BIOREMEDIATION OF A HOME HEATING OIL, KEROSENE, SPILL

USING PROCATIVE BIOREMEDIATION PRODUCT S-200

NOVEMBER 2011

Louth County Council

Contractor: Comco Environmental
Paradise Place
William Street
Drogheda
Co. Louth

SUMMARY

In August 2011 a domestic oil tank leak occurred in a semidetached house within a housing estate. The tank contained heating oil, Kerosene, which pooled around the tank causing primary contamination of the soil in the vicinity of the tank itself and secondary contamination in the concrete yard of the adjoining neighbour's house.

A proactive bioremediation product S-200 was used to bond with the fuel. S-200 is a crystalline matrix that behaves like a liquid, that attaches to carbon atoms to form small perfect spheres wherein the contaminate is digested by naturally occurring microbes, turning the carbon based fuel into carbon dioxide (CO2) and Water (H2O).

As S-200 can be used on site, there is no need to dig and haul the contaminated soil away. Full information on S-200, its multitude of uses and successful applications can be found on the Comco Environmental website www.cen.ie

The soil samples collected were sent for independent analysis to Fitz Scientific, Unit 35, Boyne Business Park, Drogheda for analysis by gas chromatography (*GC*) with flame ionization detection (*FID*). Fitz Scientific is accredited by the UK Accreditation Service (UKAS)

Soil samples were taken from two boreholes, five weeks apart and the analytical results show that 99.99% of the contaminated was bioremediated.

Fitz Scientific	27.10.11 mg/kg	21.11.11 mg/kg	% REDUCTION
BH1	4527.56	0.10923	99.99%
BH2	3212.42	0.08882	99.99%

- Client and neighbour satisfied with result
- All contaminate in soil and concrete eliminated
- Pungent odour of spilled fuel eradicated within 48 hours of application.
- Process is tidy and non intrusive
- No harmful or toxic residue left
- No chemicals used
- No danger to the water table.
- No flora or fauna damaged or ever endangered.
- No further action required

Background Information

In August 2011 a domestic oil tank leak occurred in a semidetached house wothin a housing estate. The tank contained heating oil, Kerosene, which pooled around the tank causing primary contamination of the soil in the vicinity of the tank itself and secondary contamination in the concrete yard of the adjoining neighbour's house.

The faulty tank was replaced with a new one and the household Insurance Company was contacted regarding applicable clean-up procedures. The insurance company contacted an environmental cleanup company which sent a representative to visit the site. The procedure that this company recommended was the classic "Dig and Haul" procedure, whereby the soil would be dug up and hauled away to be treated at a alternative location. The cost estimate for this operation was in five figures.

The client sought advice from his Insurance Broker in relation to a number of concerns, mamely

- The expense of the operation.
- The inconvenience and mental anguish involved in seeing his garden destroyed.
- The dirt and noise generated by such a procedure would adversely affect the cleanliness and general wellbeing of his domicile.

Comco Environmental was contacted by the insurance brooker and asked to recommend an alternative course of corrective action, if feasible.

Initial Site Visit

On the 27th of September 2011, an initial site visit was carried out by Comco Environmental.

The oil tank within the garden is located at the northern section of the garden with a concrete path and the main residence to the left (West) and a dividing single block wall to a neighbour's garden at the north. (Appendix 1)

On closer inspection, it transpired that there was in fact no wall separating the client's oil tank from the neighbours. They are positioned adjacent to each other with a gap of several centimetres between them. This is a common feature within the estate.

The surface area of the spill was easily identified by the damaged grass on the lawn, expanding to the South and East of the tank's location. The depth and width of the spill below the surface would be established by bore holes at specific sites and depths in the area within the garden.

Traces of Kerosene could be seen at the rear of the tank base where in all probabilities it had seeped into the neighbour's backyard.

A number of observations were made

1. The back garden where the fuel spill was located was only accessible down a narrow side lane and then via a 90 degree turn up three steep steps through a small door.
2. The side lane in question that ran between the client's house and that of the other neighbour to the South, actually entered the back garden of this neighbour's house through one door, where the steps up to the client's garden and entrance door are located.
3. In our opinion, these facts would have made the actual exercise of digging up the client's garden and hauling it away down this one access route very difficult and discommoding for all concerned.
4. In addition, the process would have to be repeated in reverse, that is to say that the soil would have to be replaced at a later date, thus adding to the inconvenience, and
5. Contaminated soil in some "Dig and Haul" operations is often cleaned with a mixture of chemicals / microbial agents and may result in the destruction of the naturally occurring microbial activity within the soil itself, thus making the returned soil not the best suited for gardening purposes.

As a consequence of the initial site visit Comco Environmental submitted a quote on the 4th of October, 2011 to carry out the work of cleaning up the spilled kerosene by use of a proactive bioremediation product S-200.

Bioremediation technology used

S-200 is a crystalline matrix that behaves like a liquid, that attaches to carbon atoms to form small perfect spheres wherein the contaminate is digested by naturally occurring microbes, turning the carbon based fuel into carbon dioxide (CO2) and Water (H2O). As S-200 can be used on site, there is no need to dig and haul the contaminated soil away. Full information on S-200, its multitude of uses and successful applications can be found on the Comco Environmental website www.cen.ie

Cunningham Lindsey Limited

During the course of October several letters, e mails and telephone conversations were made between Comco Environmental and Cunningham Lindsey Ireland, the nominated loss adjusters on behalf of Kennco Underwriting Limited, the insurance company of the client. The go ahead to commence operations was given to Comco Environmental on the 13th October 2011.

Soil Sampling

The Comco Environmental initial field survey involved the installation three sampler bore holes. Information on the geology, hydrogeology and soils of the area from the Geological Survey of Ireland (GSI) was reviewed. The principal soil type in the area is gleys, which generally displays poor drainage characteristics. The gleys parent material consists mainly of Ordovician and Silurian shale and sandstone glacial till.

On investigation of the bore holes themselves, the poor quality drainage of the gley soil composition was a contributor to the spilled fuel largely pooling in an area 200 to 300 mm in dept and approximately a metre in width to the South and East of the fuel tanks location.

On the 17th October, 2011 a series of bore holes were excavated at selected sites and soil samples were extracted for Total Petroleum Hydrocarbons (TPH) analysis. These boreholes were located in three sites, to the south to the east and to the southeast of the oil tanks location. (Appendix 2) Whereas borehole 1 and 2 contained fuel, the borehole at site 3 was negative for contaminates

The soil samples collected were sent for independent analysis to Fitz Scientific, Unit 35, Boyne Business Park, Drogheda for analysis by gas chromatography (*GC*) with flame ionization detection (*FID*). Fitz Scientific is accredited by the UK Accreditation Service (UKAS)

Pollutant Pathway

Once the boreholes had been drilled at the three sites and some exploratory holes dug the contaminate pathway was identified. The dense concrete foundations of the house to the west of the spill had acted as a wall and had helped keep the pollutant to an area to the south and the east of the oil tank. During the course of treatment, this foundation area was also treated so as to negate any Kerosene particles that might have impregnated the concrete.

The fuel to the south and the east had pooled at a level between 200 and 300 mm from the surface. The nature and composition of the soil had helped prevent the easy flow of the liquid.

To the North, some fuel had spilled from the tank, through the open recess in the wall to fall on the concrete yard of the client's neighbour. Although the quantity of fuel that had spilled into her yard was not a considerable amount the fact that it was on concrete and exposed to the elements meant that it has a high pungent odour. This odour was causing discomfort to the neighbour and her young son, who played in the area affected by this spill.

Aerobic Quality

In cleaning soil contaminated by a spilled hydrocarbon in a domestic scenario there are two main issues to address.

1. The first is the pungent odour of spilled fuel. This is especially so in the case of a domestic spill where the odour can overwhelm the adjacent household. In particular if the household(s) have children or pets, this can be very worrying for them.
2. The second is the safe removal / extraction of the fuel itself.

The pungent odour associated with spilled hydrocarbons is mostly a result of the slow breakdown of the fuel when exposed to air and sunlight. As such the majority of the smell comes from the spilled fuel on the surface area of the spill site.

The householders always want the “horrid smell gone”. It is for this reason that we treat the surface areas of the spill first prior to digging up, treating and aerating the soil. This is achievable as S-200 eradicates both spilled hydrocarbons on the surface but also attaches and pulls in the carbon atoms in the surrounding air. S-200 hooks onto carbon chains be they on land, air or water and pulls them inside its matrix.

In addition, as one is usually waiting ten working days for the analytical results from any boreholes that are drilled, it helps the house owner (s) that the majority of the pungent odour has been eliminated.

S-200 was applied to the exposed surface areas of the spill. This included the spraying of the soil surface and any concrete which may have come in contact with the spilled kerosene. 48 hours later, the vast majority of the pungent odour had been eradicated. Additional odour would occur as the soil was dug up to be treated, but as the soil was being treated at the time, no additional build up of kerosene odour in the air occurred.

In addition to eradicating the pungent odour of fuel in the neighbour’s property, pictures taken shows the fuel staining on the concrete completely eliminated after just three weeks.

Initial Readings

On the 27th October, 2011 results from Fitz Scientific, shows that the kerosene concentration for site 1 (borehole 1) was 4527.56 mg/kg and the concentration for site 2 (borehole 2) was 3212.42 mg/kg (Appendix 3)

Bioremediation Procedure

During the course of late October / November, 2011 the contaminated soil was dug up and put into ridges so as to allow for maximum aeration and surface area for the application of S-200. The process of moving the ridges of soil so as to allow maximum aeration occurred twice a week. S-200 was applied five times on the newly formed soil ridges over the time period.

The top sod was cut into squares and moved aside and was treated with S-200. The most polluted sod was separated and sprayed with a higher concentration of S-200. As this sod was easily manipulated and very exposed to the air around it, the bioremediation process worked particularly well. After two weeks, there was no smell of fuel from the once fuel soaked sod.

Pictures taken on site show how the grass in general and the sod in particular recuperated over the month of November. As such, the fuel soaked sod that would under previous circumstances have been sent to a toxic dump, will soon be re-laid in the lawn.

All concrete that had any possibility of being exposed to the spilled kerosene including the oil tank bases, were thoroughly sprayed with S-200. This allowed S-200 to bond with and eliminate any fuel that might have impregnated the concrete. This was usually done when it was raining or just after. Anywhere where the fuel will have flowed, water will also flow and in this case it acts as a delivery mechanism for the S-200. S-200 links onto the carbon chain and digests the contamination one molecule at a time. As such it will follow the carbon chain (the spilled fuel) up walls and under foundations.

Secondary Readings

On the 21st November, 2011 new soil samples were taken from site 1 (borehole 1) and site 2 (borehole 2.) The result certificates from Fitz Scientific, Drogheda, arrived back to Comco Environmental on the 30/11/11. There was now so little kerosene in the soil samples that the readings had to be given in micrograms per litre (ug/L) instead of the bulkier mg/kg readings.

Site 1 (borehole 1) Kerosene concentration level was 109.23 ug/l and Site 2 (borehole 2) read as 88.82 ug/L. This converts into 0.109 mg/kg and 0.089 mg/kg respectively

Ug/L	Conversion	mg/kg
109.23	0.001	0.109
88.82	0.001	0.089

What the test results show is that 99.99% of the contaminated soil was bioremediated.

Fitz Scientific	27.10.11 mg/kg	21.11.11 mg/kg	% REDUCTION
BH1	4527.56	0.10923	99.99%
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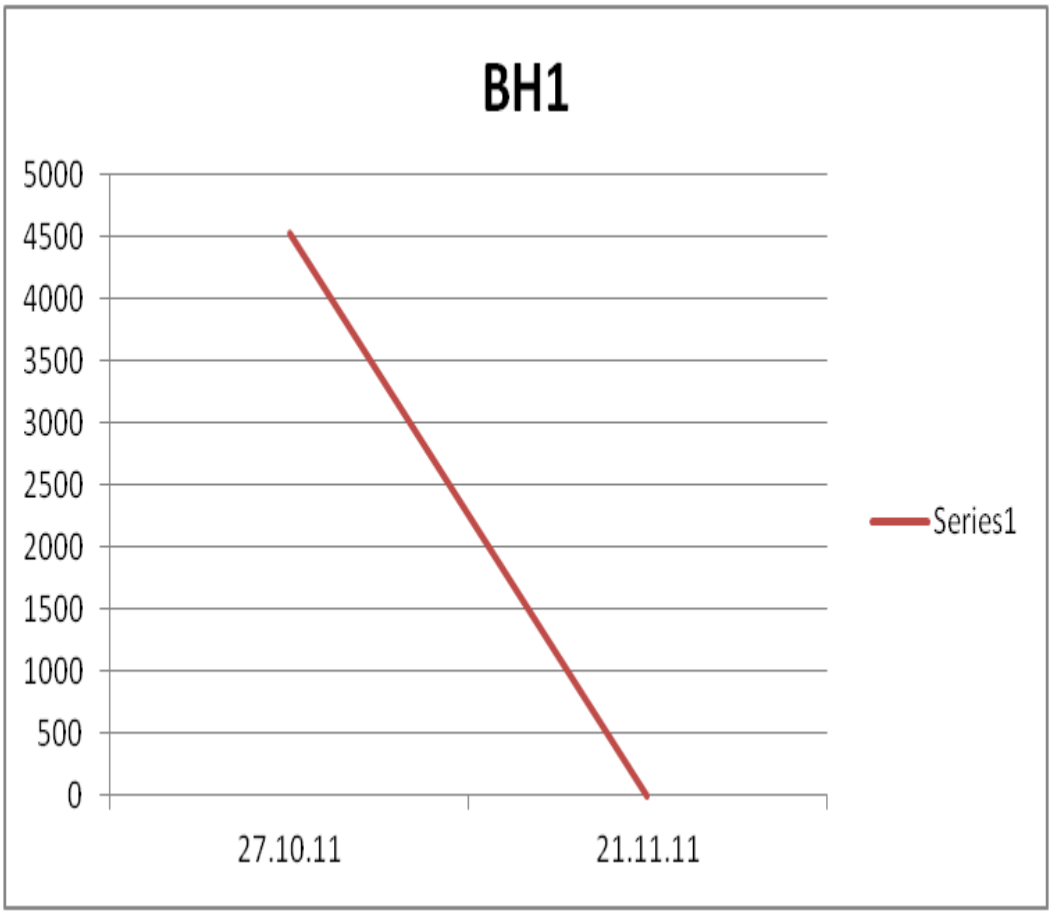
Explanation of results
Although there are no Irish regulations or European guidelines for TPH cleanup levels in general, best practice recommends as per advice received from the **Irish Environmental Protection Agency** that a conceptual site model be developed and the use of Detailed Quantitative Risk Assessment (DQRA) techniques to assess the risks posed by individual contaminants. In this case the contaminant was known, namely home heating oil, namely Kerosene in the C9 –C16 carbon range and the extent of its exposure was limited to an area of a metre circumference from the initial leak site.

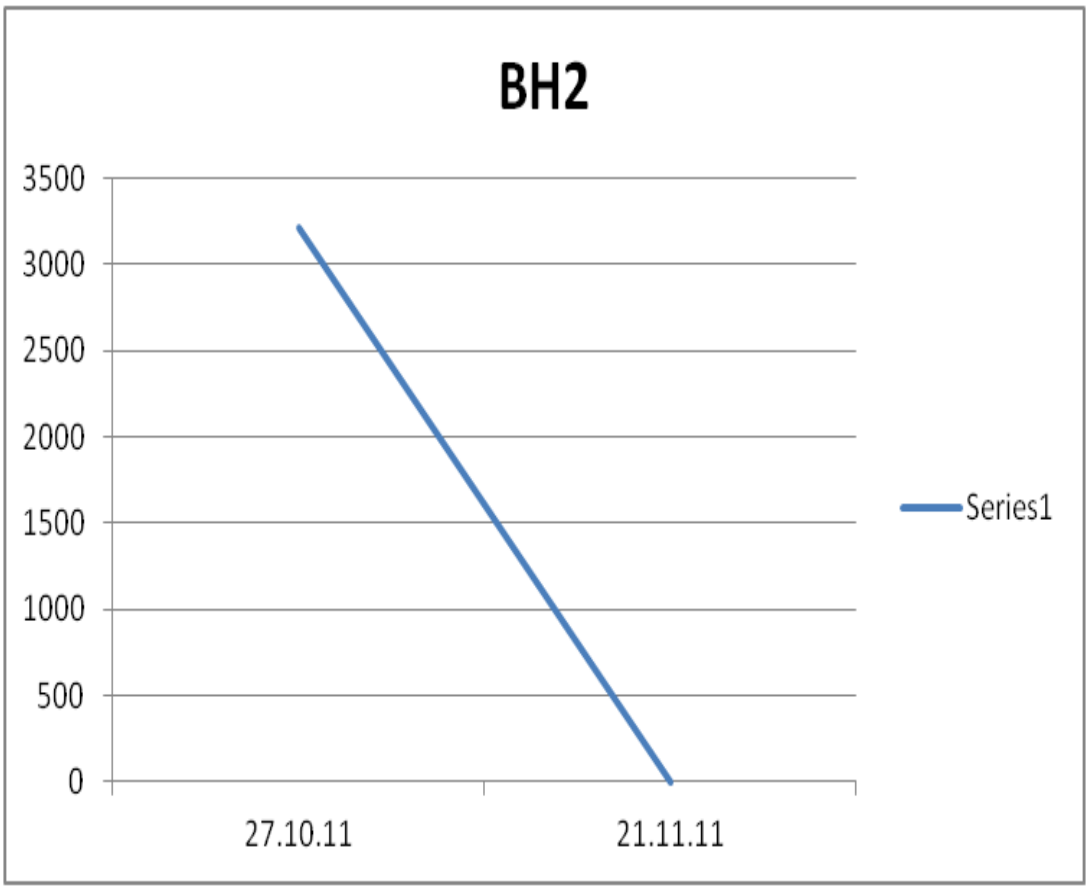
As there are no Dutch Guidelines or other limits set for TPH at present, limits set for mineral oil are sometimes used for comparison. The results determined were well below the Dutch 2000 Quality Safety Guidelines for mineral oil target levels (50 mg/kg) and way below the recommended intervention levels (5000mg/kg). As the readings achieved after five weeks were in the 0.1 mg/kg range, no further remediation is envisaged or required.

The pathway followed by the leak was also established, the majority of the fuel pooling at between 200mm and 300mm in dept around the initial leak site and secondary minor contamination of the neighbour's yard.



S – 200 mg/kg FUEL REMEDIATION RATE 99.99%

The output from DQRA normally provides Site Specific Target Levels (SSTLs) for remediation. These SSTLs are essentially clean up targets for any future remediation works and represent contaminant concentrations below which risks are deemed to be acceptable. Best practice shows that cleanup levels in excess of 85% are deemed to be successful. Again a consideration given in setting SSTLs is the possible future corrective actions that the site involved may necessitate. In this case, no further action is envisaged or needed as the clean up rate on site has reached **99.99%** efficiency.



S – 200 mg/kg FUEL REMEDIATION RATE 99.99%

Conclusion

- Client and neighbour satisfied with result
- 99.99% success clean up rate within five weeks.
- Analytical testing undertaken by Fitz Scientific.
- All contaminate in soil and concrete eliminated
- Pungent odour of spilled fuel eradicated within 48 hours of application.
- Process is tidy and non intrusive
- No harmful or toxic residue left
- No chemicals used
- No danger to the water table.
- Original grass to be restored (30.11.11 – Operation to commence 02.12.11)
- Soil quality actually enhanced as microbial activity within the soil increases with the use of S-200, whereas chemically cleaned soil has its naturally occurring microbial activity damaged.
- No flora or fauna damaged or ever endangered.
- No further action required

APPENDIX 1

Site Map

NORTH

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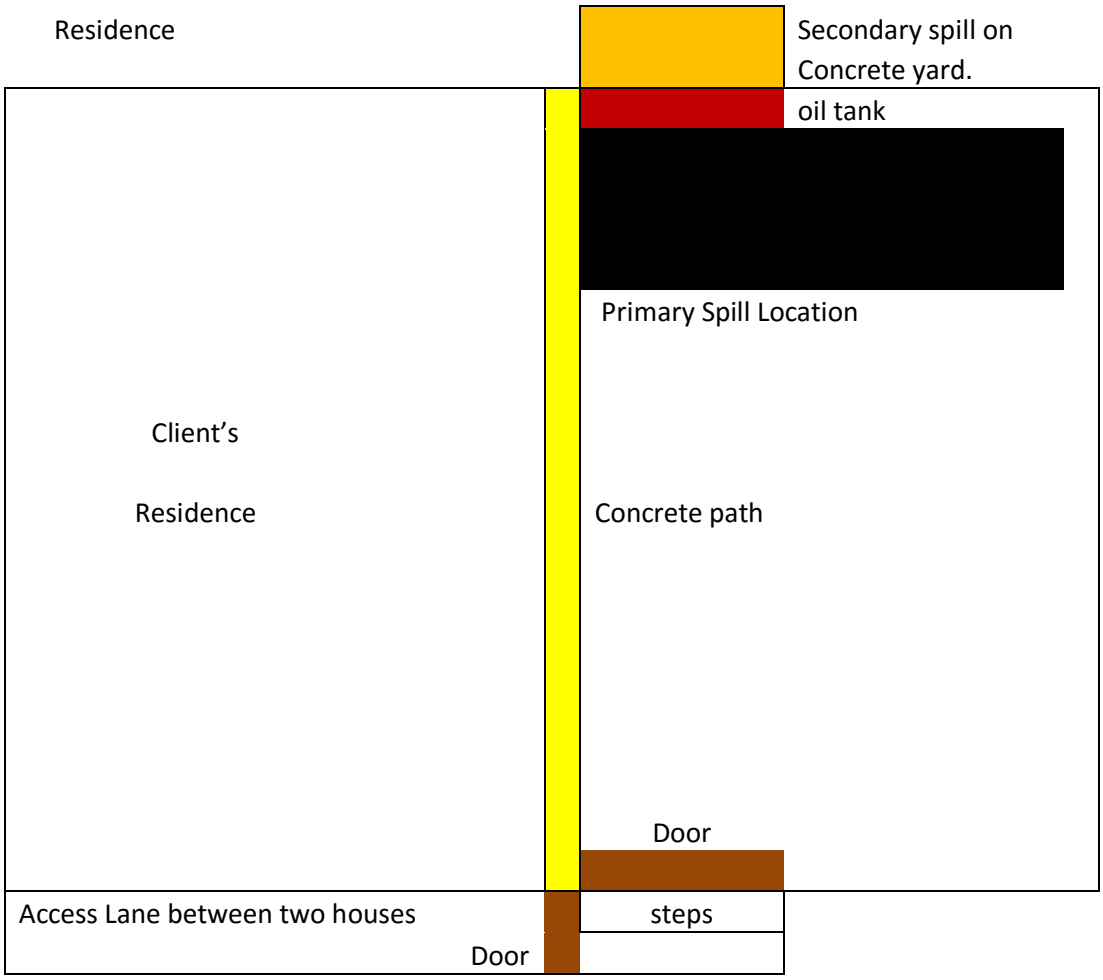

APPENDIX 2

KEROSENE CONCENTRATIONS

ANALYSISED BY

FITZ SCIENTIFIC

Fitz scientific

Monitoring and Testing Services

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.fitzsci.ie
email info@fitzsci.ie

Customer	Tom Eustace	*Lab Report Ref. No.*	0279/001/01
	Comco Sales	*Date of Receipt*	18/10/2011
	Paraoise Place	*Sampled On*	18/10/2011
	William St.	*Date Testing Commenced*	18/10/2011
	Drogheda	*Received or Collected*	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	27/10/2011
Customer Ref	Doherty Site 1 18/10/11	*Sample Type*	Soil

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Kerosene Range Organics (Soil)	317	GC-FID	4527.56	mg/Kg	

Signed : A Harmon *Date :* 27/10/11

Aoife Harmon - Technical Supervisor

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

**The analytical result for this parameter may not be reflective of the concentration present at the time of sampling. The maximum recommended preservation time for this parameter has been exceeded.

Fitz scientific

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	Drogheda	*Received or Collected*	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	27/10/2011
Customer Ref	Doherty Site 2 18/10/11	*Sample Type*	Soil

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Kerosene Range Organics (Soil)	317	GC-FID	3212.42	mg/Kg	

Signed : A Harmon *Date :* 27/10/11

Aoife Harmon - Technical Supervisor

Acc. : Accredited Parameters by ISO 17025:2005

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Customer	Tom Eustace Comco Sales Paraoise Place William St. Drogheda	*Lab Report Ref. No.*	0279/002/01
		Date of Receipt	21/11/2011
		Sampled On	21/11/2011
		Date Testing Commenced	21/11/2011
		Received or Collected	Delivered by Customer
Customer PO		*Condition on Receipt*	Acceptable
Customer Ref	Doherty BH1 21/11/11	*Date of Report*	22/11/2011
		Sample Type	Other

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Kerosene Range Organics	188	GC-FID	109.23	ug/L	

Signed : pp _____ *Date :* 23/11/2011

Aoife Harmon - Technical Supervisor

Acc. : Accredited Parameters by ISO 17025:2005

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Customer	Tom Eustace Comco Sales Paraoise Place William St. Drogheda	*Lab Report Ref. No.*	0279/002/02
		Date of Receipt	21/11/2011
		Sampled On	21/11/2011
		Date Testing Commenced	21/11/2011
		Received or Collected	Delivered by Customer
		Condition on Receipt	Acceptable
Customer PO		*Date of Report*	22/11/2011
Customer Ref	Doherty BH 2 21/11/11	*Sample Type*	Other

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Kerosene Range Organics	188	GC-FID	88.82	ug/L	

Signed : pp _____

Aoife Harmon - Technical Supervisor

Date : 23/11/2011

Acc. : Accredited Parameters by ISO 17025:2005

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