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SEAD-12 RI/FS

Final Scoping Plan

Section 4 only

Aug '98

USE AS REFERENCE

4.0 TASK PLAN FOR THE REMEDIAL INVESTIGATION (RI)

This section describes the tasks required for completion of the Remedial Investigations at SEAD-12 and SEAD-63. These include the following:

- Pre-field Activities,
- Field Investigations,
- Data Reduction, Interpretation and Assessment,
- Data Reporting,
- Task Plan Summary.

The objective of the tasks listed above is to ensure that all of the work performed is supportive of the objectives and the decisions of the remedial investigations.

4.1 PRE-FIELD ACTIVITIES

The pre-field activities include the following:

- A site inspection to familiarize key personnel with site conditions and finalize direction and scope of field activities,
- A comprehensive review of the Health & Safety Plan with field team members to ensure that site hazards and preventive and protective measures are completely understood,
- Inspection and calibration of all equipment necessary for field activities to ensure proper functioning and usage,
- A comprehensive review of sampling and work procedures with field team members.
- Site clearance, if necessary

4.2 FIELD INVESTIGATIONS AT SEAD-12

This section describes the field investigations that are to be performed at SEAD-12. The field investigations are designed to investigate three types of areas that have been identified at SEAD-12:

- Field investigations of areas and buildings within the Q Area where the maintenance or quality assurance testing of nuclear materials has been documented, these sites are referred to as Class One sites,

- Field investigations of areas and buildings within the Q Area which were used for the storage of sealed nuclear materials or sealed nuclear sources that were integral parts of military items, such as night vision devices or sealed calibration check sources, these sites are referred to as Class Two sites,
- Field investigations of areas and buildings withing the Q Area with little potential for residual radioactive contamination, these sites are referred to as Class Three sites.

The field investigations of buildings and areas that have been classified as either Class One, Class Two, or Class Three sites are designed to collect information to demonstrate if the levels of exposure to radiation and/or radioactive materials by current site workers or visitors and future site inhabitants is below the acceptable limits established by the New York State Department of Environmental Conservation and the New York State Department of Health. In these areas, the field investigation design follows the radiological survey methodologies described in the U.S. Nuclear Regulatory Commission's *Manual for Conducting Radiological Surveys in Support of License Termination* (NUREG/CR 5849), the *Working Draft Regulatory Guide on Release Criteria for Decommissioning* (the NRC's NUREG 1500 Series of documents), and the joint EPA, NRC, DOD, and DOE's *Multi Agency Radiological Site and Survey Investigation Manual* (MARSSIM, NUREG-1575, EPA 402-R-97-016, December 1997). MARSSIM was developed as a guidance document, and as such deviations from the cited MARSSIM radiological survey methodology will be documented, explained and appropriately referenced throughout the body of this document.

In addition, for Class One and Class Two sites where one or more potential chemicals of concern (including radionuclides) are currently impacting SEAD-12 media, the field investigations were designed to include EPA guidance for conducting remedial investigations and feasibility studies under CERCLA (EPA, 1989). At present the only areas where potential chemicals of concern are known to have affected SEAD-12 media are the disposal pits located in the northeastern portion of the site (the site investigated as SEAD-12A during the ESI), the groundwater in the area of monitoring well MW12B-1, and the sediment at the SD12A-1 sampling location. The sources, if any, of the potential chemicals of concern found in the two latter areas are unknown.

SEAD-12 Field Investigations

The following field investigations will be performed to complete the RI characterization of SEAD-12:

- Geophysical investigation,
- Soil gas surveys,
- Alpha (building and pavement only),beta (building and pavement only) and gamma scanning (count rate) surveys,
- Alpha and beta direct measurements (in buildings and on pavement),
- Exposure rate surveys,
- Removable radiation surveys (in buildings and on pavement),
- Investigation of radon concentrations in air (in buildings only)
- Special measurements and sampling (e.g. from floor drains, plumbing drain pipes, etc..),
- Soil Investigation (surface and subsurface soil sampling, test pits, soil borings),
- Groundwater investigation (overburden wells),
- Groundwater investigation downgradient of the 5,000 gallon tank (bedrock wells)
- Surface water and sediment investigation,
- Ecological investigation, and
- Surveying.

These investigations are described in the following sections.

4.2.1 Geophysical Investigation

In order to determine the direction of groundwater flow at SEAD-12, eight seismic refraction profiles will be surveyed in the vicinity of the disposal pits located in the northeastern portion of the site. The seismic data will be collected using a drop weight and 2.5 and/or 5 foot geophone spacings. The objective of the seismic survey will be to map the depth of the water table beneath SEAD-12. This information will be used to determine the direction of groundwater flow, which, in turn, will be used to determine whether the proposed locations for the monitoring wells are up or downgradient of the disposal pits at SEAD-12. If the proposed locations are not up or downgradient of the disposal pits, they will be located according to the information from the seismic refraction survey.

Electromagnetic (EM-31) and Ground Penetrating Radar (GPR) surveys will be performed at SEAD-12 in those areas which were not investigated during the ESI. The initial geophysical investigation will be an EM-31 survey performed along lines spaced every 20 feet throughout the area of SEAD-12. The objective of the EM-31 survey will be to identify locations where metallic objects may be buried within the subsurface. Upon completion of the EM-31 survey, contour maps of the in-phase and quadrature components of the electromagnetic field will be generated to aid in identifying the locations of possible buried metallic objects within the subsurface.

Subsequent to the EM-31 survey, a GPR survey will be performed. GPR data will be collected over each distinct EM-31 anomaly in order to provide a better characterization of the suspected anomaly source.

A borehole geophysics survey will be performed in the area of Disposal Pit A to approximately locate the extent of radium-226 (^{226}Ra) in the waste material and surrounding soil at this location. The methodology proposed herein is based upon and closely follows the methodology described in "Estimate of Volume of Radium Contaminated Soil On Five Sites In Ottawa, Illinois" prepared for the USEPA by the Argonne National Laboratory (document ANL/ESH/TS-89/100). The borehole geophysics survey will use a downhole probe equipped with a NaI(Tl) crystal and photomultiplier. The downhole probe will either be connected to a digital recording/controler unit or to a hand held ratemeter or scaler. If the digital recording/controller unit is used, it will control the rate of descent (or ascent) of the downhole probe and record the flux of gamma radiation (in counts per minute) through the NaI(Tl) crystal at preset time intervals. When recording data during this survey, the descent rate (or ascent rate) of the borehole probe will not exceed 5 feet per minute. The recording rate will be 1 measurement per second. If the borehole probe is connected to a hand held ratemeter or scaler, the borehole probe will be held at static locations at 0.5 feet (6 inches) increments from the top of the borehole to the bottom of the borehole. At each measurement depth, the total number of counts for a 20 second counting period will be recorded and multiplied by 3 to arrive a value of gamma radiation flux in units of counts per minute. The proposed locations of the boreholes that are shown in Figure 4-1. During the survey, the borehole locations will be placed at the grid nodes of a 15 foot by 15 foot grid, which will be established over the extent of the Disposal Pit A area.
Borehole locations will also be placed at fifteen foot intervals along 4 lines extending radially from the downgradient boundary of Disposal Pit A. Additionally, five boreholes will be logged at background locations. The data collected from the borehole geophysical survey will be presented as profiles of counts per minute versus depth for each measurement location. These data will be used qualitatively to identify areas of elevated count rates, which will be targeted for

intrusive investigations during the soil boring and test pit programs (discussed in Sections 4.2.4.2 and 4.2.4.3, respectively). The soil borings and test pits will be located in areas where the borehole data indicate elevated count rates in the fill/soil matrix in and immediately surrounding the disposal pit. If the borehole geophysics survey indicates that radioactive material is being transported downgradient of the disposal pit, then monitoring wells MW12-10, MW12-11, MW12-12, and/or MW12-13 will be relocated to areas where such a migration is observed.

4.2.2 Soil Gas Survey

Soil gas surveys will be performed at two location in SEAD-12. One location will be in the vicinity of Buildings 813/814 and one location will be in the vicinity of Building 817. Buildings 813, 814, and 817 are former paint shops, and SEDA personnel have indicated that small amounts of paint may have been intermittently disposed of on the ground surface near these buildings during their periods of operation.

Buildings 813, 814, and 817

A soil gas survey will be performed at the locations of Buildings 813, 814, and 817 to approximately locate the extent of any paint releases that may have occurred. Figure 4-2 shows the approximate locations of the soil gas sampling points in and around buildings 813 and 814. Figure 4-3 shows the approximate locations of soil gas sampling points around Building 817. The soil gas sampling locations were selected to provide a complete and cost effective coverage of these suspect sites. A more dense sampling pattern was established in one area where SEDA personnel have witnessed paint disposal on open ground. This area is located in between Buildings 813 and 814, and is currently covered by a recent addition that now links the two structures. In all other areas, a more open sampling pattern was established to provide information that will either confirm or refute the presence of volatile organic compounds (VOCs) from the disposal of paint or solvents to surrounding soils. In all, 52 soil gas samples will be collected, 37 from Building 813 and Building 814 and 15 from Building 817.

For all of the soil gas surveys in and around Buildings 813, 814, and 817, sample probes will be drilled into the vadose zone and soil vapor will be extracted from the probe and collected directly into a syringe. The soil gas samples will then be analyzed for VOCs in the field using a Photovac 10S50 portable gas chromatograph. The sample collection and analysis methods are described in more detail in the Generic Work Plan Appendix A, Section 3.8. If shallow groundwater is encountered during extraction of the soil gas, the liquid will be collected in a 40 ml vial with an open top septa cap and the gas from the headspace of the vial will be injected into the Photovac. Based on a list of known solvents, activators, adhesives, primers, paints, greases etc. that were used in these buildings being investigated, both BTEX and chlorinated standards will be used for the soil gas survey.

4.2.3 Radiological Surveys at SEAD-12

As discussed in the introduction to this section, the goal of the radiological surveys at SEAD-12 is to collect sufficient data to demonstrate that this site can be released for unrestricted use. To this end, radiological surveys were planned using guidance from several documents, including NUREG 1500, NUREG 1505, NUREG 1506, NUREG 1507, NUREG 5849, MARSSIM (NUREG-1575, EPA 402-R-97-016, December 1997), and Methods for Evaluating the Attainment of Cleanup Standards, Volume 3 (EPA 1989) in order to provide data that will be used as a final status survey. As these surveys are designed to compare site data sets to reference data sets, the DQOs presented in Section 3.5 of this project scoping plan were used to determine the minimum number of data points that are needed from the site and reference sites. From the DQO discussions in Section 3.5, the minimum number of data points was determined to be 34, or 17 from each survey unit and the reference area. Following NUREG and MARSSIM guidance, this number was increased by 20%, to 20 for each data set, to allow for broken samples and bad, missing, or rejected data.

Survey Units

Impacted areas are areas that have some potential for containing contaminated material. They can be subdivided into three classes:

- Class 1 areas: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys). Examples of Class 1 areas include: 1) site areas previously subjected to remedial actions, 2) locations where leaks or spills are known to have occurred, 3) former burial or disposal sites, 4) waste storage sites, and 5) areas with contaminants in discrete solid pieces of material high specific activity. Note that areas containing contamination in excess of the DCGL prior to remediation should be classified as Class 1 areas.

- Class 2 areas: These areas have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL . To justify changing an area's classification from Class 1 to Class 2, the existing data (from the HSA, scoping surveys, or characterization surveys) should provide a high degree of confidence that no individual measurement would exceed the DCGL . Other justifications for this change in an area's classification may be appropriate based on the outcome of the DQO process. Examples of areas that might be classified as Class 2 for the final status survey include: 1) locations where radioactive materials were present in an unsealed form (*e.g.*, process facilities), 2) potentially contaminated transport routes, 3) areas downwind from stack release points, 4) upper walls and ceilings of some buildings or rooms subjected to airborne radioactivity, 5) areas where low concentrations of radioactive materials were handled, and 6) areas on the perimeter of former contamination control areas.

- Class 3 areas: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL , based on site operating history and previous radiological surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification (*MARSSIM* December 1997).

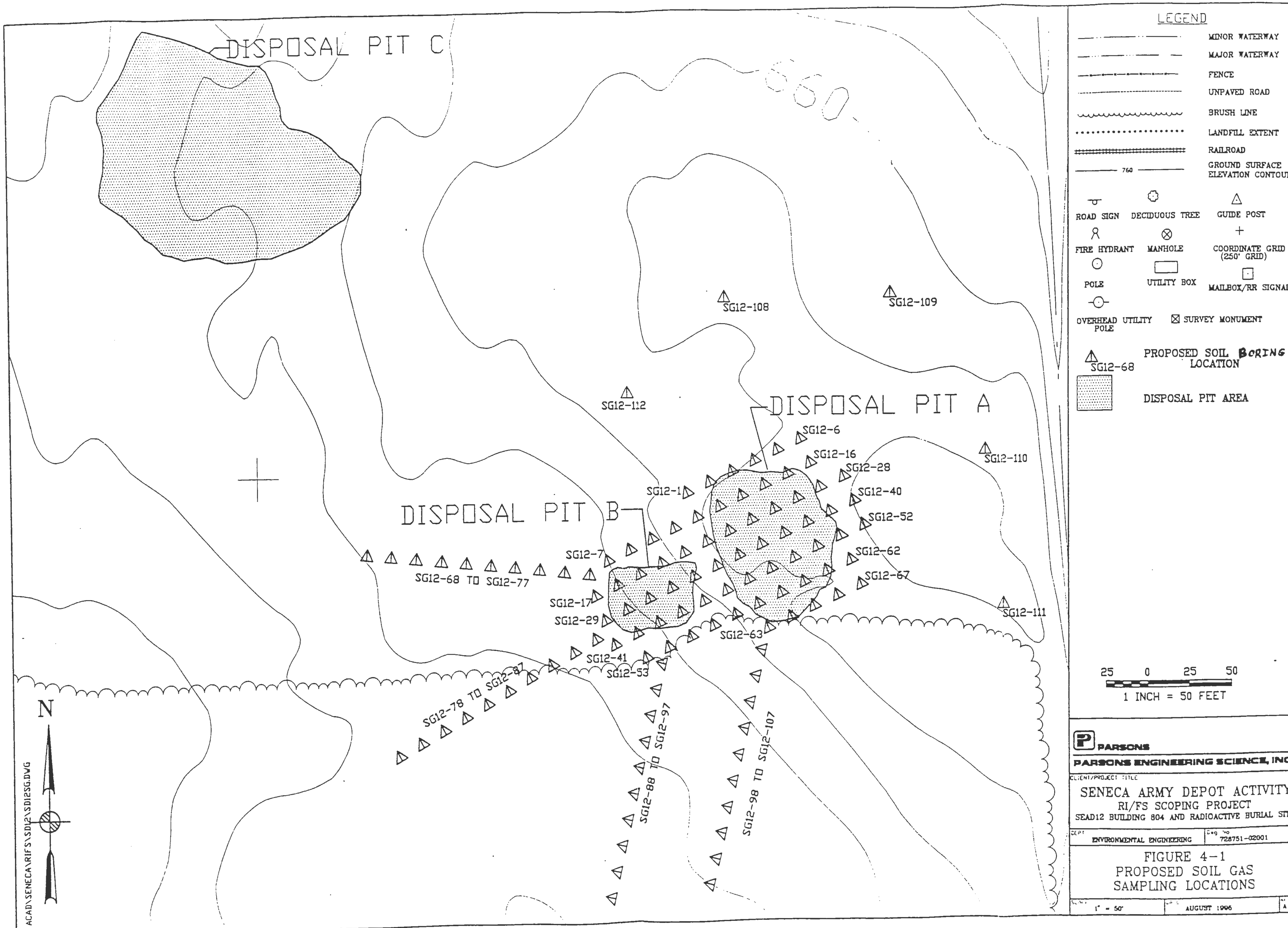
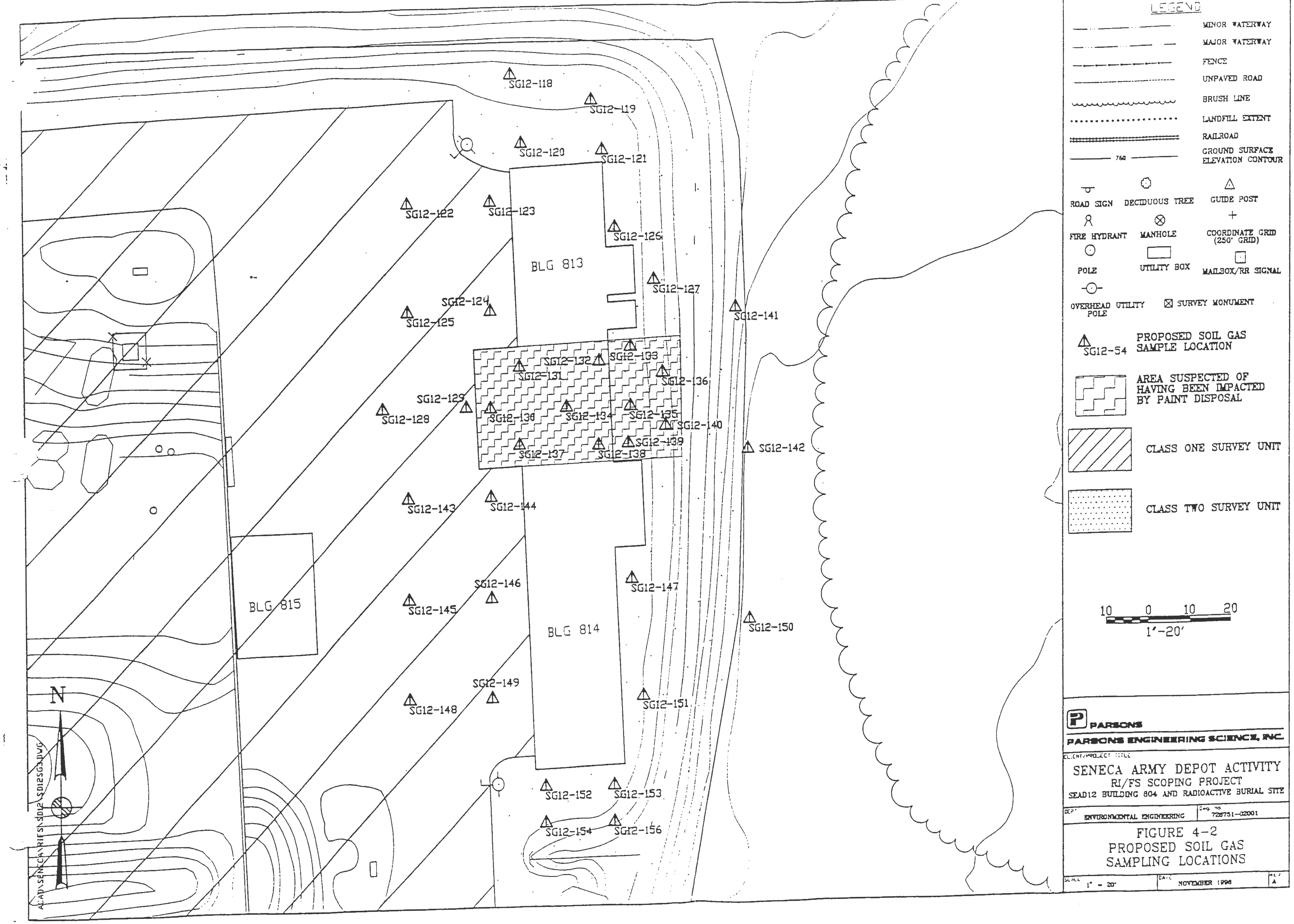


FIGURE 4-1
PROPOSED SOIL GAS SAMPLING LOCATIONS



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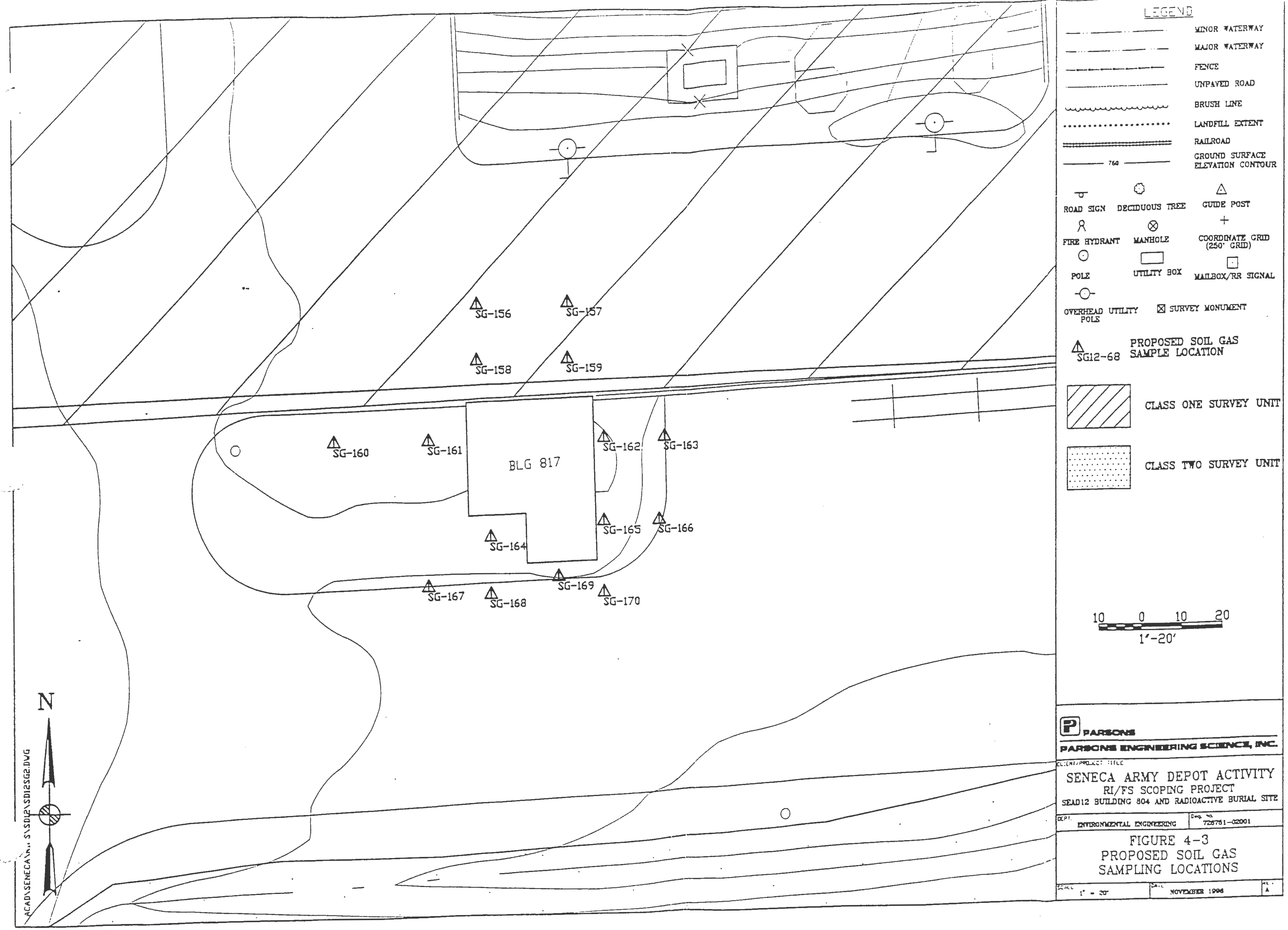
SENECA ARMY DEPOT ACTIVITY
RI/FS SCOPING PROJECT
SEAD12 BUILDING 804 AND RADIOACTIVE BURIAL SITE

ENVIRONMENTAL ENGINEERING | 726751-02001

FIGURE 4-2
PROPOSED SOIL GAS SAMPLING LOCATIONS

SCALE 1" = 20' | DATE NOVEMBER 1996 | REV A



PARSONS

PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY

RI/FS SCOPING PROJECT

SEAD12 BUILDING 804 AND RADIOACTIVE BURIAL SITE

DEPT. ENVIRONMENTAL ENGINEERING | Dwg. No. 726751-02001

FIGURE 4-3
PROPOSED SOIL GAS SAMPLING LOCATIONS

SCALE 1" = 20' | DATE NOVEMBER 1996 | REV. A

For the purposes of establishing the sampling and measurement frequency of the radiological surveys at SEAD-12, the buildings and areas within the Q Area were divided into survey units based upon their past operating history. Each survey unit was then classified as a Class One, Class Two, or Class Three site based again upon past operating history and the information presented in the Site History sections (Sections 3.1.1.1 and 3.1.2.1) of this project scoping document. The survey unit designations and the survey unit classifications, as well as the rationale for those classifications are presented in Table 4-1. These classifications were based upon a review of historical data pertaining to each individual area. It should be noted that the historical data available is limited, and questions related to that data cannot be assured. Therefore, as the interior of many of the buildings have not yet been made available to survey, the historical data review served as the basis for deciding initial area classifications.

The Army discussed the problem of limited information about this site, and decided that the logical manner to handle the historical data and determine survey units and area classifications would be to deviate from that specified in MARSSIM. The deviation occurs in that the survey areas were defined prior to the classifications being made, rather than vice versa as delineated within MARSSIM. While the methodology followed does deviate from MARSSIM, the same ultimate goal is achieved in both instances. MARSSIM also provides suggested maximum areas for Class 1, and Class 2. The limitation on the survey unit size for Class 1 and 2 areas is to ensure that each area is assigned an adequate number of data points. Although MARSSIM allows the scanning of Class 3 survey units to be based on professional judgement, the Army has agreed to perform grid-based surveys on Class 3 structures (Section 4.2.3.1 of this Workplan). Additionally, non-impacted structures (i.e. isolated buildings with no historical evidence of radionuclide impact) will be subjected to limited Class 3 surveys, such as random sampling. Utilizing the methodology followed by the Army, where each survey unit is comprised of potentially multiple classifications and the number of data points is based upon the classification, collecting an adequate number of data points will be ensured.

Reeder Creek, Building 715 (the North Post's former sewage treatment facility), and the outfall of Building 715 were classified as Class Three areas because of their direct connection to SEAD-12 Class Three sites.

Table 4-1
Seneca Army Depot Activity
SEADs 12 and 63 Project Scoping Plan
Survey Unit Classifications

Class One Survey Units	Rational For Classification	Radionuclides of Concern
Building 803	Used to store containerized radioactive waste and military items containing radionuclides.	Pu-239, U-238, U-235, Ra-226, Co-60, Co-57, H-3
Building 804	Used to perform maintenance on military items that contained radionuclides.	Pu-239, U-238, U-235, Ra-226, H-3
Building 805	Used as a stores room for Building 804.	Pu-239, U-238, U-235, Ra-226, H-3
Disposal Pit A	Radium-226 detected above background levels during ESI in 1994.	Pu-239, U-238, U-235, Ra-226, Co-60, Co-57, H-3
Roof of Building 815; Hot Room of Building 815 and areas of adjoining rooms to a distance of 2 meters from the access point to the Hot Room.	Used to perform maintainance on military items that contained radionuclides. Uranium bearing alloys were exposed to ambient air	Pu-239, U-238, U-235, Ra-226, Pm-147, Co-60, H-3
Roof of Building 816; Hot Room of Building 816 and areas of adjoining rooms to a distance of 2 meters from the access point of the Hot Room.	Used to perform maintainance on military items that contained radionuclides. Uranium bearing alloys were exposed to ambient air	Pu-239, U-238, U-235, Ra-226, Pm-147, Co-60, H-3
Building 819 And Surrounding Grounds and Asphalt	Used to perform quality assurance testing on military items that contained radionuclides.	Pu-239, U-238, U-235, Ra-226, Co-60, H-3

Class Two Survey Units	Rational For Classification	Radionuclides of Concern
Building 815 and surrounding asphalt, except hot room and adjoining areas described above	Building 815 was used to perform maintainance on military items that contained radionuclides.	Pu-239, U-238, U-235, Ra-226, Pm-147, Co-60, H-3
Building 816 and surrounding asphalt, except hot room and adjoining areas described above	Building 816 was used to perform maintainance on military items that contained radionuclides.	Pu-239, U-238, U-235, Ra-226, Pm-147, Co-60, H-3
Building 806, Calibration Lab Only	Used to calibrate radiological survey meters and store sealed radioactive callibration sources.	Am-241, U-238, U-235, Th-230, Cs-137
Building 810, Receiving Room and Platform Only	Used as a loading and unloading area for containerized military items that contained radionuclides.	U-238, Ra-226, Co-60, H-3
Building 812, Ammunition Storage Room and Garage Only	Used to store military items that contained radionuclides as integral componetry.	Ra-226, Pm-147, H-3
Drainage Ditch Between Building 816 and Reeder Creek Tributary, Reeder Creek Tributary, and Drainage Ditch Between Buildings 803, 804, 810 and Reeder Creek Tributary	These are the main surface water drainage pathways for the Class One Buildings 803, 804, 805, 815, and 816.	None, Screening for all radionuclides stored on-site will be performed
Grounds and Drainage Ditch Behind Buildings 803 and 804	ESI data and 1986 SEDA excavation data indicate that this area is most likely free from residual radioactivity.	None, Screening for all radionuclides stored on-site will be performed
Disposal Pit Areas Identified By Geophysics Except Disposal Pit A	Disposal of materials that contained radionuclides is very unlikely, but no documentation to this effect exists.	None, Screening for all radionuclides stored on-site will be performed

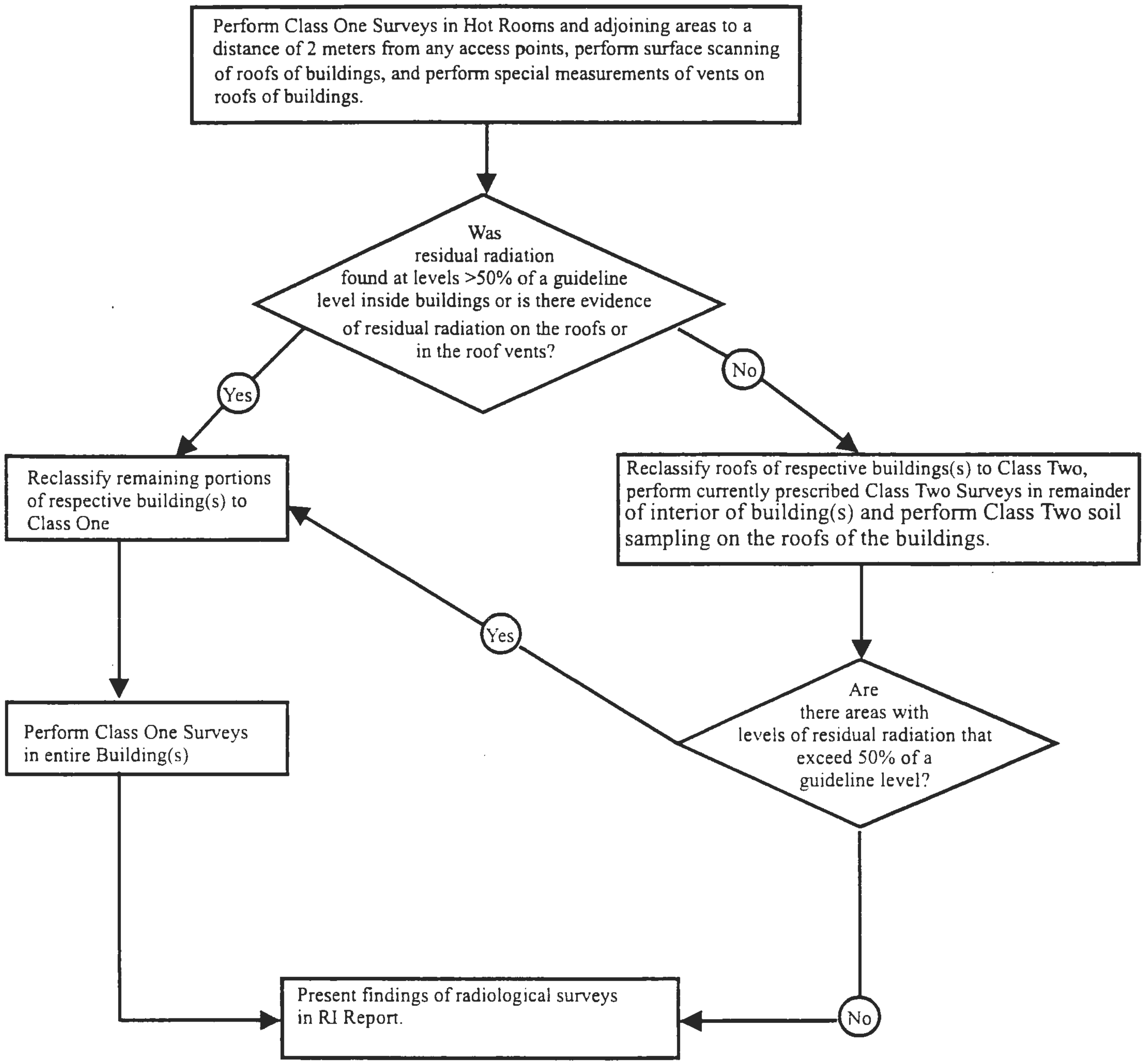
Class Three Survey Units	Rational For Classification	Radionuclides of Concern
All open grounds not classified as either Class One or Class Two Survey Units	No known uses of these areas included the storage or disposal of military items that contained radionuclides. Also, aerial photo reviews and geophysical data will demonstrated that Class Three open grounds have not been impacted.	None, Screening for all radionuclides stored on-site will be performed
All buildings, rooms, ductwork, etc. that are not classified as either Class One or Class Two Suvey Units, but are associated with higher class buildings.	No known operations or uses of these buildings included the use or storage of military items that contained radionuclides, but may be adjacent to higher class structures.	None. Screening for all radionuclides stored on-site will be performed.
Isolated buildings that are not classified or associated with Class 1 or 2 structures.	No known operations or uses of these buildings included the use or storage of military items that contained radionuclides.	None. Limited screening for all radionuclides stored on-site will be performed.

Following the initial radiological screening surveys, portions of Class Two or Class Three sites may be reclassified as either higher or lower class sites. Reclassification of sites to a higher classification will depend upon the amount of residual radiation found during the initial radiological screening surveys. Class Two or Class Three sites that are found to have residual radiation above a site specific guideline level will be reclassified as Class One sites. Buildings that have Class Two or Class Three areas that are found to have residual radiation above 50% of the guideline value, but below the site specific guideline value, will have all of its area classifications increased by one (i.e. its Class Three areas will be reclassified as Class Two and its Class Two areas will be reclassified as Class One). For Buildings 815 and 816, if a Hot Room in one of the buildings is found to have levels of residual radiation that are above 50% guideline value, then the remaining portions of that building will be reclassified from Class Two to Class One.

The reclassification schemes detailed above are illustrated in Figures 4-4 and 4-5, which present the radiological survey decision trees for Buildings 815 and 816 (Figure 4-4) and Buildings 800, 802, 803, 804, 805, 806, 810, 812, 819 and 825 (Figure 4-5). Any reclassified sites or areas will receive the same level of effort as that specified for currently classified Class One or Class Two sites. If the building surveys demonstrate that a radiological release has not occurred, then that data may be used to justify reducing the level of radiological survey efforts for Class Three exterior scanning surveys, which are detailed in Sections 4.2.3.1, Alpha, Beta, and Gamma Scanning Surveys.

This approach, which deviates from that described in MARSSIM, was discussed and agreed to in formal meetings and telephone conferences between the Army, the USEPA, and NYSDEC. During these meetings, it was explained by the Army that each area or room within a given

Figure 4-4
Radiological Survey Decision Tree
for
Buildings 815 and 816



Note: The guideline levels that will be used are those from NYCRR Title 12, Part 38, Table 5, which are presented in Table 4-3 of this project scoping plan

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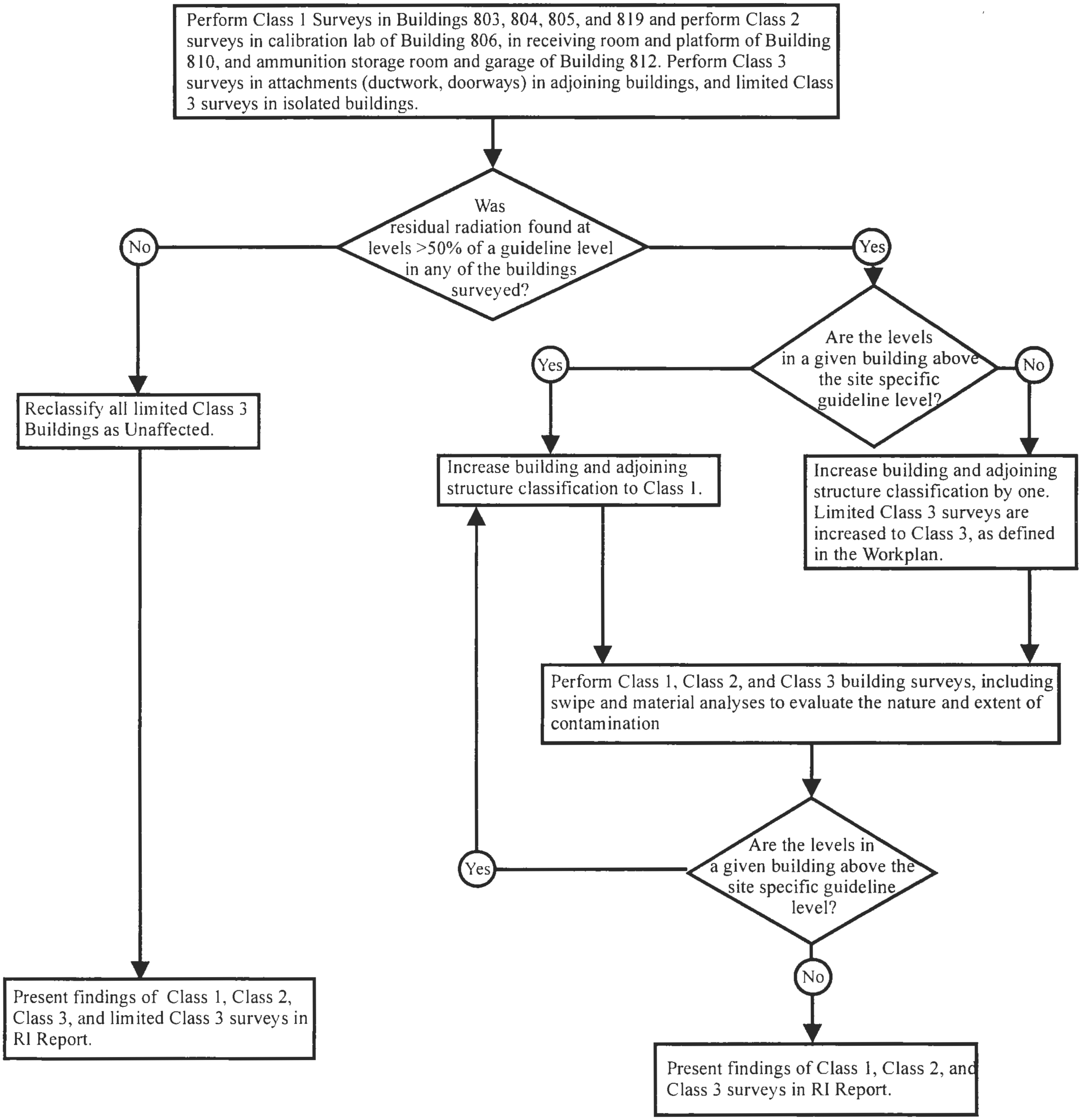
Figure 4-5
Radiological Survey Decision Tree
for
Buildings 800, 802, 803, 804, 805, 806, 810, 812, 819 and 825



Note: The guideline levels that will be used are those from NYCRR Title 12, Part 38, Table 5, which are presented in Table 4-3 of this project scoping plan

h:\eng\seneca\scoping\12-48-63\decisio1.cdr structure was used for a specific function, and that the activities in each where highly controlled. The phased survey approach detailed above provides for a high degree of effort to be expended in those few areas where the potential for radiological contamination is higher, while providing a mechanism to either upgrade (if a release is found to have occurred) or downgrade (if no evidence of a release is found) the level of effort in those areas where there is currently no data, but that had no probability, or only a very small probability, of being contaminated with radioisotopes. This phased approach allows for the programming of a large scope investigation, while providing a means to save costs from potentially unnecessary efforts in areas with little to no probability of being contaminated.

Radionuclides Of Concern

The identity of all radionuclides that were stored as integral parts of military items in the Q Area and all radionuclides that were contained in sealed calibration check sources in the Q Area has been released by the Army. These radionuclides, and the buildings in which they were stored or maintained, are shown in Table 4-1. In addition, Table 4-2 presents a partial list of the military items that may have been stored in the Q Area along with the radionuclides that would have been contained as components of those items.

Site Specific Guideline Values

To meet the objective of the radiological surveys in the Class One, Class Two, and Class Three sites, preliminary guideline values, against which the radiological survey data will be screened, are established prior to proceeding with the surveys. Guideline values are expressed in the same units as the survey instrumentation that will be used and are based upon pre-selected dose or exposure limits or state or federal release criteria.

For the purposes of the radiological surveys at SEAD-12, an exterior dose limit of 15 mrem per year above background was selected for the exterior ground surveys following discussions with the USEPA and NYSDEC. The dose limit is used with dose modeling routines to obtain a dose derived guideline level that can be expressed in the same units as the radiological survey data. To this end, the modeled dose equivalents for soil contaminations presented in Appendix B of NUREG 1500, soil concentrations for the residential scenario, were used to define preliminary

TABLE 4-2
SENECA ARMY DEPOT ACTIVITY
SEAD-12 AND SEAD-63 PROJECT SCOPING PLAN
MILITARY ITEMS THAT CONTAIN RADIONUCLIDES
AS INTEGRAL PARTS OF THEIR COMPONENTS

Taken from the Generic Radioactive Commodity Site Remediation Survey Protocol (November 1995)	
NOMENCLATURE	ISOTOPE
Front Sight Post Assembly	H-3
Radioluminous Fire Control Devices	H-3
Compasses	H-3
Infinity Collimator	H-3
M1A1 Collimator	H-3
M1A1 Quadrant Fire Control Device	H-3
M58 and M59 Aiming Light Post	H-3
Wrist Watches	H-3
M72 Light Antitank Weapon (LAW)	Pm-147
Front Sight Post Assembly	Pm-147
Radium Dial/Compass/Check Source	Ra-226
UDM/6 Radiac Calibration Set	Am-241
MC-1 Moisture Density Tester	Am-241
M8A1 Chemical Agent Alarm	U-238
MA1 Tank Armor	Cs-137
MC-1 Moisture Density Gauge	Am-241
M-1 Tank Armor	DU (Depleted Uranium)

h:\eng\seneca\scoping\12-48-63\1263text\4-2tbl.doc soil activity levels that are equivalent to 15 mrem/yr. These preliminary guideline levels assume that all of the dose is due to a single radionuclide, which is present at levels that are distinguishable from background. In the event that more than one radionuclide is found at levels that are distinguishable from background, then the unity rule described in MARSSIM will be used to derive site specific guideline values. For a known mixture of such radionuclides, each having a fixed relative fraction of the total activity, the site specific guildeline value for each radionuclide will be calculated by first determining the gross activity guideline value, and then multiplying that gross guideline level by the respective fractional contribution of each radionuclide. The unity rule will not be used when all of the radionuclides that are distinguishable from background are from the same decay chain, and the guideline value for the principal radionuclide of that chain accounts for all of the radiations from its progeny. In such instances, the levels of the principal radionuclide will be compared directly to its guideline level.

In addition, the removable activity data will be used as a diagnostic tool only and will not be utilized to determine if release criteria have been met.

The preliminary soil guideline values are presented in Table 4-3, Preliminary Guideline Values. It should be noted that these preliminary guideline values are based upon default assumptions in the NUREG 1500 Appendix B dose to contaminant ratios for a residential scenario. Final soil guideline values will be calculated by the Army using the computer program RESRAD, and using site-specific inputs, as appropriate. Where appropriate, the sum of fractions rule will apply for the calculation of dose and risk. The final soil guideline values will be used in the final presentation of the radiological data. Once calculated, the final soil guideline values will be provided for review and comment.

The interior release criteria from Table 5 of Part 38, Section 12 of the New York Code of Rules and Regulations (NYCRR) were selected for the building and structure surveys. These values are also shown in Table 4-3. The interior guideline values are expressed in units that are compatible with those used by the proposed survey instruments.

- If an interior area is found to have radiation levels that are distinguishable from background, the source of those levels will be determined through the analysis of smear samples or material samples. If applicable, the relative contribution from multiple

Table 4-3
Seneca Army Depot Activity
SEAD 12 and SEAD 63 RI/FS Project Scoping Plan
Preliminary Guideline Values

Soil Guidelines *

Nuclide	Mean of Expanded Site Inspection Data from 1994 (units=pCi/g)	Standard Deviation of Expanded Site Inspection Data	NUREG 1500 Conc. (pCi/g) at 15 mrem/yr
Am 241	NA		1.83
Pu 239	NA		1.89
U 238	0.87	0.33	7.82
U 235	0.21	0.15	2.63
Th 230	1.56**	0.36**	5.93
Ra 226	1.56	0.36	5.62
Pm 147	NA		7,290.00
Cs 137	0.06	0.14	10.70
Co 60	NA		297.00
Co 57	NA		116.00
H 3	NA		414.00

NA= Not Available

* Soil Guidelines are taken from NUREG 1500, Appendix B, Table B2, Soil Concentrations, Residential Scenario.

** Values are assumed based upon Ra-226 concentrations

Building Guidelines ***

Nuclide	NUREG 1500 Conc (dpm/100cm^2) at 15 mrem/yr	12 NYCRR Part 38 Table 5, Average	12 NYCRR Part 38 Table 5, Maximum	12 NYCRR Part 38 Table 5, Removable****
Am 241	186.00	None Available	None Available	None Available
Pu 239	192.00	None Available	None Available	None Available
U-nat., U-238, U-235, and associated decay products except Ra-226, Th-230, Ac-227, and Pa-231	Not Used	5,000 dpm alpha / 100 cm^2	15,000 dpm alpha / 100 cm^2	1000 dpm alpha / 100 cm^2
Transuranics, Ra-228, Ra 226, Ra-224, Ra-223, Th-nat., Th-228, Th-230, Th-232, Ac-227, and Pa-231	Not Used	1,000 dpm alpha / 100 cm^2	3,000 dpm alpha / 100 cm^2	200 dpm alpha / 100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except those noted above	Not Used	5,000 dpm beta/ gamma / 100 cm^2	15,000 dpm beta/ gamma / 100 cm^2	1000 dpm beta/ gamma / 100 cm^2

*** Building guidelines are taken from Table 5 of 12 NYCRR Part 38 and from NUREG 1500, Appendix B, Table B2, Surface Concentration, Building Occupancy Scenario.

**** It should be noted that removable activity data will be used as a diagnostic tool only and will not be utilized to determine if the release criteria has been met.

radionuclides that are found to be above background will be determined, and the unity rule descibed in MARSSIM (and outlined above) will be used to calculate the site specific interior activity guideline levels for each. Note that the removable activity data will be used as a diagnostic tool only and will not be utilized to determine if release criteria have been met.

Using the radionuclide specific guideline values presented in Table 4-3, guideline values that are specific to each survey unit will be established for interior and exterior radiological surveys. The survey unit specific guideline values for building surfaces, roadways, and paved areas will be selected using the following selection criteria:

- For a survey unit where the radionuclides of concern include any one of ^{241}Am, ^{239}Pu, ^{238}U, ^{235}U, ^{230}Th, or ^{226}Ra, the interior alpha guideline and the exterior soil guideline will be set equal to the lowest respective guideline value from Table 4-3 of any of these 6 radionuclides of concern that are known to have been stored or maintained in that survey unit.
- For a survey unit where the radionuclides of concern include any one of ^{147}Pm, ^{137}Cs, ^{60}Co, ^{57}Co, or ^{3}H, the beta/gamma interior guidelines will be equal to those shown in Table 4-3, and the exterior guideline value will be set equal to the lowest soil guideline value from Table 4-3 of any of these 5 radionuclides of concern that are known to have been stored or maintained in that survey unit.

Survey Instrumentation, Building Surveys

Instrumentation for building surface scanning surveys will include gas proportional detectors for alpha and beta radiations or zinc sulfide (ZnS) scintillation detectors for alpha radiations only, and FIDLER (field instrument for the detection of low energy radiations) or equivalent types of detectors for gamma radiations. Surveying speeds will be 1 detector width per second when using the alpha and beta instruments and 0.5 meters per second (1.5 feet/second) when using the gamma instruments. Audible indicators will be used to identify locations having elevated (>1.5 to 3 times ambient) levels of direct radiation. The nominal distance between the detector and the surface should be less than one centimeter (0.4 inch) for scans where alpha radiation is being monitored and less than two centimeters (0.8 inch) when only beta radiation is being monitored. The gamma scans will be performed in such a manner so that the detector is swept from side to side, where the distance between the surface and detector will be as minimal as possible when the detector is immediately in front of the survey personnel.

Direct measurements will also be performed at selected areas using the same gas proportional and ZnS scintillation detectors as the surface scanning surveys. The direct measurement surveys will be performed by integrating counts over a 1 minute period.

Survey Instrumentation, Grounds Surveys

Instrumentation for exterior surface scanning surveys will use FIDLER or equivalent types of detectors. Audible indicators will be used to identify locations having elevated (>1.5 to 3 times ambient) levels of direct radiation. Depending on the instrument's scaler/ratemeter display response time and the geometry of the detector with the ground surface, two types of scanning methodologies will be considered. The preferred method of scanning will involve moving the detector across the ground surface at speeds of 0.5 meters per second or less while sweeping the detector from side to side. The detector will be moved in such a manner so that four sweeps are achieved for every one square meter area surveyed (i.e. the detector is moving within a one square meter area for a period of at least 8 seconds). This method of scanning will be used when the instrument being used has a rapid scaler/ratemeter display response time. The reason this method is preferred is that small variations in direct radiation levels (typically between 100 and 300 counts per minute) that are detected with the audible indicators will require less time to determine if they are due to background fluctuations (the "hot spot" can not be reproduced) or due to the presence of one or more radionuclides (the "hot spot" is reproducible).

The second method of scanning will be used for instruments that have longer scaler/ratemeter display response times. For these types of meters, the instrument's detector will be maintained in a static location, at a height of one foot above the ground, for a period of at least 6 seconds for every 1 square meter area that is surveyed. If the audible indicators identify an increase in the levels of direct radiation, then the instrument will be maintained in a static location until the scaler/ratemeter display shows a constant readout. The reason this method is not preferred is because of the additional time needed for the instrument's scaler/ratemeter to show a constant readout when small increases in direct radiation levels (typically between 100 and 300 counts per minute) are detected. Such increases are often due to background fluctuations and identifying them as "hot spots" would significantly increase the number of type one errors (false positives).

Discussion on MDCs

Detection sensitivity will be evaluated by using the minimum detectable concentration (MDC) from MARSSIM 1997.

$$MDC = C*(3 + 4.65\sqrt{B})$$ (*MARSSIM*, page 6-34, eqn. 6-7)

where

C = conversion factor from counts to concentration
B = number of background counts

The MDC is the *a priori* net activity level above the critical level that an instrument can be expected to detect 95% of the time. This value should be used when stating the detection capability of an instrument. The MDC is the detection limit, L_D multiplied by C, the appropriate conversion factor to give units of activity. Again, this value is used before any measurements are made and is used to estimate the level of activity that can be detected using a given protocol.

The critical level, L_C , is the lower bound on the 95% detection interval defined for L_D and is the level at which there is a 5% chance of calling a background value "greater than background." This value should be used when actually counting samples or making direct radiation measurements. Any response above this level should be considered as above background (*i.e.*, a net positive result). This will ensure 95% detection capability for L_D (*MARSSIM* 1997).

To convert instrument counts to conventional surface activity units, a conversion factor, C, may be used:

$$\frac{dpm}{100cm^2} = \frac{\frac{C_s}{T_s}}{(\in_T)*(\frac{A}{100})}$$ (*MARSSIM*, page 6-30, eqn. 6-2)

where

C_S	=	integrated counts recorded by the instrument
T_S	=	time period over which the counts were recorded in minutes
$\in_T$	=	total efficiency in counts per disintegration; effectively the product of the instrument efficiency ($\in_i$), source efficiency ($\in_S$), and dust attenuation factor (DAF)
A	=	physical probe area in cm^2

Sample Calculation 1:

The following example illustrates the calculation of an MDC in Bq/m^2 for an instrument with a 15 cm^2 probe area when the measurement and background counting times are each one minute:

B = 40 counts
C = (5 dpm/count)(Bq/60 dpm)(1/15 cm^2 probe area)(10,000 cm^2/m^2)
= 55.6 Bq/m^2-counts

The MDC is calculated using Equation 6-7:

$$MDC = 55.6 \times (3 + 4.65 \sqrt{40}) = 1{,}800\ Bq/m^2\ (1{,}080\ dpm/100\ cm^2)$$

The critical level, L , for this example is calculated from Equation 6-6:

$$Lc = 2.33 \sqrt{B} = 15 \text{ counts}$$

Given the above scenario, if a person asked what level of contamination could be detected 95% of the time using this method, the answer would be 1,800 Bq/m^2 (1,080 dpm/100 cm^2). When actually performing measurements using this method, any count yielding greater than 55 total counts, or greater than 15 net counts (55-40=15) during a period of one minute, would be regarded as greater than background.

This formula will be used to calculate the daily MDCs for each gas proportional and ZnS scintillation instrument used. Instrument efficiencies will be determined in the field using National Institute of Standards and Technology (NIST) traceable sources that are owned by SEDA. The list of NIST traceable sources that are available are listed below.

^{241}Am (To be determined),
^{137}Cs (0.829±0.032 microcuries),
^{137}Cs (0.906±0.035 microcuries),
^{99}Tc (12,000±720 dpm),
^{99}Tc (10,800±542 dpm),
^{99}Tc (9,960±498 dpm),
^{230}Th (10,100±302 dpm),
^{230}Th (9,570±478 dpm),
^{238}U (337.2±50.6 dpm).

Table 4-4
Examples of Estimated MDCs for ^{238}U Using Alpha and Beta Survey Instrumentation

				Approximate Sensitivity			
Detector	**Probe area (cm^2)**	**Background (cpm)**	**Efficiency (cpm/dpm)**	**L_c (counts)**	**L_d (counts)**	**MDC (Bq/m^2)**	**MDC ($dpm/100\ cm^2$)**
Alpha proportional	50	1	0.15	2	7	150	90
Alpha proportional	100	1	0.15	2	7	83	50
Alpha proportional	600	5	0.15	5	13	25	15
Alpha scintillation	50	1	0.15	2	7	150	90
Beta proportional	100	300	0.20	40	83	700	420
Beta proportional	600	1500	0.20	90	183	250	150
Beta GM pancake	15	40	0.20	15	32	1800	1080

* MDC calculated using MARSSIM equations 6-6 and 6-7.

For interior scanning surveys, scanning minimum detectable concentrations (MDCs) will be determined using the methodology presented in MARSSIM. It is determined from the minimum detectable count rate (MDCR) of the ideal Poisson observer and the human factors efficiency, detector efficiency, and source efficiency. The scan MDC for interior structures will use the following formula:

$$Scan\ \ MDC = \frac{MDCR}{(E_{hf})^{.5}(e_i)(e_s)(A/100\text{cm}^2)}$$

MDCR = ideal poison observer MDC

E_{hf}= human efficiency
e_s = surface efficiency
e_i = instrument efficiency
A = active area of probe

The scanning MDCR for various background ranges will be taken from Table 6.6 of MARSSIM, and the human efficiency (E_{hf}) will be assumed to be 65%. The surface efficiency will be determined from the literature, however, a preliminary surface efficiency of 50% will be used. The various calibration sources that will be available for the cross calibration are listed above.

For exterior scanning surveys using NaI instruments, a scanning MDCR will be determined by multiplying the appropriate MDCR of the ideal Poisson observer (from MARSSIM, Table 6.6) by the human factors efficiency, which will initially be considered to be 65%. The scanning MDCR can then later be used to estimate an exterior scan MDC by cross-calibrating the scanning instruments to a Bicron Microrem per Hour meter, and relating the resultant cross calibration to a modeled exposure rate for the radiological conditions on-site. This methodology is described in MARSSIM, and it will be used at SEAD-12.

Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta scans will therefore be performed under these circumstances. Under certain circumstances, however, professional judgement may also require the scanning for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

Selection of Representative Reference Areas

For the purposes of establishing reference areas for evaluating gross alpha and gross beta activity and gamma scanning on structure surfaces, Buildings 722, 726,727, and Igloo C0912 have been identified as being of similar construction as those located in SEAD-12. Building 722 will be surveyed as the reference site for SEAD-12 buildings that are constructed of cement blocks. Building 726 or 727, whichever most resembles the current condition of those buildings at SEAD-12 at the time of the survey, will be surveyed as the reference site for buildings that are constructed of metal sheeting. As a reference site for those buildings that are earth covered (Buildings 815 and 816), Igloo C0912 was selected as the appropriate reference site. Although Igloo C0912 was not used for any purpose other than conventional munitions storage, its woven reinforcing bar / poured concrete construction is very similar to that of Buildings 815 and 816. For the land surveys, the North Post's baseball field will be gridded and surveyed as the land scanning reference site. This site is considered to be appropriate as a reference site because it is situated in close proximity to SEAD-12 (and is therefore expected to have similar geological characteristics as SEAD-12), it is located beyond the restricted areas of the Ammo Area and the Q Area, and it is not expected to have been used for any purposes, other than recreation, since the depot was established. In order to collect sufficient data to complete statistical comparisons between site and reference data, the reference area measurements will be collected according to *MARSSIM.*

To establish reference datasets for groundwater, surface water, sediment, surface soil, and sub-surface soil, databases for each of these media will be established by collecting 9 background monitoring well samples, 9 background surface water samples, 9 background sediment samples, 15 background subsurface soil samples and 20 background surface soil samples. The 9 monitoring wells will include 6 upgradient monitoring wells that will be located east and north of the Q Area fence and 3 background monitoring wells that have already been installed at the OB ground, the OD grounds, and SEAD-57. The 9 background surface water and sediment samples will be collected from within drainage ditches and Reeder Creek, at locations that are upgradient of SEAD-12. The 15 subsurface soil samples will include one mid depth soil sample to be collected near each of the 3 existing background monitoring wells that will be used for the background groundwater database, and 2 subsurface soil samples to be collected from each of the six upgradient monitoring wells that will be installed east and north of the Q Area fence. The 20 surface soil samples will include one surface soil sample collected from each of the upgradient monitoring wells installed east and north of the Q Area fence, 8 surface soil samples to be collected from various locations east and north of the Q Area fence, and 6 surface soil samples that will be collected in the scanning reference area (the North Post's baseball field).

The quantity of background data that is proposed above is needed to allow the statistical comparisons to have sufficient power to detect that a survey unit is above a survey unit specific guideline value. The Data Quality Objectives section of this project scoping plan (Section 3.5) and the Data Reduction Assessment and Interpretation section (Section 4.4) discuss in more detail the statistical comparisons that will be performed.

4.2.3.1 Alpha, Beta and Gamma Scanning Surveys

The scanning surveys will be conducted following the schedules detailed below. All scanning measurements will be performed on grid diagrams that will be directly related to the gridding patterns established in each survey unit. Building interior and exterior grid sizes will be 2 meters by 2 meters in areas below 2 meters above floor level unless stated otherwise. Building interior and exterior grid sizes will be 1 meter by 1 meter in areas above 2 meters above floor level unless stated otherwise. Exterior grounds and pavement grid sizes will be 10 meters by 10 meters.

Areas where the scanning measurements indicate that residual radiation may be present will be marked for further investigations. Professional judgement will be used to determine if additional surveys are warranted. The additional surveys may include additional direct measurements, additional surface scanning (such as a 100% coverage using a NaI detector), smear sampling, or material sampling. The purpose of any additional surveys will be to confirm that any residual radiation present is below the survey unit specific guideline value.

Class One Survey Units

Scanning of surfaces and grounds to identify locations of residual surface and near surface activity in Class One survey units will be performed according to the following schedule:

- Lower walls (up to two meters above floor level), floor surfaces, pavement, un-earthen roofs with ventilation ducts, exterior building surfaces within 2 meters of a point of access (windows, ventilation ducts, doors, etc...), horizontal surfaces above 2 meters above floor level where dust or particulates could deposit and upper walls and ceilings of the hot rooms in Buildings 815 and 816: 100% of surface,

- Upper walls (above two meters above floor level), ceilings (suspended and non-suspended), - 10% of surface to be conducted in randomly located 1 meter by 1 meter areas. These areas will also serve as direct measurement and smear sample locations. (Based upon MARSSIM, the upper walls should be reclassified to Class 2. The Army chose to deviate from MARSSIM in this instance by not reclassifying the upper walls from Class 1 to Class 2. The detail and level of the scans will be the same whether the classification of the upper walls is Class 1 or Class 2; therefore, any proposed change in verbiage would make no technical difference in the type, quantity, or quality of the data which will be developed.)
- Exterior grounds, including earthen covered buildings: 100% of surface

Building interior and exterior surface scanning surveys and pavement surface scanning surveys will be conducted for alpha radiations where ^{241}Am, ^{239}Pu, ^{238}U, ^{235}U, ^{230}Th, or ^{226}Ra are among the radionuclides of concern and for beta radiations where ^{147}Pm, ^{137}Cs, or ^{60}Co are among the radionuclides of concern. All pavement surfaces and building interior and exterior surfaces will also be scanned for gamma radiations. Surveys of exterior grounds will be for gamma radiations.

Instrumentation for the scanning surveys will include proportional detectors for alpha and beta radiations, zinc sulfide scintillators for alpha surveys and FIDLER or equivalent types of detectors for low-energy gamma surveys (detectors having thin NaI(Tl) crystals that are designed to detect low energy gamma and x-ray radiations). For all but the floor surveys and pavement surveys (where a large area gas proportional floor monitor will be used), the instruments having the lowest detection sensitivity will be used for the surveys, wherever physical surface conditions and measurement locations permit. Refer to the Survey Instrumentation-Building Surveys and the Survey Instrumentation-Grounds Surveys sub-sections of Section 4.2.3 for details on the survey methodologies that will be used. Any areas that are identified as having elevated levels of radiation will be noted for further investigation.

Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta scans will therefore be performed under these circumstances. Under certain circumstances, however, professional judgment may also require the scanning for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

Class Two Survey Units

Scanning of surfaces and grounds to identify locations of residual surface and near surface activity in Class Two survey units will be performed according to the following schedule:

- Lower walls (up to two meters above floor level), floor surfaces, pavement, access points (such as doors or windows) to a distance of two meters beyond the Class Two survey unit, and interior horizontal surfaces above 2 meters, - 50% of surface.
- Upper walls (above two meters above floor surface), ceilings, and roofs - 10% of surface in randomly located 1 meter by 1 meter areas
- Exterior Grounds - 50% of surface

Building interior and exterior surface scanning surveys and exterior pavement scanning surveys will be conducted for alpha radiations where ^{241}Am, ^{239}Pu, ^{238}U, ^{235}U, ^{230}Th, or ^{226}Ra are among the radionuclides of concern and for beta radiations where ^{147}Pm, ^{137}Cs, or ^{60}Co are among the radionuclides of concern. All pavement surfaces and building interior and exterior surfaces will also be scanned for gamma radiations. Surveys of exterior grounds will be for gamma radiations.

Instrumentation for the scanning surveys will include gas proportional detectors for alpha and beta surveys, zinc sulfide scintillators for alpha surveys and FIDLER or equivalent types of detectors for low-energy gamma surveys (detectors having thin NaI(Tl) crystals that are designed to detect low energy gamma and x-ray radiations). For all but the floor surveys and pavement surveys (where a large area gas proportional floor monitor will be used), the instruments having the lowest detection sensitivity will be used for the surveys, wherever physical surface conditions and measurement locations permit. Refer to the Survey Instrumentation-Building Surveys and the Survey Instrumentation-Grounds Surveys sub-sections of Section 4.2.3 for details on the survey methodologies that will be used. Any areas that are identified as having elevated levels of radiation will be noted for further investigation.
Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta scans will therefore be performed under these circumstances. Under certain circumstances, however, professional judgment may also require

the scanning for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

Class Three Survey Units

Scanning of surfaces and grounds to identify locations of residual surface and near surface activity in Class Three survey units will be performed according to the following schedule:

- interior surfaces below 2 meters - 10% of surfaces or 15 locations, whichever is greater, in randomly located two meter by two meter grids.
- interior surfaces above 2 meters and roofs -10% of surface in randomly located one meter by one meter grids.
- exterior pavement - 10% of surface, in randomly located 10 meter by 10 meter areas
- exterior grounds - 10% of surface, along survey lines that are separated by approximately 15 meters.

Surface scanning surveys of pavement and building interior and exterior surfaces will be conducted for alpha, beta, and gamma radiations. Surveys of exterior grounds will be for gamma radiations.

Instrumentation for the scanning surveys will include proportional detectors for alpha and beta surveys, zinc sulfide scintillators for alpha surveys and FIDLER or equivalent types of detectors for low-energy gamma surveys (detectors having thin NaI(Tl) crystals that are designed to detect low energy gamma and x-ray radiations). For all but the floor surveys and pavement surveys (where a large area gas proportional floor monitor will be used), the instruments having the lowest detection sensitivity will be used for the surveys, wherever physical surface conditions and measurement locations permit. Refer to the Survey Instrumentation-Building Surveys and the Survey Instrumentation-Grounds Surveys sub-sections of Section 4.2.3 for details on the survey methodologies that will be used. Any areas that are identified as having elevated levels of radiation will be noted for further investigation.

Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta scans will therefore be performed under these circumstances. Under certain circumstances, however, professional judgment may also require the scanning for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

4.2.3.2 Alpha and Beta Direct Measurements

Direct measurement surveys are performed as a means of detecting areas where elevated levels of surface or near surface radiation may be present at levels that are not detectable by surface scanning techniques. To this end, the direct measurement survey data are compared to two types of screening values. The first is the survey unit specific guideline value. Locations where the direct measurement is above this value will be recorded and the source(s) of the residual contamination will be determined. The second screening value is a daily flag value. Locations where the direct measurement value is above the daily flag value will be recorded and professional judgment will be used to determine if additional surveys are warranted. The additional surveys may include additional direct measurements, additional surface scanning (such as a 100% coverage using a FIDLER or equivalent type of detector), smear sampling, or material sampling. The purpose of any additional surveys will be to confirm that any residual radiation present is below the survey unit specific guideline value.

The flag value will be determined on a daily basis. Flag values will be established for both alpha and beta radiations for each instrument in use. The flag value will be calculated using the following formula:

$$Flag = \left(G \bullet f_{gd} \bullet E_{inst.}\right) + B$$

G = survey unit specific guideline value (specific for alpha and beta radiations)
f_{gd} = fraction of guideline value that must be detected, equal to 25% for interior surveys and 75% for exterior surveys
$E_{inst.}$ = detection efficiency of the instrument being used for the direct measurement
B = daily background count rate (determined on an instrument specific basis)

The equation cited is from the U.S. Army Generic Radioactive Commodity Site Radiation Survey Protocol, November 1995.

All direct measurements will be recorded on grid diagrams that will be directly related to the gridding patterns established in each survey unit. Building interior and exterior grid sizes will be 2 meters by 2 meters for areas up to two meters above floor level and 1 meter by 1 meter for areas above two meters above floor level, unless stated otherwise. Exterior pavement grid sizes will be 10 meters by 10 meters.

The direct measurement plans detailed below will provide, at a minimum, the twenty data points from each survey unit that are necessary to meet the DQOs that were selected for SEAD-12.

Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta scans will therefore be performed under these circumstances. Under certain circumstances, however, professional judgment may also require the scanning for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

Additionally, both source checks and background checks will be performed and documented daily. These tests are performed outside SEAD 12 and 63. Count rate instruments must fall within +/- 2 sigma. If the instrument reading falls between +/- 2 sigma and +/- 3 sigma a health physicist must be notified and determine if the instrument may be utilized. If the instrument reading exceeds +/- 3 sigma, the instrument will be taken out of use and tagged as such. Project Management will notify a health physicist as to this situation. The instrument will not be placed back into service until it has been checked by an instrument technician and recalibrated, as required. Dose/exposure rate instruments must fall within +/- 20%. If the instrument reading falls between +/- 20% and +/- 30% a health physicist must again be notified for determination as to whether the instrument may be utilized. If the instrument reading exceeds +/- 30%, the instrument will be taken out of use, tagged as such and Project Management will notify a health physicist as to the situation. The instrument will not be placed back into service until it has been checked by an instrument technician and recalibrated, as required. Also, background measurements will be taken daily in areas which are similar to those being surveyed on that particular day, but in uncontaminated areas. This "working background" provides the surveyor with input as to any variations in the expected versus real background in the areas of concern.

Class One Survey Units

Direct measurements of alpha and beta surface activity will be performed at selected locations using the same instruments as outlined in Section 4.2.3.1, Alpha , Beta and Gamma Scanning Surveys.

Direct measurements will be performed according to the following schedule:

- lower walls (up to two meters above floor level), floor surfaces, pavement, un-earthen roofs with ventilation ducts, exterior building surfaces within 2 meters of a point of access (windows, ventilation grills, doors, etc....), horizontal surfaces above 2 meters where dust or particulates could deposit, and upper walls and ceilings in the hot rooms in Buildings 815 and 816: - one location per 2 meter grid, situated in the area of the highest surface scanning reading,
- upper walls (above two meters above floor level), ceilings (suspended and non-suspended), - one location per one meter by one meter area that is used to perform the surface scanning surveys, situated in the area of the highest surface scanning reading.
- exterior pavement: one location per 10 meter by 10 meter grid, to be located at the area of the highest surface scanning reading.

Measurements will be conducted by integrating counts over a 1 minute period.

Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta measurements will therefore be performed under these circumstances. Under certain circumstances, however, professional judgment may also require the measurement for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

Class Two Survey Units

Direct measurements of alpha and beta surface activity will be performed at selected locations using the same instruments as outlined in Section 4.2.3.1, Alpha ,Beta and Gamma Scanning Surveys.

Direct measurements will be performed according to the following schedule

- lower walls (up to two meters above floor level), floor surfaces, floors and walls to a distance of 2 meters beyond access points to Class Two survey units, and horizontal surfaces above 2 meters - one location per 2 meter by 2 meter grid used to document the surface scanning surveys, situated in the area of the highest surface scanning reading.
- upper walls, ceilings, and roofs - one location per one meter by one meter area that is used to perform the surface scanning surveys, situated in the area of the highest surface scanning reading.
- exterior pavement - one location per 10 meter by 10 meter grid, situated in the area of the highest surface scanning reading

Measurements will be conducted by integrating counts over a 1 minute period.

Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta measurements will therefore be performed under these circumstances. Under certain circumstances, however, professional judgment may also require the measurement for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

Class Three Survey Units

Direct measurements of alpha and beta surface activity will be performed at selected locations using the same instruments as outlined in Section 4.2.3, Alpha ,Beta and Gamma Scanning Surveys.

Direct measurements will be performed according to the following schedule

- Building surfaces - one location per one meter by one meter area used for the surface scanning surveys, situated in the area of the highest surface scanning reading.
- Exterior Pavement - one location per 10 meter by 10 meter area used in the surface scanning surveys, situated in the area of the highest surface scanning reading.

Measurements will be conducted by integrating counts over a 1 minute period.

Field beta particle measurements are typically more accurate than alpha particle measurements due to the potentially irregular nature of the field sources. Most of the alpha emitting isotopes that are of concern also emit beta particles. Beta measurements will therefore be performed under these circumstances. Under certain circumstances, however, professional judgment may also require the measurement for alpha particles in addition to the beta particles. This data will be reviewed and utilized only as a health physicist determines appropriate.

4.2.3.3 Exposure Rate Surveys

Exposure rate surveys are performed to determine that the exposure rates measured at a location are below the survey unit specific guideline value. Exposure rate measurements will be obtained in the field in units of μRem/hr or counts per minute (cpm). The final exposure rate measurements will be reported in units of μR/hr. The exposure rate survey plans detailed below will provide, at a minimum, the twenty data points from each survey unit that are necessary to meet the DQOs that were selected for SEAD-12.

Dose/exposure rate surveys in building interiors is not an efficient manner in which to identify areas of contamination. The problems with this methodology are based upon both the types of radiation and their designated energies as well as the geometry of the situation in question. The Army intends to perform these surveys and utilize any information collected as a diagnostic tool. Additionally, while the situation is unlikely, from a health safety stand point, it is always best to know the radiation fields that personnel are working in and any unexpected or incongruous fields can be identified and knowledgeable decisions related to personnel exposures and personnel protective equipment can then be made. In this manner, exposure rate measurements will be performed to ensure that no over exposures related to the survey work at SEAD-12 occur.

Class One Survey Units

Gamma exposure rates will be measured at one meter above ground or floor surfaces, using a Bicron microRem/hr meter. Measurements will be uniformly spaced according to the following pattern:

- Lower walls (up to two meters above floor level), floor surfaces, pavement, un-earthen roofs with ventilation ducts - one location per 2 by 2 meter grid used to document the surface scanning and direct measurement surveys, located in the center of the grid,
- Exterior grounds, including earth covered buildings, and paved areas - one location per grid node of the 10 meter by 10 meter grid used to document the surface scanning and direct measurement surveys and at any biased soil sampling locations as defined in the surface soil sampling program (Section 4.2.4.1).

Class Two Survey Units

Gamma exposure rates will be measured at one meter above ground or floor surfaces using a Bicron microRem/hr meter. Measurements will be spaced according to the following pattern:

- building floors and lower walls (up to two meters above floor level) - one per survey grid used for the scanning and direct measurement surveys, located in the center of the grid,
- pavement - one per 10 meter by 10 meter grid used for the scanning and direct measurement surveys, located in the center of the grid,
- grounds -one per grid node of the 10 meter by 10 meter grid used to document the scanning surveys and at any biased soil sampling locations as defined in the surface soil sampling program (Section 4.2.4.1) and surface water and sediment sampling locations as defined in the surface water and sediment sampling program (Section 4.2.4.3).

Class Three Survey Units

Gamma exposure rates will be measured at one meter above ground or floor surfaces using a Bicron microRem/hr meter. Measurements will be spaced according to the following pattern:

- building floors and lower walls (up to two meters above floor level) - one per survey area used for the scanning and direct measurement surveys, located in the center of the area,

- pavement - one per 10 meter by 10 meter area used for the scanning and direct measurement surveys, located in the center of the area,
- grounds - at each surface soil sampling location (one per 200 meter by 200 meter area plus 10 biased locations) and each surface water and sediment sampling location.

4.2.3.4 Removable Radiation Surveys

Two smears for removable radioactive contamination will be performed at each of the direct measurement locations described in section 4.2.3.2, Alpha and Beta Direct Measurements. One smear will be collected for gross alpha and gross beta counting at each of the interior and exterior locations and one smear or material sample will be collected for tritium analysis at each of the interior locations. Professional judgment will be used to determine whether the location should be sampled as a tritium smear or as a material sample to be analyzed for tritium. The gross alpha and gross beta smears will be evaluated by the IRDC Nuclear Counting Laboratory at the Red Stone Arsenal in Alabama. If the integrated counts from a smear sample exceed the site guideline value for removable surface activity, that sample will be analyzed for the radionuclides specified in Section 4.2.8, Analytical Program, to determine the source of the elevated radiations. The tritium smears will be collected as a liquid scintillation smear (LS smear) and will also be submitted to the IRDC Nuclear Counting Lab for laboratory tritium analysis.

There can be a high degree in variability in smear sample results due to the nature of the sample collection technique, as well as surface conditions, contamination distribution, etc.. For this reason, MARSSIM excludes such data from quantitative comparisons and evaluations. Therefore, the smear data collected at SEAD-12 will not be compared to reference site data for the purposes of determining compliance with release criteria. Rather, smear data will be analyzed and used as a diagnostic tool to determine whether a release has occurred and to determine if additional surveys are warranted.

4.2.3.5 Investigation of Radon Concentration in Air

The concentrations of radon in buildings will be accomplished using track-etch radon detection devices. Track-etch radon testing is a long-term (3 to 6 month) radon monitoring technique and will be utilized in all of the buildings being investigated at SEAD-12. Track-etch radon detectors will be placed in all buildings that could conceivably be occupied on a frequent basis or extended period of time. For the purposes of this RI/FS, one track-etch radon detector will be placed on each level of a building at a density of no more than one track-etch radon detector per 2,000 square feet of building space. The U.S. Army's protocol for radon sampling, DA Regulation . AR200-1, will be used for determining the lowest level in a given area that is to be surveyed.

All track-etch radon detectors will be analyzed by a laboratory that is approved by the EPA's Radon Measurement Proficiency Program. Data quality will be addressed from a field perspective by collecting field duplicate samples at a rate of 1 duplicate sample per 20 field samples and by analyzing trip blank samples. Approximately 150 radon detectors will be placed in the 16 buildings situated within SEAD-12.

4.2.3.6 Special Measurement and Sampling

Floor drain inlets and outfalls, wastewater inlets, and ventilation ducts in Class One and Class Two areas will be accessed. Direct alpha, beta, and gamma measurements, and, if possible, sampling of sediments or materials from within these drains or inlets, will be performed at the access points. It is estimated that a total of 26 samples will be collected for radiochemical analysis from all of these access points. In addition, drain lines and duct work will be surveyed using specialized instrumentation. The types and sizes of these instruments will be determined on-site, and may include specialized gas proportional, ZnS, or NaI(Tl) detectors that have been modified to be "snaked" through various diameter piping or ventilation ducts. These instruments are connected to industry standard ratemeters or scalers, and measurements are taken at various locations. These types of special probes will be used to identify areas where residual radiation is present at levels that are above a site guideline for fixed radiation.

The interior of the 5,000 gallon UST located north of Buildings 804 and 805 will also be accessed. At a minimum, three samples and/or smears of the tank's interior will be obtained either by breaching the top of the tank (using a truck mounted drill rig) and collecting a sample with a split spoon, or, the top of the tank will be exposed and accessed by excavation. Two samples will be taken at each end of the tank with the third sample taken in the middle. Should field scans of any of these samples reveal residual radioactivity at levels of concern, additional samples will be taken and archived for further analysis. In the event that an excavation is necessary, such efforts will be planned around periods of low ground water levels, as the tank is likely to be situated below the average seasonal groundwater level. Should the groundwater level remain above the top of the

UST year-round, pumping of groundwater from the excavation will be necessary. If groundwater pumping is required, the excavation will not be advanced until the groundwater quality in the area of the UST has been demonstrated to be unaffected by potential chemicals of concern.

4.2.4 Soil Investigation

The soil investigation program will consist of collecting soil samples from the ground surface, soil borings and test pit excavations. Forty-Seven soil borings and 26 test pit excavations will be performed at SEAD-12. Three hundred and eighteen surface soil samples will also be collected at SEAD-12.

4.2.4.1 Surface Soil Sampling Program

A total of 318 surface soil samples will be collected at SEAD-12. Eight surface soil samples (SS12-1 through SS12-8) will be collected from areas located north and east of SEAD-12 and six surface (SS12-9 through SS12-14) soil samples will be collected from the surface scanning reference area to establish a surface soil background radionuclide concentration database. These fourteen surface soil samples will be analyzed for radionuclides only. Four surface soil samples (SS12-15, through and SS12-18) will be collected at test pit locations investigated during the ESI. Thirty-five surface soil samples (SS12-19 through SS12-53) will be collected at randomly selected locations in class three areas. These 35 locations will be positioned so that one random location is sampled per 200 m by 200 m area. An additional 10 surface soil samples (SS-12-54 through SS12-63) will be collected at biased locations in Class Three areas based upon the surface scanning and exposure measurement surveys. If fewer than ten locations are identified for biased soil sampling, any of the ten remaining surface soil samples will be collected at random locations. Two surface soil samples (SS12-64 and SS12-65) will be collected in the immediate vicinity of the outfall of Building 715's (the Sewage Treatment Plant) wastewater discharge point. Three surface soil samples (SS12-66, 67 and 68) will be collected from beneath the gravel pad at the substation north of Building 815. Surface soil samples SS12-15 through SS12-68 will be submitted for radiological and TAL/TCL analyses. The proposed locations of surface soil samples SS12-1 through SS12-68 are shown on Figure 4-6. An additional 250 surface soil samples will be collected from the grounds of the Class One and Class two survey areas surrounding Buildings 804/805, Buildings 815/816, Building 819, and in areas identified as waste disposal sites from the geophysical surveys. No residual radiation is expected in these areas, except where it is known to occur in the subsurface of Disposal Pit A.

As no residual radiation is expected in the areas of Buildings 815 and 816, and based upon comments from the USEPA, the Class One surface soil sampling planned for the earth covered roofs of Buildings 815 and 816 (currently classed as Class One areas) may be downgraded to Class Two sampling. If the surface scanning and special measurements of the roofs and roof vents of either buildings demonstrates that there is no evidence of residual radiation, the respective areas(s) will be reclassified as Class Two and 20 surface soil samples will be collected. The half of the earthen berm separating the two buildings that adjoins a reclassified area will be included in and investigated as part of the reclassified area. Up to 10 of the 20 samples will be placed at biased locations as described below, with all remaining samples to be collected at random locations. The sampling density will not exceed an average of one sample per 100 square meters.

For Class One areas, the sampling density will be one surface soil sample every ten meters, collected along sampling lines spaced ten meters apart (resulting in a 10 by 10 meter grid sampling pattern). However, if the surface scanning and/or exposure surveys indicate that a localized area of residual radiation may be present, the grid based surface soil sampling location that is closest to the localized area of residual radiation will be relocated to that localized area. Included as part of the grid based surface soil sampling, biased surface soil samples will be collected from the grounds nearest to downspout drains for Buildings 804, 805, 815, 816, and 819. At these locations, the surface soil that is closest to and in the run-off pattern of a given downspout drain will be sampled. The grid based surface soil samples around Buildings 815 and 816 will also include biased surface soil samples that will be collected from locations that would accumulate precipitation run-off from these buildings.

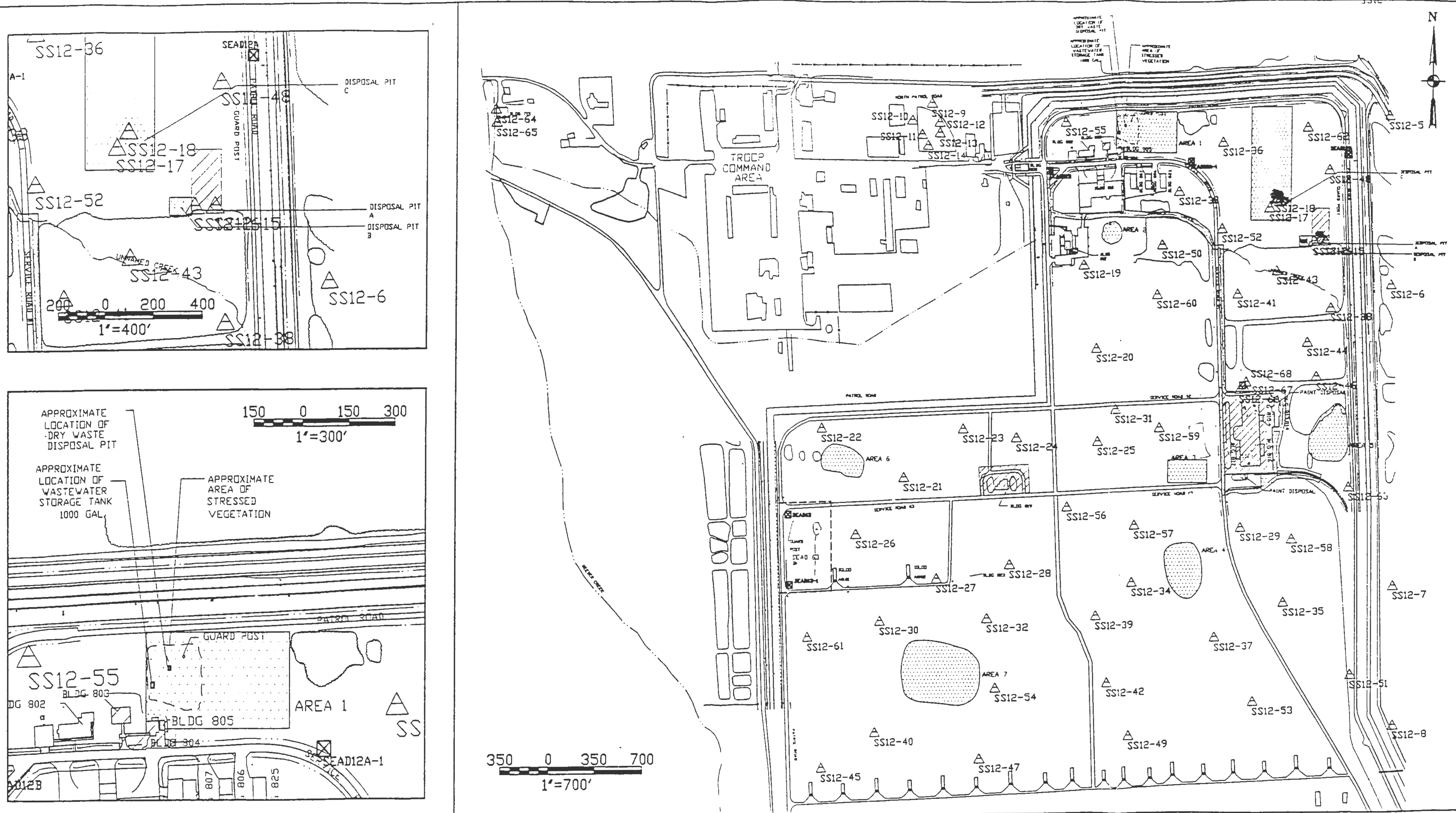
The sampling of Class Two survey areas will be performed so that up to twenty randomly located and/or biased surface soil samples are collected from each Class Two survey unit. For any Class Two survey unit, the sampling density will not exceed an average of one sample per 100 square meters. It is anticipated that a total of ten disposal areas will be identified at SEAD-12. At present, four such areas, identified as Area One (formerly SEAD-12B) and Disposal Pits A, B and C, are known to exist based upon the ESI investigations and past operations at SEDA. These areas are shown on Figure 4-6. The remaining six areas (Areas 2 through 7 on Figure 4-6) are currently estimated based upon the aerial photo review presented in Section 3.1.1.2.5 of this project scoping plan. Based upon the results of the geophysical investigations, any of these six areas that is shown not to have a potential for buried wastes will not be sampled as a Class Two area. Rather, any such area will be considered as part of the SEAD-12 Class Three area and only two confirmatory samples will be collected from those areas. The laboratory analysis costs for any un-used surface soil samples that are not collected as a result of such re-classifications may be used for analyses of archived samples from the soil boring and test pitting programs. However, if the geophysical or scanning investigations identify an area with potentially buried wastes that is not currently indicated on Figure 4-6, then the remaining proposed work for a currently identified Class Two area that is shown to be free of buried wastes will be performed in the suspected disposal area identified by the geophysical or scanning surveys.

The 250 Class One and Class Two surface soil samples will be analyzed for radionuclides. Of these 250 samples, those that are collected from the biased locations described above, (estimated to be 30 surface soil sample locations) will also be analyzed for TAL/TCL constituents.

4.2.4.2 Soil Boring Program

A total of up to 47 soil borings will be performed. These soil borings will be drilled within the Q Area or at locations immediately upgradient of the Q Area. The locations of these 47 soil borings are shown on Figure 4-7. Three additional subsurface soil samples will be collected in the immediate vicinity of the existing upgradient monitoring wells at the OB Grounds, the OD Grounds and SEAD 57. A single subsurface soil sample will be collected at each of these three locations. The subsurface soil samples collected at these three locations will be analyzed for background radionuclide concentrations only.

The purpose of the 47 soil borings will be to determine the thickness of waste materials, observe subsurface soils, measure the depth to bedrock, and obtain subsurface soil samples for chemical and radiochemical analyses. These data will also be used to assess the potential for contaminant migration to groundwater as part of the groundwater receptor pathway.



LEGEND

- MINOR WATERWAY
- MAJOR WATERWAY
- FENCE
- UNPAVED ROAD
- BRUSH LINE
- LANDFILL EXTENT
- RAILROAD
- GROUND SURFACE ELEVATION CONTOUR
- UNDERGROUND ELECTRIC UTILITY LINE
- UNDERGROUND WATER UTILITY LINE
- SURVEY MONUMENT
- ROAD SIGN
- DECIDUOUS TREE
- FIRE HYDRANT
- MANHOLE
- GUIDE POST
- POLE
- UTILITY BOX
- COORDINATE GRID (250' GRID)
- OVERHEAD UTILITY POLE
- MAILBOX/RR SIGNAL

(NOT ALL SYMBOLS MAY APPEAR ON MAP)

KNOWN DISPOSAL PIT AREA (PITS A,B, AND C)

PROPOSED SURFACE SOIL SAMPLE SD12-25

CLASS ONE SURVEY UNIT

CLASS TWO SURVEY UNIT

ACAD\SENECA\RIFS\SD12\SD12PSS.DWG

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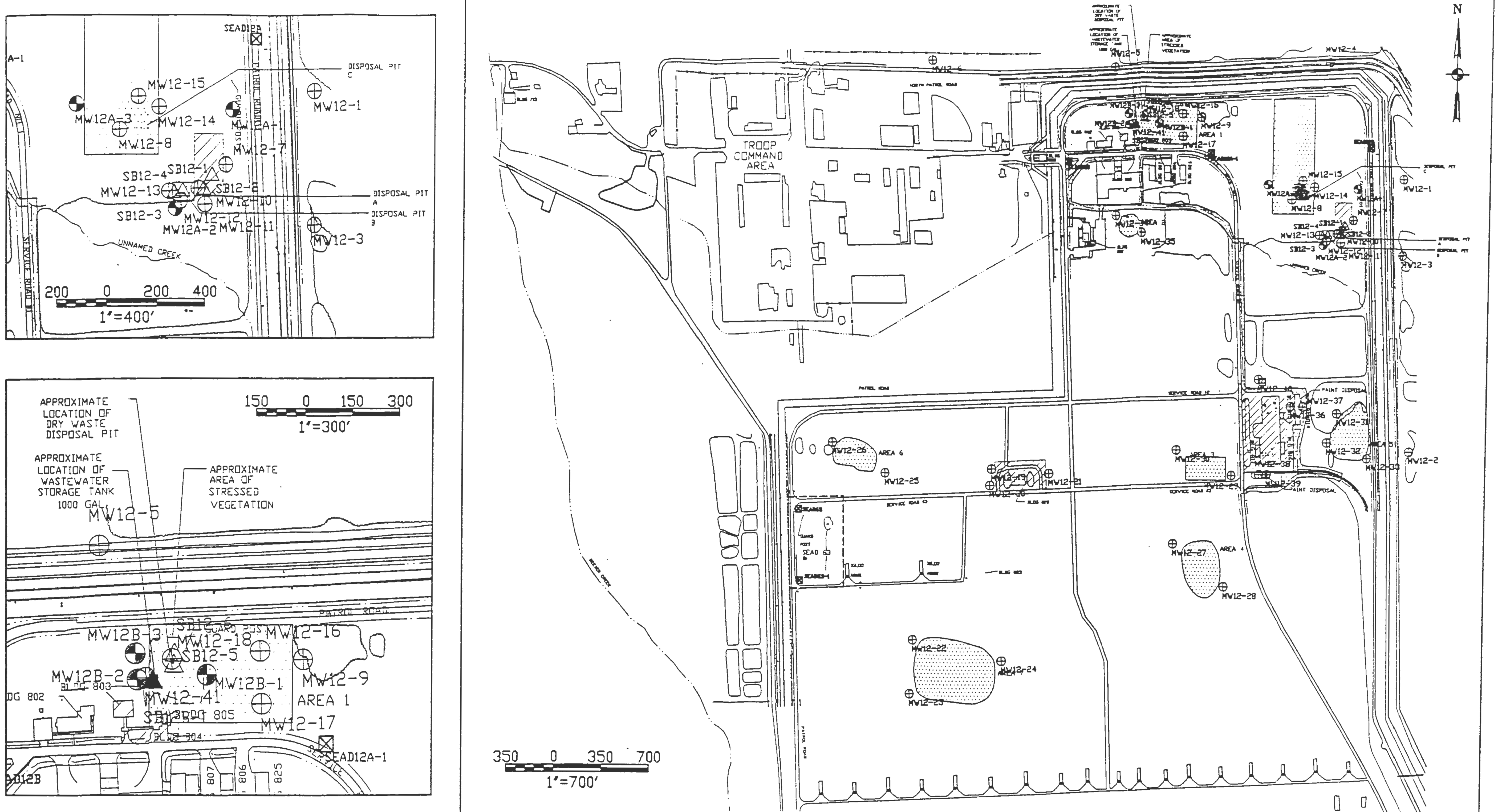
FIGURE 4-6
SEAD-12 PROPOSED SURFACE SURFACE SAMPLE LOCATIONS

VARIES PER VIEW | NOVEMBER 1996 | NA



ACAD\SENECA\RIFS\SD12\SD12PHW.DWG

LEGEND

- MINOR WATERWAY
- MAJOR WATERWAY
- FENCE
- UNPAVED ROAD
- BRUSH LINE
- LANDFILL EXTENT
- RAILROAD
- GROUND SURFACE ELEVATION CONTOUR
- UNDERGROUND ELECTRIC UTILITY LINE
- UNDERGROUND WATER UTILITY LINE
- SURVEY MONUMENT
- ROAD SIGN
- DECIDUOUS TREE
- FIRE HYDRANT
- MANHOLE
- GUIDE POST
- POLE
- UTILITY BOX
- COORDINATE GRID (250' GRID)
- OVERHEAD UTILITY POLE
- MAILBOX/RR SIGNAL

(NOT ALL SYMBOLS MAY APPEAR ON MAP)

- KNOWN DISPOSAL PIT AREA (PITS A,B, AND C)
- CLASS ONE SURVEY UNIT
- CLASS TWO SURVEY UNIT
- PROPOSED MONITORING WELL
- PROPOSED SOIL BORING
- EXISITNG MONITORING WELL

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CLIENT/PROJECT TITLE

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DEPT ENVIRONMENTAL ENGINEERING

FIGURE 4-7
SEAD-12 PROPOSED MONITORING WELLS AND SOIL BORINGS

VARIES PER VIEW | NOVEMBER 1996 | NA

Up to forty-one of the soil borings will be completed as monitoring wells. The purpose for installing most of these soil borings/monitoring wells is to identify if any impacts are occurring downgradient of known release areas. The soil boring/monitoring wells that are proposed for the suspected Class Two areas identified by the aerial photo reviews (Areas 2 through7 on Figure 4-7) will be installed only if any of the radiological surveys or test pit excavations indicate that a release has occurred. Evidence that a release has occurred will be considered as any of the following: an above background measurement on a volatile organic vapor meter, an above background measurement on a volatile organic head-space analysis using a photo-vac or similar type of instrument, visual staining of the ground or subsurface, the presence of military components or miscellaneous military debris (not to include waste from former occupants of the area, such as farming debris), or a measurement value greater than the calculated critical level, L_C.

If none of these types of evidence are found during the surface scanning, direct exposure rate measurements, or test pitting activities, then the laboratory analysis costs for any un-used soil boring samples may be used for analyses of archived samples from other soil borings or from archived samples collected during the test pitting program.

In order to select locations for the monitoring wells, the groundwater direction was assumed to follow the contours of the ground surface. The groundwater elevation map presented in Figure 3-11 indicated that the groundwater flow direction in the northeast portion of SEAD-12 is to the northwest. However, the groundwater contouring was based on data from three monitoring wells, which are not enough data points to accurately depict the groundwater flow direction. In addition, the groundwater elevations in the three wells differed by 0.68 feet, which does not indicate a strong gradient in any direction. Generally, the groundwater flow direction at SEDA is expected to be in a direction consistent with ground surface elevations. In the northeast portion of the site, the ground surface contours and the presence of the unnamed stream south of Disposal Pit A indicate that groundwater may flow radially from the topographic high between monitoring wells MW12A-1 and MW12A-2, toward the southwest following the ground contours.

Soil borings will be drilled according to the following schedule: Six soil borings will be drilled at locations east and north of SEAD-12, and will be completed as background overburden monitoring wells (MW12-1 through and MW12-6). Three soil borings will be drilled at locations which are upgradient of the known and suspected disposal pits identified in the northeastern portion of SEAD-12 and will be completed as overburden monitoring wells (MW12-7, MW12-8, and MW12-9). Two soil borings will be drilled within Disposal Pit A (SB12-1 and SB12-2) and two soil borings will be drilled in Disposal Pit B (SB12-3 and SB12-4), which is located approximately 50 feet west of Disposal Pit A. One soil boring will be drilled in between Disposal Pit A and Disposal Pit B and will be completed as overburden monitoring well MW12-10. Three soil borings will be drilled downgradient of Disposal Pit B and each will be completed as an overburden monitoring well (MW12-11 through MW12-13). Monitoring wells MW12-10 through MW12-13 will be situated using the borehole geophysics results from this area. Two soil borings will be drilled downgradient of Disposal Pit C and completed as overburden monitoring wells MW12-14 and MW12-15. Two soil borings will be drilled in the area to the northeast of Building 805 (Area 1 on Figure 4-7) and will be completed as overburden monitoring wells MW12-16 and MW12-17. Two soil borings will be drilled at the location of the former Dry Waste Disposal Pit situated north of Building 805 (SB12-5 and SB12-6). One soil boring will be drilled immediately downgradient of the location of the former Dry Waste Disposal Pit and completed as overburden monitoring well MW12-18. Three soil borings will be drilled in the vicinity of Building 819 and will be completed as overburden monitoring wells MW12-19, MW12-20, and MW12-21. Two soil borings will be drilled in each of the two areas (for a total of 4 soil borings) suspected of having been impacted by releases of paint and will be completed as groundwater monitoring wells (MW12-36 through MW12-39). The locations of these soil borings will be determined using soil gas survey results. If the soil gas surveys suggest that no releases have occurred, these soil borings will be situated in areas where it is most likely that paint would have been disposed of (i.e, in close proximity to building doors or windows). One soil boring will be drilled in a downgradient location of the sub-station situated north of Building 815. This soil boring will be completed as monitoring well MW12-40. One soil boring will be drilled immediately downgradient of the 5,000 gallon UST north of Building 804 and completed as bedrock monitoring well MW12-41. Depending on the results of the scanning surveys, the exposure rate measurements, and the test pit excavations in Areas 2 through 7 (on Figure 4-7), up to fourteen soil borings will be drilled around these potential Class Two areas. The criteria for proceeding with a soil boring in these areas is detailed in the second paragraph above. Any of these fourteen soil borings that are performed will subsequently be completed as overburden monitoring wells (MW12-22 through MW12-35).

Soil borings will be performed by the continuous split-spoon method. Samples will be collected every two feet from the ground surface to the bottom of the boring. At each boring location except soil borings SB12-5 and SB12-6, a 0-2" surface soil sample will be collected and submitted for chemical and radiochemical testing. Two subsurface soil samples will also be collected from each soil boring to be submitted for chemical and radiochemical testing. The criteria for the selection of the subsurface soil samples submitted to the lab for chemical and radiochemical testing is provided in Section 3.4 of Appendix A, Field Sampling and Analysis Plan of the Generic Installation RI/FS Workplan. Additional sample selection criteria will include any impacts that are observed during the radiological field screening of the slit spoon material.

Additional samples will be collected from the soil borings for archive purposes. These samples may be submitted for radiochemical testing in the event that additional analyses are required to characterize any radiological impacts at SEAD-12. Archive samples will be taken from all segments of the split spoon material where the screening measurements are more than 50% above readings without a sample present. Additionally, the material immediately above and below any such segments will also be sampled and archived. Professional judgment and the radiological field screening of the split spoon material will be used to select any other archive samples.

Soil samples will be collected from the soil borings SB12-5 and SB12-6 to obtain one sample for each 3 foot interval of the soil borings. These samples are required to demonstrate that there is no residual radioactivity from the past operations at the Dry Waste Disposal Pit.

All soil boring samples collected within SEAD-12 will be submitted for TCL/TAL and radiochemical testing. All background soil boring samples will be submitted for radiochemical testing only. Each soil boring will be drilled until auger refusal is encountered. Auger refusal for this project is defined in Section 3.4 of Appendix A, Field Sampling and Analysis Plan, in the Generic Installation RI/FS Workplan

In addition, 6 total soil samples will be collected for limited chemical testing and physical testing at 2 soil boring locations. One location will be selected in each of Disposal Pits A and B in the northeastern portion of SEAD-12. At each location, one near surface sample, one sample from immediately below the fill materials, and an intermediate sample will be collected.

4.2.4.3 Test Pitting Program

A total of 26 test pits will be excavated at SEAD-12. The locations of these test pits are shown on Figure 4-8. The test pits will be excavated within the known disposal pits and over areas of geophysical anomalies. Test pits will be performed so that a visual evaluation of the subsurface soils and fill materials can be made, and also for the purpose of collecting soil samples for chemical and radiochemical testing. Four test pits (test pits TP12-1 through TP12-4) will be excavated in Disposal Pits A and C, located in the northeastern portion of SEAD-12. Four test pits (TP12-5 through TP12-8) will be located in an area of weak GPR signal returns identified during the ESI. Eighteen additional test pits (test pits TP12-9 through TP12-26) will be located based upon geophysical anomalies identified during the geophysical investigations to be performed for this RI/FS.

Test pits will be excavated to the bottom of the fill layer. The bedrock surface (if encountered) and bottom of fill layer will be documented at each test pit location. One surface soil sample and two (2) subsurface soil samples will be collected from each test pit. The samples will be collected at depths where there is evidence of impacts based upon field screening and visual observations. If no impacts are evident in the test pit, the samples will be collected from the floor of the pit and at the mid-depth of the wall of the excavation. Additional samples will be collected for archive purposes in the event that additional analyses are required to characterize any radiological impacts at SEAD-12. Archive samples will be taken from areas in the test pit excavation where the screening measurements of excavated materials are more than 50% above readings without a sample present. Additionally, the material immediately above and below any such areas will also be sampled and archived. Professional judgement and the radiological field screening of the test pit material will be used to select any other archive samples.

In addition, six total soil samples will be collected for limited chemical testing and physical testing at 2 test pit locations. One location will be selected in Disposal Pit C and one location will be selected in Area 1, located north and east of Buildings 804/805. At each location, one near surface sample, one sample from immediately below the fill materials, and an intermediate sample will be collected. If fill material is not present in the area north and east of Buildings 804/805, this sample will be collected below the water table.

The materials removed for characterization purposes will be returned to the excavated area at the completion of each test pit investigation. This procedure was discussed with and agreed to by the New York State Department of Environmental Conservation, Bureau of Radiation, Division of Hazardous Substances (see Appendix J, Letter of Confirmation of Telephone Conversation Between Parsons ES and NYSDEC, on July 17, 1995). This procedure assures that any residual radiation found at a test pit site will not have the potential to migrate via over-land transport (i.e. by precipitation run-off or by wind transport), and it will minimize any potential radiation dose or contamination to on-site workers or visitors during the RI/FS process.

All personnel performing the test pit operations will be wearing Level C equipment to avoid possible exposure. The excavated soils will be monitored for VOCs and radiation during test pitting. The level of personal protective equipment may increase (to Level B) or decrease (to Level D) during the course of the excavation based upon the readings of the VOC and radiation monitoring. Test pitting procedures are provided in Section 3.4.3 of Appendix A, Field Sampling and Analysis Plan in the Generic Installation RI/FS Workplan.

4.2.4.4 Soil Sampling Summary

One surface soil sample and two subsurface soil samples will be collected from each of the 47 soil borings shown on Figure 4-7. One mid-depth subsurface soil sample will be collected from 3 background monitoring well installations at the OB Grounds, the OD Grounds, and SEAD-57. One surface soil and two subsurface soil samples will be collected from each of test pit performed at SEAD-12. Up to three hundred and eighteen surface soil samples will also be collected from the locations described in Section 4.2.4.1 and shown on Figure 4-6. In total, up to 285 soil samples will be collected for chemical and radiochemical testing and up to an additional 255 soil samples will be collected for radiochemical testing only.

In addition, 16 subsurface soil samples will be collected from 2 soil borings and 2 test pit excavation for physical testing and limited chemical testing. The soil samples will be tested according to the analyses specified in section 4.2.8, Analytical Program.

4.2.5 Surface Water and Sediment Investigation

Surface water and sediment sampling will be conducted in areas of SEAD-12 which have the potential for acting as an exposure pathway or for off-site transport of site contaminants.

Potential on-site surface water areas include small drainage swales located throughout SEAD-12, and an unnamed creek that flows westward from the eastern boundary of SEAD-12 and eventually drains into Reeder Creek. Forty-seven surface water and sediment samples (SW/SD12-1 through SW/SD12-47) will be collected at the on-site locations shown on Figure 4-9. Twenty additional surface water and sediment samples will be collected at the off-site locations shown on Figure 4-10. Eleven of these 20 samples (SW/SD12-48 through SW/SD12-58) will be collected from down gradient locations in the un-named tributary of Reeder Creek and Reeder Creek itself. An additional 9 samples (SW/SD12-59 through SW/SD12-67) will be collected from up-gradient locations and analyzed for background radionuclide and metals concentrations. All of the surface water and sediment samples will be collected in areas where sedimentation is likely to occur, such as on the inside of bends in a creek's or tributary's path or in areas where the width of a tributary or creek increases.

The surface water and sediment will be analyzed as described in section 4.2.8, Analytical Program. These data will be used to determine if there is a surface water or sediment exposure pathway at SEAD-12. If concentrations exceeding applicable guidelines are present, the data will be used to perform a baseline risk assessment for this exposure pathway. The surface water and sediment sampling procedures are described in Section 3.7 of Appendix A, Field Sampling and Analysis Plan in the Generic Installation RI/FS Workplan.

4.2.6 Groundwater Investigation

4.2.6.1 Monitoring Well Installation and Sampling

Six groundwater monitoring wells were installed as part of the ESI completed at SEAD-12. Based upon water level measurements, the groundwater flow direction in the area of SEAD-12A was determined to be to the northwest, while the groundwater flow direction in the area of SEAD-12B was determined to be to the south. Groundwater samples from the ESI contained two metals (iron and manganese), two principal radionuclides (U-235 and Ra-226), and gross
Figure 4-8

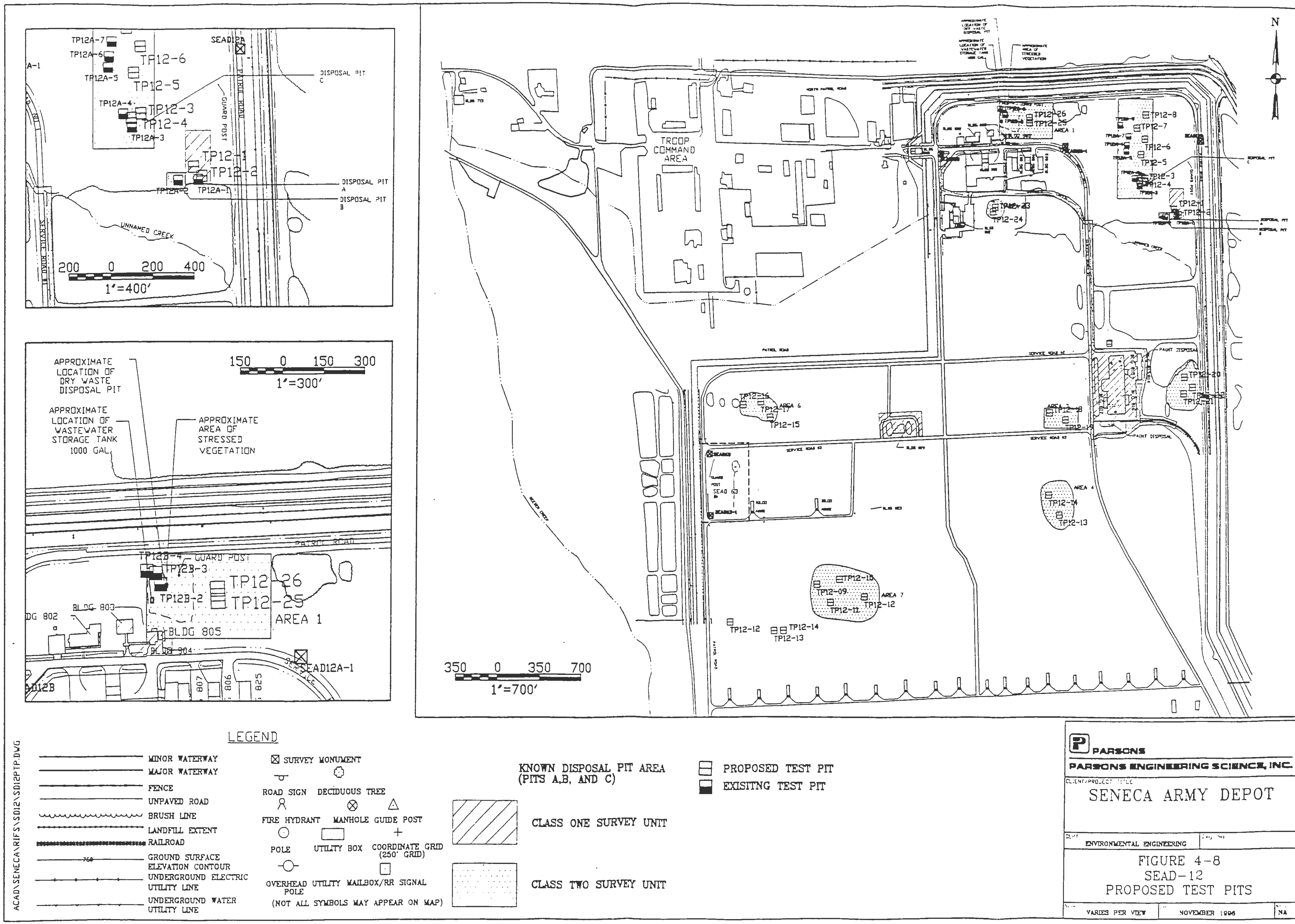
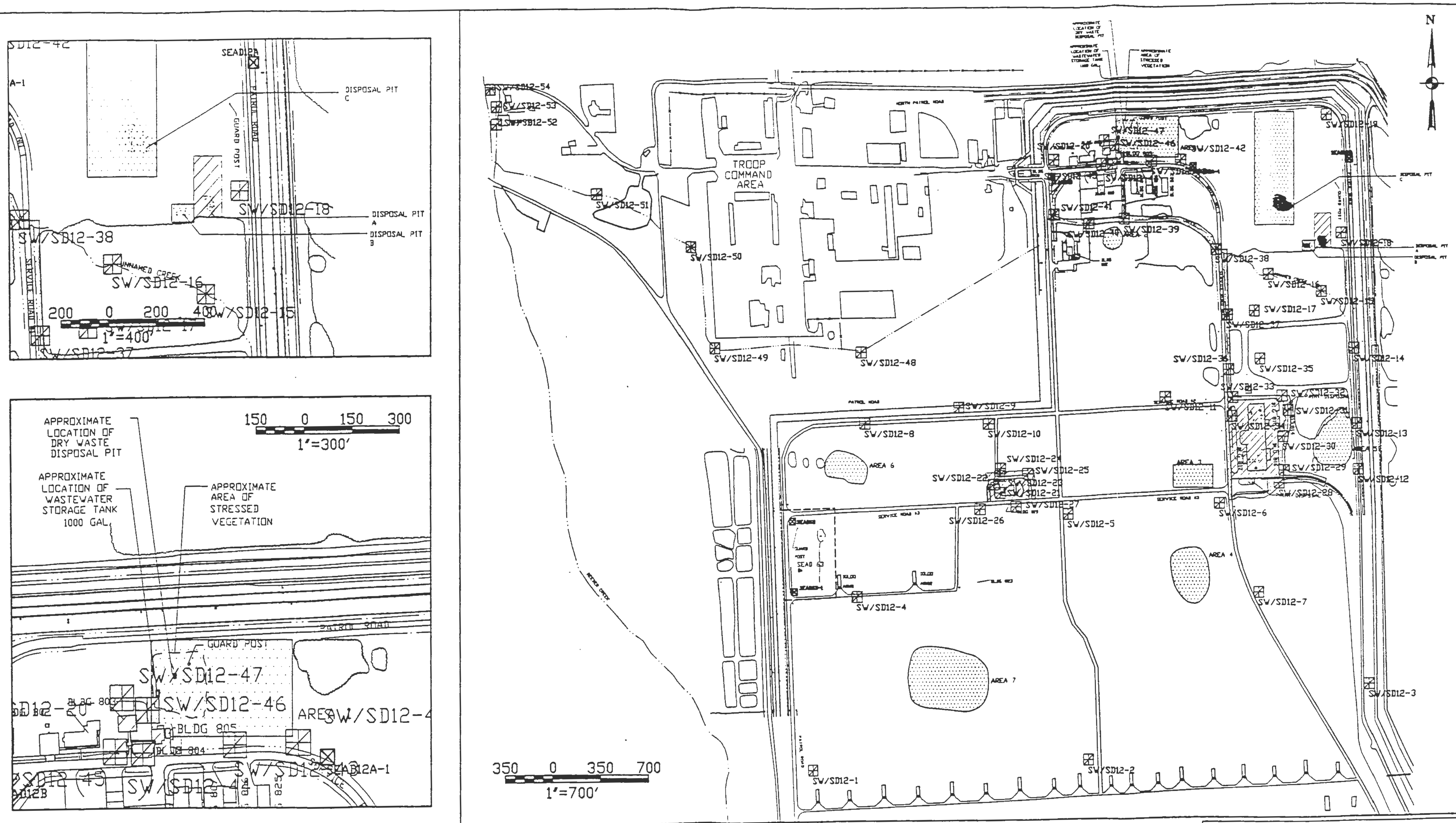


FIGURE 4-8
SEAD-12
PROPOSED TEST PITS



LEGEND

- MINOR WATERWAY
- MAJOR WATERWAY
- FENCE
- UNPAVED ROAD
- BRUSH LINE
- LANDFILL EXTENT
- RAILROAD
- GROUND SURFACE ELEVATION CONTOUR
- UNDERGROUND ELECTRIC UTILITY LINE
- UNDERGROUND WATER UTILITY LINE
- SURVEY MONUMENT
- ROAD SIGN
- DECIDUOUS TREE
- FIRE HYDRANT
- MANHOLE
- GUIDE POST
- POLE
- UTILITY BOX
- COORDINATE GRID (250' GRID)
- OVERHEAD UTILITY POLE
- MAILBOX/RR SIGNAL

(NOT ALL SYMBOLS MAY APPEAR ON MAP)

- KNOWN DISPOSAL PIT AREA (PITS A,B, AND C)
- PROPOSED SURFACE WATER/SEDIMENT SAMPLE
- CLASS ONE SURVEY UNIT
- CLASS TWO SURVEY UNIT

ACAD\SENECA\RIFS\SD12\SD12PSW.DWG

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CLIENT/PROJECT TITLE
SENECA ARMY DEPOT

DEPT
ENVIRONMENTAL ENGINEERING

FIGURE 4-9
SEAD-12 PROPOSED SURFACE WATER/SEDIMENT SAMPLES

VARIES PER VIEW | NOVEMBER 1998 | NA

LEGEND

CREEK OR TRIBUTARY

SW/SD12-65 PROPOSED SURFACE WATER AND SEDIMENT LOCATION

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CLIENT/PROJECT TITLE: SENECA ARMY DEPOT

DEPT: ENVIRONMENTAL ENGINEERING

FIGURE 4-10
LOCATION OF PROPOSED OFF-SITE SURFACE WATER/SEDIMENT SAMPLES

SCALE: NA | DATE: NOVEMBER 1998 | NA

4.3.3 Soil Investigation

The soil investigation program will consist of collecting soil samples from the ground surface, test pits, and soil borings. Eight soil borings and 5 test pits will be performed at SEAD-63. As SEAD-63 is bounded by Class Three grounds of SEAD-12 to the north, east and south, background soil samples are not proposed in the immediate vicinity of this site. The background soil samples collected as part of the RI/FS investigations at SEAD 12 will be used for the background comparisons of SEAD-63 data.

4.3.3.1 Surface Soil Sampling Program

Seventeen surface soil samples will be collected at SEAD-63. Surface soil samples SS63-1 through SS63-12 will be collected at the test-pit locations that were excavated during the ESI. The five remaining surface soil samples (SS63-13 through SS63-17) will be located randomly as shown on Figure 4-11.

4.3.3.2 Soil Boring Program

A total of eight soil borings will be performed. The locations of these 8 soil borings are shown in Figure 4-11. Five of the eight soil borings will be completed as monitoring wells. The purpose of the soil borings will be to observe subsurface soils, measure the depth to bedrock, and obtain subsurface soil samples for chemical and radiochemical analyses. These data will also be used to assess the potential for contaminant migration to groundwater as part of the groundwater receptor pathway.

Three soil borings (SB63-1, SB63-2, and SB63-3) will be drilled in the areas where previous test pit excavations have identified buried wastes. These soil borings will be drilled to determine the vertical extent of the disposal pits. Three soil borings will be drilled at locations that are immediately downgradient of the disposal trenches and one soil borings will be drilled at a location that is immediately upgradient of the disposal trenches. These four soil borings will be completed as monitoring wells MW63-4 through MW63-7. One soil boring will be drilled downgradient of the ESI monitoring wells that had high gross alpha and gross beta radiations. This soil boring will be completed as overburden monitoring well MW63-8.

alpha and gross beta radiations at concentrations exceeding state or federal drinking water criteria. However, the vertical and lateral extent of potential contaminant migration from the disposal pit areas has not been fully characterized.

The goals of the groundwater investigation during the RI are to verify previous sampling data, determine the extent of groundwater contamination in impacted areas, gather additional potentiometric data to confirm the groundwater flow direction, determine background groundwater quality, and determine the hydraulic conductivity of the aquifer. To accomplish this, up to 41 additional monitoring wells will be installed at the approximate locations shown on Figure 4-7. The rationale for installing a monitoring well at a given location (and collecting soil samples from the soil boring performed to install the well) is detailed in Section 4.2.4.2 , Soil boring Program. In that section, it is explained that monitoring wells intended for suspected Class Two areas identified by the aerial photo reviews (Areas 2 through 7 on Figure 4-7) may not be installed if there is no evidence of a release having occurred. The types of evidence that a release has occurred are explained in Section 4.2.4.2, and include the chemical analysis and radioanalysis of test pit soil samples. Therefore, if field observations at these locations do not indicate that a release has occurred, the groundwater monitoring wells proposed for those areas may be installed only after the test pit sample analysis results have been reviewed. The remaining groundwater monitoring wells intended for all other areas will be installed as currently described in this project scoping plan.

Table 4-5 lists each of the currently proposed monitoring wells shown on Figure 4-7 and provides a brief rationale for the installation of each. A description of the monitoring well locations is presented in Section 4.2.4.2. Based upon field observations, scanning or exposure rate measurements, or borehole geophysical data, the final location of these wells may differ slightly from those shown in Figure 4-7. All soil borings to be drilled for the installation of each well will be continuously sampled to competent bedrock. A monitoring well will then be installed and screened in the saturated overburden overlying the bedrock. All monitoring wells installed during the RI, as well as the six existing wells installed during the ESI, an existing groundwater well located immediately west of Building 815, and 3 background wells from the OB Grounds, the OD Grounds and SEAD-57, will then be sampled according to the following schedule:

- First Round - approximately 2 weeks after well development, and,
- Second Round - approximately 3 months after the first round.

Table 4-5-1
SEAD -12 RI/FS Project Scoping Plan
Monitoring Well Justification Table
Seneca Army Depot Activity

Monitoring Well ID	Monitoring Well Location	Rationale for Installation of Monitoring Well
MW12-1	East of eastern Q Area boundary	Offsite background Monitoring Well
MW12-2	East of eastern Q Area boundary	Offsite background Monitoring Well
MW12-3	East of eastern Q Area boundary	Offsite background Monitoring Well, Upgradient of Disposal Pit Area
MW12-4	North of northern Q Area boundary	Offsite background Monitoring Well
MW12-5	North of northern Q Area boundary	Offsite background Monitoring Well
MW12-6	North of northern Q Area boundary	Offsite background Monitoring Well
MW12-7	Northeast of Disposal Pit A	Upgradient of Disposal Pit A, to establish the local groundwater flow direction
MW12-8	Southwest of Disposal Pit C	Upgradient of Disposal Pit C, to establish the local groundwater flow direction
MW12-9	East of Building 804; East of area with stressed vegetation	Upgradient of area with stressed vegetation, to establish the local groundwater flow direction
MW12-10	Between Disposal Pits A and B	Downgradient Monitoring Well for Disposal Pit A
MW12-11	South-southwest of Disposal Pit A	Downgradient Monitoring Well for Disposal Pit A
MW12-12	Southwest of Disposal Pit B	Downgradient Monitoring Well for Disposal Pit B
MW12-13	West of Disposal Pit B	Downgradient Monitoring Well for Disposal Pit B
MW12-14	Northeast of Disposal Pit C	Downgradient Monitoring Well for Disposal Pit C
MW12-15	North of Disposal Pit C	Downgradient Monitoring Well for Disposal Pit C
MW12-16	East of existing monitoring well MW12B-1	Downgradient or within area of stressed vegetation
MW12-17	East of existing monitoring well MW12B-1	Downgradient or within area of stressed vegetation
MW12-18	West of former dry waste Disposal Pit, North of Building 804	Downgradient Monitoring Well for the former dry waste disposal pit; to demonstrate a satisfactory cleanup of the former dry waste disposal pit as recommended in NUREG/CR 5849
MW12-19	West of Building 819	Downgradient Monitoring Well for Building 819
MW12-20	West-northwest of Building 819	Downgradient Monitoring Well for Building 819
MW12-21	East of Building 819	Upgradient of Building 819, to establish the local groundwater flow direction

Table 4-5
SEAD -12 RI/FS Project Scoping Plan
Monitoring Well Justification Table
Seneca Army Depot Activity

Monitoring Well ID	**Monitoring Well Location**	**Rationale for Installation of Monitoring Well**
MW12-22*	North of Service Road #3, West of Proposed Well MW12-24	Downgradient Monitoring Well for a suspected burial pit
MW12-23*	West of Proposed Well MW12-24	Downgradient Monitoring Well for a suspected burial pit
MW12-24*	North of Igloo Row A0200	Upgradient Monitoring Well for a suspected burial pit, to establish a boundary between unaffected and potentially affected media
MW12-25*	North of Service Road #3, east of Patrol Road	Upgradient Monitoring Well for Area 6, a suspected disposal area
MW12-26*	Northwest of Area 6	Downgradient Monitoring Well for Area 6
MW12-27*	Northwest of Area 4	Downgradient Monitoring Well for Area 4
MW12-28*	West of Service Road #1, south of Service Road #3	Upgradient Monitoring Well for Area 4, a suspected disposal area
MW12-29*	West of Service Road #1, north of Service Road #3	Upgradient Monitoring Well for Area 3, a suspected disposal area
MW12-30*	Northwest of Area 3	Downgradient Monitoring Well for Area 3
MW12-31*	West of Proposed Well MW12-33, East of Buildings 815 and 816	Downgradient Monitoring Well for Area 5
MW12-32*	West of Proposed Well MW12-33, East of Buildings 815 and 816	Downgradient Monitoring Well for Area 5
MW12-33*	East of Area 5, east of Buildings 815 and 816	Upgradient Monitoring Well for Area 5, potential past uses may have been storage or disposal of materials
MW12-34*	South of Building 810, east of Building 812	Downgradient Monitoring Well for Area 2
MW12-35*	South of Building 810, east of Building 812	Upgradient Monitoring Well for Area 2, a suspected disposal area
MW12-36	West of Buildings 813/814	Downgradient Monitoring Well for suspected paint disposal area
MW12-37	East of Buildings 813/814	Upgradient Monitoring Well for suspected paint disposal area
MW12-38	West of Building 817	Downgradient Monitoring Well for suspected paint disposal area
MW12-39	East of Building 817	Upgradient Monitoring Well for suspected paint disposal area
MW12-40	East of power sub-station for Buildings 815/816	Downgradient Monitoring Well for area with potential releases related to the power sub-station, and to define local and regional groundwater flow directions
MW12-41	East of 5,000 gallon UST	Downgradient bedrock monitoring well for 5,000 gallon UST

* These Monitoring wells may be relocated to investigate anomalies detected by geophysical surveys.

Monitoring well installation, development, and sampling procedures are described in Section 3.5 and 3.6 of Appendix A, Field Sampling and Analysis Plan in the Generic Installation RI/FS Workplan. The groundwater samples will be tested according to the analyses described in Section 4.2.13, Analytical Program.

4.2.6.2 Aquifer Testing

Slug testing will be performed on the 47 monitoring wells at SEAD-12 to characterize the hydraulic conductivity of the overburden aquifer. Three rounds of water levels will be measured at each of the wells at SEAD-12 to further define the groundwater flow direction at the site. The groundwater level measurements will be performed according to the following schedule:

- First Round - before monitoring well development,
- Second Round - at the time of the first round of groundwater sampling and,
- Third Round - at the time of the second round of groundwater sampling.

Procedures for slug testing and water level measurements are outlined in Section 3.11 of Appendix A, Field Sampling and Analysis Plan in the Generic Installation RI/FS Workplan.

4.2.7 Ecological Risk Assessment

A general overview of the ecological risk assessment (ERA) process to be implemented for SEAD-12 is provided in this section. The ERA will contribute to the overall characterization of the site and serve as part of the baseline used to develop, evaluate, and select appropriate remedial alternatives (if necessary). The primary objective of the ERA is to evaluate whether unacceptable adverse risks are or may be posed to ecological receptors as a result of the hazardous substance releases. This objective is met by characterizing the ecological plant and animal communities in the vicinity of the site, defining the particular hazardous substances affecting environmental media at the site, identifying pathways for receptor exposure, estimating the potential for adverse impacts on ecological receptors, and determining the extent to which response actions are necessary.

The ERA will be based on field and laboratory data and available literature on the toxicology of contaminants to wildlife populations in the vicinity of the site. These studies will be conducted in accordance with the USEPA (1997a) Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, the USEPA (1998) Guidelines for Ecological Risk Assessment, the New York State Department of Environmental Conservation (NYSDEC) Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (1994), and the Procedural Guidelines for Ecological Risk Assessments at U.S. Army Sites (Wentsel et al., 1994).

The ERA is generally conducted in two phases with more or less complexity depending on the nature of site conditions and ecological receptors. Phase I of the ERA is based on field and laboratory data and on available literature on the toxicology of chemicals of potential concern (COPCs) to plant and animal species in the vicinity of the site. Phase II of the ERA may be conducted, if necessary, to provide additional empirical data and supplement the results of the first phase. The general ecological risk assessment approach to be followed for SEAD-12 is described below. The following key elements of the approach, which are adapted from recent USEPA (1997a and 1998) ERA guidance, are as follow:

Problem Formulation

- Qualitative characterization of the ecosystems potentially at risk and dominant non domesticated plant and animal species in the area of SEAD-12;
- Selection of assessment endpoints;
- Selection of receptor species;
- Preparation of a conceptual site model (CSM), with contaminant exposure pathways from the site to receptor species;
- Preliminary screening and identification of particular COPCs for ecological receptors.

Analysis (toxicity/exposure assessment)

- Assessment of the toxicity of COPCs to receptors;
- Assessment of exposure of receptors to COPCs.
- Risk characterization
- Risk estimation;
- Risk description.

Analysis of risk uncertainty

The steps outlined above represent the first phase of the ERA. If Phase I results do not indicate potential site contaminant-related risk, no further assessment will be conducted. If a site-related risk (i.e., high potential for adverse effects from site-related chemical contamination) is demonstrated or risks are uncertain due to uncertainty about site-specific factors, a second phase of the assessment will be proposed for that site. Phase II may include tissue sampling and calculation of site-specific bioaccumulation factors, biotoxicity studies, or quantitative population/community analyses, depending on characteristics of the site and chemicals of concern. Phase II will serve to reduce uncertainty in the risk characterization by refining the exposure assessment and toxicity evaluation with site-specific data.

The conclusions derived from Phases I and II will focus on identifying potential adverse effects on species, habitats, and populations in the environment. The Phase I evaluation will not include quantitative characterization of ecological; that is, no measurements of species frequency, dominance, diversity, productivity, or other biological population or community parameters will be made. Such data may be gathered in a subsequent phase, if Phase I results indicate a concern and if quantitation of population and community parameters may help characterize the site-specific risk.

4.2.7.1 Problem Formulation

Problem formulation is the first step of the ERA and defines the assessment endpoints, ecological receptors, and COPCs at the site. The components of this step are outlined in the following subsections.

Ecological Characterization

The first step in problem formulation is to characterize the site with respect to operational, physical, chemical, and ecological characteristics, and the current and anticipated future land uses. Understanding site conditions and land uses aids in the identification of potential receptors under current and likely future scenarios.

The following procedure for the ecological characterization was developed from the NYSDEC Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (1994). A wetland functional assessment will be conducted if the remedial actions, which will be developed in the FS, involve disruption of wetland areas. This assessment would be conducted as an initial step in the FS if necessary.

The purpose of the site characterization is to determine whether aquatic and terrestrial resources are present at the site and if they were present at the site prior to contaminant introduction. If they were present prior to contaminant introduction, the appropriate information will be provided to design a remedial investigation of the resources. The information to be gathered includes site maps, descriptions of aquatic and terrestrial resources at the site, the assessment of the value of the aquatic and terrestrial resources, and the appropriate contaminant-specific and site-specific regulatory criteria applicable to the remediation of the identified aquatic and terrestrial resources.

A topographic map showing the site and documented aquatic and terrestrial resources within a 2-mile radius of the site will be obtained. The aquatic and terrestrial resources of concern are Significant Habitats as defined by the New York State Natural Heritage Program; habitats supporting endangered, threatened or rare species or species of concern; regulated wetlands; wild and scenic rivers; significant coastal zones; streams; lakes; and other major resources.

A map showing the major vegetative communities within a 0.5-mile radius of the site will be developed. The major vegetative communities will include wetlands, aquatic habitats, NYSDEC Significant Habitats, and areas of special concern. These covertypes will be identified using the NYSDEC Natural Heritage Program descriptions and classifications of natural communities. Wetlands in the vicinity of SEAD-12 were delineated by the U.S. Fish and Wildlife Service as part of BRAC 95; this information will be included in vegetative community mapping for the site.

To describe the covertypes at the site, the abundance, distribution, and density of the typical vegetative species will be identified. To describe the aquatic habitats at the site, the abundance and distribution of aquatic vegetation will be identified. The physical characteristics of the aquatic habitats also will be described and will include parameters such as the water chemistry, water temperature, dissolved oxygen content, depth, sediment chemistry, discharge, flow rate, gradient, stream-bed morphology, and stream classification.

The aquatic and terrestrial species that are expected to be associated with each covertype and aquatic habitat will be determined. In particular, endangered, threatened, and rare species, as well as species of concern, will be identified. Alterations in biota, such as reduced vegetation growth or quality will be described. Alterations in, or absence of, the expected distribution or assemblages of wildlife will be described.

A qualitative assessment will be conducted evaluating the ability of the area within a 0.5-mile radius of the site to provide a habitat for aquatic and terrestrial species. The factors that will be considered will include the species' food requirements and the seasonal cover, bedding sites, breeding sites, and roosting sites that the habitats provide.

The current and potential human use of the aquatic and terrestrial resources of the site and the area within 0.5-mile of the site will be assessed. In addition to assessing this area, documented resources within 2 miles of the site and downstream of the site that are potentially affected by contaminants also will be assessed. Human use of the resources that will be considered will be activities such as hunting, fishing, wildlife observation, scientific studies, agriculture, forestry, and other recreational and economic activities.

The appropriate regulatory criteria will be identified for the remediation of aquatic and terrestrial resources and will include both site-specific and contaminant-specific criteria.

Selection of Assessment Endpoints

Protection of ecological resources, such as habitats and species of plants and animals, is a principal motivation for conducting ERAs. Key aspects of ecological protection are presented as policy goals. These are general goals established by legislation or agency policy that are based on societal concern for the protection of certain environmental resources. For example, environmental protection is mandated by a variety of legislation and government agency policies (e.g., CERCLA, National Environmental Policy Act). Other legislation includes the Endangered Species Act 16 U.S.C. 1531-1544 (1993, as amended) and the Migratory Bird Treaty Act 16 U.S.C. 703-711 (1993, as amended). Typical policy goals established for SEDA are 1) conservation of threatened/endangered species and their critical habitats and 2) protection of terrestrial and aquatic populations and ecosystems. These will be refined in the problem formulation step. To determine whether these protection goals are met at the site, assessment and measurement endpoints will be formulated to define the specific ecological values to be protected and to define the degree to which each may be protected.

To assess whether significant adverse ecological effects have occurred or may occur at the site as a result of ecological receptors' exposure to COPCs, ecological endpoints will be selected. An ecological endpoint is a characteristic of an ecological component that may be affected by exposure to a stressor, such as a contaminant. Assessment endpoints represent environmental values to be protected and generally refer to characteristics of populations and ecosystems (Suter, 1993). Unlike the human health risk assessment process, which focuses on individual receptors, the ERA focuses on populations or groups of interbreeding non-human, non-domesticated receptors. In the ERA process, the risks to individuals are assessed only if they are protected under the Endangered Species Act, as well as species that are candidates for protection and those considered rare.

Given the diversity of the biological world and the multiple values placed on it by society, there is no universally applicable list of assessment endpoints. Therefore, Suter (1993) has suggested five criteria that should be considered in selecting assessment endpoints suitable for a specific ERA. These criteria are 1) ecological relevance, 2) susceptibility to the contaminant(s), 3) accessibility to prediction and/or measurement, 4) societal relevance, and 5) definable in clear, operational terms.

As applicable, terrestrial and aquatic ecosystems at a site will be evaluated for ecological risk. The ecological site characterization will conclude which populations of plants and animals do or could utilize the site. The assessment endpoints will be selected to represent the policy goal of protection of terrestrial and/or aquatic populations and ecosystems. A typical assessment endpoint is no substantial adverse effect on survival, growth, and reproduction of resident populations of terrestrial and or aquatic biota. The assessment endpoint should define the effects being evaluated and include an agreed-upon value that will be used to identify potential effects in the assessment endpoint. If endangered/threatened/ special concern species utilize the site or could be affected by site-related contaminants, an assessment endpoint of no adverse effect on survival, growth, and reproduction of individuals of such species is appropriate. These endpoints will be further determined as part of problem formulation.

Selection of Receptor Species

The objective of this step will be to select a group of receptors to represent the focus of the ERA. The assessment of potential effects on receptors addresses potential contaminant effects on the selected receptor species, and on the habitats of these species, as appropriate.

Evaluation of ecological risks is inherently difficult and complex for several reasons. These include: the large number of species typically present at a waste site, significant differences in biological reactions to the same contaminant concentration among different species, multiple factors regulating chemical bioavailability, and multiple levels of ecological organization (e.g., population or ecosystem) susceptible to contaminant effects. To practically address these complexities and constraints, regulatory guidance allows use of specific indicator receptors to represent larger assemblages of species that share many common characteristics (USEPA, 1997a).

The receptor-species concept will be used for evaluating potential biological risks for two reasons. First, evaluating a limited number of receptor species minimizes data interpretation difficulties created by the inherent differences in the ways various species react to the same contaminants. Second, evaluating receptor species provides a practical alternative to evaluating all of the several hundred species present on site.

Receptor species will be selected based on the likelihood that they are or could be present at the site. Site biota will be organized into major groups. For terrestrial communities, the major groups are terrestrial flora and wildlife. For aquatic/wetland communities, the major groups are flora and fauna, including vertebrates (fish) and invertebrates. Species presence and relative abundance need to be determined prior to identification of target species. Some guidelines for selecting species from the potentially exposed community include the following (adapted from Phillips, 1978, in Suter, 1993):

- Relationship to the assessment endpoint;
- Actually or potentially occur in or feed on the most contaminated media;
- Abundant throughout the study area including reference sites (similar size and age) or habitat is capable of supporting the species;
- Relatively long-lived to provide chronically exposed individuals;

- Relatively sedentary to relate body burdens to specific sites;
- Large enough to provide adequate samples for analysis (if required);
- Easy to collect (if required);
- Survive well in the laboratory (if uptake and depuration studies are required).

Selection factors will be used to identify species that offer the most favorable combination of characteristics for determining the implications of on-site contaminants. The factors may include, but are not limited to, the following: 1) limited home range; 2) role in local non-human food chains; 3) potential high abundance and wide distribution at the sites; 4) sufficient toxicological information available in the literature for comparative and interpretive purposes; 5) sensitivity to chemicals of potential concern; 6) likely recurrence after site remediation; and 7) suitability for long-term monitoring, if necessary.

It is important that there be sufficient toxicological information available in the literature on the receptor species, or closely-related species selected. While the ecological communities at the site have species with many desirable characteristics for use as receptor species, not all of these species have been extensively used for toxicological testing. For some COPCs, toxicological data for appropriate surrogate species will be used when toxicological data on the site-specific receptor species are not available.

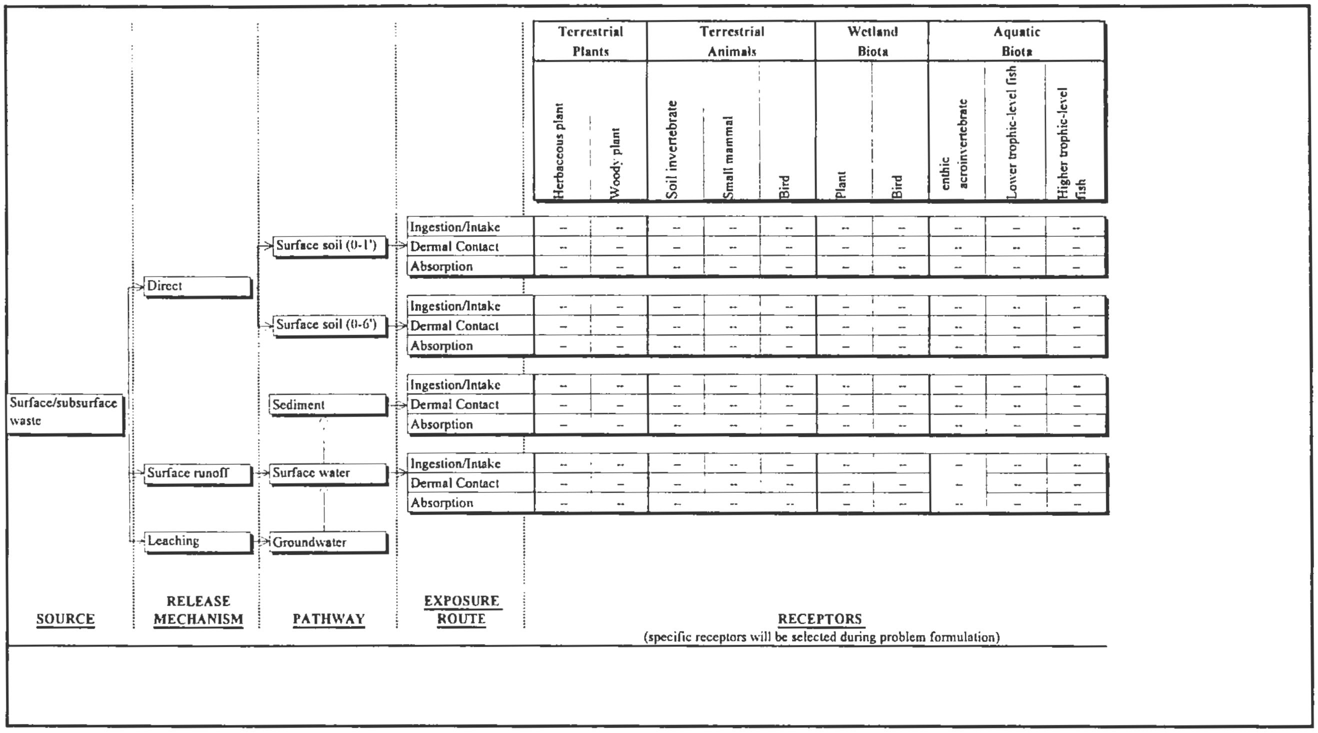
Conceptual Site Model

The CSM presents the ecological receptors at the site that are potentially exposed to hazardous substances in soil, surface water, and sediment across several pathways. A complete exposure pathway consists of the following four elements:

- A source and mechanism of contaminant release to the environment;
- An environmental transport mechanism for the released contaminants;
- A point of contact with the contaminated medium; and
- A route of contaminant entry into the receptor at the exposure point.

If any one of these elements is missing, the pathway is incomplete and is not considered further in the ERA. A pathway is complete when all four elements are present to permit potential exposure of a receptor to a source of contamination. Quantification of some potentially complete pathways may not be warranted because of minimal contribution to risk relative to other major

FIGURE 4-10A
GENERIC CONCEPTUAL SITE MODEL FOR ECOLOGICAL RISK



pathways. Such pathways may be evaluated qualitatively. A generic conceptual model of exposure is presented in Figure 1.1. Note that receptor species identified are provided as an example only, and site-specific receptors will be determined and details provided in the problem formulation step.

Exposure pathways for biota may be direct or through the food web by consuming contaminated organisms. Direct exposure pathways include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil or sediment (e.g., during burrowing or dust-bathing activities); animals ingesting surface water; plants absorbing contaminants by uptake from contaminated sediment or soil; and the dermal contact of aquatic organisms with contaminated surface water or sediment. Food web exposure pathways for biota can occur when terrestrial or aquatic fauna consume previously-contaminated biota. Examples of food web exposure include animals at higher trophic levels consuming plants or animals that bioaccumulate or bioconcentrate contaminants. Unless site-specific information indicates otherwise, bioavailability is assumed to be 100 percent for the preliminary ecological risk evaluation.

Soil Exposure Pathway

On-site soil represents a potential transport medium for contaminants. Potential sources of contaminants in soil include buried or stored waste, deposition of airborne contaminants, and migrating contaminants in surface water and groundwater. The release mechanisms for contaminants in soil include surface runoff, surface water to groundwater (percolation), direct uptake by biota, and fugitive dust generation/deposition. Potential receptors of contaminants in soil are terrestrial flora and fauna. Exposure routes for contaminants in soil include dermal contact by birds, mammals, and invertebrates; uptake by plants; and incidental ingestion or inhalation by birds and mammals while foraging and grooming. Consumption of contaminated biota by higher-order predators in the food chain can provide an exposure pathway for some soil contaminants. Because there are few toxicological data on dermal and inhalation exposure, and because these routes appear to be less important than direct or indirect ingestion of contaminants at the sites, dermal and inhalation exposure will not be assessed for any of the media in this approach.

Soil exposure pathways are potentially important for terrestrial plants and animals at SEAD-12. The vast majority of exposure to soil contaminants is in surface rather than deeper soil. For animal exposure, soil samples obtained from a depth of 0 to 1 foot will be considered, as this would be the point of exposure for above-ground and most burrowing animals. Animals may burrow to depths greater than 1 foot and may be exposed to contaminants at these depths through dermal exposure and/or inhalation. However, since few or no data exist regarding such exposures, only soil to 1 foot will be considered in the analysis. For plant exposure, soil samples taken from 0 to 6 feet (or the water table surface) will be considered because most feeder roots are located within this depth (Raven et al., 1981).

Sediment Exposure Pathway

Sediment consists of materials precipitated or settled out of suspension in surface water. Potential contaminant sources for sediment include buried or stored waste; and contaminated surface water, groundwater, and soil. The release mechanisms include surface water runoff, groundwater discharge, and airborne deposition. Potential receptors of chemicals in contaminated sediment include aquatic flora and fauna. Direct exposure routes for contaminated sediment include uptake by aquatic flora and ingestion by aquatic fauna. Indirect exposure pathways from sediment include consumption of bioaccumulated contaminants by consumers in the food chain. Chemical bioavailability of many nonpolar organic compounds, including PCBs and pesticides, decreases with increasing concentrations of organic carbon in the sediment; however, these compounds can still bioaccumulate up the food chain (Landrum and Robbins, 1990).

Surface Water Exposure Pathway

Surface water represents a potential transport medium for the ecological COPCs. Potential sources for contaminated surface water include buried or stored waste, contaminated soil and groundwater, and deposition of airborne contaminants. The release mechanisms include surface runoff, leaching, and groundwater seepage. Potential receptors of contaminated surface water include terrestrial and aquatic fauna and aquatic flora. Exposure routes for contaminated surface water include ingestion by terrestrial fauna, and uptake and absorption by aquatic flora and fauna. Consumption of bioaccumulated contaminants constitutes a potential indirect exposure pathway for faunal receptors. Chemical bioavailability of some metals and other chemicals is controlled by water hardness, pH, acid volatile sulfides, and total suspended solids.

Groundwater Exposure Pathway

Groundwater represents a potential transport medium for ecological COPCs. Potential contaminant sources for groundwater include contaminated soil, and buried or stored waste. The release mechanism for contaminants into groundwater is direct transfer of contaminants from waste materials to water as water passes through the materials.

Groundwater itself is not an exposure point except for plants whose roots extend to groundwater. However, contaminant transport along the shallow groundwater pathway is considered an exposure route to aquatic life, wetlands, and some wildlife where the groundwater discharges to surface water. This pathway is of importance to aquatic and wetland receptors located downgradient of SEAD-12 where groundwater discharges to surface water.

Preliminary Screening and Identification of Chemical

Stressors

Data evaluation will be performed concurrently for the human health and ecological risk assessments. Analytical results will be transformed and used to calculate the 95 percent upper confidence limit (UCL). The 95 percent UCL will be used to estimate site exposure point concentrations. The maximum site concentration will be used in instances where that concentration is less than the 95 percent UCL. A value equal to 1/2 of the sample quantitation limit (SQL) will be used as a surrogate concentration for non-detected compounds.

Chemicals detected in site media will be referred to as chemicals present in site samples (CPSS) (i.e., soil, surface water, or sediment) samples. From the lists of site-specific CPSS, COPCs will be identified via a two-step screening process. Chemicals retained following the preliminary screening will be designated as COPCs and will be carried through the risk assessment process. Preliminary screening steps will include:

- Screening maximum inorganic CPSS concentrations against background concentrations in like media, and
- Screening maximum exposure concentrations of remaining CPSS against toxicity-based screening benchmarks for each medium.

Following the elimination of unreliable data, concentrations in soil will be compared to appropriate background levels. Inorganic analytes in soil and groundwater will be eliminated from the site risk assessment if the statistical evaluation of significance, using the Wilcoxsin Ranked Sum (WRS) Test, determines that there is no significant difference at the 95th percentile confidence interval, between the site data set and the background database. The background database used for comparison comprises over 60 soil samples and 31 groundwater samples, collected at numerous sites throughout the 10,000-acre SEDA facility, and is representative of background soil and groundwater concentrations. Facility-wide background data will be used to identify elevated concentrations of inorganic analytes related to the site. No comparison to background for anthropogenic organic compounds will be performed as the concentrations of these compounds generally are below detectable concentrations in the background locations used to construct the existing database. The existing background soil database has been compiled over the past five years of investigations and the background groundwater database over the past three years of investigations, each from several locations within the SEDA facility boundary. These databases represent soil and groundwater concentrations at locations considered to be pristine. Consequently, no organic compounds will be eliminated from further consideration as a result of this comparison.

Identification of Nonradionuclide COPCs

In the next step in preliminary screening, the maximum detected concentration of each CPSS will be compared to an appropriate screening value, which includes the following:

A. Surface water screening using toxicity-based benchmarks

For surface water screening, the maximum concentration of each detected analyte will be compared to NYSDEC Ambient Water Quality Standards and Guidance Values (NYSDEC, 1993a). For chemicals with no NYSDEC screening value, screening values developed by Headquarters USEPA (USEPA, 1996) will be used. The values, termed Ecotox Thresholds, were developed for screening Superfund-type hazardous waste sites. For chemicals with neither a NYSDEC nor Ecotox Threshold screening value, surface water screening benchmarks developed by USEPA Region IV for hazardous waste sites (USEPA, 1996) will be used.

B. Sediment screening using toxicity-based benchmarks

For sediment screening, the maximum concentration of each detected analyte will be compared to NYSDEC benchmarks presented in Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1993B). For chemicals with no NYSDEC screening value, Ecotox Threshold screening values developed by Headquarters USEPA (USEPA, 1996) will be used. For chemicals with neither a NYSDEC nor Ecotox Threshold screening value, sediment screening benchmarks developed by USEPA Region IV for hazardous waste sites (USEPA, 1996) will be used.

C. As no generic screening benchmarks have been developed for soil, only the background comparison (for inorganic constituents) will be used for preliminary screening.

D. Previously eliminated constituents, media, or exposure groups will be evaluated to determine whether they should be re-included due to historical information or considerations such as mobility, bioaccumulation, persistence, and toxicity.

E. For each medium and/or exposure group, it will be determined whether there are any COPCs remaining. If no COPCs remain, the medium and/or exposure group will be dropped from further consideration in the ERA.

F. The constituents and exposure routes that are retained after the application of this preliminary screening process will be selected as COPCs for use as the starting point of the ecological risk analysis.

While the maximum concentration of a chemical in each medium is appropriate for a conservative preliminary screening step, the maximum concentration is an overly conservative representation of an exposure point concentration for the remainder of the ecological risk analysis. An exposure point concentration is the concentration of a COPC in an environmental medium at the location where a receptor contacts the medium. Exposure point concentrations will be calculated based on the reasonable maximum exposure (RME) concentration, a conservative concentration that is still within the range of possible exposures, for each complete pathway. Sampling data collected during characterization investigations at the site will be used to calculate the exposure point concentrations of COPCs identified in soil, surface water, and sediment. Groundwater will not be considered, as there is no complete exposure pathway for receptors to groundwater.

Identification of Radionuclide COPCs

Radionuclides may produce toxic effects as a result of their chemical properties as well as their radioactive properties. Radioactive emissions are considered to be responsible for most of the biologically deleterious effects that may be produced in exposed organisms as a result of radionuclide intake (ATSDR 1989). Ecological receptors also may be affected by radionuclides through direct exposure to external radiation. Therefore, both routes of exposure are considered in evaluating potentially toxic effects from radioactive constituents.

The toxic effects induced in an organism by the chemical properties of a constituent are characteristic of that specific substance. The adverse effects induced in an organism by radiation, on the other hand, are independent of the chemical toxicity of the radionuclide and are related to the amount of radiation absorbed by tissues and organs. While chemical properties affect the distribution and biological half-life of a radionuclide and influence the retention of the radionuclide within a target organ, the damage from a given type of radiation is independent of the source of that radiation (ATSDR 1992a).

Radiation occurs as a result of the spontaneous disintegration of the nucleus of certain isotopes of certain elements, which results in the emission of one or more characteristic types of radiation. The types of radiation most commonly produced are alpha particles, beta particles, and gamma rays.

The presence of radionuclides in environmental media can result in the two forms of potential radiation exposure discussed above: internal and external. The term, "exposure," when used with regard to radiation, refers to the physical interaction of radiation emitted by radionuclides with the cells and tissues of organisms. Internal exposures occur when radionuclides that have entered the body (e.g., such as through ingestion of contaminated soil) undergo radioactive decay, resulting in the deposition of energy to internal organs. External exposures occur when radiation enters the body directly from sources located outside the body (e.g., such as from radionuclides present in soil or water).

In general, external exposures result from radionuclides that emit gamma radiation, which readily penetrates skin and other body coverings. Alpha and beta radiation from external sources are far less penetrating and deposit their energy primarily on the skin's outer layer. Consequently, their contribution to the total dose of external radiation absorbed by an organism is negligible compared to that deposited by gamma rays (ATSDR 1992a). Therefore, in evaluating the receptors' exposure to external radiation from radionuclides in media of concern, only the gamma-emitting radionuclides in each medium are included.

Because media-specific screening benchmarks have not been developed for radionuclides, the process used to identify COPCs is more complicated for these contaminants. External and internal dose estimates are calculated for representative receptors in each medium present. These dose estimates are then compared to chronic no observed effect chronic dose rates developed by The International Atomic Energy Agency (IAEA; 1992). The IAEA reports that irradiation at chronic dose rates of 0.1 rad per day and 1.0 rad per day or less do not appear likely to cause observable changes in terrestrial and aquatic animal populations, respectively. Therefore, for terrestrial receptor populations exposed to soil, the screening benchmark is set at 0.01 rad/d. For aquatic receptor populations exposed to surface water or sediment, the screening benchmark is 0.1 rad/d.

A. Radionuclide Screening for Soil

Potential risk from external exposure to radionuclides in soil is evaluated by calculating external gamma dose rates for a small mid-level predator (i.e., a carnivore with small home ranges preying predominantly on biota with small home ranges e.g., earthworms). Small mammals are sensitive to radionuclides, have a high dietary intake relative to body weight, and feed on soil invertebrates exposed maximally to any soil contamination.

Radionuclide dose rates are compared to an external radiation toxicity benchmark of 0.01 rad/d. The soil external dose is calculated by multiplying the maximum concentration of each gamma-emitting radionuclide by the appropriate external dose conversion factor (DCF) using the following equation (NRC 1992).

$$D = Cs \times DCF \times CFa \times CFd \times 4$$

where:

D	=	dose (rem/d)
Cs	=	maximum radionuclide concentration in soil (pCi/g)
DCF	=	dose conversion factor (Sievert/d per Bq/m^3) (includes daughters)
Cfa	=	conversion factor for activity (5.92E+04 Bq/m^3 = 1 pCi/g)
Cfd	=	conversion factor for dose (100 rem/Sv)
4	=	adjustment factor for height above ground to account for burrowing behavior

The external DCF values obtained from NRC (1992) are based on exposures at a height of 1 m (3.28 ft). However, the dose rate from a large plane source of radiation declines as a function of height above the source. Consequently, for small animals, the calculated dose rates are multiplied by a factor of 4 to account for their greater proximity to the radiation source (soil) due to burrowing. If a large animal (e.g., deer) or non-burrowing animal is used, the dose estimate must be revised accordingly.

The quantity obtained from the above equation is the dose equivalent (H) of the radiation to which an organism may be exposed. The dose equivalent is equal to absorbed dose (D), measured in rads, multiplied by a quality factor to account for the relative biological effectiveness of a radiation type. Because the value of the quality factor for gamma rays is considered to be 1, H is essentially equal to D, and the calculated dose equivalent in rems is equal to the absorbed dose in rads. Consequently, the calculated value can be directly compared to the benchmark value of 0.01 rad/d.

Internal dose of radionuclides is calculated using the concentration of each radionuclide ingested by a small mammal receptor. The concentration in a small mammal relative to the concentration in soil and food materials is modeled using a simple food uptake model. The absorbed doses from alpha-, beta-, and gamma-emitting sources are considered. Intakes from plant, animal, and incidental soil ingestion are used to evaluate the absorbed dose in animals exposed to ingested radionuclides.

The ingested concentration, C, is used in the following subsections to evaluate the absorbed dose for a, b, and g-emitters.

The internal a-radiation dose rate due to emission of a-particles at a constant rate can be evaluated as:

$D = (CF) \times C \times (E_a n_a) \times (F_a)$

where:

D	=	dose (rad/d) (includes daughters)
CF	=	conversion factor (1E-12 Ci/pCi * 3.7E+10 dis/sec per Ci * 1/62.4E+06 rad per MeV/g * 3600 sec/hr * 24 hr/d)
C	=	aily ingested concentration per gram body weight (pCi/g)
E_a	=	alpha energy of the radionuclide (MeV)
n_a	=	proportion of disintegrations producing an a-particle
F	=	absorbed fraction of energy E_a (dimensionless, assumed to be 1)

The absorbed fraction is equal to one, since essentially all the energy from a-particles is absorbed locally.

The internal b-radiation dose rate due to emission of b-particles at a constant rate can be evaluated as:

$D = (CF) \times C \times (E_b n_b) \times (F_b)$

where:

D	=	dose (rad/d) (includes daughters)
CF	=	conversion factor (1E-12 Ci/pCi * 3.7E+10 dis/sec per Ci * 1/62.4E+06 rad per MeV/g * 3600 sec/hr * 24 hr/d)
C	=	daily ingested concentration per gram body weight (pCi/g)
E_b	=	beta energy of the radionuclide (MeV)
n_b	=	proportion of disintegrations producing a b-particle
F_b	=	absorbed fraction of energy E_b (dimensionless)

Gamma-dose equations are more complex than a- and b-dose equations because the emitted g energy is absorbed at some distance from the source. However, if the source point of interest is within the source volume, it is possible to adapt the method and equation for b-dose to evaluate g-dose by using the absorbed fraction, F, as a correction factor. The internal g-radiation dose rate due to emission of g-particles at a constant rate can be evaluated as:

$$D = (CF) \times C \times (E_g n_g) \times (F_g)$$

where:

D	=	dose (rad/d) (includes daughters)
CF	=	conversion factor (1E-12 Ci/pCi * 3.7E+10 dis/sec per Ci * 1/62.4E+06 rad per MeV/g * 3600 sec/hr * 24 hr/d)
C	=	daily ingested concentration per gram body weight (pCi/g)
E_g	=	photon energy emitted during transition from a higher to a lower energy state (MeV)
n_g	=	proportion of disintegrations producing a g-particle
F_g	=	absorbed fraction of energy Eg (dimensionless)

The combined dose is the sum of external and internal doses:

$$D = (Cs \times DCF \times Cfa \times CFd \times 4) + [CF \times C \times (E_a n_a \times F_a) + (E_b n_b \times F_b) + (E_g n_g \times F_g]$$

B. Radionuclide Screening for Sediment

For sediment, the screening method for external dose from radionuclides is conducted using the method presented in Blaylock et al. (1993). The receptor is assumed to be a crayfish or other macroinvertebrate that spends all of its time at the sediment-water interface. Because the fraction of radiation absorbed is larger for crayfish than for smaller sediment dwelling animals, the resulting screen for radionuclides in sediments is conservative. The gamma-radiation dose for an animal the approximate size of a crayfish at the sediment-surface water interface is as follows:

$$D = ((2.88E\text{-}04) \times (Eg\ ng) \times (1 - F_g) \times (Csed \times CF_1 \times CF_2) \times R) \times (CF_3)$$

where:

D	=	dose (rad/d) (includes daughters)
2.88E-04	=	constant from Blaylock et al. (1993)

E_g	=	photon energy emitted during transition from a higher to a lower energy state (MeV)
n_g	=	proportion of disintegrations producing a g-ray
$1- F_g$	=	absorbed fraction of energy Eg (dimensionless)
Csed	=	maximum radionuclide concentration in sediment (pCi/g)
CF_1	=	conversion factor (1 pCi/g = 37 Bq/kg)
CF_2	=	conversion factor to convert sediment concentration from dry weight to wet weight (assume 0.75)
R	=	fraction of time organism spends at the sediment-water interface (assume 1.0)
CF_3	=	conversion factor (1 μGy/h = 2.4E-03 rad/d)

Values for $E_g n_g$ are obtained from Eckerman and Ryman (1993). Values of F_g are obtained from Blaylock et al. (1993). No internal dose calculation is performed for this receptor.

C. Radionuclide Screening for Surface Water

For surface water, external radionuclide screening is done using the method in Blaylock et al. (1993). Because the fraction of radiation energy absorbed (F) increases with the size of the receptor, small fish should be used to maximize the exposure parameter (1-F), for external radiation without being overly conservative for external radiation and underestimating internal radiation. The external gamma-radiation dose for an animal the approximate size of a small fish that is surrounded by water is as follows:

$$D = ((5.76E\text{-}04) \times (E_g n_g) \times (1- F_g) \times (Cw \times CF_1)) \times (CF_2)$$

where:

D	=	dose (rad/d) (includes daughters)
5.76E-04	=	constant from Blaylock et al. (1993)
E_g	=	photon energy emitted during transition from a higher to a lower energy state (MeV)
n_g	=	proportion of disintegrations producing a g-ray
1- F	=	absorbed fraction of energy E_g (dimensionless)
Cw	=	maximum concentration in surface water (pCi/l)

CF_1	=	conversion factor (1 pCi/l = 3.7E-02 Bq/l)
CF_2	=	conversion factor (1 µGy/h = 2.4E-03 rad/d)

Values for $E_g n_g$ are obtained from Eckerman and Ryman (1993). Values of F_g are obtained from Blaylock et al. (1993).

Screening for internal dose of radionuclides in surface water is also done using the methodology of Blaylock et al. (1993). Internal doses are calculated for alpha, beta, and gamma radiation and the total of the three for the detected radionuclides and their daughters.

Internal dose of alpha radiation is calculated as follows:

$$D = ((5.76E\text{-}04) \times (E_a\, n_a) \times (Cw \times BCF \times CF_1)) \times (CF_2)$$

where:

D	=	dose (rad/d) (includes daughters)
5.76E-04	=	constant from Blaylock et al. (1993)
E_a	=	alpha energy of the radionuclide (MeV)
n_a	=	proportion of disintegrations producing an a particle
Cw	=	maximum radionuclide concentration in surface water (pCi/l)
BCF	=	bioconcentration factor (pCi/kg in organism per pCi/l in water) (values obtained from NRC 1992)
CF_1	=	conversion factor (1 pCi/l = 3.7E-02 Bq/l)
CF_2	=	conversion factor (1 µGy/h = 2.4E-03 rad/d)

Internal dose of beta radiation is calculated as follows:

$$D = ((5.76E\text{-}04) \times (E_{\beta}\ n_{\beta}) \times (F_{\beta}) \times (Cw \times BCF \times CF_1)) \times (CF_2)$$

where:

D	=	dose (rad/d) (includes daughters)
5.76E-04	=	constant from Blaylock et al. (1993)
E_{β}	=	beta energy of the radionuclide (MeV)
n_{β}	=	proportion of disintegrations producing a ß-particle
F_{β}	=	absorbed fraction of energy E_{β} (dimensionless)
Cw	=	maximum radionuclide concentration in surface water (pCi/l)
BCF	=	bioconcentration factor (pCi/kg in organism per pCi/l in water) (values obtained from NRC 1992)
CF_1	=	conversion factor (1 pCi/l = 3.7E-02 Bq/l)
CF_2	=	conversion factor (1 µGy/h = 2.4E-03 rad/d)

Internal dose of gamma radiation is calculated as follows:

$$D = ((5.76E\text{-}04) \times (E_g\ n_g) \times (F_g) \times (Cw \times BCF \times CF_1)) \times (CF_2)$$

where:

D	=	dose (rad/d) (includes daughters)
5.76E-04	=	constant from Blaylock et al. (1993)
E_g	=	photon energy emitted during transition from a higher to a lower energy state (MeV)
n_g	=	proportion of disintegrations producing a g-ray
F_g	=	absorbed fraction of energy Eg (dimensionless)
Cw	=	maximum radionuclide concentration in surface water (pCi/l)
BCF	=	bioconcentration factor (pCi/kg in organism per pCi/l in water) (values obtained from NRC 1992)
CF_1	=	conversion factor (1 pCi/l = 3.7E-02 Bq/l)
CF_2	=	conversion factor (1 µGy/h = 2.4E-03 rad/d)

The combined internal radiation dose is the sum of alpha, beta, and gamma doses:

$D = 5.76E\text{-}04 \times (E_a n_a + E_b n_b \times F_b + E_g n_g \times F_g) \times Cw \times BCF \times CF_1 \times CF_2$

Values for $E_g n_g$, $E_\beta n_\beta$, and $E_a n_a$ are obtained from Eckerman and Ryman (1993). Values of F_b and F_g are obtained from Blaylock et al. (1993).

Screening Level HQ Calculation

The purpose of this step is to identify radioactive constituents with screening level hazard quotients (HQs) greater than one. If the total radiological exposure dose of the radionuclide (as calculated above) divided by its associated screening value (0.01 rad/day for soil, 0.1 rad/day for surface water and sediments) is less than one, then it is dropped from further evaluation in the ecological risk assessment. If the HQ is greater than one, then the constituent is carried forward.

Background Comparison

The purpose of this step is to identify radionuclide constituents for which background media concentrations (if available) can be used to eliminate them from further consideration. For the naturally occurring and anthropogenic constituents that exceed a screening level, the maximum concentration is compared to 2 times (2X) the site background average concentration. For radioactive constituents, the average activity in the background data set is determined using the reported activity for constituents with activities above the method detectable activity, and a surrogate value of one-half the method detectable activity (1/2 MDA) for constituents with activities below the MDA. The background comparison is made for each medium and exposure group (e.g., surface and subsurface soil). The constituent is eliminated as a COPC in each medium in which its maximum is less than 2X the background average concentration. For each medium and/or exposure group, COPCs with maximum concentrations greater than 2X background are retained for the risk assessment.

4.2.7.2 Analysis (Toxicity / Exposure Assessment)

The analysis step includes an assessment of potential exposures of ecological receptors to COPCs and the characterization of potential adverse effects (toxicity) due to these exposures. For the Phase I investigation, potential exposure pathways are identified, exposure concentrations/doses are estimated, and potential toxicity is characterized based on effects reported in the literature. For a Phase II investigation, if necessary, potential exposure and toxicity are evaluated using additional field data (e.g., benthic invertebrate toxicity tests, tissue analysis for COPCs).

Effects Assessment

Ecological risks should be expressed in terms of a definite endpoint. An endpoint is an environmental value to be protected. USEPA recognizes two types of endpoints. Assessment endpoints are "explicit expressions of the actual environmental value that is to be protected" (USEPA, 1997a). An assessment endpoint has a receptor and an effect on the receptor, such as x percent reduction in fertility of species y in location z. Assessment endpoints generally apply to natural populations or ecosystems. Because detailed, site-specific field studies are necessary to determine the effects of contaminants relative to such assessment endpoints, measurement endpoints are used for most ERAs. Measurement endpoints "are measurable responses to a stressor that are related to the valued characteristics chosen as the assessment endpoint" (USEPA, 1997a). Measurement endpoints are usually based on controlled laboratory studies, such as the determination of the lethal concentration of a chemical on an animal laboratory specimen. Effects relative to the assessment endpoint are extrapolated from the measurement endpoint.

In this ERA approach, the assessment endpoint focuses on effects at the individual level, with effects to species and populations extrapolated from effects on individuals. In the case of aquatic receptors, some of the toxicity studies from which the toxicity reference values will be derived are based on population effects. Habitats are addressed through the effects to major species or physical media that characterize them. For example, if the data indicate that adverse effects are likely for several aquatic species, an effect on the aquatic community may result. However, such community-level effects cannot be demonstrated directly in this approach.

The measurement endpoint used to determine this is the no observed adverse effects level (NOAEL), derived from controlled toxicity studies. The NOAEL is a dose of each ecological COPC that will produce no known adverse effects on the test species. The NOAEL is considered to be an appropriate toxicological endpoint since it will provide the greatest degree of protection to the receptor species. In addition, the lowest observed adverse effects level (LOAEL) will be used as a point of comparison for decision making for risk management purposes.

TABLE 4-5A

Conversion Factors Used in Deriving Toxicity Reference Values

CATEGORY OF UNCERTAINTY	CONVERSION VALUE[1]
Study Duration Extrapolation	
Chronic studies, equilibrium attained	1
Subchronic studies	1
Acute studies	10
Single dose	10
Unknown	10
Endpoint Extrapolation (for NOAEL endpoint)	
No observed effects level	1
No observed adverse effects level	1
Lowest observed effects level	10
Lowest observed adverse effects level	10
Effect concentration to 50% of test organisms	10
Unknown	10
Endpoint Extrapolation (for LOAEL endpoint)	
No observed effects level	1
No observed adverse effects level	1
Lowest observed effects level	1
Lowest observed adverse effects level	1
Effect concentration to 50% of test organisms	10
Unknown	10

1 The product of the appropriate conversion value from each uncertainty category becomes the conversion factor applied to develop the chemical-specific TRV.

In some instances, empirical data may be available for the specific endpoint. However, for some ecological COPCs, data on endpoints other than the NOAEL and LOAEL may have to be used. Conversion factors will be used to adjust for these differences and extrapolate risks to the sites' receptors at the NOAEL and LOAEL endpoint. In addition, in some instances where toxicological data are unavailable for a site-associated ecological COPC, toxicological information for surrogate chemicals will have to be used. Likewise, where toxicological data for the site-specific receptor are not available for a particular COPC, toxicological data for an appropriate surrogate species will be used.

Toxicity information pertinent to identified receptors will be gathered for those analytes identified as ecological COPCs. Because the measurement endpoint will range from the NOAEL to the LOAEL, preference will be given to chronic studies noting concentrations at which no adverse effects were observed and ones for which the lowest concentrations associated with adverse effects were observed. If no such studies are located, order of preference follows from median effects levels, to lowest lethal levels, and finally to median lethality levels. At each of these levels, preference will again be given to chronic studies, then subchronic, and finally, acute studies. As previously noted, where data are unavailable for the exposure of a receptor to a COPC, data for a surrogate chemical (e.g., endrin for endrin aldehyde) will be gathered for use in the risk assessments.

Using the relevant toxicity information, toxicity reference values (TRVs) will be calculated for each of the COPCs. The TRVs represent NOAELs and LOAELs with conversion factors incorporated for toxicity information derived from studies other than chronic no-effects or lowest-effects studies. TRVs will be calculated using conversion factors to adjust the reported effects doses to a final TRV. These factors are shown in Table 1.1. Separate factors are recommended to account for extrapolation to the no-effects or lowest-effects endpoints and for study duration. These factors are multiplied together to derive the total conversion factor. The reported effects dose is then adjusted to account for potential uncertainties by dividing by the total conversion factor. Where toxicity information for a surrogate chemical is used, a conversion factor will not be applied; however, the uncertainty arising from use of toxicity data from such a surrogate chemical will be discussed in the uncertainty section of the ERA report. Conversion factors for extrapolation across taxonomic groups will not be used. For chemicals for which toxicity data are not available for the site-specific receptor, but toxicity data are available for another test organism, the toxicity data will be used without conversion. Implications of this will be discussed in the uncertainty section of the ERA report.

Exposure Assessment

For the Phase I assessment, potential exposure pathways will be identified, exposure concentrations/doses estimated, and potential toxicity characterized based on effects reported in the literature. TRVs provide a reference point for the comparison of toxicological effects upon exposure to a contaminant. To complete this comparison, receptor exposure to site contaminants must be calculated. Exposure assessments recommended for Phase I rely on typical RFI data in conjunction with simple exposure models to estimate intakes. This allows a relatively rapid assessment of the potential for adverse ecological effects. When Phase I results suggest a significant risk potential, consideration of additional factors is warranted. These may include an evaluation of contaminant fate and transport mechanisms, natural attenuation of contaminants, toxicity related to specific forms of metals (e.g., Cr+III or Cr+VI) or other contaminants, etc.

For plant receptors, exposure is simply calculated as the RME concentration. Calculation of plant uptake values is not necessary as the toxicity data are expressed in concentration in the growth medium.

For terrestrial faunal receptors, calculation of exposure rates relies upon determination of an organism's exposure to COPCs found in surface water, surface soil, and sediment. Exposure rates for terrestrial wildlife receptors will be based solely upon ingestion of contaminants from these media and from consumption of other organisms. Given the scarcity of data available for wildlife dermal and/or inhalation exposure pathways, it is beyond the scope of this risk assessment approach to attempt to measure potential risk from these pathways. In addition, these pathways are generally considered to be incidental for most species, with the exception of burrowing animals and dust-bathing birds.

The first step in measuring exposure rates for terrestrial wildlife involves the calculation of feeding and watering rates for site receptors. USEPA (1997b) includes a variety of exposure information for a number of avian, herptile, and mammalian species. Data are directly available for body weights of various species. Similarly, information regarding feeding and watering rates, and dietary composition are also available for many species. To that end, USEPA (1997b) notes an algorithm developed by Nagy (1987) to calculate the feeding rates for birds as follows:

Avian feeding rate (g/day) = (0.648)(BW0.651)

where:
BW = body weight (grams)

For wading birds, the algorithm can be modified to (Kushlan, 1978, from USEPA, 1997b):

Log avian feeding rate (g/day) = (0.966 logBW) - 0.640

Data will be gathered on the incidental ingestion of soil and incorporated, for the receptor species, from studies discussed by Beyer et al. (1993).

The next step in calculating terrestrial wildlife receptor exposure rates involves the modified application of an algorithm developed by Scarano and Woltering (1993). The original algorithm was developed to calculate exposure for terrestrial vertebrates, and accounts for exposure via ingestion of contaminated water, incidental ingestion of contaminated soil, and ingestion of plants grown in contaminated soil. For purposes of this approach, the algorithm was modified to include the ingestion of lower trophic level organisms associated with contamination, and also to include exposure to contaminated sediment. The modified algorithm is as follows:

Terrestrial faunal exposure rate (mg/kg-body weight/day)=

$$(\{[(Cw * Iw) + (Cd * SP * Ip * CF) + (Cd * BAF * Ia * CF) + (Cd * Is * CF)] * De\} + \{[(Cs * SP * Ip * CF) + (Cs * BAF * Ia * CF) + (Cs * Is * CF)] * Se\}) * (SFF / BW)$$

where:

Cw	=	surface water RME concentration (mg/L)
Cd	=	sediment RME concentration (mg/kg)
Cs	=	soil RME concentration (mg/kg)
CF	=	conversion factor (0.001 kg/g)
Iw	=	animal-specific water ingestion rate (L/day)
Ip	=	animal-specific plant-matter ingestion rate (g/day)
Ia	=	animal-specific animal-matter ingestion rate (g/day)

Is	=	animal-specific incidental soil ingestion rate (g/day)
SP	=	soil-to-plant transfer factor (unitless)
BAF	=	bioaccumulation factor (unitless)
De	=	sediment exposure factor (e.g., 0.5 for exposure to sediment 50 percent of time, as described for the mallard below)
Se	=	soil exposure factor (same basis as De)
SFF	=	site foraging factor (unitless)
BW	=	body weight (kg)

Literature values for animal-specific sediment ingestion will be used if available. However, such values generally are not available in the literature. Where sediment ingestion rates cannot be found, the animal-specific incidental soil ingestion rate will be used for sediment ingestion as well. Animals that are primarily terrestrial will be assigned a soil exposure factor of 1.0, given their preferential feeding locations in uplands. Other animals, such as the mallard, that spend time in both aquatic and upland habitats, will be assigned a soil exposure factor of 0.5 and sediment and surface water exposure factors of 0.25 each.

The calculated feeding and drinking rates for terrestrial site receptors will be adjusted to account for foraging range differences. Foraging areas will be assigned a foraging factor from greater than 0 to 1, based upon the range a species exhibits in gathering food (DeSesso and Price, 1990). Selection of foraging factors will be done conservatively, using the smallest appropriate value as reported in the USEPA Wildlife Exposure Factors Handbook (USEPA, 1997b) or other literature. For those animals with a foraging range limited to within a site's boundaries, a foraging factor of 1 will be assigned. It is anticipated that animals selected as receptors will have a foraging range of no more than 2 times the size of the site; the foraging factor will be assigned a value of 1 for such animals. For animals with a foraging area greater than 2 times the size of the site, an SFF equal to 1 will be used in the initial calculation of exposure. However, as this results in an overestimation of risk, the actual SFF will be applied in the weight of evidence discussion and in the uncertainty discussion (see Section 1.4).

For aquatic faunal receptors, the calculation of exposure rates will depend on the determination of the contaminant concentration in water and on food-chain multiplication rates. A determination will be made of the time each organism spends associated with surface water or sediment pore water in order to calculate total exposure rates. The formula used to calculate aquatic exposure rates is as follows:

Aquatic exposure rate (mg/kg-body weight) = (Cw)(BAF)(W_e)

where:

Cw	=	surface water RME concentration (mg/L)
BAF	=	bioaccumulation factor (L/kg)
W_e	=	surface water exposure factor (unitless)

Fish, typically found feeding near the surface, may be assigned a surface water exposure factor of 1.0 (i.e., 100 percent exposure to surface water). However, for species such as the crayfish that are associated equally with surface water and sediment, factors of 0.5 for surface water exposure and 0.25 for sediment pore water and 0.25 for sediment exposure may be assigned. As a result, crayfish exposure would be calculated slightly differently than water-column-feeding fish exposure, as follows:

Crayfish exposure (mg/kg-body weight) = (Cp * aBAF * Pe) + (Cd * tBAF * De)

where:

Cp	=	pore water concentration (mg/L)
Cd	=	sediment RME concentration (mg/kg)
aBAF	=	aquatic bioaccumulation factor (L/kg)
tBAF	=	terrestrial bioaccumulation factor (kg/kg)
Pe	=	pore water exposure factor (unitless)
De	=	sediment exposure factor (unitless)

For species exposed to organic contaminants found in sediment, calculations will be performed to quantify interstitial (pore) water contaminant concentrations given a known sediment concentration. Pore water concentrations can be estimated from sediment concentrations using the following algorithms (USEPA 1991).

Pore water concentration (mg/L) = Cs / Kd

where:

Cs	=	sediment RME concentration (mg/kg)

Kd = sediment-water partition coefficient (L/kg)

For organic COPCs, Kd can be estimated using the following algorithm (USEPA, 1991).

Sediment-water partition coefficient (L/kg) = (F_{oc} * K_{oc} * BD)

where:

F_{oc} = fraction organic carbon in sediment (kg organic carbon/kg sediment) (default value 0.02)

K_{oc} = chemical-specific organic carbon partition coefficient (L/kg)

BD = bulk density of sediment (default value 1.9)

For metals, the sediment-water partition coefficients are affected by numerous geochemical parameters and processes including the presence of sulfides, iron and manganese oxides, organic carbon, pH, salinity, or a combination of these. Kd values reported in the literature can be determined under a variety of geochemical conditions. Where a lack of site-specific data precludes selecting the most representative Kd of the reported values, a Kd value of 1.0 should be used to determine the maximum pore water concentrations for metals. This conservative approach likely will provide a significant overestimate of actual pore water concentrations.

These concentrations are then used in determining aquatic exposure rates, as noted above. Surface water metal concentrations will be used for pore water exposure calculations as there is no standard means of estimating pore water metal concentration from known sediment concentrations.

The concepts of bioconcentration, bioaccumulation, and biomagnification are used throughout this document. These concepts historically have been applied in several ways, typically in reference to aquatic organisms. However, this approach uses these terms for both aquatic and terrestrial organisms. Therefore, the following definitions describe their application in this assessment approach.

For aquatic organisms, bioconcentration is the uptake and retention of a substance by an aquatic organism from the surrounding water, through gill membranes or other external body surfaces; bioaccumulation refers to the uptake and retention of a substance by an aquatic organism from its surrounding medium and food (USEPA, 1995); and biomagnification refers to the process by which tissue concentrations of bioaccumulated toxic substances increase as the substances pass up through two or more trophic levels (Suter, 1993).

For this approach, definitions for these terms for terrestrial organisms are similar to those for aquatic organisms. As aquatic bioconcentration focuses on the organism-level uptake and retention of contaminants, terrestrial bioconcentration focuses on uptake and retention of contaminants from the surrounding medium on an organismal level (as by the earthworm, for example). Terrestrial bioaccumulation, as with aquatic bioaccumulation, is defined as an organism's uptake and retention of a substance from its surrounding medium and food. Similarly, terrestrial biomagnification retains the same definition as that for aquatic organisms.

Adjustments will be made for the biomagnification of contaminants through the trophic levels. Food chain multipliers (FCMs), derived by USEPA (USEPA, 1995), will be used in Phase I to assess the possibility of contaminant magnification through site receptors. The FCMs are determined using chemical-specific bioconcentration factors (BCFs). These studies will either use laboratory-measured BCF values obtained from the scientific literature or BCFs will be calculated for organic compounds using the equation (USEPA, 1995):

$$BCF = K_{OW}$$

where:

K_{OW} = chemical-specific octanol/water partition coefficient.

K_{OW} values for each chemical in the ERA will be listed among the fate and transport properties. The BCF is dependent upon a chemical-specific K_{OW}, which relates to a chemical's tendency to partition to a polar versus nonpolar solution. USEPA has established a relationship between the K_{OW} and the FCM such that as the K_{OW} increases the FCM increases correspondingly. In addition to this relationship, FCMs are also related to an organism's trophic status as predator/prey, producer/consumer, etc.

Although exposures of terrestrial floral and faunal receptors are significant considerations for many hazardous waste sites, well accepted models for predicting the fate of many contaminants in terrestrial systems have not yet been developed. Trophic level compartments and transfer between compartments based on uptake, storage, and loss processes are not as well defined in terrestrial systems as in aquatic systems. In addition, the relationship between K_{OW} and bioconcentration is less well delineated by trophic level in terrestrial ecosystems, and well accepted algorithms to predict wildlife BAFs or BCFs have not been developed. However, the body of evidence is increasing that bioconcentration and bioaccumulation in terrestrial biota are largely a function of K_{OW} for most contaminants. The simplified terrestrial model proposed in this Work Plan provides a conservative screening estimate of potential risks to organisms at higher trophic levels. Additional activities proposed for Phase II (if required) would allow direct measurements of toxicity, development of specific BAFs, estimates of bioavailability, and/or population analyses to develop a more refined terrestrial model.

Per USEPA (1995) guidance, bioaccumulation factors (BAFs) will be determined by one of four methods (in order of preference):

- A measured BAF for an inorganic or organic chemical derived from a field study;
- A predicted BAF for an organic chemical derived from a field-measured biota-sediment accumulation factor (BSAF);
- A predicted BAF for an inorganic or organic chemical derived from a laboratory-measured BCF;
- A predicted BAF for an organic chemical derived from a K_{OW} and an FCM.

The BAF, BSAF, BCF, FCM, and Kow values will be found in the scientific literature or USEPA documents.

The guidance notes that for chemicals for which no Kow is available, and for which no BCF or BAF is calculable, a default FCM or BAF of 1.0 should be used. Thus, for inorganics not thought to biomagnify, this value of 1.0 will be used at each trophic level. However, for inorganics (i.e., mercury and selenium) thought capable of magnification through the food web, defaults of 1.0, 10.0, and 100.0 will be used to account for this potential at the soil-to-plant and soil-to-animal, plant-to-herbivore, and herbivore-to-carnivore levels.

Environmental conditions such as soil moisture, soil pH, and cation exchange capacities significantly influence whether potential soil contaminants remain chemically bound in the soil matrix or whether they can be chemically mobilized (in a bioavailable form) and released for plant absorption. Generally, neutral to alkaline soils (soil pH of 6.5 or greater) restrict the absorption of toxic metals, making pathway completion to plants difficult. Studies summarized by Baes et al. (1984) and NRC (1992) provide soil-to-plant transfer rates for inorganic soil contaminants; these values will be used in Phase I where applicable. For organic soil contaminants, the equation presented in Travis and Arms (1988) for transfer from soil to plant will be used in Phase I unless contaminant-specific information is available.

Additional Exposure Considerations for Radionuclides

Radionuclide COPCs are evaluated by estimating an intake dose to a receptor in media of concern using reasonable maximum exposure concentrations (RMEs). The concentration in the receptors of concern relative to the concentration in food items is modeled using a simple compartment model similar to the model used in human health evaluations. For estimating radiological dose, it is assumed that the dietary intake factors for the receptor(s) and UFFs are the same as those used for the nonradionuclide assessment. Biological transfer factors for radioactive constituents are those used for the screening evaluation.

Evaluation of COPCs involves comparison of RME values to adverse effects benchmarks. For radionuclides, the potential effects associated with an absorbed dose are evaluated based on exposure to an orally administered radionuclide, and requires consideration of decreasing concentrations due to decay or elimination. The total rate of loss of radionuclide atoms in the tissue is the sum of the rates of the loss from physical decay and biological elimination. This total fractional rate of loss by all mechanisms, called effective decay constant (l_e), can be evaluated as:

$$l_e = l_p + l_b$$

where:
l_e = effective fractional rate of loss
l_p = fractional rate of loss from physical decay
l_b = fractional rate of loss from biological elimination

The absorbed beta dose [or alpha or gamma dose by replacing the beta related parameters with alpha- or gamma-related parameters] can be calculated using the following equation:

$$D = (73.8) \times C \times (E_b) \times (T_e{}^h) \times (1\text{-}f)$$

where:

D	=	absorbed dose in rad/d
C	=	ingested concentration in mCi/g
Eb	=	average beta energy per disintegration in Mev
T_e^h	=	effective half-life in days
f	=	fraction remaining at end of time period (a time period of 1 day was assumed because the ingestion exposure period is 1 day)

4.2.7.3 Risk Characterization

Risk characterization will involve risk estimation and risk description. Risk estimation will consist of integration of the exposure and stressor-response profiles and results in an estimate of the probability that adverse effects will result to assessment endpoints (USEPA, 1998). Risk description involves a complete summary of conclusions of the risk estimates and addresses the uncertainty, assumptions, and limitations of the risk estimate. The risk description is also useful to decision-makers. This process is an iterative one involving risk management and remedial decision makers.

Risk estimation will be achieved by calculating hazard quotients (HQs). The HQs will be used to demonstrate whether there is a potential for significant adverse effects on assessment endpoints. If the HQ assessment demonstrates that no adverse effects are likely, the ERA is considered complete and no further ERA-related studies will be conducted. If the HQ assessment indicates an unacceptable ecological risk at the site or an uncertainty level too great to reach conclusions based on the Phase I ERA, the risk management process will consider all available information and make a decision on what further actions to take (i.e., Phase II of ERA, FS, etc.).

Risk Estimation

As discussed in previous sections, this risk assessment approach employs a semi-quantitative approach to estimate the likelihood of adverse effects occurring as a result of exposure of the selected site receptors to COPCs. TRVs and exposure rates will be calculated and used to generate HQs (Wentsel et al., 1994) by dividing the receptor exposure rate for each contaminant by the calculated TRV, thereby calculating a relative measure of the degree of potential ecological effect for each receptor. HQs are a means of estimating the potential for adverse effects to organisms of a contaminated site.

In addition, HQs will be summed for each receptor only for contaminants that exhibit similar modes of toxicity or effects endpoints. While individual contaminants may affect distinct target organs or systems within an organism, some chemicals may act in similar ways, thus being additive in effect. The resulting hazard index (HI) also will be evaluated as an indication of the potential for the COPCs to result in adverse effects to the assessment endpoints.

For radionuclide COPCs, HQs are calculated by dividing the combined external and internal doses by the radiological benchmarks of 0.1 rad/d and 1 rad/d for terrestrial and aquatic receptors, respectively. As discussed earlier, the International Atomic Energy Agency (IAEA) (1992) reports that irradiation at chronic dose rates of 1 milliGray per day (mGy/d) (0.1 rad/d) and 10 mGy/d (1.0 rad/d) or less do not appear likely to cause observable changes in terrestrial and aquatic animal populations, respectively. Therefore, these are the dose rates set as the benchmarks for radionuclides.

Any quotient greater than or equal to 1.0 indicates that the ecological COPC qualifies as a preliminary COC. Preliminary COCs are further evaluated to determine the actual likelihood of harm. The final COCs are selected only after an additional lines-of-evidence evaluation of the conservatism of the exposure assumptions, toxicity values, and uncertainties is conducted as part of the risk description. Lines of evidence to be evaluated will include, but not be limited to:

- Relevance of evidence to the assessment endpoints,
- Relevance of evidence to the CSM,
- Sufficiency and quality of literature toxicity data and experimental designs,
- Potential for bioaccumulation of contaminants,

- Site risk relative to background risk,
- Spatial pattern of contamination over the site (e.g., site-associated chemicals vs. those associated with stormwater runoff, past pesticide use patterns, etc.),
- Size of site relative to foraging area of receptors,
- Quality of habitat for receptors,
- Strength of cause/effect relationships, and
- Relative uncertainties of each line of evidence.

The lines of evidence will be used along with the HQs to determine if there are any COCs. An HQ greater than 1 is evidence of potential to cause adverse effects to the assessment endpoint. However, a chemical can have an HQ greater than 1, but the lines of evidence may not indicate sufficient weight to adversely affect the assessment endpoint. USEPA's (1998) Guidelines for Ecological Risk Assessment lists five criteria for evaluating adverse changes in assessment endpoints:

- Nature of effects,
- Intensity of effects,
- Spatial scale,
- Temporal scale, and
- Potential for recovery.

In addition, an assessment of hazard may be made using both a LOAEL and a NOAEL for the same representative species. This is appropriate for sites with receptors that are not endangered or threatened. An endangered or threatened species would be protected by the NOAEL-based HQs, which reflect a "no effect" measurement endpoint. For species that are not threatened or endangered, a measure of effect equivalent to "no effect" is overly conservative, in that it reflects protection of the individual, rather than the population. For non-endangered/threatened receptors, a more appropriate measure of effect, reflecting population-level response, is the LOAEL. Therefore, HQs for both the NOAEL and LOAEL TRVs will be evaluated.
These criteria will be considered in the final determination of whether the chemical is a COC (likely to cause adverse effects), not a COC (unlikely to cause adverse effects), or requires further analysis or data collection to reduce uncertainty (i.e., a Phase II study).

Risk Description

Risk description will involve preparation of a complete summary of conclusions of the risk estimates and will address the uncertainty, assumptions, and limitations of the risk estimate. The risk description is useful to project decision-makers and is an iterative process.

The uncertainty analysis is an important component of the ERA process. A qualitative analysis will be made of the uncertainties associated with the ERA. The components of the risk assessment to be evaluated represent the following steps: problem formulation including screening of contaminants and criteria used, toxicity and exposure characterization, and characterization of risk. This analysis will identify the potential magnitude of underestimating or overestimating the potential for adverse effects to organisms. Four qualitative uncertainty categories will be used in the reported analysis: low, moderate, high, and unknown.

Risk characterization represents the final stage of the ERA. All elements will be summarized and used in an iterative manner to define the nature of the ecological risks associated with SEAD-12. This information is then incorporated into the RFI report and is used by decision makers accordingly. An assessment of the ecological significance of the ERA results will be provided.

4.2.8 Analytical Program

A total of 540 soil samples, 102 groundwater samples, and 67 surface water and sediment samples will be collected from SEAD-12 for chemical and radiochemical testing. Analyses for all of the media to be sampled are summarized in Table 4-6. The proposed sample locations are shown on Figures 4-6 through 4-10. One hundred and forty-nine surface soil samples, 136 subsurface soil samples, 84 groundwater samples, and 58 surface water and sediment samples will be analyzed for the following: Target Compound List (TCL) VOCs (EPA Method 524.2 for groundwater samples only), semivolatile organic compounds (SVOCs), TCL pesticides/PCBs, Target Analyte List (TAL) metals and cyanide according to the NYSDEC Contract Laboratory Program (CLP) Statement of Work (SOW), and nitrate-nitrogen by EPA Method 353.2. An additional 9 groundwater samples and 9 surface water and sediment samples will be analyzed for background TAL metals and cyanide according to the CLP SOW. To address the need to attain lower detection limits for several analytes in the CLP SOW for groundwater and soil analyses,

Table 4-6

Summary of Sampling and Analyses
Types and Quantities of Analyses by Media
Seneca Army Depot Activity
SEAD-12

MEDIA	VOCs TCL NYSDEC CLP	VOCs Method 524.2	SVOCs TCL NYSDEC CLP (note 5)	Pesticides / PCBs TCL NYSDEC CLP (note 5)	Metals TAL NYSDEC CLP	Nitrate/ Nitrogen MCAWW 353 2 (note 3)	Gross Alpha/Beta	Uranium 235/238 Alpha Spectrometry	Thorium 230/232 Alpha Spectrometry	Plutonium 239/240 Alpha Spectrometry	Radium 226 Method 901.1	Radium 226 Method 903.1	Gamma Radiation Gamma Spectrometry	Americium 241 HASL 300	Promethium 147 EPA Method 600A	Tritium Method 906	Tritium LANL Cryogenic Method	Limited Chemical/ Physical Testing	Radon
Surface Soil Samples (318)	84	0	84	84	84	84	0	318	318	318	318	0	318	0	114	0	318	0	0
Subsurface Soil Samples (3)	0	0	0	0	0	0	0	3	3	3	3	0	3	0	3	0	3	0	0
Soil Borings (6)																			
Surface Soil	4	0	4	4	4	4	0	4	4	4	4	0	4	0	6	0	4	0	0
Subsurface Soil	14	0	14	14	14	14	0	14	14	14	14	0	14	0	12	0	14	6	0
Monitoring Well Installations by Soil Borings (41)																			
Surface Soil	35	0	35	35	35	35	0	41	41	41	41	0	41	0	0	0	41	0	0
Subsurface Soil	70	0	70	70	70	70	0	82	82	82	82	0	82	0	0	0	82	0	0
Test Pits																			
Surface Soil	26	0	26	26	26	26	0	26	26	26	26	0	26	0	0	0	26	0	0
Subsurface Soil	52	0	52	52	52	52	0	52	52	52	52	0	52	0	0	0	52	6	0
Total Surface Soil Samples	149	0	149	149	149	149	0	389	389	389	389	0	389	0	120	0	389	0	0
Total Subsurface Soil Samples	136	0	136	136	136	136	0	151	151	151	151	0	151	0	15	0	151	12	0
Groundwater	42	42	84	84	102	84	102	102	102	102	0	102	102	0	0	102	0	102	102
Surface water	58	0	58	58	67	58	67	67	67	67	0	67	67	0	19	67		67	67
Sediment	58	0	58	58	67	58	0	67	67	67	67	0	67	0	19		67	67	
Swipes (Buildings)	0	0	0	0	0	0	0	150	150	150	150	0	150	40	150	0	2100	0	
Special Measurements	0	0	0	0	0	0	0	26	26	26	26	0	26	0	26	0	26	0	

Notes:
1) QA/QC sampling requirements are described in Appendix C, Section 5.3 of the Generic Installation RI/FS Workplan.
2) The limited chemical testing and physical testing parameters for each media are described in Section 4 2 12, Analytical Program.
3) Method in soil samples will be modified For soils, a known quantity of soil will be mixed with a known volume of water, stirred, then filtered to form an aqueous extract.
4) For pH analysis, Method 904.5 will be used for soil samples and Method 150.1 will be used for water for TOC analysis Method 415.1 will be used for water and Lloyd Kahn method will be used for soil
5) The SVOC solid and liquid analyses and the PEST/PCB liquid analyses will be performed using modified CLP methods in order to achieve reporting limits that are equal to or less than most (but not all) potential ARARs
* The analysis is designated as Method 524.2, Revision 4.0, August 1992.
* The number of surface soil sampling for chemical testing includes 47 surface soil samples including 8 background samples, 4 from TPs investegutured during the ESI, 4 at POT impacted areas, 30 randomly selected and 2 near BH. 7 is discharge, 34 from soil borings and 20 from tests pits Polals 101

h \eng\seneca\scoping\12-48-83\Tbl4-8 xls modifications to the CLP SOW have been made and submitted to the EPA and NYSDEC. Once approved, these modifications to the analysis methods will provide the detection levels that are needed to meet all potential ARARS that are not being met under the current CLP SOW. These modified methods will be used for all solid and liquid analyses of environmental media samples. All of the samples collected at SEAD-12, as well as the 3 subsurface soil samples collected at the OB Grounds, the OD Grounds and SEAD-57, will be analyzed for the following radionuclides: uranium 235 and 238 by alpha spectrometry, Tritium by method 906 for water samples and LANL cryogenic method for soil and sediment samples, thorium 230 and 232 by alpha spectrometry, plutonium 239 and 240 by alpha spectrometry, and radium 223, bismuth 214, lead 210, lead 214, cesium 137, cobalt 60, and cobalt 57 by gamma spectrometry. All of these samples will be anlayzed for radium-226 by Method 901.1 (for soil or sediment samples) or Method 903.1 (for water samples).

Approximately 135 samples from Building 815, Building 816 and reference area survey units will be analyzed for promethium 147 by method 600A as this radionuclide is among the radionuclides of concern at these survey units. Gross alpha and gross beta radiation levels in all of the groundwater and surface water samples will also be determined.

Additional analyses to be performed on specific media are provided below.

4.2.8.1 Limited Physical and Chemical Testing of Soils

Twelve of the subsurface soil samples collected from 2 soil borings and 2 test pit excavations will be analyzed for limited chemical testing and physical testing. These analyses will include Toxicity Characteristics Leaching Procedure (TCLP) analysis by SW846 method 1311 and will include analyses for TCLP volatile compounds by SW846 method 8240, TCLP semivolatile compounds by SW846 method 8270A, TCLP pesticides by SW846 method 8080, TCLP herbicides by SW846 method 8150, and TCLP metals by SW846 method 6010 and 7470. The TCLP data will be used to determine the leachability characteristics of any wastes that are identified. This data will be used in the feasibility study. Also, these data will be used to determine if unknown wastes are hazardous according to 40 CFR261.24. The TCLP data will not be used in the risk assessment. These samples will also be analyzed for Total Organic Carbon (TOC) by EPA Method 415.1, for grain size distribution (including the distribution within the silt and clay size fraction), and for Cation Exchange Capacity (CEC). They will also be submitted for pH determination and density determination. Additionally, eight subsurface

Table 4-6A
Summary of Groundwater and Soil Analyses
Seneca Army Depot Activity

SEAD-12

MEDIA	Round 1 Sampling		Round 2 Sampling		
	CLP	**Modified CLP**	**CLP**	**Modified CLP**	**EPA 524.2(Note 1)**
GROUNDWATER					
VOCs	X				X
SVOCs		X		X	
Pest/PCBs		X		X	
SOILS					
VOCs	X		NA		
SVOCs		X	NA		
Pest/PCBs	X		NA		

Note 1 - EPA Method 524.1 will be used if analytes are below the detection limit and the detection limit is above the NYSDEC GA Standard.

soil samples collected from Disposal Pits A and B will be analyzed to determine the radium-226 distribution coefficient using the short term batch method (ASTM D:4319-83).

4.2.8.2 Limited Physical and Chemical Testing of Groundwater

The 102 groundwater samples will be analyzed in the field for pH, temperature, specific conductivity, dissolved oxygen, turbidity and oxidation-reduction potential in the field at the time of sampling. The 102 groundwater samples will also be analyzed for the following chemical and physical testing and will be performed by the laboratory: alkalinity, iron (ferrous), sulfate, sulfide, nitrate, TOC, biological oxygen demand (BOD), hardness, total dissolved solids (TDS), and chemical oxygen demand (COD).

4.2.8.3 Limited Physical and Chemical Testing of Surface Water and Sediment

The 67 surface water samples will be analyzed in the field for pH, temperature, specific conductivity, and dissolved oxygen (DO). The following analyses will be performed by the laboratory: total suspended solids (TSS), total dissolved solids (TDS), alkalinity, hardness, ammonia, nitrate/nitrite, phosphate, TOC, and turbidity. The 68 sediment samples will be analyzed for grain size, TOC, CEC, and pH. Three samples from known or potentially impacted sediment will also be analyzed for density. A detailed description of these methods, as well as lists of each compound included in each of the categories is presented in Appendix C, Chemical Data Acquisition Plan.

4.2.8.4 Smear Samples Analysis

Smears for removable radioactivity determination will be collected from the reference buildings and all buildings within SEAD-12. These smears will be counted for gross alpha and gross beta activity and for tritium by the IRDC Nuclear Counting Laboratory at the Red Stone Arsenal in Alabama. Any smears having removable gross alpha or gross beta activities which are above site guidelines will be submitted for the radiochemical analyses previously described. At a

minimum, five percent of the total number of smears collected will be submitted for radiochemical analyses.

4.2.8.5 Special Measurements Analysis

Twenty-six special measurements will be performed at drainage and wastewater inlets within buildings and within the 5,000 gallon UST. Collection of sediment and/or loose material from within these structures will be attempted. It is estimated that 26 samples will be collected from these structures. These samples will be submitted for the radiochemical analyses previously described.

4.2.9 Surveying

Surveying will be performed at SEAD-12 to provide data to be used for the following purposes:

- Generate a site base map by stereoscopic photo analysis,
- Locate all the environmental sampling points and geophysical surveys,
- Serve as the basis for volume estimates of impacted soil and sediment which may require a remedial action,
- Map the extent of any impacted groundwater above established ARAR limits.

The location, identification, coordinates and elevations of all the control points recovered and/or established at the site and all of the geophysical survey areas, soil gas survey areas, soil borings, monitoring wells (new and existing) and all surface water and sediment sampling points will be plotted on a topographic map to show their location with respect to surface features within the project area.

Site surveys will be performed in accordance with good land surveying practices and will conform to all pertinent state, federal, and USCOE laws and regulations governing land surveying. The surveyor shall be licensed and registered in the state of New York.

A detailed discussion of the site field survey requirements is presented in Section 3.13 of Appendix A, Field Sampling and Analysis Plan of the Generic Installation RI/FS Workplan.

4.3 FIELD INVESTIGATIONS AT SEAD-63

This section describes the field investigations that are to be performed at SEAD-63. The field investigations will be designed to gather information on two types of potential constituents of concern which may affect human health or the environment at SEAD-63:

- Field investigations to characterize the nature and extent of organic compounds and non radioactive heavy metals within SEAD-63 media, and

- Field investigations to characterize the nature and extent of radionuclides present within SEAD-63 media.

The field investigations will be designed to characterize the organic compounds and non radioactive heavy metals and will follow the EPA's guidance for conducting remedial investigations and feasibility studies under CERCLA (EPA, 1989). At present the only areas where such potential constituents of concern are known to have affected SEAD-63 media are the disposal trenches located in the central and northern portions of the site and the sediments within the drainage swale east of Patrol Road. The sources, if any, of the potential constituents of concern found in the sediments are unknown.

The radiological field investigations at SEAD-63 will follow the Nuclear Regulatory Commission's *Manual for Conducting Radiological Surveys in Support of License Termination* (NUREG/CR-5849), NUREG 1500, NUREG 1505, NUREG 1506, NUREG 1507, and MARSSIM (NUREG-1575, EPA 402-R-97-016, December 1997). The purpose of these investigations will be to collect information to serve as a final status survey for this site. The radiological surveys will be designed to investigate Class Two areas as defined in Section 4-2, Field Investigations at SEAD-12, of this project scoping plan. Based on a knowledge of the site's history and previous survey information, SEAD-63 is not expected to contain residual radioactivity resulting from past activities performed on-site. SEAD-63 was documented to have been used for the disposal of inert components and the radionuclide concentrations found in the SEAD-63 ESI soil samples were the same as those found at the single ESI background sampling location.

Following the radiological surveys, portions of the site may be reclassified as Class One areas. Reclassification of such areas will follow the guidelines presented in Section 4-2, Field Investigations of SEAD-12. Any area reclassified as a Class One area will be investigated following the protocols described for Class One areas at SEAD-12.

The following field investigations will be performed to complete the RI at SEAD-63:

- Geophysical investigation,
- Alpha (on pavement), beta (on pavement) and gamma screening surveys,
- Alpha, beta, and gamma direct measurements (on pavement surfaces),
- Exposure rate surveys,
- Removable radiation surveys (on pavement surfaces),
- Special measurements and sampling (e.g. in drainage culverts),
- Soil Investigation (surface soil sampling, test pits, and soil borings),
- Groundwater investigation (overburden wells),
- Surface water and sediment investigation,
- Ecological investigation, and
- Surveying.

These investigations are described in the following sections.

4.3.1 Geophysical Investigation

Electromagnetic (EM-61) and Ground Penetrating Radar (GPR) surveys will be performed throughout SEAD-63. The initial geophysical investigation will be an EM-61 survey performed along lines spaced every 5 feet to provide a complete coverage of the site. The objective of the EM-61 survey will be to identify locations where metallic objects are buried within the subsurface. Upon completion of the EM-61 survey, contour maps of the electromagnetic field will be generated to identify the locations of buried metallic objects within the subsurface, provide approximate sizes of the buried objects, and provide approximate depths of the buried objects.

Subsequent to the EM-61 survey, a GPR survey will be performed. GPR data will be collected over each distinct EM-61 anomaly in order to provide a better characterization of the suspected anomaly source.

4.3.2 Radiological Investigations at SEAD-63

The reader is referred to Section 4.2.3, Radiological Investigations at SEAD-12, for discussions on the radionuclides of concern in the Q Area, site specific guideline values, survey instrumentation, minimum detectable concentrations (MDCs), and the selection of reference sites.

4.3.2.1 Alpha, Beta and Gamma Scanning Surveys

The scanning surveys will be conducted following the schedules detailed below. All scanning measurements will be recorded on grid diagrams that will be directly related to the gridding patterns established in each survey unit. Exterior grounds and pavement grid sizes will be 10 meters by 10 meters.

Class Two Survey Units

Scanning of surfaces and grounds to identify locations of residual surface and near surface activity in Class Two survey units will be performed according to the following schedule:

- pavement - 50% of surface.
- Exterior Grounds - 50% of surface

Exterior pavement scanning surveys will be conducted for alpha , beta, and gamma radiations. Surveys of exterior grounds will be for gamma radiations.

If any of the scanning results indicate that residual radiation may be present at a given area, that area will be marked for further investigations. Professional judgment will be used to determine if additional surveys are warranted. The additional surveys may include additional direct measurements, additional surface scanning (such as a 100% coverage using a NaI detector), smear sampling, or material sampling. The purpose of any additional surveys will be to confirm that any residual radiation present is below the survey unit specific guideline value.

Instrumentation for the scanning surveys will include gas proportional detectors for alpha and beta surveys and sodium iodide (NaI) detectors for gamma surveys. For the pavement surveys, a large area gas proportional floor monitor will be used. Surveying speeds will be 1 detector width per second for gas proportional instruments and will be performed to cover 100% of the surface being scanned. Surveying speeds will be 0.5 meters per second (approximately 1.5 feet per second) for NaI instruments and will be performed in a zig-zag pattern such that any one square meter area is covered by at least four passes. Audible indicators will be used to identify locations having elevated (>1.5 times ambient) levels of direct radiation. Any such locations will be noted for further investigations as described above.

4.3.2.2 Alpha and Beta Direct Measurements

Direct measurement surveys are performed as a means of detecting areas where elevated levels of surface or near surface radiation may be present at levels that are not detectable by surface scanning techniques. To this end, the direct measurement survey data from SEAD-63 will be compared to a single screening value. This screening value will be a daily flag value. All locations where the direct measurement value is above the daily flag value will be recorded and professional judgement will be used to determine if additional surveys are warranted. The additional surveys may include additional direct measurements, additional surface scanning (such as a 100% coverage using a NaI detector), smear sampling, or material sampling. The purpose of any additional surveys will be to confirm that any residual radiation present is below the survey unit specific guideline value.

The flag value will be determined on a daily basis. Flag values will be established for both alpha and beta radiations for each instrument in use. The flag value will be calculated using the following formula:

$$Flag = \left(G \bullet f_{gd} \bullet E_{inst.}\right) + B$$

G = survey unit specific guideline value (specific for alpha and beta radiations)

f_{gd} = fraction of guideline value that must be detected (75% for exterior surveys)
$E_{inst.}$ = detection efficiency of the instrument being used for the direct measurement
B = daily background count rate (determined on an instrument specific basis)

The equation cited is from the U.S. Army Generic Radioactive Commodity Site Radiation Survey Protocol, November 1995.

All direct measurements will be recorded on grid diagrams that will be directly related to the gridding patterns established in each survey unit. Exterior grounds and pavement grid sizes will be 10 meters by 10 meters.

The direct measurement plans detailed below will provide, at a minimum, the twenty data points from each survey unit that are necessary to meet the DQOs that were selected for SEAD-63.

Class Two Survey Units

Direct measurements of alpha and beta surface activity will be performed at selected locations using the same instruments as outlined in Section 4.2.2.1, Alpha ,Beta and Gamma Scanning Surveys.

Direct measurements will be performed according to the following schedule

- exterior pavement - one location per 10 meter by 10 meter grid, situated in the area of the highest surface scanning reading

Measurements will be conducted by integrating counts over a 1 minute period.

4.3.2.3 Exposure Rate Surveys

Exposure rate surveys are performed to determine that the exposure rates measured at a location are below the survey unit specific guideline value. Exposure rate measurements will be obtained

in the field in units of μRem/hr. The final exposure rate measurements will be reported in units of μR/hr.

The exposure rate survey plan detailed below will provide, at a minimum, the twenty data points from each survey unit that are necessary to meet the DQOs that were selected for SEAD-63.

Class Two Survey Units

Gamma exposure rates will be measured at one meter above ground surfaces using a Bicron microRem/hr meter. Measurements will be spaced according to the following pattern:

- pavement - one per 10 meter by 10 meter grid used for the scanning and direct measurement surveys, located in the center of the grid,
- grounds -one per 10 meter by 10 meter grid used to document the scanning surveys, located in the center of the grid, and one at each surface soil sampling location.

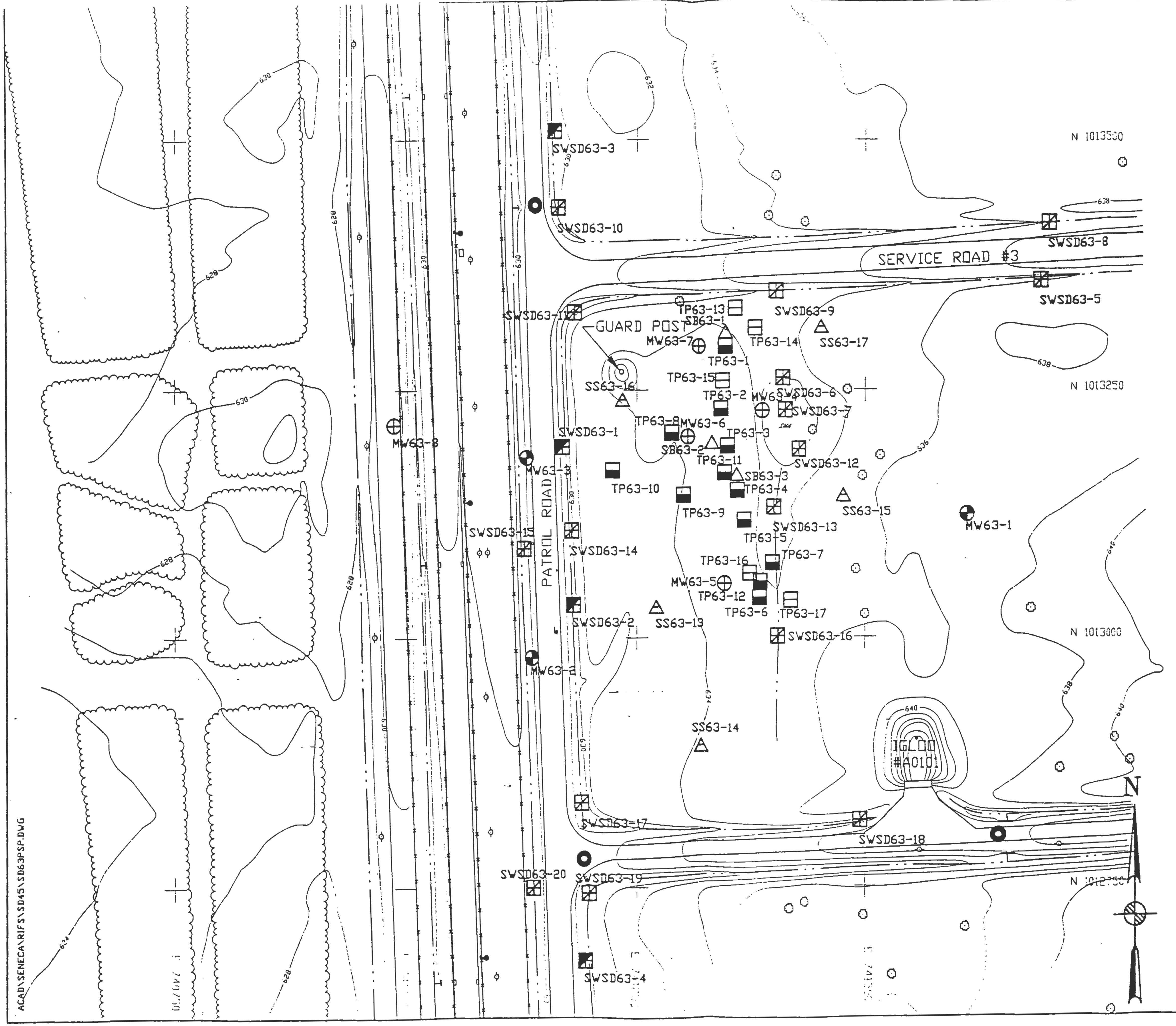
4.3.2.4 Removable Radiation Surveys

One smear for removable radioactive contamination will be performed at each of the direct measurement locations described in section 4.3.2.2, Alpha and Beta Direct Measurements. One smear will be collected for gross alpha and gross beta counting at each location. The smears will be evaluated for alpha and beta activity by the IRDC Nuclear Counting Laboratory at Red Stone Arsenal in Alabama. If the integrated counts from a smear sample exceed the site guideline value for surface activity, that sample will be submitted for the radionuclide laboratory analyses specified in Section 4.2.7, Analytical Program.

At a minimum, 17 smear samples will be collected at SEAD-63 and submitted for laboratory analysis.

4.3.2.5 Special Measurements and Sampling

Direct alpha, beta and gamma measurements and sampling of sediments from within drain converts beneath the roads at SEAD-63 will be performed. The probable locations for the collection of these measurements and samples are shown in Figure 4-11. A total of 3 samples will be collected for chemical and radiochemical analysis from these structures.



LEGEND

MINOR WATERWAY
MAJOR WATERWAY
FENCE
UNPAVED ROAD
BRUSH LINE
LANDFILL EXTENTS
RAILROAD
760 GROUND SURFACE ELEVATION CONTOUR
ROAD SIGN
DECIDUOUS TREE
GUIDE POST
FIRE HYDRANT
MANHOLE
COORDINATE GRID (250' GRID)
POLE
UTILITY BOX
MAILBOX/RR SIGNAL
OVERHEAD UTILITY POLE
SURVEY MONUMENT

PROPOSED MONITORING WELL
PROPOSED SURFACE SOIL SAMPLE
PROPOSED SOIL BORING
PROPOSED SURFACE WATER/SEDIMENT SAMPLE
PROPOSED TEST PIT
PROPOSED SPECIAL MEASUREMENT LOCATION
EXISTING TEST PIT
EXISTING MONITORING WELL
EXISTING SOIL BORING
EXISTING SURFACE SOIL SAMPLE

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SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-63 MISCELLANEOUS COMPONENTS BURIAL SITE

ENVIRONMENTAL ENGINEERING | 726511-02003

FIGURE 4-11
LOCATIONS OF PROPOSED AND EXISTING SAMPLING POINTS

1" = 100' | DECEMBER 1996 | A

Soil borings will be performed by the continuous split-spoon method. Samples will be collected every two feet from the ground surface to the bottom of the boring. At each boring location, a 0-2" surface soil sample will be collected and submitted for chemical and radiochemical testing. Two subsurface soil samples will also be collected from each soil boring to be submitted for chemical and radiochemical testing. The criteria for the selection of the subsurface soil samples submitted to the lab for chemical testing is provided in Section 3.4.2 of Appendix A, Field Sampling and Analysis Plan in the generic Installation RI/FS Workplan. Each soil boring will be drilled until auger refusal is encountered. Auger refusal for this project is defined in Appendix D, Field Sampling and Analysis Plan. Additional sample selection criteria will include any impacts that are observed during the radiological field screening of the slit spoon material.

Additional samples will be collected for archive purposes in the event that additional analyses are required to characterize any radiological impacts at SEAD-63. Archive samples will be taken from all segments of the split spoon material where the screening measurements are more than 50% above readings without a sample present. Additionally, the material immediately above and below any such segments will also be sampled and archived. Professional judgement and the radiological field screening of the split spoon material will be used to select any other archive samples.

In addition, 9 soil samples will be collected for limited chemical testing and physical testing at soil boring locations SB63-1, SB63-2, and SB63-3. At each location, one near surface sample, one sample from below the fill material and one intermediate sample will be collected.

4.3.3.3 Test Pitting Program

A total of 5 test pits will be excavated at SEAD-63. The locations of these test pits are shown on Figure 4-11. All five test pits (test pits TP63-13 through TP63-17) will be located over geophysical anomalies identified during the ESI or the geophysical investigations to be performed for this RI/FS. Test pits will be performed so that a visual evaluation of the subsurface soils and fill materials can be made, and also for the purpose of collecting soil samples for chemical and radiochemical testing. Test pits will be excavated to the bottom of the fill layer. The bedrock surface (if encountered) and bottom of fill layer will be documented at each test pit location. One surface soil sample and two (2) subsurface soil samples will be collected from each test pit. The samples will be collected at depths where there is evidence of impacts based upon field screening and visual observations. If no impacts are evident in the test pit, the samples will be collected from the floor of the excavation and at the mid-depth of the wall of the excavation.

Additional samples will be collected for archive purposes in the event that additional analyses are required to characterize any radiological impacts at SEAD-63. Archive samples will be taken from areas of the test pit excavation where the screening measurements of removed materials are more than 50% above readings without a sample present. Additionally, the material immediately above and below any such areas will also be sampled and archived. Professional judgement and the radiological field screening of the test pit material will be used to select any other archive samples.

The materials removed for characterization purposes will be returned to the excavated area at the completion of each test pit investigation. This procedure was discussed with and agreed to by the New York State Department of Environmental Conservation, Bureau of Radiation, Division of Hazardous Substances (see Appendix J, Letter of Confirmation of Telephone Conversation Between Parsons ES and NYSDEC, on July 17, 1995). This procedure assures that any radiological contamination found at a test pit site will not have the potential to migrate via over-land transport (i.e. by precipitation run-off or by wind transport), and it will minimize any potential radiation dose or contamination to on-site workers or visitors during the RI/FS process.

All personnel performing the test pit operations will be wearing Level D PPE. The excavated soils will be monitored for VOCs and radiation during test pitting. Test pitting procedures are provided in Section 3.4.3 of Appendix A, Field Sampling and Analysis Plan, in the generic Installation RI/FS Workplan

4.3.3.4 Soil Sampling Summary

One surface soil sample and two subsurface soil samples will be collected from each of the eight soil borings and 5 test pits shown on Figure 4-11. Seventeen surface soil samples will also be collected. In total, 56 soil samples will be collected for TAL/TCL and radiochemical testing.

In addition, 9 subsurface soil samples will be collected from 3 locations for physical testing and limited chemical testing.

All the soil samples will be tested according to the analyses specified in Section 4.3.7, Analytical Program.

4.3.4 Surface Water and Sediment Investigation

Surface water and sediment sampling will be conducted in areas of SEAD-63 which have the potential for acting as an exposure pathway or for off-site transport of site contaminants.

Potential on-site surface water areas include drainage swales located about SEAD-63 and a small, unsustained, wetland area in the northern portion of the site. The drainage pathways at SEAD-63 eventually flow into Reeder Creek which flows north then west and drains into Seneca Lake. Sixteen surface water and sediment samples (SW/SD63-5 through SW/SD63-20) will be collected at the on-site locations shown on Figure 4-11. Surface water samples will be collected at all of the sample locations when flowing water is present (i.e., during or immediately following a precipitation event). The surface water and sediment sampling procedures are described in Section 3.7 of Appendix A, Field Sample and Analysis, in the generic Installation RI/FS Workplan.

All of the surface water and sediment samples will be analyzed as described in Section 4.3.7, Analytical Program. The results of these analyses will be used to determine if there is a surface water or sediment exposure pathway at SEAD-63. If concentrations exceeding applicable guidelines are present, the data will be used to perform a baseline risk assessment for this exposure pathway.

4.3.5 Groundwater Investigation

The groundwater investigation program will consist of collecting groundwater samples from eight groundwater monitoring wells. Five of the 8 groundwater monitoring wells will be installed at SEAD-63 as part of the remedial investigation being performed at this site. The remaining three groundwater monitoring wells were previously installed during the ESI.

4.3.5.1 Monitoring Well Installation and Sampling

The groundwater flow direction at SEAD-63 was determined from the potentiometric measurements gathered during the ESI.

The goals of the groundwater investigation during the RI are to determine the extent of groundwater contamination, gather potentiometric data to confirm the groundwater flow direction, determine background groundwater quality, and determine the hydraulic conductivity of the aquifer. To accomplish this, five monitoring wells will be installed at the approximate locations shown in Figure 4-11. Table 4-7 lists the location of the proposed monitoring wells and provides a brief rationale for the installation of each. The five soil borings to be drilled for the installation of the five monitoring wells will be continuously sampled to competent bedrock. A monitoring well will then be installed and screened in the saturated overburden overlying the bedrock.

The eight monitoring wells at SEAD-63 will then be sampled according to the following schedule:

- First Round - approximately 2 weeks after well development, and,
- Second Round - approximately 3 months after the first round.

Monitoring well installation, development, and sampling procedures are described in Sections 3.5 and 3.6 of Appendix A, Field Sampling and Analysis Plan, in the generic Installation RI/FS Workplan. All wells will be properly developed prior to sampling. The groundwater samples will be tested according to the analyses described in Section 4.3.7, Analytical Program.

4.3.5.2 Aquifer Testing

Slug testing will be performed on the 8 wells at SEAD-63 (3 installed during the ESI and 5 during this RI) and used to estimate the hydraulic conductivity of the overburden aquifer. Three rounds of water levels will be measured at each of the wells at SEAD-63 to further define thegroundwater flow direction at the site. The groundwater level measurements will be performed according to the following schedule:

Table 4-7
SEAD-63 RI/FS Projectr Scoping Plan
Monitoring Well Justification Table
Seneca Army Depot Activity

Monitoring Well ID	Monitoring Well Location	Rationale for Installation of Monitoring Well
MW63- 4	East of disposal pit identified by geophysics	Upgradient monitoring well for sipsosal pit, to monitor influence of area with standing water on groundwater flow direction and potential contaminant migration paterns
MW63- 5	West of disposal pit identified by geophysics	Downgradiet monitoring well for disposal pit
MW63- 6	West of disposal pit identified by geophysics	Downgradiet monitoring well for disposal pit
MW63- 7	West of disposal pit identified by geophysics	Downgradiet monitoring well for disposal pit
MW63- 8	West of Q Area fence, west of existing wells MW63-2 and MW63-3	Downgradient Monitoring Well to determine the extent of potential impacts that were detected in the existing monitoring wells

- First Round - after monitoring well development,
- Second Round - at the time of the first round of groundwater sampling and,
- Third Round - at the time of the second round of groundwater sampling.

Procedures for slug testing and water level measurements are outlined in Section 3.11 of Appendix A, Field Sampling and Analysis Plan, in the Generic Installation RI/FS Workplan.

4.3.6 Ecological Investigation

The following procedure for the ecological investigation was developed from the New York State Department of Environmental Conservation (NYSDEC) Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (1994). The purpose of the ecological investigation is to determine if aquatic and terrestrial resources have been affected by a release of contaminants from the site. The investigation will be completed in two parts. The first part will be the site description, which will involve the accumulation of data describing the physical characteristics of the site, as well as the identification of aquatic and terrestrial resources present or expected to be present at the site. The second part will be the contaminant-specific impact analysis, which involves the determination of whether the identified aquatic and terrestrial resources have been impacted by contaminants that have been released at the site. The second part of the ecological investigation is dependent upon the chemical analysis data obtained for the RI.

A wetland functional assessment will be conducted if the remedial actions, which will be developed in the FS, involve disruption of wetland areas. This assessment would be conducted as an initial step in the FS if necessary.

4.3.6.1 Site Description

The purpose of the site description is to determine whether aquatic and terrestrial resources are present at the site and if they were present at the site prior to contaminant introduction. If they were present prior to contaminant introduction, the appropriate information will be provided to design a remedial investigation of the resources. The information to be gathered includes site maps, descriptions of aquatic and terrestrial resources at the site, the assessment of the value of the aquatic and terrestrial resources, and the appropriate contaminant-specific and site-specific regulatory criteria applicable to the remediation of the identified aquatic and terrestrial resources.

A topographic map showing the site and documented aquatic and terrestrial resources within a two mile radius from the site will be obtained. The aquatic and terrestrial resources of concern are Significant Habitats as defined by the New York State Natural Heritage Program; habitats supporting endangered, threatened or rare species or species of concern; regulated wetlands; wild and scenic rivers; significant coastal zones; streams; lakes; and other major resources.

A map showing the major vegetative communities within a half mile radius of the site will be developed. The major vegetative communities will include wetlands, aquatic habitats, NYSDEC Significant Habitats, and areas of special concern. These covertypes will be identified using the NYSDEC Natural Heritage Program descriptions and classifications of natural communities.

Wetlands were delineated by the U.S Fish and Wildlife Service as part of BRAC 95. This information will be used to develop the map of vegetative communities.

To describe the covertypes at the site, the abundance, distribution, and density of the typical vegetative species will be identified. To describe the aquatic habitats at the site, the abundance and distribution of aquatic vegetation will be identified. The physical characteristics of the aquatic habitats will also be described and will include parameters such as the water chemistry, water temperature, dissolved oxygen content, depth, sediment chemistry, discharge, flow rate, gradient, stream-bed morphology, and stream classification.

The aquatic and terrestrial species that are expected to be associated with each covertype and aquatic habitat will be determined. In particular, endangered, threatened and rare species, as well as species of concern, will be identified. Alterations in biota, such as reduced vegetation growth or quality will be described. Alterations in, or absence of, the expected distribution or assemblages of wildlife will be described.

A qualitative assessment will be conducted evaluating the ability of the area within a half mile of the site to provide a habitat for aquatic and terrestrial species. The factors that will be considered will include the species' food requirements and the seasonal cover, bedding sites, breeding sites and roosting sites that the habitats provide.

The current and potential human use of the aquatic and terrestrial resources of the site and the area within a half mile of the site will be assessed. In addition to assessing this area, documented resources within two miles of the site and downstream of the site that are potentially affected by contaminants will also be assessed. Human use of the resources that will be considered will be activities such as hunting, fishing, wildlife observation, scientific studies, agriculture, forestry, and other recreational and economic activities.

The appropriate regulatory criteria will be identified for the remediation of aquatic and terrestrial resources and will include both site-specific and contaminant-specific criteria.

4.3.6.2 Contaminant-Specific Impact Analysis

Information from the site description developed in Section 4.3.6.1 and from the characterization of the contaminants at the site developed from the results of the RI will be used to assess the impacts of contaminants on aquatic and terrestrial resources. The impact analysis will involve three steps, each using progressively more specific information and fewer conservative assumptions and will depend upon the conclusion reached at the previous step regarding the degree of impact. If minimal impact can be demonstrated at a specific step, additional steps will not be conducted.

Pathway Analysis

A pathway analysis will be performed identifying aquatic and terrestrial resources, contaminants of concern and potential pathways of contaminant migration and exposure. After performing the pathway analysis, if no significant resources or potential pathways are present, or if results from field studies show that contaminants have not migrated to a resource along a potential pathway, the impact on aquatic and terrestrial resources will be considered to be minimal and additional impact analyses will not be performed.

Criteria-Specific Analysis

Presuming that the presence of contaminated resources and pathways of migration of site-related contaminants has been established, the contaminant levels identified in the field investigation will be compared with available numerical criteria or criteria developed according to methods established as part of the criteria. If contaminant levels are below criteria, the impact on resources will be considered to be minimal and additional impact analyses will not be performed. If numerical criteria are exceeded or if they do not exist and cannot be developed, an analysis of the toxicological effects will be performed.

Analysis of Toxicological Effects

The analysis of toxicological effects is based on the assumption that the presence of contaminated resources and pathways of migration of site-related contaminants has been established. The purpose of the analysis of toxicological effects is to assess the degree to which contaminants have affected the productivity of a population, a community, or an ecosystem and the diversity of species assemblages, species communities or an entire ecosystem through direct toxicological and indirect ecological effects.

A number of approaches are available to conduct an analysis of toxicological effects. One or more of the four following approaches will be used to assess the toxicological effects.

- **Indicator Species Analysis**–A toxicological analysis for a indicator species will be used if the ecology of the resource and the exposure scenarios are simple. This approach assumes that exposure to contaminants is continuous throughout the entire life cycle and does not vary among individuals.

- **Population Analysis**–A population level analysis is relevant to and will be used for the evaluation of chronic toxicological effects of contaminants to an entire population or to the acute toxicological effect of contaminant exposure limited to specific classes of organisms within a population.

- **Community Analysis**– A community with highly interdependent species including highly specialized predators, highly competitive species, or communities whose composition and diversity is dependent on a key-stone species, will be analyzed for alternations in diversity due to contaminant exposure.

- **Ecosystem Analysis**–If contaminants are expected to uniformly affect physiological processes that are associated with energy transformation within a specific trophic level, an analysis of the effects of contaminant exposure on trophic structure and trophic function within an ecosystem will be performed. Bioconcentration, bioaccumulation, biomagnification, etc., are concepts that may be used to evaluate the potential effects of contaminant transfer on trophic dynamics.

4.3.7 Analytical Program

A total of 56 soil samples, 16 groundwater samples, 16 surface water and sediment samples, 3 special measurement samples, and a minimum of 2 smear samples will be collected at SEAD-63 for chemical and radiochemical testing. Analyses for all of the media to be sampled are summarized in Table 4-8. The proposed sample locations are shown in Figure 4-11.

All of the soil, water, sediment and special measurement samples collected at SEAD-63 will be analyzed for the following non-radioactive constituents: Target Compound List (TCL) VOCs (EPA Method 524.2 for groundwater samples only), semivolatile organic compounds (SVOCs), TCL pesticides/PCBs, Target Analyte List (TAL) metals and cyanide according to the NYSDEC Contract Laboratory Program (CLP) Statement of Work (SOW), and nitrate/nitrite nitrogen by EPA Method 353.2. To address the need to attain lower detection limits for several analytes in the CLP SOW for groundwater analyses, an addendum to Appendix F, Chemical Data Acquisition Plan, has been added in which the proposed modifications to the CLP SOW are presented. These modifications will provide the detection levels that are needed to meet all potential ARARS that are not being met under the current CLP SOW.

All of the samples collected at SEAD-63 will be analyzed by the following radiochemical methods: alpha spectrometry (to detect plutonium 239, uranium 235 and 238, and thorium-230 and 232), and gamma spectrometry (to detect radium-223, bismuth-214, lead 210, and lead 214). Gross alpha and gross beta radiation in all of the groundwater and surface water samples will also be determined.

All of these samples will be analyzed for radium-226 by method 901.1 (from soil samples) or 903.1 (for water samples).

Additional limited physical and chemical analyses to be performed on specific media are provided below.

Table 4-8

Summary of Sampling and Analyses
Seneca Army Depot Activity
SEAD-63

MEDIA	VOCs TCL NYSDEC CLP	VOCs Method 524 2	SVOCs TCL NYSDEC CLP	Pesticides / PCBs TCL NYSDEC CLP	Metals TAL NYSDEC CLP	Nitrate / Nitrogen MCAWW 352.1 (note 3)	Gross Alpha / Beta	Uranium 235/238 Alpha Spectrometry	Thorium 230/232 Alpha Spectrometry	Plutonium 239/240 Alpha Spectrometry	Radium 226 Method 901.1	Radium 226 Method 903.1	Gamma Radiation Gamma Spectrometry	Limited Chemical/ Physical Testing
Soil Surface	30	0	30	30	30	30	0	30	30	30	30	0	30	0
Soil Subsurface	26	0	26	26	26	26	0	26	26	26	26	0	26	9
Groundwater	0	16	16	16	16	16	16	16	16	16	0	16	0	16
Surface water	16	0	16	16	16	16	16	16	16	16	0	16	16	16
Sediment	16	0	16	16	16	16	0	16	16	16	16	0	16	16
Wipes (Asphalt)	0	0	0	0	0	0	5	5	5	5	5	0	5	0
Special Measurements	3	0	3	3	3	3	0	3	3	3	3	0	3	0

Notes
1) QA/QC sampling requirements are described in Appendix C, Section 5 3 of the Generic Installation RI/FS Workplan.
2) The limited chemical testing and physical testing parameters for each media are described in Section 4 3 7, Analytical Program
3) Method in soil samples will be modified For soils, a known quantity of soil will be mixed with a known volume of water, stirred, then filtered to form an aqueous extract
4) For pH analysis Method 904 5 will be used for soil samples and Method 150 1 will be used for water. For TOC analysis, Method 415 1 will be used for water and Lloyd Kahn method will be used for soil
* The analysis is designated as Method 524 2, Revision 4 0, August 1992

4.3.7.1 Limited Physical and Chemical Testing of Soils

Nine subsurface soil samples will be collected and analyzed for limited chemical testing and physical testing. These analyses will include Toxicity Characteristics Leaching Procedure (TCLP) analysis, Total Organic Carbon (TOC) analysis by EPA Method 415.1, grain size distribution analysis (including the distribution within the silt and clay size fraction), Cation Exchange Capacity (CEC) analysis, pH determination, and density determination.

Additionally, these nine subsurface soil samples will be analyzed to determine the radium-226 distribution coefficient using the short-term batch method (ASTM D: 4319-83).

4.3.7.2 Limited Physical and Chemical Testing of Groundwater

The 16 groundwater samples will be analyzed in the field for pH, temperature, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential. The following chemical and physical testing will be performed by the laboratory: alkalinity, iron (ferrous), sulfate, sulfide, nitrate, TOC, biological oxygen demand (BOD), hardness, total dissolved solids (TDS), and chemical oxygen demand (COD).

4.3.7.3 Limited Physical and Chemical Testing of Surface Water and Sediment

The 16 surface water samples will be analyzed in the field for pH, temperature, specific conductivity, and dissolved oxygen (DO). The surface water flow rate at the surface water sampling locations will also be determined. The following analyses will be performed by the laboratory: total suspended solids (TSS), total dissolved solids (TDS), alkalinity, hardness, ammonia, nitrate/nitrite nitrogen, phosphate, TOC, and turbidity.

The 16 sediment samples will be analyzed for grain size, TOC, CEC, and pH. Three samples from known or potentially impacted sediment will also be analyzed for density. A detailed description of these methods, as well as lists of each compound included in each of the categories is presented in Appendix F, Chemical Data Acquisition Plan.

4.3.8 Surveying

Surveying will be performed at SEAD-63 to provide data to be used for the following purposes:

- Locate all the environmental sampling points and geophysical surveys,
- Serve as the basis for volume estimates of impacted soil and sediment which may require a remedial action,
- Map the extent of any impacted groundwater above established ARAR limits.

The location, identification, coordinates and elevations of all the control points recovered and/or established at the site and all of the geophysical survey areas, soil borings, monitoring wells (new and existing) and all surface water and sediment sampling points will be plotted on a topographic map to show their location with respect to surface features within the project area.

Site surveys will be performed in accordance with good land surveying practices and will conform to all pertinent state, federal, and USACOE laws and regulations governing land surveying. The surveyor shall be licensed and registered in the state of New York.

A detailed discussion of the site field survey requirements is presented in Section 3.13 of Appendix A, Field Sampling and Analysis Plan of the Generic Installation RI/FS Workplan.

4.4 DATA REDUCTION, ASSESSMENT AND INTERPRETATION

The data collected from the radiological screening surveys, direct measurement surveys, exposure rate surveys, removable radiation surveys, special measurements, and environmental media sampling (for radionuclides) will be reduced, assessed and interpreted following the guidance in NUREG/CR-5849, NUREG 1505, and MARSSIM (NUREG-1575, EPA 402-R-97-016, December 1997). These data, as well as the metals analysis data from the soil, groundwater, and surface water and sediment sampling programs, will be used to compare the SEAD-12 and SEAD-63 data to background/reference data using the Wilcoxon Ranked Sum test and the Quantile Test following the guidance provided in NUREG 1505, MARSSIM (NUREG-1575, EPA 402-R-97-016, December 1997), and the EPA's Statistical Methods for Evaluating the Attainment of Cleanup Standards. These tests, as well as statistical graphs of the site and reference data (which may include histograms, quantile plots, power curves, etc...), and basic statistical quantities (such as the mean, standard deviation, median, maximum, and minimum values of the datasets) will be used to illustrate the conditions at SEAD-12 and SEAD-63 as compared to one or more background / reference areas.

The Data Reduction, assessment, and interpretation is discussed in general for all of the data collected at these sites in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan. Additional data reduction and assessment methods, which are specific for radiological analysis results, are presented in Appendix F (Chemical Data Acquisition Plan) of this project scoping plan.

Although MARSSIM does not recommend that non-quantitative data such as removable surface activity data or indoor exposure rate measurements be evaluated, the Army may elect to perform data reduction, assessment and data interpretation on such data. The evaluation of non-quantitative data will be done when determined necessary and/or desirable, and will be for information purposes only and not for the purpose of regulatory comparison.

4.5 BASELINE RISK ASSESSMENT

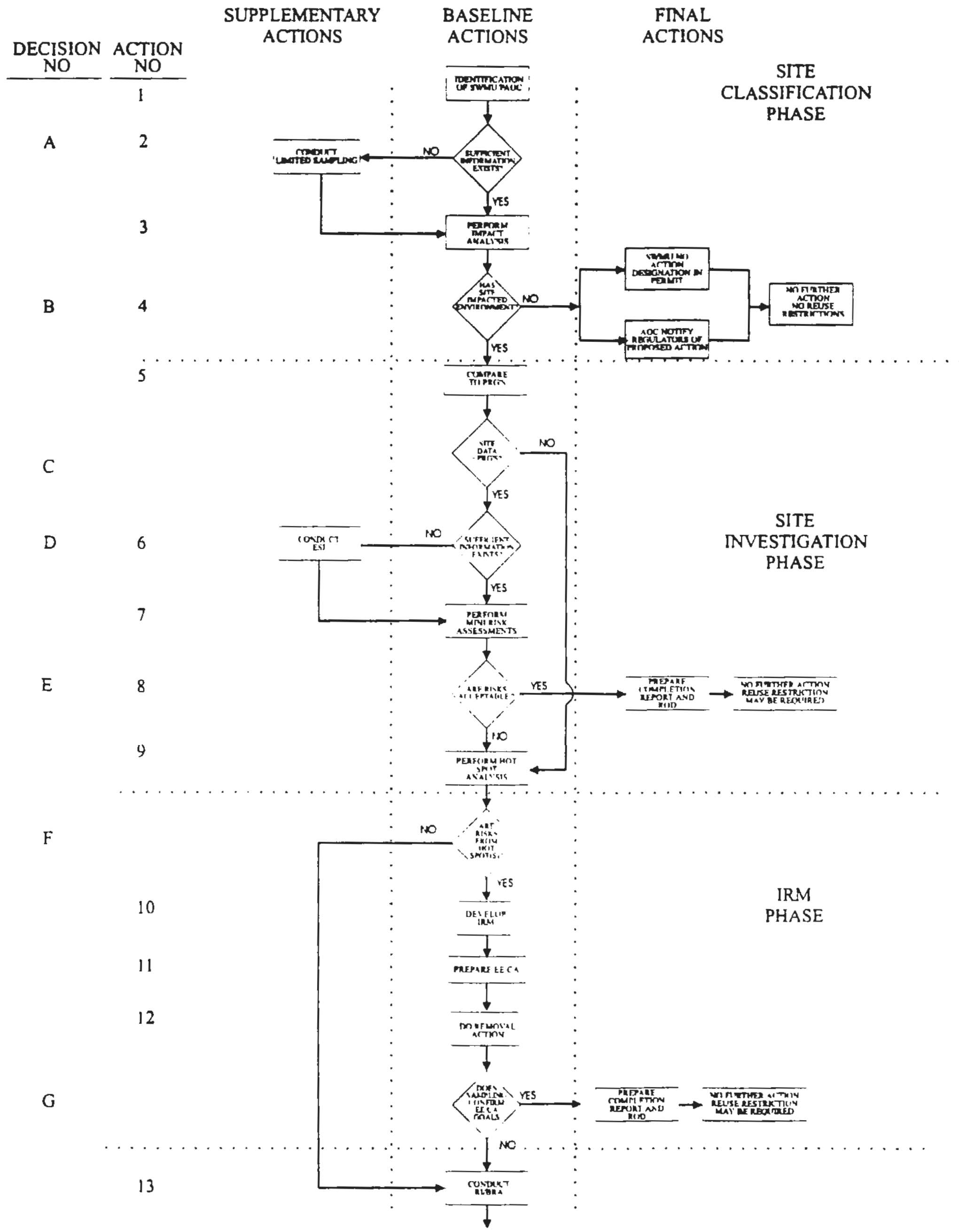
The baseline risk assessment is intended to be used as a tool to determine whether a remedial action other than no-action is required. However, the unique situation at SEAD-12, which is a CERCLA site that is being investigated using MARSSIM guidance, necessitates an incremental approach in executing the baseline risk assessment. Since the radiological survey data will be compared to site specific guideline values (following the guidance in MARSSIM and detailed in Section 4.2 above), any portion of that data that exceeds a site specific MARSSIM guideline value will require a remedial action. Such actions usually entail removal and off-site disposal at a licensed radiological waste facility. Guideline values are established using the RESRAD modeling software. This same software will be used to estimate the human health risk for the baseline risk assessment. The dose threshold of 15 mrem/year corresponds to a lifetime human health risk of approximately 3 $X10^{-4}$ based on residential exposure for 30 years (USEPA, Issues Paper on Radiation Site Cleanup Regulations, EPA 402-R-93-084) Therefore, performing a baseline risk assessment using data that has already failed a comparison to a site specific guideline value would be unnecessary since the risk would be above the USEPA acceptable risk range of 10^{-4} to 10^{-6}. Such an effort would not add any additional information for the risk management decision process. A baseline risk assessment is a requirement of CERCLA and will be conducted, but only after the MARRSIM radiological criteria have been met. The final risk assessment will consider the additive risks from any chemical and/or radiological concerns.

Since an RI has been determined to be appropriate, this site is at Action Numbers 14 through 19 of the process described in the Seneca Army Depot Activity Decision Criteria Flowchart, which is presented in Figure 4-12, and was also presented in Figure 1-4 in Section 1. This flowchart describes the decision process that will be used to evaluate this site. The decision to be made at Decision No. H of the flowchart, 'Are Risks Acceptable?' may not be answered until areas that exceed a radiological site specific guideline value have been addressed. In such instances, the goals of the EE/CA in Decision No. J would be twofold: 1) all areas are below their respective site specific guideline values, and 2) all the risks in those areas are acceptable. In following this process, the baseline risk assessment will provide risk management information that can be used to assess areas that were not previously known to present a potentially unacceptable risk to human health or to ecological receptors.

The remaining portions of this section describe the methodology that will be utilized for conducting the baseline risk assessment at SEAD-12. The discussions that follow detail the scenarios that will be evaluated, the populations that will be considered, and the methodology that will be used to establish exposure point concentrations. Five exposure scenarios for each of the three different types of area classifications (Class One, Class Two and Class Three areas) will be evaluated. For each class, the survey unit evaluated will be that with the highest levels of chemical and/or radiological contaminants, thus providing a conservative estimate of risk.

The scenarios that will be evaluated in the baseline risk assessment will be based on the current and future uses of SEADs 12 and 63. These will include an on-site industrial scenario, an on-site construction scenario, and a down-stream wading/fishing scenario for the current uses. As a result of base closure, the future scenarios to be evaluated in the baseline risk assessment will be consistent with the community reuse plan, as described in BRAC guidance. The community reuse plan, prepared by the Local Redevelopment Authority (LRA), has identified SEADs 12 and 63 to be within the wildlife conservation area. Based on this intended future use, the future use scenario that will be evaluated in the BRA will be an on-site recreational scenario. These exposure scenarios, and the exposure pathways that will be evaluated for each, are presented and discussed in Section 3.2.1, Preliminary Identification of Potential Receptors and Exposure Scenarios, SEAD-12. The populations that will be evaluated for these scenarios will be consistent with accepted risk assessment practices.

SENECA ARMY DEPOT ACTIVITY
Decision Criteria Flowchart



See Next Page

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FIGURE 4-12
DECISION CRITERIA
REMEDIATION FLOWCHART

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SENECA ARMY DEPOT ACTIVITY
Deccision Criteria Flowchart

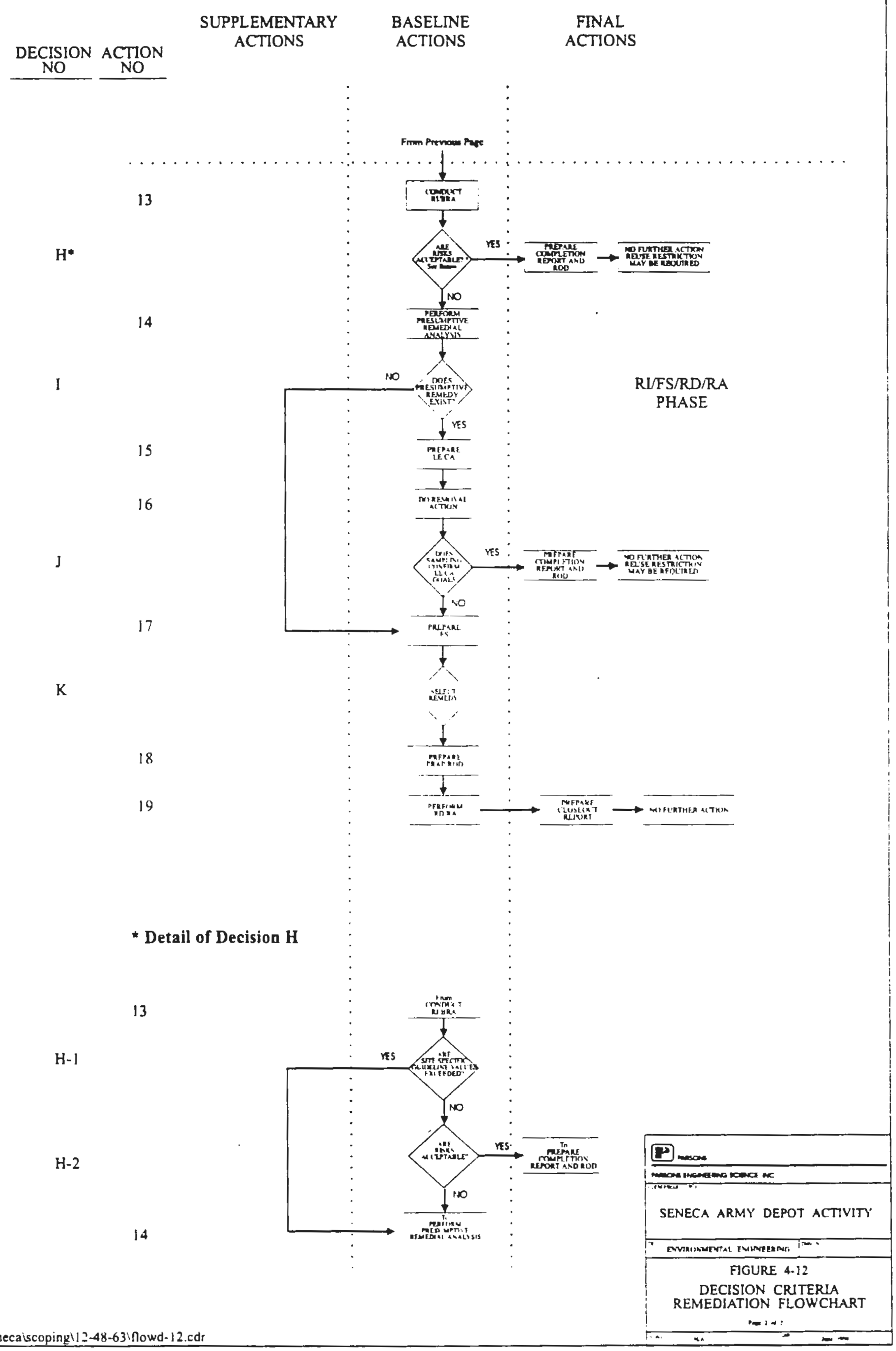

FIGURE 4-12
DECISION CRITERIA
REMEDIATION FLOWCHART

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In order to provide a spectrum of cost analysis information for the feasibility study, a future residential scenario will also be evaluated, though this exposure scenario is not consistent with the LRA's community reuse plan. The exposure pathways for this scenario are the same as those for the future recreational visitor. The exposure assumptions for this scenario will also be the same as those of the recreational visitor, except the exposure duration and averaging times will be greater. (These assumptions will be consistent with accepted risk assessment practices.)

The baseline risk assessment activities, for both the chemical and radiological concerns, will be performed using guidance from the EPA Risk Assessment Guidance for Superfund (1989) Volume I (Human Health Evaluation Manual) and Volume II (Environmental Evaluation Manual). The approach to the chemical baseline risk assessment is presented in the Generic Installation RI/FS Workplan , which serves as a supplement to this RI/FS Project Scoping Plan. The calculation of risk from radioisotopes that are found at levels above background will be performed using the most recent version of the RESRAD computer modeling routine. The RESRAD model variables will be tailored to the exposure scenarios and populations described above, and the exposure parameters used will be those presented and discussed in Section 3.2.3, Exposure Assessment Assumptions.

It is expected that a single data set from each of the three types of area classifications (Class One, Class Two, and Class Three) will be used to calculate exposure point concentrations. These EPCs will be calculated using the 7 step methodology described in Section 3.2.3, Exposure Assessment Assumptions. For the purposes of providing a conservative risk assessment for each scenario evaluated for each type of area classification, EPCs will be calculated using data from the survey unit with the highest levels of chemical and radiological contamination. If the area of highest chemical contamination differs from that of the highest radiological contamination, both areas will be evaluated independently for both chemical and radiological exposures, with the risks from each type of exposure being determined and presented separately, then summed for each individual area. In such cases, the highest chemical risk number from one area will not be summed with the highest radiation risk number from another area. The area(s) with the highest chemical and radiological contamination will be evaluated first (which is likely to be a Class One Area), followed by the area(s) with the next highest levels of contamination, etc. If the risk from a given area is found to be acceptable, and it can be demonstrated that the EPCs in the remaining less contaminated areas are equal to or less than those previously calculated, then risks from the remaining less contaminated areas will be assumed to be acceptable.

Carcinogenic risk estimates from potential radiation exposures for each survey area will be presented separately from risk estimates from chemical exposure throughout this risk assessment. Separate presentation of radiation and chemical risks is important to assure proper consideration in the subsequent risk management decisions based upon the results of this risk assessment. There is considerable regulatory guidance regarding acceptable radiation doses to the public by agencies such as the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) which must be considered. This guidance is based upon extensive data, research, and human epidemiological studies. Confidence in established regulatory radiation dose criteria is much higher than for similar guidelines for public chemical exposure, since radiation health effects have been more extensively studied and are better understood than health effects from exposures to environmental levels of chemicals.

In the Final Rule for Radiological Criteria for License Termination (Federal Register, Vol. 62, No. 139, July 21, 1997, p. 39058 - 39092), NRC selected 25 mrem/year as the acceptable level of residual radioactivity (distinguishable from background) at a decommissioned facility for unrestricted future use of the property. In its comments on the proposed NRC regulation, EPA supported an unrestricted use criterion of 15 mrem/year as adequately health-protective. The presumptive remediation action level of 15 mrem proposed for SEAD-12 is below the NRC public exposure criteria and is consistent with EPA's recommendations. Presenting potential radiation doses/risks separate from chemical exposures/risks at SEAD-12 will allow the appropriate consideration of recent findings as they are relevant to residual radiation in areas that have been evaluated and where hot-spots have been remediated where necessary.

4.6 DATA REPORTING

The data from the radiological surveys will be presented in a format which provides the calculated surface activity or radionuclide concentration value, the estimated confidence level for that value and the estimated MDC for the measurement, as detailed in NUREG/CR-5849.

Data Reporting for all other data, including sample analysis results, is discussed in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.