Dunkellin River and Aggard Stream Flood Relief Scheme

Response to An Bord Pleanála

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INTRODUCTION

RPS was commissioned by Galway County Council in 2011 to prepare an Environmental Impact Statement (EIS) for the Dunkellin River and Aggard Stream Flood Relief Scheme in south County Galway. The Dunkellin River and the Aggard Stream form part of the Dunkellin Drainage District which was constructed in or around 1857 and Galway County Council has a statutory maintenance responsibility for these works.

In 2010 a study on the Dunkellin River and the Aggard Stream (from Craughwell Village to Kilcolgan) was commissioned as a result of flooding that occurred in the area in November 2009. Galway County Council is now progressing the Flood Relief Scheme, from here on referred to as the "scheme", to design stage. The scheme was submitted to An Bord Pleanála (ABP) in October 2014 for planning approval in line with Section 175 of the Planning and Development Act 2000, as amended.

The scheme includes for flood relief works to be completed along the main channel of the Dunkellin River from Craughwell to Kilcolgan (over 11km) and along the Aggard Stream which runs from the townland of Cregaclare (near Ardrahan) to its outfall at the confluence of the Dunkellin and Craughwell Rivers (over 7.5km). A combination of river widening, deepening, culvert upgrade and replacement, bridge improvement and replacement and general channel maintenance make up the proposed measures for this scheme. The intention of the scheme is to provide optimum flood relief with minimal environmental impact, whilst also controlling the overall capital investment required.

In February 2015, the Board, in accordance with Section 175(5) (a) of the Planning and Development Act, 2000, as amended, requested further information in relation to the proposed development.

The purpose of this document is to provide a response to the issues raised by the Board and to determine what, if any, actions are now required to address further information needs which will enable the Board to make an environmental impact assessment and an appropriate assessment of the proposed flood relief scheme.

1 ITEM 1 – POST-SCHEME FLOOD PLANS

1.1 It is considered that the applicant has not provided a thorough description of the benefits of the scheme in terms of the effects on material assets

Response

A Cost Benefit Analysis (CBA) was carried out in tandem with the design of this scheme. Drawing 6408-2300, contained in **Appendix A** to this response, illustrates the location of properties (i.e. dwelling property, commercial property and social benefits) which are to be provided with protection from a flood event with a return period of 1 in 100 years with further protection of an additional 20% increase to allow for climate change (Mid-Range Future Scenario as defined by the OPW).

This design event, with a design flow of 97.7 cu.mecs is expected to exceed the November 2009 flood event which has been estimated to be 84.8 cu.mecs. Whilst the scheme will provide some degree of benefit to the adjacent agricultural lands, the project has not been designed as a land drainage or Arterial Drainage Scheme and therefore such agricultural benefits have not been accrued in the assessment of benefits to material assets.

Other benefits associated with the scheme include;

a. The minimisation of road disruption. During the November 2009 event, the R446 Road Crossing was closed for a total four days. This road closure resulted in diversions of more than 10km.

b. Reduction in emergency costs incurred by emergency services in dealing with the flood event and also in dealing with the recovery process.

c. 'Recreation benefits' arising from the enjoyment of landscape, wildlife and natural amenities as well as from the enjoyment of recreational activities. The proposed river enhancement works will aid the passage of fish up the river.

1.2 Plans showing the pre-scheme flooding compared with the post-scheme for the mean, 5%ile and 10%ile scenarios – these plans should be similar to those presented for Rahasane Turlough but should extend for the entirety of the scheme length and should clearly identify all buildings.

Response

Appendix A provides a series of drawings outlining the predicted flood extents for the *"mean, 5%ile and 10%ile scenarios"*; for both the pre-scheme channel and post-scheme channel works. The relevant drawings are provided in **Table 1.1** below.

Table 1.1 - Drawings Outlining the Predicted Flood Extents

Drawing No.	Description
6408-2300	Predicted Flood Extents for November 2009 Flow Pre & Post Flood Alleviation Works
6408-2301	Predicted Flood Extents for 5%ile Flows Pre & Post Flood Alleviation Works
6408-2302	Predicted Flood Extents for 10%ile Flows Pre & Post Flood Alleviation Works
6408-2303	Predicted Flood Extents for Mean Annual Flow Conditions Pre & Post Flood Alleviation Works

Drawing No. 6408-2300 illustrates the extent of flooding associated with the November 2009 event and the reduction in properties flooded by limiting the fluvial flow to the new channel works.

Drawing No's 6408-2301, 6408-2302 and 6408-2303 illustrate the extent of flooding associated with the *"mean, 5%ile and 10%ile scenarios"*. From these drawings it can be seen that the discharge is contained with the existing and proposed channel.

1.3 A copy of any report prepared by Dr. Goodwillie or other specialist ecologist which describes the surveys undertaken for the environmental impact statement (EIS) and/or NIS and which identifies the aspects of the hydrological regime which need to be maintained to ensure that the integrity of the Rahasane Turlough candidate Special Area of Conservation (cSAC) is not affected by the works. It is considered that the basis for the decision to 'deliberately minimise the predicted changes in water levels within the turlough so to maintain the ecologically critical water level range' should be discussed in more detail. It is considered that this conclusion, which is presented in the application submissions including Page 30 of the Description of the Proposed Works by Tobin Consulting Engineers, should be supported by more evidence in view of the stated limitations of the scheme, the stated need to consider further alternative and localised flood protection measures along the northern shore of the turlough and in response to the comments of observers. The response should include expert comment on the required duration of flood at 16.5m OD.

Response

No specific report on turlough vegetation was produced for this project by Mr Goodwillie. Instead comments were made on items in the various reports produced by Tobin on the scheme between 2012-14. These were based on Mr. Goodwillie's experience of the habitat from 1988 to the present.

Work around the turloughs in South Galway (Peach et al., 1997; Goodwillie in Otte, 2003) suggested that the length of time the vegetation was flooded and the date of release from floods in the spring were the most important factors in controlling the vegetation of turloughs. This seemed likely to be because many plants are susceptible to a lack of oxygen in the soil which occurs after a few weeks of flooding. The tolerant ones grow in the middle of the basin and the less tolerant ones toward the margins. Subsequently in a more systematic Ph.D. study of turlough vegetation Sharkey (2012) summarised that 'a wide range of environmental and management factors were found to affect the species composition of turlough vegetation. Soil type, nutrient status, grazing and hydrology were all found to affect turlough vegetation, and the conditions associated with each vegetation community were identified. Duration of flooding and nutrient status (notably phosphorus) were found to be the most important drivers of turlough vegetation.'

The pattern of flooding is highly variable from year to year in a turlough and the actual top edge of the turlough zone is in a continual state of change; either the plant communities are spreading towards the centre in response to a dry year or are recovering from the effects in a wet year with a longer flooding period. It is safe to say that no two years are the same in their effects on plant life in the turlough basin and that the edge vegetation which may only be flooded for a week or two is in constant change. This makes the designation of a top level in a basin that does not overflow inherently difficult. There is in fact, no strict edge, only a level at which a few days of flooding does not have an appreciable effect on the species composition of the vegetation. The comparison of a turlough edge with that of a floodplain is apt and would be called an ecotone, a zone of interaction between wet and dry communities.

The black moss *Cinclidotus* is often said to indicate flooding but it grows also in the wave splash zone so may reach 30cm higher than the water level on the exposed side of the basin. Woody species and the bark-dwelling lichens on them were reckoned to be the best indicators of top flood height around Coole Lough (Peach et al., 1997) but cannot be much used at Rahasane because of the high level of grazing pressure and the absence of woodland. Associated with this boundary was the appearance of yellow mosses, e.g. *Eurhynchium, Brachythecium, Holmalothecium* and, in grassland creeping thistle *Cirsium arvense*, wild thyme *Thymus polytrichus* and bulbous buttercup *Ranunculus bulbosus*. It was this level that was chosen at Rahasane and was found to be 16.5m O.D. on two sides of the basin, during a site survey on Thursday 5th April 2012, when Mr. Goodwillie was accompanied by a topographical surveyor and members of the ecological and hydrological team. The two areas identified include the following:

- Area 1: Killeeneenmore (M46891966) where the field wall showed an edge in the higher plants, about 10cm below the last traces of *Cinclidotus* moss (maintained here by wavespray), and

- Area 2: The other site was on the southern side somewhat upstream, in Carrigeen East (M49081938, M49031927, M48961928). Here three levels were considered, one marking the transition of *Ranunculus repens/Galium palustre* to yellow moss, one at the base of lichen growth on exposed *Prunus spinosa* and one in a grazed field where a flood line nicely separated a *Festuca rubra* grassland from a damper version with *Phleum*.

Images 1.1 to **1.4** below show the locations used in this site visit to establish this upper flood level.

Image 1.1 - Killeeneenmore (Northern Part of Turlough)

Image 1.2 - Killeeneenmore (Northern Part of Turlough)

Image 1.3 - Carrigeen East (Southern Part of Turlough)

Image 1.4 - Carrigeen East (Southern Part of Turlough)

It was considered that this 'top' height of Rahasane turlough was essential to maintain so this was built into the final design of the project. All the ground out to 16.5m will therefore continue to be inundated. The inundation period must change to some extent in view of the fact that water speed through the catchment will be increased by 1% but the scale of the change will be analogous to a series of slightly drier years and, it is thought, will result in minimal changes to the vegetation of the margins. Plant cover here does not have a particularly 'turlough' composition and similar stands are found in many seasonally damp locations in limestone country. There is no likelihood of changes to the typical turlough communities of deeper levels such as those containing rare or protected plants (in Rahasane these are mudwort *Limosella aquatica* (protected), turlough violet *Viola persicifolia*, needle spike rush *Eleocharis acicularis*, fat duckweed *Lemna gibba*, Northern yellow cress *Rorippa islandica*). These will continue to be inundated for similar periods as they are today and will continue to be used as before by wildfowl and other fauna.

Sharkey (2012) suggests that the mean duration of flooding for these upper levels is 50-90 days per year but this does not occur as a single period, more as a series of rises and falls in response to water levels in the basin. It should be pointed out that her experimental sites were all located in groundwater-fed basins so that a greater degree of fluctuation would be expected in a riverine site such as Rahasane in response to catchment rainfall. It was a general finding at Rahasane during surveys that the shoreline accumulation of debris, i.e. the 'high tide mark', was 10-20cms lower after winter 2014-15 than after 2013-14 which implies that the higher water level, if achieved at all in 2014-15, was fleeting.

The decision to '*deliberately minimise the predicted changes in water levels within the turlough so to maintain the ecologically critical water level range*' is based on the Targets to Maintain the Favourable Conservation Status of '3180 Turlough' at Rahasane Turlough SAC which were extracted and adapted from Galway Bay SAC conservation objectives[1] in the NIS Section 3.1.6 and reproduced in **Table 1.2** below for clarity. Taking cognisance of the targets set for Vegetation Composition (area of vegetation communities) and typical species (invertebrates) maintenance is a critical factor and there can be no change other than natural processes. Therefore the maintenance of the hydrology to its current regime is critical to achieving these targets. The distribution of vegetation communities within Rahasane Turlough are provided in **Figure 1.1**.

Table 1.2 - Targets to Maintain the Favourable Conservation Status of '3180 Turlough' at Rahasane Turlough SAC

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable at c. ***203.3*** ha or increasing/changing subject to natural processes.	The upper limit of turlough habitat at Rahasane has been assessed by Goodwillie (2012) as being at 16.5 mO.D. Maintenance of flood duration and extent at this level will maintain the turlough vegetation communities at Rahasane Turlough SAC.
Habitat distribution	Occurrence	No decline, subject to natural processes.	Turlough habitat is distributed throughout the two main basins, the main north basin and the smaller Rinn basin. Maintenance of turlough habitat over these areas will maintain habitat distribution.
Hydrological regime: flood duration, frequency, area, depth; permanently flooded area	Various	Appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat.	**Hydrological regime: groundwater contribution** Maintain appropriate groundwater contribution necessary for the natural functioning of the habitat. **Hydrological regime: flood duration** Maintain hydrological regime within current range of variation for the natural functioning of the habitat. The extent of turlough habitat at Rahasane has been assessed by Goodwillie (2012) as being at 16.5 mO.D therefore flood duration levels at this altitude should be maintained.

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[1] NPWS (2013) Conservation Objectives: Galway Bay Complex SAC 000268. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Attribute	Measure	Target	Notes
			Hydrological regime: flood frequency Maintain current seasonal temporal patterns in flood frequency. **Hydrological regime: flood area** Maintain natural temporal pattern in flood area. **Hydrological regime: flood depth** Maintain natural temporal and spatial patterns in flood depths. **Hydrological regime: permanently flooded/wet areas** Maintain any areas of permanent or semi-permanent flooding or water-logging. The northern side of the main basin remains wet throughout the year which should be maintained.
Soil type: area	Hectares	Maintain variety, area and extent of soil types necessary to support current turlough vegetation and other biota.	The maintenance of geology, morphology and hydrology will maintain soil type. Grazing pressure or other farming management could alter soil type locally.
Soil nutrient status: nitrogen and phosphorous	N and P concentration in soil	Maintain nutrient status appropriate to soil types.	Changes in concentrations of supply of nutrients, through groundwater, surface water or land management practices, including channel improvement in the Aggard Stream, may alter the N and P concentration in turlough soil.
Physical structure: bare ground	Presence	No decline in wet bare ground, as appropriate	Maintenance of flood duration and any trampling by grazers will maintain bare ground. The location may change in response to grazing.
Chemical processes: calcium carbonate deposition and concentration	$CaCO_3$ deposition rate/soil concentration	Maintenance of appropriate $CaCO_3$ deposition rates and concentration in soil	$CaCO_3$ deposition rates and concentration in soil may be affected by hydrological changes in the turlough and by drainage activities in the zone of contribution (groundwater catchment and surface water catchment). These will affect the $CaCO_3$ concentration in the floodwater, or change biological communities, impacting the precipitation processes.
Water quality: nutrients; colour; phytoplankton; epiphyton	Various	Maintain appropriate water quality to support the natural structure and functioning of the habitat.	**Water quality: nutrients** Maintain average annual TP concentration of ≤10µg l^{-1} TP, or ≤20µg l^{-1} TP, as appropriate. **Water quality: colour** Maintain appropriate water colour. **Water quality: phytoplankton biomass** Maintain appropriate chlorophyll a concentrations as follows: Annual mean/maximum chlorophyll a concentration <8µg l^{-1}/<25µg l^{-1} **Water quality: epiphyton biomass** Maintain trace/ absent epiphyton as algal mats (< 2% cover).
Active peat formation	Flood duration	Active peat formation, where appropriate.	There is no peat formation at Rahasane Turlough.

Attribute	Measure	Target	Notes
Vegetation composition: area of vegetation communities	Hectares	Maintain area of sensitive and high conservation value vegetation communities/units at each turlough.	The Turlough Vegetation Communities in accordance with the system developed by Goodwillie (1992) identified in the Galway Bay Complex SAC Conservation Objectives backing document for Turloughs as being sensitive and positive indicator communities include 2A, 2B, 3A, 3B, 4B, 6A, 6B, 7B and 8E. However further consultation with Goodwillie has suggested that the communities listed below might be more appropriately considered to be sensitive with regard to nutrient enrichment and hydrology of Rahasane Turlough. **Vegetation Community** / **Area (ha)** 2B / 10.2 3B / 1.4 6A / 25.0 9A / 26.6 10A / 11.4 10B / 3.4 11B / 14.25
Vegetation composition: vegetation zonation	Distribution	Maintain vegetation zonation/mosaic characteristic of each turlough.	Zonation as per mapping carried out by Goodwillie (1992) to be maintained. 17 vegetation communities to be retained with the same general distribution throughout the site.
Vegetation structure: sward height	Centimetres	Maintain a variety of sward heights across each turlough.	Sward height is controlled by grazing. The current proposal will not significantly impact on sward height.
Typical species: terrestrial, wetland and aquatic plants, invertebrates, birds	Presence	Maintain typical species within Rahasane	**Typical species: terrestrial, wetland and aquatic plants** Typical species are identified by cross-referencing the species listed in Goodwillie (1992) with those listed in Table 3 and Table 4 of NPWS (2013).
Fringing habitats: area	Hectares	Maintain marginal fringing habitats that support turlough vegetation, invertebrate, mammal and/or bird populations.	Most areas outside of those habitats mapped by Goodwillie (1992) could potentially support vegetation, invertebrate, mammal and/or bird populations associated with the turlough. Therefore any changes in the other attributes listed in this table could lead to a decrease in area of fringing habitats.
Vegetation structure: turlough woodland	Species diversity and woodland structure	Maintain appropriate turlough woodland diversity and structure.	Goodwillie (1992) states that the actual area of flooded woodland is too small to map at Rahasane Turlough. An increase would add to the biodiversity of the site.

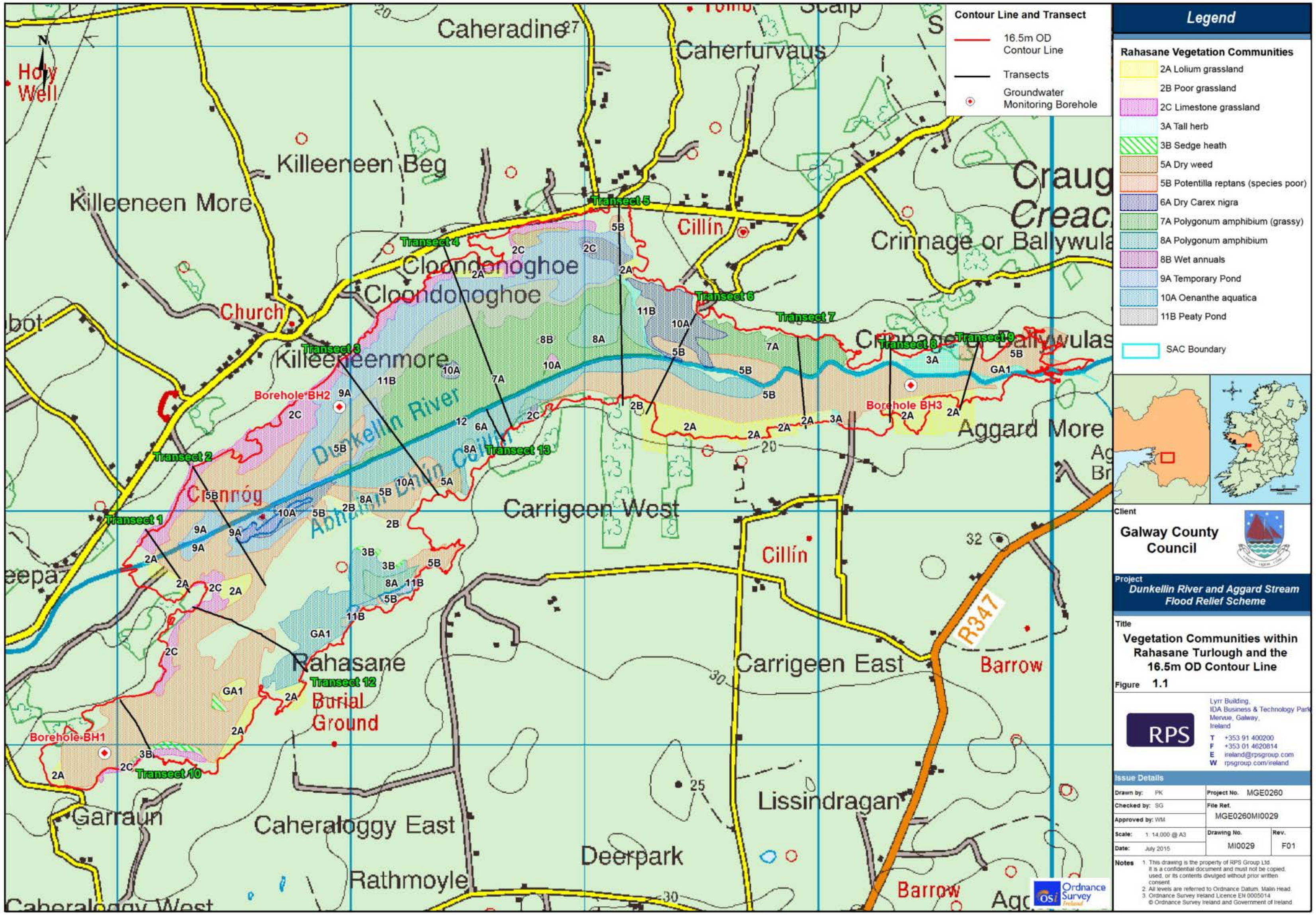


Figure 1.1 - Vegetation Communities, Transect Lines and 16.5 mO.D. Contour

To further investigate the 'ecologically critical turlough levels', a field visit was conducted on 10th June 2015 with Mr. Goodwillie and members of the RPS ecological team to identify further monitoring stations, in addition to the nine longitudinal transects identified in the EIS and NIS and to further validate the 16.5 mO.D. level. Three further transects were identified which were topographically surveyed on the 23rd June 2015.

From LiDAR mapping a 16.5 mO.D. contour map has been produced and shown in **Figure 1.1**. This figure is an amended version of the **EIS Figure 10.4** and **NIS Figure 6.1**. From this figure it can be seen that the 16.5 mO.D. contour, largely charts the boundaries of the turlough edge vegetation, which was verified through topographical surveys and which further validates the ecologically critical water level of 16.5 mO.D. level.

The overflow, during summer, from the river into the northern part of the turlough which sustains much of the aquatic flora that is not in the main channel, occurs at 14.70 mO.D.

With regard to aquatic invertebrates, the following critical level was identified in Section 11.4.10.1 of the EIS (p187):

- *Fairy shrimp, Tanymastix stagnalis, first recorded in Ireland in 1974 at the small, southeastern basin of Rahasane Turlough (Rinn Basin) (Young, 1976) and only recorded from a few Irish sites, depends on overflow from the main Rahasane basin to stimulate a rapid breeding phase. The overflow between the basins occurs at 14.70 mO.D., equating to 35th percentile flow (established using the long-term depth exceedance curve in Appendix A, Figure 3.13 of the EIS).*

Tanymastix requires seasonal or temporary pools without fish in order to escape predation (Porst, 2006). Rinn basin is isolated from the drainage channel of the Rahasane main basin where fish predators exist, and the species has only ever been found in the Rinn basin. Tanymastix is well adapted to exploit temporarily flooded environments, with the ability to hatch, grow and produce eggs within a very short time-frame, e.g. < 15 days reported in August 1974 (Young, 1976).

It is considered that ensuring overflow and flood frequency and duration in Rinn Basin is the primary "ecologically critical level" from the perspective of aquatic invertebrates at Rahasane Turlough. Wetland invertebrates, especially those of habitats with highly variable hydrology, have developed many adaptations that include:

- egg or pupal stages that can tolerate dry periods;
- initiation of egg development after specific water/oxygen levels have been reached;
- marked seasonality in life cycle;
- rapid breeding cycles and development;
- large numbers of offspring;
- diapause related to seasonal flooding; and
- parthenogenic reproduction (e.g., cladocera).

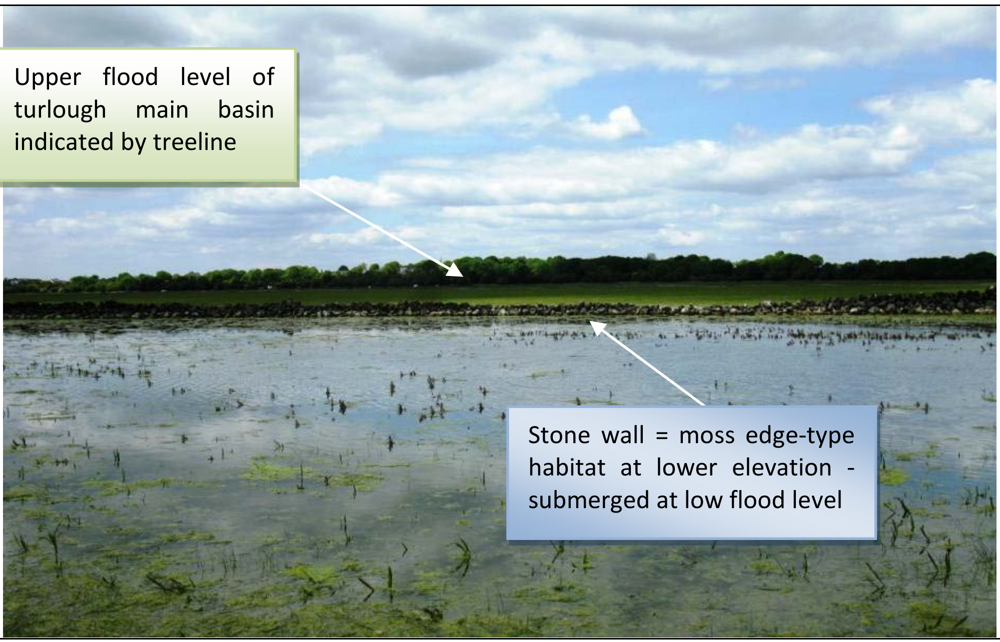
During drying out periods, invertebrates can also follow falling water levels into deeper pools; move into sediments within the water table, and those that can fly can move to other nearby pools or wetlands. Turlough fauna in particular is subject annually to highly variable hydrological regimes that can differ from year to year, e.g. there can be expected to be some degree of annual difference in flood maxima and/or frequency and duration at lower levels depending on climatic conditions. Whilst Rinn basin at Rahasane is subject to cycles of complete flooding and drying, the Rahasane main basin is not – it has year-round permanent standing water. A study by Buckley (1993) showed that this profoundly influences the Rahasane main basin and Rinn basin invertebrate communities.

Buckley (1993) sampled the invertebrate community of Rahasane turlough monthly over an annual cycle at various locations, and provided in-depth analysis comparing Rahasane main basin fauna to that of Rinn basin. These areas are delineated not just by their hydrological regimes, but by their flooding mechanism. The main basin fills largely by overflow from the Dunkellin River and retains standing water year round, while Rinn fills as overflow from the main basin and can be subject to a number of flooding and draining cycles each year, always drying completely in summer.

The data clearly showed that the main basin comprised fauna typical of both permanent and temporary Irish standing waterbodies, while Rinn basin comprised a less diverse community typical only of temporary Irish waterbodies. The Rinn Basin comprised ecological generalist species of temporary waterbodies, as well as specialist species of temporary ponds, e.g. *Tanymastix* (which is absent from the main basin). Rinn Basin also showed seasonal succession in the community while the main basin did not. Community succession is characteristic of temporary waterbodies and indicates a greater level of hydrological influence. So, while the main Rahasane and Rinn basins are both variable hydrology habitats, there is a far greater degree of habitat adversity (drying/flooding cycle) at the Rinn basin. Rahasane main basin invertebrate communities, in fact, showed more similarity to other Irish lakes than to Rinn basin. There was a low level of similarity between fauna of Rahasane main basin compared to other “classical” Irish turloughs, i.e. those that flood and drain completely. In summary, the evidence strongly suggests that variable hydrology is less “ecologically critical” to the community in the main basin given the presence of permanent water year round, but is critical to Rinn.

Given that overflow to Rinn occurs at a relatively low level (14.70 mO.D. equating to 35%ile flow), it is very unlikely that, under the proposed scheme, Rinn will not continue to flood and drain with the same frequency and duration as it currently does. That said, maintaining the hydrological regime in Rinn is evidently an “ecologically critical” aspect in terms of aquatic ecology of this protected turlough habitat. For this reason, monitoring of the Rinn basin invertebrates in the early flooding period (generally October) is recommended in association with the proposed scheme. Ongoing presence of *Tanymastix stagnalis* in the early flood period is seen as a suitable bio-indicator of any hydrological effects - considering this is the primary, unique temporary waterbody specialist in this basin of the turlough.

In addition, waterbeetles (Coleoptera) of the main Rahasane basin have been sampled on a number of occasions (Bilton, 1989; O’Connor, 2001; Waldron 2003/ 2004 – see Appendix C5 of the EIS); including recently as part of studies conducted for this Further Information Request (see **Appendix B**). On each occasion a number of species characterising turloughs and the unique “moss-edge community” were recorded, e.g. H*ygrotus quinquelineatus, Agabus nebulosus,* and *Hygrotus impressopunctatus*. On one occasion the characteristic “moss edge dweller” *Graptodytes bilineatus*, an Irish Red Listed species (Near Threatened), was recorded (Waldron, 2004, Appendix C5 EIS). Unlike many more classical turlough basins that flood and empty completely and have a fairly defined “edge”, Rahasane is vast and undulating and contains a mosaic of edge-type habitats present as rocky outcrops, stone walls and rocky vegetated islands over a range of elevations. A montage of pools and broad, shallow flooded wetlands and grasslands surround these outcrops, even when water levels are low in the turlough, as shown in Plates 1, 2 and 3, below. Rock outcrops are covered in mosses, mainly *Cinclidotis fontinaloides* with submerged *Fontanalis antipyretica*. For this reason, "moss-edge" type habitat is effectively present across a wide range of water levels in the Rahasane main basin. Hence there is less likely (in this turlough) to be an "ecologically critical" water level for the beetle community associated with this habitat. Even so, it is recommended that Coleopteran sampling be carried out bi-annually (May and August) in the Rahasane main basin, and that samples are taken from different parts of the turlough including both southern and northern sides, the southern side being the more diverse in moss-edge type habitat.



Upper flood level of turlough main basin indicated by treeline

Stone wall = moss edge-type habitat at lower elevation - submerged at low flood level

Image 1.5 - Rahasane Turlough main basin southern shore during receding, low water levels in June 2015.

Image 1.6 - Rahasane Turlough main basin northern shore during receding, low water levels in June 2015

Image 1.7 - Rahasane Turlough main basin northern shore showing a mosaic of rocky outcrops in flooded grassland.

Selecting groups that are most associated with unique hydrological aspects of this turlough achieves two things that are important considerations for a monitoring programme:

1. It focuses on specific groups that reflect this turlough's unique hydrology and avoids "noisy" data that could arise from general littoral sampling;

2. It is easily repeatable, involving simple equipment and fairly rapid collection methods;

3. Identification of samples is relatively straightforward considering *Tanymastix* is unique and highly recognisable, and there is a good key available for the Coleoptera (Friday, 1986); and

4. It is cost-effective owing to (2) and (3), above.

In relation to (1), above, it is well recognised that full community littoral or benthic invertebrate sampling largely reflects nutrient and/or substrate effects in lakes and rivers (Donohue et al., 2009). However, the goal of the proposed monitoring is to ensure ecologically critical hydrological aspects of the cSAC habitat are maintained. General littoral sampling of invertebrate communities may contain the "noise" of nutrient and substrate effects. Generalised littoral samples would also require a range of specialist identification skills to cover all groups, especially the micro-crustacea, and this would greatly increase cost and effort for potentially no greater understanding of hydrological effects.

The monitoring programme should be agreed with NPWS, and should commence in October 2015. There is also the option of collecting single general littoral samples in both the early and late flooded periods (October and March) from Rinn and during April/May in the Rahasane main basins. Results could be compared to records for these months in Buckley (1993). Although, for the reasons set out above, such an approach may not achieve the goals of the monitoring programme because: (i) it may fail to adequately sample indicator groups, and (ii) would involve greater cost and effort.

In summary, in relation to the question raised, it is determined that the "ecologically critical" water levels for aquatic invertebrates at Rahasane are at lower elevations than those that are critical to turlough vegetation. The flood maximum level of 16.5mO.D. that defines the upper turlough edge is very unlikely to be critical to any of the typically resident aquatic invertebrate groups at Rahasane. In terms of connectivity to other waterbodies, which can occur at high flood levels and foster exchange between temporary waterbodies, Rahasane Turlough has permanent water and is hydrologically connected to the wider catchment at all times through the presence of the Dunkellin River drainage channel, so this is not considered to be a critical issue for this turlough. The evidence shows that the "ecologically critical" levels for aquatic invertebrates in this turlough occur at lower elevations/water levels and it is these that need to be safe-guarded to avoid impacts on Rahasane Turlough cSAC. The scheme, as proposed, does not significantly alter the potential flood level/frequency/duration regime at lower flows, so the impact on aquatic ecology ought to be neutral. Notwithstanding, the pre- and post-works monitoring of hydrologically sensitive bio-indicators, as discussed above, is recommended.

With regard to the model, further steady state analysis, using the HEC-RAS model, has predicted that a flow of 20.1 cu.mecs will produce a water level of 16.5 mO.D. in the Rahasane Turlough. Table 2.1, contained in Appendix-A to the Main EIS, and reproduced below, presented the estimated return periods for a series of flow scenarios.

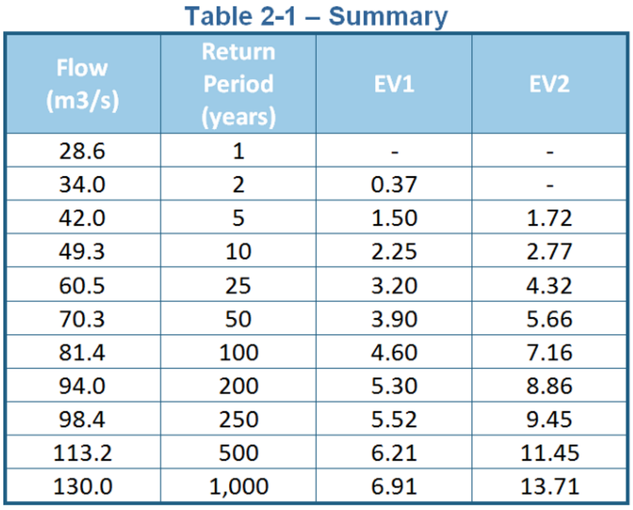


Table 2-1 – Summary

Flow (m3/s)	Return Period (years)	EV1	EV2
28.6	1	-	-
34.0	2	0.37	-
42.0	5	1.50	1.72
49.3	10	2.25	2.77
60.5	25	3.20	4.32
70.3	50	3.90	5.66
81.4	100	4.60	7.16
94.0	200	5.30	8.86
98.4	250	5.52	9.45
113.2	500	6.21	11.45
130.0	1,000	6.91	13.71

[Source: EIS, Volume 3, Appendix A (RPS, 2014)]

Referring to this table (Table 2.1) the estimated return period for a discharge or river flow of 20.1 cu.mecs is less than 1 year. Discussion on further alternative and localised flood protection measures along the northern shore of the turlough is discussed in **Section 1.4** below.

With regard to further alternative and localised flood protection measures along the northern shore of the turlough, it is considered that to achieve this localised protection at each household may be required and such an approach will be dealt with on a case by case basis. It is envisaged that such solutions, which may entail the use of demountable flood barriers or permanent flood protection walls with internal flood sumps and pumps, will be the subject of individual applications for planning consent to Galway County Council, as the Planning Authority. Such permanent, demountable flood barriers may be in excess of 2m high and initial discussions with the property owners would suggest that permanent walls of this nature would not be acceptable. The design of an individual flood protection solution for each property on an individual basis has been omitted from this planning application.

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Young, R., (1976) Tanymastix stagnalis (Linn) in County Galway, new to Britain and Ireland. Proceedings of the Royal Irish Academy 76 (B), 369–378.

1.4 *The scheme is stated to allow for potential future channel deepening upstream of Craughwell. However, there is no description of options which may be considered as future measures to relieve flooding in the vicinity of Rahasane Turlough. The applicant is requested to outline such measures which might be open to consideration in the future and to comment on whether such works might give rise to effects which need to be considered in the design and / or assessment of the current scheme.*

Response

This query deals with two separate requests;

(i) possible future works upstream of Craughwell, and
(ii) flood protection measures in the Rahasane.

Item (i): the scheme has been designed to cater for a flood event of 1 in 100 years plus an additional allowance of 20% to cater for the Mid-Range Future Scenario (i.e. climate change). The reference to "future channel deepening upstream of Craughwell", as stated, refers only to the unknown "Future Scenario" which may result from increases in flows throughout the catchment as a direct result of climate change. Such climate changes and associated "future channel deepening" will only be considered on an entire catchment basis which will entail a full review of the entire drainage system and will be the subject of a more detailed drainage scheme with its own environmental assessment.

Item (ii): Section 3.3.1 (page 38) of the works description report discusses the flood alleviation measures considered in the vicinity of Rahasane Turlough. This broadly considered two options:

Option 1: Channel Deepening immediately downstream of the Rahasane Turlough

"*where channel deepening within the environs of Craughwell and channel & bridge widening downstream of the Rahasane Turlough were considered, it was found that proposed works would have an impact on the normal depth ranges of water within the turlough. This impact was thought to be environmentally significant and have the potential to impact on the normal hydrological and thus ecological regimes within the turlough*"

Option 2: Embankments

"*This fourth scheme considered the use of flood embankments or walls along the shore of the turlough without the need to change the depth of flooding within the turlough.*

While offering flood protection on a theoretical basis, this proposal may not:

1. *provide the necessary flood protection (from the Rahasane Turlough) due to the variable karstic nature of the bedrock in the region and the unpredictable potential movement of water beneath the flood protection wall or embankment (bringing a risk of "burst up" due to differential pressure of approximately 2.2m head across the wall), and*

> 2. *Allow the drainage of surface/ground water, from lands along the northern boundary of the water body, behind the proposed wall, into the Rahasane Turlough, to occur naturally. This movement of water may be due to surface water flow or ground water movement in rock fissures or other unknown karstic features. Attempts to detail flexible pinch valves/flap valves to permit unidirectional drainage from behind the wall are unsound from a flood protection viewpoint, because such valves inevitably become blocked by debris in a partly open position.*
>
> *Considering these risks the construction of flood embankments or walls in this karstic region were not considered viable and are therefore not proposed. However, the Craughwell to Kilcolgan Road and properties along the northern shore of the turlough will continue to be at risk of flooding during the extreme design flood events."*

Future measures may involve localised protection at each household and such an approach will be dealt with on a case by case basis. It is envisaged that such solutions, which may entail the use of demountable flood barriers or permanent flood protection walls with internal flood sumps and pumps, will be the subject of individual applications for planning consent to Galway County Council, as the Planning Authority. Such permanent, demountable flood barriers may be in excess of 2m high and initial discussions with the property owners would suggest that permanent walls of this nature would not be acceptable. The design of an individual flood protection solution for each property on an individual basis has been omitted from this planning application.

Alternatively, consideration may be given to the relocation of each property owner and such a solution will only be dealt with on a case by case basis considering not only the social impacts of relocation but each individual's historical association with the townland of Rahasane.

Since the inception of the flood relief scheme in 2010/2011, and having considered the potential environmental impact of alternative schemes that would result in potential flood level reductions in the Rahasane Turlough, Galway County Council, the OPW and TOBIN Consulting Engineers have liaised with a number of the houses and property owners along the northern shore of the Rahasane Turlough. The location of the property owners is shown in **Figure 1.2** below.

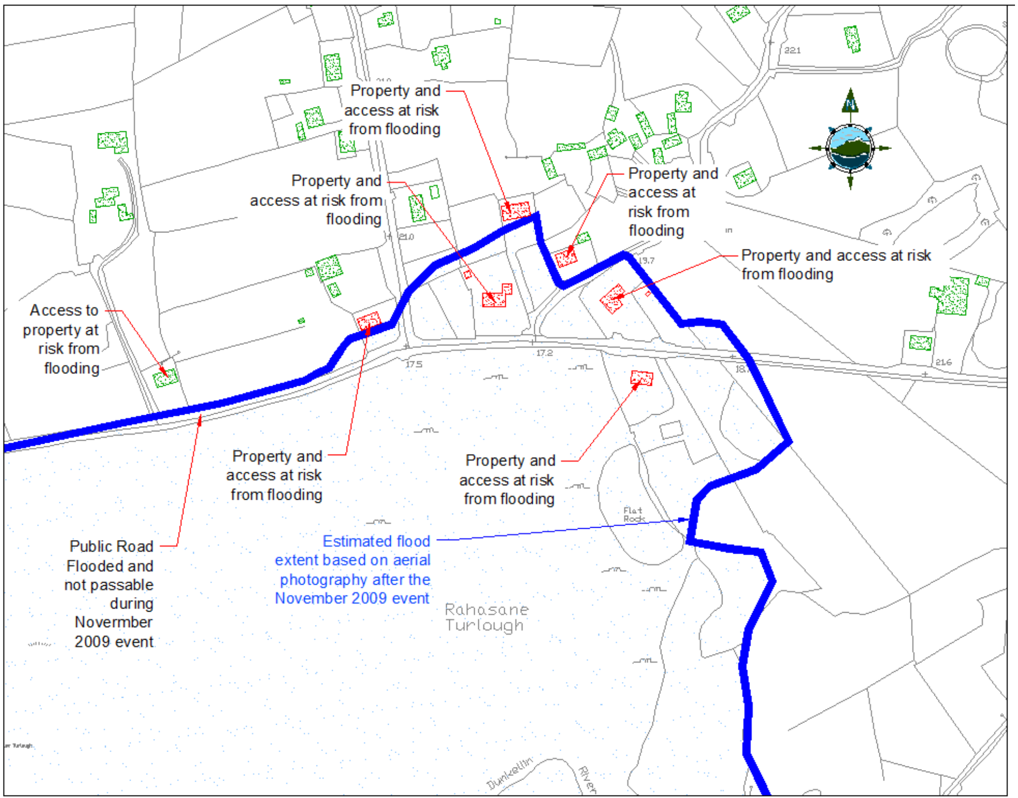


Figure 1.2 - Property owners along the northern shore of the Rahasane Turlough

These property owners were directly impacted by the November 2009 flood event and their dwellings were either cut off by the flood waters or were inundated by the Rahasane Turlough. Following written invitations from Galway County Council to the six property owners detailed in the above figure in March 2014, a meeting, with a number of the property owners was held on 25th March 2014 to discuss the implications of undertaking significant flood relief works within or adjacent to the Turlough. This meeting was attended by two of the six property owners and the purpose of the meeting was to inform the residents of the proposed works in advance of the Public Consultation process and to commence discussions on possible individual flood protection measures or alternative relocation procedures that may need to be considered by the individual property owners.

Since this meeting, further discussions in this regard took place at the Public Consultation evening on 15th July 2014 and subsequently the OPW has also recently written to one of the property owners in this regard. A copy of this letter is attached at **Appendix F**.

The use of demountable flood protection barriers or permanent flood defence walls could be located within each private property and because such measures would not be located within the Rahasane Turlough SAC there would be no direct effect on the SAC or more particularly there is no envisaged loss of habitat.

2 ITEM 2 – IMPACT ON SURFACE WATER & KARST FLOW REGIME

It is considered that the applicant has not provided sufficient information regarding the potential impact of flood construction works on surface water run-off and on the underlying karst flow regime.

2.1 The applicant is requested to assess the suitability of use of embankments along the Dunkellin River in relation to the potential for impact on underlying karst conduits and impeding surface water run-off. In this regard, it is noted that the applicant identifies two main reasons for not constructing embankments at Rahasane Turlough, namely the potential for 'burst up' and impeding surface water flow.

Response

The key difference between the use of embankments in the Rahasane Turlough and downstream along the banks of the Dunkellin River is the duration of inundation. The embankments which were initially considered in the vicinity of the Rahasane turlough would have been subject to high water levels for a matter of days, whereas downstream along the banks of the river flood peak water levels may only last for a couple of hours.

The detailed design of river embankments will take seepage, and surface water flow into account.

A review of the geophysics has shown no cavernous limestone features that would be subject to collapse. Areas of karst rock close to surface will have appropriate land spreading application methods to minimise the potential for direct sediment loss into the underlying karst fissure network. The most appropriate approach will be specified at detailed design based on the nature of sediments expected to be deposited at each area. The areas of rock close to surface are outlined in **Figure 2.1**. Further detail is provided below under **Section 2.2 below**.

2.2 Further assessment is required with respect to soil spreading on the karst regime and the potential for blockage or collapse of underlying of conduits which could give rise to flooding elsewhere. The need for such an assessment has been highlighted in the EIS and a 5m buffer zone around any identified karst feature proposed.

Response

Spoil spread will constitute the placement of up to 1 metre in thickness of excavated soil on top of the lands identified in the **EIS, Volume 3, Appendix A, Works Description Report, Table 6-1 (page 63)**. There have been no significant cavernous karst features (such as caves) identified during the drilling, hydrogeological mapping or geophysical survey. The geophysical survey, site investigation and hydrogeologist site walkover have identified a number of discrete karst features such as springs, areas of weathered rock (epikarst) and some deeper sediment filled fissures (see **Figures 2.1** to **2.6**). It is considered that these features are unlikely to be susceptible to actual physical collapse or subsidence resulting from the land spreading.

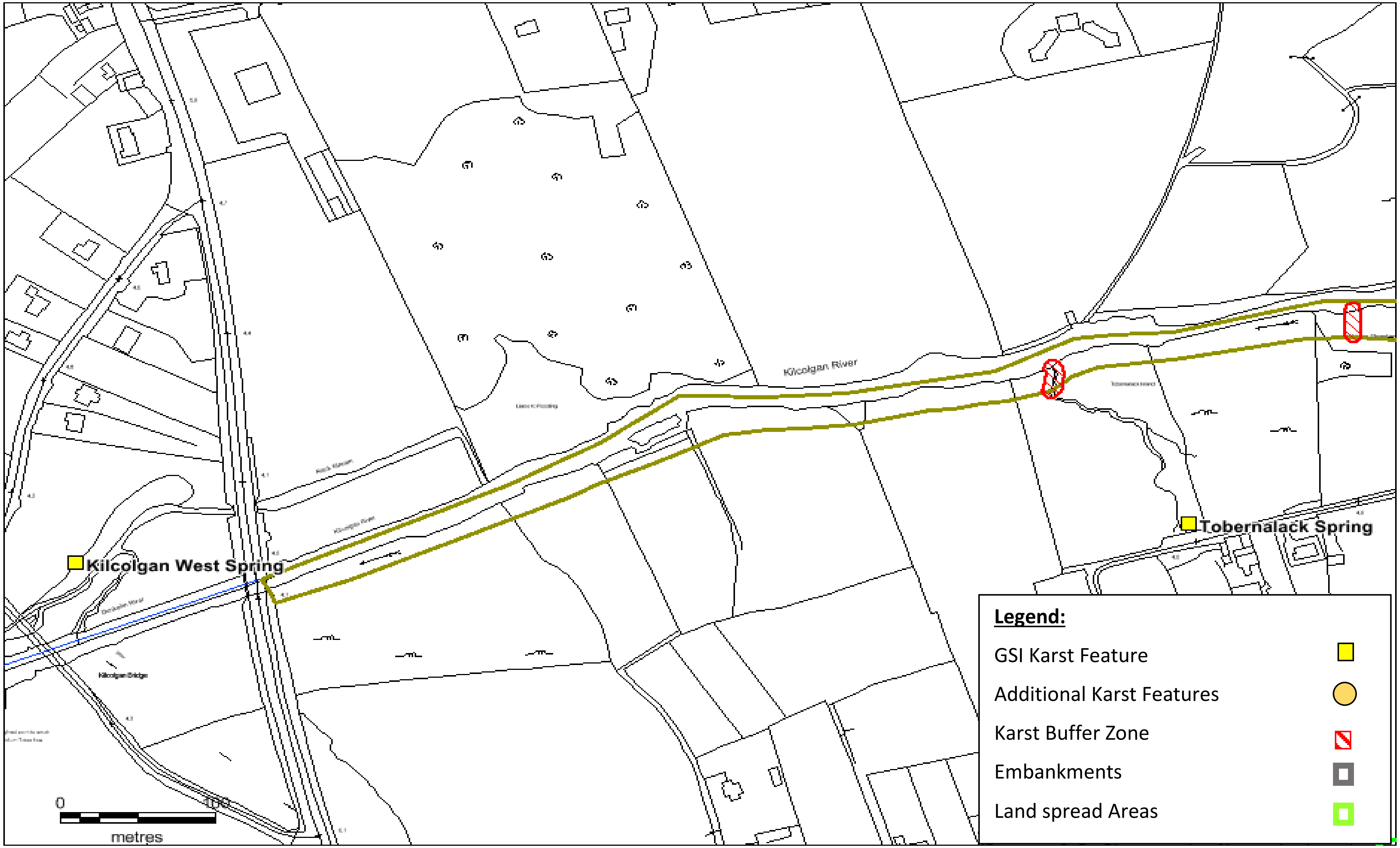


Figure 2.1 - Karst Features and Proposed Landspreading Areas (N18 Bridge, Kilcolgan to Tobernalack)

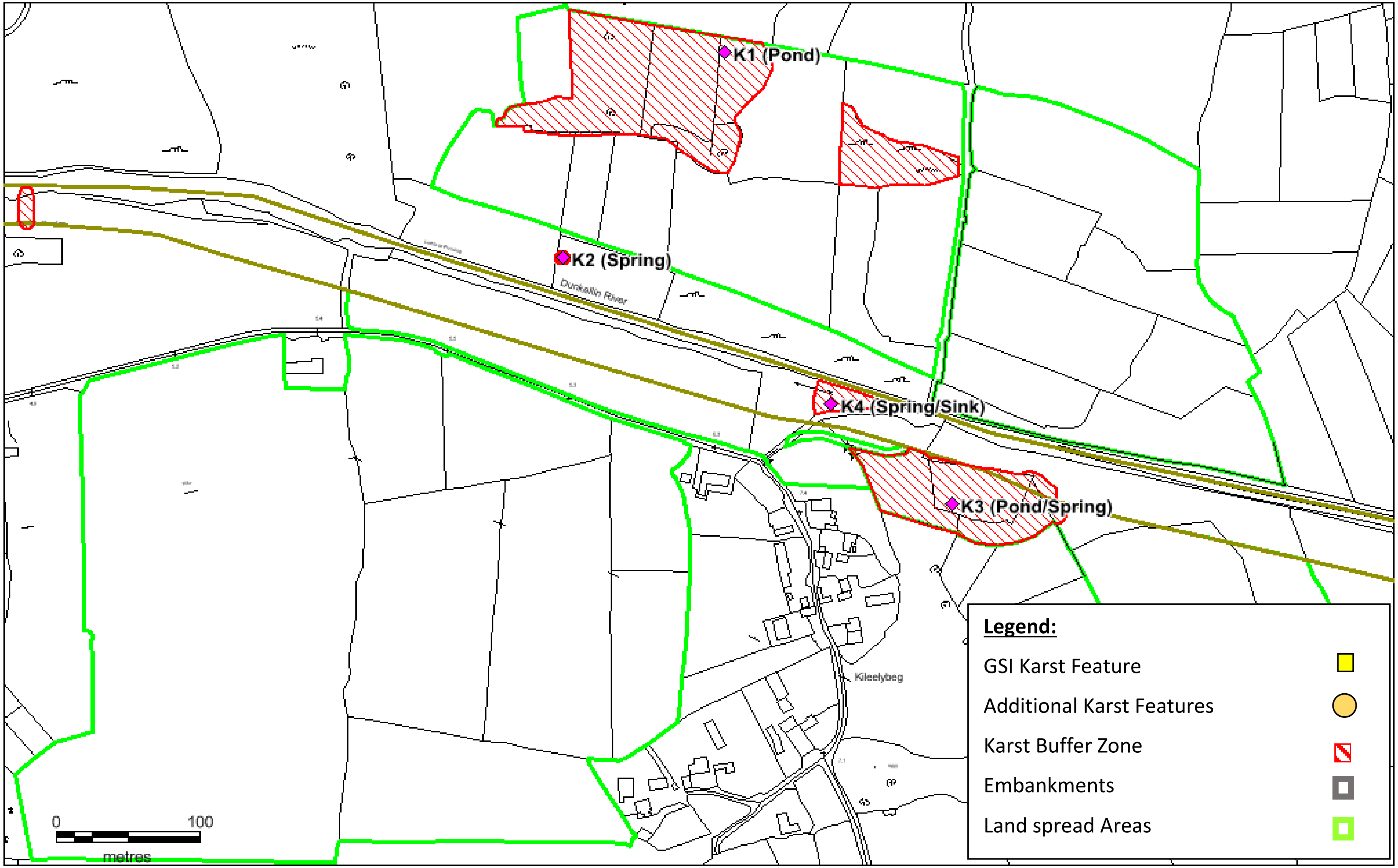


Figure 2.2 – Karst Features and Proposed Landspreading Areas (Tobernalack to Killeely Beg)

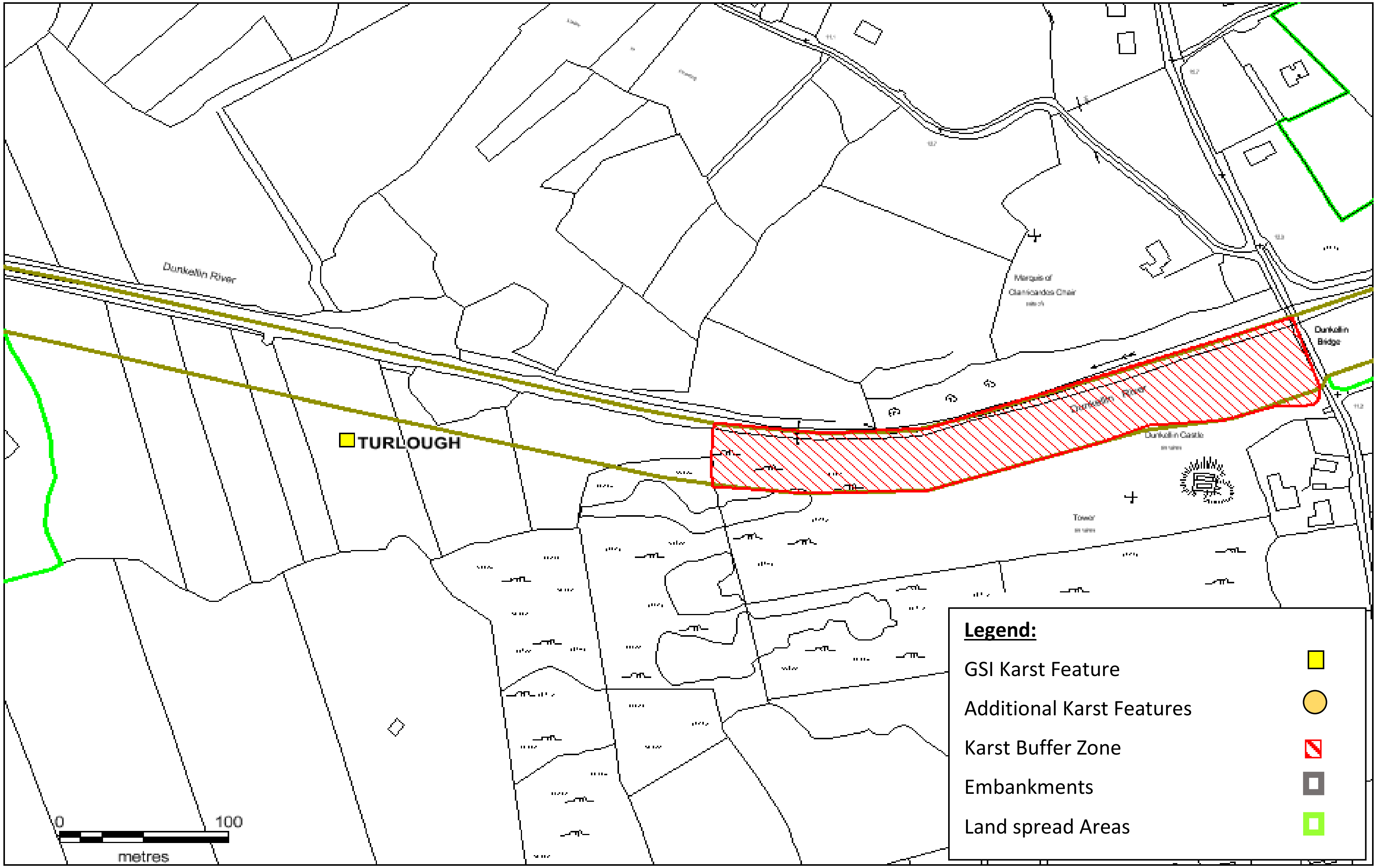


Figure 2.3 – Karst Features and Proposed Landspreading Areas (Killeely Beg to Dunkellin Bridge)

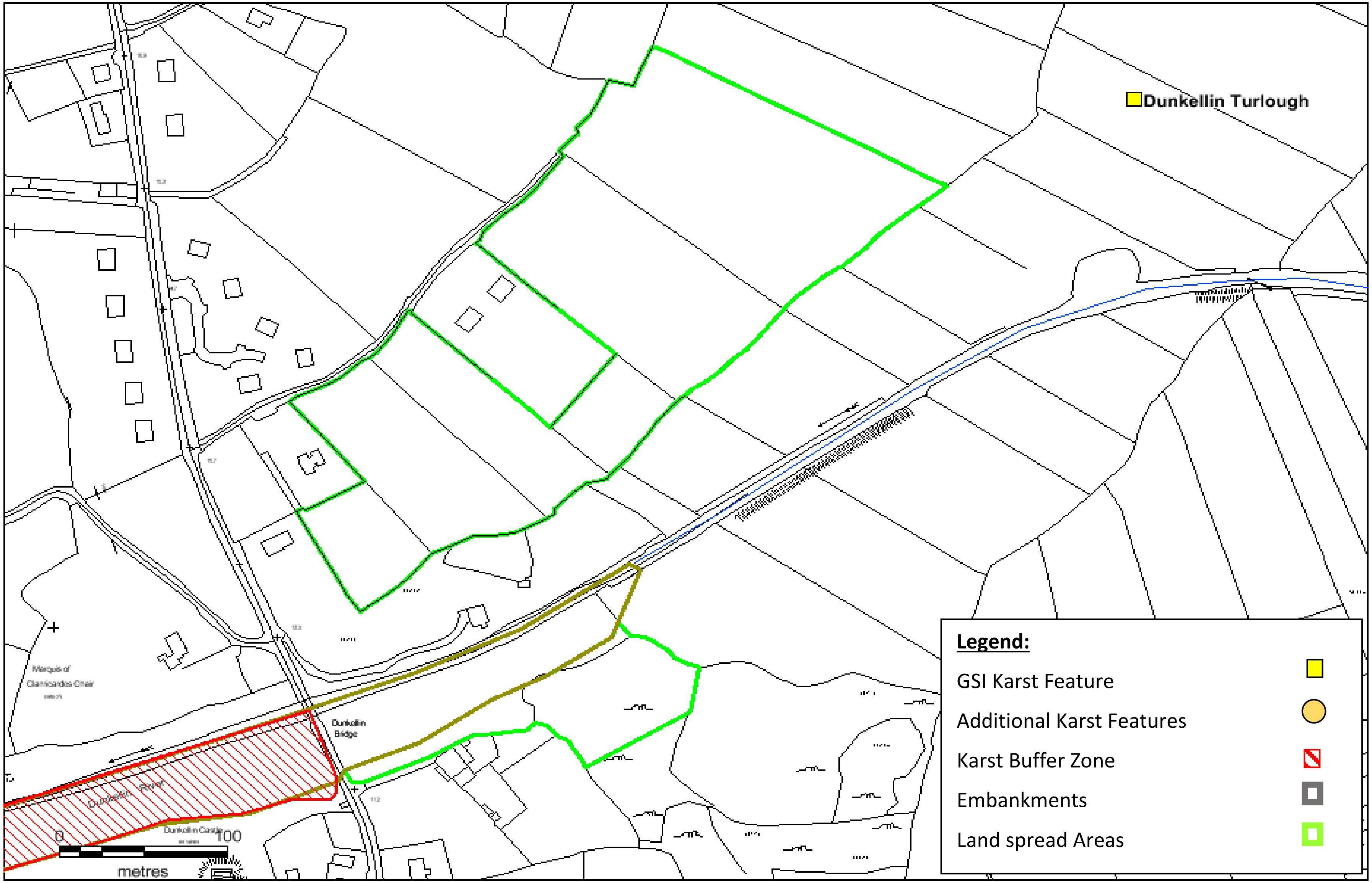


Figure 2.4 – Karst Features and Proposed Landspreading Areas (Dunkellin Bridge to Dunkellin Turlough)

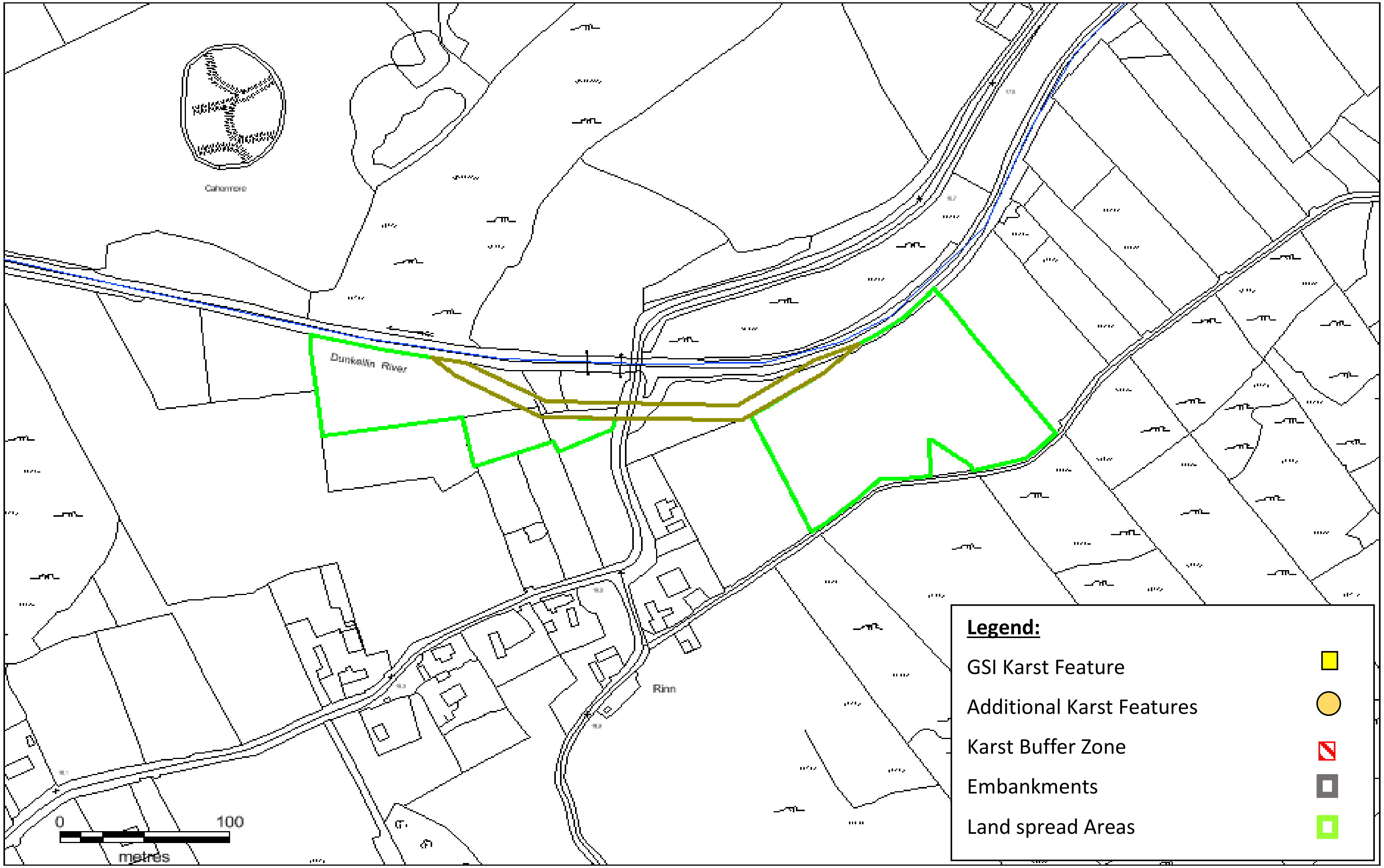


Figure 2.5 – Karst Features and Proposed Landspreading Areas (Dunkellin Turlough to Rinn Bridge)

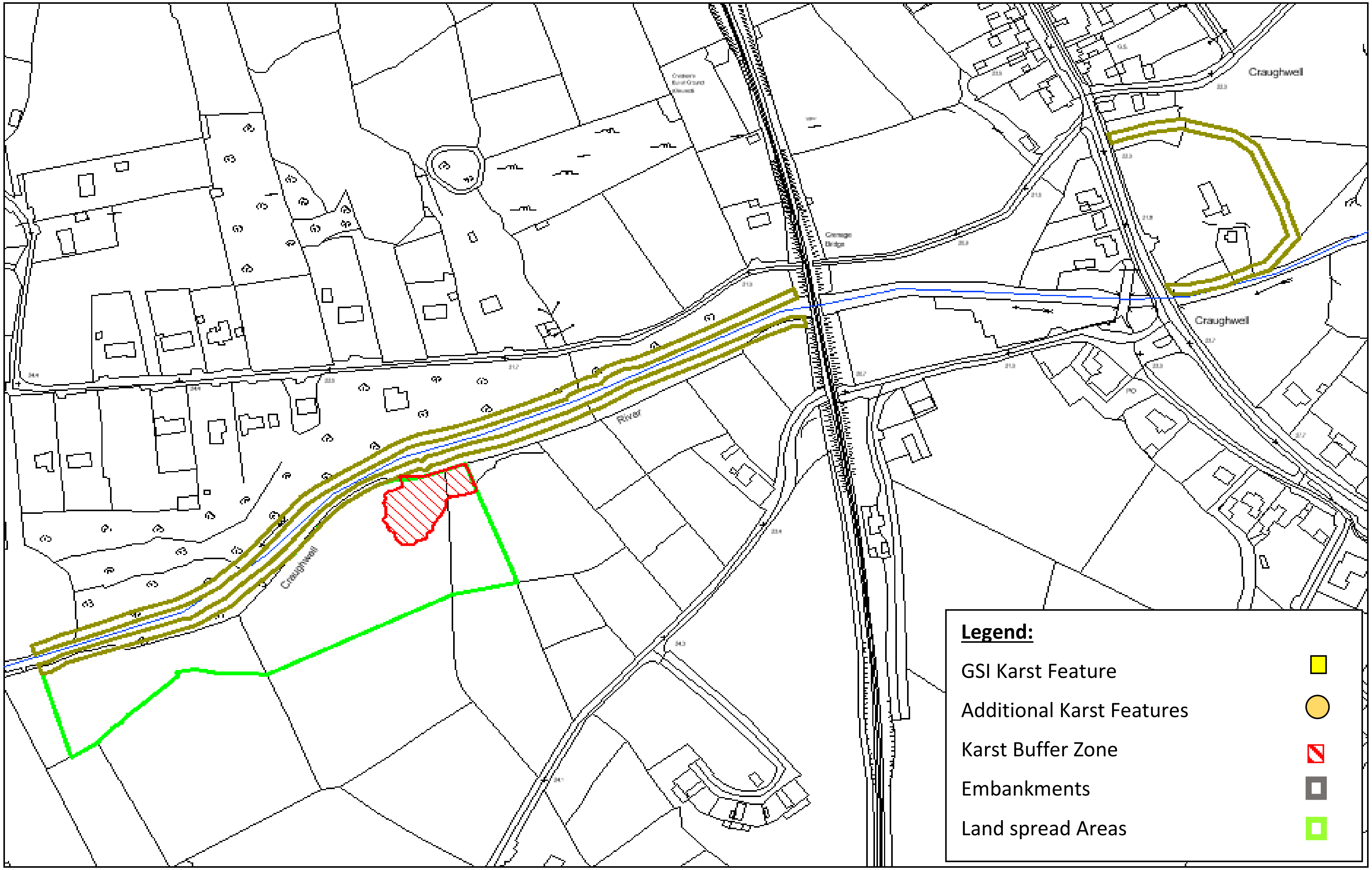


Figure 2.6 – Karst Features and Proposed Landspreading Areas (Crinnage to Grange Bridge, Craughwell)

The spreading of additional sediment may locally limit the recharge potential of surface water into the bedrock aquifer. The river corridor where the land spreading is to occur is primarily a discharge zone for the karst system. This is evident in the nature of karst features identified in the area (springs and turloughs) which are more representative of discharges from the karst system as opposed to recharge features (such as dolines and swallow holes) which are more typical of recharge zones.

Any recharge that does occur along the river corridor will mostly discharge directly through the epikarst into the Dunkellin River, which is the main discharge feature in the area. Any local reduction in recharge along the river corridor will be minute on a catchment of this scale and will discharge locally to the river in any event, meaning the overall impact will be imperceptible.

It is possible that the groundwater flow through the karst fissure system could be altered by the entrainment of an additional sediment load into the system. The entrainment of sediment into cavities will only occur where the sediment has mobilised from the initially spread location and subsequently flows into the cavities. The most likely process for the mobilisation of the sediment is where the spoil is placed directly onto areas where karstified limestone at surface allowing direct filtration of sediment through cracks in the rock.

Areas which are more at risk to the direct entrance of sediments into the karst rock are highlighted in **Figure 2.1**. These areas comprise the 5m buffer around discrete karst features and locations where rock is within 0.5m of ground surface.

Karst features have been identified by the GSI and supplementary karst mapping has been conducted during the hydrogeologist site walk over completed in April 2015 and the geophysical survey completed in June 2015. The GSI vulnerability maps areas of rock close to surface (classified as X-Extreme) which represents locations where rock is within 1m of surface. The GSI mapping has been used in conjunction with information from the hydrogeologist site walk over and the site investigation information to identify areas where the rock is expected to be within 0.5m of surface.

Areas where karst rock is close to surface (less than 0.5m) will require appropriate geotechnical design to minimise the percolation of sediment through the karst rock and into fissures. This may require the placement of a geotextile beneath the spread material. The most appropriate approach will be defined at detailed design stage to achieve this objective within these areas.

Sediment runoff may also occur close to open channels where the runoff velocity increases and turbulent flow occurs. The final topography of land spread material will be flat and therefore turbulent runoff is not expected overland outside of the existing surface water channels. However 5m buffers have been defined around surface water channels to highlight areas where measures are required to prevent erosion of spread material.

There are also some small land parcels currently not farmed within the selected spoil spread areas that will require some site preparation in advance due to presence of loose rock and boulders, these have also been included in the areas zoned on **Figure 2.1**.

2.3 In view of the above and in the particular circumstances of this case it is considered that the site investigations for the purposes of detailed design should be undertaken at this time. The applicant is requested to undertake a geophysical survey of karst features within lands affected by the proposed scheme including areas to be used for construction compounds, access tracks, spoil spreading and construction of embankments.

Response

Site investigation works were carried out in August and October 2014 to facilitate the future design of the scheme. The completed SI report is included in **Appendix C** to this response. These site investigation works included a geophysical, p-wave seismic refraction, survey to prove the top of bedrock. The geophysical survey has been completed and is provided in **Appendix D**. The survey included seismic, conductivity and EM61 resistivity surveys. The conductivity and resistivity surveys were completed on areas mapped as having a higher potential for karst features based on the hydrogeologist's walkover. The survey identified a number of karst anomalies at surface and at greater depths. These anomalies have been reviewed by the hydrogeologist in the context of the site walkover and other site investigation areas. Areas where alternative land-spreading arrangements will be considered are outlined under **Section 2.2**. Individual karst features and the associated geophysical data is presented under **Section 2.4**.

The technical description of the proposed scheme provides an outline detail of the envisaged access points to the proposed Works Areas and these are summarised as follows and detailed on the relevant Drawings accompanying the EIS:

- Access Point No. 1 (Refer to Drawing No. 6408-2202) - Provision of an access point into the Dunkellin River downstream of Killeely Beg Bridge.
- Access Point No. 2 (Refer to Drawing No. 6408-2202) - Provision of an access point into the Dunkellin River for works downstream of Killeely Beg Bridge to Kilcolgan Bridge.
- Access Point No. 3 (Refer to Drawing No. 6408-2202) - Provision of an access point into the Dunkellin River for works upstream of Killeely Beg Bridge to Dunkellin Bridge.
- Access Point No. 4 (Refer to Drawing No. 6408-2203) - Provision of an access point into the Dunkellin River for works downstream of the Dunkellin Beg Bridge to Killeely Beg Bridge.
- Access Point No. 5 (Refer to Drawing No. 6408-2203) - Provision of an access point into the Dunkellin River for works upstream of the Dunkellin Beg Bridge.
- Access Points No. 6 and 7 (Refer to Drawing No. 6408-2204) - Provision of an access point into the Dunkellin River for works at Rinn Bridge.
- Access Point No. 8 (Refer to Drawing No. 6408-2208) - Provision of an access point into the Dunkellin River for works downstream of the Railway Bridge at Craughwell Village.
- Access Point No. 9 (Refer to Drawing No. 6408-2208) - Provision of an access point into the Dunkellin River for works upstream of the Railway Bridge in Craughwell Village.
- Access Point No. 10 (Refer to Drawing No. 6408-2208) - Provision of an access point into the Dunkellin River for works upstream of the R446 at Craughwell Village.

It is envisaged that there will be four main site compounds, varying in size to reflect the extent of works being undertaken at each location, which include short term staff welfare facilities and plant and materials storage for the proposed works. The final location of these compounds is unknown at the present time and will be confirmed by the Works Contractor following direct Contractor liaison with each relevant landowner. It is envisaged that these compounds will be located a minimum of 50m to 100m from the Dunkellin River.

1. Site compound at Killeely Beg Bridge. It is envisaged that this compound will be located on lands to the north of the channel and adjacent to Killeely Beg Bridge. These lands are coloured green on Drawing No. 6408-2203 Rev G at cross section "DK33". This area is noted, in Chapter 10 of the EIS, as being "improved agricultural grassland".
2. Site compound at Dunkellin Bridge. It is envisaged that this compound will be located on lands adjacent to Dunkellin Bridge. These lands are coloured green on Drawing No. 6408-2203 Rev G at cross section "DK30". This area is noted, in Chapter 10 of the EIS, as being "improved agricultural grassland".
3. Site compound at Rinn Bridge. It is envisaged that this compound will be located on lands to the east of Rinn Bridge. These lands are coloured green on Drawing No. 6408-2204 Rev G at cross section "DK25". This area is noted, in Chapter 10 of the EIS, as being "improved agricultural grassland".
4. Site compound at Craughwell Village. It is envisaged that this compound may be placed at a number of locations in the village of Craughwell. A number of the possible locations are shown as a red circle in the following aerial view of the village. These are noted, in Chapter 10 of the EIS, as being "improved agricultural grassland", "scrub" and "Buildings and Artificial Surfaces". The potential locations of the site compounds at Craughwell are provided in **Figure 1.1** below.

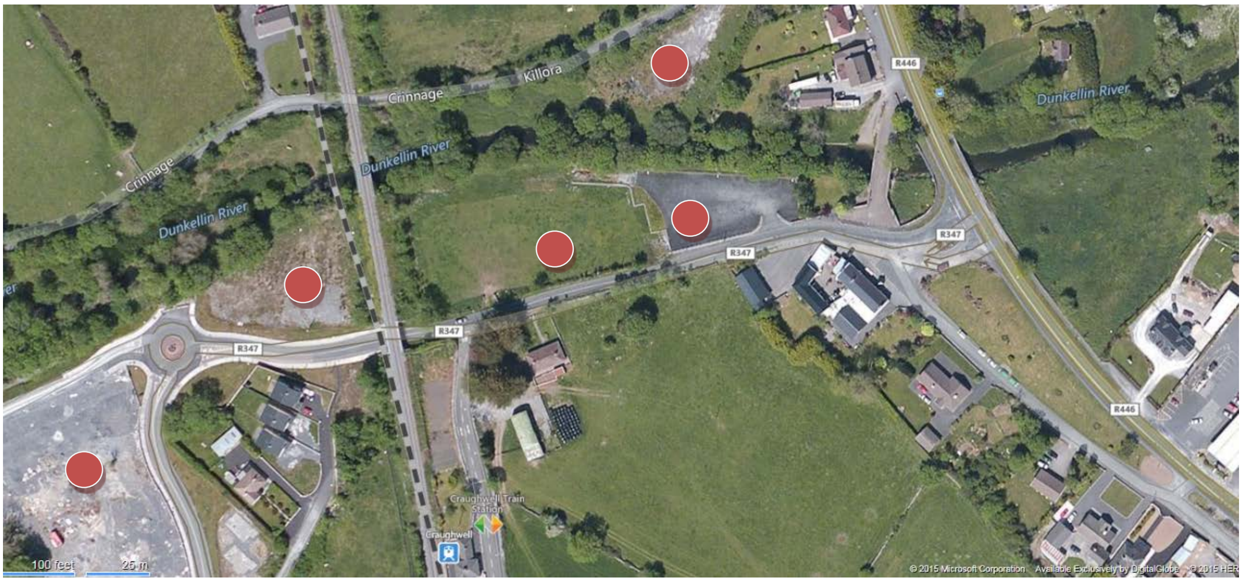


Figure 2.7 – Potential Site Compounds Locations at Craughwell

Any surface topsoil within the proposed site compounds will be removed and temporarily stored for reinstatement of all lands once work is completed. Following clearing of topsoil from the compound area it is envisaged that the working surface will be formed from imported clean stone laid on a temporary geomembrane.

None of the compound locations are within or adjacent to karst features.

2.4 Where karst features are identified, they should be clearly shown on constructive drawings along with any associated buffer zones. Any necessary re-design of the scheme should be undertaken. It is anticipated that the geophysics survey and associated commentary presented will enable the Board inter alia to consider risks of impacts on smaller turloughs and on surface water flows.

Response

A site investigation programme was completed for the project by Priority Geotechnical Limited between April and July 2014. The results of the site investigation are provided in **Appendix C**. The scope of work included the drilling of boreholes using cable percussion (20 No.) and rotary coring (32 No.), the excavation of trial pits (43 No.) and the completion of a geophysical survey. In situ and laboratory testing were completed to determine the geotechnical properties of the soils, subsoils and bedrock. The only karst feature identified during drilling was a shallow in-filled cavity/ fracture feature at RC42 which was noted between 3.8m to 4.8m below ground level.

Karst Feature mapping was completed by RPS Senior Hydrogeologist Gerry Baker in April 2015. This included a desk based review of potential karst features identified from aerial photography and historical maps. The main karst features in the area such as the Rahasane and Dunkellin turloughs are well known and are recorded in the GSI karst database. Karst features which are not included in the existing GSI database were identified through this process and subsequently visited on site. The karst features within the land spreading areas are illustrated in **Figures 2.1 to 2.6** and are labelled K1-K4. Further information on these features is provided below.

Following the completion of the hydrogeological walkover some additional areas were defined for further investigation. A supplementary geophysical programme was developed to investigate the nature of the geological environment in these areas. The results of that geophysical survey are presented in **Appendix D**. The report highlights some clear anomalies in the geophysical survey that relate to karstifed bedrock.

<u>K1 - Pool at Killeely Beg (Grid Reference ITM 543010 718816)</u>

The most significant anomaly identified in the geophysical surveys relates to a feature identified along survey section R3. The feature is an ephemeral pond surrounded by marshy land as shown in **Figure 2.2** and **Images 2.1 to 2.3**. The feature is shown on historical maps as a spring that originally flowed to the north to join the other springs at Killeely Beg before ultimately discharging back into the Dunkellin River further downstream. One of the other Killeely Beg springs to the north is noted in the GSI karst data base (Feature No. 1421SWk066). It would appear the field boundary walls now prevent the spring from overflowing. As a result a pond is formed, the level of which would relate to the hydraulic head driving the original spring. This feature may in effect function hydraulically in a similar fashion to a small turlough.

The geophysical survey sections R3 and R4 transect this area. Excerpts from the mapping are shown in **Images 2.1** and **2.2** below. R3 shows the strongest anomalous resistivity measured anywhere during this survey. R3 shows both shallow and deep karstification indicative of clay and water in-filled cavities. In contrast R4, which lies between the feature and the Dunkellin River shows no anomalies at depth suggesting that the pool along R3 is not directly linked with a karst fissure to the river but rather connects to a deeper fissure which would have originally then overflowed to the north (see **Figure 2.8**).

Image 2.1 - Karst Feature at Killeely Beg

Image 2.2 - Pond within Karst Feature at Killeely Beg

Image 2.3 - Vegetation at Karst Feature at Killeely Beg

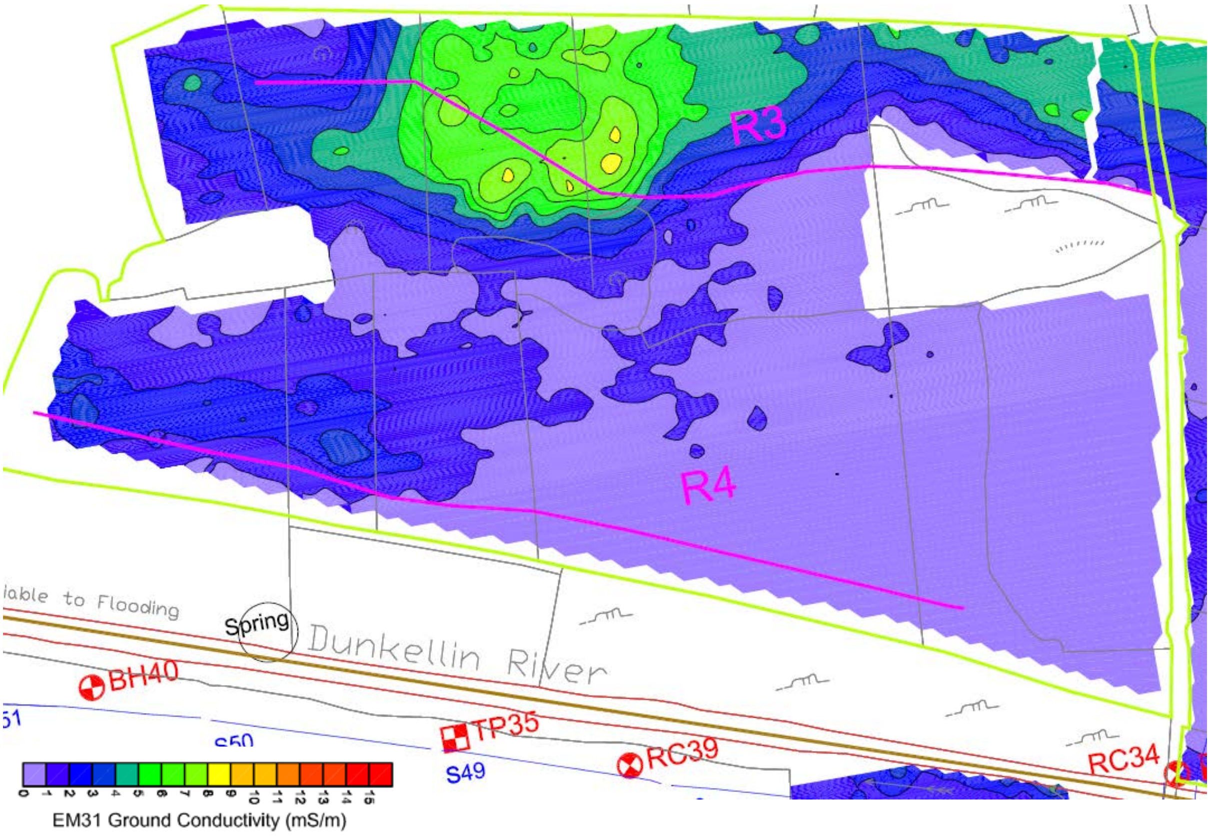


Figure 2.8 - EM31 Conductivity at Kelleely Beg Pool.

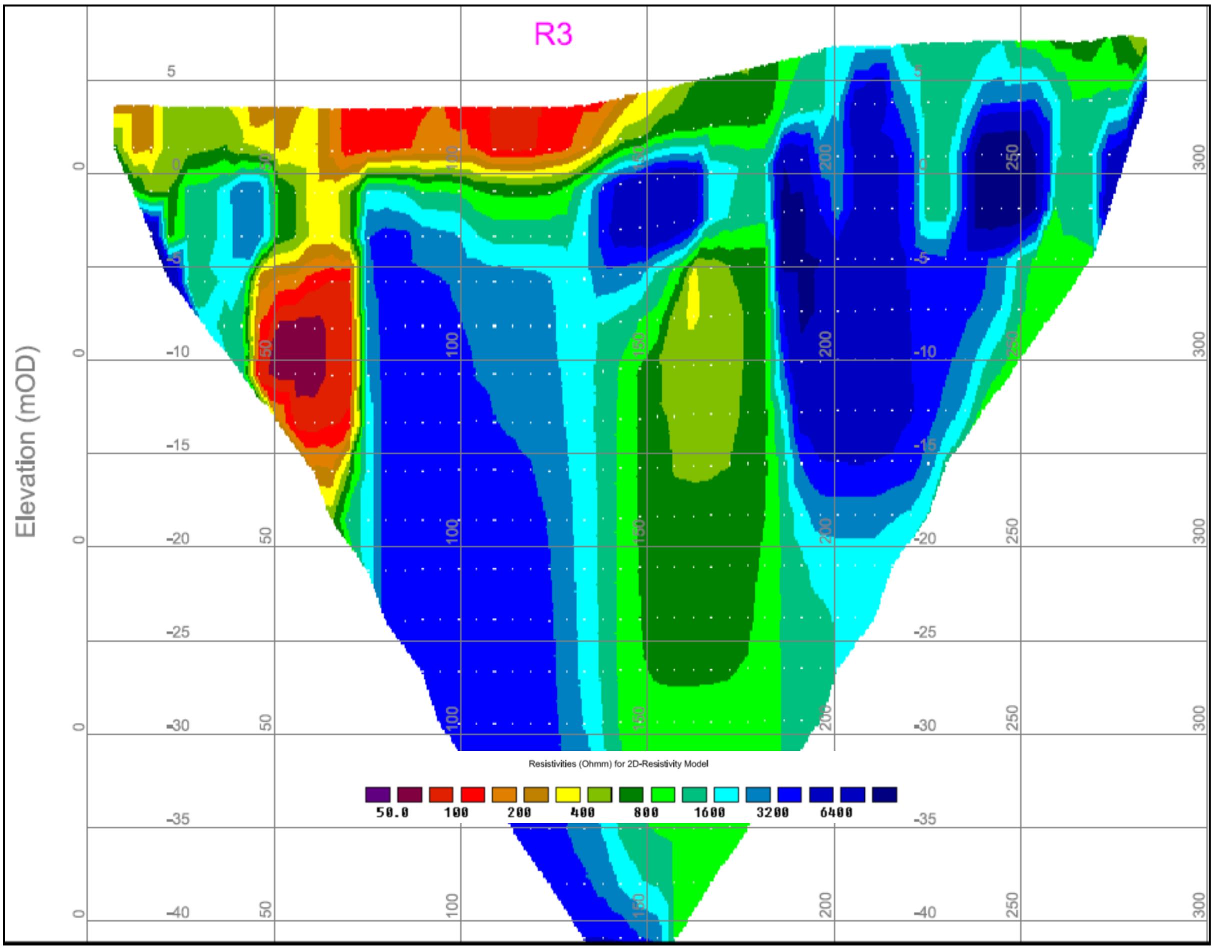


Figure 2.9 - Resistivity Survey R3 through Pond Feature at Killeely Beg

K2 - Spring at Carranhally (Grid Reference ITM 542858 718662)

This is a large pool adjacent the Dunkellin River which overflows into the river, see **Figures 2.2 and Figure 2.10** and **Images 2.4 and 2.5** below. The overflow from the pool is significant, possibly up to 100 l/s. It is possible that when the Dunkellin River is in flood the spring is engulfed but at lower flows it appears to be a discrete feature. The feature does not appear on the historical maps for the location. The historical maps pre-arterial drainage indicate the feature was within the original river channel and may have functioned as an underwater discharge feature providing baseflow to the river. The historical maps post-arterial drainage show the narrower river channel but no clear spring is identified.

There was no geophysical survey conducted in the immediate vicinity of the spring as there is no land spreading or embankment proposed at this location. Resistivity section R4 passes adjacent the feature to the north. The section shows a trough in the ground resistivity adjacent the spring which may relate to spring feature, see **Figure 2.11.**

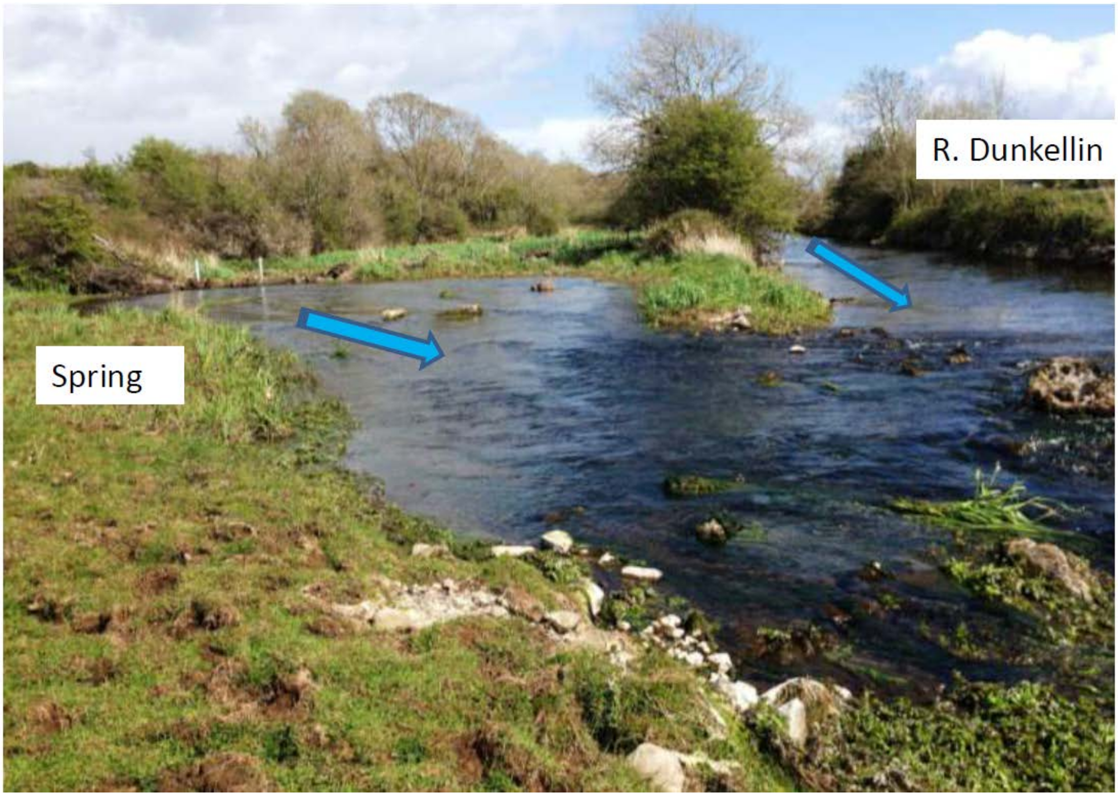


Image 2.4 - Spring at Carranhally looking upstream (Photo No. Img3655)

Image 2.5 - Spring at Carranhally looking downstream (Photo No. 3652)

Figure 2.10 - Spring at Carranhally aerial photo and location of photographs.

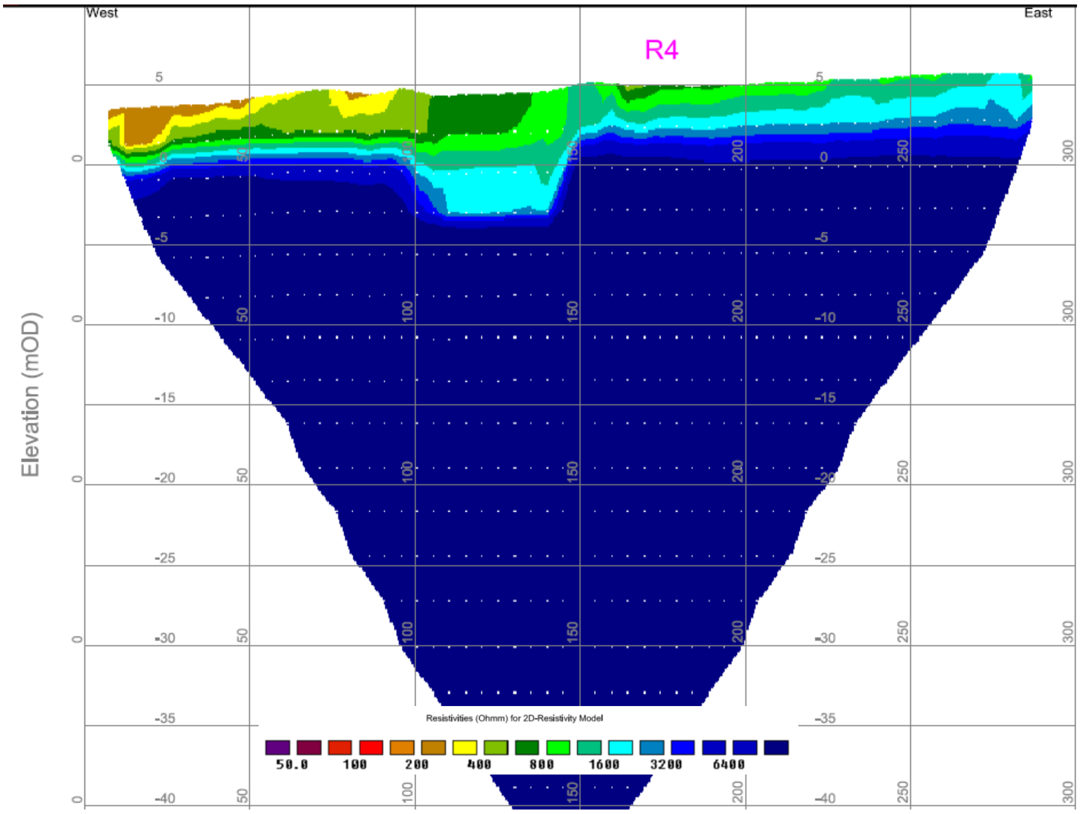


Figure 2.11 - Geophysical Section R4 with Spring Feature highlighted

K3 – Pond/Ephemeral Spring at Killeely Beg (Grid Reference ITM 543114 718485)

This feature appears as a small pool approximately 73m south of the Dunkellin River at Killeely Beg Bridge, see **Figure 2.2** and **Image 2.6**. The electrical conductivity of the water in the pool was measured on site and found to be 540 µS/cm. This is indicative of groundwater in limestone aquifers rather than ponded surface water (pluvial water) where the conductivity would be much lower (<100 µS/cm). There appears to be an overflow channel from the pool which flows north to the river. It is likely that when the hydraulic head in the aquifer is sufficiently high the water from the pond will rise to overflow down the channel into the river. The feature is located within the flood extent of the river and therefore once the river floods it will become engulfed by the main channel.

A review of historical mapping pre-arterial drainage for the location illustrates that the original course of the Dunkellin River passed over the feature (see **Figure 2.12**). It appears the river possibly sank into a swallow hole and remerged at the location of the pool. The intervening area appears to act as a turlough type feature and would appear to connect to the larger turlough area to the east which is noted on the GSI karst database.

The feature may therefore represent a remnant karst feature which previously functioned as the upwelling for the Dunkellin River but now is a small groundwater pool which is connected to the underlying karst aquifer and overflows to discharge into the river when the head in the aquifer is sufficiently high, but subsequently becomes engulfed by the river during flood events where the river bursts its banks.

Site investigation results in the vicinity of the location at borehole RC37 indicate the depth to bedrock is 3.2m and the bedrock is slightly weathered. The geophysical survey in this area shows a string of small anomalies in the EM conductivity survey and a trough in the resistivity section (see **Figure 2.13**. These both indicate shallow karst features rather than fissure connected to deep conduits.

Image 2.6 - Ephemeral Spring at Killeely Beg, looking north towards R. Dunkellin

Figure 2.12 - Historical Map at Killeely Beg (showing location of ephemeral spring)

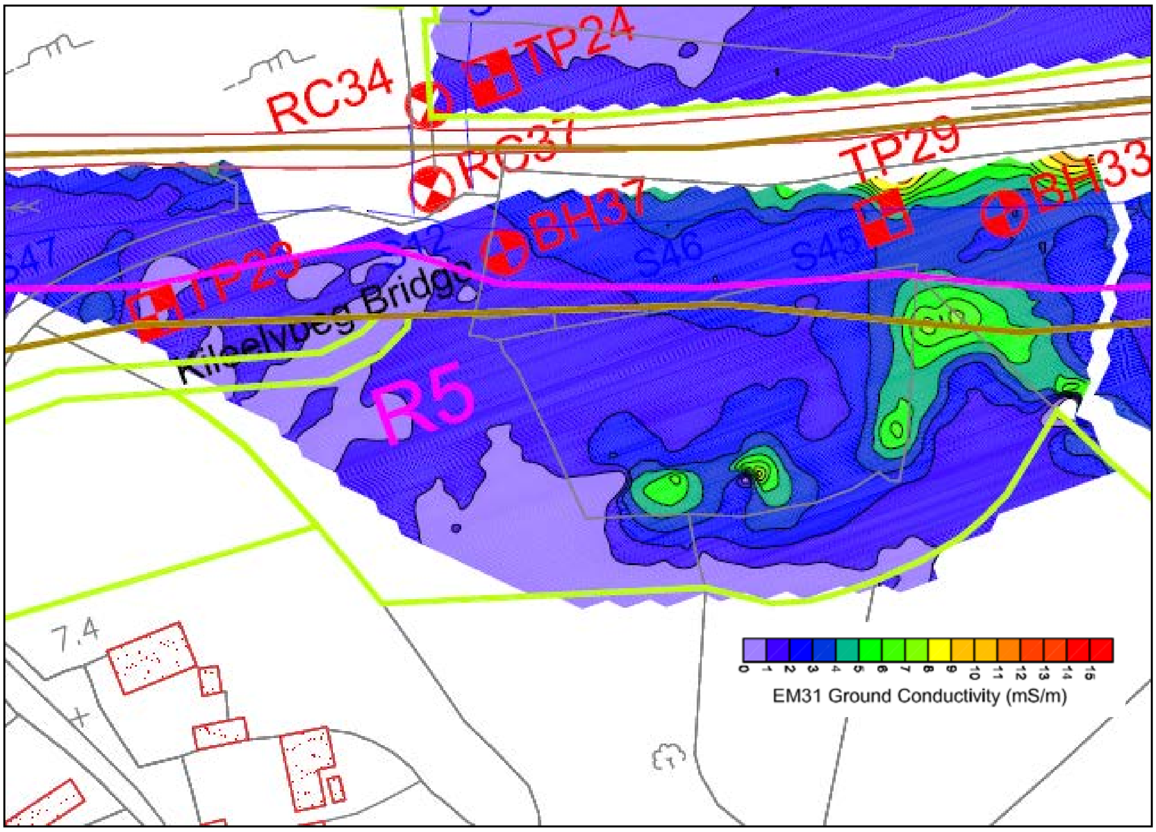


Figure 2.13 - EM Survey Results at Ephemeral Springs at Killeely Bridge

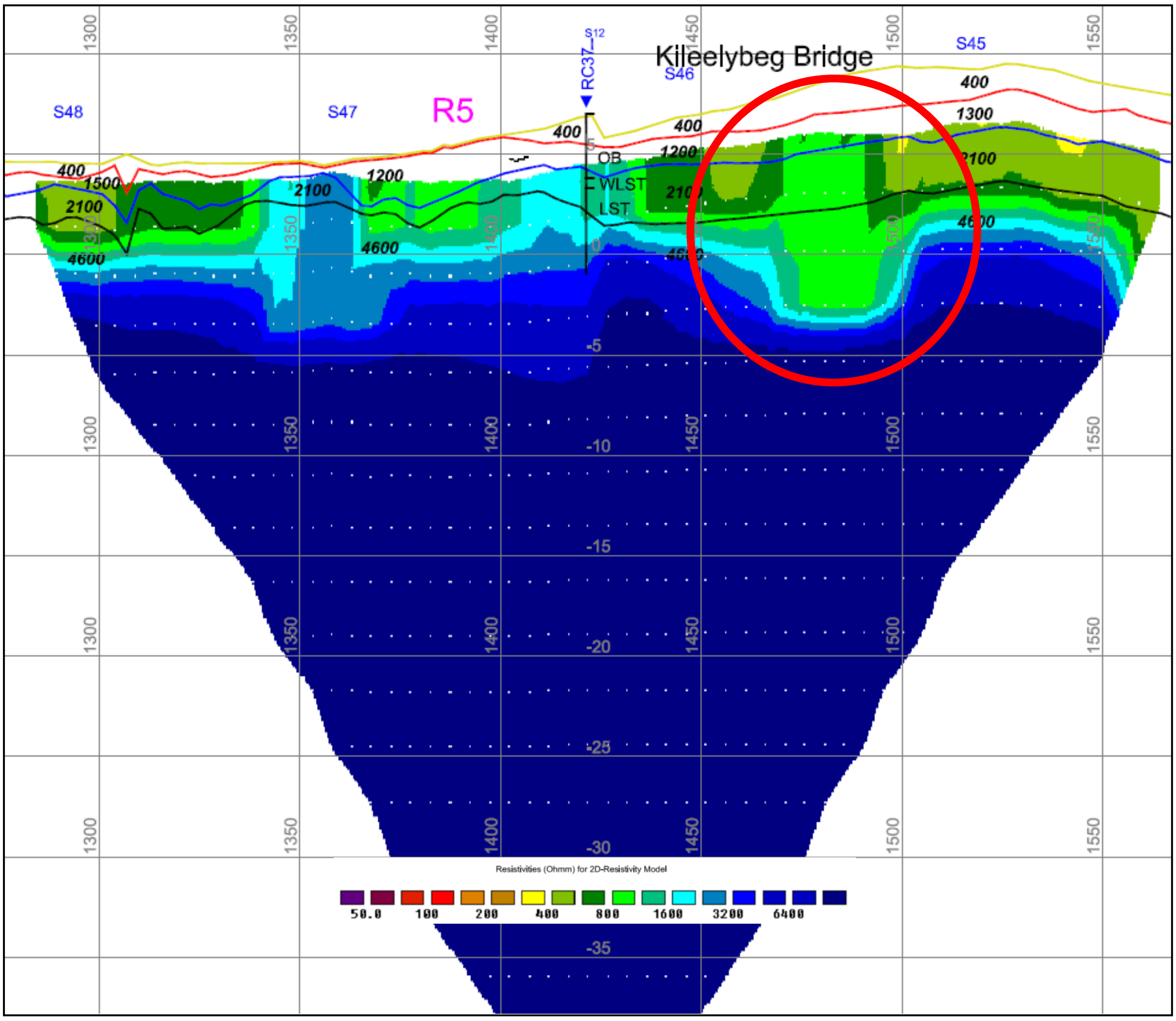


Figure 2.14 - Conductivity Section R5 with Ephemeral Spring at Killeely Beg Highlighted

K4 - Ephemeral Spring /Sink at Killeely Beg Bridge (Grid Reference ITM 542566 718681)

This feature was dry when visited during the walkover but the subdued nature of the ground and coating of the exposed rock in algal matter indicated that surface water had sank through the feature in draining the land see **Figure 2.2** and **Images 2.7 to 2.9**. It is likely the feature acts as a spring where the water-table is above ground level and then alternatively provides a sink for intermittent flood waters where these are at a higher elevation than the groundwater level. The geophysics does not show any significant anomaly in this location which implies this may be a less significant feature in terms of its connection to the overall karst fissure network, but may be a shallow connection to and from the river via the epikarst layer.

Image 2.7 - Karst feature K4

Image 2.8 - Karst feature K4

Image 2.9 - Karst feature K4

Ephemeral Spring at Crinnage – Grid Reference (ITM 542858-718662).

This spring is outside of the land spreading area and is therefore not shown on the maps but details are provided here for inclusion in the karst database. The spring is shown on the historical mapping, current OSI mapping and aerial photographs but is not in the GSI karst database, see **Figure 2.15** and **Image 2.10**. The spring channel is approximately one metre deep. The spring was dry during the site visit but it seemed clear from the depth of the channel, the sculpting and erosion patterns on the banks that there can be a considerable flow when the spring becomes active.

Geophysical surveys were not undertaken within this area as there is no land spreading proposed in this vicinity.

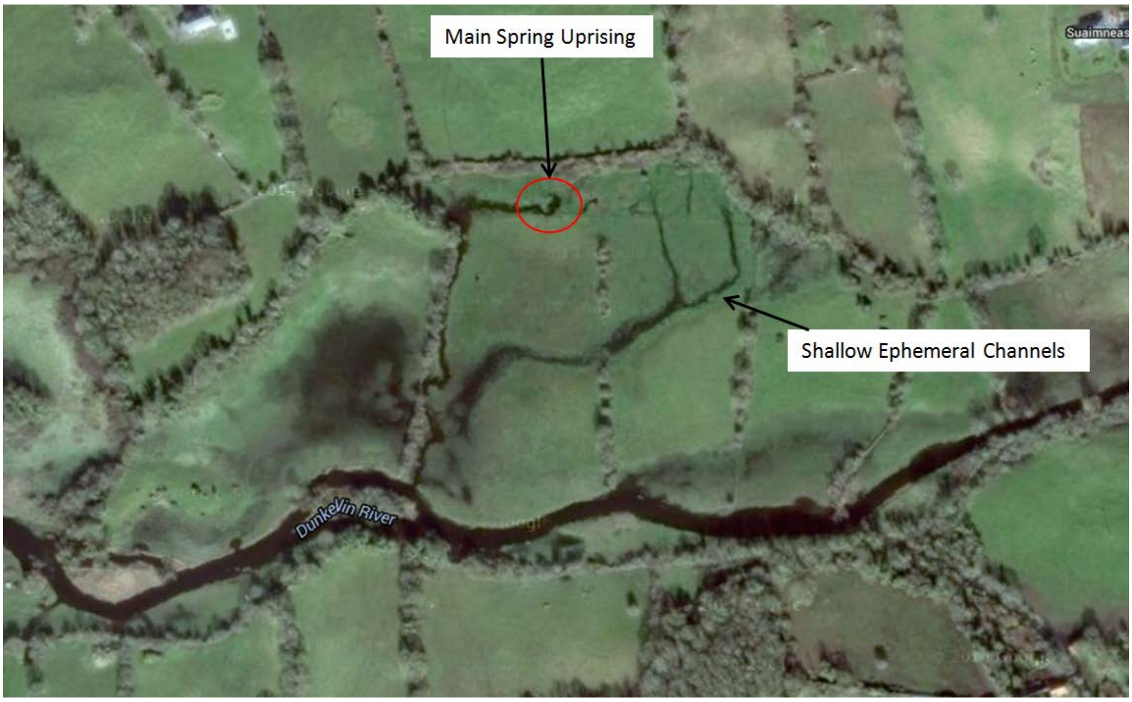


Figure 2.15 - Spring at Crinnage - Location on Aerial Photo

Image 2.10 - Spring at Upwelling Location, dry at time of site visit (28/04/2015)

3 ITEM 3 – CONSTRUCTION MANAGEMENT PLAN

3.1 ***Following on from the above the applicant is requested to present a detailed construction management plan (CMP) addressing all recommendations presented in the EIS and the NIS. Measures to control significant flood water or groundwater which might be encountered during construction shall be presented. It is noted that the information presented by the applicant contains many appropriate measures but it is considered that the CMP should be compiled into one document and be fully detailed at all time. All commitments should be firmly stated. If a preferred approach cannot be undertaken then specific alternative(s) should be contained in the CMP. This information is necessary to enable the Board to carry out an environmental impact assessment and an appropriate assessment in this case****.*

Response

The EIS sets out a comprehensive range of protection and mitigation measures to cover each stage of the construction process from site preparation, earthworks, excavation, transportation of material etc. The mitigation measures, which are repeated in the NIS, include well established and recognised protective measures which are standard best-practice to control erosion, drainage and sediment release and will carry through all phases of the works. The EIS and NIS, fully describe the phases of the project including the extensive and robust protective measures incorporated into the proposed development. There are no aspects of the project or its mitigation to be designed at the construction stage. A draft Construction Management Plan (CMP) has been prepared and is available in **Appendix E** to this report. This document incorporates all of the recommendations presented in the EIS and NIS for the scheme.

4 ITEM 4 – MONITORING & REMEDIAL STRATEGY

4.1 It is noted that the EIS identifies a need for a further 12 months of water monitoring and further ecological monitoring at Rahasane Turlough. It is stated that this will enable further calibration of the model and a review of the potential impacts on the turlough if necessary. Please clarify why this information has not been provided with the application submissions. Please comment on its relevance for the purposes of appropriate assessment and whether this information is necessary to enable the Board to fully consider the effects of the scheme and determine the case in the context of the best scientific information.

Response

As outlined in the EIS, Volume 2, Section 9.5.2, the following was recommended regarding groundwater monitoring;

'There has been limited monitoring of the groundwater levels and turlough levels at Rahasane Turlough. As such, the hydrogeological conditions controlling the water level fluctuations are poorly understood. It is recommended that groundwater level monitoring and turlough stage monitoring are undertaken as part of the scheme. The monitoring should be coordinated with the Environmental Protection Agency (EPA) who is required to monitor the hydrogeology of the turlough under the Water Framework Directive (WFD) as it constitutes a groundwater dependant ecosystem.'

4.2 It is stated that operational phase monitoring is also proposed and that if such monitoring indicates changes to Rahasane Turlough cSAC, remedial measures will be put in place. In view of the dynamic nature of the karst environment and the potential for impacts which are not related to the scheme, it is considered that the applicant should identify a suitable group of indicators at this time. The Board may require that pre-construction monitoring of these indicators be undertaken.

The indicators identified to monitor the potential changes in Rahasane Turlough cSAC include terrestrial, aquatic, hydrological and hydrogeological.

A total of thirteen longitudinal transects have been identified with a series of relevés identified along the transects to monitor vegetation communities. These transects extend from the 16.5 mO.D. contour and run perpendicular to the Dunkellin River, i.e. running in a general north to south plane across the turlough basin. The location for each relevé is determined by discrete changes in the turlough basin's topography, sourced from the baseline topographical lidar surveys and topographical surveys of the turlough (See **Figure 4.1**).

Please see **Section 1.3** (ABP_0001 Item 1B) of this report which provides a full explanation, for a suitable group of aquatic invertebrate indicators as requested under this item, in the context of what are deemed "ecologically critical" water levels.

There is surface flow monitoring directly up and down stream of the turlough at the gauges No. 29010, 29007, 29002. An analysis of the hydrographs from these gauges shows this section of the river which flows though the turlough fluctuates between a losing and gaining stream (with respect to groundwater) throughout the year.

There are three groundwater monitoring wells present in the turlough. Three groundwater monitoring boreholes have been identified within the turlough which were installed during a previous flood alleviation study, BH 1 Rinn Basin, BH 2 Killeeneenmore, northern basin of Rashane Turlough and BH 3 is situated in Aggard More in the southern basin.

4.3 It is considered that the application should be accompanied by a comprehensive and feasible remedial strategy as recommended in the EIS. The applicant is requested to present this strategy.

Response

As noted in the EIS it is proposed that if operational monitoring indicates that there are recorded changes to vegetation within the Rahasane Turlough cSAC as a result of the proposed flood relief scheme (i.e. measurable change in water level in the Turlough despite minimal change in recorded flow) remedial measures will be put in place to rectify the matter.

On the assumption that one of the long term risks associated with the proposed works is the potential for the scheme to reduce flooding within the turlough (i.e. risk of water levels in the Rahasane and Rinn basins being reduced) monitoring will include a review and recalibration of the Craughwell Gauging Station (upstream flow) and a review and recalibration of the Rahasane Gauging Station. These stations will allow Galway County Council to monitor river flow into and from the turlough.

The mathematical model predicts that the main hydraulic control at the turlough is the downstream channel from the main water body to the Rinn Bridge. This channel forms a natural restriction which controls the water level in the turlough. Whilst one of the alternative schemes considered as part of the initial studies to provide flood relief to properties along the northern boundary of the turlough was to alter this hydraulic restriction and construct a two stage channel from the turlough to Rinn Bridge, this work posed a significant risk to water levels in the turlough and was not considered in the final scheme.

However the scheme, as presented, proposes to construct two flood eyes at Rinn Bridge and this element of the scheme poses the main risk which may alter water levels in the turlough. A remedial strategy, if required in the future, to mitigate against the risk of reduced water levels in the turlough will include the provision of mechanical weirs/flood gates or removal/replaceable stop logs across each of the two flood eyes at Rinn Bridge. This strategy allows Galway County Council to control the discharge of flood waters across Rinn Bridge, by lowering or removing the flood gates/weirs, and also allows the Local Authority to maintain water level in the turlough by raising or installing the flood gates as necessary.

5 ITEM 5 – HYDROLOGICAL CONNECTIVITY

5.1 The appropriate Assessment Screening Report notes the potential for impacts on certain European sites was 'screened out' including by reason of lack of hydrological connectivity. Having regard to the proximity of these sites to the proposed works and the nature of the karst system, the applicant is required to identify the basis for the stated lack of connectivity.

Response

The Dunkellin River lies within a regionally important karst aquifer where groundwater flow occurs through an interconnected network of fissures throughout a range of scales. Groundwater tracing experiments in the area to date have shown groundwater connections across significant distances and also connections in directions contrary to the topographic gradients. Therefore any features contained within this karst aquifer could be to one extent or another hydrologically connected.

The potential for impact on any of the sites through a groundwater pathway within the aquifer is also dependant on the extent to which the influence of the impact can extend throughout the aquifer. The main impact on the water environment as a result of the proposed works will be the reduction in the flood water levels. During flood events the aquifer in the vicinity of the river will most likely be entirely saturated due to the excessive rainfall.

The influence of this alteration in the river stage will reduce to a negligible difference in groundwater levels within a short distance from the river bank. It is not possible to exactly predict the extent of this zone of influence given the karstified nature of the aquifer which is extremely heterogeneous and anisotropic.

In order to provide some quantitative prediction of impacts a representative groundwater 2D slice model was developed as illustrated in **Figure 5.1** below. The model is completed using the Modflow2005 groundwater flow modelling package. The model cannot represent the complexity of the karst fissure flow environment but is a useful tool to solve the groundwater flow equation based on representative boundary conditions and bulk aquifer parameter values. This is a risk based approach where if a significant potential impact is identified more complex modelling can then be undertaken.

The model contains a shallow upper layer representative of moderately permeable subsoil (permeability of 0.1m/d and specific yield of 0.01) and two underlying layers representative of a permeable bedrock aquifer (permeability of 10m/d and specific yield of 0.01). The inflows to the model are diffuse recharge [0.0011m/d, based on GSI recharge map for the area (equivalent to 400mm/yr)]. The outflow is via a river boundary cell at the left hand side of the model. The model is 1km wide and 40m deep with a top elevation of 15m.

The model is run initially in a steady state mode to allow levels to stabilise with the river stage set at 10.5m. A second transient stress period is added to the model where the river stage is reduced to 10.0m. This represents a 0.5m drop in river stage which approximates the typical scale of flood level reduction during at the 5 percentile flows and two year return event.

The effect on the groundwater levels as a result of this change is presented in **Figure 5.1**. This illustrates that the change in groundwater levels drops off within a short distance of the river. It also illustrates the extent and magnitude of the change is dependent on time. As the predicted changes are related to short lived flooding events that occur intermittently there will be a limited and short lived influence on the groundwater environment that will reduce to negligible levels (<10cm) within 10m of the river corridor.

Based on this assessment the predicted impact on the wider groundwater environment as a result of the proposed scheme is expected to be an intermittent localised negligible impact. The potential for any discernible impact in groundwater levels and flow in the karst environment outside the immediate river corridor is negligible.

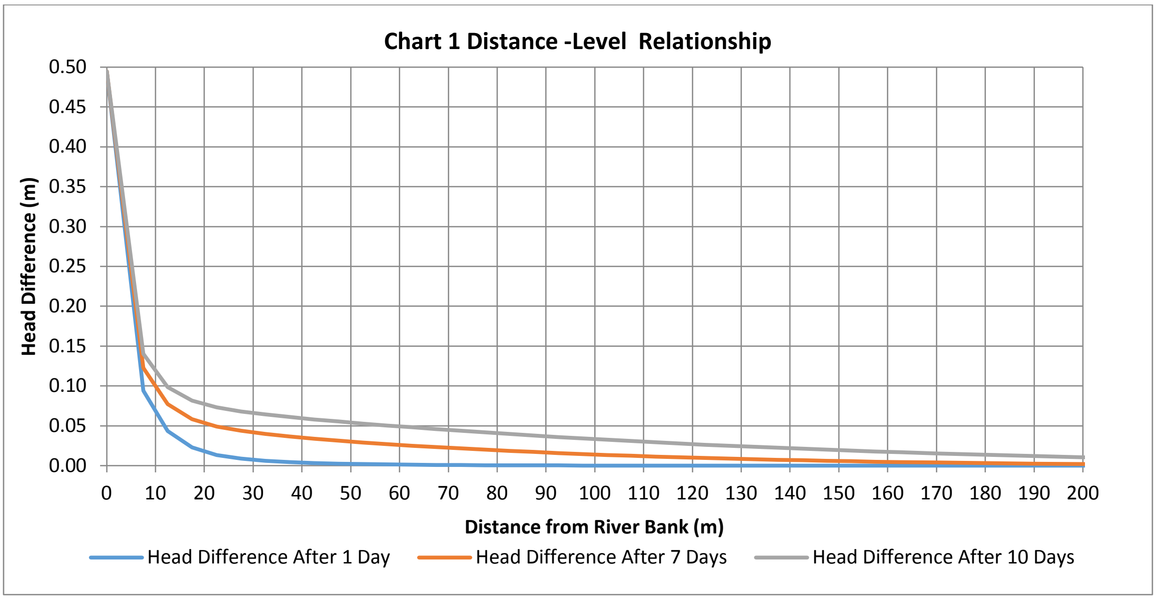


Figure 5.1 - 2D Model Illustrating Distance from River Bank and Level Relationship

6 ITEM 6 – DISCUSSION UPDATE REQUEST

6.1 The applicant is requested to provide an update of any discussions with landowners affected by the scheme and to discuss alternative arrangements which may be made in the event that consent through agreement is not forthcoming.

Response

As noted earlier, the Dunkellin River and the Aggard Stream form part of the Dunkellin Drainage District which was constructed in or around 1857 and Galway County Council has a statutory maintenance responsibility for these works. This statutory responsibility falls under the Local Authorities Works Act 1949. This Act enables certain Local Authorities to execute works affording relief or protection from flooding, landslide, subsidence and similar occurrences, and it outlines:

a. the activities that the Galway County Council, as Local Authority, can undertake,

b. the power of entry granted to Galway County Council, and

c. the compensation that Galway County Council can consider for each landowner.

With regard to the "power of entry" the 1949 Act, at Section 4.0, states, inter alia:

"Power of entry on land. *__4.__—(1) A local authority executing works pursuant to this Act or an order or agreement made thereunder, or any officer, servant or agent of such authority, may, subject to the provisions of this section, enter on any land for the purposes of the execution of the works."*

This Section 4.0 also sets out how the Local Authority is to seek consent, the measures afforded to the landowner to restrict or condition entry to lands and also states, at Section 4(7) that:

> *"(7) A person who obstructs or interferes with the exercise of the power conferred by subsection (1) of this section shall be guilty of an offence under this section and shall be liable on summary conviction thereof to a fine not exceeding ten pounds."*

Galway County Council, to date, in the development of the proposed scheme, has not been required to utilise its powers under the 1949 Act and has endeavoured to liaise with all landowners impacted by the works and has successfully sought consent and agreement from all landowners, to date, to allow entry onto lands.

This commitment by Galway County Council, to seek consent through agreement, has been utilised on the scheme to facilitate the geotechnical investigations needed to inform the current planning stage and to develop the future design stage works. As part of these investigations Galway County Council has discussed the proposed works with all landowners directly impacted by the channel works and bridge works. Consent has been provided by all landowners (14 No.) and a copy of the signed consent forms is presented in **Appendix F** to this response.

7 ITEM 7 – RESPONSE INVITATION

7.1 The applicant is invited to respond in detail to the written submissions made by parties including local residents, prescribed bodies and others. These submissions have been previously forwarded to the local authority.

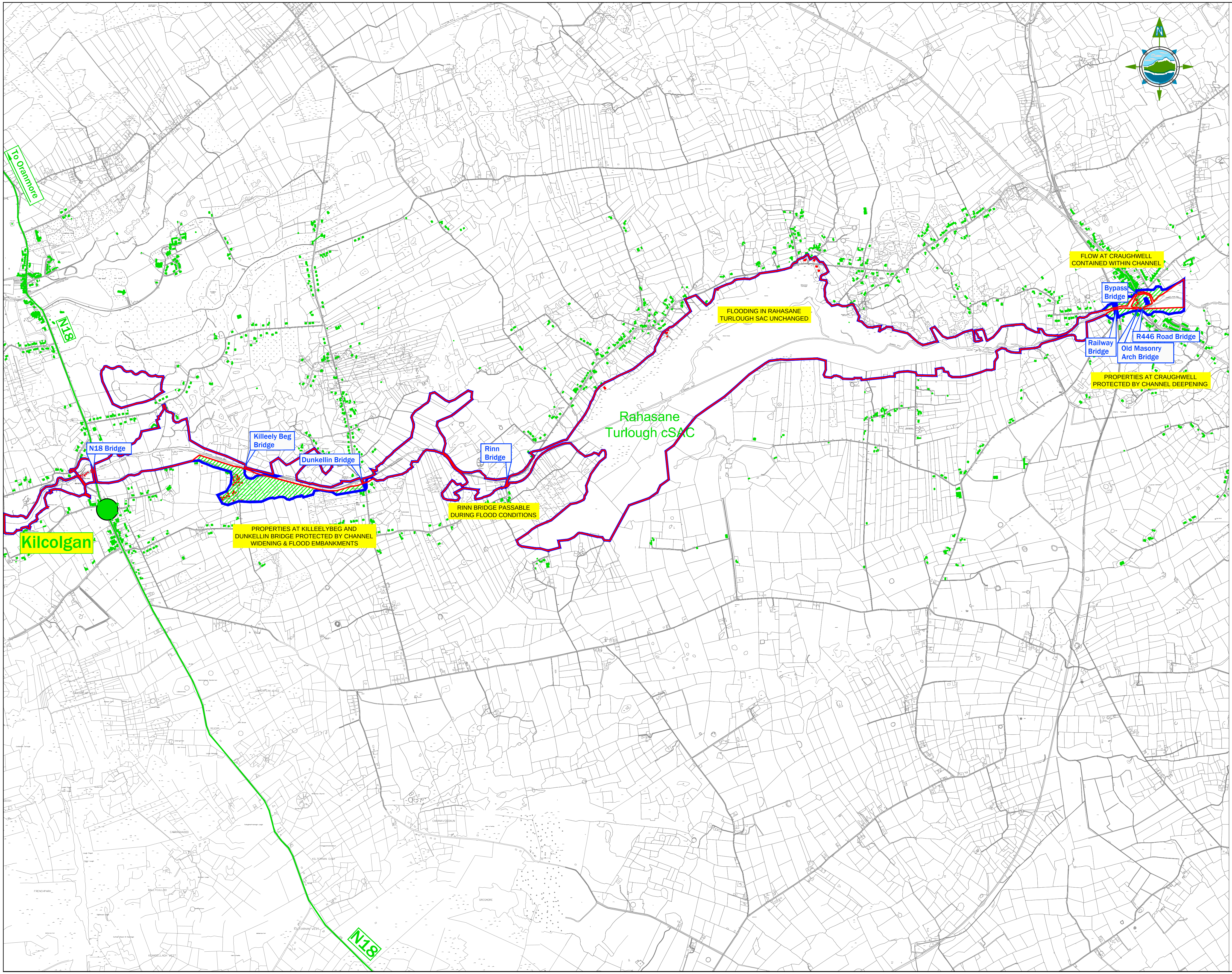
Response

Responses to these written submissions are provided in Annex I to this response. The responses prepared for each of the submissions are as follows;

(i) The Department of Arts, Heritage and the Gaeltacht
(ii) Inland Fisheries Ireland
(iii) Brendan Slevin
(iv) Bord Iascaigh Mhara
(v) Marine Institute
(vi) Clarinbridge Oyster Co-Op / Michael Kelly Shellfish
(vii) Numerics Warehouse
(viii) Iarnród Éireann
(ix) The National Roads Authority
(x) Rahasane Turlough Shareholders Committee
(xi) Geological Survey of Ireland

Appendix A

Drawings



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LEGEND:

- FLOOD EXTENTS - PRE WORKS
- FLOOD EXTENTS - POST WORKS
- ▨ BENEFITING LANDS

NOTES:

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER/EMPLOYERS REPRESENTATIVE, AS APPROPRIATE, TO BE INFORMED BY THE CONTRACTOR OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. THE CONTRACTOR SHALL UNDERTAKE A THOROUGH CHECK FOR THE ACTUAL LOCATION OF ALL SERVICES/UTILITIES, ABOVE AND BELOW GROUND, BEFORE ANY WORK COMMENCES
5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client:
Galway County Council

Project:
Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title:
Predicted Flood Extents for
November 2009 Flow
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

TOBIN
Patrick J. Tobin & Co. Ltd.

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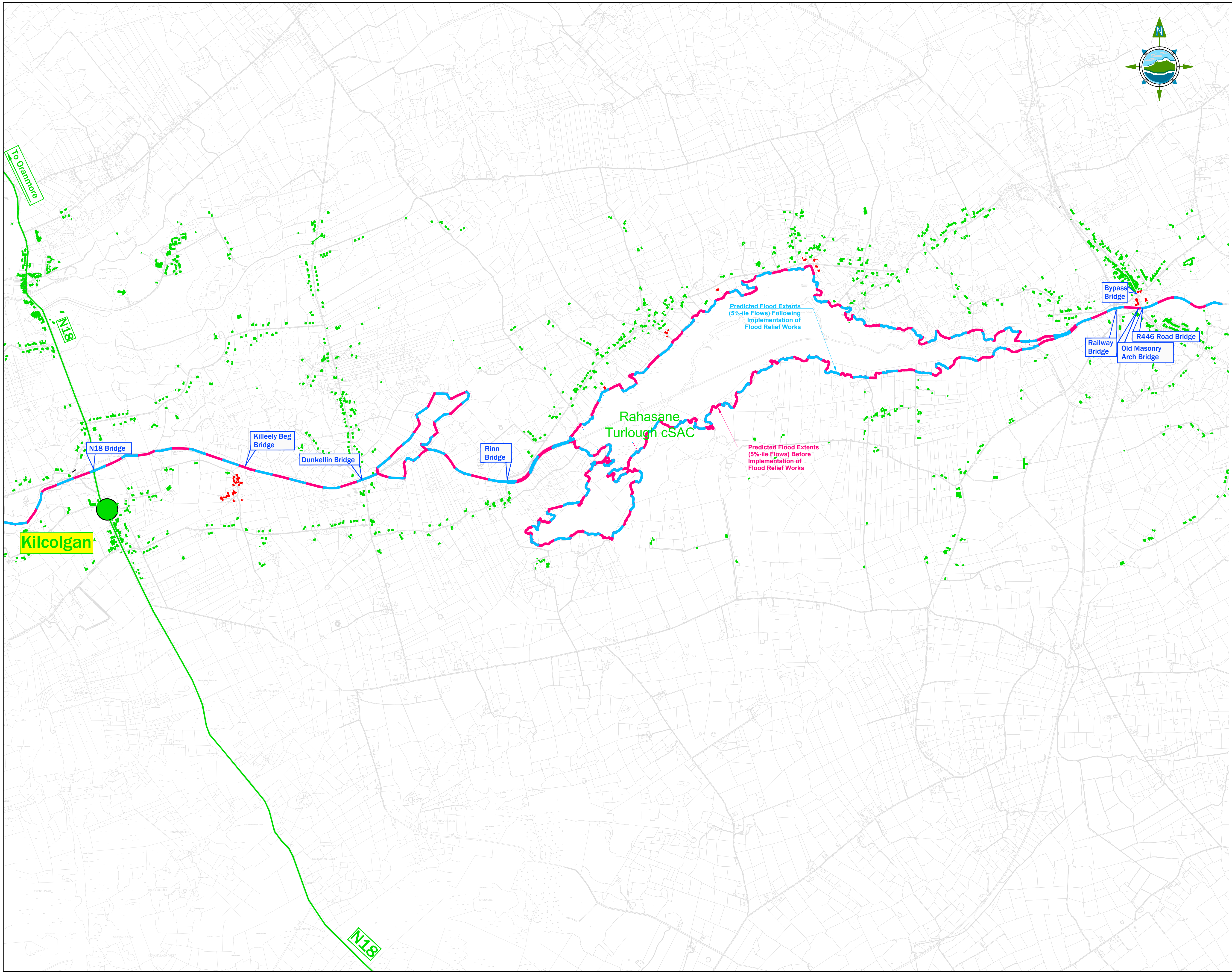
e-mail: galway@tobin.ie
www.tobin.ie

Drawing No.: 6408-2300

Revision: A



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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client:
Galway County Council

Project:
Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title:
Predicted Flood Extents for
5%-ile Flows
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

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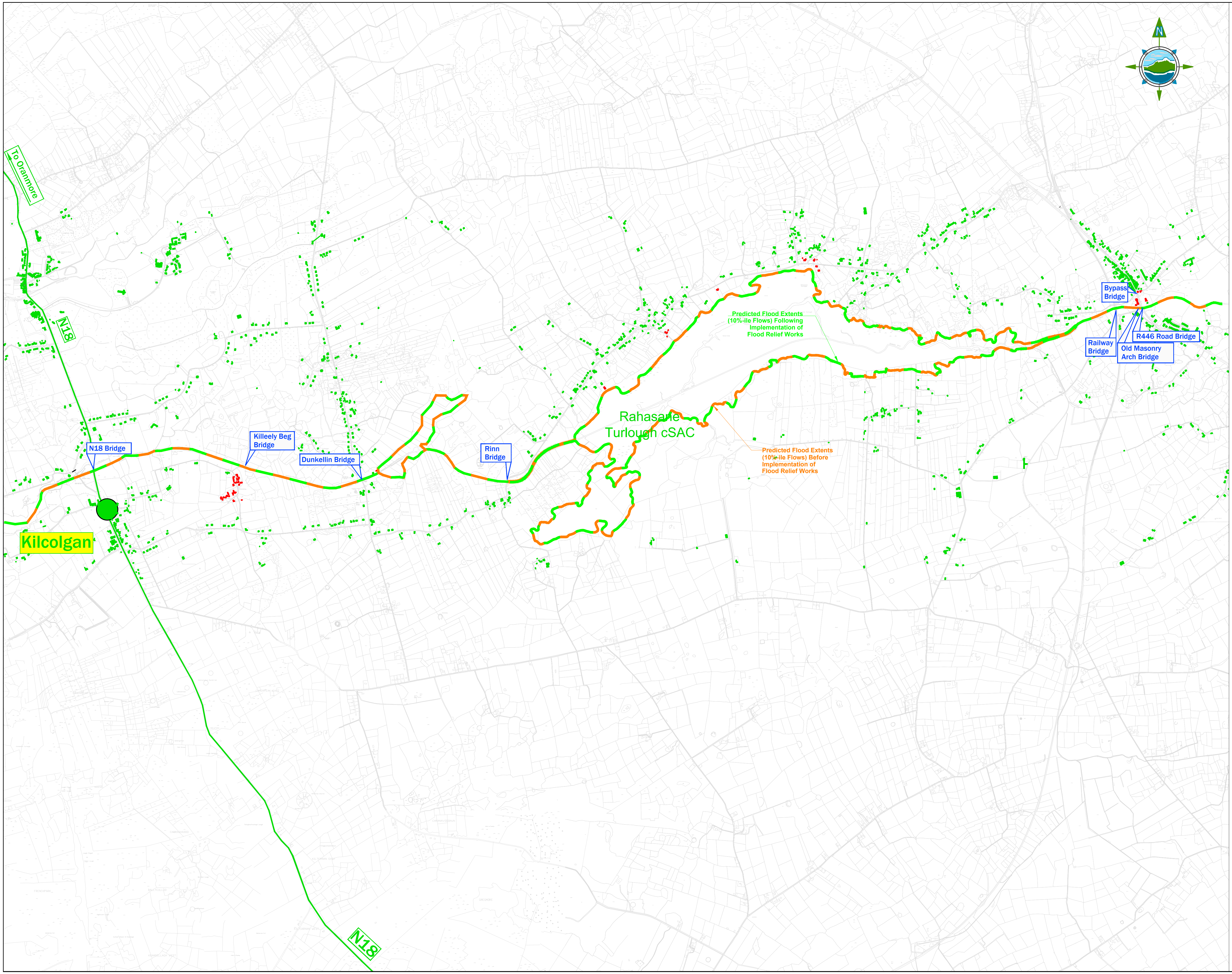
Drawing No.: 6408-2301

Revision: A



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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project:
Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title:
Predicted Flood Extents for
10%-ile Flows
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

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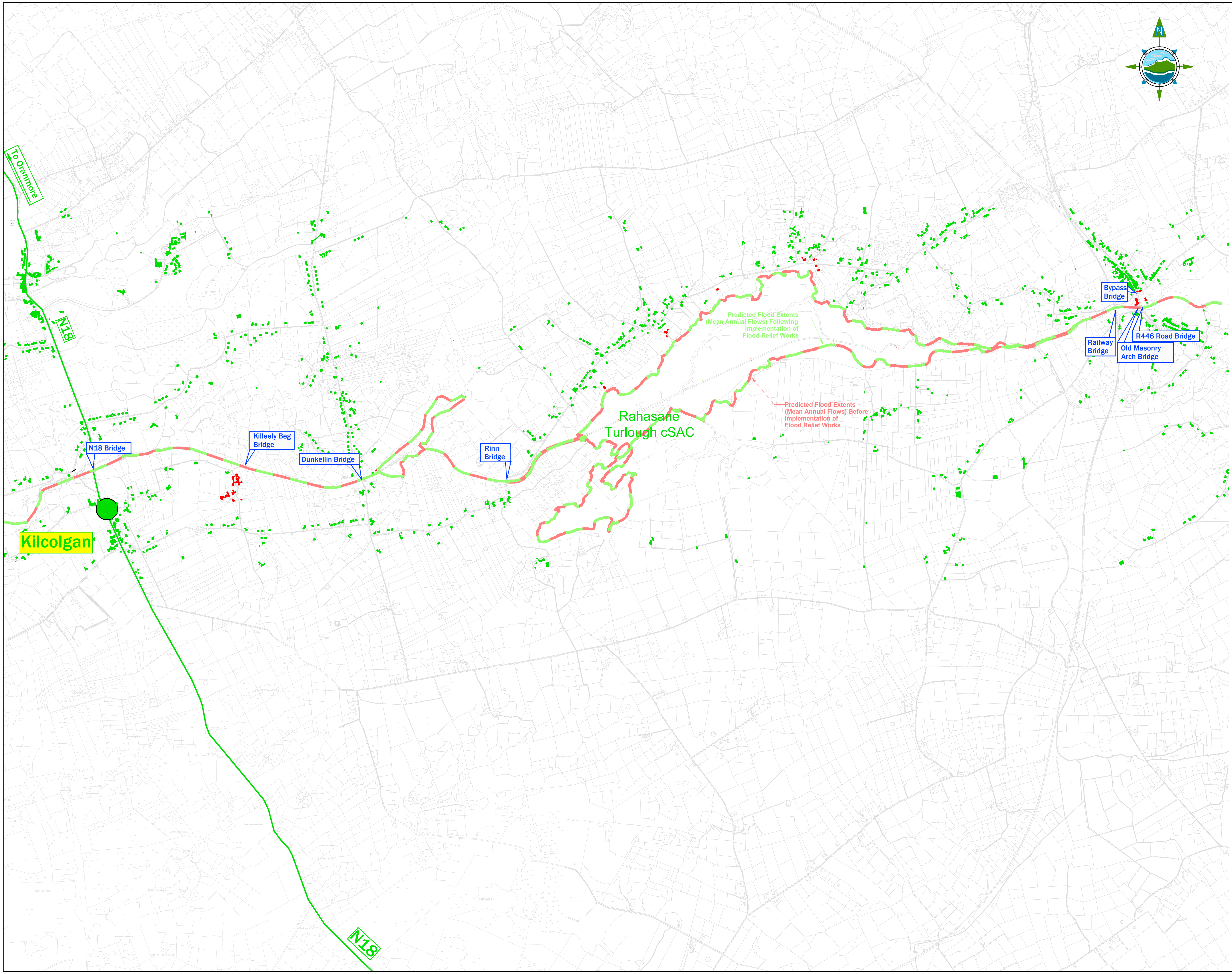
Drawing No.: 6408-2302

Revision: A



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A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project:
Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title:
Predicted Flood Extents for
Mean Annual Flow Conditions
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

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Drawing No.: 6408-2303

Revision: A

Appendix B

Rahasane Waterbeetle List 10/6/15

	Rahasane Main Basin			Rinn Basin	
	S	NE	N	Pool A	Pool B
Species	M47565 19216	M48130 20200	M47010 19577	M46473 18103	M45904 18014
Agabus bipustulatus	3			4	
*Agabus nebulosus**	4	7	1	9	2
Anacaena limbata		1		1	
*Hygrotus impressopunctatus**	1		1	3	
Hygrotus inaequalis	1				
*Hygrotus quinquelineatus**	17		16		4
Helophorus brevipalpis		1		2	
*Helophorus spp.**				1	1
Hydrobius fuscipes		1		1	
Hydroporus palustris	10	20	5	4	
Hydroporus planus		1		41	2
Ilybius fuliginosus	6	2	1	4	
*Ochthebius bicolon***		1			
Potamonectes depressus elegans	1				
*Laccophilus minutus**					3

*"Moss-edge community" and/or characteristic turlough species (Foster *et al.*, 1992, Sheehy Skeffington *et al.*, 2006).

**Irish Red Listed – Vulnerable (Foster *et al.*, 2009) (new record for Rahasane – identity to be confirmed).

Appendix C

Site Investigation Report

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DUNKELLIN RIVER AND AGGARD STREAM FLOOD RELIEF WORKS

SITE INVESTIGATION CONTRACT

FACTUAL REPORT

NO. P12012

Client:
Galway County Council,
Prospect Hill,
Galway,
Ireland.

Engineer:
Tobin Consulting Engineers,
Fairgreen House,
Fairgreen Road,
Galway,
Ireland.

28/10/2014

REPORT CONTROL SHEET

Employer	Galway County Council					
Employer's Representative	Tobin Consulting Engineers					
Project Name	Dunkellin River and Aggard Stream Flood Relief Works – Site Investigation Contract					
Report Name	Dunkellin River and Aggard Stream Flood Relief Works – Site Investigation Contract – Factual Report					
Project Number	P12012					
This Report Comprises of	RCS	TOC	Text	No. of Appendices	Drawings	Electronic data
	1	1	18	4	8	*.pdf

Revision	Status	Author(s)	Approved By	Issue Date
D01	Draft	AG	GH	03.10.2014
F01	Final		Gregory Hayes	28.10.2014

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

1.1 SCOPE OF WORKS

In February 2012, Tobin Consulting Engineers (Tobin) acting as the Employer's Representative and on behalf of their Client, Galway County Council commissioned Priority Geotechnical (PGL), to carry out a geotechnical site investigation to provide information in respect of the soil and rock ground conditions and groundwater levels for Dunkellin River and Aggard Stream Flood Relief Works. The scheme is intended to address flooding on the Dunkellin River from Craughwell to Kilcolgan and along the Aggard Stream.

The site investigations are required to facilitate the detailed design of the proposed scheme along the route of the proposed channel works (bank works and in channel works) and in the vicinity of the proposed bridge underpinning and replacement works.

The original scope of the ground investigation, which was specified by Tobin, comprised the following:

- Geophysics survey, by seismic refraction/resistivity surveying or equivalent, along existing channel route and at existing bridge structures (4 No.) from a distance of 200m upstream of Craughwell to 550m downstream of the railway crossing in Craughwell.
- Geophysics survey, by seismic refraction/resistivity surveying or equivalent, along left and right banks (where indicated) of the existing channel route from just downstream of the Rahasane Turlough SAC to Kilcolgan Bridge at the N18.
- Geophysics survey, by seismic refraction/resistivity surveying or equivalent, at each bridge structure (3 No.) between the Rahasane Turlough cSAC and the Kilcolgan Bridge at the N18.
- Interpretation of the geophysical survey results.
- The excavation of slit trenches at each bridge location (except the railway bridge) to locate existing utilities and services particularly within the vicinity of the bridges along the R446 (formerly N6) within Craughwell Village and to also verify the geophysical results.
- The drilling of boreholes (Shell & Auger and Rotary Coring) including the associated sampling and in-situ field tests.
- The Excavation of Trial Pits to log road construction materials, natural soils, rock and groundwater.

- The retention of groundwater, soil and rock samples.
- Reinstatement of all slit trenches, boreholes, inspection pits & trial pits, etc.
- Monitoring of and permeability testing in groundwater and gas installations during and after completion of the site works.
- Laboratory testing of soil and rock.
- Surveying of exploratory hole positions.
- Factual Reporting.
- Provision of traffic management to accommodate the investigation.

The final works as completed are detailed in Section 3.2 of this report.

This investigation was carried out in accordance with the contract specification: Specification and Related Documents for Ground Investigation in Ireland (Engineers Ireland, October 2006), Eurocode 7- Geotechnical Design Part 2, ground investigation and testing (BS EN 1997-2: 2007) and the relevant British Standards. The fieldworks were carried out between 29th April and 27th July, 2014.

The works were supervised and excavations monitored on behalf of PGL by Project Scientist, Mr. Brendan Goode BA MSc.

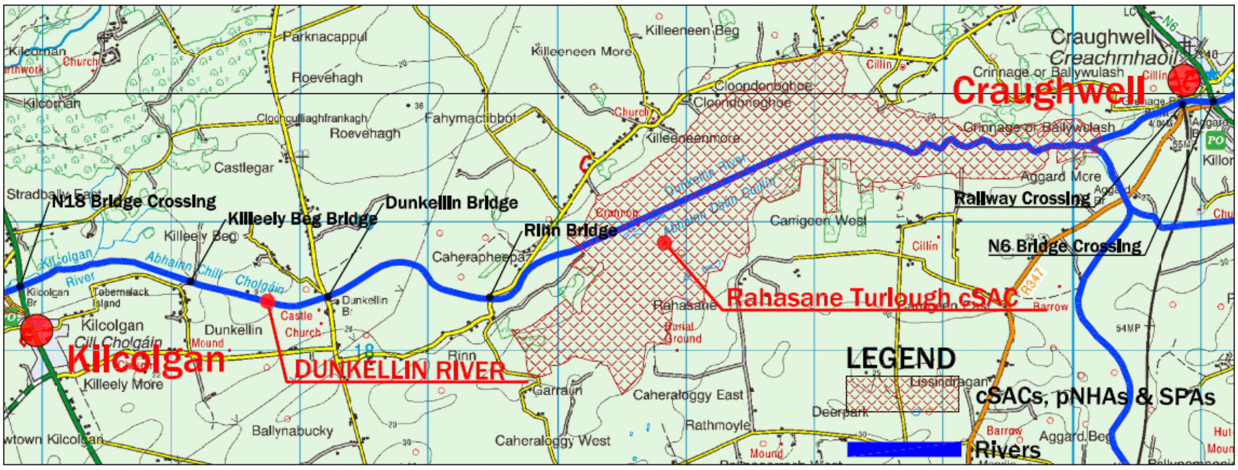
1.2 REPORTING

This geotechnical data report: P12012_RP_F01 presents the factual records of the fieldwork with respect to the site investigation works contract for the proposed Dunkellin River and Aggard Stream Flood Relief Works (FRW).

2 THE SITE

2.1 SITE LOCATION & DESCRIPTION

The site consists of work in fields, on-road and within the existing water channel (over water). It must be noted that site investigation works were carried out close to important and designated habitats. The study area is shown below and in more detail on the Exploratory Location Plans in **APPENDIX D** of this factual report.



2.2 PUBLISHED GEOLOGY

2.2.1 Solid

The Geological Survey of Ireland, 1:100,000 mapping (Sheets) were reviewed and the solid geology was summarised as follows,

Location	**Geological Formation**	**Description**	**Karst**
Dunkellin River from Kilcolgan to Craughwell	Visean Limestone Burren Formation	Undifferentiated Limestones Pale grey clean skeletal Limestones	Numerous turloughs and springs *(cave west of Kilcolgan at Stradbally South*) Sinkhole at Ballywulash. Trace lines predominantly East West and both E-W and N-S at Kilcolgan
Aggard Stream from Craughwell to Ardrahan	Visean Limestone Lucan Formation Castlequarter member	Undifferentiated Limestones Dark Limestone and shale (Calp) Monotonous Limestone and dolomite	None identified on GSI karst database

2.2.2 Superficial deposits

Teagasc, subsoil mapping was reviewed and the overburden deposits were summarised as follows:

Location	Superficial Deposits	Description	Rock outcrops
Dunkellin River from Kilcolgan to Craughwell	Alluvium Glacial Deposits Lake Sediments	Undifferentiated Limestone till Undifferentiated	Y
Aggard Stream from Craughwell to Ardrahan	Glacial Deposits Lake Sediments	Limestone till Undifferentiated	Y

3 FIELDWORK

3.1 GENERAL

The fieldwork was carried out in general accordance with BS 5930 (1999)+A2:2010 Code of Practice for Site Investigation and Part 9 of BS 1377 (1990), Method of Tests for Soil for Civil Engineering Purposes.

Details of the equipment and plant used are presented below.

Operation	Equipment	Nominal diameter, mm	Flush	Comments
Cable Percussion Boring	Dando 2000	200mm	N/A	Standard Penetration Test, N values obtained, bulk disturbed sampling. Visual observations of ground and groundwater conditions.
Rotary Coring and Open Hole Drilling	Delta Base 520	Symmetrix 131mm diameter open hole 76mm diameter core	Compressed Air mist	Standard Penetration Test, N values obtained in overburden. Visual observations of ground and groundwater conditions. Installation of standpipe wells and in situ permeability testing.
Trial pit excavations	JCB	N/A	N/A	Visual observations of ground and groundwater conditions.
Geophysics	Seismic refraction	N/A	N/A	See Minerex Geophysics Report 5825d-005.doc

The scope of the works were reviewed by PGL. Subsequently the exploratory locations were selected by PGL in consultation with Tobin and set out subject to work space restrictions and available access. The ‘as constructed’ exploratory locations were subsequently surveyed using Trimble V8 GPS equipment to the Ordinance Survey, Irish National Grid (ING) system of co-ordinates and elevations to Malin Head datum. These locations are shown on the Exploration Location Plans (dwg. No.: P12012-SI-A, P12012-SI-01 to P12012-SI-08) presented in **APPENDIX D** of this factual report.

3.2 EXPLORATORY HOLES

The exploratory holes as completed during the ground investigation are listed in the following table:

SUMMARY OF EXPLORATORY HOLES

Type	Quantity, No.	Depth Range, m bgl	Remarks
Cable Percussion Boreholes	20	0.36 – 3.40	BH01, BH01A, BH03, BH08, BH10, BH11, BH16, BH17, BH18, BH22, BH23, BH23A, BH25, BH27, BH29, BH32, BH33, BH37, BH40 and BH42.
Rotary Boreholes	32	3.0 – 15.0	RC01, RC02, RC03, RC04, RC05, RC06, RC07, RC08, RC09, RC10, RC13, RC14, RC15, RC16, RC17, RC18, RC19, RC20, RC21, RC24, RC26, RC28, RC29, RC30, RC31, RC32, RC34, RC37, RC39, RC41, RC42 and RC43.
Trial Pit Excavations	43	0.5 – 3.5	TP01, TP01A, TP01B, TP01C, TP02, TP03, TP04, TP05, TP06, TP07, TP08, TP09, TP11, TP12, TP13, TP14, TP14A, TP15, TP15A, TP18, TP18A, TP20, TP21, TP21A, TP22B, TP25, TP26, TP28,TP29, TP30, TP31, TP32, TP33, TP34, TP36 and TP37.
Slit Trenches	6	1.6 – 2.9	ST01, ST02, ST03, ST04, ST05 and ST06.

The exploration records are presented in **APPENDIX A** and should be read in conjunction with the key sheets included. The records provide descriptions, in accordance with BS 5930 (1999), of the materials encountered and details of the samples taken, together with any observations made during the investigation.

3.3 SAMPLING

A total of ninety nine (99) no. bulk disturbed samples (B), seventy one (71) no. small disturbed samples (D), and a single (1) *in situ* CBR mould and rotary core (C) were taken during the fieldworks.

3.4 GROUNDWATER MONITORING

Groundwater was recorded when observed during boring and trial pit excavations.

It must be noted that the normal rate of cable percussion and rotary drilling may not permit the recording of equilibrium groundwater levels. Groundwater may be excluded from the boring as the casing progresses through the superficial deposits. The exploratory boreholes and trial pit excavations were backfilled with arisings and/or bentonite grout.

50mm diameter HDPE standpipe wells were also constructed to allow for groundwater monitoring.

▧	BENTONITE grout Backfill to rotary borehole/ installation
▩	Arisings Backfill to cable percussion borehole/
░	GRAVEL Backfill to installation/ rotary borehole
☰	uPVC slotted pipe

3.5 IN SITU TESTING

Standard Penetration Tests, N values, were typically carried out in the boreholes at intervals of 1.0m. The Standard Penetration Test was carried out in accordance with Geotechnical Investigation and Testing, Part 3 Standard penetration test, BS EN ISO 22476-3:2005+A1:2011. The data was presented on the relevant logs in **APPENDIX A**.

In situ variable falling head permeability tests were carried out in 50mm diameter standpipe wells. *In-situ* permeability tests were carried out in accordance with BS5930: 1999, Section 4: Cl. 25.4, within the Limestone bedrock over duration up to one (1) hour, as detailed on the borehole logs, **APPENDIX A** of this report. It is noted that the duration typically was 2minutes up to a maximum of 5minutes for groundwater to dissipate to the initial static groundwater level within the standpipe well. The processed test data was presented on the relevant borehole logs presented in **APPENDIX A** of this factual report. The shape or intake factor, f was derived from the condition at the base of the borehole at the test depth and test geometry as per Hvorslev (1951).

$$k = \frac{A}{fd}\frac{\log_e (H_0 / H_t)}{t}$$

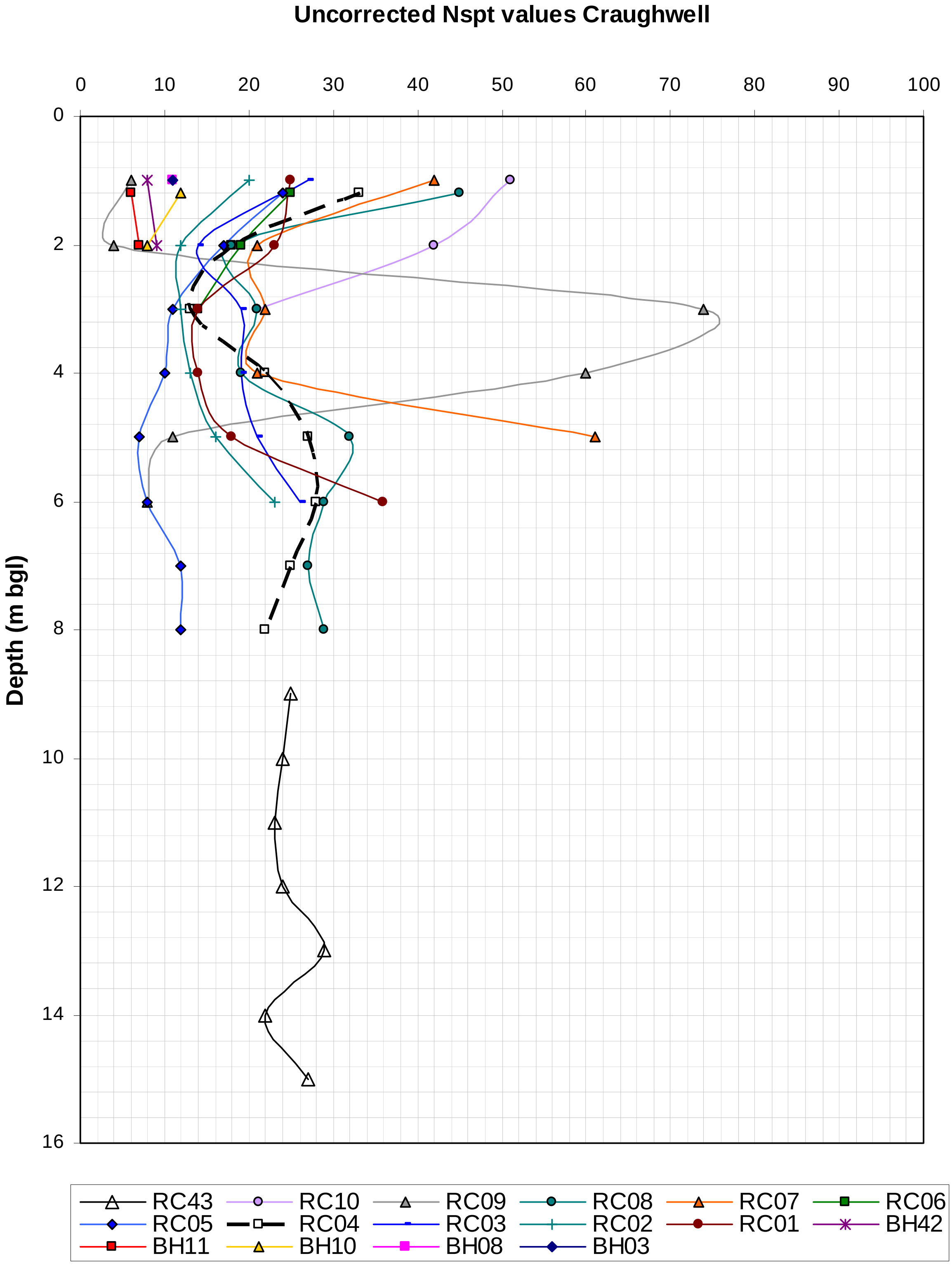
The ratio L/d was 60 to 100, giving a shape (or intake) factor, f of 20; where permeability in the bedrock was assumed equal in both horizontal and vertical direction, $k_H / k_V = 1$. Additional head was provided by adding well casing above ground level to a maximum height; existing ground + 1.0m. It is noted the L/D ratio exceeded the upper bound of 10 (BS 5930, Part 4 Cl. 25.4 Figure 7). The results should be used with caution.

A geophysical survey was undertaken by Minerex Geophysics Limited on behalf of PGL during July 2014. The results of the survey are presented by Minerex in a separate report Ref: 5825f-005.doc; October, 2014. The geophysical survey is presented in **APPENDIX C**.

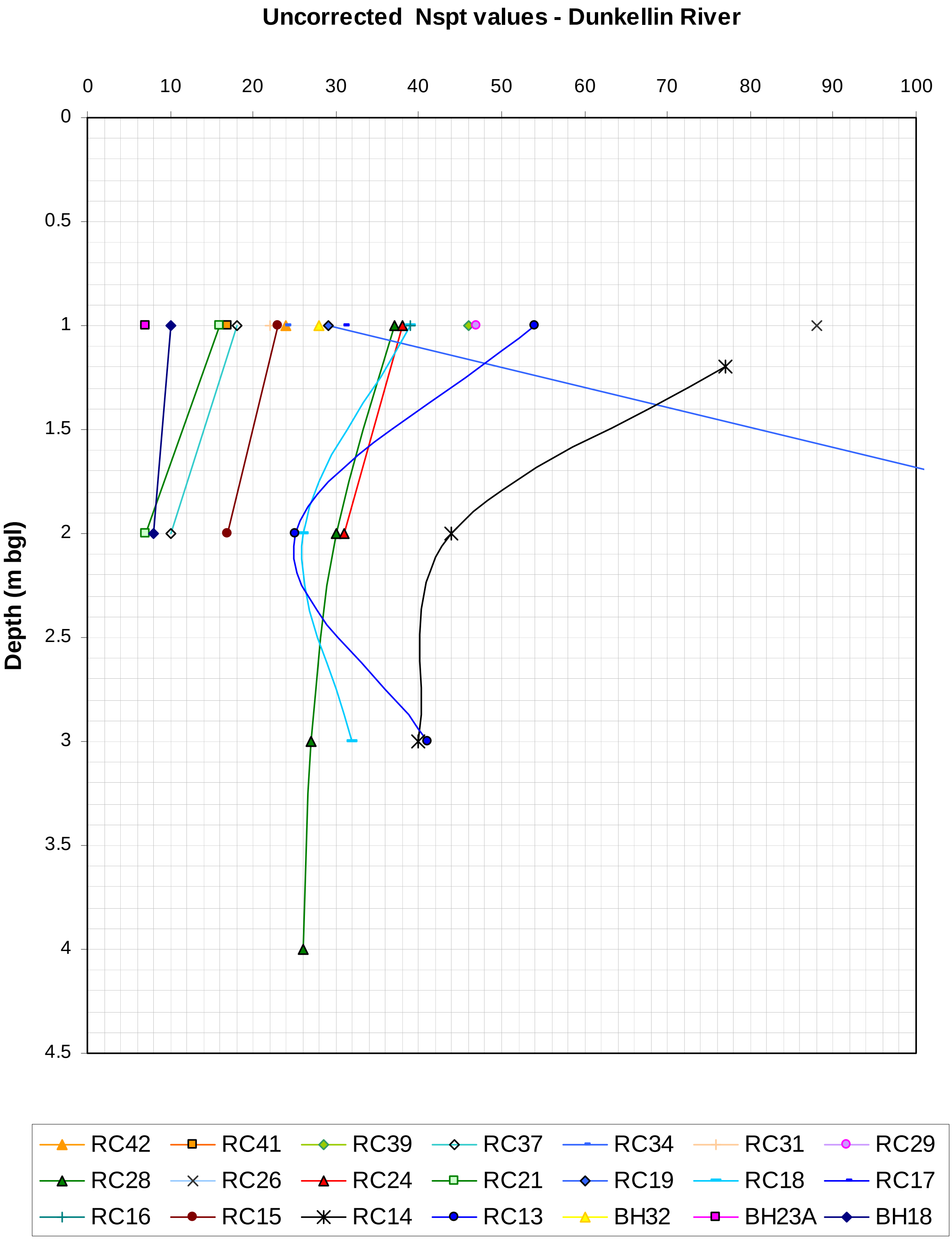
SUMMARY OF IN-SITU TESTING

Type	Quantity	Remarks
Standard Penetration Test, N value	157No.	Cone Penetration Tests (CPT) and Split Spoon Penetration Tests (SPT)
In situ permeability Test	8No.	$1.4\ x10^{-}4ms^{-1}$ to $1.8\ x10^{-}4ms^{-1}$

The distribution of uncorrected Standard Penetration Test, Nspt values with depth (m below existing ground level, bgl) is presented below for boreholes at Craughwell. Refusals, Nspt>50, where the complete set of 4 number 75mm increments were not achieved are not plotted.



The distribution of uncorrected Standard Penetration Test, Nspt values with depth is presented below for boreholes at along the Dunkellin River to Kilcolgan. Refusals, Nspt>50, where the complete set of 4 number 75mm increments were not achieved are not plotted.



4 LABORATORY TESTING

All samples were transported to Priority Geotechnical's laboratory in Midleton, Co. Cork examined, logged and prepared for scheduled testing. Laboratory testing was proposed by PGL, being approved by Tobin.

Testing was carried out by PGL, in accordance with BS1377 (1990), Methods of test for soils for civil engineering purposes and the ISRM suggested methods for rock characterisation, testing and monitoring. The laboratory test results were presented in **APPENDIX B**. A summary of tests undertaken were detailed below.

4.1 SOIL

SUMMARY OF LABORATORY TESTING UNDERTAKEN – SUPERFICIAL DEPOSITS

SOILS		
Type	**No.**	**Remarks**
Natural Moisture Content	62	8% to 46% (including a single value 307%)
Atterberg Limit	33	Liquid limit, LL 16% to 95% (226%) Plastic limit, PL 11% to 77% and NP non-plastic soils (131%) Plasticity index, PI 4 to 21 (95)
Particle Size Distribution	42	See **APPENDIX B**
Particle Size Distribution by hydrometer	32	
pH $SO_{3\ \text{water soluble}}$	2 2	7.91 and 8.00 0.008g/l and 0.022g/l
Organic Content	2	3.3% and 16.2%
Loss on ignition	2	4.5% and 12.3%
Compaction (Moisture content/dry density relationship)	12	Optimum moisture content 5.7% to 24% Maximum dry density 1.48Mg/m^3 to 2.29Mg/m^3
Moisture condition value, MCV moisture content relationship	12	See **APPENDIX B**
Moisture condition value, MCV single point	34	(0) 2.5 to 12.0
Direct shear test (60mm sq.)	9	c = 0kPa to 9kPa $\Phi = 17^o$ to 43^o

4.2 ROCK

SUMMARY OF LABORATORY TESTING UNDERTAKEN – SOLID GEOLOGY

ROCK		
Type	**No.**	**Remarks**
Uniaxial Compressive Strength (UCS)	26	36.4MPa and 121.5MPa
Point Load Test (I_{P50})	74	1.12MPa to >10MPa

5 GROUND CONDITIONS

5.1 CRAUGHWELL VILLAGE

The site at Craughwell Village was characterised by Topsoil 100mm to 500mm, averaging 210mm thick overlying glacial and alluvial deposits of; slightly sandy gravelly CLAY/ slightly sandy (slightly) gravelly SILT with variable cobble content to depths 2.0m below existing ground level (bgl) up to 15.0m bgl. An increase in coarse particle content was noted below 1.4m bgl. The rotary drilling indicated granular deposits; clayey SANDS and GRAVELS with boulder content. Strong LIMESTONE was identified at depths 4.3m bgl to 6.9m bgl.

It is noted that RC43 was drilled to a depth 15.0m with no rock encountered. Adjacent to RC43 at location RC01 Limestone was encountered at 6.5m. The geophysical survey highlighted a variable rock profile in the area, see profiles S1 – S4 and S13.

Tactile assessment in trial pit excavations indicated typically firm SILT and CLAY deposits. Some soft SILT deposits were present at locations TP08 and TP09 (BH11) to depths up to 3.0m bgl. These were noted as being having high plasticity. Based on the standard penetration test, the CLAY was described as firm with Nspt value of 6 to 12. Soft CLAY was noted at RC09 at a depth 2.0m bgl. The SILT was described as soft with Nspt values 6 and 8 (BH11) to a depth 3.0m bgl. The granular deposits were described as medium dense with Nspt values 11 to 29. At RC05 between 4.0m bgl to 7.0m bgl loose SAND was noted (Nspt 7 to 10). Elevated Nspt values were attributed to coarse Cobble particles.

5.2 RAHASANE TURLOUGH TO KILCOLGAN BRIDGE

The remainder of the site along the Dunkellin River from Rahasane Turlough to Kilcolgan Bridge, was characterised by shallow LIMESTONE bedrock. Superficial deposits of slightly sandy (slightly) gravelly SILT/ CLAY with variable cobble content and silty (very) sandy GRAVEL with low cobble and boulder content were encountered to depths of 0.5m bgl to 3.5m bgl. Organic SILT was identified at TP28 to a depth 1.7m bgl underlain by slightly sandy gravelly CLAY with variable cobble content. Cable tool borehole terminated at depths of 0.26m bgl to 2.5m bgl after one (1) hour chiselling without progress on assumed bedrock. Typically strong LIMESTONE was identified at depths of between 0.8m bgl and 5.1m bgl. Some medium strong Limestone was noted at RC28 and very strong Limestone at RC32 and RC42. At RC42 a shallow infilled cavity/ fracture feature was noted 3.8m to 4.8m with non-intact core recovered.

Tactile assessment in trial pit excavations typically indicated firm SILT deposits. Some soft and ‘soft to firm’ deposits were noted at TP18, TP21A, TP22B, TP28, TP31 and TP34. Plasticity data indicated some high plasticity SILT and organic SILT deposits. Based on the standard penetration test, the SILT was described as firm with Nspt values of 8 to 10. The CLAY was described a firm to stiff with Nspt values of 7 to 28. Below 2.0m the CLAY was described as stiff with Nspt values 40 to 44. The granular deposits were described as medium dense with Nspt values 17 to 32. Elevated Nspt values were attributed to coarse Cobble particles.

5.3 GROUNDWATER

Groundwater was encountered between depths of 0.5m bgl and 10.2m bgl. Details of the ground water and installations are presented graphically on the relevant exploratory logs within **APPENDIX A** and summarised below. See also section 3.4 for general details.

Eight (8) number 50mm diameter standpipe well, installations were constructed in rotary boreholes to allow for groundwater monitoring and *in situ* falling head permeability testing.

SUMMARY OF GROUNDWATER STRIKES- CRAUGHWELL

Location	**Groundwater level, m bgl**
RC08	6.3
TP02	1.4
TP04	2.1
TP05	1.9
TP08	2.1
RC43	10.2

Location	**Groundwater level, m bgl**	**Comments**
RC43	10.2	Rising to 8.7m

SUMMARY OF GROUNDWATER STRIKES- RAHASANE TO KILCOLGAN

Location	**Groundwater level, m bgl**	**Comments**
RC19	0.6	**Standpipe installed**
RC20	-	**Standpipe installed**
RC26	-	**Standpipe installed**
RC30		**Standpipe installed**
RC31	-	**Standpipe installed**
RC32	-	**Standpipe installed**
RC37	-	**Standpipe installed**
RC39	1.2	**Standpipe installed**
		-
RC41	1.8	

Location	Groundwater level, m bgl	Comments
TP21A	0.8	-
TP22	0.6	-
TP22B	0.5	-
TP25	1.0	-
TP26	0.8	-
TP28	1.4	-
TP28	2.1	-
TP31	0.6	-
TP35	0.7	-
TP36	2.0	-
TP37	0.6	-

SUMMARY OF GROUNDWATER MONITORING - RAHASANE TO KILCOLGAN

Location	Response zone, m	Installed, dd/mm/yyyy	Groundwater strike, m bgl	Groundwater monitoring, m bgl			
				23/07/2014	dd/mm/yyyy	dd/mm/yyyy	dd/mm/yyyy
RC19	7.0-10.0	10/07/2014	none	9.0			
RC20	3.0-6.0	11/07/2014	none	3.4			
RC26	7.0-10.0	13/07/2014	none	4.0			
RC30	3.0-6.0	12/07/2014	none	3.9			
RC31	5.0-10.0	14/07/2014	none	1.4			
RC32	3.0-7.0	14/07/2014	none	1.6			
RC37	4.0-8.0	15/07/2014	none	1.6			
RC39	3.0-6.0	13/07/2014	1.2	0.6			

It was noted during the drilling of RC42 the river broke its bank and the location was flooded over the tidal cycle.

6 SUMMARY

1. The site at Craughwell Village was characterised firm slightly sandy gravelly CLAY/ slightly (sandy slightly) gravelly SILT with variable cobble content and medium dense clayey SAND and GRAVEL deposits to depths 2.0m bgl up to 15.0m bgl. Some soft and loose deposits were identified. Strong LIMESTONE was identified at depths 4.3m bgl to 6.9m bgl.

2. The between Rahasane Turlough to Kilcolgan Bridge site was characterised by firm becoming stiff slightly sandy (slightly) gravelly SILT/ CLAY with variable cobble content and medium dense silty (very) sandy GRAVEL with low cobble and boulder content were encountered to depths of 0.5m bgl to 5.1m bgl overlying medium strong to very strong LIMESTONE. Some soft deposits were identified.

3. Groundwater was encountered between depths of 1.4m bgl and 10.2m bgl at Craughwell Village. Details are presented on the relevant logs in **APPENDIX A**.

4. Groundwater was encountered between Rahasane Turlough to Kilcolgan Bridge between depths of 0.5m bgl and 2.1m bgl. Details are presented on the relevant logs in **APPENDIX A**.

5. Eight (8) number standpipe wells were installed to allow for groundwater monitoring, see Section 5.3 and *in situ* falling head permeability testing.

6. Further, more detailed records of the ground and groundwater conditions can be found on the exploratory logs and photographic records presented within **APPENDIX A** of this factual report.

7. Laboratory testing was undertaken to determine the classification of the soil and rock encountered during the ground investigation. The data is presented in **APPENDIX B**.

8. A geophysical seismic refraction survey was undertaken by Minerex Geophysics Limited (MGX) on behalf of PGL and is presented in **APPENDIX C** of this factual report, further defining the ground conditions and bedrock profile.

9. The exploratory locations are presented on the location plans presented within **APPENDIX D** of this factual report.

APPENDIX A

EXPLORATORY HOLE AND PHOTOGRAPHIC RECORDS

Cable Percussion Boreholes	BH01, BH01A, BH03, BH08, BH10, BH11, BH16, BH17, BH18, BH22, BH23, BH23A, BH25, BH27, BH29, BH32, BH33, BH37, BH40 and BH42.
Rotary Boreholes	RC01, RC02, RC03, RC04, RC05, RC06, RC07, RC08, RC09, RC10, RC13, RC14, RC15, RC16, RC17, RC18, RC19, RC20, RC21, RC24, RC26, RC28, RC29, RC30, RC31, RC32, RC34, RC37, RC39, RC42, RC41 and RC43.
Trial Pit Excavations	TP01, TP01A, TP01B, TP01C, TP02, TP03, TP04, TP05, TP06, TP07, TP08, TP09, TP11, TP12, TP13, TP14, TP14A, TP15, TP15A, TP18, TP18A, TP20, TP21, TP21A, TP22B, TP25, TP26, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP36 and TP37.
Slit Trenches	ST01, ST02, ST03, ST04, ST05 and ST06.

KEY TO SYMBOLS ON EXPLORATORY HOLE RECORDS

All linear dimensions are in metres or millimetres

DESCRIPTIONS

**	Drillers Description
Friable	Easily crumbled

SAMPLES

U( )	Undisturbed 102mm diameter sample, ( ) denotes number of blows to drive sampler
U( )F, U( )P	F- not recovered, P-partially recovered
U38	Undisturbed 38mm diameter sample
P(F), (P)	Piston sample - disturbed
B	Bulk sample - disturbed
D	Jar Sample - disturbed
W	Water Sample
CBR	California Bearing Ratio mould sample
ES	Chemical Sample for Contamination Analysis
SPTLS	Standard Penetration Test S lump sample from split sampler

CORE RECOVERY AND ROCK QUALITY

TCR	Total Core Recovery (% of Core Run)
SCR	Solid Core Recovery (length of core having at least one full diameter as % of core run)
RQD	Rock Quality Designation (length of solid core greater than 100mm as % of core run)

Where there is insufficient space for the TCR, SCR and RQD, the results may be found in the remarks column

If	Fracture Spacing in mm (Minimum/Average/Maximum) NI - non intact, NR - no recovery
AZCL	Assumed Zone of Core Loss
NI	Non intact

GROUNDWATER

▽	Groundwater strike
▼	Groundwater level after standing period
Date/Water	Date of shift (day/month)/Depth to water at end of previous shift shown above the date and depth to water at beginning of shift given below the date

INSITU TESTING

S	Standard Penetration Test - split barrel sampler
C	Standard Penetration Test - solid 60° cone
SW	Self Weight Penetration
Ivp, HVp (R)	In Situ Vane Test, Hand Vane Test (R) demonstrates remoulded strength
K(F), (C), (R), (P)	Permeability Test
HP	Hand Penetrometer Test

MEASURED PROPERTIES

N	Standard Penetration Test - blows required to drive 300mm after seating drive
x/y	Denotes x blows for y mm within the Standard Penetration Test
x*/y	Denotes x blows for y mm within the seating drive
c_u	Undrained Shear Strength (kN/m^2)
CBR	California Bearing Ratio

ROTARY DRILLING SIZES

Index Letter	Nominal Diameter (mm)	
	Borehole	Core
N	75	54
H	99	76
P	120	92
S	146	113

PRIORITY GEOTECHNICAL

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By	WD
Logged By	

Borehole No
BH01
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551015E - 719948N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 03/06/2014	**Level:** 22.09 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨						21.94	0.15	Topsoil.	▨
▨								Dark brown, slightly sandy slightly gravelly SILT.	▨
		0.70	CPT	50 (25,25/25,25)	0.70	21.39	0.70		
		0.72	CPT	25 (25,25/25)	0.72	21.37	0.72	Chiselled from 0.7m to 0.72m for 1 hour.	
								End of Borehole at 0.72 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

1
2
3
4
5
6
7
8

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.72m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.70 to 0.72	0100	Chisel

Remarks: Borehole terminated due to obstruction. Relocated to BH01A.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/06/2014	0.00m	Start of Borehole
-	03/06/2014	0.72m	End of Borehole

Equipment & Methods: Dando 2000

PRIORITY GEOTECHNICAL

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By	WD
Logged By	JMS
Borehole No	**BH01A**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	551004E - 719949N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	03/06/2014
Level:	21.79 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						21.64	0.15	Topsoil.
		0.15-0.70	B					Dark brown, slightly sandy gravelly SILT with rootlets.
		0.60	D					
		0.90	D					
		1.20	CPT	50 (25,25/25,25)	1.20	20.59	1.20	
		1.25	CPT	50 (25,25/25,25)	1.25	20.54	1.25	Chiselled from 1.2m to 1.25m for 1 hour.
								End of Borehole at 1.25 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.25m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.20 to 1.25	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/06/2014	0.00m	Start of Borehole
-	03/06/2014	1.25m	End of Borehole

Equipment & Methods: Dando 2000

PRIORITY GEOTECHNICAL

Priority Geotechnical Ltd.
Tel: 021 4631600
Fax: 021 4638690
www.prioritygeotechnical.ie

Drilled By AK

Logged By DMC

Borehole No
RC01
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 551017E - 719951N

Hole Type Rotary Cored

Client: Galway Co. Co.

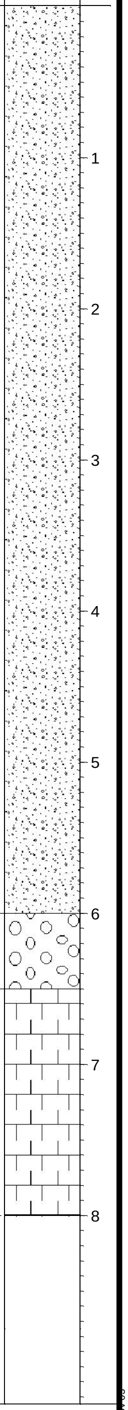
Dates: 03/07/2014

Level: 21.91 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
										Open hole boring. Driller described: SAND with boulders.
		1.00	CPT	N=25 (6,6/5,7,7,6)			1.00			
		2.00	CPT	N=23 (4,4/6,5,6,6)			2.00			
		3.00	CPT	N=14 (2,2/3,5,3,3)			3.00			
		4.00	CPT	N=14 (3,3/4,3,4,3)			4.00			
		5.00	CPT	N=18 (2,3/3,4,6,5)			5.00			
		6.00	CPT	N=36 (4,4/7,10,10,9)			6.00	15.91	6.00	Open hole boring. Driller described: BOULDERS.
							6.50 100.00%	15.41	6.50	Medium strong, pale grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay smearing. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 6.5m - 8.0m: Fracture index - 9.
		6.50-8.00	67	48	48	130mm min 240mm avg 240mm max				
							8.00	13.91	8.00	End of Borehole at 8.00 m
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	

Legend



Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.50m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

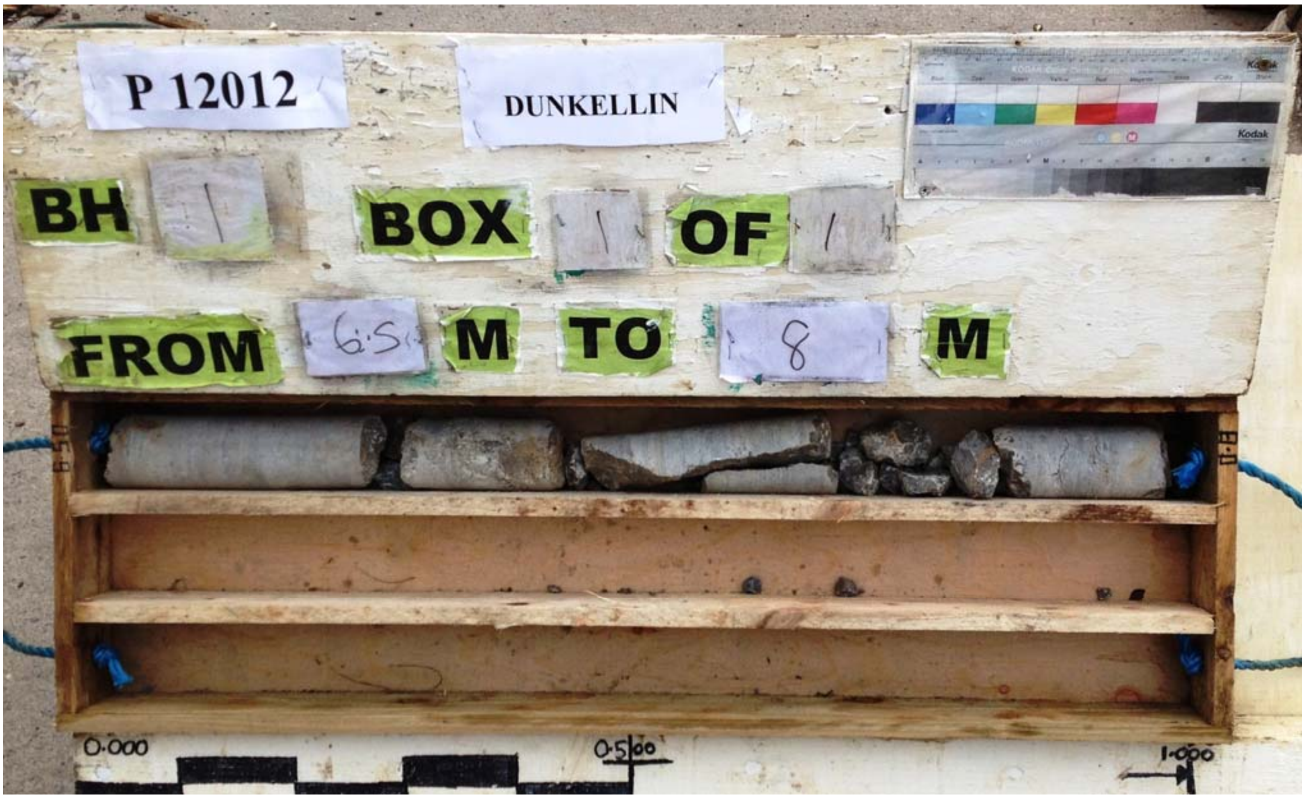
Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/07/2014	0.00m	Start of Borehole
-	03/07/2014	6.50m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record



		Project	Dunkellin River Flood Relief Works	
Number:	**RC01**	Project No Engineer	P12012 TOBIN	

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Drilled By AK

Logged By

Borehole No **RC43**
Sheet 1 of 2

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 551017E - 719951N

Hole Type RO

Client: Galway Co. Co.

Dates: 16/07/2014

Level: 21.91 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole boring. Driller described: BOULDERS.	
						20.41	1.50	Open hole boring. Driller described: SAND with boulder content.	
						18.91	3.00	Open hole boring. Driller described: SAND AND GRAVEL.	
						17.41	4.50	Open hole boring. Driller described: Gravelly SAND with boulder content.	
						15.91	6.00	Open hole boring. Driller described: Gravelly SAND.	
		9.00	CPT	N=25 (5,5/6,6,7,6)	9.00	12.91	9.00		
	Water	Depth (m)	Type	Results	Casing	Level	Depth	Continued next sheet	

Groundwater:

Struck	Rose to	After	Sealed	Comment
10.20m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. See also RC01.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	16/07/2014	0.00m	Start of Borehole
8.70m	16/07/2014	15.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By	AK
Logged By	
Borehole No	**RC43** Sheet 2 of 2
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	551017E - 719951N
Hole Type	RO
Client:	Galway Co. Co.
Dates:	16/07/2014
Level:	21.91 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend	
								Open hole boring. Driller described: GRAVEL.		
	▽	10.00	CPT	N=24 (4,6/6,5,7,6)	10.00					10
		11.00	CPT	N=23 (6,4/5,5,7,6)	11.00					11
		12.00	CPT	N=24 (4,5/5,5,7,7)	12.00	9.91	12.00	Open hole boring. Driller described: Clayey GRAVEL.		12
		13.00	CPT	N=29 (5,6/6,7,8,8)	13.00					13
						8.41	13.50	Open hole boring. Driller described: GRAVEL.		
		14.00	CPT	N=22 (4,4/6,6,5,5)	14.00					14
		15.00	CPT	N=27 (5,6/6,7,7,7)	15.00	6.91	15.00	End of Borehole at 15.00 m		15
										16
										17
	Water	Depth (m)	Type	Results	Casing	Level	Depth			

Groundwater:

Struck	Rose to	After	Sealed	Comment
10.20m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. See also RC01.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	16/07/2014	0.00m	Start of Borehole
8.70m	16/07/2014	15.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By	AK
Logged By	DMC

Borehole No
RC02
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551043E - 719989N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 04/07/2014	**Level:** 22.44 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
										Open hole boring. No recovery.	
		1.00	CPT	N=20 (4,4/5,5,5,5)			1.00				
								21.24	1.20	Open hole boring. Driller described: SAND AND GRAVEL.	
		2.00	CPT	N=12 (1,2/2,3,3,4)			2.00				
		3.00	CPT	N=12 (2,3/2,3,3,4)			3.00				
		4.00	CPT	N=13 (1,2/4,3,3,3)			4.00				
								17.94	4.50	Open hole boring. Driller described: Sandy gravelly CLAY.	
		5.00	CPT	N=16 (2,3/3,4,5,4)			5.00				
		6.00	CPT	N=23 (4,4/5,5,9,4)			6.00				
							6.30 100.00%	16.14	6.30	Medium strong, pale grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay infilling. Fractures: Closely spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 6.3m - 8.0m: Fracture index - 9.	
		6.30-8.00	100	74	62	50mm min 140mm avg 250mm max				7.3m - 7.5m: Non-intact.	
								14.44	8.00	End of Borehole at 8.00 m	
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.30m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/07/2014	0.00m	Start of Borehole
-	04/07/2014	6.30m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**RC02**	**Project No**	**P12012**	
		Engineer	**TOBIN**	

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Drilled By	WD
Logged By	JMS
Borehole No	**BH03**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	551025E - 719974N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	30/04/2014
Level:	20.03 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨		0.00-0.45	B					Loose to medium dense silty very gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia.	▨
		1.00	CPT	N=11 (2,2/3,3,3,2)	1.00				
		1.00-1.50	B						
		1.60	CPT	50 (25,25/25,25)	1.60	18.43	1.60	End of Borehole at 1.60 m	

Depth scale (m): 1, 2, 3, 4, 5, 6, 7, 8

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.60m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.60 to 1.60	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/04/2014	0.00m	Start of Borehole
-	30/04/2014	1.60m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	AK
Logged By	DMC
Borehole No	**RC03**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	551082E - 719952N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	04/07/2014
Level:	20.67 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Open hole boring. Driller described: GRAVEL with boulder content.
		1.00	CPT	N=27 (4,7/6,6,7,8)	1.00			
						19.17	1.50	Open hole boring. Driller described: SAND AND GRAVEL.
		2.00	CPT	N=14 (2,3/3,3,4,4)	2.00			
		3.00	CPT	N=19 (2,2/2,8,4,5)	3.00			
		4.00	CPT	N=19 (2,2/9,3,3,4)	4.00			
						16.17	4.50	Open hole boring. Driller described: Clayey SAND AND GRAVEL.
		5.00	CPT	N=21 (3,4/4,5,6,6)	5.00			
		6.00	CPT	N=26 (5,4/6,6,7,7)	6.00	14.67	6.00	Open hole boring. Driller described: Sandy CLAY.
					6.90 100.00%	13.77	6.90	Medium strong, grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay smearing. Fractures: Closely spaced. Fractures dip horizontally with undulating smooth surfaces. 6.9m - 7.65m: Predominantly non-intact with clay infilling. 6.9m - 8.0m: Fracture index - 4.
					8.00	12.67	8.00	End of Borehole at 8.00 m

Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth
	6.90-8.00	100	44	14	30mm min 120mm avg 150mm max			

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.90m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/07/2014	0.00m	Start of Borehole
-	04/07/2014	6.90m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	**RC03**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Drilled By AK

Logged By

Borehole No
RC04
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 551019E - 720064N

Hole Type RO

Client: Galway Co. Co.

Dates: 07/07/2014

Level: 22.34 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Inspection pit. Driller described: SAND with boulder content.
		1.20	CPT	N=33 (5,6/8,8,7,10)	1.20	21.14	1.20	Open hole boring. Driller described: SAND with boulder content.
		2.00	CPT	N=18 (3,3/4,5,5,4)	2.00			
		3.00	CPT	N=13 (2,2/2,3,4,4)	3.00			
		4.00	CPT	N=22 (3,3/4,5,6,7)	4.00			
		5.00	CPT	N=27 (5,7/6,6,8,7)	5.00			
		6.00	CPT	N=28 (5,6/6,7,7,8)	6.00			
		7.00	CPT	N=25 (4,5/5,7,6,7)	7.00			
		8.00	CPT	N=22 (5,4/5,6,6,5)	8.00	14.34	8.00	End of Borehole at 8.00 m

Legend depth scale: 1 2 3 4 5 6 7 8

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	07/07/2014	0.00m	Start of Borehole
-	07/07/2014	8.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK
Logged By

Borehole No
RC05
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551011E - 720091N	**Hole Type** RO
Client: Galway Co. Co.	**Dates:** 07/07/2014	**Level:** 22.36 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Inspection pit. Driller described: Bituminous surfacing over BOULDERS.
		1.20	CPT	N=24 (4,5/5,6,7,6)	1.20	21.16	1.20	Open hole boring. Driller described: SAND AND GRAVEL with boulder content.
		2.00	CPT	N=17 (3,4/4,3,6,4)	2.00			
		3.00	CPT	N=11 (2,2/2,3,3,3)	3.00	19.36	3.00	Open hole boring. Driller described: SAND.
		4.00	CPT	N=10 (1,2/2,2,3,3)	4.00			
		5.00	CPT	N=7 (1,1/1,2,2,2)	5.00			
		6.00	CPT	N=8 (1,2/2,2,2,2)	6.00			
		7.00	CPT	N=12 (1,1/2,3,3,4)	7.00			
		8.00	CPT	N=12 (3,2/2,2,4,4)	8.00	14.36	8.00	End of Borehole at 8.00 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	07/07/2014	0.00m	Start of Borehole
-	07/07/2014	8.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK	**Logged By** DMC	Borehole No **RC06** Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 550840E - 719987N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 07/07/2014	**Level:** 20.64 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Depth (m)	Type / TCR	SCR	RQD	Results / Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
										Open hole boring. Driller described: CLAY with boulder content.
		1.20	CPT			N=25 (4,5/5,6,7,7)	1.20	19.44	1.20	Open hole boring. Driller described: Gravelly SAND with boulder content.
		2.00	CPT			N=19 (3,4/4,5,5,5)	2.00			
		3.00	CPT			N=14 (2,2/2,5,3,4)	3.00	17.64	3.00	Open hole boring. Driller described: CLAY.
		4.00	CPT			58 (5,3/4,4,25 for 1mm)	4.00			
							4.30 100.00%	16.34	4.30	BOULDERS recovered as: Medium strong, light grey Limestone.
		4.30-6.00	26	0	0					
		6.00	~~CPT~~			~~(50 for 2mm~~)	6.00			
		6.00-7.50	67	67	67					
		7.50	~~CPT~~			~~(50 for 2mm~~)	7.50			
		7.50-8.00	50	14	0					
		8.00	~~CPT~~			~~(50 for 2mm~~)	8.00	12.64	8.00	End of Borehole at 8.00 m

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
4.30m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	07/07/2014	0.00m	Start of Borehole
-	07/07/2014	4.30m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	**RC06**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

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Drilled By AK

Logged By

Borehole No **RC07**
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 550852E - 719938N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 03/07/2014

Level: 22.03 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
										Open hole boring. Driller described: CLAY with boulder content.
		1.00	CPT	N=42 (7,7/10,10,11,11)			1.00			
								20.53	1.50	Open hole boring. Driller described: SAND with boulder content.
		2.00	CPT	N=21 (4,5/5,6,5,5)			2.00			
		3.00	CPT	N=22 (7,3/5,7,5,5)			3.00			
		4.00	CPT	N=21 (4,4/6,5,5,5)			4.00			
		5.00	CPT	N=61 (3,5/5,6,25,25)			5.00			
							5.30	16.73	5.30	Strong, grey LIMESTONE. Weathering: Slightly weathered. Localised discolouration. Fractures: 1) Closely spaced, dipping approximately 80-90 degrees with planar rough surfaces. 2) Medium spaced, dipping approximately 30-60 degrees with planar rough surfaces. 5.3m to 6.8m: Fracture index - 7.
		5.30-6.80	97	89	78	40mm min 150mm avg 570mm max				
										6.8m to 8.0m: Fracture index - 9.
		6.80-8.00	100	100	86					
							8.00	14.03	8.00	End of Borehole at 8.00 m
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.30m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/07/2014	0.00m	Start of Borehole
-	03/07/2014	5.30m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

Number:	**RC07**	**Project**	**Dunkellin River Flood Relief Works**
		Project No	**P12012**
		Engineer	**TOBIN**

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Drilled By	WD
Logged By	JMS
Borehole No	**BH08**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	550795E - 719967N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	30/04/2014
Level:	20.25 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						20.10	0.15	Topsoil.	
		0.15-1.00	B					Firm, light grey, slightly sandy, gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded. Cobbles are subrounded, 60-150mm dia.	
		1.00	CPT	N=11 (2,2/3,3,2,3)	1.00				
		1.00-1.50	B						
		1.60	CPT	50 (16,25/25,25)	1.60 1.70	18.60 18.55	1.65 1.70	Chiselled from 1.65m to 1.7m for 1 hour.	
								End of Borehole at 1.70 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.70m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.65 to 1.70	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/04/2014	0.00m	Start of Borehole
-	30/04/2014	1.70m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	AK
Logged By	
Borehole No	**RC08**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	550799E - 719969N
Hole Type	RO
Client:	Galway Co. Co.
Dates:	08/07/2014
Level:	20.40 m AOD
Scale	1:50

Well / Backfill	Water Strikes	**Samples & In Situ Testing** Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	**Stratum Description**	Legend
								Open hole boring. Driller described: SAND with boulder content.	
		1.20	CPT	N=45 (7,10/11,10,14,10)	1.20				
						18.90	1.50	Open hole boring. Driller described: CLAY.	
		2.00	CPT	N=18 (3,4/5,4,4,5)	2.00				
		3.00	CPT	N=21 (4,6/5,5,6,5)	3.00	17.40	3.00	Open hole boring. Driller described: Gravelly SAND with boulder content.	
		4.00	CPT	N=19 (3,5/5,4,5,5)	4.00				
						15.90	4.50	Open hole boring. Driller described: CLAY with boulder content.	
		5.00	CPT	N=32 (10,7/7,8,8,9)	5.00				
		6.00	CPT	N=29 (6,5/7,7,7,8)	6.00				
	▽								
		7.00	CPT	N=27 (5,5/5,7,6,9)	7.00				
		8.00	CPT	N=29 (6,7/8,7,7,7)	8.00	12.40	8.00	End of Borehole at 8.00 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.30m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/07/2014	0.00m	Start of Borehole
5.60m	08/07/2014	8.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK
Logged By DMC

Borehole No
RC09
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW
Project No. P12012
Co-ords: 550798E - 719931N
Hole Type Rotary Cored

Client: Galway Co. Co.
Dates: 02/07/2014-03/07/2014
Level: 21.23 m AOD
Scale 1:50

Samples & In Situ Testing

Depth (m)	Type			Results	Casing / Flush
1.00	CPT			N=6 (1,1/1,2,1,2)	1.00
2.00	CPT			N=4 (1,1/1,1,1,1)	2.00
3.00	CPT			N=74 (12,11/20,19,17,18)	3.00
4.00	CPT			N=60 (11,14/12,15,17,16)	4.00
5.00	CPT			N=11 (2,2/2,3,3,3)	5.00
6.00	CPT			N=8 (1,2/2,2,2,2)	6.00
					6.50 100.00%
Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing
6.60-8.10	100	100	100	190mm min 500mm avg 720mm max	8.10

Water Strikes: –

Stratum Description

Level (m AOD)	Depth (m)	Stratum Description
		Open hole boring. Driller described: CLAY with boulder content and wood.
		Open hole boring. Driller described: CLAY with boulder content.
19.73	1.50	
18.23	3.00	Open hole boring. Driller described: CLAY with boulder content and wood.
16.73	4.50	Open hole boring. Driller described: SAND AND GRAVEL with wood.
15.23	6.00	Open hole boring. Driller described: Sandy CLAY with boulder content.
14.63	6.60	Medium strong, grey LIMESTONE. Weathering: Slightly weathered. Clay smearing. Fractures: Medium spaced. Fractures dip 1) sub-horizontally with undulating smooth surfaces 2) Approximately 30-40 degrees with planar smooth surfaces. . 6.6m - 8.1m: Fracture index - 3.
13.23	8.00	End of Borehole at 8.10 m

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.50m	131mm	131mm
8.10m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/07/2014	0.00m	Start of Borehole
-	02/07/2014	3.00m	End of shift
-	03/07/2014	3.00m	Start of shift
-	03/07/2014	6.60m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**RC09**	**Project No** **Engineer**	**P12012** **TOBIN**

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Drilled By	WD
Logged By	DMC
Borehole No	**BH10**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	550693E - 719879N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	01/05/2014
Level:	22.22 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Topsoil.	
						21.92	0.30	COBBLES.	
						21.62	0.60	Firm, brown, slightly sandy gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, suabngular.	
		1.00	D						
		1.20	CPT	N=12 (2,2/3,4,2,3)	1.20				
		1.20-1.70	B						
		2.00	CPT	N=8 (3,2/2,2,2,2)	2.00				
		2.00-2.50	B						
		3.00	CPT	(25)	3.00				
		3.00-3.30	B					Below 3.0m: Increase in cobble content (chiselled from 3.0m to 3.4m for 2.5 hrs)	
		3.40	CPT	50 (25,25/25,25)	3.40	18.82	3.40		
								End of Borehole at 3.40 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.40m	200mm	200mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
3.00	to	3.20	0030	Chisel
3.20		3.30	0100	Chisel
3.40		3.40	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/05/2014	0.00m	Start of Borehole
-	01/05/2014	3.40m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	AK
Logged By	DMC
Borehole No	**RC10**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	550520E - 719855N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	08/07/2014
Level:	19.33 m AOD
Scale	1:50

Well / Backfill	Water Strikes	**Samples & In Situ Testing** Depth (m)	Type			Results	Casing / Flush	Level (m AOD)	Depth (m)	**Stratum Description**
										Open hole boring. Driller described: GRAVEL with boulder content.
		1.00	CPT			N=51 (9,11/11,10,14,16)	1.00			
								17.83	1.50	Open hole boring. Driller described: CLAY with boulder content.
		2.00	CPT			N=42 (7,9/9,10,12,11)	2.00			
		3.00	CPT			N=21 (4,3/5,6,5,5)	3.00	16.33	3.00	Open hole boring. Driller described: CLAY.
		4.00	CPT			66 (5,7/7,9,25 for 1mm)	4.00			
							4.30 100.00%	15.03	4.30	Medium strong, grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay smearing. Fractures: Medium spaced. Fractures dip approximately 20-30 degrees with undulating smooth surfaces. 4.3m - 5.2m: Fracture index - 2.
		4.30-5.20	100	100	91	60mm min 450mm avg 460mm max				
							5.20	14.13	5.20	End of Borehole at 5.20 m
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
4.30m	131mm	131mm
5.20m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/07/2014	0.00m	Start of Borehole
-	08/07/2014	4.30m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	**RC10**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Drilled By	WD
Logged By	JMS
Borehole No	**BH11**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	550539E - 719860N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	03/06/2014
Level:	19.29 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						19.19	0.10	Topsoil.
		0.10-0.45	B			18.84	0.45	Dark brown, slightly sandy slightly gravelly SILT with rootlets.
								Soft, brown, slightly sandy, gravelly SILT with medium cobble content and rootlets.
		1.00	D					
		1.20	CPT	N=6 (2,2/2,1,1,2)	1.20			
		1.20-1.70	B					
		1.80	D					
		2.00	CPT	N=7 (2,2/2,2,2,1)	2.00	17.29	2.00	Soft, dark brown, slightly sandy slightly gravelly SILT with low cobble content.
		2.80	D					
		3.00	CPT	50 (15,25/25,25)	3.00	16.19	3.10	
		3.20	CPT	25 (25,25/25)	3.20	16.09	3.20	Chiselled from 3.1m to 3.2m for 1 hour.
								End of Borehole at 3.20 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.20m	200mm	200mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
2.50	to	2.70	0030	Chisel
3.10		3.20	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/06/2014	0.00m	Start of Borehole
-	03/06/2014	3.20m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	
Logged By	IH
Borehole No	**BH42**
	Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551255E - 720059N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 04/07/2014	**Level:** 19.73 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	**Samples & In Situ Testing** Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	**Stratum Description**	Legend
						19.53	0.20	Topsoil	
								Soft to firm light brown slightly sandy gravelly SILT.	
		0.50-1.00	D						
		1.00	CPT	N=8 (2,2/2,2,2,2)	1.00				
		1.00-1.50	B						
						18.23	1.50	Soft to firm light brown slightly sandy CLAY with lenses of grey sandy Silt.	
		1.50-2.00	B						
		2.00	CPT	N=9 (2,3/2,2,2,3)	2.00				
		2.00-2.50	B						
		3.00	CPT	50 (17,25/25,25)	3.00				
								Chiselling 1hr. without progress 3.3m, obstruction.	
		3.30	CPT	50 (20,25/25,25)	3.10	16.43	3.30	End of Borehole at 3.30 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter

Chiselling:

Depths (m)	Time (hhmm)	Tool
3.10 to 3.30	0100	chisel

Remarks: JCB required to clear entrance to field. Borehoel terminated on obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks

Equipment & Methods:

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Trial Pit No
TP01
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 551212E - 720091N **Level:** 20.92 m AOD	**Date** 15/05/2014
Location: Co Galway		**Dimensions:** 3.20m 0.80m Depth 3.00m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing							
Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				20.62	0.30	Firm, light grey, slightly gravelly slightly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-500mm dia.	▨
	0.40-1.40 0.40-1.40	B D					▨
						High cobble content below 1.4m.	▨
	1.40-2.40 1.40-2.40	B D					▨
				17.92	3.00	Trial pit completed at 3.00 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at required depth.

HoleBASE III (Bld 426.58) Standard Trialpit Log v2 dated 27th Nov 03

Trial Pit Photographic Record

Number:	**TP01**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

Number:	**TP01**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Trial Pit No
TP01A
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 551273E - 720062N **Level:** 20.28 m AOD	**Date** 04/06/2014
Location: Co Galway		**Dimensions:** 3.00m × 6.00m Depth 3.50m	**Scale** 1:25
Client: Galway Co Co			**Logged By** BG

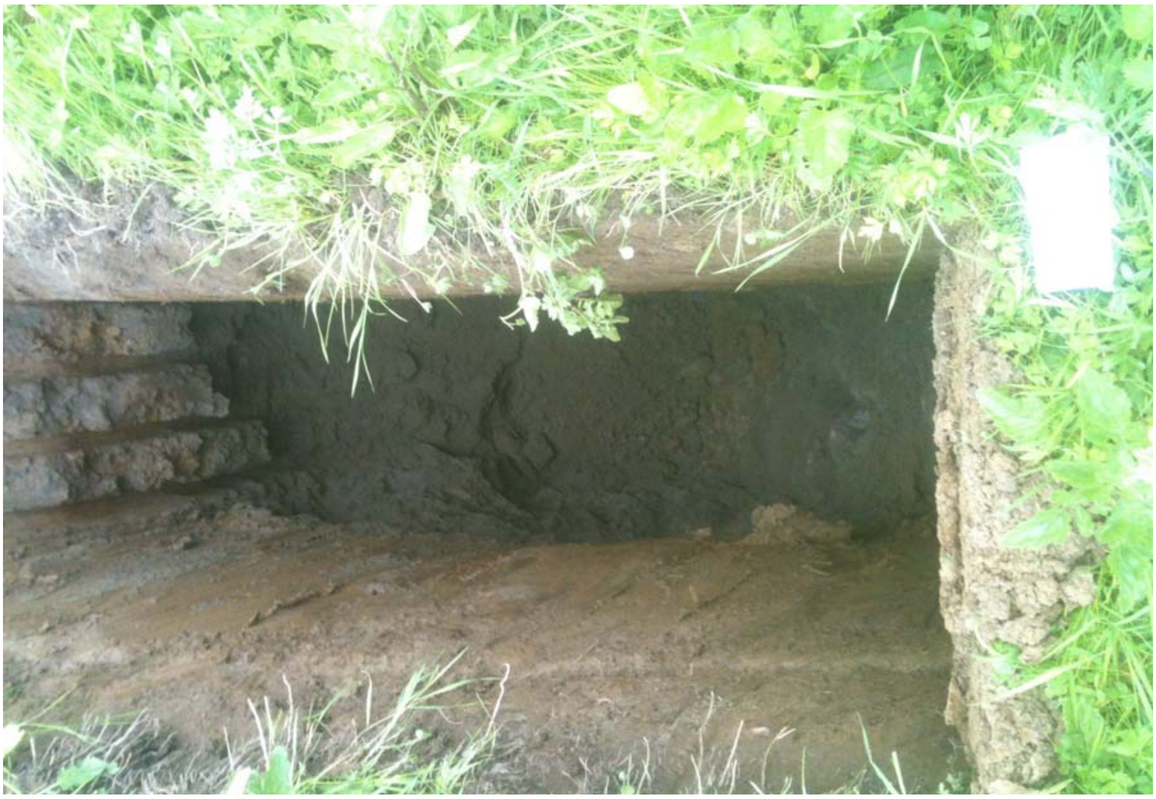
Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil soft dark brown slightly sandy slightly gravelly SILT with rootlets. Sand is fine to medium, gravel is fine.		
				19.78	0.50	Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is fine.		
	0.50-1.50 0.50-1.50	B D						1
				18.78	1.50	Loose light grey slightly gravelly slightly sandy SILT with medium cobble and boulder content. Sand is medium, gravel is fine. Cobbles to 200mm. Boulders to 400mm		
								2
	1.50-3.50 1.50-3.50	B D						
								3
				16.78	3.50	Trial pit completed at 3.50 m		
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Good
Plant: JCB
Backfill:

Groundwater:

Remarks:

Trial Pit Photographic Record



Number:	**TP01A**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP01A**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP01B
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 551235E - 720038N **Level:** 20.53 m AOD	**Date** 04/06/2014
Location: Co Galway		**Dimensions:** 3.20m 0.60m Depth 2.80m	**Scale** 1:25
Client: Galway Co Co			**Logged By** BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil soft dark brown slightly sandy slightly gravelly SILT with rootlets. Sand is fine to medium.	▨
				20.13	0.40	Loose brown slightly sandy slightly gravelly SILT. Sand is fine, Gravel is fine.	▨
				19.53	1.00	Firm light brown-orange slightly sandy slightly gravelly CLAY. Sand is fine, gravel is fine.	▨
	1.00-2.00 1.00-2.00	B D					
				18.53	2.00	Loose slightly sandy slightly gravelly SILT with low cobble content and medium boulder content. Sand is medium to coarse, gravel is medium to coarse. Cobbles up to 200mm. Boulders up to 900mm.	▨
	2.00-2.80 2.00-2.80	B D					
				17.73	2.80	Trial pit completed at 2.80 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Good
Plant: JCB
Backfill:

Groundwater:

Remarks:

Trial Pit Photographic Record

Number:	TP01B	Project	Dunkellin River Flood Relief Works
		Project No	P12012
		Engineer	TOBIN

Dunkellin River and Aggard Stream Flood Relief Scheme

Response to An Bord Pleanála

Document Control Sheet

Client:	Galway County Council
Project Title:	Dunkellin River and Aggard Stream Flood Relief Scheme
Document Title:	Response to An Bord Pleanála
Document No:	MGE0260RP0012

Text Pages:	48	Appendices:	6

Rev.	Status	Date	Author(s)	Reviewed By		Approved By	
F01	Final	8th July 2015	PK, GB, ASU,	PK	Paula Keaney	GMcE	Gareth McEll

QUALITY ISO 9001:2008 NSAI Certified | ENVIRONMENT ISO 14001:2004 NSAI Certified | HEALTH & SAFETY OHSAS 18001:2007 NSAI Certified

CERTIFIED IQNet MANAGEMENT SYSTEM

ENGINEERS IRELAND cpd ACCREDITED EMPLOYER

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INTRODUCTION

RPS was commissioned by Galway County Council in 2011 to prepare an Environmental Impact Statement (EIS) for the Dunkellin River and Aggard Stream Flood Relief Scheme in south County Galway. The Dunkellin River and the Aggard Stream form part of the Dunkellin Drainage District which was constructed in or around 1857 and Galway County Council has a statutory maintenance responsibility for these works.

In 2010 a study on the Dunkellin River and the Aggard Stream (from Craughwell Village to Kilcolgan) was commissioned as a result of flooding that occurred in the area in November 2009. Galway County Council is now progressing the Flood Relief Scheme, from here on referred to as the "scheme", to design stage. The scheme was submitted to An Bord Pleanála (ABP) in October 2014 for planning approval in line with Section 175 of the Planning and Development Act 2000, as amended.

The scheme includes for flood relief works to be completed along the main channel of the Dunkellin River from Craughwell to Kilcolgan (over 11km) and along the Aggard Stream which runs from the townland of Cregaclare (near Ardrahan) to its outfall at the confluence of the Dunkellin and Craughwell Rivers (over 7.5km). A combination of river widening, deepening, culvert upgrade and replacement, bridge improvement and replacement and general channel maintenance make up the proposed measures for this scheme. The intention of the scheme is to provide optimum flood relief with minimal environmental impact, whilst also controlling the overall capital investment required.

In February 2015, the Board, in accordance with Section 175(5) (a) of the Planning and Development Act, 2000, as amended, requested further information in relation to the proposed development.

The purpose of this document is to provide a response to the issues raised by the Board and to determine what, if any, actions are now required to address further information needs which will enable the Board to make an environmental impact assessment and an appropriate assessment of the proposed flood relief scheme.

1 ITEM 1 – POST-SCHEME FLOOD PLANS

1.1 *It is considered that the applicant has not provided a thorough description of the benefits of the scheme in terms of the effects on material assets*

Response

A Cost Benefit Analysis (CBA) was carried out in tandem with the design of this scheme. Drawing 6408-2300, contained in **Appendix A** to this response, illustrates the location of properties (i.e. dwelling property, commercial property and social benefits) which are to be provided with protection from a flood event with a return period of 1 in 100 years with further protection of an additional 20% increase to allow for climate change (Mid-Range Future Scenario as defined by the OPW).

This design event, with a design flow of 97.7 cu.mecs is expected to exceed the November 2009 flood event which has been estimated to be 84.8 cu.mecs. Whilst the scheme will provide some degree of benefit to the adjacent agricultural lands, the project has not been designed as a land drainage or Arterial Drainage Scheme and therefore such agricultural benefits have not been accrued in the assessment of benefits to material assets.

Other benefits associated with the scheme include;

a. The minimisation of road disruption. During the November 2009 event, the R446 Road Crossing was closed for a total four days. This road closure resulted in diversions of more than 10km.

b. Reduction in emergency costs incurred by emergency services in dealing with the flood event and also in dealing with the recovery process.

c. ‘Recreation benefits’ arising from the enjoyment of landscape, wildlife and natural amenities as well as from the enjoyment of recreational activities. The proposed river enhancement works will aid the passage of fish up the river.

1.2 *Plans showing the pre-scheme flooding compared with the post-scheme for the mean, 5%ile and 10%ile scenarios – these plans should be similar to those presented for Rahasane Turlough but should extend for the entirety of the scheme length and should clearly identify all buildings.*

Response

Appendix A provides a series of drawings outlining the predicted flood extents for the *“mean, 5%ile and 10%ile scenarios”*; for both the pre-scheme channel and post-scheme channel works. The relevant drawings are provided in **Table 1.1** below.

Table 1.1 - Drawings Outlining the Predicted Flood Extents

Drawing No.	Description
6408-2300	Predicted Flood Extents for November 2009 Flow Pre & Post Flood Alleviation Works
6408-2301	Predicted Flood Extents for 5%ile Flows Pre & Post Flood Alleviation Works
6408-2302	Predicted Flood Extents for 10%ile Flows Pre & Post Flood Alleviation Works
6408-2303	Predicted Flood Extents for Mean Annual Flow Conditions Pre & Post Flood Alleviation Works

Drawing No. 6408-2300 illustrates the extent of flooding associated with the November 2009 event and the reduction in properties flooded by limiting the fluvial flow to the new channel works.

Drawing No's 6408-2301, 6408-2302 and 6408-2303 illustrate the extent of flooding associated with the *"mean, 5%ile and 10%ile scenarios"*. From these drawings it can be seen that the discharge is contained with the existing and proposed channel.

1.3 A copy of any report prepared by Dr. Goodwillie or other specialist ecologist which describes the surveys undertaken for the environmental impact statement (EIS) and/or NIS and which identifies the aspects of the hydrological regime which need to be maintained to ensure that the integrity of the Rahasane Turlough candidate Special Area of Conservation (cSAC) is not affected by the works. It is considered that the basis for the decision to 'deliberately minimise the predicted changes in water levels within the turlough so to maintain the ecologically critical water level range' should be discussed in more detail. It is considered that this conclusion, which is presented in the application submissions including Page 30 of the Description of the Proposed Works by Tobin Consulting Engineers, should be supported by more evidence in view of the stated limitations of the scheme, the stated need to consider further alternative and localised flood protection measures along the northern shore of the turlough and in response to the comments of observers. The response should include expert comment on the required duration of flood at 16.5m OD.

Response

No specific report on turlough vegetation was produced for this project by Mr Goodwillie. Instead comments were made on items in the various reports produced by Tobin on the scheme between 2012-14. These were based on Mr. Goodwillie's experience of the habitat from 1988 to the present.

Work around the turloughs in South Galway (Peach et al., 1997; Goodwillie in Otte, 2003) suggested that the length of time the vegetation was flooded and the date of release from floods in the spring were the most important factors in controlling the vegetation of turloughs. This seemed likely to be because many plants are susceptible to a lack of oxygen in the soil which occurs after a few weeks of flooding. The tolerant ones grow in the middle of the basin and the less tolerant ones toward the margins. Subsequently in a more systematic Ph.D. study of turlough vegetation Sharkey (2012) summarised that 'a wide range of environmental and management factors were found to affect the species composition of turlough vegetation. Soil type, nutrient status, grazing and hydrology were all found to affect turlough vegetation, and the conditions associated with each vegetation community were identified. Duration of flooding and nutrient status (notably phosphorus) were found to be the most important drivers of turlough vegetation.'

The pattern of flooding is highly variable from year to year in a turlough and the actual top edge of the turlough zone is in a continual state of change; either the plant communities are spreading towards the centre in response to a dry year or are recovering from the effects in a wet year with a longer flooding period. It is safe to say that no two years are the same in their effects on plant life in the turlough basin and that the edge vegetation which may only be flooded for a week or two is in constant change. This makes the designation of a top level in a basin that does not overflow inherently difficult. There is in fact, no strict edge, only a level at which a few days of flooding does not have an appreciable effect on the species composition of the vegetation. The comparison of a turlough edge with that of a floodplain is apt and would be called an ecotone, a zone of interaction between wet and dry communities.

The black moss *Cinclidotus* is often said to indicate flooding but it grows also in the wave splash zone so may reach 30cm higher than the water level on the exposed side of the basin. Woody species and the bark-dwelling lichens on them were reckoned to be the best indicators of top flood height around Coole Lough (Peach et al., 1997) but cannot be much used at Rahasane because of the high level of grazing pressure and the absence of woodland. Associated with this boundary was the appearance of yellow mosses, e.g. *Eurhynchium, Brachythecium, Holmalothecium* and, in grassland creeping thistle *Cirsium arvense*, wild thyme *Thymus polytrichus* and bulbous buttercup *Ranunculus bulbosus*. It was this level that was chosen at Rahasane and was found to be 16.5m O.D. on two sides of the basin, during a site survey on Thursday 5th April 2012, when Mr. Goodwillie was accompanied by a topographical surveyor and members of the ecological and hydrological team. The two areas identified include the following:

- Area 1: Killeeneenmore (M46891966) where the field wall showed an edge in the higher plants, about 10cm below the last traces of *Cinclidotus* moss (maintained here by wavespray), and

- Area 2: The other site was on the southern side somewhat upstream, in Carrigeen East (M49081938, M49031927, M48961928). Here three levels were considered, one marking the transition of *Ranunculus repens/Galium palustre* to yellow moss, one at the base of lichen growth on exposed *Prunus spinosa* and one in a grazed field where a flood line nicely separated a *Festuca rubra* grassland from a damper version with *Phleum*.

Images 1.1 to **1.4** below show the locations used in this site visit to establish this upper flood level.

Image 1.1 - Killeeneenmore (Northern Part of Turlough)

Image 1.2 - Killeeneenmore (Northern Part of Turlough)

Image 1.3 - Carrigeen East (Southern Part of Turlough)

Image 1.4 - Carrigeen East (Southern Part of Turlough)

It was considered that this ‘top’ height of Rahasane turlough was essential to maintain so this was built into the final design of the project. All the ground out to 16.5m will therefore continue to be inundated. The inundation period must change to some extent in view of the fact that water speed through the catchment will be increased by 1% but the scale of the change will be analogous to a series of slightly drier years and, it is thought, will result in minimal changes to the vegetation of the margins. Plant cover here does not have a particularly 'turlough' composition and similar stands are found in many seasonally damp locations in limestone country. There is no likelihood of changes to the typical turlough communities of deeper levels such as those containing rare or protected plants (in Rahasane these are mudwort *Limosella aquatica* (protected), turlough violet *Viola persicifolia*, needle spike rush *Eleocharis acicularis*, fat duckweed *Lemna gibba*, Northern yellow cress *Rorippa islandica*). These will continue to be inundated for similar periods as they are today and will continue to be used as before by wildfowl and other fauna.

Sharkey (2012) suggests that the mean duration of flooding for these upper levels is 50-90 days per year but this does not occur as a single period, more as a series of rises and falls in response to water levels in the basin. It should be pointed out that her experimental sites were all located in groundwater-fed basins so that a greater degree of fluctuation would be expected in a riverine site such as Rahasane in response to catchment rainfall. It was a general finding at Rahasane during surveys that the shoreline accumulation of debris, i.e. the 'high tide mark', was 10-20cms lower after winter 2014-15 than after 2013-14 which implies that the higher water level, if achieved at all in 2014-15, was fleeting.

The decision to '*deliberately minimise the predicted changes in water levels within the turlough so to maintain the ecologically critical water level range*' is based on the Targets to Maintain the Favourable Conservation Status of '3180 Turlough' at Rahasane Turlough SAC which were extracted and adapted from Galway Bay SAC conservation objectives[1] in the NIS Section 3.1.6 and reproduced in **Table 1.2** below for clarity. Taking cognisance of the targets set for Vegetation Composition (area of vegetation communities) and typical species (invertebrates) maintenance is a critical factor and there can be no change other than natural processes. Therefore the maintenance of the hydrology to its current regime is critical to achieving these targets. The distribution of vegetation communities within Rahasane Turlough are provided in **Figure 1.1**.

Table 1.2 - Targets to Maintain the Favourable Conservation Status of '3180 Turlough' at Rahasane Turlough SAC

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable at c. ***203.3*** ha or increasing/changing subject to natural processes.	The upper limit of turlough habitat at Rahasane has been assessed by Goodwillie (2012) as being at 16.5 mO.D. Maintenance of flood duration and extent at this level will maintain the turlough vegetation communities at Rahasane Turlough SAC.
Habitat distribution	Occurrence	No decline, subject to natural processes.	Turlough habitat is distributed throughout the two main basins, the main north basin and the smaller Rinn basin. Maintenance of turlough habitat over these areas will maintain habitat distribution.
Hydrological regime: flood duration, frequency, area, depth; permanently flooded area	Various	Appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat.	**Hydrological regime: groundwater contribution** Maintain appropriate groundwater contribution necessary for the natural functioning of the habitat. **Hydrological regime: flood duration** Maintain hydrological regime within current range of variation for the natural functioning of the habitat. The extent of turlough habitat at Rahasane has been assessed by Goodwillie (2012) as being at 16.5 mO.D therefore flood duration levels at this altitude should be maintained.

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[1] NPWS (2013) Conservation Objectives: Galway Bay Complex SAC 000268. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Attribute	Measure	Target	Notes
			Hydrological regime: flood frequency Maintain current seasonal temporal patterns in flood frequency. **Hydrological regime: flood area** Maintain natural temporal pattern in flood area. **Hydrological regime: flood depth** Maintain natural temporal and spatial patterns in flood depths. **Hydrological regime: permanently flooded/wet areas** Maintain any areas of permanent or semi-permanent flooding or water-logging. The northern side of the main basin remains wet throughout the year which should be maintained.
Soil type: area	Hectares	Maintain variety, area and extent of soil types necessary to support current turlough vegetation and other biota.	The maintenance of geology, morphology and hydrology will maintain soil type. Grazing pressure or other farming management could alter soil type locally.
Soil nutrient status: nitrogen and phosphorous	N and P concentration in soil	Maintain nutrient status appropriate to soil types.	Changes in concentrations of supply of nutrients, through groundwater, surface water or land management practices, including channel improvement in the Aggard Stream, may alter the N and P concentration in turlough soil.
Physical structure: bare ground	Presence	No decline in wet bare ground, as appropriate	Maintenance of flood duration and any trampling by grazers will maintain bare ground. The location may change in response to grazing.
Chemical processes: calcium carbonate deposition and concentration	$CaCO_3$ deposition rate/soil concentration	Maintenance of appropriate $CaCO_3$ deposition rates and concentration in soil	$CaCO_3$ deposition rates and concentration in soil may be affected by hydrological changes in the turlough and by drainage activities in the zone of contribution (groundwater catchment and surface water catchment). These will affect the $CaCO_3$ concentration in the floodwater, or change biological communities, impacting the precipitation processes.
Water quality: nutrients; colour; phytoplankton; epiphyton	Various	Maintain appropriate water quality to support the natural structure and functioning of the habitat.	**Water quality: nutrients** Maintain average annual TP concentration of $\leq 10\mu g\ l^{-1}$ TP, or $\leq 20\mu g\ l^{-1}$ TP, as appropriate. **Water quality: colour** Maintain appropriate water colour. **Water quality: phytoplankton biomass** Maintain appropriate chlorophyll a concentrations as follows: Annual mean/maximum chlorophyll a concentration $<8\mu g\ l^{-1}/<25\mu g\ l^{-1}$ **Water quality: epiphyton biomass** Maintain trace/ absent epiphyton as algal mats (< 2% cover).
Active peat formation	Flood duration	Active peat formation, where appropriate.	There is no peat formation at Rahasane Turlough.

Attribute	Measure	Target	Notes
Vegetation composition: area of vegetation communities	Hectares	Maintain area of sensitive and high conservation value vegetation communities/units at each turlough.	The Turlough Vegetation Communities in accordance with the system developed by Goodwillie (1992) identified in the Galway Bay Complex SAC Conservation Objectives backing document for Turloughs as being sensitive and positive indicator communities include 2A, 2B, 3A, 3B, 4B, 6A, 6B, 7B and 8E. However further consultation with Goodwillie has suggested that the communities listed below might be more appropriately considered to be sensitive with regard to nutrient enrichment and hydrology of Rahasane Turlough. **Vegetation Community** / **Area (ha)** 2B / 10.2 3B / 1.4 6A / 25.0 9A / 26.6 10A / 11.4 10B / 3.4 11B / 14.25
Vegetation composition: vegetation zonation	Distribution	Maintain vegetation zonation/mosaic characteristic of each turlough.	Zonation as per mapping carried out by Goodwillie (1992) to be maintained. 17 vegetation communities to be retained with the same general distribution throughout the site.
Vegetation structure: sward height	Centimetres	Maintain a variety of sward heights across each turlough.	Sward height is controlled by grazing. The current proposal will not significantly impact on sward height.
Typical species: terrestrial, wetland and aquatic plants, invertebrates, birds	Presence	Maintain typical species within Rahasane	**Typical species: terrestrial, wetland and aquatic plants** Typical species are identified by cross-referencing the species listed in Goodwillie (1992) with those listed in Table 3 and Table 4 of NPWS (2013).
Fringing habitats: area	Hectares	Maintain marginal fringing habitats that support turlough vegetation, invertebrate, mammal and/or bird populations.	Most areas outside of those habitats mapped by Goodwillie (1992) could potentially support vegetation, invertebrate, mammal and/or bird populations associated with the turlough. Therefore any changes in the other attributes listed in this table could lead to a decrease in area of fringing habitats.
Vegetation structure: turlough woodland	Species diversity and woodland structure	Maintain appropriate turlough woodland diversity and structure.	Goodwillie (1992) states that the actual area of flooded woodland is too small to map at Rahasane Turlough. An increase would add to the biodiversity of the site.

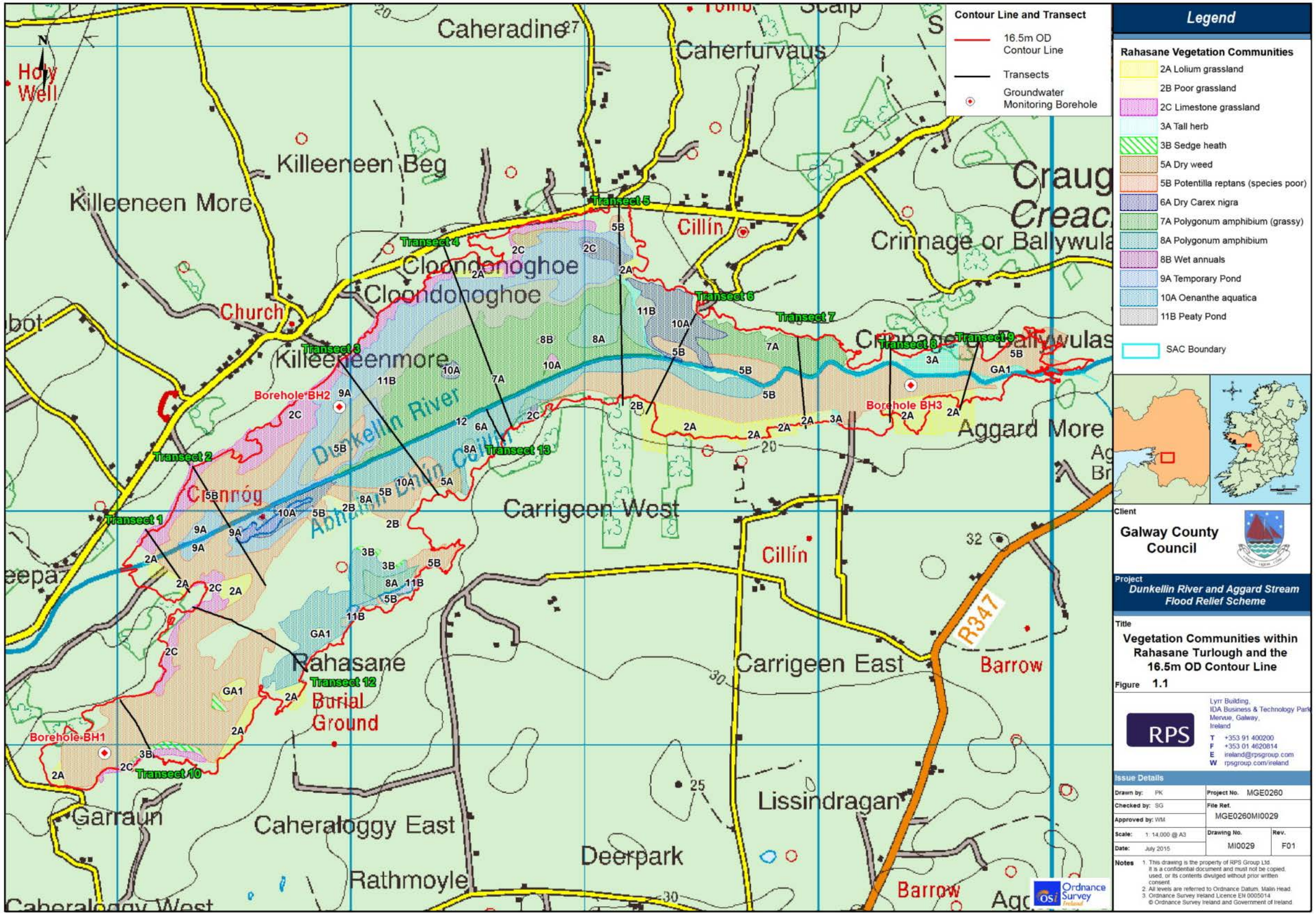


Figure 1.1 - Vegetation Communities, Transect Lines and 16.5 mO.D. Contour

To further investigate the 'ecologically critical turlough levels', a field visit was conducted on 10th June 2015 with Mr. Goodwillie and members of the RPS ecological team to identify further monitoring stations, in addition to the nine longitudinal transects identified in the EIS and NIS and to further validate the 16.5 mO.D. level. Three further transects were identified which were topographically surveyed on the 23rd June 2015.

From LiDAR mapping a 16.5 mO.D. contour map has been produced and shown in **Figure 1.1**. This figure is an amended version of the **EIS Figure 10.4** and **NIS Figure 6.1**. From this figure it can be seen that the 16.5 mO.D. contour, largely charts the boundaries of the turlough edge vegetation, which was verified through topographical surveys and which further validates the ecologically critical water level of 16.5 mO.D. level.

The overflow, during summer, from the river into the northern part of the turlough which sustains much of the aquatic flora that is not in the main channel, occurs at 14.70 mO.D.

With regard to aquatic invertebrates, the following critical level was identified in Section 11.4.10.1 of the EIS (p187):

- *Fairy shrimp, Tanymastix stagnalis, first recorded in Ireland in 1974 at the small, southeastern basin of Rahasane Turlough (Rinn Basin) (Young, 1976) and only recorded from a few Irish sites, depends on overflow from the main Rahasane basin to stimulate a rapid breeding phase. The overflow between the basins occurs at 14.70 mO.D., equating to 35th percentile flow (established using the long-term depth exceedance curve in Appendix A, Figure 3.13 of the EIS).*

Tanymastix requires seasonal or temporary pools without fish in order to escape predation (Porst, 2006). Rinn basin is isolated from the drainage channel of the Rahasane main basin where fish predators exist, and the species has only ever been found in the Rinn basin. Tanymastix is well adapted to exploit temporarily flooded environments, with the ability to hatch, grow and produce eggs within a very short time-frame, e.g. < 15 days reported in August 1974 (Young, 1976).

It is considered that ensuring overflow and flood frequency and duration in Rinn Basin is the primary "ecologically critical level" from the perspective of aquatic invertebrates at Rahasane Turlough. Wetland invertebrates, especially those of habitats with highly variable hydrology, have developed many adaptations that include:

- egg or pupal stages that can tolerate dry periods;
- initiation of egg development after specific water/oxygen levels have been reached;
- marked seasonality in life cycle;
- rapid breeding cycles and development;
- large numbers of offspring;
- diapause related to seasonal flooding; and
- parthenogenic reproduction (e.g., cladocera).

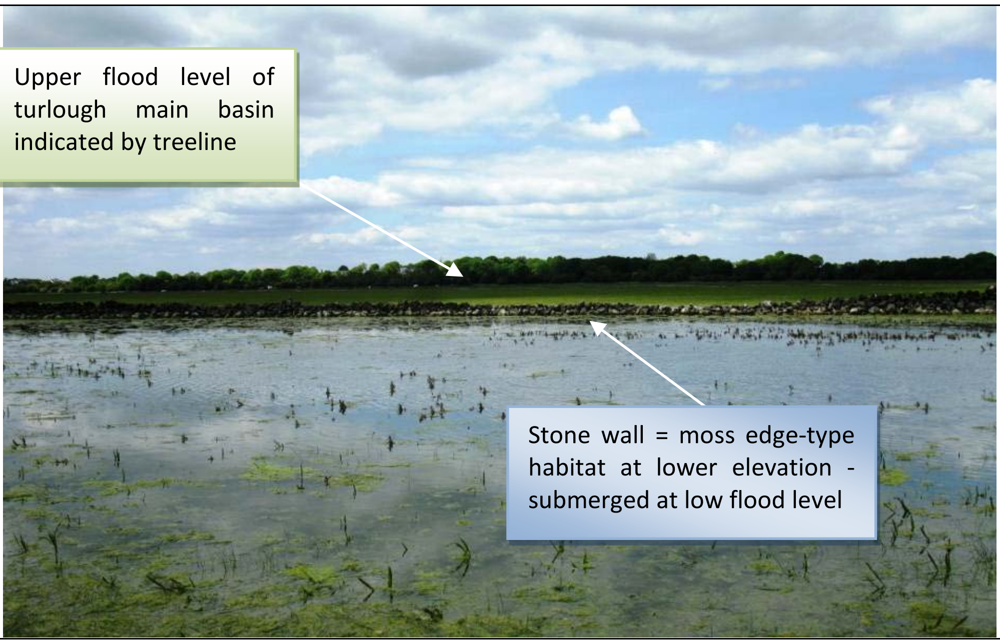
During drying out periods, invertebrates can also follow falling water levels into deeper pools; move into sediments within the water table, and those that can fly can move to other nearby pools or wetlands. Turlough fauna in particular is subject annually to highly variable hydrological regimes that can differ from year to year, e.g. there can be expected to be some degree of annual difference in flood maxima and/or frequency and duration at lower levels depending on climatic conditions. Whilst Rinn basin at Rahasane is subject to cycles of complete flooding and drying, the Rahasane main basin is not – it has year-round permanent standing water. A study by Buckley (1993) showed that this profoundly influences the Rahasane main basin and Rinn basin invertebrate communities.

Buckley (1993) sampled the invertebrate community of Rahasane turlough monthly over an annual cycle at various locations, and provided in-depth analysis comparing Rahasane main basin fauna to that of Rinn basin. These areas are delineated not just by their hydrological regimes, but by their flooding mechanism. The main basin fills largely by overflow from the Dunkellin River and retains standing water year round, while Rinn fills as overflow from the main basin and can be subject to a number of flooding and draining cycles each year, always drying completely in summer.

The data clearly showed that the main basin comprised fauna typical of both permanent and temporary Irish standing waterbodies, while Rinn basin comprised a less diverse community typical only of temporary Irish waterbodies. The Rinn Basin comprised ecological generalist species of temporary waterbodies, as well as specialist species of temporary ponds, e.g. *Tanymastix* (which is absent from the main basin). Rinn Basin also showed seasonal succession in the community while the main basin did not. Community succession is characteristic of temporary waterbodies and indicates a greater level of hydrological influence. So, while the main Rahasane and Rinn basins are both variable hydrology habitats, there is a far greater degree of habitat adversity (drying/flooding cycle) at the Rinn basin. Rahasane main basin invertebrate communities, in fact, showed more similarity to other Irish lakes than to Rinn basin. There was a low level of similarity between fauna of Rahasane main basin compared to other "classical" Irish turloughs, i.e. those that flood and drain completely. In summary, the evidence strongly suggests that variable hydrology is less "ecologically critical" to the community in the main basin given the presence of permanent water year round, but is critical to Rinn.

Given that overflow to Rinn occurs at a relatively low level (14.70 mO.D. equating to 35%ile flow), it is very unlikely that, under the proposed scheme, Rinn will not continue to flood and drain with the same frequency and duration as it currently does. That said, maintaining the hydrological regime in Rinn is evidently an "ecologically critical" aspect in terms of aquatic ecology of this protected turlough habitat. For this reason, monitoring of the Rinn basin invertebrates in the early flooding period (generally October) is recommended in association with the proposed scheme. Ongoing presence of *Tanymastix stagnalis* in the early flood period is seen as a suitable bio-indicator of any hydrological effects - considering this is the primary, unique temporary waterbody specialist in this basin of the turlough.

In addition, waterbeetles (Coleoptera) of the main Rahasane basin have been sampled on a number of occasions (Bilton, 1989; O'Connor, 2001; Waldron 2003/ 2004 – see Appendix C5 of the EIS); including recently as part of studies conducted for this Further Information Request (see **Appendix B**). On each occasion a number of species characterising turloughs and the unique "moss-edge community" were recorded, e.g. H*ygrotus quinquelineatus, Agabus nebulosus,* and *Hygrotus impressopunctatus*. On one occasion the characteristic "moss edge dweller" *Graptodytes bilineatus*, an Irish Red Listed species (Near Threatened), was recorded (Waldron, 2004, Appendix C5 EIS). Unlike many more classical turlough basins that flood and empty completely and have a fairly defined "edge", Rahasane is vast and undulating and contains a mosaic of edge-type habitats present as rocky outcrops, stone walls and rocky vegetated islands over a range of elevations. A montage of pools and broad, shallow flooded wetlands and grasslands surround these outcrops, even when water levels are low in the turlough, as shown in Plates 1, 2 and 3, below. Rock outcrops are covered in mosses, mainly *Cinclidotis fontinaloides* with submerged *Fontanalis antipyretica*. For this reason, "moss-edge" type habitat is effectively present across a wide range of water levels in the Rahasane main basin. Hence there is less likely (in this turlough) to be an "ecologically critical" water level for the beetle community associated with this habitat. Even so, it is recommended that Coleopteran sampling be carried out bi-annually (May and August) in the Rahasane main basin, and that samples are taken from different parts of the turlough including both southern and northern sides, the southern side being the more diverse in moss-edge type habitat.



Upper flood level of turlough main basin indicated by treeline

Stone wall = moss edge-type habitat at lower elevation - submerged at low flood level

Image 1.5 - Rahasane Turlough main basin southern shore during receding, low water levels in June 2015.

Image 1.6 - Rahasane Turlough main basin northern shore during receding, low water levels in June 2015

Image 1.7 - Rahasane Turlough main basin northern shore showing a mosaic of rocky outcrops in flooded grassland.

Selecting groups that are most associated with unique hydrological aspects of this turlough achieves two things that are important considerations for a monitoring programme:

1. It focuses on specific groups that reflect this turlough's unique hydrology and avoids "noisy" data that could arise from general littoral sampling;

2. It is easily repeatable, involving simple equipment and fairly rapid collection methods;

3. Identification of samples is relatively straightforward considering *Tanymastix* is unique and highly recognisable, and there is a good key available for the Coleoptera (Friday, 1986); and

4. It is cost-effective owing to (2) and (3), above.

In relation to (1), above, it is well recognised that full community littoral or benthic invertebrate sampling largely reflects nutrient and/or substrate effects in lakes and rivers (Donohue et al., 2009). However, the goal of the proposed monitoring is to ensure ecologically critical hydrological aspects of the cSAC habitat are maintained. General littoral sampling of invertebrate communities may contain the "noise" of nutrient and substrate effects. Generalised littoral samples would also require a range of specialist identification skills to cover all groups, especially the micro-crustacea, and this would greatly increase cost and effort for potentially no greater understanding of hydrological effects.

The monitoring programme should be agreed with NPWS, and should commence in October 2015. There is also the option of collecting single general littoral samples in both the early and late flooded periods (October and March) from Rinn and during April/May in the Rahasane main basins. Results could be compared to records for these months in Buckley (1993). Although, for the reasons set out above, such an approach may not achieve the goals of the monitoring programme because: (i) it may fail to adequately sample indicator groups, and (ii) would involve greater cost and effort.

In summary, in relation to the question raised, it is determined that the "ecologically critical" water levels for aquatic invertebrates at Rahasane are at lower elevations than those that are critical to turlough vegetation. The flood maximum level of 16.5mO.D. that defines the upper turlough edge is very unlikely to be critical to any of the typically resident aquatic invertebrate groups at Rahasane. In terms of connectivity to other waterbodies, which can occur at high flood levels and foster exchange between temporary waterbodies, Rahasane Turlough has permanent water and is hydrologically connected to the wider catchment at all times through the presence of the Dunkellin River drainage channel, so this is not considered to be a critical issue for this turlough. The evidence shows that the "ecologically critical" levels for aquatic invertebrates in this turlough occur at lower elevations/water levels and it is these that need to be safe-guarded to avoid impacts on Rahasane Turlough cSAC. The scheme, as proposed, does not significantly alter the potential flood level/frequency/duration regime at lower flows, so the impact on aquatic ecology ought to be neutral. Notwithstanding, the pre- and post-works monitoring of hydrologically sensitive bio-indicators, as discussed above, is recommended.

With regard to the model, further steady state analysis, using the HEC-RAS model, has predicted that a flow of 20.1 cu.mecs will produce a water level of 16.5 mO.D. in the Rahasane Turlough. Table 2.1, contained in Appendix-A to the Main EIS, and reproduced below, presented the estimated return periods for a series of flow scenarios.

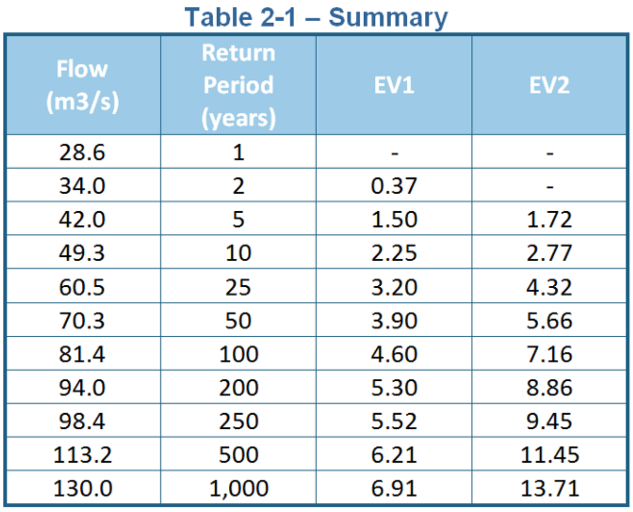


Table 2-1 – Summary

Flow (m3/s)	Return Period (years)	EV1	EV2
28.6	1	-	-
34.0	2	0.37	-
42.0	5	1.50	1.72
49.3	10	2.25	2.77
60.5	25	3.20	4.32
70.3	50	3.90	5.66
81.4	100	4.60	7.16
94.0	200	5.30	8.86
98.4	250	5.52	9.45
113.2	500	6.21	11.45
130.0	1,000	6.91	13.71

[Source: EIS, Volume 3, Appendix A (RPS, 2014)]

Referring to this table (Table 2.1) the estimated return period for a discharge or river flow of 20.1 cu.mecs is less than 1 year. Discussion on further alternative and localised flood protection measures along the northern shore of the turlough is discussed in **Section 1.4** below.

With regard to further alternative and localised flood protection measures along the northern shore of the turlough, it is considered that to achieve this localised protection at each household may be required and such an approach will be dealt with on a case by case basis. It is envisaged that such solutions, which may entail the use of demountable flood barriers or permanent flood protection walls with internal flood sumps and pumps, will be the subject of individual applications for planning consent to Galway County Council, as the Planning Authority. Such permanent, demountable flood barriers may be in excess of 2m high and initial discussions with the property owners would suggest that permanent walls of this nature would not be acceptable. The design of an individual flood protection solution for each property on an individual basis has been omitted from this planning application.

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1.4 The scheme is stated to allow for potential future channel deepening upstream of Craughwell. However, there is no description of options which may be considered as future measures to relieve flooding in the vicinity of Rahasane Turlough. The applicant is requested to outline such measures which might be open to consideration in the future and to comment on whether such works might give rise to effects which need to be considered in the design and / or assessment of the current scheme.

Response

This query deals with two separate requests;

(i) possible future works upstream of Craughwell, and
(ii) flood protection measures in the Rahasane.

Item (i): the scheme has been designed to cater for a flood event of 1 in 100 years plus an additional allowance of 20% to cater for the Mid-Range Future Scenario (i.e. climate change). The reference to "future channel deepening upstream of Craughwell", as stated, refers only to the unknown "Future Scenario" which may result from increases in flows throughout the catchment as a direct result of climate change. Such climate changes and associated "future channel deepening" will only be considered on an entire catchment basis which will entail a full review of the entire drainage system and will be the subject of a more detailed drainage scheme with its own environmental assessment.

Item (ii): Section 3.3.1 (page 38) of the works description report discusses the flood alleviation measures considered in the vicinity of Rahasane Turlough. This broadly considered two options:

Option 1: Channel Deepening immediately downstream of the Rahasane Turlough

"*where channel deepening within the environs of Craughwell and channel & bridge widening downstream of the Rahasane Turlough were considered, it was found that proposed works would have an impact on the normal depth ranges of water within the turlough. This impact was thought to be environmentally significant and have the potential to impact on the normal hydrological and thus ecological regimes within the turlough*"

Option 2: Embankments

"*This fourth scheme considered the use of flood embankments or walls along the shore of the turlough without the need to change the depth of flooding within the turlough.*

While offering flood protection on a theoretical basis, this proposal may not:

1. *provide the necessary flood protection (from the Rahasane Turlough) due to the variable karstic nature of the bedrock in the region and the unpredictable potential movement of water beneath the flood protection wall or embankment (bringing a risk of "burst up" due to differential pressure of approximately 2.2m head across the wall), and*

> 2. *Allow the drainage of surface/ground water, from lands along the northern boundary of the water body, behind the proposed wall, into the Rahasane Turlough, to occur naturally. This movement of water may be due to surface water flow or ground water movement in rock fissures or other unknown karstic features. Attempts to detail flexible pinch valves/flap valves to permit unidirectional drainage from behind the wall are unsound from a flood protection viewpoint, because such valves inevitably become blocked by debris in a partly open position.*
>
> *Considering these risks the construction of flood embankments or walls in this karstic region were not considered viable and are therefore not proposed. However, the Craughwell to Kilcolgan Road and properties along the northern shore of the turlough will continue to be at risk of flooding during the extreme design flood events."*

Future measures may involve localised protection at each household and such an approach will be dealt with on a case by case basis. It is envisaged that such solutions, which may entail the use of demountable flood barriers or permanent flood protection walls with internal flood sumps and pumps, will be the subject of individual applications for planning consent to Galway County Council, as the Planning Authority. Such permanent, demountable flood barriers may be in excess of 2m high and initial discussions with the property owners would suggest that permanent walls of this nature would not be acceptable. The design of an individual flood protection solution for each property on an individual basis has been omitted from this planning application.

Alternatively, consideration may be given to the relocation of each property owner and such a solution will only be dealt with on a case by case basis considering not only the social impacts of relocation but each individual's historical association with the townland of Rahasane.

Since the inception of the flood relief scheme in 2010/2011, and having considered the potential environmental impact of alternative schemes that would result in potential flood level reductions in the Rahasane Turlough, Galway County Council, the OPW and TOBIN Consulting Engineers have liaised with a number of the houses and property owners along the northern shore of the Rahasane Turlough. The location of the property owners is shown in **Figure 1.2** below.

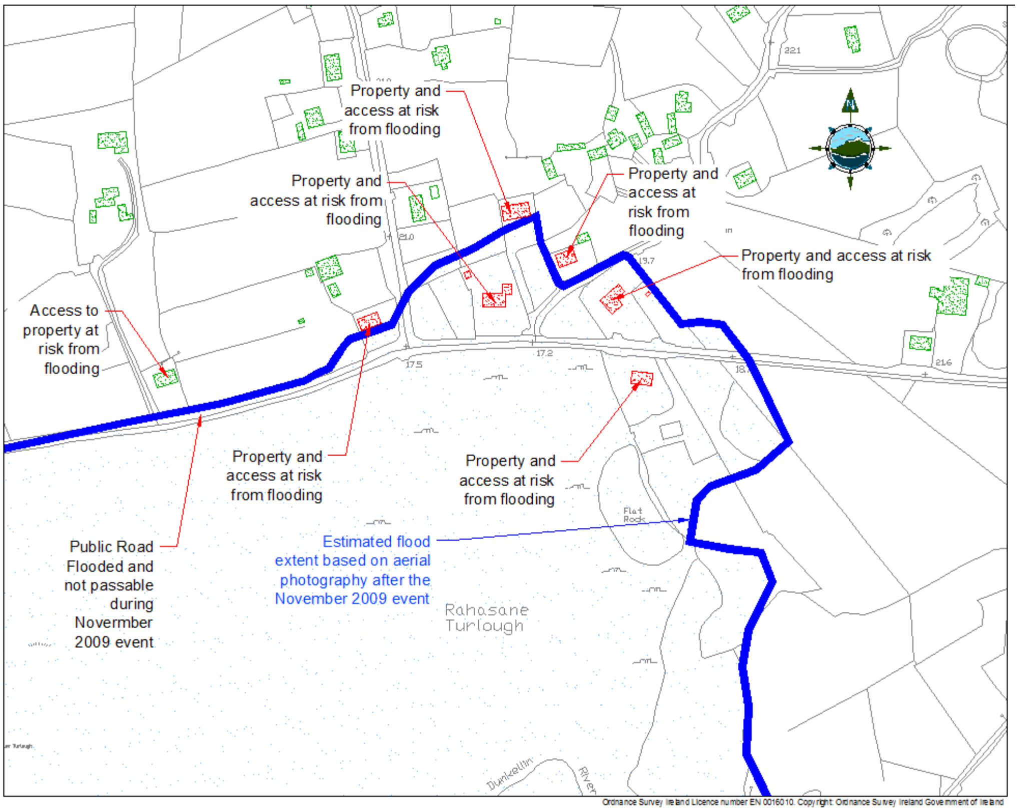


Figure 1.2 - Property owners along the northern shore of the Rahasane Turlough

These property owners were directly impacted by the November 2009 flood event and their dwellings were either cut off by the flood waters or were inundated by the Rahasane Turlough. Following written invitations from Galway County Council to the six property owners detailed in the above figure in March 2014, a meeting, with a number of the property owners was held on 25th March 2014 to discuss the implications of undertaking significant flood relief works within or adjacent to the Turlough. This meeting was attended by two of the six property owners and the purpose of the meeting was to inform the residents of the proposed works in advance of the Public Consultation process and to commence discussions on possible individual flood protection measures or alternative relocation procedures that may need to be considered by the individual property owners.

Since this meeting, further discussions in this regard took place at the Public Consultation evening on 15th July 2014 and subsequently the OPW has also recently written to one of the property owners in this regard. A copy of this letter is attached at **Appendix F**.

The use of demountable flood protection barriers or permanent flood defence walls could be located within each private property and because such measures would not be located within the Rahasane Turlough SAC there would be no direct effect on the SAC or more particularly there is no envisaged loss of habitat.

2 ITEM 2 – IMPACT ON SURFACE WATER & KARST FLOW REGIME

It is considered that the applicant has not provided sufficient information regarding the potential impact of flood construction works on surface water run-off and on the underlying karst flow regime.

2.1 The applicant is requested to assess the suitability of use of embankments along the Dunkellin River in relation to the potential for impact on underlying karst conduits and impeding surface water run-off. In this regard, it is noted that the applicant identifies two main reasons for not constructing embankments at Rahasane Turlough, namely the potential for 'burst up' and impeding surface water flow.

Response

The key difference between the use of embankments in the Rahasane Turlough and downstream along the banks of the Dunkellin River is the duration of inundation. The embankments which were initially considered in the vicinity of the Rahasane turlough would have been subject to high water levels for a matter of days, whereas downstream along the banks of the river flood peak water levels may only last for a couple of hours.

The detailed design of river embankments will take seepage, and surface water flow into account.

A review of the geophysics has shown no cavernous limestone features that would be subject to collapse. Areas of karst rock close to surface will have appropriate land spreading application methods to minimise the potential for direct sediment loss into the underlying karst fissure network. The most appropriate approach will be specified at detailed design based on the nature of sediments expected to be deposited at each area. The areas of rock close to surface are outlined in **Figure 2.1**. Further detail is provided below under **Section 2.2 below**.

2.2 Further assessment is required with respect to soil spreading on the karst regime and the potential for blockage or collapse of underlying of conduits which could give rise to flooding elsewhere. The need for such an assessment has been highlighted in the EIS and a 5m buffer zone around any identified karst feature proposed.

Response

Spoil spread will constitute the placement of up to 1 metre in thickness of excavated soil on top of the lands identified in the **EIS, Volume 3, Appendix A, Works Description Report, Table 6-1 (page 63)**. There have been no significant cavernous karst features (such as caves) identified during the drilling, hydrogeological mapping or geophysical survey. The geophysical survey, site investigation and hydrogeologist site walkover have identified a number of discrete karst features such as springs, areas of weathered rock (epikarst) and some deeper sediment filled fissures (see **Figures 2.1** to **2.6**). It is considered that these features are unlikely to be susceptible to actual physical collapse or subsidence resulting from the land spreading.

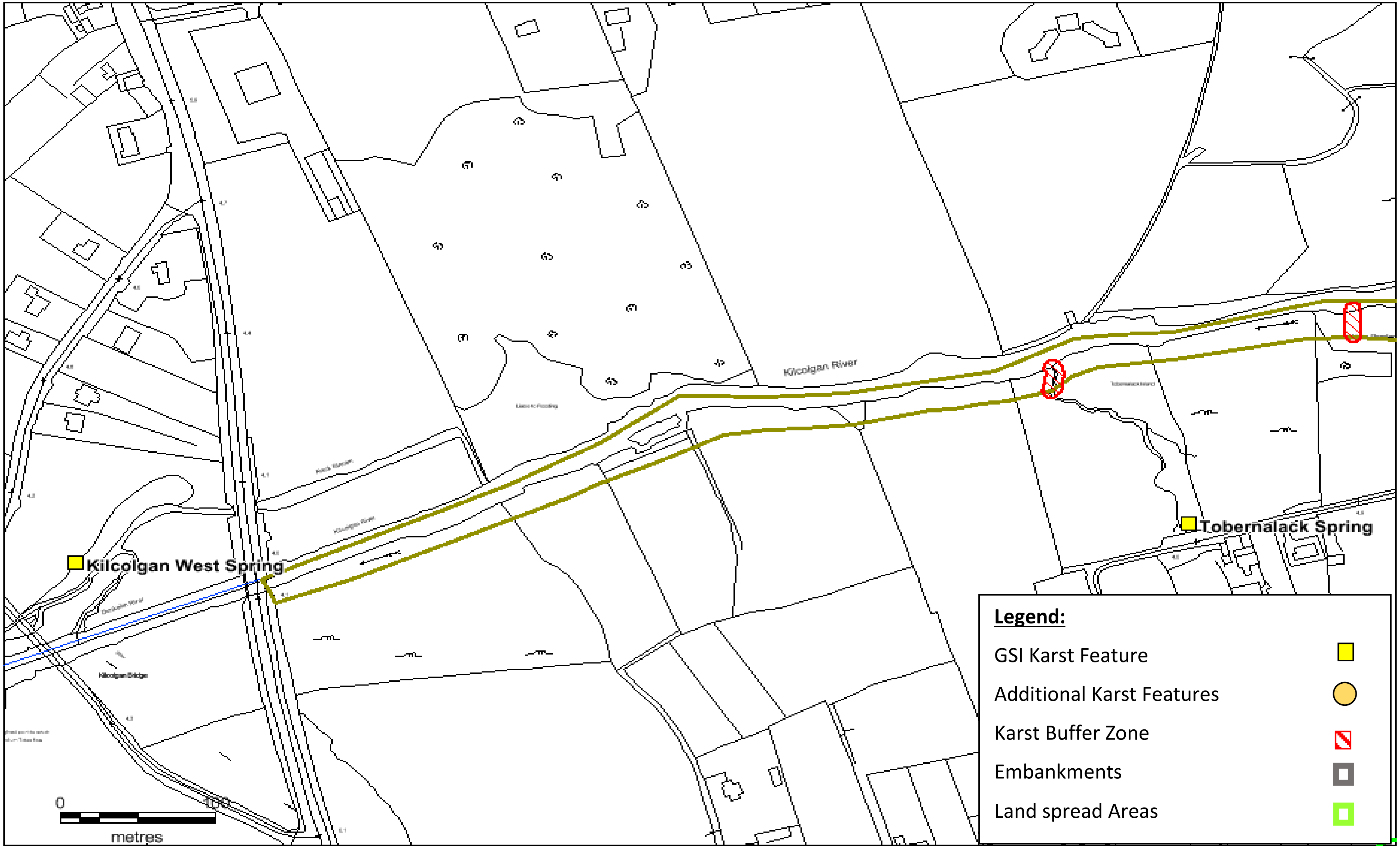


Figure 2.1 - Karst Features and Proposed Landspreading Areas (N18 Bridge, Kilcolgan to Tobernalack)

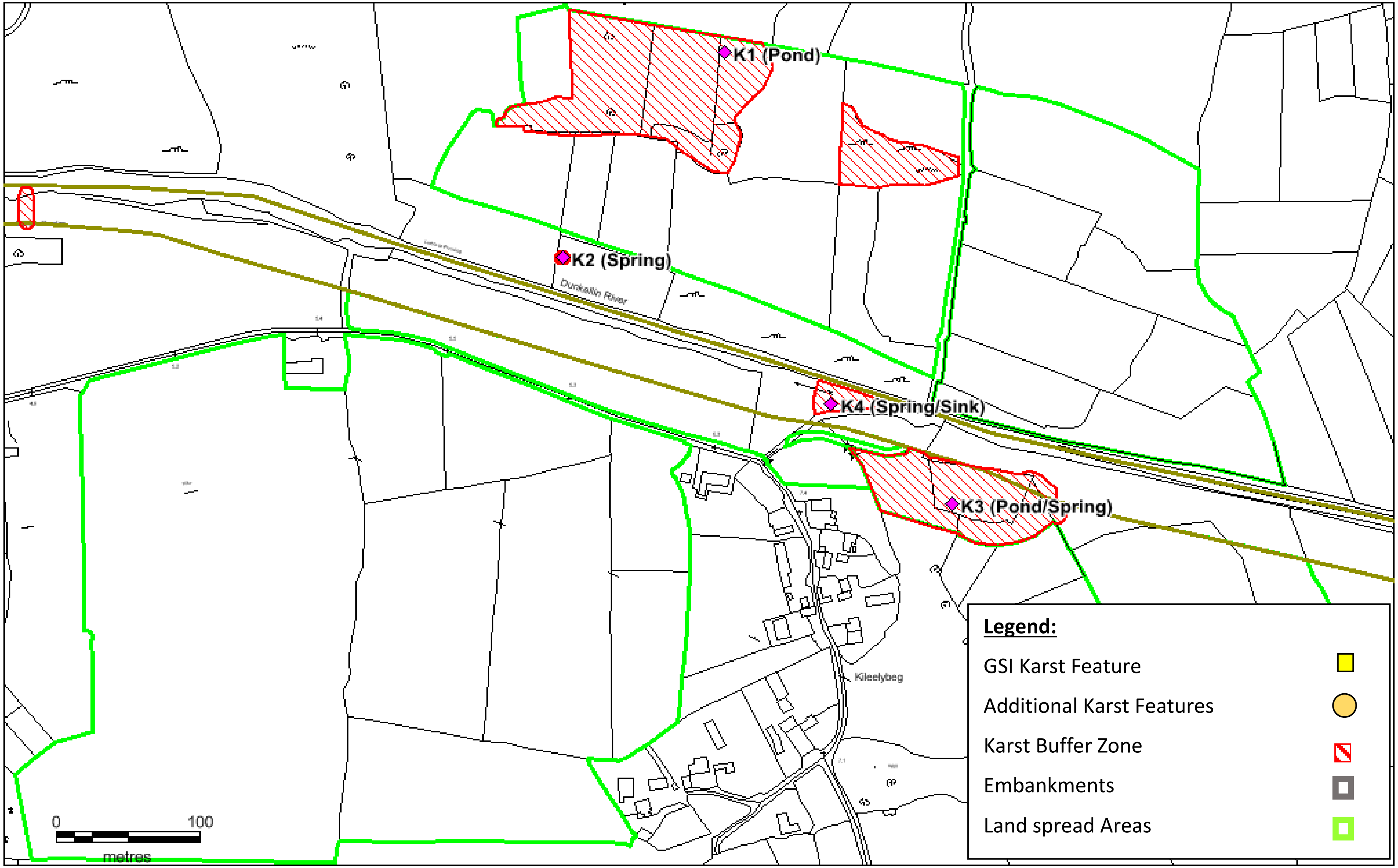


Figure 2.2 – Karst Features and Proposed Landspreading Areas (Tobernalack to Killeely Beg)

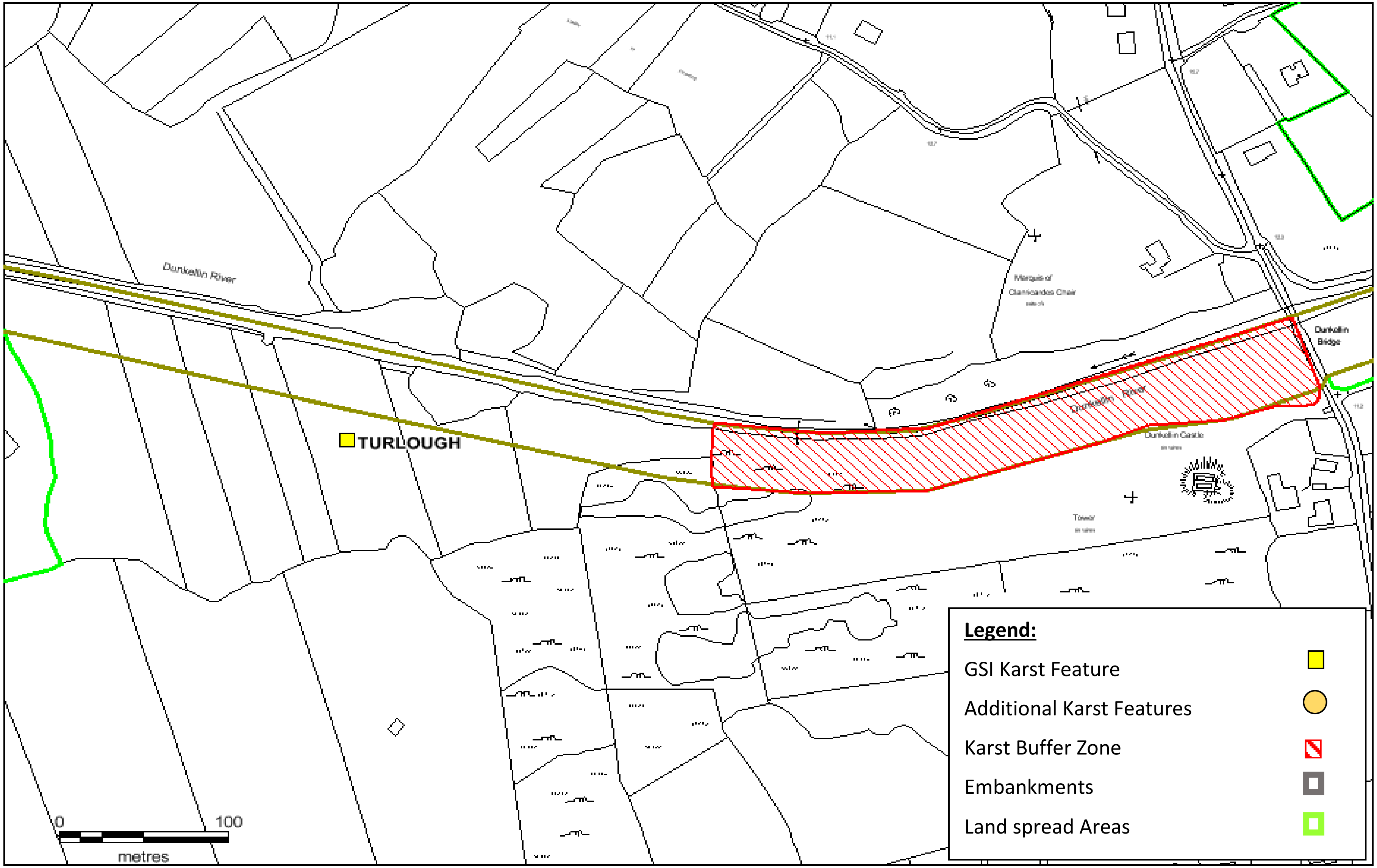


Figure 2.3 – Karst Features and Proposed Landspreading Areas (Killeely Beg to Dunkellin Bridge)

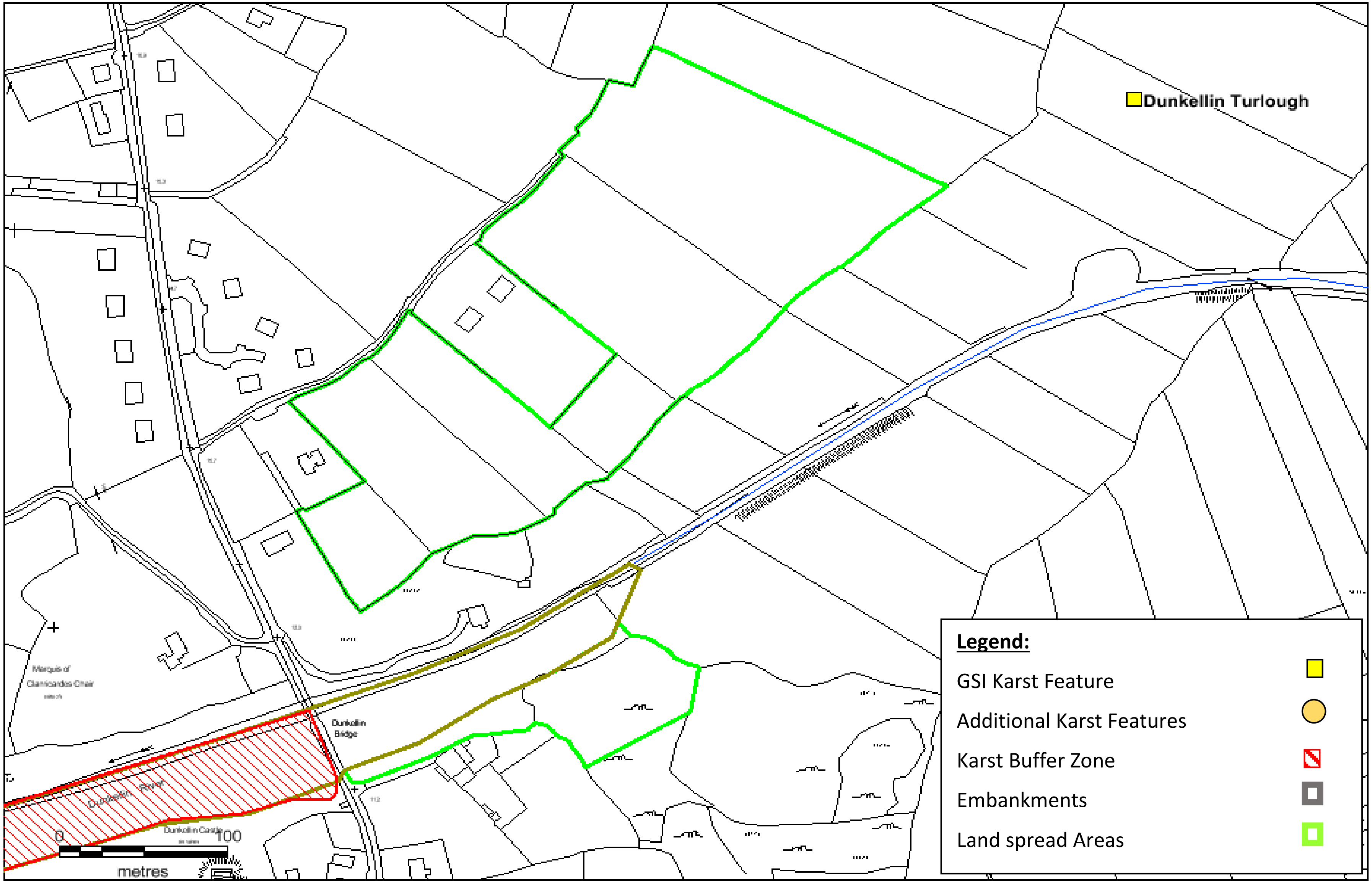


Figure 2.4 – Karst Features and Proposed Landspreading Areas (Dunkellin Bridge to Dunkellin Turlough)

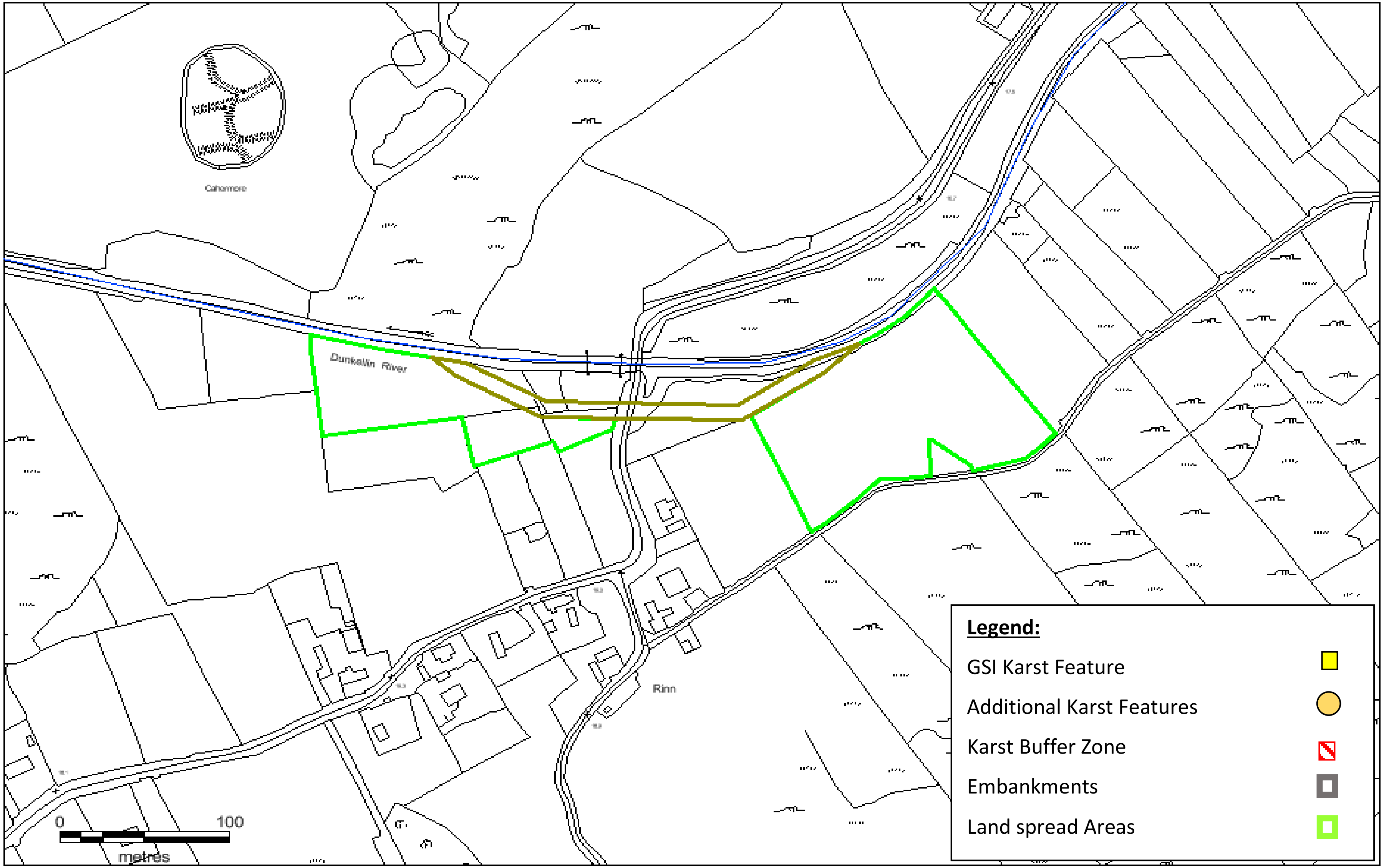


Figure 2.5 – Karst Features and Proposed Landspreading Areas (Dunkellin Turlough to Rinn Bridge)

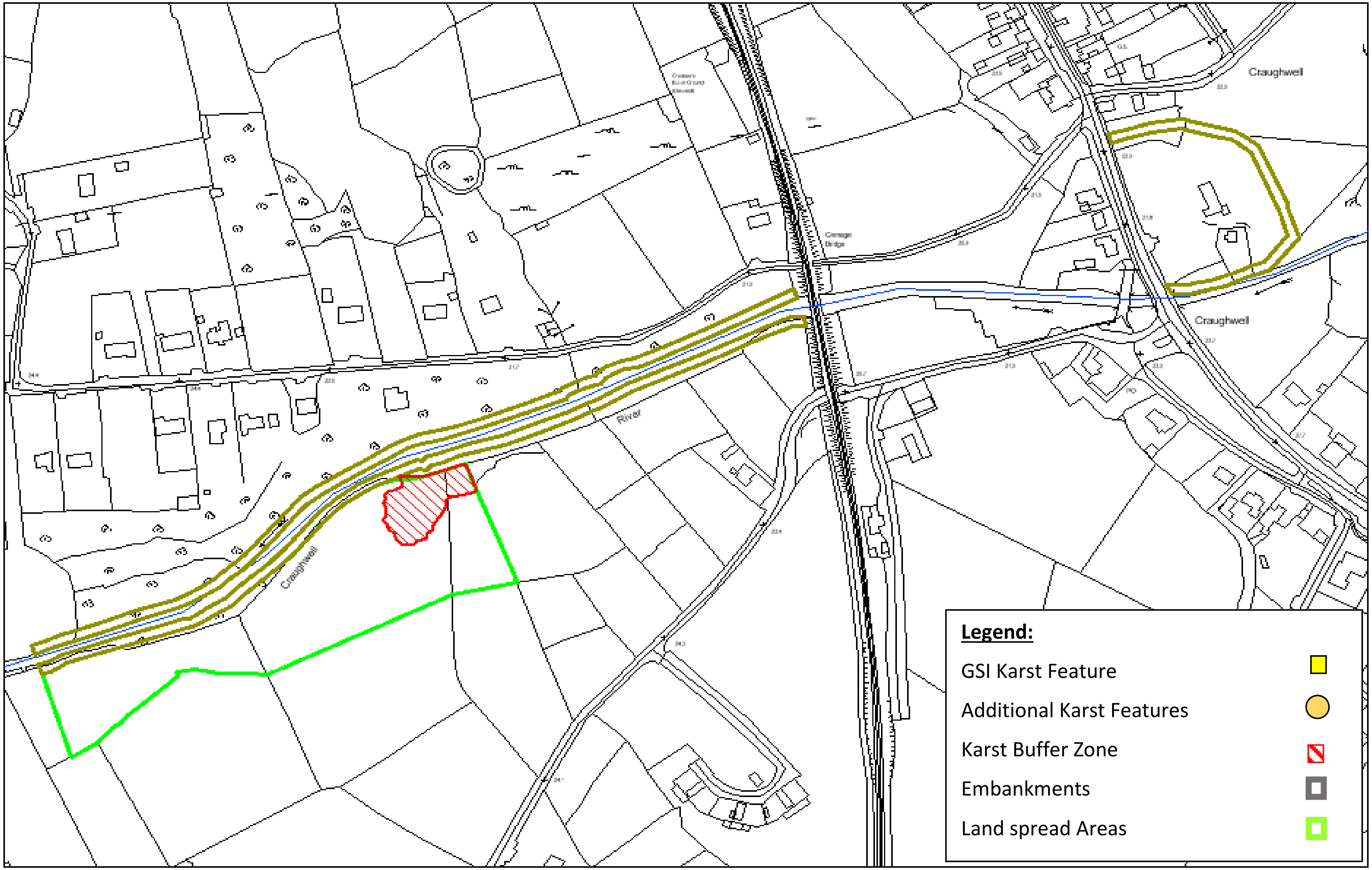


Figure 2.6 – Karst Features and Proposed Landspreading Areas (Crinnage to Grange Bridge, Craughwell)

The spreading of additional sediment may locally limit the recharge potential of surface water into the bedrock aquifer. The river corridor where the land spreading is to occur is primarily a discharge zone for the karst system. This is evident in the nature of karst features identified in the area (springs and turloughs) which are more representative of discharges from the karst system as opposed to recharge features (such as dolines and swallow holes) which are more typical of recharge zones.

Any recharge that does occur along the river corridor will mostly discharge directly through the epikarst into the Dunkellin River, which is the main discharge feature in the area. Any local reduction in recharge along the river corridor will be minute on a catchment of this scale and will discharge locally to the river in any event, meaning the overall impact will be imperceptible.

It is possible that the groundwater flow through the karst fissure system could be altered by the entrainment of an additional sediment load into the system. The entrainment of sediment into cavities will only occur where the sediment has mobilised from the initially spread location and subsequently flows into the cavities. The most likely process for the mobilisation of the sediment is where the spoil is placed directly onto areas where karstified limestone at surface allowing direct filtration of sediment through cracks in the rock.

Areas which are more at risk to the direct entrance of sediments into the karst rock are highlighted in **Figure 2.1**. These areas comprise the 5m buffer around discrete karst features and locations where rock is within 0.5m of ground surface.

Karst features have been identified by the GSI and supplementary karst mapping has been conducted during the hydrogeologist site walk over completed in April 2015 and the geophysical survey completed in June 2015. The GSI vulnerability maps areas of rock close to surface (classified as X-Extreme) which represents locations where rock is within 1m of surface. The GSI mapping has been used in conjunction with information from the hydrogeologist site walk over and the site investigation information to identify areas where the rock is expected to be within 0.5m of surface.

Areas where karst rock is close to surface (less than 0.5m) will require appropriate geotechnical design to minimise the percolation of sediment through the karst rock and into fissures. This may require the placement of a geotextile beneath the spread material. The most appropriate approach will be defined at detailed design stage to achieve this objective within these areas.

Sediment runoff may also occur close to open channels where the runoff velocity increases and turbulent flow occurs. The final topography of land spread material will be flat and therefore turbulent runoff is not expected overland outside of the existing surface water channels. However 5m buffers have been defined around surface water channels to highlight areas where measures are required to prevent erosion of spread material.

There are also some small land parcels currently not farmed within the selected spoil spread areas that will require some site preparation in advance due to presence of loose rock and boulders, these have also been included in the areas zoned on **Figure 2.1**.

2.3 In view of the above and in the particular circumstances of this case it is considered that the site investigations for the purposes of detailed design should be undertaken at this time. The applicant is requested to undertake a geophysical survey of karst features within lands affected by the proposed scheme including areas to be used for construction compounds, access tracks, spoil spreading and construction of embankments.

Response

Site investigation works were carried out in August and October 2014 to facilitate the future design of the scheme. The completed SI report is included in **Appendix C** to this response. These site investigation works included a geophysical, p-wave seismic refraction, survey to prove the top of bedrock. The geophysical survey has been completed and is provided in **Appendix D**. The survey included seismic, conductivity and EM61 resistivity surveys. The conductivity and resistivity surveys were completed on areas mapped as having a higher potential for karst features based on the hydrogeologist's walkover. The survey identified a number of karst anomalies at surface and at greater depths. These anomalies have been reviewed by the hydrogeologist in the context of the site walkover and other site investigation areas. Areas where alternative land-spreading arrangements will be considered are outlined under **Section 2.2**. Individual karst features and the associated geophysical data is presented under **Section 2.4**.

The technical description of the proposed scheme provides an outline detail of the envisaged access points to the proposed Works Areas and these are summarised as follows and detailed on the relevant Drawings accompanying the EIS:

- Access Point No. 1 (Refer to Drawing No. 6408-2202) - Provision of an access point into the Dunkellin River downstream of Killeely Beg Bridge.
- Access Point No. 2 (Refer to Drawing No. 6408-2202) - Provision of an access point into the Dunkellin River for works downstream of Killeely Beg Bridge to Kilcolgan Bridge.
- Access Point No. 3 (Refer to Drawing No. 6408-2202) - Provision of an access point into the Dunkellin River for works upstream of Killeely Beg Bridge to Dunkellin Bridge.
- Access Point No. 4 (Refer to Drawing No. 6408-2203) - Provision of an access point into the Dunkellin River for works downstream of the Dunkellin Beg Bridge to Killeely Beg Bridge.
- Access Point No. 5 (Refer to Drawing No. 6408-2203) - Provision of an access point into the Dunkellin River for works upstream of the Dunkellin Beg Bridge.
- Access Points No. 6 and 7 (Refer to Drawing No. 6408-2204) - Provision of an access point into the Dunkellin River for works at Rinn Bridge.
- Access Point No. 8 (Refer to Drawing No. 6408-2208) - Provision of an access point into the Dunkellin River for works downstream of the Railway Bridge at Craughwell Village.
- Access Point No. 9 (Refer to Drawing No. 6408-2208) - Provision of an access point into the Dunkellin River for works upstream of the Railway Bridge in Craughwell Village.
- Access Point No. 10 (Refer to Drawing No. 6408-2208) - Provision of an access point into the Dunkellin River for works upstream of the R446 at Craughwell Village.

It is envisaged that there will be four main site compounds, varying in size to reflect the extent of works being undertaken at each location, which include short term staff welfare facilities and plant and materials storage for the proposed works. The final location of these compounds is unknown at the present time and will be confirmed by the Works Contractor following direct Contractor liaison with each relevant landowner. It is envisaged that these compounds will be located a minimum of 50m to 100m from the Dunkellin River.

1. Site compound at Killeely Beg Bridge. It is envisaged that this compound will be located on lands to the north of the channel and adjacent to Killeely Beg Bridge. These lands are coloured green on Drawing No. 6408-2203 Rev G at cross section "DK33". This area is noted, in Chapter 10 of the EIS, as being "improved agricultural grassland".
2. Site compound at Dunkellin Bridge. It is envisaged that this compound will be located on lands adjacent to Dunkellin Bridge. These lands are coloured green on Drawing No. 6408-2203 Rev G at cross section "DK30". This area is noted, in Chapter 10 of the EIS, as being "improved agricultural grassland".
3. Site compound at Rinn Bridge. It is envisaged that this compound will be located on lands to the east of Rinn Bridge. These lands are coloured green on Drawing No. 6408-2204 Rev G at cross section "DK25". This area is noted, in Chapter 10 of the EIS, as being "improved agricultural grassland".
4. Site compound at Craughwell Village. It is envisaged that this compound may be placed at a number of locations in the village of Craughwell. A number of the possible locations are shown as a red circle in the following aerial view of the village. These are noted, in Chapter 10 of the EIS, as being "improved agricultural grassland", "scrub" and "Buildings and Artificial Surfaces". The potential locations of the site compounds at Craughwell are provided in **Figure 1.1** below.

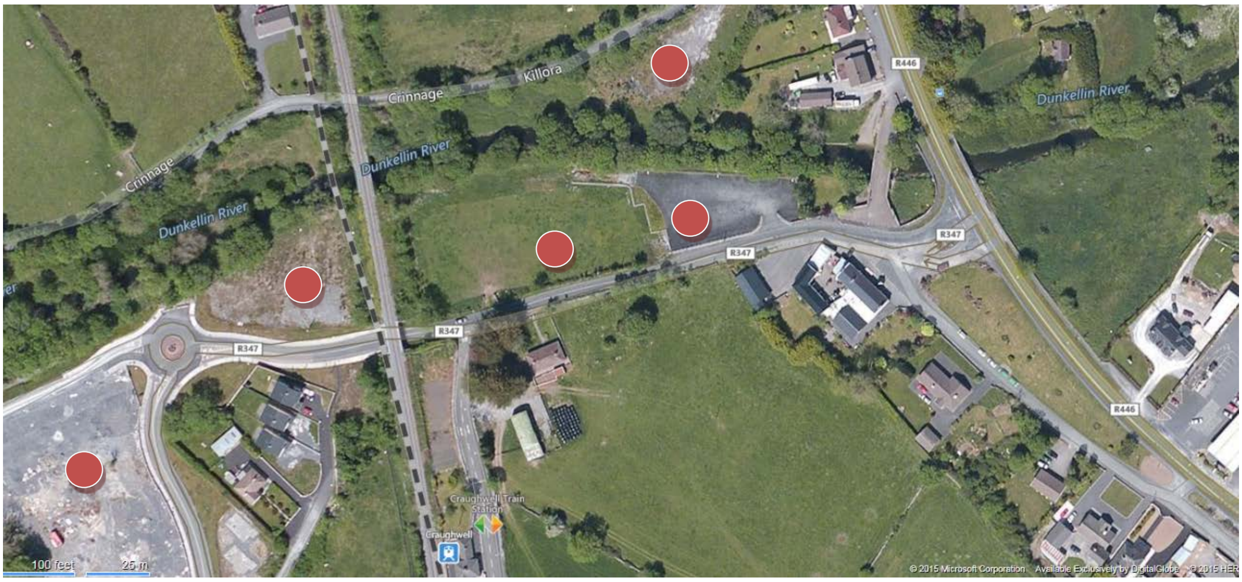


Figure 2.7 – Potential Site Compounds Locations at Craughwell

Any surface topsoil within the proposed site compounds will be removed and temporarily stored for reinstatement of all lands once work is completed. Following clearing of topsoil from the compound area it is envisaged that the working surface will be formed from imported clean stone laid on a temporary geomembrane.

None of the compound locations are within or adjacent to karst features.

2.4 Where karst features are identified, they should be clearly shown on constructive drawings along with any associated buffer zones. Any necessary re-design of the scheme should be undertaken. It is anticipated that the geophysics survey and associated commentary presented will enable the Board inter alia to consider risks of impacts on smaller turloughs and on surface water flows.

Response

A site investigation programme was completed for the project by Priority Geotechnical Limited between April and July 2014. The results of the site investigation are provided in **Appendix C**. The scope of work included the drilling of boreholes using cable percussion (20 No.) and rotary coring (32 No.), the excavation of trial pits (43 No.) and the completion of a geophysical survey. In situ and laboratory testing were completed to determine the geotechnical properties of the soils, subsoils and bedrock. The only karst feature identified during drilling was a shallow in-filled cavity/ fracture feature at RC42 which was noted between 3.8m to 4.8m below ground level.

Karst Feature mapping was completed by RPS Senior Hydrogeologist Gerry Baker in April 2015. This included a desk based review of potential karst features identified from aerial photography and historical maps. The main karst features in the area such as the Rahasane and Dunkellin turloughs are well known and are recorded in the GSI karst database. Karst features which are not included in the existing GSI database were identified through this process and subsequently visited on site. The karst features within the land spreading areas are illustrated in **Figures 2.1 to 2.6** and are labelled K1-K4. Further information on these features is provided below.

Following the completion of the hydrogeological walkover some additional areas were defined for further investigation. A supplementary geophysical programme was developed to investigate the nature of the geological environment in these areas. The results of that geophysical survey are presented in **Appendix D**. The report highlights some clear anomalies in the geophysical survey that relate to karstifed bedrock.

<u>K1 - Pool at Killeely Beg (Grid Reference ITM 543010 718816)</u>

The most significant anomaly identified in the geophysical surveys relates to a feature identified along survey section R3. The feature is an ephemeral pond surrounded by marshy land as shown in **Figure 2.2** and **Images 2.1 to 2.3**. The feature is shown on historical maps as a spring that originally flowed to the north to join the other springs at Killeely Beg before ultimately discharging back into the Dunkellin River further downstream. One of the other Killeely Beg springs to the north is noted in the GSI karst data base (Feature No. 1421SWk066). It would appear the field boundary walls now prevent the spring from overflowing. As a result a pond is formed, the level of which would relate to the hydraulic head driving the original spring. This feature may in effect function hydraulically in a similar fashion to a small turlough.

The geophysical survey sections R3 and R4 transect this area. Excerpts from the mapping are shown in **Images 2.1** and **2.2** below. R3 shows the strongest anomalous resistivity measured anywhere during this survey. R3 shows both shallow and deep karstification indicative of clay and water in-filled cavities. In contrast R4, which lies between the feature and the Dunkellin River shows no anomalies at depth suggesting that the pool along R3 is not directly linked with a karst fissure to the river but rather connects to a deeper fissure which would have originally then overflowed to the north (see **Figure 2.8**).

Image 2.1 - Karst Feature at Killeely Beg

Image 2.2 - Pond within Karst Feature at Killeely Beg

Image 2.3 - Vegetation at Karst Feature at Killeely Beg

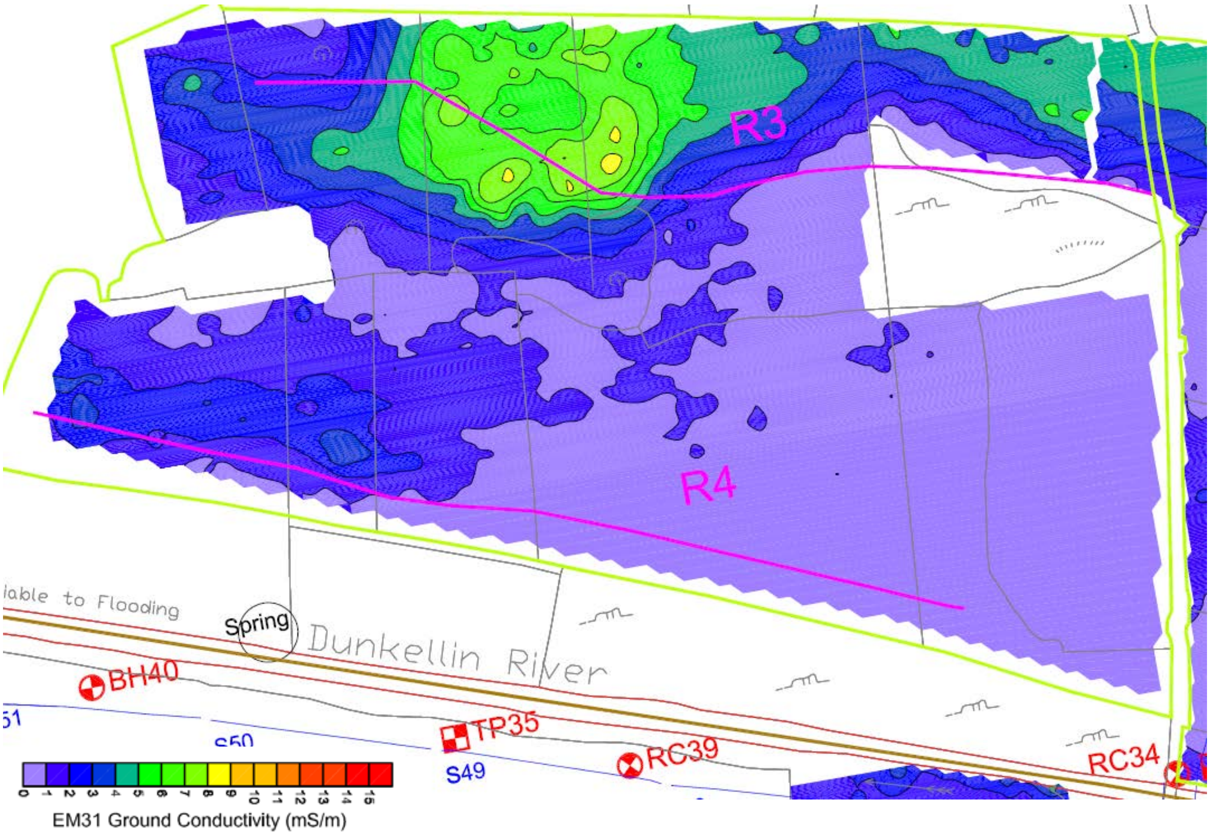


Figure 2.8 - EM31 Conductivity at Kelleely Beg Pool.

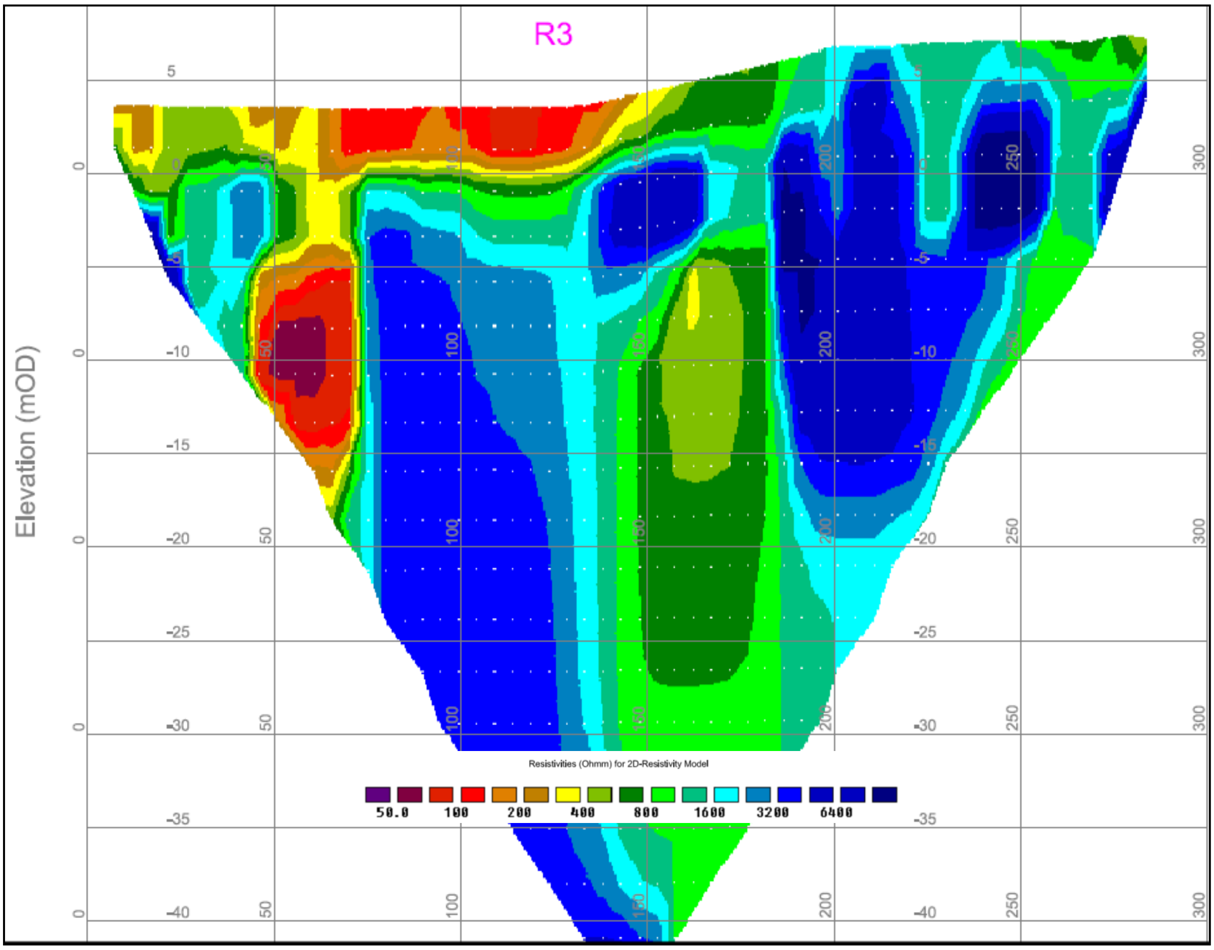


Figure 2.9 - Resistivity Survey R3 through Pond Feature at Killeely Beg

K2 - Spring at Carranhally (Grid Reference ITM 542858 718662)

This is a large pool adjacent the Dunkellin River which overflows into the river, see **Figures 2.2 and Figure 2.10** and **Images 2.4 and 2.5** below. The overflow from the pool is significant, possibly up to 100 l/s. It is possible that when the Dunkellin River is in flood the spring is engulfed but at lower flows it appears to be a discrete feature. The feature does not appear on the historical maps for the location. The historical maps pre-arterial drainage indicate the feature was within the original river channel and may have functioned as an underwater discharge feature providing baseflow to the river. The historical maps post-arterial drainage show the narrower river channel but no clear spring is identified.

There was no geophysical survey conducted in the immediate vicinity of the spring as there is no land spreading or embankment proposed at this location. Resistivity section R4 passes adjacent the feature to the north. The section shows a trough in the ground resistivity adjacent the spring which may relate to spring feature, see **Figure 2.11.**

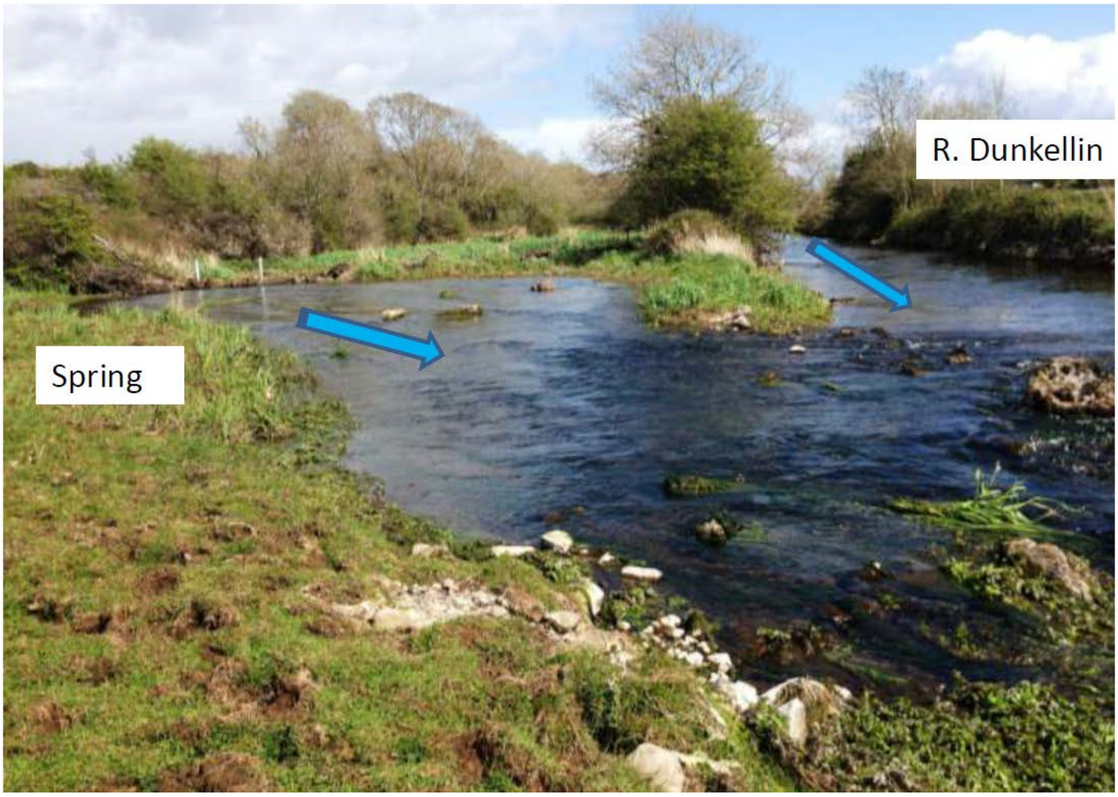


Image 2.4 - Spring at Carranhally looking upstream (Photo No. Img3655)

Image 2.5 - Spring at Carranhally looking downstream (Photo No. 3652)

Figure 2.10 - Spring at Carranhally aerial photo and location of photographs.

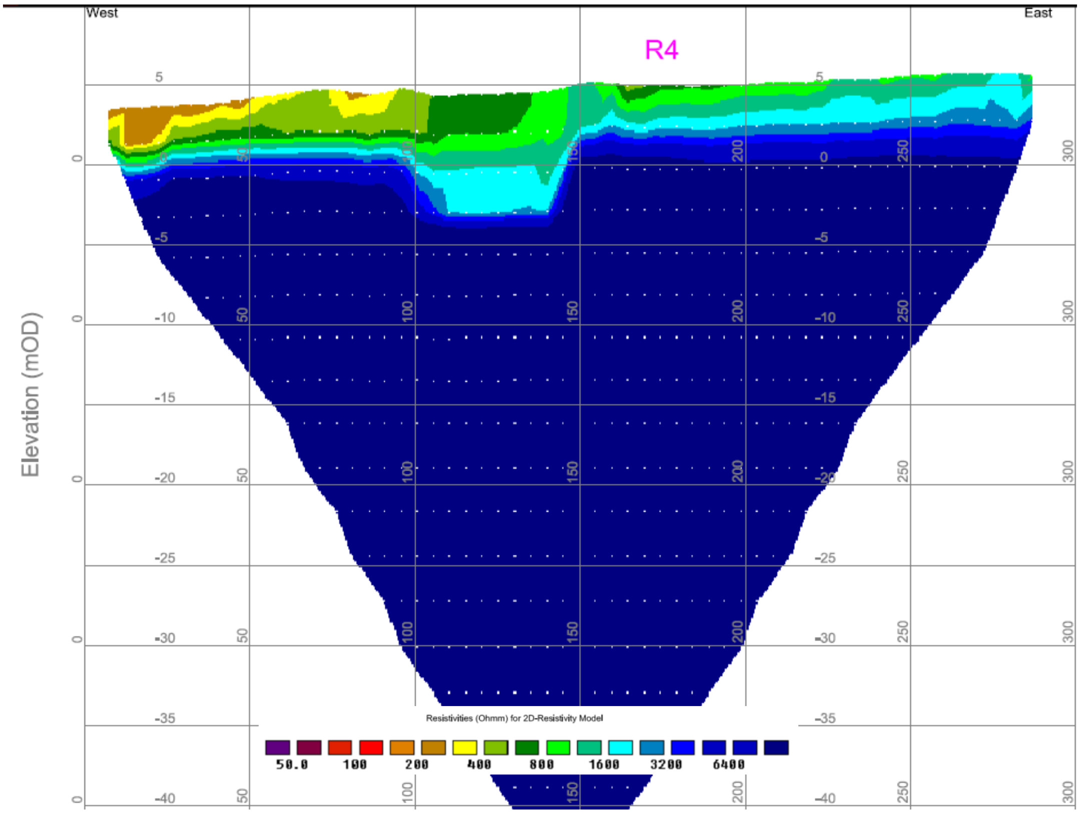


Figure 2.11 - Geophysical Section R4 with Spring Feature highlighted

K3 – Pond/Ephemeral Spring at Killeely Beg (Grid Reference ITM 543114 718485)

This feature appears as a small pool approximately 73m south of the Dunkellin River at Killeely Beg Bridge, see **Figure 2.2** and **Image 2.6**. The electrical conductivity of the water in the pool was measured on site and found to be 540 µS/cm. This is indicative of groundwater in limestone aquifers rather than ponded surface water (pluvial water) where the conductivity would be much lower (<100 µS/cm). There appears to be an overflow channel from the pool which flows north to the river. It is likely that when the hydraulic head in the aquifer is sufficiently high the water from the pond will rise to overflow down the channel into the river. The feature is located within the flood extent of the river and therefore once the river floods it will become engulfed by the main channel.

A review of historical mapping pre-arterial drainage for the location illustrates that the original course of the Dunkellin River passed over the feature (see **Figure 2.12**). It appears the river possibly sank into a swallow hole and remerged at the location of the pool. The intervening area appears to act as a turlough type feature and would appear to connect to the larger turlough area to the east which is noted on the GSI karst database.

The feature may therefore represent a remnant karst feature which previously functioned as the upwelling for the Dunkellin River but now is a small groundwater pool which is connected to the underlying karst aquifer and overflows to discharge into the river when the head in the aquifer is sufficiently high, but subsequently becomes engulfed by the river during flood events where the river bursts its banks.

Site investigation results in the vicinity of the location at borehole RC37 indicate the depth to bedrock is 3.2m and the bedrock is slightly weathered. The geophysical survey in this area shows a string of small anomalies in the EM conductivity survey and a trough in the resistivity section (see **Figure 2.13**. These both indicate shallow karst features rather than fissure connected to deep conduits.

Image 2.6 - Ephemeral Spring at Killeely Beg, looking north towards R. Dunkellin

Figure 2.12 - Historical Map at Killeely Beg (showing location of ephemeral spring)

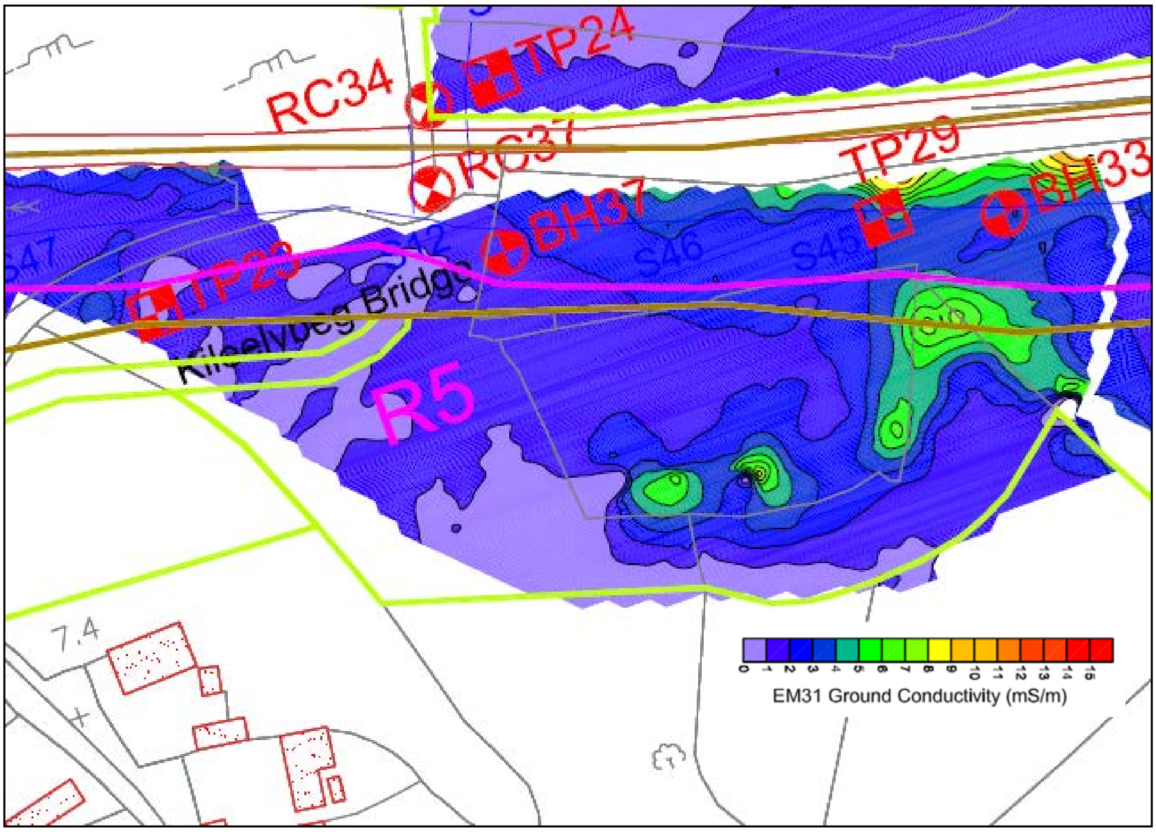


Figure 2.13 - EM Survey Results at Ephemeral Springs at Killeely Bridge

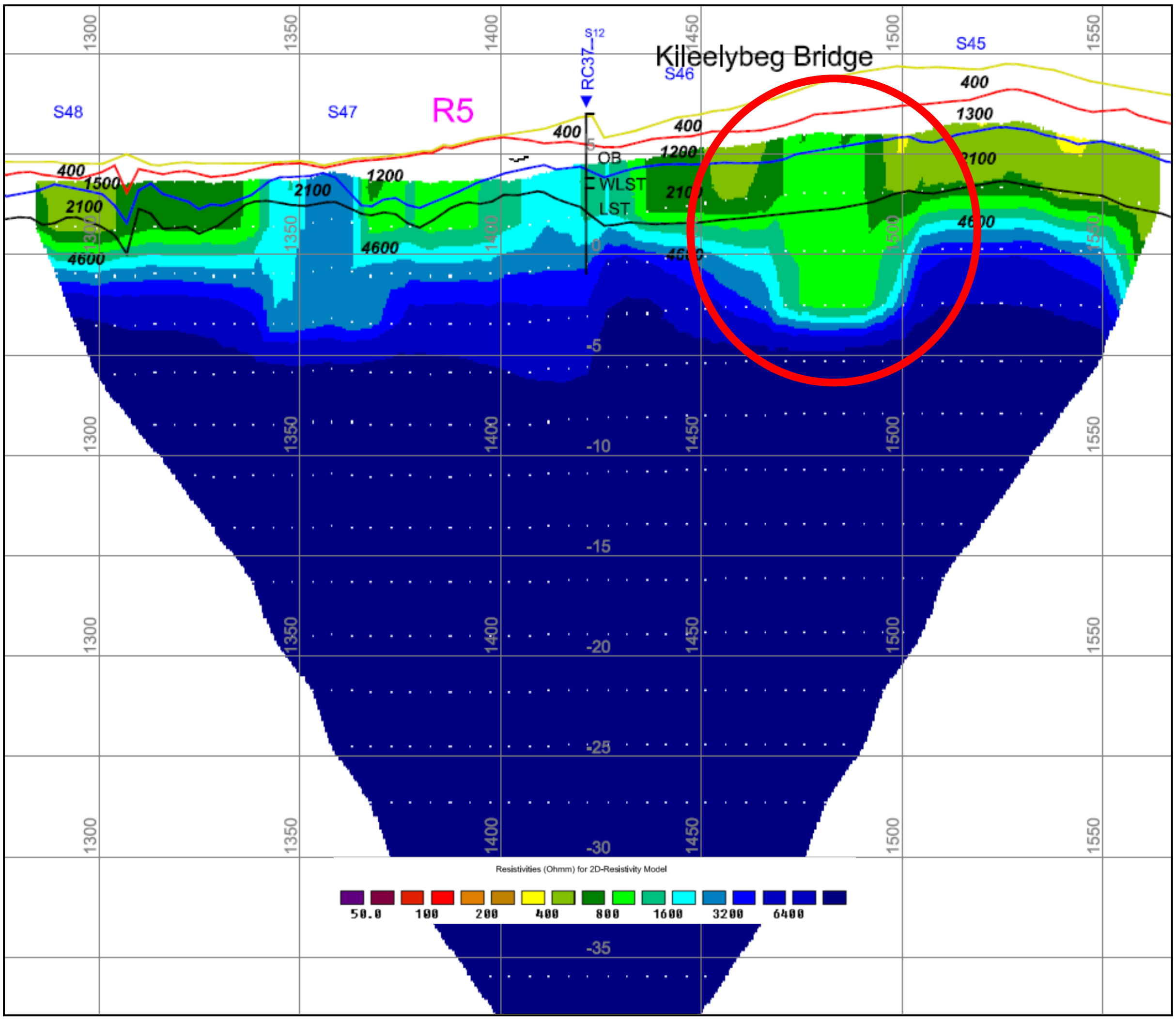


Figure 2.14 - Conductivity Section R5 with Ephemeral Spring at Killeely Beg Highlighted

K4 - Ephemeral Spring /Sink at Killeely Beg Bridge (Grid Reference ITM 542566 718681)

This feature was dry when visited during the walkover but the subdued nature of the ground and coating of the exposed rock in algal matter indicated that surface water had sank through the feature in draining the land see **Figure 2.2** and **Images 2.7 to 2.9**. It is likely the feature acts as a spring where the water-table is above ground level and then alternatively provides a sink for intermittent flood waters where these are at a higher elevation than the groundwater level. The geophysics does not show any significant anomaly in this location which implies this may be a less significant feature in terms of its connection to the overall karst fissure network, but may be a shallow connection to and from the river via the epikarst layer.

Image 2.7 - Karst feature K4

Image 2.8 - Karst feature K4

Image 2.9 - Karst feature K4

Ephemeral Spring at Crinnage – Grid Reference (ITM 542858-718662).

This spring is outside of the land spreading area and is therefore not shown on the maps but details are provided here for inclusion in the karst database. The spring is shown on the historical mapping, current OSI mapping and aerial photographs but is not in the GSI karst database, see **Figure 2.15** and **Image 2.10**. The spring channel is approximately one metre deep. The spring was dry during the site visit but it seemed clear from the depth of the channel, the sculpting and erosion patterns on the banks that there can be a considerable flow when the spring becomes active.

Geophysical surveys were not undertaken within this area as there is no land spreading proposed in this vicinity.

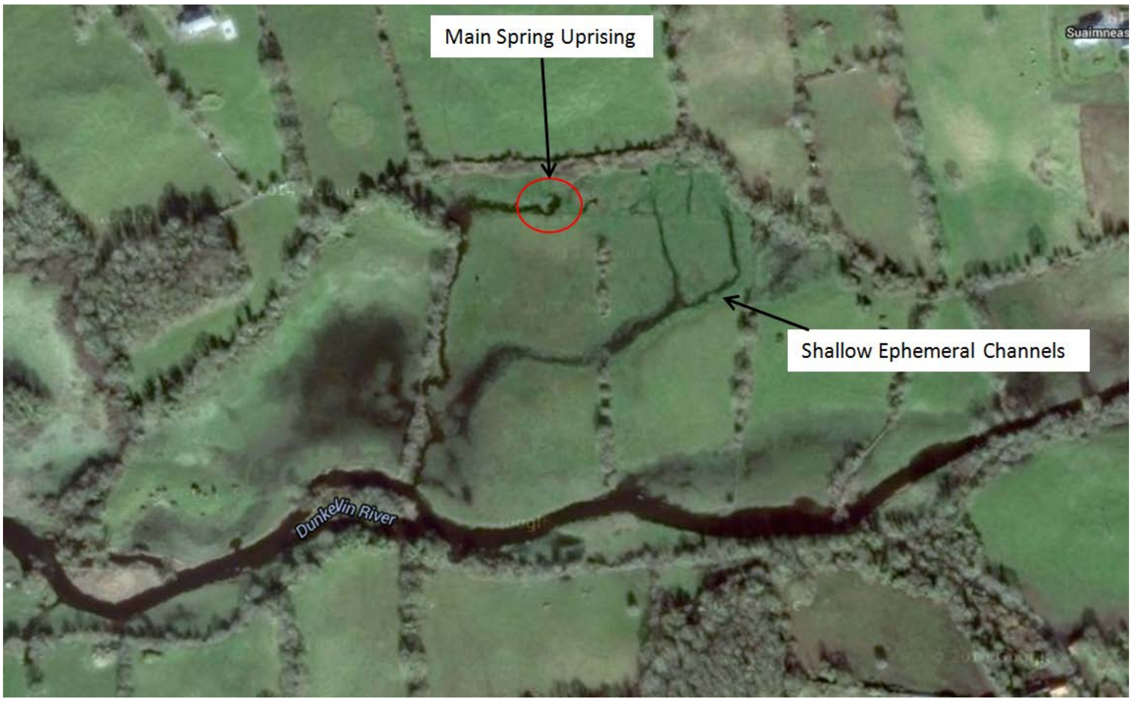


Figure 2.15 - Spring at Crinnage - Location on Aerial Photo

Image 2.10 - Spring at Upwelling Location, dry at time of site visit (28/04/2015)

3 ITEM 3 – CONSTRUCTION MANAGEMENT PLAN

3.1 ***Following on from the above the applicant is requested to present a detailed construction management plan (CMP) addressing all recommendations presented in the EIS and the NIS. Measures to control significant flood water or groundwater which might be encountered during construction shall be presented. It is noted that the information presented by the applicant contains many appropriate measures but it is considered that the CMP should be compiled into one document and be fully detailed at all time. All commitments should be firmly stated. If a preferred approach cannot be undertaken then specific alternative(s) should be contained in the CMP. This information is necessary to enable the Board to carry out an environmental impact assessment and an appropriate assessment in this case****.*

Response

The EIS sets out a comprehensive range of protection and mitigation measures to cover each stage of the construction process from site preparation, earthworks, excavation, transportation of material etc. The mitigation measures, which are repeated in the NIS, include well established and recognised protective measures which are standard best-practice to control erosion, drainage and sediment release and will carry through all phases of the works. The EIS and NIS, fully describe the phases of the project including the extensive and robust protective measures incorporated into the proposed development. There are no aspects of the project or its mitigation to be designed at the construction stage. A draft Construction Management Plan (CMP) has been prepared and is available in **Appendix E** to this report. This document incorporates all of the recommendations presented in the EIS and NIS for the scheme.

4 ITEM 4 – MONITORING & REMEDIAL STRATEGY

4.1 It is noted that the EIS identifies a need for a further 12 months of water monitoring and further ecological monitoring at Rahasane Turlough. It is stated that this will enable further calibration of the model and a review of the potential impacts on the turlough if necessary. Please clarify why this information has not been provided with the application submissions. Please comment on its relevance for the purposes of appropriate assessment and whether this information is necessary to enable the Board to fully consider the effects of the scheme and determine the case in the context of the best scientific information.

Response

As outlined in the EIS, Volume 2, Section 9.5.2, the following was recommended regarding groundwater monitoring;

'There has been limited monitoring of the groundwater levels and turlough levels at Rahasane Turlough. As such, the hydrogeological conditions controlling the water level fluctuations are poorly understood. It is recommended that groundwater level monitoring and turlough stage monitoring are undertaken as part of the scheme. The monitoring should be coordinated with the Environmental Protection Agency (EPA) who is required to monitor the hydrogeology of the turlough under the Water Framework Directive (WFD) as it constitutes a groundwater dependant ecosystem.'

4.2 It is stated that operational phase monitoring is also proposed and that if such monitoring indicates changes to Rahasane Turlough cSAC, remedial measures will be put in place. In view of the dynamic nature of the karst environment and the potential for impacts which are not related to the scheme, it is considered that the applicant should identify a suitable group of indicators at this time. The Board may require that pre-construction monitoring of these indicators be undertaken.

The indicators identified to monitor the potential changes in Rahasane Turlough cSAC include terrestrial, aquatic, hydrological and hydrogeological.

A total of thirteen longitudinal transects have been identified with a series of relevés identified along the transects to monitor vegetation communities. These transects extend from the 16.5 mO.D. contour and run perpendicular to the Dunkellin River, i.e. running in a general north to south plane across the turlough basin. The location for each relevé is determined by discrete changes in the turlough basin's topography, sourced from the baseline topographical lidar surveys and topographical surveys of the turlough (See **Figure 4.1**).

Please see **Section 1.3** (ABP_0001 Item 1B) of this report which provides a full explanation, for a suitable group of aquatic invertebrate indicators as requested under this item, in the context of what are deemed "ecologically critical" water levels.

There is surface flow monitoring directly up and down stream of the turlough at the gauges No. 29010, 29007, 29002. An analysis of the hydrographs from these gauges shows this section of the river which flows though the turlough fluctuates between a losing and gaining stream (with respect to groundwater) throughout the year.

There are three groundwater monitoring wells present in the turlough. Three groundwater monitoring boreholes have been identified within the turlough which were installed during a previous flood alleviation study, BH 1 Rinn Basin, BH 2 Killeeneenmore, northern basin of Rashane Turlough and BH 3 is situated in Aggard More in the southern basin.

4.3 It is considered that the application should be accompanied by a comprehensive and feasible remedial strategy as recommended in the EIS. The applicant is requested to present this strategy.

Response

As noted in the EIS it is proposed that if operational monitoring indicates that there are recorded changes to vegetation within the Rahasane Turlough cSAC as a result of the proposed flood relief scheme (i.e. measurable change in water level in the Turlough despite minimal change in recorded flow) remedial measures will be put in place to rectify the matter.

On the assumption that one of the long term risks associated with the proposed works is the potential for the scheme to reduce flooding within the turlough (i.e. risk of water levels in the Rahasane and Rinn basins being reduced) monitoring will include a review and recalibration of the Craughwell Gauging Station (upstream flow) and a review and recalibration of the Rahasane Gauging Station. These stations will allow Galway County Council to monitor river flow into and from the turlough.

The mathematical model predicts that the main hydraulic control at the turlough is the downstream channel from the main water body to the Rinn Bridge. This channel forms a natural restriction which controls the water level in the turlough. Whilst one of the alternative schemes considered as part of the initial studies to provide flood relief to properties along the northern boundary of the turlough was to alter this hydraulic restriction and construct a two stage channel from the turlough to Rinn Bridge, this work posed a significant risk to water levels in the turlough and was not considered in the final scheme.

However the scheme, as presented, proposes to construct two flood eyes at Rinn Bridge and this element of the scheme poses the main risk which may alter water levels in the turlough. A remedial strategy, if required in the future, to mitigate against the risk of reduced water levels in the turlough will include the provision of mechanical weirs/flood gates or removal/replaceable stop logs across each of the two flood eyes at Rinn Bridge. This strategy allows Galway County Council to control the discharge of flood waters across Rinn Bridge, by lowering or removing the flood gates/weirs, and also allows the Local Authority to maintain water level in the turlough by raising or installing the flood gates as necessary.

5 ITEM 5 – HYDROLOGICAL CONNECTIVITY

5.1 *The appropriate Assessment Screening Report notes the potential for impacts on certain European sites was 'screened out' including by reason of lack of hydrological connectivity. Having regard to the proximity of these sites to the proposed works and the nature of the karst system, the applicant is required to identify the basis for the stated lack of connectivity.*

Response

The Dunkellin River lies within a regionally important karst aquifer where groundwater flow occurs through an interconnected network of fissures throughout a range of scales. Groundwater tracing experiments in the area to date have shown groundwater connections across significant distances and also connections in directions contrary to the topographic gradients. Therefore any features contained within this karst aquifer could be to one extent or another hydrologically connected.

The potential for impact on any of the sites through a groundwater pathway within the aquifer is also dependant on the extent to which the influence of the impact can extend throughout the aquifer. The main impact on the water environment as a result of the proposed works will be the reduction in the flood water levels. During flood events the aquifer in the vicinity of the river will most likely be entirely saturated due to the excessive rainfall.

The influence of this alteration in the river stage will reduce to a negligible difference in groundwater levels within a short distance from the river bank. It is not possible to exactly predict the extent of this zone of influence given the karstified nature of the aquifer which is extremely heterogeneous and anisotropic.

In order to provide some quantitative prediction of impacts a representative groundwater 2D slice model was developed as illustrated in **Figure 5.1** below. The model is completed using the Modflow2005 groundwater flow modelling package. The model cannot represent the complexity of the karst fissure flow environment but is a useful tool to solve the groundwater flow equation based on representative boundary conditions and bulk aquifer parameter values. This is a risk based approach where if a significant potential impact is identified more complex modelling can then be undertaken.

The model contains a shallow upper layer representative of moderately permeable subsoil (permeability of 0.1m/d and specific yield of 0.01) and two underlying layers representative of a permeable bedrock aquifer (permeability of 10m/d and specific yield of 0.01). The inflows to the model are diffuse recharge [0.0011m/d, based on GSI recharge map for the area (equivalent to 400mm/yr)]. The outflow is via a river boundary cell at the left hand side of the model. The model is 1km wide and 40m deep with a top elevation of 15m.

The model is run initially in a steady state mode to allow levels to stabilise with the river stage set at 10.5m. A second transient stress period is added to the model where the river stage is reduced to 10.0m. This represents a 0.5m drop in river stage which approximates the typical scale of flood level reduction during at the 5 percentile flows and two year return event.

The effect on the groundwater levels as a result of this change is presented in **Figure 5.1**. This illustrates that the change in groundwater levels drops off within a short distance of the river. It also illustrates the extent and magnitude of the change is dependent on time. As the predicted changes are related to short lived flooding events that occur intermittently there will be a limited and short lived influence on the groundwater environment that will reduce to negligible levels (<10cm) within 10m of the river corridor.

Based on this assessment the predicted impact on the wider groundwater environment as a result of the proposed scheme is expected to be an intermittent localised negligible impact. The potential for any discernible impact in groundwater levels and flow in the karst environment outside the immediate river corridor is negligible.

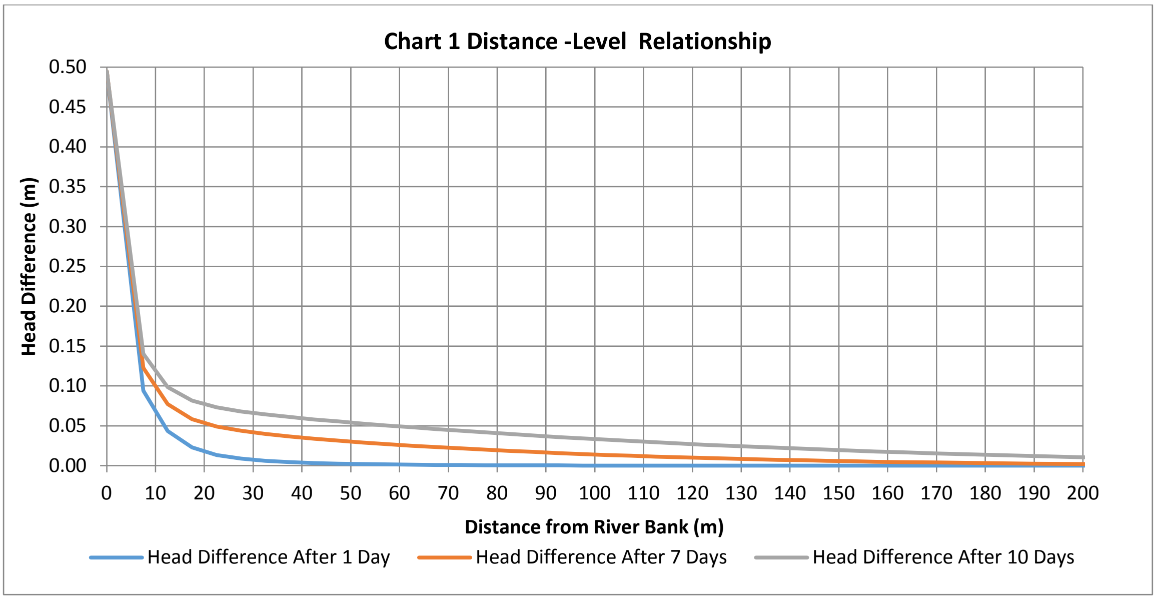


Figure 5.1 - 2D Model Illustrating Distance from River Bank and Level Relationship

6 ITEM 6 – DISCUSSION UPDATE REQUEST

6.1 The applicant is requested to provide an update of any discussions with landowners affected by the scheme and to discuss alternative arrangements which may be made in the event that consent through agreement is not forthcoming.

Response

As noted earlier, the Dunkellin River and the Aggard Stream form part of the Dunkellin Drainage District which was constructed in or around 1857 and Galway County Council has a statutory maintenance responsibility for these works. This statutory responsibility falls under the Local Authorities Works Act 1949. This Act enables certain Local Authorities to execute works affording relief or protection from flooding, landslide, subsidence and similar occurrences, and it outlines:

a. the activities that the Galway County Council, as Local Authority, can undertake,

b. the power of entry granted to Galway County Council, and

c. the compensation that Galway County Council can consider for each landowner.

With regard to the "power of entry" the 1949 Act, at Section 4.0, states, inter alia:

"Power of entry on land.	***4.**—(1) A local authority executing works pursuant to this Act or an order or agreement made thereunder, or any officer, servant or agent of such authority, may, subject to the provisions of this section, enter on any land for the purposes of the execution of the works."*

This Section 4.0 also sets out how the Local Authority is to seek consent, the measures afforded to the landowner to restrict or condition entry to lands and also states, at Section 4(7) that:

> *"(7) A person who obstructs or interferes with the exercise of the power conferred by subsection (1) of this section shall be guilty of an offence under this section and shall be liable on summary conviction thereof to a fine not exceeding ten pounds."*

Galway County Council, to date, in the development of the proposed scheme, has not been required to utilise its powers under the 1949 Act and has endeavoured to liaise with all landowners impacted by the works and has successfully sought consent and agreement from all landowners, to date, to allow entry onto lands.

This commitment by Galway County Council, to seek consent through agreement, has been utilised on the scheme to facilitate the geotechnical investigations needed to inform the current planning stage and to develop the future design stage works. As part of these investigations Galway County Council has discussed the proposed works with all landowners directly impacted by the channel works and bridge works. Consent has been provided by all landowners (14 No.) and a copy of the signed consent forms is presented in **Appendix F** to this response.

7 ITEM 7 – RESPONSE INVITATION

7.1 The applicant is invited to respond in detail to the written submissions made by parties including local residents, prescribed bodies and others. These submissions have been previously forwarded to the local authority.

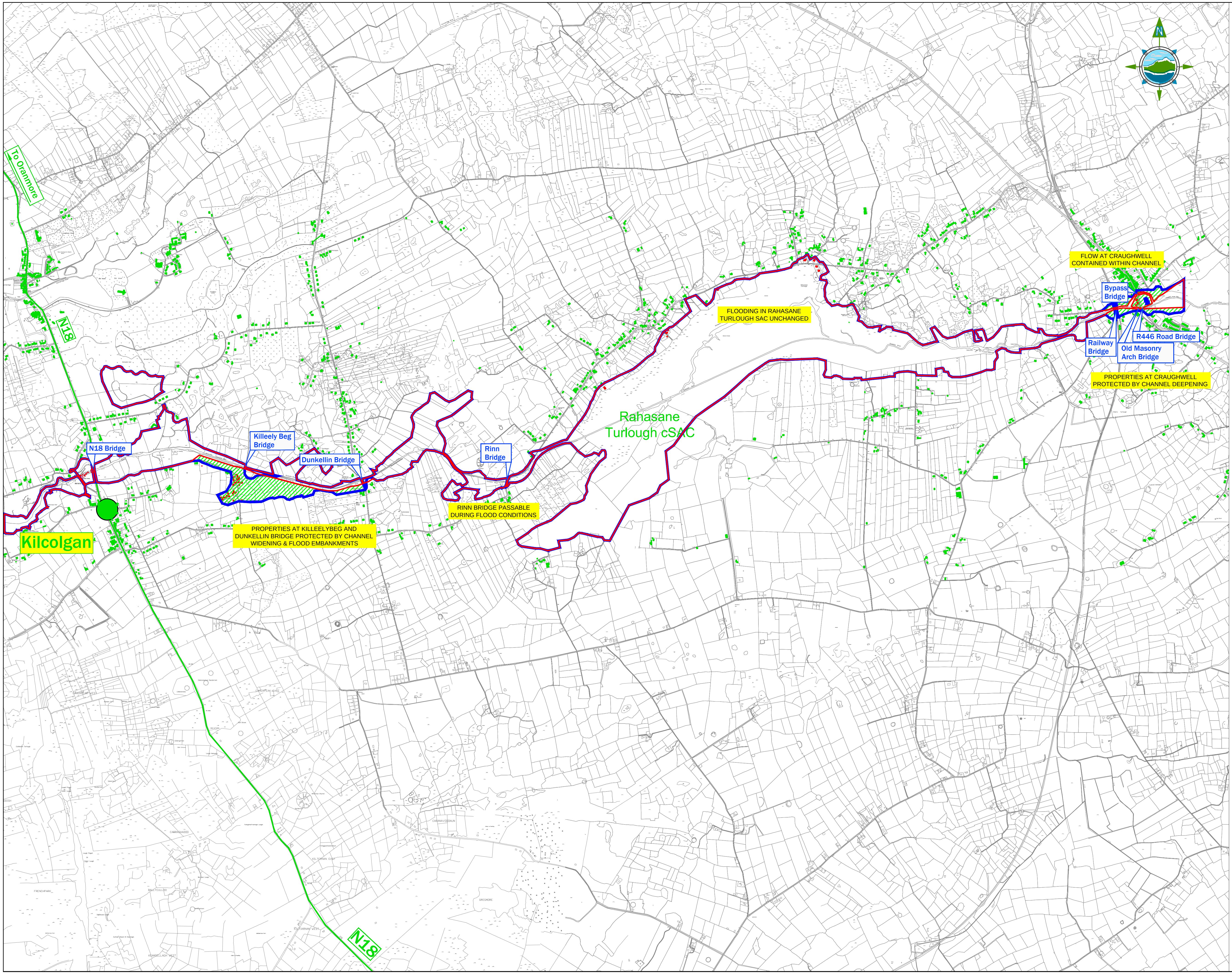
Response

Responses to these written submissions are provided in Annex I to this response. The responses prepared for each of the submissions are as follows;

(i) The Department of Arts, Heritage and the Gaeltacht
(ii) Inland Fisheries Ireland
(iii) Brendan Slevin
(iv) Bord Iascaigh Mhara
(v) Marine Institute
(vi) Clarinbridge Oyster Co-Op / Michael Kelly Shellfish
(vii) Numerics Warehouse
(viii) Iarnród Éireann
(ix) The National Roads Authority
(x) Rahasane Turlough Shareholders Committee
(xi) Geological Survey of Ireland

Appendix A

Drawings



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LEGEND:

- FLOOD EXTENTS - PRE WORKS
- FLOOD EXTENTS - POST WORKS
- ▨ BENEFITING LANDS

NOTES:

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER/EMPLOYERS REPRESENTATIVE, AS APPROPRIATE, TO BE INFORMED BY THE CONTRACTOR OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. THE CONTRACTOR SHALL UNDERTAKE A THOROUGH CHECK FOR THE ACTUAL LOCATION OF ALL SERVICES/UTILITIES, ABOVE AND BELOW GROUND, BEFORE ANY WORK COMMENCES
5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project:
Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title:
Predicted Flood Extents for
November 2009 Flow
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

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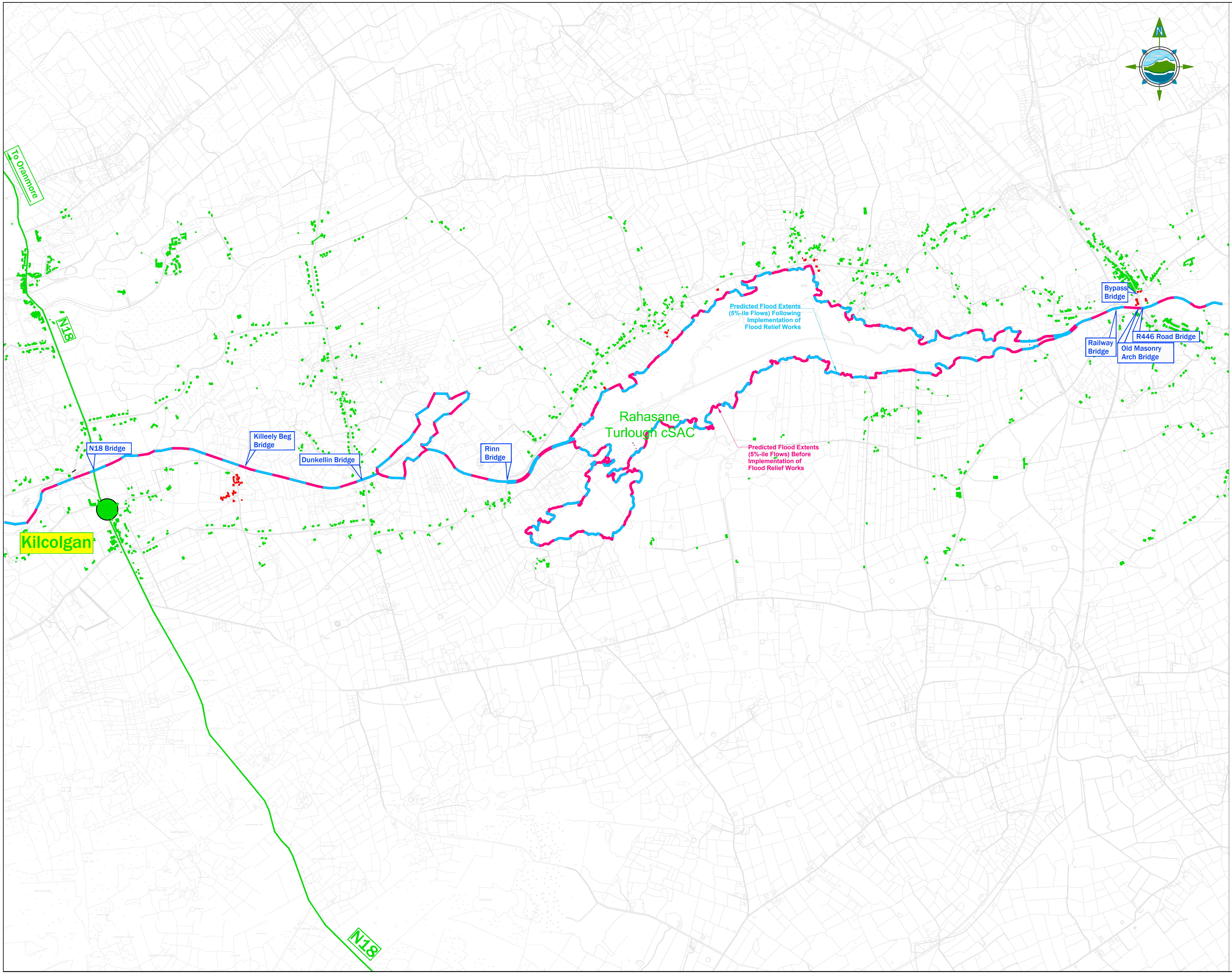
Drawing No.: 6408-2300

Revision: A



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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project: Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title: Predicted Flood Extents for
5%-ile Flows
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

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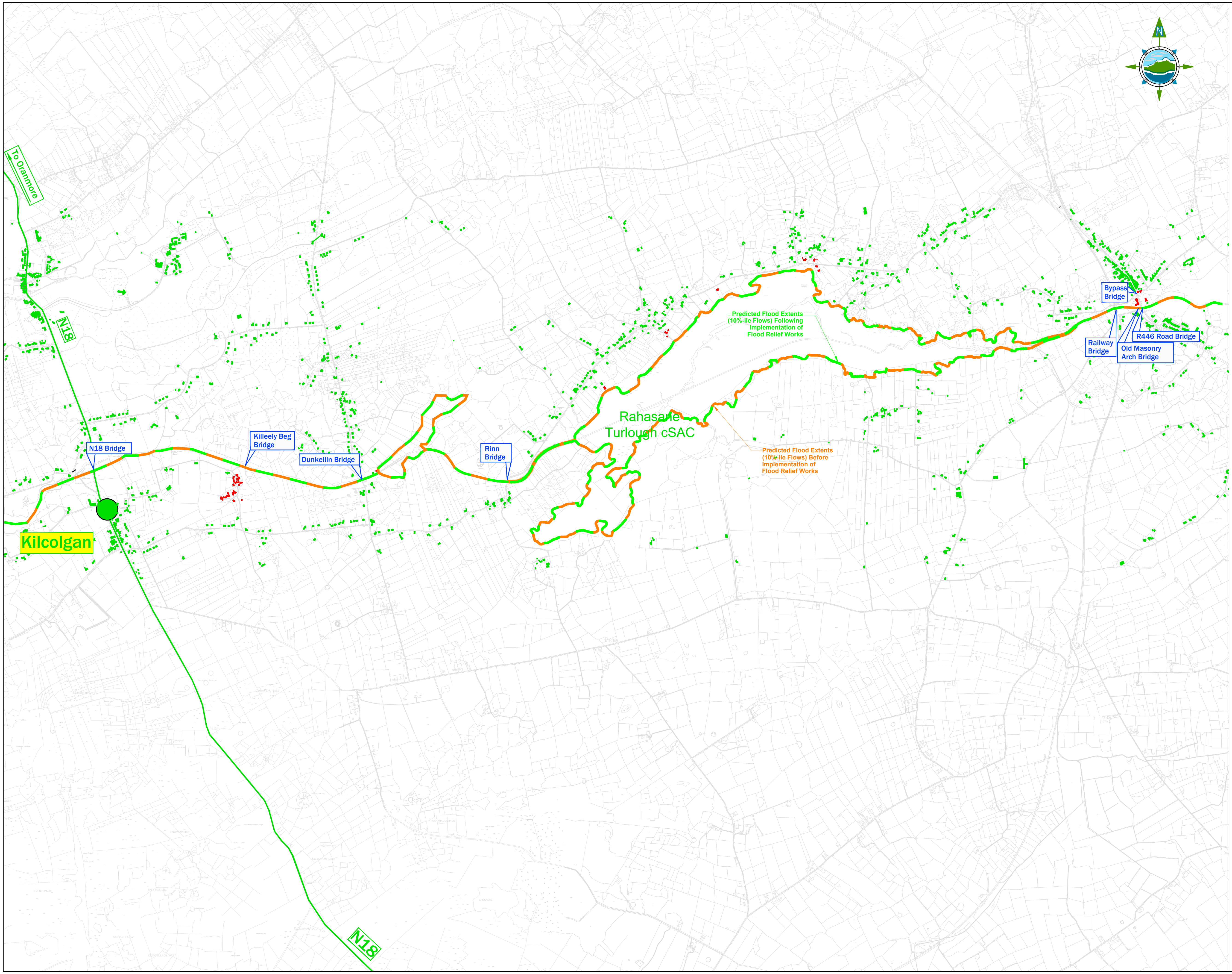
Drawing No.: 6408-2301

Revision: A



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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project:
Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title:
Predicted Flood Extents for
10%-ile Flows
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

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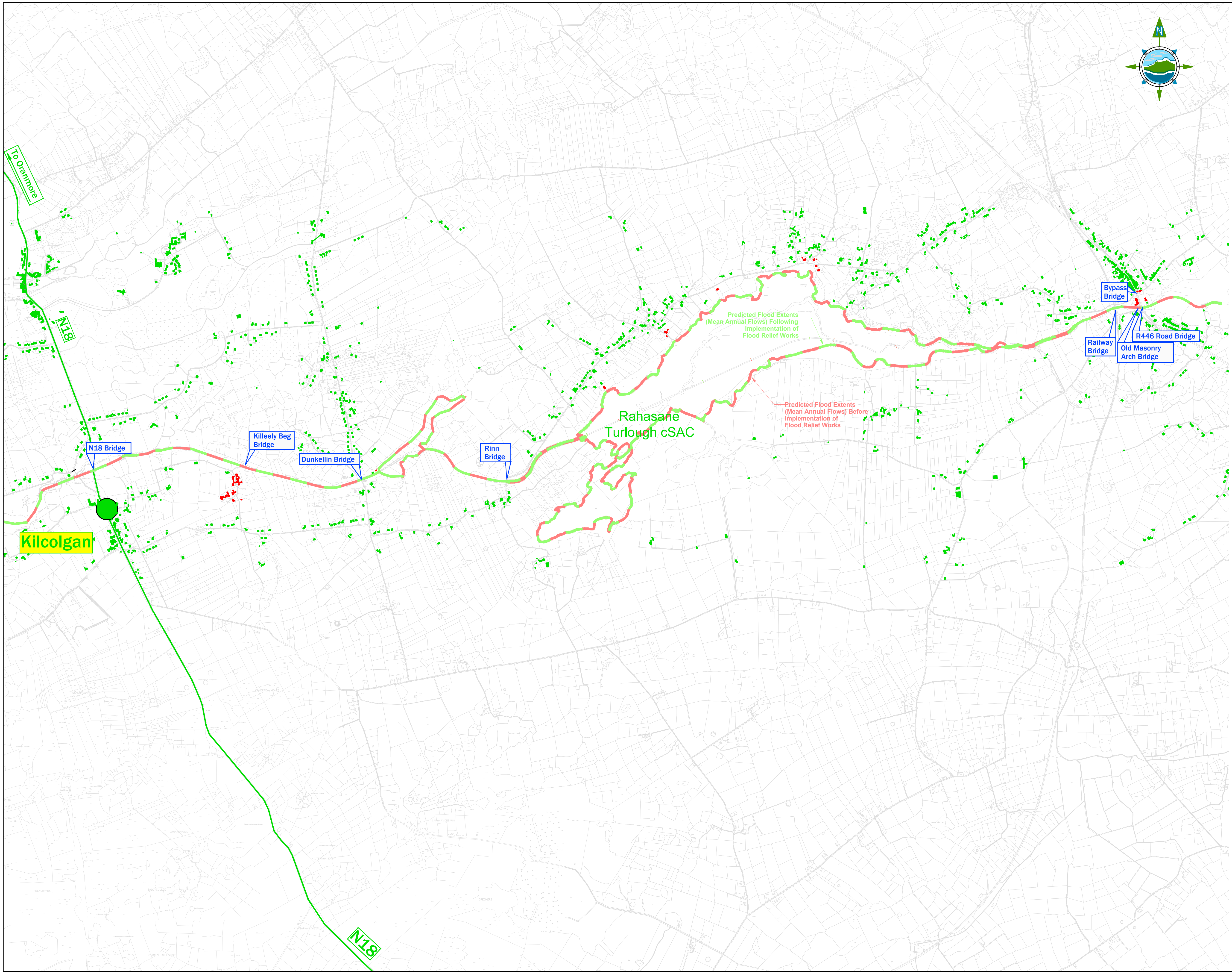
Drawing No.: 6408-2302

Revision: A



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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	June/15	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project:
Dunkellin River and
Aggard Stream
Flood Relief Scheme

Title:
Predicted Flood Extents for
Mean Annual Flow Conditions
Pre & Post Flood Alleviation Works

Scale @ A1: 32,500
Scale @ A3: 65,000

Prepared by:	Checked:	Date:
PMF	MMcD	June 2015

Project Director: Michael Garrick

Drawing Status:

TOBIN
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Drawing No.: 6408-2303

Revision: A

Appendix B

Rahasane Waterbeetle List 10/6/15

	Rahasane Main Basin			Rinn Basin	
	S	NE	N	Pool A	Pool B
Species	M47565 19216	M48130 20200	M47010 19577	M46473 18103	M45904 18014
Agabus bipustulatus	3			4	
*Agabus nebulosus**	4	7	1	9	2
Anacaena limbata		1		1	
*Hygrotus impressopunctatus**	1		1	3	
Hygrotus inaequalis	1				
*Hygrotus quinquelineatus**	17		16		4
Helophorus brevipalpis		1		2	
*Helophorus spp.**				1	1
Hydrobius fuscipes		1		1	
Hydroporus palustris	10	20	5	4	
Hydroporus planus		1		41	2
Ilybius fuliginosus	6	2	1	4	
*Ochthebius bicolon***		1			
Potamonectes depressus elegans	1				
*Laccophilus minutus**					3

*”Moss-edge community” and/or characteristic turlough species (Foster *et al*., 1992, Sheehy Skeffington *et al*., 2006).

**Irish Red Listed – Vulnerable (Foster *et al*., 2009) (new record for Rahasane – identity to be confirmed).

Appendix C

Site Investigation Report

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DUNKELLIN RIVER AND AGGARD STREAM FLOOD RELIEF WORKS

SITE INVESTIGATION CONTRACT

FACTUAL REPORT

NO. P12012

Client:

Galway County Council,

Prospect Hill,

Galway,

Ireland.

Engineer:

Tobin Consulting Engineers,

Fairgreen House,

Fairgreen Road,

Galway,

Ireland.

28/10/2014

REPORT CONTROL SHEET

Employer	Galway County Council					
Employer's Representative	Tobin Consulting Engineers					
Project Name	Dunkellin River and Aggard Stream Flood Relief Works – Site Investigation Contract					
Report Name	Dunkellin River and Aggard Stream Flood Relief Works – Site Investigation Contract – Factual Report					
Project Number	P12012					
This Report Comprises of	RCS	TOC	Text	No. of Appendices	Drawings	Electronic data
	1	1	18	4	8	*.pdf

Revision	Status	Author(s)	Approved By	Issue Date
D01	Draft	AG	GH	03.10.2014
F01	Final		Gregory Hayes	28.10.2014

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

1.1 SCOPE OF WORKS

In February 2012, Tobin Consulting Engineers (Tobin) acting as the Employer's Representative and on behalf of their Client, Galway County Council commissioned Priority Geotechnical (PGL), to carry out a geotechnical site investigation to provide information in respect of the soil and rock ground conditions and groundwater levels for Dunkellin River and Aggard Stream Flood Relief Works. The scheme is intended to address flooding on the Dunkellin River from Craughwell to Kilcolgan and along the Aggard Stream.

The site investigations are required to facilitate the detailed design of the proposed scheme along the route of the proposed channel works (bank works and in channel works) and in the vicinity of the proposed bridge underpinning and replacement works.

The original scope of the ground investigation, which was specified by Tobin, comprised the following:

- Geophysics survey, by seismic refraction/resistivity surveying or equivalent, along existing channel route and at existing bridge structures (4 No.) from a distance of 200m upstream of Craughwell to 550m downstream of the railway crossing in Craughwell.
- Geophysics survey, by seismic refraction/resistivity surveying or equivalent, along left and right banks (where indicated) of the existing channel route from just downstream of the Rahasane Turlough SAC to Kilcolgan Bridge at the N18.
- Geophysics survey, by seismic refraction/resistivity surveying or equivalent, at each bridge structure (3 No.) between the Rahasane Turlough cSAC and the Kilcolgan Bridge at the N18.
- Interpretation of the geophysical survey results.
- The excavation of slit trenches at each bridge location (except the railway bridge) to locate existing utilities and services particularly within the vicinity of the bridges along the R446 (formerly N6) within Craughwell Village and to also verify the geophysical results.
- The drilling of boreholes (Shell & Auger and Rotary Coring) including the associated sampling and in-situ field tests.
- The Excavation of Trial Pits to log road construction materials, natural soils, rock and groundwater.

- The retention of groundwater, soil and rock samples.
- Reinstatement of all slit trenches, boreholes, inspection pits & trial pits, etc.
- Monitoring of and permeability testing in groundwater and gas installations during and after completion of the site works.
- Laboratory testing of soil and rock.
- Surveying of exploratory hole positions.
- Factual Reporting.
- Provision of traffic management to accommodate the investigation.

The final works as completed are detailed in Section 3.2 of this report.

This investigation was carried out in accordance with the contract specification: Specification and Related Documents for Ground Investigation in Ireland (Engineers Ireland, October 2006), Eurocode 7- Geotechnical Design Part 2, ground investigation and testing (BS EN 1997-2: 2007) and the relevant British Standards. The fieldworks were carried out between 29th April and 27th July, 2014.

The works were supervised and excavations monitored on behalf of PGL by Project Scientist, Mr. Brendan Goode BA MSc.

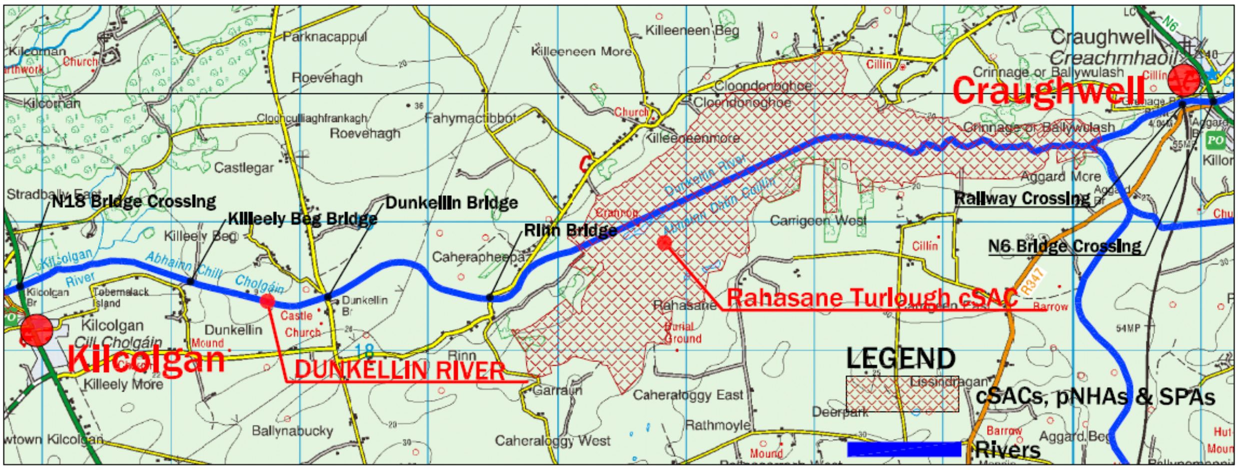
1.2 REPORTING

This geotechnical data report: P12012_RP_F01 presents the factual records of the fieldwork with respect to the site investigation works contract for the proposed Dunkellin River and Aggard Stream Flood Relief Works (FRW).

2 THE SITE

2.1 SITE LOCATION & DESCRIPTION

The site consists of work in fields, on-road and within the existing water channel (over water). It must be noted that site investigation works were carried out close to important and designated habitats. The study area is shown below and in more detail on the Exploratory Location Plans in **APPENDIX D** of this factual report.



2.2 PUBLISHED GEOLOGY

2.2.1 Solid

The Geological Survey of Ireland, 1:100,000 mapping (Sheets) were reviewed and the solid geology was summarised as follows,

Location	**Geological Formation**	**Description**	**Karst**
Dunkellin River from Kilcolgan to Craughwell	Visean Limestone Burren Formation	Undifferentiated Limestones Pale grey clean skeletal Limestones	Numerous turloughs and springs *(cave west of Kilcolgan at Stradbally South*) Sinkhole at Ballywulash. Trace lines predominantly East West and both E-W and N-S at Kilcolgan
Aggard Stream from Craughwell to Ardrahan	Visean Limestone Lucan Formation Castlequarter member	Undifferentiated Limestones Dark Limestone and shale (Calp) Monotonous Limestone and dolomite	None identified on GSI karst database

2.2.2 Superficial deposits

Teagasc, subsoil mapping was reviewed and the overburden deposits were summarised as follows:

Location	**Superficial Deposits**	**Description**	**Rock outcrops**
Dunkellin River from Kilcolgan to Craughwell	Alluvium Glacial Deposits Lake Sediments	Undifferentiated Limestone till Undifferentiated	Y
Aggard Stream from Craughwell to Ardrahan	Glacial Deposits Lake Sediments	Limestone till Undifferentiated	Y

3 FIELDWORK

3.1 GENERAL

The fieldwork was carried out in general accordance with BS 5930 (1999)+A2:2010 Code of Practice for Site Investigation and Part 9 of BS 1377 (1990), Method of Tests for Soil for Civil Engineering Purposes.

Details of the equipment and plant used are presented below.

Operation	Equipment	Nominal diameter, mm	Flush	Comments
Cable Percussion Boring	Dando 2000	200mm	N/A	Standard Penetration Test, N values obtained, bulk disturbed sampling. Visual observations of ground and groundwater conditions.
Rotary Coring and Open Hole Drilling	Delta Base 520	Symmetrix 131mm diameter open hole 76mm diameter core	Compressed Air mist	Standard Penetration Test, N values obtained in overburden. Visual observations of ground and groundwater conditions. Installation of standpipe wells and in situ permeability testing.
Trial pit excavations	JCB	N/A	N/A	Visual observations of ground and groundwater conditions.
Geophysics	Seismic refraction	N/A	N/A	See Minerex Geophysics Report 5825d-005.doc

The scope of the works were reviewed by PGL. Subsequently the exploratory locations were selected by PGL in consultation with Tobin and set out subject to work space restrictions and available access. The ‘as constructed’ exploratory locations were subsequently surveyed using Trimble V8 GPS equipment to the Ordinance Survey, Irish National Grid (ING) system of co-ordinates and elevations to Malin Head datum. These locations are shown on the Exploration Location Plans (dwg. No.: P12012-SI-A, P12012-SI-01 to P12012-SI-08) presented in **APPENDIX D** of this factual report.

3.2 EXPLORATORY HOLES

The exploratory holes as completed during the ground investigation are listed in the following table:

SUMMARY OF EXPLORATORY HOLES

Type	**Quantity, No.**	**Depth Range, m bgl**	**Remarks**
Cable Percussion Boreholes	20	0.36 – 3.40	BH01, BH01A, BH03, BH08, BH10, BH11, BH16, BH17, BH18, BH22, BH23, BH23A, BH25, BH27, BH29, BH32, BH33, BH37, BH40 and BH42.
Rotary Boreholes	32	3.0 – 15.0	RC01, RC02, RC03, RC04, RC05, RC06, RC07, RC08, RC09, RC10, RC13, RC14, RC15, RC16, RC17, RC18, RC19, RC20, RC21, RC24, RC26, RC28, RC29, RC30, RC31, RC32, RC34, RC37, RC39, RC41, RC42 and RC43.
Trial Pit Excavations	43	0.5 – 3.5	TP01, TP01A, TP01B, TP01C, TP02, TP03, TP04, TP05, TP06, TP07, TP08, TP09, TP11, TP12, TP13, TP14, TP14A, TP15, TP15A, TP18, TP18A, TP20, TP21, TP21A, TP22B, TP25, TP26, TP28,TP29, TP30, TP31, TP32, TP33, TP34, TP36 and TP37.
Slit Trenches	6	1.6 – 2.9	ST01, ST02, ST03, ST04, ST05 and ST06.

The exploration records are presented in **APPENDIX A** and should be read in conjunction with the key sheets included. The records provide descriptions, in accordance with BS 5930 (1999), of the materials encountered and details of the samples taken, together with any observations made during the investigation.

3.3 SAMPLING

A total of ninety nine (99) no. bulk disturbed samples (B), seventy one (71) no. small disturbed samples (D), and a single (1) *in situ* CBR mould and rotary core (C) were taken during the fieldworks.

3.4 GROUNDWATER MONITORING

Groundwater was recorded when observed during boring and trial pit excavations.

It must be noted that the normal rate of cable percussion and rotary drilling may not permit the recording of equilibrium groundwater levels. Groundwater may be excluded from the boring as the casing progresses through the superficial deposits. The exploratory boreholes and trial pit excavations were backfilled with arisings and/or bentonite grout.

50mm diameter HDPE standpipe wells were also constructed to allow for groundwater monitoring.

▧	BENTONITE grout Backfill to rotary borehole/ installation
▩	Arisings Backfill to cable percussion borehole/
░	GRAVEL Backfill to installation/ rotary borehole
☰	uPVC slotted pipe

3.5 IN SITU TESTING

Standard Penetration Tests, N values, were typically carried out in the boreholes at intervals of 1.0m. The Standard Penetration Test was carried out in accordance with Geotechnical Investigation and Testing, Part 3 Standard penetration test, BS EN ISO 22476-3:2005+A1:2011. The data was presented on the relevant logs in **APPENDIX A**.

In situ variable falling head permeability tests were carried out in 50mm diameter standpipe wells. *In-situ* permeability tests were carried out in accordance with BS5930: 1999, Section 4: Cl. 25.4, within the Limestone bedrock over duration up to one (1) hour, as detailed on the borehole logs, **APPENDIX A** of this report. It is noted that the duration typically was 2minutes up to a maximum of 5minutes for groundwater to dissipate to the initial static groundwater level within the standpipe well. The processed test data was presented on the relevant borehole logs presented in **APPENDIX A** of this factual report. The shape or intake factor, f was derived from the condition at the base of the borehole at the test depth and test geometry as per Hvorslev (1951).

$$k = \frac{A}{fd} \frac{\log_e (H_0 / H_t)}{t}$$

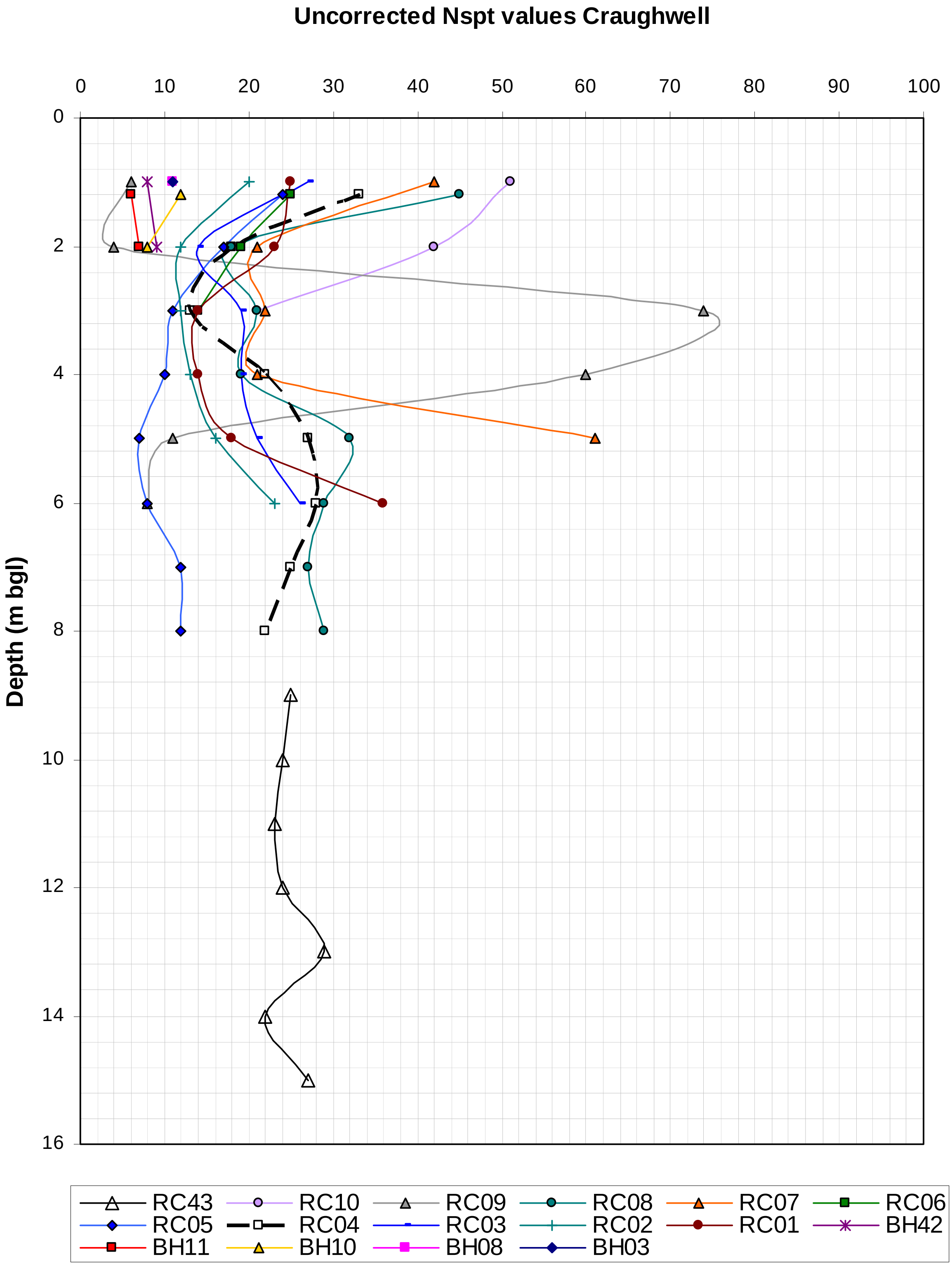
The ratio L/d was 60 to 100, giving a shape (or intake) factor, f of 20; where permeability in the bedrock was assumed equal in both horizontal and vertical direction, k_H/ k_V = 1. Additional head was provided by adding well casing above ground level to a maximum height; existing ground + 1.0m. It is noted the L/D ratio exceeded the upper bound of 10 (BS 5930, Part 4 Cl. 25.4 Figure 7). The results should be used with caution.

A geophysical survey was undertaken by Minerex Geophysics Limited on behalf of PGL during July 2014. The results of the survey are presented by Minerex in a separate report Ref: 5825f-005.doc; October, 2014. The geophysical survey is presented in **APPENDIX C**.

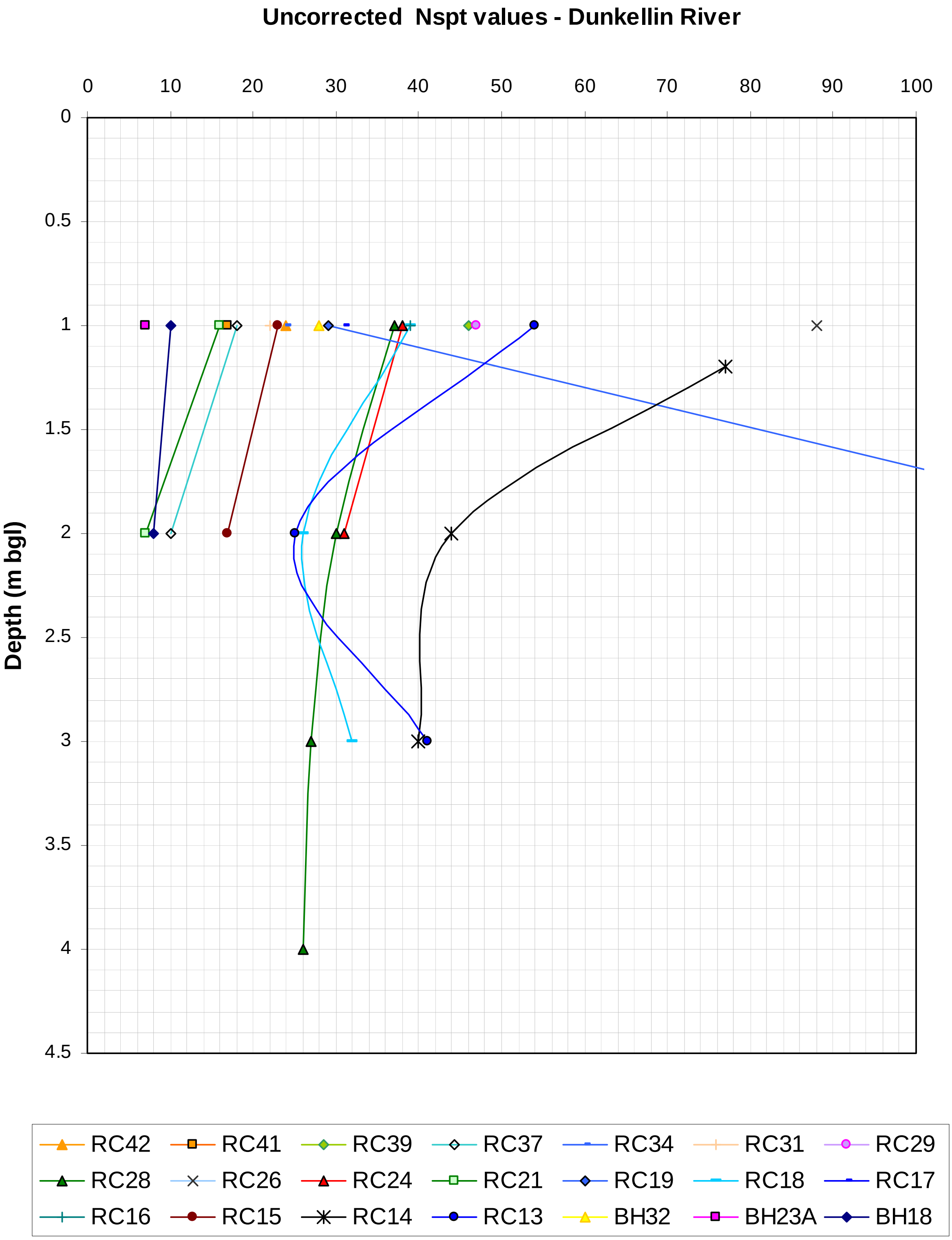
SUMMARY OF IN-SITU TESTING

Type	Quantity	Remarks
Standard Penetration Test, N value	157No.	Cone Penetration Tests (CPT) and Split Spoon Penetration Tests (SPT)
In situ permeability Test	8No.	1.4 x10^{-}4ms^{-1} to 1.8 x10^{-}4ms^{-1}

The distribution of uncorrected Standard Penetration Test, Nspt values with depth (m below existing ground level, bgl) is presented below for boreholes at Craughwell. Refusals, Nspt>50, where the complete set of 4 number 75mm increments were not achieved are not plotted.



The distribution of uncorrected Standard Penetration Test, Nspt values with depth is presented below for boreholes at along the Dunkellin River to Kilcolgan. Refusals, Nspt>50, where the complete set of 4 number 75mm increments were not achieved are not plotted.



4 LABORATORY TESTING

All samples were transported to Priority Geotechnical’s laboratory in Midleton, Co. Cork examined, logged and prepared for scheduled testing. Laboratory testing was proposed by PGL, being approved by Tobin.

Testing was carried out by PGL, in accordance with BS1377 (1990), Methods of test for soils for civil engineering purposes and the ISRM suggested methods for rock characterisation, testing and monitoring. The laboratory test results were presented in **APPENDIX B**. A summary of tests undertaken were detailed below.

4.1 SOIL

SUMMARY OF LABORATORY TESTING UNDERTAKEN – SUPERFICIAL DEPOSITS

SOILS		
Type	**No.**	**Remarks**
Natural Moisture Content	62	8% to 46% (including a single value 307%)
Atterberg Limit	33	Liquid limit, LL 16% to 95% (226%) Plastic limit, PL 11% to 77% and NP non-plastic soils (131%) Plasticity index, PI 4 to 21 (95)
Particle Size Distribution	42	See **APPENDIX B**
Particle Size Distribution by hydrometer	32	
pH SO_3 water soluble	2 2	7.91 and 8.00 0.008g/l and 0.022g/l
Organic Content	2	3.3% and 16.2%
Loss on ignition	2	4.5% and 12.3%
Compaction (Moisture content/dry density relationship)	12	Optimum moisture content 5.7% to 24% Maximum dry density 1.48Mg/m^3 to 2.29Mg/m^3
Moisture condition value, MCV moisture content relationship	12	See **APPENDIX B**
Moisture condition value, MCV single point	34	(0) 2.5 to 12.0
Direct shear test (60mm sq.)	9	c = 0kPa to 9kPa Φ = 17^o to 43^o

4.2 ROCK

SUMMARY OF LABORATORY TESTING UNDERTAKEN – SOLID GEOLOGY

ROCK		
Type	**No.**	**Remarks**
Uniaxial Compressive Strength (UCS)	26	36.4MPa and 121.5MPa
Point Load Test (I_{P50})	74	1.12MPa to >10MPa

5 GROUND CONDITIONS

5.1 CRAUGHWELL VILLAGE

The site at Craughwell Village was characterised by Topsoil 100mm to 500mm, averaging 210mm thick overlying glacial and alluvial deposits of; slightly sandy gravelly CLAY/ slightly sandy (slightly) gravelly SILT with variable cobble content to depths 2.0m below existing ground level (bgl) up to 15.0m bgl. An increase in coarse particle content was noted below 1.4m bgl. The rotary drilling indicated granular deposits; clayey SANDS and GRAVELS with boulder content. Strong LIMESTONE was identified at depths 4.3m bgl to 6.9m bgl.

It is noted that RC43 was drilled to a depth 15.0m with no rock encountered. Adjacent to RC43 at location RC01 Limestone was encountered at 6.5m. The geophysical survey highlighted a variable rock profile in the area, see profiles S1 – S4 and S13.

Tactile assessment in trial pit excavations indicated typically firm SILT and CLAY deposits. Some soft SILT deposits were present at locations TP08 and TP09 (BH11) to depths up to 3.0m bgl. These were noted as being having high plasticity. Based on the standard penetration test, the CLAY was described as firm with Nspt value of 6 to 12. Soft CLAY was noted at RC09 at a depth 2.0m bgl. The SILT was described as soft with Nspt values 6 and 8 (BH11) to a depth 3.0m bgl. The granular deposits were described as medium dense with Nspt values 11 to 29. At RC05 between 4.0m bgl to 7.0m bgl loose SAND was noted (Nspt 7 to 10). Elevated Nspt values were attributed to coarse Cobble particles.

5.2 RAHASANE TURLOUGH TO KILCOLGAN BRIDGE

The remainder of the site along the Dunkellin River from Rahasane Turlough to Kilcolgan Bridge, was characterised by shallow LIMESTONE bedrock. Superficial deposits of slightly sandy (slightly) gravelly SILT/ CLAY with variable cobble content and silty (very) sandy GRAVEL with low cobble and boulder content were encountered to depths of 0.5m bgl to 3.5m bgl. Organic SILT was identified at TP28 to a depth 1.7m bgl underlain by slightly sandy gravelly CLAY with variable cobble content. Cable tool borehole terminated at depths of 0.26m bgl to 2.5m bgl after one (1) hour chiselling without progress on assumed bedrock. Typically strong LIMESTONE was identified at depths of between 0.8m bgl and 5.1m bgl. Some medium strong Limestone was noted at RC28 and very strong Limestone at RC32 and RC42. At RC42 a shallow infilled cavity/ fracture feature was noted 3.8m to 4.8m with non-intact core recovered.

Tactile assessment in trial pit excavations typically indicated firm SILT deposits. Some soft and ‘soft to firm’ deposits were noted at TP18, TP21A, TP22B, TP28, TP31 and TP34. Plasticity data indicated some high plasticity SILT and organic SILT deposits. Based on the standard penetration test, the SILT was described as firm with Nspt values of 8 to 10. The CLAY was described a firm to stiff with Nspt values of 7 to 28. Below 2.0m the CLAY was described as stiff with Nspt values 40 to 44. The granular deposits were described as medium dense with Nspt values 17 to 32. Elevated Nspt values were attributed to coarse Cobble particles.

5.3 GROUNDWATER

Groundwater was encountered between depths of 0.5m bgl and 10.2m bgl. Details of the ground water and installations are presented graphically on the relevant exploratory logs within **APPENDIX A** and summarised below. See also section 3.4 for general details.

Eight (8) number 50mm diameter standpipe well, installations were constructed in rotary boreholes to allow for groundwater monitoring and *in situ* falling head permeability testing.

SUMMARY OF GROUNDWATER STRIKES- CRAUGHWELL

Location	**Groundwater level, m bgl**
RC08	6.3
TP02	1.4
TP04	2.1
TP05	1.9
TP08	2.1
RC43	10.2

Location	**Groundwater level, m bgl**	**Comments**
RC43	10.2	Rising to 8.7m

SUMMARY OF GROUNDWATER STRIKES- RAHASANE TO KILCOLGAN

Location	**Groundwater level, m bgl**	**Comments**
RC19	0.6	**Standpipe installed**
RC20	-	**Standpipe installed**
RC26	-	**Standpipe installed**
RC30		**Standpipe installed**
RC31	-	**Standpipe installed**
RC32	-	**Standpipe installed**
RC37	-	**Standpipe installed**
RC39	1.2	**Standpipe installed**
		-

RC41 1.8

Location	Groundwater level, m bgl	Comments
TP21A	0.8	-
TP22	0.6	-
TP22B	0.5	-
TP25	1.0	-
TP26	0.8	-
TP28	1.4	-
TP28	2.1	-
TP31	0.6	-
TP35	0.7	-
TP36	2.0	-
TP37	0.6	-

SUMMARY OF GROUNDWATER MONITORING - RAHASANE TO KILCOLGAN

Location	Response zone, m	Installed, dd/mm/yyyy	Groundwater strike, m bgl	Groundwater monitoring, m bgl			
				23/07/2014	dd/mm/yyyy	dd/mm/yyyy	dd/mm/yyyy
RC19	7.0-10.0	10/07/2014	none	9.0			
RC20	3.0-6.0	11/07/2014	none	3.4			
RC26	7.0-10.0	13/07/2014	none	4.0			
RC30	3.0-6.0	12/07/2014	none	3.9			
RC31	5.0-10.0	14/07/2014	none	1.4			
RC32	3.0-7.0	14/07/2014	none	1.6			
RC37	4.0-8.0	15/07/2014	none	1.6			
RC39	3.0-6.0	13/07/2014	1.2	0.6			

It was noted during the drilling of RC42 the river broke its bank and the location was flooded over the tidal cycle.

6 SUMMARY

1. The site at Craughwell Village was characterised firm slightly sandy gravelly CLAY/ slightly (sandy slightly) gravelly SILT with variable cobble content and medium dense clayey SAND and GRAVEL deposits to depths 2.0m bgl up to 15.0m bgl. Some soft and loose deposits were identified. Strong LIMESTONE was identified at depths 4.3m bgl to 6.9m bgl.

2. The between Rahasane Turlough to Kilcolgan Bridge site was characterised by firm becoming stiff slightly sandy (slightly) gravelly SILT/ CLAY with variable cobble content and medium dense silty (very) sandy GRAVEL with low cobble and boulder content were encountered to depths of 0.5m bgl to 5.1m bgl overlying medium strong to very strong LIMESTONE. Some soft deposits were identified.

3. Groundwater was encountered between depths of 1.4m bgl and 10.2m bgl at Craughwell Village. Details are presented on the relevant logs in **APPENDIX A**.

4. Groundwater was encountered between Rahasane Turlough to Kilcolgan Bridge between depths of 0.5m bgl and 2.1m bgl. Details are presented on the relevant logs in **APPENDIX A**.

5. Eight (8) number standpipe wells were installed to allow for groundwater monitoring, see Section 5.3 and *in situ* falling head permeability testing.

6. Further, more detailed records of the ground and groundwater conditions can be found on the exploratory logs and photographic records presented within **APPENDIX A** of this factual report.

7. Laboratory testing was undertaken to determine the classification of the soil and rock encountered during the ground investigation. The data is presented in **APPENDIX B**.

8. A geophysical seismic refraction survey was undertaken by Minerex Geophysics Limited (MGX) on behalf of PGL and is presented in **APPENDIX C** of this factual report, further defining the ground conditions and bedrock profile.

9. The exploratory locations are presented on the location plans presented within **APPENDIX D** of this factual report.

APPENDIX A

EXPLORATORY HOLE AND PHOTOGRAPHIC RECORDS

Cable Percussion Boreholes	BH01, BH01A, BH03, BH08, BH10, BH11, BH16, BH17, BH18, BH22, BH23, BH23A, BH25, BH27, BH29, BH32, BH33, BH37, BH40 and BH42.
Rotary Boreholes	RC01, RC02, RC03, RC04, RC05, RC06, RC07, RC08, RC09, RC10, RC13, RC14, RC15, RC16, RC17, RC18, RC19, RC20, RC21, RC24, RC26, RC28, RC29, RC30, RC31, RC32, RC34, RC37, RC39, RC42, RC41 and RC43.
Trial Pit Excavations	TP01, TP01A, TP01B, TP01C, TP02, TP03, TP04, TP05, TP06, TP07, TP08, TP09, TP11, TP12, TP13, TP14, TP14A, TP15, TP15A, TP18, TP18A, TP20, TP21, TP21A, TP22B, TP25, TP26, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP36 and TP37.
Slit Trenches	ST01, ST02, ST03, ST04, ST05 and ST06.

KEY TO SYMBOLS ON EXPLORATORY HOLE RECORDS

All linear dimensions are in metres or millimetres

DESCRIPTIONS

**	Drillers Description
Friable	Easily crumbled

SAMPLES

U( )	Undisturbed 102mm diameter sample, ( ) denotes number of blows to drive sampler
U( )F, U( )P	F- not recovered, P-partially recovered
U38	Undisturbed 38mm diameter sample
P(F), (P)	Piston sample - disturbed
B	Bulk sample - disturbed
D	Jar Sample - disturbed
W	Water Sample
CBR	California Bearing Ratio mould sample
ES	Chemical Sample for Contamination Analysis
SPTLS	Standard Penetration Test S lump sample from split sampler

CORE RECOVERY AND ROCK QUALITY

TCR	Total Core Recovery (% of Core Run)
SCR	Solid Core Recovery (length of core having at least one full diameter as % of core run)
RQD	Rock Quality Designation (length of solid core greater than 100mm as % of core run)

Where there is insufficient space for the TCR, SCR and RQD, the results may be found in the remarks column

If	Fracture Spacing in mm (Minimum/Average/Maximum) NI - non intact, NR - no recovery
AZCL	Assumed Zone of Core Loss
NI	Non intact

GROUNDWATER

▽	Groundwater strike
▼	Groundwater level after standing period
Date/Water	Date of shift (day/month)/Depth to water at end of previous shift shown above the date and depth to water at beginning of shift given below the date

INSITU TESTING

S	Standard Penetration Test - split barrel sampler
C	Standard Penetration Test - solid 60° cone
SW	Self Weight Penetration
Ivp, HVp (R)	In Situ Vane Test, Hand Vane Test (R) demonstrates remoulded strength
K(F), (C), (R), (P)	Permeability Test
HP	Hand Penetrometer Test

MEASURED PROPERTIES

N	Standard Penetration Test - blows required to drive 300mm after seating drive
x/y	Denotes x blows for y mm within the Standard Penetration Test
x*/y	Denotes x blows for y mm within the seating drive
c_u	Undrained Shear Strength (kN/m^2)
CBR	California Bearing Ratio

ROTARY DRILLING SIZES

Index Letter	Nominal Diameter (mm)	
	Borehole	Core
N	75	54
H	99	76
P	120	92
S	146	113

Key Sheet

PRIORITY GEOTECHNICAL

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Drilled By	WD
Logged By	
Borehole No	**BH01**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	551015E - 719948N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	03/06/2014
Level:	22.09 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨						21.94	0.15	Topsoil.	▨
		0.70	CPT	50 (25,25/25,25)	0.70	21.39	0.70	Dark brown, slightly sandy slightly gravelly SILT.	▨
		0.72	CPT	25 (25,25/25)	0.72	21.37	0.72	Chiselled from 0.7m to 0.72m for 1 hour.	
								End of Borehole at 0.72 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.72m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.70 to 0.72	0100	Chisel

Remarks: Borehole terminated due to obstruction. Relocated to BH01A.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/06/2014	0.00m	Start of Borehole
-	03/06/2014	0.72m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	WD
Logged By	JMS

Borehole No
BH01A
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551004E - 719949N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 03/06/2014	**Level:** 21.79 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						21.64	0.15	Topsoil.
		0.15-0.70	B					Dark brown, slightly sandy gravelly SILT with rootlets.
		0.60	D					
		0.90	D					
		1.20	CPT	50 (25,25/25,25)	1.20	20.59	1.20	
		1.25	CPT	50 (25,25/25,25)	1.25	20.54	1.25	Chiselled from 1.2m to 1.25m for 1 hour.
								End of Borehole at 1.25 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Legend depth scale: 1, 2, 3, 4, 5, 6, 7, 8

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.25m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.20 to 1.25	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/06/2014	0.00m	Start of Borehole
-	03/06/2014	1.25m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By AK
Logged By DMC

Borehole No **RC01**
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW
Project No. P12012
Co-ords: 551017E - 719951N
Hole Type Rotary Cored

Client: Galway Co. Co.
Dates: 03/07/2014
Level: 21.91 m AOD
Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	**Stratum Description**	Legend
										Open hole boring. Driller described: SAND with boulders.	
		1.00	CPT	N=25 (6,6/5,7,7,6)			1.00				
		2.00	CPT	N=23 (4,4/6,5,6,6)			2.00				
		3.00	CPT	N=14 (2,2/3,5,3,3)			3.00				
		4.00	CPT	N=14 (3,3/4,3,4,3)			4.00				
		5.00	CPT	N=18 (2,3/3,4,6,5)			5.00				
		6.00	CPT	N=36 (4,4/7,10,10,9)			6.00	15.91	6.00	Open hole boring. Driller described: BOULDERS.	
		6.50-8.00	67	48	48	130mm min 240mm avg 240mm max	6.50 100.00%	15.41	6.50	Medium strong, pale grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay smearing. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 6.5m - 8.0m: Fracture index - 9.	
							8.00	13.91	8.00	End of Borehole at 8.00 m	
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.50m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

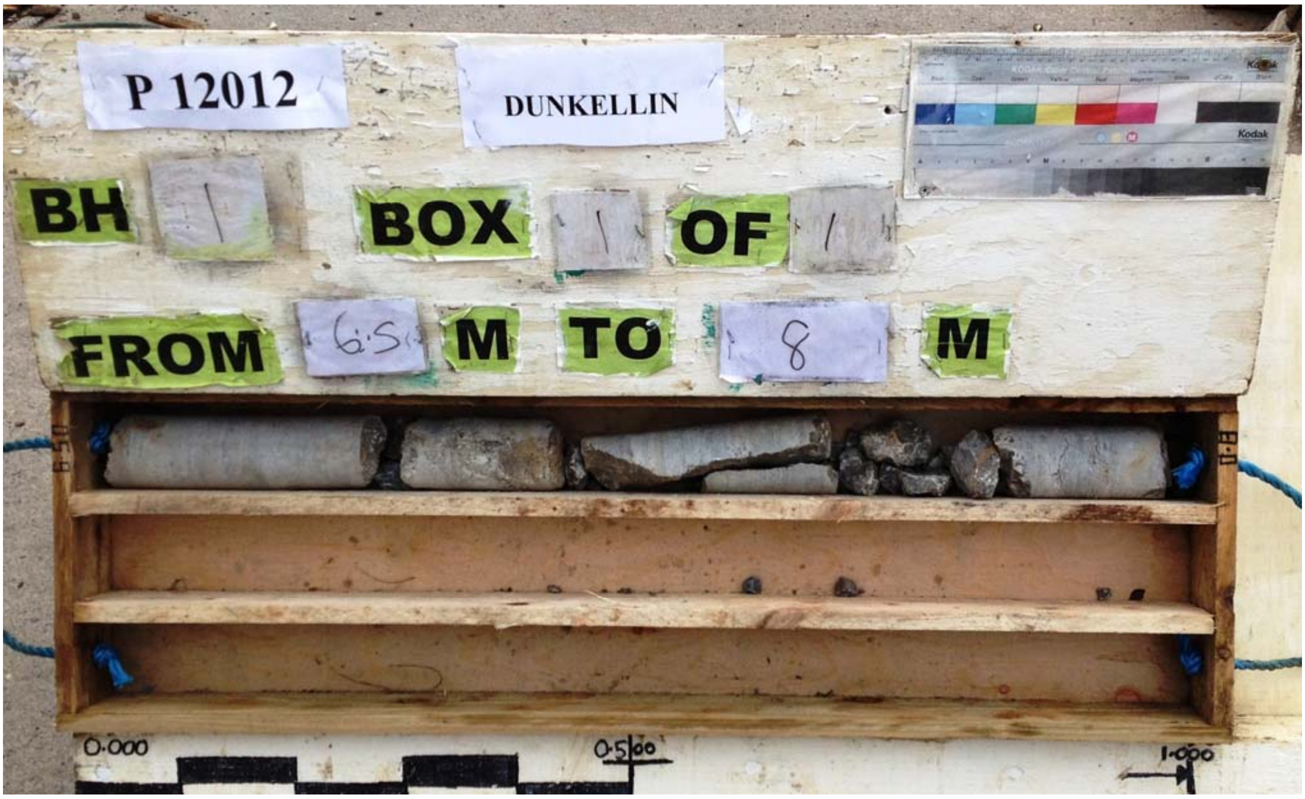
Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/07/2014	0.00m	Start of Borehole
-	03/07/2014	6.50m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record



		Project	**Dunkellin River Flood Relief Works**	
Number:	**RC01**	**Project No**	**P12012**	
		Engineer	**TOBIN**	

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Drilled By	Borehole No
AK	**RC43**
Logged By	Sheet 1 of 2

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551017E - 719951N	**Hole Type** RO
Client: Galway Co. Co.	**Dates:** 16/07/2014	**Level:** 21.91 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	**Stratum Description**	Legend
								Open hole boring. Driller described: BOULDERS.	1
						20.41	1.50	Open hole boring. Driller described: SAND with boulder content.	2
						18.91	3.00	Open hole boring. Driller described: SAND AND GRAVEL.	3 4
						17.41	4.50	Open hole boring. Driller described: Gravelly SAND with boulder content.	5
						15.91	6.00	Open hole boring. Driller described: Gravelly SAND.	6 7 8
		9.00	CPT	N=25 (5,5/6,6,7,6)	9.00	12.91	9.00		
	Water	Depth (m)	Type	Results	Casing	Level	Depth	Continued next sheet	

Groundwater:

Struck	Rose to	After	Sealed	Comment
10.20m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. See also RC01.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	16/07/2014	0.00m	Start of Borehole
8.70m	16/07/2014	15.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK

Logged By

Borehole No
RC43
Sheet 2 of 2

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 551017E - 719951N

Hole Type RO

Client: Galway Co. Co.

Dates: 16/07/2014

Level: 21.91 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type	Results					
								Open hole boring. Driller described: GRAVEL.	
	▽	10.00	CPT	N=24 (4,6/6,5,7,6)	10.00				
		11.00	CPT	N=23 (6,4/5,5,7,6)	11.00				
		12.00	CPT	N=24 (4,5/5,5,7,7)	12.00	9.91	12.00	Open hole boring. Driller described: Clayey GRAVEL.	
		13.00	CPT	N=29 (5,6/6,7,8,8)	13.00				
						8.41	13.50	Open hole boring. Driller described: GRAVEL.	
		14.00	CPT	N=22 (4,4/6,6,5,5)	14.00				
		15.00	CPT	N=27 (5,6/6,7,7,7)	15.00	6.91	15.00	End of Borehole at 15.00 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
10.20m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
15.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. See also RC01.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	16/07/2014	0.00m	Start of Borehole
8.70m	16/07/2014	15.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK	**Borehole No**	
Logged By DMC	**RC02**	Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551043E - 719989N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 04/07/2014	**Level:** 22.44 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨								Open hole boring. No recovery.	
▨		1.00	CPT	N=20 (4,4/5,5,5,5)	1.00				
▨						21.24	1.20	Open hole boring. Driller described: SAND AND GRAVEL.	⁘
▨		2.00	CPT	N=12 (1,2/2,3,3,4)	2.00				⁘
▨		3.00	CPT	N=12 (2,3/2,3,3,4)	3.00				⁘
▨		4.00	CPT	N=13 (1,2/4,3,3,3)	4.00				⁘
▨						17.94	4.50	Open hole boring. Driller described: Sandy gravelly CLAY.	⁘
▨		5.00	CPT	N=16 (2,3/3,4,5,4)	5.00				⁘
▨		6.00	CPT	N=23 (4,4/5,5,9,4)	6.00				⁘
▨					6.30 100.00%	16.14	6.30	Medium strong, pale grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay infilling. Fractures: Closely spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 6.3m - 8.0m: Fracture index - 9. 7.3m - 7.5m: Non-intact.	▦
						14.44	8.00	End of Borehole at 8.00 m	

Depth (m)	TCR	SCR	RQD	Fracture spacing
6.30-8.00	100	74	62	50mm min 140mm avg 250mm max

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.30m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/07/2014	0.00m	Start of Borehole
-	04/07/2014	6.30m	End of Borehole

Rotary Core Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**RC02**	Project No	P12012	
		Engineer	TOBIN	

PRIORITY GEOTECHNICAL	Priority Geotechnical Ltd. Tel: 021 4631600 Fax: 021 4638690 www.prioritygeotechnical.ie	**Drilled By** WD **Logged By** JMS	Borehole No **BH03** Sheet 1 of 1
Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551025E - 719974N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 30/04/2014	**Level:** 20.03 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
		0.00-0.45	B					Loose to medium dense silty very gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia.
		1.00	CPT	N=11 (2,2/3,3,3,2)	1.00			
		1.00-1.50	B					
		1.60	CPT	50 (25,25/25,25)	1.60	18.43	1.60	End of Borehole at 1.60 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.60m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.60 to 1.60	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/04/2014	0.00m	Start of Borehole
-	30/04/2014	1.60m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	AK
Logged By	DMC

Borehole No
RC03
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 551082E - 719952N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 04/07/2014	**Level:** 20.67 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Open hole boring. Driller described: GRAVEL with boulder content.	
		1.00	CPT	N=27 (4,7/6,6,7,8)	1.00				
						19.17	1.50	Open hole boring. Driller described: SAND AND GRAVEL.	
		2.00	CPT	N=14 (2,3/3,3,4,4)	2.00				
		3.00	CPT	N=19 (2,2/2,8,4,5)	3.00				
		4.00	CPT	N=19 (2,2/9,3,3,4)	4.00				
						16.17	4.50	Open hole boring. Driller described: Clayey SAND AND GRAVEL.	
		5.00	CPT	N=21 (3,4/4,5,6,6)	5.00				
		6.00	CPT	N=26 (5,4/6,6,7,7)	6.00	14.67	6.00	Open hole boring. Driller described: Sandy CLAY.	

Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	Stratum Description
						6.90 100.00%	13.77	6.90	Medium strong, grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay smearing. Fractures: Closely spaced. Fractures dip horizontally with undulating smooth surfaces. 6.9m - 7.65m: Predominantly non-intact with clay infilling. 6.9m - 8.0m: Fracture index - 4.
	6.90-8.00	100	44	14	30mm min 120mm avg 150mm max				
						8.00	12.67	8.00	End of Borehole at 8.00 m

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.90m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	04/07/2014	0.00m	Start of Borehole
-	04/07/2014	6.90m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	**RC03**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Drilled By AK

Logged By

Borehole No
RC04
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 551019E - 720064N

Hole Type RO

Client: Galway Co. Co.

Dates: 07/07/2014

Level: 22.34 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨								Inspection pit. Driller described: SAND with boulder content.	▒
▨		1.20	CPT	N=33 (5,6/8,8,7,10)	1.20	21.14	1.20	Open hole boring. Driller described: SAND with boulder content.	▒
▨		2.00	CPT	N=18 (3,3/4,5,5,4)	2.00				▒
▨		3.00	CPT	N=13 (2,2/2,3,4,4)	3.00				▒
▨		4.00	CPT	N=22 (3,3/4,5,6,7)	4.00				▒
▨		5.00	CPT	N=27 (5,7/6,6,8,7)	5.00				▒
▨		6.00	CPT	N=28 (5,6/6,7,7,8)	6.00				▒
▨		7.00	CPT	N=25 (4,5/5,7,6,7)	7.00				▒
▨		8.00	CPT	N=22 (5,4/5,6,6,5)	8.00	14.34	8.00	End of Borehole at 8.00 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	07/07/2014	0.00m	Start of Borehole
-	07/07/2014	8.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK

Logged By

Borehole No **RC05**
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 551011E - 720091N

Hole Type RO

Client: Galway Co. Co.

Dates: 07/07/2014

Level: 22.36 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type	Results					
								Inspection pit. Driller described: Bituminous surfacing over BOULDERS.	
		1.20	CPT	N=24 (4,5/5,6,7,6)	1.20	21.16	1.20	Open hole boring. Driller described: SAND AND GRAVEL with boulder content.	
		2.00	CPT	N=17 (3,4/4,3,6,4)	2.00				
		3.00	CPT	N=11 (2,2/2,3,3,3)	3.00	19.36	3.00	Open hole boring. Driller described: SAND.	
		4.00	CPT	N=10 (1,2/2,2,3,3)	4.00				
		5.00	CPT	N=7 (1,1/1,2,2,2)	5.00				
		6.00	CPT	N=8 (1,2/2,2,2,2)	6.00				
		7.00	CPT	N=12 (1,1/2,3,3,4)	7.00				
		8.00	CPT	N=12 (3,2/2,2,4,4)	8.00	14.36	8.00	End of Borehole at 8.00 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	07/07/2014	0.00m	Start of Borehole
-	07/07/2014	8.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK	**Borehole No**	
Logged By DMC	**RC06** Sheet 1 of 1	

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 550840E - 719987N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 07/07/2014	**Level:** 20.64 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing					Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type			Results					
										Open hole boring. Driller described: CLAY with boulder content.	
		1.20	CPT			N=25 (4,5/5,6,7,7)	1.20	19.44	1.20	Open hole boring. Driller described: Gravelly SAND with boulder content.	
		2.00	CPT			N=19 (3,4/4,5,5,5)	2.00				
		3.00	CPT			N=14 (2,2/2,5,3,4)	3.00	17.64	3.00	Open hole boring. Driller described: CLAY.	
		4.00	CPT			58 (5,3/4,4,25 for 1mm)	4.00				
							4.30 100.00%	16.34	4.30	BOULDERS recovered as: Medium strong, light grey Limestone.	
		4.30-6.00	26	0	0						
		6.00	CPT			(50 for 2mm)	6.00				
		6.00-7.50	67	67	67						
		7.50	CPT			(50 for 2mm)	7.50				
		7.50-8.00	50	14	0						
		8.00	CPT			(50 for 2mm)	8.00	12.64	8.00	End of Borehole at 8.00 m	
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
4.30m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	07/07/2014	0.00m	Start of Borehole
-	07/07/2014	4.30m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	**RC06**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

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Drilled By AK

Logged By

Borehole No
RC07
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 550852E - 719938N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 03/07/2014

Level: 22.03 m AOD

Scale 1:50

Water Strikes	Samples & In Situ Testing Depth (m)	Type / TCR	SCR	RQD	Results / Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
									Open hole boring. Driller described: CLAY with boulder content.
	1.00	CPT			N=42 (7,7/10,10,11,11)	1.00			
							20.53	1.50	Open hole boring. Driller described: SAND with boulder content.
	2.00	CPT			N=21 (4,5/5,6,5,5)	2.00			
	3.00	CPT			N=22 (7,3/5,7,5,5)	3.00			
	4.00	CPT			N=21 (4,4/6,5,5,5)	4.00			
	5.00	CPT			N=61 (3,5/5,6,25,25)	5.00			
						5.30	16.73	5.30	Strong, grey LIMESTONE. Weathering: Slightly weathered. Localised discolouration. Fractures: 1) Closely spaced, dipping approximately 80-90 degrees with planar rough surfaces. 2) Medium spaced, dipping approximately 30-60 degrees with planar rough surfaces. 5.3m to 6.8m: Fracture index - 7.
	5.30-6.80	97	89	78	40mm min 150mm avg 570mm max				
	6.80-8.00	100	100	86					6.8m to 8.0m: Fracture index - 9.
						8.00	14.03	8.00	End of Borehole at 8.00 m
Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.30m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/07/2014	0.00m	Start of Borehole
-	03/07/2014	5.30m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	RC07	Project No	P12012	
		Engineer	TOBIN	

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Drilled By	WD
Logged By	JMS
Borehole No	**BH08**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	550795E - 719967N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	30/04/2014
Level:	20.25 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						20.10	0.15	Topsoil.	
		0.15-1.00	B					Firm, light grey, slightly sandy, gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded. Cobbles are subrounded, 60-150mm dia.	
		1.00	CPT	N=11 (2,2/3,3,2,3)	1.00				
		1.00-1.50	B						
		1.60	CPT	50 (16,25/25,25)	1.60 1.70	18.60 18.55	1.65 1.70	Chiselled from 1.65m to 1.7m for 1 hour.	
								End of Borehole at 1.70 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.70m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.65 to 1.70	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/04/2014	0.00m	Start of Borehole
-	30/04/2014	1.70m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	AK
Logged By	
Borehole No	**RC08**
	Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 550799E - 719969N

Hole Type RO

Client: Galway Co. Co.

Dates: 08/07/2014

Level: 20.40 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Open hole boring. Driller described: SAND with boulder content.
		1.20	CPT	N=45 (7,10/11,10,14,10)	1.20			
						18.90	1.50	Open hole boring. Driller described: CLAY.
		2.00	CPT	N=18 (3,4/5,4,4,5)	2.00			
		3.00	CPT	N=21 (4,6/5,5,6,5)	3.00	17.40	3.00	Open hole boring. Driller described: Gravelly SAND with boulder content.
		4.00	CPT	N=19 (3,5/5,4,5,5)	4.00			
						15.90	4.50	Open hole boring. Driller described: CLAY with boulder content.
		5.00	CPT	N=32 (10,7/7,8,8,9)	5.00			
		6.00	CPT	N=29 (6,5/7,7,7,8)	6.00			
	▽							
		7.00	CPT	N=27 (5,5/5,7,6,9)	7.00			
		8.00	CPT	N=29 (6,7/8,7,7,7)	8.00	12.40	8.00	End of Borehole at 8.00 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
6.30m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
8.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/07/2014	0.00m	Start of Borehole
5.60m	08/07/2014	8.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK

Logged By DMC

Borehole No
RC09
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 550798E - 719931N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 02/07/2014-03/07/2014

Level: 21.23 m AOD

Scale 1:50

Samples & In Situ Testing

Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						Open hole boring. Driller described: CLAY with boulder content and wood.
1.00	CPT	N=6 (1,1/1,2,1,2)	1.00			
				19.73	1.50	Open hole boring. Driller described: CLAY with boulder content.
2.00	CPT	N=4 (1,1/1,1,1,1)	2.00			
3.00	CPT	N=74 (12,11/20,19,17,18)	3.00	18.23	3.00	Open hole boring. Driller described: CLAY with boulder content and wood.
4.00	CPT	N=60 (11,14/12,15,17,16)	4.00			
				16.73	4.50	Open hole boring. Driller described: SAND AND GRAVEL with wood.
5.00	CPT	N=11 (2,2/2,3,3,3)	5.00			
6.00	CPT	N=8 (1,2/2,2,2,2)	6.00	15.23	6.00	Open hole boring. Driller described: Sandy CLAY with boulder content.
			6.50 100.00%	14.63	6.60	Medium strong, grey LIMESTONE. Weathering: Slightly weathered. Clay smearing. Fractures: Medium spaced. Fractures dip 1) sub-horizontally with undulating smooth surfaces 2) Approximately 30-40 degrees with planar smooth surfaces. . 6.6m - 8.1m: Fracture index - 3.
			8.10	13.23	8.00	End of Borehole at 8.10 m

Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth
	6.60-8.10	100	100	100	190mm min 500mm avg 720mm max			

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
6.50m	131mm	131mm
8.10m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	02/07/2014	0.00m	Start of Borehole
-	02/07/2014	3.00m	End of shift
-	03/07/2014	3.00m	Start of shift
-	03/07/2014	6.60m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	**RC09**	**Project**	**Dunkellin River Flood Relief Works**
		Project No	**P12012**
		Engineer	**TOBIN**

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Drilled By WD

Logged By DMC

Borehole No
BH10
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 550693E - 719879N		**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 01/05/2014	**Level:** 22.22 m AOD		**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
								Topsoil.	
						21.92	0.30	COBBLES.	
						21.62	0.60	Firm, brown, slightly sandy gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, suabngular.	
		1.00	D						1
		1.20	CPT	N=12 (2,2/3,4,2,3)	1.20				
		1.20-1.70	B						
		2.00	CPT	N=8 (3,2/2,2,2,2)	2.00				2
		2.00-2.50	B						
		3.00	CPT	(25)	3.00				3
		3.00-3.30	B					Below 3.0m: Increase in cobble content (chiselled from 3.0m to 3.4m for 2.5 hrs)	
		3.40	CPT	50 (25,25/25,25)	3.40	18.82	3.40	End of Borehole at 3.40 m	
									4
									5
									6
									7
									8
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.40m	200mm	200mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
3.00	to	3.20	0030	Chisel
3.20		3.30	0100	Chisel
3.40		3.40	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/05/2014	0.00m	Start of Borehole
-	01/05/2014	3.40m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	**Logged By**	Borehole No
AK	DMC	**RC10** Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 550520E - 719855N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 08/07/2014

Level: 19.33 m AOD

Scale 1:50

Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						Open hole boring. Driller described: GRAVEL with boulder content.
1.00	CPT	N=51 (9,11/11,10,14,16)	1.00			
				17.83	1.50	Open hole boring. Driller described: CLAY with boulder content.
2.00	CPT	N=42 (7,9/9,10,12,11)	2.00			
3.00	CPT	N=21 (4,3/5,6,5,5)	3.00	16.33	3.00	Open hole boring. Driller described: CLAY.
4.00	CPT	66 (5,7/7,9,25 for 1mm)	4.00			
			4.30 100.00%	15.03	4.30	Medium strong, grey LIMESTONE. Weathering: Slightly weathered. Brown oxide staining. Clay smearing. Fractures: Medium spaced. Fractures dip approximately 20-30 degrees with undulating smooth surfaces. 4.3m - 5.2m: Fracture index - 2.
			5.20	14.13	5.20	End of Borehole at 5.20 m

Depth (m)	TCR	SCR	RQD	Fracture spacing
4.30-5.20	100	100	91	60mm min 450mm avg 460mm max

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
4.30m	131mm	131mm
5.20m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/07/2014	0.00m	Start of Borehole
-	08/07/2014	4.30m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	**RC10**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Drilled By	WD
Logged By	JMS
Borehole No	**BH11**
	Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 550539E - 719860N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 03/06/2014	**Level:** 19.29 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						19.19	0.10	Topsoil.
		0.10-0.45	B					Dark brown, slightly sandy slightly gravelly SILT with rootlets.
						18.84	0.45	Soft, brown, slightly sandy, gravelly SILT with medium cobble content and rootlets.
		1.00	D					
		1.20	CPT	N=6 (2,2/2,1,1,2)	1.20			
		1.20-1.70	B					
		1.80	D					
		2.00	CPT	N=7 (2,2/2,2,2,1)	2.00	17.29	2.00	Soft, dark brown, slightly sandy slightly gravelly SILT with low cobble content.
		2.80	D					
		3.00	CPT	50 (15,25/25,25)	3.00			
						16.19	3.10	Chiselled from 3.1m to 3.2m for 1 hour.
		3.20	CPT	25 (25,25/25)	3.20	16.09	3.20	End of Borehole at 3.20 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.20m	200mm	200mm

Chiselling:

Depths (m)			Time (hhmm)	Tool
2.50	to	2.70	0030	Chisel
3.10		3.20	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	03/06/2014	0.00m	Start of Borehole
-	03/06/2014	3.20m	End of Borehole

Equipment & Methods: Dando 2000

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Borehole No **BH42**
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 551255E - 720059N

Hole Type Cable Percussion

Client: Galway Co. Co.

Dates: 04/07/2014

Level: 19.73 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
		Depth (m)	Type	Results				
								Topsoil
						19.53	0.20	Soft to firm light brown slightly sandy gravelly SILT.
		0.50-1.00	D					
		1.00	CPT	N=8 (2,2/2,2,2,2)	1.00			
		1.00-1.50	B					
						18.23	1.50	Soft to firm light brown slightly sandy CLAY with lenses of grey sandy Silt.
		1.50-2.00	B					
		2.00	CPT	N=9 (2,3/2,2,2,3)	2.00			
		2.00-2.50	B					
		3.00	CPT	50 (17,25/25,25)	3.00			
								Chiselling 1hr. without progress 3.3m, obstruction.
		3.30	CPT	50 (20,25/25,25)	3.10	16.43	3.30	End of Borehole at 3.30 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter

Chiselling:

Depths (m)	Time (hhmm)	Tool
3.10 to 3.30	0100	chisel

Remarks: JCB required to clear entrance to field. Borehoel terminated on obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks

Equipment & Methods:

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Trial Pit No
TP01
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 551212E - 720091N **Level:** 20.92 m AOD	**Date** 15/05/2014
Location: Co Galway		**Dimensions:** 3.20m 0.80m Depth 3.00m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing							
Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				20.62	0.30	Firm, light grey, slightly gravelly slightly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-500mm dia.	▨
	0.40-1.40 0.40-1.40	B D					
						High cobble content below 1.4m.	
	1.40-2.40 1.40-2.40	B D					
				17.92	3.00	Trial pit completed at 3.00 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at required depth.

Trial Pit Photographic Record

Number:	**TP01**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP01**	**Project No**	**P12012**
		Engineer	**TOBIN**

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Trial Pit No
TP01A
Sheet 1 of 1

Project Name:	**Project No.**	**Co-ords:** 551273E - 720062N	**Date**
Dunkellin River & Aggard Stream Flood Relief Scheme	P12012	**Level:** 20.28 m AOD	04/06/2014

Location: Co Galway

Client: Galway Co Co

Dimensions: 3.00m × 6.00m
Depth
3.50m

Scale
1:25

Logged By
BG

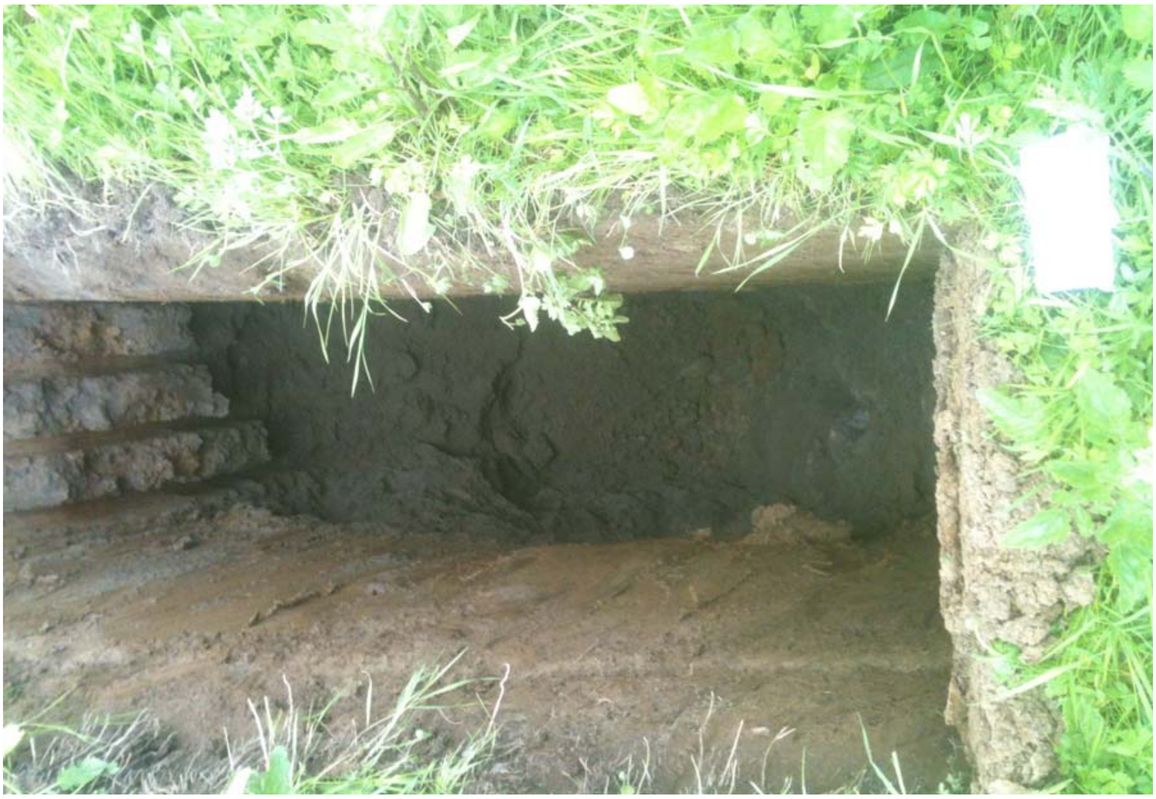
Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil soft dark brown slightly sandy slightly gravelly SILT with rootlets. Sand is fine to medium, gravel is fine.	▨	
				19.78	0.50	Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to medium, gravel is fine.	▨	
	0.50-1.50 0.50-1.50	B D						1
				18.78	1.50	Loose light grey slightly gravelly slightly sandy SILT with medium cobble and boulder content. Sand is medium, gravel is fine. Cobbles to 200mm. Boulders to 400mm	▨	
								2
	1.50-3.50 1.50-3.50	B D						
								3
				16.78	3.50	Trial pit completed at 3.50 m		
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Good
Plant: JCB
Backfill:

Groundwater:

Remarks:

Trial Pit Photographic Record



Number:	**TP01A**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP01A**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP01B
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 551235E - 720038N
Level: 20.53 m AOD

Date 04/06/2014

Location: Co Galway

Dimensions: 3.20m
Depth 2.80m
0.60m

Scale 1:25

Client: Galway Co Co

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil soft dark brown slightly sandy slightly gravelly SILT with rootlets. Sand is fine to medium.	▨	
				20.13	0.40	Loose brown slightly sandy slightly gravelly SILT. Sand is fine, Gravel is fine.	▨	
				19.53	1.00	Firm light brown-orange slightly sandy slightly gravelly CLAY. Sand is fine, gravel is fine.	▨	1
	1.00-2.00 1.00-2.00	B D						
				18.53	2.00	Loose slightly sandy slightly gravelly SILT with low cobble content and medium boulder content. Sand is medium to coarse, gravel is medium to coarse. Cobbles up to 200mm. Boulders up to 900mm.	▨	2
	2.00-2.80 2.00-2.80	B D						
				17.73	2.80	Trial pit completed at 2.80 m		
								3
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Good
Plant: JCB
Backfill:

Groundwater:

Remarks:

Trial Pit Photographic Record

Number:	TP01B	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP01B	Project No Engineer	P12012 TOBIN	

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Trial Pit No
TP01C
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 551161E - 720021N

Level: 19.25 m AOD

Date 04/06/2014

Location: Co Galway

Dimensions: 3.00m × 0.60m

Depth 2.20m

Scale 1:25

Client: Galway Co Co

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil, soft slightly sandy slightly gravelly SILT with rootlets. Sand is fine to medium	▨
				18.95	0.30	Loose light brown, slightly sandy slightly gravelly SILT. Sand is fine, Gravel is fine.	▨
	1.00-1.50 1.00-1.50	B D		18.05	1.20	Firm dark brown, slightly sandy slightly gravelly SILT. Sand is fine, Gravel is fine.	▨
	2.00-2.20 2.00-2.20	B D		17.25	2.00	Loose grey, slightly sandy slightly gravelly SILT with low cobble content and medium boulder content. Sand is medium to coarse, Gravel is medium to coarse. Cobbles up to 200mm, Boulders up to 60mm.	▨
				17.05	2.20	Trial pit completed at 2.20 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Moderate
Plant: JCB
Backfill:

Groundwater:

Remarks:

Trial Pit Photographic Record

Number:	**TP01C**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP01C	Project No Engineer	P12012 TOBIN	

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Trial Pit No
TP02
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 551132E - 720094N
Level: 20.84 m AOD

Date 13/05/2014

Location: Co Galway

Dimensions: 4.00m × 0.60m
Depth 3.00m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil: Soft, brown, slightly sandy SILT with rootlets.	▨	
				20.64	0.20	Firm, light grey/ brown, slightly gravelly slightly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-500mm dia.	▨	
	0.00-1.00 0.00-1.00	B D						
								1
▽								
	1.00-2.00 1.00-2.00	B D						
								2
				17.84	3.00	Trial pit completed at 3.00 m		3
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 1.4m.

Remarks: Trial pit terminated at required depth.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP02**	**Project No** **Engineer**	**P12012** **TOBIN**

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**TP02**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP03
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 551075E - 720107N
Level: 20.53 m AOD

Date 13/05/2014

Location: Co Galway

Dimensions: 2.80m × 0.60m
Depth 2.90m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, brown, slightly sandy SILT with rootlets.	▨
				20.33	0.20	Firm, light grey/ brown, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia.	░
	0.00-1.00 0.00-1.00	B D					
	1.00-2.00 1.00-2.00	B D					
				17.63	2.90	Trial pit completed at 2.90 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP03**	**Project**	**Dunkellin River Flood Relief Works**
		Project No	**P12012**
		Engineer	**TOBIN**

Trial Pit Photographic Record

Number:	**TP03**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Trial Pit No
TP04
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 550984E - 720048N **Level:** 20.42 m AOD	**Date** 13/05/2014
Location: Co Galway		**Dimensions:** 3.90m 0.60m Depth 2.60m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				20.22	0.20	Topsoil: Soft, brown, slightly sandy SILT with rootlets.	▨
▽	0.00-1.00 0.00-1.00 1.00-2.00 1.00-2.00	B D B D		17.82	2.60	Light blue/ grey/ brown, slightly sandy gravelly SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-350mm dia.	⊠
						Trial pit completed at 2.60 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 2.1m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works
Number:	TP04	Project No	P12012
		Engineer	TOBIN

Trial Pit Photographic Record

Number:	**TP04**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Trial Pit No
TP05
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 550966E - 720008N

Level: 20.12 m AOD

Date 13/05/2014

Location: Co Galway

Dimensions: 3.40m × 0.80m

Depth 2.40m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, brown, slightly sandy SILT with rootlets.	▨
				20.02	0.10	Light blue/ grey/ brown, slightly sandy gravelly SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-350mm dia.	▨
	0.00-1.00 0.00-1.00	B D					
	1.00-2.00 1.00-2.00	B D					
▽							
				17.72	2.40		
						Trial pit completed at 2.40 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 1.9m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**TP05**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

Number: **TP05**	**Project**	**Dunkellin River Flood Relief Works**	
	Project No **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP06
Sheet 1 of 1

Project Name:	**Project No.**	**Co-ords:**	**Date**
Dunkellin River & Aggard Stream Flood Relief Scheme	P12012	550892E - 719951N **Level:** 21.13 m AOD	07/05/2014

Location: Co Galway

Client: Galway Co Co

Dimensions: 3.30m × 0.60m
Depth 2.00m

Scale 1:25

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, brown, slightly sandy slightly gravelly SILT with rootlets. Sand is fine to medium. Gravel is fine to coarse, subangular to subrounded.	▨
				20.93	0.20	Firm, light grey, slightly gravelly slightly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-600mm dia.	▨
	0.30-1.00 0.30-1.00	B D					▨
	1.00-2.00 1.00-2.00	B D					▨
				19.13	2.00	Trial pit completed at 2.00 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Good
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP06**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

Number: TP06

Project Dunkellin River Flood Relief Works

Project No P12012
Engineer TOBIN

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Trial Pit No
TP07
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 550781E - 719921N **Level:** 21.52 m AOD	**Date** 07/05/2014
Location: Co Galway		**Dimensions:** 2.50m 0.60m Depth 3.00m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level	Depth		
Water	Depth (m)	Type	Results	(m AOD)	(m)	**Stratum Description**	Legend
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				21.42	0.10	Firm, light grey/ brown, slightly sandy gravelly CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular, 200-600mm dia.	▒
	1.00-2.00 1.00-2.00	B D					▒
				19.32	2.20	Firm, light grey/ brown, slightly sandy gravelly CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-350mm dia.	▒
	2.00-3.00 2.00-3.00	B D					▒
				18.52	3.00	Trial pit completed at 3.00 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP07**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

Number:	**TP07**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Trial Pit No
TP08
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 550573E - 719873N
Level: 19.27 m AOD

Date 13/05/2014

Location: Co Galway

Dimensions: 3.40m × 0.80m
Depth 2.90m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				18.97	0.30	Topsoil: Soft, brown, slightly sandy SILT with rootlets.	▨
	0.20-1.00 0.20-1.00	B D		16.37	2.90	Soft, light grey/ brown, slightly gravelly slightly sandy SILT with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-700mm dia.	▨
	1.00-2.00 1.00-2.00	B D					
▽							
						Trial pit completed at 2.90 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 2.1m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP08**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP08**	**Project No**	**P12012**
		Engineer	**TOBIN**

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Trial Pit No
TP09
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 550531E - 719856N
Level: 19.40 m AOD

Date 13/05/2014

Location: Co Galway

Dimensions: 2.20m × 0.80m
Depth 2.10m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description
Water	Depth (m)	Type	Results			
						Topsoil: Soft, brown, slightly sandy SILT with rootlets.
				19.25	0.15	Soft, light brown, slightly sandy gravelly SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-600mm dia.
	0.15-1.00 0.15-1.00	B D				
	1.00-2.00 1.00-2.00	B D				
				17.30	2.10	Trial pit completed at 2.10 m
Water	Depth (m)	Type	Results	Level	Depth	

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

		Project	Dunkellin River Flood Relief Works	
Number:	**TP09**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

Number:	**TP09**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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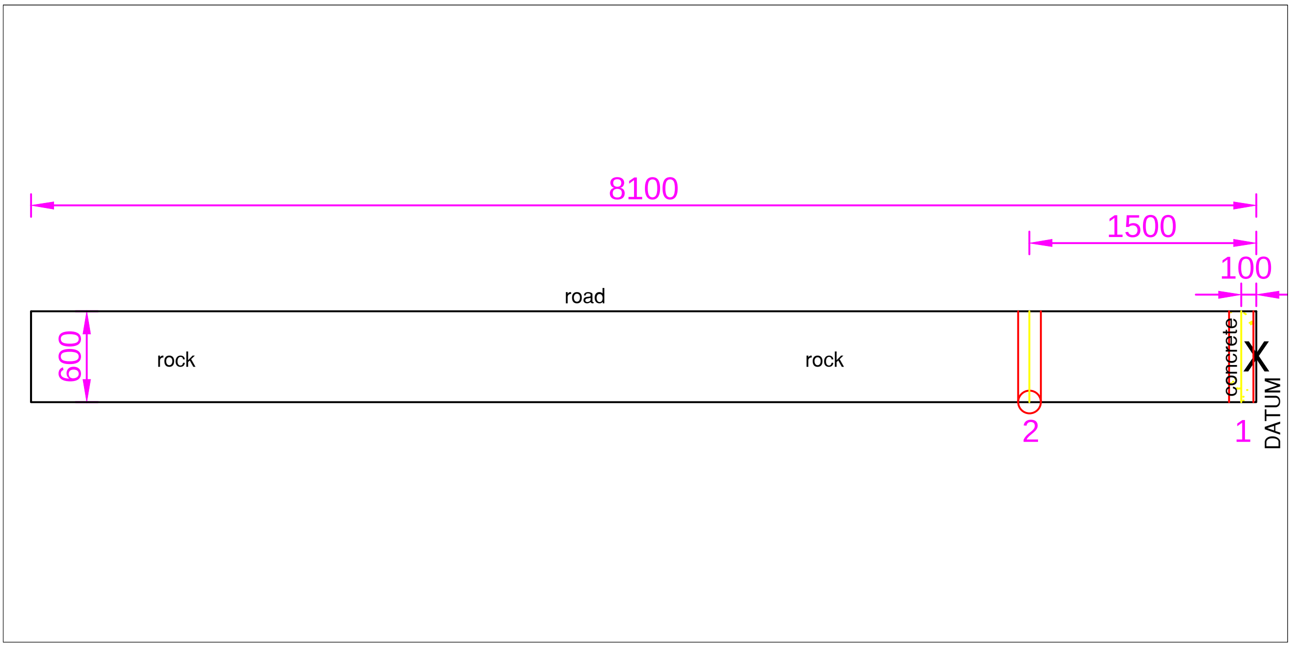
Slit Trench No
ST01
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 551068E - 719951N **Level:** 22.73 m AOD	**Date** 02/07/2014
Location: Co Galway		**Dimensions:** 8.10m 0.60m **Depth:** 2.45m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

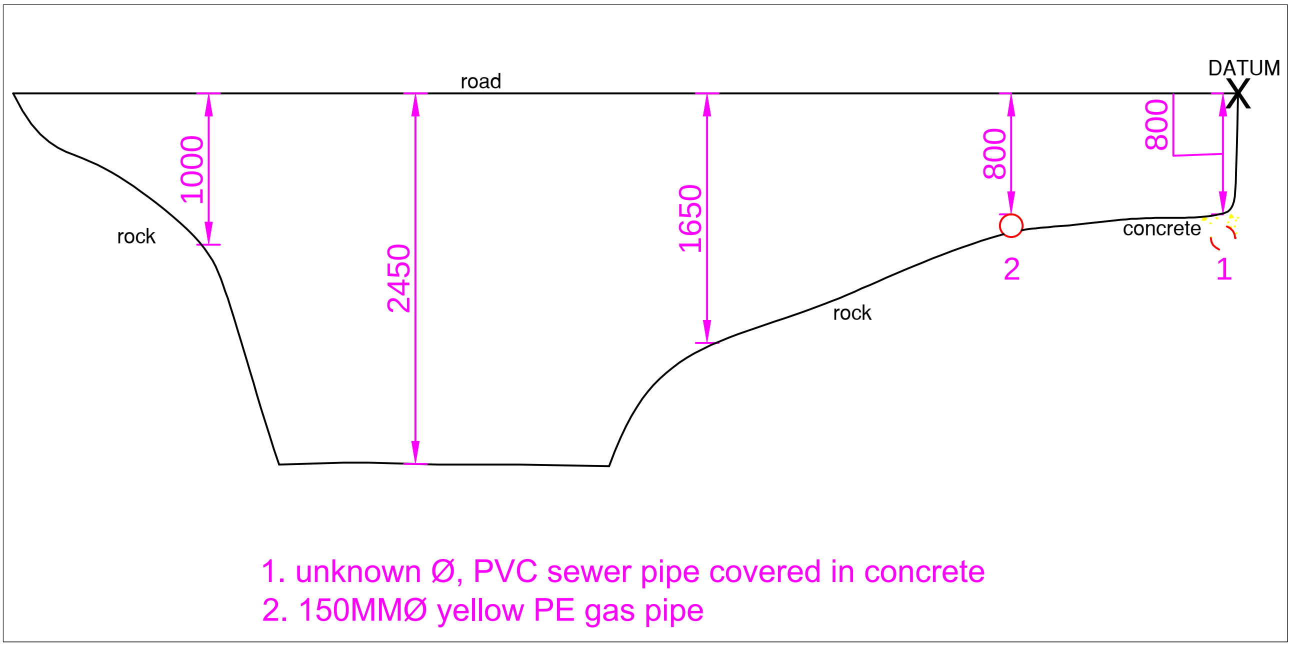
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.10	22.63		Hot Rolled Asphalt.
0.00-1.00	B					Fill: Grey/ brown, slightly gravelly silty SAND with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subronded, 60-200mm dia. Boulders are subangular to subrounded, 200-350mm dia.
1.00-1.75	B		1.75	20.98		
1.75-2.45	B		2.45	20.28		Light brown, slightly gravelly slightly silty SAND with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular ot subrounded, 60-200mm dia.
						Slit Trench Complete at 2.45 m

Remarks: See detailed section for utility information.

Groundwater: None encountered

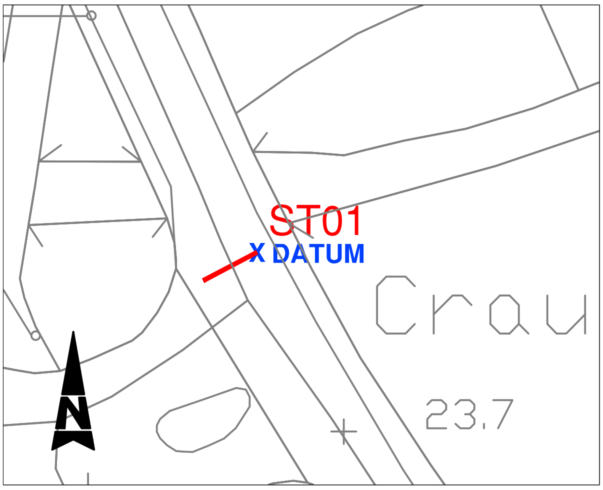


SLIT TRENCH PLAN, 1:90 ON A4



1. unknown Ø, PVC sewer pipe covered in concrete
2. 150MMØ yellow PE gas pipe

SLIT TRENCH SECTION, 1:50 ON A4



SLIT TRENCH LOCATION PLAN, 1:1000 ON A4

DATUM COORDINATES:

EASTING:	551067.8
NORTHING:	719950.9
LEVEL:	22.727mAOD

KEY:

DATUM: X

SLIT TRENCH DIMENSIONS:

LENGTH:	8.10m
WIDTH:	0.60m
DEPTH:	2.45m

STRATA SHOWN ON DETAILED LOG

DRAWN BY: Gary Curtin		DATE: 04/07/2014
LOGGED BY: I.D.		DATE: 02/07/2014
SCALE: AS STATED	APPROVED: GH	REVISION: F01

SLIT TRENCH NUMBER:

ST01

JOB NAME:

DUNKELLIN RIVER
FLOOD RELIEF
WORKS

JOB NUMBER:

P12012

DRAWING NUMBER:

P12012-ST01

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Slit Trench Photographic Record

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ST 1

Dunkillen
ST 1

Number:	**ST01**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

Slit Trench Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**ST01**	**Project No** **Engineer**	**P12012** **TOBIN**	

Slit Trench No

ST02

Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 551048E - 719993N

Level: 22.14 m AOD

Date 02/07/2014

Location: Co Galway

Dimensions: 7.30m × 0.60m

Depth: 1.60m

Scale 1:25

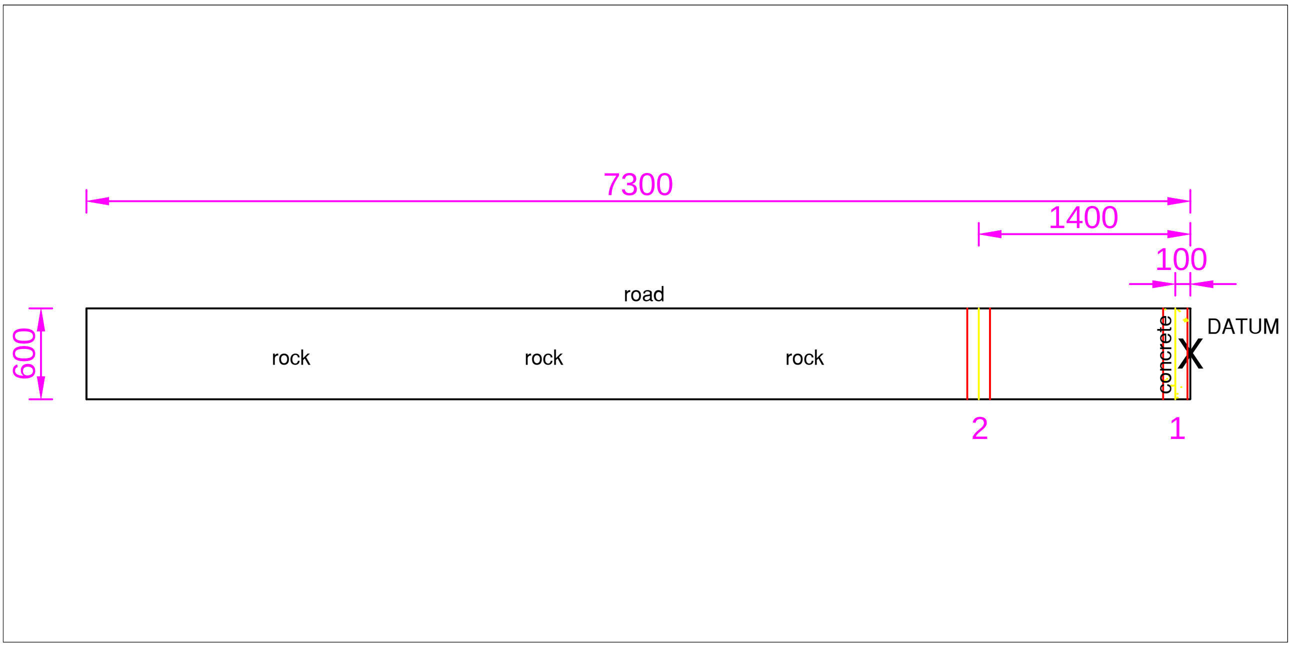
Client: Galway Co Co

Logged By ID

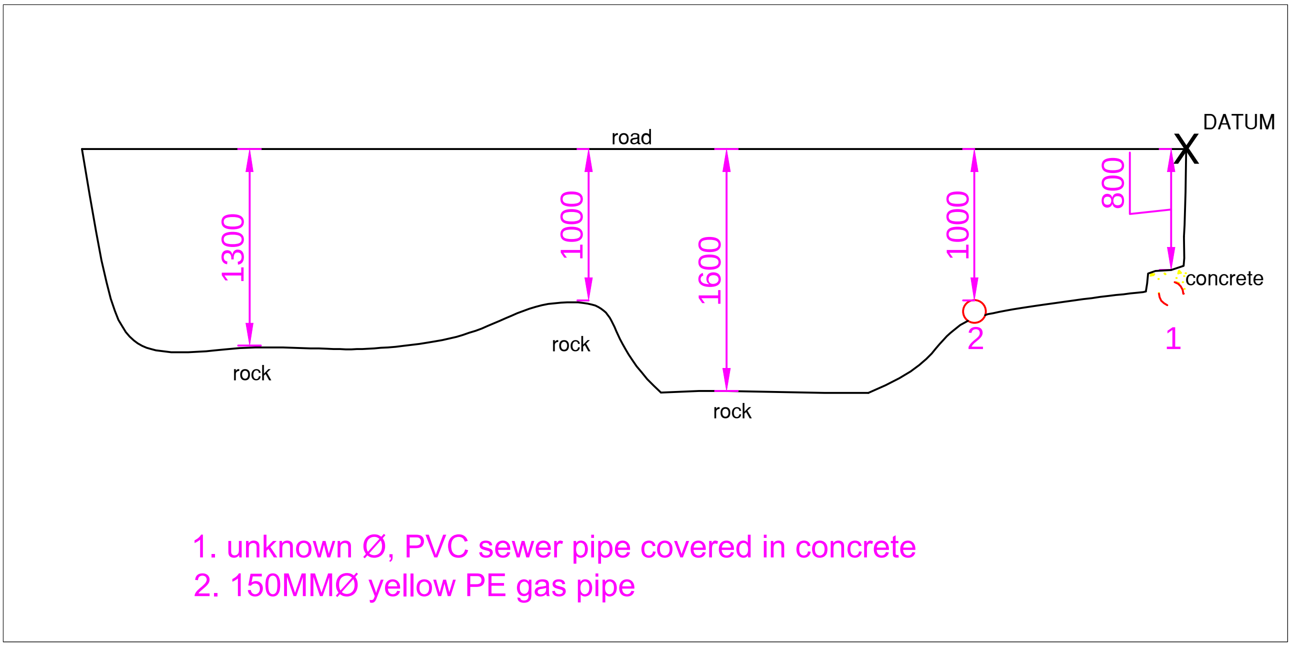
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						Hot Rolled Asphalt.
			0.10	22.04		Fill: Grey/ brown, slightly gravelly slightly silty SAND with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subronded, 60-200mm dia. Boulders are subangular to subrounded, 200-350mm dia.
			0.70	21.44		Light brown/ grey, slightly gravelly slightly silty SAND with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular ot subrounded, 60-200mm dia.
0.70-1.60	B					
			1.60	20.54		Slit Trench Complete at 1.60 m

Remarks: See detailed section for utility information.

Groundwater: None encountered

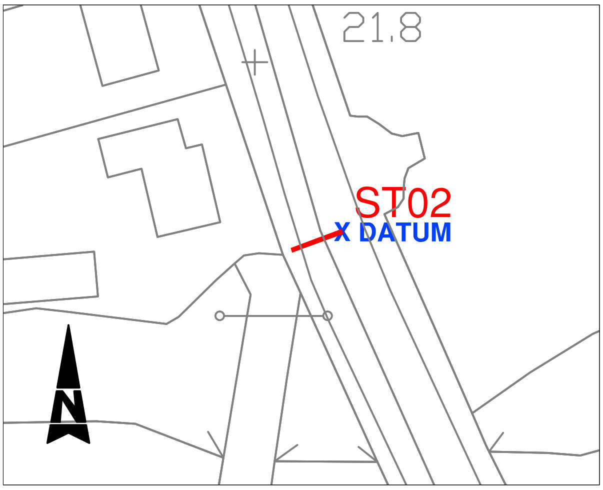


SLIT TRENCH PLAN, 1:50 ON A4



1. unknown Ø, PVC sewer pipe covered in concrete
2. 150MMØ yellow PE gas pipe

SLIT TRENCH SECTION, 1:50 ON A4



SLIT TRENCH LOCATION PLAN, 1:1000 ON A4

DATUM COORDINATES:

EASTING:	551047.9
NORTHING:	719993.3
LEVEL:	22.136mAOD

KEY:

DATUM: X

SLIT TRENCH DIMENSIONS:

LENGTH:	7.30m
WIDTH:	0.60m
DEPTH:	1.60m

STRATA SHOWN ON DETAILED LOG

DRAWN BY: Gary Curtin	DATE: 04/07/2014
LOGGED BY: I.D.	DATE: 02/07/2014

SCALE:	APPROVED:	REVISION:
AS STATED	GH	F01

SLIT TRENCH NUMBER:

ST02

JOB NAME:

DUNKELLIN RIVER
FLOOD RELIEF
WORKS

JOB NUMBER:

P12012

DRAWING NUMBER:

P12012-ST02

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Slit Trench Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**ST02**	**Project No** **Engineer**	**P12012** **TOBIN**

Slit Trench Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**ST02**	**Project No** **Engineer**	**P12012** **TOBIN**	

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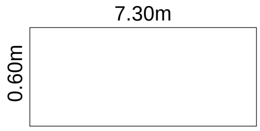
Slit Trench No

ST03

Sheet 1 of 1

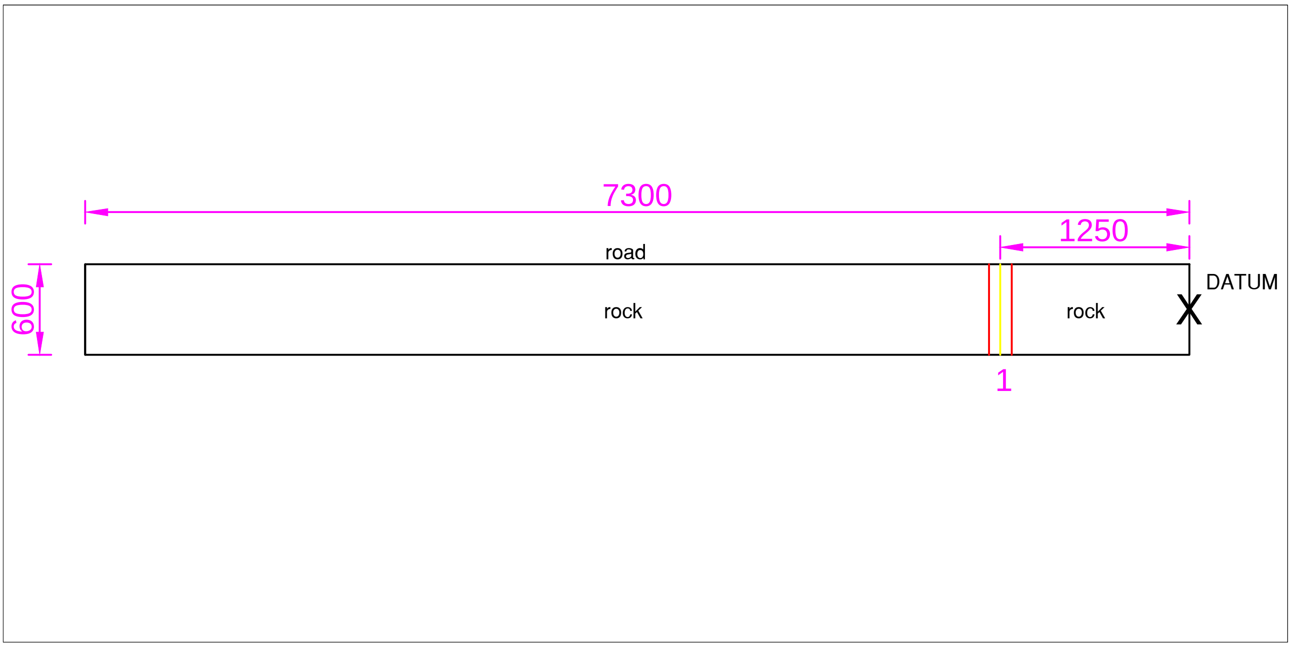
Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 551026E - 720060N **Level:** 22.10 m AOD	**Date** 02/07/2014
Location: Co Galway		**Dimensions:** **Depth:** 2.70m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID



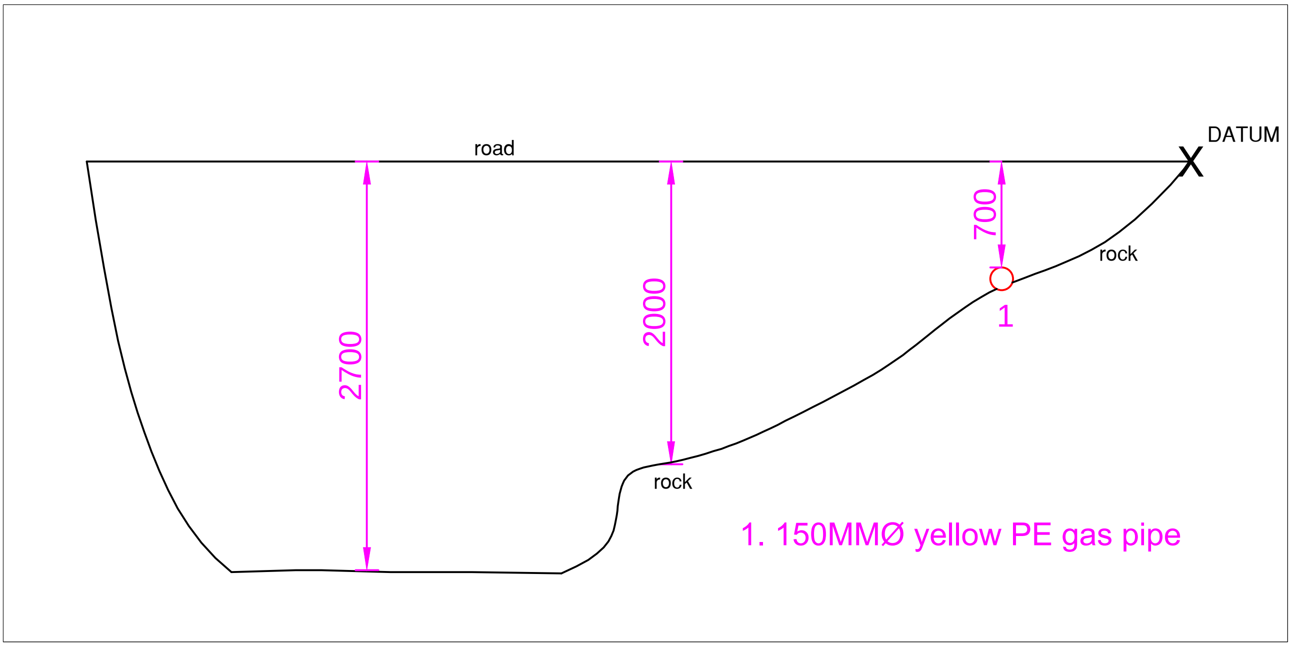
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.10	22.00	▨	Hot Rolled Asphalt.
0.00-1.00	B		0.80	21.30	▨	Fill: Grey/ brown, slightly gravelly slightly silty SAND with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subronded, 60-200mm dia.
			1.10	21.00	▨	Brown, slightly gravelly slightly sandy SILT with occasional rootlets. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.
1.00-2.00	B		2.90	19.20	▨	Light grey/ brown, slightly gravelly sandy SILT with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular ot subrounded, 60-200mm dia.
						Slit Trench Complete at 2.70 m

Remarks: See detailed section for utility information.

Groundwater: None encountered

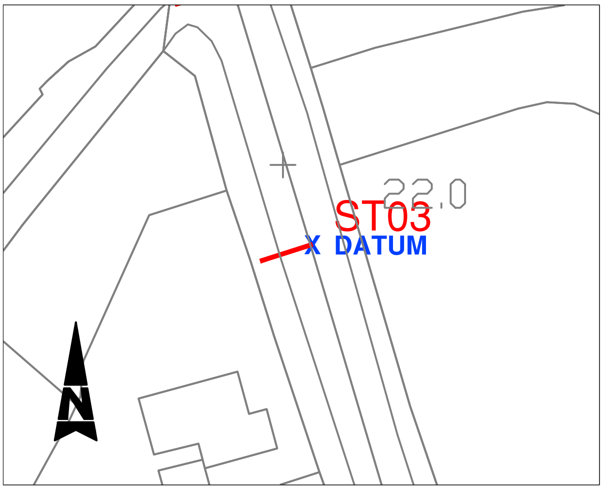


SLIT TRENCH PLAN, 1:50 ON A4



1. 150MMØ yellow PE gas pipe

SLIT TRENCH SECTION, 1:50 ON A4



SLIT TRENCH LOCATION PLAN, 1:1000 ON A4

DATUM COORDINATES:

EASTING:	551025.9
NORTHING:	720059.7
LEVEL:	22.099mAOD

KEY:

DATUM: X

SLIT TRENCH DIMENSIONS:

LENGTH:	7.30m
WIDTH:	0.60m
DEPTH:	2.70m

STRATA SHOWN ON DETAILED LOG

DRAWN BY: Gary Curtin		DATE: 04/07/2014
LOGGED BY: I.D.		DATE: 02/07/2014
SCALE: AS STATED	APPROVED: GH	REVISION: F01

SLIT TRENCH NUMBER:

ST03

JOB NAME:

DUNKELLIN RIVER FLOOD RELIEF WORKS

JOB NUMBER:

P12012

DRAWING NUMBER:

P12012-ST03

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Slit Trench Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**ST03**	**Project No** **Engineer**	**P12012** **TOBIN**	

Slit Trench Photographic Record

Number:	**ST03**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Slit Trench No
ST04
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 551015E - 720094N

Level: 22.39 m AOD

Date 02/07/2014

Location: Co Galway

Dimensions: 7.90m × 0.60m

Depth: 2.90m

Scale 1:25

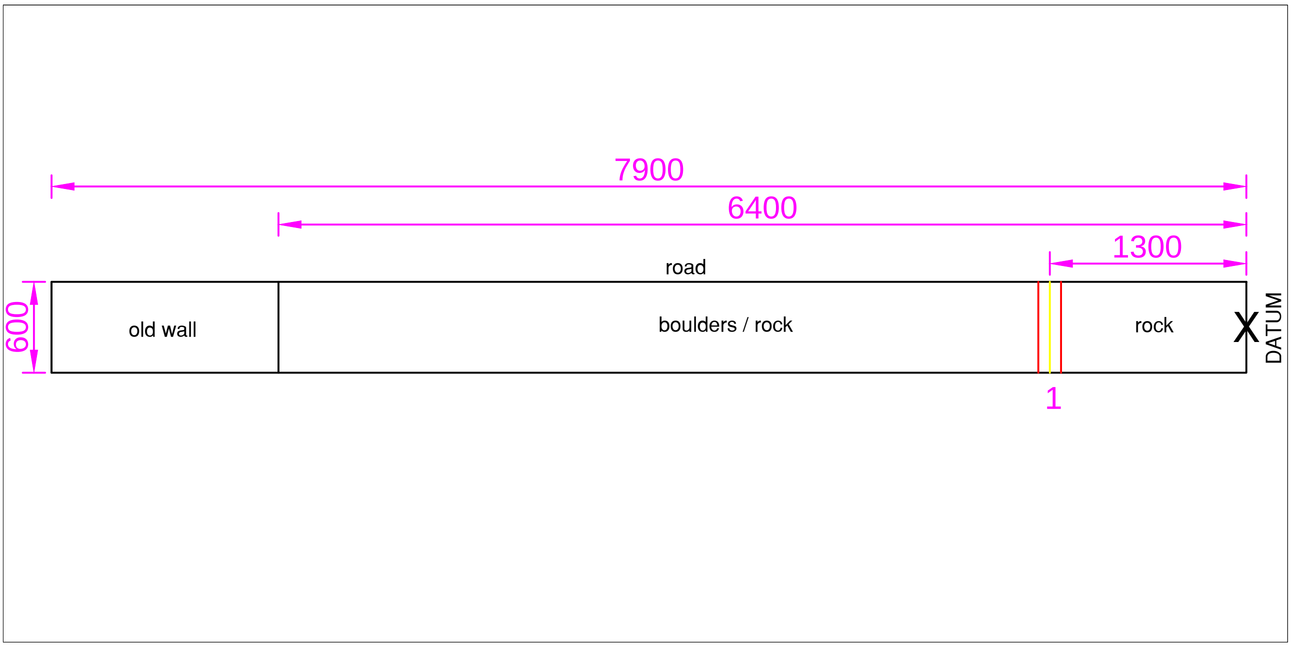
Client: Galway Co Co

Logged By ID

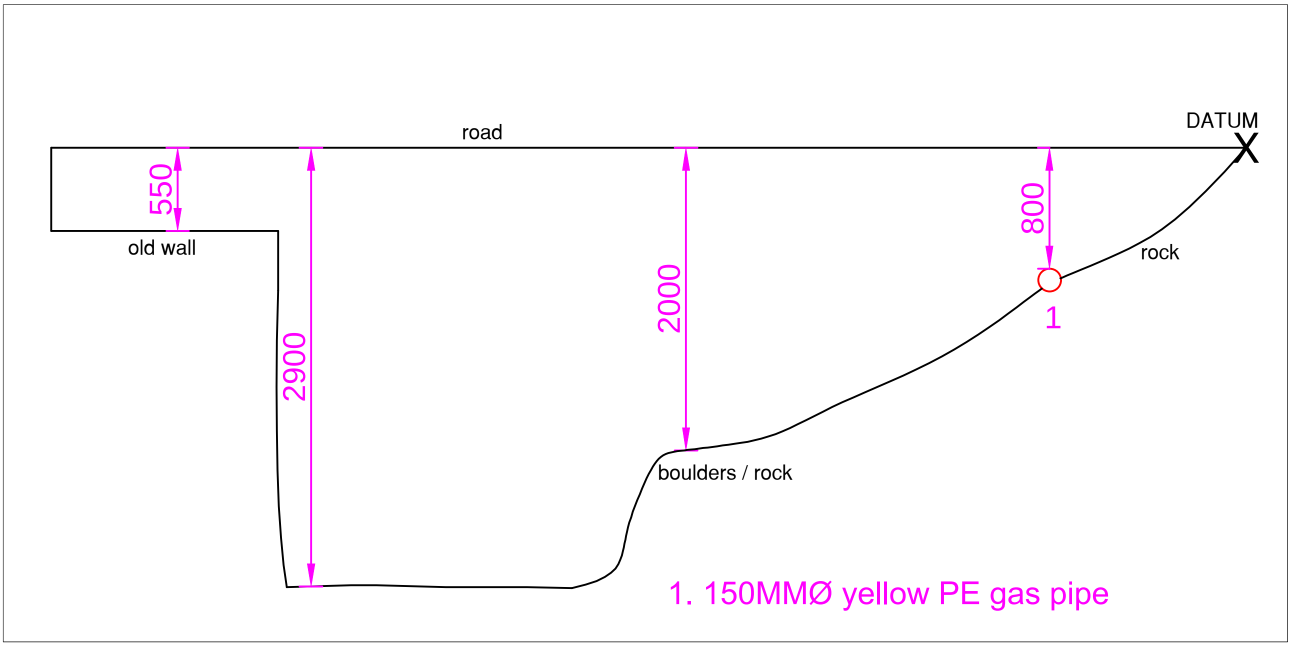
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.10	22.29	▓	Hot Rolled Asphalt.
0.00-1.00	B		1.20	21.19	▨	Fill: Grey/ brown, slightly gravelly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subronded, 60-200mm dia. Boulders are subangular ot subrounded, 200-450mm dia.
1.00-2.00	B		2.90	19.49	░	Brown/ grey, slightly gravelly slightly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular ot subrounded, 60-200mm dia.
						Slit Trench Complete at 2.90 m

Remarks: See detailed section for utility information.

Groundwater: None encountered

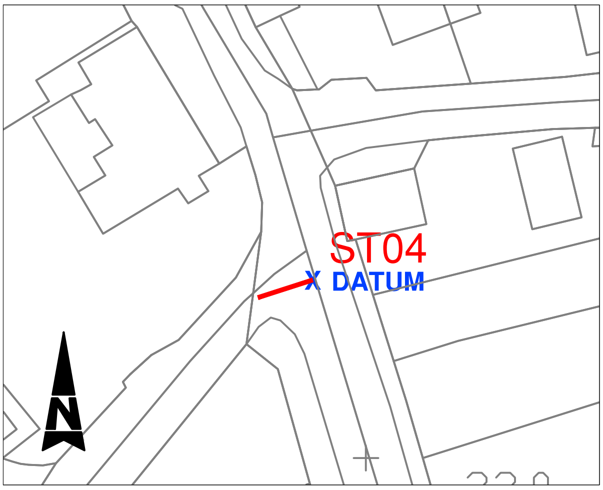


SLIT TRENCH PLAN, 1:50 ON A4



1. 150MMØ yellow PE gas pipe

SLIT TRENCH SECTION, 1:50 ON A4



SLIT TRENCH LOCATION PLAN, 1:1000 ON A4

DATUM COORDINATES:

EASTING:	551015.0
NORTHING:	720093.8
LEVEL:	22.394mAOD

KEY:

DATUM: X

SLIT TRENCH DIMENSIONS:

LENGTH:	7.90m
WIDTH:	0.60m
DEPTH:	2.90m

STRATA SHOWN ON DETAILED LOG

DRAWN BY: Gary Curtin		DATE: 04/07/2014
LOGGED BY: I.D.		DATE: 02/07/2014
SCALE: AS STATED	APPROVED: GH	REVISION: F01

SLIT TRENCH NUMBER:

ST04

JOB NAME:

DUNKELLIN RIVER
FLOOD RELIEF
WORKS

JOB NUMBER:

P12012

DRAWING NUMBER:

P12012-ST04

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Slit Trench Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**ST04**	**Project No** **Engineer**	**P12012** **TOBIN**

Slit Trench Photographic Record

Number:	**ST04**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Slit Trench No

ST05

Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 544147E - 718475N

Level: 12.14 m AOD

Date 03/07/2014

Location: Co Galway

Dimensions: 6.00m

0.60m

Depth: 2.00m

Scale 1:25

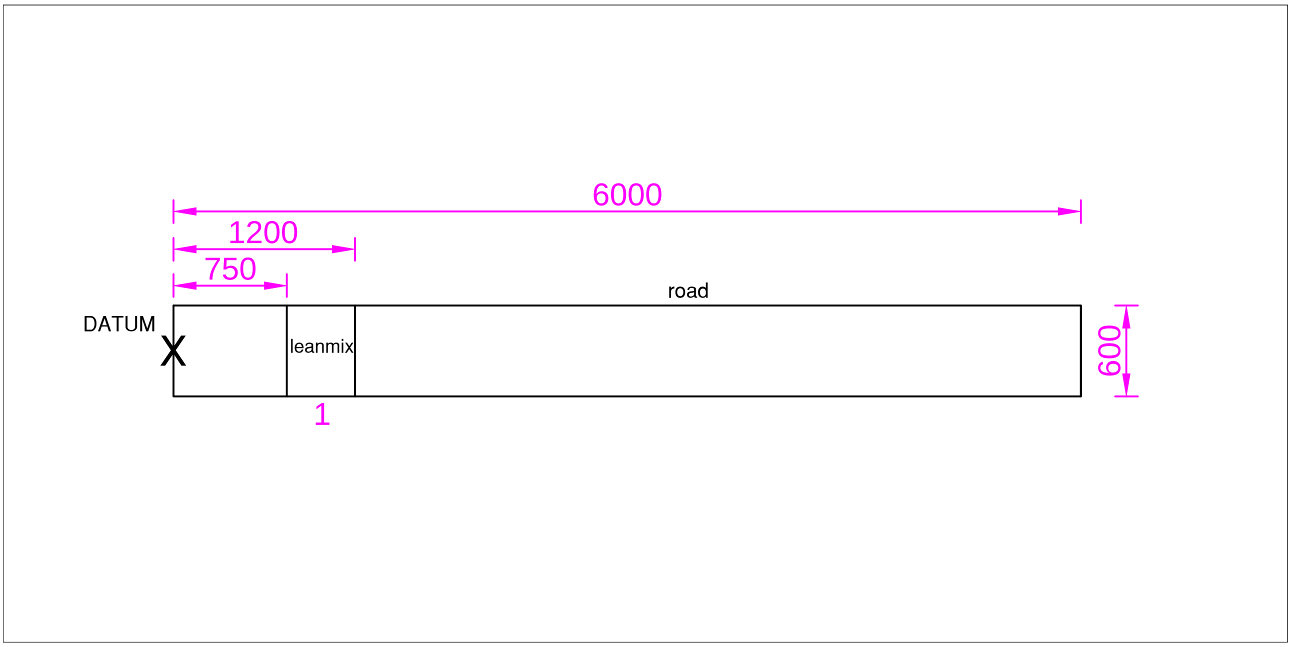
Client: Galway Co Co

Logged By ID

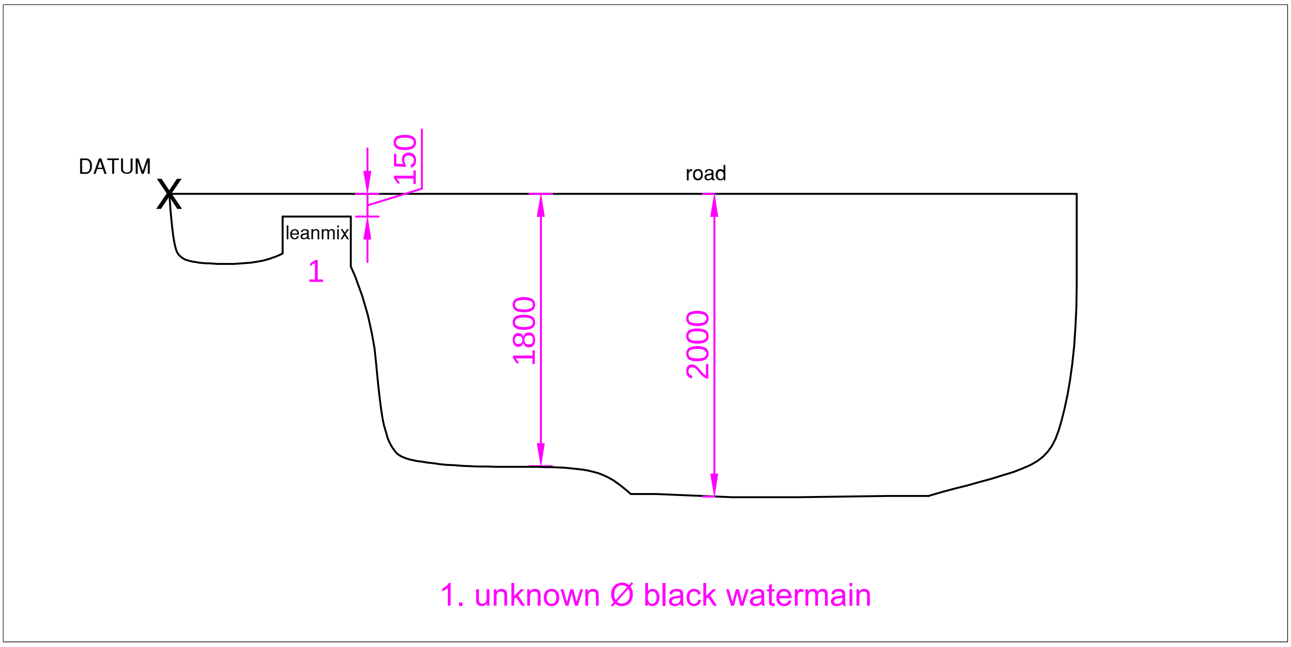
Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.10	12.04		Hot Rolled Asphalt.
			0.17	11.97		Clause 804 sub-base.
			0.19	11.95		Surface dressing.
			0.30	11.84		Clause 804 sub-base.
0.00-1.00	B					Light brown, slightly gravelly slightly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to
1.00-1.80	B					
			2.00	10.14		Slit Trench Complete at 2.00 m

Remarks: See detailed section for utility information.

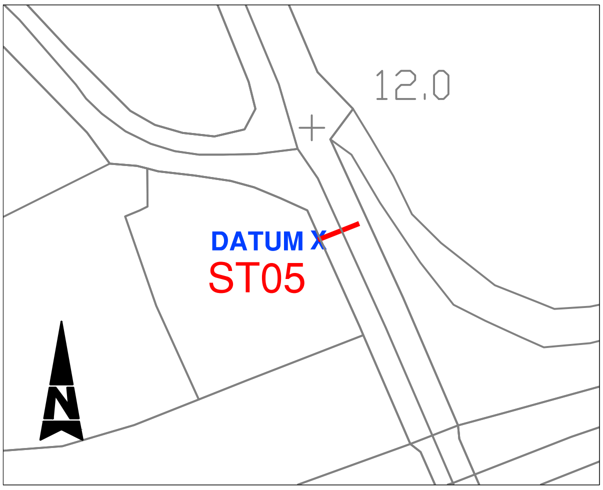
Groundwater: None encountered



SLIT TRENCH PLAN, 1:50 ON A4



SLIT TRENCH SECTION, 1:50 ON A4



SLIT TRENCH LOCATION PLAN, 1:1000 ON A4

DATUM COORDINATES:

EASTING:	544147.0
NORTHING:	718475.3
LEVEL:	12.138mAOD

KEY:

DATUM: X

SLIT TRENCH DIMENSIONS:

LENGTH:	6.00m
WIDTH:	0.60m
DEPTH:	2.00m

STRATA SHOWN ON DETAILED LOG

DRAWN BY: Gary Curtin		DATE: 04/07/2014
LOGGED BY: I.D.		DATE: 03/07/2014
SCALE: AS STATED	APPROVED: GH	REVISION: F01

SLIT TRENCH NUMBER:

ST05

JOB NAME:

DUNKELLIN RIVER
FLOOD RELIEF
WORKS

JOB NUMBER:

P12012

DRAWING NUMBER:

P12012-ST05

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Slit Trench Photographic Record

Number:	**ST05**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

Slit Trench Photographic Record

		Project	Dunkellin River Flood Relief Works
Number:	ST05	Project No	P12012
		Engineer	TOBIN

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Slit Trench No
ST06
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 544188E - 718382N

Level: 11.67 m AOD

Date 03/07/2014

Location: Co Galway

Dimensions: 6.50m × 0.60m

Depth: 2.00m

Scale 1:25

Client: Galway Co Co

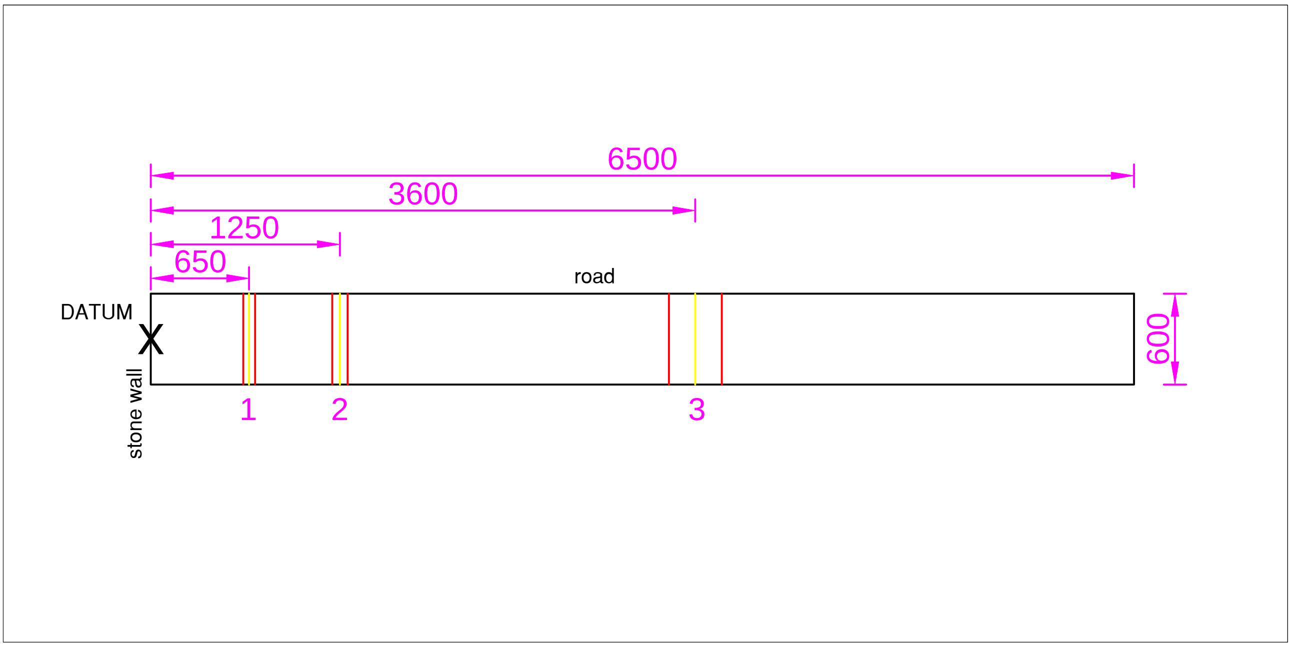
Logged By ID

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.10	11.57		Hot Rolled Asphalt.
			0.15	11.52		Clause 804 sub-base.
			0.17	11.50		Surface dressing.
			0.40	11.27		Clause 804 sub-base.
0.00-1.00	B					Light brown, slightly gravelly slightly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to
1.00-2.00	B					
			2.00	9.67		

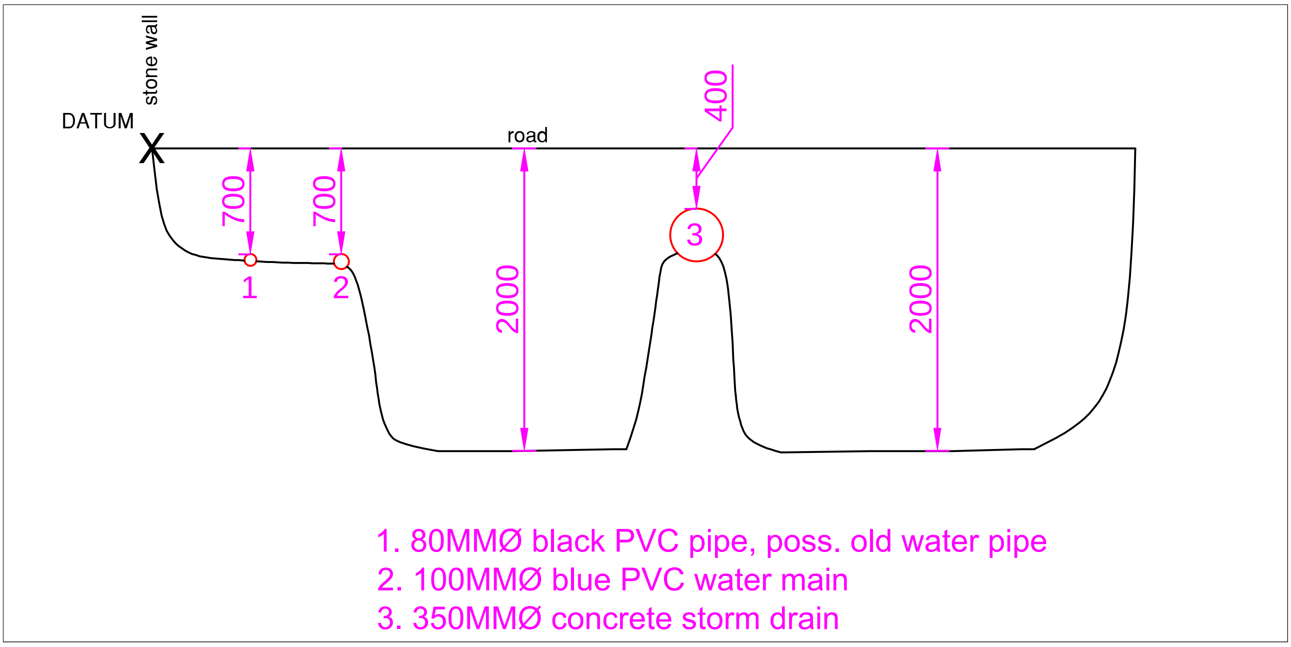
Slit Trench Complete at 2.00 m

Remarks: See detailed section for utility information.

Groundwater: None encountered

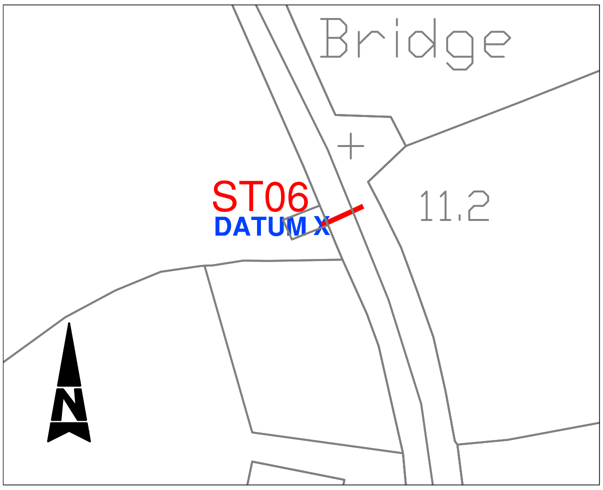


SLIT TRENCH PLAN, 1:50 ON A4



1. 80MMØ black PVC pipe, poss. old water pipe
2. 100MMØ blue PVC water main
3. 350MMØ concrete storm drain

SLIT TRENCH SECTION, 1:50 ON A4



SLIT TRENCH LOCATION PLAN, 1:1000 ON A4

DATUM COORDINATES:
EASTING: 544187.6
NORTHING: 718382.0
LEVEL: 11.674mAOD

KEY:
DATUM: X

SLIT TRENCH DIMENSIONS:
LENGTH: 6.50m
WIDTH: 0.60m
DEPTH: 2.00m

STRATA SHOWN ON DETAILED LOG

DRAWN BY: Gary Curtin	DATE: 04/07/2014
LOGGED BY: I.D.	DATE: 03/07/2014

SCALE: AS STATED	APPROVED: GH	REVISION: F01

SLIT TRENCH NUMBER:
ST06

JOB NAME:
DUNKELLIN RIVER
FLOOD RELIEF
WORKS

JOB NUMBER:
P12012

DRAWING NUMBER:
P12012-ST06

pgl priority geotechnical

Slit Trench Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**ST06**	**Project No**	**P12012**
		Engineer	**TOBIN**

Slit Trench Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**ST06**	**Project No**	**P12012**
		Engineer	**TOBIN**

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Drilled By PC	**Logged By** JMS	Borehole No **BH16** Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 545680E - 718512N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 01/05/2014	**Level:** 16.24 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨						16.04	0.20	Topsoil.	▨
▨		0.20-1.00	B					Brown/ grey, slightly sandy gravelly SILT with medium cobble content, low boulder content and rootlets. Sand is fine to coarse. Gravel is fine to coarse, subangular to rounded. Cobbles are subangular to rounded, 60-150mm dia. Boulders are 200-220mm dia, Limestone.	▨
▨		1.00	CPT	(10,25/50 for 0mm)	1.00	15.14	1.10		
		1.20	CPT	(50 for 0mm)	1.20	15.04	1.20	Chiselled from 1.1m to 1.2m for 1 hour.	
								End of Borehole at 1.20 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

1
2
3
4
5
6
7
8

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.20m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.10 to 1.20	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Equipment & Methods: Dando 2000

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/05/2014	0.00m	Start of Borehole
-	01/05/2014	1.20m	End of Borehole

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Drilled By	WD
Logged By	
Borehole No	**BH17**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	545759E - 718663N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	29/05/2014
Level:	17.68 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨								Grey, gravelly CLAY.	▨
		0.80	CPT	50 (25,25/25,25)	0.80	16.88	0.80		
								End of Borehole at 0.80 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.80m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.80 to 0.80	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/05/2014	0.00m	Start of Borehole
-	29/05/2014	0.80m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By WD	**Logged By** JMS	Borehole No **BH18** Sheet 1 of 1
Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 545945E - 718740N
Hole Type Cable Percussion	**Client:** Galway Co. Co.	**Dates:** 30/05/2014
Level: 17.05 m AOD	**Scale** 1:50	

Well / Backfill	Water Strikes	Samples & In Situ Testing			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type	Results					
						16.95	0.10	Topsoil.	
								Brown, slightly sandy SILT with medium cobble content and many rootlets.	
		0.10-1.00	B						
		1.00	CPT	N=10 (2,3/3,2,2,3)	1.00	16.05	1.00	Firm, brown, slightly sandy gravelly SILT with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to rounded. Cobbles are subangular, 60-200mm dia.	
		1.00-1.45	B						
		1.80	D						
		2.00	CPT	N=8 (3,3/2,2,2,2)	2.00				
		2.50	CPT	75 (15,17/25,25,25)	2.50	14.55	2.50	Chiselled from 2.5m to 2.54m for 1 hour.	
		2.54	CPT	50 (25,25/25,25)	2.54	14.51	2.54	End of Borehole at 2.54 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.54m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
2.50 to 2.54	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/05/2014	0.00m	Start of Borehole
-	30/05/2014	2.54m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By WD

Logged By

Borehole No
BH22
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 544643E - 718674N

Hole Type Cable Percussion

Client: Galway Co. Co.

Dates: 26/05/2014

Level: 12.15 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨		0.10-0.75	B					Brown, slightly sandy SILT with occasional rootlets and some lenses or orange/brown clay.	▨
		0.78	CPT	50 (19,25/25,25,- for 0mm)	0.80	11.45	0.70		
								End of Borehole at 0.80 m	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.80m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.75 to 0.80	0100	Chisel

Remarks: Borehole terminated at 0.8m

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	26/05/2014	0.00m	Start of Borehole
-	26/05/2014	0.80m	End of Borehole

Equipment & Methods: Dando 2000

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Logged By JMS

Borehole No **BH23**
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 544376E - 718517N

Hole Type Cable Percussion

Client: Galway Co. Co.

Dates: 01/05/2014

Level: 11.77 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type	Results					
▨		0.00-0.65	B			11.52	0.25	Topsoil.	▨
▨		0.65	CPT	(25,50 for 0mm)	0.65	11.12	0.65	Orange/ brown, slightly sandy slightly gravelly CLAY with rootlets. Sand is fine to coarse. Gravel is fine to coarse, subangular to rounded.	▨
					0.70	11.07	0.70	Chiselled from 0.65m to 0.7m for 1 hour.	
		0.90	CPT	(50 for 0mm)	0.90			End of Borehole at 0.70 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.70m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.65 to 0.70	0100	Chisel

Remarks: Borehole terminated due to obstruction. Relocated to BH23A.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/05/2014	0.00m	Start of Borehole
-	01/05/2014	0.70m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	WD
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Borehole No	**BH23A**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	544377E - 718518N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	30/05/2014
Level:	11.77 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						11.67	0.10	Topsoil.
								Orange/ firm, slightly sandy CLAY. Sand is fine to coarse.
		0.90	D					
		1.00	CPT	N=7 (2,2/2,2,2,1)	1.00			
		1.00-1.50	B					
		2.00	CPT	75 (5,7/25,25,25)	2.00			
						9.47	2.30	Chiselled from 2.3m to 2.4m for 1 hour.
		2.40	CPT	50 (25,25/25,25)	2.40	9.37	2.40	End of Borehole at 2.40 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.40m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
2.30 to 2.40	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/05/2014	0.00m	Start of Borehole
-	30/05/2014	2.40m	End of Borehole

Equipment & Methods: Dando 2000

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Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 544270E - 718467N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 29/04/2014	**Level:** 10.06 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type	Results					
▨						9.96	0.10	Topsoil.	▨
		0.35	CPT	50 (25,25/25,25)	0.35	9.71	0.35	Sandy GRAVEL.	░
					0.36	9.70	0.36	Chiselled from 0.35m to 0.36m for 1 hour.	
								End of Borehole at 0.36 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.36m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.35 to 0.36	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Equipment & Methods: Dando 2000

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/04/2014	0.00m	Start of Borehole
-	29/04/2014	0.36m	End of Borehole

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Drilled By	WD
Logged By	
Borehole No	**BH27** Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 544182E - 718433N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 29/04/2014	**Level:** 9.72 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						9.62	0.10	Topsoil.	
		0.40	CPT	50 (25,25/25,25)	0.40	9.32	0.40	Sandy gravelly CLAY.	
					0.41	9.31	0.41	Chiselled from 0.4m to 0.41m for 1 hour.	
								End of Borehole at 0.41 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.41m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.40 to 0.41	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/04/2014	0.00m	Start of Borehole
-	29/04/2014	0.41m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	WD
Logged By	JMS
Borehole No	**BH29**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	544163E - 718468N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	01/05/2014
Level:	11.12 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						11.02	0.10	Hardcore.
		0.20-0.80	B					Brown, slightly gravelly slightly sandy SILT with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 100-200mm dia.
		0.80	CPT	(25,25)	0.80	10.32	0.80	
		1.00	CPT	50 (25,25/25,25)	1.00	10.17	0.95	Chiselled from 0.8m to 0.95m for 1 hour.
								End of Borehole at 1.00 m

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.00m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.80 to 0.95	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	01/05/2014	0.00m	Start of Borehole
-	01/05/2014	1.00m	End of Borehole

Equipment & Methods: Dando 2000

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Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 543441E - 718431N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 30/04/2014	**Level:** 5.90 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
						5.70	0.20	Topsoil.	
		0.20-1.00	B					Brown, slightly sandy gravelly CLAY with rootlets. Sand is fine to coarse. Gravel is fine to coarse, subangular.	
		1.00	CPT	N=28 (4,4/6,6,8,8)	1.00	4.90	1.00		
		1.20-2.00	B					Stiff, brown, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to rounded. Cobbles are subangular, 60-200mm dia.	
		2.00	CPT	(10,25/50 for 0mm)	2.00	3.80	2.10		
		2.20	CPT	(50 for 0mm)	2.20	3.70	2.20	Chiselled from 2.1m to 2.2m for 1 hour.	
								End of Borehole at 2.20 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.20m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
2.10 to 2.20	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/04/2014	0.00m	Start of Borehole
-	30/04/2014	2.20m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	PC
Logged By	JMS
Borehole No	**BH33**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	543223E - 718512N
Hole Type	Cable Percussion
Client:	Galway Co. Co.
Dates:	29/04/2014
Level:	9.24 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨						9.04	0.20	Topsoil.	▨
▨		0.20-1.00	B					Grey/ brown, slightly sandy slightly gravelly SILT with high cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to rounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular, 200-250mm dia, Limestone.	▨
▨		1.00	CPT	(8,10/50 for 0mm)	1.00	8.14	1.10		
		1.20	CPT	(50 for 0mm)	1.20	8.04	1.20	Chiselled from 1.1m to 1.2m for 1 hour.	
								End of Borehole at 1.20 m	
	Water	Depth (m)	Type	Results	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.20m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
1.10 to 1.20	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/04/2014	0.00m	Start of Borehole
-	29/04/2014	1.20m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	PC
Logged By	JMS
Borehole No	**BH37**
	Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 543139E - 718535N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 30/04/2014	**Level:** 6.18 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						5.98	0.20	Topsoil.
		0.00-0.80	B					Brown, slightly sandy gravelly CLAY with medium cobbles and rootlets. Sand is fine to coarse. Gravel is fine to coarse, subangular. Cobbles are subangular to rounded, 60-150mm dia, Limestone.
		0.80	CPT	(50 for 0mm)	0.80	5.38	0.80	
		0.90	CPT	(50 for 0mm)	0.90	5.28	0.90	Chiselled from 0.8m to 0.9m for 1 hour.
								End of Borehole at 0.90 m
	Water	Depth (m)	Type	Results	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.90m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.80 to 0.90	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	30/04/2014	0.00m	Start of Borehole
-	30/04/2014	0.90m	End of Borehole

Equipment & Methods: Dando 2000

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Logged By JMS

Borehole No
BH40
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 542809E - 718648N	**Hole Type** Cable Percussion
Client: Galway Co. Co.	**Dates:** 29/04/2014	**Level:** 4.19 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨		0.00-0.55	B			3.69	0.50	Topsoil: Brown, slightly sandy slightly gravelly SILT with high cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to rounded. Cobbles are subangular to rounded, 60-150mm dia, Limestone.	▨
		0.55	CPT	(50 for 0mm)	0.55	3.64	0.55	Chiselled from 0.5m to 0.55m for 1 hour.	
								End of Borehole at 0.55 m	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.55m	200mm	200mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
0.50 to 0.55	0100	Chisel

Remarks: Borehole terminated due to obstruction.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	29/04/2014	0.00m	Start of Borehole
-	29/04/2014	0.55m	End of Borehole

Equipment & Methods: Dando 2000

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Drilled By	AK
Logged By	
Borehole No	**RC13** Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	545456E - 718417N
Hole Type	RO
Client:	Galway Co. Co.
Dates:	09/07/2014
Level:	13.42 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
▨								Open hole boring. Driller described: BOULDERS.	○
		1.00	CPT	N=54 (10,11/14,12,14,14)	1.00				
						11.92	1.50	Open hole boring. Driller described: CLAY with boulder content.	▨
		2.00	CPT	N=25 (3,4/6,5,7,7)	2.00				
		3.00	CPT	N=41 (10,11/11,10,9,11)	3.00	10.42	3.00	End of Borehole at 3.00 m	

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7
8

	Water	Depth (m)	Type	Results	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.00m	131mm	131mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/07/2014	3.00m	End of Borehole
-	09/07/2014	0.00m	Start of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK
Logged By

Borehole No **RC14**
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW
Project No. P12012
Co-ords: 545446E - 718411N
Hole Type Rotary Cored

Client: Galway Co. Co.
Dates: 08/07/2014
Level: 15.46 m AOD
Scale 1:50

Samples & In Situ Testing

Depth (m)	Type / TCR	SCR	RQD	Results / Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Inspection pit. Driller described: Bituminous surfacing over BOULDERS.
1.20	CPT			N=77 (17,15/19,20,19,19)	1.20	14.26	1.20	1.06m - 1.24m: Non-intact. Open hole boring. Driller described: CLAY with boulder content.
2.00	CPT			N=44 (9,8/10,11,11,12)	2.00			
3.00	CPT			N=40 (7,7/9,11,10,10)	3.00			
					3.90 100.00%	11.56	3.90	Strong, grey LIMESTONE with calcite veining. Weathering: Slightly weathered. Localised discolouration. Fractures: 1) Medium spaced, dipping approximately 80-90 degrees with planar rough surfaces. 2) Medium spaced, dipping approximately 60 degrees with planar rough surfaces. 3.9m to 5.4m: Fracture index - 8.
3.90-5.40	87	79	77	40mm min 150mm avg 540mm max				
5.40-6.90	100	100	100					5.4m to 6.9m: Fracture index - 5.
					6.90	8.56	6.90	End of Borehole at 6.90 m
6.90-7.50	75	75	68					

Water | Depth (m) | TCR | SCR | RQD | Fracture spacing | Casing | Level | Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.90m	131mm	131mm
6.90m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	08/07/2014	0.00m	Start of Borehole
-	08/07/2014	3.90m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

Number:	**RC14**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Drilled By AK

Logged By DMC

Borehole No
RC15
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 545525E - 718416N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 09/07/2014

Level: 16.18 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
										Open hole boring. Driller described: CLAY with boulder content.	
		1.00	CPT	N=23 (5,6/5,5,7,6)			1.00				
								14.68	1.50	Open hole boring. Driller described: Clayey GRAVEL.	
		2.00	CPT	N=17 (3,4/4,3,5,5)			2.00				
		3.00	CPT	25 (20,25 for 2mm/25 for 2mm)			3.00 3.10 100.00%	13.18	3.00	Medium strong, grey, fossiliferous LIMESTONE with styolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 3.1m - 4.1m: Fracture index - 2.	
		3.10-4.10	100	95	95	100mm min 400mm avg 960mm max					
										4.1m - 5.1m: Fracture index - 4.	
		4.10-5.10	100	98	98						
										5.1m - 6.1m: Fracture index - 0.	
		5.10-6.10	100	97	97						
							6.10	10.08	6.10	End of Borehole at 6.10 m	
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth		

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.10m	131mm	131mm
6.10m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/07/2014	0.00m	Start of Borehole
-	09/07/2014	3.10m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	RC15	Project	Dunkellin River Flood Relief Works	
		Project No	P12012	
		Engineer	TOBIN	

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Borehole No
RC16
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 545396E - 718411N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 10/07/2014

Level: 19.52 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing					Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type	Results							
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth		
		1.00	CPT	N=39 (7,9/11,10,9,9)			1.00			Open hole boring. Driller described: BOULDERS.	
		1.85-2.85	95	95	87	30mm min 280mm avg 640mm max	1.85 100.00%	17.67	1.85	Medium strong, grey, fossiliferous LIMESTONE with stylolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 1.85m - 2.85m: Fracture index - 4.	
		2.85-3.85	98	96	92					2.85m - 3.85m: Fracture index - 3.	
		3.85-4.85	98	95	84					3.85m - 4.85m: Fracture index - 3.	
		4.85-6.00	100	100	79					4.85m - 6.0m: Fracture index - 5.	
							6.00	13.52	6.00	End of Borehole at 6.00 m	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.85m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/07/2014	0.00m	Start of Borehole
-	10/07/2014	1.85m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

	Project	**Dunkellin River Flood Relief Works**
Number: **RC16**	**Project No**	**P12012**
	Engineer	**TOBIN**

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Drilled By	AK
Logged By	DMC
Borehole No	**RC17**
	Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 545752E - 718659N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 10/07/2014	**Level:** 17.47 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
										Open hole boring. Driller described: CLAY with boulder content.
		1.00	CPT	N=31 (5,9/7,7,8,9)			1.00			
								15.97	1.50	Open hole boring. Driller described: GRAVEL with boulder content.
		1.90-3.40	23	15	9		1.90 100.00%	15.57	1.90	BOULDERS recovered as: Medium strong, light grey Limestone.
							3.40	14.07	3.40	Open hole boring. Driller described: BOULDERS.
		4.60-6.00	100	100	100	50mm min 270mm avg 760mm max	4.60 100.00%	12.87	4.60	Medium strong, grey, fossiliferous LIMESTONE with styolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 4.6m - 6.0m: Fracture index - 3.
							6.00	11.47	6.00	End of Borehole at 6.00 m
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.90m	131mm	131mm
3.40m	76mm	76mm
4.60m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/07/2014	0.00m	Start of Borehole
-	10/07/2014	4.60m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**RC17**	Project No Engineer	P12012 TOBIN	

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Drilled By AK	**Logged By** DMC	Borehole No **RC18**	Sheet 1 of 1
Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 546007E - 718613N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 09/07/2014	**Level:** 20.27 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type			Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
										Open hole boring. Driller described: BOULDERS.
		1.00	CPT			N=39 (7,9/11,9,10,9)	1.00			
								18.77	1.50	Open hole boring. Driller described: GRAVEL with boulder content.
		2.00	CPT			N=26 (4,5/6,5,7,8)	2.00			
		3.00	CPT			N=32 (7,8/7,7,9,9)	3.00			
							3.90 100.00%	16.37	3.90	Medium strong, grey, fossiliferous LIMESTONE with styolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip 1) sub-horizontally with undulating rough surfaces 2) Approximately 80 degrees with undulating rough surfaces. 3.9m - 4.9m: Fracture index - 6. 4.9m - 5.9m: Fracture index - 3.
		3.90-4.90	98	88	61					
		4.90-5.90	96	96	96	50mm min 360mm avg 1450mm max				
		5.90-6.90	99	99	99					5.9m - 6.9m: Fracture index - 0.
		6.90-7.40	96	96	96					6.9m - 7.4m: Fracture index - 0.
							7.40	12.87	7.40	End of Borehole at 7.40 m
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.90m	131mm	131mm
7.40m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	09/07/2014	0.00m	Start of Borehole
-	09/07/2014	3.90m	End of Borehole

Equipment & Methods: DeltaBase 520
Compressed air-mist flush.

Rotary Core Photographic Record

Number:	RC18	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

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Borehole No
RC19
Sheet 1 of 2

Project Name: Dunkellin River & Aggard Stream FRW
Project No. P12012
Co-ords: 545287E - 718433N
Hole Type Rotary Cored

Client: Galway Co. Co.
Dates: 10/07/2014
Level: 18.79 m AOD
Scale 1:50

Water Strikes	Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
									Open hole boring. Driller described: BOULDERS.
	1.00	CPT	N=29 (6,6/7,8,7,7)			1.00			
							17.29	1.50	Open hole boring. Driller described: CLAY with boulder content.
	2.00	CPT	N=133 (5,7/7,8,8,110)			2.00			
	3.00	CPT	66 (7,9/8,8,25 for 1mm)			3.00			
						3.30 100.00%	15.49	3.30	Medium strong, grey, fossiliferous LIMESTONE with stylolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces.
	3.30-4.80	72	65	63	40mm min 230mm avg 800mm max				3.3m - 4.8m: Fracture index - 5. 3.7m - 4.2m: Non-intact.
	4.80-6.30	100	100	100					4.8m - 6.3m: Fracture index - 4.
	6.30-7.80	97	90	85					6.3m - 7.8m: Fracture index - 9.
	7.80-9.30	97	97	93					7.8m - 9.3m: Fracture index - 4.
Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	Continued next sheet

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.30m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia standpipe installed, response zone from 10.0m to 7.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/07/2014	0.00m	Start of Borehole
-	10/07/2014	3.30m	End of Borehole

Equipment & Methods: DeltaBase 520

Drilled By AK	**Borehole No**	
Logged By DMC	**RC19**	Sheet 2 of 2

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 545287E - 718433N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 10/07/2014	**Level:** 18.79 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	Fractures	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		9.30-10.00	100	100	96		10.00	8.79	10.00	Medium strong, grey, fossiliferous LIMESTONE with styolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 9.3m - 10.0m: Fracture index - 4.	
										End of Borehole at 10.00 m	

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	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.30m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia standpipe installed, response zone from 10.0m to 7.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	10/07/2014	0.00m	Start of Borehole
-	10/07/2014	3.30m	End of Borehole

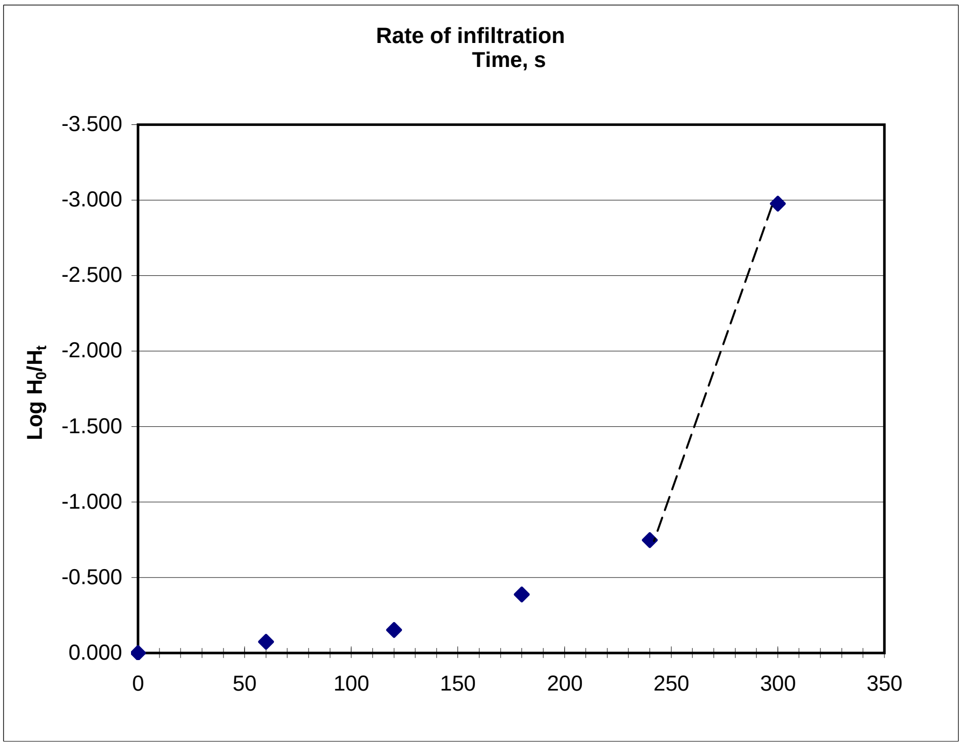
Equipment & Methods: DeltaBase 520

P12012 Falling head permeability test

Undertaken in standpipe See RC19 log for details.

Location			
BH ID	**RC19**	$H_{w/} H_o$	**9.5**
Casing diameter	**50** mm		
Casing depth	**7** m		
Borehole depth	**10** m		
Groundwater level	**1.6** mbgl		
Date	**23/07/2014**		
Strata	**LIMESTONE**		

Min	Sec	depth, m bgl	vol, cu.m	H_t	log H_0/H_t		
0	0	9.500	0.01864	9.50	0.000		
1	60	8.000	0.01570	8.00	-0.075		
2	120	6.700	0.01315	6.70	-0.152		
3	180	3.900	0.00765	3.90	-0.387		
4	240	1.700	0.00334	1.70	-0.747	**k_{mean}**	**1.68E-04 ms^{-1}**
5	300	0.000	0.00000	0.01	-2.978	**$k_H = k_V$**	



Rotary Core Photographic Record

Number:	**RC19**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Rotary Core Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	RC19	Project No Engineer	P12012 TOBIN	

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Drilled By AK
Logged By DMC

Borehole No
RC20
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 545087E - 718470N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 11/07/2014

Level: 18.12 m AOD

Scale 1:50

Samples & In Situ Testing Depth (m)	Type / TCR	SCR	RQD	Results / Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Open hole boring. Driller described: CLAY with boulder content.
					0.90 100.00%	17.22	0.90	Medium strong, grey, LIMESTONE with styolites and calcite veining. Weathering: Slightly weathered. Occasional staining. Clay smearing. Fractures: Closely spaced. Fractures dip sub-horizontally with undulating smooth surfaces.
0.90-2.40	93	93	75	20mm min 120mm avg 680mm max				0.9m - 2.4m: Fracture index - 10.
2.40-3.90	100	100	71					2.4m - 3.9m: Fracture index - 14.
3.90-6.00	100	100	69					3.9m - 6.0m: Fracture index - 17.
					6.00	12.12	6.00	End of Borehole at 6.00 m

Water | Depth (m) | TCR | SCR | RQD | Fracture spacing | Casing | Level | Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.90m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia. standpipe installed, response zone from 6.0m to 3.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/07/2014	0.00m	Start of Borehole
-	11/07/2014	0.90m	End of Borehole

Equipment & Methods: DeltaBase 520

P12012 Falling head permeability test

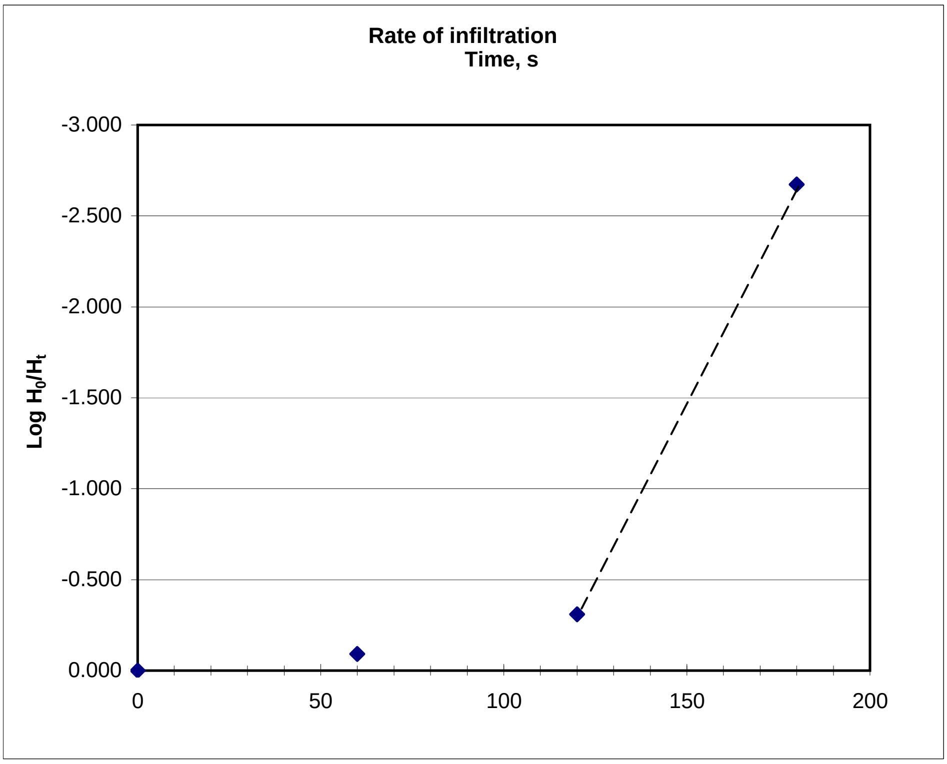
Undertaken in standpipe See RC20 log for details.

Location			
BH ID	**RC20**	$H_{w/}H_o$	**4.7**
Casing diameter	**50** mm		
Casing depth	**3** m		
Borehole depth	**6** m		
Groundwater level	**3.4** mbgl		
Date	**23/07/2014**		
Strata	**LIMESTONE**		

Min	**Sec**	**depth, m bgl**	**vol, cu.m**	**H_t**	**log H_0/H_t**
0	0	4.700	0.00922	4.70	0.000
1	60	3.800	0.00746	3.80	-0.092
2	120	2.300	0.00451	2.30	-0.310
3	180	0.000	0.00000	0.01	-2.672

k_{mean} **1.78E-04 ms^{-1}**

$k_H = k_V$



Rotary Core Photographic Record

Number:	RC20	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

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Drilled By AK
Logged By DMC

Borehole No
RC21
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW
Project No. P12012
Co-ords: 544700E - 718695N
Hole Type Rotary Cored

Client: Galway Co. Co.
Dates: 11/07/2014
Level: 12.21 m AOD
Scale 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing					Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		Depth (m)	Type	Results							
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth		
										Open hole boring. Driller described: SAND with boulder content.	
		1.00	CPT	N=16 (3,3/4,5,4,3)			1.00				
								10.71	1.50	Open hole boring. Driller described: SAND.	
		2.00	CPT	N=7 (1,1/2,2,2,1)			2.00				
		3.00	CPT	50 (12,13/25 for 1mm)			3.00	9.21	3.00	Open hole boring. Driller described: SAND with boulder content.	
							3.20 100.00%	9.01	3.20	Medium strong, grey, LIMESTONE with stylolites. Weathering: Slightly weathered. Occasional staining. Clay smearing. Fractures: Closely spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 3.2m - 4.2m: Fracture index - 7.	
		3.20-4.20	95	82	64	20mm min 160mm avg 380mm max					
		4.20-5.20	95	85	73					4.2m - 5.2m: Fracture index - 5.	
		5.20-6.00	98	98	88					5.2m - 6.0m: Fracture index - 3.	
							6.00	6.21	6.00	End of Borehole at 6.00 m	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.20m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/07/2014	0.00m	Start of Borehole
-	11/07/2014	3.20m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

		Project	Dunkellin River Flood Relief Works
Number:	RC21	Project No Engineer	P12012 TOBIN

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Drilled By	**Logged By**	Borehole No
AK	DMC	**RC24** Sheet 1 of 1

Project Name:	**Project No.**	**Co-ords:**	**Hole Type**
Dunkellin River & Aggard Stream FRW	P12012	544164E - 718464N	Rotary Cored

Client:	**Dates:**	**Level:**	**Scale**
Galway Co. Co.	12/07/2014	11.02 m AOD	1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing					Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
		Depth (m)	Type	Results						
										Open hole boring. Driller described: BOULDERS.
		1.00	CPT	N=38 (9,11/10,10,9,9)			1.00			
								9.52	1.50	Open hole boring. Driller described: GRAVEL with boulder content.
		2.00	CPT	N=31 (7,8/7,7,9,8)			2.00			
							3.00 100.00%	8.02	3.00	Medium strong, grey, fossiliferous LIMESTONE with styolites. Weathering: Slightly weathered. Clay infilling. Brown oxide staining. Fractures: Medium spaced. Fractures dip 1) sub-horizontally with undulating smooth surfaces. 2) Vertically with planar rough surfaces. 3.0m - 4.0m: Fracture index - 3. 3.0m - 4.5m: Vertical fracture. 3.25m - 3.4m: Non-intact. 4.0m - 5.0m: Fracture index - 4.
		3.00-4.00	100	75	62	20mm min 220mm avg 360mm max				
		4.00-5.00	100	95	87					
		5.00-6.00	100	96	87					5.0m - 6.0m: Fracture index - 5.
							6.00	5.02	6.00	End of Borehole at 6.00 m
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.00m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

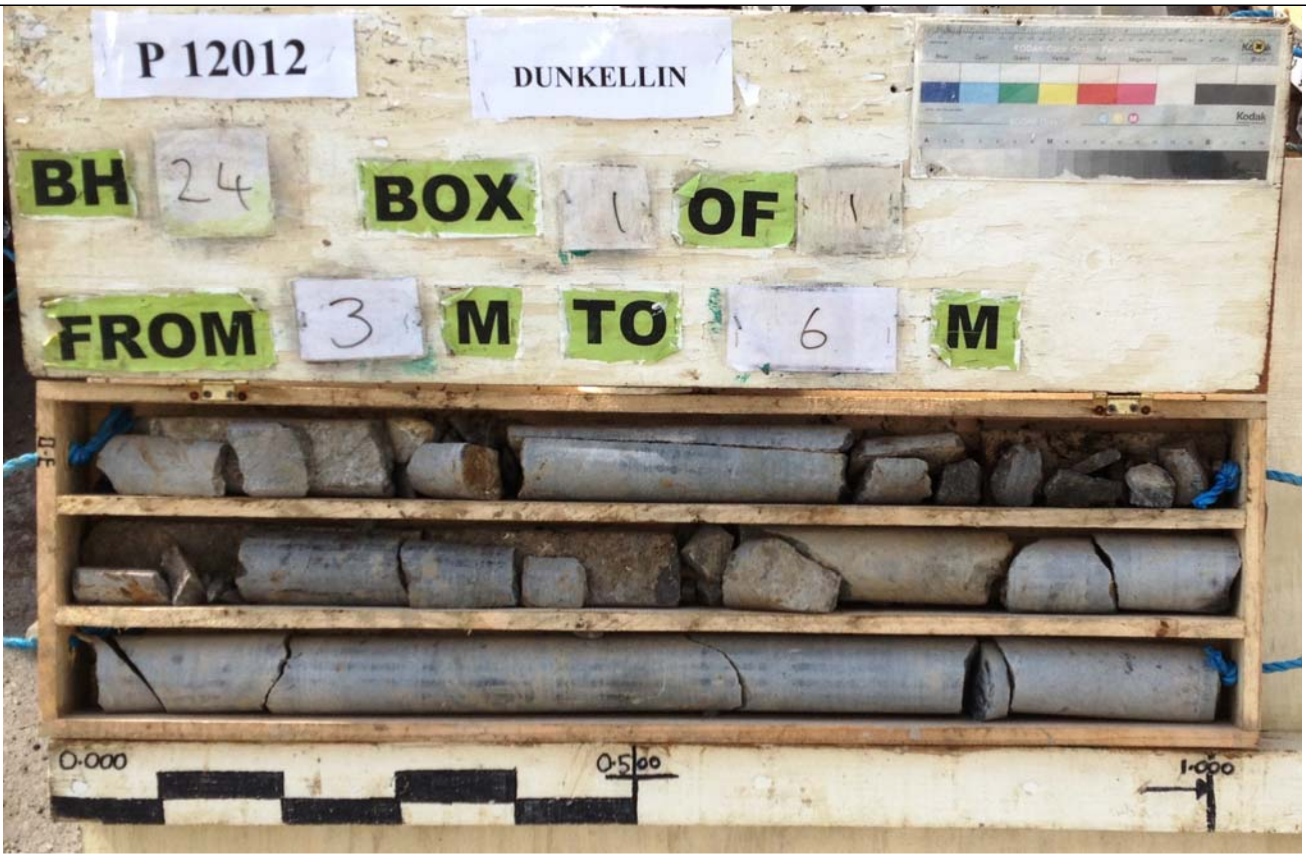
Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	12/07/2014	0.00m	Start of Borehole
-	12/07/2014	3.00m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record



		Project	Dunkellin River Flood Relief Works	
Number:	RC24	Project No Engineer	P12012 TOBIN	

PRIORITY GEOTECHNICAL	Priority Geotechnical Ltd. Tel: 021 4631600 Fax: 021 4638690 www.prioritygeotechnical.ie	**Drilled By** AK **Logged By** DMC	Borehole No **RC26** Sheet 1 of 2
Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 544180E - 718432N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 13/07/2014	**Level:** 9.71 m AOD	**Scale** 1:50

Water Strikes	Depth (m)	Type / TCR	Results / SCR	RQD	Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
									Open hole boring. Driller described: BOULDERS.
	1.00	CPT	N=88 (17,18/20,22,21,25)			1.00			
							8.21	1.50	Open hole boring. Driller described: Rock.
						2.00 100.00%	7.71	2.00	Medium strong, grey, fossiliferous LIMESTONE with stylolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip horizontally with undulating smooth surfaces. 2.0m - 3.5m: Fracture index - 4.
	2.00-3.50	93	93	93					
	3.50-5.00	100	93	91					3.5m - 5.0m: Fracture index - 7.
	5.00-6.00	96	76	47					5.0m - 5.2m: Predominantly non-intact. 5.0m - 6.0m: Fracture index - 7.
	6.00-7.00	97	97	97	10mm min 270mm avg 950mm max				6.0m - 7.0m: Fracture index - 1.
	7.00-8.00	98	92	91					7.0m - 8.0m: Fracture index - 3.
	8.00-9.00	100	98	89					8.0m - 9.0m: Fracture index - 2.
Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	Continued next sheet

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.00m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia standpipe installed, response zone from 10.0m to 7.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	13/07/2014	0.00m	Start of Borehole
-	13/07/2014	2.00m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By	AK
Logged By	DMC
Borehole No	**RC26**
	Sheet 2 of 2
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	544180E - 718432N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	13/07/2014
Level:	9.71 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	Fractures	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend	
		9.00-10.00	100	100	100					Remaining Detail : 9.00m - 10.00m : 9.0m - 10.0m: Fracture index - 10.		
							10.00	-0.29	10.00	End of Borehole at 10.00 m		10
												11
												12
												13
												14
												15
												16
												17
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth			

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.00m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia. standpipe installed, response zone from 10.0m to 7.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	13/07/2014	0.00m	Start of Borehole
-	13/07/2014	2.00m	End of Borehole

Equipment & Methods: DeltaBase 520

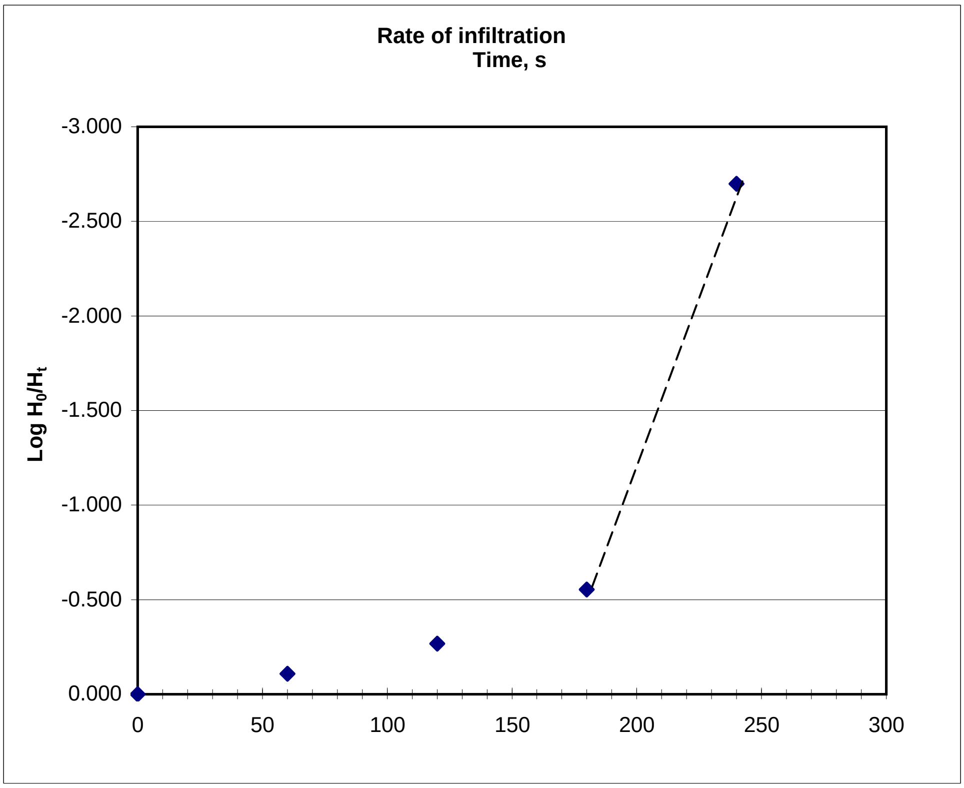
P12012 Falling head permeability test
Undertaken in standpipe See RC26 log for details.

Location

BH ID	**RC26**		$H_{w/}\,H_o$	**5**
Casing diameter	**50**	mm		
Casing depth	**10**	m		
Borehole depth	**7**	m		
Groundwater level	**4.0**	mbgl		
Date	**23/07/2014**			
Strata	**LIMESTONE**			

Min	Sec	depth, m bgl	vol, cu.m	H_t	log H_0/H_t
0	0	5.000	0.00981	5.00	0.000
1	60	3.900	0.00765	3.90	-0.108
2	120	2.700	0.00530	2.70	-0.268
3	180	1.400	0.00275	1.40	-0.553
4	240	0.000	0.00000	0.01	-2.699

k_{mean} 1.62E-04 ms^{-1}
$k_H = k_V$



Rotary Core Photographic Record

Number:	**RC26**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

Rotary Core Photographic Record

Number:	**RC26**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

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Drilled By AK

Logged By DMC

Borehole No
RC28
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 544161E - 718428N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 11/07/2014

Level: 10.38 m AOD

Scale 1:50

Water Strikes	Depth (m)	Type			Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	
									Open hole boring. Driller described: SAND AND GRAVEL.
	1.00	CPT			N=37 (10,11/11,7,9,10)	1.00			
	2.00	CPT			N=30 (5,6/7,7,8,8)	2.00			
	3.00	CPT			N=27 (4,4/6,6,7,8)	3.00	7.38	3.00	Open hole boring. Driller described: SAND with boulder content.
	4.00	CPT			N=26 (5,5/6,7,9,4)	4.00			
	5.00	CPT			25 (7,25 for 2mm/25 for 1mm)	5.00 5.10 100.00%	5.28	5.10	Medium strong, grey, fossiliferous LIMESTONE with stylolites. Weathering: Moderately weathered. Clay infilling. Brown oxide staining. 'Honeycomb' weathering. Fractures: Closely spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 5.1m - 6.6m: Fracture index - 7. 6.1m - 6.3m: Non-intact. 6.6m - 8.1m: Fracture index - 5. 7.7m - 8.1m: Clay and sand infilling.
	5.10-6.60	92	65	57	50mm min 190mm avg 420mm max				
	6.60-8.10	97	89	76					
						8.10	2.28	8.10	End of Borehole at 8.10 m

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
5.10m	131mm	131mm
8.10m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	11/07/2014	0.00m	Start of Borehole
-	11/07/2014	5.10m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**RC28**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Drilled By AK	**Logged By** DMC	Borehole No **RC29** Sheet 1 of 2

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 544167E - 718414N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 12/07/2014	**Level:** 10.00 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
										Open hole boring. Driller described: BOULDERS.
		1.00	CPT	N=47 (9,8/10,11,14,12)			1.00			
								8.50	1.50	Open hole boring. Driller described: SAND with boulder content.
		2.00	CPT	50 (7,8/25 for 1mm)			2.00			
								7.80	2.20	Open hole boring. Driller described: Rock.
							2.70 100.00%	7.30	2.70	Medium strong, grey, fossiliferous LIMESTONE with stylolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 2.7m - 4.2m: Fracture index - 4.
		2.70-4.20	92	83	80					
										3.9m - 4.15m: Non-intact.
										4.2m - 5.7m: Fracture index - 4.
		4.20-5.70	100	100	100					
										5.7m - 7.2m: Fracture index - 2.
		5.70-7.20	99	99	99	30mm min 400mm avg 920mm max				
										7.2m - 8.7m: Fracture index - 4.
		7.20-8.70	93	93	91					
										8.7m - 10.0m: Fracture index - 3.
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	Continued next sheet

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-		- None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.70m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	12/07/2014	0.00m	Start of Borehole
-	12/07/2014	2.70m	End of Borehole

Equipment & Methods: DeltaBase 520

Drilled By AK	**Logged By** DMC	Borehole No **RC29** Sheet 2 of 2

Project Name: Dunkellin River & Aggard Stream FRW	**Project No.** P12012	**Co-ords:** 544167E - 718414N	**Hole Type** Rotary Cored
Client: Galway Co. Co.	**Dates:** 12/07/2014	**Level:** 10.00 m AOD	**Scale** 1:50

Well / Backfill	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	Fractures	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		8.70-10.00	100	100	94		10.00	0.00	10.00	Medium strong, grey, fossiliferous LIMESTONE with styolites. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces.	
										End of Borehole at 10.00 m	

Depth scale: 10, 11, 12, 13, 14, 15, 16, 17

	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.70m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	12/07/2014	0.00m	Start of Borehole
-	12/07/2014	2.70m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

Number: **RC29**	**Project** **Dunkellin River Flood Relief Works** **Project No** **P12012** **Engineer** **TOBIN**	

Rotary Core Photographic Record

	Project	Dunkellin River Flood Relief Works	
Number: RC29	Project No Engineer	P12012 TOBIN	

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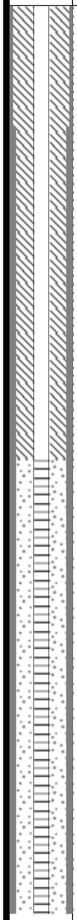
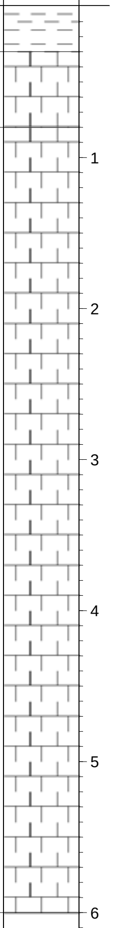
Drilled By	AK
Logged By	DMC
Borehole No	**RC30**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	543964E - 718356N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	12/07/2014
Level:	9.81 m AOD
Scale	1:50



Water Strikes	Depth (m)	Type (TCR)	SCR	RQD	Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
							9.51	0.30	Open hole boring. Driller described: CLAY.
						0.80 100.00%	9.01	0.80	Open hole boring. Driller described: Rock.
	0.80-1.80	90	90	90	10mm min 250mm avg 750mm max				Medium strong, grey, LIMESTONE with styolites and calcite veining. Weathering: Slightly weathered. Clay infilling. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 0.8m - 1.8m: Fracture index - 4.
	1.80-2.80	100	92	92					1.8m - 2.8m: Fracture index - 3.
	2.80-3.80	98	98	92					2.8m - 3.8m: Fracture index - 3.
	3.80-4.80	95	95	75					3.8m - 4.8m: Fracture index - 4.
	4.80-5.80	96	96	96					4.8m - 5.8m: Fracture index - 1.
	5.80-6.00	100	100	0		6.00	3.81	6.00	5.8m - 6.0m: Fracture index - 4.

End of Borehole at 6.00 m



Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
0.80m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia standpipe installed, response zone from 6.0m to 3.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	12/07/2014	0.00m	Start of Borehole
-	12/07/2014	0.80m	End of Borehole

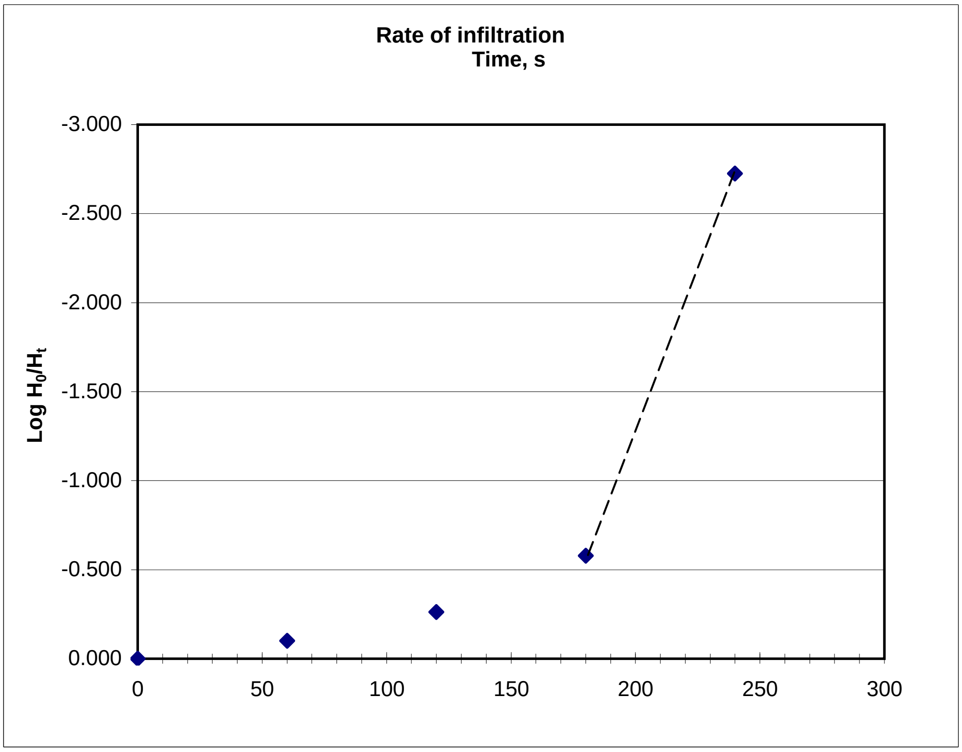
Equipment & Methods: DeltaBase 520

P12012 Falling head permeability test
Undertaken in standpipe See RC30 log for details.

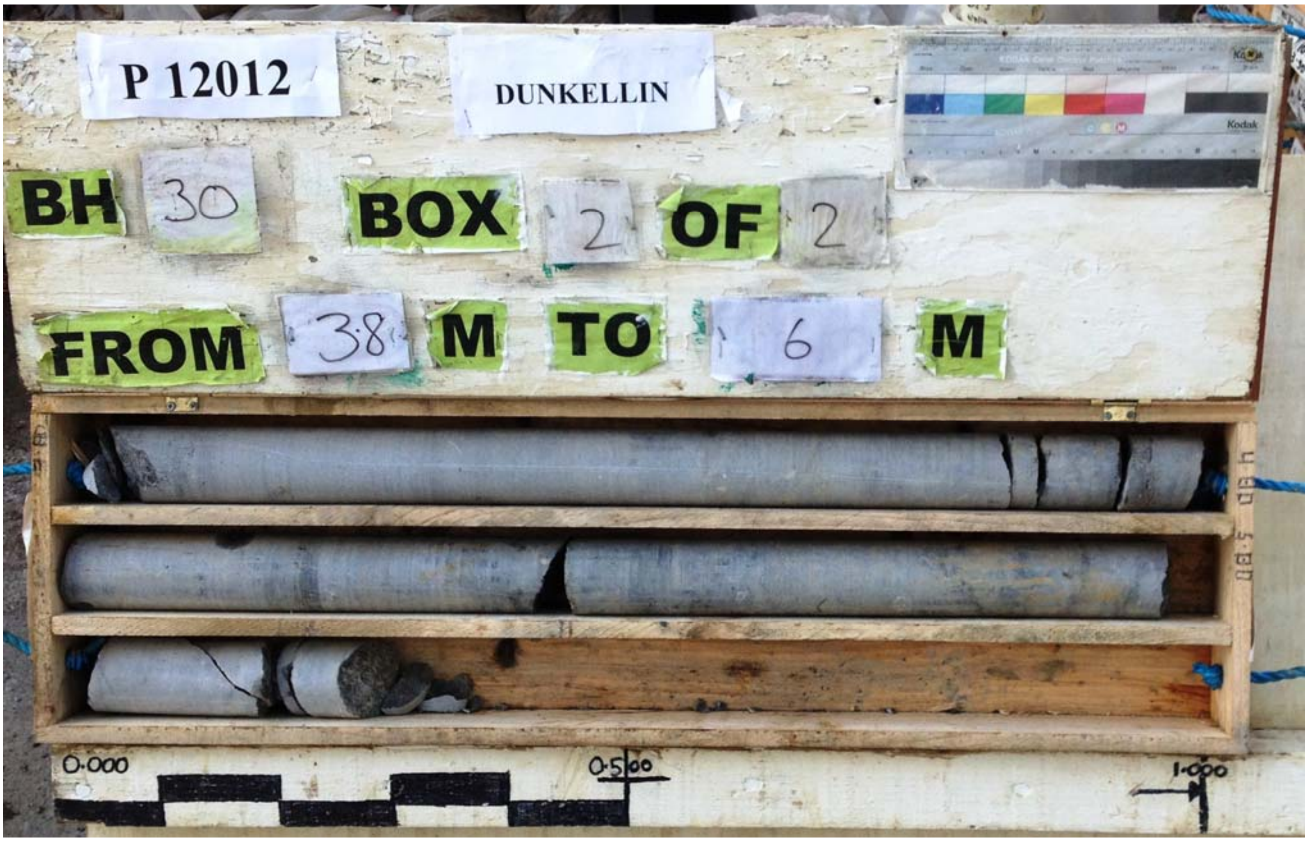
Location			
BH ID	**RC30**	$H_{w/}$ H_o	**5.3**
Casing diameter	**50** mm		
Casing depth	**3** m		
Borehole depth	**6** m		
Groundwater level	**3.9** mbgl		
Date	**23/07/2014**		
Strata	**LIMESTONE**		

Min	**Sec**	**depth, m bgl**	**vol, cu.m**	**H_t**	**log H_0/H_t**
0	0	5.300	0.01040	5.30	0.000
1	60	4.200	0.00824	4.20	-0.101
2	120	2.900	0.00569	2.90	-0.262
3	180	1.400	0.00275	1.40	-0.578
4	240	0.000	0.00000	0.01	-2.724

k_{mean} **1.62E-04 ms^{-1}**
$k_H = k_V$



Rotary Core Photographic Record



		Project	Dunkellin River Flood Relief Works	
Number:	RC30	Project No Engineer	P12012 TOBIN	

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Drilled By	AK
Logged By	DMC
Borehole No	**RC31**
	Sheet 1 of 2
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	543495E - 718438N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	14/07/2014
Level:	6.61 m AOD
Scale	1:50

Samples & In Situ Testing

Depth (m)	Type / TCR	Results / SCR	RQD	Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Open hole boring. Driller described: CLAY with boulder content.
1.00	CPT	N=22 (3,5/5,7,5,5)			1.00			
						5.11	1.50	Open hole boring. Driller described: BOULDERS.
						4.71	1.90	Open hole boring. Driller described: Rock.
					2.40 100.00%	4.21	2.40	Strong, grey to dark grey, fossiliferous LIMESTONE. Weathering: Slightly weathered. Slight discolouration. Fractures: Closely to medium spaced. Dipping approximately 80-90 degrees with planar smooth and planar rough surfaces.
2.40-3.90	97	97	35	5mm min 250mm avg 640mm max				2.4m to 3.9m: Fracture index - 30.
3.90-5.40	75	72	48					3.9m to 5.4m: Fracture index - 12.
5.40-6.90	89	88	68					5.4m to 6.9m: Fracture index - 9.
6.90-8.40	100	100	100					6.9m to 8.4m: Fracture index - 4.
8.40-10.00	79	79	76					8.4m to 10.0m: Fracture index - 6.

Continued next sheet

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.40m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia. standpipe installed, response zone from 10.0m to 5.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	14/07/2014	0.00m	Start of Borehole
-	14/07/2014	2.40m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By AK

Logged By DMC

Borehole No
RC31
Sheet 2 of 2

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 543495E - 718438N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 14/07/2014

Level: 6.61 m AOD

Scale 1:50

Well / Backfill	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	Fractures	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
							10.00	-3.39	10.00	Strong, grey to dark grey, fossiliferous LIMESTONE. Weathering: Slightly weathered. Slight discolouration. Fractures: Closely to medium spaced. Dipping approximately 80-90 degrees with planar smooth and planar rough surfaces.	▦
										End of Borehole at 10.00 m	
	Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth		

Scale: 10, 11, 12, 13, 14, 15, 16, 17

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.40m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia standpipe installed, response zone from 10.0m to 5.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	14/07/2014	0.00m	Start of Borehole
-	14/07/2014	2.40m	End of Borehole

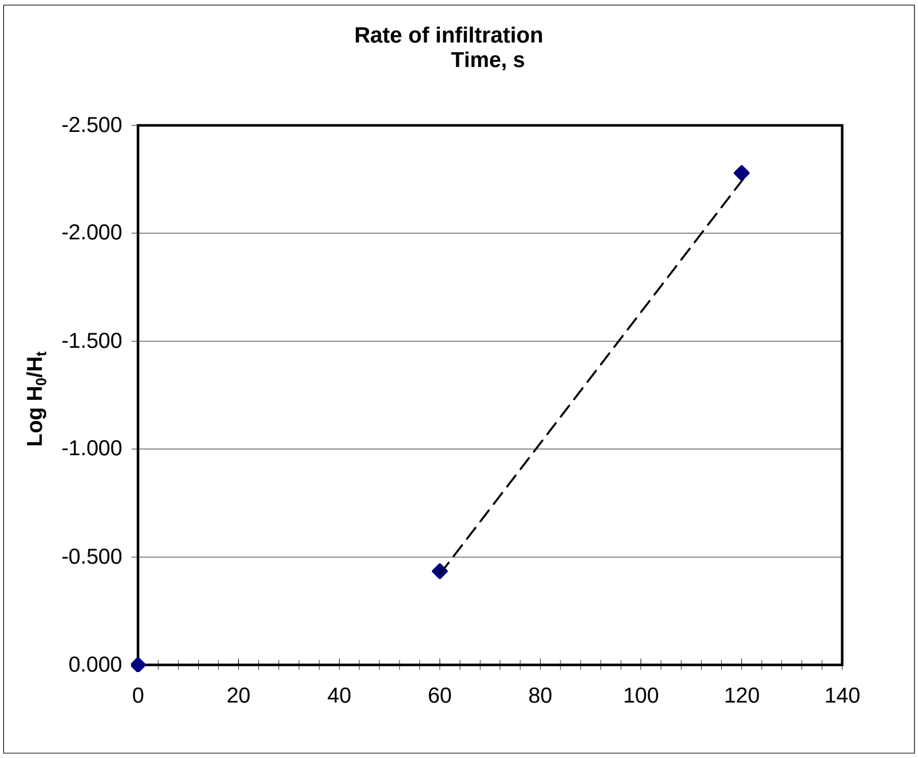
Equipment & Methods: DeltaBase 520

P12012 Falling head permeability test
Undertaken in standpipe See RC31 log for details.

Location			
BH ID	**RC31**	$H_{w/}$ H_o	**1.9**
Casing diameter	**50** mm		
Casing depth	**5** m		
Borehole depth	**10** m		
Groundwater level	**1.4** mbgl		
Date	**23/07/2014**		
Strata	**LIMESTONE**		

Min	Sec	depth, m bgl	vol, cu.m	H_t	log H_0/H_t
0	0	1.900	0.00373	1.90	0.000
1	60	0.700	0.00137	0.70	-0.434
2	120	1.400	0.00275	0.01	-2.279

k_{mean} **1.39E-04** ms^{-1}
$k_H = k_V$



Rotary Core Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**RC31**	**Project No** **Engineer**	**P12012** **TOBIN**	

Rotary Core Photographic Record

Number:	RC31	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

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Drilled By AK
Logged By DMC

Borehole No
RC32
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream FRW
Project No. P12012
Co-ords: 543378E - 718477N
Hole Type Rotary Cored
Client: Galway Co. Co.
Dates: 14/07/2014
Level: 6.11 m AOD
Scale 1:50

Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
								Open hole boring. Driller described: CLAY with boulder content.
						5.21	0.90	Open hole drilling socketing into rock. LIMESTONE 1.02m - 1.83m: Non-intact.
					1.40 100.00%	4.71	1.40	Strong, grey to dark grey, fossiliferous LIMESTONE with minor calcite veining. Weathering: Slightly weathered. Slight discolouration. Fractures: Closely to medium spaced. Dipping approximately 80-90 degrees woth planar smooth and planar rough surfaces. 1.4m to 2.9m: Fracture index - 14.
1.40-2.90	87	77	57	10mm min 250mm avg 610mm max				
2.90-4.40	77	77	77					2.9m to 4.4m: Fracture index - 7.
4.40-5.90	99	92	88					4.4m to 5.9m: Fracture index - 7. 4.74m - 4.86m: Non-intact.
5.90-7.00	100	100	100					5.9m to 7.0m: Fracture index - 5.
					7.00	-0.89	7.00	End of Borehole at 7.00 m

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.40m	131mm	131mm
7.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia. standpipe installed, response zone from 7.0m to 3.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	14/07/2014	0.00m	Start of Borehole
-	14/07/2014	1.40m	End of Borehole

Equipment & Methods: DeltaBase 520

P12012 Falling head permeability test

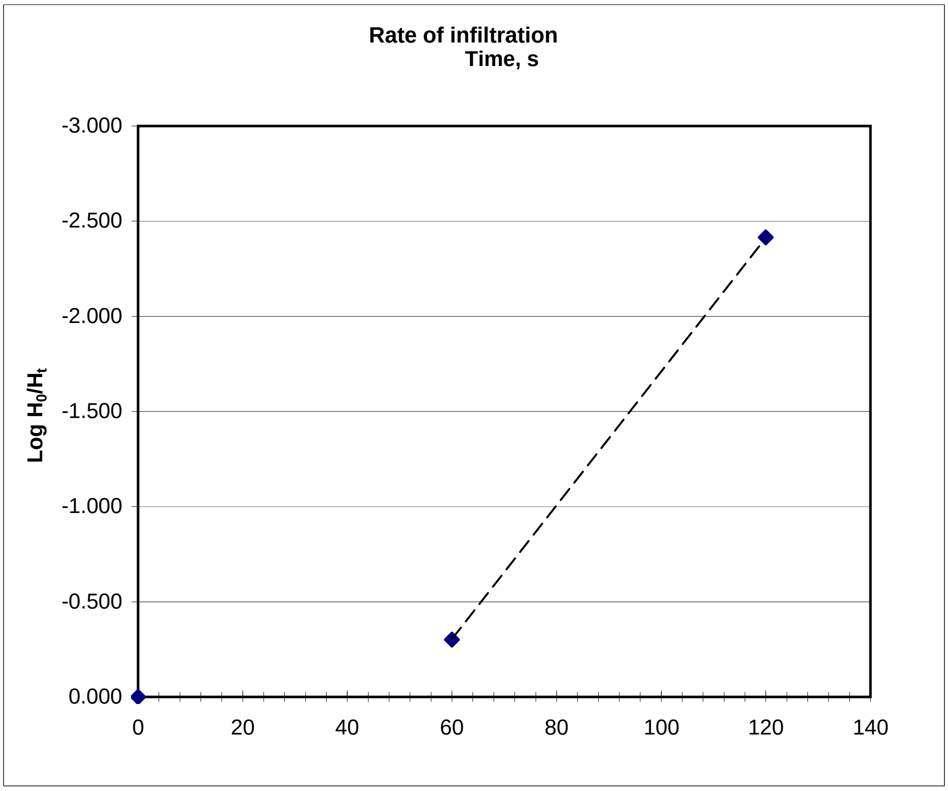
Undertaken in standpipe See RC32 log for details.

Location			
BH ID	**RC32**	$H_{w/} H_o$	**2.6**
Casing diameter	**50** mm		
Casing depth	**3** m		
Borehole depth	**7** m		
Groundwater level	**1.6** mbgl		
Date	**23/07/2014**		
Strata	**LIMESTONE**		

Min	**Sec**	**depth, m bgl**	**vol, cu.m**	**H_t**	**log H_0/H_t**
0	0	2.600	0.00510	2.60	0.000
1	60	1.300	0.00255	1.30	-0.301
2	120	0.000	0.00000	0.01	-2.415

k_{mean} **1.59E-04** **ms^{-1}**

$k_H = k_V$



Rotary Core Photographic Record

Number: RC32	Project	Dunkellin River Flood Relief Works	
	Project No	P12012	
	Engineer	TOBIN	

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Drilled By	AK
Logged By	DMC
Borehole No	**RC34**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	543136E - 718564N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	13/07/2014
Level:	7.79 m AOD
Scale	1:50

Depth (m)	Type	Results			Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	
								Open hole boring. Driller described: BOULDERS.
1.00	CPT	N=24 (7,8/8,7,2,7)			1.00			
						6.29	1.50	Open hole boring. Driller described: CLAY with boulder content.
2.00	CPT	25 (8,25 for 1mm/25 for 1mm)			2.00			
						5.69	2.10	Open hole boring. Driller described: Rock.
2.60-3.60	56	12	0	30mm min 500mm avg 620mm max	2.60 100.00%	5.19	2.60	Strong, grey, LIMESTONE with calcite veining. Weathering: Slightly weathered. Minor oxide staining. Fractures: Medium spaced. Fractures dip approximately 60-70 degrees with planar smooth surfaces. 2.6m - 3.6m: Fracture index - 2.
3.60-4.20	75	33	33					3.6m - 4.2m: Fracture index - 2.
4.20-4.80	100	100	28					4.2m - 4.8m: Fracture index - 2.
4.80-5.65	88	81	65					4.8m - 5.65m: Fracture index - 2.
5.65-6.65	100	82	74					5.65m - 6.65m: Fracture index - 2.
					6.45	1.14	6.65	End of Borehole at 6.45 m

Water

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.60m	131mm	131mm
6.45m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	13/07/2014	0.00m	Start of Borehole
-	13/07/2014	2.60m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

Number:	**RC34**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Drilled By	AK
Logged By	
Borehole No	**RC37**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	543131E - 718550N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	15/07/2014
Level:	7.01 m AOD
Scale	1:50

Samples & In Situ Testing

Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						Open hole boring. Driller described: CLAY with boulder content.
1.00	CPT	N=18 (7,7/5,5,4,4)	1.00			
				5.51	1.50	Open hole boring. Driller described: SAND.
2.00	CPT	N=10 (1,1/2,2,3,3)	2.00			
3.00	CPT	59 (4,7/9,25 for 1mm)	3.00	4.01	3.00	Open hole boring. Driller described: BOULDERS.
				3.81	3.20	Open hole boring. Driller described: Rock.
			3.70 100.00%	3.31	3.70	Strong, grey LIMESTONE with minor calcite veining. Weathering: Slightly weathered. Localised discolouration. Fractures: Medium spaced, dipping approximately 80-90 degrees with planar rough surfaces. 3.7m to 5.2m: Fracture index - 7. 5.2m to 6.7m: Fracture index - 8. 6.7m to 8.0m: Fracture index - 3.
			8.00	-0.99	8.00	End of Borehole at 8.00 m

Depth (m)	TCR	SCR	RQD	Fracture spacing
3.70-5.20	72	68	62	50mm min 150mm avg 890mm max
5.20-6.70	100	100	95	
6.70-8.00	100	100	94	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	None encountered

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
3.70m	131mm	131mm
8.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia standpipe installed, response zone from 8.0m to 4.0m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/07/2014	0.00m	Start of Borehole
-	15/07/2014	3.70m	End of Borehole

Equipment & Methods: DeltaBase 520

P12012 **Falling head permeability test**

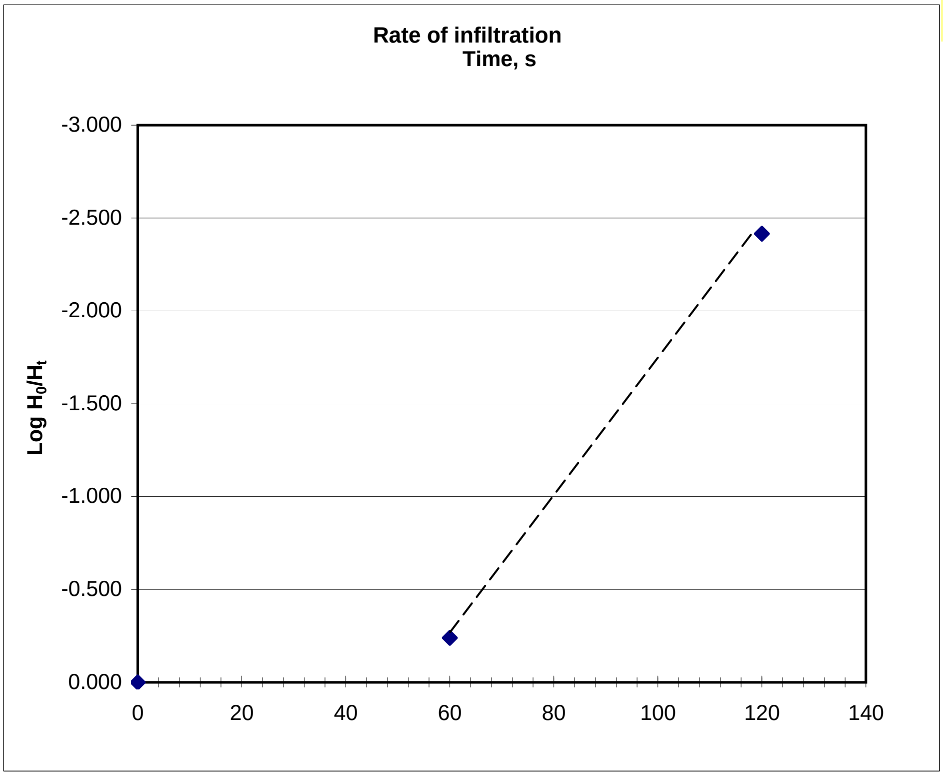
Undertaken in standpipe See RC37 log for details.

Location			
BH ID	**RC37**	$H_{w/}\,H_o$	**2.6**
Casing diameter	**50** mm		
Casing depth	**4** m		
Borehole depth	**8** m		
Groundwater level	**1.6** mbgl		
Date	**23/07/2014**		
Strata	**LIMESTONE**		

Min	**Sec**	**depth, m bgl**	**vol, cu.m**	**H_t**	**log H_0/H_t**
0	0	2.600	0.00510	2.60	0.000
1	60	1.500	0.00294	1.50	-0.239
2	120	1.600	0.00314	0.01	-2.415

k_{mean} **1.64E-04 ms^{-1}**

$k_H = k_V$



Rotary Core Photographic Record

Number: **RC37**	**Project**	**Dunkellin River Flood Relief Works**	
	Project No **Engineer**	**P12012** **TOBIN**	

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Drilled By	AK
Logged By	DMC
Borehole No	**RC39**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	542969E - 718596N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	13/07/2014
Level:	4.05 m AOD
Scale	1:50

Water Strikes	Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
							Open hole boring. Driller described: CLAY.
▽	1.00	CPT	N=46 (2,2/4,3,14,25)	1.00	2.85	1.20	
							Open hole boring. Driller described: BOULDERS.
					2.65	1.40	Open hole boring. Driller described: Rock.
				1.90 100.00%	2.15	1.90	Medium strong, grey, fossiliferous LIMESTONE with styolites. Weathering: Slightly weathered. Clay smearing. Fractures: Medium spaced. Fractures dip sub-horizontally with undulating smooth surfaces. 1.9m - 2.9m: Fracture index - 4. 1.9m - 2.25m: 80 degree fracture with planar rough surfaces. 2.9m - 3.9m: Fracture index - 5. 3.9m - 4.9m: Fracture index - 2. 4.9m - 6.0m: Fracture index - 4.
				6.00	-1.95	6.00	End of Borehole at 6.00 m

Depth (m)	TCR	SCR	RQD	Fracture spacing
1.90-2.90	96	96	80	40mm min 260mm avg 900mm max
2.90-3.90	98	98	90	
3.90-4.90	96	96	96	
4.90-6.00	100	100	95	

Groundwater:

Struck	Rose to	After	Sealed	Comment
1.20m	-	-	-	

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
1.90m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth. 50mm dia. standpipe installed response zone 3m - 6m.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	13/07/2014	0.00m	Start of Borehole
-	13/07/2014	1.90m	End of Borehole

Equipment & Methods: DeltaBase 520

P12012 Falling head permeability test

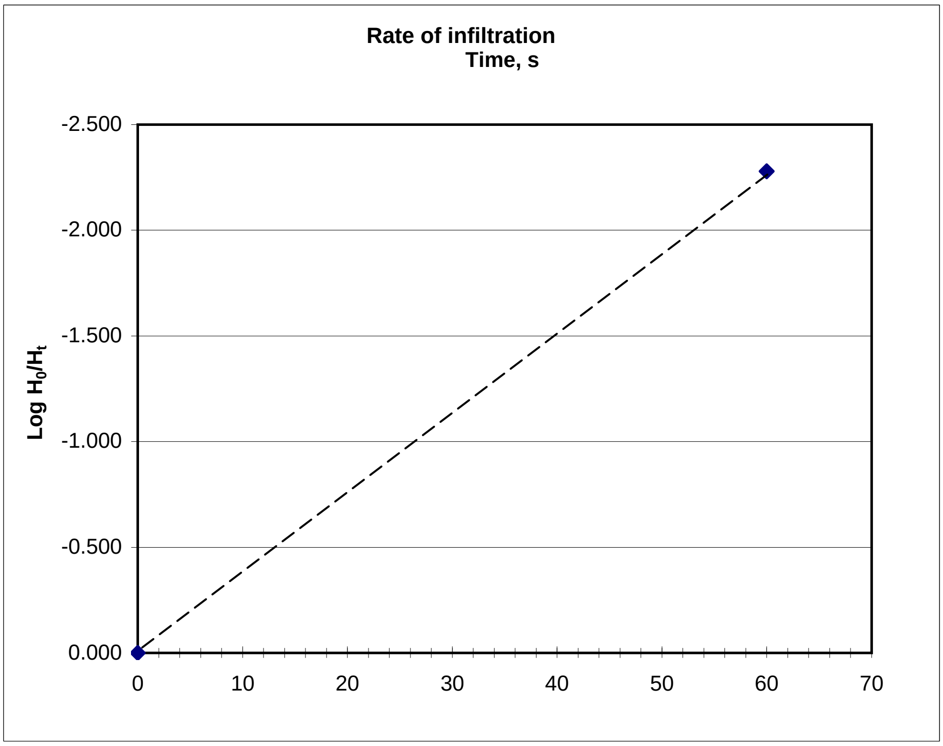
Undertaken in standpipe See RC39 log for details.

Location			
BH ID	**RC39**	$H_{w/} H_o$	**1.9**
Casing diameter	**50** mm		
Casing depth	**3** m		
Borehole depth	**6** m		
Groundwater level	**0.6** mbgl		
Date	**23/07/2014**		
Strata	**LIMESTONE**		

Min	**Sec**	**depth, m bgl**	**vol, cu.m**	**H_t**	**log H_0/H_t**
0	0	1.900	0.00373	1.90	0.000
1	60	0.000	0.00000	0.01	-2.279

k_{mean} **1.72E-04 ms^{-1}**

$k_H = k_V$



Rotary Core Photographic Record

Number:	RC39	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

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Drilled By AK

Logged By

Borehole No
RC41
Sheet 1 of 2

Project Name: Dunkellin River & Aggard Stream FRW

Project No. P12012

Co-ords: 542621E - 718685N

Hole Type Rotary Cored

Client: Galway Co. Co.

Dates: 15/07/2014

Level: 3.88 m AOD

Scale 1:50

Water Strikes	Depth (m)	Type / TCR	Results / SCR	RQD	Fracture spacing	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
									Open hole boring. Driller described: CLAY with boulder content.
	1.00	CPT	N=17 (3,3/4,5,4,4)			1.00			
							2.38	1.50	Open hole boring. Driller described: GRAVEL with boulder content.
▽									
	2.00	CPT	59 (4,9/9,25 for 1mm)			2.00			
							1.68	2.20	Open hole boring. Driller described: Rock.
						2.70 100.00%	1.18	2.70	Strong, grey to dark grey, fossiliferous LIMESTONE with minor calcite veining. Weathering: Slightly weathered. Slight discolouration. Fractures: 1) Medium spaced. Dipping approximately 80-90 degrees with planar rough surfaces. 2) Medium spaced. Dipping approximatley 25-50 degrees with planar smooth and planar rough surfaces. 2.7m to 4.5m: Fracture index - 6.
	2.70-4.50	79	79	73					
	4.50-5.70	100	100	100					4.5m to 5.7m: Fracture index - 4.
	5.70-7.20	95	92	73	40mm min 280mm avg 950mm max				5.7m to 7.2m: Fracture index - 8.
	7.20-8.70	85	85	85					7.2m to 8.7m: Fracture index - 6.
									8.7m to 10.0m: Fracture index - 2.
Water	Depth (m)	TCR	SCR	RQD	Fracture spacing	Casing	Level	Depth	Continued next sheet

Groundwater:

Struck	Rose to	After	Sealed	Comment
1.80m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.70m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/07/2014	0.00m	Start of Borehole
1.10m	15/07/2014	2.70m	End of Borehole

Equipment & Methods: DeltaBase 520

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Drilled By	AK
Logged By	
Borehole No	**RC41** Sheet 2 of 2
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	542621E - 718685N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	15/07/2014
Level:	3.88 m AOD
Scale	1:50

Well / Backfill	Water Strikes	Rotary Coring Depth (m)	TCR	SCR	RQD	Fractures	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description	Legend
		8.70-10.00	98	98	98		10.00	-6.12	10.00	Strong, grey to dark grey, fossiliferous LIMESTONE with minor calcite veining. Weathering: Slightly weathered. Slight discolouration. Fractures: 1) Medium spaced. Dipping approximately 80-90 degrees with planar rough surfaces. 2) Medium spaced. Dipping approximatley 25-50 degrees with planar smooth and planar rough surfaces.	
										End of Borehole at 10.00 m	
Water	Depth (m)	TCR	SCR	RQD	Fracture spacing		Casing	Level	Depth		

Depth scale: 10, 11, 12, 13, 14, 15, 16, 17

Groundwater:

Struck	Rose to	After	Sealed	Comment
1.80m	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.70m	131mm	131mm
10.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/07/2014	0.00m	Start of Borehole
1.10m	15/07/2014	2.70m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

Number:	**RC41**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

Rotary Core Photographic Record

		Project	Dunkellin River Flood Relief Works
Number:	RC43	Project No	P12012
		Engineer	TOBIN

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Drilled By	AK
Logged By	DMC
Borehole No	**RC42**
	Sheet 1 of 1
Project Name:	Dunkellin River & Aggard Stream FRW
Project No.	P12012
Co-ords:	542162E - 718611N
Hole Type	Rotary Cored
Client:	Galway Co. Co.
Dates:	15/07/2014
Level:	2.70 m AOD
Scale	1:50

Samples & In Situ Testing

Depth (m)	Type	Results	Casing / Flush	Level (m AOD)	Depth (m)	Stratum Description
						Open hole boring. Driller described: CLAY.
1.00	CPT	N=24 (4,5/5,7,6,6)	1.00			
2.00	CPT	49 (5,5/7,8,9,25 for 1mm)	2.00			
				0.30	2.40	Open hole boring. Driller described: Rock.
			2.90 100.00%	-0.20	2.90	Strong, grey, LIMESTONE with minor calcite veining. Weathering: Slightly weathered. Minor oxide staining. Fractures: Medium spaced. Fractures dip approximatley 60-90 degrees with planar smooth surfaces. 2.9m - 3.8m: Fracture index - 6.
				-1.10	3.80	LIMESTONE - possible cavity, clay infill feature. 3.8m - 4.1m: Fracture index - NI. Possible infilled cavity/ fracture feature
				-2.10	4.80	Strong, grey, LIMESTONE with minor calcite veining. 4.1m - 6.0m: Fracture index - 5.
			6.00	-3.30	6.00	End of Borehole at 6.00 m

Depth (m)	TCR	SCR	RQD	Fracture spacing
2.90-3.80	100	97	91	90mm min 200mm avg 720mm max
3.80-4.80	30	0	0	
4.80-6.00	96	96	88	

Groundwater:

Struck	Rose to	After	Sealed	Comment
-	-	-	-	See shift data.

Hole Information:

Hole Depth	Hole Diameter	Casing Diameter
2.90m	131mm	131mm
6.00m	76mm	76mm

Chiselling:

Depths (m)	Time (hhmm)	Tool
to		

Remarks: Inspection pit dug to 1.2m. Borehole terminated at required depth.

Shift Data:

Groundwater	Shift (dd/mm/yyyy)	Casing depth	Remarks
-	15/07/2014	0.00m	Start of Borehole
0.00m	15/07/2014	3.80m	End of Borehole

Equipment & Methods: DeltaBase 520

Rotary Core Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**RC42**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP11
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 545398E - 718411N
Level: 19.93 m AOD

Date 14/05/2014

Location: Co Galway

Dimensions: 4.50m × 1.20m
Depth 2.00m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				19.73	0.20	Firm, light grey/ brown, slightly sandy gravelly SILT with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-700mm dia.	▨
	1.00-2.00 1.00-2.00	B D					
				17.93	2.00	Trial pit completed at 2.00 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at required depth.

Trial Pit Photographic Record

Number:	**TP11**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP11**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP11**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP12
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 545360E - 718424N **Level:** 20.21 m AOD	**Date** 14/05/2014
Location: Co Galway		**Dimensions:** 3.20m × 1.60m Depth 2.30m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				20.11	0.10	Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
	1.00-2.00 1.00-2.00	B D		17.91	2.30	Firm, light brown, slightly gravelly slightly sandy SILT with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-450mm dia.	▨
						Trial pit completed at 2.30 m	
Water	Depth (m)	Type	Results	Level	Depth		

Depth scale (m): 1, 2, 3

Stability: Very poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP12	Project No Engineer	P12012 TOBIN	

Trial Pit Photographic Record

Number:	**TP12**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Trial Pit No
TP13
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

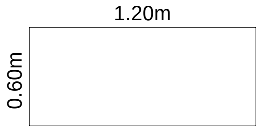
Co-ords: 545562E - 718425N

Level: 16.00 m AOD

Date 02/05/2014

Location: Co Galway

Dimensions:



Depth
1.30m

Scale 1:25

Client: Galway Co Co

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil: Soft, dark brown, slightly sandy SILT with rootlets.	▨	
				15.80	0.20	Light brown, slightly sandy SILT with high boulder content. Sand is fine to coarse. Boulders are angular to subrounded, 200-500mm dia.	▨	
				15.40	0.60	Light brown, silty sandy GRAVEL with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are angular to subrounded, 60-100mm dia. Boulders are angular to subrounded, 200-400mm dia.	▨	
	1.00 1.00	B D						1
				14.70	1.30	Trial pit completed at 1.30 m		
								2
								3
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Moderate
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	TP13	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**TP13**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP14
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 545671E - 718516N
Level: 16.48 m AOD

Date 13/05/2014

Location: Co Galway

Dimensions: 2.00m
0.60m
Depth
1.50m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				16.28	0.20	Topsoil: Soft, brown, slightly sandy slightly gravelly SILT with rootlets.	▨
	0.50-1.50 0.50-1.50	B D		14.98	1.50	Firm, light grey/ brown, slightly gravelly slightly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-600mm dia.	▨
						Trial pit completed at 1.50 m	
Water	Depth (m)	Type	Results	Level	Depth		

1
2
3

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP14**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP14**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP14A
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 545796E - 718671N **Level:** 17.43 m AOD	**Date** 13/05/2014
Location: Co Galway		**Dimensions:** 2.10m × 0.80m Depth 1.50m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil: Soft, brown, slightly sandy slightly gravelly SILT with rootlets.	▨	
				17.13	0.30	Firm, Light grey/ brown, slightly gravelly slightly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-600mm dia.	▨	
	0.50-1.50 0.50-1.50	B D						1
				15.93	1.50	Trial pit completed at 1.50 m		
								2
								3
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP14A**	**Project**	**Dunkellin River Flood Relief Works**
		Project No	**P12012**
		Engineer	**TOBIN**

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP14A**	**Project No** **Engineer**	**P12012** **TOBIN**

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Trial Pit No
TP15
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 546013E - 718761N **Level:** 16.19 m AOD	**Date** 14/05/2014
Location: Co Galway		**Dimensions:** 3.40m 0.60m Depth 2.10m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy SILT with rootlets.	
				15.99	0.20	Firm, light grey/ brown, slightly gravelly slightly sandy SILT with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-800mm dia.	
	0.00-1.00 0.00-1.00	B D					
	1.00-2.00 1.00-2.00	B D					
				14.09	2.10	Trial pit completed at 2.10 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**TP15**	**Project No**	**P12012**	
		Engineer	**TOBIN**	

Trial Pit Photographic Record

Number:	TP15	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

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Trial Pit No
TP15A
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 546123E - 718811N **Level:** 14.79 m AOD	**Date** 14/05/2014
Location: Co Galway		**Dimensions:** 3.10m Depth 1.60m 0.80m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				14.69	0.10	Topsoil: Soft, dark brown, slightly sandy SILT with rootlets.	▨
	0.00-1.00 0.00-1.00 1.00-1.60 1.00-1.60	B D B D		13.19	1.60	Firm, light grey/ brown, slightly gravelly sandy SILT with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-600mm dia.	▩
						Trial pit completed at 1.60 m	
Water	Depth (m)	Type	Results	Level	Depth		

1
2
3

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP15A**	**Project No** **Engineer**	**P12012** **TOBIN**

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP15A**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP17
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 545450E - 718411N

Level: 14.94 m AOD

Date 02/05/2014

Location: Co Galway

Dimensions: 1.40m × 0.60m
Depth 1.20m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				14.74	0.20	Firm, light brown, slightly gravelly slightly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-800mm dia.	▨
	0.20-1.00 0.20-1.00	B D					
				13.74	1.20	Trial pit completed at 1.20 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP17**	**Project No** **Engineer**	**P12012** **TOBIN**

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP17**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP18
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 545474E - 718416N

Level: 15.45 m AOD

Date 02/05/2014

Location: Co Galway

Dimensions: 2.10m × 0.60m

Depth 1.60m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing							
Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				15.25	0.20	Soft, light grey, slightly sandy slightly gravelly SILT with low cobble content and low boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-500mm dia.	▨
	0.40-1.40 0.40-1.40	B D					
				13.85	1.60	Trial pit completed at 1.60 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor

Plant: JCB

Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP18**	**Project No**	**P12012**
		Engineer	**TOBIN**

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP18**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP18A
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 544890E - 718601N
Level: 16.13 m AOD

Date 14/05/2014

Location: Co Galway

Dimensions: 4.10m × 0.80m
Depth 1.40m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	**Stratum Description**	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				15.83	0.30	Light brown, slightly gravelly slightly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-450mm dia.	▨
	0.40-1.40 0.40-1.40	B D					
				14.73	1.40	Trial pit completed at 1.40 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

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Trial Pit No
TP19
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 545127E - 718479N **Level:** 18.25 m AOD	**Date** 14/05/2014
Location: Co Galway		**Dimensions:** 2.50m x 0.80m Depth 1.20m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
						Topsoil: Soft, dark brown, slightly sandy SILT with rootlets.	▨
				18.15	0.10	Firm, light brown/ grey, slightly sandy gravelly SILT with low cobble content and low boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-300mm dia.	▨
	0.00-1.00 0.00-1.00	B D					
				17.05	1.20	Trial pit completed at 1.20 m	

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP19	Project No Engineer	P12012 TOBIN	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP19**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP20
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 544859E - 718671N **Level:** 15.10 m AOD	**Date** 14/05/2014
Location: Co Galway		**Dimensions:** 3.90m × 1.20m Depth 1.90m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨	
				14.90	0.20	Firm, light grey/ brown, slightly sandy gravelly CLAY with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-650mm dia.	▨	
	0.50-1.50 0.50-1.50	B D						1
				13.20	1.90	Trial pit completed at 1.90 m		
								2
								3
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP20**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**TP20**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP21
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 544726E - 718696N **Level:** 13.54 m AOD	**Date** 14/05/2014
Location: Co Galway		**Dimensions:** 2.60m × 0.80m Depth 3.00m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend	
				13.29	0.25	Topsoil: Soft, brown, slightly sandy slightly gravelly SILT with rootlets.	▨	
						Light brown/ grey, slightly sandy gravelly SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-400mm dia.	▨	1
	1.00-2.00 1.00-2.00	B D					▨	2
	2.00-3.00 2.00-3.00	B D		10.54	3.00		▨	3
						Trial pit completed at 3.00 m		
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated at required depth.

Trial Pit Photographic Record

Number:	**TP21**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP21**	**Project No** **Engineer**	**P12012** **TOBIN**

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Trial Pit No
TP21A
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 544643E - 718661N

Level: 11.86 m AOD

Date 14/05/2014

Location: Co Galway

Dimensions: 3.30m × 0.80m
Depth 1.60m

Scale 1:25

Client: Galway Co Co

Logged By ID

Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
						Topsoil: Soft, brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				11.66	0.20	Soft to firm, light brown/ grey, slightly gravelly slightly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-300mm dia.	▨
▽							
	0.40-1.40 0.40-1.40	B D					
				10.26	1.60	Trial pit completed at 1.60 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 0.8m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**
Number:	**TP21A**	**Project No** **Engineer**	**P12012** **TOBIN**

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP21A**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP22
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 544370E - 718511N

Level: 11.88 m AOD

Date 15/05/2014

Location: Co Galway

Dimensions: 2.10m × 0.60m

Depth 0.80m

Scale 1:25

Client: Galway Co Co

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
▽	0.00-0.80 0.00-0.80	B D		11.58	0.30	Firm, light brown, slightly gravelly slightly sandy CLAY with low cobble content and low boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-400mm dia.	▨
				11.08	0.80	Trial pit completed at 0.80 m	
Water	Depth (m)	Type	Results	Level	Depth		

1
2
3

Stability: Moderate

Plant: JCB

Backfill: Arisings

Groundwater: Steady inflow at 0.6m.

Remarks: Trial pit terminated due to obstruction. Relocated to TP22B.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP22	Project No	P12012	
		Engineer	TOBIN	

Trial Pit Photographic Record

Number:	**TP22**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Trial Pit No
TP22B
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 544407E - 718524N **Level:** 12.11 m AOD		**Date** 15/05/2014
Location: Co Galway		**Dimensions:** 2.30m × 0.60m	Depth 1.50m	**Scale** 1:25
Client: Galway Co Co				**Logged By** BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				11.91	0.20	Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
▽	0.50-1.50 0.50-1.50	B D		10.61	1.50	Soft, light brown, slightly gravelly slightly sandy CLAY with medium cobble content and medium boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-400mm dia.	▨
						Trial pit completed at 1.50 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: Steady inflow at 0.5m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP22B**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

Number:	**TP22B**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Trial Pit No
TP23
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 543079E - 718546N **Level:** 5.15 m AOD	**Date** 03/05/2014
Location: Co Galway		**Dimensions:** 1.40m × 0.70m Depth 0.80m	**Scale** 1:25
Client: Galway Co Co			**Logged By** BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				5.05	0.10	Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
	0.00-0.80 0.00-0.80 0.40	B D CBR		4.35	0.80	Mottled brown, slightly sandy gravelly SILT with medium cobble content and medium boulder content. Sand is fine to coarse. Gravel is coarse, subangular. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-500mm dia.	▩
						Trial pit completed at 0.80 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP23**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

Trial Pit Photographic Record

Number:	TP23	Project Project No Engineer	Dunkellin River Flood Relief Works P12012 TOBIN	

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Trial Pit No
TP24
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 543147E - 718564N **Level:** 8.13 m AOD	**Date** 02/05/2014
Location: Co Galway		**Dimensions:** 1.30m × 0.60m Depth 0.50m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				8.03	0.10	Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
	0.00-0.50 0.00-0.50	B D		7.63	0.50	Light brown, slightly sandy gravelly SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-300mm dia.	▩
						Trial pit completed at 0.50 m	
Water	Depth (m)	Type	Results	Level	Depth		

1
2
3

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP24**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

Number:	**TP24**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Trial Pit No
TP25
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 542607E - 718691N

Level: 3.66 m AOD

Date 02/05/2014

Location: Co Galway

Dimensions: 2.20m × 0.60m

Depth 2.00m

Scale 1:25

Client: Galway Co Co

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				3.26	0.40	Firm, light grey, slightly sandy gravelly SILT with low cobble content and low boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-500mm dia.	▨
▽							
	1.00-2.00 1.00-2.00	B D					
				1.66	2.00	Trial pit completed at 2.00 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Very poor

Plant: JCB

Backfill: Arisings

Groundwater: Trickle at 1.0m.

Remarks: Trial pit terminated due to obstruction.

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Trial Pit No
TP26
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 542407E - 718628N **Level:** 2.99 m AOD	**Date** 02/05/2014
Location: Co Galway		**Dimensions:** 2.10m × 0.60m Depth 2.30m	**Scale** 1:25
Client: Galway Co Co			**Logged By** BG

Samples & In Situ Testing							
Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
				2.79	0.20	Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
▽	1.00-2.00 1.00-2.00	B D		0.69	2.30	Firm, light grey, slightly gravelly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-500mm dia.	⊠
						Trial pit completed at 2.30 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Very poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 0.8m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP26**	**Project**	**Dunkellin River Flood Relief Works**
		Project No	**P12012**
		Engineer	**TOBIN**

Trial Pit Photographic Record

Number:	**TP26**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

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Trial Pit No
TP27
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 542165E - 718579N

Level: 2.86 m AOD

Date 07/05/2014

Location: Co Galway

Dimensions: 4.50m × 1.20m

Depth 1.00m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description
Water	Depth (m)	Type	Results			
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.
				2.71	0.15	Firm, light brown/ grey, slightly gravelly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-800mm dia.
	0.20-1.00 0.20-1.00	B D				
				1.86	1.00	Trial pit completed at 1.00 m
Water	Depth (m)	Type	Results	Level	Depth	

Stability: Poor

Plant: JCB

Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP27	Project No	P12012	
		Engineer	TOBIN	

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP27**	**Project No** **Engineer**	**P12012** **TOBIN**	

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Trial Pit No
TP28
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 541822E - 718526N **Level:** 2.17 m AOD	**Date** 15/05/2014
Location: Co Galway		**Dimensions:** 3.10m × 0.80m Depth 2.50m	**Scale** 1:25
Client: Galway Co Co			**Logged By** BG

Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				1.77	0.40	Firm, dark brown, slightly gravelly sandy peaty SILT. Sand is fine. Gravel is fine.	▨
	0.00-1.70 0.00-1.70	B D					
▽							
				0.47	1.70	Soft to firm, light grey, slightly sandy gravelly CLAY with low cobble content and low boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-400mm dia.	▨
▽	1.70-2.50 1.70-2.50	B D					
				-0.33	2.50	Trial pit completed at 2.50 m	

Stability: Moderate
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 1.4m. Slow inflow at 2.1m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP28**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

Number:	**TP28**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

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Trial Pit No
TP29
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 543203E - 718518N

Level: 9.19 m AOD

Date 02/05/2014

Location: Co Galway

Dimensions: 1.50m × 0.60m

Depth 1.50m

Scale 1:25

Client: Galway Co Co

Logged By BG

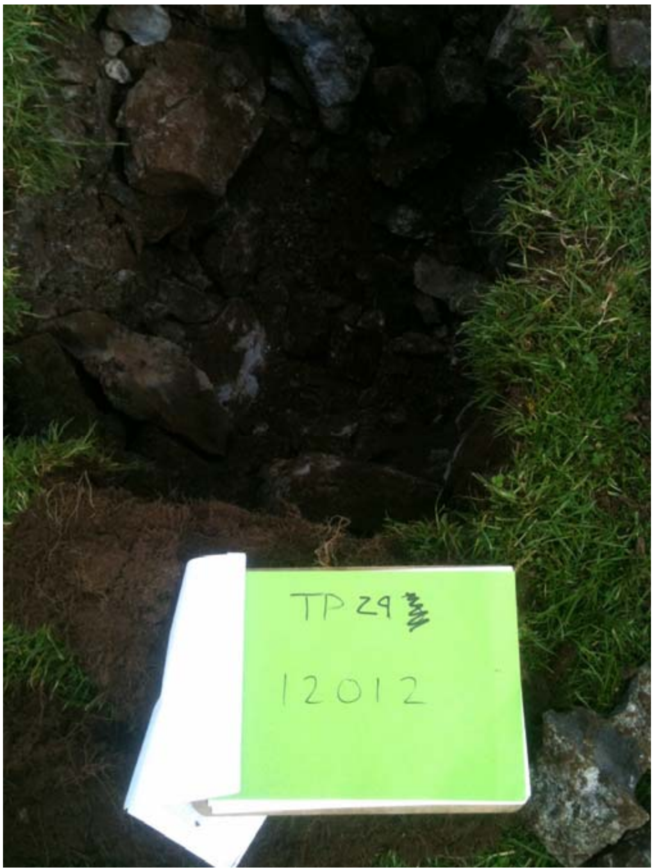
Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description	Legend
				9.09	0.10	Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
	1.50 1.50	B D		7.69	1.50	Dark brown, silty very sandy GRAVEL with high cobble content and high boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulder are subangular to subrounded, 200-500mm dia.	▒
						Trial pit completed at 1.50 m	

Stability: Moderate
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record



		Project	**Dunkellin River Flood Relief Works**
Number:	**TP29**	**Project No**	**P12012**
		Engineer	**TOBIN**

Trial Pit Photographic Record

Number:	TP29	Project	Dunkellin River Flood Relief Works	
		Project No	P12012	
		Engineer	TOBIN	

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Trial Pit No
TP30
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 543329E - 718484N **Level:** 6.43 m AOD	**Date** 06/05/2014
Location: Co Galway		**Dimensions:** 1.20m × 0.60m Depth 1.40m	**Scale** 1:25
Client: Galway Co Co			**Logged By** BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, light brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				5.93	0.50	Light brown, slightly gravelly sandy SILT with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded	▩
				5.03	1.40	Trial pit completed at 1.40 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Good
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP30	Project No	P12012	
		Engineer	TOBIN	

Trial Pit Photographic Record

Number:	**TP30**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

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Trial Pit No
TP31
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 543495E - 718438N
Level: 5.83 m AOD

Date 07/05/2014

Location: Co Galway

Client: Galway Co Co

Dimensions: 2.00m × 0.60m
Depth 3.50m

Scale 1:25

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▩
				5.53	0.30	Soft to firm, light grey, slightly gravelly slightly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-300mm dia.	▨
▽							
	0.00-2.00	B					
	0.00-2.00	D					
	2.00-3.50	B					
	2.00-3.50	D					
				2.33	3.50	Trial pit completed at 3.50 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Moderate
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 0.6m.

Remarks: Trial pit terminated due to obstruction.

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Trial Pit No
TP32
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 543568E - 718429N **Level:** 6.60 m AOD	**Date** 07/05/2014
Location: Co Galway		**Dimensions:** 2.00m 0.60m Depth 1.30m	**Scale** 1:25
Client: Galway Co Co			**Logged By** BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend	
Water	Depth (m)	Type	Results					
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨	
				6.30	0.30	Orange/ brown, slightly gravelly SILT.	▨	
	0.00-0.80 0.00-0.80	B D						
				5.80	0.80	Firm, grey, slightly sandy gravelly CLAY with medium cobble content and medium boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-400mm dia.	▨	1
	0.80-1.30 0.80-1.30	B D						
				5.30	1.30	Trial pit completed at 1.30 m		
								2
								3
Water	Depth (m)	Type	Results	Level	Depth			

Stability: Good
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit No
TP33
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 544071E - 718391N **Level:** 8.64 m AOD	**Date** 07/05/2014
Location: Co Galway		**Dimensions:** 2.20m × 0.70m Depth 1.60m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
				8.49	0.15	Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
	0.20-1.20 0.20-1.20	B D		7.04	1.60	Light brown, silty very sandy GRAVEL with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-800mm dia.	⁘
						Trial pit completed at 1.60 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor
Plant: JCB
Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP33**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	**TP33**	**Project No** **Engineer**	**P12012** **TOBIN**	

Trial Pit No
TP34
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 544181E - 718439N

Level: 9.84 m AOD

Date 15/05/2014

Location: Co Galway

Dimensions: 1.80m × 0.90m

Depth 1.20m

Scale 1:25

Client: Galway Co Co

Logged By BG

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				9.74	0.10	Soft, light brown, slightly gravelly slightly sandy SILT with medium cobble content and high boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-700mm dia.	▨
	0.00-1.20 0.00-1.20	B D					
				8.64	1.20	Trial pit completed at 1.20 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Moderate

Plant: JCB

Backfill: Arisings

Groundwater: None encountered

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP34**	**Project** **Project No** **Engineer**	**Dunkellin River Flood Relief Works** **P12012** **TOBIN**	

Trial Pit Photographic Record

Number: TP34

Project Dunkellin River Flood Relief Works

Project No P12012
Engineer TOBIN

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Trial Pit No
TP35
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 542917E - 718613N

Level: 4.11 m AOD

Date 07/05/2014

Location: Co Galway

Dimensions: 1.80m × 0.60m

Depth 1.00m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, dark brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				3.91	0.20	Firm, light brown/ grey, slightly sandy slightly gravelly CLAY with low cobble content and low boulder content. Sand is medium to coarse. Gravel is medium to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-200mm dia. Boulders are subangular to subrounded, 200-600mm dia.	▨
▽	0.20-1.00 0.20-1.00	B D					
				3.11	1.00	Trial pit completed at 1.00 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Poor

Plant: JCB

Backfill: Arisings

Groundwater: Trickle at 0.7m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number: TP35	Project	Dunkellin River Flood Relief Works	
	Project No	P12012	
	Engineer	TOBIN	

Trial Pit Photographic Record

Number:	**TP35**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No	**P12012**	
		Engineer	**TOBIN**	

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Trial Pit No
TP36
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme

Project No. P12012

Co-ords: 541867E - 718568N
Level: 2.67 m AOD

Date 15/05/2014

Location: Co Galway

Dimensions: 3.20m × 0.80m
Depth 2.50m

Scale 1:25

Client: Galway Co Co

Logged By ID

Samples & In Situ Testing				Level (m AOD)	Depth (m)	Stratum Description	Legend
Water	Depth (m)	Type	Results				
						Topsoil: Soft, brown, slightly sandy slightly gravelly SILT with rootlets.	▨
				2.27	0.40	Firm, light grey, slightly sandy gravelly SILT with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-800mm dia.	▨
	0.50-1.50 0.50-1.50	B D					
▽	1.50-2.50 1.50-2.50	B D					
				0.17	2.50	Trial pit completed at 2.50 m	
Water	Depth (m)	Type	Results	Level	Depth		

Stability: Very poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 2.0m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Number:	**TP36**	**Project**	**Dunkellin River Flood Relief Works**	
		Project No **Engineer**	**P12012** **TOBIN**	

Trial Pit Photographic Record

		Project	Dunkellin River Flood Relief Works	
Number:	TP36	Project No Engineer	P12012 TOBIN	

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Trial Pit No
TP37
Sheet 1 of 1

Project Name: Dunkellin River & Aggard Stream Flood Relief Scheme	**Project No.** P12012	**Co-ords:** 542275E - 718617N **Level:** 2.62 m AOD	**Date** 15/05/2014
Location: Co Galway		**Dimensions:** 3.00m × 0.80m Depth 2.60m	**Scale** 1:25
Client: Galway Co Co			**Logged By** ID

Water	Depth (m)	Type	Results	Level (m AOD)	Depth (m)	Stratum Description
						Topsoil: Soft, brown, slightly sandy slightly gravelly SILT with rootlets.
				2.22	0.40	Firm, grey, slightly sandy CLAY with low cobble content and low boulder content. Sand is fine to coarse. Cobbles are subangular to subrounded, 60-100mm dia. Boulders are subangular to subrounded, 200-300mm dia.
▽						
	0.60-1.60 0.60-1.60	B D				
				1.02	1.60	Firm, grey, slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded, 60-100mm dia.
	1.60-2.60 1.60-2.60	B D				
				0.02	2.60	Trial pit completed at 2.60 m

Stability: Very poor
Plant: JCB
Backfill: Arisings

Groundwater: Trickle at 0.6m.

Remarks: Trial pit terminated due to obstruction.

Trial Pit Photographic Record

Project Dunkellin River Flood Relief Works

Number: TP37

Project No P12012

Engineer TOBIN

Trial Pit Photographic Record

		Project	**Dunkellin River Flood Relief Works**	
Number:	**TP37**	**Project No** **Engineer**	**P12012** **TOBIN**	

APPENDIX B

LABORATORY RESULTS

Natural Moisture Content
Atterberg Limit
Particle Size Distribution
pH
SO_3/SO_4
Organic Content
Loss On Ignition
Compaction
MCV Relationship
MCV Single
Shear Box (60mm)
Uniaxial Compressive Strength (UCS)
Point Load Test (PLT)

KEY TO SYMBOLS - LABORATORY TEST RESULT

U	Undisturbed Sample	
P	Piston Sample	
TWS	Thin Wall Sample	
B	Bulk Sample - Disturbed	
D	Jar Sample - Disturbed	
W	Water Sample	
pH	Acidity/Alkalinity Index	
SO_3	% - Total Sulphate Content (acid soluble)	
SO_3	g/ltr - Water Soluble Sulphate (Water or 2:1 Aqueous Soil Extract)	
+	Calcareous Reaction	
Cl	Chloride Content	
PI	Plasticity Index	
<425	% of material in sample passing 425 micron sieve	
LL	Liquid Limit	
PL	Plastic Limit	
MC	Water Content	
NP	Non Plastic	
Yb	Bulk Density	
Yd	Dry Density	
Ps	Particle Density	
U/D	Undrained/Drained Triaxial	
U/C	Unconsolidated/Consolidated Triaxial	
T/M	Single Stage/Multistage Triaxial	
100/38	Sample Diameter (mm)	
REM	Remoulded Triaxial Test Specimen	
TST	Triaxial Suction Test	
V	Vane Test	
DSB	Drained Shear Box	
RSB	Residual Shear Box	
RS	Ring Shear	
σ_3	Cell Pressure	
σ_1-σ_3	Deviator Stress	
c	Cohesion	
c_	Effective Cohesion Intercept	
ϕ	Angle of Shearing Resistance - Degrees	
ϕ_	Effective Angle of Shearing Resistance	
εf	Strain at Failure	
*	Failed under 1st Load	
**	Failed under 2nd Load	
#	Untestable	
##	Excessive Strain	
p_o	Effective Overburden Pressure	
m_v	Coefficient of Volume Decrease	
c_v	Coefficient of Consolidation	
Opt	Optimum	
Nat	Natural	
Std	Standard Compaction - 2.5kg Rammer	(¶ CBR)
Hvy	Heavy Compaction - 4.5kg Rammer	(§ CBR)
Vib	Vibratory Compaction	
CBR	California Bearing Ratio	
Sat m.c.	Saturation Moisture Content	
MCV	Moisture Condition Value	

PRIORITY GEOTECHNICAL

Natural Moisture Content/Atterberg Limits Summary

BS 1377 : Part 2 : 1990 : Clause 3

Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Job Ref P12012

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH01A	1	0.15	B	Silty very sandy GRAVEL		67	47	20	57.1
BH01A	2	0.6	D	Slightly sandy gravelly SILT	18				
BH01A	3	0.9	D	Silty very sandy GRAVEL	35				
BH08	2	1	B	Slightly sandy gravelly CLAY		30	19	11	70.1
BH10	1	1	D	Slightly sandy gravelly CLAY	11				
BH10	3	2	B	Slightly sandy gravelly CLAY with medium cobble content		24	14	10	66.2
BH11	2	1	D	Slightly gravelly sandy SILT	41				
BH11	3	1.2	B	Slightly gravelly sandy SILT with medium cobble content		44	31	13	82.1
BH11	4	1.8	D	Slightly gravelly sandy SILT	43				
BH11	5	2.8	D	Slightly sandy slightly gravelly SILT	29				
BH18	2	1	B	Very silty very sandy GRAVEL with high cobble content		19	14	5	58.7
BH18	3	1.8	D	Slightly sandy gravelly SILT	11				
BH32	2	1.2	B	Slightly sandy gravelly CLAY with high cobble content		28	18	10	68.6
BH40	1	0	B	Very clayey very sandy GRAVEL with high cobble content		24	16	8	68.8
TP01	2	0.4	D	Slightly sandy gravelly SILT	10				
TP01	3	1.4	B	Slightly sandy slightly gravelly SILT with high cobble content		17	13	4	62.5
TP01	4	1.4	D	Slightly sandy slightly gravelly SILT	10				
TP02	2	0	D	Slightly sandy slightly gravelly CLAY	10				
TP02	3	1	B	Slightly sandy slightly gravelly CLAY with low cobble content		30	22	8	58.4
TP02	4	1	D	Slightly sandy slightly gravelly CLAY	11				
TP03	2	0	D	Slightly sandy gravelly CLAY	25				
TP03	3	1	B	Slightly sandy gravelly CLAY with low cobble content		30	20	10	59.4

PRIORITY GEOTECHNICAL

Natural Moisture Content/Atterberg Limits Summary

BS 1377 : Part 2 : 1990 : Clause 3

Job Ref

Location

Dunkellin River & Aggard Stream Flood Relief Scheme

P12012

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
TP03	4	1	D	Slightly sandy gravelly CLAY	13				
TP04	2	0	D	Slightly sandy gravelly SILT	10				
TP04	3	1	B	Slightly sandy gravelly SILT		19	14	5	58.7
TP04	4	1	D	Slightly sandy gravelly SILT	11				
TP05	2	0	D	Slightly sandy gravelly SILT	11				
TP05	3	1	B	Slightly sandy gravelly SILT with low cobble content		17	NP	NP	61.3
TP05	4	1	D	Slightly sandy gravelly SILT	9.6				
TP06	2	0.3	D	Slightly sandy slightly gravelly SILT	10				
TP06	3	1	B	Slightly sandy slightly gravelly SILT with low cobble content		26	19	7	63.1
TP06	4	1	D	Slightly sandy slightly gravelly SILT	17				
TP07	1	1	B	Slightly sandy gravelly CLAY with low cobble content		34	23	11	61.5
TP07	2	1	D	Slightly sandy gravelly CLAY	11				
TP07	3	2	B	Slightly sandy gravelly CLAY		43	28	15	71
TP07	4	2	D	Slightly sandy gravelly CLAY	25				
TP08	2	0.2	D	Slightly sandy slightly gravelly SILT	19				
TP08	3	1	B	Slightly sandy slightly gravelly SILT with medium cobble content		60	41	19	84.4
TP08	4	1	D	Slightly sandy slightly gravelly SILT	46				
TP09	2	0.15	D	Slightly sandy gravelly SILT	27				
TP09	4	1	D	Slightly sandy gravelly SILT	29				
TP11	1	1	B	Silty sandy GRAVEL with medium cobble content		68	47	21	46.5
TP11	2	1	D	Silty sandy GRAVEL	21				
TP12	2	1	D	Slightly sandy slightly gravelly SILT	18				

PRIORITY GEOTECHNICAL

Natural Moisture Content/Atterberg Limits Summary

BS 1377 : Part 2 : 1990 : Clause 3

Job Ref

Location

Dunkellin River & Aggard Stream Flood Relief Scheme

P12012

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
TP13	1	1	B	Silty sandy GRAVEL with low cobble content		50	33	17	43.6
TP13	2	1	D	Silty sandy GRAVEL	13				
TP14	2	0.5	D	Slightly sandy slightly gravelly SILT	16				
TP14A	2	0.5	D	Slightly sandy slightly gravelly SILT	13				
TP15	2	0	D	Slightly sandy slightly gravelly SILT	21				
TP15	4	1	D	Slightly sandy slightly gravelly SILT	11				
TP15A	2	0	D	Slightly gravelly sandy SILT	23				
TP15A	3	1	B	Slightly gravelly sandy SILT		47	31	16	79.3
TP15A	4	1	D	Slightly gravelly sandy SILT	24				
TP17	2	0.2	D	Slightly sandy slightly gravelly SILT	13				
TP18	1	0.4	B	Slightly sandy gravelly SILT		50	34	16	53.8
TP18	2	0.4	D	Slightly sandy gravelly SILT	14				
TP18A	1	0.4	B	Very silty very sandy GRAVEL with low cobble content		32	24	8	53.6
TP18A	2	0.4	D	Very silty very sandy GRAVEL	14				
TP19	1	0	B	Silty very sandy GRAVEL with low cobble content		42	31	11	45.3
TP19	2	0	D	Silty very sandy GRAVEL with low cobble content	13				
TP20	2	0.5	D	Slightly sandy gravelly SILT	12				
TP21	1	1	B	Slightly sandy gravelly SILT with low cobble content		19	NP	NP	61
TP21	2	1	D	Slightly sandy gravelly SILT	9.2				
TP21	4	2	D	Slightly sandy gravelly SILT	9.8				
TP21A	1	0.4	B	Slightly sandy CLAY		36	19	17	99.3
TP21A	2	0.4	D	Slightly sandy CLAY	27				

PRIORITY GEOTECHNICAL	**Natural Moisture Content/Atterberg Limits Summary** **BS 1377 : Part 2 : 1990 : Clause 3**	**Job Ref**
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	**P12012**

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
TP22	2	0	D	Slightly sandy slightly gravelly CLAY	19				
TP22B	2	0.5	D	Slightly sandy slightly gravelly CLAY	35				
TP23	1	0	B	Slightly sandy gravelly SILT		95	77	18	44.7
TP23	2	0	D	Slightly sandy gravelly SILT	27				
TP24	2	0	D	Slightly sandy gravelly SILT	9.2				
TP25	1	1	B	Slightly sandy gravelly SILT		16	NP	NP	52.2
TP25	2	1	D	Slightly sandy gravelly SILT	8.3				
TP26	2	1	D	Slightly sandy gravelly SILT	9.0				
TP27	1	0.2	B	Slightly gravelly sandy CLAY		23	16	7	87
TP27	2	0.2	D	Slightly gravelly sandy CLAY	13				
TP28	1	0	B	Slightly sandy gravelly SILT		226	131	95	97.9
TP28	2	0	D	Slightly sandy gravelly SILT	307				
TP28	3	1.7	B	Slightly sandy gravelly CLAY with low cobble content		35	23	12	26.8
TP28	4	1.7	D	Slightly sandy gravelly CLAY	53				
TP29	1	1.5	B	Silty very sandy GRAVEL with high cobble content		52	34	18	61.9
TP29	2	1.5	D	Silty very sandy GRAVEL	18				
TP31	2	0	D	Slightly sandy slightly gravelly CLAY	7.9				
TP31	3	2	B	Slightly sandy slightly gravelly CLAY		34	21	13	95.1
TP31	4	2	D	Slightly sandy slightly gravelly CLAY	22				
TP32	2	0	D	Slightly gravelly SILT	14				
TP32	4	0.8	D	Slightly sandy gravelly CLAY	15				
TP33	2	0.2	D	Silty very sandy GRAVEL	13				

PRIORITY GEOTECHNICAL

Natural Moisture Content/Atterberg Limits Summary

BS 1377 : Part 2 : 1990 : Clause 3

Job Ref

Location

Dunkellin River & Aggard Stream Flood Relief Scheme

P12012

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
TP34	2	0	D	Slightly sandy slightly gravelly SILT	20				
TP36	1	0.5	B	Slightly sandy gravelly SILT with medium cobble content		16	11	5	57.8
TP36	2	0.5	D	Slightly sandy gravelly SILT	8.2				
TP36	3	1.5	B	Slightly sandy gravelly SILT with medium cobble content		17	13	4	57.8
TP36	4	1.5	D	Slightly sandy gravelly SILT	9.2				
TP37	2	0.6	D	Slightly sandy CLAY	20				
TP37	4	1.6	D	Slightly sandy gravelly CLAY	39				

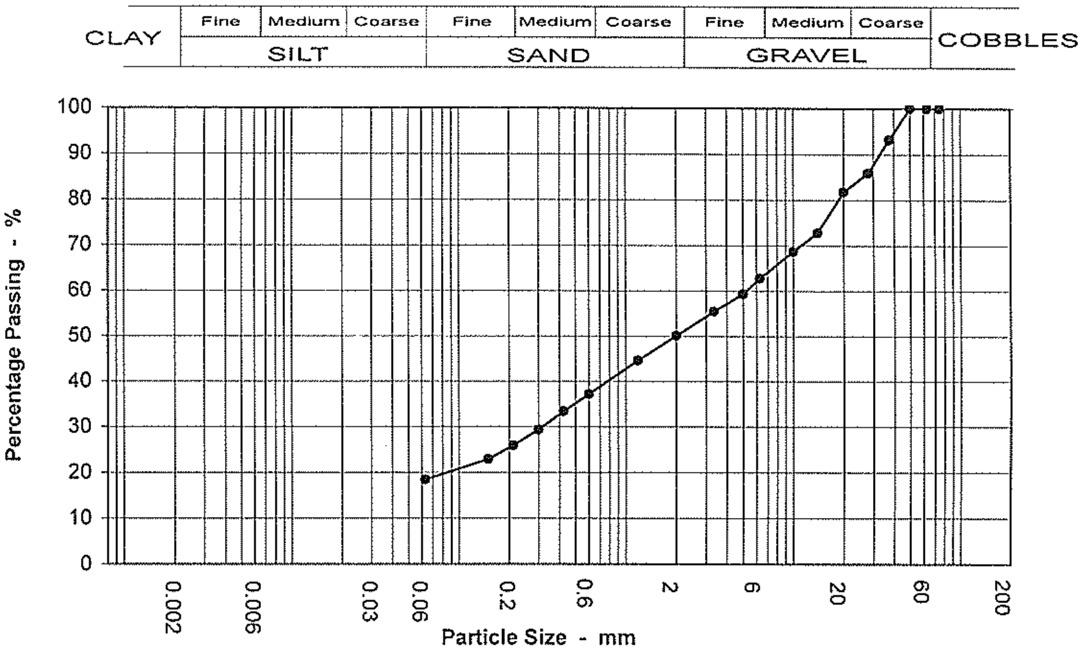
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	BH01A
Sample No	1
Depth	0.15 m
Sample type	B

Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Silty very sandy GRAVEL



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	93		
28	86		
20	82		
14	73		
10	69		
6.3	63		
5	59		
3.35	55		
2	50		
1.18	45		
0.6	37		
0.425	33		
0.3	29		
0.212	26		
0.15	23		
0.063	18		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	50.0
Sand	31.6
Silt & Clay	18.4

Grading Analysis	
D100	50.000
D60	5.273
D10	
Uniformity Coefficient	N/A

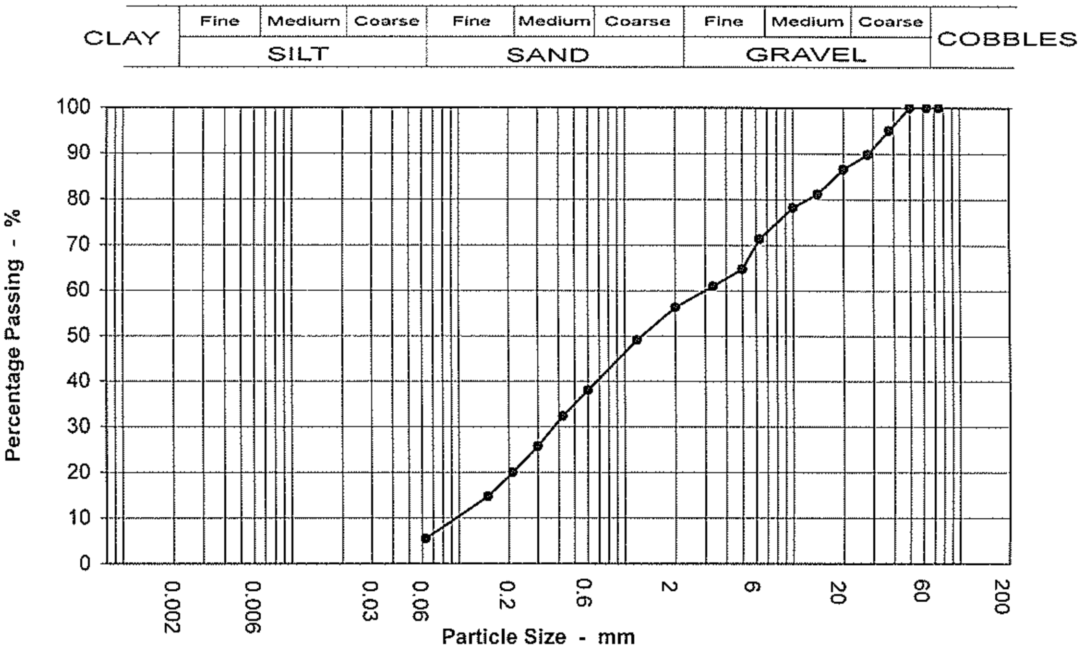
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	**P12012**
Borehole / Pit No	BH03
Sample No	2
Depth	1.00 m
Sample type	B

Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**
Soil Description	Silty very gravelly SAND



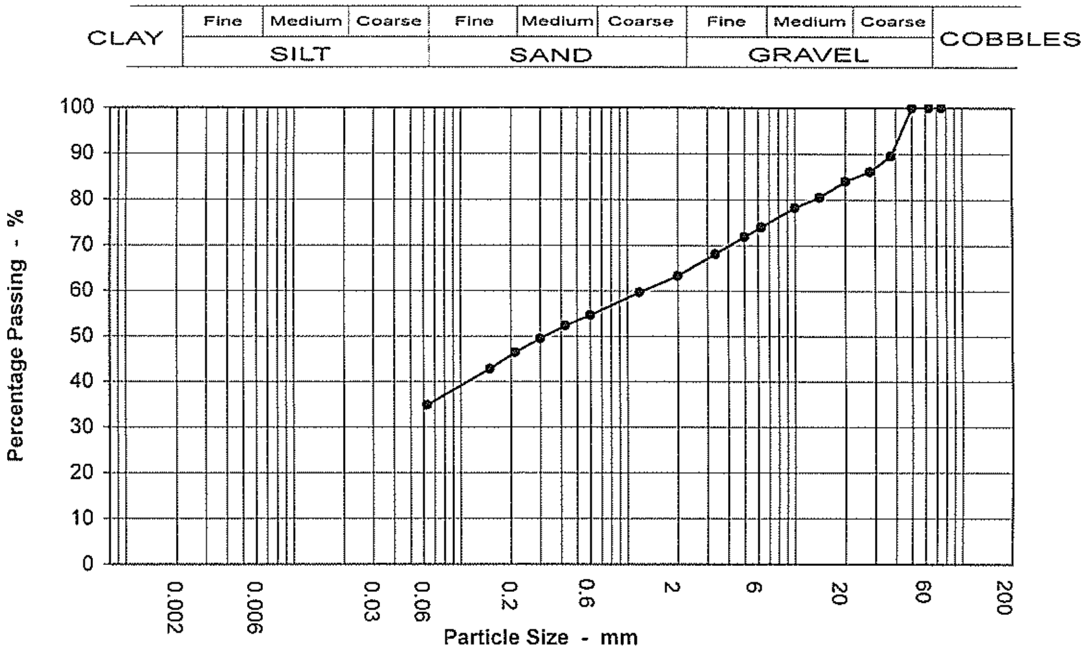
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	95		
28	90		
20	87		
14	81		
10	78		
6.3	71		
5	65		
3.35	61		
2	56		
1.18	49		
0.6	38		
0.425	32		
0.3	26		
0.212	20		
0.15	15		
0.063	5		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	43.7
Sand	50.8
Silt & Clay	5.5

Grading Analysis	
D100	50.000
D60	3.077
D10	0.106
Uniformity Coefficient	29

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	BH08
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	2
		Depth	1.00 m
Soil Description	Slightly sandy gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	90		
28	86		
20	84		
14	80		
10	78		
6.3	74		
5	72		
3.35	68		
2	63		
1.18	60		
0.6	55		
0.425	52		
0.3	49		
0.212	46		
0.15	43		
0.063	35		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	36.7
Sand	28.5
Silt & Clay	34.8

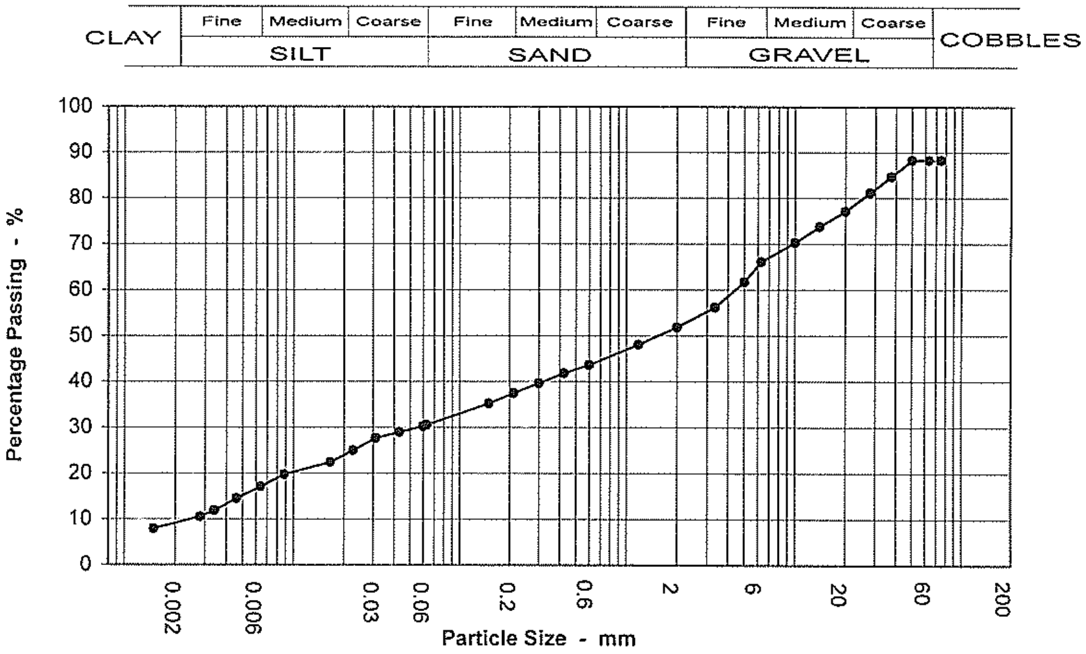
Grading Analysis	
D100	50.000
D60	1.261
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	BH10
Sample No	3
Depth	2.00 m
Sample type	B
Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Slightly sandy gravelly CLAY with medium cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.060	30
90	100	0.043	29
75	88	0.031	28
63	88	0.023	25
50	88	0.017	22
37.5	85	0.009	20
28	81	0.006	17
20	77	0.005	14
14	74	0.003	12
10	70	0.003	11
6.3	66	0.002	8
5	62		
3.35	56		
2	52		
1.18	48		
0.6	44		
0.425	42		
0.3	40		
0.212	37		
0.15	35		
0.063	30		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	11.8
Gravel	36.4
Sand	21.6
Silt	21.3
Clay	8.9

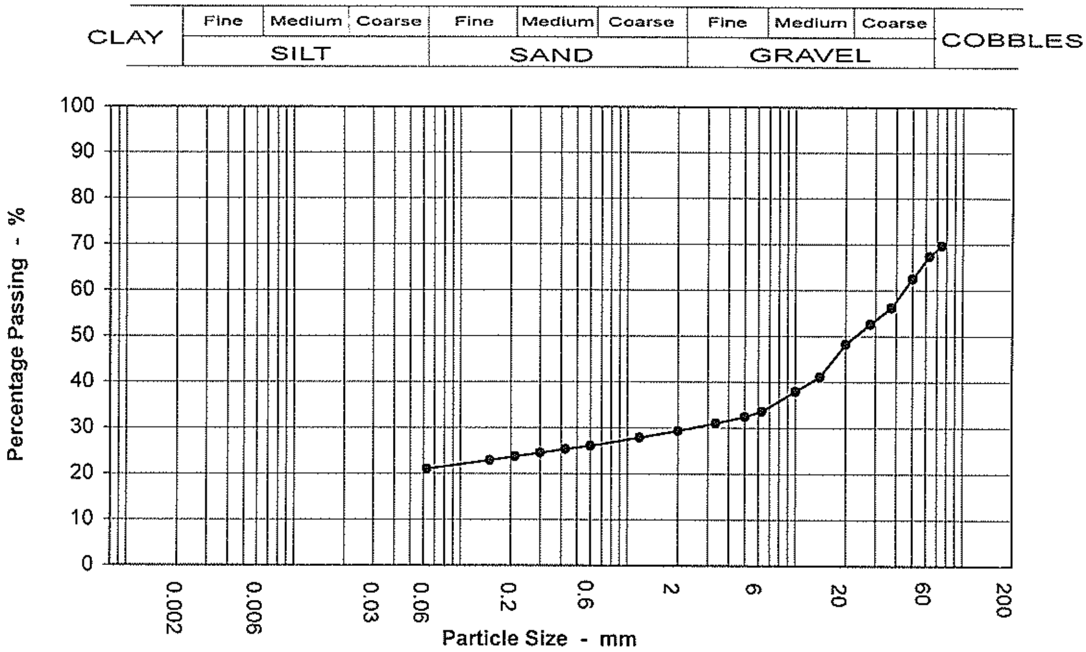
Grading Analysis	
D100	90.000
D60	4.505
D10	0.003
Uniformity Coefficient	1772

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P12012
		Borehole / Pit No	BH10
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	4
		Depth	3.00 m
Soil Description	Slightly sandy gravelly CLAY with high cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	70		
90	70		
75	70		
63	67		
50	62		
37.5	56		
28	53		
20	48		
14	41		
10	38		
6.3	34		
5	32		
3.35	31		
2	29		
1.18	28		
0.6	26		
0.425	25		
0.3	25		
0.212	24		
0.15	23		
0.063	21		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	33.8
Gravel	36.8
Sand	8.3
Silt & Clay	21.0

Grading Analysis	
D100	125.000
D60	45.173
D10	
Uniformity Coefficient	N/A

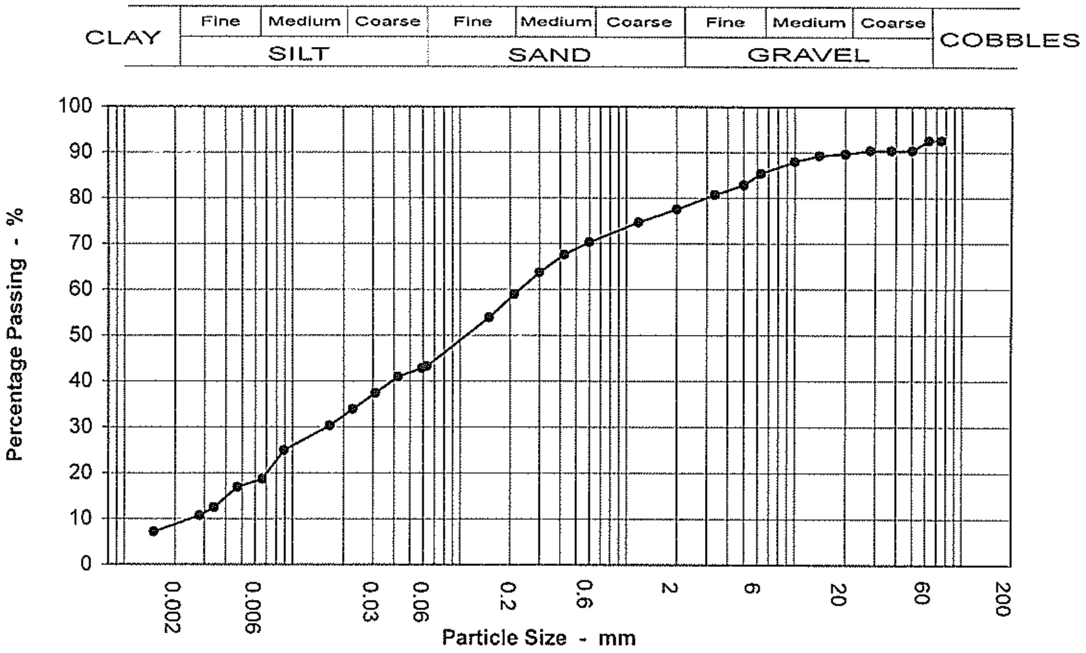
PRIORITY
GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	BH11
Sample No	3
Depth	1.20 m
Sample type	B

Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**
Soil Description	Slightly gravelly sandy SILT with medium cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	43
90	100	0.043	41
75	93	0.031	37
63	93	0.023	34
50	90	0.017	30
37.5	90	0.009	25
28	90	0.007	19
20	90	0.005	17
14	89	0.003	12
10	88	0.003	11
6.3	85	0.002	7
5	83		
3.35	81		
2	77		
1.18	75		
0.6	70		
0.425	68		
0.3	64		
0.212	59		
0.15	54		
0.063	43		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	8.0
Gravel	14.6
Sand	34.6
Silt	34.4
Clay	8.5

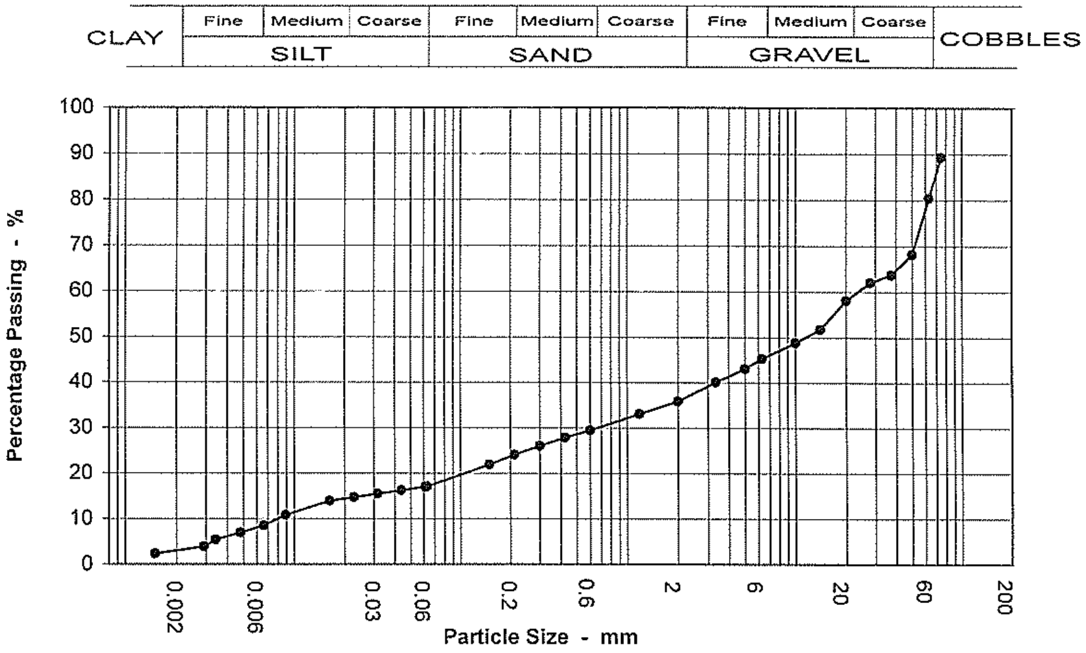
Grading Analysis	
D100	90.000
D60	0.233
D10	0.003
Uniformity Coefficient	92

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P12012
		Borehole / Pit No	BH18
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	2
		Depth	1.00 m
Soil Description	Very silty very sandy GRAVEL with high cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.061	17
90	89	0.044	16
75	89	0.032	15
63	80	0.023	15
50	68	0.016	14
37.5	64	0.009	11
28	62	0.007	8
20	58	0.005	7
14	52	0.003	5
10	49	0.003	4
6.3	45	0.002	2
5	43		
3.35	40		
2	36		
1.18	33		
0.6	29		
0.425	28		
0.3	26		
0.212	24		
0.15	22		
0.063	17		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	22.4
Gravel	41.7
Sand	18.9
Silt	14.1
Clay	2.9

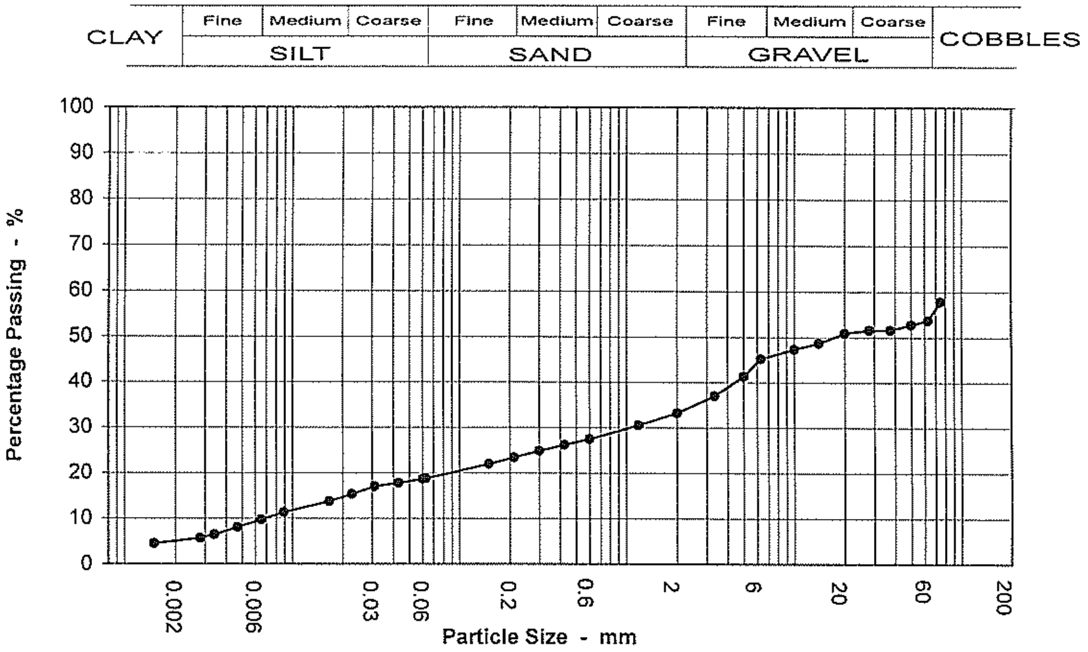
Grading Analysis	
D100	125.000
D60	23.922
D10	0.008
Uniformity Coefficient	2954

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	**Job Ref**	**P12012**
		Borehole / Pit No	BH32
		Sample No	2
Soil Description	Slightly sandy gravelly CLAY with high cobble content	Depth	1.20 m
		Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	58	0.060	19
90	58	0.043	18
75	58	0.031	17
63	54	0.023	15
50	53	0.017	14
37.5	52	0.009	11
28	52	0.007	10
20	51	0.005	8
14	49	0.003	6
10	47	0.003	6
6.3	45	0.002	4
5	41		
3.35	37		
2	33		
1.18	31		
0.6	27		
0.425	26		
0.3	25		
0.212	23		
0.15	22		
0.063	19		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	46.5
Gravel	20.3
Sand	14.6
Silt	13.7
Clay	4.9

Grading Analysis	
D100	125.000
D60	125.000
D10	0.007
Uniformity Coefficient	18000

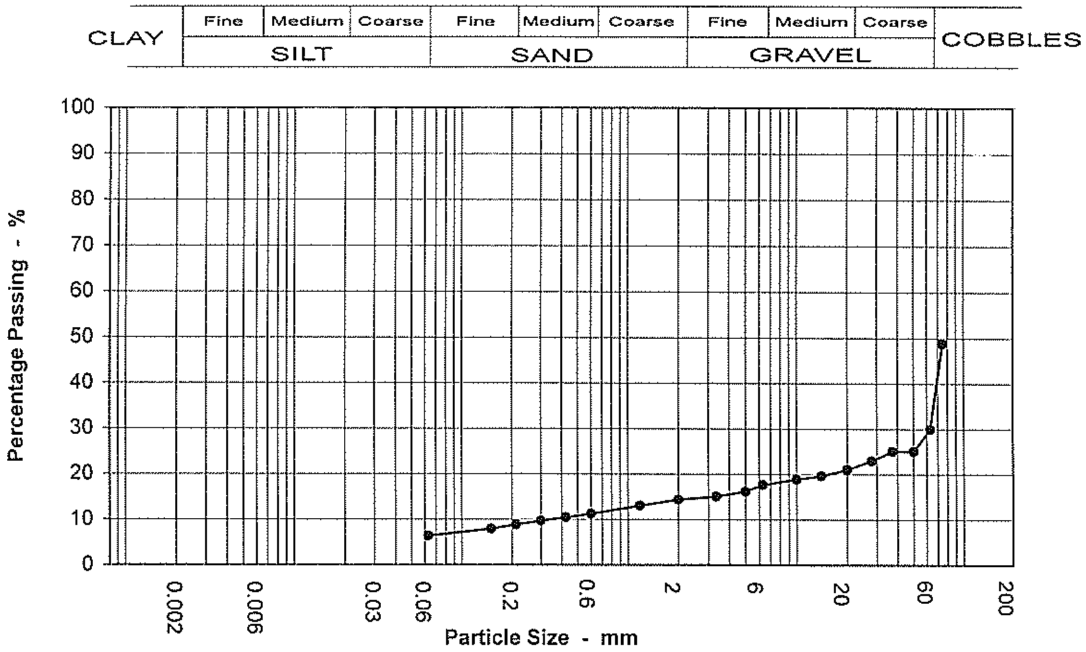
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	BH40
Sample No	1
Depth	0.00 m
Sample type	B

Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Very clayey very sandy GRAVEL with high cobble content



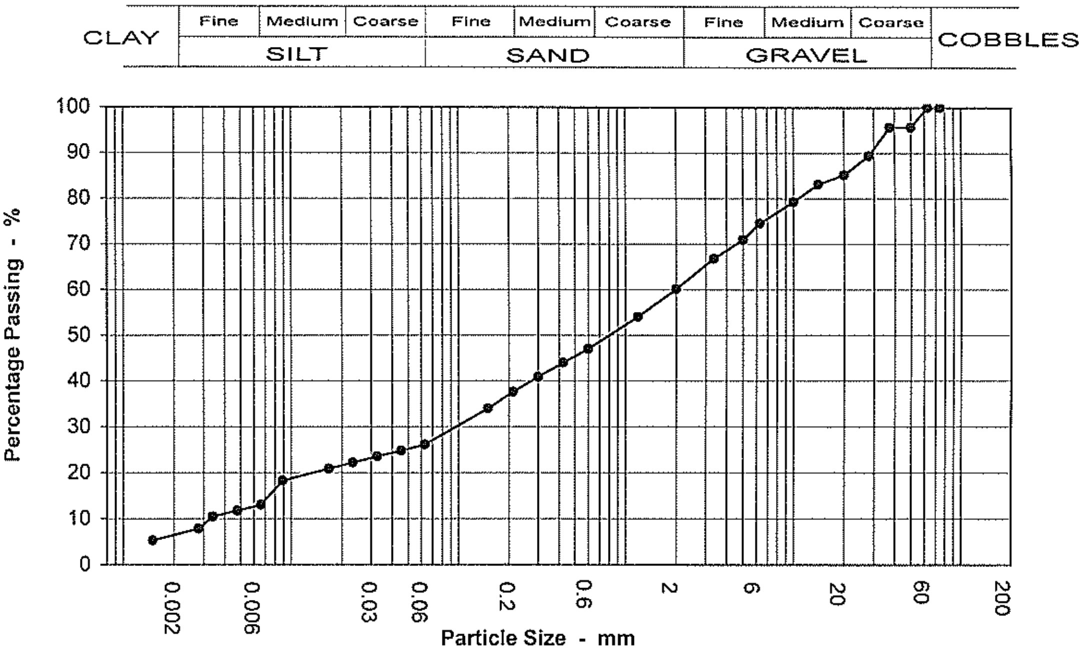
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	76		
90	64		
75	49		
63	30		
50	25		
37.5	25		
28	23		
20	21		
14	20		
10	19		
6.3	18		
5	16		
3.35	15		
2	14		
1.18	13		
0.6	11		
0.425	10		
0.3	10		
0.212	9		
0.15	8		
0.063	6		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	71.2
Gravel	14.5
Sand	8.0
Silt & Clay	6.4

Grading Analysis	
D100	125.000
D60	85.743
D10	0.360
Uniformity Coefficient	239

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP01
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.40 m
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample type	B



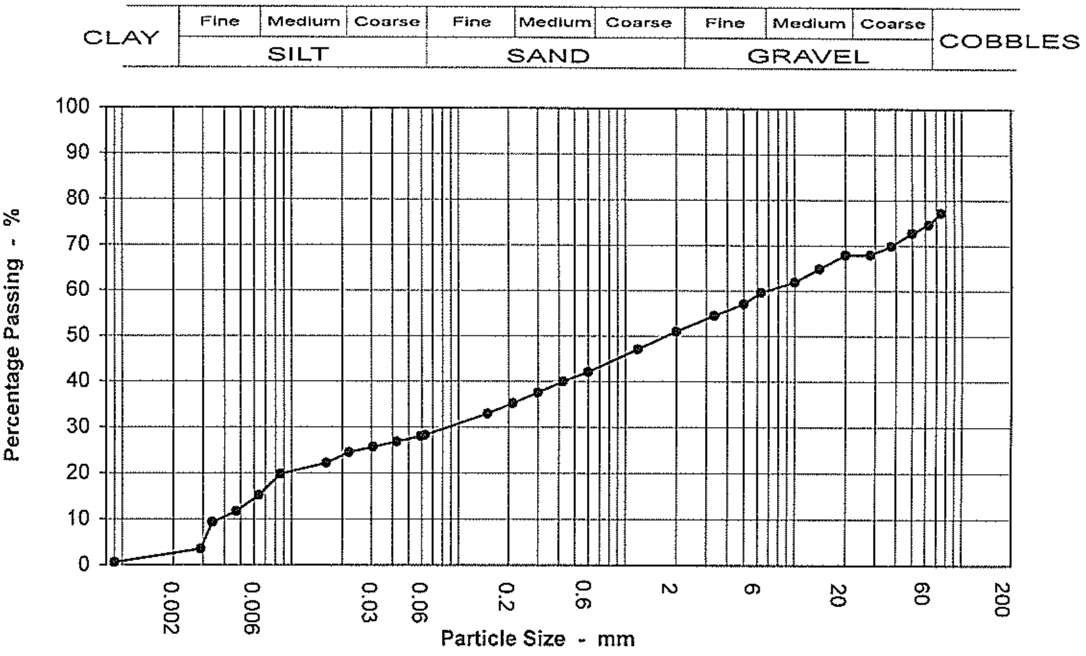
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	26
90	100	0.045	25
75	100	0.033	23
63	100	0.023	22
50	96	0.017	21
37.5	96	0.009	18
28	89	0.007	13
20	85	0.005	12
14	83	0.003	10
10	79	0.003	8
6.3	75	0.002	5
5	71		
3.35	67		
2	60		
1.18	54		
0.6	47		
0.425	44		
0.3	41		
0.212	38		
0.15	34		
0.063	26		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	1.0
Gravel	38.9
Sand	34.2
Silt	19.6
Clay	6.2

Grading Analysis	
D100	63.000
D60	1.992
D10	0.003
Uniformity Coefficient	604

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP01
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.40 m
Soil Description	Slightly sandy slightly gravelly SILT with high cobble content	Sample type	B



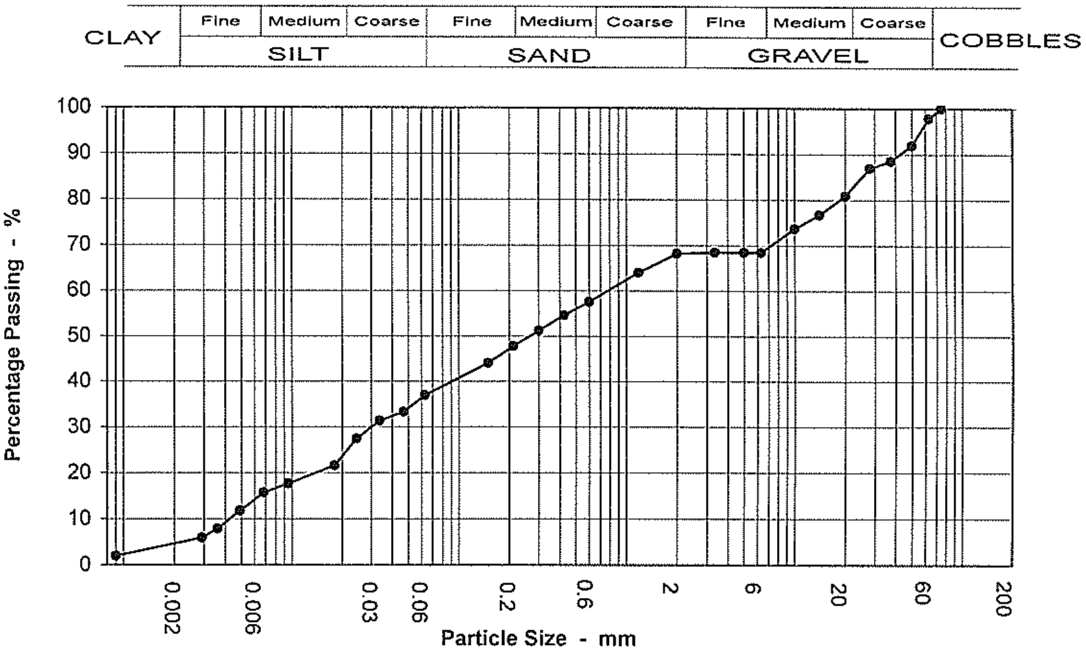
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	77	0.059	28
90	77	0.043	27
75	77	0.031	26
63	75	0.022	24
50	73	0.016	22
37.5	70	0.009	20
28	68	0.006	15
20	68	0.005	12
14	65	0.003	9
10	62	0.003	4
6.3	60	0.001	1
5	57		
3.35	54		
2	51		
1.18	47		
0.6	42		
0.425	40		
0.3	38		
0.212	35		
0.15	33		
0.063	28		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	25.9
Gravel	23.2
Sand	22.9
Silt	25.9
Clay	2.2

Grading Analysis	
D100	125.000
D60	6.971
D10	0.004
Uniformity Coefficient	1847

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP02
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content	Sample type	B



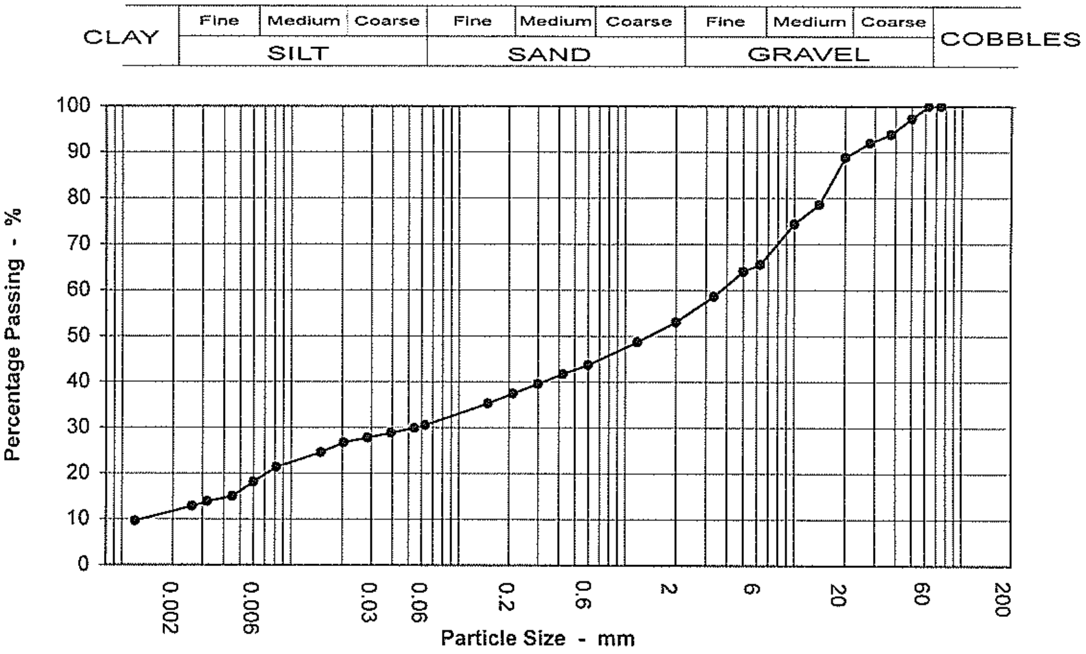
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	37
90	100	0.047	33
75	100	0.034	31
63	98	0.024	27
50	92	0.018	22
37.5	89	0.010	18
28	87	0.007	16
20	81	0.005	12
14	77	0.004	8
10	74	0.003	6
6.3	68	0.001	2
5	68		
3.35	68		
2	68		
1.18	64		
0.6	58		
0.425	55		
0.3	51		
0.212	48		
0.15	44		
0.063	37		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	3.5
Gravel	28.3
Sand	31.9
Silt	32.2
Clay	4.1

Grading Analysis	
D100	75.000
D60	0.823
D10	0.004
Uniformity Coefficient	191

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP03
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.054	30
90	100	0.039	29
75	100	0.028	28
63	100	0.021	27
50	97	0.015	25
37.5	94	0.008	21
28	92	0.006	18
20	89	0.005	15
14	79	0.003	14
10	74	0.003	13
6.3	65	0.001	10
5	64		
3.35	59		
2	53		
1.18	49		
0.6	44		
0.425	42		
0.3	40		
0.212	37		
0.15	35		
0.063	31		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.6
Gravel	46.4
Sand	22.7
Silt	18.9
Clay	11.4

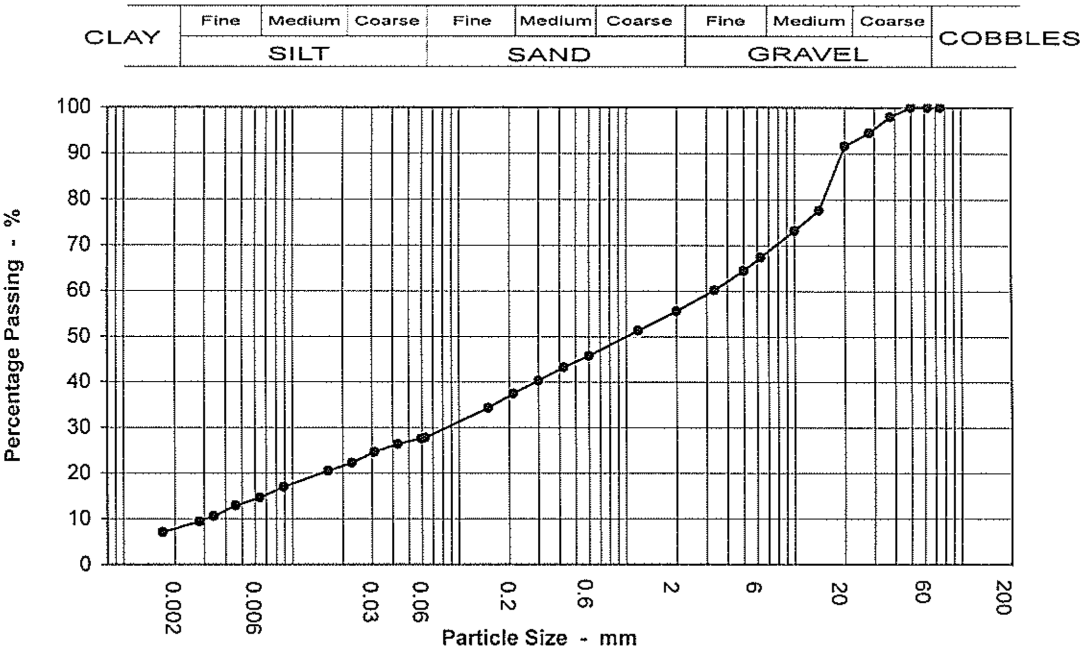
Grading Analysis	
D100	63.000
D60	3.787
D10	0.001
Uniformity Coefficient	2763

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	TP04
Sample No	3
Depth	1.00 m
Sample type	B
Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Slightly sandy gravelly SILT



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.060	28
90	100	0.043	26
75	100	0.031	25
63	100	0.023	22
50	100	0.016	21
37.5	98	0.009	17
28	94	0.006	15
20	92	0.005	13
14	78	0.003	11
10	73	0.003	9
6.3	67	0.002	7
5	64		
3.35	60		
2	56		
1.18	51		
0.6	46		
0.425	43		
0.3	40		
0.212	37		
0.15	34		
0.063	28		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	44.5
Sand	28.0
Silt	19.9
Clay	7.7

Grading Analysis	
D100	50.000
D60	3.289
D10	0.003
Uniformity Coefficient	1055

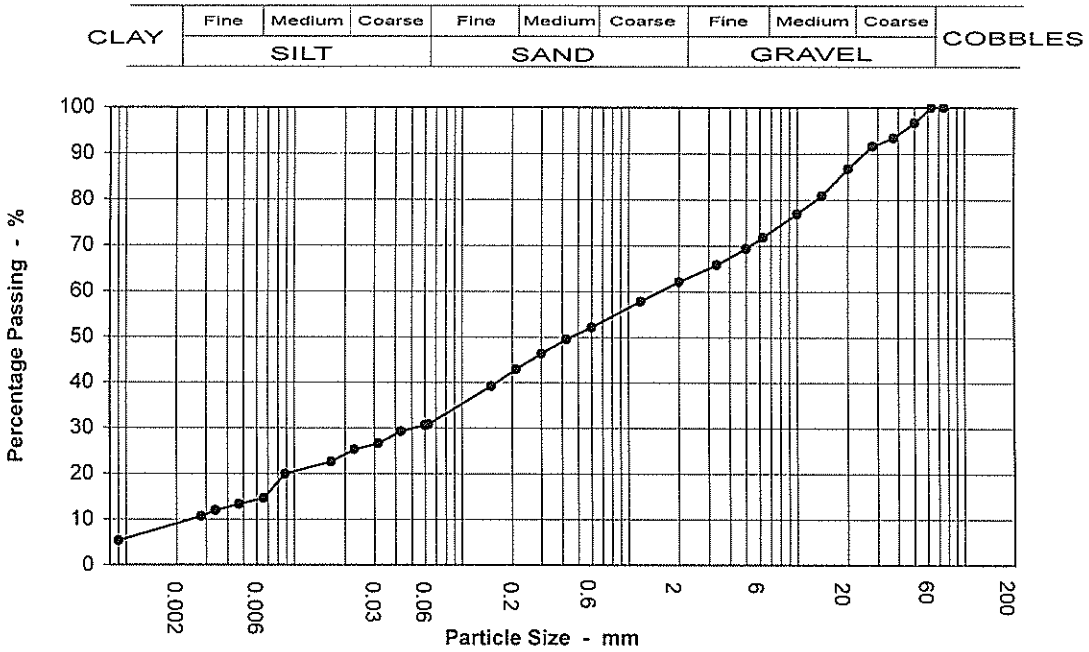
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	TP05
Sample No	1
Depth	0.00 m
Sample type	B

Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**
Soil Description	Slightly sandy gravelly SILT with low cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.060	31
90	100	0.043	29
75	100	0.032	27
63	100	0.023	25
50	97	0.017	23
37.5	93	0.009	20
28	92	0.007	15
20	87	0.005	13
14	81	0.003	12
10	77	0.003	11
6.3	72	0.001	5
5	69		
3.35	66		
2	62		
1.18	58		
0.6	52		
0.425	49		
0.3	46		
0.212	43		
0.15	39		
0.063	31		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.8
Gravel	37.2
Sand	31.5
Silt	22.2
Clay	8.4

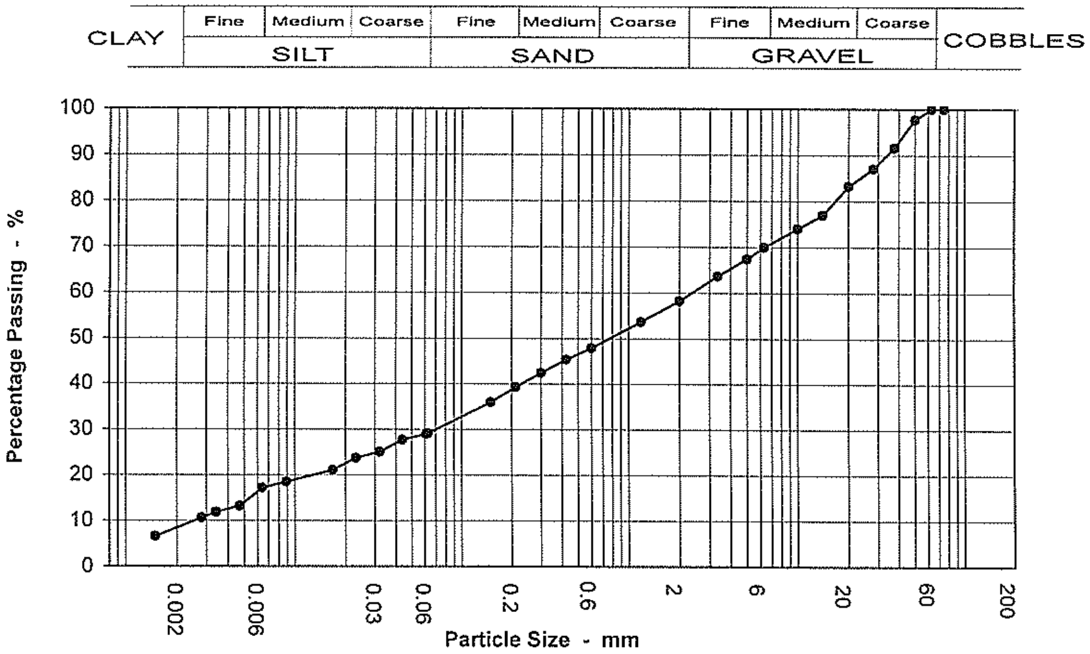
Grading Analysis	
D100	63.000
D60	1.603
D10	0.003
Uniformity Coefficient	623

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P12012**
		Borehole / Pit No	TP05
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.061	29
90	100	0.044	28
75	100	0.032	25
63	100	0.023	24
50	98	0.017	21
37.5	92	0.009	18
28	87	0.006	17
20	83	0.005	13
14	77	0.003	12
10	74	0.003	11
6.3	70	0.002	7
5	67		
3.35	64		
2	58		
1.18	54		
0.6	48		
0.425	45		
0.3	42		
0.212	39		
0.15	36		
0.063	29		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.5
Gravel	41.3
Sand	29.3
Silt	20.8
Clay	8.1

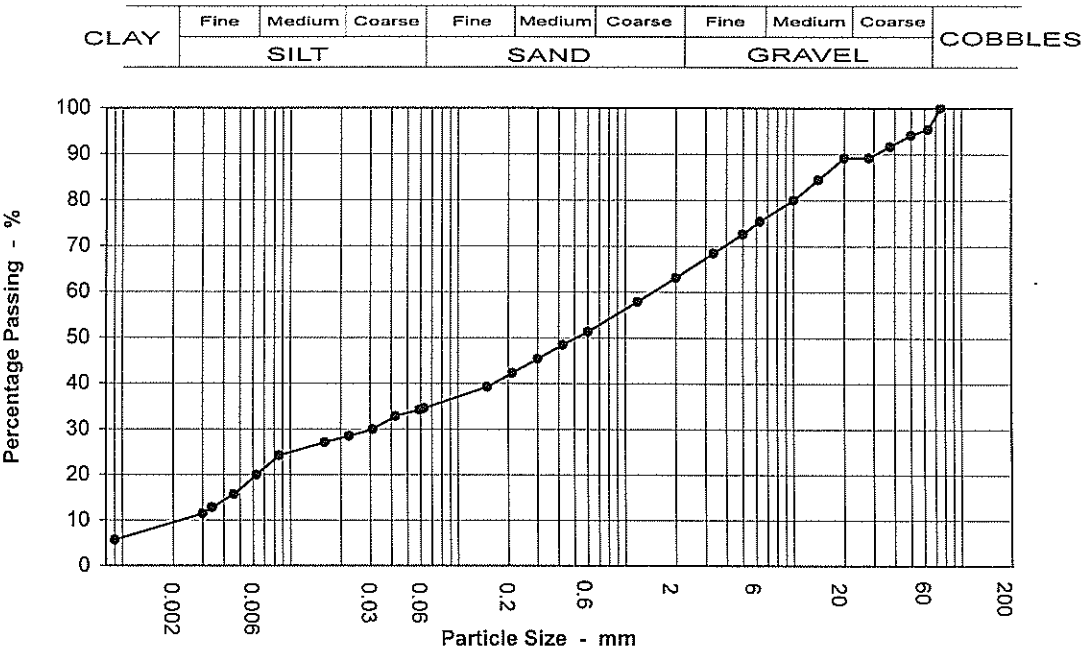
Grading Analysis	
D100	63.000
D60	2.447
D10	0.003
Uniformity Coefficient	933

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P12012**
		Borehole / Pit No	TP06
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy slightly gravelly SILT with low cobble content	Sample type	B



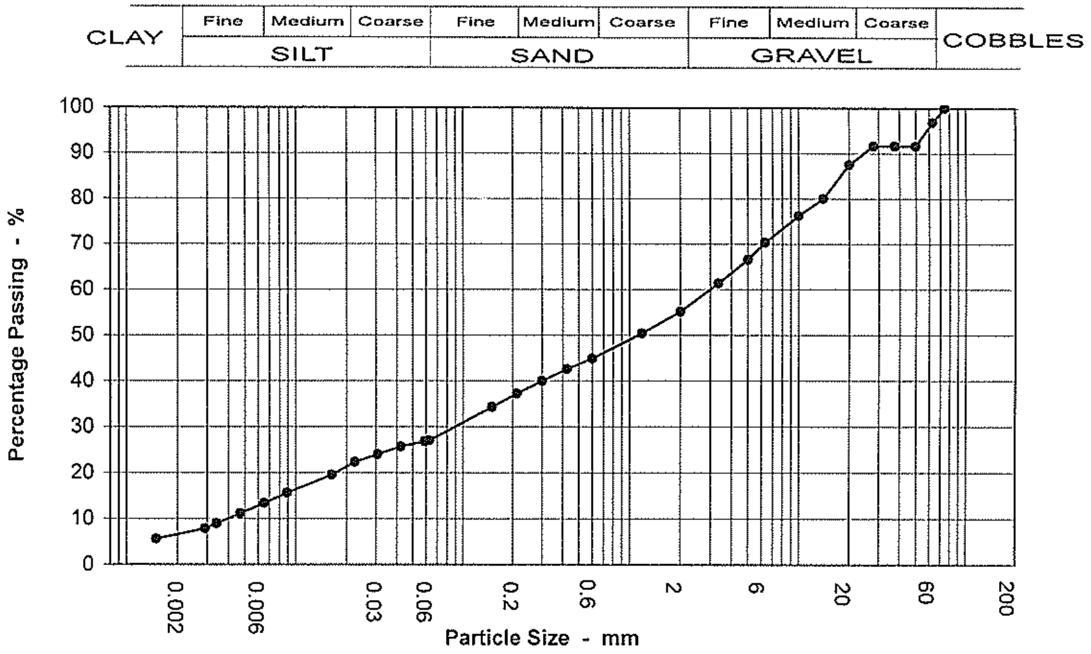
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	34
90	100	0.043	33
75	100	0.031	30
63	95	0.022	29
50	94	0.016	27
37.5	92	0.009	24
28	89	0.006	20
20	89	0.005	16
14	84	0.003	13
10	80	0.003	11
6.3	75	0.001	6
5	73		
3.35	68		
2	63		
1.18	58		
0.6	51		
0.425	48		
0.3	45		
0.212	42		
0.15	39		
0.063	35		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	4.9
Gravel	32.0
Sand	28.8
Silt	25.6
Clay	8.7

Grading Analysis	
D100	75.000
D60	1.523
D10	0.002
Uniformity Coefficient	613

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP07
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	1.00 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	27
90	100	0.043	26
75	100	0.031	24
63	97	0.022	22
50	92	0.016	20
37.5	92	0.009	16
28	92	0.007	13
20	87	0.005	11
14	80	0.003	9
10	76	0.003	8
6.3	70	0.002	6
5	66		
3.35	61		
2	55		
1.18	50		
0.6	45		
0.425	43		
0.3	40		
0.212	37		
0.15	34		
0.063	27		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	4.4
Gravel	40.6
Sand	28.2
Silt	20.5
Clay	6.4

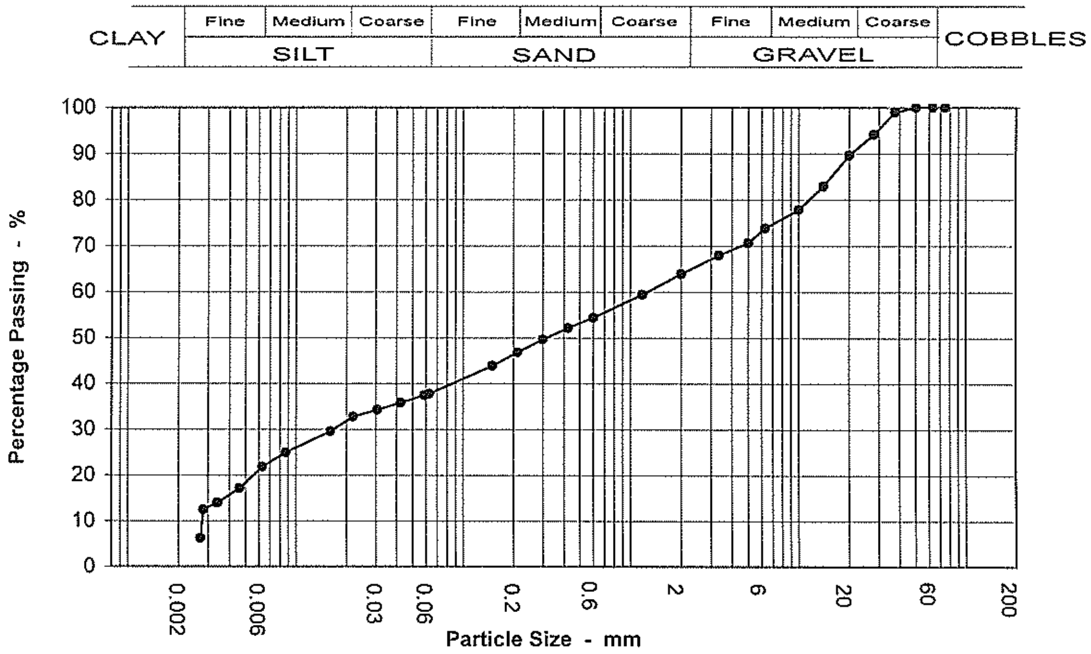
Grading Analysis	
D100	75.000
D60	3.061
D10	0.004
Uniformity Coefficient	761

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P12012
		Borehole / Pit No	TP07
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
		Depth	2.00 m
Soil Description	Slightly sandy gravelly CLAY	Sample type	B



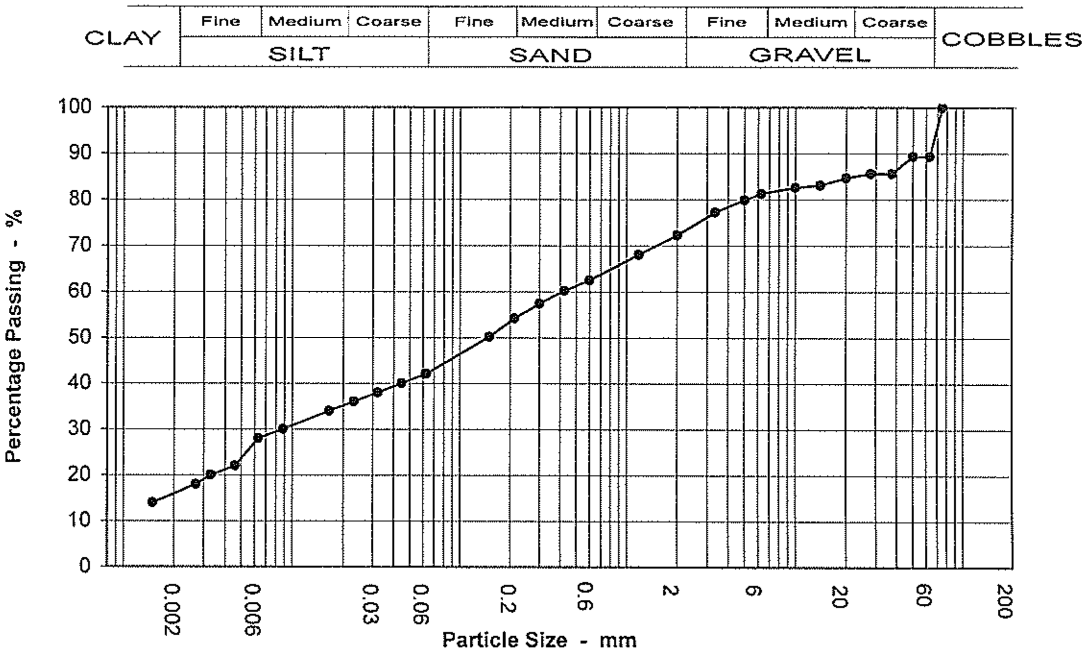
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	37
90	100	0.043	36
75	100	0.031	34
63	100	0.022	33
50	100	0.016	30
37.5	99	0.009	25
28	94	0.006	22
20	90	0.005	17
14	83	0.003	14
10	78	0.003	12
6.3	74	0.003	6
5	71		
3.35	68		
2	64		
1.18	59		
0.6	54		
0.425	52		
0.3	50		
0.212	47		
0.15	44		
0.063	38		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	36.1
Sand	26.3
Silt & Clay	31.3

Grading Analysis	
D100	50.000
D60	1.284
D10	0.003
Uniformity Coefficient	465

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP08
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy slightly gravelly SILT with medium cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.062	42
90	100	0.045	40
75	100	0.032	38
63	89	0.023	36
50	89	0.017	34
37.5	86	0.009	30
28	86	0.006	28
20	85	0.005	22
14	83	0.003	20
10	83	0.003	18
6.3	81	0.002	14
5	80		
3.35	77		
2	72		
1.18	68		
0.6	62		
0.425	60		
0.3	57		
0.212	54		
0.15	50		
0.063	42		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	10.7
Gravel	17.1
Sand	30.4
Silt	26.1
Clay	15.7

Grading Analysis	
D100	75.000
D60	0.418
D10	
Uniformity Coefficient	N/A

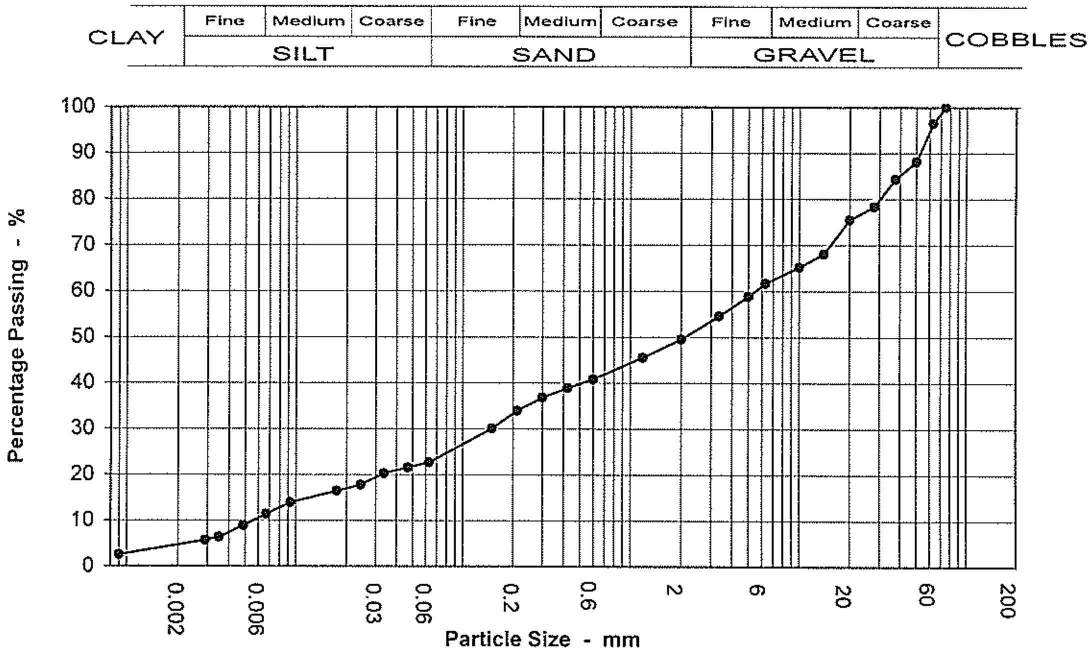
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	TP09
Sample No	3
Depth	1.00 m
Sample type	B

Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**
Soil Description	Slightly sandy gravelly SILT with medium cobble content



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	23
90	100	0.047	22
75	100	0.034	20
63	96	0.024	18
50	88	0.018	16
37.5	84	0.009	14
28	78	0.007	11
20	75	0.005	9
14	68	0.004	6
10	65	0.003	6
6.3	62	0.001	3
5	59		
3.35	55		
2	49		
1.18	45		
0.6	41		
0.425	39		
0.3	37		
0.212	34		
0.15	30		
0.063	23		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	5.5
Gravel	45.1
Sand	27.0
Silt	18.2
Clay	4.3

Grading Analysis	
D100	75.000
D60	5.554
D10	0.006
Uniformity Coefficient	974

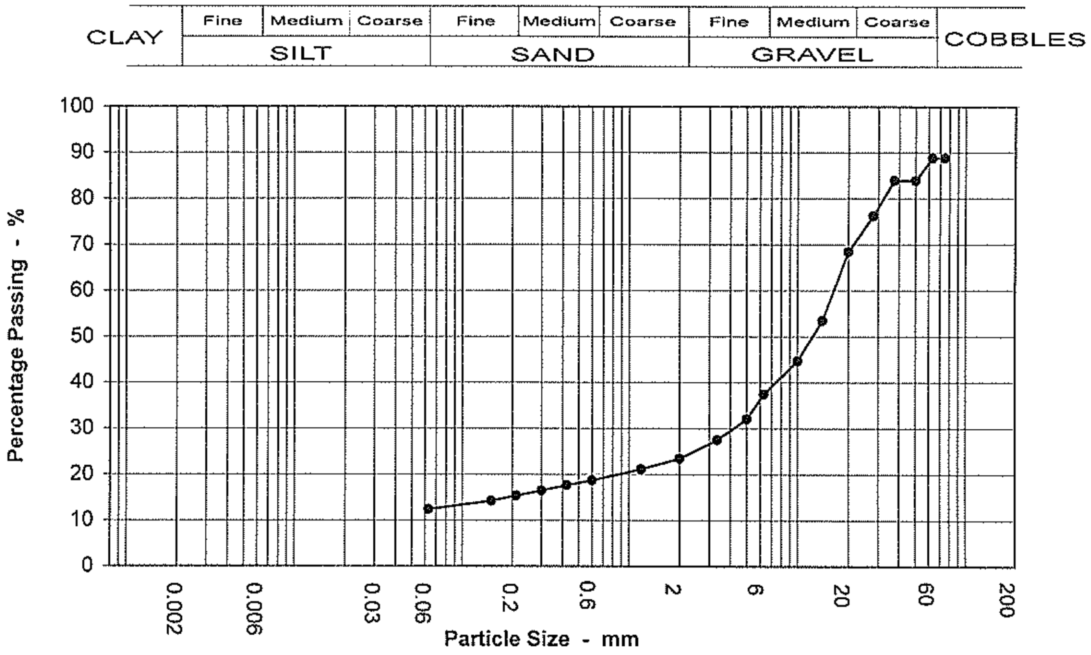
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	TP11
Sample No	1
Depth	1.00 m
Sample type	B

Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Silty sandy GRAVEL with medium cobble content



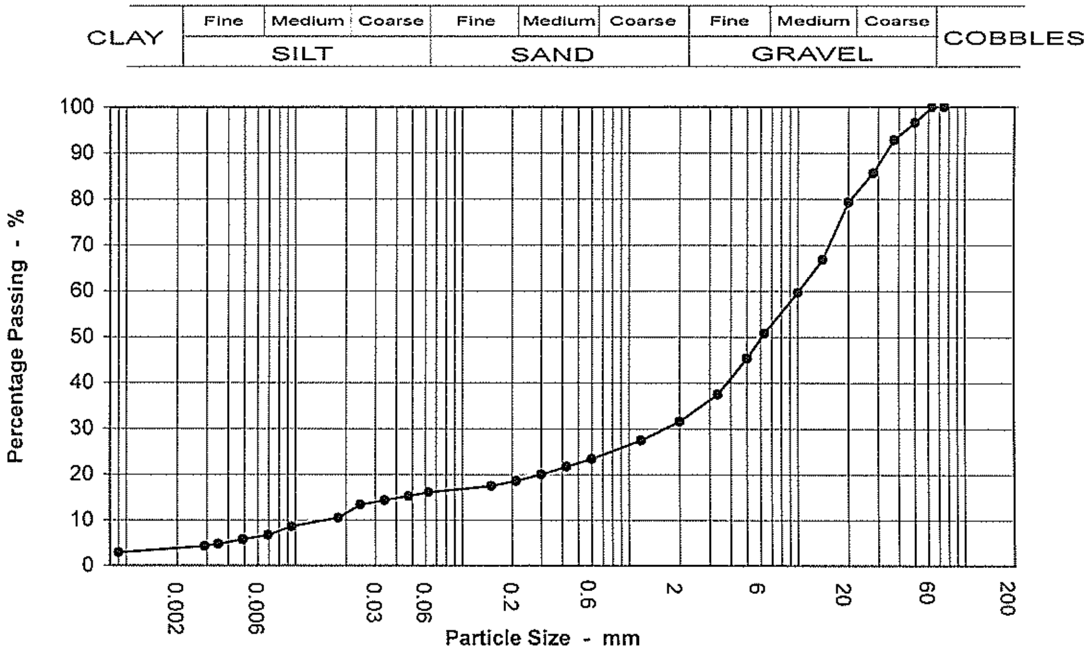
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	89		
63	89		
50	84		
37.5	84		
28	76		
20	68		
14	53		
10	45		
6.3	37		
5	32		
3.35	28		
2	23		
1.18	21		
0.6	19		
0.425	18		
0.3	16		
0.212	15		
0.15	14		
0.063	12		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	12.4
Gravel	64.1
Sand	11.1
Silt & Clay	12.4

Grading Analysis	
D100	90.000
D60	16.649
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP13
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	1.00 m
Soil Description	Silty sandy GRAVEL with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	16
90	100	0.048	15
75	100	0.034	14
63	100	0.024	13
50	97	0.018	11
37.5	93	0.010	9
28	86	0.007	7
20	79	0.005	6
14	67	0.004	5
10	60	0.003	4
6.3	51	0.001	3
5	45		
3.35	37		
2	32		
1.18	28		
0.6	23		
0.425	22		
0.3	20		
0.212	19		
0.15	17		
0.063	16		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.8
Gravel	67.6
Sand	15.7
Silt	12.3
Clay	3.7

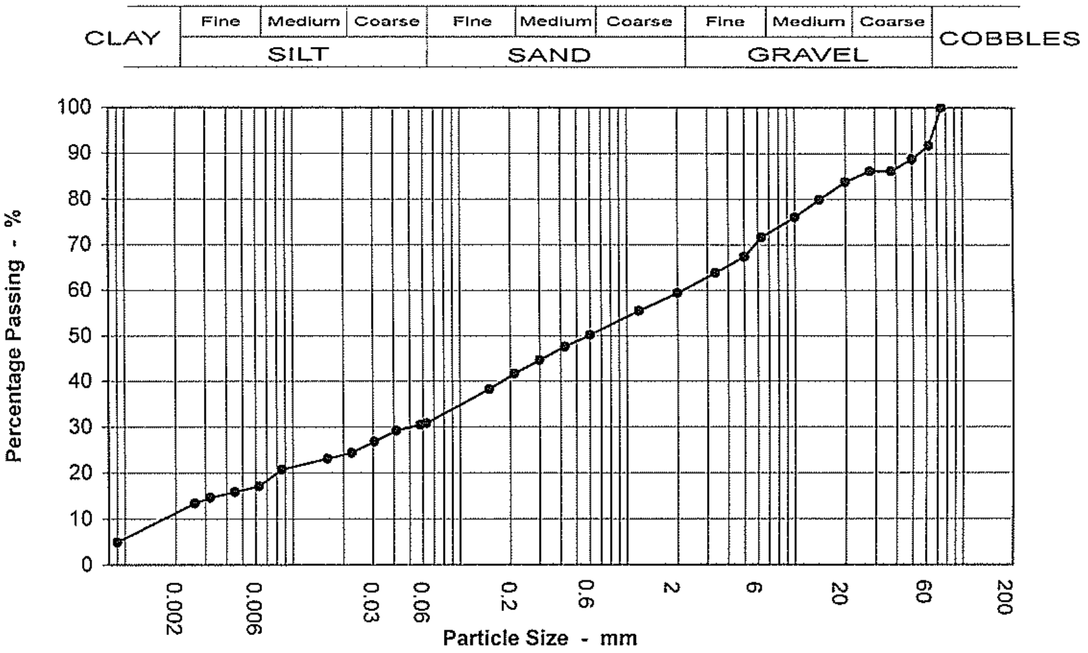
Grading Analysis	
D100	63.000
D60	10.219
D10	0.016
Uniformity Coefficient	650

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P12012
		Borehole / Pit No	TP15
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy slightly gravelly SILT with medium cobble content	Sample type	B



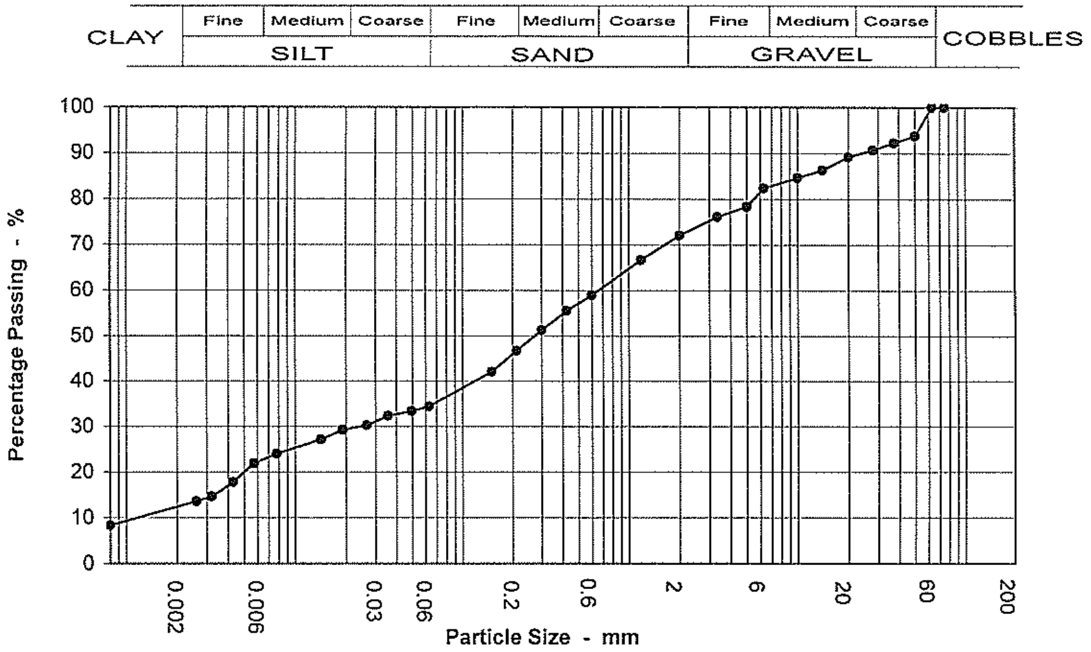
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.058	30
90	100	0.042	29
75	100	0.031	27
63	92	0.022	24
50	89	0.016	23
37.5	86	0.009	21
28	86	0.006	17
20	84	0.005	16
14	80	0.003	15
10	76	0.003	13
6.3	72	0.001	5
5	67		
3.35	64		
2	59		
1.18	55		
0.6	50		
0.425	48		
0.3	45		
0.212	42		
0.15	38		
0.063	31		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	9.0
Gravel	31.7
Sand	28.8
Silt	20.2
Clay	10.4

Grading Analysis	
D100	75.000
D60	2.193
D10	0.002
Uniformity Coefficient	1140

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP15A
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly gravelly sandy SILT	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.049	33
90	100	0.036	32
75	100	0.027	30
63	100	0.019	29
50	94	0.014	27
37.5	92	0.008	24
28	91	0.006	22
20	89	0.004	18
14	86	0.003	15
10	85	0.003	14
6.3	82	0.001	8
5	78		
3.35	76		
2	72		
1.18	67		
0.6	59		
0.425	55		
0.3	51		
0.212	47		
0.15	42		
0.063	34		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	1.4
Gravel	26.5
Sand	37.8
Silt	22.4
Clay	11.8

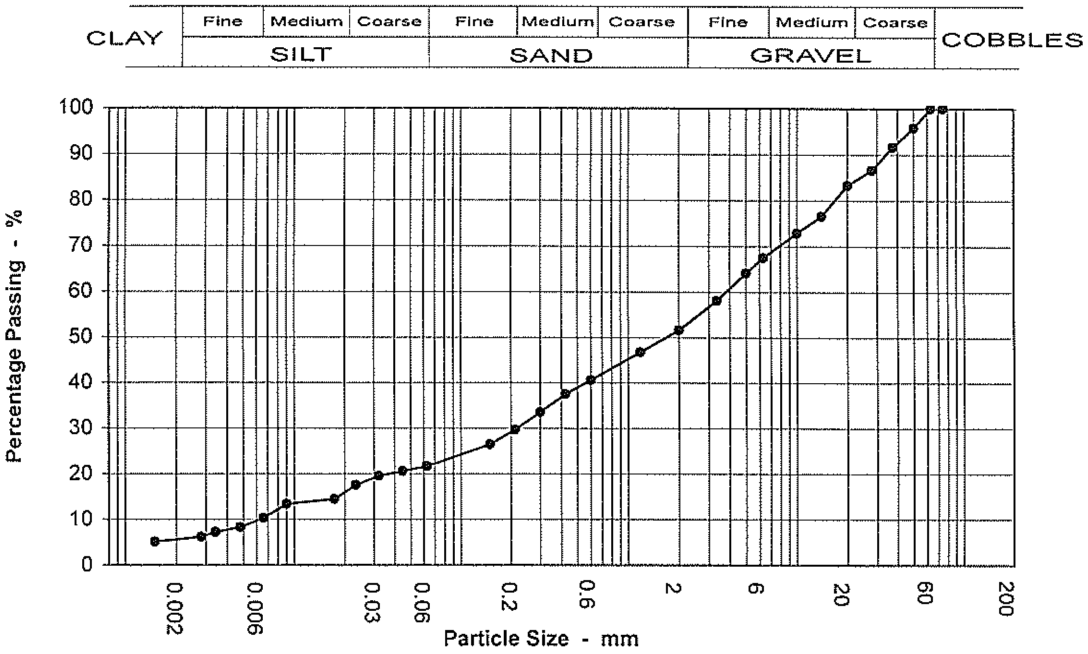
Grading Analysis	
D100	63.000
D60	0.680
D10	0.001
Uniformity Coefficient	497

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P12012**
		Borehole / Pit No	TP18A
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.40 m
Soil Description	Very silty very sandy GRAVEL with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.062	22
90	100	0.045	21
75	100	0.032	20
63	100	0.023	17
50	96	0.017	14
37.5	92	0.009	13
28	87	0.007	10
20	83	0.005	8
14	77	0.003	7
10	73	0.003	6
6.3	67	0.002	5
5	64		
3.35	58		
2	52		
1.18	47		
0.6	41		
0.425	38		
0.3	34		
0.212	30		
0.15	26		
0.063	22		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	1.0
Gravel	47.5
Sand	30.1
Silt	15.9
Clay	5.5

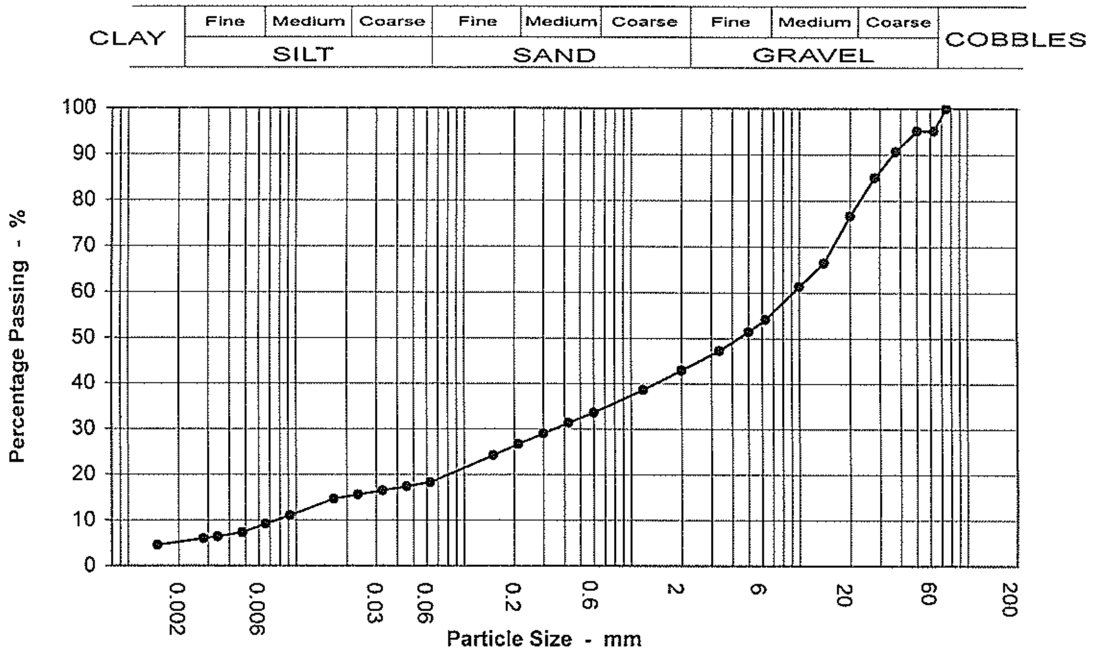
Grading Analysis	
D100	63.000
D60	3.873
D10	0.006
Uniformity Coefficient	610

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	**Job Ref**	**P12012**
		Borehole / Pit No	TP19
		Sample No	1
Soil Description	Silty very sandy GRAVEL with low cobble content	Depth	0.00 m
		Sample type	B



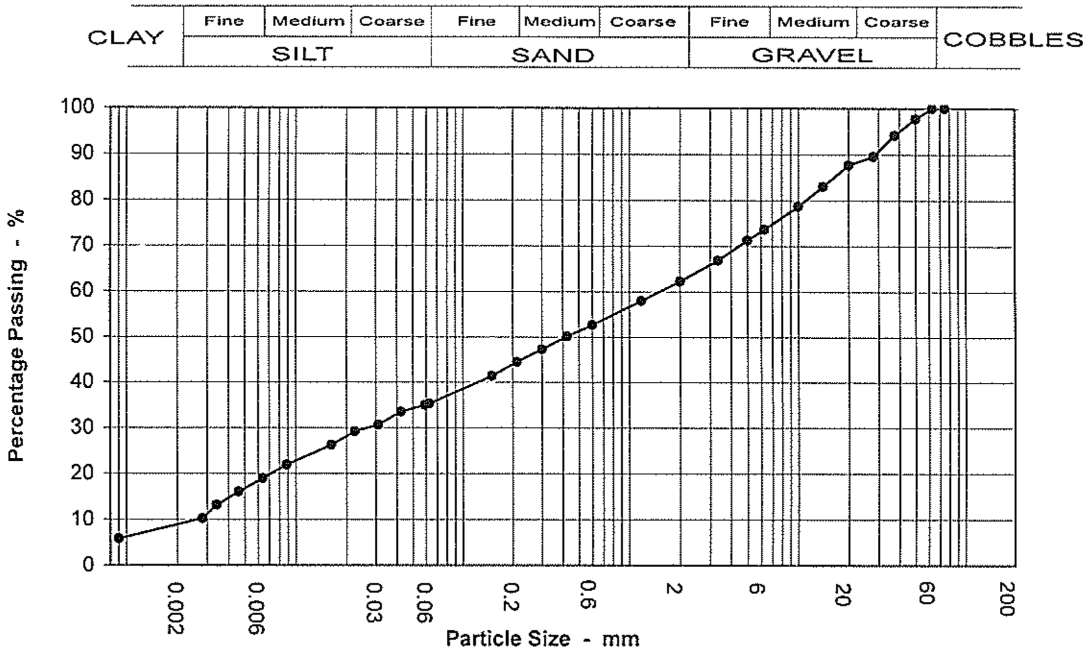
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	18
90	100	0.045	17
75	100	0.033	16
63	95	0.023	16
50	95	0.017	15
37.5	91	0.009	11
28	85	0.007	9
20	77	0.005	7
14	66	0.003	6
10	61	0.003	6
6.3	54	0.002	5
5	51		
3.35	47		
2	43		
1.18	39		
0.6	34		
0.425	31		
0.3	29		
0.212	27		
0.15	24		
0.063	18		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	4.9
Gravel	52.2
Sand	24.8
Silt	13.0
Clay	5.1

Grading Analysis	
D100	75.000
D60	9.322
D10	0.008
Uniformity Coefficient	1191

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP21
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	1.00 m
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample type	B



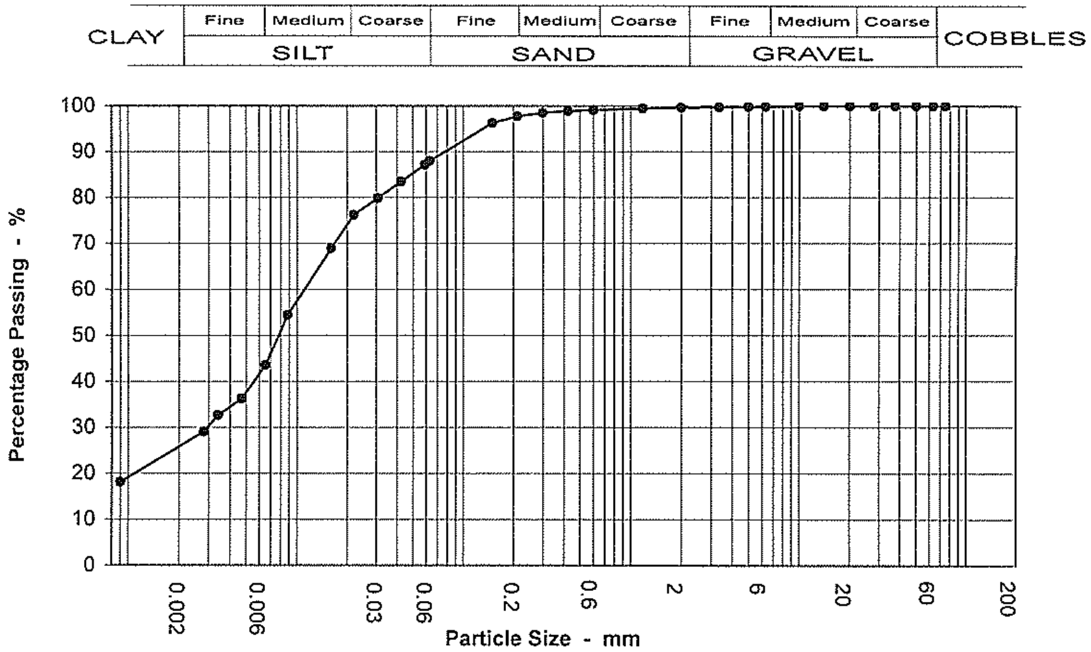
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	35
90	100	0.043	34
75	100	0.031	31
63	100	0.022	29
50	98	0.016	26
37.5	94	0.009	22
28	90	0.006	19
20	88	0.005	16
14	83	0.003	13
10	79	0.003	10
6.3	74	0.001	6
5	71		
3.35	67		
2	62		
1.18	58		
0.6	53		
0.425	50		
0.3	47		
0.212	44		
0.15	41		
0.063	35		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.5
Gravel	37.2
Sand	27.1
Silt	26.7
Clay	8.4

Grading Analysis	
D100	63.000
D60	1.570
D10	0.003
Uniformity Coefficient	580

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP21A
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.40 m
Soil Description	Slightly sandy CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	87
90	100	0.043	83
75	100	0.031	80
63	100	0.022	76
50	100	0.016	69
37.5	100	0.009	54
28	100	0.007	44
20	100	0.005	36
14	100	0.003	33
10	100	0.003	29
6.3	100	0.001	18
5	100		
3.35	100		
2	100		
1.18	99		
0.6	99		
0.425	99		
0.3	98		
0.212	98		
0.15	96		
0.063	88		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	0.4
Sand	12.4
Silt	62.8
Clay	24.4

Grading Analysis	
D100	10.000
D60	0.012
D10	
Uniformity Coefficient	N/A

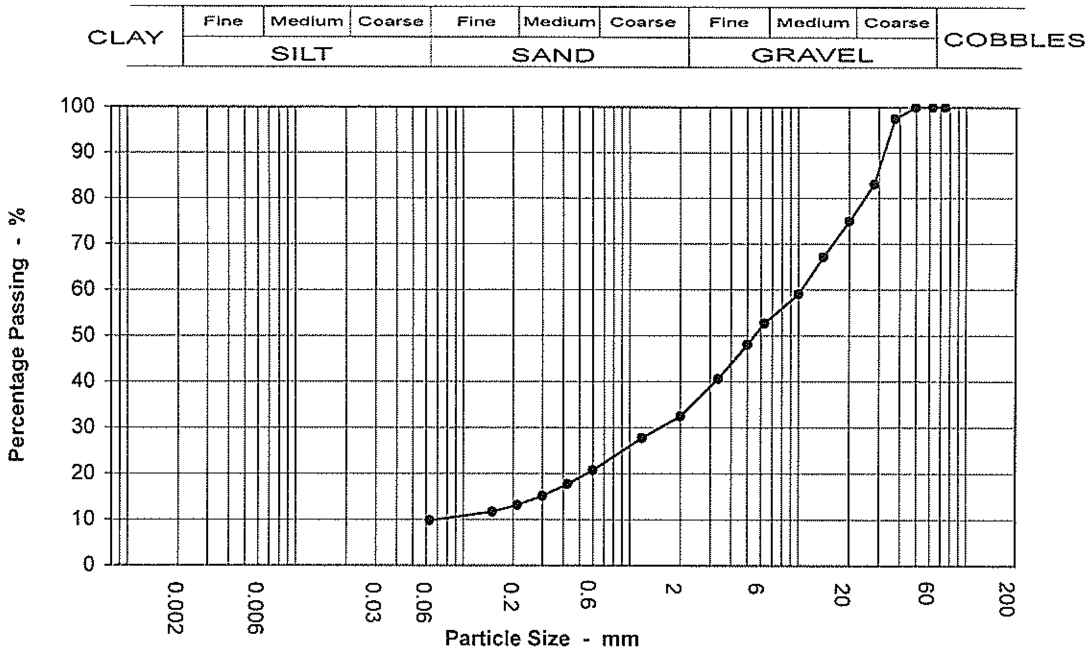
PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	P12012
Borehole / Pit No	TP23
Sample No	1
Depth	0.00 m
Sample type	B

Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**
Soil Description	Slightly sandy gravelly SILT



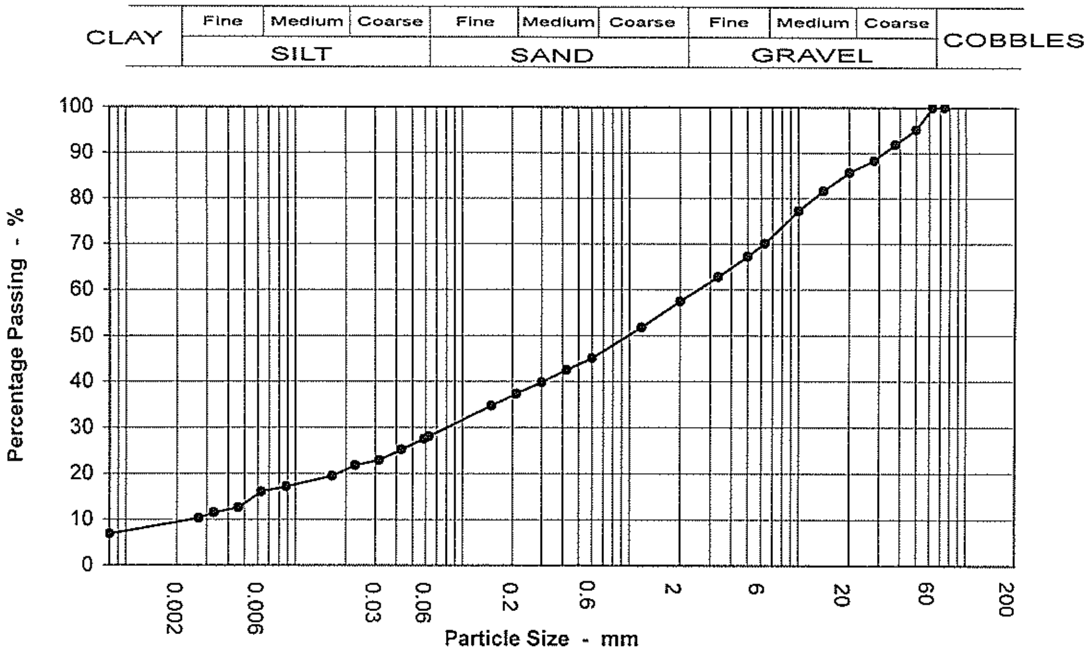
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	97		
28	83		
20	75		
14	67		
10	59		
6.3	53		
5	48		
3.35	41		
2	32		
1.18	28		
0.6	21		
0.425	18		
0.3	15		
0.212	13		
0.15	12		
0.063	10		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	67.5
Sand	22.6
Silt & Clay	9.8

Grading Analysis	
D100	50.000
D60	10.485
D10	0.072
Uniformity Coefficient	146

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP25
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	1.00 m
Soil Description	Slightly sandy gravelly SILT	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	27
90	100	0.043	25
75	100	0.032	23
63	100	0.023	22
50	95	0.017	19
37.5	92	0.009	17
28	88	0.006	16
20	86	0.005	13
14	82	0.003	11
10	77	0.003	10
6.3	70	0.001	7
5	67		
3.35	63		
2	57		
1.18	52		
0.6	45		
0.425	42		
0.3	40		
0.212	37		
0.15	35		
0.063	28		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	1.1
Gravel	41.5
Sand	29.8
Silt	18.6
Clay	9.0

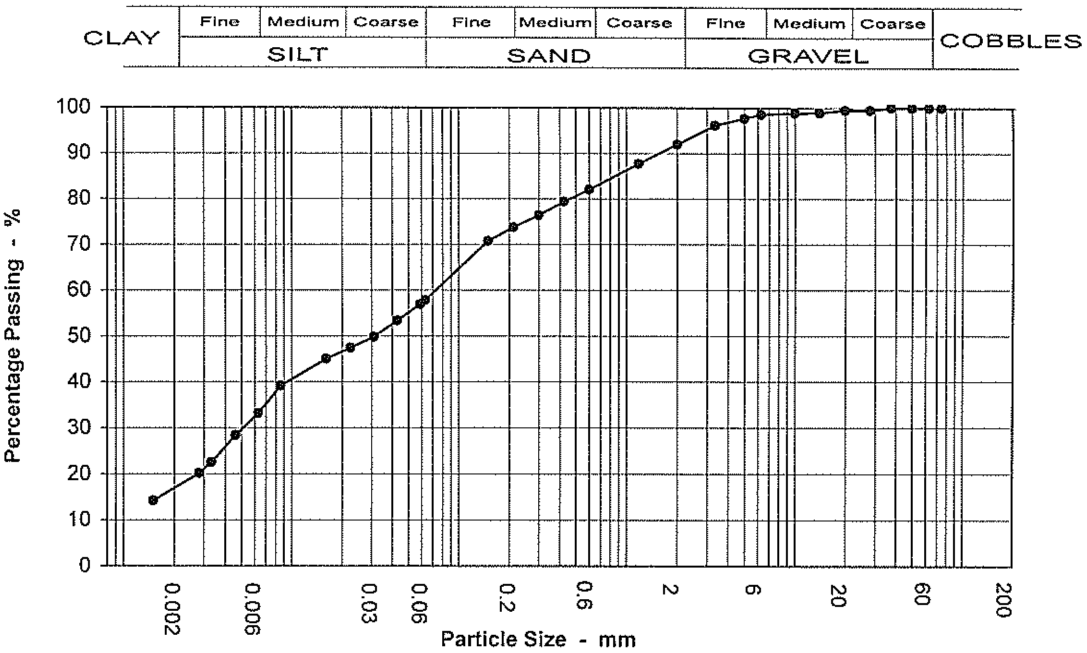
Grading Analysis	
D100	63.000
D60	2.661
D10	0.003
Uniformity Coefficient	1050

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**P12012**
		Borehole / Pit No	TP27
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.20 m
Soil Description	Slightly gravelly sandy CLAY	Sample type	B



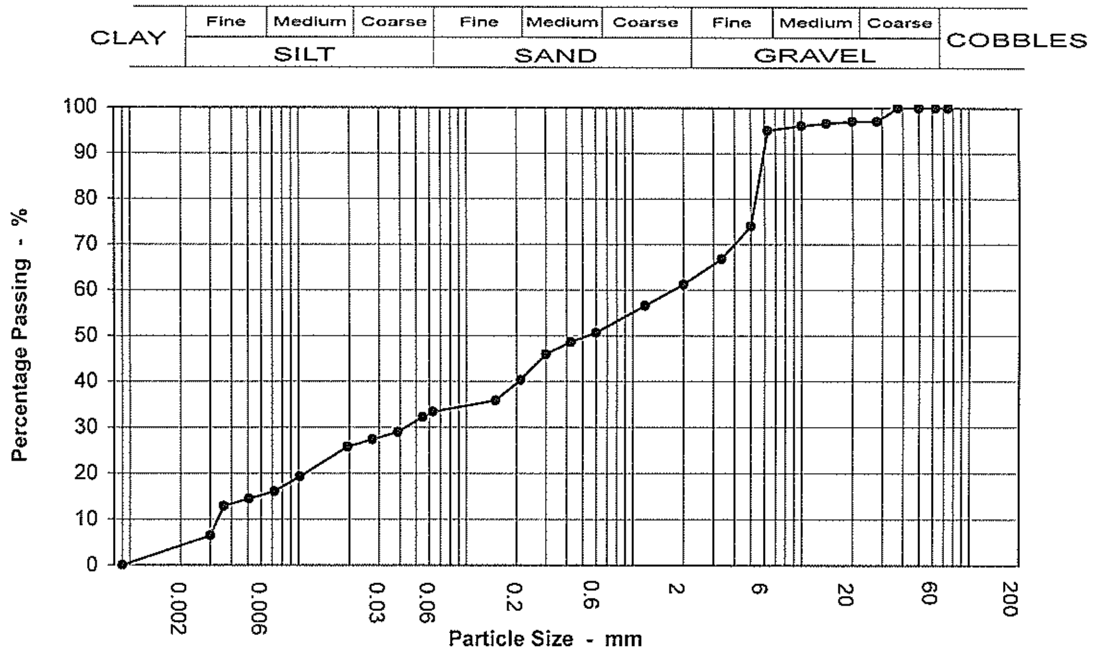
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	57
90	100	0.043	53
75	100	0.031	50
63	100	0.022	47
50	100	0.016	45
37.5	100	0.009	39
28	99	0.006	33
20	99	0.005	28
14	99	0.003	23
10	99	0.003	20
6.3	99	0.002	14
5	98		
3.35	96		
2	92		
1.18	88		
0.6	82		
0.425	79		
0.3	76		
0.212	74		
0.15	71		
0.063	58		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	8.1
Sand	34.9
Silt	40.6
Clay	16.5

Grading Analysis	
D100	37.500
D60	0.078
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP28
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.00 m
Soil Description	Slightly sandy gravelly SILT	Sample type	B



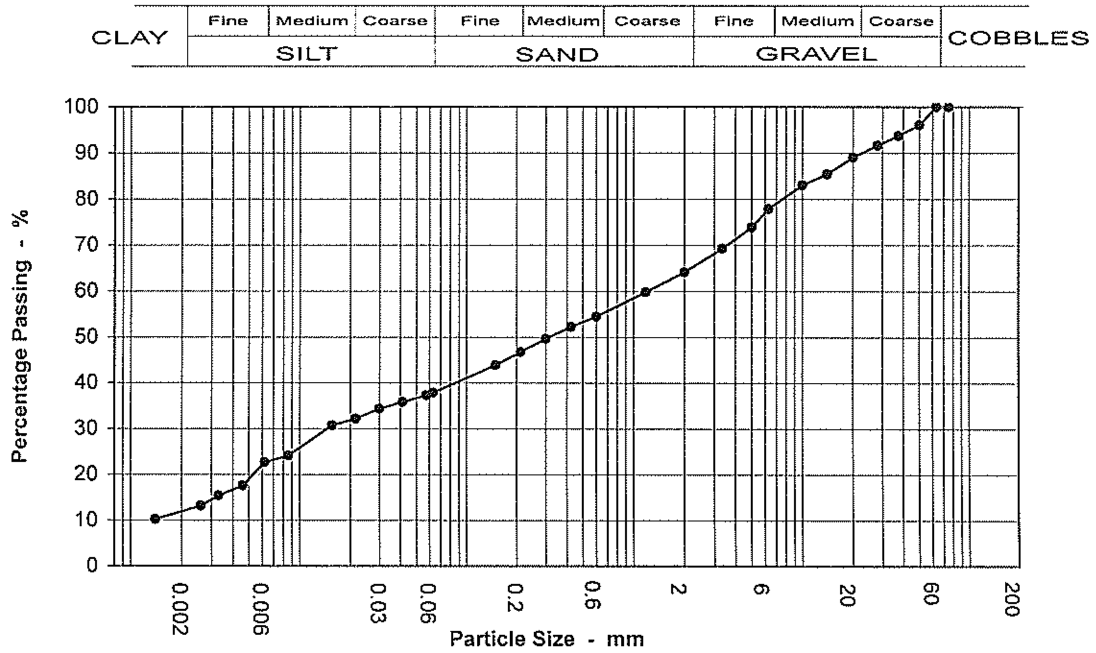
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	33
90	100	0.055	32
75	100	0.039	29
63	100	0.028	27
50	100	0.020	26
37.5	100	0.010	19
28	97	0.007	16
20	97	0.005	14
14	97	0.004	13
10	96	0.003	6
6.3	95	0.001	0
5	74		
3.35	67		
2	61		
1.18	57		
0.6	51		
0.425	49		
0.3	46		
0.212	40		
0.15	36		
0.063	33		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	38.9
Sand	28.2
Silt	29.6
Clay	3.4

Grading Analysis	
D100	37.500
D60	1.797
D10	0.003
Uniformity Coefficient	539

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP28
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.70 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



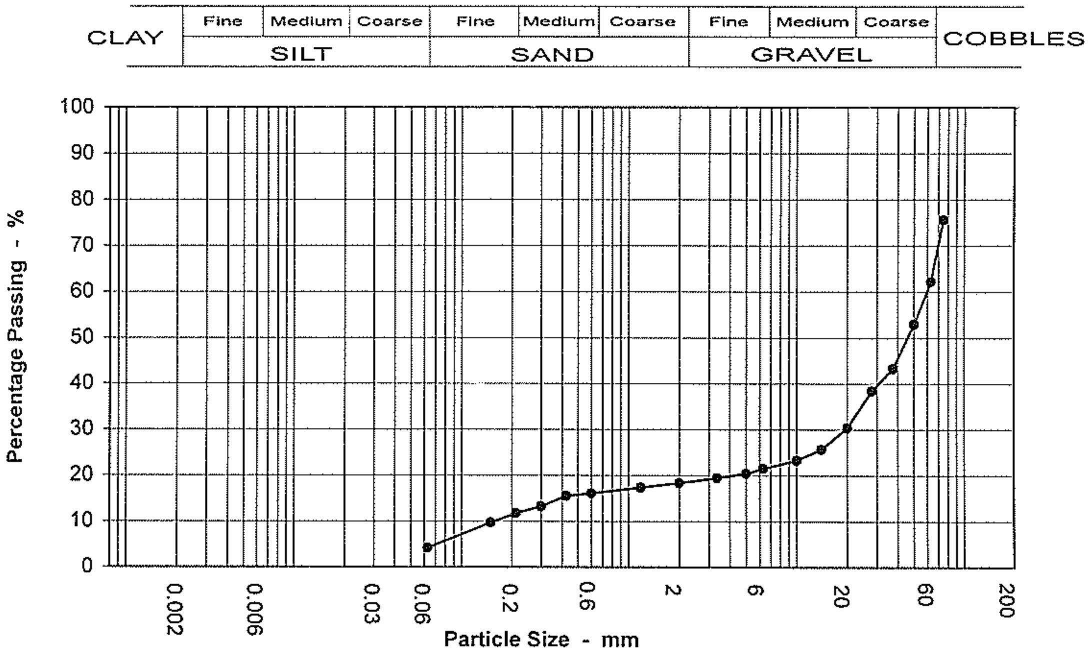
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.057	37
90	100	0.041	36
75	100	0.030	34
63	100	0.022	32
50	96	0.016	31
37.5	94	0.009	24
28	92	0.006	23
20	89	0.005	18
14	85	0.003	15
10	83	0.003	13
6.3	78	0.001	10
5	74		
3.35	69		
2	64		
1.18	60		
0.6	54		
0.425	52		
0.3	50		
0.212	47		
0.15	44		
0.063	38		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.9
Gravel	35.0
Sand	26.5
Silt	25.9
Clay	11.7

Grading Analysis	
D100	63.000
D60	1.230
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP29
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	1.50 m
Soil Description	Silty very sandy GRAVEL with high cobble content	Sample type	B



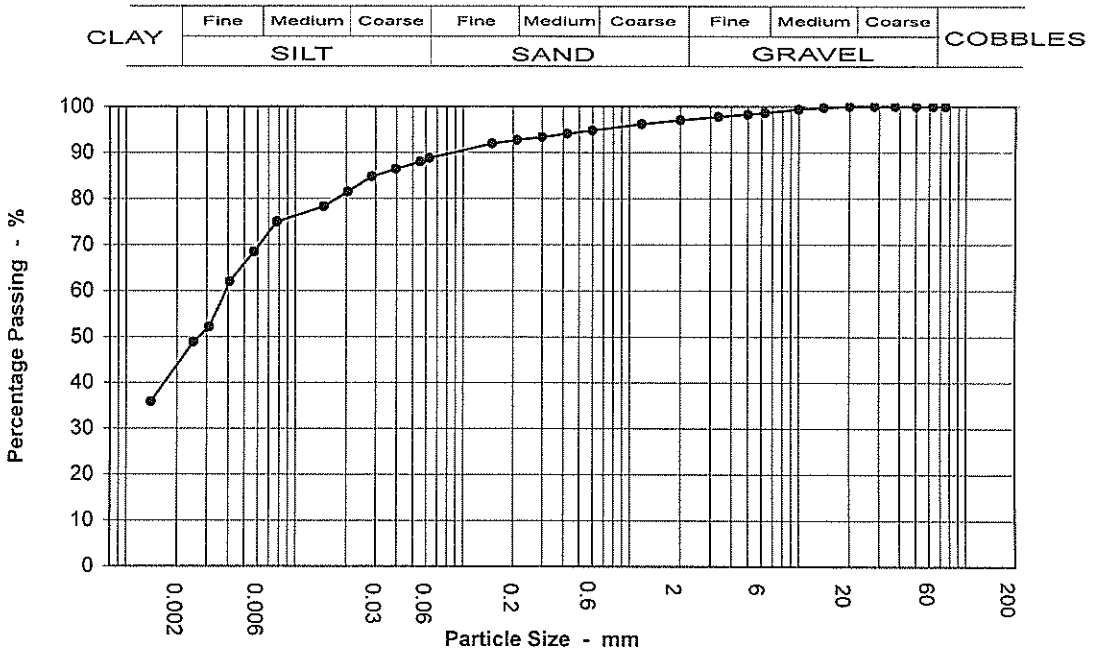
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	96		
90	83		
75	76		
63	62		
50	53		
37.5	43		
28	38		
20	30		
14	26		
10	23		
6.3	21		
5	20		
3.35	19		
2	18		
1.18	17		
0.6	16		
0.425	16		
0.3	13		
0.212	12		
0.15	10		
0.063	4		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	40.0
Gravel	41.7
Sand	14.2
Silt & Clay	4.2

Grading Analysis	
D100	125.000
D60	59.990
D10	0.158
Uniformity Coefficient	381

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP31
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
		Depth	2.00 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.056	88
90	100	0.040	86
75	100	0.028	85
63	100	0.021	81
50	100	0.015	78
37.5	100	0.008	75
28	100	0.006	68
20	100	0.004	62
14	100	0.003	52
10	99	0.003	49
6.3	99	0.001	36
5	98		
3.35	98		
2	97		
1.18	96		
0.6	95		
0.425	94		
0.3	93		
0.212	93		
0.15	92		
0.063	89		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	3.0
Sand	8.6
Silt	45.5
Clay	43.0

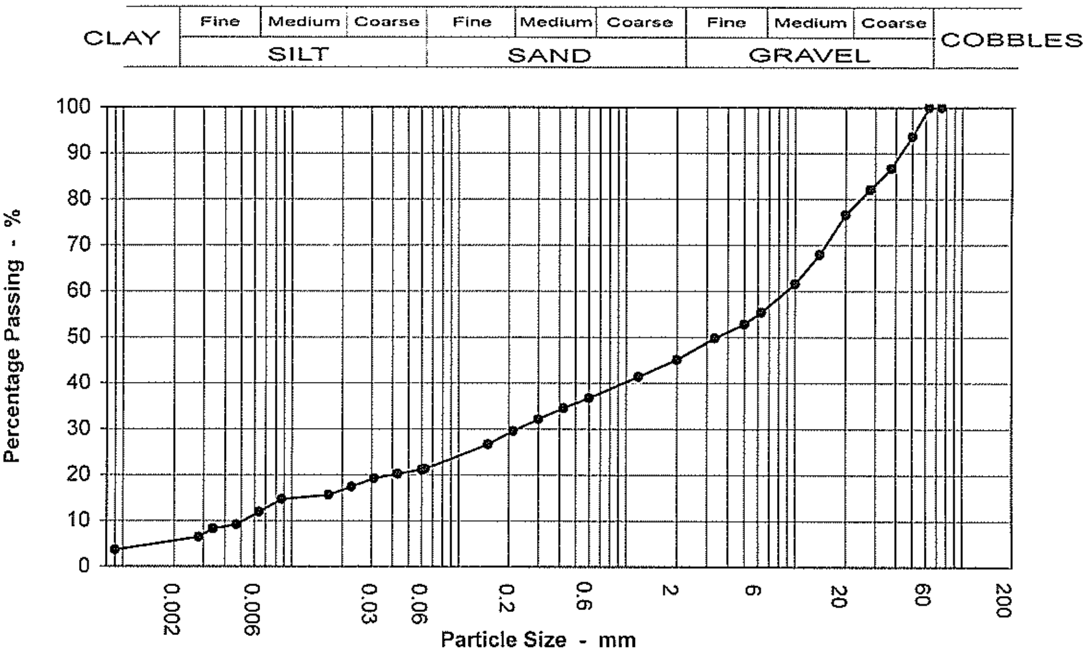
Grading Analysis	
D100	20.000
D60	0.004
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref	**P12012**	Borehole / Pit No	TP32
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	0.80 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.060	21
90	100	0.043	20
75	100	0.031	19
63	100	0.023	17
50	94	0.017	16
37.5	87	0.009	15
28	82	0.006	12
20	77	0.005	9
14	68	0.003	8
10	62	0.003	6
6.3	55	0.001	4
5	53		
3.35	50		
2	45		
1.18	41		
0.6	37		
0.425	35		
0.3	32		
0.212	30		
0.15	27		
0.063	21		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	1.5
Gravel	53.5
Sand	23.9
Silt	15.8
Clay	5.3

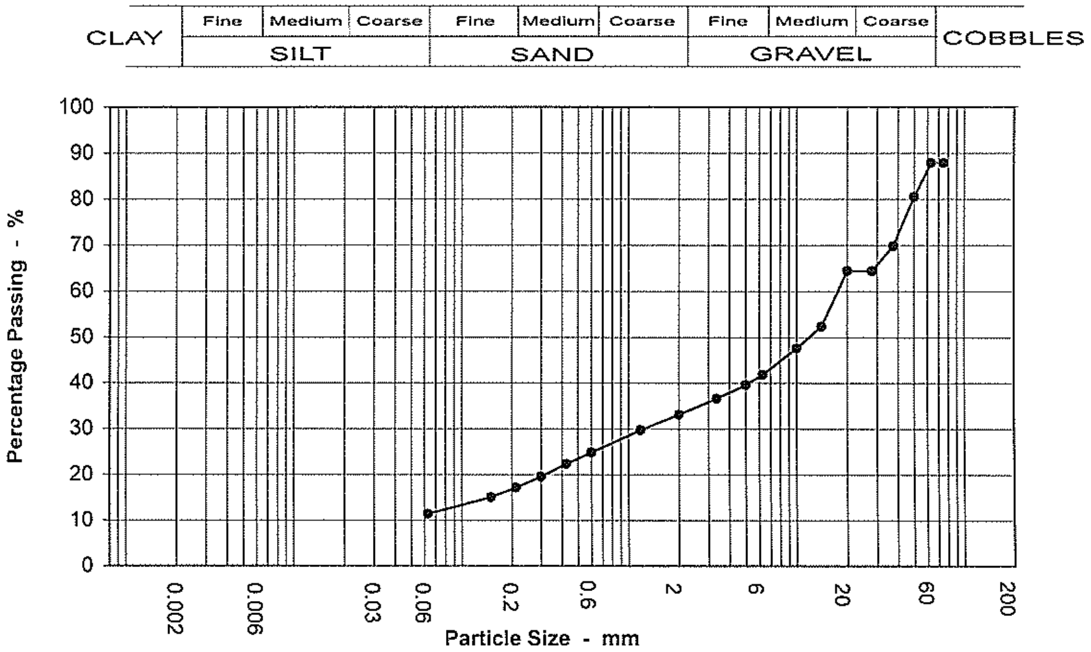
Grading Analysis	
D100	63.000
D60	9.096
D10	0.005
Uniformity Coefficient	1747

PRIORITY GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	P12012
		Borehole / Pit No	TP33
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.20 m
Soil Description	Silty very sandy GRAVEL with medium cobble content	Sample type	B



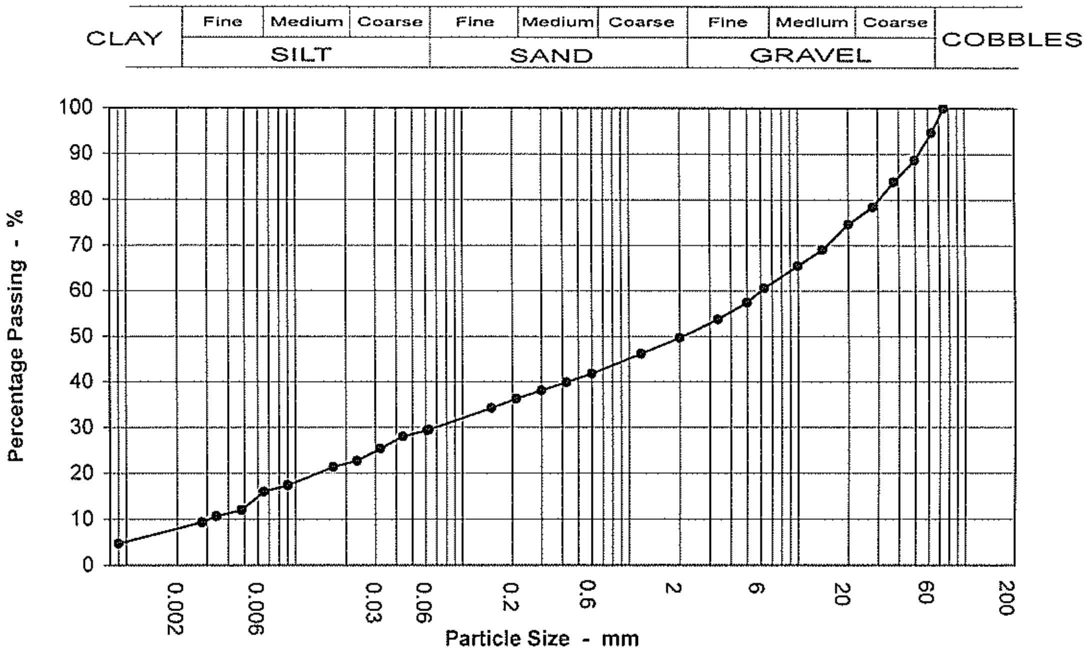
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	88		
63	88		
50	80		
37.5	70		
28	64		
20	64		
14	52		
10	48		
6.3	42		
5	40		
3.35	37		
2	33		
1.18	30		
0.6	25		
0.425	22		
0.3	20		
0.212	17		
0.15	15		
0.063	11		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	13.9
Gravel	53.0
Sand	21.7
Silt & Clay	11.4

Grading Analysis	
D100	90.000
D60	17.824
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP36
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.50 m
Soil Description	Slightly sandy gravelly SILT with medium cobble content	Sample type	B



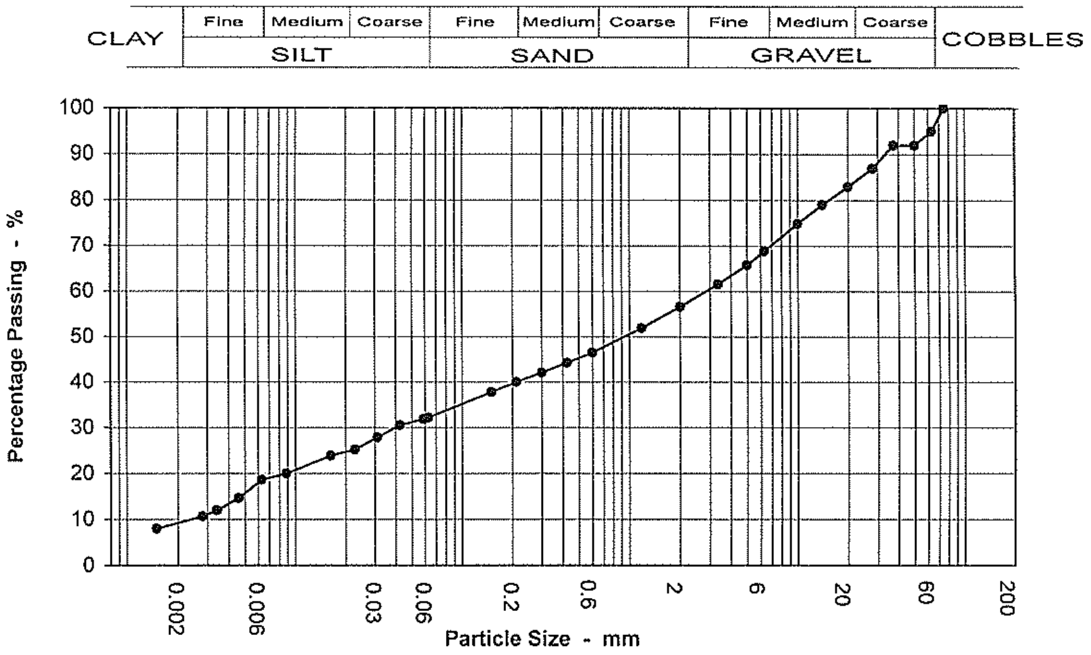
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.061	29
90	100	0.044	28
75	100	0.032	25
63	95	0.023	23
50	89	0.017	21
37.5	84	0.009	17
28	78	0.007	16
20	75	0.005	12
14	69	0.003	11
10	65	0.003	9
6.3	61	0.001	5
5	57		
3.35	54		
2	50		
1.18	46		
0.6	42		
0.425	40		
0.3	38		
0.212	36		
0.15	34		
0.063	29		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	6.7
Gravel	43.7
Sand	20.4
Silt	21.9
Clay	7.4

Grading Analysis	
D100	75.000
D60	6.078
D10	0.003
Uniformity Coefficient	1958

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP36
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.50 m
Soil Description	Slightly sandy gravelly SILT with medium cobble content	Sample type	B



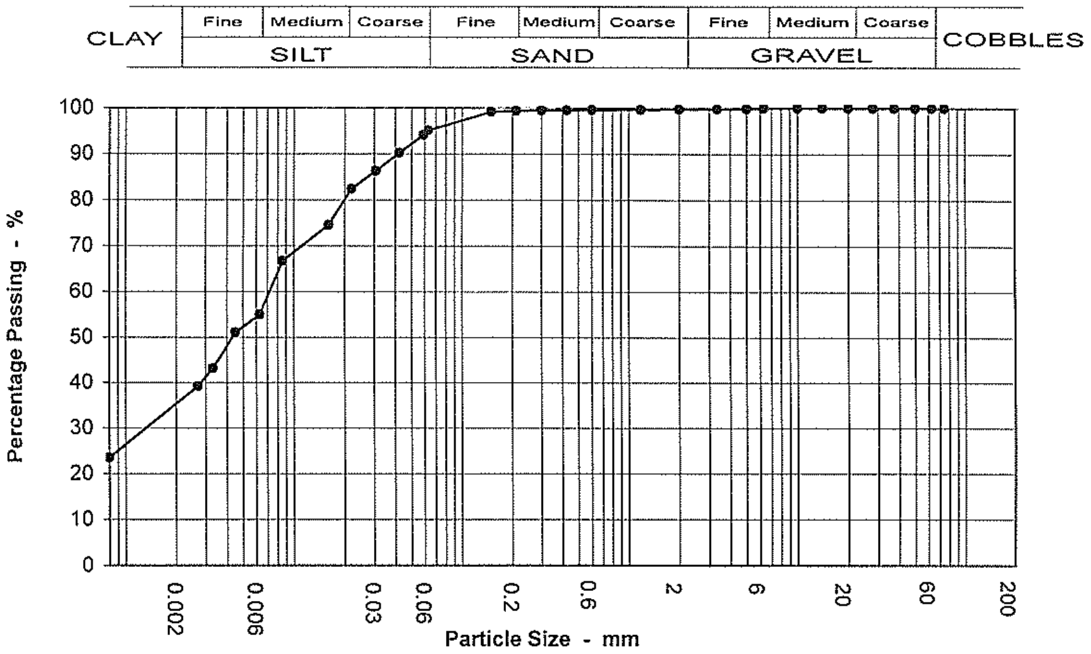
Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	32
90	100	0.043	31
75	100	0.031	28
63	95	0.023	25
50	92	0.016	24
37.5	92	0.009	20
28	87	0.006	19
20	83	0.005	15
14	79	0.003	12
10	75	0.003	11
6.3	69	0.002	8
5	66		
3.35	62		
2	57		
1.18	52		
0.6	46		
0.425	44		
0.3	42		
0.212	40		
0.15	38		
0.063	32		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	5.7
Gravel	37.7
Sand	24.6
Silt	23.0
Clay	9.0

Grading Analysis	
D100	75.000
D60	2.941
D10	0.002
Uniformity Coefficient	1178

PRIORITY GEOTECHNICAL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 : Part 2 : 1990 : Clause 9**	**Job Ref**	**P12012**
		Borehole / Pit No	TP37
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.60 m
Soil Description	Slightly sandy CLAY	Sample type	B



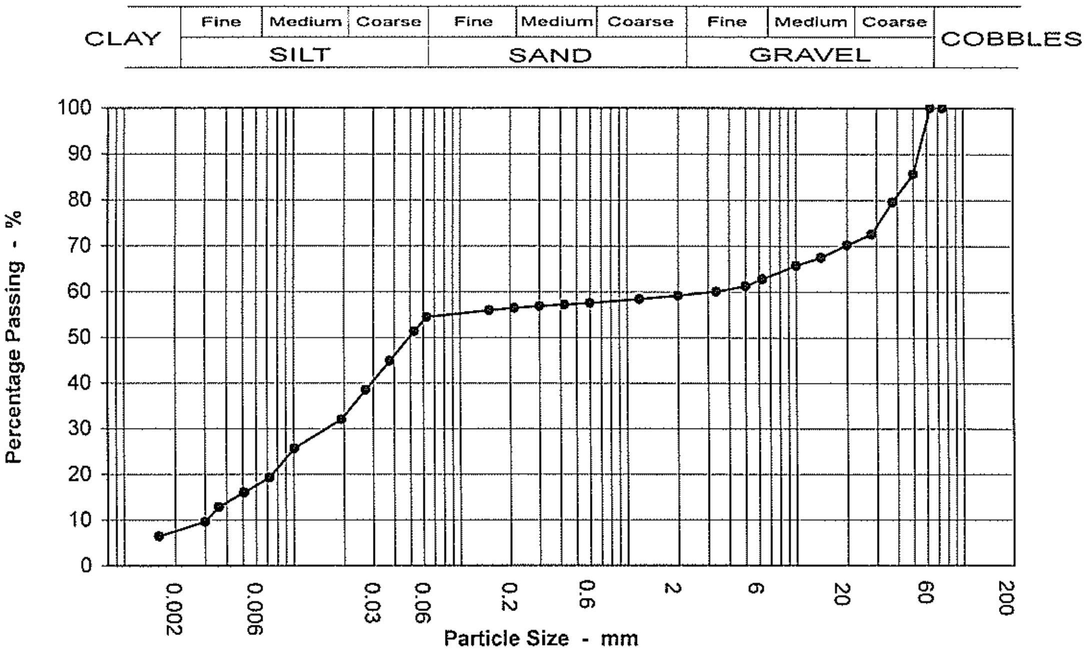
Sieving		**Sedimentation**	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.059	94
90	100	0.043	90
75	100	0.031	86
63	100	0.022	82
50	100	0.016	75
37.5	100	0.009	67
28	100	0.006	55
20	100	0.005	51
14	100	0.003	43
10	100	0.003	39
6.3	100	0.001	24
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	99		
0.3	99		
0.212	99		
0.15	99		
0.063	95		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	0.3
Sand	5.4
Silt	60.9
Clay	33.4

Grading Analysis	
D100	6.300
D60	0.007
D10	
Uniformity Coefficient	N/A

PRIORITY GEOTECHNICAL	PARTICLE SIZE DISTRIBUTION BS 1377 : Part 2 : 1990 : Clause 9	Job Ref	P12012
		Borehole / Pit No	TP37
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.60 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	54
90	100	0.053	51
75	100	0.038	45
63	100	0.027	38
50	86	0.019	32
37.5	80	0.010	26
28	73	0.007	19
20	70	0.005	16
14	67	0.004	13
10	66	0.003	10
6.3	63	0.002	6
5	61		
3.35	60		
2	59		
1.18	58		
0.6	58		
0.425	57		
0.3	57		
0.212	56		
0.15	56		
0.063	54		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	3.3
Gravel	37.6
Sand	5.6
Silt	46.2
Clay	7.3

Grading Analysis	
D100	63.000
D60	3.278
D10	0.003
Uniformity Coefficient	1067

PRIORITY GEOTECHNICAL

Sulphate Content & pH Value

BS 1377 : Part 3 : 1990 : Clause 5.5 & 9.5

Job Ref: P12012

Location: **Dunkellin River & Aggard Stream Flood Relief Scheme**

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	% < 2.0 mm	pH Value	Sulphate Content as SO3			Sulphate Content as SO4		
							GW g/L	Total Sulphate %	Water Soluble g/L	GW g/L	Total Sulphate %	Water Soluble g/L
BH29	1	0.20	B	Slightly gravelly slightly sandy SILT	50	8			0.007			0.008
BH37	1	0.00	B	TOPSOIL	48.6	7.91			0.018			0.022

PRIORITY GEOTECHNICAL

Organic Matter Content

BS 1377 : Part 3 : 1990 : Clause 3

Job Ref

Location

Dunkellin River & Aggard Stream Flood Relief Scheme

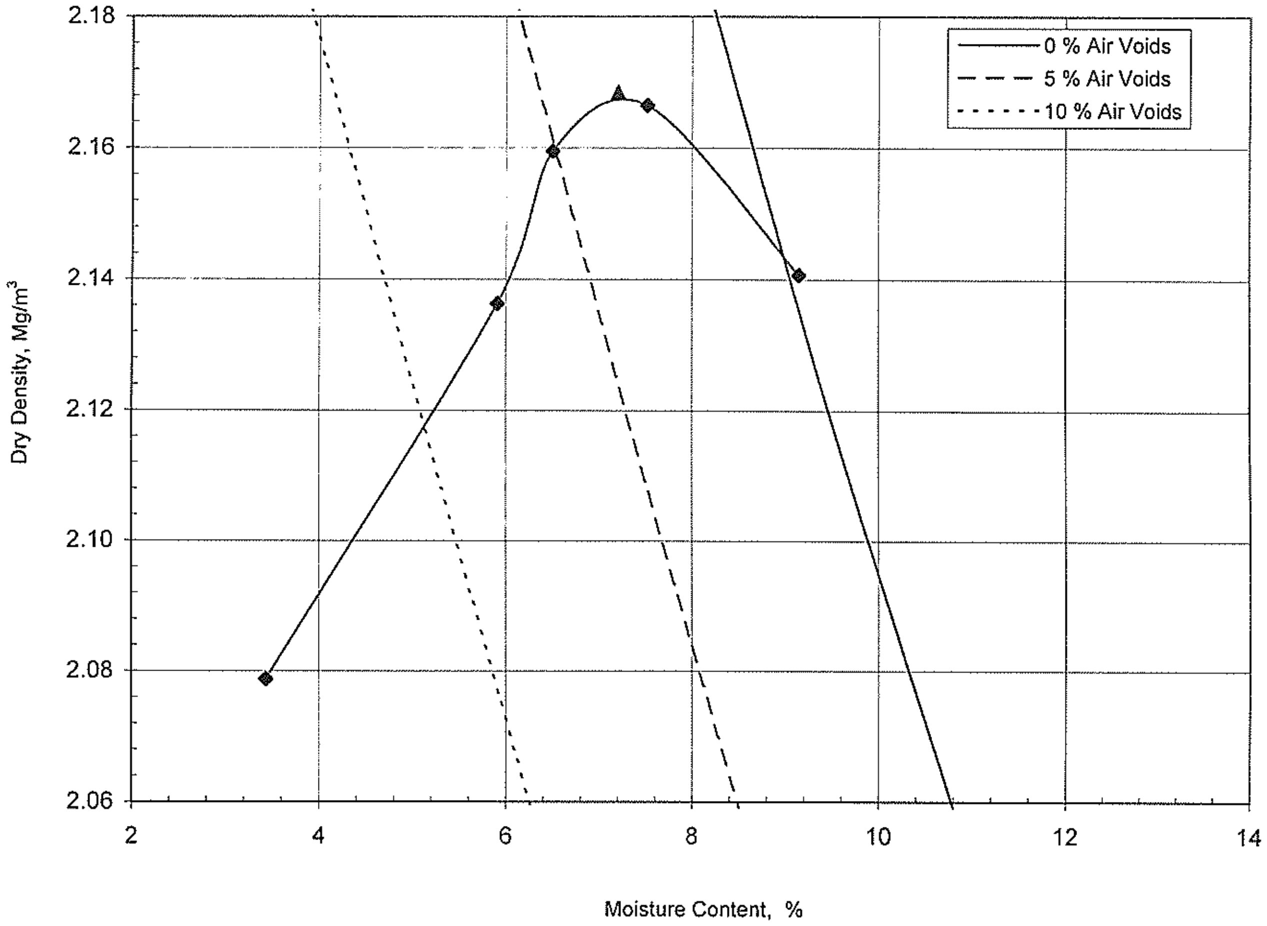
P12012

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	% Mass < 2 mm	Organic Matter Content %
BH29	1	0.20	B	Slightly gravelly slightly sandy SILT	49.98	3.38
BH37	1	0.00	B	TOPSOIL	48.6	16.18

PRIORITY GEOTECHNICAL	**Mass Loss on Ignition** **BS 1377 : Part 3 : 1990 : Clause 4**	**Job Ref**
Location	**Dunkellin River & Aggard Stream Flood Relief Scheme**	**P12012**

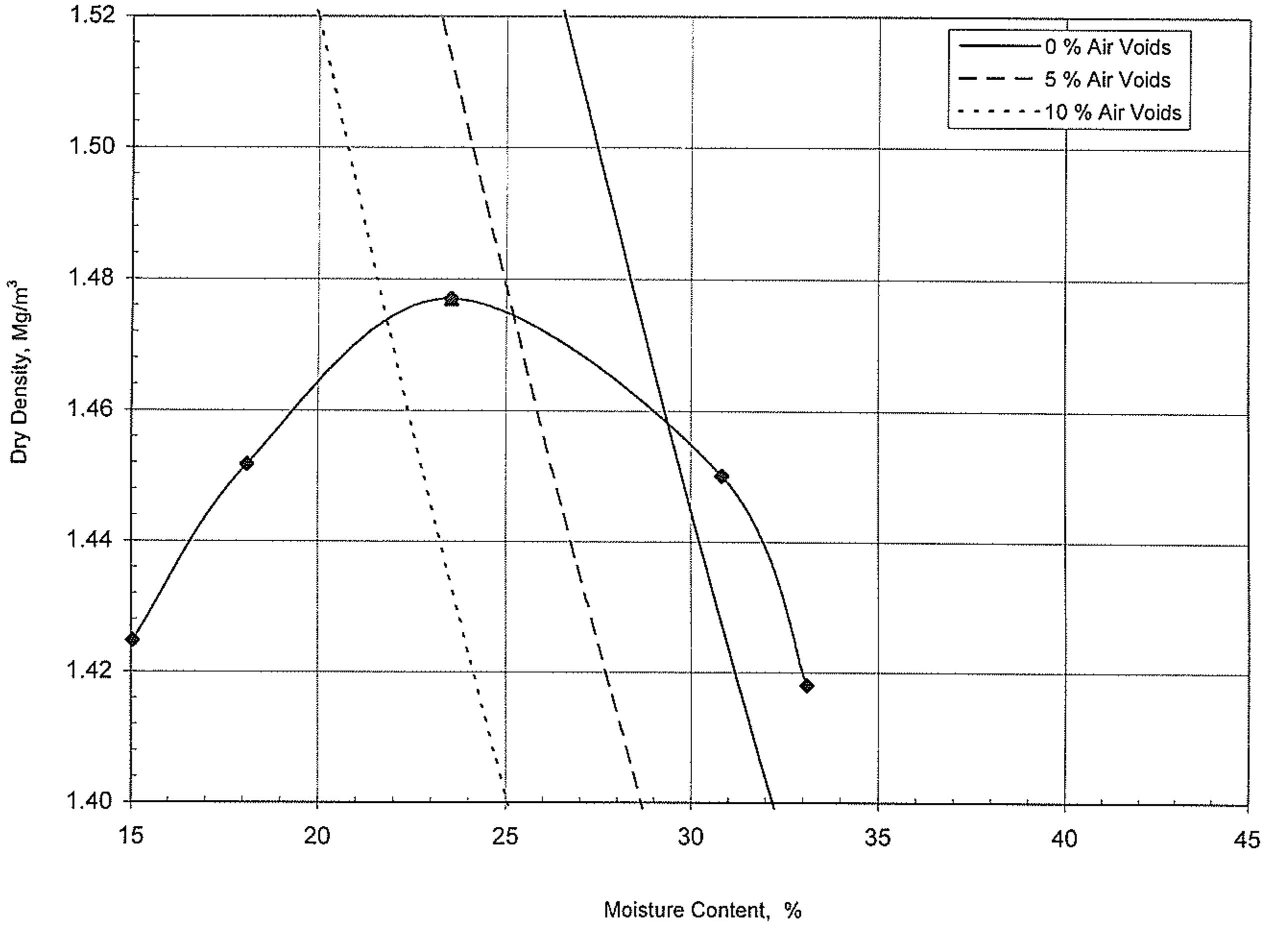
Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	% Mass < 2.0 mm	Mass Loss on Ignition %
BH29	1	0.20	B	Slightly gravelly slightly sandy SILT	50.0	4.45
BH37	1	0.00	B	TOPSOIL	48.6	12.29

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	BH18
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	2
		Depth	1.00 m
Soil Description	Very silty very sandy GRAVEL with high cobble content	Sample Type	B



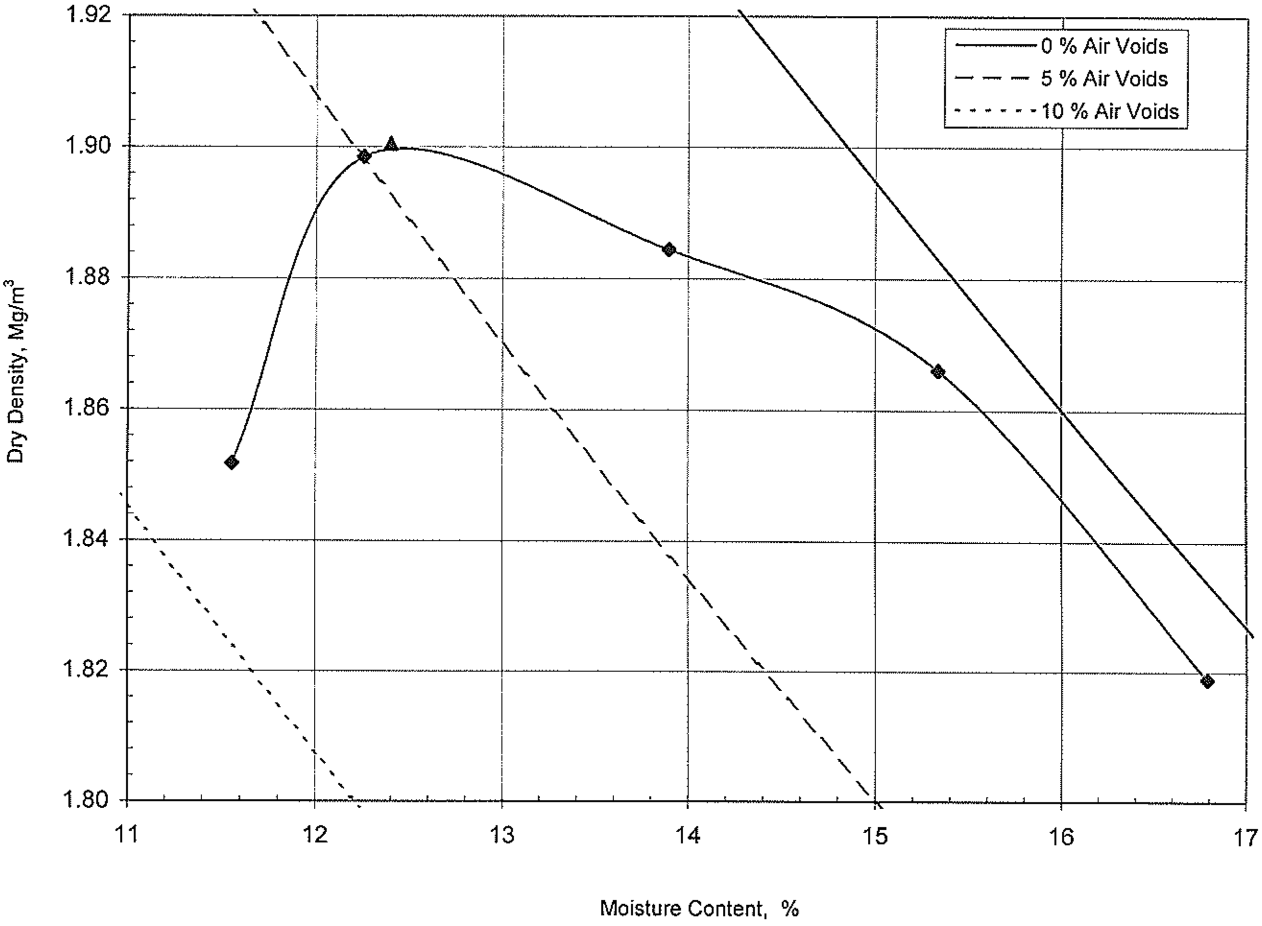
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	34
Mass Retained on 20.0 mm Sieve	%	40
Grading Zone		
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.17
Optimum Moisture Content	%	7.2
Natural Moisture Content	%	9.14

PRIORITY GEOTECHNICAL	Dry Density / Moisture Content Relationship BS 1377 : Part 4 : 1990 : Clause 3	Job Ref	P12012
		Borehole / Pit No	BH23A
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	2
		Depth	1.00 m
Soil Description	Slightly sandy CLAY	Sample Type	B



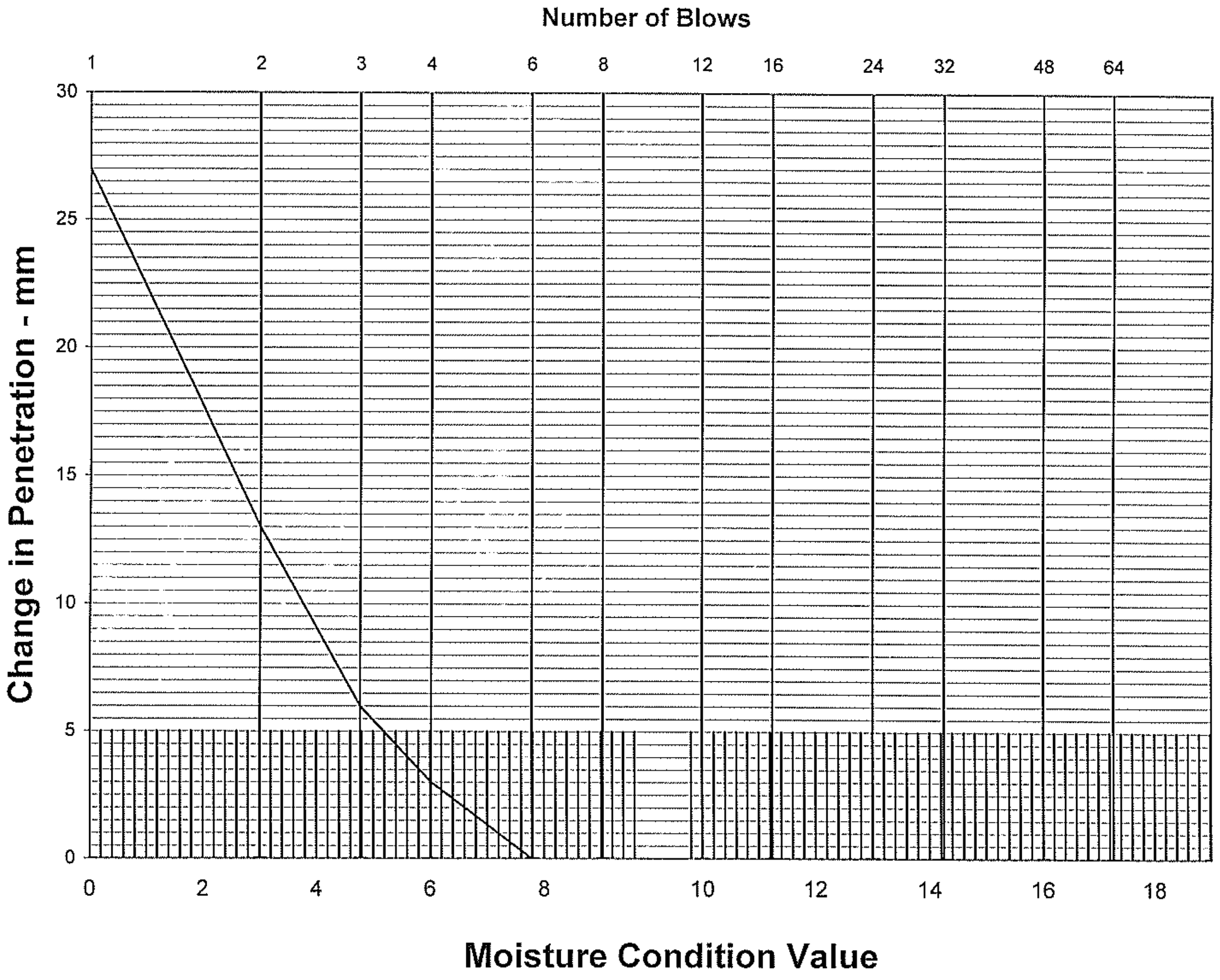
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		1 Litre
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	0
Mass Retained on 20.0 mm Sieve	%	0
Grading Zone		1
Particle Density - Assumed	Mg/m^3	2.55
Maximum Dry Density	Mg/m^3	1.48
Optimum Moisture Content	%	24
Natural Moisture Content	%	33.10

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	BH32
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	2
		Depth	1.20 m
Soil Description	Slightly sandy gravelly CLAY with high cobble content	Sample Type	B



Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	44
Mass Retained on 20.0 mm Sieve	%	46
Grading Zone		
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	1.90
Optimum Moisture Content	%	12
Natural Moisture Content	%	16.79

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	BH16
		Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	0.20 m

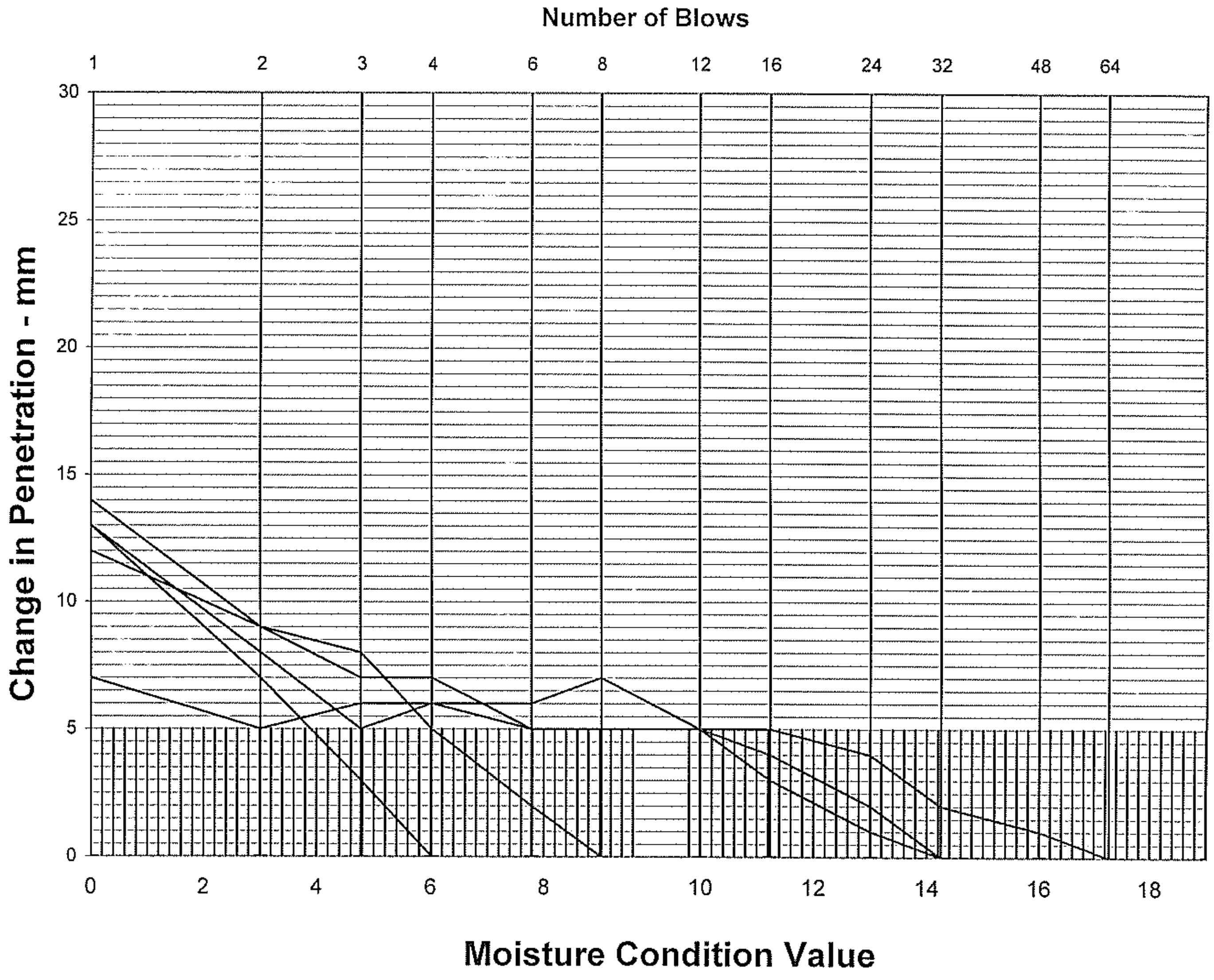


Specimen No	1	2	3	4	5	6
Moisture Condition Value	4.7					
Moisture Content %	21.02					
Bulk density after compaction Mg/m³	2.01					
Dry density after compaction Mg/m³	1.66					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	73.0					

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

Job Ref	**P12012**
Borehole / Pit No	BH18
Sample No	2
Sample Type	B
Depth	1.00 m
Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Very silty very sandy GRAVEL with high cobble content

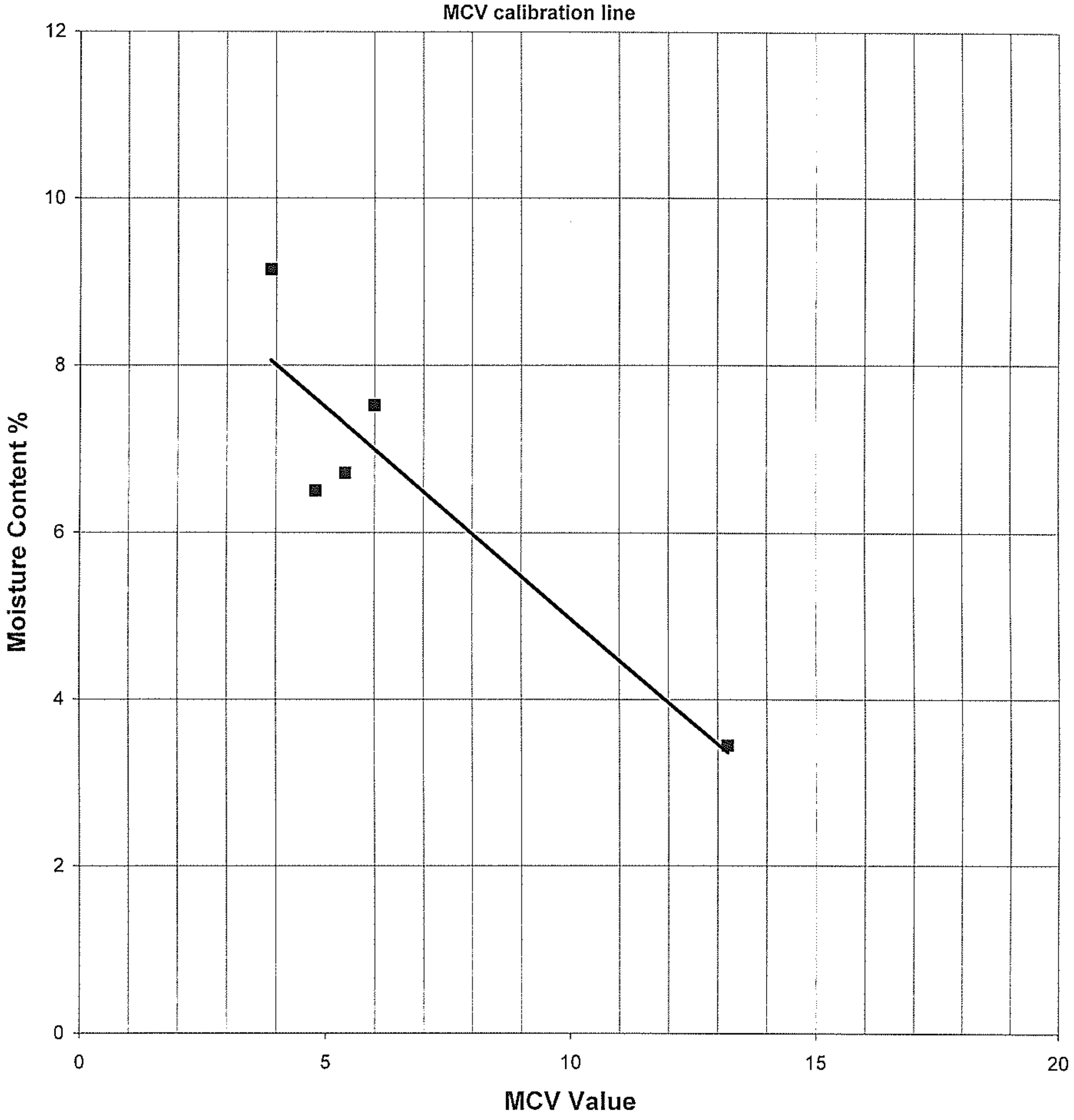


Specimen No		1	2	3	4	5	6
Moisture Condition Value		3.9	4.8	13.2	5.4	6.0	
Moisture Content	%	9.14	6.50	3.44	6.71	7.52	
Bulk density after compaction	Mg/m³	2.25	2.19	2.14	2.22	2.10	
Dry density after compaction	Mg/m³	2.06	2.06	2.07	2.08	1.95	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	40.3					

MCV Relationship Graph

BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
		Borehole / Pit No	BH18
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	2
Soil Description	Very silty very sandy GRAVEL with high cobble content	Sample Type	B
		Depth	1.00 m



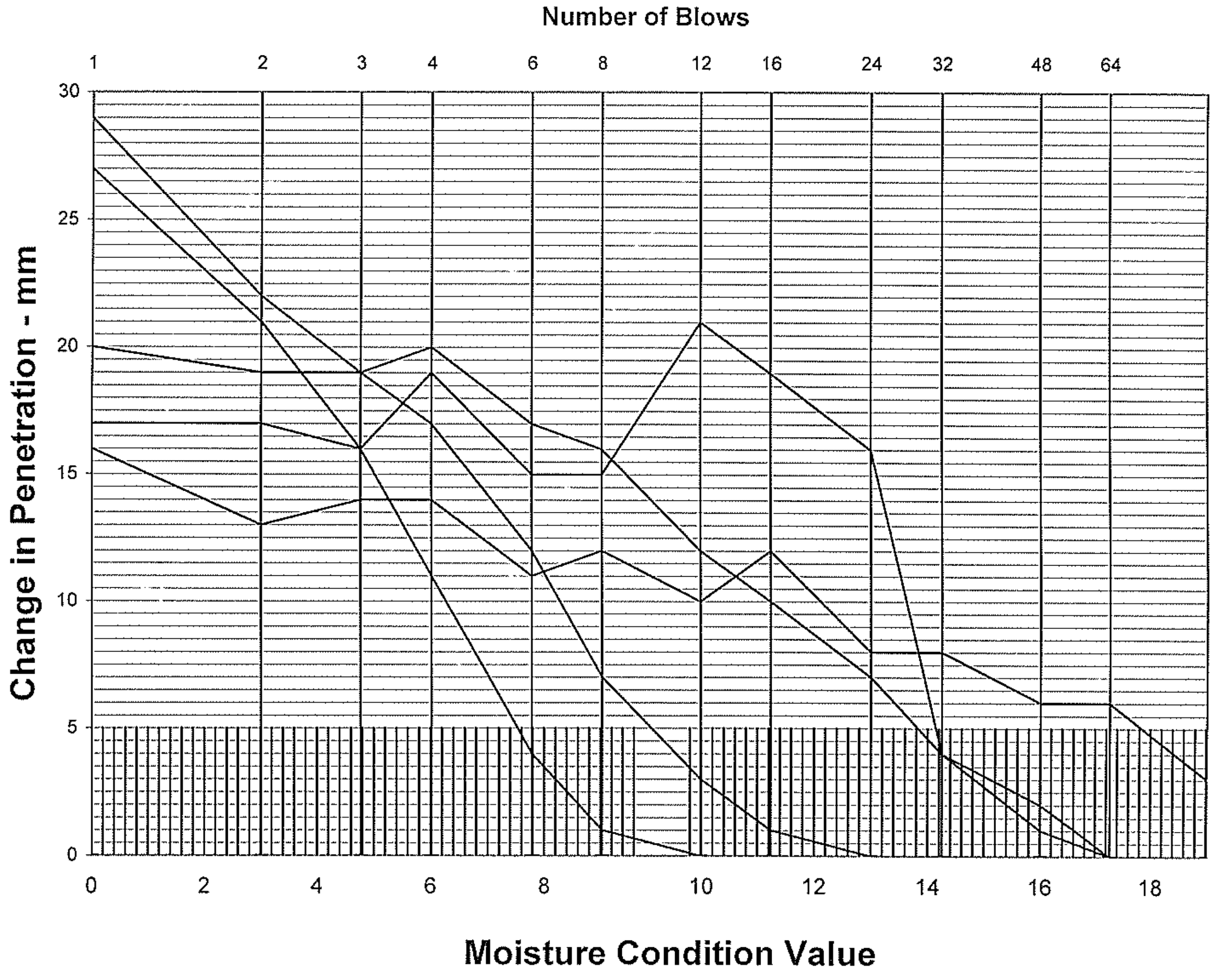
Operator	Checked	Approved	Remarks Single sample / Separate batches tested

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

Job Ref	P12012
Borehole / Pit No	BH23A
Sample No	2
Sample Type	B
Depth	1.00 m

Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Slightly sandy CLAY



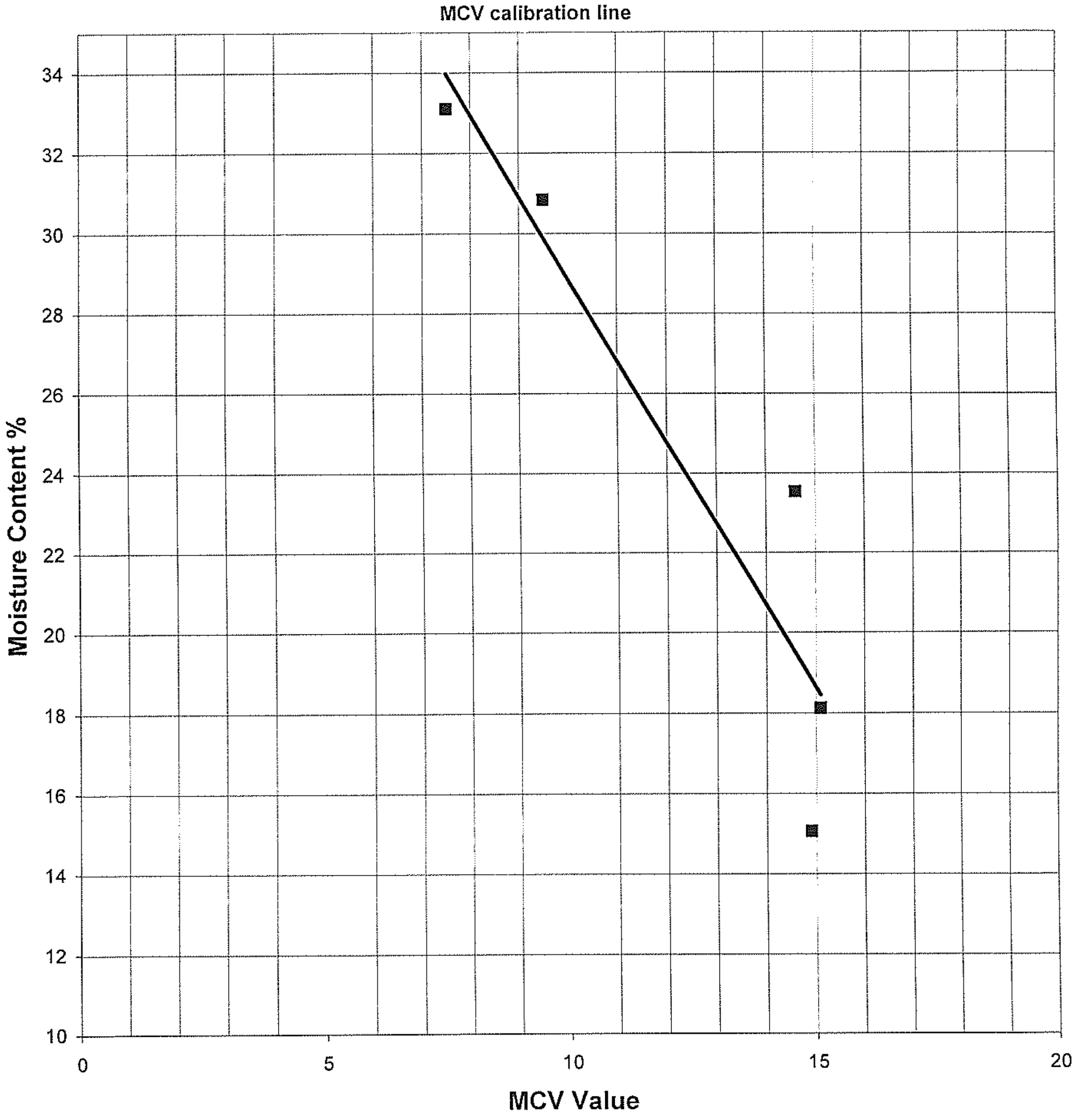
Specimen No		1	2	3	4	5	6
Moisture Condition Value		7.5	9.5	14.6	14.9	15.1	
Moisture Content	%	33.10	30.84	23.53	15.06	18.12	
Bulk density after compaction	Mg/m³	1.87	1.97	2.03	1.83	2.01	
Dry density after compaction	Mg/m³	1.40	1.51	1.64	1.59	1.70	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	0.0					

MCV Relationship Graph

BS 1377 : Part 4 : 1990 Clause 5

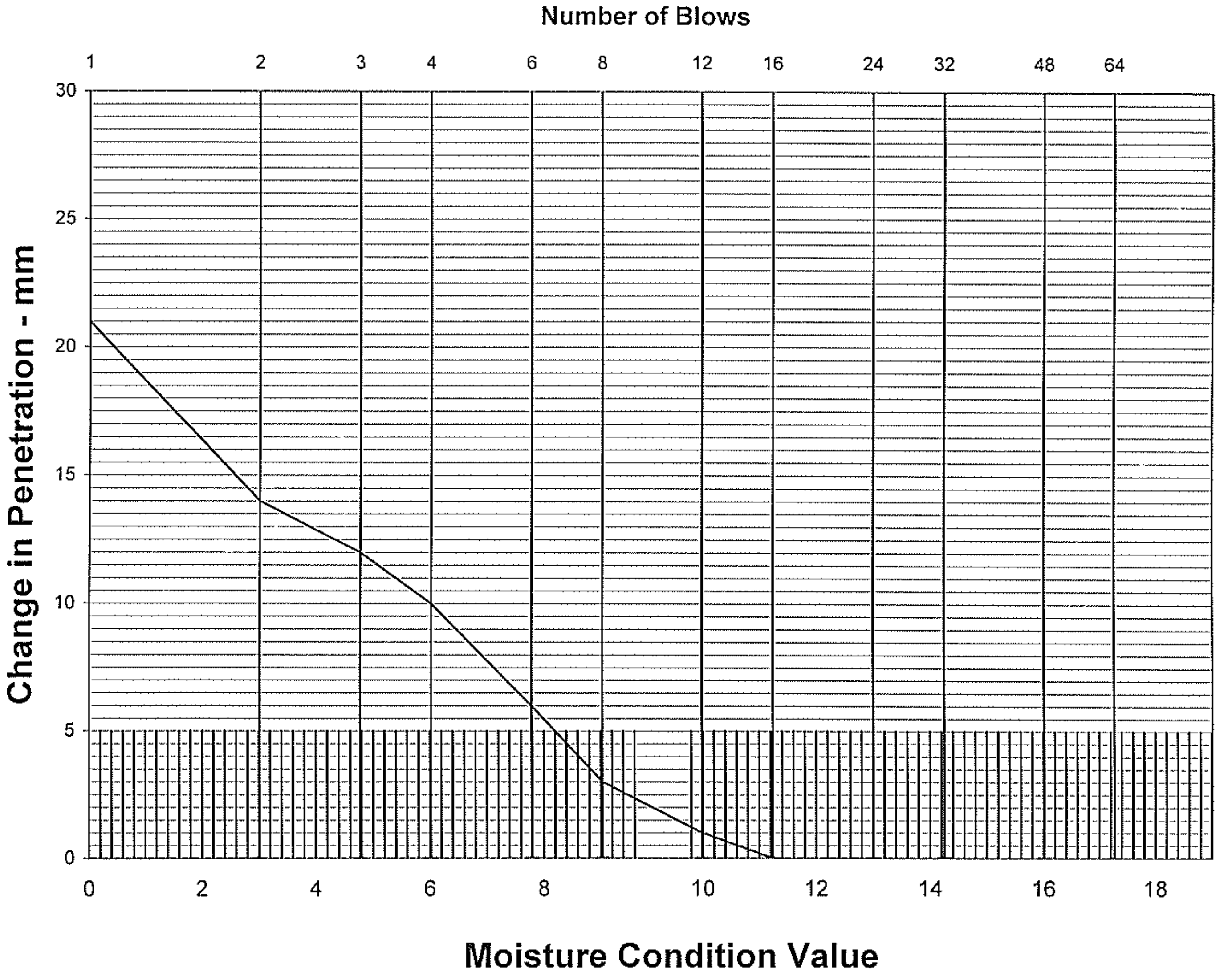
Job Ref	**P12012**
Borehole / Pit No	BH23A
Sample No	2
Sample Type	B
Depth	1.00 m

Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Slightly sandy CLAY



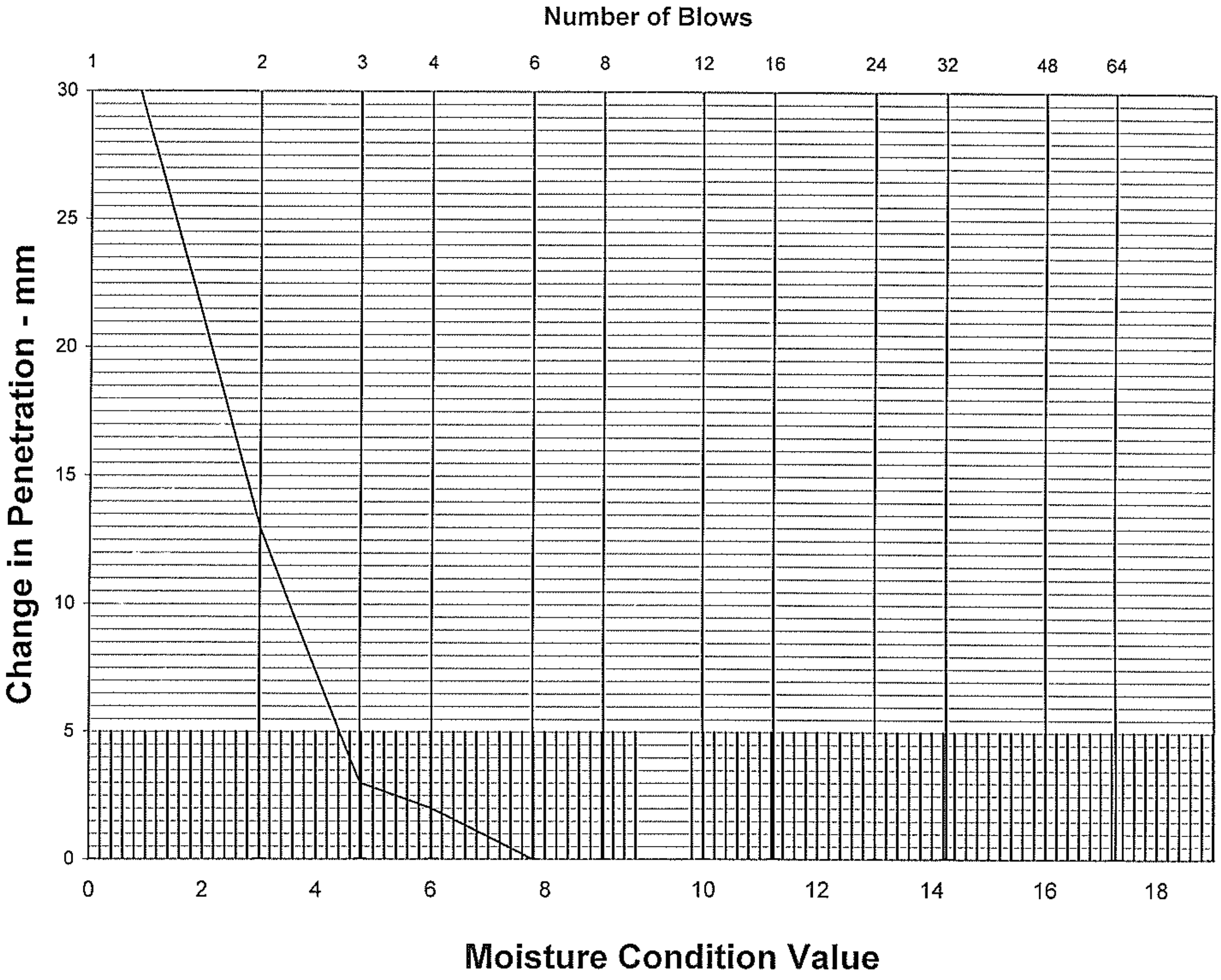
Operator	Checked	Approved	Remarks Single sample / Separate batches tested

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	BH29
		Sample No	1
Soil Description	Slightly gravelly slightly sandy SILT	Sample Type	B
		Depth	0.20 m



Specimen No	1	2	3	4	5	6
Moisture Condition Value	8.2					
Moisture Content %	14.46					
Bulk density after compaction Mg/m³	2.17					
Dry density after compaction Mg/m³	1.90					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	63.3					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	BH32
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	0.20 m

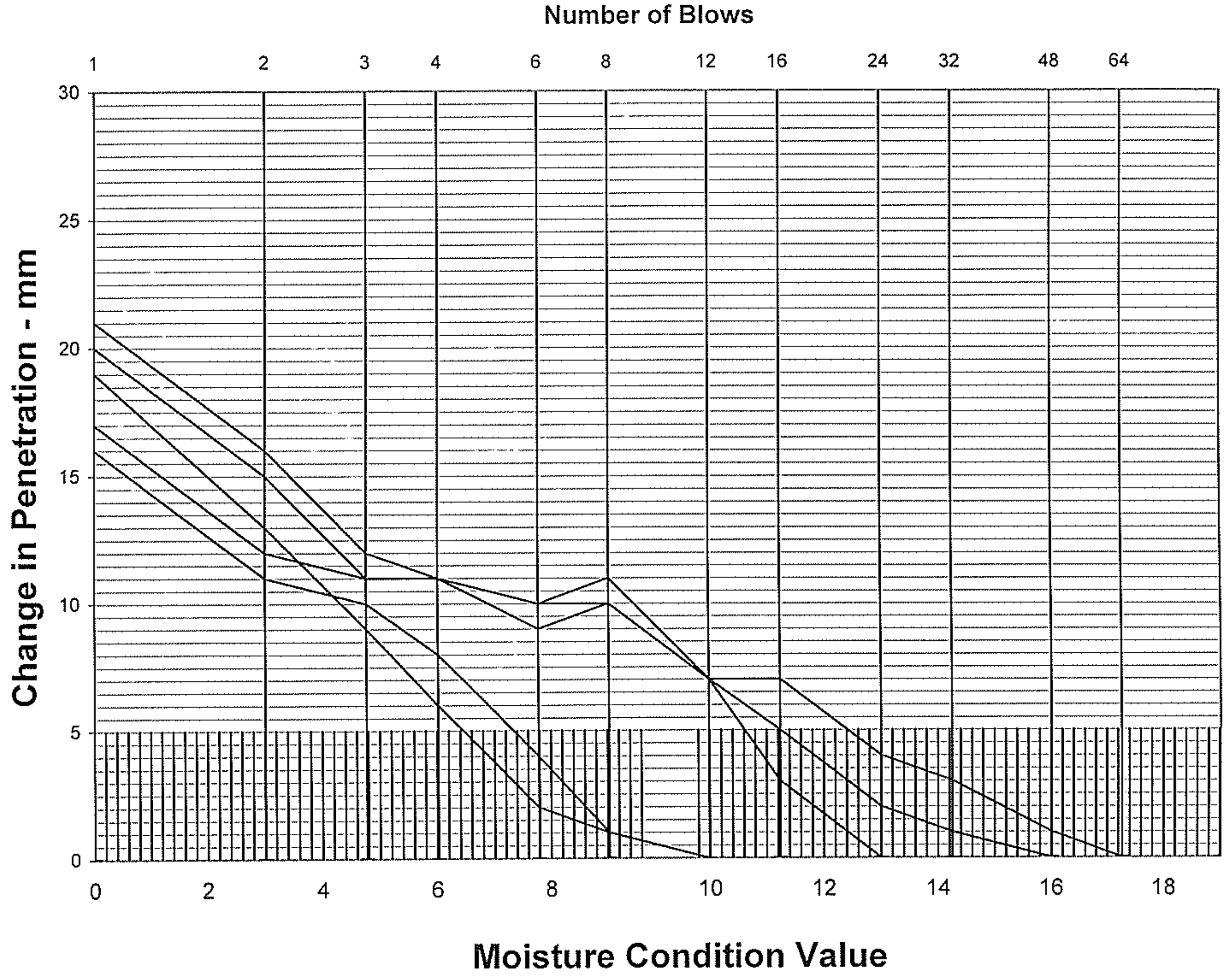


Specimen No	1	2	3	4	5	6
Moisture Condition Value	4.0					
Moisture Content %	47.34					
Bulk density after compaction Mg/m³	1.77					
Dry density after compaction Mg/m³	1.20					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	0.0					

Moisture Condition Value

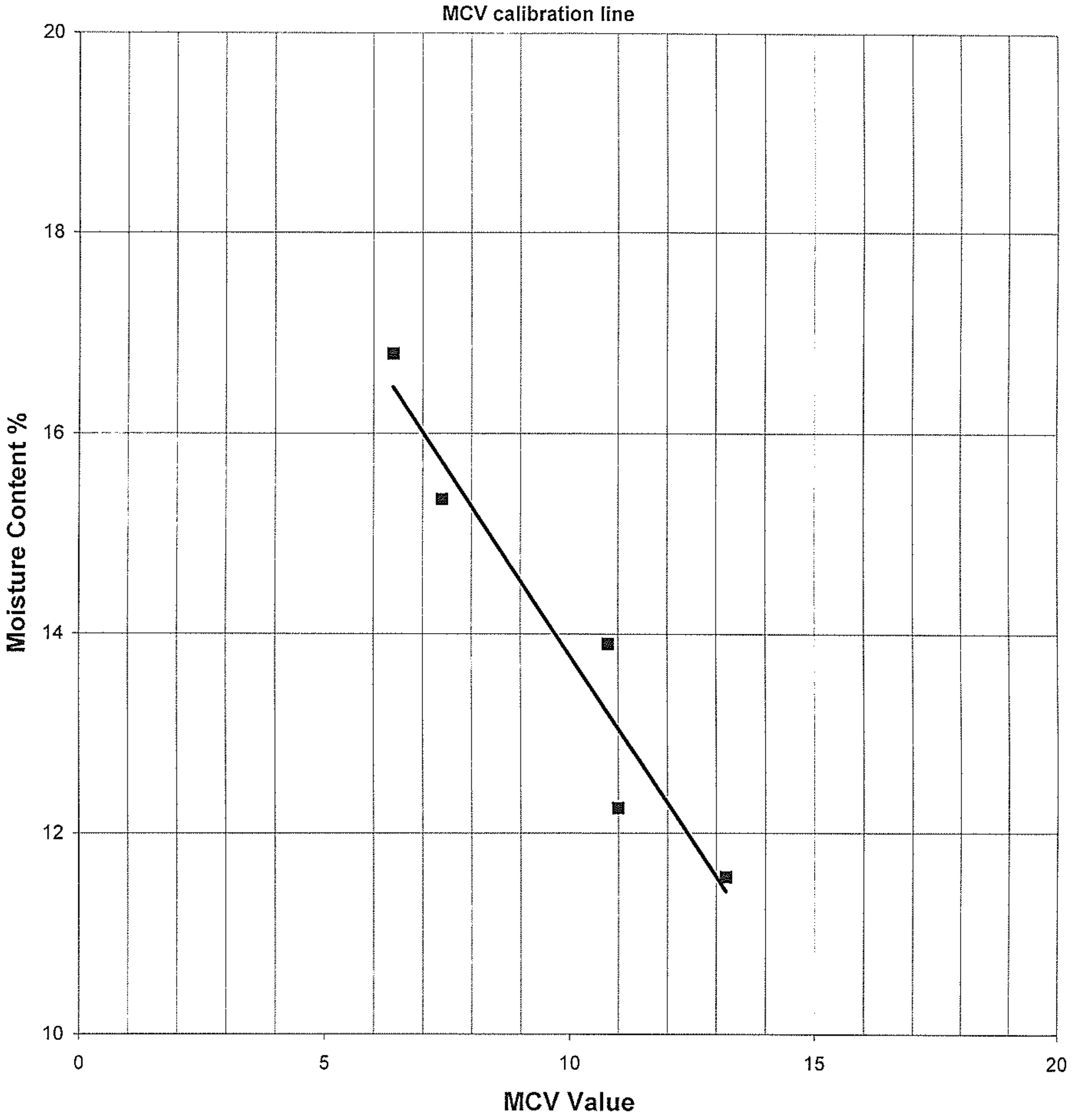
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	BH32
		Sample No	2
Soil Description	Slightly sandy gravelly CLAY with high cobble content	Sample Type	B
		Depth	1.20 m



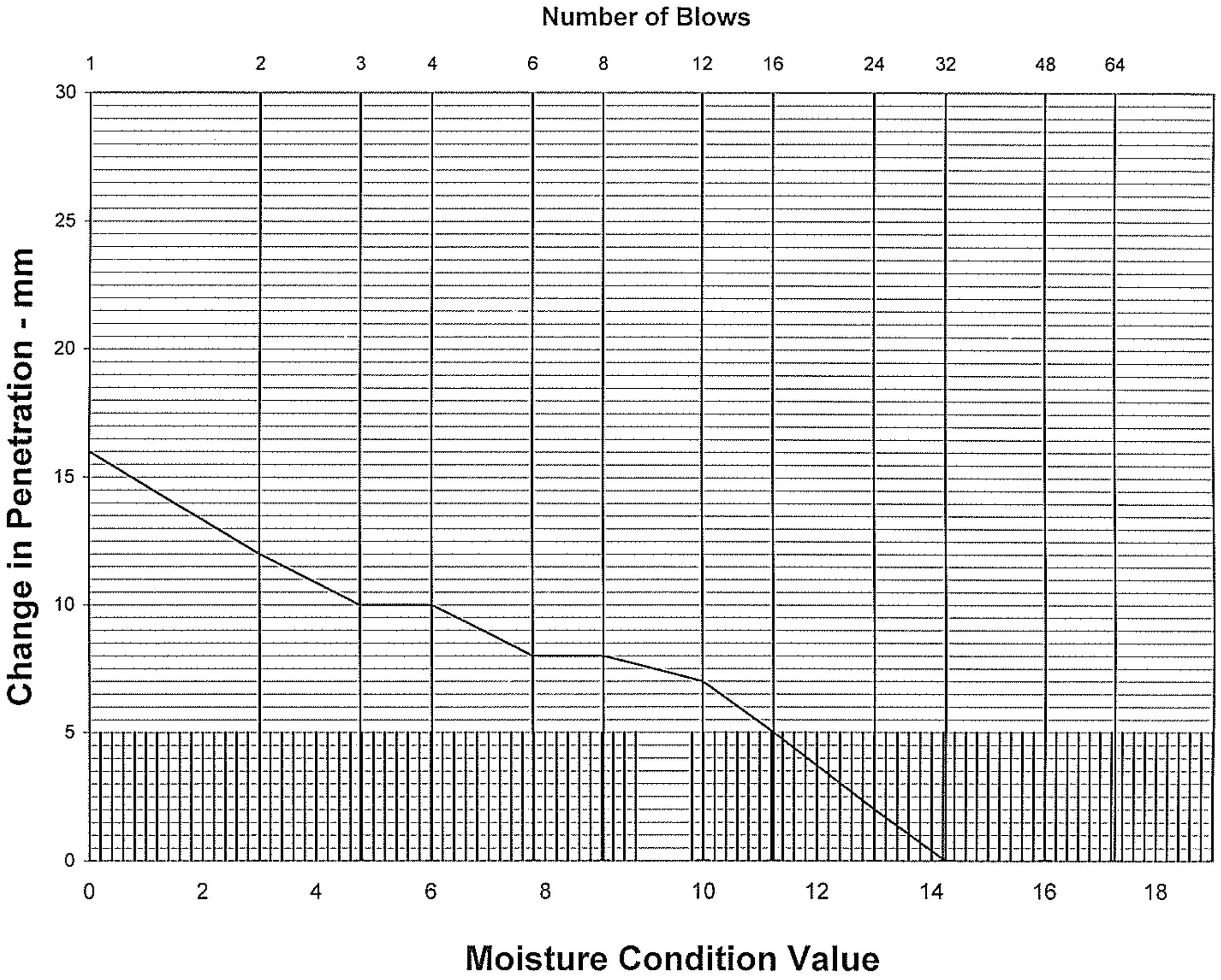
Specimen No	1	2	3	4	5	6
Moisture Condition Value	6.4	10.8	13.2	11.0	7.4	
Moisture Content %	16.79	13.90	11.56	12.25	15.34	
Bulk density after compaction Mg/m³	2.10	2.19	2.22	2.25	2.10	
Dry density after compaction Mg/m³	1.80	1.92	1.99	2.00	1.82	
Hand vane strength kPa	0	0	0	0	0	
Method of determining MCV	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve %	46.1					

	MCV Relationship Graph **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	BH32
		Sample No	2
Soil Description	Slightly sandy gravelly CLAY with high coble content	Sample Type	B
		Depth	1.20 m



Operator	Checked	Approved	Remarks Single sample / Separate batches tested

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	BH33
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy slightly gravelly SILT	Sample Type	B
		Depth	0.20 m

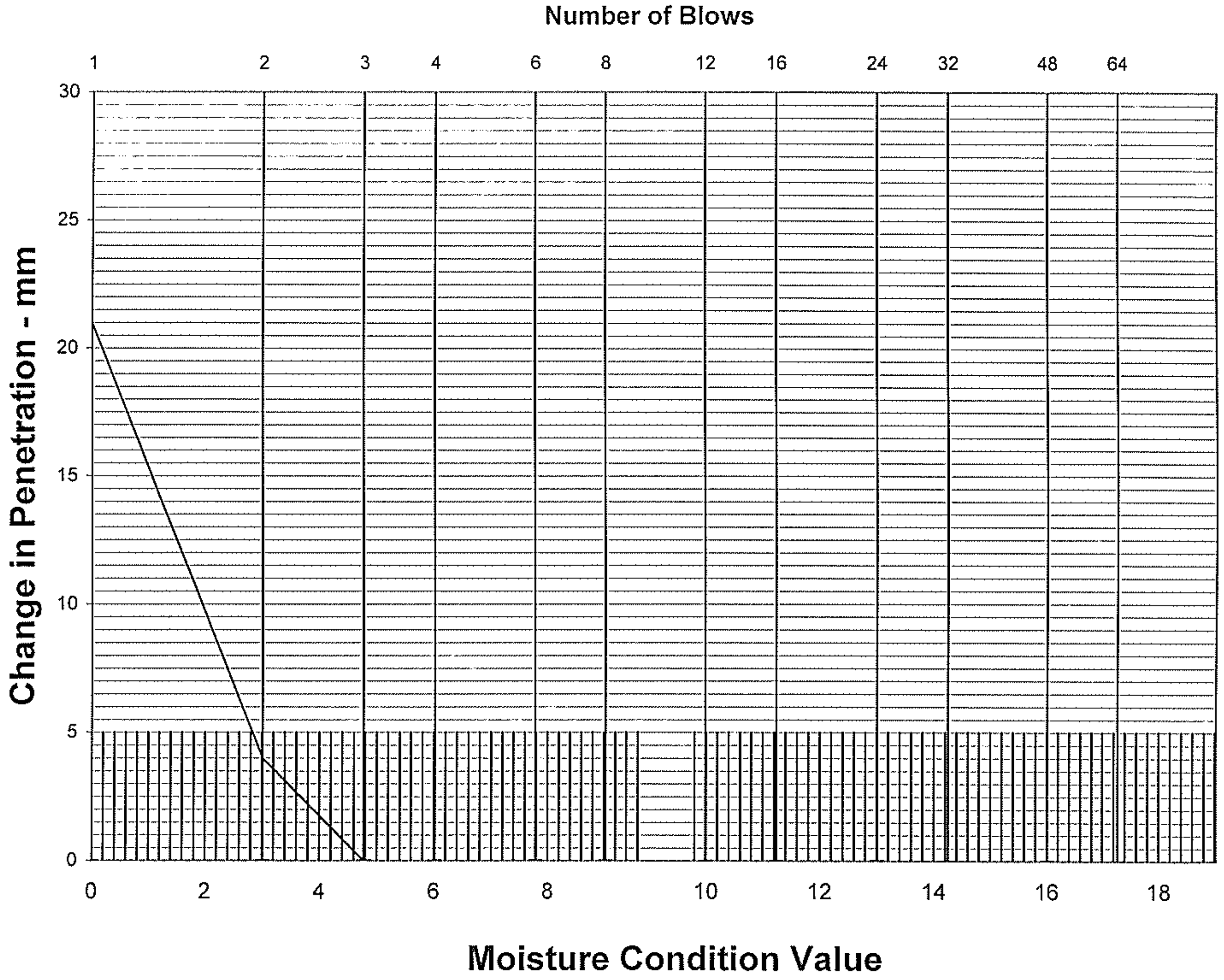


Specimen No	1	2	3	4	5	6
Moisture Condition Value	12.0					
Moisture Content %	16.59					
Bulk density after compaction Mg/m³	1.91					
Dry density after compaction Mg/m³	1.64					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	81.0					

Moisture Condition Value

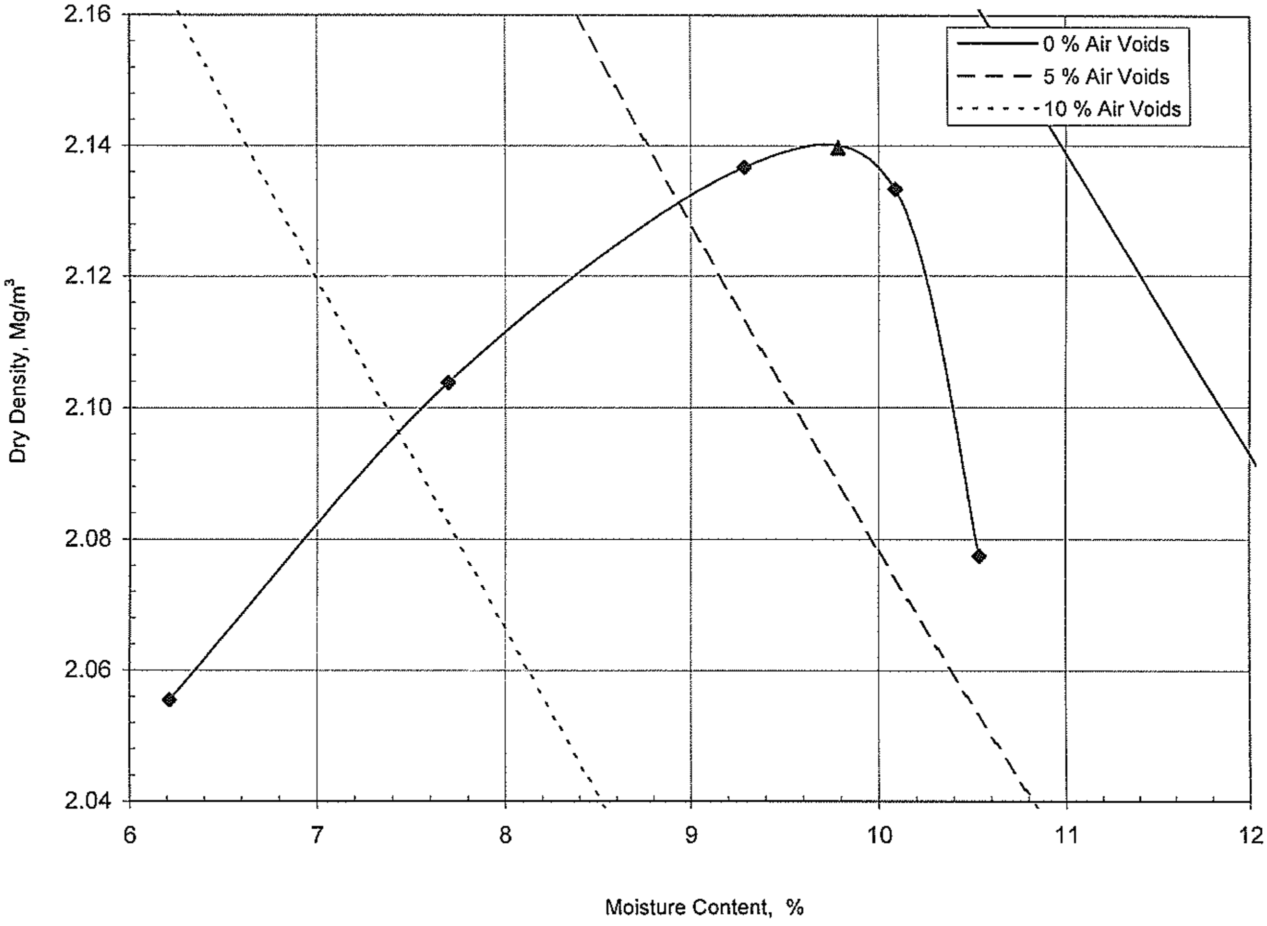
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
		Borehole / Pit No	BH40
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Very clayey very sandy GRAVEL with high cobble content	Sample Type	B
		Depth	0.00 m



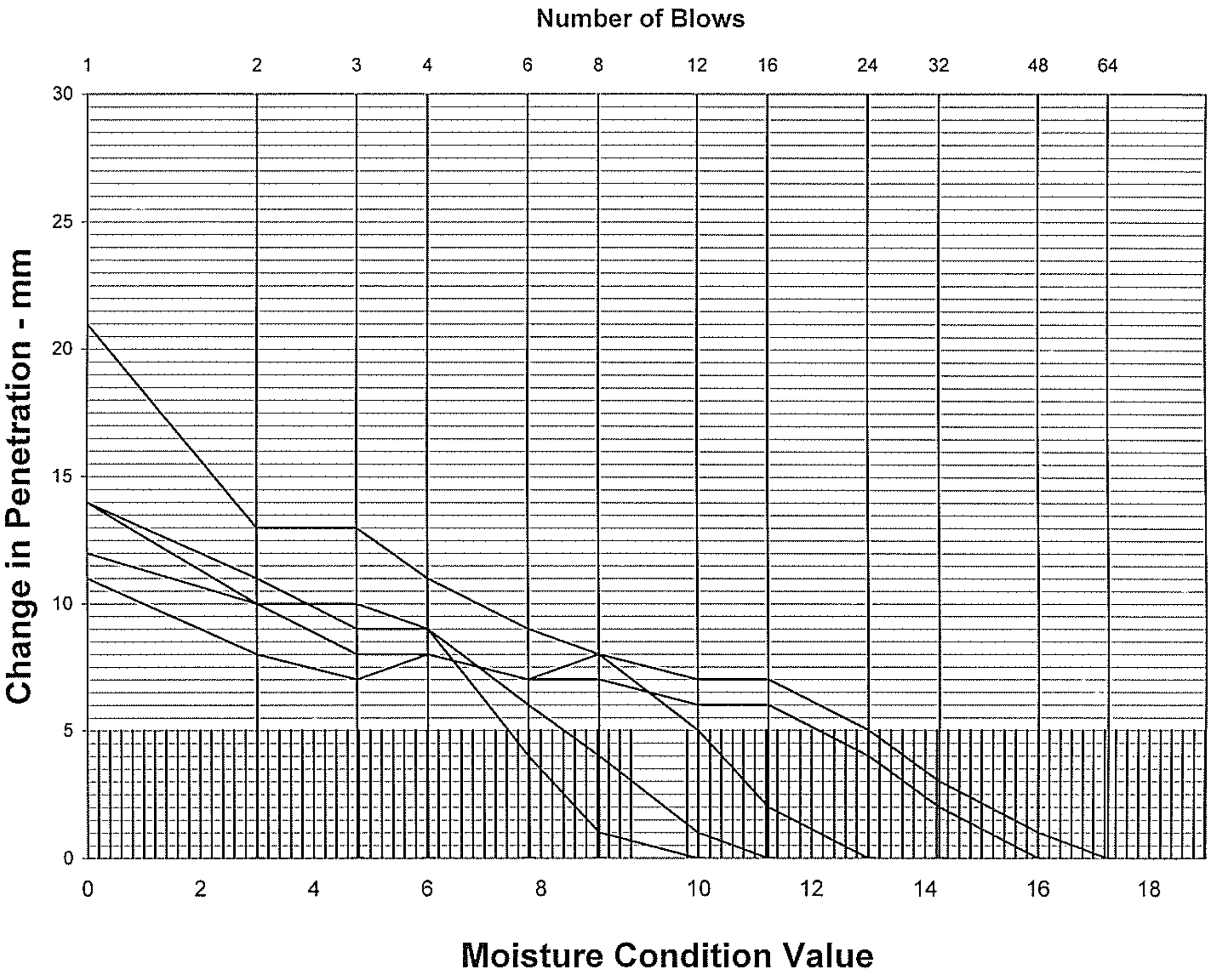
Specimen No		1	2	3	4	5	6
Moisture Condition Value		2.8					
Moisture Content	%	46.80					
Bulk density after compaction	Mg/m³	1.66					
Dry density after compaction	Mg/m³	1.13					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	71.9					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	TP01
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.40 m
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B



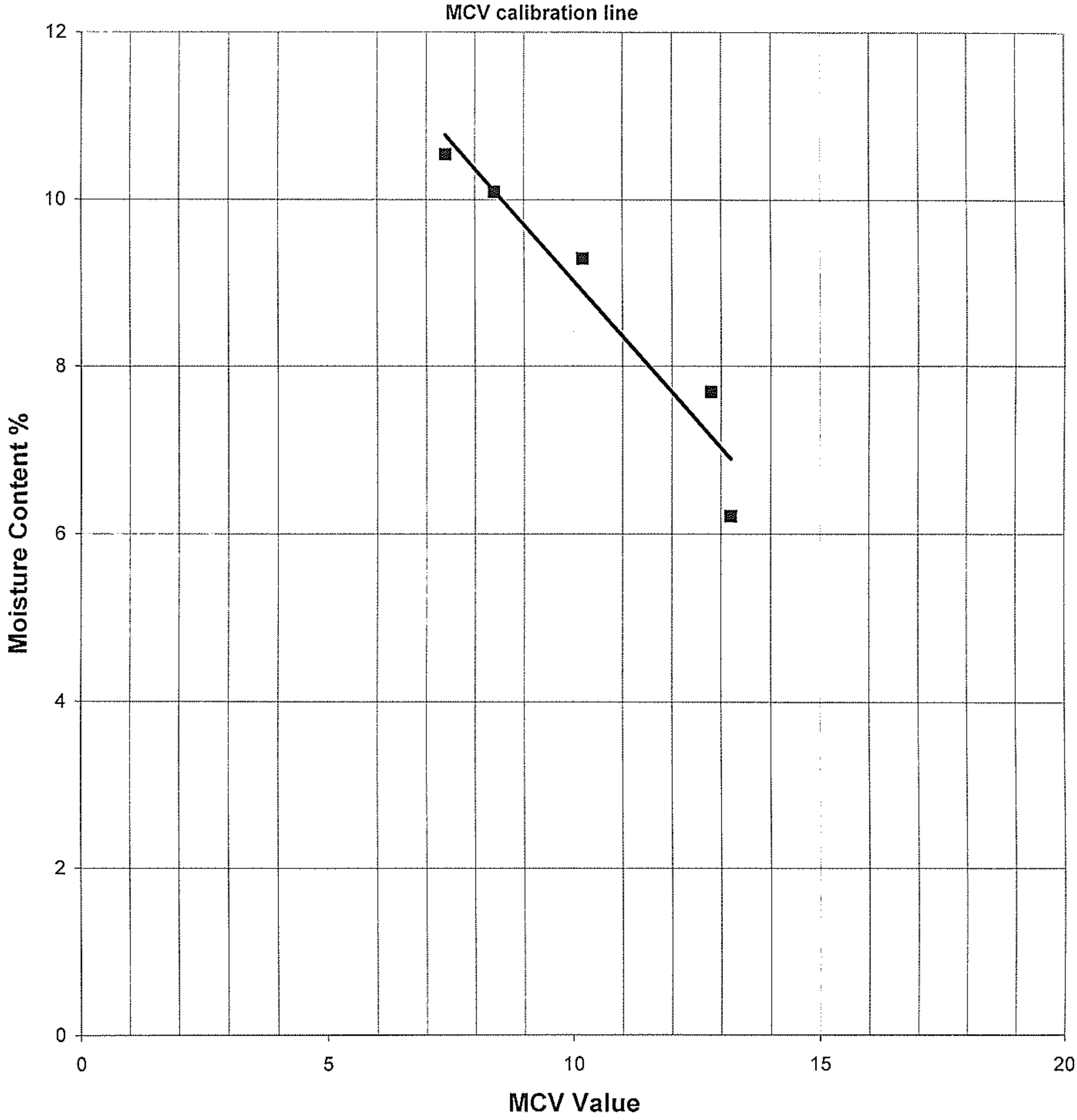
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	4
Mass Retained on 20.0 mm Sieve	%	14
Grading Zone		4
Particle Density - Assumed	$\mathrm{Mg/m^3}$	2.80
Maximum Dry Density	$\mathrm{Mg/m^3}$	2.14
Optimum Moisture Content	%	9.8
Natural Moisture Content	%	10.54

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP01
		Sample No	1
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B
		Depth	0.40 m



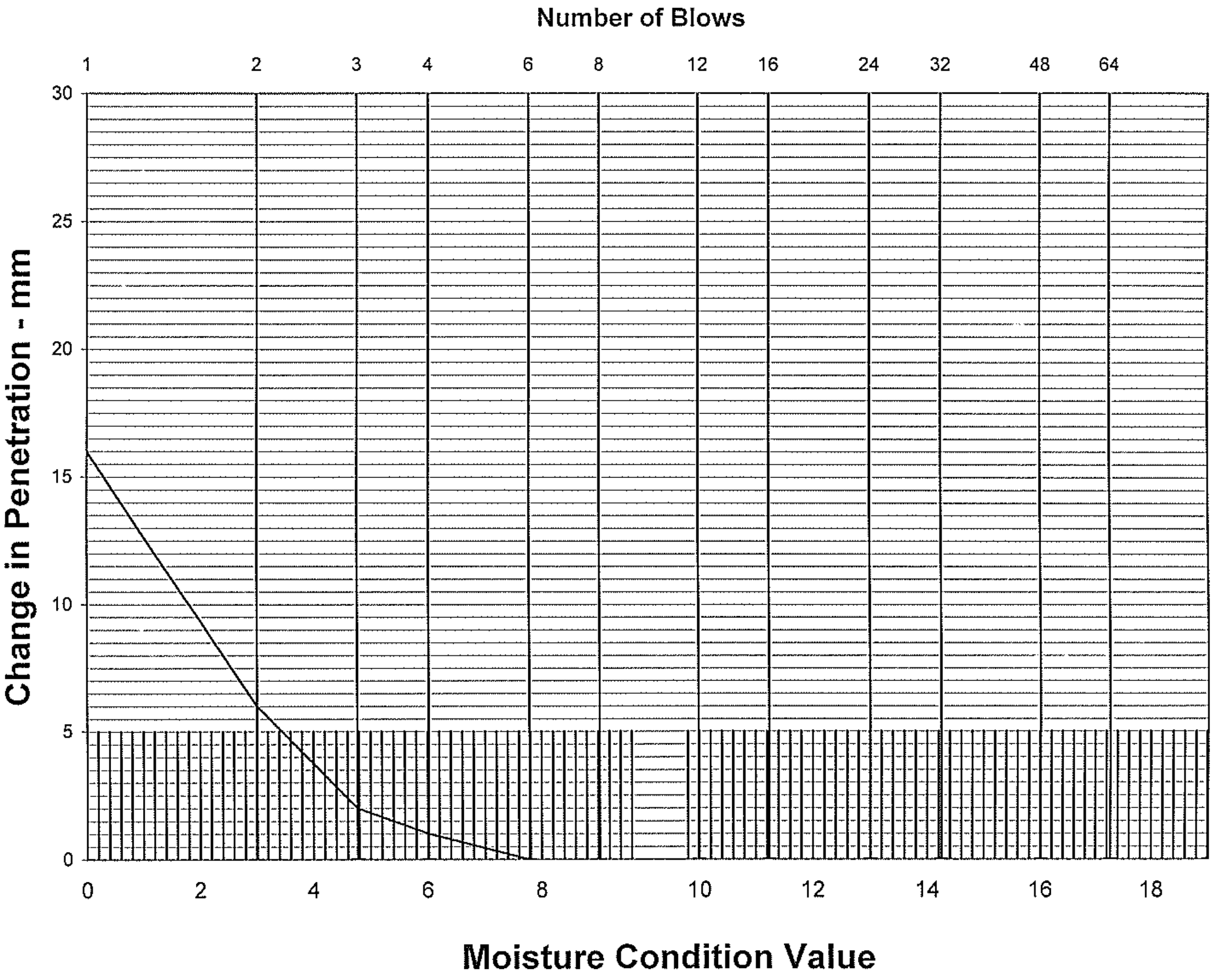
Specimen No		1	2	3	4	5	6
Moisture Condition Value		7.4	13.2	8.4	12.8	10.2	
Moisture Content	%	10.54	6.21	10.09	7.69	9.29	
Bulk density after compaction	Mg/m³	2.22	2.14	2.25	2.25	2.29	
Dry density after compaction	Mg/m³	2.01	2.01	2.04	2.09	2.10	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	13.7					

	MCV Relationship Graph **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP01
		Sample No	1
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B
		Depth	0.40 m



Operator	Checked	Approved	Remarks Single sample / Separate batches tested

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP01
		Sample No	3
Soil Description	Slightly sandy slightly gravelly SILT with high cobble content	Sample Type	B
		Depth	1.40 m

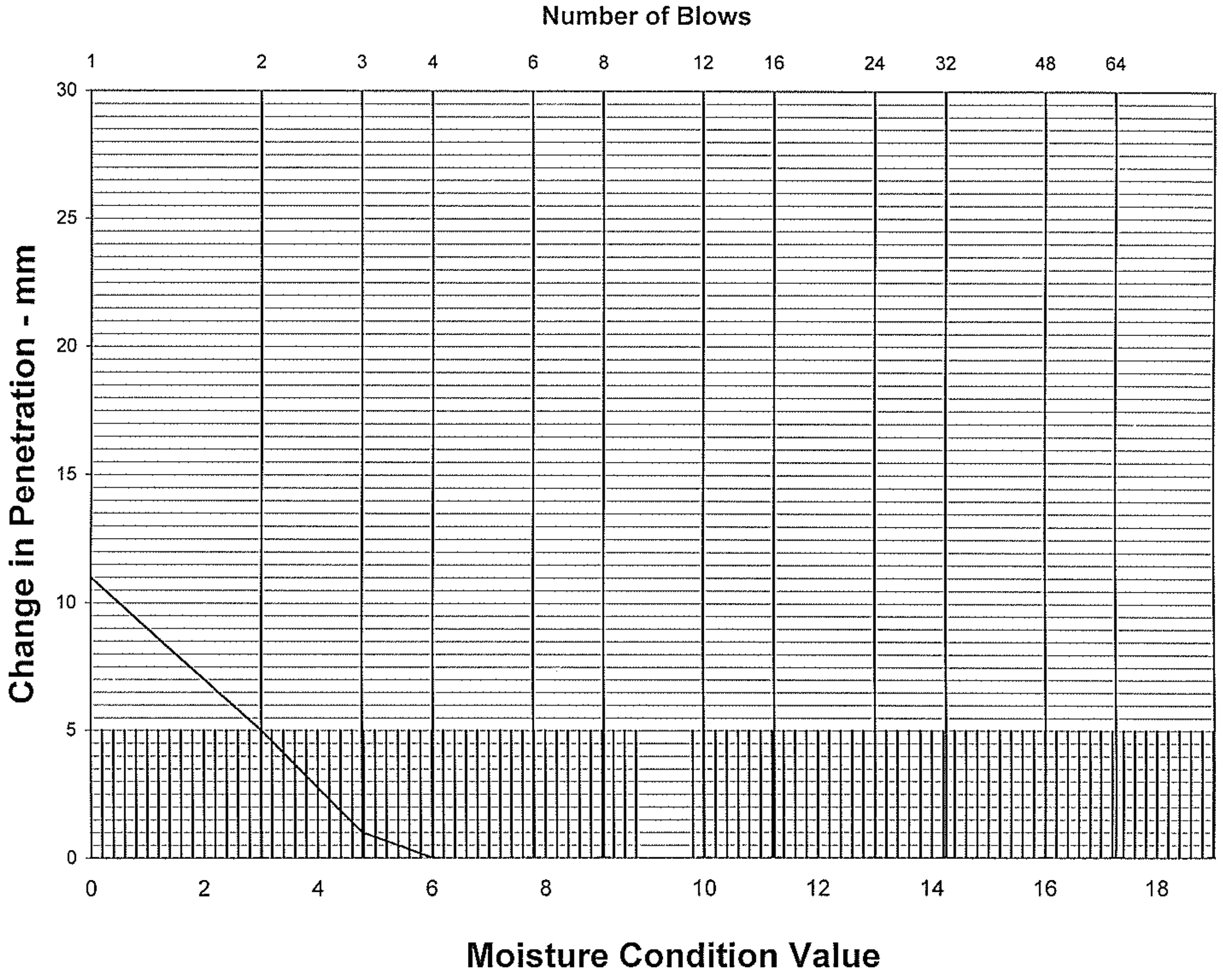


Specimen No		1	2	3	4	5	6
Moisture Condition Value		3.3					
Moisture Content	%	9.74					
Bulk density after compaction	Mg/m³	2.29					
Dry density after compaction	Mg/m³	2.09					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	69.8					

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

Location	Dunkellin River & Aggard Stream Flood Relief Scheme	**Job Ref**	**P12012**
		Borehole / Pit No	TP02
		Sample No	1
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	0.00 m

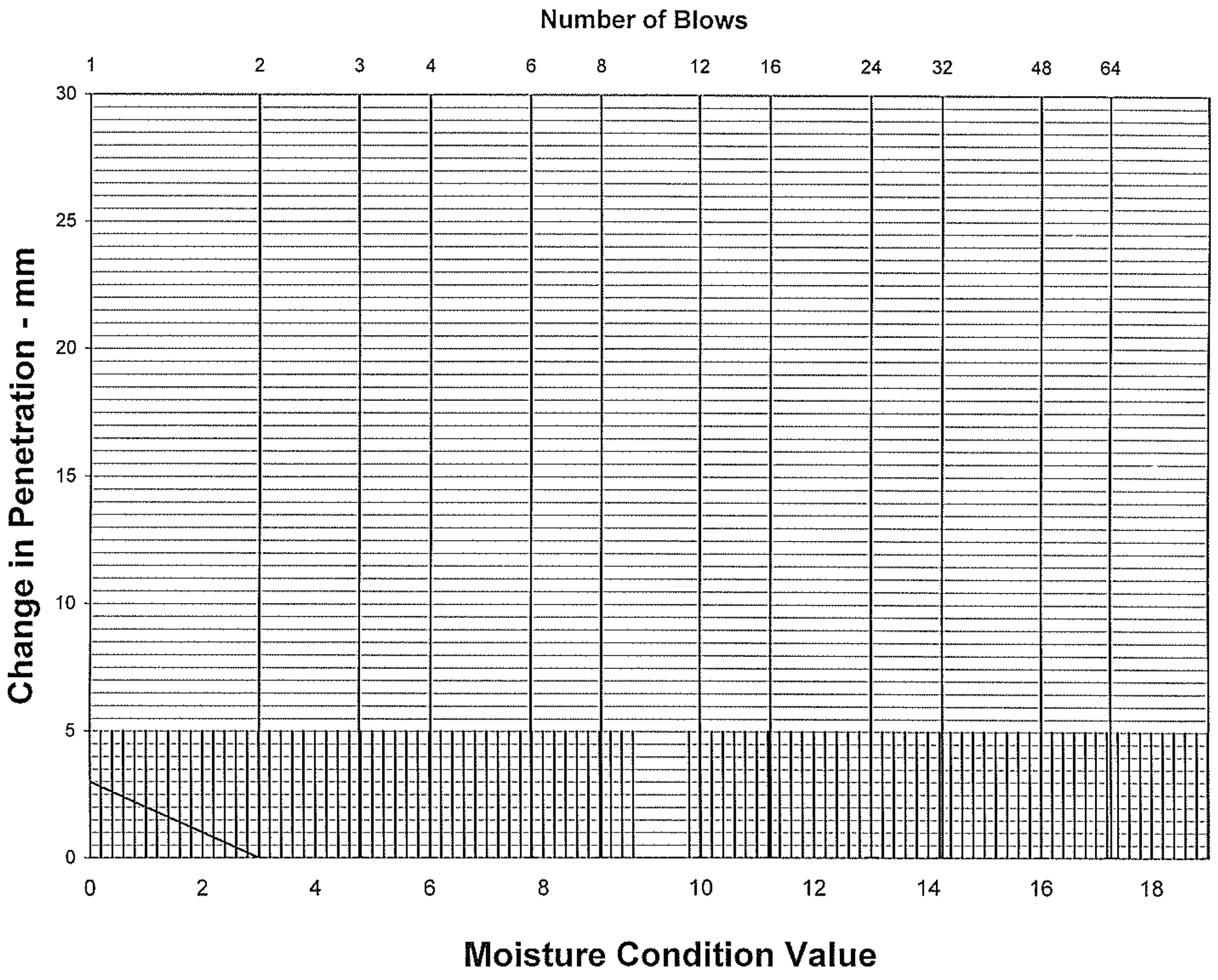


Specimen No		1	2	3	4	5	6
Moisture Condition Value		3.0					
Moisture Content	%	14.47					
Bulk density after compaction	Mg/m³	2.19					
Dry density after compaction	Mg/m³	1.91					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	21.4					

Moisture Condition Value

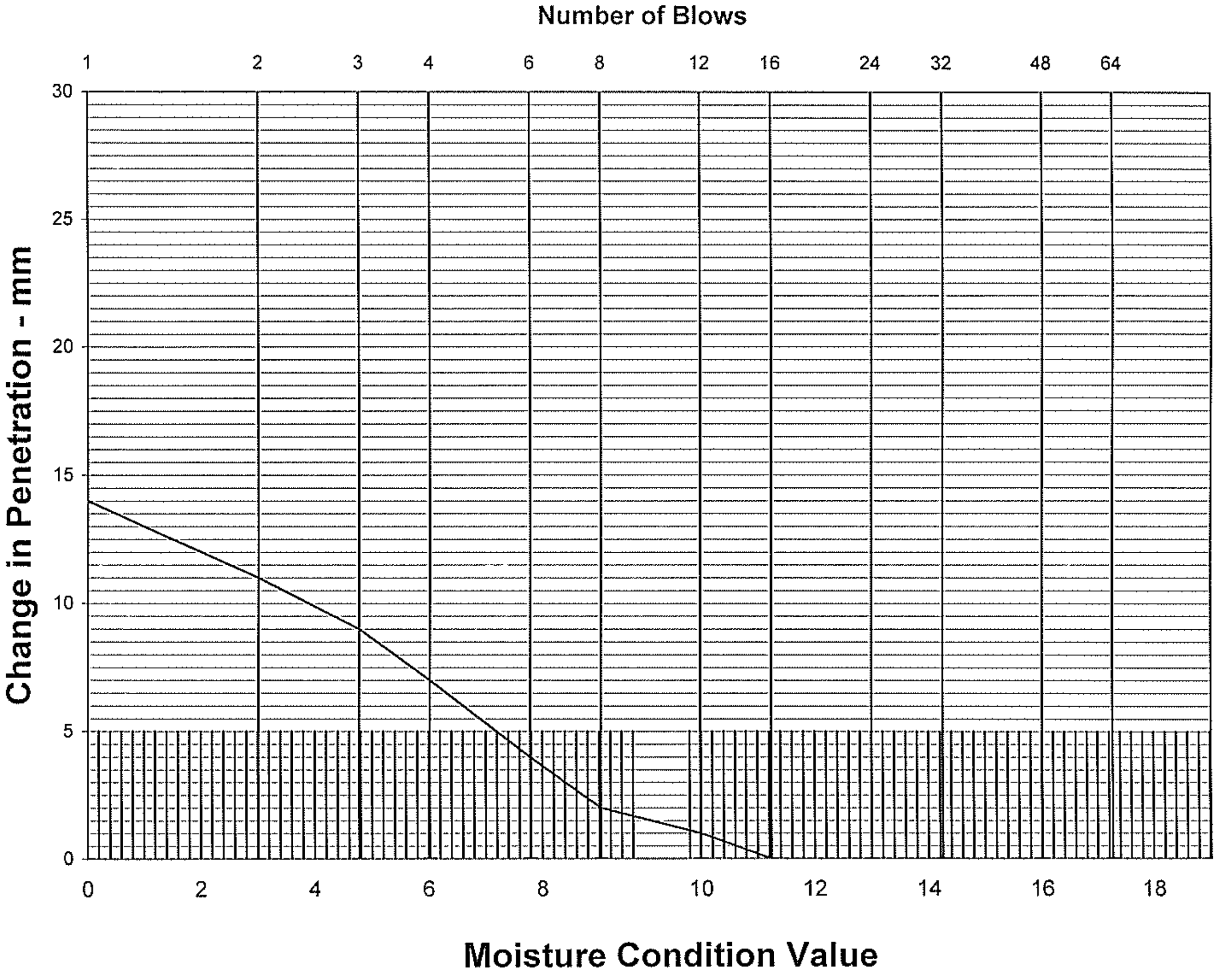
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
		Borehole / Pit No	TP02
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy slightly gravelly CLAY with low cobble content	Sample Type	B
		Depth	1.00 m



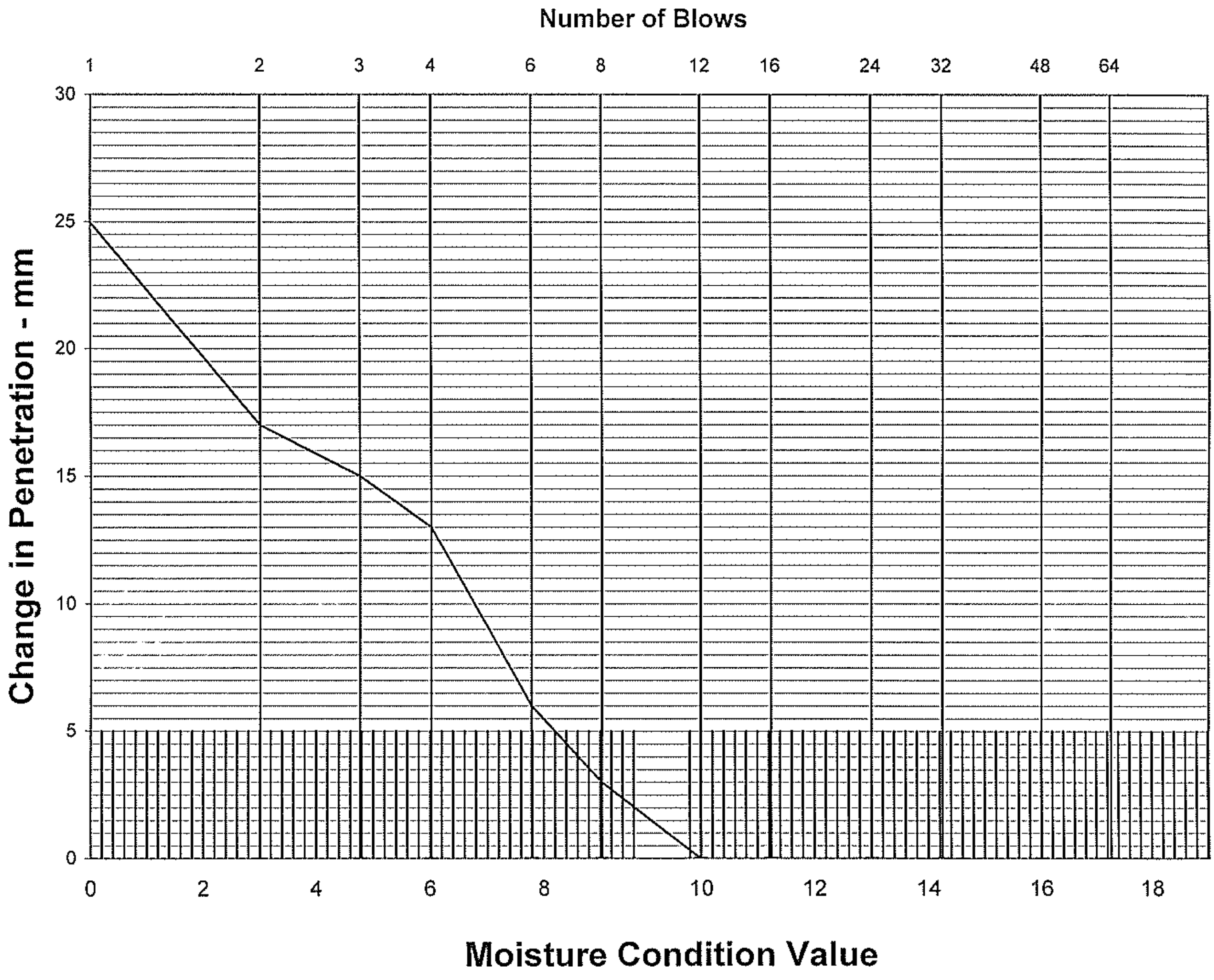
Specimen No	1	2	3	4	5	6
Moisture Condition Value	0.0					
Moisture Content %	17.31					
Bulk density after compaction Mg/m³	2.10					
Dry density after compaction Mg/m³	1.79					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	16.9					

	Moisture Condition Value BS 1377 : Part 4 : 1990 Clause 5	Job Ref	P12012
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP03
		Sample No	1
Soil Description	Slightly sandy gravelly CLAY	Sample Type	B
		Depth	0.00 m



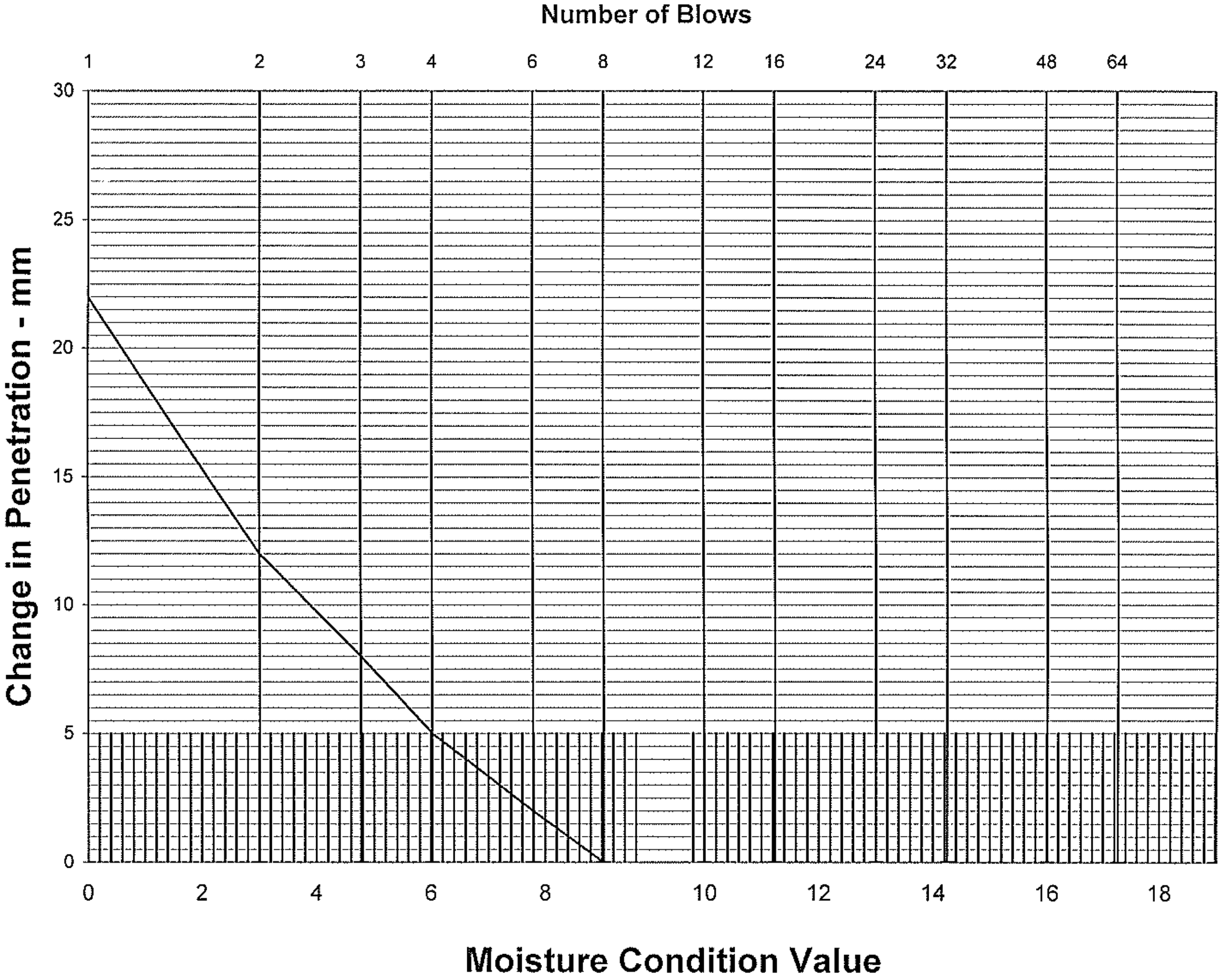
Specimen No		1	2	3	4	5	6
Moisture Condition Value		7.2					
Moisture Content	%	20.07					
Bulk density after compaction	Mg/m³	1.97					
Dry density after compaction	Mg/m³	1.64					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	9.1					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP03
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B
		Depth	1.00 m



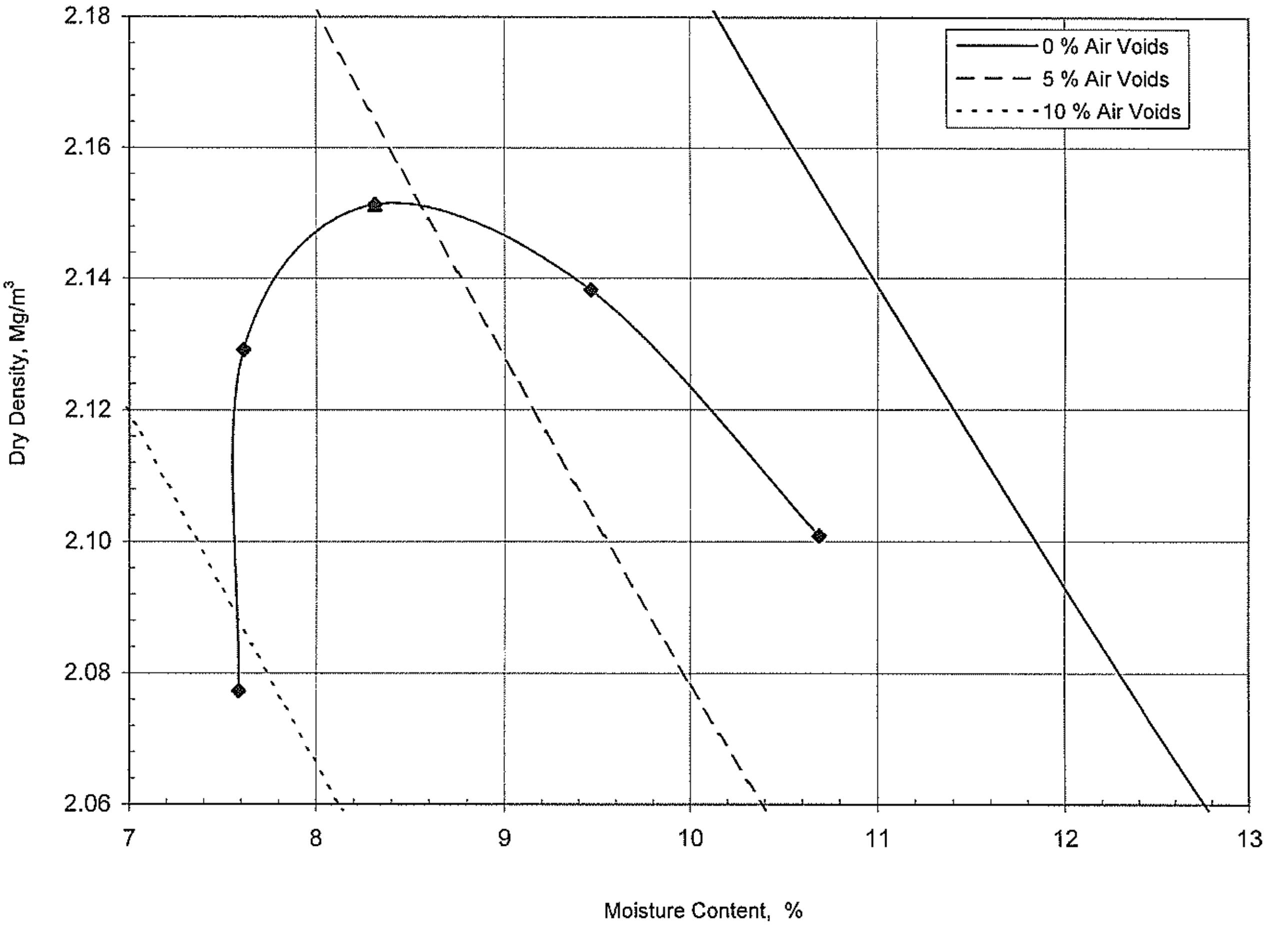
Specimen No		1	2	3	4	5	6
Moisture Condition Value		8.0					
Moisture Content	%	13.82					
Bulk density after compaction	Mg/m³	2.19					
Dry density after compaction	Mg/m³	1.92					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	10.2					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP04
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	0.00 m



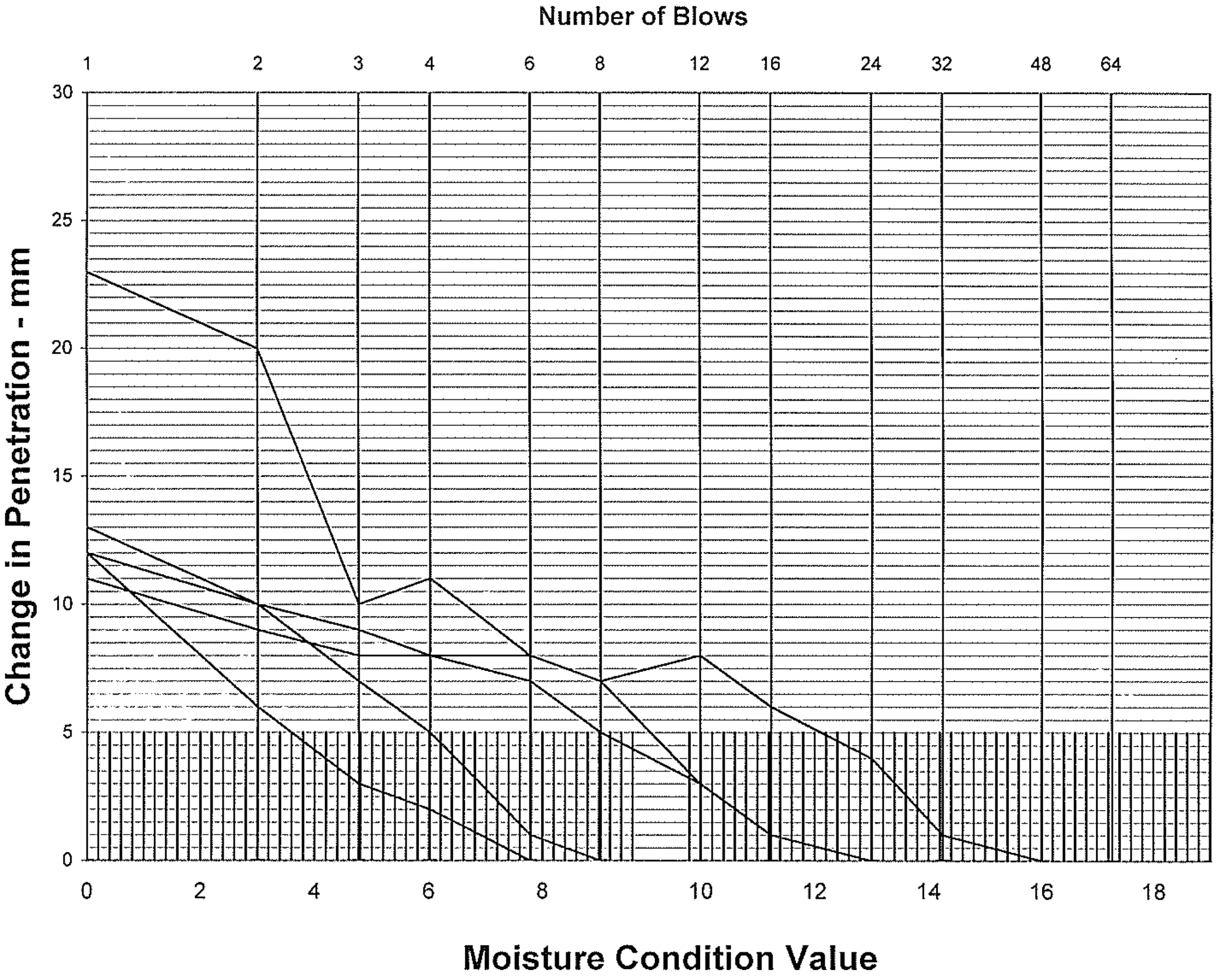
Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.1					
Moisture Content	%	10.30					
Bulk density after compaction	Mg/m³	2.29					
Dry density after compaction	Mg/m³	2.08					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	13.9					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	TP04
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.00 m
Soil Description	Slightly sandy gravelly SILT	Sample Type	B



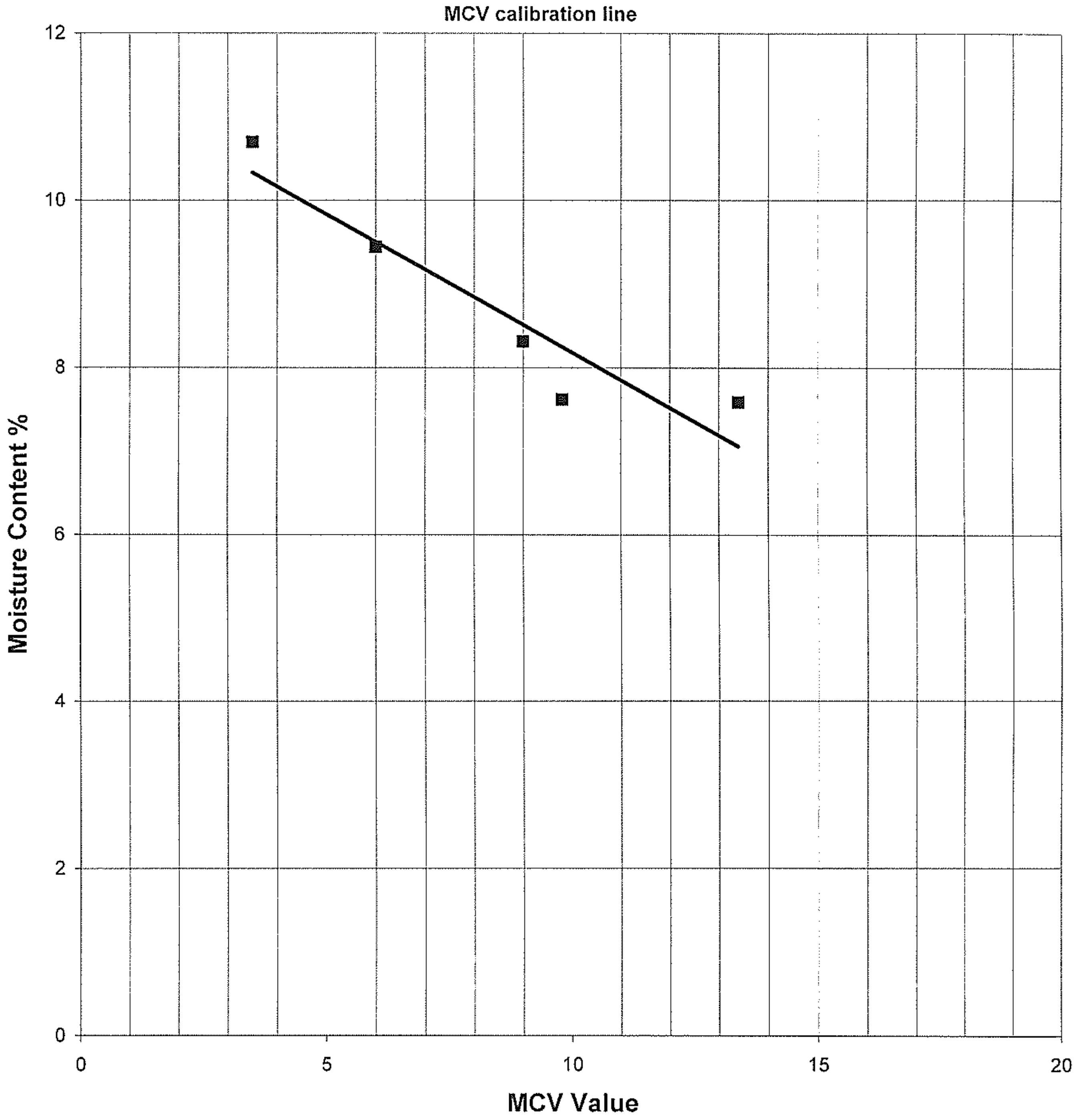
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	2
Mass Retained on 20.0 mm Sieve	%	8
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.80
Maximum Dry Density	Mg/m³	2.15
Optimum Moisture Content	%	8.3
Natural Moisture Content	%	10.69

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP04
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	1.00 m



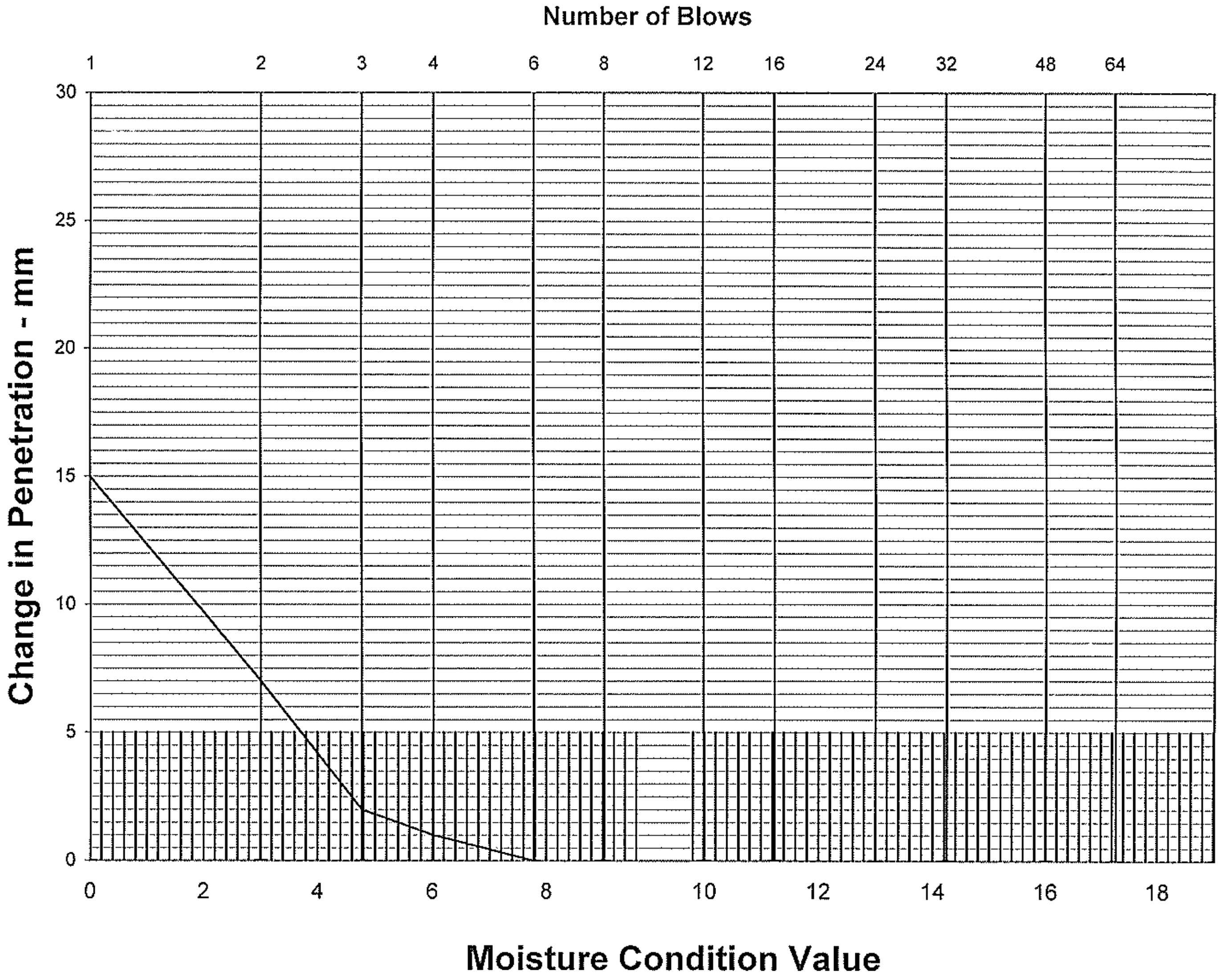
Specimen No		1	2	3	4	5	6
Moisture Condition Value		3.5	13.4	6.0	9.8	9.0	
Moisture Content	%	10.69	7.59	9.44	7.62	8.31	
Bulk density after compaction	Mg/m³	2.19	2.22	2.22	2.36	2.33	
Dry density after compaction	Mg/m³	1.98	2.06	2.03	2.19	2.15	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	7.8					

	MCV Relationship Graph **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP04
		Sample No	3
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	1.00 m



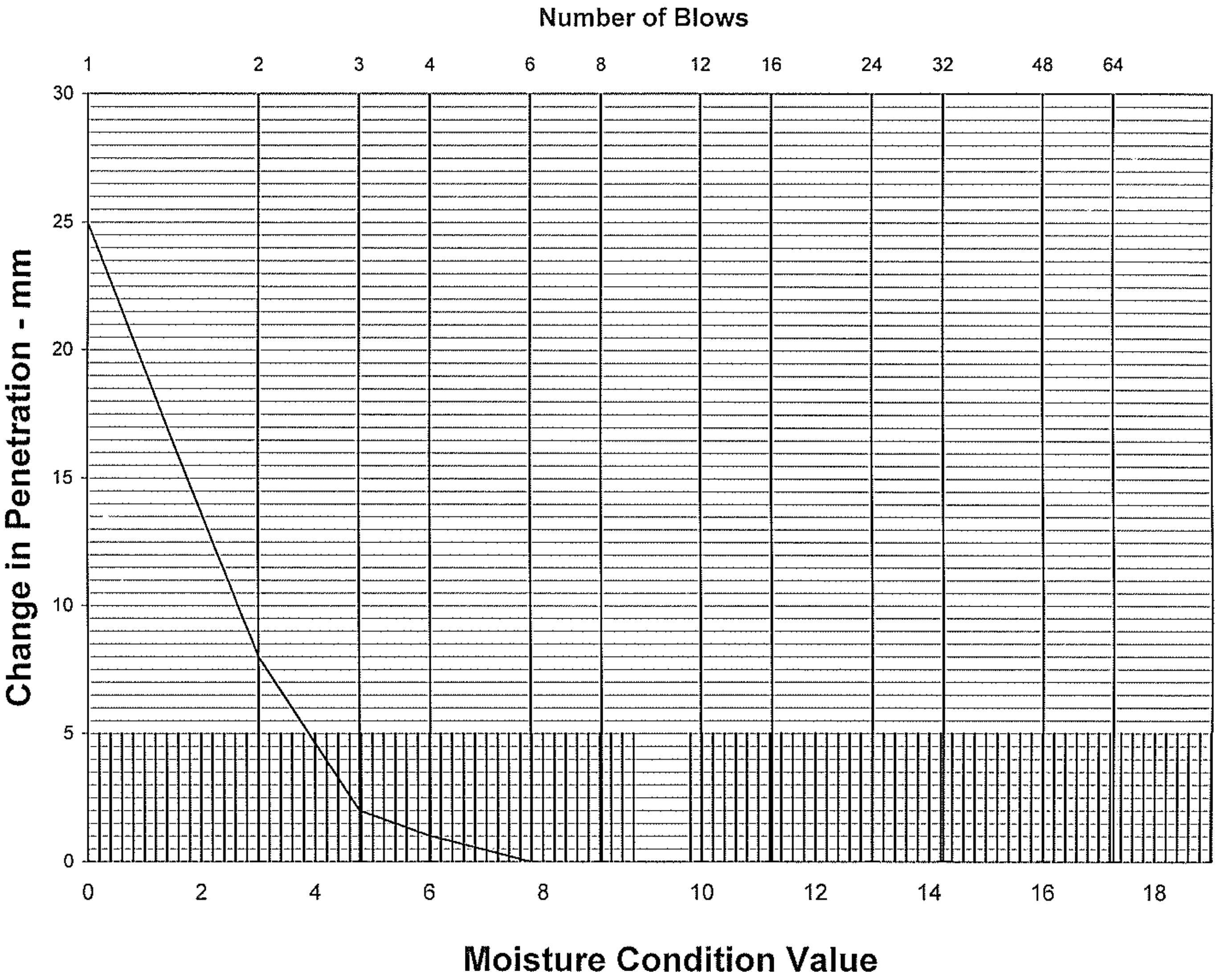
Operator	Checked	Approved	Remarks Single sample / Separate batches tested

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP05
		Sample No	1
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B
		Depth	0.00 m



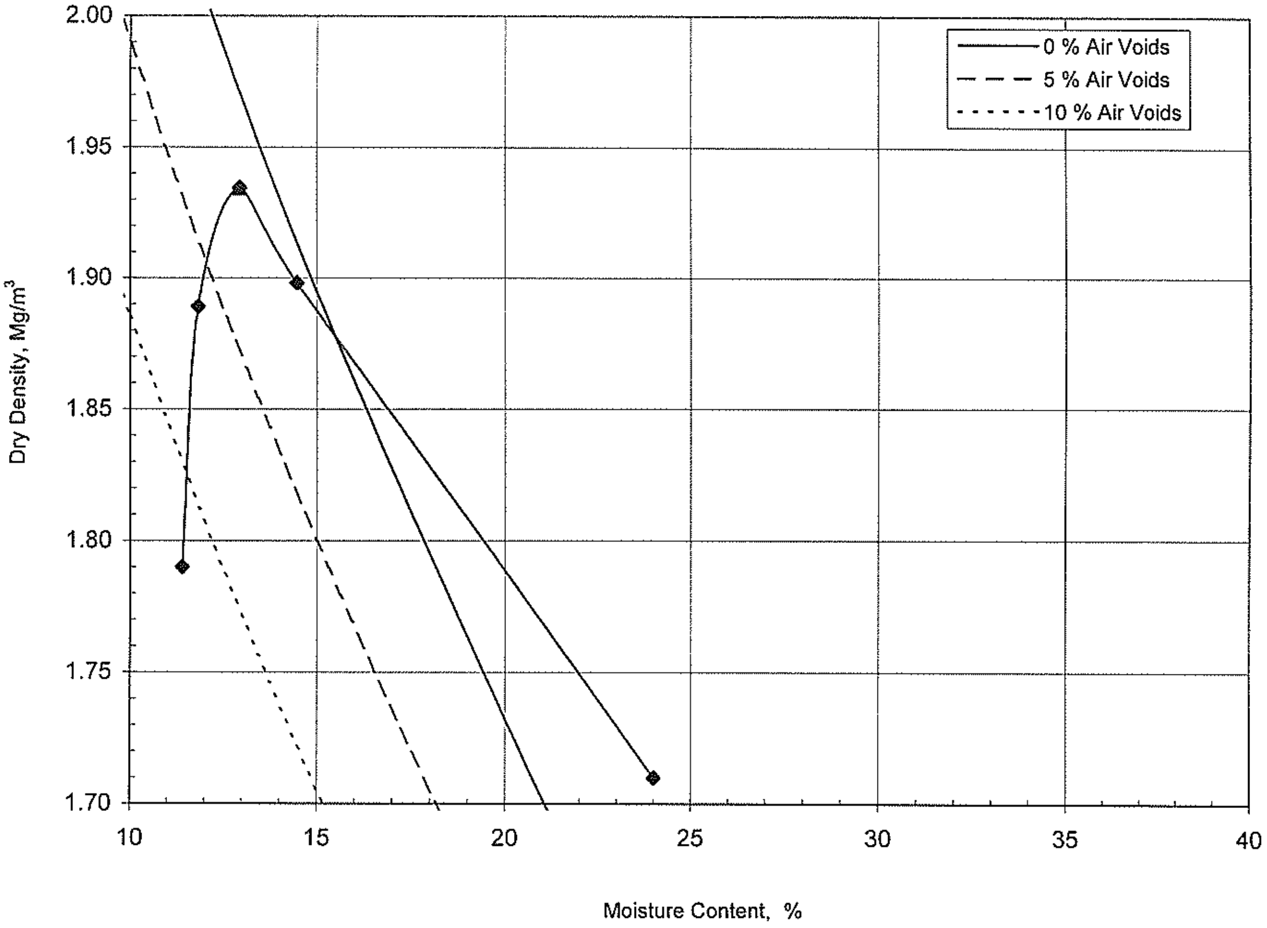
Specimen No	1	2	3	4	5	6
Moisture Condition Value	3.7					
Moisture Content %	10.27					
Bulk density after compaction Mg/m³	2.29					
Dry density after compaction Mg/m³	2.08					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	12.3					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP05
		Sample No	3
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B
		Depth	1.00 m



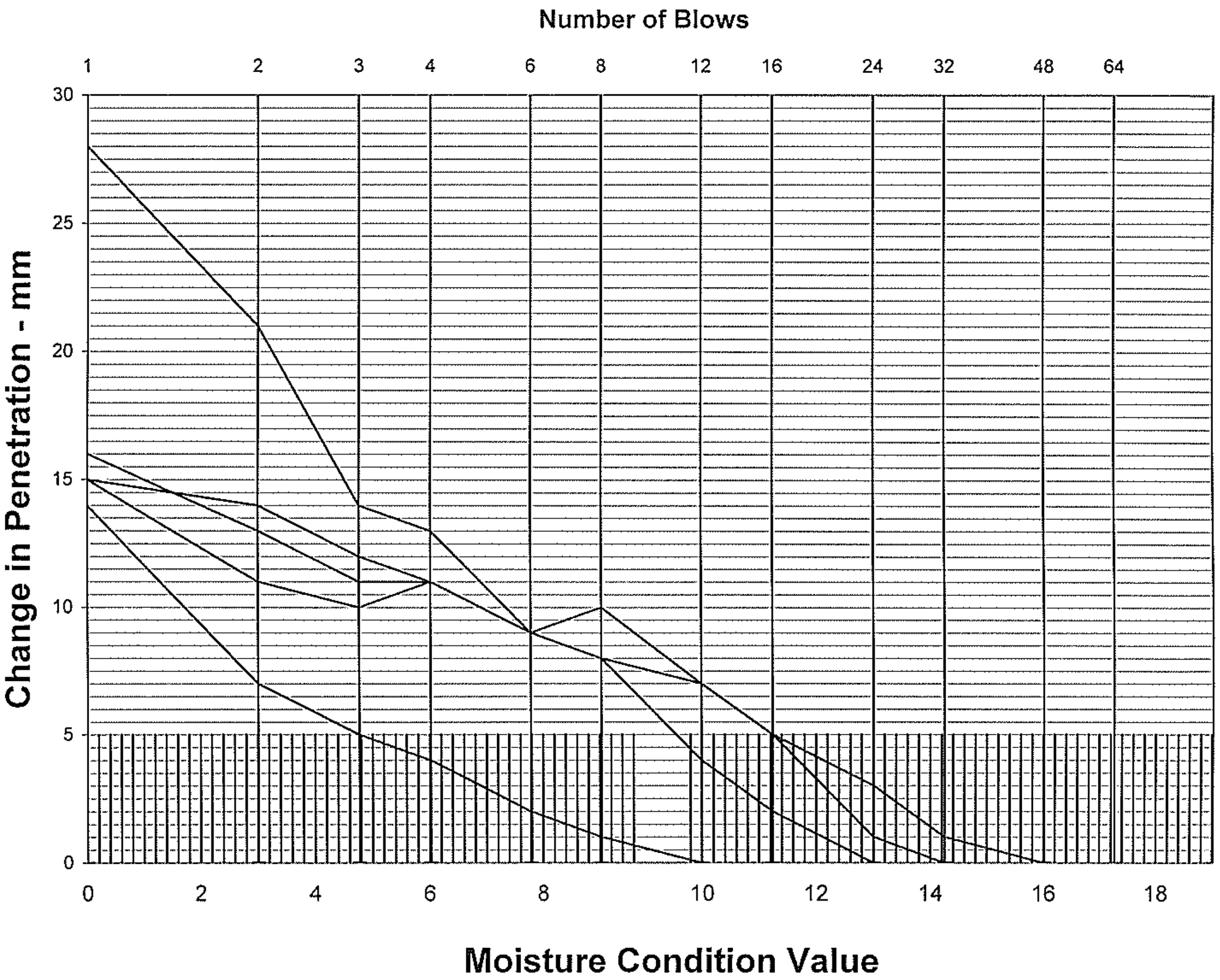
Specimen No	1	2	3	4	5	6
Moisture Condition Value	3.5					
Moisture Content %	10.42					
Bulk density after compaction Mg/m³	2.36					
Dry density after compaction Mg/m³	2.14					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	15.5					

PRIORITY GEOTECHNICAL	Dry Density / Moisture Content Relationship BS 1377 : Part 4 : 1990 : Clause 3	Job Ref	P12012
		Borehole / Pit No	TP12
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	1.00 m
Soil Description	Slightly sandy slightly gravelly SILT	Sample Type	B



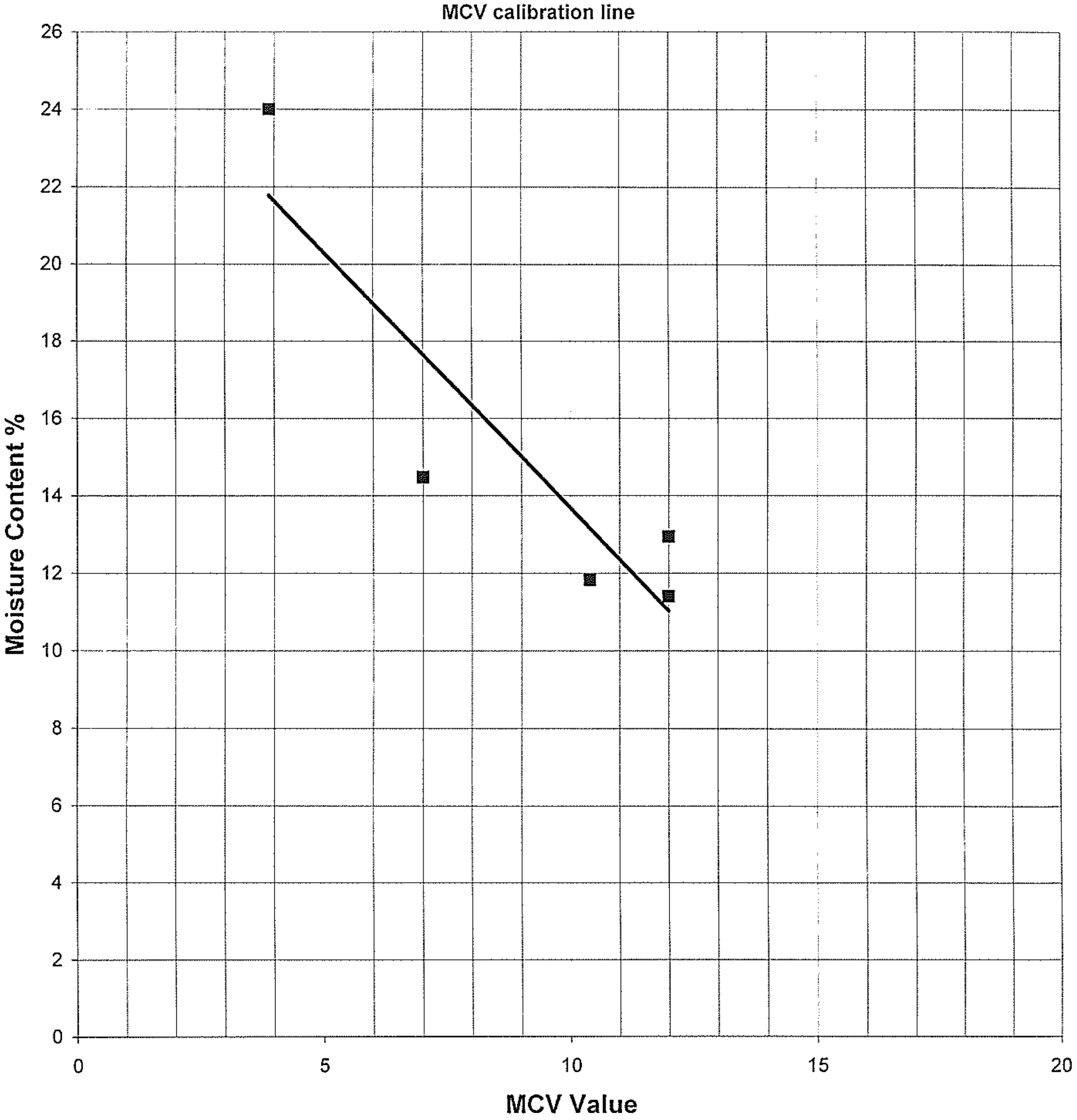
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	10
Mass Retained on 20.0 mm Sieve	%	24
Grading Zone		5
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	1.93
Optimum Moisture Content	%	13
Natural Moisture Content	%	24.00

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP12
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy slightly gravelly SILT	Sample Type	B
		Depth	1.00 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		3.9	10.4	12.0	7.0	12.0	
Moisture Content	%	24.00	11.83	11.40	14.47	12.94	
Bulk density after compaction	Mg/m³	2.10	2.10	2.10	2.19	2.19	
Dry density after compaction	Mg/m³	1.69	1.88	1.89	1.91	1.94	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	24.5					

	MCV Relationship Graph **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP12
		Sample No	1
Soil Description	Slightly sandy slightly gravelly SILT	Sample Type	B
		Depth	1.00 m

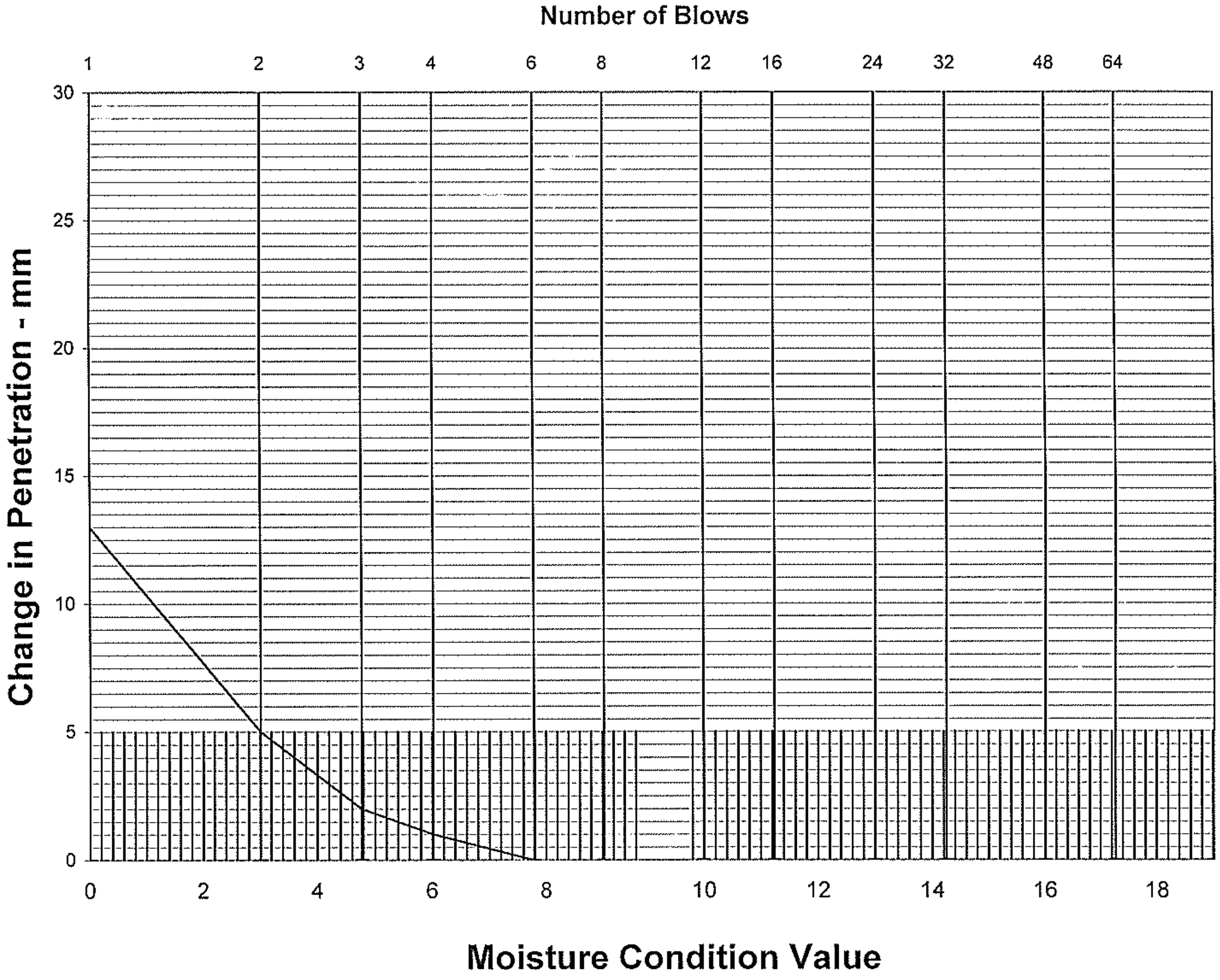


Operator	Checked	Approved	Remarks Single sample / Separate batches tested

Moisture Condition Value

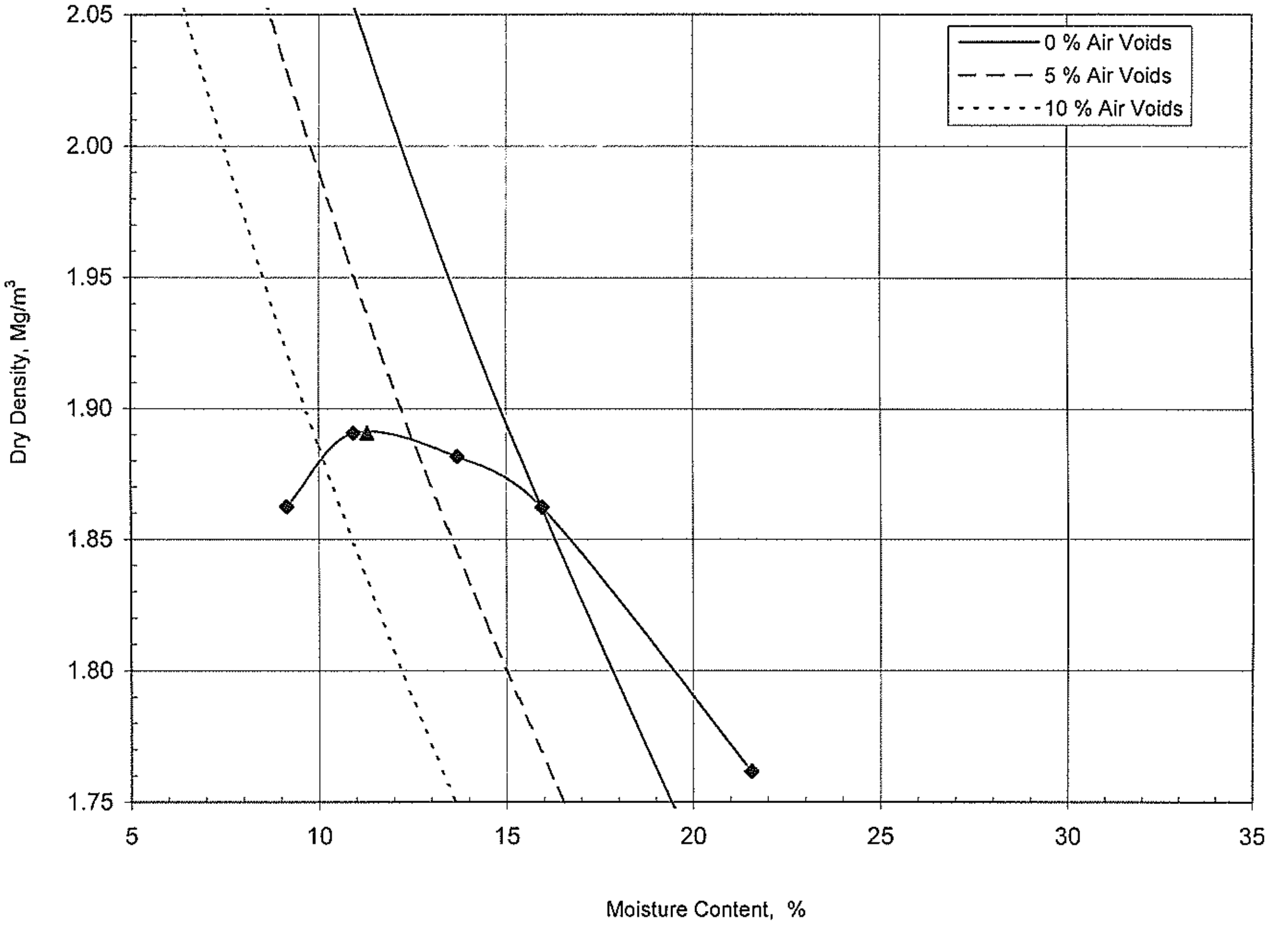
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
		Borehole / Pit No	TP13
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Silty sandy GRAVEL with low cobble content	Sample Type	B
		Depth	1.00 m



Specimen No	1	2	3	4	5	6
Moisture Condition Value	3.0					
Moisture Content %	16.93					
Bulk density after compaction Mg/m³	2.05					
Dry density after compaction Mg/m³	1.75					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	18.3					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	TP14
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	0.50 m
Soil Description	Slightly sandy slightly gravelly SILT	Sample Type	B

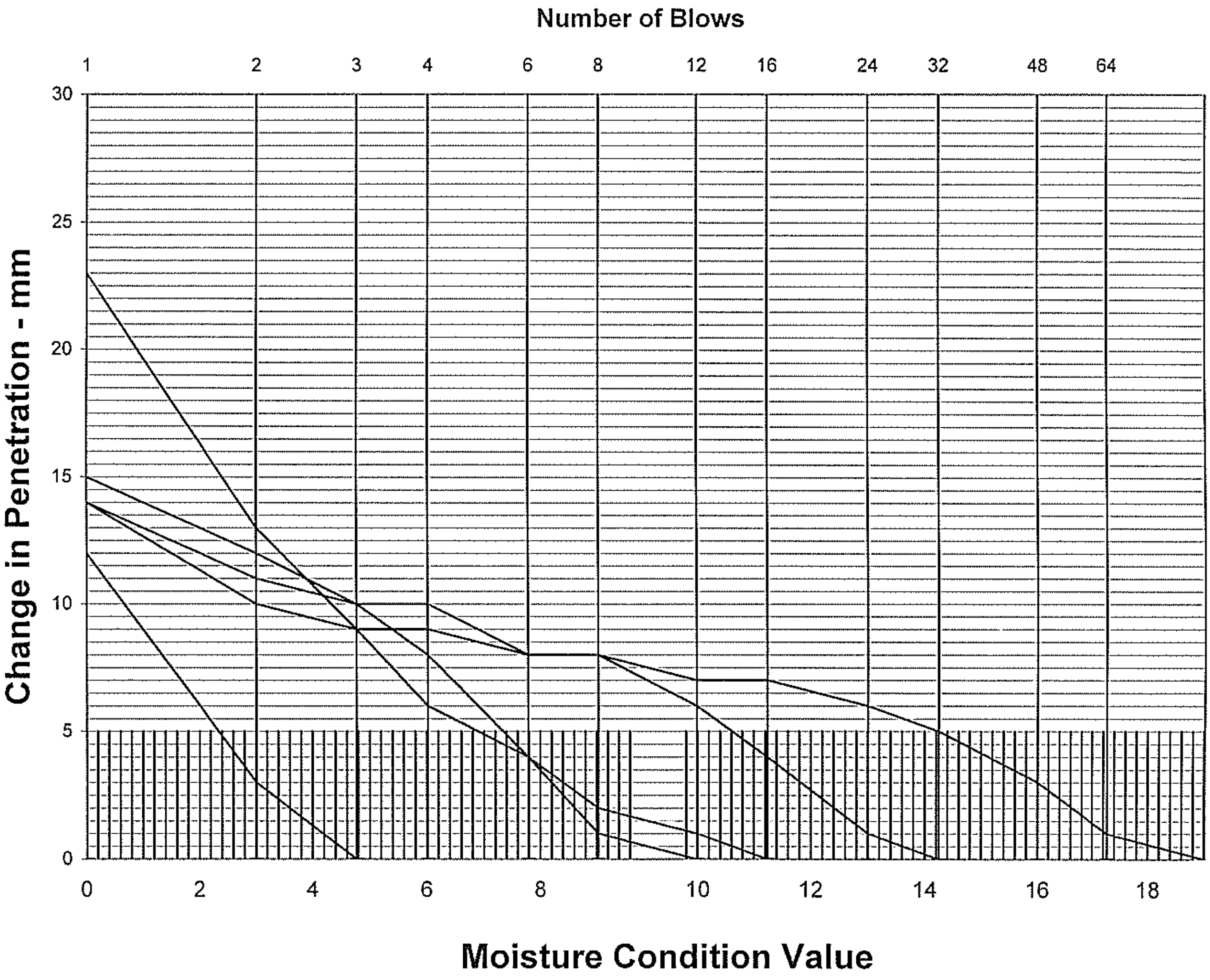


Preparation	3.2
Test Method	2.5 kg Rammer
Mould Type	CBR
Samples Used	Single Sample
Mass Retained on 37.5 mm Sieve %	22
Mass Retained on 20.0 mm Sieve %	30
Grading Zone	
Particle Density - Assumed Mg/m³	2.65
Maximum Dry Density Mg/m³	1.89
Optimum Moisture Content %	11
Natural Moisture Content %	21.57

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

Job Ref	P12012
Borehole / Pit No	TP14
Sample No	1
Sample Type	B
Depth	0.50 m
Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Slightly sandy slightly gravelly SILT

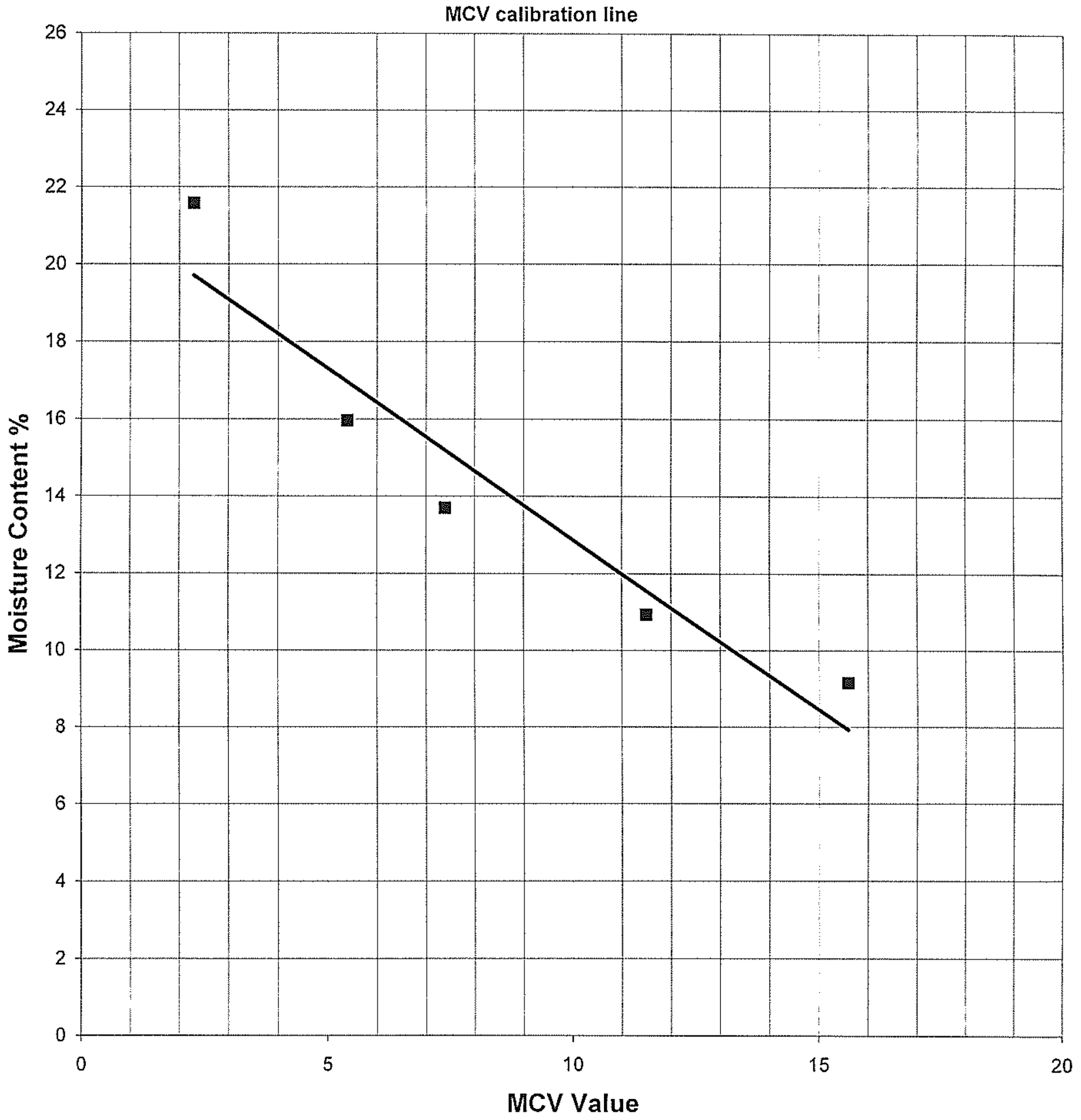


Specimen No		1	2	3	4	5	6
Moisture Condition Value		2.3	5.4	11.5	15.6	7.4	
Moisture Content	%	21.57	15.96	10.93	9.15	13.69	
Bulk density after compaction	Mg/m³	2.03	2.17	2.07	2.17	2.12	
Dry density after compaction	Mg/m³	1.67	1.87	1.87	1.99	1.86	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	29.1					

MCV Relationship Graph

BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP14
		Sample No	1
Soil Description	Slightly sandy slightly gravelly SILT	Sample Type	B
		Depth	0.50 m



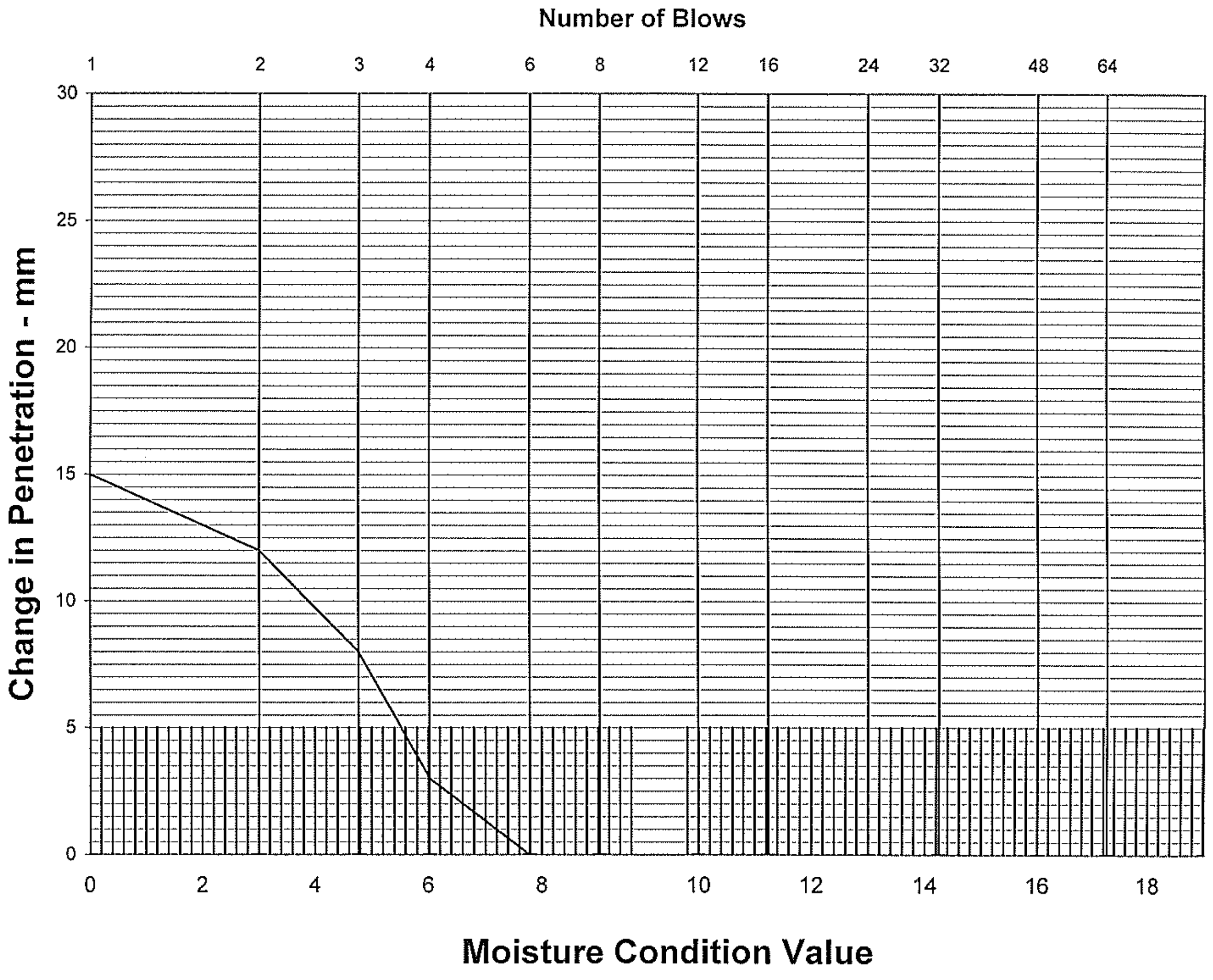
Operator	Checked	Approved

Remarks Single sample / Separate batches tested

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
		Borehole / Pit No	TP15
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy slightly gravelly SILT with medium cobble content	Sample Type	B
		Depth	1.00 m



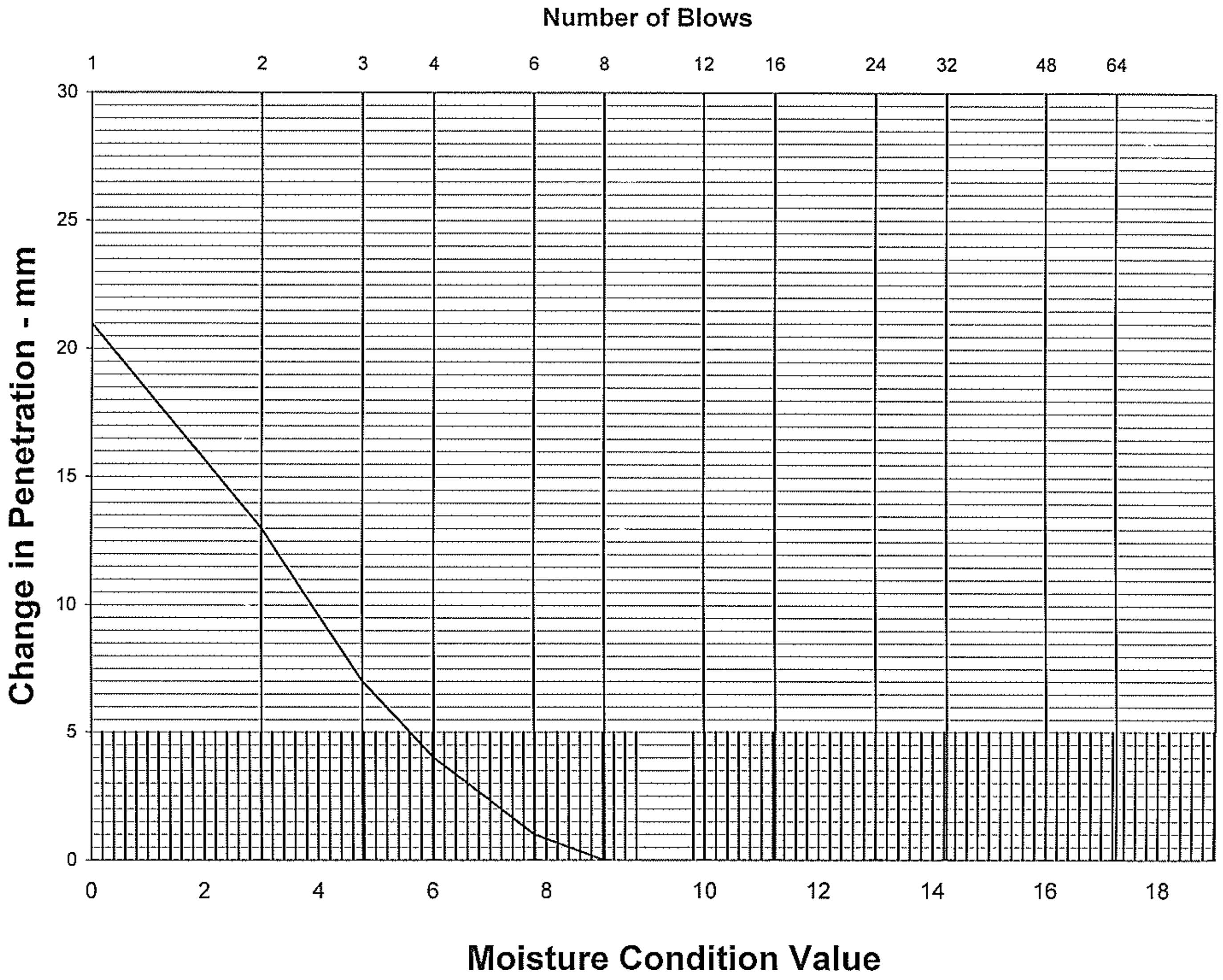
Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.5					
Moisture Content	%	11.79					
Bulk density after compaction	Mg/m³	2.19					
Dry density after compaction	Mg/m³	1.96					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	15.2					

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

Job Ref	P12012
Borehole / Pit No	TP15A
Sample No	3
Sample Type	B
Depth	1.00 m

Location	Dunkellin River & Aggard Stream Flood Relief Scheme
Soil Description	Slightly gravelly sandy SILT

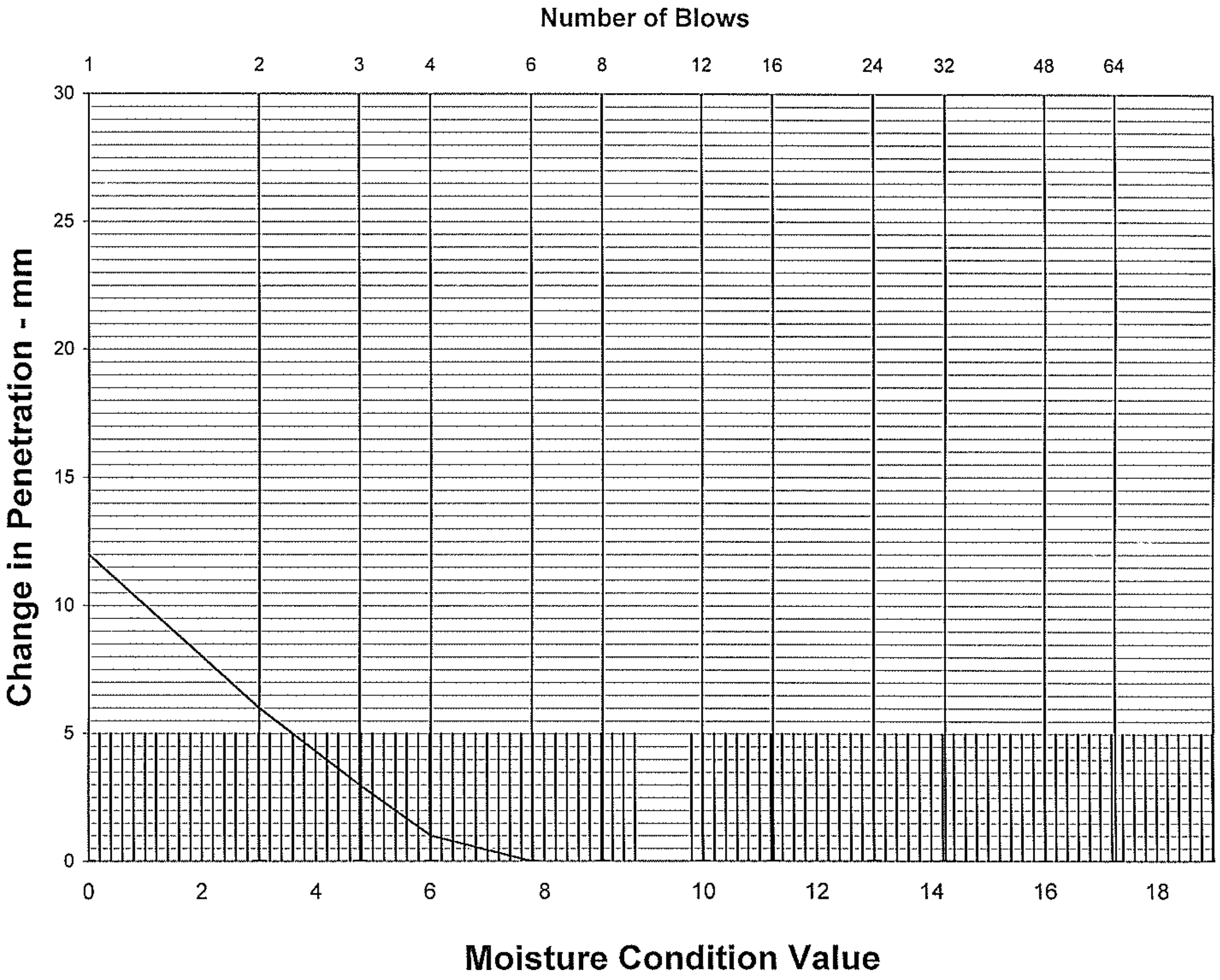


Specimen No	1	2	3	4	5	6
Moisture Condition Value	5.4					
Moisture Content %	28.52					
Bulk density after compaction Mg/m³	1.91					
Dry density after compaction Mg/m³	1.49					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	8.8					

Moisture Condition Value

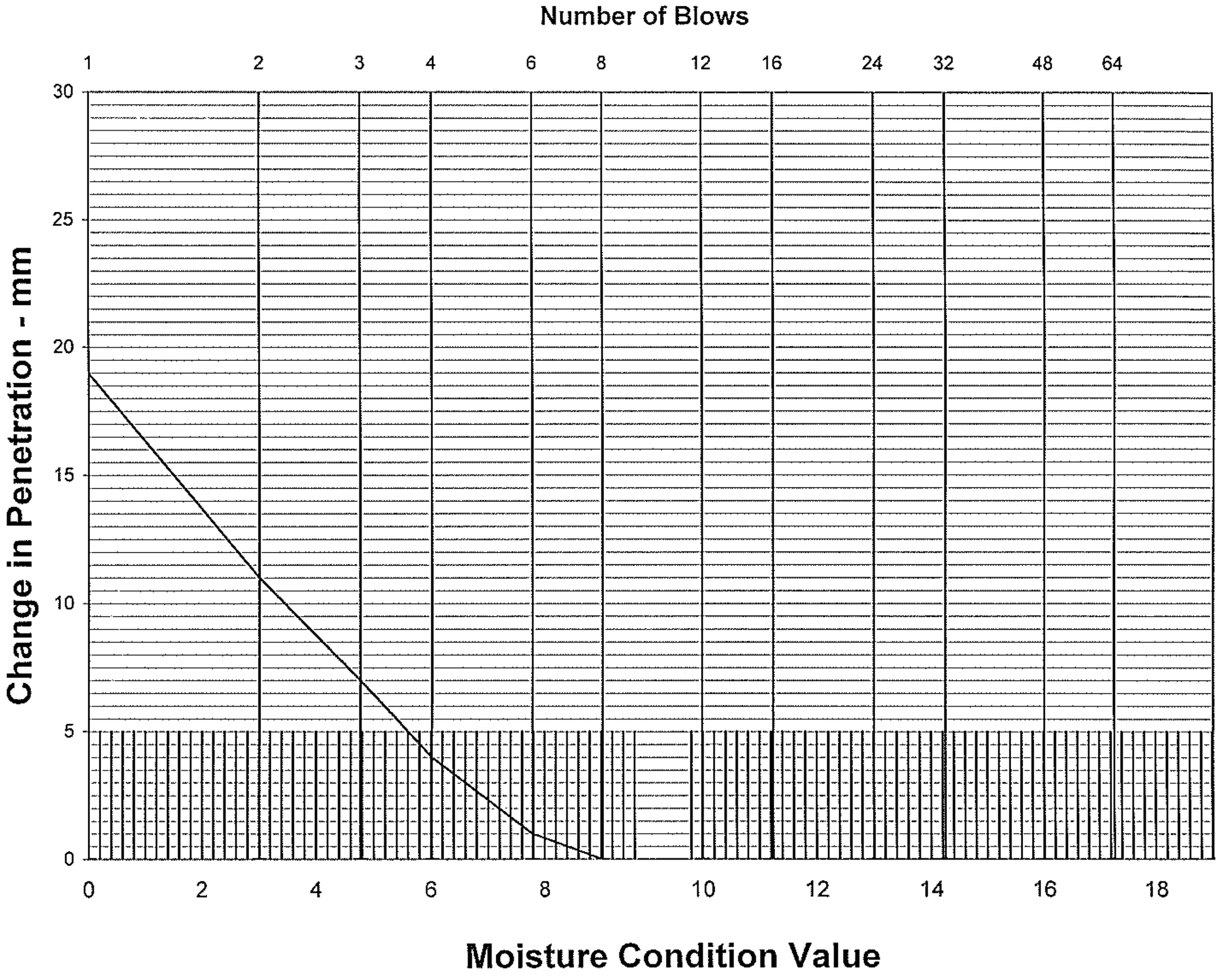
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
		Borehole / Pit No	TP17
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy slightly gravelly SILT	Sample Type	B
		Depth	0.20 m



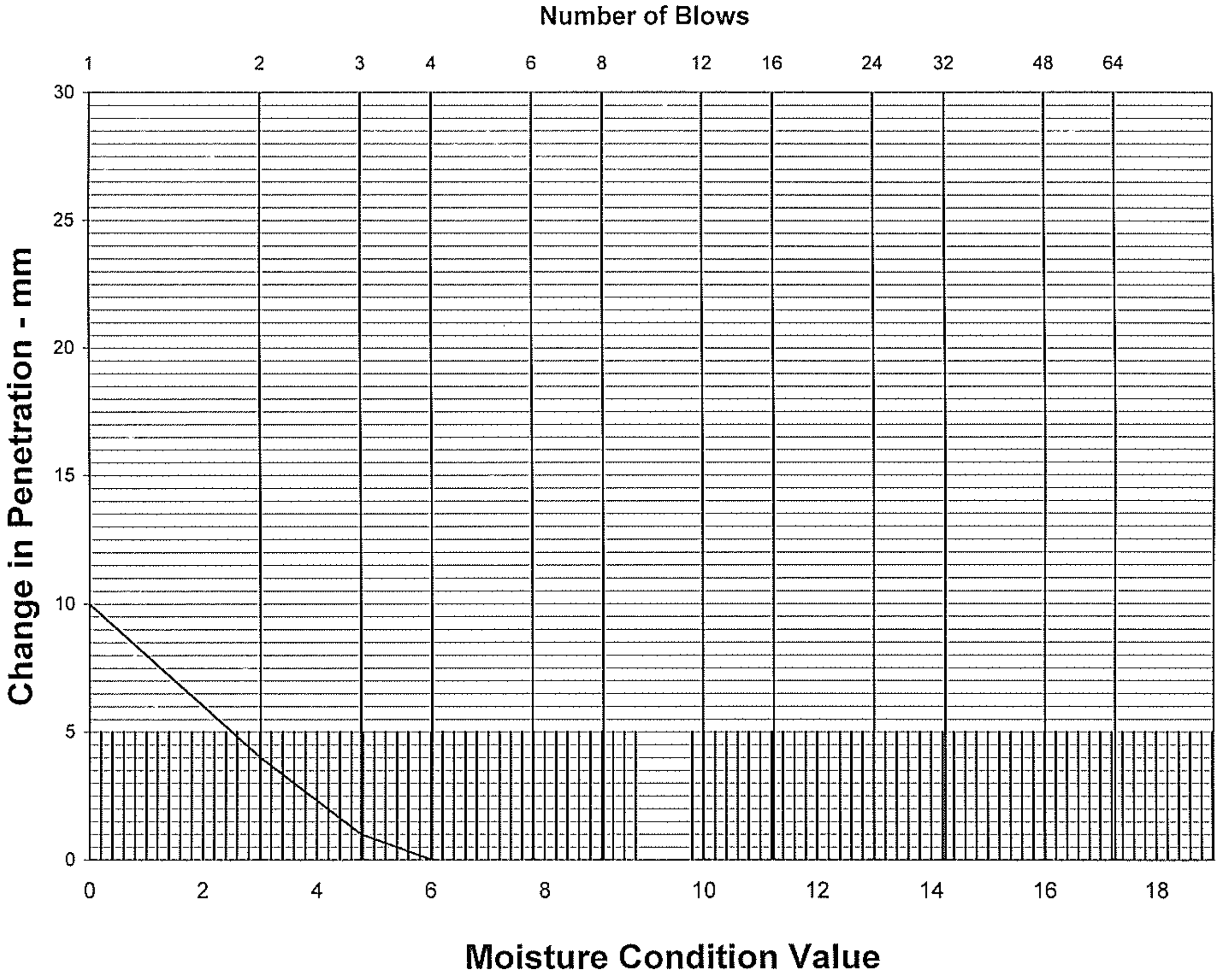
Specimen No	1	2	3	4	5	6
Moisture Condition Value	3.5					
Moisture Content %	11.97					
Bulk density after compaction Mg/m³	2.22					
Dry density after compaction Mg/m³	1.98					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	19.0					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP18
		Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	0.40 m



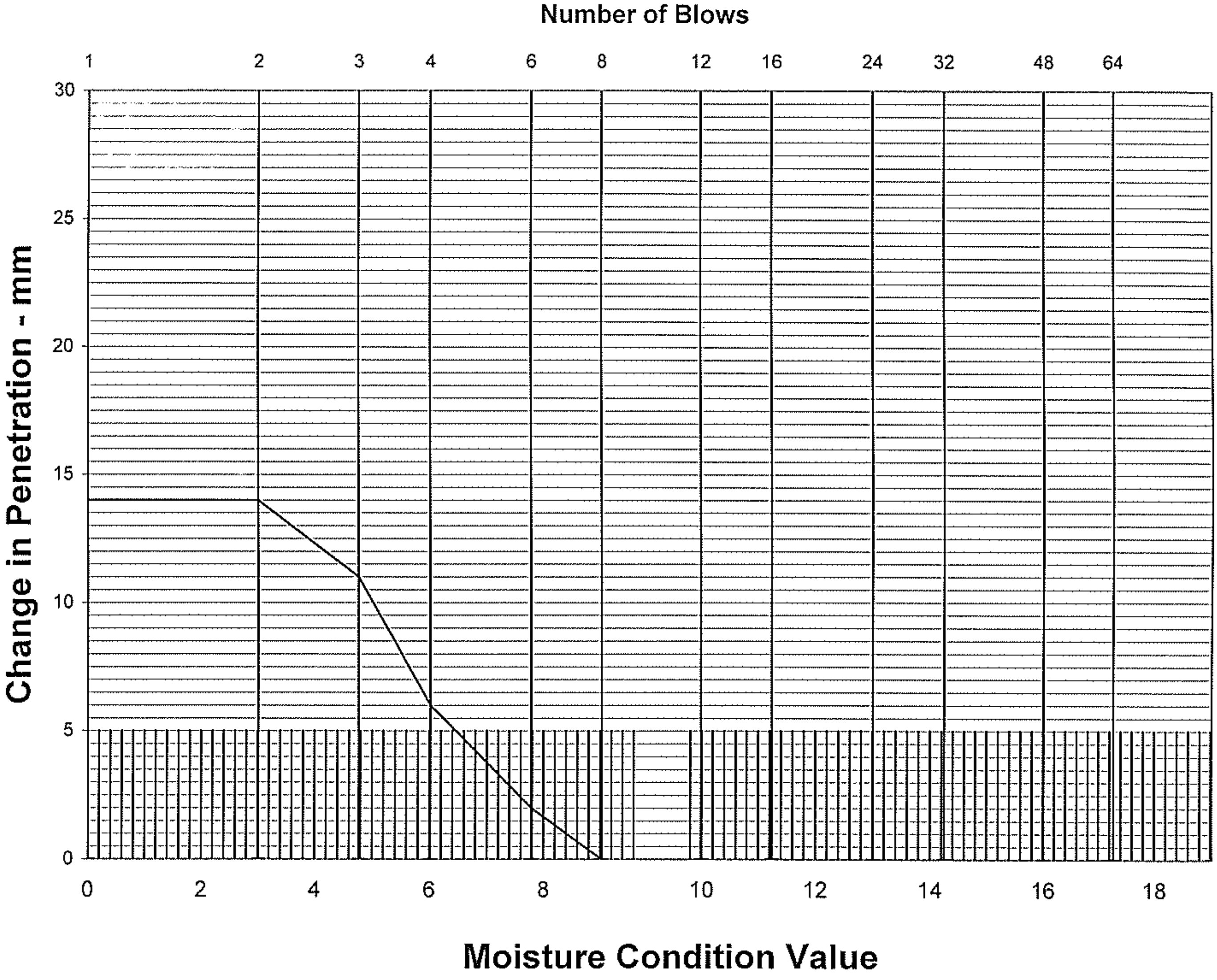
Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.3					
Moisture Content	%	17.47					
Bulk density after compaction	Mg/m³	2.05					
Dry density after compaction	Mg/m³	1.75					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	16.4					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP19
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Silty very sandy GRAVEL with low cobble content	Sample Type	B
		Depth	0.00 m



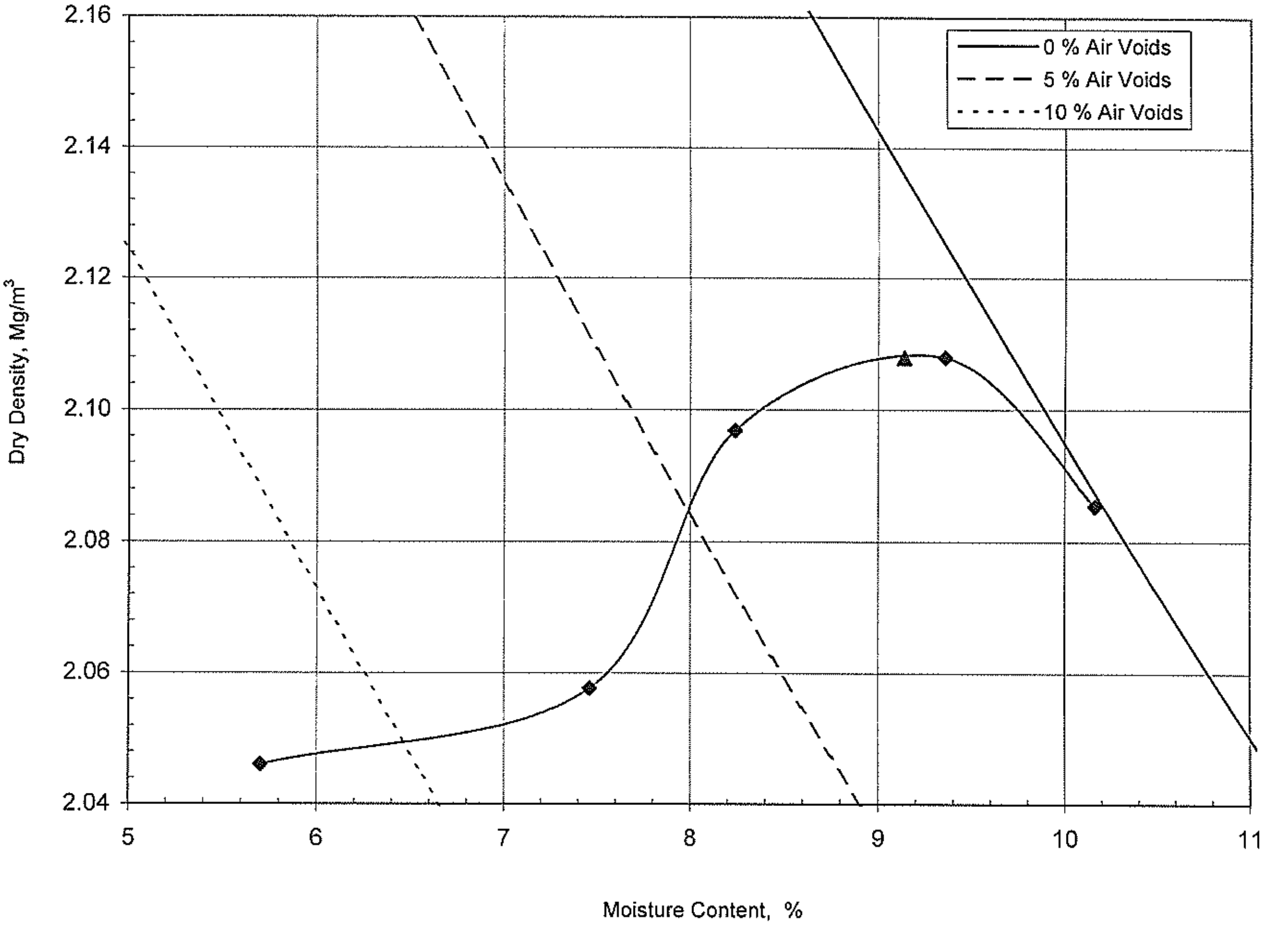
Specimen No	1	2	3	4	5	6
Moisture Condition Value	2.5					
Moisture Content %	14.35					
Bulk density after compaction Mg/m³	2.10					
Dry density after compaction Mg/m³	1.84					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	2.1					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP20
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	0.50 m



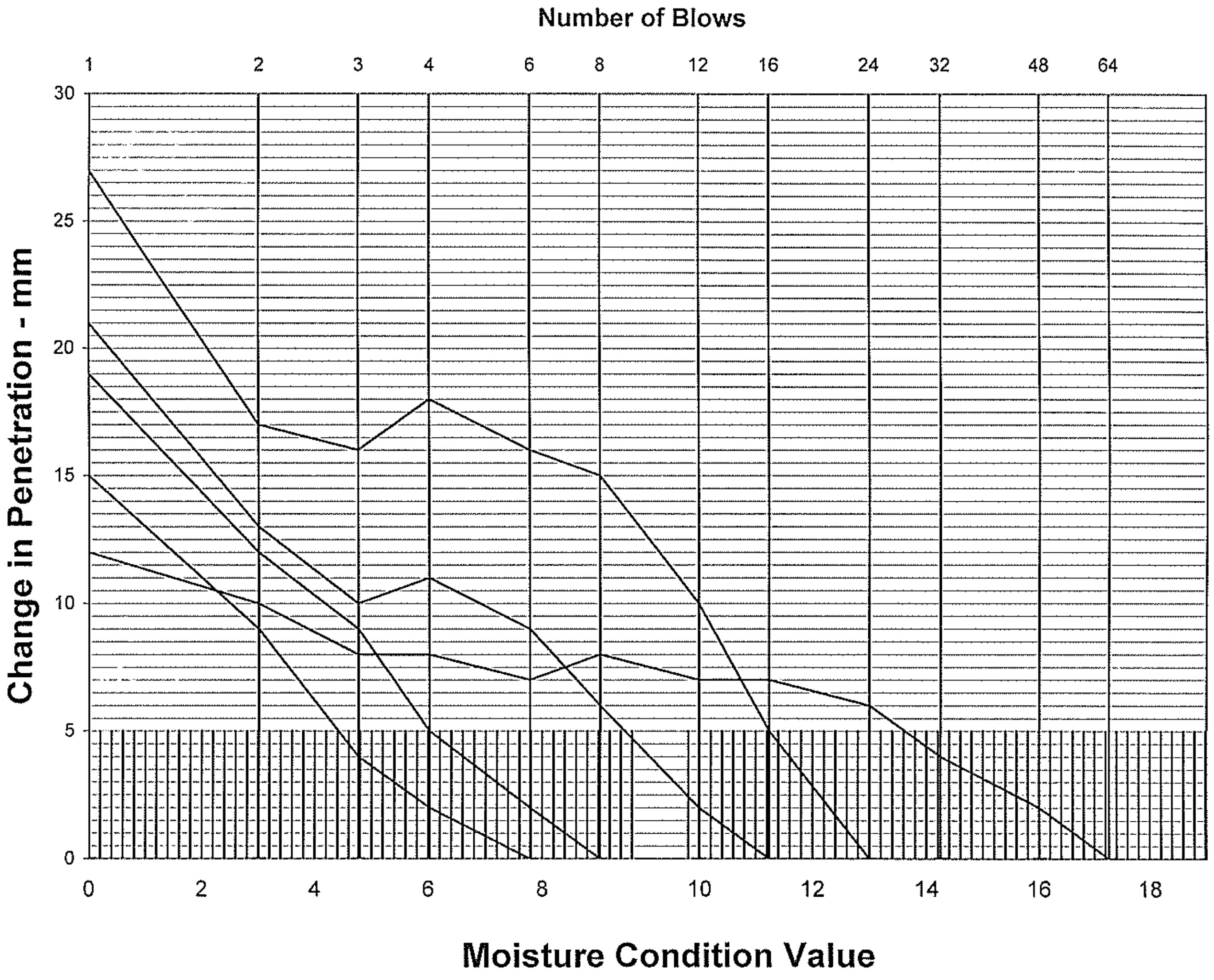
Specimen No		1	2	3	4	5	6
Moisture Condition Value		6.3					
Moisture Content	%	13.49					
Bulk density after compaction	Mg/m^3	2.25					
Dry density after compaction	Mg/m^3	1.98					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	13.3					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	TP21
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	1
		Depth	1.00 m
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B



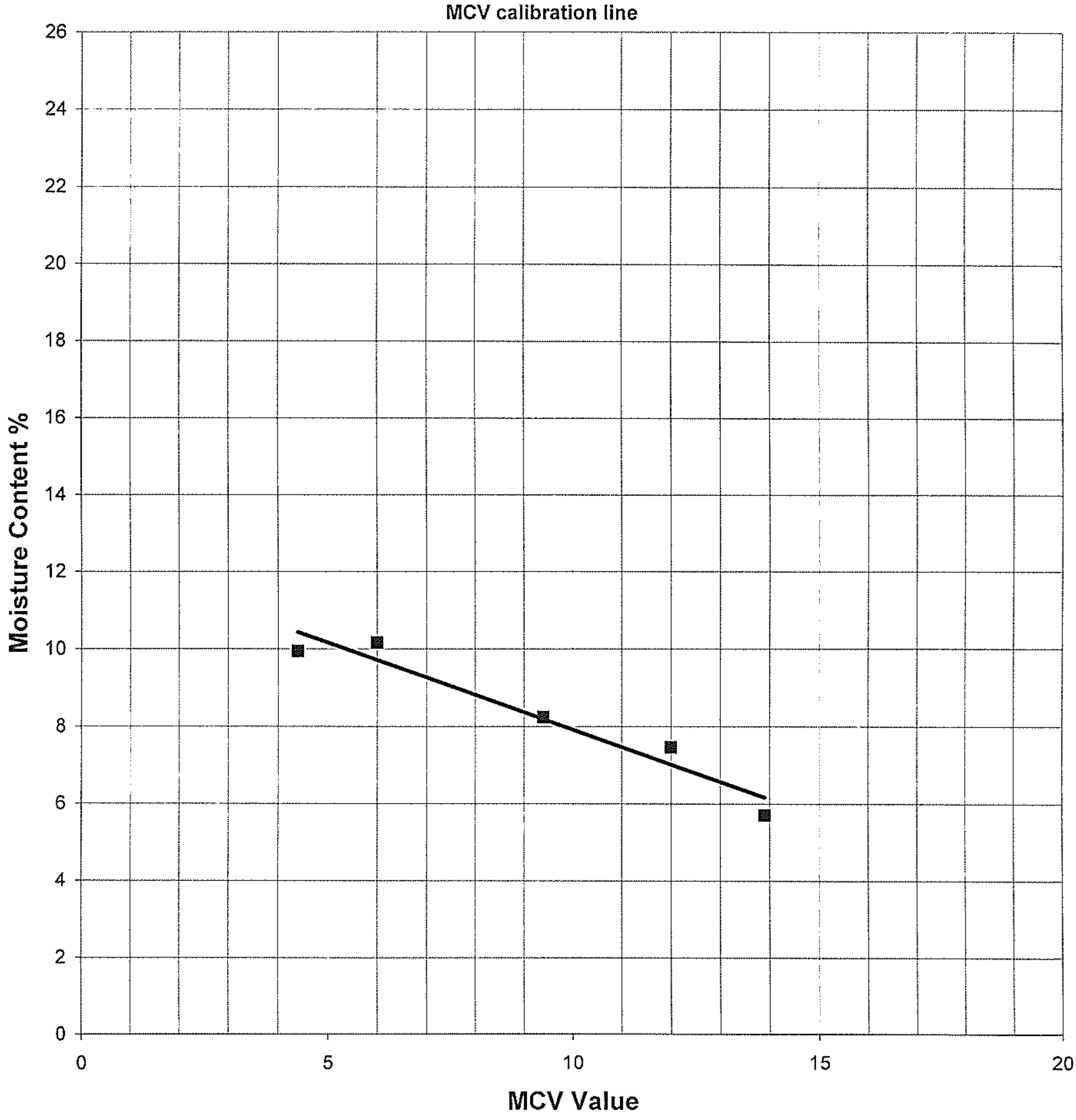
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	4
Mass Retained on 20.0 mm Sieve	%	12
Grading Zone		4
Particle Density - Assumed	Mg/m³	2.65
Maximum Dry Density	Mg/m³	2.11
Optimum Moisture Content	%	9.1
Natural Moisture Content	%	10.16

	# Moisture Condition Value BS 1377 : Part 4 : 1990 Clause 5	Job Ref	P12012
		Borehole / Pit No	TP21
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B
		Depth	1.00 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		6.0	13.9	9.4	4.4	12.0	
Moisture Content	%	10.16	5.70	8.24	9.94	7.46	
Bulk density after compaction	Mg/m³	2.25	2.22	2.27	2.22	2.19	
Dry density after compaction	Mg/m³	2.04	2.10	2.10	2.02	2.04	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	11.5					

	MCV Relationship Graph **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP21
		Sample No	1
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B
		Depth	1.00 m

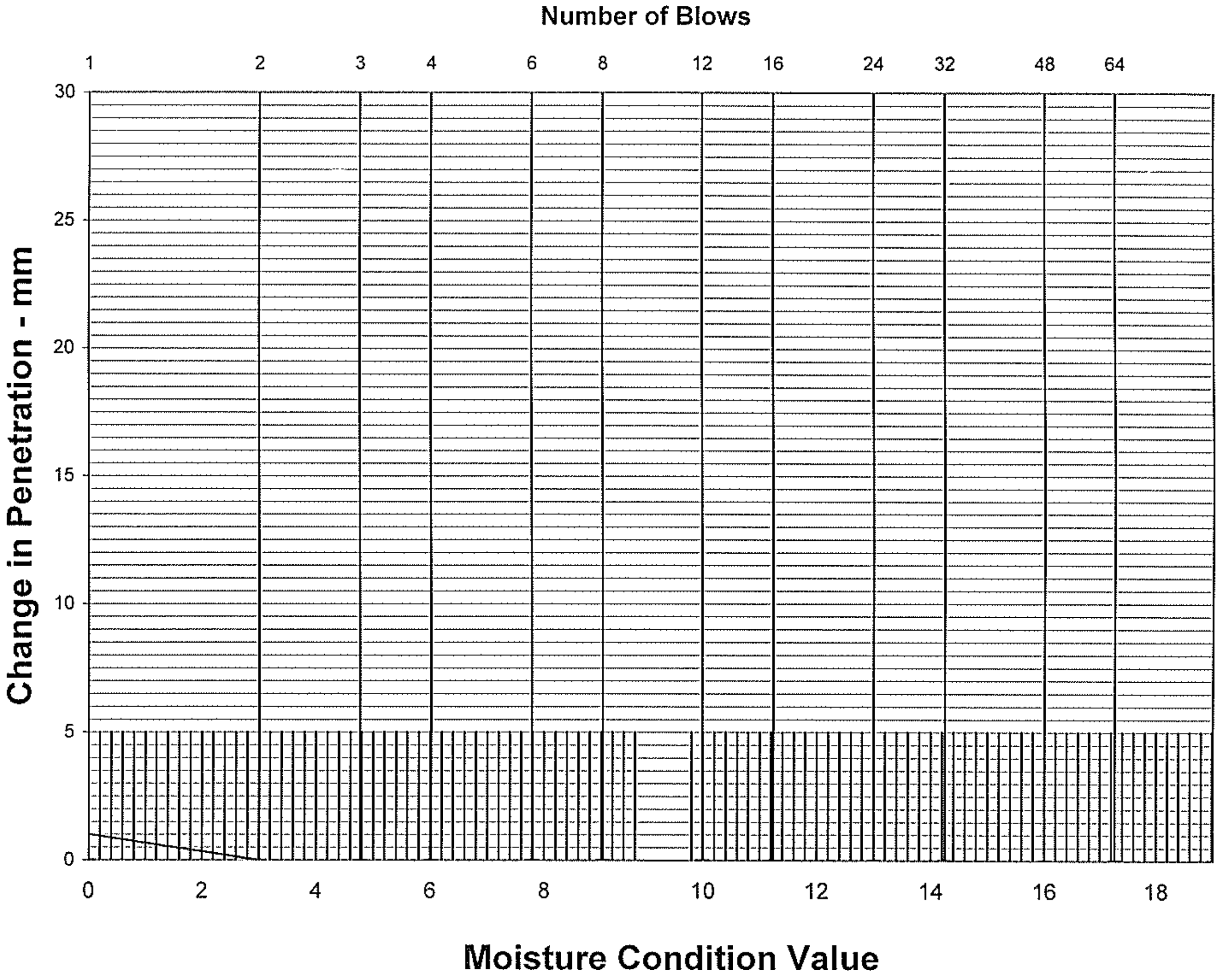


Operator	Checked	Approved	Remarks Single sample / Separate batches tested

Moisture Condition Value

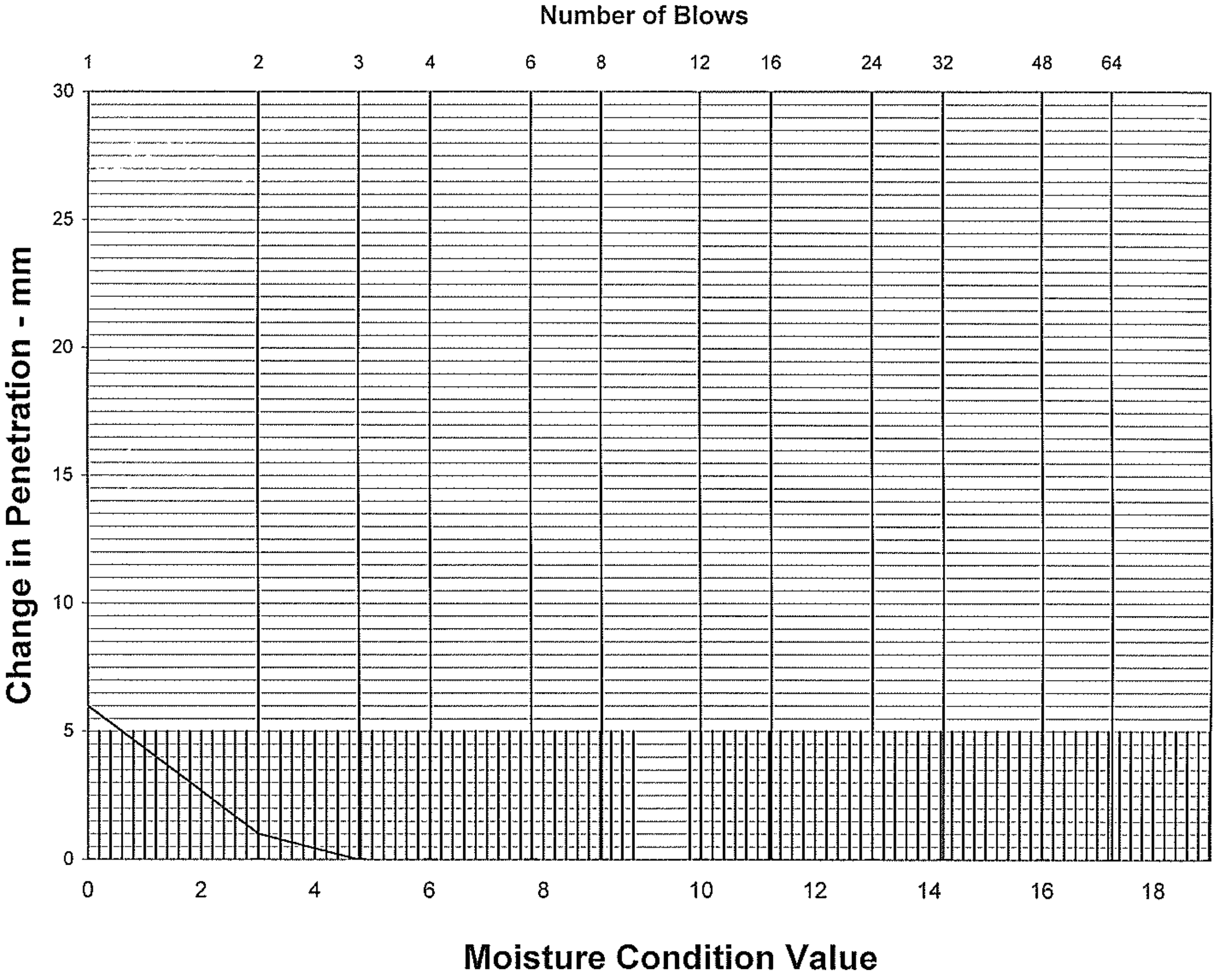
BS 1377 : Part 4 : 1990 Clause 5

Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Job Ref	P12012
		Borehole / Pit No	TP21
		Sample No	3
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	2.00 m



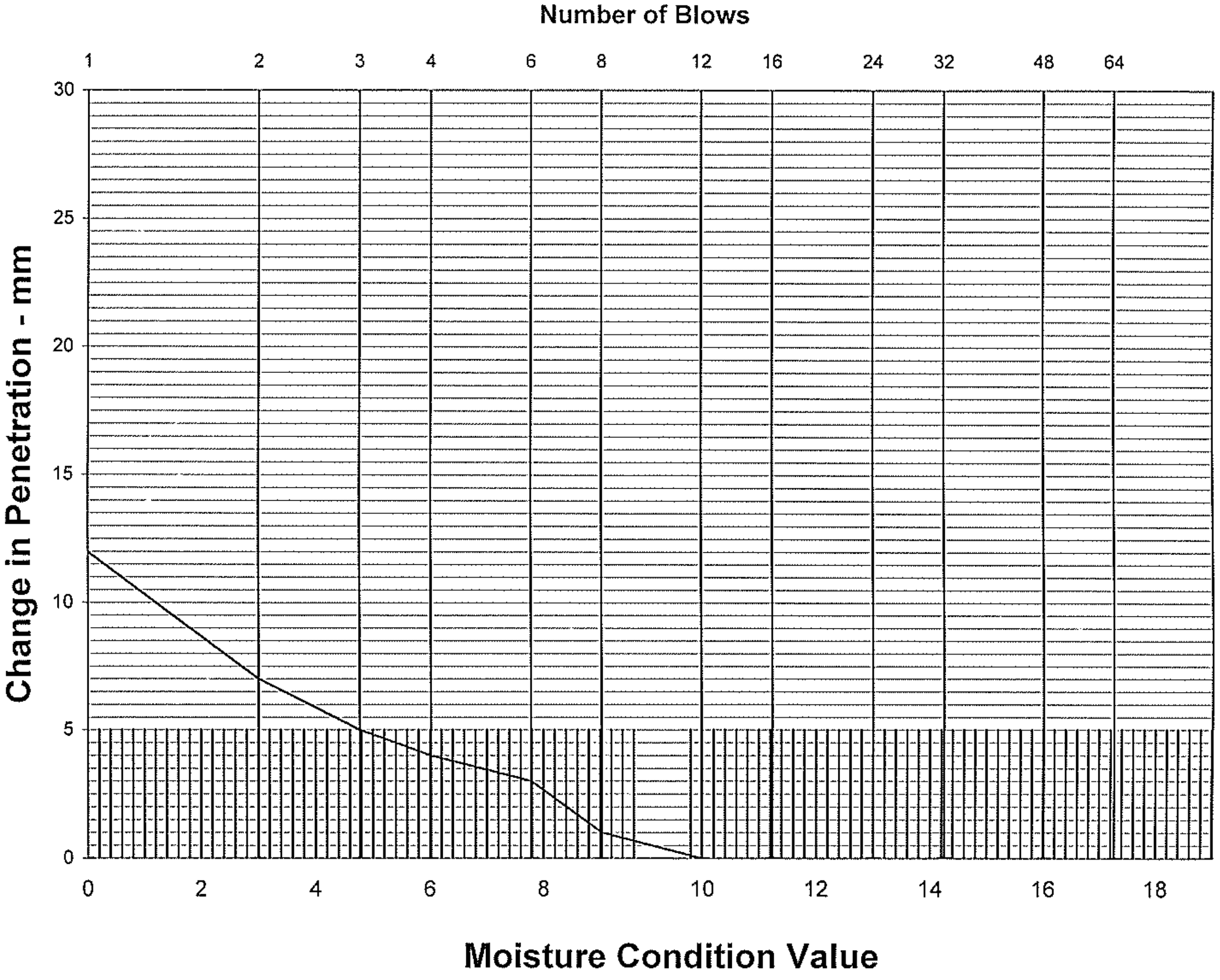
Specimen No	1	2	3	4	5	6
Moisture Condition Value	0.0					
Moisture Content %	9.98					
Bulk density after compaction Mg/m³	2.25					
Dry density after compaction Mg/m³	2.05					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	10.7					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP22
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	0.00 m



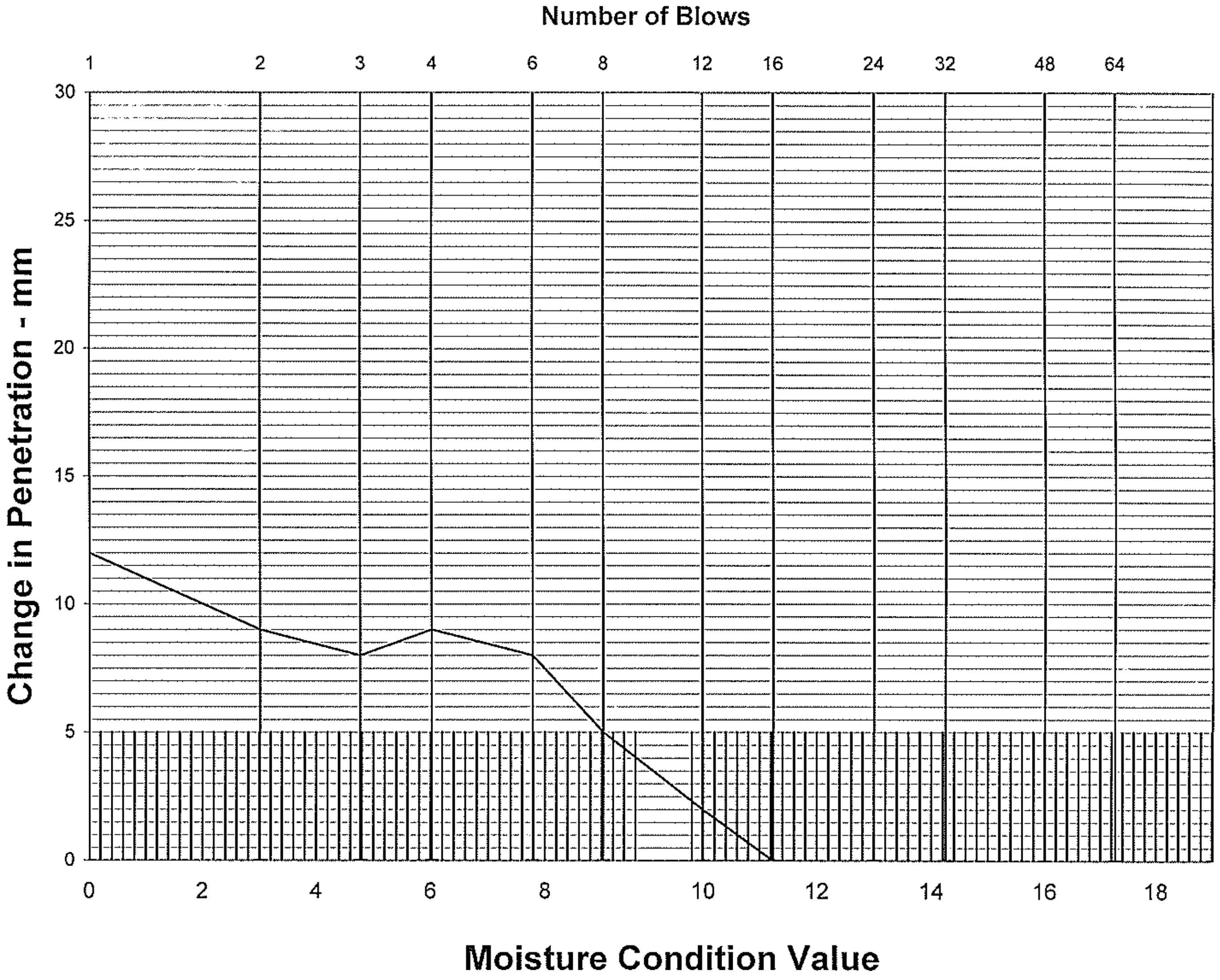
Specimen No		1	2	3	4	5	6
Moisture Condition Value		0.6					
Moisture Content	%	19.78					
Bulk density after compaction	Mg/m³	2.10					
Dry density after compaction	Mg/m³	1.75					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	6.0					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP23
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	0.00 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		4.2					
Moisture Content	%	31.13					
Bulk density after compaction	Mg/m³	0.18					
Dry density after compaction	Mg/m³	0.14					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	20.8					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP24
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	0.00 m



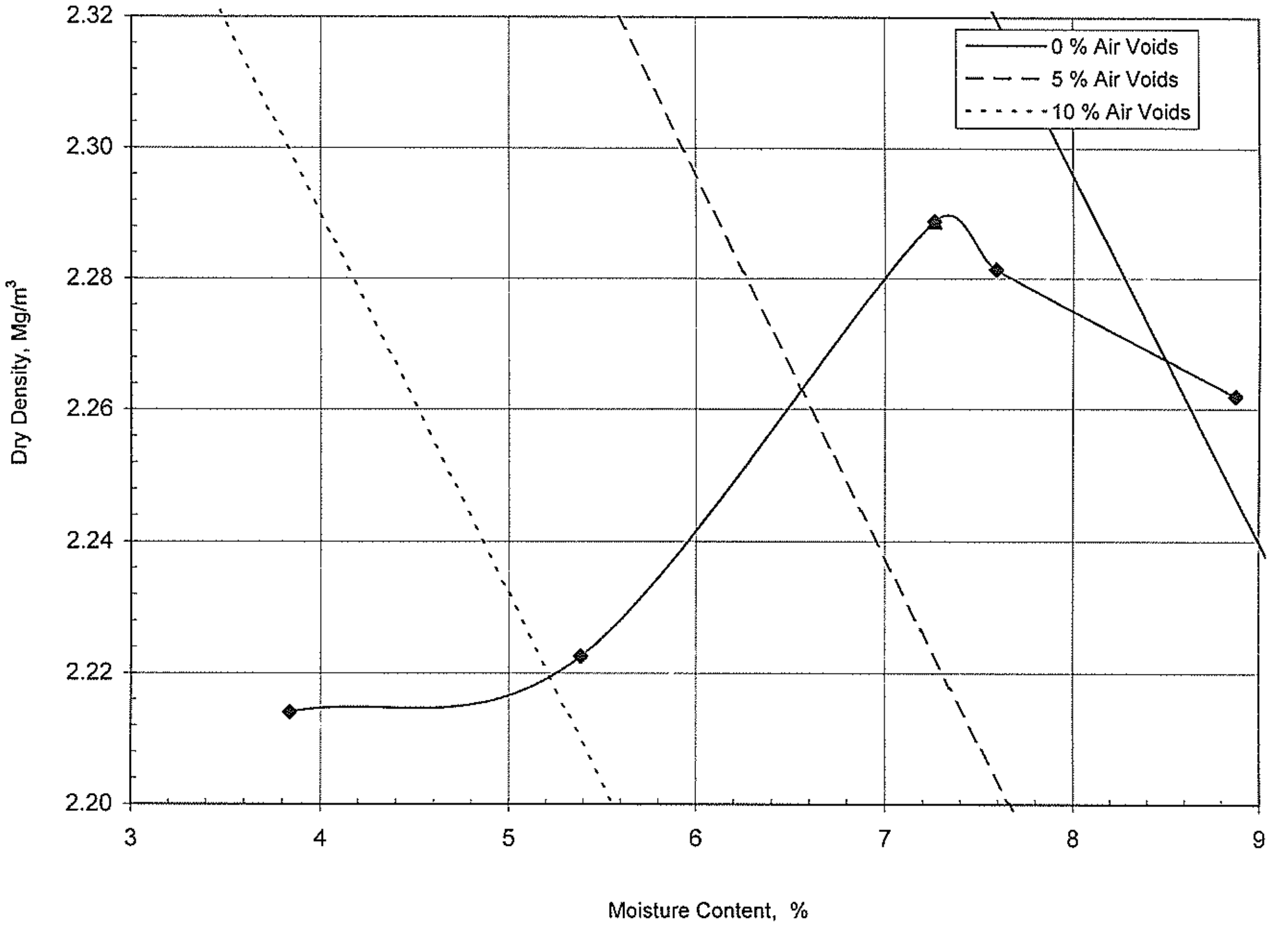
Specimen No		1	2	3	4	5	6
Moisture Condition Value		9.0					
Moisture Content	%	12.25					
Bulk density after compaction	Mg/m³	1.99					
Dry density after compaction	Mg/m³	1.77					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	25.8					

PRIORITY GEOTECHNICAL

Dry Density / Moisture Content Relationship

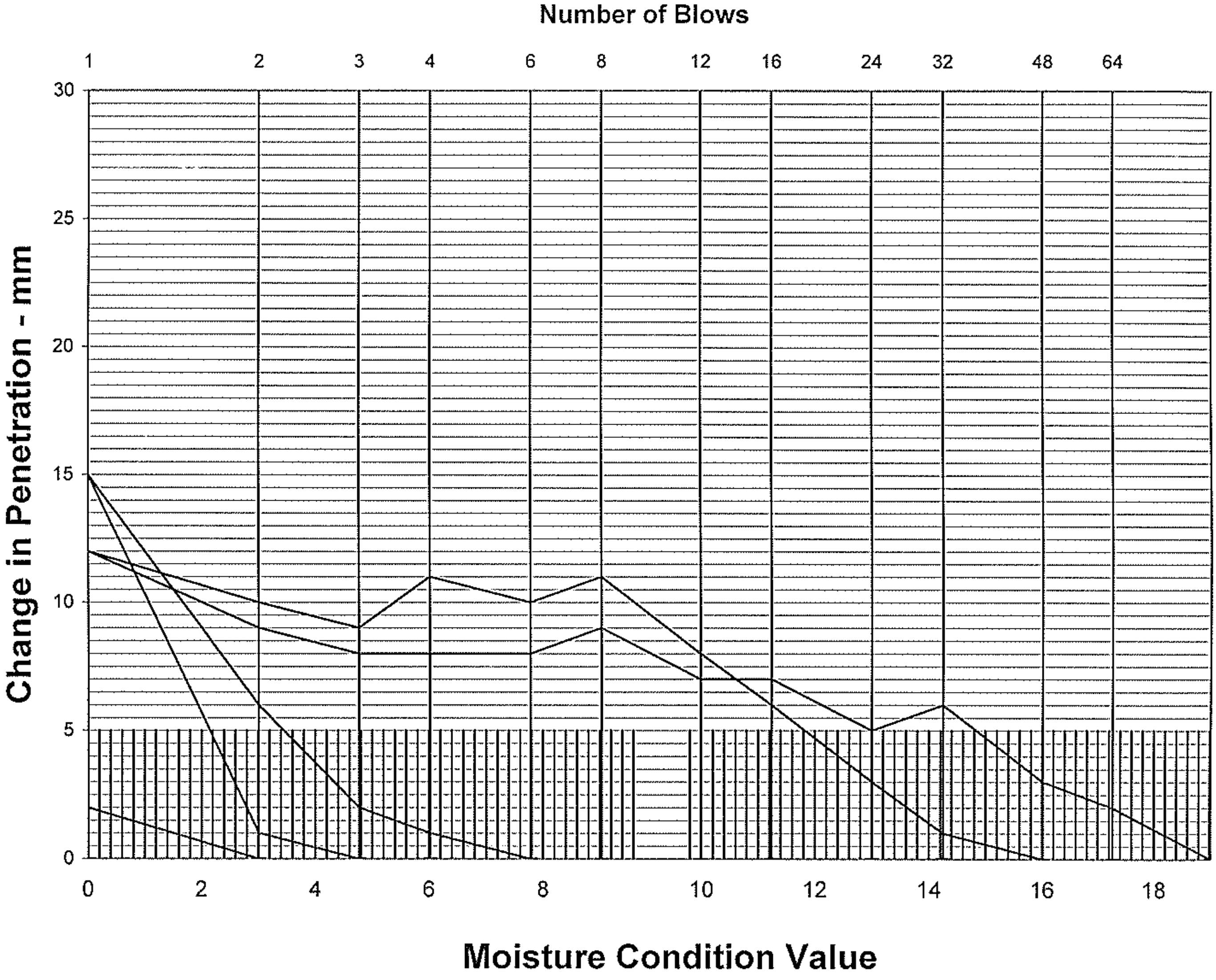
BS 1377 : Part 4 : 1990 : Clause 3

Job Ref	**P12012**
Borehole / Pit No	TP25
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**
Sample No	1
Depth	1.00 m
Soil Description	Slightly sandy gravelly SILT
Sample Type	B



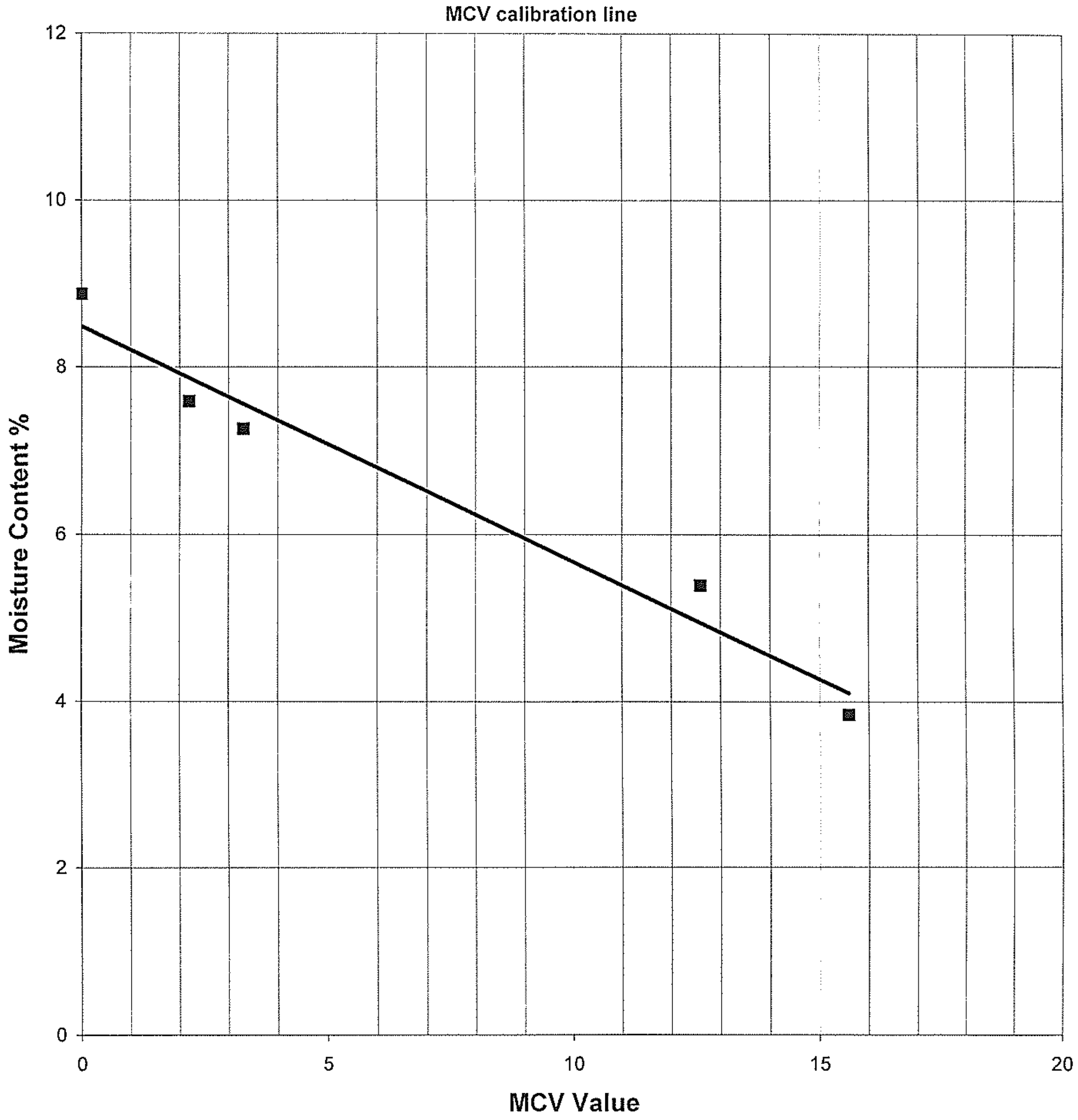
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	8
Mass Retained on 20.0 mm Sieve	%	14
Grading Zone		5
Particle Density - Assumed	Mg/m^3	2.80
Maximum Dry Density	Mg/m^3	2.29
Optimum Moisture Content	%	7.3
Natural Moisture Content	%	7.59

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP25
		Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	1.00 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		2.2	12.6	0.0	3.3	15.6	
Moisture Content	%	7.59	5.39	8.87	7.26	3.84	
Bulk density after compaction	Mg/m³	2.29	2.36	2.33	2.36	2.42	
Dry density after compaction	Mg/m³	2.13	2.24	2.14	2.20	2.33	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	13.9					

	MCV Relationship Graph BS 1377 : Part 4 : 1990 Clause 5	Job Ref	P12012
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP25
		Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	1.00 m

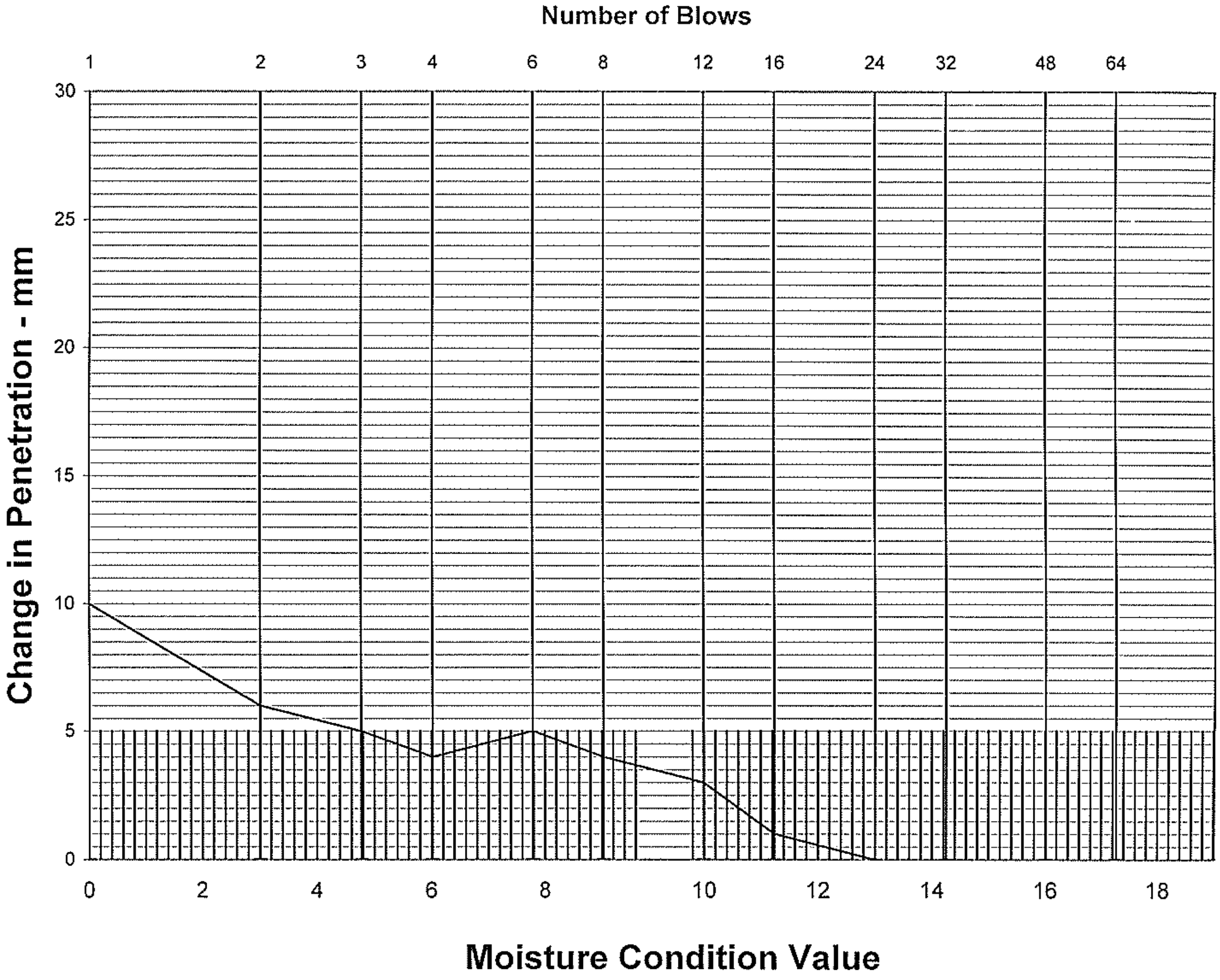


Operator	Checked	Approved	Remarks Single sample / Separate batches tested

Moisture Condition Value

BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	P12012
		Borehole / Pit No	TP26
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly SILT with low cobble content	Sample Type	B
		Depth	1.00 m

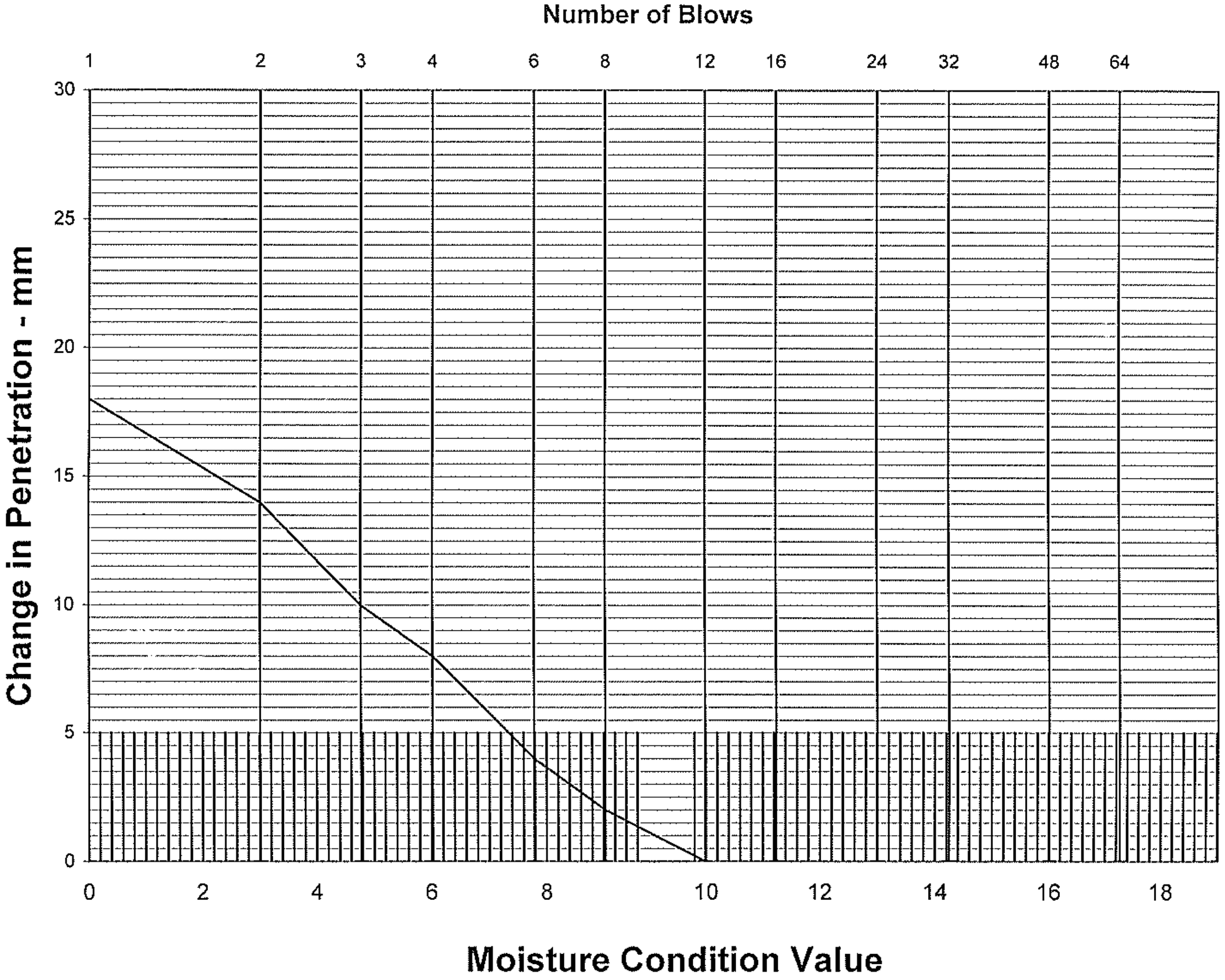


Specimen No		1	2	3	4	5	6
Moisture Condition Value		9.5					
Moisture Content	%	8.39					
Bulk density after compaction	Mg/m³	2.33					
Dry density after compaction	Mg/m³	2.15					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	11.5					

Moisture Condition Value

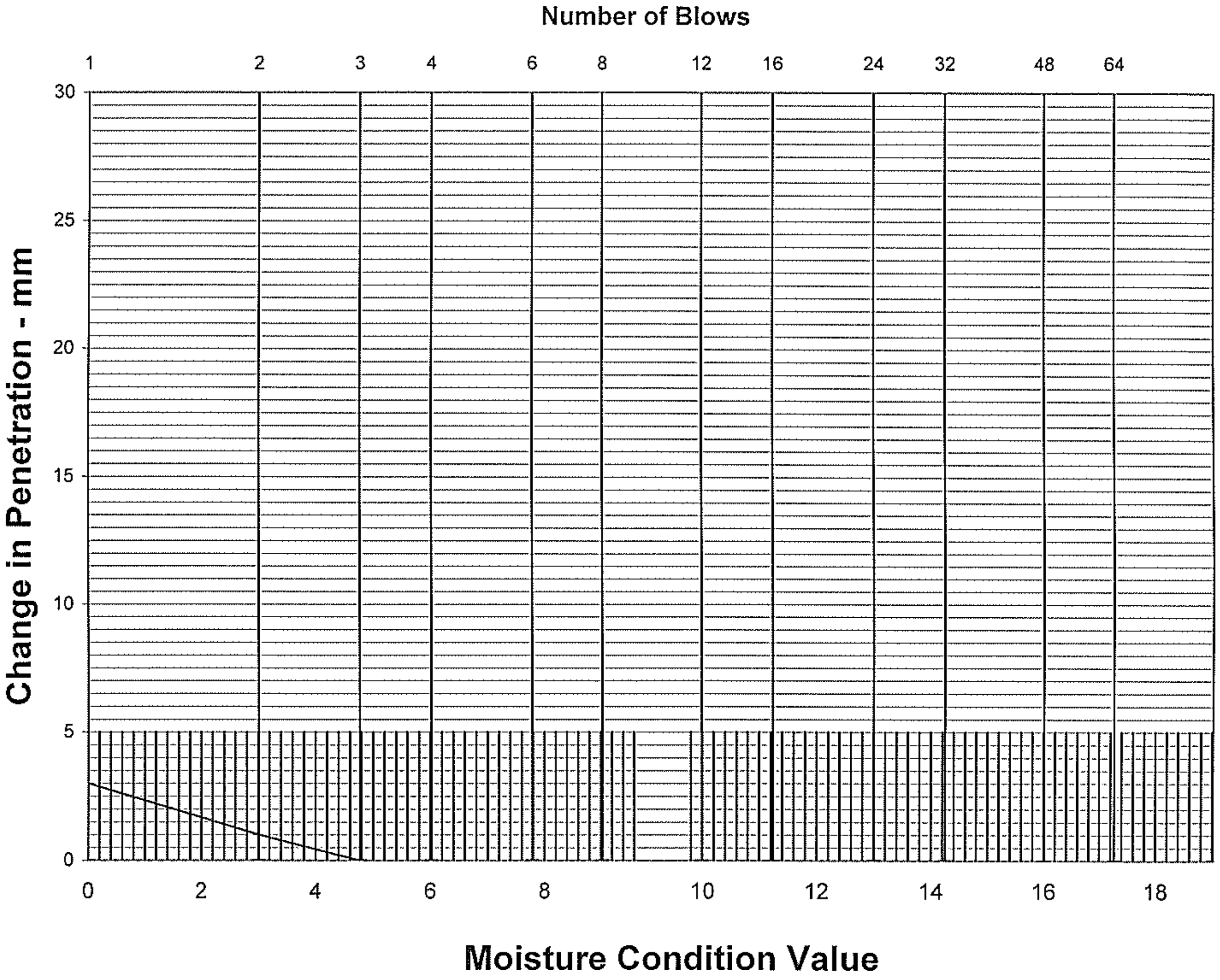
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP27
		Sample No	1
Soil Description	Slightly gravelly sandy CLAY	Sample Type	B
		Depth	0.20 m



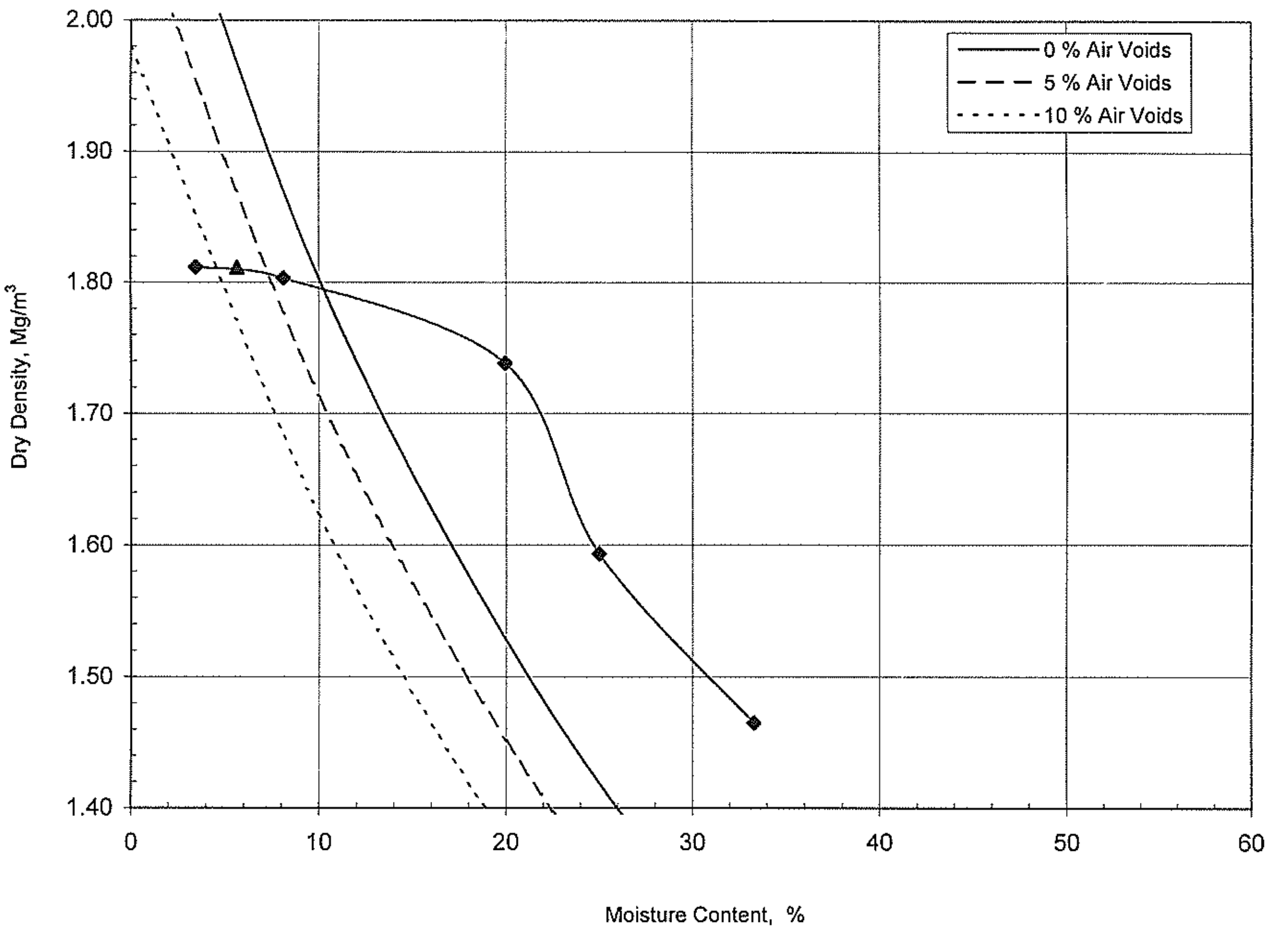
Specimen No	1	2	3	4	5	6
Moisture Condition Value	7.0					
Moisture Content %	14.26					
Bulk density after compaction Mg/m³	2.22					
Dry density after compaction Mg/m³	1.94					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	0.5					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP28
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy gravelly SILT	Sample Type	B
		Depth	0.00 m



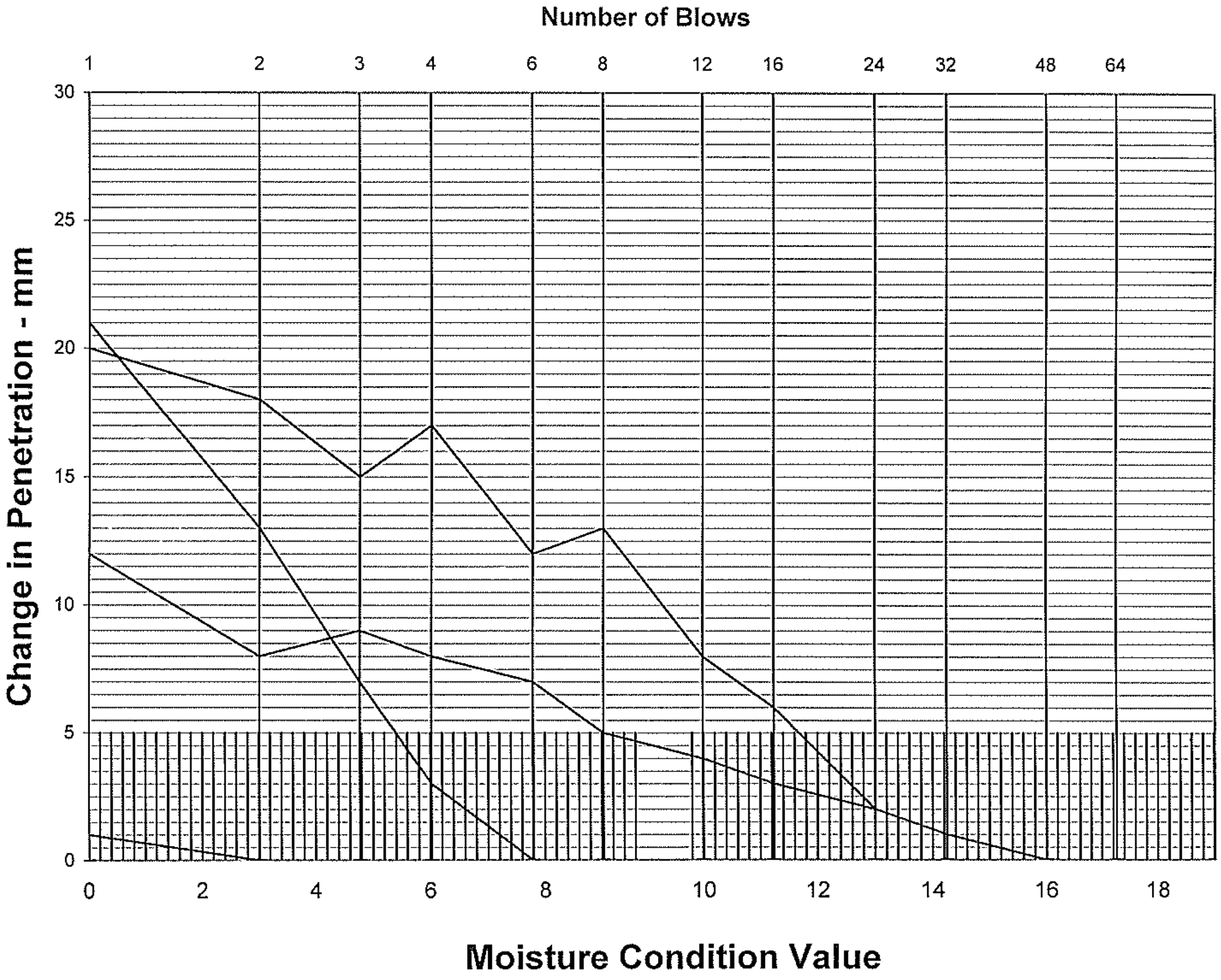
Specimen No	1	2	3	4	5	6
Moisture Condition Value	0.0					
Moisture Content %	263.30					
Bulk density after compaction Mg/m³	1.15					
Dry density after compaction Mg/m³	0.32					
Hand vane strength kPa	0					
Method of determining MCV	Steepest fit line					
Mass retained on 20mm sieve %	15.0					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	TP28
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.70 m
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B



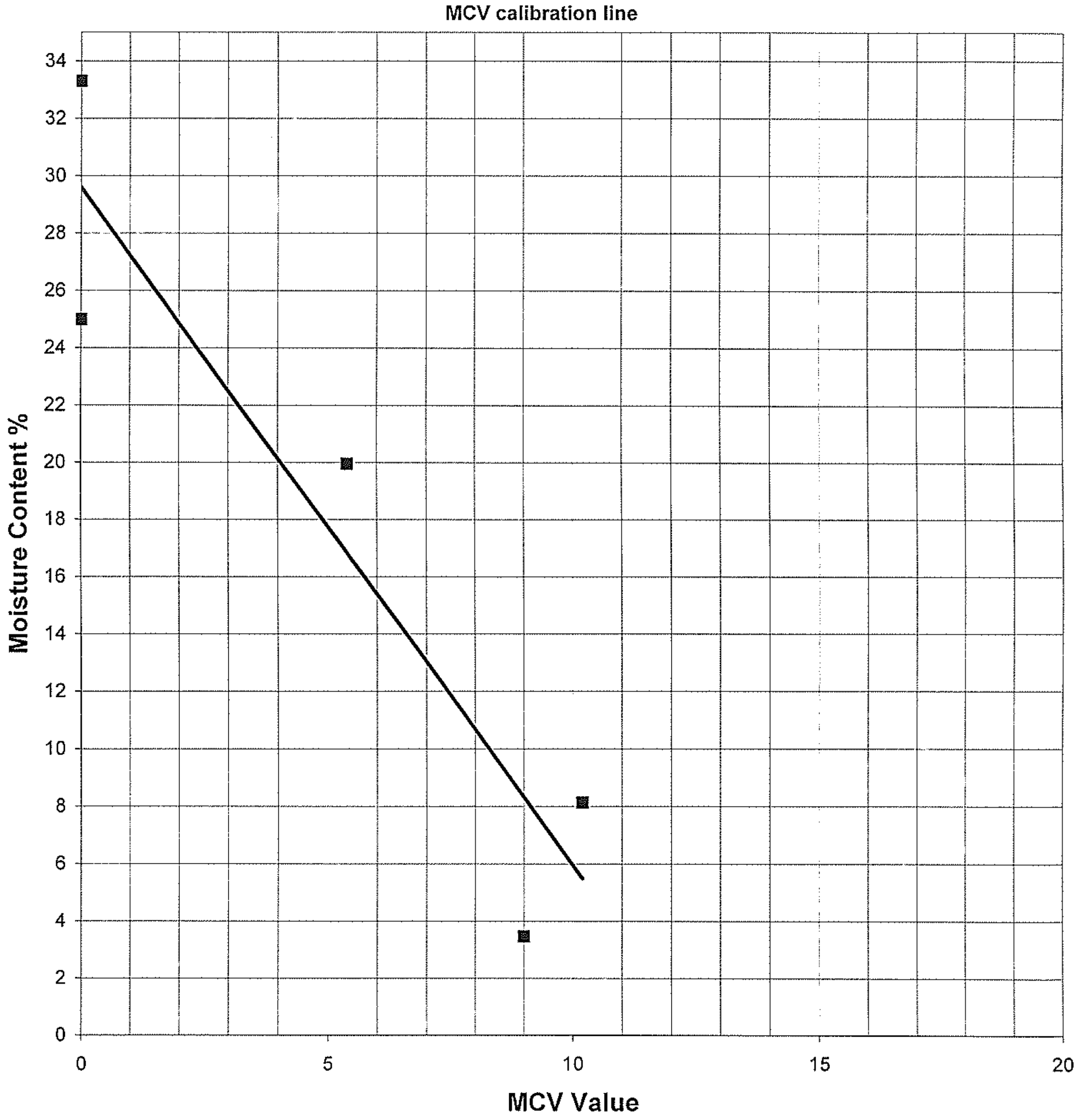
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	6
Mass Retained on 20.0 mm Sieve	%	11
Grading Zone		5
Particle Density - Assumed	Mg/m³	2.20
Maximum Dry Density	Mg/m³	1.81
Optimum Moisture Content	%	5.7
Natural Moisture Content	%	33.30

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP28
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B
		Depth	1.70 m



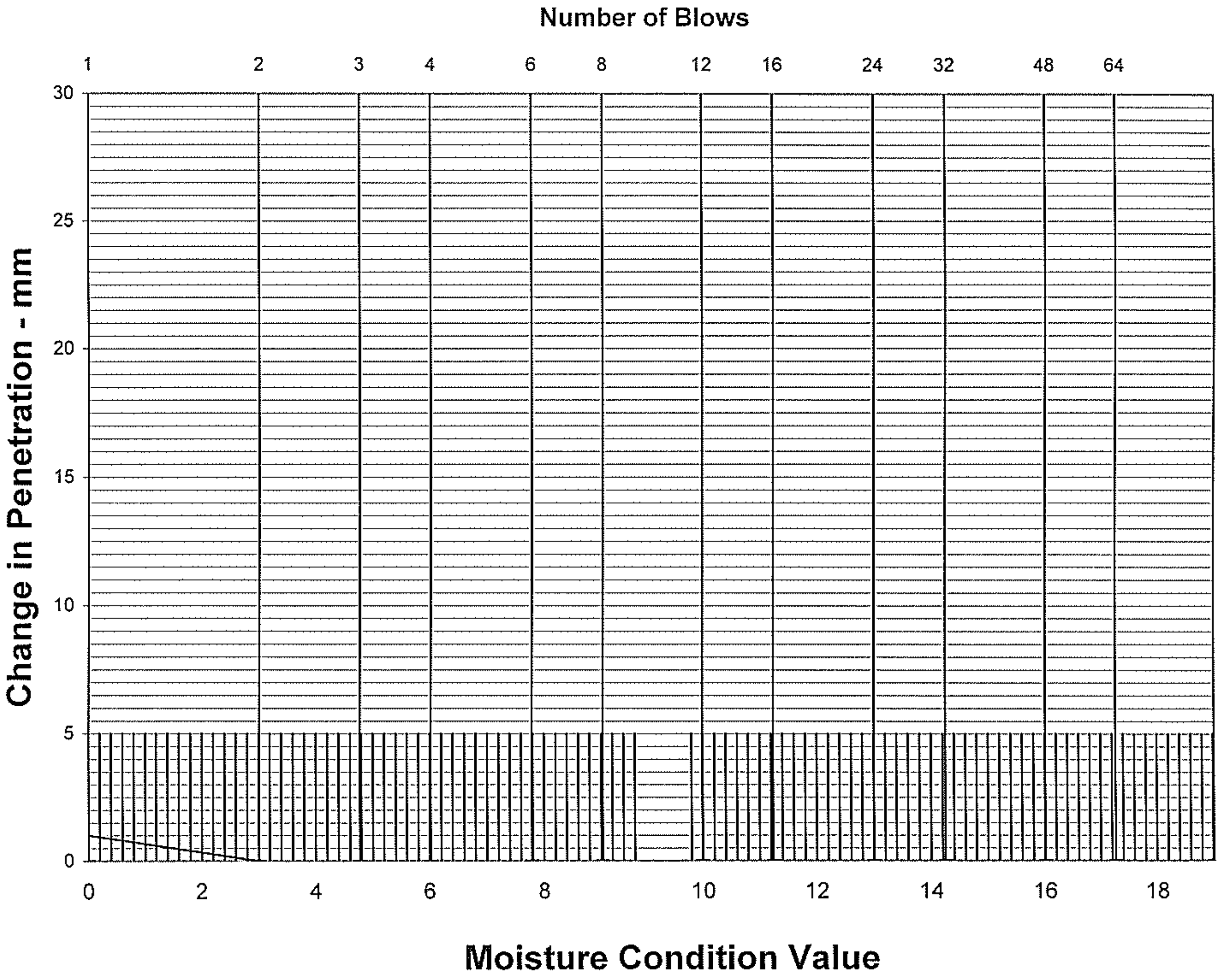
Specimen No		1	2	3	4	5	6
Moisture Condition Value		0.0	0.0	5.4	10.2	9.0	
Moisture Content	%	33.30	24.99	19.95	8.12	3.46	
Bulk density after compaction	Mg/m³	1.89	1.93	2.03	2.14	1.83	
Dry density after compaction	Mg/m³	1.42	1.54	1.69	1.98	1.77	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	10.7					

	MCV Relationship Graph **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP28
		Sample No	3
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B
		Depth	1.70 m



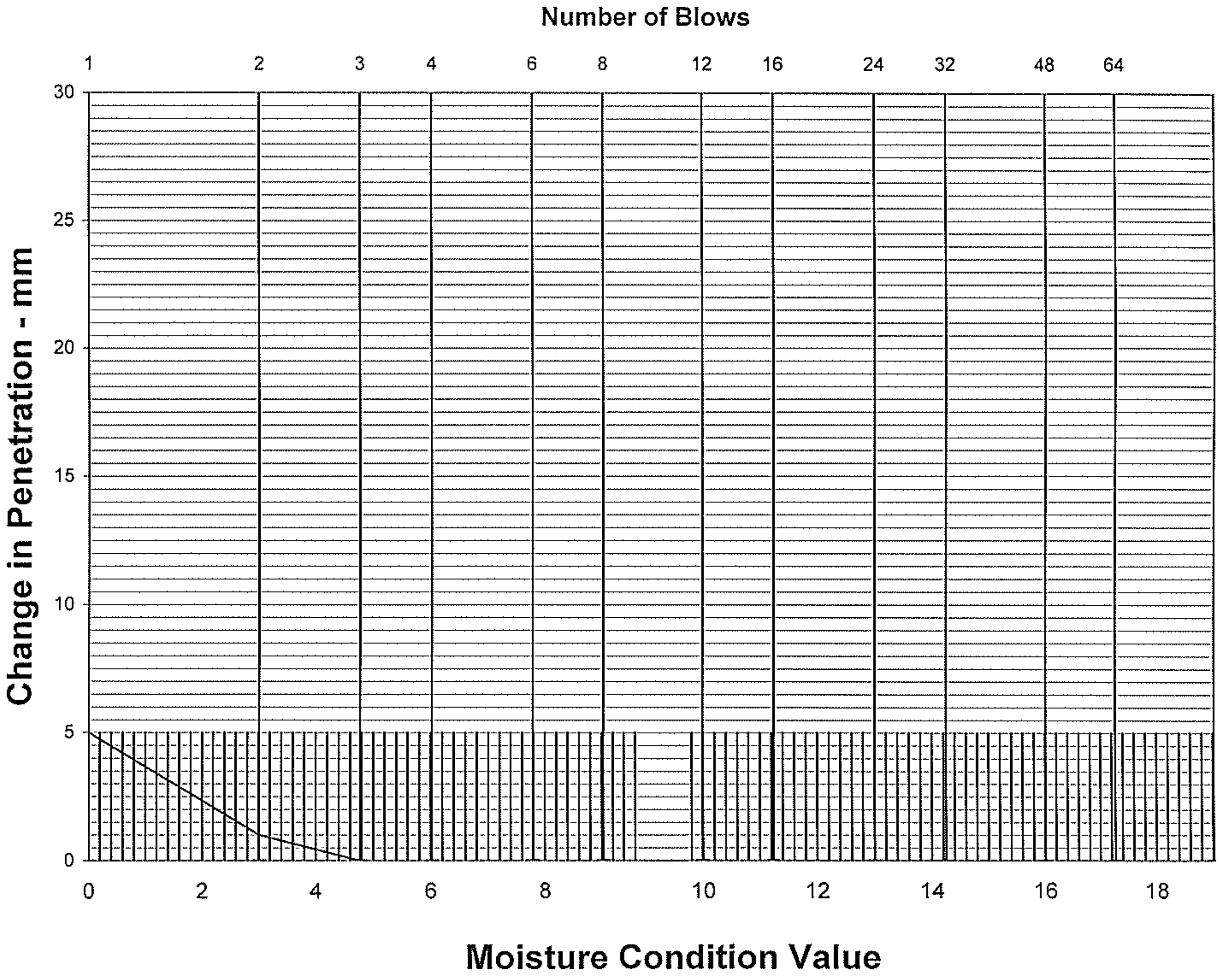
Operator	Checked	Approved	Remarks Single sample / Separate batches tested

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP29
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Silty very sandy GRAVEL with high cobble content	Sample Type	B
		Depth	1.50 m



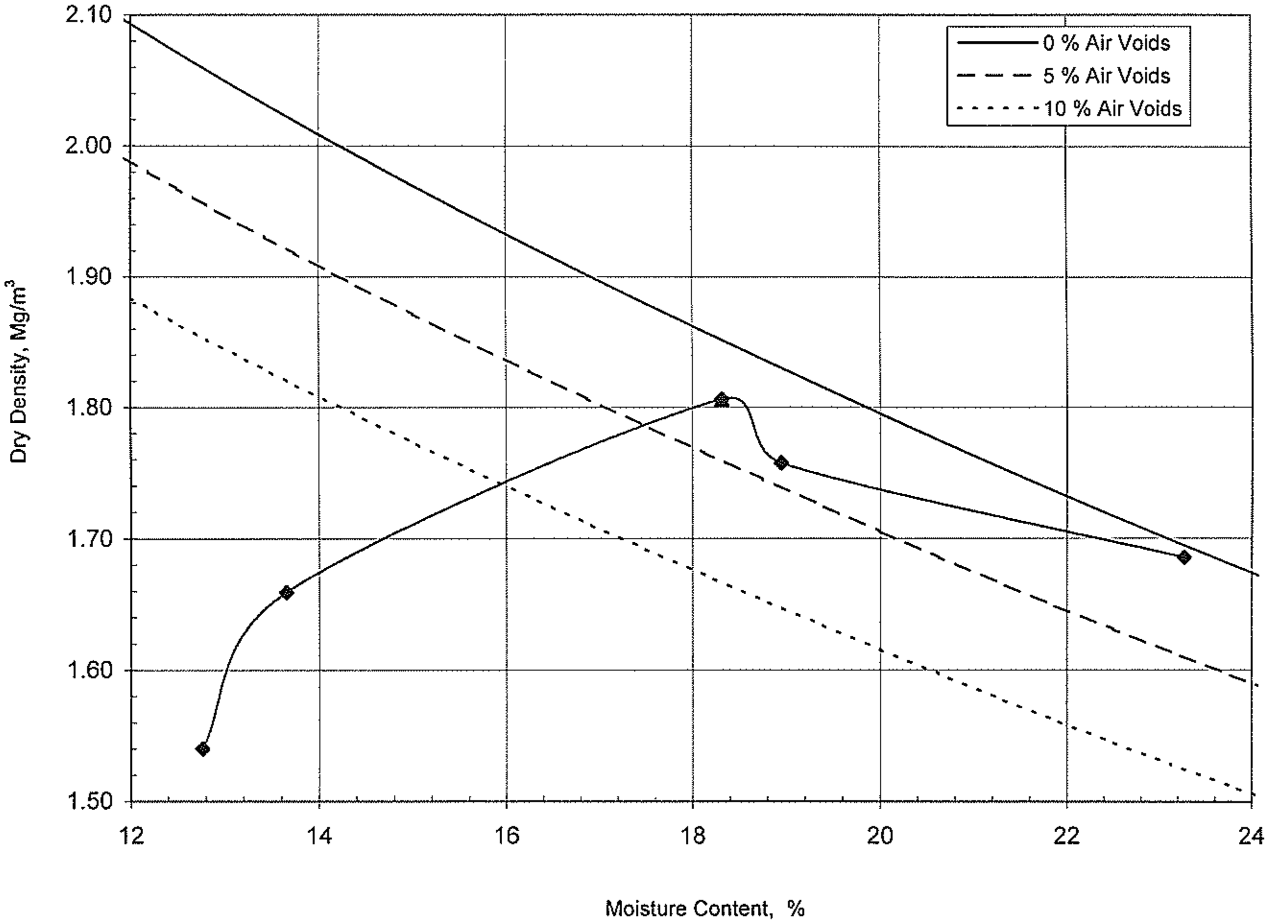
Specimen No		1	2	3	4	5	6
Moisture Condition Value		0.0					
Moisture Content	%	30.88					
Bulk density after compaction	Mg/m³	1.82					
Dry density after compaction	Mg/m³	1.39					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	64.3					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP31
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	0.00 m



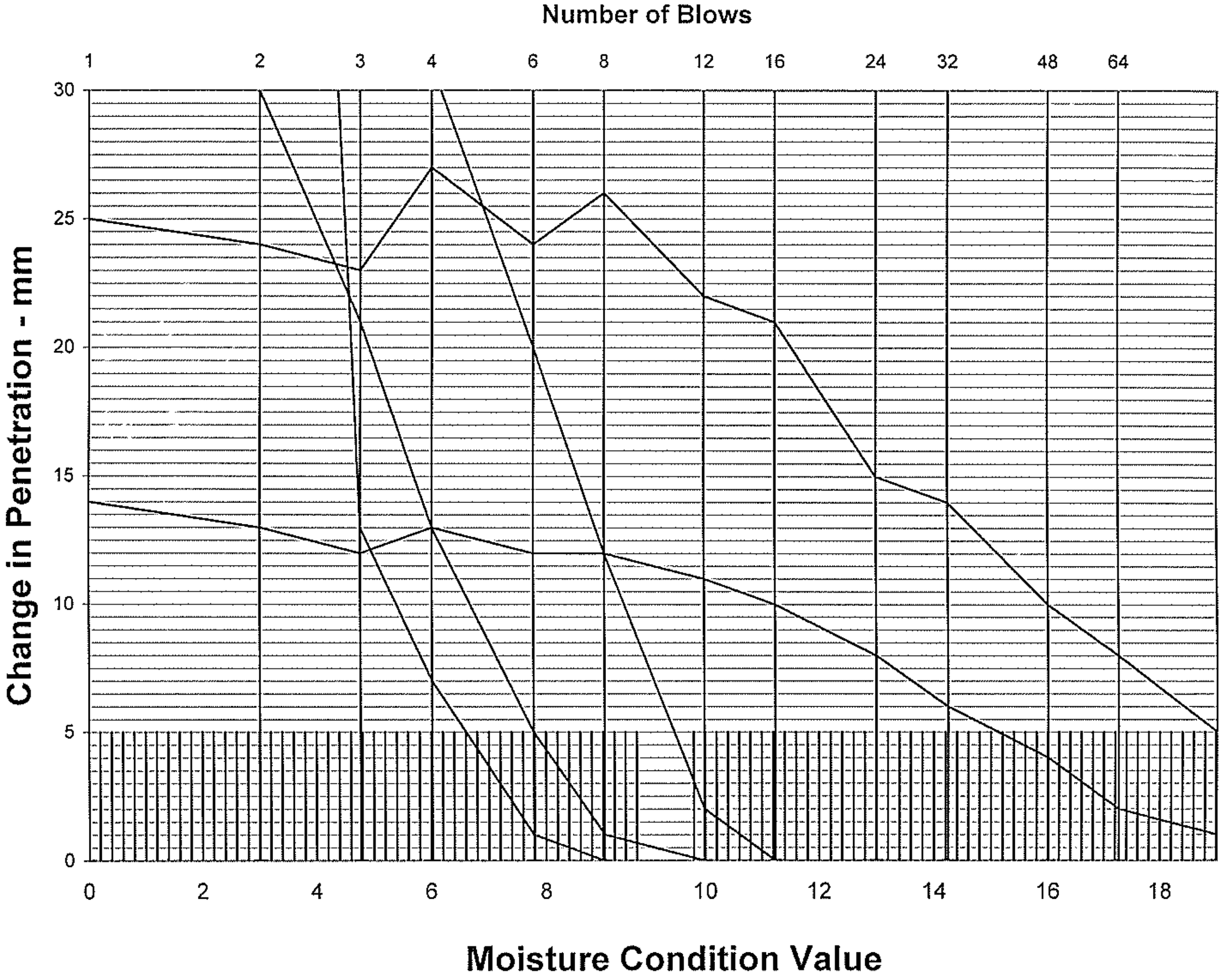
Specimen No		1	2	3	4	5	6
Moisture Condition Value		0.0					
Moisture Content	%	16.66					
Bulk density after compaction	Mg/m³	2.17					
Dry density after compaction	Mg/m³	1.86					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	19.8					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	TP31
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	2.00 m
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B



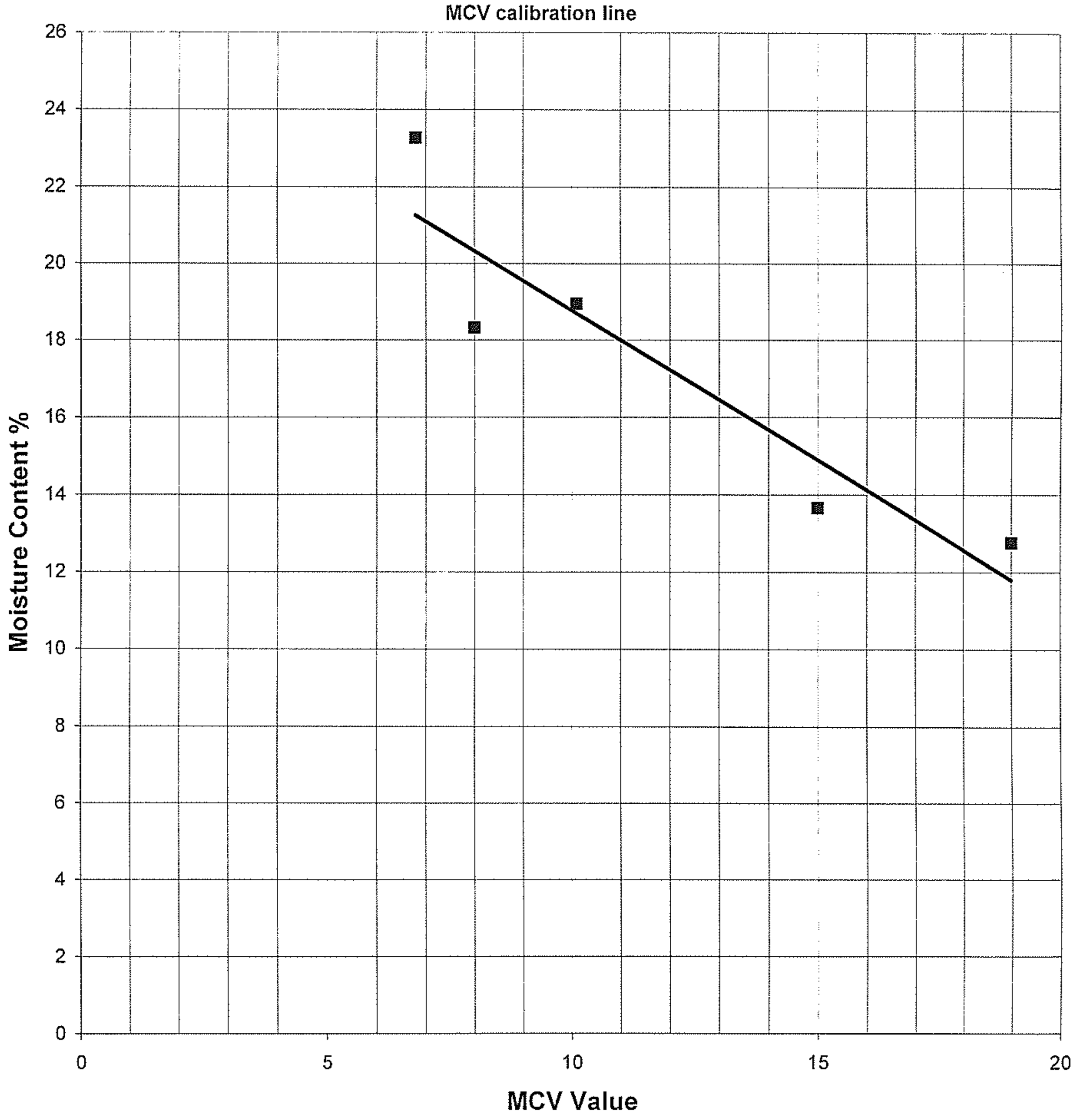
Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	0
Mass Retained on 20.0 mm Sieve	%	0
Grading Zone		1
Particle Density - Assumed	Mg/m^3	2.80
Maximum Dry Density	Mg/m^3	1.81
Optimum Moisture Content	%	18
Natural Moisture Content	%	23.27

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP31
		Sample No	3
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	2.00 m



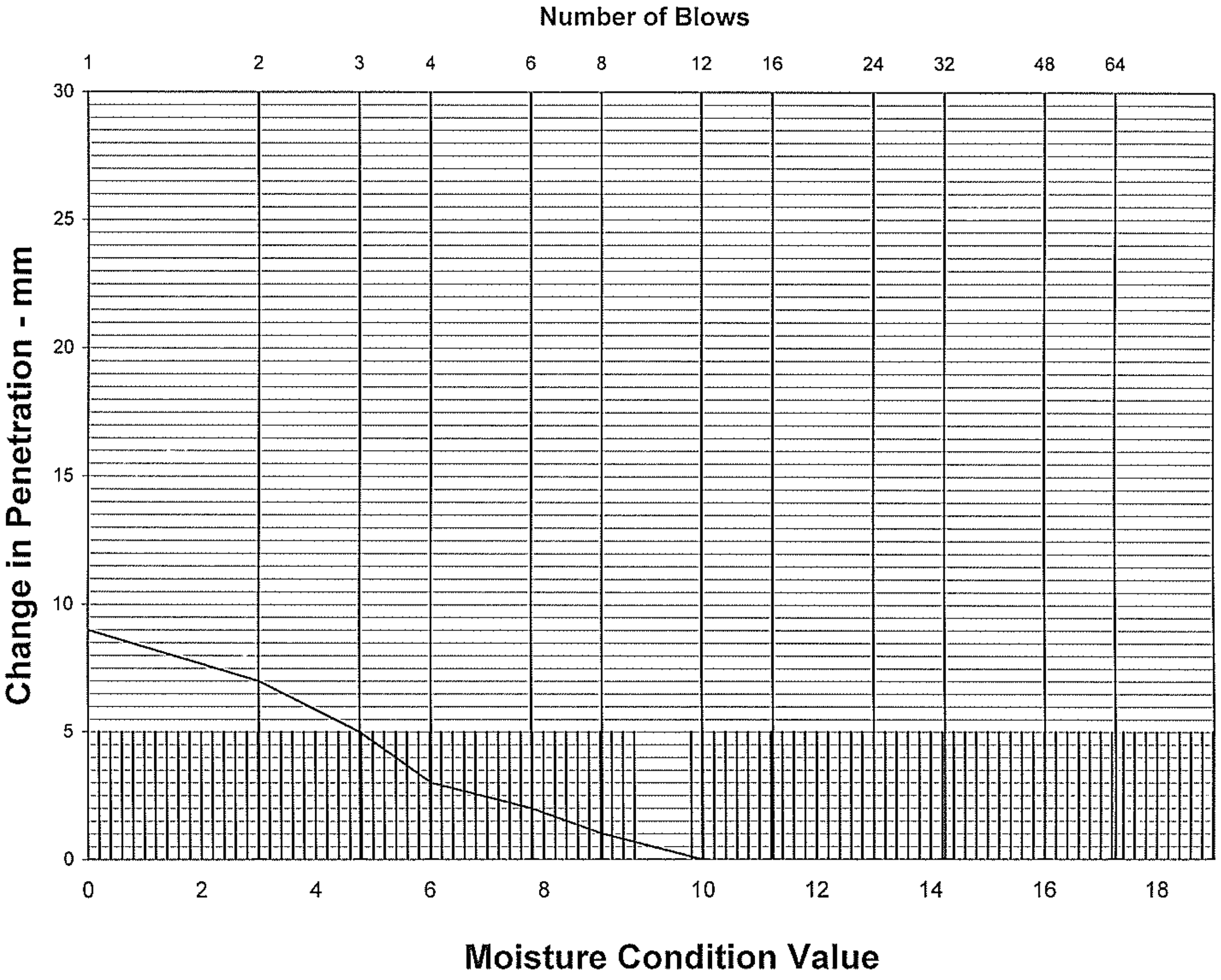
Specimen No		1	2	3	4	5	6
Moisture Condition Value		6.8	10.1	19.0	15.0	8.0	
Moisture Content	%	23.27	18.95	12.76	13.65	18.32	
Bulk density after compaction	Mg/m³	1.99	2.14	2.19	2.25	2.12	
Dry density after compaction	Mg/m³	1.61	1.80	1.94	1.98	1.79	
Hand vane strength	kPa	0	0	0	0	0	
Method of determining MCV		Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve	%	0.0					

	MCV Relationship Graph **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP31
		Sample No	3
Soil Description	Slightly sandy slightly gravelly CLAY	Sample Type	B
		Depth	2.00 m



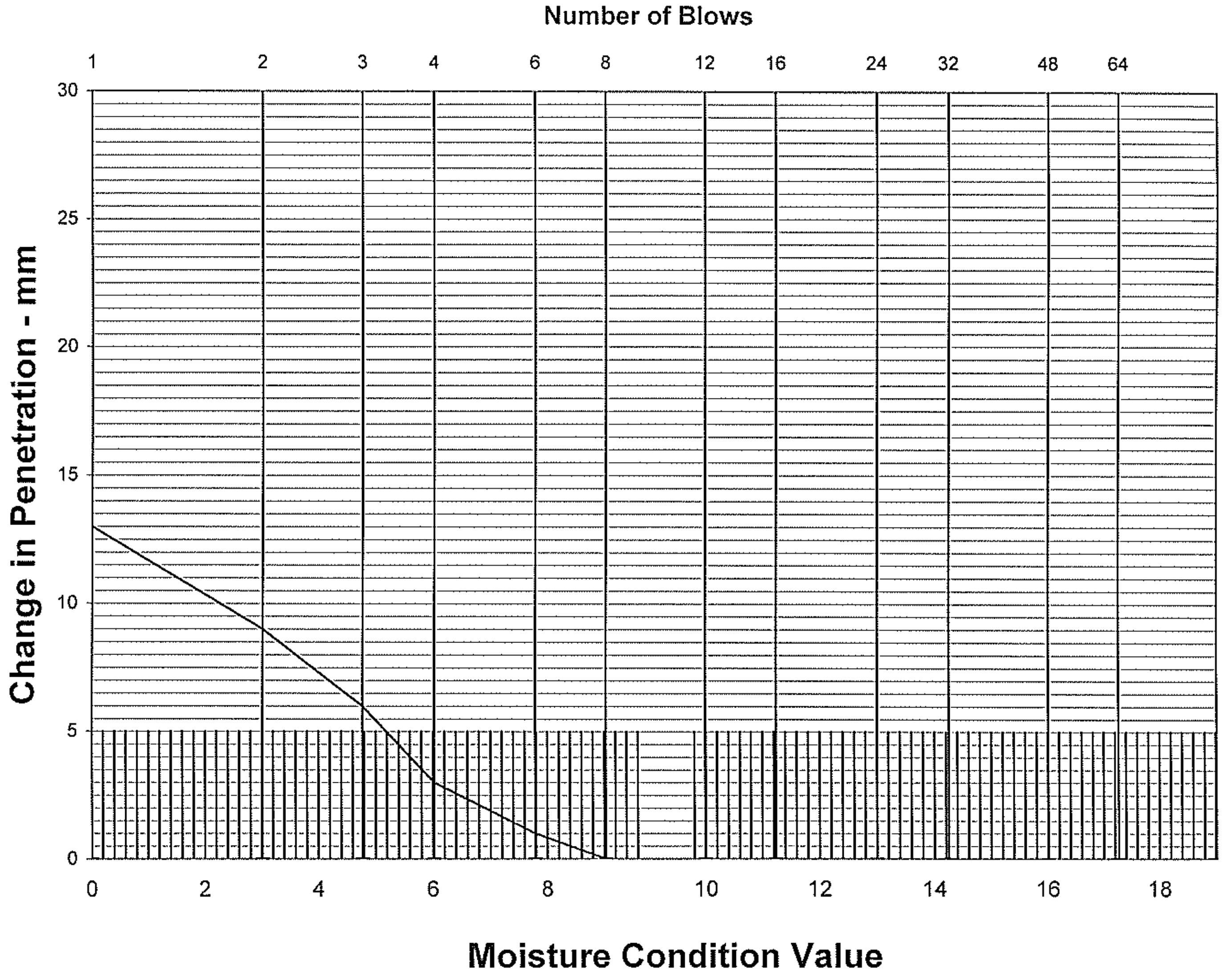
Operator	Checked	Approved	Remarks Single sample / Separate batches tested

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP32
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B
		Depth	0.80 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		4.8					
Moisture Content	%	13.22					
Bulk density after compaction	Mg/m³	2.19					
Dry density after compaction	Mg/m³	1.93					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	21.4					

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP33
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Silty very sandy GRAVEL with medium cobble content	Sample Type	B
		Depth	0.20 m

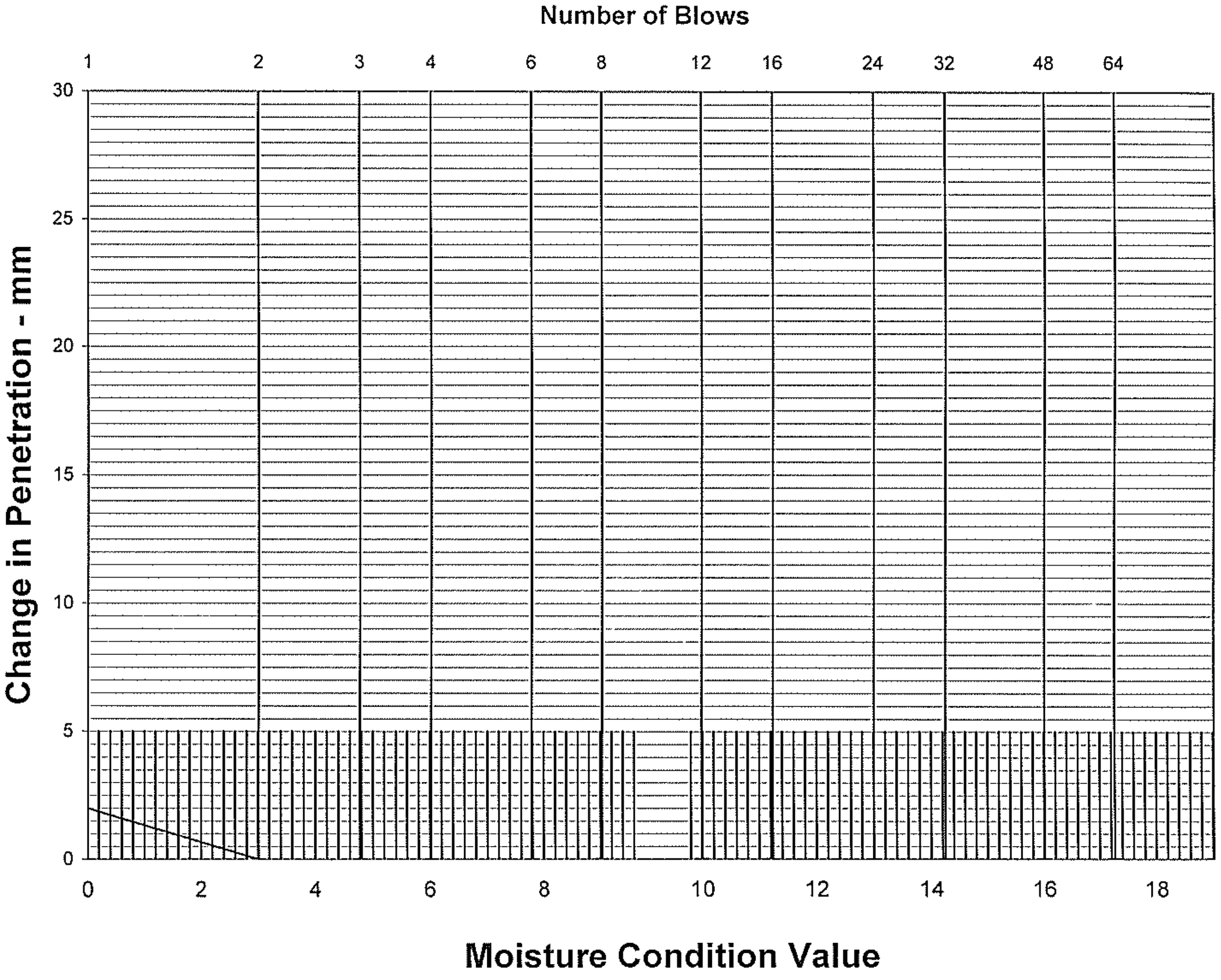


Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.2					
Moisture Content	%	16.42					
Bulk density after compaction	Mg/m³	2.14					
Dry density after compaction	Mg/m³	1.84					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	32.9					

Moisture Condition Value

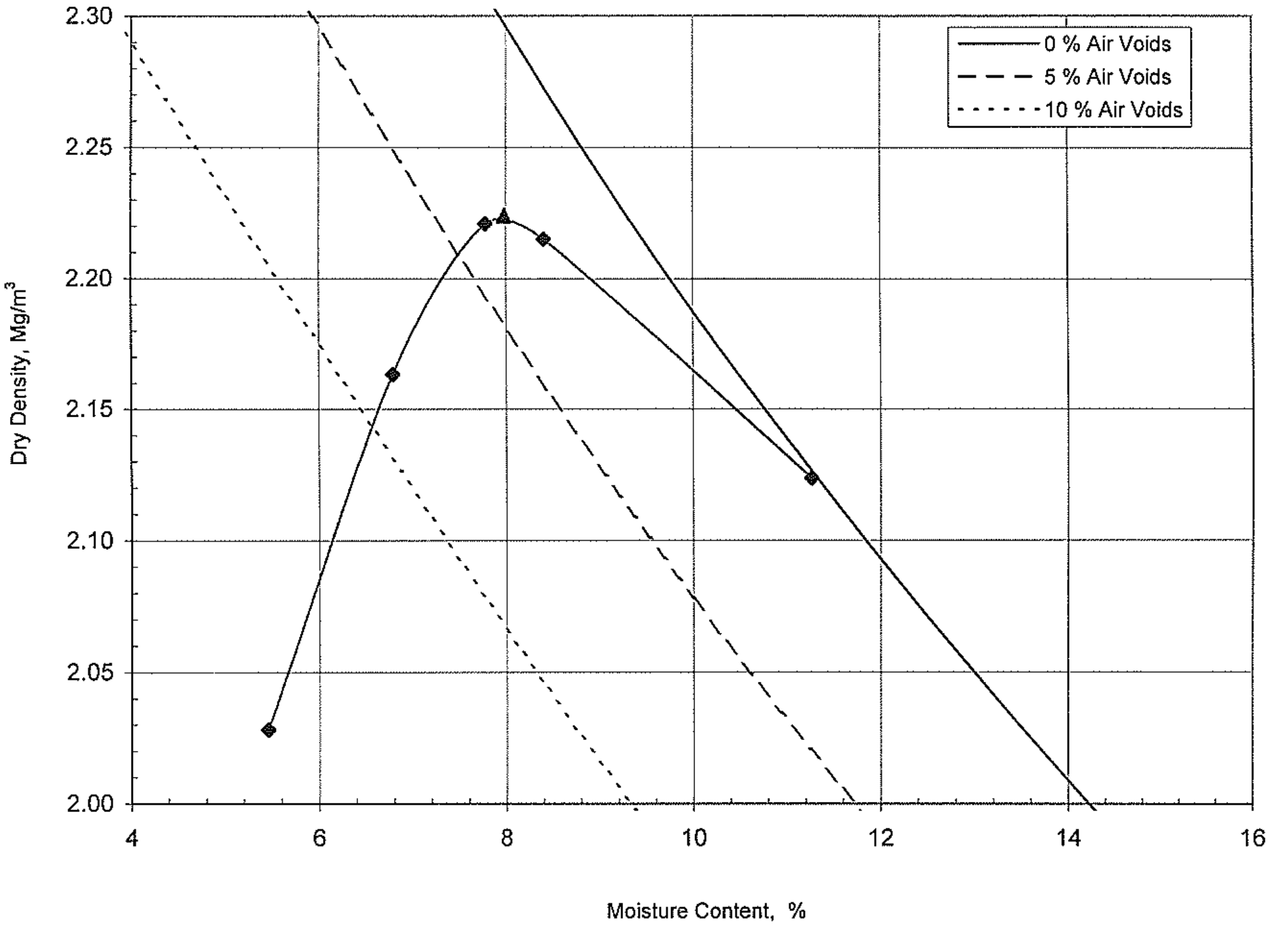
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP36
		Sample No	1
Soil Description	Slightly sandy gravelly SILT with medium cobble content	Sample Type	B
		Depth	0.50 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		0.0					
Moisture Content	%	8.49					
Bulk density after compaction	Mg/m³	2.36					
Dry density after compaction	Mg/m³	2.18					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	24.0					

PRIORITY GEOTECHNICAL	**Dry Density / Moisture Content Relationship** **BS 1377 : Part 4 : 1990 : Clause 3**	**Job Ref**	**P12012**
		Borehole / Pit No	TP36
Site Name	**Dunkellin River & Aggard Stream Flood Relief Scheme**	Sample No	3
		Depth	1.50 m
Soil Description	Slightly sandy gravelly SILT with medium cobble content	Sample Type	B

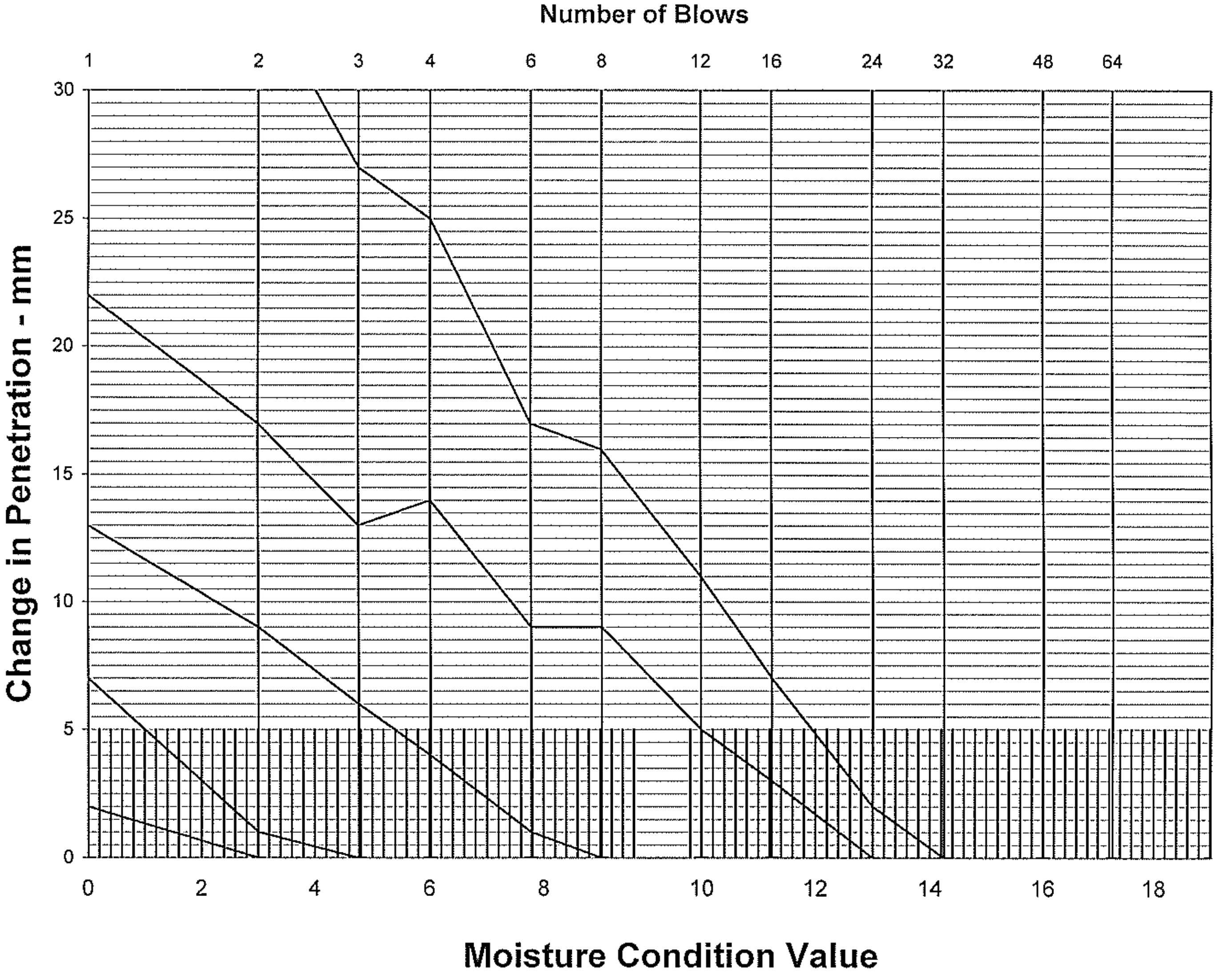


Preparation		3.2
Test Method		2.5 kg Rammer
Mould Type		CBR
Samples Used		Single Sample
Mass Retained on 37.5 mm Sieve	%	8
Mass Retained on 20.0 mm Sieve	%	16
Grading Zone		5
Particle Density - Assumed	Mg/m³	2.80
Maximum Dry Density	Mg/m³	2.22
Optimum Moisture Content	%	8.0
Natural Moisture Content	%	7.78

Moisture Condition Value

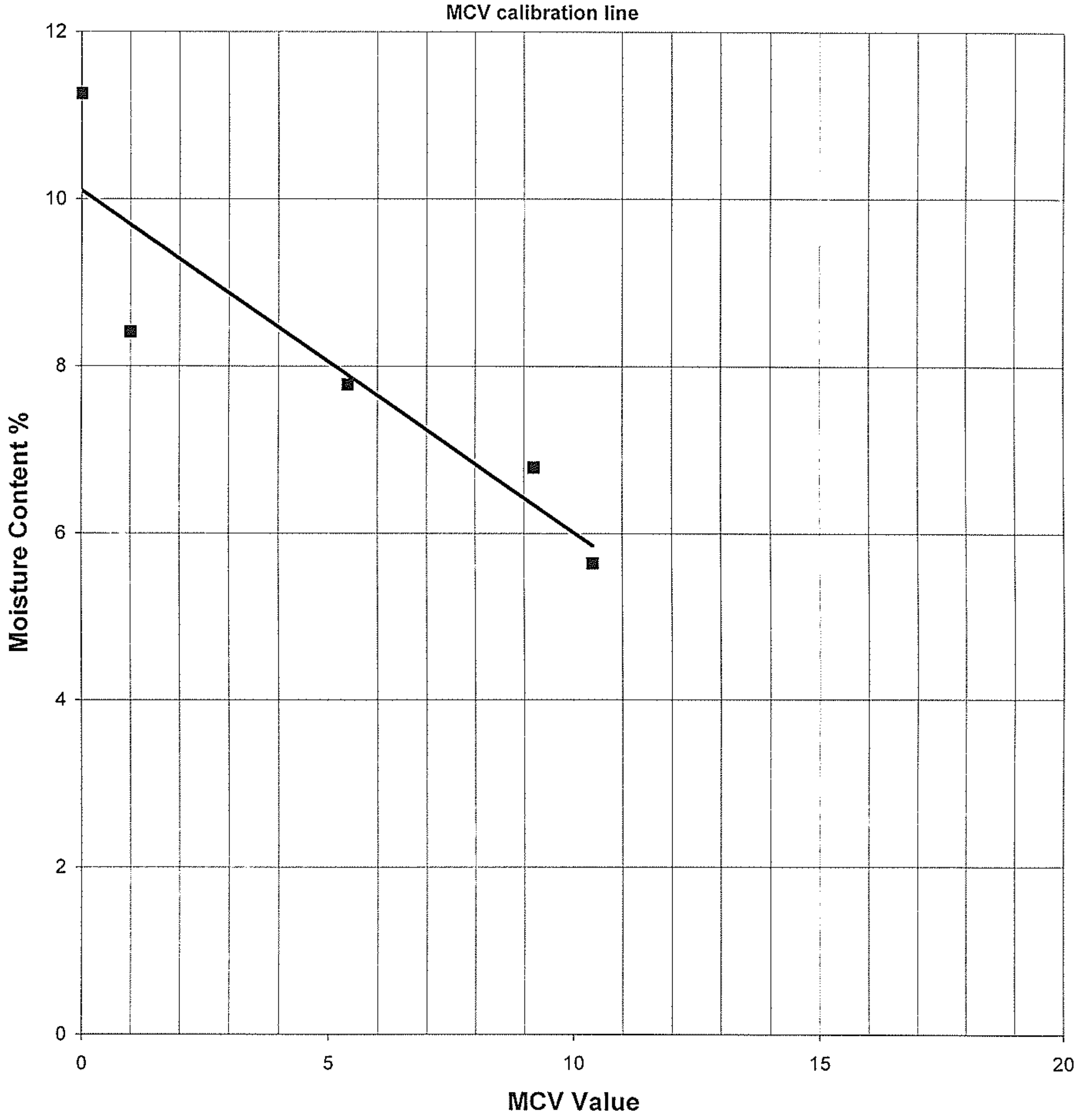
BS 1377 : Part 4 : 1990 Clause 5

		Job Ref	**P12012**
		Borehole / Pit No	TP36
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy gravelly SILT with medium cobble content	Sample Type	B
		Depth	1.50 m



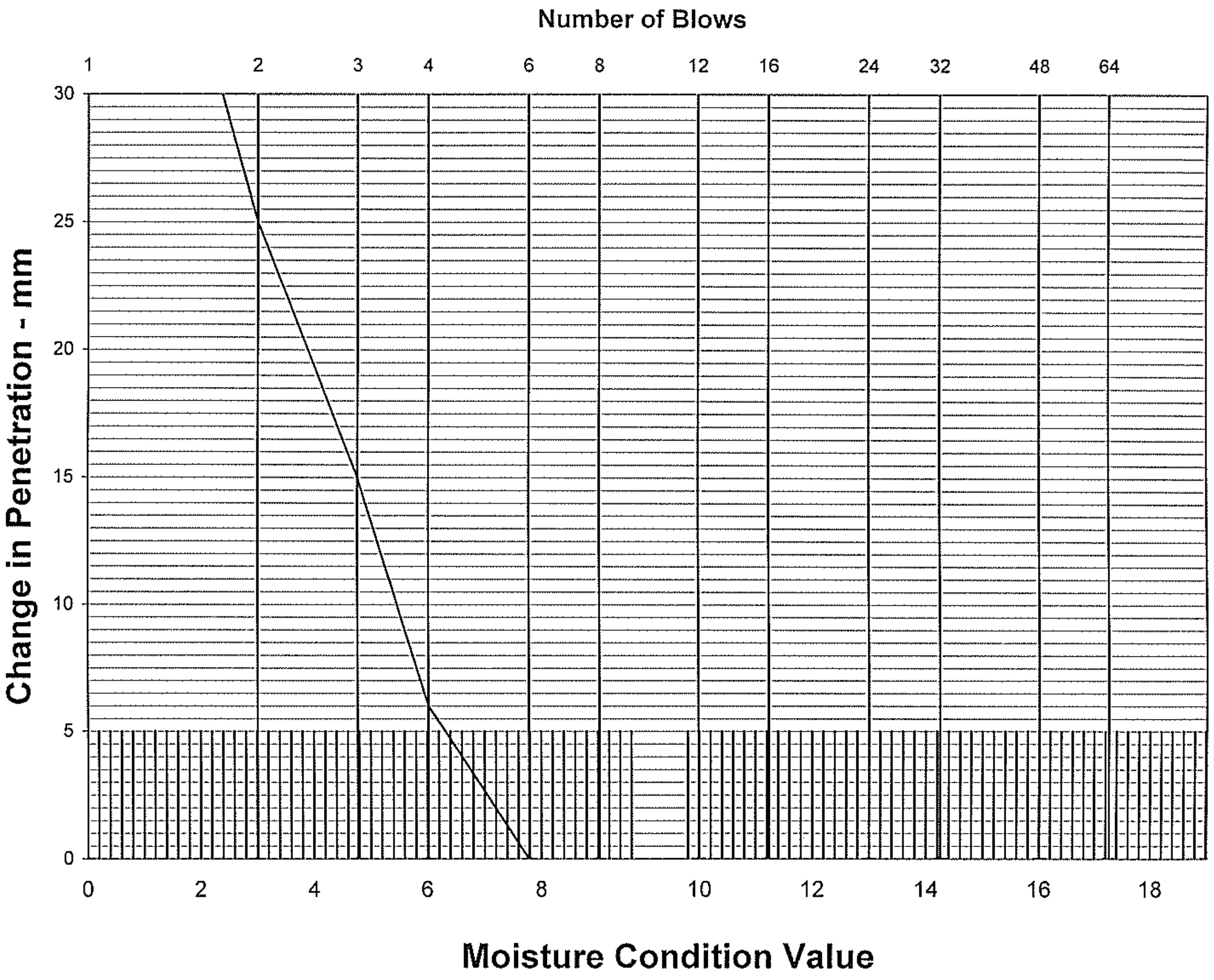
Specimen No	1	2	3	4	5	6
Moisture Condition Value	5.4	10.4	0.0	9.2	1.0	
Moisture Content %	7.78	5.64	11.26	6.79	8.41	
Bulk density after compaction Mg/m³	2.38	2.19	2.29	2.38	2.33	
Dry density after compaction Mg/m³	2.21	2.07	2.06	2.23	2.15	
Hand vane strength kPa	0	0	0	0	0	
Method of determining MCV	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	Steepest fit line	
Mass retained on 20mm sieve %	16.1					

	MCV Relationship Graph BS 1377 : Part 4 : 1990 Clause 5	**Job Ref**	**P12012**
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Borehole / Pit No	TP36
		Sample No	3
Soil Description	Slightly sandy gravelly SILT with medium cobble content	Sample Type	B
		Depth	1.50 m



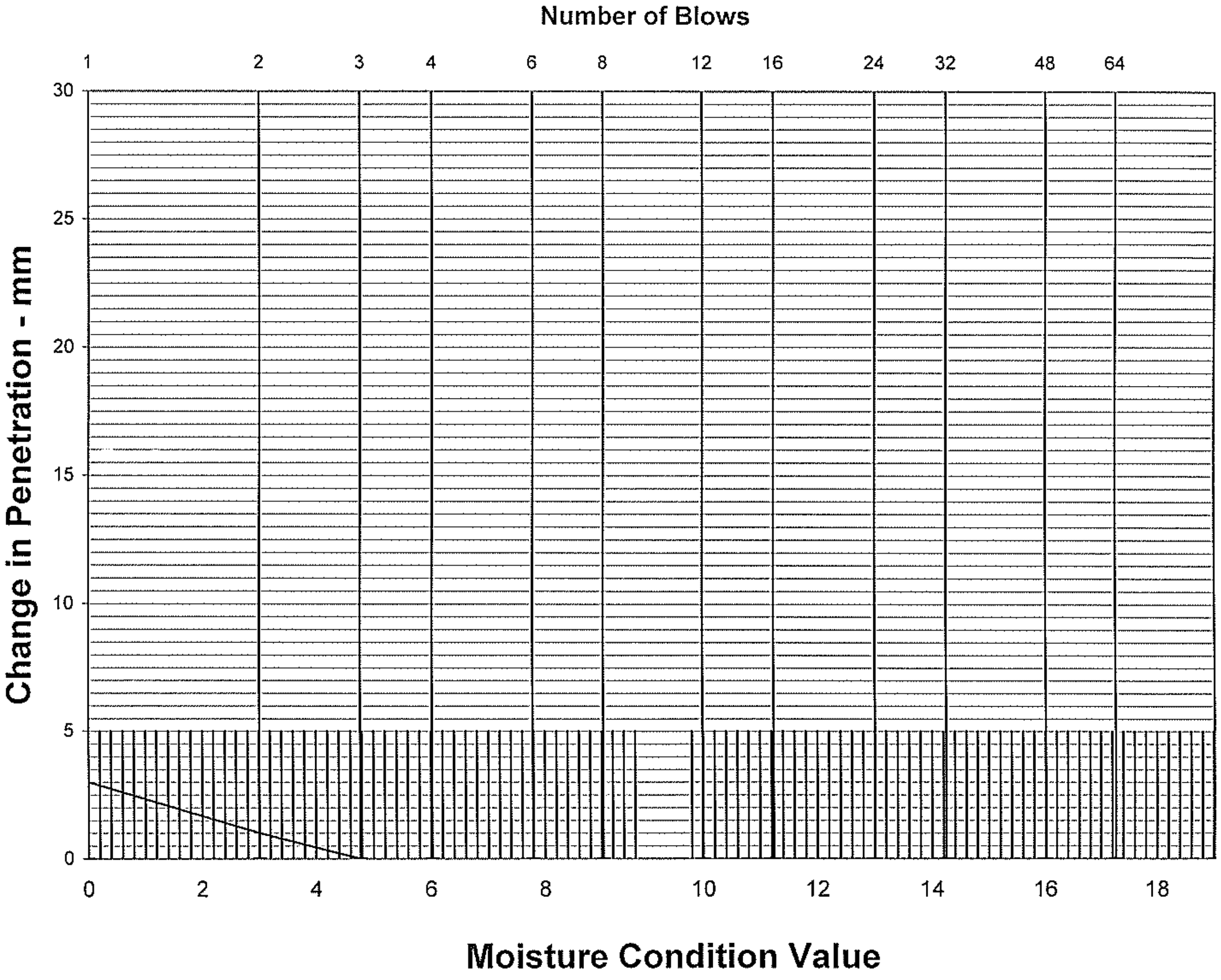
Operator	Checked	Approved	Remarks Single sample / Separate batches tested

	Moisture Condition Value **BS 1377 : Part 4 : 1990 Clause 5**	**Job Ref**	**P12012**
		Borehole / Pit No	TP37
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	1
Soil Description	Slightly sandy CLAY	Sample Type	B
		Depth	0.60 m



Specimen No		1	2	3	4	5	6
Moisture Condition Value		5.5					
Moisture Content	%	19.32					
Bulk density after compaction	Mg/m³	2.12					
Dry density after compaction	Mg/m³	1.78					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	0.0					

	Moisture Condition Value BS 1377 : Part 4 : 1990 Clause 5	Job Ref	P12012
		Borehole / Pit No	TP37
Location	Dunkellin River & Aggard Stream Flood Relief Scheme	Sample No	3
Soil Description	Slightly sandy gravelly CLAY with low cobble content	Sample Type	B
		Depth	1.60 m

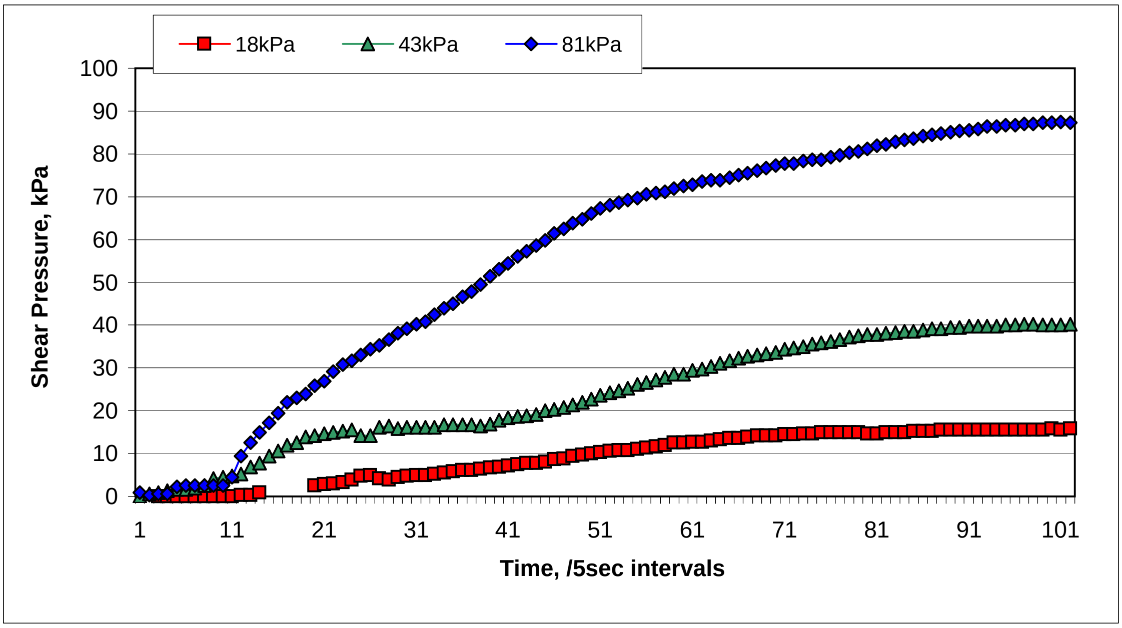


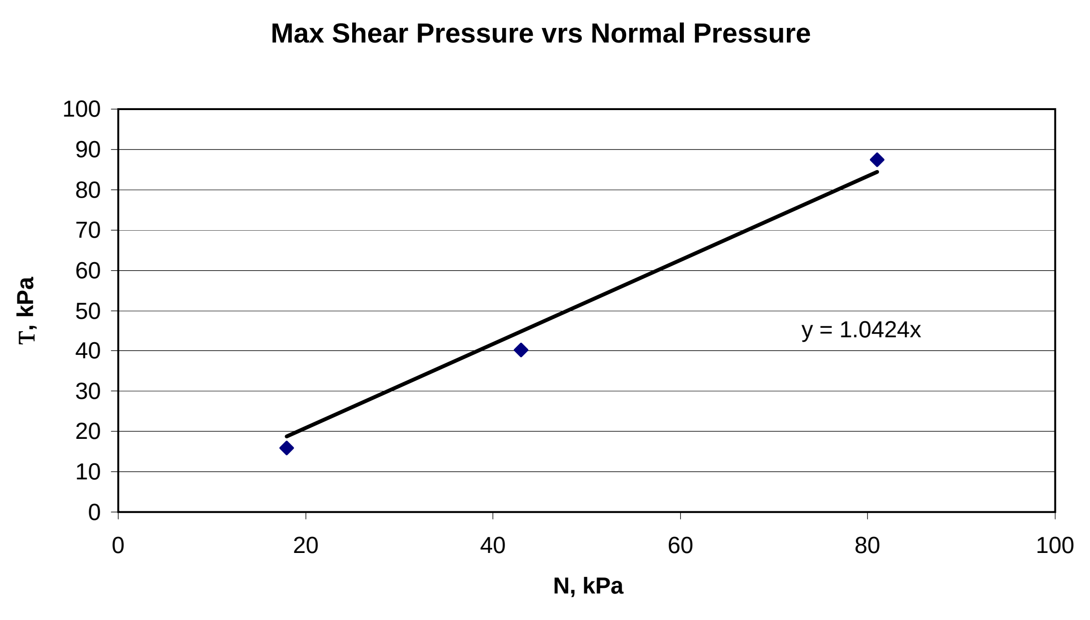
Specimen No		1	2	3	4	5	6
Moisture Condition Value		0.0					
Moisture Content	%	30.06					
Bulk density after compaction	Mg/m³	1.99					
Dry density after compaction	Mg/m³	1.53					
Hand vane strength	kPa	0					
Method of determining MCV		Steepest fit line					
Mass retained on 20mm sieve	%	25.8					

QUICK SHEARBOX TEST

BS1377: Part 7: 1990

Location	TP01
Depth	3.0 m
Test Date	13/06/13
Natural Moisture content	9.70%
Shear rate	1mm/ min
Soil description	Sightly sandy slightly gravelly SILT
Preparation	Recompacted (2.5kg) at natural moisture content



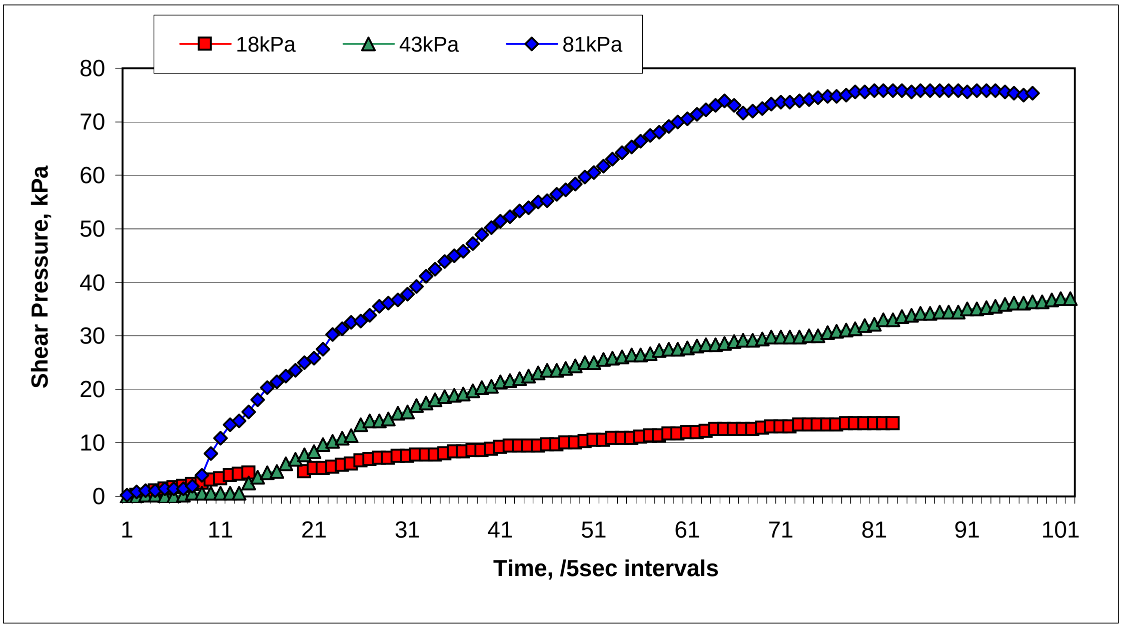


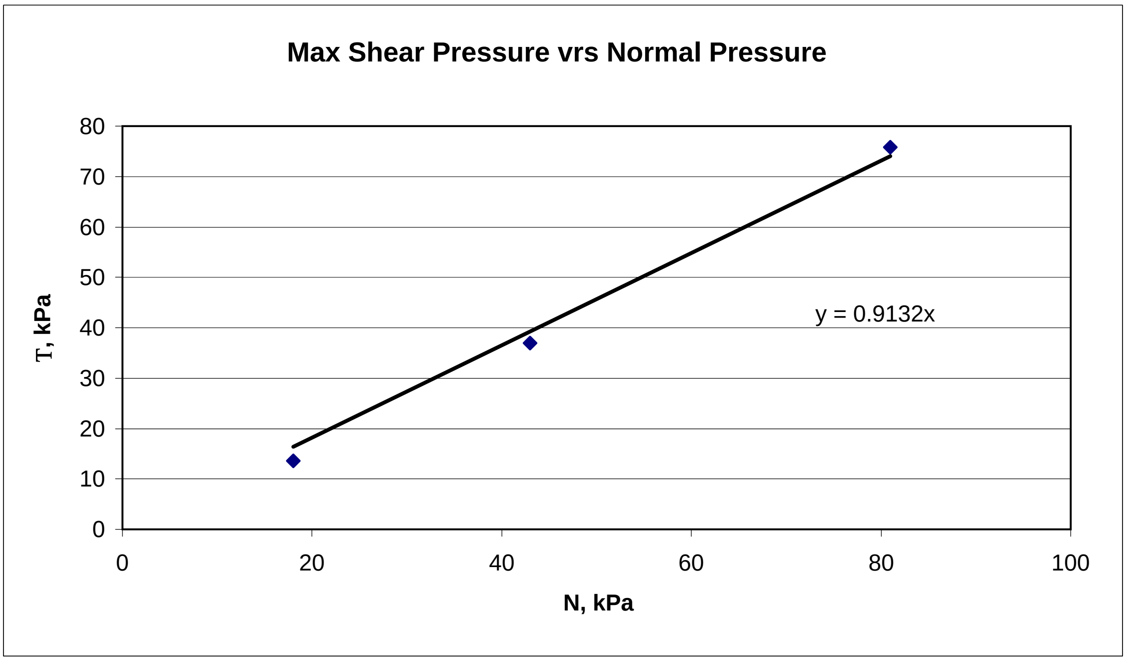
ϕ	**46 °**
c	**0 kPa**

QUICK SHEARBOX TEST

BS1377: Part 7: 1990

Location	TP04
Depth	1.0 m
Test Date	07/02/2014
Natural Moisture content	11.23%
Shear rate	1mm/ min
Soil description	Slightly sandy gravelly SILT
Preparation	Recompacted (2.5kg) at natural moisture content



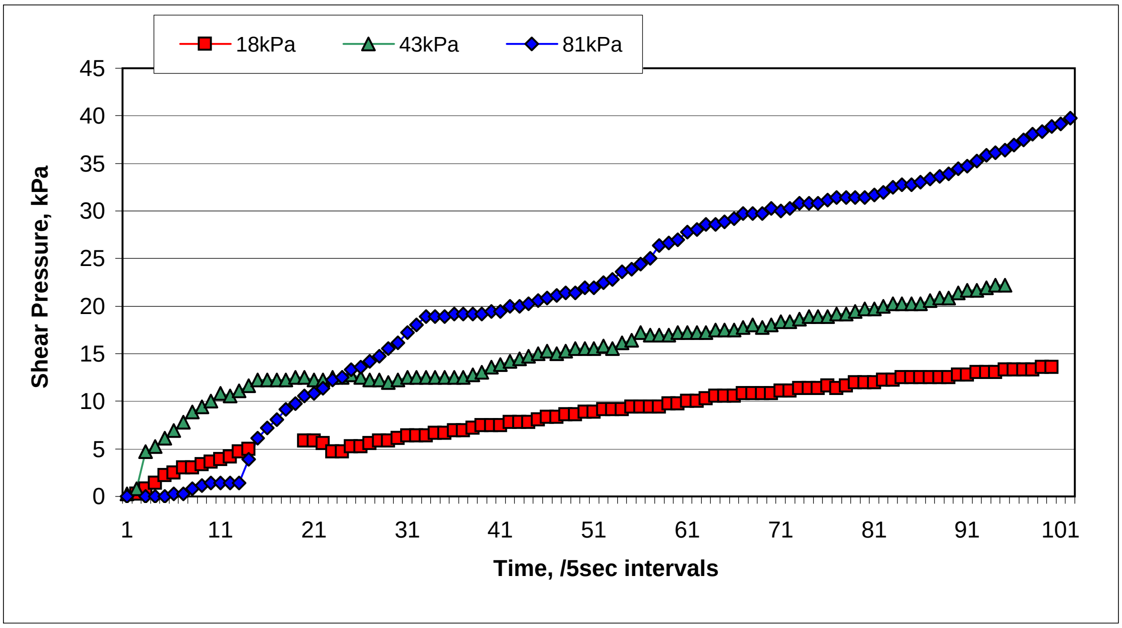


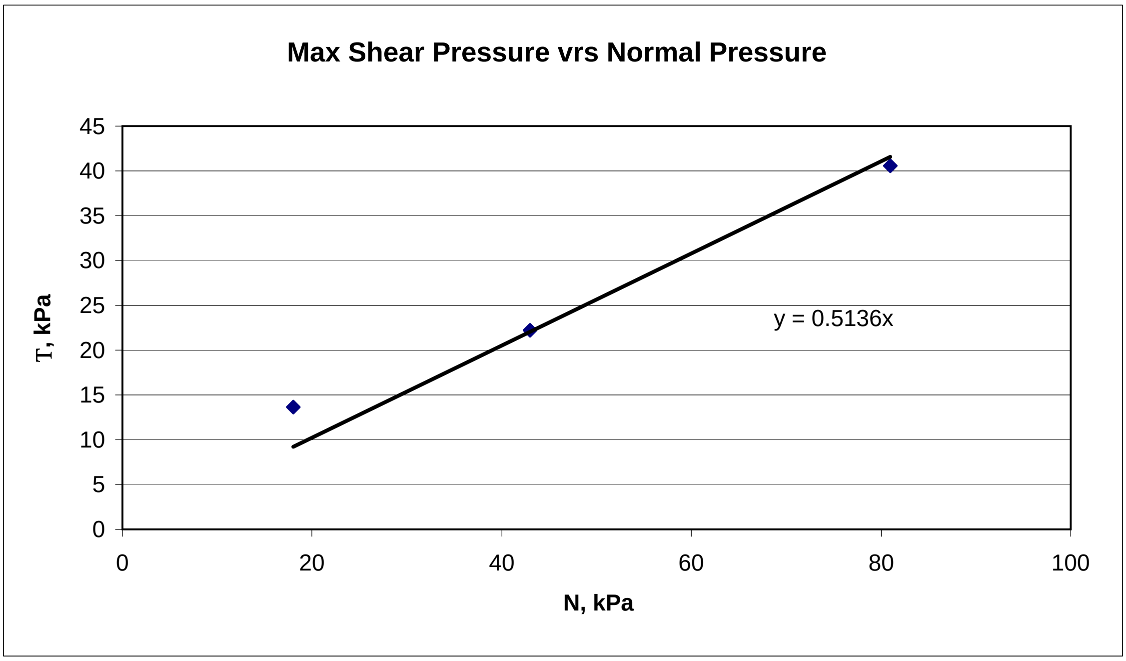
ϕ	**42 °**
c	**0 kPa**

QUICK SHEARBOX TEST

BS1377: Part 7: 1990

Location	TP12
Depth	1.0 m
Test Date	07/02/2014
Natural Moisture content	27.78%
Shear rate	1mm/ min
Soil description	Slightly sandy slightly gravelly SILT
Preparation	Recompacted (2.5kg) at natural moisture content

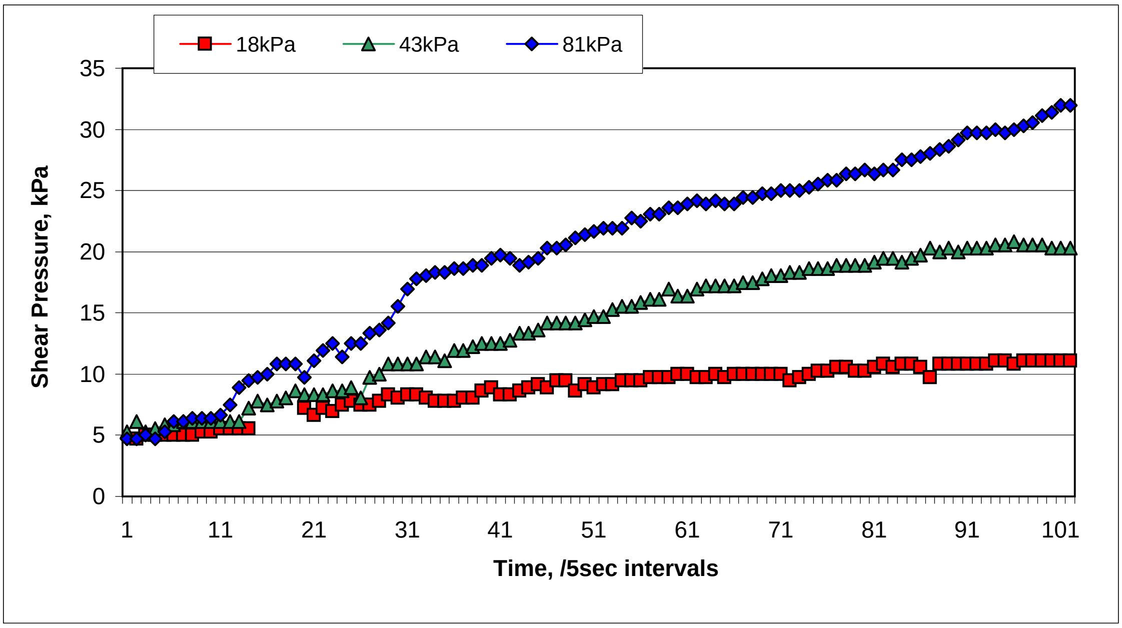


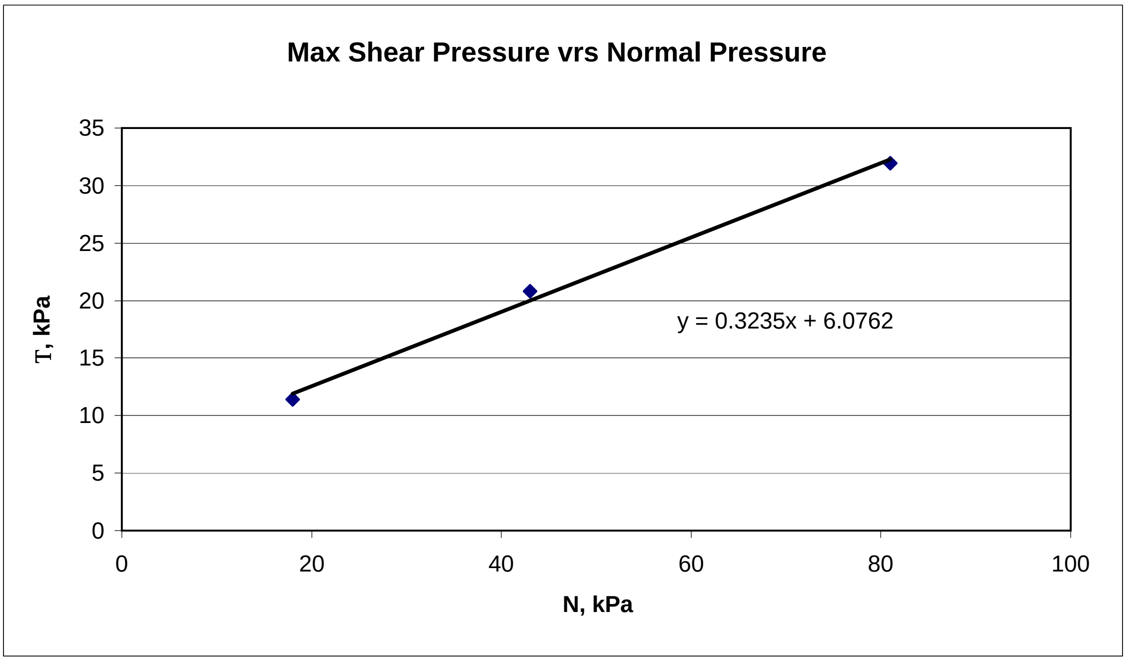


ϕ	**27 °**
c	**0 kPa**

QUICK SHEARBOX TEST
BS1377: Part 7: 1990

Location	TP14
Depth	0.5m
Test Date	17/06/14
Natural Moisture content	24.62%
Shear rate	1mm/ min
Soil description	Slightly sandy slightly gravelly SILT
Preparation	Recompacted (2.5kg) at natural moisture content



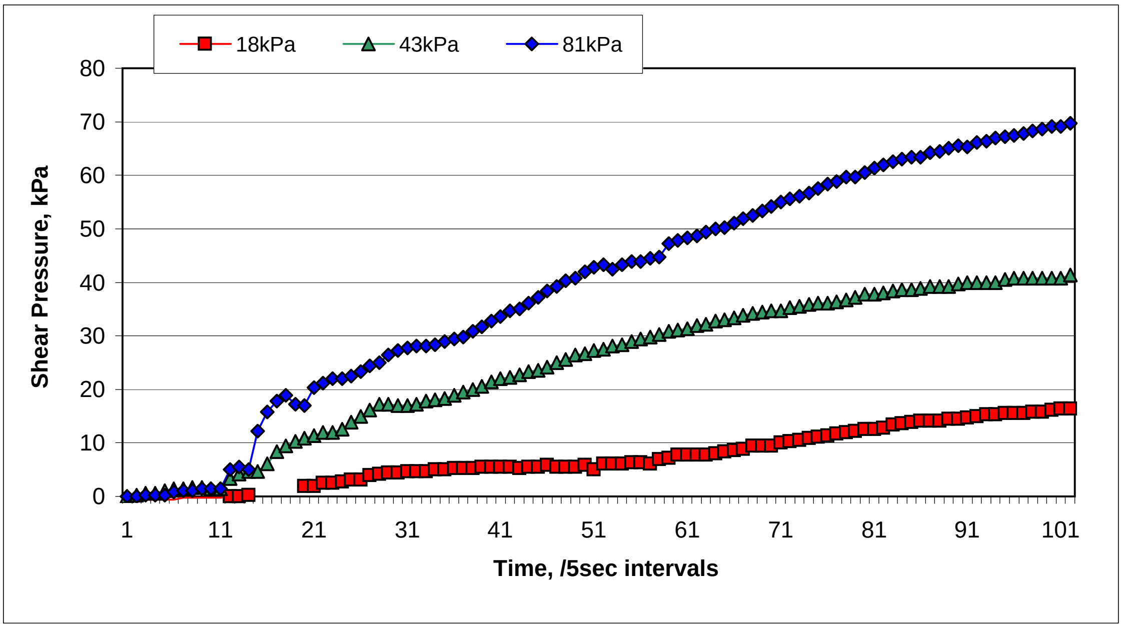


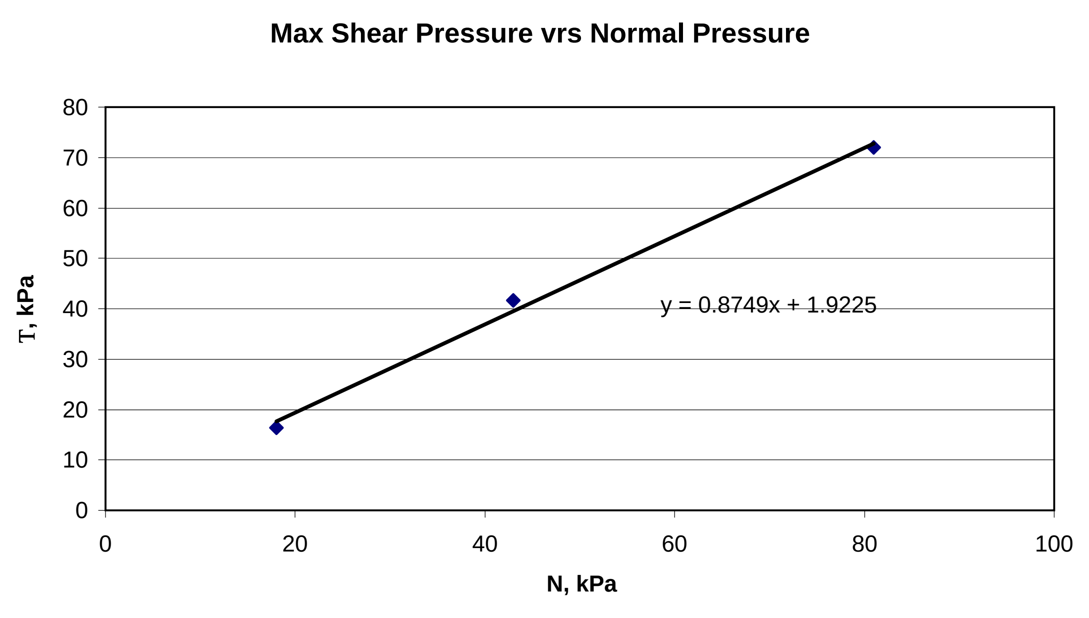
ϕ	**18 °**
c	**6 kPa**

QUICK SHEARBOX TEST

BS1377: Part 7: 1990

Location	TP21
Depth	1.0m
Test Date	07/02/2014
Natural Moisture content	10.03%
Shear rate	1mm/ min
Soil description	Slightly sandy gravelly SILT
Preparation	Recompacted (2.5kg) at natural moisture content



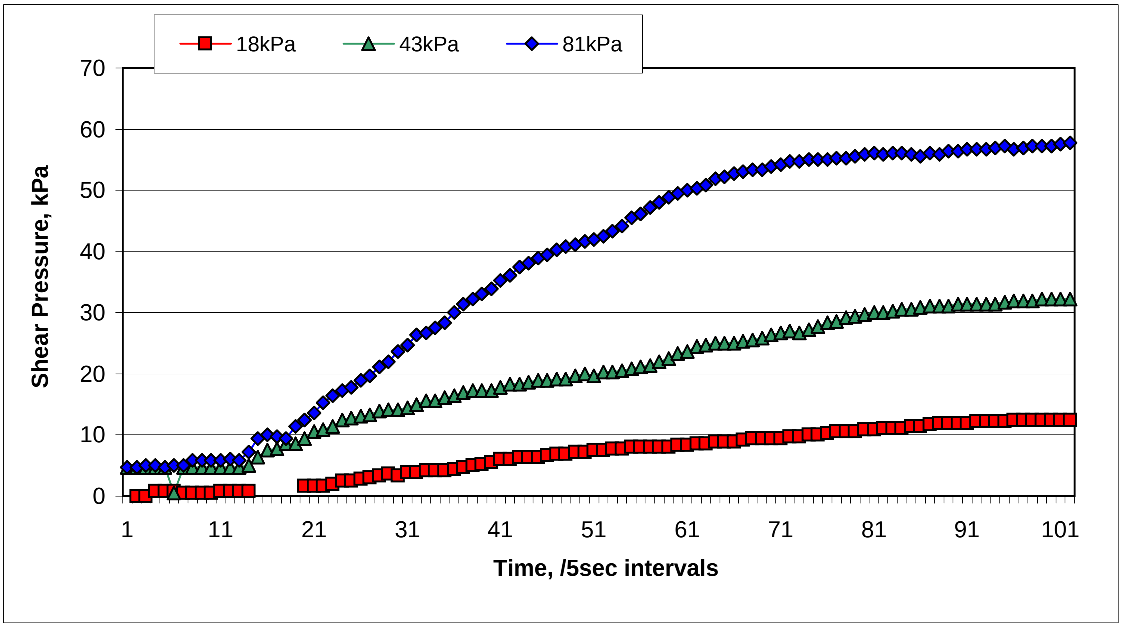


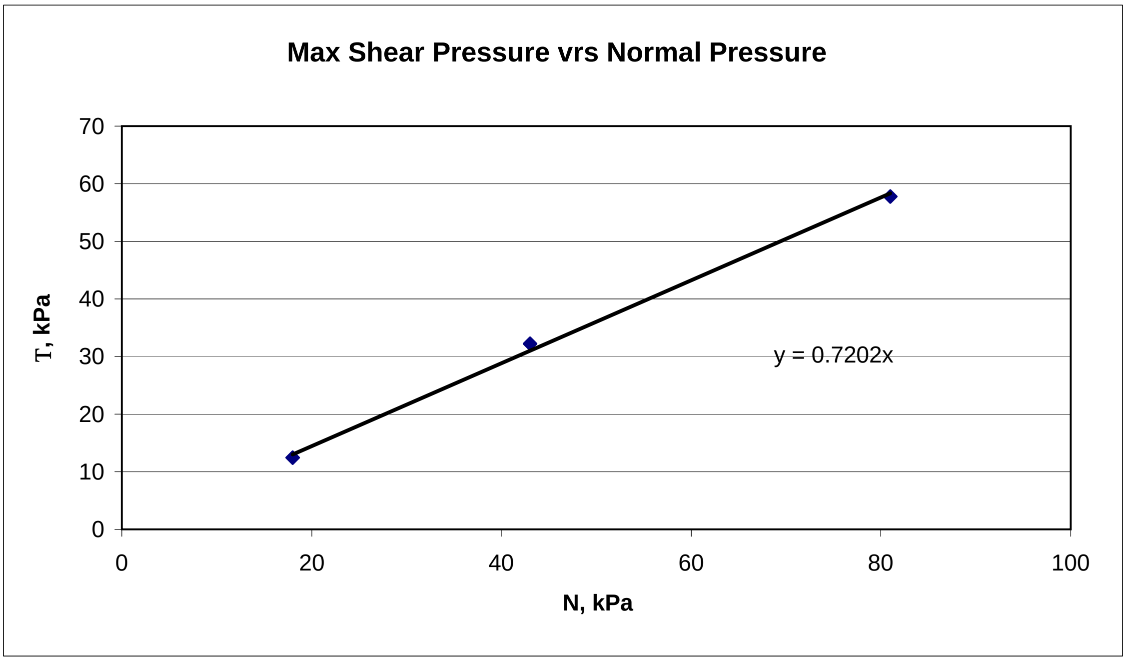
ϕ	41 ^{o}
c	2 kPa

QUICK SHEARBOX TEST

BS1377: Part 7: 1990

Location	TP25
Depth	1.0m
Test Date	17/06/14
Natural Moisture content	8.84%
Shear rate	1mm/ min
Soil description	Slightly sandy gravelly SILT
Preparation	Recompacted (2.5kg) at natural moisture content

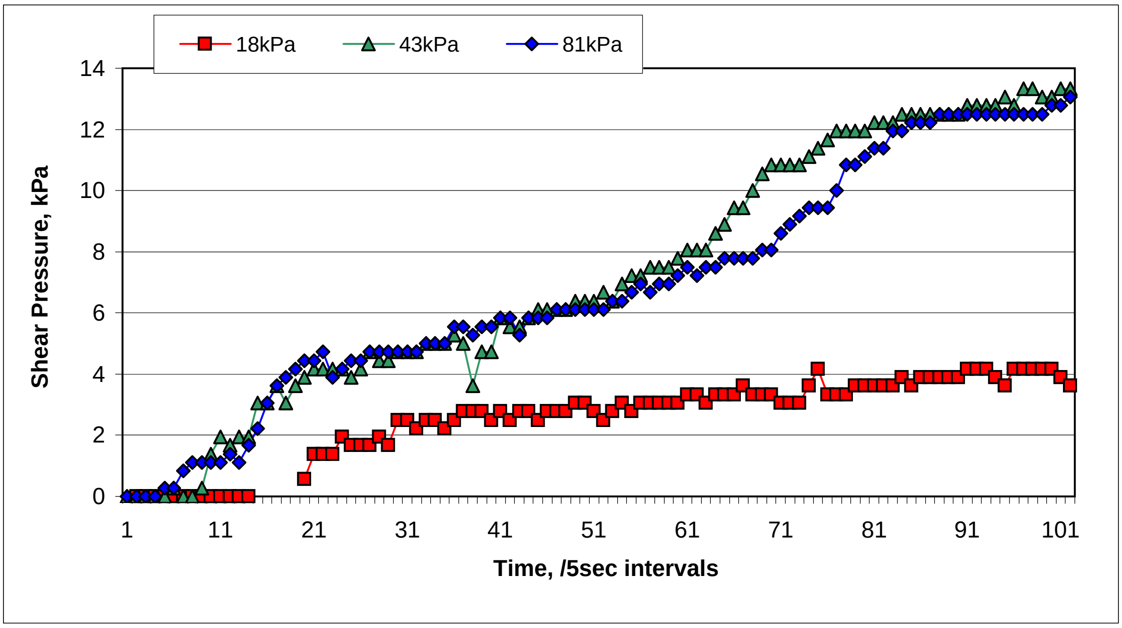


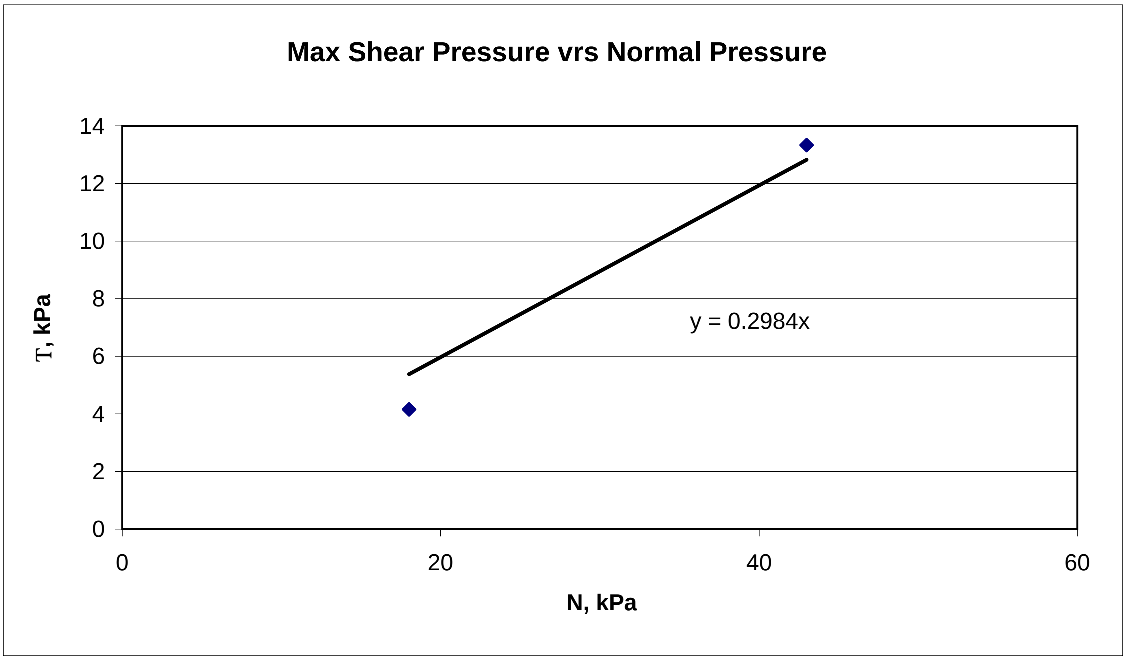


ϕ	**36 ^{o}**
c	**0 kPa**

QUICK SHEARBOX TEST
BS1377: Part 7: 1990

Location	TP28
Depth	1.7m
Test Date	07/02/2014
Natural Moisture content	43.14%
Shear rate	1mm/ min
Soil description	Slightly sandy gravelly CLAY
Preparation	Recompacted (2.5kg) at natural moisture content



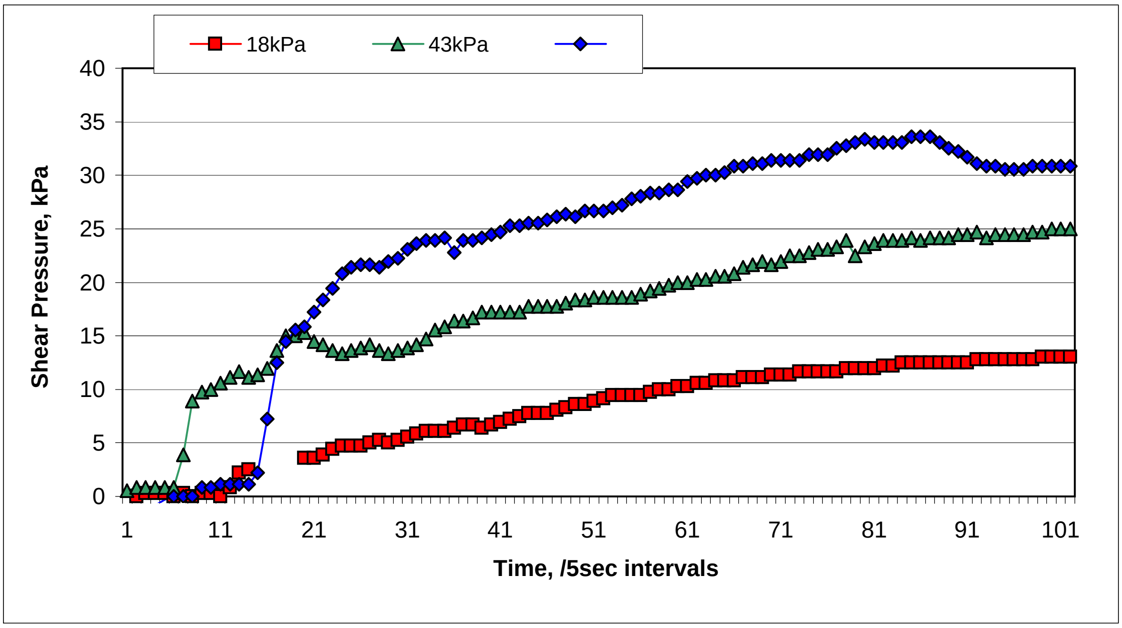


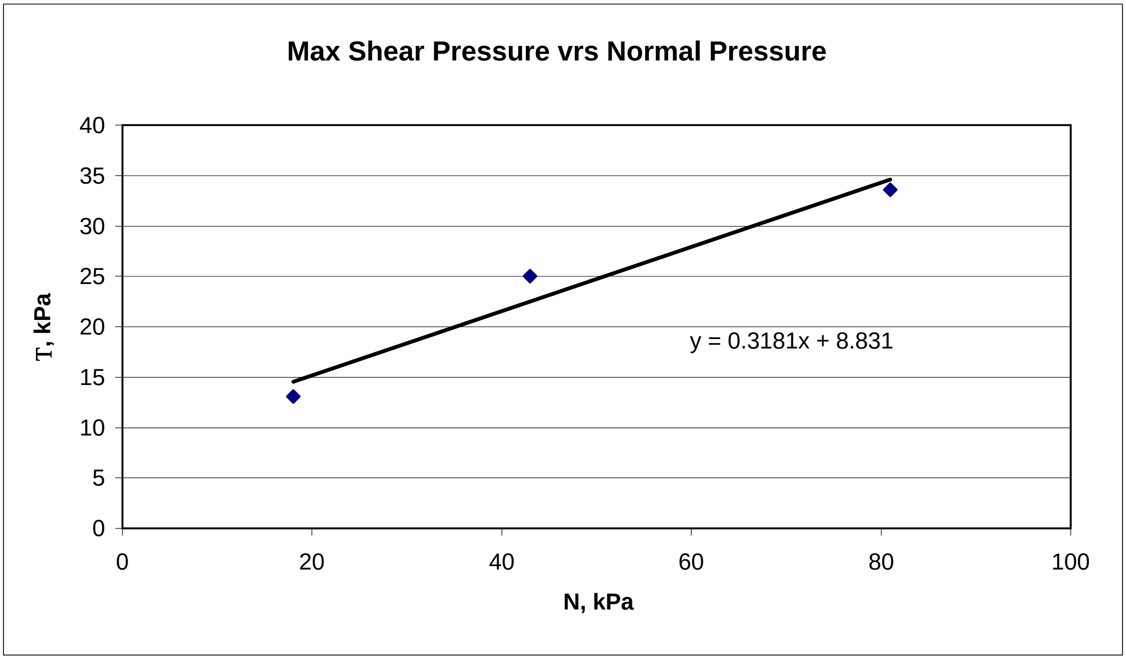
ϕ	**17 °**
c	**0 kPa**

QUICK SHEARBOX TEST

BS1377: Part 7: 1990

Location	TP31
Depth	2.0m
Test Date	07/02/2014
Natural Moisture content	21.25%
Shear rate	1mm/ min
Soil description	Slightly andy slightly gravelly CLAY
Preparation	Recompacted (2.5kg) at natural moisture content



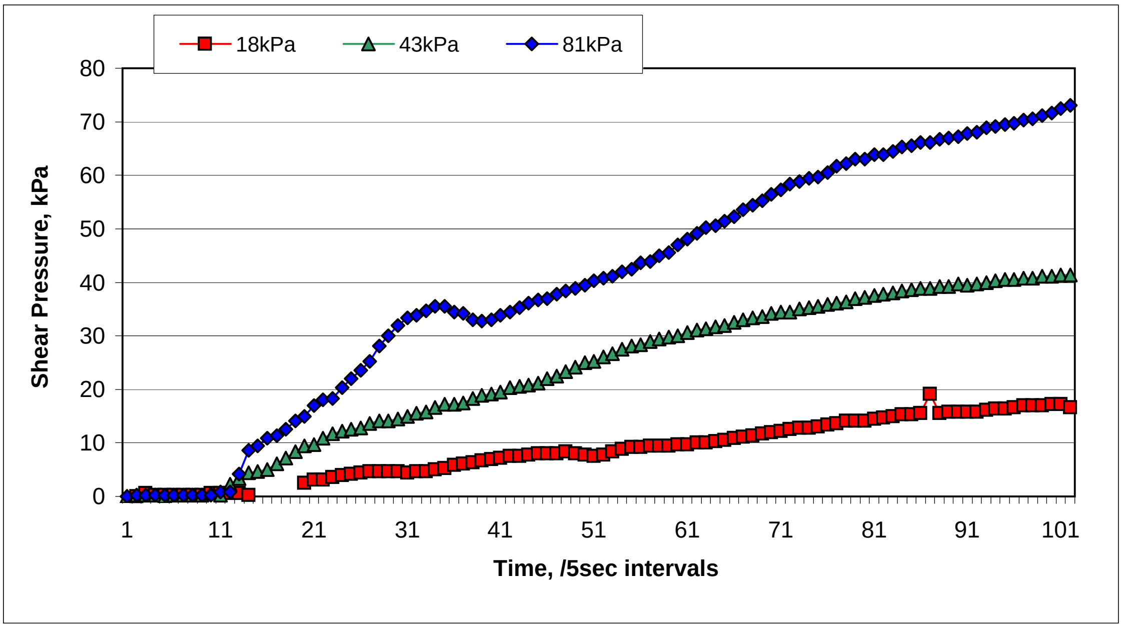


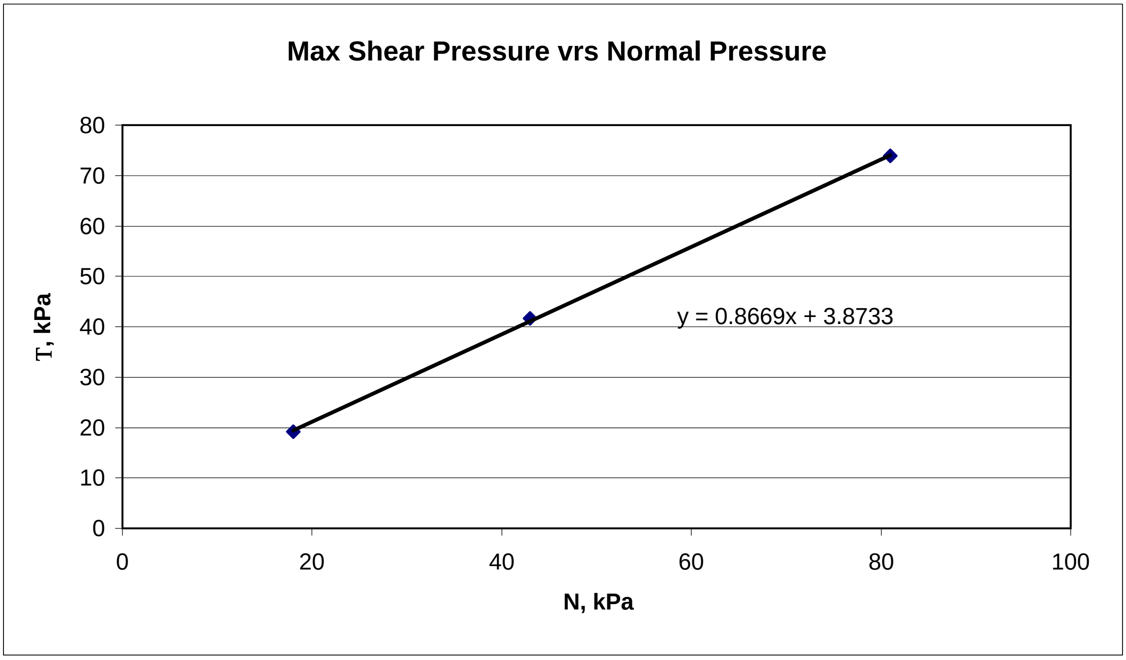
ϕ	**18 °**
c	**9 kPa**

QUICK SHEARBOX TEST

BS1377: Part 7: 1990

Location	TP36
Depth	1.5m
Test Date	07/02/2014
Natural Moisture content	8.28%
Shear rate	1mm/ min
Soil description	Slightly sandy gravelly SILT
Preparation	Recompacted (2.5kg) at natural moisture content





ϕ	**40 °**
c	**4 kPa**

Priority Geotechnical Limited

Point Load Test Results

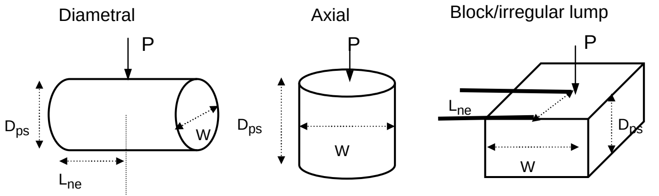
Project **Dunkellin River**

Project No P12012

Carried out by DC

Test Type
D - Diametral, A - Axial, I - Irregular Lump
Direction (U = unknown or random)
Par - parallel to planes of weakness
Per - perpendicular to planes of weakness
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P

Machine Ram Area, cm^2



Borehole	Sample Top, m BGL	Sample Ref	Sample Type	Sample Base, m BGL	Specimen Ref	Specimen Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8		Failure Valid (Y/N)	Dimensions			Gauge reading, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
								Type (D, A, I)	Direction (Par/Per/U)		L mm	Dps, mm	W mm						
RC01	6.5	1	C	7.6	1	6.5	Limestone	I	U	Y	21	17	17	4.28	4.28	19.2	11.62	7.55	Rough Undulating
RC02	6.6	1	C		1	6.6	Limestone	D	U	Y	53	65	67	18.27	18.27	66.0	4.19	4.75	Rough Undulating
RC03	7.9	1	C		1	7.9	Limestone	D	U	Y	72	67	67	15.48	15.48	67.0	3.45	3.93	Rough Undulating
RC06	8	1	C	8	1	8	Limestone	I	U	Y	22	50	64	14.14	14.14	63.8	3.47	3.87	Rough Stepped
RC07	6.8	1	C	7.2	1	6.8	Limestone	D	U	Y	35	63	63	19.45	19.45	63.0	4.90	5.44	Planar Smooth
RC09	6.6	1	C	7.5	1	6.6	Limestone	A	U	Y		29	83	12.96	12.96	55.4	4.23	4.43	Planar Rough
RC14	3.9	1	C	3.9	1	3.9	Limestone	D	U	Y	74	67	67	18.41	18.41	67.0	4.10	4.68	Rough Undulating
RC14	6.9	2	C	6.9	2	6.9	Limestone	D	U	Y	190	68	68	14.835	14.84	68.0	3.21	3.68	Rough Undulating
RC15	4.1	1	C		1	4.1	Limestone	D	U	Y	82	67	67	18.655	18.66	67.0	4.16	4.74	Planar Rough
RC15	5.1	2	C		2	5.1	Limestone	D	U	Y	153	67	67	18.945	18.95	67.0	4.22	4.81	Rough Undulating
RC16	1.85	1	C	1.85	1	1.85	Limestone	D	U	Y	92	67	68	16.925	16.93	67.5	3.71	4.25	Rough Undulating
RC16	4.65	2	C		2	4.65	Limestone	D	U	Y	90	67	67	16.96	16.96	67.0	3.78	4.31	Rough Undulating
RC16	4.85	3	C		3	4.85	Limestone	D	U	Y	87	67	67	15.5	15.50	67.0	3.45	3.94	Planar Rough
RC17	1.9	1	C		1	1.9	Limestone	D	U	Y	53	67	68	19.315	19.32	67.5	4.24	4.85	Rough Undulating
RC18	4.8	1	C	4.8	1	4.8	Limestone	D	U	Y	42	67	68	17.91	17.91	67.5	3.93	4.50	Rough Undulating
RC18	6.3	2	C	6.3	2	6.3	Limestone	D	U	Y	82	67	68	18.64	18.64	67.5	4.09	4.68	Rough Undulating
RC18	6.9	3	C	6.9	3	6.9	Limestone	D	U	Y	220	68	68	18.585	18.59	68.0	4.02	4.62	Rough Undulating
RC19	3.8	1	C	3.8	1	3.8	Limestone	D	U	Y	72	67	67	18.505	18.51	67.0	4.12	4.70	Planar Rough
RC19	4.8	2	C	4.8	2	4.8	Limestone	D	U	Y	64	67	67	21.525	21.53	67.0	4.80	5.47	Rough Undulating
RC19	6.9	3	C	6.9	3	6.9	Limestone	D	U	Y	60	67	67	18.96	18.96	67.0	4.22	4.82	Rough Undulating
RC19	7.8	4	C	7.8	4	7.8	Limestone	D	U	Y	105	68	67	18.935	18.94	67.5	4.16	4.76	Planar Rough

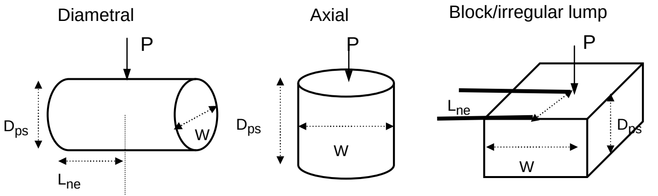
Priority Geotechnical Limited

Point Load Test Results

Project	**Dunkellin River**
Project No	P12012
Carried out by	DC

Test Type
D - Diametral, A - Axial, I - Irregular Lump
Direction (U = unknown or random)
Par - parallel to planes of weakness
Per - perpendicular to planes of weakness
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P

Machine Ram Area, cm^2



Borehole	Sample Top, m BGL	Sample Ref	Sample Type	Sample Base, m BGL	Specimen Ref	Specimen Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8		Failure Valid (Y/N)	Dimensions			Gauge reading, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
								Type (D, A, I)	Direction (Par/Per/U)		L mm	Dps, mm	W mm						
RC19	9.3	5	C	9.3	5	9.3	Limestone	D	U	Y	65	67	67	16.9	16.90	67.0	3.76	4.29	Planar Rough
RC20	2.4	1	C	2.5	1	2.4	Limestone	D	U	Y	42	62	62	8.55	8.55	62.0	2.22	2.45	Rough Undulating
RC20	3.3	2	C		2	3.3	Limestone	D	U	Y	60	67	68	14.1	14.10	67.5	3.09	3.54	Rough Undulating
RC21	3.3	1	C	3.3	1	3.3	Limestone	D	U	Y	95	66	67	18.205	18.21	66.5	4.12	4.68	Rough Undulating
RC21	5.2	2	C	5.2	2	5.2	Limestone	D	U	Y	75	66	66	17.075	17.08	66.0	3.92	4.44	Rough Undulating
RC24	3	1	C	3.1	1	3	Limestone	I	U	Y	21	11	11	5.8	5.80	12.4	37.65	20.11	Rough Stepped
RC24	5	2	C	5.2	2	5	Limestone	I	U	Y	19	18	18	7.21	7.21	20.3	17.48	11.65	Rough Undulating
RC26	2.8	1	C	2.8	1	2.8	Limestone	D	U	Y	88	68	68	17.98	17.98	68.0	3.89	4.47	Planar Rough
RC26	4.8	2	C	4.8	2	4.8	Limestone	D	U	Y	70	67	66	17.79	17.79	66.5	4.02	4.57	Planar Rough
RC26	5.9	3	C	5.9	3	5.9	Limestone	D	U	Y	43	67	66	15.73	15.73	66.5	3.56	4.04	Rough Undulating
RC26	6.9	4	C	6.9	4	6.9	Limestone	I	U	Y	55	51	67	15.81	15.81	66.0	3.63	4.12	Rough Undulating
RC26	7.3	5	C		5	7.3	Limestone	D	U	Y	52	67	67	16.4	16.40	67.0	3.65	4.17	Rough Undulating
RC26	8.7	6	C	8.7	6	8.7	Limestone	D	U	Y	75	66	67	17.745	17.75	66.5	4.01	4.56	Rough Undulating
RC26	9	7	C		7	9	Limestone	D	U	Y	73	68	67	17.71	17.71	67.5	3.89	4.45	Rough Undulating
RC28	5.1	1	C	5.4	1	5.1	Limestone	I	Per	Y	38	49	49	9.325	9.33	55.3	3.05	3.19	Rough Undulating
RC28	6.6	2	C	7.1	2	6.6	Limestone	I	Par	Y	18	41	41	12.115	12.12	46.3	5.66	5.47	Rough Undulating
RC29	2.7	1	C		1	2.7	Limestone	D	U	Y	74	68	67	22.05	22.05	67.5	4.84	5.54	Rough Undulating
RC29	7.1	2	C	7.1	2	7.1	Limestone	D	U	Y	47	66	67	15.345	15.35	66.5	3.47	3.95	Rough Undulating
RC29	8.5	3	C	8.5	3	8.5	Limestone	D	U	Y	61	68	67	14.865	14.87	67.5	3.26	3.73	Rough Undulating
RC29	8.7	4	C		4	8.7	Limestone	D	U	Y	54	67	67	14.175	14.18	67.0	3.16	3.60	Rough Undulating
RC30	0.8	1	C		1	0.8	Limestone	D	U	Y	93	68	67	17.8	17.80	67.5	3.91	4.47	Rough Undulating

Priority Geotechnical Limited

Point Load Test Results

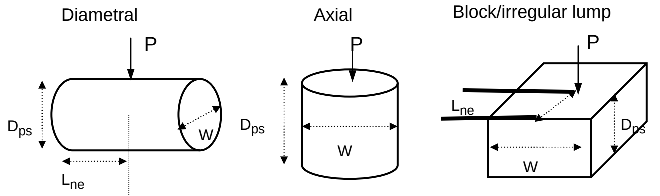
Project: **Dunkellin River**

Project No: P12012

Carried out by: DC

Test Type
D - Diametral, A - Axial, I - Irregular Lump
Direction (U = unknown or random)
Par - parallel to planes of weakness
Per - perpendicular to planes of weakness
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P

Machine Ram Area, cm^2



Borehole	Sample Top, m BGL	Sample Ref	Sample Type	Sample Base, m BGL	Specimen Ref	Specimen Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8		Failure Valid (Y/N)	Dimensions			Gauge reading, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
								Type (D, A, I)	Direction (Par/Per/U)		L mm	Dps, mm	W mm						
RC30	2.15	2	C		2	2.15	Limestone	D	U	Y	78	67	67	17.41	17.41	67.0	3.88	4.42	Rough Undulating
RC30	2.8	3	C	2.8	3	2.8	Limestone	D	U	Y	211	68	68	18.31	18.31	68.0	3.96	4.55	Rough Undulating
RC30	3.8	4	C	4.8	4	3.8	Limestone	D	Par	Y	23	63	63	5.865	5.87	63.0	1.48	1.64	Rough Undulating
RC30	4.8	5	C	5.8	5	4.8	Limestone	D	U	Y	123	63	63	12.55	12.55	63.0	3.16	3.51	Planar Rough
RC30	5.8	6	C	5.8	6	5.8	Limestone	D	U	Y	34	63	63	17.185	17.19	63.0	4.33	4.80	Rough Undulating
RC31	2.4	1	C	2.9	1	2.4	Limestone	D	U	Y	40	63	63	8.995	9.00	63.0	2.27	2.51	Rough Undulating
RC31	3.9	2	C	4	2	3.9	Limestone	A	U	Y		32	38	17.845	17.85	39.3	11.53	10.35	Planar Rough
RC31	6.9	3	C	7.3	3	6.9	Limestone	A	U	Y		31	18	11.255	11.26	26.7	15.84	11.94	Planar Rough
RC31	8.4	4	C	9.6	4	8.4	Limestone	D	U	Y	24	63	63	17.348	17.35	63.0	4.37	4.85	Rough Undulating
RC32	1.4	1	C	2.5	1	1.4	Limestone	A	U	Y		35	40	16.735	16.74	42.2	9.39	8.70	Planar Rough
RC32	2.9	2	C	3	2	2.9	Limestone	D	U	Y	24	63	63	19.3	19.30	63.0	4.86	5.40	Rough Undulating
RC32	4.4	3	C	5.65	3	4.4	Limestone	A	U	Y		30	43	18.615	18.62	40.5	11.33	10.31	Planar Rough
RC32	5.9	4	C	6.5	4	5.9	Limestone	D	U	Y	21	63	63	17.445	17.45	63.0	4.40	4.88	Rough Undulating
RC34	2.6	1	C	2.7	1	2.6	Limestone	I	U	Y	24	36	36	9.075	9.08	40.6	5.50	5.01	Rough Undulating
RC34	3.6	2	C	3.6	2	3.6	Limestone	I	U	Y	27	39	39	6.05	6.05	44.0	3.12	2.95	Rough Undulating
RC34	4.2	3	C	4.2	3	4.2	Limestone	A	Par	Y		29	62	2.605	2.61	47.8	1.14	1.12	Rough Undulating
RC34	4.8	4	C	4.9	4	4.8	Limestone	D	U	Y	42	63	63	9.995	10.00	63.0	2.52	2.79	Planar Smooth
RC34	5.65	5	C	6.3	5	5.65	Limestone	D	U	Y	35	63	63	14.985	14.99	63.0	3.78	4.19	Rough Undulating
RC37	3.7	1	C	5	1	3.7	Limestone	D	U	Y	35	70	70	14.95	14.95	70.0	3.05	3.55	Rough Undulating
RC37	5.2	2	C	5.9	2	5.2	Limestone	D	U	Y	24	70	70	13.89	13.89	70.0	2.83	3.30	Rough Undulating
RC37	6.7	3	C	7.6	3	6.7	Limestone	D	Par	Y	22	70	70	8.85	8.85	70.0	1.81	2.10	Rough Undulating

Priority Geotechnical Limited

Point Load Test Results

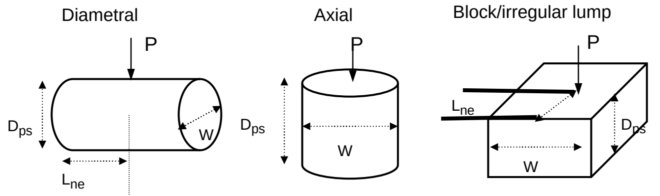
Project **Dunkellin River**

Project No P12012

Carried out by DC

Test Type
D - Diametral, A - Axial, I - Irregular Lump
Direction (U = unknown or random)
Par - parallel to planes of weakness
Per - perpendicular to planes of weakness
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P

Machine Ram Area, cm^2



Borehole	Sample Top, m BGL	Sample Ref	Sample Type	Sample Base, m BGL	Specimen Ref	Specimen Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8		Failure Valid (Y/N)	Dimensions			Gauge reading, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
								Type (D, A, I)	Direction (Par/Per/U)		L mm	Dps, mm	W mm						
RC39	1.9	1	C	2.2	1	1.9	Limestone	I	U	Y	21	38	38	12.69	12.69	42.9	6.90	6.44	Rough Undulating
RC39	2.9	2	C	3	2	2.9	Limestone	D	Per	Y	41	63	63	11.295	11.30	63.0	2.85	3.16	Planar Rough
RC39	3.9	3	C	4.7	3	3.9	Limestone	D	U	Y	70	63	63	24	24.00	63.0	6.05	6.71	Planar Rough
RC39	4.9	4	C	5.8	4	4.9	Limestone	D	U	Y	60	63	63	25	25.00	63.0	6.30	6.99	Rough Undulating
RC41	2.7	1	C	4.1	1	2.7	Limestone	D	U	Y	29	70	70	19.3	19.30	70.0	3.94	4.58	Rough Undulating
RC41	4.5	2	C	4.8	2	4.5	Limestone	D	U	Y	75	70	70	18.55	18.55	70.0	3.79	4.40	Rough Undulating
RC41	5.7	3	C	6	3	5.7	Limestone	A	U	Y		32	45	15.115	15.12	42.8	8.24	7.69	Rough Undulating
RC41	7.2	4	C	7.7	4	7.2	Limestone	D	U	Y	65	70	70	21.305	21.31	70.0	4.35	5.06	Rough Undulating
RC41	8.7	5	C	9.7	5	8.7	Limestone	D	U	Y	103	70	70	20.85	20.85	70.0	4.26	4.95	Rough Stepped
RC42	3.8	1	C	3.8	1	3.8	Limestone	I	Par	Y	25	34	34	16.25	16.25	38.4	11.04	9.80	Rough Undulating
RC42	4.1	2	C	4.6	2	4.1	Limestone	D	Per	Y	35	70	70	17.865	17.87	70.0	3.65	4.24	Planar Rough

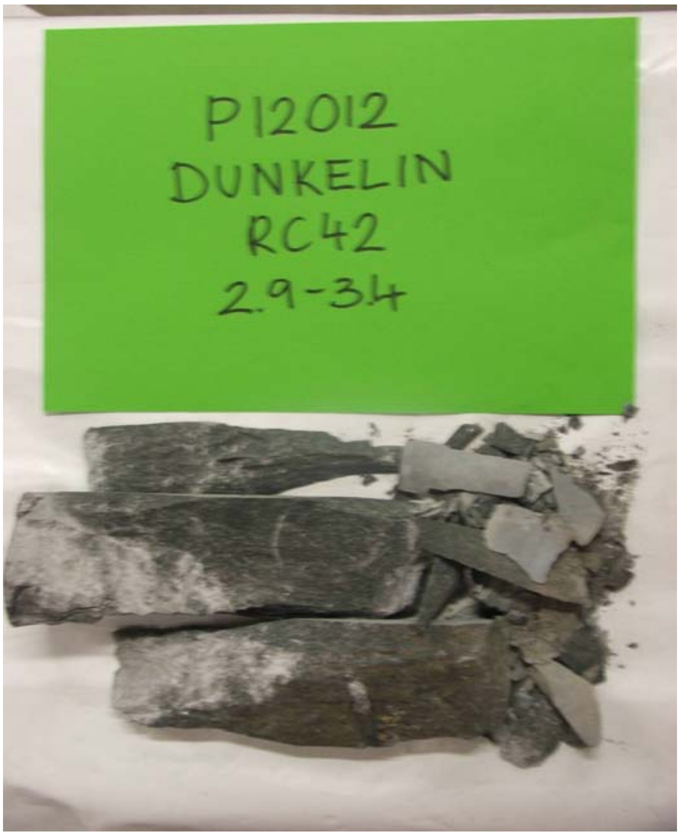
Unconfined Compressive Strength, UCS

Job Name **Dunkelin**
Job Number **P12012**

Borehole: **RC42**
Depth: **2.9-3.4** **m**
Rock Type **Limestone**

Bulk Density **2.70** **Mg/m^3**
Load at Failure, P **469.6** **kN**

Stress at Failure **103.57** **MPa**



Failure mode

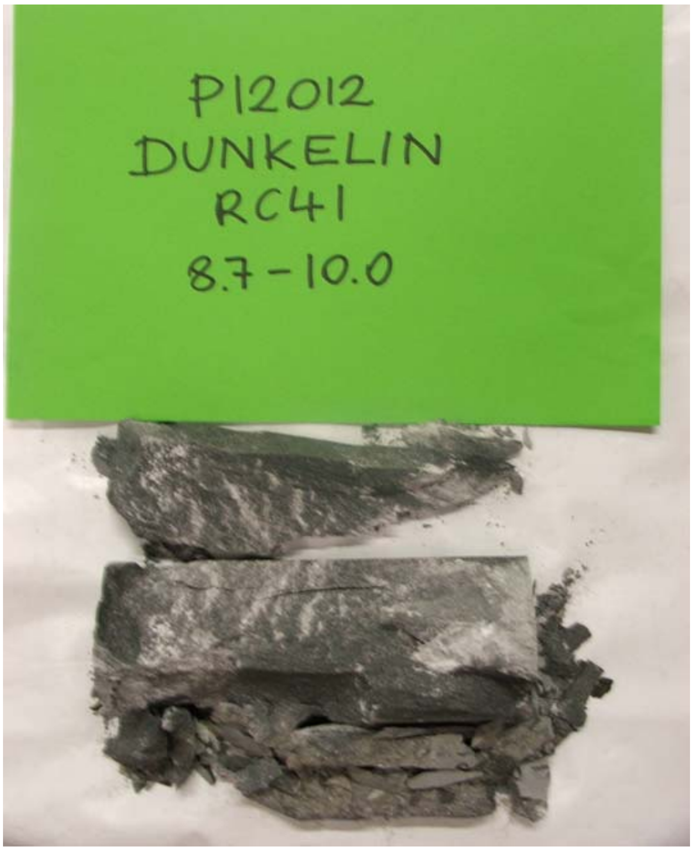
NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC41**	
Depth:	**8.7-10**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**422.4**	**kN**
Stress at Failure	**93.17**	**MPa**



Failure mode

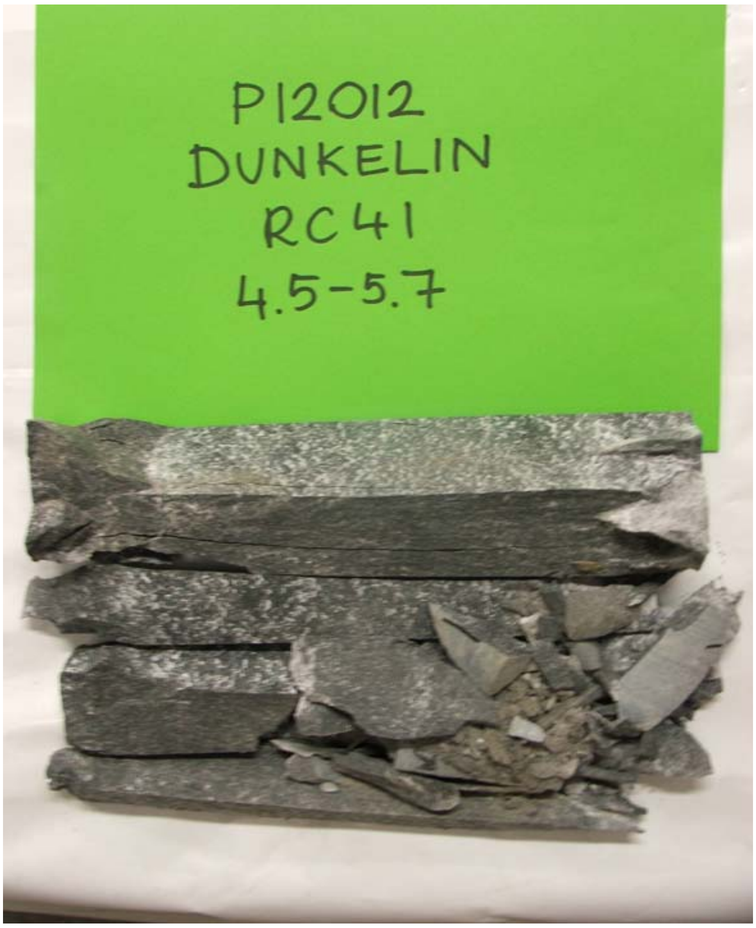
NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC41**	
Depth:	**4.5-5.7**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.69**	**Mg/m^3**
Load at Failure, P	**271.2**	**kN**
Stress at Failure	**59.87**	**MPa**



Failure mode

NOTES:

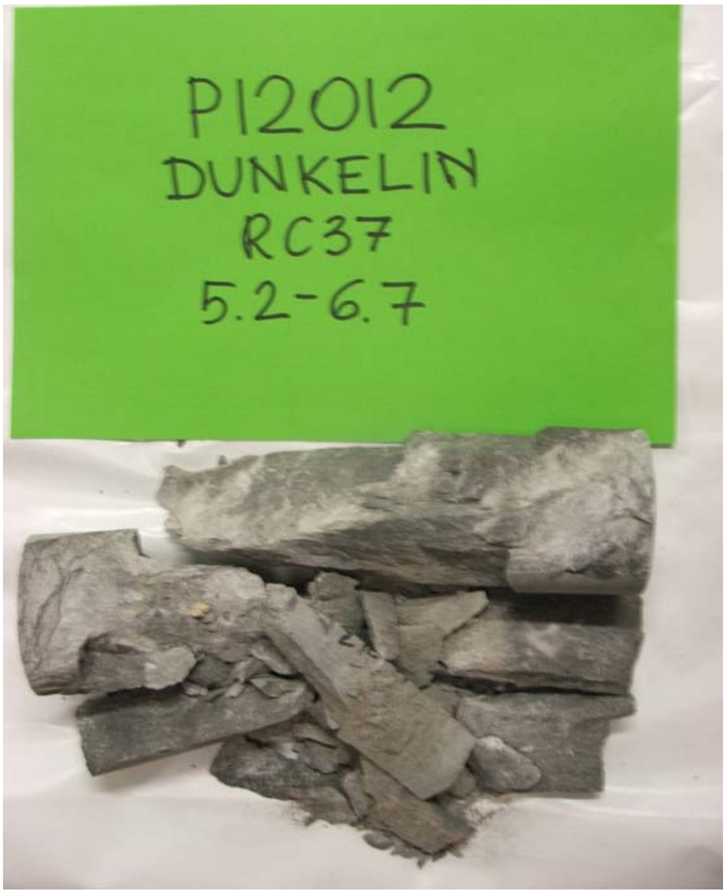
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC37**	
Depth:	**5.2-6.7**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.69**	**Mg/m^3**
Load at Failure, P	**366.6**	**kN**
Stress at Failure	**80.87**	**MPa**



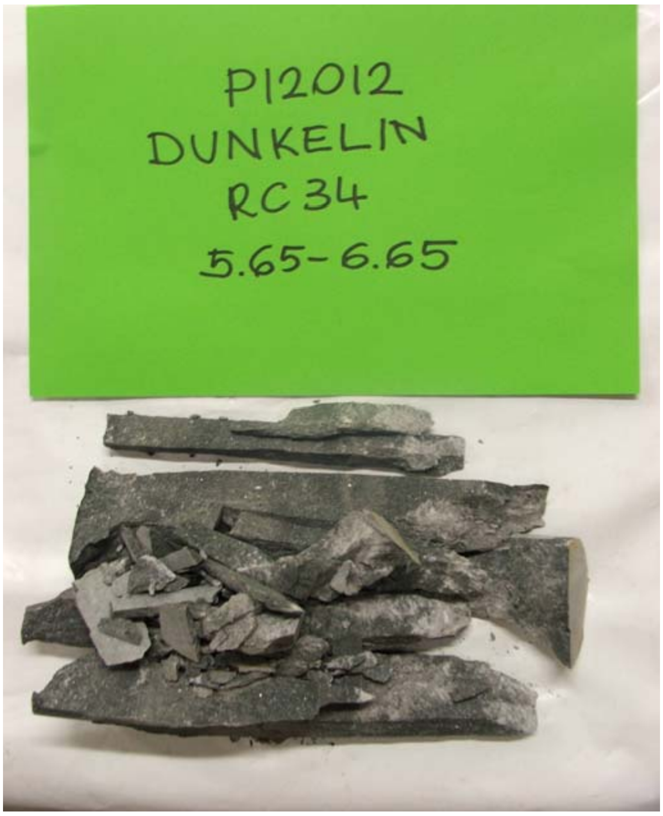
Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC34**	
Depth:	**5.65-6.65**	**m**
Rock Type	**Limestone**	
Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**263.11**	**kN**
Stress at Failure	**74.5**	**MPa**



Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC32**	
Depth:	**2.9-4.4**	**m**
Rock Type	**Limestone**	

Bulk Density	**1.24**	**Mg/m^3**
Load at Failure, P	**441.3**	**kN**
Stress at Failure	**121.54**	**MPa**

Failure mode

NOTES:

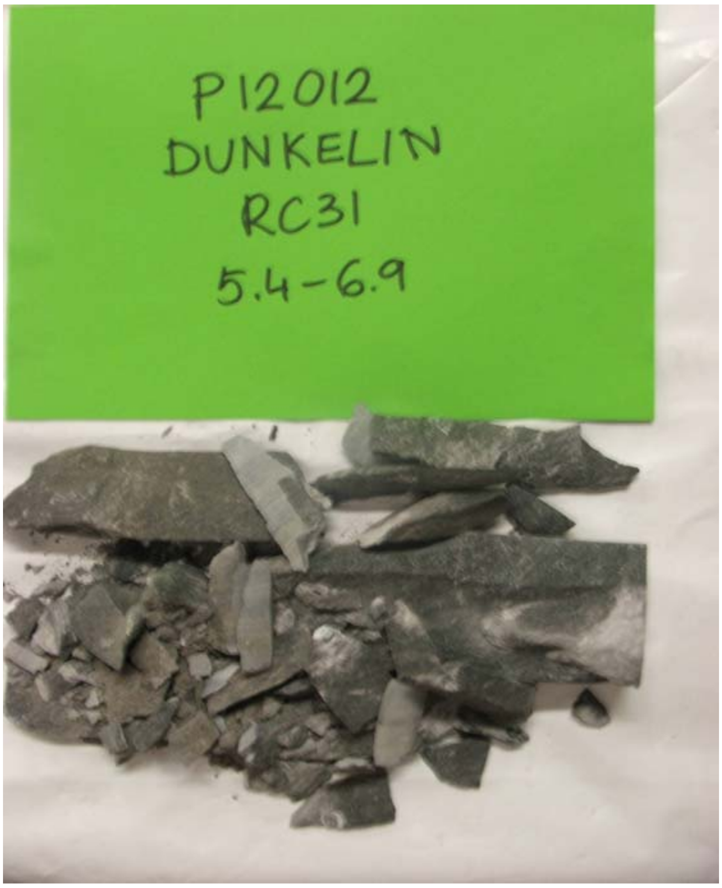
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC31**	
Depth:	**5.4-6.9**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.71**	**Mg/m^3**
Load at Failure, P	**361.7**	**kN**
Stress at Failure	**99.64**	**MPa**



Failure mode

NOTES:

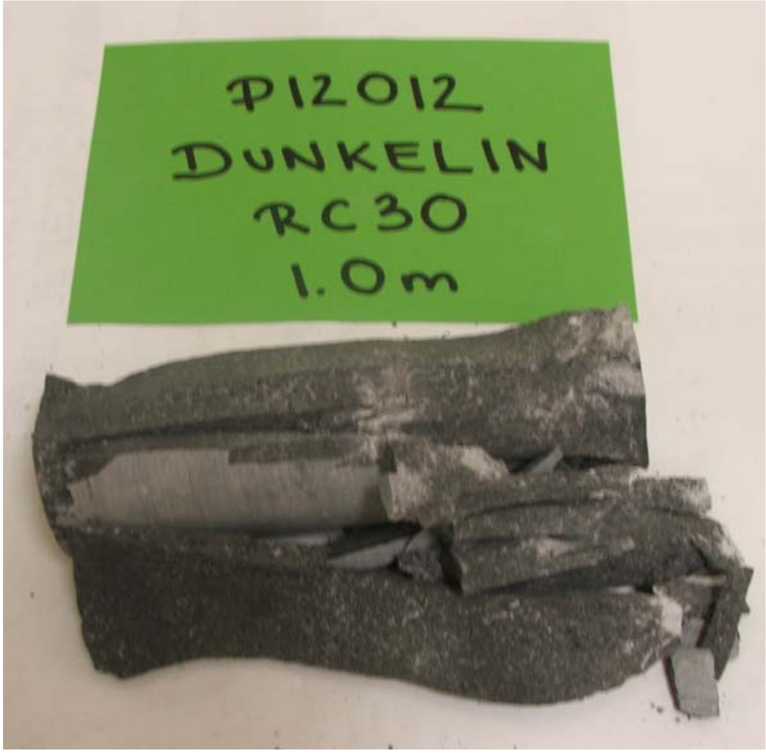
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC30**	
Depth:	**1**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**296.2**	**kN**
Stress at Failure	**81.54**	**MPa**



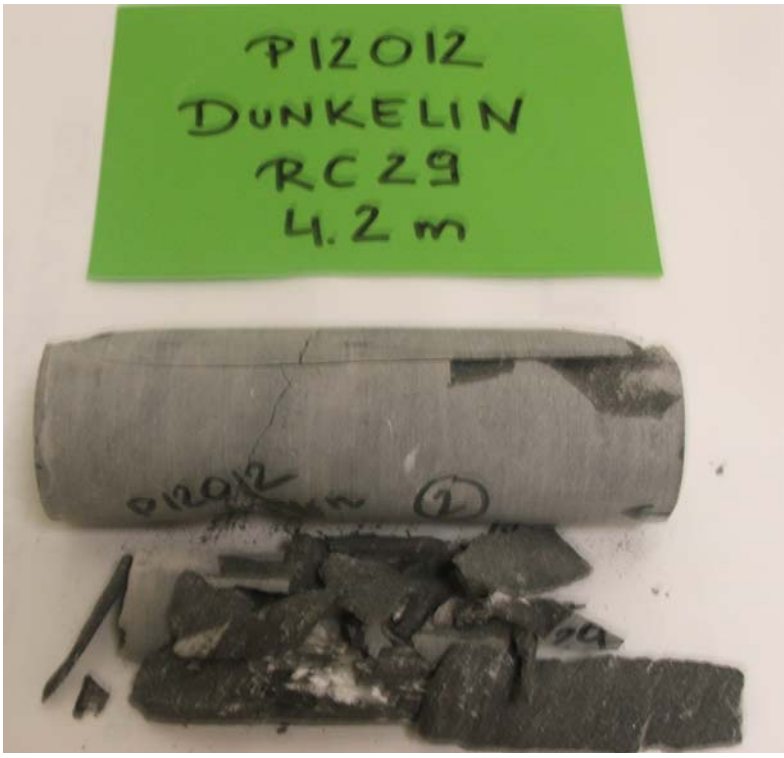
Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC29**	
Depth:	**4.2**	**m**
Rock Type	**Limestone**	
Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**318.1**	**kN**
Stress at Failure	**87.64**	**MPa**



Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC29**	
Depth:	**3.3**	**m**
Rock Type	**Limestone**	
Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**260.5**	**kN**
Stress at Failure	**71.74**	**MPa**

P12012
DUNKELIN
RC29
3.3m

Failure mode

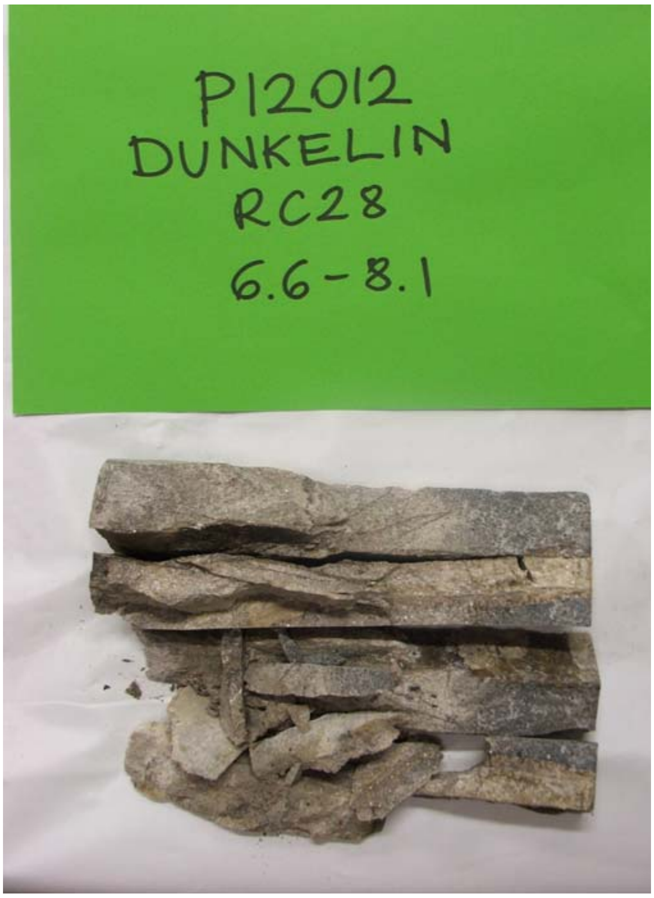
NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**
Borehole:	**RC28**
Depth:	**6.6-8.1** **m**
Rock Type	**Limestone**

Bulk Density	**2.71**	**Mg/m^3**
Load at Failure, P	**132.2**	**kN**
Stress at Failure	**36.43**	**MPa**



Failure mode

NOTES:

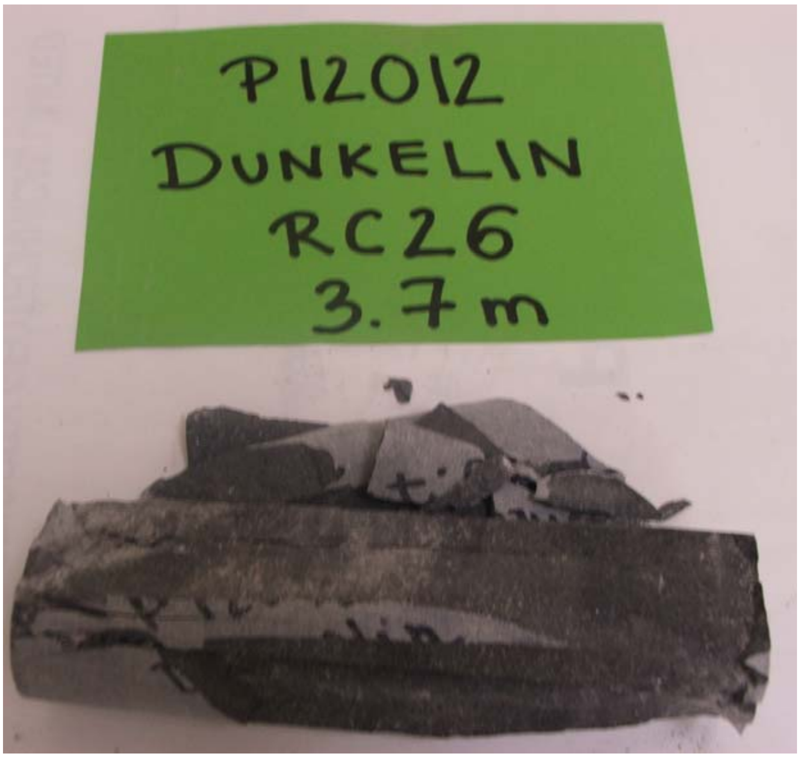
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC26**	
Depth:	**3.7**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.71**	**Mg/m^3**
Load at Failure, P	**279.9**	**kN**
Stress at Failure	**77.14**	**MPa**



Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC26**	
Depth:	**2**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**244.8**	**kN**
Stress at Failure	**67.44**	**MPa**

Failure mode

NOTES:

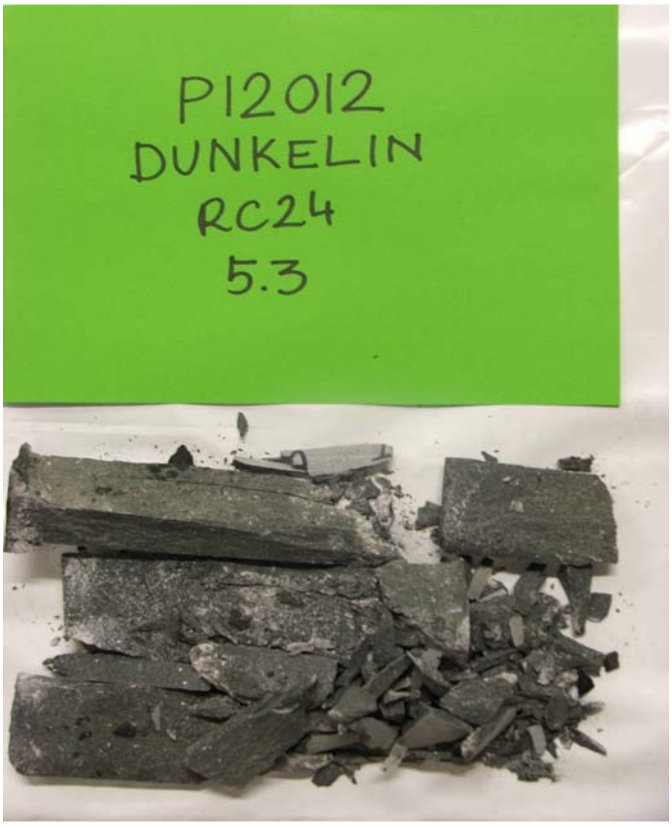
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC24**	
Depth:	**5.3**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.69**	**Mg/m^3**
Load at Failure, P	**195**	**kN**
Stress at Failure	**53.73**	**MPa**



Failure mode

NOTES:

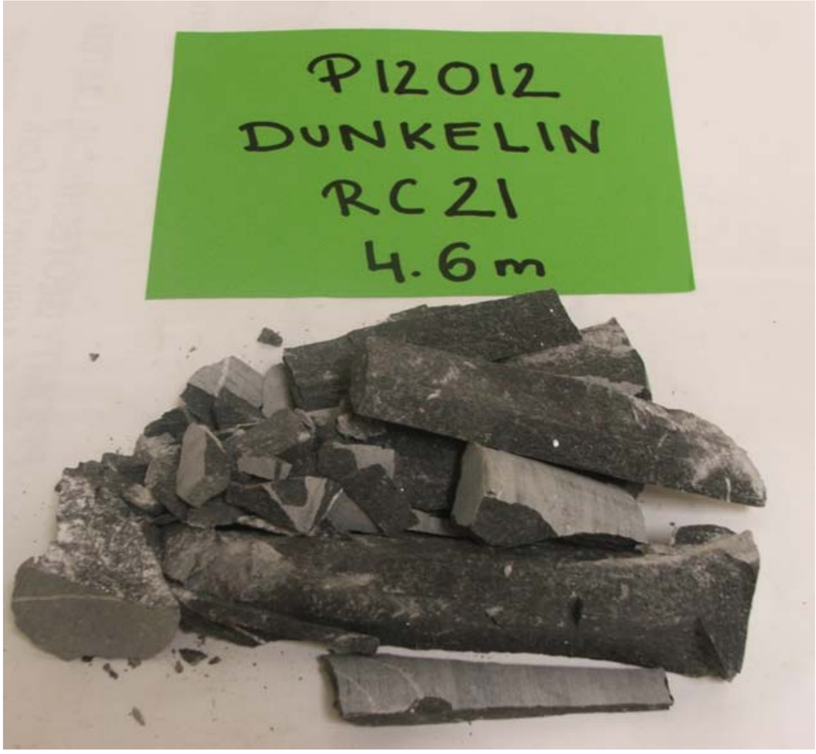
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC21**	
Depth:	**4.6**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**292.1**	**kN**
Stress at Failure	**82.95**	**MPa**



Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC20**	
Depth:	**0.9-2.4**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**332.5**	**kN**
Stress at Failure	**95.4**	**MPa**

Failure mode

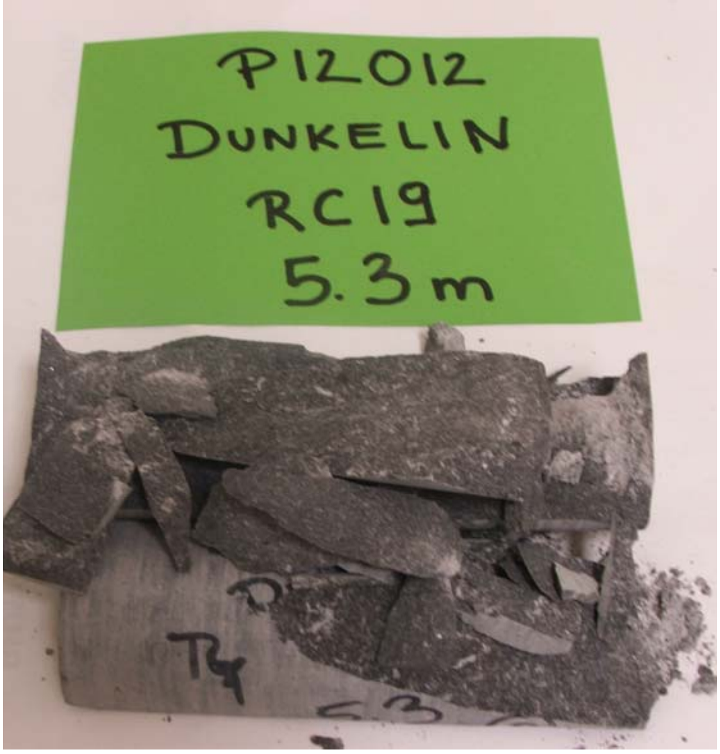
NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**
Borehole:	**RC19**
Depth:	**5.3 m**
Rock Type	**Limestone**

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**238.8**	**kN**
Stress at Failure	**67.75**	**MPa**



Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**
Borehole:	**RC18**
Depth:	**4.9** m
Rock Type	**Limestone**

Bulk Density	**2.71**	**Mg/m^3**
Load at Failure, P	**260**	**kN**
Stress at Failure	**71.64**	**MPa**

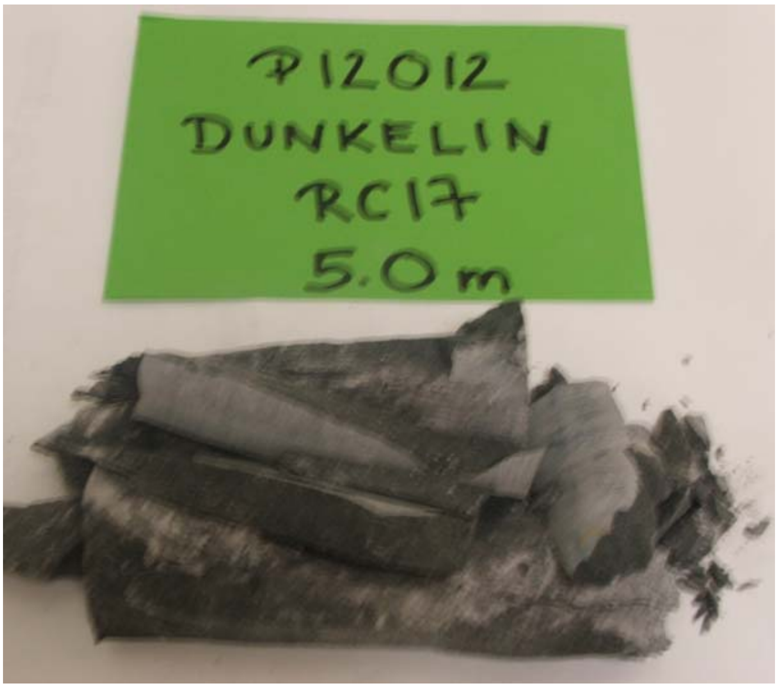
Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	
Borehole:	**RC17**	
Depth:	**5**	**m**
Rock Type	**Limestone**	
Bulk Density	**2.71**	**Mg/m^3**
Load at Failure, P	**290.4**	**kN**
Stress at Failure	**82.45**	**MPa**



Failure mode

NOTES:

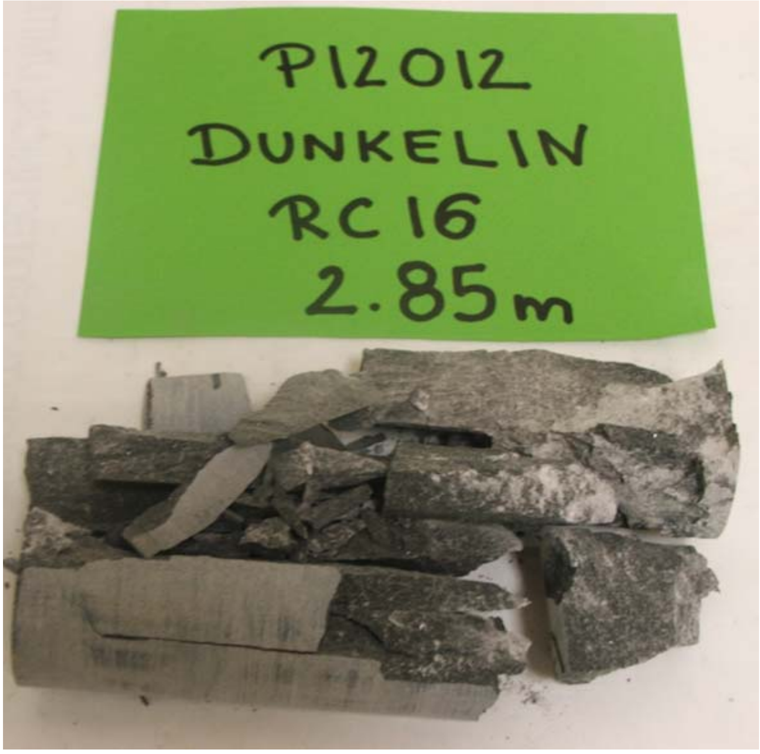
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC16**	
Depth:	**2.85**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**345.4**	**kN**
Stress at Failure	**95.14**	**MPa**



Failure mode

NOTES:

Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC15**	
Depth:	**3.1**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**306.6**	**kN**
Stress at Failure	**84.44**	**MPa**

Failure mode

NOTES:

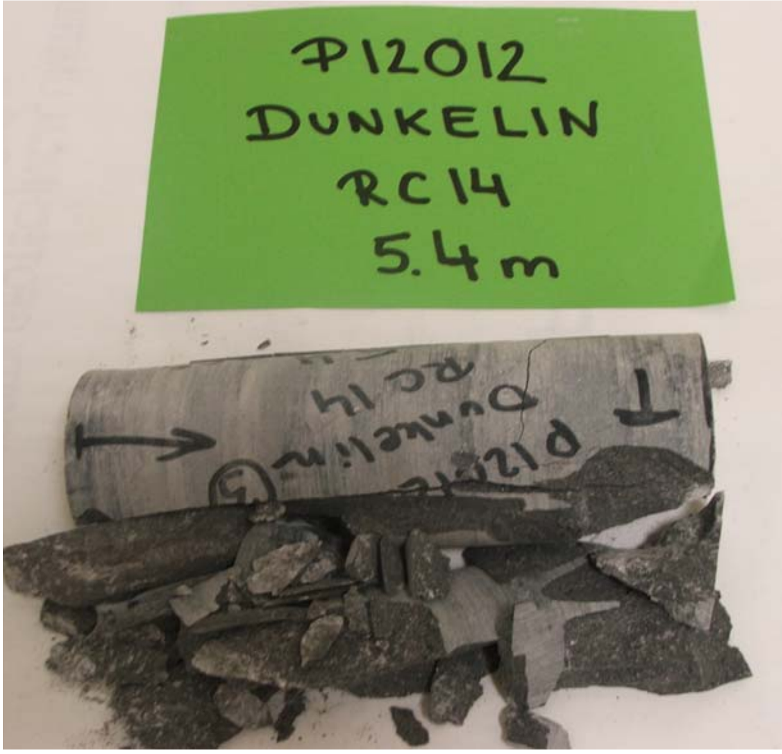
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC14**	
Depth:	**5.4**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.71**	**Mg/m^3**
Load at Failure, P	**190.8**	**kN**
Stress at Failure	**52.53**	**MPa**



Failure mode

NOTES:

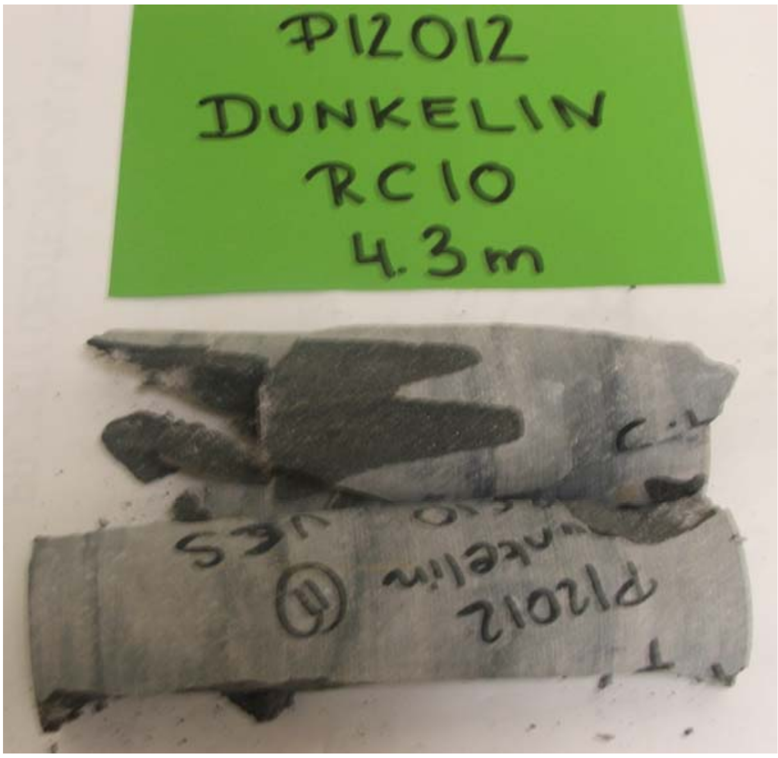
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**	
Job Number	**P12012**	

Borehole:	**RC10**	
Depth:	**4.3**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.70**	**Mg/m^3**
Load at Failure, P	**232.6**	**kN**
Stress at Failure	**66.05**	**MPa**



Failure mode

NOTES:

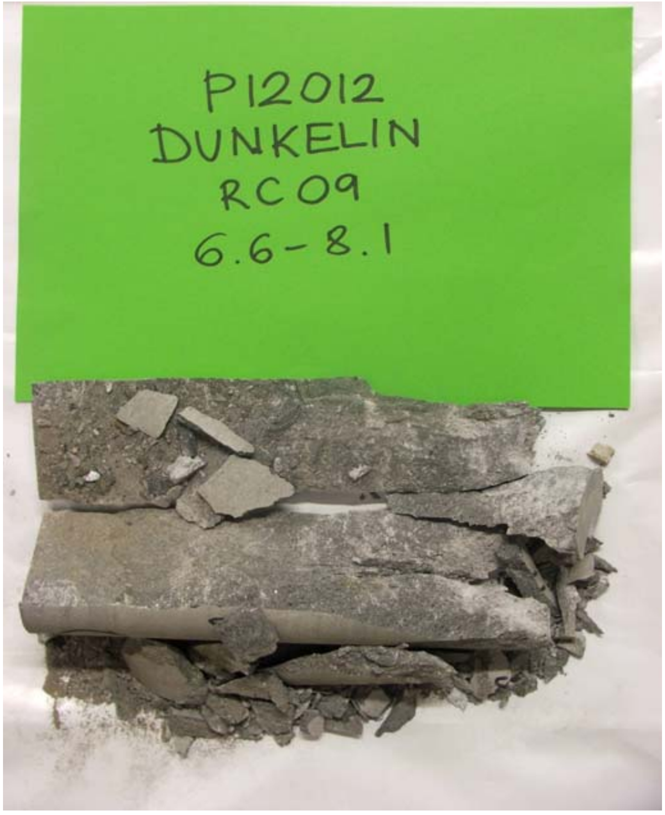
Operator	AD
Checked	CK

Unconfined Compressive Strength, UCS

Job Name	**Dunkelin**
Job Number	**P12012**

Borehole:	**RC09**	
Depth:	**6.6-8.1**	**m**
Rock Type	**Limestone**	

Bulk Density	**2.67**	**Mg/m^3**
Load at Failure, P	**240.9**	**kN**
Stress at Failure	**66.34**	**MPa**



Failure mode

NOTES:

Operator	AD
Checked	CK