

Cilent
City of Glendale

Project
Phase III Demonstration Testing for
Cr(VI) Treatment

Item
10-gpm WBA System

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

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	TOTAL COST	COMMENTS
Equipment					
	_				
CO2 Feed System	1	LS	\$ 80.000	\$ 80.0	00 Quote from TOMCO; 1.5 lb/hr PSF and (2) 380 lb cylinders
CO2 Feed Water Pump	2	EA	\$ 7,177	\$ 14,3	
Static Mixer	1	EA	\$ 330		30 Quotes from Komax & EWS; 1-inch
otatio mino.	+	271	<b>V</b> 000	,	dadisa nam kamak a 2005) i man
Bag Filters	2	EA	\$ 1,800	\$ 3,6	00 Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
	+		1,722	-,-	
Ion Exchange Equipment	1	LS	\$ 7,400	\$ 7.4	00 Quotes from Siemens; incl. first fill of resin
	+		1,122	,,,,	
Backwash Waste Tank	1	EA	\$ 7,700	\$ 7.7	00 Quotes from Core-Rosion; 2,000 gal
Discharge Pumps	2	EA	\$ 4,832		64 Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
3 p.					
Booster Pump	2	EA	\$ 6,079	\$ 12,1	58 Quote from Cortech, 10 gpm @ 15 ft; 1 duty/1 stdby
					- January - J
A contract to the contract to		1.6	<b>*</b> 40.000	. 40.0	Quote from Siemens for an aluminum forced draft aerator (65 gpm), including
Aeration Equipment	1	LS	\$ 42,000		blower, air distribution tray, and piping etc.
Exhaust Blowers	2	EA	\$ 34,874	\$ 69,7	
Off-Gas Treatment	1	LS	\$ 4,000	\$ 4,0	Cost from Glendale and quote from TIGG; 54 SCFM; (2) adsorbers in series; plus
					\$2,800 for one heater
					20 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Subtotal				\$ 253,0	Rounded up to \$1000
Equipment Installation Cost	30%			\$ 75,9	00 Including tax, freight, installation and manufacturer services.
Equipment Concrete Pads	29	CY	\$ 1,250	\$ 35,9	67
Subtotal (Installed Equipment Costs)				\$ 365,0	00 Rounded up to \$1000
					Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%			\$ 27,3	75 utilities, health and safety, office supplies, clean up, photographs, survey, erosion
- " .	50/				control, coordination, testing services, and record documents
Earthwork	5%				50 Excavation, backfill, and fill required to construct project
Site Improvements	5%				50 Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				00 Major system piping and valves
Electrical, Instrumentation and Controls	15%			\$ 55,0	00 PLC and SCADA equipment to control
Total Direct Costs				\$ 539,0	00 Rounded up to \$1000
				-	
Contractor's Overhead and Profit	20%			\$ 107,8	lncludes bonds, mobilization and demobilization, insurance, overhead and profit,
	+				and management reserves
Construction Total	+-		I	\$ 647,0	00 Rounded up to \$1000
CONSTRUCTION TOTAL	+			ψ 047,0	intourided up to \$1000
Project Level Allowance (contingency)	20%			\$ 129,4	00 Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				00 Includes permits, legal fees and engineering fees for design and construction
Engineering, Legal and Auministrative	20 /0			129,4	oo jiridaaca permita, regarrees ana engineering rees ior design and constituction
Droject Total	+		<u> </u>	\$ 906.0	00
Project Total	+			\$ 906,0	VO
Low Estimato	+			¢ 424.0	00 200/
Low Estimate				\$ 634,0	
High Estimate				\$ 1,359,0	00 +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 2011 dollars.
- 3. Costs for land or easements are not included.



Client
City of Glendale

Project
Phase III Demonstration Testing for
Cr(VI) Treatment

Item
100-gpm WBA System

Project No. 05337008	0.0000
By T.D. & C.R.	Ckd: Y.W. & T.V.
Date 12/20/11	Date: 12/22/11

DESCRIPTION	QTY	UNIT MEAS.	UNIT COST	· [	TOTAL COST	COMMENTS
Equipment						
- 1						
CO2 Feed System	1	LS	\$ 160,0	00	\$ 160,000	Quote from TOMCO; 15 lb/hr PSF and 6 ton storage
CO2 Feed Water Pump	2	FA	\$ 7,1	_	\$ 14,354	Quote from ITT; centrifugal; 15 gpm @ 80 psi; 1 duty/1 stdby
Static Mixer	1	EA			\$ 850	Quotes from Komax & EWS; 3-inch
Static IVIIACI		LA	3 0	30	<b>y</b> 030	Zudes from Komax & Ewo, 5-inch
Bag Filters	2	EA	\$ 4,3	00	\$ 8,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
Bay Fillers	2	EA	\$ 4,3	00	\$ 0,000	Quotes Hotti F31 & Ryall Fieldo, Tudity/ Tstuby
		1.0	A 00.0	00	<b>*</b> 02.000	
Ion Exchange Equipment	1	LS	\$ 93,0	00	\$ 93,000	Quotes from Siemens; incl. first fill of resin
	_					
Backwash Waste Tank	1	EA		00		Quotes from Superior & BH; 19,000 gal
Discharge Pumps	2	EA	\$ 4,8	32	\$ 9,664	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
Booster Pump	2	EA	\$ 7,7	16	\$ 15,432	Quote from ITT, 100 gpm @ 15 ft; 1 duty/1 stdby
Aeration Equipment	1	LS	\$ 42,0	00	\$ 42.000	Quote from Siemens for an aluminum forced draft aerator (65 gpm), including blower, air
* *						distribution tray, and piping etc.
Exhaust Blowers	2	EA	\$ 34,7		\$ 69,505	Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby
Off-Gas Treatment	1	LS	\$ 11,0	00	\$ 11,000	Quote from TIGG; 270 SCFM; (2) adsorbers in series with one heater
Subtotal					\$ 477,000	Rounded up to \$1000
Equipment Installation Cost	30%				\$ 143,100	Including tax, freight, installation and manufacturer services.
Equipment Concrete Pad	56	CY	\$ 1,2	50	\$ 70,525	
Equipment consists i du	- 55	· · ·	* .,_	-	70,020	
Cubtatal (Installed Equipment Costs)				+	\$ 691,000	Rounded up to \$1000
Subtotal (Installed Equipment Costs)	+			_	\$ 091,000	Rounded up to \$1000
				_		District Acceptance of the Property of the Control
Canaral Daguiramenta	7.5%				\$ 51.825	Division 1 requirements, including labor supervision, field offices, temporary utilities,
General Requirements	7.5%				\$ 31,823	health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Earthwork	5%				\$ 34.550	Excavation, backfill, and fill required to construct project
Site Improvements	5%			_		Roadways, curb and gutter, sidewalk and landscaping
	15%					, ,
Valves, Piping, and Appurtenances				_		Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$ 104,000	PLC and SCADA equipment to control
Total Direct Costs					\$ 1,020,000	Rounded up to \$1000
Contractor's Overhead and Profit	20%				\$ 204,000	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and
Contractor 5 Overnead and 1 Tolk	2070				201,000	management reserves
Construction Total					\$ 1,224,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%			T	\$ 244,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$ 244,800	includes permits, legal fees and engineering fees for design and construction
				T		
Project Total				1	\$ 1,714,000	
	_			$\dashv$	- 1,714,000	
Low Estimate	+			+	\$ 1,200,000	3004
		-				
High Estimate			l		\$ 2,571,000	+5U%

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- 2. Opinion of Probable Cost in 2011 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
By T.D. & C.R.	Ckd: Y.W. & T.V.
Date 12/20/11	Date: 12/22/11

DESCRIPTION	QTY	UNIT MEAS.	UNI	T COST	TO	OTAL COST	COMMENTS
Equipment							
<u> </u>							
CO2 Feed System	1	LS	\$	190,000	¢	100.000	Quote from TOMCO; 75 lb/hr PSF and 14 ton storage
		EA EA					· · · · · · · · · · · · · · · · · · ·
CO2 Feed Water Pump	2		\$	7,608	\$		Quote from ITT; centrifugal; 75 gpm @ 80 psi; 1 duty/1 stdby
Static Mixers	1	EA	\$	2,200	\$	2,200	Quotes from Komax & EWS; 8-inch
Bag Filters	2	EA	\$	1,800	\$	3,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
Ion Exchange Equipment	1	LS	\$	400,000	\$	400,000	Quotes from Siemens and Calgon; incl. first fill of resin
Backwash Waste Tank	1	EA	\$	100,000	\$	100,000	Quotes from Superior & BH; 95,000 gal
Discharge Pumps	2	EA	\$	4,832	\$	9,664	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
Sissinarys i amps	-	27.	*	1,002	*	7,001	addisonoment a societim ros gpm o 10 tij radiji raday
Booster Pump	2	EA	\$	10,923	\$	21,846	Quote from ITT, 500 gpm @ 15 ft; 1 duty/1 stdby
Booster Fullip		EA	ð.	10,923	Φ	21,040	Quote Iron 111, 500 gpm @ 15 it, 1 duty/1 stuby
							0 + 1 ( ()
Aeration Equipment	1	LS	\$	47,000	\$	47,000	Quote from Siemens for an aluminum forced draft aerator (500 gpm), including blower, air
Exhaust Blowers	2	EA	\$	54,237	\$	108,474	distribution tray, and piping etc. Quotes from EWS & Yardley; 1,500 SCFM @ 5 psi; 1 duty/ 1 stdby
Off-Gas Treatment	1	LS	\$	27.000	\$	27,000	Quote from TIGG; 1,500 SCFM; (2) adsorbers in series with one heater
On-Gas Treatment		LJ	Ψ	27,000	Ψ	27,000	Quote from 1100, 1,300 SCI W, (2) ausorbers in series with the heater
C. Livid						005 000	D I I
Subtotal					\$	925,000	Rounded up to \$1000
Equipment Installation Cost	30%				\$	277,500	Including tax, freight, installation and manufacturer services.
Equipment Concrete Pad	159	CY	\$	1,250	\$	199,058	
Subtotal (Installed Equipment Costs)					\$	1 402 000	Rounded up to \$1000
Subtotal (Installed Equipment 665ts)					Ψ	1,102,000	rounded up to \$1000
	-						
Caracal Danisananta	7.50/				4	105 150	Division 1 requirements, including labor supervision, field offices, temporary utilities, health
General Requirements	7.5%				\$	105,150	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%				\$	211,000	PLC and SCADA equipment to control
Total Direct Costs					\$	2,069.000	Rounded up to \$1000
					<u> </u>	_,,	· · · · · · · · · · · · · · · · · · ·
	_	<b> </b>					Includes bonds, mobilization and demobilization, insurance, overhead and profit, and
Contractor's Overhead and Profit	20%				\$	413,800	management reserves
							management reserves
Construction Total		<u> </u>			\$	2 402 000	Rounded up to \$1000
CONSTRUCTION					Ф	2,403,000	Indulued up to \$1000
	2007				_	407.7	
Project Level Allowance (contingency)	20%				\$		Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$	496,600	Includes permits, legal fees and engineering fees for design and construction
					<u> </u>		
Project Total					\$	3,477,000	
Low Estimate					\$	2,434,000	-30%
High Estimate					\$	5,216,000	
might estimate					Þ	0,∠16,000	+30 /0

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- 2. Opinion of Probable Cost in 2011 dollars.
- Costs for land or easements are not included.



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

Project No. 05337008	3.0000
By T.D. & C.R.	Ckd: Y.W. & T.V.
Date 12/20/11	Date: 12/22/11

DESCRIPTION	QTY	UNIT MEAS.	HALL	T COST	TO	TAL COST	COMMENTS
	QIY	UNIT WEAS.	UIVI	1 (031	10	TAL COST	COMINENTS
Equipment							
CO2 Feed System	1	LS	\$	280,000			Quote from TOMCO; 300 lb/hr and 50 ton storage
CO2 Feed Water Pump	2	EA	\$	8,705	\$		Quote from ITT; centrifugal; 305 gpm @ 80 psi; 1 duty/1 stdby
Static Mixer	1	EA	\$	4,200	\$	4,200	Quotes from Komax & EWS; 14-inch
Bag Filters	2	EA	\$	1,800	\$	3,600	Quotes from FSI & Ryan Herco; 1 duty/ 1 stdby
Ion Exchange Equipment	1	LS	\$	1,300,000	\$	1,300,000	Quotes from Siemens and Calgon; incl. first fill of resin
Backwash Waste Tank	1	EA	\$	150,000	\$	150,000	Quotes from Superior & BH; 189,000 gal
Discharge Pumps	2	EA	\$	4,832	\$	9,664	Quotes from ITT & Cortech 100 gpm @ 15 ft; 1 duty/ 1 stdby
3 1						·	51
Booster Pump	2	EA	\$	23,902	\$	47,804	Quote from Cortech, 2,000 gpm @ 15 ft; 1 duty/1 stdby
become i unip	<del></del>	E.r.	Ť	20,702	*	17,001	adde nom contour, 2,000 gpm o 10 k, 1 day, 1 staby
	_						Quote from Siemens for an aluminum forced draft aerator (2000 gpm), including
Aeration Equipment	1	LS	\$	71,000	\$	71,000	blower, air distribution tray, and piping etc.
Exhaust Blowers	2	EA	\$	135,000	\$	270,000	
Off-Gas Treatment	1	LS	\$	95,000	\$	95,000	Quote from TIGG; 6,000 SCFM; (2) adsorbers in series with two 12kW heaters
Subtotal					\$	2,249,000	Rounded up to \$1000
Equipment Installation Cost	30%				\$	674,700	Including tax, freight, installation and manufacturer services.
<del></del>					-		
Equipment Concrete Pad	264	CY	\$	1,250	\$	330,388	
Equipment concrete r au	204	CI	ų.	1,230	¥	330,300	
Subtatal (Installed Equipment Costs)	+		<u> </u>		\$	2 255 000	Doundad up to \$1000
Subtotal (Installed Equipment Costs)		-			Þ	3,200,000	Rounded up to \$1000
		-					District According to the Production of the College Co
Connect Descriptors	7.50/				\$	244 125	Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%				Þ	244,120	utilities, health and safety, office supplies, clean up, photographs, survey, erosion control, coordination, testing services, and record documents
Forthwork	5%	<b>†</b>			\$	1/2 750	Excavation, backfill, and fill required to construct project
Earthwork	5%						
Site Improvements		-			\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$		Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$	489,000	PLC and SCADA equipment to control
Total Direct Costs					\$	4,803,000	Rounded up to \$1000
Contractor's Overhead and Profit	20%				\$	960,600	Includes bonds, mobilization and demobilization, insurance, overhead and profit,
Contractor 5 Overhead and 1 Tolk	2070		<u> </u>		*	700,000	and management reserves
Construction Total					\$	5,764,000	Rounded up to \$1000
Project Level Allowance (contingency)	20%				\$	1,152,800	Budget item to cover change orders due to unforeseen conditions
Engineering, Legal and Administrative	20%				\$	1,152,800	Includes permits, legal fees and engineering fees for design and construction
Project Total	<u> </u>				\$	8,070,000	
	+	1	1		·	-,,	
Low Estimate			1		\$	5,649,000	-30%
	+	<del> </del>	<del>                                     </del>		\$	12,105,000	+50%
High Estimate					Þ	12,105,000	+30 /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 2011 dollars.
- 3. Costs for land or easements are not included.





Flow Rate (gpm) 10
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 (solids)	Nitrosamin es	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																		
Lag vessel effluent 1	8	8								1		At start-up and monthly thereafter	At start-up and monthly thereafter		4			4	4	
Combined IX effluent after pH	Ü	-								'		therealter	therealter	uncreaner	7			Continuou	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	3	2	2	2	2	2	3	2.2	2.3	2.3	2.8	10	0.2	0.2	12	12	1
MWH Quotes (\$/sample)	\$75	\$15	\$15	5	\$15	\$15	\$15	\$15	\$15	25	125	400	400	200	45		350			
Test America Quotes (\$/sample)	\$30							\$12	\$12	20		330	165	215	70	240				
Unit cost (\$/sample)	\$53					• •		\$14	\$14	\$23	\$125			\$208	\$58	\$240				
Sample analysis cost (\$/year)	\$25,830	\$6,642	\$540	\$312	\$360	\$360	\$360	\$324	\$324	\$810	\$3,225	\$10,074	\$7,797	\$6,848	\$6,900	\$432	\$758			
Annual shipping fee	\$1,560	One ship	ment per we	eek, \$30 pe	r shipment.															
Sum of lab analysis cost (\$/year)	\$73,455	Average	of two quote	es, plus ship	ment.															
Field meters	\$2,000	portable p	pH and con	ductivity me	ter															
Field analytical cost (without labor) Total analytical cost							ence; not inc		for field ar	alysis										

<sup>1.</sup> If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.

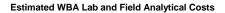
<sup>2.</sup> A composite of top, middle and bottom resin bed layers

<sup>3.</sup> Other analyses might be required by the sewer discharge permit.

<sup>4.</sup> 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

<sup>&</sup>quot;Continuous" indicates the parameter(s) will be monitored by an online meter.





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

-									L	ab									Field	
Sample Location	Cr(VI)	Total Cr	Alkalinity	Turbidity	Sulfate	Nitrate	Phosphat e	Total Iron	Silica		Uranium (solids)	Nitrosamin es	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 <sup>1</sup>	4	4								1		At start-up and monthly thereafter	At start-up and monthly thereafter	At start-up and monthly thereafter	4			4	4	
Combined IX effluent after pH increase	4	4	1	1	1	1	1	1	1						4			Continuou s	Continuou s	
Resin in lead vessel 1, 2											1									
Spent resin as residuals											At disposa	I				At disposal	At disposal			
Resin flush water as residuals <sup>3</sup>														4						
Sum of samples (# per month)	25	25	3	2	2	2	2	2	2	3	1.2	1.4	1.4	1.9	10	0.2	0.2	12	12	1
MWH Quotes (\$/sample)	\$75	\$15	\$15		\$15	\$15	\$15	\$15	\$15	25	125	400	400	200	45		350			
Test America Quotes (\$/sample)	\$30	\$12	\$15	\$13	\$15	\$15	\$15	\$12	\$12	20		330	165	215	70	240	492			
Unit cost (\$/sample)	\$53	\$14	\$15	\$13	\$15	\$15	\$15	\$14	\$14	\$23	\$125	\$365	\$283	\$208	\$58	\$240	\$421			
Sample analysis cost (\$/year)	\$15,750	\$4,050	\$540	\$312	\$360	\$360	\$360	\$324	\$324	\$810	\$1,763	\$5,913	\$4,577	\$4,669	\$6,900	\$504	\$884			
Annual shipping fee	\$1,560	One ship	ment per we	eek, \$30 pe	r shipment.													-		
Sum of lab analysis cost (\$/year)	\$49,959	Average	of two quote	es, plus ship	ment.		,										,			
Field meters	\$2,000	portable	pH and con	ductivity me	ter															
Field analytical cost (without labor)	\$1,000	Estimate	for reagents	s and appar	atus based	on experie	ence; not inc	luding labor	for field ar	alysis										
Total analytical cost	\$50,959	Including	lab and field	d analysis c	osts; not in	cluding lab	or and field r	meters												

<sup>1.</sup> If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.

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

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

<sup>2.</sup> A composite of top, middle and bottom resin bed layers

<sup>3.</sup> Other analyses might be required by the sewer discharge permit.

<sup>4.</sup> Three samples are estimated to be collected per resin changeout event for resin flush water disposal.





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

									L	ab									Field	
Sample Location	Cr(VI)	Total Cr	Alkalinity	Turbidity	Sulfate	Nitrate	Phosphat e	Total Iron		Uranium (water)	Uranium (solids)	Nitrosamin es	BNA SVOC	Aldehydes/ Ketones		TCLP (Metals)	CA WET		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	4	1	1	1	1	1	1	1						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 <sup>3</sup>														4						
Sum of samples (# per month)	25	25	3	2	2	2	2	2	2	3	1.2	1.4	1.4	1.9	10	0.2	0.2	12	12	. 1
MWH Quotes (\$/sample)	\$75	\$15	\$15		\$15	\$15	\$15	\$15	\$15	25	125	400	400	200	45		350			
Test America Quotes (\$/sample)	\$30	\$12	\$15	\$13	\$15	\$15	\$15	\$12	\$12	20		330	165	215	70	240	492			
Unit cost (\$/sample)	\$53	\$14	\$15	\$13	\$15	\$15	\$15	\$14	\$14	\$23	\$125	\$365	\$283	\$208	\$58	\$240	\$421			
Sample analysis cost (\$/year)	\$15,750	\$4,050	\$540	\$312	\$360	\$360	\$360	\$324	\$324	\$810	\$1,763	\$5,913	\$4,577	\$4,669	\$6,900	\$504	\$884			
Annual shipping fee	\$1,560	One ship	ment per we	ek, \$30 pe	r shipment.													-		
Sum of lab analysis cost (\$/year)	\$49,959	Average	of two quote	s, plus ship	ment.		,											,		
Field meters	\$2,000	portable	oH and cond	ductivity me	ter															
Field analytical cost (without labor)	\$1,000	Estimate	for reagents	and appar	atus based	on experi	ence; not inc	luding labor	for field ar	alysis										
Total analytical cost	\$50,959	Including	lab and field	d analysis c	osts; not in	cluding lab	or and field r	neters												

<sup>1.</sup> If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.

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

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

<sup>2.</sup> A composite of top, middle and bottom resin bed layers

<sup>3.</sup> Other analyses might be required by the sewer discharge permit.

<sup>4.</sup> Three samples are estimated to be collected per resin changeout event for resin flush water disposal.





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 (solids)	Nitrosamin es	BNA SVOC	Aldehydes/ Ketones	Bac-T (E. coli, T coli and HPC)	TCLP (Metals)	CA WET (Metals)	рН	Temperat ure	Conductivity
Raw	1	1	1												1			4	4	
After pH reduction	4	4	1	1	1	1	1	1	1	1		At start-up	At start-up	At start-up	1			S	S	1
Lead vessel 50% port 1	8	8																		
Lead vessel effluent 1	8	8								1		At start-up	At start-up	At start-up				4	4	
Lag vessel 50% port 1	8	8																		
Lag vessel effluent 1	8	8								1		At start-up and monthly thereafter	At start-up and monthly thereafter	At start-up and monthly thereafter				4	4	
Combined IX effluent after pH increase	4	4	1	1	1	1	1	1	1			therealter	trierearter	therealter	4			Continuou	Continuou	
Resin in lead vessel 1, 2											2									1
Spent resin as residuals											At disposa			At diamond		At disposal	At disposal			
Resin flush water as residuals <sup>3</sup>		At disposal 4																		
Sum of samples (# per month)	41	41	3	2	2	2	2	2	2	3	4.2	2.4	2.4	2.9	10	0.2	0.2	12	12	
MWH Quotes (\$/sample)	\$75	\$15	\$15	5	\$15	\$15	\$15	\$15	\$15	25	125	400	400	200	45		350			
Test America Quotes (\$/sample)	\$30	\$12	\$15	\$13	\$15	\$15	\$15	\$12	\$12	20		330	165	215	70	240	492			
Unit cost (\$/sample)	\$53	\$14	\$15	\$13	\$15	\$15	\$15	\$14	\$14	\$23	\$125	\$365	\$283	\$208	\$58	\$240	\$421			
Sample analysis cost (\$/year)	\$25,830	\$6,642	\$540	\$312	\$360	\$360	\$360	\$324	\$324	\$810	\$6,263	\$10,293	\$7,967	\$7,159	\$6,900	\$504	\$884			
Annual shipping fee	\$1,560 One shipment per week, \$30 per shipment.																			
Sum of lab analysis cost (\$/year)	\$77,391 Average of two quotes, plus shipment.																			
Field meters	\$2,000 portable pH and conductivity meter																			
Field analytical cost (without labor)	\$1,000	\$1,000 Estimate for reagents and apparatus based on experience; not including labor for field analysis																		
Total analytical cost	\$78,391	Including	lab and fiel	d analysis c	osts; not in	cluding lab	or and field i	meters												

<sup>1.</sup> If there are multiple lead-lag trains, lead or lag vessels in each train should be monitored.

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

<sup>2.</sup> A composite of top, middle and bottom resin bed layers

<sup>3.</sup> Other analyses might be required by the sewer discharge permit.

<sup>4.</sup> Three samples are estimated to be collected per resin changeout event for resin flush water disposal.

<sup>&</sup>quot;Continuous" indicates the parameter(s) will be monitored by an online meter.



# **Estimated WBA O&M Costs**

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

#### WBA System Size = 10 gpm

					Resin	۱ &	Spent Res	sin &			Other		Mair	tenance				
Potential Cr(VI)					<b>VPGA</b>	AC .	Wastewat	ter			Consu	ımables	and	Spare	Lab an	d Field		
MCL (ppb)	Electr	ricity	Che	micals	Repla	cement	Disposal		Labor		(Bag F	ilters)	Part	s	Analys	is	Annual	O&M
1	\$	6,000	\$	920	\$	7,200	\$	5,400	\$	50,000	\$	60	\$	3,650	\$	74,000	\$	147,000
2	\$	6,000	\$	920	\$	6,600	\$	5,200	\$	50,000	\$	60	\$	3,650	\$	74,000	\$	146,000
5	\$	6,000	\$	920	\$	5,900	\$	5,000	\$	50,000	\$	60	\$	3,650	\$	74,000	\$	146,000
10	\$	6,000	\$	920	\$	4,600	\$	4,600	\$	50,000	\$	60	\$	3,650	\$	74,000	\$	144,000
25	\$	6,000	\$	920	\$	2,600	\$	4,000	\$	50,000	\$	60	\$	3,650	\$	74,000	\$	141,000

WBA System Size = 100 gpm

WEA Cyclem C		JP																
					Res	in &	Spei	nt Resin &			Othe	er	Mair	ntenance				
Potential Cr(VI)					VPC	SAC	Was	tewater			Con	sumables	and	Spare	Lab	and Field		
MCL (ppb)	Electricit	у	Che	emicals	Rep	lacement	Disp	osal	Labor		(Bag	g Filters)	Part	s	Ana	llysis	Annua	I O&M
1	\$ 1	12,400	\$	9,200	\$	41,900	\$	21,600	\$	50,000	\$	130	\$	6,900	\$	51,000	\$	193,000
2	\$ 1	12,400	\$	9,200	\$	36,400	\$	18,300	\$	50,000	\$	130	\$	6,900	\$	51,000	\$	184,000
5	\$ 1	12,400	\$	9,200	\$	33,700	\$	16,700	\$	50,000	\$	130	\$	6,900	\$	51,000	\$	180,000
10	\$ 1	12,400	\$	9,200	\$	25,500	\$	11,800	\$	50,000	\$	130	\$	6,900	\$	51,000	\$	167,000
25	\$ 1	12,400	\$	9,200	\$	20,000	\$	8,500	\$	50,000	\$	130	\$	6,900	\$	51,000	\$	158,000

#### WBA System Size = 500 gpm

					Res	in &	Spe	nt Resin &			Othe	er	Mair	tenance				
Potential Cr(VI)					VPC	BAC	Was	stewater			Con	sumables	and	Spare	Lab	and Field		
MCL (ppb)	Elect	ricity	Che	emicals	Rep	lacement	Disp	oosal	Labor		(Baç	g Filters)	Part	s	Ana	lysis	Annua	I O&M
1	\$	60,500	\$	46,100	\$	206,000	\$	109,100	\$	50,000	\$	510	\$	14,000	\$	51,000	\$	537,000
2	\$	60,500	\$	46,100	\$	177,500	\$	89,900	\$	50,000	\$	510	\$	14,000	\$	51,000	\$	490,000
5	\$	60,500	\$	46,100	\$	163,300	\$	80,300	\$	50,000	\$	510	\$	14,000	\$	51,000	\$	466,000
10	\$	60,500	\$	46,100	\$	120,600	\$	51,500	\$	50,000	\$	510	\$	14,000	\$	51,000	\$	394,000
25	\$	60,500	\$	46,100	\$	92,200	\$	32,300	\$	50,000	\$	510	\$	14,000	\$	51,000	\$	347,000

#### WBA System Size = 2,000 gpm

TIDA Oystein O		5			<b>D</b>	··· 0	O	( D			041		84-1					
					Res	ın &	Spen	t Resin &			Othe	er	wan	ntenance				
Potential Cr(VI)					VPG	AC	Waste	ewater			Cons	sumables	and	Spare	Lab	and Field		
MCL (ppb)	Electri	icity	Che	micals	Rep	lacement	Dispo	osal	Labor		(Bag	Filters)	Part	s	Ana	lysis	Annua	I O&M
1	\$	194,800	\$	184,200	\$	692,500	\$	363,900	\$	50,000	\$	1,500	\$	32,600	\$	78,000	\$	1,598,000
2	\$	194,800	\$	184,200	\$	597,200	\$	298,500	\$	50,000	\$	1,500	\$	32,600	\$	78,000	\$	1,437,000
5	\$	194,800	\$	184,200	\$	549,600	\$	265,500	\$	50,000	\$	1,500	\$	32,600	\$	78,000	\$	1,356,000
10	\$	194,800	\$	184,200	\$	406,700	\$	167,200	\$	50,000	\$	1,500	\$	32,600	\$	78,000	\$	1,115,000
25	\$	194,800	\$	184,200	\$	311,400	\$	101,700	\$	50,000	\$	1,500	\$	32,600	\$	78,000	\$	954,000

# Annual O&M Summary

WBA System		Pote	enti	al Cr(VI) MC	L, į	ppb	
Size (gpm)	1	2		5		10	25
10	\$ 147,000	\$ 146,000	\$	146,000	\$	144,000	\$ 141,000
100	\$ 193,000	\$ 184,000	\$	180,000	\$	167,000	\$ 158,000
500	\$ 537,000	\$ 490,000	\$	466,000	\$	394,000	\$ 347,000
2,000	\$ 1,598,000	\$ 1,437,000	\$	1,356,000	\$	1,115,000	\$ 954,000

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

Net Fresent Val	ue i	UI ZU TEATS (	ΝU	unded to two	, Dić	Jillicant ng	ures	•)	
WBA System				Pote	nti	al Cr(VI) MC	L, p	pb	
Size (gpm)		1		2		5		10	25
10	\$	2,500,000	\$	2,400,000	\$	2,400,000	\$	2,400,000	\$ 2,400,000
100	\$	3,200,000	69	3,100,000	\$	3,000,000	\$	2,800,000	\$ 2,800,000
500	\$	9,000,000	69	8,200,000	\$	7,800,000	\$	6,600,000	\$ 5,800,000
2,000	\$	27,000,000	\$	24,000,000	\$	23,000,000	\$	19,000,000	\$ 16,000,000

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



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
100-gpm RCF System

Project No. 05337008.0	0000
By T.D. & Y.W.	Ckd: Y.W. & T.V.
	Date: 1/18/12

DESCRIPTION	QTY	UNIT MEAS.	l	JNIT COST	TO	TAL COST	COMMENTS
Equipment							
FeSO <sub>4</sub> Feed System							
Storage Tank	1	EA	\$	2,700	\$	2,700	Quotes from Ryan Herco & Core-Rosion; 100 gal PE, outdoor, incl. seismic
Metering Pumps	2	EA	\$	3,100	\$	6,200	Quotes from C.P. Crowley & HTP; 0.25 gph; 1 duty/ 1 stdby
Static Mixers	1	EA	\$	900	\$	900	Quotes from Komax & EWS; 3-inch
Reduction Tanks							
Tanks	3	EA	\$	5,100	\$		Quotes from Core-Rosion & Ryan Herco; 1,700 gal PE, outdoor, incl. seismic
Mixers	3	EA	\$	4,700	\$	14,100	Quotes from Core-Rosion & EWS; G = 60 per second
Aeration System							
Tank	1	EA	\$	3,600	\$	3,600	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic
Diffusers	1	LS	\$	400	\$	400	
Supply Blowers	2	EA	\$	30,300	\$	60,600	
Exhaust Blowers	2	EA	\$	34,900	\$		Quote from EWS; 53 SCFM @ 4 ps; 1 duty/ 1 stdby; incl. accessories
							Cost from Glendale and quotes from TIGG; 54 SCFM; (2) adsorbers in series
Off-Gas Treatment	1	LS	\$	4,000	\$	4,000	with one heater
Polymer Mixing Tank							
Rapid Mixing Tank	1	EA	\$	3,600	\$	3,600	Quotes from Core-Rosion & Ryan Herco; 700 gal PE, outdoor, incl. seismic
Mixer	1	EA	\$	3,700	\$	3,700	Quotes from Core-Rosion & EWS; G = 170 per second
Filters							
Filter Equipment (Pressure Filters)	1	LS	\$	280,000	\$	280,000	Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf, (2) 6.5 ft dia
ritter Equipment (Fressure Filters)		13		200,000	Ÿ	200,000	VPF, 1 duty/ 1 stdby
Filter Drawdown Transfer Pump	2	EA	\$	5,600	\$	11,200	Quotes from DTI and Cortech; 55 gpm @ 70 ft; 1 duty/ 1 stdby
Pumps							
Filter Feed Pumps (Progressive Cavity)	2	EA	\$	12,000	\$	24,000	Quotes from Cortech & Flow-Systems; 100 gpm @ 70 ft; 1 duty/ 1 stdby
Polymer Feed Systems							
Polymer Feed System (Coagulant Aid)	1	LS	\$	28,000	\$	28,000	
Polymer Feed System (Solids Settling Aid)	1	LS	\$	11,000	\$	11,000	Quotes from Siemens & C.P. Crowley
Filtrate Tank for Backwash	1	EA	\$	26,200	\$		Quotes from Core-Rosion & Ryan Herco; 12,500 gal PE, outdoor, incl. seismic
Backwash Pumps	2	EA	\$	8,900	\$	17,800	Quotes from ITT & Cortech; 600 qpm @ 50 ft; 1 duty/ 1stdby
Deside also Transfer and Contains							
Residuals Treatment System	2	EA	¢	22.000	ė.	(4.000	Overte from Displic Mont for 12 000 mallon come hattern tent with stand
Gravity Thickener Flo-Trend SludgeMate Container	2	EA EA	\$	32,000 14,200	\$		Quote from Plastic-Mart for 13,000-gallon cone bottom tank with stand.  Quote from Flo-Trend for 6-CY SludgeMate container.
Pumps	1	LS	\$	10,000	\$	10,000	
Fullips	- '	LJ	D.	10,000	J.	10,000	includes all sludge pumps and recycle pumps, one duty and one standby.
Subtotal					\$	686,000	Rounded up to \$1000
Subtotal					¥	000,000	Rounded up to \$1000
Equipment Installation Cost	30%				\$	206.000	Including tax, freight, installation and manufacturer services.
Equipment instantation cost	0070				•	200,000	including tax, incigni, installation and manuacturer services.
Chemical Storage Containment	2	CY	\$	1,250	\$	2,500	
						,,,,,,	
Equipment Concrete Pads	69	CY	\$	1,250	\$	86,250	
Subtotal (Installed Equipment Costs)					\$	981,000	Rounded up to \$1000
							Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%				\$	73,575	utilities, health and safety, office supplies, clean up, photographs, survey,
							erosion control, coordination, testing services, and record documents
Earthwork	5%				\$	49,050	Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$		Roadways, curb and gutter, sidewalk and landscaping
Valves, Piping, and Appurtenances	15%				\$	148,000	Major system piping and valves
Electrical, Instrumentation and Controls	15%				\$		PLC and SCADA equipment to control
Total Direct Costs					\$	1,449,000	Rounded up to \$1000



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

Project No. 05337008.0	0000
By T.D. & Y.W.	Ckd: Y.W. & T.V.
	Date: 1/18/12

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

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



Client
City of Glendale

Project
Phase III Demonstration Testing for Cr(VI)
Treatment

Item
500-gpm RCF System

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

DESCRIPTION	QTY	UNIT MEAS.	U	INIT COST	TC	TAL COST	COMMENTS
Equipment							
5.00.5							
FeSO <sub>4</sub> Feed System				2.222		2.000	
Storage Tank	1	EA	\$	3,300	\$	3,300	Quotes from Core-Rosion & Ryan Herco; 500 gal PE, outdoor, incl. seismic Quotes from C.P. Crowley & HTP; 1.3 gph; 1 duty/ 1 stdby
Metering Pumps Static Mixers	1	EA EA	\$	3,100 2,200	\$	6,200	Quotes from C.P. Crowley & HTP; 1.3 gpn; 1 duty/ 1 staby  Quotes from Komax & EWS; 8-inch
Static Mixers		EA	2	2,200	\$	2,200	Quoles from Romax & EWS; 8-inch
Reduction Tanks							
Tanks	3	EA	\$	20,000	\$	60,000	Quotes from Core-Rosion & Ryan Herco; 8,000 gal PE, outdoor, incl. seismic
Mixers	3	EA	\$	8,800	\$		Quotes from Core-Rosion & EWS; G = 60 per second
Aeration System							
Tanks	1	EA	\$	6,300	\$		Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic
Diffusers	1	LS	\$	2,000	\$		Based on previous project experience
Supply Blowers Exhaust Blowers	2	EA EA	\$	46,300	\$		Quote from EWS; 267 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessories Quote from EWS; 267 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessories
EXITAUSI DIOWEIS	- 2			34,800			Quotes from Calgon and TIGG; 270 SCFM; (2) adsorbers in series with one
Off-Gas Treatment	1	LS	\$	15,100	\$	15,100	heater
							ileatei
Polymer Mixing Tank							
Rapid Mixing Tank	1	EA	\$	6,700	\$	6,700	Quotes from Core-Rosion & Ryan Herco; 3000 gal PE, outdoor, incl. seismic
Mixers	1	EA	\$	4,400	\$	4,400	Quotes from Core-Rosion & EWS; G = 170 per second
Filters							
511 5 1 1/D 511 )				445.000		445.000	Quotes from Coombs-Hopkins & Layne, including media; 3 gpm/sf; Coombs-
Filter Equipment (Pressure Filters)	1	LS	\$	465,000	\$	465,000	Hopkins filters, 10' x 24' (4 cells, 3 duty/ 1 stdby); Layne filters, (2) 8" x 22', 1
							duty/ 1 stdby
Filter Drawdown Transfer Pump	2	EA	\$	4,800	\$	9,600	Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby
D							
Pumps Filter Feed Pumps (Progressive Cavity)	2	EA	\$	38,000	\$	74 000	Ouglas from Carlagh & Flau Custome F00 mm @ 70 ft 1 duty/ 1 addhu
Filler Feed Pullips (Progressive Cavity)	- 2	EA	Þ	36,000	\$	76,000	Quotes from Cortech & Flow-Systems; 500 qpm @ 70 ft; 1 duty/ 1 stdby
Polymer Feed Systems							
Polymer Feed Systems (Coagulant Aid)	1	LS	\$	10,500	\$	10 500	Quotes from Siemens & C.P. Crowley
Polymer Feed Systems (Solids Settling Aid)	1	LS	\$	11,400	\$		Quotes from Siemens & C.P. Crowley
r orymor r ood o joionis (conds conting rilla)	· ·		_	11/100	_	11/100	Quarter from Siemens & C.F. Oromey
Filtrate Tank for Backwash	1	EA	\$	40,000	\$	40,000	Quotes from Superior; 22,000 gal; 15 ft dia x 16 ft height
Backwash Pumps	2	EA	\$	14,300	\$		Quotes from ITT & Cortech; 1,050 gpm @ 50 ft; 1 duty/ 1stdby
Residuals Treatment System							
Equalization Tank	1	EA	\$	121,000	\$	121,154	Adjusted installed costs from RS Means for 90,000-gal tank, which was divided
Equalization rank	'	LA	Ψ	121,000	¥		by 1.3 to exclude installation cost (assuming a installation cost of 30%).
Plate Settler	1	EA	\$	59,000	\$	59,000	Quote from Meurer Research, Inc. and Parkson for a system handles a 26-gpm
						·	sludge flow.
Flo-Trend SludgeMate Container	3	EA	\$	25,900	\$	77,700	Quote from Flo-Trend for 15-CY SludgeMate container. Includes all sludge pumps and recycle pumps, one duty and one standby.
Pumps	1	LS	\$	15,000	\$	15,000	includes all sludge pumps and recycle pumps, one duty and one standby.
Subtotal					\$	1 200 000	Rounded up to \$1000
Subtotal					Ą	1,207,000	Rounded up to \$1000
Equipment Installation Cost	30%				\$	363,000	Including tax, freight, installation and manufacturer services.
Equipment installation oust	3070				*	303,000	more any respire installation and manufacturer services.
Chemical Storage Containment	6	CY	\$	1,250	\$	7,500	
Equipment Concrete Pads	166	CY	\$	1,250	\$	207,500	
Subtotal (Installed Equipment Costs)					\$	1,787,000	Rounded up to \$1000
							Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%				\$	134,025	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%				\$	269,000	PLC and SCADA equipment to control
Total Direct Costs					¢	2 420 000	Dounded up to \$1000
Total Direct Costs					\$	2,038,000	Rounded up to \$1000



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

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

20%	\$	527,600	Includes bonds, mobilization and demobilization, insurance, overhead and profit, and management reserves
	\$	3,166,000	Rounded up to \$1000
20% 20%	\$		Budget item to cover change orders due to unforeseen conditions lincludes permits, legal fees and engineering fees for design and construction
	\$	4,433,000	
	\$	3,103,000	-30%
	20%	20% \$	20% \$ 3,166,000 20% \$ 633,200 20% \$ 633,200 \$ 4,433,000

- 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 2011 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

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

DESCRIPTION	QTY	UNIT MEAS.	l	JNIT COST	TO	OTAL COST	COMMENTS
Equipment							
FeSO <sub>4</sub> Feed System	1						
Storage Tank	1	EA	\$	5,900	\$	5,900	Quotes from Core-Rosion & Ryan Herco; 2,000 gal PE, outdoor, incl. seismic
Metering Pumps	2	EA	\$	6,000	\$		Quotes from C.P. Crowley & HTP; 5 gph
Static Mixers	1	FA	\$	4,200	\$		Quotes from Komax & EWS; 14-inch
Static Wilkers	'	LA	Ψ	4,200	Ψ	4,200	Quotes iron Romax & EWS, 14-men
Reduction Tanks							
Mixers	3	EA	\$	23,500	\$	70,500	Quotes from Core-Rosion & EWS; G = 60 per second
	-		1				
Aeration System							
Diffuser	1	LS	\$	8,000	\$	8.000	Based on previous project experience and conversation w/ Brian Bubela
Supply Blowers	2	EA	\$	74,800	\$		Quote from EWS; 1,070 SCFM @ 7 psi; 1 duty/ 1 stdby; incl. accessaories
Exhaust Blowers	2	EA	\$	58,500	\$		Quote from EWS; 1,070 SCFM @ 2 psi; 1 duty/ 1 stdby; incl. accessaories
							Quotes from Calgon & TIGG; 1070 SCFM; (2) adsorbers in series with one
Off-Gas Treatment	1	LS	\$	25,300	\$	25,300	heater
Polymer Mixing Tanks							
Mixers	1	EA	\$	17,000	\$	17,000	Quotes from Core-Rosion & EWS; G = 170 per second
Filters							
Filter Freedom and (December Filter)	1	1.6		004.000		004.633	Quotes from Tonka & Layne, including media; 3 gpm/sf; Tonka filters, (2) 10' x
Filter Equipment (Pressure Filters)	1	LS	\$	984,000	\$	984,000	42', 4 cells per filter, 3 duty / 1 stdby; Layne filters, (4) 10' x 24', 3 duty/ 1 stdby
Filter Drawdown Transfer Pump	2	EA	\$	5,000	\$	10,000	Quotes from ITT and Cortech; 150 gpm @ 70 ft; 1 duty/ 1 stdby
rillei Diawdowii Halisiei Fullip		LA	Þ	3,000	ð	10,000	Quotes from 111 and contech, 130 gpm @ 70 ft, 1 duty/ 1 stuby
D							
Pumps Filter Feed Pumps (Progressive Cavity)	3	EA	¢	55,000	\$	1/5 000	Oughes from Contack & Flour Contacts 1 000 mms @ 70 ft 2 dut / 1 addition
riller reed Pullips (Progressive Cavity)	3	EA	Þ	33,000	Þ	100,000	Quotes from Cortech & Flow-Systems; 1,000 gpm @ 70 ft; 2 duty/ 1 stdby
Polymer Feed Systems	1		<del>                                     </del>				
	1	10	¢	10 500	¢	10 500	Quetos from Ciamans & C.D. Crawley
Polymer Feed Systems (Coagulant Aid)	1	LS LS	\$	10,500 11,400	\$		Quotes from Siemens & C.P. Crowley
Polymer Feed Systems (Solids Settling Aid)	-	LS	)	11,400	\$	11,400	Quotes from Siemens & C.P. Crowley
Filtrate Tank for Backwash	1	EA	\$	50,000	\$	EU 000	Quotes from Superior; 30,250 gal; 18 ft dia x 16 ft height
Backwash Pumps	2	EA	\$	21,500			Quotes from ITT & Cortech; 1,450 gpm @ 50 ft; 1 duty/ 1stdby
backwasii i uiiips		LA	φ	21,300	ų.	43,000	Quotes from 111 & Contecti, 1,450 gpin @ 50 ft, 1 duty/ 1stuby
Residuals Treatment System							
Residuais Treatment System							Adjusted installed costs from RS Means for 280,000-gal tank, which was
Equalization Tank	1	EA	\$	137,000	\$	137,385	divided by 1.3 to exclude installation cost (assuming a installation cost of 30%).
Plate Settler	1	EA	\$	78,000	\$	78,000	Quote from Meurer Research, Inc. and Parkson for a system handles a 88-gpm
							sludge flow.
Flo-Trend SludgeMate Container	3	EA	\$	38,400	\$	115,200	Quote from Flo-Trend for 40-CY SludgeMate container.
Pumps	1	LS	\$	22,000	\$	22,000	Includes sludge pumps and recycle pumps for equalization tank and plate
r umps		2.5	Ψ	22,000	Ψ	22,000	settlers, one duty and one standby.
			<u> </u>				
Subtotal					\$	2,036,000	Rounded up to \$1000
				<u> </u>		<u> </u>	
Equipment Installation Cost (30% of Equipment)	30%				\$	611,000	Including tax, freight, installation and manufacturer services.
Reduction Tanks						, and the second	25 ft x 75 ft tank, including 3 sub-tanks with shared walls
Slab	140	CY	\$	700	\$		Based on 2 ft slab or wall
Walls	155	CY	\$	800	\$		Based on 2 ft slab or wall; and 2 ft freeboard
Elevated Slab	140	CY	\$	1,100	\$	154,000	Based on 2 ft slab or wall
Aeration Tanks							15 ft x 15 ft tank
Slab	17	CY	\$	700	\$		Based on 2 ft slab or wall
Walls	35	CY	\$	800			Based on 2 ft slab or wall; and 2 ft freeboard
Elevated Slab	17	CY	\$	1,100	r.	10 700	Based on 2 ft slab or wall



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

Project No. 05337008.0000									
	Date: 1/18/12								

			1				
Rapid Mixing Tanks	+						15 ft x 15 ft tank
Slab	17	CY	\$	700	\$	11 900	Based on 2 ft slab or wall
Walls	35	CY	\$	800	\$		Based on 2 ft slab or wall; and 2 ft freeboard
Elevated Slab	17	CY	\$	1,100	\$		Based on 2 ft slab or wall
Elevated Slab	.,	01	Ψ	1,100	Ψ	10,700	based on 2 it slab or wall
Chemical Storage Containment	16	CY	\$	1,250	\$	20,000	
			1	.,,			
Equipment Concrete Pads	291	CY	\$	1,250	\$	363,750	
			1	.,,		0.007.000	
Subtotal (Installed Equipment Costs)					\$	3,524,000	Rounded up to \$1000
, , , , , , , , , , , , , , , , , , ,							
							Division 1 requirements, including labor supervision, field offices, temporary
General Requirements	7.5%				\$		utilities, health and safety, office supplies, clean up, photographs, survey,
'							erosion control, coordination, testing services, and record documents
Earthwork	5%				\$	176,200	Excavation, backfill, and fill required to construct project
Site Improvements	5%				\$	176 200	Roadways, curb and gutter, sidewalk and landscaping
one improvements	370				•	170,200	readways, carb and gatter, sidewalk and landscaping
Values Dining and Annurtaneness	15%				\$	E20 000	Malar andam vising and unlike
Valves, Piping, and Appurtenances Electrical, Instrumentation and Controls	15%		-		\$		Major system piping and valves PLC and SCADA equipment to control
Electrical, instrumentation and controls	1370				J.	329,000	PLC and SCADA equipment to control
Total Direct Costs	1 1				\$	E 100 000	Rounded up to \$1000
Total Direct Costs			+		Þ	3,177,000	Rounded up to \$1000
			1				Includes bonds, mobilization and demobilization, insurance, overhead and
Contractor's Overhead and Profit	20%				\$	1,039,800	profit, and management reserves
							pront, and management reserves
Construction Total			+		\$	6,238,800	
construction rotal					Ψ	0,230,000	
Project Level Allowance (contingency)	20%		1		\$	1 247 760	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
Engineering, Legal and Administrative	2070				Ψ	1,271,100	morades permits, regar rees and origineering rees for design and constitution
Project Total	+		1		\$	8,735,000	
rioject rotal			1		Ψ	0,733,000	
Low Estimate					\$	6,115,000	30%
High Estimate					\$	13,103,000	
rnyn Lamatt			1		φ	13,103,000	1 30 70

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



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

Flow Rate (gpm) 100 Number of Duty Filters 1

Number of Buty Filters							F	ield							
Sample Location	Total Fe	Cr(VI)	Total Cr	TSS	Silica		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	ļ	continuous	continuous
After 1st reduction tank											4	. 4	l.	4	
After 2nd reduction tank											1	1		4	
After 3rd reduction tank		4				1					4	. 4		4	4
Aeration off gas (raw)						1									
Aeration off gas (after first VPGAC)						1									
Aeration off gas (after 2nd VPGAC)						1									
Filter feed (after rapid mixing)				4		1								4	4
Filter effluent	4	. 4	4							4	. 4	. 4	continuous	1	1
Spent filter backwash	1	1	1	1											
Supernatant from thickener	1	1	1	1			4			1	1	1	1	1	1
Thickened sludge				1											
Filtrate from dewatering container	1	1	1	1			4			1	1	1	1	1	1
Dewatered solid residuals								At disposal	At disposal						
Number of samples per month^	8	15	11	8	1	5	8	1		1 10	20	20	3	23	15
Unit cost (\$/sample)	\$ 14	\$ 53	\$ 14	\$ 15	\$ 14	\$ 110	\$ 58	\$ 240	\$ 42	ı					
Sample analysis Cost (\$/year)	\$ 1,296	\$ 9,450	\$ 1,782	\$ 1,440	\$ 162	\$ 6,600	\$ 5,520	\$ 2,880	\$ 5,052	2					
Shipping fee (\$/year)	\$ 1,560	One shipment	per week, \$30	per shipment											
Sum of lab analysis cost (\$/year)	\$ 35,742	Sample analys	is plus shippir	ng fee											
Field meters	\$ 6,000	Hach Dr 3800,	portable pH r	meter and turbio	dity meter										
Field analysis cost	\$ 2,000	Estimate for re	agents and ap	pparatus based	on experience;	not including la	bor for field analy	sis							
Total analysis cost		Including lab a													

<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



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

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

		Lab														Field								
Sample Location	Total F	:e	Cr(VI)	т	otal Cr	TSS	Silica	VOCs		Bac-T (E. Coli, T. Coli and HPC)			CA V		Cr(VI)*	Ferrous	Total Fe	Turbidity	рН	Temperatur e				
Raw		1		4	4		1								4	1	1	1	1 4	4				
After ferrous addition																4	1	4	continuous	continuous				
After 1st reduction tank																4	1	4	4					
After 2nd reduction tank																1	1	1	4	ļ.				
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	ļ.		1										4	4				
Filter effluent from each cell		4		4	4										4	1 4	1	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	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 dis	sposal										
Number of samples per month^		16		23	19	8	1		5	8		1.5		1.5	18	3 28	3 :	28 :	3 25	17				
Unit cost (\$/sample)	\$	14	\$ 5	3 \$	\$ 14	\$ 15	\$ 14	\$	110	\$ 58	\$	240	\$	421										
Sample analysis Cost (\$/year)	\$	2,592	\$ 14,49	90 \$	\$ 3,078	\$ 1,440	\$ 162	\$ 6	,600	\$ 5,520	\$	4,320	\$	7,578										
Shipping fee (\$/year)	\$	1,560	One shipme	nt pe	er week, \$30	per shipment																		
Sum of lab analysis cost (\$/year)	\$	47,340	Sample ana	ysis	plus shippin	g fee																		
Field meters	\$	6,000	Hach Dr 380	0, po	ortable pH m	neter and turbi	dity meter																	
Field analysis cost	\$	3,000	Estimate for	reag	gents and ap	paratus based	d on experience;	not includ	ding la	bor for field analy	/sis													
Total analysis cost	\$	50,340	Including lab	and	I field analysi	is costs; not in	cluding labor an	d field me	ters															

<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



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

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

						Lab						Field								
Sample Location	Total Fe		Cr(VI)	Total Cr	TSS	Silica	VOCs	Bac-T (E. Coli, T. Coli and HPC)	TCLP (Metals)	CA WET (Metals)	Cr(VI)*	Ferrous	Total Fe	Turbidity	рН	Temperatur e				
Raw		1	4	. 4	1	1						4	1	1 1	1 4	4				
After ferrous addition												4	4 .	4	continuous	continuous				
After 1st reduction tank												4	4 .	4	4	l.				
After 2nd reduction tank													1	1	4	l.				
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)					4	1	1								4	4				
Filter effluent from each cell		4	4	. 4	1							4	4 .	4 continuous	1	1				
Spent filter backwash		1	1	1	,	1														
Supernatant from thickener		1	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	1				
Dewatered solid residuals									At disposal	At disposal										
Number of samples per month^		40	47	43	3 8	3 1	5	8	2	2	2 4	42 52	2 5	2 3	31	23				
Unit cost (\$/sample)	\$	14	\$ 53	\$ 14	\$ 15	\$ 14	\$ 110	\$ 58	\$ 240	\$ 42	21									
Sample analysis Cost (\$/year)	\$ 6	,480	\$ 29,610	\$ 6,966	\$ 1,440	\$ 162	\$ 6,600	\$ 5,520	\$ 5,760	\$ 10,10	)4									
Shipping fee (\$/year)	\$ 1	,560	One shipment	per week, \$30	) per shipment															
Sum of lab analysis cost (\$/year)	\$ 74	,202	Sample analys	is plus shippir	ng fee															
Field meters	\$ 6	,000	Hach Dr 3800,	portable pH i	meter and turbi	dity meter														
Field analysis cost	\$ 5	,000	Estimate for re	agents and a	pparatus base	d on experience;	not including la	bor for field analy	rsis											
Total analysis cost	\$ 79	,202	Including lab a	nd field analys		ncluding labor an	d 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).

<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



# **Estimated RCF O&M Costs**

RCF System Size = 100 gpm

Itor Cyclom Ciz		36														
Influent Cr(VI)							Filte	er Media								
Concentration	Resid	uals					and	VPGAC	Ma	intenance			Lab	and Field		
(ppb)	Dispo	sal	Ch	emicals	Labo	or	Rep	lacement	and	d Spare Parts	Ele	ectricity	An	alysis	Annua	I O&M
5	\$	5,600	\$	1,600	\$	161,000	\$	1,799	\$	9,800	\$	37,000	\$	37,700	\$	254,000
10	\$	10,600	\$	2,600	\$	161,000	\$	1,799	\$	9,800	\$	37,000	\$	37,700	\$	260,000
25	\$	17,300	\$	4,000	\$	161,000	\$	1,799	\$	9,800	\$	37,000	\$	37,700	\$	269,000
50	\$	34,000	\$	7,300	\$	161,000	\$	1,799	\$	9,800	\$	37,000	\$	37,700	\$	289,000

RCF System Size = 500 gpm

Influent Cr(VI)	1	SP***					Filte	er Media								
Concentration	Resid	luals					and	VPGAC	Mai	ntenance			Lab	and Field		
(ppb)	Dispo	osal	Che	emicals	Labo	r	Rep	lacement	and	Spare Parts	Ele	ctricity	Anal	ysis	Annua	al O&M
5	\$	27,900	\$	7,900	\$	233,000	\$	24,087	\$	17,900	\$	99,700	\$	50,300	\$	461,000
10	\$	52,800	\$	13,000	\$	233,000	\$	24,087	\$	17,900	\$	99,700	\$	50,300	\$	491,000
25	\$	86,400	\$	19,800	\$	233,000	\$	24,087	\$	17,900	\$	99,700	\$	50,300	\$	531,000
50	\$	169,800	\$	36,700	\$	233,000	\$	24,087	\$	17,900	\$	99,700	\$	50,300	\$	631,000

RCF System Size = 2,000 gpm

NOT System Size	tor System Size = 2,000 gpin															
Influent Cr(VI)				•			Filte	er Media								
Concentration	Residuals						and	and VPGAC		Maintenance			Lab and Field			
(ppb)	Disposal		Chemicals		Labor		Replacement		and Spare Parts		Electricity		Ana	alysis	Annual O&M	
5	\$	111,500	\$	31,600	\$	377,000	\$	66,052	\$	35,200	\$	177,200	\$	79,200	\$	878,000
10	\$	211,100	\$	52,000	\$	377,000	\$	66,052	\$	35,200	\$	177,200	\$	79,200	\$	998,000
25	\$	345,500	\$	79,000	\$	377,000	\$	66,052	\$	35,200	\$	177,200	\$	79,200	\$	1,159,000
50	\$	679,200	\$	146,700	\$	377,000	\$	66,052	\$	35,200	\$	177,200	\$	79,200	\$	1,561,000

**Annual O&M Summary** 

RCF System	Influent Cr(VI) Concentration, ppb												
Size (gpm)	5		10		25		50						
100	\$ 254,000	\$	260,000	\$	269,000	\$	289,000						
500	\$ 461,000	\$	491,000	\$	531,000	\$	631,000						
2,000	\$ 878,000	\$	998,000	\$	1,159,000	\$	1,561,000						

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

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

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