	1	LS	\$	10,200	\$	10,200	Includes all sludge pumps and recycle pumps, one duty and one standby; adjusted to 2012 dollars
Subtotal			<u> </u>		\$	701 000	Rounded up to \$1000
ουνισιαΙ		l .	<u> </u>		φ	101,000	Nounded up to \$1000



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

Project No. 05337008.0000						
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.				
Date 12/9/11	Date: 1/18/12	Date: 12/31/12				

Equipment Installation Cost	30%				\$	211,000	Including tax, freight, installation and manufacturer services.
01		01/	•	4.075	•	0.550	\$4050/0V - 1' - 1- 1 + 0040 1- 11- · ·
Chemical Storage Containment	2	CY	\$	1,275	\$	2,550	\$1250/CY, adjusted to 2012 dollars
Equipment Concrete Pads	69	CY	\$	1,275	\$	87 975	\$1250/CY, adjusted to 2012 dollars
Equipment condictor add	- 00	01	Ť	1,270	Ψ	07,070	\$120001; adjusted to 2012 deliate
Subtotal (Installed Equipment Costs)					\$	1,003,000	Rounded up to \$1000
, , , , ,							
							Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%				\$	75,225	utilities, health and safety, office supplies, clean up, photographs, survey,
							erosion control, coordination, testing services, and record documents
Earthwork	5%				\$		Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$	50,150	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$	151,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$	151,000	PLC and SCADA equipment to control
Total Direct Costs					\$	4 404 000	Developed in the \$4000
Total Direct Costs					ş.	1,481,000	Rounded up to \$1000
							Includes bonds, mobilization and demobilization, insurance, overhead and
Contractor's Overhead and Profit	20%				\$	296,200	profit, and management reserves
							ong and management receives
Construction Total					\$	1,777,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%				\$		Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$	355,400	Includes permits, legal fees and engineering fees for design and construction
Drainet Total	<u> </u>				•	2.488.000	
Project Total					\$	2,468,000	
Low Estimate					\$	1,742,000	-30%
High Estimate					\$	3,732,000	

- 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 2012 dollars.

  3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
500-gpm RCF System
(Granular Media Filter With Recycle)

Project No. 05337008.	0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.
Date 12/9/11	Date: 1/18/12	Date: 12/31/12

DESCRIPTION	QTY	UNIT MEAS.	UNIT	COST	TOTAL	COST	COMMENTS
Equipment							
FeSO₄ Feed System							
Storage Tank	1	EA	\$	3,400	\$	3,400	Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 1.3 gph; 1 duty/ 1 stdby; adjusted to 2012 dollars.
Static Mixers	1	EA	\$	2,200	\$	2,200	Quotes from Komax & EWS; 8-inch; adjusted to 2012 dollars.
Reduction Tanks							
Tanks	3	EA	\$	20,000	\$	60,000	Quotes from Core-Rosion & Ryan Herco; 8,000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.
Mixers	3	EA	\$	9,000	\$	27,000	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars.
Aeration System							
	4	ГА	e	C 400	¢	C 400	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic;
Tanks	1	EA	\$	6,400	Ť	6,400	adjusted to 2012 dollars.
Diffusers	1	LS	\$	2,000	\$	2,000	Based on previous project experience; adjusted to 2012 dollars.
Supply Blowers	2	EA	\$	47,200	\$	94,400	Quote from EWS; 267 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.
Exhaust Blowers	2	EA	\$	35,400	\$	70,800	Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.
Off-Gas Treatment	1	LS	\$	15,400	\$	15,400	Quotes from Calgon and TIGG; 270 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars.
Daluman Mining Tools							
Polymer Mixing Tank Rapid Mixing Tank	1	EA	\$	6,900	\$	6,900	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic; ladiusted to 2012 dollars.
Mixers	1	EA	\$	4,500	\$	4,500	Quotes from Core-Rosion & EWS; G = 170 per second; adjusted to 2012
Filters Filter Equipment (Pressure Filters)	1	LS	\$	475,000	\$	475,000	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; adjusted to 2012 dollars.
Filter Drawdown Transfer Pump	2	EA	\$	4,900	\$	9,800	Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars.
D							
Pumps Filter Feed Pumps (Progressive Cavity)	2	EA	\$	39,000	\$	78,000	Quotes from Cortech & Flow-Systems; 500 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars.
							sejected to 2012 demark.
Polymer Feed Systems		1.0		10.700	•	40.700	
Polymer Feed Systems (Coagulant Aid) Polymer Feed Systems (Solids Settling Aid)	1	LS LS	\$	10,700 11,600			Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars.  Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars.
Filtrate Tank for Backwash	1	EA	\$	41,000		41,000	Quotes from Superior; 22,000 gal; 15 ft dia x 16 ft height; adjusted to 2012
Backwash Pumps	2	EA	\$	14,600		29,200	dollars. Quotes from ITT & Cortech; 1,050 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to
·				,000	7		2012 dollars.
Residuals Treatment System			-				Adjusted installed costs from RS Means for 90,000-gal tank, which was divided
Equalization Tank	1	EA	\$	124,000	\$	121,154	by 1.3 to exclude installation cost (assuming a installation cost of 30%); ladiusted to 2012 dollars.
Plate Settler	1	EA	\$	60,000	\$	60,000	Quote from Meurer Research, Inc. and Parkson for a system handles a 26-gpm sludge flow; adjusted to 2012 dollars.
Flo-Trend SludgeMate Container	3	EA	\$	26,400	\$	79,200	Quote from Flo-Trend for 15-CY SludgeMate container; adjusted to 2012 dollars.
Pumps	1	LS	\$	15,300	\$	15,300	Includes all sludge pumps and recycle pumps, one duty and one standby; adjusted to 2012 dollars.
Subtatal			<u> </u>		\$	1.231.000	Rounded up to \$1000
Subtotal		L	1		پ	1,231,000	rounded up to \$1000



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

Project No. 05337008.0000						
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.				
Date 12/9/11	Date: 1/18/12	Date: 12/31/12				

Equipment Installation Cost	30%			\$ 370,000	Including tax, freight, installation and manufacturer services.
Chemical Storage Containment	6	CY	\$ 1,275	\$ 7,650	\$1250/CY, adjusted to 2012 dollars
Equipment Concrete Pads	166	CY	\$ 1,275	\$ 211,650	\$1250/CY, adjusted to 2012 dollars
Subtotal (Installed Equipment Costs)				\$ 1,821,000	Rounded up to \$1000
General Requirements	7.5%			\$	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%			\$ 91,050	Excavation, backfill, and fill required to construct project
Site Improvements	5%			\$ 91,050	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			\$ 274,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%			\$ 274,000	PLC and SCADA equipment to control
Total Direct Costs				\$ 2,688,000	Rounded up to \$1000
Contractor's Overhead and Profit	20%			\$ 537,600	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total				\$ 3,226,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%			\$ 645,200	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%			\$ 645,200	Includes permits, legal fees and engineering fees for design and construction
Project Total				\$ 4,517,000	
Low Estimate				\$ 3,162,000	-30%
High Estimate				\$ 6,776,000	<del>+</del> 50%

- 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 2012 dollars.

  3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
2000-gpm RCF System
(Granular Media Filter With Recycle)

Project No. 05337008.0000						
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.				
Date 12/9/11	Date: 1/18/12	Date: 12/31/12				

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST		TOTAL COST	COMMENTS
Equipment						
FeSO₄ Feed System				-		
Storage Tank	1	EA	\$ 6,000	\$	6,000	Quotes from Core-Rosion & Ryan Herco; 2,000 gal PE, outdoor, incl. seismic;
Metering Pumps	2	EA	\$ 6,200	) \$	12 400	adjusted to 2012 dollars Quotes from C.P. Crowley & HTP; 5 qph; adjusted to 2012 dollars
Static Mixers	1	EA	\$ 4,300			Quotes from Komax & EWS; 14-inch; adjusted to 2012 dollars
Reduction Tanks				+-		
Mixers	3	EA	\$ 24,000	\$	72,000	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars
Aeration System						
Diffuser	1	LS	\$ 8,200	\$	8,200	Based on previous project experience and conversation w/ Brian Bubela; adjusted to 2012 dollars
Supply Blowers	2	EA	\$ 76,300	\$	152,600	Quote from EWS; 1,070 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessaories; adjusted to 2012 dollars
Exhaust Blowers	2	EA	\$ 59,600	\$	119,200	Quote from EWS; 1,070 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessaories; adjusted to 2012 dollars
Off-Gas Treatment	1	LS	\$ 25,800	\$	25,800	Quotes from Calgon & TIGG; 1070 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars
Polymer Mixing Tanks				-		
Mixers	1	EA	\$ 17,300	\$	17,300	Quotes from Core-Rosion & EWS; G = 170 per second; adjusted to 2012 dollars
Filters						Quotes from Tonka & Layne, including media; 3 gpm/sf; Tonka filters, (2) 10' x
Filter Equipment (Pressure Filters)	1	LS	\$ 1,004,000	\$	1,004,000	42', 4 cells per filter, 3 duty / 1 stdby; Layne filters, (4) 10' x 24', 3 duty/ 1 stdby; ladiusted to 2012 dollars
Filter Drawdown Transfer Pump	2	EA	\$ 5,100	\$	10,200	Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars
D						
Pumps	_			+-		Quotes from Cortech & Flow-Systems; 1,000 gpm @ 70 ft; 2 duty/ 1 stdby;
Filter Feed Pumps (Progressive Cavity)	3	EA	\$ 56,000	\$	168,000	adjusted to 2012 dollars
Polymer Feed Systems						
Polymer Feed Systems (Coagulant Aid)	1	LS	\$ 10,700			Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars
Polymer Feed Systems (Solids Settling Aid)	1	LS	\$ 11,600	\$	11,600	Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars
Filtrate Tank for Backwash	1	EA	\$ 51,000	\$	51,000	Quotes from Superior; 30,250 gal; 18 ft dia x 16 ft height; adjusted to 2012 dollars
Backwash Pumps	2	EA	\$ 21,900	\$	43,800	Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars
Desiduals Teachard Content						
Residuals Treatment System				+		Adjusted installed costs from RS Means for 280,000-gal tank, which was
Equalization Tank	1	EA	\$ 140,000	\$	137,385	divided by 1.3 to exclude installation cost (assuming a installation cost of 30%);
Plate Settler	1	EA	\$ 79,000	\$	79,000	Quote from Meurer Research, Inc. and Parkson for a system handles a 88-gpm sludge flow; adjusted to 2012 dollars
Flo-Trend SludgeMate Container	3	EA	\$ 39,200	\$	117,600	Quote from Flo-Trend for 40-CY SludgeMate container; adjusted to 2012 dollars
Pumps	1	LS	\$ 22,000	\$	22,000	Includes sludge pumps and recycle pumps for equalization tank and plate settlers, one duty and one standby; adjusted to 2012 dollars.
Subtotal			<u> </u>	\$	2 074 000	Rounded up to \$1000
Dunioidi				ð	2,014,000	Irounded up to \$1000



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

Project No. 05337008.0000						
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.				
Date 12/9/11	Date: 1/18/12	Date: 12/31/12				

Г	T 1		1				
Equipment Installation Cost (30% of Equipment)	30%				\$	623,000	Including tax, freight, installation and manufacturer services.
Equipment installation cost (50 % of Equipment)	3070				Ψ	020,000	including tax, freight, installation and mandacturer services.
Reduction Tanks							25 ft x 75 ft tank, including 3 sub-tanks with shared walls
Slab	140	CY	\$	714	\$	99,960	Based on 2 ft slab or wall; \$700/CY; adjusted to 2012 dollars.
Walls	155	CY	\$	816	\$	126,480	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY; adjusted to 2012
Elevated Slab	140	CY	\$	1,122	\$	157,080	Based on 2 ft slab or wall; \$1100/CY; adjusted to 2012 dollars.
Aeration Tanks							15 ft x 15 ft tank
Slab	17	CY	\$	714	\$	12,138	Based on 2 ft slab or wall; \$700/CY; adjusted to 2012 dollars.
Walls	35	CY	\$	816	\$	28,560	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY; adjusted to 2012 dollars
Elevated Slab	17	CY	\$	1,122	\$	19,074	Based on 2 ft slab or wall; \$1100/CY; adjusted to 2012 dollars.
Rapid Mixing Tanks							15 ft x 15 ft tank
Slab	17	CY	\$	714	\$	12,138	Based on 2 ft slab or wall; \$700/CY; adjusted to 2012 dollars.
Walls	35	CY	\$	816	\$	28,560	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY; adjusted to 2012 dollars
Elevated Slab	17	CY	\$	1,122	\$	19,074	Based on 2 ft slab or wall; \$1100/CY; adjusted to 2012 dollars.
Chemical Storage Containment	16	CY	\$	1,275	\$	20,400	\$1250/CY, adjusted to 2012 dollars
Equipment Concrete Pads	291	CY	\$	1,275	\$	371,025	\$1250/CY, adjusted to 2012 dollars
Subtotal (Installed Equipment Costs)					\$	3 592 000	Rounded up to \$1000
Castotal (motalica Equipment Costo)					•	0,002,000	reduced up to \$1000
General Requirements	7.5%				\$	269,400	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey,
Earthwork	5%				\$	179,600	erosion control. coordination, testing services, and record documents  Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$	539.000	Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$		PLC and SCADA equipment to control
Total Direct Costs					\$	5,299,000	Rounded up to \$1000
Contractor's Overhead and Profit	20%				\$	1,059,800	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total					\$	6,358,800	
Project Level Allowance (contingency)	20%				\$	1,271,760	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$		Includes permits, legal fees and engineering fees for design and construction
Project Total					\$	8,903,000	
Low Estimate					\$	6,232,000	-30%
High Estimate					\$	13,355,000	

- 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 2012 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

Number of Duty Filters			1												1					
				1			Lab										F	ield		
Sample Location	Total Fe	c	cr(VI)	Total Cr	T	rss	Silica	v		Bac-T (E. Coli, T. Coli and HPC)			-	WET tals)	Cr(VI)*	Ferrous	Total Fe	Turbidity	рН	Temperatur e
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		<u> </u>		4	_				1	1	1	1	1	1
Thickened sludge						1		1												
Filtrate from dewatering container		1	1	1 1 1 1 1 1 1 1																
Dewatered solid residuals											A	t disposal	At d	lisposal						
Number of samples per month^		8	15	1	11	8	1	4	5	8	L	1		1	10	20	20	3	23	15
Unit cost (\$/sample)	\$	14	\$ 54	\$ 1-	4 \$	\$ 15	\$ 14	\$	112	\$ 59	\$	245	\$	429						
Sample analysis Cost (\$/year)	\$ 1,3	22	\$ 9,639	9,639 \$ 1,818 \$ 1,469 \$ 165 \$ 6,732 \$ 5,630 \$ 2,938 \$ 5,153																
Shipping fee (\$/year)	\$ 1,5	60 C	ne shipment	per week, \$	30 p	per shipment														
Sum of lab analysis cost (\$/year)	\$ 36,4	26 S	Sample analys	is plus ship	ping	g fee														
Field meters	\$ 6,0	00 F	lach Dr 3800,	portable pl	H me	eter and turbi	idity meter													
Field analysis cost	\$ 2,0	2,000 Estimate for reagents and apparatus based on experience; not including labor for field analysis 8,426 Including lab and field analysis costs; not including labor and field meters																		
Total analysis cost	\$ 38,4	26 lı					ncluding labor		d field meter	S										

<sup>\*</sup> 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).

<sup>^</sup> 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 Costs are adjusted to 2012 dollars.



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

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

Number of Duty Filter Cells		3	3												
		1	T	1	Lab	1	1	1	1			F	eld	1	
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	рН	Temperatur e
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	\$ 54	\$ 14	\$ 15	\$ 14	\$ 112	\$ 59	\$ 245	\$ 429						
Sample analysis Cost (\$/year)	\$ 2,644	\$ 14,780	14,780 \$ 3,140 \$ 1,469 \$ 165 \$ 6,732 \$ 5,630 \$ 4,406 \$ 7,730												
Shipping fee (\$/year)	\$ 1,560	One shipment	per week, \$3	0 per shipmen	t										
Sum of lab analysis cost (\$/year)	\$ 48,256	Sample analys	sis plus shipp	ing fee											
Field meters	\$ 6,000	Hach Dr 3800	, portable pH	meter and turb	idity meter										
Field analysis cost	\$ 3,000	Estimate for reagents and apparatus based on experience; not including labor for field analysis Including lab and field analysis costs; not including labor and field meters													
Total analysis cost	\$ 51,256	Including lab a	and field analy	ysis costs; not	including labor	and field mete	's								

<sup>\*</sup> 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).

<sup>^</sup> 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 Costs are adjusted to 2012 dollars.



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

Flow Rate (gpm) 2,000

·							Lab										F	ield		
Sample Location	Total Fe	C	Cr(VI)	Total Cr	TSS		Silica	voc		Bac-T (E. Coli, T. Coli and HPC)				WET etals)	Cr(VI)*	Ferrous	Total Fe	Turbidity	рН	Temperatur e
Raw		1	4		4		1	ı								4	1 1	1	4	. 4
After ferrous addition																	4 4	ı.	continuous	continuous
After 1st reduction tank																	4 4	ı	4	ļ.
After 2nd reduction tank																	1 1		4	l.
After 3rd reduction tank			4						1								4 4	ı	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 1 1 1														1				
Dewatered solid residuals											At o	disposal	At d	disposal						
Number of samples per month^		40	47	4:	3	8	1	ı	5	8		2		2	42	2 5	2 52	2 3	31	23
Unit cost (\$/sample)	\$	14	\$ 54	\$ 14	\$	15	\$ 14	\$	112	\$ 59	\$	245	\$	429						
Sample analysis Cost (\$/year)	\$ 6,6	610	\$ 30,202	\$ 7,105	\$	1,469	\$ 165	\$	6,732	\$ 5,630	\$	5,875	\$	10,306						
Shipping fee (\$/year)	\$ 1,560 One shipment per week, \$30 per shipment																			
Sum of lab analysis cost (\$/year)	\$ 75,6	555	Sample analys	is plus shipp	ing fe	е														
Field meters	\$ 6,0	000 H	Hach Dr 3800,	portable pH	meter	r and turbi	dity meter													
Field analysis cost	\$ 5,000 Estimate for reagents and apparatus based on experience; not including labor for field analysis  \$ 80,655 Including lab and field analysis costs; not including labor and field meters																			
Total analysis cost										S										

<sup>\*</sup> 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).

<sup>^</sup> 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 Costs are adjusted to 2012 dollars.

### **Estimated RCF O&M Costs**

RCF System Size = 100 gpm

	Or Cystein Oiz	<u> </u>	<u> </u>																
ı	Influent Cr(VI)											Mainten	ance						
	Concentration	Residu	als					VPGAC		Filter Media		and Spa	are			Lab and F	ield		
	(ppb)	Dispos	al	Cher	nicals	Labor		Replacement		Replacement	t	Parts		Electricit	y*	Analysis <sup>8</sup>	k.	Annual (	O&M
Ī	5	\$	5,700	\$	3,400	\$	164,000	\$ 1,	200	\$ (	600	\$	10,000	\$	37,400	\$	38,400	\$	261,000
	10	\$	10,800	\$	4,000	\$	164,000	\$ 1,	200	\$ (	600	\$	10,000	\$	37,400	\$	38,400	\$	266,000
	25	\$	17,600	\$	5,100	\$	164,000	\$ 1,	200	\$ (	600	\$	10,000	\$	37,400	\$	38,400	\$	274,000
	50	\$	34,600	\$	7,900	\$	164,000	\$ 1,	200	\$ (	600	\$	10,000	\$	37,400	\$	38,400	\$	294,000

<sup>\*</sup> Electricity includes approximately \$200 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

RCF System Size = 500 gpm

Itor Oyotom oiz	.000	90																
Influent Cr(VI)											Maint	enance						
Concentration	Residu	uals					VPGA	3	Filte	r Media	and S	pare			Lab a	and Field		
(ppb)	Dispos	sal	Cher	nicals	Labor		Replac	ement	Repl	acement	Parts	-	Ele	ctricity*	Analy	ysis <sup>&amp;</sup>	Annua	I O&M
5	\$	28,400	\$	8,800	\$	238,000	\$	22,000	\$	2,600	\$	18,200	\$	101,000	\$	51,300	\$	470,000
10	\$	53,800	\$	13,000	\$	238,000	\$	22,000	\$	2,600	\$	18,200	\$	101,000	\$	51,300	\$	500,000
25	\$	88,100	\$	18,500	\$	238,000	\$	22,000	\$	2,600	\$	18,200	\$	101,000	\$	51,300	\$	540,000
50	\$	173,200	\$	32.300	\$	238.000	\$	22,000	\$	2.600	\$	18,200	\$	101,000	\$	51.300	\$	639.000

<sup>\*</sup> Electricity includes approximately \$700 for aeration off-gas treatment.

RCF System Size = 2,000 gpm

KCF System S	12e = 2,	ooo gpiii																
Influent Cr(VI	)										Maint	enance						
Concentration	n Resi	duals					VPG	AC	Filte	er Media	and S	pare			Lab	and Field		
(ppb)	Disp	osal	Che	emicals	Labor		Repl	acement	Rep	olacement	Parts	-	Ele	ectricity*	Anal	lysis &	Ann	ual O&M
5	\$	113,700	\$	29,900	\$	384,000	\$	61,200	\$	6,200	\$	35,900	\$	180,000	\$	80,700	\$	892,000
10	\$	215,300	\$	46,400	\$	384,000	\$	61,200	\$	6,200	\$	35,900	\$	180,000	\$	80,700	\$	1,010,000
25	\$	352,400	\$	68,500	\$	384,000	\$	61,200	\$	6,200	\$	35,900	\$	180,000	\$	80,700	\$	1,169,000
50	\$	692,700	\$	123,600	\$	384,000	\$	61,200	\$	6,200	\$	35,900	\$	180,000	\$	80,700	\$	1,564,000

<sup>\*</sup> Electricity includes approximately \$2,800 for aeration off-gas treatment.

Annual O&M Summary

RCF System	-	Infl	uent Cr(VI) Co	onc	entration, pp	b	
Size (gpm)	5		10		25		50
100	\$ 261,000	\$	266,000	\$	274,000	\$	294,000
500	\$ 470,000	\$	500,000	\$	540,000	\$	639,000
2,000	\$ 892,000	\$	1,010,000	\$	1,169,000	\$	1,564,000

Costs are in 2012 dollars.

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

Not i resent valu	 1 <b>2</b> 0 1 Cai 3 (i k	Juii	aca to two si	9	ncant ngares	,	
RCF System		Infl	uent Cr(VI) Co	onc	entration, pp	b	
Size (gpm)	5		10		25		50
100	\$ 4,400,000	\$	4,500,000	\$	4,600,000	\$	4,900,000
500	\$ 7,900,000	\$	8,400,000	\$	9,000,000	\$	11,000,000
2,000	\$ 15,000,000	\$	17,000,000	\$	20,000,000	\$	26,000,000

20-year NPV O&M based on 2.5% inflation and a 4.5% discount rate Costs are in 2012 dollars.

<sup>&</sup>amp; Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis. Costs are in 2012 dollars.

<sup>&</sup>amp; Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis. Costs are in 2012 dollars.



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
100-gpm RCF System
(Granular Media Filter Without Recycle)

Project No. 05337008.0	0000	
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.
Date 12/9/11	Date: 1/18/12	Date: 1/10/13

Storage Tank	DESCRIPTION	QTY	UNIT MEAS.	U	NIT COST		TOTAL COST	COMMENTS
Storage Tank	Equipment							
Subsection   1	FeSO₄ Feed System							
Part	Storage Tank	1	EA	\$	2,700	\$	2,700	
Reduction Transs  3 EA \$ 5.200 \$ 15,000 Subtes from Core-Rosion & Ryan Herco; 1,700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Mixers  3 EA \$ 5.200 \$ 15,000 Subtes from Core-Rosion & Ryan Herco; 1,700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Agration System  1 EA \$ 3,700 \$ 3,770 Outles from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffusers  1 LS \$ 400 \$ 400 Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffusers  2 EA \$ 3,300 \$ 1,700 Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffusers  2 EA \$ 3,500 \$ 71,200 Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffusers  2 EA \$ 3,500 \$ 71,200 Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffuser Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffuser Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffuser Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffuser Subtes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; disulated to 2012 dollars  Diffuser Subtes from Tiffuser S	Metering Pumps	2	EA	\$	3,100	\$	6,200	
Tariks   3   EA   \$   \$   \$   \$   \$   \$   \$   \$   \$	Static Mixers	1	EA	\$	900	\$	900	Quotes from Komax & EWS; 3-inch; adjusted to 2012 dollars
Tariks   3   EA   \$   \$   \$   \$   \$   \$   \$   \$   \$	Reduction Tanks							
Alexandon System	Tanks	3	EA	\$	5,200	\$	15,600	
Tank	Mixers	3	EA	\$	4,800	\$	14,400	
Section   Content   Cont	Aeration System							
Supply Blowers   2	Tank	1	EA	\$	3,700	\$	3,700	
Exhaust Blowers   2	Diffusers	1	LS	\$	400	\$	400	
Exhaust Blowers   2	Supply Blowers	2	EA	\$	30,900	\$	61,800	
A	Exhaust Blowers	2	EA	\$	35,600	\$	71,200	Quote from EWS; 53 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories;
Rapid Mixing Tank	Off-Gas Treatment	1	LS	\$	4,100	\$	4,100	
Milber   1	Polymer Mixing Tank							
Filter Equipment (Pressure Filters)  1 LS \$ 286,000 \$ 286,000 \$ 286,000 \$ \text{VPF. 1 duty/ 1 stdby; adjusted to 2012 dollars} Cuotes from Coresh-Hopkins & Layne, including media; 3 gm/sf, (2) 6.5 ft dia VPF. 1 duty/ 1 stdby; adjusted to 2012 dollars Cuotes from DTI and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Pumps  Pumps  Filter Feed Pumps (Progressive Cavity)  2 EA \$ 13,000 \$ 26,000 dollars  Cuotes from DTI and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Cuotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 LS \$ 28,000 \$ 28,000 dollars  Cuotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Filter Backwash  1 EA \$ 26,700 \$ 26,700 dollars  Cuotes from Siemens & C.P. Crowley, adjusted to 2012 dollars  Cuotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic, adjusted to 2012 dollars  Cuotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic, adjusted to 2012 dollars  Cuotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic, adjusted to 2012 dollars  Cuotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic, adjusted to 2012 dollars  Cuotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic, adjusted to 2012 dollars  Sewer Discharge Pumps  2 EA \$ 5,000 \$ 35,000 \$ 35,000 \$ 36,000	Rapid Mixing Tank	1	EA	\$	3,700	\$	3,700	
Section   Filter Equipment (Pressure Filters)   1	Mixer	1	EA	\$	3,800	\$	3,800	
Section   Filter Equipment (Pressure Filters)   1	Filtere							
Filter Drawdown Transfer Pump  2 EA \$ 5,700 \$ 11,400  Quotes from DTI and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Pumps  Pumps  Polymer Feed Pumps (Progressive Cavity)  2 EA \$ 13,000 \$ 26,000  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 LS \$ 28,000 \$ 28,000  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 LS \$ 28,000 \$ 28,000  Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 26,700 \$ 26,700  Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 26,700 \$ 26,700  Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000  Subtotal  2 EA \$ 5,000 \$ 10,000  Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Polymer Feed Pumps  2 EA \$ 5,000 \$ 18,000  Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,550  Polymer Feed Pumps  2 EA \$ 1,275 \$ 2,55		4	1.0	•	000 000	•	200 200	Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf, (2) 6.5 ft dia
Pumps Filter Feed Pumps (Progressive Cavity)  2 EA \$ 13,000 \$ 26,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 LS \$ 28,000 \$ 28,000 Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars  Filtrate Tank for Backwash  1 EA \$ 26,700 \$ 26,700 Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Quotes from Tore-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Quotes from Tore-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Quotes from Tore-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Backwash Waste Storage Tank  1 EA \$ 35,000 \$ 35,000  Sewer Discharge Pumps  2 EA \$ 5,000 \$ 10,000  Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Subtotal  5 630,000 Rounded up to \$1000  Equipment Installation Cost  30%  \$ 189,000 Including tax, freight, installation and manufacturer services.  Chemical Storage Containment  2 CY \$ 1,275 \$ 2,550 \$1250/CY, adjusted to 2012 dollars  Equipment Concrete Pads  35 CY \$ 1,275 \$ 44,625 \$1250/CY, adjusted to 2012 dollars	Filter Equipment (Pressure Filters)	1	LS	\$	286,000	\$	286,000	VPF, 1 duty/ 1 stdby; adjusted to 2012 dollars
Filter Feed Pumps (Progressive Cavity)  2 EA \$ 13,000 \$ 26,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 LS \$ 28,000 \$ 28,000 Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars  Filter Backwash  Filter Backwash  1 EA \$ 26,700 \$ 26,700 Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 26,700 \$ 26,700 Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 9,000 \$ 18,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed Systems (Coagulant Aid)  Polymer Feed Syst	Filter Drawdown Transfer Pump	2	EA	\$	5,700	\$	11,400	
Filter Feed Pumps (Progressive Cavity)  2 EA \$ 13,000 \$ 26,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 LS \$ 28,000 \$ 28,000 Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars  Filter Backwash  Filter Backwash  1 EA \$ 26,700 \$ 26,700 Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 26,700 \$ 26,700 Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 9,000 \$ 18,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed System (Coagulant Aid)  1 EA \$ 35,000 \$ 35,000 \$ 35,000 Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Polymer Feed Systems (Coagulant Aid)  Polymer Feed Syst	Pumps							
Filtrate Tank for Backwash  Backwash Pumps  2 EA \$ 9,000 \$ 18,000  Backwash Waste Storage Tank  1 EA \$ 35,000 \$ 35,000  Sewer Discharge Pumps  2 EA \$ 5,000 \$ 10,000  Figuipment Installation Cost  30%  Chemical Storage Containment  2 CY \$ 1,275 \$ 2,550  Equipment Concrete Pads  35 CY \$ 1,275 \$ 44,625  S1250/CY, adjusted to 2012 dollars  Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars  Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars  Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars  Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars  Backwash Waste Storage Tank  1 EA \$ 35,000 \$ 35,000  Sased on previous quotes for various tank sizes, estimated for 21,000 gal, adjusted to 2012 dollars  Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Including tax, freight, installation and manufacturer services.  Equipment Concrete Pads  35 CY \$ 1,275 \$ 2,550  \$ 1250/CY, adjusted to 2012 dollars	Filter Feed Pumps (Progressive Cavity)	2	EA	\$	13,000	\$	26,000	
Filtrate Tank for Backwash  1 EA \$ 26,700 \$ 26,700 Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Backwash Pumps  2 EA \$ 9,000 \$ 18,000 Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars  Backwash Waste Storage Tank  1 EA \$ 35,000 \$ 35,000  Backwash Waste Storage Pumps  2 EA \$ 5,000 \$ 10,000 Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Subtotal  Subtotal  5 630,000 Rounded up to \$1000  Chemical Storage Containment  2 CY \$ 1,275 \$ 2,550  Equipment Concrete Pads  35 CY \$ 1,275 \$ 44,625  S1250/CY, adjusted to 2012 dollars  1250/CY, adjusted to 2012 dollars  1250/CY, adjusted to 2012 dollars	Polymer Feed System (Coagulant Aid)	1	LS	\$	28,000	\$	28,000	Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars
Filtrate Tank for Backwash  1 EA \$ 26,700 \$ 26,700 Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars  Backwash Pumps  2 EA \$ 9,000 \$ 18,000 Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars  Backwash Waste Storage Tank  1 EA \$ 35,000 \$ 35,000  Backwash Waste Storage Pumps  2 EA \$ 5,000 \$ 10,000 Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Subtotal  Subtotal  5 630,000 Rounded up to \$1000  Chemical Storage Containment  2 CY \$ 1,275 \$ 2,550  Equipment Concrete Pads  35 CY \$ 1,275 \$ 44,625  S1250/CY, adjusted to 2012 dollars  1250/CY, adjusted to 2012 dollars  1250/CY, adjusted to 2012 dollars	Filter Backwash							
Backwash Pumps  2 EA \$ 9,000 \$ 18,000 dollars  Backwash Waste Storage Tank  1 EA \$ 35,000 \$ 35,000  Sewer Discharge Pumps  2 EA \$ 5,000 \$ 10,000  Fequipment Installation Cost  30%  5 19,000  Chemical Storage Containment  2 CY \$ 1,275 \$ 2,550  Equipment Concrete Pads  3 2,000  Subtotal  CHA \$ 9,000 \$ 18,000  Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars  Based on previous quotes for various tank sizes, estimated for 21,000 gal, adjusted to 2012 dollars  Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Including tax, freight, installation and manufacturer services.  Chemical Storage Containment  2 CY \$ 1,275 \$ 2,550  Equipment Concrete Pads  35 CY \$ 1,275 \$ 44,625  S1250/CY, adjusted to 2012 dollars	Filtrate Tank for Backwash	1	EA	\$	26,700	\$	26,700	Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars
Basckwash Waste Storage Tank  1 EA \$ 35,000 \$ 35,000 Based on previous quotes for various tank sizes, estimated for 21,000 gal, adjusted to 2012 dollars  Sewer Discharge Pumps  2 EA \$ 5,000 \$ 10,000 Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby  Subtotal  5 630,000 Rounded up to \$1000  Equipment Installation Cost  30% \$ 189,000 Including tax, freight, installation and manufacturer services.  Chemical Storage Containment  2 CY \$ 1,275 \$ 2,550 \$1250/CY, adjusted to 2012 dollars  Equipment Concrete Pads  35 CY \$ 1,275 \$ 44,625 \$1250/CY, adjusted to 2012 dollars	Backwash Pumps	2	EA	\$	9,000	\$	18,000	Quotes from ITT & Cortech; 600 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012
Subtotal \$ 630,000 Rounded up to \$1000  Equipment Installation Cost 30% \$ 189,000 Including tax, freight, installation and manufacturer services.  Chemical Storage Containment 2 CY \$ 1,275 \$ 2,550 \$1250/CY, adjusted to 2012 dollars  Equipment Concrete Pads 35 CY \$ 1,275 \$ 44,625 \$1250/CY, adjusted to 2012 dollars	Backwash Waste Storage Tank	1	EA	\$		\$	35,000	Based on previous quotes for various tank sizes, estimated for 21,000 gal,
Equipment Installation Cost 30% \$ 189,000 Including tax, freight, installation and manufacturer services.  Chemical Storage Containment 2 CY \$ 1,275 \$ 2,550 \$1250/CY, adjusted to 2012 dollars  Equipment Concrete Pads 35 CY \$ 1,275 \$ 44,625 \$1250/CY, adjusted to 2012 dollars	Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	
Chemical Storage Containment         2         CY         \$ 1,275         \$ 2,550         \$1250/CY, adjusted to 2012 dollars           Equipment Concrete Pads         35         CY         \$ 1,275         \$ 44,625         \$1250/CY, adjusted to 2012 dollars	Subtotal					\$	630,000	Rounded up to \$1000
Equipment Concrete Pads 35 CY \$ 1,275 \$ 44,625 \$1250/CY, adjusted to 2012 dollars	Equipment Installation Cost	30%				\$	189,000	Including tax, freight, installation and manufacturer services.
	Chemical Storage Containment	2	CY	\$	1,275	\$	2,550	\$1250/CY, adjusted to 2012 dollars
Subtotal (Installed Equipment Costs) \$ 867,000   Rounded up to \$1000	Equipment Concrete Pads	35	CY	\$	1,275	\$	44,625	\$1250/CY, adjusted to 2012 dollars
	Subtotal (Installed Equipment Costs)					\$	867,000	Rounded up to \$1000



Client City of Glenda	ale
Project Phase III Demonstration To	esting for Cr(VI)
Item	
100-gpm RCF Sy	/stem
(Granular Media Filter Wit	thout Recycle)

Project No. 05337008.0000									
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.							
Date 12/9/11	Date: 1/18/12	Date: 1/10/13							

General Requirements	7.5%	\$	65,025	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%	\$		Excavation, backfill, and fill required to construct project
Site Improvements	5%	\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%	\$		Major system piping and valves
Electrical, Instrumentation and Controls	15%	\$	131,000	PLC and SCADA equipment to control
Total Direct Costs		\$	1,281,000	Rounded up to \$1000
Contractor's Overhead and Profit	20%	\$	256,200	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total		\$	1,537,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%	•	307.400	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%	\$		Includes permits, legal fees and engineering fees for design and construction
Project Total		\$	2,152,000	
Low Estimate		\$	1,506,000	-30%
High Estimate		\$	3,228,000	<b>+</b> 50%

- 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 2012 dollars.

  3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
500-gpm RCF System
(Granular Media Filter Without Recycle)

Project No. 05337008.0000									
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.							
Date 12/9/11	Date: 1/18/12	Date: 12/31/12							

DESCRIPTION	QTY	UNIT MEAS.	UNIT C	OST	TO	TAL COST	COMMENTS				
Equipment											
FeSO <sub>4</sub> Feed System											
Storage Tank	1	EA	\$	3,400	\$	3,400	Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 1.3 gph; 1 duty/ 1 stdby; adjusted to 2012 dollars.				
Static Mixers	1	EA	\$	2,200	\$	2,200	Quotes from Komax & EWS; 8-inch; adjusted to 2012 dollars.				
Reduction Tanks											
Tanks	3	EA	\$	20,000	\$	60,000	Quotes from Core-Rosion & Ryan Herco; 8,000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Mixers	3	EA	\$	9,000	\$	27,000	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars.				
Aeration System											
Tanks	1	EA	\$	6,400	\$	6,400	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Diffusers	1	LS	\$	2,000	\$	2,000					
Supply Blowers	2	EA	\$	47,200	\$	94,400	Quote from EWS; 267 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.				
Exhaust Blowers	2	EA	\$	35,400	\$	70,800	Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.				
Off-Gas Treatment	1	LS	\$	15,400	\$	15,400	Quotes from Calgon and TIGG; 270 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars.				
Polymer Mixing Tank											
Rapid Mixing Tank	1	EA	\$	6,900	\$	6,900	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Mixers	1	EA	\$	4,500	\$	4,500	Quotes from Core-Rosion & EWS; G = 170 per second; adjusted to 2012 dollars.				
Filters							Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf; Coombs-				
Filter Equipment (Pressure Filters)	1	LS	\$	475,000	\$	475,000	Hopkins filters, 10' x 24' (4 cells, 3 duty/ 1 stdby); Layne filters, (2) 8" x 22', 1 duty/ 1 stdby; adjusted to 2012 dollars.				
Filter Drawdown Transfer Pump	2	EA	\$	4,900	\$	9,800	Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars.				
Pumps											
Filter Feed Pumps (Progressive Cavity)	2	EA	\$	39,000	\$	78,000	Quotes from Cortech & Flow-Systems; 500 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars.				
Delumer Food Cystems											
Polymer Feed Systems Polymer Feed Systems (Coagulant Aid)	1	LS	\$	10,700	\$	10,700	Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars.				
Polymer Feed Systems (Solids Settling Aid)	0	LS	\$	11,600	\$	-	Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars.				
Filter Backwash											
Filtrate Tank for Backwash	1	EA	\$	41,000	\$	41,000	Quotes from Superior; 22,000 gal; 15 ft dia x 16 ft height; adjusted to 2012 dollars.				
Backwash Pumps	2	EA	\$	14,600	\$	29,200	Quotes from ITT & Cortech; 1,050 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars.				
Backwash Waste Storage Tank	1	EA	\$	70,000	\$	70,000	Based on previous quotes for various tank sizes, estimated for 85,000 gal, adjusted to 2012 dollars				
Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby				
Subtotal	<u> </u>				\$	1,023,000	Rounded up to \$1000				
Outstall	1		1		φ	1,023,000	i touriaca ap to \$1000				
Equipment Installation Cost	30%				\$	307,000	Including tax, freight, installation and manufacturer services.				
Chemical Storage Containment	6	CY	\$	1,275	\$	7,650	\$1250/CY, adjusted to 2012 dollars				
Equipment Concrete Pads	101	CY	\$	1,275	\$	128,775	\$1250/CY, adjusted to 2012 dollars				
Subtotal (Installed Equipment Costs)					\$	1,467,000	Rounded up to \$1000				



Client City of Glendale
Project Phase III Demonstration Testing for Cr(VI) Treatment
Item
500-gpm RCF System
(Granular Media Filter Without Recycle)

Project No. 05337008.0000									
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.							
Date 12/9/11	Date: 1/18/12	Date: 12/31/12							

				Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%		110,025	utilities, health and safety, office supplies, clean up, photographs, survey,
·				erosion control, coordination, testing services, and record documents
Earthwork	5%		\$ 73,350	Excavation, backfill, and fill required to construct project
Site Improvements	5%			Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%			Major system piping and valves
Electrical, Instrumentation and Controls	15%		\$ 221,000	PLC and SCADA equipment to control
Total Direct Costs		(	2,166,000	Rounded up to \$1000
Contractor's Overhead and Profit	20%		\$ 433,200	Includes bonds, mobilization and demobilization, insurance, overhead and
Contractor's Overnead and Front	20 /0	l l	\$ 433,200	profit, and management reserves
Construction Total		9	2,599,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%		\$ 519,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%		\$ 519,800	Includes permits, legal fees and engineering fees for design and construction
Project Total			3,639,000	
			•	
Low Estimate			\$ 2,547,000	-30%
High Estimate			5,459,000	+50%

- 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 2012 dollars.

  3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
2000-gpm RCF System
(Granular Media Filter Without Recycle)

Project No. 05337008.0000									
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.							
Date 12/9/11	Date: 1/18/12	Date: 12/31/12							

DESCRIPTION	SCRIPTION QTY UNIT MEAS. UNIT COST TOTAL COST		TOTAL COST	COMMENTS		
Equipment						
FeSO <sub>4</sub> Feed System						
Storage Tank	1	EA	\$ 6,0		\$ 6,000	Quotes from Core-Rosion & Ryan Herco; 2,000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars
Metering Pumps	2	EA	\$ 6,2			
Static Mixers	1	EA	\$ 4,3	00	\$ 4,300	Quotes from Komax & EWS; 14-inch; adjusted to 2012 dollars
Reduction Tanks						
	_					
Mixers	3	EA	\$ 24,0	00	\$ 72,000	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars
Aeration System						
Diffuser	1	LS	\$ 8,2	00	\$ 8,200	Based on previous project experience and conversation w/ Brian Bubela; adjusted to 2012 dollars
Supply Blowers	2	EA	\$ 76,3	00	\$ 152,600	Quote from EWS; 1,070 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessaories; adjusted to 2012 dollars
Exhaust Blowers	2	EA	\$ 59,6	00	\$ 119,200	Quote from EWS; 1,070 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessaories; adjusted to 2012 dollars
Off-Gas Treatment	1	LS	\$ 25,8	00	\$ 25,800	Quotes from Calgon & TIGG; 1070 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars
Polymer Mixing Tanks						
Mixers	1	EA	\$ 17,3	00	\$ 17,300	Quotes from Core-Rosion & EWS; G = 170 per second; adjusted to 2012 dollars
Filters						
Filter Equipment (Pressure Filters)	1	LS	\$ 1,004,0	00	\$ 1,004,000	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; ladiusted to 2012 dollars
Filter Drawdown Transfer Pump	2	EA	\$ 5,1	00	\$ 10,200	Clustes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby; adjusted to 2012 dollars
Pumps				-		
Filter Feed Pumps (Progressive Cavity)	3	EA	\$ 56,0	00	\$ 168,000	Quotes from Cortech & Flow-Systems; 1,000 gpm @ 70 ft; 2 duty/ 1 stdby; adjusted to 2012 dollars
Polymer Feed Systems		1.0	ė 40.7	00	<b>A. 700</b>	
Polymer Feed Systems (Coagulant Aid) Polymer Feed Systems (Solids Settling Aid)	0	LS LS	\$ 10,7 \$ 11,6		\$ 10,700 \$ -	Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars Quotes from Siemens & C.P. Crowley; adjusted to 2012 dollars
l Gymer i eed Gystems (Gonds Getuing Ald)		LO	Ψ 11,0	00	Ψ -	Quotes Irom Siemens & C.F. Crowley, adjusted to 2012 dollars
Filter Backwash						
Filtrate Tank for Backwash	1	EA	\$ 51,0	00	\$ 51,000	Quotes from Superior; 30,250 gal; 18 ft dia x 16 ft height; adjusted to 2012 dollars
Backwash Pumps	2	EA	\$ 21,9	00	\$ 43,800	Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stdby; adjusted to 2012 dollars
Backwash Waste Storage Tank	1	EA	\$ 168,0	00	\$ 168,000	Based on previous quotes for various tank sizes, estimated for 286,000 gal, adjusted to 2012 dollars
Sewer Discharge Pumps	2	EA	\$ 5,0	00	\$ 10,000	Quote based upon 175 gpm Hydromatic Submergible pump, 1 duty/ 1 stdby
Subtotal	<u> </u>				\$ 1,884,000	Rounded up to \$1000
Gubiotal	<del>                                     </del>				ψ 1,004,UUU	ι τουπασά αρ το φτίσου
Equipment Installation Cost (30% of Equipment)	30%			4	\$ 566,000	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	\$ 7	14	\$ 99,960	
Walls	155	CY			\$ 126,480	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY; adjusted to 2012 dollars
Elevated Slab	140	CY	\$ 1,1	22	\$ 157,080	



Client City of Glendale Project Phase III Demonstration Testing for Cr(VI) Treatment Item 2000-gpm RCF System (Granular Media Filter Without Recycle)

Project No. 05337008.0000									
By T.D. & Y.W.	Ckd: Y.W. & T.V.	Updated: Y.W.							
Date 12/9/11	Date: 1/18/12	Date: 12/31/12							

Aeration Tanks							15 ft x 15 ft tank
Slab	17	CY	\$	714	\$		Based on 2 ft slab or wall; \$700/CY; adjusted to 2012 dollars.
Walls	35	CY	\$	816	\$	28,560	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY; adjusted to 2012 dollars
Elevated Slab	17	CY	\$	1,122			Based on 2 ft slab or wall; \$1100/CY; adjusted to 2012 dollars.
						, in the second	
Rapid Mixing Tanks							15 ft x 15 ft tank
Slab	17	CY	\$	714	\$	12,138	Based on 2 ft slab or wall; \$700/CY; adjusted to 2012 dollars.
Walls	35	CY	\$	816	\$	28,560	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY; adjusted to 2012 dollars
Elevated Slab	17	CY	\$	1,122	\$	19,074	Based on 2 ft slab or wall; \$1100/CY; adjusted to 2012 dollars.
Chemical Storage Containment	16	CY	\$	1,275	\$	20,400	\$1250/CY, adjusted to 2012 dollars
5 : 10 1 5 1	200	0)/	_	4.075	•	201.005	
Equipment Concrete Pads	223	CY	\$	1,275	\$	284,325	\$1250/CY, adjusted to 2012 dollars
Subtotal (Installed Equipment Costs)	1				\$	3,258,000	Rounded up to \$1000
Subtotal (Illistatieu Equipment Costs)	+				Ą	3,236,000	Nounteed up to \$1000
	+						Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%				\$	244,350	utilities, health and safety, office supplies, clean up, photographs, survey,
Ocheral requirements	7.570				Ψ	244,000	erosion control, coordination, testing services, and record documents
Earthwork	5%				\$	162.900	Excavation, backfill, and fill required to construct project
Laitiwork	370				Ψ	102,300	Excavation, backini, and initrequired to constituct project
Site Improvements	5%				\$	162,900	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$	489.000	Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$		PLC and SCADA equipment to control
					т	,	
Total Direct Costs	i				\$	4,806,000	Rounded up to \$1000
						,,	
O a la alada O a la a la al Basti	000/				Φ.	004.000	Includes bonds, mobilization and demobilization, insurance, overhead and
Contractor's Overhead and Profit	20%				\$	961,200	profit, and management reserves
Construction Total	i		Ì		\$	5,767,200	
						-, - ,	
Project Level Allowance (contingency)	20%				\$		Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$	1,153,440	Includes permits, legal fees and engineering fees for design and construction
						<u> </u>	
Project Total					\$	8,075,000	
Low Estimate					\$	5,653,000	-30%
High Estimate					\$	12,113,000	+50%

- 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 2012 dollars. 3. Costs for land or easements are not included.



### Estimated RCF Water Quality Monitoring, Granular Media Filter Without Recycle (Number of Samples per Month)

Flow Rate (gpm) 100

Number of Duty Filters			1															
		_			1	Lab			1	1	1				F	ield	1	
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(V	'I)*	Ferrous	Total Fe	Turbidity	рН	Temperatur e
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	l.
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																		
Thickened sludge																		
Filtrate from dewatering container																		
Dewatered solid residuals																		
Number of samples per month^		6	13	9	5	1		5	0	(	D	0	8	18	18	1	21	13
Unit cost (\$/sample)	\$ 14	\$	54 \$	14	\$ 15	\$ 14	\$	112	\$ 59	\$ 245	\$ 42	9						
Sample analysis Cost (\$/year)	\$ 991	\$ 8,3	54 \$ 1,4	487	\$ 918	\$ 165	\$ 6	6,732	\$ -	\$ -	\$	-						
Shipping fee (\$/year)	\$ 1,560	One shipm	ent per week	, \$30	) per shipmen	t												
Sum of lab analysis cost (\$/year)	\$ 20,208	Sample and	lysis plus sl	nippi	ng fee													
Field meters	\$ 6,000	Hach Dr 38	00, portable	pH r	meter and turb	idity meter												
Field analysis cost	\$ 2,000	Estimate fo	reagents a	nd a	pparatus base	d on experience	e; not ind	cluding	labor for field an	alysis								
Total analysis cost	\$ 22,208					including labor		l meter	s									

<sup>\*</sup> Only if influent Cr(VI) is greater than 10 ppb, which is the method detection limit for field analysis (Hach Method ).

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 Costs are adjusted to 2012 dollars.

Continuous monitoring indicates analyzed by online meter(s).

<sup>^</sup> Assume TCLP and CA WET residuals analysis occur once a month, which is a conservative estimate.



### Estimated RCF Water Quality Monitoring, Granular Media Filter Without Recycle (Number of Samples per Month)

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

					Lab							F	ield		
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	рН	Temperatur e
Raw		1	4	1	1					4	4	1 1	1	4	4
After ferrous addition											4	4		continuous	continuous
After 1st reduction tank											4	1 4		4	į.
After 2nd reduction tank												1 1		4	í.
After 3rd reduction tank			4			1					4	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)					1	1								4	4
Filter effluent from each cell		4	4 4	1						4	1 4	1 4	continuous	1	1
Spent filter backwash		1	1 .		1										
Supernatant from thickener															
Thickened sludge															
Filtrate from dewatering container															
Dewatered solid residuals															
Number of samples per month^	1	4 2	1 17	7	5 1	ţ	0	(	0	0 16	5 26	3 26	1	23	15
Unit cost (\$/sample)	\$ 14	\$ 54	\$ 14	\$ 15	\$ 14	\$ 112	\$ 59	\$ 245	\$ 429	)					
Sample analysis Cost (\$/year)	\$ 2,313	\$ 13,495	\$ 2,809	\$ 918	\$ 165	\$ 6,732	\$ -	\$ -	\$ -						
Shipping fee (\$/year)	\$ 1,560	One shipmen	t per week, \$3	0 per shipmer	nt										
Sum of lab analysis cost (\$/year)	\$ 27,992	Sample analy	sis plus shipp	ing fee											
Field meters	\$ 6,000	Hach Dr 3800	), portable pH	meter and tur	oidity meter										
Field analysis cost	\$ 3,000	Estimate for r	eagents and a	apparatus bas	ed on experience	e; not includin	g labor for field ar	alysis							
Total analysis cost					including labor		rs								

<sup>\*</sup> 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).

<sup>^</sup> 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 Costs are adjusted to 2012 dollars.



### Estimated RCF Water Quality Monitoring, Granular Media Filter Without Recycle (Number of Samples per Month)

Flow Rate (gpm) 2,000

					Lab							F	ield		
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	рН	Temperatur e
Raw		1 .	4	1	1					4	4	1 1	1	4	4
After ferrous addition											4	4		continuous	continuous
After 1st reduction tank											4	4		4	ļ
After 2nd reduction tank												1 1		4	Á
After 3rd reduction tank			4			1					4	1 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	1								4	4
Filter effluent from each cell		4 .	4	1						4	4	4 4	continuous	1	1
Spent filter backwash		1	1 .		1										
Supernatant from thickener															
Thickened sludge															
Filtrate from dewatering container															
Dewatered solid residuals															
Number of samples per month^	3	3 4	5 4		5 1	5	0	(	0	0 40	50	50	1	29	21
Unit cost (\$/sample)	\$ 14	\$ 54	\$ 14	\$ 15	\$ 14	\$ 112	\$ 59	\$ 245	\$ 429	)					
Sample analysis Cost (\$/year)	\$ 6,279	\$ 28,917	\$ 6,775	\$ 918	\$ 165	\$ 6,732	\$ -	\$ -	\$ -						
Shipping fee (\$/year)	\$ 1,560	One shipmen	t per week, \$3	0 per shipmer	nt										
Sum of lab analysis cost (\$/year)	\$ 51,346	Sample analy	sis plus shipp	ing fee											
Field meters	\$ 6,000	Hach Dr 3800	), portable pH	meter and tur	oidity meter										
Field analysis cost	\$ 5,000	Estimate for r	eagents and a	apparatus base	ed on experience	e; not includin	g labor for field ar	alysis							
Total analysis cost					including labor		rs								

<sup>\*</sup> 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).

<sup>^</sup> 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 Costs are adjusted to 2012 dollars.



# Estimated RCF O&M Costs (Granular Media Filters Without Recyle)

RCF System Size = 100 gpm

	Cystem Cize		, 3h																
Infl	uent Cr(VI)											Maint	enance						
Cor	ncentration	Waste	ewater					VPGAC		Filter	r Media	and S	pare			Lab a	and Field		
	(ppb)	Dispo	sal	Chem	icals	Labor		Replace	ment	Repl	acement	Parts	-	Elec	tricity*	Anal	ysis <sup>&amp;</sup>	Annua	I O&M
	5	\$	10,100	\$	3,300	\$	106,000	\$	1,200	\$	600	\$	8,700	\$	37,400	\$	22,200	\$	190,000
	10	\$	10,100	\$	3,900	\$	106,000	\$	1,200	\$	600	\$	8,700	\$	37,400	\$	22,200	\$	190,000
	25	\$	10,100	\$	5,000	\$	106,000	\$	1,200	\$	600	\$	8,700	\$	37,400	\$	22,200	\$	191,000
	50	\$	10,100	\$	7,800	\$	106,000	\$	1,200	\$	600	\$	8,700	\$	37,400	\$	22,200	\$	194,000

<sup>\*</sup> Electricity includes approximately \$200 per year for aeration off-gas treatment.

Costs are in 2012 dollars.

RCF System Size = 500 gpm

Itor Oyotom oiz		90																
Influent Cr(VI)											Maint	enance						
Concentration	Waste	water					<b>VPGA</b>	С	Filte	r Media	and S	pare			Lab	and Field		
(ppb)	Dispos	sal	Cher	micals	Labor		Repla	cement	Rep	lacement	Parts	-	Ele	ctricity*	Anal	lysis <sup>&amp;</sup>	Annu	al O&M
5	\$	35,900	\$	8,200	\$	187,000	\$	22,000	\$	2,600	\$	14,700	\$	100,800	\$	31,000	\$	402,000
10	\$	35,900	\$	12,300	\$	187,000	\$	22,000	\$	2,600	\$	14,700	\$	100,800	\$	31,000	\$	406,000
25	\$	35,900	\$	17,800	\$	187,000	\$	22,000	\$	2,600	\$	14,700	\$	100,800	\$	31,000	\$	412,000
50	\$	35.900	\$	31.600	\$	187.000	\$	22.000	\$	2.600	\$	14,700	\$	100,800	\$	31.000	\$	426.000

<sup>\*</sup> Electricity includes approximately \$700 for aeration off-gas treatment.

RCF System Size = 2,000 gpm

Influent Cr(VI)											Mainte	nance						
Concentration	Waste	ewater					VPGAC		Filter M	edia	and Sp	are			Lab and	Field		
(ppb)	Dispo	sal	Che	emicals	Labor		Replaceme	ent	Replace	ment	Parts		Electric	ity*	Analysis	&	Annual (	D&M
5	\$	132,700	\$	27,200	\$	293,000	\$	61,200	\$	6,200	\$	32,600	\$	179,000	\$	56,300	\$	788,000
10	\$	132,700	\$	43,800	\$	293,000	\$ (	61,200	\$	6,200	\$	32,600	\$	179,000	\$	56,300	\$	805,000
25	\$	132,700	\$	65,800	\$	293,000	\$ (	61,200	\$	6,200	\$	32,600	\$	179,000	\$	56,300	\$	827,000
50	\$	132,700	\$	120,900	\$	293,000	\$	61,200	\$	6,200	\$	32,600	\$	179,000	\$	56,300	\$	882,000

<sup>\*</sup> Electricity includes approximately \$2,800 for aeration off-gas treatment.

Annual O&M Summary

RCF System	•	Infl	uent Cr(VI) Co	onc	entration, pp	b	
Size (gpm)	5		10		25		50
100	\$ 190,000	\$	190,000	\$	191,000	\$	194,000
500	\$ 402,000	\$	406,000	\$	412,000	\$	426,000
2,000	\$ 788,000	\$	805,000	\$	827,000	\$	882,000

Costs are in 2012 dollars.

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

Net i resent valu	CIO	i zo icais (itt	Juii	aca to two si	<u>9,,,,</u>	ncant ngares		
RCF System			Infl	uent Cr(VI) C	onc	entration, pp	b	
Size (gpm)		5		10		25		50
100	\$	3,200,000	\$	3,200,000	\$	3,200,000	\$	3,200,000
500	\$	6,700,000	\$	6,800,000	\$	6,900,000	\$	7,000,000
2,000	\$	13,000,000	\$	13,000,000	\$	14,000,000	\$	15,000,000

<sup>20-</sup>year NPV O&M based on 2.5% inflation and a 4.5% discount rate Costs are in 2012 dollars.

<sup>&</sup>amp; Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis.

<sup>&</sup>amp; Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis. Costs are in 2012 dollars.

<sup>&</sup>amp; Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis. Costs are in 2012 dollars.



Client
City of Glendale

Project
Phase IIIA Microfiltration Pilot testing in
RCF for Cr(VI) Treatment

Item
100-gpm RCF with MF System
(Vacuum MF)

Project No. 20002.0	01
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

DESCRIPTION	QTY	UNIT MEAS.		UNIT COST	T	OTAL COST	COMMENTS
Equipment							
FeSO₄ Feed System	+						
		_			<b>-</b>		Quotes from Ryan Herco & Core-Rosion; 100 gal PE, outdoor, incl. seismic;
Storage Tank	1	EA	\$	2,700	\$	2,700	adjusted to 2012 dollars.
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/ 1 stdby; adjusted to 2012 dollars.
Static Mixers	1	EA	\$	900	\$	900	Quotes from Komax & EWS; 3-inch; adjusted to 2012 dollars.
Reduction Tanks							
Tanks	3	EA	\$	5,200	\$	15,600	Quotes from Core-Rosion & Ryan Herco; 1,700 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.
Mixers	3	EA	\$	4,800	\$	14,400	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars.
Aeration System	-						
Tank	1	EA	\$	3,700	\$	3,700	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic;
					· ·		adjusted to 2012 dollars.
Diffusers	1	LS	\$	400	\$	400	Based on previous project experience Quote from EWS; 53 SCFM @ 4 psi; 1 duty/ 1 stdby; incl. accessories; adjusted
Supply Blowers	2	EA	\$	30,900	\$	61,800	to 2012 dollars.
Exhaust Blowers	2	EA	\$	35,600	\$	71,200	Quote from EWS; 53 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.
Off-Gas Treatment	1	LS	\$	4,100	\$	4,100	Cost from Glendale and quotes from TIGG; 54 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars.
NaOCI Feed System							
Storage Tank	1	LS	\$	600	\$	600	Quote from Polyprocessing; 55 gal, HDPE, outdoor, incl. seismic
Metering Pumps	2	EA	\$	4,700			Quote from Prominent; 0.06 gph, 1 duty/ 1 stdby
Static Mixers	1	EA	\$	900		900	Quotes from Komax & EWS; 3-inch; adjusted to 2012 dollars.
NEO :							
MF System MF Equipment Provided by GE/Zenon	1	LS	\$	272,000	•	272.000	Quote from GE/Zenon.
Equalization Tank	1	EA	\$	2,000			Quote from Polyprocessing; 545 gal, HDPE, outdoor, inc. seismic
Backwash Waste Storage Tank	1	EA	\$	5.000			Quote from Polyprocessing; 1250 gal, HDPE, outdoor, incl. seismic
NaOCI Clean Waste Storage Tank	1	EA	\$	7,000		7.000	Quote from Plas-Tanks: 800 gal, FRP, outdoor, incl. seismic
Acid Clean Waste Storage Tank	1	EA	\$	7,000	\$	7,000	Quote from Plas-Tanks; 800 gal, FRP, outdoor, incl. seismic
Backwash Waste Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 1 duty/ 1 stdby
NaOCI Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby
Acid Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby
Cultural					•	E40.000	
Subtotal					\$	519,000	Rounded up to \$1000
Equipment Installation Cost	30%				\$	156,000	Including tax, freight, installation and manufacturer services.
Chemical Storage Containment	3	CY	\$	1,275	\$	3,953	\$1,250/CY. Adjusted to 2012 dollars.
Equipment Concrete Pads	18	CY	\$	1,275	\$	22,950	\$1,250/CY. Adjusted to 2012 dollars.
MF Building	320	SF	\$	250	\$	80 000	Previous project experience, adjusted to 2012 dollars.
	320	31	Ť	200	Ť	00,000	
Subtotal (Installed Equipment Costs)					\$	782,000	Rounded up to \$1000
General Requirements	7.5%				\$	58,650	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey,
Constant/equilentents					Ψ	50,050	erosion control, coordination, testing services, and record documents
Earthwork	5%				\$	39,100	Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$		Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$	118,000	PLC and SCADA equipment to control
Total Direct Costs	1				\$	1,155,000	Rounded up to \$1000
			1		7	.,.00,000	



Client	City of Glendale
Projec Pha	ct ase IIIA Microfiltration Pilot testing in RCF for Cr(VI) Treatment
Item	100-gpm RCF with MF System

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

Contractor's Overhead and Profit	20%		\$	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total			\$ 1,386,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%		\$ 277,200	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%		\$ 277,200	ncludes permits, legal fees and engineering fees for design and construction
Project Total			\$ 1,941,000	
			, ,	
Low Estimate			\$ 1,359,000	
High Estimate			\$ 2,912,000	<del>+</del> 50%

- 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 2012 dollars.

  3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase IIIA Microfiltration Pilot testing in
RCF for Cr(VI) Treatment

Item
500-gpm RCF with MF System
(Vacuum MF)

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

DESCRIPTION	QTY	UNIT MEAS.	UNIT (	COST	TOTAL COST		COMMENTS
Equipment							
FeSO₄ Feed System							
Storage Tank	1	EA	\$	3,400	\$	3,400	Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 1.3 gph; 1 duty/ 1 stdby; adjusted to 2012
Static Mixers	1	EA	\$	2,200	\$		dollars. Quotes from Komax & EWS; 8-inch; adjusted to 2012 dollars.
Static Wilkers	'	EA	φ	2,200	Ą	2,200	Quotes Iron Romax & Ews, 6-inch, adjusted to 2012 dollars.
Reduction Tanks							
Tanks	3	EA	\$	20,000	\$	60,000	Quotes from Core-Rosion & Ryan Herco; 8,000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.
Mixers	3	EA	\$	9,000	\$	27,000	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars.
Aeration System							
•	4	ΓA	e	C 400	•	C 400	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic;
Tanks	1	EA	\$	6,400	\$	6,400	adjusted to 2012 dollars.
Diffusers	1	LS	\$	2,000	\$	2,000	Based on previous project experience
Supply Blowers	2	EA	\$	47,200	\$	94,400	Quote from EWS; 267 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.
Exhaust Blowers	2	EA	\$	35,400	\$	70,800	Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.
Off-Gas Treatment	1	LS	\$	15,400	\$	15,400	Quotes from Calgon and TIGG; 270 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars.
							neater, adjusted to 2012 dollars.
NaOCI Feed System							
Storage Tank	1	EA	\$	1,000	\$	1,000	Quote from Polyprocessing; 115 gal, material, outdoor, incl. seismic
Metering Pumps	2	EA	\$	4,700	\$		Quote from Prominent; 0.30 gph, 1 duty/ 1 stdby
Static Mixers	1	EA	\$	2,200	\$	2,200	Quotes from Komax & EWS; 8-inch; adjusted to 2012 dollars.
MF System							
MF Equipment Provided by GE/Zenon	1	LS		625,000		625,000	Quote from GE/Zenon.
Equalization Tank	1	EA	\$	9,000	\$		Quote from Polyprocessing; 3000 gal, HDPE, outdoor, incl. seismic
Backwash Waste Storage Tank	1	EA	\$	7,000	\$		Quote from Polyprocessing; 2000 gal, HDPE, outdoor, incl. seismic
NaOCI Clean Waste Storage Tank	1	EA	\$	8,000	\$		Quote from Plas-Tanks; 1100 gal, FRP, outdoor, incl. seismic
Acid Clean Waste Storage Tank	1	EA	\$	8,000	\$	8,000	Quote from Plas-Tanks; 1100 gal, FRP, outdoor, incl. seismic
Backwash Waste Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 1 duty/ 1 stdby
NaOCI Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby
Acid Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby
							Chemical resistance, 1 duty 1 stuby
Subtotal					\$ 9	992,000	Rounded up to \$1000
Equipment Installation Cost	30%				\$	298,000	Including tax, freight, installation and manufacturer services.
	_	21/		4.075		0.400	
Chemical Storage Containment	7	CY	\$	1,275	\$	9,180	\$1,250/CY. Adjusted to 2012 dollars.
Equipment Concrete Pads	33	CY	\$	1,275	\$	42,075	\$1,250/CY. Adjusted to 2012 dollars.
MF Building	1,000	SF	\$	250	\$	250,000	Previous project experience, adjusted to 2012 dollars.
Subtotal (Installed Equipment Costs)	<u> </u>	<u> </u>	]		\$ 1,5	502 000	Rounded up to \$1000
Subtotal (Illistalled Equipment Costs)					Ψ 1,c	392,000	Rounded up to \$ 1000
General Requirements	7.5%				\$ 1		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%				\$	79,600	Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%						Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$	239,000	PLC and SCADA equipment to control
T. (   D' ( O (	1					10.000	D I . I
Total Direct Costs		l	<b>I</b>		\$ 2,3	349,000	Rounded up to \$1000



Clien	Client City of Glendale					
,	Project Phase IIIA Microfiltration Pilot testing in RCF for Cr(VI) Treatment					
Item						
	500-gpm RCF with MF System					
	(Vacuum MF)					

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

Contractor's Overhead and Profit	20%		\$	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total			\$ 2,819,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%		\$ 563,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%		\$ 563,800	includes permits, legal fees and engineering fees for design and construction
Project Total			\$ 3,947,000	
Low Estimate			\$ 2,763,000	-30%
High Estimate			\$ 5,921,000	+50%

- 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 2012 dollars.

  3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase IIIA Microfiltration Pilot testing in
RCF for Cr(VI) Treatment

Item
2,000-gpm RCF with MF System
(Vacuum MF)

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

DESCRIPTION	QTY	UNIT MEAS.	Į	JNIT COST		TOTAL COST	COMMENTS
Equipment							
FeSO₄ Feed System							
reso <sub>4</sub> reed system							Quotes from Core-Rosion & Ryan Herco; 2,000 gal PE, outdoor, incl. seismic;
Storage Tank	1	EA	\$	6,000	\$	6,000	adjusted to 2012 dollars.
Metering Pumps	2	EA	\$	6,200	\$	12,400	Quotes from C.P. Crowley & HTP; 5 gph; adjusted to 2012 dollars.
Static Mixers	1	EA	\$	4,300	\$	4,300	Quotes from Komax & EWS; 14-inch; adjusted to 2012 dollars.
Dadustica Teals							
Reduction Tanks							Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012
Mixers	3	EA	\$	24,000	\$	72,000	dollars.
							Senator
Aeration System							
Diffuser	1	LS	\$	8,200	\$	8,200	Based on previous project experience and conversation w/ Brian Bubela;
			l .		<del> </del>		adjusted to 2012 dollars.  Quote from EWS; 1,070 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessaories;
Supply Blowers	2	EA	\$	76,300	\$	152,600	adjusted to 2012 dollars.
Exhaust Blowers	2	EA	\$	59,600	\$	119,200	Quote from EWS; 1,070 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessaories;
Exhibition Diowers		LA	Ψ	33,000	Ψ	110,200	adjusted to 2012 dollars.
Off-Gas Treatment	1	LS	\$	25,800	\$	25,800	Quotes from Calgon & TIGG; 1070 SCFM; (2) adsorbers in series with one
							heater; adjusted to 2012 dollars.
NaOCI Feed System							
Storage Tank	1	LS	\$	2,300	\$	2,300	Quote from Polyprocessing; 475 gal, HDPE, outdoor, incl. seismic
Metering Pumps	2	EA	\$	4,700			Quote from Prominent; 1.22 gph, 1 duty/ 1 stdby
Static Mixers	1	EA	\$	4,300	\$	4,300	Quotes from Komax & EWS; 14-inch; adjusted to 2012 dollars.
MF System							
MF Equipment Provided by GE/Zenon	1	LS	\$	1,202,500	\$	1 202 500	Quote from GE/Zenon.
Equalization Tank	1	EA	\$	23,000			Quote from Polyprocessing; 10300 gal, HDPE, outdoor, incl. seismic
Backwash Waste Storage Tank	1	EA	\$	16,000	\$		Quote from Polyprocessing; 5050 gal, HDPE, outdoor, incl. seismic
NaOCI Clean Waste Storage Tank	1	EA	\$	12,000	\$		Quote from Plas-Tanks; 3500 gal, FRP, outdoor, incl seismic
Acid Clean Waste Storage Tank	1	EA	\$	12,000	\$	12,000	Quote from Plas-Tanks; 3500 gal, FRP, outdoor, incl. seismic
Backwash Waste Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 1 duty/ 1 stdby
NaOCI Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby
Acid Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for
Tion trade const. Blostialige i ampe	-		Ť	0,000	*	12,000	chemical resistance, 1 duty/ 1 stdby
L Subtotal					\$	1,716,000	Rounded up to \$1000
Gubtotai					Ÿ	1,7 10,000	rounded up to \$1000
Equipment Installation Cost (30% of Equipment)	30%				\$	515,000	Including tax, freight, installation and manufacturer services.
Reduction Tanks	440	0)/	•	744	Φ.	00.000	25 ft x 75 ft tank, including 3 sub-tanks with shared walls
Slab	140	CY	\$	714	\$		Based on 2 ft slab or wall; \$700/CY, adjusted to 2012 dollars.  Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY, adjusted to 2012
Walls	155	CY	\$	816	\$	126,480	dollars.
Elevated Slab	140	CY	\$	1,122	\$	157,080	Based on 2 ft slab or wall; \$1,100/CY, adjusted to 2012 dollars.
Aeration Tanks	17	CV	•	74.4	¢	40 400	15 ft x 15 ft tank
Slab	17	CY	\$	714	\$		Based on 2 ft slab or wall; \$700/CY, adjusted to 2012 dollars.  Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY, adjusted to 2012
Walls	35	CY	\$	816	\$	28,560	dollars.
Elevated Slab	17	CY	\$	1,122	\$	19,074	Based on 2 ft slab or wall; \$1,100/CY, adjusted to 2012 dollars.
			L	-			150, 450, 1
Rapid Mixing Tanks	17	CY	\$	714	¢	10 100	15 ft x 15 ft tank Based on 2 ft slab or wall; \$700/CY, adjusted to 2012 dollars.
Slab					\$		Based on 2 ft slab or wall; \$700/CY, adjusted to 2012 dollars.  Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY, adjusted to 2012
Walls	35	CY	\$	816	\$	28,560	dollars.
Elevated Slab	17	CY	\$	1,122	\$	19,074	Based on 2 ft slab or wall; \$1,100/CY, adjusted to 2012 dollars.
			Ļ		Ļ		
Chemical Storage Containment	19	CY	\$	1,275	\$	23,715	\$1,250/CY. Adjusted to 2012 dollars.
Equipment Concrete Pads	23	CY	\$	1,275	\$	29.325	\$1,250/CY. Adjusted to 2012 dollars.
Equipment control of add	- 20	31	۳	1,210	Ψ	20,020	φτ <sub>1</sub> 250/51. Λαμοίου το 2012 ασπατό.



Client City of Glendale Project Phase IIIA Microfiltration Pilot testing in RCF for Cr(VI) Treatment Item 2,000-gpm RCF with MF System (Vacuum MF)

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

T				П
Subtotal (Installed Equipment Costs)		\$	3,263,000	Rounded up to \$1000
Canada Danisana	7.5%		044.705	Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%	\$	244,725	utilities, health and safety, office supplies, clean up, photographs, survey,
Earthwork	5%	\$	100 150	erosion control, coordination, testing services, and record documents
Lartnwork	5%	2	103,150	Excavation, backfill, and fill required to construct project
Site Improvements	5%	\$	163,150	Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%	\$		Major system piping and valves
Electrical, Instrumentation and Controls	15%	\$	490,000	PLC and SCADA equipment to control
Total Direct Costs		\$	4,814,000	Rounded up to \$1000
Contractor's Overhead and Profit	20%	\$	962,800	Includes bonds, mobilization and demobilization, insurance, overhead and
Contractor o o vernoda dira i ront	2070	Ť	002,000	profit, and management reserves
Construction Total		\$	5,776,800	
	000/		4 455 000	
Project Level Allowance (contingency)	20%	\$		Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%	\$	1,155,360	Includes permits, legal fees and engineering fees for design and construction
Project Total			8,088,000	
rioject rotai		•	0,000,000	
Low Estimate		\$	5,662,000	30%
High Estimate		\$	12,132,000	
i ligii Lətiiliate		Ý	12,132,000	F-00 /0

- 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 2012 dollars. 3. Costs for land or easements are not included.



### Estimated RCF with Vacuum MF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 100 Number of MF Trains 1

Number of Wir Trains							Lab										Field		
Sample Location	Tot	al Fe	Cr(VI) & Total Cr	Alk	alinity	Hardness	TSS	Silica	VOC	s	DBF		Bac-T (E. Coli, T. Coli and HPC)		Ferrous	Total Fe		Free Chlorine	pH & Temperature
Raw		1	4		1	1		1						4	1	1	1		4
After ferrous addition															4	4			continuous
After 1st reduction tank															4	4			4
After 2nd reduction tank															1	1			4
After 3rd reduction tank			4							1					4	4			4
Aeration off gas (raw)										1									
Aeration off gas (after first VPGAC)										1									
Aeration off gas (after 2nd VPGAC)										1									
MF feed (after Cl <sub>2</sub> injection)			2	-	1	1	4		-	1					4			continuous	continuous
MF permeate		4	4	-	1	1	4		-			1	4	4	4	4	continuous		continuous
MF backwash waste		1	1		1	1	1								1	1	4		4
MF maintenance clean waste		1	1		1	1	1		-			1		1	1	1		continuous	continuous
MF CIP NaOCI waste		1	1		1	1	1		-			1		1	1	1	1	continuous	continuous
MF CIP acid waste		1	1		1	1	1					1		1	1	1	1		continuous
Number of samples per month^		9	20		7	7	12			5		4	4	11	26	26	8		20
Unit cost (\$/sample)	\$	14	\$ 67		15					112		150							
Sample analysis Cost (\$/year)	\$	1,487	\$ 16,157	\$	1,285	\$ 1,285	\$ 2,203	\$ 165	\$ (	6,732	\$	7,200	\$ 2,815						
Shipping fee (\$/year)	\$	1,560	One shipm	ent p	er week	, \$30 per shi	pment												
Sum of lab analysis cost (\$/year)	\$	40,890	Sample an	alysis	s plus sh	ipping fee													
Field meters	\$	6,000	Hach Dr 38	300, p	oortable	pH meter an	d turbidity m	eter											
Field analysis cost	\$	2,000	Estimate for	r rea	agents ar	nd apparatus	based on e	xperience; r	not inc	luding	labor	r for field	d analysis						
Total analysis cost	\$	42,890	Including la	b an	d field ar	nalysis costs	; not includir	ng labor and	l field r	meters									

<sup>\*</sup> 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).

TSS - total suspended solids; VOCs - volatile organic compounds; DBPs - disinfection byproducts; VPGAC - vapor phase granular activated carbon Unit cost adjusted to 2012 dollars.



### Estimated RCF with Vacuum MF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) Number of MF Trains

Number of MF Trains				3			Lab										Field		
Sample Location	Tot	Cr(VI) & otal Fe Total Cr Alkalinity				Hardness	TSS	Silica	vc	)Cs	DBPs	(E	ac-T E. Coli, T. oli and PC)		Ferrous	Total Fe	Turbidity	Free Chlorine	pH & Temperature
Raw		1	4	4	1	1			1					4	. 1	1	1		4
After ferrous addition															4	4	ļ.		continuous
After 1st reduction tank															4	4	ļ		4
After 2nd reduction tank				1 1												4			
After 3rd reduction tank			4	4						1					4	4	ļ.		4
Aeration off gas (raw)										1									
Aeration off gas (after first VPGAC)										1									
Aeration off gas (after 2nd VPGAC)										1									
MF feed (after Cl <sub>2</sub> injection)	-		4	4	1	1	4			1		-			4	4	continuous	continuous	continuous
MF permeate (per train)	-	4	4	4	1	1	4					1	4	4	4	4	continuous		continuous
MF backwash waste	-	1		1	1	1	1								1	1	4		4
MF maintenance clean waste	-	1		1	1	1	1					1		1	1	1	1	continuous	continuous
MF CIP NaOCI waste	<u> </u>	1		1	1	1	1					1		1	1	1	1	continuous	continuous
MF CIP acid waste	<u> </u>	1		1	1	1	1		-			1		1	1	1	1		continuous
Number of samples per month^	<u> </u>	17	28	8	9	9	20		1	5		6	12	19	34	34	8	3	20
Unit cost (\$/sample)	\$	14	-	_					\$			) \$							
Sample analysis Cost (\$/year)	\$	2,809	\$ 22,620	\$	1,652	\$ 1,652	\$ 3,672	\$ 165	\$	6,732	\$ 10,800	) \$	8,446						
Shipping fee (\$/year)	\$	1,560	One shipm	nent	per week	, \$30 per shi	pment												
Sum of lab analysis cost (\$/year)	\$	60,108	Sample an	alys	sis plus sh	ipping fee													
Field meters	\$	6,000	Hach Dr 3	800	, portable	pH meter an	d turbidity m	neter											
Field analysis cost	\$	3,000	Estimate for	or re	eagents ar	nd apparatus	based on e	xperience;	not i	including	labor for fie	eld a	analysis						
Total analysis cost	\$	63,108	Including la	ncluding lab and field analysis costs; not including labor and field meters															

<sup>\*</sup> 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).

TSS - total suspended solids; VOCs - volatile organic compounds; DBPs - disinfection byproducts; VPGAC - vapor phase granular activated carbon Unit cost adjusted to 2012 dollars.



### Estimated RCF with Vacuum MF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 2,000 Number of MF Trains 2

Number of MF Trains							Lab											Field		
Sample Location	Tot	al Fe	Cr(VI) & Total Cr	Alk	calinity	Hardness	TSS	Silica	vo	Cs	DB		Bac-T (E. Co Coli a HPC)	li, T. nd		Ferrous	Total Fe	Turbidity	Free Chlorine	pH & Temperature
Raw		1	4	1	1	1		1							4	1	1	1		4
After ferrous addition																4	4	ļ.		continuous
After 1st reduction tank																4	4	ļ		4
After 2nd reduction tank																1	1			4
After 3rd reduction tank			4	ı						1						4	4	ļ.		4
Aeration off gas (raw)										1										
Aeration off gas (after first VPGAC)										1										
Aeration off gas (after 2nd VPGAC)										1										
MF feed (after Cl <sub>2</sub> injection)			4	ı	1	1	4			1						4	4	continuous	continuous	continuous
MF permeate (per train)		4	4	ı	1	1	4					1		4	4	4	4	continuous		continuous
MF backwash waste		1	1		1	1	1									1	1	4		4
MF maintenance clean waste		1	1		1	1	1					1			1	1	1	1	continuous	continuous
MF CIP NaOCI waste		1	1		1	1	1					1			1	1	1	1	continuous	continuous
MF CIP acid waste		1	1		1	1	1					1			1	1	1	1		continuous
Number of samples per month^		13	24	ļ	8	8	16	1		5		5		8	15	30	30	8		20
Unit cost (\$/sample)	\$	14	\$ 67	\$	15	\$ 15	\$ 15	\$ 14	\$	112	\$	150	\$	59						
Sample analysis Cost (\$/year)	\$	2,148	\$ 19,388	\$	1,469	\$ 1,469	\$ 2,938	\$ 165	\$	6,732	\$	9,000	\$ 5,	,630						
Shipping fee (\$/year)	\$	1,560	One shipm	ent p	per week	, \$30 per shi	pment													
Sum of lab analysis cost (\$/year)	\$	50,499	Sample an	alysi	s plus sh	ipping fee														
Field meters	\$	6,000	Hach Dr 38	300,	portable	pH meter an	d turbidity n	neter												
Field analysis cost	\$	5,000	Estimate fo	or rea	agents ar	nd apparatus	based on e	experience;	not ir	ncluding	lab	or for field	d analy	sis						
Total analysis cost	\$	55,499	Including la	ab ar	nd field ar	nalysis costs	; not includi	ng labor and	field	d meters										

<sup>\*</sup> 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).

TSS - total suspended solids; VOCs - volatile organic compounds; DBPs - disinfection byproducts; VPGAC - vapor phase granular activated carbon Unit cost adjusted to 2012 dollars.



# Estimated RCF with Vacuum MF O&M Costs (in 2012 Dollars)

_					Pre-Tre	atm	nent				Vacı	ıum	MF Syste	em		1									
																Main	tenance								
	System Size	Ferrou	IS	Sodi	um	۷P	GAC			Me	embrane					and	Spare	Wa	stewater			Lab a	nd Field		
	(gpm)	Sulfate	<b>∍</b> ¹	Нуро	chlorite	Replacement		Electricity <sup>2</sup>		Replacement		Chemicals <sup>3</sup>		Electricity <sup>4</sup>		Parts		Discharge		Labor		Analy	sis <sup>5</sup>	Annu	al O&M
	100	\$	5,300	\$	1,000	\$	1,200	\$	36,000	\$	900	\$	600	\$	1,000	\$	19,000	\$	14,400	\$	103,000	\$	42,900	\$	225,000
	500	\$	23,000	\$	2,200	\$	22,000	\$	96,000	\$	4,200	\$	2,200	\$	4,800	\$	39,000	\$	57,400	69	187,000	\$	63,100	\$	501,000
	2,000	\$	89,000	\$	7,600	\$	61,000	\$	161,000	\$	13,000	\$	7,500	\$	16,800	\$	81,000	\$	218,700	\$	313,000	\$	55,500	\$	1,024,000

- 1. Ferrous sulfate is based on a ferrous dose of 2.0 mg/L as Fe.
- 2. Electricity includes energy for aeration blowers and aeration off-gas treatment.
- 3. Chemicals do not include these for Maintenance Cleans for 100 and 500 gpm systems, as they are not expected necessary according to GE/Zenon. For 2000 gpm system, sodium hypochlorite is assumed for Maintenance Cleans.
- 4. Electricity includes energy process pump(s) and air compressor(s) based on a total dynamic head of 21.9 feet, as provided by GE/Zenon.
- 5. Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis.

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

	Net Present
System Size	Value for 20
(gpm)	Years
100	\$ 3,800,000
500	\$ 8,400,000
2,000	\$ 17,000,000

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



Client
City of Glendale

Project
Phase IIIA Microfiltration Pilot testing in RCF
for Cr(VI) Treatment

Item

100-gpm RCF with MF System (Pressure MF)

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

DESCRIPTION	QTY	UNIT MEAS.		UNIT COST		TOTAL COST	COMMENTS							
Equipment														
			<u> </u>											
FeSO₄ Feed System														
Storage Tank	1	EA	\$	2,700	\$	2,700	Quotes from Ryan Herco & Core-Rosion; 100 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.							
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/ 1 stdby; adjusted to 2012							
Static Mixers	1	EA	\$	900	\$	900	Quotes from Komax & EWS; 3-inch; adjusted to 2012 dollars.							
Reduction Tanks														
Tanks	3	EA	\$	5,200	\$	15,600	Quotes from Core-Rosion & Ryan Herco; 1,700 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.							
Mixers	3	EA	\$	4,800	\$	14,400	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars.							
Aeration System														
Tank	1	EA	\$	3,700	\$	3,700	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.							
Diffusers	1	LS	\$	400	\$	400	Based on previous project experience							
Supply Blowers	2	EA	\$	30,900	\$		Quote from EWS; 53 SCFM @ 4 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.							
Exhaust Blowers	2	EA	\$	35,600	\$	71,200	Quote from EWS; 53 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.							
Off-Gas Treatment	1	LS	\$	4,100	\$	4,100	Cost from Glendale and quotes from TIGG; 54 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars.							
NaOCI Feed System					L									
Storage Tank	1 2	LS EA	\$	600	\$	600	Quote from Polyprocessing; 55 gal, HDPE, outdoor, incl. seismic							
Metering Pumps	1	EA EA	\$	4,700 900			Quote from Prominent; 0.06 gph, 1 duty/ 1 stdby							
Static Mixers		EA	Þ	900	Þ	900	Quotes from Komax & EWS; 3-inch; adjusted to 2012 dollars.							
MF System														
MF Equipment Provided by Pall	1	LS	\$	371,000	\$	371,000	Quote from Pall, incl one feed tank and one reverse filtration tank							
Backwash Waste Storage Tank	1	EA	\$	2,000	\$	2,000	Quote from Polyprocessing; 475 gal, HDPE, outdoor, incl. seismic							
NaOCI Clean Waste Storage Tank	1	EA	\$	7,000			Quote from Plas-Tanks; 800 gal, FRP, outdoor, incl. seismic							
Acid Clean Waste Storage Tank	1	EA	\$	7,000	\$	7,000	Quote from Plas-Tanks; 800 gal, FRP, outdoor, incl. seismic							
Backwash Waste Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 1 duty/ 1 stdby							
NaOCI Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby							
Acid Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby							
Subtotal					\$	613 000	Rounded up to \$1000							
Oubtotal					۳	013,000	Γιουπασα αρ το φ τουο							
Equipment Installation Cost	30%				\$	184,000	Including tax, freight, installation and manufacturer services.							
Chemical Storage Containment	5	CY	\$	1,275	\$	6,503	\$1,250/CY. Adjusted to 2012 dollars.							
Equipment Concrete Pads	21	CY	\$	1,275	\$	26,775	\$1,250/CY. Adjusted to 2012 dollars.							
MF Building	320	SF	\$	250	\$	80,000	Previous project experience, adjusted to 2012 dollars.							
Subtotal (Installed Equipment Costs)					\$	911,000	Rounded up to \$1000							
	-		<u> </u>		┞									
General Requirements	7.5%				\$	68,325	Division 1 requirements, including labor supervision, field offices, temporary utilities, health and safety, office supplies, clean up, photographs, survey, erosion							
Earthwork	5%		├		\$	45,550	control, coordination, testing services, and record documents  Excavation, backfill, and fill required to construct project							
Site Improvements	5%		$\vdash$		\$		Excavation, backfill, and fill required to construct project  Roadways, curb and gutter, sidewalk and landscaping							
Valves, Piping, and Appurtenances	15%				\$		Major system piping and valves							
Electrical, Instrumentation and Controls	15%				\$		PLC and SCADA equipment to control							
Total Direct Costs			1		\$	1,344,000	Rounded up to \$1000							



Client	City of Glendale
Project Phase	ct e IIIA Microfiltration Pilot testing in RCF for Cr(VI) Treatment
Item	
	100-gpm RCF with MF System
	(Pressure MF)

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

Contractor's Overhead and Profit	20%		\$	208.800	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
Construction Total			\$	1,613,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%		\$	322,600	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%		\$ 322,600 Ir		Includes permits, legal fees and engineering fees for design and construction
Project Total			\$	2,259,000	
			•	4 504 000	2004
Low Estimate High Estimate			\$	1,581,000 3,389,000	

- 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 2012 dollars.

  3. Costs for land or easements are not included.



Client
City of Glendale
Project

Phase IIIA Microfiltration Pilot testing in RCF for Cr(VI) Treatment

Item

500-gpm RCF with MF System (Pressure MF)

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

DESCRIPTION	QTY	UNIT MEAS.	U	NIT COST	Т	TOTAL COST	COMMENTS				
Equipment	<u> </u>	OTTO MENT	<u> </u>	0001		017.12 0001	OOMMENTO				
• •											
FeSO <sub>4</sub> Feed System											
Storage Tank	1	EA	\$	3,400	\$	3,400	Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 1.3 gph; 1 duty/ 1 stdby; adjusted to 2012 dollars.				
Static Mixers	1	EA	\$	2,200	\$	2,200					
Reduction Tanks											
Tanks	3	EA	\$	20,000	\$	60,000	Quotes from Core-Rosion & Ryan Herco; 8,000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Mixers	3	EA	\$	9,000	\$	27,000	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012 dollars.				
Aeration System											
Tanks	1	EA	\$	6,400	\$	6,400	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Diffusers	1	LS	\$	2,000	\$	2,000	Based on previous project experience				
Supply Blowers	2	EA	\$	47,200	\$	94,400	Quote from EWS; 267 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.				
Exhaust Blowers	2	EA	\$	35,400	\$	70,800	Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories; adjusted to 2012 dollars.				
Off-Gas Treatment	1	LS	\$	15,400	\$	15,400	Quotes from Calgon and TIGG; 270 SCFM; (2) adsorbers in series with one heater; adjusted to 2012 dollars.				
NaOCI Feed System											
Storage Tank	1	EA	\$	1,000	_		Quote from Polyprocessing; 115 gal, HDPE, outdoor, incl. seismic				
Metering Pumps	2	EA	\$	4,700	\$		Quote from Prominent; 0.30 gph, 1 duty/ 1 stdby				
Static Mixers	1	EA	\$	2,200	\$	2,200	Quotes from Komax & EWS; 8-inch; adjusted to 2012 dollars.				
MF System											
MF Equipment Provided by Pall	1	LS	\$	495,000	\$	495.000	Quote from Pall, incl. one feed tank and one reverse filtration tank				
Backwash Waste Storage Tank	1	EA	\$	4,000	\$	4.000	Quote from Polyprocessing; 1500 gal, HDPE, outdoor, incl. seismic				
NaOCl Clean Waste Storage Tank	1	EA	\$	12,000	\$		Quote from Plas-Tanks; 3,000 gal, FRP, outdoor, incl. seismic				
Acid Clean Waste Storage Tank	1	EA	\$	11,000	\$	11,000					
Backwash Waste Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 1 duty/ 1 stdby				
NaOCI Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby				
Acid Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/1 stdby				
Subtotal	<u> </u>				\$	857.000	Rounded up to \$1000				
						, , , , , , , , , , , , , , , , , , , ,					
Equipment Installation Cost	30%				\$	258,000	Including tax, freight, installation and manufacturer services.				
Chemical Storage Containment	9	CY	\$	1,275	\$	10,838	\$1,250/CY. Adjusted to 2012 dollars.				
Equipment Concrete Pads	31	CY	\$	1,275	\$	39,525	\$1,250/CY. Adjusted to 2012 dollars.				
MF Building	1,000	SF	\$	250	\$	250,000	Previous project experience, adjusted to 2012 dollars.				
			<u> </u>								
Subtotal (Installed Equipment Costs)					\$	1,416,000	Rounded up to \$1000				
General Requirements	7.5%				\$	106,200	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%		<del>                                     </del>		\$	70 800	Excavation, backfill, and fill required to construct project				
Site Improvements	5%				\$		Roadways, curb and gutter, sidewalk and landscaping				
Valves, Piping, and Appurtenances	15%				\$		Major system piping and valves				
Electrical, Instrumentation and Controls	15%				\$		PLC and SCADA equipment to control				
Total Direct Costs			1		\$	2.090.000	Rounded up to \$1000				



Client City of Glendale Project Phase IIIA Microfiltration Pilot testing in RCF for Cr(VI) Treatment Item 500-gpm RCF with MF System (Pressure MF)

Project No. 20002.001	
	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

Contractor's Overhead and Profit	20%	\$		Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
				profit, and management reserves
Construction Total		\$	2,508,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%	\$		Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%	\$	501,600	Includes permits, legal fees and engineering fees for design and construction
Project Total		\$	3,512,000	
Low Estimate		\$	2,458,000	-30%
High Estimate		\$	5,268,000	<b>⊦</b> 50%

- 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 2012 dollars. 3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase IIIA Microfiltration Pilot testing in
RCF for Cr(VI) Treatment

2,000-gpm RCF with MF System (Pressure MF)

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST			TOTAL COST	COMMENTS				
Equipment											
FeSO <sub>4</sub> Feed System											
Storage Tank	1	EA	\$	6,000	\$	6,000	Quotes from Core-Rosion & Ryan Herco; 2,000 gal PE, outdoor, incl. seismic; adjusted to 2012 dollars.				
Metering Pumps	2	EA	\$	6,200	\$	12,400	Quotes from C.P. Crowley & HTP; 5 qph; adjusted to 2012 dollars.				
Static Mixers	1	EA	\$	4,300			Quotes from Komax & EWS; 14-inch; adjusted to 2012 dollars.				
Reduction Tanks											
Mixers	3	EA	\$	24,000	\$	72,000	Quotes from Core-Rosion & EWS; G = 60 per second; adjusted to 2012				
			Ľ	,,,,,	Ļ.	,	dollars.				
Aeration System					╁						
					+		Based on previous project experience and conversation w/ Brian Bubela;				
Diffuser	1	LS	\$	8,200	\$	8,200	adjusted to 2012 dollars.				
Cunnik Blaucra	2	EA	\$	76,300	\$	152,600	Quote from EWS; 1,070 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessaories;				
Supply Blowers	2	EA	Ф	70,300	ф	152,000	adjusted to 2012 dollars.				
Exhaust Blowers	2	EA	\$	59,600	\$	119,200	Quote from EWS; 1,070 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessaories;				
ZANGGO BIONOIO			Ť		Ľ	110,200	adjusted to 2012 dollars.				
Off-Gas Treatment	1	LS	\$	25,800	\$	25,800	Quotes from Calgon & TIGG; 1070 SCFM; (2) adsorbers in series with one				
			Ė		H		heater; adjusted to 2012 dollars.				
NaOCI Feed System			$\vdash$		╁						
Storage Tank	1	LS	\$	2,300	\$	2 300	Quote from Polyprocessing; 475 gal, HDPE, outdoor, incl. seismic				
Metering Pumps	2	EA	\$	4,700			Quote from Prominent; 1.22 gph, 1 duty/ 1 stdby				
Static Mixers	1	EA	\$	4,300			Quotes from Komax & EWS; 14-inch; adjusted to 2012 dollars.				
				, , , , , ,	Γ						
MF System											
MF Equipment Provided by Pall	1	LS	\$	1,100,000	_		Quote from Pall, incl. two feed tanks and two reserve filtration tanks.				
Equalization Tank	1	EA	\$	9,000	\$	9,000	Quote from Polyprocessing; 3000 gal, HDPE, outdoor, incl. seismic				
Backwash Waste Storage Tank	1	EA	\$	9,000	\$	9,000	Quote from Polyprocessing; 3000 gal, HDPE, outdoor, incl. seismic				
NaOCI Clean Waste Storage Tank	1	EA	\$	13,000	\$	13,000	Quote from Plas-Tanks; 4000 gal, FRP, outdoor, incl. seismic				
Acid Clean Waste Storage Tank	1	EA	\$	13,000	\$	13,000	Quote from Plas-Tanks; 4000 gal, FRP, outdoor, incl. seismic				
Backwash Waste Sewer Discharge Pumps	2	EA	\$	5,000	\$	10,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 1 duty/ 1 stdby				
NaOCI Waste Sewer Discharge Pumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for chemical resistance, 1 duty/ 1 stdby				
Asid Wests Cower Discharge Dumps	2	EA	\$	6,000	\$	12,000	Quote based Upon 175 gpm Hydromatic Submersible Pump, 25% added for				
Acid Waste Sewer Discharge Pumps	2	EA	Ф	6,000	ф	12,000	chemical resistance, 1 duty/ 1 stdby				
Subtotal					\$	1,595,000	Rounded up to \$1000				
F. '	200/				_	470.000					
Equipment Installation Cost (30% of Equipment)	30%				\$	479,000	Including tax, freight, installation and manufacturer services.				
Reduction Tanks					1		25 ft x 75 ft tank, including 3 sub-tanks with shared walls				
Slab	140	CY	\$	714	\$	99,960	Based on 2 ft slab or wall; \$700/CY, adjusted to 2012 dollars.				
		CY	\$		T		Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY, adjusted to 2012				
Walls	155	-	Þ	816	\$	•	dollars.				
Elevated Slab	140	CY	\$	1,122	\$	157,080	Based on 2 ft slab or wall; \$1,100/CY, adjusted to 2012 dollars.				
Aeration Tanks					t		15 ft x 15 ft tank				
Slab	17	CY	\$	714	\$	12,138	Based on 2 ft slab or wall; \$700/CY, adjusted to 2012 dollars.				
Walls	35	CY	\$	816	\$	28,560	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY, adjusted to 2012 dollars.				
Elevated Slab	17	CY	\$	1,122	\$	19,074					
					Γ						
Rapid Mixing Tanks			oxdot		L		15 ft x 15 ft tank				
Slab	17	CY	\$	714	\$	12,138					
Walls	35	CY	\$	816	\$	28,560	Based on 2 ft slab or wall; and 2 ft freeboard; \$800/CY, adjusted to 2012				
Elevated Slab	17	CY	\$	1,122	_		dollars. Based on 2 ft slab or wall; \$1,100/CY, adjusted to 2012 dollars.				
Elevated SidD	17	UT UT	à	1,122	1 3	19,074	Daseu on Z it siab of wall, \$1,100/01, aujusteu to 2012 dollars.				
Chemical Storage Containment	18	CY	\$	1,275	\$	23,460	\$1,250/CY. Adjusted to 2012 dollars.				
		<u> </u>	Ť	1,210	۲	20,100	- 1,220,511, regarded to 2012 deliaio.				
Equipment Concrete Pads	22	CY	\$	1,275	\$	28,050	\$1,250/CY. Adjusted to 2012 dollars.				



Clien	t											
	City of Glendale											
Proje Ph	ase IIIA Microfiltration Pilot testing in RCF for Cr(VI) Treatment											
Item												
	2,000-gpm RCF with MF System											
	(Pressure MF)											

Project No. 20002.001	
By B.P & Y.W.	Ckd: Y.W. & N.B.
Date 12/31/12	Date: 1/11/13

			T.		_		IL
MF Building	1,900	SF	\$	250	\$	475,000	Previous project experience, adjusted to 2012 dollars.
Subtotal (Installed Equipment Costs)					\$	3,104,000	Rounded up to \$1000
							Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%				\$	232,800	utilities, health and safety, office supplies, clean up, photographs, survey,
							erosion control, coordination, testing services, and record documents
Earthwork	5%				\$		Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$	155 200	Roadways, curb and gutter, sidewalk and landscaping
one improvemente	070				Ÿ	100,200	todawayo, carb and gattor, oldowant and landocaping
Malan Biring and Armadan day	450/		-		•	400,000	
Valves, Piping, and Appurtenances	15%		-		\$		Major system piping and valves
Electrical, Instrumentation and Controls	15%		-		\$	466,000	PLC and SCADA equipment to control
T. I.D. I.O. I	1		_			4 550 000	D + + + \$4000
Total Direct Costs			_		\$	4,579,000	Rounded up to \$1000
			_				
Contractor's Overhead and Profit	20%				\$		Includes bonds, mobilization and demobilization, insurance, overhead and
Some dotter of Stormond direct Form	2070				*	0.10,000	profit, and management reserves
Construction Total					\$	5,494,800	
Project Level Allowance (contingency)	20%				\$		Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$	1,098,960	Includes permits, legal fees and engineering fees for design and construction
Project Total					\$	7,693,000	
Low Estimate				-	\$	5,385,000	
High Estimate					\$	11,540,000	+50%

- 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 2012 dollars. 3. Costs for land or easements are not included.



### Estimated RCF with Pressure MF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 100 Number of MF Trains 1

Number of MF Trains	Lab																	Field			
Sample Location	Tota		Cr(VI) & Total Cı		Alkalinity	Hardness	TSS	S	ilica	voc	Ss	DB		Bac- (E. C Coli a HPC)	oli, T. and	Cr(VI)*	Ferrous	Total Fe	Turbidity	Free Chlorine	pH & Temperature
Raw		1		4		1	1		1							4	1	1	1		4
After ferrous addition																	4	4			continuous
After 1st reduction tank																	4	4			4
After 2nd reduction tank																	1	1			4
After 3rd reduction tank				4							1						4	4			4
Aeration off gas (raw)											1										
Aeration off gas (after first VPGAC)											1										
Aeration off gas (after 2nd VPGAC)											1										
MF feed (after Cl <sub>2</sub> injection)				4		1	1	4			1						4	4	continuous	continuous	continuous
MF permeate		4		4		1	1	4					1		4	4	4	4	continuous		continuous
MF backwash waste		1		1		1	1	1									1	1	4	!	4
MF maintenance clean waste		1		1		1	1	1					1			1	1	1	1	continuous	continuous
MF CIP NaOCI waste		1		1		1	1	1					1			1	1	1	1	continuous	continuous
MF CIP acid waste		1		1		1	1	1					1			1	1	1	1		continuous
Number of samples per month^		9		20		7	7 1	2	1		5		4		4	11	26	26	8	3	20
Unit cost (\$/sample)	\$							5 \$			112		150		59						
Sample analysis Cost (\$/year)	\$	1,487	\$ 16,1	57	\$ 1,285	\$ 1,285	\$ 2,203	3 \$	165	\$	6,732	\$	7,200	\$ 2	2,815						
Shipping fee (\$/year)	\$	1,560	One shi	ome	nt per wee	k, \$30 per sl	nipment														
Sum of lab analysis cost (\$/year)	\$ 4	40,890	Sample	anal	lysis plus s	hipping fee															
Field meters	\$	6,000	Hach Dr	380	00, portable	pH meter a	nd turbidity	met	ter												
Field analysis cost	\$	2,000	Estimate	e for	reagents	and apparatu	s based on	exp	perience; n	ot ind	cluding	lab	or for field	d anal	lysis						
Total analysis cost	\$ 4	42,890	Including	j lab	and field	analysis cost	s; not includ	ding	labor and	field	meters										

<sup>\*</sup> 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).

TSS - total suspended solids; VOCs - volatile organic compounds; DBPs - disinfection byproducts; VPGAC - vapor phase granular activated carbon Unit cost adjusted to 2012 dollars.



### Estimated RCF with Pressure MF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 50 Number of MF Trains

Number of MF Trains	Lab									Field										
Sample Location	Tot		Cr(VI) & Total Cr	A	Alkalinity	Hardness	TSS	Silica	voc	Ss	DBI		Bac-T (E. Coli, T. Coli and HPC)		Ferrous	Total Fe	Turbidity	Free Chlorine	pH & Temperature	
Raw		1		4	1	1			1					4	. 1	1	1		4	
After ferrous addition															4	4			continuous	
After 1st reduction tank															4	4			4	
After 2nd reduction tank															1	1			4	
After 3rd reduction tank				4						1					4	4			4	
Aeration off gas (raw)										1										
Aeration off gas (after first VPGAC)										1										
Aeration off gas (after 2nd VPGAC)										1										
MF feed (after Cl <sub>2</sub> injection)				4	1	1	4		-	1					4	4	continuous	continuous	continuous	
MF permeate (per train)		4		4	1	1	4		-			1	4	. 4	4	4	continuous		continuous	
MF backwash waste		1		1	1	1	1		-						1	1	4	!	4	
MF maintenance clean waste		1		1	1	1	1		-			1		1	1	1	1	continuous	continuous	
MF CIP NaOCI waste		1		1	1	1	1		-			1		1	1	1	1	continuous	continuous	
MF CIP acid waste		1		1	1	1	1					1		1	1	1	1		continuous	
Number of samples per month^		9	:	20	7	7	12		1	5		4	4	. 11	26	26	8	3	20	
Unit cost (\$/sample)	\$	14			\$ 15				\$	112		150								
Sample analysis Cost (\$/year)	\$	1,487	\$ 16,15	7	\$ 1,285	\$ 1,285	\$ 2,203	\$ 165	\$	6,732	\$	7,200	\$ 2,815							
Shipping fee (\$/year)	\$	1,560 One shipment per week, \$30 per shipment																		
Sum of lab analysis cost (\$/year)	\$	40,890	,890 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	\$	\$ 43,890 Including lab and field analysis costs; not including labor and field meters																		

<sup>\*</sup> 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).

TSS - total suspended solids; VOCs - volatile organic compounds; DBPs - disinfection byproducts; VPGAC - vapor phase granular activated carbon Unit cost adjusted to 2012 dollars.



### Estimated RCF with Pressure MF Water Quality Monitoring (Number of Samples per Month)

Flow Rate (gpm) 2,000 Number of MF Trains 2

Number of MF Trains	Lab								Field											
Sample Location	Tot	al Fe	Cr(VI) & Total Cr	Alk	calinity	Hardness	TSS	Silica	vo	Cs	DB		Bac-T (E. Co Coli a HPC)	nd		Ferrous	Total Fe	Turbidity	Free Chlorine	pH & Temperature
Raw		1	4	1	1	1		1							4	1	1	1		4
After ferrous addition																4	4	ļ.		continuous
After 1st reduction tank																4	4	ļ		4
After 2nd reduction tank																1	1			4
After 3rd reduction tank			4	ı						1						4	4	ļ.		4
Aeration off gas (raw)										1										
Aeration off gas (after first VPGAC)										1										
Aeration off gas (after 2nd VPGAC)										1										
MF feed (after Cl <sub>2</sub> injection)			4	ı	1	1	4			1						4	4	continuous	continuous	continuous
MF permeate (per train)		4	4	ı	1	1	4					1		4	4	4	4	continuous		continuous
MF backwash waste		1	1		1	1	1									1	1	4		4
MF maintenance clean waste		1	1		1	1	1					1			1	1	1	1	continuous	continuous
MF CIP NaOCI waste		1	1		1	1	1					1			1	1	1	1	continuous	continuous
MF CIP acid waste		1	1		1	1	1					1			1	1	1	1		continuous
Number of samples per month^		13	24	ļ	8	8	16	1		5		5		8	15	30	30	8		20
Unit cost (\$/sample)	\$	14	\$ 67	\$	15	\$ 15	\$ 15	\$ 14	\$	112	\$	150	\$	59						
Sample analysis Cost (\$/year)	\$	2,148	\$ 19,388	\$	1,469	\$ 1,469	\$ 2,938	\$ 165	\$	6,732	\$	9,000	\$ 5,	630						
Shipping fee (\$/year)	\$	1,560	1,560 One shipment per week, \$30 per shipment																	
Sum of lab analysis cost (\$/year)	\$	50,499	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	\$	\$ 55,499 Including lab and field analysis costs; not including labor and field meters																		

<sup>\*</sup> 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).

TSS - total suspended solids; VOCs - volatile organic compounds; DBPs - disinfection byproducts; VPGAC - vapor phase granular activated carbon Unit cost adjusted to 2012 dollars.



# Estimated RCF with Pressure MF O&M Costs (in 2012 Dollars)

_	Pre-Treatment Pressure MF System						em		1																	
																Maintenance										
System Size	Ferrous	•	Sodiu	ım	VPC	SAC		_	Men	mbrane		_			and S	pare	Was	stewater			Lab and	Field				
(gpm)	Sulfate <sup>1</sup>		Нуро	chlorite	Rep	lacement	Ele	ctricity <sup>2</sup>	Rep	lacement	Che	micals <sup>3</sup>	Ele	ctricity⁴	Parts	Parts		Discharge		Discharge		bor	Analysi	s <sup>5</sup>	Annua	I O&M
100	\$	5,300	\$	1,000	\$	1,200	\$	36,000	\$	1,400	\$	2,000	\$	1,200	\$	23,000	\$	14,400	\$	103,000	\$	42,900	\$	231,000		
500	\$ 2	23,000	\$	2,200	\$	22,000	\$	96,000	\$	6,700	\$	5,800	\$	6,000	\$	35,000	\$	57,400	\$	187,000	\$	43,900	\$	485,000		
2,000	\$ 8	89,000	\$	7,600	\$	61,000	\$	161,000	\$	26,700	\$	15,000	\$	23,600	\$	77,000	\$	218,700	\$	313,000	\$	55,500	\$	1,048,000		

- 1. Ferrous sulfate is based on a ferrous dose of 2.0 mg/L as Fe.
- 2. Electricity includes energy for aeration blowers and aeration off-gas treatment.
- 3. Chemicals do not include these for Enhanced Flux Maintenance.
- 4. Electricity includes energy process pump(s) and air compressor(s) based on a filtration production of 15 psi and an overall pump efficiency of 70%, as provided by Pall.
- 5. Lab and field analysis includes approximately \$4,000 per year for aeration off-gas analysis.

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

	Net Present									
System Size	Value for 20									
(gpm)	Years									
100	\$ 3,900,000									
500	\$ 8,100,000									
2,000	\$ 18,000,000									

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