



APPENDIX F PRE-DEVELOPMENT GREENFIELD RUNOFF CALCULATIONS

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18 Frogmore Road
Hemel Hempstead
Herts, HP3 9RT



Date 26/02/2019 10:09
File

Designed By RBrenton
Checked By

Elstree Computing Ltd

Source Control W.12.5

ICP SUDS Mean Annual Flood

Input

| | | | |
|-----------------------|-------|---------------|----------|
| Return Period (years) | 1 | Soil | 0.150 |
| Area (ha) | 4.020 | Urban | 0.000 |
| SAAR (mm) | 757 | Region Number | Region 7 |

Results 1/s

| | |
|------------|-----|
| QBAR Rural | 1.8 |
| QBAR Urban | 1.8 |

Q1 year 1.5

| | |
|------------|-----|
| Q1 year | 1.5 |
| Q30 years | 4.0 |
| Q100 years | 5.7 |

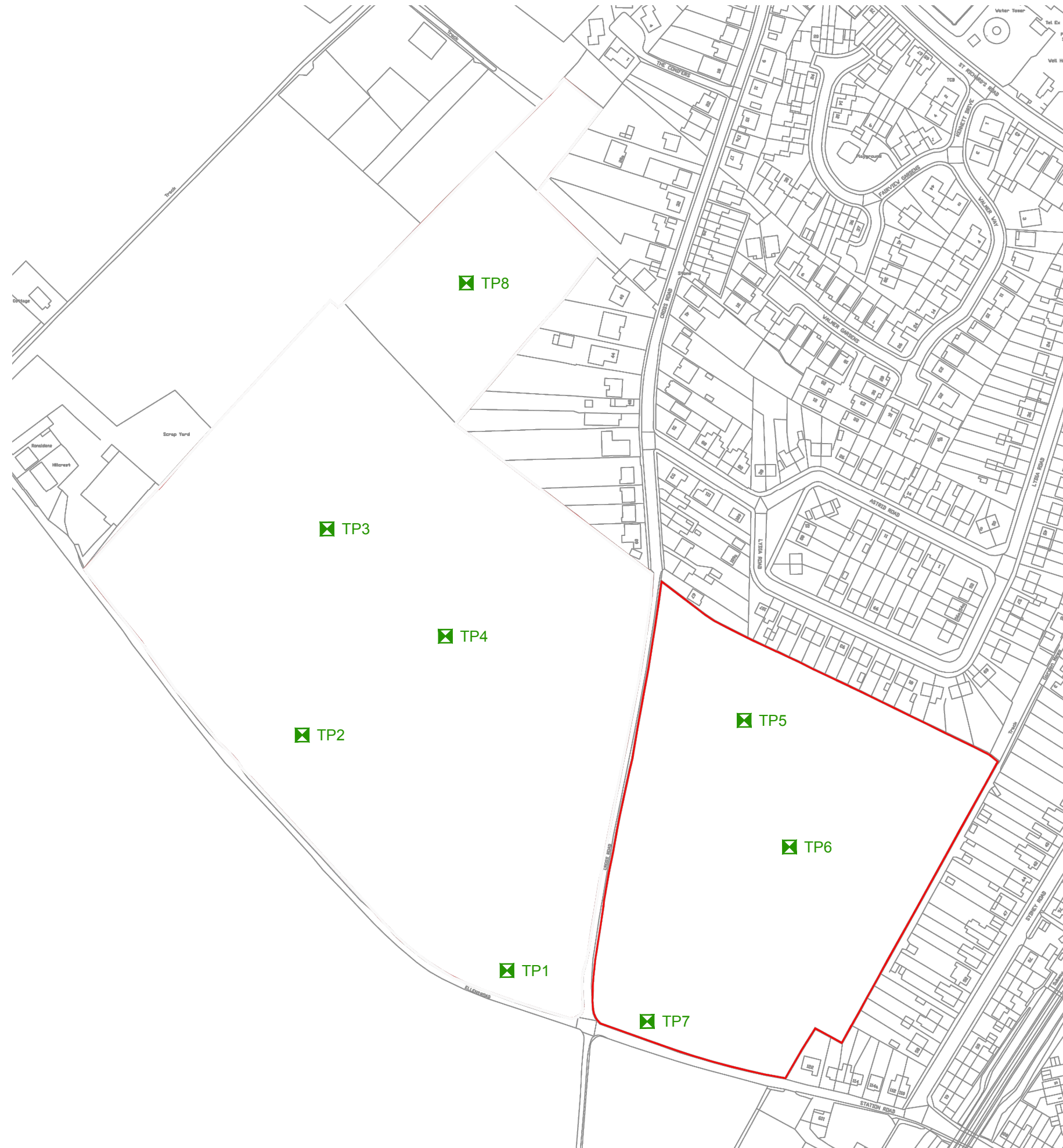
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APPENDIX G

LOCATION OF INFILTRATION TESTS

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LEGEND

- Site Boundary
- ✕ Trial Pit Location

| Rev. | Date | Amendment | Drawn | Chkd. | Appd. |
|------|------|-----------|-------|-------|-------|
| | | | | | |



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Web: www.rsk.co.uk

Client
GLADMAN DEVELOPMENTS

Project Title
**CROSS ROAD,
DEAL**

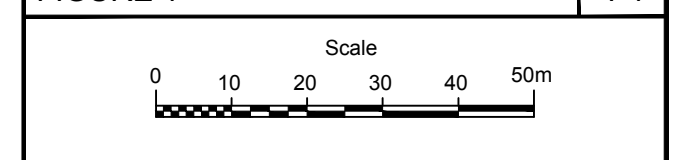
Drawing Title
**EXISTING
SITE LAYOUT
PLAN**

| | | | | | |
|--------------|------------------|---------------|------------------|----------------|------------------|
| Drawn ASC | Date 17.02.17 | Checked SF | Date 17.02.17 | Approved SF | Date 17.02.17 |
|--------------|------------------|---------------|------------------|----------------|------------------|

| | | |
|-----------------|-----------------|-----------------|
| Scale 1:1000 | Orig Size A3 | Dimensions m |
|-----------------|-----------------|-----------------|

| | |
|----------------------------|---------------------------------------|
| Project No. 28926 - L01 | Drawing File 28926 (L01) Fig 1.dwg |
|----------------------------|---------------------------------------|

| | |
|--------------------------------|-------------------|
| Drawing No. FIGURE 1 | Rev. P1 |
|--------------------------------|-------------------|



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APPENDIX H

INFILTRATION TEST RESULTS

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FULL SCALE SOAKAWAY TEST

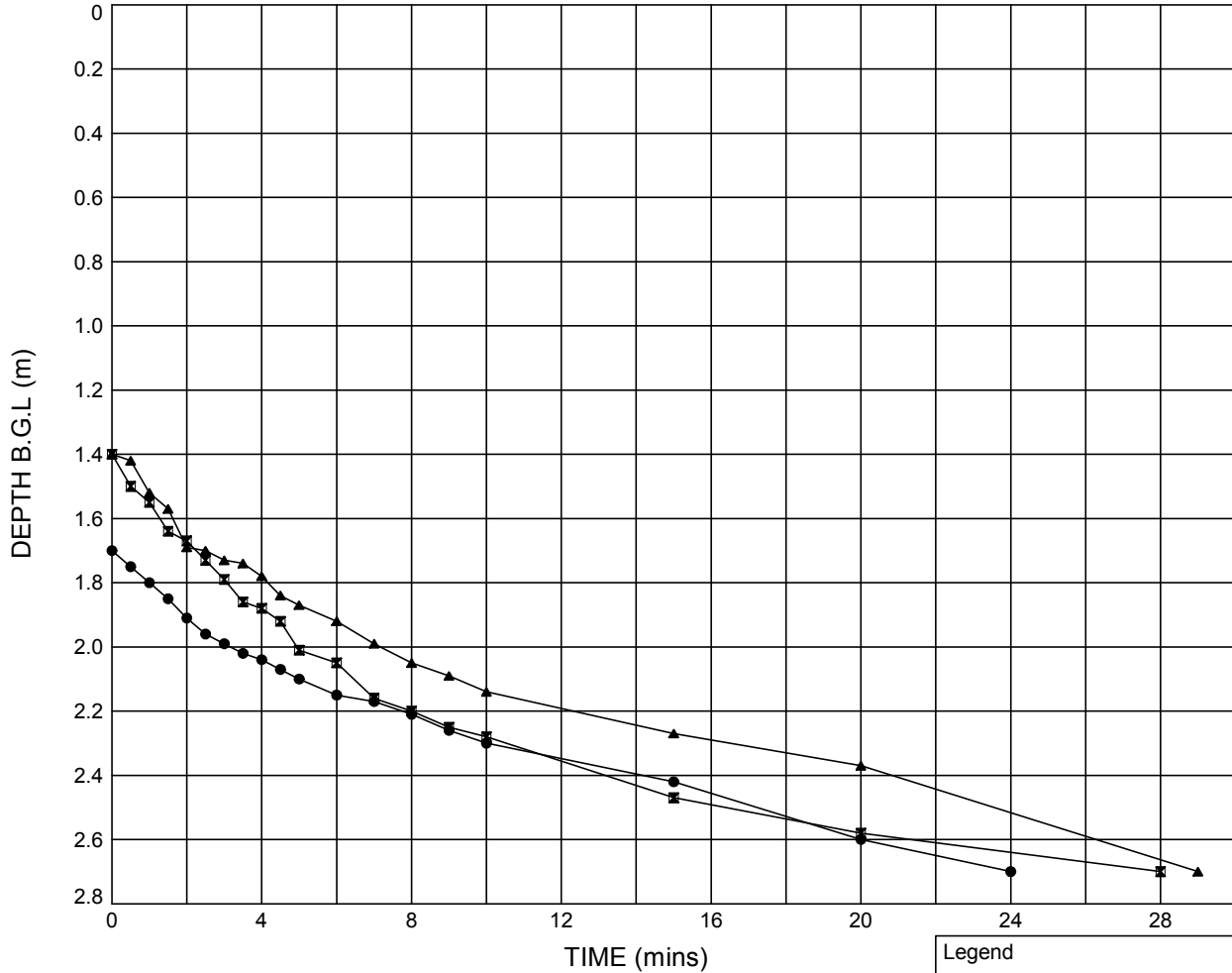
In accordance with BRE Digest 365

Soakaway Test - Position ID : TP1

Ground Level: ---

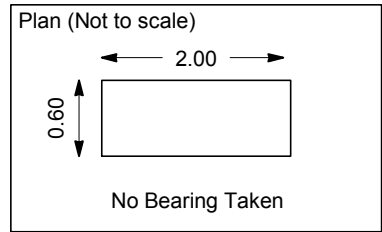
Co-ordinates: ---

Plot of Depth of Water Below Ground Level Against Time

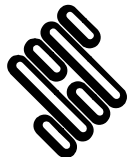


| | Test 1 | Test 2 | Test 3 | |
|--|-------------------------|-----------------------|-----------------------|----------------|
| Pit start depth: | = 2.70 | 2.70 | 2.70 | m |
| Pit final depth: | = 2.55 | 2.45 | 2.45 | m |
| Effective depth, D_e | = 0.85 | 1.05 | 1.05 | m |
| Effective storage volume, V_{p75-25} | = 0.5100 | 0.6300 | 0.6300 | m ³ |
| Surface area, a_{p50} | = 3.4100 | 3.9300 | 3.9300 | m ² |
| Time, t_{p75-25} | = 573 | 348 | 597 | secs |
| Infiltration rate, f | = 2.61×10^{-4} | 4.61×10^{-4} | 2.69×10^{-4} | m/s |

| Legend | | |
|--------|--------|------------|
| ● | Test 1 | (09.02.17) |
| ■ | Test 2 | (09.02.17) |
| ▲ | Test 3 | (09.02.17) |



GINT_LIBRARY_V8_06_GLB.LibVersion: v8_06_015 ProjVersion: v8_06 - Core+Logs - 002 | Graph 1 - TP SOAKAWAY - 2 - FINAL REPORT - A4P | 28296_CROSS ROAD.GPJ - v8_06 | 15/02/17 - 17:20 | CM4 |



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

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| Compiled By | Date | Checked By | Date |
| <i>Clare Morley</i> | 15/02/17 | | |
| Contract | | Contract Ref: | |
| Cross Road | | 28926 | |

FULL SCALE SOAKAWAY TEST

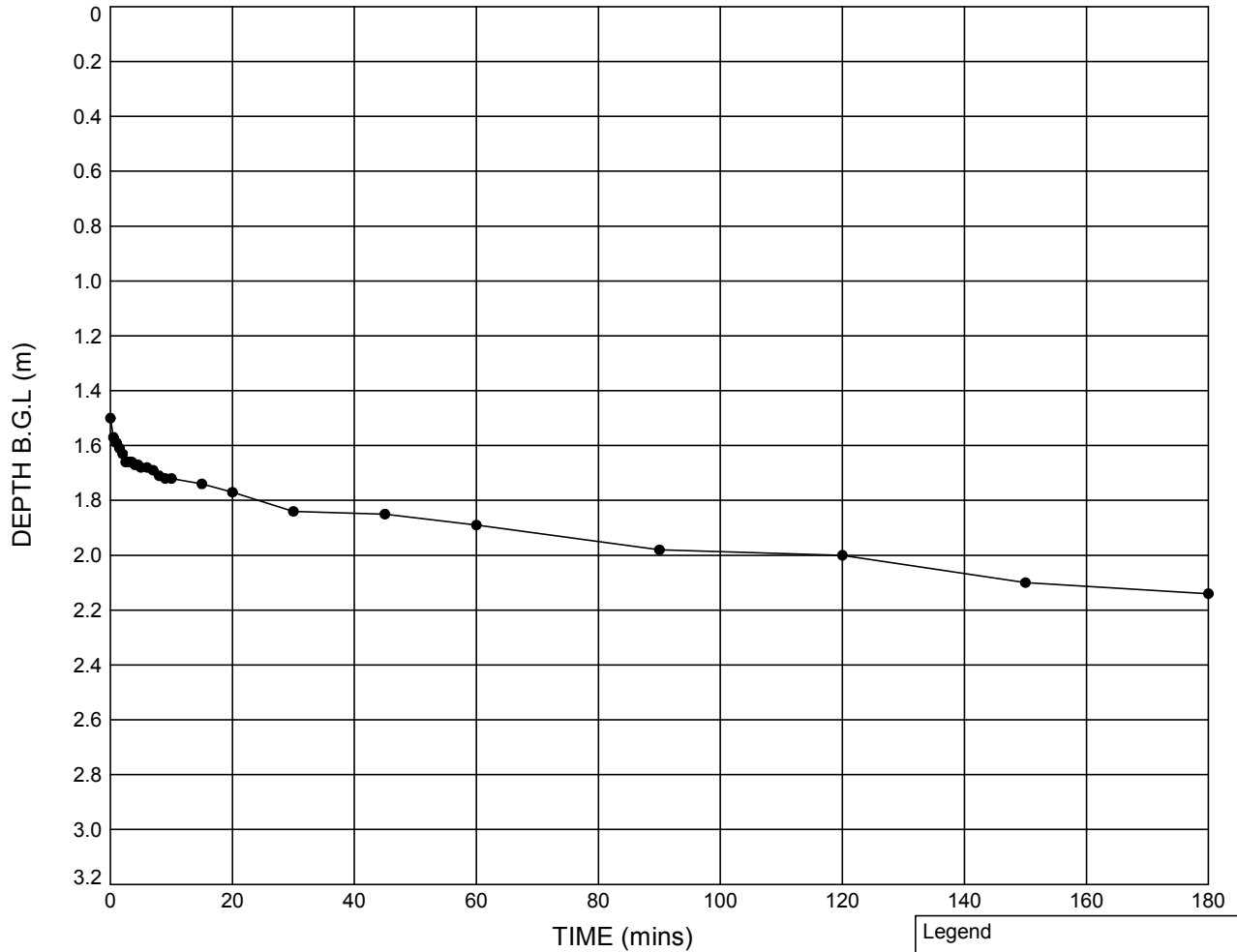
Non-standard test

Soakaway Test - Position ID : TP2

Ground Level: ---

Co-ordinates: ---

Plot of Depth of Water Below Ground Level Against Time



Pit start depth: = **3.10** m
 Pit final depth: = **3.00** m
 Effective depth, D_e = **1.50** m
 Effective storage volume, V_{p75-25} = **0.9000** m³
 Surface area, a_{p50} = **5.1000** m²
 Time, t_{p75-25} = **315** secs
 Infiltration rate, f = **5.60×10^{-6}** m/s

Please note test data was extrapolated to obtain tp75-tp25.

Legend

● Test 1 (09.02.17)

Plan (Not to scale)

No Bearing Taken

GINT_LIBRARY_V8_06_GLB.LibVersion: v8_06_015 ProjVersion: v8_06 - Core+Logs - 002 | Graph 1 - TP SOAKAWAY - 2 - FINAL REPORT - A4P | 28296_CROSS ROAD.GPJ - v8_06 | 15/02/17 - 17:20 | CM4 |



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FULL SCALE SOAKAWAY TEST

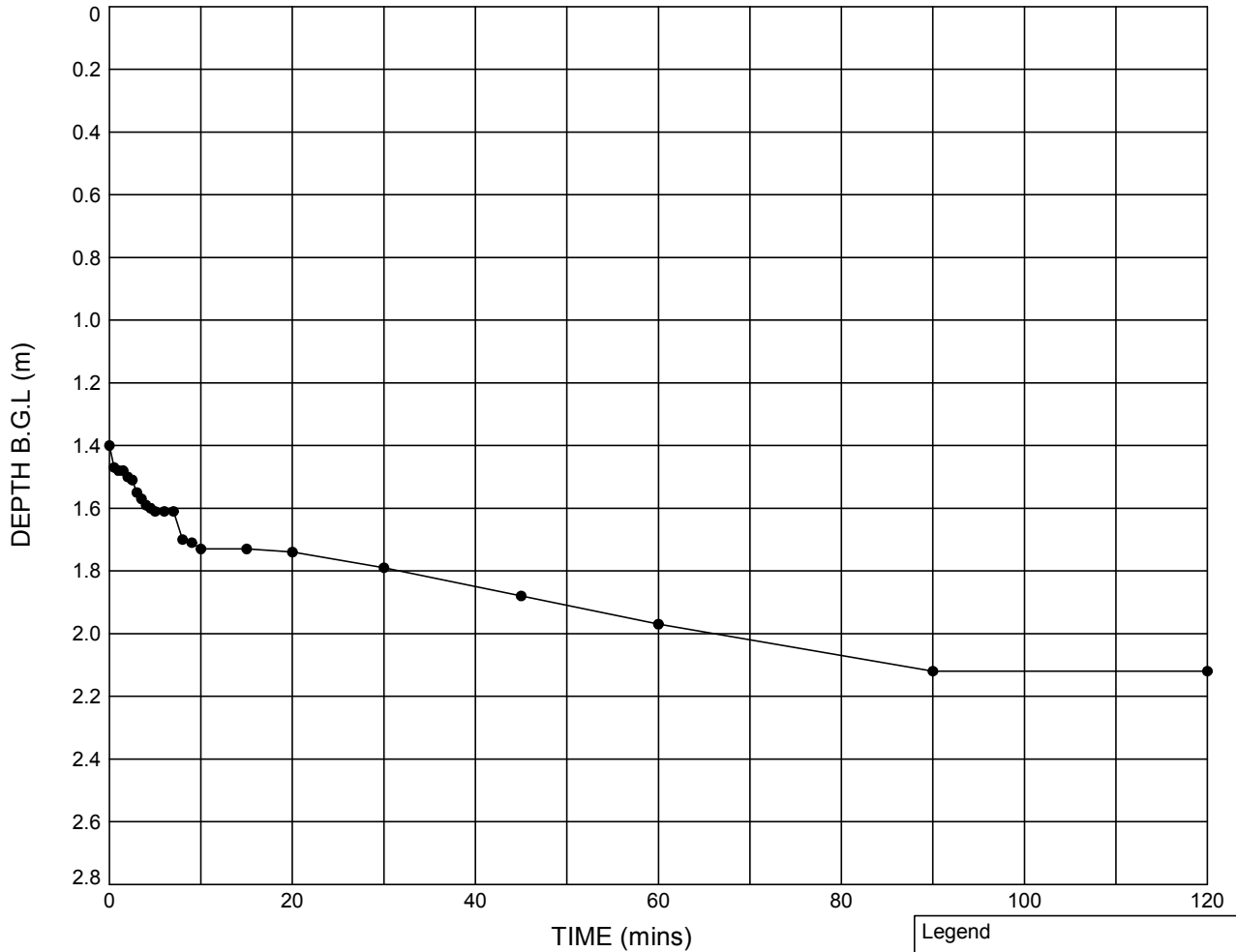
Non-standard test

Soakaway Test - Position ID : TP3

Ground Level: ---

Co-ordinates: ---

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Pit start depth: = **2.70** m
 Pit final depth: = **2.75** m
 Effective depth, D_e = **1.35** m
 Effective storage volume, V_{p75-25} = **0.8100** m³
 Surface area, a_{p50} = **4.7100** m²
 Time, t_{p75-25} = **8100** secs
 Infiltration rate, f = **2.12×10^{-5}** m/s

Please note test data was extrapolated to obtain tp75-tp25.

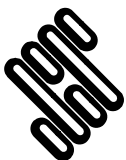
Legend

● Test 1 (09.02.17)

Plan (Not to scale)

No Bearing Taken

GINT_LIBRARY_V8_06_GLB.LibVersion: v8_06_015 ProjVersion: v8_06 - Core+Logs - 002 | Graph 1 - TP SOAKAWAY - 2 - FINAL REPORT - A4P | 28296_CROSS ROAD.GPJ - v8_06 | 15/02/17 - 17:20 | CM4 |



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| Cross Road | | 28926 | |

FULL SCALE SOAKAWAY TEST

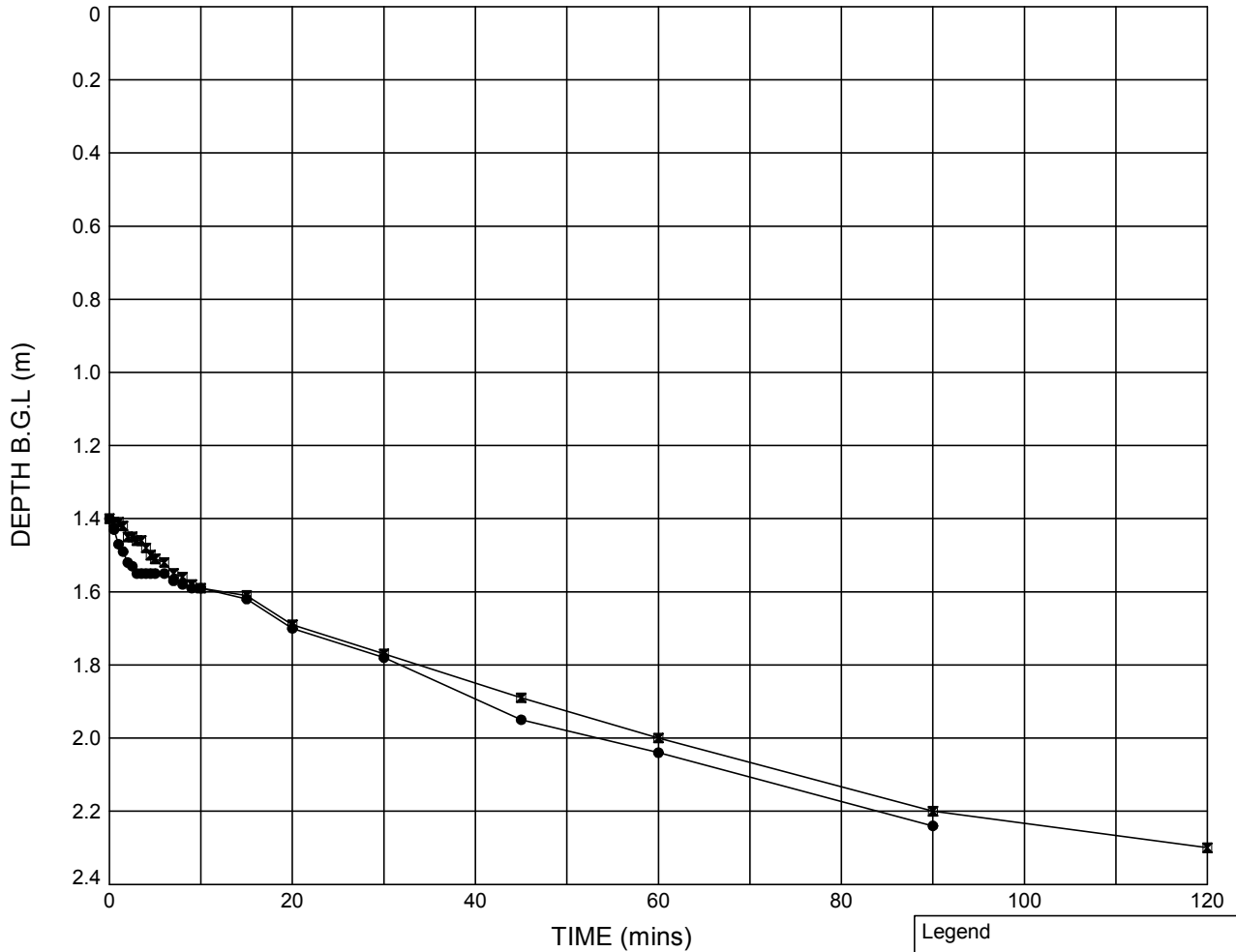
Non-standard test

Soakaway Test - Position ID : **TP4**

Ground Level: ---

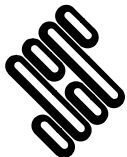
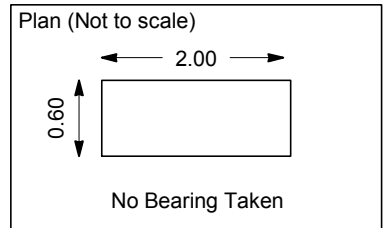
Co-ordinates: ---

Plot of Depth of Water Below Ground Level Against Time



| | Test 1 | Test 2 | |
|--|-------------------------|-----------------------|-------|
| Pit start depth: | = 2.40 | 2.40 | m |
| Pit final depth: | = 2.40 | 2.35 | m |
| Effective depth, D_e | = 1.00 | 0.95 | m |
| Effective storage volume, V_{p75-25} | = 0.6000 | 0.5700 | m^3 |
| Surface area, a_{p50} | = 3.8000 | 3.6700 | m^2 |
| Time, t_{p75-25} | = 3578 | 3609 | secs |
| Infiltration rate, f | = 4.41×10^{-5} | 4.30×10^{-5} | m/s |

| Legend | | |
|--------|--------|------------|
| ● | Test 1 | (10.02.17) |
| ■ | Test 2 | (10.02.17) |



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FULL SCALE SOAKAWAY TEST

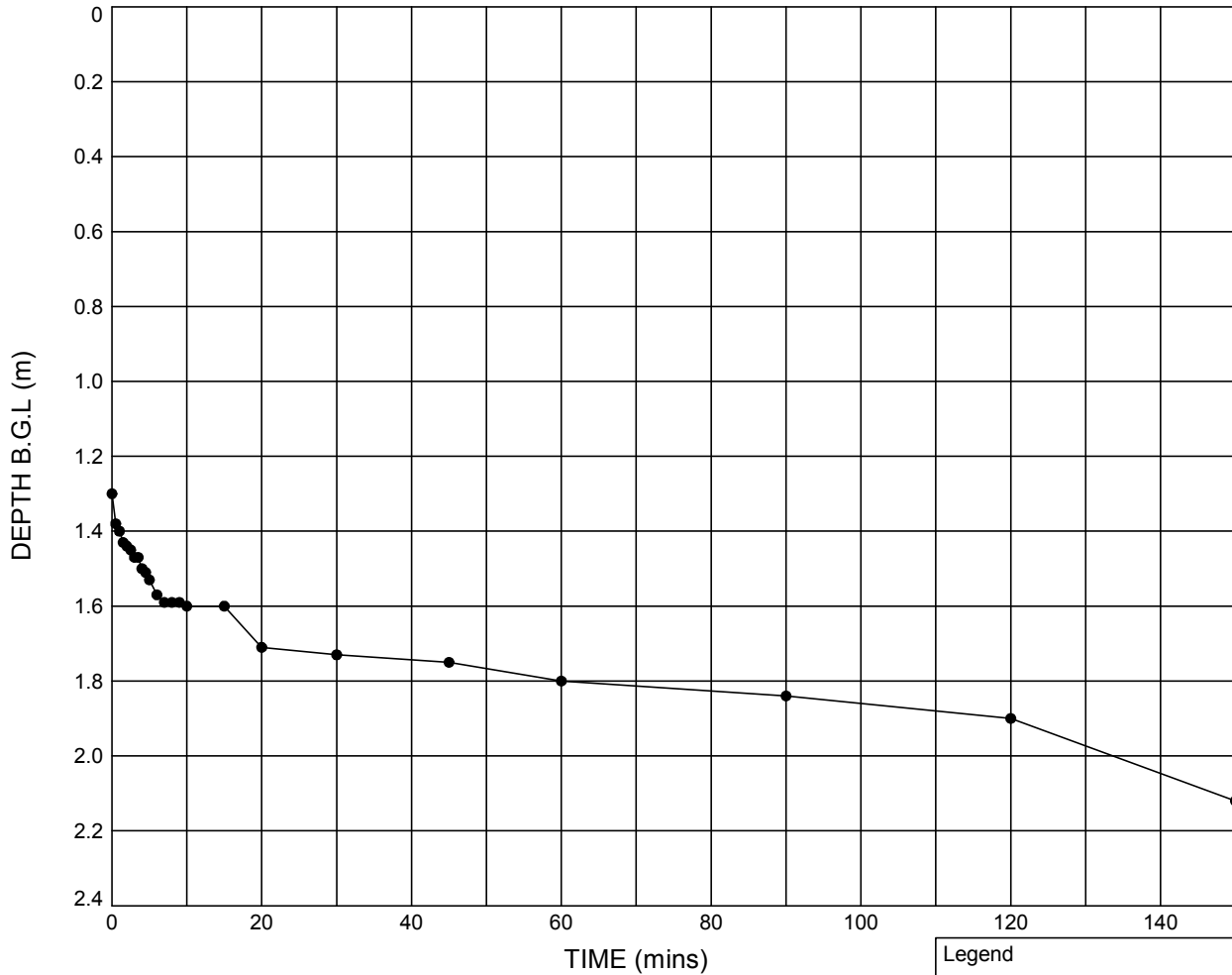
Non-standard test

Soakaway Test - Position ID : **TP5**

Ground Level: ---

Co-ordinates: ---

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Pit start depth: = **2.30** m
 Pit final depth: = **2.30** m
 Effective depth, D_e = **1.00** m
 Effective storage volume, V_{p75-25} = **0.6000** m³
 Surface area, a_{p50} = **3.8000** m²
 Time, t_{p75-25} = **8097** secs
 Infiltration rate, f = **1.95×10^{-5}** m/s

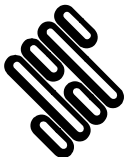
Legend

● Test 1 (10.02.17)

Plan (Not to scale)

No Bearing Taken

GINT_LIBRARY_V8_06_GLB.LibVersion: v8_06_015 ProjVersion: v8_06 - Core+Logs - 002 | Graph 1 - TP SOAKAWAY - 2 - FINAL REPORT - A4P | 28296_CROSS ROAD.GPJ - v8_06 | 15/02/17 - 17:21 | CM4 |



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| Contract | | Contract Ref: | |
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FULL SCALE SOAKAWAY TEST

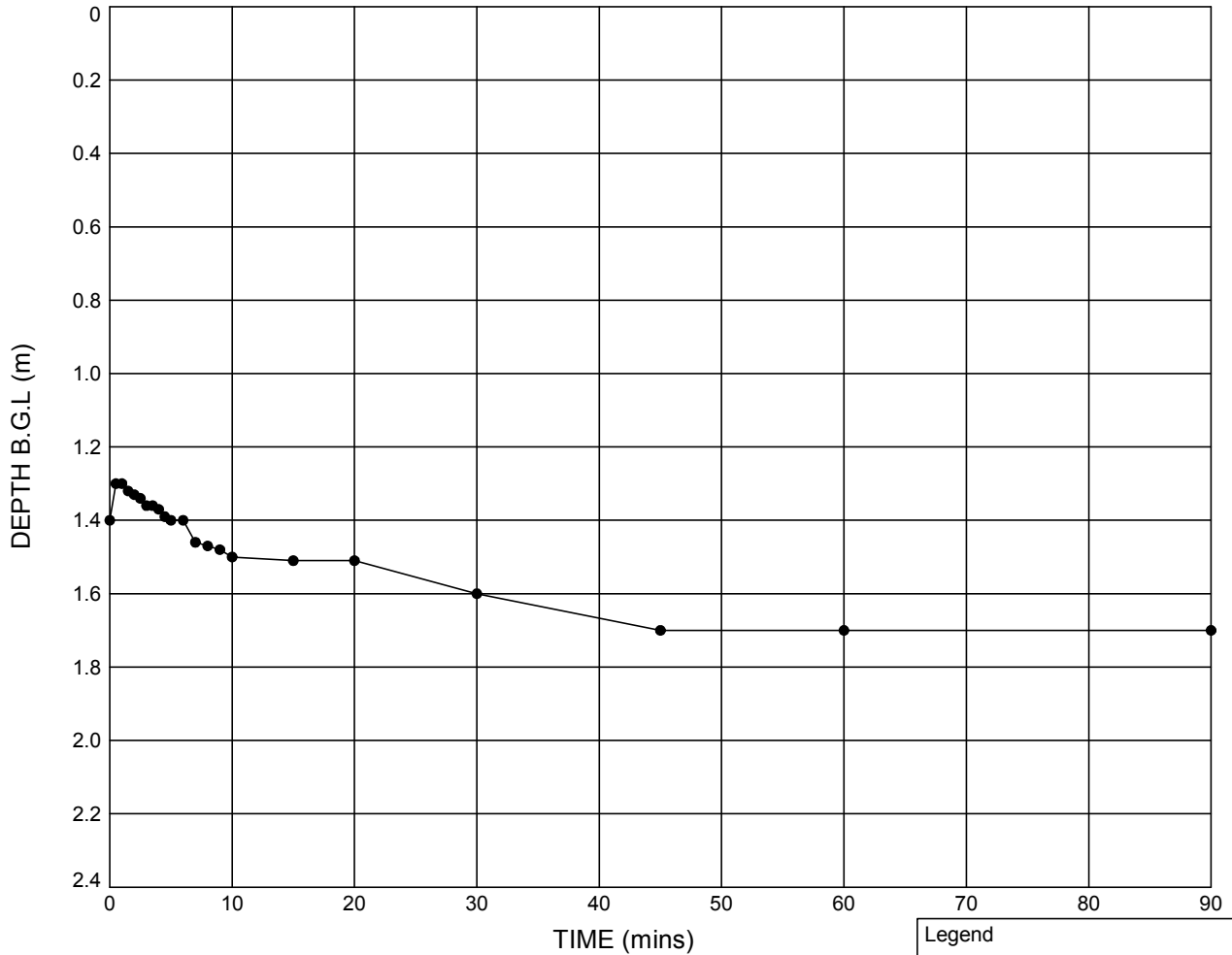
Non-standard test

Soakaway Test - Position ID : **TP6**

Ground Level: ---

Co-ordinates: ---

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Pit start depth: = **2.40** m
 Pit final depth: = **1.80** m
 Effective depth, D_e = **0.40** m
 Effective storage volume, V_{p75-25} = **0.2400** m³
 Surface area, a_{p50} = **2.2400** m²
 Time, t_{p75-25} = **2100** secs
 Infiltration rate, f = **5.10×10^{-5}** m/s

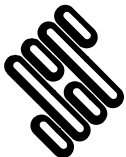
Legend

● Test 1 (10.02.17)

Plan (Not to scale)

No Bearing Taken

GINT_LIBRARY_V8_06_GLB.LibVersion: v8_06_015 ProjVersion: v8_06 - Core+Logs - 002 | Graph 1 - TP SOAKAWAY - 2 - FINAL REPORT - A4P | 28296_CROSS ROAD.GPJ - v8_06 | 15/02/17 - 17:21 | CM4 |



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| Contract | | Contract Ref: | |
| Cross Road | | 28926 | |

FULL SCALE SOAKAWAY TEST

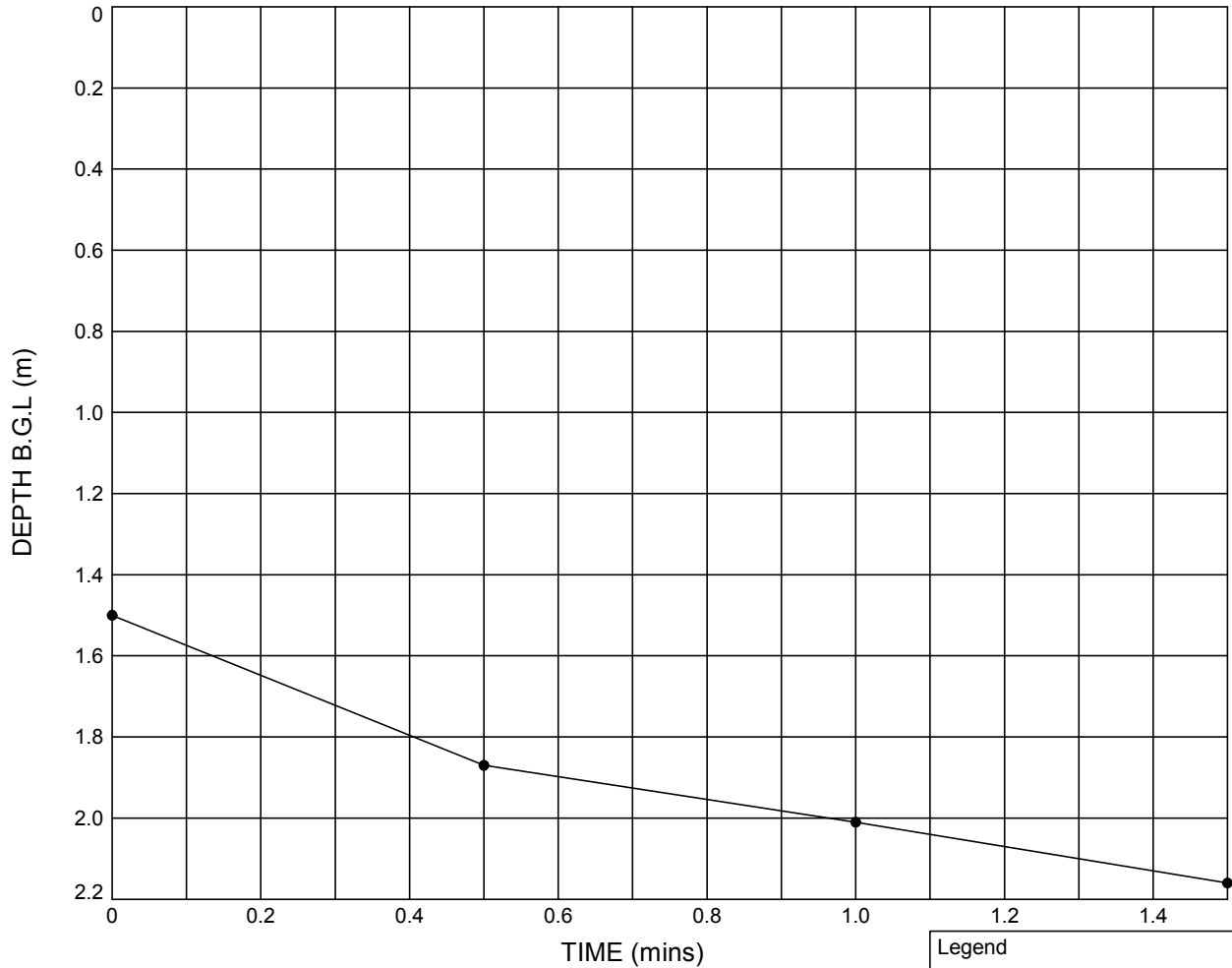
Non-standard test

Soakaway Test - Position ID : **TP7**

Ground Level: ---

Co-ordinates: ---

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Pit start depth: = **2.60** m
 Pit final depth: = **2.10** m
 Effective depth, D_e = **0.60** m
 Effective storage volume, V_{p75-25} = **0.3600** m³
 Surface area, a_{p50} = **2.7600** m²
 Time, t_{p75-25} = **35** secs
 Infiltration rate, f = **3.73×10^{-3}** m/s

Legend

- Test 1 (10.02.17)

Plan (Not to scale)

No Bearing Taken

GINT_LIBRARY_V8_06_GLB.LibVersion: v8_06_015 ProjVersion: v8_06 - Core+Logs - 002 | Graph 1 - TP SOAKAWAY - 2 - FINAL REPORT - A4P | 28296_CROSS ROAD.GPJ - v8_06 | 15/02/17 - 17:21 | CM4 |



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FULL SCALE SOAKAWAY TEST

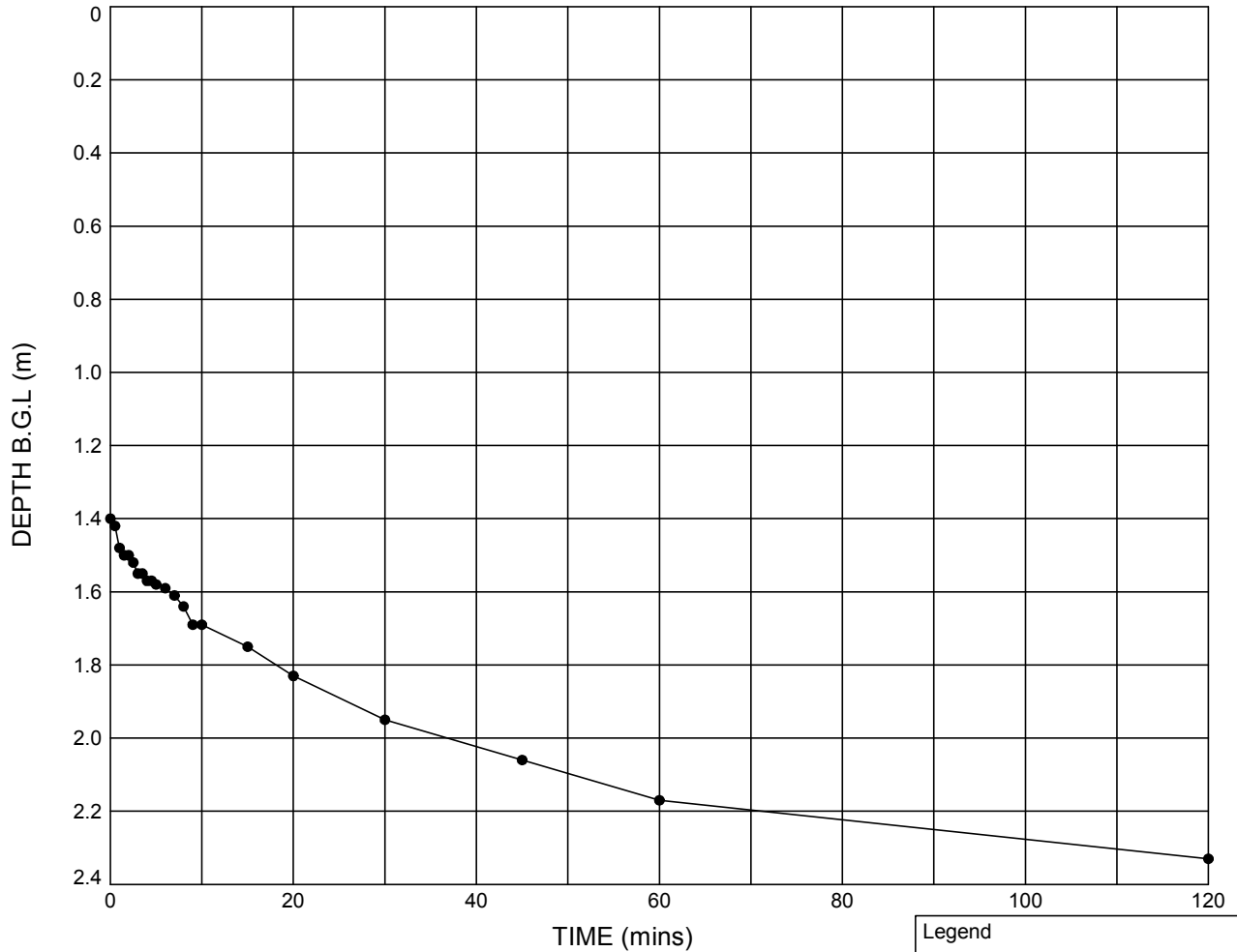
Non-standard test

Soakaway Test - Position ID : TP8

Ground Level: ---

Co-ordinates: ---

Plot of Depth of Water Below Ground Level Against Time



Pit start depth: = **2.40** m
 Pit final depth: = **2.40** m
 Effective depth, D_e = **1.00** m
 Effective storage volume, V_{p75-25} = **0.6000** m³
 Surface area, a_{p50} = **3.8000** m²
 Time, t_{p75-25} = **2944** secs
 Infiltration rate, f = **5.36×10^{-5}** m/s

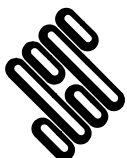
Legend

● Test 1 (09.02.17)

Plan (Not to scale)

No Bearing Taken

GINT_LIBRARY_V8_06_GLB.LibVersion: v8_06_015 ProjVersion: v8_06 - Core+Logs - 002 | Graph 1 - TP SOAKAWAY - 2 - FINAL REPORT - A4P | 28296_CROSS ROAD.GPJ - v8_06 | 15/02/17 - 17:22 | CM4 |



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| <i>Clare Harty</i> | 15/02/17 | | |
| Contract | | Contract Ref: | |
| Cross Road | | 28926 | |



APPENDIX I

PARCEL INILTRATION BASIN SIZING

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18 Frogmore Road
Hemel Hempstead
Herts, HP3 9RT



Date 04/04/2019 08:56
File 4 Stage 04.04.201...

Designed By RBrenton
Checked By

Elstree Computing Ltd

Source Control W.12.5

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 4 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m ³) | Status |
|-----------------|---------------|---------------|------------------------|------------------------------|--------|
| 15 min Summer | 18.878 | 1.078 | 601.9 | 167.9 | O K |
| 30 min Summer | 18.914 | 1.114 | 629.8 | 178.1 | O K |
| 60 min Summer | 18.831 | 1.031 | 565.8 | 155.4 | O K |
| 120 min Summer | 18.586 | 0.786 | 433.9 | 102.0 | O K |
| 180 min Summer | 18.403 | 0.603 | 356.1 | 69.2 | O K |
| 240 min Summer | 18.272 | 0.472 | 302.0 | 49.0 | O K |
| 360 min Summer | 18.098 | 0.298 | 232.9 | 26.7 | O K |
| 480 min Summer | 17.987 | 0.187 | 190.5 | 15.0 | O K |
| 600 min Summer | 17.911 | 0.111 | 162.0 | 8.2 | O K |
| 720 min Summer | 17.856 | 0.056 | 141.5 | 3.9 | O K |
| 960 min Summer | 17.842 | 0.042 | 114.3 | 2.9 | O K |
| 1440 min Summer | 17.831 | 0.031 | 82.1 | 2.1 | O K |
| 2160 min Summer | 17.823 | 0.023 | 59.6 | 1.6 | O K |
| 2880 min Summer | 17.818 | 0.018 | 47.3 | 1.3 | O K |
| 4320 min Summer | 17.813 | 0.013 | 33.9 | 0.9 | O K |
| 5760 min Summer | 17.811 | 0.011 | 27.4 | 0.8 | O K |
| 7200 min Summer | 17.810 | 0.010 | 24.7 | 0.8 | O K |
| 8640 min Summer | 17.808 | 0.008 | 19.6 | 0.6 | O K |

| Storm Event | Rain (mm/hr) | Time-Peak (mins) |
|-----------------|--------------|------------------|
| 15 min Summer | 185.630 | 18 |
| 30 min Summer | 120.567 | 26 |
| 60 min Summer | 73.889 | 40 |
| 120 min Summer | 43.472 | 70 |
| 180 min Summer | 31.706 | 100 |
| 240 min Summer | 25.287 | 130 |
| 360 min Summer | 18.336 | 190 |
| 480 min Summer | 14.573 | 250 |
| 600 min Summer | 12.186 | 308 |
| 720 min Summer | 10.523 | 368 |
| 960 min Summer | 8.342 | 484 |
| 1440 min Summer | 6.003 | 734 |
| 2160 min Summer | 4.312 | 1076 |
| 2880 min Summer | 3.407 | 1432 |
| 4320 min Summer | 2.442 | 2148 |
| 5760 min Summer | 1.930 | 2848 |
| 7200 min Summer | 1.609 | 3592 |
| 8640 min Summer | 1.386 | 4288 |

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Source Control W.12.5

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m ³) | Status |
|----------------------|---------------|---------------|------------------------|------------------------------|-------------------|
| 10080 min Summer | 17.807 | 0.007 | 17.0 | 0.6 | O K |
| 15 min Winter | 18.957 | 1.157 | 663.7 | 191.1 | Flood Risk |
| 30 min Winter | 18.971 | 1.171 | 674.2 | 195.2 | Flood Risk |
| 60 min Winter | 18.817 | 1.017 | 555.5 | 151.9 | O K |
| 120 min Winter | 18.471 | 0.671 | 384.7 | 80.8 | O K |
| 180 min Winter | 18.256 | 0.456 | 295.7 | 46.9 | O K |
| 240 min Winter | 18.119 | 0.319 | 241.1 | 29.1 | O K |
| 360 min Winter | 17.953 | 0.153 | 177.7 | 11.9 | O K |
| 480 min Winter | 17.857 | 0.057 | 142.0 | 4.0 | O K |
| 600 min Winter | 17.844 | 0.044 | 120.3 | 3.0 | O K |
| 720 min Winter | 17.838 | 0.038 | 103.8 | 2.6 | O K |
| 960 min Winter | 17.831 | 0.031 | 82.1 | 2.1 | O K |
| 1440 min Winter | 17.823 | 0.023 | 59.6 | 1.5 | O K |
| 2160 min Winter | 17.817 | 0.017 | 43.2 | 1.2 | O K |
| 2880 min Winter | 17.813 | 0.013 | 33.9 | 1.0 | O K |
| 4320 min Winter | 17.810 | 0.010 | 26.0 | 0.7 | O K |
| 5760 min Winter | 17.809 | 0.009 | 22.2 | 0.7 | O K |
| 7200 min Winter | 17.807 | 0.007 | 17.0 | 0.6 | O K |
| 8640 min Winter | 17.806 | 0.006 | 15.7 | 0.5 | O K |

| Storm Event | Rain (mm/hr) | Time-Peak (mins) |
|----------------------|----------------|------------------|
| 10080 min Summer | 1.222 | 4944 |
| 15 min Winter | 185.630 | 18 |
| 30 min Winter | 120.567 | 25 |
| 60 min Winter | 73.889 | 40 |
| 120 min Winter | 43.472 | 72 |
| 180 min Winter | 31.706 | 100 |
| 240 min Winter | 25.287 | 130 |
| 360 min Winter | 18.336 | 190 |
| 480 min Winter | 14.573 | 248 |
| 600 min Winter | 12.186 | 308 |
| 720 min Winter | 10.523 | 364 |
| 960 min Winter | 8.342 | 490 |
| 1440 min Winter | 6.003 | 748 |
| 2160 min Winter | 4.312 | 1032 |
| 2880 min Winter | 3.407 | 1408 |
| 4320 min Winter | 2.442 | 2212 |
| 5760 min Winter | 1.930 | 2648 |
| 7200 min Winter | 1.609 | 3408 |
| 8640 min Winter | 1.386 | 4224 |

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File 4 Stage 04.04.201...

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Source Control W.12.5

Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|--------------------|----------------------|----------------------|-------------------------------|-----------------------------------|---------------|
| 10080 min Winter | 17.806 | 0.006 | 14.5 | 0.5 | O K |

| Storm Event | Rain (mm/hr) | Time-Peak (mins) |
|--------------------|---------------------|-------------------------|
| 10080 min Winter | 1.222 | 5296 |

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Source Control W.12.5

Rainfall Details

| | | | |
|-----------------------|-------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 26.250 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

Time / Area Diagram

Total Area (ha) 1.660

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|------------------------|----------------------|------------------------|----------------------|------------------------|----------------------|
| 0-4 | 0.553 | 4-8 | 0.553 | 8-12 | 0.553 |

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 Herts, HP3 9RT



Date 04/04/2019 08:56
 File 4 Stage 04.04.201...

Designed By RBrenton
 Checked By

Elstree Computing Ltd

Source Control W.12.5

Model Details

Storage is Online Cover Level (m) 19.000

Infiltration Basin Structure

Invert Level (m) 17.800
 Infiltration Coefficient Base (m/hr) 13.42800
 Infiltration Coefficient Side (m/hr) 13.42800
 Safety Factor 2.0
 Porosity 1.00

| Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) | Depth (m) | Area (m ²) |
|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|
| 0.000 | 65.0 | 1.000 | 230.0 | 1.001 | 250.0 | 1.200 | 320.0 |

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APPENDIX J

SURFACE WATER DRIANAGE STRATEGY

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File Location: \\WV-D01\DRG\NORTH001_JOBS\LIVE\WGAN\881725 - CROSS ROAD_DEAL_GLADMAN\GRAPH\FLOOD_RISK\881725_10-01_P3.DWG



Infiltration basin
 Indicative Surface Area: 320m²
 Indicative Volume: 195.2m³
 Depth up to 1.2m.

Notes
 Do not scale from this drawing
 Layout provided by fpcr
 Drawing is indicative and subject to change following layout revisions
 Soakage testing should be undertaken and drawing is subject to change

- Key**
- Proposed Surface Water Pipes
 - Infiltration Basin
 - Proposed Surface Water Manhole
 - Proposed Surface Water Headwalls
 - Proposed Surface Water Swale
 - Red Line Boundary

| Rev. | Date | Amendment | Drawn | Chkd. | Appd. |
|------|----------|----------------------------------|-------|-------|-------|
| P3 | 10.04.19 | Updated following revised layout | RB | K□ | IC |
| P2 | 26.02.19 | Updated following revised layout | RB | K□ | IC |
| P1 | 26.02.19 | Issued for Discussion | RB | K□ | IC |



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Client
Gladman Developments Ltd.

Project Title
Cross Road Deal

Status
For Discussion

Drawing Title
Surface Water Drainage Strategy

| | | | | | |
|-------|--------|---------|--------|----------|--------|
| Drawn | Date | Checked | Date | Approved | Date |
| RB | Apr 19 | K□ | Apr 19 | IC | Apr 19 |

| | | |
|--------|-----------|------------|
| Scale | Orig Size | Dimensions |
| 1:1250 | A3 | m |

| | |
|-------------|--------------|
| Project No. | Drawing File |
| 881725 | |

| | |
|-------------|------|
| Drawing No. | Rev. |
| 10-01 | P3 |

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