

ATTACHMENT B

EXCERPT FROM "STATISTICAL ANALYSIS OF GROUNDWATER MONITORING DATA AT RCRA FACILITIES" AND ADDENDUM

HAZARDOUS WASTE FACILITY POST-CLOSURE PERMIT

**The Boeing Company
Rocketdyne Propulsion and Power Division
Santa Susana Field Laboratory, Areas I and III**

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**STATISTICAL ANALYSIS OF
GROUND-WATER MONITORING DATA
AT RCRA FACILITIES**

INTERIM FINAL GUIDANCE

**OFFICE OF SOLID WASTE
WASTE MANAGEMENT DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY
401 M STREET, S.W.
WASHINGTON, D.C. 20460**

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Observation from compliance wells in excess of 2,082 mg/L would give statistically significant evidence of contamination.

INTERPRETATION

Cohen's method provides maximum likelihood estimates of the mean and variance of a censored normal distribution. That is, of observations that follow a normal distribution except for those below a limit of detection, which are reported as "not detected." The modified estimates reflect the fact that the not detected observations are below the limit of detections, but not necessarily zero. The large sample properties of the modified estimates allow for them to be used with the normal theory procedures as a means of adjusting for not detected values in the data. Use of Cohen's method in more complicated calculations such as those required for analysis of variance procedures, requires special consideration from a professional statistician.

8.2 OUTLIERS

A ground-water constituent concentration value that is much different from most other values in a data set for the same ground-water constituent concentration can be referred to as an "outlier." Possible reasons for outliers can be:

- A catastrophic unnatural occurrence such as a spill;
- Inconsistent sampling or analytical chemistry methodology that may result in laboratory contamination or other anomalies;
- Errors in the transcription of data values or decimal points; and
- True but extreme ground-water constituent concentration measurements.

There are several tests to determine if there is statistical evidence that an observation is an outlier. The reference for the test presented here is ASTM paper E178-75.

PURPOSE

The purpose of a test for outliers is to determine whether there is statistical evidence that an observation that appears extreme does not fit the distribution of the rest of the data. If a suspect observation is identified as an outlier, then steps need to be taken to determine whether it is the result of an error or a valid extreme observation.

PROCEDURE

Let the sample of observations of a hazardous constituent of ground water be denoted by x_1, \dots, x_n . For specificity, assume that the data have been ordered and that the largest observation, denoted by x_n , is suspected of being an outlier. Generally, inspection of the data suggests values that do not

appear to belong to the data set. For example, if the largest observation is an order of magnitude larger than the other observations, it would be suspect.

Step 1. Calculate the mean, \bar{X} and the standard deviation, S , of the data including all observations.

Step 2. Form the statistic, T_n :

$$T_n = (x_n - \bar{X}) / S$$

Note that T_n is the difference between the largest observation and the sample mean, divided by the sample standard deviation.

Step 3. Compare the statistic T_n to the critical value given the sample size, n , in Table 8 in Appendix B. If the T_n statistic exceeds the critical value from the table, this is evidence that the suspect observation, x_n , is a statistical outlier.

Step 4. If the value is identified as an outlier, one of the actions outlined below should be taken. (The appropriate action depends on what can be learned about the observation.) The records of the sampling and analysis of the sample that led to it should be investigated to determine whether the outlier resulted from an error that can be identified.

- If an error (in transcription, dilution, analytical procedure, etc.) can be identified and the correct value recovered, the observation should be replaced by its corrected value and the appropriate statistical analysis done with the corrected value.

- If it can be determined that the observation is in error, but the corrected value cannot be determined, then the observation should be deleted from the data set and the appropriate statistical analysis performed. The fact that the observation was deleted and the reasons for its deletion should be reported when reporting the results of the statistical analysis.

- If no error in the value can be documented then it must be assumed that the observation is a true but extreme value. In this case it must not be altered. It may be desirable to obtain another sample to confirm the observation. However, analysis and reporting should retain the observation and state that no error was found in tracing the sample that led to the extreme observation.

EXAMPLE

Table 8-4 contains 19 values of total organic carbon (TOC) that were obtained from a monitoring well. Inspection shows one value which at 11,000 mg/L is nearly an order of magnitude larger than most of the other observations. It is a suspected outlier.

TABLE 8-4. EXAMPLE DATA FOR TESTING FOR AN OUTLIER

| Total organic carbon (mg/L) |
|-----------------------------|
| 1,700 |
| 1,900 |
| 1,500 |
| 1,300 |
| 11,000 |
| 1,250 |
| 1,000 |
| 1,300 |
| 1,200 |
| 1,450 |
| 1,000 |
| 1,300 |
| 1,000 |
| 2,200 |
| 4,900 |
| 3,700 |
| 1,600 |
| 2,500 |
| 1,900 |

Step 1. Calculate the mean and standard deviation of the data

$$\bar{X} = 2300 \text{ and } S = 2325.9$$

Step 2. Calculate the statistic T_{19} .

$$T_{19} = (11000 - 2300) / 2325.9 = 3.74$$

Step 3. Referring to Table 8 of Appendix B for the upper 5% significance level, with $n = 19$, the critical value is 2.532. Since the value of the statistic $T_{19} = 3.74$ is greater than 2.532, there is statistical evidence that the largest observation is an outlier.

Step 4. In this case, tracking the data revealed that the unusual value of 11,000 resulted from a keying error and that the correct value was 1,100. This correction was then made in the data.

INTERPRETATION

An observation that is 4 or 5 times as large as the rest of the data is generally viewed with suspicion. An observation that is an order of magnitude different could arise by a common error of misplacing a decimal. The test for an outlier provides a statistical basis for determining whether an observation

is statistically different from the rest of the data. If it is, then it is a statistical outlier. However, a statistical outlier may not be dropped or altered just because it has been identified as an outlier. The test provides a formal identification of an observation as an outlier, but does not identify the cause of the difference.

Whether or not a statistical test is done, any suspect data point should be checked. An observation may be corrected or dropped only if it can be determined that an error has occurred. If the error can be identified and corrected (as in transcription or keying) the correction should be made and the corrected values used. A value that is demonstrated to be incorrect may be deleted from the data. However, if no specific error can be documented, the observation must be retained in the data. Identification of an observation as an outlier but with no error documented could be used to suggest resampling to confirm the value.

**STATISTICAL ANALYSIS OF
GROUND-WATER MONITORING
DATA AT RCRA FACILITIES**

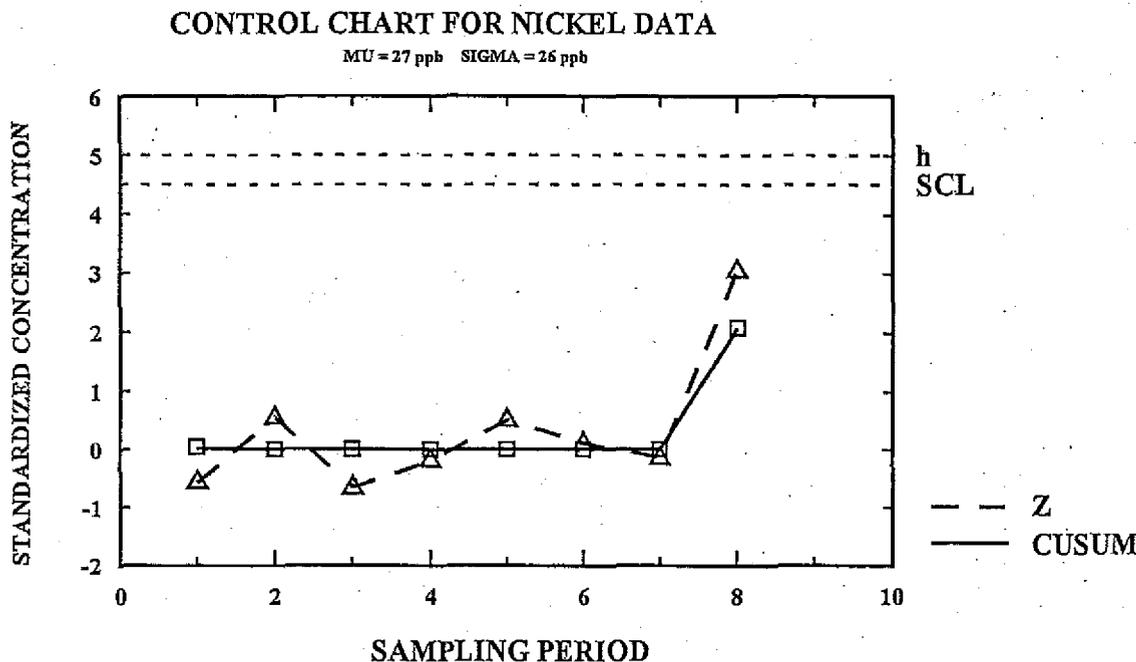
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**ADDENDUM TO INTERIM FINAL
GUIDANCE**

**OFFICE OF SOLID WASTE
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Note: In the above Control Chart, the CUSUMs are compared to threshold h , while the standardized means (Z) are compared to the SCL threshold.

6.2 OUTLIER TESTING

Formal testing for outliers should be done only if an observation seems particularly high (by orders of magnitude) compared to the rest of the data set. If a sample value is suspect, one should run the outlier test described on pp. 8-11 to 8-14 of the EPA guidance document. It should be cautioned, however, that this outlier test assumes that the rest of the data values, except for the suspect observation, are Normally distributed (Barnett and Lewis, 1978). Since Lognormally distributed measurements often contain one or more values that appear high relative to the rest, it is recommended that the outlier test be run on the logarithms of the data instead of the original observations. That way, one can avoid classifying a high Lognormal measurement as an outlier just because the test assumptions were violated.

If the test designates an observation as a statistical outlier, the sample should not be treated as such until a specific reason for the abnormal measurement can be determined. Valid reasons may, for example, include contaminated sampling equipment, laboratory contamination of the sample,

or errors in transcription of the data values. Once a specific reason is documented, the sample should be excluded from any further statistical analysis. If a plausible reason cannot be found, the sample should be treated as a true but extreme value, not to be excluded from further analysis.

EXAMPLE 19

The table below contains data from five wells measured over a 4-month period. The value 7066 is found in the second month at well 3. Determine whether there is statistical evidence that this observation is an outlier.

| Carbon Tetrachloride Concentration (ppb) | | | | |
|--|--------|--------|--------|--------|
| Well 1 | Well 2 | Well 3 | Well 4 | Well 5 |
| 1.69 | 3.02 | 16.2 | 199 | 275 |
| 3.25 | 35.1 | 7066 | 41.6 | 6.5 |
| 7.3 | 15.6 | 350 | 75.4 | 59.7 |
| 12.1 | 13.7 | 70.14 | 57.9 | 68.4 |

SOLUTION

Step 1. Take logarithms of each observation. Then order and list the logged concentrations.

ATTACHMENT C

SCOPE OF WORK FOR INTERIM MEASURES IMPLEMENTATION

PURPOSE

Interim measures are actions to control and/or eliminate releases of hazardous waste and/or hazardous constituents from a facility prior to the implementation of a final corrective measure. Interim measures must be used whenever possible to achieve the goal of stabilization which is to control or abate threats to human health and/or the environment, and to prevent or minimize the spread of contaminants while long-term corrective action alternatives are being evaluated.

SCOPE

The documents required for Interim Measures (IM) are, unless the Department of Toxic Substances Control (Department) specifies otherwise, an IM Workplan, an Operation and Maintenance Plan and IM Plans and Specifications. The scope of work (SOW) for each document is specified below. The SOWs are intended to be flexible documents capable of addressing both simple and complex site situations. If the Owner/Operator or Respondent can justify, to the satisfaction of the Department, that a plan or portions thereof are not needed in the given site specific situation, then the Department may waive that requirement.

The scope and substance of interim measures should be focused to fit the site specific situation and be balanced against the need to take quick action.

The Department may require the Owner/Operator or Respondent to conduct additional studies beyond what is discussed in the SOWs in order to support the IM program. The Owner/Operator or Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

A. Interim Measures Workplan

The Owner/Operator or Respondent shall prepare an IM Workplan that evaluates interim measure options and clearly describes the proposed interim measure, the key components or elements that are needed, describes the designer's vision of the interim measure in the form of conceptual drawings and schematics, and includes procedures and schedules for implementing the interim measure(s). The IM Workplan must be approved by the Department prior to implementation. The IM Workplan must, at a minimum, include the following elements:

1. Introduction/Purpose

Describe the purpose of the document and provide a summary of the project.

2. Conceptual Model of Contaminant Migration

It is important to know where the contaminants are and to understand how they are moving before an adequate interim measure can be developed. To address this critical question, the Owner/Operator or Respondent must present a conceptual model of the site and contaminant migration. The conceptual model consists of a working hypothesis of how the contaminants may move from the release source to the receptor population. The conceptual model is developed by looking at the applicable physical parameters (e.g., water solubility, density, Henry's Law Constant, etc.) for each contaminant and assessing how the contaminant may migrate given the existing site conditions (geologic features, depth to ground water, etc.). Describe the phase (water, soil, gas, non-aqueous) and location where contaminants are likely to be found. This analysis may have already been done as part of earlier work (e.g., Current Conditions Report). If this is the case, then provide a summary of the conceptual model with a reference to the earlier document.

3. Evaluation of Interim Measure Alternatives

List, describe and evaluate interim measure alternatives that have the potential to stabilize the facility. Propose interim measures for implementation and provide rationale for the selection. Document the reasons for excluding any interim measure alternatives.

4. Description of Interim Measures

Qualitatively describe what the proposed interim measure is supposed to do and how it will function at the facility.

5. Data Sufficiency

Review existing data needed to support the design effort and establish whether there are sufficient accurate data available for this purpose. The Owner/Operator or Respondent must summarize the assessment findings and specify any additional data needed to complete the interim measure design. The Department may require or the Owner/Operator or Respondent may propose that sampling and analysis plans and/or treatability study workplans be developed to obtain the additional data. Submittal times for any new sampling and analysis plans and/or treatability study workplans must be included in the project schedule.

6. Project Management

Describe the levels of authority and responsibility (include organization chart), lines of communication and a description of the qualifications of key personnel who will direct the interim measure design and implementation effort (including contractor personnel).

7. Project Schedule

The project schedule must specify all significant steps in the process, when any key documents (e.g., plans and specifications, operation and maintenance plan) are to be submitted to the Department and when the interim measure is to be implemented.

8. Design Basis

Discuss the process and methods used to design all major components of the interim measure. Discuss the significant assumptions made and possible sources of error. Provide justification for the assumptions.

9. Conceptual Process/Schematic Diagrams.

10. Site plan showing preliminary plant layout and/or treatment area.

11. Tables listing number and type of major components with approximate dimensions.

12. Tables giving preliminary mass balances.

13. Site safety and security provisions (e.g., fences, fire control, etc.).

14. Waste Management Practices

Describe the wastes generated by the construction of the interim measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

15. Required Permits

List and describe the permits needed to construct the interim measure. Indicate on the project schedule when the permit applications will be submitted to the applicable agencies and an estimate of the permit issuance date.

16. Sampling and Monitoring

Sampling and monitoring activities may be needed for design and during construction of the interim measure. If sampling activities are necessary, the IM Workplan must include a complete sampling and analysis section which specifies at a minimum the following information:

- a. Description and purpose of monitoring tasks;
- b. Data quality objectives;
- c. Analytical test methods and detection limits;
- d. Name of analytical laboratory;
- e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
- f. Sample collection procedures and equipment;

- g. Field quality control procedures:
 - (1). duplicates (10% of all field samples)
 - (2). blanks (field, equipment, etc.)
 - (3). equipment calibration and maintenance
 - (4). equipment decontamination
 - (5). sample containers
 - (6). sample preservation
 - (7). sample holding times (must be specified)
 - (8). sample packaging and shipment
 - (9). sample documentation (field notebooks; sample labeling, etc.);
 - (10). chain of custody;
- h. Criteria for data acceptance and rejection; and
- i. Schedule of monitoring frequency.

The Owner/Operator or Respondent shall follow all Department and U.S. EPA guidance for sampling and analysis. The Department may request that the sampling and analysis section be a separate document.

17. Appendices including:

- a. Design Data - Tabulations of significant data used in the design effort;
- b. Equations - List and describe the source of major equations used in the design process;
- c. Sample Calculations - Present and explain one example calculation for significant calculations; and
- d. Laboratory or Field Test Results.

B. Interim Measures Operation and Maintenance Plan

The Owner/Operator or Respondent shall prepare an Interim Measures Operation and Maintenance (O&M) Plan that includes a strategy and procedures for performing operations, maintenance, and monitoring of the interim measure(s). An Interim Measures Operation and Maintenance Plan shall be submitted to the Department simultaneously with the Plans and Specifications. The O&M plan shall, at a minimum, include the following elements:

1. Purpose/Approach

Describe the purpose of the document and provide a summary of the project.

2. Project Management

Describe the levels of authority and responsibility (include organization chart), lines of communication and a description of the qualifications of key personnel who will operate and maintain the interim measure(s) (including contractor personnel).

3. System Description

Describe the interim measure and identify significant equipment.

4. Personnel Training

Describe the training process for O&M personnel. The Owner/Operator or Respondent shall prepare, and include in the technical specifications governing treatment systems, contractor requirements for providing: appropriate service visits by experienced personnel to supervise the installation, adjustment, start up and operation of the treatment systems, and training covering appropriate operational procedures once the start-up has been successfully accomplished.

5. Start-Up Procedures

Describe system start-up procedures including any operational testing.

6. Operation and Maintenance Procedures

Describe normal operation and maintenance procedures including:

- a. Description of tasks for operation;
- b. Description of tasks for maintenance;
- c. Description of prescribed treatment or operation condition, and
- d. Schedule showing frequency of each O&M task.

7. Replacement schedule for equipment and installed components.

8. Waste Management Practices

Describe the wastes generated by operation of the interim measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

9. Sampling and Monitoring

Sampling and monitoring activities may be needed for effective operation and maintenance of the interim measure. If sampling activities are necessary, the O&M plan must include a complete sampling and analysis section which specifies at a minimum the following information:

- a. Description and purpose of monitoring tasks;
- b. Data quality objectives;
- c. Analytical test methods and detection limits;
- d. Name of analytical laboratory;

- e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
- f. Sample collection procedures and equipment;
- g. Field quality control procedures:
 - (1). duplicates (10% of all field samples)
 - (2). blanks (field, equipment, etc.)
 - (3). equipment calibration and maintenance
 - (4). equipment decontamination
 - (5). sample containers
 - (6). sample preservation
 - (7). sample holding times (must be specified)
 - (8). sample packaging and shipment
 - (9). sample documentation (field notebooks, sample labeling, etc.);
 - (10). chain of custody;
- h. Criteria for data acceptance and rejection; and
- i. Schedule of monitoring frequency.

The Owner/Operator or Respondent shall follow all Department and U.S. EPA guidance for sampling and analysis. The Department may request that the sampling and analysis section be a separate document.

10. O&M Contingency Procedures:

- a. Procedures to address system breakdowns and operational problems including a list of redundant and emergency back-up equipment and procedures;
- b. Should the interim measure suffer complete failure, specify alternate procedures to prevent release or threatened releases of hazardous substances, pollutants or contaminants which may endanger public health and/or the environment or exceed cleanup standards; and
- c. The O&M Plan must specify that, in the event of a major breakdown and/or complete failure of the interim measure (includes emergency situations), the Owner/Operator or Respondent will orally notify the Department within 24 hours of the event and will notify the Department in writing within 72 hours of the event. The written notification must, at a minimum, specify what happened, what response action is being taken and/or is planned, and any potential impacts on human health and the environment.

11. Data Management and Documentation Requirements

Describe how analytical data and results will be evaluated, documented and managed, including development of an analytical database. State the criteria that will be used by the project team to review and determine the quality of data.

The O&M Plan shall specify that the Owner/Operator or Respondent collect and maintain the following information:

- a. Progress Report Information
 - (1). Work Accomplishments (e.g., performance levels achieved, hours of treatment operation, treated and/or excavated volumes, concentration of contaminants in treated and/or excavated volumes, nature and volume of wastes generated, etc.).
 - (2). Record of significant activities (e.g., sampling events, inspections, problems encountered, action taken to rectify problems, etc.).
- b. Monitoring and laboratory data;
- c. Records of operating costs; and
- d. Personnel, maintenance and inspection records.

The Department may require that the Owner/Operator or Respondent submit additional reports that evaluate the effectiveness of the interim measure in meeting the stabilization goal.

C. Interim Measures Plans and Specifications

1. The Owner/Operator or Respondent shall prepare Plans and Specifications for the interim measure that are based on the conceptual design but include additional detail. The Plans and Specifications shall be submitted to the Department simultaneously with the Operation and Maintenance Plan. The design package must include drawings and specifications needed to construct the interim measure. Depending on the nature of the interim measure, many different types of drawings and specifications may be needed. Some of the elements that may be required are:
 - a. General Site Plans
 - b. Process Flow Diagrams
 - c. Mechanical Drawings
 - d. Electrical Drawings
 - e. Structural Drawings
 - f. Piping and Instrumentation Diagrams
 - g. Excavation and Earthwork Drawings
 - h. Equipment Lists
 - i. Site Preparation and Field Work Standards
 - j. Preliminary Specifications for Equipment and Material

2. General correlation between drawings and technical specifications is a basic requirement of any set of working construction plans and specifications. Before submitting the project specifications to the Department, the Owner/Operator or Respondent shall:
 - a. Proofread the specifications for accuracy and consistency with the conceptual design; and
 - b. Coordinate and cross-check the specifications and drawings.

ATTACHMENT D

SCOPE OF WORK FOR A RCRA FACILITY INVESTIGATION

PURPOSE

The purpose of this RCRA Facility Investigation (RFI) is to determine the nature and extent of releases of hazardous waste or constituents from regulated units, solid waste management units, and other source areas at the Facility and to gather all necessary data to support the Corrective Measures Study. The RFI must include characterization of the facility (processes, waste management, etc), environmental setting, source areas, nature and extent of contamination, migration pathways (transport mechanisms) and all potential receptors.

SCOPE

The documents required for a RFI are, unless the Department of Toxic Substances Control (Department) specifies otherwise, a Current Conditions Report, a RCRA Facility Investigation Workplan and a RCRA Facility Investigation Report. The scope of work (SOW) for each document is specified below. The SOWs are intended to be flexible documents capable of addressing both simple and complex site situations. If the Owner/Operator or Respondent can justify, to the satisfaction of the Department, that a plan and/or report or portions thereof are not needed in the given site specific situation, then the Department may waive that requirement.

The scope and substance of the RFI should be focused to fit the complexity of the site-specific situation. It is anticipated that Owner/Operator's or Respondent's of sites with complex environmental problems may need more extensive RFI's than other facilities with less complex problems.

The Department may require the Owner/Operator or Respondent to conduct additional studies beyond what is discussed in the SOWs in order to meet the objectives of the RFI. The Owner/Operator or Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

A. Current Conditions Report

The Current Conditions Report must describe existing information pertinent to the facility including operations, processes, waste management, geology, hydrogeology, contamination, migration pathways, potential receptor populations and interim corrective measures. The required format for a current conditions report is described below. If some of this information does not exist, so indicate in the applicable section.

1. Introduction

a. Purpose

Describe the purpose of the current conditions report (e.g., summary and evaluation of existing information related to the facility; required as a component of RFI).

b. Organization of Report

Describe how the report is organized.

2. Facility Description

Summarize background, current operations, waste management and products produced at the facility. Include a map that shows the general geographic location of the facility.

Describe current facility structures including any buildings, tanks, sumps, wells, waste management areas, landfills, ponds, process areas and storage areas.

Include detailed facility maps that clearly show current property lines, the owners of all adjacent property, surrounding land use (residential, commercial, agricultural, recreational, etc.), all tanks, buildings, process areas, utilities, paved areas, easements, rights-of-way, waste management areas, ponds, landfills, piles, underground tanks, wells and other facility features.

3. Facility History

a. Ownership History

Describe the ownership history of the facility.

b. Operational History

Describe in detail how facility operations, processes and products have changed over time (historical aerial photographs could be useful for this purpose).

c. Regulatory History

Describe all permits (including waste discharge requirements) requested or received, any enforcement actions taken by the Department or designated agencies and any closure activities that are planned or underway.

d. Waste Generation

Describe all wastes (solid or hazardous) that have been generated at the facility. Include approximate waste volumes generated and summaries of any waste analysis data. Show how the waste stream (volume and chemical composition) has changed over time.

e. Waste Management

Describe in detail all past solid and hazardous waste treatment, storage and disposal activities at the facility. Show how these activities have changed over time and indicate the current status. Make a clear distinction between active waste management units and older out of service waste management units. Identify which waste management units are regulated under RCRA or California Health and Safety Code.

Include maps showing: (1) all solid or hazardous waste treatment, storage or disposal areas active after November 19, 1980, (2) all known past solid waste or hazardous waste treatment, storage or disposal areas regardless of whether they were active on November 19, 1980 and (3) all known past or present underground tanks or piping.

f. Spill and Discharge History

Provide approximate dates or periods of past product and waste spills, identify the materials spilled and describe any response actions conducted. Include a summary of any sampling data generated as a result of the spill. Include a map showing approximate locations of spill areas at the facility.

g. Chronology of Critical Events

Provide a chronological list (including a brief description) of major events, communications, agreements, notices of violation, spills, discharges that occurred throughout the facility's history.

4. Environmental Setting

a. Location/Land Use

Discuss facility size, location and adjacent land use. Include a rough demographic profile of the human population who use or have access to the facility and adjacent lands. Provide approximate distance to nearest residential areas, schools, nursing homes, hospitals, parks, playgrounds, etc.

b. Local Ecology

Describe any endangered or threatened species near the facility. Include a description of the ecological setting on and adjacent to the facility. Provide approximate distance to nearest environmentally sensitive areas such as marsh lands, wetlands, streams, oceans, forests, etc.

c. Topography and Surface Drainage

Describe the regional and site specific topography and surface drainage patterns that exist at the facility. Include a map that shows the topography and surface drainage depicting all waterways, wetlands, floodplains, water features, drainage patterns and surface water containment areas.

d. Climate

Discuss mean annual temperatures, temperature extremes, 25-year 24-hour maximum rainfall, average annual rainfall, prevailing wind direction, etc.

e. Surface Water Hydrology

Describe the facility's proximity (distance) and access to surface water bodies (e.g., coastal waters, lakes, rivers, creeks, drainage basins, floodplains, vernal pools, wetlands, etc.). Describe flows on-site that lead to holding basins, etc., and describe flows that leave the site.

f. Geology

Describe the regional and site specific geology including stratigraphy and structure. Include a geologic map and cross-sections to show the subsurface structure. Cross-sections should be at a natural scale (vertical equals horizontal) and of sufficient detail to accurately plot cut and fills, alluvium, and structural features. Cross-sections should be taken on a grid pattern oriented normal to major geologic structure and spaced close enough to determine geology and ground water flow on a unit-by-unit basis.

g. Hydrogeology

Describe the regional and site specific hydrogeologic setting including any information concerning local aquifers, ground water levels, gradients, flow direction, hydraulic conductivity, and velocity. Include potentiometric surface contour maps. Describe the beneficial uses of the ground water (e.g., drinking water supply, agricultural water supply, etc.). Plot ground water elevations on the geologic cross-sections and indicate ground water flow directions and likely contaminant pathways. Describe temporal variations (seasonal and historical).

h. Ground Water Monitoring System

Describe the facility's ground water monitoring system including a table detailing the existing well construction. The table must, at a minimum, identify the following construction details for each well:

- (1). Well ID
- (2). Completion Date
- (3). Drilling Method
- (4). Borehole Diameter (inches)
- (5). Well Casing Diameter and Type
- (6). Measuring Point Elevation (feet MSL)
- (7). Borehole Depth (feet BGS)
- (8). Depth of Well (feet)
- (9). Screened Interval
- (10). Formation Screened
- (11). Slot Size & Type (inches)
- (12). Filter Pack Material
- (13). Filter Pack Thickness and Spacing
- (14). Type of Filter Pack Seal

- (15). Thickness of Filter Pack Seal
- (16). Pump System (dedicated or non-dedicated)
- (17). Type of Pump and Depth in the Well
- (18). Approximate Depth to Water (feet BGS)

If some of this information is not available, so indicate on the table with an "NA". {BGS: Below Ground Surface, MSL: Mean Sea Level}

The monitoring well locations must be shown on the facility map (see Section A.2 of this Attachment).

5. Existing Degree and Extent of Contamination

For each medium where the Permit or Order identifies a release (e.g., soil, ground water, surface water, air, etc.), describe the existing extent of contamination. This description must include all available monitoring data and qualitative information on the locations and levels of contamination at the facility (both onsite and offsite). Include a general assessment of the data quality, a map showing the location of all existing sampling points and potential source areas and contour maps showing any existing ground water plumes at the facility (if ground water release). Highlight potential ongoing release areas that would warrant use of interim corrective measures (see Section 8, Interim Corrective Measures).

a. Previous Investigations

List and briefly describe all previous investigations that have occurred at the facility, agencies (e.g., the Department's Site Mitigation Branch, the Regional Water Quality Control Board, etc.) which required and/or oversaw the investigations, and agency contacts.

6. Potential Migration Pathways

a. Physical Properties of Contaminants

Identify the applicable physical properties for each contaminant that may influence how the contaminant moves in the environment. These properties could include melting point (degrees C), water solubility (mg/l), vapor pressure (mm Hg), Henry's law constant (atm-m³/mol), density (g/cc), dynamic viscosity (cp), kinematic viscosity (cs), octanol/water partition coefficient (log K_{ow}), soil organic carbon/water partition coefficient (log k_{oc}) and soil/water partition coefficients, etc. Include a table that summarizes the applicable physical properties for each contaminant.

b. Conceptual Model of Contaminant Migration

Develop a conceptual model of contaminant migration. The conceptual model consists of a working hypothesis of how the contaminants may move from the release source to the receptor population. The conceptual model is developed by looking at the applicable physical parameters for each contaminant and assessing how the contaminant may migrate given the existing site conditions (geologic features, depth to ground water, etc.).

Describe the phase (water, soil, gas, non-aqueous) and location where contaminants are likely to be found (e.g., if a ground water contaminant has a low water solubility and a high density, then the contaminant will likely sink and be found at the bottom of the aquifer, phase: non-aqueous). Include a discussion of potential transformation reactions that could impact the type and number of contaminants (i.e., what additional contaminants could be expected as a result of biotic and abiotic transformation reactions given the existing soil conditions).

A typical conceptual model should include a discussion similar to the following: benzene, ethylbenzene, toluene and xylenes are potential contaminants at the facility. Based on their high vapor pressures and relatively low water solubilities (see Henry's Law constant), the primary fate of these compounds in surface soils or surface water is expected to be volatilization to the atmosphere. These mono-cyclic aromatic hydrocarbons may leach from soils into ground water. The log k_{oc} (soil organic carbon/water partition coefficient) values for these compounds ranges from 1.9 to 4.0, indicating that sorption to organic matter in soils or sediments may occur only to a limited extent.

7. Potential Impacts of Existing Contamination

Describe the potential impacts on human health and the environment from any existing contamination and/or ongoing activities at the facility. This description must consider the possible impacts on sensitive ecosystems and endangered species as well as on local populations. Potential impacts from any releases to ground water, surface water, soil (including direct contact with contaminated surface soil) and air (including evaporation of volatile organic compounds from contaminated soil) must be discussed. If air could be a significant pathway, soil gas or vapor emissions and/or ambient air monitoring should be described.

a. Ground Water Releases

Identify all wells (municipal, domestic, agricultural, industrial, etc.) within a 1-mile radius of the facility. Include a summary of available water sampling data for any identified municipal, industrial or domestic supply wells.

Develop a well inventory table that lists the following items for each identified well:

- (1). Well Designation
- (2). State ID
- (3). Reported Owner
- (4). Driller
- (5). Date of Completion
- (6). Original Use of Well
- (7). Current Use of Well
- (8). Drilling Method
- (9). Borehole Diameter (inches)
- (10). Casing Diameter (inches)
- (11). Perforated Interval (feet)
- (12). Gravel Pack Interval (feet)

- (13). Total Well Depth (feet)
- (14). Depth to Water (feet below ground surface)
- (15). Date of Water Level Measurement

If some of this information is not available, so indicate on the table with an "NA".

Include a regional map showing the facility, ground water flow direction (if known) and the location of all identified wells within a 1-mile radius of the facility.

Identify and describe any potential ground water discharge to surface water bodies.

Identify and list all relevant and applicable water standards for the protection of human health and the environment (e.g., maximum contaminant levels, water quality standards, etc).

b. Surface Water Releases

Discuss the facility's potential impact on surface water within a 2-mile radius of the facility. Describe the potential beneficial uses of the surface water (e.g., drinking water supply, recreational, agricultural, industrial, or environmentally sensitive). Identify all water supply intake points and contact areas within a 2-mile radius of the facility. Include a summary of the most recent water sampling data available for each of the identified water supply intake points. Include a description of the biota in surface water bodies on, adjacent to, or which can be potentially affected by the release. Also summarize any available sediment sampling data.

Include a regional map showing the facility, surface water flow direction, beneficial use areas, and the location of any identified water supply intake points or contact areas that are within a 2-mile radius of the facility.

c. Sensitive Ecosystems/Habitats

Discuss the facility's potential impact on sensitive ecosystems.

8. Interim Corrective Measures and Stabilization Assessment

Identify all corrective measures that were or are being undertaken at the facility to stabilize contaminant releases. Describe the objectives of the corrective measures including how the measure is mitigating a potential threat to human health and the environment. Summarize the design features of the corrective measure. Include a schedule for completing any ongoing or future work.

Identify and describe potential interim corrective measure alternatives that could be implemented immediately to stabilize any ongoing releases and/or prevent further migration of contaminants and control source areas.

9. Data Needs

Assess the amount and quality of existing data concerning the facility and determine what additional information must be collected to meet the objectives of the RFI. This assessment must identify any additional information that may be needed to (1) support development of interim measures for early action and (2) adequately evaluate and compare corrective measures alternatives (e.g., field work, treatability studies, computer modeling, literature searches, vendor contacts, etc.). For example, if soil vapor extraction (SVE) is a likely option to address contamination at the facility, then the RFI should collect applicable field data to assess SVE (e.g., soil gas analysis, depth to ground water, etc.). The RFI Workplan must detail how this additional information will be collected.

10. References

Provide a list of references cited in the Current Conditions Report.

B. RCRA Facility Investigation Workplan

The RFI Workplan shall define the procedures necessary to:

- o Gather all necessary data to determine where interim measures are needed and to support the use of interim measures to address immediate threats to human health and/or the environment, to prevent or minimize the spread of contaminants, to control sources of contamination and to accelerate the corrective action process (required for all releases);
- o Characterize the presence, magnitude, extent (horizontal and vertical), rate of movement and direction of any ground water contamination in and around the facility (only required for releases to ground water);
- o Characterize the geology and hydrogeology in and around the facility (only required for releases to ground water and possibly for releases to soil);
- o Characterize the presence, magnitude, extent (horizontal and vertical), rate of movement and direction of any soil contamination in and around the facility (only required for releases to soil);
- o Characterize the presence, magnitude, extent (horizontal and vertical), rate of movement and direction of any soil gas contamination in and around the facility (may be required for releases to ground water and/or soil depending on the circumstances);
- o Characterize the presence, magnitude, extent (horizontal and vertical), rate of movement and direction of any surface water contamination (includes surface water sediments) at the facility (only required for releases to surface water);
- o Characterize the presence, magnitude, extent (horizontal and vertical), rate of movement and direction of any air releases at the facility (only required for air releases);
- o Characterize any potential sources of contamination (required for all releases);

- o Characterize the potential pathways of contaminant migration (required for all releases);
- o Identify any actual or potential receptors (required for all releases);
- o Gather all data to support a risk and/or ecological assessment (if required);
- o Gather all necessary data to support the Corrective Measures Study (required for all releases). This could include conducting treatability, pilot, laboratory and/or bench scale studies to assess the effectiveness of a treatment method.

The RFI Workplan shall describe all aspects of the investigation, including project management, sampling and analysis, well drilling and installation and quality assurance and quality control. If the scope of the investigation is such that more than one phase is necessary, the "Phase 1" RFI Workplan must include a summary description of each phase. For example, the first phase of a RFI could be used to gather information necessary to focus the second phase into key areas of the facility that need further investigation.

The required format for a RFI Workplan is described below:

1. Introduction

Briefly introduce the RFI Workplan. Discuss the Order or Permit requiring the RFI and how the RFI Workplan is organized.

2. Investigation Objectives

a. Project Objectives

Describe the overall objectives and critical elements of the RFI. State the general information needed from the site (e.g., soil chemistry, hydraulic conductivity of aquifer, stratigraphy, ground water flow direction, identification of potential receptors, etc.). The general information should be consistent with the objectives of the RFI and the data needs identified in the Current Conditions Report.

b. Data Quality Objectives

Provide data quality objectives that identify what data are needed and the intended use of the data.

3. Project Management

a. Describe how the investigation will be managed, including the following information:

- (1). Organization chart showing key personnel, levels of authority and lines of communication;

- (2). Project Schedule; and
- (3). Estimated Project Budget.

b. Identify the individuals or positions who are responsible for: project management, field activities, laboratory analysis, database management, overall quality assurance, data validation, etc. Include a description of qualifications for personnel performing or directing the RFI, including contractor personnel.

4. Facility Background

Summarize existing contamination (e.g., contaminants, concentrations, etc.), local hydrogeologic setting and any other areas of concern at the facility. Include a map showing the general geographic location of the facility and a more detailed facility map showing the areas of contamination. Provide a reference to the Current Conditions Report and/or other applicable documents as a source of additional information.

5. Field Investigation

a. Task Description

Provide a qualitative description of each investigation task. Example tasks may include, but are not limited to the following:

- (1). Task 1: Surface Soil Sampling
- (2). Task 2: Surface Geophysics, Subsurface Soil Boring, and Borehole Geophysics
- (3). Task 3: Data Gathering to Support Interim Corrective Measures
- (4). Task 4: Monitoring Well Installation
- (5). Task 5: Aquifer Testing
- (6). Task 6: Ground Water Sampling
- (7). Task 7: Potential Receptor Identification
- (8). Task 8: Treatability Studies

b. Rationale for Sampling

Describe where all samples will be collected (location and depth), types of media that will be sampled and the analytical parameters. Explain the rationale for each sampling point, the total number of sampling points, and any statistical approach used to select these points. The conceptual model of contaminant migration developed in the Current Conditions Report should be considered when selecting sampling locations and depths.

If some possible sampling points are excluded, explain why. Describe any field screening techniques that will be used to identify samples for laboratory analysis. Include the rationale for use of field screening techniques and criteria for sample selection.

(1). Background Samples

Background samples should be analyzed for the complete set of parameters for each medium; treat sediments, surface soils and subsurface soils as separate media. Background samples are collected, numbered, packaged, and sealed in the same manner as other samples. For long term and/or especially large projects, it is recommended that 10% of samples collected be from background locations.

c. Sample Analysis

(1) List and discuss all analyses proposed for the project. Include a table that summarizes the following information for each analysis to be performed:

(A). Analytical Parameters

(B). Analytical Method Reference Number (from U.S. EPA SW 846)

(C). Sample Preparation and/or Extraction Method Reference Number (from U.S. EPA SW 846)

(D). Detection and Practical Quantitation Limits (Data above the detection limit but below the practical quantitation limit must be reported with the estimated concentration.)

(2). Discuss the rationale for selection of the analytical parameters. The rationale must relate to site history and the RFI objectives. The achievable detection limits or quantitation limits stated in the selected methods must be adequate for valid comparisons of analytical results against any action levels or standards. For example, the objective may be to collect ground water data for comparison with Maximum Contaminant Levels (MCL's). If this were the case, it would be important to ensure that any ground water test methods had detection limits below the MCL's. Give an explanation if all samples from the same medium will not be analyzed for the same parameters.

(3). Provide the name(s) of the laboratory(s) that will be doing the analytical work. Indicate any special certifications or ratings of the laboratory. Describe the steps that will be taken to select and pre-qualify analytical laboratories to be used including any previous audits and/or other criteria. If a definite laboratory has not yet been selected, list at least 3 laboratories that are being considered for the analytical work.

d. Sample Collection Procedures

- (1) Describe how sampling points will be selected in the field, and how these locations will be documented and marked for future reference. If a sampling grid will be used, describe the dimensions and lay out planned for the grid.

Outline sequentially or step-by-step the procedure for collecting a sample for each medium and each different sampling technique. Include a description of sampling equipment (including materials of construction), field measurements, sample preservation, housekeeping/cleanliness techniques and well purging procedures. The procedure described must ensure that a representative sample is collected, and that sample handling does not result in cross contamination or unnecessary loss of contaminants. Special care in sample handling for volatile organic samples must be addressed.

Describe how and when duplicates, blanks, laboratory quality control samples and background samples will be collected. If samples will be filtered, describe filtration equipment and procedures.

The Owner/Operator or Respondent must include sufficient maps and tables to fully describe the sampling effort. This shall include, at a minimum, a map showing all proposed sampling locations and tables that contain the following information:

(A) Sample Collection Table:

Sampling Location/Interval
Analytical Parameters (e.g., volatile organic compounds)
Analytical Method Number
Medium
Preservation Method
Holding Times (as specified in U.S. EPA SW 846)
Containers (quantity, size, type plus footnotes that discuss source and grade of containers)

(B) Sample Summary Table:

Sample Description/Area (include QC samples)
Analytical Parameters
Analytical Method Number
Preparation or Extraction Method Number
Medium
Number of Sample Sites
Number of Analyses

(2) Equipment Decontamination

Describe the decontamination procedure for all drilling, sampling equipment (including metal sleeves), and field-parameter testing equipment.

The following is a recommended generic procedure for decontamination of sampling equipment:

- o Wash with non-phosphate detergent
- o Tap water rinse
- o 0.1M nitric acid rinse (when cross contamination from metals is a concern)
- o Deionized/distilled water rinse
- o Pesticide grade solvent rinse (when semivolatiles and non-volatile organic contamination may be present)
- o Deionized/distilled water rinse (twice)
- o Organic free water rinse (HPLC grade)

The above procedure is not appropriate for every field condition. Clearly document the decontamination procedures.

(3) Equipment Calibration and Maintenance

Logbooks or pre-formatted calibration worksheets should be maintained for major field instruments, to document servicing, maintenance and instrument modification. The calibration, maintenance and operating procedures for all instruments, equipment and sampling tools must be based upon manufacturer's instructions. List all field equipment to be used, specify the maintenance/calibration frequency for each instrument and the calibration procedures (referenced in text and included in appendices).

(4) Sample Packaging and Shipment

Describe how samples will be packaged and shipped. All applicable Department of Transportation regulations must be followed.

(5) Sample Documentation

Discuss the use of all paperwork including field notebooks, record logs, photographs, sample paperwork, and Chain of Custody forms (include a blank copy in RFI Workplan Appendices) and seals.

Describe how sample containers will be labeled and provide an example label if available. At a minimum, each sample container label should include: project ID, sample location, analytical parameters, date sampled and any preservative added to the sample.

A bound field log book must be maintained by the sampling team to provide a daily record of events. Field log books shall provide the means of recording all data regarding sample collection. All documentation in field books must be made in permanent ink. If an error is made, corrections must be made by crossing a line through the error and entering the correct information. Changes must be initialed, no entries shall be obliterated or rendered unreadable. Entries in the log book must include, at a minimum, the following for each day's sampling:

- Date
- Starting Time
- Meteorological Conditions
- Field Personnel Present
- Level of Personal Protection
- Site Identification
- Field Observations/Parameters
- Sample Identification Numbers
- Location and Description of Sampling Points
- Number of Samples Collected
- Time of Sample Collection
- Signature of Person Making the Entry
- Observation of Sample Characteristics
- Photo Log
- Deviations

(6). Disposal of Contaminated Materials

Describe the storage and disposal methods for all contaminated cuttings, well development and purge water, disposable equipment, decontamination water, and any other contaminated materials. The waste material must be disposed of in a manner consistent with local, state and federal regulations.

(7). Standard Operating Procedures

If Standard Operating Procedures (SOPs) are referenced, the relevant procedure must be summarized in the RFI Workplan. The SOP must be specific to the type of tasks proposed and be clearly referenced in the RFI Workplan. The SOP must also be directly applicable, as written, to the RFI Workplan; otherwise, modifications to the SOP must be discussed. Include the full SOP description in the RFI Workplan appendix.

e. Well Construction and Aquifer Testing

When new monitoring wells (or piezometers) are proposed, describe the drilling method, well design and construction details (e.g., depth of well, screen length, slot size, filter pack material, etc.) and well development procedures. Describe the rationale for proposed well locations and selection of all well design and construction criteria (i.e., provide rationale for selection of slot size and screen length).

When aquifer testing is proposed, describe the testing procedures, flow rates, which wells are involved, test periods, how water levels will be measured, and any other pertinent information.

6. Quality Assurance and Quality Control

Quality control checks of field and laboratory sampling and analysis serve two purposes: to document the data quality, and to identify areas of weakness within the measurement process which need correction.

Include a summary table of data quality assurance objectives that, at a minimum, lists:

- o Analysis Group (e.g., volatile organic compounds)
- o Medium
- o Practical Quantitation Limits (PQL)
- o Spike Recovery Control Limits (%R)
- o Duplicate Control Limits +/- (RPD)
- o QA Sample Frequency
- o Data Validation

A reference may note the specific pages from U.S. EPA's SW 846 Guidance Document that list the test method objectives for precision and accuracy. If the field and laboratory numerical data quality objectives for precision are the same and presented on a single table, then a statement should be made to this effect and added as a footnote to the table (e.g., "These limits apply to both field and laboratory duplicates"). Include a copy of the analytical laboratory quality assurance/quality control plan in the appendices of the RFI Workplan and provide the equations for calculating precision and accuracy.

a. Field Quality Control Samples

(1). Field Duplicates

Duplicates are additional samples that must be collected to check for sampling and analytical precision. Duplicate samples for all parameters and media must be collected at a frequency of at least one sample per week or 10 percent of all field samples, whichever is greater.

Duplicates should be collected from points which are known or suspected to be contaminated. For large projects, duplicates should be spread out over the entire site and collected at regular intervals.

Duplicates must be collected, numbered, packaged, and sealed in the same manner as other samples; duplicate samples are assigned separate sample numbers and submitted blind to the laboratory.

(2). Blank Samples

Blanks are samples that must be collected to check for possible cross-contamination during sample collection and shipment and in the laboratory. Blank samples should be analyzed for all parameters being evaluated. At least one blank sample per day must be done for all water and air sampling. Additionally, field blanks are required for soil sampling if non-dedicated field equipment is being used for sample collection.

Blank samples must be prepared using analytically-certified, organic-free (HPLC-grade) water for organic parameters and metal-free (deionized-distilled) water for inorganic parameters. Blanks must be collected, numbered, packaged, and sealed in the same manner as other samples; blank samples are assigned separate sample numbers and submitted blind to the laboratory. The following types of blank samples may be required:

- (A). Equipment Blank: An equipment blank must be collected when sampling equipment (e.g., bladder pump) or a sample collection vessel (e.g., a bailer or beaker) is decontaminated and reused in the field. Use the appropriate "blank" water to rinse the sampling equipment after the equipment has been decontaminated and then collect this water in the proper sample containers.
- (B). Field Bottle Blank: This type of blank must be collected when sampling equipment decontamination is not necessary. The field bottle blank is obtained by pouring the appropriate "blank" water into a container at a sampling point.

b. Laboratory Quality Control Samples

Laboratories routinely perform medium spike and laboratory duplicate analysis on field samples as a quality control check. A minimum of one field sample per week or 1 per 20 samples (including field blanks and duplicates), whichever is greater, must be designated as the "Lab QC Sample" for the medium and laboratory duplicate analysis.

Laboratory quality control samples should be selected from sampling points which are suspected to be moderately contaminated. Label the bottles and all copies of the paperwork as "Lab QC Sample"; the laboratory must know that this sample is for their QC analyses. The first laboratory QC sample of the sampling effort should be part of the first or second day's shipment. Subsequent laboratory QC samples should be spread out over the entire sampling effort.

For water media, 2-3 times the normal sample volume must be collected for the laboratory QC sample. Additional volume is usually not necessary for soil samples.

c. Performance System Audits by the Owner/Operator or Respondent

This section should describe any internal performance and/or system audit which the Owner/Operator or Respondent will conduct to monitor the capability and performance of the project. The extent of the audit program should reflect the data quality needs and intended data uses. Audits are used to quickly identify and correct problems thus preventing and/or reducing costly errors. For example, a performance audit could include monitoring field activities to ensure consistency with the workplan. If the audit strategy has already been addressed in a QA program plan or standard operating procedure, cite the appropriate section which contains the information.

7. Data Management

Describe how investigation data and results will be evaluated, documented and managed, including development of an analytical database. State the criteria that will be used by the project team to review and determine the quality of data. To document any quality assurance anomalies, the RFI QC Summary Forms (see Appendix A of this attachment) must be completed by the analytical laboratory and submitted as part of the RFI Report. In addition, provide examples of any other forms or checklists to be used.

Identify and discuss personnel and data management responsibilities, all field, laboratory and other data to be recorded and maintained, and any statistical methods that may be used to manipulate the data.

8. References

Provide a list of references cited in the RFI Workplan.

C. RCRA Facility Investigation Report

1. A RFI Report must be prepared that describes the entire site investigation and presents the basic results. The RFI Report must clearly present an evaluation of investigation results (e.g., all potential contaminant source areas must be identified, potential migration pathways must be described, and affected media shown, etc.).
2. The RFI Report must also include an evaluation of the completeness of the investigation and indicate if additional work is needed. This work could include additional investigation activities and/or interim corrective measures to stabilize contaminant release areas and limit contaminant migration. If additional work is needed, the Owner/Operator or Respondent must submit a Phase 2 RFI Workplan and/or Interim Corrective Measures Workplan must be submitted to the Department along with the RFI Report.
3. At a minimum, the RFI Report must include:
 - a. A summary of investigation results (include tables that summarize analytical results).
 - b. A complete description of the investigation, including all data necessary to understand the project in its entirety including all investigative methods and procedures.

- c. A discussion of key decision points encountered and resolved during the course of the investigation.
 - d. Graphical displays such as isopleths, potentiometric surface maps, cross-sections, plume contour maps (showing concentration levels, isoconcentration contours), facility maps (showing sample locations, etc.) and regional maps (showing receptor areas, water supply wells, etc.) that describe report results. Highlight important facts such as geologic features that may affect contaminant transport.
 - e. Tables that list all chemistry data for each medium investigated.
 - f. An analysis of current and existing ground water data to illustrate temporal changes for both water chemistry and piezometric data (use graphics whenever possible).
 - g. A description of potential or known impacts on human and environmental receptors from releases at the facility. Depending on the site specific circumstances, this analysis could be based on the results from contaminant dispersion models if field validation is performed.
 - h. A discussion of any upset conditions that occurred during any sampling events or laboratory analysis that may influence the results. The discussion must include any problems with the chain of custody procedures, sample holding times, sample preservation, handling and transport procedures, field equipment calibration and handling, field blank results that show potential sample contamination and any field duplicate results that indicate a potential problem. Summary tables must be provided that show the upset condition and the samples that could be impacted. The RFI QC Summary Forms (see Appendix A of this attachment) must be completed by the analytical laboratory and submitted as part of the RFI Report.
 - I. Assessment of the entire QA/QC program effectiveness.
 - j. Data validation results should be documented in the RFI Report.
4. In addition to the RFI Report, the Department may require the Owner/Operator or Respondent to submit the analytical results (database) on a floppy disk (Department will specify the format). All raw laboratory and field data (e.g., analytical reports) must be kept at the facility and be made available or sent to the Department upon request.

**ATTACHMENT D
APPENDIX A**

RCRA INVESTIGATION QC SUMMARY FORMS

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REGION 9 RCRA FACILITY INVESTIGATION LABORATORY QC SUMMARY

Inorganic Analyses

PART 1: SUMMARY OF QC LIMITS

Method:

LABORATORY:
 COMPLETED BY:
 ORGANIZATION:
 DATE:

SITE/PROJECT:
 NUMBER OF SAMPLES:
 TYPE OF SAMPLES:
 BATCH NUMBER:

| QC SUMMARY ELEMENT | LABORATORY CONTROL LIMITS | FREQUENCY PERFORMED |
|--|---------------------------|---------------------|
| LABORATORY BLANKS | | |
| SAMPLE DUPLICATE %RPD | | |
| LABORATORY CONTROL SAMPLE RECOVERY | | |
| STANDARD ADDITION RESULTS* | | |
| ICP SERIAL DILUTION %D | | |
| SPIKED SAMPLE RECOVERY | | |
| INITIAL CALIBRATION VERIFICATION %D | | |
| CONTINUING CALIBRATION VERIFICATION %D | | |
| INTERFERENCE CHECK SAMPLE RECOVERY | | |

* expressed as the correlation coefficient

Describe any method modifications or specific problem areas:

1. Does the laboratory have access to the project QAPJP? YES/NO
2. Are the Laboratory Control Limits listed above the same as the limits in the QAPJP? YES/NO
3. Were there QC results outside the stated Control Limits or Frequency listed above? YES/NO
4. If yes to 3, report, in PART 2, all QC results which are outside the stated QC limits or frequency.
5. Was a Case Narrative, describing any difficulties and deviations submitted? YES/NO

All information reported on this form are certified true and correct.

Name: _____
 Title: _____
 Date: _____

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REGION 9 RCRA FACILITY INVESTIGATION LABORATORY QC SUMMARY

Organic Analyses

PART 1: SUMMARY OF QC LIMITS

Method:

LABORATORY:
 COMPLETED BY:
 ORGANIZATION:
 DATE:

SITE/PROJECT:
 NUMBER OF SAMPLES:
 TYPE OF SAMPLES:
 BATCH NUMBER:

| QC SUMMARY ELEMENT | LABORATORY CONTROL LIMITS | FREQUENCY PERFORMED |
|---------------------------------------|---------------------------|---------------------|
| LABORATORY BLANKS | | |
| INITIAL CALIBRATION - % RSD | | |
| CONTINUING CALIBRATION - % D | | |
| MATRIX SPIKE/SPIKE DUPLICATE RECOVERY | | |
| MATRIX SPIKE/SPIKE DUPLICATE % RPD | | |
| SURROGATE PERCENT RECOVERY | | |
| INTERNAL STANDARD AREA | | |
| SECOND COLUMN CONFIRMATION | | |

1. Method surrogates used:

2. Internal standards used:

3. Describe any method modifications or specific problem areas:

1. Does the laboratory have access to the project QAPJP? YES/NO
2. Are the Laboratory Control Limits listed above the same as the limits in the QAPJP? YES/NO
3. Were there QC results outside the stated Control Limits or Frequency listed above? YES/NO
4. If yes to 3, report, in PART 2, all QC results which are outside the stated QC limits or frequency.
5. Was a Case Narrative, describing any difficulties and deviations submitted? YES/NO

All information reported on this form are certified true and correct.

Name: _____
 Title: _____
 Date: _____

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ATTACHMENT E

SCOPE OF WORK FOR A CORRECTIVE MEASURES STUDY

PURPOSE

The purpose of the Corrective Measures Study (CMS) is to identify and evaluate potential remedial alternatives to address contaminant releases from a facility.

SCOPE

A Corrective Measures Study Workplan and a Corrective Measures Study Report are, unless otherwise specified by the Department of Toxic Substances Control (Department), required elements of the CMS. The Scope of Work (SOW) for the Corrective Measures Study Workplan and Report describe what should be included in each document. The SOWs are intended to be flexible documents capable of addressing both simple and complex site situations. If the Owner/Operator or Respondent can justify, to the satisfaction of the Department, that sections of a plan and/or report are not needed in the given site specific situation, then the Department may waive that requirement.

The scope and substance of the CMS should be focused to fit the complexity of the site-specific situation. It is anticipated that Owner/Operator's or Respondent's of sites with complex environmental problems may need to evaluate a number of technologies and corrective measure alternatives. For other facilities, however, it may be appropriate to evaluate a single corrective measure alternative.

The Department may require the Owner/Operator or Respondent to conduct additional studies beyond what is discussed in the SOWs in order to support the CMS. The Owner/Operator or Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks. The SOW for the Corrective Measures Study Workplan and Report are specified below:

A. Corrective Measures Study Workplan

The purpose of the Corrective Measures Study (CMS) Workplan is to specify how the CMS Report will be prepared. The CMS Workplan shall, at a minimum, include the following elements:

1. A brief project summary;
2. A site-specific description of the overall purpose of the CMS;
3. A description of the proposed media cleanup standards and points of compliance that will be used in the corrective measures study report. Include the justification and supporting rationale for the proposed media cleanup standards and points of compliance. The proposed media cleanup standards must be based on available promulgated federal and state cleanup standards, risk based

analysis, data and information gathered during the corrective action process (e.g., from RCRA Facility Investigation, etc.), and/or information from other applicable guidance documents. The Department may require that the Owner/Operator or Respondent conduct a risk assessment to gather information for establishing cleanup standards. Based on the CMS Report and other information including public comments, the Department will establish final cleanup standards and points of compliance as part of the remedy selection process.

4. A description of the specific corrective measure technologies and/or corrective measure alternatives which will be studied;
5. A description of the general approach to investigating and evaluating potential corrective measures;
6. A detailed description of any proposed treatability, pilot, laboratory and/or bench scale studies. Proposed studies must be further detailed in either the CMS Workplan or in separate workplans. Submittal times for separate workplans must be included in the CMS Workplan project schedule;
7. A proposed outline for the CMS Report including a description of how information will be presented;
8. A description of overall project management including overall approach, levels of authority (include organization chart), lines of communication, budget and personnel. Include a description of qualifications for personnel directing or performing the work; and
9. A project schedule that specifies all significant steps in the process and when key documents (e.g., CMS Report) are to be submitted to the Department.

B. Corrective Measures Study Report

The CMS Report shall, at a minimum, include the following elements:

1. Introduction/Purpose

Describe the purpose and intent of the document.

2. Description of Current Conditions

The Owner/Operator or Respondent shall include a brief discussion of any new information that has been developed since the RCRA Facility Investigation Report was finalized. This discussion should concentrate on those issues which could significantly affect the evaluation and selection of the corrective measure alternative(s).

3. Proposed Media Cleanup Standards

The Owner/Operator or Respondent shall describe and justify the proposed media cleanup standards and points of compliance.

4. Identification and Screening of Corrective Measure Technologies

a. Identification

List and briefly describe potentially applicable technologies for each affected media that may be used to achieve the media cleanup standards. The Owner/Operator or Respondent should consider including a table that summarizes the available technologies.

The Owner/Operator or Respondent should consider innovative treatment technologies, especially in situations where there are a limited number of applicable corrective measure technologies. Innovative technologies are defined as those technologies for source control other than incineration, solidification/stabilization and pumping with conventional treatment for contaminated ground water. Innovative treatment technologies may require extra initial effort to gather information, analyze options and to adapt the technology to site specific situations. However, in the long run, innovative treatment technologies could be more cost effective. Treatability studies and on-site pilot scale studies may be necessary for evaluating innovative treatment technologies.

b. Screening

Technologies must be screened to eliminate those that may prove unfeasible to implement given the existing set of waste and site-specific conditions. The screening is accomplished by evaluating technology limitations (e.g., for volume, area, contaminant concentrations, interferences, etc.) and using contaminant and site characterization information from the RCRA Facility Investigation to screen out technologies that cannot be fully implemented at the facility. The screening process must focus on eliminating those technologies which have severe limitations for a given set of waste and site-specific conditions (e.g., depth to ground water and aquitards). As with all decisions during the CMS, the screening of technologies must be fully documented. This is especially true if the screening step indicates that only one corrective action technology should proceed to the next step and be evaluated in detail. List the corrective action technologies selected for further evaluation. Also document the reasons for excluding any corrective action technologies. The Owner/Operator or Respondent should consider including a table that summarizes the findings.

5. Corrective Measure Alternative Development

Assemble the technologies that pass the screening step into specific alternatives that have potential to meet the corrective action objectives. Options for addressing less complex sites could be relatively straightforward and may only require evaluation of a single or limited number of alternatives.

Each alternative may consist of an individual technology or a combination of technologies used in sequence (e.g., treatment train). Depending on the site specific situation, different alternatives may be considered for separate areas of the facility. List and briefly describe each corrective measure alternative.

6. Evaluation of Corrective Measure Alternatives

The four corrective action standards and five remedy selection decision factors described below shall be used to evaluate the corrective measure alternatives. All alternatives must meet the corrective action standards before the remedy selection decision factors are used for further evaluation.

The corrective action standards are as follows:

- o Be protective of human health and the environment;
- o Attain media cleanup standards;
- o Control the source(s) of releases in order 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
- o Comply with any applicable federal, state, and local standards for management of wastes.

The remedy selection decision factors are as follows:

- o Short- and Long-Term Effectiveness;
- o Reduction of Toxicity, Mobility and/or Volume;
- o Long-Term Reliability;
- o Implementability; and
- o Cost.

The corrective action standards and decision factors are described in further detail below.

a. Be Protective of Human Health and the Environment

Describe in detail how each corrective measure alternative is protective of human health and the environment.

This standard for protection of human health and the environment is a general mandate of the RCRA statute. The standard requires that remedies include any measures that are needed to be protective. These measures may or may not be directly related to media cleanup, source control, or management of wastes. An example would be a requirement to provide alternative drinking water supplies in order to prevent exposures to a contaminated drinking water supply.

b. Attain Media Cleanup Standards

Describe in detail each corrective measure alternatives ability to meet the proposed media cleanup standards.

c. Control the Sources of Releases

Describe in detail each corrective measure alternatives ability to control the sources of releases.

A critical objective of any remedy must be to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to cleanup releases may be ineffective or, at best, will essentially involve a perpetual cleanup. Therefore, an effective source control program is essential to ensure the long-term effectiveness and protectiveness of the corrective action effort.

The source control standard is not intended to mandate a specific remedy or class of remedies. Instead, the Owner/Operator or Respondent is encouraged to examine a wide range of options. This standard should not be interpreted to preclude the equal consideration of using other protective remedies to control the source, such as partial waste removal, capping, slurry walls, in-situ treatment/stabilization and consolidation.

d. Comply With Any Applicable Standards for Management of Wastes

Discuss how any specific waste management activities will be conducted in compliance with all applicable state or federal regulations (e.g., CAMU closure requirements, land disposal restrictions).

e. Short- and Long-Term Effectiveness

Each corrective measure alternative must be evaluated with regard to its effectiveness in protecting human health and the environment and meeting the proposed media cleanup standards. Both short- and long-term components of effectiveness must be evaluated; short-term referring to the construction and implementation period, and long-term referring to the period after the remedial action is complete. Estimate approximately how much time it will take to implement each corrective measure alternative, the length of time before initial beneficial results are obtained, and the length of time required to achieve the proposed media cleanup standards.

The evaluation of short-term effectiveness must include possible threats to the safety of nearby communities, workers, and environmentally sensitive areas (e.g., oceans, wetlands) during construction of the corrective measure alternative. Factors to consider are fire, explosion, exposure to hazardous substances and potential threats associated with treatment, excavation, transportation and re-disposal or containment of waste material. Laboratory and/or field studies are extremely useful in estimating the effectiveness of corrective measures and should be used whenever possible.

The evaluation of long-term effectiveness must include possible threats to the safety of nearby communities workers, and environmentally sensitive areas (e.g., oceans, wetlands) during operation of the corrective measure alternative.

f. Reduction of Toxicity, Mobility and/or Volume

Each corrective measure alternative must be evaluated for its ability to reduce the toxicity, mobility, and/or volume of the contaminated media. Reduction in toxicity, mobility, and/or volume refers to changes in one or more characteristics of the contaminated media by the use of corrective measures that decrease the inherent threats associated with the media.

Estimate how much the corrective measure alternative will reduce the waste toxicity, volume and/or mobility (compare initial site conditions to post-corrective measure conditions). In general, the Department strongly prefers corrective measures that have a high degree of permanence and reduce the contaminant toxicity, mobility and volume through treatment.

g. Long-Term Reliability

Each corrective measure alternative must be evaluated with regards to its long-term reliability. This evaluation includes consideration of operation and maintenance requirements.

Demonstrated and expected reliability is a way of assessing the risk and effect of failure. Discuss whether the technology or combination of technologies have been used effectively together under analogous site conditions, whether failure of any one technology in the alternative has an impact on receptors or contaminant migration, and whether the alternative would have the flexibility to deal with uncontrollable changes at the site (e.g., heavy rain storms, earthquakes, etc).

Operation and maintenance requirements include the frequency and complexity of necessary operation and maintenance. Technologies requiring frequent or complex operation and maintenance activities should be regarded as less reliable than technologies requiring little or straightforward operation and maintenance. The availability of labor and materials to meet these requirements must also be considered.

Most corrective measure technologies, with the exception of destruction, deteriorate with time. Often, deterioration can be slowed through proper system operation and maintenance, but the technology eventually may require replacement. Each corrective measure alternative shall be evaluated in terms of the projected useful life of the overall alternative and of its component technologies. Useful life is defined as the length of time the necessary or required level of effectiveness can be maintained.

h. Implementability of Corrective Measure Alternatives

The implementability criterion addresses the technical and administrative feasibility of implementing a corrective measure alternative and the availability of various services and materials needed during implementation. Each corrective measure alternative must be evaluated using the following criteria:

- (1). **Construction and Operation:** Corrective measure alternatives must be feasible to implement given the existing set of waste and site-specific conditions. This evaluation was initially done for specific technologies during the screening process and is addressed again in this detailed analysis of the alternative as a whole. It is not intended that the screening process be repeated here, but instead to highlight key differences and/or changes from the screening analysis that may result from combining technologies.
- (2). **Administrative Feasibility:** Discuss the administrative activities needed to implement the corrective measure alternative (e.g., permits, public acceptance, rights of way, off-site approvals, etc.).

Availability of Services and Materials: Discuss the availability of adequate off-site treatment, storage capacity, disposal services, needed technical services and materials, and the availability of prospective technologies for each corrective measure alternative.

i. Cost

Develop a preliminary cost estimate for each corrective measure alternative (and for each phase or segment of the alternative). The cost estimate shall include both capital and operation and maintenance costs. Include a description of how the costs were estimated and what assumptions were used.

- (1). The preliminary capital cost estimate must consider all key costs including, at a minimum, costs for engineering, mobilization, demobilization, site preparation, construction, materials, labor, equipment purchase and rental, sampling, analysis, waste disposal, permitting and health and safety measures.
- (2). The preliminary operation and maintenance cost estimate must consider all key costs including, at a minimum, costs for labor, training, sampling, analysis, maintenance materials, utilities, waste disposal, waste treatment, permitting and health and safety measures.
- (3). Calculate the net present value of preliminary capital and operation and maintenance costs for each corrective measure alternative.

7. Owner/Operator or Respondent's Recommended Corrective Measure Alternative

The Owner/Operator or Respondent may recommend a preferred corrective measure alternative for consideration by the Department. Such a recommendation should include a description and supporting rationale for the preferred alternative that is consistent with the corrective action standards and remedy selection decision factors discussed above.

Based on the CMS Report and other information including public comments, the Department will establish final cleanup standards, points of compliance and will select a final remedy for the facility.

ATTACHMENT F

SCOPE OF WORK FOR HEALTH AND SAFETY PLAN

The Department of Toxic Substances Control (Department) may require that the Owner/Operator or Respondent prepare a Health and Safety Plan for any corrective action field activity (e.g., soil or ground water sampling, drilling, construction, operation and maintenance of a treatment system, etc.). The Health and Safety Plan must, at a minimum, include the following elements:

1. Objectives

Describe the goals and objectives of the Health and Safety Plan (must apply to on-site personnel and visitors). The Health and Safety Plan must be consistent with the facility Contingency Plan, OSHA Regulations, NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (1985), all state and local regulations and other Department guidance as provided.

2. Hazard Assessment

List and describe the potentially hazardous substances that could be encountered by field personnel during field activities.

Discuss the following:

- a. Inhalation Hazards
- b. Dermal Exposure
- c. Ingestion Hazards
- d. Physical Hazards
- e. Overall Hazard Rating

Include a table that, at a minimum, lists: Known Contaminants, Highest Observed Concentration, Media, Symptoms/Effects of Acute Exposure.

3. Personal Protection/Monitoring Equipment

For each field task, describe personal protection levels and identify all monitoring equipment.

Describe any action levels and corresponding response actions (i.e., when will levels of safety be upgraded).

Describe decontamination procedures and areas.

4. Site Organization and Emergency Contacts

List and identify all contacts (include phone numbers). Identify the nearest hospital and provide a regional map showing the shortest route from the facility to the hospital. Describe site emergency procedures and any site safety organizations. Include evacuation procedures for neighbors (where applicable).

Include a facility Map showing emergency station locations (first aid, eye wash areas, etc.).

ATTACHMENT G

SCOPE OF WORK FOR A PUBLIC INVOLVEMENT PLAN

The Public Involvement Plan (PIP) must address the public involvement needs for all aspects of corrective action including Interim Measures, RCRA Facility Investigation (RFI), Corrective Measures Study (CMS), and Corrective Measures Implementation (CMI) (if required). The PIP must be updated as necessary to address changing public concerns and situations. For additional information, see the U.S. EPA guidance document, RCRA Public Involvement Manual and the Department of Toxic Substances Control's (Department) guidance document for community relation program. The PIP shall, unless the Department specifies otherwise, include the following elements:

1. Introduction

Describe the public involvement goals and objectives for corrective action (e.g., provide the community with information updates and respond to inquiries, provide for citizen input and involvement).

The amount of public involvement work must be consistent with the nature and degree of community concerns and with any state or federal requirements. The public involvement program should be flexible and able to respond to changing public concerns as the corrective action process proceeds from the RFI to the CMS and into CMI.

2. Public Involvement Background

Identify and describe any known issues or community concerns. Indicate if any community or local officials have been interviewed. Acquire and describe demographic information about the potentially impacted community.

3. Techniques to Reach Public Involvement Goals

Many community relations techniques may be used to accomplish the objectives. These techniques include: fact sheets, press releases, informal community workgroup meetings, community advisory committees, community meetings, information repositories, mailing lists and public service announcements. Include a detailed description of how the local community will be contacted and informed. At a minimum, the following items must be developed as described below:

a. Mailing List

Establish and maintain a mailing list of all: local officials; interested, affected and potentially affected private citizens; residents within a one-half mile radius of the facility; and news media representatives who should receive fact sheets or other information regarding the investigation/mitigation activities at the facility. The mailing list should at least include those on the mailing list developed for the RCRA permitting process. The mailing list must be expanded as time goes on to include all interested persons. The mailing list should be submitted to the Department separately from the PIP.

b. Information Repository

Establish and maintain an information repository at a location convenient to public access (e.g., local library). The purpose of the information repository is to allow open and convenient public access to all site-related documents approved by the agency for public disclosure. At a minimum, the repository for a site must include copies of the following:

- o Administrative Order or Consent Decree;
- o RFI Workplans;
- o RFI Reports;
- o Interim Measures Workplans;
- o Corrective Measures Study Workplans;
- o Corrective Measures Study Reports;
- o Public Involvement Plan;
- o Statement of Basis for Remedy Selection; and

other Information:

- o Copy of RCRA;
- o Copies of press releases and newspaper clippings that refer to the site;
- o Brochures, fact sheets, and other information about RCRA program and specific site; and
- o Any other relevant material (e.g., published studies on the potential risks associated with specific chemicals that have been found at the site).

c. Fact Sheets

The Respondent shall prepare fact sheets to inform the community of key events in the corrective action process (e.g., interim measures, RFI, RFI findings, etc.).

It is important that all fact sheets be written clearly so that the public will understand the information. In general, facility fact sheets should include a description of the overall investigation/remedial process from start to finish, a summary of existing contamination at the facility, a summary of possible impacts on the local community (e.g., drinking water supplies, etc.), a summary of any interim measures being taken or planned at the facility, a synopsis of upcoming tasks, and a brief description about the potential uses, available documents, and the location of the information repository.

4. Submittal Schedule

The submittal schedule must specify when key documents are to be submitted to the Department and when public involvement activities are to be implemented.

ATTACHMENT H

SCOPE OF WORK FOR CORRECTIVE MEASURES IMPLEMENTATION

PURPOSE

The purpose of the Corrective Measures Implementation (CMI) program is to design, construct, operate, maintain and monitor the performance of the corrective measure or measures selected by the Department. Corrective measures are intended to protect human health and/or the environment from hazardous waste releases from the Facility. The Owner/Operator or Respondent will furnish all personnel, materials and services necessary to implement the corrective measures program.

SCOPE

The documents required for Corrective Measures Implementation are, unless the Department of Toxic Substances Control (Department) specifies otherwise, a Corrective Measures Implementation Workplan, Operation and Maintenance Plan, Draft Plans and Specifications, Final Plans and Specifications, Construction Workplan, Construction Completion Report and Corrective Measure Completion Report. The scope of work (SOW) for each document is specified below. The SOWs are intended to be flexible documents capable of addressing both simple and complex site situations. If the Owner/Operator or Respondent can justify, to the satisfaction of the Department, that a plan and/or report or portions thereof are not needed in the given site specific situation, then the Department may waive that requirement.

The scope and substance of the CMI should be focused to fit the complexity of the site-specific situation. Not all of the documents included in the CMI SOW may be needed for every facility.

The Department may require the Owner/Operator or Respondent to conduct additional studies beyond what is discussed in the SOWs in order to support the CMI program. The Owner/Operator or Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

A. Corrective Measures Implementation Workplan

The Owner/Operator or Respondent shall prepare a CMI Workplan that clearly describes the size, shape, form, and content of the proposed corrective measure, the key components or elements that are needed, describes the designers vision of the corrective measure in the form of conceptual drawings and schematics, and includes procedures and schedules for implementing the corrective measure(s).

Note that more than one CMI Workplan may be needed in situations where there is a complex site with multiple technologies being employed at different locations. The CMI Workplan must be approved by the Department prior to implementation. The CMI Workplan must, at a minimum, include the following elements:

1. Introduction/Purpose

Describe the purpose of the document and provide a summary description of the project.

2. Media Cleanup Standards

Discuss the media cleanup standards for the facility.

3. Conceptual Model of Contaminant Migration

It is important to know where the contaminants are and to understand how they are moving before an adequate corrective measure can be developed. To address this critical question, the Owner/Operator or Respondent must present a conceptual model of the site and contaminant migration. The conceptual model consists of a working hypothesis of how the contaminants may move from the release source to the receptor population. The conceptual model is developed by looking at the applicable physical parameters (e.g., water solubility, density, Henry's Law Constant, etc.) for each contaminant and assessing how the contaminant may migrate given the existing site conditions (geologic features, depth to ground water, etc.). Describe the phase (water, soil, gas, non-aqueous) and location where contaminants are likely to be found. This analysis may have already been done as part of earlier work (e.g., Current Conditions Report). If this is the case, then provide a summary of the conceptual model with a reference to the earlier document. If not, then field validation of the conceptual model is required.

4. Description of Corrective Measures

Considering the conceptual model of contaminant migration, qualitatively describe what the corrective measure is supposed to do and how it will function at the Facility. Discuss the constructability of the corrective measure and its ability to meet the corrective measure objectives.

5. Data Sufficiency

Review existing data needed to support the design effort and establish whether or not there are sufficient accurate data available for this purpose. The Owner/Operator or Respondent must summarize the assessment findings and specify any additional data needed to complete the corrective measure design. The Department may require or the Owner/Operator or Respondent may propose that sampling and analysis plans and/or treatability study workplans be developed to obtain the additional data. Submittal times for any new sampling and analysis plans and/or treatability study workplans must be included in the project schedule.

6. Project Management

Describe the management approach including levels of authority and responsibility (include organization chart), lines of communication and the qualifications of key personnel who will direct the corrective measure design and implementation effort (including contractor personnel).

7. Project Schedule

The project schedule must specify all significant steps in the process and when all CMI deliverables (e.g., Operation and Maintenance Plan, Corrective Measure Construction Workplan, etc.) are to be submitted to the Department.

8. Design Criteria

Specify performance requirements for the overall corrective measure and for each major component. The Owner/Operator or Respondent must select equipment that meets the performance requirements.

9. Design Basis

Discuss the process and methods for designing all major components of the corrective measure. Discuss the significant assumptions made and possible sources of error. Provide justification for the assumptions;

10. Conceptual Process/Schematic Diagrams.

11. Site plan showing preliminary plant layout and/or treatment area.

12. Tables listing number and type of major components with approximate dimensions.

13. Tables giving preliminary mass balances.

14. Site safety and security provisions (e.g., fences, fire control, etc.).

15. Waste Management Practices

Describe the wastes generated by the construction of the corrective measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

16. Required Permits

List and describe the permits needed to construct and operate the corrective measure. Indicate on the project schedule when the permit applications will be submitted to the applicable agencies and an estimate of the permit issuance date.

17. Long-Lead Procurement Considerations

The Owner/Operator or Respondent shall prepare a list of any elements or components of the corrective measure that will require custom fabrication or for some other reason must be considered as long-lead procurement items. The list must include the reason why the items are considered long-lead items, the length of time necessary for procurement, and recognized sources of such procurement.

18. Appendices including:

- a. Design Data - Tabulations of significant data and assumptions used in the design effort;
- b. Equations - List and describe the source of major equations used in the design process;
- c. Sample Calculations - Present and explain one example calculation for significant or unique design calculations; and
- d. Laboratory or Field Test Results.

B. Operation and Maintenance Plan

The Owner/Operator or Respondent shall prepare an Operation and Maintenance (O&M) Plan that includes a strategy and procedures for performing operations, long term maintenance, and monitoring of the corrective measure. A draft Operation and Maintenance Plan shall be submitted to the Department simultaneously with the draft Plans and Specifications. A final Operation and Maintenance Plan shall be submitted to the Department simultaneously with the final Plans and Specifications. The O&M plan shall, at a minimum, include the following elements:

1. Introduction/Purpose

Describe the purpose of the document and provide a summary description of the project.

2. Project Management

Describe the management approach including levels of authority and responsibility (include organization chart), lines of communication and the qualifications of key personnel who will operate and maintain the corrective measures (including contractor personnel);

3. System Description

Describe the corrective measure and identify significant equipment.

4. Personnel Training

Describe the training process for O&M personnel. The Owner/Operator or Respondent shall prepare, and include in the technical specifications governing treatment systems, contractor requirements for providing: appropriate service visits by experienced personnel to supervise the installation, adjustment, start up and operation of the treatment systems, and training covering appropriate operational procedures once the start-up has been successfully accomplished.

5. Start-Up Procedures

Describe system start-up procedures including and operational testing.

6. Operation and Maintenance Procedures

Describe normal operation and maintenance procedures including:

- a. Description of tasks for operation;
- b. Description of tasks for maintenance;
- c. Description of prescribed treatment or operation conditions; and
- d. Schedule showing frequency of each O&M task.

7. Replacement schedule for equipment and installed components.

8. Waste Management Practices

Describe the wastes generated by operation of the corrective measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

9. Sampling and Monitoring

Sampling and monitoring activities may be needed for effective operation and maintenance of the corrective measure. If sampling activities are necessary, the O&M plan must include a complete sampling and analysis section which specifies at a minimum the following information:

- a. Description and purpose of monitoring tasks;
- b. Data quality objectives;
- c. Analytical test methods and detection limits;
- d. Name of analytical laboratory;
- e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
- f. Sample collection procedures and equipment;
- g. Field quality control procedures:
 - o duplicates (10% of all field samples)
 - o blanks (field, equipment, etc.)
 - o equipment calibration and maintenance
 - o equipment decontamination
 - o sample containers
 - o sample preservation
 - o sample holding times (must be specified)
 - o sample packaging and shipment
 - o sample documentation (field notebooks, sample labeling, etc)
 - o chain of custody
- h. Criteria for data acceptance and rejection; and
- i. Schedule of monitoring frequency.

The Owner/Operator or Respondent shall follow all Department and U.S. EPA guidance for sampling and analysis. The Department may request that the sampling and analysis section be a separate document.

10. Corrective Measure Completion Criteria

Describe the process and criteria (e.g., ground water cleanup goal met at all compliance points for one year) for determining when corrective measures may cease. Also describe the process and criteria for determining when maintenance and monitoring may cease. Criteria for corrective measures such as a landfill cap must be carefully crafted to account for the fact that a landfill cap will never actually "cease" but will need to be maintained and monitored for a long period of time. Satisfaction of the completion criteria will trigger preparation and submittal of the Corrective Measure Completion Report.

11. O&M Contingency Procedures:

- a. Procedures to address system breakdowns and operational problems including a list of redundant and emergency back-up equipment and procedures;
- b. Should the corrective measure suffer complete failure, specify alternate procedures to prevent release or threatened releases of hazardous substances, pollutants or contaminants which may endanger public health and/or the environment or exceed cleanup standards;
- c. The O&M Plan must specify that, in the event of a major breakdown and/or complete failure of the corrective measure (includes emergency situations), the Owner/Operator or Respondent will orally notify the Department within 24 hours of the event and will notify the Department in writing within 72 hours of the event. The written notification must, at a minimum, specify what happened, what response action is being taken and/or is planned, and any potential impacts on human health and/or the environment; and
- d. Procedures to be implemented in the event that the corrective measure is experiencing major operational problems, is not performing to design specifications and/or will not achieve the cleanup goals in the expected timeframe. For example, in certain circumstances both a primary and secondary corrective measure may be selected for the Facility. If the primary corrective measure were to fail, then the secondary would be implemented. This section would thus specify that if the primary corrective measure failed, then design plans would be developed for the secondary measure.

12. Data Management and Documentation Requirements

Describe how analytical data and results will be evaluated, documented and managed, including development of an analytical database. State the criteria that will be used by the project team to review and determine the quality of data.

13. The O&M Plan shall specify that the Owner/Operator or Respondent collect and maintain the following information:

- a. Progress Report Information
 - (1). Work Accomplishments (e.g., performance levels achieved, hours of treatment operation, treated and/or excavated volumes, concentration of contaminants in treated and/or excavated volumes, nature and volume of wastes generated, etc.).

(2). Record of significant activities (e.g., sampling events, inspections, problems encountered, action taken to rectify problems, etc.).

- b. Monitoring and laboratory data;
- c. Records of operating costs; and
- d. Personnel, maintenance and inspection records.

These data and information should be used to prepare Progress Reports and the Corrective Measure Completion Report.

C. Draft Plans and Specifications

[Note - The Owner/Operator or Respondent may propose or the Department may require the submittal of other draft plans and specifications.]

1. The Owner/Operator or Respondent shall prepare draft Plans and Specifications that are based on the CMI Workplan but include additional design detail. A draft Operation and Maintenance Plan and Construction Workplan shall be submitted to the Department simultaneously with the draft Plans and Specifications. The draft design package must include drawings and specifications needed to construct the corrective measure. Depending on the nature of the corrective measure, many different types of drawings and specifications may be needed. Some of the elements that may be required are:

- a. General Site Plans
- b. Process Flow Diagrams
- c. Mechanical Drawings
- d. Electrical Drawings
- e. Structural Drawings
- f. Piping and Instrumentation Diagrams
- g. Excavation and Earthwork Drawings
- h. Equipment Lists
- i. Site Preparation and Field Work Standards
- j. Preliminary Specifications for Equipment and Material

2. General correlation between drawings and technical specifications is a basic requirement of any set of working construction plans and specifications. Before submitting the project specifications to the Department, the Owner/Operator or Respondent shall:

- a. Proofread the specifications for accuracy and consistency with the CMI Workplan; and
- b. Coordinate and cross-check the specifications and drawings.

D. Final Plans and Specifications

1. The Owner/Operator or Respondent shall prepare final Plans and Specifications that are sufficient to be included in a contract document and be advertised for bid. A final Operation and Maintenance Plan and Construction Workplan shall be submitted to the Department simultaneously with the final Plans and Specifications. The final design package must consist of the detailed drawings and specifications needed to construct the corrective measure. Depending on the nature of the corrective measure, many different types of drawings and specifications may be needed. Some of the elements that may be required are:
 - a. General Site Plans
 - b. Process Flow Diagrams
 - c. Mechanical Drawings
 - d. Electrical Drawings
 - e. Piping and Instrumentation Diagrams
 - f. Structural Drawings
 - g. Excavation and Earthwork Drawings
 - h. Site Preparation and Field Work Standards
 - i. Construction Drawings
 - j. Installation Drawings
 - k. Equipment Lists
 - l. Detailed Specifications for Equipment and Material

2. General correlation between drawings and technical specifications is a basic requirement of any set of working construction plans and specifications. Before submitting the final project specifications to the Department, the Owner/Operator or Respondent shall:
 - a. Proofread the specifications for accuracy and consistency with the preliminary design; and
 - b. Coordinate and cross-check the specifications and drawings.

E. Construction Workplan

The Owner/Operator or Respondent shall prepare a Construction Workplan which documents the overall management strategy, construction quality assurance procedures and schedule for constructing the corrective measure. A draft Construction Workplan shall be submitted to the Department simultaneously with the draft Plans and Specifications and draft Operation and Maintenance Plan. A final Construction Workplan shall be submitted to the Department simultaneously with the final Plans and Specifications and final Operation and Maintenance Plan. Upon receipt of written approval from the Department, the Owner/Operator or Respondent shall commence the construction process and implement the Construction Workplan in accordance with the schedule and provisions contained therein. The Construction Workplan must be approved by the Department prior to the start of corrective measure construction. The Construction Workplan must, at a minimum, include the following elements:

1. Introduction/Purpose

Describe the purpose of the document and provide a summary description of the project.

2. Project Management

Describe the construction management approach including levels of authority and responsibility (include organization chart), lines of communication and the qualifications of key personnel who will direct the corrective measure construction effort and provide construction quality assurance/quality control (including contractor personnel);

3. Project Schedule

The project schedule must include timing for key elements of the bidding process, timing for initiation and completion of all major corrective measure construction tasks as specified in the Final Plans and Specifications, and specify when the Construction Completion Report is to be submitted to the Department;

4. Construction Quality Assurance/Quality Control Program

The purpose of construction quality assurance is to ensure, with a reasonable degree of certainty, that a completed corrective measure will meet or exceed all design criteria, plans and specifications. The Construction Workplan must include a complete construction quality assurance program to be implemented by the Owner/Operator or Respondent.

5. Waste Management Procedures

Describe the wastes generated by construction of the corrective measure and how they will be managed.

6. Sampling and Monitoring

Sampling and monitoring activities may be needed for construction quality assurance/quality control and/or other construction related purposes. If sampling activities are necessary, the Construction Workplan must include a complete sampling and analysis section which specifies at a minimum the following information:

- a. Description and purpose of monitoring tasks;
- b. Data quality objectives;
- c. Analytical test methods and detection limits;
- d. Name of analytical laboratory;
- e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
- f. Sample collection procedures and equipment;

- g. Field quality control procedures:
 - o duplicates (10% of all field samples)
 - o blanks (field, equipment, etc.)
 - o equipment calibration and maintenance
 - o equipment decontamination
 - o sample containers
 - o sample preservation
 - o sample holding times (must be specified)
 - o sample packaging and shipment
 - o sample documentation (field notebooks, sample labeling, etc);
 - o chain of custody
- h. Criteria for data acceptance and rejection; and
- i. Schedule of monitoring frequency.

The Owner/Operator or Respondent shall follow all Department and U.S. EPA guidance for sampling and analysis. The Department may request that the sampling and analysis section be a separate document.

7. Construction Contingency Procedures

- a. Changes to the design and/or specifications may be needed during construction to address unforeseen problems encountered in the field. Procedures to address such circumstances, including notification of the Department, must be included in the Construction Workplan;
- b. The Construction Workplan must specify that, in the event of a construction emergency (e.g., fire, earthwork failure, etc.), the Owner/Operator or Respondent will orally notify the Department within 24 hours of the event and will notify the Department in writing within 72 hours of the event. The written notification must, at a minimum, specify what happened, what response action is being taken and/or is planned, and any potential impacts on public health and/or the environment; and
- c. Procedures to be implemented if unforeseen events prevent corrective measure construction. For example, in certain circumstances both a primary and secondary corrective measure may be selected for the Facility. If the primary corrective measure could not be constructed, then the secondary would be implemented. This section would thus specify that if the primary corrective measure could not be constructed, then design plans would be developed for the secondary measure.

8. Construction safety procedures should be specified in a separate Health and Safety Plan.

9. Data Management and Documentation Requirements

Describe how analytical data and results will be evaluated, documented and managed, including development of an analytical database. State the criteria that will be used by the project team to review and determine the quality of data.

The Construction Workplan shall specify that the Owner/Operator or Respondent collect and maintain the following information:

- a. Progress Report Information
 - (1). Work Accomplishments (e.g., hours of operation, excavated volumes, nature and volume of wastes generated, area of cap completed, length of trench completed, etc.).
 - (2). Record of significant activities (e.g., sampling events, inspections, problems encountered, action taken to rectify problems, etc.).
- b. Monitoring and laboratory data;
- c. Records of construction costs; and
- d. Personnel, maintenance and inspection records.

This data and information should be used to prepare progress reports and the Construction Completion Report.

10. Cost Estimate/Financial Assurance

If financial assurance for corrective measure construction and operation is required by an enforcement order, facility permit, or through use of Department discretion, the Construction Workplan must include a cost estimate, specify which financial mechanism will be used and when the mechanism will be established. The cost estimate shall include both construction and operation and maintenance costs. An initial cost estimate shall be included in the draft Construction Workplan and a final cost estimate shall be included in the final Construction Workplan. The financial assurance mechanism may include a performance or surety bond, a trust fund, a letter of credit, financial test and corporate guarantee equivalent to that in the California Code of Regulations, Title 22, Section 66264.143, 66265.143 or any other mechanism acceptable to the Department.

Financial assurance mechanisms are used to assure the Department that the Owner/Operator or Respondent has adequate financial resources to construct and operate the corrective measure.

F. Construction Completion Report

The Owner/Operator or Respondent shall prepare a Construction Completion Report which documents how the completed project is consistent with the Final Plans and Specifications. A Construction Completion Report shall be submitted to the Department when the construction and any operational tests have been completed. The Construction Completion Report shall, at a minimum, include the following elements:

1. Purpose;
2. Synopsis of the corrective measure, design criteria, and certification that the corrective measure was constructed in accordance with the Final Plans and Specifications;

3. Explanation and description of any modifications to the Final Plans and Specifications and why these were necessary for the project;
4. Results of any operational testing and/or monitoring, indicating how initial operation of the corrective measure compares to the design criteria;
5. Summary of significant activities that occurred during construction. Include a discussion of problems encountered and how they were addressed;
6. Summary of any inspection findings (include copies of key inspection documents in appendices);
7. As built drawings; and
8. A schedule indicating when any treatment systems will begin full scale operations.

G. Corrective Measure Completion Report

The Owner/Operator or Respondent shall prepare a Corrective Measure Completion Report when the Owner/Operator or Respondent believes that the corrective measure completion criteria have been satisfied. The purpose of the Corrective Measure Completion Report is to fully document how the corrective measure completion criteria have been satisfied and to justify why the corrective measure and/or monitoring may cease. The Corrective Measure Completion Report shall, at a minimum, include the following elements:

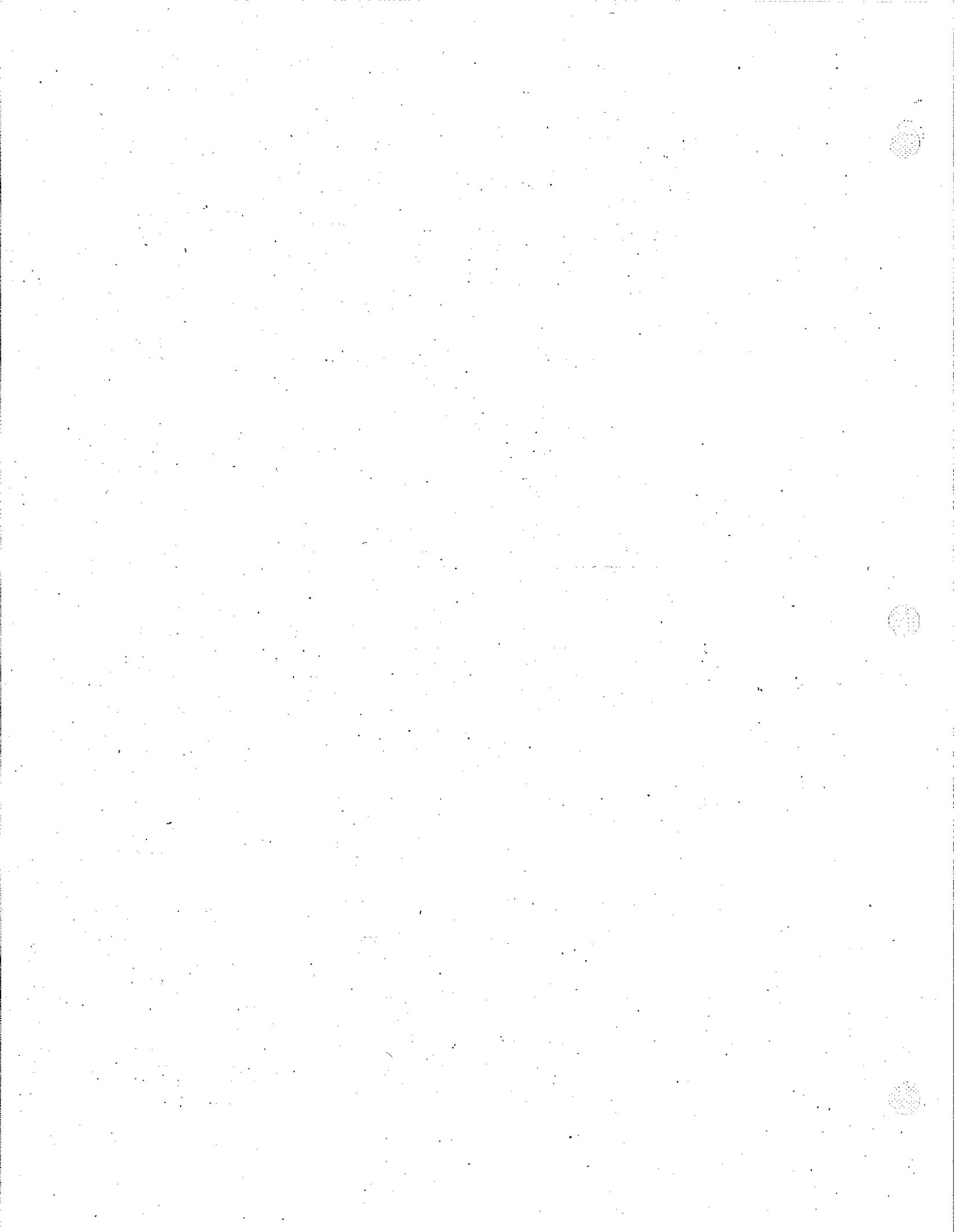
1. Purpose;
2. Synopsis of the corrective measure;
3. Corrective Measure Completion Criteria

Describe the process and criteria for determining when corrective measures, maintenance and monitoring may cease. Corrective measure completion criteria were given in the final Operation and Maintenance (O&M) Plan;
4. Demonstration that the completion criteria have been met. Include results of testing and/or monitoring, indicating how operation of the corrective measure compares to the completion criteria;
5. Summary of work accomplishments (e.g., performance levels achieved, total hours of treatment operation, total treated and/or excavated volumes, nature and volume of wastes generated, etc.);
6. Summary of significant activities that occurred during operations. Include a discussion of problems encountered and how they were addressed;
7. Summary of inspection findings (include copies of key inspection documents in appendices); and
8. Summary of total operation and maintenance costs.

H. Submittal Summary

The following list provides a summary of when and how key documents should be submitted to the Department. The Department may adjust this list to meet site-specific circumstances.

1. The submittal schedule for the documents listed below should be included in an enforcement order, permit or otherwise specified by the Department.
 - a. CMI Workplan
2. The submittal schedule for the documents listed below must be specified in the CMI Workplan. The groupings reflect which documents should be submitted together.
 - a. Draft Plans and Specifications
 - b. Draft Operation and Maintenance Plan
 - c. Draft Construction Workplan
 - d. Final Plans and Specifications
 - e. Final Operation and Maintenance Plan
 - f. Final Construction Workplan
3. The submittal schedule for the document listed below must be specified in the Final Construction Workplan.
 - a. Construction Completion Report
4. The submittal schedule for the document listed below is based on when the Owner/Operator or Respondent believes the completion criteria have been satisfied.
 - a. Corrective Measure Completion Report
5. The submittal schedule for Progress Reports and a Health and Safety Plan shall be specified in the order or permit.

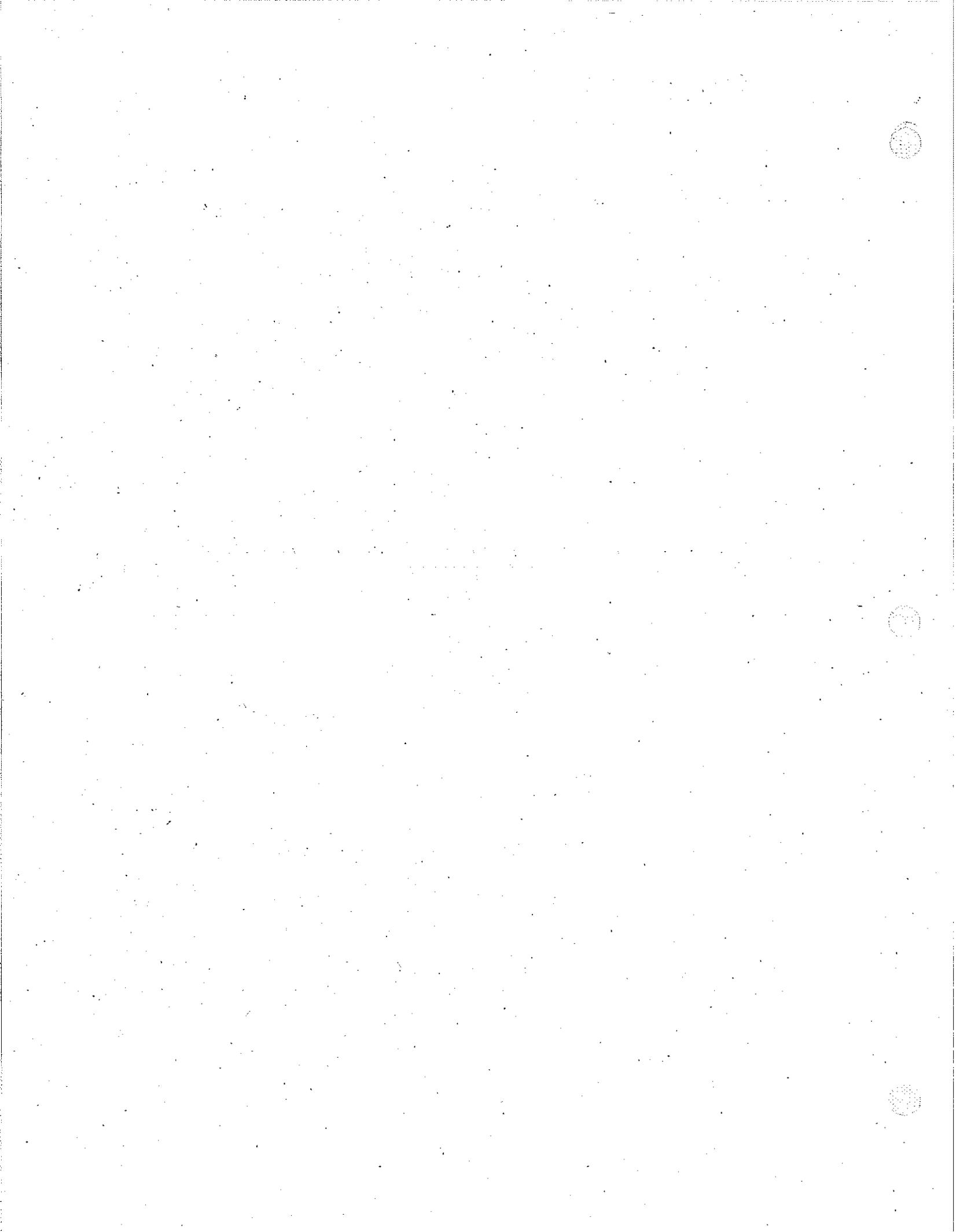


ATTACHMENT I

SCOPE OF WORK FOR PROGRESS REPORTS

Progress Reports shall, at a minimum, include the following information:

1. A description of significant activities and work completed during the reporting period;
2. A summary of any findings made during the reporting period;
3. Summaries of all problems or potential problems encountered during the reporting period;
4. Actions taken and/or planned to rectify problems;
5. All projected work for the next reporting period;
6. A discussion of any changes in personnel that occurred during the reporting period;
7. Summaries of all contacts with representatives of the press, local community or public interest groups during the reporting period;
8. Summary of treatment system effectiveness. Provide a comparison of treatment system operation to predicted performance levels (applicable only if there is an operating treatment system); and
9. If requested by the Department of Toxic Substances Control, the results of any sampling tests and/or other data generated during the reporting period.



ATTACHMENT J

PERMIT MODIFICATION HISTORY

CLASS 2 MODIFICATION – November 19, 2004

Modification Number: MOD SC3-111904-A

Permittee Initiated Modification Request

Updating the groundwater monitoring program for the four closed RCRA surface impoundments, and updating the Groundwater Sampling and Analysis Plan.

The 2004 November Class 2 Permit Modification performed the following:

- 1) Changes in the text were made to provide clarification for the description of the three groundwater treatment systems described in Part I of Attachment A. Permit conditions were not added or removed.
- 2) The groundwater monitoring programs for the four closed RCRA surface impoundments were updated. Wells were deleted, changed, or added to the background monitoring wells, the point-of-compliance wells, detection monitoring program and the evaluation monitoring program.
- 3) The list of Constituents of Concern were updated to better reflect the historic usage of the four closed surface impoundments.
- 4) Changes were made to the text in Attachment A Part V affecting the groundwater monitoring programs for the four closed surface impoundments. The text was updated to be consistent with current regulations.
- 5) Significant formatting changes were made to Attachment A Part V, including the addition of tables describing the monitoring programs.
- 6) The Groundwater Sampling and Analysis Plan was updated to be consistent with current sampling and analytical methods, and also to be consistent with other sampling programs throughout the Santa Susana Field Laboratory.

CLASS 2 MODIFICATION – November 9, 2001

Modification Number: MOD-SC3-110901-A

Permittee Initiated Modification Request

Rerouting Extracted Groundwater between Interim Groundwater Remediation Systems: Reduction of Sampling and Inspection Frequency: SVOC and Perchlorate Sampling.

The 2001 November Class 2 Permit Modification allows the following:

- 1) Deactivate the Area I Canyon Air Stripping System and place the system on standby. Reroute the extracted groundwater from Canyon to the Area I WS-5 UV/Peroxidation system. The Canyon system can be reactivated if/when additional capacity is desired or needed.

- 2) Deactivate the Area 1 Road Air Stripping System and place the system on standby. Reroute the extracted groundwater from Area 1 Road to the Area I WS-5/Peroxidation system. The Area 1 Road system can be reactivated if/when additional capacity is desired or needed.
- 3) Deactivate the Area II RD-9 UV/Peroxidation System and place the system on standby. Reroute the extracted groundwater from RD-9 to the Area II Bravo Air Stripping System. The RD-9 system can be reactivated if/when additional capacity is desired or needed.
- 4) Add carbon canisters to the Area II Bravo Air Stripping System for possible capture of semi-volatile organics (SVOCs). Boeing will test the influent to the Bravo system for SVOCs monthly for 12 consecutive months. At the end of the 12 months, the carbon will be tested for accumulated semi-volatile organics. If semi-volatile organics are not present at unacceptable levels, then the canisters may be removed if other evidence does not exist to indicate that SVOCs may be entering the system
- 5) Reduce the sampling frequency of the groundwater across all the groundwater remediation facilities from semi-monthly (twice per month) to monthly.
- 6) Change the inspection frequency of all groundwater remediation facilities and appurtenances according to the Groundwater Remediation Operation Plan (GROP), generally reduced from daily to weekly. DTSC requires Boeing to continue daily visual inspections of the systems to comply with CCR-22 66264.195(b) and Section VI.F.3 of the post-closure permit.
- 7) DTSC requires Boeing to begin sampling for perchlorate in the WS-5 UV/P, STL-IV and Delta systems. Extracted groundwater feeding these three systems were in or near known perchlorate contamination. DTSC added this requirement to the Class 2 Permit Modification pursuant to CCR-22 Section 66270.42(b)(6)(A)1.

CLASS 1 MODIFICATION – JUNE 30, 2000

Modification Number: MOD-SC3-063000-A

Permittee Initiated Modification Request

Name Change, Permit Corrections and Permit Updates

In 1995, Rockwell International Corporation, Rocketdyne Division was the Facility Owner and Operator of Areas I and III of the Santa Susana Field Laboratory in Simi Hills, California. Rockwell-Rocketdyne applied to the California Department of Toxic Substance Control (Department) for a hazardous waste facility post-closure permit to operate hazardous waste groundwater extraction, treatment and monitoring systems at the Rockwell-Rocketdyne Site (Facility) as well as maintenance of caps at closed impoundments. These units are located at the Santa Susana Field Laboratory, Areas I and III. After issuance of the post-closure permit in 1995, Rockwell International Corporation, Rocketdyne Division was purchased by The Boeing Company to become a wholly owned subsidiary renamed as Boeing North American. As of January 1, 2000, the name of this Permit was updated to The Boeing Company, Rocketdyne Propulsion and Power. This permit modification changed the name from Rockwell to Boeing throughout the Permit, including the header.

Shortly after issuance of the Permit on April 7, 1995 (effective May 11, 1995), Rockwell submitted a "Petition for Review" (Appeal) as allowed under the California Code of Regulations, Title 22, Section

66271.18. Among the issues was a list of errors made in the Permit. Most of the technical issues were later resolved and the Appeal was withdrawn by Boeing on February 8, 2000. This permit modification corrects the errors mentioned in Rockwell's Appeal, as well as additional corrections, updates and adjustments encountered while reviewing the Permit. These corrections, updates and adjustments do not altered the operating conditions of the permit.

These modifications -- name change, corrections, updates, adjustments -- met the requirements of a Class 1 Modification. DTSC deemed these changes to meet the definition of "ministerial" under the CEQA Guidelines 14 CCR Section 15369 and, therefore, exempt under 14 CCR Section 15268.