D
2 3

Jackson, Richard G POA02

From: Ronald J. Scrudato [scrudato@Oswego.EDU]
Sent: Tuesday, May 01, 2001 10:57 AM
To: Richard G. Jackson
Subject: NE Cape workplan draft

Richard,

Attached is the draft of the NE Cape workplan. Please note that we attempted to be further clarification on many points. We tried to include some information on the remedial process for readers who have not had experience dealing with the site remediation and we attempted to make it as "readable" as possible.

Feel free to call for clarification and/or questions.

Regards,

Ron
Ronald J. Scrudato
319 Piez Hall
SUNY at Oswego
Oswego, NY 13126
315/341-3639; (5346 fax); scrudato@oswego.edu

Review of Draft Work Plan--Draft 1
2000/2001 Remedial Investigation/Feasibility Study
Northeast Cape, St. Lawrence Island, Alaska

Ronald J. Scrudato and Jeffrey R. Chiarenzelli
R&M Technologies, Inc.
April 30, 2001

Understanding the Remediation Process

To remediate is to provide a remedy to a problem. At contaminated sites, the remedy can range from "no further action" (NFA) in which the site remains unchanged from its contaminated state to "cleaned up" in which the site is restored to its original pre-contaminated condition or to some state or federal remediation standard. Most waste sites are not restored to their original condition. ***Remediation does not, therefore, mean the site will be cleaned up*** and in most instances, the site will continue to be impacted by some contaminants. Even if the contaminants are removed or destroyed, the site will be changed, likely forever, as a consequence of the remedial process which has resulted in changes to the ecology of the site.

The effective remediation of hazardous waste sites requires extensive evaluation, assessment and understanding of the natural environmental conditions that may effect the concentration, movement and the effect of contaminants on plants and animals. Understanding the natural site conditions including the geological, hydrological, geochemical and biological components, as well as the interaction of those components, is very important in the design and implementation of a site remediation.

Once a site or sites, such as the sites at Northeast Cape or Gambell, are identified, they are subjected to a sequence of investigations usually including (the specific terms or sequences might be termed differently, but most sites will follow the following general schedule):

Phase 1 or a preliminary site assessment **(PSA)**-involving an examination of the site to learn more about the extent and seriousness of the problem. In this phase of the investigation, field samples of soils, perhaps surface waters or the contents of drums and/or tanks might be collected and analyzed and preliminary maps drawn to establish the seriousness of the problem and the threats posed to humans and wildlife by the contaminants found on the site.

If the Phase 1 investigation indicates the contaminants are potential threats to humans or to the environment, the next series of investigations are conducted and involve the **Remedial Investigation (RI) / Feasibility Study (FS)** commonly referred to as the **RI/FS**. The RI/FS is normally a far more extensive series of investigations, involving soil and sediment sampling analysis, drilling of monitoring wells, geological and hydrological investigations to determine the migration of surface and groundwater, groundwater and surface water sampling and analysis, sampling of local plants and animals that may have accumulated contaminants such as the fish in the Suqi River. This phase of the investigation will usually include collection of samples of the contents of abandoned drums, surface and buried storage tanks, buildings, landfills and other

constructed facilities, such as radar and electrical generating facilities and the soils, sediments impacted by spills or deliberate releases of contaminants.

The RI/FS is an attempt to determine the lateral and vertical extent of contamination as well as to predict where and how contaminants are moving at the various sites. This site characterization which commonly includes gaining an understanding of the natural or pre-impacted site conditions and the effect of the contaminants on the site, determines how the sites will be remediated.

All future remedial decisions will be based on the site characterization conducted during the RI/FS and on the information and interpretation of the data developed during these series of investigations. It is therefore critical that the site characterizations be accurate and complete to determine the most appropriate remedy for each site.

The Feasibility Study phase of the process involves the assessment of remedial technologies that might be used for each of the sites. The choices can range from NFA, left as is, to complete cleanup perhaps including off island disposal and restoration of the site to its near original state. NFA determinations mean the sites will not be dealt with any longer, and no further action will be taken to reduce the level of contamination and no further monitoring of the site will be conducted.

Institutional controls (ICs) are at times recommended to isolate humans and/or wildlife from contaminants as opposed to technologies that isolate contaminants from humans and/or wildlife. These can include the use of fences, signs and other warnings and/or restrictions to ensure people and wildlife are restricted, or at least in the case of humans, notified of the dangers of a specific site or area. For example, signs might be used to warn people to not eat wildlife taken from certain rivers or areas because of elevated contaminant concentrations. ICs are commonly used to keep humans away from the possibility of coming in contact with unexploded ordnance, such as mortar shells, bullets, land mines and other forms of explosives or devices that might be harmful or lethal to living things.

Costs included in the range of possible remedial processes that might be used at each of the sites is fully considered in each remedial option and can range from no costs for some of the NFA sites to millions of dollars if expensive options are selected. Examples of more costly remedial options include onsite or offsite incineration of contaminants or excavation of contaminated soils and off island disposal. Final remedial decisions, therefore, consider costs an essential factor in the selection of the technologies recommended for each site.

Once the Remedial Investigations have been completed and the public has had an opportunity to voice their concerns in writing on the RI/FS report, the Preferred Remedial Action Plan or PRAP will be determined outlining the agencies preferences on the remedial process to be used at the various sites. Once the time for citizen response has elapsed, the agency will review and take into consideration citizen's comments and then issue the Record of Decision (ROD) detailing the responsible agency's decisions on the remediation to be used at each of the sites. The ROD defines the remedial technologies to be used at each of the sites and once issued, they are very difficult to change unless compelling technical reasons can be cited.

Design of the remedial technologies for each of the sites will begin once the ROD has been approved by all involved agencies. Construction for those sites designated for use of active remedial processes will begin once the design phase has been completed. The construction period on St. Lawrence Island will be effected by weather and access and therefore take longer than sites located in more temperate climates. Sites selected for some form of active remediation such as excavation of contaminated soils, air stripping or carbon adsorption of groundwater contaminants, etc. will continue to be monitored to determine the effectiveness of the applied technology. Once a site has been designated for NFA, however, no additional investigation or monitoring will occur and the site will remain unchanged.

The length of time to remediate sites varies depending on a range of factors and many sites will require a decade or more to complete the process. Once the site remedial construction phase has been completed, the post remedial monitoring can last for several decades or more before the remedial process is completed. The post construction monitoring phase is intended to gauge the effectiveness of the technology used at the specific site and might include groundwater, surface water collection and monitoring or possibly soil and sediment and/or biological sampling and analysis.

General Comments

Based on our review of the Proposed Work plan for the 2001 (2000) field season at the Northeast Cape and other reports completed previously, we have reached the following general conclusions. These comments are not site specific, but deal with the overall proposed field activities:

1. Basic physical and chemical parameters should be measured for each new environmental sample collected for analysis. For soil and sediment samples, this should include characteristics such as grain-size distribution, organic carbon, porosity, water content, etc. For groundwater, parameters such as temperature, dissolved organic carbon, dissolved iron, pH, conductivity, and dissolved oxygen should be measured. These factors should be considered in the interpretation of the results and assessments of remedial options.

2. Throughout the report, shallow water is considered non-potable. On what criteria is this determination made? What is the drinking water source(s) for the seasonal community at the Northeast Cape?

3. In many contaminated areas, relatively little regard is given to the vertical extent of contamination. This information is critical in determining the lateral extent and volume of contaminated materials and has direct relevance to remedial measures.

4. Key features on some of the figures provided, including relationships between water bodies and topographic contours, are in error. For example, some water bodies are depicted crossing topographic contours. These discrepancies should be addressed and figures revised in subsequent documents.

5. Human exposure routes at the site are not fully addressed in the available documents, but certainly warrant detailed investigation related to Site 4 and the entire complex. Will a separate document addressing these issues be produced?

6. Sediment core samples should be collected at appropriate points within the Suqi River system, especially if fine-grained sediment is present. These core samples could be used to gain a historic perspective of contaminants contributed to the drainage during military occupation and the lower portions of the core (pre-military occupancy) used to determine true background concentrations.

7. Composite sampling should not be used since it minimizes the maximum concentrations of contaminants and obscures areas with non-detectable amounts of contamination. Given the reliance of contaminant concentrations for the determination of remedial alternatives, composite sampling could lead to the selection of inappropriate remedies or amounts of material for treatment or removal.

8. Drainage basins should be delineated and depicted for the entire Northeast Cape facility. This is critical for understanding the intra-basin distribution of contaminants as well as the inter-relationships between sites.

9. The hydrology of each of the major sites or site groupings should be determined to provide guidance for groundwater sampling and contaminant migration. For example, how does the surface and groundwater hydrology affect the migration of contaminants at sites 13, 15, 19, 27 and 28? An understanding of the hydrology of Sites 14 and 16 would also be helpful to determine potential contaminant migration pathways. The surface and groundwater hydrology of the White Alice sites should also be delineated to allow the assessment of the potential impacts to the tributaries and down gradient areas.

10. Background samples (Site 30) should not be collected from areas in proximity to contaminated sites or former roadways. Background contaminant concentrations can be assessed from dated cores collected from lakes and ponds, as well as from areas known to be outside the influence of former military activities. Given the range of activities at the sites, volume and range of hazardous materials used, documented spills and disposal activities, and time periods involved, background sampling should be conducted at least several kilometers from the site, preferably upwind of the dominant wind direction.

11. It appears the landfills being considered for closure are impacting surface and groundwater. An assessment of leachate volume and composition should be determined for each of the landfills. If volumes or contaminant loadings are significant, collection and treatment may be required to reduce impacts to surrounding areas.

12. An important objective in the overall site assessment at Northeast Cape is to gain an understanding of the lateral and vertical distribution of contaminants at the various sites. This requires that samples of soil, sediment, groundwater, and surface water are sampled and analyzed to delineate the specific areas impacted by contaminants. Only by sampling

outward from contaminated areas until non-detect concentrations are reached can the extent of contamination be accurately determined and delineated.

Congener specific analysis and data should be reported for all future PCB sample collections. This will enable assessment of the potential for migration of the contaminant and whether the PCBs have been altered with time. Congener specific analysis may also prove helpful in identifying the source(s) of PCBs to area streams, such as the Suqi River.**Site Specific Comments**

Sites 1 and 2 – Runway and terminal building

Before sites 1 and 2 can be removed from consideration additional sampling is required. Particularly at site 1 where no samples have been previously taken and where there is reported incidences of waste material that was burned.

Site 3 - Fuel line corridor and pumphouse

The pumphouse is located on an elevated gravel pad and this pad contains diesel range organics (DRO) and total residual petroleum hydrocarbons (TRPH) at levels exceeding ADEC benchmark criteria. The direction of groundwater flow in this area is assumed to be northerly, but no data is available to support this. We suggest placing well points or monitoring wells directly west and downhill of the pumphouse to test the possibility of groundwater contaminant migration in this direction related to site activities.

Is the use of well points adequate to determine groundwater hydrology for this site? The two-foot screened intervals used in well points may be inadequate for seasonal fluctuations of water levels.

Low levels of PCBs were also detected at this site. Why isn't further PCB sampling planned associated with the present work plan activities? Is it justifiable to assume the highest PCB concentrations were in the collected sample?

Considerable lead was detected in environmental samples at this site. Will delineation of lead concentrations and distributions be part of the work plan?

There is a surface drainage immediately to the east (~100 feet) of site 4 and it may serve as a contaminant pathway. Should water and/or sediments be collected from this drainage?

Although the PCB levels are lower than the benchmark level of 1000 ug/kg, a value of 750 ug/kg was reported from the gravel pad at location SS-102. This value apparently indicates the use and spillage of PCBs at this locality. Are there any plans to investigate this further? Given the likelihood of gravity-driven PCB product migration through coarse materials, is there the potential for additional PCB contamination at depth and laterally?

Site 4 - Subsistence fishing and hunting camp

Since the present and future use of this area by residents of St. Lawrence Island is assured, additional data is needed to assess the extent of contamination. In particular, since reuse of some abandoned materials from the military facilities has occurred, sampling in and around seasonal structures may be justified. Exposure routes involving the use of hazardous materials by island residents for fuel, lubricants, insulation, and heating are of concern and may have led to the contamination of the interior of seasonal structures. In addition, the recycling of containers, a valuable commodity in remote areas, could also have caused inadvertent exposure to a variety of hazardous materials, particularly if used for storage of food stuffs or potable liquids. In addition, walking across contaminated areas may also result in the transportation of dust and dirt into indoor structures. Wipe tests, inspection of seasonal structures, and sampling of soil in main foot traffic ways in the temporary residences would be useful in determining the extent of contamination related to inadvertent exposure to hazardous materials.

TRPH concentrations of 47,000 mg/kg at locality SS-108 indicate substantial spillage occurred at this site. Additional soil samples west and north of the site in the small drainage that parallels the road, appear necessary for defining the lateral extent of contamination. Additional sampling is needed to determine the vertical extent of contaminants.

Site 5 - Cargo Beach

Sample SS 100 taken just down slope from a 55-gallon barrel cache (275 barrels) near the west end of Cargo Beach, had DRO levels of 260 mg/kg and TRPH levels of 1790 mg/kg. Is any follow up sampling planned to further define the extent of contamination and determine the amount of soil required to be excavated as proposed by the Phase II Remedial Investigation Remedial Action Alternatives Technical Memorandum? Have the drums been removed? How far is the site from the shoreline? Are seasonal residences located nearby? Is it possible this site is contributing contaminants to the coastal waters by groundwater migration through the beach deposits?

Site 6 - Cargo Beach Road Drum Field

Since the contaminants identified are at least partly related to the drum field, why not remove the drums and contaminated soils before any further additional action, including additional field sampling? The range and concentrations of contaminants in the ephemeral (periodically flooded) pond west/northwest of the drum field are considerably elevated suggesting direct or indirect contaminant migration by surface and/or groundwater flow.

The analysis of sediment conducted at this site had a very high detection limit for PCBs of 1.1 and 16.6 mg/kg. What is the reason for such an elevated detection limit? It seems appropriate to resample these areas. PCB analysis should be reported on a congener specific basis to verify the Aroclor or Aroclors present.

Since the drum field is located on or forms a hill, the ponds to the north and south of the drum field should be core sampled, sectioned, dated, and analyzed.

Site 7-Cargo Beach Road Landfill

Note that the ponds cross topographic contours. A better understanding of the surface and groundwater migration is needed. Radial drainage from the elevated site is likely thereby potentially distributing contaminants over a broad region from the source(s) area (s). Core samples from surrounding ponds should be taken to define the vertical extent of contamination. As with Site 6, an assessment for the potential for leachate generation and migration from this landfill is needed. Note from the site map, that there is a suggested drainage way to the northeast along the Cargo Beach Road, as well as drainage to the southwest, also paralleling the road. The road therefore has a major influence on surface and possible groundwater drainage. It is therefore important to determine the surface drainage and subsurface hydrology of the site before attempting to define a sampling program to determine contaminant migration.

Mercury and PCBs were detected in groundwater, but not in the sediments collected from the same sampling site locations. Normally, there is a higher concentration of these substances found in sediments or soils as opposed to water because of their limited solubility and affinity for sediment. One possibility is that these contaminants are derived from contaminated sediments from another location and the contaminants have migrated to the site in groundwater. Additional sampling should attempt to clarify this issue.

Lateral and vertical sampling of the drum field should be conducted to determine whether removal of the drums would reduce the mass of the contaminants at this site.

Site 9-Housing and Operations Landfill

Contours are not in conformity with surface drainages. Drainage swales or intermittent flows should be sampled.

Is the site contributing leachate to the surrounding surface and groundwaters? Is there need to establish a leachate collection and treatment system? A sampling protocol should be established to determine leachate composition, quantity, and migration pathways.

This landfill has impacted surface water as evidenced by the presence of DRO contaminants in three adjacent pond samples and the landfill does not appear to meet the ADEC criteria for closure.

Sites 10 and 11 - Buried Drum Field and Fuel Storage Tank Area

Although not part of this work plan, the failure to locate 29,500 drums reputedly buried at Site 10 using a geophysical survey makes one wonder where else these drums might be. Are there any future plans to investigate other potential drum burial areas? This number of drums could imply the potential for massive contamination, if only a small percent of drums were buried containing liquid.

Sites 13, 15, 19, and 27 - Main Operations Complex

Definition of surface drainage and groundwater is required to ensure that proposed sampling will be effective. The effect of the drum field (site 27) on site 28 needs to be determined. Samples collected at the toe or base of the filled area indicate significant concentrations of DRO. The lateral and vertical distributions of these contaminants need to be determined. Sampling of soils and groundwater should be conducted to define the extent of contamination related to the drum field.

It might be useful to have one or more monitoring wells north of sites 13 and 27 to sample groundwater down gradient of these sites. These wells should be located within the boundary of adjacent site 28 for which no wells or well points are currently planned.

Site 14 - Emergency Power and Operations Building

What measures will be taken to define PCB contamination at depth? This information is critical for selecting proper remediation alternatives or determining how much soil might need to be managed.
Given the location of the three transformers in Building 98 and PCB-contaminated soil directly outside the building, additional wipe samples near the transformers should be collected to insure the contaminant free (<standard) status of the building's interior?

Site 16 - Paint and Dope Storage Building

Additional sampling to determine the source of high metal (Pb, Zn, Cr) levels in groundwater and soil seem more appropriate than focused sampling for a known and common laboratory contaminant (bis-(2-ethylhexyl)phthalate).

No sampling planned near the power plant. Detection limits seem very high for PCBs in water and there seems to be considerable PCB and lead contamination. What are the sources, as well as the lateral and vertical extent of contamination. It would be helpful if isopach (equal concentration) maps and cross-sections could be prepared from data sets depicting the concentrations of the contaminants, which include the lateral and vertical changes.

Site 28 - Drainage Basin

Is the Suqitughneq (Suqi) River used, or has it been used, for subsistence fishing or as a potable water source by seasonal residents? If so, it seems appropriate to also sample the water in this drainage, as well as, the sediment. Water samples should be analyzed for a range of organic and inorganic contaminants identified in tributaries to the Suqi, including congener specific PCBs. Since this drainage (the Suqi) can be impacted by a number of sites including 9, 13, 14, 15, 16, 19, and 27, it seems prudent to sample the water at the 2001 field sampling selected sediment locations.

There is considerable concern about the PCB concentrations identified in the composite samples of edible fish collected and analyzed from the Suqi River. ATSDR's primary criticism of the sampling protocol was that composite samples were used for analysis. The rationale for the use of composite samples was that the fish were too small for the sampling of fillets and therefore

required that more than one fish sample be used to make up the necessary amount of tissue required for analysis.. The planned field sampling scheduled for the Suqi should include the resampling and analysis of individual fish species for congener- specific PCB analysis and for trace metals identified within the Suqi River subdrainages. The edible portions of individual fish should be analyzed for congener-specific PCBs, as well as, select trace metals including, but not limited to lead, mercury, zinc, chromium and others.

Site 30 - Background Areas

Given the lengthy occupation of the site by the military and widespread use, disposal, and spillage of a variety of contaminants in the general area, it seems unlikely that 'background' samples taken near site roadways, runway, or formerly occupied areas can truly represent background concentrations of contaminants of concern. Meaningful background samples should be taken from undisturbed areas well removed from base activities. An alternative would be to collect, section and analyze dated sediment cores sampled from a series of small lakes and ponds located within the same geologic setting, but distant (1-2 miles) and upgradient and upwind of prevailing wind directions from areas of former military use. Analysis of the core sections would be reflective of the changes in contaminant concentrations with time including those that existed before military occupation and use of the Northeast Cape .

Site 31 - White Alice Site

We know little about the surface and groundwater drainage of this site. Is it possible contaminants are moving offsite in surface and/or ground waters? The hydrology of the site should be determined and a sampling protocol developed based on the surface and groundwater flow and movement.

How will the building composite sample be taken? As noted earlier, we believe composite sampling should not be used and recommend that individual samples be collected and analyzed separately.

Given the PCB soil concentration of 1.6 mg/kg southwest of transformer bank #1, Building 1001, we recommend additional surface soil samples from this locality to determine the full lateral and vertical extent of PCB contamination. We also suggest the lateral sampling be extended beyond the proposed grid. At the southeastern border of the grid, the concentration identified in the 1992 sampling and analysis is 1 mg/kg. What assurance is there that higher levels do not occur outside the original grid? Additional samples should be collected and the soils characterized relative to grain-size and organic carbon. Soil samples should be taken southwest of the proposed sampling grid depicted on Site 31 Proposed Sampling Locations (Figure 2-12).

Site 32 - Lower Tram Terminal

The use of part of this site as a generating and storage facility suggests considerable potential for the release of contaminants. A more thorough sampling regime should be established to ensure soils and groundwaters have not been impacted by organic and inorganic contaminants.

Site 33 - Upper tram Terminal

How will the building composite sample be taken? Again, we recommend composite sampling be avoided.

Site 34 - Upper Camp

The drum field should be sampled more thoroughly and beyond the drum field borders to learn more about off-site contaminant migration. Surface and groundwater flow patterns should be defined. The depth of contamination in sampled soils should be determined.

2001 Workplan Objectives

Page 1-1 of the 2000 (2001) Draft Work Plan states:

"Further investigation of some sites at Northeast Cape is necessary because (1) the extent of contamination has not been adequately defined to perform risk assessments and feasibility studies for some sites; and (2) the White Alice Communications System (WACS) recently became eligible for investigation and cleanup under the DERP-Formerly Used Defense Sites (FUDS) program. Although WACS has been investigated in the past, there are data gaps."

Data objectives listed on Page 1-2 of the Work Plan are:

1. Determine the volume, including depth and areal extent, of contaminated soil/sediment at Sites 6, 13, 14, 15, 19, 27, 28, 31, 32, 33, and 34.

2. Assess whether Sites 6 and 9 meet Alaska Department of Environmental Conservation (ADEC) criteria for landfill closure.

3. Characterize background concentrations of organic and inorganic analytes in gravel soil, tundra soil, sediment, and groundwater.

4. Perform hydrologic characterization studies for Sites 3, 4, 6, 7, 9, 28, and the Main Operations Complex.

5. Complete and update previous human risk assessments for Sites 4, 10, 11, 13, 16, 19, 21, 27, and 28.

6. Prepare human health risk assessments for Sites 3, 6, 7, 9, 15, 29, 31, 32, 33, and 34.

7. Complete and update previous ecological risk assessment for Site 28.

8. Prepare ecological risk assessments for Sites 3, 4, 6, 7, 9, 21, 29, 31, 32, 33, and 34.

9. Develop alternative cleanup levels (ACL) or risk-based cleanup levels (RBCLs), as appropriate.

Objective 1. The goal of additional sampling is to determine the volume, including depth and areal extent, of contaminated soil and sediment.

Site 6 - Elevated levels of TRPH and DRO are found in soil and sediment samples at the margins of the approximate area of distressed vegetation or stained soil. Therefore, the only closure to the documented surface contamination on site comes from subjective interpretation. No further soil sampling is planned for 2001.

Sites 13, 15, 19, and 27 - The lateral and vertical extent of contamination has not been identified by the soil sampling completed too date. For example, soil sample SS180 is located on the boundary of Sites 27 and 28 yet contains some of the highest TRPH and DRO concentrations identified. The extent of PCB contamination has also not yet been defined. No further soil sampling is planned for 2001.

Site 14 - Given the occurrence of transformers in Bldg. 98 and soil contaminated with PCBs outside of the building, is one non-detect (ND) wipe sample result inside the building sufficient to characterize the building's interior?

Site 28 - Planned sampling appears adequate. Will ecological sampling be conducted? There is a need to effectively assess the ecological status of the Suqi relative to the impact of the 1969 fuel spill as well as the effects of the elevated PCB concentrations in the Suqi waters, sediments and biota.

Site 31 - PCB soil contamination adjacent to the Bldg. 1001 transformer bank is at levels of 1 mg/kg or greater at several locations near the original sampling grid boundary. Why not use the proposed soil samples to define the extent of PCB contamination by encircling the grid? Are any studies to define the depth of contamination planned for areas adjacent to Transformer Bank No. 1?

Site 32 - A composite sample taken inside the tram terminal building will yield an average value that does not help in defining areas of PCB contamination exceeding regulatory action levels. We support the sampling of discrete areas within the building as opposed to composite sampling.

Site 33 - A composite sample taken inside the tram terminal building will yield an average value which does not help in defining areas of PCB contamination exceeding regulatory action levels. We support the sampling of discrete areas within the building.

Site 34 - To adequately define contamination in the drum dump field, the depth of contamination is needed in order to gain an understanding of the extent of contamination at this site. Are there plans for test pits or borings to determine the depth of contamination? Additional PCB sample should be taken just east of grid sample 5Z (Transformer Bank 3) where levels of 1.4 mg/kg were previously measured.

A composite sample taken inside buildings 124 and 221 will yield an average value, which does not help in defining areas of PCB contamination exceeding regulatory action levels. We support the sampling of discrete areas within the building.

Sites 31-34 - The White Alice sites lack any consideration of groundwater contamination. Is this related to the lack of soil in this area or to other factors?

Objective 2. The proposed sampling at Site 6 will not define the extent of contamination and therefore cannot provide the data needed to evaluate closure.

Objective 3. Background samples should be taken from areas well removed from all Northeast Cape facilities and influence. The proposed sediment, soil, and well point locations are too close to the facility to truly represent background. Given the range in concentrations found in natural materials, more samples are required, particularly if the goal is to adequately characterize different soil and sediment types. Information on grain-size and organic content is clearly needed on each soil or sediment sample analyzed.

Objective 4. None of the sites can be adequately characterized in terms of hydrology by the proposed monitoring well/well point installation plans. Several problems exist including the lack of piezometric data, lack of subsurface data or cross-sections, influences related to undefined permafrost conditions, and the lack of data to assess seasonal or long-term variabilities.

The proximity of the sites strongly suggests that groundwater contamination has crossed site boundaries and requires the placement of monitoring wells without regard to site boundaries. For example, none of the wells proposed for the Main Operations Complex are located within the boundaries of Site 28, the area most likely to be impacted by subsurface contaminant migration from Sites 13, 15, and 27, as well as, drums along Site 27's northern boundary. Some attempt needs to be made to define the extent of site related groundwater contamination on a site wide basis. A series of wells placed down gradient of the Main Operations Complex, Sites 6 and 7, Site 3, and Site 31 would help define the extent of groundwater contamination related to areas of maximum use and disposal/spillage at the site.

Objectives 5-8. Risk assessments for each site depends on the data provided from various on-site media and thus will depend heavily on the data collected to define the extent of contamination (Objective 1). Thus, it is critically important to define the limits (lateral and vertical) of contamination at all the sites, effectively characterize off-site background concentrations, and determine actual, rather than averaged (composited), concentrations whenever possible.

Recommendations

1. Background samples should be taken from areas far enough removed from facility activities or to insure they actually represent background values. The number of background samples collected and analyzed should be numerous enough to represent natural variability and similar enough to the materials sampled on site to be directly comparable.

2. The extent of soil/sediment contamination at a number of sites is not adequately defined laterally or vertically. Samples should be located in areas that will allow unequivocal definition of the extent of contamination. Judgements strictly based on field inspections are subjective and should not be used when the outermost samples taken are still highly contaminated.

3. The hydrology of the sites is poorly characterized and defined because of the complexity of the geology and hydrology of the various sites, site interrelationships as well because of the alterations created by previous military activities including construction of buildings, roadways, landfills, storage facilities as well as the disposal and spill of contaminants. Groundwater sampling programs that are designed to evaluate the extent of contaminant plumes are more useful than limited site-specific investigations. A plan for coordinated site-wide groundwater and subsurface investigation is needed. Several areas, including the Main Operation Complex, warrant detailed groundwater investigation because of the analytical results obtained, historic use, and recorded spills that have impacted the area.

4. Evaluation of analytical data should include consideration of the collected sample's physical characteristics. Contamination in gravel suggests gravity-driven vertical migration of contaminants will result with the potential that the concentrations of the contaminant(s) will likely be elevated in associated finer-grained materials that underlie or lie adjacent to the sampled gravel pads. It is well known that finer-grained, organic soils and/or sediments will normally contain higher concentrations of contaminants relative to coarser grained material sampled from the same environment.

5. We do not support composite sampling. Composite samples provide contaminant averages and hence obscure and/or minimize 'hot-spots' while masking uncontaminated areas.

6. Data from intact sediment cores within or adjacent to the Northeast Cape facility would be invaluable in establishing pre-military occupation contaminant levels, changes related to activities at the site, and/or reductions in contaminants since site demobilization (natural attenuation). If suitable sampling sites can be found, we recommend a retrospective study of this nature be conducted to gain a better understanding of background concentrations as well as provide an historical perspective on military occupancy related to contaminant impacts.

7. Since the Northeast Cape is occupied for seasonal traditional food gathering activities, any risk assessments or remedial activities done must take this into account. More information regarding the use of the site, drinking water sources, and potential exposure pathways of the defined sites at Northeast Cape related to seasonal camp use are needed before realistic risk assessments can be completed.

8. Landfill closure at Site 6 should not be considered until the extent of contamination is defined by analytical results.

9. If at all feasible, groundwater sampling and migration pathways at the White Alice site, particularly the drum dump field at Site 34, is needed.