6. CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The following bullets summarize the general conclusions of the Phase I RI of high-priority AOCs at the RVAAP:

- Load Lines 1, 2, 3, 4, and 12 appear to be the most highly contaminated AOCs investigated during the Phase I RI at RVAAP. In these areas, soil concentrations of explosives, primarily 2,4,6-TNT, are several order of magnitude greater than soil risk-based screening levels. Maximum TNT concentrations in the load lines area soils range from 5,800 mg/kg (Load Line 1) to 390,000 mg/kg (Load Line 3). TNT concentrations (maximum 2.2 mg/kg) in soil samples at Load Line 4 were slightly above the risk screening level of 1.5 mg/kg.

- Demolition Area #2 and the Winklepeck Burning Grounds contain contaminant concentrations in soils that clearly exceed risk-based screening levels.

- Contamination at the Landfill North of Winklepeck Burning Grounds, Upper and Lower Cobbs Ponds, and Building 1200 is limited to a small number (<2) of inorganic compounds occurring at low concentrations (<2 mg/kg) but exceeding risk-based screening levels. Low levels of explosives (<1 mg/kg) were also detected in sediments at Building 1200 and Cobbs Pond.

- Because of the sporadic and isolated occurrence of contamination, contaminants do not appear to be migrating horizontally away from soil to adjacent soils and sediment. Further, based on the Phase I RI groundwater assessment, contamination does not appear to have reached to the water table at the perimeter locations sampled in significant concentrations.

- Perimeter groundwater monitoring at Load Lines 1 and 2 suggests that contamination may not be migrating from the RVAAP facility via groundwater at these locations.

- Manganese appears to be elevated throughout the AOCs in sediments and groundwater. It has not been determined whether the elevated manganese reflects relatively high background levels in the region or actual site-related contamination; however, sampling in source areas does not indicate elevated manganese in the source area soils.

- Beryllium was identified as a COPC for several AOCs; however, the risk-based screening values for beryllium are extremely conservative, e.g., less than observed background levels.

- Re-prioritization of the RVAAP high-priority AOCs using Phase I RI data and the DoD Relative Risk Evaluation Methodology indicates the following priority of AOCs:

  High Priority

  Demolition Area 2 (RVAAP-04)
  Winklepeck Burning Grounds (RVAAP-05)
  Load Line 1 (RVAAP-08)

Load Line 2 (RVAAP-09)
Load Line 3 (RVAAP-10)
Load Line 4 (RVAAP-11)
Load line 12 (RVAAP-12)

Medium Priority

Building 1200 (RVAAP-13)
Landfill North of Winklepeck Burning Grounds (RVAAP-19)
Upper and Lower Cobbs Ponds (RVAAP-29)

Provided below is a summary of Phase I RI results for each individual AOC.

6.1.1 Demolition Area #2

- Explosives and several inorganic compounds were detected frequently in both the surface and subsurface soils at Demolition Area #2. Detected contaminants occur predominantly in the southern portions of the AOC and at the old OD area. Non-explosive organics were not detected in the soils.

- Explosives appear to be similarly distributed in both surface and subsurface soils.

- Concentrations of inorganic compounds in sediment appear to be within background values. No soil-related organic chemicals were detected in stream sediments downgradient/ downstream of the AOC; therefore, it is assumed that contaminants are not migrating away from the AOC via surface runoff.

- No Phase I RI groundwater samples were collected at this AOC.

- Several inorganics exceeded at least one soil risk screening value; however, many of the exceedances were based on the comparison to "leaching to groundwater" screening value.

6.1.2 Winklepeck Burning Grounds

- Several discreet areas of elevated explosive, inorganic, and inorganic compounds were detected at the Winklepeck Burning Ground. These areas are:

  — near the burning trays in the east-central portions of the AOC;
  — south of Pallet Road A, West,
  — south of Pallet Road E, West, and
  — south of Pallet Road E, East.

- The highest concentrations of explosives were detected south of Pallet Road E, East.

- Cadmium and lead were detected frequently above background concentrations and appear to be co-located in existence.

- No Phase I RI groundwater samples were collected at this AOC.

- There does not appear to be widespread migration of contamination from soils to sediments at this AOC. Low concentrations of explosives (<1 mg/kg) and manganese above background concentrations were detected in sediment samples taken north of the RCRA burning trays. No other sediment samples indicate the presence of site-related chemicals.

- Explosives (TNT, DNT, TNB, RDX) and several inorganics exceed risk screening values for soils at this AOC.

6.1.3 Load Line 1 and Dilution/Settling Pond

- Elevated concentrations of explosives, inorganics, and organics occur in the central portion of the load line complex, particularly around the doorways, drains, and vacuum pumps associated with the melt/pour buildings, Buildings CB-3A and CB-101, and near the main concrete settling tank adjacent to LL1mw-063.

- Maximum concentrations of inorganics are higher in Load Line 1 soils than any other AOC investigated during the Phase I RI.

- Unlike soils, concentrations of metals and explosives in sediment do not exhibit a pattern of distribution.

- Metals and several organic compounds were detected in groundwater. No explosives were detected in the locations sampled near the perimeter of the AOC.

- Several explosives were detected in soils above risk-based screening levels. The maximum detected TNT value is over 5,000 times greater than the residential screening level. Several metals, PAHs, pesticides and one PCB also exceed risk screening levels. All detected non-explosive organics were found at low concentrations (≤1 mg/kg).

- Explosives and pesticides were not detected above risk-based screening levels in sediment; however, many of the same inorganics and a few of the PAHs detected in soils were detected above sediment risk-based screening levels.

6.1.4 Load Line 2 and Dilution/Settling Pond

- Elevated concentrations of explosives, inorganics, and organics occur in the central portion of the load line, particularly around the doorways, drains, and vacuum pumps of the melt/pour buildings and other buildings.

- Several explosives were detected in soils. The maximum concentration of TNT was 12,000 mg/kg. Several inorganics occur at concentrations above background values.

- Explosives, inorganics, and PAHs/PCBs were observed in the drainages leading to Kelly's Pond and in pond sediments, but these do not appear to be exiting Kelly's Pond.

- Concentrations of DNT were found in groundwater < 1 $\mu g/L$. Metals were also detected. Most other chemicals found in soil and sediment do not appear to have migrated to groundwater.

- Several explosives, inorganics, pesticides/PCBs, and PAHs exceed the risk screening levels for soils. Explosives concentrations in soils are even higher than at Load Line 1; TNT occurs at almost 10,000 times greater than the residential screening level.

- Three metals (copper, silver, and zinc) were detected in sediments slightly above ecological screening levels in sediment. PAH concentrations in sediments exceed risk-based screening levels by an order of magnitude.

- DNT was detected in groundwater at this site (Table 5.10), the only detection of any explosive in groundwater during Phase I sampling. The detected concentration exceeds risk-based screening levels for groundwater. All detections of metals were below risk-based screening levels.

6.1.5 Load Line 3 and Dilution/Settling Pond

- Elevated concentrations of explosives, inorganics, and organics occur particularly around the doorways, drains, and vacuum pumps of the melt/pour buildings and other buildings.

- Explosives occur at high concentrations in soil (maximum TNT concentration 390,000 mg/kg). Chromium, copper, and lead occur at concentrations in excess of site-related background criteria and USGS reference values.

- Explosives occur at moderate concentrations in sediment (maximum concentration of TNT is 4.6 mg/kg), especially in ditches around the melt/pour buildings. The highest concentrations of metals in sediments occur at or near Building EB-4 and in the drainage channel leading to Upper and Lower Cobbs Ponds.

- No Phase I groundwater sampling was conducted.

- The highest concentration of TNT in soil is almost 100,000 times greater than the residential soil screening value. The maximum detected lead soil concentration was 2,620 mg/kg. The residential screening level is 400 mg/kg; the industrial screening value is 1,200 mg/kg.

- TNT was detected in six of nine sediments samples at concentrations below the soil risk-based screening levels. Silver and zinc detections in sediments exceeded ecological screening criteria. These exceedances may represent a systematic problem with the screening values themselves, e.g., the screening value for silver (1.8 to 2.2 mg/kg) is within the range of USGS values for silver in background soils (0.7 to 5 mg/kg) (Shacklette and Boerngen 1984).

6.1.6 Load Line 4 and Dilution/Settling Pond

- Explosives, inorganics, and organics were observed concentrated around buildings G-12, G-12A, G-8, and G-13 (the melt/pour buildings), as in other load lines.

- Pond sediments contain elevated concentrations of inorganics, but not explosives or organics. Ditch sediment samples contain inorganics also, but at lower concentrations. Cadmium, lead, and zinc were the most prevalent metals.

- No explosives or organic compounds were detected in groundwater, but several inorganics were detected in at least one groundwater sample.

- Explosives were detected slightly above the soil risk-based screening level of 1.5 mg/kg. Several inorganics were detected above risk screening levels, with manganese being the most prevalent.

- The only chemical detected above groundwater screening levels at Load Line 4 is manganese.

- There are no COPCs in sediment at Load Line 4.

6.1.7 Load Line 12 and Dilution/Settling Pond

- Explosives, inorganics, and organics occur at elevated concentrations in soil throughout this AOC. Explosives are concentrated around the Building 904 (demilitarization facility), Building 900 fertilizer/demilitarization operations facility, and the Nitrate Settling Basin and Filter Bed facility. Inorganics are also concentrated at these three areas and Building FF-19. Other organic contaminants detected include PAHs in the Building 904 area, and pesticides/ PCBs in the vicinity of Buildings 900 and FF-19.

- Sediments also exhibited elevated concentrations of explosives, inorganics, and organics. Explosive concentrations were several orders of magnitude lower in sediment than in soil, and the maximum concentration was detected in the area of the Nitrate Settling Basin and Filter Beds. The maximum concentration of many inorganics and organic compounds was in the sample adjacent to Building FF-19.

- There does appear to be some migration of contaminants in sediment, with likely sources at Buildings 904, 900, FF-19, and the Nitrate Settling Basin and Filter Beds. The extent of sediment contamination was not determined at this AOC during the Phase I RI, but appears to extend beyond the AOC boundary.

- As with the other load lines, several explosives are present in soils at levels that greatly exceed screening levels. The maximum TNT concentration is 19,000 mg/kg. Cadmium, lead, and several other metals are present at levels above risk-based screening levels.

- Low levels of pesticides/PCB and PAHs were detected in soils, some which exceed screening value. Most of these values are low ($\leq$1 mg/kg).

6.1.8 Building 1200 and Dilution/Settling Pond

- No widespread contamination was detected in soil at Building 1200. No inorganics were detected above background values, and no explosives were detected in soils. PAHs were detected in one soil sample analyzed for organic adjacent to Building 1200.

- Low concentrations (< 1 mg/kg) of explosives were detected in the drainage sediments leading from Building 1200. Inorganics were below USGS values in the sediments.

- Low levels of explosives were observed in the settling pond sediments.

- The risk screen identified two COPCs in soils: beryllium (which was below the background screening values) and benzo(a)pyrene. The detections that caused the exceedances are both < 1 mg/kg.

6.1.9 Landfill North of Winklepeck Burning Grounds

- No widespread organic contamination was detected in the nine trench samples from the landfill area. Low levels of pesticides and PCBs (e.g., < 0.1 mg/kg) were detected in some samples.

- A single inorganic was detected in soil slightly above the risk screening level (110 vs. 100 mg/kg).

- Scattered detections of inorganic were observed above background in sediments from drainage leading to and from the beaver pond north of the landfill with the highest concentrations occurring downstream of this pond.

- There does not appear to be a defined source of contamination or evidence of contaminant migration in the area.

- The risk screen identified beryllium as a COPC in soil, although the concentrations detected (< 1 mg/kg) were below the USGS reference value.

6.1.10 Upper and Lower Cobbs Pond

- Several inorganics were detected above soil background values in the Upper and Lower Cobbs Pond sediments, primarily in the center of each pond. This may be a result of sediment settling and accumulation. There is no clear distribution pattern of the various metals.

- Explosives were detected in a single pond sediment sample, with a concentration of 0.38 mg/kg TNB.

- Manganese was detected in groundwater and in sediments adjacent to the stream exiting Lower Cobbs Ponds. These detections exceed screening value for both media. It has not been determined whether the manganese is naturally occurring or process-related.

6.2 RECOMMENDATIONS

The following bullets summarize general recommendations for follow-on activities at the AOCs investigated:

- Conduct a Phase II RI to determine extent of soil and sediment contamination at high- and medium-priority AOCs as defined by Phase I RI, and collect data (i.e., geotechnical soil properties, contaminated material volumes, aquifer testing, etc.) to support development of an FS, if necessary, at these AOCs.

- Evaluate groundwater within and immediately downgradient of known secondary (e.g., soils) source areas within high- and medium-priority AOCs as defined by Phase I RI.

- Evaluate background (soil and groundwater) conditions at each AOC requiring further investigation.

- Further evaluate potential off-site (facility) contaminant migration potential via groundwater at other high-priority AOCs located adjacent to the facility boundary (e.g., additional perimeter monitoring).

- Evaluate potential off-site contaminant migration potential via surface water and sediment pathways from high-priority AOCs studied during the Phase I RI (e.g., perimeter monitoring).

- Perform a BRA (human health and ecological) including Ecological Assessment of the RVAAP facility to support decision making regarding environmental conditions and remedial alternatives at RVAAP.

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