# DRAINAGE STRATEGY

# FOR

# TEMPORARY NORTH CAR PARK

# BY

**SUTCLIFFE**

PLANNING
ACK'D
REPLIED
RECD DEC 2008
DATE
FOR ACTION

PLANNING
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REPLIED
RECD 21 NOV 2008
INIT. RECD | DATE
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FOR ACTION

Reference: LRD24341_Drain Strat_002
Issue: Issue 004

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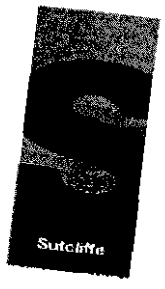

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## 1.0 Introduction

It is proposed to provide a temporary car park to the north of a recently refurbished building known as No. 1 Building. The car park will be constructed to provide public car parking, for 226 cars, that will be accessed from Whitworth Street.

In the long term the car park will be developed as part of a redevelopment that is planned for the area.

To facilitate the planning application for the temporary north car park a drainage strategy is required to outline the methodology of proposed surface water drainage.

The site area is 0.8Ha with the area of the car park being 0.73 Ha.

The site is in a flood zone as defined by the Environment Agency and in accordance with PPS25 a flood risk assessment is required.

A flood risk assessment for the First Street Regeneration Site has been prepared by Ove Arup & Partners and has been agreed as being acceptable by the Environment Agency. However, the Environment Agency have stated in correspondence that 'The flood risk assessment will have to be completed with the study on surface water runoff and submitted to Manchester City Council with any subsequent planning applications for the site.'

A conversation with the Environment Agency (Gareth Owen t: 01925 543411) was held on 25 September 2008 during which they confirmed that 'if a planning application located within a flood zone, temporary or permanent, is submitted then a flood risk assessment is required.

It is intended that this drainage strategy be used to supplement the flood risk assessment to demonstrate that the site will not flood due to normal occurrences.

This drainage strategy will consider previous use, current use and current legislation (PPS25) to formulate a suitable drainage scheme for the proposed car park.

## 2.0 Previous Site Use

Historic maps have been inspected and the following summary is provided.

1787 Partially developed to the east of the site

1793 Partially developed to the east of the site

1818 Site developed with industrial buildings across whole area

1824 Site developed with industrial buildings across whole area

1831 Site developed with industrial buildings across whole area

1845 Site more densely developed with industrial buildings and roads

1849 As 1845

1894 Gaythorn gas works over whole site and over river culvert

1905 As 1894

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1915 As 1894

1932 As 1894

1965 As 1894

Current Car park to east of site and undeveloped to west of site

Historically the site has been developed since 1818 to current day.

## 3.0 Proposed Site Use

The site is to be initially used as a public car park and will consist of 226 spaces. When Building No. 1 is occupied its tenants will use the car park.

The car park is to be surfaced with Tarmac.

A general layout of the proposed car park is included in Appendix A of this strategy, and has been prepared by Stride Treglown Chapman Robinson Architects.

The existing levels vary from approximately 31.50m AOD to 30.40m AOD. The flood risk assessment, prepared by others, indicates a maximum water level for the River Medlock as 30.03m AOD.

It is usual to allow for a 600mm freeboard above anticipated water levels and as such a minimum level of 30.63m AOD should be designed for. However, previous correspondence from the Environment Agency has stated that they would 'exceptionally accept a 320mm freeboard in lieu of the usual 600mm freeboard.' Therefore, the lowest proposed level to the car park has been set at 30.35m AOD.

A copy of correspondence from the Environment Agency has been included in appendix E for reference.

## 4.0 Existing Drainage

There are no adopted sewers located within the site.

Running through the site from north to south is the River Tib overflow culvert. This culvert discharges into the River Medlock culvert.

Running from east to west is the River Medlock culvert that cuts through some of the site and then to the southern boundary of the car park.

On the site is a network of private drains that run into the River Tib culvert.

The depths of the existing drains are in the region of 4.5m to 4.8m below existing ground levels.

To the south of the River Medlock a new attenuation tank has been provided by Ove Arup & Partners which has taken into account the area of the car park to the south of the culvert.

The culverts and drains can be seen on drawing 24341/601 in appendix B.

The existing car park is drained by road gullies located within existing car park and it is assumed that a private network of drains that ultimately discharge into the River Medlock drains the gullies.

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## 5.0 Proposed Drainage

### 5.1 Surface Water Drainage

The car park will be drained using a network of pipes. The rainwater will be collected via a combination of road gullies and drainage channels.

The site has been previously developed over the years and will have been only partially drained as the historic maps indicate industrial development.

The North car park will be drained by two drainage systems.

To the north of the River Medlock culvert a drainage system will be attenuated and discharged into the River Tib culvert.

To the south of the River Medlock culvert a drainage system will be designed to drain to a previously designed attenuation tank by Ove Arup & Partners.

To the north of the River Medlock culvert the area of the site is approximately 6950$m^2$ (0.695 Ha), of which we have estimated that 2935$m^2$ of the site is currently drained by positive drainage.

The existing / allowable discharge off site, has been calculated as being:

$Q = 3.61x\ C_v\ x\ i\ x\ A$
$Q = 3.61 \times 0.75 \times 50 \times 0.29 = 39.2$ l/s

Therefore, attenuation of surface water run off is required. The volume of attenuation required has been calculated as being 146.9$m^3$.

The calculations have assumed that cellular storage will be used and orifice flow controls with an overflow will be used.

Calculations for the attenuation requirements are included within Appendix D of this Drainage Strategy.

Options to attenuate the surface water are:

- Cellular Storage
- Box Culverts
- Oversized Pipes

To ensure that flooding of rainfall events greater than 1 in 100 year storms will not occur, an overflow pipe will be provided as a relief measure to the site drainage system. In addition, the car park levels have been designed such that the car park will provide surface attenuation in extreme events.

To collect the surface water from the car park a mixture of road gullies and channel drainage will be used.

Two Class 1 bypass separators will be required due to the number of car parking spaces provided. The separator to the north of the Medlock River will need to be designed for 39.2 l/s flows. The separator to the south of the Medlock River will need to be designed for an area of 2200$m^2$.

A discharge consent from the Environment Agency will be required for the connection of the discharge point into the River Tib culvert.

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Plans indicating proposed levels and drainage layout are included in Appendix C.

### 5.2 Foul Water Drainage

No foul water drainage is required for the car park. Therefore, no further consideration in this matter is required.

## 6.0 Conclusion

From the above it has been concluded that the car park will be drained on two separate systems

To the north of Medlock River the car park will be drained using an arrangement of road gullies, drainage channels and pipes designed to collect and carry the surface water to an attenuation tank formed using cellular storage, such as Waterloc by Marley, or similar approved. A volume of 146.9m$^3$ is required to attenuate the surface water run off for up to a 1 in 100 year rain fall event with a maximum allowable discharge rate of 39.2 l/s. For rainfall events exceeding a 1 in 100 year rain fall event an overflow pipe has been provided. The car park levels are also designed to provide surface attenuation for events that exceed the capabilities of the drainage collection points (gullies and channel drains)

To the south of Medlock River the car park will be drained using an arrangement of road gullies, drainage channels and pipes designed to collect and carry the surface water to an attenuation tank that has been designed by others.

A class 1 bypass separator will be required for both sections of the car park as the surface water discharges into the Medlock River.

A discharge consent from the Environment Agency will be required for the connection of the discharge point into the River Tib culvert.

A minimum ground level of 30.40 has been designed in accordance with a previous agreement with the Environment Agency level of 30.35 and the flood risk assessment prepared by Ove Arup & Partners.

In conjunction with the flood risk assessment, dealing with site wide issues, emergency access / egress etc, and this drainage strategy, addressing local drainage issues, we believe that the requirements of PPS25 have been addressed in a suitable manner to enable the site to be developed with the proposed development.

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**Appendix A**

15074/SK019 North Car Park General Arrangement

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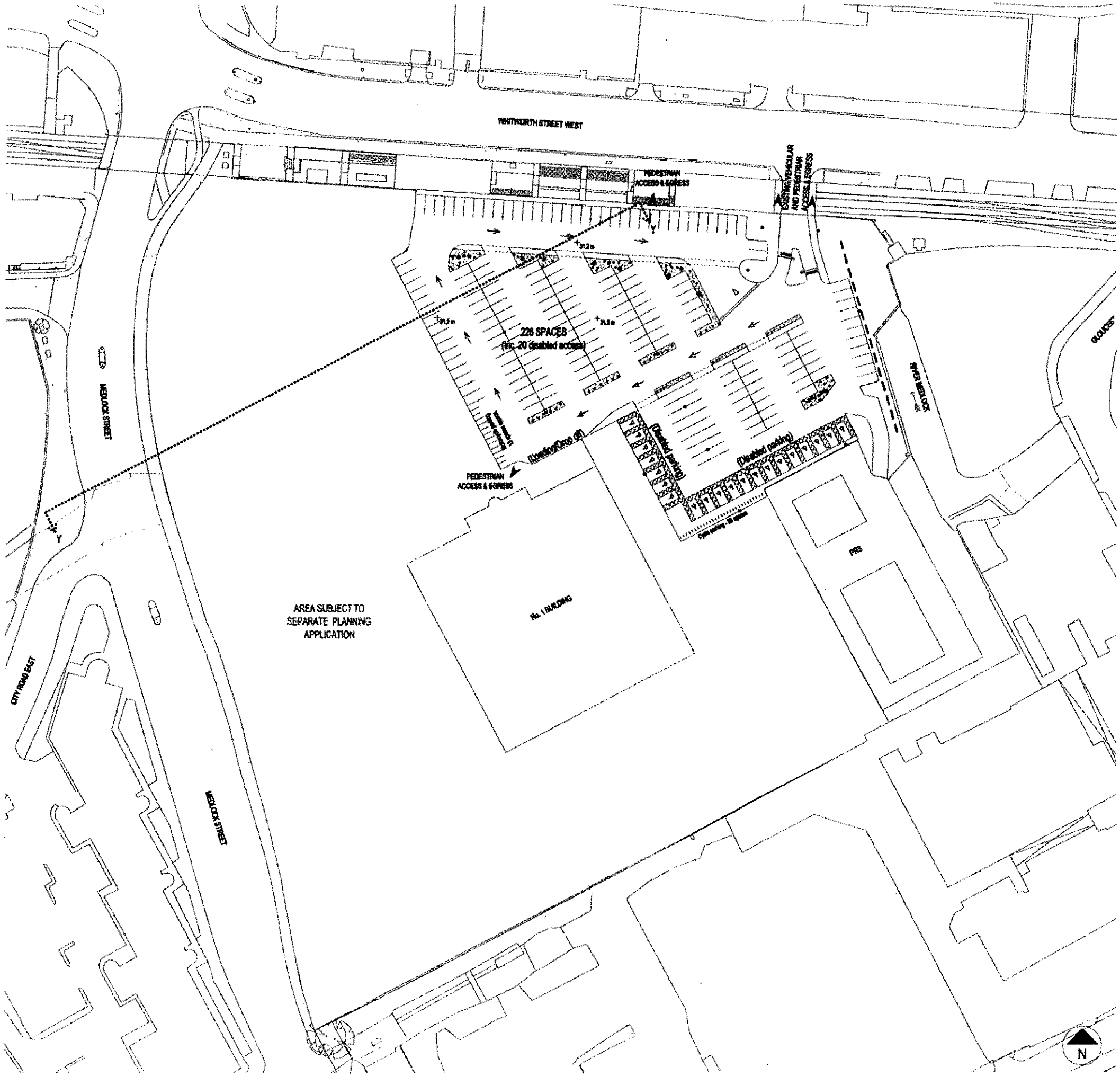


Proposed General Arrangement
Scale 1:500

Stride Treglown
Chapman Robinson

PROJECT
First Street
North Temporary Car Park

DRAWING TITLE
Proposed Temporary Car Park GA Plan
(Barriered Option)

| DATE | SCALE | DRAWN BY | CHECKED BY |
|---|---|---|---|
| 20/10/08 | 1:500 | CP | GT |

DRAWING NUMBER: 45074 SK019
REVISION NO.: /

**Appendix B**

24341/601$^{P1}$ Existing Drainage Layout

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DO NOT SCALE OFF THIS DRAWING

DIMENSIONS NOTED

The drawing to read in conjunction with all relevant architectural and structural drawings and specifications.

All dimensions to be checked on site by the contractor / fabricator prior to commencement of works.

All dimensions are in millimetres unless stated otherwise.

All works to be carried out in strict accordance with the engineer's specifications, relevant British Standards and where applicable Local Authority requirements.

For final working out information relating to pipe lines and wall locations refer to the architects drawings.

EXISTING SERVICES

Route, depth and likely presence of the site engineer is to be verified if required by and to the approval of the Local Authority.

Confirmation of suitable clearances from existing and proposed services to be obtained with proposed drainage.

Known statutory services are indicated on this plan where they cross the proposed service route. The exact type and location shall be confirmed by the contractor prior to start of works to ensure that proposed drainage routes do not interfere with services. All discrepancies shall be reported to engineer immediately.

The following existing services information is indicated on this drawing and has been obtained from the sources listed:

| EXISTING SERVICE | OBTAINED FROM |
|---|---|
| SEWERS | |
| GAS | |
| ELECTRICITY | |
| TELEPHONE | |
| CABLE | |
| OTHERS | |

The contractor shall check all existing cover / invert levels and pipe / sewer sizes on site prior to start of works to ensure proposed drainage can be connected as indicated on the drawing. Any discrepancies to be reported to the engineer immediately.

All new/altered drainage within existing highway to be carried out, cleared and passed for acceptance of local authority.

KEY

Existing combined water / sewer

Existing surface water drain / sewer

Existing foul water drain / sewer

Existing manhole / access chamber

Existing flood gully

Existing Reading Hydrotech sensor (from survey)

Existing gas services

Existing electric services

Existing telephone services

Existing cable services

Existing water mains

SEGMENT TEXT — Easements required

EXISTING PRIVATE MANHOLE
CL: 37.20
I: 36.20

EXISTING GRADED INFILL WALL

EXISTING BRIDGE OVER IRWELL

IRWELL WATERLOCK

EXISTING GRADED INFILL WALL

EXISTING BRIDGE OVER IRWELL

| Rev | Date | Checked | Description | By |
|---|---|---|---|---|
| P1 | 29.10.08 | DS | ISSUED FOR COMMENTS | DR |

PRELIMINARY DRAWING

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Client: SOUTHSIDE REGENERATION

Project: FIRST STREET
MANCHESTER
TEMPORARY CAR PARK

Drawing title: EXISTING SITE LAYOUT
SHOWING EXISTING DRAINAGE
AND DRAINAGE BY OTHERS

| | | | |
|---|---|---|---|
| Scale at A1 | 1:200 | Drawing number | 24341-601 |
| Drawn by | DR | Revision suffix | P1 |
| Date | 29.10.08 | | |

**Appendix C**

24341/615[P1] Proposed External Levels

24341/620[P1] Proposed Drainage Layout

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GENERAL NOTES

This drawing is to be read in conjunction with all relevant structural and architectural drawings and specifications.

All dimensions to be checked on site by the contractor before prior to commencement of all works.

All dimensions are in millimetres unless stated otherwise.

All works to be carried out in accordance with the engineers sole discretion, relevant British Standards and where applicable Local Authorities requirements.

Any local existing site information relating to grid lines and level positions refer to the architect's drawings.

EXISTING SITE CONDITIONS

This plans open sheet, not to scale, is for any work which affects the public highway and all the approved traffic safety and management measures implemented by the works and replace

This plans open sheet also shows schemes to be existing all existing footways, streets accessway, public rights of way and proposed crossings of the works throughout the construction phase.

The contractor is to confirm on site by day 1 levels on all proposed junctions extension ways and on any road construction prior to commencement of works.

HIGHWAYS ON HIGHWAY WORKS

All highways works to be designed and constructed in accordance with Cheshire County Council Design guide and Specification, Volume 1 and Edition 1998 and to the approval of the local authority highways department.

All road opening notices etc., to be carried out under the highways code are to be obtained prior to commencement of works on site. All works are to be inspected by the road authority.

All materials shall be transported & laid in accordance with the recommendations of the appropriate current British standard formulations.

All grid lines to be protected from silt during the construction process with a layer of hessian sheeting pushed under the gully grating. The hessian shall be cleaned & removed throughout the construction period.

Refer to adjacent drawings for all roads / footpaths widths and datum. Refer to drawing ... for a full set of drawings.

SURFACE FINISHES

All existing trees to be retained shall be root pruned cut over as shown in ground and as directed. All rotten timber to be disposed of off site contractor.

Shrubs and roots from felled trees, bushes and hedges shall be grubbed out with equipment off by the contractor. Holes left from shrubs and roots shall be filled with acceptable material and compacted.

All reasonable existing trees, shrubs, grass and land to be shown or adjoining the site shall be protected from damage arising throughout the operations.

RETAINING STRUCTURES

Extent of all retaining walls, gabions and pile caps shown on existing and outline plans on the planning and reserved only. Refer to separate sheet sign for all notes and details. Refer to drawing ... for a full set of drawings.

The contractor is to be fully responsible for all temporary / permanent propping and shoring on this project. Contractor to ensure that all parts of the structure are adequately designed prior to any commencement of works. Retaining walls may be longer than a specified or from the drawings.

MOTORCYCLE PARKING 15 SPACES PROVIDED

LOADING BAY OFF

No. 1 BUILDING

PRS

| Rev | Date | Checked | Description | By |
|---|---|---|---|---|
| P1 | 23.10.08 | DS | ISSUED FOR COMMENTS | CR |

PRELIMINARY DRAWING

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Client: SOUTHSIDE REGENERATION

Project: FIRST STREET MANCHESTER TEMPORARY CAR PARK

Drawing title: PROPOSED EXTERNAL LEVELS

| | | | |
|---|---|---|---|
| Scale at A1 | 1:200 | Drawing number | 24341-615 |
| Drawn by | CR | Revision suffix | P1 |
| Date | 16.10.08 | | |

DO NOT SCALE OFF THIS DRAWING

GENERAL NOTES

This drawing is to be read in conjunction with all relevant architectural and engineering drawings and project specification.

All dimensions to be checked on site by the contractor before setting out or the commencement of any work.

All dimensions are in millimetres unless stated otherwise.

All work to be carried out strictly in accordance with the consultant's specifications, relevant British Standards and current applicable Local Authority regulations.

Any level setting out or dimension relating to grid lines is to be read in conjunction with the architects drawings.

All floor levels to be confirmed by architect prior to construction.

All paved areas to be constructed by approved plant or contractor.

All drainage and existing drainage invert levels and materials are to be confirmed on site by contractor prior to commencement of any work. Any discrepancies to be reported to engineer immediately.

EXISTING SERVICES

Read in conjunction with the site survey plan. No liability is accepted for any services shown or not shown on the survey plan.

Contractor to satisfy themselves as to the location of all existing services prior to the commencement of any works.

Where existing services are indicated on the plan where they cross the proposed drainage runs, the exact type and location shall be confirmed by the contractor prior to start of drainage. The exact type and location of all services shall be established by the contractor prior to the commencement of any work to ensure that proposed drainage levels do not interfere with services. All affected services shall be reported to engineer immediately.

The following existing services are shown on the information on this drawing and have been plotted from the records listed:

| EXISTING SERVICE | OBTAINED FROM |
|---|---|
| SEWERS | UNITED UTILITIES PLAN NOT AVAILABLE |
| GAS | NOT INDICATED |
| ELECTRICITY | NOT INDICATED |
| TELEPHONE | NOT INDICATED |
| CABLE | NOT INDICATED |
| OTHERS | NOT INDICATED |

The contractor shall check all existing sewer invert levels and pipe diameters on site prior to start of works to ensure proposed drainage can be constructed as indicated on the drawing. Any discrepancies to be reported to the engineer immediately.

All excavations to be kept within site or be guarded with chestnut pale fencing to approval of local authority.

DRAINAGE DESIGN

Outside edge of polygonal channels shall be 1 no. 150mm dia gully each.
Outside edge of adjacent roads we shall not provide gullies within 0.5m of kerb line.

Surface water channel

All cylindrical surface water channels to be 150mm dia at 1:100 gradient unless noted otherwise.
Allowance to be made for driveway gradients and access road gradients where applicable.

Foul water / Combined sewer mains

All foul water manholes to be 1200mm dia at 1:60 gradient unless noted otherwise.
Internal benching to manholes outlined to engineers details.

DRAWING KEY

| | |
|---|---|
| | New combined drain / sewer |
| | Existing combined drain / sewer |
| | New surface water drain / sewer |
| | Existing surface water drain / sewer |
| | New foul water pipe work |
| | Existing foul water pipe work |
| | Existing pipe to be abandoned to U.U. standard |
| | New manhole / inspection chamber (IMH) |
| | New rodding eye / inspection chamber (RMH) |
| | New interceptor manhole chamber |
| | Existing manhole / inspection chamber |
| EXIST MH Ct: XXX Il: XXX | |
| RWP | Rainwater pipe location |
| SPA | Soil pipe location |
| SVP | Ventilation pipe location |
| WCH | Back inlet gulley |
| EXG | Existing Pipe gulley |
| RG | New yard gulley |
| CG | Trade effluent gulley |

| Rev | Date | Checked | Description | CR |
|---|---|---|---|---|
| P1 | 29.10.08 | CR | ISSUED FOR COMMENTS | |

PRELIMINARY DRAWING

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Client
SOUTHSIDE REGENERATION

Project
FIRST STREET
MANCHESTER
TEMPORARY CAR PARK

Drawing title
PROPOSED DRAINAGE LAYOUT

| | | | |
|---|---|---|---|
| Scale at A1 | 1:200 | Drawing number | 24341-620 |
| Drawn by | CR | Revision | P1 |
| Date | 16.10.08 | | |

CHANNEL DRAINAGE
CHANNEL DRAINAGE
CHANNEL DRAINAGE

**Appendix D**

Hydraulic Calculations

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## Summary of Results for 100 year Return Period

Half Drain Time : 40 minutes

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Filtration (l/s) | Maximum Overflow (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Overflow Volume (m³) | Maximum Volume (m³) | Status |
|---|---|---|---|---|---|---|---|---|---|
| 15 Summer | 31.2 | 0.0 | 0.0 | 31.2 | 10.6498 | 0.6498 | 0.0 | 90.6 | O K |
| 30 Summer | 34.8 | 0.0 | 0.0 | 34.8 | 10.7943 | 0.7943 | 0.0 | 110.8 | O K |
| 60 Summer | 36.7 | 0.0 | 0.0 | 36.7 | 10.8753 | 0.8753 | 0.0 | 122.2 | O K |
| 120 Summer | 36.7 | 0.0 | 0.0 | 36.7 | 10.8738 | 0.8738 | 0.0 | 121.9 | O K |
| 180 Summer | 35.4 | 0.0 | 0.0 | 35.4 | 10.8198 | 0.8198 | 0.0 | 114.4 | O K |
| 240 Summer | 33.9 | 0.0 | 0.0 | 33.9 | 10.7568 | 0.7568 | 0.0 | 105.6 | O K |
| 360 Summer | 30.9 | 0.0 | 0.0 | 30.9 | 10.6413 | 0.6413 | 0.0 | 89.5 | O K |
| 480 Summer | 28.4 | 0.0 | 0.0 | 28.4 | 10.5528 | 0.5527 | 0.0 | 77.2 | O K |
| 600 Summer | 26.3 | 0.0 | 0.0 | 26.3 | 10.4838 | 0.4837 | 0.0 | 67.5 | O K |
| 720 Summer | 24.5 | 0.0 | 0.0 | 24.5 | 10.4283 | 0.4282 | 0.0 | 59.8 | O K |
| 960 Summer | 21.5 | 0.0 | 0.0 | 21.5 | 10.3473 | 0.3472 | 0.0 | 48.4 | O K |
| 1440 Summer | 17.4 | 0.0 | 0.0 | 17.4 | 10.2513 | 0.2512 | 0.0 | 35.1 | O K |
| 2160 Summer | 13.8 | 0.0 | 0.0 | 13.8 | 10.1903 | 0.1902 | 0.0 | 26.6 | O K |
| 2880 Summer | 11.1 | 0.0 | 0.0 | 11.1 | 10.1643 | 0.1643 | 0.0 | 22.9 | O K |
| 4320 Summer | 8.2 | 0.0 | 0.0 | 8.2 | 10.1348 | 0.1348 | 0.0 | 18.8 | O K |
| 5760 Summer | 6.5 | 0.0 | 0.0 | 6.5 | 10.1178 | 0.1178 | 0.0 | 16.4 | O K |
| 7200 Summer | 5.4 | 0.0 | 0.0 | 5.4 | 10.1048 | 0.1048 | 0.0 | 14.6 | O K |
| 8640 Summer | 4.7 | 0.0 | 0.0 | 4.7 | 10.0943 | 0.0943 | 0.0 | 13.2 | O K |
| 10080 Summer | 4.2 | 0.0 | 0.0 | 4.2 | 10.0868 | 0.0868 | 0.0 | 12.1 | O K |
| 15 Winter | 33.3 | 0.0 | 0.0 | 33.3 | 10.7323 | 0.7323 | 0.0 | 102.2 | O K |
| 30 Winter | 37.3 | 0.0 | 0.0 | 37.3 | 10.8993 | 0.8993 | 0.0 | 125.5 | O K |
| 60 Winter | 39.0 | 0.0 | 0.0 | 39.0 | 10.9778 | 0.9778 | 0.0 | 136.4 | O K |
| 120 Winter | 38.2 | 0.0 | 0.0 | 38.2 | 10.9433 | 0.9433 | 0.0 | 131.6 | O K |
| 180 Winter | 36.2 | 0.0 | 0.0 | 36.2 | 10.8518 | 0.8518 | 0.0 | 118.9 | O K |
| 240 Winter | 33.9 | 0.0 | 0.0 | 33.9 | 10.7583 | 0.7583 | 0.0 | 105.8 | O K |
| 360 Winter | 29.8 | 0.0 | 0.0 | 29.8 | 10.6008 | 0.6008 | 0.0 | 83.8 | O K |
| 480 Winter | 26.5 | 0.0 | 0.0 | 26.5 | 10.4887 | 0.4887 | 0.0 | 68.2 | O K |
| 600 Winter | 23.8 | 0.0 | 0.0 | 23.8 | 10.4073 | 0.4072 | 0.0 | 56.8 | O K |
| 720 Winter | 21.5 | 0.0 | 0.0 | 21.5 | 10.3468 | 0.3467 | 0.0 | 48.4 | O K |
| 960 Winter | 18.1 | 0.0 | 0.0 | 18.1 | 10.2658 | 0.2657 | 0.0 | 37.1 | O K |
| 1440 Winter | 13.9 | 0.0 | 0.0 | 13.9 | 10.1913 | 0.1913 | 0.0 | 26.7 | O K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|---|---|---|
| 15 Summer | 84.56 | 18 |
| 30 Summer | 56.67 | 30 |
| 60 Summer | 36.29 | 46 |
| 120 Summer | 22.50 | 80 |
| 180 Summer | 16.79 | 114 |
| 240 Summer | 13.55 | 146 |
| 360 Summer | 9.94 | 210 |
| 480 Summer | 7.98 | 272 |
| 600 Summer | 6.72 | 332 |
| 720 Summer | 5.84 | 392 |
| 960 Summer | 4.68 | 512 |
| 1440 Summer | 3.42 | 750 |
| 2160 Summer | 2.49 | 1104 |
| 2880 Summer | 1.98 | 1468 |
| 4320 Summer | 1.44 | 2200 |
| 5760 Summer | 1.15 | 2936 |
| 7200 Summer | 0.96 | 3672 |
| 8640 Summer | 0.83 | 4400 |
| 10080 Summer | 0.73 | 5088 |
| 15 Winter | 84.56 | 19 |
| 30 Winter | 56.67 | 30 |
| 60 Winter | 36.29 | 50 |
| 120 Winter | 22.50 | 86 |
| 180 Winter | 16.79 | 122 |
| 240 Winter | 13.55 | 154 |
| 360 Winter | 9.94 | 220 |
| 480 Winter | 7.98 | 282 |
| 600 Winter | 6.72 | 342 |
| 720 Winter | 5.84 | 402 |
| 960 Winter | 4.68 | 518 |
| 1440 Winter | 3.42 | 742 |

©1982-2008 Micro Drainage

Summary of Results for 100 year Return Period

| Storm Duration (mins) | Maximum Control (l/s) | Maximum Filtration (l/s) | Maximum Overflow (l/s) | Maximum Outflow (l/s) | Maximum Water Level (m OD) | Maximum Depth (m) | Overflow Volume (m³) | Maximum Volume (m³) | Status |
|---|---|---|---|---|---|---|---|---|---|
| 2160 Winter | 10.2 | 0.0 | 0.0 | 10.2 | 10.1548 | 0.1548 | 0.0 | 21.6 | O K |
| 2880 Winter | 8.1 | 0.0 | 0.0 | 8.1 | 10.1343 | 0.1343 | 0.0 | 18.7 | O K |
| 4320 Winter | 5.9 | 0.0 | 0.0 | 5.9 | 10.1113 | 0.1113 | 0.0 | 15.5 | O K |
| 5760 Winter | 4.7 | 0.0 | 0.0 | 4.7 | 10.0943 | 0.0943 | 0.0 | 13.1 | O K |
| 7200 Winter | 4.0 | 0.0 | 0.0 | 4.0 | 10.0838 | 0.0838 | 0.0 | 11.7 | O K |
| 8640 Winter | 3.4 | 0.0 | 0.0 | 3.4 | 10.0778 | 0.0778 | 0.0 | 10.8 | O K |
| 10080 Winter | 3.0 | 0.0 | 0.0 | 3.0 | 10.0733 | 0.0733 | 0.0 | 10.2 | O K |

| Storm Duration (mins) | Rain (mm/hr) | Time-Peak (mins) |
|---|---|---|
| 2160 Winter | 2.49 | 1104 |
| 2880 Winter | 1.98 | 1468 |
| 4320 Winter | 1.44 | 2204 |
| 5760 Winter | 1.15 | 2936 |
| 7200 Winter | 0.96 | 3616 |
| 8640 Winter | 0.83 | 4360 |
| 10080 Winter | 0.73 | 5112 |

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## Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Region | ENG+WAL | Cv (Summer) | 0.750 | Summer Storms | Yes |
| Return Period (years) | 100 | Cv (Winter) | 0.840 | Winter Storms | Yes |
| M5-60 (mm) | 18.000 | Shortest Storm (mins) | 15 | Climate Change % | +0 |
| Ratio-R | 0.358 | Longest Storm (mins) | 10080 | | |

## Time / Area Diagram

Total Area (ha) = 0.695

| Time from: | (mins) to: | Area (ha) | Time from: | (mins) to: | Area (ha) |
|---|---|---|---|---|---|
| 0 | 4 | 0.348 | 4 | 8 | 0.347 |

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## Cellular Storage Details

| | | | |
|---|---|---|---|
| Infil Coef - Base (m/hr) | 0.000000 | Porosity | 0.95 |
| Infil Coef - Sides (m/hr) | 0.000000 | Invert Level (m) | 10.000 |
| Safety Factor | 2.0 | Ground Level (m) | 12.000 |

| Depth (m) | Area (m²) | Infil. Area (m²) | Depth (m) | Area (m²) | Infil. Area (m²) | Depth (m) | Area (m²) | Infil. Area (m²) | Depth (m) | Area (m²) | Infil. Area (m²) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 146.9 | 146.9 | 0.70 | 146.9 | 181.0 | 1.40 | 0.0 | 195.7 | 2.10 | 0.0 | 195.7 |
| 0.10 | 146.9 | 151.8 | 0.80 | 146.9 | 185.9 | 1.50 | 0.0 | 195.7 | 2.20 | 0.0 | 195.7 |
| 0.20 | 146.9 | 156.6 | 0.90 | 146.9 | 190.8 | 1.60 | 0.0 | 195.7 | 2.30 | 0.0 | 195.7 |
| 0.30 | 146.9 | 161.5 | 1.00 | 146.9 | 195.7 | 1.70 | 0.0 | 195.7 | 2.40 | 0.0 | 195.7 |
| 0.40 | 146.9 | 166.4 | 1.10 | 0.0 | 195.7 | 1.80 | 0.0 | 195.7 | 2.50 | 0.0 | 195.7 |
| 0.50 | 146.9 | 171.3 | 1.20 | 0.0 | 195.7 | 1.90 | 0.0 | 195.7 | | | |
| 0.60 | 146.9 | 176.2 | 1.30 | 0.0 | 195.7 | 2.00 | 0.0 | 195.7 | | | |

## Orifice Outflow Control

Diameter (m) 0.140 Discharge Coefficient 0.600 Invert Level (m) 10.000

## Orifice Overflow Control

Diameter (m) 0.150 Discharge Coef 0.600 Invert Level (m) 11.000

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**Appendix E**

Environment Agency Correspondence

Sutcliffe
18 – 20 Harrington Street
Liverpool L2 9QA
T: 0151 227 3155
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RE: Central Spine FRA

**From:** Thomas, Sandrine [sandrine.thomas@environment-agency.gov.uk]
**Sent:** 21 September 2007 13:43
**To:** Tom Saville
**Cc:** Barrett, Helen; Gordon Blair (FBA)
**Subject:** RE: Central Spine FRA

Tom

I can confirm that the Environment Agency would exceptionally accept a 320 mm freeboard in lieu of the usual 600 mm freeboard given the modelling work you have conducted and the estimated flow used for the study. Therefore, the proposed Finished Floor Level at the Central Spine site of 30.35mAOD is accepted.

As discussed in our phone conversations the Flood Risk Assessment that you have prepared will have to be completed with the study on surface water runoff and submitted to Manchester City Council with any subsequent planning applications for the site.
Regards
Sandrine

**Sandrine Thomas**
**Development Control Engineer (East Manchester Area)**
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