YSGOL GYFUN GYMRAEG, GLANTAF

CARDIFF, WALES

SOIL RESOURCE SURVEY & RESOURCE PLAN

Prepared on behalf of:

CARDIFF COUNCIL

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1.0 INTRODUCTION

Tim O'Hare Associates (TOHA) LLP was commissioned by Cardiff Council to undertake a Soil Resource Survey and provide a Soil Resource Plan at the Ysgol Gyfun Gymraeg Glantaf school site in Cardiff, Wales.

The authority to carry out the work was confirmed via receipt of the Purchase Order (*PO No. 4501865103*) from Clare Jones (Cardiff Council), dated 15/09/2023.

1.1 Purpose

It is understood that the development is to comprise two new building extensions on the Ysgol Gyfun Gymraeg Glantaf site, along with the reworking of the existing car park, expansion of some areas of hardstanding, and construction of new pedestrian footpath infrastructure. A total of 3 No. areas of existing soft landscape are to be affected, covering approximately 0.56ha in total.

From the supplied plans the building improvement works will be complemented by a new soft landscape scheme, to include amenity grass with a narrow band of wildflower seeding around the southern boundaries, together with the creation of a sensory garden with ornamental shrubs and herbaceous planting adjacent to an existing gym and school buildings. In addition, some rain garden / SuDS are proposed adjacent to several of the paths / wetpour areas.

There is currently no information available on the horticultural quality of the soil resources within the 3 No. areas of existing soft landscape to be disturbed by the scheme. As such, a Soil Resource Survey (SRS) is required to identify the soil resources present across the surveyed areas, and to determine their potential for re-use for soft landscaping. The report also provides soil management advice, in the form of the Soil Resource Plan chapter within this report.

1.2 Actions

TOHA has evaluated the quality and suitability of the soils for general landscape purposes by a combination of desk study review, on-site investigation and laboratory analysis.

This report issues the findings of the soil resource survey for the Ysgol Gyfun Gymraeg, Glantaf, site in Cardiff, including the site observations and soil descriptions, results and interpretation of all analyses, discussion on the soil's quality and its suitability for future landscape construction.

2.0 DESK STUDY REVIEW

2.1 Documents Reviewed

Prior to commencing the site investigation work, the following documents were reviewed:

- *Soil Map of England and Wales - Sheet 2 – Wales (1:250,000);*
- *British Geological Survey Website (Geology of Britain);*
- *Stride Treglown – Ysgol Glantaf SRB, Bridge Road, Cardiff CF14 2JL – Proposed Concept Site Arrangement – Drawing No. 155452-STL-XX-00-DR-A-XXXX-10001 – Rev. PL_PL01, dated 16/12/2022;*
- *Stride Treglown – Ysgol Glantaf SRB, Bridge Road, Cardiff CF14 2JL – Landscape General Arrangement Plan – Drawing No. GSRV-STL-XX-XX-DR-L-09001 – Rev. S4_932, dated 28/09/2023;*
- *Stride Treglown – Ysgol Glantaf, Future Dining Provision – Dining Extension - Option 1 – Drawing No. 155452-STL-ZZ-00-DR-A-SK102 – Rev. S2_P01, 12/05/2023.*

2.2 Summary of Findings

Geology and Soils

The British Geological Survey 1:50,000 Solid and Drift map indicates that the site is underlain by *Mercia Mudstone Group (marginal fancies) - Conglomorate*, which comprises sedimentary bedrock formed approximately 252 to 201 million years ago during the Triassic Period. The formation is variable, but comprises '*typically of conglomerate and/or breccia with clasts derived locally from rocks lying immediately below the unconformable base of these deposits. The matrix generally consists of finer-grained rock fragments or, less commonly, siltstone, sandstone or micritic limestone'.*

Superficial deposits of *Alluvium – Clay, silt sand and gravel,* which comprises superficial deposits of unconsolidated detrital material deposited by a river, stream or other body of running water, during the last 11-12,000 years of the Quaternary.

The Soil Map of England and Wales classifies the soils within the survey area as: *Unsurveyed (Urban)*. Soils within urban and industrial areas are potentially subject to a wide range of natural and anthropologic influences and impacts, and can include building materials and soils which have been imported from outside of the subject site. In horticultural terms, this can result in variable soil conditions with regards to soil chemistry, fertility status and physical condition, including compaction and the presence of foreign matter within the soil matrix.

The LandIS Soilscapes information indicates that most of the site lies within a zone of slightly acid loamy and clayey soils with impeded drainage.

Proposed Landscape Uses

The landscape design (*Stride Treglown – Landscape General Arrangement Plan*) comprises a mix of planting around the proposed new buildings / infrastructure. Amenity grass is to be retained / reinstated in the southern portion of the site, dissected by a new footpath. Trees planting is proposed along the northern and western edge of the field. Along the proposed new access pathway along the western boundary, a band of wildflowers are proposed, while to the north, there is to be ornamental / herbaceous planting has been supplied near the new car park and service yard. A new area of sensory and ornamental planting is also proposed in the north-east of the area to be redeveloped. Finally, new SuDS are to be installed around the wetpour area in the north-east and along the pathway edge along the north of the proposed grass field / 2G pitch. The current landscape proposals do not include formal grass sports pitches or re-use of the site-won soils within the wider school playing field.

In the west of the site, an extension to the existing kitchen and dining facilities is proposed. No new planting is to be undertaken in this area.

Based on this information, planting on the scheme is set to include the following planting types:

- Tree planting;
- Ornamental shrub and herbaceous planting;
- Hedge planting;
- Sensory planting;
- Rain garden / SuDS
- Amenity grass;
- Wildflower seeding.

These landscape environments will require a number of soil types (varying in terms of drainage characteristics and fertility status) in order to meet their demands. The soil requirements of each landscape type are considered below.

New Trees

Trees that are supplied with a rootball are usually the most demanding planting type. Good, aeration and drainage around the rootball, as well as moderate to high fertility status are critical at planting and during the establishment period. Without these properties, trees will very quickly suffer and possibly die during their first few growing seasons after planting.

Given their demanding nature, all rootballed trees should be planted with well-aerated and free-draining soils to the full rooting depth (normally considered to be 1.0m).

Containerised Specimens

Containerised stock, such as ornamental shrubs, herbaceous and hedge planting, is normally planted with shallower depths of soil than trees and the plants themselves can be variable in their specific soil requirements. Container grown shrubs in particular are not typically tolerant of adverse soils conditions and would normally require soils which are fertile, well drained and aerated.

Bare Root Trees and Transplants

Bare root specimens, such as native hedging, are considered to be less demanding than containerised or rootballed stock. As such, a broader range of soil types may be re-used for these planting types provided the species selected do not exhibit any specific preferences. The soils must possess a satisfactory structure to support plant growth. The topsoil and subsoil should have suitable drainage characteristics for the selected species.

Amenity Grass

Amenity grass can typically be established on a wide range of soil types and on relatively shallow soil depths. The topsoil and subsoil should possess adequate soil structure and no excessive compaction to allow sufficient infiltration, drainage and aeration. A low stone content, without medium or large sized stones, is normally required for seeded grass. High fertility, especially of nitrogen and potassium, is usually required to promote a healthy, dense grass sward, especially in areas of higher use.

Grass in high use areas needs soil that is resistant to wear and compaction and has good infiltration and drainage capacities.

Wildflower Grassland

Generally, wildflower mixes should be established on soils that are not too fertile and do not have a problem with perennial weeds.

Low phosphorus levels are particularly important to encourage species diversity and prevent aggressive species, such as nettles and rye grass, from dominating the sward. Appropriate management practices (e.g. periodic mowing and collection of cuttings to prevent seed head development) may be necessary to maximise diversity in the sward.

Rain Gardens / SuDS

Details concerning the required functioning and properties of the back-fill media for the proposed Rain Gardens and SuDS have not be provided for this review.

Typically, the back-fill should allow drainage water to pass through it at a suitable rate so that the surface of the Rain Garden / SuDs does not become waterlogged. The back-fill should also perform the role of 'topsoil' to support plant growth. This material will need to demonstrate acceptable physical performances including a rapid saturated hydraulic conductivity and high total porosity. Satisfactory horticultural properties (soil reaction, organic matter content and major plant nutrients) are also essential.

Additional drainage media may be required to complete the construction of these planting environments and link it to any further drainage infrastructure.

3.0 SITE INVESTIGATION

3.1 Site Visit

The site visit took place on 28th September 2023, during a period of overcast weather. The site was located in north-west Cardiff.

3.2 Site Observations

Three areas of existing soft landscape were surveyed, which for the purpose of the investigation are referred to as Area 1, Area 2 and Area 3.

Area 1 comprised an area of amenity grass with a couple of trees located in the west of the site, with an embankment sloping up towards the road to the west of the site. Area 2 comprised a large flat area of amenity grass, while Area 3 comprised some areas of amenity grass adjacent to a car park, with some established hedgerows and a large tree.

At the time of our visit, soil across the survey areas remained in-situ.

Plate 1: View north from TH2 of Area 1, showing grass area with embankment running up towards road

Plate 2: View north across Area 2 from near TH6, showing flat grass field

Plate 3: View of Area 3 near TH8, showing small grass area besides hedgerow

Plate 4: View of Area 3 near TH10, showing grass area with established tree

3.3 Soil Conditions

The soils were examined by constructing a total of 10 No. hand-dug trial holes (TH) at representative locations across the survey areas. The location of these sample locations is indicated in **Appendix 1**.

All trial holes were constructed a combination of spade and hand driven soil auger, to a maximum depth of 1.0m below ground level (bgl).

At each trial hole, the soils were examined with reference to the Soil Survey Field Handbook. Important physical soil characteristics were recorded, including texture, structure, compaction, waterlogging, anaerobism, topsoil depths, stone content and the presence of deleterious materials. At the same time, representative soil samples were taken for laboratory analysis.

3.4 Soil Descriptions

The topsoil across the survey areas was largely consistent comprising a heavy textured topsoil. However, the underlying soils were variable comprising of subsoil and/or made ground layers. Summary trial hole logs are presented in **Appendix 2**.

At the majority of trial holes, the *Topsoil* was underlain by *Subsoil*. However within Area 1, around TH1, the *Topsoil* was present in an embankment with no underlying materials. At TH2 and TH3, no *Subsoil* layer was noted, with *Made Ground* underlying the *Topsoil* and extending down to the maximum sampled depth, while at TH9 and TH10, a band of *Made Ground* was present underlying the *Topsoil* and overlying the *Subsoil*. These conditions are summarised below.

Topsoil GL – 200-620mm Average: 380mm	Dark greyish brown (Munsell Colour 10YR 4/2), slightly moist, very slightly plastic, non-calcareous medium CLAY LOAM with a well developed, fine to coarse sub-angular blocky structure. Slightly stony, including sub-rounded stones up to 80mm in size. Occasional fine brick fragments.
Made Ground (where present) 200/280 – 410/580mm Found at TH2, TH3, TH9 and TH10.	Reddish brown (Munsell Colour 5YR 4/3) slightly moist to wet, friable, moderately to very calcareous SANDY CLAY LOAM. Moderately to very stony, typically comprising smaller stones (<20mm), but with occasional larger stones up to 100mm in size. Common intermixed fine fragments of deleterious material. Progress restricted at TH2 at 410mm due to solid obstruction within the soil.
Subsoil 280/620 – 1000mm Found at all TH locations, with the exception of TH2 and TH3	Brownish yellow (Munsell Colour 10YR 6/6) slightly moist to moist, friable, non-calcareous heavy CLAY LOAM. Virtually stone-free. Occasional lenses of sand, particularly at TH6.

Plate 5: Typical soil profile

Plate 6: *Topsoil* arisings (TH2)

Plate 7: *Topsoil* arisings (TH5)

Plate 8: *Made Ground* observed at TH10

Plate 7: *Subsoil* arisings

Plate 8: Auger arisings (TH9), showing intermixed material and fragments of foreign matter within *Made Ground*

3.5 Topsoil Depths

The following *Topsoil* depths (mm) were recorded during our survey:

Table 1: Topsoil Depths

Trial Hole Ref.	Topsoil Depth (mm)	Trial Hole Ref.	Topsoil Depth (mm)
TH1	800*	TH6	500
TH2	280	TH7	350
TH3	350	TH8	485
TH4	310	TH9	200
TH5	350	TH10	200
Average Depth		**380**	

* Trial hole located on perimeter embankment. Subsoil/made ground not reached.

4.0 LABORATORY ANALYSIS

4.1 Analytical Schedule

Representative samples of the *Topsoil, Subsoil* and *Made Ground* from across the surveyed areas were submitted to the laboratory for analysis. The samples were analysed in accordance with the following schedule:

- particle size analysis (clay, silt, sand);
- stone content (2-20mm, 20-50mm, >50mm);
- pH value;
- electrical conductivity values;
- major plant nutrients - N, P, K, Mg;
- organic matter content;
- C:N ratio.

The results are presented on the Certificates of Analyses in **Appendix 3** and an interpretation of the results is given below.

4.2 Results of Analysis

Particle Size Analysis

The *Topsoil* and *Subsoil* samples fell into the heavy clay loam texture class. Soils such as these usually have good water and nutrient retention capacities, but they tend to be slow-draining and can suffer from seasonal waterlogging following periods of prolonged or heavy rainfall. They are also prone to structural degradation and compaction during handling, and especially when plastic in consistency Any damage to the structural condition of the soil can further reduce its drainage and aeration properties.

This texture class may be considered suitable for more robust landscape applications, including hardy trees and shrubs and amenity grass, provided the physical condition of the soil is satisfactory and provided species tolerant of moisture retentive, heavy soil are selected. The soil would not be ideally suited to more demanding planting environments or plant species that require or prefer light or free-draining soil. In addition, smaller plant stock, such as whips and transplants, would be more suited than containerised or rootballed stock, as they tend to be more tolerant of adverse soil conditions.

The *Made Ground* samples fell into the sandy clay loam texture class, which is usually considered suitable for general landscape applications provided the soil's physical condition is satisfactory. Such soils usually have good water and nutrient retention capacities, but they are also prone to structural degradation and compaction during handling, and especially when plastic in consistency. Any damage to the structural condition of this soil is likely to reduce its drainage and aeration properties.

Stone Content

The stone contents of the *Topsoil* and *Subsoil* samples were low and, as such, stones are unlikely to constitute a significant limitation for general landscape purposes.

The *Made Ground* samples were moderately high, and, as such, stones are unlikely to constitute a limitation for planting purposes. For amenity grass areas, it would be advisable to reduce the stone content, and in particular the larger stones, for example by mechanically raking, picking, burying and/or screening.

Please note that larger stones (>50mm) recorded during the visual examination of the soil were not included within samples submitted for laboratory analysis.

pH and Electrical Conductivity

The *Topsoil* samples were found to be slightly acid to slightly alkaline in reaction (pH 6.0 – 7.5). The *Subsoil* samples were found to be slightly to strongly alkaline in reaction (pH 7.1 – 8.0), while the *Made Ground* samples were found to be strongly alkaline in reaction (pH 8.3).

The electrical conductivity (salinity) values of all the samples were low, which indicates that soluble salts were not present at levels that would be harmful to plants.

Organic Matter and Nutrient Status

The *Topsoil* and *Made Ground* samples were adequately supplied with organic matter, total nitrogen and extractable magnesium, with deficiencies in extractable phosphorus and extractable potassium.

The C:N ratios of these samples would be considered suitable for general landscaping.

The organic matter content of the *Subsoil* was low, and would be considered acceptable for subsoil for general landscape purposes.

5.0 DISCUSSION

It is understood that the development comprises the construction of a building extension to the existing school, alongside creation of a 2G pitch, in addition to associated pedestrian infrastructure. This is to be supplemented by the creation of some new landscape areas, with tree, shrub and herbaceous planting, wildflower and amenity grass seeding, and creation of a SuDS system.

5.1 Summary of Findings

The soil resources from the surveyed areas consisted of a reasonably consistent in-situ *Topsoil* and *Subsoil*, with *Made Ground* also identified at TH2, Th3, TH9 and TH10.

Topsoil

The *Topsoil* may be described as a non-saline, slightly acid to slightly alkaline, non-calcareous HEAVY CLAY LOAM, with a moderately developed soil structure. Soils were slightly stony, including stones up to 80mm in size. The topsoil contained adequate levels of organic matter, total nitrogen and extractable magnesium, with deficiencies in extractable phosphorus and extractable potassium.

Subsoil

The *Subsoil* may be described as non-saline, slightly to strongly alkaline, non-calcareous HEAVY CLAY LOAM with a low organic matter content and low stone content.

Made Ground

The *Made Ground* may be described as non-saline, strongly alkaline, moderately to very calcareous SANDY CLAY LOAM, with a moderate to high organic matter content and a moderate to high proportion of stones / deleterious materials.

5.2 Soil Suitability

There are several properties that may restrict the potential for re-use of the soils for landscaping. These are outlined below.

Physical Properties

Soil Texture

The *Topsoil* and *Subsoil* would be considered to be heavy in texture. Soils such as these have inherent poor physical properties (e.g. low sand content, moisture retentive, with reduced aeration and drainage performances) and as such, their potential for re-use is limited. This is mostly associated with their susceptibility to structural degradation/compaction during handling. Due to their poor drainage characteristics and high risk of seasonal waterlogging, only hardy species tolerant of moisture-retentive soils should also be considered.

Their suitability for use will also be dependent on how well their soil structure is preserved during the bulk earthworks and subsequent soiling works. This normally requires programming the works (eg. soil stripping, stockpiling, respreading, cultivation) during the summer months and when the soils are non-plastic (friable) in consistency (see *Section 5.9*).

The soils would only be considered suitable for more robust landscape environments, such as native bare-root stock/hedging, low foot-fall amenity grass areas, and biodiverse habitats (eg. wildflower grassland), provided that the physical condition of the soil is adequate, and provided plant species / seed mixes tolerant of heavy, moisture retentive soils are selected.

The soils would not be considered suitable for more demanding planting types (e.g. semi-mature trees and high footfall amenity grass areas) and species that require well drained soils would not be ideally suited to the site soils.

Stone Treatment

The *Topsoil* was slightly to moderately stony, including stones up to 80mm in size. This should not restrict the re-use potential of the topsoil for most landscape purposes, but it may be prudent to reduce the proportion of larger stones, for example by raking, picking or burying where the topsoil is used for amenity grass and wildflower seeding.

The stone content of the *Subsoil* was low and, as such, should not restrict the use of these subsoils for landscape purposes.

Chemical Properties

Soil Fertility Levels

The *Topsoil* had deficiencies in both extractable phosphorus and extractable magnesium. These deficiencies should be remedied prior to planting (except where the topsoil is to be re-used for wildflower seeding – see *Section 5.5*).

pH Levels

The *Topsoil* and *Subsoil* were found to be slightly acid to slightly alkaline in reaction. This pH range would be considered suitable for general landscape purposes, provided species with a wide pH tolerance or those known to prefer alkaline soils are selected for planting, turfing and seeding.

Made Ground

The *Made Ground* would be considered to have a lower potential for re-use than the site *Topsoil* and *Subsoil,* on account of the moderate to high stone content, proportion of deleterious material, and high alkalinity / calcium carbonate content. As such, where possible, it is advised that the *Topsoil* and *Subsoil* are re-used where possible.

Should additional soil resources be required, the *Made Ground* identified around TH9 and TH10 only may have potential for use as subsoil for soft landscaping, provided the physical condition of the soil is satisfactory and species tolerant of strongly alkaline, calcareous soils are selected.

The *Made Ground* identified around TH2 and TH3 would not be considered suitable for re-use for landscaping, on account of the high proportion of stones / deleterious material and low proportion of 'fines'.

5.3 Rootballed Tree Planting and Land Drainage

The soils would not be considered suitable as backfill for rootballed tree pit planting due to their heavy texture. It is recommended that an appropriate free-draining sandy topsoil and subsoil is used to backfill tree pits.

Furthermore, there is a risk of tree pits acting as sumps for surface draining water. To avoid this, appropriate modifications should be incorporated into their design. This may include mounding around trees or groups of trees or installing soakage layers / positive drainage as necessary / feasible.

Drainage assistance may also be required in areas where surface draining water may collect, e.g. at the toe of slopes or alongside pathways. It should be noted that positive drainage will require a suitable outfall.

5.4 Amenity Grass

Foot traffic can be damaging to soil structure and restrict important functions, including aeration, and drainage. The texture of the topsoil would be considered suitable for areas of amenity grass anticipated to receive low to moderate levels of foot traffic. On-going maintenance is also likely to be required to maintain soil aeration and sward establishment.

The heavy texture of the *Topsoil* is not well suited to amenity grass anticipated to receive high levels of foot traffic. Whereby, the physical condition of the topsoil should be expected to be degraded (smearing and compaction) if subjected to high rates of usage, particularly when moist / wet and plastic in consistency. This smearing can effectively seal the surface of the soil and reduces infiltration, percolation drainage and aeration capabilities through the soil profile. Such conditions are unfavourable for root growth and would subject the grass to significant stress. Continual or intensive use when wet is likely to damage/destroy grass cover, further compounding the problem of poor aeration and impeded infiltration.

5.5 Wildflower Seeding

With regard to species-rich wildflower grassland establishment, the overall fertility status of the *Topsoil* across most of the surveyed area was low. Plant available phosphorus is the key nutrient when considering the fertility status of soil in relation to species-rich grassland establishment. Whereby, infertile soil is required to prevent domination of the sward by grasses and aggressive weeds such as broad leaved dock (Rumex obtusifolius) and stinging nettle (Urtica diocia).

The overall fertility status of the *Topsoil*, containing low levels of extractable phosphorus, is considered to be low. Furthermore, the overall balance of fertility with generally satisfactory levels of organic matter (linked to biological activity) and total nitrogen is currently ideal for seed germination and establishment. With appropriate management, the current fertility status of this topsoil should help to encourage high levels of floristic diversity over time.

It should be noted that the topsoil is likely to contain an existing weed seedbank, which will need to be supressed during initial establishment. No application of either compost or fertiliser should be made to areas intended for wildflower meadow.

5.6 Rain Garden / SuDS

Soils are an essential part of a rain garden system, with their performance in this capacity fundamentally linked to their physical properties and condition. Soil texture and soil structure are key characteristics in determining the performance of rain gardens, as they will affect the soil's infiltration rate, water holding capacity and drainage potential. Furthermore, soil structure affects porosity and therefore oxygen supply (aeration).

The selection of soils for use within rain garden system will depends on the necessary performance of the soils. For example, if they are to provide a specialist function such as bioretention or simply to slow rainwater run-off.

It is anticipated that the site won soils would be slow draining. However, there is currently insufficient information available on the required function of the rain garden system to comment on the suitability of the site soils.

5.7 Summary of Soil Suitability

A summary of the re-use potential of the site soils for particular landscape types is given in the table below. This summary is given on the proviso that the considerations discussed above are adhered to. It is important to note that for all planting and seeding, the soils must be uncompacted and have an adequate structural condition.

Planting Environment	***Topsoil***	***Subsoil***	***Made Ground (TH2 + TH3)***	***Made Ground (TH9 + TH10)***
Tree Planting	X	X	X	X
Hedge Planting	✓	✓	X	✓
Ornamental Shrub & Herbaceous Planting	✓	✓	X	✓
Sensory Planting	✓	✓	X	✓
Native tree and shrub planting	✓	✓	X	✓
Amenity Grass (low to moderate footfall)	✓*	✓*	X	✓*
Amenity Grass (high footfall)	X	X	X	X
Wildflower Seeding	✓	✓	X	✓
Rain Garden / SuDS	Dependant on required SuDS function	Dependant on required SuDS function	X	Dependant on required SuDS function

✓ Suited to this landscape type **provided** the topsoil and subsoil are in optimum condition and selected species are suited to the heavy moisture retentive site soils. Additional drainage support may be necessary.

✓* On-going maintenance likely to be required to maintain soil aeration and drainage.

X Not suited to this landscape type.

5.8 Soil Structure & Physical Degradation

It is essential to provide a structured, uncompacted topsoil for the successful establishment and subsequent growth of plants and grass. Adequate soil structure is a key element for healthy plant growth to ensure aeration and drainage within the rootzone. If the site's development programme requires the soils to be disturbed by activities such as excavation, storage and respreading, soil structure can easily be destroyed by compaction. Any damage to soil structure will reduce the drainage rate of this topsoil.

Almost all soils are physically degraded during intensive handling and the potential quality and the ultimate suitability of the topsoil for re-use will depend on how well its soil structure is preserved during the earthworks phase. Very heavy topsoil is prone to structural damage if handled and moved when wet. In this situation, the larger (air containing) soil pores are destroyed and replaced

by smaller (water retentive) pores. This will restrict gaseous exchange with the atmosphere and cause the topsoil to become anaerobic (oxygen depleted). In addition, the lack of larger pores prevents effective drainage and results in an increased risk of waterlogging.

Waterlogged and anaerobic conditions, if they persist, can be severely detrimental to plants in two main ways. Firstly, aerobic bacteria are replaced by anaerobic bacteria that produce ammonia and methane gases which are harmful to plants. Secondly, without oxygen plant roots are unable to take up water and nutrients.

5.9 Soil Handling & Programming

Despite the inevitable degradation caused by stockpiling, provided the in-situ topsoil is stripped, stored and respread correctly and cultivated to break up any compacted lumps, this topsoil should return to a healthy, aerobic state in a matter of days.

If the site topsoils are to be re-used successfully, structural degradation must be kept to a minimum. In order to achieve this, it is best practice for topsoil to only be handled when it is dry and non-plastic in consistency. The most appropriate time to carry out the topsoil strip will therefore be during the summer months (May/June to September/October), and then only when the topsoil is dry. If the topsoil is dry when it goes into the temporary stockpile, it can be kept dry until it is respread.

If the development's programme requires the topsoil to be handled when moist/wet and plastic, it is inevitable that significant damage is likely to occur to its structure. This damage will be potentially irreparable (particularly in the short to medium term), and planning the programme of earthworks should therefore be carefully considered by the project team at the earliest stage.

Should the topsoil become damaged through wet handling, it may still be possible to repair the damage provided there is sufficient time and dry weather. It will therefore be essential that the *Topsoil Respreading Phase* take place during a summer season, to allow enough time for the soil to dry out effectively and be thoroughly cultivated before soil cultivation and planting/seeding takes place in autumn (grass seeding) and winter (planting).

If the project's programme results in wet topsoil being respread for planting/seeding in the wetter/colder, winter or following spring months, there is unlikely to be any opportunity to recondition and prepare the topsoil to address the structural degradation caused by the stripping/stockpiling process. Planting into such adverse conditions is likely to result in poor establishment rates of both planting stock and grass.

6.0 SOIL RESOURCE PLAN

6.1 Outline Requirements

6.1.1 This section highlights the sequential treatments for the recovery, storage and re-use of the existing topsoil resource.

6.2 General Soil Handling

6.2.1 It is important to avoid soil physical degradation during all phases of soil handling (e.g. stripping, storage, respreading and amelioration). Soil handling operations should ideally be carried out when the soil is reasonably dry and non-plastic (friable) in consistency.

6.2.2 The soils (topsoil and subsoil) should not be unnecessarily compacted by trampling or trafficking by site machinery.

6.2.3 If, during the course of the earthworks, the soil is structurally damaged, it should be suitably cultivated to relieve the compaction and restore the structure prior to any planting.

6.3 Pre-treatment of Existing Vegetation

6.3.1 It is good practice to minimise the quantity of vegetation entering the storage stockpiles in order to minimise the formation of anaerobic conditions during storage. As such, in advance of soil stripping, the topsoil should be cleared of surface vegetation by a method suited to the vegetation type present.

6.3.2 If necessary, the grass should be close mown (< 100mm) and the cuttings collected where necessary for removal to a suitable green-waste recycling facility.

6.3.3 Trees/hedgerows should be pre-treated before soil stripping, in two stages:

1. Each tree/hedgerow should be felled/cut and removed from site, including all branches/brash.
2. Stumps and associated large roots (> 20mm diameter) should be lifted using a suitable excavator fitted with a hydraulic grab.
3. All woody materials (tree trunks, stumps, branches and brash, etc.), including wood chippings, should be removed from site to a suitable green-waste material processing facility for recycling.

6.3.4 To minimise anaerobism during storage and preserve the quality of the topsoil as a growing medium, coarse woody materials should not be incorporated with the soils during stripping. This includes any chippings left on the surface after clearance of trees/hedgerows.

6.4 Topsoil Stripping

6.4.1 The topsoil should be stripped separately, and intermixing should be avoided.

6.4.2 The loose tip method, using appropriately sized dump trucks and hydraulic excavators, should be used to strip, transport and stockpile the topsoil.

6.4.3 The loose-tipping method involves the use of a tracked hydraulic excavator, fitted with a flat edged grading bucket to strip the topsoil and load it into a dump truck.

6.4.4 The dump truck, running along a pre-designated route, then transports the topsoil to the desired stockpile location.

6.4.5 This operation should be monitored to ensure that the topsoil is recovered without the inclusion of other soils (subsoil) or wastes. Cross contamination with other soil could significantly degrade the quality of the topsoil.

6.4.6 Any stones, waste or non-topsoil materials (>50mm) should be removed from areas to be stripped prior to topsoil stripping.

6.4.7 Stripping should ideally be carried out whilst the soil is reasonably dry and friable. However, if due to construction programme constraints topsoil stripping needs to be carried out whilst the topsoil is wet, an alternative method for topsoil stockpiling will be used (Figure 2).

6.5 Depth of Topsoil Strip

6.5.1 The depth of topsoil strip for the access road should be set at 380mm to enable the majority of the topsoil to be recovered without the inclusion of significant quantities of subsoil.

6.5.2 When using an excavator to strip the topsoil, the colour differences between the topsoil and underlying subsoil/made ground may be seen by the machine operator carrying out the soil strip so that some discretion can be made.

6.6 Topsoil Stockpiling

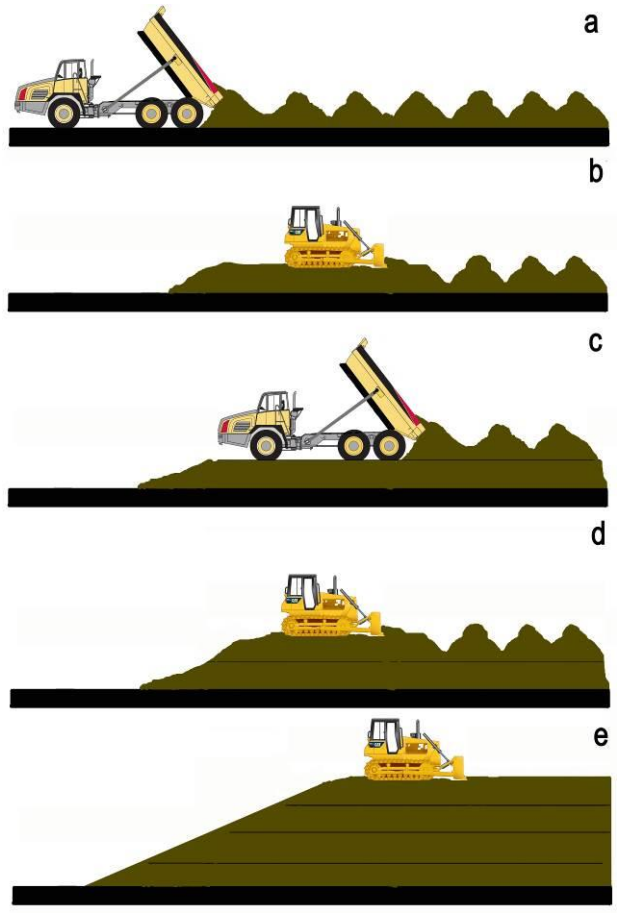
6.6.1 The topsoil should be stockpiled prior to re-spreading into the landscape areas following completion of the scheme.

6.6.2 The topsoil should be stored in an area of the site where it will not interfere with other site operations so that it can be left undisturbed during other construction activities. The area that is to be used for storing the topsoil will be cleared of vegetation, in-situ topsoil and any waste arising from the development e.g. building rubble and fill materials.

6.6.3 The topsoil should be transported to the storage area in a dump truck and be 'loose tipped' in a series of heaps, starting at the furthest point and working back towards the storage area access.

6.6.4 There are two options for stockpiling the topsoil depending on the **moisture content** and **plasticity**. These are referred to here as *dry soil stockpiling* and *wet soil stockpiling*.

6.6.5 The dry stockpiling method is illustrated below (*Figure 1*).



The process requires the topsoil to be transported to the storage area in a dump truck, and 'loose tipped' in a line of heaps to form a windrow (a).

Once the heaps cover the storage area, a tracked dozer (e.g. D6 Caterpillar or tracked excavator) should level the heaps to form a level, stable platform for dump trucks to travel across to tip a second layer of topsoil. (b and c) This sequence should be repeated until the maximum stockpile height is achieved (d).

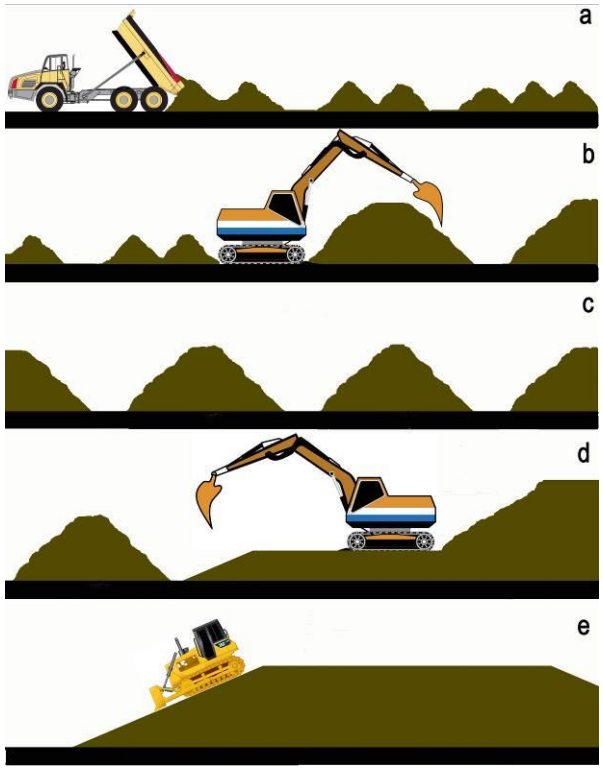
Assuming that the topsoil is reasonably dry and friable during the stripping and storage operation, it will be heaped to a maximum of 6.0 metres (health and safety permitting).

To protect from wet weather once the final height is achieved, the excavator or blade should re-grade the sides and top of the stockpile to firm the surface by tracking across it to form a smooth gradient. The aim is to seal in the dry topsoil and reduce rainfall infiltration. (e).

If the topsoil is to be stored for more than 3 months, a quick germinating fescue/clover seed mix should be sown over the sides and top of the stockpile to stabilise the surface and reduce the risk of erosion.

Once the stockpile has been completed the area should be cordoned off with secure fencing to prevent any disturbance or contamination by other construction activities.

6.6.6 The wet stockpiling method is illustrated below (*Figure 2*); the wet soils are tipped for temporary storage as windrows until the topsoil has dried out. This technique minimises the amount of compaction caused by stockpiling as well as maximising the surface area of the stockpile to enable to soil to dry out. The reconditioning operation would ideally be timed during the summer months (May to September), to allow enough time for the topsoil to dry out effectively.



The soil is tipped in a line of heaps to form a 'windrow', starting at the furthest point in the storage area and working back toward the access point (a).

Any additional windrows are spaced sufficiently apart to allow tracked plant to gain access between them so that the soil can be heaped up to a maximum height of 2.5m (b). To avoid compaction no machinery, even tracked plant, traverses the windrow.

Once the soil has dried out and is non-plastic in consistency (this usually requires several weeks of dry and windy or warm weather), (c) the windrows can be combined to form a larger stockpile(s) with a maximum height of 6.0m, using a tracked excavator (d).

The surface of the stockpile should be re-graded and compacted (e) by a tracked machine (dozer or excavator) to reduce rainwater infiltration.

Figure 2: Wet Stockpiling Method.

6.7 Subsoil Grading and Preparation

6.7.1 Prior to any subsoil preparation works, the location and depth of all services shall be determined and clearly marked out to ensure that all services are avoided and not damaged.

6.7.2 All temporary surface materials, for example sub-base stone and geotextile, should be removed prior to subsoil preparation.

6.7.3 Subsoil should be graded in accordance with the Engineer's requirements. Grade to smooth flowing contours to achieve the desired formation levels and falls and the specified finished levels of topsoil.

6.7.4 Any large stones and other debris larger than 75mm brought to the surface during subsoil spreading should be stone picked or raked and removed. The stones should either be re-used on site or they should be removed off-site to a suitably licensed waste facility.

6.7.5 It is likely that the subsoil will have been heavily compacted following the completion of the scheme. Therefore, the subsoil should be loosened to a depth of at least **400mm at 300mm centres** to break up any panning.

6.7.6 A suitably sized tracked excavator, fitted with a single tine ripper attachment (ripper tooth) should be used to loosen the subsoil. A toothed bucket is not an acceptable alternative.

Plate 11: Excavator arm fitted with a Single Tine Ripper Attachment

Plate 12: Single Tine Ripper working

6.7.7 Repeated passes may be needed to break up the subsoil sufficiently. This will be largely dependent on the strength of the soil and its resistance to cultivation at the time of the operation.

6.7.8 Any large stones and other debris >75mm brought to the subsoil surface by this cultivation should be stone picked or raked and removed. The stones (and other debris) should be removed off-site to a suitably licensed waste recycling facility.

6.7.9 Following decompaction and stone picking, any large subsoil clods should be broken up using a toothed excavator bucket and then the subsoil surface should be roughly levelled and lightly firmed (without recompacting) to provide a sensible surface to place the topsoil.

6.8 Topsoil Respreading

6.8.1 The aim of this operation is to respread the topsoil and to minimise and eliminate any soil compaction caused during the process.

6.8.2 Following respreading of the topsoil, the soil profile shall comprise a minimum of 400mm decompacted soil (topsoil and subsoil combined) for handover to the Landscape Contractor. The aim of the decompaction operation is to break up compacted soil layers, prior to the final topsoil cultivation.

6.8.3 Prior to commencement, the Groundworks Contractor shall set out a proposed Method Statement to respread approved topsoil onto prepared (ripped) subsoil based on the following guidelines.

- The topsoil should be respread using a combination of tracked excavator and dump truck.
- During topsoil spreading, all plant should work from the subsoil layer only.

- Trafficking over the ripped subsoil with either tracked or wheeled vehicles will cause further compaction. Therefore, all operations should be organised to minimise trafficking over ripped subsoil.
- Trafficking by wheeled vehicles is more damaging to soils than tracked equipment and should therefore be kept to an absolute minimum. Dump trucks should run on pre-designated access routes only. Drivers should be disciplined to keep to these routes at all times.
- A larger excavator (e.g. 8 tonne) with a longer reach may be beneficial to reduce tracking over the subsoil. Wherever possible, the reach of the excavator should be utilised to minimise tracking on the subsoil.
- Following spreading of the approved topsoil, the access routes should be decompacted to break up the compaction caused during placement, e.g. by ripping using the excavator fitted with the single rigid tine attachment to a **minimum depth of 400 mm at 300 mm centres**.

6.8.4 An example sequence of the required operations is presented below for reference.

Example Sequence of Operations: Subsoil Decompaction and Topsoil Spreading

1. The subsoil is prepared by ripping, working backwards towards the area access point.
2. Prior to respreading the approved topsoil, a minimum number of access routes are clearly designated.
3. Running on the designated access routes, the dump truck deposits the approved topsoil in a number of small heaps.
4. Running on the designated access routes, the excavator respreads the approved topsoil to the required thickness.
5. The excavator decompacts the access routes using the rigid tine to provide a minimum 400mm loosened soil.

6.9 Topsoil Depths

6.9.1 The topsoil depths after firming and settlement are summarised in the table below.

Landscape Type	Topsoil Depth (mm)	Topsoil Build Up
Tree Planting	300	Imported Topsoil
Shrub and Herbaceous Planting	300	Site-won Topsoil
Sensory Garden Planting	300	Site-won Topsoil
Native Woodland and Hedge Planting	300	Site-won Topsoil
Amenity Grass – Low to moderate Footfall	150*	Site-won Topsoil
Amenity Grass – High Footfall / Intensive Use Areas	150	Imported Topsoil
Rain Garden / SuDS	Dependant on required SuDS function	Dependant on required SuDS function

*Topsoil depth could be increased to 300mm if surplus topsoil is available

6.10 Final Topsoil Cultivation

6.10.1 After respreading and regrading the approved topsoil, any large, compacted lumps should be broken down using suitable tillage equipment to produce a fine tilth suitable for planting (<40mm), turfing and seeding (<10mm).

6.10.2 Examples of appropriate equipment to use for this cultivation include a *pedestrian power harrow* or *rotavator.*

Plate 13: Pedestrian power harrow


Plate 14: Pedestrian rotavator

6.10.3 Within each area, cultivation should begin at the point farthest from the plot access, working backwards. Once the approved topsoil has been cultivated, **no further machinery should traffic over the soil surface.** Unnecessary foot trafficking must also be minimised.

6.10.4 Any undesirable material brought to the surface during this exercise should be removed by picking or hand raking. For example, fill materials and stones larger than 50mm in any dimension.

6.11 Soil Ameliorants

6.11.1 For areas of planting, we recommend applying and incorporating suitable compost (e.g. PAS100:2018 /Landscape Institute/WRAP grade (10mm screened) green compost) into the upper 200mm of topsoil (ensuring the soil is dry and friable) at a rate of **15%** by volume.

6.11.2 For areas of amenity grass, we recommend applying and incorporating the pre-seeding grass fertiliser ICL Sportsmaster Pre-seeder (8%N:12%P2O5:8%K2O+3%MgO) prior to seeding or turfing at a rate of **35 g/m2** and to a depth of 100mm.

6.11.3 No applications of fertiliser or compost should be applied for areas intended for wildflower seeding.

6.12 Stone Reduction

6.12.1 It would be prudent to remove a portion of the larger stones (>50mm) within the topsoil by intensive picking, raking, or burying prior to planting. Furthermore, any large stones brought to the surface of the topsoil or subsoil should be picked and removed.

We would like to thank Cardiff Council for entrusting the practice with this commission. We trust this report meets with your approval and provides the necessary information. Please do not hesitate to contact the undersigned for further assistance.

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Senior Associate

For & on behalf of Tim O'Hare Associates LLP

Report Qualifications

TOHA's interpretation of the soil conditions is based on observations made during the site investigation and the results of laboratory tests. This report presents TOHA's site observations and test results and the interpretation of those observations and results. On any site there may be variations in soil conditions between these exploratory positions. TOHA can therefore not accept any responsibility for soil conditions that have not been exposed by this investigation.

This investigation considers the re-use of the site soils for landscape purposes at the Ysgol Gyfun Gymraeg, Glantaf site in Cardiff. It should not therefore be relied on for alternative end-uses or for other schemes. This report has been prepared solely for the benefit of the client Cardiff Council. No warranty is provided to any third party and no responsibility or liability will be accepted for any loss or damage in the event that this report is relied upon by a third party or is used in circumstances for which it was not originally intended.

Appendix 1

Site Plan showing Trial Hole Locations

■ - Trial Hole Location (approx.)

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	AECOM (Wales)		
Project:	YGG Glentaff, Cardiff		
Job ref no.:	TOHA/23/8691/AC		
Drawing no.:	8691/1		
Drawing title	Site Plan showing Trial Hole Locations		
Date:	Sept '23	Scale:	NTS
Drawn by:	AC	Checked by:	

Tim O'Hare Associates LLP
Howbery Park Wallingford Oxfordshire OX10 8BA
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www.toha.co.uk

Appendix 2

Trial Hole Log

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	Cardiff Council
Project:	Ysgol Gyfun Gymraeg, Glantaf
Job:	Soil Resource Survey - Trial Hole Log
Surveyor:	Aaron Cross
Survey Date:	28/09/2023
Job Ref No:	TOHA/23/8691/AC

Trial Hole	Current Landscape Type	Layer	Depth (mm)
1	Grass Embankment	Topsoil	0-800
2	Amenity Grass	Topsoil	0-280
		Made Ground	280-410
3	Amenity Grass	Topsoil	0-350
		Made Ground	350-850
4	Amenity Grass	Topsoil	0-310
		Subsoil	310-1000
5	Amenity Grass	Topsoil	0-350
		Subsoil	350-1000
6	Amenity Grass	Topsoil	0-500
		Subsoil	500-1000
7	Amenity Grass	Topsoil	0-350
		Subsoil	350-1000
8	Amenity Grass (adjacent to planting beds)	Topsoil	0-480
		Subsoil	480-1000
9	Amenity Grass (adjacent to planting beds)	Topsoil	0-200
		Made Ground	200-620
		Subsoil	620-1000
10	Amenity Grass (adjacent to planting beds)	Topsoil	0-200
		Made Ground	200-580
		Subsoil	580-1000

This trial hole log should be read in conjunction with the report it is issued with

Appendix 3

Laboratory Analysis Results

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Cardiff Council**
Project:	**Ysgol Gyfun Gymraeg, Glantaf**
Job:	**Soil Resource Survey - Topsoil Analysis**
Date:	**October 2023**
Job Ref No:	**TOHA/23/8691/AC**

Sample Reference			**Topsoil 1**	**Topsoil 2**	**Topsoil 3**	**Made Ground 1**
Trial Hole Locations			**TH1, TH2**	**TH4, TH5**	**TH8, TH10**	**TH2**
		Accreditation				
Clay (<0.002mm)	%	UKAS	25	27	26	18
Silt (0.002-0.063mm)	%	UKAS	31	39	34	36
Sand (0.063-2.0mm)	%	UKAS	44	34	40	46
Texture Class (UK Classification)	--	UKAS	CL	CL	CL	SCL
Stones (2-20mm)	% DW	GLP	4	0	0	23
Stones (20-50mm)	% DW	GLP	8	2	3	21
Stones (>50mm)	% DW	GLP	8	0	6	14
pH Value (1:2.5 water extract)	units	UKAS	7.5	6.0	7.3	8.3
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	143	84	221	241
Electrical Conductivity (1:2 $CaSO_4$ extract)	uS/cm	UKAS	2027	1977	2064	2058
Exchangeable Sodium Percentage	%	UKAS	0.6	1.1	0.7	0.4
Organic Matter (LOI)	%	UKAS	8.3	4.5	6.5	7.2
Total Nitrogen (Dumas)	%	UKAS	0.25	0.17	0.20	0.23
C : N Ratio	ratio	UKAS	19	16	19	18
Extractable Phosphorus	mg/l	UKAS	13	9	19	14
Extractable Potassium	mg/l	UKAS	48	50	123	92
Extractable Magnesium	mg/l	UKAS	181	98	132	313

CL = CLAY LOAM

Results of analysis should be read in conjunction with the report they were issued with

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BSc MSc
Senior Soil Scientist

TIM O'HARE ASSOCIATES
SOIL & LANDSCAPE CONSULTANCY

Client:	**Cardiff Council**
Project:	**Ysgol Gyfun Gymraeg, Glantaf**
Job:	**Soil Resource Survey - Subsoil Analysis**
Date:	**October 2023**
Job Ref No:	**TOHA/23/8691/AC**

Sample Reference			**Subsoil 1**	**Subsoil 2**	**Made Ground 2**
Trial Hole Locations			**TH4, TH5**	**TH8, TH9, TH10**	**TH10**
		Accreditation			
Clay (<0.002mm)	%	UKAS	29	28	22
Silt (0.002-0.063mm)	%	UKAS	29	31	27
Sand (0.063-2.0mm)	%	UKAS	42	41	51
Texture Class (UK Classification)	--	UKAS	CL	CL	SCL
Stones (2-20mm)	% DW	GLP	1	1	10
Stones (20-50mm)	% DW	GLP	1	1	6
Stones (>50mm)	% DW	GLP	0	0	1
pH Value (1:2.5 water extract)	units	UKAS	7.1	8.0	8.3
Electrical Conductivity (1:2.5 water extract)	uS/cm	UKAS	124	117	271
Organic Matter (LOI)	%	UKAS	1.5	2.0	3.5

Cl = CLAY LOAM
SCL = SANDY CLAY LOAM

Results of analysis should be read in conjunction with the report they were issued with

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