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STATEMENT OF BASIS

Proposed Remedy Selection for Soil, Soil Gas, and Groundwater

at

CENTRAL PLANT AREA
FMC Corporation
1125 Coleman Avenue
San Jose, Santa Clara County, California

Prepared by

Standardized Permiting and Corrective Action Branch

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February 2006

TABLE OF CONTENTS

1.0 INTRODUCTION

The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) has prepared this Statement of Basis in support of its proposed decision on Corrective Action Remedy Selection for soil, soil gas, and groundwater at the Central Plant Area of the FMC Corporation (FMC) Facility, located at 1125 Coleman Avenue, San Jose, Santa Clara County, California. DTSC has reviewed the Corrective Measures Study (CMS) Report dated September 22, 2005 for the Central Plant Area and is proposing to approve the remediation measures in that report.

In addition to this Statement of Basis, DTSC has prepared the following documents as a part of the public review process to seek public comments on these documents prior to making a final decision to approve the selected remediation measures.

- Fact Sheet that summarizes the proposed remedy selection and provides a notice of public comment period.
- Land Use Covenant Implementation and Enforcement Plan that imposes land use restrictions on the site.
- Initial Study /Negative Declaration that is an environmental analysis under the California Environmental Quality Act (CEQA).

After the proposed approval by DTSC, FMC would be authorized to implement these remediation measures for soil, soil gas, and groundwater contamination associated with historical chemical releases. A Notice of Determination (NOD) on the CEQA environmental analysis will be filed with the State Clearinghouse after a final decision is made on the selected remediation measures.

The corrective action process conducted at the Central Plant Area addressed releases of hazardous waste and hazardous constituents at this facility. The Corrective Action Consent Agreement ("Consent Agreement") among FMC, United Defense, L.P., and DTSC, effective January 2, 1996, defined the steps and corresponding scope of work for RCRA corrective action with respect to the 146.69 acre manufacturing facility owned and/or operated, or formerly owned and/or operated, by FMC near the San Jose International Airport. This facility includes the approximately 25 acre Central Plant Area. Prior to the Consent Agreement becoming effective in

January 1996, RCRA corrective action was performed through the requirements of various permits.

The corrective action process for the Central Plant Area included a RCRA Facility Assessment (RFA) to identify possible releases of hazardous waste or constituents requiring further investigation; a RCRA Facility Investigation (RFI) to evaluate the nature and extent of the releases; and a CMS to identify, develop and implement appropriate corrective measures to protect human health and the environment. This Statement of Basis summarizes the key information derived from the RFA, RFI, and CMS, focusing primarily on the CMS Report.

FMC submitted the CMS Report to DTSC on September 22, 2005. This report evaluated remediation alternatives and recommended specific measures to address the presence of hazardous constituents in soil, soil gas, and groundwater. This evaluation of remediation alternatives considered the following criteria: (1) short- and long-term effectiveness; (2) reduction of toxicity, mobility, and volume of hazardous constituents; (3) long-term reliability; (4) implementability; and (5) cost. DTSC has evaluated the CMS Report, approved the report as technically complete by letter dated December 20, 2005, and thus proposes to approve the selected remediation measures.

The remediation proposed for groundwater contamination consists of the continued extraction of groundwater from existing wells at the northern property boundary. The extracted groundwater would continue to be treated in an existing activated carbon treatment system to remove volatile organic compounds (VOCs). Treated groundwater would be discharged to a storm drain under a National Pollutant Discharge Elimination System (NPDES) permit issued by the San Francisco Bay Regional Water Quality Control Board (RWQCB).

Contaminated soils with chemicals above levels approved by DTSC have already been removed from the site during interim measures, thus no further remediation of soils is required. These removed soils were replaced with clean imported soils. FMC will prepare a soil management plan that would be implemented whenever there are future soil excavations.

In addition, DTSC and FMC would enter into a Land Use Covenant that would prohibit the use of groundwater for drinking or irrigation purposes; limit land use to commercial and/or industrial activities; require specific sub-areas of the site (approximately 5.5 acres out of the total approximate 25 acre Central Plant Area) to include vapor intrusion mitigation measures for any future buildings; and prohibit the construction of residences, schools, hospitals, or day-care centers. Also, all soils currently at the site must be either covered by a continuous cover (e.g., asphalt or concrete) or be covered by at least six inches of clean loose materials (e.g., top soil or gravel). These land use restrictions are described in the Land Use Covenant Implementation and Enforcement Plan.

The CMS Report, Land Use Covenant Implementation and Enforcement Plan, and CEQA Initial Study/Negative Declaration are available for public review at the following location:

Dr. Martin Luther King Public Library
180 West San Carlos Street
San Jose, CA 95113

The full Administrative Record for this site is available for public review at the following location.

DTSC File Room
700 Heinz Avenue
Berkeley, CA 94710
(501) 540-3800

2.0 FACILITY BACKGROUND

2.1 FACILITY DESCRIPTION AND HISTORY

The approximately 25-acre Central Plant Area is rectangular in shape and is located in the City of San Jose, south of the San Francisco Bay and east of the San Jose/City of Santa Clara border. To the north of the Central Plant Area is Coleman Avenue, to the west is the former FMC Test Track Area, to the south is the Union Pacific Railroad property, and to the east is FMC's former Plant No. 7 owned by Arcadia. The Norman Y. Mineta San Jose International Airport is located across Coleman Avenue north of the Central Plant Area.

The Central Plant Area was part of the 146.69 acre 1125 Coleman Avenue property that was purchased from the City of San Jose in 1946. Prior to that time, the land was reportedly used for agricultural purposes. Most of FMC's operations at the Central Plant Area since 1951 were dedicated to the design, production, and testing of military tracked vehicles under United States Department of Defense contracts. Various types of vehicles with numerous uses were manufactured since about 1951. Production operations in the Central Plant Area were ceased in 1997.

Buildings or pavement cover most of the Central Plant Area. The buildings are called "Plants" and are numbered. They were used principally for the manufacturing of military tracked vehicles (e.g., tanks). The principal operations at the Central Plant Area included machining, degreasing, heat treatment, plating, surface cleaning and preparation, and painting for the manufacture and rehabilitation of military tracked vehicles. Raw aluminum and steel were used to fabricate parts. The machining required water- and oil-based coolants to cool the machine bits. These operations included the use of acid solutions (phosphoric and chromic), alkaline solutions, cyanide, metals, hydrocarbons (lubricating and cutting oil, mineral oil, and oil emulsions), paints, solvents (trichloroethylene [TCE], 1,1,1-trichloroethane [1,1,1-TCA], methylene chloride, methyl chloroform, toluene, xylene, and methanol), ethylene glycol, ethylene oxide, polyalkylene glycols, and polychlorinated biphenyls (PCBs). The Department of Defense required the use of certain materials, including solvents and paints, through military specifications. In addition, Diesel and gasoline fuel, along with motor oil, was stored and dispensed at the Central Plant Area for testing engines and road testing the vehicles.

Some waste streams and sludge were processed in a wastewater treatment plant at the Central Plant Area which was constructed in 1978 and began operation in 1979. The plant was primarily used for neutralizing acid and alkali waste, reducing hexavalent chromium, facilitating cyanide destruction, precipitating heavy metals, and removing solids from metal finishing and electroplating wastes before discharging process effluents to the City of San Jose Publicly Owned Treatment Works.

2.2 HYDROGEOLOGY

The upper 100 feet of the subsurface beneath the Central Plant Area comprises clays with sand and gravel channel deposits that are part of the Upper Aquifer Zone of the Santa Clara Valley Basin, as defined by the Santa Clara Valley Water District. Four geologic units are identified in order to describe the occurrence and movement of groundwater beneath the Central Plant Area and are listed below in order of increasing depth.

- The Water Table Zone (WTZ) [ground surface to approximately 18 feet below ground surface], composed of silty clays and clay, and saturated below 5 to 7 feet.
- Fluvial Sand Zone 1 (FS1) [approximately 18 to 33 feet below ground surface], composed of discrete sand channels bounded by silty clays.
- Fluvial Sand Zone 2a (FS2a) [approximately 33 to 45 feet below ground surface], composed of discrete sand channels bounded by silty clays.
- Fluvial Sand Zone 2b (FS2b) [approximately 45 to 70 feet below ground surface], a network of relatively thick sand channels bounded by silty clays.

Groundwater in the WTZ is generally encountered at depths of approximately 5 to 7 feet below ground surface. The fluvial sand zones beneath the WTZ (FS1, FS2a, and FS2b) are fully saturated, buried ancient stream channel deposits, much coarser-grained and more permeable than the WTZ materials. These channel deposits vary greatly in aerial extent and thickness.

Groundwater generally flows northward and northeastward. The depth to the groundwater fluctuates slightly seasonally. However, flow directions remain constant since the groundwater elevation fluctuations are approximately the same from well to well. No surface water bodies are located in the Central Plant Area.

3.0 RCRA FACILITY ASSESSMENT (RFA)

In June 1992, DTSC issued an RFA Report that identified solid waste management units (SWMUs) at the 146.69 acre facility including the Central Plant Area. The RFA and subsequent addenda identified units or locations where releases of hazardous waste or hazardous constituents to the environment may have occurred. These "units" were categorized at time of the Consent Agreement (1996) into four categories: (1) Solid Waste Management Units (SWMUs); (2) Other Units; (3) Units Undergoing RCRA Closure; and (4) Units Requiring No Further Action (NFA).

The original 1992 unit list was revised and updated by DTSC and FMC. Sixty-three (63) units in categories (1) and (2) were designated in the Central Plant Area. The August 2003 RFI Report summarizes the units by number, type and location, and provides a description and history of each.

4.0 RCRA FACILITY INVESTIGATION (RFI)

The RFA provided the basis for the subsequent RFI performed for the Central Plant Area. The RFI was performed by FMC in accordance with the scope of work presented in Attachment 3 of the Consent Agreement. The RFI defined the potential sources, nature, and extent of subsurface contamination and included the following: a Current Conditions Report (1996); six phases of soil and groundwater sampling (1997-2003); and a soil gas survey and vapor intrusion assessment (2004-2005). In addition, FMC performed several interim corrective measures (1998-2002). FMC submitted an RFI Report in August 2003, and based on DTSC's comments, FMC submitted an RFI Report Addendum in August 2004. DTSC approved the RFI for the Central Plant Area in a letter dated July 29, 2005.

The Current Conditions Report provided available information and data collected through February 1996 for the property at 1125 Coleman Avenue including the Central Plant Area, and two other FMC properties (328 and 333 West Brokaw Road). This report summarized the then-current and historical information with respect to operations, processes, waste management, geology and hydrogeology, subsurface investigations, constituents of concern, potential receptor populations, corrective measures implemented, and closure activities.

The results of the RFA and Current Conditions Report, along with provisions contained in the Consent Agreement, were used to guide the RFI for the Central Plant Area. Thousands of environmental samples (soil, groundwater, and soil gas) were collected at the Central Plant Area during the RFI. The initial work performed for Central Plant Area RFI was completed in accordance with a Phase I RFI Work Plan (February 1997), approved by DTSC in June 1997. A Phase II RFI work scope was submitted to DTSC in June 1997, a Phase II RFI Work Plan was submitted to DTSC in March 1998, and a Phase III RFI Work Plan was submitted to DTSC in December 1998. In lieu of Work Plans for Phases IV, V and VI of the RFI, work progress was reported to DTSC on a quarterly basis in progress reports initiated in 1996 under the Consent Agreement and in technical meetings with DTSC. During the performance of the RFI, DTSC and FMC representatives met regularly to review results and plans for additional work.

Risk-Based Target Levels (RBTLs) were developed during the RFI as a decision-making tool for characterization and remediation assessments. The RBTLs serve as screening concentrations to evaluate whether a release that might have occurred from a unit may pose a potentially unacceptable health risk to human receptors. Construction/excavation workers during and following property redevelopment were identified as the appropriate human receptors. The RBTLs are concentrations of constituents in soil and groundwater that represent a specific level of potential risk and/or hazard to a receptor posed by a single constituent through the cumulative effects of inhalation, ingestion, and dermal contact of soil, or inhalation of vapors from and dermal contact with groundwater. The RBTLs were then used to determine the extent of investigation needed at each unit, and were used to determine the extent of remediation of soil and groundwater necessary at some units as part of interim corrective measures conducted during the RFI. Groundwater investigations were also performed for characterization of groundwater conditions across the Central Plant Area independent of unit-specific investigations, and computer modeling was conducted to simulate groundwater flow and transport of contaminants in groundwater.

Two phases of off-site investigation north of the Central Plant Area were conducted on City of San Jose property. The first phase was conducted in April 2001 and reported to DTSC in May 2002. The second phase of work was requested by DTSC in comments on the August 2003 RFI Report, was conducted in July 2004, and results were reported in the Central Plant Area RFI Report Addendum of August 2004.

The soil gas survey was conducted over the entire Central Plant Area to assess the potential for subsurface vapor intrusion into buildings that could be constructed in the future, and corresponding potential health risks and hazards that could exist from exposure to air in such buildings. Results of the assessment were used to define areas of the Central Plant Area where future buildings would have certain requirements to address the potential health risks and hazards. A Soil Gas Investigation and Vapor Intrusion Assessment Report was submitted to DTSC in January 2005, and based on DTSC comments, a Technical Memorandum presenting additional analysis for the vapor intrusion assessment was submitted to DTSC in July 2005.

On July 29, 2005, DTSC approved the RFI and requested the CMS Report to be submitted. The letter approved the RFI Report dated August 2003 (5 volumes), the RFI Report Addendum dated

August 2004, the Soil Gas Investigation and Vapor Intrusion Assessment Report dated January 2005, and the Technical Memorandum-Additional Analysis for the January 2005 Vapor Intrusion Assessment dated July 14, 2005.

5.0 RISK ASSESSMENTS

Human and environmental receptors of potential impacts from contaminants in the environment at the Central Plant Area were identified, and the pathways of exposure from contaminants to receptors were defined, to develop an assessment of the potential risks and hazards to human health and the environment. The pathways considered potentially complete were evaluated further for a quantitative and cumulative assessment of risks and hazards. Other pathways considered incomplete were removed from further analysis. The corrective measures alternatives (developed later) address the potentially complete pathways.

Based on continued commercial/industrial operations at the Central Plant Area property, and a pathway-receptor conceptual site model, potentially complete pathways from contamination in soil, groundwater, and soil gas exist to two receptors: (1) future construction/excavation workers, and (2) future indoor office workers. Future construction/excavation workers may become exposed to residual concentrations in soil through inhalation, ingestion, and/or dermal contact created by mechanical disturbance of impacted soil (e.g., excavation for construction or other purposes). These workers also may become exposed to impacted groundwater through inhalation of vapors from and/or dermal contact with impacted groundwater created by excavation activities.

Future indoor office workers may become exposed to indoor air quality affected by the presence of volatile organic compounds (VOCs) due to the subsurface vapor intrusion pathway from impacted groundwater. The pathway for this potential exposure would be inhalation of vapors indoors created by the upward migration of those vapors from the subsurface (i.e., soil gas) that are present due to the volatilization of VOCs dissolved in groundwater.

A cumulative risk and cumulative hazard to future construction/excavation workers for the Central Plant Area as a whole was estimated by comparing the RBTLs to estimates of exposure point concentrations. The estimated risks and hazards are shown on Table 1.

Table 1

Summary of Cumulative Cancer Risks and Hazards in Soil and Groundwater to Future Construction / Excavation Workers, Central Plant Area

Medium	Cumulative Incremental Cancer Risk	Cumulative Hazard from Non-Carcinogens (Hazard Index)
Soil	2.80×10^{-7}	0.6450
Groundwater	5.60×10^{-7}	0.0386
TOTALS	$\mathbf{8.40 \times 10^{-7}}$	**0.6836**

These risks and hazards are independent of and not cumulative with those estimated to the future indoor office worker receptor. Cumulative risks and hazards for the future indoor office worker receptor were estimated by implementing a vapor intrusion assessment. The evaluation was performed within the context of a future commercial or industrial land use scenario and considering the presence of future 10,000 square-foot buildings. A cumulative risk and hazard was calculated for each quarter-acre portion of the Central Plant Area. Predicted cumulative cancer risks are less than 1×10^{-4} in every quarter-acre, less than 1×10^{-5} in all but 2 quarter-acres, and less than 1×10^{-6} in all but 8 quarter-acres. The estimated cumulative hazard index is less than 1.0 in all but one quarter-acre.

Ecological resources of concern specific to the Central Plant Area were identified and evaluated. This assessment included the identification of potential ecological receptors, specifically special status plants and special status animals, in conjunction with the preparation of an Environmental Impact Report conducted for the 1125 Coleman Avenue Facility in 2002. Special status plant and animal species include Federal and California listed threatened and endangered species, Federal and State proposed or candidate threatened or endangered species, California fully protected species, and species that may be considered endangered or rare under the California Environmental Quality Act. No special status plants or potentially suitable habitat for these species have been observed in the Central Plant Area. No suitable habitat exists to support resident or breeding populations of special status animals.

6.0 INTERIM CORRECTIVE ACTION MEASURES

Four types of interim measures were implemented between October 1998 and July 2002 for soil and groundwater in the Central Plant Area during the course of the RFI, and were performed consistent with Attachment 5 of the Consent Agreement. These measures were implemented to control and/or eliminate releases of hazardous waste and/or hazardous constituents prior to the implementation of a final corrective measure. Some of the measures, particularly excavations, removed impacted soil where concentrations of individual constituents were above RBTLs. Experience with the interim measures also assisted in the selection and development of appropriate alternatives for final corrective measures.

The interim measures that were implemented are listed below.

- ***In-Situ Chemical Oxidation (ISCO) —*** to destroy diesel fuel hydrocarbons and halogenated VOCs in soil and shallow groundwater by oxidation through the injection of hydrogen peroxide.
- ***Soil Excavation —*** to remove the shallow, less mobile contaminants from locations where future construction activities may take place and could potentially expose construction/excavation workers to metals or petroleum hydrocarbons.
- ***Dual Phase Extraction (DPE) —*** to reduce concentrations of VOCs, specifically TCE, at and near the water table in soil and groundwater for protection of construction/excavation workers; and to reduce concentrations of VOCs in order to minimize or eliminate further impacts to groundwater that can migrate to and beyond the downgradient property boundary.
- ***Hydraulic Groundwater Plume Containment (Extraction and Treatment) —*** to control, minimize, or eliminate potential migration of halogenated VOCs in groundwater, primarily TCE, at concentrations above State of California drinking water standards (i.e., Maximum Contaminant Levels [MCLs]) to off-site areas north of the Central Plant Area.

The groundwater extraction system quickly attained plume containment and continues to successfully meet this objective. The soil excavations reduced the concentrations of constituents of concern to below risk-based levels (i.e., below soil RBTLs). The DPE system that was implemented for VOC removal was an appropriate technology for interim measures based on the selection process, and was able to accomplish removal of approximately 400 pounds of VOCs in some areas. The in situ chemical oxidation (via hydrogen peroxide) pilot study that was implemented was applicable for VOCs but was not carried forward to full-scale implementation.

7.0 CMS REPORT

The purpose of the CMS is to (1) develop and evaluate corrective measure alternatives that could be applicable at the Central Plant Area to address releases of hazardous wastes (including hazardous constituents) in the environment; and (2) recommend the final corrective measures to be taken at the Central Plant Area that are protective of human health and the environment. The CMS Report submitted to DTSC on September 22, 2005 describes the development and evaluation of corrective measure alternatives and recommends final corrective actions at the Central Plant Area. Based on review of the CMS Report and FMC's December 1, 2005 response to DTSC's comments on the CMS Report (Response), DTSC has determined that the CMS Report and the Response are technically complete.

Recommended final corrective measures are based on the identification and screening of potentially applicable corrective measures technologies, and the subsequent development, evaluation, and selection of corrective measures alternatives. This is a progression of analysis and understanding of conditions at the Central Plant Area. The progressive steps leading to the selection of corrective action objectives are as follows.

Site Conditions → **Pathway-Receptor Analysis** → **Risk and Hazard Quantification** → **Corrective Action Objectives**

The conditions at the Central Plant Area ("site conditions"), including the results of the RFI and the interim corrective measures, were used as the basis for the pathway-receptor analysis that is the foundation for the quantification of risks and hazards to potential human receptors. The corrective action objectives are based in part on the quantified risks and hazards, and deriving those objectives was the final step before the development and evaluation of corrective measure alternatives. An assessment of the technical practicability of achieving those objectives was performed as part of the screening and evaluation of the technologies and corrective measure alternatives.

After the corrective action objectives were defined, the process leading to the recommendation of final corrective measures for the Central Plant Area was implemented as follows.

Identification of Potentially Applicable Technologies → **Screening of Technologies** → **Identification of Corrective Measures Alternatives** → **Evaluation of Alternatives and Recommended Alternative**

Based on the corrective action objectives, technologies were identified as candidates for corrective action. These technology options were then screened to eliminate some options from further consideration and retain others for further evaluation based on site-specific conditions. The initial screening step was performed based on professional experience given the contamination and hydrogeology at the Central Plant Area. The retained options considered potentially feasible were then further evaluated using more specific criteria: general effectiveness; general implementability; and relative cost. This evaluation screened out technology options that would likely prove to be the most infeasible given the conceptual model of the Central Plant Area and the corrective action objectives. The remaining technology options were then carried forward to identify corrective measure alternatives to be further evaluated.

The potentially applicable technologies remaining after screening were used to develop corrective measure alternatives, which are assemblies of one or more of the candidate technologies. Six corrective measure alternatives were identified and then evaluated against established criteria—the Five Corrective Measures Criteria given in Attachment 6, Part B of the Consent Agreement: (1) short- and long-term effectiveness; (2) reduction of toxicity, mobility and/or volume; (3) long-term reliability; (4) implementability; and (5) preliminary cost. Additional evaluation used the Four Corrective Action Standards: (1) protect human health and the environment; (2) attain corrective action objectives, including media cleanup standards; (3) control the source(s) of releases so as to reduce or eliminate, to the extent practicable, further releases of hazardous wastes (including hazardous constituents) that may pose a threat to human health and the environment; and (4) comply with any applicable Federal, state, and local standards for management of wastes.

The following sections present details of the development of corrective action objectives, technology screening, and alternatives identification, evaluation, and recommendation.

7.1 CORRECTIVE ACTION OBJECTIVES AND MEDIA CLEANUP STANDARDS

The corrective action objectives derived for the CMS Report were developed within two categories: (1) those that are based on potential risks to human health specific to conditions at the Central Plant Area; and (2) those that are based on regulatory policy. The corrective action objectives are as follows.

Human Health Risk Based Corrective Action Objectives

- Attain the DTSC cancer risk target level of less than 10^{-6} and the target hazard index of less than 1.0 for the future construction/excavation worker and future indoor office worker receptors using the corresponding potentially complete exposure pathways.

Regulatory Policy Based Corrective Action Objectives

- Protect and/or restore groundwater quality at the Central Plant Area to levels that are protective of beneficial uses for drinking water in areas where groundwater meets SWRCB criteria for potential drinking water sources under SWRCB Resolution 88-63.
- Control the migration of groundwater impacted by releases of hazardous waste and hazardous constituents at the Central Plant Area so that constituents of concern in groundwater do not migrate beyond the property boundary at levels above drinking water standards.

These objectives were linked to specific numeric standards known as Media Cleanup Standards (MCSs) (sometimes referred to as “cleanup goals”) that are concentrations of constituents in specific media (e.g., soil, groundwater, soil gas) that are to be attained by the corrective measures. Such media-specific numeric standards were developed for soil and groundwater corresponding to the human health risk based objectives. Media-specific numeric standards were not developed for soil gas since the potentially unacceptable risks from soil gas determined by the vapor intrusion assessment will be managed through institutional controls and soil gas mitigation measures. Such media-specific standards corresponding to regulatory policy based corrective action objectives only exist for groundwater. The proposed MCSs and the related corrective action objectives and components of the pathway-receptor analysis are shown on the following summary table.

Table 2

Summary of Corrective Action Objectives and Media Cleanup Standards for the Corrective Measures Study, Central Plant Area

Corrective Action Objective	Media	Receptor	Media Cleanup Standards (MCSs)
Human Health Risk Based Corrective Action Objectives and Media Cleanup Standards			
Attain the DTSC cancer risk target level of less than 10^{-6} and the target hazard index of less than 1.0 for the future construction/ excavation worker and future indoor office worker receptors using the corresponding potentially complete exposure pathways.	Soil Groundwater Soil Gas	Construction/excavation worker Construction/excavation worker Indoor office worker	RBTLs (soil) RBTLs (groundwater) None
Regulatory Policy Based Corrective Action Objectives and Media Cleanup Standards			
Protect and/or restore groundwater quality to levels that are protective of beneficial uses for drinking water in areas where groundwater meets SWRCB criteria for potential drinking water sources under SWRCB Resolution 88-63.	Groundwater	On-site groundwater	MCLs
Control the migration of on-site contaminated groundwater so that constituents of concern in on-site groundwater do not migrate off-site to protect off-site groundwater from further impacts above drinking water standards.	Groundwater	Off-site groundwater	MCLs

MCLs are considered long-term numeric goals specific to regulatory policy-based objectives and not human health risk based objectives. The approach toward achieving the goal of MCLs in on-site groundwater would be natural degradation of contaminants within the framework of a long-term monitoring program. The approach toward achieving the goal of MCLs in off-site groundwater would be containment of the further off-site migration of contaminated groundwater. Note that there are no regulatory policy based Corrective Action Objectives for soil and soil gas.

The characterization of conditions at the Central Plant Area resulted in a determination that achieving MCSs for on-site groundwater related to regulatory policy based corrective action objectives is technically impracticable. This assessment of site conditions, combined with corrective action implemented as interim measures at the Central Plant Area, is sufficient basis for this determination of technical impracticability based on policy and guidance related to technical impracticability as well as research of implemented corrective measures and associated technical impracticability of those measures. This determination of technical impracticability is based on site characterization data, specifically hydrogeology and contaminant characteristics, and corrective measures performance data (i.e., pilot testing and interim corrective measures).

Since restoration of on-site groundwater to MCLs is technically impracticable, the National Contingency Plan (NCP) requires that an alternative strategy be adopted which involves containment to mitigate or control migration of groundwater plumes, prevention of exposure to contaminated groundwater, and evaluation of further risk reduction methods. The recommended alternative strategy for the Central Plant Area is to continue groundwater plume containment and implement appropriate institutional controls. Such institutional controls will include restrictions on the use of groundwater and will be defined in deed restrictions for the property that will be implemented through a land use covenant with the DTSC. Contamination in soil and soil gas are not addressed herein since corrective measures have already been successfully applied for soil, and institutional controls with soil gas mitigation measures are recommended for management of potential risks from soil gas contamination.

7.2 TECHNOLOGY SCREENING AND THE DEVELOPMENT AND EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

The recommendation of a corrective measure for the Central Plant Area is the result of a comprehensive screening and evaluation process summarized below.

Identification of Potentially Applicable Technologies → **Screening of Technologies** → **Grouping of Remaining Technologies into Corrective Measures Alternatives** → **Evaluation of Alternatives and Recommended Alternative**

7.2.1 Identification and Screening of Potentially Applicable Corrective Measures Technologies

The development of corrective measures alternatives began with the identification of technologies potentially applicable for groundwater corrective action. Technologies specific to soil were not considered because further soil remediation beyond that accomplished as interim measures was determined to be not necessary based on the exposure pathway and receptor analysis, implementation of interim measures which resulted in removing soils to the extent where no constituents of concern remain at levels above RBTLs, and absence of unacceptable residual risk from soil based on the site-wide assessment of cumulative risks and hazards.

Technologies specific to soil gas were also not considered because potential unacceptable risks to the indoor office worker receptor from intrusion of subsurface vapor to inside buildings as defined in the vapor intrusion assessment were determined to be manageable via institutional controls and soil gas mitigation measures.

With respect to groundwater, general response actions were identified as follows: general categories of approaches: no action, institutional actions, containment actions, removal actions, in situ remediation actions, ex situ treatment actions, and disposal actions. A comprehensive list of corresponding corrective measures technology options for groundwater was compiled and these options were correlated to each of the general response actions and defined as potentially applicable to achieve the groundwater corrective action objectives. These groundwater technology options were then screened as previously stated, and the remaining technologies, listed in Table 3, were carried forward to identify corrective measure alternatives to be further evaluated.

Table 3

Summary of General Response Actions and Corresponding Groundwater Technology Options for the Corrective Measures Study, Central Plant Area

General Response Action	*Corresponding Groundwater Technology Options*
No Action	None
Institutional Actions	Restrictions (Institutional Controls / Land Use Covenants) Groundwater Monitoring
Containment Actions	Hydraulic Barriers Reactive Barriers (i.e., Zero-Valent Iron Reactive Wall)
Removal Actions	Groundwater Extraction via Wells (near clay source areas)
In-Situ Remediation Actions	In-Situ Chemical Oxidation Electrical Resistance Heating
Ex-Situ Treatment Actions (with groundwater extraction)	Carbon Adsorption
Disposal Actions	Discharge to Storm Drain

7.2.2 Development of Corrective Measures Alternatives

The corrective measures technologies for groundwater remaining after screening were used to develop corrective measures alternatives, which are assemblies of one or more of the groundwater corrective measure technologies. Thus, the developed corrective measures alternatives comprise technologies applicable to groundwater (source areas and dissolved plume). The technical impracticability of restoring groundwater at the Central Plant Area to MCSs was incorporated in the evaluation of the alternatives. Table 4 provides a summary of each corrective measures alternative.

Table 4

Summary of Corrective Measure Alternatives for the Corrective Measures Study, Central Plant Area

Alternative	Plume Containment at Downgradient Property Boundary	Source Zone Depletion	Dissolved Plume Remediation
A	*No Action Alternative*		
B	Existing hydraulic barrier		
C	Permeable Reactive Barrier		
D	Existing hydraulic barrier[1]	Groundwater extraction[1]	
E	Existing hydraulic barrier	Electrical resistance heating	ISCO
F	Permeable Reactive Barrier	Electrical resistance heating	

[1]Groundwater extraction would be for source zone depletion.

Alternative A —No Action

This alternative is included for the purposes of providing a baseline against which the other alternatives can be compared. No action would be performed under this alternative. Operation of the existing groundwater containment system at the northern property boundary (the operating interim measure) would be discontinued, the current groundwater monitoring program would be discontinued, and all existing groundwater monitoring wells would be decommissioned.

Alternative B —Plume Containment at the Downgradient Property Boundary with the Existing Hydraulic Barrier

This alternative would involve continued operation of the interim measure—groundwater extraction and ex-situ treatment—for the purpose of controlling and minimizing or eliminating off-site migration of dissolved VOCs in excess of MCLs. The strategy of this alternative is to continue operation of the existing effective containment system. Groundwater monitoring will also continue as part of the remedy. Institutional controls to restrict use of groundwater would be implemented.

Alternative C — Plume Containment at the Downgradient Property Boundary with a Permeable Reactive Barrier

This alternative would involve replacing the existing interim measure (Alternative B described above) with a subsurface Permeable Reactive Barrier (PRB)—a reactive wall filled in part with zero-valent iron. The strategy of this alternative is to mitigate the off-site migration of VOCs with a potential reduced long-term cost due to savings on O&M. Groundwater monitoring will also be performed as part of the remedy. Institutional controls to restrict use of groundwater would be implemented.

Alternative D — Plume Containment at the Downgradient Property Boundary with the Existing Hydraulic Barrier, and Source Zone Depletion and Isolation/Containment by Groundwater Extraction

This alternative consists of operating the interim measure (Alternative B described above) to continue plume containment, while additional groundwater extraction in source areas for source depletion (and possible source isolation/containment) is implemented to reduce the necessary duration of the property boundary plume containment system; and then discontinue the existing property boundary hydraulic containment system and implement plume containment at the interior portion of the Central Plant Area to free up the frontage portion of the property (adjacent to Coleman Avenue). The existing hydraulic barrier would be operated until source zone remediation resulted in alleviating the need for further plume containment, estimated to be approximately 20 years in FS1 and about 30 years in FS2a if source zone depletion to the extent required (approximately 90 percent depletion) were technically practicable. However, over 90 percent source depletion is unlikely due to the characteristics and relatively wide distribution (vertically and horizontally) of the contamination in the Central Plant Area. Groundwater monitoring will also be performed as part of the remedy. Institutional controls to restrict use of groundwater would be implemented.

Alternative E — Source Zone Depletion by Electrical Resistance Heating, Dissolved Plume Remediation by ISCO, and Plume Containment at the Downgradient Property Boundary with the Existing Hydraulic Barrier

This alternative consists of operating the interim measure (Alternative B described above) to continue plume containment, implementing source zone depletion by electrical resistance heating in the clayey source zones, and removing additional contaminant mass from the dissolved plume between the sources and downgradient property boundary by ISCO. The strategy of this alternative is to alleviate the need for lengthy downgradient plume containment (the existing plume containment system would operate until sufficient source zone and dissolved plume remediation was accomplished). The existing hydraulic barrier would be operated until source zone remediation resulted in alleviating the need for further plume containment, estimated to be approximately 20 years in FS1 and about 30 years in FS2a if source zone depletion to the extent required (approximately 90 percent depletion) were technically practicable. However, over 90 percent source depletion is unlikely due to the characteristics and relatively wide distribution (vertically and horizontally) of the contamination in the Central Plant Area. Groundwater monitoring will also be performed as part of the remedy. Institutional controls to restrict use of groundwater would be implemented.

Alternative F — Source Zone Depletion by Electrical Resistance Heating and Plume Containment at the Downgradient Property Boundary with a Permeable Reactive Barrier

This alternative consists of replacing the currently operating interim measure (Alternative B described above) with a subsurface permeable reactive barrier (PRB) in the form of a zero-valent iron reactive wall, and implementing source zone depletion by electrical resistance heating in the clayey source zones. The strategy of this alternative is to mitigate the off-site migration of VOCs with a potential reduced long-term cost due to savings on O&M, and reduce the necessary duration of downgradient plume containment. The PRB would be operated until source zone remediation resulted in alleviating the need for further plume containment, estimated to be approximately 20 years in FS1 and about 30 years in FS2a if source zone depletion to the extent required (approximately 90 percent depletion) were technically practicable. However, over 90 percent source depletion is unlikely due to the characteristics and relatively wide distribution (vertically and horizontally) of the contamination in the Central Plant Area. Groundwater monitoring will also be performed as part of the remedy. Institutional controls to restrict use of groundwater would be implemented.

7.2.3 Evaluation of Corrective Measures Alternatives

The differences among these six corrective measure alternatives were identified and compared in order to recommend a single corrective measure alternative for the Central Plant Area. These differences were identified through the process of evaluating each of the corrective measure alternatives based on the Five Corrective Measures Criteria, which are identified in Attachment

6, Part B of the Consent Agreement as: (1) short- and long-term effectiveness; (2) reduction of toxicity, mobility and/or volume; (3) long-term reliability; (4) implementability; and (5) preliminary cost. The results of this comprehensive evaluation are summarized in Table 5 and the text that follows.

Table 5
Summary of Evaluations of Corrective Measure Alternatives for the Corrective Measures Study, Central Plant Area

							Estimated Cost[3], $	
	Alternative	Short- and Long-term Effectiveness	Reduction of Toxicity, Mobility and/or Volume	Long-term Reliability	Implementability	Time that Alternative Remains Operational	Total Cost (Construction and O&M)	Net Present Value[1]
A	No Action	None	No Impact	Not Applicable	Likely not acceptable	>>30 years[2]	Capital $0.5 M O&M $0.0 M **Total $0.5 M**	$ 0.5 M
B	Plume Containment at the Downgradient Property Boundary with the Existing Hydraulic Barrier	High [4]	Low-Moderate	Moderate	High	>>30 years [2,4]	Capital$0.06 M O&M $6.0 M **Total $6.1 M**	$ 3.3 M
C	Plume Containment at the Downgradient Property Boundary with a PRB	Moderate [4]	Moderate	Unknown	Moderate	>>30 years [2,4]	Capital $1.9 M O&M $3.3 M **Total $5.2 M**	$ 3.4 M
D	Plume Containment at the Downgradient Property Boundary with the Existing Hydraulic Barrier and Source Zone Depletion and Isolation/Containment by Groundwater Extraction	Low (90% source depletion required)	Low-Moderate	Low	High	>>30 years [2,4]	Capital $0.9 M O&M $8.2 M **Total $9.1 M**	$ 4.9 M

	Alternative	Short- and Long-term Effectiveness	Reduction of Toxicity, Mobility and/or Volume	Long-term Reliability	Implementability	Time that Alternative Remains Operational	Estimated Cost[3], $ Total Cost (Construction and O&M)	Net Present Value[1]
E	Source Zone Depletion by Electrical Resistance Heating, Dissolved Plume by ISCO and Plume Containment at the Downgradient Property Boundary with the Existing Hydraulic Barrier	Low (90% source depletion required)	Moderate	Low	Moderate	FS1 14 years FS2a 22 years (if technically practicable)	Capital $6.1 M O&M $4.6 M **Total $10.7 M**	$ 8.7 M
F	Source Zone Depletion by Electrical Resistance Heating and Plume Containment at the Downgradient Property Boundary with a PRB	Low (90% source depletion required)	Moderate	Low	Moderate	FS1 18 years FS2a30 years (if technically practicable)	Capital $7.0 M O&M $3.4 M **Total $10.4 M**	$ 8.6 M

[1] Present value calculation assuming a 5.2% long term interest rate.

[2] The actual time to achieve MCLs at the property boundary was not estimated.

[3] Cost estimate includes a 2-year post-closure monitoring period and demolition of groundwater wells and above-grade equipment. The cost estimate is for a maximum of 30-year operation. Additional costs would be incurred for alternatives that extend beyond 30 years.

[4] Requires continual operation until on-site groundwater contamination naturally attenuates.

7.2.3.1 Short- and Long-Term Effectiveness

The corrective measures alternatives that include plume containment (Alternatives B and C) have a high degree of short-term effectiveness in terms of near-term operation with immediate results of plume containment (immediate beneficial results). Alternative B is already demonstrating effectiveness. Alternative C relies on the PRB technology for plume containment which is a recognized method that has been demonstrated at many sites to attain short-term effectiveness for plume containment. The alternatives that include implementation of source zone depletion (Alternatives D, E, and F) will not be effective in the short-term. The No Action Alternative A will have no short term benefit.

With proper operation and maintenance, Alternative B should have a high level of long-term effectiveness since it is a proven technology for achieving plume control. Long-term effectiveness of the technology for Alternative C (PRB) has not been proven, since its history of full-scale implementation at sites as a remedial technology is less than 20 years. Long-term effectiveness of other alternatives that include source zone depletions component technologies (Alternatives D, E, and F) would be achievable only if those alternatives could be technically practicable. The No Action Alternative A will have little to no long-term benefit beyond natural degradation processes.

Each of the alternatives (with the exception of the no action alternative) requires the disturbance and/or removal of contaminated media. However, the potential risk to construction workers, the public, or the environment from contact with the contaminants is expected to be minimal. The application of ISCO and thermal methods (Alternatives D, E, and F) for groundwater remediation poses elevated risks to workers based on the use of strong oxidants and steam and the potential for contact with a significant electrical current. A construction health and safety plan would have to be implemented.

7.2.3.2 Reduction of Toxicity, Mobility and/or Volume

Alternatives B and C will have a relatively high ability to reduce contaminant volume, mobility, and toxicity off-site (downgradient) of the property as demonstrated through the performance of Alternative B since first implemented in 2002 (plume containment) and the likely successful performance of the PRB technology to contain the plume (Alternative C). Alternatives B and C will have little effect on groundwater on-site. The alternatives incorporating source zone depletion (Alternatives D, E, and F) are unlikely to result in a measurable ability to reduce contaminant volume, mobility, and toxicity on-site due to technical impracticability concerns already discussed. The No Action Alternative A will not reduce the toxicity, mobility or volume of contaminants beyond natural degradation processes.

7.2.3.3 Long-Term Reliability

With proper operation and maintenance, Alternative B should have a high level of long-term reliability since it is a proven technology for achieving plume control. Long-term reliability of the technology for Alternative C (PRB) has not been proven, since its history of full-scale implementation at sites as a remedial technology is less than 20 years. Both alternatives will require long-term monitoring and maintenance. The system currently operating (Alternative B) will require long-term monitoring, continual maintenance, and intermittent equipment repair and replacement. Alternative C will also require long-term monitoring, but its advantage is that it would require little to no maintenance unless it required complete replacement due to deteriorated performance.

Other alternatives that include source zone depletions component technologies (Alternatives D, E, and F) are relatively short-term applications of technologies with no long-term technical management requirements. However, it has been determined that these alternatives are technically impracticable. Groundwater modeling indicates that even if more than 90 percent of the contaminant mass could practicably be removed, groundwater throughout the Central Plant Area would still contain VOCs at concentrations above MCLs after 30 years. Thus, 100 percent of the contaminant mass would have to be removed, which is highly unlikely due likely technical impracticability.

The potential failure of any of the alternatives will not likely result in an immediate threat to the general public or environmentally sensitive receptors. However, the failure would have to be addressed and resolved promptly. The hydraulic barrier and PRB technologies for Alternatives B and C are sufficiently robust to deal with significant changes in uncontrollable site factors (i.e., significant storm events). The PRB technology would have an advantage in that it would not be subject to infrastructure or power failures that may coincide with the uncontrollable factors.

Institutional controls required to control the use of on-site groundwater, protect future site workers where necessary, and maintain access to the corrective measure for maintenance and monitoring. The institutional controls would have to be reliable and enforceable, which would be possible through the application of deed restrictions implemented via the land use covenant regulations of the DTSC. The No Action Alternative A has no reliability in its ability to protect the generally public or the environment beyond natural degradation processes.

7.2.3.4 Implementability

Alternative B is implementable; it is already constructed full-scale. Also, Alternative B is equal to other alternatives in its feasibility regarding administrative requirements, which are already being followed via applicable permits and the verification monitoring and reporting program described previously in this section. Alternative C is implementable because the required depth of a PRB is shallow enough to permit fairly standards trench excavation methods and iron/sand emplacement methods. However, replacement of an effective technology (Alternative B) with another technology (Alternative C) does involve some implementability risk associated with engineering, construction, and performance uncertainties.

The alternatives involving source depletion technologies (Alternatives D, E, and F) are potentially constructible and implementable, since they involve known technologies. Specific design criteria would have to be developed for each alternative prior to construction except for Alternative B (already constructed). Services for the thermal technology, as well as for the PRB technology, are provided by a limited number of specialty contractors; hence, the immediate availability of specialty contractors may be problematic. However, implementation of these technologies is typically short, unless repeated applications over time due to technical impracticability becomes necessary. Alternatives that combine technologies (Alternatives D, E, and F) might require that construction/implementation of each to be staged to minimize interference.

Each of the technologies (Alternatives B, C, D, and E) is considered. The time required for design and permitting any of the alternatives, other than the currently operating Alternative B, should be approximately three to six months. The No Action Alternative A would likely not be implementable because it would likely not be accepted by regulatory agencies or the public.

7.2.3.5 Preliminary Cost Estimate

Total costs based on an NPV analysis range from approximately $3.3 million for implementation and operation of Alternative B over 30 years to nearly $9 million for Alternative E, if it could be proven to be technically practicable. The No Action Alternative A would cost approximately $0.5 million for proper destruction of the existing hydraulic containment system, including monitoring wells, and implementing institutional controls. From the standpoint of up-front capital cost, Alternative B would be the least expensive alternative since it has already been constructed and is operating successfully.

The cost estimates do not include costs already incurred for corrective measures implemented at the Central Plant Area. Approximately $8 million have been spent for implementation of the interim corrective measures: nearly $1 million for soil excavation, $4 million for DPE, and $3 million for groundwater extraction and treatment for the purposes of hydraulic plume containment.

7.3 SELECTION OF THE RECOMMENDED FINAL CORRECTIVE MEASURE ALTERNATIVE

The recommended final corrective measure alternative for groundwater is Alternative B—continued operation of the plume containment system at the property boundary —which is effective in achieving the corrective action objectives for groundwater. Institutional controls to restrict use of groundwater on site, and groundwater monitoring as currently implemented, would be part of the corrective measures. The evaluation and selection process incorporated technologies regardless of the determination of technical impracticability of restoring on-site groundwater to MCLs. However, this impracticability was used as a critical evaluation metric to determine an appropriate alternative that could be effective and reliable.

The recommended final corrective measure alternative for soil is soil excavation as already accomplished as interim corrective measures at the Central Plant Area. These excavations reduced the concentrations of constituents of concern to below risk-based levels (i.e., RBTLs). Thus, further soil remediation beyond that accomplished as interim measures was determined to be not necessary based on a human health exposure pathway and receptor analysis (potential impacts to future construction/excavation workers only) that concludes the interim measures resulted in no unacceptable risks from residual concentrations in soil. Also, no unacceptable risks from residual concentrations in soil exist based on the site-wide assessment of cumulative risks and hazards.

The recommended final corrective measures alternative for soil gas is the implementation of institutional controls, including soil gas mitigation measures that will be defined in deed restrictions for the property implemented through land use covenant regulations of the DTSC. This recommendation was based on a vapor intrusion assessment which concluded that potential unacceptable risks to the future indoor office workers from intrusion of subsurface vapor to inside buildings that may be constructed within specific areas of the Central Plant Area could be effectively managed by such measures.

The recommended continued operation of the groundwater plume containment system (Alternative B) is justified because it has been effective since its implementation in 2002 as an interim measure, it offers an acceptable balance of the Five Corrective Measure Criteria, and it can satisfactorily comply with the Four Corrective Action Standards. The recommended institutional controls and soil gas mitigation measures will prevent potential vapor intrusion into future buildings.

8.0 DESCRIPTION OF THE RECOMMENDED FINAL CORRECTIVE MEASURE ALTERNATIVE(S)

The recommended final corrective measure alternative(s) for the Central Plant Area are as follows.

- Continued operation and maintenance of the property boundary groundwater extraction and treatment system for groundwater plume containment, and including site groundwater monitoring.
- The soil excavations already implemented as part of interim corrective measures for soil contamination. FMC will prepare a soil management plan that would be implemented whenever there are future soil excavations.
- Soil gas mitigation measures for specific sub-areas of the site (approximately 5.5 acres out of the total approximate 25 acre Central Plant Area) that will prevent potential vapor intrusion into future buildings.

DTSC and FMC will enter into a Land Use Covenant that would restrict the use of groundwater for drinking or irrigation purposes; limit land use to commercial and/or industrial activities; require the soil gas mitigation measures mentioned above; and prohibit the construction of residences, schools, hospitals, or day-care centers. These land use restrictions are described in the Land Use Covenant Implementation and Enforcement Plan.

Since no further soil remediation is recommended beyond soil excavations implemented as part of interim measures, and no vadose zone remediation is recommended beyond soil gas mitigation measures that will render the potentially complete exposure pathway of soil gas into buildings via vapor intrusion as incomplete, the following descriptions of the recommended final corrective measure alternative only address groundwater.

8.1 DESCRIPTION OF RECOMMENDED FINAL CORRECTIVE MEASURE ALTERNATIVE FOR GROUNDWATER CONTAMINATION

The recommended final corrective measure alternative for groundwater is Alternative B, which is continued operation of the groundwater extraction and treatment system at the property boundary. The strategy of this alternative is to continue to control off-site migration of VOCs at concentrations exceeding MCLs, the numeric goals and the primary drinking water standards,

The system includes groundwater extraction from nine extraction wells; one screened in FS1 and eight screened in FS2a. The extraction flow rate averages between 80 and 90 gallons per minute, with nearly half via extraction from the one well screened in FS1. The extracted groundwater is treated by adsorption (i.e., GAC), and treated water exists the GAC vessels and discharged directly to a nearby storm drain under appropriate NPDES permit requirements.

Since implementation and start-up of full-time operation on March 27, 2002, this groundwater plume containment system has met its goals and objectives by extracting groundwater from the FS1 and FS2a hydrostratigraphic units. Assessment of sufficient hydraulic performance of the system to maintain containment of the on-site groundwater contamination to prevent further degradation of groundwater quality offsite is accomplished by groundwater monitoring and system O&M. Groundwater in the Central Plant Area is monitored according to the Amended Groundwater Monitoring Plan of September 2004 approved by DTSC. Thus, the recommended final corrective measure alternative(s) will include groundwater monitoring with the objectives stated in the amended plan listed below.

1. Continue to assess any changes in contaminant plume magnitude and distribution (i.e., plume behavior) over time throughout the Central Plant Area.
2. Monitor the quality of groundwater migrating from upgradient source areas (south of the Central Plant Area) onto the FMC property.
3. Assess the distribution of metals in groundwater and determine if 1,4-dioxane is present above the California Department of Health Services Action Level of 3 ug/L.
4. Evaluate the effectiveness of the hydraulic containment of the contaminant plume at the downgradient (northern) property boundary.
5. Monitor the quality of groundwater to the north (downgradient and offsite) of the Central Plant Area.

The first objective will be achieved by sampling wells throughout the Central Plant Area and comparing results to previous analyses. The wells selected for sampling are a subset of the 330 wells that were sampled during the February 2002 comprehensive groundwater monitoring event. The selected wells are located within plume source areas, within the plume but away from source areas, and transgradient to the plume. The second objective will be achieved by sampling wells along the upgradient (southern) property boundary and comparing results to previous analyses. The third objective will be achieved by analyzing groundwater samples for metals and for 1,4-dioxane at a reporting limit that is equal to or less than 3 μg/L. This objective addresses specific comments made by DTSC in the May 10, 2004 comments. The fourth objective will be achieved by sampling monitoring and extraction wells at the downgradient property boundary for VOCs, water levels, and groundwater extraction rates. The fifth objective will be achieved by sampling MW1-OA2, a monitoring well located off-site, on the San Jose International Airport property.

Monitoring and maintenance of the extraction and treatment system will also continue to be conducted following the various protocols described in the following documents: Interim Measure Work Plan (August 2000), Design Report (May 2001), the Operation and Maintenance Plan (May 2002), and the Construction Completion Report (July 2002). In accordance with the DTSC-approved Design Report, the Groundwater Verification Monitoring Plan (Appendix B of the Construction Completion Report) will be followed, which describes methods to be used for collection and evaluation of groundwater level measurements and groundwater sample analytical results to verify consistency with the objectives. Performance verification monitoring for the hydraulic containment system will continue to be documented in the annual groundwater verification monitoring reports (December 2002, March 2004, and March 2005) as required by DTSC.

8.2 JUSTIFICATION OF THE FINAL CORRECTIVE MEASURE ALTERNATIVE

The recommended final corrective measure alternative for groundwater, Alternative B, is justified based on the following: (1) an acceptable balance of short- and long-term effectiveness; reduction of toxicity, mobility and/or volume of contaminants; long-term reliability; implementability; and estimated cost (The Five Corrective Measure Criteria); and, (2) protection of human health and the environment; attainment of corrective action objectives; control of the source(s) of contaminants; and compliance with applicable standards for management of wastes (The Four Corrective Action Standards). In addition, institutional controls that are effective and enforceable are recommended to be a component of the final corrective measure alternative(s).

These institutional controls will include restrictions on the use of groundwater and will be defined in deed restrictions for the property that will be implemented through a land use covenant with the DTSC.

Justification of the recommended alternatives for groundwater as well as soil and soil gas based on the Four Corrective Action Standards is presented below. These standards are identified in the Consent Agreement as: (1) protect human health and the environment; (2) attain corrective action objectives, including media cleanup standards; (3) control the source(s) of releases so as to reduce or eliminate, to the extent practicable, further releases of hazardous wastes (including hazardous constituents) that may pose a threat to human health and the environment; and (4) comply with any applicable Federal, state, and local standards for management of wastes.

8.2.1 Protection of Human Health and the Environment

The methods considered for protection of human health and the environment are not limited to groundwater cleanup, source control, or management of wastes, but also include institutional controls such as deed restrictions implemented and managed via land use covenants. The recommended alternative will be protective of potential on-site receptors via institutional controls that will restrict the use of groundwater from beneath the Central Plant Area. Institutional controls will be implemented with deed restrictions that are enforced through the land use covenant regulations of the DTSC. Future construction/excavation workers will be protected via construction management measures, and future indoor office workers will be protected via soil gas mitigation measures. For the recommended remediation alternative, cumulative cancer risk for all potential human pathways (industrial/commercial use only) is calculated to be less than 10^{-6} (one cancer among one million exposed individuals), thereby meeting DTSC maximum acceptable cancer risk target level of 10^{-6}. In addition, the calculated cumulative hazard index for the proposed remediation alternative is below the hazard index target level of one. The recommended alternative will also be protective of potential off-site receptors by controlling off-site migration of dissolved VOCs in groundwater. The recommended alternative will require the operation and maintenance of the hydraulic plume containment system and management of deed restrictions.

8.2.2 Attainment of Corrective Action Objectives

The recommended final corrective measures alternatives attain the human health risk based corrective action objectives for potential on-site receptors. Further soil and groundwater remediation on-site is not necessary to protect human health, beyond the measures already accomplished. This is based on the exposure pathway and receptor analysis (potential impacts to future construction/excavation workers only), absence of residual constituents of concern at levels above MCSs (RBTLs), and absence of unacceptable risk from residual concentrations in soil based on the site-wide assessment of cumulative risks and hazards. Remediation of soil gas is not necessary because potential unacceptable risks to the indoor office worker receptor from intrusion of subsurface vapor to inside buildings as defined in the vapor intrusion assessment will be managed via soil gas mitigation measures.

The recommended final corrective measure alternative(s) attains the regulatory policy based corrective action objectives for off-site groundwater via hydraulic control of the migration of on-site contaminated groundwater to control off-site impacts from constituents of concern in on-site groundwater. The recommended alternative protects the regulatory policy based corrective action objectives for on-site groundwater by natural degradation. These objectives are technically impracticable to achieve within a reasonable time frame. Since restoration of on-site groundwater to MCLs is technically impracticable, the NCP requires that an alternative strategy be adopted which involves containment of further migration of groundwater plumes, prevention of exposure to contaminated groundwater, and evaluation of further risk reduction methods. The recommended alternative complies with these requirements via groundwater plume containment and restrictions on groundwater use.

8.2.3 Attainment of Source Control

As demonstrated by the performance of the recommended final corrective measure alternative for groundwater as an interim measure since March 2002, source control is attained and will continued to be attained through the operation, monitoring, and maintenance of the currently operating groundwater extraction and treatment property boundary. Adjusting the location of the containment system to be closer to the source areas—areas represented in the groundwater modeling as those required for mass removal of containment—is not necessary or justified due to the relative size/width of the impacted areas.

8.2.4 Compliance with Applicable Standards for Management of Wastes

The recommended final corrective measure alternative(s) has and will continue to comply with applicable standards for management of wastes. Other than groundwater that is extracted, treated, and disposed, no wastes are produced. All extracted groundwater is handled in accordance with Federal and state standards. An NPDES permit is required from the San Francisco Bay RWQCB to discharge industrial wastewater to surface waters or storm water drainage systems that discharge to surface waters. The current permit is under Order No. R2-2004-0055, NPDES general permit No. CAG912003, WDID No. 2438520006, adopted by the San Francisco Bay RWQCB on July 21, 2004. Quarterly self-monitoring reports are issued by FMC to the RWQCB with copies to the Santa Clara Valley Water District, the DTSC, the City of San Jose Environmental Services Department (ESD), and the San Jose International Airport.

The City of San Jose's ESD governs discharges to both the storm and sanitary systems. Approval for discharge to the storm drain system involved a Wastewater Discharge Permit with ESD. Discharge is not allowed to enter the sanitary system based on discussions with ESD representatives due to flow capacity and other issues. The design plans for the interim measure were submitted to and approved by the City of San Jose's Building Division, who issued a building permit prior to commencement of system start-up activities. All inspections performed by City of San Jose building officials were satisfactorily passed.

The SCVWD required well construction permits submitted for each extraction well and charges a fee for extraction of groundwater at the Central Plant Area. This required the installation of meters on the extraction wells by SCVWD and paying a fee on a per-acre-foot of groundwater extracted basis to the SCVWD for the duration of extraction system operation. The flow totalizer used to measure and record the volume of groundwater extracted was inspected and approved by SCVWD personnel. A semi-annual water production statement is issued to SCVWD by FMC with payment for extraction and information on flow meter readings and replacements.