Los Alamos Environmental Restoration Records Processing Facility

ER Record I.D.# 57761

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION
Records Processing Facility
ER Records Index Form

ER ID NO. 57761 *Date Received:* 5/28/98 *Processor:* YCA *Page Count:* 11

Privileged: (Y/N) N *Record Category:* P *Record Package No:* 0

FileFolder: N/A

Correction: (Y/N) N *Corrected No.* 0 *Corrected By Number:* 0

Administrative Record: (Y/N) Y

Refilmed: (Y/N) N *Old ER ID Number:* 0 *New ER ID Number:* 0

Miscellaneous Comments:
REFERENCE CITED

THIS FORM IS SUBJECT TO CHANGE. CONTACT THE RPF FOR LATEST VERSION. (JUNE 1997)

(11) 57761

206.57761.1

RISK-BASED DECISION TREE
Description

All or portions of this Risk-based Decision Tree may not be applicable to all facilities. Please contact the RPMP Facility Manager if applicability is questionable.

Box 1: Perform RCRA Facility Investigation (RFI) or equivalent project.

Box 2: Perform Data Assessment. (This step corresponds to Step 3 in the Accelerated Corrective Action Process [ACAP]).

Criteria:

1. Compare results to data quality objectives (DQOs);
2. Determine the nature, rate, and extent (vertical and horizontal) of contamination;
3. Compare the maximum constituent concentrations to the Administrative Authority (AA)-approved:
   1. Background for inorganic constituent concentrations,
   2. Fallout for radionuclide concentrations, or
   3. MDLs, PQLs, or EQLs for organic constituent concentrations; and
4. Compare the maximum constituent concentrations to AA applicable standards or other approved values.

Box 3: Are there contaminants above Criterion 3 and 4?

If **NO**, move to Box 4
If **YES**, move to Box 5

Box 4: Use this determination in conjunction with other criteria to support a petition for NFA (HSWA Corrective Action Process).

Box 5: Assess Environmental Fate & Transport from the Source Term. (This step corresponds to Step 7 of the ACAP.)

Consider the following:

1. Determine if bioaccumulation in plant and/or animal tissue is of concern. The constituent is considered a bioaccumulator, if:
   a. For inorganics (including radionuclides), the bioconcentration factor (BCF) exceeds 40, or
   b. For organics, the logarithm of the octanol-water partition coefficient (log K_{ow}) exceeds 4.
2. Other important environmental fate processes to be evaluated include, but

RISK-BASED DECISION TREE
Description

are not limited to the following:

a. Soil/sediment sorption/desorption potential;
b. Leaching to underlying ground water and discharging into surface water and/or other habitats;
c. Vertical migration in unsaturated zone;
d. Erosion of contaminated soils as a potential contaminant transport pathway;
e. Other movement of contaminant within various components of the ecosystem (e.g., plant uptake, soil or aquatic invertebrate uptake); and
f. Chemical and biological transformation and degradation processes in abiotic media.

Box 6: Are bioaccumulators present at the site?

The constituent is considered a bioaccumulator, if:

1. for inorganics (including radionuclides), the bioconcentration factor (BCF) exceeds 40, or
2. for organics, the logarithm of the octanol-water partition coefficient (log K_{ow}) exceeds 4.

If **YES**, move to Box 7.
If **NO**, move to Box 10.

Box 7 : Determine if there is a fate and transport mechanism?

If bioaccumulators are present at the site, evaluate the following environmental fate and transport processes:

1. Soil/sediment sorption/desorption potential;
2. Leaching to underlying ground water and discharging into surface water and/or other habitats;
3. Vertical migration in unsaturated zone;
4. Erosion of contaminated soils as a potential contaminant transport pathway;
5. Other movement of contaminant within various components of the ecosystem (e.g., plant uptake, soil or aquatic invertebrate uptake); and
6. Chemical and biological transformation and degradation processes in abiotic media.

If, as a result of this evaluation the environmental transport is of concern, move to Box 8.

RISK-BASED DECISION TREE
Description

If, as a result of this evaluation the environmental transport is not of concern, move to Box 11.

Box 8: No risk assessment needed: clean up the site to AA-approved site background levels or risk-based concentrations or non-detect.

Criteria:

1. Background constituent level is the naturally occurring concentration of inorganic chemicals (including naturally occurring radionuclides) present in the area upgradient or upwind from the site prior to industrial or hazardous waste operations in the area. Fallout concentrations of man-made radionuclides derived from sources unrelated to the facility activities are considered baseline levels. A facility shall have it's background inorganic constituent concentrations (including naturally occurring radionuclides) and baseline fallout concentrations of man-made radionuclides approved by the AA prior to their use.

2. Risk-based concentrations are represented by ecological or toxicological benchmarks/criteria developed on a case by case basis, addressing the results of the fate and transport evaluation to protect human health and the environment.

3. The concept of "non detect" applies to man-made organic constituents that shall be cleaned up to levels of their PQLs, EQLs, or an analytical method detection limit, if cleanup to "non detect" is the elected remedy for the site.

Box 9: Submit final report. (This step corresponds to Step 5 of the ACAP.)

Box 10: Determine if there is a fate and transport mechanism.

If BIOACCUMULATORS are NOT present at the site, at a minimum, evaluate the following environmental fate and transport processes. The results of this evaluation shall be used to adequately focus a screening assessment (see Box 11).

1. Soil/sediment sorption/desorption potential;
2. Leaching to underlying ground water and discharging into surface water and/or other habitats;

RISK-BASED DECISION TREE
Description

3. Vertical migration in unsaturated zone;
4. Erosion of contaminated soils as a potential contaminant transport pathway;
5. Other movement of contaminant within various components of the ecosystem (e.g., plant uptake, soil or aquatic invertebrate uptake); and
6. Chemical and biological transformation and degradation processes in abiotic media.

Box 11: Perform Screening Assessment.

1. Perform Ecological Screening Assessment:
   a. Develop site conceptual model and relevant food webs, and select receptors representing all feeding guilds and trophic levels;
   b. In the absence of site-specific data, estimate potential exposure of these receptors to site contaminants using the following conservative/protective assumptions and exposure parameter values:
      i. Use the highest measured contaminant concentrations at a site to represent the exposure point concentration to biota;
      ii. Use the highest (conservative) literature transfer coefficients to address constituents bioconcentration/bioaccumulation and biomagnification potential and food chain transfer;
      iii. Assume the receptor resides 100% of time in the contaminated area;
      iv. Assume the constituents bioavailability to be 100%;
      v. Assume the most sensitive life stage of the receptor for the exposure assessment;
      vi. Use minimum body weight and maximum ingestion rate;
      vii. Assume that 100% of diet consists of the most contaminated dietary component; however, if evaluating potential exposure of an omnivore receptor, it acceptable to assume that diet consists of e.g., about 50% of plant material and about 50% of invertebrates (with soil ingestion rate estimate at less than 1%);

      In the subsequent phases of the ACAP (e.g., ecological baseline risk assessment) following collection of additional information/data, these conservative assumptions can be examined and adjusted (relaxed) to better reflect site and receptor-specific conditions.

   c. Select a current literature no-observed-adverse-effect level (NOAEL) to represent the ecotoxicity screening reference value (ESRV) (i.e., exposure dose). NOAELs shall be derived for each ecologically significant exposure pathway/route and they shall:

RISK-BASED DECISION TREE
Description

i. Utilize the most sensitive species (select most sensitive assessment endpoints);
ii. Be derived from chronic mortality, reproduction, and growth studies; and
iii. Utilize the lowest NOAEL.

In the absence of a literature NOAEL, the NOAEL can be estimated by applying an uncertainty/safety factor of 10 for the lowest available lowest-observed-adverse-effect level (LOAEL) or of 100 for the lowest available acute toxicity value (LD50 or LC50) or effective concentration (EC50). If toxicity values are not available for the habitat of interest (e.g., terrestrial or aquatic), toxicity values derived from other habitat studies should not be used, and the constituent should be retained for further evaluation in the ecological (baseline) risk assessment. In any case, the original study (i.e., primary literature from which the ESRV is derived) shall be examined and referenced.

d. Calculate hazard quotients (HQs) and hazard indices (HIs) for exposure to multiple contaminants of receptors of concern.

e. And/or estimate abiotic media (e.g., soil, sediment, or water) ecological screening levels (ESLs) from calculated HQs (for receptor's exposure to a single contaminant) or HIs (for receptor's exposure to multiple contaminants) assuming HQ=1 or HI=1, respectively;

f. Perform an uncertainty analysis; at a minimum, analysis should focus on the following key sources of uncertainty associated with a screening assessment:
   i. Definition of a site physical setting (e.g., exposure assumptions such as the likelihood of exposure pathways and land uses actually occurring, and receptors selected for evaluation);
   ii. environmental monitoring data (e.g., media-contaminant distribution, using laboratory or otherwise qualified data, lack of quantitation, high detection limits);
   iii. Environmental fate and transport models;
   iv. Constituent toxicity values (or their lack) and interactions;
   v. Intake parameters and their assumed values; and
   vi. Multiple pathway exposure assumptions.

g. Combine the results of Steps (d) or (e) and (f) above.

In the subsequent phases of the Corrective Action process (e.g., ecological

RISK-BASED DECISION TREE
Description

baseline risk assessment) and following collection of additional information/data, these conservative assumptions can be examined and adjusted (relaxed) to better reflect site and receptor-specific conditions.

2. Perform Human Health Screening Assessment:

   a. Follow the process presented in the RCRA Permits Management Program (RPMP) position paper entitled "*Human Health Risk-Based Screening Action Levels and Screening-Level Assessment*".

      Note, that although food-chain transfer of contaminants has been excluded from consideration in calculation of human health screening action levels (HHSALs) it may be important under certain exposure scenarios (e.g., agricultural) or for certain exposure pathways (e.g., human consumption of home-grown produce under residential exposure scenario). Therefore, when these exposure scenarios or pathways are of potential concern at a site, a contaminant food-chain transfer shall also be evaluated and the results shall be incorporated into the revised HHSAL.

   b. Perform an uncertainty analysis; at a minimum, analysis should focus on the following key sources of uncertainty associated with a screening assessment:
      i. Definition of a site physical setting (e.g., exposure assumptions such as the likelihood of exposure pathways and land uses actually occurring, and receptors selected for evaluation);
      ii. Environmental monitoring data (e.g., media-contaminant distribution, using laboratory or otherwise qualified data, lack of quantitation, high detection limits);
      iii. Environmental fate and transport models;
      iv. Constituent toxicity values (or their lack) and interactions;
      v. Intake parameters and their assumed values; and
      vi. Multiple pathway exposure assumptions.

   c. Combine the results of Steps (1) or (2) and (3) above.

   In the subsequent phases of the Corrective Action process (e.g., human health baseline risk assessment) and following collection of additional information/data, these conservative assumptions can be examined and adjusted (relaxed) to better reflect site-specific conditions.

Box 12: Is risk acceptable?

RISK-BASED DECISION TREE
Description

Use both ecological and human health screening assessment determinations.

1. Ecological

Ecological risk is considered acceptable, if:

a. HQ<1 (for receptor's exposure to a single contaminant) or HI<1 (for receptor's exposure to multiple contaminants); and/or
b. The maximum constituent media concentrations are below their respective media ecological screening level (ESL)s.

2. Human Health

Human health risk is considered acceptable, if:

a. For noncarcinogens, HQ<1 (for exposure to a single contaminant) or HI<1 (for exposure to multiple contaminants), and for carcinogens, excess lifetime risk of developing cancer by an individual is less than 10^{-6} for Class A and B carcinogens and less than 10^{-5} for Class C carcinogens; and/or
b. The maximum constituent media concentrations are below their respective human health screening action levels (HHSALs).

If answer to both 1 and 2 is **YES**, move to Box 13.

If answer to either 1 and 2 is **NO**[1], move to Box 14.

Box 13: Use this determination in conjunction with other criteria to support a petition for NFA (HSWA Corrective Action Process).

Box 14: Risk Management Decision

A risk management decision (RMD) must be made at this point. It should be determined whether it would be less costly to clean up the site to generic preliminary cleanup levels (PCLs) based on risk-based concentrations (HHSALs and/or ESLs, whichever is more stringent) or to collect more site-specific data and conduct baseline risk assessment (i.e, ecological and/or human health baseline risk assessments [EBRA and/or HHBRA]). As a result

[1] This determination does not automatically require corrective action (e.g., cleanup) but may require more analysis (e.g., a baseline risk assessment should be conducted).

RISK-BASED DECISION TREE
Description

of these EBRA and HHBRA, site-specific risk-based cleanup levels (CLs) could be established. Consideration should be given to fact that even after considerable expense conducting an EBRA or HHBRA, the site may still need to be cleaned up to PCLs.

Box 15: Conduct Baseline Risk Assessment.

Both ecological and human health baseline risk assessments should be performed, if warranted. Additional information and site-specific data shall be collected to address the critical data needs (gaps) identified during the ecological and human health screening assessments that will support baseline risk assessments. The following steps shall be considered for site-specific baseline risk assessments:

1. Collect additional information and/or site-specific data;
2. Select Contaminants of Potential Concern (COPCs);
3. Evaluate receptors exposure;
4. Evaluate contaminants toxicity, including potential interactions;
5. Estimate and characterize risk (including quantification of risk and uncertainty analysis);
6. Provide risk interpretation and recommendations; and
7. Calculate revised ESLs (RESLs) and/or HHSALs (RHHSALs) and obtain AA approval.

Box 16: Are concentrations of contaminants above AA approved risk-based concentrations?

Compare site-specific RESLs and RHHSALs to the site media constituent concentrations.

If site-specific RESLs and/or RHHSALs exceed the site media constituent concentrations, move to Box 17.

If site-specific RESLs and/or RHHSALs are below the site media constituent concentrations, move to Box 18.

Box 17: Use this determination in conjunction with other criteria to support a petition for NFA (HSWA Corrective Action Process).

Box 18: Risk Management Decision

RISK-BASED DECISION TREE
Description

A risk management decision must be made at this point. A decision must be made to defer further action at this time (Box 19) **or** to cleanup the site to AA approved site-specific risk-based cleanup levels (CLs)(based on RESLs and/or RHHSALs, whichever is more stringent)(Box 20).

Box 19: Documentation prepared to justify deferral. To be incorporated into the schedule of compliance.

Prepare documentation to justify deferral. If approved by AA, deferral will be incorporated into the schedule of compliance.

Box 20: Cleanup site to AA-approved risk-based concentrations or background levels.

Cleanup the site to AA approved site-specific risk-based cleanup levels (CLs) or background levels or "non detects" (as defined in Box 8, Steps 1 and 3).

Box 21: Submit Final Report. (This step corresponds to Step 5 of the ACAP.)

Requirements:

1. Verification sampling and analysis is conducted to determine COPCs concentrations have been reduced to RCLs or background levels or "non-detects" (as defined in Box 8, Steps 1 and 3).

2. This determination should be used in conjunction with other criteria to support petition for NFA (HSWA CA Process).

Box 22: Cleanup site to AA-approved risk-based concentrations or background levels.

1. Calculate generic preliminary risk-based cleanup levels (PCLs) based on ESLs (RESLs) and/or HHSALs (RHHSALs) and obtain AA approval.

2. Cleanup the site to AA approved PCLs or background levels or "non-detects" (as defined in Box 8, Steps 1 and 3).

Box 23: Submit Final Report. (This step corresponds to Step 5 of the ACAP.)

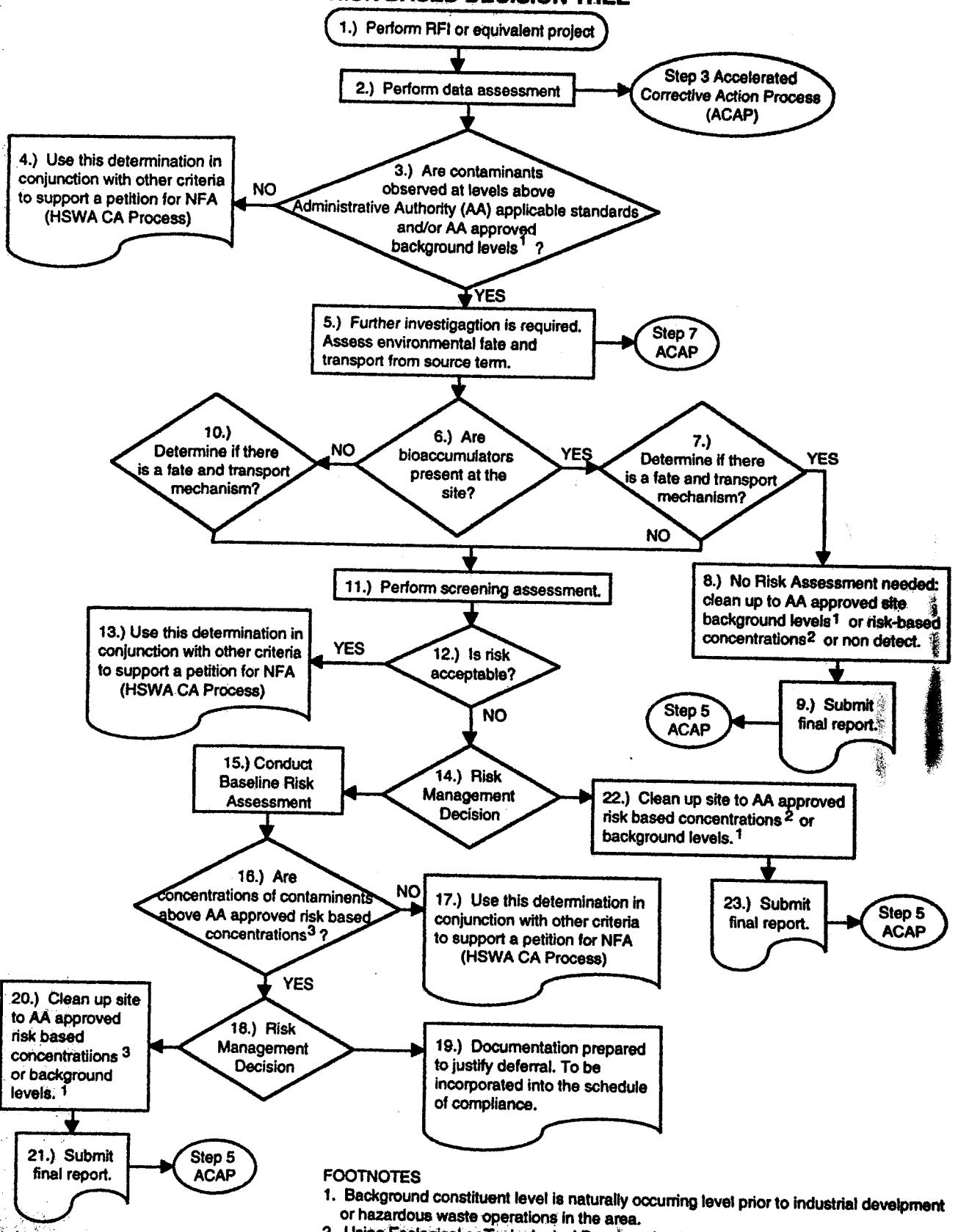
Requirements:

1. Verification sampling and analysis is conducted to determine COPCs

concentrations have been reduced to PCLs or background levels or "non detects" (as defined in Box 8, Steps 1 and 3).

2. This determination should be used in conjunction with other criteria to support petition for NFA (HSWA CA Process).

RISK BASED DECISION TREE



FOOTNOTES

1. Background constituent level is naturally occurring level prior to industrial development or hazardous waste operations in the area.
2. Using Ecological or Toxicological Benchmarks develped on a case by case basis.
3. Developed on a site specific basis by conducting a baseline risk assessment.