Response to Comments on the Human Health Risk Assessment
Caltrans Modesto Soil Stockpiles, Stanislaus County, California

Comments by: Department of Toxic Substances Control Human and Ecological Risk Division (HERD)			
No.	**Section**	**Comments**	**Response**
1	Page 3-2 Section 3.3 Chemical of Potential Concern for Soil.	Criteria are presented here for choosing chemicals of potential concern (COPCs) in soil. It should be noted that only data from samples identified as from the stockpile were evaluated in this risk assessment. Samples taken from the stockpile but identified as representing native soil were not included.	The following text was incorporated into Section 3.3, first paragraph. 1. "Only data from samples identified as from the stockpile were evaluated in this risk assessment. Samples taken from the stockpile but identified as representing native soil were not included."
2	Page 4-5 Section 4.1.3 Inhalation of Soil Particulates in Current Outdoor Air from Wind Erosion.	To the table of parameters, add the dust level in µg/m^3 for each particulate emission factor (PEF) calculated for each soil stockpile.	Dust levels were provided in µg/m^3 in the table in Section 4.1.3. Value = 0.51 µg/m^3 for SP#1 Value = 0.61 µg/m^3 for SP#2 Value = 0.51 µg/m^3 for SP#3
3	Page 4-6 Section 4.1.3 Inhalation of Soil Particulates in Current Outdoor Air from Wind Erosion, and Table 9 Exposure Parameters.	Change the inhalation rate for the construction worker from 2 m^3/hour to 2.5 m^3/hour as was listed in the draft table of exposure parameters submitted and approved as part of the table of contents, dated August 9, 2006. The inhalation rate of 2.5 m^3/hour for the construction worker has been recommended by the DTSC in the *Human Health Risk Assessment (HHRA) Note Number* 1 (October 27,2005).	The construction worker inhalation rate was corrected in Section 4.1.3, page 4-6, first paragraph, second sentence. However, no revisions to the construction work risk calculations were required. The correct inhalation rate of 2.5 m^3/hour was used in the risk calculations.

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4	Page 4-6 Section 4.1.4 Inhalation of Soil Particulates in Future Outdoor Air from Construction Activities, and Table 13 Estimated Particulate Emissions Based on Assumed Future Construction Activities.	The method described by the U.S. Environmental Protection Agency (US EPA) in the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (December 2002) is used to calculate site-specific respirable dust concentrations during construction of the highway exchange. The steps of this method and the results are summarized in Table 13. The on-site dust concentration is calculated to be 102 µg/m^3. The dust concentration for the off-site resident is calculated to be *75.7* µg/m^3. These values are much lower than the default respirable dust concentration of 1 ,000 µg/m^3 used to derive a particulate emission factor (PEF) for the construction worker scenario recommended in the *Human Health Risk Assessment (HHRA) Note Number* 1 (October 27, 2005)). A) The HERD requests that all spreadsheets. used to calculate the results shown in this table be submitted as an appendix. B) The final PEF equations should be presented, and the PEFs calculated for the construction worker and the off-site resident should be included in Table 13. C) Part A of Table 13 is arranged in such a way to make it difficult to delineate the equations and parameters used to calculate on-site construction and off-site residential PEFs and associated respirable dust concentrations. The equations in this table should be augmented to make it easy for the reviewer to follow the calculations. D) There is one emission rate from dump trucks, Jt, calculated in Step 4, and another emission rate shown in Steps 6 and 8. Explain the difference, and/or correct the calculations. E) The O/C term in Step 5 is identified as the off-site air dispersion factor and is identical to the on-site air dispersion factor shown in Step 6. Explain or correct. F) In Step 4, the factor converting a year to seconds is different in the equation and in the parameter list. Please correct.	A) The spreadsheets used in the dust modeling calculations (both construction worker and off-site resident) will be included as Appendix C, Spreadsheets for Table 13. The spreadsheets are attached. This appendix will be referenced with the first reference to Table 13. B) The final particulate emissions and associated equations are provided in Table 13 Part C. C) Table 13 has been reformatted and is attached. D) The emission rate as calculated in Step 4 is correct. The rates shown in Steps 6 and 8 were corrected to reflect this and the associated risks were updated. This included revision to Tables 13, 23, 24, 26, and 27 (see attached). The inhalation results were updated in Section 6.2, second paragraph: "The cumulative excess lifetime cancer risk associated with exposure to COPCs detected in soil (0 to 20 feet bgs) is 9.2E-7 for the construction worker (Table 24), which is just below the 1E-06 cancer risk criterion generally recognized. The cumulative noncancer HI associated with exposure to COPCs detected in soil is 0.4 for the construction worker (Table 24), which does not exceed the threshold of 1." The inhalation results were updated in Section 6.3, second paragraph: "The excess lifetime cancer risk associated with exposure to COPCs detected in soil (0 to 20 feet bgs) is 6E-10 for the off-site resident (Table 27), which is well below the 1E-06 cancer risk criterion generally recognized. The cumulative noncancer HI associated with exposure to COPCs detected in soil is 0.017 (Table 27), which does not exceed the threshold of 1."

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			E) The Step 5 O/C term is mislabeled as the "off-site" air dispersion factor. It was corrected to be "on-site". Table 13 was revised and is attached. F) The correct value is in the parameter list. The value in the equation has been corrected. Table 13 was revised and is attached.
5	Page 7-3 Section 7.3 Toxicity Assessment.	This section discusses the uncertainty inherent in the toxicity criteria routinely used in health risk assessment and correctly states that these toxicity criteria are intended for the evaluation of long-term, chronic exposures. The section should be revised and expanded to point out that the application of such chronic toxicity criteria to evaluate the risk and hazards from the relatively short-term exposure during the future construction of the highway interchange is highly uncertain and conservative.	The uncertainty text was revised in Section 7.3, second paragraph, to include the following text as the first sentence: "In addition, the application of chronic toxicity criteria to evaluate the risk and hazards from the relatively short-term exposure during the future construction of the highway interchange is highly uncertain and conservative."

Comments by: Department of Toxic Substances Control Site Evaluation and Remediation Unit (SERU)			
No.	**Section**	**Comments**	**Response**
1		The PEA for this Site consists of numerous reports with various titles as described above. DTSC requests that Caltrans prepare a final report titled "Final PEA Caltrans Modesto Soil Stockpiles, State Route 132/99 Interchange", Stanislaus County, California, following responses to our comments and prior to our concurrence with the Final PEA. The Final PEA may make references to various supporting reports but should summarize the supporting reports and should include a section discussing recommendations for further action, including institutional controls (ICs) consisting of a land use covenant and soil management plan; and an operation and maintenance plan/agreement. As requested in DTSC's June 22, 2007 correspondence, all final documents should be submitted to DTSC in hard copy and in electronic format via DTSC's FTP server or on CDs in files no larger than ten mega-bites.	The report accompanying this Response to Comments table is a reformatted version of the report titled Human Health Risk Assessment, Caltrans Modesto Soil Stockpiles, Stanislaus County, California, May 14, 2007. This reformatted report, titled Final PEA, Caltrans Modesto Stockpiles, State Route 132/99 Interchange, Stanislaus County, California, June 30, 2009, summarizes the supporting studies (included as appendices) and contains a section addressing further site action and Institutional Controls. Electronic versions will be uploaded to DTSC's FTP server.
2		The Human Risk Assessment (HRA) and your cover letter conclude that the Site does not pose an unacceptable risk/hazard to offsite residents, trespassers, and future construction workers and recommends no further action with respect to current and future exposure during construction. DTSC can not make a final determination on these conclusions until comments from HERD on the HRA are addressed. Please refer to the enclosed HERD comments regarding risk input parameters and other requested information.	Response to the HERD comments are addressed in said section of this Response to Comments Table.
3		Although the Site may not pose an unacceptable risk/hazard to offsite residents, trespassers, and construction workers, it is not suitable for unrestricted use (e.g. residential and other sensitive uses). The risk assessment for offsite residents and trespassers is based on relatively low surface concentrations of contaminants of concern (COC), primarily barium, lead, and arsenic. However, there are elevated concentrations of barium at depth in stockpiles No. 2 and 3 that would not be suitable for unrestricted use but are still protective of future construction workers and offsite residents during construction. Additionally, the elevated concentrations of barium at depth in Stockpiles No. 2 and 3 would not be suitable for unrestricted uses at other locations with respect to sensitive uses, including potential RWQCB water quality concerns. To this end, DTSC concurs with your recommendation that Institutional Controls (ICs) consisting of a land use covenant restricting land use and a soil management plan; and an operation and maintenance plan/agreement to maintain the existing fence be implemented for this Site. The above ICs and operation and maintenance plan/agreement will be necessary conditions for DTSC's approval of the Final PEA.	Institutional Controls are discussed in the Conclusions and Recommendations section of the PEA.

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4		Per requirements of a land use covenant, Caltrans will need to 1) to prepare a soil management plan for DTSC's approval addressing the on site management of the soil stockpiles including characterization requirements for appropriate soil management for small quantities (to be defined) of soil from the stockpiles that are moved on site or removed from the Site; 2) notify DTSC prior to any future construction activities involving use of the stockpiles in the State Route 132/99 interchange project and prepare a Removal Action Work Plan or Remedial Action Plan for DTSC's approval; and 3) prepare an operation and maintenance plan/agreement for DTSC's approval for the maintenance of existing Caltrans fence(s).	A Soil Management Plan, Notification Procedure, Remedial Action Work Plan, and Operation and Maintenance Plan are discussed in the Conclusion and Recommendations section of the PEA.
5		The HRA, based on to two sampling events, concludes that hypothetical use of shallow (approximately 35 to 40 feet below ground surface) groundwater does not present an unacceptable risk/hazard to a user. It also states that water for domestic use is provided from municipal wells from deeper zones and that no private well currently exists within a one mile radius of the Site. DTSC notes that a Site background monitoring well was not constructed and thus no Site specific groundwater background data was obtained for comparison to Site data. Instead, Site groundwater data was compared to maximum concentration limits (MCLs) for respective COC. However, groundwater background data is available from investigations conducted at the FMC Modesto site located a few hundred feet north of the Site. DTSC compared groundwater data from the stockpiles to background groundwater data at the FMC Modesto site; and based on this comparison, DTSC notes that barium in groundwater at stockpile No. 2 exceeds background for barium in groundwater at the FMC Modesto site. Therefore, it appears that stockpile No. 2 has impacted shallow groundwater. The groundwater flow direction appears to be from west to east. However, DTSC notes that this gradient is based on groundwater monitoring wells which are located along the west-east alignment of the stockpiles and it does not adequately account for northern or southern gradient components. To address the above, DTSC recommends that Caltrans 1) evaluate the groundwater flow direction based on data from at least one monitoring well located to the north of the stockpiles; 2) compare Site groundwater data to background groundwater data colleted at the FMC Site or a Site background monitoring well; and 3) continue quarterly groundwater sampling/analysis to evaluate seasonal variations of COC In groundwater. Also, due to the shallow depth of Site groundwater data and apparent release from stockpile No. 2, DTCSC recommends that deeper Site groundwater	***DTSC Comment* – "DTSC notes that a Site background monitoring well was not constructed, and thus no Site specific groundwater background data was obtained for comparison to Site data. Instead, Site groundwater data was compared to maximum concentration limits (MCLs) for respective COC. However, groundwater background data is available from investigations conducted at the FMC Modesto site located a few hundred feet north of the Site."** The comparison of hydrogeologic and geochemical data from the FMC site and the Caltrans Modesto Stockpile location strongly suggests that the Stockpile site lies within "area of influence" of contamination derived from the upgradient (FMC) site. The evaluation of water quality data from Caltrans site monitoring wells must take into account the impacts of FMC's long-term disposal practices. This situation precludes the use of groundwater background chemical concentrations for the FMC Modesto Site as a basis of comparison for the (Caltrans) Modesto Stockpile site. Typically, a "background" well is installed upgradient of a contaminant release location and downgradient wells are used to evaluate the

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		monitoring be conducted to evaluate the concentration trends of COC at depths in which a hypothetical well would extract water; and to characterize the vertical extent of COC in groundwater under stockpile No. 2. An applicable land use covenant restricting the use of Site water would be necessary if COC in groundwater in deeper zones exceed MCLs.	relative impact of the suspected source. The FMC background well provides water quality information that represents background conditions for that site but the information does not represent valid background data for the Modesto Stockpile site. The groundwater underneath the Caltrans site is influenced by flow from the upgradient FMC site and constituents present in site waters bears the chemical residue from the historic operations upgradient. The variability in groundwater flow directions, as discussed below, has produced conditions that facilitated the migration of contaminated groundwater from FMC across the entire Caltrans site. The Caltrans Modesto Stockpile wells currently monitor groundwater that is already impacted by FMC's discharge of liquid waste to unlined ponds for over 25 years. The FMC and the Caltrans site share a common water table aquifer and similar near surface lithologies with the first encountered groundwater found at approximately 30 to 35 feet below ground surface. This observation is based on water level measurements made by FMC, the Caltrans Stockpile site, and those complied by the Department of Water Resources (*Modesto Groundwater Basin, Spring 2000, Lines of Equal Depth to Water in Wells, Unconfined Aquifer, DWR*, attached). Long term variations in regional groundwater flow is presented in maps prepared by DWR from 1958 to 2006 (*Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer*, attached). The figures depict the changing flow directions and show the proximity of the stockpiles to the FMC site. The ground water

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			elevation contours depict flow directions that vary from southwest to southeast in the vicinity of FMC. The earliest of the DWR elevation maps (1958, 1962, 1969, and 1970) show groundwater flow shifting from southwest to south, with the majority of the remaining 20 contour maps (1976 – 2006) showing flow toward the south and southeast. It is crucial to note that the Caltrans Modesto Stockpile Site is located 1,000 feet due south of the unlined disposal ponds operated by FMC from the mid 1950's to 1980, and that the stockpile site is hydraulically downgradient from FMC with respect to past groundwater flow directions. The hydrogeologic regime described in the FMC site characterization reports and depicted in the accompanying potentiometric surface maps document southerly flow from the FMC site toward the stockpiles. These reports include the following publications; *Comprehensive Remedial Investigation Report, FMC Corporation*, (GeoTrans, 2004), ; *Addendum to the Comprehensive Remedial Investigation Report*, (GeoTrans, 2005); *Annual Groundwater Monitoring and Groundwater Remediation System Operations Reports, FMC Corporation*, (Parsons, 2005 and 2006). Based on this information we maintain that using the FMC background well to evaluate the Caltrans Site's downgradient wells results in false indicators of groundwater impact from the stockpiles. This contention is based on the following observations: • There is uninhibited flow of shallow groundwater between the FMC site and the stockpile location,

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			• The groundwater flow direction varies from southwest to southeast as observed in historical data. • FMC's has discharged liquid waste for over 25 years to unlined ponds 1,000 feet north of the stockpiles, • Iso-concentration contaminant map trends, and the general geochemical signature of groundwater in stockpile wells indicate southeast constituent migration from FMC toward the Caltrans site. FMC contaminant geochemistry and shallow groundwater iso-concentration contour maps of NO_3, SO_4, and TDS depict chemical gradients radiating from FMC that imply migration of constituent's in the direction of the stockpiles. Metal and mineral concentrations in the stockpile wells, as evidenced by Stiff diagrams (MW-1 through MW-8, See Appendix B), reflect differences in groundwater geochemistry, (from west to east) that corroborate shallow-zone impacts from FMC. Past and present flow directions from FMC toward the stockpiles indicate that flow conditions favored the migration of constituents toward the Caltrans Site. Based on the data collected to complete this PEA and from data compiled by FMC, seepage from FMC's waste percolation ponds appears to be the source of barium that impacts to shallow groundwater in the vicinity of the stockpiles. The migration of stockpile contaminants to groundwater is the result of the circumstances created by FMC's long-term disposal of liquid waste to unlined ponds located upgradient of the stockpiles.

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			<u>DTSC Comment</u> – "DTSC compared groundwater data from the stockpiles to background groundwater data at the FMC Modesto site; and based on this comparison, DTSC notes that barium in groundwater at stockpile No. 2 exceeds background for barium in groundwater at the FMC Modesto site. Therefore, it appears that stockpile No. 2 has impacted shallow groundwater." The direct comparison of groundwater from the Caltrans Stockpile wells with FMC background values ignores the presence of a known upgradient source of contamination which, in-turn, produces erroneous conclusions regarding the impacts of the stockpiles to groundwater. The groundwater flowing to the Caltrans stockpile site has been impacted by FMC's past disposal practices. The method of stockpile construction and characteristics of the underlying native material discourage the infiltration of stockpile constituents into the groundwater. Stockpile No.2 is not the most probable source of barium in groundwater since it is down gradient from a know barium source area. The stockpiles include native soils and pond tailings that were generated when Caltrans constructed a segment of Route 99 north of Kansas Avenue in the 1960's. The excavation included a portion of a 4.3-acre parcel, purchased from FMC, which was previously occupied by of FMC's southernmost percolation pond. The native soils and pond tailings were removed and placed in lifts to form abutments for the future SR 99/132 Interchange due south of FMC. A 1963 Division of Highways and Department of Public Works Journal (attached) indicated that 55,000 yd^3 of pond tailings were excavated during construction. The article describes the nature of the tailings and the need to spread them in thin lifts interspersed with thick layers of soil in order to achieve road sub-grade stability. The article also indicates that most of the tailings were placed in the larger stockpiles (SP-2 and SP-3). The content of the article is

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			consistent with boring logs and analytical results in the Stockpile Site Characterization study. The stockpiles were constructed at three separate locations on native ground. Altogether, the stockpiles contained approximately 120,000 yd^3 of soil spread across 12.5 acres. The stockpiles were mounded to a height of up to 25 feet with slightly sloped top decks and graded side slopes. Precipitation has been the only source of water contact since the stockpiles were created. The vadose zone beneath the stockpiles includes of a 30-foot thick section of interbedded and laterally discontinuous (native) clays, silts and sands. Native soils below the SP-2 stockpile/native soil contact were collected in eight borings (N4 – N11), with two of the eight borings advanced ten feet below the contact and the remaining six borings advanced 15 feet below. Barium concentrations of soil samples collected between the native ground surface and up to ten-feet below the pre-existing ground surface ranged from 30 to 60 mg/kg. The barium concentration in soil samples collected at the 15-foot depth (below the pre-existing ground surface) ranged from 60 to 120 mg/kg. The background soil barium concentration at the Stockpile Site was determined by pooling the five, ten, and 15-foot deep sample results from eight borings west of SP-1. Based on a 95% UCL of the sample population, the background concentration was determined to be 72.8 mg/kg. The layering of fine-grained tailings and native soils within the stockpiles discourages the vertical migration of rain water. The high adsorption and cation exchange rates typical of granitically-derived alluvium, the high pH of background soils (8.5) (FMC, January 2005), a relatively thick 30-foot thick vadose zone, and the presence of barium at or below background level concentrations in native soils under the stockpiles supports the conclusion that the Barium

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			within the stockpiles is relatively immobile and is not impacting groundwater. A number of conditions exist that further suggest an offsite source (e.g. FMC) for barium in groundwater. These include; • the contiguous nature of the water table aquifer between FMC and the Caltrans site, • the decades-long discharge of liquid barite processing waste to unlined impoundments 1,000 feet to the north, and • the historic variability of groundwater flow direction toward the Stockpile Site (between 1976 and 2006). Based on these observations the most plausible source location for the barium is the hydraulically upgradient FMC ponds. The stockpiles are not the most likely source of barium in shallow groundwater beneath stockpile SP-2. The evidence strongly suggests that the source of barium and other constituents detected in groundwater below the Stockpiles is the FMC property. ***<u>DTSC Comment</u> – "The groundwater flow direction appears to be from west to east. However, DTSC notes that this gradient is based on groundwater monitoring wells, which are located along the west-east alignment of the stockpiles and it does not adequately account for northern or southern gradient components."*** The location of the wells installed at the Caltrans stockpile location is adequate to evaluate hydraulic gradients in all cardinal directions. A monitoring well system's effectiveness in detecting spatially divergent gradient components is a function of well spacing and the relative magnitude of the water surface elevation changes between wells. The wells must be completed in the same aquifer and have adequate separation.

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			The Caltrans Stockpile wells are all completed in the shallow zone aquifer (45 – 50 feet, MSL), and have plenty of west/east separation from one another (minimum 609 feet between adjacent wells). The ability of the west/east aligned well system to account for redirection of northern or southern gradient components comes down to the question of whether or not the north/south separation between wells is adequate. Confirming the adequacy of north/south separation was accomplished by examining the directional variations observed in the Caltrans water table gradients and secondarily by comparing trends in the historic FMC data. It should be noted that the minimum and maximum north/south separation between wells west of State Route 99 is 200 and 217 feet, respectively. The minimum and maximum north/south separation between wells east of Route 99 is 240 and 563 feet, respectively. The overall north/south separation between all wells is 610 feet. The ability to account for northern and southern gradient components was evaluated by dividing the well system into three well clusters. Each cluster shared at least one common well along the upgradient (northern) and downgradient (southern) boundary of the Site, with a minimum 200-foot separation between north/south wells. The clusters are: MW-1, 3, and 4; MW-3, 5, and 6; and MW-3, 6, and 8 as shown in Figure (attached). The figure shows flow direction shifts within same-month clusters; especially directions that shift from southeast to northeast within adjacent cluster groups. These direction shifts demonstrate the capability of the monitoring system to account for northern and southern gradient components. A consistent northwest/southeast flow direction has been observed at FMC for a number of years. Groundwater elevations and shifting flow directions at FMC and the

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			Stockpile Site, namely flow beneath SP-2 and SP-3 is reflected in both the FMC maps and in those prepared by Caltrans. The flow direction at FMC has been established by years of sampling shallow-zone (45 – 50 feet, MSL) monitoring wells that are spread across 43 acres. The general flow direction across FMC's site is northwest/southeast (1996, 2000, and 2004 Shallow Zone Time Series Potentiometric Surface Maps, FMC, January 2005). Maps for January and July 2005 also show a northwest/southeast flow. However, the potentiometric elevations on the FMC maps depict and easterly redirection of flow at southwestern edge of the FMC site, less than 1,000 feet from SP-2 and SP-3. In particular, potentiometric elevations drawn across the stockpiles on the FMC January and July 2005 maps depict eastern flow beneath SP-2 and SP-3. The July 2005 map shows multidirectional flow components (southeastern/eastern/northeastern) across SP-2 and areas of northeastern and southeastern flow beneath SP-3. The southeast to northeast shift in flow beneath the Stockpile Site coincides with the potentiometric elevations and eastern/northeastern flow directions observed in the Caltrans June and October 2006 map along the southwestern edge of the FMC site. Therefore, it is concluded that the monitoring well system at the Caltrans Stockpile Site accounts for northern and southern gradient components and adequately represents the existing flow conditions beneath and next to the stockpiles. To further reinforce the validity of the Caltrans well network the potentiometric contours were compared to DWR maps, The groundwater elevations and flow directions beneath the FMC site as depicted on the Caltrans maps are consistent with 1996, 2000, 2004 and 2005 DWR maps (Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer). Corresponding flow between the DWR maps and FMC

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			further validates the ability of the Site's well system to account for gradient changes. **<u>DTSC Comment</u> – "Evaluate the groundwater flow direction based on data from at least one monitoring well located to the north of the stockpiles."** This topic is addressed above. Please refer to the response to DTSC's comment about west to east flow direction and the ability of the Site's monitoring well system to account for northern and southern gradient components. Based on our response, the Site's monitoring system accurately determines groundwater flow direction. **<u>DTSC Comment</u> – "Compare Site groundwater data to background groundwater data collected at the FMC Site or a Site background monitoring well."** This topic is addressed above. Please refer to the response to DTSC's comment about a Site background monitoring well. Based on our response, using MW-1 or FMC's background well as the water quality comparative to the Sites downgradient wells results in false-positive indicators of a groundwater impact. **<u>DTSC Comment</u> – "Continue quarterly groundwater sampling/analysis to evaluate seasonal variations of COC in groundwater. Also, due to the shallow depth of Site**

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			groundwater data and apparent release from stockpile No. 2, DTSC recommends that deeper Site groundwater monitoring be conducted to evaluate the concentration trends of COC at depths in which a hypothetical well would extract water; and to characterize the vertical extent of COC in groundwater under stockpile No. 2. An applicable land use covenant restricting the use of Site water would be necessary if COC in groundwater in deeper zones exceed MCLs." Please refer to the response to DTSC's comment about: 1) a Site background monitoring well, and 2) the barium in groundwater at stockpile No. 2 exceeding background for barium in groundwater at the FMC Modesto site. Based on our responses, the Site's wells monitor groundwater that is already impacted by FMC's discharge of liquid waste to unlined ponds for over 25 years. This disqualifies the use of additional data to detect an impact to groundwater from a release from the stockpiles. Based on all of our responses to DTSC's comments, we contend that justification for deeper Site groundwater monitoring by Caltrans is not warranted. Additionally, qualifying Constituents of Potential Concern exposure to a hypothetical future shallow groundwater user, the zone most contaminated by FMC's historic discharge, has already been evaluated in our May 14, 2007 Human Health Risk Assessment, which determined that Exposure Point Concentrations do not appear to present an unacceptable human health hazard.

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6		Given that the Site is currently zoned as "Agricultural" and its future use will be for the construction of the State Route 132/99 interchange project and rezoned accordingly, the future habitat for ecological receptors will be very limited (e.g. the stockpiles will be used in the construction of the subject interchange project); and any existing habitat associated with the soil stockpiles will be dissipated. The existing Site habitat is also limited (e.g., the site is zoned for agricultural use, fenced with a chain link fence and is comprised primarily of soil stockpiles which are mowed by Caltrans periodically for fire protection). However, per DTSC's PEA Guidance Manual, June 1999, an ecological screening evaluation should be conducted for existing site conditions to qualitatively evaluate potential risk to ecological receptors. To this end, DTSC recommends that Caltrans discuss any existing Site habitat and potential risk to any existing ecological receptors in the Final PEA.	An ecological screening evaluation of the Site is included in the PEA

Appendix C
Spreadsheets for Table 13

Table X
Hypothetical Groundwater User Noncarcinogenic Hazard Characterizations from Groundwater Exposure
Caltrans TO 23
Modesto, California

$$\text{Hazard Quotient}_{oral} = (ADD_{ing} + ADD_{skin}) / RfD_{oral}$$
$$\text{Hazard Index} = \Sigma\text{Hazard Quotients}_{oral}$$

ADD values are from Table F-11
RfD values are from Table F-13

COPC	ADD_{ing} mg/kg-day	ADD_{skin} mg/kg-day	RfD_o mg/kg-day	Oral Hazard Quotient*
Barium	2.6E-02	1.7E-04	0.200	0.13
Chromium	#N/A	#N/A	#N/A	#N/A
Cobalt	1.9E-04	5.1E-07	0.020	0.01
Copper	4.0E-04	2.6E-06	0.040	0.01
Lead	2.2E-04	1.4E-07	Calculated Using Lead Spread	
Molybdenum	8.9E-04	5.9E-06	0.005	0.18
Nickel	4.5E-04	6.0E-07	0.020	0.02
Selenium	1.9E-04	1.3E-06	0.005	0.04
Vanadium	2.2E-03	1.4E-05	0.007	0.31
Zinc	9.6E-04	3.8E-06	0.300	0.00
Hazard Index				#N/A

TABLE

Lead Risk Assessment Spreadsheet
California Department of Toxic Substances Control
Human Health Risk Assessment
Caltrans TO 23, Groundwater
Modesto, California

USER'S GUIDE to version 7

INPUT

MEDIUM	LEVEL
Lead in Air (µg/m3)	0.028
Lead in Soil/Dust (µg/g)	150.0
Lead in Water (µg/l)	3.4
% Home-grown Produce	0%
Respirable Dust (µg/m3)	1.5

OUTPUT

	Percentile Estimate of Blood Pb (µg/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(µg/g)	(µg/g)
BLOOD Pb, ADULT	0.6	1.1	1.3	1.6	1.8	3110	4496
BLOOD Pb, CHILD	1.9	3.4	4.0	4.9	5.6	359	539
BLOOD Pb, PICA CHILD	2.9	5.3	6.3	7.7	8.7	180	271
BLOOD Pb, OCCUPATIONAI	1.1	2.0	2.4	2.9	3.3	3468	5452

EXPOSURE PARAMETERS

	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (µg/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	µg/cm2	70	200
Dermal uptake constant	(µg/dl)/(µg/day)	0.00011	
Soil ingestion	kg/day	50	100
Soil ingestion, pica	kg/day		200
Ingestion constant	(µg/dl)/(µg/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(µg/dl)/(µg/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	µg/kg	3.1	
Lead in produce	µg/kg	67.5	

PATHWAYS

ADULTS

	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	4.2E-5	0.01	1%	1.5E-5	0.00	0%
Soil Ingestion	8.8E-4	0.13	22%	6.3E-4	0.01	1%
Inhalation1		0.05	8%		0.03	3%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.19	31%		0.84	75%
Food Ingestion1		0.23	38%		0.23	21%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN

	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	6.1E-5	0.01	0%		0.01	0%
Soil Ingestion	7.0E-3	1.06	57%	1.4E-2	2.11	72%
Inhalation1	1.5E-6	0.00	0%		0.00	0%
Inhalation		0.04	2%		0.04	1%
Water Ingestion		0.22	12%		0.22	7%
Food Ingestion, child		0.54	29%		0.54	19%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

Table X
Toxicity and Dermal Absorption Criteria
Caltrans TO 23
Modesto, California

Chemical	Soil Dermal Absorption[a]	Carcinogenic Slope Factors				Noncarcinogenic Factors			
		CSF_{oral} $(mg/kg\ day)^{-1}$	Source	CSF_{inh} $(mg/kg\ day)^{-1}$	Source	RfD_{oral} (mg/kg day)	Source	RfD_{inh} (mg/kg day)	Source
Acenaphthylene[b]	0.15					0.06	IRIS		
Benzo(a)pyrene	0.15	12	OEHHA	3.9	OEHHA				
Benzo[b]fluoranthene	0.15	1.2	OEHHA	0.39	OEHHA				
Benzo(g,h,i)perylene	0.15					0.03	IRIS		
Chrysene	0.15	0.12	OEHHA	0.039	OEHHA				
Fluoranthene	0.15					0.04	IRIS	0.04	Route
Phenanthrene[b]	0.15					0.03	IRIS		
Pyrene	0.15					0.03	IRIS	0.03	Route
Antimony	0.01					4.00E-04	IRIS		
Arsenic	0.03	9.45	OEHHA	12	OEHHA	3.00E-04	IRIS	8.57E-06	OEHHA
Barium	0.01					0.2	IRIS	0.02	Route
Beryllium	0.01			8.4	PRG	0.002	IRIS	2.00E-06	OEHHA
Chromium III	0.01					1.5	IRIS		
Chromium VI	0.01			510	OEHHA	0.003	IRIS	5.71E-05	OEHHA
Cobalt	0.01			9.8	PRG	0.02	PRG	5.70E-06	PRG
Copper	0.01					0.04	HEAST		
Lead	0.01								
Manganese	0.01					0.14	IRIS	1.00E-05	IRIS
Mercury	0.01					3.00E-04	IRIS	2.60E-05	OEHHA
Molybdenum	0.01					0.005	IRIS		
Selenium	0.01					0.005	PRG	0.01	OEHHA
Nickel	0.01			0.91	OEHHA	0.02	IRIS	1.40E-05	OEHHA
Vanadium	0.01					0.007	HEAST		
Zinc	0.01					0.3	IRIS		

Notes:
a: dermal absorption factors are from the Preliminary Endangerment Assessment Manual (DTSC, 1999)
b: No toxicity factors available for these analytes (IRIS, OEHHA, PRGs)
IRIS = U.S. Environmental Protection Agency Integrated Risk Information System, searched December 2005
OEHHA = California Office of Environmental Health Hazard Assessment Toxicity Criteria Database, searched December 2005
PRG = U.S. Environmental Protection Agency Preliminary Remediation Goals Toxicity Values, October 2004
Route: Indicates a exposure route to exposure route extrapolation toxicity factors
HEAST, NCEA, Provisional, and Route-to-Route extrapolation (Route) are from the 2004 Preliminary Remediation Goals Documentation

Table X
Exposure Parameters
Caltrans TO 23
Modesto, California

	A	B	C	D	E	F	H	I	J	K
3	Parameter	Definition	Units	Current and Future Off-Site Resident and Trespasser [a]			Construction Worker	Hypothetical Groundwater User		
4				Child	Adult	Age-Weighted [d]		Child	Adult	Age-Weighted [d]
5	SA_{GW}	Exposed Skin Surface Area - Groundwater Contact	cm^2/day[e]	Not Applicable	Not Applicable	Not Applicable	Not Applicable	6600	18000	15720
6	SA_{soil}	Exposed Skin Surface Area - Soil	cm^2/day[f]	2900	5700	5140	5700	2800	5700	5120
9	t_{event}	Event Time for Groundwater Contact	hours/day[e]	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1	0.58	0.664
13	EF	Exposure Frequency - Groundwater/Soil Ingestion	days/year	350	350	350	Not Applicable	350	350	350
15	EF_{const}	Exposure Frequency - Construction	days/year[h]	60	60	60	60	Not Applicable	Not Applicable	Not Applicable
17	ED	Exposure Duration	years	6	24	30	Not Applicable	6	24	30
18	ED_{cons}	Exposure Duration During Construction	years	1	1	1	1	Not Applicable	Not Applicable	Not Applicable
20	ET_{air}	Exposure Time	hours/day	24	24	24	Not Applicable	24	24	24
22	ET_{const}	Exposure Time - Construction	hours/day	10	10	10	10			
24	SI	Site Soil Ingestion Rate	kg/day	0.0002	0.0001	0.00012	0.00033	Not Applicable	Not Applicable	Not Applicable
25	IR	Inhalation Rate [b]	m^3/hour	0.35	0.83	0.73	2	Not Applicable	Not Applicable	Not Applicable
26	GWI	Groundwater (Drinking Water) Ingestion Rate	L/day	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1	2	1.8
27	SWI	Stormwater Incidental Ingestion Rate	L/day	0.05	0.05	0.05	Not Applicable	Not Applicable	Not Applicable	Not Applicable
29	AT_n	Averaging Time - Noncarcinogen	days	2190	Not Applicable	Not Applicable	365	2190	Not Applicable	Not Applicable
30	AT_c	Averaging Time - Carcinogen	days	Not Applicable	Not Applicable	25550	25550	Not Applicable	Not Applicable	25550
31	AT_{cons}	Averaging Time - Noncarcinogen During Construction	days	365	365	365	365	Not Applicable	Not Applicable	Not Applicable
33	BW	Body Weight	kg	15	70	59	70	15	70	59
35	AF	Adherence Factor	kg soil/ cm^2skin	2.0E-07	7.0E-08	9.6E-08	3.E-07	2.0E-07	7.0E-08	9.6E-08

38 Sources

39 a Unless otherwise noted, the source of the parameter value is EPA (2001a). Supplemental Guidance for Developing
40 Soil Screening Levels for Superfund Sites. Peer Review Draft EPA OSWER 9344.4-25
41 http://www.epa.gov/superfund/resources/soil/ssgmarch01.pdf

42 b Respiration rate for a child is based on 8.3 m^3/day that EPA recommends as the default value for children between 3 and 5.
43 EPA. 2002. Child-Specific Exposure Factors Handbook. EPA 600-P-00-002B
44 http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=55145

45 c EPA (2001b). Source for residential values is Risk Assessment Guidance for Superfund, Volume 1 (Human Health
46 Evaluation Manual: Part E, Supplemental Guidance for Dermal Risk Assessment. Interim EPA 540/R/99/005 (RAGS, Part E)
47 http://www.epa.gov/superfund/programs/risk/ragse/introduction.pdf

48 d Exposure parameters were age-weighted as follows
49 Age Weighted Value = [(6 years/30 years) * child value] + [(24 years/30 years) * adult value]

50 e Based on complete skin contact, value is adult skin surface area for RAGS, Part E, for the work day

51 f Based on partial skin contact, for child and adult, arms, hands, feet, lower legs. Value is child skin surface area for RAGS, Part E, 2 hours per day

52 g Exposure freqency to stormwater puddle based on number of days in Modesto (1931 - 2006) with a minimum of 0.1 inch of rain fall, Western Regional Climate Center, wrcc@dri.edu

53 h Exposure freqency for construction worker is based on 2 excavators removing 2000 cubic yards of soil per day which equals 60 days to remove all soil

Table 13
Estimated Particulate Emissions Based on Assumed Future Construction Activities
Caltrans TO 23, Modesto, California

PART A: Particulate Emissions by Dumptrucks During Construction Activities

Step 1. Equipment Assumed to be used in earthmoving activities

Number	Equipment	Example Model	Weight (tons)
2	20 cubic yard dump truck	Tandem Axle Dump Truck	36.2 [a]
2	Excavators	CAT-330	

a. Current Federal weight limits on interstate highway and bridges for a tandem-axel dump truck, www.fhwa.dot.gov

Step 2. Travel on Unpaved Roads: Assumed Vehicle Kilometer Traveled (VKT) for Construction

Number (day^{-1})	Equipment	Distance Traveled[b] (km)	Number of Days	VKT (km)
100 trucks	Dumptruck	0.286	60	1716

b. Assumed typical truck travel distance for load in and out is approximately 940 feet

Step 3. Total Particulate Mass Emitted Over Project

$$M_{road} = 556 * (W/3)^{0.4} *[(365 - p)/365] * VKT$$ (Eq. 5-10, EPA 2002)

Where	556	Constant	556	(constant, portion of Eq. E-18, EPA 2002)
	W	Average vehicle weight, tons	36.2	(assumed as indicated by a above)
	p	number if days with 0.01 inches or more of rain	0	(conservative assumption)
	VKT	total vehicle kilometers travels over project (km)	1716	(calculated)
	M_{road}	emission, grams	2.58E+06	(calculated)

Step 4. Average Emission Rate During Construction Project

$$J_t = M_{road}/(A_{site} * ED * 3.15E7)$$

Where	A_{site}	area of site, m^2	4.05E+04	(approx. 10 acres total for 3 stockpiles)
	ED	assumed duration of 60 days in 1 year	1.6E-01	(assumed duration of earth movement)
	3.15E+07	conversion of year to seconds	3.15E+07	(conversion)
	J_t	emission rate from dump trucks, g/m^2-s	1.23E-05	(calculated)

Table 13
Estimated Particulate Emissions Based on Assumed Future Construction Activities
Caltrans TO 23, Modesto, California

Step 5. Calculation of On-Site Air Particulate Dispersion Factor - From Dumptrucks

$$Q/C_{wind} = A * \exp((\ln(A_{site})) - B)^2/C)$$ (Eq. D-1, EPA 2002)

Where	A	constant from EPA (2002) for Fresno Area	10.22	(constant for Fresno, EPA 2002)
	A_{site}	Site Area (acres)	10	(total of 3 stockpiles)
	B	constant from EPA (2002) for Fresno Area	19.26	(constant for Fresno, EPA 2002)
	C	constant from EPA (2002) for Fresno Area	220.06	(constant for Fresno, EPA 2002)
	Q/C_{wind}	On-site air dispersion factor, $(g/m^2\text{-}s)/(kg/m^3)$	37.7	(calculated)

Step 6. On-Site Soil Concentration in Air for Construction Workers - From Dumptrucks

$$PA_{on\text{-}truck} = J_t * Fd * (1/QC_{wind})$$ (Eq. E-18, EPA, 2002)

Where	F_d	correction factor	0.194	(Eq. E-16, EPA 2002; 60 days & 10 hr per day)
	Q/C_{wind}	On-site air dispersion factor for Fresno, 10 acres, $(g/m^2\text{-}s)/(kg/m^3)$	37.7	(calculated)
	J_t	emission rate from dump trucks, $g/m^2\text{-}s$	1.23E-05	(calculated)
	$PA_{on\text{-}truck}$	On-site dust concentration from trucks, kg soil/m^3	6.34E-08	(calculated)

Step 7. Calculation of Off-Site Air Particulate Dispersion Factor - From Dumptrucks

$$Q/C_{off} = A * \exp((\ln(A_{site})) - B)^2/C)$$ (Eq. D-1, EPA 2002)

Where	A	constant from EPA (2002) for Fresno Area	11.55	(constant for Fresno, EPA 2002)
	A_{site}	Site Area (acres)	10	(site-specific total of 3 stockpiles)
	B	constant from EPA (2002) for Fresno Area	22.25	(constant for Fresno, EPA 2002)
	C	constant from EPA (2002) for Fresno Area	268.03	(constant for Fresno, EPA 2002)
	Q/C_{off}	Off-site air dispersion factor, $(g/m^2\text{-}s)/(kg/m^3)$	51.0	(calculated)

Step 8. Calculation of Off-Site Air Particulate Concentration - From Dumptrucks

$$PA_{off\text{-}trucks} = J_t * F_d * (1/QC_{off})$$ (Eq. E-18, EPA, 2002)

Where	F_d	correction factor	0.194	(Eq. E-16, EPA 2002; 60 days & 10 hr per day)
	QC_{off}	air dispersion factor, $(g/m^2\text{-}s)/(kg/m^3)$	51.0	(calculated)
	J_t	emission rate from dump trucks, $g/m^2\text{-}s$	1.23E-05	(calculated)
	$PA_{off\text{-}trucks}$	Off-site dust concentration from trucks, kg soil/m^3	4.69E-08	(calculated)

Table 13
Estimated Particulate Emissions Based on Assumed Future Construction Activities
Caltrans TO 23, Modesto, California

PART B: Particulate Emissions by Excavators During Construction Activities

Step 1. Particulate Emissions Generated by Excavator

Excavation Model:

120,000 yd^3(1.5 tons/yd^3) = 1.8E+5 tons
1.8E5 tons (0.9Mega grams/ton) = 1.6E+5 Mg
1.6E+5 Mg/(60day*10hr/day*3600s/hour) = 0.075 Mg/s

$$E = k(0.0016)\,X \frac{(U/2.2)^{1.3}}{(M/2)^{1.4}}$$

(portion of Eq. E-21, EPA 2002)

Where	E	Emission rate from Excavator, kg/Mg	1.37E-04	(calculated)
	k	particle size multiplier (dimensionless); 0.48	0.48	(conservative estimate)
	U	mean wind speed (m/sec); 3.3 m/s for Stockton Area	3.3	(Western Climate Research, 2006)
	M	material moisture content (%); estimated 10%	10	(conservative estimate)

Emission Rate for Excavator: $J_t = E * (0.075\ Mg/s) * X / A_{site}$ (Eq. E-25 and portion of E-21, EPA 2002)

Where	E	Emission factor from Excavator, kg/Mg	1.37E-04	(calculated)
	X	conversion kg to g	1.00E+03	(conversion factor)
	A_{site}	area of site, m^2	4.05E+04	(approx. 10 acres total for 3 stockpiles)
	J_t	emission rate from excavator, g/m^2-s	2.53E-07	(calculated)

Step 2. On-Site Soil Concentration in Air for Construction Workers - From Excavators

$$PA_{on\text{-}exc} = J_t * F_d * (1/QC_{wind})$$

(Eq. E-18, EPA, 2002)

Where	F_d	correction factor	0.194	(Eq. E-16, EPA 2002; 60 days & 10 hr per day)
	QC_{wind}	air dispersion factor, $(g/m^2\text{-}s)/(kg/m^3)$	37.7	(calculated)
	J_t	emission rate from excavator, g/m^2-s	2.53E-07	(calculated)
	$PA_{on\text{-}exc}$	On-site dust concentration from excavators, kg soil/m^3	1.30E-09	(calculated)

Step 3. Calculation of Off-Site Air Particulate Concentration - From Excavators

$$PA_{off\text{-}exc} = J_t * F_d * (1/QC_{off})$$

Where	F_d	correction factor	0.194	(Eq. E-16, EPA 2002; 60 days & 10 hr per day)
	QC_{off}	air dispersion factor, $(g/m^2\text{-}s)/(kg/m^3)$	51.0	(calculated)
	J_t	emission rate from excavator, g/m^2-s	2.53E-07	(calculated)
	$PA_{off\text{-}exc}$	Off-site dust concentration from excavators, kg soil/m^3	9.64E-10	(calculated)

Table 13
Estimated Particulate Emissions Based on Assumed Future Construction Activities
Caltrans TO 23, Modesto, California

PART C: Final Estimated Particulate Emissions for On and Off Site During Construction

PA_{on}	On-site dust concentration for Construction Workers (kg/m^3) = $PA_{on\text{-}truck}$ + $PA_{on\text{-}exc}$ =	**6.47E-08**	(calculated)
PA_{off}	Off-Site dust concentration for Off-Site Resident (kg/m^3) = $PA_{off\text{-}truck}$ + $PA_{off\text{-}exc}$ =	**4.79E-08**	(calculated)

Reference:
EPA, 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. OSWER 9355.4-24, December.

Table 23
Future On-Site Construction Worker Estimated Doses Based
Upon Exposure to Construction Zone Soil (0 to 20 ft bgs) from SP#1, SP#2, and SP#3
Caltrans TO 23, Modesto, California

COPC	C_{soil} (mg/kg)	C_{air} (mg/m^3)	Inhalation		Ingestion		Dermal Contact	
			Noncancer Dose (mg/kg-day)	Carcinogenic Dose (mg/kg-day)	Noncancer Dose (mg/kg-day)	Carcinogenic Dose (mg/kg-day)	Noncancer Dose (mg/kg-day)	Carcinogenic Dose (mg/kg-day)
Metals								
Arsenic	5.5E+00	3.6E-07	1.7E-08	2.4E-10	4.3E-06	6.1E-08	1.8E-06	2.5E-08
Barium	7.2E+04	4.7E-03	2.2E-04	3.1E-06	5.6E-02	8.0E-04	7.7E-03	1.1E-04
Chromium III	2.3E+01	1.5E-06	7.0E-08	1.0E-09	1.8E-05	2.6E-07	2.5E-06	3.5E-08
Chromium VI	3.9E+00	2.5E-07	1.2E-08	1.7E-10	3.0E-06	4.3E-08	4.1E-07	5.9E-09
Cobalt	7.3E+00	4.7E-07	2.2E-08	3.2E-10	5.7E-06	8.1E-08	7.8E-07	1.1E-08
Copper	2.9E+01	1.9E-06	8.8E-08	1.3E-09	2.2E-05	3.2E-07	3.1E-06	4.4E-08
Lead	1.5E+03	9.7E-05	4.6E-06	6.5E-08	1.2E-03	1.7E-05	1.6E-04	2.3E-06
Molybdenum	1.5E+00	9.7E-08	4.6E-09	6.5E-11	1.2E-06	1.7E-08	1.6E-07	2.3E-09
Nickel	1.6E+02	1.0E-05	4.9E-07	6.9E-09	1.2E-04	1.8E-06	1.7E-05	2.4E-07
Vanadium	2.3E+02	1.5E-05	7.0E-07	1.0E-08	1.8E-04	2.5E-06	2.5E-05	3.5E-07
Zinc	1.1E+02	7.1E-06	3.3E-07	4.8E-09	8.5E-05	1.2E-06	1.2E-05	1.7E-07
PAHs								
Benzo(a)pyrene	1.9E-02	1.2E-09	5.8E-11	8.2E-13	1.5E-08	2.1E-10	3.1E-08	4.4E-10

C_{soil} = Maximum detected concentration in soil of Stockpiles #1, #2, and #3.
$C_{air} = C_{soil} * PA_{on}$ (see Table 13)
COPC = Chemicals of potential concern
PAH = Polycyclic Aromatic Hydrocarbons
mg/kg = milligrams per kilogram
mg/m^3 = milligrams per cubic meter
mg/kg-day = millograms per kilogram day
SP = stock pile
ft bgs = feet below ground surface

Table 24
Future On-Site Construction Worker Risk and Hazard Estimates based on Exposure to Construction Zone Soil (0 to 20 ft bgs) from SP#1, SP#2, and SP#3
Caltrans TO 23, Modesto, California

Noncarcinogenic Hazard for On-Site Construction Worker Exposures To Construction Zone Soil (0 to 20 ft bgs)

	Inhalation			*Ingestion*	*Dermal*	*Oral*	*Oral + Dermal*
COPC	Dose (mg/kg-day)	RfD (mg/kg-day)	Hazard Quotient	Dose (mg/kg-day)	Dose (mg/kg-day)	RfD (mg/kg-day)	Hazard Quotient
Metals							
Arsenic	1.7E-08	8.57E-06	1.95E-03	4.3E-06	1.8E-06	3.00E-04	2.01E-02
Barium	2.2E-04	2.00E-02	1.09E-02	5.6E-02	7.7E-03	2.00E-01	3.18E-01
Chromium III	7.0E-08	NA	NA	1.8E-05	2.5E-06	1.50E+00	1.36E-05
Chromium VI	1.2E-08	5.71E-05	2.05E-04	3.0E-06	4.1E-07	3.00E-03	1.13E-03
Cobalt	2.2E-08	5.70E-06	3.89E-03	5.7E-06	7.8E-07	2.00E-02	3.22E-04
Copper	8.8E-08	NA	NA	2.2E-05	3.1E-06	4.00E-02	6.39E-04
Lead	4.6E-06	NA	NA	1.2E-03	1.6E-04	NA	NA
Molybdenum	4.6E-09	NA	NA	1.2E-06	1.6E-07	5.00E-03	2.65E-04
Nickel	4.9E-07	1.40E-05	3.47E-02	1.2E-04	1.7E-05	2.00E-02	7.06E-03
Vanadium	7.0E-07	NA	NA	1.8E-04	2.5E-05	7.00E-03	2.90E-02
Zinc	3.3E-07	NA	NA	8.5E-05	1.2E-05	3.00E-01	3.23E-04
PAHs							
Benzo(a)pyrene	5.8E-11	NA	NA	1.5E-08	3.1E-08	NA	NA
Hazard Index By Pathway			**0.05**				**0.38**
Total Hazard	**4.E-01**						

Carcinogenic Risk for On-Site Construction Worker Exposures To Construction Zone Soil (0 to 20 ft bgs)

	Inhalation			*Ingestion*	*Dermal*	*Oral*	*Oral +*
COPC	Dose (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ELCR	Dose (mg/kg-day)	Dose (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	Dermal ELCR
Metals							
Arsenic	2.4E-10	1.20E+01	2.86E-09	6.09E-08	2.52E-08	9.45E+00	8.1E-07
Barium	3.1E-06	NA	NA	7.97E-04	1.10E-04	NA	NA
Chromium III	1.0E-09	NA	NA	2.56E-07	3.54E-08	NA	NA
Chromium VI	1.7E-10	5.10E+02	8.54E-08	4.27E-08	5.90E-09	NA	NA
Cobalt	3.2E-10	9.80E+00	3.11E-09	8.08E-08	1.12E-08	NA	NA
Copper	1.3E-09	NA	NA	3.21E-07	4.44E-08	NA	NA
Lead	6.5E-08	NA	NA	1.66E-05	2.29E-06	NA	NA
Molybdenum	6.5E-11	NA	NA	1.66E-08	2.29E-09	NA	NA
Nickel	6.9E-09	9.10E-01	6.32E-09	1.77E-06	2.45E-07	NA	NA
Vanadium	1.0E-08	NA	NA	2.55E-06	3.52E-07	NA	NA
Zinc	4.8E-09	NA	NA	1.22E-06	1.68E-07	NA	NA
PAHs							
Benzo(a)pyrene	8.2E-13	3.90E+00	3.22E-12	2.10E-10	4.36E-10	1.20E+01	7.8E-09
Total Risk by Pathway			**9.8E-08**				**8.2E-07**
Total Risk	**9.2E-07**						

COPC = Chemicals of potential concern
CSF = Cancer Slope Factor
ELCR = Excess Lifetime Cancer Risk
PAH = Polycyclic Aromatic Hydrocarbons
RfD = Reference Dose
NA = Not available or Not applicable
mg/kg = milligram per kilogram
SP = Stock pile
ft bgs = feet below ground surface

Table 26
Future Off-Site Resident Estimated Doses During Constrution Activities from Construction Zone Soil (0 to 20 ft bgs) from SP#1, SP#2, and SP#3
CalTrans TO 23, Modesto, California

COPC	C_{soil} (mg/kg)	C_{air} (mg/m^3)	Inhalation		Ingestion		Dermal Contact	
			Noncancer Dose (mg/kg-day)	Carcinogenic Dose (mg/kg-day)	Noncancer Dose (mg/kg-day)	Carcinogenic Dose (mg/kg-day)	Noncancer Dose (mg/kg-day)	Carcinogenic Dose (mg/kg-day)
Metals								
Arsenic	5.50E+00	2.6E-07	5.38E-09	1.57E-12	Incomplete Pathway		Incomplete Pathway	
Barium	7.20E+04	3.4E-03	7.04E-05	2.06E-08	Incomplete Pathway		Incomplete Pathway	
Chromium III	2.31E+01	1.1E-06	2.26E-08	6.61E-12	Incomplete Pathway		Incomplete Pathway	
Chromium VI	3.86E+00	1.8E-07	3.78E-09	1.10E-12	Incomplete Pathway		Incomplete Pathway	
Cobalt	7.30E+00	3.5E-07	7.14E-09	2.08E-12	Incomplete Pathway		Incomplete Pathway	
Copper	2.90E+01	1.4E-06	2.84E-08	8.28E-12	Incomplete Pathway		Incomplete Pathway	
Lead	1.50E+03	7.2E-05	1.47E-06	4.28E-10	Incomplete Pathway		Incomplete Pathway	
Molybdenum	1.50E+00	7.2E-08	1.47E-09	4.28E-13	Incomplete Pathway		Incomplete Pathway	
Nickel	1.60E+02	7.7E-06	1.57E-07	4.57E-11	Incomplete Pathway		Incomplete Pathway	
Vanadium	2.30E+02	1.1E-05	2.25E-07	6.57E-11	Incomplete Pathway		Incomplete Pathway	
Zinc	1.10E+02	5.3E-06	1.08E-07	3.14E-11	Incomplete Pathway		Incomplete Pathway	
PAHs								
Benzo(a)pyrene	1.90E-02	9.1E-10	1.86E-11	5.42E-15	Incomplete Pathway		Incomplete Pathway	

C_{soil} = Maximum detected concentration in soil of Stockpiles #1, #2, and #3.
$C_{air} = C_{soil} * PA_{off}$ (see Table 13)
COPC = Chemicals of potential concern
PAH = Polycyclic Aromatic Hydrocarbons
mg/kg = milligrams per kilogram
mg/m^3 = milligrams per cubic meter
mg/kg-day = millograms per kilogram day
ft bgs = feet below ground surface
SP = Stock pile

Table 27
Future Off-Site Resident Risk and Hazard Estimates
for Exposure to Construction Zone Soil (0 to 20 ft bgs) from SP#1, SP#2, and SP#3
Caltrans TO 23, Modesto, California

Estimated Noncarcinogenic Hazard

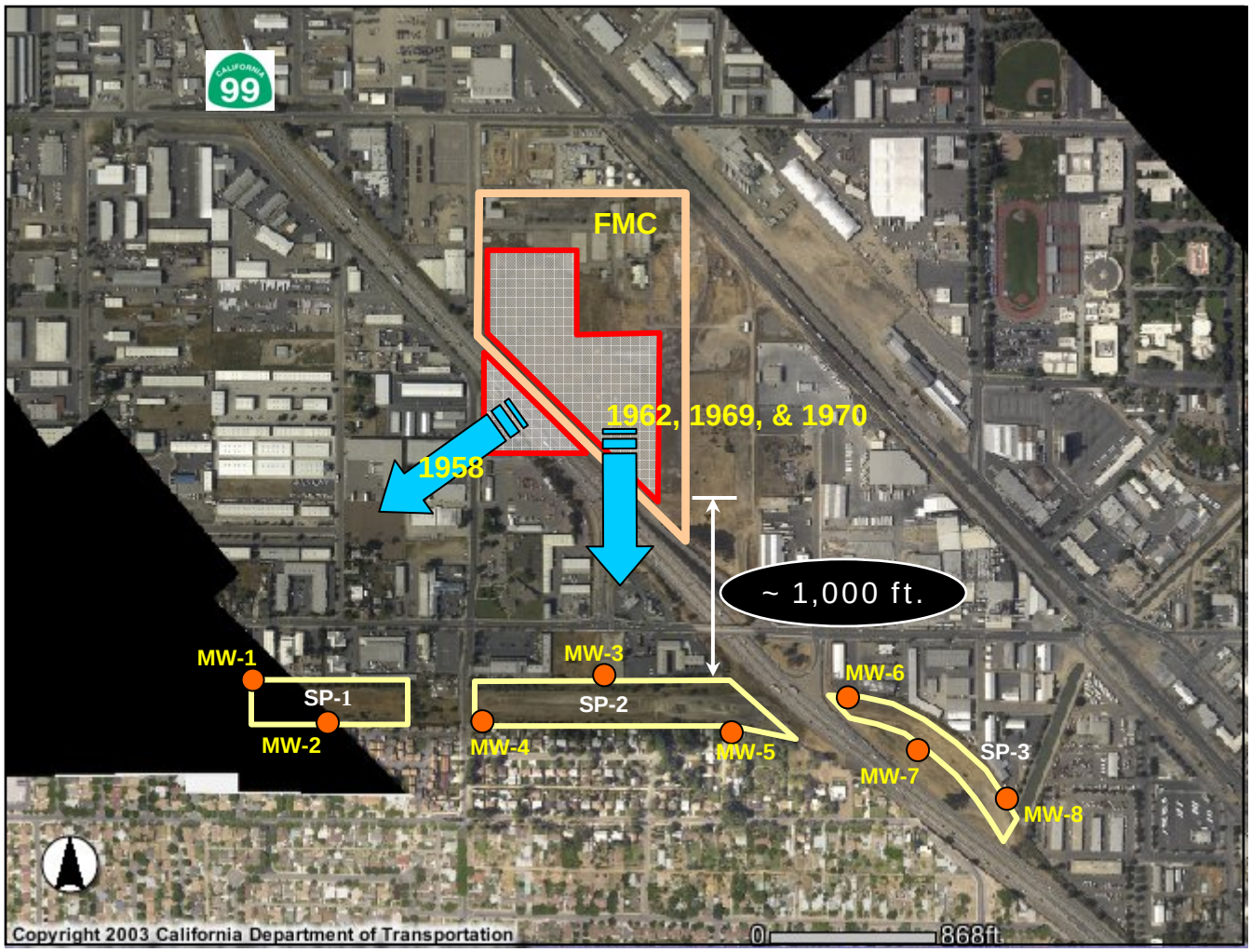
	Inhalation		
COPC	Dose (mg/kg-day)	RfD (mg/kg-day)	Hazard Quotient
Metals			
Arsenic	5.4E-09	8.57E-06	6.28E-04
Barium	7.0E-05	2.00E-02	3.52E-03
Chromium III	2.3E-08	NA	NA
Chromium VI	3.8E-09	5.71E-05	6.61E-05
Cobalt	7.1E-09	5.70E-06	1.25E-03
Copper	2.8E-08	NA	NA
Lead	1.5E-06	NA	NA
Molybdenum	1.5E-09	NA	NA
Nickel	1.6E-07	1.40E-05	1.12E-02
Vanadium	2.3E-07	NA	NA
Zinc	1.1E-07	NA	NA
PAHs			
Benzo(a)pyrene	1.9E-11	NA	NA
Hazard Index			**0.017**

Estimated Carcinogenic Risk

	Inhalation		
COPC	Dose (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ELCR
Metals			
Arsenic	1.6E-12	12	1.9E-11
Barium	2.1E-08	NA	NA
Chromium III	6.6E-12	NA	NA
Chromium VI	1.1E-12	510	5.6E-10
Cobalt	2.1E-12	10	2.0E-11
Copper	8.3E-12	NA	NA
Lead	4.3E-10	NA	NA
Molybdenum	4.3E-13	NA	NA
Nickel	4.6E-11	0.910	4.2E-11
Vanadium	6.6E-11	NA	NA
Zinc	3.1E-11	NA	NA
PAHs			
Benzo(a)pyrene	5.4E-15	3.90	2.1E-14
Total Risk			**6.E-10**

COPC = Chemicals of potential concern
CSF = Cancer Slope Factor
ELCR = Excess Lifetime Cancer Risk
PAH = Polycyclic Aromatic Hydrocarbons
RfD = Reference Dose
NA = Not available or Not applicable
mg/kg-day = millograms per kilogram day
SP = Stock pile
ft bgs = feet below ground surface

1958 - 1970
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California



Current FMC Boundary – Former Disposal Ponds in Red

1958

Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

SP-1

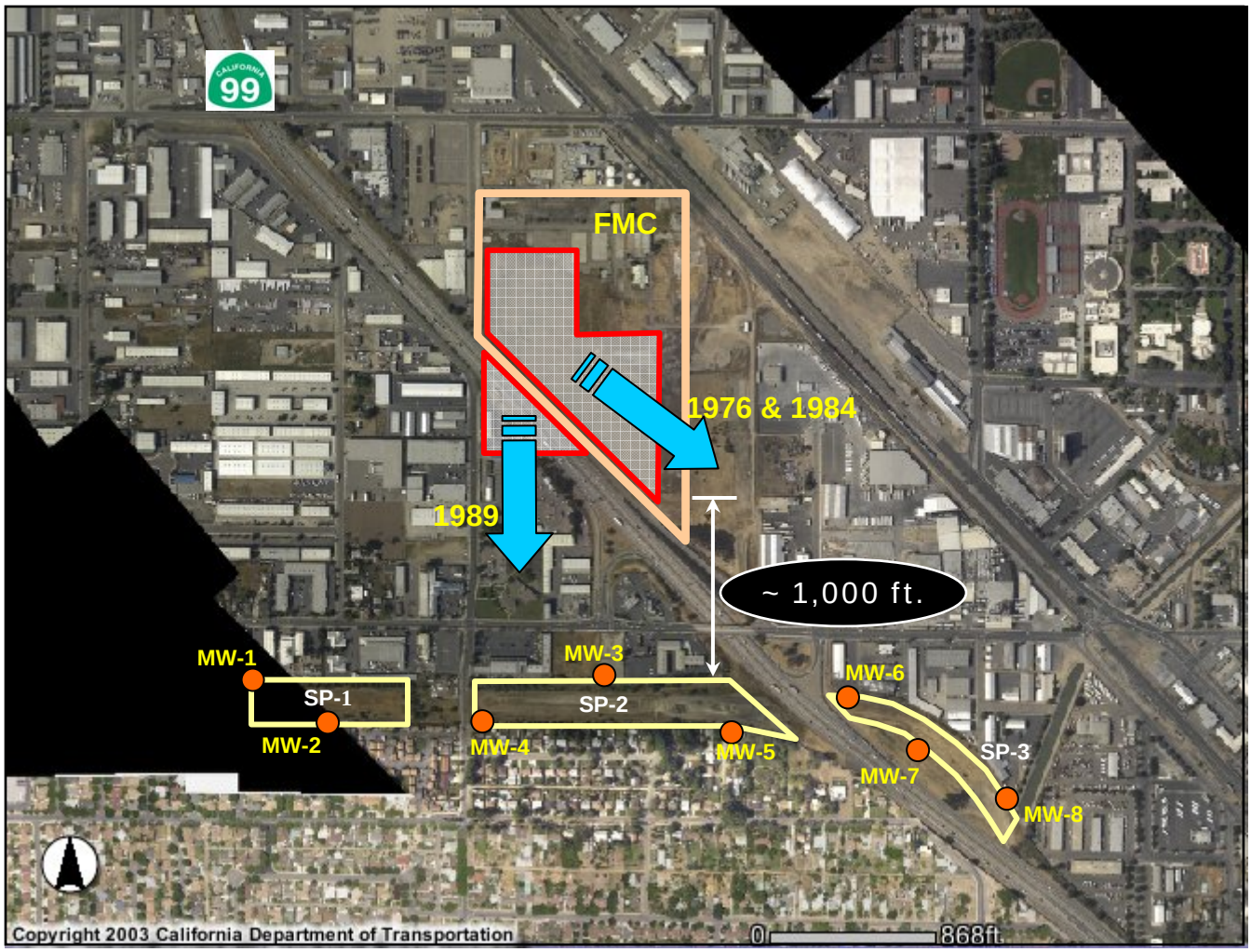
Caltrans Soil Stockpile Location and Designation

MW-1

Caltrans Groundwater Monitoring Well Location and Designation

Caltrans

1976 - 1989
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California



Current FMC Boundary – Former Disposal Ponds in Red

1976

Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

SP-1

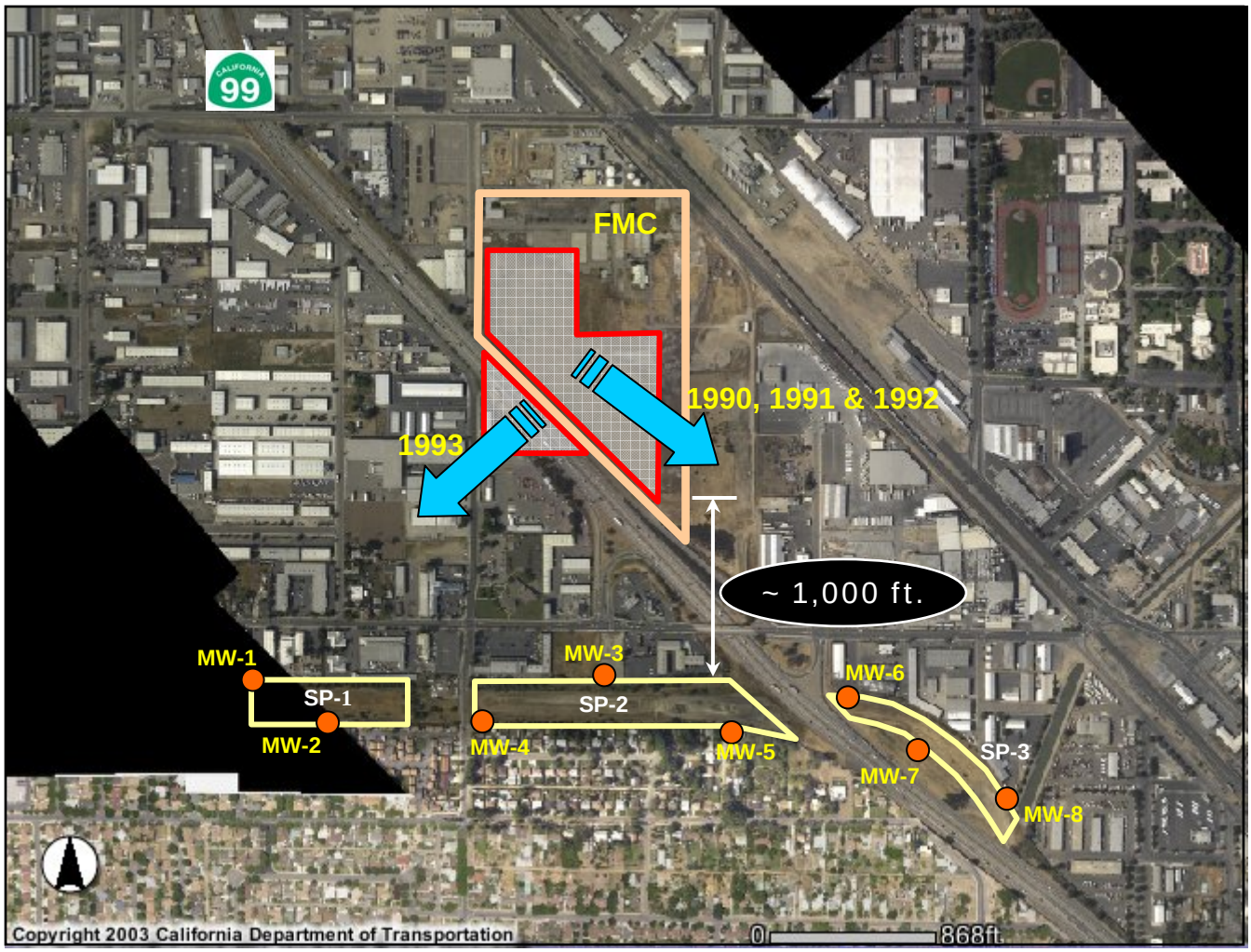
Caltrans Soil Stockpile Location and Designation

MW-1

Caltrans Groundwater Monitoring Well Location and Designation

Caltrans

1990 - 1993
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California



Current FMC Boundary – Former Disposal Ponds in Red

1990

Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

SP-1

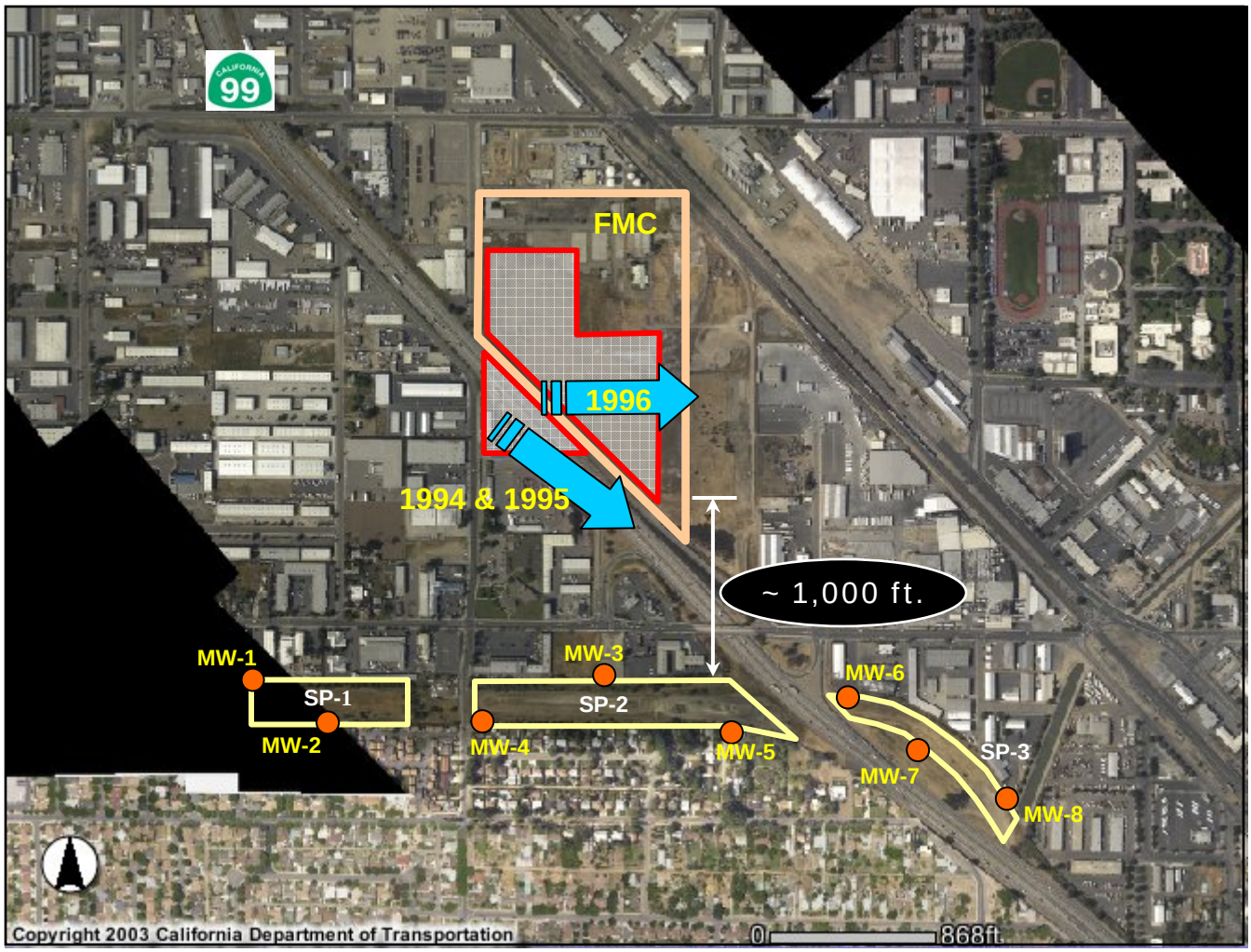
Caltrans Soil Stockpile Location and Designation

MW-1

Caltrans Groundwater Monitoring Well Location and Designation

Caltrans

1994 - 1996
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California



Current FMC Boundary – Former Disposal Ponds in Red

1994

Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

SP-1

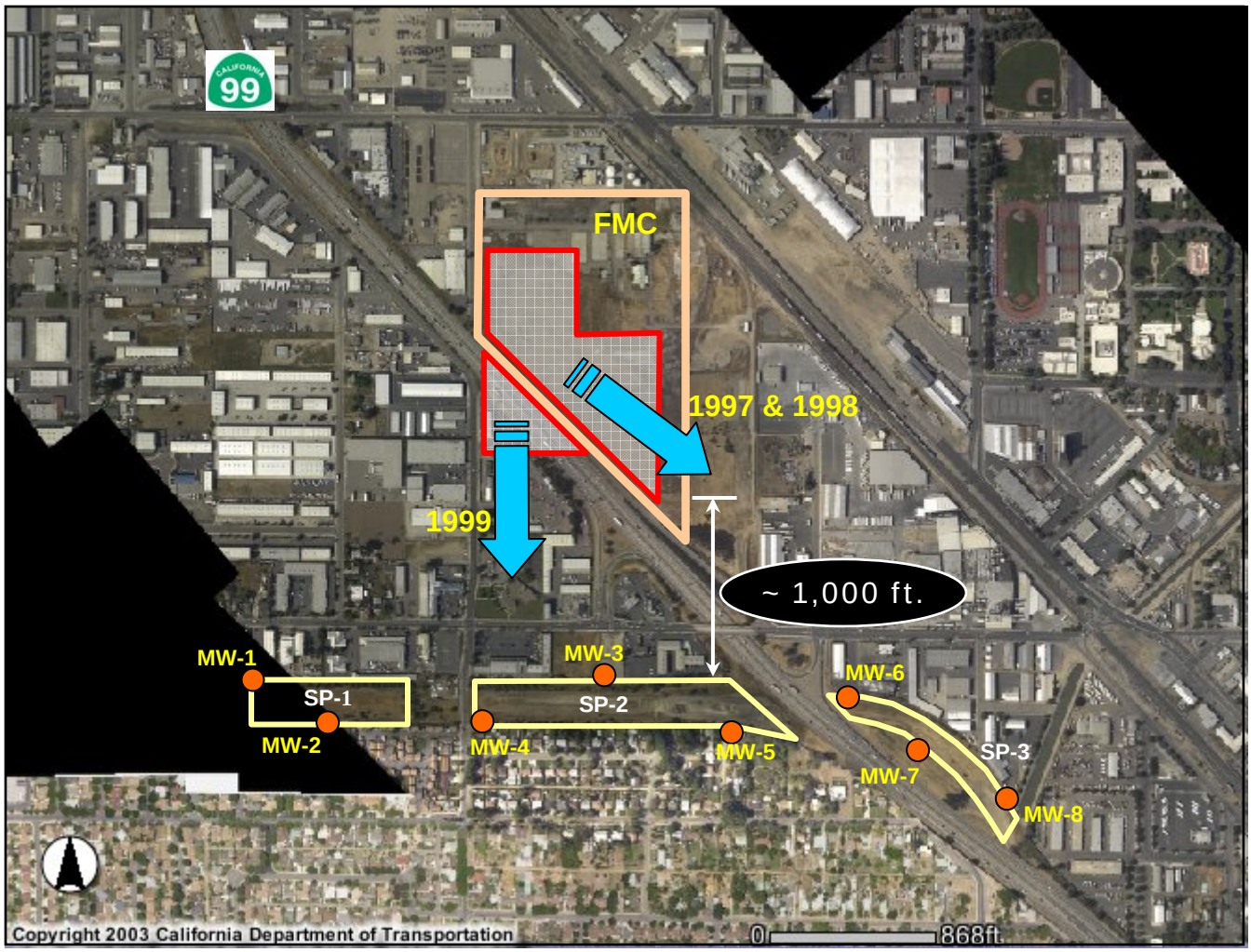
Caltrans Soil Stockpile Location and Designation

MW-1

Caltrans Groundwater Monitoring Well Location and Designation

Caltrans

1997 - 1999
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California



Current FMC Boundary – Former Disposal Ponds in Red

1997

Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

SP-1

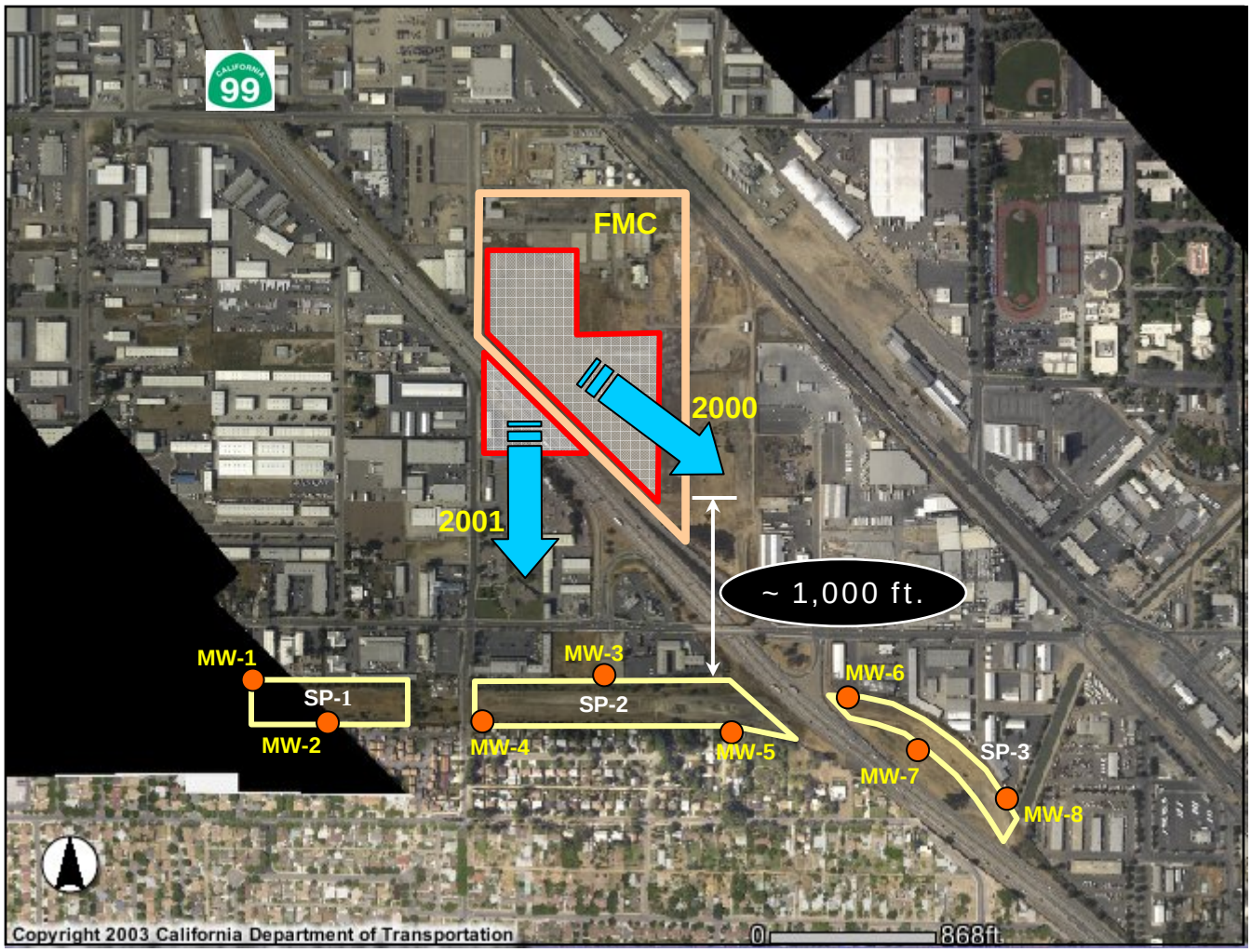
Caltrans Soil Stockpile Location and Designation

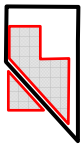
MW-1

Caltrans Groundwater Monitoring Well Location and Designation

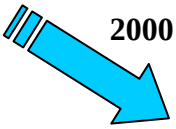
Caltrans

2000 - 2001
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California





Current FMC Boundary – Former Disposal Ponds in Red



Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

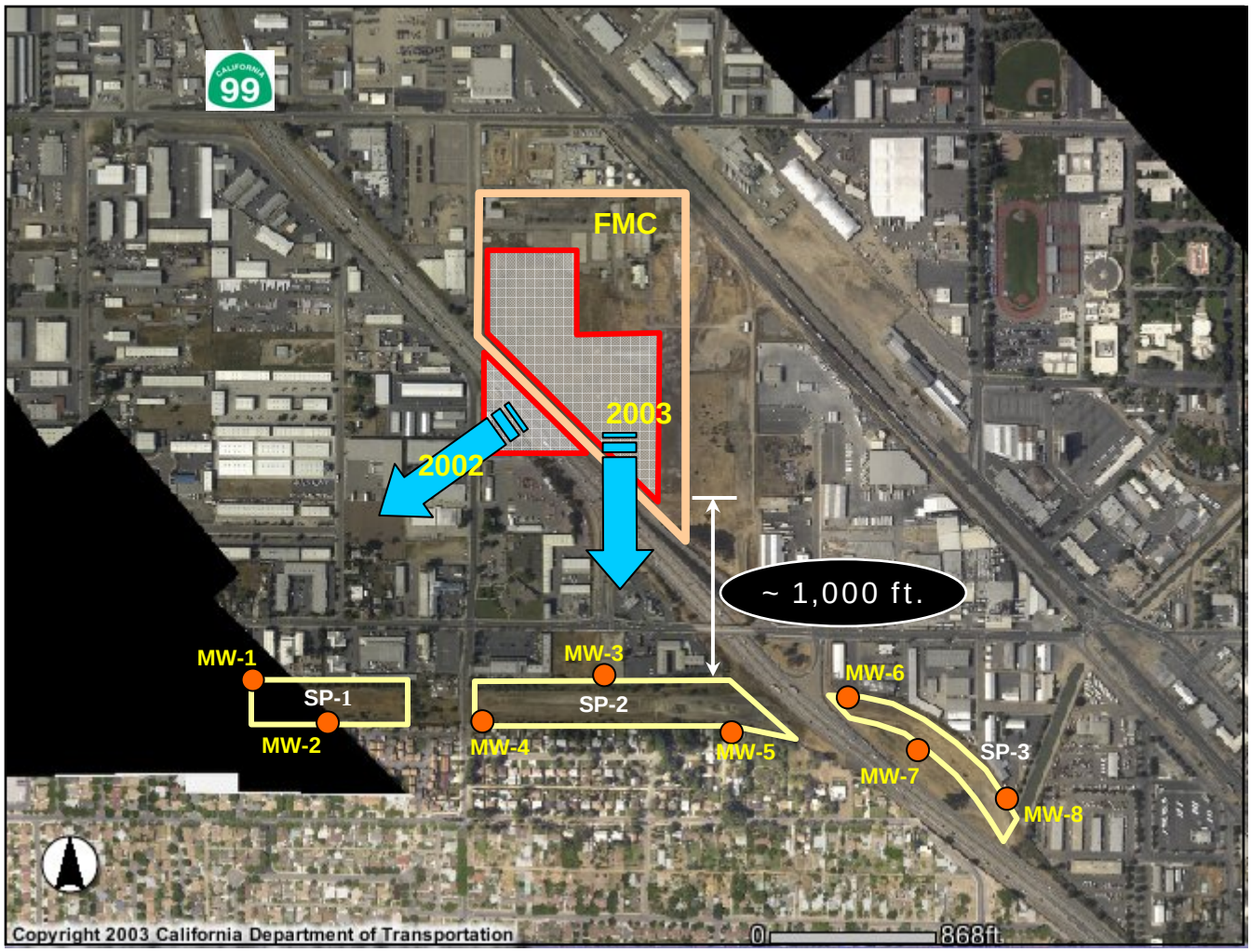
SP-1

Caltrans Soil Stockpile Location and Designation

MW-1

Caltrans Groundwater Monitoring Well Location and Designation

2002 - 2003
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California



Current FMC Boundary – Former Disposal Ponds in Red

2002

Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

SP-1

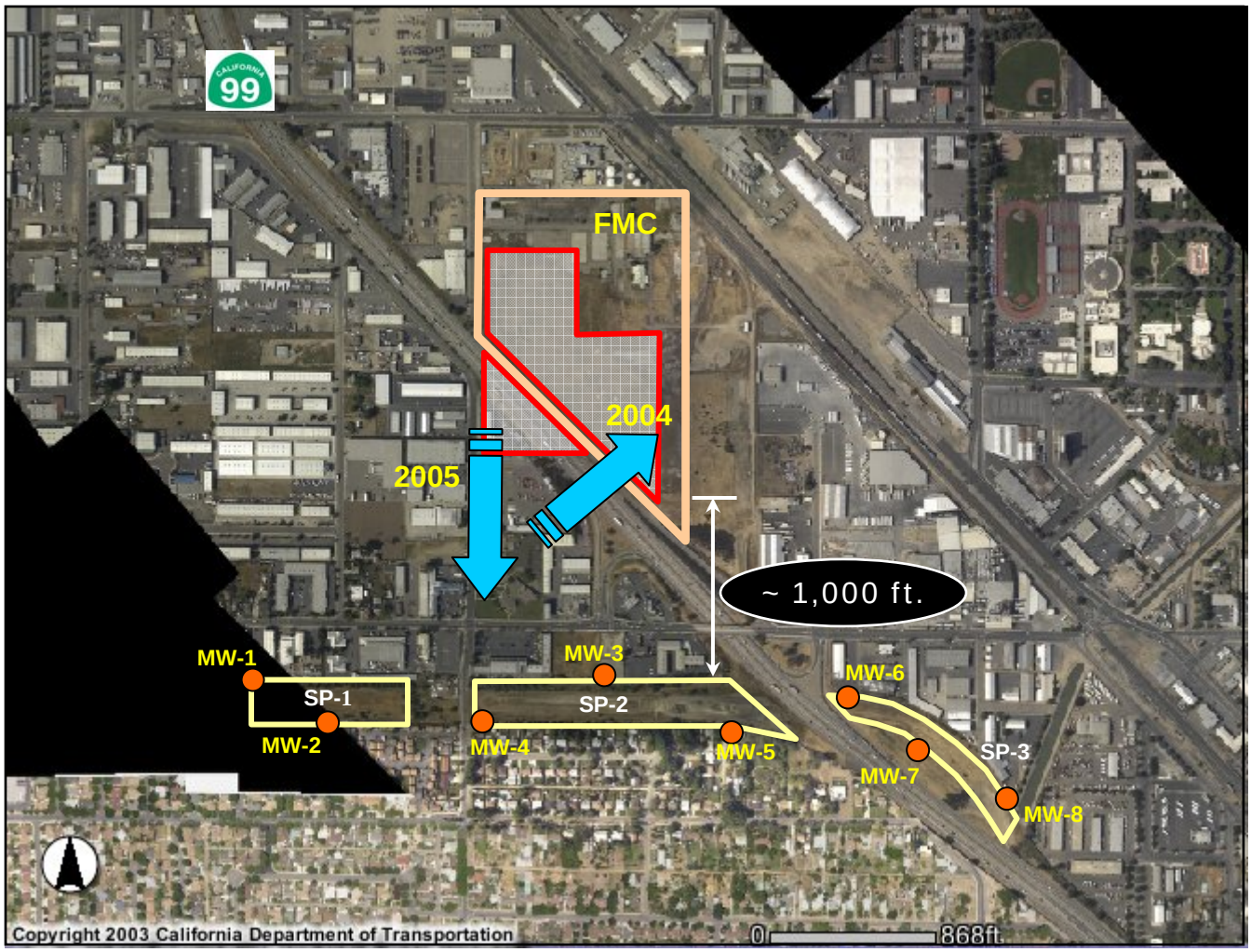
Caltrans Soil Stockpile Location and Designation

MW-1

Caltrans Groundwater Monitoring Well Location and Designation

Caltrans

2004 - 2005
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California



Current FMC Boundary – Former Disposal Ponds in Red

2004

Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

SP-1

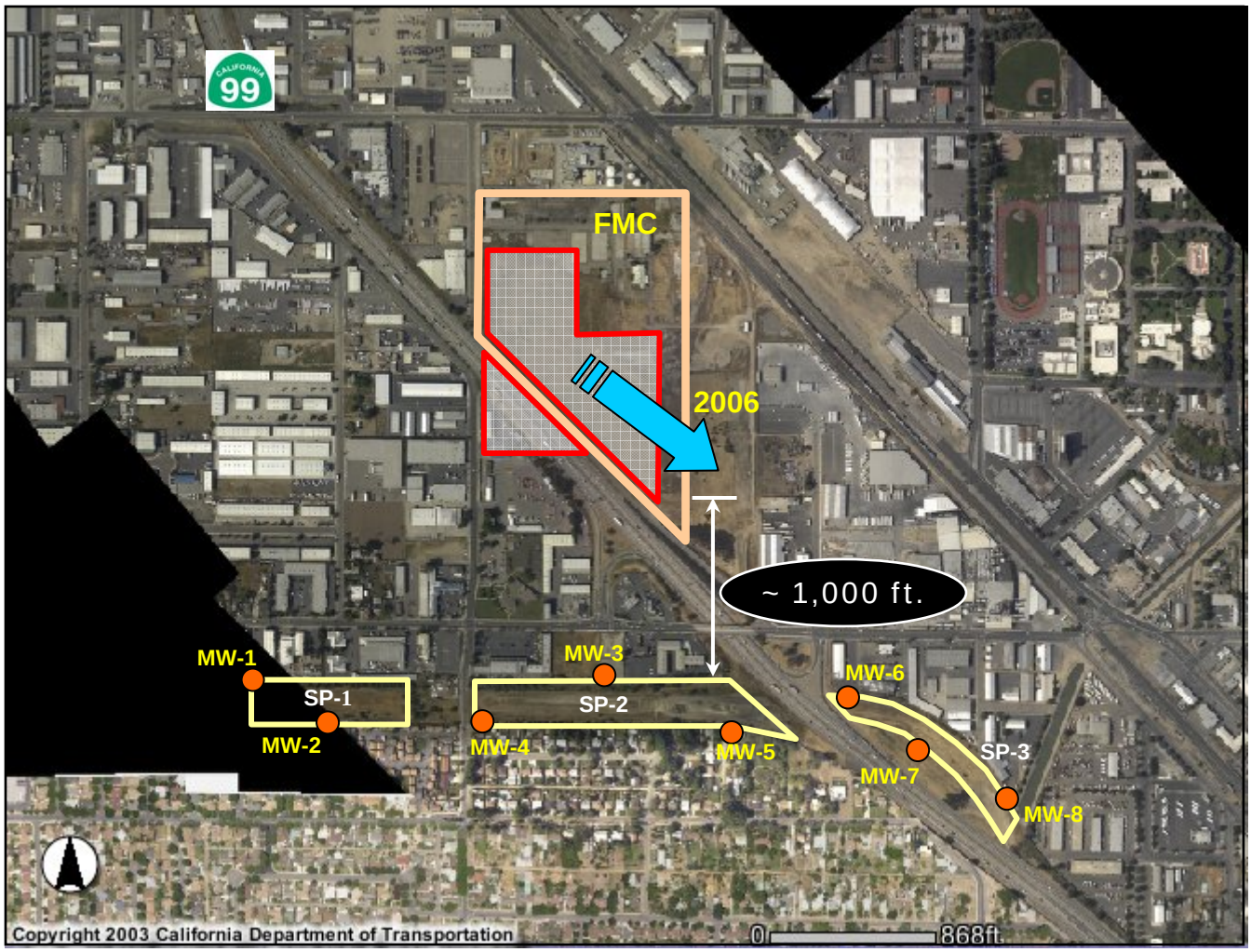
Caltrans Soil Stockpile Location and Designation

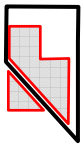
MW-1

Caltrans Groundwater Monitoring Well Location and Designation

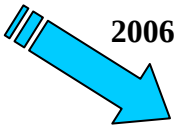
Caltrans

2006
Shallow Groundwater Flow Direction
Caltrans Modesto Soil Stockpiles
Modesto, California





Current FMC Boundary – Former Disposal Ponds in Red



Springtime Ground Flow Direction - *Modesto Groundwater Basin, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer, Department of Water Resources*
http://www.sjd.water.ca.gov/groundwater/basin_maps/

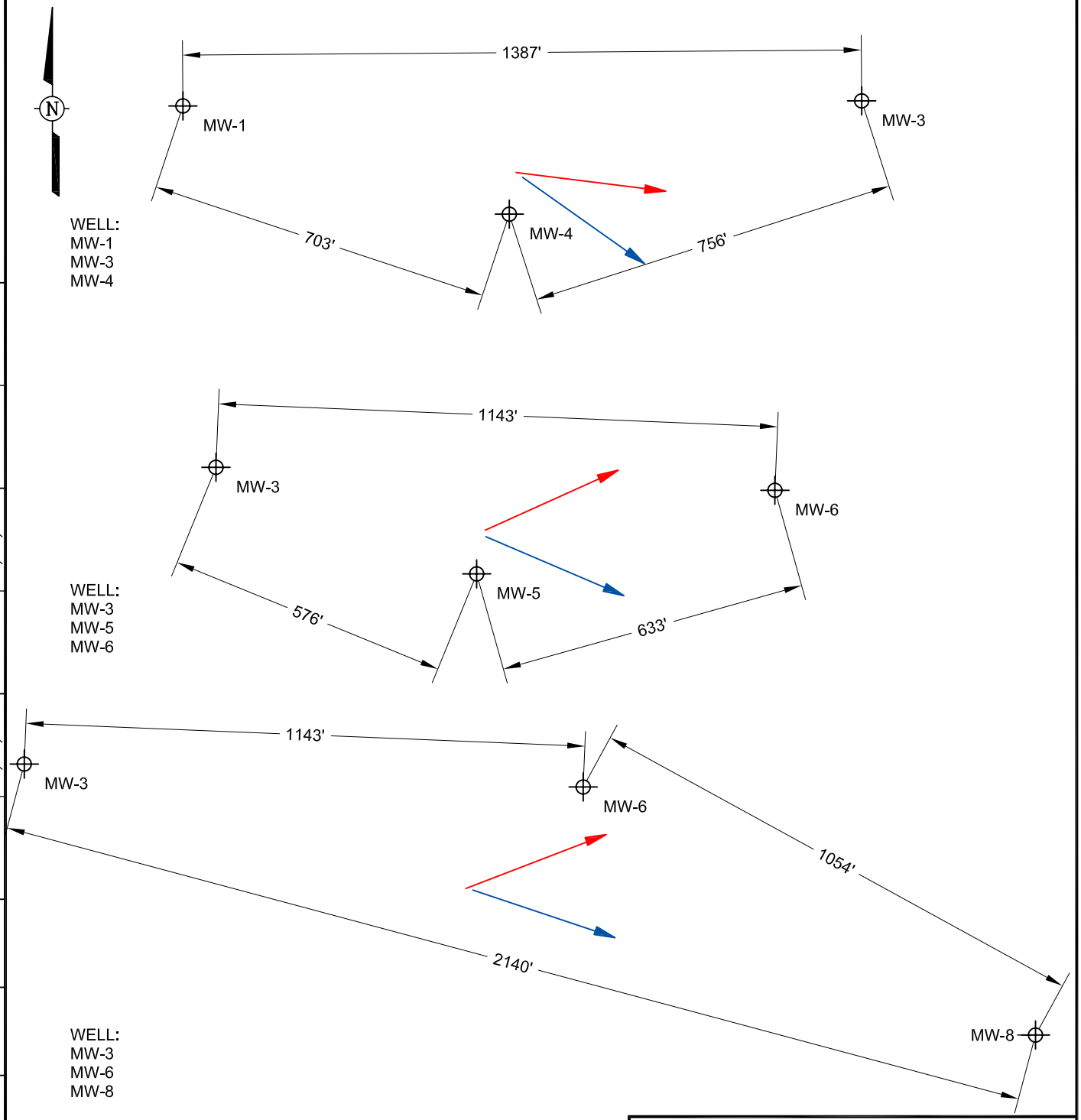
SP-1

Caltrans Soil Stockpile Location and Designation

MW-1

Caltrans Groundwater Monitoring Well Location and Designation

Caltrans



LEGEND

MONITORING WELL

108°/N62E FLOW AZIMUTH AND QUADRANT

FLOW DIRECTION JUNE 2006

FLOW DIRECTION OCTOBER 2006

SCALE

0 300 600 FEET

Shaw® Shaw Environmental, Inc.

CALIFORNIA DEPARTMENT OF TRANSPORTATION
STATE ROUTE 99/132 PROJECT
MODESTO, CALIFORNIA
TASK ORDER 35

FIGURE

GROUNDWATER FLOW DIRECTIONS
THREE-POINT VECTORS
JUNE AND OCTOBER 2006

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY	DRAWING NUMBER
---	---	Concord	SCHAEFFER	6/30/09	T. AULT	6/30/09		128232-A1