7. Summary of Site Characteristics

7.1 Extent and Distribution of Contamination

An understanding of the distribution of contamination in each of the hydrostratigraphic units in question is crucial to the understanding of this selected remedy. The reader is referred to the critical documents listed in Section 5 of this ROD; including the remedial investigation reports and Section 2 of the Joint Groundwater Feasibility Study (JGWFS), for a complete summary of the extent and distribution of contamination. This ROD only summarizes this information.

This remedy defines a number of zones laterally and vertically within the groundwater, and assigns differing remedial actions to each. These zones are based on the characteristics summarized in this section. This ROD relies heavily on the special definition and use of the term ***plume*** for special zones of groundwater. This definition is given later in this section in Section 7.2, "Conventions for Dividing the Contamination into Plumes." A thorough understanding of the use of the term *plume* is essential to comprehension of the remedial action selected by this ROD, and the reader is encouraged to carefully review Section 7.2 before proceeding to other sections of the ROD. The intervening information on contaminant distributions greatly facilitates and elucidates the definition of plumes and is therefore presented first.

Driving Chemicals of Concern for Remedy Selection Purposes

More than 30 hazardous substances and pollutants or contaminants have been detected in groundwater at the Joint Site. These are identified in the remedial investigation reports (see Section 5). Among the hazardous substances or chemicals of concern at the Joint Site are: chlorobenzene, benzene, ethylbenzene, dichlorobenzene, naphthalene, DDT, benzene hexachloride (BHC), chloroform, trichloroethylene (TCE), perchloroethylene (PCE), dichloroethylene (DCE), and trichloroethane (TCA). Of these, however, **benzene**, **chlorobenzene, TCE and PCE** are by-far the most-widely distributed, consistently detected, and are found in the highest concentrations at the Joint Site. These chemicals also present the greatest potential toxicity to a potential groundwater user when their innate toxicity and concentrations are considered together (See Section 8, Summary of Groundwater-Related Risks).

While EPA's risk assessment addressed all chemicals in groundwater, EPA's feasibility study focused on remedial actions for these four chemicals. The distributions of all other chemicals in groundwater at the Joint Site, except pCBSA, fall within one or more of the distributions of these three chemicals. EPA has determined that the same remedial actions selected for chlorobenzene, benzene, TCE, and PCE will also address the other chemicals of concern in the course of

remedial implementation. Requirements in this ROD that apply to chlorobenzene, benzene, TCE and PCE also shall apply to the other chemicals in the contaminant distributions at the Joint Site, as specified in this ROD.

TCE, PCE, DCE, and TCA are chlorinated aliphatic organic solvents. For simplicity, unless otherwise noted, the term "TCE" hereafter in this ROD refers to TCE, PCE, DCE, and TCA.

The chemical pCBSA is also present in groundwater. The distribution and remedial action selected for this contaminant represents an exception to the statements in the preceding paragraph. pCBSA is addressed separately from the other contaminants as further-described in Sections 8, 11, 12, and 13 of this ROD.

Non-aqueous Phase Liquids (NAPL)

As described previously in Section 4 of this ROD, several of the hazardous substances and chemicals or concern at the Joint Site are present both in the dissolved phase and as NAPL. The NAPL is the primary principal threat at the Joint Site. The NAPL continues to dissolve in the groundwater, feeding the distribution of dissolved contamination which can move in the groundwater laterally and vertically and pose a health threat. It is the NAPL which gives rise to the inability to cleanup all groundwater at the Joint Site (See Section 10) and the need to develop strategies in which the contamination surrounding the NAPL is contained and isolated (discussed in Section 4, 9, 10, and 11). Because the NAPL largely provides the genesis for the dissolved phase contamination, the nature and extent of NAPL at the Joint Site is discussed in this section in advance of discussing the distribution of dissolved phase contamination, and "plumes" of groundwater contamination. The distribution of dissolved phase contamination, and its behavior, is better understood in the context of the nature and distribution of NAPL sources.

DNAPL at the Montrose Chemical Superfund Site

Chlorobenzene is the primary chemical which occurs as NAPL at the former Montrose plant. Chlorobenzene is a dense non-aqueous phase liquid, or ***DNAPL***, which means it is denser than water and tends to sink in aqueous media due to a positive density gradient. DNAPL likely entered the ground at the Montrose Chemical Site through the bottom of the Montrose waste disposal pond, through trenches, and via the operations such as the filter press rework facility (See Chapter 1 of the Montrose Site RI Report, EPA 1998). DNAPL at the Montrose Chemical Site may have penetrated as far as the Gage Aquifer (see Section 2 of the JGWFS and discussion of hydrostratigraphic units, below) to a depth potentially exceeding 130 feet below the ground surface. The exact depth to which NAPL has migrated is not known, but the lack of such knowledge is not unusual at NAPL sites because making determinations of NAPL depth and distribution can be exceedingly difficult, particularly in the heterogeneous soils found at the

Montrose Chemical Site. Concentrations of chlorobenzene in groundwater in the Gage aquifer remain reasonably consistent with the presence of DNAPL. Concentrations in the Lynwood Aquifer do not appear to be consistent with the presence of NAPL at this time.

In a treatability test at the former Montrose plant, DNAPL was actively pumped from the MBFB Sand (see discussion of hydrostratigraphic units, below) at rates of up to 10 gallons per day, which demonstrated that mobile DNAPL (i.e. above residual saturation levels) is present in some locations under the former Montrose plant property. DNAPL resides in a lateral area of about 600 feet by 350 feet, centered on the Central Processing Area of the former plant (See Section 2 and Appendix E of the JGWFS). The total mass, volume, and relative saturation distribution of the DNAPL is unknown, though this also is not unusual at DNAPL sites. Multiple lines of evidence indicate that there are significant quantities of DNAPL beneath the Central Processing Area of the former Montrose plant, including: (1) chlorobenzene concentrations in groundwater over a significant area near the NAPL are at or near the saturation limit, (2) a significant amount of DNAPL can be removed by hydraulic extraction (pumping), and (3) DNAPL accumulates in some wells even when no pumping is taking place.

Data indicate that the chlorobenzene DNAPL contains a significant percentage (perhaps up to 50%) of dissolved DDT. This does *not* refer to DDT dissolved in the aqueous phase, but to DDT dissolved in the chlorobenzene DNAPL itself. This process is called co-solvation. Chlorobenzene is an effective organic solvent for DDT (i.e. DDT has a high solubility in pure chlorobenzene). DDT at the former Montrose plant normally adsorbs strongly to soils and therefore remains contained in the top several feet of soil. However, where chlorobenzene NAPL is present, significant DDT is co-solvated in the chlorobenzene. The DDT dissolved in chlorobenzene DNAPL migrated with the DNAPL to the groundwater. This transport process allowed DDT to reach the groundwater. However, because of DDT's low water solubility, the distribution of dissolved DDT is limited, and represents a tiny fraction of the distance that dissolved-phase chlorobenzene has migrated in groundwater.

Dissolved chlorobenzene has left the Montrose property and has migrated laterally up to 1.3 miles in five successively deeper aquifers (See below). While dissolved contamination has been able to migrate vertically from shallower to deeper hydrostratigraphic units, it is highly likely that the expansion of dissolved groundwater contamination in the deeper units was greatly hastened as NAPL arrived in the deeper units, allowing dissolution to originate directly in those units. Due to the extensive depth and quantity of DNAPL and other factors, EPA considers it technically impracticable to remove enough DNAPL to allow for attaining drinking water standards in the groundwater in the vicinity of the DNAPL. Support for this conclusion is provided in the Joint Groundwater Feasibility Study, Appendix E, and summarized in Section 10 of this ROD.

LNAPL at the Del Amo Superfund Site

To the east of the former Montrose plant at the former Del Amo plant, benzene is the primary chemical present as NAPL. Benzene, when in NAPL form, is less dense than water and therefore tends to float upward in aqueous media under a negative density gradient (buoyancy forces). This is referred to as Light NAPL, or ***LNAPL***. This LNAPL originally spread out and floated on the water table when the water table was lower. In the 1960s, the local groundwater basin was adjudicated to reduce the amount of water being withdrawn from the basin and, in turn, limit saltwater intrusion into the basin. As less water was withdrawn from production wells, the water table slowly but steadily rose and overtook the LNAPL, smearing it upward. As a result of this upward movement in the heterogeneous sediments of the Upper Bellflower (see description of hydrostratigraphic units, below), some LNAPL was trapped underneath the water table by layers and lenses of the low-permeable formations. Most of the benzene LNAPL that was discovered during the remedial investigation to date at the former Del Amo plant property now occurs in the *saturated* zone, near and under the water table. At some of the source areas where NAPL investigations remain ongoing, LNAPL could also be present in the vadose zone and/or floating on top of the water table, in addition to being present below the water table. LNAPL sources are depicted in Figures 2-3a and 2-3b of this ROD, in Section 2 and Appendix E of the JGWFS, and in the Del Amo Groundwater Remedial Investigation Report.

LNAPL at the Del Amo Site occurs in several distinct locations, separated by no more than 600-1000 feet. These LNAPL sources have been slowly dissolving into groundwater, and have therefore resulted in corresponding distributions of dissolved contamination, which have largely merged and overlapped over time. These areas of LNAPL and dissolved phase benzene contamination were also discussed in Section 2 of the JGWFS (see also figures 2.3a and 2.3b), and in the Del Amo Groundwater RI Report.

An extensive amount of NAPL-related data has been collected at the ***MW-20 Area***, which refers to the area around Monitoring Well No. MW-20. This well is located near what was historically a crude benzene storage tank of at least 500,000 gallons capacity, and a number of pipelines which carried benzene at the former Del Amo plant. Floating benzene product has been observed in this well. An extensive number of borings were drilled in this area and analyses of microstratigraphy as well as LNAPL indicator techniques were used. In addition, a six-month hydraulic extraction test was performed in which four NAPL extraction wells were pumped. Only approximately 23 gallons of benzene LNAPL was recovered, while a total of about 400,000 gallons of water was pumped, which results in a total LNAPL: water ratio (fluid ratio) of 0.00006 to 1. The results of this test, in conjunction with the LNAPL saturation data obtained by laboratory analyses of the selected soil sampled, indicated that the NAPL near the wells is likely to be present at relatively low average saturations. While an overall effort to assess NAPL at the

MW-20 area was more extensive than that performed at most NAPL sites, the actual distribution of LNAPL, LNAPL saturation, and the total LNAPL mass in the subsurface cannot be determined with a high degree of certainty from these studies. As previously stated, such determinations are exceedingly difficult to make in virtually all large sites with NAPL where stratigraphy is highly heterogeneous, as is the case at the Joint Site. As mentioned earlier, studies at both the Montrose Chemical and Del Amo Sites continue with respect to the evaluation of NAPL characteristics and the potential for NAPL recovery and immobilization.

The historical operations and the high concentrations of dissolved benzene in groundwater at the locations of the waste pits, the tank farm, and the styrene plant production units (east of the tank farm) are consistent with and strongly suggestive of a NAPL source in these areas. Mixtures containing NAPL were disposed in the waste pits. NAPL has not been directly detected in wells at these locations; however, this does not preclude the presence of NAPL. It is highly likely that NAPL is present but at low enough saturations that it would not flow into the wells. Additional sampling is taking place to characterize these areas with respect to NAPL for the second phase of remedial decisionmaking for this operable unit which shall address NAPL recovery/ immobilization, as previously discussed in the Declaration and in Section 4 of this ROD. It is important to note that precisely locating NAPL can be difficult, and further investigation may or may not directly reveal the NAPL presence, even though NAPL is present. For this reason, the presence of NAPL is evaluated not only from the standpoint of its presence in wells but the entire historical context and observed characteristics of contamination in these areas.

Recent studies using the Remedial Optical Scanning Tool (ROST™) near the former laboratories in the butadiene plancor and near the pipeline directly east of the waste pits have confirmed the presence of NAPL with relatively high certainty. Dissolved benzene concentrations in groundwater in well XMW-04HD near the pipeline east of the waste pits have been measured in excess of 1 million parts per billion (ppb), which is more than half the solubility limit for benzene. This provides exceptionally strong evidence for the presence of NAPL at this location.

It appears that the NAPL at other locations at the Del Amo Site occurs as “smeared” under the water table, similar to that at the MW-20 area. However, there is the possibility that LNAPL may be present in the vadose zone or floating on top of the water table at any of the LNAPL source areas defined in the JGWFS (See Section 2 of the JGWFS).

Hydrostratigraphic Units and Groundwater Flow

As shown in Figure 7-1, there are seven hydrostratigraphic units under the Joint Site that are currently affected by contamination. These are: the Upper Bellflower (UBF), the Middle Bellflower "B" Sand (MBFB Sand) the Middle Bellflower "C" Sand (MBFC Sand), the Lower Bellflower Aquitard (LBF), the Gage Aquifer, the Gage-Lynwood Aquitard, and the Lynwood Aquifer. The water table is inclined relative to the interface between the UBF and the MBFB Sand, and it crosses this interface roughly between the two sites. Therefore, the water table occurs in the UBF at most of the Del Amo site, but it occurs in the MBFB Sand at the Montrose Chemical Site. The UBF is only saturated under (most of) the former Del Amo plant - it is unsaturated under the former Montrose plant.

The greatest contaminant migration potential, as well as the greatest potential facility in applying hydraulic extraction or aquifer injection, exists in the coarser-grained MBFC Sand, Gage Aquifer, and Lynwood Aquifer, because of the relatively higher hydraulic conductivity of these units. These units typically can sustain maximum pumping rates of 50-100 gpm per well. The UBF and MBFB Sand are much finer-grained and can typically sustain maximum pump rates on the order of 1 gpm and 10 gpm, respectively, at the Joint Site. The degree of heterogeneity of the UBF and MBFB Sand is high, especially near the former Montrose plant. The State of California has classified all hydrostratigraphic units under the Joint Site, including the UBF and MBFB Sand, as potential drinking water sources.

The lateral hydraulic gradient of the groundwater varies locally in the upper units, but is largely consistent in the MBFC Sand and all hydrostratigraphic units beneath it. The direction of groundwater flow in the UBF has local perturbations but is generally to the south. The groundwater flow direction in the MBFB Sand, MBFC Sand, Gage Aquifer, and Lynwood Aquifer, is to the south to south/southeast. The magnitude of the eastward component of the horizontal groundwater flow vector increases slightly as the depth of the unit increases. Under natural gradients (i.e. in the absence of local pumping) the vertical component of the hydraulic gradient is generally downward between all hydrostratigraphic units discussed above.

Wells were not installed in the aquitards (the LBF and the Gage-Lynwood Aquitard) in the course of the remedial investigation. Monitoring these units is extraordinarily difficult due to their low hydraulic conductivities.

Generalized Dissolved Contaminant Distributions

The distribution of dissolved-phase contaminants at the Joint Site is based on remedial investigation efforts performed, with EPA oversight, both by Montrose Chemical Corporation for the Montrose Chemical Site, and Shell Oil Company and Dow Chemical Company for the Del Amo Site. More than 100 wells have been installed. In addition, wells previously-installed by other parties have been sampled and/or past sampling data associated with such wells has been obtained. Figure 7-2 shows the overlapping distributions of benzene, chlorobenzene, and TCE in the UBF, MBFB Sand, MBFC Sand, and Gage Aquifer. The superimposed icon represents the hydrostratigraphic layers in the vertical plane and serves to orient the surrounding lateral plane figures. The observations discussed below are crucial to the development of the zones of groundwater to which remedial actions under this ROD are established.

The chlorobenzene downgradient of the former Montrose plant has moved as far as about 1.3 and 0.6 miles from the Montrose plant source in the MBFC Sand and Gage Aquifer, respectively. This contamination has traversed all of the water-bearing units above the Silverado Aquifer. Near the DNAPL source at the former Montrose plant, chlorobenzene is present in concentrations up to its solubility limit, near 400,000 ppb.

Concentrations of benzene up to its solubility limit, approximately 1,700,000 ppb, are present at the Joint Site, both near the former Montrose Chemical plant and the former Del Amo plant, near benzene LNAPL sources. The dissolved benzene distribution displays differing characteristics depending on its location.

In contrast to the chlorobenzene distribution, the dissolved benzene distribution near the LNAPL sources at the former Del Amo plant relatively closely surrounds the NAPL itself (Figure 7-3). This benzene lies outside (is not presently commingled with) the chlorobenzene distribution. There are very steep benzene concentration gradients in this portion of the benzene distribution.

There is also dissolved benzene at the Joint Site that *is* commingled with the large chlorobenzene distribution. In contrast to the benzene near the NAPL sources under the former Del Amo plant, the benzene that is commingled with the chlorobenzene does not exhibit steep concentration gradients at the leading (i.e. downgradient) edges of the plume, but rather a flatter and larger distribution similar to that found in the chlorobenzene plume (Figure 7-2).

TCE (including, by reference, the related chlorinated organic solvents such as PCE) is present both within the Joint Site and in the areas surrounding the Joint Site. The TCE within the Joint Site is present (1) commingled with the chlorobenzene distribution under and just downgradient of the former Montrose plant, and (2) in another distribution not commingled with (outside) the chlorobenzene distribution extending upgradient of and beneath the former Del Amo plant

(Figure 7-2).

Concentrations of TCE are present in groundwater up to about 9,400 ppb at the Joint Site. With respect to the TCE near the former Del Amo plant, the proximity of the TCE distribution to the benzene distribution differs with the hydrostratigraphic unit. In the Upper Bellflower and the MBFB Sand, the TCE is commingled with the benzene, but in the deeper MBFC Sand, data from the remedial investigation indicates that the TCE distribution is still to the north of the benzene distribution, which is limited to the area under the Del Amo Waste Pits at the southern end of the former Del Amo plant. Therefore, in the MBFC Sand, under and near the former Del Amo plant, the TCE and the benzene are not commingled (Figures 7-4 and 7-2).

There are fewer data available pertaining to the TCE present near the former Del Amo plant than for chlorobenzene and benzene. TCE at these locations may or may not be present as DNAPL. Additional field data about the TCE distribution will be necessary in remedial design; however, the remedial actions selected by this ROD for TCE are justified based on the data that are available. PCE is present in distributions largely similar to those for TCE, but, for the most part, in lower concentrations. The concentrations of chlorinated solvents at the Joint Site are small in comparison to those for chlorobenzene and benzene, but still are up to thousands of times above the drinking water standards for these compounds.

Because it is much more water-soluble than chlorobenzene, pCBSA is more mobile in groundwater and the lateral extent of the pCBSA in groundwater exceeds that of the chlorobenzene in all directions. The pCBSA plume is commingled with the benzene on the west side of the former Del Amo plant. The maximum concentration of pCBSA is about 1,500,000 ppb, near the Central Process Area. The concentration of pCBSA is 500-1000 ppb at the toe of the chlorobenzene plume (point where chlorobenzene concentrations are at the MCL for chlorobenzene, which is 70 ppb). The pCBSA distribution is shown in Figure 7-5. Because it has no promulgated or provisional health-based standards associated with it, pCBSA is addressed independently of all other chemicals in this ROD. See Sections 11, 12, and 13 for actions selected with respect to this contaminant and Section 8 for a discussion of its toxicological status.

7.2 Conventions for Dividing the Contamination into Plumes

As can be seen in the discussion of contaminant distributions above and in Figure 7-2, the groundwater contamination at the Joint Site displays differing physical, chemical, spatial and situational characteristics depending on its location within the overall contaminant distribution. Most notably, such characteristics differ widely depending on whether chlorobenzene is present. Where chlorobenzene is absent, such characteristics also differ depending on the relative spatial distributions of the other primary contaminants (most notably benzene and TCE) to each other.

As previously discussed, this ROD selects a single unified action; all remedial actions selected in this ROD have been considered as part of an interrelated whole. However, because of the differences just mentioned, it was necessary in the development and evaluation of remedial alternatives to make distinctions among various portions of the overall contaminant distribution in groundwater. The particular physical and chemical properties exhibited by the combinations of contaminants in groundwater appeared to be a better basis for evaluating remedial alternatives than did a simple consideration of where any given contaminant was located. For instance, because the benzene commingled with the chlorobenzene exhibits differing characteristics than the benzene not commingled, it would have been tedious and complicated, and likely would have lead to confusion, to try to evaluate remedial actions for "the benzene," if referring to all benzene at the Joint Site.

In order to facilitate the evaluation and selection of remedial alternatives, EPA defined and identified areas that were subsets of the overall groundwater such that one set of remedial objectives and requirements could apply within each area, consistent with the particular chemical and physical characteristics of the groundwater within the area. By convention, EPA has used the term ***plume*** to refer to each of these areas. These plumes are depicted in Figure 7-6 and discussed below.

In order to avoid confusion, it is particularly important to note that *plume* is not used in this ROD in its most-common sense. Usually, the term refers to the entire distribution of a particular contaminant in groundwater at a given site. So, for instance, "chloroform plume" would usually mean the distribution of chloroform in groundwater. In the more specialized case of this ROD, *plume* refers to a defined area in the groundwater based on physical and chemical characteristics. Under this approach, a plume in some cases includes only a subset of the distribution of the chemical bearing its name. Hence, for example, in this ROD the term *benzene plume* does <u>*not*</u> refer to all benzene in groundwater at the Joint Site; and, there is benzene in the *chlorobenzene plume* not considered to be part of the benzene plume. The term "plume" refers to all hydrostratigraphic units in which the contamination identified by the plume definition occurs, unless otherwise noted.

EPA has not defined the plumes for the purposes of allocating responsibility or liability for cleanup, or to designate from which site (Montrose Chemical or Del Amo Site) particular contamination in groundwater originated. For instance, the contributions of benzene may have arrived in either the chlorobenzene plume or the benzene plume from multiple sources. The purpose of this ROD is simply to select the remedial actions that will address contamination in Joint Site groundwater.

The JGWFS considered a separate set of remedial options, which it called "scenarios," for each plume. Each full remedial alternative considered in the JGWFS contained one scenario for each plume. Because each scenario for one plume had potential interrelationships with scenarios for the other plumes, this process could not be achieved by simply combining scenarios considered independently for each plume. Rather, the JGWFS screened and evaluated scenarios for each plume individually first, with respect to the immediate objectives for each plume. Then the JGWFS performed a second screening and evaluation in assembling the scenarios into alternatives. This second evaluation considered potential interactions and interrelationships that would exist if scenarios for differing plumes were implemented together. Only those combinations of scenarios for each plume which survived the second screening were evaluated as full alternatives in the detailed analysis of alternatives.

Upon consideration and evaluation of the information derived during the remedial investigation and feasibility study, EPA decided that the smallest reasonable number of plumes which can be used to define the Joint Site is three. The union of the three plumes encompasses all groundwater at the Joint Site; hence, actions selected for each of the plumes completely address the Joint Site groundwater. The basis for the EPA's decision to use these particular plumes is provided in the course of the ensuing discussions in this ROD with regard to the presence of reliable intrinsic biodegradation, the designation of the TI waiver zone, the technical considerations pertaining to the benzene and TCE plume, and the remedial alternatives considered for this remedy.

The plumes are defined below. These definitions are repeated in Section 13 of this ROD to facilitate the use of that section and for clarity. Section 13 contains other requirements and specifications with respect to the plumes which shall apply in this remedy.

- ***Chlorobenzene plume*** refers to the entire distribution of chlorobenzene in groundwater at the Joint Site, *and* all other contaminants that are commingled with the chlorobenzene. Benzene, TCE, PCE, and a variety of other contaminants are present within the chlorobenzene plume. The chlorobenzene plume is present in the MBFB Sand (note that the UBF is generally not saturated in the area where the chlorobenzene plume occurs), the MBFC Sand, the Lower Bellflower Aquitard (LBF), the Gage Aquifer, the Gage-Lynwood Aquitard, and the Lynwood Aquifer, based on data collected in the remedial investigation.

- ***Benzene plume*** refers to the portion of the distribution of benzene in groundwater at the Joint Site *that is not commingled* with chlorobenzene. Put another way, the benzene plume is that benzene within the Joint Site that lies outside the chlorobenzene plume. The benzene plume occurs in the Upper Bellflower, the MBFB Sand, the MBFC Sand, and may occur in the LBF, based on data collected in the remedial investigation. Benzene that is commingled with chlorobenzene is not considered to be part of the benzene plume, but is instead part of the chlorobenzene plume. The benzene plume includes ethyl benzene and naphthalene, among other contaminants.

- ***TCE* and *TCE plume***. The term *TCE,* when used in this ROD, unless otherwise noted, represents a series of chlorinated solvents, including TCE, PCE, DCE, TCA, and any isomers of these compounds in groundwater at the Joint Site. The term *TCE plume* refers to the portions of the distributions of any such contaminants in groundwater at the Joint Site *that are not commingled* with the chlorobenzene plume. The TCE plume occurs in the UBF, the MBFB Sand, and the MBFC Sand, and may occur in the LBF, based on data collected during the remedial investigation. The TCE plume in the Upper Bellflower and MBFB Sand is commingled with and contained within the benzene plume; the TCE plume in the MBFC Sand lies *under* the benzene plume in the MBFB Sand and north of the benzene plume in the MBFC Sand (See Figure 7-4). TCE (chlorinated solvent) contamination outside the chlorobenzene plume which may exist in the Gage Aquifer is addressed separately and not as part of the TCE plume. TCE that is commingled with chlorobenzene is not considered part of the TCE plume but is part of the chlorobenzene plume.

Figure 7-6 shows the three plumes (see legend). Note that this Figure uses, as a base, Figure 7-2 which shows the actual distribution of the major contaminants. However, Figure 7-6 outlines the actual plume boundaries on this distribution. Notice, for example, that the benzene commingled with the chlorobenzene is visible on Figure 7-6; but that such benzene is in the *chlorobenzene plume,* not in the benzene plume.

Some of the requirements and provisions in this ROD differ according to the plume being referenced. Additionally, this ROD in some instances assigns differing remedial action requirements to various hydrostratigraphic units *within* a plume (e.g. the benzene plume in the MBFC Sand versus the benzene plume in the MBFB Sand). The specifications and requirements are established in Section 13 of this ROD.

7.3 Presence of Intrinsic Biodegradation

The term ***intrinsic biodegradation*** refers specifically to the process of the chemical breakdown of a contaminant by microorganisms that are native and innate to the existing soils. In general, intrinsic biodegradation occurs in association with the metabolic processes of microorganisms which use inorganic materials in soil (such as oxygen, nitrate, sulfate, and ferric iron) as terminal electron acceptors and break down the contaminant into carbon dioxide, water, and in some cases, methane. The microorganisms then live off the energy produced by such processes.

Intrinsic biodegradation is a specific form of the more general term, ***natural attenuation***. While natural attenuation sometimes is used so as to be synonymous with intrinsic biodegradation, the former can also refer to other processes, including but not limited to dilution and dispersion.

This ROD makes a distinction between natural attenuation and intrinsic biodegradation because EPA has evaluated the potential for *relying* on intrinsic biodegradation (specifically, as opposed to all forms of natural attenuation) as a remedial mechanism to assist in obtaining remedial objectives at the Joint Site. This is discussed in detail in Sections 11 and 12. This ROD and the JGWFS make use of the more specific term to remove ambiguities that might arise.

It should be noted that, as intrinsic biodegradation is a specific form of natural attenuation, the two are consistent terms in the context of EPA's policy, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites,* (EPA OSWER Directive 9200.4-17, December 1997).

As this section focuses on site characteristics and not yet on remedial selection, only a short presentation as to the *presence* of intrinsic biodegradation is provided here. It is important to note that there is a key difference between demonstrating the presence of intrinsic biodegradation at a site, on one hand, and demonstrating its reliability as a remedial mechanism in a remedy selection process, on the other. The latter is addressed in Section 11 of this ROD.

Potential for Intrinsic Biodegradation in the Benzene Plume

At the Joint Site, there is substantial and significant evidence that significant intrinsic biodegradation of the benzene plume is occurring in the UBF, MBFB Sand, and MBFC Sand. These factors include:

- The concentration gradients at the leading edge of the benzene plume are steep;
- The lateral extent of the dissolved plume outside of the NAPL sources is small;

- The benzene plume is much smaller than what would be expected based on groundwater velocity and expected retardation in the absence of intrinsic biodegradation; benzene has not migrated far from the NAPL sources despite likely being in the ground 20-40 years;

- The plume appears to be at stable and does not appear to be migrating laterally;

- In-situ measurements of geochemical parameters (e.g. dissolved oxygen, nitrate, sulfate, methane, etc.) indicate biological activity that is related to (varies spatially with) the benzene concentration in groundwater;

- Biodegrader organism counts in groundwater indicate greater biological activity inside the benzene plume than outside the benzene plume;

- Computer modeling runs could not be reasonably calibrated without assuming significant benzene biodegradation.

Potential for Intrinsic Biodegradation in the Chlorobenzene Plume

The lines of evidence just discussed for the benzene plume do *not* exist for the benzene that is commingled with the chlorobenzene plume (this benzene is, by definition, *in* the chlorobenzene plume). This benzene has migrated up to ¾ mile in the MBFC Sand from the former Montrose Chemical and Del Amo plants with no known intervening sources.

Similarly, observations do not support the presence of intrinsic biodegradation in the chlorobenzene plume. The chlorobenzene plume has migrated up to 1/3 miles from the former Montrose plant, has traversed six hydrostratigraphic units, and is more than 1000 feet wide at its widest point. Contamination has not remained near the sources. Concentration gradients are relatively flat. Moreover, even though the modeling effort performed in the remedial selection process (see Section 11) assumed no degradation of chlorobenzene, approximate attempts at modeling transport calibration resulted in less simulated migration than that observed, further indicating a lack of significant chlorobenzene intrinsic biodegradation. The rate of biodegradation of chlorobenzene has not been directly measured nor modeled for several reasons which are presented in Appendix B of this ROD, and is discussed in the Response to Comments received from Montrose Chemical Corporation. More critical details on the issue of the potential for the reliability of intrinsic biodegradation of chlorobenzene are presented in Section 11 of this ROD.

Potential for Intrinsic Biodegradation in the TCE Plume

EPA has not measured nor modeled the rate of intrinsic biodegradation of TCE within the TCE plume. The limited modeling of TCE migration in the JGWFS, which was performed only for No Action assumptions, assumed that TCE degrades at rates similar to those found at other sites (See Section 2 and Appendix B of the JGWFS). It is important to note that data from the remedial investigation indicate that TCE and PCE are migrating under existing conditions (that is, the TCE plume is not presently spatially stable with time, and is not naturally contained by intrinsic biodegradation). However, as assumed by the limited modeling of TCE in the JGWFS, intrinsic biodegradation may be occurring to some degree in the TCE plume. In fact, the significant rate of biodegradation of benzene in the benzene plume may be enhancing the rate of biodegradation of TCE in a process called co-degradation. This could potentially result in reductions in the field resident half-life of TCE at the Joint Site compared to typical half-lives for TCE in the absence of benzene biodegradation.

7.4 Land Use and Zoning

A brief discussion of the land use and zoning was given in Section 1 of this Decision Summary. Land use at the Joint Site facilities includes heavy and light industrial, commercial, and residential zoning. Government jurisdictions within the Joint Site include the City of Los Angeles and unincorporated Los Angeles County. The Cities of Torrance and Carson lie to the west and east, respectively, of the Joint Site which lies primarily within the Harbor Gateway (see Section 1 of this ROD).

The former Montrose plant property is vacant and sits under a temporary asphalt cover. This property is zoned industrial. The former Del Amo plant property has been subdivided and redeveloped and contains light industrial enterprises. This property is zoned industrial and commercial. Areas directly south of the former Del Amo plant and southeast and southwest of the former Montrose plant contain primarily low-income residential properties. Some of these homes lie in unincorporated Los Angeles County. The general area surrounding the former plant properties includes industrial, commercial, and residential zoning. In several instances, heavy industrial and residential land use are adjacent to the former plant properties, particularly where islands of Los Angeles county jurisdiction exist among the Harbor Gateway and the Cities of Torrance and Carson (See Figure 7-7). Active petroleum refineries are operating within several miles to the east and west of the former plant properties.

Low-to-moderate-income residential areas lie adjacent to the two former industrial plants. Most of the benzene plume lies under the former Del Amo plant, but some of it lies under the northern edge of the residential zone south of the former plant. Most of the chlorobenzene plume lies under residential and commercial areas south and southeast of the former Montrose plant;

although most of this portion of the chlorobenzene plume is in the MBFC Sand and Gage Aquifer, with most of the overlying water table zone being uncontaminated. The TCE plume (as specifically defined in this ROD) lies entirely within industrial areas. An estimated 2400 homes lie within one mile and 3000 people live within one quarter mile to the south, southeast, and southwest of the former Montrose plant.

7.5 Groundwater Use and Designations

The State of California designates all of the water-bearing hydrostratigraphic units under the Joint Site as having potential potable beneficial use, i.e. as being a potential source of drinking water. Therefore, EPA considers drinking water standards (maximum contaminant levels, or MCLs) to be relevant and appropriate requirements for in-situ cleanup of groundwater at the Joint Site (See Section 9 of this ROD). The ARARs pertaining to this determination are discussed in Appendix A of the ROD.

There currently is no known municipal water or municipal production wells in use within the area of contaminated groundwater under the Joint Site. EPA also is not aware of current use of private potable water wells within the contaminated groundwater affected by the Joint Site. The nearest municipal supply wells are about ½ to 1 mile downgradient of the current leading edge of the chlorobenzene plume in the MBFC Sand. These wells are screened primarily in the Silverado aquifer, though some are screened in the Lynwood Aquifer. Wells within a 2-mile radius of the Joint Site are shown on Figure 7-8. The Silverado Aquifer is the most extensively used water-bearing unit for municipal supply purposes in the southern west coast groundwater system. This aquifer occurs at approximately 450 feet below land surface near the Joint Site. There are a number of other private and industrial wells within a mile of the plume, some of which have screens in the Gage Aquifer. None of these are located within the current contaminant distribution of the Joint Site. It appears likely that some water use within the Joint Site would exist if the aquifers were not contaminated. The groundwater basin under the Joint Site is presently adjudicated to reduce salt water intrusion problems which were occurring in the 1960s. At present, this would limit, but not eliminate, the degree of use of groundwater in the area were the groundwater not contaminated.

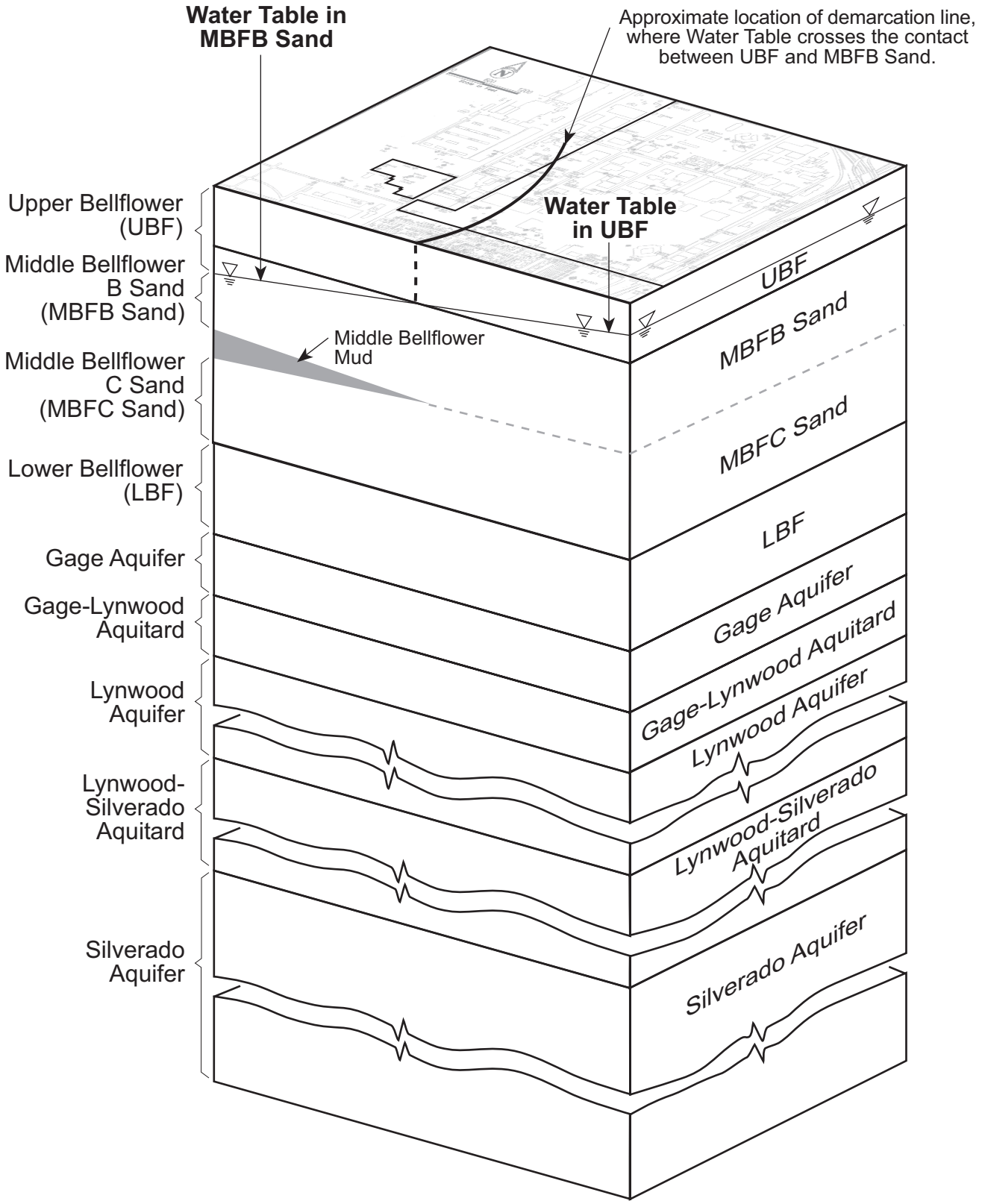
EPA is concerned that the groundwater contamination may continue to move both laterally outward and vertically downward, and may eventually reach locations where it would be drawn into wells which are used for drinking or other potable purposes. As contamination spreads, less of the groundwater resource can be used in the future.

The laws and policies of the State of California are generally focused on protecting potential future beneficial uses of groundwater, even where it is not currently used. In addition, the National Contingency Plan (NCP) requires that EPA consider future potential groundwater uses

in making decisions on remedial actions for groundwater.

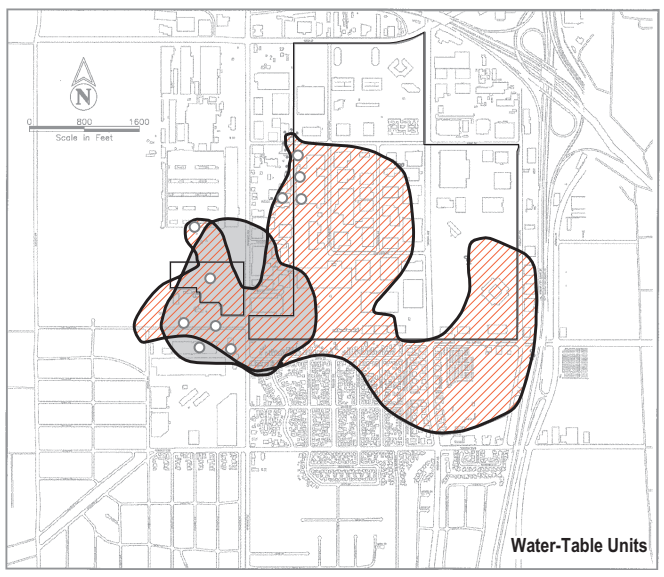
Without the Joint Site contamination, the Lynwood and the Gage Aquifers would be of sufficient water quality and production to make them strong candidates as actual sources of drinking water. The MBFC Sand and shallower units contain sufficiently high levels of total dissolved solids and total suspended solids such that future direct use of the water, particularly for potable purposes, would be less likely. In addition, the MBFB Sand and Upper Bellflower units generally do not yield enough water to make major production wells in these units cost-effective.

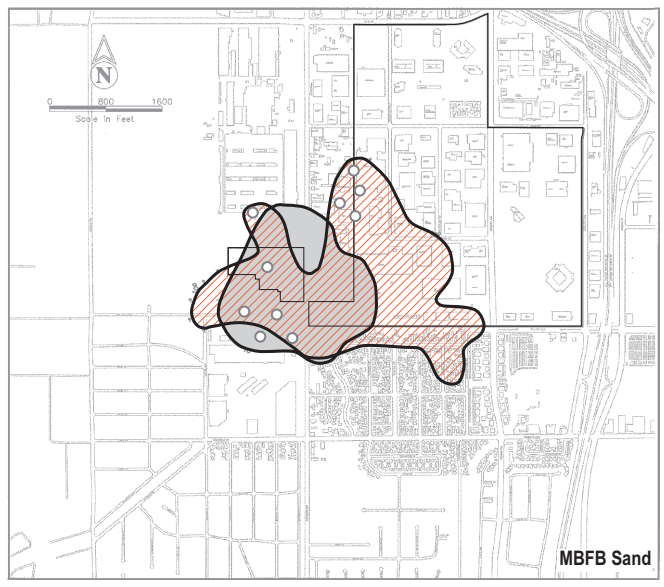
Migration of contaminants from the upper to the lower units at these sites has occurred and there is the potential for continued migration. Therefore, the potential for such migration to affect units which currently are not significantly impacted or used was strongly considered by EPA, in conjunction with the direct current water use and State designations for all the hydrostratigraphic units. Because of the potential hydraulic connection between the upper units and the underlying Gage and Lynwood Aquifers, non-potable as well as potable water uses are considered possible in all of the affected units. While there is not evidence that persons have been exposed to groundwater contaminants from these sites, EPA is concerned about preventing future threats to public health and with preserving the groundwater resource.

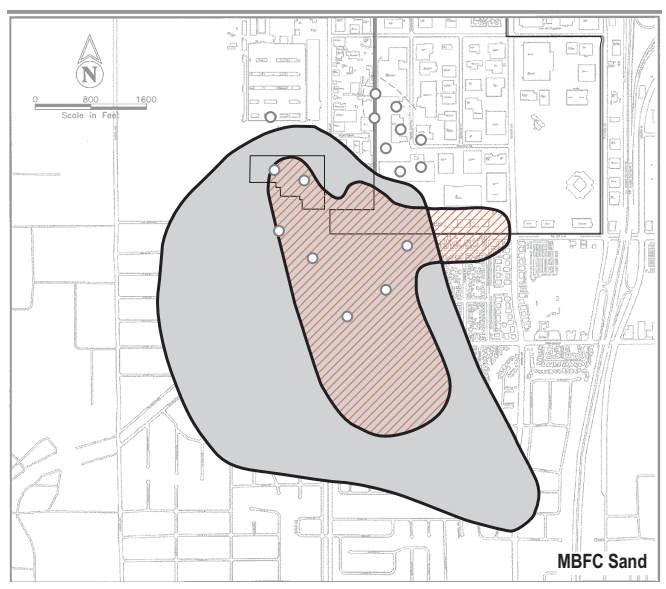


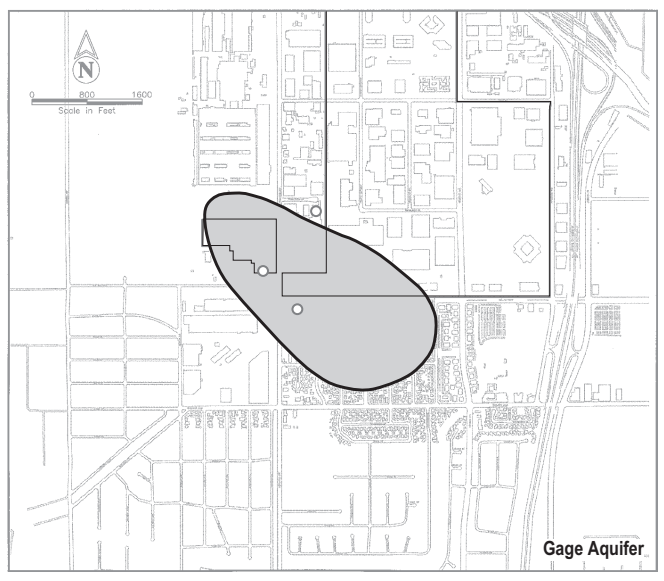
Not to scale

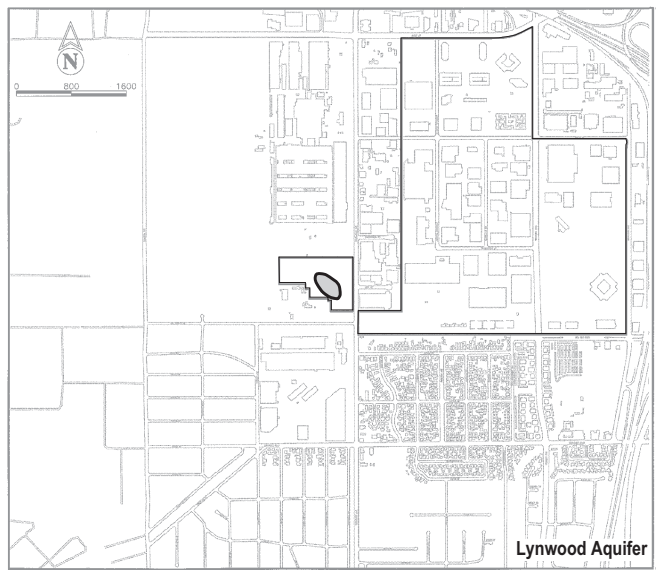
Figure 7-1
Schematic Presentation of Hydrostratigraphic Units at the Joint Site
Record of Decision
Dual Site Groundwater Operable Unit
Montrose and Del Amo Superfund Sites











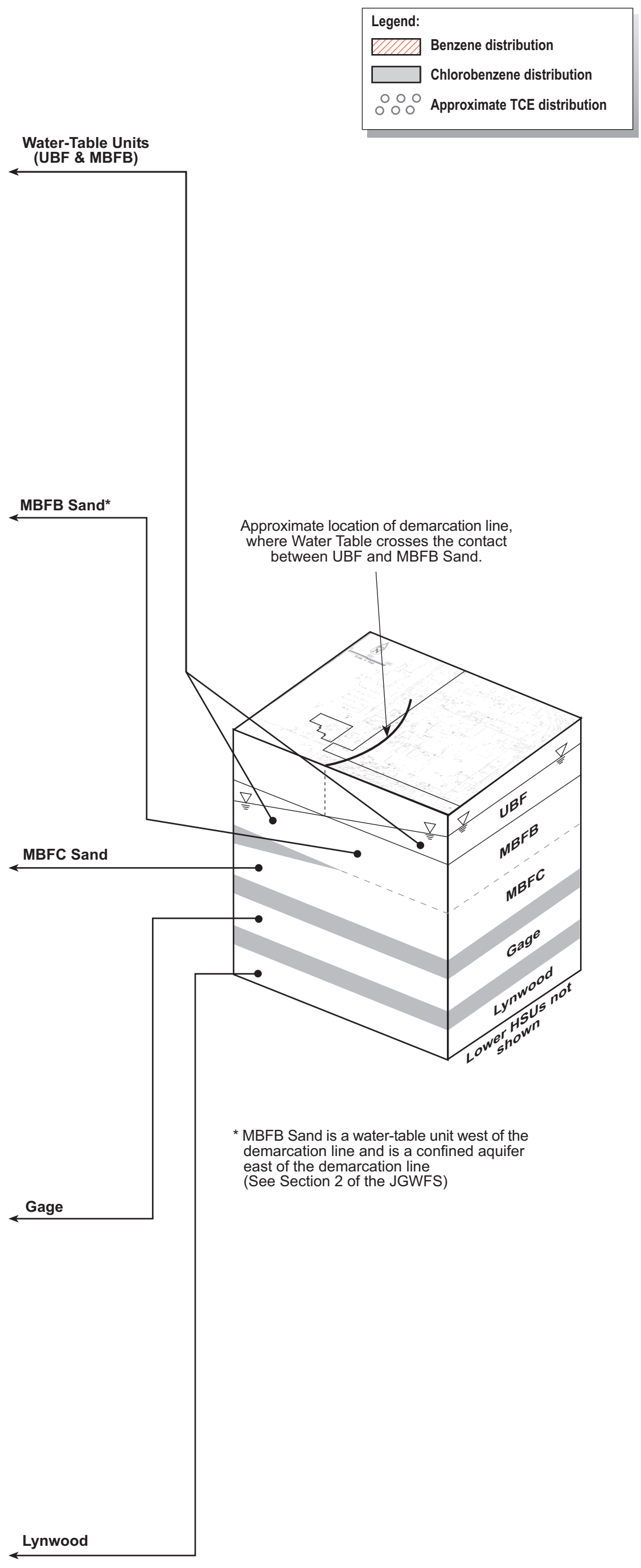
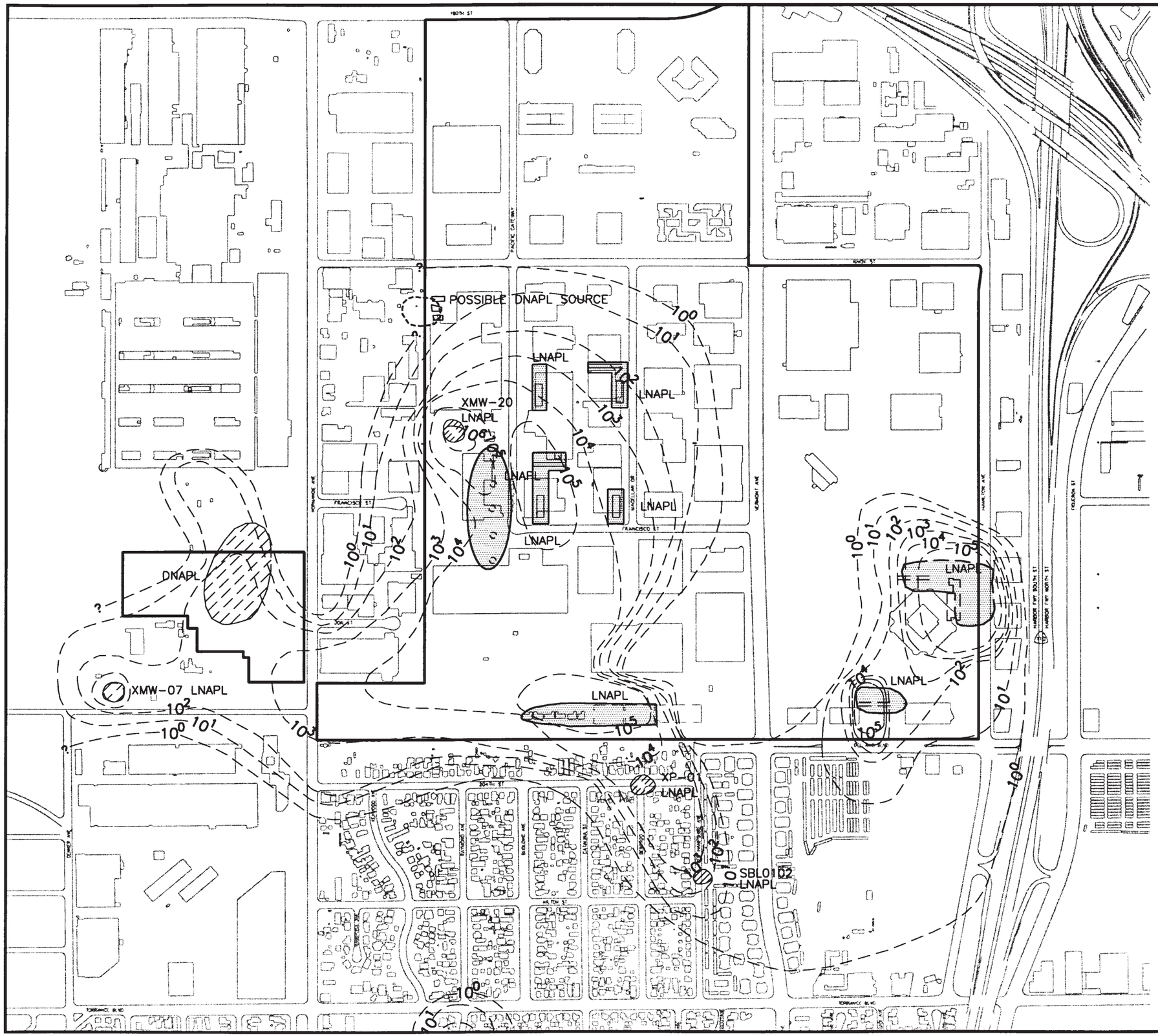
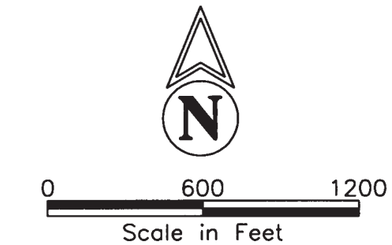


Figure 7-2
Contaminant Distributions
Record of Decision
Dual Site Groundwater Operable Unit
Montrose and Del Amo Superfund Sites

EPA US EPA Region IX





EXPLANATION

Approximate area of known LNAPL/DNAPL

Approximate area of highly suspected LNAPL

105 Benzene concentration isopleth (µg/L)

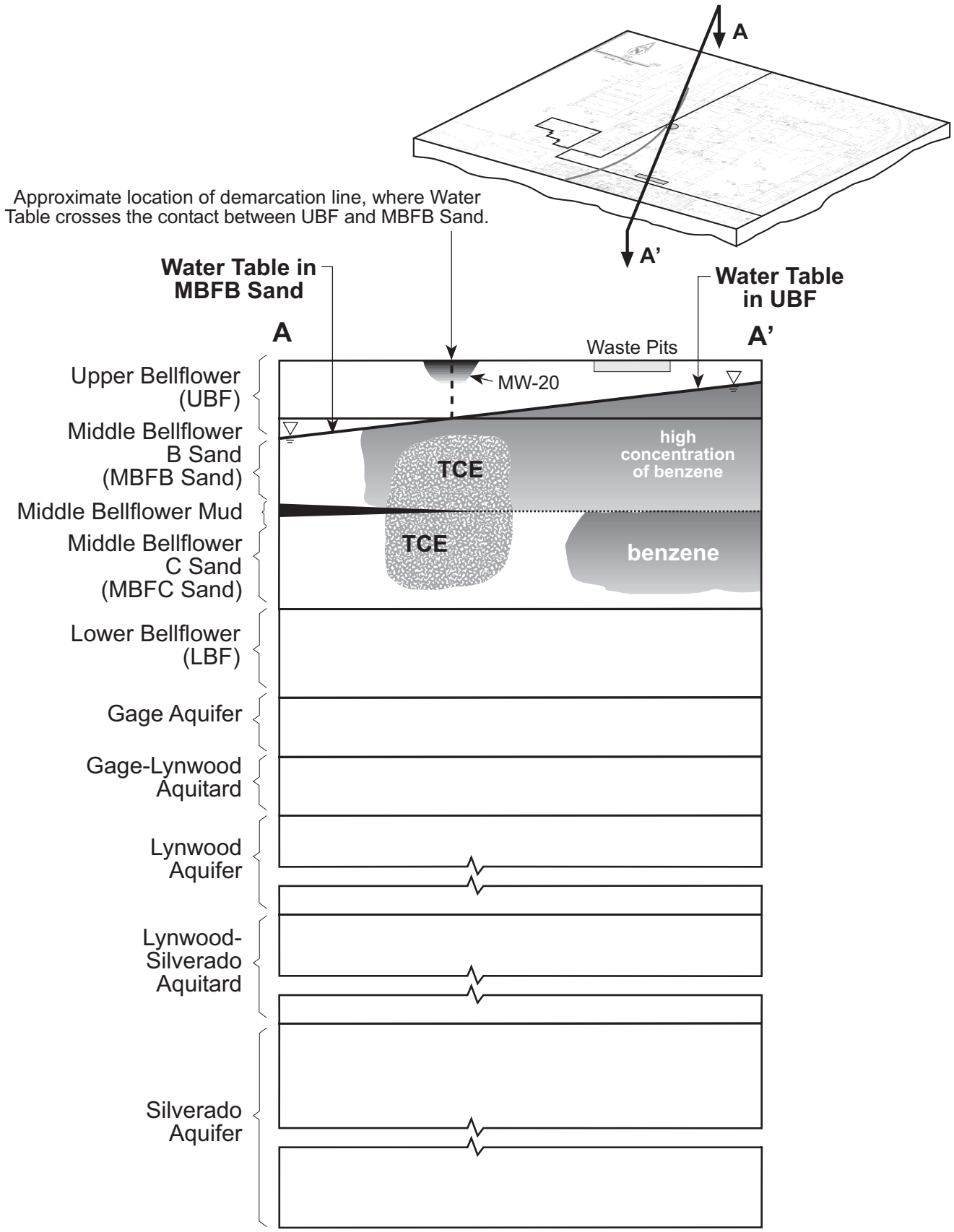
Note:
This map is not intended to precisely portray the limits of known or suspected areas of NAPL. With the exception of the XMW-20 LNAPL and Montrose DNAPL, the extent of the NAPL areas has not been fully determined.

FIGURE 7-3

Benzene Distribution Relative to the Locations of Areas of Known or Highly Suspected NAPL

Record of Decision
Dual Site Groundwater Operable Unit
Montrose and Del Amo Superfund Sites

US EPA Region IX



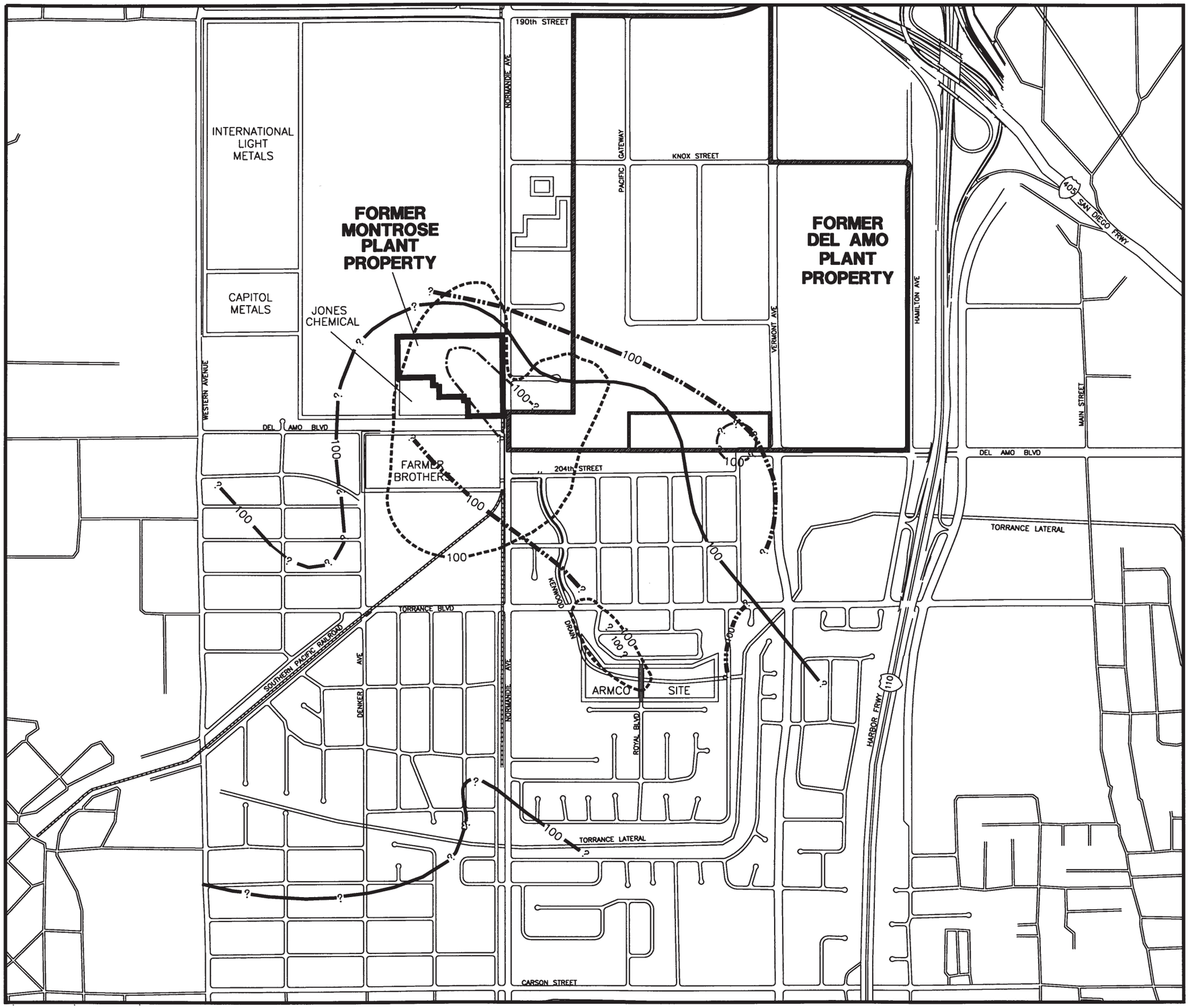
Conceptual Representation

Figure 7-4
TCE Distribution Relative to Benzene
Record of Decision
Dual Site Groundwater Operable Unit
Montrose and Del Amo Superfund Sites

Not to scale

EPA US EPA Region IX

SCO102580.16.12 hydrostrat2 fh 1/99



EXPLANATION

BF-05 — BELLFLOWER SAND MONITOR WELL

<100 — CONCENTRATION IN MICROGRAMS PER LITER

BF-32 — DESTROYED WELL

?——100——? CONTOUR LINE OF EQUAL CONCENTRATION OF PCBSA IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

NS = NOT SAMPLED

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF THE FOURTH QUARTER 1995. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY. SAMPLE DATES RANGE FROM APRIL 1990 TO DECEMBER 1995. SAMPLE DATES AND A SAMPLE RESULTS SUMMARY FOR MONTROSE WELLS ARE PROVIDED IN TABLE 5.5. ANALYTICAL RESULTS FOR ALL ANALYSES FOR MONTROSE WELLS ARE PROVIDED IN APPENDIX G. ANALYTICAL METHODS ARE PROVIDED IN APPENDIX B.

LEGEND

- UPPER BELLFLOWER AQUITARO
- BELLFLOWER SAND
- GAGE AQUIFER
- LYNWOOD AQUIFER

N

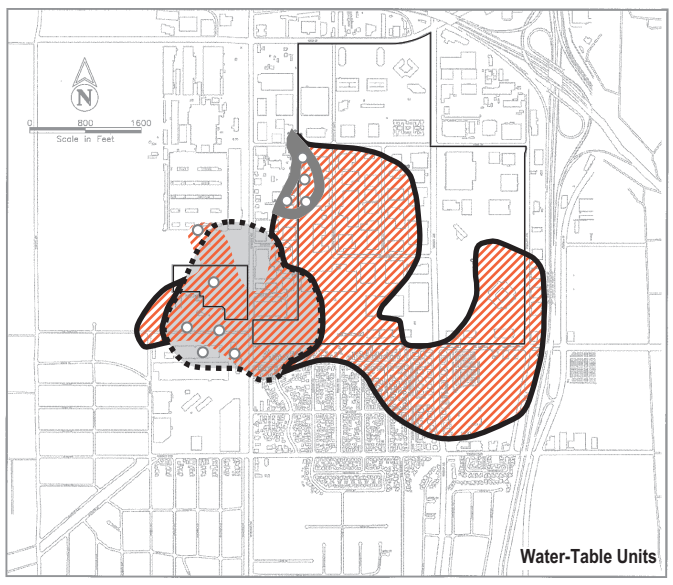
0 1000 2000
FEET

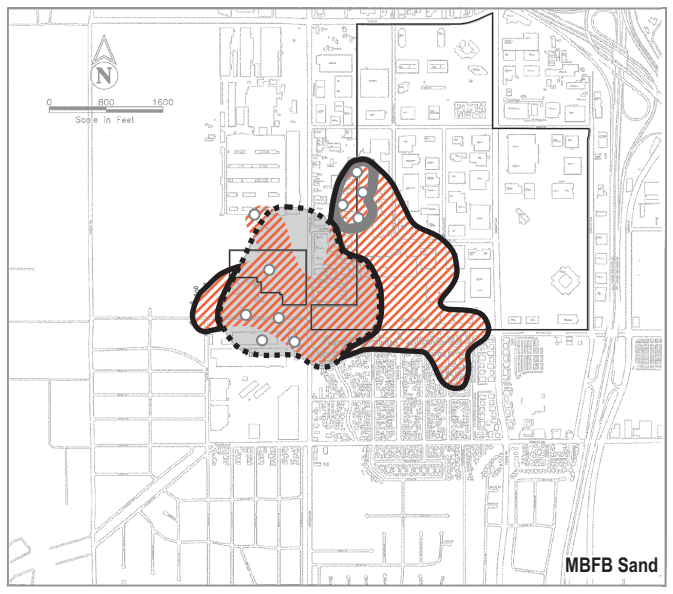
FIGURE 7-5

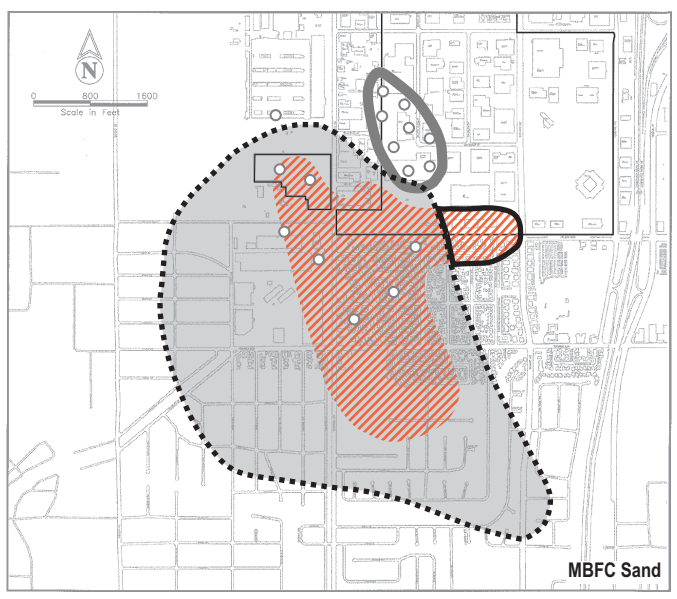
PCBSA DISTRIBUTION IN GROUNDWATER AT CONCENTRATIONS GREATER THAN 100 MICROGRAMS PER LITER
RECORD OF DECISION
DUAL SITE GROUNDWATER OPERABLE UNIT
MONTROSE AND DEL AMO SUPERFUND SITES

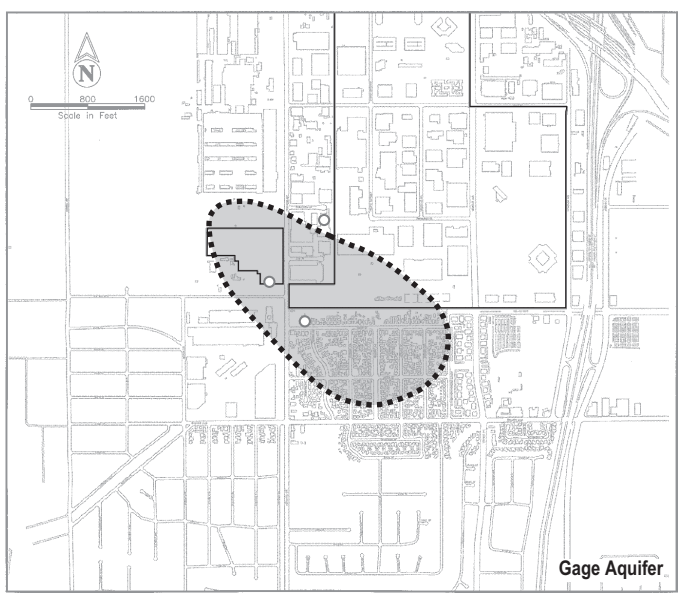
US EPA Region IX

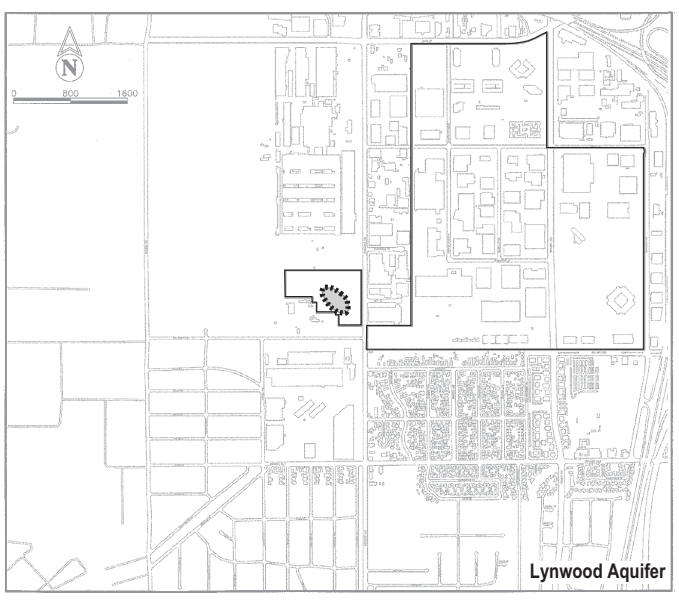
PREP BY _____ REV BY _____ RPT NO. _____











Legend:
- Boundary of the benzene plume
- Benzene distribution
- Boundary of the chlorobenzene plume
- Chlorobenzene distribution
- Approximate boundary of the TCE Plume
- Approximate TCE distribution

Water-Table Units (UBF & MBFB)

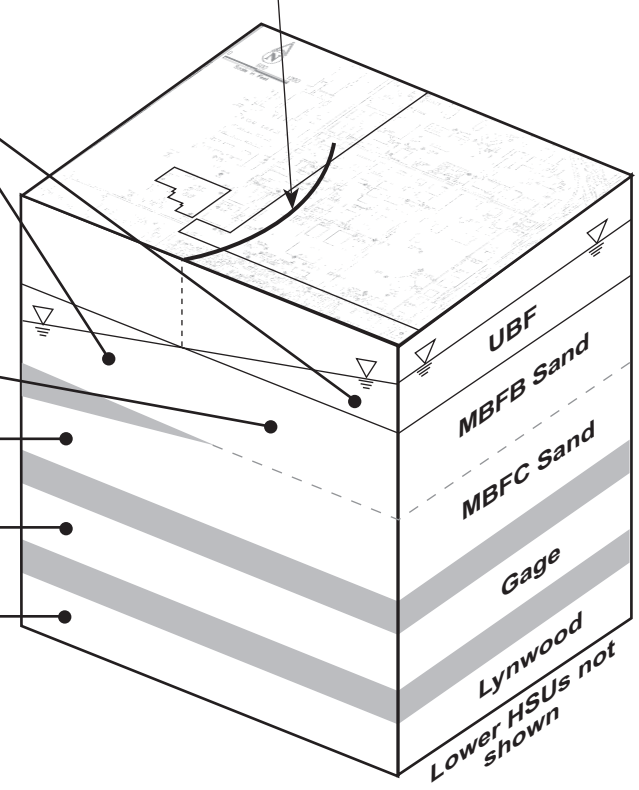
MBFB Sand*

MBFC Sand

Gage

Lynwood

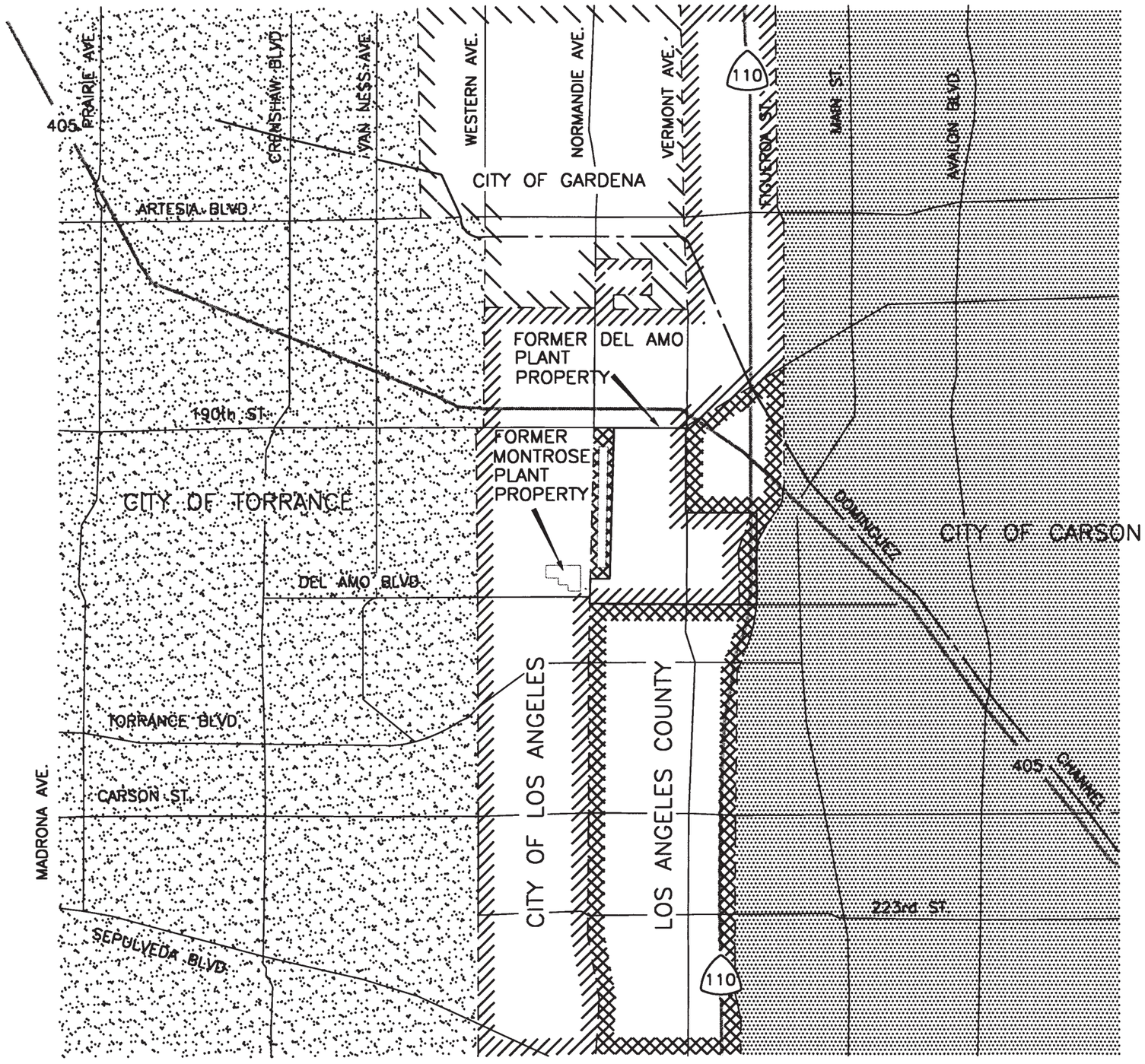
Approximate location of demarcation line, where Water Table crosses the contact between UBF and MBFB Sand.



* MBFB Sand is a water-table unit west of the demarcation line and is a confined aquifer east of the demarcation line (See Section 2 of the JGWFS)

Figure 7-6
Contaminant Distributions and Plumes
Record of Decision
Dual Site Groundwater Operable Unit
Montrose and Del Amo Superfund Sites

US EPA Region IX



EXPLANATION

- CITY OF GARDENA
- CITY OF LOS ANGELES
- LOS ANGELES COUNTY
- JURISDICTIONAL BOUNDARY
- CITY OF CARSON
- CITY OF TORRANCE

N

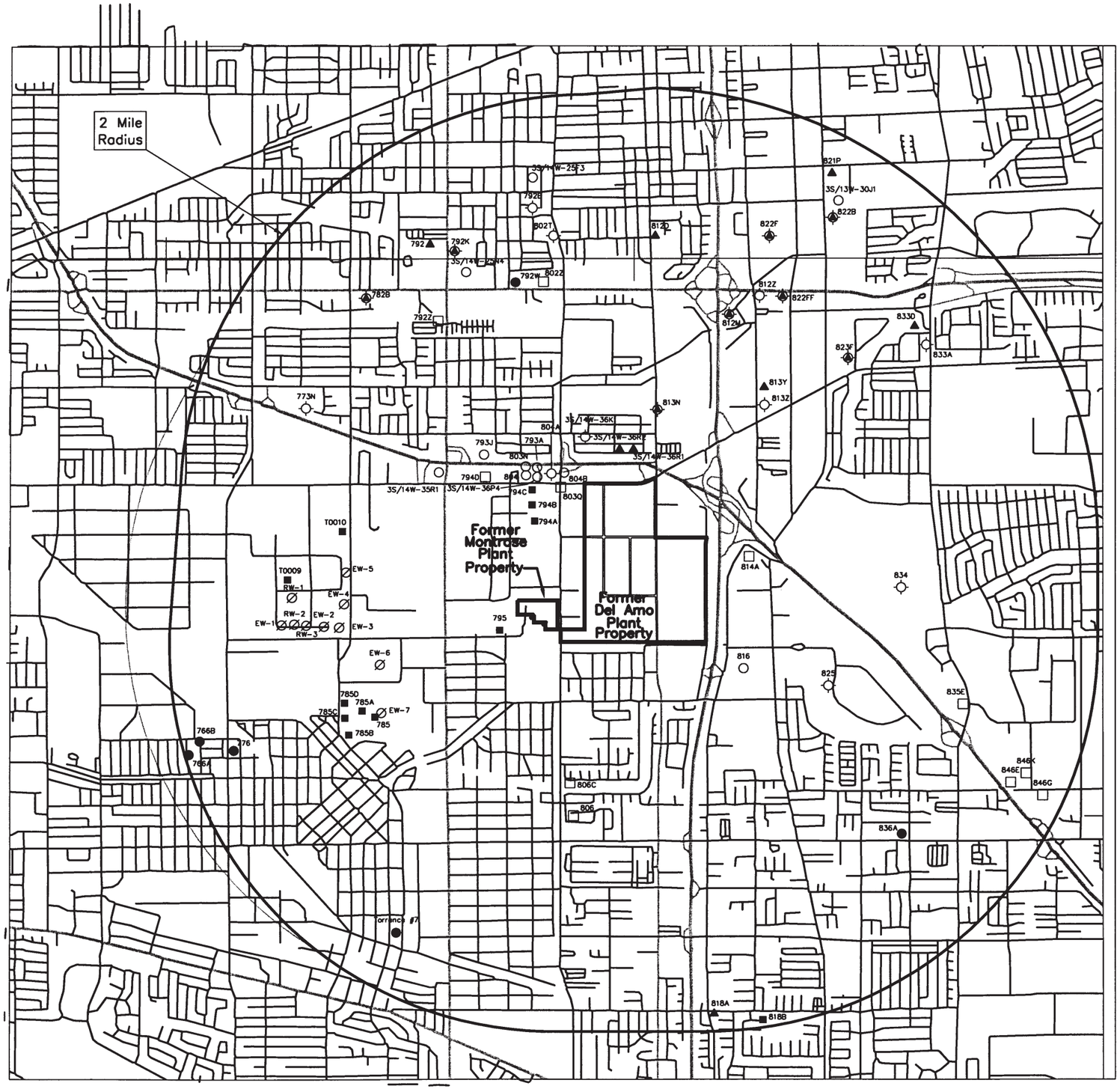
0 3,000 6,000

FEET

FIG. 7-7

LAND JURISDICTIONS
IN THE VICINITY OF THE JOINT SITE
RECORD OF DECISION
DUAL SITE GROUNDWATER OPERABLE UNIT
MONTROSE AND DEL AMO SUPERFUND SITES

US EPA Region IX



N

0 ¼ ½ ? 1

Scale in Miles

EXPLANATION

- Municipal supply well
- Domestic supply well
- Irrigation supply well
- Domestic/Irrigation supply well
- Industrial supply well
- Remediation/cleanup well
- Observation well
- Well of unknown use

FIGURE 7-8

Wells of Record Within 2-Mile Radius of Study Area

Record of Decision
Dual Site Groundwater Operable Unit
Montrose and Del Amo Superfund Sites

US EPA Region IX