Profile 2

Profile 2 – Woodland Soils is described as:

P2 Topsoil	**Humus Layer**	Very dark brown to black, (Munsell Colour 10YR 2/2 to 10YR 2/1) partially to fully decomposed litter.
	Mineral Layer	Brown (Munsell Colour 10YR 5/3), dry to slightly moist, friable, non-calcareous, fine SANDY LOAM, with a weakly-developed, fine to medium granular structure. Slightly stony. Occasional glass fragments were recorded within the woodland topsoil.
P2 Subsoil		Dark yellowish brown to strong brown (Munsell Colour 10YR 4/4 to 7.5YR 4/6), slightly moist, non-calcareous, fine SANDY LOAM with a single grain and weakly developed granular structure. Slightly stony. No evidence of impeded drainage was observed.

Plate 15: *Profile 2 Topsoil* with darker coloured humic layer on surface

Plate 16: *Profile 2 Subsoil*

Plate 17: Glass fragment observed within *Profile 2 Topsoil* at TH18

Profile 3

Profile 3 – Heavy Textured Soils is described as:

P3 Topsoil	Very dark greyish brown (Munsell Colour 10YR 3/2) to dark greyish brown (Munsell Colour 10YR 4/2), slightly moist to moist, firm to plastic, slightly calcareous HEAVY CLAY LOAM. The topsoil typically has a moderately-developed blocky structure. Virtually stone-free to slightly stony. No foreign matter observed.
P3 Subsoil	Dark yellowish brown to strong brown (Munsell Colour 10YR 5/4 to 10YR 5/6), slightly moist, firm to plastic, slightly calcareous HEAVY CLAY LOAM to CLAY with a moderately developed structure. Virtually stone-free. Common ochreous mottling was recorded, indicating impeded drainage and seasonal waterlogging.

Plate 18: *Profile 3 Topsoil* (left) and *Subsoil* (right) at TH10

Plate 19: *Profile 3 Subsoil* at TH11

5.0 LABORATORY ANALYSIS

5.1 Analytical Schedule

Representative samples of topsoil and subsoil were submitted to the laboratory for analysis.

The samples were analysed in accordance with the following schedule:

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

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

5.2 Results of Topsoil Analysis

Particle Size Analysis

The majority of the topsoil samples (*Profile 1* and *Profile 2*) fell into the *sandy loam* texture class. Further detailed particle size analysis indicated that the topsoil contained significant quantities of 'fines (clay, silt, very fine sand and fine sand) and this soil would be considered to have a slightly *broad* particle size distribution.

The *Profile 3* topsoil sample comprising a composite of topsoil from TH10, TH11 and TH20 fell into the *clay loam* texture class and would be described as heavy in texture.

Stone Content

The stone contents of the samples were low to moderate.

pH and Electrical Conductivity

The topsoil samples were strongly acid to alkaline in reaction (pH 4.9 – 7.9). The most acidic topsoil sample was associated with the *Profile 2, Woodland Topsoil*, whilst the most alkaline topsoil was associated with the heavier textured *Profile 3 Topsoil.*

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

Organic Matter and Nutrient Status

The topsoil samples contained sufficient reserves of organic matter.

The topsoil samples were all adequately supplied with total nitrogen and extractable magnesium. The majority of the samples were deficient in extractable potassium and extractable phosphorus (except the samples from TH5 and TH22).

5.3 Results of Subsoil Analysis

Particle Size Analysis and Stone Content

The majority of the subsoil samples were found to be light to medium in texture (*Profile 1* and *Profile 2*), falling into the *sandy loam* and *sandy clay loam* classes. Further detailed particle size analysis indicated that these subsoils have a slightly *broad* particle size distribution. The sand sized fraction of these samples (0.05 – 2.0mm) comprised mainly *very fine sand* (0.05 – 0.15mm), *fine sand* (0.15 – 0.25mm) and *medium sand* (0.25 – 0.50mm).

The *Profile 3* subsoil samples fell into the *clay loam* and *clay* texture classes and would be described as heavy in texture.

The stone content of the subsoil samples was low.

pH and Electrical Conductivity

The pH range of the subsoil samples was broad, ranging from acid to strongly alkaline (pH 5.5 – 8.4). The acid to slightly acid subsoil samples mostly correspond with the sandier textured soils, whilst the heavier textured subsoils tend to be more alkaline.

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

Organic Matter and Nutrient Status

The majority of the subsoil samples contained low levels of organic matter, which is considered typical of subsoil.

The subsoil samples from TH2, TH3 and TH11 contained moderate levels of organic matter, above levels typically recorded in subsoil material. These trial holes were constructed within areas that are understood to flood periodically and as such, the increased levels are likely to be due to accumulation of organic matter within the flooded alluvial environment.

6.0 DISCUSSION

The purpose of this survey was to ascertain the nature and horticultural quality of the existing site soils in selected locations in Marble Hill Park, together with the provision of advice on how to improve the soils for landscape works as necessary. The survey information is to support the emerging design for the Park and to highlight areas where more detailed investigation will be required.

6.1 Soil Conditions

From our visual examinations, three distinct soil profile types were observed and the subsequent laboratory analysis confirmed that the chemical properties were reasonably consistent within the profile types.

These soil profiles are identified for each trial hole within the trial hole record given in Appendix 2.

The characteristics of the three soil profiles are summarised in Table 1 below:

Table 1: Soil Profile Characteristics

Profile 1 – Light to Medium Textured Soils	***Profile 2 – Woodland Soils***	***Profile 3 – Heavy Textured Soils***
• Sandy loam to sandy clay loam soil textures • Fine textures – significant proportions of 'fines' (very fine sand, clay, silt) • Slightly broad particle size distribution • Virtually stone-free to slightly stony • Acid to slightly alkaline soil reaction • Non-calcareous, with occasionally slightly calcareous subsoil • Non-saline • Topsoil has sufficient reserves of organic matter, nitrogen and magnesium • Topsoil is deficient in phosphorus and potassium	• Humic surface layer – 40-50mm thick • Sandy loam soil texture • Fine textures – significant proportions of 'fines' (very fine sand, clay, silt) • Slightly stony • Strongly acid soil reaction • Non-calcareous • Non-saline • Topsoil has sufficient reserves of organic matter, and all major plant nutrients	• Heavy clay loam to clay soil textures • Virtually stone-free to slightly stony • Alkaline to strongly alkaline soil reaction • Slightly calcareous • Non-saline • Topsoil has sufficient reserves of organic matter, nitrogen and magnesium • Topsoil is slightly deficient in phosphorus and potassium

The soil considerations for future landscape works are discussed in Section 6.2 below.

6.2 Re-Use of the Site Soils

Physical Considerations

Profile 1 and 2 Soils

The 'fineness' and slightly broad particle size distribution of the *Profile 1* and *Profile 2* soils will make them particularly prone to structural degradation during all phases of soil handling. This would be especially so during and after intensive operations such as topsoil stripping or stockpiling, which are not necessarily going to take place as part of this project, but also includes compaction during initial vegetation removal, cultivation and planting work (e.g. tree pit excavation). At present in their undisturbed state, the soils have sufficient soil structure to enable satisfactory drainage and aeration. However, these structures can easily be lost once such fine textured soil is disturbed.

Provided their physical condition is satisfactory and suitable species are selected, the *texture* of the *Profile 1* and *Profile 2 Soils* should be suitable for most general landscape applications, including shrub planting, native transplants and grass establishment. The *Profile 1* and *Profile 2 Topsoils* should also be suitable for smaller sized rootballed tree planting, provided they their physical condition is maintained. A suitable imported topsoil would be recommended for larger rootballed trees (e.g. extra heavy standard or semi-mature).

The *Profile 1* and *Profile 2 Subsoils* could be prone to self-compaction if placed below the weight of a tree root ball and so are not considered suitable for use as backfill in tree pits for large rootballed trees. An appropriate free-draining, coarser textured sand or sandy subsoil is recommended for backfilling the lower portion of these tree pits.

The presence of glass within the *Profile 2 Topsoil* inspected could present a safety risk to end users. Appropriate safety precautions would need to be adhered to with regard to presence of glass during any vegetation clearance and subsequent cultivation/planting works. If any of these areas are to be converted to amenity grass, the presence of glass should be considered as the risk of injury to end users may be higher in such areas.

Profile 3 Soils

The heavy texture of the *Profile 3* soils and presence of mottling in the subsoil indicates that this soil profile type will be prone to seasonal waterlogging following periods of prolonged or heavy rainfall. It is also likely that these soils will be prone to structural degradation during landscape preparation and planting works which will further reduce their permeability, particularly if they are handled when wet and plastic in consistency. As such, the physical condition of these soils will need to be maintained by careful handling and sensitive soil management to ensure they are fit for planting or seeding.

Provided the soils are left with a satisfactory soil structure, they should be suitable for a range of planting types, provided species tolerant of moisture retentive soils are selected. However, if the structure of the soils is damaged during the landscape works, their usage potential will be reduced significantly.

The heavy texture of the *Profile 3 Soils* is not ideal for large rootballed tree planting and as such, suitable imported soils are recommended for this purpose.

Chemical Characteristics

Soil Reaction

The strongly acid to slightly acid (occasionally slightly alkaline) soil reaction of the *Profile 1* and *Profile 2* samples (topsoil and subsoil) means that the species selected should ideally have a wide pH tolerance, or have a preference for acidic soils. If it is desired to plant species that prefer or require alkaline soils, a suitable application of lime may be required in the locality of these specimens. However, it would not be practical to amend the pH of the subsoil and therefore, the planting of species that specifically demand alkaline soil is not recommended within the majority of the Park.

The *Profile 3* soils were alkaline to strongly alkaline in reaction and, as such, specimens planted in the locality of these soils should be tolerant of alkaline soil conditions.

Fertility Status

The topsoils across the site contained sufficient reserves of organic matter and as such, no applications of organic ameliorant (e.g. compost) would be required.

The samples contained sufficient levels of total nitrogen and magnesium, with significant deficiencies in extractable phosphorus and potassium recorded within the majority of the samples. The *Profile 2 Topsoil* contained sufficient levels of all major plant nutrients. The nutrient deficiencies may be addressed by routine fertiliser applications where required.

If it is desired to establish species-rich wildflower grassland habitats as part of landscape improvements, the soil fertility should be considered. Species-rich wildflower grasslands typically require low-nutrient soils, and in particular low phosphorus levels, so that aggressive weeds and grasses such as dandelion, nettle and rye-grass cannot dominate the sward. Moderate to high organic matter and total nitrogen content is desirable to support healthy seed growth. Appropriate management practices (e.g. periodic mowing and collection of cuttings to prevent seed head development) are often necessary to maximise diversity in the sward.