ENVIRONMENTAL CLAIM INVESTIGATION

FINAL REPORT

OHES Ref:	**OHES_FJ5773 Clarach**
Adjuster:	**Quadra**
Adjuster Ref:	**16256803**
Insurer:	**Ecclesiastical Insurance Group**
Insurer Ref:	**405728**
Insured:	**The Vicar & Chns FTTB & the PCC of Llangorwen in the Diocese of St Davids**
Site:	**All Saints Church** **Clarach** **Aberystwyth** **SY23 3DW**
Report Author:	**Joe Rowland BSc** **Environmental Consultant**
Report Approver:	**Nick Tomlin** **Regional Manager**
Issue Date:	**September 22nd 2020**

This report has been prepared for Ecclesiastical Insurance Group and their agents Quadra, in accordance with their instruction dated 18th June 2020. The report is intended to provide information relevant to an insurance claim related to the above property and is not intended for any other purpose. OHES Environmental Ltd (OHES) cannot accept any responsibility for any use of, or reliance on the contents of this report by any third party.

1.0 INTRODUCTION

Photograph 1 – Front view of the Church from the road (19.06.20)

1.1 Previous Reports

This report should be read in conjunction with OHES Environmental Ltd (OHES) Initial Investigation Report (Ref: OHES_FJ5773 Clarach) dated 14th July 2020 and OHES Scope of Works (Ref: OHES_5773 Clarach) dated July 2020. The initial report details Initial Investigation (II) works undertaken at the property (**Photograph 1**).

This report does not necessarily repeat information contained in the initial report.

1.2 Incident Summary

It was reported to OHES that on Wednesday 17th June 2020, a member of the church congregation was walking through the church grounds and noticed a strong kerosene odour near to the oil storage tank (OST). This odour was reported to Mr. Smith (church warden) who inspected the OST and surrounding area. Although an oil odour was apparent there was no obvious leak from the OST. Most of the OST was obscured by a small concrete block wall (crude bund) and timber fencing. Mr. Smith checked and noted the volume of the tank via the site gauge on the front of the OST.

Mr. Smith returned the following day (18th June) and found the oil level had dropped by two to three inches and that nearby grass was wet with oil. Mr. Smith then contacted the Church's insurers.

Anecdotal evidence was provided to Mr. Smith on the 19th June by a nearby resident. The resident reported that they had noticed a strong kerosene odour close to the OST a week prior to the 17th June. The OST therefore may have been leaking for up to and over a week prior to Mr. Smith contacting the Church's insurers.

After Mr. Smith had called the Church's insurers (18th June), he phoned the Church's oil supplier and requested that they uplift the kerosene from within the OST to prevent any further loss of oil. The oil supplier advised that they would attend the site that afternoon/evening to uplift the kerosene.

1.3 Previous Works

OHES were instructed by Quadra at 14:45 Hrs on Thursday 18th June 2020. OHES first contacted Quadra and requested authorisation to attend site immediately and undertake any necessary Emergency Response measures given the risks posed to sensitive receptors identified both within the instruction and very brief desk study. Authorisation was provided verbally by Mr. Richard Wilson of Quadra at 15:14 Hrs, the aim being to limit the impact to the environment and consequently limit the cost of remedial works. Mr. Smith was contacted at 15:16 Hrs who advised that to his knowledge oil had not entered the nearby river. Mr. Smith advised OHES that he had contacted the Church's oil supplier and had requested that they attend and pump out the compromised OST. This was scheduled to be undertaken that afternoon/ evening.

Although oil had not entered the river at this stage, given the sensitive receptors identified, OHES deemed it appropriate to attend site immediately to undertake a site walkover and check the site surface water drainage.

OHES arrived at the Church site at 19:00 Hrs and met with Mr. Smith. The 2,500-litre capacity, plastic, single skinned OST was inspected and it was apparent that it still contained kerosene. The oil supplier had not yet been to site and at approximately 19:10 Hrs, Mr. Smith received communications from the oil supplier that they would not be attending that day but would attend in the morning.

A strong kerosene odour was apparent close to the OST however it was difficult to inspect all of the OST given the surrounding wooden fence. Staining was apparent to the concrete blocks surrounding the OST and elevated volatile organic carbon (VOC) readings taken with a photo-ionisation device (PID) confirmed they had been impacted by oil. OHES removed panels from the fence to facilitate inspection of the OST - puddles of oil were apparent on the concrete surface beneath the raised OST base. Additional panels were removed revealing a large crack and multiple smaller surrounding cracks in the plastic OST approximately half-way up the structure (**Photograph 2**). The OST was observed to be bowed in its centre and bulging close to the crack (**Photograph 3**). Kerosene was dripping from the crack onto the ground below. The OST was almost full, with approximately 1,000 litres of kerosene above the crack.

Given the volume of kerosene that could potentially be lost from a catastrophic failure of the OST, the risk of the OST failing at any moment and the sensitive receptors that could be impacted (**Photograph 4**) OHES deemed it necessary to instruct emergency response contractors, requesting immediate site attendance and equipment to facilitate a fuel transfer from the compromised OST.

Responders were contacted at 19:55 Hrs and arrived at site at 22:30 Hrs. During this time OHES placed a bucket beneath the crack to catch any kerosene and applied a clay patch to the crack. OHES conducted a brief air survey inside the church, no elevated ambient or point source readings were apparent. OHES removed the timber surround and checked the surface water drainage and the river for evidence of contamination, none was apparent.

Spill response contractors brought a specialised response vehicle that provided lighting for the route to the OST and work area. Two bunded, temporary OST's (1,300 litre and 1,100 litre), were supplied with robust matting to provide a solid base. Due to the local topography the temporary OSTs were positioned on a slight incline and therefore could not be filled to capacity. Approximately 2-3 inches of kerosene remained in the compromised OST, however there was no longer a risk of loss from the tank, given that pressure had been relieved and any remaining kerosene was well below the crack. Absorbents were placed around the concrete block wall and it was agreed that responders and OHES would attend the following day to pump out the remainder of the kerosene from the OST, remove the OST and undertake further clean up works to remove any surface contamination. OHES and responders left site at 00:45 Hrs (19th June).

OHES and responders returned the following morning. The remainder of the kerosene was pumped into barrels (approx. 200L) and removed from site. The OST was removed and fuel transfer line (FTL) capped, revealing the raised OST base, constructed of railway sleepers positioned on top of concrete blocks. The sleepers were removed (only one had been impacted by the loss), small pools of kerosene were visible beneath. Absorbents were used to soak up pooled oil and impacted sediment/ rubble was removed by hand. The concrete blocks forming the base and wall surrounding the OST were heavily impacted and were removed to prevent leaching of contaminants from these structures. All rubble and sediment were removed from the concrete pad and absorbents used to vigorously wipe down the pad collecting any residual oil. The compromised OST, spent absorbents, contaminated concrete blocks, rubble and sediment were removed from site for appropriate disposal by the response contractors.

Following the completion of emergency response works, OHES undertook initial investigation works on the 19th June to determine the extent of contamination caused as a result of the kerosene leak. Mr. Smith had checked the burial records and confirmed that the grassed area that had been impacted close to the OST had never been used as a burial site, as such he gave permission for a ground investigation to be undertaken in this area.

1.4 Scope of Works

Based on the findings from the initial investigation the following scope of works was recommended:

1. Site preparation; Local council to be contacted to check if a road permit is required for the skip, skip delivered to site, install signage on the roadway, welfare unit to be delivered to site, fencing delivered to site, Site folder etc brought to site, CAT scan work area prior to breaking ground.

   Remediation

2. Break out a 0.5m strip at the edge of the concrete pad, extending out 2.5m from the church wall, the pad thickness is unknown. The strip requiring breakout is directly beside the church wall buttress and area of contaminated soils. Take care when removing concrete beside the church to avoid any damage to the church wall stonework.
3. Allow for OHES to sample the material beside the church wall and buttress.
4. Excavate kerosene contaminated soils over specified area. Initially measuring 1.5m length x 0.7m width to a depth of 1.0m. When excavating beside the church wall buttress take care to avoid damaging the stonework. The depth/ presence of the church wall foundations is unknown. Take care so as not to undermine the footings if they are revealed during excavation.
5. Allow for soil sampling to be undertaken in tandem with excavation works. OHES will advise if the excavation needs to be widened to remove contaminated soils that were inaccessible (beneath the concrete pad) during the initial investigation.
6. If necessary, batter the excavation edge to base to retain stability and enable safe access and egress. Do not undermine the concrete pad during excavation works, if necessary cut back/ break out the pad as required.
7. Allow for full validation soil sampling by OHES Consultant/ Technician.
8. If the belowground church wall stonework is found to have been impacted by kerosene allow for cleaning of the wall. Use a stiff brush to remove all loose soils clinging to the stonework. Undertake a surfactant scrub of the stonework, scrubbing, rinsing and collecting the washings, allow for multiple applications as required. Allow the stonework to vent, uncovered for a few days prior to re-testing by OHES.
9. If complete excavation of contaminated soils is thought to have been achieved, make the excavation area safe;

   -Take measurements for backfilling and re-instatement purposes.

   -Install robust fencing around the work area.

   -Make the site safe and tidy

   -Cover the skip and secure the fenced compound.

   -Demobilise from site for a minimum of 5 days to allow for validation soil sample results to be returned.

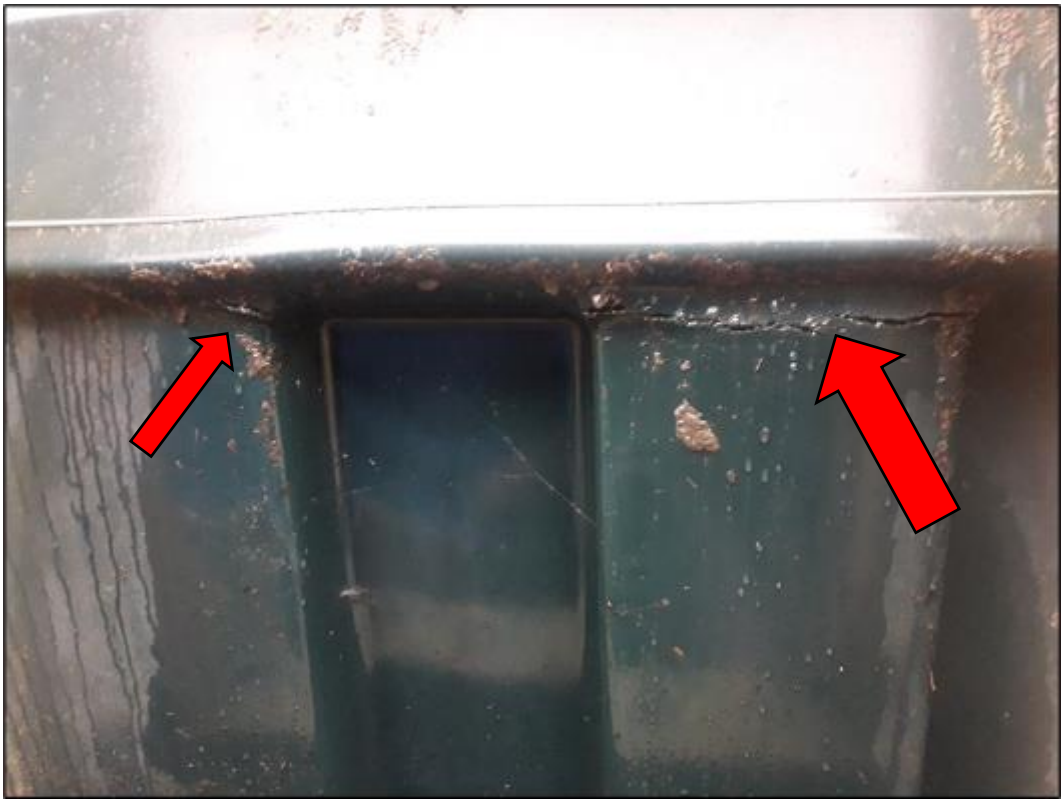
Reinstatement

10. If validation sample results and vapours readings are satisfactory backfill the excavation with clean, imported material compacted in layers.
11. Re-instate the concrete pad strip- tying the newly poured pad into the existing pad. Allow the concrete to cure.
12. Install appropriate paving slabs to act as the new OST base. The slabs should extent at least 0.3m out from all sides of the new OST. The new OST dimensions will be specified in due course but for scoping purposes allow for a 3.0m x 2.0m concrete slab base. Ensure the new OST position complies to OFTEC regulations; 1.8m distance from the church window and allow sufficient room between the OST and church wall so that all sides of the OST can be visually inspected.
13. Allow the base to cure. Position the new OST on the base. Re-instate topsoil over the upper 0.3m of the previously grassed area. Scatter grass seed over the area.
14. Install a new FTL from the OST to the boiler. The old FTL attached to the wall will be above the height of the new OST install outlet pipe. Remove the old FTL and attach the new FTL at an appropriate level along the length of the wall. Please note, a core hole will need to be advanced through the boiler room wall for the new FTL, sheath the FTL as it passes through the wall. Allow for a 15m length of FTL. A watchman oil level monitor should be included for in the scoping costs and fitted to the OST, as well as any other necessary fittings, such as oil filters/ fire valve.
15. Transfer kerosene from the temporary OST's into the new install. Bleed the FTL and test fire the boiler. Remove the temporary OST's and matting from site.
16. Install feather edge timber frame fencing around the OST base, to match the previous install style (Photograph 8). The fencing should be positioned at least 0.6m from the OST as per OFTEC regulations. The fencing should extend at least 0.3m above the height of the OST – for scoping purposes allow for a 1.8m high fence covering a 9.0m length. The fencing should surround three sides of the OST with the church wall acting as the fourth side. Install an access door at the front of the OST. Attach a door bolt to the front so that the door can be secured with a padlock.
17. Paint the exterior fencing to match the previous colour (as close as possible to the church stonework), reportedly dove grey paint (Photograph 8).
18. Demobilise from site; skip to be uplifted, fencing, materials and plant to be removed, final clean up to ensure site is left in a tidy state to the satisfaction of the church.

1.5 Compliance

This investigation and assessment has been carried out in general accordance with Environment Agency LCRM Guidance (Land Contamination: Risk Management) and BS 10175:2011+A1:2013 (Investigation of potentially contaminated sites – Code of practice).

1.6 Photographs



Photograph 2 – Fence panels removed to reveal a large crack and smaller cracks in OST (18.06.20)

Photograph 3 – The OST was bowed in its centre and bulging close to the crack (18.06.20)

Photograph 4 – Sensitive receptors identified close to the OST; cemetery, surface water drainage and church structure (18.06.20)

2.0 REMEDIATION WORKS

2.1 Overview of Completed Works

An overview of the completed works is presented in the table below.

Date	Works Completed
18th June 2020	Emergency response works.
19th June 2020	Further emergency response works and Initial Investigation works undertaken.
27th July 2020	Remediation and validation; Site set-up and excavation works commence.
28th July 2020	Remediation and Validation; Concrete pad broken out and comprehensive sampling of material beneath. Requirement for excavation to be advanced to area previously covered by concrete pad.
30th July 2020	Remediation and Validation; Validation samples retrieved from excavation.
7th August 2020	Results returned, NRW confirm that no further remedial works are required to address potential risks posed to surface and ground waters.
12th – 27th August 2020	Reinstatement works undertaken; excavation backfilled, concrete slabs laid to form tank base, new OST installed, timber fence installed, fuel transfer, FTL re-fitted, fire valve replaced, boiler test fired, fence painted, top soil and grass seed, temporary tanks removed, site demobilise and tidy.
1st September 2020	Project completion visit; completion photos taken, meeting with Church representative and job completion note provided.

Please note that field data and laboratory certificates are available on request.

Prior to commencement of the remediation works, the insured was issued with a copy of the Homeowner Information Sheet and Health and Safety Mandate. Signed copies of both documents are available on request.

2.2 Variation from Original Scope

The original scope detailed that further investigation works would be required beneath the concrete slab to delineate the extent of contamination. Sampling works identified that a large area of soils beneath the concrete pad were contaminated by kerosene. It appeared as though a large crack in the concrete pad, which had initially been hidden by the concrete block bund had provided a pathway for the kerosene to migrate to soils beneath the concrete pad (**Photograph 5**).

An area measuring 2.7m x 2.3m to a depth of at least 1.7m was found to be contaminated by kerosene beneath the concrete slab, this was in addition to the area beside the pad identified for excavation (1.3m x 0.7m to 1.0m depth) during the initial investigation. The excavation beneath the pad was advanced to 2.7m x 2.3m to 1.2m depth over this area (**Photograph 6**). Validation works identified that the sides of the excavation were clear of kerosene contamination. Contaminated soils remained in some areas in the base of the excavation.

As it was not possible to vertically delineate the extent of contamination and as contaminated soils were apparent at 1.7m depth, Natural Resources Wales (NRW) were informed. NRW were contacted on the 6th August 2020 (reference number; WIRS 2004367 relates to this spillage incident). Details of the incident and OHES findings to date were provided to NRW. NRW had been contacted by the Church and informed of the spillage on the 18th June so were aware of the incident details. NRW confirmed on the 7th August 2020 that they were content with the excavation works undertaken and that they did not require any further remedial works/ ground investigations to be completed. They requested that the nearby Afon Clarach be monitored periodically and especially following heavy rainfall. They advised that this could be performed by the Church Warden, Mr. Smith. Mr. Smith agreed he would undertake the monitoring and would report any oil impact to the watercourse if any became apparent.

The large slate slab at the top of the stairs leading down to the boiler room had to be lifted to facilitate the additional excavation works. The slab was heavily cracked prior to lifting and broke up as expected. The church had been informed of this and were content for the slate slab to be replaced with concrete slabs to match those being installed for the OST base.

The FTL was installed at the same height as the previous installation. The OFTEC registered heating engineer advised that as the boiler was located in the below ground boiler room it would not be necessary to lower the height of the FTL.

Due to inclement weather, some weather dependant works (slab laying and painting) had to be postponed, increasing the overall length of the remedial works.

2.3 Enabling Works

Enabling works included the following;

1. Local council was contacted to check if a road permit was necessary to position the skip in the lay-by. A road permit was not required. Skips delivered to site and positioned in the lay-by. Plastic sheeting used to line the skip, skips were covered with plastic sheeting at the end of each day.
2. Signage installed on the road-way to warn road users of work-men crossing the road.
3. Welfare unit delivered to site and positioned in the lay-by, site folder was kept in the welfare unit at all times. Fencing delivered to site, a compound was created in the lay-by surrounding the welfare unit and skips. Additional fencing taken to the work area to position around excavation.
4. Work area CAT scanned prior to breaking ground.

2.4 Removal of Materials

The wooden fencing, breeze block wall and OST base had been removed during the emergency response phase. A 0.5m strip of the concrete slab was cut out over a 2.5m length directly beside the grassed area highlighted as requiring excavation (**Photograph 7**). Soil samples were obtained and an appropriately calibrated PID was used to field screen these samples for the presence of VOC's. The readings obtained informed further investigation works. Soil samples from under the slab were found to be displaying elevated VOC readings, suggestive of kerosene contamination. A small crack in the concrete slab was identified (**Photograph 5**) and a 0.8m wide strip of the concrete cut out along a 2.5m length of this crack (**Photograph 8**). The crack appeared to be positioned where the small concrete bund wall previously sat around the OST. Soil samples retrieved from beneath the removed concrete indicated gross kerosene contamination, extending both laterally and vertically from the surface soils. A wider area of the slab was broken out, extending up to the church wall. The total area of break-out was 2.7m x 2.5m (**Diagram 1, Photograph 9**).

During excavation works, a redundant clay pipe was unearthed (**Photograph 10**). This was traced back during the excavation works and was found to terminate in the soil, with no apparent start point. A section of the pipe was found to be impacted by kerosene contamination. Sampling indicated that contamination had not migrated along the pipework. The church were consulted and as the pipe served no apparent function it was agreed that it could be removed.

2.5 Excavation of Contaminated Soils

Based on the findings of the initial investigation, soils were initially excavated over the grassed area beside the concrete slab. Soil sampling was completed in tandem with excavation works in order to delineate the extent of kerosene contamination. An area measuring 1.4m x 0.6m was excavated to a depth of 0.85m beside the concrete slab and in front of the church wall buttress (**Diagram 2, Photograph 7**).

As indicated in Section 2.4, soil sampling and screening with the PID identified a large area beneath the concrete slab that had been impacted by the kerosene spillage. Soils were excavated over a 2.7m x 2.3m area to a maximum depth of 1.2m (**Photograph 11**). Soils directly beside the church wall were left in situ and were sloped away from the wall to maintain stability. The other edges were sloped or stepped to maintain stability and to provide access to the excavation. The slate slab (**Photograph 12**) at the top of the stairs to the boiler room was removed to facilitate the excavation works. Contaminated soils were initially excavated by hand, when it was apparent that a large quantity of material was requiring removal, a micro excavator was used. Contaminated material was transported by wheelbarrow to the skips, located in the road lay-by (**Photograph 13**). In total 16.78 tons of contaminated sub soil and rubble was removed from site and disposed of as kerosene contaminated non-hazardous waste, at a licensed waste facility.

2.6 Surface Water Monitoring

As discussed in Section 2.2, NRW requested that the Afon Clarach be monitored periodically and especially following any high rainfall events. They advised that this task could be performed by the Church Warden (Mr. Smith) as he lived locally. Mr. Smith has monitored the river on several occasions since the instruction by NRW, including after high rainfall events and no oil contamination to the Afon Clarach has been apparent. He will continue to monitor the river and take photographs as evidence. He will inform OHES If any contamination becomes apparent.

2.7 Photographs

Photograph 5 – Crack in the concrete pad allowed migration of kerosene to underlying soils (28.07.20)

Photograph 6 – Extent of excavation beneath the concrete pad (30.07.20)

Photograph 7 – Concrete strip initially removed beside contaminated soils (27.07.20)

Photograph 8 – Concrete strip broken out, tracking contaminated soils beneath (28.07.20)

Photograph 9 – Concrete pad broken out to allow the underlying soils to be assessed (28.07.20)

Photograph 10 – Redundant clay pipe unearthed, route highlighted (28.07.20)

Photograph 11 - Soils were excavated over a 2.7m x 2.3m area to a maximum depth of 1.2m (30.07.20)

Photograph 12 – The slate slab had to be removed during remediation works (30.07.20)

Photograph 13 – Skips and welfare unit in fenced compound in lay-by (30.07.20)

3.0 VALIDATION WORKS

3.1 Overview of Validation Sampling

Validation sampling of the exposed soils and soils beneath the concrete pad were undertaken alongside the excavation of contaminated soils over three days between the 27th and 30th July 2020.

Samples obtained on the 27th and 28th July informed the additional excavation works required beneath the area previously covered by the concrete slab. Validation sampling of the excavated area was then undertaken on the 30th July.

3.2 Soil Sampling

PID Screening

A total of 133 samples were obtained from 48 locations (designated **V1** – **V34** and **EV1** – **EV14** as illustrated in **Diagrams 1 and 2, Photographs 13 and 14**). An appropriately calibrated Photo-Ionisation Detector (PID) was used to field screen these samples for the presence of VOC's.

Based on the results of the PID screening, a total of 21 soil samples were sent to an independent UKAS accredited laboratory (Element Deeside Ltd) for hydrocarbon analysis. Laboratory test certificates and field notes are available on request.

Chemical Analysis Results and GQRA

The following table presents a summary of the soil laboratory analysis results and a comparison of the concentrations of the contaminants of concern in soils against OHES Generic Assessment Criteria (GAC) for assessing risks to health from soil contamination. The derivation of the GAC is described in OHES Technical Guidance Note No. 6 which can be provided upon request.

Determinand	Sample Location and Depth (m)							GAC 2.5% SOM
	EV1 0.75m	EV2 1.0m	EV3 1.25m	EV4 1.25m	EV5 1.1m	EV6 1.0m	EV7 1.25m	
VOC (ppm)	*3.3*	*8.6*	*515*	*786*	*364.9*	*28.4*	*30.4*	-
EPH $>C_8$-C_{10}	<5	<5	**1766**	**3573**	<5	<5	<5	65
EPH $>C_{10}$-C_{12}	<10	<10	**1909**	**3282**	<10	<10	<10	180
EPH $>C_{12}$-C_{16}	<10	<10	**1738**	**3097**	<10	<10	<10	330
EPH $>C_{16}$-C_{21}	<10	<10	54	108	<10	<10	<10	540
EPH $>C_{21}$-C_{35}	<10	<10	29	15	<10	<10	<10	1,500
EPH (C_8-C_{35})	<30	<30	5496	10075	<30	<30	<30	-

Determinand	Sample Location and Depth (m)							GAC 2.5% SOM
	EV8 1.25m	EV9 1.25m	EV11 1.7m	EV12 1.25m	EV13 1.7m	EV14 1.0m	V1 0.5m	
VOC (ppm)	*18.4*	*1051*	*763*	*52.8*	*899*	*780*	*1.2*	-
EPH $>C_8$-C_{10}	<5	**4352**	**1701**	<5	**403**	**1194**	<5	65
EPH $>C_{10}$-C_{12}	<10	**3744**	**1381**	<10	**542**	**1891**	<10	180
EPH $>C_{12}$-C_{16}	<10	**3610**	**1214**	<10	**643**	**2017**	<10	330
EPH $>C_{16}$-C_{21}	<10	110	64	<10	22	55	<10	540
EPH $>C_{21}$-C_{35}	<10	<10	<10	<10	<10	<10	<10	1,500
EPH (C_8-C_{35})	<30	11816	4360	<30	1610	5157	<30	-

Determinand	Sample Location and Depth (m)							GAC 2.5% SOM
	V2 0.85m	V3 0.85m	V7 0.3m	V9 0.85m	V21 1.0m	V23 0.8m	V29 1.0m	
VOC (ppm)	*3.0*	*1.0*	*2.5*	*3.1*	*1308*	*51.0*	*9.2*	-
EPH >C_8-C_{10}	<5	<5	<5	<5	**7851**	<5	<5	65
EPH >C_{10}-C_{12}	<10	<10	<10	<10	**4842**	<10	<10	180
EPH >C_{12}-C_{16}	15	15	<10	<10	**3543**	20	<10	330
EPH >C_{16}-C_{21}	<10	<10	<10	<10	114	<10	<10	540
EPH >C_{21}-C_{35}	<10	<10	<10	<10	14	<10	<10	1,500
EPH (C_8-C_{35})	<30	<30	<30	<30	16364	<30	<30	-

Notes: Concentrations presented in mg/kg. GAC – LQM / CIEH (2015) based on residential with plant uptake land use scenario and 2.5% SOM. Concentrations which exceed GAC highlighted in **bold.**

Of the 21 samples submitted for analysis, 14 returned results below the laboratory limit of detection (LLD). The other seven samples returned results in exceedance of the LLD and of the GAC. All samples that returned TPH concentrations in exceedance of the GAC were interpreted as 'Kerosene' by the laboratory.

The **V** (validation) samples were retrieved prior to the mass excavation works beneath the concrete pad, the on-site PID readings from the V samples informed the excavation strategy. The **EV** (excavation validation) samples were retrieved following excavation works. All samples retrieved from the sides of the excavation returned results below the LLD. The excavation was widened to remove material at locations **EV3** and **EV4** in front of the slate slab as the sample results were found to be in exceedance of the GAC. The excavation was widened, to a maximum depth of 1.25m to sample locations **V23** and **V29** where results below the LLD had been returned. Samples **EV5 @ 1.1m, EV6 @ 1.0m and EV7 @ 1.25m**, taken from the face of the excavation between the POL and the church wall returned results below the LLD.

The highest sample result returned was from location **V21 @ 1.0m** with a total TPH concentration of 16,364 mg/kg, this location is thought to have been directly beneath the crack in the concrete where kerosene had initially migrated. The excavation was terminated at a maximum depth of 1.25m due to the close proximity of the church wall, validation samples were retrieved from the excavation base. Base validation samples **EV8** and **EV12 @ 1.25m** returned concentrations below the LLD. Base validation samples **EV3, EV4, EV9 @ 1.25m** and **EV14 @ 1.0m** returned concentrations above the GAC's. Two samples were retrieved from beneath the base of the excavation in an attempt to delineate the vertical extent of the contamination plume.

A maximum sample depth of 1.7m bgl was reached. Sample **EV11** and **EV13 @ 1.7m** returned exceedances of the GAC, however the total TPH concentrations for these samples (4,360 and 1,610 mg/kg) respectively were the two lowest concentrations out of the seven samples in exceedance of the GAC.

3.3 Mass Balance Calculation

Given the volume of kerosene that was recovered during the emergency response works it is expected that the loss volume would not have been more than 200 litres.

Taking into account the excavation dimensions, surface concrete that was removed and weigh bridge data it is estimated that the mass of contaminated soil removed was 12,076 kg.

The average total TPH concentration of samples in exceedance of the LLD taken at or above 1.25m bgl within the excavation was 9781.6 mg/kg.

From these figures it has been calculated that 147.66 litres of kerosene has been recovered within the excavated soils.

The volume of kerosene that is therefore unaccounted for is approximately 52 litres.

3.4 Consultation with Natural Resources Wales

Natural Resources Wales were contacted by OHES on the 6th August given that elevated sample results had been returned at the base of the excavation and the contamination plume had not been vertically delineated. The Initial Investigation report, validation sample results and validation sample plan were provided for NRW. OHES explained that mass excavation works had been undertaken within the top 1.25m of the soil profile to address risks posed to flora and fauna, human health, building structure and surface waters. The estimated maximum loss volume of 200 litres and mass balance calculation figure was also provided to NRW.

Heidi Markham, Environment Team Officer at Natural Resources Wales advised the following in an email to OHES on the 7th August 2020.

"Given the information that you have provided about the maximum spill amount, the approximate amount that has been recovered and taking account of the location of the spill (being in such close proximity to the Church building), we do not require any further excavation / remediation works to be carried out on site at this time."

She did request that the Afon Clarach be monitored periodically and especially following any high rainfall events. She advised that this task could be performed by the Church Warden (Mr. Smith) as he lived locally.

Mr Smith has monitored the river on several occasions since the instruction by NRW, including after high rainfall events and no oil contamination to the Afon Clarach has been apparent.

Given that Natural Resources Wales had advised that no further excavation/ remedial works were required, reinstatement works proceeded on the 12th August.

3.5 Photographs

Photograph 13 – Validation (V) samples retrieved from beneath the concrete pad (28.07.20)

Photograph 14 – Excavation Validation (EV) samples retrieved (30.07.20)

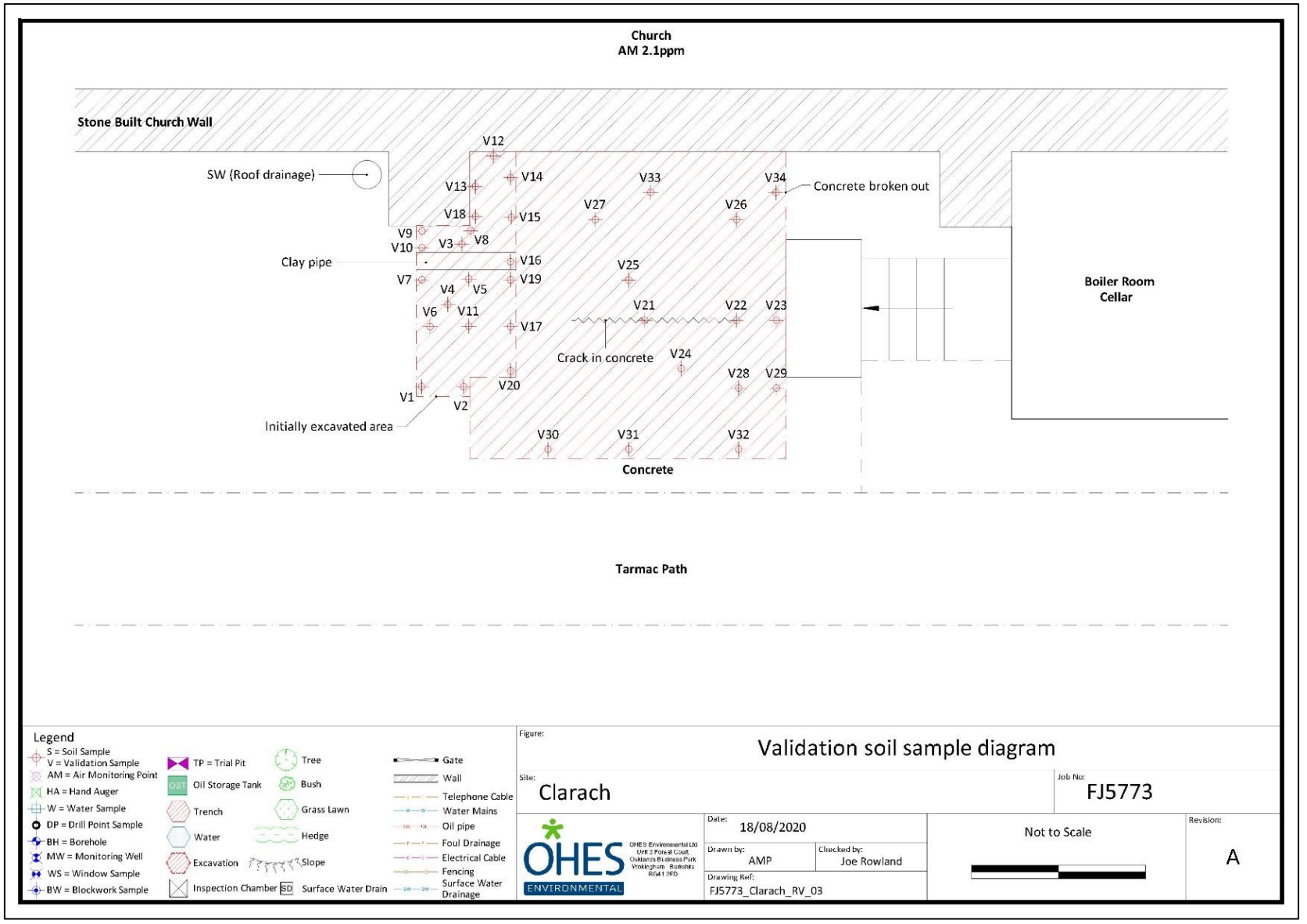


Diagram 1 – Validation soil sample diagram and area of concrete breakout

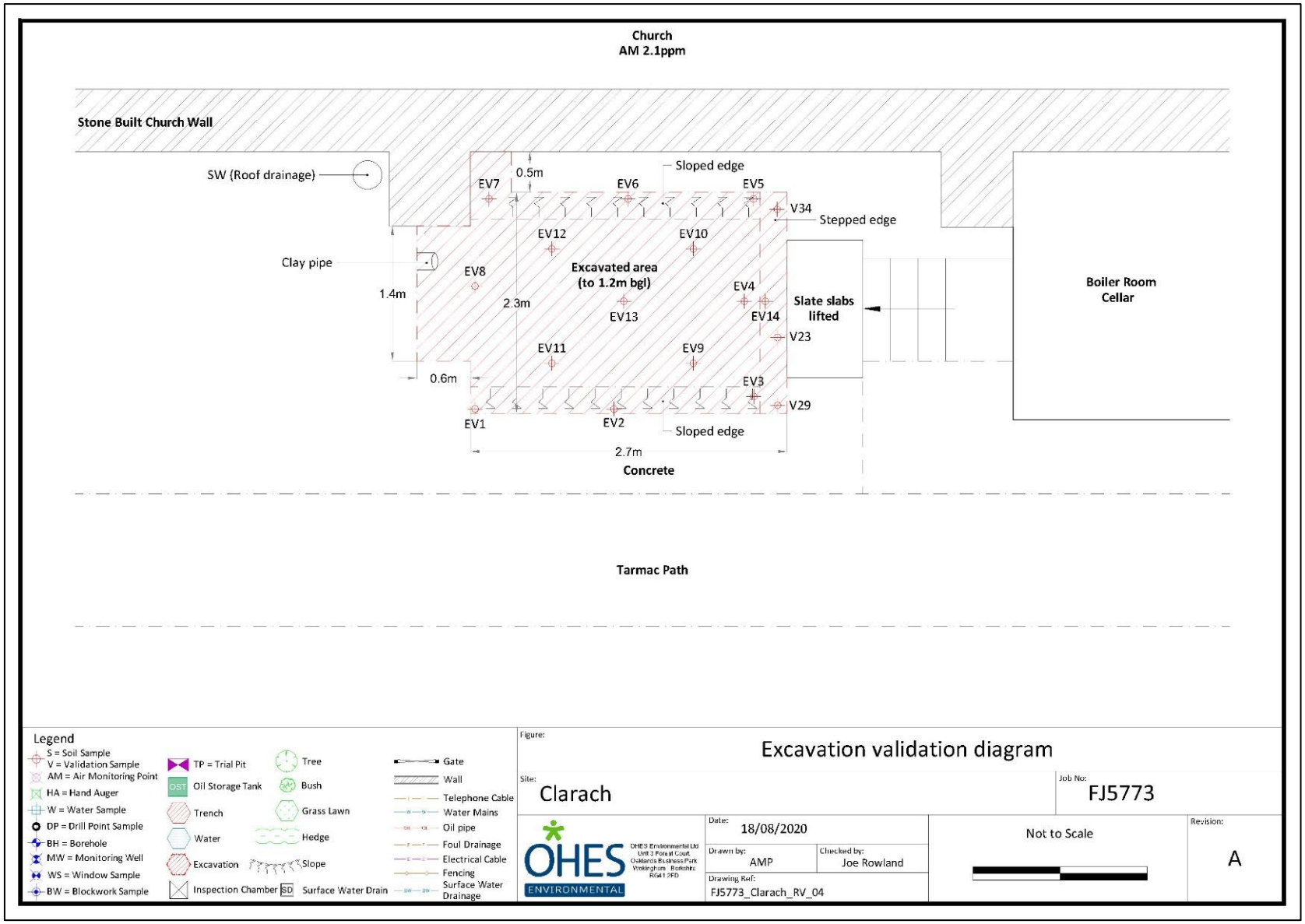


Diagram 2 – Excavation validation soil sample diagram

4.0 REINSTATEMENT

4.1 Reinstatement Works

Following validation sampling and consultations with NRW, reinstatement works proceeded. OHES were satisfied that risks to the identified receptors; human health, flora and fauna, building structure and surface waters had been addressed via mass excavation of soils within the upper 1.25m of the soil profile. A low to moderate risk remained to the underlying aquifer, however NRW had deemed the risk to be acceptable. Reinstatement works proceeded on the 12th August and were completed on the 27th August. Inclement weather prolonged reinstatement works, delaying weather dependant activities such as painting and slab laying.

It was agreed upon with the Church that the new OST could be positioned at ground level given that the boiler is located in the below ground boiler room. A larger OST base was required to allow for the larger bunded OST and to comply with OFTEC guidelines. The configuration of the OST would need to be changed to maintain an appropriate distance from the church window and to allow for the timber fencing to be installed around the OST. The church were content with the required alterations and gave permission to proceed as planned.

MOT was used to backfill the excavation and was compacted in layers to form a firm substrate (**Photograph 15 and 16**). The excavation was backfilled to ground level, concrete was removed up to the tarmac path and remaining concrete pad edges cut to form a clean face (**Photograph 17**). Concrete slabs were laid over the compacted MOT to form an OFTEC compliant tank base for the new OST (**Photographs 18 and 19**). The 50mm thick slabs were laid over the area previously covered by the concrete pad. Slabs were also laid at the top of the stairs down to the boiler room to replace the slate slab (**Photograph 19**). The Church purchased a new 2,500-litre, plastic, bunded OST to replace the compromised OST. The OST was positioned on the concrete slabs, ensuring that OFTEC guidelines were adhered to and a 1.8m distance was maintained from the church window (**Photograph 20**). A new FTL was installed, running from the OST to the boiler, the FTL was attached to the church wall to match the previous installation (**Photograph 21**). The heating engineer advised that it was not necessary to lower the height of the FTL on the wall as the fall to the boiler would be sufficient to keep a constant pull of kerosene to the boiler. A timber frame was constructed around the OST (**Photograph 22**), maintaining a distance of at least 0.6m between the OST and the frame as per OFTEC guidelines. Timber boards were fixed to the frame to match the previous 'feather edge' style fencing and were painted grey to match the previous colouring (**Photograph 23**). Topsoil was applied to the area of ground that had previously been grassed and was topped with grass seed (**Photograph 24**). The kerosene was transferred from the temporary OST's to the new installation on the 26th August and temporary OST's removed the following day. Due to a stoppage issue with the previous fire valve, which was preventing fuel supply to the boiler a new fire valve had to be fitted. Following this the boiler was successfully test fired. A 'Watchman' type electronic fuel measuring device was supplied with the new OST and the monitor plugged in, in the boiler room (**Photograph 25**).

The skips were uplifted from the compound area, welfare unit removed, Heras fencing off-hired and all materials removed from site. The pathways to the work area and lay-by were brushed down and left clean and tidy (**Photographs 26 and 27**). OHES visited site on the 1st September and met with Mr Smith from the Church for final completion photos, project sign off and to address any snagging issues. Mr Smith was very pleased with the works undertaken and the completed reinstatement.

4.2 Consideration of Betterment

The length of timber fencing surrounding the OST had to be increased to ensure the new installation complied with current OFTEC regulations.

A new fire valve had to be installed as the previous fitting was blocking the supply of fuel to the boiler.

4.3 Photographs

Photograph 15 – Excavation backfilled with MOT compacted in layers (12.08.20)

Photograph 16 – Excavation backfilled with MOT compacted in layers (13.08.20)

Photograph 17 – Excavation backfilled to ground level (13.08.20)

Photograph 18 – Concrete slabs laid onto compacted surface to form OST base (13.08.20)

Photograph 19 – Concrete slabs laid to form OST base (17.08.20)

Photograph 20 – OST positioned on concrete slabs (17.08.20)

Photograph 21 – Newly installed FTL attached to the OST (17.08.20)

Photograph 22 – Timber frame constructed around the OST (21.08.20)

Photograph 23 – Timber surround installed around OST to match previous style (01.09.20)

Photograph 24 – Topsoil and grass seed applied beside the OST base (01.09.20)

Photograph 25 – Electronic fuel level monitor in the boiler room (01.09.20)

Photograph 26 – Access routes were left clean and tidy (01.09.20)

Photograph 27 – Lay-by brushed down and left clean and tidy (01.09.20)

5.0 RISK ASSESSMENT AND CONCEPTUAL SITE MODEL (CSM)

Pre-Remediation CSM				Post-Remediation CSM	
Source	**Pathway**	**Receptor**	**Original Risk Classification**	**Comments**	**Revised Risk Classification**
Kerosene loss from crack in OST	Direct soil/dust ingestion and dermal contact (outdoors)	Human Health	**Moderate**	All kerosene contaminated surface soils have been removed to at least 1.25m depth. Any residual contamination at depth does not pose a risk via dermal contact or ingestion.	**Low**
	Vapour inhalation (indoors)		**Low**	No elevated PID readings within the church.	**Low**
	Vapour inhalation (outdoors)		**Low**	No external vapours following removal of impacted surface soils.	**Low**
	Ingestion of impacted drinking water		**Low**	Mains water pipe was not encountered during removal of contaminated soils.	**Low**
	Lateral migration of free phase / mobile contaminants through ground / services	Ecology (flora & fauna)	**Moderate**	Source contamination in surface soils removed.	**Low**
		Surface water	**Moderate**	Source contamination in surface soils removed, no longer a risk to the Afon Clarach via the surface water drainage migration pathway.	**Low**
		Building Structure	**Moderate**	Contaminated soils beside the building structure removed.	**Low**
		Third Party	**Low**	Contaminated soils not close to third party land.	**Low**
	Vertical migration of free phase / mobile contaminants	Groundwater	**Low**	Kerosene contaminated soils present at 1.7m depth. Vertical extent of the contamination plume not delineated. Source contamination in the upper 1.25m of the soil profile removed however a risk remains to groundwater.	**Low/ Moderate**
	Lateral migration of dissolved phase contaminants	Groundwater (Secondary A aquifer)	**Moderate**	Kerosene contaminated soils present at 1.7m depth. Vertical extent of the contamination plume not delineated. Source contamination in the upper 1.25m of the soil profile removed however a risk remains to groundwater.	**Low/ Moderate**
		Third Party abstraction borehole	**Low**	No nearby abstraction BH's.	**Low**
		Surface water	**Moderate**	Lateral extent of contamination plume delineated and source contamination removed to 1.25m depth.	**Low**

5.1 Risk Classifications

The pollutant linkages identified during the previous investigation and assessment work have been re-assessed to take account of the remediation works, to determine whether unacceptable risks remain. This is presented in Section 5.0 above. The above risk assessment is based on use of the site and surroundings as domestic properties. It does not take into account any future changes in land use which may arise.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very High	High	Moderate	Moderate / Low
	Likely	High	Moderate	Moderate / Low	Low
	Low Likelihood	Moderate	Moderate / Low	Low	Very Low
	Unlikely	Moderate / Low	Low	Very Low	Very Low
	No Linkage	No risk			

The potential pollution linkages are identified and assessed in general accordance with guidance in CIRIA Report C552 (Rudland et al 2001), but with the addition of a 'no linkage' category, as shown in the Risk Classification Matrix below. Full descriptions of each risk classification are included in **Appendix 4**.

6.0 PROJECT SUMMARY

6.1 Summary of Completed Works and Conclusions

- Validation sampling and laboratory analysis indicates that kerosene impacted soils in the upper 1.25m of the soil profile were removed from site eliminating risks to church ground users, flora and fauna, surface waters and building structure.
- Laboratory results indicate that kerosene contaminated soils are still present below 1.25m depth. Natural Resources Wales were informed and advised that they were content with the remedial works that had been completed and did not require any further investigations to be undertaken.
- A moderate/low risk remains to the groundwater underlying the site. The removal of source contamination to 1.25m depth has reduced the severity of the risk to this receptor. Mass balance calculations estimate that approximately 150 litres of kerosene has been recovered within contaminated soils during excavation works.
- The impacted area was reinstated to the satisfaction of the Church. It was agreed with the Church that the OST could be installed at ground level, the configuration of the OST could be changed and fencing around the OST increased in length to cover a larger area. These changes were necessary to comply with OFTEC regulations for new OST installations. A new bunded OST was purchased by the Church.

Based on the information available the site has been successfully remediated to a point where all unacceptable risks have been mitigated.

APPENDIX 3 – OHES LIMITATIONS

This report has been prepared for the Client in accordance with their instruction. The report is intended to provide information relevant to an insurance claim related to the property detailed herein and is not intended for any other purpose. OHES Environmental cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

Sub-surface ground conditions are by their nature hidden from view and on this basis may differ to the understanding obtained through completion of the above assessment.

All works will be carried out in accordance with OHES Terms and Conditions which can be viewed at www.ohes.co.uk.

APPENDIX 4 – RISK CLASSIFICATION DEFINITIONS

CIRIA C552 presents the following descriptions of risk classifications and likely action required.

Risk Classification	Description
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, if is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Moderate / Low	Not defined within CIRIA C552.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.