# Rotary Core Log

GROUNDTECH CONSULTING

| | | |
|---|---|---|
| Project Name: TRINITY ACADEMY | Client: WATERMAN I&E | Date: 01/02/2021 |
| Location: BARNSLEY | Contractor: | Co-ords: E433382.55 N405566.70 |
| Project No. : 20063 | Crew Name: | Drilling Equipment: |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| RC204 | CP+RC | 146.94m AoD | CH | 1:10 | Sheet 7 of 10 |

| Well | Water | Depth (m) | Type /Fl | Coring TCR | Coring SCR | Coring RQD | Diameter Recovery (SPT) | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NR | | | | | | | | Very weak to medium strong grey SILTSTONE moderately to highly weathered with horizontal to sub-horizontal (10°) (45°) and vertical (90°) rough planar to smooth stepped very closely to closely spaced discontinuities. |
| | | | NI | | | | | | | | *Recovered as subangular to subrounded cobbles of siltstone between 11.95m and 12.0m bgl.* |
| | | | | | | | | | | | *NO RECOVERY between 12.0m and 12.20m bgl.* |
| | | | 3 | | | | | | | | *Recovered as angular to subangular cobbles of siltstone between 12.20m and 12.42m bgl.* |
| | | | NI | | | | | | | | *Extremely close discontinuities between 12.58m and 12.59m bgl.* |
| | | 12.00 - 13.50 | | 86 | 39 | 24 | | | | | |
| | | | 1 | | | | | | | | |
| | | | NI | | | | | | | | *Recovered as angular to subangular fine to coarse gravel of siltstone between 12.83m and 12.86m bgl.* |
| | | | 1 | | | | | | | | |
| | | | NI | | | | | | | | *Recovered as angular to subangular fine to coarse gravel and cobbles of siltstone between 12.91m and 12.97m bgl.* |
| | | | 4 | | | | | | | | *Core split by vertical fractures and small white salt like crystals present within discontinuities, possible iron pyrite.* |
| | | | NI | | | | | | | | *Recovered as angular to subangular fine to coarse gravel and cobbles of siltstone between13.18m and 13.26m bgl.* |
| | | | 4 | | | | | | | | |
| | | | NI | | | | | 13.50 | 133.44 | | *Recovered as angular to subangular fine to coarse gravel and cobbles of siltstone between13.42m and 13.5m bgl.* NO RECOVERY. |

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | | Drilling Flush | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation | Depth Top | Depth Base | Type | Colour | Min (%) | Max (%) |
| | | | | | | | | | | | | | | | | | |

## Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

# Rotary Core Log

| | | |
|---|---|---|
| Project Name: TRINITY ACADEMY | Client: WATERMAN I&E | Date: 01/02/2021 |
| Location: BARNSLEY | Contractor: | Co-ords: E433382.55 N405566.70 |
| Project No. : 20063 | Crew Name: | Drilling Equipment: |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| RC204 | CP+RC | 146.94m AoD | CH | 1:10 | Sheet 8 of 10 |

| Well | Water | Depth (m) | Type /Fl | Coring TCR | Coring SCR | Coring RQD | Diameter Recovery (SPT) | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NR | | | | | | | | NO RECOVERY. |
| | | | | | | | | 14.26 | 132.68 | | |
| | | | NI | | | | | | | | Very weak to weak grey SILTSTONE moderately weathered with horizontal to sub-horizontal (30°) rough planar closely to medium spaced discontinuities. *Recovered as firm grey clay between 14.26m and 14.31m bgl.* |
| | | | 2 | | | | | | | | |
| | | 13.50 - 15.00 | NI | 49 | 26 | 20 | | | | | *Recovered as subrounded cobbles of siltstone between 14.50m and 14.55m bgl.* |
| | | | 1 | | | | | | | | |
| | | | NI | | | | | | | | *Recovered as subrounded cobbles of siltstone between 14.76m and 15.0m bgl.* |
| | | | | | | | | 15.00 | 131.94 | | NO RECOVERY. |
| | | | NR | | | | | | | | |
| | | 15.00 - 16.50 | | 61 | 20 | 17 | | | | | |
| | | | | | | | | 15.58 | 131.36 | | Very weak to weak grey SILTSTONE moderately weathered with horizontal to sub-horizontal (30°) rough planar closely spaced discontinuities. *Recovered as angular to subangular coarse gravel and cobbles of siltstone between 15.58m and 16.19m bgl. Vertical fractures splitting core.* |
| | | | NI | | | | | | | | |

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | | Drilling Flush | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation | Depth Top | Depth Base | Type | Colour | Min (%) | Max (%) |
| | | | | | | | | | | | | | | | | | |

**Remarks**

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

# Rotary Core Log

| | | |
|---|---|---|
| Project Name: TRINITY ACADEMY | Client: WATERMAN I&E | Date: 01/02/2021 |
| Location: BARNSLEY | Contractor: | Co-ords: E433382.55 N405566.70 |
| Project No. : 20063 | Crew Name: | Drilling Equipment: |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| RC204 | CP+RC | 146.94m AoD | CH | 1:10 | Sheet 9 of 10 |

| Well | Water | Depth (m) | Type /Fl | Coring TCR | Coring SCR | Coring RQD | Diameter Recovery (SPT) | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | | | | | | | | Very weak to weak grey SILTSTONE moderately weathered with horizontal to sub-horizontal (30°) rough planar closely spaced discontinuities. |
| | | | | | | | | 16.50 | 130.44 | | VOID - suspected workings. |
| | | | | | | | | 17.90 | 129.04 | | Black angular to subangular fine to coarse gravel of anthracite coal. (Broken Ground). |

17

18

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | | Drilling Flush | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation | Depth Top | Depth Base | Type | Colour | Min (%) | Max (%) |
| | | | | | | | | | | | | | | | | | |

## Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

# Rotary Core Log

| | | |
|---|---|---|
| Project Name: TRINITY ACADEMY | Client: WATERMAN I&E | Date: 01/02/2021 |
| Location: BARNSLEY | Contractor: | Co-ords: E433382.55 N405566.70 |
| Project No. : 20063 | Crew Name: | Drilling Equipment: |

| Borehole Number | Hole Type | Level | Logged By | Scale | Page Number |
|---|---|---|---|---|---|
| RC204 | CP+RC | 146.94m AoD | CH | 1:10 | Sheet 10 of 10 |

| Well | Water | Depth (m) | Type /Fl | Coring TCR | Coring SCR | Coring RQD | Diameter Recovery (SPT) | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Black angular to subangular fine to coarse gravel of anthracite coal. (Broken Ground). |
| | | | | | | | | 18.40 | 128.54 | | Grey SILTSTONE. |
| | | | | | | | | 20.00 | 126.94 | | End of Borehole at 20.000m |

19

20

| Hole Diameter | | Casing Diameter | | Chiselling | | | | Inclination and Orientation | | | | Drilling Flush | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Base | Diameter | Depth Base | Diameter | Depth Top | Depth Base | Duration | Tool | Depth Top | Depth Base | Inclination | Orientation | Depth Top | Depth Base | Type | Colour | Min (%) | Max (%) |
| | | | | | | | | | | | | | | | | | |

## Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.



RC202 2.0 – 4.5m



RC202 4.5 – 7.5m



RC202 7.5 – 10.5m



RC202 10.5 – 13.5m



RC201 2.0 – 4.5m



RC201 4.5 – 7.5m



RC201 7.5 – 10.5m



RC201 10.5 – 12m



RC203 1.5 – 3.5m



RC203 3.5 – 9.0



RC203 9.0 - 12.0m



RC203 12.0 – 15.0m



RC203 15.0 – 18.0



RC204 2.0 - 6.0m



RC204 6.0 – 9.5m



RC204 9.5 – 12.5m



RC204 12.5 – 16.5m

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT201**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433296.93 - 405576.94<br>Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m): Depth 3.40 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.20<br>0.25 - 0.50 | ES<br>B | | 0.24 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.40<br>0.40 | D<br>ES | | 0.50 | | | MADE GROUND: Soft to firm brown mottled grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is subangular fine to medium of coal and sandstone. |
| | 1.00<br>1.00 - 1.50 | D<br>B | | | | | Weak to moderately strong light grey to brown fine to medium grained SANDSTONE moderately weathered recovered as slightly sandy slightly clayey angular to subangular fine to coarse gravel and tabular cobbles of sandstone. Sand is fine to medium. |
| | 2.50<br>2.50 - 3.00 | D<br>B | | | | | |
| | | | | 3.40 | | | End of pit at 3.40 m |

1
2
3
4
5

Remarks: 1. No groundwater encountered. 2. No workings encountered. 3. Pit sides stable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No **TT202**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433308.97 - 405586.88<br>Level: | Date 28/01/2021 |
| Location: BARNSLEY | | Dimensions (m): Depth 4.00 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | 0.23 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.30 - 0.45 | B | | | | | |
| | 0.40 | D | | 0.45 | | | MADE GROUND: Soft to firm brown mottled grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is subangular fine to medium of coal and sandstone. |
| | 0.40 | ES | | | | | |
| | 0.50 - 1.00 | B | | | | | Extremely weak orange brown to grey fine to medium grained SANDSTONE highly weathered recovered as angular to subangular fine to coarse gravel and tabular cobbles in a clay matrix. |
| | 1.00 | D | | | | | |
| | 2.00 | D | | | | | |
| | 2.50 - 3.00 | B | | | | | |
| | 3.00 | D | | | | | |
| | | | | 4.00 | | | End of pit at 4.00 m |

1 2 3 4 5

Remarks: 1. Open tunnel encountered trending north east to south west perpendicular to orientation of trench. 2. Top of arch present at 2.1m bgl in north east elevation of trench and 3.0m bgl in south west elevation of trench. 3. Tunnel measured c.1.5m wide and was still present at base of pit at 4.0m bgl. 4. No groundwater encountered. 4. Tunnel unstable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No **TT203**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433326.92 - 405599.98<br>Level: | Date 28/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 3.40 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | 0.24 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.40 | D | | | | | MADE GROUND: Soft to firm brown mottled grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is subangular fine to medium of coal and sandstone. |
| | 0.40<br>0.50 - 1.00 | ES<br>B | | 0.50 | | | Very weak to weak light brown to light grey SANDSTONE interbedded with siltstone highly weathered, recovered as slightly sandy angular to subangular fine to coarse gravel and tabular cobbles sandstone in a clay matrix. Sand is fine to medium. |
| | 1.00 | D | | | | | |
| | 3.20 - 3.30 | B | | 3.20 | | | Weak grey SILTSTONE moderately weathered, recovered as slightly sandy slightly clayey angular to subangular gravel and tabular cobbles and boulders of siltstone. Sand is fine. |
| | 3.30 | D | | 3.40 | | | End of pit at 3.40 m |

1 2 3 4 5

Remarks: 1. Loosely Infilled tunnel encountered trending north east to south west perpendicular orientation of trench. 2. Top of tunnel present at 0.6m bgl covered with large sandstone blocks. 3. unnel measured c.1.5m wide and was still present at base of pit at 3.4m bgl. 4. Seepage of groundwater encountered at 3.1m bgl with faint sheen observed. 5. Tunnel unstable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No **TT204**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433348.10 - 405613.98<br>Level: | Date 28/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 2.10 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.20 | ES | | | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.30 | D | | 0.30 | | | |
| | 0.30 | ES | | 0.40 | | | MADE GROUND: Soft to firm brown mottled grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is subangular fine to medium of coal and sandstone. |
| | 1.00 - 1.50 | B | | | | | Weak to moderately strong orange brown to dark grey brown medium grained SANDSTONE partially to unweathered, recovered as slightly sandy slightly gravelly angular to subangular tabular cobbles and boulders of sandstone. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone. Vertical open joint fractures visible oriented N-S. |
| | 2.00 | D | | | | | |
| | | | | 2.10 | | | End of pit at 2.10 m |

1
2
3
4
5

Remarks: 1. Position terminated at 2.1m bgl due to competent sandstone bedrock. 2. Sandstone highly fractured with subvertical open joints observed. 3. No groundwater encountered. 4. No workings encountered. 5. Pit sides unstable within fractured sandstone.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT205**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433309.01 - 405561.05<br>Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 2.30 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.10 | ES | | 0.23 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.50<br>0.50 - 1.00 | ES<br>B | | | | | Weak brown to grey fine to medium grained SANDSTONE moderately to highly weathered, recovered as slightly sandy slightly clayey angular to subangular fine to coarse tabular gravel with moderate cobble content of sandstone. |
| | 1.00 | D | | | | | |
| | 2.00<br>2.00 - 2.30 | D<br>B | | 2.00<br>2.30 | | | Weak grey SILTSTONE moderately weathered, recovered as slightly sandy gravelly angular to subangular tabular cobbles and boulders of siltstone. Weathering orange brown. Sand is fine to medium. Gravel is angular to subangular fine to coarse of siltstone.<br>End of pit at 2.30 m |

1
2
3
4
5

Remarks: 1. Position terminated at 2.3m bgl due to competent siltstone. 2. No groundwater encountered. 3. No workings encountered. 4. Pit sides stable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT206**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433333.90 - 405579.00<br>Level: | Date 28/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 3.80 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | 0.10 | ES | | | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.30 | D | | 0.24 | | | |
| | 0.30 | ES | | 0.34 | | | MADE GROUND: Soft to firm brown mottled grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is subangular fine to medium of coal and sandstone. |
| | 0.50 - 1.00 | B | | | | | |
| | 1.00 | D | | | | | Extremely weak to weak grey brown fine grained SANDSTONE interebedded with siltstone highly weathered, recovered as slightly sandy gravelly tabular caobbles and boulders of sandstone and siltstone. Sand is fine to medium. Gravel is angular to subangular fine to coasre of sandstone and siltstone. |
| | 2.50 - 3.00 | B | | | | | |
| | 3.00 | D | | | | | |
| | | | | 3.80 | | | End of pit at 3.80 m |

1
2
3
4
5

Remarks: 1. No groundwater encountered. 2. No workings encountered. 3. Pit sides stable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT207**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433361.07 - 405596.96<br>Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 1.50 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.20 | ES | | 0.31 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 1.00 | D | | 1.50 | | | Weak to moderately strong orange brown to dark brown medium grained SANDSTONE partially to unweathered, recovered as slightly sandy slightly gravelly angular to subangular tabular cobbles and boulders of sandstone. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone. Vertical open joint fractures visible oriented N-S. |
| | | | | | | | End of pit at 1.50 m |

1
2
3
4
5

Remarks: 1. Position terminated at 1.5m bgl due to competent sandstone bedrock. 2. Sandstone highly fractured with subvertical open joints observed. 3. No groundwater encountered. 4. No workings encountered. 5. Pit sides unstable within fractured sandstone.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT208**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433344.91 - 405565.99<br>Level: | Date 28/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 2.30 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.10 | ES | | 0.18 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.50<br>0.50<br>0.50 - 1.00 | D<br>ES<br>B | | | | | Extremely weak to weak grey brown fine to medium grained SANDSTONE interbedded with siltstone, highly weathered recovered as sandy angular to subangular fine to coarse gravel and tabular cobbles of sandstone. Sand is fine to medium. |
| | 1.50<br>1.50 - 2.00 | D<br>B | | | | | |
| | 2.00 | D | | | | | |
| | | | | 2.30 | | | End of pit at 2.30 m |

1
2
3
4
5

Remarks: 1. Position terminated at 2.3m bgl due to competent sandstone. 2. No groundwater encountered. 3. No workings encountered.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT209**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433354.94 - 405535.98<br>Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m): Depth 2.50 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.10 | ES | | 0.21 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.40<br>0.40<br>0.50 - 1.00 | D<br>ES<br>B | | 0.50 | | | MADE GROUND: Firm orange brown mottled light grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is angular to subangular fine to medium of coal, sandstone and siltstone. |
| | 1.00 | D | HVP=84 | 1.20 | | | Firm orange brown mottled light grey slightly sandy slightly gravelly silty CLAY. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone and mudstone. |
| | 2.00<br>2.00 - 2.50 | D<br>B | | 2.50 | | | Weak to moderately strong light grey brown fine to medium grained SANDSTONE partially weathered, recovered as sandy slightly clayey angular to subangular fine to coarse tabular gravel and cobbles. Sand is fine to medium.<br>End of pit at 2.50 m |

1
2
3
4
5

Remarks: 1. Position terminated at 2.5m bgl due to competent sandstone. 2. No groundwater encountered. 3. No workings encountered. 4. Pit sides stable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT210**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433375.03 - 405549.97<br>Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 3.30 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.20 | ES | | | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.40 - 0.70 | B | | 0.38 | | | MADE GROUND: Soft to firm dark orange brown sandy gravelly friable reworked clay. Sand is fine to medium. Gravel is subangular to subrounded fine to coarse of coal, sandstone and siltstone. |
| | 0.60 | ES | | 0.70 | | | Stiff orange brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is angular to subangular fine to coarse of siltstone. |
| | 1.00 | D | HVP=102 | | | | |
| | 1.00 - 1.50 | B | | | | | |
| | | | | 1.70 | | | Weak to moderately strong light grey brown fine to medium grained SANDSTONE moderatley weathered, recovered as sandy angular to subangular fine to coarse gravel and tabular cobbles of sandstone with low boulder content of sandstone. Sand is fine to medium. |
| | 2.00 | D | | | | | |
| | 2.50 - 3.00 | B | | | | | |
| | 3.00 | D | | | | | |
| | | | | 3.30 | | | End of pit at 3.30 m |

1
2
3
4
5

Remarks: 1. No groundwater encountered. 2. No workings encountered. 3. Pit sides stable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT211**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433364.87 - 405518.98<br>Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m):<br>Depth 2.20 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.20 | ES | | 0.34 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.60 | ES | | 0.80 | | | MADE GROUND: Firm orange brown mottled light grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is angular to subangular fine to medium of coal, sandstone and siltstone. |
| | 0.90 | D | HVP=76 | | | | Firm orange brown mottled light grey slightly sandy slightly gravelly silty CLAY. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone and mudstone. |
| | 1.00 - 1.50 | B | | | | | |
| | 1.70 - 2.00 | B | | 1.70 | | | Weak to moderately strong light grey brown fine to medium grained SANDSTONE partially weathered, recovered as slightly sandy angular to subangular fine to coarse tabular gravel and cobbles of sandstone. Sand is fine to medium. |
| | 2.00 | D | | 2.20 | | | End of pit at 2.20 m |

1
2
3
4
5

Remarks: 1. Position terminated at 2.2m bgl due to competent sandstone. 2. No groundwater encountered. 3. No workings encountered. 4. Pit sides stable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No **TT212** Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: 433385.92 - 405533.95 Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m): Depth 3.40 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | Depth | Type | Results | | | | |
| | 0.20 | ES | | | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | 0.30 - 0.50 | B | | 0.30 | | | |
| | 0.40 | D | | | | | MADE GROUND: Soft to firm dark orange brown sandy gravelly friable reworked clay. Sand is fine to medium. Gravel is subangular to subrounded fine to coarse of coal, sandstone and siltstone. |
| | 0.40 | ES | | 0.50 | | | Stiff orange brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is angular to subangular fine to coarse of siltstone. |
| | 0.80 - 1.20 | B | | | | | |
| | 1.00 | D | HVP=100 | | | | |
| | | | | 1.20 | | | Very weak orange brown medium grained SANDSTONE highly weathered, recovered as sandy gravelly slightly clayey subangular to subrounded cobles of sandstone. Sand is fine to medium. Gravel is angular to subangular fine to coarse. |
| | 1.50 | D | | | | | |
| | 1.50 - 1.80 | B | | | | | |
| | | | | 1.80 | | | Weak to moderately strong orange brown medium grained SANDSTONE interbedded with grey siltstone partially weathered, recovered as sandy angular to subangular fine to coarse gravel and tabular cobbles of sandstone and siltstone. Sand is fine to medium. |
| | 2.50 | D | | | | | |
| | | | | 3.40 | | | End of pit at 3.40 m |

1 2 3 4 5

Remarks: 1. No groundwater encountered. 2. No workings encountered. 3. Pit sides stable.

Stability:

GROUNDTECH CONSULTING

# Trial Pit Log

Trialpit No
**TT213**
Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: TRINITY ACADEMY | Project No. 20063 | Co-ords: - Level: | Date 29/01/2021 |
| Location: BARNSLEY | | Dimensions (m): Depth 3.40 | Scale 1:25 |
| Client: WATERMAN I&E | | | Logged CH |

| Water Strike | Samples and In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | 0.25 | | | MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone. |
| | | | | 0.40 | | | MADE GROUND: Soft to firm brown mottled grey slightly sandy slightly gravelly reworked clay. Sand is fine to medium. Gravel is subangular fine to medium of coal and sandstone. |
| | | | | | | | Extremely weak orange brown to grey fine to medium grained SANDSTONE interbedded with siltstone highly weathered, recovered as angular to subangular fine to coarse gravel and tabular cobbles in a clay matrix. |
| | | | | 3.40 | | | End of pit at 3.40 m |

1
2
3
4
5

Remarks: 1. No groundwater encountered. 2. No workings encountered. 3. Pit sides stable.

Stability:

# Appendix C Gas and Groundwater Monitoring Results

# PERMANENT GROUND GAS MONITORING FORM

GROUNDTECH CONSULTING

| | | | |
|---|---|---|---|
| ***SITE NAME:*** | *TRINITY ACADEMY, BARNSLEY* | ***ENGINEER:*** | *Joshua Turton* |
| ***CLIENT:*** | *WATERMAN I&E* | ***DATE:*** | *17/02/2021* |
| ***JOB NO:*** | *20063* | | |

| | | | | | |
|---|---|---|---|---|---|
| ***Pressure Trend:*** | *Falling* | ***Weather:*** | *Overcast* | ***Equipment:*** | *GFM 436* |

| ***Ambient:*** | $O_2$ (%v/v) | $CH_4$ (%v/v) | $CO_2$ (%v/v) | LEL | $H_2S$ (ppm) | CO (ppm) |
|---|---|---|---|---|---|---|
| ***Start*** | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| ***Finish*** | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| BH Ref. | Gas Flow Rate (l/hr) | | Borehole Pressure (mb) | Methane (%v/v) | | | Carbon Dioxide (%v/v) | | Oxygen (%v/v) | | Hydrogen Sulphide (ppm) | | Carbon Monoxide (ppm) | | $Q_{hg}$ $CO_2$ (l/hr) | $Q_{hg}$ $CH_4$ (l/hr) | Atmos Press (mb) | PID (ppm) | Sheen (Y/N) | Depth to Water (m bgl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peak | Steady | | Peak | Steady | LEL | Peak | Steady | Peak | Steady | Peak | Steady | Peak | Steady | | | | | | |
| RC201 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20.8 | 20.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0000 | 986 | - | N | 4.55 |
| RC202 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20.7 | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0000 | 986 | - | N | NGW |
| RC203 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 19.6 | 20.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0009 | 0.0000 | 986 | - | N | NGW |
| RC204 | -0.1 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 19.7 | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0008 | 0.0000 | 986 | - | N | NGW |
| **Notes:** | | | | | | | | | | | | | | | | | | | | |

# PERMANENT GROUND GAS MONITORING FORM

GROUNDTECH CONSULTING

| | | | |
|---|---|---|---|
| ***SITE NAME:*** | *TRINITY ACADEMY, BARNSLEY* | ***ENGINEER:*** | *Joshua Turton* |
| ***CLIENT:*** | *WATERMAN I&E* | ***DATE:*** | *08/03/2021* |
| ***JOB NO:*** | *20063* | | |

| | | | | | |
|---|---|---|---|---|---|
| ***Pressure Trend:*** | *Falling* | ***Weather:*** | *Overcast* | ***Equipment:*** | *GFM 436* |

| ***Ambient:*** | $O_2$ (%v/v) | $CH_4$ (%v/v) | $CO_2$ (%v/v) | LEL | $H_2S$ (ppm) | CO (ppm) |
|---|---|---|---|---|---|---|
| ***Start*** | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| ***Finish*** | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| BH Ref. | Gas Flow Rate (l/hr) | | Borehole Pressure (mb) | Methane (%v/v) | | | Carbon Dioxide (%v/v) | | Oxygen (%v/v) | | Hydrogen Sulphide (ppm) | | Carbon Monoxide (ppm) | | $Q_{hg}$ $CO_2$ (l/hr) | $Q_{hg}$ $CH_4$ (l/hr) | Atmos Press (mb) | PID (ppm) | Sheen (Y/N) | Depth to Water (m bgl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peak | Steady | | Peak | Steady | LEL | Peak | Steady | Peak | Steady | Peak | Steady | Peak | Steady | | | | | | |
| RC201 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20.0 | 20.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0000 | 1002 | - | N | NGW |
| RC202 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20.6 | 20.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0000 | 1002 | - | N | NGW |
| RC203 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 16.7 | 20.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0012 | 0.0000 | 1002 | - | N | NGW |
| RC204 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 17.6 | 20.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0009 | 0.0000 | 1002 | - | N | NGW |

**Notes:**

# Appendix D Results of Geotechnical Testing

# LABORATORY REPORT

4043

**Contract Number: PSL21/1600**

Report Date: 11 March 2021

Client's Reference: 20063

Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

**For the attention of: Connor Hastings**

Contract Title: Trinity Academy, Barnsley

Date Received: 24/2/2021
Date Commenced: 24/2/2021
Date Completed: 11/3/2021

**Notes: Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

| | | |
|---|---|---|
| A Watkins<br>(Director) | R Berriman<br>(Quality Manager) | S Royle<br>(Laboratory Manager) |
| L Knight<br>(Senior Technician) | S Eyre<br>(Senior Technician) | H Daniels<br>(Senior Technician) |



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# DETERMINATION OF UNCONFINED COMPRESSIVE STRENGTH

**ISRM Suggested Methods, pp 111 –116, 1981.**

| Hole Number | Sample Number | Sample Type | Top Depth (m) | Base Depth (m) | Sample Diameter (mm) | Sample Length (mm) | Height Ratio | Initial Mass (g) | Bulk Density (Mg/m) | Moisture Content (%) | Dry Density (Mg/m) | Load Failure (kN) | UCS (MPa) | Failure Mode | Date Tested | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RC203 | | C | 3.79 | 4.00 | 85 | 157 | 1.8 | 2185 | 2.45 | 7.2 | 2.29 | 82.2 | 14.5 | Brittle | 09/03/21 | |
| RC203 | | C | 6.30 | 6.46 | 85 | 132 | 1.6 | 1861 | 2.48 | 5.1 | 2.36 | 93.8 | 16.5 | Brittle | 09/03/21 | |
| RC203 | | C | 11.41 | 11.60 | 85 | 126 | 1.5 | 1774 | 2.48 | 3.9 | 2.39 | 32.5 | 5.7 | Brittle | 09/03/21 | |
| RC204 | | C | 9.66 | 9.95 | 85 | 170 | 2.0 | 2425 | 2.51 | 5.0 | 2.39 | 123.4 | 21.7 | Brittle | 09/03/21 | |
| | | | | | | | | | | | | | | | | |
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Professional Soils Laboratory

**Trinity Academy, Barnsley**

| Contract No: |
|---|
| PSL21/1600 |
| Client Ref: |
| 20063 |

# SUMMARY OF POINT LOAD TEST RESULTS

**ISRM Suggested Methods : 2007**

| Borehole Number | Depth (m) | Sample Ref | Test Type | Orientation | Dimensions (mm) | | Area | $D_e^2$ | $D_e$ | Failure Load (P) | | $I_s$ | Corr Fac | $I_{s50}$ | Failure Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Par / Perp | W | D | (mm2) | | (mm) | (Mpa) | (kN) | (MPa) | F | (MPa) | | |
| RC201 | 2.10 | | A | Perp | 76 | 38 | 2888 | 3677.12 | 60.64 | - | 3.50 | 0.95 | 1.091 | 1.04 | Valid | |
| RC201 | 3.50 | | A | Perp | 70 | 60 | 4200 | 5347.61 | 73.13 | - | 2.89 | 0.54 | 1.187 | 0.64 | Valid | |
| RC201 | 5.00 | | A | Perp | 85 | 28 | 2380 | 3030.31 | 55.05 | - | 1.04 | 0.34 | 1.044 | 0.36 | Valid | |
| RC201 | 6.50 | | A | Perp | 85 | 27 | 2295 | 2922.08 | 54.06 | - | 0.91 | 0.31 | 1.036 | 0.32 | Valid | |
| RC202 | 2.60 | | A | Perp | 43 | 35 | 1505 | 1916.23 | 43.77 | - | 3.04 | 1.59 | 0.942 | 1.49 | Valid | |
| RC202 | 4.50 | | A | Perp | 55 | 28 | 1540 | 1960.79 | 44.28 | - | 1.20 | 0.61 | 0.947 | 0.58 | Valid | |
| RC202 | 8.50 | | A | Perp | 85 | 38 | 3230 | 4112.56 | 64.13 | - | 1.10 | 0.27 | 1.119 | 0.30 | Valid | |
| RC202 | 10.00 | | A | Perp | 49 | 48 | 2352 | 2994.66 | 54.72 | - | 1.19 | 0.40 | 1.041 | 0.41 | Valid | |
| RC202 | 11.50 | | A | Perp | 85 | 45 | 3825 | 4870.14 | 69.79 | - | 0.50 | 0.10 | 1.162 | 0.12 | Valid | |
| RC202 | 13.40 | | A | Perp | 85 | 29 | 2465 | 3138.54 | 56.02 | - | 4.38 | 1.40 | 1.053 | 1.47 | Valid | |
| RC203 | 2.50 | | A | Perp | 60 | 37 | 2220 | 2826.59 | 53.17 | - | 4.51 | 1.60 | 1.028 | 1.64 | Valid | |
| RC203 | 3.50 | | A | Perp | 47 | 35 | 1645 | 2094.48 | 45.77 | - | 4.00 | 1.91 | 0.961 | 1.84 | Valid | |
| RC203 | 4.60 | | A | Perp | 50 | 28 | 1400 | 1782.54 | 42.22 | - | 3.56 | 2.00 | 0.927 | 1.85 | Valid | |
| RC203 | 5.40 | | A | Perp | 85 | 34 | 2890 | 3679.66 | 60.66 | - | 6.19 | 1.68 | 1.091 | 1.84 | Valid | |
| RC203 | 6.00 | | A | Perp | 85 | 38 | 3230 | 4112.56 | 64.13 | - | 1.60 | 0.39 | 1.119 | 0.44 | Valid | |
| RC203 | 7.00 | | A | Perp | 85 | 30 | 2550 | 3246.76 | 56.98 | - | 4.16 | 1.28 | 1.061 | 1.36 | Valid | |
| RC203 | 9.20 | | A | Perp | 73 | 35 | 2555 | 3253.13 | 57.04 | - | 1.37 | 0.42 | 1.061 | 0.45 | Valid | |
| RC203 | 9.80 | | A | Perp | 85 | 38 | 3230 | 4112.56 | 64.13 | - | 1.85 | 0.45 | 1.119 | 0.50 | Valid | |
| RC203 | 10.40 | | A | Perp | 85 | 61 | 5185 | 6601.75 | 81.25 | - | 2.97 | 0.45 | 1.244 | 0.56 | Valid | |
| RC203 | 11.00 | | A | Perp | 85 | 54 | 4590 | 5844.17 | 76.45 | - | 2.92 | 0.50 | 1.211 | 0.60 | Valid | |
| RC203 | 12.30 | | A | Perp | 85 | 34 | 2890 | 3679.66 | 60.66 | - | 5.94 | 1.61 | 1.091 | 1.76 | Valid | |
| RC203 | 13.00 | | A | Perp | 85 | 46 | 3910 | 4978.37 | 70.56 | - | 3.28 | 0.66 | 1.168 | 0.77 | Valid | |

***Note*** All testing carried out on samples at as received water content  Par = parallel, Perp = perpendicular, U = Random  A = Axial, D = Diametral, I = Irregular

UKAS TESTING 4043

PSL Professional Soils Laboratory

**Trinity Academy, Barnsley**

**Contract No:**

**PSL21/1600**

**Client Ref:**

**20063**

# SUMMARY OF POINT LOAD TEST RESULTS

**ISRM Suggested Methods : 2007**

| Borehole Number | Depth (m) | Sample Ref | Test Type | Orientation | Dimensions (mm) | | $D_e^2$ | $D_e$ | Failure Load | | $I_s$ | Corr Fac | $I_{s50}$ | Failure Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Par / Perp | L | D | | (mm) | (Mpa) | (kN) | (MPa) | F | (MPa) | | |
| RC201 | 2.80 | | D | Par | - | 48 | 2304 | 48.00 | - | 4.33 | 1.879 | 0.982 | 1.85 | Valid | |
| RC201 | 4.00 | | D | Par | - | 66 | 4356 | 66.00 | - | 1.05 | 0.241 | 1.133 | 0.27 | Valid | |
| RC201 | 6.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 1.65 | 0.228 | 1.270 | 0.29 | Valid | |
| RC201 | 7.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.17 | 0.024 | 1.270 | 0.03 | Valid | |
| RC202 | 2.60 | | D | Par | - | 43 | 1849 | 43.00 | - | 2.68 | 1.449 | 0.934 | 1.35 | Valid | |
| RC202 | 4.50 | | D | Par | - | 55 | 3025 | 55.00 | - | 0.21 | 0.069 | 1.044 | 0.07 | Valid | |
| RC202 | 8.50 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.59 | 0.082 | 1.270 | 0.10 | Valid | |
| RC202 | 10.00 | | D | Par | - | 49 | 2401 | 49.00 | - | 1.19 | 0.496 | 0.991 | 0.49 | Valid | |
| RC202 | 11.50 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.12 | 0.017 | 1.270 | 0.02 | Valid | |
| RC202 | 13.40 | | D | Par | - | 85 | 7225 | 85.00 | - | 1.24 | 0.172 | 1.270 | 0.22 | Valid | |
| RC203 | 2.50 | | D | Par | - | 60 | 3600 | 60.00 | - | 5.38 | 1.494 | 1.086 | 1.62 | Valid | |
| RC203 | 3.50 | | D | Par | - | 47 | 2209 | 47.00 | - | 3.73 | 1.689 | 0.973 | 1.64 | Valid | |
| RC203 | 4.60 | | D | Par | - | 50 | 2500 | 50.00 | - | 3.93 | 1.572 | 1.000 | 1.57 | Valid | |
| RC203 | 5.40 | | D | Par | - | 85 | 7225 | 85.00 | - | 2.88 | 0.399 | 1.270 | 0.51 | Valid | |
| RC203 | 6.50 | | D | Par | - | 85 | 7225 | 85.00 | - | 2.37 | 0.328 | 1.270 | 0.42 | Valid | |
| RC203 | 8.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.13 | 0.018 | 1.270 | 0.02 | Valid | |
| RC203 | 9.20 | | D | Par | - | 73 | 5329 | 73.00 | - | 0.19 | 0.036 | 1.186 | 0.04 | Valid | |
| RC203 | 9.80 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.10 | 0.014 | 1.270 | 0.02 | Valid | |
| RC203 | 10.40 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.65 | 0.090 | 1.270 | 0.11 | Valid | |
| RC203 | 11.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.36 | 0.050 | 1.270 | 0.06 | Valid | |
| RC203 | 12.30 | | D | Par | - | 85 | 7225 | 85.00 | - | 1.31 | 0.181 | 1.270 | 0.23 | Valid | |
| RC203 | 13.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 2.04 | 0.282 | 1.270 | 0.36 | Valid | |

***Note*** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

UKAS TESTING 4043

PSL Professional Soils Laboratory

**Trinity Academy, Barnsley**

**Contract No:**

**PSL21/1600**

**Client Ref:**

**20063**

# SUMMARY OF POINT LOAD TEST RESULTS

**ISRM Suggested Methods : 2007**

| Borehole Number | Depth (m) | Sample Ref | Test Type | Orientation | Dimensions (mm) | | Area | $D_e^2$ | $D_e$ | Failure Load (P) | | $I_s$ | Corr Fac | $I_{s50}$ | Failure Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Par / Perp | W | D | (mm2) | | (mm) | (Mpa) | (kN) | (MPa) | F | (MPa) | | |
| RC203 | 13.50 | | A | Perp | 85 | 40 | 3400 | 4329.01 | 65.80 | - | 2.04 | 0.47 | 1.131 | 0.53 | Valid | |
| RC203 | 14.00 | | A | Perp | 85 | 31 | 2635 | 3354.99 | 57.92 | - | 2.45 | 0.73 | 1.068 | 0.78 | Valid | |
| RC203 | 13.84 | | A | Perp | 85 | 30 | 2550 | 3246.76 | 56.98 | - | 3.22 | 0.99 | 1.061 | 1.05 | Valid | |
| RC203 | 14.00 | | A | Perp | 85 | 31 | 2635 | 3354.99 | 57.92 | - | 2.45 | 0.73 | 1.068 | 0.78 | Valid | |
| RC203 | 15.00 | | A | Perp | 78 | 30 | 2340 | 2979.38 | 54.58 | - | 0.69 | 0.23 | 1.040 | 0.24 | Valid | |
| RC204 | 7.70 | | A | Perp | 85 | 48 | 4080 | 5194.82 | 72.08 | - | 6.37 | 1.23 | 1.179 | 1.45 | Valid | |
| RC204 | 8.50 | | A | Perp | 85 | 36 | 3060 | 3896.11 | 62.42 | - | 4.43 | 1.14 | 1.105 | 1.26 | Valid | |
| RC204 | 11.30 | | A | Perp | 85 | 37 | 3145 | 4004.34 | 63.28 | - | 1.53 | 0.38 | 1.112 | 0.42 | Valid | |
| RC204 | 12.00 | | A | Perp | 85 | 29 | 2465 | 3138.54 | 56.02 | - | 1.40 | 0.45 | 1.053 | 0.47 | Valid | |
| RC204 | 13.00 | | A | Perp | 85 | 41 | 3485 | 4437.24 | 66.61 | - | 1.31 | 0.30 | 1.138 | 0.34 | Valid | |
| RC204 | 13.50 | | A | Perp | 85 | 42 | 3570 | 4545.47 | 67.42 | - | 2.78 | 0.61 | 1.144 | 0.70 | Valid | |
| RC204 | 14.50 | | A | Perp | 85 | 29 | 2465 | 3138.54 | 56.02 | - | 2.15 | 0.69 | 1.053 | 0.72 | Valid | |
| RC204 | 15.00 | | A | Perp | 85 | 32 | 2720 | 3463.21 | 58.85 | - | 1.36 | 0.39 | 1.076 | 0.42 | Valid | |
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***Note*** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular

UKAS TESTING 4043

PSL Professional Soils Laboratory

**Trinity Academy, Barnsley**

**Contract No:**

**PSL21/1600**

**Client Ref:**

**20063**

# SUMMARY OF POINT LOAD TEST RESULTS

**ISRM Suggested Methods : 2007**

| Borehole Number | Depth (m) | Sample Ref | Test Type | Orientation | Dimensions (mm) | | $D_e^2$ | $D_e$ | Failure Load | | $I_s$ | Corr Fac | $I_{s50}$ | Failure Type | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Par / Perp | L | D | | (mm) | (Mpa) | (kN) | (MPa) | F | (MPa) | | |
| RC203 | 13.50 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.41 | 0.057 | 1.270 | 0.07 | Valid | |
| RC203 | 14.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.62 | 0.086 | 1.270 | 0.11 | Valid | |
| RC203 | 13.84 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.32 | 0.044 | 1.270 | 0.06 | Valid | |
| RC203 | 14.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.41 | 0.057 | 1.270 | 0.07 | Valid | |
| RC203 | 15.00 | | D | Par | - | 78 | 6084 | 78.00 | - | 0.18 | 0.030 | 1.222 | 0.04 | Valid | |
| RC204 | 8.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 3.45 | 0.478 | 1.270 | 0.61 | Valid | |
| RC204 | 9.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 3.45 | 0.478 | 1.270 | 0.61 | Valid | |
| RC204 | 11.30 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.17 | 0.024 | 1.270 | 0.03 | Valid | |
| RC204 | 12.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.19 | 0.026 | 1.270 | 0.03 | Valid | |
| RC204 | 13.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.21 | 0.029 | 1.270 | 0.04 | Valid | |
| RC204 | 13.50 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.42 | 0.058 | 1.270 | 0.07 | Valid | |
| RC204 | 14.50 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.22 | 0.030 | 1.270 | 0.04 | Valid | |
| RC204 | 15.00 | | D | Par | - | 85 | 7225 | 85.00 | - | 0.33 | 0.046 | 1.270 | 0.06 | Valid | |
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***Note*** All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

UKAS TESTING 4043

PSL Professional Soils Laboratory

**Trinity Academy, Barnsley**

**Contract No:**

**PSL21/1600**

**Client Ref:**

**20063**

# LABORATORY REPORT

4043

**Contract Number: PSL21/1658**

Report Date: 15 March 2021

Client's Reference: 20063

Client Name: Groundtech Consulting
First Floor
Lloyd House
Orford Court
Greenfold Way
WN7 3XJ

**For the attention of: Callum Holden**

Contract Title: Trinity Academy, Barnsley

Date Received: 25/2/2021
Date Commenced: 25/2/2021
Date Completed: 15/3/2021

**Notes: Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

| | | |
|---|---|---|
| A Watkins<br>(Director) | R Berriman<br>(Quality Manager) | S Royle<br>(Laboratory Manager) |
| L Knight<br>(Senior Technician) | S Eyre<br>(Senior Technician) | T Watkins<br>(Senior Technician) |



**5 – 7 Hexthorpe Road, Hexthorpe,**
**Doncaster DN4 0AR**
**tel: +44 (0)844 815 6641**
**fax: +44 (0)844 815 6642**
**e-mail: rberriman@prosoils.co.uk**
**awatkins@prosoils.co.uk**

# SUMMARY OF LABORATORY SOIL DESCRIPTIONS

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Description of Sample |
|---|---|---|---|---|---|
| TT205 | | D | 1.00 | | Brown highly weathered MUDSTONE. |
| TT205 | | B | 0.50 | | Brown mottled grey highly weathered MUDSTONE. |
| TT206 | | B | 0.50 | | Brown mottled grey highly weathered MUDSTONE. |
| TT211 | | B | 1.00 | | Brown mottled grey slightly gravelly sandy CLAY. |
| TT212 | | D | 0.40 | | Brown slightly gravelly sandy CLAY. |
| TT212 | | D | 1.00 | | Brown slightly gravelly sandy CLAY. |
| TT212 | | B | 0.80 | | Brown mottled grey gravelly sandy CLAY. |
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# SUMMARY OF SOIL CLASSIFICATION TESTS

**(BS1377 : PART 2 : 1990)**

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content % Clause 3.2 | Linear Shrinkage % Clause 6.5 | Particle Density $Mg/m^3$ Clause 8.2 | Liquid Limit % Clause 4.3/4 | Plastic Limit % Clause 5.3 | Plasticity Index % Clause 5.4 | Passing .425mm % | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT205 | | D | 1.00 | | 11 | | | | | | | |
| TT211 | | B | 1.00 | | 18 | | | | | | | |
| TT212 | | D | 0.40 | | 15 | | | | | | | |
| TT212 | | D | 1.00 | | 16 | | | 37 | 19 | 18 | 96 | Intermediate Plasticity CI |
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**SYMBOLS :** **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

4043

Professional Soils Laboratory

**Trinity Academy, Barnsley**

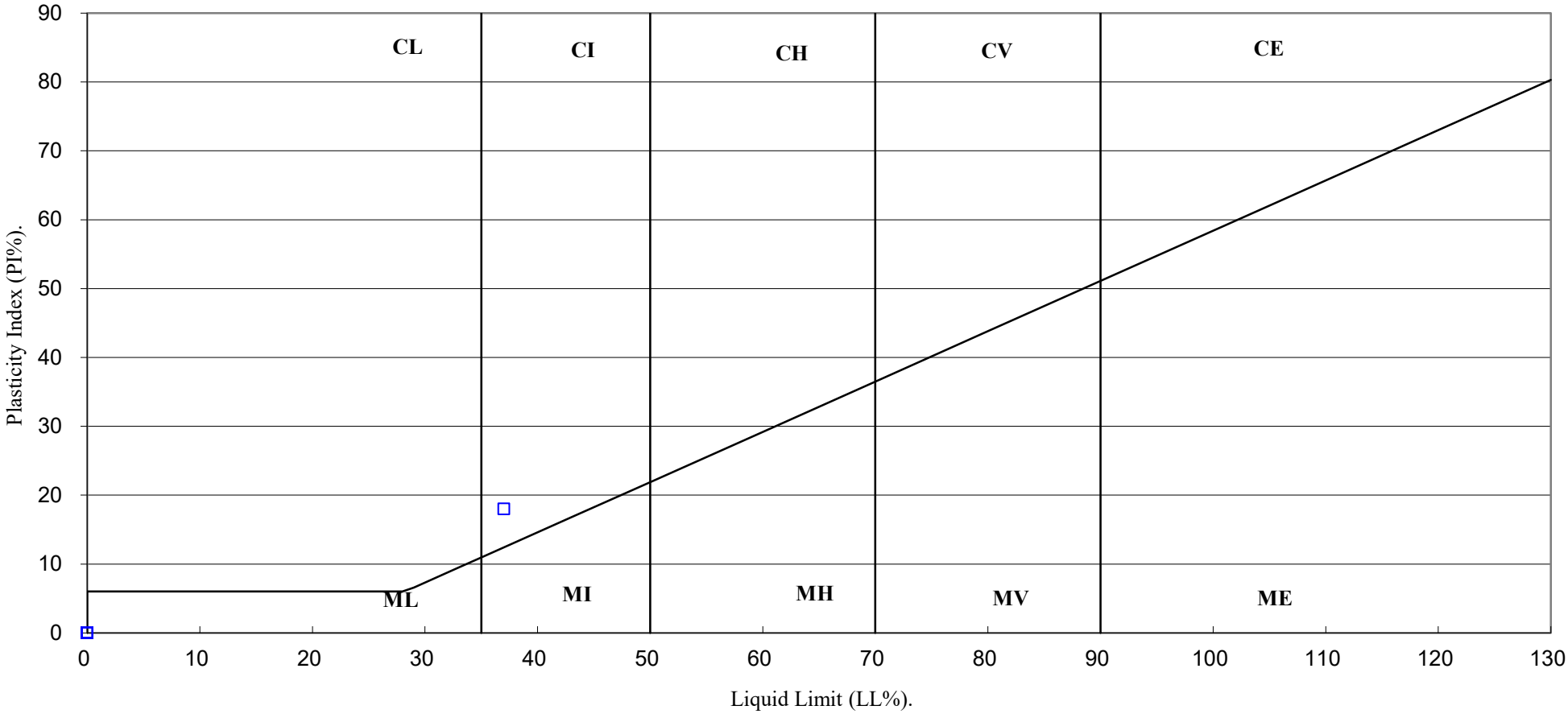
**Contract No:**

**PSL21/1658**

**Client Ref:**

**20063**

# PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.




| | | | |
|---|---|---|---|
| 4043 | Professional Soils Laboratory | Trinity Academy, Barnsley | Contract No: PSL21/1658 Client Ref: 20063 |

# PARTICLE SIZE DISTRIBUTION TEST

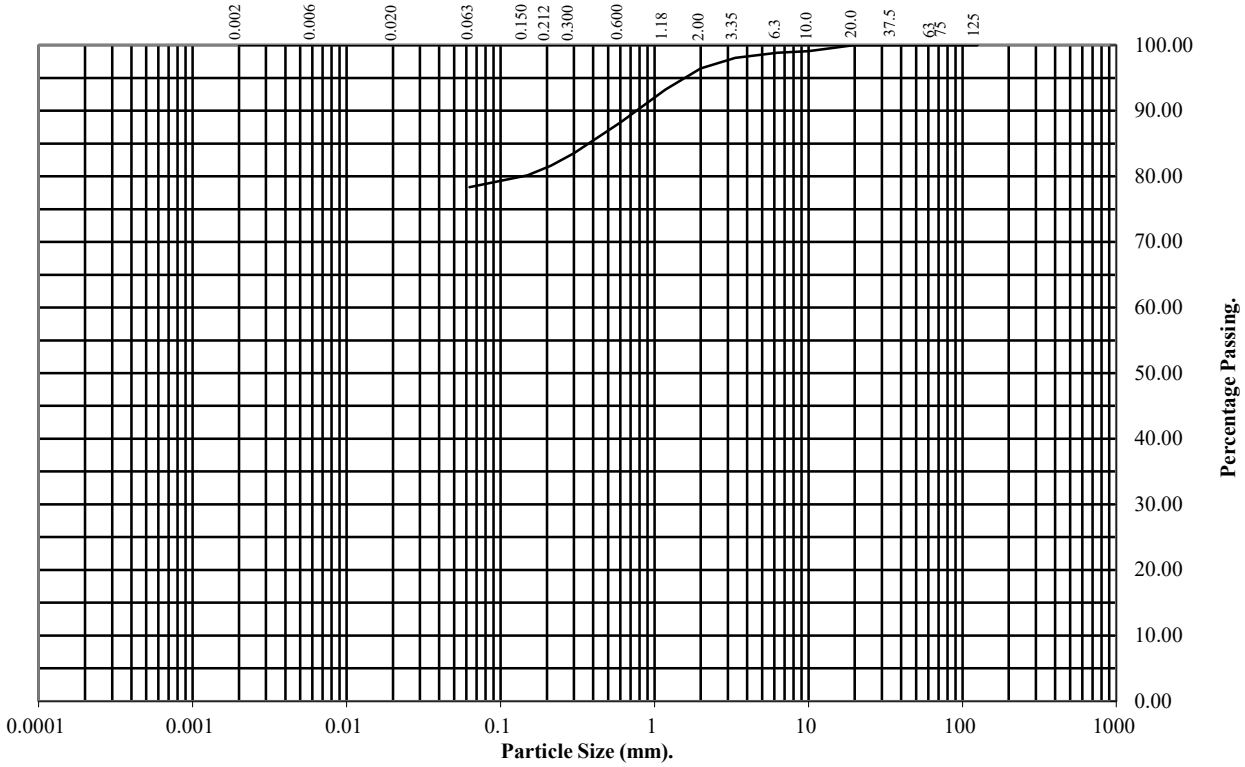
**BS1377 : Part 2 : 1990**

Wet Sieve, Clause 9.2

**Hole Number:** TT211 **Top Depth (m):** 1.00

**Sample Number:** **Base Depth(m):**

**Sample Type:** B




| BS Test Sieve (mm) | Percentage Passing |
|---|---|
| 125 | 100 |
| 75 | 100 |
| 63 | 100 |
| 37.5 | 100 |
| 20 | 100 |
| 10 | 99 |
| 6.3 | 99 |
| 3.35 | 98 |
| 2 | 96 |
| 1.18 | 93 |
| 0.6 | 88 |
| 0.3 | 84 |
| 0.212 | 82 |
| 0.15 | 80 |
| 0.063 | 78 |

| Soil Fraction | Total Percentage |
|---|---|
| Cobbles | 0 |
| Gravel | 4 |
| Sand | 18 |
| Silt/Clay | 78 |

**Remarks:**

See Summary of Soil Descriptions

4043

PSL Professional Soils Laboratory

**Trinity Academy, Barnsley**

**Contract No:** PSL21/1658

**Client Ref:** 20063

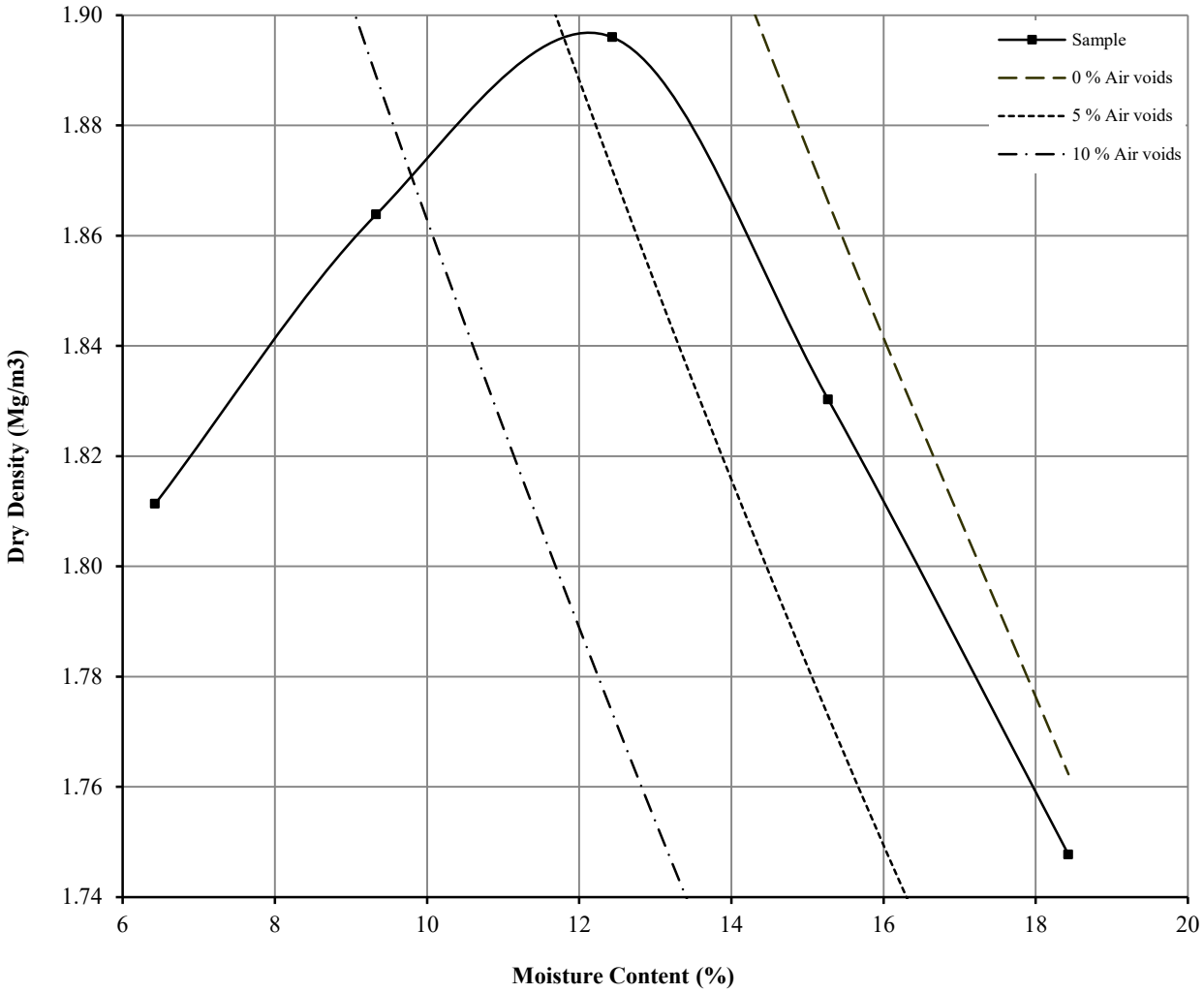
# DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

**BS 1377 : Part 4 : Clause 3.3 : 1990**

**Hole Number:** TT205 **Top Depth (m) :** 0.50

**Sample Number:** **Base Depth (m) :**

**Sample Type:** B




| | | | | | |
|---|---|---|---|---|---|
| Initial Moisture Content: | | 12 | Method of Compaction: | 2.5kg | Separate Samples |
| Particle Density (Mg/m3): | 2.61 | Assumed | Material Retained on 37.5 mm Test Sieve (%): | | 0 |
| Maximum Dry Density (Mg/m3): | | 1.90 | Material Retained on 20.0 mm Test Sieve (%): | | 2 |
| Optimum Moisture Content (%): | | 12 | | | |
| Remarks See summary of soil descriptions | | | | | |

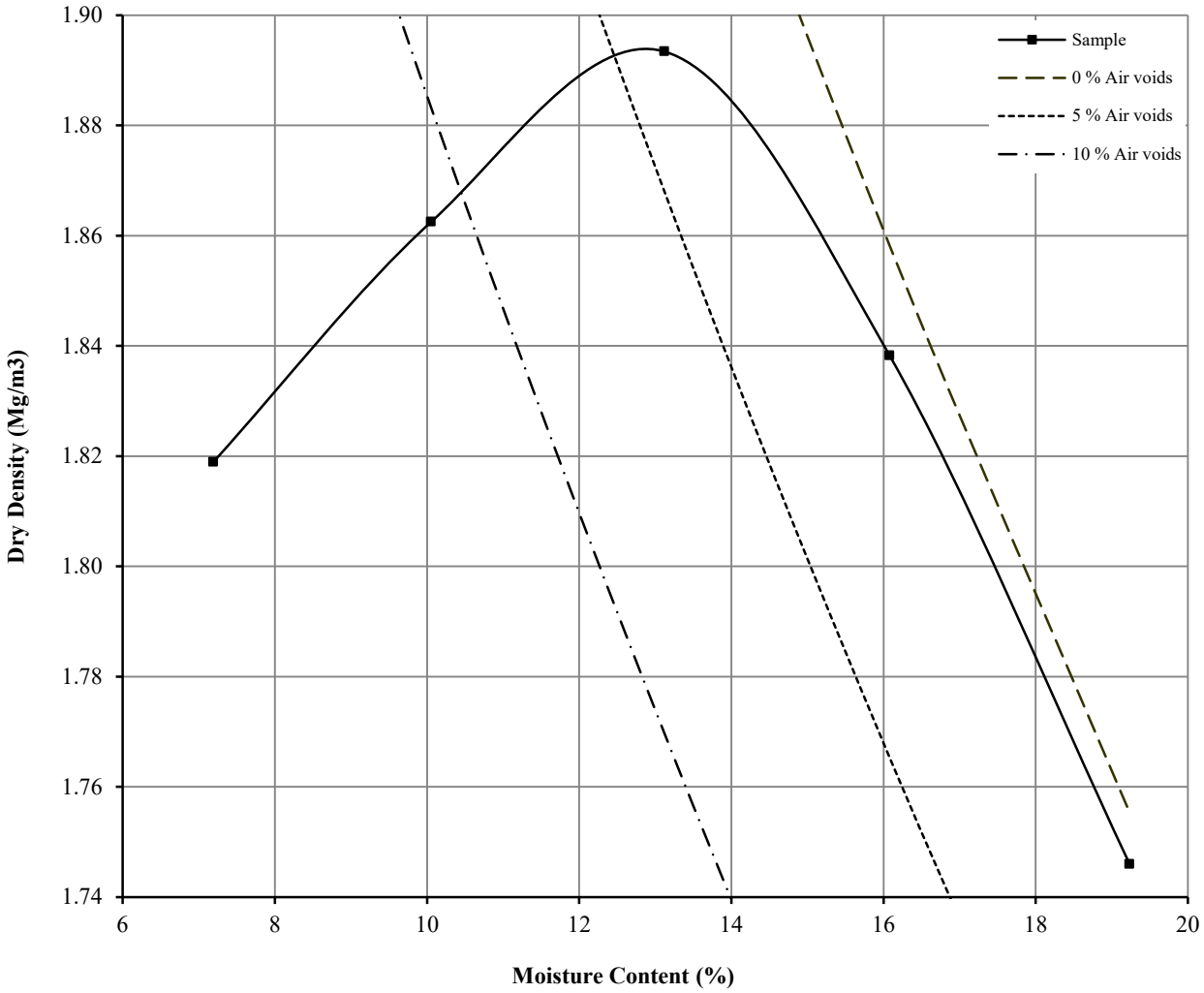
# DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

**BS 1377 : Part 4 : Clause 3.3 : 1990**

**Hole Number:** TT206 **Top Depth (m) :** 0.50

**Sample Number:** **Base Depth (m) :**

**Sample Type:** B




| | | | | | |
|---|---|---|---|---|---|
| Initial Moisture Content: | | 10 | Method of Compaction: | 2.5kg | Separate Samples |
| Particle Density (Mg/m3): | 2.65 | Assumed | Material Retained on 37.5 mm Test Sieve (%): | | 0 |
| Maximum Dry Density (Mg/m3): | | 1.89 | Material Retained on 20.0 mm Test Sieve (%): | | 2 |
| Optimum Moisture Content (%): | | 13 | | | |
| Remarks See summary of soil descriptions | | | | | |

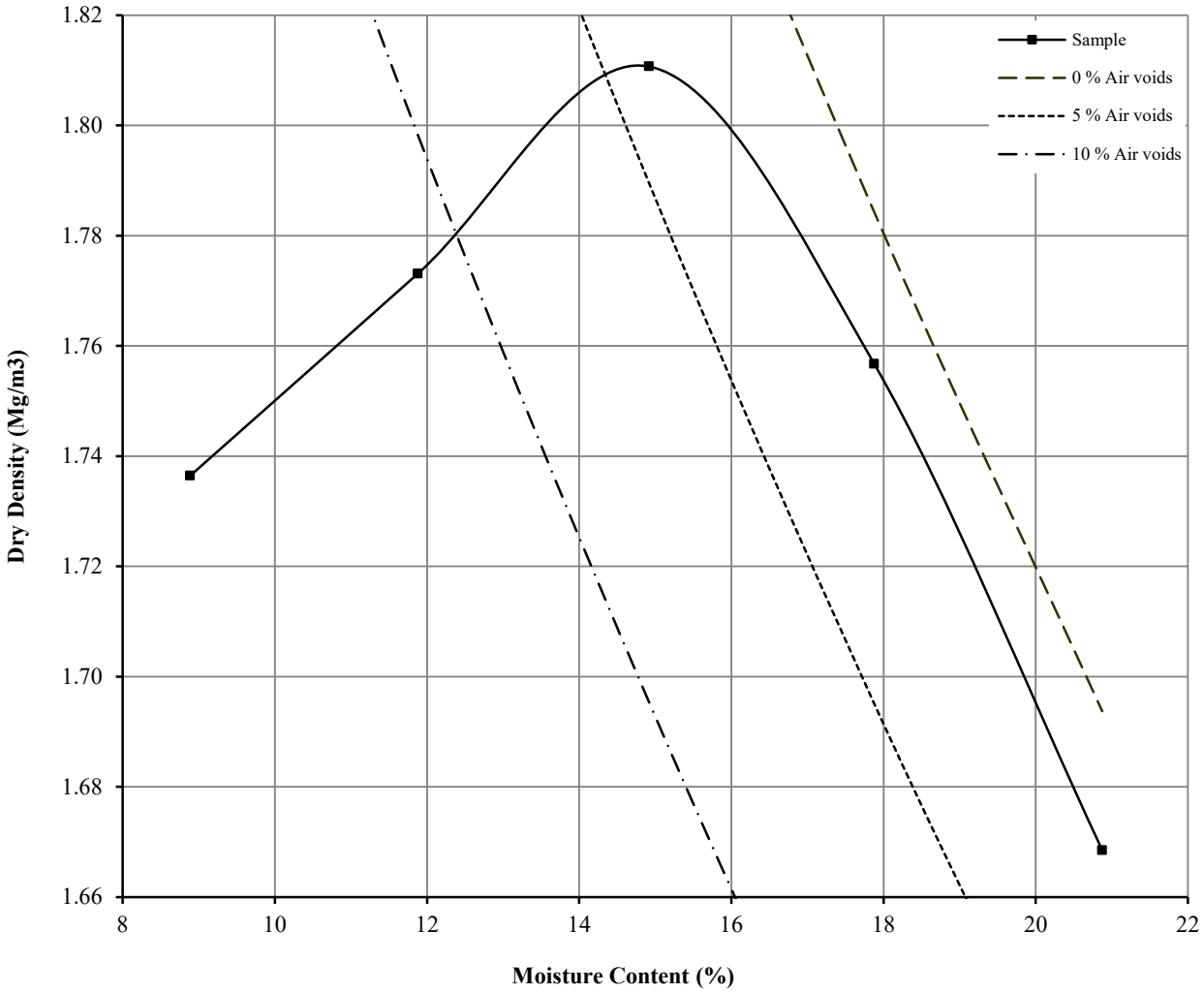
# DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

**BS 1377 : Part 4 : Clause 3.3 : 1990**

**Hole Number:** TT211 **Top Depth (m) :** 1.00

**Sample Number:** **Base Depth (m) :**

**Sample Type:** B




| | | | | | |
|---|---|---|---|---|---|
| Initial Moisture Content: | | 18 | Method of Compaction: | 2.5kg | Separate Samples |
| Particle Density (Mg/m3): | 2.62 | Assumed | Material Retained on 37.5 mm Test Sieve (%): | | 0 |
| Maximum Dry Density (Mg/m3): | | 1.81 | Material Retained on 20.0 mm Test Sieve (%): | | 0 |
| Optimum Moisture Content (%): | | 15 | | | |
| Remarks See summary of soil descriptions | | | | | |

# SUMMARY OF SOIL DENSITY RELATED TESTS

**(BS1377 : PART 2 & 4 : 1990 )**

| Hole Number | Sample Number | Sample Type | Top Depth m | Base Depth m | Moisture Content % | Bulk Density $Mg/m^3$ | Dry Density $Mg/m^3$ | Retained 20mm % | Retained 37.5mm % | Method of compaction kg | Maximum Dry Density $Mg/m^3$ | Minimum Dry Density $Mg/m^3$ | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TT205 | | B | 0.50 | | 12 | 2.13 | 1.90 | | | | | | |
| TT212 | | B | 0.80 | | 21 | 2.03 | 1.68 | | | | | | |
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4043

PSL Professional Soils Laboratory

Trinity Academy, Barnsley

**Contract No:**

**PSL21/1658**

**Client Ref:**

**20063**

2531

# ANALYTICAL TEST REPORT

**Contract no:** 94116

**Contract name:** Trinity Academy, Barnsley 20063

**Client reference:** PSL21/1658

**Clients name:** Professional Soils Laboratory

**Clients address:** 5/7 Hexthorpe Road
Doncaster
DN4 0AR

**Samples received:** 05 March 2021

**Analysis started:** 05 March 2021

**Analysis completed:** 12 March 2021

**Report issued:** 12 March 2021

**Notes:**
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

**Key:**
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

**Approved by:**
Rachael Burton
Customer Support Squad Leader

# Chemtech Environmental Limited

# SOILS

| **Lab number** | | | 94116-1 | 94116-2 | 94116-3 | 94116-4 |
|---|---|---|---|---|---|---|
| **Sample id** | | | TT205 | TT206 | TT211 | TT212 |
| **Depth (m)** | | | 1.00 | 0.50 | 1.00 | 0.40 |
| **Date sampled** | | | 04/03/2021 | 04/03/2021 | 04/03/2021 | 04/03/2021 |
| **Test** | **Method** | **Units** | | | | |
| pH | CE004 [U] | units | 7.6 | 7.1 | 7.4 | 7.1 |
| Magnesium (2:1 water soluble) | CE061 | mg/l Mg | 29 | 5.8 | 2.7 | 3.3 |
| Chloride (2:1 water soluble) | CE049 [U] | mg/l Cl | 2.2 | 1.4 | <10 | <1 |
| Nitrate (2:1 water soluble) | CE049 [U] | mg/l $NO_3$ | 1.7 | <1 | <10 | <1 |
| Sulphate (2:1 water soluble) | CE061 | mg/l $SO_4$ | 78 | 18 | 13 | 27 |
| Sulphate (total) | CE062 | mg/kg $SO_4$ | 321 | <100 | 186 | 111 |
| Sulphur (total) | CE119 | mg/kg S | 369 | <100 | 115 | <100 |
| Sulphur (total) | CE119 | % w/w S | 0.04 | <0.01 | 0.01 | <0.01 |
| Total Organic Carbon (TOC) | CE072 | % w/w C | 1.5 | 0.5 | - | 0.2 |
| Estimate of OMC (calculated from TOC) | CE072 | % w/w | 2.6 | 0.8 | - | 0.4 |

# Chemtech Environmental Limited

# METHOD DETAILS

| METHOD | SOILS | METHOD SUMMARY | SAMPLE | STATUS | LOD | UNITS |
|---|---|---|---|---|---|---|
| CE004 | pH | Based on BS 1377, pH Meter | As received | U | - | units |
| CE061 | Magnesium (2:1 water soluble) | Aqueous extraction, ICP-OES | Dry | | 1 | mg/l Mg |
| CE049 | Chloride (2:1 water soluble) | Aqueous extraction, IC-COND | Dry | U | 1 | mg/l Cl |
| CE049 | Nitrate (2:1 water soluble) | Aqueous extraction, IC-COND | Dry | U | 1 | mg/l $NO_3$ |
| CE061 | Sulphate (2:1 water soluble) | Aqueous extraction, ICP-OES | Dry | | 10 | mg/l $SO_4$ |
| CE062 | Sulphate (total) | Acid extraction, ICP-OES | Dry | | 100 | mg/kg $SO_4$ |
| CE119 | Sulphur (total) | Acid extraction, ICP-OES | Dry | | 100 | mg/kg S |
| CE119 | Sulphur (total) | Acid extraction, ICP-OES | Dry | | 0.01 | % w/w S |
| CE197 | Total Organic Carbon (TOC) | Carbon Analyser | Dry | | 0.1 | % w/w C |
| CE197 | Estimate of OMC (calculated from TOC) | Calculation from Total Organic Carbon | Dry | | 0.1 | % w/w |

# Chemtech Environmental Limited

# DEVIATING SAMPLE INFORMATION

**Comments**
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

**Key**

| | |
|---|---|
| N | No (not deviating sample) |
| Y | Yes (deviating sample) |
| NSD | Sampling date not provided |
| NST | Sampling time not provided (waters only) |
| EHT | Sample exceeded holding time(s) |
| IC | Sample not received in appropriate containers |
| HP | Headspace present in sample container |
| NCF | Sample not chemically fixed (where appropriate) |
| OR | Other (specify) |

| Lab ref | Sample id | Depth (m) | Deviating | Tests (Reason for deviation) |
|---|---|---|---|---|
| 94116-1 | TT205 | 1.00 | N | |
| 94116-2 | TT206 | 0.50 | N | |
| 94116-3 | TT211 | 1.00 | N | |
| 94116-4 | TT212 | 0.40 | N | |

# Appendix E Results of Laboratory analysis

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781
W: www.element.com

Waterman Infrastructure & Environment Limited
11 Peter Street
Manchester
M2 5QR

| | |
|---|---|
| **Attention :** | Andrew Mould |
| **Date :** | 12th February, 2021 |
| **Your reference :** | 20063 |
| **Our reference :** | Test Report 21/1161 Batch 1 |
| **Location :** | Trinity Academy Barnsley |
| **Date samples received :** | 29th January, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Six samples were received for analysis on 29th January, 2021 of which one were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**

**Simon Gomery BSc**
**Project Manager**

Please include all sections of this report if it is reproduced

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy Barnsley
**Contact:** Andrew Mould
**EMT Job No:** 21/1161

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EMT Sample No.** | 13-15 | | | | | | | | | | | | |
| **Sample ID** | RC202 | | | | | | | | | | | | |
| **Depth** | 0.50 | | | | | | | | | | | | |
| **COC No / misc** | | | | | | | | | | | | | |
| **Containers** | V J T | | | | | | | | | | | | |
| **Sample Date** | 26/01/2021 | | | | | | | | | | | | |
| **Sample Type** | Soil | | | | | | | | | | | | |
| **Batch Number** | 1 | | | | | | | | | | | | |
| **Date of Receipt** | 29/01/2021 | | | | | | | | | | | | |
| | | | | | | | | | | | LOD/LOR | Units | Method No. |
| Arsenic # | 3.3 | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 71 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Beryllium | 1.4 | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 39.3 | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cobalt # | 6.9 | | | | | | | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 30 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Iron | 59330 AA | | | | | | | | | | <20 | mg/kg | TM30/PM15 |
| Lead # | 19 | | | | | | | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Molybdenum # | 1.1 | | | | | | | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 19.8 | | | | | | | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | <1 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Vanadium | 41 | | | | | | | | | | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 0.9 | | | | | | | | | | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 73 | | | | | | | | | | <5 | mg/kg | TM30/PM15 |
| | | | | | | | | | | | | | |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | | | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | <0.03 | | | | | | | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | <0.06 | | | | | | | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | <0.02 | | | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | <0.07 | | | | | | | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| Coronene | <0.04 | | | | | | | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 17 Total | <0.64 | | | | | | | | | | <0.64 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | <0.05 | | | | | | | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | <0.02 | | | | | | | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 85 | | | | | | | | | | <0 | % | TM4/PM8 |

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy Barnsley
**Contact:** Andrew Mould
**EMT Job No:** 21/1161

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| EMT Sample No. | 13-15 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | RC202 | | | | | | | | | | | | |
| Depth | 0.50 | | | | | | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | | | | | | | | | | | | |
| Sample Date | 26/01/2021 | | | | | | | | | | | | |
| Sample Type | Soil | | | | | | | | | | | | |
| Batch Number | 1 | | | | | | | | | | | | |
| Date of Receipt | 29/01/2021 | | | | | | | | | | | | |

| | | | | | | | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 (HS_1D_AL)# | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 (HS_1D_AL)# | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 (HS_1D_AL) | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 (EH_CU_1D_AL)# | <0.2 | | | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 (EH_CU_1D_AL)# | <4 | | | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 (EH_CU_1D_AL)# | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 (EH_CU_1D_AL)# | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C35-C44 (EH_1D_AL) | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-44 (EH+HS_1D_AL) | <26 | | | | | | | | | | <26 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 (HS_1D_AR)# | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 (HS_1D_AR)# | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 (HS_1D_AR)# | <0.1 | | | | | | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 (EH_CU_1D_AR)# | <0.2 | | | | | | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 (EH_CU_1D_AR)# | <4 | | | | | | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 (EH_CU_1D_AR)# | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 (EH_CU_1D_AR)# | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC35-EC44 (EH_1D_AR) | <7 | | | | | | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-44 (EH+HS_1D_AR) | <26 | | | | | | | | | | <26 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-44) (EH+HS_CU_1D_Total) | <52 | | | | | | | | | | <52 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| MTBE# | <0.005 | | | | | | | | | | <0.005 | mg/kg | TM36/PM12 |
| Benzene# | <0.005 | | | | | | | | | | <0.005 | mg/kg | TM36/PM12 |
| Toluene# | <0.005 | | | | | | | | | | <0.005 | mg/kg | TM36/PM12 |
| Ethylbenzene# | <0.005 | | | | | | | | | | <0.005 | mg/kg | TM36/PM12 |
| m/p-Xylene# | <0.005 | | | | | | | | | | <0.005 | mg/kg | TM36/PM12 |
| o-Xylene# | <0.005 | | | | | | | | | | <0.005 | mg/kg | TM36/PM12 |
| Natural Moisture Content | 20.6 | | | | | | | | | | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium# | <0.3 | | | | | | | | | | <0.3 | mg/kg | TM38/PM20 |
| Total Organic Carbon# | 0.26 | | | | | | | | | | <0.02 | % | TM21/PM24 |
| Calorific Value | <1 | | | | | | | | | | <1 | MJ/kg | TM21/PM24 |
| Organic Matter | 0.4 | | | | | | | | | | <0.2 | % | TM21/PM24 |
| pH# | 7.91 | | | | | | | | | | <0.01 | pH units | TM73/PM11 |

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy Barnsley
**Contact:** Andrew Mould

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/1161 | 1 | RC202 | 0.50 | 15 | 09/02/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 09/02/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type** | NAD |
| | | | | | 09/02/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy Barnsley
**Contact:** Andrew Mould

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/1161 | | | | | | |

**Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.**
**Only analyses which are accredited are recorded as deviating if set criteria are not met.**

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

***EMT Job No.:*** 21/1161

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x5 Dilution |

**HWOL ACRONYMS AND OPERATORS USED**

| | |
|---|---|
| HS | Headspace Analysis. |
| EH | Extractable Hydrocarbons - i.e. everything extracted by the solvent. |
| CU | Clean-up - e.g. by florisil, silica gel. |
| 1D | GC - Single coil gas chromatography. |
| Total | Aliphatics & Aromatics. |
| AL | Aliphatics only. |
| AR | Aromatics only. |
| 2D | GC-GC - Double coil gas chromatography. |
| #1 | EH_Total but with humics extracted. |
| #2 | EU_Total but with fatty acids extracted. |
| _ | Operator - underscore to separate acronyms (exception for +). |
| + | Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total |
| MS | Mass Spectrometry. |

**EMT Job No:** 21/1161

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | | | AD | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |

**EMT Job No:** 21/1161

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

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11 Peter Street
Manchester
M2 5QR

| | |
|---|---|
| **Attention :** | Andrew Mould |
| **Date :** | 12th February, 2021 |
| **Your reference :** | 20063 |
| **Our reference :** | Test Report 21/1396 Batch 1 |
| **Location :** | Trinity Academy |
| **Date samples received :** | 2nd February, 2021 |
| **Status :** | Final report |
| **Issue :** | 1 |

Twenty five samples were received for analysis on 2nd February, 2021 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**

**Simon Gomery BSc**
**Project Manager**

Please include all sections of this report if it is reproduced

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy
**Contact:** Andrew Mould
**EMT Job No:** 21/1396

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

| EMT Sample No. | 1-3 | 37-39 | 40-42 | 52-54 | 55-57 | 61-63 | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | TT201 | TT207 | TT208 | TT210 | TT210 | TT211 | | | | | | | |
| Depth | 0.20 | 0.20 | 0.10 | 0.20 | 0.60 | 0.60 | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | V J T | V J T | V J T | | | | | | | |
| Sample Date | 29/01/2021 | 29/01/2021 | 28/01/2021 | 29/01/2021 | 29/01/2021 | 29/01/2021 | | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| Date of Receipt | 02/02/2021 | 02/02/2021 | 02/02/2021 | 02/02/2021 | 02/02/2021 | 02/02/2021 | | | | | | | |
| Arsenic # | 15.6 | 19.2 | 16.1 | 19.8 | 9.1 | 7.3 | | | | | <0.5 | mg/kg | TM30/PM15 |
| Barium # | 103 | 122 | 67 | 108 | 70 | 62 | | | | | <1 | mg/kg | TM30/PM15 |
| Beryllium | 1.5 | 1.5 | 1.2 | 1.6 | 1.1 | 1.3 | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cadmium # | 0.2 | 0.3 | 0.2 | 0.2 | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM30/PM15 |
| Chromium # | 50.1 | 61.0 | 64.5 | 55.0 | 58.6 | 55.3 | | | | | <0.5 | mg/kg | TM30/PM15 |
| Cobalt # | 15.3 | 23.6 | 16.7 | 17.3 | 25.1 | 16.9 | | | | | <0.5 | mg/kg | TM30/PM15 |
| Copper # | 35 | 45 | 28 | 44 | 16 | 27 | | | | | <1 | mg/kg | TM30/PM15 |
| Iron | 48710 | 57350$_{AA}$ | 48170 | 51410$_{AA}$ | 49860 | 49930 | | | | | <20 | mg/kg | TM30/PM15 |
| Lead # | 69 | 81 | 63 | 80 | 39 | 29 | | | | | <5 | mg/kg | TM30/PM15 |
| Mercury # | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM30/PM15 |
| Molybdenum # | 4.3 | 5.5 | 5.3 | 4.9 | 3.7 | 3.1 | | | | | <0.1 | mg/kg | TM30/PM15 |
| Nickel # | 22.6 | 25.5 | 24.1 | 23.0 | 16.1 | 22.1 | | | | | <0.7 | mg/kg | TM30/PM15 |
| Selenium # | 2 | 2 | 2 | 2 | 2 | <1 | | | | | <1 | mg/kg | TM30/PM15 |
| Vanadium | 41 | 48 | 33 | 41 | 37 | 37 | | | | | <1 | mg/kg | TM30/PM15 |
| Water Soluble Boron # | 0.9 | 0.6 | 0.5 | 1.1 | 0.5 | 0.5 | | | | | <0.1 | mg/kg | TM74/PM32 |
| Zinc # | 117 | 112 | 91 | 132 | 81 | 86 | | | | | <5 | mg/kg | TM30/PM15 |
| PAH MS | | | | | | | | | | | | | |
| Naphthalene # | <0.04 | 0.19 | 0.05 | 0.12 | <0.04 | <0.04 | | | | | <0.04 | mg/kg | TM4/PM8 |
| Acenaphthylene | <0.03 | 0.20 | <0.03 | 0.18 | <0.03 | <0.03 | | | | | <0.03 | mg/kg | TM4/PM8 |
| Acenaphthene # | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | | | | | <0.05 | mg/kg | TM4/PM8 |
| Fluorene # | <0.04 | 0.10 | <0.04 | 0.05 | <0.04 | <0.04 | | | | | <0.04 | mg/kg | TM4/PM8 |
| Phenanthrene # | 0.18 | 1.47 | 0.17 | 1.03 | <0.03 | 0.10 | | | | | <0.03 | mg/kg | TM4/PM8 |
| Anthracene # | <0.04 | 0.44 | <0.04 | 0.30 | <0.04 | <0.04 | | | | | <0.04 | mg/kg | TM4/PM8 |
| Fluoranthene # | 0.39 | 3.07 | 0.33 | 2.30 | 0.05 | 0.19 | | | | | <0.03 | mg/kg | TM4/PM8 |
| Pyrene # | 0.33 | 2.52 | 0.29 | 1.91 | 0.04 | 0.16 | | | | | <0.03 | mg/kg | TM4/PM8 |
| Benzo(a)anthracene # | 0.25 | 1.45 | 0.21 | 1.14 | <0.06 | 0.13 | | | | | <0.06 | mg/kg | TM4/PM8 |
| Chrysene # | 0.26 | 1.54 | 0.22 | 1.21 | 0.04 | 0.13 | | | | | <0.02 | mg/kg | TM4/PM8 |
| Benzo(bk)fluoranthene # | 0.39 | 2.65 | 0.34 | 1.97 | <0.07 | 0.16 | | | | | <0.07 | mg/kg | TM4/PM8 |
| Benzo(a)pyrene # | 0.18 | 1.14 | 0.14 | 0.95 | <0.04 | 0.06 | | | | | <0.04 | mg/kg | TM4/PM8 |
| Indeno(123cd)pyrene # | 0.14 | 0.83 | 0.10 | 0.59 | <0.04 | 0.05 | | | | | <0.04 | mg/kg | TM4/PM8 |
| Dibenzo(ah)anthracene # | <0.04 | 0.17 | <0.04 | 0.11 | <0.04 | <0.04 | | | | | <0.04 | mg/kg | TM4/PM8 |
| Benzo(ghi)perylene # | 0.13 | 0.78 | 0.10 | 0.58 | <0.04 | 0.05 | | | | | <0.04 | mg/kg | TM4/PM8 |
| Coronene | <0.04 | 0.19 | <0.04 | 0.11 | <0.04 | <0.04 | | | | | <0.04 | mg/kg | TM4/PM8 |
| PAH 17 Total | 2.25 | 16.74 | 1.95 | 12.55 | <0.64 | 1.03 | | | | | <0.64 | mg/kg | TM4/PM8 |
| Benzo(b)fluoranthene | 0.28 | 1.91 | 0.24 | 1.42 | <0.05 | 0.12 | | | | | <0.05 | mg/kg | TM4/PM8 |
| Benzo(k)fluoranthene | 0.11 | 0.74 | 0.10 | 0.55 | <0.02 | 0.04 | | | | | <0.02 | mg/kg | TM4/PM8 |
| PAH Surrogate % Recovery | 95 | 96 | 95 | 97 | 89 | 101 | | | | | <0 | % | TM4/PM8 |

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy
**Contact:** Andrew Mould
**EMT Job No:** 21/1396

**Report : Solid**

**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub

| EMT Sample No. | 1-3 | 37-39 | 40-42 | 52-54 | 55-57 | 61-63 | | | | | LOD/LOR | Units | Method No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | TT201 | TT207 | TT208 | TT210 | TT210 | TT211 | | | | | | | |
| Depth | 0.20 | 0.20 | 0.10 | 0.20 | 0.60 | 0.60 | | | | | | | |
| COC No / misc | | | | | | | | | | | | | |
| Containers | V J T | V J T | V J T | V J T | V J T | V J T | | | | | | | |
| Sample Date | 29/01/2021 | 29/01/2021 | 28/01/2021 | 29/01/2021 | 29/01/2021 | 29/01/2021 | | | | | | | |
| Sample Type | Soil | Soil | Soil | Soil | Soil | Soil | | | | | | | |
| Batch Number | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| Date of Receipt | 02/02/2021 | 02/02/2021 | 02/02/2021 | 02/02/2021 | 02/02/2021 | 02/02/2021 | | | | | | | |
| TPH CWG | | | | | | | | | | | | | |
| **Aliphatics** | | | | | | | | | | | | | |
| >C5-C6 (HS_1D_AL)# | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C6-C8 (HS_1D_AL)# | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C8-C10 (HS_1D_AL) | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM36/PM12 |
| >C10-C12 (EH_CU_1D_AL)# | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >C12-C16 (EH_CU_1D_AL)# | <4 | <4 | <4 | <4 | <4 | <4 | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >C16-C21 (EH_CU_1D_AL)# | <7 | <7 | <7 | <7 | <7 | <7 | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C21-C35 (EH_CU_1D_AL)# | <7 | <7 | <7 | <7 | <7 | <7 | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >C35-C44 (EH_1D_AL) | <7 | <7 | <7 | <7 | <7 | <7 | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aliphatics C5-44 (EH+HS_1D_AL) | <26 | <26 | <26 | <26 | <26 | <26 | | | | | <26 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| **Aromatics** | | | | | | | | | | | | | |
| >C5-EC7 (HS_1D_AR)# | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC7-EC8 (HS_1D_AR)# | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC8-EC10 (HS_1D_AR)# | <0.1 | <0.1 SV | <0.1 | <0.1 SV | <0.1 | <0.1 | | | | | <0.1 | mg/kg | TM36/PM12 |
| >EC10-EC12 (EH_CU_1D_AR)# | <0.2 | <0.2 | <0.2 | <0.2 | 1.2 | 1.0 | | | | | <0.2 | mg/kg | TM5/PM8/PM16 |
| >EC12-EC16 (EH_CU_1D_AR)# | <4 | <4 | <4 | 7 | <4 | <4 | | | | | <4 | mg/kg | TM5/PM8/PM16 |
| >EC16-EC21 (EH_CU_1D_AR)# | <7 | 12 | <7 | 21 | <7 | <7 | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC21-EC35 (EH_CU_1D_AR)# | <7 | 16 | <7 | 37 | <7 | <7 | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| >EC35-EC44 (EH_1D_AR) | <7 | <7 | <7 | <7 | <7 | <7 | | | | | <7 | mg/kg | TM5/PM8/PM16 |
| Total aromatics C5-44 (EH+HS_1D_AR) | <26 | 28 | <26 | 65 | <26 | <26 | | | | | <26 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| Total aliphatics and aromatics(C5-44) (EH+HS_CU_1D_Total) | <52 | <52 | <52 | 65 | <52 | <52 | | | | | <52 | mg/kg | TM5/TM36/PM8/PM12/PM16 |
| MTBE# | <0.005 | <0.005 SV | <0.005 | <0.005 SV | <0.005 | <0.005 | | | | | <0.005 | mg/kg | TM36/PM12 |
| Benzene# | <0.005 | <0.005 SV | <0.005 | <0.005 SV | <0.005 | <0.005 | | | | | <0.005 | mg/kg | TM36/PM12 |
| Toluene# | <0.005 | <0.005 SV | <0.005 | <0.005 SV | <0.005 | <0.005 | | | | | <0.005 | mg/kg | TM36/PM12 |
| Ethylbenzene# | <0.005 | <0.005 SV | <0.005 | <0.005 SV | <0.005 | <0.005 | | | | | <0.005 | mg/kg | TM36/PM12 |
| m/p-Xylene# | <0.005 | <0.005 SV | <0.005 | <0.005 SV | <0.005 | <0.005 | | | | | <0.005 | mg/kg | TM36/PM12 |
| o-Xylene# | <0.005 | <0.005 SV | <0.005 | <0.005 SV | <0.005 | <0.005 | | | | | <0.005 | mg/kg | TM36/PM12 |
| Natural Moisture Content | 38.9 | 24.3 | 30.0 | 37.1 | 21.1 | 26.6 | | | | | <0.1 | % | PM4/PM0 |
| Hexavalent Chromium# | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | | | | | <0.3 | mg/kg | TM38/PM20 |
| Total Organic Carbon# | 5.51 | 8.73 | 5.71 | 6.02 | 1.26 | 1.39 | | | | | <0.02 | % | TM21/PM24 |
| Calorific Value | 2 | 3 | 2 | 2 | <1 | <1 | | | | | <1 | MJ/kg | TM21/PM24 |
| Organic Matter | 9.5 | 15.1 | 9.8 | 10.4 | 2.2 | 2.4 | | | | | <0.2 | % | TM21/PM24 |
| pH# | 6.51 | 6.44 | 6.41 | 6.99 | 7.43 | 7.41 | | | | | <0.01 | pH units | TM73/PM11 |

Please see attached notes for all abbreviations and acronyms

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy
**Contact:** Andrew Mould

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Date Of Analysis | Analysis | Result |
|---|---|---|---|---|---|---|---|
| 21/1396 | 1 | TT201 | 0.20 | 3 | 09/02/2021 | **General Description (Bulk Analysis)** | Soil/Stone |
| | | | | | 09/02/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/02/2021 | **Asbestos Fibres (2)** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM (2)** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type (2)** | NAD |
| | | | | | 09/02/2021 | **Asbestos Level Screen** | NAD |
| 21/1396 | 1 | TT207 | 0.20 | 39 | 09/02/2021 | **General Description (Bulk Analysis)** | soil.stones |
| | | | | | 09/02/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type** | NAD |
| | | | | | 09/02/2021 | **Asbestos Level Screen** | NAD |
| 21/1396 | 1 | TT208 | 0.10 | 42 | 09/02/2021 | **General Description (Bulk Analysis)** | Soil/Stones |
| | | | | | 09/02/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type** | NAD |
| | | | | | 09/02/2021 | **Asbestos Level Screen** | NAD |
| 21/1396 | 1 | TT210 | 0.20 | 54 | 09/02/2021 | **General Description (Bulk Analysis)** | soil.stones |
| | | | | | 09/02/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type** | NAD |
| | | | | | 09/02/2021 | **Asbestos Level Screen** | NAD |
| 21/1396 | 1 | TT210 | 0.60 | 57 | 09/02/2021 | **General Description (Bulk Analysis)** | Soil/Stones |
| | | | | | 09/02/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type** | NAD |
| | | | | | 09/02/2021 | **Asbestos Level Screen** | NAD |
| 21/1396 | 1 | TT211 | 0.60 | 63 | 09/02/2021 | **General Description (Bulk Analysis)** | Soil/Stones |
| | | | | | 09/02/2021 | **Asbestos Fibres** | NAD |
| | | | | | 09/02/2021 | **Asbestos ACM** | NAD |
| | | | | | 09/02/2021 | **Asbestos Type** | NAD |
| | | | | | 09/02/2021 | **Asbestos Level Screen** | NAD |

**Client Name:** Waterman Infrastructure & Environment Limited
**Reference:** 20063
**Location:** Trinity Academy
**Contact:** Andrew Mould

| EMT Job No. | Batch | Sample ID | Depth | EMT Sample No. | Analysis | Reason |
|---|---|---|---|---|---|---|
| No deviating sample report results for job 21/1396 | | | | | | |

**Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.**
**Only analyses which are accredited are recorded as deviating if set criteria are not met.**

# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

***EMT Job No.:*** 21/1396

**SOILS**

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

**WATERS**

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

**DEVIATING SAMPLES**

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

**SURROGATES**

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

**DILUTIONS**

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

**BLANKS**

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**ABBREVIATIONS and ACRONYMS USED**

| | |
|---|---|
| # | ISO17025 (UKAS Ref No. 4225) accredited - UK. |
| SA | ISO17025 (SANAS Ref No.T0729) accredited - South Africa |
| B | Indicates analyte found in associated method blank. |
| DR | Dilution required. |
| M | MCERTS accredited. |
| NA | Not applicable |
| NAD | No Asbestos Detected. |
| ND | None Detected (usually refers to VOC and/SVOC TICs). |
| NDP | No Determination Possible |
| SS | Calibrated against a single substance |
| SV | Surrogate recovery outside performance criteria. This may be due to a matrix effect. |
| W | Results expressed on as received basis. |
| + | AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page. |
| >> | Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited. |
| * | Analysis subcontracted to an Element Materials Technology approved laboratory. |
| AD | Samples are dried at 35°C ±5°C |
| CO | Suspected carry over |
| LOD/LOR | Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS |
| ME | Matrix Effect |
| NFD | No Fibres Detected |
| BS | AQC Sample |
| LB | Blank Sample |
| N | Client Sample |
| TB | Trip Blank Sample |
| OC | Outside Calibration Range |
| AA | x5 Dilution |

**HWOL ACRONYMS AND OPERATORS USED**

| | |
|---|---|
| HS | Headspace Analysis. |
| EH | Extractable Hydrocarbons - i.e. everything extracted by the solvent. |
| CU | Clean-up - e.g. by florisil, silica gel. |
| 1D | GC - Single coil gas chromatography. |
| Total | Aliphatics & Aromatics. |
| AL | Aliphatics only. |
| AR | Aromatics only. |
| 2D | GC-GC - Double coil gas chromatography. |
| #1 | EH_Total but with humics extracted. |
| #2 | EU_Total but with fatty acids extracted. |
| _ | Operator - underscore to separate acronyms (exception for +). |
| + | Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total |
| MS | Mass Spectrometry. |

**EMT Job No:** 21/1396

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| PM4 | Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990. | PM0 | No preparation is required. | | | AR | |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | | | AR | Yes |
| TM4 | Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS. | PM8 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required. | Yes | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | | | AR | Yes |
| TM5 | Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present. | PM8/PM16 | End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE. | Yes | | AR | Yes |
| TM5/TM36 | please refer to TM5 and TM36 for method details | PM8/PM12/PM16 | please refer to PM8/PM16 and PM12 for method details | | | AR | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | | | AD | Yes |
| TM21 | Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4. | PM24 | Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis. | Yes | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | | | AD | Yes |
| TM30 | Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP | PM15 | Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground. | Yes | | AD | Yes |

**EMT Job No:** 21/1396

| Test Method No. | Description | Prep Method No. (if appropriate) | Description | ISO 17025 (UKAS/SANAS) | MCERTS (UK soils only) | Analysis done on As Received (AR) or Dried (AD) | Reported on dry weight basis |
|---|---|---|---|---|---|---|---|
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | | | AR | Yes |
| TM36 | Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested. | PM12 | Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis. | Yes | | AR | Yes |
| TM38 | Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l | PM20 | Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker. | Yes | | AR | Yes |
| TM65 | Asbestos Bulk Identification method based on HSG 248 First edition (2006) | PM42 | Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065. | Yes | | AR | |
| TM73 | Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser. | PM11 | Extraction of as received solid samples using one part solid to 2.5 parts deionised water. | Yes | | AR | No |
| TM74 | Analysis of water soluble boron (20:1 extract) by ICP-OES. | PM32 | Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio. | Yes | | AD | Yes |
| | | | | | | | |
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| | | | | | | | |

| Job No | WIE17125-100 |
|---|---|
| Site Name | Trinity Academy, Barnsley - Supplementary GI |

## END USE SCENARIO

**Residential without plant uptake (1% SOM)**

| | | | | | Sample I.D | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | RC202 | TT201 | TT207 | TT208 | TT210 | TT210 | TT211 |
| | | | | | Depth | 0.50 | 0.20 | 0.20 | 0.10 | 0.20 | 0.60 | 0.60 |
| | | | | | Strata | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| In-organics | Metals | Arsenic | **40.00** | mg/kg | 3.30 | 15.60 | 19.20 | 16.10 | 19.80 | 9.10 | 7.30 |
| | | Barium | | mg/kg | 71.00 | 103.00 | 122.00 | 67.00 | 108.00 | 70.00 | 62.00 |
| | | Beryllium | **1.70** | mg/kg | 1.40 | 1.50 | 1.50 | 1.20 | 1.60 | 1.10 | 1.30 |
| | | Boron (Water Soluble) | **11000.00** | mg/kg | 0.90 | 0.90 | 0.60 | 0.50 | 1.10 | 0.50 | 0.50 |
| | | Cadmium | **150.00** | mg/kg | <0.1 | 0.20 | 0.30 | 0.20 | 0.20 | <0.1 | <0.1 |
| | | Chromium (Total) | **910.00** | mg/kg | 39.30 | 50.10 | 61.00 | 64.50 | 55.00 | 58.60 | 55.30 |
| | | Chromium (VI) | **21.00** | mg/kg | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| | | Cobalt | **0.00** | mg/kg | 6.90 | 15.30 | 23.60 | 16.70 | 17.30 | 25.10 | 16.90 |
| | | Copper | **7100.00** | mg/kg | 30.00 | 35.00 | 45.00 | 28.00 | 44.00 | 16.00 | 27.00 |
| | | Iron | | mg/kg | 59330.00 | 48710.00 | 57350.00 | 48170.00 | 51410.00 | 49860.00 | 49930.00 |
| | | Lead | **310.00** | mg/kg | 19.00 | 69.00 | 81.00 | 63.00 | 80.00 | 39.00 | 29.00 |
| | | Mercury | **1.20** | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | Molybdenum | | mg/kg | 1.10 | 4.30 | 5.50 | 5.30 | 4.90 | 3.70 | 3.10 |
| | | Nickel | **180.00** | mg/kg | 19.80 | 22.60 | 25.50 | 24.10 | 23.00 | 16.10 | 22.10 |
| | | Selenium | **430.00** | mg/kg | <1 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | <1 |
| | | Vanadium | **1200.00** | mg/kg | 41.00 | 41.00 | 48.00 | 33.00 | 41.00 | 37.00 | 37.00 |
| | | Zinc | **40000.00** | mg/kg | 73.00 | 117.00 | 112.00 | 91.00 | 132.00 | 81.00 | 86.00 |
| Organics | TPH CWG | Aliphatic EC5 - EC6 | **42.00** | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | Aliphatic EC6 - EC8 | **100.00** | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | Aliphatic EC8-EC10 | **27.00** | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | Aliphatic EC10-EC12 | **130.00** | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| | | Aliphatic EC12-EC16 | **1100.00** | mg/kg | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| | | Aliphatic EC16-EC21 | **65000.00** | mg/kg | <7 | <7 | <7 | <7 | <7 | <7 | <7 |
| | | Aliphatic EC21-EC35 | **65000.00** | mg/kg | <7 | <7 | <7 | <7 | <7 | <7 | <7 |
| | | Aliphatic EC35-EC44 | | mg/kg | <7 | <7 | <7 | <7 | <7 | <7 | <7 |
| | | Total Aliphatics (EC5 - EC44) | | mg/kg | <26 | <26 | <26 | <26 | <26 | <26 | <26 |
| | | Aromatic EC5-EC7 | **370.00** | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | Aromatic EC7-EC8 | **860.00** | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | Aromatic EC8-EC10 | **47.00** | mg/kg | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | Aromatic EC10-EC12 | **250.00** | mg/kg | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 1.20 | 1.00 |
| | | Aromatic EC12-EC16 | **1800.00** | mg/kg | <4 | <4 | <4 | <4 | 7.00 | <4 | <4 |
| | | Aromatic EC16-EC21 | **1900.00** | mg/kg | <7 | <7 | 12.00 | <7 | 21.00 | <7 | <7 |
| | | Aromatic EC21-EC35 | **1900.00** | mg/kg | <7 | <7 | 16.00 | <7 | 37.00 | <7 | <7 |
| | | Aromatic EC35-EC44 | **1900.00** | mg/kg | <7 | <7 | <7 | <7 | <7 | <7 | <7 |
| | | Total Aromatics (EC5-EC44) | | mg/kg | <26 | <26 | 28.00 | <26 | 65.00 | <26 | <26 |
| | | Total Aliphatics and Aromatics (EC5-EC35) | | mg/kg | <52 | <52 | <52 | <52 | 65.00 | <52 | <52 |
| | BTEX | GRO (C5-C10) | | mg/kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | GRO (C10-C12) | | mg/kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Benzene | **0.38** | mg/kg | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | Toluene | **880.00** | mg/kg | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | Ethyl Benzene | **83.00** | mg/kg | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | Xylene - m | **82.00** | mg/kg | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | Xylene - o | **88.00** | mg/kg | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | Xylene - p | **79.00** | mg/kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | MTBE | **0.00** | mg/kg | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | 16 US EPA PAHs (GCMS) | Naphthalene | **2.30** | mg/kg | <0.04 | <0.04 | 0.19 | 0.05 | 0.12 | <0.04 | <0.04 |
| | | Acenaphthylene | **2900.00** | mg/kg | <0.03 | <0.03 | 0.20 | <0.03 | 0.18 | <0.03 | <0.03 |
| | | Acenaphthene | **3000.00** | mg/kg | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| | | Fluorene | **2800.00** | mg/kg | <0.04 | <0.04 | 0.10 | <0.04 | 0.05 | <0.04 | <0.04 |
| | | Phenanthrene | **1300.00** | mg/kg | <0.03 | 0.18 | 1.47 | 0.17 | 1.03 | <0.03 | 0.10 |
| | | Anthracene | **31000.00** | mg/kg | <0.04 | <0.04 | 0.44 | <0.04 | 0.30 | <0.04 | <0.04 |
| | | Fluoranthene | **1500.00** | mg/kg | <0.03 | 0.39 | 3.07 | 0.33 | 2.30 | 0.05 | 0.19 |
| | | Pyrene | **3700.00** | mg/kg | <0.03 | 0.33 | 2.52 | 0.29 | 1.91 | 0.04 | 0.16 |
| | | Benzo(a)anthracene | **11.00** | mg/kg | <0.06 | 0.25 | 1.45 | 0.21 | 1.14 | <0.06 | 0.13 |
| | | Chrysene | **30.00** | mg/kg | <0.02 | 0.26 | 1.54 | 0.22 | 1.21 | 0.04 | 0.13 |
| | | Benzo(b)fluoranthene | **3.90** | mg/kg | <0.05 | 0.28 | 1.91 | 0.24 | 1.42 | <0.05 | 0.12 |
| | | Benzo(k)fluoranthene | **110.00** | mg/kg | <0.02 | 0.11 | 0.74 | 0.10 | 0.55 | <0.02 | 0.04 |
| | | Benzo(a)pyrene | **3.20** | mg/kg | <0.04 | 0.18 | 1.14 | 0.14 | 0.95 | <0.04 | 0.06 |
| | | Indeno(1,2,3-cd)pyrene | **45.00** | mg/kg | <0.04 | 0.14 | 0.83 | 0.10 | 0.59 | <0.04 | 0.05 |
| | | Di-benzo(a.h.)anthracene | **0.31** | mg/kg | <0.04 | <0.04 | 0.17 | <0.04 | 0.11 | <0.04 | <0.04 |
| | | Benzo(g.h.i.) Perylene | **360.00** | mg/kg | <0.04 | 0.13 | 0.78 | 0.10 | 0.58 | <0.04 | 0.05 |
| General | Soil Properties | S.O.M % (Calc) | | % | 0.40 | 9.50 | 15.10 | 9.80 | 10.40 | 2.20 | 2.40 |
| | | Total Organic Carbon | | % M/M | 0.26 | 5.51 | 8.73 | 5.71 | 6.02 | 1.26 | 1.39 |
| | | pH | | pH units | 7.91 | 6.51 | 6.44 | 6.41 | 6.99 | 7.43 | 7.41 |
| | | Moisture Content | | % | 20.60 | 38.90 | 24.30 | 30.00 | 37.10 | 21.10 | 26.60 |
| | | Loss on Ignition | | % | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Calorific Value | **2.00** | MJ/kg | <1 | 2.00 | **3.00** | 2.00 | 2.00 | <1 | <1 |
| | Soil Screens | Asbestos (screening) | **0.00** | Visual | NAD | NAD | NAD | NAD | NAD | NAD | NAD |

## Appendix F Environmental Receptors

The Contaminated Land Statutory Guidance has a four category system that considers harm to human health, controlled waters, flora and fauna, property, livestock and crops. The Categories are broadly defined as follows:

1 Contaminated Land – similar to land where it is known that significant harm has been caused or significant harm is being caused

2 Contaminated Land – no significant harm being caused but there is a significant possibility for significant harm to be caused in the future

3 Not Contaminated Land – there may be harm being caused but no significant possibility for significant harm to be caused in the future

4 Not Contaminated Land – no contaminant linkage, normal levels of contaminants and no significant harm being caused and no significant possibility for significant harm to be caused in the future.

Table F.1: Significant pollution to controlled waters

| **Pollution of controlled waters** |
|---|
| Under Section 78A(9) of Part 2A the term "pollution of controlled waters means the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter. The term "controlled waters" in relation to England has the same meaning as in Part 3 of the Water Resources Act 1991, except that "ground waters" does not include water contained in underground strata but above the saturation zones. (Paragraph 4.36) |
| Given that the Part 2A regime seeks to identify and deal with significant pollution (rather than lesser levels of pollution), the local authority should seek to focus on pollution which: (i) may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems; (ii) which may result in damage to material property; or (iii) which may impair or interfere with amenities and other legitimate uses of the environment. (Paragraph 4.37). |
| **Significant pollution of controlled waters** |
| Paragraph 4.38 states that "The following types of pollution should be considered to constitute significant pollution of controlled waters:<br>(a) Pollution equivalent to "environmental damage" to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations;<br>(b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use;<br>(c) A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway;<br>(d) Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)5)".<br>Paragraph 4.39 states that "In some circumstances, the local authority may consider that the following types of pollution may constitute significant pollution: (a) significant concentrations6 of hazardous substances or non-hazardous pollutants in groundwater; or (b) significant concentrations of priority hazardous substances, priority substances or other specific polluting substances in surface water; at an appropriate, risk based compliance point. The local authority should only conclude that pollution is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 (of the Contaminated Land Statutory Guidance). This would normally mean that the authority should conclude that less serious forms of pollution are not significant. In such cases the authority should consult the Environment Agency".<br>The following types of circumstance should not be considered to be contaminated land on water pollution grounds: |

## Significant pollution of controlled waters

(a) The fact that substances are merely entering water and none of the conditions for considering that significant pollution is being caused set out in paragraphs 4.38 and 4.39 above are being met.

(b) The fact that land is causing a discharge that is not discernible at a location immediately downstream or down-gradient of the land (when compared to upstream or up-gradient concentrations).

(c) Substances entering water in compliance with a discharge authorised under the Environmental Permitting Regulations.

## Significant pollution of controlled waters is being caused

In deciding whether significant pollution of controlled waters is being caused, the local authority should consider that this test is only met where it is satisfied that the substances in question are continuing to enter controlled waters; or that they have already entered the waters and are likely to do so again in such a manner that past and likely future entry in effect constitutes ongoing pollution. For these purposes, the local authority should:

(a) Regard substances as having entered controlled waters where they are dissolved or suspended in those waters, or (if they are immiscible with water) they have direct contact with those waters on or beneath the surface of the water.

(b) Take the term “continuing to enter” to mean any measurable entry of the substance(s) into controlled waters additional to any which has already occurred.

(c) Take the term “likely to do so again” to mean more likely than not to occur again.

Land should not be determined as contaminated land on grounds that significant pollution of controlled waters is being caused where: (a) the relevant substance(s) are already present in controlled waters; (b) entry into controlled waters of the substance(s) from land has ceased; and (c) it is not likely that further entry will take place.

## Significant Possibility of Significant Pollution of Controlled Waters

In deciding whether or not a significant possibility of significant pollution of controlled waters exists, the local authority should first understand the possibility of significant pollution of controlled waters posed by the land, and the levels of certainty/uncertainty attached to that understanding, before it goes on to decide whether or not that possibility is significant. The term “possibility of significant pollution of controlled waters” means the estimated likelihood that significant pollution of controlled waters might occur. In assessing the possibility of significant pollution of controlled waters from land, the local authority should act in accordance with the advice on risk assessment in Section 3 and the guidance in this sub-section.

In deciding whether the possibility of significant pollution of controlled waters is significant the local authority should bear in mind that Part 2A makes the decision a positive legal test. In other words, for particular land to meet the test the authority needs reasonably to believe that there is a significant possibility of such pollution, rather than to demonstrate that there is not.

Before making its decision on whether a given possibility of significant pollution of controlled waters is significant, the local authority should consider:

(a) The estimated likelihood that the potential significant pollution of controlled waters would become manifest; the strength of evidence underlying the estimate; and the level of uncertainty underlying the estimate.

(b) The estimated impact of the potential significant pollution if it did occur. This should include consideration of whether the pollution would be likely to cause a breach of European water legislation, or make a major contribution to such a breach.

(c) The estimated timescale over which the significant pollution might become manifest.

(d) The authority’s initial estimate of whether remediation is feasible, and if so what it would involve and the extent to which it might provide a solution to the problem; how long it would take; what benefit it would be likely to bring; and whether the benefits would outweigh the costs and any impacts on local society or the environment from taking action.

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Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.

Table F.2: Significant harm to human health, ecological systems and property

| Relevant types of receptor | Significant harm | Significant possibility of significant harm |
|---|---|---|
| Human beings | The following health effects should always be considered to constitute significant harm to human health: death; life threatening diseases (eg cancers); other diseases likely to have serious impacts on health; serious injury; birth defects; and impairment of reproductive functions.<br>Other health effects may be considered by the local authority to constitute significant harm. For example, a wide range of conditions may or may not constitute significant harm (alone or in combination) including: physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts. In deciding whether or not a particular form of harm is significant harm, the local authority should consider the seriousness of the harm in question: including the impact on the health, and quality of life, of any person suffering the harm; and the scale of the harm. The authority should only conclude that harm is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 of the Contaminated Land Statutory Guidance. | The risk posed by one or more relevant contaminant linkage(s) relating to the land comprises:<br>(a) The estimated likelihood that significant harm might occur to an identified receptor, taking account of the current use of the land in question.<br>(b) The estimated impact if the significant harm did occur – i.e. the nature of the harm, the seriousness of the harm to any person who might suffer it, and (where relevant) the extent of the harm in terms of how many people might suffer it.<br>In estimating the likelihood that a specific form of significant harm might occur the local authority should, among other things, consider:<br>(a) The estimated probability that the significant harm might occur: (i) if the land continues to be used as it is currently being used; and (ii) where relevant, if the land were to be used in a different way (or ways) in the future having regard to the guidance on “current use” in Section 3 of the Contaminated Land Statutory Guidance.<br>(b) The strength of evidence underlying the risk estimate. It should also consider the key assumptions on which the estimate of likelihood is based, and the level of uncertainty underlying the estimate. |
| Any ecological system, or living organism forming part of such a system, within a location which is:<br>• a site of special scientific interest (under section 28 of the Wildlife and Countryside Act (WCA) 1981 (as amended) and Part 4 of the Natural Environment and Rural Communitites Act 2006 (as amended)); | The following types of harm should be considered to be significant harm:<br>• harm which results in an irreversible adverse change, or in some other substantial adverse change, in the functioning of the ecological system within any substantial part of that location; or<br>• harm which significantly affects any species of special interest within | Conditions would exist for considering that a significant possibility of significant harm exists to a relevant ecological receptor where the local authority considers that:<br>• significant harm of that description is more likely than not to result from the |

| Relevant types of receptor | Significant harm | Significant possibility of significant harm |
|---|---|---|
| • a national nature reserve (under Section 35 of the WCA 1981 (as amended));<br>• a marine nature reserve (under Section 36 of the WCA 1981 (as amended));<br>• an area of special protection for birds (under Section 3 of the WCA 1981 (as amended));<br>• a "European site" within the meaning of regulation 8 of the Conservation of Habitats and Species Regulations 2010 (as amended);<br>• any habitat or site afforded policy protection under Section 11 of The National Planning Policy Framework (NPPF) on conserving and enhancing the natural environment (i.e. possible Special Areas of Conservation, potential Special Protection Areas and listed or proposed Ramsar sites); or<br>• any nature reserve established under Section 21 of the National Parks and Access to the Countryside Act 1949. | that location and which endangers the long-term maintenance of the population of that species at that location.<br>In the case of European sites, harm should also be considered to be significant harm if it endangers the favourable conservation status of natural habitats at such locations or species typically found there. In deciding what constitutes such harm, the local authority should have regard to the advice of Natural England and to the requirements of the Conservation of Habitats and Species Regulations 2010 (as amended). | contaminant linkage in question; or<br>• there is a reasonable possibility of significant harm of that description being caused, and if that harm were to occur, it would result in such a degree of damage to features of special interest at the location in question that they would be beyond any practicable possibility of restoration.<br>Any assessment made for these purposes should take into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant. |
| Property in the form of:<br>• crops, including timber;<br>• produce grown domestically, or on allotments, for consumption;<br>• livestock;<br>• other owned or domesticated animals;<br>• wild animals which are the subject of shooting or fishing rights. | For crops, a substantial diminution in yield or other substantial loss in their value resulting from death, disease or other physical damage. For domestic pets, death, serious disease or serious physical damage. For other property in this category, a substantial loss in its value resulting from death, disease or other serious physical damage.<br>The local authority should regard a substantial loss in value as occurring only when a substantial proportion of the animals or crops are dead or otherwise no longer fit for their intended purpose. Food should be regarded as being no longer fit for purpose when it fails to comply with the provisions of the Food Safety Act 1990. Where a diminution in yield or loss in value is caused by a contaminant linkage, a 20% diminution or loss should be regarded as a benchmark for what constitutes a substantial diminution or loss.In the Guidance states that this description of significant harm is referred to as an | Conditions would exist for considering that a significant possibility of significant harm exists to the relevant types of receptor where the local authority considers that significant harm is more likely than not to result from the contaminant linkage in question, taking into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant. |

| Relevant types of receptor | Significant harm | Significant possibility of significant harm |
|---|---|---|
| | "animal or crop effect". | |
| Property in the form of buildings. For this purpose 'building' means any structure or erection and any part of a building, including any part below ground level, but does not include plant or machinery comprised in a building, or buried services such as sewers, water pipes or electricity cables. | Structural failure, substantial damage or substantial interference with any right of occupation. The local authority should regard substantial damage or substantial interference as occurring when any part of the building ceases to be capable of being used for the purpose for which it is or was intended.<br>In the case of a scheduled Ancient Monument, substantial damage should be regarded as occurring when the damage significantly impairs the historic, architectural, traditional, artistic or archaeological interest by reason of which the monument was scheduled.<br>The Guidance states that this description of significant harm is referred to as a 'building effect'. | Conditions would exist for considering that a significant possibility of significant harm exists to the relevant types of receptor where the local authority considers that significant harm is more likely than not to result from the contaminant linkage in question during the expected economic life of the building (or in the case of a scheduled Ancient Monument the foreseeable future), taking into account relevant information for that type of contaminant linkage. |

Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.

# Appendix G Generic Assessment Criteria

## Human Health Generic Assessment Criteria

### Background

In order to be able to make inference on whether the results obtained during the site investigation (e.g. chemical concentrations in soils, waters and gas) point to the presence of a potential hazard to human health, it is necessary to distinguish between the results, reflecting background and/or insignificantly elevated levels of contamination (i.e. with negligible potential to cause harm or pollution) and the results with significantly elevated concentrations (i.e. with significant potential to cause harm or pollution).

The approach to risk assessment with respect to risks to human health from contaminated land in the UK is set out in the publication Model Procedures for the Management of Land Contamination (CLR11) Environment Agency (2004).

This sets out a tiered approach:

- Preliminary Risk Assessment (e.g. establishing potential contaminant linkages);
- Generic Quantitative Risk Assessment (GQRA) (e.g. comparison of site contaminant concentrations against generic standards and compliance criteria e.g. Soil Guideline Values (SGV) or other Generic Assessment Criteria including an assessment of risk using the source pathway target model); and
- Detailed Quantitative Risk Assessment (DQRA) (e.g. the comparison of contaminant concentrations against site specific assessment criteria).

### Preliminary Risk Assessment

This typically encompasses a desk based generation of a conceptual model to establish the potential contaminant linkages associated with the site and any proposed development. Works would typically involve:

- Evaluation of the potential sources of contamination on the site and in the locality and from both a current and historical perspective;
- Statutory Consultation;
- Evaluation of a sites geology, hydrology and hydrogeology;
- Site inspection;
- Additional pertinent information as necessary on a site by site basis.

Where works indicate the presence of a potential contaminant linkage further evaluation and potentially site investigation works are necessary to determine the significance of the linkage.

### Generic Quantitative Risk Assessment (GQRA)

In August 2008 the Environment Agency (EA) and Department of Environment Food and Rural Affairs (DEFRA) announced the withdrawal of the Contaminated Land Reports CLR7 – 10, CLEA UK (beta) and existing SGV reports as they no-longer fully reflected the revised approach to human health risk assessment.

New partial guidance (in particular Science Reports SR2, SR3 and SR7) and new risk assessment tools (CLEA model version v1.04, v1.05 and currently v1.06) were published in 2009 and these allow environmental practitioners to derive generic and site specific Soil Assessment Criteria (GAC and SAC).

### *Soil Guideline Values (SGVs)*

The EA and DEFRA updated the TOX reports and Soil Guideline Values (SGVs) to reflect the guidance documents published in 2009. SGVs for arsenic, cadmium, nickel, mercury, selenium, BTEX compounds (benzene, toluene, ethylbenzene and xylenes), dioxins, furans and dioxin like PCBs and phenol have been made available.

Since publishing the revised SGVs the CLEA model was updated to version v1.06. The Environment Agency has however confirmed that v1.05 has only a "minor effect on assessment criteria calculated using the CLEA software 1.04" and consequently the GACs derived are considered to remain valid. Environment Agency SGVs generated using v1.04 have also not been updated. Software version v1.06 is identical to v1.05 with some password protection enhancements that in no way affect the GAC values generated.

Owing to the scientific advances since 2009 and in particular toxicological research outputs, less significance is now placed on the SGVs in the hierarchy outlined below.

### *Category 4 Screening Levels (C4SLs)*

Category 4 Screening Levels were generated by Contaminated Land: Applications in Real Environments (CL:AIRE) on behalf of DEFRA and made available to the public in April 2014. Category 4 Screening Levels were derived in response to policy changes outlined in the recently revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A). Part 2A was originally introduced to ensure that the risks from land contamination to human health, property and the environment are managed appropriately, with the revised SG being designed to address concerns regarding its real-world application. The revised SG presents a new four category system for classifying land under Part 2A, ranging from Category 4, where the level of risk posed is acceptably low, to Category 1, where the level of risk is clearly unacceptable.

The document SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (March 2014) states that:

*The Impact Assessment that accompanied the revised Part 2A Statutory Guidance identified a potential role for new 'Category 4 Screening Levels' in providing a simple test for deciding when land is suitable for use and definitely not contaminated land. It was envisaged that these new screening levels would allow 'low-risk' land to be dismissed from the need for further risk assessment more quickly and easily and allow regulators to focus efforts on the highest-risk land. The C4SLs were proposed to be more pragmatic (whilst still strongly precautionary) compared to existing generic screening levels. It is anticipated that, where they exist, C4SLs will be used as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the currently or previously available SGVs*.

### *Suitable For Use Screening Levels (S4USLs)*

In January 2015, Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) have published updated screening criteria that were derived in line with UK guidance on risk assessment (SR2 and SR3). The resultant screening criteria reflect the industries greater knowledge of the relevant toxicology and further consideration of exposure scenarios as set out in SP1010.

### *Waterman's Generic Assessment Criteria (GACs)*

Waterman have used the following hierarchy for the generic assessment of soils to evaluate Human Health.

- Published Category 4 Screening Values (C4SLs
- v1.06 model by authoritative bodies (e.g. Contaminated Land Applications in Real Environme) derived by CL:AIRE on behalf of DEFRA; or in their absence;
- Suitable 4 Use Screening Levels (S4USLs) derived by LQM/CIEH; or in their absence;
- Published Soil Guideline Values (SGVs);
- GAC prepared in accordance with the CLEA v1.04 / nts (CL:AIRE) 2009; and
- Waterman in-house GAC prepared in accordance with the CLEA V1.06 model and associated documents.

Tabulated values of the GACs used are presented overleaf. The references of the sources quoted in the table are:

- Environment Agency, 2009. CLEA Software, version 1.06;
- DEFRA, Environment Agency, 2004. Model Procedures for the Management of Land Contamination, Contaminated Land Report 11;
- DEFRA, 2014, SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document and appendices;
- LQM / CIEH, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment;
- Environment Agency, 2009. Human health toxicological assessment of contaminants in soil. Report SC050021/SR2;
- Environment Agency, 2009. Updated technical background to the CLEA model. Report SC050021/SR3;
- Environment Agency, 2008. Compilation of chemical data for priority organic pollutants for derivation of Soil Guideline Values. Report SC050021/SR7; and
- EIC / CL:AIRE, 2010. Soil generic assessment criteria for human health risk assessment.

### Detailed Quantitative Risk Assessment (DQRA)

Detailed Quantitative Risk Assessments are undertaken on a site specific basis and full details of the alterations to the CLEA model and generic land use scenarios will be described within the specific reports.

## Benzo(a)pyrene Surrogate Marker (SM) Approach

The DEFRA Category 4 Screening Level for B(a)P is based on the surrogate marker approach. In order to utilise the GAC or others based on this approach, the sample assessed must exhibit certain properties that comply with underlying assumptions.

SP1010, Appendix E states:

*"The SM approach estimates the toxicity of a mixture of PAHs in an environmental matrix by using toxicity data for a PAH mixture for which the composition is known. Exposure to the SM is assumed to represent exposure to all PAHs in that matrix therefore the toxicity of the SM represents the toxicity of the mixture. In most cases, BaP is chosen as the SM due to its ubiquitous nature and the vast amount of data available*

*and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food (EFSA 2008). However, RIVM considered that 'it would not be suitable to use BaP as a SM for carcinogenic risk assessment of PAH mixtures in soil due to the wide variety in composition of PAH mixtures in Dutch land contamination sites', although little data was provided in the report to support this statement (RIVM 2001). Similarly, the Canadian Council of Ministers of the Environment (CCME) also stated that contaminated soil is likely to contain a diverse range of carcinogenic and non-carcinogenic PAH of varying potency (CCME, 2008).*

*The SM approach relies on a number of assumptions (HPA 2010).*

- *The SM (BaP) must be present in all soil samples;*
- *The profile of the different PAH relative to BaP should be similar in all samples;*
- *The PAH profile in the soil samples should be similar to that used in the pivotal toxicity study on which HBGV was based i.e. the Culp study.*

*[sic] To assess the PAH profile in the test soil sample [complies with the assumptions above], the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated to ensure it is similar to the test material used in the Culp study (HPA 2010). To be considered sufficiently similar, the ratio relative to BaP should fit within the upper and lower limits (representing an order of magnitude above and below the mean ratio to BaP of test material used in the Culp study). In such cases BaP is considered an adequate SM and the LLTC for BaP may be used in the risk assessment.*

*If the site falls outside the order of magnitude limits, it may be appropriate to considering a LLTC for groups of surrogate markers, such as groups of 2, 4 or 8 PAHs, as used by EFSA for the evaluation of PAHs in food (EFSA 2008). Expert judgement should be sought in such situations where there is uncertainty as to whether BaP is sufficiently representative (HPA 2010)."*

The ratios of the seven genotoxic PAHs relative to B(a)P can be calculated 'by hand' or using LQM's PAH profiling tool.

## Generic Quantitative Risk Assessment Criteria

| Proposed End Use | units | Residential with plant uptake | | | Residential without plant uptake | | | Allotment | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil Organic Matter Content | % | 1 | 2.5 | 6 | 1 | 2.5 | 6 | 1 | 2.5 | 6 | |
| Arsenic | mg/kg | 37 | 37 | 37 | 40 | 40 | 40 | 49 | 49 | 49 | DEFRA C4SLs |
| Antimony | mg/kg | | | | 550 | 550 | 550 | | | | CL:AIRE 2009 |
| Barium | mg/kg | | | | 1300 | 1300 | 1300 | | | | CL:AIRE 2009 |
| Beryllium | mg/kg | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 35 | 35 | 35 | LQM S4ULs 2015 |
| Boron (Water Soluble) | mg/kg | 290 | 290 | 290 | 11000 | 11000 | 11000 | 45 | 45 | 45 | LQM S4ULs 2015 |
| Cadmium | mg/kg | 22 | 22 | 22 | 150 | 150 | 150 | 3.9 | 3.9 | 3.9 | DEFRA C4SLs |
| Chromium (Total) | mg/kg | 910 | 910 | 910 | 910 | 910 | 910 | 18000 | 18000 | 18000 | LQM S4ULs 2015 |
| Chromium (VI) | mg/kg | 21 | 21 | 21 | 21 | 21 | 21 | 170 | 170 | 170 | DEFRA C4SLs |
| Copper | mg/kg | 2400 | 2400 | 2400 | 7100 | 7100 | 7100 | 520 | 520 | 520 | LQM S4ULs 2015 |
| Lead | mg/kg | 200 | 200 | 200 | 310 | 310 | 310 | 80 | 80 | 80 | DEFRA C4SLs |
| Mercury | mg/kg | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 21 | 21 | 21 | LQM S4ULs 2015 |
| Molybdenum | mg/kg | | | | 670 | 670 | 670 | | | | CL:AIRE 2009 |
| Nickel | mg/kg | 130 | 130 | 130 | 180 | 180 | 180 | 53 | 53 | 53 | LQM S4ULs 2015 |
| Selenium | mg/kg | 250 | 250 | 250 | 430 | 430 | 430 | 88 | 88 | 88 | LQM S4ULs 2015 |
| Vanadium* | mg/kg | 410 | 410 | 410 | 1200 | 1200 | 1200 | 91 | 91 | 91 | LQM S4ULs 2015 |
| Zinc | mg/kg | 3700 | 3700 | 3700 | 40000 | 40000 | 40000 | 620 | 620 | 620 | LQM S4ULs 2015 |
| Cyanide (Free) | mg/kg | 26 | 26 | 26 | | | | 4.1 | 4.1 | 4.1 | Waterman GAC - CLEA v1.06 |
| Complex Cyanide | mg/kg | 63000 | 63000 | 63000 | | | | 1200 | 1200 | 1200 | Waterman GAC - CLEA v1.06 |
| Thiocyanate | mg/kg | 230 | 230 | 230 | | | | 46 | 46 | 46 | Waterman GAC - CLEA v1.06 |

| Proposed End Use | units | Residential with plant uptake | | | Residential without plant uptake | | | Allotment | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Soil Organic Matter Content | % | 1 | 2.5 | 6 | 1 | 2.5 | 6 | 1 | 2.5 | 6 | |
| Aliphatic EC5 - EC6 | mg/kg | 42 | 78 | 160 | 42 | 78 | 160 | 730 | 1700 | 3900 | LQM S4ULs 2015 |
| Aliphatic EC6 - EC8 | mg/kg | 100 | 230 | 530 | 100 | 230 | 530 | 2300 | 5600 | 13000 | LQM S4ULs 2015 |
| Aliphatic EC8-EC10 | mg/kg | 27 | 65 | 150 | 27 | 65 | 150 | 320 | 770 | 1700 | LQM S4ULs 2015 |
| Aliphatic EC10-EC12 | mg/kg | 130 | 330 | 760 | 130 | 330 | 770 | 2200 | 4400 | 7300 | LQM S4ULs 2015 |
| Aliphatic EC12-EC16 | mg/kg | 1100 | 2400 | 4300 | 1100 | 2400 | 4400 | 11000 | 13000 | 13000 | LQM S4ULs 2015 |
| Aliphatic EC16-EC35 | mg/kg | 65000 | 92000 | 110000 | 65000 | 92000 | 110000 | 260000 | 270000 | 270000 | LQM S4ULs 2015 |
| Aliphatic EC35-EC44 | mg/kg | 65000 | 92000 | 110000 | 65000 | 92000 | 110000 | 260000 | 270000 | 270000 | LQM S4ULs 2015 |
| Aromatic C5-C7 | mg/kg | 70 | 140 | 300 | 370 | 690 | 1400 | 13 | 27 | 57 | LQM S4ULs 2015 |
| Aromatic C7-C8 | mg/kg | 130 | 290 | 660 | 860 | 1800 | 3900 | 22 | 51 | 120 | LQM S4ULs 2015 |
| Aromatic C8-C10 | mg/kg | 34 | 83 | 190 | 47 | 110 | 270 | 8.6 | 21 | 51 | LQM S4ULs 2015 |
| Aromatic C10-C12 | mg/kg | 74 | 180 | 380 | 250 | 590 | 1200 | 13 | 31 | 74 | LQM S4ULs 2015 |
| Aromatic C12-C16 | mg/kg | 140 | 330 | 660 | 1800 | 2300 | 2500 | 23 | 57 | 130 | LQM S4ULs 2015 |
| Aromatic C16-C21 | mg/kg | 260 | 540 | 930 | 1900 | 1900 | 1900 | 46 | 110 | 260 | LQM S4ULs 2015 |
| Aromatic C21-C35 | mg/kg | 1100 | 1500 | 1700 | 1900 | 1900 | 1900 | 370 | 820 | 1600 | LQM S4ULs 2015 |
| Aromatic C35-C44 | mg/kg | 1100 | 1500 | 1700 | 1900 | 1900 | 1900 | 370 | 820 | 1600 | LQM S4ULs 2015 |
| Benzene | mg/kg | 0.087 | 0.17 | 0.37 | 0.38 | 0.7 | 1.4 | 0.017 | 0.034 | 0.075 | LQM S4ULs 2015 |
| Toluene | mg/kg | 130 | 290 | 660 | 880 | 1900 | 3900 | 22 | 51 | 120 | LQM S4ULs 2015 |
| Ethyl Benzene | mg/kg | 47 | 110 | 260 | 83 | 190 | 440 | 16 | 39 | 91 | LQM S4ULs 2015 |
| Xylene - m | mg/kg | 59 | 140 | 320 | 82 | 190 | 450 | 31 | 74 | 170 | LQM S4ULs 2015 |
| Xylene - o | mg/kg | 60 | 140 | 330 | 88 | 210 | 480 | 28 | 67 | 160 | LQM S4ULs 2015 |
| Xylene - p | mg/kg | 56 | 130 | 310 | 79 | 180 | 430 | 29 | 69 | 160 | LQM S4ULs 2015 |

| Proposed End Use | units | Residential with plant uptake | | | Residential without plant uptake | | | Allotment | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil Organic Matter Content** | **%** | **1** | **2.5** | **6** | **1** | **2.5** | **6** | **1** | **2.5** | **6** | |
| MTBE (Methyl tert-butyl ether) | mg/kg | 49 | 84 | 160 | | | | 23 | 44 | 90 | CL:AIRE 2009 |
| Naphthalene | mg/kg | 2.3 | 5.6 | 13 | 2.3 | 5.6 | 13 | 4.1 | 10 | 24 | LQM S4ULs 2015 |
| Acenaphthylene | mg/kg | 170 | 420 | 920 | 2900 | 4600 | 6000 | 28 | 69 | 160 | LQM S4ULs 2015 |
| Acenaphthene | mg/kg | 210 | 510 | 1100 | 3000 | 4700 | 6000 | 34 | 85 | 200 | LQM S4ULs 2015 |
| Fluorene | mg/kg | 170 | 400 | 860 | 2800 | 3800 | 4500 | 27 | 67 | 160 | LQM S4ULs 2015 |
| Phenanthrene | mg/kg | 95 | 220 | 440 | 1300 | 1500 | 1500 | 15 | 38 | 90 | LQM S4ULs 2015 |
| Anthracene | mg/kg | 2400 | 5400 | 11000 | 31000 | 35000 | 37000 | 380 | 950 | 2200 | LQM S4ULs 2015 |
| Fluoranthene | mg/kg | 280 | 560 | 890 | 1500 | 1600 | 1600 | 52 | 130 | 290 | LQM S4ULs 2015 |
| Pyrene | mg/kg | 620 | 1200 | 2000 | 3700 | 3800 | 3800 | 110 | 270 | 620 | LQM S4ULs 2015 |
| Benzo(a)anthracene | mg/kg | 7.2 | 11 | 13 | 11 | 14 | 15 | 2.9 | 6.5 | 13 | LQM S4ULs 2015 |
| Chrysene | mg/kg | 15 | 22 | 27 | 30 | 31 | 32 | 4.1 | 9.4 | 19 | LQM S4ULs 2015 |
| Benzo(b)fluoranthene | mg/kg | 2.6 | 3.3 | 3.7 | 3.9 | 4 | 4 | 0.99 | 2.1 | 3.9 | LQM S4ULs 2015 |
| Benzo(k)fluoranthene | mg/kg | 77 | 93 | 100 | 110 | 110 | 110 | 37 | 75 | 130 | LQM S4ULs 2015 |
| Benzo(a)pyrene | mg/kg | 2.2 | 2.7 | 3 | 3.2 | 3.2 | 3.2 | 0.97 | 2 | 3.5 | LQM S4ULs 2015 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 27 | 36 | 41 | 45 | 46 | 46 | 9.5 | 21 | 39 | LQM S4ULs 2015 |
| Di-benzo(a.h.)anthracene | mg/kg | 0.24 | 0.28 | 0.3 | 0.31 | 0.32 | 0.32 | 0.14 | 0.27 | 0.43 | LQM S4ULs 2015 |
| Benzo(g.h.i.) Perylene | mg/kg | 320 | 340 | 350 | 360 | 360 | 360 | 290 | 470 | 640 | LQM S4ULs 2015 |
| Phenol | mg/kg | 280 | 550 | 1100 | 750 | 1300 | 2300 | 66 | 140 | 280 | LQM S4ULs 2015 |
| Pentachlorophenol (PCP) | mg/kg | 0.22 | 0.52 | 1.2 | 27 | 29 | 31 | 0.03 | 0.08 | 0.19 | LQM S4ULs 2015 |
| 1,1,2,2 Tetrachloroethane | mg/kg | 1.6 | 3.4 | 7.5 | 3.9 | 8 | 17 | 0.41 | 0.89 | 2 | LQM S4ULs 2015 |
| 1,1,1,2 Tetrachloroethane | mg/kg | 1.2 | 2.8 | 6.4 | 1.5 | 3.5 | 8.2 | 0.79 | 1.9 | 4.4 | LQM S4ULs 2015 |

| Proposed End Use | units | Residential with plant uptake | | | Residential without plant uptake | | | Allotment | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil Organic Matter Content** | **%** | **1** | **2.5** | **6** | **1** | **2.5** | **6** | **1** | **2.5** | **6** | |
| 1,1,1 Trichloroethane | mg/kg | 8.8 | 18 | 39 | 9 | 18 | 40 | 48 | 110 | 240 | LQM S4ULs 2015 |
| Trichloroethene | mg/kg | 0.016 | 0.034 | 0.075 | 0.017 | 0.036 | 0.08 | 0.041 | 0.091 | 0.21 | LQM S4ULs 2015 |
| Tetrachloromethane (Carbon Tetrachloride) | mg/kg | 0.026 | 0.056 | 0.13 | 0.026 | 0.056 | 0.13 | 0.45 | 1 | 2.4 | LQM S4ULs 2015 |
| 1,2- Dichloroethane | mg/kg | 0.0071 | 0.011 | 0.019 | 0.0092 | 0.013 | 0.023 | 0.0046 | 0.0083 | 0.016 | LQM S4ULs 2015 |
| Chloroethene (Vinyl chloride) | mg/kg | 0.00064 | 0.00087 | 0.0014 | 0.00077 | 0.001 | 0.0015 | 0.00055 | 0.001 | 0.0018 | LQM S4ULs 2015 |
| Trichloroethene | mg/kg | 0.016 | 0.034 | 0.075 | 0.017 | 0.036 | 0.08 | 0.041 | 0.091 | 0.21 | LQM S4ULs 2015 |
| Tetrachloroethene | mg/kg | 0.18 | 0.39 | 0.9 | 0.18 | 0.4 | 0.92 | 0.65 | 1.5 | 3.6 | LQM S4ULs 2015 |
| Trichloromethane (Chloroform) | mg/kg | 0.91 | 1.7 | 3.4 | 1.2 | 2.1 | 4.2 | 0.42 | 0.83 | 1.7 | LQM S4ULs 2015 |
| Sum of PCDDs, PCDFs and dioxins like PCBs | ug/kg | | | 8 | | | | | | 8 | CLEA SGVs 2009 |
| Isopropylbenzene | mg/kg | 11 | 27 | 64 | 12 | 28 | 67 | 32 | 79 | 190 | CL:AIRE 2009 |
| Propylbenzene | mg/kg | 34 | 82 | 190 | 40 | 97 | 230 | 34 | 83 | 200 | CL:AIRE 2009 |
| Styrene | mg/kg | 8.1 | 19 | 43 | 35 | 78 | 170 | 1.6 | 3.7 | 8.7 | CL:AIRE 2009 |
| Bromobenzene | mg/kg | 0.87 | 2 | 4.7 | 0.91 | 2.1 | 4.9 | 3.2 | 7.6 | 18 | CL:AIRE 2009 |
| 1,1,2 Trichloroethane | mg/kg | 0.6 | 1.2 | 2.7 | 0.88 | 1.8 | 3.9 | 0.28 | 0.61 | 1.4 | CL:AIRE 2009 |
| 1,1-Dichloroethane | mg/kg | 2.4 | 3.9 | 7.4 | 2.5 | 4.1 | 7.7 | 9.2 | 17 | 35 | CL:AIRE 2009 |
| 1,1-Dichloroethene | mg/kg | 0.23 | 0.4 | 0.82 | 0.23 | 0.41 | 0.82 | 2.8 | 5.6 | 12 | CL:AIRE 2009 |
| 1,2,4-Trimethylbenzene | mg/kg | 0.35 | 0.85 | 2 | 0.41 | 0.99 | 2.3 | 0.38 | 0.93 | 2.2 | CL:AIRE 2009 |
| 1,2-Dichloropropane | mg/kg | 0.024 | 0.042 | 0.084 | 0.024 | 0.042 | 0.085 | 0.62 | 1.2 | 2.6 | CL:AIRE 2009 |
| 2-Chloronaphthalene | mg/kg | 3.7 | 9.2 | 22 | 3.8 | 9.3 | 22 | 40 | 98 | 230 | CL:AIRE 2009 |
| Bromodichloromethane | mg/kg | 0.016 | 0.03 | 0.061 | 0.019 | 0.034 | 0.07 | 0.016 | 0.032 | 0.068 | CL:AIRE 2009 |

| Proposed End Use | units | Residential with plant uptake | | | Residential without plant uptake | | | Allotment | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil Organic Matter Content** | **%** | **1** | **2.5** | **6** | **1** | **2.5** | **6** | **1** | **2.5** | **6** | |
| Bromoform | mg/kg | 2.8 | 5.9 | 13 | 5.2 | 11 | 23 | 0.95 | 2.1 | 4.6 | CL:AIRE 2009 |
| Chloroethane | mg/kg | 8.3 | 11 | 18 | 8.4 | 11 | 18 | 110 | 200 | 380 | CL:AIRE 2009 |
| Chloromethane | mg/kg | 0.0083 | 0.0098 | 0.013 | 0.0085 | 0.0099 | 0.013 | 0.066 | 0.13 | 0.23 | CL:AIRE 2009 |
| Cis 1,2 Dichloroethene | mg/kg | 0.11 | 0.19 | 0.37 | 0.12 | 0.2 | 0.39 | 0.26 | 0.5 | 1 | CL:AIRE 2009 |
| Dichloromethane | mg/kg | 0.58 | 0.98 | 1.7 | 2.1 | 2.8 | 4.5 | 0.1 | 0.19 | 0.34 | CL:AIRE 2009 |
| Hexachloroethane | mg/kg | 0.2 | 0.48 | 1.1 | 0.22 | 0.54 | 1.3 | 0.27 | 0.67 | 1.6 | CL:AIRE 2009 |
| Trans 1,2 Dichloroethene | mg/kg | 0.19 | 0.34 | 0.7 | 0.19 | 0.35 | 0.71 | 0.93 | 1.9 | 4 | CL:AIRE 2009 |
| Bis (2-ethylhexyl) phthalate | mg/kg | 280 | 610 | 1100 | 2700 | 2800 | 2800 | 47 | 120 | 280 | CL:AIRE 2009 |
| Butyl benzyl phthalate | mg/kg | 1400 | 3300 | 7200 | 42000 | 44000 | 44000 | 220 | 550 | 1300 | CL:AIRE 2009 |
| Diethyl Phthalate | mg/kg | 120 | 260 | 570 | 1800 | 3500 | 6300 | 19 | 41 | 94 | CL:AIRE 2009 |
| Di-n-butyl phthalate | mg/kg | 13 | 31 | 67 | 450 | 450 | 450 | 2 | 5 | 12 | CL:AIRE 2009 |
| Di-n-octyl phthalate | mg/kg | 2300 | 2800 | 3100 | 3400 | 3400 | 3400 | 940 | 2100 | 3900 | CL:AIRE 2009 |
| Biphenyl | mg/kg | 66 | 160 | 360 | 220 | 500 | 980 | 14 | 35 | 83 | CL:AIRE 2009 |
| 2,4-Dinitrotoluene | mg/kg | 1.5 | 3.2 | 7.2 | 170 | 170 | 170 | 0.22 | 0.49 | 1.1 | CL:AIRE 2009 |
| 2,6-Dinitrotoluene | mg/kg | 0.78 | 1.7 | 3.9 | 78 | 84 | 87 | 0.12 | 0.27 | 0.61 | CL:AIRE 2009 |
| Tributyl tin oxide | mg/kg | 0.25 | 0.59 | 1.3 | 1.4 | 3.1 | 0.24 | 0.042 | 0.1 | 0.24 | CL:AIRE 2009 |

## Soil Contamination – Risk of Harm to Property

### Structures and Underground Services

#### *Buried Concrete*

BRE Special Digest 1 (2005), 3rd Edition, entitled *Concrete in aggressive ground*, provides guidance on the specification for concrete for installation in natural ground and in brownfield locations. The procedures given for the ground assessment and concrete specification cover the fairly common occurrences of sulfates, sulfides and acids, and the more rarely occurring aggressive carbon dioxide found in some ground and surface waters, which affects concrete foundations and sub-structures. It gives procedures for specification of concrete and applies to both buildings and civil engineering construction.

#### *Water Supply Pipes*

Guidance is provided in the UK Water Industry Research (UKWIR) report entitled *"Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites"* Report Ref. No. 10/WM/03/21, 2010.

Guidance is provided in the November 2010 Q&A Update and the Questions and Answers Sheet dated 4 May 2011 included at the back of the UKWIR report. Item 3 has been reproduced here:

| Item | Question | Answer |
|---|---|---|
| 3 | Following the flow chart in Figure 1.1, **would it be acceptable to not undertake a site investigation and specify the use of barrier pipes** (these seem to be suitable for all conditions)? Would it be acceptable to adopt the blanket approach of always using barrier pipes at Brownfield sites, negating the need for a desk study or intrusive investigation? | The UKWIR project steering group decided that barrier pipes would provide sufficient protection for the supply of drinking water in all Brownfield site conditions. It is therefore reasonable to expect that water companies will accept the use of barrier pipe in all situations as a blanket approach |

### Soil Contamination – Risk of Combustion

The combustibility of soils is a complex function of soil type, energy content, and availability of oxygen. The Building Research Establishment (BRE) has published guidance based on Calorific Value (i.e. energy content, alone), namely *IP 2/87, Fire and explosion hazards associated with the redevelopment of contaminated land*. This document provides a level below which combustibility is unlikely (2MJ/kg) and a level above which combustibility is likely (10MJ/kg). In the range between these two values combustibility is uncertain. Therefore, where the lower value is exceeded, the other key factors mentioned above need to be considered.

### Soil Contamination – Risk of Harm to Vegetation

Where there is topsoil present on Site and it is being considered for reuse in landscaped areas then it needs to be assessed for its suitability for use by an appropriately qualified specialist. Topsoil can be both naturally-occurring and manufactured. The requirements for topsoil that is to be reused on site are specified in BS3882:2007 and cover a range of properties including texture, organic matter content, grading, pH, nutrients and phytotoxic contaminants. The specification for phytotoxic contaminants is reproduced in the table below:

Phytotoxic Contaminants (by soil pH) for Topsoil

| Contaminant* | pH | | |
|---|---|---|---|
| | <6 | 6.0 to 7.0 | >7 |
| Zinc (Nitric acid extractable**) | <200mg/kg | <200mg/kg | <300mg/kg |
| Copper (Nitric acid extractable**) | <100mg/kg | <135mg/kg | <200mg/kg |
| Nickel (Nitric acid extractable**) | <60mg/kg | <75mg/kg | <110mg.kg |

Footnotes: * The lower of the Generic Assessment Criteria for chemical contaminants (human health and the environment) and phytotoxicity shall be used for topsoil

** The method of testing is given in Annex D to BS3882:2007 Specification for topsoil and requirements for use.

The risk to human health and the environment needs to be considered as well as phytotoxicity and this will be carried out using the Generic Assessment Criteria selected for these risks as described elsewhere in this appendix and this report.

In order to assess the suitability of topsoil to be reused the full range of testing specified needs to be carried out and assessed by an appropriately qualified specialist.

## Controlled Waters Generic Assessment Criteria

The Screening Values adopted by Waterman for ground and surface water quality have been selected on the basis of the water quality standards that apply at the controlled water receptor considered to be at potential risk of harm.

### Surface Waters

The Water Framework Directive (WFD) (2000/60/EC) was originally introduced in 2000, however a raft of Daughter Directives has been brought in to address the objectives the WFD originally set out. Over time the WFD and its Daughter Directives have gradually replaced number of the existing Directives including the Dangerous Substances Directive (DSD) and Surface Water Directive (SWD).

The WFD identifies 'Priority' and 'Priority Hazardous Substances', to which Environmental Quality Standards (EQS) have been determined. The WFD EQS do not provide a full complement of applicable values to adopt. In the absence of an EQS, values under the replaced Surface Water Directive have been used as a guide.

### Groundwater

The EU Drinking Water Directive (DWD) (98/83/EC) lays out the standards for drinking water EU wide. The UK have followed the EU regulations and translated the Directive into the Water Supply (Water Quality) Regulations England 2000. The UK Drinking Water Standards are the most relevant criteria to use for the assessment of risks to water destined for potable sources.

The WFD, to date, have not set threshold values for groundwater on a river basin basis.

#### *TPH and PAHs*

A suitable risk based assessment criteria for risks from TPH in both surface waters and groundwater are not available in the UK. The WHO have produced a health based risk assessment for drinking waters with

regard to TPH “Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123”.

The WHO Guideline values have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of TPH (70kg body weight and 2l of water consumed per day).

A complete list of assessment criteria for PAHs is absent from the UK (benzo(a)pyrene is available). However, the risk from PAHs should be considered. The theory presented in the WHO document “Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123” has been applied to provide indicative screening values for PAHS with regard to drinking water. Published TDI and ID effects have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of PAHs (70kg body weight and 2l of water consumed per day).

The derived TPH and PAH screening values are used as an indication of the risks from TPH and PAHs to human health through drinking water only.

The standards for the substances tested for in this investigation are provided in Table G3 and G4 below.

**Table G3 Screening Values – Water Quality Standards**

| | Concentration (µg/l) | | |
|---|---|---|---|
| **Determinand** | **Surface Water - EQS Freshwater (DEFRA Directions 2015)** | **UK Drinking Water Standard (DWS)** | **WHO Drinking Water Standard** |
| **Metals** | | | |
| Arsenic | 50 | 10 | - |
| Barium | - | - | 700 |
| Beryllium | - | - | 12 |
| Boron | - | 1000 | - |
| Cadmium | 0.25* | 5 | - |
| Copper | 1 (bioavailable) | 2000 | - |
| Chromium (total) | 4.7 | 50 | - |
| Chromium (VI) | 3.4 | - | - |
| Chromium (III) | 4.7 | - | - |
| Iron | 1000 | 200 | - |
| Lead | 1.2 (partial bioavailable) | 10 | - |
| Manganese | 123 (bioavailable) | 50 | - |
| Mercury | 0.07 | 1 | - |
| Nickel | 4 (bioavailable) | 20 | - |
| Selenium | - | 10 | - |
| Zinc | 10.9+X** (bioavailable X is catchment related) | - | - |

| Determinand | Concentration (µg/l) | | |
|---|---|---|---|
| | Surface Water - EQS Freshwater (DEFRA Directions 2015) | UK Drinking Water Standard (DWS) | WHO Drinking Water Standard |
| **Metals** | | | |
| **Non-Metals** | | | |
| Cyanide | 1 | 50 | - |
| Chloride | - | 250,000 | - |
| Nitrate | - | 50,000 | - |
| Sulphate | - | 250,000 | - |
| Ammonia (total) | - | 500 | - |
| Nitrite | - | 500 | - |
| **BTEX** | | | |
| Benzene | 10 | 1 | - |
| Ethyl Benzene | - | - | 300 |
| Toluene | 74 | - | - |
| Xylene (p+m) | 30 | - | 500 |
| MTBE | - | - | 15*** |
| Phenol | 7.7 | - | - |
| **Petroleum Hydrocarbons** | | | |
| Aliphatic EC5 - EC6 | - | - | 15,000 |
| Aliphatic EC6 - EC8 | - | - | 15,000 |
| Aliphatic EC8-EC10 | - | - | 300 |
| Aliphatic EC10-EC12 | - | - | 300 |
| Aliphatic EC12-EC16 | - | - | 300 |
| Aromatic EC6-EC7 (Benzene) | 10 | 1 | |
| Aromatic EC7-EC8 (Toluene) | 74 | - | 700 |
| Aromatic EC8-EC10 | - | - | 300**** |
| Aromatic EC10-EC12 | - | - | 90 |
| Aromatic EC12-EC16 | - | - | 90 |
| Aromatic EC16-EC21 | - | - | 90 |
| Aromatic EC21-EC35 | - | - | 90 |
| **Polycyclic Aromatic Hydrocarbons** | | | |
| Anthracene | 0.1 | - | 1050 |
| Acenaphthene | - | - | 210***** |
| Acenaphthylene | - | - | 210***** |

| Determinand | Concentration (µg/l) | | |
|---|---|---|---|
| | Surface Water - EQS Freshwater (DEFRA Directions 2015) | UK Drinking Water Standard (DWS) | WHO Drinking Water Standard |
| **Metals** | | | |
| Chrysene | - | - | 1.085***** |
| Di-benzo(a.h.)anthracene | - | - | 0.01085***** |
| Phenanthrene | - | - | 43.75***** |
| Benzo(a)pyrene | 0.00017 | 0.01 | - |
| Benzo(b)fluoranthene | 0.00017 | 0.1b | - |
| Benzo(g.h.i.) Perylene | 0.00017 | 0.1 | - |
| Benzo(k)fluoranthene | 0.00017 | 0.1 | - |
| Fluoranthene | 0.0063 | - | - |
| Indeno(1,2,3-cd)pyrene | 0.00017 | 0.1 | - |
| Naphthalene | 2 | - | 70 |
| Fluorene | - | - | 140***** |
| Benzo(a)anthracene | - | - | 0.543***** |
| Pyrene | - | - | 105***** |
| **Volatile Organic Compounds** | | | |
| Vinyl Chloride | - | 0.5 | - |
| 1,1-dichloroethene | - | - | 30 |
| Trans 1,2-Dichloroethene | - | - | 0.3 |
| Chloroform | - | 100c | - |
| 1,2-Dichloroethane | 10 | 3 | - |
| Trichloroethene (TCE) | - | 10 | - |
| Bromodichloromethane | - | 100 | - |
| Tetrachloroethene (PCE) | - | 10 | - |
| 1,3-Dichloropropane | - | 100 | 40 |
| Bromoform | - | 100 | - |
| 1,4-Dichlorobenzene | - | - | 300 |
| 1,2-Dichlorobenzene | - | - | 1000 |
| 1,2-Dibromo-3-chloropropane | - | - | 1 |

* Value for Class 5 water, assumes >200mg$CaCO_3$/L
** 10.9 + 2.9 (ambient background concentration for Humber catchment)
*** Odour and taste threshold
**** Value for ethylbenzene
***** Waterman-derived criteria based on guidance in WHO document and UK background data
b - Sum of 4 PAHs
c - sum of 4 trichlorohalides – Chloroform, bromoform, dibromoform and bromodichloromethane

## Bioavailability based Environmental Quality Standards

Under the Water Framework Directive, originally introduced in 2000, and transposed into the UK regulatory framework via the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015, we are now required take account of the bioavailability when assessing the toxicity of heavy metal contamination in the freshwater environment.

### *What is Bioavailability and Why Account for it?*

It is widely accepted that the total concentration of certain metals in freshwater often has limited relevance to potential environmental risk, but it is the 'bioavailable' fraction that is likely to result in toxic effects to aquatic organisms. Effectively, it's the bioavailability of a metal which reflects the actual metal concentration that the organism will be exposed to, and thus is the relevant concentration that we are interested in when assessing risk.

EQS developed under previous legislation (including the Dangerous Substances Directive (76/464/EEC)) were expressed as total concentration relative to hardness bandings to reflect the indications that toxicity to aquatic life was influenced by water hardness. Scientific knowledge and understanding on the impact of metals has since developed, and metal bioavailability in aquatic systems is now understood to be influenced by several site-specific physio-chemical factors including the pH, calcium content and the level of dissolved organic carbon (DOC) present within the water body under consideration.

Taking bioavailability into account as part of the risk assessment process is now considered best practice and will enable more accurate estimation of metal toxicity and the risks posed to the freshwater environment.

### *How to Account for Metal Bioavailability*

The increased understanding of the impact of certain metals on the aquatic environment has enabled EQSs to be published by the UK Secretary of State for a number of metals based on their bioavailable concentration. These are referred to as EQSbioavailable and are listed in the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

It is very difficult to measure the bioavailable concentration of a metal directly. We therefore have to rely on models to predict the bioavailable concentration from dissolved concentrations. In the UK, a simple predictive tool has been developed that can take account of water quality parameters such as pH, and calcium to determine the amount of bioavailable metal present in the freshwater environment.

The tool is called the Metal Bioavailability Assessment Tool (M-BAT) and is acceptable for use under the UK regulatory framework.

### *Use of Background Concentrations for the Assessment of Zinc.*

Metals occur naturally in the aquatic environment due to weathering of surface geology, and under the EQS Directive (2008/105/EEC) background concentrations for metals can be considered when assessing compliance against the respective EQS.

The situation for Zinc is now slightly different, and consideration of background concentration is now an explicit part of the zinc EQS released under the WFD and needs to be taken into account as part of the initial compliance assessment.

Using this approach, a local background concentration should be subtracted from the monitoring data before the bioavailability estimate is performed using M-BAT. Under the WFD, catchment specific

background values have been defined for England and Wales to be used in conjunction with the EQSbioavailable. The background values are listed within the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 Schedule 3, Part 2, Table 2, and also reproduced in Appendix A of the M-BAT user guide available here.

*Lead*

Lead is not included in the M-BAT tool (referred to above) as it is not a full bioavailable EQS. The EQS for lead is an EU standard under WFD. It takes into account the influence of DOC on the toxicity of lead but, unlike the full bioavailable standards for zinc, copper, manganese and nickel which are included in M-BAT, it only considered the influence of DOC, and does not require the consideration of calcium or pH.

## Ground Gas and Volatile Organic Compounds Generic Assessment Criteria

### Ground Gas

Current UK guidance has been produced by CIRIA, the British Standards Institution (BSI) and CL:AIRE. The following relevant documents have been prepared to date:

- CIRIA C665 – Assessing the risks posed by hazardous ground gases to buildings, 2007;
  - Aims to consolidate good practice in investigation, facilitate the collection of relevant data, instigate appropriate monitoring programmes, all in a risk based approach to gas contaminated land.
- BS 8576 – Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs), 2013;
  - Provides guidance on the monitoring and sampling of ground gases, including methane, carbon dioxide, oxygen, and VOCs. Guidance is not provided on the risk evaluation and characterisation of site's, the selection and design of protective measures, verification of protective measures, sampling of atmospheric gases, and the monitoring and sampling of radon.
- CIRIA C735 – Good practice on the testing and verification of protection systems for buildings against hazardous ground gases, 2014; and
  - Sets out the good practice guidance for the designer, installer, verifier, and regulator on the verification and integrity testing of gas protection systems.
- BS 8485 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, 2015:
  - Provides guidance on the appropriate ground gas parameters that can be used to identify a range of possible design solutions for protection against methane and carbon dioxide on a development.
- CL:AIRE - Technical Bulletin (TB 17), August 2018;
  - The bulletin provides guidance on assessing ground gas monitoring data to ensure that sufficient data has been collected to cover critical variations in barometric pressure.

Both the CIRIA and BSI publications have been prepared to be generally consistent with CLR11, *Model Procedures for the management of land contamination,* (Defra and the Environment Agency, 2004a) and follow a step by step approach summarised below:

1. Desk Study and Site Walkover.
2. Development of a Preliminary Conceptual Model and Risk Assessment.

3. Site Investigation (If deemed necessary from stage 2).
4. Risk Assessment and Site Characterisation.
5. Recommendation and Mitigation.

Where the preliminary conceptual model has deemed further investigation necessary to characterise the ground gas regime, an appropriate site investigation and monitoring regime should be designed and undertaken. In-depth guidance to assist in the design of the investigation is provided within C665 and BS 8576, which describes intrusive investigation techniques and provides guidance on selecting the number and location of monitoring wells based on the site specific conceptual model.

Waterman has generally followed the approach recommended in CIRIA C665, BS 8576, and BS 8485 with respect to characterising a site and determining the levels of gas protection methods required. Where deviations from the methodology detailed within above guidance occurs, the reasoning behind the deviation and implication of the analysis of the results has been included within the report.

### Risk Assessment

In accordance with C665, to assess the ground gas regime at a site, the ground gas monitoring data should be assessed by determining the Gas Screening Value (GSV) (ℓ/hr). BS 8485 details further guidance on which GSV can be adopted based on a number of modifiers.

GSV = (Measured Maximum $CO_2$ or $CH_4$ Gas Concentration (%) / 100) x Maximum Measured Gas Flow Rate from boreholes (ℓ/hr).

Both C665 and BS 8485 dictate where the gas flow has been measured as less than the detection limit of the instrument used (typically <0.1ℓ/hr), the limit of detection of the instrumented should be used as the gas flow rate.

As per the guidance given in BS 8485 where a negative flow has been recorded, and there is an absence of a positive flow, a qualitative assessment has been undertaken into whether under different temporal conditions, a similar positive flow could occur. When the cause for negative flow is reasonably understood, it has been possible to rule out a corresponding credible positive flow and discount the negative flow.

The Gas Screening Value is used to classify the site, subject to the proposed end use of the site.

The Modified Wilson and Card classification system is used to attribute a Characteristic Situation (CS) value to the site/zone depending upon the calculated GSV. When attributing a CS, additional factors including the maximum recorded gas concentration and the maximum recorded gas flow rate should also be taken into account and may result in an increase in the CS value. Table G5 below, outlines the CS values associated GSV's and additional factors which must be taken into account.

Table G5 Modified Wilson and Card Classification

| Characteristic Situation (CIRIA 149) | Risk Classification | Gas screening value ($CH_4$ $CO_2$) l/hr | Additional Factors | Typical source of generation |
|---|---|---|---|---|
| **1** | **Very low risk** | **<0.07** | Typically methane ≤1% and / or carbon dioxide ≤5%. Otherwise consider increase to CS 2. | Natural soils with low organic content<br>'Typical' made ground |
| **2** | **Low risk** | **<0.7** | Borehole air flow rate not to exceed 70 l/hr. Otherwise consider increase to CS 3. | Natural soil, high peat/organic content.<br>'Typical' made ground |
| **3** | **Moderate risk** | **<3.5** | | Old landfill, inert waste, mineworking flooded |
| **4** | **Moderate to high risk** | **<15** | Quantitative risk assessment required to evaluate scope of protective measures. | Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria) |
| **5** | **High risk** | **<70** | | Mineworking unflooded inactive with shallow workings near surface |
| **6** | **Very High risk** | **>70** | | Recent landfill site |

**Notes:**

1) Gas screening value: litres of gas / hour is calculated by multiplying the gas concentration (%) by the measured borehole flow rate (l/hr)
2) Source of gas and generation potential/performance must be identified.
3) If there is no detectable flow use the limit of detection of the instrument.

Following determination of the site's CS, the requirements and scope of gas protection measures can be prescribed based on the guidance given in BS 8485:2015.

BS 8485 details the required ground gas protection measures for a development using a points-based system, whereby a certain number of points must be accumulated through the installation of various protection measures to mitigate the risk to structures or buildings from the accumulation of methane or carbon dioxide. The number of points assigned will be dependent on the building type and the CS.

Table G6 Building types are separated into four distinct scenarios.

| Kj,f Modifier | Building Type | | | |
|---|---|---|---|---|
| | Type A | Type B | Type C | Type D |
| Ownership | Private | Private or commercial / public, possible multiple | Commercial / public | Commercial / industrial |
| Control (change of use, structural alterations, ventilation) | None | Some but not all | Full | Full |
| Room sizes | Small | Small / medium | Small to large | Large industrial / retail park style |

Further details on the description of the building types, along with examples are included in BS 8485.

Following identification of the appropriate Building Type and CS, the minimum gas protection score can be determined through the use of the following table.

Table G7: Gas Protection Score

| Characteristic Situation | Minimum Gas Protection Score | | | |
|---|---|---|---|---|
| | Type A | Type B | Type C | Type D |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 3.5 | 3.5 | 2.5 | 1.5 |
| 3 | 4.5 | 4 | 3 | 2.5 |
| 4 | 6.5[A] | 5.5[A] | 4.5 | 3.5 |
| 5 | N/A[B] | 6[A] | 5.5 | 4.5 |
| 6 | N/A[B] | N/A[B] | N/A[B] | 6 |

[A]Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system e.g. in Institutional and / or fully serviced contractual situations.
[B]The gas hazard is too high for this empirical method to be used to define the gas protection measures.

Post determination of the minimum gas protection score, a combination of two or more of the following three types of protection measures should be used to achieve the score:

- The structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
- Ventilation measures; and
- Gas resistant measures.

Through combining at least two ground gas protection measures, the lack of redundancy in the use of a single protection measure approach is negated. The ground gas protection measures should work independently and collaboratively.

The tables below detail the specific ground gas protection measures and their associated scores.

## Structural Barrier

Table G8

| Floor and substructure design | Score[A] |
|---|---|
| Precast suspended segmental subfloor (I.e. beam and block) | 0 |
| Cast in-situ ground bearing floor slab (with only nominal mesh reinforcement) | 0.5 |
| Cast in-situ monolithic ground bearing raft or reinforced cast in-situ suspended floor slab with minimal penetrations | 1 or 1.5[B] |
| Basement floor and slab conforming to BS 8102:2009, Grade 2 waterproofing[C, D] | 2 |
| Basement floor and walls conforming to BS 1802:2009, Grade 3 waterproofing[C, D] | 2.5 |

[A]The scores are conditional on breaches of floor slabs, etc., being effectively sealed.

[B]To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast.

[C]The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product.

## Ventilation Measures

Table G9

| Protection element / system | Score | Comments |
|---|---|---|
| Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building. | 0.5 | Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measure systems.<br>If the layer has a low permeability and / or is not terminated in a venting trench or similar, then the score is zero. |
| Passive sub floor dispersal layer:<br>Very good performance:<br>Good performance:<br>Media used to provide the dispersal layer are;<br>• Clear void;<br>• Polystyrene void former blanket;<br>• Geocomposite void former blanket<br>• No-fines gravel layer with gas drains;<br>• No-fines gravel layer. | <br>2.5<br>1.5 | The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing, and type and thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS 8485 2015. Passive ventilation should be designed to meet at least good performance, see in Annex B of BS 8485 2015. |
| Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may compromise a clear void or be formed of geocomposite or polystyrene void formers. | 1.5 to 2.5 | This system relies on continues serviceability of the pumps, therefore alarm and response systems should be in place.<br>There should be robust management systems in place to ensure the continued maintenance of the system including pumps and vents. Active ventilation should always be designed to meet at least good performance as described in in Annex B of BS 8485 2015. |

| Protection element / system | Score | Comments |
|---|---|---|
| Active positive pressurization by the creation of a blanket of external fresh air beneath the floor slabs by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket. | 1.5 to 2.5 | This system relies on continues serviceability of the pumps, therefore alarm and response systems should be in place.<br>The score assigned should be based on the efficient coverage of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least good performance. |
| Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park). | 4 | Assumes that the car fumes is vented to deal with exhaust fumes designed to *Buildings Regulations 2000, Approved Document F.* |

It should be noted that for Type A Buildings active ventilation systems are inappropriate.

### Membrane

Table G10

| Protection element / system | Score | Comments |
|---|---|---|
| Gas resistant membrane meeting all of the following criteria;<br>• Sufficiently impervious both in the sheet material [A] and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and / or carbon dioxide through the membrane;<br>• Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;<br>• Sufficiently strong [B] to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc.); and to withstand in-service stresses (e.g settlement if placed below a floor slab);<br>• Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and<br>Verified in accordance with CIRIA C735. | 2 | The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints.<br>If a membrane is installed that does not meet the all the criteria in column 1 then the score is zero. |

A gas protection score should only be assigned to a membrane which is formed of a material with suitably low gas permeability and which has been installed so it completely seals the foundation (including effective seals around all penetrations) and does not sustain damage from in-service stresses.

## Volatile Organic Compounds (VOCs)

The Building Regulations 2000 Approved Document C (2004 Edition) also refers to volatile organic carbons (VOCs). These are primarily assessed by examination of the VOC content of site soils. Further guidance

on VOCs is provided in *"The VOCs Handbook; Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination"*, CIRIA Report C682, 2009.

For former landfill sites the risk from a wider range of trace gases are considered on a site specific basis when appropriate.

### VOCs in groundwater

Under the Environmental Protect Act 1990, Building Regulations Approved Document C 2004 and the National Planning Policy Framework there is a requirement to ensure that Volatile Organic Compounds (VOC) are considered on a risk assessment basis.

VOCs are organic compounds that are volatile under normal atmospheric conditions. However, they may be found in the solid, liquid, and the dissolved phase as well as in the gaseous phase. VOCs are typically found in the following contaminants:

- Petroleum (non-halogenated) hydrocarbons (e.g. benzene, toluene, and butylbenzenes);
- Halogenated hydrocarbons (e.g. chlorinated ethenes and ethanes (dry cleaning fluids or degreasers) or chlorofluorocarbons (freons)); and
- Organic compounds containing nitrogen, sulphur, and oxygen (e.g. tetrahydrofuran).

The likely sources of the above contaminants include:

- Spills, leaks, and discharges from industries;
- Landfills;
- Buildings, furnishings, and common household products;
- Vehicle emissions;
- Marshland; and
- Uncontrolled waste disposal.

The risk to receptors from VOC occur from inhalation (acute and chronic), and a flammable / explosive risk when present at high concentrations in confined spaces.

Current UK guidance for VOCs are limited in comparison to ground gas, and is primarily given in the *"The VOCs Handbook; Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination"*, CIRIA Report C682, 2009.

Additional guidance was published in 2017 by the Society of Brownfield Risk Assessments (SoBRA) *'Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile contaminants in Groundwater*', February 2017. The 2017 SoBRA document provided a set of Generic Assessment Criteria (GAC) to allow the risk to a residential/commercial premise to be assessed quantitatively using the contamination concentrations recorded in the groundwater. The GAC were generated using the CLEA model, with each GAC being the theoretical concentration in groundwater/perched water beneath a property that is modelled as resulting in estimated average daily exposure (ADE) to the critical receptor that is equal to the Health Criteria Value (HCV).

The GAC were designed to incorporate several precautionary assumptions, these conservatisms include;

- The assumption that the impacted groundwater/perched water is directly beneath the building, when it may instead be offset from the receptor;

- The assumption that there is an infinite source term, when in fact the source may be finite;
- The assumption that there is no biodegradation between the source term and the receptor;
- The assumption that the groundwater source is at a depth of 0.65m bgl;
- The use of sand soil type for both the saturated and unsaturated zone.
- The omission of a capillary zone between the saturated and unsaturated zone.

These GAC are detailed in the Tables below.

Table G11 Petroleum Hydrocarbons

| Chemical | CAS | GACgwvap (µg/l) 1,2 | | Aqueous Solubility (µg/l) |
|---|---|---|---|---|
| | | Residential | Commercial | |
| 1,2,4-Trimethylbenzene | 95-63-6 | 24 | 2,200 | 559,000 |
| Benzene 3 | 71-43-2 | 210 | 20,000 | 1,780,000 |
| Ethylbenzene 3 | 100-41-4 | 10,000 | *960,000 (sol)* | 180,000 |
| Isopropylbenzene | 98-82-8 | 850 | *86,000 (sol)* | 56,000 |
| Propylbenzene | 103-65-1 | 2,700 | *240,000 (sol)* | 54,100 |
| Styrene | 100-42-5 | 8,800 | *810,000 (sol)* | 290,000 |
| Toluene 3 | 108-88-3 | 230,000 | *21,000,000 (sol)* | 590,000 |
| TPH Aliphatic EC5-EC6 3 | | 1,900 | *190,000 (sol)* | 35,900 |
| TPH Aliphatic >EC6-EC8 3 | | 1,500 | *150,000 (sol)* | 5,370 |
| TPH Aliphatic >EC8-EC10 3 | | 57 | *5,700 (sol)* | 427 |
| TPH Aliphatic >EC10-EC12 3 | | 37 | *3,600 (sol)* | 34 |
| TPH Aromatic >EC5-EC7 2,3 | | 210,000 | *20,000,000 (sol)* | 1,780,000 |
| TPH Aromatic >EC7-EC8 3 | | 220,000 | *21,000,000 (sol)* | 590,000 |
| TPH Aromatic >EC8-EC10 3 | | 1,900 | *190,000 (sol)* | 64,600 |
| TPH Aromatic >EC10-EC 12 3 | | 6,800 | *660,000 (sol)* | 24,500 |
| TPH Aromatic >EC12-EC16 3 | | 39,000 | *3,700,000 (sol)* | 5,750 |
| meta-Xylene 3,5 | 108-38-3 | 9,500 | *940,000 (sol)* | 200,000 |
| ortho-Xylene 3,5 | 95-47-6 | 12,000 | *1,100,000 (sol)* | 173,000 |
| para-Xylene 3,5 | 106-42-3 | 9,900 | *980,000 (sol)* | 200,000 |

Table G12: Polycyclic Aromatic Hydrocarbons

| Chemical | CAS | GAC gw vap (µg/l) 1,2 | | Aqueous Solubility (µg/l) |
|---|---|---|---|---|
| | | Residential | Commercial | |
| Acenaphthene | 83-32-9 | *170,000 (sol)* | *15,000,000 (sol)* | 4,110 |
| Acenaphthylene | 208-96-8 | *220,000 (sol)* | *20,000,000 (sol)* | 7,950 |
| Fluorene | 86-73-7 | *210,000 (sol)* | *18,000,000 (sol)* | 1,860 |
| Naphthalene | 91-20-3 | 220 | *23,000 (sol)* | 19,000 |

Table G13: Pesticides

| Chemical | CAS | GACgwvap (µg/l) 1,2 | | Aqueous Solubility (µg/l) |
|---|---|---|---|---|
| | | Residential | Commercial | |
| Aldrin | 309-00-2 | *47 (sol)* | *3,700 (sol)* | 20 |
| *alpha*-Endosulfan | 959-98-8 | *7,400 (sol)* | *590,000 (sol)* | 530 |
| *beta*-Endosulfan | 33213-65-9 | *7,500 (sol)* | *600,000 (sol)* | 280 |

Table G14: Halogenated Organics

| Chemical | CAS | GACgwvap (µg/l) 1,2 | | Aqueous Solubility (µg/l) |
|---|---|---|---|---|
| | | Residential | Commercial | |
| 1,1,1,2-Tetrachloroethane | 79-34-5 | 240 | 22,000 | 1,110,000 |
| 1,1,1-Trichloroethane | 71-55-6 | 3,000 | 290,000 | 1,300,000 |
| 1,1,2,2-Tetrachloroethane | 79-35-4 | 1,600 | 150,000 | 2,930,000 |
| 1,1,2-Trichloroethane | 79-00-5 | 520 | 49,000 | 4,491,000 |
| 1,1-Dichloroethane | 75-34-3 | 2,700 | 260,000 | 3,666,000 |
| 1,1-Dichloroethene | 75-35-4 | 160 | 16,000 | 3,100,000 |
| 1,2,3,4-Tetrachlorobenzene | 634-66-2 | 240 | *31,000 (sol)* | 7,800 |
| 1,2,3,5-Tetrachlorobenzene | 634-90-2 | 7.0 | 600 | 3,500 |
| 1,2,3-Trichlorobenzene | 87-61-7 | 35 | 3,100 | 21,000 |
| 1,2,4,5-Tetrachlorobenzene | 95-94-3 | 8.1 | *700 (sol)* | 600 |
| 1,2,4-Trichlorobenzene | 120-82-1 | 68 | 7,200 | 41,400 |
| 1,2-Dichlorobenzene | 95-50-1 | 2,000 | *220,000 (sol)* | 133,000 |
| 1,2-Dichloroethane | 107-06-2 | 8.9 | 850 | 8,680,000 |
| 1,2-Dichloropropane | 78-87-5 | 22 | 2,600 | 2,050,000 |
| 1,3,5-Trichlorobenzene | 108-70-3 | 7.4 | 660 | 6,000 |
| 1,3-Dichlorobenzene | 541-73-1 | 31 | 2,800 | 103,000 |
| 1,4-Dichlorobenzene | 106-46-7 | 5,000 | 460,000 (sol) | 51,200 |
| Bromobenzene | 108-86-1 | 220 | 20,000 | 388,040 |

| Chemical | CAS | GACgwvap (µg/l) 1,2 | | Aqueous Solubility (µg/l) |
|---|---|---|---|---|
| | | Residential | Commercial | |
| Bromodichloromethane | 75-27-4 | 17 | 1,600 | 3,000,000 |
| Bromoform (Tribromomethane) | 75-25-2 | 3,100 | 400,000 | 3,000,000 |
| Chlorobenzene | 108-90-7 | 98 | 15,000 | 387,000 |
| Chloroethane | 75-00-3 | 10,000 | 1,000,000 | 5,742,000 |
| Chloroethene (Vinyl Chloride) | 75-01-4 | 0.62 | 63 | 2,760,000 |
| Chloromethane | 74-87-3 | 14 | 1,400 | 5,350,000 |
| cis-1,2-Dichloroethene | 156-59-2 | 130 | 13,000 | 7,550,000 |
| Dichloromethane | 75-09-2 | 3,300 | 370,000 | 20,080,000 |
| Hexachlorobenzene | 118-74-1 | 16 (sol) | 1,400 (sol) | 10 |
| Hexachlorobutadiene | 87-68-3 | 1.7 | 230 | 4,800 |
| Hexachloroethane | 67-72-1 | 8.5 | 740 | 49,900 |
| Pentachlorobenzene | 608-93-5 | 140 | 12,000 (sol) | 500 |
| Tetrachloroethene | 127-18-4 | 34 | 4,600 | 225,000 |
| Tetrachloromethane (Carbon Tetrachloride) | 56-23-5 | 5.3 | 770 | 846,000 |
| trans-1,2-Dichloroethene | 156-60-5 | 160 | 16,000 | 5,250,000 |
| Trichloroethene | 79-01-6 | 5.7 | 530 | 1,370,000 |
| Trichloromethane (Chloroform) | 67-66-3 | 790 | 85,000 | 8,950,000 |

Table G15: Others (Organic and Inorganic)

| Chemical | CAS | GACgwvap (µg/l) 1,2 | | Aqueous Solubility (µg/l) |
|---|---|---|---|---|
| | | Residential | Commercial | |
| 2-Chloronaphthalene | 91-58-7 | 160 | *14,000 (sol)* | 11,700 |
| Biphenyl (Lemonene) | 92-52-4 | *15,000 (sol)* | *1,300,000 (sol)* | 4,060 |
| Carbon disulphide | 75-15-0 | 56 | 5,600 | 2,100,000 |
| Mercury, elemental | 7439-97-6 | 1.1 | *95 (sol)* | 56 |
| Methyl tertiary butyl ether (MTBE) | 1634-04-4 | 83,000 | 7,800,000 | 48,000,000 |

The risks to receptors from vapours will be assessed through assessment of the volatile contaminant concentrations recorded in groundwater samples against the SoBRA derived GAC. Where an exceedance is recorded, a qualitative assessment will be made, given the conservative approach of the SoBRA derived GAC as to whether a significant vapour regime is present on-site and possible risk to receptors exists. The vapour concentration recorded during headspace analysis of soils, SVOC / VOC contaminant concentration within soil samples, and the vapour concentration within installed boreholes will also be considered qualitatively during this assessment.

Where a significant vapour regime is present and a risk to receptors exists, further assessment will be required, this may include, vapour sampling, further intrusive investigations, or a Detailed Quantitative Risk

Assessment (DQRA). Dependent on the results of the further assessment, remedial measures will be required to mitigate the risk to receptors.

# UK and Ireland Office Locations











# Trinity Academy, Barnsley

## Phase 2 Ground Investigation

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Revision: P01

Issue Date: 07 March 2022

Client Name: Bowmer + Kirkland

Client Address: High Edge Court, Heage, Belper, Derbyshire, DE56 2BW

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# Executive Summary

| | |
|---|---|
| **Appointment** | In September 2021 Curtins were instructed by Bowmer & Kirkland to undertake a Phase 2 Ground Investigation at the former Keresforth Medical Centre NHS facility and adjacent public open field located off Keresforth Close, Barnsley. The site is centred on an easting and northing of 433423, 405601, and covers an area of approximately 7.20 Ha.<br><br>**The** primary focus of the ground investigation was to provide ground conditions information within the area of open land proposed as a sports field. In addition, this ground investigation addresses recommendations as presented in the geo-environmental report completed by Waterman Infrastructure & Environment Limited for the area proposed for buildings development. The aim of the additional information is to support the existing findings and to refine and characterise geo-environmental conditions prior to the development of a new secondary school facility with associated sports field. |
| Current Site Status | The site is currently recorded as two distinct parcels of land; Keresforth Medical Centre, now disused in the north-east comprising of low rise buildings with access roads, parking areas and soft landscaping and a public open space in the south-west. The area of public open space is predominately flat and comprised of grass cover whilst the Keresforth Medical Centre is covered by a mixture of buildings, hardstanding, and soft landscaping. There is a mine shaft recorded to be present on site within the public open field.<br><br>Based on satellite imagery, the site is bounded to the north by Keresforth Close comprising of residential dwellings, to the northwest Barnsley Fire Station is opposite to the field. To the east by Joseph Locke Primary School. To the south by a sparse treeline and beyond this several residential buildings and allotments are situated with sparsely populated local shops. The site is bound to the west by the A6133 and beyond this by open fields and Greenacre School. |
| Summary of Waterman Infrastructure & Environment Limited Phase 2 GI and CMRA | Historically the site was recorded as undeveloped arable farmland until 1978 when Keresforth Close Medical Centre was constructed. The site is underlain by both Glacial Till (superficial deposits) and the Pennine Middle Coal Measures Formation (bedrock – Secondary A Aquifer). A geological fault runs along the northern boundary of the public open field that forms part of the site area and across the access road, aligned generally east-west through the proposed development position. The geological fault that runs NE-SW north of the open field and links the Champany Hill Fault (SW of fault) and the Barebones Fault (NE of the fault).<br><br>The site is recorded to be affected by historical coal mining activities. A mine shaft is recorded present on site within the public open field. The mine shaft was identified during the ground investigation completed by Waterman Infrastructure & Environment Limited in a trial pit; TP110 within the public open field with the shaft remaining uncapped and a diameter of 2.50m. The seams of concern are the Barnsley Coal seams. Potential workings were identified beneath the proposed building footprints. CS2 ground gas protection measures were recommended, and isolated exceedances of PAHs were recorded in the proposed sports field area. |
| Fieldworks Undertaken | Fieldworks were carried out between the 18th October and 17th November 2021 and comprised of 6x rotary core/open boreholes to a maximum depth 40.00m bgl within the public open field and 5x window sample boreholes to a maximum depth 1.90m bgl, across the former Keresforth Medical Centre NHS facility and associated car park. Ground gas and groundwater monitoring standpipes were installed in selected boreholes. Seven ground gas and groundwater monitoring visits have been completed between November 2021 and January 2022. Selected soils and rock samples were subjected to laboratory analysis. |
| Encountered Ground Conditions | The ground conditions at the site generally comprised of both made ground and topsoil to maximum depths ranging between 0.10m bgl and 0.50m bgl, this was underlain by residual soils and weathered bedrock (soft to firm or stiff clay and sandy gravels) and bedrock (extremely weak to extremely strong mudstone, siltstone, and sandstone with bands of coal) of the Pennine Middle Coal Measures Formation to depths ranging between 0.30m bgl and 40.00m bgl. The base of the Pennine Middle Coal Measures deposit was not proven due to the maximum proposed depth of the rotary boreholes, |

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| | |
|---|---|
| | all window sample boreholes encountered were unable to penetrate beyond 1.90m bgl. The points at which refusals are recorded vary laterally and vertically, particularly to the east of the site. Groundwater levels have currently been recorded at depths ranging between Dry and 7.65m bgl. However, this is not likely to be representative of the natural groundwater conditions. It is likely this is surface water getting trapped in the standpipe. |
| Environmental Laboratory Testing and Land Gas Monitoring Results | Elevated concentrations of individual PAH species, heavy metals have been recorded above the 'Residential without home grown produce' thresholds using a soil organic matter content of 6.0% within the public open space area of the proposed sports field. Elsewhere, generally low concentrations of potential contaminants were noted. No asbestos was identified in the samples or during the ground investigation works.<br><br>Groundwater sampling and analysis is outside the scope of this report.<br><br>During ground gas monitoring, a maximum concentration of 6.4% $^{v}/_{v}$ carbon dioxide ($CO_2$) was recorded in RC06D on the fourth visit. Hydrogen Sulphide ($H_2S$) and carbon monoxide were recorded at maximum concentrations of 0ppm and 3ppm, respectively. Methane ($CH_4$) and gas flow (l/hr) were recorded to be below the detection limit of the gas monitor between visits 1-6. During visit 7, maximum methane concentrations of 2.2% to 27% were recorded within the shallow installs and a maximum concentration of 7.2% to 15.9% within the deeper installs were recorded. The maximum recorded level of $CO_2$ results in a calculated Gas Screening Value (GSV) of 0.0096 l/hr, if maximum flow is taken as 0.1 l/hr. The maximum recorded level of $CH_4$ results in a calculated Gas Screening Value (GSV) of 0.41 l/hr, if maximum flow is taken as 0.1 l/hr. |
| Ground Contamination and Ground Gas Assessment | The risk to the end users of the site from shallow soils across the site is Moderate to Low. With regards to the public open field, exceedances were recorded within the made ground/topsoil. Much of the field will be capped to break the source-pathway-receptor. The risk to the groundwater and surface water receptors from the site soils is assessed as Low. This is due to no historical source of contamination being recorded within the site boundary and despite recorded exceedances of heavy metals recorded to be present in the made ground/topsoil, the underlying clays were noted to have low concentrations of heavy metals and act as a natural barrier inhibiting migration of contaminants. Therefore, there is no viable source-pathway-receptor link. The risk to the end users from ground gases is assessed as Moderate to Low based on the monitoring data obtained. Maximum concentration of 6.4% was recorded for carbon dioxide. Concentrations of methane were recorded between 2.2 – 27% classifying the site as CS2. Therefore, further monitoring is required to determine increased levels of these gas emissions and an allowance should be made for CS2 ground gas protection measures against carbon dioxide and methane and should be implemented as a pre-caution. |
| Geotechnical Assessment | With regards to the public open field, the presence of a mine shaft on site is a risk to the ground stability of the site. In RC06 where possible workings were recorded is located directly below where proposed developments of a MUGA pitch are intended. A separate ground movement assessment was completed specific to the proposed sports pitch only and recommends the use of geogrid across the playing field area to mitigate against any potential crown hole collapses, rather than grout treating the entire field. However, the collapse feature that occurred in 2014 is likely to require further investigation in the form of geophysical techniques to try to determine whether anomalies can be identified due to how shallow the feature was. This is likely to be followed by intrusive ground investigation works to determine the location of the shallow unrecorded workings. The proposed building footprint areas will require further ground investigation to confirm geotechnical designs and whether shallow mining features can be identified below ground. |
| Ground Contamination & Additional Recommendations | Overall, the site is deemed suitable for use for development of a new school with associated sport field within the open public field and existing buildings east of the site, subject to specific mitigation measures. The mine shaft located within the public open field must be treated and capped prior to any development works progress. Further investigation of the collapse feature in the field along the northern boundary is likely to require further investigation. Further ground investigation will be required for the proposed building footprint areas to obtain geotechnical information and potential additional shallow mine working information. |

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| | |
|---|---|
| | An allowance for CS2 ground gas protection measures against carbon dioxide and methane ground gases. A Remediation Strategy will be required to detail the ground gas protection measures and details on the remediation of the mine shaft and shallow mine workings where applicable. On completion of the development a Verification / Completion Report will be needed to record the gas protection measures have been installed to the necessary standards and guidance along with details on the Remediation completed to the mine shaft and potential mine workings where applicable. |

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Appendix A2 - Exploratory Hole Logs

Appendix A3 - Chemical Laboratory Testing Results

Appendix A4 - Geotechnical Laboratory Testing Results

Appendix A5 - Land Gas and Groundwater Monitoring Results

Appendix A6 - Tier 1 Screening Thresholds

Appendix A7 - Risk Assessment Methodology

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# 1.0 Introduction

## 1.1 Project Background

In September 2021 Curtins were instructed by Bowmer & Kirkland to undertake a Phase 2 Ground Investigation at the former Keresforth Medical Centre NHS Facility and adjacent public open field located just off Keresforth Close in Barnsley. The site is centred on an easting and northing of 433423, 405601, and covers an area of approximately 7.20 Ha. Post-demolition the site is proposed for the development of a new 900-place secondary school: Trinity Academy, Barnsley, and associated sports field. The new school building and sports hall is planned for development at the previous NHS health facility, with the associated sports playing field planned for development within the current public open field located off Keresforth Close.

## 1.2 Scope of Services

This investigation is intended to provide an overview of the geo-environmental and geo-technical setting of the site, prior to proposed development for a new school: Trinity Academy and associated sports playing field located off Keresforth Close, Barnsley. The aim of the Curtins Phase 2 ground investigation works is to characterise geo-environmental and geo-technical conditions prior to the development of the 900-place secondary school and sports field at the site. The proposed development drawings are included in Appendix A.

Specifically, the Phase 2 report is intended to determine:

a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;

b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use;

c) If there is a risk to the proposed development works from historical unrecorded shallow coal mining <40m depth;

d) If there is a risk to the end user from soil gases including methane, carbon dioxide, oxygen, and hydrogen sulphide;

e) Recommendations for the design of foundations and building ground floor slabs; and

f) Recommendations for the specification of sub-structure concrete and water supply pipes.

Consideration of detailed flood risk, ecology and archaeological issues are outside of the scope of this report.

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# 2.0 Phase 1 Preliminary Risk Assessment Summary

This section presents a summary of the Waterman Infrastructure & Environment Limited Geotechnical Report (Ref. 13). The information provides background information into the current site setting, history, geology, and hydrogeology/hydrology to support the revised Phase 2 ground investigation works conceptual site model (CSM as presented in Section 8).

## 2.1 Current Setting

The site is currently recorded as two distinct parcels of land; Keresforth Medical Centre, now disused in the north-east comprising of low rise buildings with access roads, parking areas and soft landscaping and a public open space in the south-west. The area of public open space is predominately flat and comprised of grass cover whilst the Keresforth Medical Centre is covered by a mixture of buildings, hardstanding, and soft landscaping. There is a mine shaft recorded to be present on site within the public open field.

Based on satellite imagery, the site is bounded to the north by Keresforth Close comprising of residential dwellings, to the northwest Barnsley Fire Station is opposite to the field. To the east by Joseph Locke Primary School. To the south by a sparse treeline and beyond this several residential buildings and allotments are situated with sparsely populated local shops. The site is bound to the west by the A6133 and beyond this by open fields and Greenacre School.

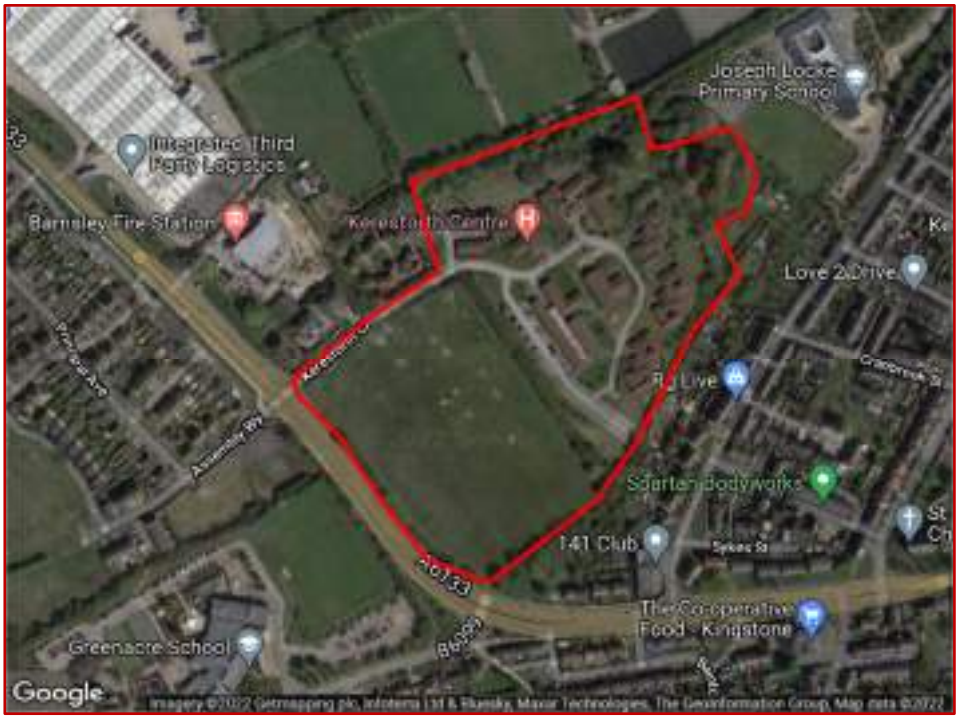



**Fig 2.1 – Site location showing the field and existing buildings off Keresforth Close. Site boundary shown in red.**

## 2.2 Previous Site Use

A review of the available historical mapping information for the site (as presented within the Waterman Infrastructure & Environment Phase 1 report) (Ref. 13) has been undertaken.

The site is has remained as undeveloped comprising of arable farmland until 1978 when the Keresforth Close Medical Centre was constructed. The surrounding area was recorded as industrial land uses including foundries, works, mills and quarrying activities. No further notable change to site layout is recorded up to the present day.

## 2.3 Ground Conditions

As part of the Waterman Infrastructure & Environment Limited investigation, the site works were completed in October 2020 with groundwater and ground gas monitoring completed in December 2020. The ground investigation consisted of 4 No. rotary boreholes to a maximum depth of 30.00m below ground level (bgl) and 12 No. trial pits to a maximum depth of 4.10m bgl.

Made ground was described as both topsoil and gravelly clay. The made ground topsoil was described as grass over dark brown sandy clayey topsoil with gravel of ash, sandstone, quartzite, ceramic, coal, brick, glass, concrete and limestone found at depths between 0.20 and 0.42m bgl. Another unit of made ground was described as soft to stiff grey-brown sandy gravelly clay with a low cobble content of concrete, brick and gravel of brick, wood, concrete, steel, sandstone, coal, and plastic. Made ground in general was proven to maximum depths ranging between 0.20 and 3.10m bgl.

Superficial deposits were recorded to be present on site and underlay the made ground deposits which were recorded at maximum depths ranging between 0.40 – 1.80m bgl. The superficial deposits were identified as Glacial Till and recorded as firm to very stiff, medium to high strength orange-brown mottled grey sandy gravelly silty clay. The gravel is angular to sub-rounded fine to medium of coal and sandstone.

This was subsequently recorded to be underlain by the residual soils and bedrock deposits of the Pennine Middle Coal Measures Formation. This was encountered at depths ranging between 0.20 – 3.20m bgl. Various units were encountered but three distinct units were described. The first unit is described as interbedded brown to grey sandstone and siltstone with bands of soft mudstone. The second unit was described as extremely to very weak brown to grey fine-grained sandstone highly weathered, recovered as slightly sandy slightly clayey angular to sub-angular fine to coarse gravel and tabular cobbles of sandstone. Sand is fine to medium. The final unit was described as extremely weak grey siltstone, highly weathered with horizontal rough planar closely spaced discontinuities and small-scale bedding structures present.

Groundwater strikes were not observed during the ground investigation but were monitored post-investigation. Groundwater levels recorded to range between 5.48 and 10.72m bgl with RC102

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recorded as dry and RC103 flooded on the first monitoring visit due to localised puddling due to heavy rain.

Visual evidence of possible contamination was observed to contain ash within the topsoil in TP110 and TP112 situated west of the site. TP112 was reported to have a band of black ash and clinker between 0.42m and 0.53 m bgl. No further visual and olfactory evidence was reported including no reports of hydrocarbon contamination.

## 2.4 Human Health Risk Assessment

The samples collected at the site were assessed against 'Residential without plant uptake land use' end use with the soils assessed using a soil organic matter (SOM) content of 1%. The results of the chemical testing compared with the end use thresholds mentioned above identified the following exceedances in two samples:

- Two exceedances for beryllium (TP110 at 1.00m bgl and TP112 at 0.20m bgl)
- one exceedance for benzo(a)pyrene in TP112 at 0.20m bgl
- one exceedance for benzo(b)fluoranthene in TP112 at 0.20m bgl
- One exceedance for Dibenzo(a.h.) anthracene in TP112 at 0.20m bgl

The exceedances are all recorded within the made ground soils. It was recommended that mitigation measures to break pollutant linkage in the form of a cover layer of sufficient thickness should be required where soft and hard landscaping is present

## 2.5 Ground Gas Risk Assessment

Ground gas concentrations have been monitored on six occasions with only three monitoring visit data made readily available at the time of writing (Ref.14). The results show that no methane has been detected during the visits and was recorded below the equipment detection limit (<0.1). Carbon dioxide has been recorded at concentrations ranging between 0.1% and 2.9%. Positive flow has been recorded in the position of RC101 and RC102 with flows recorded at 0.1 l/hr.

As steady state gas screening value (GSV) of 0.0001 l/hr is calculated for methane and a 0.0012 l/hr for carbon dioxide. The steady state values indicate that the site with respect to ground gas protection measures against methane and carbon dioxide is classified as Characteristic Situation 1 (CS1) for the site. The report further advises that the risk assessment should be re-assessed once all gas monitoring visits are complete and consider cautionary action to implement protective ground gas measures in accordance with Characteristic Situation 2 (CS2).

## 2.6 Coal Mining Risk Assessment

A Coal Mining Risk Assessment (CMRA) was also completed by Waterman Infrastructure & Environment Limited (Ref.15) to assess and determine the risk to the site based on desk-based information, this is further discussed in section 9.4. A Consultants Coal Authority Mining Report identified that the site is recorded to be within a development high risk area, past and probable shallow coal mine workings are noted to be present beneath the site. A mine shaft is located within the development site boundary within the public open field.

The site area is recorded to have up to six seams that have been known to have been worked historically beneath the site and the surrounding area. These are recorded as the Barnsley, Flockton Thick, Top Fenton, Parkgate, Middleton Main and Silkstone, coal seams and are generalised to represent the entire Barnsley area. Ranging in extraction thickness from 0.66m up to 2.74m. One Coal Authority Recorded Mine Entry (433405-008) is located on site within the public open field. The mine shaft referenced has no record of treatment and no further information is provided. A summary of historical collieries that worked beneath the site are presented in table 2.6.1 below.

**Table 2.6.1: Summary of historical underground mining beneath the property by Waterman Infrastructure & Environment Limited**

| Colliery | Coal Seam | Details |
|---|---|---|
| **Unnamed Colliery** | Barnsley Coal | Mined seam at a depth between 10.00 – 21.00m with dipping rate 5.0° – 7.4° in an easterly direction.<br>Seam had an extraction thickness of 2.74m<br>Last worked in 1925. |
| **Rob Royd Colliery** | Silkstone Coal | Mined seam between depths of 278 – 293m bgl.<br>Seam dips to the east and north-east at an angle between 4.2°-6.7°.<br>Extraction thickness of 1.67m.<br>Last worked in 1910 |
| **Dodworth Colliery** | Flockton Thick, Top Fenton, Parkgate and Middleton Main | Mined seam between 200m bgl and dip east and northeast at an angle between 3.6° – 7.2° (Top Fenton and Parkgate).<br>Extraction thickness between 0.66-1.50m.<br>Last worked beneath the site in 1956 |

It was determined that any future ground investigation should where possible investigate the presence of potential worked coal seams and, determine the location of the mine shaft situated within the public open field. The Coal Mining Risk Assessment identified:

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- High risk associated with ground collapse of Coal Authority shaft located within the public open field on site;
- Low risk of subsidence associated with deep mining beneath the site;
- High risk associated with surface subsidence when activated by underground mining;
- High risk of subsidence / ground collapse associated with historic shallow mining beneath the site; and
- Moderate risk of ground gas migration, inhalation or explosion associated with mine gasses beneath the site.

The ground investigation carried out by Watermans confirmed the presence of the Barnsley Coal Seam within the proposed site area. All intact coal and suspected mine workings are associated with the Barnsley Coal Seam in the area. Table 2.6.2 summarises the recovered coal and suspected mine workings found on site from the completed ground investigation.

**Table 2.6.2: Summary of coal and suspected mine workings from ground investigation on site**

| Exploratory Hole Type | Exploratory Hole Depth (m bgl) | Description |
|---|---|---|
| **RC101** | 1.50 – 1.98<br>3.00 – 3.53<br>4.50 – 4.96 | **Zones of no recovery** - presence of weak or weathered rock |
| **RC101** | 7.50 – 8.40<br>9.00 – 10.26 | **Zones of no recovery** – suspected mine workings due to loss of drilling flush |
| **RC101** | 10.50 – 10.90 | Intact coal |
| **RC102** | 1.50 – 2.19<br>4.50 – 5.36<br>6.00 – 7.02<br>7.50 – 8.40 | **Zones of no recovery** - presence of weak or weathered rock |
| **RC102** | 9.00 – 10.50 | **Void** – suspected mine workings due to loss of drilling flush |
| **RC103** | 19.50 – 22.00 | Intact Coal |
| **RC104** | 3.00 – 3.72<br>4.50 – 4.84<br>6.00 – 6.60<br>7.50 – 7.69 | **Zones of no recovery** – presence of weak or weathered rock |

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| Exploratory Hole Type | Exploratory Hole Depth (m bgl) | Description |
|---|---|---|
| **RC104** | 15.40 -16.80 | **Void** – suspected mine workings |

Based on the findings of the ground investigation, the greatest reported thickness of the Barnsley Coal seam suspected from no recovery or voids was 3.00m beneath the site within RC102 from 7.50- 10.50m bgl. Based on CIRIA C758D, likely propagation of voids to 10 times worked seam thickness through bedrock. It is unlikely that there is sufficient rock cover above this void to prevent a collapse feature (crown hole) reaching the surface. Therefore, the suspected workings are considered to constitute a risk to possible surface instability. Therefore, Waterman Infrastructure & Environment Limited recommend further investigation below the footprint of the proposed building in the form of Primary Consolidation Grouting to confirm presence of workings or with Secondary Grouting if workings are identified.

A mine shaft was identified in trial pit; TP110 within the public open field with the shaft remaining uncapped and a diameter of 2.50m. The shaft was backfilled with colliery spoils from 0.50m bgl. It is recommended that the mine shaft should be investigated and appropriately treated with a reinforced concrete cap.

Deliberation of the design for the proposed sport field on site should consider mitigation of the risk of ground collapse associated with unidentified coal mining features and remedial works should be implemented to both shallow mine workings and the mine shaft on site with agreement of the Coal Authority with appropriate permissions and licenses obtained.

## 2.7 Geotechnical Assessment

Based on geotechnical *in-situ* testing and nature of the made ground observed from the ground investigation, it is concluded that the made ground is of a soft and loose nature and is not suitable bearing strata for shallow foundations.

Strip foundations in glacial till deposits at a minimum depth of 1.00m below current ground levels at an allowable bearing pressure of 150 kPa at 1.00m bgl should be adopted.

However, with the presence of the Barnsley Coal seam at relatively shallow depths beneath the site, there should be consideration of influence of the foundation loads on potential shallow mine workings.

Appropriate rock cover should also be present between the base of the shallow/pile foundation and underlying coal seams. Given the limited made ground found during the ground investigation within the vicinity of the proposed site there is a low risk of heave and ground conditions are likely to be relatively uniform across the site.

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All foundations should be advanced through the competent bedrock by a minimum of 200mm. Localised deepening or an alternative foundation solution may be required in areas where proposed demolition is expected to be completed. Should higher loads be required, or the proposed depths of strip footings be considered unfeasible consideration should be given to ground improvement via piling.

Below ground concrete classification in accordance with BRE Special Digest 1 is assessed as DS-1 and AC-1 for the concrete in contact with the made ground and Pennine Middle Coal Measures Formation.

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# 3.0 Phase 2 Ground Investigation Scope of Works

The ground investigation works were undertaken between the 18th October and 17th November 2021.

The scope of the ground investigation was designed in general accordance with current UK guidance including Land Contamination: Risk Management (Ref. 1), British Standard (BS) 10175:2011+A2:2017 (Ref. 2), BS5930: 2015+A1:2020 (Ref.3), and Eurocode 7 (Ref.4). A summary of the scope and rationale are summarised in Table 3.0 below.

**Table 3.0 - Scope and Rationale of Fieldwork Undertaken**

| Exploratory Hole Type | Exploratory Hole Reference | Exploratory Hole Depth (m bgl) | Rationale |
|---|---|---|---|
| Window Sample Boreholes | **WS01 – WS05** | **Max 1.90** | Confirm shallow ground conditions.<br>Collect soil and samples for chemical and geotechnical analysis.<br>Undertake in-situ geotechnical testing.<br>Post site works ground gas and groundwater monitoring.<br>Determine geotechnical parameters. |
| Rotary Core/open Boreholes | **RC01-RC06** | **Max 40.00** | Confirm deeper ground conditions.<br>Determine potential shallow worked coal seams are present.<br>Collect soil and samples for chemical and geotechnical analysis.<br>Undertake in-situ geotechnical testing.<br>Post site works ground gas and groundwater monitoring.<br>Determine geotechnical parameters. |
| Trial Pit | **TP01** | **Max 0.60** | Locate and confirm a mine shaft is present on site |

Two positions for the proposed window sampling boreholes (WS01 and WS02) were adjusted during the ground investigation due to existing service lines. Due to bedrock hardness, most of the window sample boreholes could not progress past depths beyond 1.80m – 1.90m bgl at maximum depth, with two boreholes encountering refusals between 0.75m bgl (WS01) and 0.90m bgl (WS02).

Curtins drawing ref. 079532-CUR-XX-XX-DR-GE-00001-P02_EHLP records the locations of the exploratory holes, a copy of which is contained within Appendix A1.

## 3.1 Soil Logging and Sampling

Exploratory window sample and rotary cored borehole arisings were logged on site by a qualified Engineer. The open hole section of the rotary drilling was logged by the lead driller. All exploratory holes

were logged in accordance with the requirements of BS5930 (Ref.**Error! Bookmark not defined.**), including recording observed visual and olfactory indications of contamination. Exploratory hole logs are provided in Appendix A2.

## 3.2 Monitoring Well Installations

Ground gas and groundwater monitoring installations (50mm & 19mm diameter) were installed within two, window sample boreholes (WS04 and WS05) and two rotary cored boreholes (RC04 and RC06). A bentonite seal was placed above and below the screened section of the borehole to minimise potential for downward migration of contaminants and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

The 50 mm diameter monitoring wells were primarily designed to assess the potential for ground gas concentrations in the window sample boreholes and strata likely to have the highest permeability and as such the screened section would ideally focus on made ground where sufficient depth is encountered or the underlying natural strata. The 50mm diameter monitoring wells in the rotary boreholes were primarily designed to assess the groundwater conditions, and the 19mm diameter pipe was primarily designed to assess the ground gas concentrations. Due to shallow made ground or no made ground encountered, the response zone was installed within the underlying Pennine Middle Coal Measures Formation.

A summary of the response zones is presented in Table 3.2 below.

**Table 3.2 - Monitoring Well Response Zones**

| Borehole Reference | Response Zone(s) (m bgl) | Strata Description(s) |
|---|---|---|
| WS04 | 0.50 – 1.80 | Gravelly CLAY into SANDSTONE into Gravelly CLAY |
| WS05 | 0.50 – 1.90 | Gravelly CLAY/ CLAY into SANDSTONE |
| RC04S | 3.00 – 5.00 | CLAY into SANDSTONE |
| RC04D | 7.00 – 12.00 | SANDSTONE and MUDSTONE |
| RC06S | 2.00 – 5.00 | CLAY into SANDSTONE |
| RC06D | 8.00 – 13.00 | MUDSTONE |

Copies of borehole logs can be referred to in Appendix A2 of this report.

## 3.3 Post-Investigation Monitoring

### 3.3.1 Groundwater & Ground Gas Monitoring

The monitoring schedule has been completed with seven visits completed between November 2021 and January 2022. An additional visit was completed due to weather conditions (snow) disrupting observation of the deeper well locations.

### 3.3.2 Groundwater Sampling

Groundwater sampling is outside the scope of this reporting and ground investigation. This is further discussed in section 6.2.

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# 4.0 Laboratory Analysis

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the made ground where present and natural strata encountered. Selected soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical analysis was Envirolab and i2 Analytical Ltd Laboratories, a UKAS and MCERTS accredited laboratory.

Given the previously identified areas source of contamination (made ground topsoil in the playing field) the sampling positions (boreholes) were generally located in a targeted array to target the building footprints and even spread across the playing field. The rotary boreholes in the playing field were completed to determine whether shallow mine workings are present.

## 4.1 Soil Analysis

The contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, petroleum hydrocarbons (e.g., fuel/oils), heavy metals and asbestos the extent of which is captured by the broad environmental testing suite listed in Table 4.1 below.

**Table 4.1 - Environmental Chemistry Analysis Suite: Soils**

| Suite Ref. | Analyte | LOD |
|---|---|---|
| Soils Suite 1B (All window samples + RC01 and RC02) | Asbestos Screen | N/A |
| | pH | N/A |
| | Soil Organic Matter (SOM) | 0.1 % |
| | Arsenic, chromium, chromium VI copper, lead, selenium, zinc, nickel | 1 – 1.2 mg/kg |
| | Boron (water soluble) | 0.2 mg/kg |
| | Cadmium | 0.2 mg/kg |
| | Mercury | 0.3 mg/kg |
| | Cyanide (total) | 1 mg/kg |
| | Sulphate (total) | 1.25 mg/l |
| | Phenols (screen) | 1 mg/kg |
| | Poly Aromatic Hydrocarbons (PAHs) (USEPA 16) | 0.8 mg/kg |
| | Total Petroleum Hydrocarbons (TPH) (aromatic/aliphatic split) | 0.0001 – 10 mg/kg |
| Suite 1A (RC03-RC06) | Asbestos Screen | N/A |
| | pH | N/A |
| | Soil Organic Matter (SOM) | 0.1 % |

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| Suite Ref. | Analyte | LOD |
|---|---|---|
| | Arsenic, Chromium, Chromium VI, Copper, Lead, Selenium, Zinc, Nickel | 1 – 1.2 mg/kg |
| | Boron (water soluble) | 0.2 mg/kg |
| | Cadmium | 0.2 mg/kg |
| | Mercury | 0.3 mg/kg |
| | Cyanide (total) | 1 mg/kg |
| | Ammoniacal Nitrogen (N, NH3, NH4+) | 0.5 mg/kg |
| | Total Phenols (HPLC) | 1.3 mg/kg |
| | Total Petroleum Hydrocarbons (TPH) (aromatic/aliphatic split) | 0.0001 – 10 mg/kg |
| | Volatile Organic Compounds (VOCs) | 1 µg/kg |
| | Semi-Volatile Organic Compounds (SVOCs) | 0.05 – 0.3 mg/kg |

A total of 11 soil samples were taken from within the made ground or natural soils, whichever was encountered first from each exploratory hole location and tested for Curtins Suite 1B (all window sample boreholes and RC01 and RC02) and Curtins Suite 1A (RC03, RC04, RC05 and RC06).

Copies of the environmental chemistry testing certificates are presented in Appendix A3.

## 4.2 QA/QC

No samples were classed as deviating.

## 4.3 Geotechnical Analysis

Soil samples for testing were prepared in accordance with BS1377: Part One: 1990 and representative sub-samples were taken for testing. The following tests were carried out:

- 44 No. Moisture contents (12 No. of these included within the environmental testing suite, 8 from Atterberg Limit, 24 from BRE Suite D).
- 36 No. Water soluble sulphate (12 No. of these included within the environmental testing suite).
- 36 No pH value (12 No. of these included within the environmental testing suite).
- 29 Point Load Strength Index Tests
- 8 No. Atterberg Limits
- 8 No. Particle Size Distribution by wet/dry sieve
- 24 BRE Suite D including:
    - Water soluble sulphate

- Water soluble chloride
- Water soluble nitrate
- Water soluble magnesium
- Total sulphate
- Total Sulphur

Rock samples for geotechnical testing were prepared and tested in accordance with ISRM Suggested Methods. The following tests were carried out:

- 29 No. Point Load Strength Index Test (PLT)

Copies of the geotechnical testing certificates are presented in Appendix A4.

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# 5.0 Encountered Ground Conditions

## 5.1 General

A summary of the ground conditions encountered during the ground investigation works is presented below, with detailed information presented in the exploratory hole logs included in Appendix A2 and a summary of each strata presented in subsequent sections.

**Table 5.1 - Summary of Ground Conditions Encountered**

| Stratum | Depth to top of strata (m bgl) | Thickness (m) | | Description |
|---|---|---|---|---|
| | | Min | Max | |
| MADE GROUND | 0.00 | 0.10 | 0.10 | ASPHALT |
| | 0.10 | 0.30 | 0.40 | Extremely weak, cream coarse sandy GRAVEL. Gravel comprises of angular to sub-angular sand, sandstone, and asphalt. |
| TOPSOIL | 0.00 | 0.20 | 0.50 | Generally recorded as grass cover over brown soft, slightly sandy, slightly silty CLAY with very fine grass rootlets throughout. Occasional pebbles are present. |
| RESIDUAL SOILS & WEATHERED BEDROCK (Pennine Middle Coal Measures Formation) | 0.30 | 0.10 | 1.50 | Soft to firm, brown to beige sometimes gravelly CLAY. Gravel comprises of small angular to sub-angular fragments of sandstone, black, dark grey and light grey mudstone. Plant fibres are common. |
| | 0.30 | 0.30 | 0.65 | Soft to firm, yellow to yellowish-brown CLAY with extremely weak sandstone or siltstone horizons occasionally retrieved as gravel comprising of sub-angular clasts. |
| | 3.00 | 0.35 | 0.35 | Very stiff, light brown mottled orange CLAY |
| BEDROCK (Pennine Middle Coal Measures Formation) | 0.80 – 3.00 | 0.10* | 39.20* | Extremely weak to extremely strong thinly bedded, dark to light grey parallel laminated or lenticular bedded MUDSTONE.<br>Extremely weak to extremely strong, light grey stained orange or yellow-brown, fine to medium/coarse grained SANDSTONE.<br>Very weak to extremely strong, grey thinly laminated, laminated SILTSTONE.<br>Extremely weak and weathered, dull rarely lignitic, sub-bituminous to bituminous grey-brown to black COAL. |

* - Thickness not proved due to open hole drilling
+ - Based on no recovery and drilling flush

## 5.2 Made Ground / Topsoil

Made ground deposits were mainly encountered around the hardstanding areas of the former NHS Keresforth Medical Facilities and associated car park. Only two of the window sample exploratory boreholes recorded made ground deposits comprising of 0.10m of asphalt and underlain by 0.30 – 0.40m of beige to cream coarse, sandy GRAVEL. The gravel comprised of angular to sub-angular sands, sandstones, and asphalt. The other borehole positions both within window sample and rotary core holes encountered topsoil. Topsoil was recorded as grass cover over brown soft, slightly silty CLAY with very fine grass rootlets found throughout with occasional pebbles present. In RC01, the topsoil was noted as slightly sandy. Only in one position, RC03 fragments of made ground comprising of broken pottery and sandstone were common within the topsoil units. It was also noted within TP01, the topsoil was brown soft, slightly clayey SILT possibly reworked as it was overlaying a coal authority mine shaft.

**Table 5.2 - Summary of Geotechnical Test Results – Made Ground/Topsoil deposits**

| Parameter | | No. of tests | Minimum | Maximum | Average |
|---|---|---|---|---|---|
| Made Ground | Moisture Content (%) | 2 | 3.7 | 5.3 | 4.5 |
| | pH | 2 | 8.6 | 8.8 | 8.7 |
| | Water Soluble Sulphate (mg/l) | 2 | 8.4 | 95.4 | 51.8 |
| Topsoil | Moisture Content (%) | 6 | 12 | 17 | 14.8 |
| | pH | 6 | 6.4 | 7.3 | 6.92 |
| | Water Soluble Sulphate (mg/l) | 3 | 14.6 | 15.5 | 15.1 |

## 5.3 Residual Soils (Pennine Middle Coal Measures Formation)

Superficial deposits were not interpreted to be encountered directly below the topsoil or made ground units in any of the exploratory boreholes across the site. Localised areas were reported and identified as superficial deposits of Glacial Till within the Watermans Infrastructure & Environment Geo-environmental assessment report (Ref.13) and was recorded further south from their exploratory positions. Based on BGS mapping Barnsley (Sheet 87, 1:50,000) (Ref.16) there are no records of superficial deposits on site. During the ground investigation, it was found that several gravelly CLAY would overlay the bedrock units, but this is likely to be the residual soils and weathered bedrock of the Pennine Middle Coal Measures Formation.

Several units were described and identified as the residual soils and weathered bedrock of the Pennine Middle Coal Measures Formation and was encountered directly below both the made ground and topsoil units. Most of the exploratory boreholes except for WS01-WS03 and RC01 recorded deposits

comprising of 0.10 – 1.50m of soft to firm, brown to beige, sometimes gravelly CLAY. The Gravel comprises of small angular to sub-angular fragments of either sandstone, black to dark grey or light grey mudstone. Plant fibres were also common at the top of the unit. Within exploratory position RC02, the clay was described as silty with no gravel components. RC04 observed a thickness of 1.50m of the unit with all other exploratory holes having a thickness between 0.10- 0.90m of clay. Several variations in the gravel component of the clay unit was observed within RC03, RC05 and RC06, the gravel comprised solely of angular to sub-angular sandstones with only RC04 where the gravel comprised of black, dark grey and light grey mudstones at 0.50 – 3.00m bgl.

The second unit described comprised of 0.30 - 0.65m of soft to firm, yellow to yellowish-brown CLAY with extremely weak sandstone or siltstone horizons. The sandstone and siltstone horizons were occasionally retrieved as gravel comprising of sub-angular clasts especially within the window sampling. This unit was only observed within exploratory positions: RC03 at 1.00- 1.65m bgl and underlay the brown gravelly CLAY unit described above and WS02 at 0.30 – 0.60m bgl and was found to underlie the topsoil units. Exploratory position RC01 at 0.80 – 1.00m bgl a unit was described as a light yellowish brown, fine to medium SILTSTONE recovered as sand and gravel.

Within exploratory borehole RC01, a unit comprising of 0.35m of light orange sandy GRAVEL was encountered between 0.35 – 0.70m bgl. The gravel was fine to coarse, angular to sub-rounded siltstones. This unit was not observed in any other exploratory position. It is likely that exploratory position RC01 had very little to no residual soil deposit cover in comparison to all other exploratory positions and the shallower units are due to drilling recovery or reworked colliery spoils from previous mining.

## 5.4 Bedrock (Pennine Middle Coal Measures Formation)

The bedrock deposits of the Pennine Middle Coal Measures Formation were encountered directly below the residual soils described previously in all locations. The units mostly comprised of interbedded sandstones, mudstones, siltstones with occasional coal seams across all rotary exploratory holes. Due to the hardness of the bedrock, window sample exploratory boreholes were unable to penetrate past the residual soils into the bedrock.

The first unit encountered was at depths ranging between 0.80m and 5.20m bgl within all rotary exploratory positions. The unit was described as extremely weak to weak, thinly to thickly laminated to massive light grey stained orange, fine to medium to coarse grained sublitharenite SANDSTONE. Occasionally dark bands/laminations of black grains across the sandstone were observed. Within exploratory position RC03, these sandstones encountered at a depth of 1.65m bgl were described as yellow massive fine to medium grained sublitharenite sandstones and at 2.50m bgl the sandstones were lenticular bedded or ripple cross laminated and yellowish-brown. Rarely this unit is interbedded with beds of grey mudstones and siltstones as observed in RC04 at 3.50m bgl. The sandstones are mostly

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fractured due to the drilling process during core recovery, but natural fractures tend to be present horizontally across the bedding planes of the unit. The nature of these fractures were planar rough and closely spaced. The lateral thickness of the sandstone units was found to increase in thickness in the south-western extent and north-eastern extent of the open field as observed within exploratory position RC03 with sandstones units present between 1.00m – 8.00m bgl and RC06 between 2.45 – 7.10m bgl. The sandstones base is marked by a graded transition by interbedded beds of thin grey siltstones or grey mudstones.

The sandstone unit as described above is underlain by extremely weak to very weak, thickly laminated and thinly bedded, light grey, ripple cross bedded to laminated SILTSTONE interbedded with grey mudstone. This unit was encountered at depths between 2.85 – 7.10m bgl, however, within exploratory borehole RC04 and RC05, no siltstone unit was recorded to underlie the sandstone unit. Within exploratory borehole position RC06, the siltstones were interbedded with mudstones as well as medium grained sandstones. In exploratory borehole RC02, these SILSTONES are interbedded with thin coal horizons between 2.85 - 3.00m bgl. The unit base is marked by a gradational increase in the number of interbedded mudstone beds.

The following unit that underlays the siltstones are a succession of interbedded mudstones, rare siltstones and sandstones and coal that are encountered at depths ranging between 3.00m - 9.10m bgl. Where the previous siltstone unit was not present (RC04 and RC05), the sandstone unit described previously was underlain by this interbedded succession of mudstones, siltstones, and sandstones. The unit is predominantly described as an extremely weak to weak, thinly bedded, dark to light grey parallel laminated or lenticular bedded MUDSTONE that is interbedded with grey or light brown siltstones and infrequent clay horizons. The clay is soft to firm and light grey. Rarely the mudstones can contain fossilised plant fragments such as leaves wood and possible tree trunks. The mudstones are infrequently interbedded with thin coal bands as recorded within all exploratory rotary boreholes. Within exploratory position RC02 at 13.00m – 13.90m bgl and RC05 at 9.50m – 11.00m bgl, the mudstones are interbedded with soft light grey clay and gravelly coal. Within exploratory position RC06, the MUDSTONE sequence is encountered at 7.40m bgl and is interbedded with horizons of light grey gravelly clay. The thickness of the mudstones can vary between 0.90 – 3.65m and are fractured horizontally across the bedding planes. The nature of the fractures are usually very closely to medium spaced, planar smooth and clean.

Occasionally, mudstones become interbedded with rare beds of grey siltstones and grey fine-grained ripple cross laminated or argillaceous sandstones with the siltstone beds becoming predominant through the middle sequence as observed within RC04 between 5.00 – 6.35m bgl and RC02 between 9.00 -10.80m. The siltstones can be described as extremely weak, thinly bedded grey or brown SILTSTONE interbedded with grey fine to medium-grained sublitharenite sandstones and grey mudstones. Towards the base of the mudstones, the mudstones generally become massive.

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Several units of clay are also encountered within exploratory positions RC02, RC03 and RC06. These clays are found to underlie the extremely weak to weak MUDSTONE units or overlay and underlay coal deposits. This is possibly due to the coal deposits acting as a pathway for water which weathers the mudstones. The first non-residual clay at a depth of 12.50 – 13.00m bgl in RC02 and 13.00-13.50m bgl in RC06, the clay was described as a firm light grey CLAY with thin beds of extremely weak dark grey mudstone but at an encountered depth of 14.05-14.35m bgl in RCO2 the clay is soft and grades into sub-bituminous coal.

A sharp boundary defines the weaker bedrock of the Pennine Middle Coal Measures from the stronger bedrock. The extremely weak to weak MUDSTONES are separated by extremely strong units of mudstones, sandstones and siltstones that vary in sequence throughout all exploratory rotary positions. Strong to extremely strong MUDSTONEs are encountered at depths at 12.50m bgl within exploratory boreholes RC03 – RC05 and at 21.50m bgl within RC02. The mudstones are described as strong to extremely strong, thinly bedded, parallel laminated dark grey MUDSTONE. Mudstones contains fossilised plant remains including wood and leaves.

The stronger siltstones are only observed within exploratory boreholes RC01, RC02 and RC06 and encountered at a depth between 18.50m – 23.00m bgl. This unit is described as medium strong to extremely strong, laminated to ripple cross-bedded light to dark grey SILTSTONE interbedded with light grey, fine grained sandstones, or light grey mudstones. The beds of sandstones become infrequent towards the base. The SILTSTONE unit is marked by a sharp boundary at the top and base. Within exploratory position RC01 the siltstones are medium strong and interbedded with light grey mudstones. Within RC02 between 23.00m – 25.55m bgl, the siltstones are repeatedly bedded with sandstones.

Stronger units of sandstones are only encountered within exploratory positions RC01, RC02 and RC04 between depths of 8.15m – 24.50m bgl. The shallowest encounter was within exploratory position RC04 and the deepest encounter within RC02. The unit is recorded as medium strong to extremely strong, massive fine grained grey SANDSTONE interbedded with grey laminated siltstones. The SANDSTONES are found to underlie the deposits of the extremely strong siltstones previously described. Within RC01, the SANDSTONES are approximately 3m thick, medium strong and encountered between 20.00-23.00m bgl. The sandstones are underlain by repeated units of strong to extremely strong MUDSTONES. From the exploratory logs, it was observed that the mudstones are the last units observed at depths between 30.00 - 40.00m bgl. A unit of siltstone was observed as the last observed strata within RC06 at 20.00 – 40.00m bgl. The thickness of the units at depths beyond 30.00 or 40.00m bgl were not proven due to the completion of the boreholes at these depths.

Several bands and horizons of COAL were observed at varying depths within RC01-RC06. The coal units varied in thickness ranging between 0.05m – 2.35m. The coal was described as extremely weak and weathered, dull rarely lignitic, sub-bituminous to bituminous grey-brown to black COAL. The coal is of low grade and occasionally vitrinite rich and infrequently thinly laminated however, due to the drilling

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procedure and the nature of the coal any structural features were undetermined due to fractured recovery. Coal was not encountered within the window sampling exploratory holes due to the rigs only penetrating to a maximum depth of 1.90m bgl.

The coal units encountered are likely to be associated with the Barnsley Coal Seam rather than the Barnsley Rider Coal as the Rider Beds are known to dip towards the east in the region and more likely to have been encountered around the eastern site boundary. There is a clear offset of the Barnsley Coal Seams noted within the exploratory positions during the ground investigation from the depths of encounter which may be due to a geological fault that runs NE-SW north of the open field and links the Champany Hill Fault (SW of fault) and the Barebones Fault (NE of the fault). This fault along the northern boundary is recorded to dip to the southeast with the bedrock generally recorded to dip to the north-east or east. Evidence of soft sediment deformation and loading structures geological features are present within the mudstones within RC04 at a depth of 5.65m – 5.75m bgl and RC02 at 31.20m – 31.30m bgl Where coal is encountered at deeper depths within the Pennine Middle Coal Measures bedrock, the mudstones are found to be of a weaker nature.

**Table 5.4a: Summary of coal encountered during ground investigation on site**

| Exploratory Hole | Depth Encountered (m bgl) | Description of Strata |
|---|---|---|
| **RC01** | 10.05 – 12.40 | Extremely weak, dull black coal zones of no recovery - presence of weak or weathered rock |
| **RC02** | 4.00 – 4.10 | Coal recovered as gravel paste |
| | 10.80 – 12.50 | Loose fragmented coal – Zone of no to very little recovery. Coal likely to have fallen out of core. |
| | 13.90 – 14.05 | Fragmented sub-bituminous coal |
| | 14.35 – 14.85 | Coal recovered as gravel |
| | 26.40 – 26.45 | Moderately weak COAL |
| | 34.00 – 34.15 | Vitrinite rich, very light COAL |
| | 34.25 – 34.45 | Black COAL |
| | 35.80 – 36.00 | Black coal that is not fractured |
| **RC03** | 15.30 – 15.60 | Coal recovered as gravel |

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| | | |
|---|---|---|
| **RC04** | 16.80 – 18.00 | Drillers Description (open hole) – COAL |
| **RC05** | 17.00 – 18.20 | Drillers Description (open hole) – COAL – flush colour turned black |
| **RC06** | 9.50 – 17.00 | Potential broken ground – suspected mine workings due to poor core recovery |
| | 15.50 – 17.00 | Zone of no recovery - COAL |
| | 17.85 – 18.05 | Extremely weak and fragmented COAL |

Plasticity testing undertaken for the residual soil clay is recorded to be low plasticity. In accordance with NHBC standards Part 4 Chapter 4.2 building near trees, the clay can be described as having a low to medium volume change potential. The plasticity index of the deposits as an average across all the samples is 17. Based on published relationships, undrained shear strength (cu) may be estimated from SPT 'N' values where full penetration was achieved. Using a factor of 5.8 estimated cu values range between 41 Cu KPa and 452 Cu KPa. Taking into consideration the logging descriptions, in situ and laboratory testing, the clay is likely to range from low to very high strength. Table 5.4b below provides a summary of the geotechnical test results for the Pennine Middle Coal Measures Formation deposits.

**Table 5.4b - Summary of Geotechnical Test Results – Residual Soil & Bedrock Deposits – Pennine Middle Coal Measures Formation**

| Parameter | No. of tests | Minimum | Maximum | Average |
|---|---|---|---|---|
| Moisture Content (%) | 24 | 0.73 | 17 | 5.48 |
| pH | 24 | 6.8 | 8.9 | 8.03 |
| Water Soluble Sulphate (mg/l) | 24 | 2 | 67.3 | 11.58 |
| Water Soluble Chloride (mg/l) | 24 | 0.9 | 16 | 3.47 |
| Water Soluble Nitrate (mg/l) | 24 | < 2.0 | < 2.0 | < 2.0 |
| Water Soluble Magnesium (mg/kg) | 24 | 5.4 | 47 | 21.97 |
| Total Sulphate (%) | 24 | 0.005 | 0.037 | 0.012 |
| Total Sulphur (%) | 24 | 0.005 | 0.073 | 0.017 |
| Liquid Limit (%) | 8 | 34 | 39 | 37 |
| Plastic Limit (%) | 8 | 18 | 22 | 20 |
| Plasticity Index (%) | 8 | 15 | 19 | 17 |

| Parameter | No. of tests | Minimum | Maximum | Average |
|---|---|---|---|---|
| SPT 'N' Value in Clay | 8 | 7 | 50+ (4) | 47 |
| Undrained Shear Strength in Residual Soils Cu (kPa) (1) | 10 | 41 | 452 | 277 |
| Coefficient of volume compressibility for Residual Soils (Mv) (m2/MN) (2) | 10 | 0.02 | 0.25 | 0.06 |
| PSD (%) (3) | 8 | | | |
| Very Coarse | | 0 | 0 | 0 |
| Gravel | | 7 | 84 | 35.88 |
| Sand | | 6 | 35 | 16.38 |
| Fines (<0.063mm) | | 10 | 76 | 47.88 |
| Point Load Strength Index Test (Is50) – Sandstone (MPa) | 4 | 0.33 | 1.38 | 0.98 |
| Estimated Uniaxial Compressive Strength (UCS) – (Is50*Factor) (5) – Sandstone (MPa) | 4 | 21.8 | 35 | 28 |
| Point Load Strength Index Test (Is50) – Mudstone (MPa) | 10 | 0.04 | 1.75 | 0.46 |
| Estimated Uniaxial Compressive Strength (UCS) (Is50*Factor) (5) – Mudstone (MPa) | 10 | 0.8 | 41.6 | 10.2 |
| Point Load Strength Index Test (Is50) – Siltstone (MPa) | 15 | 0.32 | 6.65 | 1.77 |
| Estimated Uniaxial Compressive Strength (UCS) (Is50*Factor) (5) (MPa) | 15 | 8.6 | 149.4 | 41.2 |

(1) Cu estimated from SPT N value correlation with average Plasticity Index using a Factor of 5.8 (Stroud and Butler, 1975).
(2) Mv estimated from SPT N value correlation with average Plasticity Index using a Factor of 0.58 (Stroud and Butler, 1975).
(3) Shown results are intended to show the variation in the PSD analysis across the samples. Borehole specific results are contained in Appendix A4.
(4) Some of the SPT values refused on the weathered bedrock material. Borehole specific are contained in Appendix A2.
(5) Is50 value multiplied by a factor of 20 to estimate a UCS value.

Point Load Tests were undertaken on four sandstone, ten mudstone and fifteen siltstone samples from the rotary core holes. An approximation of the uniaxial compressive strength (UCS) of the strata may be derived from the relationship Is (50) x 20 (conversion factor) = UCS. On this basis approximate UCS values of 21.80MPa to 35.00MPa for the sandstone have been calculated, classifying the rock as a moderately weak to medium strong rock. Calculated UCS values of 0.80MPa to 41.60MPa was recorded for the mudstones and classifying the mudstones as extremely weak to medium strong rock. Estimated UCS values of 8.60 MPa to 149.40MPa for siltstones classifying the siltstones as weak to very strong rock. UCS tests could not be completed bedrock samples. Due to the highly weathered and fractured nature of the sandstone, siltstone, and mudstones it was difficult to obtain samples of a sufficient length for UCS testing.

## 5.5 Observed Potential Contamination

No visual or olfactory signs of contamination were noted during the ground investigation.

## 5.6 Obstructions Encountered

None of the borehole positions encountered anthropogenic below ground obstructions. However, refusals were encountered in the natural strata of the weathered Pennine Middle Coal Measures Formation within all window samples.

## 5.7 Groundwater

A summary of the groundwater level conditions recorded during the ground investigation works, and subsequent monitoring visits, is presented in Table 5.7. Full details of the water strikes recorded during progression of the investigation positions are presented on the exploratory hole logs included in Appendix A2 and full details of the water levels recorded during the monitoring visits are presented in Appendix A5. It should be noted that the groundwater monitoring was completed during November 2021 and January 2022.

**Table 5.7 - Groundwater strikes during investigation and subsequent monitoring levels.**

| Exploratory Hole Location Ref. | Water Strikes During Ground Investigation | | Post Investigation Monitored Water Levels | |
|---|---|---|---|---|
| | Strike Depth (mbgl) | Strata | Installation Strata | Monitored Levels (mbgl) |
| WS04 | - | - | CLAY /SANDSTONE | 1.10 – 1.70 |
| WS05 | - | - | CLAY/SANDSTONE | Dry |
| RC04S | - | - | CLAY/SANDSTONE | Dry – 4.80 |
| RC04D | - | - | SANDSTONE/MUDSTONE | 5.00 – 7.65 |
| RC06S | - | - | CLAY/SANDSTONE | 4.50 – 4.85 |
| RC06D | - | - | SILTSTONE/MUDSTONE/CLAY | Dry |

- No groundwater strikes during the ground investigation.
* No install pipework for long term groundwater monitoring.

No groundwater strikes were recorded during the ground investigation in any of the boreholes. Post investigation monitoring has recorded the shallow installation varied between dry and 4.85m bgl whilst the deep installations varied between dry and 7.65m bgl to date. However, the groundwater levels recorded are not likely to be representative of the natural background level of the geology. It is likely the water has infiltrated through the surface and is unable to drain into the surrounding cohesive soils.

## 5.8 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C2 of the Building Research Establishment (BRE) Special Digest 1, third edition of 2005. Table 5.8 details the classification based on the recent ground investigation results.

**Table 5.8 - Aggressive Chemical Environment for Concrete (ACEC) Site Classification**

| Stratum | Design Sulphate Class | ACEC Class (1) |
|---|---|---|
| Made Ground | DS-1 | AC-1 |
| Residual Soil & Weathered Bedrock (Pennine Middle Coal Measures Formation | DS-1 | AC-1 |

(1) ACEC assessment was based on the likely mobile groundwater condition for the scheme area.

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# 6.0 Ground and Groundwater Contamination Assessment

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end users, associated utilities, and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (Ref.5).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the existing risk assessment presented in Watermans Phase 2 GI (Ref. 13), in conjunction with observations made during Curtins ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in Section 8.0 of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

## 6.1 Human Health GQRA

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.071 model (Ref.6), Science Report 2 (Ref.7) and Science Report 3 (Ref.8).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGVs give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for several contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and

dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;

ii) **Supplementary Screening Values (SSVs):** In addition to the SGVs developed by the EA, other third-party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL: AIRE published thresholds;

iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref.9) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

### 6.1.1 Adopted Soil Human Health GACs Screening Methodology

The proposed use of the site noted as a proposed new secondary school building with associated sports field with both soft landscaping and hardstanding areas. As there is no published or accepted guidance for a school environment, it is considered the most analogous end use scenario is 'Residential without home grown produce' as a conservative assessment. Therefore, assessment has been undertaken against the following GACs, in order of preference:

1. Environment Agency Soil Guideline Values,
2. CL: AIRE, AGS, EIC. Soil Generic Assessment Criteria for Human Health Risk Assessments,
3. LQM/CIEH 2015 S4ULs for Human Health Risk Assessment, and
4. DEFRA Category 4 Screening Levels.

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e., the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for the topsoil site soils ranged from 5.47% to 16.1%. The underlying clay recorded SOM values ranging between 1.7% to 21.7%.

With consideration for a calculated geometric average, topsoil features determine a SOM of 8.25 %, whereas the underlying clay determines a SOM of 7.68%. As such, a comparison against Tier 1 thresholds for a conservative SOM of 6% for 'Residential without home grown produce' end use has been adopted for both topsoil and natural clay soil features, where applicable.

Many of the exposure pathways considered in the CLEA model assume that the adult or child is in contact with the contaminated ground or that such contamination is easily mobilised from the surface. However, plant uptake of chemicals and the release of soil vapour may occur from greater depths. Although, the highest density of roots occurs in the top 80 cm, many crop plant root depths are between one and two metres. Based on the 'Residential without home grown produce', this pathway has been discounted. Although the transport potential decreases, vapours have the potential of migrating to the surface over distances of tens of metres (Updated technical background to the CLEA model - SC050021/SR3).

The adopted GACs are listed in Appendix A6.

### 6.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results

The results of the environmental testing can be referred to in Appendix A3.

With respect to the proposed end use of the site, several exceedances are noted within recovered soil samples as detailed below.

**Table 6.1.2 - Soil Tier 1 Exceedances for a Residential without home grown produce end use with a SOM of 6%.**

| Exploratory Hole ID | Depth (m bgl) | Stratum | Determinant | Concentration (mg/kg) | GAC (mg/kg) |
|---|---|---|---|---|---|
| RC01 | 0.20 | Made Ground/Topsoil | Chromium (VI) | 42 | 6.0 |
| RC02 | 0.30 | Residual Soils | Arsenic<br>Chromium (VI) | 36<br>61 | 35<br>6.0 |
| RC06 | 0.15 | Made Ground/Topsoil | Benzo(a)pyrene<br>Dibenzo(ah)anthracene | 3.7<br>0.44 | 3.2<br>0.32 |

Selected soil samples were screened for asbestos. No suspected asbestos containing materials (ACMs) were identified in any of the exploratory hole logs or by laboratory screening of all soil samples.

The above result table indicates that the Made Ground/Topsoil present on site shows isolated exceedances for heavy metals and PAHs across the north, north-western and north-eastern extent of the public open field with most of the exceedances found within Made Ground topsoil units found at depth (RC01 at 0.20m bgl, RC02 at 0.30m bgl and RC06 at 0.15m bgl). Exceedances of chromium (VI) were encountered within intrusive locations RC01 at a depth of 0.20m bgl and RC02 at a depth of 0.30m bgl. There was also a slight exceedance in Arsenic encountered within RC02 at a depth of 0.30m bgl. There is notable exceedance in PAHs: Benzo(a)pyrene and Dibenzo(ah)anthracene within intrusive location RC06 at a depth of 0.15m bgl.

## 6.2 Controlled Waters GQRA

Historically the site has been recorded as open land likely to be farmlands with no further change until 1978 which recorded the development of NHS Keresforth Medical Facility. No further changes up to the present day are recorded. No industrial or commercial source of potential contamination has been recorded to be present on site however, possible contamination of TPHs from fire and ambulance headquarters noted immediately adjacent north to the site boundary are recorded (mapping dated 1970). The site is not recorded to be underlain by superficial deposits. It is straight onto the residual soil and bedrock of the Pennine Middle Coal Measures Formation which is identified as a Secondary A Aquifer. The site is not located within a Source Protection Zone, with no licensed potable groundwater abstractions recorded within 1km of the site boundary.

The chemical soil analysis of the soils recorded PAHs to be largely below or within 0.5mg/kg of the detection limit within majority of the samples except for RC06. Heavy metals were recorded at low concentrations within majority of the tested samples except for RC01 and RC02. The contaminants of concern included PAHs (benzo(a)pyrene and dibenz(a)anthracene), arsenic, and chromium (VI). These contaminants are considered to have low mobility and a strong affinity to absorption. In addition, the low solubility of the PAH species identified and hydrophobic nature, would reduce contaminant transport mobility. It is therefore considered unlikely that the contaminants identified in the soils would have an impact on the underlying groundwater or nearby surface water features. TPHs were all recorded below the detection limit.

Despite these exceedances being recorded within the Made Ground/Topsoils across the north-western and north-eastern extent of the open field, it is unlikely that any concentrations of contamination will migrate through to the permeable layers of the Pennine Middle Coal Measures Formation on site. Due to the above reasons, the risk to the groundwater receptors is assessed as Low.

The closest surface water feature is located off site recorded to be a small watercourse approximately 26m south-east of the site. As noted above, historically there is very limited potential for a credible source of contamination to cause problems for the surface water receptor. The isolated soil

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exceedances within the made ground/topsoil deposits are unlikely to affect the surface water feature. It is assessed that the risk to the surface water receptor is assessed as Low.

## 6.3 Water Supply Pipe Assessment

With reference to the UKWIR publication 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' document reference 10/WM/03/21 advice is given on the appropriate materials for these ground conditions.

The concentrations observed within the topsoil and clay indicate that PVC pipe would be suitable materials for the water supply pipes. The exact requirements are to be confirmed with the relevant utility supplier.

# 7.0 Ground Gas Assessment

The assessment of risk presented by ground gases is assessed with reference to BSI Publication (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015+A1:2019 (Ref.10), guidance published by CIRIA (Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref.11), and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref.12).

The gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Waterman Infrastructure & Environment Geo-Environmental Assessment of Trinity Academy, Barnsley (Ref. 13) and, thereafter, validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

## 7.1 Ground Gas Monitoring Results

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk standpipe installations were incorporated within two of the window sample borehole locations and two of the rotary core borehole locations as detailed in section 3.2.

The ground gas monitoring programme has been completed with seven ground gas monitoring visits undertaken in November 2021 and January 2022, with barometric pressure recorded between 982 and 1010 mb. The results log sheets are contained within Appendix A5 and summarised in Table 7.1 below:

**Table 7.1 - Summary of Ground Gas Monitoring Results**

| Location | Maximum Methane Concentration (%) | Maximum Carbon Dioxide Concentration (%) | Minimum Oxygen Steady Reading (%) | Maximum Steady Gas Flow (l/hr) |
|---|---|---|---|---|
| WS04 | 2.2 | 2.3 | 16.3 | 0.0* |
| WS05 | 27.0 | 0.9 | 18.4 | 0.0* |
| RC04D | 7.2 | 0.8 | 20.0 | 0.0* |
| RC06D | 15.9 | 6.4 | 11.2 | 0.0* |

* Detection limit of the gas monitor.

Methane ($CH_4$) was recorded below the instrument's detection limit between visits 1-6 in all monitoring wells. However, on the final monitoring visit, methane concentration was recorded between 2.2% - 27.0% across all monitoring positions. It was noted within position WS05 the methane concentration was 27.0% and within the deeper wells methane concentrations was noted as 7.2% and 15.9%. Hydrogen sulphide ($H_2S$) was recorded at 0ppm on the first three visits across the window sample positions and increased to 2ppm in both window sample wells on the fourth visit. The fifth visit recorded concentrations of 0ppm before increasing to a concentration of 1ppm during visit 6 and WS04 increasing

to 2ppm. Across the deeper wells, Hydrogen sulphide ($H_2S$) concentrations were consistently between 0 - 1ppm with RC06D recording a 1ppm concentration during one visit. Carbon monoxide was recorded to range between 0 – 3ppm across the seven visits. No gas flow (l/hr) was recorded in any of the boreholes across the seven visits except for RC06D where a maximum flow of 1.5 l/hr was recorded during visit four. Carbon dioxide ($CO_2$) was recorded in peak concentrations between 0.8% and 6.4%. A concentration of 6.4% was noted within RC06D during the fourth visit. Oxygen ($O_2$) was recorded during the monitoring visits to range between 11.2% and 20.0% within the installations.

## 7.2 Land Gas Assessment

The Conceptual Site Model presented within the Waterman Infrastructure & Environment Geo-Environmental Assessment identified possible made ground deposits as a potential source of ground gas generation both on-site and off-site resulting from historical developments and land uses. The report suggests no organic rich drift deposits (e.g., peat) being present. Coal deposits are recorded to underlie the site; and with previous historical mining of the area the mine workings could affect the site. Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane, and hydrogen sulphide.

Made ground was recorded to be present across both the hardstanding and soft landscaping areas of the site, with most areas recorded as a topsoil deposit. This was underlain by residual soils of the natural deposits which were generally clay or gravelly clay with occasional coarse sandstone gravel. This was further underlain by the bedrock deposits of the Pennine Middle Coal Measures Formation comprising of interbeds of siltstones, sandstones, mudstones, and coal seams. The position of RC02 recorded soil organic matter of 21.7% at 0.30m bgl in the residual soil. This high reading was in an extremely weathered soft brown silty clay. Within RC01 at 0.20m, the maximum concentration was 16.1% in the topsoil materials. Some plant debris was noted in the topsoil as well.

Consideration of the recorded soil gas flow rates, presented above, enables hazardous gas flow rates to be evaluated. $Q_{hg}$ can be derived for both ‘worst credible’, and ‘worst possible’ scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a ‘worst credible’ scenario steady state flow rates are adopted, whilst for a ‘worst possible’ scenario peak flows are adopted.

Evaluation of the ‘worst credible scenario’ (highest hazardous gas flow rate that is realistically possible, i.e., in a single borehole) records a maximum $Q_{hg}$ of 0.0096 l/hr for carbon dioxide. Evaluation of the ‘worst credible scenario’ (highest hazardous gas flow rate that is realistically possible, i.e., in a single borehole) records a maximum $Q_{hg}$ of 0.00 l/hr for methane.

Evaluation of the ‘worst possible scenario’ (highest $Q_{hg}$ across the entire dataset irrespective of location and discrete monitoring events) records a maximum $Q_{hg}$ of 0.0096 l/hr for carbon dioxide. Evaluation of

the ‘worst possible scenario’ (highest Qhg across the entire dataset irrespective of location and discrete monitoring events) records a maximum Qhg of 0.41 l/hr for methane.

Both scenarios for carbon dioxide results in the same GSV as the flow rates and carbon dioxide concentrations are the same due to the same values being recorded. With regards to methane, In accordance with assessment by BS8485:2015+A1:2019 the GSV indicates a Characteristic Situation 2 (CS2) gas regime which does require ground gas protection measures. However, it is recommended ground gas protection measures are implemented as a precaution.

The site is recorded to be in an area reported to be within elevated radon potential of 1-3%. Therefore, no radon ground gas protective measures are necessary in the construction of new extensions or dwellings. Where the development incorporates a basement a specialist radon risk assessor should be contacted.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

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# 8.0 Revised Conceptual Site Model

The Conceptual Site Model (CSM) presented in the Waterman Infrastructure & Environment Geo-Environmental Assessment for Trinity Academy, Barnsley (Ref.13) and discussed in Section 2.0 of this report has been considered following the GQRA in sections 6.0 & 7.0 above. The Revised Conceptual Site Model (CSM) is summarised in the table overleaf and graphically presented and included within Appendix A1.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified as relevant for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

The CSM follows the framework outlined within CIRIA C552 which is summarised within Appendix A7.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors, and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model. Reference should be given to the environmental testing results discussed within Section 6.0 and presented within Appendix A3.

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- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e., low to negligible risk. The purpose of each stage of risk assessment is to establish if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g., remedial action.

| Conceptual Site Model | | | Generic Qualitative Risk Assessment | | | Comments | Action |
|---|---|---|---|---|---|---|---|
| Identified Source | Pathway(s) | Receptor(s) | Consequence | Likelihood of Occurrence | Risk Rating | | |
| Site soils with some recorded exceedances based on chemical analysis. Exceedances encountered within the made ground/topsoil deposits within RC01, RC02 and RC06 with several exceedances in Heavy Metals and PAHs. No visual or olfactory contamination detected within soils during ground investigation.<br>Made ground and colliery spoils including fragments of brick, pottery, quartz, and slag. | Direct contact and dermal uptake, soil and dust ingestion, dust, and migration inhalation (indoor & outdoor air) | School end users (assessed as residential without home grown produce) | Medium | Low | Moderate / Low | Soils did exceed Tier 1 thresholds based on a conservative SOM of 6% for 'Residential without home grown produce end use. However, current proposed plans show the development of the sports field is likely to be capped stopping the source-pathway-receptor linkage. Therefore, it is a low likelihood the end users are exposed to potential contaminants. | Based on the proposed developments in the open public space, the area is likely to be capped with additional soils to break the source-pathway-receptor link. |
| | Direct contact and dermal uptake, soil and dust ingestion, dust & migration inhalation (outdoor air) | Construction and maintenance workers | Mild | Likely | Moderate / Low | Construction workers are likely to encounter the soils as part of the construction process. | Standard Health & Safety precautions to be used by workers.<br>Relevant RAMS to be completed by specific contractors. |
| | Soil dust ingestion/inhalation produced during construction (indoor and outdoor air) | School end users and adjacent residents | Medium | Unlikely | Low | PAHs are strongly absorbed to the soil matrix with the species identified having a low volatilisation. It is unlikely that impacted soils would migrate to the adjacent residents. Likely that site will be dampened down to prevent dust and reduce ingestion. | Dust mitigation required in future construction works. |
| | Vertical Migration through the made ground, residual soil, and bedrock deposits | Water Environment (Groundwater) | Medium | Unlikely | Low | PAHs are strongly absorbed to the soil matrix with the species identified having a low volatilisation. It is unlikely that impacted soils would migrate through to the permeable layers of the bedrock and affect the groundwater. | No further action required. |
| | Horizontal Migration over and through the made ground, residual soil, and bedrock deposits | Water Environment<br>(Surface Water) | Medium | Unlikely | Low | Soils showed exceedances in heavy metals and PAHs. Given the distance of the surface water receptor from site and the nature of the natural strata deposits, it is unlikely that any potential contamination will affect the surface water receptor due to attenuation. | No further action required. |
| Organic matter and/or contamination as a source material for the generation of ground gas was not identified on site during ground | Ground gas & vapour (migration and inhalation) | School end users (assessed as residential without home grown produce) | Medium | Low | Moderate / Low | Concentrations of methane recorded from the monitoring visits to date of both the shallow and deeper installations range from 2.2% to 27%. Concentrations of carbon dioxide exceed above 5% threshold despite the GSV classifying the site as CS1. | Allowance for CS2 grade ground gas protection measures to protect against carbon dioxide and methane ground gases.<br>Further monitoring would be recommended if looking to |

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| Conceptual Site Model | | | Generic Qualitative Risk Assessment | | | Comments | Action |
|---|---|---|---|---|---|---|---|
| Identified Source | Pathway(s) | Receptor(s) | Consequence | Likelihood of Occurrence | Risk Rating | | |
| investigation. Gas monitoring also shows very high concentrations of methane during a single visit. | | | | | | Characteristic Gas Situation is assessed as CS2 with regards to Methane no gas protection measures required in accordance with BS8485. However, recommended ground gas protection measures are implemented as a pre-cautionary. | remove the requirement for CS2 ground gas protection measures. |
| | | Construction and maintenance workers | Medium | Low | Moderate / Low | Reflecting the concentrations found to date. | Standard Health & Safety precautions to be used by workers.<br>Relevant RAMS to be completed by specific contractors. |

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## 8.1 Summary of Significant Pollutant Linkages

The risk to the end users of the site from shallow soils across the site is assessed as Moderate to Low. With regards to the public open field, exceedances were recorded within the made ground/topsoil. Much of the site will be covered by the proposed development footprint with areas of soft landscaping and hardstanding. Where soil exceedances were recorded (current public open field), it is likely to be capped with additional soils based on current proposed development plans before it is developed into a sports field. Chemical analysis shows low concentrations of all other potential contaminants. This will break the source-pathway-receptor link.

The risk to the groundwater and surface water receptors from the site soils is assessed as Low. This is due to no historical source of contamination being recorded within the site boundary and despite recorded isolated exceedances of heavy metals recorded to be present in the made ground/topsoil, the underlying clays were noted to have low concentrations of heavy metals. This is suggestive that migration of the contaminants occurring are at a very slow rate and based on the nature of the clays it is likely to act as a natural barrier preventing migration of contaminants. Therefore, there is no viable source-pathway-receptor link.

The risk to the end users from ground gases is assessed as Moderate / Low based on the monitoring data obtained. Concentrations generally are low between monitoring visits 1-6. However, on visit 7, a maximum concentration of 6.4% was recorded for carbon dioxide. Although concentrations of carbon dioxide exceed the 5% threshold, the current GSV classifies the site as CS1 for carbon dioxide. Concentrations of methane were recorded between 2.2 – 27% classifying the site as CS2. Therefore, further monitoring is required to determine increased levels of these gas emissions and an allowance should be made for CS2 ground gas protection measures against carbon dioxide and methane and should be implemented as a precaution.

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# 9.0 Engineering Assessment and Recommendations

## 9.1 Introduction

This section will assess the relevant geotechnical issues for the proposed development of a new school and associated sports field at the open field and former MHS Keresforth Medical Centre, Barnsley. The proposed development plan is contained within Appendix A1. The engineering assessment considers preliminary excavation stability and, suggestions about any future earthworks for the site, where required. Structural details and loadings have not yet been provided. It should be noted that details may change in the development of designs beyond the issue of this Phase 2 Ground Investigation Report and the Construction designer should satisfy themselves regarding the adequacy of their design and proposed approach to construction by reference to the on-going project design proposals, the ground investigation information, and their own examination of the site.

It should be noted that this geotechnical section provides recommendations for the proposed sports pitch area only. Additional ground investigation including rotary boreholes are yet to be completed to determine the ground conditions beneath the footprints of the proposed school building and sports hall.

## 9.2 Summary of Ground Conditions

The ground conditions at the site generally comprised of Made Ground to a maximum depth ranging between 0.10 and 0.40m bgl or topsoil to maximum depths ranging between 0.20m bgl and 0.50m bgl, this was underlain by residual soil and bedrock of the Pennine Middle Coal Measures Formation to depths ranging between 0.30m bgl and 3.00m bgl. This was further underlain by the bedrock of the Pennine Middle Coal Measures Formation at depths ranging between 0.80m and 40.00m bgl and comprises of alternating beds of siltstones, mudstones, and sandstones with occasional deposits of coal identified as the Barnsley Coal Seam.

There is a mine shaft present on site identified and situated within exploratory position TP01. Groundwater levels have currently been recorded at depths ranging between dry and 4.85m bgl in the shallow installs and between dry and 7.65m bgl in the deeper installs. However, this is not likely to be representative of the natural groundwater conditions. It is likely this is surface water getting trapped in the standpipe.

The geotechnical parameters recommended for use in the design based on the ground conditions encountered are summarised in Table 9.2 below.

**Table 9.2 - Geotechnical Parameters for Pennine Middle Coal Measures Formation**

| Parameter | Pennine Middle Coal Measures Formation |
|---|---|
| Unit Weight Above Water Table, γ (kN/m$^3$) (1) | 15 - 21 |

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| Parameter | Pennine Middle Coal Measures Formation |
|---|---|
| Drained Angle of Internal Friction, Φ' (°) (2) | 24 - 27 |
| Undrained Shear Strength cu (kPa) (3) | 40 - 300 |
| Coefficient of volume compressibility mv ($m^2$/MN) (3) | 0.05 – 0.25 |

(1) *From published sources (BS8002).*
(2) *Estimated from the relationship between typical SPT 'N' value and angle of shearing resistance (BS8004).*
(3) *Average value estimated from the correlation between SPT' N value and average plasticity index (Stroud and Butler, 1975).*

## 9.3 Excavations

Excavation through layers of topsoil and the weathered Pennine Middle Coal Measures Formation where shallow enough to be encountered across the site should be feasible using conventional site plant within the public open field.

Based on observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to less than 1.2 m depth from current ground levels is unlikely to stand unsupported in the short term. Excavated side slope angles in wet soft to firm Clay of 10-25 degrees is likely to be suitable increasing to 30-45 degrees for dry soft-firm Clay, based on guidance provided by CIRIA report 97 Trenching Practice

Side support for safety purposes should of course be provided to all excavations which appear unstable, and those more than 1.20m deep, in accordance with Health and Safety Regulations. Groundwater is unlikely to encountered. However, it is considered that surface water or groundwater inflows, if encountered, may be controlled by pumping from sumps.

## 9.4 Coal Mining Risks

Based on the available proposed development plans for the site to date, the Coal Authority Interactive Map Viewer records the site to be within a development high risk area, past and probable shallow coal mine workings are also noted to be present beneath the site. A Coal Mining Risk Assessment (CMRA) has been completed by Waterman Infrastructure & Environment Limited (Ref. 15) previously, to assess and determine the risk to the site from desk-based information. The recommendations of this CMRA report included the completion of rotary boreholes up to a depth of 30.00m bgl to determine the presence/absence of coal seams below the site and evidence of any workings in the form of mine waste or voids recorded to be present. Table 9.4 below provides a summary of intact coal seams that were encountered during the ground investigation works. The seam of concern is the Barnsley Coal seam.

**Table 9.4: Summary of the coal encountered during the ground investigation on site**

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| Exploratory Hole | Depth Encountered (m bgl) | Thickness (m) | Description of Strata |
|---|---|---|---|
| **RC01** | 10.05 – 12.40 | 2.35 | Extremely weak, dull black coal zones of no recovery - presence of weak or weathered rock |
| **RC02** | 4.00 – 4.10 | 0.10 | Coal recovered as gravel paste |
| | 10.80 – 12.50 | 1.70 | Loose fragmented coal – Zone of no to very little recovery. Coal likely to have fallen out of core. |
| | 13.90 – 14.05 | 0.15 | Fragmented sub-bituminous coal |
| | 14.35 – 14.85 | 0.50 | Coal recovered as gravel |
| | 26.40 – 26.45 | 0.05 | Moderately weak COAL |
| | 34.00 – 34.15 | 0.15 | Vitrinite rich, very light COAL |
| | 34.25 – 34.45 | 0.20 | Black COAL |
| | 35.80 – 36.00 | 0.20 | Black coal that is not fractured |
| **RC03** | 15.30 – 15.60 | 0.30 | Coal recovered as gravel |
| **RC04** | 16.80 – 18.00 | 1.20* | Drillers Description (open hole) – COAL |
| **RC05** | 17.00 – 18.20 | 1.20* | Drillers Description (open hole) – COAL – flush colour turned black |
| **RC06** | 9.50 – 17.00 | 7.50 | Potential broken ground – suspected mine workings due to poor core recovery |
| | 15.50 – 17.00 | 1.50 | Zone of no recovery - COAL |
| | 17.85 – 18.05 | 0.20 | Extremely weak and fragmented COAL |

*Thickness based on open hole drilling

During the ground investigation works loss of water flush was recorded within all boreholes where mudstones and siltstones were encountered due to the fractured nature of the bedrock strata as well as where there was a presence of coal. The loss of flush was observed during the coring and subsequent open holing techniques. Coal seams were not encountered within the window sample boreholes. Where coal was encountered, during the coring portion of the drilling works, the coal was

recorded to be fractured and retrieved as loose gravel. Within RC02, at depths beyond 34.00m bgl, coal encountered was recorded as intact, with no loose ground or voids being recorded at this depth. There was a notable change in the colour of flush from light grey to black during the open hole drilling within exploratory borehole RC05 indicative of coal encountered between depths of 17.00 – 18.20m bgl.

Possible broken ground may have been encountered within exploratory borehole position RC06 between depths of 9.50 – 17.00m bgl which was situated north-east of the mine shaft located by TP01. Several core runs between 9.50 – 17.00m bgl encountered a zone of core loss as well as the time for the core run was significantly reduced in comparison to previous boreholes. It is difficult to ascertain at this time if the coal seams encountered within RC01 and RC02, if the loss of the flush during the drilling was due to the natural fracture state of the bedrock that has occurred over hundreds of millions of years. Or, whether this is due to potential voids or broken ground in the immediate vicinity in the process of collapsing or they have already collapsed. If this is the likely scenario, the voiding is likely to be present along the northern extent of the proposed sports field only.

A geological fault runs along the northern boundary of the public open field that forms part of the site area and across the access road, aligned generally east-west through the proposed development position. The geological fault that runs NE-SW north of the open field and links the Champany Hill Fault (SW of fault) and the Barebones Fault (NE of the fault). This fault splay is dipping southeast with the bedrock recorded to dip to the east or north-east. Given the age of historic mining activities at shallow depths (1924/1925 or earlier) it is anticipated that any surface subsidence associated with faulting may have already occurred.

There is one record of a coal authority mine shaft (433405-008) present within the public open field and the proposed development footprint. This is displayed in figure 9.4 below.

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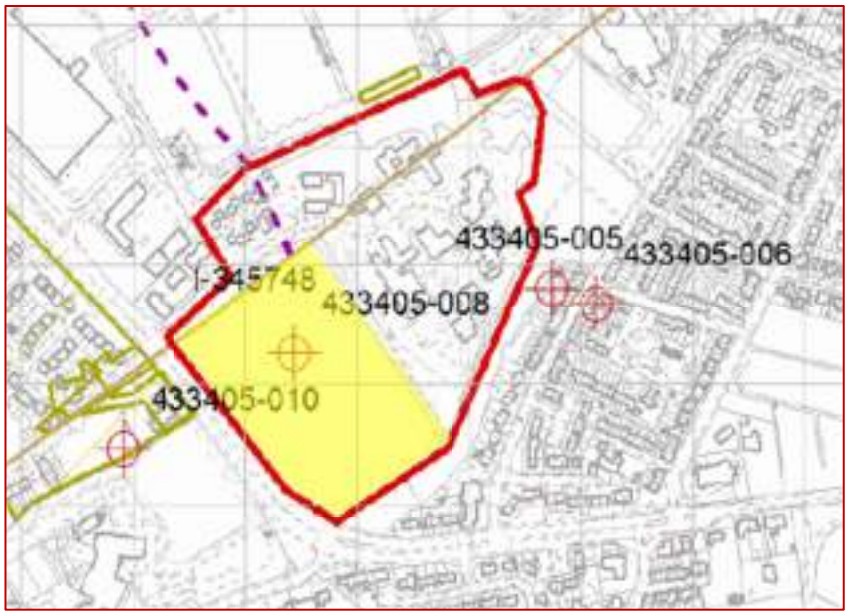



**Figure 9.4 – The coal authority recorded mine shaft present on site, reference 433405-008 with yellow shaded area outlining the public open field. Site boundary shown in red.**

The shaft is recorded to have no known treatment at the time of writing. This mine shaft was identified by TP01 during the ground investigation. TP01 identified the location of the coal authority mine shaft. The trial pit was excavated by 5.6m by 5.4m and found the shaft had a diameter of approximately 3.50m and was situated 0.60m bgl below the residual clays. The shaft was backfilled with old colliery spoils to include broken fine-grained sandstones, coal, pottery, and slag. As part of any future works the location of the mine shaft should be drilled to determine depth of the mine shaft and remediation is required to undergo appropriate treatment of the shaft and construct the cap of the mine shaft. The risk assigned in the CMRA is Moderate. The risk rating has not changed after the completion of this set of ground investigation works.

Previous remedial works are recorded on site based on a surface hazard incident report completed by the Coal Authority in 2014. The treatment works included opening out a small crown hole situated very close to the northern boundary of the site adjacent to the entrance of the field, by 2.20m by 1.50m and excavating to a depth of 4.50m below the surface to the base of a void. It was also reported that there were three separate roadways heading in north-east, south-east and south-west directions. The area was filled and compacted in layers with 12 tonnes of clean 75-150mm limestones not exceeding 300mm to within 1.5m to the surface. Geo-textile was placed across the fill and around the exposed sides with the as-dug sandy clay spoil placed and compacted in layers not exceeding a thickness of 150mm to the underside of the existing turf. This was overlayed by the topsoil to reinstate the surface of the pre-existing field. No remediation of the visual ‘roadways’ was undertaken by the Coal Authority.

It has been assessed that the sports field is likely to have localised mine workings along the southern boundary as identified on the available abandonment plans and towards the northern boundary as

unrecorded workings. A separate ground movement assessment report has been produced as part of the overall reporting for the proposed sports field and recommends the use of geogrid across the playing field area to mitigate against any potential crown hole collapses, rather than grout treating the entire field. However, the collapse feature along the northern boundary is likely to require further investigation in the form of geophysical techniques to try to determine whether anomalies can be identified due to how shallow the workings are. This is likely to be followed by intrusive ground investigation works to determine the location of the shallow unrecorded workings.

It is also recommended that stabilisation works across the development area post demolition of the existing building structures (where former Keresforth Medical Facilities occupy) should be completed to determine whether coal seams have been worked and require remedial or stabilisation works.

## 9.5 Sports Field Engineering

At the time of writing, it is understood that the proposed development comprises of a 900-place secondary school building and sports hall and car parking within the hardstanding, and soft landscaping areas where the former NHS Keresforth Medical Facilities Buildings Occupy. The ground investigation for this section of the site is yet to be completed. When the ground investigation has been completed the recommendations for the foundation designs will be made in a separate report.

This report primarily focuses on the proposed sports field. At the time of writing there are no building structures proposed for the sports field. Currently there is proposed to be a multi-use games area (MUGA) in the north-east of the proposed sports field. The remaining area is recorded to be grassed pitches. This report should be read in conjunction with the coal mining ground movement assessment (Ref. 17) that has been completed for the proposed sports field which recommends the use of specialist geogrid across the playing field area to mitigate against any potential crown hole collapses, rather than grout treating the entire field.

This report should be sent to a specialist geogrid contractor to determine what products would be applicable to the site and help to mitigate the mining risk.

## 9.6 Hardstanding Assessment

Hardstanding assessment was outside the scope of works for the ground investigation works and reporting. At the time the ground investigation was scoped, it was not defined whether the ground levels would be reducing or increasing as part of the proposed development.

In-situ California bearing ratio (CBR), or preferably, in-situ plate load tests should be completed at the proposed formation levels to confirm the design values.

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## 9.7 Soakaway Drainage

Infiltration assessment was outside the scope of works for the ground investigation works and reporting. At the time the ground investigation was scoped, it was not defined where the likely soakaway points would be for the proposed development or if the ground levels would be increasing or decreasing. Given the ground conditions that have been encountered at the site, it is unlikely that the residual soil clay material would be efficient drainage materials.

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# 10.0 Conclusions & Recommendations

## 10.1 Conclusions

A revised tabulated revised Conceptual Site Model has been derived following the findings on the Generic Quantitative Risk Assessment risk assessment and is presented in Section 8.0.

### 10.1.1 Coal Mining Legacy

Ground investigation works were completed to identify the mine workings present within the Pennine Middle Coal Measures Formation beneath the proposed sports pitch. Rotary coring was completed to 30.00m & 40.00m bgl within RC01 and RC02 and to 15.00 to 20.00m bgl within RC03-RC06 to obtain rock description information with rotary open holing completed to maximum depths of 40.00m bgl. Possible mine workings / broken ground was encountered within the Pennine Middle Coal Measures Formation within exploratory borehole position RC06 at depths encountered between 9.50 – 17.00m bgl and, is situated north-east of the coal authority shaft located within TP01. Therefore, it is recommended that the mine shaft will require appropriate treatment of the shaft and construction of a cap. Further ground investigation works a planned for the proposed building footprints.

### 10.1.2 Geotechnical Assessment

This report primarily focuses on the proposed sports field. At the time of writing there are no building structures proposed for the sports field. Currently there is proposed to be a multi-use games area (MUGA) in the north-east of the proposed sports field. The remaining area is recorded to be grassed pitches. This report should be read in conjunction with the ground movement assessment that has been completed for the proposed sports field. recommends the use of geogrid across the playing field area to mitigate against any potential crown hole collapses, rather than grout treating the entire field. This report should be sent to a specialist geogrid contractor to determine what products would be applicable to the site and help to mitigate the mining risk.

### 10.1.3 Ground and Groundwater Contamination

The environmental chemistry soil results have been compared with the Curtins Tier 1 assessment criteria for soils with respect to human health against ‘Residential without home grown produce’ thresholds as there is no published guidance for a school environment.

The risk to the end users of the site from shallow soils across the site is Moderate to Low. With regards to the public open field, exceedances were recorded within the made ground/topsoil. Much of the site will be covered be capped. Chemical analysis shows low concentrations of all

potential contaminants. Therefore, there is no viable source-pathway-receptor link. The risk to the groundwater and surface water receptors from the site soils is assessed as Low. This is due to no historical source of contamination being recorded within the site boundary and despite recorded exceedances of heavy metals recorded to be present in the made ground/topsoil, the underlying clays were noted to have low concentrations of heavy metals and act as a natural barrier preventing migration of contaminants. Therefore, there is no viable source-pathway-receptor link.

### 10.1.4 Ground Gas Assessment

The ground gas monitoring schedule has been completed with seven visits undertaken between November 2021 and January 2022, with maximum carbon dioxide concentration of 6.4% and a maximum methane concentration of 27.0%. No flow was recorded during the gas monitoring visits. The $Q_{hg}$ recorded for the site for carbon dioxide was 0.0096 l/hr and 0.41 l/hr for methane. The risk to the end user of the development site from soil gases is, therefore, assessed to be Moderate / Low. The site is currently assessed as CS2 requirements for ground gas protection measures against carbon dioxide.

The site is recorded to be in an area reported to be within an area of elevated radon levels potential between 1-3%. Therefore, radon ground gas protective measures are unnecessary in the construction of new extensions or dwellings. Where the development incorporates a basement a specialist radon risk assessor should be contacted.

## 10.2 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

1) It is recommended that construction workers are provided with appropriate PPE and sanitary facilities with reference to the environmental testing results presented herein and within Appendix A3.

2) Allowance for a capping layer for the proposed sports pitch to break the source-pathway-receptor link to the end users of the site.

3) Allowance for CS2 grade ground gas protection measures against carbon dioxide and methane ground gases.

4) Further geophysical investigation is likely to be required at the northern boundary of the proposed sports pitch, which may be followed by intrusive investigation.

5) Additional ground investigation will be required beneath the proposed building footprints to determine whether mine workings are present and obtain geotechnical design information.

6) Production of a grouting and remediation specification relating specifically to the mine shaft. This will detail grouting requirements and need for a concrete cap to be constructed at the top of the mine shaft.

7) Allowance for a Remediation Strategy to detail the requirements for the ground gas protection measures and details. This is followed by a Verification / Completion Report that the ground gas protection measures have been installed to the necessary standards and guidance along with details on the Remediation completed to the mine shaft and potential mine workings where applicable.

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# 11.0 References

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# Appendix A1 – Drawings

- Proposed Development Plan
- Curtins drawing ref. 079532.300-CUR-XX-XX-DR-GE-80001-P02_EHLP

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**Note**

1. Do not scale from this drawing
2. To be read in conjunction with Project Risk Register REF: XXX
3. To be read in conjunction with all other Landscape Architect's drawings

## KEY

- Site Boundary
- Proposed Building
- Proposed Tree
- Proposed Multi-Stem Tree
- Grass Seed
- Synthetic Turf Pitch
- MUGA
- Planting Area
- Planting Hedge
- Pedestrain Macadam Paving
- Vehicular Macadam Paving
- Resinbound Gravel
- Proposed Steps
- Cycle Shelter
- Bench seating
- Picnic bench seating
- Proposed Fencing
- Proposed Gate

| ID | RISK | MITIGATION | DATE MITIGATED |
|---|---|---|---|

**RESIDUAL PROJECT RISKS**

| DATE | REV | DESCRIPTION OF REVISION | DRAWN BY | APPROVED BY |
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PROJECT TITLE :

**Trinity Academy St Edwards Barnsley**

DRAWING TITLE :

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3. To be read in conjunction with all other Landscape Architect's drawings

## KEY

- Site Boundary
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- Proposed Tree
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- Grass Seed
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- Pedestrain Macadam Paving
- Vehicular Macadam Paving
- Resinbound Gravel
- Proposed Steps
- Cycle Shelter
- Bench seating
- Picnic bench seating
- Proposed Fencing
- Proposed Gate

| ID | RISK | MITIGATION | DATE MITIGATED |
|---|---|---|---|

## RESIDUAL PROJECT RISKS

| DATE | REV. | DESCRIPTION OF REVISION | DRAWN BY | APPROVED BY |
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DRAWING TITLE :

**Landscape General Arrangement 2 of 2**

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|---|---|---|
| 1:500 | PH | 17/09/2021 |
| PAPER SIZE : | APPROVED BY : | ALA PROJECT CODE: |
| A1 | RA | ALA696 |

DRAWING NUMBER : **696-ALA-00-XX-DR-L-0003** STATUS : REVISION : **P01**

Rotary Core & Open Boreholes Positions to maximum depths ranging between 30m to 40m bgl.

Window Sample Borehole Positions.

Machine Excavated Trial Pit to identify presence of the coal authority recorded mine shaft.

GENERAL NOTES:

| Rev: | Description: | Date: | By: |
|---|---|---|---|
| – | DRAFT Proposed Plan | 08/07/21 | BC |

Status: FINAL

Drawn By: RS | Checked By: BC

Designed By: RS | Date: 25/02/2022

Scale: NTS

Project: Proposed Trinity Academy, Barnsley

Drg Title: Exploratory Hole Location Plan

Project No: | Originator: | Zone: | Level: | Type: | Discipline: | Category / Number: | Rev:

079532-CUR-XX-XX-D-GE-80001-P03

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# Appendix A2 – Exploratory Hole Logs

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# Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433343.80 - 405528.49<br>Level: 148.52 | Date 20/10/2021 |
| Location: Keresforth Close, Barnsley | | Dimensions (m):<br>Depth 0.60 | Scale 1:10 |
| Client: Bowmer & Kirkland | | | Logged RH |

| Water Strike | Samples and In Situ Testing: Depth | Type | Results | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL. Grass cover on top. Soft brown slightly clayey SILT with grass rootlets and pebbles throughout. |
| | | | | 0.20 | 148.32 | | SHAFT FILL: Soft dark grey to black slightly sandy slightly gravelly CLAY. Gravel is fine to coarse grained and very angular to sub-angular of of coal, fine grained, light grey sandstone, pottery, slag and stone.<br>SURROUNDING NATURAL SOIL: Stiff to very stiff weathered yellow-orange, slightly gravelly CLAY. Gravel is fine to coarse grained and very angular of mudstone and sandstone lithorelicts. |
| | | | | 0.60 | 147.92 | | End of pit at 0.60 m |

1

2

Remarks: Machine excavated to 0.6m. Shaft exposed and observed to have a dark grey to black gravelly CLAY infill and an approximate 3.5m diameter. Surrounded by natural residual soil of the Pennine Middle Coal Measures Formation.

Stability:

AGS

# Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433410.11 - 405615.98 | Hole Type WS |
| Location: Keresforth Close, Barnsley | | Level: 140.96 | Scale 1:10 |
| Client: Bowmer & Kirkland | | Dates: 28/10/2021 - | Logged By RH |

| Well | Water Strikes | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.10 | 140.86 | | MADE GROUND - Asphalt |
| | | 0.20 | ES | | | | | MADE GROUND - beige-cream coarse gravel comprising of angular to sub-angular coarse grained sand and sandstone gravel. |
| | | 0.50 | | 50 (25 for 95mm/50 for 40mm) | 0.50 | 140.46 | | Soft light grey silty sandy gravelly CLAY with broken sub-angular clasts of orange sandstone. |
| | | 0.50 - 0.95 | D | | 0.60 | 140.36 | | Extremely weak, grey coarse grained SANDSTONE. Recovered as gravel. |
| | | 0.75 | D | | 0.75 | 140.21 | | End of borehole at 0.75 m |
| | | 0.75 | | 50 (25 for 85mm/50 for 50mm) | | | | |

1

2

Remarks
Handpit dug to 0.5m due to nature of ground. Hole refused at 0.75m.

AGS

# Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433406.90 - 405636.80 | Hole Type WS |
| Location: Keresforth Close, Barnsley | | Level: 141.20 | Scale 1:10 |
| Client: Bowmer & Kirkland | | Dates: 28/10/2021 - | Logged By RH |

| Well | Water Strikes | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | 0.30 | ES | | 0.30 | 140.90 | | TOPSOIL. Brown silty CLAY with grass cover on top. Grass rootlets and pebbles throughout. |
| | | 0.60<br>0.60 - 0.70 | D | 78 (8,11/78 for 130mm) | 0.60 | 140.60 | | Soft to firm, light yellow CLAY with broken sand and pebbles throughout. |
| | | | | | 0.90 | 140.30 | | Extremely weak, grey sandy fine grained SANDSTONE and grey mudstone recovered as a gravel.<br>End of borehole at 0.90 m |

Remarks
Handpit dug to 0.6m due to nature of ground. Hole refused at 0.90m.

# Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433487.85 - 405654.16 | Hole Type WS |
| Location: Keresforth Close, Barnsley | | Level: 137.47 | Scale 1:20 |
| Client: Bowmer & Kirkland | | Dates: 28/10/2021 - | Logged By RH |

| Well | Water Strikes | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.10 | 137.37 | | MADE GROUND - Asphalt |
| | | 0.30 | ES | | 0.40 | 137.07 | | Extremely weak, cream coarse sandy GRAVEL. Gravel comprises of angular to sub-angular sandstone and asphalt. |
| | | 0.85<br>0.85 - 1.30 | D | N=47 (2,3/6,9,14,18) | 0.85 | 136.62 | | Soft to firm light grey CLAY with broken fragments of extremely weak orange medium grained sandstone. |
| | | 1.65 | | 50 (25 for 101mm/50 for 65mm) | 1.35 | 136.12 | | Soft orange gravelly CLAY. Gravel comprises of angular to sub-angular orange sandstone. |
| | | 1.85 | D | | 1.85 | 135.62 | | Extremely weak, grey-green parallel laminated fine grained SANDSTONE interbedded with rare grey mudstones. Recovered as gravel. |
| | | | | | | | | End of borehole at 1.85 m |

Remarks

Handpit dug to 0.85m due to nature of ground. Hole refused at 1.85m.

# Borehole Log

Borehole No. **WS04**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433443.79 - 405622.25 | Hole Type WS |
| Location: Keresforth Close, Barnsley | | Level: 140.94 | Scale 1:10 |
| Client: Bowmer & Kirkland | | Dates: 28/10/2021 - | Logged By RH |

| Well | Water Strikes | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | | | | TOPSOIL. Soft brown CLAY with grass cover on top and grass rootlets and pebbles throughout. |
| | | | | | 0.35 | 140.59 | | |
| | | 0.40 | ES | | | | | Soft beige slightly gravelly CLAY. |
| | | 0.50<br>0.50 - 0.95 | D | N=30 (3,4/5,7,9,9) | 0.50 | 140.44 | | Very stiff to firm beige-orange gravelly CLAY. Gravel comprises of small angular sandstones and black mudstones. |
| | | | | | 1.20 | 139.74 | | Extremely weak, recovered as a sandy gravel, grey fine to coarse grained, well sorted sublitharenite SANDSTONE. |
| | | 1.50<br>1.50 - 1.80 | D | N=50 (12,10/50 for 260mm) | 1.50 | 139.44 | | Firm to stiff, grey gravelly CLAY. Gravel comprises of angular to sub-angular fragments of grey sandstone. |
| | | 1.80 | D | | 1.80 | 139.14 | | End of borehole at 1.80 m |

Remarks

Handpit dug to 0.5m due to nature of ground. Hole refused at 1.80m

# Borehole Log

Borehole No. **WS05**

Sheet 1 of 1

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433463.40 - 405594.85 | Hole Type WS |
| Location: Keresforth Close, Barnsley | | Level: 140.02 | Scale 1:10 |
| Client: Bowmer & Kirkland | | Dates: 28/10/2021 - | Logged By RH |

| Well | Water Strikes | Samples and In Situ Testing | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|
| | | Depth (m) | Type | Results | | | | |
| | | | | | 0.30 | 139.72 | | TOPSOIL. Soft brown CLAY with grass cover on top and grass rootlets and pebbles throughout. |
| | | 0.45 | ES | | | | | Soft to firm beige-orange slightly gravelly CLAY. The gravel comprises of angular to sub-angular orange sandstones. |
| | | 0.80<br>0.80 - 1.10 | D | N=7 (3,2/2,1,2,2) | 0.80 | 139.22 | | Soft beige-orange gravelly CLAY. The gravel comprises angular to sub-rounded white and light grey sandstone. |
| | | 1.80<br>1.80 - 1.90 | D | 50 (25 for 50mm/50 for 10mm) | 1.80 | 138.22 | | Extremely weak, beige-orange, light grey fine grained SANDSTONE. Recovered as a coarse gravel. |
| | | 1.90 | D | | 1.90 | 138.12 | | End of borehole at 1.90 m |

Remarks

Handpit dug to 0.8m due to nature of ground. Hole refused at 1.90m.

# Rotary Core Log

Borehole No. **RC01**

Sheet 1 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433297.93 - 405518.08 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 149.63 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 18/10/2021 - 22/10/2021 | Logged By MH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0.35 | 149.28 | | TOPSOIL. Soft brown slightly sandy, silty CLAY with grass cover on top and grass rootlets and pebbles throughout. |
| | | | | | | | 0.70 | 148.93 | | Light orange sandy GRAVEL. Gravel is fine to coarse, angular to sub-rounded siltstone. |
| | | | | | | | 0.80 | 148.83 | | Light orange, gravelly fine SAND. Gravel is fine to medium, angular to sub-rounded siltstone. |
| | | | | | | | 1.00 | 148.63 | | Light yellowish brown, fine to medium SILTSTONE. Recovered as sand and gravel. Gravel is fine to medium siltstone. |
| | | 1.00 - 2.00 | NI | 100 | 100 | 38 | | | | Extremely weak to weak, light grey and light orange, fine grained SANDSTONE. *Fractures extremely close to closely spaced, planar rough or smooth (0-10° dip).* *1 Iron stained vertical fracture (90°)* |
| | | 2.10 - 2.23 | C | | | | | | | |
| | | 2.00 - 3.50 | | 100 | 86 | 56 | | | | *1 fracture clean, rough planar (45°)* *Non-intact. Recovered as gravel of fine grained sandstone.* *Horizontal fractures parallel to bedding. Fractures are very closely to medium spaced, planar smooth to rough (10°). 30 cross cutting fractures, closely spaced to widely spaced. Planar or stepped, clean and rough.* |
| | | 3.34 - 3.50 | C | | | | 3.35 | 146.28 | | Very weak, grey thinly laminated SILTSTONE. Moderately weathered. |
| | | 3.50 - 5.00 | 49 | 100 | 100 | 57 | | | | *2 vertical fractures, planar rough clean and closely spaced.* |
| | | 4.40 - 4.45 | C | | | | | | | |
| | | 5.00 - 6.50 | | 100 | 100 | 16 | | | | *Drilling induced fractures* *Fractures are closely spaced to very closely spaced planar smooth (0-10°) Iron staining across fracture sutures.* *Fractures are closely spaced, planar smooth (30°). Iron staining across fracture planes.* |

Continued on next sheet

Remarks

Handpit dug to 1.0m due to hardness of ground. Cored to 29m

AGS

# Rotary Core Log

Borehole No. **RC01**

Sheet 2 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433297.93 - 405518.08 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 149.63 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 18/10/2021 - 22/10/2021 | Logged By MH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 28 | | | | | | | *1 vertical fracture 5cm thick* |
| | | | | | | | | | | *Drilling induced fractures* |
| | | 6.50 - 8.00 | 28 | 100 | 96 | 38 | | | | *Non-intact. Recovered as gravelly sandy clay. Gravel is fine angular sandstone.* *Fractures are very closely spaced to closely spaced planar, rough and smooth, clean. Fractures are iron stained.* |
| | | | | | | | | | | *1 fracture clean planar (45°)* |
| | | 8.00 - 9.50 | 16 | 100 | 96 | 60 | | | | *Non-intact. Recovered as grey gravelly clay.* *Fractures are very closely to closely spaced, planar smooth and iron-stained. 2 widely spaced vertical fractures* |
| | | 9.50 - 11.00 | | 66 | 51 | 17 | 10.05 | 139.58 | | Extremely weak, dull black COAL. Recovered as medium angular gravel of COAL. *Incipient fractures cross cut vertical/horizontal. Extremely close to very closely spaced.* *AZCL* |
| | | 11.00 - 12.50 | | 64 | 0 | 0 | | | | *AZCL* *Coal recovered as black slightly clayey, sandy, fine to medium angular gravel.* |

7 8 9 10 11 12

Continued on next sheet

Remarks
Handpit dug to 1.0m due to hardness of ground. Cored to 29m

AGS

# Rotary Core Log

Borehole No. **RC01**

Sheet 3 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433297.93 - 405518.08 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 149.63 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 18/10/2021 - 22/10/2021 | Logged By MH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 12.40 | 137.23 | | |
| | | 12.50 - 14.00 | 10 | 92 | 92 | 65 | | | | Recovered as a stiff brownish grey slightly gravelly, sandy mottled orange CLAY/Very weak grey SILTSTONE. Gravel comprises of angular to sub-angular mudstone. |
| | | | | | | | | | | *Loss of water flush at 12.50m possibly due to extremely weak coal seam.* |
| | | | | | | | | | | *Extremely weak, grey slightly weathered siltstone.* |
| | | | | | | | | | | *Fractures are closely to medium spaced, planar rough (0-10°). Some fractures are infilled.* |
| | | | | | | | | | | *Extremely weak, grey slightly weathered siltstone.* |
| | | 14.00 - 15.50 | 12 | 100 | 66 | 33 | | | | |
| | | 15.50 - 17.00 | 11 | 100 | 69 | 57 | | | | |
| | | | | | | | | | | *3 fractures, planar rough and clean (30-40°)* |
| | | 17.00 - 18.50 | 11 | 100 | 87 | 42 | | | | *Fractures very closely to medium spaced, planar, rough and clean (0-10°)* |

13 14 15 16 17 18

Continued on next sheet

Remarks

Handpit dug to 1.0m due to hardness of ground. Cored to 29m

# Rotary Core Log

Borehole No. **RC01**

Sheet 4 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433297.93 - 405518.08 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 149.63 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 18/10/2021 - 22/10/2021 | Logged By MH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | *Fractures very closely to widely spaced, planar, rough and clean (0-10°)* |
| | | | | | | | 18.50 | 131.13 | | Medium strong, thinly laminated to thickly laminated grey SILTSTONE interbedded with light grey MUDSTONE. |
| | | 18.50 - 20.00 | 3 | 100 | 100 | 98 | | | | *Two widely spaced, iron stained fractures, planar rough and clean (45°).* |
| | | | | | | | 20.00 | 129.63 | | Medium strong, light grey fine grained SANDSTONE. |
| | | 20.00 - 21.50 | 9 | 100 | 100 | 100 | | | | *1 sub-vertical fracture that is planar rough and clean.* |
| | | | | | | | | | | *Two horizontal fractures, closely spaced, planar rough, clean and iron stained.* |
| | | | | | | | | | | *Fractures are widely spaced to medium spaced, planar rough (0-10°)* |
| | | 21.50 - 23.00 | 4 | 100 | 100 | 69 | | | | *Drilling induced fractures* |
| | | | | | | | | | | *Fractures are closely to medium spaced, planar rough and clean.* |
| | | | | | | | 23.00 | 126.63 | | Extremely weak to weak grey, very thinly to thinly laminated MUDSTONE. |
| | | 23.00 - 24.50 | | 28 | 0 | 0 | | | | *Poor recovery, rock broken during drilling. Recovered as Not-intact gravel of sandstone and mudstone. Pockets of clayey gravel of grey mudstone.* |
| | | | | | | | | | | *AZCL* |

Continued on next sheet

Remarks

Handpit dug to 1.0m due to hardness of ground. Cored to 29m

AGS

# Rotary Core Log

Borehole No. **RC01** Sheet 5 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433297.93 - 405518.08 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 149.63 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 18/10/2021 - 22/10/2021 | Logged By MH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | 24.50 - 26.00 | | 100 | 79 | 30 | | | | *Not-intact. Recovered as gravel of mudstone.*<br>*3 vertical fractures, widely spaced, planar smooth and clean. 6 horizontal fractures very closely to closely spaced, planar smooth.*<br>*Clay weathering on core surface* |
| | | 26.00 - 27.50 | | 100 | 91 | 19 | | | | *Fractures are very closely to closely spaced, planar rough (0-10?) and clay weathering on surface.*<br>*Not-intact. Recovered as clayey gravel of grey mudstone.*<br>*Fractures are very closely spaced to closely spaced planar, rough (0-10˚). 2 medium spaced vertical fractures* |
| | | 27.50 - 29.00 | | 100 | 100 | 40 | | | | *Core could not be removed from liner. Fractures are close to medium spaced, planar, rough and clean.*<br>*1 fracture (45˚), planar rough and clean.* |
| | | | | | | | 29.00 | 120.63 | | End of borehole at 29.00 m |

25 26 27 28 29 30

Remarks
Handpit dug to 1.0m due to hardness of ground. Cored to 29m

AGS

# Rotary Core Log

Borehole No. **RC02**

Sheet 1 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433349.28 - 405474.81 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.62 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 25/10/2021 - 29/10/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.25 | ES | | | | 0.30 | 148.32 | | TOPSOIL. Soft brown slightly silty CLAY with grass cover on top and grass rootlets and pebbles throughout. |
| | | | | | | | | | | Soft extremely weathered brown silty CLAY |
| | | | | | | | 1.20 | 147.42 | | Extremely weak, thinly bedded weathered beige, grey-green SILTSTONE. The siltstones are parallel laminated and slightly clayey in places with rare coal seams present. Drilling induced fractures |
| | | 1.70 - 2.10 | C | | | | 1.70 | 146.92 | | *3 horizontal fractures very closely to closely spaced, planar rough (0-10° dip/015-020° dip direction). Fractures are parallel to bedding* |
| | | 1.20 - 3.00 | 3 | 33 | 30 | 28 | | | | Extremely weak, medium bedded massive, orange medium to coarse grained sublitharenite SANDSTONES. Rare laminations of coal are present towards the base. Sandstones become increasingly interbedded with grey parallel laminated to lenticular bedded siltstones towards the base. |
| | | | | | | | | | | *2 sets of fractures closely spaced, planar smooth (45° dip/ 010° dip direction)* |
| | | | | | | | 2.85 | 145.77 | | Extremely weak, thinly bedded grey parallel laminated SILTSTONE interbedded with thin coal horizons. |
| | | | | | | | 3.00 | 145.62 | | Extremely weak, thinly bedded grey parallel laminated and ripple cross laminated MUDSTONES. Towards the base the mudstones are interbedded with grey siltstones and grey fine grained argillaceous sandstones. Drilling induced fractures |
| | | 3.30 - 3.70 | C | | | | | | | *Mudstones are stained orange due to iron leaching* |
| | | 3.70 - 4.00 | C | | | | | | | |
| | | 3.00 - 4.50 | NI | 7 | 7 | 7 | | | | |
| | | | | | | | 4.00 | 144.62 | | Extremely weak and weathered, dark grey-brown to black low grade, lignitic COAL. Recovered as a gravel paste |
| | | | | | | | 4.10 | 144.52 | | Extremely weak, thinly bedded, weathered beige, grey parallel laminated MUDSTONE interbedded with parallel laminated grey siltstones and fine-medium grained grey sandstones. |
| | | 4.50 - 5.00 | C | | | | 4.50 | 144.12 | | Extremely weak, recovered fragmented, thinly bedded grey SILTSTONE interbedded with grey fine-grained sublitharenite sandstones. |
| | | | | | | | 5.00 | 143.62 | | Extremely weak, grey lenticular bedded thinly laminated MUDSTONES. |
| | | 4.50 - 6.00 | 5 | 46 | 41 | 37 | | | | *5 fractures, medium spaced, planar rough and clean (40-45° dip/180° dip direction)* |
| | | | | | | | | | | Continued on next sheet |

Remarks

Handpit dug to 0.6m due to hardness of ground. Cored to 40.5m

AGS

# Rotary Core Log

Borehole No. **RC02**

Sheet 2 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433349.28 - 405474.81 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.62 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 25/10/2021 - 29/10/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 6.10 - 6.40 | C | | | | | | | *Horizontal fractures parallel to bedding that are closely spaced, undulating smooth and planar rough. Horizontal fractures follow trend of 0-15° dip/ 10-20° dip direction. Two fractures dip 45° dip/160° dip direction.* |
| | | 6.00 - 7.50 | 7 | 89 | 87 | 83 | | | | |
| | | 7.50 - 7.70 | C | | | | 7.50 | 141.12 | | Extremely weak, thinly bedded, parallel laminated grey MUDSTONE. |
| | | 8.20 - 8.40<br>7.50 - 9.00 | C<br>5 | 73 | 56 | 37 | | | | *Grey medium grained SANDSTONE HORIZON*<br>*Very closely spaced to closely spaced fractures parallel to bedding that are planar rough (15-20° dip)* |
| | | 9.00 - 10.50 | 3 | 66 | 63 | 53 | 9.00 | 139.62 | | Extremely weak, thinly bedded grey MUDSTONE interbedded with light brown siltstone.<br>*Fractures present across bedding plane that are closely spaced, planar rough and clean (0-10° dip)* |
| | | 10.50 - 12.00 | NI | 27 | 0 | 0 | 10.80 | 137.82 | | Extremely weak, loose fragmented COAL. No to very little recovery (AZCL) |

Continued on next sheet

Remarks
Handpit dug to 0.6m due to hardness of ground. Cored to 40.5m

# Rotary Core Log

Borehole No. **RC02**

Sheet 3 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433349.28 - 405474.81 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.62 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 25/10/2021 - 29/10/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 12.50 | 136.12 | | Firm, light grey CLAY with thin beds of extremely weak dark grey mudstone. *AZCL* |
| | | 12.00 - 13.50 | NI | 41 | 33 | 26 | 13.00 | 135.62 | | Extremely weak, light grey MUDSTONE interbedded with light grey clay and bands of gravelly coal. |
| | | | | | | | 13.90 | 134.72 | | Extremely weak, fragmented sub-bituminous COAL. |
| | | 13.50 - 15.00 | 2 | 35 | 35 | 35 | 14.05 | 134.57 | | Soft to firm light grey CLAY grading into sub-bituminous coal |
| | | | | | | | 14.35 | 134.27 | | Extremely weak, fragmented sub-bituminous to bituminous COAL. Fragments are gravel comprising of angular to sub-angular coal. |
| | | 15.00 - 16.50 | 8 | 87 | 83 | 75 | 14.85 | 133.77 | | Extremely weak, light grey , massive MUDSTONE. The mudstones are slightly clayey in places and contain fragments of coal and fossilised plants including tree bark and leaves. *Two horizontal fractures, closely spaced, planar rough and undulating (12° dip)* *Fractures are very closely to medium spaced, planar rough to smooth and horizontal to bedding plane (15-20° dip/ 010-015° dip direction)* |
| | | 16.50 - 18.00 | 5 | 99 | 99 | 95 | | | | *Horizontal fractures that are closely spaced, planar rough and with aperture of 1-2mm with possible light grey clay infill.* *Bedding joint (45° dip/ 150° dip direction) between two horizontal fractures (0-15° dip/ 010° dip direction).* |

Continued on next sheet

Remarks

Handpit dug to 0.6m due to hardness of ground. Cored to 40.5m

# Rotary Core Log

Borehole No. **RC02**

Sheet 4 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433349.28 - 405474.81 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.62 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 25/10/2021 - 29/10/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | *Soft to firm light grey clay horizon with fragmented, extremely weak dark grey mudstone.* |
| | | | | | | | 18.50 | 130.12 | | Extremely weak, dark grey massive MUDSTONE that grade into parallel laminated and ripple cross laminated mudstones at the base. *Fractures are closely to medium spaced, planar smooth and clean (10-15° dip/010° dip direction).* |
| | | 18.00 - 19.50 | 11 | 29 | 29 | 27 | | | | |
| | | | | | | | | | | *Fragments of fossilised wood* |
| | | | | | | | | | | *Grey soft to firm clay infilled, undulating fracture forming a vein running across direction of bedding plane. Approximately 6cm long and 1cm thick.* |
| | | | | | | | 20.00 | 128.62 | | Firm light grey gravelly CLAY. The gravel comprises of light grey to dark grey sub-angular mudstones. |
| | | 19.50 - 21.00 | 4 | 83 | 44 | 43 | 20.13 | 128.49 | | Extremely weak, thick bedded dark grey massive MUDSTONE that are parallel laminated in places. |
| | | | | | | | 21.50 | 127.12 | | Extremely strong, dark grey blocky and massive MUDSTONE *Several horizontal fractures closely to medium spaced, planar smooth to rough (10-20° dip/15-30° dip direction).* |
| | | 21.00 - 22.50 | 14 | 97 | 91 | 77 | 22.30 | 126.32 | | Extremely strong, dark to light grey silty MUDSTONE that grades into grey-brown siltstone towards the base. *Light grey firm clay infilled vein with a aperture of 2cm formed along a horizontal fracture.* |
| | | 22.50 - 24.00 | 2 | 83 | 80 | 77 | 23.00 | 125.62 | | Extremely strong, thinly bedded dark grey parallel laminated and ripple cross laminated SILTSTONE interbedded with light grey mudstones. |

Continued on next sheet

Remarks
Handpit dug to 0.6m due to hardness of ground. Cored to 40.5m

# Rotary Core Log

Borehole No. **RC02**

Sheet 5 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433349.28 - 405474.81 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.62 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 25/10/2021 - 29/10/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | *Two very closely spaced horizontal fractures that are planar smooth (10° dip)* |
| | | 24.00 - 25.50 | 5 | 82 | 82 | 76 | 24.50 | 124.12 | | Extremely strong, thinly bedded light grey, fine grained, litharenitic SANDSTONE interbedded with grey siltstones and mudstones. The sandstones have darker grains of sand that form prominent ripple cross laminations with some lenticular bedding. |
| | | | | | | | | | | *Supercritically climbing ripples identified. Superimposed migrating ripples with forcets dipping 20-30° (climbing angle)* |
| | | | | | | | 25.25 | 123.37 | | Extremely strong, dark grey parallel laminated SILTSTONE interbedded with grey mudstone. Siltstone unit is marked by a sharp boundary at the top and base. |
| | | | | | | | 25.45 | 123.17 | | Extremely strong, massive fine grey SANDSTONE interbedded with grey parallel laminated siltstone. |
| | | 25.50 - 27.00 | 5 | 73 | 29 | 18 | 25.55 | 123.07 | | Extremely strong, thinly bedded dark grey MUDSTONE that grades into a fissile grey mudstone towards the base of the unit. |
| | | | | | | | 26.40 | 122.22 | | Moderately weak and weathered, sub-bituminous black COAL |
| | | | | | | | 26.45 | 122.17 | | Extremely strong, massive dark grey MUDSTONE with rare light grey siltstone horizons. The mudstones become parallel laminated towards the base. |
| | | | | | | | | | | *Fractures are very closely to closely spaced, planar rough (0-10° dip).* |
| | | 27.00 - 28.50 | 7 | 67 | 22 | 21 | | | | *Horizontal fractures are closely spaced, planar rough and smooth (0-10° dip).* |
| | | | | | | | | | | *Extremely weak, light grey siltstone bed* |
| | | | | | | | | | | *Extremely weak, light grey siltstone bed* |
| | | | | | | | | | | *Extremely weak, light grey siltstone bed* |
| | | 28.50 - 30.00 | 5 | 73 | 32 | 21 | | | | |
| | | | | | | | | | | Continued on next sheet |

25 26 27 28 29 30

Remarks

Handpit dug to 0.6m due to hardness of ground. Cored to 40.5m

AGS

# Rotary Core Log

Borehole No. **RC02**

Sheet 6 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433349.28 - 405474.81 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.62 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 25/10/2021 - 29/10/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 30.50 | 118.12 | | |
| | | 30.00 - 31.50 | 6 | 95 | 75 | 50 | | | | Weak to medium strong, parallel laminated dark grey MUDSTONE that becomes fissile mudstone towards the base. |
| | | | | | | | | | | *Siltstone load cast within mudstone at base.* |
| | | 31.50 - 33.00 | 9 | 90 | 50 | 41 | | | | *Horizontal fractures that are closely spaced, planar rough (10-15˚ dip).* |
| | | | | | | | 33.50 | 115.12 | | Extremely weak, parallel laminated dark grey MUDSTONE with clay horizons. |
| | | 33.00 - 34.50 | 7 | 68 | 28 | 20 | | | | *Very closely to closely spaced fractures that are stepped smooth (10˚ dip)* |
| | | | | | | | 34.00 | 114.62 | | Extremely weak and weathered, sub-bituminous to bituminous COAL. The coal is vitrinite rich, extremely light and is thinly laminated. |
| | | | | | | | 34.15 | 114.47 | | |
| | | | | | | | 34.25 | 114.37 | | Extremely weak, thinly bedded, parallel laminated dark grey MUDSTONE. |
| | | | | | | | 34.45 | 114.17 | | Extremely weak and moderately weathered, sub-bituminous to bituminous black COAL. |
| | | | | | | | 34.75 | 113.87 | | Extremely weak, thinly bedded, parallel laminated dark grey MUDSTONE. |
| | | | | | | | | | | Soft, dark grey CLAY retrieved as a paste. |
| | | 34.50 - 36.00 | 2 | 90 | 87 | 85 | 35.00 | 113.62 | | Extremely strong, thinly bedded massive, dark grey MUDSTONE. |
| | | | | | | | | | | *Fractures are horizontal, closely spaced and planar rough and clean (10˚ dip)* |
| | | | | | | | 35.80 | 112.82 | | Extremely weak and slightly weathered sub-bituminous black coal. The coal is very light and |
| | | | | | | | 36.00 | 112.62 | | |

Continued on next sheet

Remarks

Handpit dug to 0.6m due to hardness of ground. Cored to 40.5m

AGS

# Rotary Core Log

Borehole No. **RC02**

Sheet 7 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433349.28 - 405474.81 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.62 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 25/10/2021 - 29/10/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | not fractured. Extremely strong, parallel laminated dark grey MUDSTONE. The mudstones contain fragments of fossilised plants including wood and leaves. |
| | | 36.00 - 37.50 | 2 | 99 | 95 | 93 | | | | |
| | | | | | | | | | | *Horizontal fractures very closely to medium spaced and planar rough (10-15˚ dip)* |
| | | 37.50 - 39.00 | 1 | 77 | 58 | 55 | | | | |
| | | 39.00 - 40.50 | 4 | 68 | 65 | 61 | | | | *Horizontal fractures that are closely spaced, planar rough to smooth (10-15˚ dip).* |
| | | | | | | | 40.50 | 108.12 | | End of borehole at 40.50 m |

37 38 39 40 41 42

Remarks
Handpit dug to 0.6m due to hardness of ground. Cored to 40.5m

# Rotary Core Log

Borehole No. **RC03**

Sheet 1 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433382.23 - 405423.20 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.26 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 01/11/2021 - 04/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.20 | ES | | | | 0.50 | 147.76 | | TOPSOIL. Soft brown silty CLAY with grass cover on top and grass rootlets and pebbles throughout. Fragments of made ground comprising of broken sandstone and pottery are common. |
| | | 0.50 - 2.00 | 4 | 73 | 50 | 48 | 1.00<br>1.65 | 147.26<br>146.61 | | Soft to firm brown gravelly CLAY. Gravel comprises of small sub-angular to angular fragments of sandstone.<br>Firm, yellowish brown CLAY with rare extremely weak sandstone horizons. The sandstones are extremely weathered, light grey, stained orange and medium grained.<br>*Fractures are closely spaced to very closely spaced planar smooth (0-10˚ dip) Iron staining across fracture sutures.* |
| | | 2.00 - 3.50<br>2.80 - 3.10 | 12<br>C | 72 | 58 | 58 | 2.50 | 145.76 | | Extremely weak, thinly bedded, massive yellow, fine to medium grained sublitharenite SANDSTONE.<br>*Horizontal fractures that are very closely spaced planar rough (0-10˚ dip) Iron staining across fracture plane.*<br>Firm to stiff, yellowish brown gravelly CLAY. The gravel comprises of angular to sub-angular extremely weak, yellow-brown siltstone and fine grained sandstones. |
| | | ~~3.50 - 3.70~~ | ~~C~~ | | | | 3.00<br>3.50 | 145.26<br>144.76 | | Extremely weak, thin to medium bedded yellowish brown, medium grained sublitharenite SANDSTONES. Generally massive with some lenticular bedding features.<br>Extremely weak, lenticular bedded beige to dark grey, fine to medium grained, ripple cross laminated sublitharenite SANDSTONE interbedded with thinly bedded grey siltstone and mudstones.<br>*Fractures are horizontal, closely spaced and planar rough and undulating rough (10-15˚ dip)* |
| | | 3.50 - 5.00 | 16 | 95 | 39 | 39 | 4.15 | 144.11 | | Extremely weak, weathered orange, coarse grained parallel laminated sublitharenite SANDSTONE. Darker black grains of sand across bedding planes is common. |
| | | ~~5.00 - 5.20~~ | ~~C~~ | | | | 5.00 | 143.26 | | Extremely weak, light grey, fine grained parallel laminated sublitharenite SANDSTONE interbedded with thinly bedded parallel laminated grey siltstone and mudstone. Beds become increasingly sandier towards the base. Fractures are horizontal, closely spaced, planar smooth (10-15˚ dip). |
| | | 5.00 - 6.50<br>5.80 - 6.00 | 7<br>C | 59 | 17 | 12 | | | | |

Continued on next sheet

Remarks

Handpit dug to 0.5m due to hardness of ground. Cored to 17m. Open hole drilling from 17m to final depth at 30m

AGS

# Rotary Core Log

Borehole No. **RC03**

Sheet 2 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433382.23 - 405423.20 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.26 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 01/11/2021 - 04/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ~~6.50 - 6.80~~ | ~~C~~ | | | | 6.50 | 141.76 | | |
| | | 6.50 - 8.00 | 8 | 99 | 40 | 28 | | | | Extremely weak, thin to medium bedded light grey, fine grained sublitharenite SANDSTONE interbedded with grey siltstones. The units are generally parallel laminated but occasionally are ripple cross laminated in places. Fractures are horizontal and very closely to closely spaced, planar rough to smooth (10˚ dip). Set of 5 fractures were found orientating 10-15˚ dip/ parallel to bedding. |
| | | 8.10 - 8.40 | C | | | | 8.00 | 140.26 | | Weak, medium bedded massive grey SILTSTONE grading into mudstone. |
| | | 8.00 - 9.50 | 11 | 90 | 64 | 54 | 8.30 | 139.96 | | Extremely weak, thinly bedded, parallel laminated dark grey MUDSTONE. Fractures are horizontal, very closely spaced to closely spaced, parallel to bedding that are planar rough (15-20˚ dip/ 010˚ dip direction). |
| | | 9.10 - 9.40 | C | | | | | | | *A small fracture (45˚ dip/020˚ dip direction)* |
| | | 9.50 - 11.00 | 5 | 100 | 52 | 45 | 9.50 | 138.76 | | Extremely weak, medium bedded massive, light grey MUDSTONE. Fractures are horizontal, closely to medium spaced, planar smooth and clean (10-15˚ dip). |
| | | 11.00 - 12.50 | 7 | 99 | 75 | 71 | | | | |

Continued on next sheet

Remarks

Handpit dug to 0.5m due to hardness of ground. Cored to 17m. Open hole drilling from 17m to final depth at 30m

# Rotary Core Log

Borehole No. **RC03**

Sheet 3 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433382.23 - 405423.20 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 148.26 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 01/11/2021 - 04/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 12.50 | 135.76 | | |
| | | 12.50 - 14.00 | 4 | 91 | 63 | 60 | | | | Strong to extremely strong, thin to medium bedded, light grey parallel laminated MUDSTONE with rare horizons of grey siltstone. Fractures are horizontal, closely spaced, planar smooth (10-15° dip). |
| | | | | | | | 14.00 | 134.26 | | |
| | | 14.00 - 15.50 | 3 | 72 | 35 | 31 | | | | Weak to medium strong, light grey MUDSTONE. Recovered fragmented and core loss. |
| | | | | | | | | | | *AZCL* |
| | | | | | | | 15.30 | 132.96 | | Extremely weak, very weathered sub-bituminous COAL retrieved as gravel. |
| | | | | | | | 15.60 | 132.66 | | |
| | | | | | | | 15.70 | 132.56 | | Soft to firm brown gravelly CLAY. Gravel comprises of small broken fragments of sub-angular sub-bituminous black COAL. |
| | | 15.50 - 17.00 | | 81 | 55 | 28 | | | | Stiff dark brown to black CLAY with gravelly angular coal bands towards base. |
| | | | | | | | 16.90 | 131.36 | | |
| | | | | | | | 17.00 | 131.26 | | Very stiff, grey CLAY with angular to sub-angular grey mudstone clasts containing fossilised plants Drillers Description: MUDSTONE |
| | | | | | | | | | | Continued on next sheet |

Remarks

Handpit dug to 0.5m due to hardness of ground. Cored to 17m. Open hole drilling from 17m to final depth at 30m

# Rotary Core Log

Borehole No.
**RC03**
Sheet 4 of 5

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433382.23 - 405423.20 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 148.26 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 01/11/2021 - 04/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |

19
20
21
22
23
24

Continued on next sheet

Remarks
Handpit dug to 0.5m due to hardness of ground. Cored to 17m. Open hole drilling from 17m to final depth at 30m

AGS

# Rotary Core Log

Borehole No. **RC03**

Sheet 5 of 5

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433382.23 - 405423.20 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 148.26 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 01/11/2021 - 04/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |
| | | | | | | | 30.00 | 118.26 | | End of borehole at 30.00 m |

25
26
27
28
29
30

Remarks

Handpit dug to 0.5m due to hardness of ground. Cored to 17m. Open hole drilling from 17m to final depth at 30m

# Rotary Core Log

Borehole No. **RC04**

Sheet 1 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433446.18 - 405474.58 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 145.67 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 05/11/2021 - 09/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.30 | ES | | | | 0.50 | 145.17 | | TOPSOIL. Soft brown slightly silty CLAY with grass cover on top and grass rootlets and pebbles throughout. |
| | | 0.50 - 2.00 | | 58 | 29 | 20 | | | | Soft brown gravelly CLAY. Gravel comprises of angular to sub-angular small, black, dark grey and light grey mudstone. Plant fibres are present throughout the lay and becomes firm to stiff towards base of the unit. |
| | | 2.00 - 3.50 | | 78 | 58 | 33 | | | | *Gravel sizes vary between 1mm to 5cm.* |
| | | | | | | | 3.00 | 142.67 | | Very stiff, light brown mottled orange CLAY |
| | | | | | | | 3.35 | 142.32 | | Stiff light grey, slightly gravelly CLAY with medium strong sandstone bands. The sandstones are light grey and fine grained and thinly bedded. |
| | | | | | | | 3.50 | 142.17 | | *3 beds of sandstone that are approximately 3-4cm thick.* |
| | | 4.00 - 4.10<br>3.50 - 5.00 | C<br>7 | 85 | 43 | 13 | | | | Extremely weak, thin to medium bedded, light grey, fine to medium grained sublitharenite SANDSTONE interbedded with light grey mudstone. The unit is ripple cross laminated and is lenticularly bedded. Fractures are close to medium spaced planar rough (0-10˚ dip) and iron staining across fracture sutures. |
| | | | | | | | 5.00 | 140.67 | | |
| | | 5.00 - 6.50 | 6 | 97 | 17 | 15 | | | | Extremely weak, medium bedded, massive light grey slightly clayey MUDSTONE interbedded with grey fine grained sandstones. Recovered fragmented and most of core not intact. Small horizontal fractures are present across bedding plane, very closely spaced and undulating smooth (0-10˚ dip). |
| | | | | | | | | | | *Load cast of approximately 6cm was observed* |

Continued on next sheet

Remarks

Handpit dug to 0.8m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

# Rotary Core Log

Borehole No. **RC04**

Sheet 2 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433446.18 - 405474.58 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 145.67 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 05/11/2021 - 09/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 6.35 | 139.32 | | Extremely weak, thinly bedded grey, fine to medium grained parallel laminated sublitharenite SANDSTONES. Fractures are closely spaced, planar rough (0-10˚ dip) and iron stained. *Sandstones are stained orange due to iron leaching* |
| | | 6.90 - 7.00 | C | | | | | | | |
| | | 6.50 - 8.00 | 4 | 93 | 75 | 60 | | | | *Trace fossil running through core and is infilled with quartz* |
| | | | | | | | 8.00 | 137.67 | | Extremely weak, thinly bedded light grey iron stained parallel laminated MUDSTONE. |
| | | | | | | | 8.15 | 137.52 | | Extremely strong, thinly bedded, light grey, fine grained lenticular bedded, ripple cross laminated sublitharenite SANDSTONE. Horizontal fractures are present across bedding plane, very closely spaced and planar smooth to undulating smooth (0-10˚ dip). |
| | | 8.50 - 8.60 | C | | | | | | | |
| | | 8.00 - 9.50 | 13 | 93 | 85 | 77 | | | | *Two horizontal fractures (0-10˚ dip) joined by a bedding joint (90˚ dip). Both horizontal fractures are closely spaced and planar rough to smooth.* *Sandstone units grade into mudstone* |
| | | | | | | | 9.30 | 136.37 | | Extremely weak, lenticular bedded, light grey parallel laminated MUDSTONE. Mudstones contain fossilised plant fragments across bedding planes. Fractures are horizontal, closely spaced, planar rough to smooth with 6 fractures dipping 45˚ from horizontal plane. |
| | | ~~9.50 - 9.60~~ | C | | | | | | | |
| | | 9.50 - 11.00 | 22 | 80 | 43 | 22 | | | | |
| | | | | | | | 11.00 | 134.67 | | Extremely weak, massive dark grey parallel laminated MUDSTONE. Fractures are closely to medium spaced, planar rough (0-10˚ dip). |
| | | 11.00 - 12.50 | 19 | 98 | 79 | 71 | | | | |

Continued on next sheet

Remarks

Handpit dug to 0.8m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

# Rotary Core Log

Borehole No. **RC04**

Sheet 3 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433446.18 - 405474.58 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 145.67 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 05/11/2021 - 09/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 12.50 | 133.17 | | |
| | | 12.50 - 14.00 | 8 | 68 | 36 | 27 | | | | Strong, medium bedded dark grey parallel laminated MUDSTONE with rare bands of grey clay and siltstone. Fractures are closely to medium spaced, planar rough (0-10˚ dip) and iron stained across sutures. |
| | | 14.00 - 15.50 | 3 | 89 | 42 | 0 | | | | |
| | | | | | | | 15.50 | 130.17 | | Drillers Description: MUDSTONE |
| | | | | | | | 16.80 | 128.87 | | Drillers Description: COAL |
| | | | | | | | 18.00 | 127.67 | | Continued on next sheet |

Remarks

Handpit dug to 0.8m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

# Rotary Core Log

Borehole No.
**RC04**
Sheet 4 of 5

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433446.18 - 405474.58 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 145.67 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 05/11/2021 - 09/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |
| | | | | | | | | | | Drillers Description: MUDSTONE |
| | | | | | | | | | | Continued on next sheet |

19
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Remarks
Handpit dug to 0.8m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

# Rotary Core Log

Borehole No. **RC04**

Sheet 5 of 5

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433446.18 - 405474.58 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 145.67 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 05/11/2021 - 09/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |
| | | | | | | | 30.00 | 115.67 | | End of borehole at 30.00 m |

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Remarks
Handpit dug to 0.8m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

# Rotary Core Log

Borehole No. **RC05**

Sheet 1 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433416.86 - 405516.50 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 146.33 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 10/11/2021 - 11/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.40 | ES | | | | 0.30 | 146.02 | | TOPSOIL. Soft brown CLAY with grass cover on top and grass rootlets and pebbles throughout. |
| | | | | | | | 0.70 | 145.62 | | Firm light brown CLAY with plant rootlets and broken sub-angular fine grained sandstone fragments. |
| | | 0.70 - 2.00 | | 53 | 0 | 0 | | | | Soft light brown gravelly CLAY. Gravel comprises of angular to sub-angular fine-grained, light grey sandstone. Recovered as a paste |
| | | ~~2.00 - 2.10~~ | ~~C~~ | | | | | | | |
| | | | | | | | 2.20 | 144.12 | | Firm to stiff, light to dark grey CLAY |
| | | | | | | | 2.35 | 143.98 | | Stiff brown gravelly CLAY with gravel horizons. Gravel comprises of angular, sub-angular to rounded sized fine to medium grained orange sandstones. |
| | | 2.00 - 3.50 | | 90 | 87 | 77 | 2.50 | 143.82 | | Very stiff light orange-brown mottled grey, cobbly gravelly CLAY. Both cobbles and gravel are angular to sub-angular grey, medium grained sandstones |
| | | 3.00 - 3.50 | B | | | | | | | |
| | | 3.50 - 5.00 | | 87 | 83 | 80 | 3.50 | 142.82 | | Stiff to firm light orange-brown mottled grey, gravelly CLAY. Gravel comprises of angular to sub-angular to rounded light grey, fine to medium grained sandstones. |
| | | 5.20 - 5.30 | C | | | | 5.20 | 141.12 | | *Horizon of very thin bed of grey siltstone* |
| | | 5.00 - 6.50 | NI | 83 | 31 | 11 | | | | Extremely weak, massive orange, medium grained sublitharenite SANDSTONE. Recovered fragmented and not intact. Several drilling induced fractures. |

Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

# Rotary Core Log

Borehole No. **RC05**

Sheet 2 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433416.86 - 405516.50 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 146.33 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 10/11/2021 - 11/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ~~6.50 - 6.60~~ | ~~C~~ | | | | | | | |
| | | 6.50 - 8.00 | 7 | 79 | 28 | 27 | 6.95 | 139.38 | | Extremely weak, very thin to medium bedded, light grey, fine to medium grained sublitharenite SANDSTONE interbedded with light grey parallel laminated siltstone and mudstones. Fractures are closely to medium spaced, planar rough to smooth (0-10˚ dip). |
| | | 8.50 - 8.60 | C | | | | 8.00 | 138.32 | | Extremely weak, massive, light grey fine to medium grained SANDSTONE. Fractures are horizontal and very closely to closely spaced, planar rough to smooth and clean (0-10˚ dip). |
| | | 8.00 - 9.50 | 11 | 81 | 33 | 24 | | | | |
| | | ~~9.50 - 9.60~~ | ~~C~~ | | | | 9.10 | 137.22 | | Extremely weak, light grey parallel laminated MUDSTONE interbedded with light grey ripple cross laminated sandstone. Units of mudstone increase towards the base. |
| | | 9.50 - 11.00 | 4 | 73 | 48 | 25 | 9.50 | 136.82 | | Extremely weak, thinly bedded light grey parallel laminated MUDSTONE with soft clay horizons. Fractures are horizontal and very closely to closely spaced, planar rough to smooth (0-10˚ dip). |
| | | 11.00 - 12.50 | 4 | 82 | 60 | 56 | 11.00 | 135.32 | | Extremely weak, thinly bedded light grey parallel laminated MUDSTONE. Fractures are horizontal and very closely to closely spaced, planar rough to smooth and clean (0-10˚ dip). |

Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

# Rotary Core Log

Borehole No. **RC05**

Sheet 3 of 5

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433416.86 - 405516.50 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 146.33 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 10/11/2021 - 11/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 12.50 | 133.82 | | |
| | | 12.50 - 14.00 | 13 | 93 | 79 | 71 | | | | Extremely strong, massive dark grey MUDSTONE with fragments of fossilised plant. Mudstones become parallel laminated towards base of unit. Fractures are horizontal and very closely to closely spaced, planar rough to smooth and undulating smooth and clean (0-10˚ dip). |
| | | 14.00 - 15.50 | 23 | 88 | 79 | 75 | | | | |
| | | | | | | | 15.50 | 130.82 | | Drillers Description: MUDSTONE |
| | | | | | | | 17.00 | 129.32 | | Drillers Description: COAL |

13 14 15 16 17 18

Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

AGS

# Rotary Core Log

Borehole No.
**RC05**
Sheet 4 of 5

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433416.86 - 405516.50 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 146.33 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 10/11/2021 - 11/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 18.20 | 128.12 | | Drillers Description: MUDSTONE |
| | | | | | | | | | | Continued on next sheet |

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Remarks
Handpit dug to 0.7m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

AGS

# Rotary Core Log

Borehole No.
**RC05**
Sheet 5 of 5

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433416.86 - 405516.50 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 146.33 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 10/11/2021 - 11/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |
| | | | | | | | 30.00 | 116.32 | | End of borehole at 30.00 m |

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Remarks
Handpit dug to 0.7m due to hardness of ground. Cored to 15.5m. Open hole drilling from 15.5m to final depth at 30m

AGS

# Rotary Core Log

Borehole No. **RC06**

Sheet 1 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433372.52 - 405575.15 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 147.13 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 15/11/2021 - 17/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.15 | ES | | | | 0.30 | 146.83 | | TOPSOIL. Soft brown silty CLAY with grass cover on top and grass rootlets and pebbles throughout. |
| | | | | | | | | | | Firm beige-orange gravelly CLAY with plant rootlets and broken sub-angular sandstone fragments throughout. |
| | | 0.70 - 1.15 | D | | | | 0.70 | 146.43 | | |
| | | | | | | | 0.80 | 146.33 | | Firm light brown CLAY with broken sub-angular fragments of sandstone. |
| | | 0.70 - 2.00 | 2 | 27 | 7 | 7 | | | | Extremely weak, orange medium bedded, medium grained SANDSTONE. Recovered as broken fragments. |
| | | | | | | | 2.00 | 145.13 | | Firm orange-brown gravelly CLAY with extremely weak, thinly bedded orange-brown sandstone horizons. The sandstones are medium grained and well sorted. |
| | | | | | | | 2.45 | 144.68 | | Extremely weak, thinly bedded, light grey mottled orange parallel laminated, medium grained SANDSTONE. The sandstones are interbedded with grey siltstone. |
| | | 2.60 - 2.70 | C | | | | 2.65 | 144.48 | | |
| | | 2.00 - 3.50 | 6 | 80 | 53 | 43 | | | | Extremely weak, massive, light grey stained orange, medium grained, well sorted sublitharenite SANDSTONE. Fractures are horizontal, very closely to closely spaced, planar rough to smooth (10-15˚ dip). |
| | | 3.20 - 3.40 | C | | | | | | | |
| | | | | | | | 3.50 | 143.63 | | Extremely weak to very weak, massive medium bedded, stained orange, medium to coarse grained SANDSTONE. Fractures are horizontal, very closely to closely spaced, planar rough to smooth and clean (10-15˚ dip). |
| | | 4.00 - 4.20 | C | | | | | | | |
| | | 3.50 - 5.00 | 12 | 99 | 69 | 55 | | | | |
| | | 5.00 - 5.10 | C | | | | 5.00 | 142.13 | | Extremely weak, thinly laminated light grey fine to medium grained SANDSTONE. The sandstones are reverse graded. Fractures are horizontal, closely to medium spaced, planar smooth (10˚ dip). |
| | | 5.00 - 6.50 | 11 | 25 | 15 | 6 | | | | |

Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 23m. Open hole drilling from 23m to final depth to 40m. Very little to no recovery between 9.5m -17.0m due to possible mine workings

# Rotary Core Log

Borehole No. **RC06**

Sheet 2 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433372.52 - 405575.15 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 147.13 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 15/11/2021 - 17/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 6.40 - 6.50 | C | | | | 6.50 | 140.63 | | Weak, thinly bedded light grey fine grained parallel laminated SANDSTONE. |
| | | 7.00 - 7.20 | C | | | | 7.10 | 140.03 | | Extremely weak, thinly bedded, light grey ripple cross laminated SILTSTONE interbedded with grey mudstone and medium grained sandstones. |
| | | 6.50 - 8.00 | 8 | 77 | 60 | 39 | 7.40 | 139.73 | | Extremely weak, thinly bedded, light grey parallel laminated MUDSTONE. *Fractures are horizontal, closely spaced, planar rough (10° dip).* |
| | | 7.85 - 8.00 | C | | | | | | | *Small fracture (30° dip/010° dip direction)* |
| | | 8.00 - 9.50 | 7 | 53 | 33 | 28 | | | | *Not-intact, core retrieved as gravel. Gravel comprised of angular to sub-angular light grey mudstone.* *AZCL* |
| | | 9.00 - 9.10 | C | | | | | | | |
| | | 10.00 | C | | | | 9.50 | 137.63 | | Stiff to very stiff light grey slightly gravelly CLAY. The gravel comprises of angular to sub-angular light grey mudstone. *AZCL* |
| | | 9.50 - 11.00 | | 40 | 39 | 19 | | | | |
| | | 11.00 - 12.50 | | 25 | 2 | 0 | 11.00 | 136.13 | | Extremely weak, thinly bedded, light grey MUDSTONE. Recovered as gravel. The gravel comprises of broken angular grey mudstone. |

Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 23m. Open hole drilling from 23m to final depth to 40m. Very little to no recovery between 9.5m -17.0m due to possible mine workings

# Rotary Core Log

Borehole No. **RC06**

Sheet 3 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433372.52 - 405575.15 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 147.13 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 15/11/2021 - 17/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 13.00 | 134.13 | | |
| | | 12.50 - 14.00 | | 42 | 27 | 27 | | | | Stiff light grey gravelly CLAY with grey mudstone horizons. The gravel comprises of large broken angular grey mudstone. |
| | | | | | | | 13.50 | 133.63 | | Extremely weak, light grey parallel laminated MUDSTONE. Recovered as gravel. The gravel comprises of broken angular to sub-angular grey mudstone. |
| | | | | | | | 14.00 | 133.13 | | Stiff, light grey cobbly gravelly CLAY. Cobble comprises of large broken sub-angular fragments of extremely weak and weathered orange sandstones. The gravel comprises of light grey angular to sub-angular mudstone. |
| | | 14.00 - 15.50 | | 7 | 7 | 5 | | | | *AZCL - Only retrieved 14-14.1m of core as cobbly gravelly stiff light grey CLAY.* |
| | | | | | | | 15.50 | 131.63 | | Drillers Description: COAL due to no core retrieval |
| | | 15.50 - 17.00 | | 0 | 0 | 0 | | | | |
| | | | | | | | 17.00 | 130.13 | | Very stiff to stiff, light grey gravelly CLAY. Gravel comprises of angular to sub-angular grey mudstones with some rare coal towards the base. |
| | | 17.00 - 18.50 | 3 | 93 | 93 | 73 | | | | |
| | | | | | | | 17.85 | 129.28 | | Extremely weak and fragmented black |

Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 23m. Open hole drilling from 23m to final depth to 40m. Very little to no recovery between 9.5m -17.0m due to possible mine workings

AGS

# Rotary Core Log

Borehole No. **RC06**

Sheet 4 of 7

| | | | |
|---|---|---|---|
| Project Name: Trinity Academy | Project No. 079532 | Co-ords: 433372.52 - 405575.15 | Hole Type RC |
| Location: Keresforth Close, Barnsley | | Level: 147.13 | Scale 1:30 |
| Client: Bowmer & Kirkland | | Dates: 15/11/2021 - 17/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring TCR | Coring SCR | Coring RQD | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 18.05 | 129.08 | | sub-bituminous COAL. Extremely weak, thinly bedded light grey parallel laminated MUDSTONE. Fractures are horizontal and very closely to closely spaced, planar rough to smooth and clean (0-10˚ dip). |
| | | 18.50 - 20.00 | 6 | 79 | 49 | 33 | 18.50 | 128.63 | | Extremely weak, light grey parallel laminated very fissile MUDSTONE grading into massive grey MUDSTONE at the base. *Fractures are horizontal, very closely to closely spaced, planar rough to smooth and clean (10-15˚ dip).* |
| | | 20.00 - 21.50 | 5 | 98 | 77 | 55 | 20.00 | 127.13 | | Extremely strong, massive light grey SILTSTONE interbedded with light grey, fine grained sandstones. The beds of sandstones become infrequent towards the base. Fractures are horizontal (0-10˚ dip), closely to medium spaced, planar rough to smooth with a few fractures dipping 45˚. |
| | | 21.50 - 23.00 | 2 | 95 | 81 | 45 | 23.00 | 124.13 | | Drillers Description: LIMESTONE/SILTSTONE |

19 20 21 22 23 24

Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 23m. Open hole drilling from 23m to final depth to 40m. Very little to no recovery between 9.5m -17.0m due to possible mine workings

AGS

# Rotary Core Log

Borehole No. **RC06**

Sheet 5 of 7

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433372.52 - 405575.15 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 147.13 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 15/11/2021 - 17/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |

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Continued on next sheet

Remarks

Handpit dug to 0.7m due to hardness of ground. Cored to 23m. Open hole drilling from 23m to final depth to 40m. Very little to no recovery between 9.5m -17.0m due to possible mine workings

# Rotary Core Log

Borehole No.
**RC06**
Sheet 6 of 7

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433372.52 - 405575.15 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 147.13 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 15/11/2021 - 17/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |

31
32
33
34
35
36

Continued on next sheet

Remarks
Handpit dug to 0.7m due to hardness of ground. Cored to 23m. Open hole drilling from 23m to final depth to 40m. Very little to no recovery between 9.5m -17.0m due to possible mine workings

# Rotary Core Log

Borehole No.
**RC06**
Sheet 7 of 7

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Trinity Academy | Project No. 079532 | Co-ords: | 433372.52 - 405575.15 | Hole Type RC |
| Location: | Keresforth Close, Barnsley | | Level: | 147.13 | Scale 1:30 |
| Client: | Bowmer & Kirkland | | Dates: | 15/11/2021 - 17/11/2021 | Logged By RH |

| Well | Water Strikes | Depth (m) | Type / FI | Coring | | | Depth (m) | Level (m) | Legend | Stratum Description |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TCR | SCR | RQD | | | | |
| | | | | | | | 40.00 | 107.13 | | End of borehole at 40.00 m |

37
38
39
40
41
42

Remarks
Handpit dug to 0.7m due to hardness of ground. Cored to 23m. Open hole drilling from 23m to final depth to 40m. Very little to no recovery between 9.5m -17.0m due to possible mine workings

AGS

# Appendix A3 – Chemical laboratory Testing Results

- Environmental Chemistry Analysis Results (Soil)
  - Envirolab, Certificate No. 21/11618
  - I2 Analytical Ltd, Certificate No. 21-19813-1
  - I2 Analytical Ltd, Certificate No. 21-20798-1

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envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

**Envirolab Job Number:** 21/11618
**Issue Number:** 1 **Date:** 01 November, 2021

**Client:**
Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

**Project Manager:** EBMA/Matthew Holroyd/Rob Swinnerton
**Project Name:** Trinity Academy
**Project Ref:** B079532
**Order No:** EBBI1021
**Date Samples Received:** 25/10/21
**Date Instructions Received:** 26/10/21
**Date Analysis Completed:** 01/11/21

**Prepared by:**

Melanie Marshall
Laboratory Coordinator

**Approved by:**

Sophie France
Client Service Manager

**Envirolab Job Number: 21/11618**

**Client Project Name: Trinity Academy**

**Client Project Ref: B079532**

| Lab Sample ID | 21/11618/1 | 21/11618/2 | | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | RBH01 | RBH02 | | | | | | | | |
| Depth to Top | 0.20 | 0.30 | | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 18-Oct-21 | 18-Oct-21 | | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | | | | | | | | |
| Sample Matrix Code | 6AE | 6AE | | | | | | | | |
| % Stones >10mm$_A$ | 9.3 | 6.9 | | | | | | % w/w | 0.1 | A-T-044 |
| pH$_D$$^{M\#}$ | 6.49 | 6.14 | | | | | | pH | 0.01 | A-T-031s |
| Sulphate (water sol 2:1)$_D$$^{M\#}$ | 0.03 | <0.01 | | | | | | g/l | 0.01 | A-T-026s |
| Cyanide (total)$_A$$^{M\#}$ | <1 | <1 | | | | | | mg/kg | 1 | A-T-042sTCN |
| Phenols - Total by HPLC$_A$ | <0.2 | <0.2 | | | | | | mg/kg | 0.2 | A-T-050s |
| Organic matter$_D$$^{M\#}$ | 16.1 | 21.7 | | | | | | % w/w | 0.1 | A-T-032 OM |
| Arsenic$_D$$^{M\#}$ | 22 | 36 | | | | | | mg/kg | 1 | A-T-024s |
| Boron (water soluble)$_D$ | <1.0 | <1.0 | | | | | | mg/kg | 1 | A-T-027s |
| Cadmium$_D$$^{M\#}$ | 1.3 | 1.6 | | | | | | mg/kg | 0.5 | A-T-024s |
| Copper$_D$$^{M\#}$ | 42 | 61 | | | | | | mg/kg | 1 | A-T-024s |
| Chromium$_D$$^{M\#}$ | 22 | 27 | | | | | | mg/kg | 1 | A-T-024s |
| Chromium (hexavalent)$_D$ | <1 | <1 | | | | | | mg/kg | 1 | A-T-040s |
| Lead$_D$$^{M\#}$ | 71 | 111 | | | | | | mg/kg | 1 | A-T-024s |
| Mercury$_D$ | <0.17 | <0.17 | | | | | | mg/kg | 0.17 | A-T-024s |
| Nickel$_D$$^{M\#}$ | 23 | 33 | | | | | | mg/kg | 1 | A-T-024s |
| Selenium$_D$$^{M\#}$ | <1 | <1 | | | | | | mg/kg | 1 | A-T-024s |
| Zinc$_D$$^{M\#}$ | 105 | 132 | | | | | | mg/kg | 5 | A-T-024s |

**Envirolab Job Number: 21/11618**

**Client Project Name: Trinity Academy**

**Client Project Ref: B079532**

| Lab Sample ID | 21/11618/1 | 21/11618/2 | | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | RBH01 | RBH02 | | | | | | | | |
| Depth to Top | 0.20 | 0.30 | | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 18-Oct-21 | 18-Oct-21 | | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | | | | | | | | |
| Sample Matrix Code | 6AE | 6AE | | | | | | | | |
| **Asbestos in Soil (inc. matrix)** | | | | | | | | | | |
| Asbestos in soil$_{D}^{\#}$ | NAD | NAD | | | | | | | | A-T-045 |
| Asbestos Matrix (visual)$_{D}$ | - | - | | | | | | | | A-T-045 |
| Asbestos Matrix (microscope)$_{D}$ | - | - | | | | | | | | A-T-045 |
| Asbestos ACM - Suitable for Water Absorption Test?$_{D}$ | N/A | N/A | | | | | | | | A-T-045 |

**Envirolab Job Number: 21/11618**

**Client Project Name: Trinity Academy**

**Client Project Ref: B079532**

| Lab Sample ID | 21/11618/1 | 21/11618/2 | | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | RBH01 | RBH02 | | | | | | | | |
| Depth to Top | 0.20 | 0.30 | | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 18-Oct-21 | 18-Oct-21 | | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | | | | | | | | |
| Sample Matrix Code | 6AE | 6AE | | | | | | | | |
| **PAH-16MS (MSD order)** | | | | | | | | | | |
| Naphthalene$_A^{M\#}$ | <0.03 | <0.03 | | | | | | mg/kg | 0.03 | A-T-019s |
| Acenaphthylene$_A^{M\#}$ | 0.04 | 0.02 | | | | | | mg/kg | 0.01 | A-T-019s |
| Acenaphthene$_A^{M\#}$ | 0.01 | 0.02 | | | | | | mg/kg | 0.01 | A-T-019s |
| Fluorene$_A^{M\#}$ | 0.02 | 0.01 | | | | | | mg/kg | 0.01 | A-T-019s |
| Phenanthrene$_A^{M\#}$ | 0.49 | 0.34 | | | | | | mg/kg | 0.03 | A-T-019s |
| Anthracene$_A^{M\#}$ | 0.21 | 0.08 | | | | | | mg/kg | 0.02 | A-T-019s |
| Fluoranthene$_A^{M\#}$ | 1.91 | 0.87 | | | | | | mg/kg | 0.08 | A-T-019s |
| Pyrene$_A^{M\#}$ | 1.65 | 0.73 | | | | | | mg/kg | 0.07 | A-T-019s |
| Benzo(a)anthracene$_A^{M\#}$ | 1.20 | 0.45 | | | | | | mg/kg | 0.04 | A-T-019s |
| Chrysene$_A^{M\#}$ | 1.17 | 0.54 | | | | | | mg/kg | 0.06 | A-T-019s |
| Benzo(b)fluoranthene$_A^{M\#}$ | 1.22 | 0.51 | | | | | | mg/kg | 0.05 | A-T-019s |
| Benzo(k)fluoranthene$_A^{M\#}$ | 0.50 | 0.27 | | | | | | mg/kg | 0.07 | A-T-019s |
| Benzo(a)pyrene$_A^{M\#}$ | 1.17 | 0.50 | | | | | | mg/kg | 0.04 | A-T-019s |
| Indeno(123-cd)pyrene$_A^{M\#}$ | 0.62 | 0.29 | | | | | | mg/kg | 0.03 | A-T-019s |
| Dibenzo(ah)anthracene$_A^{M\#}$ | 0.13 | 0.06 | | | | | | mg/kg | 0.04 | A-T-019s |
| Benzo(ghi)perylene$_A^{M\#}$ | 0.47 | 0.23 | | | | | | mg/kg | 0.05 | A-T-019s |
| Total PAH-16MS (MSD order)$_A^{M\#}$ | 10.8 | 4.92 | | | | | | mg/kg | 0.03 | A-T-019s |

**Envirolab Job Number: 21/11618**

**Client Project Name: Trinity Academy**

**Client Project Ref: B079532**

| Lab Sample ID | 21/11618/1 | 21/11618/2 | | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | RBH01 | RBH02 | | | | | | | | |
| Depth to Top | 0.20 | 0.30 | | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 18-Oct-21 | 18-Oct-21 | | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | | | | | | | | |
| Sample Matrix Code | 6AE | 6AE | | | | | | | | |
| **TPH CWG** | | | | | | | | | | |
| Ali >C5-C6$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C6-C8$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C8-C10$_A$ | <1 | 1 | | | | | | mg/kg | 1 | A-T-055s |
| Ali >C10-C12$_A^{M\#}$ | <1 | <1 | | | | | | mg/kg | 1 | A-T-055s |
| Ali >C12-C16$_A^{M\#}$ | <1 | 1 | | | | | | mg/kg | 1 | A-T-055s |
| Ali >C16-C21$_A^{M\#}$ | <1 | 1 | | | | | | mg/kg | 1 | A-T-055s |
| Ali >C21-C35$_A^{M\#}$ | 5 | 7 | | | | | | mg/kg | 1 | A-T-055s |
| Total Aliphatics$_A$ | 5 | 11 | | | | | | mg/kg | 1 | A-T-055s |
| Aro >C5-C7$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C7-C8$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C8-C10$_A$ | 1 | 2 | | | | | | mg/kg | 1 | A-T-055s |
| Aro >C10-C12$_A$ | <1 | 1 | | | | | | mg/kg | 1 | A-T-055s |
| Aro >C12-C16$_A$ | 3 | 3 | | | | | | mg/kg | 1 | A-T-055s |
| Aro >C16-C21$_A^{M\#}$ | 6 | 9 | | | | | | mg/kg | 1 | A-T-055s |
| Aro >C21-C35$_A^{M\#}$ | 33 | 49 | | | | | | mg/kg | 1 | A-T-055s |
| Total Aromatics$_A$ | 44 | 65 | | | | | | mg/kg | 1 | A-T-055s |
| TPH (Ali & Aro >C5-C35)$_A$ | 49 | 76 | | | | | | mg/kg | 1 | A-T-055s |
| BTEX - Benzene$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Toluene$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Ethyl Benzene$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - m & p Xylene$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - o Xylene$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |
| MTBE$_A^{\#}$ | <0.01 | <0.01 | | | | | | mg/kg | 0.01 | A-T-022s |

## REPORT NOTES

**General**
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

**Soil chemical analysis:**
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

**TPH analysis of water by method A-T-007:**
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

**Electrical Conductivity of water by Method A-T-037:**
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

**Asbestos:**
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

**Predominant Matrix Codes:**
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample, 9 = INCINERATOR ASH.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
**Secondary Matrix Codes:**
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

**Key:**
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

v1

# Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

**Client:** Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

**Project:** Trinity Academy

**Clients Project No:** B079532

**Project No:** 21/11618

**Date Received:** 26/10/2021 (am)

**Cool Box Temperatures (°C):** 10.6

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples 5 ± 3°C), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

# Envirolab Analysis Dates

| Lab Sample ID | 21/11618/1 | 21/11618/2 |
|---|---|---|
| Client Sample No | | |
| Client Sample ID/Depth | RBH01 0.20m | RBH02 0.30m |
| Date Sampled | 18/10/21 | 18/10/21 |
| A-T-019s | 28/10/2021 | 28/10/2021 |
| A-T-022s | 29/10/2021 | 29/10/2021 |
| A-T-024s | 01/11/2021 | 01/11/2021 |
| A-T-026s | 29/10/2021 | 29/10/2021 |
| A-T-027s | 01/11/2021 | 01/11/2021 |
| A-T-031s | 29/10/2021 | 29/10/2021 |
| A-T-032 OM | 29/10/2021 | 29/10/2021 |
| A-T-040s | 29/10/2021 | 29/10/2021 |
| A-T-042sTCN | 27/10/2021 | 27/10/2021 |
| A-T-044 | 29/10/2021 | 29/10/2021 |
| A-T-045 | 27/10/2021 | 27/10/2021 |
| A-T-050s | 28/10/2021 | 28/10/2021 |
| A-T-055s | 29/10/2021 | 29/10/2021 |

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

**End of Report**

**Rob Swinnerton**
Curtins
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Bridge Street
Birmingham
B1 2JS

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**e:** reception@i2analytical.com

# Analytical Report Number : 21-20798

| | | | |
|---|---|---|---|
| **Project / Site name:** | Trinity Academy, Barnsley | **Samples received on:** | 03/11/2021 |
| **Your job number:** | 079532 | **Samples instructed on/ Analysis started on:** | 04/11/2021 |
| **Your order number:** | EBBI1029 | **Analysis completed by:** | 11/11/2021 |
| **Report Issue Number:** | 1 | **Report issued on:** | 11/11/2021 |
| **Samples Analysed:** | 4 soil samples | | |

**Signed:** Izabela Wójcik

Izabela Wójcik
Technical Reviewer (Reporting Team)
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

| | |
|---|---|
| soils | - 4 weeks from reporting |
| leachates | - 2 weeks from reporting |
| waters | - 2 weeks from reporting |
| asbestos | - 6 months from reporting |

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 21-20798**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1029**

| Lab Sample Number | | | | 2071608 | 2071609 | 2071610 | 2071611 |
|---|---|---|---|---|---|---|---|
| **Sample Reference** | | | | RC03 | RC04 | RC05 | RC06 |
| **Sample Number** | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| **Depth (m)** | | | | 0.20 | 0.30 | 0.40 | 0.15 |
| **Date Sampled** | | | | 01/11/2021 | 02/11/2021 | 02/11/2021 | 02/11/2021 |
| **Time Taken** | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 12 | 17 | 16 | 15 |
| Total mass of sample received | kg | 0.001 | NONE | 0.50 | 0.50 | 0.50 | 0.50 |
| Asbestos in Soil | Type | N/A | ISO 17025 | Not-detected | Not-detected | Not-detected | Not-detected |
| **General Inorganics** | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 6.8 | 7.2 | 8.4 | 7.3 |
| Total Cyanide | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Free Cyanide | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Ammoniacal Nitrogen as N | mg/kg | 0.5 | MCERTS | < 0.5 | < 0.5 | < 0.5 | < 0.5 |
| Ammoniacal Nitrogen as NH3 | mg/kg | 0.5 | MCERTS | < 0.5 | < 0.5 | < 0.5 | < 0.5 |
| Ammoniacal Nitrogen as NH4 | mg/kg | 0.5 | MCERTS | < 0.5 | < 0.5 | < 0.5 | < 0.5 |
| Organic Matter (automated) | % | 0.1 | MCERTS | 6.4 | 7.2 | 1.7 | 6.1 |
| **Phenols by HPLC** | | | | | | | |
| Catechol | mg/kg | 0.1 | ISO 17025 | < 0.10 | < 0.10 | < 0.10 | < 0.10 |
| Resorcinol | mg/kg | 0.1 | ISO 17025 | < 0.10 | < 0.10 | < 0.10 | < 0.10 |
| Cresols (o-, m-, p-) | mg/kg | 0.3 | ISO 17025 | < 0.30 | < 0.30 | < 0.30 | < 0.30 |
| Total Naphthols (sum of 1- and 2- Naphthol) | mg/kg | 0.2 | ISO 17025 | < 0.20 | < 0.20 | < 0.20 | < 0.20 |
| 2-Isopropylphenol | mg/kg | 0.1 | ISO 17025 | < 0.10 | < 0.10 | < 0.10 | < 0.10 |
| Phenol | mg/kg | 0.1 | ISO 17025 | < 0.10 | < 0.10 | < 0.10 | < 0.10 |
| Trimethylphenol (2,3,5-) | mg/kg | 0.1 | ISO 17025 | < 0.10 | < 0.10 | < 0.10 | < 0.10 |
| Total Xylenols and Ethylphenols | mg/kg | 0.3 | ISO 17025 | < 0.30 | < 0.30 | < 0.30 | < 0.30 |
| **Total Phenols** | | | | | | | |
| Total Phenols (HPLC) | mg/kg | 1.3 | ISO 17025 | < 1.3 | < 1.3 | < 1.3 | < 1.3 |
| **Heavy Metals / Metalloids** | | | | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | 19 | 25 | 16 | 26 |
| Boron (water soluble) | mg/kg | 0.2 | MCERTS | 0.3 | 0.3 | < 0.2 | 0.7 |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Chromium (hexavalent) | mg/kg | 1.2 | MCERTS | < 1.2 | < 1.2 | < 1.2 | < 1.2 |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 18 | 19 | 20 | 19 |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 45 | 50 | 38 | 43 |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 61 | 68 | 22 | 84 |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 17 | 20 | 23 | 21 |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 86 | 98 | 78 | 110 |

This certificate should not be reproduced, except in full, without the express permission of the laboratory.
The results included within the report relate only to the sample(s) submitted for testing.

**Analytical Report Number: 21-20798**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1029**

| Lab Sample Number | | | | 2071608 | 2071609 | 2071610 | 2071611 |
|---|---|---|---|---|---|---|---|
| Sample Reference | | | | RC03 | RC04 | RC05 | RC06 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 0.20 | 0.30 | 0.40 | 0.15 |
| Date Sampled | | | | 01/11/2021 | 02/11/2021 | 02/11/2021 | 02/11/2021 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | |
| **Monoaromatics & Oxygenates** | | | | | | | |
| Benzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Toluene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Ethylbenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| p & m-xylene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| o-xylene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| MTBE (Methyl Tertiary Butyl Ether) | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| **Petroleum Hydrocarbons** | | | | | | | |
| TPH-CWG - Aliphatic >EC5 - EC6 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| TPH-CWG - Aliphatic >EC6 - EC8 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| TPH-CWG - Aliphatic >EC8 - EC10 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| TPH-CWG - Aliphatic >EC10 - EC12 | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH-CWG - Aliphatic >EC12 - EC16 | mg/kg | 2 | MCERTS | < 2.0 | < 2.0 | < 2.0 | < 2.0 |
| TPH-CWG - Aliphatic >EC16 - EC21 | mg/kg | 8 | MCERTS | < 8.0 | < 8.0 | < 8.0 | < 8.0 |
| TPH-CWG - Aliphatic >EC21 - EC35 | mg/kg | 8 | MCERTS | < 8.0 | < 8.0 | < 8.0 | < 8.0 |
| TPH-CWG - Aliphatic (EC5 - EC35) | mg/kg | 10 | MCERTS | < 10 | < 10 | < 10 | < 10 |
| TPH-CWG - Aromatic >EC5 - EC7 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| TPH-CWG - Aromatic >EC7 - EC8 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| TPH-CWG - Aromatic >EC8 - EC10 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| TPH-CWG - Aromatic >EC10 - EC12 | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| TPH-CWG - Aromatic >EC12 - EC16 | mg/kg | 2 | MCERTS | < 2.0 | < 2.0 | < 2.0 | 8.9 |
| TPH-CWG - Aromatic >EC16 - EC21 | mg/kg | 10 | MCERTS | < 10 | < 10 | < 10 | 20 |
| TPH-CWG - Aromatic >EC21 - EC35 | mg/kg | 10 | MCERTS | 16 | 18 | < 10 | 51 |
| TPH-CWG - Aromatic (EC5 - EC35) | mg/kg | 10 | MCERTS | 23 | 26 | < 10 | 80 |
| **VOCs** | | | | | | | |
| Chloromethane | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Chloroethane | µg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Bromomethane | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Vinyl Chloride | µg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Trichlorofluoromethane | µg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,1-Dichloroethene | µg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,1,2-Trichloro 1,2,2-Trifluoroethane | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Cis-1,2-dichloroethene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| MTBE (Methyl Tertiary Butyl Ether) | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,1-Dichloroethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 2,2-Dichloropropane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Trichloromethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,1,1-Trichloroethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2-Dichloroethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,1-Dichloropropene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Trans-1,2-dichloroethene | µg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Benzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Tetrachloromethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2-Dichloropropane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Trichloroethene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Dibromomethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Bromodichloromethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Cis-1,3-dichloropropene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Trans-1,3-dichloropropene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Toluene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |

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The results included within the report relate only to the sample(s) submitted for testing.

**Analytical Report Number: 21-20798**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1029**

| Lab Sample Number | | | | 2071608 | 2071609 | 2071610 | 2071611 |
|---|---|---|---|---|---|---|---|
| Sample Reference | | | | RC03 | RC04 | RC05 | RC06 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 0.20 | 0.30 | 0.40 | 0.15 |
| Date Sampled | | | | 01/11/2021 | 02/11/2021 | 02/11/2021 | 02/11/2021 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | |
| 1,1,2-Trichloroethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,3-Dichloropropane | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Dibromochloromethane | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Tetrachloroethene | µg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2-Dibromoethane | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Chlorobenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,1,1,2-Tetrachloroethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Ethylbenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| p & m-Xylene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Styrene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Tribromomethane | µg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| o-Xylene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,1,2,2-Tetrachloroethane | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Isopropylbenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Bromobenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| n-Propylbenzene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 2-Chlorotoluene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 4-Chlorotoluene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,3,5-Trimethylbenzene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| tert-Butylbenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2,4-Trimethylbenzene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| sec-Butylbenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,3-Dichlorobenzene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| p-Isopropyltoluene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2-Dichlorobenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,4-Dichlorobenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Butylbenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2-Dibromo-3-chloropropane | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2,4-Trichlorobenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Hexachlorobutadiene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| 1,2,3-Trichlorobenzene | µg/kg | 1 | ISO 17025 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |

**SVOCs**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Aniline | mg/kg | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Phenol | mg/kg | 0.2 | ISO 17025 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 2-Chlorophenol | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Bis(2-chloroethyl)ether | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 1,3-Dichlorobenzene | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 1,2-Dichlorobenzene | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 1,4-Dichlorobenzene | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Bis(2-chloroisopropyl)ether | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 2-Methylphenol | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Hexachloroethane | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Nitrobenzene | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 4-Methylphenol | mg/kg | 0.2 | NONE | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Isophorone | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 2-Nitrophenol | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 2,4-Dimethylphenol | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Bis(2-chloroethoxy)methane | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 1,2,4-Trichlorobenzene | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | 0.26 |
| 2,4-Dichlorophenol | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 4-Chloroaniline | mg/kg | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 |

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**Analytical Report Number: 21-20798**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1029**

| Lab Sample Number | | | | 2071608 | 2071609 | 2071610 | 2071611 |
|---|---|---|---|---|---|---|---|
| Sample Reference | | | | RC03 | RC04 | RC05 | RC06 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 0.20 | 0.30 | 0.40 | 0.15 |
| Date Sampled | | | | 01/11/2021 | 02/11/2021 | 02/11/2021 | 02/11/2021 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | |
| Hexachlorobutadiene | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 4-Chloro-3-methylphenol | mg/kg | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 2,4,6-Trichlorophenol | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 2,4,5-Trichlorophenol | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 2-Methylnaphthalene | mg/kg | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 2-Chloronaphthalene | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Dimethylphthalate | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 2,6-Dinitrotoluene | mg/kg | 0.1 | MCERTS | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | 0.22 |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| 2,4-Dinitrotoluene | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Dibenzofuran | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 4-Chlorophenyl phenyl ether | mg/kg | 0.3 | ISO 17025 | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Diethyl phthalate | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 4-Nitroaniline | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Azobenzene | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Bromophenyl phenyl ether | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Hexachlorobenzene | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Phenanthrene | mg/kg | 0.05 | MCERTS | 0.27 | 0.94 | < 0.05 | 1.8 |
| Anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.22 | < 0.05 | 0.54 |
| Carbazole | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Dibutyl phthalate | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Anthraquinone | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Fluoranthene | mg/kg | 0.05 | MCERTS | 0.43 | 1.6 | 0.25 | 5.8 |
| Pyrene | mg/kg | 0.05 | MCERTS | 0.40 | 1.4 | 0.24 | 5.1 |
| Butyl benzyl phthalate | mg/kg | 0.3 | ISO 17025 | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | 0.33 | 0.99 | < 0.05 | 3.2 |
| Chrysene | mg/kg | 0.05 | MCERTS | 0.30 | 0.94 | < 0.05 | 3.0 |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | 0.39 | 0.99 | < 0.05 | 3.9 |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | 0.15 | 0.48 | < 0.05 | 1.9 |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | 0.32 | 0.94 | < 0.05 | 3.7 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.48 | < 0.05 | 1.6 |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | 0.44 |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.49 | < 0.05 | 1.7 |

U/S = Unsuitable Sample  I/S = Insufficient Sample

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**Analytical Report Number : 21-20798**
**Project / Site name: Trinity Academy, Barnsley**

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

| Lab Sample Number | Sample Reference | Sample Number | Depth (m) | Sample Description * |
|---|---|---|---|---|
| 2071608 | RC03 | None Supplied | 0.2 | Brown loam and clay with gravel and vegetation. |
| 2071609 | RC04 | None Supplied | 0.3 | Brown loam and clay with gravel and vegetation. |
| 2071610 | RC05 | None Supplied | 0.4 | Brown clay and loam with gravel and vegetation. |
| 2071611 | RC06 | None Supplied | 0.15 | Brown loam and clay with gravel and vegetation. |

**Analytical Report Number : 21-20798**
**Project / Site name: Trinity Academy, Barnsley**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Metals in soil by ICP-OES | Determination of metals in soil by aqua-regia digestion followed by ICP-OES. | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil. | L038-PL | D | MCERTS |
| Asbestos identification in soil | Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques. | In house method based on HSG 248 | A001-PL | D | ISO 17025 |
| Phenols, speciated, in soil, by HPLC | Determination of speciated phenols by HPLC. | In house method based on Blue Book Method. | L030-PL | W | ISO 17025 |
| Boron, water soluble, in soil | Determination of water soluble boron in soil by hot water extract followed by ICP-OES. | In-house method based on Second Site Properties version 3 | L038-PL | D | MCERTS |
| Hexavalent chromium in soil (Lower Level) | Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry. | In-house method | L080-PL | W | MCERTS |
| Free cyanide in soil | Determination of free cyanide by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | MCERTS |
| Moisture Content | Moisture content, determined gravimetrically. (30 oC) | In house method. | L019-UK/PL | W | NONE |
| D.O. for Gravimetric Quant if free fibres detected | Dependent option for Gravimetric Quant if Screen/ID positive for free fibres | In house asbestos methods A001 & A006. | A006-PL | D | NONE |
| pH in soil (automated) | Determination of pH in soil by addition of water followed by automated electrometric measurement. | In house method. | L099-PL | D | MCERTS |
| Stones content of soil | Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight. | In-house method based on British Standard Methods and MCERTS requirements. | L019-UK/PL | D | NONE |
| Semi-volatile organic compounds in soil | Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS. | In-house method based on USEPA 8270 | L064-PL | D | MCERTS |
| Total cyanide in soil | Determination of total cyanide by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | MCERTS |
| Volatile organic compounds in soil | Determination of volatile organic compounds in soil by headspace GC-MS. | In-house method based on USEPA8260 | L073B-PL | W | MCERTS |
| BTEX and MTBE in soil (Monoaromatics) | Determination of BTEX in soil by headspace GC-MS. | In-house method based on USEPA8260 | L073B-PL | W | MCERTS |
| Ammonia as NH3 in soil | Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L082-PL | W | MCERTS |
| Ammoniacal Nitrogen as N in soil | Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the discrete analyser (colorimetric) salicylate/nitroprusside method,10:1 water extraction. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L082-PL | W | MCERTS |
| Ammonium as NH4 in soil | Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L082-PL | W | MCERTS |

**Analytical Report Number : 21-20798**
**Project / Site name: Trinity Academy, Barnsley**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| TPHCWG (Soil) | Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID. | In-house method with silica gel split/clean up. | L088/76-PL | W | MCERTS |
| Organic matter (Automated) in soil | Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate. | In house method. | L009-PL | D | MCERTS |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**

**Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.**

# Appendix A4 – Geotechnical Laboratory Testing Results

- Geotechnical Analysis Results
  - I2 Analytical Ltd, Certificate No. 21-24603-1
  - I2 Analytical Ltd, Certificate No. 21-24590-1

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# Analytical Report Number : 21-24603

| | | | |
|---|---|---|---|
| **Project / Site name:** | Trinity Academy, Barnsley | **Samples received on:** | 17/11/2021 |
| **Your job number:** | | **Samples instructed on/ Analysis started on:** | 23/11/2021 |
| **Your order number:** | EBBI1042 | **Analysis completed by:** | 07/12/2021 |
| **Report Issue Number:** | 1 | **Report issued on:** | 07/12/2021 |
| **Samples Analysed:** | 24 soil samples | | |

Izabela Wójcik

**Signed:**

Izabela Wójcik
Technical Reviewer (Reporting Team)
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 21-24603**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1042**

| Lab Sample Number | | | | 2091754 | 2091755 | 2091756 | 2091757 | 2091758 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | WS01 | WS01 | WS02 | WS04 | RC01 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 0.50-0.95 | 0.75 | 0.60-0.70 | 1.50-1.80 | 2.10-2.23 |
| Date Sampled | | | | 28/10/2021 | 28/10/2021 | 28/10/2021 | 28/10/2021 | 21/10/2021 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 2.8 | 2.1 | 4.6 | 5.0 | 6.4 |
| Total mass of sample received | kg | 0.001 | NONE | 0.30 | 0.30 | 0.70 | 1.0 | 0.30 |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 8.5 | 8.9 | 8.1 | 7.4 | 8.0 |
| Total Sulphate as SO4 | % | 0.005 | MCERTS | 0.008 | 0.011 | 0.012 | 0.016 | 0.015 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.0096 | 0.0058 | 0.013 | 0.0097 | 0.0027 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 9.6 | 5.8 | 12.8 | 9.7 | 2.7 |
| Water Soluble Chloride (2:1) (leachate equivalent) | mg/l | 0.5 | MCERTS | 16 | 15 | 0.9 | 0.9 | 1.9 |
| Total Sulphur | % | 0.005 | MCERTS | < 0.005 | < 0.005 | 0.006 | 0.007 | < 0.005 |
| Water Soluble Nitrate (2:1) as N (leachate equivalent) | mg/l | 2 | NONE | < 2.0 | < 2.0 | < 2.0 | < 2.0 | < 2.0 |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Magnesium (water soluble) | mg/kg | 5 | NONE | 24 | 41 | 28 | 18 | < 5.0 |
| Magnesium (leachate equivalent) | mg/l | 2.5 | NONE | 12 | 21 | 14 | 8.9 | < 2.5 |

U/S = Unsuitable Sample  I/S = Insufficient Sample

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The results included within the report relate only to the sample(s) submitted for testing.

**Analytical Report Number: 21-24603**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1042**

| Lab Sample Number | | | | 2091759 | 2091760 | 2091761 | 2091762 | 2091763 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | RC02 | RC02 | RC02 | RC02 | RC02 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 1.70-2.10 | 3.30-3.70 | 3.70-4.00 | 6.10-6.40 | 8.20-8.40 |
| Date Sampled | | | | 27/10/2021 | 27/10/2021 | 27/10/2021 | 27/10/2021 | 27/10/2021 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 11 | 2.4 | 1.7 | 2.1 | 3.7 |
| Total mass of sample received | kg | 0.001 | NONE | 0.40 | 0.40 | 0.50 | 0.40 | 0.40 |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 7.4 | 8.1 | 8.3 | 8.6 | 8.7 |
| Total Sulphate as SO4 | % | 0.005 | MCERTS | 0.010 | 0.006 | 0.013 | 0.020 | 0.037 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.0051 | 0.0028 | 0.0027 | 0.020 | 0.014 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 5.1 | 2.8 | 2.7 | 20.3 | 14.3 |
| Water Soluble Chloride (2:1) (leachate equivalent) | mg/l | 0.5 | MCERTS | 1.2 | 0.9 | 1.3 | 1.6 | 1.9 |
| Total Sulphur | % | 0.005 | MCERTS | < 0.005 | < 0.005 | < 0.005 | 0.027 | 0.016 |
| Water Soluble Nitrate (2:1) as N (leachate equivalent) | mg/l | 2 | NONE | < 2.0 | < 2.0 | < 2.0 | < 2.0 | < 2.0 |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Magnesium (water soluble) | mg/kg | 5 | NONE | < 5.0 | < 5.0 | < 5.0 | 13 | 9.3 |
| Magnesium (leachate equivalent) | mg/l | 2.5 | NONE | < 2.5 | < 2.5 | < 2.5 | 6.5 | 4.6 |

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**Analytical Report Number: 21-24603**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1042**

| Lab Sample Number | | | | 2091764 | 2091765 | 2091766 | 2091767 | 2091768 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | RC03 | RC03 | RC03 | RC03 | RC04 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 2.80-3.10 | 3.50-3.70 | 5.80-6.00 | 8.10-8.40 | 4.00-4.10 |
| Date Sampled | | | | 03/11/2021 | 03/11/2021 | 03/11/2021 | 03/11/2021 | 09/11/2021 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 9.5 | 3.0 | 4.1 | 4.8 | 3.7 |
| Total mass of sample received | kg | 0.001 | NONE | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 8.3 | 8.2 | 6.8 | 7.4 | 7.2 |
| Total Sulphate as SO4 | % | 0.005 | MCERTS | 0.015 | 0.007 | 0.006 | 0.020 | 0.005 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.0048 | 0.0020 | 0.0049 | 0.067 | 0.0034 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 4.8 | 2.0 | 4.9 | 67.3 | 3.4 |
| Water Soluble Chloride (2:1) (leachate equivalent) | mg/l | 0.5 | MCERTS | 2.8 | 1.0 | 1.4 | 2.2 | 1.0 |
| Total Sulphur | % | 0.005 | MCERTS | < 0.005 | < 0.005 | < 0.005 | 0.073 | < 0.005 |
| Water Soluble Nitrate (2:1) as N (leachate equivalent) | mg/l | 2 | NONE | < 2.0 | < 2.0 | < 2.0 | < 2.0 | < 2.0 |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Magnesium (water soluble) | mg/kg | 5 | NONE | < 5.0 | < 5.0 | < 5.0 | 22 | 5.4 |
| Magnesium (leachate equivalent) | mg/l | 2.5 | NONE | < 2.5 | < 2.5 | < 2.5 | 11 | 2.7 |

U/S = Unsuitable Sample  I/S = Insufficient Sample

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**Analytical Report Number: 21-24603**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1042**

| Lab Sample Number | | | | 2091769 | 2091770 | 2091771 | 2091772 | 2091773 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | RC04 | RC04 | RC04 | RC05 | RC05 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 6.90-7.00 | 8.50-8.60 | 9.50-9.60 | 2.00-2.10 | 5.20-5.30 |
| Date Sampled | | | | 09/11/2021 | 09/11/2021 | 09/11/2021 | 11/11/2021 | 11/11/2021 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | 86 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 1.1 | 0.73 | 1.4 | 16 | 5.7 |
| Total mass of sample received | kg | 0.001 | NONE | 0.60 | 1.5 | 0.40 | 0.40 | 0.40 |

**General Inorganics**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| pH - Automated | pH Units | N/A | MCERTS | 8.7 | 8.7 | 7.8 | 7.8 | 8.3 |
| Total Sulphate as SO4 | % | 0.005 | MCERTS | 0.018 | 0.014 | 0.010 | 0.009 | 0.005 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.012 | 0.022 | 0.016 | 0.0064 | 0.0063 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 11.6 | 22.2 | 15.8 | 6.4 | 6.3 |
| Water Soluble Chloride (2:1) (leachate equivalent) | mg/l | 0.5 | MCERTS | 12 | 7.0 | 1.7 | 1.1 | 1.9 |
| Total Sulphur | % | 0.005 | MCERTS | 0.007 | 0.005 | 0.015 | 0.011 | < 0.005 |
| Water Soluble Nitrate (2:1) as N (leachate equivalent) | mg/l | 2 | NONE | < 2.0 | < 2.0 | < 2.0 | < 2.0 | < 2.0 |

**Heavy Metals / Metalloids**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Magnesium (water soluble) | mg/kg | 5 | NONE | 25 | 47 | 6.9 | < 5.0 | < 5.0 |
| Magnesium (leachate equivalent) | mg/l | 2.5 | NONE | 13 | 24 | 3.5 | < 2.5 | < 2.5 |

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**Analytical Report Number: 21-24603**
**Project / Site name: Trinity Academy, Barnsley**
**Your Order No: EBBI1042**

| **Lab Sample Number** | | | | 2091774 | 2091775 | 2091776 | 2091777 |
|---|---|---|---|---|---|---|---|
| **Sample Reference** | | | | RC06 | RC06 | RC06 | RC06 |
| **Sample Number** | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| **Depth (m)** | | | | 2.60-2.70 | 6.40-6.50 | 9.00-9.10 | 10.00 |
| **Date Sampled** | | | | 16/11/2021 | 16/11/2021 | 16/11/2021 | 16/11/2021 |
| **Time Taken** | | | | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | 0.01 | NONE | 17 | 3.8 | 5.0 | 14 |
| Total mass of sample received | kg | 0.001 | NONE | 0.40 | 0.40 | 0.40 | 0.40 |
| **General Inorganics** | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 7.1 | 8.2 | 8.0 | 8.3 |
| Total Sulphate as SO4 | % | 0.005 | MCERTS | 0.008 | 0.006 | 0.010 | 0.014 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.0094 | 0.0046 | 0.013 | 0.020 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 9.4 | 4.6 | 13.1 | 20.4 |
| Water Soluble Chloride (2:1) (leachate equivalent) | mg/l | 0.5 | MCERTS | 2.5 | 1.9 | 2.0 | 3.1 |
| Total Sulphur | % | 0.005 | MCERTS | 0.009 | < 0.005 | 0.019 | 0.009 |
| Water Soluble Nitrate (2:1) as N (leachate equivalent) | mg/l | 2 | NONE | < 2.0 | < 2.0 | < 2.0 | < 2.0 |
| **Heavy Metals / Metalloids** | | | | | | | |
| Magnesium (water soluble) | mg/kg | 5 | NONE | < 5.0 | < 5.0 | 12 | 34 |
| Magnesium (leachate equivalent) | mg/l | 2.5 | NONE | < 2.5 | < 2.5 | 5.9 | 17 |

U/S = Unsuitable Sample  I/S = Insufficient Sample

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**Analytical Report Number : 21-24603**
**Project / Site name: Trinity Academy, Barnsley**

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

| Lab Sample Number | Sample Reference | Sample Number | Depth (m) | Sample Description * |
|---|---|---|---|---|
| 2091754 | WS01 | None Supplied | 0.50-0.95 | Brown sandy clay with gravel. |
| 2091755 | WS01 | None Supplied | 0.75 | Brown sandy clay with gravel. |
| 2091756 | WS02 | None Supplied | 0.60-0.70 | Brown sandy clay. |
| 2091757 | WS04 | None Supplied | 1.50-1.80 | Brown sandy clay with vegetation and gravel |
| 2091758 | RC01 | None Supplied | 2.10-2.23 | Brown clay. |
| 2091759 | RC02 | None Supplied | 1.70-2.10 | Brown sandy clay. |
| 2091760 | RC02 | None Supplied | 3.30-3.70 | Light brown clay. |
| 2091761 | RC02 | None Supplied | 3.70-4.00 | Light brown clay. |
| 2091762 | RC02 | None Supplied | 6.10-6.40 | Light grey clay. |
| 2091763 | RC02 | None Supplied | 8.20-8.40 | Grey sandy clay. |
| 2091764 | RC03 | None Supplied | 2.80-3.10 | Brown clay. |
| 2091765 | RC03 | None Supplied | 3.50-3.70 | Light brown clay. |
| 2091766 | RC03 | None Supplied | 5.80-6.00 | Grey clay. |
| 2091767 | RC03 | None Supplied | 8.10-8.40 | Light brown clay. |
| 2091768 | RC04 | None Supplied | 4.00-4.10 | Brown clay. |
| 2091769 | RC04 | None Supplied | 6.90-7.00 | Grey clay. |
| 2091770 | RC04 | None Supplied | 8.50-8.60 | Brown sandy clay with concrete and stones. |
| 2091771 | RC04 | None Supplied | 9.50-9.60 | Grey clay. |
| 2091772 | RC05 | None Supplied | 2.00-2.10 | Brown clay and sand with gravel. |
| 2091773 | RC05 | None Supplied | 5.20-5.30 | Brown clay and sand. |
| 2091774 | RC06 | None Supplied | 2.60-2.70 | Brown clay and sand with gravel. |
| 2091775 | RC06 | None Supplied | 6.40-6.50 | Light brown sand. |
| 2091776 | RC06 | None Supplied | 9.00-9.10 | Grey clay. |
| 2091777 | RC06 | None Supplied | 10 | Grey clay and sand with gravel. |

**Analytical Report Number : 21-24603**
**Project / Site name: Trinity Academy, Barnsley**

**Water matrix abbreviations:**
**Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Magnesium, water soluble, in soil | Determination of water soluble magnesium by extraction with water followed by ICP-OES. | In-house method based on TRL 447 | L038-PL | D | NONE |
| Moisture Content | Moisture content, determined gravimetrically. (30 oC) | In house method. | L019-UK/PL | W | NONE |
| pH in soil (automated) | Determination of pH in soil by addition of water followed by automated electrometric measurement. | In house method. | L099-PL | D | MCERTS |
| Stones content of soil | Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight. | In-house method based on British Standard Methods and MCERTS requirements. | L019-UK/PL | D | NONE |
| Total Sulphate in soil as % | Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES. | In house method. | L038-PL | D | MCERTS |
| Total Sulphur in soil as % | Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES. | In house method. | L038-PL | D | MCERTS |
| Sulphate, water soluble, in soil (16hr extraction) | Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent). | In house method. | L038-PL | D | MCERTS |
| Water Soluble Nitrate (2:1) as N in soil | Determination of nitrate by reaction with sodium salicylate and colorimetry. | In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction. | L078-PL | W | NONE |
| Chloride, water soluble, in soil | Determination of Chloride colorimetrically by discrete analyser. | In house method. | L082-PL | D | MCERTS |
| Sulphate, water soluble, in soil | Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent). | In house method. | L038-PL | D | MCERTS |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**

**Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.**

# Sample Deviation Report

**Analytical Report Number : 21-24603**
**Project / Site name: Trinity Academy, Barnsley**

| Sample ID | Other ID | Sample Type | Lab Sample Number | Sample Deviation | Test Name | Test Ref | Test Deviation |
|---|---|---|---|---|---|---|---|
| RC01 | None Supplied | S | 2091758 | c | Chloride, water soluble, in soil | L082-PL | c |
| RC01 | None Supplied | S | 2091758 | c | Water Soluble Nitrate (2:1) as N in soil | L078-PL | c |
| RC01 | None Supplied | S | 2091758 | c | pH in soil (automated) | L099-PL | c |

# TEST CERTIFICATE

**DETERMINATION OF LIQUID AND PLASTIC LIMITS**
Tested in Accordance with:BS 1377-2:1990:Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

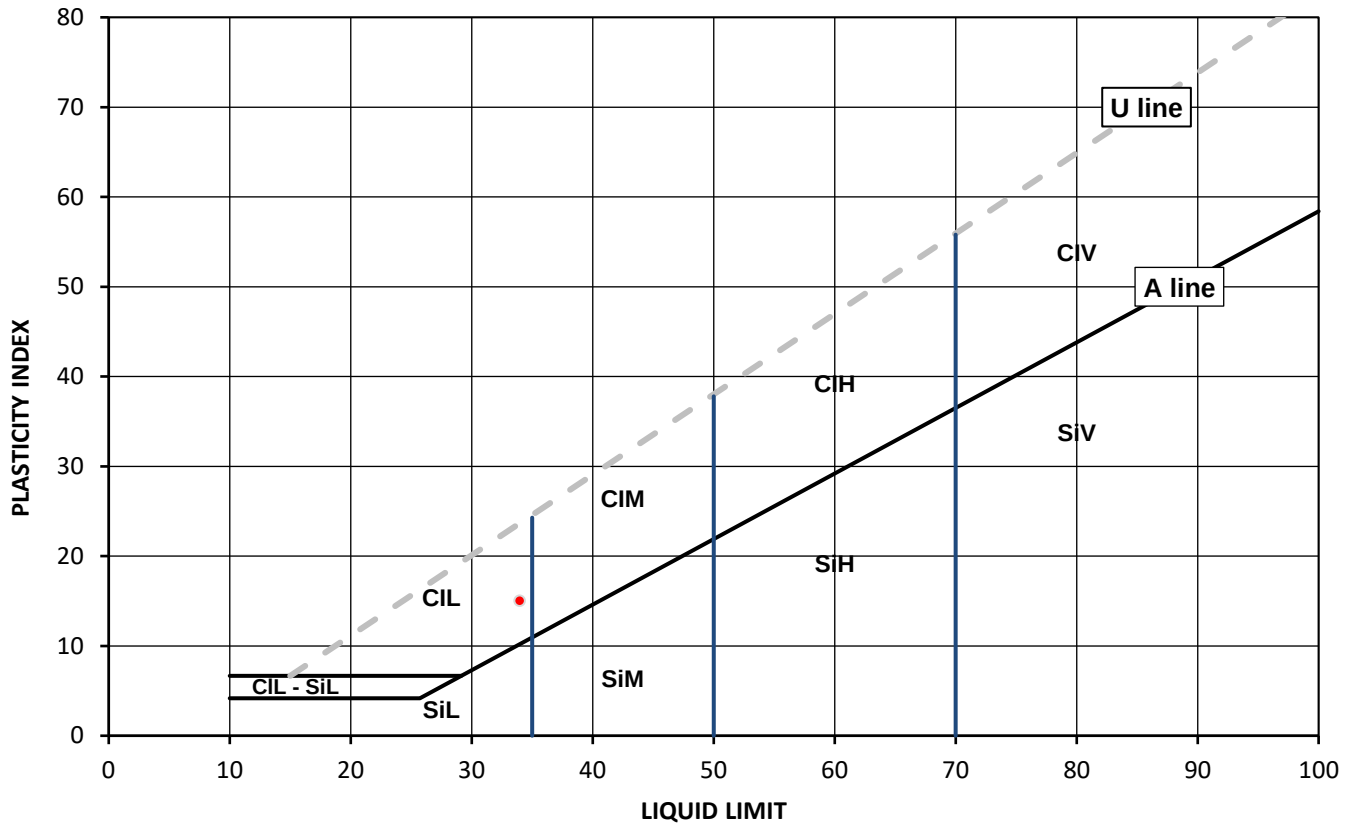
*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091668 | Depth Top [m]: | 0.85 |
| Hole No.: | WS03 | Depth Base [m]: | 1.30 |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Brown gravelly sandy CLAY | | |

Sample Preparation: Tested after >425um removed by hand

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 10 | 34 | 19 | 15 | 73 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 232.11**

# TEST CERTIFICATE

**DETERMINATION OF LIQUID AND PLASTIC LIMITS**
Tested in Accordance with:BS 1377-2:1990:Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

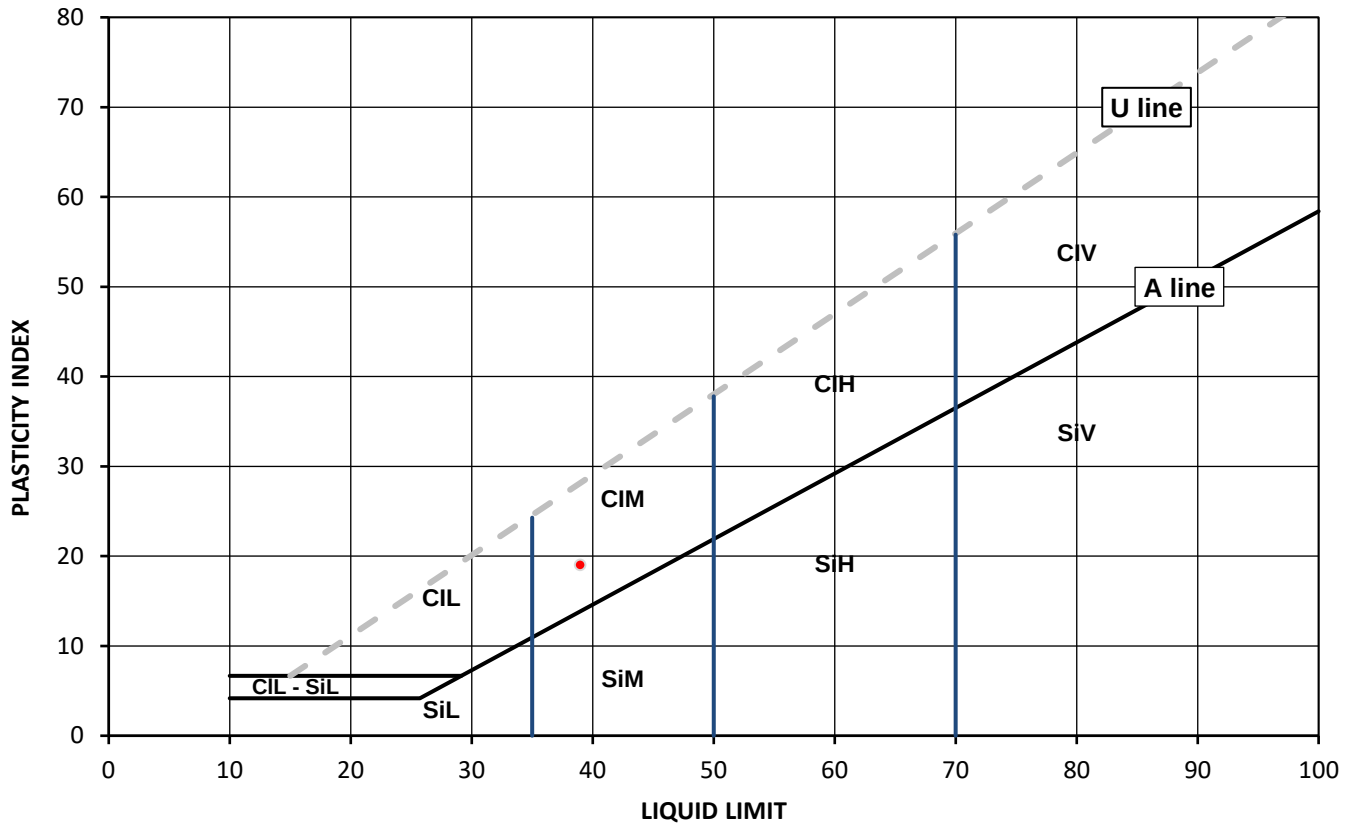
*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091670 | Depth Top [m]: | 0.50 |
| Hole No.: | WS04 | Depth Base [m]: | 0.95 |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Brown gravelly sandy CLAY | | |

Sample Preparation: Tested after washing to remove >425um

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 9.7 | 39 | 20 | 19 | 70 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

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Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 232.11**

# TEST CERTIFICATE

**DETERMINATION OF LIQUID AND PLASTIC LIMITS**
Tested in Accordance with:BS 1377-2:1990:Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

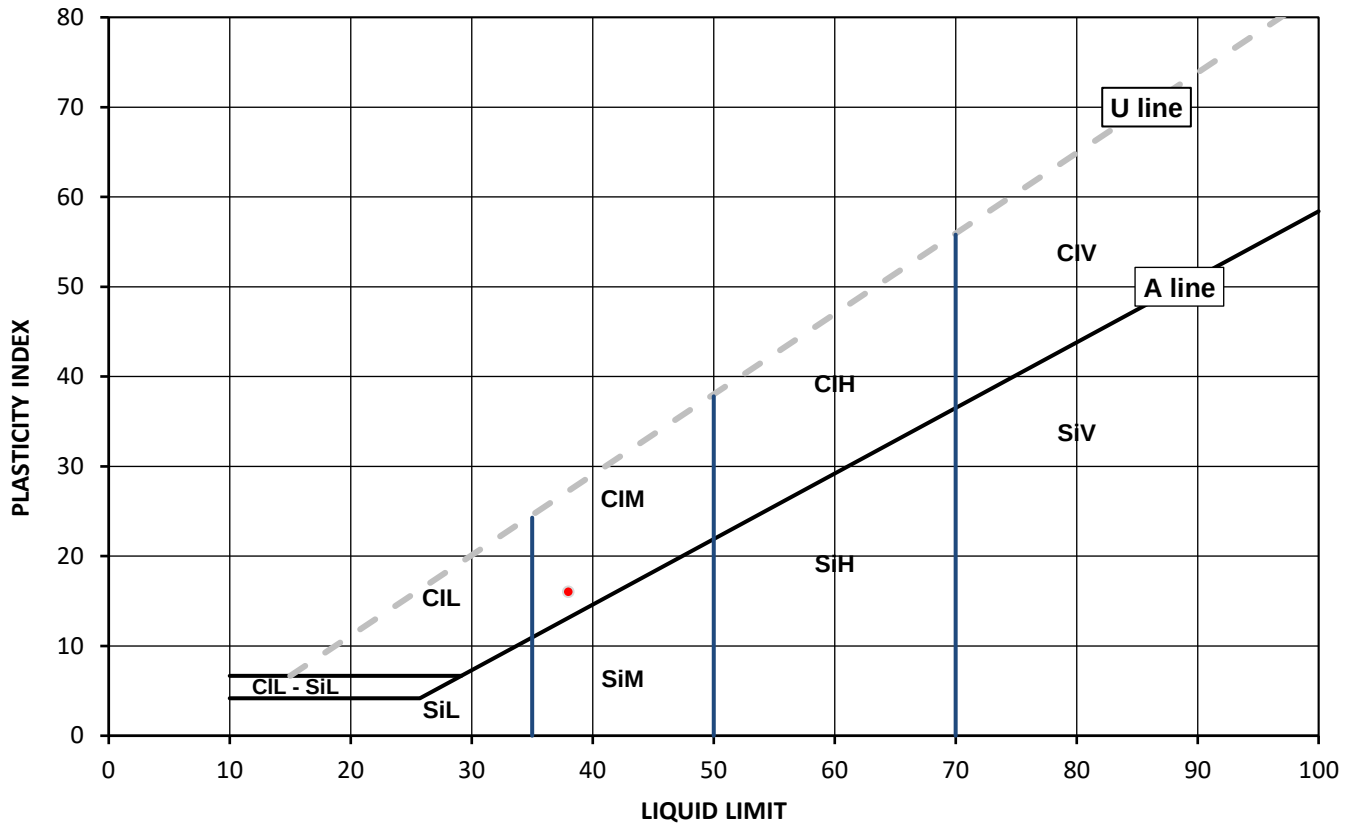
*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091672 | Depth Top [m]: | 0.80 |
| Hole No.: | WS05 | Depth Base [m]: | 1.10 |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Brown gravelly sandy CLAY | | |

Sample Preparation: Tested after washing to remove >425um

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 23 | 38 | 22 | 16 | 59 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

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**Signed:**

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Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 232.11**

# TEST CERTIFICATE

**DETERMINATION OF LIQUID AND PLASTIC LIMITS**

Tested in Accordance with:BS 1377-2:1990:Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

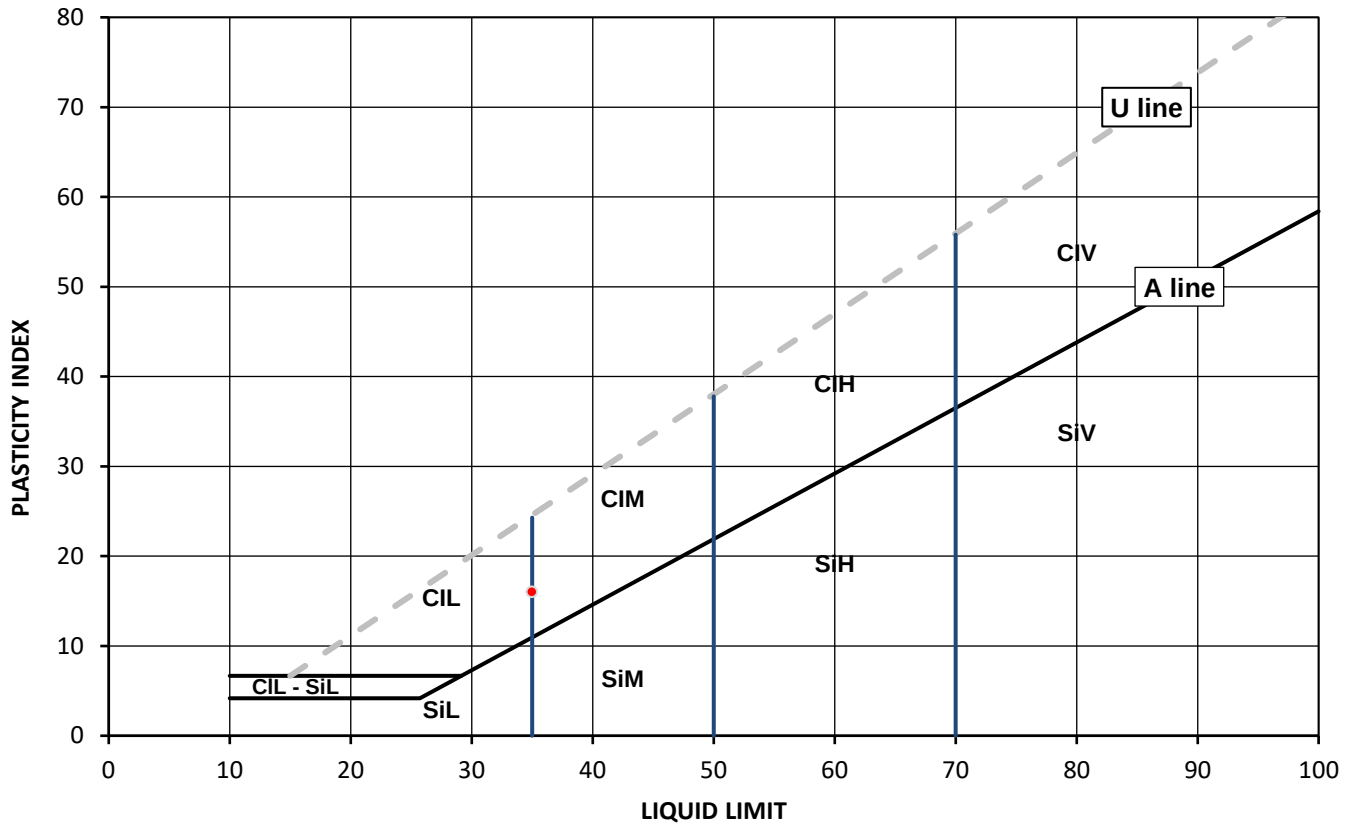
| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 03/11/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 10/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091684 | Depth Top [m]: | 2.80 |
| Hole No.: | RC03 | Depth Base [m]: | 3.10 |
| Sample Reference: | Not Given | Sample Type: | C |
| Sample Description: | Yellowish brown mottled light grey sandy CLAY | | |
| Sample Preparation: | Tested in natural condition | | |

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 14 | 35 | 19 | 16 | 100 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 232.11**

# TEST CERTIFICATE

**DETERMINATION OF LIQUID AND PLASTIC LIMITS**
Tested in Accordance with:BS 1377-2:1990:Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

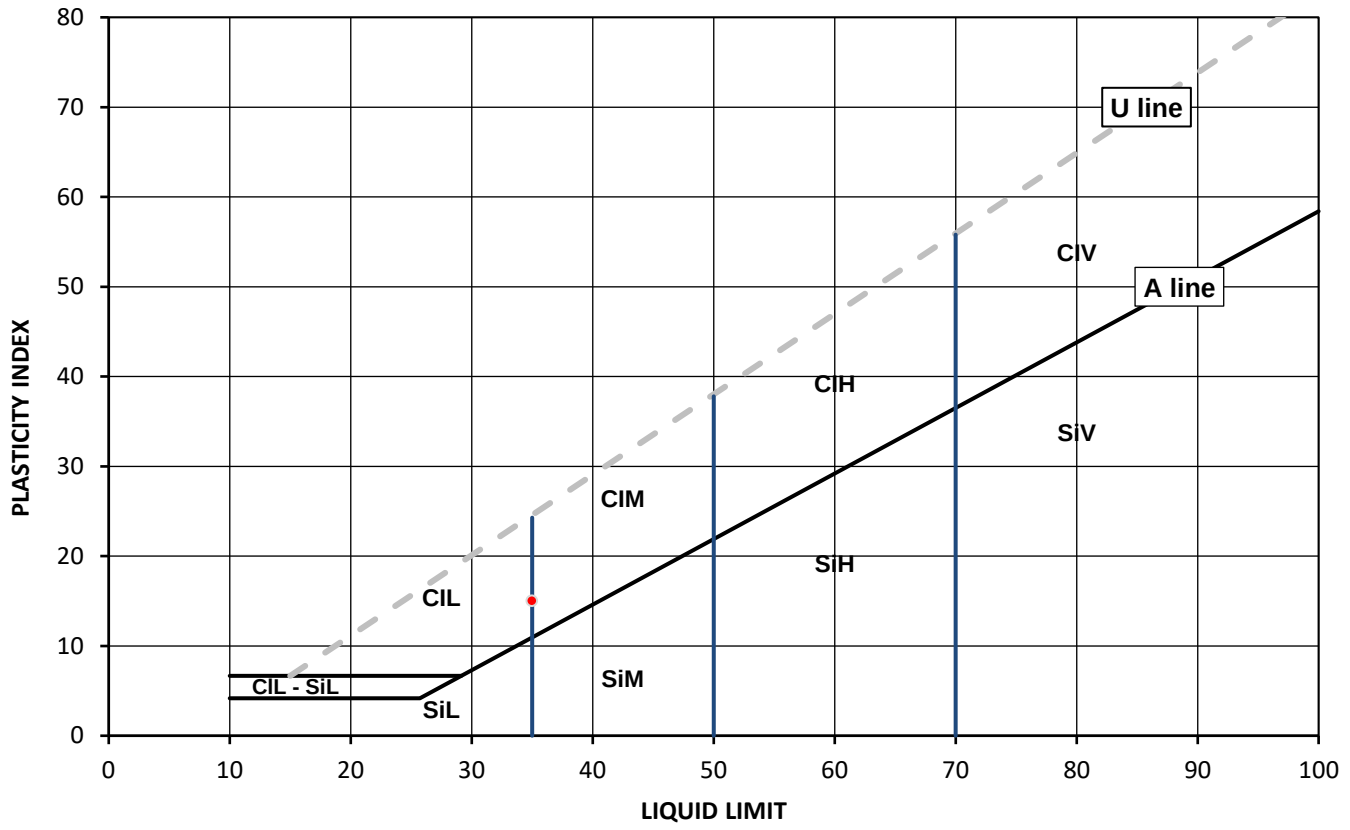
| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 09/11/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 10/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091694 | Depth Top [m]: | 2.00 |
| Hole No.: | RC05 | Depth Base [m]: | 2.10 |
| Sample Reference: | Not Given | Sample Type: | C |
| Sample Description: | Yellowish brown mottled light grey slightly gravelly sandy CLAY | | |
| Sample Preparation: | Tested after washing to remove >425um | | |

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 20 | 35 | 20 | 15 | 87 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

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**Date Reported:** 14/12/2021

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# TEST CERTIFICATE

**DETERMINATION OF LIQUID AND PLASTIC LIMITS**
Tested in Accordance with:BS 1377-2:1990:Clause 4.4 and 5

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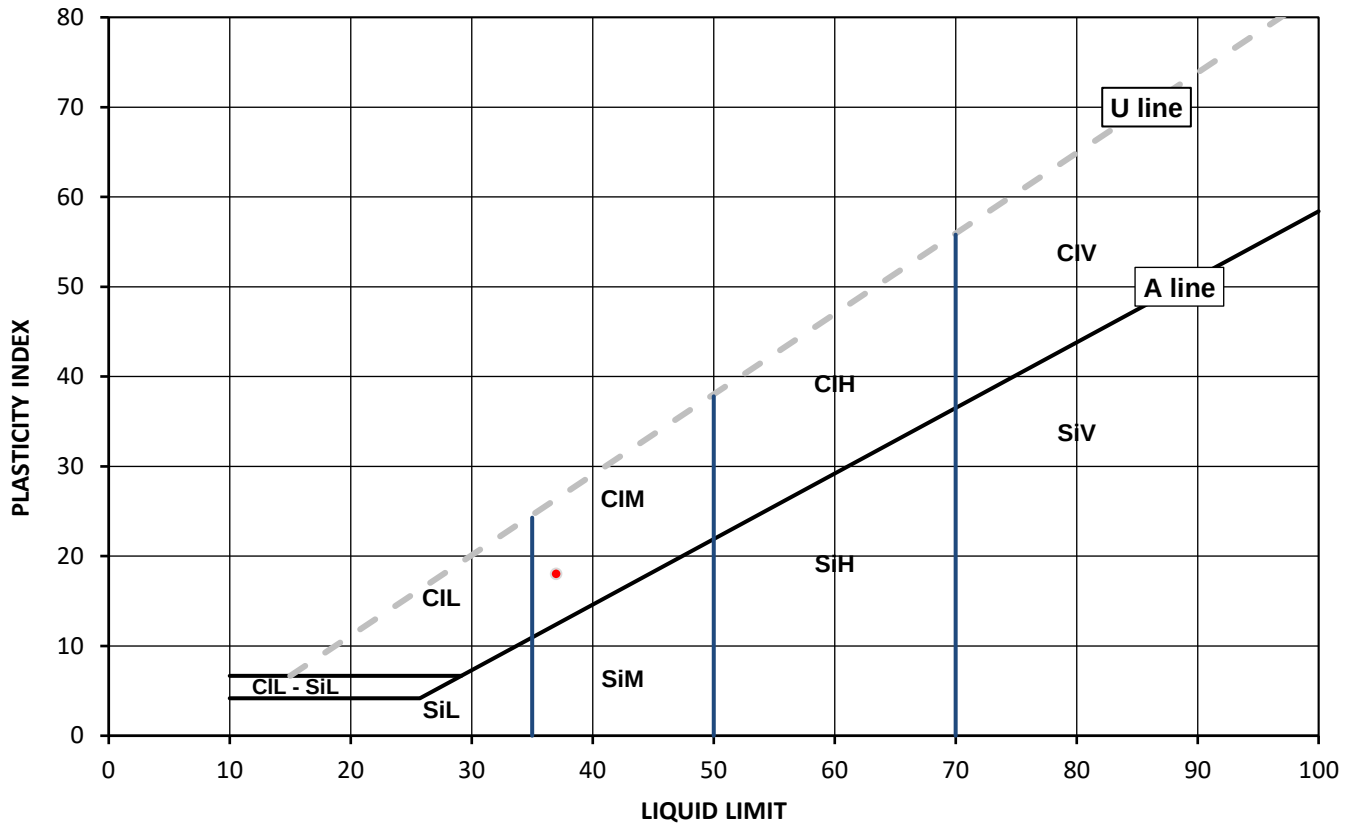
| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 11/11/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 10/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091695 | Depth Top [m]: | 3.00 |
| Hole No.: | RC05 | Depth Base [m]: | 3.50 |
| Sample Reference: | Not Given | Sample Type: | B |
| Sample Description: | Multicolour sandy very gravelly CLAY | | |
| Sample Preparation: | Tested after washing to remove >425um | | |

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 14 | 37 | 19 | 18 | 56 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

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**Date Reported:** 14/12/2021

**GF 232.11**

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Northampton NN4 7EB

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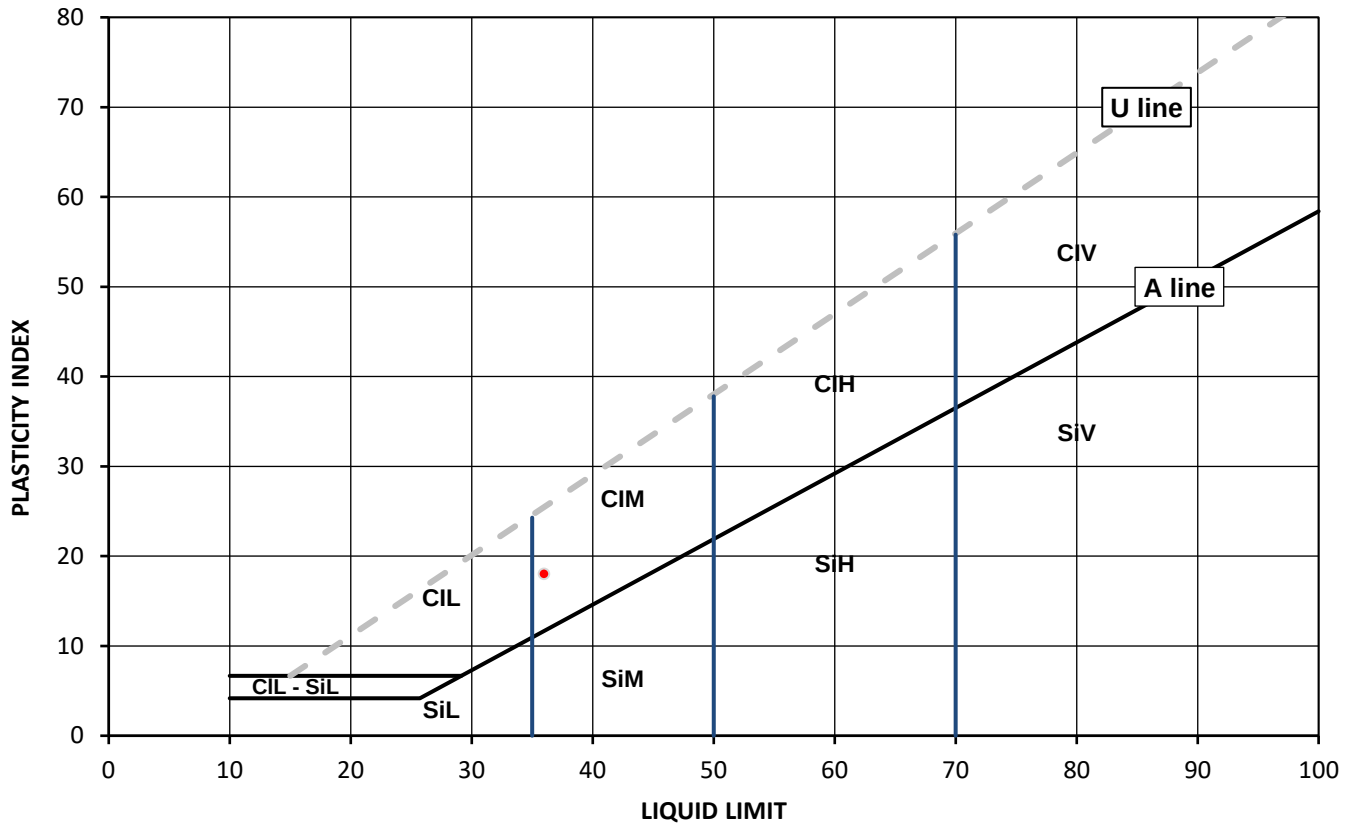
| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 11/11/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 10/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091699 | Depth Top [m]: | 2.60 |
| Hole No.: | RC06 | Depth Base [m]: | 2.70 |
| Sample Reference: | Not Given | Sample Type: | C |
| Sample Description: | Multicolour slightly gravelly sandy CLAY with shales | | |
| Sample Preparation: | Tested after >425um removed by hand | | |

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 14 | 36 | 18 | 18 | 98 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

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Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 232.11**

# TEST CERTIFICATE

**DETERMINATION OF LIQUID AND PLASTIC LIMITS**
Tested in Accordance with:BS 1377-2:1990:Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 16/11/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 10/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

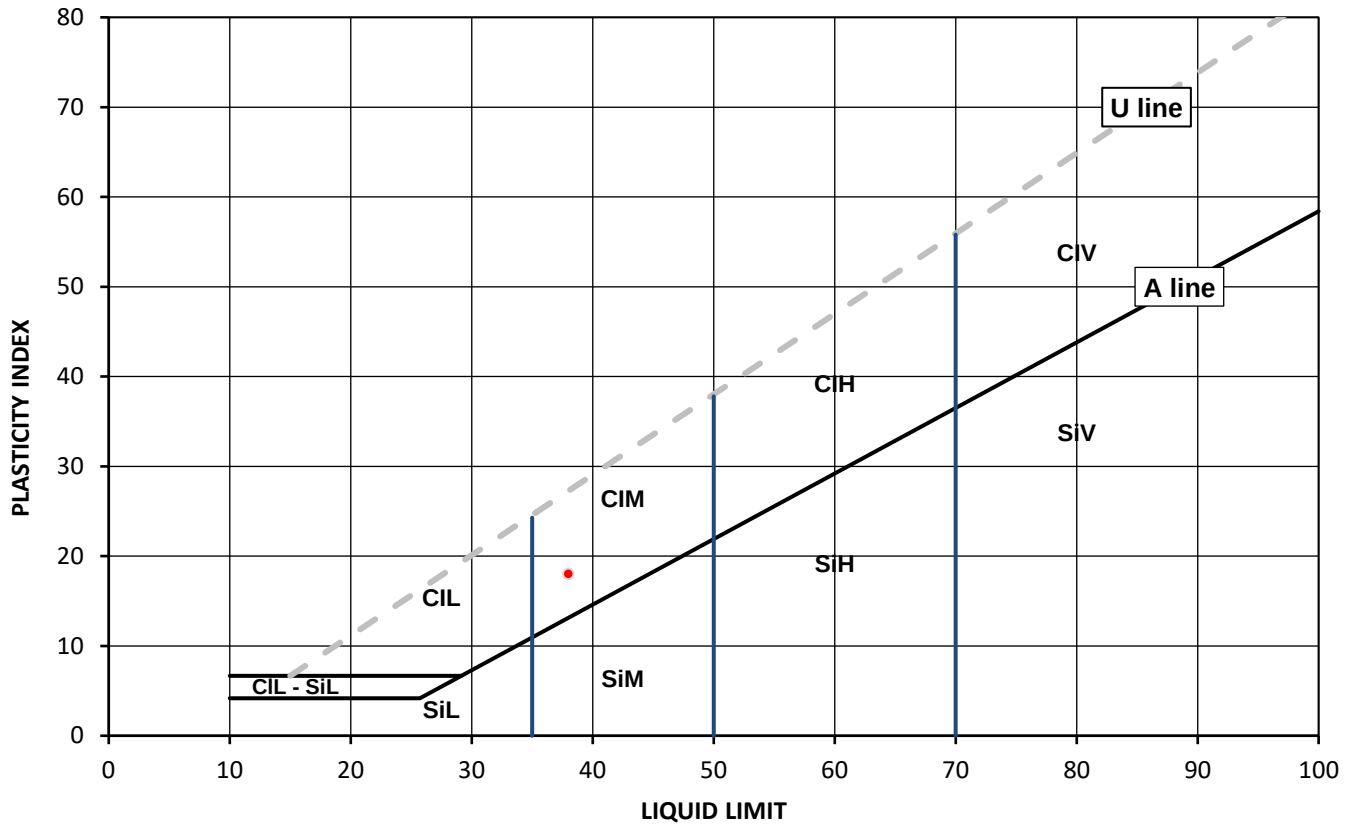
*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091707 | Depth Top [m]: | 10.00 |
| Hole No.: | RC06 | Depth Base [m]: | Not Given |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Grey sandy gravelly CLAY | | |

Sample Preparation: Tested after washing to remove >425um

| As Received Moisture Content [ W ] % | Liquid Limit [ WL ] % | Plastic Limit [ Wp ] % | Plasticity Index [ Ip ] % | % Passing 425µm BS Test Sieve |
|---|---|---|---|---|
| 17 | 38 | 20 | 18 | 67 |




Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

| | | Plasticity | | Liquid Limit |
|---|---|---|---|---|
| Cl | Clay | L | Low | below 35 |
| Si | Silt | M | Medium | 35 to 50 |
| | | H | High | 50 to 70 |
| | | V | Very high | exceeding 70 |
| | | O | Organic | append to classification for organic material ( eg ClHO ) |

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

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Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 232.11**

# SUMMARY REPORT

## SUMMARY OF CLASSIFICATION TEST RESULTS

Tested in Accordance with:

Moisture Content by BS 1377-2: 1990: Clause 3.2; Water Content by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3 (4 Point Test), Clause 4.4 (1 Point Test) and 5; PD by BS 1377-2: 1990: Clause 8.2

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client: CURTINS

Client Address: 2 The Wharf, Bridge Street, Birmingham, B1 2JS

Contact: Rowshi Hussain

Site Address: Trinity Academy, Barnsley

Client Reference: 21-24590
Job Number: 21-24590
Date Sampled: 28/10 - 16/11/2021
Date Received: 17/11/2021
Date Tested: 02/12 - 10/12/2021
Sampled By: Not Given

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

### Test results

| Laboratory Reference | Hole No. | Sample | | | | Description | Remarks | Moisture Content [ W ] | Water Content [ W ] | Atterberg | | | | Density | | | Total Porosity# | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reference | Depth Top | Depth Base | Type | | | | | % Passing 425um | WL | Wp | Ip | bulk | dry | PD | | | |
| | | | m | m | | | | % | % | % | % | % | % | Mg/m3 | Mg/m3 | Mg/m3 | % | | |
| 2091684 | RC03 | Not Given | 2.80 | 3.10 | C | Yellowish brown mottled light grey sandy CLAY | Atterberg 1 Point | 14 | | 100 | 35 | 19 | 16 | | | | | | |
| 2091694 | RC05 | Not Given | 2.00 | 2.10 | C | Yellowish brown mottled light grey slightly gravelly sandy CLAY | Atterberg 1 Point | 20 | | 87 | 35 | 20 | 15 | | | | | | |
| 2091695 | RC05 | Not Given | 3.00 | 3.50 | B | Multicolour sandy very gravelly CLAY | Atterberg 1 Point | 14 | | 56 | 37 | 19 | 18 | | | | | | |
| 2091699 | RC06 | Not Given | 2.60 | 2.70 | C | Multicolour slightly gravelly sandy CLAY with shales | Atterberg 1 Point | 14 | | 98 | 36 | 18 | 18 | | | | | | |
| 2091707 | RC06 | Not Given | 10.00 | Not Given | D | Grey sandy gravelly CLAY | Atterberg 1 Point | 17 | | 67 | 38 | 20 | 18 | | | | | | |
| 2091666 | WS01 | Not Given | 0.50 | 0.95 | D | Light brown CLAY | | 6.1 | | | | | | | | | | | |
| 2091668 | WS03 | Not Given | 0.85 | 1.30 | D | Brown gravelly sandy CLAY | Atterberg 1 Point | 10 | | 73 | 34 | 19 | 15 | | | | | | |
| 2091670 | WS04 | Not Given | 0.50 | 0.95 | D | Brown gravelly sandy CLAY | Atterberg 1 Point | 9.7 | | 70 | 39 | 20 | 19 | | | | | | |
| 2091672 | WS05 | Not Given | 0.80 | 1.10 | D | Brown gravelly sandy CLAY | Atterberg 1 Point | 23 | | 59 | 38 | 22 | 16 | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Note: # Non accredited; NP - Non plastic

Comments:

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**

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**Date Reported:** 14/12/2021

**GF 234.13**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

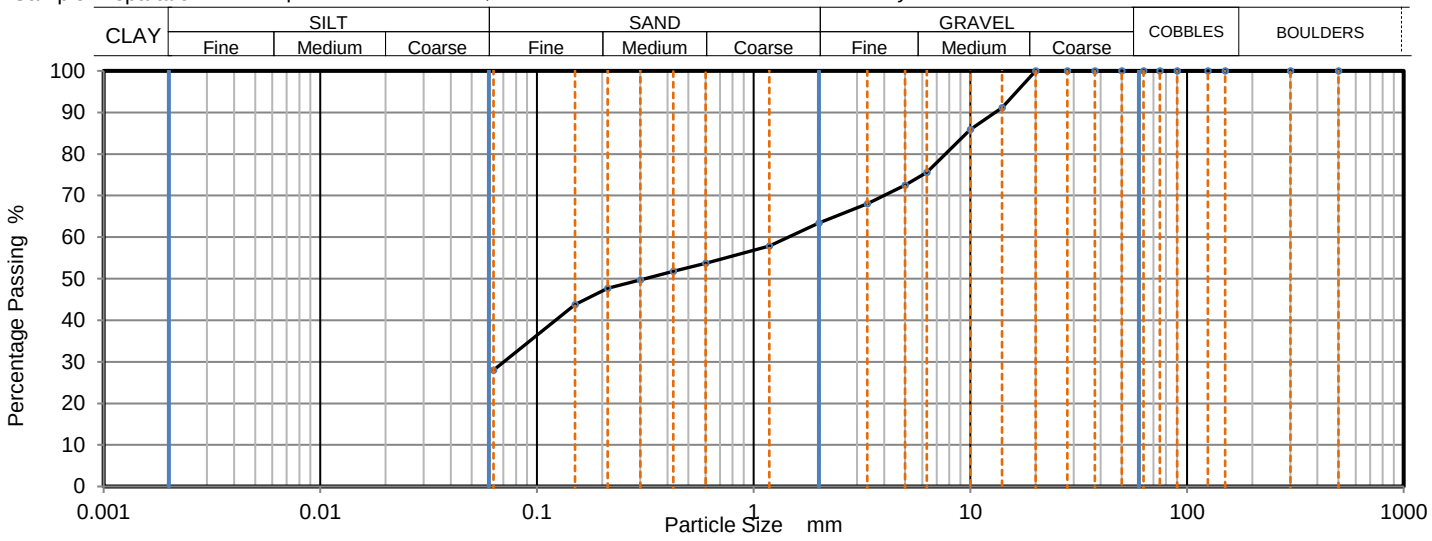
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091667 | Depth Top [m]: | 0.75 |
| Hole No.: | WS01 | Depth Base [m]: | Not Given |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Yellowish brown very sandy very clayey GRAVEL | | |
| Sample Preparation: | Sample was whole tested, oven dried at 106.0 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 100 | | |
| 20 | 100 | | |
| 14 | 91 | | |
| 10 | 86 | | |
| 6.3 | 76 | | |
| 5 | 73 | | |
| 3.35 | 68 | | |
| 2 | 63 | | |
| 1.18 | 58 | | |
| 0.6 | 54 | | |
| 0.425 | 52 | | |
| 0.3 | 50 | | |
| 0.212 | 48 | | |
| 0.15 | 44 | | |
| 0.063 | 28 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 37 |
| Sand | 35 |
| | |
| Fines <0.063mm | 28 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 20 |
| D60 | mm | 1.44 |
| D30 | mm | 0.0704 |
| D10 | mm | |
| Uniformity Coefficient | | > 23 |
| Curvature Coefficient | | |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**

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**Date Reported:** 14/12/2021

**GF 100.21**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

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Unit 8 Harrowden Road
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Northampton NN4 7EB

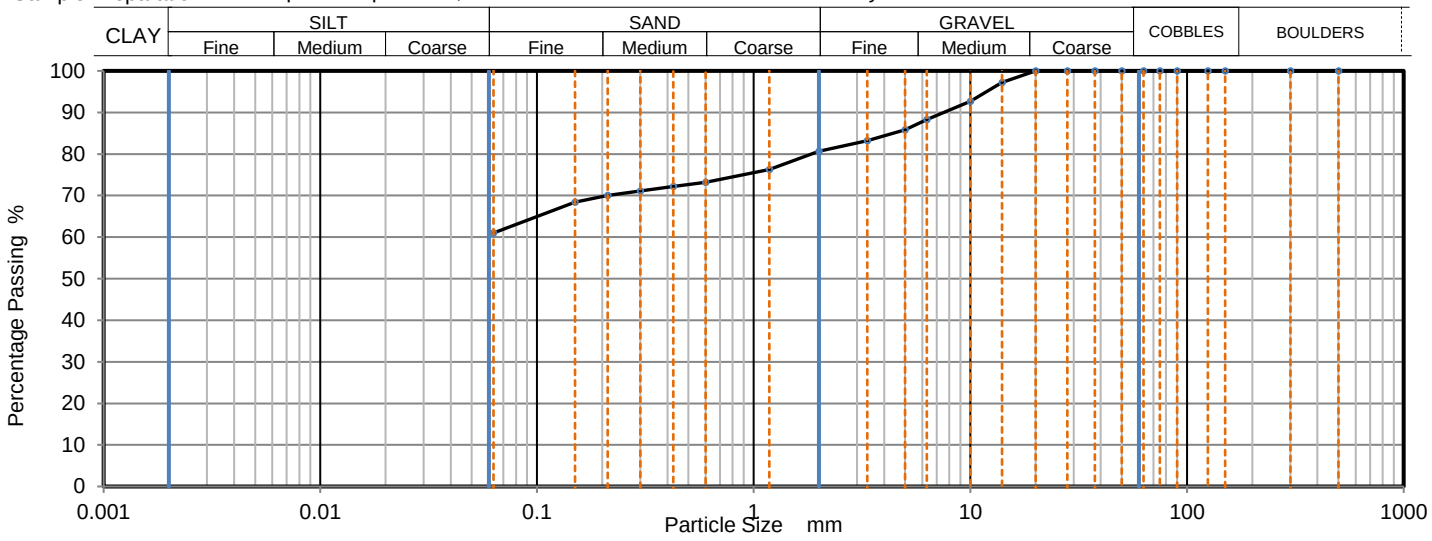
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091668 | Depth Top [m]: | 0.85 |
| Hole No.: | WS03 | Depth Base [m]: | 1.30 |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Brown gravelly sandy CLAY | | |
| Sample Preparation: | Sample was quartered, oven dried at 106.2 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 100 | | |
| 20 | 100 | | |
| 14 | 97 | | |
| 10 | 93 | | |
| 6.3 | 88 | | |
| 5 | 86 | | |
| 3.35 | 83 | | |
| 2 | 81 | | |
| 1.18 | 76 | | |
| 0.6 | 73 | | |
| 0.425 | 72 | | |
| 0.3 | 71 | | |
| 0.212 | 70 | | |
| 0.15 | 68 | | |
| 0.063 | 62 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 19 |
| Sand | 19 |
| | |
| Fines <0.063mm | 62 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 20 |
| D60 | mm | |
| D30 | mm | |
| D10 | mm | |
| Uniformity Coefficient | | N/A |
| Curvature Coefficient | | |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 100.21**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

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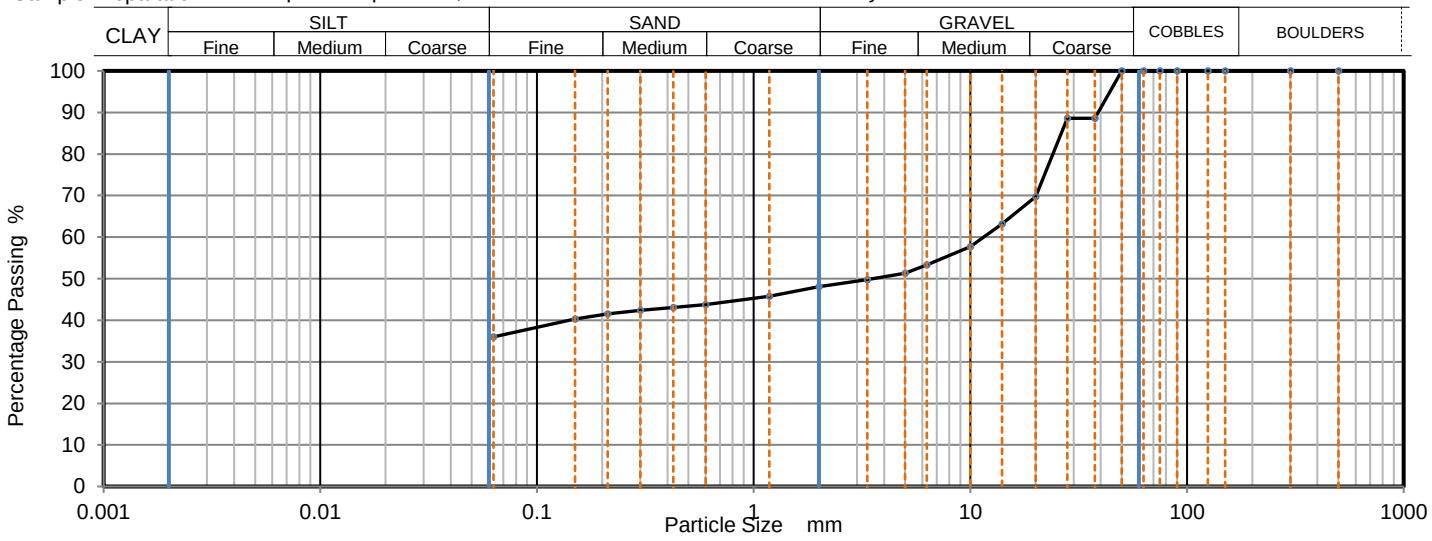
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091669 | Depth Top [m]: | 1.85 |
| Hole No.: | WS03 | Depth Base [m]: | Not Given |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Light brown very clayey sandy GRAVEL with fragments of shales | | |
| Sample Preparation: | Sample was quartered, oven dried at 106.0 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 89 | | |
| 28 | 89 | | |
| 20 | 70 | | |
| 14 | 63 | | |
| 10 | 58 | | |
| 6.3 | 53 | | |
| 5 | 51 | | |
| 3.35 | 50 | | |
| 2 | 48 | | |
| 1.18 | 46 | | |
| 0.6 | 44 | | |
| 0.425 | 43 | | |
| 0.3 | 42 | | |
| 0.212 | 42 | | |
| 0.15 | 40 | | |
| 0.063 | 36 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 52 |
| Sand | 12 |
| | |
| Fines <0.063mm | 36 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 50 |
| D60 | mm | 11.5 |
| D30 | mm | |
| D10 | mm | |
| Uniformity Coefficient | | > 180 |
| Curvature Coefficient | | |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.



**Date Reported:** 14/12/2021

**GF 100.21**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

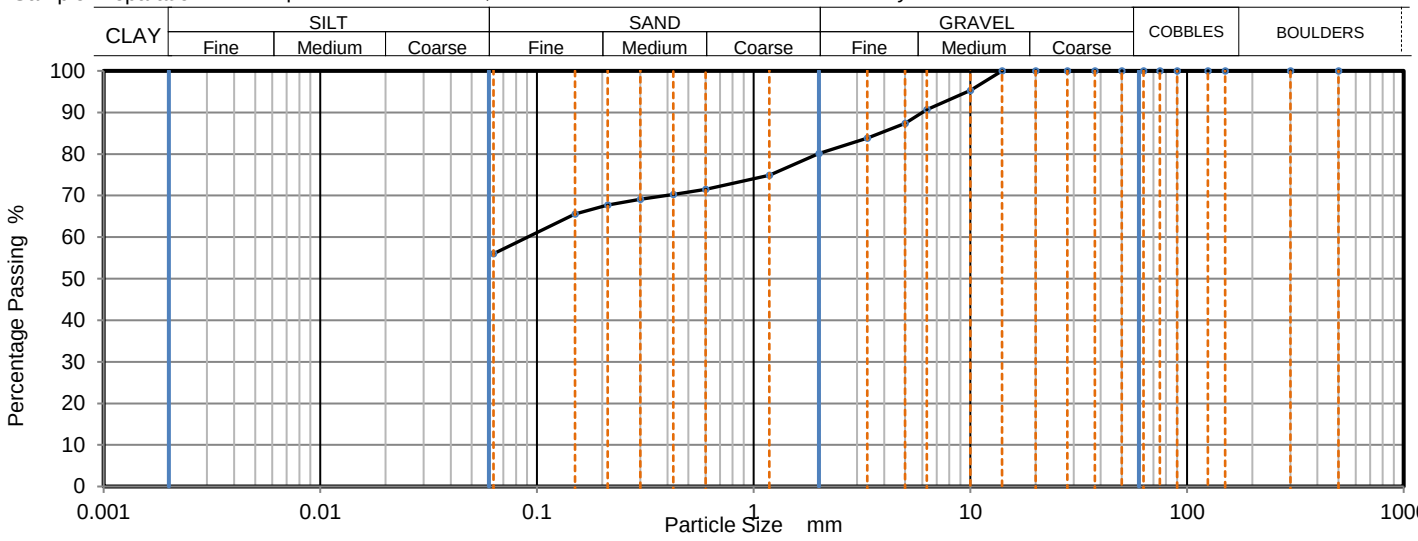
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091670 | Depth Top [m]: | 0.50 |
| Hole No.: | WS04 | Depth Base [m]: | 0.95 |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Brown gravelly sandy CLAY | | |
| Sample Preparation: | Sample was whole tested, oven dried at 106.0 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 100 | | |
| 20 | 100 | | |
| 14 | 100 | | |
| 10 | 95 | | |
| 6.3 | 91 | | |
| 5 | 87 | | |
| 3.35 | 84 | | |
| 2 | 80 | | |
| 1.18 | 75 | | |
| 0.6 | 72 | | |
| 0.425 | 70 | | |
| 0.3 | 69 | | |
| 0.212 | 68 | | |
| 0.15 | 66 | | |
| 0.063 | 56 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 20 |
| Sand | 24 |
| | |
| Fines <0.063mm | 56 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 14 |
| D60 | mm | 0.0904 |
| D30 | mm | |
| D10 | mm | |
| Uniformity Coefficient | | > 1.4 |
| Curvature Coefficient | | |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 100.21**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

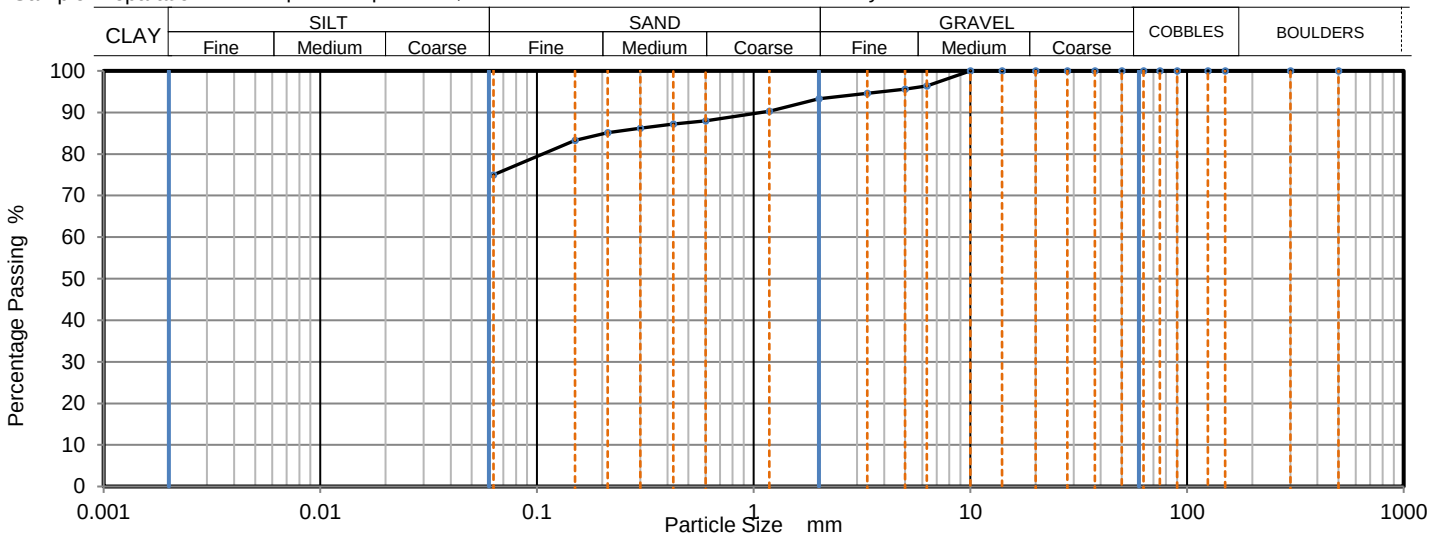
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091671 | Depth Top [m]: | 1.50 |
| Hole No.: | WS04 | Depth Base [m]: | 1.80 |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Greyish brown sandy slightly gravelly CLAY | | |
| Sample Preparation: | Sample was quartered, oven dried at 107.0 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 100 | | |
| 20 | 100 | | |
| 14 | 100 | | |
| 10 | 100 | | |
| 6.3 | 96 | | |
| 5 | 96 | | |
| 3.35 | 95 | | |
| 2 | 93 | | |
| 1.18 | 90 | | |
| 0.6 | 88 | | |
| 0.425 | 87 | | |
| 0.3 | 86 | | |
| 0.212 | 85 | | |
| 0.15 | 83 | | |
| 0.063 | 76 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 7 |
| Sand | 17 |
| | |
| Fines <0.063mm | 76 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 10 |
| D60 | mm | |
| D30 | mm | |
| D10 | mm | |
| Uniformity Coefficient | | N/A |
| Curvature Coefficient | | |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 100.21**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

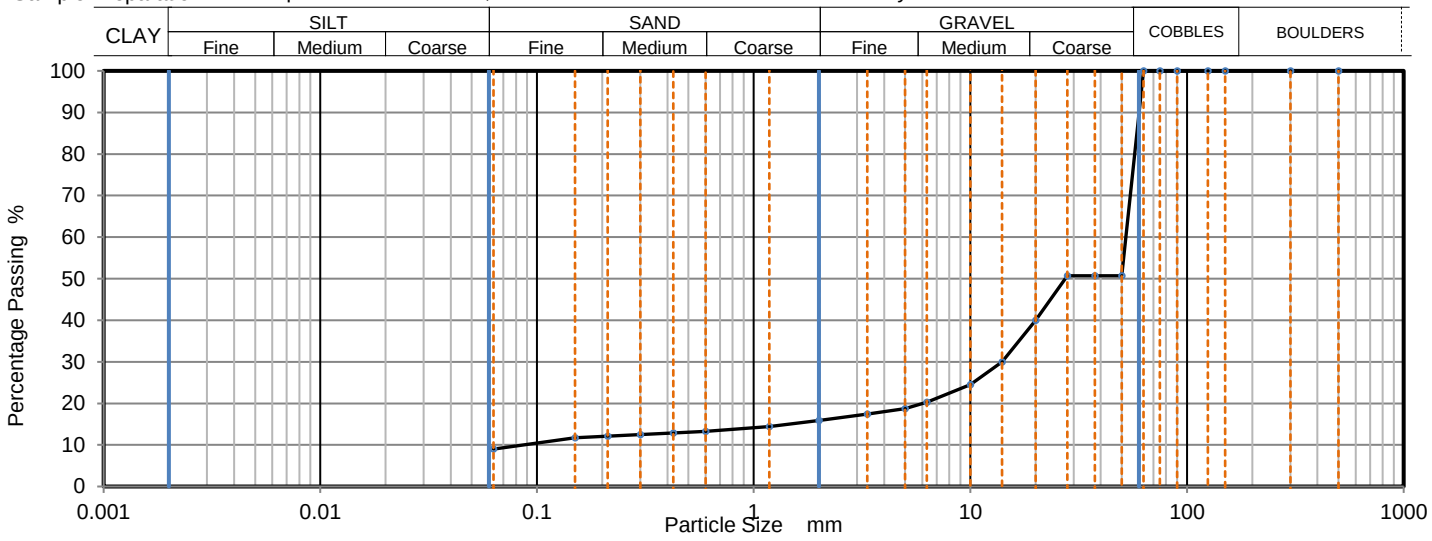
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 28/10/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 02/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091673 | Depth Top [m]: | 1.80 |
| Hole No.: | WS05 | Depth Base [m]: | 1.90 |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Brown clayey slightly sandy GRAVEL | | |
| Sample Preparation: | Sample was whole tested, oven dried at 106.2 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 51 | | |
| 37.5 | 51 | | |
| 28 | 51 | | |
| 20 | 40 | | |
| 14 | 30 | | |
| 10 | 25 | | |
| 6.3 | 20 | | |
| 5 | 19 | | |
| 3.35 | 17 | | |
| 2 | 16 | | |
| 1.18 | 14 | | |
| 0.6 | 13 | | |
| 0.425 | 13 | | |
| 0.3 | 13 | | |
| 0.212 | 12 | | |
| 0.15 | 12 | | |
| 0.063 | 10 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 84 |
| Sand | 6 |
| | |
| Fines <0.063mm | 10 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 63 |
| D60 | mm | 52.2 |
| D30 | mm | 14 |
| D10 | mm | 0.0733 |
| Uniformity Coefficient | | 710 |
| Curvature Coefficient | | 51 |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks: The material submitted - fails to meet the minimum mass requirements as stated in BS1377 Part 2 Table 3

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**

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**Date Reported:** 14/12/2021

**GF 100.21**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

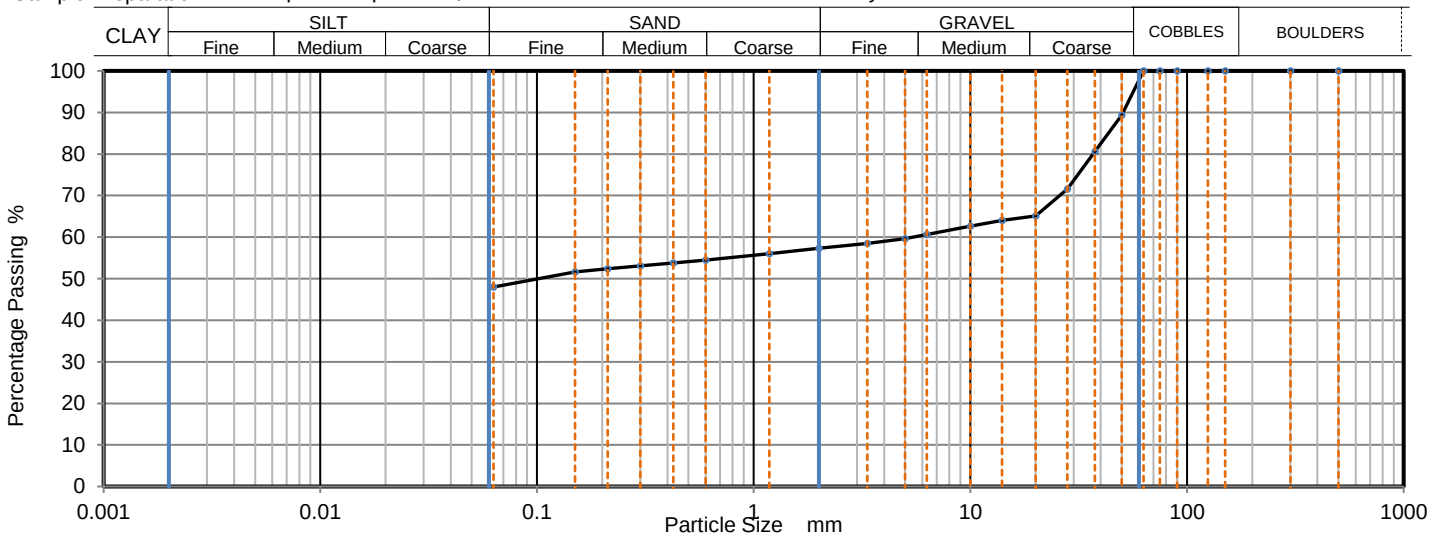
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 11/11/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 10/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091695 | Depth Top [m]: | 3.00 |
| Hole No.: | RC05 | Depth Base [m]: | 3.50 |
| Sample Reference: | Not Given | Sample Type: | B |
| Sample Description: | Multicolour sandy very gravelly CLAY | | |
| Sample Preparation: | Sample was quartered, oven dried at 106.0 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 89 | | |
| 37.5 | 81 | | |
| 28 | 72 | | |
| 20 | 65 | | |
| 14 | 64 | | |
| 10 | 63 | | |
| 6.3 | 61 | | |
| 5 | 60 | | |
| 3.35 | 59 | | |
| 2 | 57 | | |
| 1.18 | 56 | | |
| 0.6 | 55 | | |
| 0.425 | 54 | | |
| 0.3 | 53 | | |
| 0.212 | 52 | | |
| 0.15 | 52 | | |
| 0.063 | 48 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 43 |
| Sand | 9 |
| | |
| Fines <0.063mm | 48 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 63 |
| D60 | mm | 5.48 |
| D30 | mm | |
| D10 | mm | |
| Uniformity Coefficient | | > 87 |
| Curvature Coefficient | | |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 100.21**

# TEST CERTIFICATE

**DETERMINATION OF PARTICLE SIZE DISTRIBUTION**

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

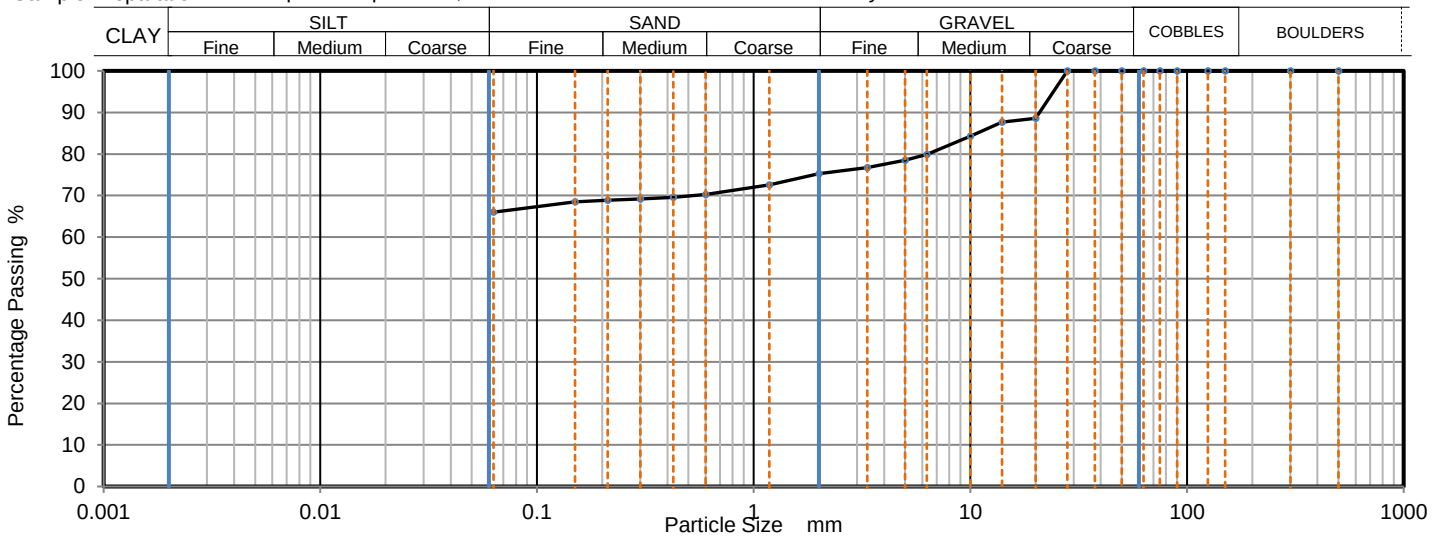
4041

| | | | |
|---|---|---|---|
| Client: | CURTINS | Client Reference: | 21-24590 |
| Client Address: | 2 The Wharf, Bridge Street, Birmingham, B1 2JS | Job Number: | 21-24590 |
| | | Date Sampled: | 16/11/2021 |
| | | Date Received: | 17/11/2021 |
| Contact: | Rowshi Hussain | Date Tested: | 10/12/2021 |
| Site Address: | Trinity Academy, Barnsley | Sampled By: | Not Given |

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

**Test Results:**

| | | | |
|---|---|---|---|
| Laboratory Reference: | 2091707 | Depth Top [m]: | 10.00 |
| Hole No.: | RC06 | Depth Base [m]: | Not Given |
| Sample Reference: | Not Given | Sample Type: | D |
| Sample Description: | Grey sandy gravelly CLAY | | |
| Sample Preparation: | Sample was quartered, oven dried at 107.0 °C and broken down by hand. | | |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 500 | 100 | | |
| 300 | 100 | | |
| 150 | 100 | | |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 100 | | |
| 28 | 100 | | |
| 20 | 89 | | |
| 14 | 88 | | |
| 10 | 84 | | |
| 6.3 | 80 | | |
| 5 | 79 | | |
| 3.35 | 77 | | |
| 2 | 75 | | |
| 1.18 | 73 | | |
| 0.6 | 70 | | |
| 0.425 | 70 | | |
| 0.3 | 69 | | |
| 0.212 | 69 | | |
| 0.15 | 69 | | |
| 0.063 | 67 | | |

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 25 |
| Sand | 9 |
| | |
| Fines <0.063mm | 67 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | 28 |
| D60 | mm | |
| D30 | mm | |
| D10 | mm | |
| Uniformity Coefficient | | N/A |
| Curvature Coefficient | | |

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

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**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**



**Date Reported:** 14/12/2021

**GF 100.21**

# SUMMARY REPORT

## Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Client: CURTINS

Client Address: 2 The Wharf, Bridge Street, Birmingham, B1 2JS

Contact: Rowshi Hussain

Site Address: Trinity Academy, Barnsley

Client Reference: 21-24590
Job Number: 21-24590
Date Sampled: 21/10 - 27/10/2021
Date Received: 17/11/2021
Date Tested: 13/12/2021
Sampled By: Not Given

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

### Test results

| Laboratory Reference | Hole No. | Sample | | | | Description | Remarks # (including water content if measured) | Specimen Reference | Test Type see ISRM | | Failure Valid (Y/N) | Dimensions | | | | Force P | Equivalent diameter, De | Point Load Strength Index | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reference | Depth Top | Depth Base | Type | | | | Type (D, A, I, B) | Direction (L, P or U) | | Lne | W | Dps | Dps' | | | Is | Is(50) |
| | | | m | m | | | | | | | | mm | mm | mm | mm | kN | mm | MPa | MPa |
| 2091674 | RC01 | Not Given | 2.10 | 2.23 | C | Light brown to light grey SHALE | WC = 4.4% | 1 | A | P | YES | - | 100.3 | 71.0 | 29.0 | 3.7 | 60.9 | 1.00 | 1.09 |
| 2091675 | RC01 | Not Given | 3.34 | 3.50 | C | Grey to brown SHALE | WC = 6.5% | 1 | A | P | YES | - | 100.4 | 68.0 | 61.0 | 0.4 | 88.3 | 0.05 | 0.07 |
| 2091676 | RC01 | Not Given | 4.40 | 4.45 | C | Grey to brown SHALE | WC = 5.7% | 1 | A | P | YES | - | 100.9 | 37.0 | 33.0 | 1.6 | 65.1 | 0.37 | 0.41 |
| 2091677 | RC02 | Not Given | 1.70 | 2.10 | C | Orange SANDSTONE | WC = 11.4% | 1 | I | U | YES | 60.8 | 100.1 | 84.0 | 52.0 | 2.2 | 81.4 | 0.33 | 0.41 |
| 2091678 | RC02 | Not Given | 3.30 | 3.70 | C | Light brown SHALE | WC = 2.5% | 1 | I | U | YES | 49.2 | 53.1 | 33.0 | 25.0 | 0.8 | 41.1 | 0.44 | 0.41 |
| 2091679 | RC02 | Not Given | 3.70 | 4.00 | C | Light brown SHALE | WC = 3.6% | 1 | A | P | YES | - | 100.2 | 55.0 | 51.0 | 1.4 | 80.7 | 0.21 | 0.26 |
| 2091680 | RC02 | Not Given | 4.50 | 5.00 | C | Grey to brown SHALE | WC = 10.2% | 1 | A | P | YES | - | 100.1 | 39.0 | 31.0 | 0.2 | 62.9 | 0.04 | 0.04 |
| 2091681 | RC02 | Not Given | 6.10 | 6.40 | C | Light grey SILTSTONE | WC = 2.5% | 1 | A | U | YES | - | 100.1 | 38.0 | 16.0 | 3.3 | 45.2 | 1.62 | 1.55 |
| 2091682 | RC02 | Not Given | 7.50 | 7.70 | C | Light grey SILTSTONE | WC = 2.2% | 1 | A | U | YES | - | 99.9 | 46.0 | 29.0 | 6.8 | 60.7 | 1.84 | 2.01 |
| 2091683 | RC02 | Not Given | 8.20 | 8.40 | C | Light grey SILTSTONE | WC = 2.3% | 1 | A | U | YES | - | 98.3 | 55.0 | 33.0 | 3.6 | 64.3 | 0.87 | 0.98 |

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens ( platen separation ), Dps' - at failure ( see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
Detailed legend for test and dimensions, based on ISRM, is shown above; Size factor, F = (De/50)0.45 for all tests

Comments:

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.



**Date Reported:** 14/12/2021

**GF 134.12**

# SUMMARY REPORT

## Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Client: CURTINS

Client Address: 2 The Wharf, Bridge Street, Birmingham, B1 2JS

Contact: Rowshi Hussain

Site Address: Trinity Academy, Barnsley

Client Reference: 21-24590
Job Number: 21-24590
Date Sampled: 03/11 - 11/11/2021
Date Received: 17/11/2021
Date Tested: 13/12/2021
Sampled By: Not Given

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

### Test results

| Laboratory Reference | Hole No. | Sample | | | | Description | Remarks # (including water content if measured) | Specimen Reference | Test Type see ISRM | | Failure Valid (Y/N) | Dimensions | | | | Force P | Equivalent diameter, De | Point Load Strength Index | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reference | Depth Top m | Depth Base m | Type | | | | Type (D, A, I, B) | Direction (L, P or U) | | Lne mm | W mm | Dps mm | Dps' mm | kN | mm | Is MPa | Is(50) MPa |
| 2091685 | RC03 | Not Given | 3.50 | 3.70 | C | Light brown SHALE | WC = 4.5% | 1 | I | P | YES | 47.4 | 55.7 | 39.0 | 28.0 | 1.1 | 44.6 | 0.53 | 0.50 |
| 2091686 | RC03 | Not Given | 5.00 | 5.20 | C | Light brown SANDSTONE | WC = 14.6% | 1 | I | U | YES | 50.9 | 80.6 | 53.0 | 48.0 | 6.8 | 70.2 | 1.38 | 1.61 |
| 2091687 | RC03 | Not Given | 5.80 | 6.00 | C | Light brown SHALE | WC = 6.6% | 1 | A | P | YES | - | 100.5 | 65.0 | 42.0 | 9.4 | 73.3 | 1.75 | 2.08 |
| 2091688 | RC03 | Not Given | 6.50 | 6.80 | C | Light grey SILTSTONE | WC = 1.8% | 1 | A | P | YES | - | 100.7 | 66.0 | 55.0 | 5.6 | 84.0 | 0.79 | 0.99 |
| 2091689 | RC03 | Not Given | 8.10 | 8.40 | C | Light grey SILTSTONE | WC = 3.7% | 1 | A | P | YES | - | 100.8 | 71.0 | 34.0 | 3.2 | 66.1 | 0.73 | 0.83 |
| 2091690 | RC03 | Not Given | 9.10 | 9.40 | C | Light grey SILTSTONE | WC = 1.5% | 1 | A | U | YES | - | 99.4 | 58.0 | 48.0 | 10.1 | 77.9 | 1.66 | 2.03 |
| 2091691 | RC04 | Not Given | 4.00 | 4.10 | C | Light brown SILTSTONE | WC = 3.8% | 1 | A | P | YES | - | 101.1 | 42.0 | 33.0 | 6.8 | 65.2 | 1.59 | 1.79 |
| 2091692 | RC04 | Not Given | 6.90 | 7.00 | C | Light grey SILTSTONE | WC = 0.7% | 1 | A | U | YES | - | 99.9 | 58.0 | 33.0 | 27.9 | 64.8 | 6.65 | 7.47 |
| 2091693 | RC04 | Not Given | 9.50 | 9.60 | C | Grey SILTSTONE | WC = 1.2% | 1 | A | P | YES | - | 100.4 | 54.0 | 31.0 | 10.9 | 63.0 | 2.74 | 3.04 |
| 2091696 | RC05 | Not Given | 5.20 | 5.30 | C | Grey to light brown SILTSTONE | WC = 4.7% | 1 | A | P | YES | - | 99.9 | 75.0 | 59.0 | 6.6 | 86.6 | 0.87 | 1.12 |

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens ( platen separation ), Dps' - at failure ( see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
Detailed legend for test and dimensions, based on ISRM, is shown above; Size factor, F = (De/50)0.45 for all tests

Comments:

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**

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**Date Reported:** 14/12/2021

**GF 134.12**

# SUMMARY REPORT

## Summary of Point Load Strength Index Tests Results

Tested in Accordance with: ISRM: 2007, pages 125-132

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Client: CURTINS

Client Address: 2 The Wharf, Bridge Street, Birmingham, B1 2JS

Contact: Rowshi Hussain

Site Address: Trinity Academy, Barnsley

Client Reference: 21-24590
Job Number: 21-24590
Date Sampled: 11/11 - 16/11/2021
Date Received: 17/11/2021
Date Tested: 13/12/2021
Sampled By: Not Given

*Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland*

### Test results

| Laboratory Reference | Hole No. | Sample | | | | Description | Remarks # (including water content if measured) | Specimen Reference | Test Type see ISRM | | Failure Valid (Y/N) | Dimensions | | | | Force P | Equivalent diameter, De | Point Load Strength Index | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Reference | Depth Top m | Depth Base m | Type | | | | Type (D, A, I, B) | Direction (L, P or U) | | Lne mm | W mm | Dps mm | Dps' mm | kN | mm | Is MPa | Is(50) MPa |
| 2091697 | RC05 | Not Given | 6.50 | 6.60 | C | Yellowish brown SANDSTONE | WC = 6.3% | 1 | I | U | YES | 71.8 | 99.7 | 84.0 | 79.0 | 8.4 | 100.1 | 0.84 | 1.14 |
| 2091698 | RC05 | Not Given | 8.50 | 8.60 | C | Yellowish brown to light grey SILTSTONE | WC = 2.8% | 1 | A | P | YES | - | 101.1 | 53.0 | 44.0 | 15.3 | 75.3 | 2.69 | 3.24 |
| 2091700 | RC06 | Not Given | 3.20 | 3.40 | C | Yellowish brown to light grey SILTSTONE | WC = 9.5% | 1 | A | P | YES | - | 100.6 | 57.0 | 45.0 | 6.5 | 75.9 | 1.12 | 1.35 |
| 2091701 | RC06 | Not Given | 4.00 | 4.20 | C | Yellowish brown to light grey SANDSTONE | WC = 6.2% | 1 | A | L | YES | - | 100.7 | 66.0 | 55.0 | 9.8 | 84.0 | 1.38 | 1.75 |
| 2091702 | RC06 | Not Given | 5.00 | 5.10 | C | Yellowish brown SILTSTONE | WC = 9.4% | 1 | A | L | YES | - | 100.1 | 78.0 | 60.0 | 9.3 | 87.4 | 1.21 | 1.56 |
| 2091703 | RC06 | Not Given | 6.40 | 6.50 | C | Light brown to light grey SILTSTONE | WC = 3.7% | 1 | I | L | YES | 50.4 | 84.2 | 82.0 | 79.0 | 2.8 | 92.0 | 0.32 | 0.43 |
| 2091704 | RC06 | Not Given | 7.00 | 7.20 | C | Light brown to light grey SILTSTONE | WC = 2.9% | 1 | A | P | YES | - | 100.1 | 80.0 | 66.0 | 15.9 | 91.7 | 1.89 | 2.48 |
| 2091705 | RC06 | Not Given | 7.85 | 8.00 | D | Brown to grey SHALE | WC = 8.8% | 1 | A | P | YES | - | 98.3 | 42.0 | 25.0 | 0.2 | 55.9 | 0.05 | 0.05 |
| 2091706 | RC06 | Not Given | 9.00 | 9.10 | D | Brownish grey SHALE | WC = 7.0% | 1 | A | P | YES | - | 100.8 | 52.0 | 37.0 | 0.8 | 68.9 | 0.16 | 0.18 |
| | | | | | | | | | | | | | | | | | | | |

Note: # non accredited; Test Type: D - Diametral, A - Axial, I - Irregular Lump, B - Block; Direction: L - parallel to planes of weakness, P - perpendicular to planes of weakness, U - unknown or random;
Dimensions: Dps - Distance between platens ( platen separation ), Dps' - at failure ( see ISRM note 6), Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P;
Detailed legend for test and dimensions, based on ISRM, is shown above; Size factor, F = (De/50)0.45 for all tests

Comments:

**Signed:**

Katarzyna Koziel
Technical Reviewer
**for and on behalf of i2 Analytical Ltd**

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**Date Reported:** 14/12/2021

**GF 134.12**

# Appendix A5 – Ground Gas and Groundwater Monitoring Results

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**Curtins**
2 The Wharf, Bridge Street, Birmingham, B1 2JS
Tel: 0121 463 4694

# GAS MONITORING LOG SHEET

| | | | |
|---|---|---|---|
| **Project:** | Trinity Academy | **Date:** | 12/11/2021 |
| **Job Number:** | B079532 | **Visit:** | 1 |
| **Client:** | B&K | **Weather:** | Overcast |
| **Barometric State:** | Steady | **Ground Conditions:** | Damp |

| Borehole Reference | Barometric Pressure mb | Flow l/hr | | Methane % | | Carbon Dioxide % | | Oxygen % | Hydrogen Sulphide ppm | Carbon Monoxide ppm | Water Level m bgl | Borehole Base m bgl | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | SS | Max | SS | Max | SS | | | | | | |
| WS04 | 987 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 1.7 | 17.3 | 0 | 0 | 1.60 | 1.80 | |
| WS05 | 987 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 | 20.6 | 0 | 0 | Dry | 1.70 | |
| RC04S | | | | | | | | | | | | | 1 |
| RC04D | | | | | | | | | | | | | 1 |
| RC06S | | | | | | | | | | | | | 1 |
| RC06D | | | | | | | | | | | | | 1 |

**Notes**

1 - Boreholes still being drilled, not available for monitoring.

**Logged by**

RH

*1% gas volume = 10,000 ppm*
*Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.*
*All other gases recorded at 'steady state' unless otherwise stated*

**Curtins**
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

# GAS MONITORING LOG SHEET

| | | | |
|---|---|---|---|
| **Project:** | Trinity Academy | **Date:** | 17/11/2021 |
| **Job Number:** | B079532 | **Visit:** | 2 |
| **Client:** | B&K | **Weather:** | Sunny |
| **Barometric State:** | Steady | **Ground Conditions:** | Damp |

| Borehole Reference | Barometric Pressure mb | Flow l/hr | | Methane % | | Carbon Dioxide % | | Oxygen % | Hydrogen Sulphide ppm | Carbon Monoxide ppm | Water Level m bgl | Borehole Base m bgl | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | SS | Max | SS | Max | SS | | | | | | |
| WS04 | 1005 | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 | 1.8 | 17.2 | 0 | 0 | 1.65 | 1.80 | |
| WS05 | 1006 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.7 | 19.7 | 0 | 1 | Dry | 1.70 | |
| RC04S | | | | | | | | | | | | | 1 |
| RC04D | | | | | | | | | | | | | 1 |
| RC06S | | | | | | | | | | | | | 1 |
| RC06D | | | | | | | | | | | | | 1 |

**Notes**

1 - Boreholes still being drilled, not available for monitoring.

**Logged by**

RH

*1% gas volume = 10,000 ppm*
*Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.*
*All other gases recorded at 'steady state' unless otherwise stated*

**Curtins**
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Fax: 0161 228 7902

# GAS MONITORING LOG SHEET

| | | | |
|---|---|---|---|
| **Project:** | Trinity Academy | **Date:** | 27/11/2021 |
| **Job Number:** | B079532 | **Visit:** | 3 |
| **Client:** | B&K | **Weather:** | Sunny |
| **Barometric State:** | Falling | **Ground Conditions:** | Snow & Ice |

| Borehole Reference | Barometric Pressure mb | Flow l/hr | | Methane % | | Carbon Dioxide % | | Oxygen % | Hydrogen Sulphide ppm | Carbon Monoxide ppm | Water Level m bgl | Borehole Base m bgl | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | SS | Max | SS | Max | SS | | | | | | |
| WS04 | 997 | 0.0 | 0.0 | 0.0 | 0.0 | 2.3 | 2.3 | 16.6 | 0 | 3 | 1.70 | 1.80 | |
| WS05 | 995 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 | 19.6 | 0 | 1 | Dry | 1.80 | |
| RC04S | | | | | | | | | | | | | 1 |
| RC04D | | | | | | | | | | | | | 1 |
| RC06S | | | | | | | | | | | | | 1 |
| RC06D | | | | | | | | | | | | | 1 |

**Notes**

1 - Positions could not be found due to snow cover.

**Logged by**

RS

*1% gas volume = 10,000 ppm*
*Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.*
*All other gases recorded at 'steady state' unless otherwise stated*

**Curtins**
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# GAS MONITORING LOG SHEET

| | | | |
|---|---|---|---|
| **Project:** | Trinity Academy | **Date:** | 06/12/2021 |
| **Job Number:** | B079532 | **Visit:** | 4 |
| **Client:** | B&K | **Weather:** | Overcast |
| **Barometric State:** | Falling | **Ground Conditions:** | Wet |

| Borehole Reference | Barometric Pressure mb | Flow l/hr | | Methane % | | Carbon Dioxide % | | Oxygen % | Hydrogen Sulphide ppm | Carbon Monoxide ppm | Water Level m bgl | Borehole Base m bgl | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | SS | Max | SS | Max | SS | | | | | | |
| WS04 | 989 | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 | 2.1 | 16.4 | 2 | 1 | 1.35 | 1.80 | |
| WS05 | 988 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 19.2 | 2 | 0 | Dry | 1.80 | |
| RC04S | | | | | | | | | | | Dry | 5.00 | |
| RC04D | 987 | -7.6 | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 | 20.0 | 0 | 0 | 5.00 | 12.10 | |
| RC06S | | | | | | | | | | | 4.75 | 5.00 | |
| RC06D | 987 | 1.5 | 0.0 | 0.0 | 0.0 | 6.4 | 6.4 | 11.2 | 0 | 0 | Dry | 13.00 | |

**Notes**

**Logged by**

RS

*1% gas volume = 10,000 ppm*
*Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.*
*All other gases recorded at 'steady state' unless otherwise stated*

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# GAS MONITORING LOG SHEET

| | | | |
|---|---|---|---|
| **Project:** | Trinity Academy | **Date:** | 13/12/2021 |
| **Job Number:** | B079532 | **Visit:** | 5 |
| **Client:** | B&K | **Weather:** | Overcast |
| **Barometric State:** | Falling | **Ground Conditions:** | Damp |

| Borehole Reference | Barometric Pressure mb | Flow l/hr | | Methane % | | Carbon Dioxide % | | Oxygen % | Hydrogen Sulphide ppm | Carbon Monoxide ppm | Water Level m bgl | Borehole Base m bgl | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | SS | Max | SS | Max | SS | | | | | | |
| WS04 | 1002 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 1.9 | 16.3 | 0 | 0 | 1.40 | 1.80 | |
| WS05 | 1002 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 19.2 | 0 | 0 | DRY | 1.90 | |
| RC04S | 1002 | | | | | | | | | | DRY | 5.00 | |
| RC04D | 1002 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 20.5 | 0 | 0 | 6.70 | 12.00 | |
| RC06S | 1001 | | | | | | | | | | 4.80 | 5.00 | |
| RC06D | 1001 | 0.0 | 0.0 | 0.0 | 0.0 | 5.6 | 5.6 | 19.7 | 0 | 0 | DRY | 13.00 | |

**Notes**

**Logged by**

RS

*1% gas volume = 10,000 ppm*
*Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.*
*All other gases recorded at 'steady state' unless otherwise stated*

**Curtins**
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

# GAS MONITORING LOG SHEET

| | | | |
|---|---|---|---|
| **Project:** | Trinity Academy | **Date:** | 22/12/2022 |
| **Job Number:** | B079532 | **Visit:** | 6 |
| **Client:** | B&K | **Weather:** | Overcast |
| **Barometric State:** | Falling | **Ground Conditions:** | Damp |

| Borehole Reference | Barometric Pressure mb | Flow l/hr | | Methane % | | Carbon Dioxide % | | Oxygen % | Hydrogen Sulphide ppm | Carbon Monoxide ppm | Water Level m bgl | Borehole Base m bgl | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | SS | Max | SS | Max | SS | | | | | | |
| WS04 | 1010 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 16.4 | 1 | 1 | 1.45 | 1.80 | |
| WS05 | 1008 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 | 18.4 | 1 | 2 | DRY | 1.70 | |
| RC04S | 1006 | | | | | | | | | | DRY | 5.00 | |
| RC04D | 1006 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.3 | 20.1 | 0 | 1 | 7.65 | 12.00 | |
| RC06S | 1006 | | | | | | | | | | 4.85 | 5.00 | |
| RC06D | 1006 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 1.2 | 17.6 | 1 | 0 | DRY | 13.00 | |

**Notes**

**Logged by**

RS

*1% gas volume = 10,000 ppm*
*Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.*
*All other gases recorded at 'steady state' unless otherwise stated*

**Curtins**
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
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# GAS MONITORING LOG SHEET

| | | | |
|---|---|---|---|
| **Project:** | Trinity Academy | **Date:** | 04/01/2022 |
| **Job Number:** | B079532 | **Visit:** | 7 |
| **Client:** | B&K | **Weather:** | Sunny |
| **Barometric State:** | Falling | **Ground Conditions:** | Snow and Ice |

| Borehole Reference | Barometric Pressure mb | Flow l/hr | | Methane % | | Carbon Dioxide % | | Oxygen % | Hydrogen Sulphide ppm | Carbon Monoxide ppm | Water Level m bgl | Borehole Base m bgl | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max | SS | Max | SS | Max | SS | | | | | | |
| WS04 | 984 | 0.0 | 0.0 | 2.2 | 2.2 | 0.7 | 0.7 | 19.0 | 2 | 3 | 1.10 | 1.80 | **1** |
| WS05 | 984 | 0.0 | 0.0 | 27.0 | 27.0 | 0.9 | 0.8 | 19.1 | 1 | 0 | DRY | 1.90 | |
| RC04S | 982 | | | | | | | | | 0 | 4.80 | 5.00 | |
| RC04D | 982 | 0.0 | 0.0 | 7.2 | 7.2 | 0.0 | 0.0 | 20.7 | 0 | 2 | 7.40 | 12.00 | |
| RC06S | 982 | | | | | | | | | | 4.50 | 5.00 | |
| RC06D | 982 | 0.0 | 0.0 | 15.9 | 15.9 | 3.6 | 3.6 | 13.4 | 0 | 0 | DRY | 13.00 | |

**Notes**

1 - WS04 was initially flooded. After removal of bung water drained into well.

**Logged by**

RH

*1% gas volume = 10,000 ppm*
*Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.*
*All other gases recorded at 'steady state' unless otherwise stated*

# Appendix A6 – Tier 1 Screening Thresholds

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## Adopted Soil Generic Assessment Criteria
## Sandy loam with 6% SOM

curtins

| Contaminants | Residential with home grown produce | Residential without home grown produce | Allotments | Commercial | Public open space near residential housing $POS_{resi}$ | Public park $POS_{park}$ |
|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | |
| Beryllium | *1.7* | *1.7* | *35* | *12* | *2.2* | *63* |
| Boron | *290* | *11,000* | *45* | *240,000* | *21,000* | *46,000* |
| Cadmium | **10**[13] 22 | **85**[13] 150 | **1.8** 3.9 | **230** 410 | *120* 220 | *560* 880 |
| Chromium III | *910* | *910* | *18,000* | *8,600* | *1,500* | *33,000* |
| Chromium VI | *6* 21 | *6* 21 | *1.8* 170 | *33* 49 | *7.7* 21 | *220* 250 |
| Lead | 200 | 310 | 80 | 2,300 | 630 | 1,300 |
| Mercury *(elemental)* | **1** | **1** | **26** | **26** | *16* | **26**[8] [*30*] |
| *Mercury (inorganic)* | **170** | **240** | **80** | **3600** | *120* | *240* |
| Nickel | *130*[10] | *180*[10] | *53*[11] | *980*[10] | *230* | *800* |
| Vanadium | *410* | *1200* | *91* | *9000* | *2000* | *5000* |
| Copper | *2400* | *7100* | *520* | *68000* | *12000* | *44000* |
| Zinc | *3700* | *40000* | *620* | *730000* | *81000* | *170000* |
| ***Semi-Metals and non-metals*** | | | | | | |
| Arsenic | **32**[12] 37 | **35**[12] 40 | **43**[12] 49 | **640**[12] 640 | *79* 79 | *170* 170 |
| Antimony | | ***550*** | | ***7500*** | ***1500*** | ***3300*** |
| Selenium | **350** | **600** | **120** | **13000** | *1100* | *1800* |
| ***Inorganic chemicals*** | | | | | | |
| Cyanide | 34 | 34 | 34 | 34 | 34 | 34 |
| ***Organic contaminants*** | | | | | | |
| *Aliphatic risk banded hydrocarbons - TPHCWG method* | | | | | | |
| $EC_{>5}$ - $EC_6$ | *160* | *160* | *3900* | *12000* | *600000* | *180000* |
| $EC_{>6}$ - $EC_8$ | *530* | *530* | *13000* | *40000* | *620000* | *320000* |
| $EC_{>8}$ - $EC_{10}$ | *150* | *150* | *1700* | *11000* | *13000* | *21000* |
| $EC_{10}$-$EC_{12}$ | *760* | *770* | *7300* | *47000* | *13000* | *24000* |
| $EC_{12}$-$EC_{16}$ | *4300* | *4400* | *13000* | *90000* | *13000* | *26000* |
| $EC_{>16}$ - $EC_{35}$ | *110000* | *110000* | *270000* | *1800000* | *250000* | *490000* |
| $EC>_{35}$ - $EC_{44}$ | *110000* | *110000* | *270000* | *1800000* | *250000* | *490000* |
| *Aromatic risk banded hydrocarbons - TPHCWG method* | | | | | | |
| $EC>_5$ - $EC_7$ | *300* | *1400* | *57* | *86000* | *56000* | *92000* |
| $EC>_7$ - $EC_8$ | *660* | *3900* | *120* | *180000* | *56000* | *100000* |
| $EC_{>8}$ - $EC_{10}$ | *190* | *270* | *51* | *17000* | *5000* | *9300* |
| $EC_{10}$ - $EC_{12}$ | *380* | *1200* | *74* | *34000* | *5000* | *10000* |
| $EC_{12}$ - $EC_{16}$ | *660* | *2500* | *130* | *38000* | *5000* | *10000* |
| $EC_{>16}$ - $EC_{21}$ | *930* | *1900* | *260* | *28000* | *3800* | *7800* |
| $EC_{>21}$ - $EC_{35}$ | *1700* | *1900* | *1600* | *28000* | *3800* | *7900* |
| $EC>_{35}$ - $EC_{44}$ | *1700* | *1900* | *1600* | *28000* | *3800* | *7900* |
| | | | | | | |
| Aliph + Arom EC >44-70 | *1900* | *1900* | *3000* | *28000* | 3800 | 7900 |
| *Aromatic* | | | | | | |
| Benzene | **0.33** 0.87 | **1.0** 3.3 | **0.07** 0.18 | **95** 98 | *73* 140 | *110* 230 |
| Ethyl benzene | **350** | **840** | **90** | **2800**[8] [66000] | **2800**[8] [*25000*] | **2800**[8] [*27000*] |
| Toluene | **610** | **2700** | **120** | **4400**[8] [190000] | **4400**[8] [*56000*] | **4400**[8] [*100000*] |
| Xylene[9] | **230** | **290** | **160** | **2600**[8] [32000] | **2600**[8] [*43000*] | **2600**[8] [*31000*] |
| Phenol | **420** | **520** | **280** | **3200**[14] (38000) | **3200**[14] (*10000*) | **3200**[14] (*9300*) |
| *Polycyclic Aromatic Hydrocarbons (PAH)* | | | | | | |
| Naphthalene | *13* | *13* | *24* | *1100* | *4900* | *3000* |
| Acenaphthylene | *920* | *6000* | *160* | *100000* | *15000* | *30000* |
| Acenaphthene | *1100* | *6000* | *200* | *100000* | *15000* | *30000* |
| Fluorene | *860* | *4500* | *160* | *71000* | *9900* | *20000* |
| Phenanthrene | *440* | *1500* | *90* | *23000* | *3100* | *6300* |
| Anthracene | *11000* | *37000* | *2200* | *540000* | *74000* | *150000* |
| Fluoranthene | *890* | *1600* | *290* | *23000* | *3100* | *6400* |
| Pyrene | *2000* | *3800* | *620* | *54000* | *7400* | *15000* |
| Benz(a)anthracene | *13* | *15* | *13* | *180* | *29* | *62* |
| Chrysene | *27* | *32* | *19* | *350* | *57* | *120* |
| Benzo(b)fluoranthene | *3.7* | *4.0* | *3.9* | *45* | *7.2* | *16.0* |
| Benzo(k)fluoranthene | *100* | *110* | *130* | *1200* | *190* | *440* |
| Benzo(a)pyrene | *3.0* 5.0 | *3.2* 5.3 | *3.5* 5.7 | *36* 77 | *5.7* 10 | *13* 21 |
| Indeno(123cd)pyrene | *41* | *46* | *39* | *510* | *82* | *180* |
| Dibenzo(ah)anthracene | *0.3* | *0.32* | *0.43* | *3.6* | *0.58* | *1.4* |
| Benzo(ghi)perylene | *350* | *360* | *640* | *4000* | *640* | *1600* |
| ***Chlorinated Aliphatic Hydrocarbons*** | | | | | | |
| Vinyl chloride | *0.0014* | *0.0015* | *0.0018* | *0.12* | *3.5* | *5.4* |
| Trichloroethene (TCE) | *0.075* | *0.08* | *0.21* | *5.7* | *120* | *120* |
| 1,1,1,2 Tetrachlorethane | *6.4* | *8.2* | *4.4* | *560* | *1400* | *2100* |
| Tetrachlorethene (PCE) | *0.90* | *0.92* | *3.6* | *95* | *1400* | *1500* |
| 1,1,1 Trichlorethane | *39* | *40* | *240* | *3000* | *140000* | *100000* |

**Notes**

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs* , ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 6% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg $m^{-3}$
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

## Adopted Soil Generic Assessment Criteria
## Sandy loam with 2.5% SOM

| Contaminants | Residential with home grown produce | Residential without home grown produce | Allotments | Commercial | Public open space near residential housing $POS_{resi}$ | Public park $POS_{park}$ |
|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | |
| Beryllium | *1.7* | *1.7* | *35* | *12* | *2.2* | *63* |
| Boron | *290* | *11,000* | *45* | *240,000* | *21,000* | *46,000* |
| Cadmium | **10**[13] 22 | **85**[13] 150 | **1.8** 3.9 | **230** 410 | *120* 220 | *560* 880 |
| Chromium III | *910* | *910* | *18,000* | *8,600* | *1,500* | *33,000* |
| Chromium VI | *6* 21 | *6* 21 | *1.8* 170 | *33* 49 | *7.7* 21 | *220* 250 |
| Lead | 200 | 310 | 80 | 2,300 | 630 | 1,300 |
| Mercury *(elemental)* | **1** | **1** | **26** | **26** | *16* | **26**[8] [*30*] |
| *Mercury (inorganic)* | **170** | **240** | **80** | **3600** | *120* | *240* |
| Nickel | *130*[10] | *180*[10] | *53*[11] | *980*[10] | *230* | *800* |
| Vanadium | *410* | *1200* | *91* | *9000* | *2000* | *5000* |
| Copper | *2400* | *7100* | *520* | *68000* | *12000* | *44000* |
| Zinc | *3700* | *40000* | *620* | *730000* | *81000* | *170000* |
| ***Semi-Metals and non-metals*** | | | | | | |
| Arsenic | **32**[12] 37 | **35**[12] 40 | **43**[12] 49 | **640**[12] 640 | *79* 79 | *170* 170 |
| Antimony | | ***550*** | | ***7500*** | ***1500*** | ***3300*** |
| Selenium | **350** | **600** | **120** | **13000** | *1100* | *1800* |
| ***Inorganic chemicals*** | | | | | | |
| Cyanide | 34 | 34 | 34 | 34 | 34 | 34 |
| ***Organic contaminants*** | | | | | | |
| *Aliphatic risk banded hydrocarbons - TPHCWG method* | | | | | | |
| $EC_{>5}$ - $EC_6$ | *78* | *78* | *1700* | *5900* | *590000* | *130000* |
| $EC_{>6}$ - $EC_8$ | *230* | *230* | *5600* | *17000* | *610000* | *220000* |
| $EC_{>8}$ - $EC_{10}$ | *65* | *65* | *770* | *4800* | *13000* | *18000* |
| $EC_{10}$-$EC_{12}$ | *330* | *330* | *4400* | *23000* | *13000* | *23000* |
| $EC_{12}$-$EC_{16}$ | *2400* | *2400* | *13000* | *82000* | *13000* | *25000* |
| $EC_{>16}$ - $EC_{35}$ | *92000* | *92000* | *270000* | *1700000* | *250000* | *480000* |
| $EC_{>35}$ - $EC_{44}$ | *92000* | *92000* | *270000* | *1700000* | *250000* | *480000* |
| *Aromatic risk banded hydrocarbons - TPHCWG method* | | | | | | |
| $EC_{>5}$ - $EC_7$ | *140* | *690* | *27* | *46000* | *56000* | *84000* |
| $EC_{>7}$ - $EC_8$ | *290* | *1800* | *51* | *110000* | *56000* | *95000* |
| $EC_{>8}$ - $EC_{10}$ | *83* | *110* | *21* | *8100* | *5000* | *8500* |
| $EC_{10}$ - $EC_{12}$ | *180* | *590* | *31* | *28000* | *5000* | *9700* |
| $EC_{12}$ - $EC_{16}$ | *330* | *2300* | *57* | *37000* | *5100* | *10000* |
| $EC_{>16}$ - $EC_{21}$ | *540* | *1900* | *110* | *28000* | *3800* | *7700* |
| $EC_{>21}$ - $EC_{35}$ | *1500* | *1900* | *820* | *28000* | *3800* | *7800* |
| $EC_{>35}$ - $EC_{44}$ | *1500* | *1900* | *820* | *28000* | *3800* | *7800* |
| | | | | | | |
| Aliph + Arom EC >44-70 | *1800* | *1900* | *2100* | *28000* | 3800 | 7800 |
| *Aromatic* | | | | | | |
| Benzene | **0.16** | **0.49** | **0.035** | **50** | *72* | *100* |
| Ethyl benzene | **150** | **380** | **39** | **1200**[8] [35000] | **1200**[8] [*24000*] | **1200**[8] [*22000*] |
| Toluene | **270** | **1300** | **51** | **1900**[8] [110000] | **1900**[8] [*56000*] | **1900**[8] [*95000*] |
| Xylene[9] | **98** | **120** | **70** | **1200**[8] [14000] | **1200**[8] [*42000*] | **1200**[8] [*23000*] |
| Phenol | **290** | **420** | **140** | **1500**[14] (35000) | **1500**[14] (*10000*) | **1500**[14] (*8300*) |
| *Polycyclic Aromatic Hydrocarbons (PAH)* | | | | | | |
| Naphthalene | *5.6* | *5.6* | *10* | *460* | *4900* | *1900* |
| Acenaphthylene | *420* | *4600* | *69* | *97000* | *15000* | *30000* |
| Acenaphthene | *510* | *4700* | *85* | *97000* | *15000* | *30000* |
| Fluorene | *400* | *3800* | *67* | *68000* | *9900* | *20000* |
| Phenanthrene | *220* | *1500* | *38* | *22000* | *3100* | *6200* |
| Anthracene | *5400* | *35000* | *950* | *540000* | *74000* | *150000* |
| Fluoranthene | *560* | *1600* | *130* | *23000* | *3100* | *6300* |
| Pyrene | *1200* | *3800* | *270* | *54000* | *7400* | *15000* |
| Benz(a)anthracene | *11* | *14* | *6.5* | *170* | *29* | *56* |
| Chrysene | *22* | *31* | *9.4* | *350* | *57* | *110* |
| Benzo(b)fluoranthene | *3.3* | *4.0* | *2.1* | *44* | *7.2* | *15* |
| Benzo(k)fluoranthene | *93* | *110* | *75* | *1200* | *190* | *410* |
| Benzo(a)pyrene | *2.7* | *3.2* | *2* | *35* | *5.7* | *12* |
| Indeno(123cd)pyrene | *36* | *46* | *21* | *510* | *82* | *170* |
| Dibenzo(ah)anthracene | *0.28* | *0.32* | *0.27* | *3.6* | *0.57* | *1.3* |
| Benzo(ghi)perylene | *340* | *360* | *470* | *4000* | *640* | *1500* |
| ***Chlorinated Aliphatic Hydrocarbons*** | | | | | | |
| Vinyl chloride | *0.00087* | *0.001* | *0.001* | *0.077* | *3.5* | *5* |
| Trichloroethene (TCE) | *0.034* | *0.036* | *0.091* | *2.6* | *120* | *91* |
| 1,1,1,2 Tetrachlorethane | *2.8* | *3.5* | *1.9* | *250* | *1400* | *1800* |
| Tetrachlorethene (PCE) | *0.39* | *0.4* | *1.5* | *42* | *1400* | *1100* |
| 1,1,1 Trichlorethane | *18* | *18* | *110* | *1300* | *140000* | *76000* |

**Notes**

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs* , ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg $m^{-3}$
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

# Adopted Soil Generic Assessment Criteria
## Sandy loam with 1% SOM

curtins

| Contaminants | Residential with home grown produce | Residential without home grown produce | Allotments | Commercial | Public open space near residential housing $POS_{resi}$ | Public park $POS_{park}$ |
|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | |
| Beryllium | *1.7* | *1.7* | *35* | *12* | *2.2* | *63* |
| Boron | *290* | *11,000* | *45* | *240,000* | *21,000* | *46,000* |
| Cadmium | **10**[13] 22 | **85**[13] 150 | **1.8** 3.9 | **230** 410 | *120* 220 | *560* 880 |
| Chromium III | *910* | *910* | *18,000* | *8,600* | *1,500* | *33,000* |
| Chromium VI | *6* 21 | *6* 21 | *1.8* 170 | *33* 49 | *7.7* 21 | *220* 250 |
| Lead | 200 | 310 | 80 | 2,300 | 630 | 1,300 |
| Mercury *(elemental)* | **1** | **1** | **26** | **26** | *16* | **26**[8] [*30*] |
| *Mercury (inorganic)* | **170** | **240** | **80** | **3600** | *120* | *240* |
| Nickel | *130*[10] | *180*[10] | *53*[11] | *980*[10] | *230* | *800* |
| Vanadium | *410* | *1200* | *91* | *9000* | *2000* | *5000* |
| Copper | *2400* | *7100* | *520* | *68000* | *12000* | *44000* |
| Zinc | *3700* | *40000* | *620* | *730000* | *81000* | *170000* |
| ***Semi-Metals and non-metals*** | | | | | | |
| Arsenic | **32**[12] 37 | **35**[12] 40 | **43**[12] 49 | **640**[12] 640 | *79* 79 | *170* 170 |
| Antimony | | ***550*** | | ***7500*** | ***1500*** | ***3300*** |
| Selenium | **350** | **600** | **120** | **13000** | *1100* | *1800* |
| ***Inorganic chemicals*** | | | | | | |
| Cyanide | 34 | 34 | 34 | 34 | 34 | 34 |
| ***Organic contaminants*** | | | | | | |
| *Aliphatic risk banded hydrocarbons - TPHCWG method* | | | | | | |
| $EC_{>5}$ - $EC_6$ | *42* | *42* | *730* | *3200* | *570000* | *95000* |
| $EC_{>6}$ - $EC_8$ | *100* | *100* | *2300* | *7800* | *600000* | *150000* |
| $EC_{>8}$ - $EC_{10}$ | *27* | *27* | *320* | *2000* | *13000* | *14000* |
| $EC_{10}$-$EC_{12}$ | *130* | *130* | *2200* | *9700* | *13000* | *21000* |
| $EC_{12}$-$EC_{16}$ | *1100* | *1100* | *11000* | *59000* | *13000* | *25000* |
| $EC_{>16}$ - $EC_{35}$ | *65000* | *65000* | *260000* | *1600000* | *250000* | *450000* |
| $EC>_{35}$ - $EC_{44}$ | *65000* | *65000* | *260000* | *1600000* | *250000* | *450000* |
| *Aromatic risk banded hydrocarbons - TPHCWG method* | | | | | | |
| $EC>_5$ - $EC_7$ | *70* | *370* | *13* | *26000* | *56000* | *76000* |
| $EC>_7$ - $EC_8$ | *130* | *860* | *22* | *56000* | *56000* | *87000* |
| $EC_{>8}$ - $EC_{10}$ | *34* | *47* | *8.6* | *3500* | *5000* | *7200* |
| $EC_{10}$ - $EC_{12}$ | *74* | *250* | *13* | *16000* | *5000* | *9200* |
| $EC_{12}$ - $EC_{16}$ | *140* | *1800* | *23* | *36000* | *5100* | *10000* |
| $EC_{>16}$ - $EC_{21}$ | *260* | *1900* | *46* | *28000* | *3800* | *7600* |
| $EC_{>21}$ - $EC_{35}$ | *1100* | *1900* | *370* | *28000* | *3800* | *7800* |
| $EC>_{35}$ - $EC_{44}$ | *1100* | *1900* | *370* | *28000* | *3800* | *7800* |
| | | | | | | |
| Aliph + Arom EC >44-70 | *1600* | *1900* | *1200* | *28000* | 3800 | 7800 |
| *Aromatic* | | | | | | |
| Benzene | **0.08** | **0.3** | **0.017** | **28** | *72* | *90* |
| Ethyl benzene | **65** | **170** | **16** | **520**[8] [17000] | **520**[8] *[24000]* | **520**[8] *[17000]* |
| Toluene | **120** | **610** | **22** | **860**[8] [59000] | **860**[8] *[56000]* | **860**[8] *[87000]* |
| Xylene[9] | **41** | **53** | **28** | **480**[8] [69000] | **480**[8] *[41000]* | **480**[8] *[17000]* |
| Phenol | **180** | **310** | **66** | **760**[14] (31000) | **760**[14] *(10000)* | **760**[14] *(7600)* |
| *Polycyclic Aromatic Hydrocarbons (PAH)* | | | | | | |
| Naphthalene | *2.3* | *2.3* | *4.1* | *190* | *4900* | *1200* |
| Acenaphthylene | *170* | *2900* | *28* | *83000* | *15000* | *29000* |
| Acenaphthene | *210* | *3000* | *34* | *84000* | *15000* | *29000* |
| Fluorene | *170* | *2800* | *27* | *63000* | *9900* | *20000* |
| Phenanthrene | *95* | *1300* | *15* | *22000* | *3100* | *6200* |
| Anthracene | *2400* | *31000* | *380* | *520000* | *74000* | *150000* |
| Fluoranthene | *280* | *1500* | *52* | *23000* | *3100* | *6300* |
| Pyrene | *620* | *3700* | *110* | *54000* | *7400* | *15000* |
| Benz(a)anthracene | *7.2* | *11* | *2.9* | *170* | *29* | *49* |
| Chrysene | *15* | *30* | *4.1* | *350* | *57* | *93* |
| Benzo(b)fluoranthene | *2.6* | *3.9* | *0.99* | *44* | *7.1* | *13* |
| Benzo(k)fluoranthene | *77* | *110* | *37* | *1200* | *190* | *370* |
| Benzo(a)pyrene | *2.2* | *3.2* | *0.97* | *35* | *5.7* | *11* |
| Indeno(123cd)pyrene | *27* | *45* | *9.5* | *500* | *82* | *150* |
| Dibenzo(ah)anthracene | *0.24* | *0.31* | *0.14* | *3.5* | *0.57* | *1.1* |
| Benzo(ghi)perylene | *320* | *360* | *290* | *3900* | *640* | *1400* |
| ***Chlorinated Aliphatic Hydrocarbons*** | | | | | | |
| Vinyl chloride | *0.00064* | *0.00077* | *0.00055* | *0.059* | *3.5* | *4.8* |
| Trichloroethene (TCE) | *0.016* | *0.017* | *0.041* | *1.2* | *120* | *70* |
| 1,1,1,2 Tetrachlorethane | *1.2* | *1.5* | *0.79* | *110* | *1400* | *1500* |
| Tetrachlorethene (PCE) | *0.18* | *0.18* | *0.65* | *19* | *1400* | *810* |
| 1,1,1 Trichlorethane | *8.8* | *9* | *48* | *660* | *140000* | *57000* |

**Notes**

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs* , ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg $m^{-3}$
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

# Appendix A7 – Risk Assessment Methodology

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem, or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway, and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of an event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe, medium, mild, or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

| | | **Consequence** | | | |
|---|---|---|---|---|---|
| | | **Severe** | **Medium** | **Mild** | **Minor** |
| **Probability (Likelihood)** | **High Likelihood** | Very High Risk | High Risk | Moderate Risk | Moderate/Low Risk |
| | **Likely** | High Risk | Moderate Risk | Moderate/Low Risk | Low Risk |
| | **Low Likelihood** | Moderate Risk | Moderate/Low Risk | Low Risk | Very Low Risk |
| | **Unlikely** | Moderate/Low Risk | Low Risk | Very Low Risk | Very Low Risk |

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In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

| Classification | Definition | Examples |
|---|---|---|
| Severe | Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem. | High concentrations of cyanide on the surface of an informal recreation area.<br><br>Major spillage of contaminants from site into controlled water.<br><br>Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied). |
| Medium | Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem. | Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria.<br><br>Leaching of contaminants from a site to a Principal or Secondary A aquifer.<br><br>Death of a species within a designated nature reserve.<br><br>Lesser toxic and asphyxiate effects |
| Mild | Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services. Damage to sensitive buildings/structures/services or the environment. | Pollution of non-classified groundwater (Inc. Secondary B aquifers).<br><br>Damage to building rendering it unsafe to occupy (e.g., foundation damage resulting in instability). |
| Minor | Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures, and services. | The presence of contaminants at such concentrations that protective equipment is required during site works.<br><br>The loss of plants in a landscaping scheme.<br>Discoloration of concrete. |

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In accordance with DoE guidance, the following categorisation of **probability** has been developed.

| Classification | Definition |
|---|---|
| High Likelihood | There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution. |
| Likely | There is a pollution linkage, and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term. |
| Low Likelihood | There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term. |
| Unlikely | There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term. |

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

| Classification | Definition |
|---|---|
| **Very High Risk** | There is a *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action. |
| **High Risk** | *Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action. |
| **Moderate Risk** | *It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe**,*** and if any harm were to occur it is *more likely* that such harm would be *relatively mild.* |
| **Low Risk** | *It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.* |
| **Negligible Risk** | The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor. |

The term ‘risk’ in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.

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Our Ref: 079532-CUR-XX-XX-T-GE-00003-P01_CMA

22/03/2022

Chris Allen
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Dear Chris,

**Trinity Academy Sports Pitches – Coal Mining Assessment**

Further to the completion of the intrusive investigation on the proposed Trinity Academy Sports Pitches we have pleasure in submitting our specific report in relation to the Coal Mining legacy on the site as follows.

## 1. Background

§ 1.1 The proposed site for the sports pitches is part of a wider development site, referred to as the *Trinity Academy, Barnsley*, which is proposed for development as an educational facility with associated car parking, MUGA, landscaping and sports pitches. The site under consideration (hereafter referred to as the site) within this report, forms the sports pitches for the wider development site (see Figure 1).



**Figure 1** – Wider development site Boundary shown in red and "the site" boundary shown in blue.

§ 1.2 The site can be approximately located on National Grid Reference SE 33355 05502 and is located within the south-west of the wider development site.

§ 1.3 The site is a grassed area with trees present on the north-east, south-east and south-west boundaries; the north-west boundary is formed by Keresforth Close. Buildings are present to the north-west, north-east, and south-east with a dual carriageway present to the south-west.



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§ 1.4 Curtins have undertaken a ground investigation across the wider development area, which included several deeper exploratory holes undertaken on the site. The ground investigation works in the wider development site comprised shallow window sampler holes to enable the monitoring of potential ground gas risk to proposed buildings. The ground investigation is reported in Trinity Academy, Barnsley Phase 2 Ground Investigation document reference 079532-CUR-XX-XX-T-GE-00002-P01 dated 01 March 2022 (Ref.1).

§ 1.5 The site is known to be in a Coal Mining High Risk Development Area as shown on Figure 2 which has been extracted from the Coal Authority Interactive Map.



**Figure 2** – Site Boundary shown in red and as High Risk Development Area
**Source**: https://mapapps2.bgs.ac.uk/coalauthority/home.html, accessed on 20/01/2022

§ 1.6 A Coal mining Risk Assessment has been undertaken by Waterman in October 2020, document reference WIE17125-100-R-7.1.3-CMRA, October 2022 (Ref.2)).

## 2. Aim and Objective

§ 2.1 The aim of this report is to assess the potential impact of the shallow coal workings accounting for a proposed use of the site as sports pitches with no structures, buildings or otherwise, being proposed on the site.

§ 2.2 This report will provide advice on remedial works required to mitigate the significant risks regarding shallow worked coal seams and a proven shaft. This report does not, otherwise cover the suitability of the ground conditions for construction of the sports ground.

## 3. Coal Mining Risk Assessment Summary

§ 3.1 A Coal Mining Risk Assessment (CMRA) has been completed by Waterman, document reference WIE17125-100-R-7.1.3-CMRA (Ref.2)). A Coal Authority Report is appended to the CMRA, Coal Authority reference 51002307645001. In relation to this assessment pertinent information contained within the CMRA is discussed below. For more detailed information, reference should be made to the CMRA (Ref.2).

§ 3.2 The site is underlain by bedrock of the Pennine Middle Coal Measures Formation. Generally, the unit's lithology is described as Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams.

§ 3.3 The site is in an area where the Barnsley Coal is expected to sub-outcrop on the site with the overlying Barnsley Rider Coal at around 40m above not expected to outcrop and the underlying Dunsill Coal being too deep to present a risk of disturbance at the ground surface.

§ 3.4 The Barnsley Coal seam is recorded as being around 2.29m to 3.1m thick. The record for Hound Hill No.2 Colliery further describes the seam as,



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Day Bed – 305mm
Middle Bed – 380mm
Low Bed – 381mm
Dirt over Clay – 355mm
Hards – 685mm
Bottom Softs – 560mm
Total thickness = 2.67m

§ 3.5 The Coal Authority Report indicates that the Barnsley Coal has been worked between 10m and 21m below the site dipping to the east. The thickness is approximately 2.74m and it has been last worked in 1925.

§ 3.6 Abandonment plans obtained from the Coal Authority report indicates that workings of the Barnsley Coal underlie the site as shown on Figure 3.




**Figure 3** – Abandonment plans approximately overlayed on the site boundary (blue) and wider site boundary (red)

§ 3.7 Records also suggest that an unnamed colliery located on the Sports Pitches site mined the Barnsley Coal. This record also stated that the seam had a dip of 5° to 7.4° to the east; this is possibly the Keresforth Hill Pit.

§ 3.8 A geological fault is present within the site boundary along the northern boundary of the sports pitches striking in a south-west to north-east direction with a downthrow to the south-east.

§ 3.9 The Coal Authority record shaft no. 433405-010 on the site as shown on Figure 4 below. There are no records of its depth, diameter and whether it has been treated.



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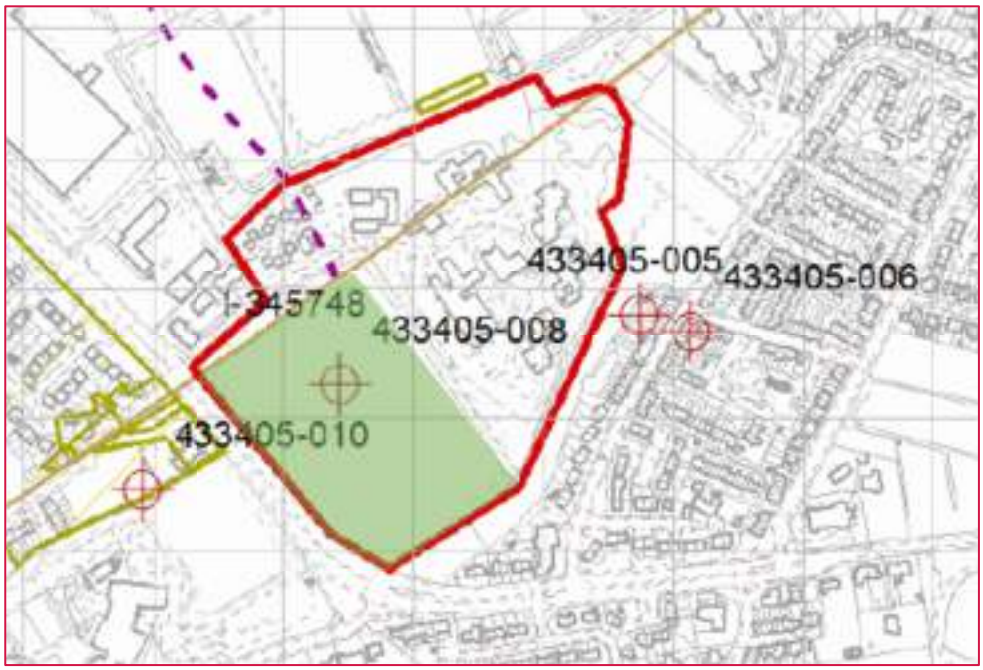



**Figure 4** – Mine Shaft Record Plan (Site shaded green)

§ 3.10 Remedial works have been undertaken on the site by the Coal Authority further to the compilation of a Surface Hazard Incident Report. An area of collapse of 182 cm diameter (assumed although unitless in the Coal Authority report) was located to the north of the site as shown by reference 1-345748 on Figure 5 below.

§ 3.11 The Surface Hazard Incident Report has been obtained and it provides information about the work undertaken. The area of collapse has been treated by opening out the collapse to 2.2m by 1.5m and excavating to a depth of 4.5m below the surface to the base of the workings. A total of three potential roadways could be seen to run off from the base of the excavation in a north-east, south-east, and south-westerly direction.

§ 3.12 Remedial works comprised the placing of 12 Tonnes of clean 75mm to 150mm sized limestone compacted in layers not exceeding 300mm to within 1.5m of the surface. A layer of geo-textile has been placed across the fill and around the exposed sides. The as-dug sandy clay spoil has been then placed and compacted in layers not exceeding 150mm thickness to the underside of the existing turf. Finally, the existing topsoil was used to reinstate the surface to the pre-existing field profile.




**Figure 5** – Location of Feature 1-345748 requiring Remedial Action



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## 4. Ground Conditions

§ 4.1 The relevant exploratory holes, undertaken during the 2021 Curtins ground investigations and as reported in Ref.1 are rotary cored boreholes RC01 to RC06 and trial pit TP01.

§ 4.2 The ground conditions revealed typically comprise topsoil overlying possible reworked natural soils and superficial deposits of variable thickness and composition. The reworked natural soils and superficial deposits are described as soft to firm cohesive soils and sands and gravel. The superficial deposits overlie solid geology of the Pennine Middle Coal Measures, which comprise interbedded sandstone, siltstone, and mudstone with a layer of coal and seat earth. Full detail and description of the geology is presented within the ground investigation report (Ref.1).

§ 4.3 The presence of coal, assumed zone of core loss and loss of flush (open hole), as a marker of possible workings that could present a risk of disturbance at the ground surface, are summarised in Table 1.

**Table 1** – Summary of Coal Layers Encountered

| Exploratory Hole | Top Depth (m bgl) | Bottom Depth (m bgl) | Thickness (m) | Notes |
|---|---|---|---|---|
| RC01 | 10.05 | 12.40 | 2.35 | Assumed Zone of Core Loss (AZCL) between 10.5 to 11.5m. |
| | 12.50 | 12.80 | 0.30 | Likely extremely weak coal |
| RC02 | 10.80 | 12.50 | 1.70 | Extremely weak, loose fragmented coal. **AZCL** |
| | 13.90 | 14.05 | 0.15 | Extremely weak, fragmented sub-bituminous COAL. |
| | 14.05 | 14.35 | 0.30 | Soft to firm light grey CLAY grading into sub-bituminous coal |
| | 14.35 | 14.85 | 0.50 | Extremely weak, fragmented sub-bituminous to bituminous COAL. |
| RC03 | 15.30 | 15.60 | 0.30 | Extremely weak, very weathered sub-bituminous COAL retrieved as gravel. |
| RC04 | 16.80 | 18.00 | 1.20 | Drillers Description: COAL |
| RC05 | 17.00 | 18.20 | 1.20 | Drillers Description: COAL |
| RC06 | 15.50 | 17.00 | 1.50 | Drillers Description: COAL due to no core retrieval |
| | 17.00 | 17.85 | 0.85 | Very stiff to stiff, light grey gravelly CLAY. Gravel comprised of angular to sub-angular grey mudstones with some rare coal towards the base. |
| | 17.85 | 18.05 | 0.20 | Extremely weak and fragmented black sub-bituminous COAL. |

§ 4.4 Due to the methods of drilling utilised during the ground investigation and specifically the use of water flush, any groundwater strikes will have been masked. Consequently, groundwater levels during these works were not recorded.

§ 4.5 A summary of the groundwater levels recorded during the ground investigation works and subsequent monitoring visits, is presented in Table 2. It should be noted that the groundwater monitoring was completed



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during November 2021 and January 2022. Post investigation monitoring to date has recorded the water level in shallow installations varying between dry and 4.85m below ground level (bgl) whilst in the deep installations the water level varied between dry and 7.65m bgl. However, the groundwater levels recorded are not likely to be representative of the natural background level of the geology. It is likely the water has infiltrated through the surface and is unable to drain through the cohesive soils.

**Table 2** – Groundwater Levels

| Exploratory Hole | Water Strikes During Ground Investigation | | Post Investigation Monitored Water Levels | |
|---|---|---|---|---|
| | Strike Depth (m bgl) | Strata | Monitored Levels (m bgl) | Installation Strata |
| WS04 | - | - | 1.10 – 1.70 | CLAY /SANDSTONE |
| WS05 | - | - | Dry | CLAY/SANDSTONE |
| RC04S | - | - | Dry – 4.80 | CLAY/SANDSTONE |
| RC04D | - | - | 5.00 – 7.65 | SANDSTONE/MUDSTONE |
| RC06S | - | - | 4.50 – 4.85 | CLAY/SANDSTONE |
| RC06D | - | - | Dry | SILTSTONE/MUDSTONE/CLAY |

- No groundwater strikes recorded.

§ 4.6 Figure 5 shows the location of the rotary cored boreholes and shaft location trial pit. It should be noted that the playing fields were raised around 1966, the depth of fill being unknown. This may complicate the accurate determination of depth to workings and confirmation of dip.

§ 4.7 However, with interrogation of the boreholes logs as summarised within Table 1, solid strata are determined to generally dip to the east.

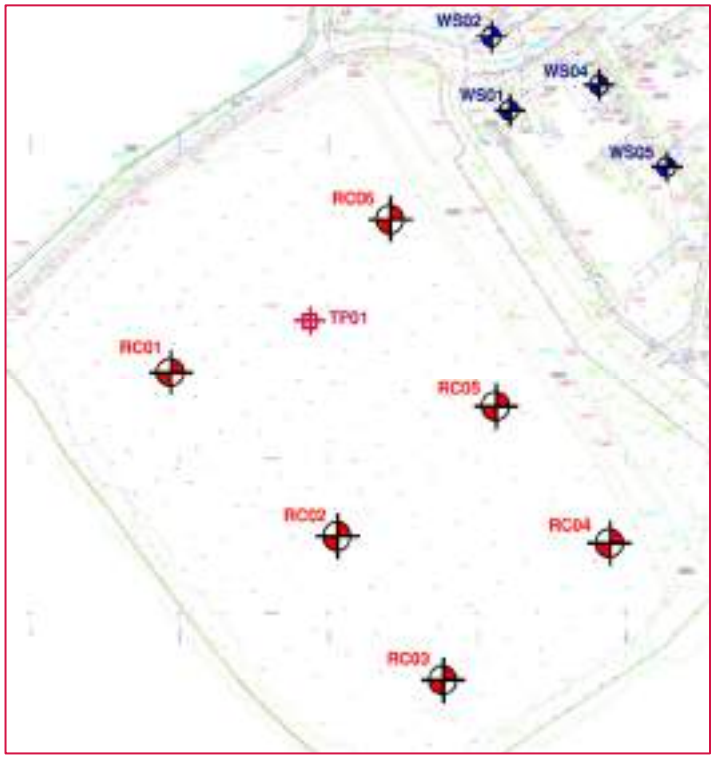



**Figure 5** – Exploratory Hole Location Plan



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§ 4.8 Coal, thought to be the Barnsley Coal seam was observed in exploratory holes RC01, RC02, RC03, RC04, RC05 and RC06; this is summarised in Table 3.

**Table 3** – Summary of Barnsley Coal Levels

| Exploratory Hole | Depth to top of Coal (m) | Approximate Level (m AOD) | Thickness (m) | Comment |
|---|---|---|---|---|
| RC01 | 10.05 | 139.58 | 2.35 | Likely disturbed Barnsley Coal |
| RC02 | 10.80 | 137.82 | 4.05* | Likely disturbed Barnsley Coal |
| RC03 | 15.30 | 132.96 | 1.7* | Possibly disturbed Barnsley Coal |
| RC04 | 16.80 | 128.87 | 1.2 | Possibly disturbed Barnsley Coal |
| RC05 | 17.00 | 129.32 | 1.2 | Possibly disturbed Barnsley Coal |
| RC06 | 15.50 | 131.63 | 2.55* | Likely disturbed Barnsley Coal |

* - May indicate a disturbed zone and not the original seam thickness

§ 4.9 The ground investigation does not conclusively prove workings in the Barnsley Coal due to variation in seam thickness and disposition, but it is considered likely in 50% of the exploratory holes and possible in the remainder. This suggests that unrecorded workings extended further north and west.

§ 4.10 Shaft record, Coal Authority no. 433405-010 was located by trial pit TP01 as shown in Figure 6 below.



**Figure 6** – Encountered Mine Shaft

## 5. Assessment and Conclusions

§ 5.1 The coal seam encountered within the exploratory holes is considered to be the Barnsley Coal and it is possible to likely that this has been worked under most of the site at shallow depth; approximately 10m to 17m below existing ground level.



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§ 5.2 The proposed development works comprise the construction of sports pitches across the site; there are no structures proposed, buildings or otherwise. In addition, it is understood that the levels across the site are to remain the same. An increase in load due to foundation loading and or increased depth of soils is not anticipated and therefore the total stress conditions across the site will not change. Therefore, an increased risk of collapse of the worked seam induced through this factor will not be mobilised.

§ 5.3 However failure of the seam crown or collapse due to degradation/deterioration of the seam and or surrounding strata cannot be discounted. Based on the thickness of the worked seam and the depth at which it is located, it is considered very unlikely that any failure would cause a catastrophic impact at the ground surface and would be manifested by a relatively local depression at the ground surface.

§ 5.4 With regard to any treatment of the Barnsley Coal and given its depth and the proposed use as sports pitches it is considered that employing grouting treatment for the site for this feature is overly onerous and against a sustainable approach.

§ 5.5 The final sports pitch surface construction should incorporate one or two layers of geogrid, to be designed by an specialist. This will provide some mitigation in minimising any settlement at the ground surface mobilised by any collapse of the Barnsley Coal workings. It is also recommended that a periodic inspection of the pitches in undertaken by a suitably qualified person.

§ 5.6 The previously mentioned Surface Hazard Incident Report identified the presence of shallow tunnels at around 4.5m below ground level on the northern boundary. Further investigation has shown that the remedial works undertaken has not completely addressed these voids and further investigation and remedial action will be required due to the proximity of the tunnels to the ground surface.

§ 5.7 The shaft recorded by the Coal Authority reference no. 433405-010 has been located on site. Failure of shaft infill and or collapse of the shaft (both recorded and unrecorded) could result in a catastrophic impact.

§ 5.8 It is recommended that initially the site is subjected to a geophysical survey to a) determine the extent of any tunnel network on the northern boundary and b) assess the site for possible unrecorded shafts.

§ 5.9 Should non-intrusive works prove to be inconclusive, intrusive works should be undertaken.

§ 5.10 All shafts are to be treated appropriately; CIRIA document C758D Abandoned mine workings manual (Ref.3) is recommended for reference and guidance.

Yours faithfully,



**Ronak Amirhosseiny**
Principal Geotechnical Engineer
For and on behalf of
**Curtins Consulting Ltd**



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## References

1) Curtins (2022) *Phase 2 Ground Investigation – Stage 1.* Document reference: 079532-CUR-XX-XX-T-GE-00002-P01.

2) Watermans (2020) *Coal Mining Risk Assessment (CMRA).* Document reference: WIE17125-100-R-7.1.3-CMRA

3) CIRIA (2019) C758D – *Abandoned Mine Workings Manual*



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# Trinity Academy, Barnsley

## Supplemental Ground Investigation

Curtins Ref: 079532-CUR-XX-XX-T-GE-00005

Revision: P01

Issue Date: 19 October 2022

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# Executive Summary

| | |
|---|---|
| Appointment | In July 2022 Curtins were instructed by Bowmer & Kirkland to undertake a Phase 2 Ground Investigation at the former NHS Keresforth centre site in Barnsley. The site is centred on an easting and northing of 433442, 405618.<br><br>This investigation addresses recommendations as presented in the Phase 1 report Watermans Geo Environmental Assessment Report (ref. 7), and Curtins Phase 2 GI Report (ref. 10). The aim of this Phase 2 GI works is to characterise the geo-technical ground conditions associated with the main school blocks and surrounding hardstanding and soft landscaping designs to support an associated planning application. |
| Current Site Status | The site is currently the now disused Keresforth Medical Centre, comprising of low-rise buildings with access roads, parking areas and soft landscaping. The site slopes to the east and south-east with a big difference in levels between the north-west corner of the site to the south-east corner of the site.<br><br>Based on satellite imagery, the site is bounded to the north by Keresforth Close comprising of residential dwellings, to the northwest Barnsley Fire Station is opposite to the field. To the east by Joseph Locke Primary School. To the south by a sparse tree line and beyond this several residential buildings and allotments are situated with sparsely populated local shops. The site is bound to the west by the A6133 and beyond this by open fields and Greenacre School. |
| Summary of Curtins Previous GI for the playing field and shallow boreholes for the NHS Keresforth Centre | Limited made ground deposits were encountered which was recorded to be underlain by residual soils onto the bedrock of the Pennine Middle Coal Measures Formation with a combination of window sample boreholes for the former NHS Keresforth centre. Rotary cored and open borehole drilling were completed on the playing field area only to determine the ground conditions.<br><br>Limited exceedances for a residential without home grown produce end use threshold was recorded in the playing field area only. Exceedances for isolated heavy metals of arsenic and chromium VI along with poly aromatic hydrocarbons (PAHs). For ground gas risk assessment, the concentrations were generally low until the final visit, where methane concentrations were recorded between 2.2% and 27%. Carbon dioxide was generally recorded between 0.8% and 6.4%. Due to the results of the monitoring, it was recommended that CS2 grade ground gas protection measures be incorporated as a precaution.<br><br>The mining risk assessment for the playing field area only identified potential broken ground in the position of RC06 in the north-east of the playing field between 9.50m – 17.00m bgl as the core recovery was poor. The other positions completed in the field did not indicate potential broken ground or workings. However, loss of flush was prevalent across all of the rotary boreholes. A collapse feature was recorded by the coal authority in 2014 close to the northern boundary of the playing field which was remediated by the coal authority. However, it was reported 'tunnels' ran off in north-east, south-east and south-west directions. It was recommended that geophysical investigation techniques are used to try to target these potential features which could be followed by further ground investigation in the future. For the playing field it was recommended that geogrid be incorporated to mitigate against any potential crown hole collapses. |
| Fieldworks Undertaken | The ground investigation works were completed between the 1st and 16th August 2022 for the former NHS Keresforth centre. The investigation comprised 5 No. dynamic probing super heavy (DPSH) up to refusals and 5 No. rotary cored boreholes up to 30.50m bgl using geobore S wireline coring to obtain descriptions of the bedrock strata. Groundwater monitoring standpipes were installed in selected rotary boreholes only. Selected soil and rock samples were subjected to laboratory analysis and 4 No. return groundwater monitoring visits were undertaken between September and October 2022. It should be noted that ground gas monitoring and groundwater sampling are outside the scope of these ground investigation works and reporting. |
| Encountered Ground Conditions | The made ground deposits were proven to maximum depths ranging between 0.15m and 1.90m bgl (141.25m – 138.83m AOD) as either topsoil or asphalt over brown clayey soils in areas of soft landscaping and light yellow to cream compact sandy very angular gravel in areas of hardstanding. This was underlain |

| | |
|---|---|
| | by residual soils up to maximum depths ranging between 1.55m and 2.00m bgl (139.90m AOD in RC09 – 137.60m AOD in RC08) as a stiff to very stiff yellowish brown, brown, orange mottled grey slightly gravelly CLAY or as a stiff to very stiff brown CLAY. Lastly this was underlain by the bedrock of the Pennine Middle Coal Measures Formation (PMCM) up to 30.50m bgl. The base of the formation was not proven. This was encountered as interbedded mudstone (extremely weak to moderately weak), siltstone (weak to medium strong), sandstone (medium strong to strong) and coal with very rare ironstone. It is interpreted that the Barnsley coal seam has been encountered with likely workings identified in the position of RC09 between 8.00m and 9.60m bgl (133.40m – 131.80m AOD). Water flush was generally lost in or around where the Barnsley coal seam was encountered in all of the rotary boreholes. No visual or olfactory indication of contamination during the fieldworks. |
| Materials Management and Soils Reuse | Based on the geochemical testing results presented as part of previous investigations it is considered that there is no specific requirement to remove soils from site because of them presenting an unacceptable risk to human health or the environment. These principles are described in greater detail within the CL:AIRE document The Definition of Waste: Development Industry Code of Practice (Version 2).<br><br>Excavated soils should be suitable for reuse at the site following appropriate waste management regulations and/or under a Materials Management Plan (MMP). |
| Geotechnical Assessment | The likely presence of unrecorded mine workings identified in RC09, the same coal seam in RC07 and RC08 and the geological fault line, will influence the foundation options on the development site. Despite good recovery of the coal seam in the positions of RC07 and RC08 these could have been pillars used to hold up the surrounding bedrock material. Given that the site has a geological fault and unrecorded workings adjacent to each other, this is likely to make the bedrock strata unstable over time where sizeable loads are added to the stratum and may result in ground instability as identified above and in Section 6.2. It is considered that shallow foundations would not be a viable foundation solution without treatment of the identified ground instability.<br><br>To reduce the risk to the proposed structures it is recommended that piles are used to transfer the structural loads past the base of the underlying workings (Barnsley coal seam). North of the fault this is between 10.65m and 11m bgl (130.75m and 129.27m AOD). South of the fault this is between 16.00m and 19.30m bgl (124.81m and 120.10m AOD). The Watermans report (ref. 7) should also be reviewed for final depths of the Barnsley coal seam. It is not recommended to locate the toe of the piles above the zone of the worked ground or Barnsley coal seam. Prior to any piling works, grouting treatment works would need to be undertaken. The carrying capacity of the piles depends not only on their size and the ground conditions but also on their method of installation. Pile design and installation are continuously evolving processes. Therefore, it is recommended that a specialist piling contractor, with suitable experience of these ground conditions be contacted and be provided with this ground investigation report, as well as the previous reports completed for the site to determine the most cost-effective pile technique pertaining to the ground conditions identified.<br><br>As noted in section 6.7 the ground levels are likely to be reducing for the sports hall and the main school building and subject to both cut and fill. The adoption of ground bearing floor slab could be considered if the cut and fill operation is undertaken and controlled under a suitable earthworks specification with appropriate geotechnical classification of proposed material with subsequent validation of their placement. Where the earthworks specification criteria cannot be met due to the ground conditions then suspended floor slabs should be adopted which can be supported off ground beams and or pile caps to minimise differential settlements.<br><br>At this stage, the PMCM formation would be assessed as DS-1 and AC-1 where concrete is not in contact with the coal seams. However, where concrete will be in contact with the coal seams this should increase to DS-2 and AC-2z due to oxidisable sulphides and more acidic ground conditions. |
| Ground Engineering Recommendations | Overall, the site requires specific mitigation measures to be completed to make the site suitable for use. This would require grouting works to be completed beneath the proposed building footprints and a suitable distance away from these. Consideration should also be given to the hardstanding areas i.e., car parking and MUGA. This would require engineer supervision to confirm that the grouting works are being completed to the specification which should have prior approval by the coal authority. This would be followed by a mine working verification report to confirm the above. |

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# Appendices

Appendix A1 - Drawings

Appendix A2 - Exploratory Hole Logs

Appendix A3 - Geotechnical Laboratory Testing Results

Appendix A4 - Groundwater Monitoring Results

Appendix A5 - Risk Assessment Methodology

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# 1.0 Introduction

## 1.1 Project Background

It is proposed to redevelop the former NHS Keresforth Centre site in Barnsley. To address relevant Local Authority planning conditions and or obtain design information in relation to the proposed redevelopment the site has been subject to ground investigation by Waterman Geo-Environmental and Curtins. Further to this previous ground investigation supplemental investigation was recommended and accordingly Curtins submitted proposals for additional intrusive investigation of the area of proposed buildings to the east of the development site. In July 2022 Curtins was instructed by Bowmer & Kirkland (B&K) to undertake the supplemental ground investigation to which this report refers. A site location plan is presented in Figure 1, the development site is centred on an easting and northing of 433442, 405618.

## 1.2 Scope of Services

As advised in Section 1.1 the investigation reported herein addresses recommendations as presented in previous ground investigation reports, notably in the Watermans Geo-Environmental Assessment Report (ref. 7), and Curtins Phase 2 GI Report (ref. 10). The aim of this additional investigation is to confirm the geo-technical ground conditions in the location of the proposed school blocks, surrounding hardstanding and soft landscaping to aid design and recommendations for stabilisation of mining legacy. The current development plans can be referred to within Appendix A1 of this report.

Specifically, the supplemental investigation is intended to confirm:

a) Whether historical shallow (less than 30m depth) coal mine workings extend beneath the footprints of the proposed buildings, associated hardstanding and soft landscaping areas and if so, require treatment;

b) Recommendations for the design of foundations and building ground floor slabs with particular focus on the geological features likely to affect the site; and

c) Recommendations for the specification of sub-structure concrete.

The Curtins report (ref. 10) also included an appropriate contaminated land assessment, considering relevant contaminant/pollutant linkages in relation to human health and groundwater of the proposed sports pitch to the south-west along with the main school area. Therefore, no further assessment is provided within this report.

It is also advised that consideration of flood risk, ecology and archaeological issues are outside of the scope of this report.

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## 1.3 References

- Waterman Infrastructure & Environment (2020) Geo-Environmental Assessment Report (ref. 7);
- Waterman Infrastructure & Environment (2020) Coal Mining Risk Assessment (ref. 8);
- Waterman Infrastructure & Environment (2021) Ground Gas Monitoring (ref. 9);
- Curtins (2022) Phase 2 Ground Investigation (Playing Field Area) (ref. 10); and
- Curtins (2022) Coal Mining Ground Movement Assessment (Playing Field Area) (ref. 11).

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# 2.0 Summary of Previous Investigations

This section presents a summary of previous ground investigations completed at the site, as detailed in Section 1.3.

This summary specifically focuses on the findings of Curtins previous ground investigation report (ref. 10) with other reports having been used as background information.

- Waterman Infrastructure & Environment (2020) Geo-Environmental Assessment Report (ref. 7);
- Waterman Infrastructure & Environment (2020) Coal Mining Risk Assessment (ref. 8);
- Waterman Infrastructure & Environment (2021) Ground Gas Monitoring (ref. 9);
- Curtins (2022) Phase 2 Ground Investigation (Playing Field Area) (ref. 10); and
- Curtins (2022) Coal Mining Ground Movement Assessment (Playing Field Area) (ref. 11).

## 2.1 Current Setting

The site is currently identified as two distinct parcels of land; Keresforth Medical Centre, now disused in the north-east comprising of low rise buildings with access roads, parking areas and soft landscaping and a public open space in the south-west. The area of public open space is predominately flat and is grass covered whilst the Keresforth Medical Centre (pre-demolition) is utilised by a mix of buildings, hardstanding, and soft landscaping. The Coal Authority record the presence of a mine shaft within the public open space.

Based on satellite imagery, the site is bounded to the north by Keresforth Close comprising residential dwellings and sports fields, to the east by Joseph Locke Primary School, to the south by the A6133 Broadway, residential property, and allotments and to the west by the A6133.

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**Fig 1 – Site Location Plan, site boundary shown in red for this Stage 2 ground investigation. Dark blue area is the playing field which references 10 and 11 refer too.**

## 2.2 Previous Site Use

A review of available historical mapping information for the site (as presented within the Waterman Infrastructure & Environment Phase 1 report) (Ref. 7) has been undertaken.

The site remained undeveloped comprising arable farmland until 1978 when the Keresforth Close Medical Centre was constructed. No further notable change to site layout is recorded up to the present day. The mapping of the surrounding area recorded industrial land uses including foundries, works, mills and quarrying activities.

## 2.3 Ground Conditions

The ground investigation covered both the playing field and the NHS Keresforth Centre. However, the boreholes for the Keresforth Centre area to the east were shallow to assess human health risk from contaminated land and ground gas.

Made ground deposits were mainly encountered around the hardstanding areas of the former NHS Keresforth Medical Facilities location. Two of the window sample exploratory boreholes recorded made ground deposits comprising 0.10m of asphalt and underlain by 0.30 – 0.40m of beige to cream coarse, sandy GRAVEL. The gravel comprised angular to sub-angular sands, sandstones, and asphalt. The other borehole positions both in window sample and rotary core holes encountered topsoil. Topsoil was recorded as grass cover over brown soft, slightly silty CLAY with very fine grass rootlets throughout with occasional pebbles present. In exploratory hole RC01, the topsoil was noted as slightly sandy. In RC03, fragments of made ground comprising broken pottery and sandstone were common within the topsoil.

It was also noted within trial pit TP01, that the topsoil was brown soft, slightly clayey SILT possibly reworked; possibly as it was overlaying a coal authority mine shaft.

Superficial deposits were not encountered directly below the topsoil or made ground in any of the exploratory boreholes in Curtins investigation. Locally and further to the south, Watermans assessment report record surficial soils immediately underlaying made ground and or topsoil. BGS mapping Barnsley (Sheet 87, 1:50,000) records no superficial deposits on site. During the ground investigation, it was found in several locations that gravelly CLAY overlies the bedrock units; this is likely to be the residual soils and weathered bedrock of the Pennine Middle Coal Measures Formation.

The bedrock of the Pennine Middle Coal Measures Formation was encountered directly below the residual soils in all locations. The bedrock mostly comprised interbedded sandstones, mudstones, and siltstones with occasional coal seams. Due to the hardness of the bedrock, window sample exploratory boreholes were unable to penetrate past the residual soils into the bedrock. Bedrock was described as extremely weak to extremely strong thinly bedded, dark to light grey parallel laminated or lenticular bedded MUDSTONE, extremely weak to extremely strong, light grey stained orange or yellow-brown, fine to medium/coarse grained SANDSTONE, very weak to extremely strong, grey thinly laminated, laminated SILTSTONE and extremely weak and weathered, dull rarely lignitic, sub-bituminous to bituminous grey-brown to black COAL.

Possible broken ground was identified in exploratory hole RC06 between 9.50m – 17.00m bgl evidenced by poor core recoveries.

## 2.4 Human Health Risk Assessment

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e., the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for the topsoil ranged from 5.47% to 16.1%. The underlying clay recorded SOM values ranging between 1.7% to 21.7%.

With consideration for a calculated geometric average, a SOM of 8.25 % was calculated for topsoil , and a SOM of 7.68% for underlying clay. For comparison against Tier 1 thresholds a conservative SOM value of 6% for ‘Residential without home grown produce’ end use has been adopted for both topsoil and natural clay soils, where applicable.

Assessment of environmental chemistry laboratory testing results for the Made Ground/Topsoil present on site determined isolated exceedances for metals and PAHs across the north, north-western and north-eastern extent of the public open space (playing fields) with most of the exceedances found within topsoil (RC01 at 0.20m bgl, RC02 at 0.30m bgl and RC06 at 0.15m bgl). Exceedances of chromium (VI) were encountered within exploratory hole locations RC01 at a depth of 0.20m bgl and RC02 at a depth of 0.30m bgl. There was also a slight exceedance in Arsenic encountered at RC02 at a depth of

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0.30m bgl. There is notable exceedance in the PAHs, Benzo(a)pyrene and Dibenzo(ah)anthracene at RC06 at a depth of 0.15m bgl.

## 2.5 Ground Gas Risk Assessment

Methane ($CH_4$) was recorded below the instrument's detection limit during monitoring visits 1-6 in all monitoring wells. However, on the final monitoring visit, methane concentration was recorded in all monitoring positions between 2.2% - 27.0%. It was noted within position WS05 the methane concentration was 27.0% and within the deeper wells methane concentrations was noted as 7.2% and 15.9%.

Hydrogen sulphide ($H_2S$) was recorded at 0ppm on the first three visits across the two window sample positions (WS04 and WS05) and increased to 2ppm in both window sample wells on the fourth visit. The fifth visit recorded concentrations of 0ppm before increasing to a concentration of 1ppm during visit 6 and WS04 increasing to 2ppm in visit 7. Across the deeper wells, Hydrogen sulphide ($H_2S$) concentrations were consistently between 0 - 1ppm with RC06D recording a 1ppm concentration during one visit. Carbon monoxide was recorded to range between 0 – 3ppm across the seven visits. No gas flow (l/hr) was recorded in any of the boreholes across the seven visits except for RC06D where a maximum flow of 1.5 l/hr was recorded during visit four. Carbon dioxide ($CO_2$) was recorded in peak concentrations between 0.8% and 6.4%. A concentration of 6.4% was noted within RC06D during the fourth visit. Oxygen ($O_2$) was recorded during the monitoring visits to range between 11.2% and 20.0% within the installations.

Evaluation of the 'worst credible scenario' (highest hazardous gas flow rate that is realistically possible, i.e., in a single borehole) records a maximum $Q_{hg}$ of 0.0096 l/hr for carbon dioxide. Evaluation of the 'worst credible scenario' (highest hazardous gas flow rate that is realistically possible, i.e., in a single borehole) records a maximum $Q_{hg}$ of 0.41 l/hr for methane.

Evaluation of the 'worst possible scenario' (highest $Q_{hg}$ across the entire dataset irrespective of location and discrete monitoring events) records a maximum $Q_{hg}$ of 0.0096 l/hr for carbon dioxide. Evaluation of the 'worst possible scenario' (highest Qhg across the entire dataset irrespective of location and discrete monitoring events) records a maximum Qhg of 0.41 l/hr for methane.

In accordance with assessment by BS8485:2015+A1:2019 the GSV indicates a Characteristic Situation 2 (CS2) gas regime which does require ground gas protection measures.

## 2.6 Mining Risk Assessment

During the ground investigation works loss of water flush was recorded within all boreholes where mudstones and siltstones were encountered due to the fractured nature of the bedrock strata as well as where there was a presence of coal. The loss of flush was observed during the coring and subsequent open holing techniques. Coal seams were not encountered within the window sample

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boreholes. Where coal was encountered, during coring in the drilling works, the coal was recorded to be fractured and retrieved as loose gravel. Within exploratory hole RC02, at depths beyond 34.00m bgl, coal encountered was recorded as intact, with no loose ground or voids being recorded at this depth. There was a notable change in the colour of flush from light grey to black during the open hole drilling within exploratory borehole RC05 indicative of coal encountered between depths of 17.00 – 18.20m bgl.

Possible broken ground may have been encountered within exploratory borehole position RC06 between depths of 9.50 – 17.00m bgl which was situated north-east of the mine shaft located by TP01. Several core runs between 9.50 – 17.00m bgl encountered a zone of core loss as well as the time for the core run being significantly reduced in comparison to previous boreholes. It is difficult to ascertain at this time if the coal seams encountered within RC01 and RC02 have been worked. The logs show a varying succession of strata and losses of flush could be due to the natural fracture state of the bedrock or voids or broken ground due to mining operations.; however, it is considered voiding is likely to be present along the northern extent of the proposed sports field.

A geological fault runs along the northern boundary of the public open field that forms part of the site area and across the access road, aligned generally east-west through the proposed development position. The geological fault that runs NE-SW north of the open field and links the Champany Hill Fault (SW of fault) and the Barebones Fault (NE of the fault). This fault splay is dipping southeast with the bedrock recorded to dip to the east or north-east. Given the age of historic mining activities at shallow depths (1924/1925 or earlier) it is anticipated that any surface subsidence associated with faulting may have already occurred.

TP01 identified the location of the coal authority recorded mine shaft. The trial pit was excavated at 5.6m by 5.4m and found the shaft had a diameter of approximately 3.50m and was situated 0.60m bgl below the residual clays. The shaft was backfilled with old colliery spoils including broken fine-grained sandstones, coal, pottery, and slag. As part of any future works the location of the mine shaft should be drilled to determine the depth of the mine shaft with appropriate treatment of the shaft and construction of a cap to the mine shaft. The shaft is recorded to have no known treatment at the time of writing.

Previous remedial works are recorded on site based on a surface hazard incident report completed by the Coal Authority in 2014. The treatment works included opening out a small crown hole situated very close to the northern boundary of the site adjacent to the entrance of the field, by 2.20m by 1.50m and excavating to a depth of 4.50m below the surface to the base of a void. It was also reported that there were three separate roadways heading in north-east, south-east and south-west directions. The area was filled and compacted in layers with 12 tonnes of clean 75-150mm limestones not exceeding 300mm to within 1.5m to the surface. Geo-textile was placed across the fill and around the exposed sides with the as-dug sandy clay spoil placed and compacted in layers not exceeding a thickness of 150mm to

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the underside of the existing turf. This was overlayed by the topsoil to reinstate the surface of the pre-existing field. No remediation of the visual 'roadways' was undertaken by the Coal Authority.

It has been assessed that the sports field is likely to have localised mine workings along the southern boundary as identified on the available abandonment plans and towards the northern boundary as unrecorded workings. A separate ground movement assessment report has been produced as part of the overall reporting for the proposed sports field and recommends the use of geogrid across the playing field area to mitigate against any potential crown hole collapses, rather than grout treating the entire field. However, the collapse feature along the northern boundary is likely to require further investigation in the form of geophysical techniques to try to determine whether anomalies can be identified due to how shallow the workings are. This is likely to be followed by intrusive ground investigation works to determine the location of the shallow unrecorded workings.

It is also recommended that stabilisation works across the development area post demolition of the existing building structures (where former Keresforth Medical Facilities occupy) should be completed to determine whether coal seams have been worked and require remedial or stabilisation works.

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# 3.0 Phase 2 Ground Investigation Scope of Works

The ground investigation (GI) works were undertaken between the 1st and 16th August 2022.

The scope of the GI was designed in general accordance with current UK guidance including Land Contamination: Risk Management (Ref.1), British Standard (BS) 10175:2011+A2:2017 (Ref.2), BS5930: 2015+A1:2020 (Ref.3), and Eurocode 7 (Ref.4). A summary of the scope and rationale are summarised in Table 3.0 below.

**Table 3.0 - Scope and Rationale of Fieldwork Undertaken**

| Exploratory Hole Type | Exploratory Hole Reference | Exploratory Hole Depth (m bgl) | Rationale |
|---|---|---|---|
| Dynamic Probing Super Heavy (DPSH) | **DCP01 – DCP05** | **Max 0.50 – 4.20** | Undertake in-situ geotechnical testing to determine potential rockhead levels across the site.<br>Determine geotechnical parameters. |
| Geobore S Wireline Rotary Cored Boreholes | **RC07 – RC11** | **Max 30.50** | Confirm ground conditions including determine presence of historic unrecorded shallow mine workings targeting coal seams in the area.<br>Collect soil and rock samples for geotechnical analysis.<br>Undertake in-situ geotechnical testing.<br>Post site works groundwater monitoring.<br>Determine geotechnical parameters. |

The exploratory hole locations were surveyed by Safe Dig Surveys during the GI works. The positions are approximately recorded on Curtins drawing ref. 079532-CUR-XX-XX-D-GE-80001-P03, a copy of which is contained within Appendix A1.

## 3.1 Soil Logging and Sampling

Rotary Cored boreholes including the manually excavated hand inspection pit arisings were logged on site by a qualified engineer. All exploratory holes were logged in accordance with the requirements of BS5930 (Ref.3), including recording observed visual and olfactory indications of contamination. Exploratory hole logs are provided in Appendix A2.

## 3.2 Monitoring Well Installations

Dual groundwater monitoring installations (50mm and 19mm diameter) were installed within three of the five rotary cored boreholes. A bentonite seal was placed above and below the screened section of the borehole to minimise potential for downward migration of contaminants and the creation of a

preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

The monitoring wells were primarily designed to assess groundwater levels within the Pennine Middle Coal Measures Formation (PMCM). Ground gas monitoring assessment has been completed in the existing Watermans and Curtins reporting.

A summary of the response zones is presented in Table 3.2 below.

**Table 3.2 - Monitoring Well Response Zones**

| Borehole Reference | Response Zone(s) (m bgl) | Strata Description(s) |
|---|---|---|
| RC07S | 2.00 – 5.00 | MUDSTONE |
| RC07D | 20.00 – 25.00 | SANDSTONE into MUDSTONE |
| RC09S | 3.00 – 6.00 | SILTSTONE & MUDSTONE |
| RC09D | 15.00 – 20.00 | SANDSTONE, SILTSTONE & MUDSTONE |
| RC11S | 2.00 – 4.00 | SILTSTONE into MUDSTONE |
| RC11D | 10.00 – 15.00 | SILTSTONE & MUDSTONE |

S = Shallow D = Deep

Copies of borehole logs can be referred to in Appendix A2 of this report.

## 3.3 Post-Investigation Monitoring

### 3.3.1 Groundwater Monitoring

An initial programme of 4 No. groundwater monitoring visits over two months was proposed to assess the groundwater levels at the site. The visits were completed between September and October 2022.

### 3.3.2 Ground Gas Monitoring & Groundwater Sampling

Ground gas monitoring and groundwater sampling are not included in the scope of the ground investigation works and reporting, as these have been assessed and completed in previous ground investigations by Watermans and Curtins.

# 4.0 Laboratory Analysis

Representative soil samples were selected for laboratory geotechnical analysis, based on field observations and to provide a characterisation of the made ground and natural strata encountered. Selected soil samples were transported to the nominated laboratory under the laboratory's chain of custody documentation. Geotechnical samples were taken in the form of bulk bags and, disturbed tub samples for soils. Rock samples were wrapped in cling film. The laboratory selected by Curtins for geotechnical analysis was i2 Analytical Ltd, a UKAS and MCERTS accredited laboratory.

This ground investigation has been designed to assess geotechnical ground conditions, appropriate assessment of relevant contaminant/pollutant linkages has been undertaken in the previous reports referred to in Section 1.3. Consequently, the exploratory holes were generally located in a targeted method specific to the proposed buildings primarily to obtain ground condition information and determine geotechnical design parameters.

## 4.1 Geotechnical Analysis

Soil samples for testing were prepared in accordance with BS1377: Part 1: 2016 and representative sub-samples were taken for testing in accordance with BS EN ISO 17892, for the respective tests where applicable. The following tests were carried out:

- 36 No. Water content
- 27 No. BRE Suite D – pH (2:5:1 extract), Sulphate as $SO_4$, Magnesium, Nitrate as $NO_3$ and Chloride (water soluble 2:1). Sulphate (as $SO_4$ Total) and Sulphur (Total)
- 9 No. Plasticity Index – 1 point liquid limit (inc. moisture content)

Rock samples for geotechnical testing were prepared and tested in accordance with ISRM Suggested Methods. The following tests were carried out:

- 94 No. Point Load Test (PLT)
- 5 No. Uniaxial Compressive Strength (UCS)

Copies of the geotechnical testing certificates are presented in Appendix A4.

# 5.0 Encountered Ground Conditions

## 5.1 General

A summary of the ground conditions encountered during the ground investigation works is presented below, with detailed information presented in the exploratory hole logs included in Appendix A2 and a summary of each strata presented in subsequent sections. The values specified in tables 5.2 and 5.3 should not be used for geotechnical design purposes unless specified otherwise. Geotechnical parameters for design will be provided in section 6.2.

**Table 5.1 - Summary of Ground Conditions Encountered**

| Stratum | Depth to top of strata (m bgl) (m AOD) | Thickness (m) | | Description |
|---|---|---|---|---|
| | | Min | Max | |
| MADE GROUND | 0.00 (141.40 – 139.40) | 0.15 | 1.90 | Encountered as either topsoil or asphalt over light yellow to cream compact sandy very angular gravel of limestone in areas of hardstanding. |
| RESIDUAL SOIL (Pennine Middle Coal Measures Formation) | 0.15 – 1.90 (141.25 – 138.83) | 0.10 | 1.85 | The deposit was typically described as a stiff to very stiff yellowish brown, brown and orange mottled grey slightly gravelly CLAY. Gravel is fine to coarse grained and very angular of coal and mudstone lithorelicts or as a stiff to very stiff brown CLAY. |
| BEDROCK (Pennine Middle Coal Measures Formation) | 1.55 – 2.00 (139.40 – 137.60) | 28.50* | 28.95* | The mudstone is typically described as an extremely weak progressing to moderately weak, grey to dark grey, rare medium strong to strong dark grey, rare moderately weak to medium strong black MUDSTONE. Completely to highly weathered, becoming slightly weathered.<br>The siltstone is described as weak to strong rarely strong light and dark grey lenticular bedded SILTSTONE. Highly weathered to slightly weathered.<br>The sandstones are described as a medium strong to strong rarely very strong light grey, rarely dark grey cross bedded fine grained SANDSTONE. Slightly weathered to fresh with closely to widely spaced discontinuities |

* Thickness / base of deposit not proven.

## 5.2 Made Ground

Made ground deposits were encountered in all of the exploratory hole positions proven to maximum depths ranging between 0.15m and 1.90m bgl (141.25m – 138.83m AOD). The made ground was encountered as topsoil in the locations of RC07, RC08 and RC09 to maximum depths between 0.15m

– 0.20m. Described as grass over brown clayey topsoil. In the positions of RC10 and RC11 the made ground is encountered as asphalt up to maximum depths of 0.10m bgl. The made ground soils were proven to maximum depths ranging between 1.00m and 1.90m bgl (139.81 – 138.83m AOD). This was described as a light yellow to cream compact sandy very angular GRAVEL of limestone with the location of RC10 also recorded to have a firm light brown gravelly CLAY made ground soil. The gravel is fine to coarse grained and very angular of coal, mudstone, and sandstone lithorelicts.

**Table 5.2 - Summary of Geotechnical Test Results – Made Ground Deposits**

| Parameter (units) | No. of tests | Minimum | Maximum | Average |
|---|---|---|---|---|
| SPT 'N' Value | 1 | - | 8 | - |

## 5.3 Residual Soil & Bedrock (Pennine Middle Coal Measures Formation)

The residual soil was encountered in all rotary borehole locations directly beneath the made ground deposits. The deposits were encountered at depths ranging between 0.15m and 1.90m bgl (141.25m AOD in RC09 – 138.83m AOD in RC11). The residual soils were proven to maximum depths ranging between 1.55m and 2.00m bgl (139.90m AOD in RC09 – 137.60m AOD in RC08). The shallow residual soils were primarily encountered as a CLAY deposit and are interpreted to be the weathered surface zone of the Pennine Middle Coal Measures Formation (PMCM). The deposit was typically described as a stiff to very stiff yellowish brown, brown and orange mottled grey slightly gravelly CLAY. Gravel is fine to coarse grained and very angular of coal and mudstone lithorelicts or as a stiff to very stiff brown CLAY. This residual soil deposit thickness is likely to vary laterally across the site, particularly where the site slopes in a south-east direction. Where possible, plasticity index tests were completed on the residual soil and bedrock interface.

Plasticity testing was undertaken on several residual soil samples which recorded the clay to be of low to medium plasticity. In accordance with NHBC guidelines the clay can be described as having a worst case low volume change potential in the shallow samples. One sample at 8.00m bgl just above the worked ground zone is recorded to be of medium volume change potential. Based on published relationships, undrained shear strengths (cu) may be estimated from SPT 'N' values where full penetration was achieved, using a factor of 6.5, estimated cu values ranged between 125 kPa and 235 kPa. Taking into consideration the logging descriptions, in-situ testing, and laboratory testing, the PMCM residual soil clay is likely to range from medium strength up to very high strength. This is likely to vary laterally.

**Table 5.3 - Summary of Geotechnical Test Results – Residual Soil & Bedrock Deposits**

| Parameter (units) | No. of tests | Minimum | Maximum | Average |
|---|---|---|---|---|
| Moisture Content (%) BS1377-2 | 35 | 6.4 | 28 | 11.3 |
| pH | 26 | 4.5 | 8.9 | 8.05 |
| Total Sulphate (%) as SO4 | 26 | 0.01 | 0.22 | 0.03 |
| Water Soluble Sulphate (mg/l) | 26 | 3.4 | 266 | 61.8 |
| Water Soluble Chloride (mg/l) | 26 | 2.3 | 53 | 10 |
| Total Sulphur (%) | 26 | 0.005 | 0.872 | 0.073 |
| Water Soluble Nitrate (mg/l) | 26 | 2 | 2.2 | 2.11 |
| Water Soluble Magnesium (mg/l) | 26 | 2.5 | 46 | 12.7 |
| Liquid Limit (%) | 9 | 26 | 48 | 36 |
| Plastic Limit (%) | 9 | 16 | 25 | 20 |
| Plasticity Index (%) | 9 | 10 | 27 | 16 |
| SPT 'N' Value – Residual Soil Stratum | 4 | 19 | 100+(1) | 60 |
| Undrained Shear Strength (cu) (kPa) (2) | 4 | 124 | 650 | 392 |
| Coefficient of volume compressibility (Mv) (m2/MN) (3) | 4 | 0.09 | 0.02 | 0.04 |
| SPT 'N' Value – Bedrock Stratum | 34 | 3 | 100+(1) | 91 |
| Point Load Test Is50 (MPa) - Mudstone | 51 | 0.06 | 3.26 | 0.82 |
| Estimated Uniaxial Compressive Strength (UCS) (Is50*Factor) (4) (MPa) - Mudstone | 51 | 1.2 | 65.2 | 16.4 |
| Point Load Test Is50 (MPa) - Siltstone | 24 | 0.06 | 4.56 | 1.3 |
| Estimated Uniaxial Compressive Strength (UCS) (Is50*Factor) (4) (MPa) - Siltstone | 24 | 1.2 | 91.2 | 26.3 |
| Point Load Test Is50 (MPa) - Sandstone | 18 | 0.54 | 3.76 | 2.12 |
| Estimated Uniaxial Compressive Strength (UCS) (Is50*Factor) (4) (MPa) - Sandstone | 18 | 10.8 | 75.2 | 42.4 |
| Uniaxial Compressive Strength Test (UCS) (MPa) | 5 | 18.5 | 57.3 | 35.4 |

(1) Specific SPT 'N' values are provided on the exploratory borehole logs contained in Appendix A2.
(2) cu estimated from SPT N value correlation with average Plasticity Index using a Factor of 6.5 (Stroud and Butler, 1975).
(3) mv estimated from SPT N value correlation with average Plasticity Index using a Factor of 0.57 (Stroud and Butler, 1975).
(4) Estimated uniaxial compressive strength using Is50 value multiplied by a factor of 20.

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The bedrock deposits were encountered directly beneath the residual soils. The bedrock was encountered at depths ranging between 1.55m and 2.00m bgl (139.40m AOD in RC09 – 137.60m AOD in RC08). The base of the PMCM was not proven but the base of the boreholes were advanced up to 30.50m bgl (110.90m – 108.90m AOD). The deposits that were encountered were of interbedded mudstone, siltstone sandstone and coal of varying weathering grades and fracture states.

The mudstone is generally the most common of the interbedded deposits, generally the weakest and has a higher degree of weathering compared to the siltstone and sandstone. The mudstone is typically described as an extremely weak progressing to moderately weak, grey to dark grey MUDSTONE. Initially completely to highly weathered, becoming slightly weathered with extremely closely becoming closely spaced discontinuities. Fractures are generally iron stained dark purple, dark orange and orange with the orientation of the fractures generally horizontal to sub-horizontal with rare vertical fractures. Rare black plant fossil remains were present.

The siltstones are the second most common of the interbedded deposits and is generally described as a weak to medium strong light and dark grey lenticular bedded SILTSTONE. Highly weathered to slightly weathered with very closely to medium spaced discontinuities. Fractures are generally iron oxide stained light to dark orange with largely horizontal to sub-horizontal with rare vertical fractures.

The sandstones are the third most common of the interbedded deposits and are generally described as a medium strong to strong rarely very strong light grey, rarely dark grey cross bedded fine grained SANDSTONE. Slightly weathered to fresh with closely to widely spaced discontinuities. Rarely fracture planes have possible calcite minerals deposited on the fracture planes. Some of the fracture planes are also iron oxide stained.

Coal deposits were encountered throughout with distinct layers encountered that are interpreted to be the Barnsley coal seam (recorded in historical records as a 2.68m thick split seam) . The position of RC09 between 8.00 and 9.50m identified a zone of worked ground, possible void. The positions of RC07, RC08, RC10 and RC11 encountered intact coal which could have passed through potential pillars supporting the below ground unrecorded workings. In RC11 between 13.25m and 15.50m bgl above the coal seam was a residual soil / extremely weak deposit of material which was not encountered in any of the other boreholes. Further discussion with relation to the historical coal mining is discussed in section 6.4.

Numerous point load tests were undertaken across all of the different rock types to help provide estimations of the UCS values. These are shown in the table above and show a wide range of strengths. It was difficult to obtain samples to undertake full UCS tests due to the fracture spacing of the bedrock and large portions of the material being recovered as core stones in the mudstone and siltstone primarily. With the sandstone sometimes breaking up into gravel and cobble pieces, potentially breaking

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up along the sand grains. SPTs were undertaken within the top 10m or where the ground conditions became unusually soft which was encountered in RC09 and RC11.

## 5.4 Observed Potential Contamination

During the ground investigation works no visual or olfactory evidence of contamination was identified within the boreholes.

## 5.5 Obstructions Encountered

No anthropogenic obstructions were encountered as part of the ground investigation works that prevented advancement of any of the exploratory holes. However, at the time of the ground investigation the buildings and associated areas hardstanding were still present. On the last monitoring visit completed on the 11th October 2022 all of the buildings have been demolished to ground level; foundations will require breaking to remove hard spots. An enabling works package is likely to be required to remove these anthropogenic features.

The underlying bedrock deposits are likely to be encountered at varying depths across the site with the topography of the land currently sloping to the south-east.

## 5.6 Groundwater Conditions

A summary of the groundwater levels recorded during the ground investigation works, and subsequent monitoring, is presented in Table 5.6. Full details of the water strikes recorded during progression of the investigation positions are presented on the exploratory hole logs included in Appendix A2 and full details of the water levels recorded during the monitoring visits are presented in Appendix A5.

**Table 5.6 - Groundwater strikes during investigation and subsequent monitoring levels.**

| Exploratory Hole Location Ref. | Water Strikes During Ground Investigation | | Post Investigation Monitored Water Levels | |
|---|---|---|---|---|
| | Strike Depth (mbgl) (m AOD) | Strata | Installation Strata | Monitored Levels (m bgl) (m AOD) |
| RC07S | - | - | PMCM - Mudstone | Dry |
| RC07D | - | - | PMCM – Sandstone & Mudstone | 20.25 – 20.45 (120.02m – 119.82m AOD) |
| RC09S | - | - | PMCM – Siltstone & Mudstone | Dry |

| Exploratory Hole Location Ref. | Water Strikes During Ground Investigation | | Post Investigation Monitored Water Levels | |
|---|---|---|---|---|
| | Strike Depth (mbgl) (m AOD) | Strata | Installation Strata | Monitored Levels (m bgl) (m AOD) |
| RC09D | - | - | PMCM – Primarily Sandstone with Mudstone & Siltstone present | 18.60 – 19.90 (122.80m – 121.50m AOD) |
| RC11S | - | - | PMCM – Siltstone & Mudstone | 2.15 – 2.65 (138.58m – 138.08m AOD) |
| RC11D | - | - | PMCM – Siltstone & Mudstone within extremely weak zone | Dry |

- No groundwater not recorded to be struck during ground investigation.

During the rotary drilling groundwater flush was lost completely at certain depths in all five of the rotary boreholes. This required water to be constantly pumped from the hydrant at the site to be able to complete the works efficiently. Due to this it was not possible to record the amount of water used at each location to drill to 30.50m bgl. The depths at which flush was lost is noted in section 6.4.

The groundwater levels recorded in RC11S are unlikely to be representative of a perched shallow water table within the completely to highly weathered zone. Due to the highly fractured and iron stained nature of the material, water is likely to flow vertically as well as laterally albeit at a very slow to slow rate.

The groundwater levels recorded in RC07D an RC09D are unclear whether this would be the representative natural groundwater table. Due to the rate at which the water flush was being lost during drilling of the rotary positions it is unlikely that this would be the natural groundwater table. It is possible that this is residual flush water after the drilling works have been completed.

## 5.7 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C2 of the Building Research Establishment (BRE) Special Digest 1, third edition of 2005. Table 5.7 details the classifications.

**Table 5.7 - Aggressive Chemical Environment for Concrete (ACEC) Site Classification**

| Stratum | Design Sulphate Class | ACEC Class (1) |
|---|---|---|
| Residual Soil & Bedrock (PMCM) | DS-1 where concrete not in contact with coal seams. | AC-1 where concrete not in contact with coal seams. |