2.0 LPGAC COMPONENT DESCRIPTION

This section provides details on various components of the groundwater treatment system. In addition to LPGAC components, this section presents information on the extraction system, collection system, existing air strippers, and treatment system bypass.

2.1 EXTRACTION WELLS

Groundwater is currently extracted from four existing wells (nos. 1 through 4). Section 1.4 presents the location and number of existing and new extraction wells based on groundwater modeling results. Table 2-1 presents information on total depth, screened intervals, expected flow, and diameter of the wells. The City expressed preference for submersible well pumps on all new wells. Submersible pumps are usually reliable and require minimal maintenance. There is no need for a special lubrication system consisting of either water or oil lubrication. Submersible pumps are less disruptive in a residential neighborhood because there is no noise generation and no or only a small building required to house the wellhead. The smaller wellhead building reduces problems related to vandalism, such as graffiti. Submersible pumps are available at 250 horsepower (hp) and higher. A below-grade or above-grade wellhead completion will depend on several factors such as location and access to well site. However, the DHS does not usually allow below-ground completion of production well heads because of possible contamination by stormwater.

The extracted groundwater is expected to be clear and low in total suspended solids (TSS). However, after installation and development, each well's discharge will be tested for TSS and particle size distribution. Solids in the water may either settle out in the pipelines or in the LPGAC filters, restricting water flow. If TSS are of concern, a filter or strainer will be installed at the wellhead.

2.2 INFLUENT PIPELINE

The four existing extraction wells are connected to the air strippers via 12- and 16-inch diameter concrete lined and wrapped raw water steel pipe. The two proposed extraction wells and the existing extraction well no. 3 will be routed in 12-, 16-, and 20-inch diameter raw water pipelines to the treatment system. This new pipeline will be routed to the treatment system along Western Avenue and the drainage channel. The raw water collection piping will be installed below ground. The existing raw water collection pipe manifold is located near the air strippers. The new raw water collection pipeline from the proposed wells will be located between the two LPGAC filter trains. The new raw water header will be connected to the existing raw water collection pipe manifold. A normally closed valve will separate the new from the existing treatment system. A new 16-inch diameter pipeline will provide connection of the existing air strippers to the raw water lines from the existing extraction wells nos. 1 and 4. Piping to and from the new LPGAC plant will tie into the existing plant piping as shown on Sheet C-3 (URSG 1997b).

Table 2-1

EXISTING AND NEW EXTRACTION WELLS

Extraction Well No.	Total Depth (ft)	Screened Intervals (ft)	Diameter (in)	Flow Rate (gpm)	Pump Type
Newmark No. 3 (Existing)	495	232-270 283-305 331-462	16	1,600	Line Shaft Turbine
EW-6 (New)	335	115-315	16	1,000	Submersible
EW-7 (New)	490	200-470	16	1,300	Submersible

Note: Total depths, screened intervals and diameters of the wells are based on information provided by the city of San Bernardino Water Department.

ft = feet
in = inch
gpm = gallons per minute

The City proposed to treat the LPGAC effluent through the existing air strippers in case a change in MCLs will require removal of Freon® in the future. This could be accomplished by providing stub-outs with blind flanges on the air stripper outlet manifold and the LPGAC discharge manifold. The piping connection between the two manifolds and the associated valves will be added in the future if Freon® treatment is required.

2.3 LPGAC ADSORPTION SYSTEM

The proposed LPGAC adsorption system will employ multiple pairs of adsorption vessels containing granular activated carbon (GAC) that will be regenerated off-site through emptying spent carbon from the vessels and transporting the material to an approved carbon regeneration facility. This technology is widely accepted and used in the drinking water industry. The vessels will be refilled with virgin or regenerated GAC. Until recently, municipal drinking water plants were required to use virgin GAC only. However, attempts by several municipalities (with the City in a lead position) to relieve this rule, resulted in an alteration of the requirements. The DHS is now allowing the use of regenerated carbon if, among other requirements, the carbon is treated in special plants designated for drinking water applications only, and if the carbon is tracked through the entire process to ensure that the material is not mixed with carbon from other locations. This change in requirements will result in lower operation costs.

The raw water will be delivered to the site by a new raw water pipeline. The raw water will be treated by the LPGAC filters and then discharged into the reservoir. The water level in the LPGAC filters will be above the water level in the reservoir. To maintain LPGAC vessels full with water at all times, the discharge piping will be equipped with a pipe loop extending above the top of the vessels. The design basis for the proposed treatment system is presented in Tables 2-2 through 2-4. A system layout is presented on Sheet C-4 (URSG 1997b). The concentration data presented in Table 2-3 are based on analytical results from groundwater monitoring events at Newmark OU, and on actual influent data at four existing groundwater treatment plants in the Newmark OU area. The contaminant concentrations presented in Table 2-3 are conservative estimates for the North Plant. For comparison, Appendix B summarizes groundwater analytical results.

Based on vendor-provided data and the design criteria presented in Tables 2-2 and 2-3, the adsorption system will consist of seven pairs of adsorption vessels, each containing 20,000 pounds of GAC. Each pair is equipped with manifolds and valves to allow for either serial (double-pass) or parallel (single-pass) flow configuration and backwashing. A hydraulic contact time of fifteen minutes is required to maintain a high degree of reliability in reaching discharge water quality requirements. Flow through each vessel should be maintained below 750 gpm to minimize pressure drop across the vessels. The carbon vessels will be rated at 75 pounds per square inch (psi) and the connected piping will be rated at 125 psi. The pressure drop across each unit at 500 gpm is estimated to be 2 psi, or 4.6 feet of water column. A rupture disk assembly will protect each carbon vessel from over pressurization. The carbon vessels will be built of mild steel, externally primed and painted, and internally coated with vinyl ester.

Table 2-2

DESIGN BASIS FOR LPGAC SYSTEM

Influent Pipe (From Wells to System)	
Material	Steel Schedule 40 & Ductile Iron
Diameter	16 in.
Carbon System	
Carbon Unit Type	Calgon Model 10, Westates HP-20-11-700, Northwestern Carbon LF-810, or approved equal
Number of Carbon Units	7 serial pairs in parallel
Total Design Flow Rate	4,875 gpm
Design Flow Rate per Pair	696 gpm
Weight of Carbon per Unit	20,000 lb
Weight of Carbon per Pair	40,000 lb
Carbon Usage Rate (estimated)	386 lb/day
Estimated Carbon Life	362 days
Diameter per Vessel	10 ft.
Carbon Unit Height	≈ 20 ft. overall
Carbon Unit Shipping Weight (per pair)	48,000 lb
Carbon Unit Weight (operating, per pair)	253,000 lb
Carbon Volume per Unit	714 ft^3
Flange Connection	8" pipe
Carbon Unit Pressure Rating	75 psi
Unit Material	Mild Steel
External Coating	Prime and Paint
Internal Coating	Vinyl Ester
Piping Material	Steel Schedule 40
Backwash Type	Manual Valve

Table 2-2 (Cont'd.)

DESIGN BASIS FOR LPGAC SYSTEM

Carbon	
Type of Carbon	Virgin or Reactivated Filtrasorb 300, or approved equivalent
Apparent Density	28-30 lb/ft^3
Pore Volume	0.85 cm^3/g
Hardness	75 Min.
U.S. Standard Sieve Size	8 x 30
Larger than No. 8, max.	5%
Smaller than No. 30, max.	5%
Mean Particle Diameter	0.8 - 1.0 mm
Moisture	2%
Iodine Number (AWWA)	900 min.
Backwash	
Flow	1,500 gpm, maximum
Time	15 minutes
Volume	3,000 ft^3
Electrical (Controls)	
Requirements	120 volt single-phase
Location	Existing Transformer/Control Room
Emergency Power	None
Process Controls	TBD
Reservoir Hydraulic Grade Line	1,416 feet

Note:

TBD	to be determined	psi	pounds per square inch
in	inches	gpm	gallons per minute
lb	pound	cm^3/g	cubic centimeters per gram
ft	feet	mm	millimeter
ft^3	cubic feet	min.	minimum
AWWA	American Water Works Association	gpm	gallons per minute

Table 2-3

ESTIMATED LOADING RATES TO THE LPGAC SYSTEM

Constituent in Water	Influent Concentration (ppb)	MCL Fed/CA
Tetrachloroethene	35	5/5
Trichloroethene	7	5/5
cis-1,2-Dichloroethene	3	70/6
Chloroform	0.2	100/100
Chloroethane	0.4	NE/NE
Methylene Chloride	0.2	5/NE
Toluene	2	1000/NE
Freon® 11	7	NE/150
Freon® 12	51	NE/NE

Fed/CA	Federal and California
MCL	Maximum contaminant level
ppb	parts per billion
NE	Not established

Table 2-4

DESIGN CRITERIA FOR OTHER LPGAC COMPONENTS

Component	Design Criteria	Design Dimension
Backwash Water Supply	System Water	1,500 gpm 70 to 90 psi
Spent Backwash Collection Sumps	Storage Volume Length, total Width, each Average Depth	22,500 gallons 203 feet 5.5 feet 3.6 feet and 3.3 feet

gpm gallons per minute
psi pounds per square inch

The LPGAC system will be designed to treat groundwater to meet drinking water standards for both PCE and TCE at 5 parts per billion (ppb). However, the LPGAC system will be operated in a serial (double-pass) configuration. Breakthrough of contaminants will be monitored before the second LPGAC filter, and no detectable residual carcinogens will remain in the treated water stream. The legend sheet and typical process flow diagram (PFD) of the proposed system along with the required connections to existing piping are presented on Sheet G-4 and Sheet P-1, respectively (URSG 1997b). The entire LPGAC system, including pairs of LPGAC vessels with the required piping manifolds and valves, will be provided by one vendor. Other components that are provided by different vendors are: concrete foundation, pipe headers, yard piping, chlorination system, and electrical controls with line pressure sensors, rupture disk sensors, and flow meters.

The proposed adsorption system will be equipped with automated safety features and the system operation will be interlocked with the existing control panel and extraction wells. System interlocks and instrumentation details are provided in Section 4.0. Design criteria for other system components are listed in Table 2-4.

2.4 BACKWASH SYSTEM

Water extracted from the existing wells is expected to be free of silt and other solids. However, the LPGAC adsorption units may experience an increase in pressure drop across the filter media, which indicates clogging by solids deposits. In this situation, the vessel will be taken off-line and the flow through the vessel will be reversed. The purpose of reversing the flow is to expand the carbon bed which facilitates the dislocation of accumulated solids. The flow rate will be adjusted to achieve sufficient force to dislocate solids and flush them into the spent backwash sump.

The backwash water will be supplied from an existing 16-inch-diameter plant water line. The backwash flow rate will be adjusted by a valve in a range of 800 to 1,500 gpm. The spent backwash water generated during a backwash cycle will be collected in two sumps, one along each LPGAC treatment train. The two sumps are connected using a 12-inch-diameter pipeline. The sump system is designed to hold the volume of one vessel's backwash at a flow rate of 1,500 gpm for 15 minutes. The sumps are covered with steel grating so that the spent backwash water quality can be visually monitored during a backwash cycle. This allows the operator to reduce the backwash flow rate in case of carbon flush-out. Steel grating will be rated for 1-ton forklift loading.

The spent backwash water, collected in the two sumps, will be pumped and discharged into the sewer system. A 200-gpm sump pump will be used to pump spend backwash water, which will be conveyed by 4-inch diameter pipe to a sewer manhole located at the corner of 48th Street and Western Avenue. Sump pump, pipeline, valves and manhole tie-in details are shown in sheet C-3 and C-15 (URSG 1997b).

2.5 TREATMENT SYSTEM BYPASS

PCE and TCE concentrations in the influent water are expected to remain above MCLs for several years. Eventually, concentrations may fall below the MCLs and treatment may no longer be required. A bypass for the LPGAC system will be provided to allow direct discharge of groundwater into the reservoir. The raw water collection manifold will be connected to an existing 30-inch-diameter pipe that is connected with the reservoir. Valves will separate the raw water collection manifold from the reservoir inlet.

2.6 CHLORINATION SYSTEM

The treated water must be disinfected before final discharge to the reservoir. The City's existing disinfection system (chlorination) is capable of handling the flow from the LPGAC system, in addition to the air stripping treatment system. However, to allow proper dosage of chlorine, a new chlorination unit will be installed inside the existing control and chlorine building. A new 1-inch-diameter polyvinyl chloride (PVC) line will be installed to inject chlorine solution before final discharge to the reservoir. The chlorine dosage will be guided by the total flow rate measured by the effluent flow meter (Appendix E).

3.0 SITE WORK

This section describes the activities required to install the LPGAC adsorption system and related appurtenances at the site.

The LPGAC system will be located directly west of the existing air strippers (Sheet C-2, URSG 1997b). Seven pairs of LPGAC vessels, with related piping, valves, and manifolds, will be installed on concrete pads designed to support the cumulative load of the components of the system filled with water. The concrete pads will be designed for a loading of approximately 253,000 pounds per pair of LPGAC vessels in operating condition. The vessels will be held in place by anchors sized for Seismic Zone 4 forces. Two concrete pads with a total area of approximately 3,000 square feet will be required. Structural details are presented on Sheets S-1 and S-3 (URSG 1997b). All concrete will be rated at minimum 3,000 psi. Reinforcement steel will be Grade 60.

The LPGAC system will be installed with the following features:

- Each carbon vessel will be equipped with a differential pressure gauge and transmitter. Pressure differential will be measured between the inlet and the outlet pipe of each vessel. An increase in pressure differential indicates a blockage in the carbon filter. The differential pressure gauges will be equipped with electrical contacts that can be manually set. The differential pressure sensors will be tied into the remote monitoring system as described in Section 4.0.

- Each pair of carbon vessels will be equipped with a propeller flow meter in the treated water line between the vessel outlet and the treated water header.

- Each LPGAC vessel will be equipped with a rupture disk to protect the vessel from overpressurization. Each rupture disk will be equipped with a burst sensor that will send a signal to the interface cabinet and Supervisory Control and Data Acquisition System (SCADA) system when a rupture disk fails.

- The LPGAC system will be equipped with a pipe loop with an air release/vacuum breaker valve designed to maintain the LPGAC vessels full with water.

- The treated water header will be equipped with a propeller flow meter.

Detailed information on all gauges, settings, and valve operation will be provided in the Operation and Maintenance (O&M) Manual in Section 7.0.

The carbon vessels will be equipped with the required valves to allow parallel, serial, reversed serial, and backwash operation modes. The butterfly valves will be adjusted manually. During a backwash cycle, the clogged vessel will be taken off-line by adjusting the valves accordingly. The backwash water will be supplied from an existing 16-inch-diameter plant water pipe. A backflow preventer and a propeller flow meter will be installed in the backwash water supply line. A maximum flow of 1,500 gpm through a carbon vessel is required. The spent backwash water will be discharged though an 8-inch-diameter pipe into the sump. A minimum of 1 foot air gap is maintained between the discharge pipe and the water surface in the sump.

Adjacent to the pads, two concrete sumps (both sumps are 5.5-feet wide and average depths of the sumps are 3.6 and 3.3 feet) will be installed. The sumps will be covered with grating. The sumps will be sized to hold the volume of one backwash at 1,500 gpm for a duration of 15 minutes (i.e., approximately 22,500 gallons or 3,000 cubic feet with a freeboard of more than 6 inches). The bottom of the two sumps will slope 0.5 percent towards the westerly end of the sumps, where a 12-inch-diameter steel pipe will connect the two sumps. The connection pipe will drain towards the south sump. A 200-gpm sump pump, located at the west end of the south sump, will pump the backwash water through a new 4-inch-diameter PVC pipe to a sewer manhole. The 4-inch pipe will be burried below ground (URSG 1997b), except at the crossing of the storm water canal. All the burried segments of pipe will be PVC and only steel pipe will be used at the storm drain crossing.

To avoid future complications in case of necessary repairs on the underground pipe, existing 4-inch-diameter steel, 1-inch-diameter irrigation, and 16-inch-diameter concrete-lined and wrapped steel underground pipes will be rerouted.

The existing air strippers are supplied by three-phase, 60 Hertz, 460 volt electrical service. Power for the proposed equipment will be supplied from the existing air stripper control panel, as described in Section 4.0.

Piping to convey raw water and treated water to and from the LPGAC adsorption modules will consist of connections to the existing yard piping, valves, and steel piping rated at 125 psi. The aboveground piping will be supported with steel pipe supports where required. Joint restrainers will be provided as necessary. A new chlorination unit will be installed inside the existing control and chlorine building. A new 1-inch-diameter PVC line will be installed to inject chlorine solution before the final discharge to the reservoir. The chlorine dosage will be paced by the total flow rate measured by the effluent flowmeter.

The treatment area will be enclosed by a security fence, which will match the type of fence currently installed around the air strippers. The existing fence will be removed at the west side and expanded to include the concrete pad with the proposed equipment. The proposed treatment area will be equipped with sufficient lighting for maintenance work during night hours. An existing double-wing gate will be relocated to the west end of the proposed concrete pad to provide access to the LPGAC vessels. The existing asphalt driveway will be expanded westward between the two LPGAC trains. At the western end of the treatment area, the driveway will turn north and end at the relocated gate. This arrangement will provide access for the typical truck used for carbon changeouts. Landscaped areas removed or damaged during construction will be restored to pre-construction conditions. Paint colors will be chosen to match existing equipment color schemes.

Each equipment component will be bolted to the concrete pad in consideration of Seismic Zone 4 forces.

4.0 ELECTRICAL INSTRUMENTATION AND CONTROLS

This section describes the electrical, instrumentation, and control requirements of the LPGAC system, which include the LPGAC filtration units located adjacent to the water storage reservoir. Electrical, instrumentation and control requirements of the remotely located existing well pump and two new submersible well pumps will be designed by the Water Department.

Electrical products, materials, and installation practices will be suitable for outdoor installation. Control panels installed outdoors shall be within National Electrical Manufacturers Association (NEMA) 4 enclosures, and other outdoor apparatuses and boxes shall be NEMA 3R. Control panels installed indoors shall be within NEMA 12 enclosures and other indoor apparatuses and boxes shall be NEMA 1.

Surface, embedded, or above grade circuits will be installed in rigid galvanized steel (RGS) conduit and below grade conduits will be Schedule 40 PVC. Transition conduits from below grade to above grade will be PVC-coated RGS. All electrical fittings and bodies will be of cast, weather-proof type unless otherwise noted.

The power requirements of the LPGAC system are minimal, and the electrical demand will be significantly less than the present air stripper system. No additional power capacity will need to be added to the site, and power service requirements will be obtained by modification of existing equipment. Power to submersible well pump stations will be obtained for each site by new services from Southern California Edison Company (SCE) and each site will include electrical service entrance equipment and power distribution and control equipment. Well equipment design will be provided by the City.

<u>LPGAC Filtration Units</u>

The operation and control of the LPGAC filtration units is by manual operation. The filter assemblies will be monitored and alarmed as follows:

- High Differential Pressure Alarm. Initiate local and remote warning alarm to indicate that filter maintenance is required.

- High Differential Pressure Critical Alarm. Initiate local and remote warning alarm to indicate that filter shutdown and isolation should be performed.

  Note: The differential pressure switches above will be adjustable relays, included within a differential pressure indicator. The indicator will be installed on each filter unit and will provide a visual meter indication of the differential pressure.

- Low Pressure and Flow Shutdown. Initiate local and remote alarms.

- Flow Transmitters. Included for each pair of filters and will include instantaneous and totalizing local flow indicators and output for remote telemetry.

- Rupture Disk Burst Sensors. Installed at each filter configured to initiate an alarm in case the rupture disk bursts.

A flow meter with flow transmitter and flow pulse output will be located in the discharge pipeline to the reservoir to monitor total filter output flow. The flow signal will be distributed to the local monitor panel, to the existing control panel for remote telemetry, and to the new chlorine delivery equipment. The flow signal will be used to automatically adjust chlorine delivery to suite the flow rate.

Local alarms will be connected to an annunciator panel located in the existing control building. Remote alarm processing will be provided by existing City's SCADA. Remote alarms will be dry contacts from retransmit relays within the annunciator panel. The remote alarms will be terminated in an interface cabinet furnished and installed by the Contractor. The City will perform the final interconnection of the alarms, prepare the SCADA software modification/configuration, and test the alarms.

The annunciator panel will include visual and audible indicators and include normal annunciator functions (acknowledge, flash, test, silence, and seal-in options).

Exterior lighting will consist of high pressure sodium area luminaires installed on poles. Each luminaire will include photoelectric control. The lighting fixtures will be similar to existing lighting fixtures. Specific or other task lighting, as needed, will be by portable fixtures provided by maintenance personnel.

Power to site equipment will include 120-volt instrumentation power (differential pressure indicators and flow transmitters) and power to duplex receptacles, ground-fault circuit interrupter (GFCI) type, at convenient locations among the LPGAC filtration units.

5.0 TREATMENT SYSTEM SAMPLING STRATEGY

Treatment system sampling at each LPGAC filter pair is necessary to:

- Track effectiveness of the LPGAC system.
- Estimate date for carbon replacement.
- Satisfy DHS permit requirements (Title 22).
- Monitor hydraulic capture of plume through groundwater level measurement.

The details of the sampling requirements are presented in the Newmark OU Remedial Action, Performance Monitoring Program, Field Sampling Plan (FSP) Addendum to the Source OU LTMP, FSP (PMPFSP) (URSG 1997c). Additional sampling will be required to track the effectiveness of the LPGAC system. Sampling intervals will be shorter during the startup phase. Table 5-1 illustrates the types of analyses and sampling intervals.

Table 5-1

PROPOSED LPGAC TREATMENT SYSTEM SAMPLING PROCEDURES

		Sampling Intervals			
	Type of Analysis	**Inlet Port**	**Intermediate Port**	**Effluent Port**	**Groundwater Level[(1)]**
Startup phase (10 days)	EPA 524	Daily	None	Daily	Daily
6 month optimization	EPA 524	Weekly	Weekly	Weekly	Weekly
Ongoing operation	EPA 524	Monthly	Monthly	Monthly	Monthly

(1) Groundwater levels will be continuously collected electronically and downloaded on the presented schedule.

6.0 OPERATION AND MAINTENANCE MANUAL

The O&M manual will provide information on O&M of the LPGAC adsorption modules and connected equipment. The O&M manual will include system description, instructions for different operation modes with valve schedule, maintenance schedules, monitoring requirements, and safety information. Because a majority of this information comes from the equipment supplier upon delivery, an O&M manual has not been developed at this time. Following final selection of system components, and prior to installation or system operation, a draft O&M manual will be prepared. The probable outline for this document is presented below.

1.0 Introduction
- 1.1 Project Description
- 1.2 General Process Description

2.0 Process Components
- 2.1 Connections and Valves Between Existing Yard Piping and Groundwater Treatment System, and System Bypass
- 2.2 Package LPGAC Adsorption Modules
- 2.3 Pressure Sensors and Controls
- 2.4 Flow Meters
- 2.5 Valves and Valve Schedule for Different Operation Modes
- 2.6 Carbon Vessel Sampling
- 2.7 Inlet and Outlet Sampling
- 2.8 Backwash System
- 2.9 Spent Backwash Storage and Discharge
- 2.10 Spent Carbon Replacement
- 2.11 Instrumentation
- 2.12 Electrical
- 2.13 Remote Alarm Transmission

3.0 Operating Procedures
- 3.1 Initial Startup
- 3.2 Routine Startup
- 3.3 Routine Operations
- 3.4 Routine Shutdown
- 3.5 Routine Maintenance
- 3.6 Process Monitoring
- 3.7 Troubleshooting Guide

4.0 Health and Safety

Appendices:
- Equipment Specifications and O&M Manuals
- Operating Logs

7.0 CAPITAL AND OPERATION AND MAINTENANCE COST ESTIMATES

The revised cost estimates for capital and O&M costs are summarized below. Detailed cost tables are presented in Table 7-1. The revised costs are based on the original Newmark RI/FS costs (URS 1993), updated to reflect the level of detailed understanding of the project at the current stage of the design process, and discussions between the USEPA WAM, the City, and URSG.

The main changes from the Newmark RI/FS cost estimates are:

- The portion for contingencies was reduced.
- The number of extraction wells including pumps and conveyance piping was adjusted.
- The number of LPGAC units was changed to reflect a double-pass configuration with a total contact time of approximately 15 minutes.
- Some treatment facility components, such as effluent tank, chlorination system, booster pumps, and buildings, were deleted according to the changed location of the treatment system and its integration into existing treatment facilities.
- The electrical power costs were revised to consider actual energy for pumping to the required hydraulic grade elevation.
- The LPGAC costs were revised based on the latest concentration data from monitoring wells and from influent of existing treatment plants.

Table 7-1
WATER TREAMENT COST ESTIMATE
NEWMARK OU NORTH PLANT
SAN BERNARDINO, CA

Description	Quantity Unit	Unit Cost Material [1]	Labor [2]	Estimated Cost	Subtotal
CAPITAL COST					
GW Extraction					
Well Site Access	2 sites	$54,500		$109,000	
Extraction Wells	1,000 lf	$182	$64	$245,455	
Extraction Headworks	2 ea	$68,200	$22,700	$454,500	
Subtotal:					$536,255
Contingency:	10%			$53,625	
Total GW Extraction Wells				[3]	**$589,900**
Pipeline					
Pipeline	ls			$139,500	
Backwash Pipeline	ls			$22,000	
Mooselodge grading	ls			$23,700	
Subtotal:					$185,200
Contingency:				$18,520	
Total Pipeline				[4]	**$203,720**
Treatment Facilities					
GAC Units	7 pairs	$190,460	$7,020	$1,382,360	
Chlorination System	1 ls	$7,500	$7,500	$15,000	
Structural	1 ls			$130,000	
Site Work & Yard Piping	1 ls			$389,720	

Table 7-1 (Cont'd.)
WATER TREAMENT COST ESTIMATE
NEWMARK OU NORTH PLANT
SAN BERNARDINO, CA

Description	Quantity Unit	Unit Cost Material (1)	Labor (2)	Estimated Cost	Subtotal
Site Electrical	1 ls			$95,920	
Subtotal:					$2,013,000
Contingency:	10%			$201,300	
Total Treatment Facilities				(5)	**$2,214,300**
SUBTOTAL CAPITAL COST					**$3,007,920**
Construction Management	6.0%				$180,480
GW Monitoring Wells					
Wells	1,200 lf	$74	$147	$265,200	
Subtotal:					$265,200
Contingency:				$26,520	
Total GW Monitoring Wells				(6)	**$291,720**
TOTAL CAPITAL COST					**$3,480,120**
ANNUAL O&M COST					
(7) Carbon Usage	lb GAC	$1.00		$156,000	
(8) Material and Labor			(10)	$65,000	
(9) Power			(10)	$65,000	
Monitoring System				$50,000	
TOTAL ANNUAL O&M COST					**$336,000**
PRESENT WORTH OF ANNUAL O&M COST		(30 yrs.,i=5%)		$5,165,140	
TOTAL PRESENT WORTH					**$8,645,260**

Table 7-1 (Cont'd.)
WATER TREAMENT COST ESTIMATE
NEWMARK OU NORTH PLANT
SAN BERNARDINO, CA

(1) Materials include a 15% markup.
(2) Labor includes a 15% markup for contractor overhead and profit.
(3) Costs based on Well Extraction Technical Memorandum.
(4) Pipeline length same as Newmark RI/FS, but one more pump added.
(5) Costs based on modified Newmark RI/FS. Changes are: no effluent tank, 7 pairs of GAC (instead of 4 pairs), and no building.
(6) From Newmark OU RA Work Plan.
(7) New operation costs based on updated concentration data and GAC consumption vendor model results. GAC cost assumed at $1.00 per pound GAC.
(8) Cost for material/labor/extraordinary distribution costs estimated at $10/acre-foot.
(9) Cost for higher power costs (standard versus night-only rates) estimated at $10/acre-foot.
(10) Cost provided by USEPA.

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