# II. PCB REMEDIATION

## A. General

Remediation work to remove CEPA soils continued this year with the excavation of about eighty percent of the S1/S4 Beach Area. Three small CEPA areas in the S1/S4 Valley were found and excavated this year. Tier II soils were removed from large areas in the S1/S4 valley by scraping the surface soils into stockpiles. The Tier II soils in these stockpiles will be transported to the Tier II landfill in 2005 as the construction of landfill berms and liners was only completed at the end of the 2004 field season. The excavation work is described in Sections C and D for the S1/S4 Beach and S1/S4 Buildings and Valley Areas respectively. Section B describes the methodology used in this work. QA/QC relating to the analytical work is given in Chapter III, section N

## B. Methodology

### *1. Excavation*

#### a) CEPA Soils

The following is the general methodology that was used to excavate CEPA soils.

Ropes and spray paint of various colours were placed on the ground to indicate the extent of PCB contamination at the >2000 ppm (green), CEPA (yellow), Tier II (blue) and Tier I (pink) levels. Spray paint was found to be more useful when heavy equipment was working in the vicinity. CEPA soils were excavated and taken to the screening plant. Material not passing through the screener was classified as Tier II and stockpiled. The CEPA material passing through the 2 inch screen was classified as CEPA soil and taken to the main PCB storage facility. At the PCB storage facility the soil was placed into conical steel containers. After excavating to the depth indicated from the sampling/analysis work, generally 30 cm, the soil in the area was tested to ascertain if its concentration was now below the CEPA criterion. If not, further excavation was carried out. The soils were dug up with an excavator equipped with a bucket or clam. However, in many areas the bedrock needed to be further cleared of PCB-contaminated soils which could not be excavated with heavy machinery. This was achieved by shoveling by hand and by using a vacuum truck.

Decontamination centers were set up for personnel at all locations where contaminated soils were being dealt with. The large decontamination trailer was used at B2 where containers were being filled. Smaller units comprised of containers of wash water and supplies of personal protective equipment were used elsewhere. The personal protective equipment used is given in the Health and Safety Plan and was described fully in the 1999 ASU report. Tyvec suits, gloves and rubber boots were always worn when working in contaminated areas. In general, half-faced respirators were used whenever the odour of Askarel (PCB mixture) was encountered; dust masks were worn whenever it was dusty.

b) Tier II Soils

This year the ASU produced a "Resolution Island Excavation Protocol for Tier I and Tier II Soils". A copy of this is included as Annex A at the end of this chapter.

All Tier II soils are to be removed and placed in the Tier II landfill. This year some Tier II soils were excavated and placed in stock piles because the Tier II landfill was not ready to receive them. Soils were removed by heavy equipment by taking off the first 0-30 cm. A composite sample of the excavated area was then taken and analyzed. If necessary excavation was continued by taking off 30 cm at a time until the remaining soil is < 5.0 ppm PCBs or bedrock was reached. All soil which could be safely removed by heavy equipment was removed.

No Tier I soils were excavated this year.

*2. Sampling*

Soil samples were collected using plastic scoops and placed in WhirlPak bags. Discrete sampling locations were marked with a six inch nail to which was attached a numbered metal disk and a piece of flagging tape. However, most soil samples taken this year were composite samples for areas that had been excavated. The size of the areas from which composite samples were taken depended on the overall size of the area excavated, and the terrain. The general guidelines were to take four confirmation samples per quadrant or to sample 3 m by 3 m areas depending on the topography. Tables containing the analytical results cross reference sample numbers with location. Soil samples were generally restricted to the upper 10 cm but in order to determine the depth of contamination, test pits were also excavated (manually and by machine) and samples collected at specific depths.

Water samples for PCBs were collected in 1 L Teflon bottles or 1 L glass bottles with teflon lined lids. Absorbent boom material was collected by cutting open a small section of boom and extracting some material by hand. The absorbent material was placed in WhirlPak bags. Care was taken to extract boom material from the center of the boom to avoid material that was in direct contact with contaminated soil (this barrier work is reported in Chapter III, Section H).

Most samples were analysed on site in the mobile laboratory. Other samples were shipped by air freight to Queen's University for testing. In order to conform with regulations regarding sample control, a rigorous chain of custody was maintained. Chain-of-custody forms were filled out and checked for each sample before shipment from the North, and the contents of shipments were verified upon receipt in the laboratory. The relevant documentation is available on request.

### *3. Mapping*

A 20 x 20 m grid system, graphically constructed using Autocad Map 2000 was established for both the S1/S4 Beach and S1/S4 Valley and Buildings Areas. For the S1/S4 Beach Area, the grid was labeled 3 to 9 grid in a N/S orientation and B to G in a W/E orientation. For the S1/S4 Valley and Buildings Area the grid was labelled A to S in a N/S orientation and 1 to 25 in a W/E orientation. Each grid reference relates to the bottom right hand corner of the relevant 20 x 20 m square. The co-ordinates required to set-up the grid were exported to a Reliance mapping program and uploaded as a waypoint file to a GPS FS/2 handheld controller unit. On Resolution Island, the Ashtech Reliance differential GPS mobile receiver system was operated in 'rover mode' which allowed navigation to the individual grid points to within 1 m accuracy. Individual grid points were marked with flags and an "X", using spray paint. The grid co-ordinates were marked in several locations within the confines of the grid, on available surfaces and rocks. This provided a convenient reference point for workers and provided the scientific team with an accurate method of documenting the cleanup process.

Three map binders were constructed for each of the two areas. The first contained individual maps for all the quadrants containing PCB contaminated soil. These maps included colour coded contamination levels, previous sampling locations, tag and sample numbers and rope locations pertaining to the site as it appeared at the beginning of the field season. When any sampling or excavation occurred in a grid, the details were recorded on a quadrant log sheet and were sketched onto the relevant map. Where

possible, samples were restricted according to the grid lines and sampling areas did not cross grid lines. Ongoing map and log sheets were placed in a second binder 'Map Work in Progress'. A new map was used and updated for every day work occurred in that grid. When the grid had been excavated such that any remaining soil tested was less than the appropriate criteria, or was completely removed, the quadrant log sheet was dated and signed by a Queens Representative (Team Leader), an Engineering representative and a QC representative (Site Supervisor). All of the individual maps for that quadrant were attached to the log sheet and transferred to a third binder 'Completed Map Quadrants'. Copies of the completed documents were given to the engineering company (Sinanni) and to the Qikiqtaaluk Corporation. Copies of all quadrant log sheets completed this year are included in Chapter VII: Appendix.

### *4. PCB Analysis*

Two methods were available at Resolution Island to analyze for PCBs in soils namely the standard laboratory technique using gas chromatography with an electron capture detector (GC/ECD) and the field method using immunoassay test kits. As the GC/ECD method worked without any major problems the test kits were not employed this year. Analysis of other matrices by the GC/ECD method were conducted at the ASU laboratory in Kingston.

#### a) Laboratory Analyses (GC/ECD) (Soil Samples)

The standard analytical procedure for the analysis of PCBs, namely gas chromatography with an electron capture detector (GC/ECD) was used. These analyses were performed at the Mobile Laboratory on-site and at the Analytical Services Unit, Queen's University by one of the three following procedures. For all procedures a separate soil sample was first taken for the determination of wet weight/dry weight ratio. Soils were analyzed by using approximately 10 g (dry weight equivalent), spiking with an internal standard solution (decachlorobiphenyl) and extracting. The soxhlet method used approximately 250 mL dichloromethane in a soxhlet extractor for four hours. The DCM shaker method used 3 times 25 mL dichloromethane with agitation on a platform shaker for 20 minutes for each extract. The ACHX shaker method used a single extraction with 50 mL of a 1:1 mixture of acetone and hexane with agitation on a platform shaker for 20 minutes.

The shaker methods were used for most soil samples while the soxhlet method was generally used for other solid matrices. The solutions obtained from the soxhlet and DCM extraction methods were concentrated to 1-2 mL and the solvent exchanged for hexane. This concentrate was then applied to a Florisil column (Supelco SPE tube) and the resulting eluent analyzed using an HP 5890 Series II Plus gas chromatograph equipped with electron capture detector and a 30 m SPB-1 capillary column and calibrated with Aroclor 1260 standards. For the ACHX method, the extraction was applied directly to the GC.

b) Laboratory Analyses (GC/ECD) (Other Matrices)

Samples of metal, wood and barrier absorbent materials were analyzed as for soil by generally using the soxhlet extraction techniques. Water was analyzed by using approximately 800 mL of sample, spiking with internal standard and extracting three times with dichloromethane. The extract was filtered through sodium sulphate and concentrated to 1-2 mL and the solvent exchanged for hexane. This concentrate was then applied to a Florisil column for cleanup of the extract and the resulting eluent analyzed by GC/ECD. Air samples were analysed according to NIOSH Method 5503 by desorbing both the filter and absorbent with hexane and running the samples on a GC/ECD system.

## C. S1/S4 Beach Area

### *1. Background*

The original delineation of the S1/S4 beach area was conducted in 1994. Additional samples were taken in 2000 and 2002 in order to better define the contaminated area and also to confirm the location of the line between the uncontaminated zone required for a road turnaround area at the base of the cliff and the Tier I area adjacent to it. It was found in 1994, and confirmed in 2003, that PCB test kits do not give reliable results on soils from this location. The area was mapped by GPS in 2000 and 2003. A grid, similar to that which was used in the S1/S4 valley was created for use at the S1/S4 beach area (Map II-1). In total 26 points each at the corner of a 20m x 20m grid were located and survey flags and spray paint used to mark these locations. In 2004 a number of samples were taken to confirm location of the ropes.

### *2. Soil Excavation*

Work started in the S1/S4 Beach area early in the season on 3 July and progressed rapidly. The grid markers were re-established and the areas to be excavated were highlighted. Flags, spray paint and ropes must be set up each year due to wear and tear over the winter.

As a compromise between worker safety and project goals, the PMT agreed that only CEPA soil would be removed from the highest part of the area designated for excavation. The area get progressively steeper until it becomes part of the 300 m cliffs (Photograph II-1). In many locations, large rocks had to be moved first so as to access the contaminated soil underneath and to allow the heavy equipment to move unrestricted in the area. As a consequence, large rock piles were created at the edges of excavated areas (Photograph II-2).

Much of the initial excavation took place on steep gradients and access was only possible with the assistance of a skilled heavy equipment operator (Photograph II-3). CEPA soil was first removed from the least accessible grids, (3B, 3C, 4B, 4C, 4D). The CEPA material was pulled down and used as a stable excavation platform and then this pad of soil gradually moved down the slope as excavation progressed. Once the initial excavation of CEPA was made on the steep grade, it was essentially impossible to make it back up the slope, therefore, in these areas, the depth of soil excavated was increased

from the usual 30 cm to approximately 60 cm to ensure all the CEPA material was removed the first time round. Confirmatory testing in grids 3B, 3C, 4B, 4C, 4D, showed that after 60 cm was excavated the remaining soil was at the mid to low Tier II level. A temporary stockpile of CEPA material was established behind building B2. A lined berm was created around the stockpile to contain the PCB contaminated soil.

As the excavation proceeded, it became necessary to remove the large northern barrier installed in 1994. The barrier material was analysed for PCBs in order to determine its fate. Results given in Table II-1 show that the PCB level is Tier II. This result agreed with levels found over the period 1995-2003. The culverts over the barrier were first removed to the edge of the excavation area (Photograph II-4). The barrier materials were then placed into plastic liner bags which were in turn placed into three brown conical steel containers. These were moved adjacent to the 60 wooden boxes of metal contaminated soil and the contents will be placed in the Tier II landfill next year.

**Table II-1: PCB Concentrations in Barrier Material from the S1/S4 Beach Upper Barrier**

| Location of Sample | Material | Sample | PCB Concentration (ppm) |
|---|---|---|---|
| S1/S4 Beach – upper barrier | Matasorb | RI04-188 | 21 |
| S1/S4 Beach – upper barrier | Matasorb | RI04-205 | 5.6 |
| S1/S4 Beach – upper barrier | 3M absorbent | RI04-189 | 1.7 |
| S1/S4 Beach – upper barrier | 3M absorbent | RI04-204 | 2.8 |

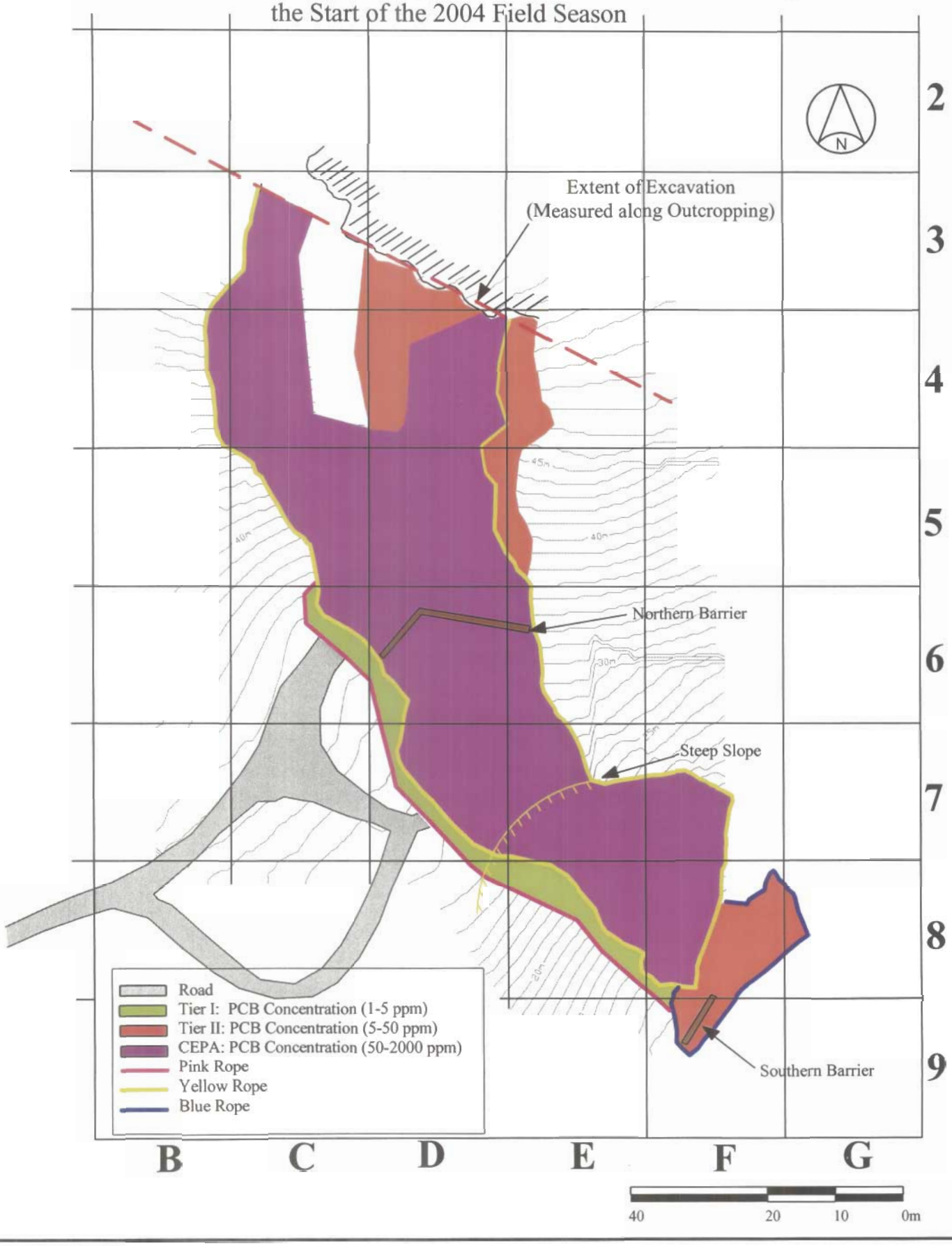
As the available space in the stockpile behind the B2 building decreased and as the excavation moved into less elevated locations, CEPA soil was stockpiled in and around the location of the former beach barrier (grids 5C, 5D, 5E, 6C, 6D and 6E) (Photograph II-5). Soil continued to be added to this location until the arrival of a screener and conical containers on the sealift. Removal of soil from both stockpiles started on 18 August 2004. All soils were screened at B2.

Excavation on the lower grids at the beach continued until the start of September (Photograph II-6). In total, excavation of 14 out the 18 quadrants was completed (3B, 3C, 4B, 4C, 4D, 4E, 5B, 5C, 5D, 5E, 6C, 6D, 6E and 7D). The summary signoff sheets associated with these 14 quadrants are in Chapter VII: Appendix. Of the remaining 4 grids, 7E and 7F have almost been completed and only 2 grids (8E and 8F) remain untouched. At the end of the season, some work on an access road from the southeast

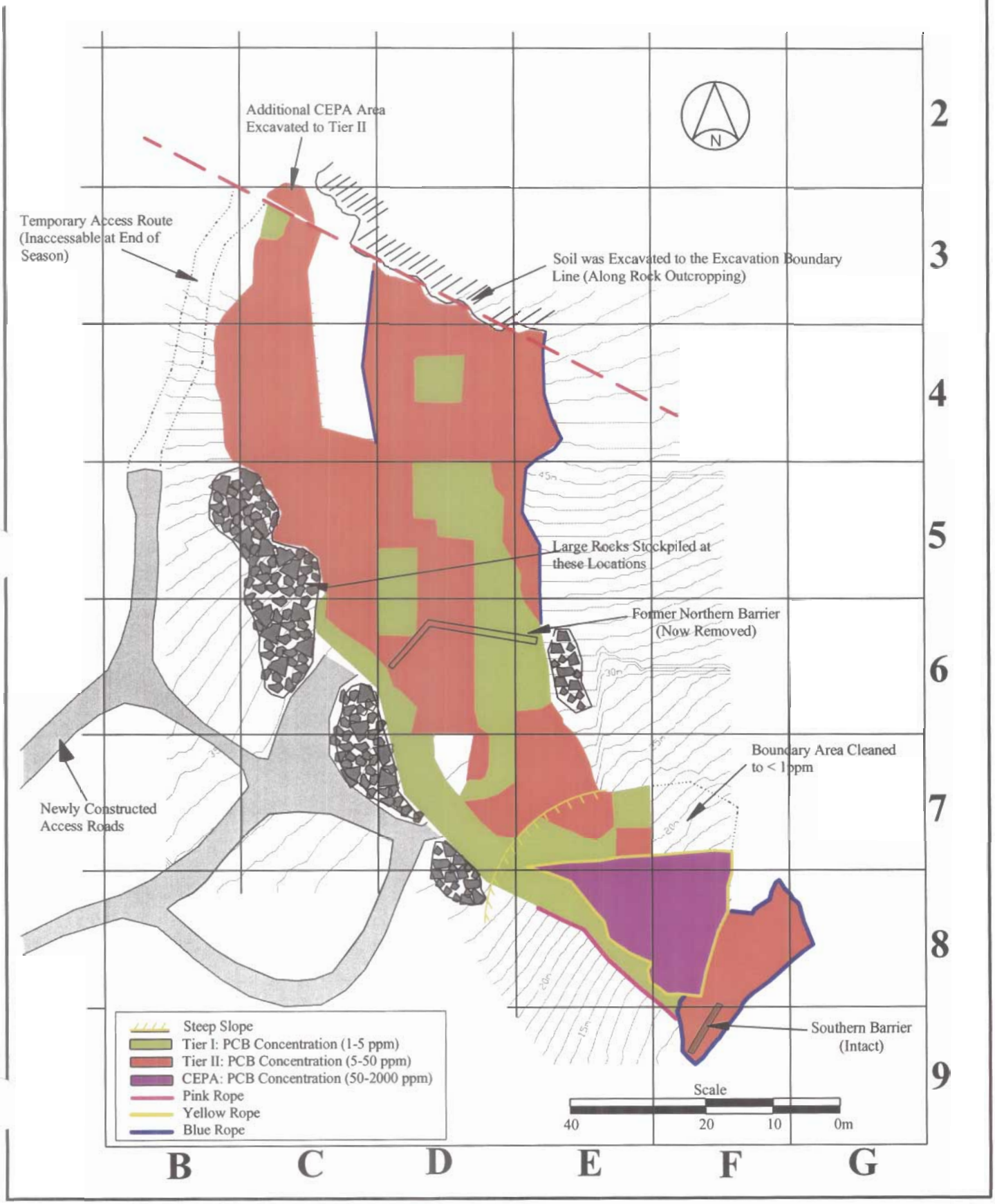
location (from 6E to 8F) was underway and it is expected that the remaining CEPA materials will be excavated quickly in the 2005 season.

The CEPA soils remaining to be excavated are estimated to have a volume of 250 $m^3$. The removal of the CEPA soil from quadrants 3, 4 and 5 left these areas with a much greater slope than previously existed and with less stable terrain. It is therefore probably too dangerous to remove the Tier II soils from these quadrants. The estimated volume of Tier II soils to be removed from the remaining quadrants is 650 $m^3$.

Map II-1: The S1/S4 Beach Area Showing the Contaminated Zones and the Quadrants at the Start of the 2004 Field Season



# Map II-2: The S1/S4 Beach Area Showing the Contaminated Zones and the Quadrants at the End of the 2004 Field Season



**Photograph II-1: The S1/S4 Beach Area at the Start of the Season: Note the Two Grassy Locations Which Mark the Main PCB Contaminated Zones**


**Photograph II-2: During the CEPA Soil Excavation Large Rocks Were Separated: The Excavated Soil Was Then Passed Through a Screener and Containerised**

**Photograph II-3: The S1/S4 Beach Area at the Start of Excavation of CEPA Soil Showing the Roadways: Excavation Higher Up the Contamination Zone Was Too Dangerous Because of the Steep Slope**

**Photograph II-4: The Barrier Placed Across the Drainage Pathway in 1994 Was Removed. Analysis of the Barrier Material Showed That the PCB Level Was Tier II**

**Photograph II-5: Excavation of the CEPA Soil at the S1/S4 Beach Area**

**Photograph II-6: Excavation of the S1/S4 Beach Area Near the Base of the Cliff Slope**

**Table II-2: PCB Concentrations in Soil Samples Collected During Excavation at the S1/S4 Beach Area**

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 001 | 1-July-04 | 5E | 20 | Delineation confirmation |
| 002 | 1-July-04 | 4E | <1.0 | Delineation confirmation |
| 003 | 1-July-04 | 5B | <1.0 | Delineation confirmation |
| 004 | 1-July-04 | 5C | 19 | Delineation confirmation |
| 005 | 1-July-04 | 6C | <1.0 | Delineation confirmation |
| 006 | 3-July-04 | 3C | 16 | Top of excavation |
| 007 | 3-July-04 | 3C | 5.9 | Upper E corner of CEPA |
| 008 | 3-July-04 | 3C | 5.8 | Directly below 007 |
| 009 | 3-July-04 | 3C/3B | <1.0 | Clean area W of CEPA |
| 010 | 3-July-04 | 3C | 1.8 | W of 007 |
| 011 | 3-July-04 | 3C | 16 | Directly below 010 |
| 014 | 4-July-04 | 3C | 21 | Lower E corner of CEPA |
| 015 | 4-July-04 | 3C | 7.6 | Lower W corner of 3C |
| 016 | 4-July-04 | 3B | 17 | Small SE corner of 3B |
| 017 | 4-July-04 | 4B | 28 | Steep slope; Tier II will not be excavated |
| 018 | 4-July-04 | 4B/5B | 46 | Steep slope; Tier II will not be excavated |
| 019 | 4-July-04 | 4C | 21 | W of clean area |
| 020 | 4-July-04 | 4C | 9.1 | W of clean area |
| 021 | 4-July-04 | 4C | 18 | Upper W corner of 4C |
| 022 | 4-July-04 | 4C | 33 | Lower W corner of 4C |
| 036 | 6-July-04 | 4C | 20 | Last Area of C4 |
| 037 | 6-July-04 | 4D | 6.7 | Upper area of CEPA |
| 038 | 6-July-04 | 4D | 2.3 | Central location |
| 039 | 6-July-04 | 4D | 11 | Central location |
| 040 | 6-July-04 | 4D | 7.3 | Lower E corner of CEPA |

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 041 | 6-July-04 | 4D | 17 | Lower W corner of CEPA |
| 050 | 7-July-04 | 5D | 4.2 | Directly below 052 |
| 052 | 7-July-04 | 5D | 4.4 | Upper E corner of 5D |
| 053 | 7-July-04 | 5D | 3.8 | Between 052 and 054 |
| 054 | 7-July-04 | 5D | 10 | Upper W corner of 5D |
| 103 | 10-July-04 | 5D | 2.4 | Below 050 |
| 104 | 10-July-04 | 5D | 9.3 | Below 053 and 054 |
| 105 | 10-July-04 | 5D | 7.3 | Composite sample of former small CEPA area |
| 106 | 10-July-04 | 5C | 29 | Upper W corner of CEPA |
| 107 | 10-July-04 | 5C | 24 | Upper E corner of 5C |
| 558 | 23-Aug-04 | 5D/6D | 2.9 | Lower W corner of 5D and upper W corner of 6D |
| 559 | 23-Aug-04 | 6D | 7.3 | W of former northern barrier; continues into 5D |
| 560 | 23-Aug-04 | 5D/6D | 20 | W of 058 |
| 610B | 21-Aug-04 | 5D/5E/6D /6E | 5.6 | Composite at 30 cm depth from original surface |
| 611 | 21-Aug-04 | 5D/5E/6D /6E | 5.2 | Composite at 60 cm depth from original surface |
| 612 | 21-Aug-04 | 6D | 1.3 | Confirmatory point sample |
| 613 | 21-Aug-04 | 6D | 11 | Confirmatory point sample |
| 617 | 23-Aug-04 | 6D | 12 | Directly S of 559 |
| 618 | 25-Aug-04 | 7F | <1.0 | Upper half of CEPA |
| 619 | 25-Aug-04 | 7F | <1.0 | Middle of CEPA |
| 623 | 23-Aug-04 | 5D/5E/ 6D/6E | 4.0 | Lower E corner of 5D |
| 624 | 23-Aug-04 | 6D/6E | 2.2 | S of former northern barrier |
| 625 | 23-Aug-04 | 5D/6D | 16 | W of 623 |

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 626 | 23-Aug-04 | 6D | 6.1 | S of former northern barrier |
| 627 | 23-Aug-04 | 6D | 8.8 | S of former northern barrier |
| 628 | 25-Aug-04 | 5C | 27 | Lower E corner of 5C |
| 629 | 25-Aug-04 | 6C | 27 | CEPA of 6C |
| 630 | 26-Aug-04 | 7E | 2.1 | NE corner of 7E |
| 632 | 26-Aug-04 | 7E | 6.0 | W of 630 |
| 633 | 26-Aug-04 | 7E | 6.8 | Below 630 |
| 634 | 26-Aug-04 | 7E | 2.0 | Between 633 and 635 |
| 635 | 26-Aug-04 | 7E | 4.1 | SW corner of 7E |
| 636 | 27-Aug-04 | 7D | <1.0 | Upper W corner of CEPA |
| 637 | 27-Aug-04 | 7D | 3.3 | Between 636 and 638 |
| 638 | 27-Aug-04 | 7D/7E | 7.5 | Lower corner of CEPA in 7D |
| 639 | 27-Aug-04 | 7E | 5.1 | E of 638 |
| 640 | 30-Aug-04 | 6E/7E | 5.0 | Small lower W corner of 6E; upper W corner of 7E |
| 641 | 30-Aug-04 | 6D | 7.5 | Between 642 and 644 |
| 642 | 30-Aug-04 | 6D/6E | 2.1 | Lower E corner of 6D; directly N of 640 in 6E |
| 643 | 30-Aug-04 | 6D | 9.9 | N of 644; separated from 644 by small area of water |
| 644 | 30-Aug-04 | 6D | 12 | Small lower W corner of CEPA in 6D |
| 738 | 4-Sept-04 | 7D | 1.6 | Upper E corner of 7D |
| 739 | 4-Sept-04 | 7D | 6.7 | W of 738 |
| 741 | 4-Sept-04 | 7D | 2.6 | Small area S of 738 and 739 |
| 743 | 4-Sept-04 | 6D | 25 | Small area of water between 643 and 644 |

## D. S1/S4 Buildings and Valley Area

### *1. Background*

The soil in the S1/S4 Buildings and Valley Area were found during the environmental investigations (1993-94) to be highly contaminated with PCBs. The PCBs originated in the area surrounding the buildings and migrated over the years down the S1/S4 Valley Area and over the cliff to the S1/S4 Beach Area. In the three summer seasons from 2001 to 2003 an approximately 2150 $m^3$ of CEPA soil was excavated from the S1/S4 Buildings and Valley Area. Map II-3 shows the extent of the remaining Tier I and Tier II soil contamination at the start of the work this year. Much of the Tier II soil was scraped into stockpiles this year.

### *2. Soil Excavation*

Following the arrival on site of ASU personnel at the end of June, work began immediately in the S1/S4 valley area. Grid flags, ropes and spray paint markings, were located and re-applied or replaced where necessary (Photograph II-7). Confirmatory samples were taken in and around selected Tier I/II boundary areas to ensure that these contaminated zones had not changed as a result of soil movement during the spring run-off.

Excavation of Tier II soil started on 24 July 2004, after most of the snow had melted from the surface. Excavation began in the far south-west corner of the valley (Photograph II-8) and moved in a north east direction. The majority of Tier II soil is located along the valley area and large areas were cleared quickly and stockpiled in convenient areas for transport to the Tier II landfill (Photograph II-9) at a later date. Snow melt from higher elevations in this drainage pathway continued into August and a temporary boom was constructed to prevent PCB migration in the oil stained area (Photograph II-10).

During the excavation, the 1994 northern and southern barriers were removed. Analysis of the barrier material showed it contained PCBs at the CEPA or high Tier II level (16-79 ppm) as shown in Table II-3. This agrees well with analytical results from previous years and therefore, the sorbent materials were placed into large liner bags and subsequently into conical steel containers for off-site disposal (see chapter IV).

**Table II-3: PCB Concentrations in Barrier Material Samples**

| Location of Sample | Material | Sample | PCB Concentration (ppm) |
|---|---|---|---|
| S1/S4 Valley – southern barrier | 3M absorbent | RI03-059 | 38 |
| S1/S4 Valley – southern barrier | 3M absorbent | RI03-060 | 33 |
| S1/S4 Valley – southern barrier | Matasorb | RI03-057 | 9.3 |
| S1/S4 Valley – southern barrier | Matasorb | RI04-058 | 79 |
| S1/S4 Valley – northern barrier | 3M absorbent | RI03-S1/S4-B1 | 15.8 |
| S1/S4 Valley – northern barrier | 3M absorbent | RI03-S1/S4-B2 | 27 |
| S1/S4 Valley – northern barrier | Matasorb | RI03-S1/S4-B3 | 36 |
| S1/S4 Valley – northern barrier | Matasorb | RI03-S1/S4-B4 | 29 |

Due to access constraints, Tier II materials were not excavated from several road areas this season, but will be addressed in 2005 (Photograph II-11).

As a result of the varied terrain and the magnitude of the Tier II operation, in some areas, ASU personnel mapped excavated areas and sampling locations using GPS survey equipment at the end of each day. This data was downloaded and transferred into Autocad Map. New working copy maps were produced and this data correlated with the concentrations of samples processed each evening. This ensured that the excavation progress was monitored very closely and a detailed end of season map (Map II-4) produced.

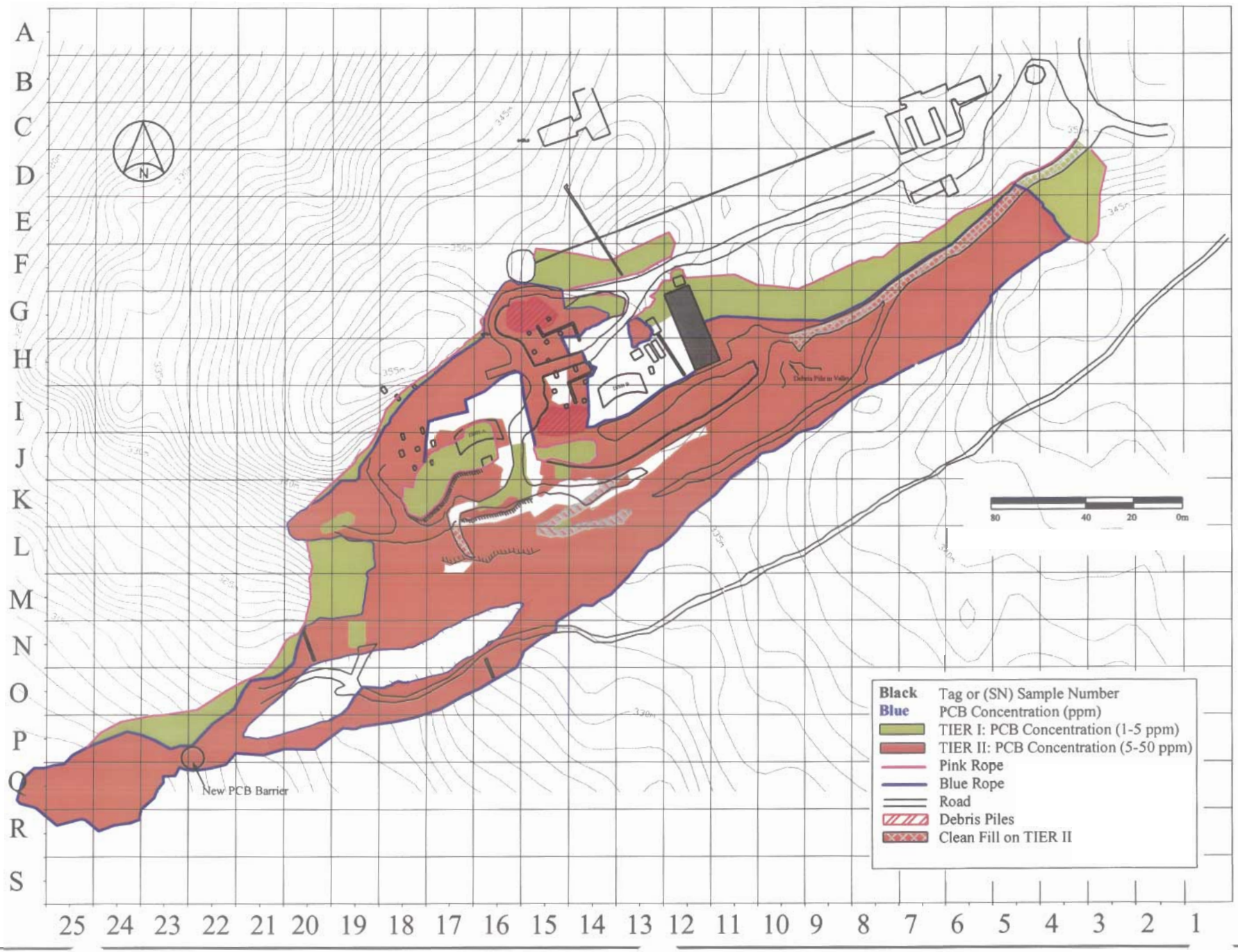
As the excavation in the valley progressed, three additional CEPA areas were located (Grids I11, I12, M18). The discovery of small areas of CEPA is not entirely unexpected, given the magnitude and levels of the original PCB contamination and the fractured nature of the bedrock in the area. These were delineated, clearly marked (Photograph II-12), excavated and moved to the stockpile of CEPA behind the B2 building. The area located in M17 was small in size and the concentration of 68 ppm, only slightly over the 50 ppm criteria limit. The patches found at higher elevations (I11 and I12), were larger and higher in concentration (I11: 120 ppm, I12: 200, 220 ppm). The location of CEPA material in these areas was not entirely unexpected. During the original excavation in 2001, due to the instability of the slope after all the surface rocks had been removed, there was a partial collapse at the face ("Resolution Island 2001 Scientific

Investigations", page II-7). Samples taken along the surface and several depth samples indicated that CEPA materials had inadvertently been mixed with less contaminated soil and thus diluted. A maximum PCB concentration of 33 ppm was reported.

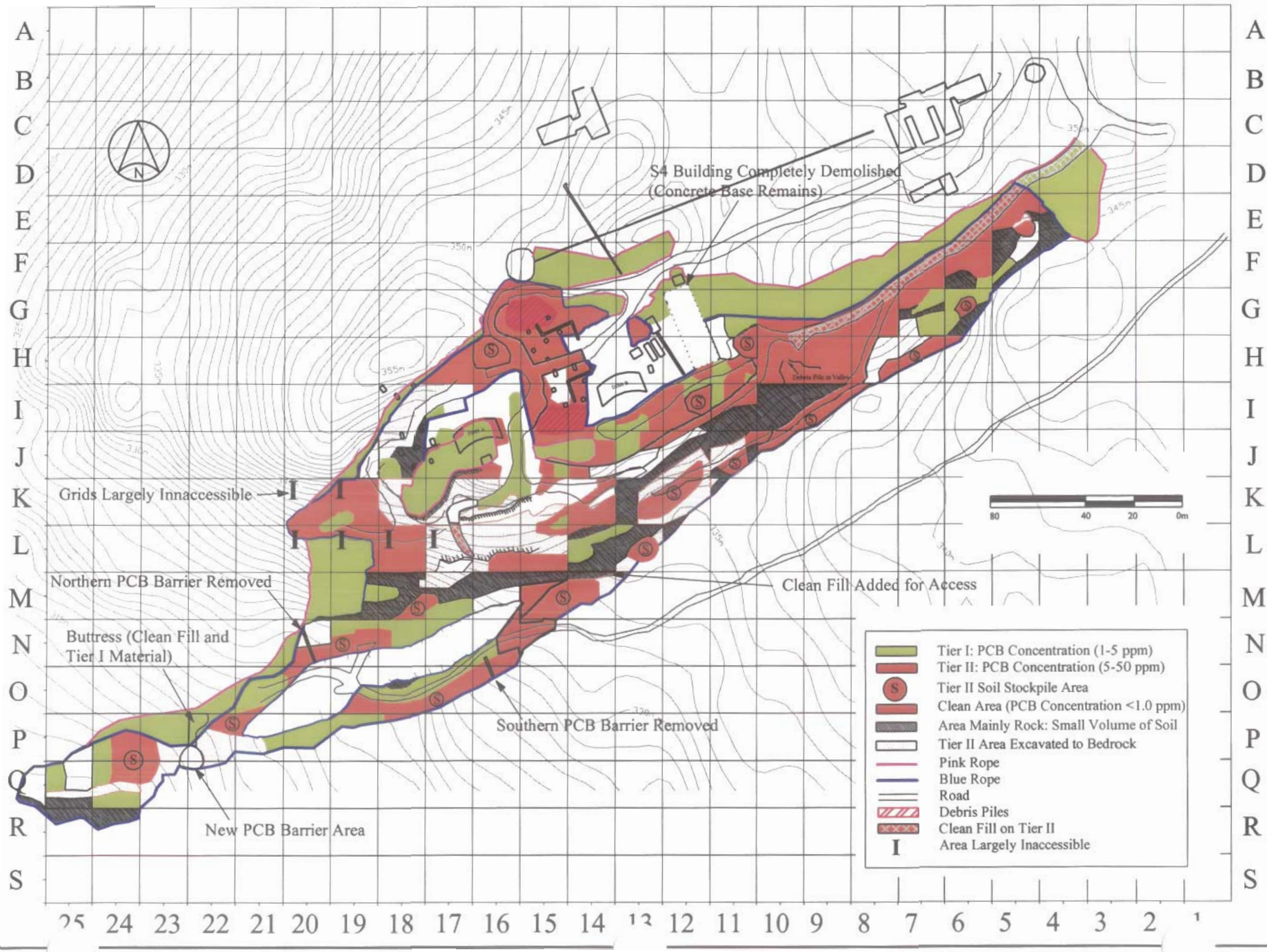
Sample RI04-244 from quadrants N15 and N16 was taken from a former CEPA area, excavated in 2003. Confirmatory samples taken in 2003 indicated the area was just under the CEPA criterion (48 ppm). The concentration in the sample taken this year gave a result of 50 ppm. In view of the required access to Tier II stockpiles via this road, excavation was not undertaken. The area will be re-sampled early in the 2005 season. If at this point it is found to be >50 ppm, it will be excavated and clean fill added for access. If less than the criteria, it can be used for access and then excavated into the Tier II landfill after access is no longer required.

At the beginning of the season, there were 108 grids in total in the S1/S4 buildings and valley area, which contained Tier II soil. By the end of the season, the soil was largely removed or scraped into piles in 47 of these grids, partial excavation took place in 19 grids, and 23 grids were untouched (these included 7 grids which were deliberately left intact to allow access). From the original 108 grids, upon close examination, 19 were eliminated (11 in the valley and 8 around the buildings) because they were determined to have very small amounts of soil and/or were very difficult to reach. The volume of the remaining Tier II soils to be excavated (ie those which have not been scraped into piles) is estimated at 330 $m^3$. The areas which have not been excavated are predominantly around the S1/S4 buildings and access roads.

Map II-3: Contaminated Zones in the S1/S4 Buildings and Valley Areas for the Start of the 2004 Field Season



# Map II-4: Contaminated Zones in the S1/S4 Buildings and Valley Areas for the Start of the 2005 Field Season



**Photograph II-7: The S1/S4 Valley in Late June: Repositioning Quadrant Markers**


**Photograph II-8: Starting the Excavation of Tier II Soil in the S1/S4 Valley at the End of the Valley Where a Lush Cover of Moss Predominates**

**Photograph II-9: The Tier II Soil Excavated in the S1/S4 Valley Was Scraped into Piles**

**Photograph II-10: The Heavily Oiled Area in the S1/S4 Valley Was Boomed During Excavation of the Tier II Soil**

**Photograph II-11: The Roadway in the S1/S4 Valley: PCB Contaminated Soil Was Not Excavated from Roadways in 2004**

**Photograph II-12: The Yellow Spray Paint Marking One of the CEPA Areas Located This Year**

**Table II-4: PCB Concentrations in Soil Samples Collected During Excavation at the S1/S4 Buildings and Valley Areas**

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 028 | 05-July-04 | 019 | 2.9 | New PCB barrier area |
| 029 | 05-July-04 | 019 | 1.2 | New PCB barrier area |
| 030 | 05-July-04 | 019 | 1.1 | New PCB barrier area |
| 031 | 05-July-04 | 019 | 5.4 | New PCB barrier area |
| 032 | 05-July-04 | J18 | 1.3 | Checking ropes |
| 033 | 05-July-04 | I17 | 2.6 | Checking ropes |
| 034 | 05-July-04 | I17 | 6.0 | Checking ropes |
| 035 | 05-July-04 | I16 | 2.6 | Checking ropes |
| 041 | 07-July-04 | K16 | 17 | Confirmatory samples of Tier I area |
| 042 | 07-July-04 | K15 | <1.0 | Confirmatory samples of Tier I area |
| 043 | 07-July-04 | J16 | <1.0 | Confirmatory samples of Tier I area |
| 100 | 11-July-04 | K16 | 4.5 | Checking former clean fill area |
| 101 | 11-July-04 | J16 | 6.0 | Checking former clean fill area |
| 102 | 11-July-04 | M20 | <1.0 | Checking Tier I boundary |
| 103 | 11-July-04 | M20 | 2.4 | Checking Tier I boundary |
| 108 | 11-July-04 | M20 | 1.4 | Checking Tier I boundary |
| 109 | 11-July-04 | L20 | 2.5 | Checking Tier I boundary |
| 110 | 11-July-04 | K20 | <1.0 | Checking Tier I boundary |
| 111 | 11-July-04 | J19 | <1.0 | Checking Tier I boundary |
| 112 | 11-July-04 | I19 | <1.0 | Checking Tier I boundary |
| 113 | 11-July-04 | I18 | <1.0 | Checking Tier I boundary |
| 114 | 11-July-04 | H17 | <1.0 | Checking Tier I boundary |

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 115 | 11-July-04 | I18 | 2.0 | Former >2000 ppm area. Vacuum cleaned. Now slightly contaminated with runoff sediment. |
| 116 | 11-July-04 | G16 | 4.5 | Checking Tier I/II boundary |
| 190 | 19-July 04 | H10 | 10.4 | Checking Tier I/II boundary |
| 191 | 19-July 04 | H11 | 20 | Checking Tier I/II boundary |
| 192 | 19-July 04 | H11 | 2.6 | Checking Tier I/II boundary |
| 193 | 19-July 04 | I11 | 52 | Checking Tier I/II boundary |
| 194 | 19-July 04 | I11 | 120 | Checking Tier I/II boundary |
| 195 | 19-July 04 | I10 | 69 | Checking Tier I/II boundary |
| 196 | 19-July 04 | I12 | 48 | Checking Tier I/II boundary |
| 197 | 19-July 04 | H12 | 1.5 | Checking Tier I/II boundary |
| 207 | 3-Aug-04 | I13 | 17 | Tier II excavation |
| 208 | 3-Aug-04 | I12 | 6.7 | Tier II excavation |
| 209 | 3-Aug-04 | I12/I13 | 217 | Tier II excavation |
| 210 | 29-July-04 | L13 | 15 | Tier II excavation |
| 211 | 29-July-04 | M13/M14 | 12 | Tier II excavation |
| 212 | 29-July-04 | M13/L13 | 15 | Tier II excavation |
| 213 | 30-July-04 | L14 | 2.2 | Tier II excavation |
| 214 | 30-July-04 | L13, L14 | 1.2 | Tier II excavation |
| 215 | 31-July-04 | J11 | 31 | Tier II excavation |
| 216 | 2-Aug-04 | G6/G7 | 1.5 | Lower W corner of G6; Lower E corner of G7 |
| 217 | 2-Aug-04 | G7 | 3.2 | N of rock outcrop and bedrock |
| 218 | 2-Aug-04 | H7 | < 1.0 | Tier II excavation |
| 219 | 2-Aug-04 | G7 | <1.0 | W of 216; S of bedrock |
| 220 | 31-July-04 | J11 | 16 | Tier II excavation |
| 221 | 1-Aug-04 | J11 | 22 | Tier II excavation |

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 222 | 1-Aug-04 | I9 | 11 | Between Tier II soil pile and bedrock |
| 223 | 1-Aug-04 | H8 | <1.0 | Lower W corner of H8 |
| 224 | 1-Aug-04 | H8 | <1.0 | NE of 223 |
| 225 | 2-Aug-04 | G6 | <1.0 | N of Tier II stockpile |
| 226 | 2-Aug-04 | F5 | 3.2 | Central area of grid |
| 227 | 2-Aug-04 | E5/F5 | <1.0 | Upper E corner of F5. Extends to E5 |
| 228 | 2-Aug-04 | J14 | 1.1 | Upper E corner of J14 |
| 229 | 1-Aug-04 | J10/ K10 | 16 | Tier II excavation |
| 230 | 3-Aug-04 | I12/I13 | 200 | Tier II excavation |
| 231 | 3-Aug-04 | H12/ I12 | 4.8 | Tier II excavation |
| 232 | 2-Aug-04 | H11 | 1.4 | Area below SE corner of S4 building |
| 233 | 2-Aug-04 | H12 | 6.2 | Lower E corner of H12 |
| 234 | 3-Aug-04 | M17 | 22 | Upper E corner of M17 |
| 235 | 3-Aug-04 | M17 | 68 | Upper W corner of M17 |
| 236 | 3-Aug-04 | M18 | 14 | S and W of 235 |
| 239 | 3-Aug-04 | I12 | 40 | Tier II excavation |
| 240 | 2-Aug-04 | F5/F6/G6 | 2.0 | Tier II excavation |
| 241 | 28-July-04 | M14 | 17 | Tier II excavation |
| 242 | 28-July-04 | M15 | 32 | Tier II excavation |
| 243 | 28-July-04 | M15/ N15 | 29 | Tier II excavation |
| 244 | 28-July-04 | N15/ N16 | 50 | Confirmatory sample |
| 245 | 28-July-04 | N16/ N17/ O16/ O17 | 2.6 | Tier II excavation |
| 246 | 28-July-04 | N16 | 4.0 | Tier II excavation |
| 247 | 28-July-04 | O17/ O18/ N17 | 4.9 | Tier II excavation |
| 248 | 28-July-04 | O18 | 1.4 | Tier II excavation |

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 249 | 28-July-04 | O18/ O19 | 3.4 | Tier II excavation |
| 250 | 24-July-04 | Q26 | <1.0 | Tier II excavation below new barrier |
| 251 | 24-July-04 | Q26 | <1.0 | Tier II excavation below new barrier |
| 252 | 24-July-04 | Q24 | 3.1 | Tier II excavation below new barrier |
| 253 | 24-July-04 | Q24 | 4.7 | Tier II excavation below new barrier |
| 254 | 25-July-04 | Q24/ P24 | 1.5 | Tier II excavation |
| 255 | 3-Aug-04 | I12 | 25 | Tier II excavation |
| 256 | 25-July-04 | Q23/ P23 | 15 | Tier II excavation |
| 257 | 25-July-04 | P21/ P22 | 14 | Tier II excavation |
| 258 | 25-July-04 | Q25 | 1.1 | Tier II excavation |
| 259 | 25-July-04 | P25/ Q25 | < 1.0 | Tier II excavation |
| 261 | 26-July-04 | O21 | 1.2 | Tier II excavation |
| 262 | 26-July-04 | P21 | 4.6 | Tier II excavation |
| 263 | 26-July-04 | P20 | 2.0 | Tier II excavation |
| 264 | 26-July-04 | P19/P20 | 3.5 | Tier II excavation |
| 265 | 26-July-04 | O20/ O21 | 1.2 | Tier II excavation |
| 267 | 2-Aug-04 | J14 | 18 | Tier II excavation |
| 268 | 1-Aug-04 | I9/I10 | 13 | Between Tier II soil and bedrock of I10; Small W area between Tier II soil and bedrock |
| 269 | 26-July-04 | O21/ O22/ P22 | 2.3 | Tier II excavation |
| 271 | 27-July-04 | M15 | 14 | Between Tier II soil pile and bedrock |
| 272 | 27-July-04 | M16 | < 1.0 | Tier II excavation |
| 273 | 27-July-04 | M17/N17 | 1.1 | S of soil pile and bedrock in M17; upper W corner of N17 |

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 274 | 27-July-04 | N18 | 4.4 | Upper E corner of N18 |
| 276 | 27-July-04 | M18/ M19 | 2.3 | Tier II excavation |
| 277 | 27-July-04 | N18/N19 | 2.9 | Upper W corner of N18; upper E corner of N19 |
| 278 | 27-July-04 | N19 | 1.2 | Upper W corner of N19 |
| 279 | 27-July-04 | N20 | < 1.0 | Tier II excavation |
| 290 | 2-Aug-04 | J13 | 26 | S of 291 |
| 291 | 2-Aug-04 | I13 | 29 | Lower E corner S of ridge in I13 |
| 291 | 2-Aug-04 | I13/J13 | 29 | Lower E corner of I13; Small upper E corner of J13 |
| 292 | 3-Aug-04 | I13 | 2.7 | Re-sampled 299 |
| 293 | 3-Aug-04 | J13 | 1.0 | Re-sampled W half of 298 |
| 294 | 3-Aug-04 | I13/J13 | 1.4 | Re-sampled W half of 299 |
| 295 | 3-Aug-04 | I14 | 1.6 | Tier II excavation |
| 296 | 3-Aug-04 | I13 | 44 | Tier II excavation |
| 297 | 3-Aug-04 | J13 | 11 | Re-sampled W half of 298 |
| 298 | 2-Aug-04 | J13 | 58 | S of 299 |
| 299 | 2-Aug-04 | I13/J13 | 6.3 | Lower W corner S of ridge in I13; upper W corner of J13 |
| 300 | 25-July-04 | P22/Q22 | 9.0 | Tier II excavation |
| 423 | 4-Aug-04 | G11/H11 | <1.0 | Lower W corner of G11; Upper W corner of H11 |
| 424 | 4-Aug-04 | H11 | 5.3 | Area in center of grid |
| 425 | 4-Aug-04 | G11 | 1.8 | South in the middle of the grid, just below ridge |
| 426 | 4-Aug-04 | H11 | 11 | East area, close to former screener |
| 431 | 7-Aug-04 | M17 | 46 | Re-sampled 234 |
| 433 | 7-Aug-04 | M17 | 77 | Re-sampled 235 |

| Sample (prefix RI04-) | Date Sampled | Quadrant | PCB Concentration (ppm) | Comments |
|---|---|---|---|---|
| 434 | 7-Aug-04 | M17 | 44 | Re-sampled 236 |
| 441 | 5-Aug-04 | I17/J17 | 10 | Area adjacent to NE corner of Radar dish A |
| 442 | 5-Aug-04 | I17/J17 | 3.4 | Top middle of grid, W of sample 442 |
| 443 | 5-Aug-04 | I12 | 21 | Road |
| 444 | 5-Aug-04 | I12/J12 | 49 | Road |
| 445 | 5-Aug-04 | H11/I11 | 3.6 | Small lower W corner of H11; Upper W corner of I11 |
| 446 | 5-Aug-04 | H11/I11 | 61 | E of 445 in H11; Continues to road in I11 |
| 447 | 5-Aug-04 | H11 | 1.3 | Small lower E corner above road of H11 |
| 448 | 6-Aug-04 | J19 | <1.0 | Lower E corner of J19 |
| 449 | 6-Aug-04 | J19 | <1.0 | N of 448 |
| 450 | 5-Aug-04 | I12/I13 | 11.8 | Re-sampled 209 |
| 451 | 6-Aug-04 | J18 | 8.1 | Upper W corner of J18 |
| 452 | 6-Aug-04 | I18 | 8.1 | W of road |
| 453 | 6-Aug-04 | I18 | 24 | W of road |
| 454 | 5-Aug-04 | I12 | 17 | Re-sampled 230, 230 |
| 457 | 6-Aug-04 | H11/I11 | 15 | Re-sampled S half of 446 |
| 458 | 6-Aug-04 | H11 | 38 | Re-sampled N half of 446 |
| 459 | 6-Aug-04 | J18 | 3.9 | Lower W corner of J18 |
| 460 | 6-Aug-04 | I17 | 4.5 | Upper W corner of I17 |
| 609 | 19-Aug-04 | P22 | 6.1 | Area scraped for S1/S4 barrier |

**Annex A**

## Resolution Island Excavation Protocol for Tier I and Tier II Soils

All responsibilities are as outlined in the Resolution Island Excavation Protocol which was finalized in January 2001.

For large areas with contaminated Tier I and Tier II soils, such as the S1/S4 valley and beach areas, a grid system will be established by Queen's ASU personnel. For other areas with Tier I and Tier II soils such as the PCL dump and the North Slope dump these will be followed with maps rather than grids. All grids and maps must be signed off by the three parties on site: Queen's ASU, Qikiqtaaluk Corporation and their Resident Engineer. Excavation of each of these areas is described in the 3 year Remediation Plan. The airstrip dump contains Tier I and Tier II soils. These have been covered by 0.5 m of fill and no further action is required at present except the addition of extra fill where debris remains exposed.

There are various locations in all areas with soils contaminated at the Tier I and Tier II level which cannot be easily reached using heavy equipment. All areas will be inspected by personnel from Queen's ASU, Qikiqtaaluk Corporation and their Resident Engineer. If practical removal or covering of soils will be attempted. Safety of personnel is the highest priority and will not be compromised for removal of contaminated soils.

The vacuum truck will not be employed to remove Tier I or Tier II soils from small pockets and thin layers of soil after machine excavation.

Tier II soils

All Tier II soil will be removed and placed in the Tier II landfill. Soil will be removed by heavy equipment by taking off the first 0-30 cm. A composite sample of the excavated area will then be taken by Queen's personnel and analyzed. If necessary excavation will be continued by taking off 30 cm at a time until the remaining soil is < 5.0 ppm PCBs or bedrock is reached. All soil which can be safely removed by heavy equipment will be removed. If a significant amount of soil remains all parties (ASU Queens, Qikiqtaaluk Corporation and their Resident Engineer) will inspect the area and determine the best way to proceed. In some cases it may be necessary to leave Tier II soil on the ground. In these cases the soil will be covered with 1.0 m of clean fill if at all practical.

Tier I soils

All Tier I soil will be removed and placed in the non-hazardous engineered landfill. As described above excavation should proceed by taking off 30 cm at a time until the remaining soil is < 1.0 ppm PCBs or bedrock is reached. This method will not be strictly enforced as there is no landfill size limitation for Tier I soils. If it is easier to remove the Tier I soil to bedrock rather than by 30 cm stages, then this may be done. However, the extra work involved this approach versus the dig and test technique should be considered, and the appropriate method used at each location. If excavation is not practical the Tier I soil may be covered in place with 0.5 m of clean fill.