III. SITE INVESTIGATIONS

A. General

This chapter contains reports on the various scientific research activities and routine analyses conducted by the ASU this year. All the work related to hydrocarbon remediation activities is reported in chapter V while all research related to PCB barriers is written up in chapter VI. Section N contains the QA/QC data for the entire report.

B. Building S4

The concrete floor of Building S4 was found to be contaminated with PCBs in 1997. Further testing in 2003 revealed a small area of the concrete floor contaminated above the 50 ppm level. The building S4 consists of two parts on different elevations. The lower part contained air and water recirculating equipment and was contaminated at the Tier I level. The upper level contains several large generators and other equipment and was contaminated at the Tier II level except for the small CEPA area.

It was decided that the whole building should be demolished and all equipment on the floors removed to leave the concrete pads. This was accomplished this year (Photograph III-1). The concrete from the small CEPA area (Photograph III-2) was then removed and transported to the Beach PCB storage facility. The removal of the CEPA concrete was undertaken according to the protocol as written by ASU and set out in Annex A. Two composite samples of concrete powder were obtained after the excavation. Analysis of these sample (RI04-480 and RI04-480D) showed that the level of PCBs in the concrete had been reduced to 0.6 and 1.0 ppm respectively.

The concrete pads will be covered with clean fill once all the surrounding area is free from Tier II and Tier I PCB contaminated soil in 2005. The depth of this fill should be 30 cm for the lower level and 50 cm for the upper level area.

Photograph III-1: Demolishing Building S4. The Concrete Floor of the Building is Contaminated With PCBs and Will be Covered With Clean Fill

Photograph III-2: The Interior of Building S4 Prior to Demolition: The Area Marked in Yellow was Contaminated Above 50 ppm with PCBs

C. Tier II Landfill

As part of the new remediation plan, a special lined landfill is to be constructed at the Maintenance area for all Tier II soils and other materials. Construction of this facility was started in 2003 with the partial building of three of the four berms. This year construction of the exterior of the facility was finished with the completion of the berms (Photograph III-3) and the placement of the bottom liner (Photograph III-4). The facility is now ready to receive the Tier II material in 2005. The list of material and estimated volumes to be placed in at the facility is given in Table III-1.

Table III-1: Proposed Contents of the Tier II Landfill

Item	Estimated Volume (m^3)	Contaminant
SOILS		
S1/S4 buildings and valley	3,500-7,000	PCBs
S1/S4 beach	2,000-3,000	PCBs
Furniture dump	750	PCBs
PCL dump	125	PCBs
North Slope dump	35	Copper
Maintenance dump	50	Cobalt
Beach dump	500	Lead
DND Helipad	95	PCBs
Wooden boxes of soil	60	Metals
OTHER MATERIALS		
Debris from S1/S4 buildings area	100	PCBs
Furniture dump debris	50	PCBs
Shredded wood	10	PCBs
Insulation from PCB storage building	100	PCBs
TOTAL AMOUNT	**7,375-11,875**	

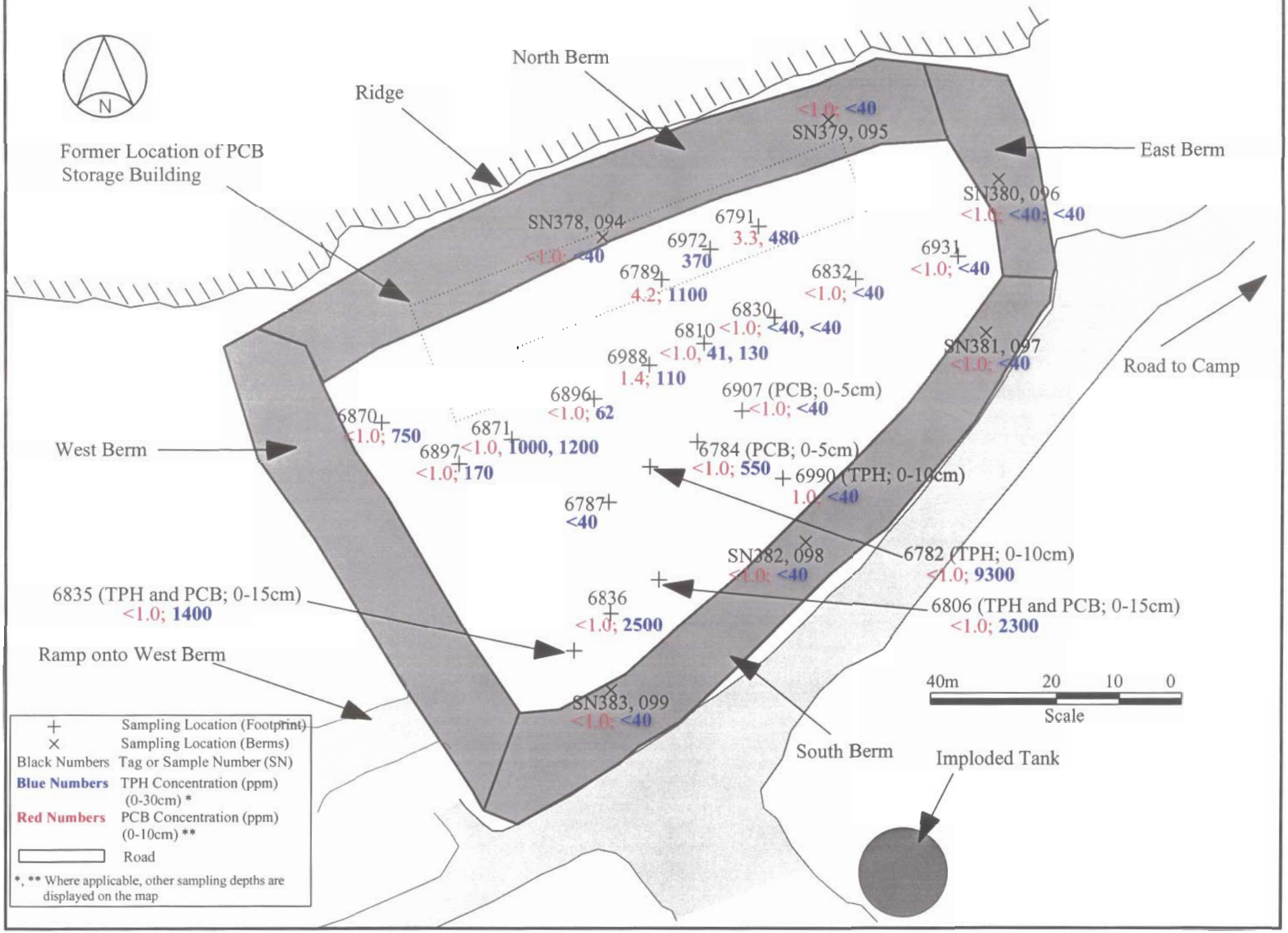
Additional monitoring wells were installed around the landfill site this year. Results of analyses of monitoring water and monitoring soil samples are presented in the next part of this chapter, Section D.

1. Site Investigation

Construction of the berms on three sides of the proposed landfill was partially completed in 2003. During the 2003 field season, the presence of hydrocarbon contaminated soil below the surface at the landfill site was discovered. This raised the question as to whether the contamination should remain or be excavated. The center of the landfill was free from contamination as it was originally a rock outcrop which had since been removed to the level of the base of the landfill. The contamination was therefore generally in the western edge of the area. The contamination was greatest at depth and the depth to bedrock was from 0.5 - 2 meters. As a result of discussions of the Resolution Island project management team it was recommended that, at the start of the 2004 season, all the easily accessible material at the western portion of the footprint of the Tier II landfill be excavated. The excavated soil was placed just across the road near the imploded tank on the sloping area leading towards the station and later landfarmed as described in Chapter V. After this excavation the base of the landfill was gridded and 36 soil samples taken, 19 of which were analysed. Results of these analyses are given in Table III-2. They show that for metals, levels were generally fairly constant and at site background levels. Copper levels were elevated with one result of 149 ppm above the DCC levels; the average copper concentration was 69 ppm. Lead levels were generally in the <10 to 35 ppm range but with one high value of 1140 ppm. PCB levels were generally less than 1 ppm but 4 of the 19 samples registered levels above this detection limit (1.0, 1.4, 3.3 and 4.2 ppm). Hydrocarbons chiefly in the form of diesel fuel were found in 14 of the 19 samples (detection limit 40 ppm). Six of these contained > 1000 ppm hydrocarbons and the average concentration found was 1070 ppm. While this is high, the volume of the hydrocarbon contaminated material remaining was low. This material is below the bottom liner of the landfill and should remain permanently frozen.

It was also decided that the berms constructed in 2003 should be checked for contamination. Six samples were collected and analysed. The results shown in Table III-3 show that no contamination was present. Similarly, five samples were taken from the borrow areas. The results of analyses of these samples given in Table III-4 again show no contamination.

III-1: Sampling Locations, Tag and Sample Numbers, and PCB Concentrations at the Base of the Tier II Landfi.



Photograph III-3: Construction of the Berms of the Tier II Landfill

Photograph III-4: Installation of the Tier II Landfill Liner

Table III-2: Results of Analyses for Metals, PCBs and TPH of Samples Taken From the Base of the Tier II Landfill Site After Excavation of the Foundation (ppm)

Sample Prefix RI04-	63/350	64/345	68/352	72/357	74/358	75/359	76/360	79/363	81/364	82/366
As	1.1	1.4	1.5	1.5	<1.0	1.4	1.4	1.3	1.4	1.2
Cd	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Co	9.2	12.0	18.8	17.6	17.9	12.2	13.8	14.4	15.2	9.3
Cr	28	37	45	47	40	35	38	40	41	32
Cu	47	57	82	75	149	51	59	62	61	52
Ni	41	53	80	88	65	50	55	60	64	45
Pb	29	23	12	32	<10	34	23	<10	<10	152
Zn	59	75	75	99	46	90	79	72	62	98
PCBs	<1.0	<1.0	<1.0	<1.0	<1.0	1.4	<1.0	<1.0	<1.0	<1.0
TPH (fuel)	920	710	<40	1300	<40	71	56	170	<40	2500
TPH (lube)	170	40	62	50	<40	42	47	<40	<40	<40

Sample Prefix RI04-	83/367	84/368	85/369	86/370	88/372	89/373	90/374	92/376	93/377
As	1.6	1.2	1.0	1.1	1.4	1.4	1.2	1.5	1.4
Cd	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Co	13.7	9.3	15.1	12.9	14.0	16.1	13.6	17.9	10.4
Cr	38	30	33	38	36	40	38	48	44
Cu	62	65	59	56	76	71	55	86	80
Ni	66	46	60	54	59	69	58	84	50
Pb	<10	1140	73	16	84	133	<10	<10	<10
Zn	67	315	152	76	303	248	69	68	58
PCBs	<1.0	4.2	<1.0	<1.0	1.0	3.3	<1.0	<1.0	<1.0
TPH (fuel)	5700	1100	550	<40	305	75	<40	<40	1400
TPH (lube)	3600	<40	<40	<40	60	400	<40	<40	930

Table III-3: Results of Analyses for Metals, PCBs and TPH of Samples Taken From the Berms of the Tier II Landfill Site at the Start of the Year (ppm)

Sample Prefix RI04-	94/378	95/379	96/380	97/381	98/382	99/383
As	1.8	1.6	1.8	1.8	1.9	1.7
Cd	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Co	16.2	18.8	14.6	13.6	15.0	13.7
Cr	39	45	36	37	42	36
Cu	62	80	54	50	53	50
Ni	70	78	62	54	60	55
Pb	<10	<10	<10	<10	<10	<10
Zn	59	67	51	46	54	48
PCBs	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
TPH (total)	<40	<40	<40	<40	<40	<40

Table III-4: Results of Analyses for Metals, PCBs and TPH of Samples Taken From the Borrow Source of Material for the Berm Construction (ppm)

Sample Prefix RI04-	44/323	45/324	46/325	47/326	48/327
As	1.9	1.6	2.1	1.7	1.6
Cd	<1.0	<1.0	<1.0	<1.0	<1.0
Co	12.4	16.8	21.0	14.3	16.5
Cr	39	40	52	40	43
Cu	76	76	83	59	62
Ni	59	79	86	62	65
Pb	<10	<10	<10	<10	<10
Zn	55	68	75	54	62
PCBs	<1.0	<1.0	<1.0	<1.0	<1.0
TPH (total)	<40	<40	<40	<40	<40

D. Tier II Landfill Monitoring Program

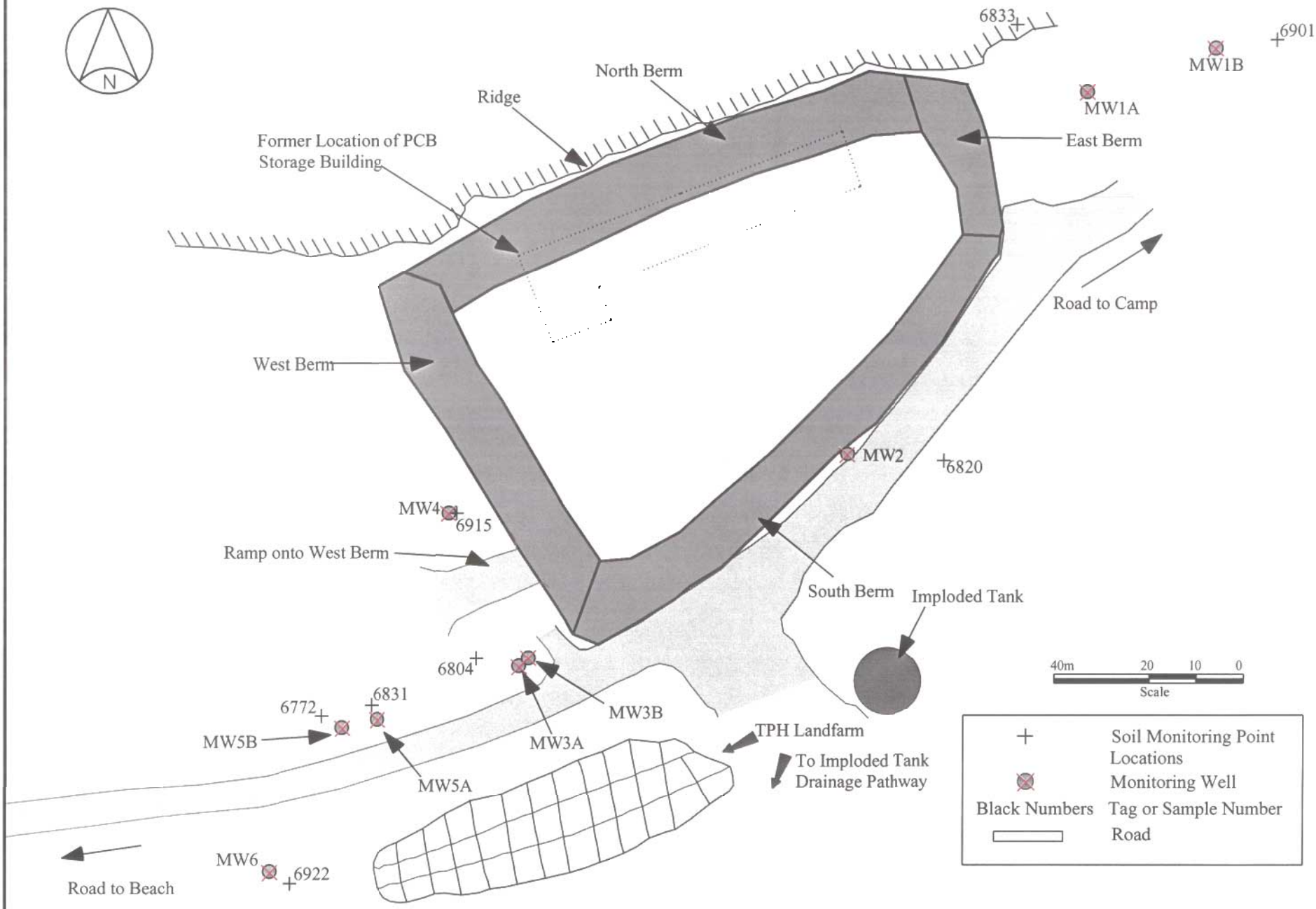
A long term post-remediation monitoring program, which forms part of the remediation plan for the site, contains provisions for monitoring wells and associated soil points at the Tier II landfill. The plan called for the establishment of three monitoring wells below the landfill and one above in 2004. The landfill is being constructed at a somewhat contaminated location as was evidenced by the discovery of TPH in the sub-surface soils at the site location and from results obtained from the monitoring wells and associated soil monitoring points which were established and sampled in 2003. It was therefore decided that several more monitoring wells be installed this year and that they be sampled several times during the season. Map III-2 shows the locations of the monitoring wells (MW) and their associated soil sampling points. Analytical results for the water and soil samples are presented in the next two sections. This is followed by a discussion of these results.

1. Monitoring Wells

Six more wells were installed around the Tier II landfill site at the beginning of the season (Photograph III-5). Two wells numbered 1A and 1B were established above the landfill. MW 1B remained dry all season whereas MW 1A was sampled on 7 occasions. MW 3B was installed near to MW 3A which was established in 2003. MW 3B was constructed such that the slotted part was sealed below bedrock. This well was however, dry all season. MW 5A and 5B were constructed in a similar manner as MW 3A and MW 3B but about 30 m further away from the landfill berm on the down gradient. There was a distance of 7.7 m between them and both produced water. MW 6 was a further 34 m down gradient from MW 5B.

Water was collected from the wells after purging (Photograph III-6) but due to the lack of water in some wells these were sampled less frequently. Results of the analyses are presented in Tables III-5A to III-5G.

Map III-2: Monitoring Well and Associated S Sample Locations at the Tier II Landfill



Photograph III-5: Installation of a Monitoring Well at Resolution Island

Photograph III-6: Paleah Preparing to Purge a Monitoring Well Prior to Collection of Water Samples

Table III-5A: Results of Analyses of Water Samples Taken From MW 1A

Sample (Prefix RI04-)	Units	024W	031W	047W	127W	058W	063W	084W
Date Sampled		10Jul04	14Jul04	30Jul04	13Aug04	20Aug04	27Aug04	03Sep04
As	ppm	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cd	ppm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	ppm	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cr	ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cu	ppm	0.020	0.024	<0.005	0.030	0.015	0.022	0.033
Ni	ppm	0.005	0.005	<0.005	0.009	0.012	0.016	0.011
Pb	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zn	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
PCBs	ppb	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-
TPH (lube oil)	ppm	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0
TPH (fuel)	ppm	<1.0	<1.0	<1.0	<1.0	<1.0	-	1.0

Table III-5B: Results of Analyses of Water Samples Taken From MW-2

Sample (Prefix RI04-)	Unit	023W	030W	040W	046W	051W	060W	061W	082W
Date Sampled		10Jul04	14Jul04	21Jul04	30Jul04	13Aug04	20Aug04	27Aug04	3Sep04
As	ppm	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cd	ppm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	ppm	<0.003	<0.003	0.003	<0.003	<0.003	0.018	0.021	<0.003
Cr	ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cu	ppm	<0.005	<0.005	<0.005	0.022	<0.005	<0.005	<0.005	<0.005
Ni	ppm	0.058	0.043	0.027	0.005	<0.005	0.094	0.113	<0.005
Pb	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zn	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	0.014	0.036	0.014
PCBs	ppb	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02
TPH (lube oil)	ppm	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0
TPH (fuel)	ppm	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0

Table III-5C: Results of Analyses of Water Samples Taken From MW-3A

Sample (Prefix RI04-)	Unit	020W	028W	042W	048W	126W	055W	067W	083W
Date Sampled		6Jul04	14Jul04	21Jul04	30Jul04	13Aug04	20Aug04	27Aug04	03Sep04
As	ppm	<0.003	0.005	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cd	ppm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	ppm	<0.003	<0.003	0.022	0.016	<0.003	0.017	0.031	<0.003
Cr	ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cu	ppm	0.005	0.014	<0.005	<0.005	<0.005	<0.005	0.008	<0.005
Ni	ppm	<0.005	0.022	0.014	0.013	<0.005	0.018	0.036	<0.005
Pb	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Zn	ppm	<0.010	0.016	<0.010	<0.010	<0.010	0.011	<0.010	<0.010
PCBs	ppb	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
TPH (lube oil)	ppm	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0
TPH (fuel)	ppm	3.3	<1.0	<1.0	1.3	<1.0	<1.0	-	1.0

Table III-5D: Results of Analyses of Water Samples Taken From MW-4

Sample (Prefix RI04-)	Unit	021W	029W	041W	049W	054W	057W	066W
Date Sampled		6Jul04	14Jul04	21Jul04	30Jul04	13Aug04	20Aug04	27Aug04
As	ppm	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Cd	ppm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Co	ppm	<0.003	0.019	0.019	0.010	0.007	0.032	0.035
Cr	ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cu	ppm	<0.005	0.005	0.010	<0.005	<0.005	<0.005	0.007
Ni	ppm	0.007	0.037	0.039	0.026	0.021	0.048	0.140
Pb	ppm	<0.010	<0.010	<0.010	<0.010	0.022	<0.010	<0.010
Zn	ppm	<0.010	0.019	0.011	<0.010	0.025	0.030	0.031
PCBs	ppb	<0.02	<0.02	<0.02	<0.02	<0.02	0.54	<0.02
TPH (lube oil)	ppm	<1.0	<1.0	<1.0	-	<1.0	<1.0	-
TPH (fuel)	ppm	<1.0	1.0	<1.0	-	<1.0	1.5	-

Table III-5E: Results of Analyses of Water Samples Taken From MW-5A

Sample (Prefix RI04-)	Units	039W	050W	059W	065W	078W	085W
Date Sampled		30Jul04	13Aug04	20Aug04	27Aug04	03Sep04	03Sep04
As	ppm	<0.003	<0.003	<0.003	<0.003	<0.003	-
Cd	ppm	<0.001	<0.001	<0.001	<0.001	<0.001	-
Co	ppm	0.045	0.016	0.011	0.009	<0.003	-
Cr	ppm	<0.005	<0.005	<0.005	<0.005	<0.005	-
Cu	ppm	0.021	0.008	<0.005	<0.005	<0.005	-
Ni	ppm	0.032	0.021	0.016	0.015	<0.005	-
Pb	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	-
Zn	ppm	0.118	0.030	0.022	0.018	<0.010	-
PCBs	ppb	<0.02	0.33	0.39	<0.02	<0.02	0.05
TPH (lube oil)	ppm	-	<1.0	<1.0	-	<1.0	-
TPH (fuel)	ppm	-	<1.0	<1.0	-	<1.0	-

Table III-5F: Results of Analyses of Water Samples Taken From MW-5B

Sample (Prefix RI04-)	Unit	022W	045W	128W	056W	062W	080W	086W
Date Sampled		10Jul04	30Jul04	13Aug04	20Aug04	27Aug04	03Sep04	03Sep04
As	ppm	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Cd	ppm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Co	ppm	<0.003	<0.003	0.010	0.011	<0.003	0.005	-
Cr	ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Cu	ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Ni	ppm	0.005	<0.005	0.039	0.032	0.015	0.019	-
Pb	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-
Zn	ppm	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-
PCBs	ppb	<0.02	<0.02	0.16	<0.02	<0.02	-	<0.02
TPH (lube oil)	ppm	<1.0	<1.0	<1.0	<1.0	-	<1.0	-
TPH (fuel)	ppm	<1.0	2.5	<1.0	<1.0	-	<1.0	-

Table III-5G: Results of Analyses of Water Samples Taken From MW-6

Sample (Prefix RI04-)	Unit	038W	125W	044W	064W	079W
Date Sampled		30Jul04	13Aug04	20Aug04	27Aug04	03Sep04
As	ppm	<0.003	<0.003	<0.003	<0.003	<0.003
Cd	ppm	<0.001	<0.001	<0.001	<0.001	<0.001
Co	ppm	<0.003	<0.003	<0.003	<0.003	<0.003
Cr	ppm	<0.005	<0.005	<0.005	<0.005	<0.005
Cu	ppm	<0.005	<0.005	<0.005	<0.005	0.009
Ni	ppm	<0.005	<0.005	<0.005	0.007	0.022
Pb	ppm	<0.010	<0.010	<0.010	<0.010	<0.010
Zn	ppm	<0.010	<0.010	<0.010	<0.010	<0.010
PCBs	ppb	<0.02	<0.02	<0.02	0.55	<0.02
TPH (lube oil)	ppm	<1.0	<1.0	<1.0	-	<1.0
TPH (fuel)	ppm	<1.0	<1.0	<1.0	-	<1.0

2. Soil Samples

Eight soil sampling points were established near to each of the monitoring wells. One soil monitoring point served both 3A and 3B. The soil was sampled twice during the season to give the results shown in Table III-6.

Table III-6 : Results of Analyses of Soil Samples Taken From Close to the Monitoring Wells at the Tier II Landfill Site

Location	Unit	MW 1A		MW 1B		MW 2		MW 3	
Sample Prefix RI04-		158/ 341	518/ 606	153/ 336	322/ 605	155/ 340	519/ 607	154/ 339	528/ 553
Arsenic	ppm	<1.0	1.8	1.2	1.1	1.1	1.9	1.5	1.3
Cadmium	ppm	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	ppm	34	61	33	32	41	47	33	32
Cobalt	ppm	9.5	12.4	7.7	7.9	7.8	12.4	8.5	6.9
Copper	ppm	51	64	52	52	47	72	48	35
Lead	ppm	<10	63	<10	<10	34	<10	21	17
Nickel	ppm	50	53	44	41	33	45	36	28
Zinc	ppm	60	77	51	46	36	59	81	55
PCBs	ppb	85	41	15	10	18	9	100	490
TPH (lube)	ppm	820	<40	<40	<40	<40	<40	<40	<40
TPH (fuel)	ppm	<40	160	<40	<40	<40	<40	80	<40

Location	Unit	MW 4		MW 5A		MW 5B		MW 6	
Sample Prefix RI04-		156/ 331	522/ 608	151/ 334	514/ 550	152/ 342	511/ 554	157/ 329	516/ 551
Arsenic	ppm	1.5	1.7	1.2	1.8	1.2	2.0	1.2	1.4
Cadmium	ppm	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	ppm	41	36	41	39	33	57	33	33
Cobalt	ppm	17.6	16.5	9.6	11.3	8.8	22	5.7	5.6
Copper	ppm	61	48	63	80	55	111	52	47
Lead	ppm	13	<10	<10	<10	<10	17	<10	<10
Nickel	ppm	70	46	37	47	36	90	26	24
Zinc	ppm	56	42	52	56	50	92	40	33
PCBs	ppb	26	9	-	9	16	23	51	23
TPH (lube)	ppm	240	<40	-	<40	<40	<40	<40	<40
TPH (fuel)	ppm	<40	<40	-	<40	40	85	<40	<40

3. *Discussion of Analytical Results*

The objective of the monitoring wells and associated soils program is to establish baseline values for levels of parameters in the soil and water. Any increases in the levels of these parameters might be then attributed to failure of the landfill to have contained the contaminants placed within it. Unfortunately the Tier II landfill site is contaminated at levels that one might expect at an industrial site and the variability of some of these initial levels is larger than desirable.

a) Metals

For the soil samples, all metals except copper gave consistent results with good precision. As with the results from three sampling points in 2003, the precision for copper was poorer. In 2003 the copper levels for six samples was 58 ppm with a standard deviation of 21 ppm, and analyzing two samples from the same location three times each gave a value of 71 ppm with a standard deviation of 48 ppm. For the sixteen samples analysed for copper this year, the average level found was 59 ppm with a standard deviation of 18 ppm. Because there is so much rusty material and small particles of metal around, the soil samples are heterogeneous and therefore variable results are expected for some elements. The water results for metals were as follows. Of the eight elements, no arsenic, cadmium or chromium were detected and lead was only found in one of the 46 samples analysed. Copper, cobalt, nickel and zinc were detected in many samples but all were within the range of these elements found in surface waters at Resolution Island. For each of these elements for a particular well there was often variability with time.

b) PCBs

PCB levels in the soil samples at the monitoring points ranged from 9 to 490 ppb. In 2003 the range was 45 to 520. These levels are below the cleanup standard of 1.0 ppm (1000 ppb) and at levels expected at this location at the site; PCBs can be found at low levels in all surface soil near the station summit (see discussion with respect to plant background levels in section L). The average value for PCBs found this year in the soil samples was 62 ppb with a standard deviation of 122 ppb. Clearly with these variable levels, any PCBs emanating from the Tier II landfill will not be able to be detected. PCB levels in the monitoring well water samples were generally very low and below the detection limit of 0.02 ppb or 20 parts per trillion. Of the 46 samples analysed only 8