5 Source Characterisation

5.1 Origin and Extent

5.1.1 Potential Contaminants

From the 1940s, until its closure in 2004, the site was utilised for the synthesis, formulation, packaging and storage of a variety of agrochemical products (as outlined in Section 2.3). The accidental or unintentional release of compounds directly or indirectly associated with these processes has resulted in the contamination of the underlying soils and groundwater.

5.1.2 Historical Contamination Incidents

5.1.2.1 Main Site

Concentrations of contaminants in the soils and groundwater underlying the Main Site are thought to have resulted from a combination of the gradual release of chemicals, from leaky drains or deposited waste for example, and incidental releases such as spills, fires and explosions.

Reported occurrences were identified in the Aspinwall & Co. Ltd Report (1991) and also summarised in the Enviros Report (2005). The key incidents or operations that may have led to the release of contaminants are provided below with reference to the subdivision of the site into Areas (Figure 7) based on the operational activities and distribution of contamination on-site:

1. In the 1940s spent nitration and sulphonation acids were disposed of into 'Chalk Pits' thought to have been located in the area of the Clofentezine Plant in the south west corner of Area 1N. It is also likely that drums of irrecoverable, out-of-specification product were disposed of in these locations.
2. In 1952 an explosion destroyed the Hanane Plant which was located in the eastern part of Area 2.
3. The earliest record of contamination (c.1965) relates to the reported seepage of yellow coloured groundwater into the cellar of the Chequers Public House, formerly located on the western boundary of Area 1N where the Laboratory block 2 now stands. The public house was located down-hydraulic gradient from the DNOC (Denocate or DNBP) plant which was located on the northern boundary of Area 1S.
4. "Brown pools" were first reported in the bed of the Riddy during periods of low flow in 1972. A bentonite / cement cut-off wall was installed in 1974 to prevent migration of contaminants from the site.
5. Over 45000 litres of spent nitric and sulphuric acid were released during the loading of a tanker on the roadway outside the Process Development Pilot Plant located near the south west corner of Area 1N in the early 1970s.
6. Ingress of toluene contaminated groundwater into the Riddy Brook was reported during the 1980s. The source was traced to the works and a leaking

floor sump within the Prochloraz Plant which was located near the centre of the southern boundary to Area 1N. Toluene is believed to have flowed over the groundwater surface between the top of the cut-off wall and the base of the works perimeter wall to reach the Riddy, this is possible because toluene is a LNAPL substance.

7. There was a major release of fuel oil in 1985 from the then unbunded storage tanks located in Area 3, which entered the boiler house sumps. These sumps were linked to the groundwater collection system at that time. Some oil escaped from the site into the Riddy Brook, which led to upgrading of the site's containment provisions.
8. In 1985 there was an explosion in the General Purpose Plant near the centre of Area 1N.
9. A fire occurred in the Small Pack Filling Plant located in Area 2 in 1987.
10. A mass balance check of the drumming off of product in the Bulk Handling Plant, located in the southern part of Area 1S, indicated a shortfall of product which inferred leaks from tanks, the duration of which is unknown.
11. There are also numerous locations on-site where drums have historically been stored on unsurfaced ground.
12. Sodium hydroxide spillage occurred in 1986 in Area 1N near the Prochloraz plant.

The impacts of incidents early in the site's history are likely to have been exacerbated by the partial sealing of the plant's surface, restricting infiltration of meteoric water. Later incidents are considered unlikely to have resulted in significant contamination owing to the surface of the works area being sealed and the surface water drainage from the site being discharged via the WWTP [Ref 3].

5.1.2.2 Waste Water Treatment Plant

The primary source of contamination to soils at the WWTP is considered to have resulted from the overflow of effluent from tanks or the lagoon or through pipe bursts, which historically included the breaking of pipes to remove blockages that resulted in effluent being allowed to drain freely onto the ground [Ref 3].

Soil contamination along the path of the former pipeline (linking the Main Site to the WWTP) had also occurred, but was subsequently remediated during the installation of the new encased pipeline. The soil from the excavated area beneath the warehouse, which was used to construct the mound surrounding the WWTP, is assumed to be clean material. This will be confirmed during the course of future remediation works on the WWTP site.

The main sources of contamination to groundwater at the WWTP are the former effluent trenches located to the south-west and north-west of the treatment plant and the former landfill thought to be located adjacent to the eastern boundary of the WWTP [Ref 3]. It is thought that the former landfill accepted waste from the Main Site and is likely to contain some phytotoxic metals. It is believed that the facility was operated and completed prior to 1952 and it is unlikely that that leachate control or containment measures would have been incorporated into the design [Ref 3].

5.2 Spatial Distribution of Contaminants

5.2.1 Previous Understanding

The conclusions drawn in the Enviros January 2005 Part IIA Site Investigation Report were that:

1 Soil contamination is largely restricted to localised hot spots (1) within the main area of contamination in the Main Site and (2) in the vicinity of the historical trenches at the WWTP; and

2 Soil contamination has a very small and localised contribution as a contaminant source. Leaching tests have also shown that any potential contribution to contamination would mostly have occurred historically. The unsaturated zone is thin and contaminated soil volumes are small.

The additional investigation was carried out to fill in any obvious data gaps identified and confirm or refute the conclusions by Enviros.

5.2.2 Current Understanding

The following evaluation refers to the subdivision of the site according to the Enviros 2005 report (see Table 2.1) amended to separate Area 1 into two parts. The northern (Area 1N) and southern areas (Area 1S) have been divided along a line drawn westwards from the north end of Area 3 to the A10 trunk road, along the east/west orientated roadway immediately south of the former Prochloraz and Clofentezine plants (building reference C12). This refinement has been made to differentiate the pattern of contaminant distributions noted in soils and groundwater on the Main Site, within the relatively large Area 1. The revised Areas are illustrated in Figure 3 (Appendix A).

Summary tables for each Area provide the levels of selected priority contaminants of concern (MCPA, Mecoprop, Ethofumesate, 2,3,6-TBA, DDT, Dieldrin, toluene, xylene, trichlorethene, tetrachlorethene, trimethylbenzenes and copper) that have been used to illustrate the general levels of soil and groundwater contamination in each area. Where other contaminants have been determined to be elevated with respect to average concentrations then relevant levels have also been provided.

An overall summary table of the levels of contaminants of concern identified in the Enviros 2005 report and the Atkins 2006 site investigations is provided in Appendix E, with post plots of selected priority contaminants provided in Appendix G, to further illustrate the distribution of these substances across the site area (both Main Site and WWTP site).

The minimum concentrations noted in the tables below represent the lowest recorded value above the reporting limits, and the mean concentrations represent the average of the concentrations above the reporting limits. This allows for averaging out of contaminated areas to provide a reasonable indication of ‘hot spot’ or plume concentrations rather than this being skewed to a lower value by samples with concentrations below reporting limits. Where no results are above reporting limits then ND has been used (Not detected).

5.2.2.1 Soils

Area 1N

The two ground investigations have identified a wide range of contaminants in the soils in the northern part of Area 1 including high concentrations of pesticides/herbicides and other organic contaminants encountered over wide areas as shown in Table 5.1. The concentrations of some of the pesticides (e.g. MCPA and 2,3,6-TBA) and other organic substances (e.g. toluene) show a marked decrease in concentration between those reported by Enviros (2005) and those recorded from the 2006 site investigation. This may be due to natural degradation of the pesticides following the cessation of operational activities in 2004, or sampling/testing variations between the two investigations.

There are substances such as copper, PAHs and trichloroethene which show a marked increase in concentrations between the two sampling events, which may be the result of sampling differences in some cases, or may reflect real increases in soil concentrations as a result of increased breakdown products of the pesticides produced at the site.

Toluene has been detected in soils in this part of Area 1N in both the Enviros and Atkins data in the highest concentrations found on the site. There was an incident reported in the site history of a leakage of toluene from a floor sump in the Prochloraz Plant in the 1980s, and resulting contamination of ground and groundwater from this incident at the time. The sump was fixed, although the period of leakage prior to fixing is unknown, and remedial measures were put in place with respect to vapours in the buildings. It is not reported whether any soil or groundwater remediation took place but most likely not.

DDT and Dieldrin were two of the products manufactured at the site during its early history (1940-50's) which were not tested for by the Enviros (2005) and other previous site investigations. These two substances have been detected by Atkins in 2006 in the soils in the northern part of Area 1N despite their not having been handled at the site recently. These two substances are known to be relatively resistant to degradation in the environment (see Appendices I & J).

On the basis of the soils sample analyses available, the soils Area 1N appear to be the most highly contaminated on the site with respect to herbicides, pesticides and volatile organic compounds.

Table 5.1 – Area 1N Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005					Atkins 2006				
		Limits of detection	No. samples	Min	Max	Mean	Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**15**	*200*	*132000*	*27030*	**<100**	**3**	-	1880	-
2,3,6-TBA	µg/kg	**<150**	**15**	*850*	*9000*	*4612*	**<100**	**3**	-	280	-
Mecoprop	µg/kg	**<150**	**15**	*400*	*38000*	*18675*	**<100**	**3**	-	-	460
MCPA	µg/kg	**<150**	**15**	*310*	*107000*	*27880*	**<100**	**3**	340	580	280
DDT	µg/kg	**n/a**	-	-	-	-	**<100**	**3**	100	14100	7523
Dieldrin	µg/kg	**n/a**	-	-	-	-	**<100**	**3**	120	3320	1720
toluene	µg/kg	**-**	**19**	*2*	*87000*	*10498*	**<100**	**11**	330	2600	1465
m&p-xylene	µg/kg	**-**	**19**	*4*	*36600*	*5628*	**<0.2**	**11**	-	3800	-
trichloroethene	µg/kg	**-**	**19**	*54*	*734*	*284*	**<100**	**11**	170	18000	9085
tetrachloroethene	µg/kg	**-**	**19**	*65*	*3980*	*855*	**<100**	**11**	240	45000	12023
1,2,4 trimethylbenzene	µg/kg	**-**	**19**	*23.3*	*81.7*	*57.8*	**<100**	**11**	-	600	-
1,3,5 trimethylbenzene	µg/kg	**-**	**19**	-	-	-	**<100**	**11**	-	510	-
Copper (Total)	mg/kg	**< 2.5**	**10**	*8.4*	*240*	*71.7*	**<2.5**	**11**	9.0	2400	305
2,4-DB	µg/kg	**<150**	**15**	*580*	*9000*	*3830*	**<100**	**3**	ND	ND	ND
Dicamba	µg/kg	**<150**	**15**	*370*	*4890*	*2630*	**<100**	**3**	-	390	-
Simazine	µg/kg	**<100**	-	-	-	-	**<100**	**3**	-	87180	-
Pentachlorophenol	µg/kg	**<150**	**15**	*560*	*1250*	*905*	**-**	**-**	-	-	-
1,2,4-trichlorobenzene	µg/kg	**-**	**19**	*1*	*1330*	*362*	**<100**	**11**	150	8700	3250
1,3,5-trichlorobenzene	µg/kg	**-**	**19**	*ND*	*ND*	*ND*	**<100**	**11**	-	8700	-
cis-1,2-dichloroethene	µg/kg	**-**	**19**	*1*	*34300*	*7546*	**<100**	**11**	1000	380000	127500
bis(2-chloroethyl)ether	µg/kg	**-**	**19**	*400*	*6200*	*1667*	**<1000**	**11**	2000	3800	3033
1,2-dichlorobenzene	µg/kg	**-**	**13**	-	*900*	-	**<100**	**11**	140	1300000	444380
naphthalene	µg/kg	**-**	**13**	**-**	*300*	**-**	**<1000**	**11**	-	6300	-
benzo(a)pyrene	µg/kg	**-**	**13**	**-**	*400*	**-**	**<1000**	**11**	10000	19000	14500
Dibenzofuran	µg/kg	**-**	**13**	*200*	*500*	*350*	**<1000**	**11**	1000	52000	24675
phenanthrene	µg/kg	**-**	**13**	*200*	*500*	*333*	**<1000**	**11**	1100	52000	23175
fluoranthene	µg/kg	**-**	**13**	-	*400*	-	**<1000**	**11**	1000	56000	20950
pyrene	µg/kg	**-**	**13**	-	*300*	-	**<1000**	**11**	-	6300	-

Area 1S

High concentrations of pesticides/herbicides and organic substances have been identified in the soil in the southern part of Area 1 (see Table 5.2), the operational area of the Main Site. However, few of the pesticides/herbicides detected in the Enviros (2005) data were found in the 2006 site investigation. This could be due to relatively few samples taken (4 No.) from this part of the site in 2006.

The concentrations of pesticides recorded in the Enviros (2005) samples show broadly similar levels of contamination across Area 1S as were recorded in the northern part of Area 1 at the same time. As in Area 1N, DDT and Dieldrin have been detected at concentrations well in excess of the analytical detection limit. Other organic contaminants such as PAHs, BTEX, trichlorethene (TCE) and tetrachloroethene (PCE) were generally recorded in lower concentrations in this part of Area 1 compared to the northern part in 2005.

There appears from comparing the Enviros (2005) and Atkins (2006) soil analytical results in Area 1 as a whole to be a decline with time in the concentrations of most substances recorded, with a few exceptions such as 2-methylnaphthalene and Trietazine in Area 1S. This apparent general decline in the levels of soil contamination may reflect a real fall in the levels of soil contamination or may be the result of a sampling anomaly from the relatively limited number of soil samples analysed during the 2006 investigation. This latter investigation was carried out to fill in data gaps left from the previous investigations, hence the limited number of samples taken.

A real decline in the levels of organic soil contamination could be explained by the cessation of production and storage of chemicals and products on-site preventing the introduction of further contaminating substances to the ground. Natural degradation in the soils and leaching of contaminants into groundwater may also have depleted the source concentrations from historical spills and leaks. The detection of certain substances (2-methylnaphthalene and Trietazine in Area 1S) in 2006 at concentrations above those found in 2005 does not preclude the possibility of a declining soil source concentration on-site.

The differences in contaminant concentrations may also be influenced by how extensive the contaminated area is and whether soil samples are taken; within these areas; within areas where the contamination has spread; or in areas immediately adjacent to the area of main contamination. The variable extent of such areas means that samples taken close together could show similar or completely different contaminant profiles as demonstrated by data. This potential influence is also relevant to the other areas, and in particular Area 1N discussed above.

The amount of soils sampling data available to date cannot confirm the appropriateness and importance of the influences described above in relation to changes in observed contaminant concentrations. Therefore, further confirmatory testing is considered necessary in order to substantiate these hypotheses.

Table 5.2 – Area 1S Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005					Atkins 2006				
		Limits of detection	No. samples	Min	Max	Mean	Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**12**	*200*	*404000*	*61488*	**<100**	**4**	-	6640	-
Mecoprop	µg/kg	**<150**	**12**	*210*	*11000*	*2677*	**<100**	**4**	ND	ND	ND
MCPA	µg/kg	**<150**	**12**	*5040*	*510000*	*179047*	**<100**	**4**	ND	ND	ND
2,3.6-TBA	µg/kg	**<150**	**12**	*480*	*120000*	*31648*	**<100**	**4**	ND	ND	ND
DDT	µg/kg	**n/a**	**-**	-	-	-	**<100**	**4**	290	10200	4537
Dieldrin	µg/kg	**n/a**	**-**	-	-	-	**<100**	**4**	590	1170	870
toluene	µg/kg	**-**	**13**	*1.7*	*20400*	*4195*	**<100**	**11**	-	660	-
m&p-xylene	µg/kg	**-**	**13**	*270*	*395000*	*81425*	**<0.2**	**11**	250	760	470
trichloroethene	µg/kg	**-**	**13**	*130*	*28500*	*9661*	**<100**	**11**	1200	13000	7100
tetrachloroethene	µg/kg	**-**	**13**	*2*	*757000*	*195563*	**<100**	**11**	-	480	-
1,2,4-trimethylbenzene	µg/kg	**-**	**13**	*1.3*	*3330*	*940*	**<100**	**11**	450	1500	975
1,3,5-trimethylbenzene	µg/kg	**-**	**13**	*105*	*5260*	*1806.2*	**<100**	**11**	180	4500	2340
Copper (Total)	mg/kg	**<2.5**	**7**	*14*	*490*	*155*	**<2.5**	**11**	5.7	240	99
Trietazine	µg/kg	**<100**	**12**	*1700*	*4700*	*2867*	**<100**	**4**	-	23500	-
4-chloro-3-methylphenol	µg/kg	**-**	**7**	*6100*	*130000*	*68050*	**<1000**	**11**	ND	ND	ND
2-methylnaphthalene	µg/kg	**-**	**7**	*500*	*32500*	*9617*	**<1000**	**11**	1300	51000	20767
ethylbenzene	µg/kg	**-**	**13**	*1.2*	*128000*	*14632*	**<100**	**11**	190	250	220
Naphthalene	µg/kg	**-**	**13**	*1.1*	*26400*	*4344*	**n/a**	**11**	-	-	-

Area 2

Site records suggest that the operational and production activities present on this part of the site were less intensive and continuous, which may have resulted in generally lower levels of soil contamination, and more discrete areas of soil contamination associated with individual historical sources (e.g. leaking tanks or pipes and spills) of a more limited number of contaminants. This area of the site has been used extensively for the storage of drums containing product and process chemicals in addition to formulation/production of TBA and Hanane historically. The Hanane Plant exploded in 1952, however there is no definitive source of soil contamination identified with this incident by the ground investigations in 2005/06. This is consistent with Hanane's relatively rapid decay rate in the environment (see Appendices I & J).

Relatively few samples from Area 2 have reported levels of contamination as high as identified in Area 1 (see Table 5.3). However, Mecoprop has been detected at a high concentration in a single sample from the 2006 investigation and Ethofumesate and 2,3,6-TBA were detected in potentially significant concentrations in 2 and 1 (No.) samples respectively in the 2005 investigations. DDT has been detected at concentrations above the analytical detection limit, but at a lower concentration than detected in Area 1N and Area 1S. Unlike Areas 1N and 1S, Dieldrin was not detected. The contamination of soils in this part of the Main Site appears to be less extensive than in Area 1; however discrete areas appear to be affected by pesticides and other organic contaminants.

Much of this area remains covered by buildings and therefore was inaccessible for soil sampling. Gaps from these areas will need to be filled at a later date. Until gaps in the data for areas currently covered by buildings are filled then it is not possible to make any definitive assessment with respect to soil contamination.

Table 5.3 – Area 2 Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005					Atkins 2006				
		Limits of detection	No. samples	Min	Max	Mean	Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**3**	*100*	*21000*	*5400*	**<100**	5	-	200	-
Mecoprop	µg/kg	**<150**	**3**	-	*6000*	-	**<100**	5	-	11500	-
MCPA	µg/kg	**<150**	**3**	-	*220*	-	**<100**	5	-	3120	-
2,3.6-TBA	µg/kg	**<150**	**3**	-	*300*	-	**<100**	5	ND	ND	ND
DDT	µg/kg	**n/a**	**-**	-	-	-	**<100**	5	-	420	-
Dieldrin	µg/kg	**n/a**	**-**	-	-	-	**<100**	5	ND	ND	ND
toluene	µg/kg	**-**	**3**	*1*	*1*	*1*	**<100**	19	ND	ND	ND
m&p-xylene	µg/kg	**-**	**3**	*ND*	*ND*	*ND*	**<0.2**	19	ND	ND	ND
trichloroethene	µg/kg	**-**	**3**	*2.9*	*3.6*	*3.3*	**<100**	19	ND	ND	ND
tetrachloroethene	µg/kg	**-**	**3**	-	*23*	-	**<100**	19	ND	ND	ND
1,2,4-trimethylbenzene	µg/kg	**-**	**3**	-	*1.3*	-	**<100**	19	ND	ND	ND
1,3,5-trimethylbenzene	µg/kg	**-**	**3**	*ND*	*ND*	*ND*	**<100**	19	ND	ND	ND
Copper (Total)	mg/kg	**< 2.5**	**-**	-	-	-	**<2.5**	19	3.6	67	18
2,6-dinitrotoluene	µg/kg	**-**	**-**	-	-	-	**<1000**	19	-	47000	-

Area 3

Relatively few of the products produced during the operational period have been detected in the soils sampled from Area 3. Area 3 contained historically the engineering department, fuel store and boiler house amongst other unspecified uses and does not appear to have been an active area of production. The concentrations of MCPA and Ethofumesate detected in 2006 are lower than those reported in Area 1; however, DDT has been detected at concentrations similar to those observed in Area 1.

Whilst concentrations of herbicides and pesticides are generally lower than those detected in the production areas, concentrations of PAHs have been identified above analytical detection limits from the 2006 data for this area e.g. benzo(a)pyrene (12,000 µg/kg).

Trichloroethene and tetrachloroethene were detected in soils within this area by the Enviros (2005) report, however these substances were not detected in the 2006 samples from this area, which may be a result of the limited sampling (3 No.) in 2006.

Copper detected in soils in this Area is possibly related to the historical use of hydrochloric acid to digest scrap copper in tanks above and later below ground in the of manufacture Blintox (copper oxychloride). The former location of these tanks is not certain, but levels of copper in soils in this area are the highest reported at the site in both the 2005 and 2006 ground investigations. The results of the soil analysis are summarised in Table 4.4.

The soils in Area 3 do not appear to represent the greatest potential source of on-going contamination for groundwater in terms of concentrations of contaminants. However, the position of this area on the river side of the cut-off wall makes it particularly sensitive due to its close proximity to Riddy Brook, the most likely receptor, and the absence of any low permeability barrier. Therefore care will need to be taken in this area to limit future mobilisation of contaminants for example following the break up of hardstanding.

Table 5.4 – Area 3 Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005					Atkins 2006				
		Limits of detection	No. samples	Min	Max	Mean	Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**15**	*200*	*12700*	*3014*	**<100**	**3**	100	870	485
Mecoprop	µg/kg	**<150**	**15**	*520*	*15000*	*6173*	**<100**	**3**	ND	ND	ND
MCPA	µg/kg	**<150**	**15**	*1640*	*1640*	*1640*	**<100**	**3**	-	390	-
2,3.6-TBA	µg/kg	**<150**	**15**	*3000*	*7910*	*5303*	**<100**	**3**	ND	ND	ND
DDT	µg/kg	**n/a**	**-**	-	-	-	**<100**	**3**	650	20100	10375
Dieldrin	µg/kg	**n/a**	**-**	-	-	-	**<100**	**3**	ND	ND	ND
toluene	µg/kg	**-**	**17**	-	*17.3*	-	**<100**	**5**	ND	ND	ND
m&p-xylene	µg/kg	**-**	**17**	-	*36.4*	-	**<0.2**	**5**	ND	ND	ND
trichloroethene	µg/kg	**-**	**17**	*1.3*	*227*	*101*	**<100**	**5**	ND	ND	ND
tetrachloroethene	µg/kg	**-**	**17**	*10.7*	*4510*	*1373*	**<100**	**5**	ND	ND	ND
1,2,4-trimethylbenzene	µg/kg	**-**	**17**	-	*867*	-	**<100**	**5**	ND	ND	ND
1,3,5-trimethylbenzene	µg/kg	**-**	**17**	-	*420*	-	**<100**	**5**	ND	ND	ND
Copper (Total)	mg/kg	**< 2.5**	**12**	*9.2*	*670*	*108*	**<2.5**	**5**	30	1200	438
bis(2-chloroethyl)ether	µg/kg	**-**	**9**	-	*3900*	-	**<1000**	**5**	ND	ND	ND
benzo(a)pyrene	µg/kg	**-**	**9**	*300*	*500*	*400*	**<1000**	**5**	1100	12000	6700
fluoranthene	µg/kg	**-**	**9**	*500*	*800*	*650*	**<1000**	**5**	12000	19000	15333
pyrene	µg/kg	**-**	**9**	*500*	*700*	*600*	**<1000**	**5**	11000	17000	13000
hexachlorocyclopentadien	µg/kg	**n/a**	**9**	-	-	-	**<1000**	**5**	6400	12000	9200

Area 4

The soils sampled from the car park area (Area 4) in the north-west of the Main Site during the Enviros 2005 and Atkins 2006 investigations, as summarised in Table 5.5, appear to be relatively uncontaminated with respect to the process chemicals and products produced at the site. The concentration of n-nitrosodibutylamine is however the highest noted in soils from the site for this substance, suggesting that there may be some parts of this area that have high levels of soil contamination from individual incidents not recorded in the site history. Most of the area appears to be relatively uncontaminated as a result of site activities subject to further confirmatory analysis.

Table 5.5 – Area 4 Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005					Atkins 2006				
		Limits of detection	No. samples	Min	Max	Mean	Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
Mecoprop	µg/kg	**<150**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
MCPA	µg/kg	**<150**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
2,3.6-TBA	µg/kg	**<150**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
DDT	µg/kg	**n/a**	**-**	-	-	-	**<100**	**2**	ND	ND	ND
Dieldrin	µg/kg	**n/a**	**-**	-	-	-	**<100**	**2**	ND	ND	ND
toluene	µg/kg	**-**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
m&p-xylene	µg/kg	**-**	**1**	ND	ND	ND	**<0.2**	**2**	ND	ND	ND
trichloroethene	µg/kg	**-**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
tetrachloroethene	µg/kg	**-**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
1,2,4-trimethylbenzene	µg/kg	**-**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
1,3,5-trimethylbenzene	µg/kg	**-**	**1**	ND	ND	ND	**<100**	**2**	ND	ND	ND
Copper (Total)	mg/kg	**< 2.5**	**1**	-	11	-	**<2.5**	**2**	6.3	12	9.2
n-nitrosodibutylamine	µg/kg	**n/a**	**1**	-	-	-	**<1000**	**2**	-	22000	-

Areas 5 to 9

Area 5 is located between the WWTP site and the Main Site. Area 7 encloses much of the area in which the WWTP infrastructure is located, but with smaller areas also included within the boundaries of Area 6. Areas 8 and 9 meanwhile form the southern, western (Area 8) and northern (Area 9) boundaries to the WWTP site. The Atkins 2006 ground investigation focused on the Main Site with only the addition of two groundwater monitoring boreholes, BH11/06 and BH12/06, located in Area 5 and Area 8 respectively. The review of soil contamination data therefore is predominantly of the Enviros (2005) results. Areas 5 to 9 will be investigated at a later date in accordance with the redevelopment programme.

Area 5

Area 5 has historically been a recreational area (sports ground) and has not been part of the site where potentially polluting activities are believed to have occurred. Relatively limited sampling of soils from this area has taken place in the various site investigations, 2,3,6 TBA was detected in the soil although no other contamination has been encountered in this area, albeit from limited testing (see Table 5.6).

There is a possibility that soil contamination may be present along the line of the pipelines through this Area which took effluents and still takes surface water and water from the groundwater management systems to the WWTP site for treatment. Any leaks from these pipes could contaminate areas of soil around these locations which is a possibility that should be noted for the remediation strategy of the site.

Table 5.6 – Area 5 Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005					Atkins 2006				
		Limits of detection	No. samples	Min	Max	Mean	Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**1**	*ND*	*ND*	*ND*	**<100**	**-**	-	-	-
Mecoprop	µg/kg	**<150**	**1**	*ND*	*ND*	*ND*	**<100**	**-**	-	-	-
MCPA	µg/kg	**<150**	**1**	*ND*	*ND*	*ND*	**<100**	**-**	-	-	-
2,3.6-TBA	µg/kg	**<150**	**1**	*-*	*200*	*-*	**<100**	**-**	-	-	-
DDT	µg/kg	**n/a**	**-**	*-*	*-*	*-*	**<100**	**-**	-	-	-
Dieldrin	µg/kg	**n/a**	**-**	*-*	*-*	*-*	**<100**	**-**	-	-	-
toluene	µg/kg	**-**	**1**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
m&p-xylene	µg/kg	**-**	**1**	*ND*	*ND*	*ND*	**<0.2**	**2**	ND	ND	ND
trichloroethene	µg/kg	**-**	**1**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
tetrachloroethene	µg/kg	**-**	**1**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
1,2,4-trimethylbenzene	µg/kg	**-**	**1**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
1,3,5-trimethylbenzene	µg/kg	**-**	**1**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
Copper (Total)	mg/kg	**<2.5**	**1**	*7.0*	*8.0*	*9.0*	**<2.5**	**2**	-	16	-

Area 6

Area 6 defines the approximate area of the reported former effluent trenches used to dispose of effluents in the early history of the site. No investigation of the WWTP site has been undertaken for soil contamination to date by Atkins. The Enviros (2005) data as summarised in Table 5.7 show high levels of soil contamination in the former effluent trench areas with organic substances, but none of the pesticides tested for in 2005 were detected. DDT and Dieldrin were not tested in the Enviros soil samples and therefore cannot be excluded from the potential list of soil contaminants in this area. They were produced early in the site history. However whether they may have been in the effluents discharged to the trenches in this area is uncertain. DDT and Dieldrin are relatively durable in the environment and could be expected to have remained in the soils if they were discharged in this area historically. Area 6 in terms of levels of soil contamination and the thickness of soils above the water table represents a potential ongoing source for groundwater pollution. However, the age of the contamination in this area and absence of any hardstanding would suggest that any leaching is likely to have taken place.

Table 5.7 – Area 6 Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005				
		Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**8**	*ND*	*ND*	*ND*
Mecoprop	µg/kg	**<150**	**8**	*ND*	*ND*	*ND*
MCPA	µg/kg	**<150**	**8**	*ND*	*ND*	*ND*
2,3.6-TBA	µg/kg	**<150**	**8**	*ND*	*ND*	*ND*
DDT	µg/kg	**n/a**	**-**	-	-	-
Dieldrin	µg/kg	**n/a**	**-**	-	-	-
toluene	µg/kg	**-**	**8**	*ND*	*ND*	*ND*
m&p-xylene	µg/kg	**-**	**8**	*10600*	*33000*	*19100*
trichloroethene	µg/kg	**-**	**8**	*66.5*	*8350000*	*2907046*
tetrachloroethene	µg/kg	**-**	**8**	*452*	*17400000*	*2522987*
1,2,4-trimethylbenzene	µg/kg	**-**	**8**	*925*	*81100*	*54206*
1,3,5-trimethylbenzene	µg/kg	**-**	**8**	*534*	*40600*	*26833.5*
Copper (Total)	mg/kg	**< 2.5**	**8**	*35*	*14000*	*2372*
naphthalene	µg/kg	**-**	**8**	*300*	*161000*	*42425*
bis(2-chloroethyl)ether	µg/kg	**-**	**8**	*4900*	*8800*	*6850*
2-methylnaphthalene	µg/kg	**-**	**8**	*1100*	*373000*	*100575*
cis-1,2-dichloroethene	µg/kg	**-**	**8**	*2280*	*9690*	*6560*

Area 7

Area 7 encloses much of the WWTP infrastructure, which is still operational, treating surface drainage and groundwater abstracted from the Main Site. The Enviros (2005) data summarised in Table 5.8 identified some soil affected by more recently produced pesticides and certain other organic substances. The number of occurrences detected are relatively limited however. No definitive statement can be made as to the extent of the soil contamination in this area other than there appears to be some contamination from effluents or contaminated waters treated at the WWTP. This suggests spills and leaks of effluents and contaminants water may have occurred at the WWTP during its operational history.

Table 5.8 – Area 7 Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005				
		Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**5**	*ND*	*ND*	*ND*
Mecoprop	µg/kg	**<150**	**5**	*250*	*340*	*295*
MCPA	µg/kg	**<150**	**5**	*240*	*2060*	*1020*
2,3.6-TBA	µg/kg	**<150**	**5**	*ND*	*ND*	*ND*
DDT	µg/kg	**n/a**	**-**	-	-	-
Dieldrin	µg/kg	**n/a**	**-**	-	-	-
toluene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*
m&p-xylene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*
trichloroethene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*
tetrachloroethene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*
1,2,4-trimethylbenzene	µg/kg	**-**	**5**	*1.2*	*1.3*	*1.25*
1,3,5-trimethylbenzene	µg/kg	**-**	**5**	-	*1*	-
Copper (Total)	mg/kg	**< 2.5**	**-**	-	-	-
bis(2-chloroethyl)ether	µg/kg	**-**	**5**	-	*2800*	-
4-chloro-3-methylphenol	µg/kg	**-**	**5**	*7200*	*7600*	*7400*

Area 8

Contamination associated with the WWTP site and the former effluent lagoons and effluent trenches in Area 6 may have migrated into Area 8, which based on the known site history had limited potentially contaminative activities historically. The concentrations of contaminants reported in the Enviros 2005 data (see Table 5.9) suggest that trichlorethene and tertrachloroethene represent the principal contaminants of concern in this area in common with Area 6. The lack of Diedrin and DDT testing of soils in this area to date means no comment can be made on their possible presence in soils in the vicinity of the WWTP site.

Table 5.9 – Area 8 Summary table of priority contaminants in soils.

Substances	Units	**Enviros 2005**					**Atkins 2006**				
		Limits of detection	No. samples	Min	Max	Mean	Limits of detection	No. samples	Min	Max	Mean
Ethofumesate	µg/kg	**<100**	**5**	-	*140*	-	**<100**	**-**	-	-	-
Mecoprop	µg/kg	**<150**	**5**	*ND*	*ND*	*ND*	**<100**	**-**	-	-	-
MCPA	µg/kg	**<150**	**5**	*ND*	*ND*	*ND*	**<100**	**-**	-	-	-
2,3.6-TBA	µg/kg	**<150**	**5**	*ND*	*ND*	*ND*	**<100**	**-**	-	-	-
DDT	µg/kg	**n/a**	**-**	-	-	-	**<100**	**-**	-	-	-
Dieldrin	µg/kg	**n/a**	**-**	-	-	-	**<100**	**-**	-	-	-
toluene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
m&p-xylene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*	**<0.2**	**2**	ND	ND	ND
trichloroethene	µg/kg	**-**	**5**	*50.7*	*265*	*157.9*	**<100**	**2**	ND	ND	ND
tetrachloroethene	µg/kg	**-**	**5**	*1.8*	*632*	*316.9*	**<100**	**2**	ND	ND	ND
1,2,4-trimethylbenzene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
1,3,5-trimethylbenzene	µg/kg	**-**	**5**	*ND*	*ND*	*ND*	**<100**	**2**	ND	ND	ND
Copper (Total)	mg/kg	**< 2.5**	**1**	-	*15*	-	**<2.5**	**2**	-	13	-

Area 9

Only the pesticide 2,3,6 TBA of the priority contaminants has been identified in the single soil sample from Area 9 analysed by Enviros in 2005. However two PAHs were detected along with 2,4-dimethylphenol and fluoroxypyr. There is a possibility therefore that more extensive soil contamination may be located north and east of the WWTP site but further investigation of this area is required. It should be noted however that no potentially contaminative historical activities have been reported for this area.

Table 5.10 – Area 9 Summary table of priority contaminants in soils.

Substances	Units	Enviros 2005				
		No. Samples	Limits of detection	**Min**	**Max**	**Mean**
2,3,6-TBA	µg/kg	1	-	-	*23*	-
Fluoroxypyr	µg/kg	1	-	-	*93*	-
2,4-dimethylphenol	µg/kg	1	-	-	*400*	-
benzo(a)anthracene	µg/kg	1	-	-	*300*	-
Naphthalene	µg/kg	1	-	-	*1.1*	-

5.2.2.2 Summary of Soil Contamination

In summary, the main production and storage areas within the Main Site (Areas 1N, 1S and 3) and Area 6 in the WWTP site represent the main areas of soil contamination. Elevated concentrations of pesticides/herbicides and other substances have, however, been detected in soils from various locations across both the Main Site and WWTP Site. Considering the extent of the site investigations to date and the pattern of soil contamination observed from these investigations there is a potential for soil contamination at locations other than those already identified by the existing site investigations.

There may be some degradation of the concentrations of contaminants in soils on the Main Site following the cessation of production on-site, however this would need to be confirmed by further site investigations and testing.

The detection of DDT and Dieldrin in soils from a large number of the samples tested in the Atkins 2006 GI (Areas 1, 2 and 3) suggests that there may be other areas of soil contamination from these two substances in the Main Site, but also that there is a possibility of their presence at the WWTP site where they were not analysed for in previous site investigations.

5.2.2.3 Leachability

The leachable concentrations of contaminants are summarised below in Tables 5.11 to 5.13 based on contaminant types. At the time of writing only a single leachability analysis for herbicides/pesticides and semi-volatile organic compounds (SVOCs) of soil from the Atkins (2006) GI was available (BH2/06 0.75mbgl, Area 1S).

The leaching data on pesticides compared to the water quality standards indicates that there is a potential for the contaminated soils on site to leach concentrations of

these substances that would exceed environmental standards. The leachable concentrations reported will vary with the soil concentration present in the individual samples and particular soil chemistry therefore no inference can be made into the single sample tested in the Atkins (2006) data about a decrease in leachable component with time since the Enviros (2005) testing.

Table 5.11 – Leachable concentrations of pesticides from soils.

				Enviros 2005			Atkins 2006
	Units	**EQS**	**DWS**	**Min**	**Max**	**Mean**	
2,3.6-TBA	µg/l	**-**	**0.1**	***0.2***	***30.4***	***5.34***	**3.7**
2,4,5-T	µg/l	**-**	**0.1**	***0.27***	***21.5***	***10.9***	ND
2,4-D	µg/l	**1**	**0.1**	***0.15***	***21.6***	***8.53***	ND
2,4-DB	µg/l	**-**	**0.1**	*0.08*	***16.9***	***8.49***	**1.59**
Atrazine	µg/l	**2**	**0.1**	*0.05*	***4.5***	***1.58***	ND
Benazolin	µg/l	**-**	**0.1**	***0.23***	***19***	***5.71***	**9.65**
Benazolin-Ethyl	µg/l	**-**	**0.1**	**-**	***0.28***	**-**	ND
Benfuresate	µg/l	**-**	**0.1**	*0.07*	***10***	***2.61***	ND
Bentazone	µg/l	**0.5**	**0.1**	*ND*	*ND*	*ND*	ND
Bromoxynil	µg/l	**100**	**0.1**	**-**	***0.17***	**-**	**0.31**
Clopyralid	µg/l	**-**	**0.1**	**-**	***4.64***	**-**	ND
Dicamba	µg/l	**-**	**0.1**	*0.08*	***11.6***	***2.11***	**0.34**
Dichlorprop	µg/l	**-**	**0.1**	*0.07*	***0.52***	***0.25***	**34.2**
Ethofumesate	µg/l	**-**	**0.1**	***0.23***	***8100***	***766.64***	**42**
Fenoprop	µg/l	**-**	**0.1**	*ND*	*ND*	*ND*	ND
Fluoroxypyr	µg/l	**-**	**0.1**	*ND*	*ND*	*ND*	ND
Hempa	µg/l	**-**	**0.1**	***1.3***	***5000***	***580.34***	ND
Ioxynil	µg/l	**10**	**0.1**	**-**	***0.28***	**-**	**0.12**
MCPA	µg/l	**2**	**0.1**	***0.18***	***159***	***27.61***	**0.23**
MCPB	µg/l	**-**	**0.1**	***0.81***	***3.61***	***2.21***	ND
Mecoprop	µg/l	**20**	**0.1**	***0.06***	***29.7***	***4.01***	**24.1**
Pentachlorophenol	µg/l	**2**	**0.1**	***0.07***	***3.1***	***1.66***	-
Prometryn	µg/l	**-**	**0.1**	***0.17***	***9.8***	***2.89***	-
Schradan	µg/l	**-**	**0.1**	***0.3***	***700***	***99.19***	**5**
Simazine	µg/l	**2**	**0.1**	***0.2***	***3.8***	***2***	ND
Terbutryne	µg/l	**-**	**0.1**	***0.2***	***180***	***38.14***	ND
Trietazine	µg/l	**-**	**0.1**	***0.2***	***120***	***20.23***	**29**
Trifluralin	µg/l	**-**	**0.1**	**-**	***0.6***	**-**	ND

Table 5.12 – Leachable concentrations of metals and inorganic substances from soils.

				Enviros 2005			Atkins 2006		
	Units	**EQS**	**DWS**	**min**	**max**	**mean**	**min**	**max**	**mean**
Arsenic, Total as As	µg/l	**50**	**10**	*3.00*	***106.00***	***29.60***	1.00	**100.00**	**12.78**
Mercury, total as Hg	µg/l	**1**	**1**	-	*0.10*	-	-	0.21	-
Boron, Total as B	µg/l	**2000**	**1000**	*0.20*	*0.60*	*0.32*	52.00	110.00	78.00
Cadmium , Total as Cd	µg/l	**5**	**5**	*0.50*	*2.00*	*1.13*	ND	ND	ND
Chromium , Total as Cr	µg/l	**5-250**	**50**	***7.00***	***49.00***	***28.00***	2.50	**17.00**	**5.81**
Copper , Total as Cu	µg/l	**1-28**	**2000**	***22.00***	***73.00***	***41.20***	**5.80**	**120.00**	**26.82**
Nickel , Total as Ni	µg/l	**50-200**	**20**	*13.00*	*18.00*	*15.50*	2.50	8.20	5.36
Lead , Total as Pb	µg/l	**4-250**	**10**	***6.00***	***9.00***	***7.75***	1.10	**140.00**	**41.95**
Vanadium , Total as V	µg/l	**20-60**	**-**	*5.00*	***34.00***	*16.00*	10.00	**53.00**	**25.33**
Zinc in filtrate as Zn	µg/l	**8-500**	**-**	***11.00***	***143.00***	***50.25***	5.00	**37.00**	**16.34**
Selenium , Total as Se	µg/l	**-**	**10**	-	-	-	0.32	2.50	0.68
Iron (Soluble)	µg/l	**1000**	**200**	-	-	-	2.50	170.00	21.12
Manganese (Soluble)	µg/l	**-**	**50**	-	-	-	11.00	**1000.00**	**163.29**
Cobalt (Soluble)	µg/l	**3**	**-**	-	-	-	**10.00**	**14.00**	**12.00**
Chromium (Hexavalent)	µg/l	**5-250**	**50**	-	-	-	**590.00**	**660.00**	**625.00**
Ammonia as N	µg/l	**15**	**-**	-	-	-	**240.00**	**4900.00**	**1624.17**
Chloride as Cl	µg/l	**250000**	**250000**	-	-	-	2300.00	180000.00	19006.67
Nitrate as NO3	µg/l	**-**	**100000**	-	-	-	2400.00	7400.00	3514.29
Sulphide as S	µg/l	**0.25**	**-**	-	-	-	**-**	**12.00**	**-**
pH	µg/l	**-**	**-**	-	-	-	7.20	11.40	8.93
Copper (Soluble)	µg/l	**1-28**	**2000**	-	-	-	**-**	**370.00**	**-**
Iron (Soluble)	µg/l	**1000**	**200**	-	-	-	-	1.70	-
Zinc (Soluble)	µg/l	**8-500**	**-**	-	-	-	**-**	**120.00**	**-**

The concentrations of metals and inorganic substances in leachates generated from soil samples from the site have exceeded the minimum freshwater environmental and UK drinking water quality standards for a number of substances.

Table 5.13 – Leachable concentrations of VOCs and SVOCs from soils.

				Enviros 2005		
	Units	**EQS**	**DWS**	**min**	**max**	**mean**
Dichloromethane	µg/l	**-**	**-**	*3.50*	*59.80*	*18.58*
Cis-1,2-dichloroethene	µg/l	**-**	**-**	*1.80*	*12.40*	*7.10*
Chloroform	µg/l	**12**	**-**	*0.80*	***1140.00***	***378.46***
Trichloroethene	µg/l	**10**	**10**	*0.50*	***27500.00***	***7557.13***
Bromodichloromethane	µg/l	**-**	**-**	*0.60*	*2.20*	*1.40*
Tetrachloroethene	µg/l	**10**	**10**	*23.60*	***29600.00***	***9995.87***
Dibromochloromethane	µg/l	**-**	**-**	*-*	*1.20*	*-*
m,p-xylene	µg/l	**30**	**-**	*0.70*	*19.00*	*7.23*
o-xylene	µg/l	**30**	**-**	*2.00*	*16.40*	*6.83*
Styrene	µg/l	**50**	**-**	*-*	*1.20*	*-*
1,3,5-trimethylbenzene	µg/l	**-**	**-**	*5.10*	*52.70*	*28.90*
1,2,4-trimethylbenzene	µg/l	**-**	**-**	*8.30*	*96.60*	*52.45*
Naphthalene	µg/l	**10**	**-**	***11.30***	***119.00***	***70.77***
2-chlorophenol	µg/l	**50**	**-**	*-*	*0.40*	*-*
Isophorone	µg/l	**-**	**-**	*-*	*7.60*	*-*
2-nitrophenol	µg/l	**-**	**-**	*0.30*	*0.70*	*0.50*
2,4-dimethylphenol	µg/l	**-**	**-**	*0.50*	*0.80*	*0.65*
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	*17.40*	*211.00*	*114.20*
2,4-Dichlorophenol	µg/l	**20**	**-**	*0.90*	***20.80***	*7.67*
4-Chloro-3-methylphenol	µg/l	**40**	**-**	*-*	*5.00*	*-*
2,4,6-Trichlorophenol	µg/l	**2-300**	**-**	*1.70*	***13.50***	***7.60***
2,4,5-Trichlorophenol	µg/l	**2-300**	**-**	*0.30*	*1.90*	*1.10*
Fluoranthene	µg/l	**-**	**0.1**	**-**	***0.30***	**-**
Acenaphthene	µg/l	**-**	**0.1**	**-**	***0.70***	**-**
Pyrene	µg/l	**-**	**0.1**	**-**	***0.30***	**-**

The concentrations of selected VOCs and SVOCs in leachates generated from soil samples from the site exceed the minimum water quality standards for a number of substances. The high leachable concentrations of trichloroethene and tetrachloroethene are related to a sample with a very high solid concentration for these two substances from Area 6 (the former effluent trenches).

The available leachability data, although limited in quantity, demonstrates that certain contaminants can be readily leached into water percolating to the water table. The Main Site is covered with a hardstanding surface which was designed to collect surface water and prevent infiltration to the ground. The efficiency of this surface may have suffered over time, and with the demolition of buildings post site closure, however it still presents a barrier to infiltration that may be protecting soils from percolating rain water. The removal of this layer could cause a mobilisation of contamination from the soils into groundwater, while also increasing infiltration rates of surface water to the ground across the Main Site.

Locations within Area 6 where soil contamination has been found to comprise high concentrations of trichlorethene and tetrachloroethene, particularly, have been found

to be highly leachable from some samples. There is no hardstanding in this area and therefore no barrier to prevent these contaminants migrating to groundwater currently.

5.2.2.4 Groundwater

Groundwater samples were collected in May 2006 from all of the new boreholes installed during the March 2006 SI and a selected number of the existing monitoring installations, as described in Section 3.1.3. In the evaluation and comparison that follows, data have been used from the new installations as well as the data from the existing installations that were monitored by Enviros in July 2004. As such, the data sets provided by Atkins and Enviros contain differences in spatial coverage.

Area 1N

Area 1N has high levels of groundwater contamination with herbicides/pesticides, BTEX and various other organic substances as shown by the summary of results presented in Table 5.14. The highest concentrations recorded in the Enviros and Atkins data vary considerably with generally lower concentrations noted for pesticides in 2006 than in 2005, however 2,3,6-TBA is anomalous in this respect. The average toluene concentration in both analyses is similar. The distribution of groundwater contamination is broadly similar also however the peak concentration recorded in 2005 were often within BH7, while in 2006 higher concentrations were generally found in S/15 and BH5 located a short distance to the south and east respectively of BH7.

Toluene concentrations in groundwater are highest in the north-east corner of the site around the position of the groundwater abstraction sumps in this part of the site (see section 4.2.2.4).

DDT and Dieldrin have been recorded in the groundwater in Area 1N. The concentrations are lower than those recorded for other pesticides in groundwater in this area of the site but still exceed water quality standards.

The distributions of individual contaminants in groundwater is generally discontinuous with little evidence of close interconnection of groundwater bodies at individual boreholes with those adjacent i.e. boreholes close together often show different contaminant profiles.

Table 5.14 – Groundwater concentrations of priority substances from Area 1N

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	Min	Max	Mean	min. limits of detection	Min	Max	Mean
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	*3*	*26400*	*3424*	**<0.05**	459	2140	1123
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	*1*	*235000*	*19363*	**<0.04**	31	74400	8560
MCPA	µg/l	**2**	**0.1**	**<0.10**	*2*	*390000*	*37359*	**<0.05**	1	249000	42856
236-TBA	µg/l	**-**	**0.1**	**<0.1**	*3*	*8400*	*1505*	**<0.05**	8	28700	4538
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	-	-	-	**<1**	-	8	-
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	-	-	-	**<1**	3	190	67
Toluene	µg/l	**50**	**-**	**-**	*6*	*234000*	*41105*	**<10**	120	180000	41055
m,p-xylene	µg/l	**30**	**-**	**-**	*46*	*37200*	*6182*	**<20**	95	720	372
Trichloroethene	µg/l	**10**	**10**	**-**	*10*	*15800*	*2651*	**<10**	77	2000	760
Tetrachloroethene	µg/l	**10**	**10**	**-**	*2*	*47530*	*9617*	**<10**	18	910	389
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*53*	*128*	*90*	**<10**	13	500	136
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	13	240	97
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	*7*	*4630*	*1232*	**<10**	13	2800	491
Dicamba	µg/l	**-**	**0.1**	**<0.05**	*1*	*37400*	*2938*	**<0.05**	2	1820	259
1,2-Dichloroethane	µg/l	**10**	**3**	**-**	*1*	*59900*	*7795*	**<10**	110	47000	8825
1,2-dichlorobenzene	µg/l	**-**	**-**	**-**	*1*	*45500*	*18164*	**<10**	11	380	137
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	*1850*	*105000*	*48228*	**<1.0**	22	24000	3056

Area 1S

Data from Area 1S as summarised in Table 5.15 indicate that groundwater in this area is less highly contaminated with herbicides/pesticides and other organic substances than Area 1N. However, there are high concentrations of some substances reported in the data such as 2,3,6-TBA, Schradan and Chloroform, which have not been recorded in Area 1N in such high concentrations. The bulk handling plant (building reference C19, Appendix M) located in Area 1S was the source of ongoing leakages of products to the ground and groundwater and may be the explanation of the occurrence of 2,3,6-TBA contamination in this area, a substance known to have been manufactured historically in plants within Areas 1N and 2.

DDT was not detected in the groundwater in this Area nor any other Areas of the site other than Area 1N. This most likely reflecting the limited mobility of DDT and suggests that the DDT contamination may be largely restricted to the soils on site, apart from parts of Area 1N.

Table 5.15 – Groundwater concentrations of priority substances from Area 1S.

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	Min	Max	Mean	min. limits of detection	Min	Max	Mean
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	*77*	*901*	*358*	**<0.05**	23	4140	1119
MCPA	µg/l	**2**	**0.1**	**<0.10**	*0.3*	*11*	*4*	**<0.05**	1	5340	914
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	*1*	*320*	*197*	**<0.04**	5	1300	338
236-TBA	µg/l	**-**	**0.1**	**<0.1**	*2*	*346000*	*69228*	**<0.05**	1	3650	893
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	*-*	*-*	*-*	**<1**	ND	ND	ND
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	*-*	*-*	*-*	**<1**	ND	ND	ND
Toluene	µg/l	**50**	**-**	**-**	*1*	*49*	*24*	**<10**	13	450	131
m,p-xylene	µg/l	**30**	**-**	**-**	*1*	*211*	*70*	**<20**	76	1000	435
Trichloroethene	µg/l	**10**	**10**	**-**	*47*	*325*	*136*	**<10**	18	1900	485
Tetrachloroethene	µg/l	**10**	**10**	**-**	*26*	*118*	*82*	**<10**	18	200	88
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*20*	*39*	*30*	**<10**	13	14	14
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*53*	*142*	*97*	**<10**	15	61	32
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	*74*	*62600*	*31337*	**<10**	11	7800	1988
Copper (Soluble)	µg/l	**1-28**	**2000**	**-**	*-*	*-*	*-*	**-**	-	20	-
Chloroform	µg/l	**12**	**-**	**-**	*3*	*124*	*64*	**<10**	14	56000	14142
Schradan	µg/l	**-**	**0.1**	**<0.4**	*ND*	*ND*	*ND*	**<1**	8	27800	9568
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	*13*	*982*	*340*	**<1.0**	1	2900	640

Area 2

The groundwater in Area 2 has generally lower concentrations of the priority contaminants than Areas 1S and 1N (Table 5.16). However, although lower than in Areas 1S and 1N, concentrations of 2,3,6-TBA and Ethofumesate are still far in excess (2 to 3 orders of magnitude) of their water quality standards.

Groundwater is abstracted from under the warehouses in the south-western half of Area 2 which has depressed groundwater levels in this part of the site, almost to the level of the Gault Clay in places (BH4). This abstraction has possibly had a flushing effect on groundwater in Area 2, which could explain in part the lower contaminant concentrations. The drawdown of groundwater levels in Area 2 around this abstraction may also have isolated contaminant sources within the soil materials and Made Ground above the water table and below the hardstanding covering the Main Site.

Table 5-16 – Groundwater concentrations of priority substances from Area 2.

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	Min	Max	Mean	min. limits of detection	Min	Max	Mean
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	-	0.90	-	**<0.05**	1.00	90.00	45.50
MCPA	µg/l	**2**	**0.1**	**<0.10**	-	1.25	-	**<0.05**	-	0.06	-
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	-	1.10	-	**<0.04**	0.05	1.55	0.64
236-TBA	µg/l	**-**	**0.1**	**<0.1**	-	0.23	-	**<0.05**	0.10	259.00	89.13
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	-	-	-	**<1**	ND	ND	ND
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	-	-	-	**<1**	ND	ND	ND
Toluene	µg/l	**50**	**-**	**-**	ND	ND	ND	**<10**	ND	ND	ND
m,p-xylene	µg/l	**30**	**-**	**-**	-	1.90	-	**<20**	ND	ND	ND
Trichloroethene	µg/l	**10**	**10**	**-**	-	-	-	**<10**	-	50.00	-
Tetrachloroethene	µg/l	**10**	**10**	**-**	-	0.70	-	**<10**	-	21.00	-
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	ND	ND	ND	**<10**	ND	ND	ND
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	ND	ND	ND	**<10**	ND	ND	ND
Copper (Soluble)	µg/l	**1-28**	**2000**	**-**	-	-	-	**-**	-	-	-
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	-	80.00	-	**<10**	-	18.00	-

Area 3

Area 3 located between the cut-off wall and the Riddy Brook appears to have poor groundwater quality as summarised in Table 5.17. The contamination noted in this area includes herbicides such as MCPA, 2,3,6-TBA and chlorinated hydrocarbons such as tetrachloroethene and 1,2-dichloroethane. This area of contaminated groundwater behind the cut-off wall is likely to have some degree of continuity with the Riddy Brook, however is unlikely under current conditions to be discharging significant baseflow to the Riddy based on its isolated hydrogeological position with respect to the cut-off wall, i.e. the only groundwater flow likely is from recharge through the surface or bank storage from the Riddy Brook during flood events. The hardstanding in this area is likely to be preventing a significant amount of surface water recharge in this area currently, but the break up of the hardstanding surface could potentially mobilised the groundwater in this area.

Table 5.17 – Groundwater concentrations of priority substances from Area 3.

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	Min	Max	Mean	min. limits of detection	Min	Max	Mean
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	*27*	*4100*	*1198*	**<0.05**	382	813	598
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	*5*	*680*	*188*	**<0.04**	1	1230	362
MCPA	µg/l	**2**	**0.1**	**<0.10**	*0.4*	*470*	*75*	**<0.05**	0.4	9670	1937
236-TBA	µg/l	**-**	**0.1**	**<0.1**	*0.3*	*310*	*104*	**<0.05**	0.2	4030	820
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	-	-	-	**<1**	ND	ND	ND
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	-	-	-	**<1**	ND	ND	ND
Toluene	µg/l	**50**	**-**	**-**	*2*	*19400*	*4268*	**<10**	170	7600	2155
m,p-xylene	µg/l	**30**	**-**	**-**	*1*	*9800*	*2150*	**<20**	47	760	404
Trichloroethene	µg/l	**10**	**10**	**-**	*6*	*59000*	*14979*	**<10**	38	38000	8202
Tetrachloroethene	µg/l	**10**	**10**	**-**	*5*	*75800*	*25566*	**<10**	17	45000	11313
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*8*	*12*	*10*	**<10**	ND	ND	ND
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*27*	*43*	*35*	**<10**	-	22	-
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	*351*	*637*	*500*	**<10**	26	550	201
Dicamba	µg/l	**-**	**0.1**	**<0.05**	*0.02*	*11*	*5*	**<0.05**	0.5	131	35
Chloroform	µg/l	**12**	**-**	**-**	*12*	*30100*	*15056*	**<10**	80	490	285
1,2-Dichloroethane	µg/l	**10**	**3**	**-**	*8*	*2780*	*933*	**<10**	95	2200	862
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	*0.2*	*23000*	*6442*	**<1.0**	34	1900	708

Area 4

The levels of groundwater contamination in Area 4 as summarised in Table 5.18 are important in that this area is down hydraulic gradient of the heavily contaminated Area 1N. There is little evidence of any contamination sources within Area 4 (soil contamination or historical incidents) from which groundwater contamination could be derived. It is, however, in this area in which contaminated groundwater was first noted within the basement of the Chequers Public House in 1965 (see Section 5.1.2.1)

The inference is that the groundwater contamination in this area, largely comprising both pesticides and chlorinated solvents, has migrated from other parts of the Main Site (Area 1). Contamination appears to be moving north and west down hydraulic gradient then along the cut-off wall before discharging with groundwater from the west to the Riddy Brook and River Cam or Granta north of the site.

Table 5.18 – Groundwater concentrations of priority substances from Area 4.

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	**Min**	**Max**	**Mean**	min. limits of detection	**Min**	**Max**	**Mean**
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	*5.2*	*84.4*	*36.5*	**<0.05**	ND	ND	ND
236-TBA	µg/l	**-**	**0.1**	**<0.1**	*0.4*	*120.0*	*20.4*	**<0.05**	-	9.5	-
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	*33.0*	*2100*	*552*	**<0.04**	ND	ND	ND
MCPA	µg/l	**2**	**0.1**	**<0.10**	*0.3*	*38.0*	*11.1*	**<0.05**	-	1.0	-
Dieldrin	µg/l	**0.01**	**0.03**	**-**	-	-	-	**<1**	-	1350	-
DDT	µg/l	**0.03**	**0.1**	**-**	-	-	-	**<1**	ND	ND	ND
Toluene	µg/l	**50**	**-**	**-**	-	*15.9*	-	**<10**	ND	ND	ND
m,p-xylene	µg/l	**30**	**-**	**-**	*11.5*	*39.5*	*25.5*	**<20**	ND	ND	ND
Trichloroethene	µg/l	**10**	**10**	**-**	*1.4*	*36.0*	*10.7*	**<10**	ND	ND	ND
Tetrachloroethene	µg/l	**10**	**10**	**-**	*0.8*	*30.5*	*10.8*	**<10**	ND	ND	ND
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	*5.0*	*23.0*	*14.0*	**<10**	-	17.0	-
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	*1.4*	*977*	*331.4*	**<1.0**	1.6	870.0	435.8

Area 5

Area 5 contains a limited number of monitoring locations therefore it is not clear where the groundwater contamination in this area is originating. Pesticide contamination in groundwater in this area (see Table 5.19) is generally at low concentrations relative to other parts of the site, although where recorded were often in excess of water quality standards. The groundwater contamination in this area is considered likely to derive from the WWTP site. Contaminant migration from the WWTP site appears to be migrating down hydraulic gradient towards the River Cam from within the transmissive units present in this area particularly the sands and gravels of the alluvium and River Terrace Gravels.

Table 5.19 – Groundwater concentrations of priority substances from Area 5.

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	Min	Max	Mean	min. limits of detection	Min	Max	Mean
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	*0.2*	*7.5*	*2.7*	**<0.05**	-	102.0	-
236-TBA	µg/l	**-**	**0.1**	**<0.1**	*0.8*	*14.7*	*6.0*	**<0.05**	-	4.2	-
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	*0.8*	*3.1*	*2.0*	**<0.04**	-	0.2	-
MCPA	µg/l	**2**	**0.1**	**<0.10**	*ND*	*ND*	*ND*	**<0.05**	ND	ND	ND
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	-	-	-	**<1**	ND	ND	ND
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	-	-	-	**<1**	ND	ND	ND
Toluene	µg/l	**50**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	-	23.0	-
m,p-xylene	µg/l	**30**	**-**	**-**	*ND*	*ND*	*ND*	**<20**	ND	ND	ND
Trichloroethene	µg/l	**10**	**10**	**-**	-	*25.6*	-	**<10**	-	160.0	-
Tetrachloroethene	µg/l	**10**	**10**	**-**	*ND*	*ND*	*ND*	**<10**	-	18.0	-
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
Copper (Soluble)	µg/l	**1-28**	**2000**	**-**	-	-	-	**-**	-	**-**	-
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	-	*130*	-	**<1.0**	-	45.0	-

Area 6

Groundwater quality, as summarised in Table 5.20, is poor in Area 6 as would be expected from the soil and leaching test data. Trichloroethene in particular appears to be leaching from areas of the former effluent trenches into groundwater along with certain other substances such as MCPA. There is a need for additional monitoring of groundwater in the vicinity of the WWTP site to ascertain the continued presence or migration of contamination in groundwater from the source area identified by the Enviros data in Area 6 as currently the number of monitoring locations and volume of data are limited.

Table 5.20 – Groundwater concentrations of priority substances from Area 6.

Substances	Units	EQS	UK DWS	Enviros 2005			
				min. limits of detection	**Min**	**Max**	**Mean**
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	*-*	*2.1*	*-*
236-TBA	µg/l	**-**	**0.1**	**<0.1**	*2.4*	*83.9*	*29.7*
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	*-*	*0.1*	*-*
MCPA	µg/l	**2**	**0.1**	**<0.10**	*9.5*	*3000.0*	*1009.0*
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	*-*	*-*	*-*
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	*-*	*-*	*-*
Toluene	µg/l	**50**	**-**	**-**	*ND*	*ND*	*ND*
m,p-xylene	µg/l	**30**	**-**	**-**	*ND*	*ND*	*ND*
Trichloroethene	µg/l	**10**	**10**	**-**	*-*	*301000*	*-*
Tetrachloroethene	µg/l	**10**	**10**	**-**	*-*	*1230*	*-*
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	*-*	*35*	*-*
Cis-1,2-dichloroethene	µg/l	**-**	**-**	**-**	*-*	*9210*	*-*
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	*-*	*4220*	*-*

Area 7

Groundwater beneath the WWTP site (Area 7) appears to be less contaminated than that monitored in Area 6. The contaminants detected are similar and may represent a mixture of migrating contaminants from Area 6 such as trichloroethene and contaminants leaching from source areas within Area 7 itself such as the ethofumesate detected in the Enviros 2005 monitoring (see Table 5.21).

Table 5.21 – Groundwater concentrations of priority substances from Area 7.

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	**Min**	**Max**	**Mean**	min. limits of detection	**Min**	**Max**	**Mean**
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	-	*32.7*	-	**<0.05**	ND	ND	ND
236-TBA	µg/l	**-**	**0.1**	**<0.1**	-	*12.7*	-	**<0.05**	-	62.4	-
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	-	*1.6*	-	**<0.04**	ND	ND	ND
MCPA	µg/l	**2**	**0.1**	**<0.10**	-	*0.76*	-	**<0.05**	ND	ND	ND
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	-	-	-	**<1**	ND	ND	ND
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	-	-	-	**<1**	ND	ND	ND
Toluene	µg/l	**50**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
m,p-xylene	µg/l	**30**	**-**	**-**	*ND*	*ND*	*ND*	**<20**	ND	ND	ND
Trichloroethene	µg/l	**10**	**10**	**-**	*ND*	*ND*	*ND*	**<10**	-	27	-
Tetrachloroethene	µg/l	**10**	**10**	**-**	*ND*	*ND*	*ND*	**<10**	-	41	-
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*	**<10**	ND	ND	ND
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	-	-	-	**<10**	-	29.0	-
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	-	-	-	**<1.0**	-	90	-

Area 8

The contaminant profile of groundwater in Area 8 resembles that found in Area 6 with additional substances detected such as HEMPA and toluene (see Table 5.22). The concentrations of contamination are generally higher than those encountered in groundwater within Areas 7 or 9, but are significantly less than those detected in Area 6.

Table 5.22 – Groundwater concentrations of priority substances from Area 8.

Substances	Units	EQS	UK DWS	Enviros 2005				Atkins 2006			
				min. limits of detection	**Min**	**Max**	**Mean**	min. limits of detection	**Min**	**Max**	**Mean**
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	0.1	25.4	12.7	**<0.05**	ND	ND	ND
236-TBA	µg/l	**-**	**0.1**	**<0.1**	0.8	187.0	53.6	**<0.05**	-	0.5	-
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	0.9	1.5	1.2	**<0.04**	-	0.2	-
MCPA	µg/l	**2**	**0.1**	**<0.10**	0.2	0.5	0.3	**<0.05**	ND	ND	ND
DDT Hauxton	µg/l	**0.03**	**0.1**	**-**	-	-	-	**<1**	ND	ND	ND
Toluene	µg/l	**50**	**-**	**-**	-	4	-	**<10**	-	29	-
m,p-xylene	µg/l	**30**	**-**	**-**	ND	ND	ND	**<20**	ND	ND	ND
Trichloroethene	µg/l	**10**	**10**	**-**	15	287	151	**<10**	400	570	485
Tetrachloroethene	µg/l	**10**	**10**	**-**	-	1	-	**<10**	21	70	46
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	ND	ND	ND	**<10**	ND	ND	ND
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	ND	ND	ND	**<10**	ND	ND	ND
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	ND	ND	ND	**<10**	ND	ND	ND
HEMPA	µg/l	**-**	**0.1**	**<0.4**	-	4180	-	**<1**	ND	ND	ND
Bis(2-chloroethyl) ether	µg/l	**-**	**-**	**-**	-	27	-	**<1.0**	-	54	-

Area 9

Groundwater impacted with a number of herbicides/pesticides at concentrations greater than water quality standards, but relatively low compared with other areas of the site, has been recorded in Area 9 as demonstrated by the results summarised in Table 5.23. Area 9 is located down hydraulic gradient of the WWTP site and the data are considered likely to indicate a plume of contamination flowing from the WWTP site towards the River Cam or Granta. Further systematic groundwater monitoring in this area would be required to confirm this, together with ground investigation to rule out the possibility of local sources of contamination.

Table 5.23 – Groundwater concentrations of priority substances from Area 9.

Substances	Units	EQS	UK DWS	Enviros 2005			
				min. limits of detection	**Min**	**Max**	**Mean**
Ethofumesate	µg/l	**-**	**0.1**	**<0.1**	*0.1*	*142*	*25.8*
236-TBA	µg/l	**-**	**0.1**	**<0.1**	*0.1*	*23*	*5.8*
Mecoprop	µg/l	**20**	**0.1**	**<0.1**	*0.1*	*14.5*	*3.8*
MCPA	µg/l	**2**	**0.1**	**<0.10**	*0.1*	*12.0*	*1.6*
Dieldrin Hauxton	µg/l	**0.01**	**0.03**	**-**	*-*	*-*	*-*
DDT Hauxton	µg/l	**0.025**	**0.1**	**-**	*-*	*-*	*-*
Toluene	µg/l	**50**	**-**	**-**	*0.7*	*2.7*	*1.7*
m,p-xylene	µg/l	**30**	**-**	**-**	*ND*	*ND*	*ND*
Trichloroethene	µg/l	**10**	**10**	**-**	*0.5*	*1.9*	*1.2*
Tetrachloroethene	µg/l	**10**	**10**	**-**	*-*	*1.2*	*-*
1,3,5-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*
1,2,4-trimethylbenzene	µg/l	**-**	**-**	**-**	*ND*	*ND*	*ND*
Copper , Total as Cu	µg/l	**1-28**	**2000**	**<5**	*12*	*16*	*14*
Hempa	µg/l	**-**	**0.1**	**<0.4**	*15.4*	*288.0*	*122.5*
1,2-Dichloropropane	µg/l	**-**	**0.1**	**-**	*0.6*	*889*	*174.8*

5.2.2.5 Summary of Groundwater Contamination

In summary groundwater contamination in Areas 1 and 3 show high levels of pesticides and organic substances in solution within groundwater without any consistent pattern of groundwater contamination, transport or migration. There appears to be relatively poor interaction between groundwater sampled in the various boreholes in Area 1 based on the distribution of contamination. The groundwater in these parts of the site appears to be relatively stable under the current site conditions. Plumes of contamination appear to be relatively contained by the mixture of cohesive deposits present in these areas.

Groundwater in Area 2 is less contaminated than other areas of the Main Site, which may be related to the abstraction of the water from under the warehouses in this area, or the general absence of production facilities, with the exception of the HANANE plant, historically in this area.

Area 4 is downstream of the contamination in Area 1N and as such, in the absence of any significant identified sources of contamination in Area 4 itself, the contaminants recorded in groundwater in Area 4 are considered likely to represent a plume emanating from Area 1N north-westwards.

The WWTP site and surrounding disposal areas represent a source of groundwater contamination which appears to be producing a plume which is flowing north-eastwards towards the River Cam.

The screened lengths of the previous (pre march 2006) boreholes appear in general to cover the whole depth of the boreholes to within 0.5 or 1.0m of the ground surface. The boreholes installed in March 2006 have restricted screened lengths near the base of the strata overlying the Gault Clay. These differences may be the reason for some of the variations in concentrations and distribution of contaminants detected between 2005 and 2006.

There is a possibility that fully screened boreholes may be forming preferential pathways between groundwater units. This would result in cross contamination of different perched or isolated groundwater and deeper groundwater bodies, potentially diluting or introducing contamination where it would otherwise be restricted.

Borehole BH1/06 was installed with two standpipes at different depths to record the shallow and deeper groundwater bodies encountered in the drilling of the hole. This borehole location recorded noticeably higher concentrations of toluene and other BTEX substances in the shallow compared to the deeper groundwater at this location. This would suggest that the distribution of contamination in the groundwater may be more complex than can be illustrated by the existing network of fully screened boreholes. This is discussed further in the following sections on non-aqueous phase liquid (NAPL).

5.2.2.6 LNAPL (Light Non-Aqueous Phase Liquid)

Toluene is by nature an LNAPL and has been detected in groundwater and soils in Area 1N, possibly associated with historical spills and leakage of large quantities of this substance from the Prochloraz plant. Borehole BH1/06 located close to the former location of the Prochloraz plant and in the area of soil and groundwater contaminated with Toluene has two monitoring standpipes fitted with different non overlapping screened lengths. The two standpipes are BH1/06D and BH1/06S

denoting deep and shallow respectively. The two installations were installed to sample apparently different water bodies noted in the construction of the borehole. The concentration of toluene detected in each installation was 170,000 µg/l and 12,000 µg/l respectively for the shallow and deep standpipes suggesting that there are two water bodies not directly linked at this location, and that there might be an LNAPL layer on the groundwater/perched groundwater.

Ethyl benzene and xylene, other BTEX substances, were not recorded in the deep groundwater borehole at BH1/06, but were however detected at 100 µg/l and 600 µg/l respectively in the shallow installation at this location. This further supports the presence of discontinuous and vertically separate water bodies present within the made ground on the Main Site.

5.2.2.7 DNAPL (Dense Non-Aqueous Phase Liquid)

In the most recent groundwater monitoring (May 2006) DNAPL has been registered as present below groundwater in several of the boreholes in significant thicknesses in some cases e.g. BH7 3.98m and BH6 4.4m. DNAPL has not been noted in any of the previous reports from the site. There was no separate sampling and testing of the DNAPL noted in the boreholes and the Low Flow Sampling methodology used may not have mixed the DNAPL with the groundwater in the sampling process.

There is potential for significant volumes of free phase contaminants to be present in parts of the site from this monitoring evidence. This may not be the case if the borehole is acting as a sump however collecting the DNAPL below a discrete source layer in the geology from where this contamination is present.

It is proposed as a priority to sample and test any DNAPL found in subsequent groundwater monitoring rounds and where appropriate use purging techniques to investigate the thicknesses any DNAPL reported.