OREGON DEQ'S RECOMMENDED FORMAT, REMEDIAL INVESTIGATION/FEASIBILITY STUDY SCOPE OF WORK (LONG VERSION)

I. OBJECTIVES

Work performed shall complement and incorporate existing site information with the following overall objectives:

A. Identify the hazardous substances which have been released to the environment.

B. Determine the nature, extent and distribution of hazardous substances in affected media.

C. Determine the direction and rate of migration of hazardous substances.

D. Identify migration pathways and receptors.

E. Determine the risk to human health and/or the environment.

F. Identify hot spots of contamination.

G. Develop the information necessary to identify and evaluate potential Interim Removal Measures.

H. Develop the information necessary to evaluate remedial action alternatives and select a remedial action.

I. Generate or use data of sufficient quality for site characterization, risk assessment, and the subsequent analysis and selection of remedial alternatives.

II. REMEDIAL INVESTIGATION PROPOSAL

The Remedial Investigation (RI) Proposal shall briefly discuss Respondent's proposed approach to the RI, addressing soil, groundwater, surface water, sediments, and air. The proposal will provide the framework for the RI Work Plan and shall include the following:

A. A summary of site-specific issues and a review of the results of previously completed work.

B. A conceptual site model showing contaminant sources, release mechanisms, transport routes and media, potential human and ecological receptors, and relevant exposure scenarios based on current and reasonably likely future land and water use.

C. A general description of each proposed RI phase, including the goals and objectives of each.

D. The estimated schedule for implementation of the RI.

III. REMEDIAL INVESTIGATION WORK PLAN

The work plan shall be developed in accordance with applicable Oregon Administrative Rules (OAR 340-122-0010 through -0115), DEQ guidance and, as appropriate, follow the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, OSWER Directive 9355.3-01, 1988. Existing data, reports or information, including data from any investigation activity conducted prior to the initiation of the RI may be used, if such data is consistent with the procedures and quality assurance/quality control criteria approved by DEQ. The submitted work plan shall include, but not be limited to the following items:

A. PROJECT MANAGEMENT PLAN

The Project Management Plan shall indicate the following:

1. A proposed schedule for submittals and implementation of all proposed activities and phases pertaining to this Scope of Work (SOW). This schedule shall specify submittal dates for the draft and final Risk Assessment, Interim Removal Measure Assessment and Feasibility Study work plans and the draft and final Remedial Investigation, Risk Assessment, Interim Removal Measure Assessment and Feasibility Study reports. These target dates may be revised by Respondent, in subsequent work plans or amendments, subject to DEQ approval.

2. A description of the personnel (including subcontractors if known) involved in the project and their respective roles in the project.

3. A discussion of how proposed variations from the approved work plan will be managed.

B. SITE DESCRIPTION

A description of facility operations shall include, but not be limited to the following:

1. A description of current and historical operating activities and practices, including approximate time periods and a list of chemical products used currently and historically.

2. The estimated volume of waste disposed of and/or discharged.

3. Time, volume and location of known spills.

4. A description of past and present waste treatment/disposal practices and areas.

5. The location of past and present raw material and finished product storage areas.

6. Any available aerial photographs that may provide information regarding disposal practices at the site.

7. Preliminary identification of current and reasonably likely future land and water use.

C. SITE CHARACTERIZATION PLAN

The Site Characterization Plan shall be consistent with DEQ guidance and the requirements specified in OAR 340-122-0080. The Site Characterization Plan shall include, but not be limited to characterization of the hazardous substances, characterization of the facility, identification of potential receptors and the collection and evaluation of information relevant to the identification of hot spots of contamination, and shall address the following:

1. Soils

Objective: To identify and characterize releases of hazardous substances at or from the facility to soils.

Scope: The plan shall supplement previous soil sampling at the facility. The plan shall address all areas which could potentially have received spills, leaks from tanks or piping, been used for waste treatment or disposal, or have been affected by contaminated surface water or storm water runoff, and all other areas where soil contamination is known or suspected.

Procedures: The plan shall be designed and implemented to determine the vertical and lateral extent of soil contamination, characterize the site geology, determine the physical and chemical soil characteristics relevant to the RI and FS, evaluate the potential for contaminant migration and gather the information necessary to identify hot spots of contamination. At a minimum, the plan shall include, but not be limited to the following:

a. For each sample:

   i. Location.
   ii. Sampling interval or depth.
   iii. Sampling procedures.
   iv. Analytical parameters and methods.
   v. Justification for all of the above.

b. Provisions for describing soil samples, to include:

   i. The soil type according to the ASTM D 2487-93, Classification of Soils for Engineering Purposes (Unified Soil Classification System), and ASTM D 2488-93, Description and Identification of Soils (Visual-Manual Procedures), including soil color, structure, texture, mineral composition, moisture, and percent recovery.

   ii. Other relevant characteristics such as visual identification of contamination, odor, and vapor monitoring using HNU, OVA or other equivalent type equipment as described by a qualified environmental professional shall be noted.

   iii. Provisions to collect and describe formation materials during installation of soil borings. Respondent shall obtain continuous core samples or provide justification for why obtaining continuous cores is not appropriate. Borehole geophysics may be used to supplement coring.

c. A method for determining background concentrations for potential contaminants of concern.

2. Groundwater

Objective: To identify and characterize releases of hazardous substances at or from the facility to groundwater.

Scope: The plan shall supplement previous investigations at the facility and shall identify and characterize all past, current and potential releases of hazardous substances to groundwater.

Procedures: The plan shall be designed and implemented to determine the vertical and lateral extent of groundwater contamination, characterize the site hydrogeology, determine the physical and chemical water bearing zone characteristics relevant to the RI and FS, evaluate the potential for contaminant migration through groundwater, and gather the information necessary to identify hot spots of contamination. The plan shall include the proposed methodology for characterizing groundwater. Alternative methods for characterizing groundwater should be considered to accelerate the RI. Monitoring wells and other holes must be drilled, constructed and decommissioned, in accordance with OAR Chapter 690, Division 240 and DEQ "Ground Water Monitoring Well, Drilling, Construction and Decommissioning" guidelines (1992). The plan shall include, but not be limited to the following:

a. Groundwater investigation plan to include:

i. Proposed sampling locations.
ii. Proposed sampling depths.
iii. Proposed length and depth of screened intervals.
iv. Proposed drilling methods.
v. Proposed well construction materials and installation methods.
vi. Proposed well development and completion methods.
vii. Proposed methods to prevent cross contamination if drilling in contaminated soils or drilling through contaminated shallow aquifers or perched zones.
viii. The justification for all of the above.

b. Groundwater quality monitoring plan, to include:

i. Proposed monitoring locations.
ii. Sampling methods.
iii. A schedule and proposal for periodic sampling of monitoring wells.
iv. Analytical parameters and methods.
v. The justification for all of the above

c. Hydrologic characterization proposal to include:

i. Provisions to collect and describe formation materials during drilling. Respondent shall obtain continuous core samples or provide justification for why obtaining continuous cores is not appropriate. Borehole geophysics may be used to supplement coring.

ii. A means to characterize the hydrogeology including:
(a) stratigraphy
(b) structural geology
(c) depositional history
(d) regional groundwater flow patterns

iii. A means to characterize the hydrogeologic properties of all hydrogeologic units found at the site, including:
(a) hydraulic conductivity
(b) porosity
(c) lithology
(d) hydraulic interconnections between saturated zones
(e) test and analysis methods for the above

iv. Procedures to identify for each aquifer, the following:
(a) A description of groundwater flow direction.
(b) Identification of vertical and horizontal gradient(s).
(c) Interpretation of the flow system including the rate (horizontal and vertical) of groundwater flow, and including seasonal variations.

v. Procedures to identify hydraulic influences, including:
(a) Identification of pumping groundwater wells, past and present.
(b) Influences of rivers, streams, and ditches.
(c) Influences of ponds and lakes.
(d) Identification of areas of recharge/discharge.

vi. Procedures to determine background groundwater concentrations for potential contaminants of concern.

d. Well inventory to identify all active and inactive water wells within a radius of the facility acceptable to DEQ, to include:

i. Identification of all wells listed with the Oregon Water Resources Department,
ii. A field survey to identify wells for which no logs are on file, one-half mile downgradient if off-site contamination is present.
iii. For all located wells, to the extent practicable, identify:
(a) Owner
(b) Address
(c) Map location
(d) Driller
(e) Date drilled
(f) Depth
(g) Casing and screen material, depths and intervals
(h) Seal types, depths and intervals
(i) Static pumping levels
(j) Approximate land surface elevation
(k) Reported water quality and use of well
iv. A plan and schedule to sample those wells identified above, unless there is sufficient hydrogeological information available to demonstrate that sampling is not necessary.

3. <u>Surface Water and Sediments</u>

<u>Objective</u>: To identify and characterize releases of hazardous substances at or from the facility to surface water and sediments.

<u>Scope</u>: The plan shall supplement previous investigations at the facility and shall identify all past, existing, and potential impacts to surface waters and sediments.

<u>Procedures</u>: At a minimum, the plan shall delineate past and present surface drainage patterns at the site and evaluate whether surface water and sediments may have been impacted by the facility. Unless this evaluation is sufficient to demonstrate that surface water or sediment quality has not been impacted, an appropriate surface water and sediment characterization plan shall be prepared. The plan shall be designed to delineate the nature and extent of contamination, characterize the site hydrology, determine the physical and chemical surface water and sediment characteristics relevant to the RI and FS, evaluate the potential for contaminant migration and gather the information necessary to identify hot spots of contamination. The plan shall include, but not be limited to the following;

a. Surface water characterization plan to include for each sample:

i. Location.
ii. Depth.
iii. Sampling procedures.
iv. Analytical parameters and methods.
v. Justification for all of the above.

b. Sediment characterization plan to include for each sample:

i. Location.
ii. Depth.

iii. Sampling procedures.
iv. Analytical parameters and methods.
v. Justification for all of the above.

c. A means to characterize surface water bodies to include:

i. Flow characteristics
ii. Seasonal size and depth
iii. Chemical characteristics
iv. Channel characteristics
v. Flooding tendencies
vi. Tidal influences

d. A method for determining background concentrations for potential contaminants of concern.

4. Air

Objective: To identify and characterize the release of hazardous substances to the air, from soil, surface water, or groundwater contamination at or from the facility.

Scope: The plan shall supplement previous investigations at the facility and shall identify and characterize all past, current and potential releases (e.g., from contaminated soil or groundwater) of hazardous substances to air.

Procedures: The plan shall include the proposed methodology for evaluating air emissions using appropriate emission calculations and/or a field sampling program. The plan shall be designed to delineate the nature and extent of contamination, characterize the site climatology, determine the physical and chemical air characteristics relevant to the RI and FS, evaluate the potential for contaminant migration and gather the information necessary to identify hot spots of contamination. At a minimum, the plan shall include, but not be limited to the following:

a. Procedures for modeling air emissions including:

i. A description of proposed modeling methods.
ii. Identification of emission modeling data needs and a plan to obtain the necessary data.

b. Procedures for the collection of air samples including:

i. Location.
ii. Height.
iii. Sampling methodology.
iv. Sampling duration.
v. Analytical parameters and methods.
vi. Procedures for monitoring ambient air conditions (e.g. wind speed and direction).

c. A method for determining background concentrations for potential contaminants of concern.

5. Identification of Current and Reasonably Likely Future Land and Water Use

Objective: To identify current and reasonably likely future land and water uses in the locality of the facility.

Scope: The plan shall be designed to identify current and reasonably likely future land and water uses for the purposes of identifying hot spots of contamination and conducting the baseline human health and ecological risk assessments, in accordance with OAR 340-122-0080 and DEQ guidance.

Procedures: The plan shall include the proposed methodology for identifying current and reasonably likely future land and water uses in the locality of the facility. The plan shall include, but not be limited to the following:

a. Identification of current and reasonably anticipated land uses in the locality of the facility considering:

   i. Current land use zoning and other land use designations.
   ii. Land use plans as established in local comprehensive plans and land use implementing regulations of any governmental body having land use designations.
   iii. Concerns of the facility owner, neighboring property owners, and the community.
   iv. Any other relevant information, such as developmental patterns and population projections.

b. Identification of current and reasonably likely future beneficial uses of groundwater and surface water in the locality of the facility, considering:

   i. Federal, state, and local regulations governing the appropriation and/or use of water.
   ii. Nature and extent of current groundwater and surface water uses.
   iii. Suitability of groundwater and surface water for beneficial uses.
   iv. The contribution of water to the maintenance of aquatic or terrestrial habitat.
   v. Any beneficial uses of water which the Water Resources Department or other federal, state or local program is managing in the locality of the facility.
   vi. Reasonably likely future uses of groundwater and surface water, based on:
      (a) Historical land and water uses.
      (b) Anticipated future land and water uses.
      (c) Community and nearby property owners' concerns regarding future water use.
      (d) Regional and local development patterns.
      (e) Regional and local population projections.
      (f) Availability of alternate water sources including, but not limited to public water supplies, groundwater sources, and surface water sources.
   vii. Potential for contaminant migration.

D. SAMPLING AND ANALYSIS PLAN (SAP)

Objective: To adequately document all sampling and analysis procedures.

Scope: In preparation of the SAP, the following guidance documents shall be utilized: Data Quality Objectives Process for Superfund, EPA 540-R-93-071, September, 1993; Test Methods for Evaluating Solid Waste, SW-846; and A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001 (OSWER Directive 9355.0-14), December, 1987. The SAP shall address all topics listed in Environmental Cleanup Division Policy #760.000, Quality Assurance Policy.

Procedures: The work plan shall include a Sampling and Analysis Plan (SAP) for all sampling activities. The SAP shall be sufficiently detailed to function as a manual for field staff. The SAP shall include, at a minimum:

1. Proposed sampling parameters.
2. Sampling locations and frequency.
3. Description of sample collection techniques, sampling equipment, decontamination procedures, sample handling procedures, and management of investigation derived waste.
4. Quality assurance and quality control procedures for both field and lab procedures, and as described in EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, August, 1994.
5. Chain of custody procedures.
6. Analytical methods.

E. HEALTH AND SAFETY PLAN (HASP)

Objective: To establish policies and procedures to protect workers and the public from the potential hazards posed by a hazardous materials site.

Scope: The HASP portion of the work plan shall comply with 29 CFR 1910.120 and OAR Chapter 437, Division 2.

Procedures: The HASP shall include, at a minimum, the following elements:

1. Name of key personnel and alternates responsible for site safety.

2. Description of the risks associated with each site task or operation found in the RI work plan.

3. Confirmation that personnel are adequately trained to perform their job responsibilities and to handle the specific hazardous situations they may encounter.

4. Description of protective clothing and equipment to be worn by personnel during various site operations.

5. Description of any site-specific medical surveillance requirements.

6. Description of the program for periodic air monitoring, personnel monitoring, and environmental sampling, if needed. Air monitoring should be conducted to determine possible hazardous conditions and to confirm the adequacy of personal protection equipment. The results of the air monitoring shall be used as the basis for specifying personal protective equipment and determining the need to upgrade protective measures.

7. Description of the actions to be taken to mitigate existing hazards (e.g., containment of contaminated materials) to make the work environment less hazardous.

8. Definition of the site access control measures including a site map.

9. Description of decontamination procedures for personnel and equipment.

10. An Emergency Response Plan or Contingency Plan for safe and effective responses to emergencies, including a spill containment program, the necessary personal protective equipment and other equipment.

F. MAPS

The work plan shall include a map or maps of the facility which clearly shows:

1. Site topography and surface drainage.

2. On-site structures, including tanks, sumps, catch basins, wells, pipelines and utilities.

3. The location of past spills, disposal areas, and all other waste and product management areas.

4. All pertinent structures adjacent to or nearby the site such as drainage ditches, pipelines, roadways, wells and utility corridors.

5. The location of all existing and proposed sampling locations, including background sampling points.

6. The locations of hydrogeologic cross-sections.

7. The drawing date, orientation, and scale.

IV. RISK ASSESSMENT WORK PLAN

A. HUMAN HEALTH RISK ASSESSMENT PLAN

Objective: To evaluate the collective demographic, geographic, physical, chemical, and biological factors at the site, for the purposes of characterizing current and reasonably likely future risks to human health as a result of a threatened or actual release(s) of a hazardous substance; documenting the magnitude of the potential risk at a site; supporting risk management decisions; and establishing remedial action goals if necessary.

Scope: The Human Health Risk Assessment shall evaluate risk in the context of current and reasonably likely future land and water uses and in the absence of any actions to control or mitigate these risks (i.e., under an assumption of no action). The human health risk assessment portion of the work plan shall be developed based on the requirements specified in OAR 340-122-0084; DEQ guidance; and, as appropriate, the Risk Assessment Guidance for Superfund - Human Health Evaluation Manual Part A, United States Environmental Protection Agency (EPA), Interim Final, July 1989, (RAGS-HHEM); Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors", EPA, March 1991,(HHE-SG); and the Exposure Factors Handbook, EPA, 1996. A suggested outline for the human health evaluation is given in Exhibit 9-1 of the RAGS-HHEM. The work plan should use this outline as a framework for discussing the methodologies and assumptions to be used in assessing the potential human health risks at the site.

Procedure: The work plan shall describe the different tasks involved in preparing the Human Health Risk Assessment. The Human Health Risk Assessment can be completed using either deterministic or probabilistic methodologies. If probabilistic methodologies are to be used, then Respondent shall discuss risk protocol with DEQ before the commencement of a probabilistic risk assessment. If deterministic methodologies are to be used, then the Human Health Risk Assessment shall include an estimate of both the central tendency exposure (CTE) and the reasonable maximum exposure (RME) expected to occur under both current and future land use conditions. In general, RME exposures should be based on the 90th percentile exposure case. Additional guidance on quantifying the RME is given in Chapter 6 of the RAGS-HHEM, SRAGS, and HHE-SG. Quantifying the potential risks associated with the RME shall be the overall goal of the risk assessment.

The Human Health Risk Assessment Work Plan should include, but not be limited to the following:

1. A conceptual site model for the site. This model should be an iterative flow chart based on available site information showing contaminant sources, release mechanisms, transport routes and media, potential receptors, and other important information as appropriate. Iterations of this model shall be carried through the work plan and the risk assessment as additional information is generated. Exhibit 4-1 of the RAGS-HHEM presents an example of a conceptual site model.

2. Data quality objectives based on the conceptual site model.

3. A plan for identifying contaminants of concern to focus subsequent efforts in the risk assessment process. The plan shall include a list of all chemicals identified at the site (by media), and rationale for selecting chemicals that will be carried through the human health risk assessment.

4. A plan for conducting an exposure assessment for the site identifying actual and potential exposure pathways, characterizing the potentially exposed populations, and determining the exposure risk from each pathway. Procedures for defining exposure units, performing a spatial analysis of the contaminant data and calculation of exposure point concentrations should be provided. The exposure parameters shall be based on both current and reasonably anticipated future land and water use scenarios.

5. The analytical methods used during the site investigation, and the method detection limits that were used for all analytes. In addition, an explanation of how non-detect values and qualified data will be used to estimate exposure point concentrations shall be provided.

6. A discussion of how the fate and transport of site-related chemicals will be evaluated, including a description of the fate and transport model that will be used to estimate the potential movement of contaminants within and between environmental media.

7. A plan for conducting a toxicity assessment considering: 1) the types of adverse health effects associated with individual and multiple chemical exposures; 2) the relationship between magnitude of exposures and adverse effects; and 3) related uncertainties such as the weight of evidence for a chemical's potential carcinogenicity in humans. A summary table of the chemicals found, and their respective critical toxicity values (reference doses - RfDs), slope factors, and other relevant critical toxicity factors) and citations for these values; data on absorption factors that will be used (e.g., dermal absorption factors) should also be included.

8. A plan for conducting a risk characterization assessing the potential risks of adverse health effects for each of the exposure scenarios derived in the exposure assessment. The exposure points and exposure point concentrations to be used in the Human Health Risk Assessment (and/or how they will be estimated). A description of the model(s) that will be to estimate exposure point concentrations should be provided, if necessary.

9. A plan for conducting an uncertainty analysis identifying and discussing all appropriate uncertainties that could affect calculated risk. An explanation of how the uncertainty analysis will be conducted.

B. ECOLOGICAL RISK ASSESSMENT PLAN

Objective: To evaluate the collective demographic, geographic, physical, chemical, and biological factors at the site, for the purposes of characterizing current and reasonably likely future risks to the environment as a result of a threatened or actual release(s) of a hazardous substance; documenting the magnitude of the potential risk at a site; supporting risk management decisions; and establishing remedial action goals if necessary.

Scope: The Ecological Risk Assessment shall evaluate risk in the context of current and reasonably likely future land and water uses and in the absence of any actions to control or mitigate these risks (i.e., under an assumption of no action). The Ecological Risk Assessment will use a tiered approach (with four levels) to produce a focused and cost-effective assessment of risk. The Ecological Risk Assessment Work Plan shall be developed based on the requirements specified in OAR 340-122-0084; DEQ guidance; and, as appropriate, Proposed Guidelines for Ecological Risk Assessment, EPA, September 1996; Framework for Ecological Risk Assessment, EPA, February 1992; and Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual, Interim Final, EPA, March 1989 (RAGS-EEM).

Procedure: The plan shall describe the different tasks involved in preparing the Ecological Risk Assessment. Ecological risk assessments may include a Level I Scoping plan; a Level II Screening plan; and a Level III Baseline plan or Level IV Field Baseline plan. The Level III and Level IV Baseline plans shall include an exposure analysis, an ecological response analysis, a risk characterization and an uncertainty analysis as required by OAR 340-122-0084(3). The Ecological Risk Assessment can be completed using either deterministic or probabilistic methodologies. If probabilistic methodologies are to be used, then Respondent shall discuss risk protocol with DEQ before the commencement of a probabilistic risk assessment. If deterministic methodologies are to be used, then the Ecological Risk Assessment shall include an estimate of both the central tendency exposure (CTE) and the reasonable maximum exposure (RME) expected to occur. Estimating the potential risks associated with the RME shall be the overall goal of the risk assessment.

The work plan should include, but not be limited to the following:

1. A Level I Scoping plan to conduct conservative, qualitative determination of whether there is any reason to believe that ecological receptors and/or complete exposure pathways are present or potentially present at or in the locality of the site.

2. A Level II Screening plan to include identification of contaminants of potential ecological concern, potential ecological effects, ecological receptors, exposure pathways, initial definition of assessment and measurement endpoints, all with respect to current and reasonably likely future land and water uses. The plan for the problem formulations should include a preliminary conceptual site model that integrates ecological receptors, contaminants of potential ecological concern, and exposure routes. Similar to the human health risk assessment, the conceptual site model for the ecological risk assessment should be an iterative flow chart based on available information. Iterations of this model shall be carried through the work plan and risk assessment as additional information is generated.

3. Data quality objectives based on the conceptual site model.

4. A Baseline Level III or Level IV plan for conducting an exposure analysis which would refine the preliminary conceptual site model and include the identification and selection of contaminants of ecological concern; definition of population based on habitat and spatial extent of the population; identification and selection of target ecological receptors; a spatial analysis of contaminant data; calculation of exposure point concentrations; an exposure pathway model relating target receptors, their exposure routes, and measurement endpoints; and a quantitative estimate of exposure for both current and reasonably likely future land and water use scenarios.

5. A Baseline Level III or Level IV plan for conducting an ecological response analysis to include a summary of current information regarding the toxicological effects, ecological effects, and bioaccumulation potential of the identified contaminants of potential ecological concern, as well as ecological benchmarks values.

6. A Baseline Level III or Level IV plan for conducting a risk characterization presenting the quantitative ecological risks potentially associated with the facility, a weight-of-

evidence analysis of risk, a discussion of any available facility-specific ecological studies, and consideration of any other available published peer-reviewed scientific information on other sources of stress as appropriate.

7. A Baseline Level III or Level IV plan for conducting an uncertainty analysis identifying and discussing all appropriate uncertainties that could affect calculated risk.

V. INTERIM REMOVAL MEASURE ASSESSMENT AND FEASIBILITY STUDY WORK PLANS

Objective: To develop the information required to evaluate the feasibility of interim removal measures and to identify and evaluate remedial action alternatives and select or approve a final remedial action alternative to be taken at the facility.

Scope: The Interim Removal Measure (IRM) Assessment Work Plan shall identify and evaluate potentially feasible IRMs (e.g., fencing, and other measures to restrict access; soil removal; capping; hydraulic containment; and other risk reduction measures) that could mitigate immediate threats to human health and safety or the environment and prevent or reduce further contaminant migration.

Scope: The Feasibility Study (FS) shall be developed in accordance with the requirements specified in OAR 340-122-0085 and 0090, DEQ guidance, and, as appropriate, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, OSWER Directive 9355.3-01, 1988. The FS shall develop and evaluate an appropriate range of alternatives. The FS may be developed in parallel with Remedial Investigation (RI) activities or may be developed and submitted separately after commencement of RI activities.

Procedures: A work plan shall be submitted which will include, but not be limited to, the following:

A. PRELIMINARY EVALUATION OF REMEDIAL INVESTIGATION DATA

The work plans for the IRM Assessment and FS shall include a preliminary evaluation of data collected during the RI. The evaluation should be used to identify potential IRMs, preliminary remedial alternatives and additional data needs. The preliminary evaluation of the RI data shall include, but not be limited to, the following:

1. A determination of the current and reasonably likely future beneficial uses of groundwater and surface water in the locality of the facility.

2. A determination of the current and reasonably likely future land uses in the locality of the facility.

3. A preliminary identification of hot spots that meet the definition in OAR 340-122-0115(31), including a preliminary estimate of hot spot volumes.

4. A preliminary identification of relevant federal, state, and local laws and regulations.

5. Proposed contaminant concentration levels that meet preliminary remedial goals and a preliminary estimate of the volume exceeding those concentrations, for each affected environmental medium.

6. Description of any additional investigative work that needs to be conducted to complete the IRM Assessment and FS.

B. DESCRIPTION OF IRM ASSESSMENT PROCESS

The IRM Assessment Work Plan shall include a description of how potential IRMs will be identified, screened, and evaluated in detail, including discussions of the feasibility and costs of each potential IRM identified, and a schedule for implementation.

C. DESCRIPTION OF FS EVALUATION PROCESS

The FS Work Plan shall include a description of how remedial action technologies will be identified and screened and how remedial action alternatives will be developed, screened, and evaluated in detail. The plan shall include but not be limited to the following:

1. Identify how the areas or volumes of media which require remedial actions will be determined. Describe selection criteria for identification of areas needing remedial action.

2. Describe development of remedial action objectives (RAOs) that meet the standards in OAR 340-122-0040. RAOs should specify the contaminants and media of interest, exposure pathways, and preliminary remediation goals that permit a range of treatment, engineering and institutional controls, and removal alternatives to be developed.

3. Describe interim removal or remediation activities which have been implemented to date or are planned, and the relationship of the interim activities to the preliminary RAOs.

4. Describe how general response actions will be identified. General response actions should describe areas or volumes of media to which containment, treatment or removal actions may be applied that may satisfy the RAOs for the site.

5. Describe how potential remedial action technologies applicable to each general response action will be identified and evaluated (screened), based on effectiveness, implementablity and cost.

6. Describe how technology process options will be identified and evaluated to select a representative process for each technology type retained for consideration.

7. Describe how the selected representative technologies and process options will be assembled into a range of media-specific or site-wide preliminary remedial action alternatives representing no action, treatment, engineering or institutional controls, excavation and off-site disposal or combinations thereof as specified in OAR 340-122-0085(2).

8. Describe how the preliminary remedial action alternatives will be developed and eliminated (screened), if necessary, based on effectiveness, implementablity, and cost.

9. Describe how the detailed analysis of remedial action alternatives retained through the screening process will be completed including application of the higher threshold of cost for the treatment of hot spots. Detailed analysis of remedial action alternatives should be completed in compliance with OAR 340-122-0085 and 340-122-0090.

10. Describe how the remedial action alternatives retained through the screening process and detailed analysis will be compared to one another.

11. Describe how compliance with other applicable or relevant and appropriate laws and regulations will be achieved.

12. Describe how the residual risk assessment will be performed in accordance with OAR 340-122-0084(4).

13. Describe how concerns of the facility owner, neighboring owners and the community will be addressed.

VI. REPORTS

A. MONTHLY REPORTS

___ copies of the Monthly Reports shall be submitted to DEQ by the 10th day of the month following the reporting period. These reports shall include, but not limited to the following:

1. Activities that occurred during the past month.

2. Data collected or received during the past month.

3. Description of any problems or difficulties experienced during the past month. Discussion of how any problems or difficulties experienced were resolved or will be resolved.

4. Description of activities planned for the upcoming two months.

B. REMEDIAL INVESTIGATION REPORT

The Remedial Investigation Report shall follow the outline in Table 3-13 (page 3-30 - 3-31) in the CERCLA RI/FS guidance, as applicable, and address the items listed below:

1. **Executive Summary**.

2. **Introduction**.

    a. Purpose.
    b. Report organization.

3. **Site Background**. A description and supporting maps of facility operations, including, but not limited to, the following:

    a. Site description.

        i. Location.
        ii. Physical features, such as buildings, roads, etc.
        iii. Site history.

    b. Facility operations.

        i. Location, time and volume of known hazardous substance spills, including a map.
        ii. Past and present waste treatment/disposal practices and areas.
        iii. The approximate time periods for past operational, treatment, storage, disposal and/or discharge practices.
        iv. A map of all pertinent structures on, adjacent to or near the site, such as buildings, tanks, drainage ditches, pipelines, roadways, wells and utility corridors.

    c. Site setting.

        i. Geology.
        ii. Hydrogeology.
        iii. Surface water.
        iv. Aquatic and terrestrial habitat
        v. Climatology.

d. Historic, current and reasonably likely future land use at the facility and in the locality of the facility. The report shall include as appropriate:

i. Maps and descriptions of current and historic land use zoning.
ii. Other land use designations.
iii. Land use plans as established in the local comprehensive plans and land use implementing regulations of any governmental body having land use jurisdiction.
iv. Concerns of the facility owner, neighboring owners, and the community.
v. Any other relevant information.

e. Current and reasonably likely future beneficial uses of groundwater and surface water in the locality of the facility. This report shall include as appropriate:

i. Nature and extent of current groundwater and surface water users.
ii. Suitability of groundwater and surface water for beneficial uses.
iii. Reasonably likely future uses of groundwater and surface water, based on:
(a) Historical land and water uses.
(b) Anticipated future land and water uses.
(c) Community and nearby property owners' concerns regarding future water use.
(d) Regional and local development patterns.
(e) Regional and local population projections.
(f) Federal, state, and/or local regulations governing the appropriation and/or use of water.
(g) Availability of alternate water sources including, but not limited to, public water supplies, groundwater sources and surface water sources.
(h) The contribution of water in the locality of the facility to the maintenance of aquatic or terrestrial habitat.
(i) The potential for contaminant migration.

f. Previous investigations.

i. Summary of previous investigations.
ii. List of reports referenced.

4. **Study Area Investigation**.

a. **Soils**. The report shall include, but not be limited to, the following:

i. A map and description of the location of soil samples, including depth of sample, sampling parameters, sampling interval, sampling methods, analytical methods and any deviations from the SAP.
ii. Description of soil samples.
iii. Geologic cross-sections.
iv. A map showing the locations of geologic cross-sections.
v. Presentation of results and data analysis, including data limitations.

b. **Groundwater**. The report shall include, but not be limited to, the following:

i. Describe the groundwater investigation plan, including well locations, well depths, length of screened intervals, drilling methods, construction materials and installation methods, analytical methods, well development and completion methods and any deviations from the SAP.

ii. A map of all groundwater sampling locations.
iii. Characterize the hydrogeology, including a description of formation materials, the hydrogeology, and hydrogeologic properties of each pertinent aquifer.
iv. Present water table/potentiometric maps. Describe hydraulic influences from groundwater wells and surface water bodies.
v. Identify areas of recharge/discharge.
vi. Present results of the well inventory to identify all active and inactive water wells within an acceptable radius of the facility.
vii. Present results and data analysis, including data limitations.

c. **Surface Water and Sediments**. The report shall include, as applicable:

i. Identify, and show on a map, all relevant surface water bodies within an acceptable radius of the facility.
ii. Delineate past and present surface drainage patterns at the site and include a map showing the storm water collection system.
iii. A map and description of all surface water and sediment sampling locations, including depth of sample, sampling parameters, sampling methods, analytical methods and any deviations from the SAP.
iv. Present results and data analysis, including data limitations.

d. **Air**. The report shall include as applicable:

i. Provide a map and description of air sampling locations, including sampling parameters, sampling methods, analytical methods and any deviations from the SAP.
ii. An analysis of ambient air conditions.
iii. Present results and data analysis, including data limitations.

5. **Summary and Conclusions**

a. A discussion of the nature and extent of contamination, including a discussion of data limitations.

b. A discussion of the fate and transport of contaminants in all affected environmental media.

6. **Appendices**.

Supporting information of the Remedial Investigation shall be submitted in the Appendices of the report. The report shall include, at a minimum:

a. All boring and lithologic logs for soil borings and monitoring wells.

b. Well construction details, including:

i. Surveyed location (latitude or longitude).
ii. Elevation of top of casing.
iii. Size and depth of well.
iv. Screened interval.
v. Well construction diagrams.

c. Results of all chemical and physical analyses.

d. Quality assurance and quality control data and a data validation report.

C. RISK ASSESSMENT REPORT

1. Human Health Risk Assessment Report

The results of the human health risk assessment should follow the outline suggested by the RAGS-HHEM (see Exhibit 9-1 of the RAGS-HHEM). Justification for not following the outline should be explained.

The main sections of the Human Health Risk Assessment Report should include the following:

a. Introduction

Provide a detailed description of the site, its environmental problems, its geographic location, and its history. Also, provide the specific objectives, scope and organization of the risk assessment report.

b. Chemicals of Concern

Provide a detailed description of how data was gathered or generated in order to identify a set of chemicals that are likely to be site-related. The concentrations of these chemicals that are of acceptable quality for use in the quantitative analysis of the risk should be reported.

c. Exposure Assessment

Provide a detailed description of the exposure pathways (source, release mechanisms, transfer or transport mechanisms, potentially exposed population, exposure routes). The quantitative estimate of exposure based on both current and future land use scenarios should be included.

d. Toxicity Assessment

Provide a summary of current toxicity information on the carcinogenic and non-carcinogenic effects of the chemicals of concern, and provide up-to-date reference levels (reference doses and slope factors) for chemicals of concern.

e. Risk Characterization

Present the quantitative current or reasonably likely future risks to human receptors potentially associated with the site. In addition, present an assessment of uncertainty and consideration of any site-specific human health studies, if available and appropriate. If portions of these sections have been prepared for other sections of the RI Report, these may be referenced.

f. Uncertainty Analysis

Present a quantitative and qualitative uncertainty analysis as appropriate for each element of the risk assessment.

2. Ecological Risk Assessment Report

The main sections of the Ecological Risk Assessment Report should include the following:

a. Problem Formulation

Identify contaminants of ecological interest, potential ecological effects, ecological receptors, including individual threatened and endangered species and populations of plants or animals in the locality of the facility, relevant exposure pathways, initial definition of assessment and measurement endpoints, all with respect to current and reasonably likely future land and water uses, as shown in a conceptual site model.

b. Exposure Analysis.

Identify and select potential contaminants of ecological concern; identify and select target ecological receptors; develop an exposure pathway model relating target receptors, exposure routes and measurement endpoints; and present a quantitative estimate of exposure for both current and reasonably likely future land and water use scenarios.

c. Ecological Response Analysis.

Summarize current information regarding the toxicological effects, ecological effects, bioconcentration potential, bioaccumulation potential, biomagnification potential, and persistence of the identified contaminants of ecological concern as well as ecological benchmark values.

d. Risk Characterization

Present the quantitative ecological current or reasonably likely future risks potentially associated with the facility; a weight-of-evidence analysis of risk; identifications of contaminants of ecological concern; a discussion of risks associated with the bioconcentration potential, bioaccumulation potential, biomagnification potential, and persistence of each contaminant; and consideration of any other available, published and peer-reviewed scientific information on other sources of stress as appropriate.

e. Uncertainty Analysis.

Present a quantitative and qualitative uncertainty analysis as appropriate for each element of the risk assessment.

D. INTERIM REMOVAL MEASURE ASSESSMENT REPORT

The results of the Interim Removal Measure Assessment shall be submitted to DEQ in a report, which includes the identification and screening of general response actions and technologies, and the development and detailed evaluation of a representative number of potential IRMs. For each alternative, the report shall discuss its technical and administrative feasibility, its advantages and disadvantages, its estimated construction/implementation time, its operational and maintenance (O&M) requirements (including monitoring activities), and its associated capital and O&M costs. The report shall also include Respondent's conclusions and recommendations.

E. FEASIBILITY STUDY REPORT

The results of the Feasibility Study (FS) shall be submitted to DEQ in a report which, at a minimum, includes a full evaluation of remedial action alternatives, providing a workable number of alternatives, acceptable to DEQ, which achieve the remedial action objectives and are protective of public health, safety and welfare, and the environment.

The results of the FS shall comply with OAR 340-122, DEQ Guidance, and, as appropriate, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA OSWER Directive 9355.3-01, 1988. The results of the feasibility study should follow the outline suggested in Table 6-5 (Page 6-15) of the CERCLA RI/FS guidance as appropriate.

The main sections of the FS Report shall include the following:

1. **Introduction**

Provide site background information summarized from the Remedial Investigation (RI) Report. Background information should include summary of the site history; nature and extent of contamination, relevant contaminant fate and transport information and baseline human health and ecological risk assessments. Describe the purpose and organization of the FS Report.

2. **Identification of Hot Spots of Contamination**

The FS Report shall identify hot spots of contamination for the purpose of evaluating remedial action alternatives. Information obtained from the remedial investigation/site characterization report, human health risk assessment, and ecological risk assessment will be required to complete the identification of hot spots. The identification of hot spots of contamination shall include:

a. Identification of significant adverse effects on current and reasonably likely future beneficial uses of groundwater and surface water or waters to which the hazardous substances would be reasonably likely to migrate and for which treatment is reasonably likely to restore or protect such beneficial uses within a reasonable time, as determined in the FS. The identification of significant adverse effects on current or reasonably likely future beneficial uses of water shall be based on current or reasonably likely future exceedance of:

   i. Applicable or relevant federal, state or local water quality standards, criteria, guidance or specifications;
   ii. In the absence of applicable or relevant water quality standards, criteria, guidance or specifications, the acceptable risk level, as defined by OAR 340-122-0115; or
   iii. If i and ii do not apply, the concentration of the hazardous substance indicated by available published peer-reviewed scientific information to have a significant adverse effect on a current or reasonably likely future beneficial use of water.

b. Identification of hot spots of contamination for media other than water (e.g., contaminated soil, debris, sediments and sludges; drummed wastes; "pools" of dense non-aqueous phase liquids submerged beneath groundwater or in fractured bedrock; and non-aqueous phase liquids floating on groundwater), if hazardous substances present a risk to human health or the environment exceeding the acceptable risk level. The identification of hot spots in other media shall be based on any one of the following:

   i. Individual contaminants that are present in concentrations exceeding a risk-based concentration corresponding to:
      (a) 100 times the acceptable risk level for human exposure to each individual carcinogen;
      (b) 10 times the acceptable risk level for human exposure to each individual noncarcinogen; or
      (c) 10 times the acceptable risk level for exposure of individual ecological receptors or populations of ecological receptors to each individual hazardous substance.
   ii. Contaminants reasonably likely to migrate to such an extent that another hot spot of contamination would be created.
   iii. Contaminants not reliably containable, as determined in the FS.

3. **Identification of Areas or Volumes of Media which Require Remedial Action**

The FS Report shall identify areas or volumes of media which exceed the acceptable risk level and areas or volumes of media which have been identified as hot spots of contamination.

4. **Development of Remedial Action Objectives**

Develop and discuss remedial action objectives (RAOs) that meet the standards in OAR 340-122-0040 specifying the contaminants and each media of interest, exposure pathways, and preliminary remediation goals that permit a range of treatment, containment, and removal alternatives to be developed. Develop and discuss general response actions for each medium of interest defining containment, treatment, and removal actions singly or in combination, that may be taken to satisfy the RAOs for the site.

5. **Identification and Screening of Remedial Technologies**

Identify potential containment, treatment, and removal technologies applicable to each general response action and eliminate (screen) those technologies that cannot be implemented technically at the site. Identify and evaluate technology process options to select a representative process for each technology type to be retained for consideration. Assemble the selected representative technologies into preliminary remedial action alternatives representing a range of containment, treatment and removal combinations.

6. **Development and Screening of Preliminary Remedial Action Alternatives**

a. Develop a range of preliminary remedial action alternatives acceptable to DEQ, including any or all of the following:

i. No action;
ii. Remedial action utilizing engineering and/or institutional controls;
iii. Remedial action utilizing treatment;
iv. Remedial action utilizing excavation and off-site disposal; and
v. Any combination of the above, as appropriate.

b. Each preliminary remedial action alternative developed must be demonstrated to be protective of human health and the environment based upon the standards set forth in OAR 340-122-0040.

c. Preliminary remedial action alternatives may be screened, if appropriate, with only the alternatives judged as most promising, based on evaluation factors, retained for detailed analysis. Preliminary remedial action alternatives should be evaluated against the following criteria:

i. Effectiveness;
ii. Implementability; and
iii. Cost.

7. **Detailed Analysis of Remedial Action Alternatives**

Each preliminary remedial action alternatives retained through the screening process shall be analyzed in detail. The detailed analysis of each remedial action alternative shall include, but not be limited to the following:

a. The feasibility of the remedial action alternative based upon a balancing of the remedy selection factors (OAR 340-122-0090). The remedy selection factors are:

   i. Effectiveness;
   ii. Long-term reliability;
   iii. Implementability;
   iv. Implementation risk; and
   v. Reasonableness of cost.

b. For each remedial action alternative, the FS Report shall present the following information:

   i. Description and comparison of the remedial action alternatives, estimated present worth cost, and rationale for selection.
   ii. Performance expectation (i.e., reductions in contaminant concentration levels), reliability, and ability to implement.
   iii. Design criteria and rationale.
   iv. General operation and maintenance requirements; necessary engineering or institutional controls.
   v. Monitoring program to assure both short-term and long-term performance of the alternative.
   vi. Estimated time for implementation.
   vii. Evaluation of the short-term and long-term effectiveness and risks of the alternative.
   viii. A schedule for implementation of the remedial action.
   ix. Identification of necessary exemptions under ORS 465.315(3).

c. The extent to which the remedial action treats hot spots of contamination, as follows:

   i. For hot spots of contamination in groundwater or surface water the FS shall evaluate treatment to concentrations that ensure significant adverse effects on current or reasonably likely future use of water will not occur. Specifically, the following shall be evaluated: whether treatment is reasonably likely to restore or protect a beneficial use within a reasonable time, and the extent to which treatment is feasible, considering the remedy selection factors (OAR 340-122-0090), including application of the higher threshold for evaluating the reasonableness of the cost of treating hot spots of contamination.

   ii. For hot spots of contamination in groundwater or surface water where the treatment concentration identified for waters is not equivalent to an acceptable risk level, the FS shall evaluate the feasibility of treatment to the concentration, regardless of whether that level is more or less stringent than the acceptable risk level, applying the higher threshold for reasonableness of the cost of treatment. Where the acceptable risk level is more stringent than the treatment concentration identified for groundwater or surface water, the FS shall also evaluate the feasibility of treatment to the acceptable risk level, without application of the higher threshold for reasonableness of the cost of treatment. If treatment to a more stringent acceptable risk level is not feasible, the FS study shall evaluate other remedial measures providing protection while allowing beneficial use of the water.

iii. For contamination of media other than groundwater or surface water, the FS shall evaluate the extent to which the hazardous substances cannot be reliably contained.

iv. For hot spots of contamination in media other than groundwater or surface water, the FS shall evaluate the feasibility of treatment and of excavation and off-site disposal to a point where the concentration or condition making the hazardous substance a hot spot would no longer occur, based upon a balancing of the remedy selection factors and an application of the higher threshold for evaluating the reasonableness of the cost of treatment and of excavation and off-site disposal of hot spots of contamination.

v. For hot spots of contamination in media other than groundwater, the FS shall evaluate the feasibility of treatment and of excavation and off-site disposal to the acceptable risk level through comparison to other remedial methods without application of the higher threshold for reasonableness of the cost of the treatment and of excavation and off-site disposal.

8. **Comparative Analysis of Remedial Action Alternatives**

Once the alternatives have been analyzed in detail, a comparative analysis shall be completed including a narrative discussion describing the strengths and weaknesses of the individual alternatives relative to one another. The discussion should include how reasonable variations of key uncertainties could change the expectations of their relative performance.

9. **Recommended Remedial Action Alternative**

The FS Report shall recommend a protective and feasible remedial action from the remedial action alternatives developed and evaluated in the FS. For any recommended remedial action the FS Report shall:

a. Demonstrate the protectiveness of the recommended remedial action through presentation of the results of the residual risk assessment in accordance with OAR 340-122-0084(4).

b. Identify the extent to which the remedial action alternative would be conducted onsite.

c. Identify all state or local permits, licenses, or other authorizations or procedural requirements proposed to be exempted.

d. Describe any consultation with affected state or local government bodies.

e. Identify applicable substantive requirements of the affected state or local laws and how they would be addressed.

F. REPORT DISTRIBUTION

1. ____ bound and ____ unbound copy(s) of all work plans and reports shall be submitted to DEQ.

2. DEQ requests that all copies of work plans and reports be duplex printed on recycled paper.

3. Electronic copies of work plans and reports, including all data and figures, if requested, shall be submitted in Microsoft Office or ArcView compatible format. All photographs must be submitted in both hard copy and electronic file formats.