**Table 10-1**
**Factors Affecting Groundwater Restoration at the Site**
**Casmalia Resources Superfund Site**
**Casmalia, CA**

| | Contaminant Characteristics | Generalized Remediation Difficulty Scale Increasing Difficulty | | Casmalia Site Condition | Notes | Primary RI Section Describing Site Condition |
|---|---|---|---|---|---|---|
| *Site Use* | **Nature of Release** | Small Volume → | Large Volume | Large Volume | The site is a former Class 1 hazardous waste management facility. It accepted large quantities of liquid and solid wastes, much of which remains buried in capped (but unlined) landfills, within trenches, and surrounding injection wells. Disposal features include:<br>• Six landfills,<br>• 43 surface impoundments,<br>• 15 evaporation pads,<br>• Two non-hazardous waste spreading areas,<br>• Six oil field waste spreading areas,<br>• 11 shallow injection wells,<br>• Seven disposal trenches, and<br>• One drum burial unit. | Section 2.2 - Site History and Use |
| | | Short Duration → | Long Duration | Long Duration | Localized environmental impacts to on-site soil and groundwater began once the site accepted wastes in 1972 and continue through today. | Section 2.2 - Site History and Use |
| | | Slug Release → | Continual Release | Continual Release | Wastes in some areas (e.g., selected surface impoundments, evaporation pads, spreading areas) have been removed and no longer represent an ongoing continual release, but several disposal features (e.g., capped landfills, injection wells, burial trenches) remain significant sources of environmental impacts to soil and groundwater. Waste in capped landfills cannot be physically removed. | Section 2.2 - Site History and Use |
| *Chemical Properties* | **Biotic/Abiotic Decay Potential** | High → | Low | High to Low | Onsite groundwater impacts are characterized by mixed liquids waste disposal. Biotic or abiotic decay may be appropriate for some classes of chemicals, but are not effective on others (e.g., metals cannot be degraded). | Section 6.4.2.3.1 - Migration and Persistence of Groundwater COPCs and Appendix O – Monitored Natural Attenuation Evaluation |
| | **Volatility** | High → | Low | High to Low | VOCs are present in groundwater, but heavy hydrocarbons also exist that are less volatile. Synthetic organic compounds (PAHs, PCBs, Herbicides, Pesticides, Dioxin/ Furans and Others, excluding the VOCs), typically have less affinity for water (very low solubility) and a greater affinity to absorb to soil. Because of their higher molecular weight, these compounds tend to be viscous and less volatile than VOCs. | Section 6.4.2.3.1 - Migration and Persistence of Groundwater COPCs and Appendix O – Monitored Natural Attenuation Evaluation |
| | **Contamimant Retardation (Sorption) Potential** | Low → | High | High | VOCs, particularly HVOCs like TCE and PCE, are not expected to selectively concentrate on or be sorbed by soils. But SVOCs, pesticides, herbicides, dioxins/furans, and PCBs are expected to be readily adsorbed to subsurface soils because of their insoluble nature, and sorption appears to be the primary environmental fate-governing mechanism for these classes of chemicals. | 6.4.2.1.1 Migration and Persistence of Subsurface Soil COPCs, Section 6.4.2.3.1 - Migration and Persistence of Groundwater COPCs, and Appendix O – Monitored Natural Attenuation Evaluation |
| *Contaminant Distribution* | **Contaminant Phase** | Aqueous, Gaseous → Sorbed → LNAPL → | DNAPL | DNAPL | LNAPL and/or DNAPL have both been detected in monitoring points in isolated locations north of the PSCT, including locations within the Central Drainage Area and the Capped Landfills Area. DNAPL is present in an area between the P/S Landfill and PSCT-1. Previous site conditions could have resulted in downward DNAPL migration based on reasonable assumptions for DNAPL properties (densities and interfacial tensions), DNAPL pooled heights, and fracture apertures. The observation of DNAPLs in piezometers RGPZ-7C and RGPZ-7D suggest that vertical migration of DNAPLs through the limited but potentially interconnected fracture network in the Lower HSU has already occurred within the Central Drainage Area. | Section 6.4.2.4.2 - Site-specific Factors Controlling Constituent Transport in NAPL, Appendix G, Section 3.3.1 - NAPL Chemistry and Physical Properties |
| | **Volume of Contaminated Media** | Small → | Large | Large | Volume and mass of impacted media will be calculated in the FS, but impacts to groundwater are widespread. LNAPL is present as a separate phase in 16 Upper HSU wells and piezometers in an area from the Gallery Well at the toe of the P/S Landfill to just north of PSCT-1. DNAPL is present in P/S Landfill piezometer RIPZ-13, installed in August 2007, the Upper HSU Gallery Well, and in two Lower HSU piezometers between the P/S Landfill and PSCT-1. LNAPL and DNAPL depths and thicknesses are routinely measured in these wells and piezometers, and a summary of historical NAPL levels is presented in Appendix F. | Section 5.4.5 - Groundwater, Section 5.4.6 - NAPL, Appendix G - Groundwater Chemistry, and Appendix F - Groundwater Flow |
| | **Contaminant Depth** | Shallow → | Deep | Deep | Most of the LNAPL and dissolved phased contaminants are within the Upper HSU, but DNAPLs have been observed in in piezometers RGPZ-7C and RGPZ-7D, which are screened up to 148 feet below ground surface. | Section 3.2.1.2 - DNAPL Distribution within Appendix F - Groundwater Flow |
| *Geology* | **Stratigraphy** | Simple Geology → | Complex Geology | Complex Geology | Surficial deposits on-site include clayey soils, colluvium, alluvium, and artificial fill ranging from a few feet to up to 50 feet thick. These near-surface deposits have been reworked over a majority of the Site. The alluvium generally consists of a silty clay, and is confined to drainages. Artificial fill consists of predominantly disturbed claystone with varying amounts of admixed alluvium. The surficial deposits are in hydraulic communication with the underlying weathered claystone. The Upper HSU consists of the weathered and highly fractured claystone. The Lower HSU consists of the unweathered claystone that is also fractured. | Section 4.5.2.2 - Hydrostratigraphic Units |
| | **Texture of Unconsolidated Deposits** | Sand → | Clay | Clay | The Upper and Lower HSU are fine grained mudstone deposits. | Section 4.5.2.2 - Hydrostratigraphic Units |
| | **Degree of Heterogeneity** | Homogeneous → | Heterogeneous | Heterogeneous | Discontinuous, localized deposits of alluvium have been reported at the Site. Engineered fill is present throughout the Site as dikes, berms, environmental barriers, and solid waste disposal units. Fill material was also placed in association with landfill capping activities, and as buttresses at the toe of some landfills. Fill was generally derived from excavation of on-site soils and consists of silty clay and pebble-to-cobble size fragments of claystone and silty claystone. Upper HSU is weathered claystone that is pervasively fractured. Lower HSU is unweathered claystone that is also fractured. | Section 4.4.2 - Local Geology and Section, Section 4.4.4 - Site Structural Features, and Section 4.5.1 - Regional and Site Hydrogeologic Setting |
| *Hydraulics/Flow* | **Hydraulic Conductivity** | High (>$10^{-2}$ cm/sec) → | Low (<$10^{-4}$ cm/sec) | Low | Geometric Mean Upper horizontal HSU hydraulic conductivity: 1.05 X 10-05 cm/sec,<br>Geometric Lower Upper horizontal HSU hydraulic conductivity: 1.03 X 10-06 cm/sec | Section 4.5.2 - Site Hydrogeologic Characteristics |
| | **Temporal Variation** | Little/None → | High | Medium | Water level trends for most of the Upper HSU wells showed relatively rapid response to rainfall events and a quick decline in water levels after rainfall recharge has dissipated, but significant rainfall events are relatively infrequent. | Appendix F, Section 3.1.3 - Groundwater Elevation Changes 1997-2009 |
| | **Vertical Flow** | Little or Upward Flow Component → | Large Downward Flow Component | Large Downward Flow Component | Significant downward vertical gradients are present in Interior Zone 1 | Appendix F, Table F-4. Vertical Head Differences in Nested Wells |

Notes:
Based on Figure 1 from *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration, Interim Final*, USEPA OSWER Directive 9234.2-25, September 1993