

INVISTA Textiles (UK) Limited

PO Box 401
Wilton
Redcar
TS10 4XY

**Surrender Site Condition Report
Permit Application No. BM 2063IR
INVISTA Textiles (UK) Limited
PO Box 401
Wilton
Redcar
TS10 4XY**

**September 2010
960100303**

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Glossary

bgl	Below Ground Level
BOD	Biochemical Oxygen Demand
CCTV	Closed Circuit Television
COD	Chemical Oxygen Demand
COGA	Common Off Gas Abatement unit
COMAH	Control of Major Accident Hazards
COSHH	Control of Substances Hazardous to Health
DRO	Diesel Range Organics
EA	Environment Agency
HSE	Health & Safety Executive
HMD	Hexamethylene diamine
HV	High Voltage
IBC	Intermediate Bulk Container
ICI	Imperial Chemical Industries
KA	Ketone Alcohol
m	Metres
NACS	Nitric Acid Concentration Still
PCB	Polychlorinated Biphenyls
PPC	Pollution Prevention and Control
PRO	Petrol Range Organics
PVC	Polyvinyl Chloride
SVOC	Semi Volatile Organic Compounds
TIC	Tentatively Identified Compounds
TOC	Total Organic Carbon
UKAS	United Kingdom Accreditation Service
VOC	Volatile Organic Compounds
WALE	Waste and Liquor Equalisation
WEEE	Waste Electrical and Electronic Equipment

1. INTRODUCTION

ARCADIS (UK) Ltd (ARCADIS) was commissioned by INVISTA Textiles (UK) Limited (INVISTA) to assist with the surrender of the Environmental Permit for the INVISTA manufacturing site located at Wilton, Redcar, TS10 4XY (the Site). Figure 1 presents the site location and Figure 2 presents the site boundary.

1.1 Site Details

Name of the applicant	INVISTA Textiles (UK) Ltd
Activity address	PO Box 401 Wilton Redcar TS10 4XY
National grid reference	NZ 565 210

Document reference and dates for Site Condition Report	URS Corporation Ltd, October 2002, Phase 2 Environmental Site Assessment Report for IPPC Permit Application Number BM 2063 ARCADIS (UK) Ltd, February 2010; Environmental Assessment
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Document references for site plans	Figure 1 Site Location Plan Figure 2 Site Boundary and Location of Kettle Beck Figure 4 Sample Locations - 2002 Baseline Survey Figure 8 Sample Locations - 2009 Closure Survey Figure 9 BH304 Characterisation Borehole Locations Figure 10 BH1101 Characterisation Borehole Locations Figure 11 BH1104 Characterisation Borehole Locations
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2. CONDITION OF THE LAND AT PERMIT ISSUE

The condition of the land is described in the Site Condition Report which was prepared for DuPont Textiles & Interiors (U.K.), the then operator of the Site, by URS Corporation in October 2002. This report was included in the Application of the Pollution Prevention and Control (PPC) Permit which was made on 12th August 2003. The Permit was granted on 15th November 2004.

This section summarises information supplied in the Site Condition Report and also includes the results of routine groundwater monitoring carried out on-site and the records of pollution incidents between the permit application and issue of the permit.

2.1 Geology

The formation sequence below the site comprises of unconsolidated drift deposits overlying mudstone. The drift deposits comprise silty clay overlying glacial Boulder Clay and in places the silty clay is overlain by a layer of black laminated clay. The mudstone is approximately 300m thick and is generally considered to be impermeable. The mudstone formation overlays the Sherwood Sandstone Group.

The characteristics of the unconsolidated deposits have been explored through site investigations carried out at the site between 1993 and 2002 for geotechnical and due diligence purposes. Fifty one shallow boreholes were drilled as part of the investigations.

Unconsolidated formations encountered during the drilling of these boreholes are as follows:

- Made ground comprising a mix of brown or black clay, broken bricks, concrete rubble, furnace clinker, mudstone cobbles and gravels. Made ground has also been found to contain fragments of plastic sheeting, slag, glass and coal. The made ground extends to depths up to 1.5 metres (m) below ground level (bgl) but is typically to 0.5m bgl.
- Black laminated clay up to 1.0m in thickness.
- Soft to firm medium brown silty clay with some mottling and occasional lenses of sandy silt up to 4.0m in thickness.
- Stiff reddish brown clay with occasional gravel which has been inferred to be Boulder Clay. The Boulder Clay has been found to extend to depths of between seven and fourteen metres below ground level.

In places the laminated clay and, less commonly, the silt clay formations have been found to be absent. Figure 3 presents a typical section through the shallow geology below the site.

2.2 Hydrogeology

The Environment Agency's Groundwater Vulnerability Map shows the Wilton Industrial Complex including the Site to be an area classified as a "non-aquifer (negligibly permeable)", this has since been reclassified as Secondary B Aquifer (April 2010).

Shallow groundwater monitoring wells were installed in thirty two of the boreholes drilled on site. In summary:

- Little or no shallow groundwater inflows have been observed from either the black laminated clay or the Boulder Clay;
- Significant seepages of shallow groundwater into the boreholes occur from the sand and silt horizons in the brown silty clay and, in particular, the more granular types of made ground;
- The clay is relatively impermeable and the sand and silt horizons which occur with it are discontinuous; and

- Groundwater levels have been found to vary widely over short distances and it has not been possible to infer any shallow groundwater flow direction.

It has therefore been concluded that the majority of the groundwater detected comprises localised perched water bodies.

2.3 Surface waters

The Kettle Beck, a partially culverted stream, flows in a northerly direction parallel to the western boundary of the Site. (See Figure 2) A flood relief ditch runs from the beck south of Broadway, along the north-western boundary of site, and discharges into the INVISTA Site H Drain. The site's drainage system is further described in Section 5.1. The Kettle Beck has not been classified by the Environment Agency.

The Kinkerdale Beck is mentioned in the Site Report, however there is no evidence of this stream on or near the site but it would appear, from examination of plans, to drain in to the old rail sidings located to the north of Broadway, which run parallel to but north of the northern boundary of the site. This land is now occupied by a wood recycling company (UK Wood Recycling Limited).

2.4 Pollution History

The Wilton Industrial Complex remained as agricultural fields with small roads and drainage ditches until it was developed between 1955 and 1961. Production on the Site commenced with the start-up of the Salt and Polymer Plants in 1957. Cyclohexane was produced on site by the hydrogenation of benzene, as a feed stock for the Ketone Alcohol (KA) Plant, from 1957 to 1968. A number of expansions and rationalisations occurred on site over the intervening years culminating in the closure of the Acids 1 Plant in August 2004 and the commissioning of the Non-Boric KA production process in January 2005.

Detailed records of pollution incidents have been kept since 2002 but there is limited information available prior to that date.

2.5 Evidence of Historic Contamination

Data collected from the due diligence investigation (1993) and geotechnical investigations carried out between 1993 and 1998 identified contamination of soil and groundwater due to historic events and work practices.

2.5.1 Site Investigation (1993)

The 1993 site investigation, comprised the drilling of forty shallow boreholes, the collection of soil samples and the installation of twenty-four monitoring wells. It was carried out as part of the due diligence process for the sale of the site by ICI to DuPont Textiles & Interiors (UK) Limited.

According to the summary documented in the 2002 baseline survey two “residual contaminant sources areas” were identified during the 1993 site investigation:

- Soil below the former benzene bulk storage facility within the KA Plant was contaminated with benzene; and
- Shallow groundwater below the Acids 2 Plant re-crystallisation area had low pH (<1) and elevated concentrations of copper, vanadium, general inorganic compounds and dibasic acids.

2.5.2 Geotechnical Investigations (1993-1998)

Site investigations, in preparation for various construction projects, were carried out between 1993 and 1998. Testing of a relatively small number of samples identified:

- An elevated concentration of copper detected in one of nine soil samples taken from made ground on the site of the proposed effluent treatment plant (Zone 5 - south);
- Elevated concentrations of sulphide and sulphur in soil and groundwater pH of 8 to 9.9 on the site of the new Salt Plant on the Polymer Plant (Zone 4);
- Elevated concentrations of arsenic, nickel and sulphide in soil samples taken from the site of the HMD product loading facility (Zone 6);
- Elevated concentrations of arsenic, nickel and sulphide in soil samples taken from the site of the proposed NACS Purge Plant (Zone 5);
- Elevated concentrations of zinc in a sample taken from the made ground on the proposed site of the COGA unit (Zone 5 - south);
- Elevated concentrations of chromium, lead, copper and zinc in the made ground and of copper and zinc in the clay on the proposed site of the WALE tank (Zone 5 - south); and
- Elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) in soil on the proposed site for the Acids 2 Plant crude crystalliser (Zone 5 - south).

The zones referred to here are shown on Figure 4.

It is understood that steel works slag was used for fill in the made ground under much of the site and that this material may be the source of the heavy metals rather than the processes used on site.

2.6 Baseline Soil and Groundwater Reference Data (2002)

A site investigation was carried out for the baseline assessment for the PPC Permit application in 2002. This comprised the drilling of eight shallow boreholes (BH1101 to BH1108), the installation of monitoring wells and the collection of soil, soil vapour and groundwater samples. In addition groundwater was sampled from seventeen of the wells completed in 1993. The locations of these boreholes are shown in Figure 4 and results of testing are presented in Appendix A.

A summary of the results from this investigation are as follows:

- Elevated concentrations of ammoniacal nitrogen were detected in soil samples taken from the made ground horizon in BH1105 (Zone 6) and BH1108 (Zone 5);
- Elevated concentrations of metals were found in soil samples taken from BH1104, BH1105 and BH1106 (Zone 6);
- Elevated concentrations of C6 to C9 acids were found in soil samples taken from BH1101 (Zone 3);
- Elevated concentrations of ammoniacal nitrogen were found in groundwater sampled in BH1105 (Zone 6);
- Boron was found at an elevated concentration in groundwater sampled in BH1101 (Zone 3);
- Petrol range organics (PRO) were found at elevated concentrations in groundwater sampled in BH1105 and BH304 (Zone 6); and
- Diesel range organics (DROs) were found at elevated concentrations in groundwater sampled in BH1101 (Zone 3), BH1103 (Zone 4) and BH304 (Zone 6).

2.7 Conceptual model

The conceptual model provided in the 2002 Site Report is summarised as:

- a) Sources – no specific sources of soil and groundwater contamination were identified. However all operations on site have the potential to be sources of such contamination.
- b) Potential pathways for contaminant migration given in the report were:
 - Run off of leaked or spilled material across hard standing into surface drainage or ground in the vicinity of the edge of the hard standing. It was suggested that this would be unlikely given the quality of containment around the edges of these areas.
 - Potentially rapid migration of leaked or spilt material through cracks in hard standing. Again it was suggested that this was unlikely given the quality of hard standing on site.
 - Potentially rapid migration of leaked or spilt material through cracks in sumps.
 - Potentially rapid horizontal migration of contamination through groundwater in made ground into the site drainage system.
 - Potentially slow horizontal migration through the sand lenses and laminations in the drift. The depth and characteristics of the boulder clay probably rule out vertical migration of contamination through the drift to rock head.
- c) Receptors for contaminant migration given in the report include:
 - Kettle Beck to the west of the site – discounted due to the distance from site and the presence of drain channels;
 - Filled zones around underground drainage systems which could act as pathways to the Tees; and
 - People working on or near to site.

It was concluded that the Site had low sensitivity with respect to groundwater. This was due to the considerable depth of low permeability material which underlies the site. The shallow groundwater that does occur is limited to a number of discontinuous perched water bodies in the unconsolidated formations. The site also has low sensitivity to surface waters given the distance to surface water courses and the protection provided by the intervening site drainage system.

2.8 Reference Data between Permit Application (2002) and Permit Issue (2004)

2.8.1 Groundwater Sampling

As part of the site's routine monitoring programme groundwater was sampled during the period between the baseline survey and the granting of the Permit. The sample locations are shown on Figure 4.

Wells were purged and sampled using the installed inertia pumps. Samples were analysed in the site laboratory for pH, conductivity and TOC. Samples from boreholes in the Acids 1 and Acids 2 Plant areas were also analysed for copper. Samples from boreholes on the KA Plant area were analysed for cyclohexane. Results of sampling are presented on Table 1 to Table 5.

Groundwater samples were also taken from leak detection wells installed around the WALE and Dump tanks. These wells are all 1.5 metres deep. Wells are located as shown on Figure 5. Water sampled from the leak detection wells was analysed for pH, conductivity, nitric acid and copper. Results from representative wells are presented on Table 6.

2.8.2 Recorded Incidents

Incidents which occurred in the period between the baseline survey and the permit issue and had the potential to result in contamination of soil and groundwater are listed below. Locations of any losses of containment are shown on Plan 1 in Appendix B.

Date	Incident	Result	Potential for contamination	Ref on plan
29-Oct-02	No 1 Crystalliser Overflow	Contained within plant	No	1
06-Dec-02	Emission of Thermex Heater Combustion material.	Small release of combustion solids found on parked cars	No	2
23-Jan-03	Dilute Acetic Acid leakage when breaking flange joint	Small spillage flushed to drain	No	3
06-Mar-03	Seal failure on Disintegrator.	Leak within contained area transferred to Spill containment Tank	No	4
12-Jun-03	Diesel leak from bowser on N3 Road.	Sand applied to spilled material and then swept up	No	5
04-Oct-03	Crude Slurry Leak	Leak contained and collected in crude building sump. Contents transferred to the Spill Containment Tank.	No	6
20-Nov-03	Oil separator collection IBC overtopped to drain	Small loss to drain	No	7
08-Feb-04	Crude condensate tank overflowed to crude building sump.	Sump contents transferred to Spill Containment Tank	No	8
20-Feb-04	Diesel leak on Aggreko Generator	Leak contained with spill mats and sandbags. Material (less than 5 kg) collected and disposed.	No	9
22-Mar-04	Loss of containment from Draining Oxidiser	Loss of about 2m ³ of caustic and demineralised water to road drains to the west of KA Plant	No	10
03-May-04	Spillage from settling tank containment bund into plant drains	Loss of TiO ₂ slurry to drain	No	11
11-May-04	Overfilling of IBC requiring diversion to Buffer Tanks	Loss of TiO ₂ slurry to drain	No	12

None of the incidents listed above are believed to have caused any actual contamination to soil and groundwater, due to their scale, secondary containment and/or response actions

2.8.3 Zone 1 – KA Plant

No contamination was detected during routine groundwater sampling. No losses of containment occurred which could have caused contamination of soil or groundwater. There is no evidence to suggest that conditions had changed over the two year interval.

2.8.4 Zone 2 – Services Area

No contamination was detected during routine groundwater sampling. No losses of containment occurred which could have caused contamination of soil or groundwater during the period. There is no evidence to suggest that conditions had changed over the two year interval.

2.8.5 Zone 3 – Nitric Acid and the redundant Acids 1 Plants

No contamination was detected during routine groundwater sampling. No losses of containment occurred which could have caused contamination of soil or groundwater. BH1101, in which Diesel Range Organics (DRO) were found in the base line survey, was not re-sampled. There is no evidence to suggest that conditions had changed over the two year interval.

2.8.6 Zone 4 – Polymer Plant

No losses of containment occurred which could have caused contamination of soil or groundwater. BH1103, in which DRO were found in the base line survey, was not re-sampled. There is no evidence to suggest that conditions had changed over the two year interval.

2.8.7 Zone 5 – Acids 2 Plant , WALE Tank, Dump Tank and COGA

No losses of containment occurred which could have caused contamination of soil or groundwater. Boreholes 1107 and 1108 were not re-sampled.

2.8.8 Zone 6 – HMD Plant

No losses of containment occurred which could have caused contamination of soil or groundwater. Boreholes 1105, 1104 and 1106 were not re-sampled. Borehole 304, in which PRO was found, was re-sampled but was not found to have elevated levels of TOC or conductivity.

3. PERMITTED ACTIVITIES

The Site falls under Schedule 1 of The Environmental Permitting (England and Wales) Regulations 2010. Sections of Schedule 1 applicable to the site are:

- Section 1.1 Part A(1)b(iii) – the burning of fuel manufactured from waste
- Section 4.1 Part A(1)a(ii) – the production of organic chemicals containing oxygen
- Section 4.1 Part A(1)a(iv) – the production of organic chemicals containing nitrogen
- Section 4.1 Part A(1)a(viii) – the production of polymer

Details of the operations are covered in Section 2.3 of the PPC Application

- 2.3a(1) – Manufacture of KA oil and co-products
- 2.3a(2) – Manufacture of Nitric Acid
- 2.3a(3) – Manufacture of Adipic Acid and co-products
- 2.3b – Manufacture of HMD
- 2.3c – Manufacture of Nylon Polymer

The operation of the installation was authorised by PPC Permit BM2063IR on 15-Nov-04.

Other aspects of the operation include:

- Operation of four cooling towers, which are regulated by the Local Authority; and
- Processing of waste, using a compactor, and the storage of waste samples, for which an exemption was obtained under the Environmental Permitting Regulations.

No other activities were carried out on the Site. Given the nature of the processes carried out on site very high standards of house keeping, inspection and maintenance and security were expected by the regulators (the HSE and the EA) and achieved by the company.

3.1 Environmental Risk Assessment

The environmental risk assessment of the Site was carried out in accordance with the Environment Agency's H1 Guidance document. Results of the H1 assessment form part of the PPC Application.

It was concluded that the site had low sensitivity with respect to groundwater. This was due to the considerable depth of low permeability material which underlies the site. The shallow groundwater that does occur is limited to a number of discontinuous perched water bodies in the unconsolidated formations. The site also has low sensitivity to surface waters given the distance to surface water courses and the protection provided by the intervening site drainage system.

4. CHANGES TO THE ACTIVITY

Changes to the activity boundary - the activity boundary has not changed from that shown on the site plan attached to the Application.

- Changes to the permitted activities have been authorised by the granting of Variations to the Permit. In summary these have been:
 - 15-Apr-05; JP3438SF – change in pH limits for discharges to the Tees from continuous to daily composite
 - 22-Dec-05; XP3232ST – waste incineration permitted in Thermex heaters
 - 30-Jul-07; JP3138UG – waste incineration emission limit values altered
 - 06-Jun-08; EP3431UA – change in TOC limits for discharges to the Tees from continuous to daily composite and COGA availability
- There have been no changes to the “dangerous substances” used or produced on site since the granting of the Permit.

5. MEASURES TAKEN TO PROTECT LAND

Measures to protect land, surface water and groundwater are described in Section 2.3.4 of the PPC Application and in Site Procedure WSP1719 (Appendix D).

5.1 Drainage System

Drainage on the Site comprised original underground drains and modern above ground piped systems. A general schematic of the site's underground drains is shown in Appendix C. The original drain systems discharged into the Wilton Site C Drain and carried storm water, foul effluent and cooling tower purge as well as condensate from the autoclaves and evaporators on the Polymer Plant. Most process effluent flowed to sumps in the plant areas from where it was pumped above ground to the WALE (Waste and Liquor Equalisation) Tank and then sent via surface pipeline to Northumbrian Water Ltd's Bran Sands Waste Water Treatment plant. With the exception of the HMD Plant and the modern stainless steel lined drains on the Nitric Acid Plant, process effluent did not flow underground to collection sumps.

Process drains containing or likely to contain corrosive material (e.g. nitric acid) were lined with acid resistant paint, tiles or stainless steel. Other process drains were constructed from concrete, with stainless steel liners where required. Drains were categorised using a risk based process described in site procedure NES8407 (Appendix D). In summary drainage was considered to be "critical" where a loss of containment could cause significant harm to people or the environment. Critical drains are listed below and a plan showing the critical drains is given in Appendix C.

Zone	Plant	Drain system	Flows to	Comment
Zone 1	KA Plant	Process drains	SDC Sump	Drains are channels cast in concrete
Zone 2	Services	None	-	-
Zone 3	Nitric Acid	Nitric	Nitric sump	Drains are lined with stainless steel
Zone 4	Polymer Plant	None	-	-
Zone 5	Crude Building	Crude	Crude sump	Drains are channels cast in concrete
Zone 6	HMD Plant	Plant drains	HMD sump	Underground drains 12", 9" and 6" diameter.

Drains were registered and were periodically inspected in accordance with the site procedure NES8407. Results of drain inspections were maintained in the site engineering registry.

A general schematic is shown in Appendix C. The north and western portion of the site drains via the H Drain. The south-eastern portion of the site drains via the NY Drain. The H Drain also picks up waste water from Air Product's Hydrogen Plant (Environmental Permit PP3236LS), flood water from the Kettle Beck in times of storm and rain water from the road surface of Broadway and the UK Wood Recycling yard. Discharges from the Wilton Waste site (Environmental Permit QP3838XG) will flow through the H Drain once this plant comes into production.

Water quality in the H Drain is monitored at release point W1. Water quality in the NY Drain is monitored at release point W4. Flow, pH and TOC were monitored in real time at these two locations.

Daily composite samples were taken until December 2009 from W1 and W4 and analysed by Sembcorp (UKAS accredited) for a range of parameters and substances including BOD, COD, TOC, suspended solids, $\text{NH}_3\text{-N}$, $\text{NO}_3\text{-N}$, Cu and Zn.

Since cessation of production, in April 2009, the results of the composite sampling have been reported at much lower values than during operation of the facility. In January 2010 the frequency of sampling was reduced to spot sampling. The spot samples continue to show a very low level of effluent loading.

5.2 Surfacing

Areas within the Nitric and Adipic Acid Plants where corrosive chemicals (nitric acid) were used, are surfaced with acid-resistant tiling, concrete and/or PVC. These areas are kerbed to ensure that any losses of containment were directed to the process drains, thereby going for treatment, rather than to the storm water drainage system. Contained areas were routinely inspected by plant personnel.

5.3 Storage Tanks and Vessels

Storage tanks and other vessels containing liquid raw materials, intermediates and products were risk assessed and appropriate inspection regimes put in place in accordance with site procedure NES8201B. Results of these inspections were maintained in the engineering registry. Tanks were designed to facilitate visual detection of leaks. Most tanks were constructed on plinths with a clear break between the base of the tank and the top of the plinth. (See example in Appendix E – photograph 2). Contents of tanks in the permitted areas is presented in Table 7a to 7f)

5.4 Secondary Containment Measures

Appendix E presents a photolog of the secondary containment systems used on the site. Tables 7a to 7f provide a description of the secondary containment for the storage tanks on site.

Bulk storages and other vessels containing liquid raw materials, intermediates and products and associated transfer facilities on the Site were assessed, during 1997 and 1998, for their potential to cause pollution. The assessments were carried out to meet the EA's requirement to prevent, minimise or render harmless releases of organic compounds from tanks, vessels and pipework and from leaks during chemical transfer to/from tankers. Assessments reviewed the potential for a leak to impact on the River Tees, Northumbrian Water's Bran Sands waste water treatment plant and/or groundwater below the site.

Controls taken into account as part of the assessments included level indication and alarms, vessel inspection routines, sump discharge analysers and alarms, contained areas and bunds. The nature of stored substances was also taken into account, many of which (for example blended acid, salt and HMD) would solidify at ambient temperatures. Releases of 67% nitric acid and other hot liquors containing nitric acid are quickly identified by the smell and colour of the NO_x fumes evolved facilitating timely response to any release.

Containment structures were designed with regard to British Standard design codes, for example BS8007; Design of Concrete Structure for Retaining Aqueous Liquids, BS8110; Structural use of Concrete and BS5950; Structural use of Steelwork in Building. Account was also taken of the properties of the materials stored and the need to provide specific linings to prevent corrosion.

Site procedure NES8410 covers the inspection regimes for secondary containment systems for all storage tanks. Results of inspections were maintained in the engineering registry. All listed bunds were last inspected in 2007 and found to be in good condition.

A list of tanks containing liquids, including dangerous substances under COMAH, hazardous materials and other materials with a potential for environmental impact, are listed in Tables 7a to 7f. The locations of these tanks in relation to the various boreholes are shown on schematic diagrams in Appendix F.

5.5 Chemical Transfer Area

Chemical transfers e.g. raw material unloading and product loading activities, were carried out in contained zones with drains leading to containment sumps. An example of such a facility is shown on Plate 3, Appendix E.

5.6 Storage of Materials

IBCs and drums were stored in designated areas which were either contained or where containment pallets were provided. Examples of arrangements are shown on Plates 4 and 5. IBC and drum storage areas are inspected as part of the plant routines. Water treatment chemicals were stored in double skinned containers as shown on Plates 6 and 7 of Appendix E.

5.7 Transformers

All transformers were located in bunded compounds, Plate 8. Transformer oil was tested and PCBs were not detected in excess of 50 parts per million (ppm).

6. POLLUTION INCIDENTS THAT MAY HAVE HAD AN IMPACT ON LAND, AND THEIR REMEDIATION

6.1 Recorded Incidents (2004 – 2009)

Recorded incidents at the site since the issue of the Permit are listed below. Locations of these incidents are shown on Plan 2 in Appendix B. None of the incidents were thought to have had the potential to impact on soil or groundwater based on the containment measures, actions taken or severity of the incident.

Date	Incident	Result	Potential for contamination	Ref on plan
25-Apr-05	Following a change over of the salt filters, the main body joint of the filter brought on line leaked.	Salt solution spilled from through the building and some entered the site drains. EA notified.	No	1
05-Jul-06	Cold cyclohexane leak from vaporiser feed tank isolation valve body.	300 to 490 kg of cyclohexane lost but contained on the plant. EA notified.	No	2
15-Jul-06	A plug blew out from the west side header on No1 Oil Cooler, releasing mineral oil into the bund and splashing onto adjacent floor area.	Isolations made to minimise leak rate and replacement plug fitted. Spillage contained using spill kits.	No	3
18-Sep-06	Leak of 106 kg of 40% TiO ₂ and 20 kgs flushing water from 27 Auto.	Spill mats put in place but about 50% of release went to drain. C Drain diverted to Sembcorp buffer tanks.	No	4
07-Oct-06	Crude building sump overflowed. Release was about 5 tonnes of acid.	Ground floor flooded but contained by bund wall.	No	5
27-Jan-07	Salt leaked out from the gaskets of No.1 Salt Preheater.	The potential for a release of had been anticipated, a temporary bund was in place and it was contained	No	6
02-Apr-07	After a tanker offloading operation, approximately 500kgs of Caprolactam solution entered the site drain.	No breach of PPC limit.	No	7
09-Aug-07	HMD tanker was being loaded with 60% solution for export, tanker over-filled and over flowed in drainage system.	Spillage estimated to be 600 kg, of this about 60 kg was not contained and was washed down to the site drainage system. No breach of PPC limit.	No	8
12-Oct-07	During start up of ammonia recovery the Weak Liquor Tank overfilled resulting in a blown bursting disc.	The release was contained in the bunded area. The ammonia content of the liquor was negligible due to washing during shutdown.	No	9
28-Nov-07	80% HMD Tanker loading hose leaked.	Washed to drain to W1. No breach of PPC limit	No	10
06-Sep-08	AGS methanol loss into sump.	Loss (approximately 34 tonnes) was fully contained and, after testing, sent forward to NWL for treatment.	No	11
01-Jan-09	Release of HMD from the Refinery stack. Fire brigade attended and washed down structure and surfaces.	No breach of PPC limit. EA notified.	Area washed to drain after incident	12

7. SOIL, GAS AND WATER QUALITY MONITORING

7.1 Soil sampling

Soil sampling activities were carried out across the Site by URS in 2002 to determine the site baseline conditions as part of the permit application. Results of the baseline survey are detailed in Section 2.6.

No further soil samples were collected during the lifetime of the permit.

7.2 Groundwater

Groundwater sampling was carried out by URS to determine the site baseline conditions as part of the permit application as detailed in Section 2.6.

As part of the site's routine monitoring programme groundwater was sampled during the lifetime of the permit from the following monitoring wells using the installed inertia pumps; 201, 202, 203, 204, 112, 601B, 605, 606, 501, 504, 401, 404, 405, 105 and 304 (Figure 4). Groundwater was analysed at the in-house laboratory for pH, TOC, copper, conductivity and cyclohexane. The results are presented in Table 8 to Table 12.

Groundwater samples were also taken from leak detection wells installed around the WALE and Dump tanks. Wells are located as shown on Figure 5. Water sampled from the leak detection wells was analysed for pH, conductivity, nitric acid and copper. Results from representative wells are presented in Table 13.

8. DECOMMISSIONING AND REMOVAL OF POLLUTION RISK

8.1 Site closure plan

The Site closure plan was submitted as Section 2.11 of the PPC Application. The closure plan was reviewed following INVISTA's announcement of site closure on 13th January 2009 and the revised document was submitted to the EA on 13th March 2009. A copy of the revised closure plan is attached in Appendix G.

8.2 Site decommissioning

The general principles for Site decommissioning and decontamination are described in the Site Closure Plan. In practice these objectives have been delivered and demonstrated as summarised below.

Each of the site's process plants were divided into a number of "systems" and each system was made up of a number of different vessels and associated pipework. These were identified on system equipment lists and process and instrument diagrams (P&IDs). An example of the decontaminated equipment and systems located in the Acids area is presented as Appendix H. This spreadsheet serves to demonstrate how each plant operating team tracked the progression of decommissioning from the development of the scope of the decontamination, through equipment inspections, decommissioning of associated electrical and/or rotating equipment, to the final sign off and filing of the documentation. As each step was completed the appropriate cell in the spreadsheet was marked off in red.

Process Hazards Analysis (PHA) teams, made up of a cross section of the operating team in each area, carried out PHA on the installations to determine the level of cleanliness and methods of decontamination necessary for each part of the plant in order to leave the plant in a safe condition and to remove any pollution risk. Typically this meant removal of material, including hazardous material, from vessels and pipelines with the goal being to have vessels as clean as if they were being prepared for vessel entry and pipelines, material free as if they were being prepared for hot work.

In a minority of cases where the material could be shown to be non-hazardous, not a pollution risk and/or where it would be very difficult to remove e.g. inert polymeric material coated on the walls of the KA Wash Water Recovery Column, it was left in-situ, secure within the vessel. Each of these exceptions was reviewed, documented and approved by INVISTA Area leadership.

The execution of the decontamination work was carried out under the Permit to Work system which included a requirement to identify risks to safety and the environment and to put in place risk control measures before work can start.

Once cleaning work on a piece of equipment was completed, the equipment was inspected, photographed and a decontamination certificate was completed and approved by Area Leadership. This, together with the photographs and a marked up copy of the P&ID showing the final condition of vessels and pipework have been collected together in a "Decontamination Pack" which documents the condition of each system on the Plant. An example of a typical decontamination pack is presented in Appendix I.

Progress of the decontamination programme, system cleaning and filing of the completed decontamination packs was tracked weekly by the Site leadership team. A graphical summary of the completed site-wide decontamination work plan is presented as Appendix J. This shows how cleaning of the vessels and pipework progressed throughout 2009. This work was

essentially complete by the end of 2009. The only remaining item remaining by then was final cleaning of the WALE tank. This was completed and all wastes disposed of during Feb 2010.

8.2.1 Tanks

Tanks used for the storage and transfer of hazardous or potentially contaminating materials were subjected to the following decontamination process:

- Vessel and associated linework boiled, steamed out and drained. Wash waters were sent to effluent treatment.
- Lines isolated (by disconnection where possible).
- Manways removed, valves opened, vessel ventilated and internal atmosphere tested for entry.
- Any solid residues removed and disposed of as waste
- Internal condition inspected and photographic record of condition and effectiveness of cleaning operations. If required additional cleaning would be conducted.
- Any residual hazards (e.g. slight residues) are documented within the decontamination certificate.

8.2.2 Sumps

Sumps used for the collection and transfer of hazardous or potentially contaminated water or materials were subjected to the following decontamination process:

- Sump chamber washed and pumped out.
- Analysis of sump rinse water to determine effectiveness. Wash waters were sent to effluent treatment.
- Gratings or covers removed and internal condition inspected, photographic record of condition and effectiveness of cleaning operations. If required additional cleaning would be conducted.
- Any residual hazards (e.g. slight residues) are documented within the decontamination certificate.
- Gratings or covers replaced.

8.2.3 Pumps

Pumps used for the transfer of hazardous materials or potentially contaminated water or materials were subjected to the following decontamination process:

- Pumps flushed / cleaned (e.g. with hot demineralised water) and drained. Wash waters were sent to effluent treatment.
- Inspection or testing of rinse water to verify cleaning effectiveness.
- Valves left open.
- Pumps isolated.

8.2.4 Radioactive Sources

All radioactive sources were removed from the Site by a licensed contractor (Tracerco). Notification of their removal and transport was provided to the EA in July 2009 and the notices of cancellation of certificates to keep and dispose of radioactive sources was received on 18th August 2009.

8.2.5 Oils

Any oil being stored in drums was removed from the site. All equipment containing oil was identified and as far as possible with the oil drained, collected and disposed off. If possible, oil

was sent for reuse or recycling. In the event that the oil was not reusable, or it was contaminated it was sent for disposal to a licensed disposal facility.

8.2.6 Gearboxes, Pumps and Compressors

All gearbox, pump and compressor systems had oil removed and then allowed to stand for a few days so that any residual oil could be collected. Once as much oil as possible had been removed, the equipment was boxed up to ensure that any small remaining amounts of oil would be contained. Trace amounts of oil may remain, coating the insides of the equipment.

8.2.7 Transformers

Transformer oil within on-site systems had previously been tested and confirmed as PCB free or levels below 50 ppm. Once circuits fed from a transformer had been decommissioned and disconnected, the transformer oil was drained down and left to stand to ensure that the bulk of residues were removed. The waste oil was removed from site for recycling. The drain valves were then closed to prevent any remaining seepage. All power cables were removed from the transformer. Transformer bays were cleaned of any oil contamination or residue.

Examples of oil cooled transformer decontamination records are presented as Appendix K.

8.2.8 Batteries

All batteries which posed a risk of leaking and presented a potential pollution risk e.g. lead acid type associated with Uninterruptable Power Supply (UPS) systems, have been removed and disposed off in accordance with the Hazardous Waste Regulations. Other batteries, which were in good condition and did not pose a pollution risk, such as those associated with emergency lighting systems have been left in place and will be removed and disposed off as part of any future demolition project.

8.2.9 Equipment

Process equipment and vessels were cleaned as stated and left in place, with a few exceptions which have been removed for resale or reuse at other INVISTA facilities. Portable electrical equipment such as fridges, microwave ovens etc, have been removed and sent for reuse elsewhere or disposed off in accordance with Waste Electronic and Electrical Equipment Regulations.

Desktop and laptop computers and other portable computer equipment such as printers have been removed from the site. This equipment has been removed and sent to another INVISTA location for reuse. Other process control equipment, integrated in the plant design, has been left in place.

Analyzers have been cleaned and de-energized. Gas cylinders have been removed from the units and sent off-site.

8.2.10 Mercury containing equipment

All equipment containing mercury has been identified and as far as possible mercury has been safely removed. A tracking document for the removal of mercury from all identified equipment is presented as Appendix L.

A decommissioning survey was undertaken in the laboratory which included an assessment of any residual mercury within the working areas in the laboratory building. There was no positive visual evidence of mercury found during the survey however, there was a small amount of

mercury remaining in inaccessible parts of the lab and has been recorded so that future demolition contractors are aware of its presence. The results of the survey can be found in the Wilton Nylon Laboratory Decommissioning Report in Appendix L.

8.2.11 Asbestos

Inspection of INVISTA's asbestos inventory was completed by the end of November 2009, in accordance with site procedures, all necessary repairs were completed and the records were brought up to date.

INVISTA have appointed an Asbestos Manager for the site who will be responsible for compliance with asbestos legislation.

INVISTA will manage the asbestos program to the schedule using competent third parties. Contracts will set up with independent providers of inspection and repair/disposal services. The repair and disposal contractor will set up his own facilities to execute their work.

The asbestos inspection frequency will remain consistent with past practice i.e. all asbestos will be formally inspected every twelve months. The asbestos management process is documented separately within INVISTA's procedures. Routine security related patrols by the local INVISTA team will also look out for asbestos falls to initiate clean up and further inspection.

8.2.12 Electrical supply

The site's electrical supply system has been isolated at the 11kV sources. All circuits once isolated and locked out have been physically tested, using an approved voltage tester, to prove them dead.

Area electrical inspection files contain copies of all the documentation for each HV circuit breaker's redundant distribution. Plant hand over electrical certificates have been completed and signed off by the electrical inspector.

A few live cables belonging to SembCorp Utilities remain on the facility. To facilitate identification of these cables in the event of a demolition project, all redundant cable has been removed from the Site cable/pipe trenches. This leaves only a few cables and these remain live.

8.2.13 Critical drains

Critical drains, including sumps, have been treated as plant systems. A plan showing the location of all critical drains, marked in green, is attached in Appendix C. Decontamination packs have been prepared for these drains and a summary is presented below.

KA Plant

Plant drains were washed and inspected. Sumps were cleaned.

Nitric Acid Plant

Plant drains were washed through to the sump. Sump was then cleaned.

HMD plant drains

Drain gullies, sumps and oil separators on the HMD synthesis, ammonia recovery and refinery areas were cleaned. Underground drains, including oil separators, were cleaned using a water wash and gully sucking vehicle. The planned inspection of the underground drains with a

CCTV camera was precluded by the presence of hard deposits. Attempts to remove these hard deposits with a high pressure water jet were unsuccessful. A sample of the solids was taken, analysed and found to be calcium carbonate. The final effluent sump was cleaned and the drains flushed.

Acids 2 Plant drains

Drain gullies on the Acids 2 Crude and NACS Purge Buildings and all collection sumps were cleaned.

Polymer Plant

Drain gullies and the underground drain to the north of the plant were cleaned.

8.2.14 Residual contamination in H and NY drains.

The storm water drains were monitored after plant operation ceased, the results identified that the drains did not pose a potential source of pollution.

Following an intense rain storm (17mm) on 3rd July 2009 peak flow rate was recorded at 1,000 m³/hr. Figure 6 and Figure 7, generated by the site's InfoPlus (IP) 21 system, show real time data for flow (blue) and TOC (red) from 1st to 6th July 2009. TOC results did not exceed permitted limits; 800mg/l for W1 and 500mg/l for W4 during the rain storm, indicating that there is no residual contamination in the drainage network.

Daily composite sampling results for this period were generally very low or below the limit of detection (Table 14 and Table 15).

8.2.15 Residual Wastes

The objective of the decontamination process was to clean vessels to a standard suitable for vessel entry and for pipes so that they were suitable for hot work i.e. no residues. Appendix M presents a list of equipment where that standard was not achieved and where residual contamination remains. The decision to leave these residues was based on a number of factors e.g.

- In most cases the bulk of the material had been removed and the effort to remove the amount remaining was very significant for little or no environmental benefit since the materials were typically solids and non-hazardous
- In many cases removal of the residual material would have required vessel entry with difficult access thereby posing an unacceptable risk to personnel with no benefit for environmental protection
- In all cases since the material is secure and contained it is considered that it does not pose an environmental risk
- In all cases safe removal of the material can best be achieved as part of the demolition process.

All demolition contractors being considered for the demolition project have been made aware of these residual materials and have included the cost of safe removal and disposal as part of their bids for the project. Detailed risk assessments, including environmental risk, will be carried out on every aspect of the demolition. This will include COSHH assessments for potential exposure, the necessary soil and groundwater protection, collection, treatment and disposal of any resultant water run off, as well as waste analysis and designation of suitable disposal routes for the material.

In many cases, the amount of residue is very small or represents a coating on the walls of the vessel or pipework. In some cases there are more significant amounts. For example there are five of the vessels in the KA plant which contain solid process residues, which have been tested and would be classified as hazardous waste. The demolition activity is planned to start in 3Q, 2010 and INVISTA will commit to remove this material as a priority. It will be removed and disposed off within 12 months of the start of demolition.

8.2.16 Security

A security fence has been erected around the periphery of the installation. This fence is made up of two metre high weldmesh panels topped with barbed wire. The line of the fence is shown on the plan in Appendix N. Gates through the fence are marked with an "X". Security patrols are being carried out by a third party provider, SembCorp, with the status reported to INVISTA personnel still located in the vicinity of the Site.

9. REFERENCE DATA AND REMEDIATION

ARCADIS was contracted by INVISTA to collect data for comparison against the 2002 baseline survey. The repeat groundwater sampling exercise comprised an initial round of groundwater monitoring in July 2009 followed by an intrusive investigation and groundwater monitoring in November 2009. Following this an additional two rounds of groundwater monitoring of selected boreholes was undertaken in June 2010.

9.1 Permit Surrender Groundwater Monitoring (July 2009)

In July 2009, a site reconnaissance was undertaken at the Site which included well inspection, purging of the monitoring wells and subsequent groundwater monitoring (Figure 8). Wells were generally found to be in good condition with little silting, including wells which had not been sampled since 2002. A number of the well covers required remedial works to maintain their integrity: i.e. the borehole cover at BH304 was observed to be damaged and the monitoring well potentially exposed to the inflow of surface water runoff from the surrounding area. The monitoring well was subsequently fitted with a protective standpipe to prevent surface water running into the well.

All wells were purged using a surge block and where possible the equivalent of ten well volumes of water was purged from each well. However, many of the wells ran dry before this volume had been removed. In such cases wells were left to recharge before being purged again.

Groundwater samples were taken, using a low flow, peristaltic pump system. Low flow techniques allow the collection of representative samples from the screened formation without entrained particulate material. Hydro-geochemical data (pH, Redox, dissolved oxygen, conductivity and temperature) was collected, where there was sufficient recharge, during sampling.

Groundwater samples were submitted for testing, to a UKAS accredited laboratory, for the same analytical suites used in the baseline survey in 2002:

- VOC inc TIC, all groundwater samples;
- SVOC inc TIC, all groundwater samples;
- TPH separated into Petrol Range Organics (PRO) and Diesel Range Organics (DRO), including benzene, toluene, ethyl benzene and xylene (BTEX), selected samples;
- Metals – arsenic, boron, cadmium, chromium, copper, mercury, nickel, lead, selenium, vanadium and zinc, selected samples;
- Ammonia, all groundwater samples;
- Acids, pH and acids identified in the VOC and SVOC TIC, selected samples;
- Methanol, selected samples;
- PCBs by Aroclor, selected samples;
- Cyclohexane, all groundwater samples; and
- TOC, all groundwater samples.

For quality assurance and quality control, three samples, comprising two blind duplicates and one field blank were also submitted for analysis for the complete set of suites.

All boreholes sampled during the baseline survey were re-sampled with the exception of boreholes BH207, BH1107 and BH1108 which could not be located and BH1105 which had insufficient water to sample.

9.1.1 Results of Groundwater Monitoring

A detailed report of the July 2009 groundwater monitoring is presented as Appendix O and a summary of the results is presented below.

Analytical results for the majority of samples collected in 2009 were of similar magnitude to the 2002 baseline monitoring with the following exceptions: BH1101; BH1104 and BH304. A comparison of analytical results, showing key increases in concentrations, is presented below:

Borehole	Analysis	2002 (µg/l)	2009 (µg/l)
304	TOC	10,000	580,000
	SVOC	<MDL	311
	NH ₄ (N)	1,200	260,000
1101	SVOC (TIC)	595 ⁽¹⁾	101,920 ⁽²⁾
	TPH – GRO	<MDL	931
	NH ₄ (N)	1,000	4,000
1104	Boron	590	15,000

- Below method detection levels

Note SVOC-TICs (1); C₆ to C₉ acids, (2); carboxylic acid group and dicarboxylic acid.

BH304

Concentrations of total organic carbon (TOC), ammonium and SVOC were recorded above the baseline investigation. It is considered likely that the source of the elevated concentrations may be a result of the damaged borehole cover and potentially contaminated surface water run-off that has entered the monitoring well.

BH1101

Concentrations of tentatively identified semi-volatile organic compounds, TPH-GRO and ammonium were recorded above the baseline levels. It is likely that the variations of TPH GRO are a result of differing sampling techniques and the tentatively identified elevated concentrations of SVOC are from historical activities prior to the issue of the permit. Elevated levels of SVOC-TIC C₆ to C₉ acids were reported in the soil sample from BH1101 in 2002 at concentrations of 14.94mg/kg.

BH1104

Concentrations of boron were detected in higher concentrations than in the baseline investigation. The 2002 baseline investigation recorded elevated concentrations of boron (50ug/l to 1,010ug/l) across the site and the 1993 investigation also recorded elevated levels of boron across the site (max. 56,150ug/l). There have been no recorded releases of this material over the lifetime of the permit.

Based on the findings from the groundwater monitoring it was decided to undertake additional characterisation of the soil and groundwater around boreholes BH304, BH1101 and BH1104.

9.2 Additional Characterisation (November 2009)

An investigation was designed to provide additional characterisation of impacts identified in and around the three boreholes.

The investigation, carried out by ARCADIS, comprised the drilling of four boreholes around BH304 (Figure 9), three boreholes around BH1101 (Figure 10) and three boreholes around BH1104 (Figure 11). The additional boreholes were drilled to comparable depths as the target boreholes with comparable monitoring well design. Soil and groundwater samples were collected and submitted to an accredited laboratory.

Ground conditions encountered in boreholes comprised made ground, consisting of concrete and a layer of gravel, over clay. Groundwater recharge into the new wells was slow. Rest water levels indicated that groundwater is non-continuous.

Groundwater was sampled on two occasions; 4th November and 18th November 2009. Samples were scheduled for the same suite of analysis as previously tested and results are presented in Appendix O.

9.2.1 BH304 Area

Results of analysis of groundwater samples taken from BH304 and the four newly installed monitoring wells are presented below.

Borehole	Analysis	2002	July 2009	04/11/09	18/11/09
		(µg/l)			
304	TOC	10,000	580,000	160,000	N/S
	TPH - DRO	2,062	643	1,100	N/S
	NH ₄ (N)	1,200	260,000	390,000	N/S
304-1	TOC	-	-	N/S	<MDL
	TPH - DRO	-	-	N/S	<MDL
	NH ₄ (N)	-	-	N/S	<MDL
304-2	TOC	-	-	6,000	4,000
	TPH - DRO	-	-	<MDL	<MDL
	NH ₄ (N)	-	-	<MDL	<MDL
304-3	TOC	-	-	N/S	8,000
	TPH - DRO	-	-	N/S	<MDL
	NH ₄ (N)	-	-	N/S	<MDL
304-4	TOC	-	-	10,000	6,000
	TPH - DRO	-	-	<MDL	<MDL
	NH ₄ (N)	-	-	<MDL	<MDL

-: Borehole not in existence; N/S: Not sampled; <MDL: Below method detection levels

The elevated concentrations of ammonium detected in borehole BH304 in July 2009 were not recorded in any of the characterisation boreholes. As such borehole BH304 is considered an isolated hotspot and likely caused by surface water run off ingress into the unprotected borehole.

9.2.2 BH1101 Area

A summary of the results of groundwater samples taken from BH1101, and the three new installed monitoring wells is presented below. An additional groundwater sample was also collected from borehole BH501 located between BH1101 and the former Nitric Acid plant.

Borehole	Analysis	2002	July 2009	03/11/09	18/11/09
		(µg/l)			
1101	SVOC (TIC)	595	101,920	487,753	N/S
	TPH – GRO	<MDL	931	190	N/S
	NH ₄ (N)	1,000	4,000	500	N/S
501	SVOC (TIC)	<MDL	<MDL	<MDL	N/S
	TPH – GRO	<MDL	<MDL	<MDL	N/S
	NH ₄ (N)	<MDL	800	400	N/S
1101-1	SVOC (TIC)	-	-	451,841	263,147
	TPH – GRO	-	-	1,600	1,800

Borehole	Analysis	2002	July 2009	03/11/09	18/11/09
		(µg/l)			
	NH ₄ (N)	-	-	13,000	9,100
1101-2	SVOC (TIC)	-	-	413	<MDL
	TPH – GRO	-	-	N/T	<MDL
	NH ₄ (N)	-	-	600	200
1101-3	SVOC (TIC)	-	-	144	<MDL
	TPH – GRO	-	-	N/T	<MDL
	NH ₄ (N)	-	-	300	200

:- Borehole not in existence; N/S: Not sampled; N/T: Not tested <MDL: Below method detection levels

Soil

The laboratory analysis from the soil samples collected from the three new boreholes tentatively identified organic acids in borehole BH1101-1 which is located to the immediate south (<10m) of borehole BH 1101. None of the other soil samples collected from the surrounding boreholes identified elevated concentrations of tentatively identified organic acid compounds.

Groundwater

Results of the laboratory analysis recorded tentatively identified organic acids in all of the characterisation boreholes with the exception of borehole BH501.

Borehole BH1101 is located in an area that historically used organic acids similar to those tentatively identified in the permit monitoring. These activities ceased in this area prior to 1990 and have been subsequently decommissioned and demolished. An area 95m to the east of BH1101 did use a mixture of organic acids during the lifetime of the permit (Figure 12). However, there have been no recorded releases over the lifetime permit.

Based on the evidence of the July 2009 monitoring and subsequent characterisation work, along with a review of site processes and records for the lifetime of the permit it is concluded that the organic acids are associated with historical site activities.

9.2.3 BH1104 Area

A summary of the results of the groundwater samples taken from BH1104 and adjacent boreholes is presented below. The July 2009 closure survey recovered elevated concentration of boron above the baseline survey. Subsequent monitoring was conducted in November 2009 and June 2010 to provide trending data for the contaminant of concern.

Borehole	Analysis	2002	July 2009	04/11/09	18/11/09	10/06/10	23/06/10
		(µg/l)					
1104	Boron	590	15,000	1,100	N/S	16,400	14,300
1104-1	Boron	-	-	1,200	1,100	676	1,030
1104-2	Boron	-	-	1,500	1,000	1,010	1,310
1104-3	Boron	-	-	1,800	1,500	1,230	998

The results of characterisation exercise show that concentrations of boron in borehole BH1104 are elevated above the 2002 baseline conditions and that concentrations of boron are also detected in all of the characterisation boreholes.

Borehole BH1104 is located immediately adjacent to a building which historically was used to manufacture Ammoniated Boron Phosphate (ABP) catalyst. The ABP plant closed in 1992 when the site began to import adiponitrile (ADN) and since 2002 the building has been used

as a warehouse to store boxes of new lagging for the on-site Lagging Contractor. Borehole BH1104 is also located in close proximity (<5m) to a sump / interceptor which would have contained any effluent generated in the ABP plant. It is likely that the potential source of boron in this area from the historical ABP catalyst plant and/or associated drainage.

Following a review of the historical activities that took place in and around borehole BH1104, the elevated concentrations of boron identified in the groundwater in the baseline survey in 2002 (see section 2.6) and in consideration the site process changes to the non-boric KA process in 2004, it is concluded that the elevated levels of boron are related to historical site activities that took place prior to issue of the environmental permit.

9.3 Remedial Actions

Elevated concentrations of contaminants of concern have been recorded in three isolated areas of the site between the granting of the PPC Permit and closure. However, the organic acids tentatively identified in BH1101 and elevated concentrations of boron in borehole BH1104 are considered to be an historic issue and not associated with permitted activities, as such no remedial actions are considered necessary under this environmental permitting regime.

9.3.1 BH304

The elevated concentration of ammonium recorded in BH304 is considered to be an isolated hotspot. Given the nature of the site geology which comprises of made ground over clay with pockets of discontinuous sand lenses, and the limited area of impact, this borehole will be decommissioned and a limited excavation of the immediate area (approx 2m x 2m) will be undertaken. The excavation material will be sampled to enable a suitable disposal route to be defined.

Due to the fact that there is no baseline for ammonium in soil for borehole BH304 and that the soil in the area has shown historically to have been impacted, ARCADIS did not define specific remedial targets for this work, but aimed to improve ground conditions so that the land immediately around BH304 was in a satisfactory state at surrender. The remediation report is summarised below, the full report can be found in Appendix P.

ARCADIS attended site on 16th August 2010 accompanied by a representative from INVISTA. A visual inspection of the proposed excavation works was undertaken and utility locations were discussed and the area was cleared by the INVISTA representative. Due to the nature of the site geology and the limited area of impact a small excavation of the immediate area was undertaken and the borehole was decommissioned.

As the soil was removed the excavation was logged and sampled. Approximately 16 tonnes of material was excavated and was disposed of via road transport to landfill. The excavation was backfilled with some of the concrete removed from the surface and 6F2. Based on the elevated ammonium levels identified in the previous monitoring and discussions with INVISTA, the soil and groundwater samples were submitted for the ammonium analysis.

Ammonium was not detected in any of the samples from the excavation. Following the removal of the target material around BH304 and the decommissioning of the well it is the opinion of ARCADIS that the area is no longer impacted and requires no further action.

10. STATEMENT OF SITE CONDITION

Based on the information presented in this report, it is concluded that the Site was operated to Best Available Techniques with respect to protection of soil and groundwater.

The 2009/10 conditions are generally comparable to those seen in 2002 when the permit was issued, with the exception of three remaining areas where detected concentrations of contaminants of concern are above the initial baseline survey. Of these three areas; the concentrations of contaminants of concern in BH1101 and BH1104 are attributed to historical activities (pre environmental permit) and the ground around borehole BH304 is considered to be a result of permitted activities. Subsequently, no further works are proposed around BH1101 and BH1104. A limited excavation and removal of impacts was successfully undertaken around BH304.

INVISTA consider that these proposed works are adequate to enable the surrender of the environmental permit and return the site to a satisfactory state in accordance with the relevant guidelines and legislation.

11. REFERENCES

1. Dames and Moore International, May 1993, Phase 2 Due Diligence Investigation – Project Blue, Wilton Site
2. URS Corporation Ltd, October 2002, Phase 2 Environmental Site Assessment Report for IPPC Permit Application Number BM 2063
3. ARCADIS (UK) Ltd, February 2010, Environmental Assessment

TABLES

Environmental Permit Surrender INVISTA Textiles (UK) Ltd

Table 1 - Groundwater Quality Between Baseline and Granting of Permit (pH)

Area	Borehole	Jul-02	Dec-02	Jun-03
Zone 1	201	6.9	6.5	7.4
	202	5.9	6.5	7.2
	203	6.2	6.7	7.5
	204	6.2	6.6	7.3
Zone 2	112	6.2	6	6.9
	601 B	6.4	5.5	7.1
	605	6.5	6	7.1
	606	6.7	6.6	7.5
Zone 3	501	6.7	6.5	7.5
	504	6.3	6.8	7.8
Zone 5	401	5	4.8	6.8
	404	6.1	5.2	7.8
	405	5.1	5.6	6.6
	105	5.5	6.2	8.9
Zone 6	304	5.3	6.4	7.8

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Table 2 - Groundwater Quality Between Baseline and Granting of Permit (Conductivity uS)

Area	Borehole	Jul-02	Dec-02	Jun-03
Zone 1	201	800	595	810
	202	810	780	817
	203	595	615	595
	204	700	800	643
Zone 2	112	2,920	1,850	2,170
	601 B	1,350	1,422	1,405
	605	1,410	1,334	1,355
	606	570	308	520
Zone 3	501	1,499	1,305	1,205
	504	715	463	705
Zone 5	401	1,175	1,120	789
	404	1,060	703	650
	405	5,750	6	4
	105	530	722	661
Zone 6	304	1,700	1,005	1,253

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Table 3 - Groundwater Quality Between Baseline and Granting of Permit (TOC ppm)

Area	Borehole	Jul-02	Dec-02	Jun-03
Zone 1	201	15	10	10
	202	5	5	3
	203	10	15	5
	204	25	20	25
Zone 2	112	20	15	40
	601 B	<5	<5	<5
	605	5	70	10
	606	10	15	10
Zone 3	501	<5	20	5
	504	5	10	10
Zone 5	401	15	15	15
	404	15	25	20
	405	1,800	2,305	310
	105	10	25	110
Zone 6	304	10	<5	30

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Table 4 - Groundwater Quality Between Baseline and Granting of Permit (Copper ppm)

Area	Borehole	Jul-02	Dec-02	Jun-03
Zone 3	501	<0.01	<0.01	0
	504	<0.01	<0.01	0
Zone 5	401	1	0.33	0
	404	0	<0.01	0
	405	0	<0.01	0

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Table 5 - Groundwater Quality Between Baseline and Granting of Permit (Cyclohexane ppm)

Area	Borehole	Jul-02	Dec-02	Jun-03
Zone 1	201	<5	<5	0
	202	<5	<5	0
	203	<5	<5	0
	204	<5	<5	0

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Table 6 - Water Quality Between Baseline and Granting of Permit WALE and Dump Tanks

	DATE	Dec-02	Jun-03	Dec-03	Jul-04
WALE 1	Cu (ppm)	<0.01	<0.01	<0.01	<0.01
WALE 6	Cu (ppm)	<0.01	<0.01	<0.01	<0.01
WALE1	HNO3 (ppm)	25	10	10	10
WALE6	HNO3 (ppm)	25	10	10	10
WALE1	Conductivity (uS)	980	720	690	860
WALE6	Conductivity (uS)	820	640	590	845
WALE1	pH	7.7	6.8	6.3	7.5
WALE6	pH	7.4	6.6	6.6	7.4
DT 5	Cu (ppm)	0.04	0.01	0.02	<0.01
DT 5	HNO3 (ppm)	50	25	25	50
DT 5	Conductivity (uS)	8,170	7,600	7,700	8,300
DT 5	pH	7.4	6.7	6.4	7.5

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Table 7a - Adipic Acid Storage Tanks

Tank number	Description	Capacity(m3)	Substance stored
5031-141	60% HMD storage tank	198	60% HMD
5031-142	60% HMD storage tank	198	60% HMD
5031-160	Spill containment tank	80	high copper/ high conductivity sump material from Crude building/ NACS/ Purge building, normally disposed of to Bio.
5031-163	Mother liquor storage	205	Collection of liquors from various different sources; Semi-ref dissolvers drain headers/ soutuon recycle manifold/ semi-ref crystalliser drain.
5031-164	Mother liquor storage	206	Collection of liquors from various different sources; Semi-ref dissolvers drain headers/ soutuon recycle manifold/ semi-ref crystalliser drain.
5031-171	Dryer liquor tank	180	liquor from 3 and 4 Dry Refined Centrifuges and No. 2 dryer Scrubber. Comp????
5031-191	1st ML collection tank	308	filtrate from Semi ref thickeners and centrifuges & Semi ref slurry from the thickener ringmain
5031-200	Salt-refined crystaliser feed tank	180	Salt
5031-203	Wash liquor storage	275	~78% water, 11% nitric, 9% Adipic & 2% trace elements.
5031-220	Recycled Acid Tank (RAT)	968	Nitric & organic acids
5031-233	Blended Acid Tank (BAT)	968	Nitric & organic acids
5031-246	Spillage disolver		00S
5031-276	No 2 Mother liquor collection tank		DI water with low Adipic content (~5%) & Nitric acid (trace only) - from filtrate from the 4 Salt refined c/fuges.
5031-303	Semi-refined sol collection	90	typically 45 - 49% Adipic <100ppm Nitric Acid
5031-340	No 1 Semi-refined solution tank	90	used as buffer space. typically 45 - 49% Adipic <100ppm Nitric Acid
5031-341	No 2 Semi-refined solution tank	90	used as buffer space. typically 45 - 49% Adipic <100ppm Nitric Acid
5031-346	Dryer crstaliser feed tank	90	35 - 40% adipic acid dissolved in water, plus impurities mainly NA at < 150ppm.
5031-371	Half-salt disolver		half - salt solution (DI water/ HMD / Salt ref c/fuges export)
5031-422	Re-work solution tank		out of spec material from Semi - ref/ Salt refined that require recyclig & re-added to the process, in solution.
5031-466	Waste liquor tank		Semi - Ref distillate. Process effluent (sent via AA sump)
5031-600	WALE	5,500	Process effluent
5031-605	Dump Tank	1,467	Process effluent
5031-690	Crude solution tank		Crude solution - exit Crude dissolvers 40 - 42% Adipic, <0.2% Ntritic
5031-2152	60% HMD storage tank	748	60% HMD
5031-2250	Salt solution tanks	145 (te)	Salt solution
5031-2251	Salt solution tanks	145 (te)	Salt solution
5031-2252	Salt solution tanks	145 (te)	Salt solution
5031-2257	Blended salt solution tank	3,398	Blended salt solution
5031-4700	NACS tails tank	40	Typical comp: 35% nitric, 33% water, 22% Adipic, 8% Glutaric, 3% Succinic, pp, levels vanadium & copper.
5031-4900	Sulphuric acid tank	23	Sulphuric acid
5031-5900	Recovered catalyst storage tank		Regen acid containing copper & vanadium catalyst exit ISEP unit
5031-5990	Methanol storage tank	95	Methanol
5031-5951	AGS Methanol storage tank	232	Methanol and a mixture of organic acids
	IBCs in curbed Area within the Acids Area		Copper (II) Nitrate

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Table 7b -HMD Storage Tanks

Tank number	Description	Capacity (m3)	Substance stored
5101-112	Liquid ammonia (100%) storage	25 (te)	NH ₃ (100%)
5102-134	HMI storage tank	40	Crude HMI
5101-147	No 3 Refined ADN storage tank	62 (te)	Adipontrile
5101-148	No 4 Refined ADN storage tank	62 (te)	Adipontrile
5101-154	No 1Crude HMD storage tank	280 (te)	HMD
5101-155	No 2 Crude HMD storage tank	280 (te)	HMD
5101--156	No 3 Crude HMD storage tank	280 (te)	HMD
5103-115	No 1 DH forshots	4.5 (te)	Crude HMI
5103-116	No 2 DH forshots	4.5 (te)	Crude HMI
5103-134	HMI storage tank	40 (te)	HMI
5103-187	No 1 TCT storage tank	145 (te)	TCT
5103-188	No 2 TCT storage tank	145 (te)	TCT
5103-189	Nos 3 TCT storage tank	112 (te)	TCT
5103-190	Nos 4 TCT storage tank	112 (te)	TCT
5103-210	No 1 Salt Plant Feed Tank	70 (te)	Salt
5103-211	No 2 Salt Plant Feed Tank	70 (te)	Salt
5103-212	No 1 Solution Mix Tank	75 (te)	Salt
5103-213	No 2 Solution Mix Tank	75 (te)	Salt
5103-271	DACH storage tank	37 (te)	DACH
5103-275	Purge column tops tank	19 (te)	DACH
5103-286	No 5 Salt Plant Feed Tank	82 (te)	Salt
5103-325	Methanol storage tank		OOU
5111-110	Weak liquor storage tank	450 (te)	
5111-120	20% ammonia storage	650 (te)	NH ₃ (20%)
5111-121	20% ammonia storage	650 (te)	NH ₃ (20%)
5111-122	20% ammonia storage	650 (te)	NH ₃ (20%)
5111-142	Recovered ammonia (100%) storage	70 (te)	NH ₃ (100%)
5111-153	Ammonia (100%) drain tank	30	NH ₃ (100%)

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Table 7c - KA Storage Tanks

Tank number	Description	Capacity (m3)	Substance stored
5020-212	Caustic	109	Caustic (47%)
5020-321	No 1 ICI KA test tanks	196	KA - used oil
5020-322	No 2 ICI KA test tanks	196	KA - used oil
5020-323	No 3 ICI KA test tanks	196	KA - used oil
5020-326	No 4 General Storage	495	NIRU
5020-330	No 1 CH buffer tank	1,845	Boric (8%) washings
5020-331	No 2 CH buffer tank	1,845	Cyclohexane
5020-351	No 5 KA storage tank	2,003	KA
5020-352	No 6 KA storage tank	2,003	KA
5020-356	No 8 KA storage tank	2,930	KA
5020-357	No 9 KA storage tank	2,930	KA
5020-590 a	Chromium octoate storage	23	OOS
5020-590 b	Chromium octoate storage	23	OOS
5020-595	New mineral oil storage	78	
F102	CH recycle tank	333	Cyclohexane
F543	No 1 Dycal 66	182	Dycal
5020-1815	No 2 Dycal 66	184	Dycal
5020-1816	No 3 Dycal 75	184	Dycal
F930	No 4 Dycal 75	280	Dycal
F931	No 5 Dycal 75		
F551-1	No 1 SDC KA test tank	196	40% KA in water
F551-2	No 2 SDC KA test tank	196	5% KA in water
F551-3	No 3 SDC KA test tank	196	5% KA in water
F551-4	No 4 SDC KA test tank	210	5% KA in water
F9110	Caustic effluent storage	4,764	Caustic washings

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Table 7d - Nitric and Services Storage Tanks

Tank number	Description	Capacity(m3)	Substance stored
5051-252	Nitric acid export buffer tank	3,885 (te)	Nitric Acid
5051-231	No 3 Nitric acid storage tank	700 (te)	Nitric Acid
5051- 232	No 4 Nitric acid storage tank	700 (te)	Nitric Acid

Table 7e - Polymer Storage Tanks

Tank number	Description	Capacity(m3)	Substance stored
5130-1862	Copper acetate tank		Copper Acetate
5130-1864	Copper acetate tank		Copper Acetate
5151-203	TiO ₂ mill feed tank		TiO ₂ Slurry
5151-204	TiO ₂ mill feed tank		TiO ₂ Slurry
5151-212,	TiO ₂ settling tank	2.8	TiO ₂ Slurry
5151- 213	TiO ₂ settling tank	2.8	TiO ₂ Slurry
5151-214	TiO ₂ settling tank	2.8	TiO ₂ Slurry
5151-215	TiO ₂ settling tank	2.8	TiO ₂ Slurry
5151-224	TiO ₂ bulk storage	10	TiO ₂ Slurry
5151-225	TiO ₂ bulk storage	10	TiO ₂ Slurry
5151-227	No 1 TiO ₂ conc adjustment tank	2.5	TiO ₂ Slurry
5151-229	No 2 TiO ₂ conc adjustment tank		TiO ₂ Slurry
5151-245	TiO ₂ tanker offloading tank	135	TiO ₂ Slurry
5151-7810	TiO ₂ drainage collection tank	56	TiO ₂ Slurry
5151-949	Effluent tank	56	Process Effluent
5151-925	Dycal storage tank	50	Dycal
5130-2526	Dowtherm storage tanks	105	Dowtherm
5130-2527	Dowtherm storage tanks	105	Dowtherm
5130-2537	Dowtherm storage tanks	14	Dowtherm
	80% acetic acid tank		Acetic Acid
	Casting water storage tank	22	Water
	No 1 & 2 vent drains tanks	0.5	
	Thermex E, W & containment tanks		Dowtherm
	Calgon solution & storage tanks		
	Caprolactam storage tank		Caprolactam
	TiO ₂ weak storage		TiO ₂ Slurry

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Table 7f -NALCO Storage Tanks

Location	Number	Comment
NITRICS 2 BOILERS (72100)	907575	
NITRICS 2 BOILERS (7208)	907559	
NITRICS 3 BOILERS (72100)	182216	
NITRICS 3 BOILERS (7208)	181444	
COGA BOILER (72100)	180059	Plastic IBC (379 l) in plastic containment tank
COGA BOILER (72210)	180124	Plastic IBC (379 l) in plastic containment tank
POLYMER CASTING (93033)	181869	
NITRICS 2 CT (HYPO)	TS06 – 039A	HDPE double skinned tank (3,000 l)
NITRICS 2 CT (23210)	IPS4088	Steel IBC (PE lined) in steel containment tank
NYLON 1A CT (72211)	CT003211	HDPE tank with steel IBC on frame above
NYLON 1A (HYPO)	TS06 – 039B	HDPE double skinned tank (5,000 l)
NYLON 1B (HYPO)	IBC - TEMPORARY	Hays IBC (No 2516)
NYLON 2 CT (HYPO)	PV 198	GRP tank in concrete bund (5320-255)
NYLON 2 CT (H ₂ SO ₄)	PV 250	Steel tank in concrete bund
NYLON 2 CT (73275)	96850	Double stack steel IBC in steel tank - hose linking IBCs protrudes beyond tank outline
NYLON 2 CT (CL-50)	6220	Double stack steel IBC in steel tank - hose linking IBCs protrudes beyond tank outline
NYLON 2 CT (Phosphoric Acid)	IBC - TEMPORARY	Two plastic IBCs in steel cages on containment pallet
NYLON 3 CT (HYPO)	PV 199	GRP tank in concrete bund (5320/260)
NYLON 3 CT (H ₂ SO ₄)	PV 192	Steel tank in concrete bund
NYLON 3 CT (7396)	PV 196	Steel tank in concrete bund
NYLON 3 CT (23203)	PV 197	Steel tank in concrete bund
NYLON 3 CT (CL-37)	IBC - TEMPORARY	Two plastic IBCs in steel cages. No containment (east side of tower)
ALL COOLING TOWERS (7348)	25KG DRUMS	

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Table 8 - Groundwater Quality During the Lifetime of the Permit (pH)

Area	Borehole	Jul-07	Apr-08	Nov-08	May-09
Zone 1	201	7.1	7.3	7.3	7.3
	202	7.3	7.4	7.3	7.5
	203	7.7	7.9	7.9	8.1
	204	7.4	7.4	7.5	7.6
Zone 2	112	7	7.1	6.9	7.2
	601 B	7.5	7.5	7.4	7.5
	605	7.1	7.8	7.5	7.4
	606	7.5	7.4	7.7	7.7
Zone 3	501	6.8	7.6	7.5	7.5
	504	6.9	8.1	7.8	8.2
Zone 5	401	6.6	6.8	4.9	6.8
	404	7.9	7.9	7.5	8.1
	405	7.3	7.2	7.3	7.5
	105	8.2	8.7	8.4	8.2
Zone 6	304	7.2	7.9	10.1	8.7

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Table 9 - Groundwater Quality During the Lifetime of the Permit (Conductivity uS)

Area	Borehole	Jul-07	Apr-08	Nov-08	May-09
Zone 1	201	761	743	810	988
	202	583	583	740	856
	203	397	388	440	583
	204	509	576	500	635
Zone 2	112	1,386	1,448	1,450	4,380
	601 B	1,343	1,295	1,274	1,702
	605	1,378	1,509	1,535	1,860
	606	175	388	250	375
Zone 3	501	1,530	983	1,315	1,628
	504	516	457	500	743
Zone 5	401	1,692	27,400	795	2,850
	404	632	1,090	585	1,424
	405	635	787	810	159
	105	415	523	435	533
Zone 6	304	4,070	1,775	1,680	918

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Table 10 - Groundwater Quality During the Lifetime of the Permit (TOC ppm)

Area	Borehole	Jul-07	Apr-08	Nov-08	May-09
Zone 1	201	46	22	14	50
	202	12	13	12	45
	203	9	5	7	10
	204	5	6	17	55
Zone 2	112	30	16	4	12
	601 B			10	N/D
	605	11	18	8	7
	606	19	17	10	9
Zone 3	501	8	11		4
	504	14	9		3
Zone 5	401	14	18	489	65
	404	15	11	14	6
	405	13	10	17	20
	105	12	9	7	13
Zone 6	304	3,170	420	1,589	11,610

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Table 11 - Groundwater Quality During the Lifetime of the Permit (Copper ppm)

Area	Borehole	Jul-07	Apr-08	Nov-08	May-09
Zone 3	501	<0.1	0	0.02	<0.01
	504	<0.1	0	0.01	<0.01
	405	0	1	0	<0.01
Zone 5	401	0.06	1.21	3.11	2.72
	404	0	0	0	<0.01

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Table 12 - Groundwater Quality During the Lifetime of the Permit (Cyclohexane ppm)

Area	Borehole	Jul-07	Apr-08	Nov-08	May-09
Zone 1	201	0	<1	0	<0.01
	202	0	<1	0	<0.01
	203	5	<1	0	<0.01
	204	0	<1	0	<0.01

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Table 13 - WALE and Dump Tank Quality During the Lifetime of the Permit

		Jan-05	Jun-05	Dec-05	Jun-06	Mar-07	Mar-09
WALE 1	Cu (ppm)	0.02	<0.01	0.01	0.01	0.01	<0.01
WALE 6	Cu (ppm)	0.01	<0.01	0.01	0.01	0.01	<0.01
WALE1	HNO3 (ppm)	10	10	10	5	10	10
WALE6	HNO3 (ppm)	<10	10	10	<5	<5	<5
WALE1	Conductivity (uS)	745	775	780	685	695	755
WALE6	Conductivity (uS)	620	755	765	570	635	625
WALE1	pH	7.5	7.4	7.6	8.6	7.6	7
WALE6	pH	8.4	7.9	8.5	9.3	8.6	7.4
DT 5	Cu (ppm)	0.01	0.09	0.1	0.03	0.03	0.01
DT 5	HNO3 (ppm)	50	50	50	50	50	50
DT 5	Conductivity (uS)	6,200	6,320	6,060	6,610	6,840	4,300
DT 5	pH	8.1	7.5	8.1	7.9	7.5	7.9

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Table 14 - Effluent Quality W1 (H Drain)

Date	pH	BOD	TOC	COD	NH ₃ -N	NO ₃ -N	Cu	Zn	S Solids
		ppm							
01/07/2009	8.5	<10	10	74	2	1	<0.01	0.04	12
02/07/2009	8.7	<10	<10	70	<1	1	<0.01	0.02	2
03/07/2009	7.6	<10	<10	36	<1	2	<0.01	0.04	2
04/07/2009	7.6	13	<10	34	<1	2	<0.01	0.04	2
05/07/2009	7.1	<10	<10	50	1	3	<0.01	0.04	13

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Table 15 - Effluent Quality W4 (NY Drain)

Date	pH	BOD	TOC	COD	NH ₃ -N	NO ₃ -N	Cu	Zn	S Solids
		ppm							
01/07/2009	7.5	<10	<10	66	<1	2	<0.01	0.02	5
02/07/2009	7.5	<10	<10	48	<1	2	<0.01	0.01	2
03/07/2009	7.6	<10	<10	42	<1	3	<0.01	0.01	2
04/07/2009	7.5	<10	<10	38	<1	2	<0.01	0.01	3
05/07/2009	7.4	10	<10	56	<1	2	0.01	0.02	31