ARCS

Remedial Planning Activities at Selected
Uncontrolled Hazardous Substance Disposal
Sites in the Zone of Regions IX and X

FINAL
100 PERCENT DESIGN SUBMITTAL
NEWMARK OU REMEDIAL DESIGN
NEWMARK GROUNDWATER
CONTAMINATION SUPERFUND SITE
SOUTH PLANT

U.S. Environmental Protection Agency
Contract No. 68-W9-0054

URS Greiner

Team Subcontractors:

Black & Veatch Special Projects Corp.
Shannon and Wilson, Inc.

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Prepared For:

Contract No. 68-W9-0054 / WA No. 54-37-9NJ5
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Region IX
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San Francisco, CA 94105

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IDENTIFICATION FORM

Document Title:	**FINAL 100 PERCENT DESIGN SUBMITTAL NEWMARK OU REMEDIAL DESIGN NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE SOUTH PLANT**
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Plan Coverage:	This document constitutes the 100 percent design submittal for the Newmark Operable Unit Remedial Design, Newmark Groundwater Contamination Superfund Site work assignment (WA) in the U.S. Environmental Protection Agency's (EPA) Region IX under EPA Contract No. 68-W9-0054. These services are provided by URS Greiner, Inc. - California as prime contractor.

APPROVAL FORM

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ABBREVIATIONS AND ACRONYMS

A:W	Air-to-water ratio
ARARs	Applicable or relevant and appropriate requirements
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
BACT	Best available control technology
BC	Basement complex
bgs	Below ground surface
City	City of San Bernardino
DHS-ODW	Department of Health Services - Office of Drinking Water
DTSC	Department of Toxic Substances Control
ECS	Emissions control system
ft^2/day	Square feet per day
GAC	Granular activated carbon
GFCI	Ground-fault circuit interrupter
gpm	Gallons per minute
hp	Horsepower
LPGAC	Liquid-phase granular activated carbon
LWBM	Lower water-bearing member
MCL	Maximum contaminant level
MCM	Middle confining member
NEMA	National Electrical Manufacturers Association
NPL	National Priority List
O&M	Operation and maintenance
OU	Operable unit
P&ID	Piping and instrumentation diagram
PCE	Tetrachloroethene
PFD	Process flow diagram
ppb	Parts per billion
psi	Pounds per square inch
PVC	Polyvinyl chloride
RGS	Rigid galvanized steel
RI/FS	Remedial investigation/feasibility study
ROD	Record of decision
RWQCB	Regional Water Quality Control Board
SCADA	Supervisory control and data acquisition system
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison Company
TCE	Trichloroethene
TSS	Total suspended solids
URSG	URS Greiner, Inc. - California
USEPA	United States Environmental Protection Agency
UWBM	Upper water-bearing member
WA	Work assignment
μg/L	Micrograms per liter

1.0 INTRODUCTION

Previous investigations have concluded that a plume of groundwater contamination (Newmark Plume) exceeding state of California maximum contaminant levels (MCLs) exists beneath the city of San Bernardino, California (Figure 1-1). The Newmark Operable Unit (OU) encompasses the area impacted by this contaminant plume. A Record of Decision (ROD), dated August 4, 1993 (USEPA 1993), outlines the requirement for two groundwater extraction and treatment systems, one system (of two components) in the southern area of the Newmark OU, designated as the South Plants, and one in the northern area, designated as the North Plant.

This 100 Percent Design Submittal presents the design developed for the South Plants. While both the South Plants and North Plant drawings and technical specifications are presented in "Newmark OU Remedial Design, North and South Plants 100% Construction Specifications and Drawings" (URSG 1997a), the North Plant design is being submitted under a separate cover (URSG 1997c), concurrently with this document. This design has been prepared by URS Greiner, Inc. - California (URSG) under U.S. Environmental Protection Agency (USEPA) contract number 68-W9-0054/work assignment number 54-37-9NJ5.

This 100 percent design document addresses comments on the 30 (URS 1995b), 60 (URS 1995c), and 90 (URS 1996a) percent design documents provided by the USEPA. In addition to USEPA input, to ensure that the design reflects actual conditions and to provide a smooth connection to existing facilities, URSG met with city of San Bernardino (City) and state agencies throughout the design process. State requirements and all design comments have been incorporated, as well as City preferences for future system operation and maintenance.

The groundwater extraction and treatment systems design has been divided into two major design projects:

- Water transmission pipeline design.
- Groundwater treatment system design.

The water transmission pipeline design is complete and a portion of the pipeline was constructed during the latter part of 1996 and early part of 1997. A separate deliverable was developed for the pipeline design (URS 1996b). This document covers the South Plants groundwater treatment systems, which have been designed to make use of existing groundwater treatment facilities: the Waterman Plant, an air-stripping facility; and the 17th Street Plant, a liquid-phase, granular activated carbon (LPGAC) facility. The Waterman Plant facilities will be modified and enhanced to handle treatment of the groundwater extracted from newly installed extraction wells. Minor modifications to the 17th Street Plant will be performed to handle treatment of a portion of groundwater extracted from the newly installed extraction wells. The wellhead facility design will be provided by the City.

1.1 BACKGROUND

1.1.1 History

The California Department of Health Services - Office of Drinking Water (DHS-ODW) discovered chlorinated solvents in municipal water-supply wells (municipal wells) within the northern San Bernardino/Muscoy region of San Bernardino County during a 1980 groundwater investigation. Several investigations were conducted to locate the potential source(s) of contamination. On March 30, 1989, USEPA placed this region on the National Priorities List (NPL), thereby releasing federal funds for cleanup of the region, now identified as the Newmark Groundwater Contamination Superfund Site (site).

The principal contaminants identified in site investigations were trichloroethene (TCE) and tetrachloroethene (PCE). Reported concentrations of these contaminants exceed federal and California MCLs for drinking water in several municipal wells within the San Bernardino and Muscoy areas, including the Newmark Municipal Wellfield (Newmark Wellfield). These municipal wells are operated by the City of San Bernardino Water Department (Water Department).

1.1.2 Conceptual Hydrogeologic Model

The conceptual hydrogeologic model for this site is evolving over time as more information becomes available. It consists of data assembled from historical drillers' logs and other information supplied by the Water Department, monitoring well installations, groundwater sampling events, and shallow seismic reflection studies. A brief highlight of the conceptual model is presented here. For more details, refer to the Detailed Hydrogeologic Investigation Technical Memorandum for the North and South Facility Areas (URSG 1995d).

General Model

The conceptual hydrogeologic model consists of four units (or members) based on interpretations of the available data. The units include two water-bearing members (upper and lower) separated by a confining member with a relatively lower permeability. The bottom unit is a basement complex (BC) composed of bedrock that is locally altered.

The upper water-bearing member (UWBM) is interpreted as unconsolidated dune and river channel deposits consisting of boulders, gravel, sand, and silt. This unit is generally unsaturated, but may contain groundwater under perched conditions. Early indications from the Source OU remedial investigation (RI) activities are that perched or seasonal saturated conditions may be present in the northeast portions of the Source OU. Further data accumulation and investigation will provide information necessary to make a more detailed statement regarding perched water conditions.

The middle confining member (MCM) is interpreted as poorly to moderately consolidated alluvial and fluvial deposits consisting of interbedded heterogeneous gravel, sand, silt, and clay.

The lower water-bearing member (LWBM) is interpreted as unconsolidated alluvial and fluvial deposits consisting of interbedded silty gravel; silty, clayey sand; and sandy clay lenses. This member can locally contain a massive granitic/dioritic gravel bed 300-to 400-feet-thick.

The BC is interpreted as competent igneous and metamorphic material consisting of granodiorite and schist. This unit can locally be overlain by a zone of altered material. This altered zone is typically represented by angular, schistose rock fragments and clayey silts which contain mottled clasts. Clasts commonly exhibit relict texture and are interpreted as altered bedrock.

Evaluation of five seismic lines and historical aerial photographs concluded that the area studied is crossed with a series of lineaments with corresponding conjugate sets that roughly intersect at right angles. When reviewing aerial photos through a stereoscope, these conditions give the appearance of blocks of material which have been up- and down-thrown relative to one another.

Based on the analytical results from monitoring wells near the leading edge of the contaminant plume (MW10 and MW11), it is concluded that contamination appears to be limited to the upper portions of the LWBM. The eastern boundary of the leading edge of the Newmark Plume is currently delineated by the absence of contaminants in Muni-24 (Gilbert Street well). The western edge is delineated by low levels of contaminants detected in Muni-18, 19, and 20 (27th Street, North E Street, and 23rd Street).

MW11 is located near the intersection of Genevieve Avenue and Baseline Street in an area interpreted to be a bedrock low. Altered bedrock was encountered in MW11 at approximately 1,200 feet below ground surface (bgs). Competent bedrock was encountered at approximately 1,254 feet bgs.

1.2 EXISTING TREATMENT FACILITIES

Currently, there are two groundwater treatment plants in operation in the vicinity of the leading edge of the Newmark Plume: the Waterman Plant and the 17th Street Plant. The Waterman Plant is located north of 30th Street and east of Waterman Avenue, and the 17th Street Plant is located at the intersection of Sierra Way and 17th Street (Figure 1-1). The City operates both plants.

1.2.1 Waterman Plant

The Waterman Plant includes two air strippers. Each stripper is rated for a hydraulic volumetric capacity of 5,000 gallons per minute (gpm). Emissions from the strippers are currently "not controlled." Table 1-1 presents design data of the two existing air strippers and Table 1-2 presents actual air stripper operational data at the Waterman Plant. Additional information on operational data is presented in Appendix A.

USEPA determined that the South Coast Air Quality Management District's (SCAQMD's) regulations are applicable or relevant and appropriate requirements (ARARs). Under the anticipated increased flow rates and contaminant concentrations of USEPA's remedial action, off-gas treatment would be required. An engineering cost analysis based on the latest contaminant concentrations indicated that liquid-phase granular activated carbon (LPGAC) is the more cost-effective means of treating the groundwater and, therefore, an LPGAC adsorption plant is being designed (URS 1994b).

Although USEPA's remedial action does not directly incorporate the existing air strippers at the Waterman Plant, it does not preclude their use by the City for peak demand periods. The existing air strippers will have valves added so that they may be used for groundwater treatment in the future.

LEGEND

Approximate Extent Of Groundwater Contamination, (K. Mayer EPA)

Fault

0 ½ 1

SCALE IN MILES

N

Base Map: USGS San Bernardino Quad

URS Consultants, Inc. Sacramento, Ca	NEWMARK OU RD NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE	FIGURE 1-1 NEWMARK OU PLUME LOCATION

Table 1-1

DATA RELATED TO EXISTING AIR STRIPPERS AT WATERMAN PLANT

Item	South Air Stripper [1]	North Air Stripper [1]
Diameter (ft)	16	16
Total Height (ft)	42	42
Packing Height (ft)	23	23
Packing Type	#2 Rauschert	#2 Rauschert
Blower Flow Rate (max. cfm)	40,000	40,000
Flow Rate Adjustment	Louvers	Louvers
Blower Motor hp	200	200
Design Water Flow Rate (gpm)	5,000	5,000
Effluent Design Quality (ppb)	PCE: 300 to ND TCE: 100 to ND	PCE: 300 to ND TCE: 100 to ND
Design Air: Water Ratio (A:W)	50:1	50:1
Design Packing Loading (gpm/ft^2)	25	25
Design Removal Efficiency	99.7%	99.7%
Inlet Pipe Diameter (in)	16	16
Effluent Pipe Diameter (in)	20	20

Note: Actual operational data are listed in Table 1-2.

[1] Existing two air strippers at Waterman Plant are designated by City of San Bernardino as South and North Air Strippers.

ND Non detect
ft Feet
cfm Cubic feet per minute
gpm Gallons per minute
ft^2 Square feet
ppb Parts per billion
in Inches
PCE Tetrachloroethene
TCE Trichloroethene

Table 1-2

ACTUAL OPERATIONAL DATA OF EXISTING AIR STRIPPERS AT WATERMAN PLANT

Item	South Air Stripper [1]	North Air Stripper [1]
Air Flow Range (cfm)	20,000 to 32,400	27,300 to 36,250
Water Flow Range (gpm)	2,524 to 5,900	3,600 to 4,900
Air:Water Ratio (A:W)	29:1 to 83:1	43:1 to 72:1

Note: Data summarized from monthly operational data recorded from January 1993 to October 1994.
[1] Existing two air strippers at Waterman Plant are designated by city of San Bernardino as South and North Air Strippers.
cfm Cubic feet per minute
gpm Gallons per minute

1.2.2 17th Street Plant

The existing 17th Street Plant consists of LPGAC vessels rated at a flow rate of 4,000 gpm in a single-pass configuration. The LPGAC facility consists of six LPGAC vessels with a capacity of 20,000 pounds of carbon each. The vessels are piped in parallel without an option for serial (double-pass) configuration. The facility is equipped with a backwash system and backwash sump that is connected to the sewer system. The backwash system is explained in further detail in Subsection 2.4. The treated water is disinfected with chlorine before discharge to an on-site reservoir. A booster station pumps water from the reservoir into the City's municipal water supply system.

1.3 DESIGN OBJECTIVE

The primary objective of this report is to design on-site groundwater treatment systems for the two South Plants. Groundwater will be extracted from five new wells located near the downgradient edge of the groundwater PCE plume south of Baseline Road, Newmark OU. As part of remedial action implementation at Newmark OU South, groundwater has to be extracted to intercept further plume migration into uncontaminated portions of the aquifer, and to protect downgradient water purveyors. For further details, refer to Subection 1.4 and URS' Remedial Investigation/Feasibility Study (RI/FS) Report (URS 1993). Extracted groundwater will be delivered to and treated at two existing treatment facilities (Waterman and 17th Street Plants) that will be converted to fulfill the project requirements.

Originally, air stripping with an emissions control system (ECS) was identified as the preferred alternative to treat the extracted groundwater. A study identified the PURUS ECS as the best available control technology (BACT) (URS 1994a). Present worth cost comparisons, however, which were based on more recent concentration data from the Newmark OU plume and actual extraction data from existing treatment plants, indicated that LPGAC groundwater treatment is more cost efficient than off-gas treatment (URS 1994b). Upon direction by USEPA, URSG has designed LPGAC groundwater treatment systems. Treated water will be discharged to the City's municipal water supply system, and therefore, drinking water standards must be met.

1.4 NEWMARK PLUME FRONT EXTRACTION WELL SYSTEM DESIGN

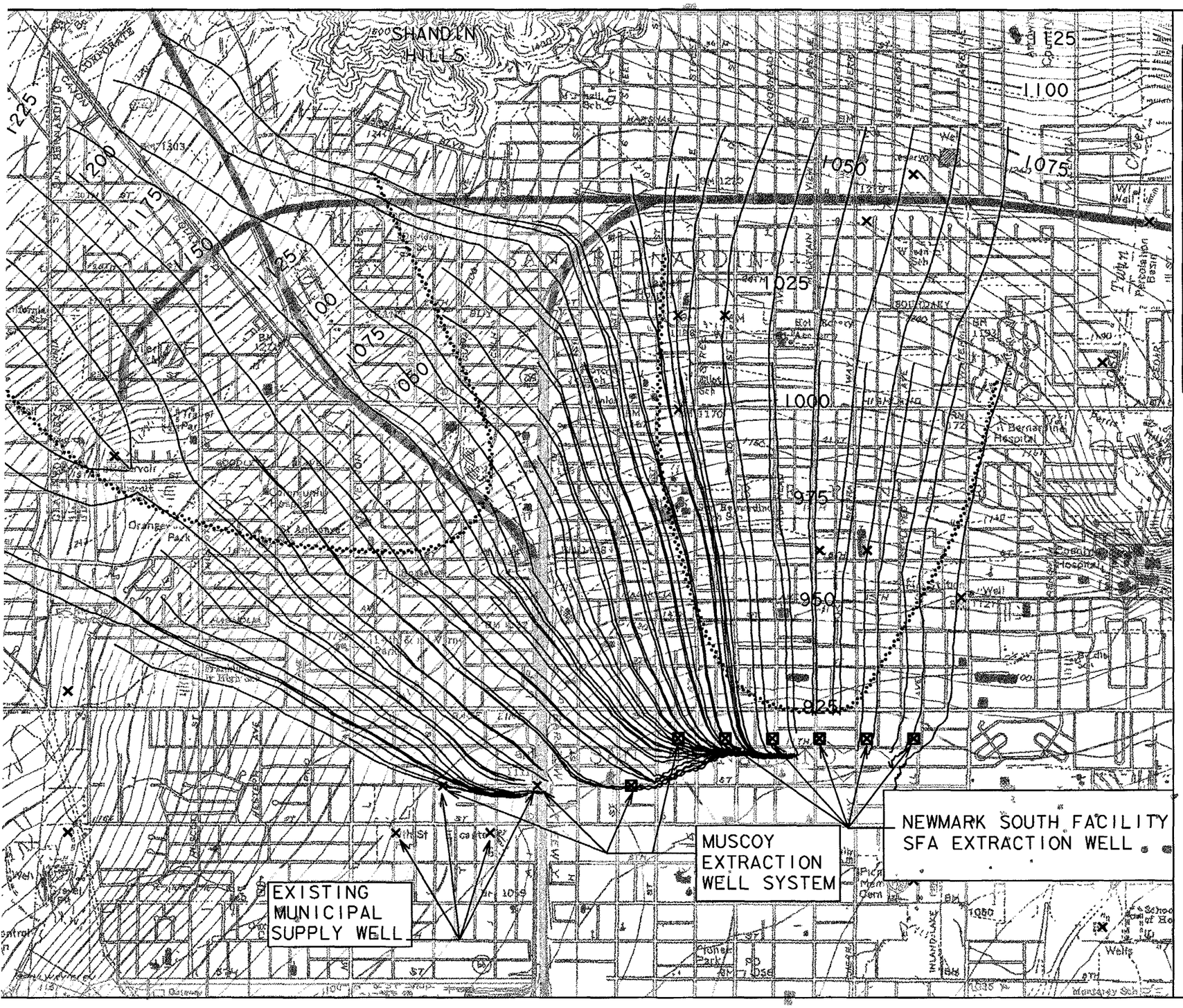
This section describes the extraction well location design of the Newmark OU plume front extraction well system. Figure 1-1 presents the assumed locations for the Newmark and Muscoy contamination plumes. Design of the system includes the location, number, and extraction rates of the proposed new extraction wells. The physical design of the extraction well system (e.g., casing diameter, screen interval and size, packing materials) was completed using data from the pilot borings for the extraction wells. The project flow model was used as the basis for the extraction well system location and flow rates. Computer runs performed during the FS phase were used as the starting point for the design presented herein.

1.4.1 Scope and Objective

The goal of the Newmark OU plume front extraction system is to inhibit further migration of the Newmark groundwater contaminant plume. The proposed extraction well system is located near the Newmark plume front along Baseline Street. To design an effective extraction system, the following parameters were determined:

(1) Location of Newmark plume front extraction wells.
(2) Number of extraction wells.
(3) Pumping rates from the extraction wells.

During design of the Newmark plume front extraction system, a design was initiated for the Muscoy plume front extraction system. Several groundwater flow model runs were conducted. The model results indicated that the two extraction systems effect each other so pumping from both systems was simulated. The results of these "collective" system model runs required increasing flow from the Newmark plume front extraction wells. The model results which form this latest phase of groundwater flow and particle path modeling are documented in the Muscoy Plume Front Extraction Well Technical Memorandum (URSG 1997d). This document is incorporated as Appendix F.



LEGEND

- Extraction Well
- Muncipal Supply Well
- 5ug/L PCE Isoconcentration Contour
- Imaginary Particle Pathline
- Predicted Groundwater Elevation Contour

N

0′ 2000′ 4000′

SCALE IN FEET

NEWMARK PLUME OU RD
NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE

FIGURE 1-2
EXTRACTION WELL LOCATIONS
AND PATHLINE PLOT (81 A) LAYER 2

1.4.2 Proposed Extraction Well System

Based on the project model results, run 81a was chosen as the proposed extraction well system design, combining pumping at the fronts of both the Newmark and Muscoy plumes. The proposed system consists of operation of the five newly constructed Newmark plume front extraction wells located along Baseline Street. Two proposed Muscoy extraction wells about 1,160 feet apart along with two existing Water Department wells (Olive & Garner and 10th & J Street water supply wells) are also part of the proposed combined pumping strategy. The locations of the combined system wells are shown in Figure 1-2. The following pumping rates, based on the model results, are proposed for the combined system:

- Newmark plume front extraction wells from west to east
  1,700-gpm, 1,700-gpm, 2,000-gpm, 1,700-gpm, 1,700-gpm

- Muscoy plume front extraction wells from west to east
  1,300-gpm each

- Existing Water Department wells (9th & Garner and 10th & J Street wells)
  2,550-gpm each.

This model scenario, among the 29 scenarios evaluated, is most conducive to efficient water transfer with minimum new pipeline construction and relatively minimal groundwater pumping and treatment for the affected area. This scenario assumes that existing water supply wells at the Baseline Feeder Wellfield (9th & Garner and 9th & Perris Street wells) and the Water Department 7th Street well will not be operated for the duration of the remedial action (at least 30 years). Some of the municipal water supply wells in this region have pumping capacity as high as 3,000-gpm, or more. Pumping rates between 1,300-gpm and 2,500-gpm are considered more reasonable for this area based on nearby pumping from the Baseline Feeder Wellfield.

It should be noted that the proposed extraction well system design is an estimate based on the project flow model, and therefore subject to the same uncertainty and limitations as the model. The following limitations particularly affect the well system design:

- Model Grid Spacing. Project flow model uses a grid spacing of 820 feet in x and y directions. Because of the grid size, a minimum well spacing of 820 feet can be used in the model simulation. If smaller well spacings were used, a lower extraction rate might effectively capture the imaginary particles.

- Extraction Well Screen Lengths. The model does not allow for separate screening intervals within an aquifer or for partial penetration of an aquifer. Although the plume front appears to be more shallow in the Muscoy Plume than the Newmark Plume, it is not present over the entire thickness of the aquifer. The model assumes extraction wells are fully penetrating over the entire model layer (layer 2). This difference could allow the

model to predict a greater pumping rate than necessary. The proposed extraction wells will be screened over a portion of the lower aquifer to optimize plume capture. Actual pumping rates will be based on pumping tests performed on the newly constructed wells. Regardless, the design proposed is considered optimal based on the available data and the specific objectives of the overall system.

1.5 BASIS FOR PROCESS DESIGN AND COMPONENT SIZING

LPGAC system design and component sizing is based on pumping results conducted at wells located near the proposed new well locations, groundwater extraction modeling, records from existing well pumping, and recommendations from carbon vendors. Data from other groundwater treatment plants operated by the City were also incorporated in this evaluation. The operational data are collected from the City-operated existing treatment plants: Waterman facilities (air strippers), North Plant (air strippers), 19th Street facility (LPGAC) and 17th Street facility (LPGAC). The operational parameter of these plants are comparable to the anticipated operational parameters of the proposed South Plants. Additionally, URSG's professional judgment and past experience with similar projects, plus a consensus reached during a project meeting in San Bernardino between the USEPA, the City, the Department of Toxic Substances Control (DTSC), the DHS-ODW, and URSG on November 16, 1994, were also instrumental in the design (URS 1994b).

Appendix A presents operational data provided by the City. Figures A-1 through A-2 graphically present air and groundwater flow data from the two existing air strippers at the Waterman Plant. Appendix B summarizes results from groundwater analyses at the Waterman, 17th Street, 19th Street, and North Plants. Figures B-1 through B-3 present graphs of influent concentrations at these plants. Appendix C presents design calculations and graphs used during design. Appendix D presents design information submitted by LPGAC vendors for equipment sizing. Appendix E presents design information for the chlorination system and the flowmeters.

Information received by the LPGAC vendors indicates that a minimum contact time of ten minutes is required to achieve adequate removal efficiencies by the LPGAC filters. This can be achieved in a parallel, i.e., single-pass, configuration at a maximum flow rate of approximately 500 gpm through each vessel. However, serial, i.e., a double-pass, configuration of LPGAC filters is recommended for the following reasons:

- Higher reliability to meet discharge requirements.
- Reduced carbon usage due to more complete carbon loading.
- Simplified breakthrough sampling. In serial configuration, sampling is required between primary and secondary LPGAC filters only. For parallel configuration, however, vendors recommend collection of actual carbon samples from the vessels at different depths.

Because the maximum recommended flow rate through each LPGAC filter is limited to approximately 750-gpm, more LPGAC vessels would be necessary for treatment in serial configuration. The additional capital costs are expected to be offset by the reduced LPGAC usage over the project duration. URSG's review of this information indicates that a hydraulic contact time of fifteen minutes across two LPGAC vessels

arranged in series will be required to keep the flow rate through each vessel below 750 gpm, and to minimize pressure drop. Figures C-1 through C-4 graphically present the relationship between flow rates and total contact time.

As a result of the hydrologic modeling described in Subsection 1.4 extracted water from the Newmark Extraction Well No. 1 will be conveyed to the proposed Muscoy OU water treatment plant for treatment. Water extraction from the remaining four Newmark Extraction wells will be brought to the South Plants (Waterman and 17th Street Plants) for treatment. This gives a total flow rate of 7,100 gpm (1,700 + 2,000 + 1,700 + 1,700) and a total design flow rate of 7,810-gpm to the South Plants. A 10 percent factor of safety is added to the flow rate from the extraction wells to calculate the design flow rate. Approximately 2,200-gpm can be treated in the existing 17th Street Plant after modifying the system for double-pass treatment of water. Because the entire water extracted from the Newmark Extraction Well No. 3 (extraction rate of 2,000-gpm) can be treated at the 17th Street Plant, this well will be piped directly to the 17th Street Plant. Hence, the design flow rate for the Waterman Plant of 5,610-gpm (7,810 - 2,200) requires installation of eight pairs of LPGAC vessels (Sheets P-7 through P-12, URSG 1997a). It follows that the Newmark Extraction Well No.'s 2, 4, and 5 will be piped to the Waterman Plant.

The process components, and the expected contaminants and their respective levels in the groundwater are discussed in Section 2.0.