A REPORT TO ANY TOWN PRIMARY SCHOOL

A feasibility study for proposed improvement works to the playing field at Any Town Primary School.

17 July 2013

Directors: Dr Richard Earl, Tim Colclough, Dr Iain James
Registered Office: TGMS Limited ♦ Cranfield Innovation Centre ♦ University Way ♦ Cranfield ♦ Bedfordshire ♦ MK43 0BT. Company Registration Number: 06623973

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1 EXECUTIVE SUMMARY ANY TOWN PRIMARY SCHOOL

KEY: **No action required** **Action may be required** **Action required**

Site information

	1.	The principal objective of this project is to improve the quality of the playing field which suffers from poor drainage.
	2.	The site currently comprises a natural turf recreation area. A land drainage system was installed in around 1990, however in recent years the pitches have been suffering from poor drainage in winter.
	3.	A shallow ditch runs parallel with the northern site boundary and terminates in an inspection chamber. This inspection chamber would provide a convenient means of disposal of excess water should a new land drainage scheme be installed.
	4.	Based on the ADAS 345 method, a drainage scheme (if required) should be designed to accommodate a peak drain flow rate of approximately **8.6 L s^{-1} ha^{-1}**.
	5.	The site does not lie within an indicative flood plain.
	6.	According to Sheet 6 of the Soil Survey of England and Wales 1:250,000 soil map (1983), the indigenous soil in this area may form part of the FRILFORD Soil Association. The underlying geology for this area is Mesozoic and Tertiary sands and the soils are characterised by deep well drained sandy and coarse loamy soils.
	7.	With respect to gradient, the site falls from the south-western corner to the north-eastern corner at an average gradient of approximately 1.7 %. The gradients of pitches comply with guideline values stipulated by Sport England, however given that the gradient along the length of the pitches is close to the recommended maximum, then consideration should be given to rotating the pitches round by 90°. The area contains some undulations and depressions and would benefit from re-grading.
	8.	The pitches are generally orientated to 98° and therefore do not comply with Sport England guidance with respect to addressing low winter sunshine. If the pitches were to be rotated by 90° to take account of the gradient along the length of the pitches, then this would also mean that the pitches would comply with Sport England recommendations for pitch orientation.
	9.	The site is characterised by sandy loam or loamy sand topsoil over sandy loam or sand subsoil. Although these soils are generally considered to be ideal for the construction of winter games pitches as they are normally relatively freely draining, they are also prone to compaction when played on in wet conditions which can significantly impede drainage rates. In addition, there is evidence that the site is affected by seasonal shallow groundwater. The result is a playing surface that is poorly drained during winter months and following high intensity/duration rainfall events at other times of the year.
	10.	A land drainage scheme installed around 1990 is poorly designed (the lateral drains are too widely spaced) and no longer functional due to ingress of soil in the permeable backfill.
	11.	Sward cover ranged from 80 % to 100 % (mean of 95 %) with 30 % to 40 % broad leaved weeds (mainly creeping buttercup, daisy and plantain). The grass condition can be improved by following a careful turf management system encompassing herbicide applications, over-seeding and top dressing to fill any undulations across the site.
	12.	With respect to nutrient status, the topsoil is generally deficient for the major plant nutrients Phosphorus and Potassium. Therefore, it is recommended that the fertiliser regime be adjusted to increase the concentration of these nutrients. Soil pH in the range of 6.0 – 6.1 is ideal for the cultivation of perennial ryegrass species.
	13.	In its current state, it is anticipated that the number of hours of play that could be supported by the playing field without causing excessive wear and tear on the grass sward or damage to soil structure will be limited by the relatively low permeability of the topsoil and subsoil due to compaction and poor functionality of the land drainage scheme.

Recommendations

Re-arrange the pitch layout to accommodate either (A) 1 No. U11/U12 80 x 50 yard 9v9 pitch, 1 No. U9/U10 60 x 40 yard 7v7 pitch and 1 No. U7/U8 40 x 30 yard 5v5 pitch, or (B) 1 No. U13/U14 90 x 55 yard 11v11 pitch plus 2 No. U7/U8 40 x 30 yard 5v5 pitches. In order to create a well-drained, uniform, playing surface, consideration should be given to:

Option 1 (recommended option)	Re-grading and the installation of a new land drainage scheme.
Option 2 (intermediate option)	Installation of a land drainage scheme.
Option 3 (Low cost, less effective option)	Decompaction and enhanced agronomic maintenance.

The total costs for the pitch works, inclusive of preliminaries, 10% contingency and 12-months agronomic maintenance post-construction (Options 1 and 2 only), could be in the region of

Option 1	**£80,905 + VAT**
Option 2	**£66,715 + VAT**
Option 3	**£10,505 + VAT**

These estimates do not include the cost of professional fees and permissions, or VAT where applicable. An indicative work programme is also provided.

Richard Earl -– July 2013

2 INTRODUCTION AND OBJECTIVES

TGMS Limited has conducted a detailed site investigation at Any Town Primary School to explore the feasibility of improving the quality of the playing field.

The objectives of the feasibility study are as follows:

- To undertake a detailed site investigation in order to characterise the underlying soil profile.
- To prepare a set of development options for redevelopment of the existing recreation area.
- To derive indicative construction costs for budgetary purposes and present costed options where applicable.
- To provide an indicative work programme for the possible phasing and duration of the proposed construction works. This will also indicate when the recreation area may be available for use.

3 PHYSICAL SITE SURVEY

TGMS Limited carried out an initial survey of the site on the 15th May 2013. The area was surveyed in order to produce topographical data (RTK-GPS) and to establish the degree of variation in the type and condition of soil at different locations (Electro-magnetic inductance scan). Maps produced from the scanning operation were used as a basis for identifying appropriate locations for more detailed investigations to be conducted during a follow-up site visit. Dr Richard Earl conducted the follow-up visit on the 5th June 2013.

3.1 Site location and access

Any Town Primary School
Any Road
Any Town
AB12 3CD

Grid reference;
Eastings 123456
Northings 654321

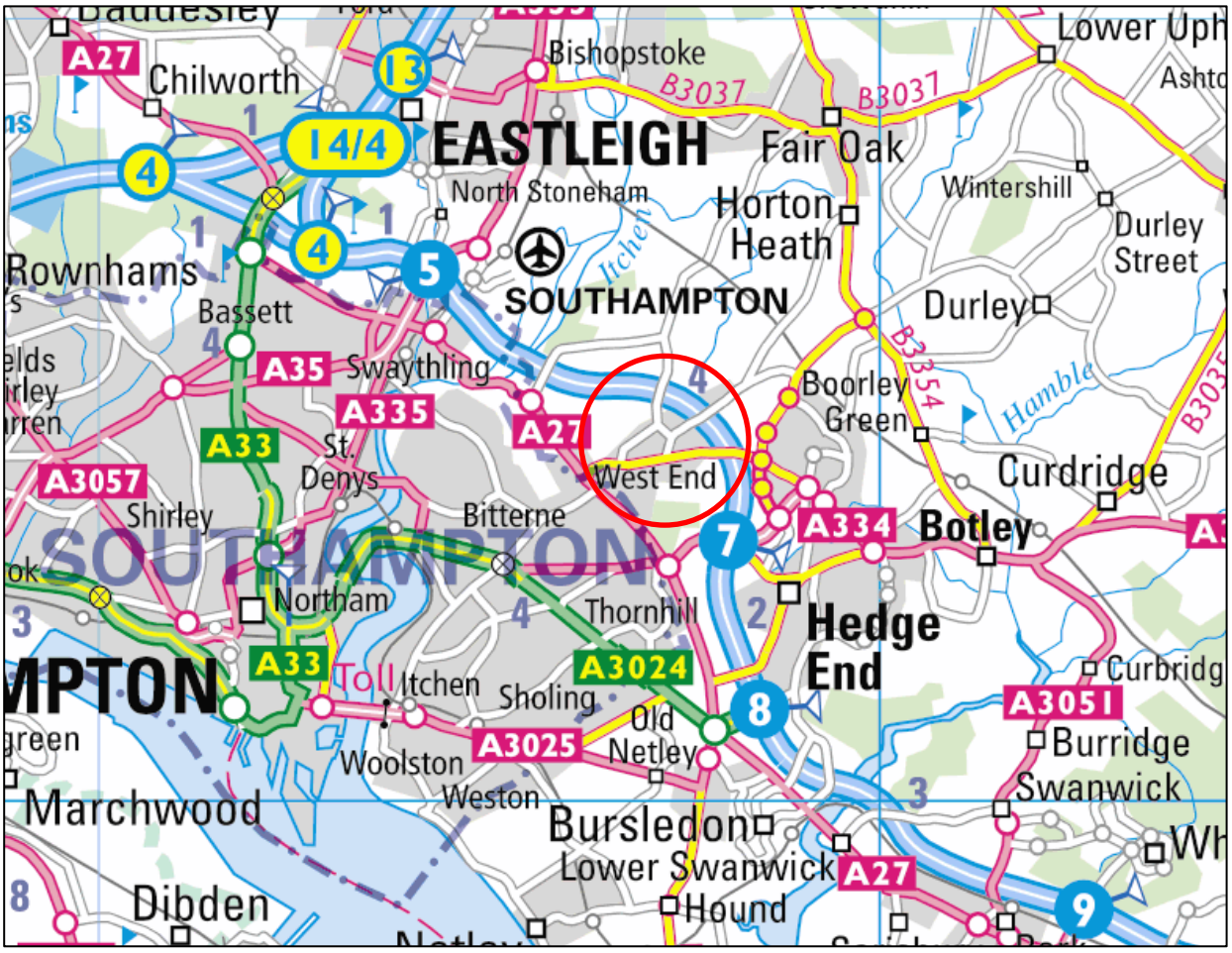

Figure 1 Site location (red circle). The location circle is indicative only and not to scale.

The site currently comprises a natural turf recreation area. According to the Site Manager, a land drainage system was installed some years ago however in recent years the pitches have been getting very boggy in winter.

A copy of the land drainage layout drawing was made available which indicates that the scheme was installed around 1990 and comprised a system of widely spaced (~20 m apart) lateral drains in combination with sand slits installed at 2 m spacing, outfalling into an inspection chamber to the east of the site. Approximate locations of the drains are presented in Figure 4.

Figure 2. General View 1 (GV1) of site looking east

Figure 3. General View 2 (GV2) looking south-east.

Figure 4 Any Town Primary School re-development. TP1 and TP2 mark the location of the trial pits. The dashed red line indicates the site development area (indicative only –not to scale). GV1 and GV2 are general views of the site and refer to Figure 2 and Figure 3 respectively. 'IC' represents an inspection chamber on site and the blue lines represent the approximate location of drains.

3.2 Geomorphology and climate

3.2.1 Hydrology

A shallow ditch runs parallel with the northern site boundary and terminates in IC 1 (Figures 5 & 6). With respect to climate, data obtained from the Flood Estimation Handbook (FEH) indicate that the standard-period average annual rainfall (SAAR) is 806 mm for this catchment. Based on existing levels (provided by TGMS) and using the methodology for calculating peak flood flow developed by ADAS[1], it is estimated that the peak flood flow rates will be **8.6 L s^{-1} ha^{-1}**; this method is based on a 1:5 year rainfall return event.

Figure 5. Shallow ditch running into IC 1

Figure 6. 150 mm carrier drain connected to IC 1.

Based on information obtained from the Environment Agency (EA), the site is located in Flood Zone 1 and at very low risk of flooding from rivers or sea (Figure 7).

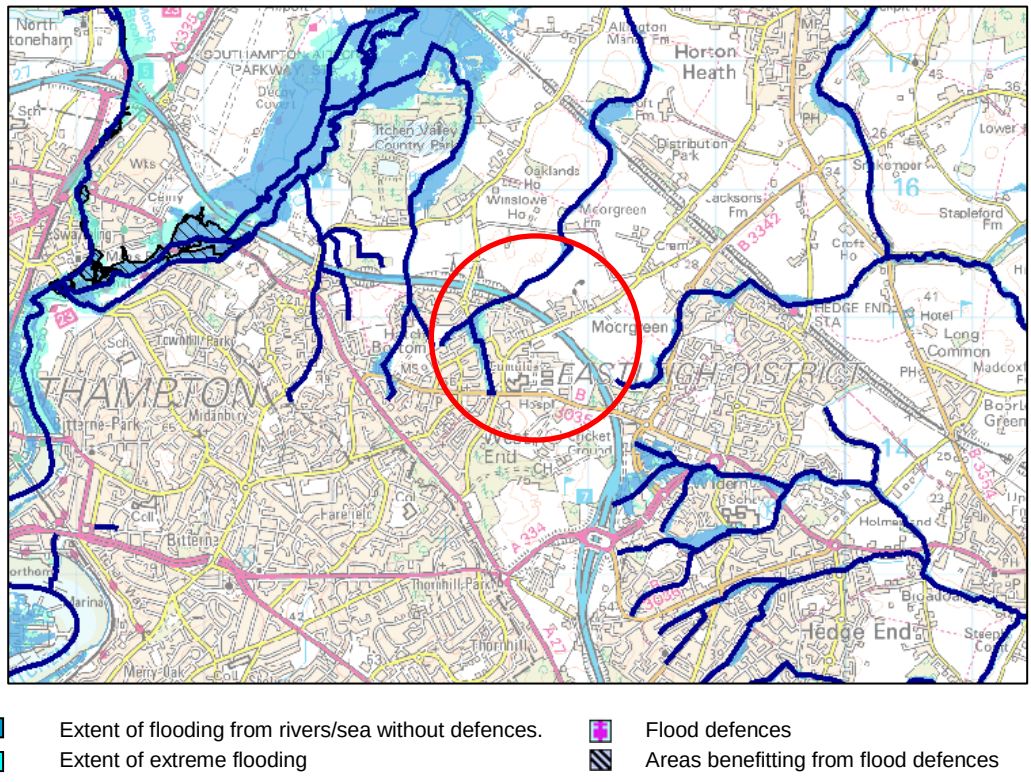

Figure 7 Flooding from rivers or the sea. Reproduced from the Environment Agency website [Accessed 21 June 2013]

[1] (Anon. 1983. Ministry of Agriculture, Fisheries and Food Reference Book 345: The design of field drainage pipe systems. Her Majesty's Stationery Office, London. 20pp.)

3.2.2 Soils and geology

According to Sheet 6 of the Soil Survey of England and Wales 1:250,000 soil map (1983), the indigenous soil in this area may form part of the FRILFORD Soil Association. The underlying geology for this area is Mesozoic and Tertiary sands and the soils are characterised by deep well drained sandy and coarse loamy soils.

3.3 Topographical (levels) survey

An important aspect of site evaluation and remediation is appropriate utilisation of the natural grade (slope) of the site to optimise future earthworks and effect rapid removal of excess water. Topographical data were collected at a sampling density of approximately 10,000 data points / ha using RTK-GPS equipment, which is accurate to within ± 3 cm; these data are appended using 0.25 m contour intervals.

With respect to gradient, the site falls from 34.00 m Above Ordnance Datum (AOD) in the south-western corner to 32.25 m AOD in the north-eastern corner at an average gradient of approximately 1.7 %.

3.4 Electromagnetic inductance (EMI)

EMI scanning is a non-invasive method for assessing the degree of variation in soil type and/or condition. The results are predominately affected by clay content and water content and, therefore, the technique provides a rapid means for determining the most appropriate locations around a site for conducting more detailed analyses of the soil, including the excavation of soil test pits. Very often, the EMI scan can also detect the presence of existing drainage infra-structure, electricity cables or water mains.

EMI maps of the results of scans of the top 0.75 m (termed 'Horizontal EMI Scan') and the top 1.5 m (termed 'Vertical EMI Scan') of the soil beneath the surface of the site are appended. With reference to these figures, lighter coloured areas typically represent drier and/or less clayey conditions whereas darker coloured areas typically represent wetter and/or more clayey conditions. With respect to the EMI scan images, the condition or type of soil across the site varies with wetter and/or more clayey soils in the northern half of the area and drier and/or sandier soils in the south.

3.5 Proposed pitch layout and grading

The site comprises a rectangular area of natural turf of approximately 94 m x 91 m. With reference to the latest guidance from the Football Association on recommended pitch sizes (which is presented in 'yards' rather the 'metres'), this provides the flexibility to accommodate either:

Option A:
1 No. U11/U12 80 x 50 yard 9v9 pitch
1 No. U9/U10 60 x 40 yard 7v7 pitch
1 No. U7/U8 40 x 30 yard 5v5 pitch.

or

Option B:
1 No. U13/U14 90 x 55 yard 11v11 pitch
2 No. U7/U8 40 x 30 yard 5v5 pitches

Sport England has usefully provided some guidance on the maximum acceptable slopes for natural turf sports pitches. In summary, the maximum slope along the direction of play should not exceed 1.25%, whilst the maximum cross-fall should not exceed 2.00%. However, it is not desirable for both the longitudinal and cross-falls to be at these maximum values. Sport England guidance, along with the survey data, is presented in Table 1 below.

Table 1. Summary of maximum recommended slopes for sports pitches as specified by Sport England compared with actual gradients measured on site.

	Sport England Guidance		Measured on site	
	Along length	*Across width*	*Along length*	*Across width*
Any Town Primary School	1.25%	2.00%	1.25 %	1.10 %

Red box denotes gradient is outside Sport England recommendations.

With reference to Table 1, the gradients of pitches comply with guideline values stipulated by Sport England, however given that the gradient along the length of the pitches is close to the recommended maximum, then consideration should be given to rotating the pitches round by 90°.

With respect to minor surface levels, the area contains some undulations and depressions and would benefit from re-grading.

With respect to pitch orientation, Sport England has published guidance on optimum pitch orientation for a range of sports (Figure 8). For winter sports pitches the limits of orientation are 285° and 20°.

With reference to Figure 8, the pitches are generally orientated to 98° and therefore do not comply with the guidance.

If the pitches were to be rotated by 90° to take account of the gradient along the length of the pitches, then this would also mean that the pitches would comply with Sport England recommendations for pitch orientation.

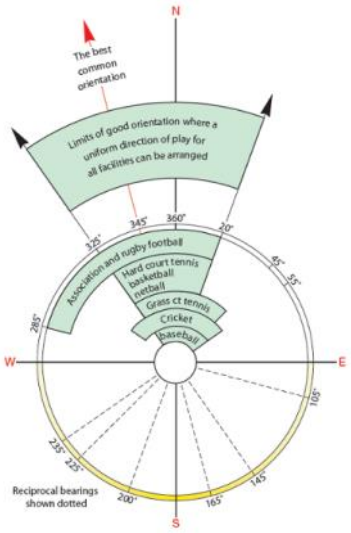

Figure 8. Optimum pitch orientation (Sport England).

3.6 Soil sampling

Two soil trial pits (TP1 & TP2, Figure 4) were excavated by hand to characterise the underlying soil profile. Soil samples were removed for laboratory analysis to determine soil texture and basic nutrient status. The two pits were also located such that they coincided with an intersection with a lateral drain and a sand slit. These were located using a spiked probe (Figure 9).

3.6.1 Trial Pit Profile Description

TP1 was located towards the north-western corner of the site in an area demarcated by the EMI scan as being relatively wetter and/or more clayey. The lateral drain was found to comprise 60 mm of loamy sand topsoil over sand to 100 mm depth over 6 to 14 mm gravel over a 60 mm diameter pipe with a soffit at 490 mm below ground level (bgl). The gravel was contaminated with ingress of soil which will be compromising permeability (Figure 11).

A slit drain intersected the lateral drain at 90° (Figures 10 and 12) and was found to comprise 60 mm of loamy sand topsoil over 6 to 14 mm gravel to 250 mm however the gravel was badly contaminated with soil ingress. For slit drains to function efficiently, it is important that the permeable backfill extends to the surface so that it can intercept surface water and convey it rapidly to the system of lateral drains below. The slit drain excavated at TP1 was found to be capped off by 60 mm of topsoil thereby completely compromising its function.

Figure 9. Locating drains using a spiked probe.

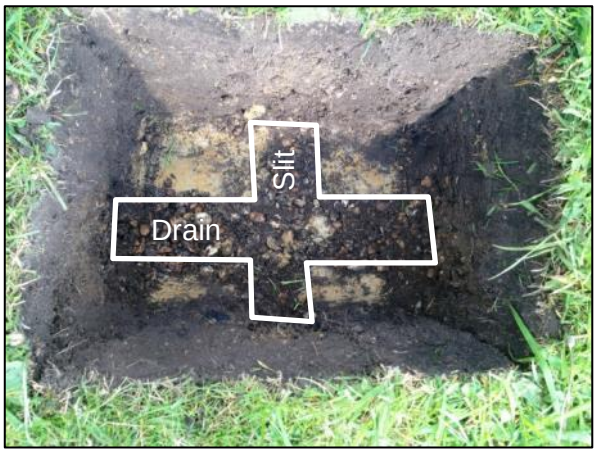

Figure 10. Intersection of drain and slit drain – TP1.

Figure 11. Gravel contaminated with soil.

Figure 12. Excavation of slit drain – TP1.

Away from the drain, the underlying soil profile was found to comprise 170 mm of loamy sand topsoil (Figure 13) over yellow sandy loam subsoil to 0.80 m over dark organic-rich subsoil (probably formally the original topsoil prior to earthworks associated with the M27) which extended beyond the maximum depth of excavation of 1.0 m (Figure 14).

Figure 13. 170 mm of topsoil – TP1.

Figure 14. Subsoil – TP1.

It is concluded that the drainage status in the vicinity of TP 1 is being compromised through a combination of drainage infrastructure being capped off with 60 mm of topsoil, contamination

of the permeable backfill in the drains with soil, excessively wide spacing of lateral drains (20 m whereas a spacing of 3 to 4 m is recommended), general compaction of the topsoil as a result of playing on the pitches in wet conditions and a lack of decompaction operations as part of a routine maintenance schedule.

TP2 was located towards the south-eastern corner of the site in an area demarcated by the EMI scan as being relatively drier and/or sandier. The soil profile was found to comprise 200 mm of compact sandy loam topsoil (Figure 15) over compact, light yellow sand which extended beyond the maximum sampling depth of 1.2 m (Figure 16). No ground water was encountered in the upper 1.2 m of the soil profile however there was evidence of mottling (orange discolouration) which is indicative of seasonal waterlogging and so although the sand subsoil is likely to be relatively freely draining, it may be sitting on less permeable strata which could be causing a perched water table to build up in the winter months when the rate of precipitation exceeds the rate of water loss though transpiration through the grass leaves and evaporation from the surface.

Figure 15. 200 mm of topsoil over sand – TP2.

Figure 16. Yellow sand subsoil – TP2.

Water content (by volume) was measured using a Theta Probe (Figure 17) and found to be 25.4 % at the surface reducing to 19.2 % at the interface between the topsoil and subsoil. This indicates that the underlying subsoil is relatively freely draining and that the poor drainage status experienced in recent years can be largely attributed to the degree of compaction in the topsoil (Figure 18). An effective land drainage scheme would manage the development of a perched water table in winter.

Figure 17. Measurement of water content using a Theta Probe.

Figure 18. Compact topsoil – TP2.

It is concluded that the drainage status in the vicinity of TP 2 is being compromised through a combination of drainage infrastructure being capped off with 60 mm of topsoil, contamination of the permeable backfill in the drains with soil, excessively wide spacing of lateral drains, general compaction of the topsoil as a result of playing on the pitches in wet conditions and a lack of decompaction operations as part of a routine maintenance schedule.

3.6.2 Soil Texture

Laboratory analysis of soil texture confirmed field observations (Table 2).

Table 2 Soil texture

Trial Pit	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
1	0.00 – 0.17	76	18	6	LOAMY SAND
	0.17 – 0.80	71	12	17	SANDY LOAM
	0.80 - >1.00	62	19	19	SANDY CLAY LOAM
2	0.00 – 0.20	67	25	8	SANDY LOAM
	0.20 – 1.20	88	6	6	SAND

3.6.3 Topsoil Nutrient Status

Samples of topsoil were sent to a contract laboratory for analysis of nutrient status (Table 3).

Table 3 Topsoil nutrient status

Trial Pit	pH	Phosphorus (P) (mg/l)	Index	Potassium (K) (mg/l)	Index	Magnesium (Mg) (mg/l)	Index
1	6.1	3.8	0	57	0	70	2
2	6.0	2.8	0	38	0	43	1

Indices of 2 and above indicate that there is sufficient supply of a particular nutrient. With reference to Table 3, the nutrient status of the topsoil is generally deficient for the major plant nutrients Phosphorus and Potassium. Therefore, it is recommended that the fertiliser regime be adjusted to increase the concentration of these nutrients. Soil pH in the range of 6.0 – 6.1 is ideal for the cultivation of perennial ryegrass species.

In summary, the site is characterised by sandy loam or loamy sand topsoil over sandy loam or sand subsoil. Although these soils are generally considered to be ideal for the construction of winter games pitches as they are normally relatively freely draining, they are also prone to compaction when played on in wet conditions which can significantly impede drainage rates. In addition, there is evidence that the site is affected by seasonal shallow groundwater. The result is a playing surface that is poorly drained during winter months and following high intensity/duration rainfall events at other times of the year.

In order to correct this situation, consideration should be given to the installation of a new surface by-pass drainage system. These systems work by intercepting rain water at the surface before it has had an opportunity to soak in to the soil profile, and then removing this water to a system of piped drains. Typical systems would comprise sand grooves (Figure 19) linked into a system of lateral drains beneath the playing field.

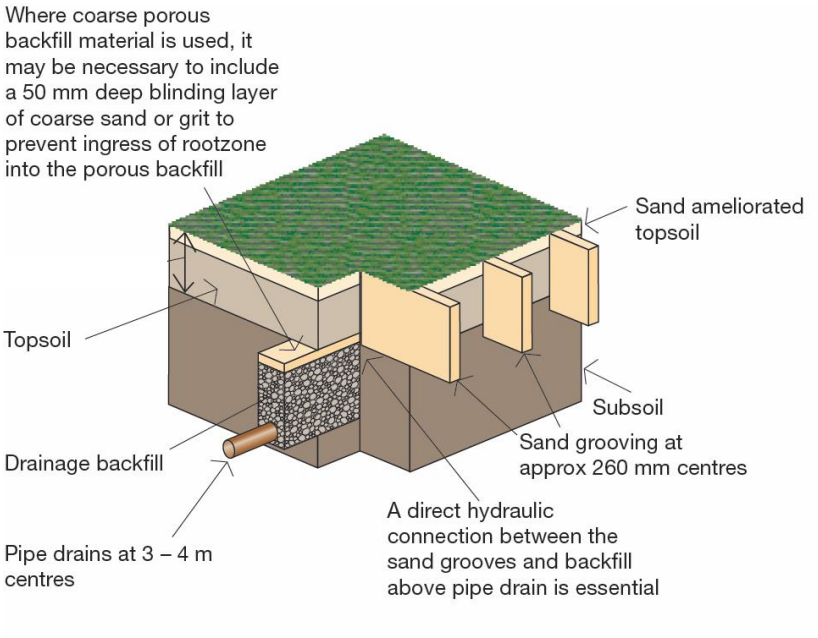

Figure 19. Typical sand groove based surface by-pass drainage system (Ref: Sport England Design Guidance Note "Natural Turf for Sport", 2011).

In addition, shallow groundwater will cause upward movement of water through capillarity and surface tension effects (i.e. a wicking action). The shallow groundwater may be an atypical occurrence resulting from the unusually wet weather experienced recently, however if this is not the case, then the area would benefit from the installation of a drainage scheme designed to deal with this (Figure 20).

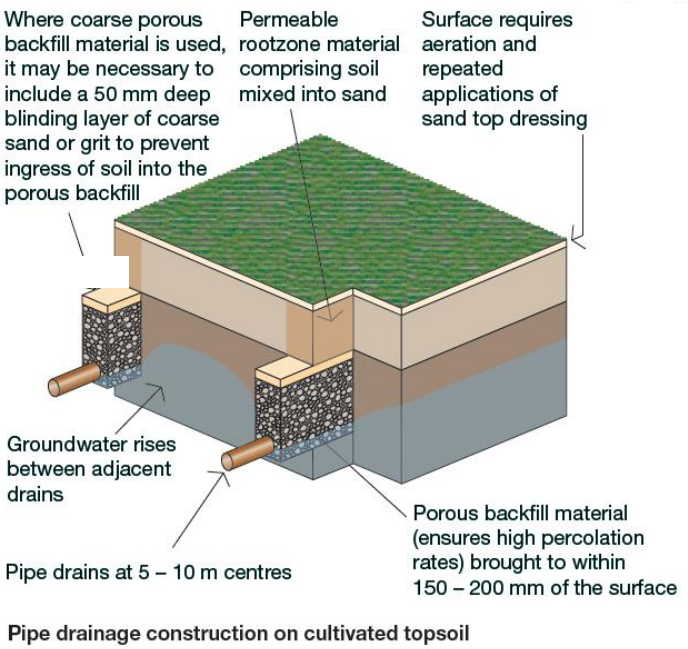

Figure 20. Typical groundwater drainage system (Ref: Sport England Design Guidance Note "Natural Turf for Sport", 2011).

3.7 Existing drainage infrastructure

The land drainage scheme installed around 1990 is poorly designed (the lateral drains are too widely spaced) and no longer functional due to ingress of soil in the permeable backfill.

3.8 Agronomic assessment

Sward cover ranged from 80 % to 100 % (mean of 95 %) with 30 % to 40 % broad leaved weeds (mainly creeping buttercup, daisy and plantain - Plates 21 & 22).

Plate 21. Creeping buttercup.

Plate 22. Daisy.

The grass condition can be improved by following a careful turf management system encompassing herbicide applications, over-seeding and top dressing to fill any undulations across the site.

3.9 Site usage

It is difficult to predict with any accuracy the likely improvement in hours of play achievable if the pitches were to be renovated and a new drainage scheme installed as this depends on local weather conditions, schedule of use, age of participants and the quality of the on-going maintenance, however Sport England considers the following (Table 4) to represent a reasonable estimation (Ref: Natural Turf for Sport, 2000, ISBN 1 86078 103 9 – 2nd Edition, 2011).

Table 4 Sport England estimated usage levels

Drainage status	Adult weekly use* (hours)
Undrained	Under 2
Pipe-drained	2 - 3
Pipe-drained with mole drains	2 - 4
Pipe-drained with sand grooves	3 - 6
Pipe-drained with slit drains	3 - 6
Pipe-drained with topsoil and drainage layer	3 - 6
Pipe and slit drained	3 - 6
Pipe-drained with suspended water table	4 - 6

*The usage levels shown will increase by ~50 % for players 15 years of age and under.

3.10 Performance Quality Standards (PQS)

Performance Quality Standards (PQS) provide a recommended minimum quality standard for the construction and maintenance of natural turf pitches. PQS were originally developed via a voluntary technical consortium with representation from the Sports Turf Research Institute, National Playing Fields Association and the Institute of Groundsmanship, and have now been adopted by Sport England and Governing Bodies of Sport (Ref: Appendix 4 of Natural Turf for Sport, 2000, ISBN 1 86078 103 9 – 2nd Edition, 2011).

Sport England has produced a pro forma for summarising the condition of natural turf sports pitches by conducting a Performance Quality Standard assessment and comparing the results for a given site against minimum standards. The results of this assessment are presented in Appendix I.

4 SUMMARY AND RECOMMENDATIONS

4.1 Principal factors affecting the condition of the site

1. The principal objective of this project is to improve the quality of the playing field which suffers from poor drainage.
2. The site currently comprises a natural turf recreation area. A land drainage system was installed in around 1990 however in recent years the pitches have been suffering from poor drainage in winter.
3. A shallow ditch runs parallel with the northern site boundary and terminates in an inspection chamber. This inspection chamber would provide a convenient means of disposal of excess water should a new land drainage scheme be installed.
4. Based on the ADAS 345 method, a drainage scheme (if required) should be designed to accommodate a peak drain flow rate of approximately **8.6 L s^{-1} ha^{-1}**.
5. The site does not lie within an indicative flood plain.
6. According to Sheet 6 of the Soil Survey of England and Wales 1:250,000 soil map (1983), the indigenous soil in this area may form part of the FRILFORD Soil Association. The underlying geology for this area is Mesozoic and Tertiary sands and the soils are characterised by deep well drained sandy and coarse loamy soils.
7. With respect to gradient, the site falls from 34.00 m AOD in the south-western corner to 32.25 m AOD in the north-eastern corner at an average gradient of approximately 1.7 %. The gradients of pitches comply with guideline values stipulated by Sport England, however given that the gradient along the length of the pitches is close to the recommended maximum, then consideration should be given to rotating the pitches round by 90°. The area contains some undulations and depressions and would benefit from re-grading.
8. The pitches are generally orientated to 98^{o} and therefore do not comply with Sport England guidance with respect to addressing low winter sunshine. If the pitches were to be rotated by 90° to take account of the gradient along the length of the pitches, then this would also mean that the pitches would comply with Sport England recommendations for pitch orientation.
9. The site is characterised by sandy loam or loamy sand topsoil over sandy loam or sand subsoil. Although these soils are generally considered to be ideal for the construction of winter games pitches as they are normally relatively freely draining, they are also prone to compaction when played on in wet conditions which can significantly impede drainage rates. In addition, there is evidence that the site is affected by seasonal shallow groundwater. The result is a playing surface that is poorly drained during winter months and following high intensity/duration rainfall events at other times of the year.
10. A land drainage scheme installed around 1990 is poorly designed (the lateral drains are too widely spaced) and no longer functional due to ingress of soil in the permeable backfill.
11. Sward cover ranged from 80 % to 100 % (mean of 95 %) with 30 % to 40 % broad leaved weeds (mainly creeping buttercup, daisy and plantain). The grass condition can be improved by following a careful turf management system encompassing herbicide applications, over-seeding and top dressing to fill any undulations across the site.
12. With respect to nutrient status, the topsoil is generally deficient for the major plant nutrients Phosphorus and Potassium. Therefore, it is recommended that the fertiliser regime be adjusted to increase the concentration of these nutrients. Soil pH in the range of 6.0 – 6.1 is ideal for the cultivation of perennial ryegrass species.

13. In its current state, it is anticipated that the number of hours of play that could be supported by the playing field without causing excessive wear and tear on the grass sward or damage to soil structure will be limited by the relatively low permeability of the topsoil and subsoil due to compaction and poor functionality of the land drainage scheme.

4.2 Development options

Based on the findings from the site investigation, development options will need to address a combination of compaction, shallow groundwater and impeded surface water infiltration rates. The following options are tailored to address the various issues encountered across the site.

4.2.1 Option 1: Site remodelling and installation of a drainage scheme.

Based on the findings from the site assessment, the following development option is recommended for the whole site.

1. Removal of existing vegetation.
2. Cultivation of topsoil (ca 200 mm depth) to incorporate the organic matter residue.
3. Strip topsoil and remove to stockpile on-site for re-use.
4. Regrading earthworks within the subsoil to create new levels.
5. Replace topsoil from stockpile and laser grade to final levels.
6. Stone pick.
7. Installation of a pipe drainage scheme linked to existing outfall.
8. Establishment of a new grass sward (including seeding and fertiliser).
9. Verti-draining of established sward to relieve compaction.
10. Installation of a secondary bypass drainage scheme.
11. Application of 3 x 8 mm of sand topdressing.

4.2.2 Option 2: Installation of a drainage scheme.

If budget does not permit Option 1 then Option 2 would comprise:

1. Fraise mowing to removal a proportion of the existing vegetation.
2. Installation of a new pipe drainage scheme linked to existing outfall.
3. Overseeding and fertiliser.
4. Verti-draining of established sward to alleviate compaction.
5. Installation of a secondary bypass drainage scheme.
6. Application of 3 x 8 mm of sand topdressing.

4.2.3 Option 3: Decompaction and enhanced agronomic maintenance.

If budget does not permit Option 2 then Option 3 would comprise:

1. Fraise mowing to removal a proportion of the existing vegetation.
2. Compaction alleviation (e.g. Vertidraining).
3. Selective weed control (as required).
4. Pest and disease control (as required).
5. Fertiliser application.
6. Overseeding
7. Application of 1 x 6 mm of sand top dressing.

4.2.4 12-months maintenance post-construction

Depending on the construction option selected, timetable and funding requirements, it is possible that on-going maintenance will be required for the first 12-months following completion of the remediation works. This will include the following items:

1. Mowing.
2. Overseeding
3. Fertiliser application.
4. Compaction alleviation (e.g. Vertidraining).
5. Selective weed control (as required).
6. Pest and disease control (as required).

N.B.:

- **Earthworks should only be carried out under suitable weather and ground conditions (i.e. soil in a dry and friable state) to avoid structural damage.**
- **In order to maintain the playability of the surface in the longer-term, the site would benefit from light annual sand topdressing. This should be factored into the on-going maintenance budget for the site.**

4.3 Indicative cost estimates

4.3.1 Natural turf pitch works

	Option 1 (0.85 ha)	Option 2 (0.85 ha)	Option 3 (0.85 ha)
Removal of existing vegetation (flail mow and herbicide application)	£600		
Partial removal of existing vegetation (fraise mowing)		£1,750	£1,750
Rotary cultivate existing topsoil	£550		
Strip top soil and stockpile on site	£3,000		
Regrading earthworks	£1,700		
Deep soil loosening	1,150		
Replace topsoil	£3,750		
Final cultivations and (laser) grading	£1,700		
Stone removal	£1,700		
Installation of a piped drainage infrastructure including surface bypass drainage.	£27,750	£27,750	
Grass establishment / overseeding	£2,250	£2,250	£2,250
Vertidraining	£700	£700	£700
Installation of sand grooves	£7,000	£7,000	
Sand topdressing (24 mm Options 1 & 2, 6 mm Option 3)	£9,750	£9,750	£2,500
Selective herbicide			£300
Pest and disease control			£550
Mowing (12 cuts – Option 3)			£1,000
Subtotal (ex VAT)	£61,600	£49,200	£9,050
Contractor Preliminaries	£3,000	£2,500	£500
Subtotal (ex VAT)	£64,600	£51,700	£9,550
Contingency (10%)	£6,460	£5,170	£955
Subtotal (ex VAT)	**£71,060**	**£56,870**	**£10,505**

4.3.2 Initial 12-months maintenance post-construction costs [Options 1 and 2)]

12-MONTHS MAINTENANCE [TOTAL AREA ≈ 8,500 m^2]	**Indicative Cost**
Mowing (30 cuts)	£2,400
Fertiliser x 3	£1,600
Verti-draining x 4	£2,500
Selective herbicide (if required)	£300
Overseeding	£1,600
Pest & disease control (if required)	£550
SUBTOTAL (EXCL. VAT):	**£8,950**
CONTINGENCY (10%)	**£895**
TOTAL (EXCL. VAT)	**£9,845**

NOTES:

a. Costs are based on a general estimation of the works required. If conducted in isolation, the costs are likely to increase and would need to be costed accordingly.
b. Costs assume that the arisings associated with drainage installation will be disposed of on-site.
c. Costs based on recent Contractors rates (2013)
d. Costs do not include provision for temporary irrigation (may be required if dry conditions persist following seeding).

4.3.3 Summary of project costs

The total costs for the pitch works, inclusive of preliminaries, 10% contingency and 12-months agronomic maintenance post-construction (Options 1 and 2 only), could be in the region of

Option 1	**£80,905 + VAT**
Option 2	**£66,715 + VAT**
Option 3	**£10,505 + VAT**

These estimates do not include the cost of professional fees and permissions, or VAT where applicable.

4.4 Indicative work programme

With respect to timescales for completing the project, it is recommended that the construction works are only completed under suitable ground and weather conditions to avoid any potential performance-related problems later on.

Indicative programme

Option 1	**Year 1**												**Year 2**											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Mobilisation of Contractor																								
Total herbicide application																								
Rotary cultivation of topsoil																								
Remodelling or re-grading works																								
Drainage installation																								
Cultivations, fertilisation and seeding																								
12-months maintenance																								
Installation of sand grooves																								
Fertilisation and overseeding																								
Application of topdressing sand																								
Pitches ready for use																								

Option 2	**Year 1**												**Year 2**											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Mobilisation of Contractor																								
Fraise mowing																								
Drainage installation																								
Cultivations, fertilisation and seeding																								
12-months maintenance																								
Installation of sand grooves																								
Fertilisation and overseeding																								
Application of topdressing sand																								
Pitches ready for use																								

Option 3	Year 1												Year 2											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Mobilisation of Contractor																								
Fraise mowing																								
Decompaction																								
Application of topdressing sand																								
Fertilisation and overseeding																								
Selective herbicide																								
Pest and disease control																								
Mowing (12 cuts)																								
Pitches ready for use																								

N.B. The precise date for the return to play is highly dependent on the weather conditions that prevail during the construction works and growing-in period. Play/use shall recommence upon approval from the Contract Administrator.

4.5 Implications of works on future maintenance, system longevity and usage

4.5.1 Maintenance issues

- With surface bypass drainage systems, such as that recommended for the playing field here (Options 1 and 2), it is essential that after the initial 12 months maintenance period has been completed, adequate allowance is made for light annual sand topdressings in subsequent years as this helps to protect the sand grooves (or sand slits) from contamination with topsoil. As a guide it is recommended that a minimum 5 mm depth of sand should be applied annually as part of the renovations programme. For Options 1 and 2, 5 mm depth of sand over the whole development area would equate to approximately 70 t at a cost of approximately £5,100 + VAT (2013 prices).

- Land drains can be prone to differential settlement (i.e. there can be some sinkage over the drain lines) as the soil surrounding the drain pipe dries out and shrinks; this is perfectly normal in new constructions. Whilst topping up drain lines is usually covered by the Contractor during the first 12-months following construction, it is possible that drains may continue to sink to some extent after this time. Therefore, there should be some allowance within the maintenance programme to ensure that drains are kept topped up.

- In general terms, an ongoing maintenance budget of ~£13 k would be required to maintain a facility of this size in good condition if all operations were conducted by a contractor. This figure would include the cost for annual sand topdressing referred to above but not re-topping up of land drains.

4.5.2 System longevity

- Whilst only a guide, the piped drainage system should have an operational lifespan of approximately 25 years if well maintained (e.g. silt traps regularly inspected and emptied and collector drains flushed).

- If managed well (i.e. annual sand topdressing) and not over-used (please see Item 4.5.3 below), the sand grooves should have an operational lifespan of 5 – 7 years, hence a sinking fund should be in place to repeat this operation periodically. The cost for sand grooving for Options 1 and 2 is estimated to be approximately **£7,000 + VAT** (2013 prices) therefore a sum of approximately **£1,170 + VAT** should be set aside annually (over 6 years) for this purpose.

4.5.3 Usage

- Provided the site is well maintained, the type of drainage system proposed for this site (Options 1 and 2) should allow 4.5 – 9 hours of use / week (for U15s) on average without causing detriment to the grass sward or soil structure. In very wet conditions, usage may be less than this.

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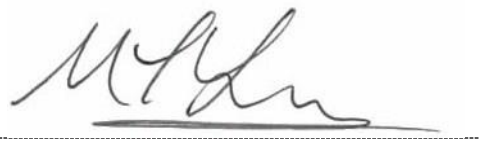
CONTACT DETAILS

TGMS Limited
Cranfield Innovation Centre
University Way
Cranfield
Bedfordshire
MK43 0BT

Tel: 01234 756040
Fax: 01234 756042
Email: richard.earl@tgms.co.uk

Author:	Dr Richard Earl
Released by:	Matt Young
Signed:	
Date:	25th June 2013

5 APPENDICES

Appendix I Performance Quality Standards.
Appendix II Outline Maintenance Recommendations.

Appendix I: Performance Quality Standards

Client: Any Town Primary School Physical Site Survey date: 5 June 2013

Project Title: Proposed improvements to the playing field

ELEMENT	LIMITS	METHOD OF TEST	Visit 1	Visit 2
Ground cover %	>70 for SH 25-30 >80 for SH 30-35	BS 7370 : P3 A6	✓	
Broad-leaved weeds %	<10	BS 7370 : P3 A6	×	
Sward height mm	20-60 PS 20-75 SM	BS 7370 : P3 A3	✓	
Thatch depth mm	<5	BS 7370 : P3 A7	✓	
Hardness in g	35-200	STRI method of test using a 0.5 kg Clegg Impact Hammer from a drop height of 0.55 m	×	
*Water infiltration rate mm h^{-1}	5	BS 7370 : P3 A8	×	
Evenness (2 metre straight edge)	<20 mm	BS 7370 : P3 A6	✓/×	
Slope: Direction of play Across play	<1.25% <2.00%	BS 7370 : P3 A5	✓ (just) ✓	
pH value	5.5 – 7.5	ISO 10390	✓	
GUIDANCE FOR ROOTZONE LAYER				
Maximum diameter	<32 mm	Particle Size Distribution	✓	

KEY: SH = Sward Height PS = Playing Season SM = Summer Maintenance

* Based on previous experience of pitches on similar soils it is expected that once the soils are wet to depth during the winter, the rate of infiltration will decline to less than 5 mm / hr.

Visual assessment is an acceptable alternative method of testing, if undertaken by a turfgrass consultant who is able to satisfy the selection criteria identified within the Turfgrass Consultants – Construction/Upgrade Brief.

Assessment undertaken by: Dr Richard Earl Consultancy: TGMS Limited

Appendix II: Outline Maintenance Recommendations

Mowing. The grass shall be maintained between a height of 20 and 25 mm using cylinder mowing equipment. The grass should never be allowed to exceed a height of 30 mm. If the grass does become too long, the height of cut should be reduced gradually over 3 – 4 cuts allowing some time for recovery in between. N.B. On no account should the grass height be reduced by more than 50% on any one occasion. Overall, approximately 30 mowing operations may be required each year, depending on weather and growing conditions.

Fertiliser application. Allowance should be made for a sufficient number of fertiliser applications to maintain healthy growth and colour. The fertiliser regime should be based on the results of annual soil sampling to determine nutrient concentrations, but the following programme is provided as a guide:

- April 12:6:6 at 350 kg/ha
- September 5:5:20 at 350 kg/ha

Fertiliser shall be applied with appropriate equipment that ensures a uniform distribution.

Weed control. Apply a selective herbicide in the spring (if required) to combat the weeds present. This to be applied at least two weeks after the first fertiliser treatment (April) and at a time when grass growth is strong and healthy. NB. Do not apply herbicide during periods of potential turf stress, i.e. if the weather is hot and dry or if frosts are forecast. Apply herbicide strictly according to the manufacturers label recommendations and only by suitably qualified personnel.

Pesticide/Fungicide [If required]. A pesticide/fungicide application may be required should disease be present within the grass sward. An approved fungicide should be used with activity against the pathogens present and be applied following the manufacturers label recommendations by suitably qualified personnel.

Aeration / Compaction Alleviation. Verti-drain (or other similar de-compaction treatment) the pitches on at least two occasions in the spring and autumn. Use 18 mm diameter solid tines working to a minimum depth of 200 mm below the surface set to provide some heave. Verti-draining must not be carried out if ground conditions are too soft or during frost.

Additional aeration treatments (e.g. slitting or spiking) during the playing season would also be highly beneficial to maintain surface drainage rates. These treatments should only be undertaken when ground conditions are suitable.

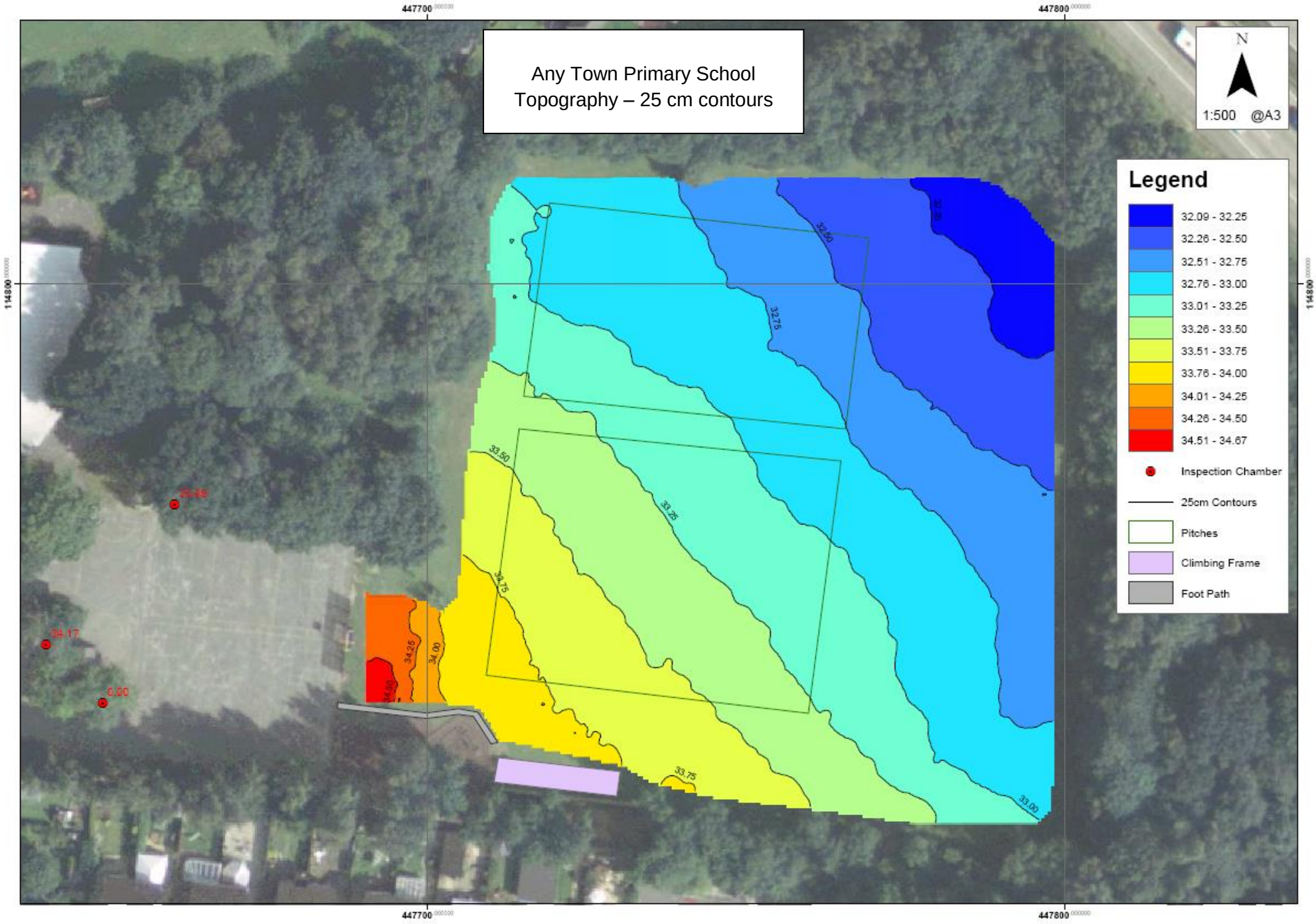
Sand topdressing. Supply and spread an approved medium-fine sand suitable for sports use during the renovations period at the rate of 85 t/ha. After each application, the sand should be worked into the surface with brushes or drag mats.

Overseeding. Overseed the pitches and safety margins as required at the application rate of approximately 200 kg/ha immediately after the end of season topdressing application. Use at least three cultivars of perennial ryegrass chosen form the latest Turfgrass Seed booklet with live ground cover and visual merit ratings of 6.5 or more. Make at least two passes with seeding equipment designed to place the seed approximately 5 mm below the surface.

Divot repair [Playing season]. After each match, divot and tread the divots back into position. This will remove any bare soil which allows weeds and weed grasses to germinate. Filling in divots with seed/soil mix will help to maintain better grass coverage.

Renovation of worn areas [Playing season]. Areas of high wear should be dressed and seeded using a divot repair mix (seed/rootzone) during the playing season as required in order to maintain good grass cover. These areas should be hand watered (if necessary) to ensure rapid grass germination and establishment.

Line Marking [Playing season]. Line marking should be undertaken on a weekly basis during the playing season.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33.76 - 34.00
34.01 - 34.25
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34.51 - 34.67
Inspection Chamber
25cm Contours
Pitches
Climbing Frame
Foot Path
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447800
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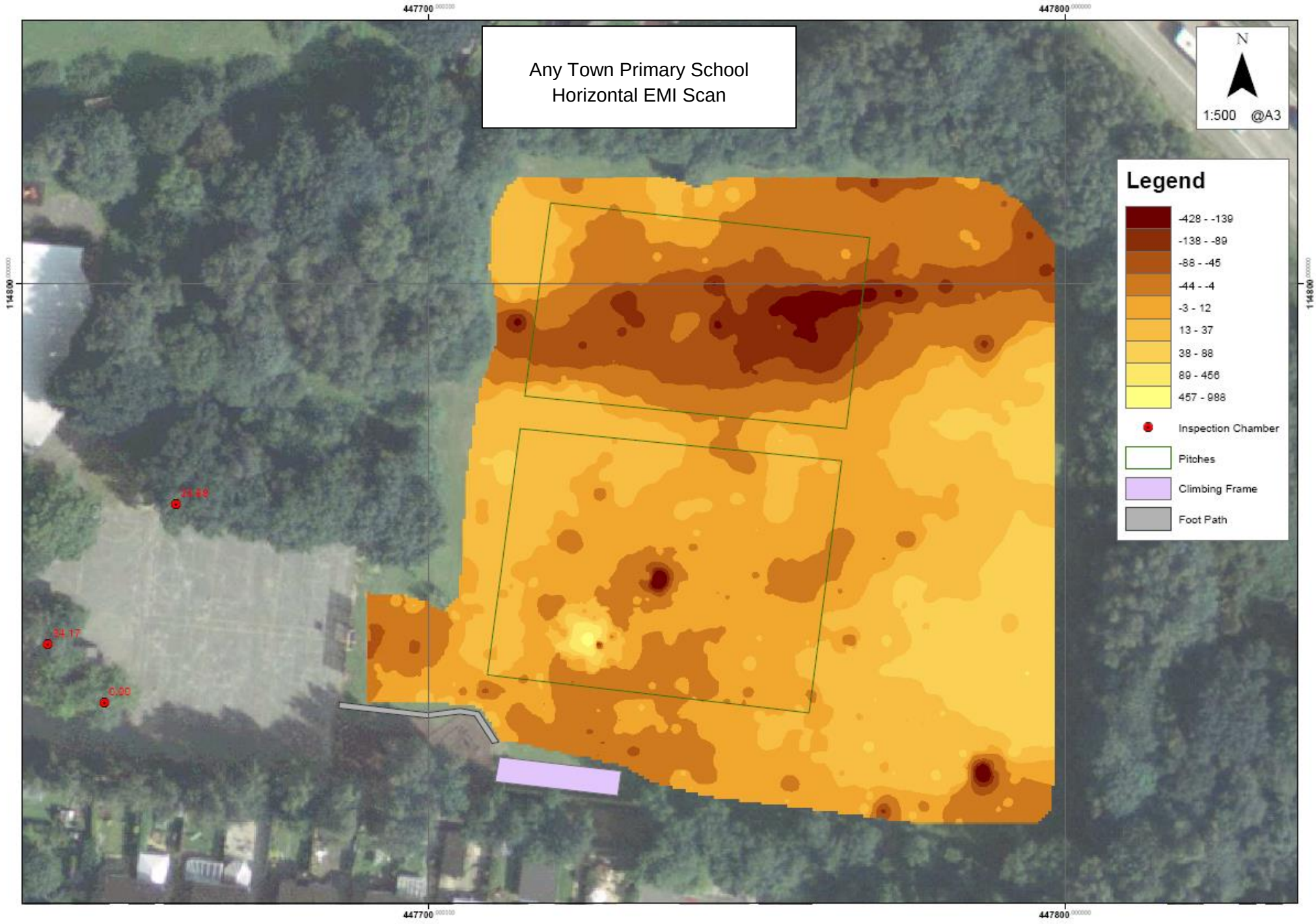
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13 - 37
38 - 88
89 - 456
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Pitches
Climbing Frame
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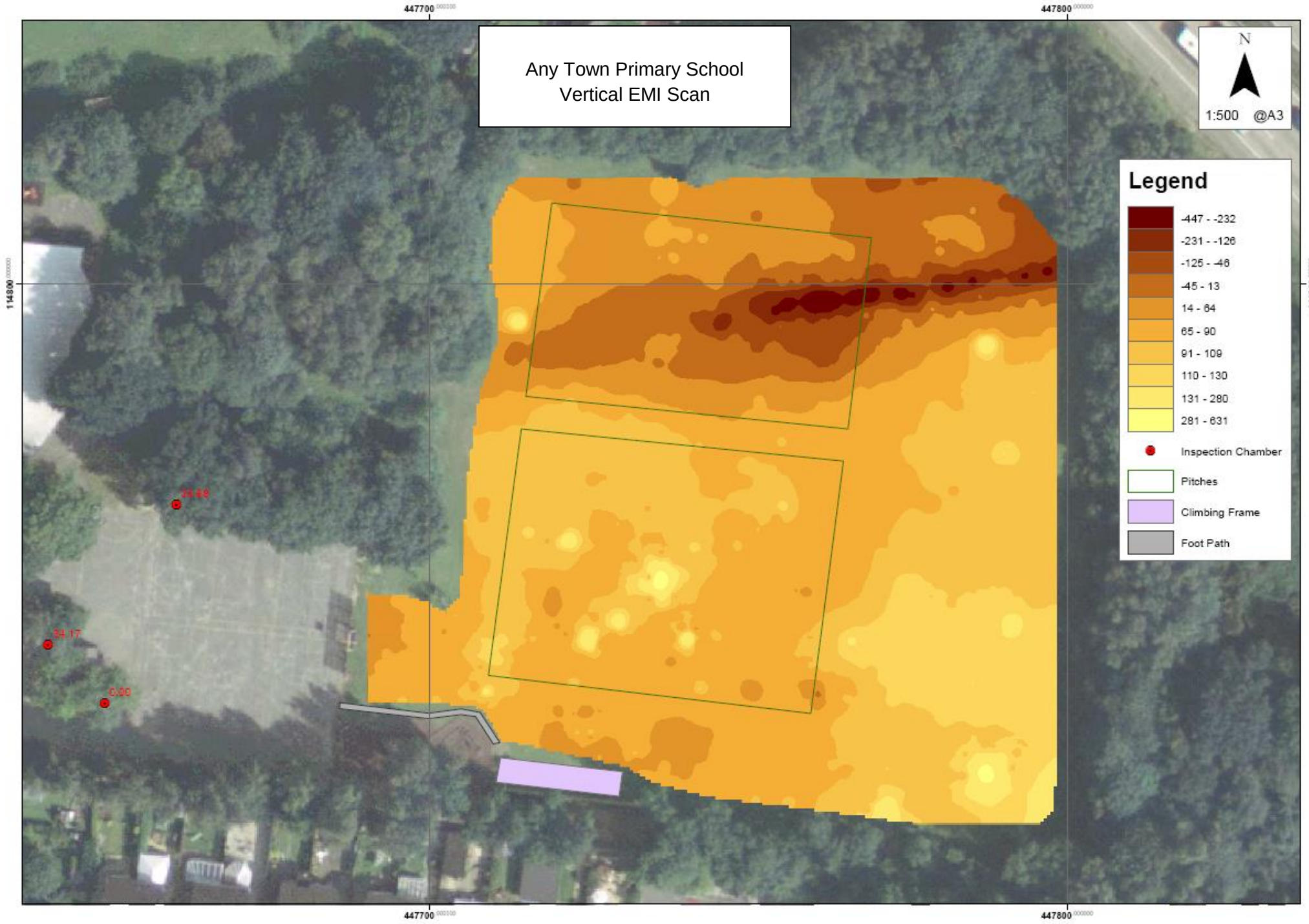
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Inspection Chamber
Pitches
Climbing Frame
Foot Path
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