Ceredigion County Council
Highways Properties & Works
Penrhos Department
Llanddysyl
Aberystwyth
SA44 4SX

Date: 6th September 2013
Test Report Ref. STR: 335910A

LABORATORY TEST REPORT

INTRODUCTION:

TEST REQUIREMENTS: To determine chemical analysis as per client's request.

SAMPLE DETAILS:

Certificate of sampling received:	**Yes**
Laboratory Ref. No:	**S44031**
Client Ref. No:	**Rural Road Sweeping - Sample 4**
Date and Time of Sampling:	**07/08/2013 @ 04:30pm**
Date of Receipt at Lab:	**15/08/2013**
Date of Start of Test.:	**05/09/013**
Sampling Location:	**Waste Transfer Station**
Name of Source:	**Waste Transfer Station**
Method of Sampling:	**Unknown**
Sampled By:	**Client**
Material Description:	**Rural Road Sweepings**
Target Specification:	**N/A**

RESULTS:

See Attached

Nick Dumbarton – Assistant Laboratory Manager

1. NUTRIENT STATUS ASSESSMENT

1.1 INTERPRETATION OF SOIL P and K

Soil analysis provides an estimate of available P and K concentrations in soil to sampling depth - in practice this is equivalent to plough or cultivation depth because of the distribution of nutrients when the land is worked. Response experiments with different crop groups have provided the relationship between crop yield and soil nutrient concentration. Normally, yields increase with increasing nutrient concentration to a maximum, beyond which there is no further benefit from additional nutrient. Below this value, which will vary with crop species, there is a yield penalty. Whilst soil analysis is not a precise guide, the lower the value the greater the risk of poor performance. To aid interpretation of the different concentrations of individual nutrients, Index or descriptive scales are used. These scales provide a general indication of the likely crop response and therefore a guide to the need for additional nutrient supplementation, as shown in the Table 1.

Table 1 : Crop response to Soil Nutrient Index (status reference)

Defra Index	SAC description	Yield response to added nutrient by:	
		vegetable crops	arable crops & grass
0	Very low	highly likely	highly likely
1	Low	highly likely	probable
2	Moderate	likely	unlikely
3	High	possible	nil
4	High	unlikely	nil
5	High	nil	nil

SAC = Scottish Agricultural College

1.2 Soil P and K concentrations (mg/l) and Defra index scale

The DEFRA index is related to the concentration of extractable nutrient (P and K), traditionally estimated as mg/l. Laboratory methods to extract nutrients vary and are continually updated; however, the index system is based on the Olsen (bicarbonate) extraction for P, and ammonium nitrate extraction of both K. The concentrations of each nutrient relative to the index classification is presented in Table 2.

Besides providing a basis to decide fertiliser quantities, soil analysis should also be used to monitor changes in fertility especially where there are uncertainties in the amounts of nutrient removed (e.g. with forage crops) and in the amounts of nutrients applied (e.g. with manures and slurries). For this purpose it is desirable to use the mg/l values not the index. However differences of less than 5 mg/l Olsen P and 25 mg/l K should be ignored unless part of a sustained trend. Where accurate nutrient balance information is used in conjunction with regular soil analysis, it is important to recognise the possibilities of variation as discussed above.

Table 2 : Relationship of P and K concentration (mg/l) with Index Value

PHOSPHORUS		POTASSIUM	
Olsen extraction		Ammonium nitrate extraction	
Olsen P		exchangeable K	
Index	mg/l	Index	mg/l
0	0-9	0	0-60
1	10-15	1	61-120
2	16-25	2	121-240
3	26-45	3	241-400
4	46-70	4	401-600
5	71-100	5	601-900
6	101-140	6	901-1500
7	141-200	7	1501-2400
8	201-280	8	2401-3600
9	over 280	9	over 3600

1.3 Soil P and K concentrations (mg/l) and SAC descriptive scale

The Scottish Agricultural College laboratory uses different extractants to those used in England and Wales and a descriptive rather than a numeric scale; SAC index descriptors and nutrient concentrations are presented in Table 3.

Table 3 : Relationship of P and K concentration (mg/l) with SAC Descriptor Index

DESCRIPTION	PHOSPHORUS	POTASSIUM
	Modified Morgans extraction	
Very low	0-10	0-40
Low	10-25	40-75
Moderate	26-75	76-200
High	76-200	201-1000
Excessively High	201-	1001-

1.4 Relationship between DEFRA and SAC scales

The relationship between the DEFRA Index and SAC scales are presented in Table 4

Table 4 : Relationship between DEFRA and SAC Nutrient Indices

DEFRA INDEX	SAC Description
0	Very low
1	Low
2	Moderate
3-7	High
8-9	Excessively high

2. CONTAMINATION STATUS ASSESSMENT

2.1 INTRODUCTION

Assessment of samples with regards to potential deleterious impact on human health, flora and the built environment follows the UK adopted risk assessment process utilised to assess contaminated land. The concentration of Chemicals of Concern (COCs) depend on the end use of the material. The suite of contaminant parameters selected for analysis should be based on the history of the source(s) of the material, and the intended use where the material is to be used. Where this information is not available, as in the case here, an appropriate conservative assumption has been made resulting in the broad suite of parameters selected for analysis.

In line with UK practice, parameter concentrations were utilised to estimate the significance of risk to human health, flora, and the built environment, following contemporary UK Risk Assessment guidance.

To estimate the significance of risk, Quantitative Risk Assessment (QRA) is used. The first stage in QRA is to undertake a Generic QRA (GQRA) to determine whether contaminant concentrations are above target levels for soil set by the UK government within either statutory or non-statutory policies.

2.2 HUMAN HEALTH RISK ASSESSMENT (HHRA)

The new non-statutory guidance published by DEFRA and the Environment Agency (SC050021/SR3 (the CLEA Report) and SC050021/SR2 (the TOX report)) in 2008 replaces the old Contaminated Land Report series, CLR 7-10. Updated versions of SGV and TOX reports are expected in Spring 2009.

Risk assessment here includes a Tier 1 Risk Screening GQRA using integrated Generic Assessment Criteria (GACs) calculated using alternative models, e.g. RBCA. Initial assessment of the soil data by comparing with GACs indicates the determined Chemicals of Concern (COCs) to be significant hazards. Where the GAC is exceeded, the source parameter is identified.

This exercise forms the basis of GQRA for the soil sample considered in this report.

2.3 PHYTOTOXICITY ASSESSMENT AND INTERPRETATION

Parameters known to be harmful to flora include the metals copper, nickel, and zinc.

Guidelines for phytotoxicity assessment are documented in the British Standard Specification BS 3882 : 2007, Topsoil and Requirements for use. The cited limits for heavy metals are a function of soil pH for all topsoil classes; the guidelines are summarised below (Table 5).

Table 5 : Phytotoxic Contaminant Limits for Topsoils

Phytotoxic Contaminant	**Multipurpose and Specific Purpose Topsoils**		
Soil pH range	***pH <6.0***	***pH 6.0-7.0***	***pH >7***
Copper (mg/kg)	**<100**	**<135**	**<200**
Nickel (mg/kg)	**<60**	**<75**	**<110**
Zinc (mg/kg)	**<200**	**<200**	**<300**

Several species of flora can tolerate a broad pH range (typically 3.5-9.0), although the range of ‘acid-loving’ plants is more limited (3.5-5.5).

2.4 BUILT ENVIRONMENT ASSESSMENT AND INTERPRETATION

Parameters known to be harmful to the built environment include pH, sulphate and sulphide.

Guidelines for the pH and aqueous sulphate parameter assessments are documented in the BRE Special Digest 1 (SD1 : 2005), 3rd Edition : 17 June 2005. Also, guidelines for the aqueous and acid-soluble sulphate and sulphide parameter assessments are documented in the TRL Report TRL447 “Sulphate specification for structural backfills” Limits. The guidelines are summarised in the appended tables.

Results: DECLARATION OF SOIL ANALYSIS TO BS 3882 : 2007

CHEMICAL ANALYSIS – **Sample Ref: RURAL ROAD SWEEPINGS**
S44031 Sample No. 4

Parameter	Component	Units	Results
Soil reaction	pH	pH units	**7.15**
Plant Nutrients	Total Nitrogen	% $^{w}/_{w}$	**0.015**
	Total Nitrogen	mg/kg	**149**
	Available Nitrogen	% $^{w}/_{w}$	**0.0003**
	Available Nitrogen	mg/kg	**2.8**
	Total Phosphorus	% $^{w}/_{w}$	**0.061**
	Total Phosphorus	mg/kg	**608.5**
	Available Phosphorus	mg/l	**64.0**
	Total Potassium	% $^{w}/_{w}$	**0.095**
	Total Potassium	mg/kg	**949.9**
	Available Potassium	mg/l	**330.0**
Potential metal contamination	Cadmium	mg/kg	**0.6**
	Copper	mg/kg	**22**
	Mercury	mg/kg	**<0.05**
	Nickel	mg/kg	**16**
	Lead	mg/kg	**13**
	Zinc	mg/kg	**58**
Visible Contaminants	>2mm non-soil material	% $^{w}/_{w}$	**0**
	Plastics	% $^{w}/_{w}$	**0**
	Sharps	% $^{w}/_{w}$	**0**

All results based on dry matter

Comment:

NUTRIENT STATUS

The analysed nutrient characteristics of the material referenced S44031 indicate a useful nutrient source, with respect to N, P and K.

The Total Nitrogen content is low (compare to Multipurpose Topsoil requirements of a minimum of 0.15%), but nevertheless will provide a beneficial supplement to nitrogen-starved soils. The readily available N content is approximately 2% of the Total N. Available nitrogen is typically in the form of ammonium salts and/or nitrates.

The Total Phosphorus content is high, indicating the material will provide a beneficial supplement to soils. The readily available P content is 64 mg/l, which indicates a DEFRA Index of 4 (note the available nutrient content is cited in units of mg/l to enable DEFRA indexing). The available P is approximately 11% of the Total P.

The Total Potassium content is high, and, again, will provide a beneficial supplement to potassium-starved soils. The readily available K content is 330 mg/l, which indicates a DEFRA Index of 3 (note the available nutrient content is cited in units of mg/l to enable DEFRA indexing). The available K is approximately 35% of the Total K.

CONTAMINATION STATUS

HHRA :
A Tier 1 Human Health Risk Assessment of the results of analysis of the total metal parameters analysed indicates that all are present at concentrations lower than the most stringent recommended levels for all standard land uses, including residential with gardens, and allotments; recommended levels include published CLEA Soil Guidance Values (SGVs). Where CLEA SGVs have not been published, in-house Generic Assessment Criteria (GAC) have been calculated and utilised; the results of analysis indicate soil parameters to be present at either typically low concentrations or found at levels below the limits of analytical detection.

PHYTOTOXICITY ASSESSMENT :
A Phytotoxic Risk Assessment of the results of analysis of salient parameters indicates that all are present at concentrations lower than the most stringent recommended levels for all topsoil classifications. The pH of the material indicates suitability for almost all flora except acid-loving plants.

SUMMARY OF CONTAMINATION ASSESSMENT

The summary of assessment of analytical data of the sample referenced RURAL ROAD SWEEPINGS MATERIAL S44031 Sample No. 4 with regards to contamination status is tabulated in Table 6 below.

Table 6 : Summary of Contamination Assessment of Sample ref RURAL ROAD SWEEPINGS MATERIAL

Sample Reference	Contamination Status
RURAL ROAD SWEEPINGS MATERIAL S44031 Sample No. 4	**NO RISK OF HARM TO HUMAN HEALTH** Note 1**;** **NO RISK OF PHYTOTOXICITY** Note 1**;**

Note 1 : With respect to the contamination parameters assessed.

Conclusions:

Sample Ref RURAL ROAD -SWEEPINGS MATERIAL S44031

With respect to nutrient status, the results of chemical analysis of the Rural Road Sweepings material referenced S44031 Sample No. 4 demonstrate the following:

1. The material provides a useful Total Nitrogen content, with a small readily available N content, probably in the form of inorganic ammonium salts and/or nitrates. Such a composition is ideal for providing slow-release N nutrient over the plant growing season, without causing a deleterious impact on the aqueous environment, particularly with respect to nitrate vulnerable zones.

2. The material provides a high source of Total and Available Phosphorus, which is essential for healthy root development in plants. The DEFRA index of 4 clearly indicates the benefice of the nutrient to soils.

3. The material provides a high source of Total and Available Potassium, DEFRA index 3; potassium is essential for flower and fruit development. Many soils lose potassium by plant utilisation and leaching, and, therefore, the material would provide a very useful supplement.

With respect to human health, the results of contaminant analysis of the material sample referenced S44031 Sample No. 4 demonstrate compliance with all of the most sensitive guidelines, for those total parameters analysed. The Generic Quantitative Risk Assessment has not identified any analysed parameter concentration to exceed generic soil guidance and/or screening values for any of the standard land uses currently considered in the UK; therefore, regarding risk of harm to human targets, no analysed parameter is considered to be a Chemical of Concern (COC). With respect to phytotoxicity, the results of metal contaminant analysis of the sample referenced S44031 Sample No. 4 demonstrate compliance with published criteria (refer to Table 5). The pH is at a level considered to be suitable for all but acid-loving plants.

	Species / Type	**LAND-USE**		
		Residential	Allotments	Commercial
ARSENIC SGV (mg.kg^{-1} dry weight soil)		**32**	**43**	**640**
CADMIUM SGV (mg.kg^{-1} dry weight soil)		**10**	**1.8**	**230**
MERCURY SGV (mg.kg^{-1} dry weight soil)	***Elemental***	**1.0**	**26**	**26**
	Inorganic	**170**	**80**	**3600**
	Methyl mercury	**11**	**8**	**410**
NICKEL SGV (mg.kg^{-1} dry weight soil)		**130**	**230**	**1800**
SELENIUM SGV (mg.kg^{-1} dry weight soil)		**350**	**120**	**13000**
BENZENE SGV (mg.kg^{-1} dry weight soil)		**0.33**	**0.07**	**95**
TOLUENE SGV (mg.kg^{-1} dry weight soil)		**610**	**120**	**4400**
ETHYLBENZENE SGV (mg.kg^{-1} dry weight soil)		**350**	**90**	**2800**
XYLENE SGV (mg.kg^{-1} dry weight soil)	***o-Xylene***	**250**	**160**	**2600**
	m-Xylene	**240**	**180**	**3500**
	p-Xylene	**230**	**160**	**3200**
PHENOL SGV (mg.kg^{-1} dry weight soil)		**420**	**280**	**3200**
Sum of PCDDs, PCDFs and dioxin-like PCBs SGV (mg.kg^{-1} dry weight soil)		**0.008**	**0.008**	**0.240**

UK CLEA SOIL "OLD" GUIDANCE VALUES (as a guide only)

	STANDARD LAND-USE			
	Residential with plant uptake	Residential without plant uptake	Allotments	Commercial/industrial
CHROMIUM SGV ($mg.kg^{-1}$ dry weight soil)	**130**	**200**	**130**	**5000**
LEAD SGV ($mg.kg^{-1}$ dry weight soil)	**450**	**450**	**450**	**750**

END OF REPORT