AGRICULTURAL LAND CLASSIFICATION

AND SOIL ASSESSMENT

ALTERNATIVE ALLOTMENT SITES
AT HUNSLET, LEEDS

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1. AGRICULTURAL LAND CLASSIFICATION

1.1 Introduction

The present allotment site at Organ Yard is located around National Grid Reference SE 314318 on the north east side of Hunslet Road about 2½ km south east of the city centre. It covers an area of 1.0 ha some of which is not presently cultivated and is surrounded by industrial and derelict land. The proposed alternative site of 0.6 ha adjoining Telford Terrace lies about 800 m south of Organ Yard, at National Grid Reference SE 313309. This site, which is bounded by the railway to the north, a partially derelict children's play area to the east and a residential area to the south, is already partially used for allotments. Agricultural Land classification (ALC) survey work was carried out on both sites in early May 1989 when soils were examined by hand auger borings to a depth of one metre at a density of about four borings per hectare. In order to determine fertility levels topsoil samples were also collected at representative points on each site for detailed chemical and biological analyses. The analytical results and suggested treatment of the Telford Terrace site are discussed in Parts 2 and 3 of this report.

Physical land quality assessments were made using the revised guidelines published by the Ministry of Agriculture, Fisheries and Food (MAFF) in 1988. Definitions of all terms used in this report can be found in this publication. Brief descriptions of the 5 land quality grades defined by MAFF are given below:-

Grade 1 - excellent quality agricultural land

Land with no or very minor limitations to agricultural use. A very wide range of agricultural and horticultural crops can be grown and commonly includes top fruit, soft fruit, salad crops and winter harvested vegetables. Yields are high and less variable than on land of lower quality.

Grade 2 - very good quality agricultural land

Land with minor limitations which affect crop yield, cultivations or harvesting. A wide range of agricultural and horticultural crops can usually be grown but on some land in the grade there may be reduced flexibility due to difficulties with the production of the more demanding crops such as winter harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than Grade 1.

Grade 3 - good to moderate quality agricultural land

Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Where more demanding crops are grown yields are generally lower or more variable than on land in Grades 1 and 2.

subgrade 3a - good quality agricultural land

Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of a wide range of crops including cereals, grass, oilseed rape, potatoes, sugar beet and the less demanding horticultural crops.

Subgrade 3b - moderate quality agricultural land

Land capable of producing moderate yields of a narrow range of crops, principally cereals and grass or lower yields of a wider range of crops or high yields of grass which can be grazed or harvested over most of the year.

Grade 4 - poor quality agricultural land

Land with severe limitations which significantly restrict the range of crops and/or level of yields. It is mainly suited to grass with occasional arable crops (eg cereals and forage crops) the yields of which are variable. In moist climates, yields of grass may be moderate to high but there may be difficulties in utilisation. The grade also includes very droughty arable land.

Grade 5 - very poor quality agricultural land

Land with very severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.

1.2 Climate and Relief

Average annual rainfall at both sites is approximately 660 mm and the accumulated temperature above $0^{o}C$ (January to June) is 1385 day ^{o}C. The land is at field capacity (ie maximum water content retained against gravity) for about 163 days a year. The combination of temperature and rainfall indicate that there is no overall climatic limitation on ALC grade.

The Organ Yard site lies at an altitude of 25 m aod and is level except for a slight north facing slope at the southern end. The Telford Terrace site is level at an altitude of 30 m aod.

1.3 Geology and Soils

1.3.1 Organ Yard: This site lies on the edge of the Aire floodplain. Soils however, are formed largely on made ground consisting of a peaty loam topsoil (see appendix, between 40 cm and 80 cm in thickness over coal ash and cindery material. On the south western edge of the site where the land rises slightly on to the adjoining river terrace, organic sandy loam topsoils overlie sandy clay loam subsoils. Droughtiness calculations based on a comparison of soil available water capacities[1] with summer moisture deficits indicate that droughtiness is unlikely to restrict crop growth on this site except in very dry years. Most soils on the Organ Yard site are well structured, unmottled and contain no slowly permeable[2] layers and thus fall within Wetness Class I (ie well drained).

1 Available water capacity is a measure of the amount of water held in a soil which can be used by plants.

2 Slowly permeable layer - poorly structured clayey or heavy textured layer through which water passes very slowly and so causes waterlogging in the soil above.

1.3.2 Telford Terrace: Although this site lies on the Aire terrace there are no light textured gravelly deposits typical of river terraces present and soils are formed on disturbed, heavy textured material, derived from Coal Measure shales or boulder clay. Topsoils consist of about 30 cm of medium organic clay loam over strongly mottled slowly permeable heavy silty clay loam or silty clay subsoils. Slowly permeable soils of this type meet the requirements of Wetness Class IV (ie poorly drained).

1.4 Land Use

Both sites are at present designated for use as allotments. In the MAFF Agricultural Land classification system allotments are usually placed within the "non-agricultural" category even though they are producing crops. This is done only because it is normally difficult to obtain access and permission to survey small areas in multiple occupancy. In this case, however, access was freely available to both sites and the land has been assessed as normal agricultural land.

1.5 Agricultural Land Classification

1.5.1 Organ yard

Grade or subgrade	Area	% of total land area
3b	0.9	90%
Not Surveyed	0.1	10%
Total	1.0	100

Subgrade 3b

The whole allotment area falls within this subgrade. Although soils are deep, easily worked and freely drained, chemical analyses (see section on soil fertility) show them to contain unacceptably high levels of certain toxic heavy metals, particularly cadmium. According to the agricultural land classification guidelines (page 15), "Land will not be graded higher than subgrade 3b if it is considered to be unsuitable for growing crops for direct human consumption". The Organ Yard site falls into this category and for this reason is restricted to subgrade 3b.

Not surveyed

This consists of a small derelict area at the north eastern corner of the site which is not used for allotments.

1.5.2 Telford Terrace

Grade or subgrade	Area	% of Total Areas
3b	0.6	100%

Subgrade 3b

All of the Telford Terrace site is placed within subgrade 3b. Soils are all heavy textured and consist of medium or heavy clay loam topsoils 25-30 cm in thickness over slowly permeable heavy clay loam or silty clay subsoils. Soils of this type fall within Wetness Class IV and in areas with more than 150 field capacity days (Hunslet = 163 days) are restricted to subgrade 3b by soil wetness and workability problems. An additional problem on this site is the pressure of rubble and concrete in a number of places.

Recommendations for the improvement of this site to a standard suitable for intensive allotment use are made in section 3 of this report.

2. SOIL FERTILITY AT THE ORGAN YARD AND TELFORD TERRACE SITES

2.1 Introduction

Soil samples (0-15 cm depth) were taken from both allotment sites to compare their potential for that purpose. Analysis included pH and lime requirement, major nutrients, minor nutrients, soil pests and potentially toxic elements (according to guidance Note 59-83 - "Guidance on the assessment and redevelopment of contaminated land" by the Interdepartmental Committee on the Redevelopment of Contaminated land.

The fertility of the Organ Yard site could be expected to be high as the allotments will have been tended intensively by enthusiastic occupants for many years. It is understood, however, that land at Organ Yard had been owned by a nearby sewage works and high heavy metal levels were suspected prior to sampling.

2.2 Soil analysis

2.2.1 Major nutrients

Appendix 2 shows soil analyses for pH and major nutrients. This analysis reflects the reserve of fertility built up in the soil and is related to previous fertiliser and manure applications. All of the pHs are satisfactory for vegetable production and so lime is not required on either site. Phosphorus, potassium and magnesium are all satisfactory to very well supplied. There is very little advantage in the Organ Yard site over the Telford Terrace site nutritionally except soil reserves of nutrients are generally higher.

2.2.2 Heavy metals and other toxic substances

Appendix 3 shows the analysis data for the above. All results have been compared with the ICRCL 'Trigger' concentration thresholds for allotments and all comments are based on these thresholds. Phenol, cyanides, sulphate and sulphide are all well within the acceptable limits for both sites.

Cyclohexane extractable oil is higher in the Organ Yard site than the Telford Terrace site, presumably reflecting the application of soot containing tar oils. This level is higher than would be desirable for the growth of crops and it may cause some loss in yield and quality

Boron is an essential plant nutrient and is very similar in both sites. Soils are considered satisfactory if boron levels range between 1.1-4.0 mg/l B.

Chromium and selenium are both at acceptable concentrations.

Arsenic, cadmium, lead, mercury, copper and zinc, however, all give rise for concern, particularly in the Organ Yard site. Arsenic, cadmium, lead and mercury can present significant public health risks. Cadmium and lead can be taken up by food plants and passed into the human food chain when consumed. Long term exposure to low level concentrations of cadmium is thought to result in growth retardation, cancer, hypertension, anaemia and kidney failure. Arsenic and mercury can adhere to plants, which are incompletely washed (particularly root vegetables), and injested in large quantities. Copper and zinc have a minimal impact on human health by plant uptake, however, they can have a phytotoxic (kill plant cells) effect on growing crops. Both sites are high in arsenic, copper and zinc and the Organ Yard site is high in cadmium, lead and mercury.

2.2.3 Soil samples were analysed for Potato Cyst Nematode (PCN) and Free Living Eelworm (FLE) as indicators of potential pest damage (See Appendix 4).

Potato Cyst Nematodes (PCN) - Generally the Telford Terrace samples have a lower infestation of PCN than the Organ Yard, With the exception of Telford Terrace we would not advise growing potatoes in any of the sites with a high (H) infestation. You would also expect damage to a potato crop grown where there was a moderate (M) infestation and a nematicide would be advisable (I would not consider using nematicides in an allotment - and I am not sure if there are any available).

Free Living Nematodes (FLN) -
Longidorus and Xiphinema - can cause direct feeding damage or act as virus vectors - none recorded on either the allotments or new site.

Trichodorus - stubby root nematodes - can cause direct feeding damage or act as virus vectors (eg transmit virus causing spraing in potatoes) - none recorded on new sites. Numbers found in Organ Yard allotments 1, 2 and 19 could be a potential virus vector threat or could cause direct damage to tap-rooted crops.

Heterodera - Larvae of PCN in soil. Greater numbers in Organ Yard reflects results from PCN analyses.

Other species Although the remaining species are potential pests of crop plants the numbers present are unlikely to pose any problems. The one possible exception is Pratylenchus spp which is present in greatest numbers in the new sites. However the pathogenicity of this beast is very dependant upon which species is present.

3. Recommendations

3.1 The heavy metal levels in the Organ Yard Allotments are excessively high and pose an environmental health risk. The extent to which this may affect individuals who consume vegetables grown on this area is difficult to assess. However, allotment holders ought to be made aware of the risks involved.

3.2 The high heavy metal levels override all other considerations when comparing the merits of the Organ Yard site versus the Telford Terrace site. Other factors such as soil nutrition or pests are of academic interest.

3.3 In terms of the physical nature of the two sites (ease of cultivation, depth of permeable soil, drainage and organic matter content) the Organ Yard site is superior to the Telford Terrace site. A major uplift of the Telford Terrace site will, therefore, be necessary to achieve this. The following is suggested:

- Remove all surface features and level the site.

- Import 1 m depth of permeable soil to the site and place in 30 cm deep layers. As these layers are placed, work a bulky organic material such as mushroom compost, organic manure, shoddy, leaf mould etc into the surface before depositing the next layer. This will incorporate organic matter into the full depth of the new soil profile.

- Install a drainage system appropriate to the nature of the imported soil. This will depend on soil texture, location of outfalls and intensity of system required.

- Analyse soil and apply fertiliser to increase soil nutrient status to an acceptable level.

- Deep loosen the whole site to a depth of 45 cm.

- Install water, fences, power, huts etc as agreed by the allotment holders and LDC.

MAPS

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APPENDIX 1

Schedule of Soil Auger Borings

Glossary of abbreviations used

Org	SL	Organic sandy loam
	SL	Sandy loam
	FSCL	Fine sandy clay loam
	SCL	Sandy clay loam
	MCL	Medium clay loam
	HCL	Heavy clay loam
	HZCL	Heavy silty clay loam
	C	Clay
	ZC	Silty clay

Mottles

Comm	Common
Dist	Distinct
Prom	Prominent
Och	Ochreous

Soil textures are defined according to the MAFF Agricultural Land Classification system.

All soil colours (eg 10YR5/6) are defined according to Munsell soil colour system (Munsell color Company Inc., Baltimore, Maryland, 2128, USA).

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A. Organ Yard, Schedule of Soil Auger Borings

Boring	Depth (cm)	Texture	Colour	Mottles
01	0-80	Org SL	N5	-
	80-100	Cinders/SL	N4	-
02	0-40	Org SL	N5	-
	40-100	Cinders	-	-
03	0-45	FSCL	10YR3/2	-
	45-80	MCL	10YR3/2	-
	80+	Hard (stone?)	-	-
04	0-40	Org SL	N5	-
	40-100	Cinders/SL	N4	-
05	0-50	Org SL	N5	-
	50-100	Cinders		
06	0-65	Org SL	N5	-
	65-100	SCL	10YRS/6	Comm dist.ochs and grey

B. Telford Terrace, Schedule of Soil Auger Borings

T1	0-35	MCL	5YR2.5/1	
	35-70	ZC/HZCL	10YR6/8	Comm dist.ochs and grey
	70-100	ZC	10YR5/3	Many dist.ochs. and grey
T2	0-30	MCL	10YR3/2	-
	20-40	HCL	10YR5/3	Many prom.ochs and grey
	40-100	C	10YR5/3	Many prom.ochs and grey
T3	0-100 (subsoil from surface)	HCL	10YR5/6	Many prom ochs and grey
T4	0-25	MCL	10YR3/2	-
	25-50	HCL	10YR5/3	Many prom.ochs and grey
	50-100	C	10YR5/3	Many prom.ochs and grey

APPENDIX 2

PARTICLE SIZE ANALYSIS (TEXTURE) AND ORGANIC MATTER

Site	Org Mat %	Coarse Sand %	Medium Sand %	Fine Sand %	Coarse Silt %	Fine Silt %	Clay %	Soil Texture %
Organ Yard - Allotment								
No. 1 + 2	30.2	8	17	28	14	21	12	Peaty loam
5	25.7	13	16	18	15	22	16	Peaty loam
13	26.3	18	18	17	12	22	13	Peaty loam
19	26.1	13	18	25	14	19	11	Peaty loam
Telford Terrace								
1	18.2	16	15	18	13	21	17	Organic sandy silt loam
2	16.8	11	16	21	14	20	18	Organic clay loam
3	19.9	12	17	20	13	20	18	Organic clay loam
4	19.6	11	20	16	12	22	19	Organic clay loam

Particle size range -		
	Coarse sand	600-2000 um
	Medium sand	212-600 um
	Fine sand	63-212 um
	Coarse silt	20-63 um
	Fine silt	2-63 um
	Clay	<2 um

APPENDIX 3

SOIL FERTILITY ANALYSES

Site	pH	Phosphorus mg/l(index)	Potassium mg/l(index)	Magnesium mg/l(index)	Nitrate mg/l(index)	Conductivity micro S (index)
Organ Yard						
Altmnt No 1+2	7.5	129 (6)	401 (4)	140 (3)	20 (0)	2043 (0)
5	7.7	699 (9)	224 (2)	920 (7)	5 (0)	1992 (0)
13	7.7	70 (4)	86 (1)	84 (2)	10 (0)	1992 (0)
19	7.4	86 (5)	179 (2)	85 (2)	16 (0)	2000 (0)
Telford Terrace						
1	6.7	99 (5)	280 (3)	94 (2)	34 (1)	2088 (0)
2	7.3	98 (5)	359 (3)	117 (3)	8 (0)	2043 (0)
3	6.8	91 (5)	209 (2)	117 (3)	2 (0)	1992 (0)
4	7.2	89 (5)	232 (2)	134 (3)	5 (0)	2000 (0)

Interpretation: a. pH Optimum for vegetables 6.5-7.0

b. Phosphorus, potassium, magnesium

Index		
	0	Deficient
	1-2	Low to moderate
	3-9	Good to excessive

c. Nitrate and conductivity - index 0 is common for a field soil

APPENDIX 4

TOXIC ELEMENT RESULTS - HEAVY METALS (mg/kg)

	Arsenic	Cadmium	Chromium	Lead	Mercury	Selenium	Copper	Nickel	Zinc
Organ Yard									
Alltmnt No 1+2	66	3.6	65	540	1.37	0.3	325	36	481
5	11	3.3	67	385	1.17	1.3	228	30	359
13	65	3.5	70	473	1.75	0.6	261	41	455
19	66	3.3	114	670	3.35	0.9	313	45	540
Telford Terrace									
1	39	2.6	57	432	0.45	1.3	153	40	580
2	37	2.1	69	399	0.60	1.3	152	39	530
3	47	2.3	85	391	0.59	0.5	147	47	500
4	39	2.1	89	356	0.52	1.0	128	42	457

TOXIC ELEMENT RESULTS

	Available Boron mg/l	Pherols mg/l	Cyanides mg/l	Sulphate mg/l	Sulphide mg/l	oils/tars %
Organ Yard						
Alltmnt No 1+2	1.3	< 2	< 1	17	3	1.0
5	1.1	< 2	< 1	6	2	0.7
13	0.9	< 2	< 1	8	2	0.8
19	0.9	< 2	< 1	13	4	1.1
Telford Terrace						
1	0.9	< 2	< 1	69	72	0.4
2	0.9	< 2	< 1	22	57	0.4
3	0.7	< 2	< 1	8	77	0.4
4	0.7	< 2	< 1	12	37	0.4
Maximum recommended soil concentration	4.1	5	25	2000	250	

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APPENDIX 5

SOIL PEST RESULTS

POTATO CYST NEMATODES (PCN):

Site	Viable eggs /gramme soil	Viable cysts /100g soil	Advisory Category
Organ Yard			
1 + 2	240	205	H
5	19	42	M
13	146	101	H
19	75	103	H
Telford Terrace			
1	345	122	H
2	1	1	L
3	0	1	L
4	2	3	L

H = High M = Medium L = Low

Free living nematodes (FLN)

Species	Number per litre soil							
	1	2	3	4	1+2	5	13	19
Longidorus SPP	0	0	0	0	0	0	0	0
Xiphinema spp	0	0	0	0	0	0	0	0
Trichodorus spp	0	0	0	0	25	0	0	50
Heterodera spp	1875	0	0	50	1425	550	2550	600
Tylenchorynchus spp	175	0	50	150	125	25	250	0
Pratylenchus spp	325	250	550	75	75	50	25	0
Spirals	0	25	0	0	0	0	0	0
Paratylenchus spp	75	0	0	75	0	25	75	50