Contents

3. Physical Characteristics of Area 3

This section evaluates the physical characteristics of the San Gabriel Valley Area 3 ***Superfund*** Site (Area 3) pertaining to the site ***hydrogeology*** to construct the hydrogeologic ***conceptual site model*** for Subtask 1 of the ***remedial investigation*** (RI). Appendix D presents a more detailed evaluation of the ***hydrostratigraphy*** in Area 3.

The hydrogeologic conceptual site model for Area 3 describes the primary mechanisms that control the migration of ***contaminants*** in ***groundwater,*** and provides a foundation for development of the ***contamination*** migration conceptual site model (RI Subtask 3) in Section 5. The information on the physical characteristics of Area 3 presented in this section also supports the ***human health and ecological risk assessments*** (RI Subtasks 4 and 5) discussed in Sections 6 and 7, respectively.

As Section 2.2 describes, the United States Environmental Protection Agency (EPA) uses ***data quality objectives*** (DQOs) to guide data collection, analysis, and interpretation for each of the RI subtasks. Table 2-1 (at the end of Section 2) presents the overall DQOs for the Area 3 RI; Table 3-1 (at the end of this section) presents the DQOs developed for the hydrogeologic conceptual site model (RI Subtask 1).

Table 3-1 defines the evaluation to be completed in RI Subtask 1, which is to develop the hydrogeologic conceptual site model. Table 3-1 also identifies potential evaluation results and methods to avoid incorrect results. Table 3-1 defines evaluation boundaries for the groundwater investigation for Area 3, lists data needs to complete the subtask, and describes how the data will be used. Finally, Table 3-1 includes an evaluation of the assessment conducted to determine the quality and usability of the data set.

3.1 Key Components of the Hydrogeologic Conceptual Site Model

Key components of the hydrogeologic conceptual site model include the following physical characteristics of Area 3.

- Physical setting and site location
- Meteorology
- Land and water use
- Surface water hydrology
- Regional hydrogeology
- Area 3 hydrogeology

Each section of this report provides a discussion of the subject, followed by any tables or figures cited in the text. In addition, exhibits and text boxes noted in the margins present key concepts, tables, and figures.

*The glossary explains words presented in **bold, italicized** text.*

Appendix D evaluates the hydrostratigraphy in Area 3.

Table 2-1 presents the overall DQOs for the Area 3 RI.

Table 3-1 presents the DQOs developed for the hydrogeologic conceptual site model.

The following sections present an analysis of data collected during the RI and from published information, including reports prepared by California Department of Water Resources (CDWR), California Division of Mines and Geology, and EPA.

3.1.1 Physical Setting and Site Location

The San Gabriel Valley Groundwater ***Basin*** (San Gabriel Basin) is a bowl-shaped topographic depression of approximately 170 square miles located in San Gabriel Valley. The San Gabriel Basin contains a broad ***alluvial plain*** that slopes gradually to the south (CDWR, 1966). Figure 3-1 illustrates the location of Area 3 in the western portion of San Gabriel Valley, northeast of the City of Los Angeles in Los Angeles County, California.

Figure 3-1 illustrates the location of Area 3.

Faulting plays an important role in the evolution of the San Gabriel Basin. The basin formed largely by downward movement of ***bedrock*** along ***fault*** zones near its margins. Coincidental uplift on opposite sides of the lower San Gabriel Valley floor formed the surrounding hills and mountains exposed along the perimeter of the basin (CDWR, 1966).

The San Gabriel Mountains, which form the northern boundary of the San Gabriel Basin, range in elevation from 900 to over 10,000 feet above mean sea level (msl). The eastern boundary of the basin consists of bedrock that separates the San Gabriel Basin from the Upper Santa Ana Valley Basin.

A crescent-shaped pattern of low-lying hills bound the San Gabriel Basin to the southwest, south, and southeast. From west to east, these hills include the Repetto Hills, Montebello Hills, Puente Hills, and San Jose Hills with elevations of approximately 500 feet above msl. The only significant break along the southern boundary falls between the Montebello Hills and the Puente Hills at Whittier Narrows, the lowest point in the San Gabriel Basin and the outflow location for the San Gabriel River, the Rio Hondo, and associated tributaries.

Figure 3-2 illustrates the topography of Area 3.

The ground surface of Area 3 generally slopes toward the southeast, as shown in Figure 3-2. However, in southwestern (SW) Area 3, the ground surface slopes to the southwest. The highest point occurs in northwestern (NW) Area 3, where the Repetto Hills exceed an elevation of 800 feet above msl; the lowest point occurs in southeastern (SE) Area 3, where the Rubio Wash intersects the San Bernardino Freeway at an elevation less than 300 feet above msl.

3.1.2 Meteorology

The climate in Los Angeles County, west of the San Gabriel Mountains, ranges from subtropical to semiarid with moderate temperatures that rarely drop below freezing. The highest temperatures generally occur during the months of July through September.

Rainfall in Los Angeles County occurs primarily during the winter months and ranges annually from 8 inches in the desert east of the San Gabriel Mountains to 28 inches in the San Gabriel Mountains (Los Angeles Department of Public Works [LADPW], 2006). The San Gabriel Valley averaged approximately

19 inches of rainfall between 1974 and 2007. However, during the RI, annual precipitation was below average, except in 2005 when rainfall measured 32.5 inches (Main San Gabriel Basin Watermaster [Watermaster], 1974 through 2006).

3.1.3 Land and Water Use

The 19th century saw a rapid influx of new settlers and an increase in farming, resulting in dwindling surface water supplies. Groundwater pumping significantly increased early in the twentieth century with the urbanization of agricultural land in the western portion of the San Gabriel Valley and the use of high-capacity, deep well, motor-powered turbine pumps (CDWR, 1966). The increase in pumping profoundly influenced groundwater flow conditions regionally and locally and caused the decline of groundwater levels in Area 3.

Between 1930 and 1960, population growth increased by 50 percent in the cities of Alhambra and San Gabriel, and urbanized land increased by 30 percent in Area 3 (CDWR, 1966). Figure 3-3 illustrates that in the late 1970s, residential land use predominated in Area 3, with scattered areas of commercial and industrial development among agricultural and open space areas.

Figure 3-3 shows that residential land use predominates in Area 3.

Groundwater production in the San Gabriel Basin increased contemporaneously with population growth, from approximately 160,000 acre-feet per year (1933 to 1934) to approximately 200,000 acre-feet per year (1959 to 1960) (CDWR, 1966). By the 1950s, increased groundwater production, coupled with an extended period of drought, created a groundwater deficit in the San Gabriel Basin. Natural recharge processes alone no longer met the demands of groundwater usage.

In 1973, to resolve supply shortages, the court adjudicated water rights in the San Gabriel Basin and appointed the Main San Gabriel Basin Watermaster (Watermaster) to manage groundwater resources. Each year, Watermaster calculates the operating safe yield of the basin and allocates proportioned shares to entitled users (Watermaster, 2006). Imported water introduced through infiltration at spreading basins in the San Gabriel Basin offsets the groundwater overdraft created by production.

Groundwater in the San Gabriel Basin provides the primary supply of water for local residents and businesses. Six water purveyors operate and serve water from production wells in Area 3.

- California American Water Company
- City of South Pasadena
- City of Alhambra
- San Gabriel County Water District
- Golden State Water Company
- Sunny Slope Water Company

Highest groundwater production generally occurs during summer when temperatures in the San Gabriel Valley are highest. Production wells within

Area 3 draw an average of 28,000 acre-feet of groundwater annually, a quantity equivalent to the annual water use of approximately 56,000 average households. Figure 3-4 illustrates the location of production wells in Area 3.

Figure 3-4 shows the location of production wells in Area 3.

Changes in production rates show a recent shift in the spatial distribution of pumping toward the south and east in Area 3, and a slight increase in annual production. No groundwater production currently occurs in the western portion of Area 3. However, limited groundwater production occurred west of the ***structural bedrock discontinuity*** prior to 1974.

3.1.4 Surface Water Hydrology

The San Gabriel Basin receives runoff from surrounding basins and the peripheral hills and mountains. Several spreading facilities across the northern third of the basin artificially recharge the San Gabriel Basin. The largest spreading facility is the Santa Fe Spreading Grounds, located behind Santa Fe Dam.

The Rio Hondo and San Gabriel River form the two principal surface water features in the San Gabriel Basin, as shown in Figure 3-1. Both rivers generally flow from northeast to southwest, draining the San Gabriel Mountains to the north, carrying runoff into the San Gabriel Basin, and eventually flowing through Whittier Narrows to the south. Flow in waterways in the basin varies from year to year depending on the amounts of rainfall and imported water. The San Gabriel River and a portion of the Rio Hondo near Whittier Narrows are unlined, which allows surface water to recharge the underlying groundwater ***aquifers***. The Santa Fe and Whittier Narrows dams control the flow of the San Gabriel River.

Figure 3-1 shows the surface water features of Area 3.

Surface water features in Area 3, shown in Figure 3-1, include the Eaton Spreading Basin, Alhambra Wash, San Pasqual Wash, Rubio Wash, and Eaton Wash. The San Pasqual Wash discharges to the Alhambra Wash in Area 3; and the Alhambra, Rubio, and Eaton Washes discharge to the Rio Hondo south of Area 3. Although the washes in Area 3 collect surface water runoff, the concrete lining virtually eliminates infiltration of surface water into the underlying aquifers.

3.1.5 Regional Hydrogeology

Appendix D evaluates the hydrostratigraphy in Area 3.

The description of regional hydrogeology provides a foundation for explaining the hydrogeology of Area 3 as discussed in Section 3.1.6 and Appendix D. This evaluation includes (1) review of published geologic and hydrogeologic reports and maps; and (2) interpretation of ***lithologic and geophysical logs*** from ***groundwater monitoring wells*** and production wells.

3.1.5.1 Regional Geology and Hydrostratigraphy

Unconsolidated to semiconsolidated ***alluvial*** deposits of relatively recent age and older ***sedimentary*** bedrock occur in the San Gabriel Basin. The alluvial deposits, derived primarily from erosion of the surrounding mountains and hills, form a broad alluvial plain that gently slopes toward the southern margin of the basin, reaching up to 4,000 feet in thickness (EPA, 1992).

The regional hydrostratigraphy generally consists of a two-layer system made of ***alluvium*** overlying sedimentary bedrock.

Faulting plays an important role in the evolution of the San Gabriel Basin. Three major faults (Sierra Madre, Raymond, and Whittier Narrows) form the boundaries of the San Gabriel Basin. Figure 3-1 shows the location of these faults and their relationship to the San Gabriel Basin.

Figure 3-1 shows the faults within the San Gabriel Basin.

The Sierra Madre Fault system trends east-west along the southern base of the San Gabriel Mountains and includes several distinct, low-angle (relatively horizontal) ***reverse faults***.

The Raymond Fault (or Raymond Hill Fault), a high-angle (relatively steep) reverse fault, trends northeasterly across the northwestern portion of the San Gabriel Basin. This fault separates the San Gabriel Basin from the Raymond Groundwater Basin (Raymond Basin).

The Whittier Fault, a right lateral ***strike-slip fault***, with some northward high-angle reverse slip, trends to the northwest along the Puente Hills in the southern portion of the San Gabriel Basin. Appendix D presents a detailed evaluation of the faults in Area 3.

3.1.5.2 Regional Groundwater Flow

The water table in an unconfined aquifer, like in the San Gabriel Basin, typically slopes in a pattern that follows the topography (Domenico and Schwartz, 1990). Because flow occurs from areas of high groundwater elevation to areas of low groundwater elevation, the slope of the topography can provide an indication of likely groundwater flow directions. Flow in a confined aquifer follows the gradient of the ***potentiometric surface***.

Groundwater pumping in unconfined and confined aquifers influences the actual direction of groundwater flow. Land use features in urban areas also could alter the locations where rainfall recharge occurs. Paved areas typically hinder rainfall infiltration, whereas open space areas, such as golf courses and parks, facilitate rainfall infiltration. Groundwater flow directions could shift in response to changes in rainfall infiltration patterns.

Groundwater level measurements collected throughout the basin indicate that the water table fluctuates over time in response to pumping, recharge from rainfall, and other variables. The water table occurs throughout the San Gabriel Basin at depths ranging from 10 feet to more than 400 feet below ground surface (bgs).

Groundwater elevation contour maps prepared over a period of 70 years show trends in historical groundwater flow patterns for the San Gabriel Basin (LADPW, 2006; Watermaster, 1999 through 2005). Prior to significant groundwater production in the San Gabriel Basin, groundwater discharged from

Figures 3-5 and 3-6 depict groundwater elevations in the San Gabriel Basin in 1933 and 2005, respectively.

Figure 3-7 shows the location of the Alhambra Pumping Hole, which is the result of long-term groundwater production in the area.

Figure 3-8 compares data for annual rainfall with data for groundwater levels measured in the central portion of the San Gabriel Basin and in Area 3.

Figure 3-9 illustrates a three-dimensional view of the conceptual geology of Area 3.

Figure 3-4 presents the location of the cross-sections in plan view within Area 3.

Figures 3-10 through 3-15 present the cross-sections A-A′ through F-F′.

the basin primarily through the alluvium at Whittier Narrows, a topographic low. Figure 3-5 presents the 1933 groundwater contour map, which shows the topographic low at Whittier Narrows.

Figure 3-6 illustrates that concentrated groundwater production depressed groundwater levels locally, affecting the natural flow direction in some areas of the basin, including Area 3. Groundwater production accounts for the greatest outflow from the basin (CDWR, 1966). Figure 3-6 also shows that a westward component of groundwater flow recently developed toward Area 3. Figure 3-6 shows the Alhambra Pumping Hole, an area of concentrated pumping, which is the result of long-term groundwater production in the area since around 1960 (Watermaster, 2004).

Recharge in the San Gabriel Basin occurs primarily from infiltration of precipitation, runoff, imported water, and reclaimed water. The Raymond Basin provides the only significant source of groundwater into the San Gabriel Basin in the eastern part of Area 3, even though the Raymond Fault partially impedes groundwater flow (CDWR, 1966).

Precipitation events strongly influence groundwater levels in the central portion of the San Gabriel Basin due to increases in ***groundwater recharge*** from rainfall and infiltration of surface runoff. Groundwater levels in Area 3 respond less to precipitation events. Differences in soil types and land use result in variable levels of rainfall infiltration across the San Gabriel Basin (EPA, 1992). Figure 3-8 compares data for annual rainfall with groundwater levels measured in the central portion of the San Gabriel Basin and in Area 3 to illustrate the effect of precipitation on groundwater elevations.

3.1.6 Area 3 Hydrogeology

This subsection describes the conceptual hydrogeology of Area 3 in terms of the following features.

- Geology
- Hydrostratigraphy
- Groundwater flow

3.1.6.1 Area 3 Geology

Figure 3-9 illustrates a three-dimensional view of the conceptual geology of Area 3. This report presents six cross-sections developed to illustrate the conceptual geology. Figure 3-4 presents the locations of the cross-sections in plan view and Figures 3-10 through 3-15 present the cross-sections A-A′ through F-F′ in Area 3.

The interpretation of the subsurface geology is based on data from multiple sources including lithologic logs, geophysical logs, and the CDWR Well Completion Reports.

Adequate data have been collected to conduct the RI. However, additional data needs are inherent due to the large size of Area 3 and variations in the alluvial deposits. Large distances of uncharacterized areas remain between current measurement points. The ***feasibility study*** will consider the data needs identified in the RI to characterize the hydrostratigraphy in both lateral and vertical directions.

Figure 3-1 shows the faults located in and near Area 3. The Raymond Fault forms the northern boundary of Area 3 and separates the San Gabriel Basin from the Raymond Basin. Groundwater north of the Raymond Fault in the Raymond Basin occurs at shallower depths than groundwater to the south in the San Gabriel Basin. Groundwater flows across sections of the fault from the Raymond Basin to the San Gabriel Basin at a rate of approximately 5,600 acre-feet per year (EPA, 2002a). No evidence exists to indicate that other faults affect groundwater flow in Area 3.

Figure 3-1 shows the faults within the San Gabriel Basin.

Figure 3-16 shows a structural bedrock discontinuity, possibly a fault zone associated with the Whittier Fault system, identified during the RI. Appendix D presents an interpretation of the structural bedrock discontinuity, which appears to impede groundwater flow and differentiates the hydrostratigraphy and groundwater conditions between the western and eastern portions of Area 3.

Figure 3-16 shows the structural bedrock discontinuity, possibly a fault zone.

Appendix D presents an interpretation of the structural bedrock discontinuity.

3.1.6.2 Area 3 Hydrostratigraphy

Relatively young floodplain and stream channel deposits compose alluvium in Area 3 and consist of interbedded layers and lenses of fine-grained and coarse-grained sediments. Floodplain deposits tend to contain more fine-grained sediments, which include clay, silty sands, and sandy clays. Stream channel deposits contain more coarse-grained material that consists mostly of cobbles, gravel, and sand. The interbedded layers of sediments resulted from the erosion and southward transport of coarse-grained sediments from the San Gabriel Mountains, and the erosion of finer-grained sediments from the sedimentary rocks in the adjacent hills.

Underlying the alluvium in Area 3, the bedrock sequence with increasing depth consists of the Pico, Puente, and Topanga Formations, and the Santa Monica Slate basement complex (Lamar, 1970).

The Repetto Hills form the western edge of Area 3 and consist primarily of the Puente Formation, the Pico Formation, and the Topanga Formation (Lamar, 1970). Figure 3-16 illustrates the three formations of the uppermost sedimentary bedrock throughout the western portion of Area 3.

Figure 3-16 illustrates the three formations of the uppermost sedimentary bedrock in the western portion of Area 3.

The bedrock has been folded and faulted by large-scale pressures and movements in the crust of the earth. The folded sedimentary bedrock forms ***anticlines*** and ***synclines***, respectively defined as convex and concave arch-shaped sequences of sedimentary rock layers. As anticlines and synclines formed, the uppermost sedimentary rock layers were subjected to tension or compression forces, respectively, causing fractures and faults along, and parallel to, the axes of the folds (Ray, 1986).

Appendix D provides a detailed discussion and interpretation of the hydrostratigraphy of Area 3.

Appendix D provides a detailed discussion and interpretation of the hydrostratigraphy of Area 3.

3.1.6.3 Area 3 Groundwater Flow

Figure 3-17 presents a hydrograph that shows the changes in groundwater elevation.

A comparison of Figure 3-5 and Figure 3-16 shows that groundwater elevations historically were higher than the top of the bedrock elevations in the western portion of Area 3.

Figure 3-17 presents a ***hydrograph*** that shows the western and eastern alluvial aquifers exhibited similar groundwater level fluctuations and direct hydraulic communication prior to the late 1940s. A comparison of Figures 3-5 and 3-16 shows that groundwater elevations historically were higher than the top of the bedrock elevation in the western portion of Area 3. Therefore, groundwater historically flowed eastward.

After the 1940s, groundwater levels in the eastern alluvial aquifer significantly dropped due to increased pumping in the San Gabriel Basin. As groundwater levels dropped below the western bedrock elevation, the western alluvial aquifer became hydraulically separated from the eastern alluvial aquifer. Abandonment of production wells located within the western portion of Area 3 occurred afterward.

Figures 3-7 and 3-18 provide groundwater elevation contour maps of the western alluvial aquifer and bedrock aquifer in winter 2004 and spring 2007, respectively.

Figures 3-7 and 3-18 provide the groundwater elevation contour maps of the western alluvial aquifer and bedrock aquifer in winter 2004 and spring 2007, respectively. The measured elevations represent the level of the first-encountered groundwater in the western portion of Area 3. As discussed in Section 8, groundwater elevation monitoring will continue during the feasibility study and elevation contour maps will be refined to support the evaluation of remedial alternatives for Area 3.

Groundwater in the western alluvial aquifer flows generally southeastward to eastward following the bedrock structural features, in particular the southeastward-eastward ***plunging*** syncline where the saturated thickness of the alluvium is greatest. The groundwater contours show a steep gradient away from the anticline, most likely due to the relatively fine-grained nature of the bedrock, which acts to restrict groundwater flow away from the anticline.

Figure 3-18 shows steeper horizontal gradients in the western alluvial aquifer than the eastern alluvial aquifer.

Figure 3-18 shows that the western alluvial aquifer exhibits steeper horizontal hydraulic gradients than the eastern alluvial aquifer. The finer-grained nature of the alluvium within the western portion of Area 3 most likely restricts groundwater flow.

A component of the bedrock discontinuity, which may be the fine-grained nature of the bedrock, most likely restricts groundwater flow. However, groundwater flow might seep along the bedrock surface or through the bedrock to the eastern alluvial aquifer. Additional data are needed to characterize groundwater flow conditions in the area of the structural bedrock discontinuity.

Figures 3-10 through 3-15 present the cross-sections A-A′ through F-F′.

In the eastern alluvial aquifer, the distinct breaks in the vertical gradients identify the presence of three zones classified as the shallow, intermediate, and deep groundwater zones shown in Figures 3-10 through 3-15.

Figure 3-7 presents groundwater elevation contours for the eastern alluvial aquifer in Area 3 for winter 2004. This figure represents composite conditions because the data consist of measurements collected from production wells screened across multiple groundwater zones and from the shallowest port from the ***multiport monitoring wells.*** Figure 3-7 also shows that pumping strongly influences the flow of groundwater toward areas of high groundwater production. Groundwater in Area 3 flows radially to the Alhambra Pumping Hole and toward individual production wells locally.

Figure 3-7 presents groundwater elevation contours for winter 2004 and shows the location of the Alhambra Pumping Hole.

The eastern alluvial aquifer consists of a ***multiple, leaky aquifer system***. Figures 3-18, 3-19, and 3-20 show groundwater contour maps for the intermediate, shallow, and deep groundwater zones, respectively, based on groundwater levels measured at monitoring wells and at production wells generally screened within a single groundwater zone.

Figures 3-18, 3-19, and 3-20 show groundwater contour maps for the intermediate, shallow, and deep groundwater zones, respectively.

The main influences on groundwater flow in the eastern alluvial aquifer include (1) groundwater pumping, (2) the presence of fine-grained units that either allow leakage or obstruct vertical groundwater flow, and (3) limited groundwater recharge. Appendix D provides a detailed discussion and interpretation of the groundwater flow within Area 3.

Appendix D provides a detailed discussion and interpretation of the groundwater flow within Area 3.

3.2 Summary of Area 3 Physical Characteristics

Historically, the western and eastern alluvial aquifers were in direct hydraulic communication, and groundwater elevations in the eastern alluvial aquifer were higher than the western bedrock elevation. Increased pumping in the San Gabriel Basin since the late 1940s caused a major decline in groundwater elevations in the eastern alluvial aquifer to below the western bedrock elevation. Area 3 groundwater historically flowed from west to east, with regional groundwater flow toward the San Gabriel Basin outlet, Whittier Narrows. Regional groundwater east of Area 3 flows southwestward.

Figure 3-9 shows a structural bedrock discontinuity, possibly a fault zone associated with the Whittier Fault system, identified during the RI. The bedrock discontinuity appears to affect groundwater flow and differentiate the hydrostratigraphy and groundwater conditions between the western and eastern portions of Area 3.

Figure 3-9 illustrates a three-dimensional view of the conceptual geology of Area 3.

The hydrogeologic conceptual site model provides a foundation for development of the contamination migration conceptual site model for Area 3 (RI Subtask 3) in Section 5. Information on the physical and ecological characteristics of Area 3 supports the human health and ecological risk assessments (RI Subtasks 4 and 5) discussed in Sections 6 and 7, respectively.

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Glossary

Glossary

alluvial: Relating to alluvium.

alluvial plain: A relatively flat landform created by the deposition of sediments over time by one or more rivers coming from highland regions.

alluvium: Sediment deposited by flowing water, as in a riverbed, flood plain, or delta.

anticline: A convex upward series of folded geologic units that contains older rocks at its core.

aquifer: A saturated geologic unit, often of sand or gravel, which contains and transmits significant quantities of water under normal conditions.

basin: A large geologic depression in the bedrock that is filled with unconsolidated sediments.

bedrock: The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

conceptual site model: A planning tool that provides the framework from which the study design is structured. It is frequently created as a site map that organizes information that already is known about a site.

contaminant: A substance not naturally present in the environment or present in unnatural concentrations that can, in sufficient concentration, adversely alter an environment.

contamination: The presence of hazardous substances in the environment.

data quality objectives: Performance and acceptance criteria that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

ecological risk assessment: A process for systematically evaluating the likelihood that **adverse** ecological effects may occur as a result of exposure to one or more contaminants**.**

fault: A fracture in the continuity of a rock formation, caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture.

feasibility study: The mechanism for the development, screening, and detailed evaluation of alternative remedial actions.

geophysical log: A graphical representation record of properties of subsurface geologic materials; commonly used to determine soil or rock type and the location of the water table.

groundwater: Water occurring underground, in the zone of saturation in an aquifer.

groundwater monitoring well: A type of well specially designed and installed to sample groundwater at specific locations and depths to evaluate groundwater flow and contamination.

groundwater recharge: Infiltration of water from the earth's surface into the groundwater system.

human health risk assessment: Qualitative and quantitative evaluation of the risk posed to human health by the actual or potential presence of specific contaminants.

hydrogeology: The study of the occurrence and movement of water beneath the surface of the earth.

hydrograph: A graph showing the variation of the elevation of the groundwater table with respect to time.

hydrostratigraphy: The body of soil or rock having considerable lateral extent that also exhibits reasonably distinct groundwater conditions.

lithologic log: Record of visual observations and manual testing that describe the type of rock and/or soil encountered at depth, as described when drilling a borehole.

multiple, leaky aquifer system: A layered series of aquifers and discontinuous aquitards in which groundwater flow between aquifers occurs but the flow could be limited due to the presence of aquitards.

multiport monitoring well: A type of monitoring well equipped with a sampling port for monitoring groundwater at multiple depth intervals of an aquifer.

plunging: A term used to describe a folded geologic unit that is not horizontal. A fold will plunge in a particular direction.

potentiometric surface: An imaginary surface representing the level to which water will rise in a well that penetrates a confining unit.

remedial investigation: Actions undertaken to characterize the full nature and extent of contamination, including characterization of hazardous substances, identification of contaminant sources, and assessment of human health and ecological risk.

reverse fault: A fault in which the block of material on top of the fault plane moves upward and the block below the fault plane remains in place.

sedimentary: A type of rock consisting of layers resulting from consolidation of sediment; one of three main categories or classes into which all rocks are divided, the others being igneous and metamorphic.

strike-slip fault: A fault in which a majority of the movement is lateral and parallel to the fault plane rather than vertical.

structural bedrock discontinuity: In structural geology, a subsurface bedrock zone or surface separating two unrelated groups of rocks across which an abrupt geologic change occurs, e.g., a fault.

Superfund: The program operated under the legislative authority of CERCLA and SARA that funds and carries out EPA solid waste emergency and long-term response actions, including conducting or supervising cleanup actions.

syncline: A concave upward series of folded geologic units that contains younger rocks at its core.

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Tables

Figures