Green Valley Estates Inc.
and Green Valley Estates II Inc.

Proposed GE I & GE II Subdivision Development

City of London

Functional Servicing Report

December 2013 ▪ File 12116

TMIG
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1 Introduction

1.1 Objective

The Municipal Infrastructure Group Ltd. (TMIG) has been retained by Green Valley Estates Inc. and Green Valley Estates II Inc. to prepare a Functional Servicing Report (FSR) in support of the proposed GE I and GE II development in the City of London. The purpose of this report is to provide a functional servicing and grading plan for the subject site. This report provides details regarding the engineering design requirements and criteria upon which the site will be developed, addressing matters including stormwater management, sanitary servicing, water supply and preliminary site grading. The FSR considers all aspects needed to achieve an efficient, well planned development, which contributes to and enhances the community within the City of London.

1.2 Location

The site is Part of Lot 12, Concession 3. It is bounded by Green Valley Road to the north, Highbury Avenue South to the east, Dingman Drive to the south and the Canadian National Railway tracks to the west, as illustrated in **Figure 1-1**. The site is surrounded by agricultural lands to the east and south, residential properties to the west and industrial properties to the north. The site is roughly 'L' shaped and is about 64 hectares (ha) in size. Dingman Creek, a tributary of the Thames River, bisects the site into two areas.

Figure 1-1: *Site Location*

1.3 Proposed Development

The proposed development consists mainly of residential homes, with the remaining lands consisting of parks, stormwater management (SWM) facilities and a small commercial block, as illustrated on the site plan in **Figure 1-2**. The proposed site will have the following characteristics, which have been broken down by land-use.

Table1-3: *Proposed Land-Use*

Land-use	Area (ha)	Runoff Coefficient
Residential	18.1	0.50-0.65
Park/SWM pond	3.8	0.20
Road	8.3	0.90
Lands to be Retained by Owner (Residential / Commercial)	8.5	0.65 / 0.80
Total	38.7	

The remainder of the site area is comprised of valley lands associated with Dingman Creek and are not proposed to be developed.

1.4 Background Information / Supporting Reports

Background information for this report has been obtained from the following studies:

- Dingman Creek Subwatershed Study Update: Volume 1 – Main Report

  Prepared by Delcan Corporation, Stantec Consulting Limited and Cummings Cockburn Limited, April 2005

- Dingman Creek Subwatershed Study Update: Volume 2 – Tributary Fact Sheets

  Prepared by Delcan Corporation, April 2005

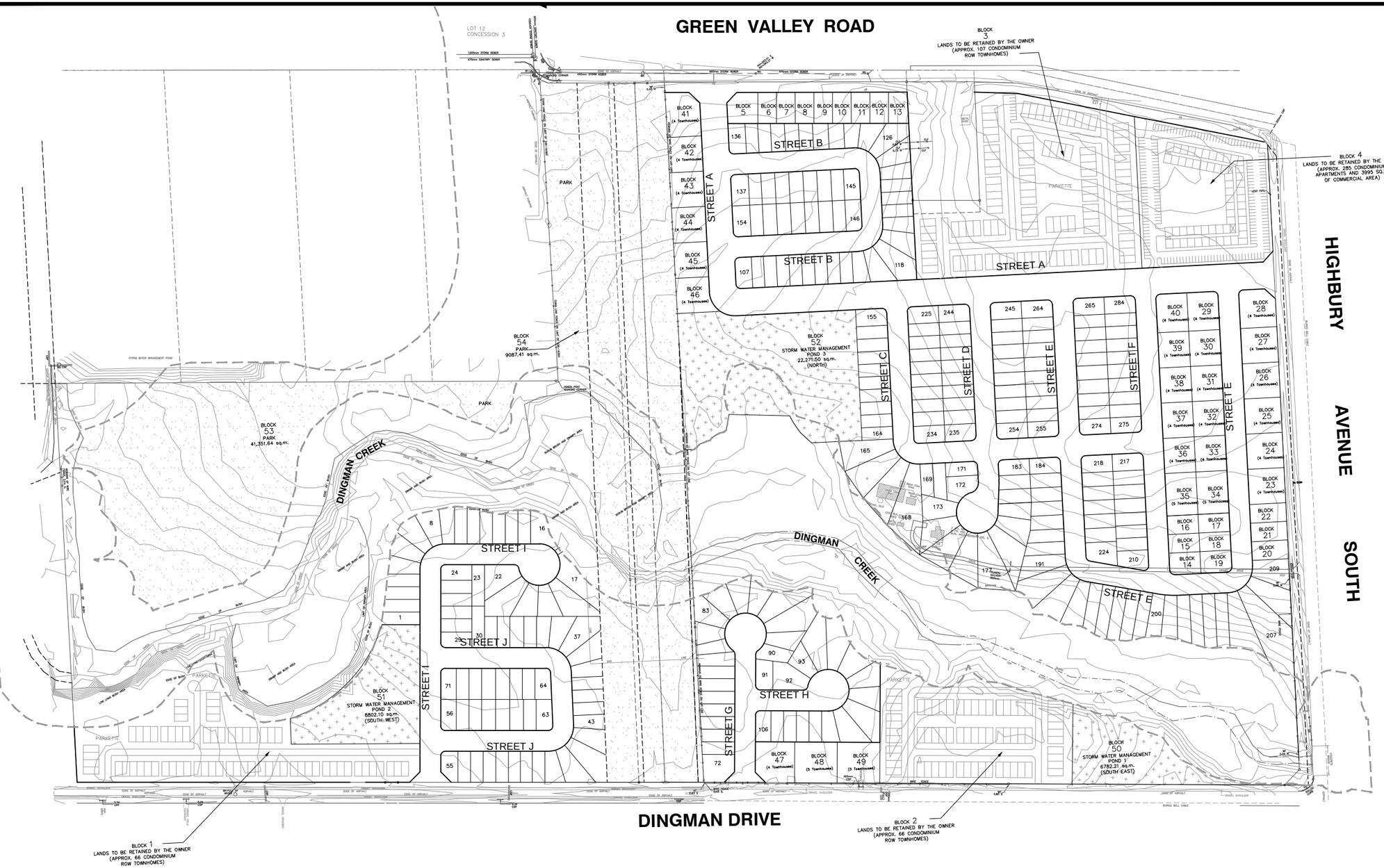
- City of London Design Specifications & Requirements Manual

  Prepared by the Corporation of the City of London September 2012

In addition, a preliminary geotechnical investigation has been completed for the subject site. The findings are provided in the report entitled "*Preliminary Geotechnical Investigation, Proposed GE I & GE II Subdivision Development, Dingman Drive and Highbury Avenue South, London, Ontario, AMEC Earth & Environmental, 24 May 2012"*. A copy of this report has been provided in **Appendix A**.

PROPOSED SITE PLAN

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON



TMIG The Municipal Infrastructure Group Ltd 8800 Dufferin Street, Suite 200, Vaughan, ON L4K 0C5 p: 905.738.5700 f: 905.738.0065		DATE: DECEMBER 2013	PROJECT No. 12116
		SCALE: NTS	FIGURE No. 1-2

G:\Projects\2012\12116 - TSI London GE1 & GE2\Drawings\FSR FIGURES\FIGURE 1-2 - Proposed site plan.dwg

2 Existing Conditions and Site Constraints

2.1 Topography and Drainage

Dingman Creek traverses the subject site from east to west. North of Dingman Creek the topography slopes generally to the south-west, while lands south of Dingman Creek generally slope to the north. Elevation ranges from 268m at the northern edge of the subject property to 259.6m at Dingman Creek at the western limit of the subject site. The subject lands lie entirely within the Dingman Creek Subwatershed and drainage is presently conveyed by means of sheet flow across the agricultural fields and vegetated areas to the creek. Dingman Creek is part of the Thames River watershed, which eventually drains into Lake St Clair. From the watershed boundary map, it was determined that an external area of approximately 46.1 ha south of the subject site currently drains onto the subject site as shown on **Figure 2-1**. No other external areas flow onto the subject site.

According to the preliminary geotechnical report, the soils within the subject area are comprised of topsoil underlain by silt and sandy silt. These soils are within the Hydrologic Soils Groups B and can be described as having moderate infiltration rates and are moderately to well drained.

2.2 Environmental Features

The subject area is dominated by agricultural lands; however the subject site is bisected by Dingman Creek, which is a tributary of the Thames River. Development within the subject site will be constrained by floodlines, top of slope, erosion hazards, and wetlands associated with Dingman Creek. The constraint lines and the required 10m buffer, provided by the Upper Thames River Conservation Authority (UTRCA), were used to determine the development limit, as shown on **Figure 2-2**.

2.3 Existing Hydrology

An existing topographic survey was completed for the subject site by Holstead & Redmond Limited, Ontario Land Surveyors. Existing drainage areas have been delineated using the existing topographic information and have been broken up based on the proposed SWM pond locations. The existing drainage areas are illustrated in **Figure 2-1**. Pre-development conditions peak flow rates from the drainage areas were determined using a representative Visual OTTHYMO^{TM} Version 2.0 (VO2) hydrologic model. This hydrologic model simulated the 2-year through 100-year return period events for the following storm types:

- 3-hour Chicago
- 24-hours SCS Type II and
- 1-hour AES

The model parameters were determined in accordance with UTRCA and City of London design guidelines. Pre-development peak flow rates for the 3hr Chicago storm, 24-hour SCS Type II storm and 1hr AES storm are summarized in **Table 2-1** to **Table 2-3.**

Detailed calculations and modeling output are provided in **Appendix B**.

Table 2-1: *Pre-development Peak Flow Rates (3-hour Chicago Storm)*

Storm Event	Pre-development Peak Flow (m^3/s)		
	North Pond (Drainage Area = 27.7 ha)	**Southwest Pond (Drainage Area = 8.4 ha)**	**Southeast Pond (Drainage Area = 6.4 ha)**
25 mm	0.106	0.032	0.029
2-year	0.256	0.076	0.072
5-year	0.508	0.151	0.147
10-year	0.676	0.201	0.197
25-year	0.863	0.256	0.251
50-year	1.014	0.299	0.295
100-year	1.163	0.344	0.338

Table 2-2: *Pre-development Peak Flow Rates (24-hour SCS Type II storm)*

Storm Event	Pre-development Peak Flow (m^3/s)		
	North Pond (Drainage Area = 27.7 ha)	**Southwest Pond (Drainage Area = 8.4 ha)**	**Southeast Pond (Drainage Area = 6.4 ha)**
25 mm	0.106	0.032	0.029
2-year	0.430	0.127	0.125
5-year	0.635	0.188	0.184
10-year	0.839	0.248	0.243
25-year	1.165	0.345	0.337
50-year	1.399	0.415	0.404
100-year	1.670	0.495	0.482

Table 2-3: *Pre-development Peak Flow Rates (1-hr AES storm)*

Storm Event	Pre-development Peak Flow (m^3/s)		
	North Pond (Drainage Area = 27.7 ha)	**Southwest Pond (Drainage Area = 8.4 ha)**	**Southeast Pond (Drainage Area = 6.4 ha)**
25 mm	0.106	0.032	0.029
2-year	0.191	0.056	0.059
5-year	0.427	0.125	0.132
10-year	0.620	0.182	0.192
25-year	0.899	0.264	0.278
50-year	1.124	0.330	0.347
100-year	1.365	0.401	0.422

LEGEND

EXTERNAL
4.9ha
0.2

EXTERNAL DRAINAGE AREA
RUNOFF COEFFICIENT

4.4 / 0.20 — DRAINAGE AREA
RUNOFF COEFFICIENT

HUBREY ROAD

LOT 12
CONCESSION 3

GREEN VALLEY ROAD

HIGHBURY AVENUE SOUTH

27.7 / 0.20

4.4 / 0.20

DINGMAN CREEK

8.4 / 0.20

6.4 / 0.20

DINGMAN DRIVE

1 2 3

EXTERNAL
4.9ha
0.2

EXTERNAL
13.7ha
0.2

EXTERNAL
27.5ha
0.2

EXISTING CULVERT SUMMARY

CULVERT ID	SIZE
1	400mmØ CSP
2	500mmØ CSP
3	1.77m x 1.0m ELLIPTICAL CSP

G:\Projects\2012\12116 - TSI London GE1 & GE2\Drawings\FSR FIGURES\FIGURE 2-1 - Existing Drainage Area.dwg

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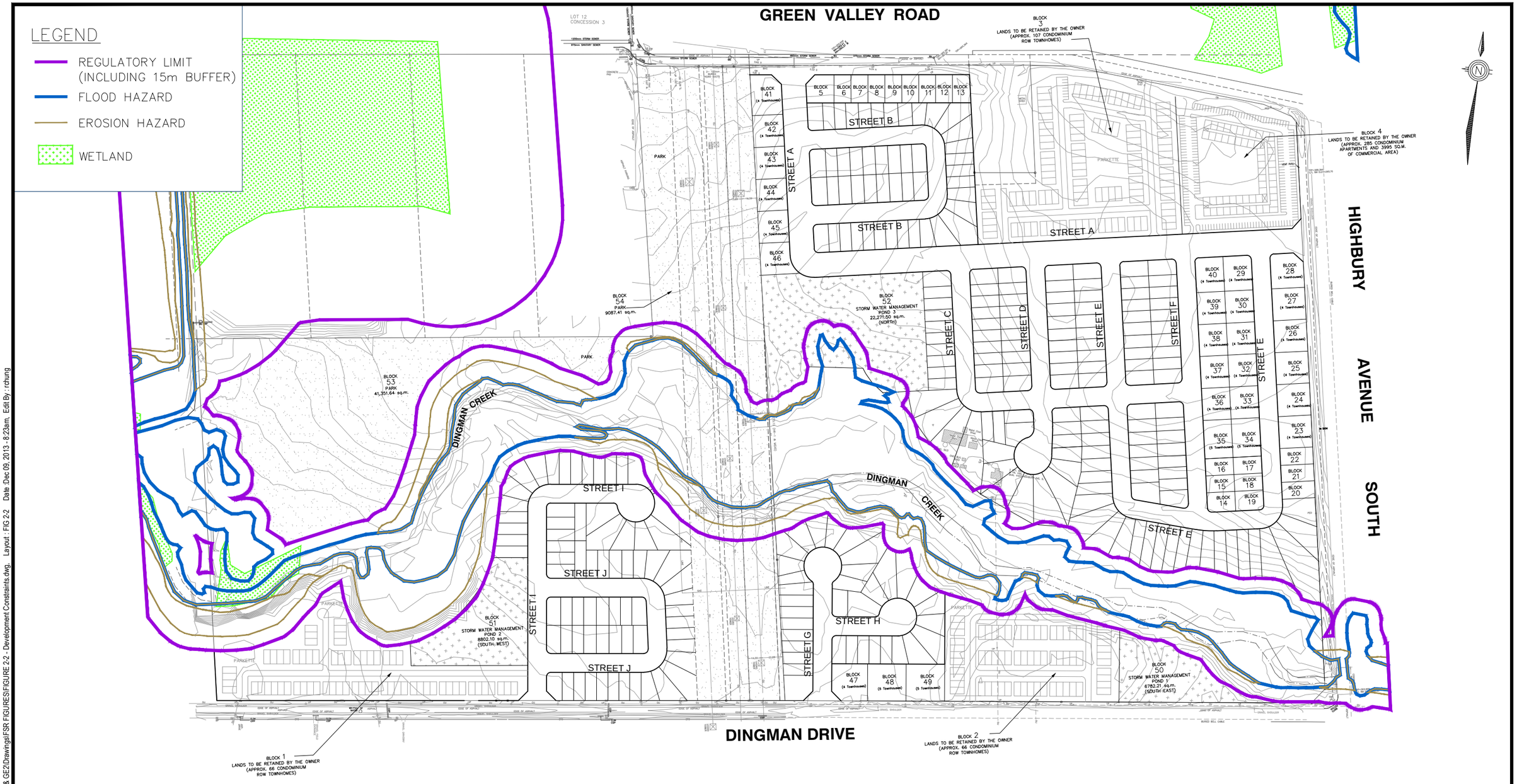
EXISTING DRAINAGE AREA AND CULVERT LOCATION
GREEN VALLEY ESTATES I
AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE:	PROJECT No.
DEC 2013	12116
SCALE: 1:5,000	FIGURE No. 2-1



File : G:\Projects\2012\12116 - TSI London GE1 & GE2\Drawings\FSR FIGURES\FIGURE 2-2 - Development Constraints.dwg, Layout : FIG 2-2 Date :Dec 09, 2013 - 8:23am, Edit By : rchung

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DEVELOPMENT CONSTRAINTS

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE:	PROJECT No.
DECEMBER 2013	12116
SCALE:	FIGURE No.
1 : 4,000	2-2

3 Hydraulics

The existing regulatory floodplain was determined using the HEC-RAS hydraulic simulation model, which was completed by the UTRCA for Dingman Creek. The regulatory floodplain is based on water surface elevations during the 250-year storm. The HEC-RAS cross-section locations and the associated 250-year floodline are shown on **Figure 3-1** .

The output from existing hydraulic model of Dingman Creek is summarized in **Table 3-1** for reference.

Table 3-1: *Existing Hydraulic Modeling Output*

Reach	River Sta.	Profile	Q Total (m^3/s)	W.S. Elev (m)	Volume (1000 m^3)
Reach-9	36.9135	1:250 Existing	26.7	262.53	472.81
Reach-9	36.7485	1:250 Existing	26.7	262.47	465.67
Reach-9	36.5735	1:250 Existing	26.7	262.42	456.49
Reach-9	36.5615	1:250 Existing	26.7	262.38	455.70
Reach-9	36.5575		Bridge		
Reach-9	36.5535	1:250 Existing	29.4	262.38	455.46
Reach-9	36.4865	1:250 Existing	29.4	262.37	451.40
Reach-9	36.3115	1:250 Existing	29.4	262.23	443.59
Reach-9	36.1465	1:250 Existing	29.4	262.10	437.71
Reach-9	35.9765	1:250 Existing	29.4	262.01	427.84
Reach-9	35.8065	1:250 Existing	29.4	261.92	419.12
Reach-9	35.6165	1:250 Existing	29.4	261.72	410.50
Reach-9	35.3965	1:250 Existing	29.4	261.54	403.82
Reach-9	35.2315	1:250 Existing	29.4	261.08	398.64
Reach-9	35.0415	1:250 Existing	29.4	261.01	395.26
Reach-9	34.9415	1:250 Existing	32.4	260.94	390.84
Reach-9	34.7265	1:250 Existing	32.4	260.76	384.84
Reach-9	34.5515	1:250 Existing	32.4	260.68	380.62
Reach-9	34.3515	1:250 Existing	32.4	260.59	369.70
Reach-9	34.1815	1:250 Existing	32.4	260.59	362.31

Note: Subject site is located between cross sections 36.487 to cross section 34.942
Source: UTRCA

The proposed site plan (as illustrated on **Figure 1-2**) incorporates three stormwater management (SWM) ponds. As can be seen on the site plan, the proposed north SWM pond extends into the existing floodplain by 0.08ha. This encroachment will result in a minor floodplain reduction due to the proposed minor grading works within the Dingman Creek valley. A cut and fill balance is proposed to provide compensating cut for any fill works within the valley, thus ensuring that no detrimental impacts occur to the environment or any adjacent lands. Therefore the proposed works will not reduce the floodplain storage or increase the regulatory water levels within Reach 9 of Dingman Creek.

In order to better define the area of the proposed cut and fill works, a new river cross-section was added to the existing HEC-RAS model between cross-sections 35.9765 and 35.8065, as shown on **Figure 3-2**. The new cross-section was given river station ID 35.917 and was included in the revised existing scenario within the HEC-RAS model. The existing topographic information was used to generate the ground surface for the new cross-section 35.917, which was then added to the existing geometry within the HEC-RAS model and the upstream and downstream reach lengths were adjusted accordingly. The output from the revised existing hydraulic model of Dingman Creek is summarized in **Table 3-2**.

Table 3-2 Revised Existing Hydraulic Modeling Output

Reach	River Sta.	Profile	Q Total (m^3/s)	W.S. Elev (m)	Volume (1000 m^3)
Reach-9	36.9135	1:250 Existing	26.7	262.53	473.31
Reach-9	36.7485	1:250 Existing	26.7	262.46	466.19
Reach-9	36.5735	1:250 Existing	26.7	262.41	457.04
Reach-9	36.5615	1:250 Existing	26.7	262.38	456.25
Reach-9	36.5575		Bridge		
Reach-9	36.5535	1:250 Existing	29.4	262.38	456.01
Reach-9	36.4865	1:250 Existing	29.4	262.36	451.98
Reach-9	36.3115	1:250 Existing	29.4	262.23	444.20
Reach-9	36.1465	1:250 Existing	29.4	262.09	438.37
Reach-9	35.9765	1:250 Existing	29.4	262.00	428.67
Reach-9	35.917	1:250 Existing	29.4	261.97	425.15
Reach-9	35.8065	1:250 Existing	29.4	261.92	419.12
Reach-9	35.6165	1:250 Existing	29.4	261.72	410.50
Reach-9	35.3965	1:250 Existing	29.4	261.54	403.82
Reach-9	35.2315	1:250 Existing	29.4	261.08	398.64
Reach-9	35.0415	1:250 Existing	29.4	261.01	395.26
Reach-9	34.9415	1:250 Existing	32.4	260.94	390.84
Reach-9	34.7265	1:250 Existing	32.4	260.76	384.84
Reach-9	34.5515	1:250 Existing	32.4	260.68	380.62
Reach-9	34.3515	1:250 Existing	32.4	260.59	369.70
Reach-9	34.1815	1:250 Existing	32.4	260.59	362.31

As shown in **Table 3-2**, running the revised existing scenario revealed that with the addition of the new cross-section 35.917 the water surface elevations remain roughly the same as the original existing scenario.

Proposed Model

A proposed hydraulic scenario was generated within the HEC-RAS model to reflect the proposed grading around the north SWM pond. **Figure 3-2** illustrates the proposed ground at cross section 35.917. Due to the berming around the north SWM pond, an area of approximately 0.08 ha with an average depth of 0.12m will be filled. To compensate for the floodplain reduction, a cut area of approximately 0.12 ha and a depth of 0.15m is proposed. The preliminary analysis demonstrates that the fill required for the SWM pond berm would result in a floodplain reduction of 105 m^3. However, this area could be compensated for by a balancing cut area, which would provide an additional floodplain volume of 180 m^3.

The area of proposed grading is mostly within ineffective floodplain that has resulted due to the existing topography. Nonetheless, the hydraulic analysis demonstrates that the proposed cut and fill balance would ensure that there is no change in the regulatory floodplain surface water levels and no reduction in floodplain storage.

The output from the proposed hydraulic model of Dingman Creek is summarized in **Table 3-3**.

Table 3-3 *Proposed Hydraulic Modeling Output*

Reach	River Sta.	Profile	Q Total (m^3/s)	W.S. Elev (m)	Volume (1000 m^3)
Reach-9	36.9135	1:250 Existing	26.7	262.53	473.35
Reach-9	36.7485	1:250 Existing	26.7	262.46	466.25
Reach-9	36.5735	1:250 Existing	26.7	262.41	457.13
Reach-9	36.5615	1:250 Existing	26.7	262.38	456.34
Reach-9	36.5575		Bridge		
Reach-9	36.5535	1:250 Existing	29.4	262.37	456.10
Reach-9	36.4865	1:250 Existing	29.4	262.36	452.08
Reach-9	36.3115	1:250 Existing	29.4	262.22	444.33
Reach-9	36.1465	1:250 Existing	29.4	262.09	438.53
Reach-9	35.9765	1:250 Existing	29.4	261.99	428.95
Reach-9	35.917	1:250 Existing	29.4	261.97	425.35
Reach-9	35.8065	1:250 Existing	29.4	261.92	419.12
Reach-9	35.6165	1:250 Existing	29.4	261.72	410.50
Reach-9	35.3965	1:250 Existing	29.4	261.54	403.82
Reach-9	35.2315	1:250 Existing	29.4	261.08	398.64
Reach-9	35.0415	1:250 Existing	29.4	261.01	395.26
Reach-9	34.9415	1:250 Existing	32.4	260.94	390.84
Reach-9	34.7265	1:250 Existing	32.4	260.76	384.84
Reach-9	34.5515	1:250 Existing	32.4	260.68	380.62
Reach-9	34.3515	1:250 Existing	32.4	260.59	369.70
Reach-9	34.1815	1:250 Existing	32.4	260.59	362.31

As can be seen by comparing **Table 3-3** and **Table 3-2**, the surface water elevations within Reach 9 of Dingman Creek are the same for both the existing and proposed scenarios. The total storage volume provided within the subject site during the regulatory storm event (1:250 year storm) is 61,140 m^3 under existing conditions and 61,240 m^3 under the proposed conditions. Therefore the proposed cut and fill balance ensures that the total storage volume provided exceeds the existing conditions. In summary, the proposed grading works will not have any negative impacts on the hydraulics of Dingman Creek.

Detailed output from hydraulic analysis is included in **Appendix C**.

LEGEND

34.942 / 260.34 — CROSS SECTION ID / 250YR WATER LEVEL

GREEN VALLEY ROAD

HIGHBURY AVENUE SOUTH

DINGMAN CREEK

DINGMAN DRIVE

LOT 12
CONCESSION 3

STORM WATER MANAGEMENT POND

34.942 / 260.34
35.042 / 261.01
35.232 / 261.08
35.537 / 261.58
35.617 / 261.79
35.807 / 261.92
35.977 / 262.01
36.147 / 262.10
36.312 / 262.23
36.487 / 262.37

NOTE: ORIGINAL EXISTING HYDRAULIC MODEL FROM UPPER THAMES CONSERVATION AUTHORITY

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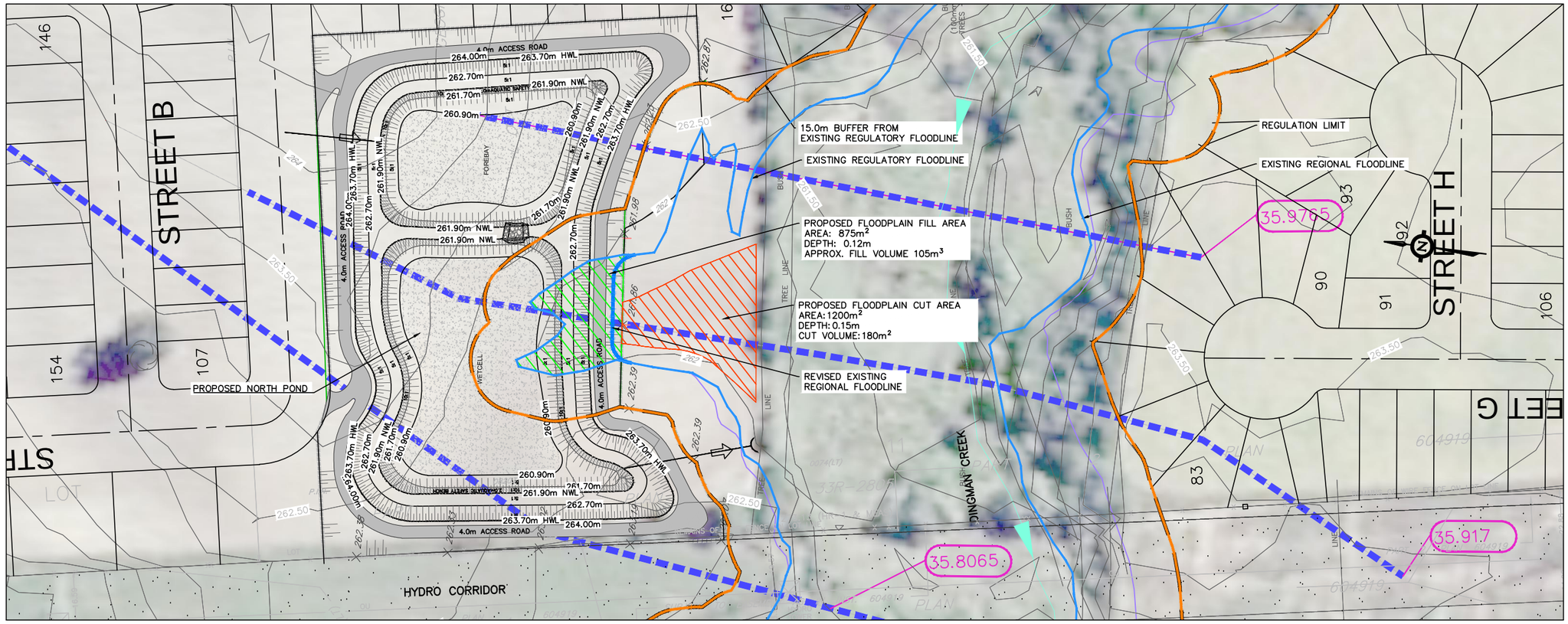
HEC-RAS CROSS SECTION LOCATIONS & EXISTING 250YR FLOODLINE
GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE: DECEMBER 2013

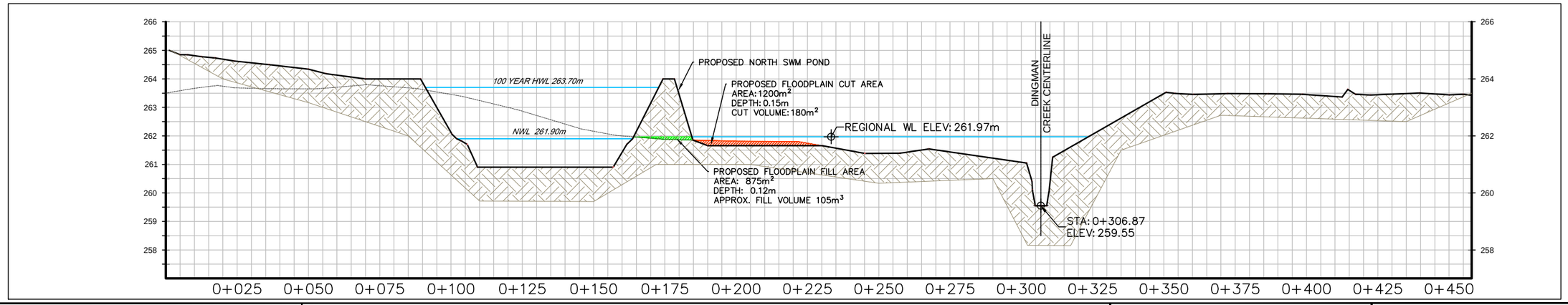
PROJECT No. 12116

SCALE: NTS

FIGURE No. 3-1



PROFILE ALONG XS 35.917



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CUT AND FILL BALANCE AT HEC-RAS CROSS SECTION 35.917

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE:	PROJECT No.
DECEMBER 2013	12116
SCALE:	FIGURE No.
NTS	3-2

4 Stormwater Management Plan

4.1 Stormwater Management Design Criteria

The stormwater management design criteria will comply with policies and standards of:

- Upper Thames River Conservation Authority (UTRCA)
- City of London
- Ministry of the Environment

Stormwater management criteria for the proposed development include:

- Normal Level Water Quality protection with assumed 70% removal of suspended sediments;
- Control of post development peak flows to 60% of pre-development levels for all storms up to and including the 100-year storm;
- No impacts to receiving watercourse or downstream drainage network;
- Control runoff volume generated by a 25mm storm event in the extended detention portion of the pond; and
- Maintain post development to pre-development water balance.

4.2 Target Release Rates

As per the recommendations of the *Dingman Creek Subwatershed Study Update (dated 2005)* the target release rates were calculated to be 60% of the pre-development peak flow rates. As outlined in **Section 2.3** of this report, the existing drainage areas have been delineated using the existing topographic information and have been broken up based on the proposed SWM pond locations. The existing drainage areas are illustrated in **Figure 2-1**. The pre-development peak flow rates where determined using the Visual OTTHYMO^{TM} Version 2.0 (VO2) hydrologic model for the 2-year through 100-year return period events for the 3hr Chicago storm, 24-hour SCS Type II storm and 1hr AES storm. The pre-development peak flow rates are summarized in **Table 2-1** to **Table 2-3** and detailed calculations and modeling output are provided in **Appendix B**.

The target release rates for the subject site where calculated as 60% of the pre-development peak flow rates for the 3hr Chicago storm, 24-hour SCS Type II storm and 1hr AES storm. The target release rates are summarized in **Table 4-1** through **Table 4-3**.

Table 4-1: *Target Release Rates (3-hour Chicago Storms)*

Storm Event	Target Release Rates (m^3/s)		
	North Pond (Drainage Area = 27.7 ha)	**Southwest Pond (Drainage Area = 8.4 ha)**	**Southeast Pond (Drainage Area = 6.4 ha)**
2-year	0.154	0.046	0.043
5-year	0.305	0.091	0.088
10-year	0.406	0.121	0.118
25-year	0.518	0.154	0.151
50-year	0.608	0.179	0.177
100-year	0.698	0.206	0.203

Table 4-2: *Target Release Rates (24-hour SCS Type II Storms)*

Storm Event	Target Release Rates (m^3/s)		
	North Pond (Drainage Area = 27.7 ha)	**Southwest Pond (Drainage Area = 8.4 ha)**	**Southeast Pond (Drainage Area = 6.4 ha)**
2-year	0.258	0.076	0.075
5-year	0.381	0.113	0.110
10-year	0.503	0.149	0.146
25-year	0.699	0.207	0.202
50-year	0.839	0.249	0.242
100-year	1.002	0.297	0.289

Table 4-3: *Target Release Rates (1-hour AES Storms)*

Storm Event	Target Release Rates (m^3/s)		
	North Pond (Drainage Area = 27.7 ha)	**Southwest Pond (Drainage Area = 8.4 ha)**	**Southeast Pond (Drainage Area = 6.4 ha)**
2-year	0.115	0.034	0.035
5-year	0.250	0.075	0.079
10-year	0.372	0.109	0.115
25-year	0.539	0.158	0.167
50-year	0.674	0.198	0.208
100-year	0.819	0.241	0.253

4.3 Stormwater Management Pond

The subject lands are proposed to be serviced by three stormwater management (SWM) ponds, which are planned to be located adjacent to Dingman Creek within the three distinct north, southeast and southwest drainage areas within the subject site. The post development drainage plan is shown on **Figure 4-1**.

The proposed SWM ponds will be designed as normal quality wet ponds servicing post development flows from the subject site, and will provide quality, quantity and erosion control. Flows will inlet to the SWM ponds via storm sewers and overland flow routes, with attenuated and controlled discharge outletting to Dingman Creek. Preliminary SWM Pond layouts are provided in **Figure 4-2** to **Figure 4-4.**

LEGEND

13.2 / 0.6 — PROPOSED DRAINAGE AREA RUNOFF COEFFICIENT

PROPOSED SWM DRAINAGE AREA

GREEN VALLEY ROAD

HIGHBURY AVENUE SOUTH

DINGMAN DRIVE

DINGMAN CREEK

LOT 12
CONCESSION 3

BLOCK 1
LANDS TO BE RETAINED BY THE OWNER
(APPROX. 66 CONDOMINIUM ROW TOWNHOMES)

BLOCK 2
LANDS TO BE RETAINED BY THE OWNER
(APPROX. 66 CONDOMINIUM ROW TOWNHOMES)

BLOCK 3
LANDS TO BE RETAINED BY THE OWNER
(APPROX. 107 CONDOMINIUM ROW TOWNHOMES)

BLOCK 4
LANDS TO BE RETAINED BY THE OWNER
(APPROX. 285 CONDOMINIUM APARTMENTS AND 3995 SQ.M. OF COMMERCIAL AREA)

BLOCK 51
STORM WATER MANAGEMENT POND 2
8802.10 sq.m.
(SOUTH WEST)

BLOCK 52
STORM WATER MANAGEMENT POND 3
22,271.50 sq.m.
(NORTH)

BLOCK 50
STORM WATER MANAGEMENT POND 1
6782.21 sq.m.
(SOUTH EAST)

BLOCK 53
PARK
41,351.64 sq.m.

BLOCK 54
PARK
9057.41 sq.m.

STREET A
STREET B
STREET C
STREET D
STREET E
STREET F
STREET G
STREET H
STREET I
STREET J

PARK
PARKETTE

25.49 / 0.6
7.6 / 0.6
5.6 / 0.6

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PROPOSED DRAINAGE AREA

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE: DECEMBER 2013

PROJECT No. 12116

SCALE: 1 : 4,000

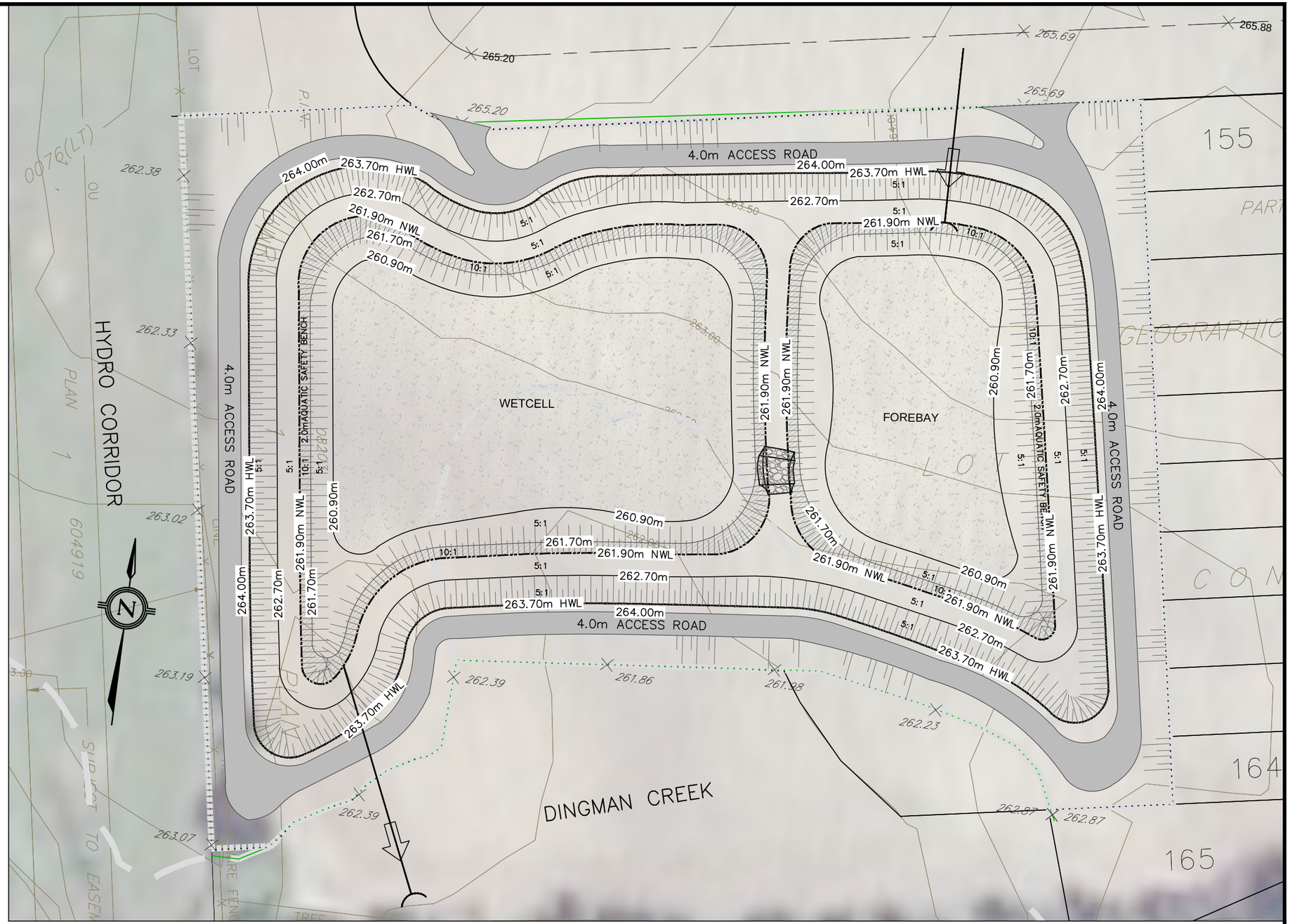
FIGURE No. 4-1

G:\Projects\2012\12116 - TSI London GE1 & GE2\Drawings\FSR FIGURES\FIGURE 4-1 - Proposed Drainage Area.dwg

DESCRIPTION	REQUIRED STORAGE	PROVIDED STORAGE
PERMANENT POOL EL.260.90 – EL.261.90 (1.0m)	2,081m^3	6,084m^3
ACTIVE POOL EL.261.90. – EL.263.70 (1.8m)	13,705m^3	18,478m^3

POND GEOMETRIC DATA	
ITEM	DATA
DRAINAGE AREA	25.5 HA
POND BLOCK AREA	1.9 HA
PERMANENT POOL ELEV.	261.90m
BOTTOM OF POND ELEV.	260.90m
HWL (100 YR WATER LEVEL)	263.70m
FREE BOARD ELEV /ACCESS RD ELEV.	264.00m
POND SLOPES	5:1
AQUATIC SAFETY BENCH	10:1
POND OUTLET INVERT	261.50m

HEC RAS MODEL RECEIVED FROM CONSERVATION AUTHORITY INDICATE THAT 5 YEAR EXISTING WATER LEVEL IN DINGMAN CREEK IN THE PROXIMITY OF POND OUTLET IS 261.50m



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CONCEPTUAL DESIGN - NORTH POND

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE: DECEMBER 2013

PROJECT No. 12116

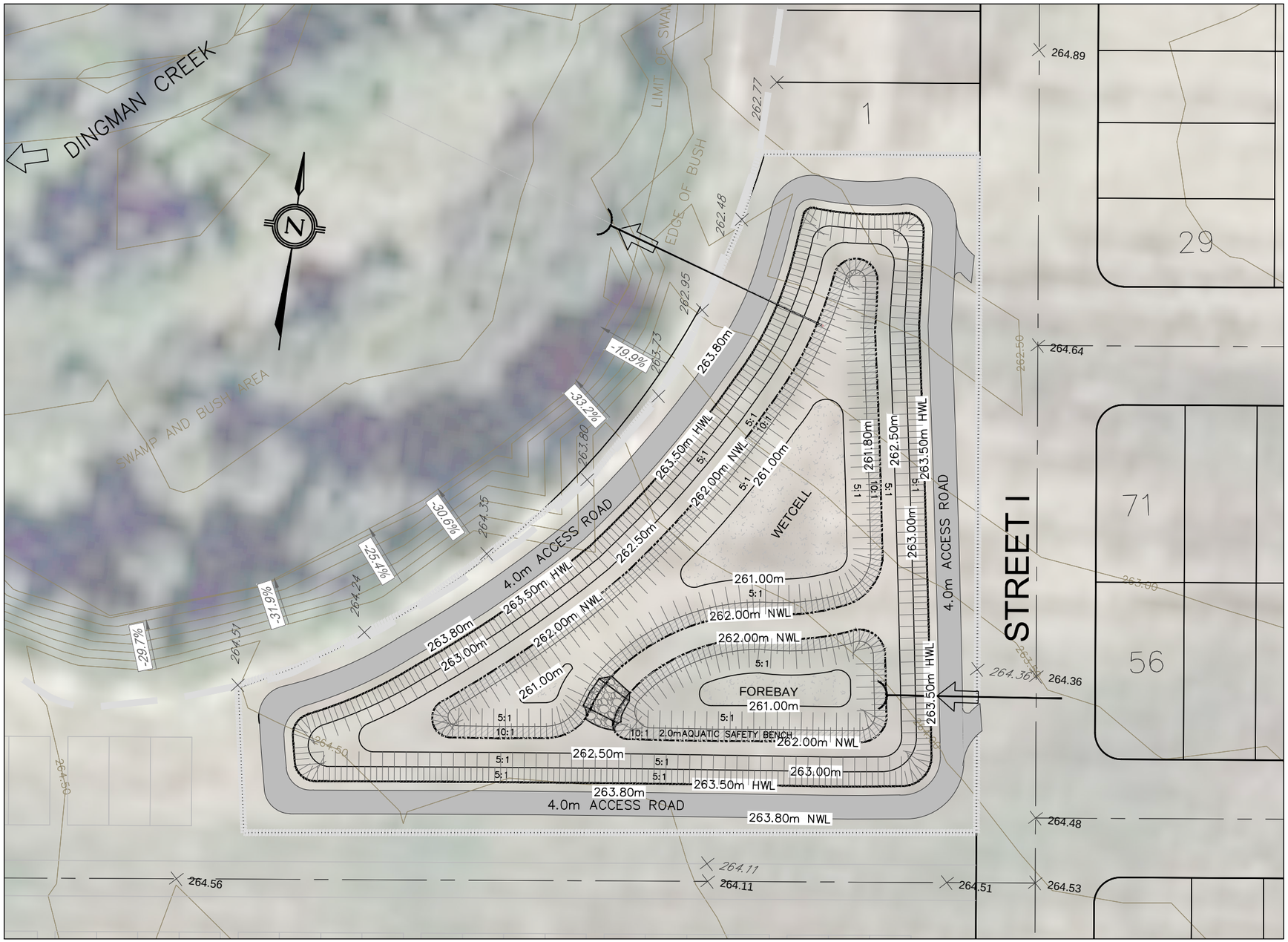
SCALE: 1:750

FIGURE No. 4-2

DESCRIPTION	REQUIRED STORAGE	PROVIDED STORAGE
PERMANENT POOL EL.261.00 – EL.262.00 (1.0m)	582 m^3	1,477 m^3
ACTIVE POOL EL.262.00. – EL.263.50 (1.5m)	3,992 m^3	6,097 m^3

POND GEOMETRIC DATA	
ITEM	DATA
DRAINAGE AREA	7.6 HA
POND BLOCK AREA	0.94 HA
PERMANENT POOL ELEV.	262.00m
BOTTOM OF POND ELEV.	261.00m
HWL (100 YR WATER LEVEL)	263.50m
FREE BOARD ELEV /ACCESS RD ELEV.	263.80m
POND SLOPES AQUATIC SAFETY BENCH	5:1 10:1
POND OUTLET INVERT	261.50m

HEC RAS MODEL RECEIVED FROM CONSERVATION AUTHORITY INDICATE THAT 5 YEAR EXISTING WATER LEVEL IN DINGMAN CREEK IN THE PROXIMITY OF POND OUTLET IS 260.80m



File : G:\Projects\2012\12116 - TSI London GE1 & GE2\Drawings\FSR FIGURES\FIGURE 4-2 to 4-4 -pond concepts.dwg, Layout : figure 4-3 WEST POND Date :Dec 09, 2013 - 12:59pm, Edit By : rchung

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CONCEPTUAL DESIGN - SOUTHWEST POND

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE: DECEMBER 2013

PROJECT No. 12116

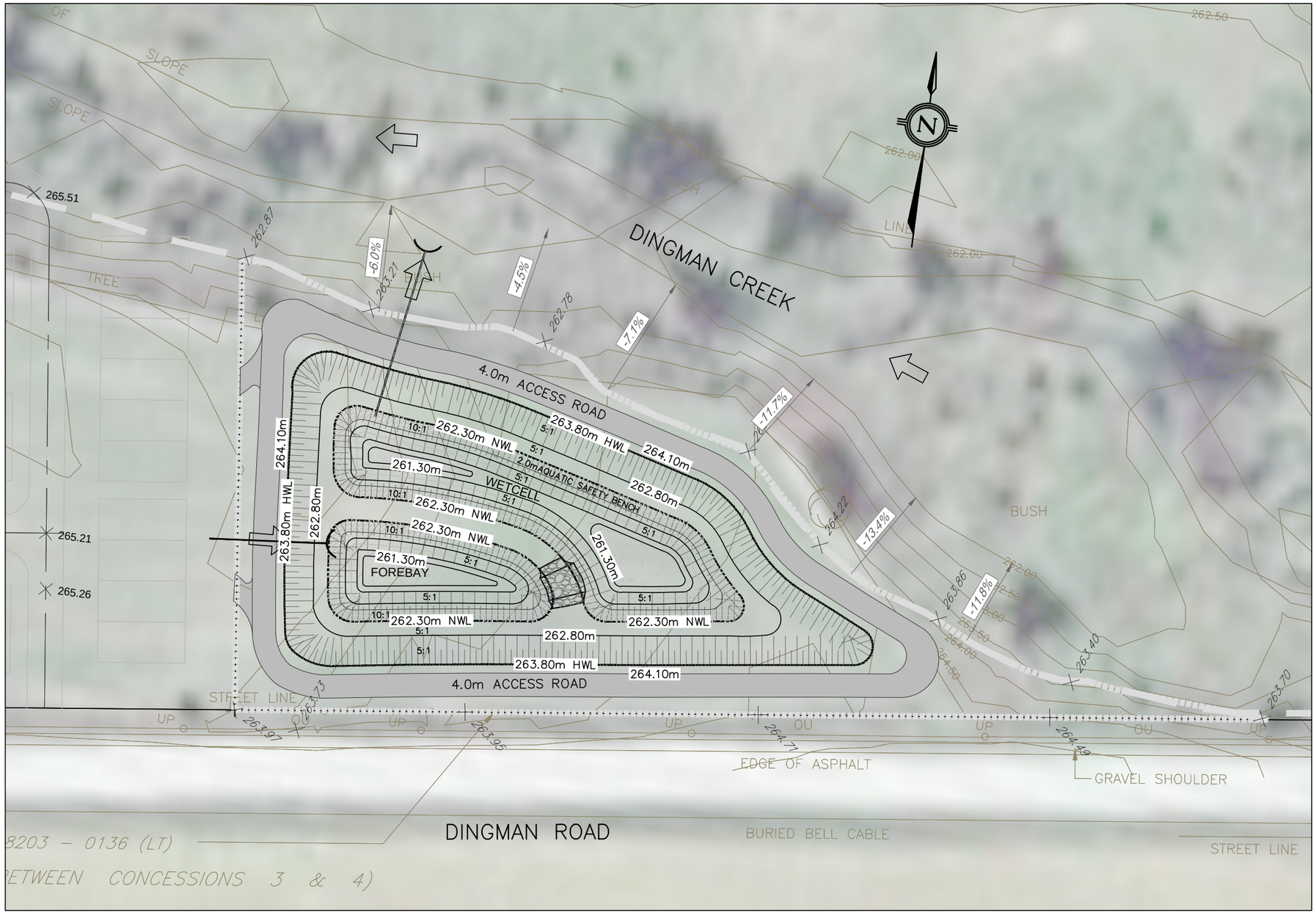
SCALE: 1:750

FIGURE No. 4-3

DESCRIPTION	REQUIRED STORAGE	PROVIDED STORAGE
PERMANENT POOL EL.261.30 – EL.262.30 (1.0m)	424 m^3	779 m^3
ACTIVE POOL EL.262.30. – EL.263.80 (1.5m)	2,782 m^3	4,003 m^3

POND GEOMETRIC DATA	
ITEM	DATA
DRAINAGE AREA	5.6 HA
POND BLOCK AREA	0.67 HA
PERMANENT POOL ELEV.	262.30m
BOTTOM OF POND ELEV.	261.30m
HWL (100 YR WATER LEVEL)	263.80m
FREE BOARD ELEV /ACCESS RD ELEV.	264.10m
POND SLOPES	5:1
AQUATIC SAFETY BENCH	10:1
POND OUTLET INVERT	262.10m

HEC RAS MODEL RECEIVED FROM CONSERVATION AUTHORITY INDICATE THAT 5 YEAR EXISTING WATER LEVEL IN DINGMAN CREEK IN THE PROXIMITY OF POND OUTLET IS 261.80m



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CONCEPTUAL DESIGN - SOUTHEAST POND

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE: DECEMBER 2013

PROJECT No. 12116

SCALE: 1:750

FIGURE No. 4-4

The following sections outline the design criteria for the SWM Pond.

4.3.1 Water Quality Control (Permanent Pool)

The water quality requirements for the SWM ponds have been determined in accordance with the *MOE Stormwater Management Planning and Design (SWMPD) Manual (March 2003)* for *Normal* protection (70% long-term suspended solids removal). The required and provided permanent pool volumes are summarized in **Tables 3-3** to **3-5**. Detailed calculations are provided in **Appendix D**.

Table 4-4: *Water Quality Requirements for the North Pond*

Type of Facility	Wet Pond
Level of Protection	*Normal*
Drainage Area	25.5 ha
Weighted Imperviousness	64%
Total Storage Volume Requirement	3,101 m^3
Minimum Extended Detention Storage Volume Requirement	40 m^3/ha = 1,020m^3
Permanent Pool Requirement	81.65 m^3/ha
Required Permanent Pool Storage Volume	2,081 m^3
Provided Permanent Pool Storage Volume	6,084 m^3

Table 4-5: *Water Quality Requirements for the Southwest Pond*

Type of Facility	Wet Pond
Level of Protection	*Normal*
Drainage Area	7.6 ha
Weighted Imperviousness	60%
Total Storage Volume Requirement	886 m^3
Minimum Extended Detention Storage Volume Requirement	40 m^3/ha = 304 m^3
Permanent Pool Requirement	76.07 m^3/ha
Required Permanent Pool Storage Volume	582 m^3
Provided Permanent Pool Storage Volume	1,477 m^3

Table 4-6: *Water Quality Requirements for the Southeast Pond*

Type of Facility	Wet Pond
Level of Protection	*Normal*
Drainage Area	5.6 ha
Weighted Imperviousness	60%
Total Storage Volume Requirement	648 m^3
Minimum Extended Detention Storage Volume Requirement	40 m^3/ha = 224 m^3
Permanent Pool Requirement	76.07 m^3/ha
Required Permanent Pool Storage Volume	424 m^3
Provided Permanent Pool Storage Volume	779 m^3

A preliminary geotechnical investigation was completed for the subject site (a copy of this report has been provided in **Appendix A**). However, the preliminary geotechnical report was completed prior to the establishment of the current site plan and the number and locations of SWM ponds have changed. Therefore, the exact subsurface soil conditions and groundwater levels at the proposed SWM pond locations remain unknown. Based on the available subsurface soil conditions it should be feasible to construct the proposed SWM ponds, however additional boreholes will be required at the detailed design stage to ensure that compacted-clay liners and / or geosynthetic liners are not required within the SWM ponds in order to retain water in the permanent pool due to silty sand and sandy silt deposits encountered across the site.

4.3.2 Erosion Control

Based on the *Dingman Creek Subwatershed Study Update (dated 2005)*, the erosion control storage requirements for the SWM Pond should be determined based on providing a minimum of 72-hour detention of the stormwater runoff generated from a 25 mm storm event. The erosion control storage requirements are summarized in **Table 4-7** through **Table 4-10**. Detailed calculations are provided in **Appendix D**.

Table 4-7: *Erosion Control Requirements for North Pond*

Drainage Area	25.5 ha
Stormwater Runoff Volume (25-mm Design Storm)	15.12 mm
Required Erosion Control Storage Volume	3,853 m^3
Required Detention Time	72 hours
Average Release Rate	0.015 m^3/s
Approximate Peak Release Rate (1.5 x Average)	0.022 m^3/s

Table 4-8: *Erosion Control Requirements for Southwest Pond*

Drainage Area	7.6 ha
Stormwater Runoff Volume (25-mm Design Storm)	14.05 mm
Required Erosion Control Storage Volume	1,068 m^3
Required Detention Time	72 hours
Average Release Rate	0.004 m^3/s
Approximate Peak Release Rate (1.5 x Average)	0.006 m^3/s

Table 4-9: *Erosion Control Requirements for Southeast Pond*

Drainage Area	5.6 ha
Stormwater Runoff Volume (25-mm Design Storm)	14.05 mm
Required Erosion Control Storage Volume	782 m^3
Required Detention Time	72 hours
Average Release Rate	0.003 m^3/s
Approximate Peak Release Rate (1.5 x Average)	0.005 m^3/s

4.3.3 Water Quantity Control

Water quantity control will be provided to reduce the post development release rates to the target release rates. As discussed in **Section 4.2,** the target release rates were calculated as 60% of the pre-development peak flow rates, as per the recommendations of the *Dingman Creek Subwatershed Study Update (dated 2005).* To determine the required attenuation storage volumes for the SWM ponds post development storm runoff from the proposed development was modelled using the Visual OTTHYMO^{TM} Version 2.0 (VO2) hydrologic model. The 2-year through 100-year return period events were simulated using the 3-hour Chicago, 1-hour AES and 24-hour SCS Type II design storms. Summaries of the expected storage volumes and release rates under the three design storm scenarios for each pond are presented in **Table 4-10** through **Table 4-18**. The VO2 hydrologic model output files are provided in **Appendix E**.

Table 4-10: *Summary of Expected Storage Volumes and Release Rates - North SWM Pond (3-hour Chicago Storm)*

Component	Target Release Rate	North SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	2,081 m^3
Erosion Control	0.022 m^3/s	0.022 m^3/s	3,853 m^3
2-year	0.154 m^3/s	0.149 m^3/s	4,864 m^3
5-year	0.305 m^3/s	0.302 m^3/s	6,869 m^3
10-year	0.406 m^3/s	0.399 m^3/s	8,113 m^3
25-year	0.518 m^3/s	0.508 m^3/s	9,390 m^3
50-year	0.608 m^3/s	0.595 m^3/s	10,361 m^3
100-year	0.698 m^3/s	0.678 m^3/s	11,286 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-11: *Summary of Expected Storage Volumes and Release Rates - North SWM Pond (1-hour AES Storm)*

Component	Target Release Rate	North SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	2,081 m^3
Erosion Control	0.022 m^3/s	0.022 m^3/s	3,853 m^3
2-year	0.115 m^3/s	0.113 m^3/s	4,195 m^3
5-year	0.250 m^3/s	0.246 m^3/s	6,520 m^3
10-year	0.372 m^3/s	0.368 m^3/s	8,060 m^3
25-year	0.539 m^3/s	0.491 m^3/s	10,172 m^3
50-year	0.674 m^3/s	0.629 m^3/s	11,667 m^3
100-year	0.819 m^3/s	0.781 m^3/s	13,120 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-12: *Summary of Expected Storage Volumes and Release Rates - North SWM Pond (24-hour SCS Type II Storm)*

Component	Target Release Rate	North SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	2,081 m^3
Erosion Control	0.022 m^3/s	0.022 m^3/s	3,853 m^3
2-year	0.258 m^3/s	0.256 m^3/s	5,954 m^3
5-year	0.381 m^3/s	0.378 m^3/s	7,471 m^3
10-year	0.503 m^3/s	0.501 m^3/s	8,910 m^3
25-year	0.699 m^3/s	0.696 m^3/s	10,941 m^3
50-year	0.839 m^3/s	0.837 m^3/s	12,243 m^3
100-year	1.002 m^3/s	0.999 m^3/s	13,705 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-13: *Summary of Expected Storage Volumes and Release Rates - Southwest SWM Pond (3-hour Chicago Storm)*

Component	Target Release Rate	Southwest SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	582 m^3
Erosion Control	0.006 m^3/s	0.006 m^3/s	1,068 m^3
2-year	0.046 m^3/s	0.042 m^3/s	1,370 m^3
5-year	0.091 m^3/s	0.088 m^3/s	1,969 m^3
10-year	0.121 m^3/s	0.116 m^3/s	2,342 m^3
25-year	0.154 m^3/s	0.147 m^3/s	2,723 m^3
50-year	0.179 m^3/s	0.172 m^3/s	3,017 m^3
100-year	0.206 m^3/s	0.197 m^3/s	3,295 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-14: *Summary of Expected Storage Volumes and Release Rates - Southwest SWM Pond (1-hour AES Storm)*

Component	Target Release Rate	Southwest SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	582 m^3
Erosion Control	0.006 m^3/s	0.006 m^3/s	1,068 m^3
2-year	0.034 m^3/s	0.024 m^3/s	1,216 m^3
5-year	0.075 m^3/s	0.074 m^3/s	1,903 m^3
10-year	0.109 m^3/s	0.107 m^3/s	2,363 m^3
25-year	0.158 m^3/s	0.150 m^3/s	2,974 m^3
50-year	0.198 m^3/s	0.190 m^3/s	3,419 m^3
100-year	0.241 m^3/s	0.236 m^3/s	3,872 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-15: *Summary of Expected Storage Volumes and Release Rates - Southwest SWM Pond (24-hour SCS Type II Storm)*

Component	Target Release Rate	Southwest SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	582 m^3
Erosion Control	0.006 m^3/s	0.006 m^3/s	1,018 m^3
2-year	0.076 m^3/s	0.074 m^3/s	1,693 m^3
5-year	0.113 m^3/s	0.112 m^3/s	2,143 m^3
10-year	0.149 m^3/s	0.148 m^3/s	2,568 m^3
25-year	0.207 m^3/s	0.205 m^3/s	3,170 m^3
50-year	0.249 m^3/s	0.246 m^3/s	3,558 m^3
100-year	0.297 m^3/s	0.294 m^3/s	3,992 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-16: *Summary of Expected Storage Volumes and Release Rates - Southeast SWM Pond (3-hour Chicago Storm)*

Component	Target Release Rate	Southeast SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	424 m^3
Erosion Control	0.005 m^3/s	0.005 m^3/s	782 m^3
2-year	0.043 m^3/s	0.040 m^3/s	980 m^3
5-year	0.088 m^3/s	0.084 m^3/s	1,407 m^3
10-year	0.118 m^3/s	0.107 m^3/s	1,675 m^3
25-year	0.151 m^3/s	0.141 m^3/s	1,941 m^3
50-year	0.177 m^3/s	0.169 m^3/s	2,143 m^3
100-year	0.203 m^3/s	0.194 m^3/s	2,332 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-17: *Summary of Expected Storage Volumes and Release Rates - Southeast SWM Pond (1-hour AES Storm)*

Component	Target Release Rate	Southeast SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	424 m^3
Erosion Control	0.005 m^3/s	0.005 m^3/s	782 m^3
2-year	0.035 m^3/s	0.034 m^3/s	877 m^3
5-year	0.079 m^3/s	0.076 m^3/s	1,370 m^3
10-year	0.115 m^3/s	0.106 m^3/s	1,699 m^3
25-year	0.167 m^3/s	0.158 m^3/s	2,139 m^3
50-year	0.208 m^3/s	0.200 m^3/s	2,443 m^3
100-year	0.253 m^3/s	0.248 m^3/s	2,769 m^3

*Represents results from VO2 model output (**Appendix E**).

Table 4-18: *Summary of Expected Storage Volumes and Release Rates - Southeast SWM Pond (24-hour SCS Type II Storm)*

Component	Target Release Rate	Southeast SWM Pond*	
		Peak Flow	Storage
Permanent Pool	N/A	N/A	424 m^3
Erosion Control	0.005 m^3/s	0.005 m^3/s	782 m^3
2-year	0.075 m^3/s	0.073 m^3/s	1,208 m^3
5-year	0.110 m^3/s	0.109 m^3/s	1,521 m^3
10-year	0.146 m^3/s	0.145 m^3/s	1,811 m^3
25-year	0.202 m^3/s	0.200 m^3/s	2,218 m^3
50-year	0.242 m^3/s	0.239 m^3/s	2,480 m^3
100-year	0.289 m^3/s	0.286 m^3/s	2,782 m^3

*Represents results from VO2 model output (**Appendix E**).

Even though as demonstrated in **Table 4-10** through **Table 4-18** the results from the SCS Type II design storm models require the most storage volume within all three drainage areas, the SCS Type II storm is used to model rural or undeveloped areas. So for the purpose of modelling the controls for a proposed development the 3-hour Chicago design storm is deemed to be the most appropriate (as recommended by the City of London design standards).

The SWM ponds are required to attenuate all storms up to the 100-year return period. The required and provided storage volumes for the SWM ponds for the 100-year event are summarized in **Table 4-19**.

Table 4-19: *Provided and Required Storage within SWM Ponds during 100-Year Event*

SWM Pond	Provided Active Storage Volume (m^3)	Required Storage Volume (m^3)
North	18,478	13,705
Southwest	6,097	3,992
Southeast	4,003	2,782

As shown in **Table 4-19**, the provided storage volume is greater than the required storage volume. Therefore, sufficient storage volume has been provided for the subject site.

4.4 Preliminary Water Balance

The water balance criteria set out by the *Dingman Creek Subwatershed Study Update (dated 2005)* requires that the subject site maintain recharge rates to existing levels by assessing the surface runoff, evapotranspiration, groundwater recharge and baseflow processes on a catchment area basis and to simulate potential change in hydrologic conditions due to future development. The goal of water balance is to maintain the theoretical pre-development water column to the greatest extent possible by promoting infiltration and evapotranspiration.

A preliminary water balance analysis has been completed for the subject site using the Thornthwaite and Mather method set out in the *MOE SWMPD Manual (March 2003)*. Based on the soil type and land use across the subject site the average annual infiltration rate is 163 mm/yr under existing conditions. The pre-development annual infiltration volumes are summarized in **Table 4-20**.

Under post development conditions 60% to 65% of the surface will be impervious; therefore infiltration will decrease within the study area unless mitigation measures are implemented.

The post development annual infiltration volumes and the infiltration deficit are summarized in **Table 4-20**. Detailed calculations are provided in **Appendix D**.

Table 4-20: *Preliminary Analysis of Annual Infiltration Volumes*

Drainage Area	Pre-Development Annual Infiltration Volume	Post Development Annual Infiltration Volume	Annual Infiltration Volume Deficit
North	41,522 m^3/yr	17,332 m^3/yr	24,190 m^3/yr
Southwest	12,380 m^3/yr	5,788 m^3/yr	6,592 m^3/yr
Southeast	9,073 m^3/yr	4,242 m^3/yr	4,831 m^3/yr

As can be seen in **Table 4-20** the proposed development will result in an annual infiltration deficit in each of the three drainage areas. At the detailed design stage a hydrogeology study should be completed to determine if the reduction in infiltration has a significant impact on the study area. If required, Low Impact Development (LID) measures can be implemented to address the remaining infiltration deficit.

LID measures, which are typically small scaled and site based, contribute to reducing the post development infiltration and evapotranspiration deficits as opposed to traditional end-of-pipe stormwater practices which tend to manage runoff through detention and controlled release. The types of LID measures that may be implemented on site include the following:

- *Directing Roof Leaders to Pervious Areas* – Conveying rooftop runoff to pervious areas, such as rear yards and side yards increases the opportunity for infiltration and evapotranspiration. The amount of water stored on-site can be increased by increasing the depth of topsoil in landscaped areas.
- *Rainwater Harvesting* - Rainwater harvesting is the storage and subsequent utilization of rooftop runoff, for applications such as landscape irrigation. In general, the concept entails the conveyance of rooftop runoff to a cistern for storage and eventual use for watering. By using the rainwater for watering during a time when the soil is not saturated, it helps to promote infiltration and evapotranspiration thus helping to maintain the pre-development water balance.
- *Reduced Lot Grading* – This approach utilizes flatter grades across the property to slow down runoff and further encourage both infiltration and evapotranspiration. Reduced lot grades, along with the use of additional fill can add to the water storage capacity and the infiltration capacity of the soil.
- *Permeable Pavement* – Permeable pavements, such as pavers, pervious concrete and porous asphalt, can be used as an alternative to impervious pavement. Permeable pavements allow stormwater to drain through them and infiltrate into the underlying soil. They can be used for low traffic roads, parking lots, driveways, pedestrian plazas and walkways. Permeable pavements allow for filtration, storage, and/or infiltration of runoff.
- *Infiltration trenches* – Infiltration trenches could be implemented within the boulevards of the local roads. They would consist of perforated pipe surrounded by a volume of clear stone and filter fabric. Water storage is achieved within the voids in the clear stone, typically 30% of the facility volume. The stored water then has the potential to infiltrate. If percolation rates are less than 15mm/hr an effective overflow mechanism must be provided, as percolation rates less than 15mm/hr are typically not considered suitable for infiltration.

4.5 Stormwater Collector Systems

4.5.1 Minor Storm Systems

The minor system for the subject site has been designed to capture and convey stormwater runoff from the 2-year design storm to the proposed SWM ponds. The proposed storm sewer alignment for the subject site is shown on **Drawing STM01**. The subject lands are proposed to be serviced by three SWM ponds, which are planned to be located adjacent to Dingman Creek within the three distinct north, southeast and southwest drainage areas within the subject site. As shown on **Drawing STM01** the storm sewer systems within each drainage area will convey stormwater runoff into their respective SWM ponds – the north area to the North SWM pond, the southwest to the Southwest SWM pond, and the southeast to the Southeast SWM pond.

The proposed storm sewers are designed as per the City of London's guidelines, providing the capture and conveyance of stormwater runoff from the 2 year storm event. Preliminary storm sewer design sheets are included in **Appendix F**. All storm sewer slopes, pipe cover depths and manholes meet the minimum design requirements of the City of London.

4.5.2 Major Systems

Major system conveyance has been planned to effectively route flows greater than the minor system, up to the 100 year storm event to the three proposed SWM ponds. The major system overland flow routes include the road right-of-ways and easements. Any required easements will be a minimum of 5 m wide.

4.5.3 External Drainage

As outlined in **Section 2.1** of this report, an external area south of the subject site naturally drains onto the subject site. The external area is approximately 46.1 ha. The drainage is conveyed under Dingman Drive through three (3) existing culverts. The external drainage area, as well as the locations and sizes of the culverts are shown on **Figure 2-1**.

The flows from the externals areas are proposed to be conveyed to Dingman Creek as shown on **Drawing STM01**. The flows from culvert 1 and 2 will be combined and conveyed to the creek using a 900mm pipe at slope of 0.5%. Similarly the flows from culvert 3 will be conveyed to the creek through a 975mm pipe at a slope of 0.5%. The conveyance pipes are proposed to outlet into Dingman Creek above the 2-year water level. The construction of the conveyance pipes may require re-grading of the roadside ditch.

The conveyance pipes have been sized to accommodate flows from the existing 100-year 24 hour SCS design storm, calculated using VO2. The model output is included in **Appendix B** for reference.

5 Sanitary Servicing

5.1 Existing Sanitary Servicing

The subject site is situated in the Wilton Grove Industrial Park Trunk Sanitary Sewer area. Existing sanitary sewers adjacent to the subject site are illustrated in **Figure 5-1**. Sewage is conveyed southerly from Wilton Grove Road along Hubrey Road towards Green Valley Road via a 900mm diameter gravity sewer. This sewer bends at the Intersection of Hubrey Road and Green Valley Road, where it conveys sewage westerly via a 975mm diameter gravity sewer towards the Dingman Creek Sewage Pumping Station. The pumping station is located on Dingman Drive, west of Highway 401, which pumps the sanitary flows through forcemains to the Greenway Pollution Control Centre.

5.2 Proposed Sanitary Servicing

As noted in **Section 5.1** existing sanitary sewer infrastructure is available at the intersection of Hubrey Road and Green Valley Road as an outlet for the proposed development. The internal sanitary sewer system for the development is divided into two systems by Dingman Creek. The area north of Dingman Creek will be serviced by a conventional gravity system and will outlet at the existing manhole at Hubrey Road and Green Valley Road.

The portion of the site south of Dingman Creek will be serviced by a gravity system that will drain to a sanitary pumping station located at the east end of Street H, adjacent to Dingman Creek. The pumping station will convey flows via a forcemain under Dingman Creek to proposed MH10A, at the south end of Street D. The proposed sanitary sewer system is illustrated on **Drawing SAN01** (provided in Appendix I).

The sanitary sewer design criteria are set out in the City of London Design Specification and Requirements Manual (September 2012). The design criteria are summarized in **Table 5-1**.

Table 5-1: *Sanitary Sewer System Design Criteria*

	City of London
Average Daily Residential Flow	250 Lpcd (1)
Average Day Commercial Flow	25 m^3/ha/day (1)
Peaking Factor	Harmon (1)
Infiltration Allowance	0.10 L/ha/s (1)
Minimum Velocity	0.6 m/s (1)
Maximum Velocity	4.5 m/s (1)
Notes: 1. Source: City of London Design Specifications & Requirements Manual – Chapter 3	

The proposed sanitary sewers are to be sized for maximum design flows plus an allowance for infiltration. Based on the City of London design criteria, expected sewerage flows are 250 Lpcd for residential development and 25 m^3/ha/day for Commercial development. Infiltration is calculated at a rate of 0.1 L/s/ha.

The peaking factor is based on the Harmon Peaking formula:

$M = 1 + 14 / (4 + P^{0.5})$

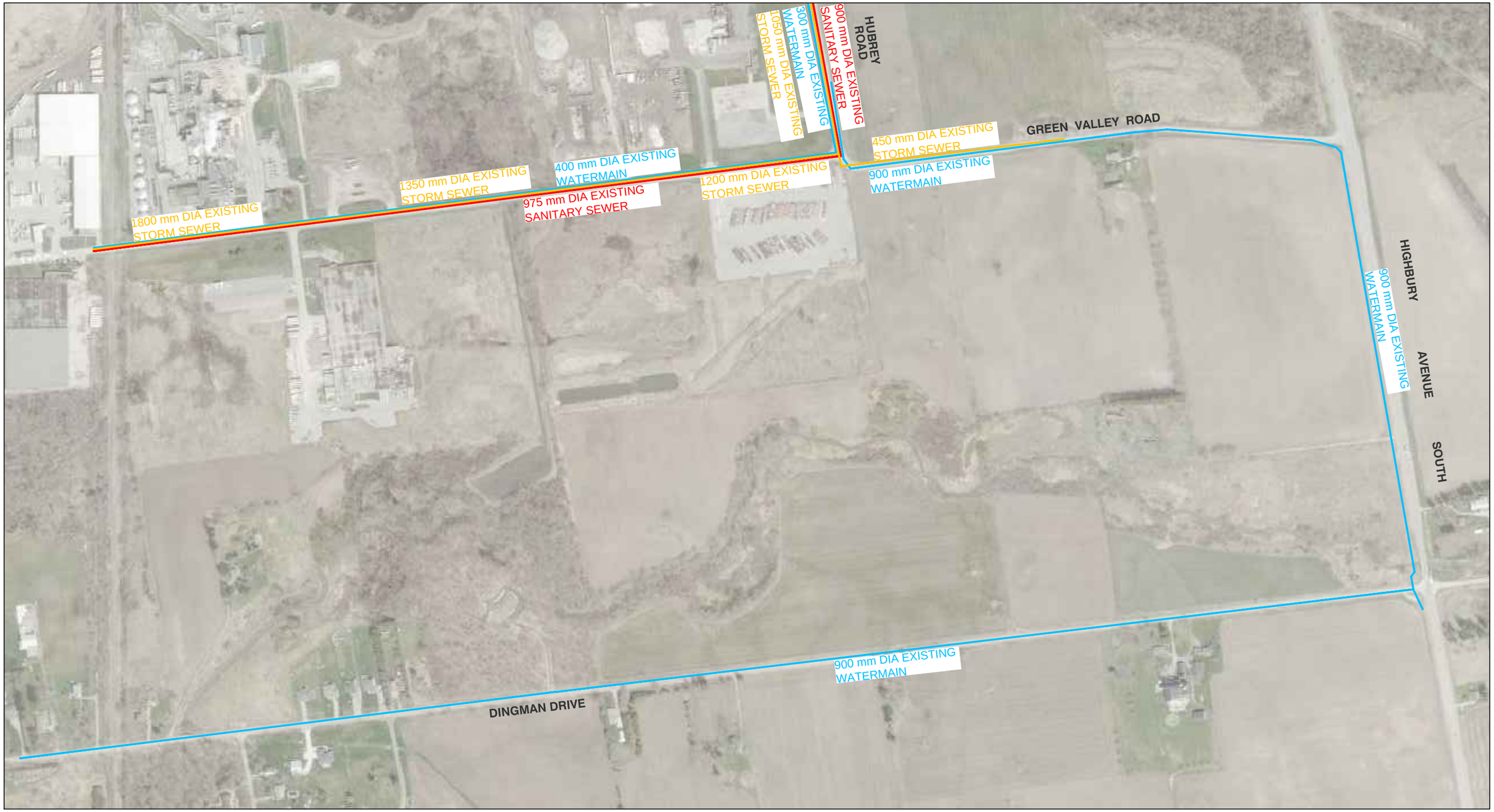
where M is the peaking factor and P is the design population in thousands (since the area development lands are 64 ha, the design criteria for tributary areas less than 200 ha will apply (Design and Specifications Manual, City of London)).

The proposed sanitary flows were calculated based on 239 Condo Townhomes, 285 Condo Apartments, 112 townhouse units, 36 semi-detached units, 284 detached units, and 3995 m^2 Commercial area. To ensure that the proposed sanitary system is sized for ultimate conditions, calculations include both lots noted on the proposed draft plan and those lots as being future development. The flows from the proposed development are summarized in **Table 5-2**, the supporting calculations are provided in **Appendix G**.

Table 5-2: *Sanitary Sewer Flow Requirements*

	Residential	Commercial
Site Area	36.40 ha	0.40 ha
Total Population	2259	40
Per Capita Flow Rate	250 Lpcd	25 m^3/ha/day
Average Daily Flow	6.5 L/s	0.12 L/s
Peaking Factor	3.54	4.33
Site Area	36.40 ha	0.40 ha
Infiltration Allowance	3.6 L/s	0.04 L/s
Total Flow	**26.7 L/s**	**0.56 L/s**

The peak sanitary flow rate generated by the proposed development will be 27.3 L/s. The sanitary sewer system, illustrated in **Drawing SAN01** (provided in **Appendix I**), has been designed to convey the flows from the subject site to the existing 975mm diameter sanitary sewer within Green Valley Road.



G:\Projects\2012\12116 - TSI London GE1 & GE2\Drawings\FSR FIGURES\Figure 5-1 - existing servicing.dwg

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EXISTING SERVICES
GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON

DATE:	PROJECT No.
DECEMBER 2013	12116
SCALE:	FIGURE No.
NTS	5-1

6 Water Servicing

6.1 Existing Water Supply Servicing

The subject site is not currently serviced with municipal water. The existing residential property, located on the northern edge of the property is serviced by a well system. Existing watermain infrastructure is available to the site via watermain on Green Valley Road, Highbury Avenue South and Dingman Drive as shown on **Figure 5-1**.

The development is located within the City of London Southeast Pressure Zone, which is defined by a hydraulic grade elevation of 322m.

6.2 Proposed Water Supply Servicing

The preliminary watermain servicing schematic is illustrated on **Drawing WM01** (provided in **Appendix I**). The watermain design criteria are set out in the City of London Design Specification and Requirements Manual (September 2012) and are summarized in **Table 6-1**.

Table 6-1: *Water System Design Criteria*

	City of London
Average Day Domestic Demand	270 Lpcd
Average Day Commercial Demand	28 m^3/ha/day
Maximum Day Demand Factor	3.5
Peak Hour Demand Factor	7.80

The water demand for the subject site is calculated based on the City of London design criteria and a total anticipated population of 2,259 persons. Similar to the sanitary system, the proposed watermain has been sized to include future development lands within the plan. The water demands from the proposed development are summarized in **Table 6-2**, the supporting calculations are provided in **Appendix H**.

Table 6-2: *Water Demands Requirements*

	Residential	Commercial
Average Demand	7.1 L/s	0.13 L/s
Peak Hour Demand	55.4 L/s	1.0 L/s
Maximum Day Demand	24.9 L/s	0.46 L/s
Fire Protection Demand	64 L/s	
Max Day + Fire Flow	89.4 L/s	

The peak hour demand is anticipated to be 56.4 L/s, and the maximum day demand is anticipated to be 25.4 L/s.

The required fire flows for the subject site were evaluated using the Fire Underwriters Survey (FUS) method as recommended in the City of London's Design Specifications and Requirements Manual. The FUS calculation recommends providing a fire flow of 38 L/s for Apartments, 38 L/s Condo Townhomes, 38 L/s for townhouse units, 38 L/s for semi-detached units, and 64 L/s for detached units; therefore, the governing fire flow requirement for the proposed development will be that of the detached units (see **Appendix H** for details).

Based on the above calculations, the design water demand for the proposed development is 89.4 L/s (i.e. the sum of the maximum day demand and the fire flow requirements).

AS can be seen on **Drawing WM01** (provided in **Appendix I**), the watermain system for the area of the proposed development north of Dingman Creek will be connected to the existing system in two locations. One on Green Valley Road, east of Hubrey Road, and one on Highbury Avenue South, south of Green Valley Road.

The watermain system for the area of the proposed development south of Dingman Creek will be connected to the existing watermain on Dingman Drive in two locations. A proposed 300mm diameter watermain will be constructed within the north edge of the Dingman Road road allowance, parallel to the existing watermain. This will allow for multiple connections within the proposed project, while limiting connections to the existing system to two.

7 Grading

As noted in previous sections of this study the subject site is divided into north and south areas by Dingman Creek. The south area topography generally falls from Dingman Drive, northerly to Dingman Creek at an average slope of 1.0%. The northern area topography generally falls south westerly from the corner of Green Valley Road and Highbury Avenue South to Dingman creek at an average slope of 2.0%

The proposed site grading is conceptually shown on **Drawing GR01** (provided in **Appendix I**) with more detail to be provided at the detailed design stage. The grading design will generally generate a net fill condition on the site in support of the servicing design. The lot grading will consist of Front to Split lots interior to the site and Walkout/Back-splits around the boundary to grade to existing. Existing grades will be matched along the boundary of the subject site. Proposed grading will follow the City of London design criteria.

8 Summary and Conclusion

Based on our review and analysis, we conclude that the proposed development can be serviced by existing and proposed infrastructure base on the City of London Design Criteria.

A summary of our findings are as follows;

- The proposed stormwater management (SWM) ponds (North, Southwest and Southeast SWM Ponds) provide the required water quantity control, water quality treatment, and erosion control.
- The proposed storm sewer system is designed to capture and convey stormwater runoff from the 2 year design storm for the proposed development plan.
- Proposed site grading will generally be higher than existing ground in support of servicing design. Grading will result in a net fill condition.
- The proposed sanitary system is divided into two systems by Dingman Creek. The north sanitary system will outfall via gravity to the existing sanitary sewer at the intersection of Hubrey Road and Green Valley Road. The south sanitary system will drain by a gravity system to a pumping station. The pumping station will convey flows via a forcemain under Dingman Creek to proposed MH10A at the south end of Street D.
- The proposed watermain system can be appropriately serviced via connections to the existing 900mm diameter watermain located along Green Valley Road, Highbury Avenue South and Dingman Drive. A proposed 300mm diameter watermain will be constructed along Dingman Drive, in an attempt to eliminate multiple connections to the existing watermain.

We trust that you will find this submission satisfactory. If you have any questions or comments, please do not hesitate to contact the undersigned.

Sincerely,

THE MUNICIPAL INFRASTRUCTURE GROUP LTD.

Prepared By:

Lana Russell

Lana Russell, P. Eng.
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Reviewed By:

David F. Ashfield, P. Eng.
Partner

Appendix A:

Geotechnical Report

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED GE I AND GE II SUBDIVISION DEVELOPMENT
DINGMAN DRIVE & HIGHBURY AVENUE SOUTH
LONDON, ONTARIO

Submitted to:

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24 May 2012

TT123014

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FIGURES

APPENDICES

1.0 INTRODUCTION

AMEC Environment & Infrastructure, a Division of AMEC Americas Limited ("AMEC"), was retained by Greenvalley Estate Canada Inc./TSI International-Grandtag A2A GE II Inc. ("Greenvalley/TSI")to conduct a preliminary geotechnical investigation for a proposed residential subdivision development to be located at the north-west corner of the intersection of Dingman Drive and Highbury Avenue South in London, Ontario. The site location is shown in Figure No. 1.

The purpose of this geotechnical investigation was to obtain information on the subsurface conditions at the site by means of a limited number of boreholes, in-situ tests and laboratory tests on selected samples. Based on interpretation of the data obtained, recommendations are provided on the geotechnical aspects of the project.

Authorization to proceed with this investigation was received in a signed authorization dated 8 February 2012 from Mr. Dan Lane of Greenvalley Estate Canada Inc./TSI International-Grandtag A2A GE II Inc. The work carried out for this investigation was completed in accordance with AMEC's proposal Ref. No. P11150-R2 dated 20 May 2011.

This report contains the findings of geotechnical investigation, together with AMEC's recommendations and comments. These recommendations and comments are based on factual information and are intended only for use of the design engineers. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The anticipated construction conditions are also discussed, but only to the extent that they may influence design decisions. Construction methods discussed, however, express AMEC's opinion only and are not intended to direct the contractors on how to carry out the construction. Contractors should also be aware that the data and their interpretation presented in this report may not be sufficient to assess all the factors that may have an effect upon the construction.

The report was prepared with the condition that the design would be in accordance with all applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice. Further, the recommendations and opinions in this report are applicable only to the proposed project as described above.

On-going liaison with AMEC is recommended during the final design and construction phase of the project to ensure that the recommendations in this report are applicable and / or correctly interpreted and implemented. Also, any queries concerning the geotechnical aspects of the proposed project should be directed to AMEC for further elaboration and/or clarification.

2.0 SITE AND PROJECT DESCRIPTION

The site is located on Part of Lot 12 Concession 3, west of Highbury Avenue South and north of Dingman Drive in City of London, Ontario (Figure No. 1). The property plan area is roughly an "L" shape and covers approximately 64.4 hectares.

Aside from the north east quadrant of the site, the existing ground surface was fairly flat and generally sloping from east to west. The ground surface across the north east quadrant of the site was, approximately, 5 m to 6 m higher than the rest of the site.

At the time of field work, six small metal-clad sheds and barn buildings were located at the middle of the site. Scattered trees and debris were also noted. The remaining and major portion of the site was covered with farm land, grass and bush.

The site will be, mainly, developed for a residential subdivision. The proposed development will likely consist of one or two storey dwellings with one basement floor. In addition, commercial plazas are proposed at the north east corner of the site. A storm water management pond will be located near the west end of the property.

3.0 INVESTIGATION PROCEDURES

The fieldwork was performed on 24 and 25 April 2012, and consisted of drilling and sampling a total of 14 boreholes, each extending to an approximate depth of 6.0 m below the existing ground surface. The borehole locations were staked out at site by AMEC personnel using hand-held GPS equipment and were based on UTM Zone 17T coordinates. The approximate borehole locations are shown on the Borehole Location Plan in Figure No. 2.

The boreholes were advanced using solid-stem continuous-flight and/or hollow-stem augers, with a track-mounted power-auger drilling rig. All boreholes were advanced under the full-time supervision of experienced geotechnical personnel from AMEC. Soil samples were generally taken at 0.76 m intervals, while performing the Standard Penetration Test (SPT) in accordance with ASTM D1586. This consisted of freely dropping a 63.5 kg (140 lbs.) hammer for a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inches) diameter O.D. split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m (12 inches) was recorded as SPT 'N' value of the soil which indicated the consistency of cohesive soils or the compactness of non-cohesive soils. On completion of drilling, all boreholes were backfilled with bentonite.

The existing ground surface elevations at the borehole locations were obtained, by approximation, from a Topographical Plan of Survey that was prepared by Holstead and Redmond Limited and issued on 8 October 2008. The Topographical Plan of Survey was provided to AMEC by Greenvalley/TSI. It should therefore be noted that the provided ground

surface elevations at the borehole locations in the attached Records of Boreholes are approximate in nature and should be verified prior to design and construction.

Groundwater levels, where encountered, were measured in the open boreholes at the completion of drilling work. Monitoring wells were installed in five borehole locations for future groundwater monitoring. The groundwater depth measurements in the boreholes and monitoring wells are presented on the Record of Boreholes and in Table 4.3 in Section 4 of this report.

Upon completion of the field investigation, the soil samples were transported to AMEC Soil Laboratory in London for further examination and laboratory testing i.e., water content determination and grain size distribution on selected soil samples.

Two soil samples were transported to Maxxam Analytic's Laboratory in Mississauga for corrosivity testing (pH, Chloride, Sulphate, Resistivity and Conductivity).

The soil conditions, groundwater levels, and the results of in-situ and laboratory tests are presented on the corresponding Record of Boreholes, and in Appendix A (where applicable) while the Certificate of Analyses is presented in Appendix B.

4.0 SUB-SURFACE CONDITIONS

Based on the soil conditions encountered at the borehole locations, the soil profile consisted predominantly of topsoil underlain by native soils (silt/sandy silt, silty clay/clayey silt till, sand and silt/silty sand/sandy silt, sand or silt).

The stratigraphic units and groundwater conditions are discussed in detail in the following sections. Detailed information is provided in the Record of Boreholes.

The following summary is to assist the designers of the project with an understanding of the anticipated soil conditions across the site. However, it should be noted that the soil and groundwater conditions might vary between these locations.

4.1 Topsoil

Topsoil was encountered in all boreholes with measured thicknesses typically ranging from 200 mm to 300 mm. The topsoil consisted primarily of organic matter and rootlets mixed with soils.

The thickness of the topsoil can vary significantly between and beyond the borehole locations. For accurate quantity estimates, if required, a regular interval of shallow test pits should be excavated to measure the topsoil thickness, and it is recommended that allowance be made for possible variations when making construction estimates.

4.2 Upper Zone of Silt/Sandy Silt

An upper zone of silt/sandy silt was encountered below the topsoil in Boreholes BH 1 to BH 3, BH 8, BH 9 and BH 11. The silt/sandy silt extended between 0.6 m and 1.8 m below existing ground surface.

The silt/sandy silt was brown to grey in colour, and contained trace clay. The SPT 'N' values measured in the silt/sandy silt ranged widely from 4 to 22 blows per 0.3 m, indicating a loose to compact compactness. The measured moisture contents in the silt/sandy silt ranged from 16 % to 24 %.

4.3 Silty Clay / Clayey Silt Till

Glacial till comprising silty clay / clayey silt was encountered below the silt/sandy silt in Boreholes BH 1, BH 2, BH 3, BH 8 and BH 11 and below the topsoil in Borehole BH 4, BH 5, BH 10, BH 12 through BH 14. The silty clay / clayey silt till extended between 2.1 m and 6.6 m (termination depth) below exiting ground surface. Silty clay was encountered in BH 6 below the topsoil and extended to 0.8 m depth. The silty clay / clayey silt till was encountered for a second time in BH 14 at a depth of 4.6 m and extended to the maximum depth of exploration.

The silty clay / clayey silt till was brown to grey in colour, and contained trace sand and gravel. The SPT 'N' values measured in the silty clay / clayey silt till ranged widely from 10 to 37 blows per 0.3 m, indicating a stiff to hard consistency. The measured moisture contents in the silty clay / clayey silt till ranged from 11 % to 23 %.

4.4 Sand and Silt/Silty Sand/Sandy Silt

Sand and silt/silty sand/sandy silt was encountered below the silty clay / clayey silt till in Boreholes BH 1, BH 3, BH 13 and BH 14, below the silt and the sand in BH7, BH 8 and BH 9 and below the upper zone of silt/sandy silt in BH 11. The sand and silt/silty sand/sandy silt extended between 4.0 m and 6.6 m depths (termination depth) below the existing grade.

The sand and silt/silty sand/sandy silt was light brown to grey in colour. The SPT 'N' values measured in the sand ranged from 10 to 38 blows per 0.3 m, indicating a loose to dense compactness. The measured moisture contents in the sand and silt/silty sand/sandy silt ranged from 12 % to 24 %.

Two samples were tested for grain size distribution, and the results are presented in Table 4.1.

Table 4.1 - Results of Grain Size Distribution Analysis (Sand and Silt/Silty Sand/Sandy Silt)

Borehole No.	Sample No.	Depth (m)	Grain Size Distribution		
			Gravel (%)	Sand (%)	Fines (Silt & Clay) (%)
BH 3	SS 7	5.8 – 6.6	0	64	36
BH 8	SS7	6.1 – 6.6	0	57	43

The grain size distribution curves are presented in Figure No. A 1, in Appendix A.

4.5 Sand

Sand with trace of silt was encountered below the sand and silt/silty sand/sandy silt in Borehole BH 1 and below the silty clay/clayey silt till in BH 6 and BH 8. The sand was encountered below the upper zone of the silt/sandy silt in BH 7, BH 8 and BH 9. The sand extended between 2.1 m and 6.6 m depths (termination depth) below the existing grade.

The sand was light brown to brown in colour. The SPT 'N' values measured in the sand ranged from 9 to 43 blows per 0.3 m, indicating a loose to dense compactness. The measured moisture contents in the sand ranged from 11 % to 26 %.

One sample was tested for grain size distribution, and the results are presented in Table 4.2.

Table 4.2 - Results of Grain Size Distribution Analysis (Sand)

Borehole No.	Sample No.	Depth (m)	Grain Size Distribution		
			Gravel (%)	Sand (%)	Fines (Silt & Clay) (%)
BH 6	SS 2	5.8 – 6.6	0	84	16

The grain size distribution curve is presented in Appendix B.

4.6 Lower Zone of Silt

A lower zone of silt was encountered below the sand or the silty sand/sand and silt/sandy silt in Boreholes BH 6, BH 7, BH 11, BH 13 and BH 14. The silt extended between 4.6 m and 6.6 m below existing ground surface.

The silt was brown to grey in colour, and contained trace clay. The SPT 'N' values measured in the silt ranged widely from 14 to 48 blows per 0.3 m, indicating a compact to very dense compactness. The measured moisture contents in the silt ranged from 21 % to 26 %.

4.7 Groundwater Conditions

Groundwater conditions were observed in the open boreholes during and on completion of drilling. Groundwater levels were later observed in the installed monitoring wells on 9 May 2012. Groundwater was encountered in some of the boreholes and results of groundwater depth measurement are shown on the Record of Boreholes and summarized in Table 4.3.

Table 4.3 - Results of Groundwater Depth Measurement

Borehole No.	Groundwater Levels in Boreholes on Completion of Drilling (25 April 2012)		Groundwater Levels in Installed Monitoring Wells Two Weeks After Drilling (9 May 2012)	
	Depth (m)	Approximate Geodetic Elevation (m)	Depth (m)	Approximate Geodetic Elevation (m)
BH 1	4.3 m	264.5 m	-	-
BH 2	-	Dry	1.2 m	263.0 m
BH 3	1.5 m	265.0 m	-	-
BH 4	-	Dry	-	-
BH 5	-	Dry	-	-
BH 6	3.4 m	264.3 m	-	-
BH 7	1.5 m	261.5 m	1.3 m	261.7 m
BH 8	2.1 m	262.2 m	-	-
BH 9	1.4 m	261.4 m	-	-
BH 10	-	Dry	6.0 m	257.3 m
BH 11	3.7 m	260.6 m	-	-
BH 12	-	Dry	-	-
BH 13	3.5 m	259.4 m	3.8 m	259.1 m
BH 14	3.0 m	259.5 m	2.2 m	260.3 m

It should be noted that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

5.0 DISCUSSION AND RECOMMENDATIONS

Based on the information provided to AMEC, the site would be developed for a residential subdivision. The proposed development would likely consist of one or two storey dwellings with one basement floor. The north west corner of the site will also house a commercial plaza.

Based on the soil conditions encountered at the borehole locations, the soil profile consisted predominantly of topsoil underlain by native soils (silt/sandy silt, silty clay/clayey silt till, sand and silt/silty sand/sandy silt, sand or silt). The measured groundwater levels ranged from about 1.4 to 4.3 m below the existing ground surface on completion of drilling (Geodetic Elevations ranging from 260.6 m to 265.0 m).

Based on the investigation results, the silty clay/clayey silt till, silty sand, sand and silt deposits below the topsoil are capable of supporting conventional spread / strip footing foundations and concrete floor slab-on-grade for the proposed structures. All footings should be placed within the competent native undisturbed deposit or founded on engineered fill, if required (Section 5.3).

At the time of preparing this report, the details of site grading and invert depths for underground utility services are unknown. Additional borehole investigation would be needed if the utility depths are more than 5 m.

The following discussion and recommendations are based on the available information mentioned and should be revised or supplemented when details are finalized.

5.1 Site Grading

The site topography, based on the provided topographical survey plan, indicated that at the ground surface slopes gently down from east to west. The north east quadrant of the site was generally higher than the rest of the site by approximately 5 m to 6 m. A maximum ground surface elevation difference of 6.3 m was noted between the locations of BH 1 and BH 14.

The design grades were not available at the time of writing this report. It is anticipated that the final grades would generally be set to facilitate access to the existing adjacent road. Some limited cut and fill operations should, therefore, be anticipated.

A barn and a few sheds were observed in the middle of the site. The site development will require removal of all existing structures including all associated foundations and all present underground services to a minimum depth of 1.0 m below the final grade within the proposed residential development footprint areas, internal roads and driveways, and backfilling of the void (where necessary). The development of the site will also require cutting and removal of trees, clearing and stripping of grass, bushes, vegetation cover, topsoil, organic matter, existing debris, and deleterious materials (if any), encountered during excavation.

It is recommended that all fill, if required for site grading, be placed as Engineered Fill. Prior to placement of Engineered Fill, surficial topsoil, organic matter and deleterious materials, should be stripped from planned fill areas to expose the inorganic and native subgrade. The exposed subgrade should be proof-rolled with a suitable roller to identify weak areas. Any weak or excessively wet zones identified during proof-rolling should be sub-excavated and replaced with compacted competent soils to establish stable and uniform conditions. Prior to placement of Engineered Fill, the subgrade should be inspected and approved by a geotechnical engineer. Recommendations regarding the Engineered Fill placement are provided in Section 5.3.

5.2 Foundations

The investigation results indicated that the use of conventional shallow strip/ spread footings is feasible to support the proposed dwellings. Shallow footings should be founded on competent undisturbed and native soil or within Engineered Fill (Section 5.3).

Based on the investigation results, the recommended footing depths, Geotechnical Reaction at Serviceability Limit State (SLS) and Geotechnical Resistance at Ultimate Limit State (ULS) for strip / spread footings placed within the native soil encountered at the borehole locations are given in Table 5.1.

Table 5.1 - Approximate Footing Depth, Elevation and SLS and ULS Values

Borehole Number	Foundation Soil Strata	Depth Below Existing Grade	Geodetic Elevation (m)	Geotechnical Reaction at SLS (kPa)	Factored Geotechnical Resistance at ULS [1] (kPa)
BH 1	Stiff Silt	0.8 m to 1.0 m (±)	268.0 m to 267.8 m (±)	100	150
	Stiff to Very Stiff Silty Clay Till	1.0 m to 2.0 m (±)	267.8 m to 266.8 m(±)	150	225
	Compact Silty Sand	2.0 m to 4.0 m (±)	266.8 m to 264.8 m (±)	150	225
	Dense Sand	Below 4 m (±)	Below 264.8 m (±)	300	450
BH 2	Very Stiff to Hard Silty Clay Till	Below 0.8 m (±)	Below 263.4 m (±)	200	300
BH 3	Very Stiff Silty Clay Till	below 2.5 m (±)	Below 264.7 m (±)	150	225
BH 4	Very Stiff Silty Clay Till	Below 0.8 m (±)	Below 262.2 m (±)	200	300
BH 5	Firm to Stiff Clayey Silt Till	0.8 m to 2.3 m (±)	262.0 m to 260.6 m (±)	75	115
	Very Stiff Silty Clay Till	Below 2.3 m (±)	Below 260.6 m (±)	200	300

Borehole Number	Foundation Soil Strata	Depth Below Existing Grade	Geodetic Elevation (m)	Geotechnical Reaction at SLS (kPa)	Factored Geotechnical Resistance at ULS [1] (kPa)
BH 6	Compact Sand	0.8 m to 5.0 m (±)	266.9 m to 262.5 m (±)	200	300
	Compact to Dense Silt	Below 5.0 m (±)	Below 262.5 m (±)	300	450
BH 7	Compact Sand	2.3 m to 3.5 m (±)	260.5 m to 259.4 m (±)	150	225
	Compact Silt	3.5 m to 5.0 m (±)	259.4 m to 257.9 m (±)	200	300
	Compact Silty Sand	Below 5.0 m (±)	Below 257.9 m (±)	200	300
BH 8	Loose Silt	0.8 m to 1.5 m (±)	263.5 m to 262.9 m (±)	100	150
	Dense to Compact Sand	1.5 m to 3.0 m (±)	262.9 m to 261.3 m (±)	150	225
	Very Stiff Silty Clay Till	3.0 m to 4.5 m (±)	261.3 m to 259.9 m (±)	150	225
	Compact Sand	Below 4.5 m (±)	Below 259.9 m (±)	200	300
BH 9	Compact Silt	0.8 m to 1.4 m (±)	262.0 m to 261.4 m (±)	200	300
	Compact Sand	1.4 m to 2.1 m (±)	261.4 m to 260.7 m (±)	200	300
	Compact Sandy Silt	2.1 m to 3.0 m (±)	260.7 m to 259.8 m (±)	200	300
	Dense Sand	Below 3.0 m (±)	Below 259.8 m (±)	250	325
BH 10	Compact Silt	0.8 m to 1.4 m (±)	262.5 m to 261.9 m (±)	100	150
	Very Stiff Silty Clay/Clayey Silt Till	below 1.4 m (±)	below 261.9 m (±)	150	225
BH 11	Very Stiff Silty Clay Till	0.8 m to 2.1 m (±)	263.5 m to 262.2 m (±)	150	225
	Very Dense to Dense Silt	2.1 m to 3.7 m (±)	262.2 m to 260.6 m (±)	250	325
	Dense Silty Sand	3.7 m to 4.4 m (±)	260.6 m to 259.9 m	250	325
	Dense Sandy Silt	Below 4.4 m (±)	Below 259.9 m (±)	250	325
BH 12	Very Stiff Silty Clay Till	Below 0.8 m (±)	Below 262.2 m (±)	200	300

Note: [1] A resistance factor of $\Phi = 0.5$ has been applied to the values provided

Higher soil bearing pressures may be achievable at deeper depths, if required.

For spread / strip footings, the minimum footing sizes, footing thickness, excavations and other footing requirements should be designed in accordance to the latest edition of the Ontario Building Code.

The footings should be kept as high as possible to avoid the groundwater table. The footing subgrade should be inspected and evaluated by the geotechnical engineer prior to concreting to confirm that the footings are founded on competent subgrade capable of supporting the recommended design pressure.

The design frost penetration for the general area is 1.2 m. Therefore, a permanent soil cover of 1.2 m or its thermal equivalent is required for frost protection of foundations. All exterior footings and footings beneath unheated areas should have at least 1.2 m of earth cover or equivalent synthetic insulation for frost protection.

Where necessary, the stepping of the spread / strip footings at different elevations should be carried out at an angle no steeper than 2 horizontal (clear horizontal distance between footings) to 1 vertical (difference in elevation) and no individual footing step should be greater than 0.6 m and may have to be as low as 0.3 m if weaker soils are encountered.

For spread / strip footings designed and constructed as recommended in this report and in accordance with good construction practice, total and differential settlements should be less than 25 mm and 20 mm, respectively. Detailed foundation analysis should be carried out if more accurate values are required.

5.3 Engineered Fill

In low-lying areas, Engineered Fill may be used to found the footings and the slab-on-grade. The following Engineered Fill, if required, placement procedure is recommended to prepare a subgrade capable of supporting the house foundation.

(i) The aerial extent of Engineered Fill should be controlled by proper surveying techniques to ensure that the top of the Engineered Fill extends a minimum of 2.5 m beyond the perimeter of the houses to be supported. Where the depth of Engineered Fill exceeds 1.5 m, this horizontal distance of 2.5 m beyond the perimeter of the house should be increased by at least 1.0 m for each 1.0 m depth of fill.

(ii) The area to receive the Engineered Fill should be stripped of any topsoil, organic matter and other compressible, weak and deleterious materials. After stripping, the entire area should be inspected and approved by the geotechnical engineer. Spongy, wet or soft/loose spots should be sub-excavated to stable subgrade and replaced with compactable approved soil, compatible with subgrade conditions, as directed by the geotechnical engineer.

(iii) The fill material should be placed in thin layers not exceeding approximately 200 mm when loose. Oversize particles (cobbles and boulders) larger than 120 mm should be discarded, and each fill layer should be uniformly compacted with heavy compactors, suitable for the type of fill used, to at least 100 % of its Standard Proctor Maximum Dry Density (SPMDD) for supporting footing and 98% SPMDD for pavement.

The on-site soils (silt/sandy silt, silty clay/clayey silt, sand and silt/silty fine sand/sandy silt and find sand) are generally acceptable for use as Engineered Fill, provided they are not contaminated with any organic inclusions. The excavated soils may require reconditioning (e.g., drying) prior to reuse.

(iv) Full-time geotechnical inspection and quality control (by means of frequent field density and laboratory testing) are necessary for the construction of a certifiable Engineered Fill and compaction procedure and efficiency should be controlled by the geotechnical engineer.

(v) The Engineered Fill should not be frozen and should be placed at moisture content within 2 % of the optimum value for compaction. The Engineered Fill should not be performed during winter months when freezing ambient temperatures occur persistently or intermittently.

Geotechnical reaction / resistance of 150 kPa (SLS) and 225 kPa (factored ULS) for spread / strip footings supported by at least 1.0 m of Engineered Fill on competent native soils constructed in accordance with the above recommendations may be used for design. It is recommended that the footing subgrade be evaluated by the geotechnical engineer prior to placing the formwork. All footings should have at least 1.2 m of earth cover or equivalent artificial insulation for frost protection.

It is recommended to increase the rigidity of foundations of structures erected over engineered fill, and this is generally achieved by making the footings at least 0.5 m wide, and adding nominal reinforcement (e.g. two 15M bars), to the footings. This measure helps bridge over eventual weak spots in the fill.

For footings designed and constructed in accordance with the above criteria, total and differential settlements should be less than 25 mm and 20 mm respectively. The total and differential settlements quoted also apply to footings founded partly on native soil and partly on Engineered Fill. Detailed foundation analysis should be carried out if more accurate values are required.

5.4 Excavation and Dewatering

All excavations should be carried out in accordance with the Ontario Health and Safety Regulations. The soils to be excavated can be classified as follows:

Silt /sandy silt / sand and silt / silty sand / sand	Type 3
Silty clay / clayey silt till	Type 2

Accordingly, for Type 2 and Type 3 soils, a bank slope of 1H:1V is required for excavations in accordance with Occupational Health and Safety Act and Regulations for Construction Projects. For Type 2 soils, a 1.2 m high vertical cut at the bottom of excavation may generally be used. However, this may not be stable if it is below groundwater table, especially in the sand deposit. For excavations within the loose / soft surficial deposits and/or with high groundwater table, flatter slopes (e.g. 3H:1V) may be required.

Stockpiles of excavated materials should be kept at least 3.0 m from the edge of the excavation to avoid slope instability, subject to confirmation by the geotechnical engineer. Care should also be taken to avoid overloading of any underground services / structures by stockpiles.

Normal excavation equipment will be suitable for excavating trenches, but allowance should be made for removing boulders and cobbles that may be encountered within the till strata. The terms describing the compactness (very loose, loose, compact, dense, and very dense) of non-cohesive soils and the consistency (soft, firm, stiff, very stiff, hard) of cohesive soils give an indication of the effort needed for excavation. In very dense/hard soils, additional effort may be required (i.e., excavators with rippers, hydraulic impact hammers, etc.).

Based on the groundwater levels measured during this investigation, the bottom of excavations for basements, footings and utility trenches would likely be below groundwater table if the proposed final grade is similar to or below the existing ground surface elevation. The groundwater levels measured in the boreholes are provided in the Record of Boreholes and Table 4.3. Water seepage in the silty clay / clayey silt till should be manageable through gravity drainage and / or a filtered sump and pump system. However, a significant seepage is anticipated through the sand and silt and all sandy/silty soils with groundwater. Therefore, the use of a series of temporary filtered sumps and pumps, and possibly well points may be required during construction. Test pits should be excavated to evaluate the appropriate method of dewatering prior to construction.

5.5 Basement Slab-on-Grade

Concrete floor slab-on-grade may be built on properly prepared natural subgrade or Engineered Fill. For Engineered Fill subgrade, Section 5.3 should be followed.

The basement floor slab-on-grade should be kept as high as possible to avoid the groundwater table. Should the basement level be below the groundwater table, a system of sumps and pumps will be required for permanently dewatering the groundwater underneath the basement during the service life of the residential dwellings. As a minimum, a permanent underfloor subdrain and perimeter drain system consisting of perimeter weeping tiles, damp/water-proofing and an underfloor granular drainage layer should be also installed. If the basement is constructed in sandy soils under groundwater table, the basement floor and walls should be totally water-proofed, together with installing a permanent sump and pump system with a system of underfloor drain pipes.

Underneath the slabs, a 150 mm thick base course consisting of 20 mm size clear stone or OPSS Granular A should be placed to improve the support for the floor slab. This base course should be compacted with vibratory equipment to a uniform high density for the 20 mm size clear stone or 100 % Standard Proctor Maximum Dry Density for OPSS Granular A. If the subgrade is wet, the clear stone or OPSS Granular A base should be separated from the subgrade by an approved filter fabric (e.g. non-woven geotextile, with FOS of 75 - 150 µm, Class II).

5.6 Backfill, Perimeter and Basement Floor Drainage

The house basement walls should be backfilled with granular materials placed in 200 mm thick loose lifts that can be compacted with light equipment to avoid damaging the basement walls. Heavy compaction equipment should not be operated along basement walls, especially when the walls are unsupported at their top. The backfill should not be over-compacted to avoid damage to basement walls. Due to its high permeability, the granular soil will permit quick drainage of water to perimeter drains, but in order to reduce the quantity of water percolating into the backfill, the uppermost 0.5 m of the backfill should consist of clayey soils.

Due to their rigidity and unyielding character, basement walls should be designed for the at-rest earth pressure condition calculated in accordance with the Canadian Foundation Engineering Manual, 4th Edition. The following parameters may be adopted:

coefficient of lateral earth pressure = 0.45
bulk unit weight of retained soils = 21 kN/m^3

It is recommended, for basements, a permanent underfloor subdrains and perimeter drainage system consisting of weeping tiles, damp/water-proofing and an underfloor granular drainage layer be installed. In the event that the basement level is below the groundwater table, a

system of permanent sumps and pumps is required, together with water-proofing of basement floor and walls as indicated in Section 5.5. Weeping tiles should be installed along the perimeters of the house and under floor slab to prevent accumulation of water in the backfill and possible dampness of floor slabs. The weeping tile system should be installed to provide a positive discharge to a non-frost susceptible sump or outlet. The weeping tiles should be surrounded by a designed graded granular filter or wrapped with an approved geotextile to prevent migration of fines into the system.

The upper 0.5 m of backfill should consist of a relatively impermeable clayey soil, which will minimize the ingress of surface water. The site should be graded for drainage away from foundations. A minimum cross fall of 3% immediately adjacent to foundation walls is recommended to allow for some settlement and promote good surface drainage.

5.7 Sewer Installation

The following discussion and recommendations are provided for the installation of sewers. It is assumed that the invert level of the underground utilities will not be deeper than 5 m below the existing ground surface.

5.7.1 Trench excavation

Trench excavation should be carried out as per Occupational Health and Safety Act and Regulations for Construction Projects. The native soils are classified in Section 5.4 in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. Within these soils, above the groundwater table, the sides of excavations are expected to be temporarily stable at 1H:1V for Type 2 and Type 3 soils, provided the sewer pipes are installed and backfilled within a reasonable short period of time (i.e. within the day). Depending on the design final grade, the bottom of the excavations may be below groundwater table. Considering that the groundwater level is high (as presented in Table 4.3) at the site, flatter slopes (3H:1V) or trench boxes may be required in the weak surficial layer and / or in the soils located under the groundwater table.

Groundwater seepage within the silty clay/ clayey silt till deposits should be manageable by gravity drainage or filtered sumps and sumps. Excessive groundwater seepage will likely occur in the sandy and silty deposits (if located below groundwater table), from perched water and / or surface water flow, which should be manageable by increased number of filtered sumps and pumps, and / or well points. To prevent disturbance of the soil at the bedding level, the groundwater table must be lowered to at least 0.8 m below the invert of the trench. In no case should the pipes be placed on dilated or disturbed subsoil. It is recommended that test pits be excavated, prior to construction, to evaluate the groundwater conditions at the site and determine the need and the type of dewatering system to be used.

Normal excavation equipment will be suitable for excavating trenches, but allowance should be made for removing boulders and cobbles or other obstacles which may be encountered with the till strata. The terms describing the compactness (very loose, loose, compact, dense, and very dense) of non-cohesive soils and the consistency (soft, firm, stiff, very stiff) of cohesive soils give an indication of the effort needed for excavation. If the excavation is extended into hard / very dense soils, additional effort will be required (i.e., excavators with rippers, hydraulic impact hammers, etc.). The excavation and dewatering requirements are also discussed in Section 5.4.

5.7.2 Bedding

Based on the investigation results, the subgrade likely comprises stiff to hard silty clay / clayey silt till and / or compact to very dense native silty/sandy soils, which will provide adequate support for the sewer pipes and allow the use of normal Class 'B' Type bedding (i.e., compacted granular bedding material - OPSD-802). The recommended minimum thickness of granular bedding below the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered.

5.7.3 Backfill

Based on visual and tactile examination of the soil samples, the on-site excavated native soils may generally be re-used as backfill in service trenches provided that their moisture contents at the time of construction are at or near optimum. The backfill should be placed in maximum 200 mm thick layers at or near (± 2 %) their optimum moisture content, and each layer should be compacted to at least 95 % Standard Proctor Maximum Dry Density. This value should be increased to at least 98 % within 0.6 m of the road subgrade surface.

The excavated soils may require reconditioning (e.g., drying) prior to reuse. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc., should not be used for backfilling. The compaction requirements are also discussed in Section 5.3 (Engineered Fill).

5.8 Pavement Thickness

5.8.1 Pavement Structure

The predominant subgrade at the site generally consisted of silty clay / clayey silt till or silt or silty sand/sandy silt which are frost susceptible. Using good engineering and construction practice, the following minimum pavement structure could be used (Table 5.2). The pavement thickness and materials may be revised according to local standards.

Table 5.2 - Pavement Thickness

Pavement Structure	Compaction	Internal Residential (mm)	Residential Collector (mm)
HL-3 Asphaltic Concrete HL-8 Asphaltic Concrete	92 % Marshall Maximum Relative Density	40 75	50 100
20 mm Crusher Run Limestone	100 %	150	150
50 mm Crusher Run Limestone	100 %	300	450

Note: HL-3 and HL-8 asphaltic concrete to conform to Ministry of Transportation's Number SP110F12.

For longevity of the pavement, the roadbed should be well drained at all times. It is recommended that full-length perforated sub-drain pipes of 150 mm diameter be installed along both sides of the road, below the roadbed level, and connected to proper outlets, to provide effective drainage. The sub-drain pipes should be surrounded by 20 mm size clear stone drainage zone of minimum 150 mm thickness, which should have suitable non-woven geotextile wraparound to minimize infiltration of fines in pipes which would reduce their effectiveness. The granular materials should be compacted as per American Society for Testing and Material D698. The placing, spreading and rolling of the asphalt should be in accordance with Ontario Provincial Standard Specifications Form 310, or equivalent.

Construction traffic over exposed subgrade materials should be minimized, and temporary construction hauling routes should be established. If these routes coincide with future paved areas, adequately reinforced haul roads (increased thickness of granular base, geo-fabrics, etc.) should be constructed to reduce disturbance to the subgrade soils. These provisions are particularly important if the construction is scheduled during wet and cold seasons.

5.8.2 Construction Comments

In order to provide a durable pavement structure, the following pavement construction method is recommended.

The subgrade should be adequately prepared to receive the sub-base course. Disturbed and wet subgrade materials should be removed and the top of the subgrade should then be inspected and approved, by proof-rolling, by qualified geotechnical personnel. Cavities created by the removal of unsuitable materials should be backfilled with approved, inorganic fill materials similar to the existing subgrade material. All new fill should be placed in maximum 200 mm loose lifts within $\pm$ 2 % of its optimum moisture content, and each lift compacted with suitable equipment to minimum 95 % Standard Proctor Maximum Dry Density, before placing the next lift.

The uppermost zones of the roadfill, within 600 mm of the roadbed, should be compacted to minimum 98 % Standard Proctor Maximum Dry Density. If construction of the roadfill is carried out in wet weather, the thickness of the sub-base course should be increased. The existing inorganic native material on site can be re-used to raise the grade beneath the proposed pavement, provided it is not contaminated with the overlying topsoil.

Special attention should be paid to proper grading of the subgrade surface. Depressions and undulations should be eliminated and, to permit quick drainage, the subgrade surface should be sloped towards ditches, sub-drains and/or catch-basins.

It is recommended that a programme of geotechnical/material inspection and testing be carried out during the construction phase of the project to confirm that the conditions exposed in the excavations are consistent with those encountered in the boreholes and the design assumptions, and to confirm that the various project specifications and materials requirements are being met.

5.9 Soil Corrosivity Analysis

To assess the soil aggressiveness to concrete and embedded metal features, two (2) soil samples were submitted to Maxxam Analytics Laboratory in Mississauga and tested for pH, soluble chloride, sulphate, electrical conductivity, and resistivity determinations.

Summarized results are provided in Table 5.3 with full results and Certificate of Analyses presented in Appendix B.

Table 5.3 - Results of Soil Corrosivity Analysis

Sample ID	Depth (m)	pH	Electrical Conductivity (µmho/cm)	Resistivity (ohm-cm)	Soluble Sulphate (µg/g)
BH 1 / SS 2	1.5 – 2.0	7.6	137	7300	<20
BH 8 / SS 2	1.5 – 2.0	7.8	93	11000	<20

The measured resistivity values of soil were 7300 ohm-cm in Borehole BH 1 and 11000 ohm-cm in Borehole BH 8. Therefore, the degree of corrosivity should be considered as "mild" for exposed metallic structures. This is based on a comparison of the test results to literature references (J.D. Palmer, Soil Resistivity Measurement and Analysis, Materials Performance, Volume 13, 1974).

The measured water soluble sulphate in soil was less than 20 µg/g. In accordance with Table 3 of CSA A23.1-09, any soil with the sulphate content of less than 0.1 % (i.e., 1000 ppm or µg/g) is not considered aggressive to concrete.

Therefore, in accordance with Table 6 of CSA A23.1-09, Type GU Portland cement may be used for concrete. The corrosivity should be assessed by a corrosivity expert.

It should be noted that soil and groundwater conditions across the site may vary and further chemical testing should be carried out if deemed necessary. In addition, chemical testing of the excavated and/or relocated soils should be carried out at a minimum frequency to confirm the quality of the soils.

5.10 Earthquake Considerations

In conformance with the criteria in Table 4.1.8.4A, Part 4, Division B of the 2006 Building Code (Ontario), the project site may be classified as Site Class "D - Stiff Soil" if the proposed foundations are founded in competent native deposits.

The four values of the spectral response acceleration, Sa (T), for different periods and the Peak Ground Acceleration (PGA) can be obtained from Table C-2 in Appendix C, Division B of the National Building Code (2005). The design values of Fa and Fv for the project site should be determined in accordance with Table 4.1.8.4 B and C in Division of the 2006 Building Code (Ontario).

5.11 Storm Water Management and Quality Pond

According to the draft plan (Drawing No. SP1 dated September 2010), issued by Mainline Planning Services Inc. and provided to AMEC by Greenvalley/TSI, a water management and quality pond (SWMP) is planned at the west end of the Site, as shown in Figure No. 2.

Based on Boreholes BH 14 and BH 13 which were advanced within the approximate footprint of the proposed SWMP, the subsurface soil conditions consisted of native silty clay till deposit extended to 3.0 m to 3.5 m depth underlain by silty sand/sandy silt deposits. The installed monitoring wells in both boreholes were dry on 25 April 2012.

The detailed design of the proposed SWMP is yet to be finalized. The following general comments are provided to assist in the design of the pond.

Based on subsurface soil conditions encountered, it should be feasible to construct the storm water management facility at the location intended. It is anticipated that the entire footprint of the pond area will require cut to achieve the desired pond base grade. The exact depth of cut is not known.

The borehole information indicates that the pond base and side slopes are expected to predominantly consist of silty clay till, if the pond bottom is required to be low permeability. The pond slopes and base must be inspected by a geotechnical engineer to assess the exposed soil conditions. Impermeable liner may not be required on the bottom and side slopes in order to retain water based on Boreholes BH 14 and BH 13 information, if both pond walls and bottom are in clayey soils. However, silty sand and sandy silt deposits were encountered in Boreholes BH 13 and 14 below 3.0 m to 3.5 m depths. The silty sand/sandy silt deposits were also encountered in other boreholes drilled across the site. Therefore, should the pond's base be deeper than 3.0 m depth or if during excavation, silty sand and / or sandy silt are found exposed, an impermeable liner (or similar) would be required. The liner may consist of a compacted clay liner and / or a geosynthetic liner. The side slopes and the bottom surface of the pond should be protected against erosion by using rip-rap, crushed stone, vegetative cover, etc. A side slope in the order of 5H:1V or flatter may be required for the portion of the pond that will be under water.

Conventional excavation is anticipated for pond construction. After completing the excavation of the pond, the exposed subgrade should be inspected by the geotechnical engineer. Any detrimental materials including organic matters, if encountered, should be sub-excavated and replaced with Engineered Fill constructed as per Section 5.3. The subgrade preparation should be carried out under full-time inspection of a qualified geotechnical engineer. The excavation and the dewatering requirements are as discussed in Section 5.4.

The geotechnical aspects (including the assessment of slope stability) of the proposed SWMP can better be assessed once the details of the pond have been finalized. Additional geotechnical investigation may be required.

6.0 CLOSURE

The sub-soil information and recommendations contained in this report should be used solely for the purpose of geotechnical assessment of this site.

It is recommended that AMEC be retained to review the sub-soil information and recommendations for this specific applicability, once the details of the development are available and prior to the final design stage of the project. Additional borehole investigation and analyses may be required to fulfill the final design requirements.

The attached Report Limitations is an integral part of this report.

This report was prepared by Wissam Farah, M.Eng., P.Eng., PMP and reviewed by Prapote Boonsinsuk, Ph.D., P.Eng.

Sincerely,

AMEC Environment & Infrastructure,
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REPORT LIMITATIONS

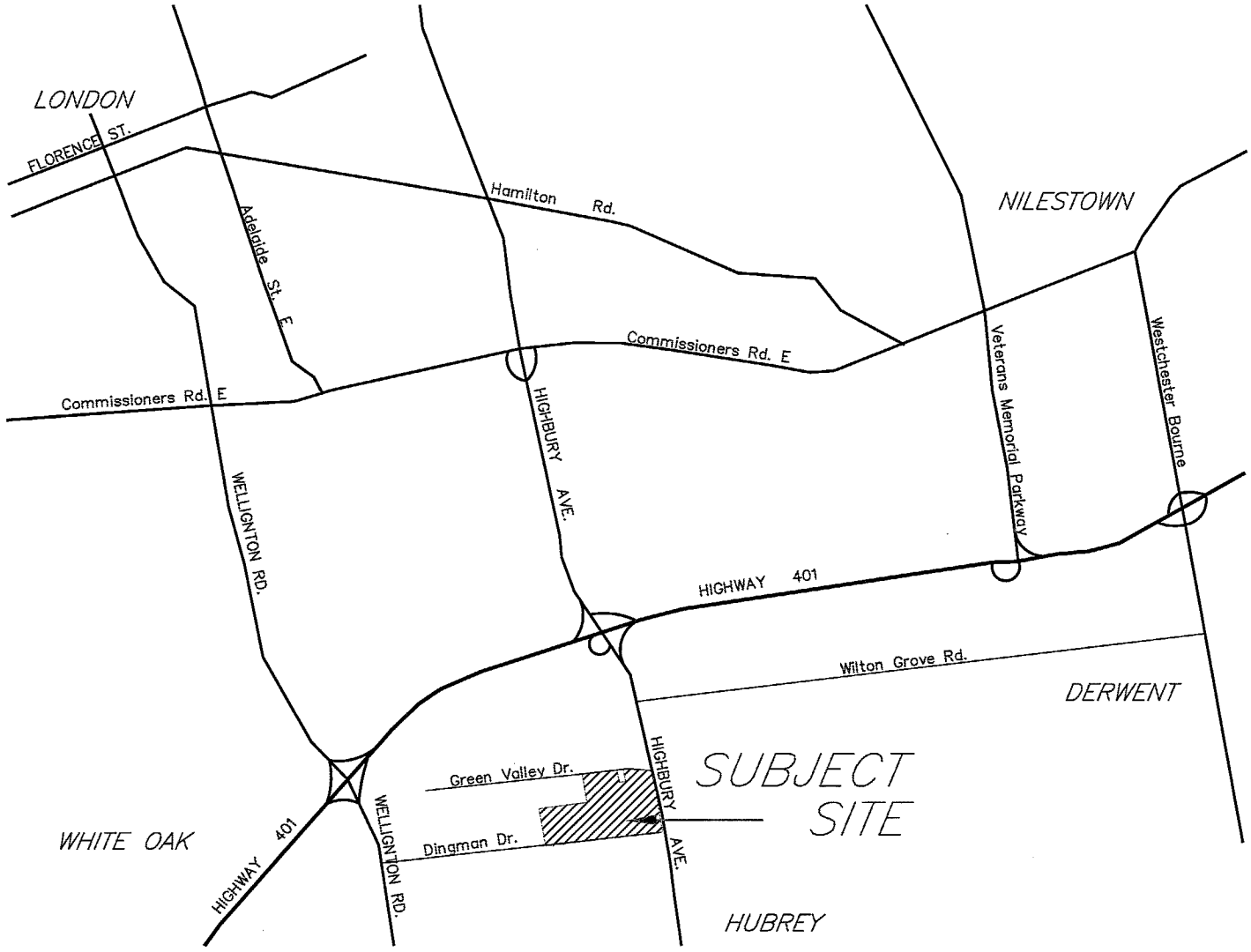
The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that AMEC be retained during the final design stage to verify that the design is consistent with AMEC recommendations, and that assumptions made in our analysis are valid.

The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. AMEC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



CLIENT LOGO	CLIENT GREENVALLEY ESTATES CANADA INC./ TSI INTERNATIONAL-GRANDTAG A2A GE II INC.	DWN BY: KW CHK'D BY: GB	TITLE SITE LOCATION PLAN	REV. NO.: A DATE: MAY 2012
AMEC Environment & Infrastructure, a Division of AMEC Americas Limited 104 Crockford Blvd, Scarborough, Ontario, M1R 3C3	amec	DATUM: - PROJECTION: - SCALE: N.T.S.	PROJECT PRELIMINARY GEOTECHNICAL INVESTIGATION PROPOSED GE I & GE II SUBDIVISION DEVELOPMENT Dingman Drive and Highbury Avenue South, London, Ontario	PROJECT NO: TT123014 FIGURE No. 1

Z:\Projects\2012\TT123014_Mainline_Dingman Drive Development, London\Drawings\TT123014 – Borehole Location Plan_Fig2.dwg – Site Map – May. 17, 2012 10:22am – kent.wong

APPENDIX A

EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

SOIL LITHOLOGY

Elevation and Depth

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

Lithology Plot

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

Description

This column gives a description of the soil stratums, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *Modified Unified Soil Classification System.*

The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows *(Ref. Canadian Foundation Engineering Manual)*:

Compactness of Cohesionless Soils	SPT N-Value
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

Consistency of Cohesive Soils	Undrained Shear Strength kPa	Undrained Shear Strength psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very stiff	100 to 200	2000 to 4000
Hard	Over 200	Over 4000

Soil Sampling

Sample types are abbreviated as follows:

SS	Split Spoon	TW	Thin Wall Open (Pushed)	RC	Rock Core
AS	Auger Sample	TP	Thin Wall Piston (Pushed)	WS	Washed Sample

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

Field and Laboratory Testing

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

Instrumentation Installation

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section. Water levels, if measured during fieldwork, are also plotted. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors.

Comments

This column is used to describe non-standard situations or notes of interest.

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MODIFIED * UNIFIED CLASSIFICATION SYSTEM FOR SOILS

*The soil of each stratum is described using the Unified Soil Classification System (Technical Memorandum 3-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S Army, Vol 1 March 1953,) modified slightly so that an inorganic clay of "medium plasticity" is recognized.

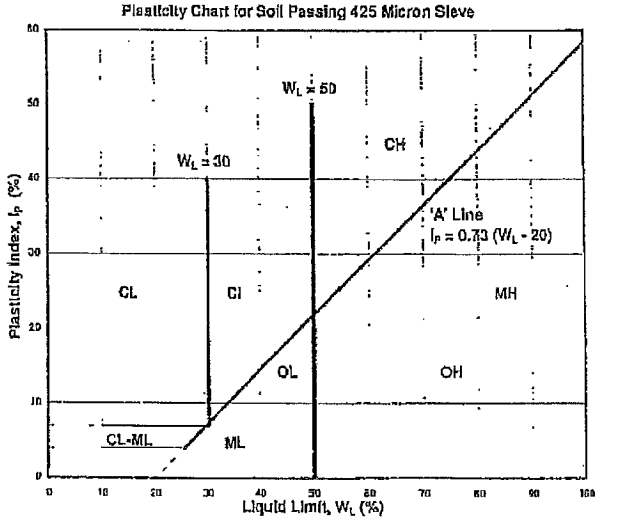
MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ = 1 to 3
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM	SILTY GRAVELS, GRAVEL-SAND- SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ = 1 to 3
			SP	POORLY GRADED GRAVELS, GRAVEL- SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		W_L < 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < W_L < 50%	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L < 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	W_L < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		W_L < 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGH ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

SOIL COMPONENTS

FRACTION	U.S STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS		
		PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	COARSE	75 mm	19 mm	35-50	AND
	FINE	19 mm	4.75 mm	20-35	VERY
SAND	COARSE	4.75 mm	2.00 mm	10-20	SOME
	MEDIUM	2.00 mm	425 µm	1-10	TRACE
	FINE	425 µm	75 µm		
FINES (SILT OR CLAY BASED ON PLASTICITY)		75 µm			

OVERSIZED MATERIAL

ROUNDED OR SUBROUNDED: COBBLES 75 mm TO 300 mm BOULDERS > 300 mm	NOT ROUNDED: ROCK FRAGMENTS > 75 mm ROCKS > 0.76 CUBIC METRE IN VOLUME



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Note 1: Soils are classified and described according to their engineering properties and behaviour.

Note 2: The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual (3rd Edition, Canadian Geotechnical Society, 1992.)

Rev 5 Nov. '06

RECORD OF BOREHOLE No. BH1 Co-Ord. E 485807, N 4752248

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Project Number: TT123014
Drilling Location: See Figure 1
Logged by: SD

Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Drilling Method: 100 mm Solid Stem Auger
Compiled by: SS

Project Name: Proposed GE I and GE II Subdivision Development
Drilling Machine: Track Mounted Drill
Reviewed by: PB

Project Location: Dingman Drive & Highbury Avenue South, London ON.
Date Started: Apr 24, 12
Date Completed: Apr 24, 12
Revision No.: 0, 5/24/12

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 268.8 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; 20 40 60 80	Atterberg Limits: W_P W W_L; Plastic Liquid; ✳ p.p (TSF) ❖ Unit Weight (KN/CM) ○ Moisture Content (%) * Undrained Shear Strength (kPa); 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL	brown										
	268.5											
	SILT, trace clay	0.3										
	stiff	brown						268				
	267.7		SS	1	50	10	1		○	○16		
	SILTY CLAY TILL	1.1										
	stiff to very stiff	brown										
			SS	2	100	18		267	○	○20		
	266.7						2					
	SILTY SAND	2.1										
	compact	brown	SS	3	80	10			○	○12		
								266				
							3					
			SS	4	100	24			○	○20		
								265				
	dense		SS	5	100	33	4		○	○24		
	264.4											
	SAND, trace silt	4.4										
	dense	brown	SS	6	100	32		264	○	○23		
							5					
								263				
							6					
	some silt		SS	7	100	35			○	○20		
	262.2											
	END OF BOREHOLE	6.6						262				
							7					
								261				
							8					
								260				
							9					
								259				
							10					

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▽ Groundwater depth on completion of drilling: 4.3.

■ Cave in depth recorded on completion of drilling: 4.3.

Scale 1: 45

RECORD OF BOREHOLE No. BH2 Co-Ord. E 485454, N 4752228

amec

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.
Drilling Location: See Figure 1
Drilling Method: 200 mm Hollow Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 25, 12 Date Completed: Apr 25, 12
Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 264.2 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	PenetrationTesting ○ SPT ● DCPT MTO Vane* △ Intact ▲ Remould Nilcon Vane* ◇ Intact ◆ Remould 20 40 60 80	Atterberg Limits W_P W W_L Plastic Liquid ✳ p.p (TSF) ❖ Unit Weight (KN/CM) ○ Moisture Content (%) * Undrained Shear Strength (kPa) 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL brown 263.9											
	SILT, trace sand 0.3 brown 263.6											
	SILTY CLAY TILL, some sand and gravel 0.6											
	very stiff brown		SS	1	100	22	1	264	○	16		0 - 2.4 m RISER1-BENTONITE 2.4 - 3.0 m RISER1-SAND 3.0 - 6.1 m SCREEN
								263 ▼				
			SS	2	100	28	2	262	○	17		
	hard grey		SS	3	100	36			○	15		
	very stiff grey		SS	4	100	24	3	261	○	16		
			SS	5	100	17	4	260	○	20		
			SS	6	100	18	5	259	○	18		
			SS	7	100	18	6	258	○	19		
	257.6											
	END OF BOREHOLE 6.6						7	257				
	Groundwater level on: 9 May, 2012 was 1.22 m depth 23 May, 2012 was 1.40 m depth						8	256				
							9	255				
							10					

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▽ Groundwater depth on completion of drilling: Dry.

▼ Groundwater depth observed on 5/9/2012 at a depth of: 1.2.

Scale 1: 45

RECORD OF BOREHOLE No. BH3 Co-Ord. E 485221, N 4752235

amec

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.
Drilling Location: See Figure 1
Drilling Method: 100 mm Solid Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 25, 12
Date Completed: Apr 25, 12
Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 266.5 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	PenetrationTesting ○ SPT ● DCPT MTO Vane* △ Intact ▲ Remould Nilcon Vane* ◇ Intact ◆ Remould 20 40 60 80	Atterberg Limits W_P W W_L Plastic Liquid ✳ p.p (TSF) ❖ Unit Weight (KN/CM) ○ Moisture Content (%) * Undrained Shear Strength (kPa) 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL brown	266.2					0	266				
	SANDY SILT 0.3 loose brown		SS	1	80	4	1		○	20		
								265				
		264.7	SS	2	60	7			○	17		
	Sandy SILTY CLAY TILL 1.8 firm to very stiff brown						2					
			SS	3	50	16		264	○	12		
	grey						3					
			SS	4	100	26			○	11		
		262.8						263				
	SILTY CLAY TILL, some sand and gravel 3.7		SS	5	40	21	4		○	19		
	very stiff							262				
			SS	6	100	22	5		○	22		
		260.7						261				
	SILTY SAND 5.8 dense grey						6					
			SS	7	20	35		260	○	22		% Gravel = 0 % Sand = 64 % Silt and clay = 36
		259.9					7					
	END OF BOREHOLE 6.6							259				
							8	258				
							9	257				
							10					

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▽ Groundwater depth on completion of drilling: 1.5.

Scale 1: 45

RECORD OF BOREHOLE No. BH4 Co-Ord. E 485264, N 4751981

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.
Drilling Location: See Figure 1
Drilling Method: 100 mm Solid Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 25, 12 Date Completed: Apr 25, 12
Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 263.0 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (O SPT, ● DCPT); MTO Vane* (△ Intact, ▲ Remould); Nilcon Vane* (◇ Intact, ◆ Remould); 20 40 60 80	LAB TESTING: Atterberg Limits (W_P W W_L Plastic Liquid); ✳ p.p (TSF); ❖ Unit Weight (KN/CM); ○ Moisture Content (%); * Undrained Shear Strength (kPa); 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL brown 262.8										
	SILTY CLAY, some sand and gravel 0.2										
	very stiff brown	SS	1	70	18	1	262		16		
		SS	2	100	26	2	261		15		
	greyish brown	SS	3	70	25				18		
	grey	SS	4	100	18	3	260		18		
		SS	5	100	19	4	259		19		
		SS	6	100	21	5	258		17		
	256.4	SS	7	100	21	6	257		18		
	END OF BOREHOLE 6.6					7	256				
						8	255				
						9	254				
						10	253				

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▽ Groundwater depth on completion of drilling: Dry.

RECORD OF BOREHOLE No. BH5 Co-Ord. E 485470, N 4752002

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.

Drilling Location: See Figure 1
Drilling Method: 100 mm Solid Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 25, 12 Date Completed: Apr 25, 12

Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; 20 40 60 80	Atterberg Limits: W_P W W_L; Plastic Liquid; ✳ p.p (TSF); ❖ Unit Weight (KN/CM); ○ Moisture Content (%); * Undrained Shear Strength (kPa); 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Geodetic Ground Surface Elevation: 262.9 m											
	Silty TOPSOIL	brown										
	262.6											
	CLAYEY SILT TILL	0.3										
	firm	brown	SS	1	100	8	1	262	○	14		
	261.4											
	Sandy CLAYEY SILT TILL	1.5										
	stiff		SS	2	100	15	2	261	○	10		
	260.6											
	SILTY CLAY TILL	2.3										
	very stiff	grey	SS	3	60	24	3	260	○	14		
			SS	4	100	20	4	259	○	17		
			SS	5	100	16	5	258	○	18		
			SS	6	100	19	6	257	○	19		
	hard		SS	7	100	37	7	256	○	19		
	256.3											
	END OF BOREHOLE	6.6					8	255				
							9	254				
							10	253				

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▽ Groundwater depth on completion of drilling: Dry.

RECORD OF BOREHOLE No. BH6 Co-Ord. E 485847, N 4752073

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Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.

Drilling Location: See Figure 1
Drilling Method: 100 mm Solid Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 24, 12 Date Completed: Apr 24, 12

Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 267.7 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (SPT / DCPT), MTO Vane* (Intact / Remould), Nilcon Vane* (Intact / Remould)	LAB TESTING: Atterberg Limits (W_P, W, W_L; Plastic, Liquid); p.p (TSF); Unit Weight (KN/CM); Moisture Content (%); * Undrained Shear Strength (kPa)	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL, brown — 267.5										
	SILTY CLAY — 0.2										
	brown — 266.9										
	SAND, some silt — 0.8										
	compact, light brown	SS	1	100	15	1	267		17		
		SS	2	100	26	2	266		14		% Gravel = 0 % Sand = 84 % Silt and clay = 16
	dense	SS	3	100	38	3	265		21		
		SS	4	100	38	4	264		19		
		SS	5	100	37	5	263		23		
	trace silt, compact, brown	SS	6	100	25	6	262		24		
	262.5 — SILT, trace sand — 5.2										
	compact to dense, light brown	SS	7	100	32	7	261		24		
	261.1 — END OF BOREHOLE — 6.6					8	260				
						9	259				
						10	258				

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▽ Groundwater depth on completion of drilling: 3.4.

Cave in depth recorded on completion of drilling: 3.4.

Scale 1: 45

RECORD OF BOREHOLE No. BH7 Co-Ord. E 485926, N 4751793

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.
Drilling Location: See Figure 1
Drilling Method: 200 mm Hollow Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 24, 12 Date Completed: Apr 24, 12
Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 262.9 m)		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (SPT / DCPT), MTO Vane* (Intact / Remould), Nilcon Vane* (Intact / Remould)	LAB TESTING: Atterberg Limits (W_P, W, W_L; Plastic, Liquid); p.p (TSF); Unit Weight (KN/CM); Moisture Content (%); Undrained Shear Strength (kPa)	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL	brown										
		262.6										
	SAND AND SILT	0.3										
	loose	brown										
			SS	1	20	5	1	262		26		0 - 1.5 m RISER1-BENTONITE 1.5 - 3.0 m RISER1-SAND 3.0 - 6.1 m SCREEN
		261.7										
	SAND, trace gravel and silt	1.2										
	loose	brown										
			SS	2	20	9	2	261		16		
	trace silt											
	compact		SS	3	100	19				26		
							3	260				
			SS	4	100	18				26		
		259.4										
	SILT, trace sand	3.5										
	compact	light brown										
			SS	5	100	20	4	259		26		
			SS	6	100	16				26		
		257.9					5	258				
	SILTY SAND	5.0										
	compact	light brown										
							6	257				
			SS	7	100	13				24		
		256.3										
	END OF BOREHOLE	6.6					7	256				
	Groundwater level on: 9 May, 2012 was 1.34 m depth 23 May, 2012 was 1.41 m depth											
							8	255				
							9	254				
							10	253				

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▽ Groundwater depth on completion of drilling: 1.5.

▼ Groundwater depth observed on 5/9/2012 at a depth of: 1.3.

RECORD OF BOREHOLE No. BH8 Co-Ord. E 485685, N 4751886

amec

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.
Drilling Location: See Figure 1
Drilling Method: 200 mm Hollow Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 25, 12 Date Completed: Apr 25, 12
Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 264.3 m)		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (○ SPT ● DCPT); MTO Vane* (△ Intact ▲ Remould); Nilcon Vane* (◇ Intact ◆ Remould); 20 40 60 80	LAB TESTING: Atterberg Limits (W_P W W_L Plastic Liquid); ✳ p.p (TSF) ❖ Unit Weight (KN/CM) ○ Moisture Content (%) * Undrained Shear Strength (kPa); 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	TOPSOIL	black					0	264				
	264.0											
	SILT, trace sand	0.3										
	loose	brown	SS	1	70	9	1	263	○	19		
	262.9											
	SAND, trace gravel and silt	1.4										
	dense	brown	SS	2	100	32	2	262	○	11		
	compact		SS	3	100	19			○	14		
	261.3						3	261				
	SILTY CLAY TILL	3.0	SS	4	20	18			○	13		
	very stiff		SS	5	100	13	4	260	○	23		
	259.9											
	SAND, some silt	4.4										
	compact	light brown	SS	6	100	22	5	259	○	23		
	258.2						6	258				
	SILTY SAND	6.1										% Gravel = 0
	compact	light brown	SS	7	100	25			○	21		% Sand = 57
	257.7											% Silt and clay = 43
	END OF BOREHOLE	6.6					7	257				
							8	256				
							9	255				
							10					

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▽ Groundwater depth on completion of drilling: 2.1.

Cave in depth recorded on completion of drilling: 2.1.

Scale 1: 45

RECORD OF BOREHOLE No. BH9 Co-Ord. E 485603, N 4751685

amec

Project Number:	TT123014	Drilling Location:	See Figure 1	Logged by:	SD
Project Client:	Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.	Drilling Method:	100 mm Solid Stem Auger	Compiled by:	SS
Project Name:	Proposed GE I and GE II Subdivision Development	Drilling Machine:	Track Mounted Drill	Reviewed by:	PB
Project Location:	Dingman Drive & Highbury Avenue South, London ON.	Date Started:	Apr 24, 12	Date Completed: Apr 24, 12	Revision No.: 0, 5/24/12

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 262.8 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	PenetrationTesting ○ SPT ● DCPT MTO Vane* △ Intact ▲ Remould Nilcon Vane* ◇ Intact ◆ Remould 20 40 60 80	Atterberg Limits W_P W W_L Plastic Liquid ✳ p.p (TSF) ❖ Unit Weight (KN/CM) ○ Moisture Content (%) * Undrained Shear Strength (kPa) 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	TOPSOIL, grass dark brown	262.6										
	SILT, some sand	0.2										
	compact brown		SS	1	25	22	1	262	○	24		
		261.4										
	SAND, trace silt	1.4										
	compact brown		SS	2	100	29	2	261	○	23		
		260.7										
	SANDY SILT	2.1										
	compact greyish brown		SS	3	100	27	3	260	○	19		
		259.8										
	SAND, some silt	3.0										
	dense light brown		SS	4	100	30	4	259	○	19		
			SS	5	100	32	5	258	○	19		
			SS	6	100	35	6	257	○	21		
		256.2	SS	7	100	43	7	256	○	17		
	END OF BOREHOLE	6.6					8	255				
							9	254				
							10	253				

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▽ Groundwater depth on completion of drilling: 1.4.

▪ Cave in depth recorded on completion of drilling: 1.4.

RECORD OF BOREHOLE No. BH10 Co-Ord. E 485303, N 4751646

amec

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.

Drilling Location: See Figure 1
Drilling Method: 200 mm Hollow Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 24, 12 Date Completed: Apr 24, 12

Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 263.3 m)	Elevation	Depth	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
	silty TOPSOIL, brown	263.1	0.2				
	SILT, trace clay, compact, brown			SS	1	50	12
	CLAYEY SILT TILL, very stiff, grey	261.9	1.4	SS	2	100	19
	SILTY CLAY TILL, very stiff, grey	261.2	2.1	SS	3	100	19
				SS	4	100	20
				SS	5	100	20
				SS	6	100	17
	stiff	256.7	6.6	SS	7	100	14
	END OF BOREHOLE						

Groundwater level on:
9 May, 2012 was 6.01 m depth
23 May, 2012 was 5.54 m depth

FIELD TESTING: Penetration Testing — ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; 20 40 60 80

LAB TESTING: Atterberg Limits W_P W W_L — Plastic — Liquid; ✳ p.p (TSF) ❖ Unit Weight (KN/CM) ○ Moisture Content (%); * Undrained Shear Strength (kPa); 20 40 60 80

INSTRUMENTATION INSTALLATION

0 - 2.7 m RISER1-BENTONITE
2.7 - 3.0 m RISER1-SAND
3.0 - 6.1 m SCREEN

COMMENTS

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▽ Groundwater depth on completion of drilling: Dry.

▼ Groundwater depth observed on 5/9/2012 at a depth of: 6.0.

Scale 1: 45

RECORD OF BOREHOLE No. BH11 Co-Ord. E 485226, N 4751796

amec

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.

Drilling Location: See Figure 1
Drilling Method: 100 mm Solid Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 24, 12 Date Completed: Apr 24, 12

Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 264.3 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)
	Silty TOPSOIL brown 264.1						
	SILT 0.2 brown 263.7						
	SILTY CLAY TILL 0.6 very stiff brown	SS	1	100	16	1	263
		SS	2	100	24	2	262
	SILT, some sand 262.2 2.1 very dense to dense light brown	SS	3	100	51	3	261
		SS	4	100	49	4	260
	SILTY SAND 260.6 3.7 dense light brown	SS	5	100	34	5	259
	SANDY SILT 259.9 4.4 dense light brown	SS	6	100	38	6	258
	SILT, trace sand 258.2 6.1 dense grey 257.7	SS	7	100	48	7	257
	END OF BOREHOLE 6.6					8	256
						9	255
						10	

FIELD TESTING: Penetration Testing — SPT, DCPT; MTO Vane* (Intact, Remould); Nilcon Vane* (Intact, Remould); 20 40 60 80

LAB TESTING: Atterberg Limits — W_P W W_L; Plastic Liquid; p.p (TSF); Unit Weight (KN/CM); Moisture Content (%); * Undrained Shear Strength (kPa); 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS

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▽ Groundwater depth on completion of drilling: 3.7.

▪ Cave in depth recorded on completion of drilling: 3.7.

RECORD OF BOREHOLE No. BH12 Co-Ord. E 485227, N 4751796

amec

Project Number: TT123014
Drilling Location: See Figure 1
Logged by: SD

Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Drilling Method: 100 mm Solid Stem Auger
Compiled by: SS

Project Name: Proposed GE I and GE II Subdivision Development
Drilling Machine: Track Mounted Drill
Reviewed by: PB

Project Location: Dingman Drive & Highbury Avenue South, London ON.
Date Started: Apr 24, 12
Date Completed: Apr 24, 12
Revision No.: 0, 5/24/12

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 262.9 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; 20 40 60 80	Atterberg Limits: W_P W W_L; Plastic Liquid; ✳ p.p (TSF); ❖ Unit Weight (KN/CM); ○ Moisture Content (%); * Undrained Shear Strength (kPa); 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL brown 262.7										
	SILTY CLAY TILL 0.2 very stiff brown										
		SS	1	100	18	1	262	○	○16		
		SS	2	100	20	2	261	○	○15		
		SS	3	100	26	3	260	○	○17		
		SS	4	100	27			○	○22		
	greyish brown	SS	5	100	22	4	259	○	○17		
	grey	SS	6	100	17	5	258	○	○18		
		SS	7	100	18	6	257	○	○15		
	256.3					7	256				
	END OF BOREHOLE 6.6					8	255				
						9	254				
						10	253				

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▽ Groundwater depth on completion of drilling: Dry.

RECORD OF BOREHOLE No. BH13 Co-Ord. E 485029, N 4751841

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.

Drilling Location: See Figure 1
Drilling Method: 200 mm Hollow Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 25, 12 Date Completed: Apr 25, 12

Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 262.9 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; 20 40 60 80	Atterberg Limits: W_P W W_L; Plastic Liquid; ✳ p.p (TSF); ❖ Unit Weight (KN/CM); ○ Moisture Content (%); * Undrained Shear Strength (kPa); 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL	brown										
	262.6											
	SILTY CLAY TILL, some sand and gravel	0.3										
	stiff	brown	SS	1	100	11	1	262	○	14		0 - 2.4 m RISER1-BENTONITE 2.4 - 2.7 m RISER1-SAND 2.7 - 5.8 m SCREEN
	very stiff		SS	2	100	20	2	261	○	15		
	hard	grey	SS	3	100	32	3	260	○	14		
	very stiff	grey	SS	4	100	22	▽ ▼		○	19		
	259.4											
	SANDY SILT	3.5										
	dense to compact	grey	SS	5	100	32	4	259	○	21		
	sand lenses compact	grey	SS	6	100	26	5	258	○	21		
	256.8						6	257				
	SILT, trace sand	6.1										
	compact	grey	SS	7	100	14	7	256	○	21		
	256.3											
	END OF BOREHOLE	6.6					8	255				
	Groundwater level on: 9 May, 2012 was 3.83 m depth 23 May, 2012 was 3.79 m depth						9	254				
							10	253				

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▽ Groundwater depth on completion of drilling: 3.5.

▼ Groundwater depth observed on 5/9/2012 at a depth of: 3.8.

RECORD OF BOREHOLE No. BH14 Co-Ord. E 484926, N 4751831

Project Number: TT123014
Project Client: Greenvalley Estates Canada Inc. / TSI International-Grandtag A2A GE II Inc.
Project Name: Proposed GE I and GE II Subdivision Development
Project Location: Dingman Drive & Highbury Avenue South, London ON.

Drilling Location: See Figure 1
Drilling Method: 200 mm Hollow Stem Auger
Drilling Machine: Track Mounted Drill
Date Started: Apr 25, 12 Date Completed: Apr 25, 12

Logged by: SD
Compiled by: SS
Reviewed by: PB
Revision No.: 0, 5/24/12

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 262.5 m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing (SPT / DCPT), MTO Vane* (Intact / Remould), Nilcon Vane* (Intact / Remould)	LAB TESTING: Atterberg Limits (W_P, W, W_L; Plastic; Liquid), p.p (TSF), Unit Weight (KN/CM), Moisture Content (%), Undrained Shear Strength (kPa)	INSTRUMENTATION INSTALLATION	COMMENTS
	Silty TOPSOIL, brown — 262.3					0	262			0 - 2.4 m RISER1-BENTONITE 2.4 - 3.0 m RISER1-SAND 3.0 - 6.1 m SCREEN	
	SILTY CLAY TILL, some sand and gravel — 0.2 stiff, brown	SS	1	100	10	1			17		
	very stiff	SS	2	100	28	2	261		15		
	hard	SS	3	100	35		260		13		
	259.5 SILTY SAND — 3.0 dense to compact, light brown	SS	4	100	31	3	259		22		
		SS	5	100	12	4			19		
	258.1 SILT, trace sand, grey — 257.9						258				
	SILTY CLAY TILL, some sand and gravel — 4.6 stiff, grey	SS	6	100	15	5	257		16		
	255.9	SS	7	80	17	6	256		15		
	END OF BOREHOLE — 6.6 Groundwater level on: 9 May, 2012 was 2.20 m depth 23 May, 2012 was 2.24 m depth					7	255				
						8	254				
						9	253				
						10					

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▽ Groundwater depth on completion of drilling: 3.0.

▼ Groundwater depth observed on 5/9/2012 at a depth of: 2.2.

APPENDIX B

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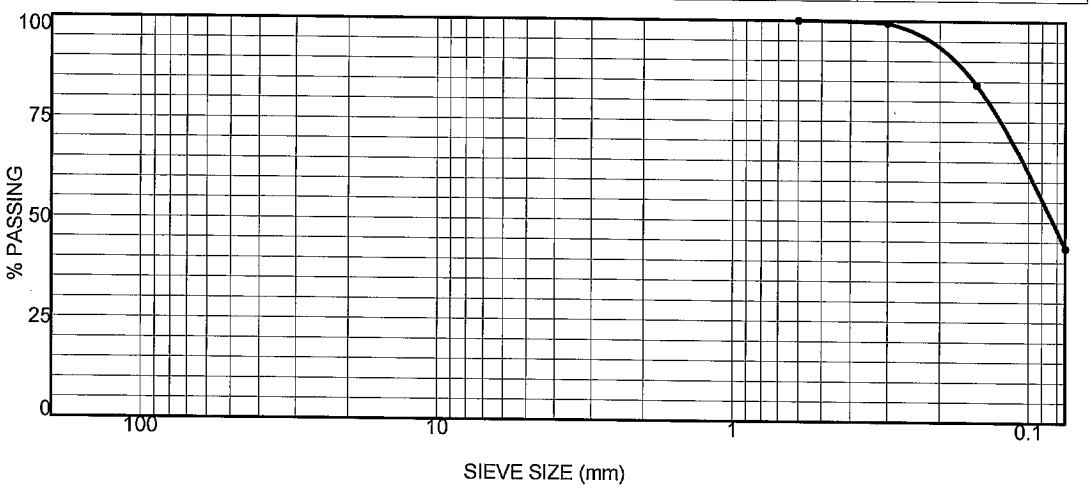
SIEVE ANALYSIS REPORT (No Specs)

LABORATORY TEST INFORMATION

CLIENT:	**Greenvalley Estates Canada Inc.**	JOB NUMBER:	**TT123014**
PROJECT:	**TSI International-Grandtag A2A GE II Inc. New Subdivision Development**	SAMPLE NUMBER:	**BH8-SS7**
LOCATION:	**Highbury Avenue South, London ON.**	DATE SAMPLED:	**April 25, 2012**
SOURCE:	**Borehole Samples**	TESTED BY:	**Sven Dahlberg**

TEST RESULTS

SIEVE	SIZE	PERCENT PASSING	SPECIFICATION
9.5 mm	3/8"		Specs Not Available
4.75 mm	#4		
2.36 mm	#8		
1.18 mm	#16		
0.6 mm	#30	100	
0.3 mm	#50	99.4	
0.15 mm	#100	84.1	
.075 mm	#200	43.5	



REMARKS

AMEC ENVIRONMENT & INFRASTRUCTURE

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5/8/2012

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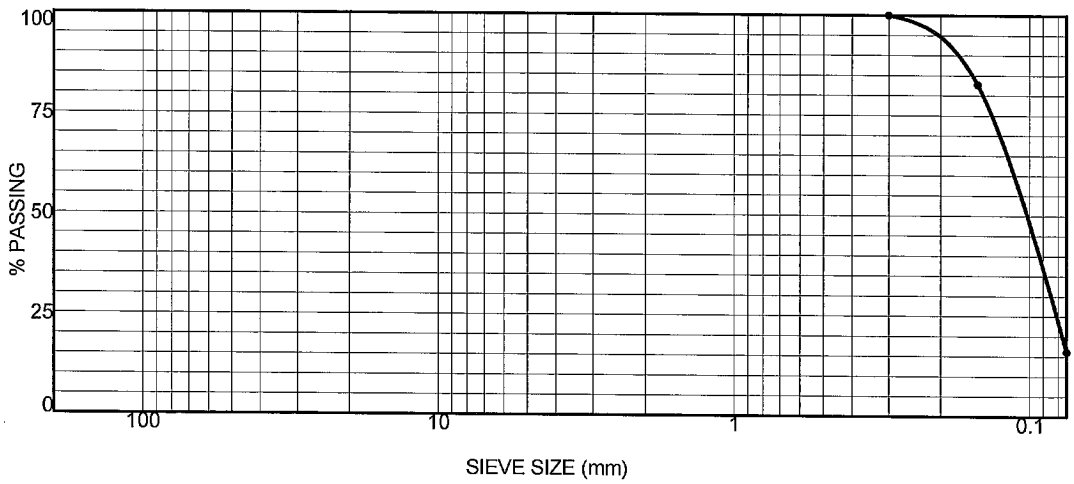
SIEVE ANALYSIS REPORT (No Specs)

LABORATORY TEST INFORMATION

CLIENT:	**Greenvalley Estates Canada Inc.**	JOB NUMBER:	**TT123014**
PROJECT:	**TSI International-Grandtag A2A GE II Inc. New Subdivision Development**	SAMPLE NUMBER:	**BH6-SS2**
LOCATION:	**Highbury Avenue South, London ON.**	DATE SAMPLED:	**April 24, 2012**
SOURCE:	**Borehole Samples**	TESTED BY:	**Sven Dahlberg**

TEST RESULTS

SIEVE	SIZE	PERCENT PASSING	SPECIFICATION
9.5 mm	3/8"		Specs Not Available
4.75 mm	#4		
2.36 mm	#8		
1.18 mm	#16		
0.6 mm	#30		
0.3 mm	#50	100	
0.15 mm	#100	82.7	
.075 mm	#200	16.1	



REMARKS

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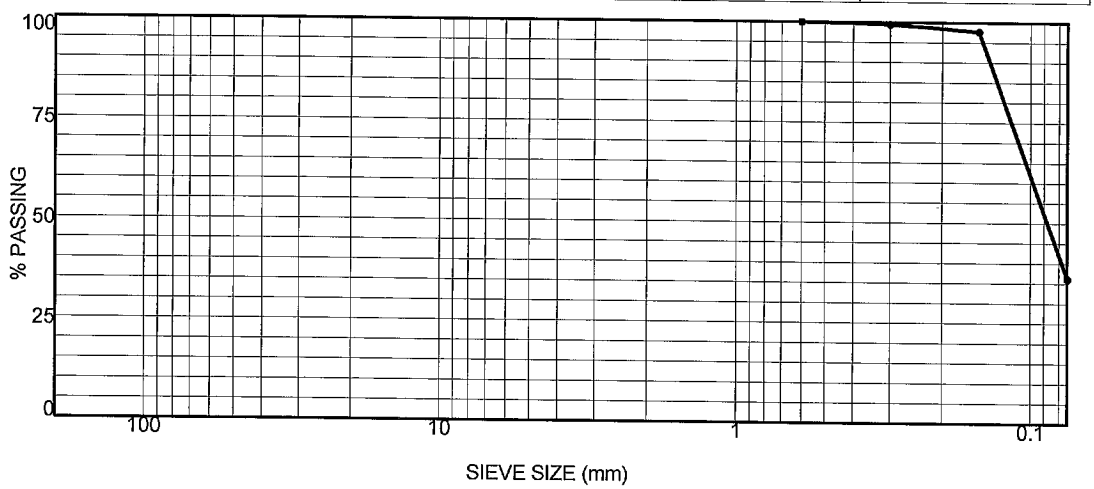
SIEVE ANALYSIS REPORT (No Specs)

LABORATORY TEST INFORMATION

CLIENT:	Greenvalley Estates Canada Inc.	JOB NUMBER:	TT123014
PROJECT:	TSI International-Grandtag A2A GE II Inc. New Subdivision Development	SAMPLE NUMBER:	BH3-SS7
LOCATION:	Highbury Avenue South, London ON.	DATE SAMPLED:	April 25, 2012
SOURCE:	Borehole Samples	TESTED BY:	Sven Dahlberg

TEST RESULTS

SIEVE	SIZE	PERCENT PASSING	SPECIFICATION
9.5 mm	3/8"		Specs Not Available
4.75 mm	#4		
2.36 mm	#8		
1.18 mm	#16		
0.6 mm	#30	100	
0.3 mm	#50	99.4	
0.15 mm	#100	97.7	
.075 mm	#200	36.1	



REMARKS

AMEC ENVIRONMENT & INFRASTRUCTURE

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Phone: (519)681-2400 Fax: (519) 668-1754

5/8/2012

Your Project #: TT123014
Site#: LONDON ON
Site Location: HIGHBURY AVE SOUTH SUBDIVISON LONDON ONTARIO

Attention: Souzan Dabbagh
AMEC Environment & Infrastructure
London - Standing Offer
1940 Oxford St E
Unit 7
London, ON
N5V 4L8

Report Date: 2012/05/15

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B262698
Received: 2012/05/02, 15:48

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Conductivity	2	N/A	2012/05/14	CAM SOP-00414	APHA 2510
Moisture	2	N/A	2012/05/11	CAM SOP-00445	R.Carter,1993
pH CaCl2 EXTRACT	2	2012/05/08	2012/05/08	CAM SOP-00413	SM 4500H+ B
Resistivity of Soil	2	2012/05/03	2012/05/14	CAM SOP-00414	APHA 2510
Sulphate (20:1 Extract)	2	N/A	2012/05/15	CAM SOP-00464	EPA 375.4
Redox Potential (1)	2	2012/05/07	2012/05/14	APHA-SM 2580 B (18th Edition:1992) Mod. & ASTM D1498-76 Mod.	

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons. The extraction date for samples field preserved with methanol for F1 and Volatile Organic Compounds is considered to be the date sampled.

Maxxam Analytics is accredited by SCC (Lab ID 97) for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Sladeview Petrochemical

../2

Maxxam Job #: B262698
Report Date: 2012/05/15

AMEC Environment & Infrastructure
Client Project #: TT123014
Site Location: HIGHBURY AVE SOUTH SUBDIVISON LONDON ONTARIO
Sampler Initials: SD

Encryption Key

Marijane Cruz
15 May 2012 15:29:35 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MARIJANE CRUZ, Project Manager
Email: MCruz@maxxam.ca
Phone# (905) 817-5756

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

Maxxam Job #: B262698
Report Date: 2012/05/15

AMEC Environment & Infrastructure
Client Project #: TT123014
Site Location: HIGHBURY AVE SOUTH SUBDIVISON LONDON ONTARIO
Sampler Initials: SD

RESULTS OF ANALYSES OF SOIL

Maxxam ID		NH8790	NH8791		
Sampling Date		2012/04/24	2012/04/25		
	Units	**BH1-SS2**	**BH8-SS2**	**RDL**	**QC Batch**
Calculated Parameters					
Resistivity	ohm-cm	7300	11000		2838509
Inorganics					
Conductivity	umho/cm	137	93	2	2848699
Moisture	%	15	11	1.0	2847324
Available (CaCl2) pH	pH	7.56	7.82		2841946
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	20	2848613
Subcontracted Analysis					
Redox Potential	mV	+91	+71		2841577

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B262698
Report Date: 2012/05/15

AMEC Environment & Infrastructure
Client Project #: TT123014
Site Location: HIGHBURY AVE SOUTH SUBDIVISON LONDON ONTARIO
Sampler Initials: SD

Test Summary

Maxxam ID NH8790
Sample ID BH1-SS2
Matrix Soil

Collected 2012/04/24
Shipped
Received 2012/05/02

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Conductivity	COND	2848699	N/A	2012/05/14	NEIL DASSANAYAKE
Moisture	BAL	2847324	N/A	2012/05/11	PHILIP MAST
pH CaCl2 EXTRACT		2841946	2012/05/08	2012/05/08	XUANHONG QIU
Resistivity of Soil		2838509	2012/05/14	2012/05/14	EWA PRANJIC
Sulphate (20:1 Extract)	AC/EC	2848613	N/A	2012/05/15	DEONARINE RAMNARINE
Redox Potential	PH	2841577	2012/05/07	2012/05/14	Rick Mastroianni

Maxxam ID NH8791
Sample ID BH8-SS2
Matrix Soil

Collected 2012/04/25
Shipped
Received 2012/05/02

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Conductivity	COND	2848699	N/A	2012/05/14	NEIL DASSANAYAKE
Moisture	BAL	2847324	N/A	2012/05/11	PHILIP MAST
pH CaCl2 EXTRACT		2841946	2012/05/08	2012/05/08	XUANHONG QIU
Resistivity of Soil		2838509	2012/05/14	2012/05/14	EWA PRANJIC
Sulphate (20:1 Extract)	AC/EC	2848613	N/A	2012/05/15	DEONARINE RAMNARINE
Redox Potential	PH	2841577	2012/05/07	2012/05/14	Rick Mastroianni

Maxxam ID NH8791 Dup
Sample ID BH8-SS2
Matrix Soil

Collected 2012/04/25
Shipped
Received 2012/05/02

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Sulphate (20:1 Extract)	AC/EC	2848613	N/A	2012/05/15	DEONARINE RAMNARINE
Redox Potential	PH	2841577	2012/05/07	2012/05/14	Rick Mastroianni

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Maxxam Job #: B262698
Report Date: 2012/05/15

AMEC Environment & Infrastructure
Client Project #: TT123014
Site Location: HIGHBURY AVE SOUTH SUBDIVISON LONDON ONTARIO
Sampler Initials: SD

Package 1	22.0°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

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Maxxam Job #: B262698
Report Date: 2012/05/15

AMEC Environment & Infrastructure
Client Project #: TT123014
Site Location: HIGHBURY AVE SOUTH SUBDIVISON LONDON ONTARIO
Sampler Initials: SD

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2841577	Redox Potential	2012/05/14					+266, RDL=	mV	9.4	N/A	+243	238 - 248
2847324	Moisture	2012/05/11							5.5	20		
2848613	Soluble (20:1) Sulphate (SO4)	2012/05/15	97	75 - 125	95	85 - 115	<20	ug/g	NC	35		
2848699	Conductivity	2012/05/14					<2	umho/cm	5.6	35	101	75 - 125

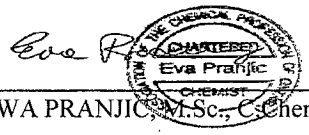
N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

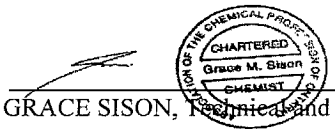
Validation Signature Page

Maxxam Job #: B262698

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



EWA PRANJIC, M.Sc., C.Chem, Scientific Specialist



GRACE SISON, Technical and Customer Service Coordinator

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Maxxam Analytics Inc
6740 Campobello Road Mississauga, ON L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5777 Toll Free: (800) 563-6266

Page ___ of ___

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:		MAXXAM JOB NUMBER:
Company Name:	AMEC	Company Name:		Quotation #		
Contact Name:	AMEC	Contact Name:		P.O. #:		
Address:	1940 Oxford St. E. Unit 7, London On. N5V 4L8	Address:		Project #:	TT123014	CHAIN OF CUSTODY # :
Phone:	519-681-2400 Fax: 519-668-1754	Phone:	Fax:	Project Name:	Highbury Ave. South Subdivision	
Email:	souzan.dabbagh@amec.com	Email:		Location:	London On.	
				Sampled By:	SD	

REGULATORY CRITERIA

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

☐ MISA ☐ Reg. 153 ☐ Table 1 ☐ Table 2 ☐ Table 3 Sewer Use ☐ Sanitary ☐ Storm ☐ Other specify
☐ PWQO Region
☐ Reg. 558
Report Criteria on C of A ? ☐

ANALYSIS REQUESTED (Please be specific):

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT:
☐ 5 to 7 Working Days

Rush TAT: Rush Confirmation # (call Lab for #)
☐ 1 day ☐ 2 days ☐ 3 days
DATE Required:
TIME Required:

Please note that TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	Regulated Drinking Water? (Y/N)	Metals Field Filtered ? (Y/N)	pH	Moisture	Resistivity	Redox Potential	Sulphide/Sulphate Content	# of Cont.	COMMENTS / TAT COMMENTS
1	BH1-SS2	24-Apr-12			N	N	x	x	x	x	x		
2	BH8-SS2	25-Apr-12					x	x	x	x	x		
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

2-May-12 15:48
MARIJANE CRUZ
B262698
TDF TON-001

RECD IN LON

NO ICE NO SEAL

RELINQUISHED BY: (Signature/Print)	RECEIVED BY: (Signature/Print)	Date:	Time:	Laboratory Use Only
Souzan Dabbagh	Damian TAMSIN DeMeo	1-May-12	2012/05/02 15:48	Temperature (°C) on Receipt 22/22/22 Condition of Sample on Receipt ☐ OK ☐ SIF

* MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS

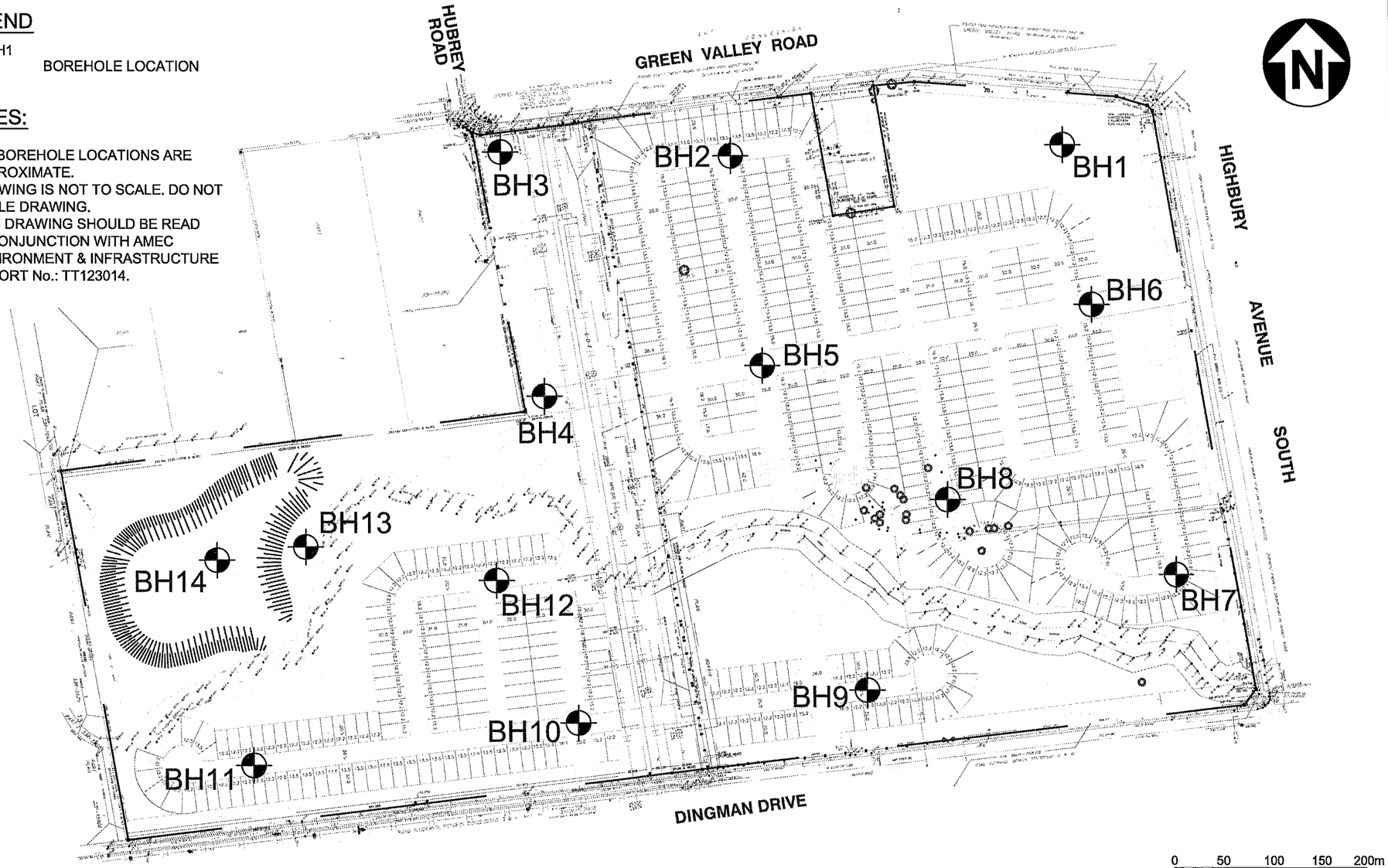
White Maxxam Yellow Mail Pink Client

LEGEND

BH1 — BOREHOLE LOCATION

NOTES:

1. ALL BOREHOLE LOCATIONS ARE APPROXIMATE.
2. DRAWING IS NOT TO SCALE. DO NOT SCALE DRAWING.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH AMEC ENVIRONMENT & INFRASTRUCTURE REPORT No.: TT123014.



CLIENT LOGO	CLIENT: GREENVALLEY ESTATES CANADA INC./ TSI INTERNATIONAL-GRANDTAG A2A GE II INC.	DWN BY: KW	TITLE: BOREHOLE LOCATION PLAN	REV. NO.: A
		CHK'D BY: GB		DATE: MAY 2012
AMEC Environment & Infrastructure, a Division of AMEC Americas Limited, 104 Crockford Blvd, Scarborough, Ontario, M1R 3C3	amec	DATUM: -	PROJECT: PRELIMINARY GEOTECHNICAL INVESTIGATION PROPOSED GE I & GE II SUBDIVISION DEVELOPMENT, Dingman Drive and Highbury Avenue South, London, Ontario	PROJECT NO: TT123014
		PROJECTION: -		FIGURE No. 2
		SCALE: AS SHOWN		

Z:\Projects\2012\TT123014_Mainline_Dingman Drive Development, London\Drawings\TT123014 – Borehole Location Plan_Fig2.dwg – BH Plan – May. 17, 2012 10:22am – kent.wong

Appendix B:

Existing Conditions Hydrology

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Pre-Development Condition Parameters - IA, CN*(AMC II)

Design Chart: Soil Conservation Service Curve Numbers

	Hydrologic Soil Group
Land Used or Surface	AB
Pasture & other unimproved land	70

Hydrologic Soil Group	CN	**CN***
AB	(AMC II)	**(AMC II)**
100%	70	**72**

CN to CN* (AMC II) Conversion

Assumption:

P = 139.2 mm (from VO2 24hrs 100-year SCS storm)
IA = 5 mm

CN (AMC II)	CN (AMC III)	S	Q	IA*	S*	CN* (AMC III)	**CN* (AMC II)**
70	85	44.82	100.60	6.72	41.98	86	**72**

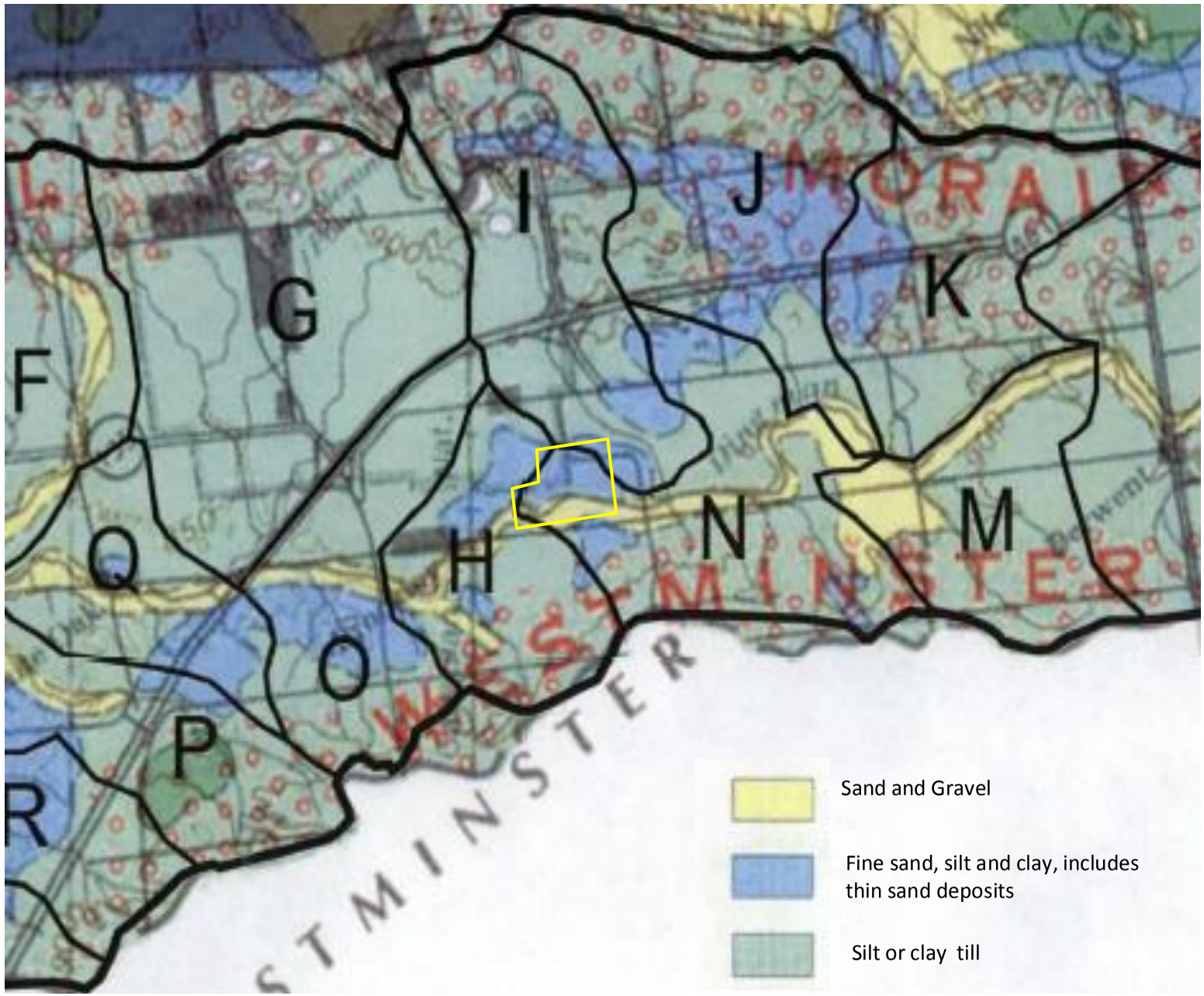
Notes: All Values are based on mean of AMC II and AMC III
IA should be set to a value in the range of 1.0 mm and 5.0 mm
You must convert CN* (AMC III) to CN* (AMCII) using MTO Tables

Source 1: Visual OTTHYMO v2.0 Reference Manual
Source 2: MTO Drainage Management Manual, 1997, Design Chart 1.09

Formulas:

$$S = \left(\frac{25400}{CN}\right) - 254 \qquad I_a = 0.2S \qquad Q = \frac{(P - I_a)^2}{(P - I_a + S)}$$

$$S^* = \frac{(P - I_a^*)^2}{Q} - P + I_a \qquad CN^* = \frac{25400}{(254 + S^*)}$$



source: Goff, Ken. 1973 Ministry of Environment Water Resources Report 14. Sheet 1: Physiography and Surface Geology

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Time of Concentration & Time to Peak Calculation - Airport Method

North Area

Drainage Area = 27.7 ha
Runoff Coefficient = 0.2
Watershed Length = 477 m
Watershed Slope = (269-263) / 477 *100
= 1.26 %

$t_c = 3.26 * (1.1-C) * L^{0.5} * S_w^{-0.33}$

= 59.4 min

= 0.99 hr

$t_p = 0.67 * t_c$

= 0.66 hr

where: t_c = time of concentration, minutes
C = runoff coefficient
L = watershed length, m
S_w = watershed sloe, %
t_p = time to peak, hr

South-West Area

Drainage Area = 8.4 ha
Runoff Coefficient = 0.20
Watershed Length = 318 m
Watershed Slope = (264-262) / 274 *100
= 0.63 %

$t_c = 3.26 * (1.1-C) * L^{0.5} * S_w^{-0.33}$

= 61.0 min

= 1.02 hr

$t_p = 0.67 * t_c$

= 0.68 hr

where: t_c = time of concentration, minutes
C = runoff coefficient
L = watershed length, m
S_w = watershed sloe, %
t_p = time to peak, hr

South-East Area

Drainage Area = 6.4 ha
Runoff Coefficient = 0.20
Watershed Length = 186 m
Watershed Slope = (265-263.5) / 186 *100
= 0.81 %

$t_c = 3.26 * (1.1-C) * L^{0.5} * S_w^{-0.33}$

= 43.0 min

= 0.72 hr

$t_p = 0.67 * t_c$

= 0.48 hr

where: t_c = time of concentration, minutes
C = runoff coefficient
L = watershed length, m
S_w = watershed sloe, %
t_p = time to peak, hr

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Time of Concentration & Time to Peak Calculation - Upland Method

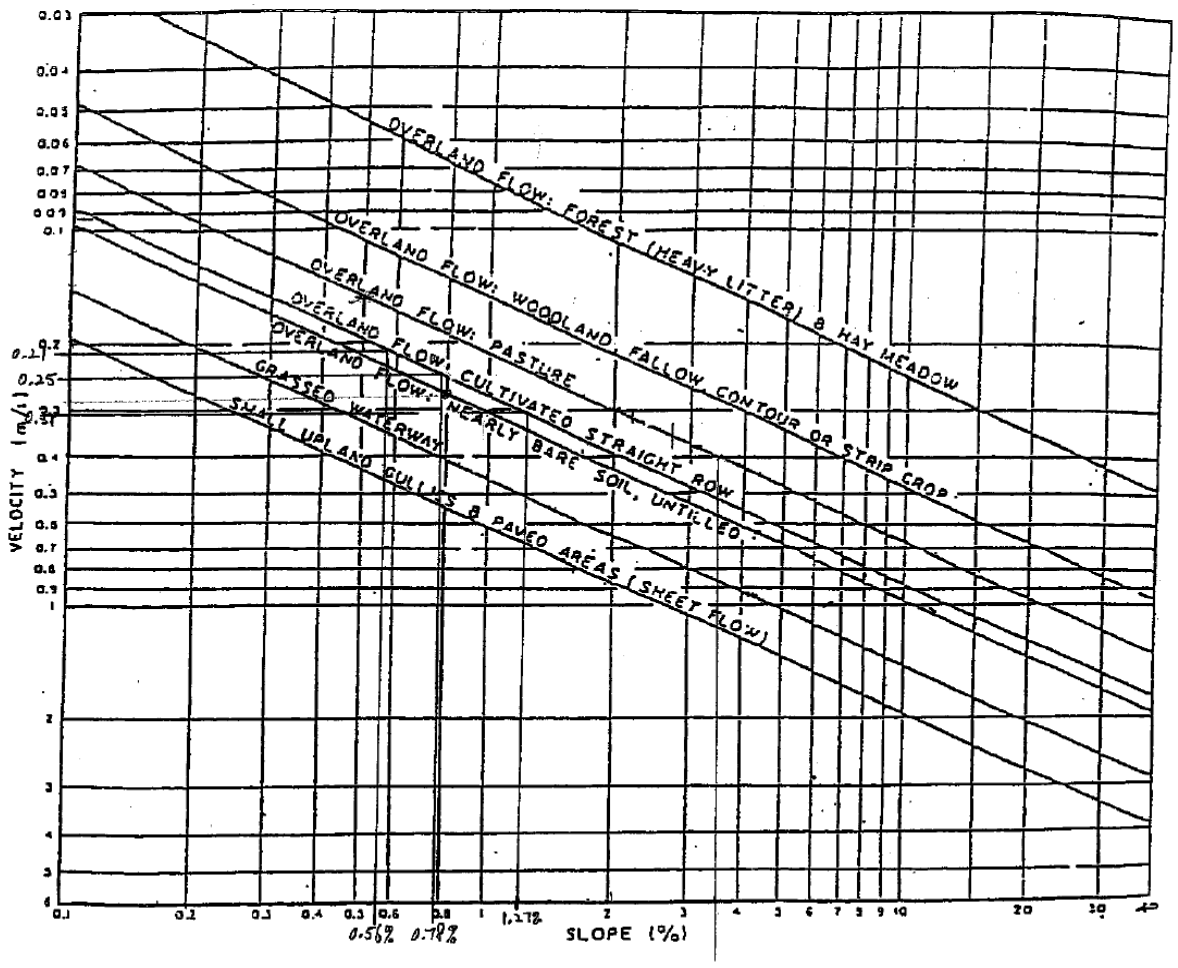


Figure A.5.2: Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

North SWM Pond

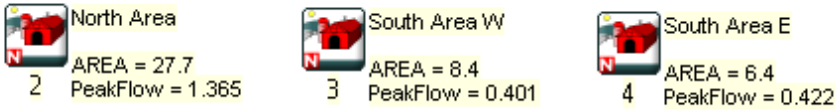
Area (ha)	27.70
Length (m)	477
Slope (%)	1.26
Velocity (m/s)	0.35
N	3
Tc (hr)	0.379
Tp (hr)	0.252

Southwest SWM Pond

Area (ha)	8.40
Length (m)	318
Slope (%)	0.63
Velocity (m/s)	0.21
N	3
Tc (hr)	0.421
Tp (hr)	0.280

Southeast SWM Pond

Area (ha)	6.40
Length (m)	186
Slope (%)	0.81
Velocity (m/s)	0.21
N	3
Tc (hr)	0.246
Tp (hr)	0.170



Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
2	0.167	27.700	0.106	2.500	3.365	0.000
2	0.167	27.700	0.191	1.000	3.140	0.000
2	0.167	27.700	0.427	1.000	7.023	0.000
2	0.167	27.700	0.620	1.000	10.195	0.000
2	0.167	27.700	0.899	1.000	14.766	0.000
2	0.167	27.700	1.124	1.000	18.472	0.000
2	0.167	27.700	1.365	1.000	22.427	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
3	0.167	8.400	0.032	2.500	3.365	0.000
3	0.167	8.400	0.056	1.167	3.140	0.000
3	0.167	8.400	0.125	1.000	7.023	0.000
3	0.167	8.400	0.182	1.000	10.195	0.000
3	0.167	8.400	0.264	1.000	14.766	0.000
3	0.167	8.400	0.330	1.000	18.473	0.000
3	0.167	8.400	0.401	1.000	22.428	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
4	0.167	6.400	0.029	2.167	3.363	0.000
4	0.167	6.400	0.059	0.833	3.138	0.000
4	0.167	6.400	0.132	0.833	7.018	0.000
4	0.167	6.400	0.192	0.833	10.188	0.000
4	0.167	6.400	0.278	0.833	14.756	0.000
4	0.167	6.400	0.347	0.833	18.460	0.000
4	0.167	6.400	0.422	0.833	22.412	0.000

```
================================================================================================
============

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
         V V    I      SS   U   U  A   A  L
          VV    I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM, Version 2.0
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O   Licensed To: TMIG
        OOO     T      T    H   H    Y    M   M   OOO                 VO2-0145

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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
  Output  filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\12116
VO2 Sept 2013\Existing 1hr AES.out
  Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\12116
VO2 Sept 2013\Existing 1hr AES.sum


DATE: 21/10/2013                          TIME: 9:06:04 AM

USER:


COMMENTS: _____________________________________________________________

------------------------------------------------------------------------------------------------
------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************


--------------------
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|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              25MM4HR.STM
| Ptotal= 25.00 mm |    Comments: Twenty-Five mm Four Hour Chicago Storm
--------------------
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                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .17    2.07 |  1.17    5.70 |  2.17    5.19 |  3.17    2.80
               .33    2.27 |  1.33   10.78 |  2.33    4.47 |  3.33    2.62
               .50    2.52 |  1.50   50.21 |  2.50    3.95 |  3.50    2.48
               .67    2.88 |  1.67   13.37 |  2.67    3.56 |  3.67    2.35
               .83    3.38 |  1.83    8.29 |  2.83    3.25 |  3.83    2.23
              1.00    4.18 |  2.00    6.30 |  3.00    3.01 |  4.00    2.14

--------------------------------------------------------------------------------


--------------------
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66
```

```
     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .106 (i)
     TIME TO PEAK    (hrs)=   2.500
     RUNOFF VOLUME    (mm)=   3.365
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .032 (i)
     TIME TO PEAK    (hrs)=   2.500
     RUNOFF VOLUME    (mm)=   3.365
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .029 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   3.363
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   2 **
  ****************************


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|                  |             1hrAES\AES2yr.stm
| Ptotal= 24.25 mm |    Comments: City of London AES 2Yr 1-Hour Distributi
--------------------
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                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42   71.19 |   .75    3.81 |  1.08     .08
                 .17   17.80 |   .50   70.33 |   .83    1.44 |
                 .25   35.59 |   .58   26.60 |   .92     .54 |
                 .33   53.39 |   .67   10.06 |  1.00     .21 |

--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

     NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167    8.90 |  .500   70.76 |  .833    2.62 |  1.17     .04
                .333   44.49 |  .667   18.33 | 1.000     .37 |

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .191 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=   3.140
     TOTAL RAINFALL   (mm)=  24.253
     RUNOFF COEFFICIENT   =    .129

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .056 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   3.140
     TOTAL RAINFALL   (mm)=  24.253
     RUNOFF COEFFICIENT   =    .129

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .059 (i)
     TIME TO PEAK    (hrs)=    .833
     RUNOFF VOLUME    (mm)=   3.138
     TOTAL RAINFALL   (mm)=  24.253
     RUNOFF COEFFICIENT   =    .129

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   3 **
  ****************************


--------------------
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|                  |             1hrAES\AES5yr.stm
| Ptotal= 35.09 mm |    Comments: City of London AES 5 Yr 1-Hour Distribut
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  102.99 |   .75    5.51 |  1.08     .11
                 .17   25.75 |   .50  101.75 |   .83    2.08 |
                 .25   51.49 |   .58   38.48 |   .92     .79 |
                 .33   77.24 |   .67   14.56 |  1.00     .30 |
```

```
--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167   12.88 |  .500  102.37 |  .833    3.79 |  1.17     .05
               .333   64.37 |  .667   26.52 | 1.000     .54 |

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .427 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=   7.023
     TOTAL RAINFALL   (mm)=  35.088
     RUNOFF COEFFICIENT   =    .200

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .125 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=   7.023
     TOTAL RAINFALL   (mm)=  35.088
     RUNOFF COEFFICIENT   =    .200

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .132 (i)
     TIME TO PEAK    (hrs)=    .833
     RUNOFF VOLUME    (mm)=   7.018
     TOTAL RAINFALL   (mm)=  35.088
     RUNOFF COEFFICIENT   =    .200

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ***************************
  ** SIMULATION NUMBER:   4 **
  ***************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              1hrAES\AES10yr.stm
| Ptotal= 42.24 mm |    Comments: City of London AES 10Yr 1-Hour Distribut
--------------------
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .08     .00 |   .42  123.99 |   .75    6.63 |  1.08     .14
                .17   31.00 |   .50  122.50 |   .83    2.51 |
                .25   62.00 |   .58   46.33 |   .92     .95 |
                .33   92.99 |   .67   17.53 |  1.00     .36 |

--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .167   15.50 |  .500  123.25 |  .833    4.57 |  1.17     .07
               .333   77.50 |  .667   31.93 | 1.000     .65 |

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .620 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  10.195
     TOTAL RAINFALL   (mm)=  42.244
     RUNOFF COEFFICIENT   =    .241

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .182 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  10.195
     TOTAL RAINFALL   (mm)=  42.244
     RUNOFF COEFFICIENT   =    .241

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .192 (i)
     TIME TO PEAK    (hrs)=    .833
     RUNOFF VOLUME    (mm)=  10.188
     TOTAL RAINFALL   (mm)=  42.244
     RUNOFF COEFFICIENT   =    .241

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
  ****************************
  ** SIMULATION NUMBER:   5 **
  ****************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             1hrAES\AES25yr.stm
| Ptotal= 51.29 mm |    Comments: City of London AES 25Yr 1-Hour Distribut
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  150.54 |   .75    8.05 |  1.08     .16
                 .17   37.64 |   .50  148.73 |   .83    3.04 |
                 .25   75.27 |   .58   56.25 |   .92    1.15 |
                 .33  112.91 |   .67   21.28 |  1.00     .44 |

--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=  27.70   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167   18.82 |  .500  149.63 |  .833    5.54 |  1.17     .08
                .333   94.09 |  .667   38.76 | 1.000     .79 |

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .899 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  14.766
     TOTAL RAINFALL   (mm)=  51.288
     RUNOFF COEFFICIENT   =    .288

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   8.40   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .264 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  14.766
     TOTAL RAINFALL   (mm)=  51.288
     RUNOFF COEFFICIENT   =    .288

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=   6.40   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .278 (i)
     TIME TO PEAK    (hrs)=    .833
     RUNOFF VOLUME    (mm)=  14.756
     TOTAL RAINFALL   (mm)=  51.288
     RUNOFF COEFFICIENT   =    .288

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   6 **
  ****************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             1hrAES\AES50yr.stm
| Ptotal= 57.95 mm |    Comments: City of London AES 50Yr 1-Hour Distribut
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  170.09 |   .75    9.09 |  1.08     .19
                 .17   42.52 |   .50  168.04 |   .83    3.44 |
                 .25   85.04 |   .58   63.56 |   .92    1.30 |
                 .33  127.57 |   .67   24.04 |  1.00     .49 |

--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=  27.70   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167   21.26 |  .500  169.07 |  .833    6.26 |  1.17     .09
                .333  106.30 |  .667   43.80 | 1.000     .89 |

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=   1.124 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  18.472
     TOTAL RAINFALL   (mm)=  57.948
     RUNOFF COEFFICIENT   =    .319

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   8.40   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .330 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  18.473
     TOTAL RAINFALL   (mm)=  57.948
     RUNOFF COEFFICIENT   =    .319

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .347 (i)
     TIME TO PEAK    (hrs)=    .833
     RUNOFF VOLUME    (mm)=  18.460
     TOTAL RAINFALL   (mm)=  57.948
     RUNOFF COEFFICIENT   =    .319

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   7 **
  ****************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             1hrAES\AES100yr.stm
| Ptotal= 64.61 mm |    Comments: City of London AES 100Yr 1-Hour Distribu
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  189.64 |   .75   10.14 |  1.08     .21
                 .17   47.41 |   .50  187.35 |   .83    3.83 |
                 .25   94.82 |   .58   70.86 |   .92    1.45 |
                 .33  142.23 |   .67   26.80 |  1.00     .55 |

--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.


                        ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .167   23.70 |  .500  188.50 |  .833    6.98 |  1.17     .10
                .333  118.52 |  .667   48.83 | 1.000    1.00 |

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=   1.365 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  22.427
     TOTAL RAINFALL   (mm)=  64.607
     RUNOFF COEFFICIENT   =    .347

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .401 (i)
     TIME TO PEAK    (hrs)=   1.000
     RUNOFF VOLUME    (mm)=  22.428
     TOTAL RAINFALL   (mm)=  64.607
     RUNOFF COEFFICIENT   =    .347

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .422 (i)
     TIME TO PEAK    (hrs)=    .833
     RUNOFF VOLUME    (mm)=  22.412
     TOTAL RAINFALL   (mm)=  64.607
     RUNOFF COEFFICIENT   =    .347

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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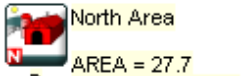

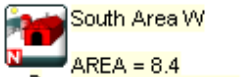

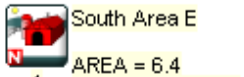

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
2	0.167	27.700	0.106	2.500	3.365	0.000
2	0.167	27.700	0.256	1.833	6.297	0.000
2	0.167	27.700	0.508	1.833	11.697	0.000
2	0.167	27.700	0.676	1.667	15.457	0.000
2	0.167	27.700	0.863	1.667	19.870	0.000
2	0.167	27.700	1.014	1.667	23.334	0.000
2	0.167	27.700	1.163	1.667	26.916	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
3	0.167	8.400	0.032	2.500	3.365	0.000
3	0.167	8.400	0.076	1.833	6.297	0.000
3	0.167	8.400	0.151	1.833	11.697	0.000
3	0.167	8.400	0.201	1.833	15.457	0.000
3	0.167	8.400	0.256	1.833	19.870	0.000
3	0.167	8.400	0.299	1.667	23.334	0.000
3	0.167	8.400	0.344	1.667	26.917	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
4	0.167	6.400	0.029	2.167	3.363	0.000
4	0.167	6.400	0.072	1.500	6.293	0.000
4	0.167	6.400	0.147	1.500	11.689	0.000
4	0.167	6.400	0.197	1.500	15.446	0.000
4	0.167	6.400	0.251	1.500	19.856	0.000
4	0.167	6.400	0.295	1.500	23.318	0.000
4	0.167	6.400	0.338	1.500	26.898	0.000

```
================================================================================
==========================

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO    TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM, Version 2.0
       O   O     T      T    H   H   Y Y   MM MM  O   O
       O   O     T      T    H   H    Y    M   M  O   O   Licensed To: TMIG
        OOO      T      T    H   H    Y    M   M   OOO                 VO2-0145

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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
  Output  filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR
Calcs\VO2\12116 VO2 Sept 2013\Existing Chicago.out
  Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR
Calcs\VO2\12116 VO2 Sept 2013\Existing Chicago.sum


DATE: 18/10/2013                          TIME: 3:35:49 PM

USER:


COMMENTS: _____________________________________________________________


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  ***************************
  ** SIMULATION NUMBER:   1 **
  ***************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |               GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              25MM4HR.STM
| Ptotal= 25.00 mm |    Comments: Twenty-Five mm Four Hour Chicago Storm
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.07 |  1.17    5.70 |  2.17    5.19 |  3.17    2.80
                 .33    2.27 |  1.33   10.78 |  2.33    4.47 |  3.33    2.62
                 .50    2.52 |  1.50   50.21 |  2.50    3.95 |  3.50    2.48
                 .67    2.88 |  1.67   13.37 |  2.67    3.56 |  3.67    2.35
                 .83    3.38 |  1.83    8.29 |  2.83    3.25 |  3.83    2.23
                1.00    4.18 |  2.00    6.30 |  3.00    3.01 |  4.00    2.14

--------------------------------------------------------------------------------
```

```
--------------------
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .106 (i)
     TIME TO PEAK    (hrs)=   2.500
     RUNOFF VOLUME    (mm)=   3.365
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .032 (i)
     TIME TO PEAK    (hrs)=   2.500
     RUNOFF VOLUME    (mm)=   3.365
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .029 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   3.363
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   2 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 724.690
| Ptotal= 33.29 mm |                          B=   5.500
--------------------                          C=    .800
                       used in:   INTENSITY =  A / (t + B)^C
                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

    TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
     hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
     .17    3.02 |  1.00   80.89 |  1.83    5.36 |  2.67    2.88
     .33    3.72 |  1.17   24.52 |  2.00    4.54 |  2.83    2.65
     .50    4.95 |  1.33   12.70 |  2.17    3.95 |  3.00    2.46
     .67    7.61 |  1.50    8.64 |  2.33    3.51 |
     .83   18.60 |  1.67    6.59 |  2.50    3.16 |

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .256 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=   6.297
     TOTAL RAINFALL   (mm)=  33.291
     RUNOFF COEFFICIENT   =    .189

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .076 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=   6.297
     TOTAL RAINFALL   (mm)=  33.291
     RUNOFF COEFFICIENT   =    .189

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .072 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   6.293
     TOTAL RAINFALL   (mm)=  33.291
```

```
     RUNOFF COEFFICIENT   =    .189

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ***************************
  ** SIMULATION NUMBER:   3 **
  ***************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1330.310
| Ptotal= 45.35 mm |                          B=   7.938
--------------------                          C=    .855
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    3.43 |  1.00  112.71 |  1.83    6.69 |  2.67    3.25
                 .33    4.38 |  1.17   36.59 |  2.00    5.51 |  2.83    2.95
                 .50    6.09 |  1.33   17.98 |  2.17    4.69 |  3.00    2.70
                 .67   10.04 |  1.50   11.61 |  2.33    4.08 |
                 .83   27.27 |  1.67    8.50 |  2.50    3.61 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=  27.70   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .508 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=  11.697
     TOTAL RAINFALL   (mm)=  45.346
     RUNOFF COEFFICIENT   =    .258

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   8.40   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .151 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=  11.697
     TOTAL RAINFALL   (mm)=  45.346
     RUNOFF COEFFICIENT   =    .258

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=   6.40   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .147 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  11.689
     TOTAL RAINFALL   (mm)=  45.346
     RUNOFF COEFFICIENT   =    .258

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ***************************
  ** SIMULATION NUMBER:   4 **
  ***************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1497.190
| Ptotal= 52.57 mm |                          B=   7.188
--------------------                          C=    .850
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    3.99 |  1.00  133.46 |  1.83    7.67 |  2.67    3.78
                 .33    5.07 |  1.17   41.53 |  2.00    6.35 |  2.83    3.44
                 .50    7.00 |  1.33   20.35 |  2.17    5.42 |  3.00    3.16
                 .67   11.44 |  1.50   13.20 |  2.33    4.73 |
                 .83   30.92 |  1.67    9.71 |  2.50    4.20 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=  27.70   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .676 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=  15.457
     TOTAL RAINFALL   (mm)=  52.567
     RUNOFF COEFFICIENT   =    .294

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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```
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .201 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=  15.457
     TOTAL RAINFALL   (mm)=  52.567
     RUNOFF COEFFICIENT   =    .294

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .197 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  15.446
     TOTAL RAINFALL   (mm)=  52.567
     RUNOFF COEFFICIENT   =    .294

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
  ****************************
  ** SIMULATION NUMBER:   5 **
  ****************************

-------------------
| CHICAGO STORM    |    IDF curve parameters: A=1455.000
| Ptotal= 60.35 mm |                          B=   5.000
-------------------                          C=    .820
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    4.97 |  1.00  157.93 |  1.83    9.00 |  2.67    4.74
                 .33    6.18 |  1.17   43.82 |  2.00    7.58 |  2.83    4.35
                 .50    8.28 |  1.33   21.99 |  2.17    6.56 |  3.00    4.02
                 .67   12.92 |  1.50   14.73 |  2.33    5.80 |
                 .83   32.88 |  1.67   11.14 |  2.50    5.21 |
```

```
| CALIB            |
| NASHYD    (0002) |   Area     (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .66

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .863 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=  19.870
     TOTAL RAINFALL   (mm)=  60.347
     RUNOFF COEFFICIENT   =    .329

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
| CALIB            |
| NASHYD    (0003) |   Area     (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .256 (i)
     TIME TO PEAK    (hrs)=   1.833
     RUNOFF VOLUME    (mm)=  19.870
     TOTAL RAINFALL   (mm)=  60.347
     RUNOFF COEFFICIENT   =    .329

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
| CALIB            |
| NASHYD    (0004) |   Area     (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .251 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  19.856
     TOTAL RAINFALL   (mm)=  60.347
     RUNOFF COEFFICIENT   =    .329

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
  ****************************
  ** SIMULATION NUMBER:   6 **
  ****************************

-------------------
| CHICAGO STORM    |    IDF curve parameters: A=1499.060
| Ptotal= 66.08 mm |                          B=   4.188
-------------------                          C=    .809
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =   .33
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	5.60	1.00	175.35	1.83	9.92	2.67	5.35
.33	6.91	1.17	46.15	2.00	8.41	2.83	4.92
.50	9.16	1.33	23.48	2.17	7.33	3.00	4.56
.67	14.05	1.50	15.95	2.33	6.51		
.83	34.80	1.67	12.19	2.50	5.86		

CALIB					
NASHYD (0002)	Area (ha)=	27.70	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.66			

Unit Hyd Qpeak (cms)= 1.603

PEAK FLOW (cms)= 1.014 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 23.334
TOTAL RAINFALL (mm)= 66.083
RUNOFF COEFFICIENT = .353

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area (ha)=	8.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.68			

Unit Hyd Qpeak (cms)= .472

PEAK FLOW (cms)= .299 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 23.334
TOTAL RAINFALL (mm)= 66.083
RUNOFF COEFFICIENT = .353

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area (ha)=	6.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.48			

Unit Hyd Qpeak (cms)= .509

PEAK FLOW (cms)= .295 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 23.318
TOTAL RAINFALL (mm)= 66.083
RUNOFF COEFFICIENT = .353

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 7 **
****

CHICAGO STORM	IDF curve parameters: A=1499.530
Ptotal= 71.76 mm	B= 3.297
	C= .794

used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	6.35	1.00	192.17	1.83	10.97	2.67	6.07
.33	7.76	1.17	47.73	2.00	9.37	2.83	5.61
.50	10.16	1.33	24.88	2.17	8.21	3.00	5.22
.67	15.26	1.50	17.22	2.33	7.33		
.83	36.28	1.67	13.33	2.50	6.64		

CALIB					
NASHYD (0002)	Area (ha)=	27.70	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.66			

Unit Hyd Qpeak (cms)= 1.603

PEAK FLOW (cms)= 1.163 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 26.916
TOTAL RAINFALL (mm)= 71.759
RUNOFF COEFFICIENT = .375

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area (ha)=	8.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.68			

Unit Hyd Qpeak (cms)= .472

PEAK FLOW (cms)= .344 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 26.917
TOTAL RAINFALL (mm)= 71.759
RUNOFF COEFFICIENT = .375

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area (ha)=	6.40	Curve Number (CN)=	72.0	

```
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .338 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  26.898
     TOTAL RAINFALL   (mm)=  71.759
     RUNOFF COEFFICIENT   =    .375

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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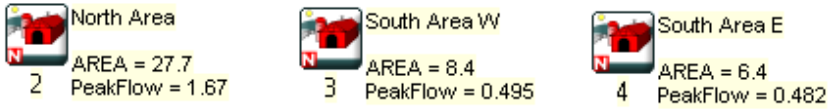

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
2	0.167	27.700	0.106	2.500	3.365	0.000
2	0.167	27.700	0.430	12.500	14.913	0.000
2	0.167	27.700	0.635	12.500	21.660	0.000
2	0.167	27.700	0.839	12.500	28.348	0.000
2	0.167	27.700	1.165	12.500	38.973	0.000
2	0.167	27.700	1.399	12.500	46.547	0.000
2	0.167	27.700	1.670	12.500	55.325	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
3	0.167	8.400	0.032	2.500	3.365	0.000
3	0.167	8.400	0.127	12.500	14.914	0.000
3	0.167	8.400	0.188	12.500	21.661	0.000
3	0.167	8.400	0.248	12.500	28.349	0.000
3	0.167	8.400	0.345	12.500	38.974	0.000
3	0.167	8.400	0.415	12.500	46.549	0.000
3	0.167	8.400	0.495	12.500	55.326	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
4	0.167	6.400	0.029	2.167	3.363	0.000
4	0.167	6.400	0.125	12.333	14.903	0.000
4	0.167	6.400	0.184	12.333	21.646	0.000
4	0.167	6.400	0.243	12.333	28.329	0.000
4	0.167	6.400	0.337	12.333	38.947	0.000
4	0.167	6.400	0.404	12.333	46.516	0.000
4	0.167	6.400	0.482	12.333	55.288	0.000

```
================================================================================
==========================

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO    TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM, Version 2.0
       O   O     T      T    H   H   Y Y   MM MM  O   O
       O   O     T      T    H   H    Y    M   M  O   O   Licensed To: TMIG
        OOO      T      T    H   H    Y    M   M   OOO                 VO2-0145

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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
  Output  filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR
Calcs\VO2\12116 VO2 Sept 2013\Existing 24hr SCS.out
  Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR
Calcs\VO2\12116 VO2 Sept 2013\Existing 24hr SCS.sum


DATE: 23/10/2013                          TIME: 3:48:17 PM

USER:


COMMENTS: ____________________________________________________________

--------------------------------------------------------------------------------
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  ***************************
  ** SIMULATION NUMBER:   1 **
  ***************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              25MM4HR.STM
| Ptotal= 25.00 mm |    Comments: Twenty-Five mm Four Hour Chicago Storm
--------------------

                TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.07 |  1.17    5.70 |  2.17    5.19 |  3.17    2.80
                 .33    2.27 |  1.33   10.78 |  2.33    4.47 |  3.33    2.62
                 .50    2.52 |  1.50   50.21 |  2.50    3.95 |  3.50    2.48
                 .67    2.88 |  1.67   13.37 |  2.67    3.56 |  3.67    2.35
                 .83    3.38 |  1.83    8.29 |  2.83    3.25 |  3.83    2.23
                1.00    4.18 |  2.00    6.30 |  3.00    3.01 |  4.00    2.14
```

```
--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=  27.70   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=    .106 (i)
     TIME TO PEAK    (hrs)=   2.500
     RUNOFF VOLUME    (mm)=   3.365
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   8.40   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .032 (i)
     TIME TO PEAK    (hrs)=   2.500
     RUNOFF VOLUME    (mm)=   3.365
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=   6.40   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .029 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   3.363
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =    .135

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   2 **
  ****************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |               GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              SCS Type II - London\2yrSCSTypeII24hr.stm
| Ptotal= 51.56 mm |    Comments: 2-Year 24 hour SCS Type II: London Airpo
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.57	6.25	1.03	12.25	7.43	18.25	.93
.50	.57	6.50	1.03	12.50	7.43	18.50	.93
.75	.57	6.75	1.03	12.75	3.82	18.75	.93
1.00	.57	7.00	1.03	13.00	3.82	19.00	.93
1.25	.57	7.25	1.03	13.25	2.68	19.25	.93
1.50	.57	7.50	1.03	13.50	2.89	19.50	.93
1.75	.57	7.75	1.03	13.75	2.17	19.75	.93
2.00	.57	8.00	1.03	14.00	2.17	20.00	.93
2.25	.67	8.25	1.39	14.25	1.55	20.25	.62
2.50	.67	8.50	1.39	14.50	1.55	20.50	.62
2.75	.67	8.75	1.39	14.75	1.55	20.75	.62
3.00	.67	9.00	1.39	15.00	1.55	21.00	.62
3.25	.67	9.25	1.65	15.25	1.55	21.25	.62
3.50	.67	9.50	1.65	15.50	1.55	21.50	.62
3.75	.67	9.75	1.86	15.75	1.55	21.75	.62
4.00	.67	10.00	1.86	16.00	1.55	22.00	.62
4.25	.82	10.25	2.37	16.25	.93	22.25	.62
4.50	.82	10.50	2.37	16.50	.93	22.50	.62
4.75	.82	10.75	3.20	16.75	.93	22.75	.62
5.00	.82	11.00	3.20	17.00	.93	23.00	.62
5.25	.82	11.25	4.95	17.25	.93	23.25	.62
5.50	.82	11.50	4.95	17.50	.93	23.50	.62
5.75	.82	11.75	21.45	17.75	.93	23.75	.62
6.00	.82	12.00	56.93	18.00	.93	24.00	.62

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--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=  27.70   Curve Number   (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .66

        NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.57	6.167	1.03	12.167	7.43	18.17	.93
.333	.57	6.333	1.03	12.333	7.43	18.33	.93
.500	.57	6.500	1.03	12.500	7.42	18.50	.93
.667	.57	6.667	1.03	12.667	3.82	18.67	.93
.833	.57	6.833	1.03	12.833	3.82	18.83	.93
1.000	.57	7.000	1.03	13.000	3.82	19.00	.93
1.167	.57	7.167	1.03	13.167	2.68	19.17	.93
1.333	.57	7.333	1.03	13.333	2.78	19.33	.93
1.500	.57	7.500	1.03	13.500	2.89	19.50	.93
1.667	.57	7.667	1.03	13.667	2.17	19.67	.93
1.833	.57	7.833	1.03	13.833	2.17	19.83	.93
2.000	.57	8.000	1.03	14.000	2.17	20.00	.93
2.167	.67	8.167	1.39	14.167	1.55	20.17	.62
2.333	.67	8.333	1.39	14.333	1.55	20.33	.62
2.500	.67	8.500	1.39	14.500	1.55	20.50	.62
2.667	.67	8.667	1.39	14.667	1.55	20.67	.62
2.833	.67	8.833	1.39	14.833	1.55	20.83	.62
3.000	.67	9.000	1.39	15.000	1.55	21.00	.62
3.167	.67	9.167	1.65	15.167	1.55	21.17	.62

3.333	.67	9.333	1.65	15.333	1.55	21.33	.62
3.500	.67	9.500	1.65	15.500	1.55	21.50	.62
3.667	.67	9.667	1.86	15.667	1.55	21.67	.62
3.833	.67	9.833	1.86	15.833	1.55	21.83	.62
4.000	.67	10.000	1.86	16.000	1.55	22.00	.62
4.167	.82	10.167	2.37	16.167	.93	22.17	.62
4.333	.82	10.333	2.37	16.333	.93	22.33	.62
4.500	.82	10.500	2.37	16.500	.93	22.50	.62
4.667	.82	10.667	3.20	16.667	.93	22.67	.62
4.833	.82	10.833	3.20	16.833	.93	22.83	.62
5.000	.82	11.000	3.20	17.000	.93	23.00	.62
5.167	.82	11.167	4.95	17.167	.93	23.17	.62
5.333	.82	11.333	4.95	17.333	.93	23.33	.62
5.500	.82	11.500	4.95	17.500	.93	23.50	.62
5.667	.82	11.667	21.45	17.667	.93	23.67	.62
5.833	.82	11.833	39.19	17.833	.93	23.83	.62
6.000	.82	12.000	56.93	18.000	.93	24.00	.62

Unit Hyd Qpeak (cms)= 1.603

PEAK FLOW (cms)= .430 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 14.913
TOTAL RAINFALL (mm)= 51.563
RUNOFF COEFFICIENT = .289

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area (ha)=	8.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.68			

Unit Hyd Qpeak (cms)= .472

PEAK FLOW (cms)= .127 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 14.914
TOTAL RAINFALL (mm)= 51.563
RUNOFF COEFFICIENT = .289

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area (ha)=	6.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.48			

Unit Hyd Qpeak (cms)= .509

PEAK FLOW (cms)= .125 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 14.903
TOTAL RAINFALL (mm)= 51.563
RUNOFF COEFFICIENT = .289

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
**** SIMULATION NUMBER: 3 ****
****

READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\5yrSCSTypeII24hr.stm
Ptotal= 63.35 mm	Comments: 5-Year 24 hour SCS Type II: London Airpo

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.70	6.25	1.27	12.25	9.12	18.25	1.14
.50	.70	6.50	1.27	12.50	9.12	18.50	1.14
.75	.70	6.75	1.27	12.75	4.69	18.75	1.14
1.00	.70	7.00	1.27	13.00	4.69	19.00	1.14
1.25	.70	7.25	1.27	13.25	3.29	19.25	1.14
1.50	.70	7.50	1.27	13.50	3.55	19.50	1.14
1.75	.70	7.75	1.27	13.75	2.66	19.75	1.14
2.00	.70	8.00	1.27	14.00	2.66	20.00	1.14
2.25	.82	8.25	1.71	14.25	1.90	20.25	.76
2.50	.82	8.50	1.71	14.50	1.90	20.50	.76
2.75	.82	8.75	1.71	14.75	1.90	20.75	.76
3.00	.82	9.00	1.71	15.00	1.90	21.00	.76
3.25	.82	9.25	2.03	15.25	1.90	21.25	.76
3.50	.82	9.50	2.03	15.50	1.90	21.50	.76
3.75	.82	9.75	2.28	15.75	1.90	21.75	.76
4.00	.82	10.00	2.28	16.00	1.90	22.00	.76
4.25	1.01	10.25	2.91	16.25	1.14	22.25	.76
4.50	1.01	10.50	2.91	16.50	1.14	22.50	.76
4.75	1.01	10.75	3.93	16.75	1.14	22.75	.76
5.00	1.01	11.00	3.93	17.00	1.14	23.00	.76
5.25	1.01	11.25	6.08	17.25	1.14	23.25	.76
5.50	1.01	11.50	6.08	17.50	1.14	23.50	.76
5.75	1.01	11.75	26.35	17.75	1.14	23.75	.76
6.00	1.01	12.00	69.93	18.00	1.14	24.00	.76

CALIB					
NASHYD (0002)	Area (ha)=	27.70	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.66			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.70	6.167	1.27	12.167	9.12	18.17	1.14
.333	.70	6.333	1.27	12.333	9.12	18.33	1.14
.500	.70	6.500	1.27	12.500	9.12	18.50	1.14
.667	.70	6.667	1.27	12.667	4.69	18.67	1.14
.833	.70	6.833	1.27	12.833	4.69	18.83	1.14
1.000	.70	7.000	1.27	13.000	4.69	19.00	1.14
1.167	.70	7.167	1.27	13.167	3.29	19.17	1.14
1.333	.70	7.333	1.27	13.333	3.42	19.33	1.14
1.500	.70	7.500	1.27	13.500	3.55	19.50	1.14

1.667	.70	7.667	1.27	13.667	2.66	19.67	1.14
1.833	.70	7.833	1.27	13.833	2.66	19.83	1.14
2.000	.70	8.000	1.27	14.000	2.66	20.00	1.14
2.167	.82	8.167	1.71	14.167	1.90	20.17	.76
2.333	.82	8.333	1.71	14.333	1.90	20.33	.76
2.500	.82	8.500	1.71	14.500	1.90	20.50	.76
2.667	.82	8.667	1.71	14.667	1.90	20.67	.76
2.833	.82	8.833	1.71	14.833	1.90	20.83	.76
3.000	.82	9.000	1.71	15.000	1.90	21.00	.76
3.167	.82	9.167	2.03	15.167	1.90	21.17	.76
3.333	.82	9.333	2.03	15.333	1.90	21.33	.76
3.500	.82	9.500	2.03	15.500	1.90	21.50	.76
3.667	.82	9.667	2.28	15.667	1.90	21.67	.76
3.833	.82	9.833	2.28	15.833	1.90	21.83	.76
4.000	.82	10.000	2.28	16.000	1.90	22.00	.76
4.167	1.01	10.167	2.91	16.167	1.14	22.17	.76
4.333	1.01	10.333	2.91	16.333	1.14	22.33	.76
4.500	1.01	10.500	2.91	16.500	1.14	22.50	.76
4.667	1.01	10.667	3.93	16.667	1.14	22.67	.76
4.833	1.01	10.833	3.93	16.833	1.14	22.83	.76
5.000	1.01	11.000	3.93	17.000	1.14	23.00	.76
5.167	1.01	11.167	6.08	17.167	1.14	23.17	.76
5.333	1.01	11.333	6.08	17.333	1.14	23.33	.76
5.500	1.01	11.500	6.08	17.500	1.14	23.50	.76
5.667	1.01	11.667	26.35	17.667	1.14	23.67	.76
5.833	1.01	11.833	48.14	17.833	1.14	23.83	.76
6.000	1.01	12.000	69.93	18.000	1.14	24.00	.76

Unit Hyd Qpeak (cms)= 1.603

PEAK FLOW (cms)= .635 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 21.660
TOTAL RAINFALL (mm)= 63.346
RUNOFF COEFFICIENT = .342

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area (ha)=	8.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.68			

Unit Hyd Qpeak (cms)= .472

PEAK FLOW (cms)= .188 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 21.661
TOTAL RAINFALL (mm)= 63.346
RUNOFF COEFFICIENT = .342

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area (ha)=	6.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.48			

Unit Hyd Qpeak (cms)= .509

PEAK FLOW (cms)= .184 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 21.646
TOTAL RAINFALL (mm)= 63.346
RUNOFF COEFFICIENT = .342

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 4 **
****

READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\10yrSCSTypeII24hr.stm
Ptotal= 73.97 mm	Comments: 10-Year 24 hour SCS Type II: London Airp

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.81	6.25	1.48	12.25	10.65	18.25	1.33
.50	.81	6.50	1.48	12.50	10.65	18.50	1.33
.75	.81	6.75	1.48	12.75	5.47	18.75	1.33
1.00	.81	7.00	1.48	13.00	5.47	19.00	1.33
1.25	.81	7.25	1.48	13.25	3.85	19.25	1.33
1.50	.81	7.50	1.48	13.50	4.14	19.50	1.33
1.75	.81	7.75	1.48	13.75	3.11	19.75	1.33
2.00	.81	8.00	1.48	14.00	3.11	20.00	1.33
2.25	.96	8.25	2.00	14.25	2.22	20.25	.89
2.50	.96	8.50	2.00	14.50	2.22	20.50	.89
2.75	.96	8.75	2.00	14.75	2.22	20.75	.89
3.00	.96	9.00	2.00	15.00	2.22	21.00	.89
3.25	.96	9.25	2.37	15.25	2.22	21.25	.89
3.50	.96	9.50	2.37	15.50	2.22	21.50	.89
3.75	.96	9.75	2.66	15.75	2.22	21.75	.89
4.00	.96	10.00	2.66	16.00	2.22	22.00	.89
4.25	1.18	10.25	3.40	16.25	1.33	22.25	.89
4.50	1.18	10.50	3.40	16.50	1.33	22.50	.89
4.75	1.18	10.75	4.59	16.75	1.33	22.75	.89
5.00	1.18	11.00	4.59	17.00	1.33	23.00	.89
5.25	1.18	11.25	7.10	17.25	1.33	23.25	.89
5.50	1.18	11.50	7.10	17.50	1.33	23.50	.89
5.75	1.18	11.75	30.77	17.75	1.33	23.75	.89
6.00	1.18	12.00	81.66	18.00	1.33	24.00	.89

CALIB					
NASHYD (0002)	Area (ha)=	27.70	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.66			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN

hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.167	.81	6.167	1.48	12.167	10.65	18.17	1.33
.333	.81	6.333	1.48	12.333	10.65	18.33	1.33
.500	.81	6.500	1.48	12.500	10.65	18.50	1.33
.667	.81	6.667	1.48	12.667	5.47	18.67	1.33
.833	.81	6.833	1.48	12.833	5.47	18.83	1.33
1.000	.81	7.000	1.48	13.000	5.47	19.00	1.33
1.167	.81	7.167	1.48	13.167	3.85	19.17	1.33
1.333	.81	7.333	1.48	13.333	3.99	19.33	1.33
1.500	.81	7.500	1.48	13.500	4.14	19.50	1.33
1.667	.81	7.667	1.48	13.667	3.11	19.67	1.33
1.833	.81	7.833	1.48	13.833	3.11	19.83	1.33
2.000	.81	8.000	1.48	14.000	3.11	20.00	1.33
2.167	.96	8.167	2.00	14.167	2.22	20.17	.89
2.333	.96	8.333	2.00	14.333	2.22	20.33	.89
2.500	.96	8.500	2.00	14.500	2.22	20.50	.89
2.667	.96	8.667	2.00	14.667	2.22	20.67	.89
2.833	.96	8.833	2.00	14.833	2.22	20.83	.89
3.000	.96	9.000	2.00	15.000	2.22	21.00	.89
3.167	.96	9.167	2.37	15.167	2.22	21.17	.89
3.333	.96	9.333	2.37	15.333	2.22	21.33	.89
3.500	.96	9.500	2.37	15.500	2.22	21.50	.89
3.667	.96	9.667	2.66	15.667	2.22	21.67	.89
3.833	.96	9.833	2.66	15.833	2.22	21.83	.89
4.000	.96	10.000	2.66	16.000	2.22	22.00	.89
4.167	1.18	10.167	3.40	16.167	1.33	22.17	.89
4.333	1.18	10.333	3.40	16.333	1.33	22.33	.89
4.500	1.18	10.500	3.40	16.500	1.33	22.50	.89
4.667	1.18	10.667	4.59	16.667	1.33	22.67	.89
4.833	1.18	10.833	4.59	16.833	1.33	22.83	.89
5.000	1.18	11.000	4.59	17.000	1.33	23.00	.89
5.167	1.18	11.167	7.10	17.167	1.33	23.17	.89
5.333	1.18	11.333	7.10	17.333	1.33	23.33	.89
5.500	1.18	11.500	7.10	17.500	1.33	23.50	.89
5.667	1.18	11.667	30.77	17.667	1.33	23.67	.89
5.833	1.18	11.833	56.22	17.833	1.33	23.83	.89
6.000	1.18	12.000	81.66	18.000	1.33	24.00	.89

Unit Hyd Qpeak (cms)= 1.603

PEAK FLOW (cms)= .839 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 28.348
TOTAL RAINFALL (mm)= 73.968
RUNOFF COEFFICIENT = .383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area (ha)=	8.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.68			

Unit Hyd Qpeak (cms)= .472

PEAK FLOW (cms)= .248 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 28.349
TOTAL RAINFALL (mm)= 73.968
RUNOFF COEFFICIENT = .383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area (ha)=	6.40	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.48			

Unit Hyd Qpeak (cms)= .509

PEAK FLOW (cms)= .243 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 28.329
TOTAL RAINFALL (mm)= 73.968
RUNOFF COEFFICIENT = .383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 5 **
****

READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\25yrSCSTypeII24hr.stm
Ptotal= 89.53 mm	Comments: 25-Year 24 hour SCS Type II: London Airp

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.98	6.25	1.79	12.25	12.89	18.25	1.61
.50	.98	6.50	1.79	12.50	12.89	18.50	1.61
.75	.98	6.75	1.79	12.75	6.63	18.75	1.61
1.00	.98	7.00	1.79	13.00	6.63	19.00	1.61
1.25	.98	7.25	1.79	13.25	4.66	19.25	1.61
1.50	.98	7.50	1.79	13.50	5.01	19.50	1.61
1.75	.98	7.75	1.79	13.75	3.76	19.75	1.61
2.00	.98	8.00	1.79	14.00	3.76	20.00	1.61
2.25	1.16	8.25	2.42	14.25	2.69	20.25	1.07
2.50	1.16	8.50	2.42	14.50	2.69	20.50	1.07
2.75	1.16	8.75	2.42	14.75	2.69	20.75	1.07
3.00	1.16	9.00	2.42	15.00	2.69	21.00	1.07
3.25	1.16	9.25	2.87	15.25	2.69	21.25	1.07
3.50	1.16	9.50	2.87	15.50	2.69	21.50	1.07
3.75	1.16	9.75	3.22	15.75	2.69	21.75	1.07
4.00	1.16	10.00	3.22	16.00	2.69	22.00	1.07
4.25	1.43	10.25	4.12	16.25	1.61	22.25	1.07
4.50	1.43	10.50	4.12	16.50	1.61	22.50	1.07
4.75	1.43	10.75	5.55	16.75	1.61	22.75	1.07
5.00	1.43	11.00	5.55	17.00	1.61	23.00	1.07
5.25	1.43	11.25	8.60	17.25	1.61	23.25	1.07
5.50	1.43	11.50	8.60	17.50	1.61	23.50	1.07
5.75	1.43	11.75	37.25	17.75	1.61	23.75	1.07
6.00	1.43	12.00	98.84	18.00	1.61	24.00	1.07

```
| CALIB            |
| NASHYD    (0002) |   Area    (ha)=  27.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .66

         NOTE:  RAINFALL WAS TRANSFORMED TO  10.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.98	6.167	1.79	12.167	12.89	18.17	1.61
.333	.98	6.333	1.79	12.333	12.89	18.33	1.61
.500	.98	6.500	1.79	12.500	12.89	18.50	1.61
.667	.98	6.667	1.79	12.667	6.63	18.67	1.61
.833	.98	6.833	1.79	12.833	6.63	18.83	1.61
1.000	.98	7.000	1.79	13.000	6.62	19.00	1.61
1.167	.98	7.167	1.79	13.167	4.66	19.17	1.61
1.333	.98	7.333	1.79	13.333	4.84	19.33	1.61
1.500	.98	7.500	1.79	13.500	5.01	19.50	1.61
1.667	.98	7.667	1.79	13.667	3.76	19.67	1.61
1.833	.98	7.833	1.79	13.833	3.76	19.83	1.61
2.000	.98	8.000	1.79	14.000	3.76	20.00	1.61
2.167	1.16	8.167	2.42	14.167	2.69	20.17	1.07
2.333	1.16	8.333	2.42	14.333	2.69	20.33	1.07
2.500	1.16	8.500	2.42	14.500	2.69	20.50	1.07
2.667	1.16	8.667	2.42	14.667	2.69	20.67	1.07
2.833	1.16	8.833	2.42	14.833	2.69	20.83	1.07
3.000	1.16	9.000	2.42	15.000	2.69	21.00	1.07
3.167	1.16	9.167	2.86	15.167	2.69	21.17	1.07
3.333	1.16	9.333	2.87	15.333	2.69	21.33	1.07
3.500	1.16	9.500	2.87	15.500	2.69	21.50	1.07
3.667	1.16	9.667	3.22	15.667	2.69	21.67	1.07
3.833	1.16	9.833	3.22	15.833	2.69	21.83	1.07
4.000	1.16	10.000	3.22	16.000	2.69	22.00	1.07
4.167	1.43	10.167	4.12	16.167	1.61	22.17	1.07
4.333	1.43	10.333	4.12	16.333	1.61	22.33	1.07
4.500	1.43	10.500	4.12	16.500	1.61	22.50	1.07
4.667	1.43	10.667	5.55	16.667	1.61	22.67	1.07
4.833	1.43	10.833	5.55	16.833	1.61	22.83	1.07
5.000	1.43	11.000	5.55	17.000	1.61	23.00	1.07
5.167	1.43	11.167	8.60	17.167	1.61	23.17	1.07
5.333	1.43	11.333	8.60	17.333	1.61	23.33	1.07
5.500	1.43	11.500	8.60	17.500	1.61	23.50	1.07
5.667	1.43	11.667	37.25	17.667	1.61	23.67	1.07
5.833	1.43	11.833	68.05	17.833	1.61	23.83	1.07
6.000	1.43	12.000	98.84	18.000	1.61	24.00	1.07

```
     Unit Hyd Qpeak  (cms)=   1.603

     PEAK FLOW       (cms)=   1.165 (i)
     TIME TO PEAK    (hrs)=  12.500
     RUNOFF VOLUME    (mm)=  38.973
     TOTAL RAINFALL   (mm)=  89.534
     RUNOFF COEFFICIENT   =    .435

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0003) |   Area    (ha)=   8.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .68

     Unit Hyd Qpeak  (cms)=    .472

     PEAK FLOW       (cms)=    .345 (i)
     TIME TO PEAK    (hrs)=  12.500
     RUNOFF VOLUME    (mm)=  38.974
     TOTAL RAINFALL   (mm)=  89.534
     RUNOFF COEFFICIENT   =    .435

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD    (0004) |   Area    (ha)=   6.40   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=    .48

     Unit Hyd Qpeak  (cms)=    .509

     PEAK FLOW       (cms)=    .337 (i)
     TIME TO PEAK    (hrs)=  12.333
     RUNOFF VOLUME    (mm)=  38.947
     TOTAL RAINFALL   (mm)=  89.534
     RUNOFF COEFFICIENT   =    .435

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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  ****************************
  ** SIMULATION NUMBER:   6 **
  ****************************


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|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             SCS Type II - London\50yrSCSTypeII24hr.stm
| Ptotal= 99.98 mm |    Comments: 50-Year 24 hour SCS Type II: London Airp
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```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	1.10	6.25	2.00	12.25	14.40	18.25	1.80
.50	1.10	6.50	2.00	12.50	14.40	18.50	1.80
.75	1.10	6.75	2.00	12.75	7.40	18.75	1.80
1.00	1.10	7.00	2.00	13.00	7.40	19.00	1.80
1.25	1.10	7.25	2.00	13.25	5.20	19.25	1.80
1.50	1.10	7.50	2.00	13.50	5.60	19.50	1.80
1.75	1.10	7.75	2.00	13.75	4.20	19.75	1.80
2.00	1.10	8.00	2.00	14.00	4.20	20.00	1.80
2.25	1.30	8.25	2.70	14.25	3.00	20.25	1.20
2.50	1.30	8.50	2.70	14.50	3.00	20.50	1.20
2.75	1.30	8.75	2.70	14.75	3.00	20.75	1.20
3.00	1.30	9.00	2.70	15.00	3.00	21.00	1.20
3.25	1.30	9.25	3.20	15.25	3.00	21.25	1.20
3.50	1.30	9.50	3.20	15.50	3.00	21.50	1.20
3.75	1.30	9.75	3.60	15.75	3.00	21.75	1.20
4.00	1.30	10.00	3.60	16.00	3.00	22.00	1.20
4.25	1.60	10.25	4.60	16.25	1.80	22.25	1.20
4.50	1.60	10.50	4.60	16.50	1.80	22.50	1.20

4.75	1.60	10.75	6.20	16.75	1.80	22.75	1.20
5.00	1.60	11.00	6.20	17.00	1.80	23.00	1.20
5.25	1.60	11.25	9.60	17.25	1.80	23.25	1.20
5.50	1.60	11.50	9.60	17.50	1.80	23.50	1.20
5.75	1.60	11.75	41.59	17.75	1.80	23.75	1.20
6.00	1.60	12.00	110.37	18.00	1.80	24.00	1.20

CALIB			
NASHYD (0002)	Area (ha)= 27.70	Curve Number (CN)= 72.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .66		

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	1.10	6.167	2.00	12.167	14.40	18.17	1.80
.333	1.10	6.333	2.00	12.333	14.40	18.33	1.80
.500	1.10	6.500	2.00	12.500	14.40	18.50	1.80
.667	1.10	6.667	2.00	12.667	7.40	18.67	1.80
.833	1.10	6.833	2.00	12.833	7.40	18.83	1.80
1.000	1.10	7.000	2.00	13.000	7.40	19.00	1.80
1.167	1.10	7.167	2.00	13.167	5.20	19.17	1.80
1.333	1.10	7.333	2.00	13.333	5.40	19.33	1.80
1.500	1.10	7.500	2.00	13.500	5.60	19.50	1.80
1.667	1.10	7.667	2.00	13.667	4.20	19.67	1.80
1.833	1.10	7.833	2.00	13.833	4.20	19.83	1.80
2.000	1.10	8.000	2.00	14.000	4.20	20.00	1.80
2.167	1.30	8.167	2.70	14.167	3.00	20.17	1.20
2.333	1.30	8.333	2.70	14.333	3.00	20.33	1.20
2.500	1.30	8.500	2.70	14.500	3.00	20.50	1.20
2.667	1.30	8.667	2.70	14.667	3.00	20.67	1.20
2.833	1.30	8.833	2.70	14.833	3.00	20.83	1.20
3.000	1.30	9.000	2.70	15.000	3.00	21.00	1.20
3.167	1.30	9.167	3.20	15.167	3.00	21.17	1.20
3.333	1.30	9.333	3.20	15.333	3.00	21.33	1.20
3.500	1.30	9.500	3.20	15.500	3.00	21.50	1.20
3.667	1.30	9.667	3.60	15.667	3.00	21.67	1.20
3.833	1.30	9.833	3.60	15.833	3.00	21.83	1.20
4.000	1.30	10.000	3.60	16.000	3.00	22.00	1.20
4.167	1.60	10.167	4.60	16.167	1.80	22.17	1.20
4.333	1.60	10.333	4.60	16.333	1.80	22.33	1.20
4.500	1.60	10.500	4.60	16.500	1.80	22.50	1.20
4.667	1.60	10.667	6.20	16.667	1.80	22.67	1.20
4.833	1.60	10.833	6.20	16.833	1.80	22.83	1.20
5.000	1.60	11.000	6.20	17.000	1.80	23.00	1.20
5.167	1.60	11.167	9.60	17.167	1.80	23.17	1.20
5.333	1.60	11.333	9.60	17.333	1.80	23.33	1.20
5.500	1.60	11.500	9.60	17.500	1.80	23.50	1.20
5.667	1.60	11.667	41.59	17.667	1.80	23.67	1.20
5.833	1.60	11.833	75.98	17.833	1.80	23.83	1.20
6.000	1.60	12.000	110.37	18.000	1.80	24.00	1.20

Unit Hyd Qpeak (cms)= 1.603

PEAK FLOW (cms)= 1.399 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 46.547
TOTAL RAINFALL (mm)= 99.981
RUNOFF COEFFICIENT = .466

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0003)	Area (ha)= 8.40	Curve Number (CN)= 72.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .68		

Unit Hyd Qpeak (cms)= .472

PEAK FLOW (cms)= .415 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 46.549
TOTAL RAINFALL (mm)= 99.981
RUNOFF COEFFICIENT = .466

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0004)	Area (ha)= 6.40	Curve Number (CN)= 72.0	
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .48		

Unit Hyd Qpeak (cms)= .509

PEAK FLOW (cms)= .404 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 46.516
TOTAL RAINFALL (mm)= 99.981
RUNOFF COEFFICIENT = .465

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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** SIMULATION NUMBER: 7 **
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READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\100yrSCSTYPEII124HR.stm
Ptotal=111.61 mm	Comments: 100-Year 24 hour SCS: London Airport

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	1.23	6.25	2.23	12.25	16.07	18.25	2.01
.50	1.23	6.50	2.23	12.50	16.07	18.50	2.01
.75	1.23	6.75	2.23	12.75	8.26	18.75	2.01
1.00	1.23	7.00	2.23	13.00	8.26	19.00	2.01
1.25	1.23	7.25	2.23	13.25	5.80	19.25	2.01
1.50	1.23	7.50	2.23	13.50	6.25	19.50	2.01
1.75	1.23	7.75	2.23	13.75	4.69	19.75	2.01
2.00	1.23	8.00	2.23	14.00	4.69	20.00	2.01

2.25	1.45	8.25	3.01	14.25	3.35	20.25	1.34
2.50	1.45	8.50	3.01	14.50	3.35	20.50	1.34
2.75	1.45	8.75	3.01	14.75	3.35	20.75	1.34
3.00	1.45	9.00	3.01	15.00	3.35	21.00	1.34
3.25	1.45	9.25	3.57	15.25	3.35	21.25	1.34
3.50	1.45	9.50	3.57	15.50	3.35	21.50	1.34
3.75	1.45	9.75	4.02	15.75	3.35	21.75	1.34
4.00	1.45	10.00	4.02	16.00	3.35	22.00	1.34
4.25	1.79	10.25	5.13	16.25	2.01	22.25	1.34
4.50	1.79	10.50	5.13	16.50	2.01	22.50	1.34
4.75	1.79	10.75	6.92	16.75	2.01	22.75	1.34
5.00	1.79	11.00	6.92	17.00	2.01	23.00	1.34
5.25	1.79	11.25	10.71	17.25	2.01	23.25	1.34
5.50	1.79	11.50	10.71	17.50	2.01	23.50	1.34
5.75	1.79	11.75	46.42	17.75	2.01	23.75	1.34
6.00	1.79	12.00	123.20	18.00	2.01	24.00	1.34

CALIB					
NASHYD (0002)	Area (ha)= 27.70	Curve Number (CN)= 72.0			
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00			
	U.H. Tp(hrs)= .66				

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	1.23	6.167	2.23	12.167	16.07	18.17	2.01
.333	1.23	6.333	2.23	12.333	16.07	18.33	2.01
.500	1.23	6.500	2.23	12.500	16.07	18.50	2.01
.667	1.23	6.667	2.23	12.667	8.26	18.67	2.01
.833	1.23	6.833	2.23	12.833	8.26	18.83	2.01
1.000	1.23	7.000	2.23	13.000	8.26	19.00	2.01
1.167	1.23	7.167	2.23	13.167	5.80	19.17	2.01
1.333	1.23	7.333	2.23	13.333	6.03	19.33	2.01
1.500	1.23	7.500	2.23	13.500	6.25	19.50	2.01
1.667	1.23	7.667	2.23	13.667	4.69	19.67	2.01
1.833	1.23	7.833	2.23	13.833	4.69	19.83	2.01
2.000	1.23	8.000	2.23	14.000	4.69	20.00	2.01
2.167	1.45	8.167	3.01	14.167	3.35	20.17	1.34
2.333	1.45	8.333	3.01	14.333	3.35	20.33	1.34
2.500	1.45	8.500	3.01	14.500	3.35	20.50	1.34
2.667	1.45	8.667	3.01	14.667	3.35	20.67	1.34
2.833	1.45	8.833	3.01	14.833	3.35	20.83	1.34
3.000	1.45	9.000	3.01	15.000	3.35	21.00	1.34
3.167	1.45	9.167	3.57	15.167	3.35	21.17	1.34
3.333	1.45	9.333	3.57	15.333	3.35	21.33	1.34
3.500	1.45	9.500	3.57	15.500	3.35	21.50	1.34
3.667	1.45	9.667	4.02	15.667	3.35	21.67	1.34
3.833	1.45	9.833	4.02	15.833	3.35	21.83	1.34
4.000	1.45	10.000	4.02	16.000	3.35	22.00	1.34
4.167	1.79	10.167	5.13	16.167	2.01	22.17	1.34
4.333	1.79	10.333	5.13	16.333	2.01	22.33	1.34
4.500	1.79	10.500	5.13	16.500	2.01	22.50	1.34
4.667	1.79	10.667	6.92	16.667	2.01	22.67	1.34
4.833	1.79	10.833	6.92	16.833	2.01	22.83	1.34
5.000	1.79	11.000	6.92	17.000	2.01	23.00	1.34
5.167	1.79	11.167	10.71	17.167	2.01	23.17	1.34
5.333	1.79	11.333	10.71	17.333	2.01	23.33	1.34
5.500	1.79	11.500	10.71	17.500	2.01	23.50	1.34
5.667	1.79	11.667	46.42	17.667	2.01	23.67	1.34
5.833	1.79	11.833	84.81	17.833	2.01	23.83	1.34
6.000	1.79	12.000	123.20	18.000	2.01	24.00	1.34

Unit Hyd Qpeak (cms)= 1.603

PEAK FLOW (cms)= 1.670 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 55.325
TOTAL RAINFALL (mm)= 111.612
RUNOFF COEFFICIENT = .496

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area (ha)= 8.40	Curve Number (CN)= 72.0			
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00			
	U.H. Tp(hrs)= .68				

Unit Hyd Qpeak (cms)= .472

PEAK FLOW (cms)= .495 (i)
TIME TO PEAK (hrs)= 12.500
RUNOFF VOLUME (mm)= 55.326
TOTAL RAINFALL (mm)= 111.612
RUNOFF COEFFICIENT = .496

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area (ha)= 6.40	Curve Number (CN)= 72.0			
ID= 1 DT=10.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00			
	U.H. Tp(hrs)= .48				

Unit Hyd Qpeak (cms)= .509

PEAK FLOW (cms)= .482 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 55.288
TOTAL RAINFALL (mm)= 111.612
RUNOFF COEFFICIENT = .495

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

FINISH

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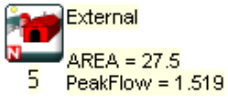
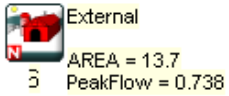
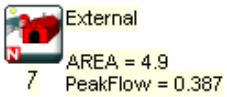
Existing External Flows







Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
5	0.167	27.500	0.394	12.667	14.915	0.000
5	0.167	27.500	0.580	12.667	21.662	0.000
5	0.167	27.500	0.765	12.667	28.351	0.000
5	0.167	27.500	1.062	12.667	38.976	0.000
5	0.167	27.500	1.274	12.667	46.552	0.000
5	0.167	27.500	1.519	12.667	55.330	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
6	0.167	13.700	0.191	12.667	14.915	0.000
6	0.167	13.700	0.281	12.667	21.663	0.000
6	0.167	13.700	0.371	12.667	28.351	0.000
6	0.167	13.700	0.515	12.667	38.977	0.000
6	0.167	13.700	0.618	12.667	46.553	0.000
6	0.167	13.700	0.738	12.667	55.332	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
7	0.167	4.900	0.101	12.333	14.898	0.000
7	0.167	4.900	0.148	12.333	21.637	0.000
7	0.167	4.900	0.195	12.333	28.318	0.000
7	0.167	4.900	0.270	12.333	38.932	0.000
7	0.167	4.900	0.324	12.333	46.498	0.000
7	0.167	4.900	0.387	12.333	55.267	0.000

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================================================================================================================
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       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM, Version 2.0
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O   Licensed To: TMIG
        OOO     T      T    H   H    Y    M   M   OOO                VO2-0145

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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
  Output  filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\12116
VO2 Sept 2013\Existing 24hr SCS - External.out
  Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\12116
VO2 Sept 2013\Existing 24hr SCS - External.sum


DATE: 23/10/2013                          TIME: 3:52:21 PM

USER:


COMMENTS: ____________________________________________________________

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  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************


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|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              SCS Type II - London\2yrSCSTypeII24hr.stm
| Ptotal= 51.56 mm |    Comments: 2-Year 24 hour SCS Type II: London Airpo
--------------------

                TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
                 hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr
                 .25      .57 |  6.25     1.03 | 12.25     7.43 | 18.25      .93
                 .50      .57 |  6.50     1.03 | 12.50     7.43 | 18.50      .93
                 .75      .57 |  6.75     1.03 | 12.75     3.82 | 18.75      .93
                1.00      .57 |  7.00     1.03 | 13.00     3.82 | 19.00      .93
                1.25      .57 |  7.25     1.03 | 13.25     2.68 | 19.25      .93
                1.50      .57 |  7.50     1.03 | 13.50     2.89 | 19.50      .93
                1.75      .57 |  7.75     1.03 | 13.75     2.17 | 19.75      .93
                2.00      .57 |  8.00     1.03 | 14.00     2.17 | 20.00      .93
                2.25      .67 |  8.25     1.39 | 14.25     1.55 | 20.25      .62
                2.50      .67 |  8.50     1.39 | 14.50     1.55 | 20.50      .62
                2.75      .67 |  8.75     1.39 | 14.75     1.55 | 20.75      .62
                3.00      .67 |  9.00     1.39 | 15.00     1.55 | 21.00      .62
                3.25      .67 |  9.25     1.65 | 15.25     1.55 | 21.25      .62
                3.50      .67 |  9.50     1.65 | 15.50     1.55 | 21.50      .62
                3.75      .67 |  9.75     1.86 | 15.75     1.55 | 21.75      .62
                4.00      .67 | 10.00     1.86 | 16.00     1.55 | 22.00      .62
                4.25      .82 | 10.25     2.37 | 16.25      .93 | 22.25      .62
                4.50      .82 | 10.50     2.37 | 16.50      .93 | 22.50      .62
                4.75      .82 | 10.75     3.20 | 16.75      .93 | 22.75      .62
                5.00      .82 | 11.00     3.20 | 17.00      .93 | 23.00      .62
```

5.25	.82	11.25	4.95	17.25	.93	23.25	.62
5.50	.82	11.50	4.95	17.50	.93	23.50	.62
5.75	.82	11.75	21.45	17.75	.93	23.75	.62
6.00	.82	12.00	56.93	18.00	.93	24.00	.62

CALIB					
NASHYD (0005)	Area (ha)=	27.50	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.74			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.57	6.167	1.03	12.167	7.43	18.17	.93
.333	.57	6.333	1.03	12.333	7.43	18.33	.93
.500	.57	6.500	1.03	12.500	7.42	18.50	.93
.667	.57	6.667	1.03	12.667	3.82	18.67	.93
.833	.57	6.833	1.03	12.833	3.82	18.83	.93
1.000	.57	7.000	1.03	13.000	3.82	19.00	.93
1.167	.57	7.167	1.03	13.167	2.68	19.17	.93
1.333	.57	7.333	1.03	13.333	2.78	19.33	.93
1.500	.57	7.500	1.03	13.500	2.89	19.50	.93
1.667	.57	7.667	1.03	13.667	2.17	19.67	.93
1.833	.57	7.833	1.03	13.833	2.17	19.83	.93
2.000	.57	8.000	1.03	14.000	2.17	20.00	.93
2.167	.67	8.167	1.39	14.167	1.55	20.17	.62
2.333	.67	8.333	1.39	14.333	1.55	20.33	.62
2.500	.67	8.500	1.39	14.500	1.55	20.50	.62
2.667	.67	8.667	1.39	14.667	1.55	20.67	.62
2.833	.67	8.833	1.39	14.833	1.55	20.83	.62
3.000	.67	9.000	1.39	15.000	1.55	21.00	.62
3.167	.67	9.167	1.65	15.167	1.55	21.17	.62
3.333	.67	9.333	1.65	15.333	1.55	21.33	.62
3.500	.67	9.500	1.65	15.500	1.55	21.50	.62
3.667	.67	9.667	1.86	15.667	1.55	21.67	.62
3.833	.67	9.833	1.86	15.833	1.55	21.83	.62
4.000	.67	10.000	1.86	16.000	1.55	22.00	.62
4.167	.82	10.167	2.37	16.167	.93	22.17	.62
4.333	.82	10.333	2.37	16.333	.93	22.33	.62
4.500	.82	10.500	2.37	16.500	.93	22.50	.62
4.667	.82	10.667	3.20	16.667	.93	22.67	.62
4.833	.82	10.833	3.20	16.833	.93	22.83	.62
5.000	.82	11.000	3.20	17.000	.93	23.00	.62
5.167	.82	11.167	4.95	17.167	.93	23.17	.62
5.333	.82	11.333	4.95	17.333	.93	23.33	.62
5.500	.82	11.500	4.95	17.500	.93	23.50	.62
5.667	.82	11.667	21.45	17.667	.93	23.67	.62
5.833	.82	11.833	39.19	17.833	.93	23.83	.62
6.000	.82	12.000	56.93	18.000	.93	24.00	.62

Unit Hyd Qpeak (cms)= 1.419

PEAK FLOW (cms)= .394 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 14.915
TOTAL RAINFALL (mm)= 51.563
RUNOFF COEFFICIENT = .289

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0006)	Area (ha)=	13.70	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.77			

Unit Hyd Qpeak (cms)= .680

PEAK FLOW (cms)= .191 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 14.915
TOTAL RAINFALL (mm)= 51.563
RUNOFF COEFFICIENT = .289

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0007)	Area (ha)=	4.90	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.44			

Unit Hyd Qpeak (cms)= .425

PEAK FLOW (cms)= .101 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 14.898
TOTAL RAINFALL (mm)= 51.563
RUNOFF COEFFICIENT = .289

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 2 **
****

READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\5yrSCSTypeII24hr.stm
Ptotal= 63.35 mm	Comments: 5-Year 24 hour SCS Type II: London Airpo

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.70	6.25	1.27	12.25	9.12	18.25	1.14
.50	.70	6.50	1.27	12.50	9.12	18.50	1.14
.75	.70	6.75	1.27	12.75	4.69	18.75	1.14
1.00	.70	7.00	1.27	13.00	4.69	19.00	1.14
1.25	.70	7.25	1.27	13.25	3.29	19.25	1.14
1.50	.70	7.50	1.27	13.50	3.55	19.50	1.14
1.75	.70	7.75	1.27	13.75	2.66	19.75	1.14
2.00	.70	8.00	1.27	14.00	2.66	20.00	1.14
2.25	.82	8.25	1.71	14.25	1.90	20.25	.76
2.50	.82	8.50	1.71	14.50	1.90	20.50	.76
2.75	.82	8.75	1.71	14.75	1.90	20.75	.76
3.00	.82	9.00	1.71	15.00	1.90	21.00	.76
3.25	.82	9.25	2.03	15.25	1.90	21.25	.76
3.50	.82	9.50	2.03	15.50	1.90	21.50	.76
3.75	.82	9.75	2.28	15.75	1.90	21.75	.76
4.00	.82	10.00	2.28	16.00	1.90	22.00	.76
4.25	1.01	10.25	2.91	16.25	1.14	22.25	.76
4.50	1.01	10.50	2.91	16.50	1.14	22.50	.76
4.75	1.01	10.75	3.93	16.75	1.14	22.75	.76
5.00	1.01	11.00	3.93	17.00	1.14	23.00	.76
5.25	1.01	11.25	6.08	17.25	1.14	23.25	.76
5.50	1.01	11.50	6.08	17.50	1.14	23.50	.76
5.75	1.01	11.75	26.35	17.75	1.14	23.75	.76
6.00	1.01	12.00	69.93	18.00	1.14	24.00	.76

CALIB					
NASHYD (0005)	Area (ha)=	27.50	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.74			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.70	6.167	1.27	12.167	9.12	18.17	1.14
.333	.70	6.333	1.27	12.333	9.12	18.33	1.14
.500	.70	6.500	1.27	12.500	9.12	18.50	1.14
.667	.70	6.667	1.27	12.667	4.69	18.67	1.14
.833	.70	6.833	1.27	12.833	4.69	18.83	1.14
1.000	.70	7.000	1.27	13.000	4.69	19.00	1.14
1.167	.70	7.167	1.27	13.167	3.29	19.17	1.14
1.333	.70	7.333	1.27	13.333	3.42	19.33	1.14
1.500	.70	7.500	1.27	13.500	3.55	19.50	1.14
1.667	.70	7.667	1.27	13.667	2.66	19.67	1.14
1.833	.70	7.833	1.27	13.833	2.66	19.83	1.14
2.000	.70	8.000	1.27	14.000	2.66	20.00	1.14
2.167	.82	8.167	1.71	14.167	1.90	20.17	.76
2.333	.82	8.333	1.71	14.333	1.90	20.33	.76
2.500	.82	8.500	1.71	14.500	1.90	20.50	.76
2.667	.82	8.667	1.71	14.667	1.90	20.67	.76
2.833	.82	8.833	1.71	14.833	1.90	20.83	.76
3.000	.82	9.000	1.71	15.000	1.90	21.00	.76
3.167	.82	9.167	2.03	15.167	1.90	21.17	.76
3.333	.82	9.333	2.03	15.333	1.90	21.33	.76
3.500	.82	9.500	2.03	15.500	1.90	21.50	.76
3.667	.82	9.667	2.28	15.667	1.90	21.67	.76
3.833	.82	9.833	2.28	15.833	1.90	21.83	.76
4.000	.82	10.000	2.28	16.000	1.90	22.00	.76
4.167	1.01	10.167	2.91	16.167	1.14	22.17	.76
4.333	1.01	10.333	2.91	16.333	1.14	22.33	.76
4.500	1.01	10.500	2.91	16.500	1.14	22.50	.76
4.667	1.01	10.667	3.93	16.667	1.14	22.67	.76
4.833	1.01	10.833	3.93	16.833	1.14	22.83	.76
5.000	1.01	11.000	3.93	17.000	1.14	23.00	.76
5.167	1.01	11.167	6.08	17.167	1.14	23.17	.76
5.333	1.01	11.333	6.08	17.333	1.14	23.33	.76
5.500	1.01	11.500	6.08	17.500	1.14	23.50	.76
5.667	1.01	11.667	26.35	17.667	1.14	23.67	.76
5.833	1.01	11.833	48.14	17.833	1.14	23.83	.76
6.000	1.01	12.000	69.93	18.000	1.14	24.00	.76

Unit Hyd Qpeak (cms)= 1.419

PEAK FLOW (cms)= .580 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 21.662
TOTAL RAINFALL (mm)= 63.346
RUNOFF COEFFICIENT = .342

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0006)	Area (ha)=	13.70	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.77			

Unit Hyd Qpeak (cms)= .680

PEAK FLOW (cms)= .281 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 21.663
TOTAL RAINFALL (mm)= 63.346
RUNOFF COEFFICIENT = .342

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0007)	Area (ha)=	4.90	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.44			

Unit Hyd Qpeak (cms)= .425

PEAK FLOW (cms)= .148 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 21.637
TOTAL RAINFALL (mm)= 63.346
RUNOFF COEFFICIENT = .342

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 3 **
****

READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\10yrSCSTypeII24hr.stm
Ptotal= 73.97 mm	Comments: 10-Year 24 hour SCS Type II: London Airp

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.81	6.25	1.48	12.25	10.65	18.25	1.33
.50	.81	6.50	1.48	12.50	10.65	18.50	1.33
.75	.81	6.75	1.48	12.75	5.47	18.75	1.33
1.00	.81	7.00	1.48	13.00	5.47	19.00	1.33
1.25	.81	7.25	1.48	13.25	3.85	19.25	1.33
1.50	.81	7.50	1.48	13.50	4.14	19.50	1.33
1.75	.81	7.75	1.48	13.75	3.11	19.75	1.33
2.00	.81	8.00	1.48	14.00	3.11	20.00	1.33
2.25	.96	8.25	2.00	14.25	2.22	20.25	.89
2.50	.96	8.50	2.00	14.50	2.22	20.50	.89
2.75	.96	8.75	2.00	14.75	2.22	20.75	.89
3.00	.96	9.00	2.00	15.00	2.22	21.00	.89
3.25	.96	9.25	2.37	15.25	2.22	21.25	.89
3.50	.96	9.50	2.37	15.50	2.22	21.50	.89
3.75	.96	9.75	2.66	15.75	2.22	21.75	.89
4.00	.96	10.00	2.66	16.00	2.22	22.00	.89
4.25	1.18	10.25	3.40	16.25	1.33	22.25	.89
4.50	1.18	10.50	3.40	16.50	1.33	22.50	.89
4.75	1.18	10.75	4.59	16.75	1.33	22.75	.89
5.00	1.18	11.00	4.59	17.00	1.33	23.00	.89
5.25	1.18	11.25	7.10	17.25	1.33	23.25	.89
5.50	1.18	11.50	7.10	17.50	1.33	23.50	.89
5.75	1.18	11.75	30.77	17.75	1.33	23.75	.89
6.00	1.18	12.00	81.66	18.00	1.33	24.00	.89

CALIB					
NASHYD (0005)	Area (ha)=	27.50	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.74			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.81	6.167	1.48	12.167	10.65	18.17	1.33
.333	.81	6.333	1.48	12.333	10.65	18.33	1.33
.500	.81	6.500	1.48	12.500	10.65	18.50	1.33
.667	.81	6.667	1.48	12.667	5.47	18.67	1.33
.833	.81	6.833	1.48	12.833	5.47	18.83	1.33

1.000	.81	7.000	1.48	13.000	5.47	19.00	1.33
1.167	.81	7.167	1.48	13.167	3.85	19.17	1.33
1.333	.81	7.333	1.48	13.333	3.99	19.33	1.33
1.500	.81	7.500	1.48	13.500	4.14	19.50	1.33
1.667	.81	7.667	1.48	13.667	3.11	19.67	1.33
1.833	.81	7.833	1.48	13.833	3.11	19.83	1.33
2.000	.81	8.000	1.48	14.000	3.11	20.00	1.33
2.167	.96	8.167	2.00	14.167	2.22	20.17	.89
2.333	.96	8.333	2.00	14.333	2.22	20.33	.89
2.500	.96	8.500	2.00	14.500	2.22	20.50	.89
2.667	.96	8.667	2.00	14.667	2.22	20.67	.89
2.833	.96	8.833	2.00	14.833	2.22	20.83	.89
3.000	.96	9.000	2.00	15.000	2.22	21.00	.89
3.167	.96	9.167	2.37	15.167	2.22	21.17	.89
3.333	.96	9.333	2.37	15.333	2.22	21.33	.89
3.500	.96	9.500	2.37	15.500	2.22	21.50	.89
3.667	.96	9.667	2.66	15.667	2.22	21.67	.89
3.833	.96	9.833	2.66	15.833	2.22	21.83	.89
4.000	.96	10.000	2.66	16.000	2.22	22.00	.89
4.167	1.18	10.167	3.40	16.167	1.33	22.17	.89
4.333	1.18	10.333	3.40	16.333	1.33	22.33	.89
4.500	1.18	10.500	3.40	16.500	1.33	22.50	.89
4.667	1.18	10.667	4.59	16.667	1.33	22.67	.89
4.833	1.18	10.833	4.59	16.833	1.33	22.83	.89
5.000	1.18	11.000	4.59	17.000	1.33	23.00	.89
5.167	1.18	11.167	7.10	17.167	1.33	23.17	.89
5.333	1.18	11.333	7.10	17.333	1.33	23.33	.89
5.500	1.18	11.500	7.10	17.500	1.33	23.50	.89
5.667	1.18	11.667	30.77	17.667	1.33	23.67	.89
5.833	1.18	11.833	56.22	17.833	1.33	23.83	.89
6.000	1.18	12.000	81.66	18.000	1.33	24.00	.89

Unit Hyd Qpeak (cms)= 1.419

PEAK FLOW (cms)= .765 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 28.351
TOTAL RAINFALL (mm)= 73.968
RUNOFF COEFFICIENT = .383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0006)	Area	(ha)= 13.70	Curve Number	(CN)= 72.0	
ID= 1 DT=10.0 min	Ia	(mm)= 5.00	# of Linear Res.	(N)= 3.00	
	U.H. Tp	(hrs)= .77			

Unit Hyd Qpeak (cms)= .680

PEAK FLOW (cms)= .371 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 28.351
TOTAL RAINFALL (mm)= 73.968
RUNOFF COEFFICIENT = .383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0007)	Area	(ha)= 4.90	Curve Number	(CN)= 72.0	
ID= 1 DT=10.0 min	Ia	(mm)= 5.00	# of Linear Res.	(N)= 3.00	
	U.H. Tp	(hrs)= .44			

Unit Hyd Qpeak (cms)= .425

PEAK FLOW (cms)= .195 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 28.318
TOTAL RAINFALL (mm)= 73.968
RUNOFF COEFFICIENT = .383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 4 **
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READ STORM | Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\25yrSCSTypeII24hr.stm
Ptotal= 89.53 mm | Comments: 25-Year 24 hour SCS Type II: London Airp

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.98	6.25	1.79	12.25	12.89	18.25	1.61
.50	.98	6.50	1.79	12.50	12.89	18.50	1.61
.75	.98	6.75	1.79	12.75	6.63	18.75	1.61
1.00	.98	7.00	1.79	13.00	6.63	19.00	1.61
1.25	.98	7.25	1.79	13.25	4.66	19.25	1.61
1.50	.98	7.50	1.79	13.50	5.01	19.50	1.61
1.75	.98	7.75	1.79	13.75	3.76	19.75	1.61
2.00	.98	8.00	1.79	14.00	3.76	20.00	1.61
2.25	1.16	8.25	2.42	14.25	2.69	20.25	1.07
2.50	1.16	8.50	2.42	14.50	2.69	20.50	1.07
2.75	1.16	8.75	2.42	14.75	2.69	20.75	1.07
3.00	1.16	9.00	2.42	15.00	2.69	21.00	1.07
3.25	1.16	9.25	2.87	15.25	2.69	21.25	1.07
3.50	1.16	9.50	2.87	15.50	2.69	21.50	1.07
3.75	1.16	9.75	3.22	15.75	2.69	21.75	1.07
4.00	1.16	10.00	3.22	16.00	2.69	22.00	1.07
4.25	1.43	10.25	4.12	16.25	1.61	22.25	1.07
4.50	1.43	10.50	4.12	16.50	1.61	22.50	1.07
4.75	1.43	10.75	5.55	16.75	1.61	22.75	1.07
5.00	1.43	11.00	5.55	17.00	1.61	23.00	1.07
5.25	1.43	11.25	8.60	17.25	1.61	23.25	1.07
5.50	1.43	11.50	8.60	17.50	1.61	23.50	1.07
5.75	1.43	11.75	37.25	17.75	1.61	23.75	1.07
6.00	1.43	12.00	98.84	18.00	1.61	24.00	1.07

CALIB					
NASHYD (0005)	Area	(ha)= 27.50	Curve Number	(CN)= 72.0	
ID= 1 DT=10.0 min	Ia	(mm)= 5.00	# of Linear Res.	(N)= 3.00	
	U.H. Tp	(hrs)= .74			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	.98	6.167	1.79	12.167	12.89	18.17	1.61
.333	.98	6.333	1.79	12.333	12.89	18.33	1.61
.500	.98	6.500	1.79	12.500	12.89	18.50	1.61
.667	.98	6.667	1.79	12.667	6.63	18.67	1.61
.833	.98	6.833	1.79	12.833	6.63	18.83	1.61
1.000	.98	7.000	1.79	13.000	6.62	19.00	1.61
1.167	.98	7.167	1.79	13.167	4.66	19.17	1.61
1.333	.98	7.333	1.79	13.333	4.84	19.33	1.61
1.500	.98	7.500	1.79	13.500	5.01	19.50	1.61
1.667	.98	7.667	1.79	13.667	3.76	19.67	1.61
1.833	.98	7.833	1.79	13.833	3.76	19.83	1.61
2.000	.98	8.000	1.79	14.000	3.76	20.00	1.61
2.167	1.16	8.167	2.42	14.167	2.69	20.17	1.07
2.333	1.16	8.333	2.42	14.333	2.69	20.33	1.07
2.500	1.16	8.500	2.42	14.500	2.69	20.50	1.07
2.667	1.16	8.667	2.42	14.667	2.69	20.67	1.07
2.833	1.16	8.833	2.42	14.833	2.69	20.83	1.07

3.000	1.16	9.000	2.42	15.000	2.69	21.00	1.07
3.167	1.16	9.167	2.86	15.167	2.69	21.17	1.07
3.333	1.16	9.333	2.87	15.333	2.69	21.33	1.07
3.500	1.16	9.500	2.87	15.500	2.69	21.50	1.07
3.667	1.16	9.667	3.22	15.667	2.69	21.67	1.07
3.833	1.16	9.833	3.22	15.833	2.69	21.83	1.07
4.000	1.16	10.000	3.22	16.000	2.69	22.00	1.07
4.167	1.43	10.167	4.12	16.167	1.61	22.17	1.07
4.333	1.43	10.333	4.12	16.333	1.61	22.33	1.07
4.500	1.43	10.500	4.12	16.500	1.61	22.50	1.07
4.667	1.43	10.667	5.55	16.667	1.61	22.67	1.07
4.833	1.43	10.833	5.55	16.833	1.61	22.83	1.07
5.000	1.43	11.000	5.55	17.000	1.61	23.00	1.07
5.167	1.43	11.167	8.60	17.167	1.61	23.17	1.07
5.333	1.43	11.333	8.60	17.333	1.61	23.33	1.07
5.500	1.43	11.500	8.60	17.500	1.61	23.50	1.07
5.667	1.43	11.667	37.25	17.667	1.61	23.67	1.07
5.833	1.43	11.833	68.05	17.833	1.61	23.83	1.07
6.000	1.43	12.000	98.84	18.000	1.61	24.00	1.07

Unit Hyd Qpeak (cms)= 1.419

PEAK FLOW (cms)= 1.062 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 38.976
TOTAL RAINFALL (mm)= 89.534
RUNOFF COEFFICIENT = .435

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0006)	Area	(ha)= 13.70	Curve Number	(CN)= 72.0	
ID= 1 DT=10.0 min	Ia	(mm)= 5.00	# of Linear Res.	(N)= 3.00	
	U.H. Tp	(hrs)= .77			

Unit Hyd Qpeak (cms)= .680

PEAK FLOW (cms)= .515 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 38.977
TOTAL RAINFALL (mm)= 89.534
RUNOFF COEFFICIENT = .435

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0007)	Area	(ha)= 4.90	Curve Number	(CN)= 72.0	
ID= 1 DT=10.0 min	Ia	(mm)= 5.00	# of Linear Res.	(N)= 3.00	
	U.H. Tp	(hrs)= .44			

Unit Hyd Qpeak (cms)= .425

PEAK FLOW (cms)= .270 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 38.932
TOTAL RAINFALL (mm)= 89.534
RUNOFF COEFFICIENT = .435

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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** SIMULATION NUMBER: 5 **
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READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\
	SCS Type II - London\50yrSCSTypeII24hr.stm
Ptotal= 99.98 mm	Comments: 50-Year 24 hour SCS Type II: London Airp

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	1.10	6.25	2.00	12.25	14.40	18.25	1.80
.50	1.10	6.50	2.00	12.50	14.40	18.50	1.80
.75	1.10	6.75	2.00	12.75	7.40	18.75	1.80
1.00	1.10	7.00	2.00	13.00	7.40	19.00	1.80
1.25	1.10	7.25	2.00	13.25	5.20	19.25	1.80
1.50	1.10	7.50	2.00	13.50	5.60	19.50	1.80
1.75	1.10	7.75	2.00	13.75	4.20	19.75	1.80
2.00	1.10	8.00	2.00	14.00	4.20	20.00	1.80
2.25	1.30	8.25	2.70	14.25	3.00	20.25	1.20
2.50	1.30	8.50	2.70	14.50	3.00	20.50	1.20
2.75	1.30	8.75	2.70	14.75	3.00	20.75	1.20
3.00	1.30	9.00	2.70	15.00	3.00	21.00	1.20
3.25	1.30	9.25	3.20	15.25	3.00	21.25	1.20
3.50	1.30	9.50	3.20	15.50	3.00	21.50	1.20
3.75	1.30	9.75	3.60	15.75	3.00	21.75	1.20
4.00	1.30	10.00	3.60	16.00	3.00	22.00	1.20
4.25	1.60	10.25	4.60	16.25	1.80	22.25	1.20
4.50	1.60	10.50	4.60	16.50	1.80	22.50	1.20
4.75	1.60	10.75	6.20	16.75	1.80	22.75	1.20
5.00	1.60	11.00	6.20	17.00	1.80	23.00	1.20
5.25	1.60	11.25	9.60	17.25	1.80	23.25	1.20
5.50	1.60	11.50	9.60	17.50	1.80	23.50	1.20
5.75	1.60	11.75	41.59	17.75	1.80	23.75	1.20
6.00	1.60	12.00	110.37	18.00	1.80	24.00	1.20

CALIB					
NASHYD (0005)	Area	(ha)= 27.50	Curve Number	(CN)= 72.0	
ID= 1 DT=10.0 min	Ia	(mm)= 5.00	# of Linear Res.	(N)= 3.00	
	U.H. Tp	(hrs)= .74			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	1.10	6.167	2.00	12.167	14.40	18.17	1.80
.333	1.10	6.333	2.00	12.333	14.40	18.33	1.80
.500	1.10	6.500	2.00	12.500	14.40	18.50	1.80
.667	1.10	6.667	2.00	12.667	7.40	18.67	1.80
.833	1.10	6.833	2.00	12.833	7.40	18.83	1.80
1.000	1.10	7.000	2.00	13.000	7.40	19.00	1.80
1.167	1.10	7.167	2.00	13.167	5.20	19.17	1.80
1.333	1.10	7.333	2.00	13.333	5.40	19.33	1.80
1.500	1.10	7.500	2.00	13.500	5.60	19.50	1.80
1.667	1.10	7.667	2.00	13.667	4.20	19.67	1.80
1.833	1.10	7.833	2.00	13.833	4.20	19.83	1.80
2.000	1.10	8.000	2.00	14.000	4.20	20.00	1.80
2.167	1.30	8.167	2.70	14.167	3.00	20.17	1.20
2.333	1.30	8.333	2.70	14.333	3.00	20.33	1.20
2.500	1.30	8.500	2.70	14.500	3.00	20.50	1.20
2.667	1.30	8.667	2.70	14.667	3.00	20.67	1.20
2.833	1.30	8.833	2.70	14.833	3.00	20.83	1.20
3.000	1.30	9.000	2.70	15.000	3.00	21.00	1.20
3.167	1.30	9.167	3.20	15.167	3.00	21.17	1.20
3.333	1.30	9.333	3.20	15.333	3.00	21.33	1.20
3.500	1.30	9.500	3.20	15.500	3.00	21.50	1.20
3.667	1.30	9.667	3.60	15.667	3.00	21.67	1.20
3.833	1.30	9.833	3.60	15.833	3.00	21.83	1.20
4.000	1.30	10.000	3.60	16.000	3.00	22.00	1.20
4.167	1.60	10.167	4.60	16.167	1.80	22.17	1.20
4.333	1.60	10.333	4.60	16.333	1.80	22.33	1.20
4.500	1.60	10.500	4.60	16.500	1.80	22.50	1.20
4.667	1.60	10.667	6.20	16.667	1.80	22.67	1.20
4.833	1.60	10.833	6.20	16.833	1.80	22.83	1.20

5.000	1.60	11.000	6.20	17.000	1.80	23.00	1.20
5.167	1.60	11.167	9.60	17.167	1.80	23.17	1.20
5.333	1.60	11.333	9.60	17.333	1.80	23.33	1.20
5.500	1.60	11.500	9.60	17.500	1.80	23.50	1.20
5.667	1.60	11.667	41.59	17.667	1.80	23.67	1.20
5.833	1.60	11.833	75.98	17.833	1.80	23.83	1.20
6.000	1.60	12.000	110.37	18.000	1.80	24.00	1.20

Unit Hyd Qpeak (cms)= 1.419

PEAK FLOW (cms)= 1.274 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 46.552
TOTAL RAINFALL (mm)= 99.981
RUNOFF COEFFICIENT = .466

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0006)	Area (ha)=	13.70	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.77			

Unit Hyd Qpeak (cms)= .680

PEAK FLOW (cms)= .618 (i)
TIME TO PEAK (hrs)= 12.667
RUNOFF VOLUME (mm)= 46.553
TOTAL RAINFALL (mm)= 99.981
RUNOFF COEFFICIENT = .466

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0007)	Area (ha)=	4.90	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.44			

Unit Hyd Qpeak (cms)= .425

PEAK FLOW (cms)= .324 (i)
TIME TO PEAK (hrs)= 12.333
RUNOFF VOLUME (mm)= 46.498
TOTAL RAINFALL (mm)= 99.981
RUNOFF COEFFICIENT = .465

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 6 **
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READ STORM	Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\100yrSCSTYPEII124HR.stm	
Ptotal=111.61 mm	Comments: 100-Year 24 hour SCS: London Airport	

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	1.23	6.25	2.23	12.25	16.07	18.25	2.01
.50	1.23	6.50	2.23	12.50	16.07	18.50	2.01
.75	1.23	6.75	2.23	12.75	8.26	18.75	2.01
1.00	1.23	7.00	2.23	13.00	8.26	19.00	2.01
1.25	1.23	7.25	2.23	13.25	5.80	19.25	2.01
1.50	1.23	7.50	2.23	13.50	6.25	19.50	2.01
1.75	1.23	7.75	2.23	13.75	4.69	19.75	2.01
2.00	1.23	8.00	2.23	14.00	4.69	20.00	2.01
2.25	1.45	8.25	3.01	14.25	3.35	20.25	1.34
2.50	1.45	8.50	3.01	14.50	3.35	20.50	1.34
2.75	1.45	8.75	3.01	14.75	3.35	20.75	1.34
3.00	1.45	9.00	3.01	15.00	3.35	21.00	1.34
3.25	1.45	9.25	3.57	15.25	3.35	21.25	1.34
3.50	1.45	9.50	3.57	15.50	3.35	21.50	1.34
3.75	1.45	9.75	4.02	15.75	3.35	21.75	1.34
4.00	1.45	10.00	4.02	16.00	3.35	22.00	1.34
4.25	1.79	10.25	5.13	16.25	2.01	22.25	1.34
4.50	1.79	10.50	5.13	16.50	2.01	22.50	1.34
4.75	1.79	10.75	6.92	16.75	2.01	22.75	1.34
5.00	1.79	11.00	6.92	17.00	2.01	23.00	1.34
5.25	1.79	11.25	10.71	17.25	2.01	23.25	1.34
5.50	1.79	11.50	10.71	17.50	2.01	23.50	1.34
5.75	1.79	11.75	46.42	17.75	2.01	23.75	1.34
6.00	1.79	12.00	123.20	18.00	2.01	24.00	1.34

CALIB					
NASHYD (0005)	Area (ha)=	27.50	Curve Number (CN)=	72.0	
ID= 1 DT=10.0 min	Ia (mm)=	5.00	# of Linear Res.(N)=	3.00	
	U.H. Tp(hrs)=	.74			

NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.167	1.23	6.167	2.23	12.167	16.07	18.17	2.01
.333	1.23	6.333	2.23	12.333	16.07	18.33	2.01
.500	1.23	6.500	2.23	12.500	16.07	18.50	2.01
.667	1.23	6.667	2.23	12.667	8.26	18.67	2.01
.833	1.23	6.833	2.23	12.833	8.26	18.83	2.01
1.000	1.23	7.000	2.23	13.000	8.26	19.00	2.01
1.167	1.23	7.167	2.23	13.167	5.80	19.17	2.01
1.333	1.23	7.333	2.23	13.333	6.03	19.33	2.01
1.500	1.23	7.500	2.23	13.500	6.25	19.50	2.01
1.667	1.23	7.667	2.23	13.667	4.69	19.67	2.01
1.833	1.23	7.833	2.23	13.833	4.69	19.83	2.01
2.000	1.23	8.000	2.23	14.000	4.69	20.00	2.01
2.167	1.45	8.167	3.01	14.167	3.35	20.17	1.34
2.333	1.45	8.333	3.01	14.333	3.35	20.33	1.34
2.500	1.45	8.500	3.01	14.500	3.35	20.50	1.34
2.667	1.45	8.667	3.01	14.667	3.35	20.67	1.34
2.833	1.45	8.833	3.01	14.833	3.35	20.83	1.34
3.000	1.45	9.000	3.01	15.000	3.35	21.00	1.34
3.167	1.45	9.167	3.57	15.167	3.35	21.17	1.34
3.333	1.45	9.333	3.57	15.333	3.35	21.33	1.34
3.500	1.45	9.500	3.57	15.500	3.35	21.50	1.34
3.667	1.45	9.667	4.02	15.667	3.35	21.67	1.34
3.833	1.45	9.833	4.02	15.833	3.35	21.83	1.34
4.000	1.45	10.000	4.02	16.000	3.35	22.00	1.34
4.167	1.79	10.167	5.13	16.167	2.01	22.17	1.34
4.333	1.79	10.333	5.13	16.333	2.01	22.33	1.34
4.500	1.79	10.500	5.13	16.500	2.01	22.50	1.34
4.667	1.79	10.667	6.92	16.667	2.01	22.67	1.34
4.833	1.79	10.833	6.92	16.833	2.01	22.83	1.34
5.000	1.79	11.000	6.92	17.000	2.01	23.00	1.34
5.167	1.79	11.167	10.71	17.167	2.01	23.17	1.34
5.333	1.79	11.333	10.71	17.333	2.01	23.33	1.34
5.500	1.79	11.500	10.71	17.500	2.01	23.50	1.34
5.667	1.79	11.667	46.42	17.667	2.01	23.67	1.34
5.833	1.79	11.833	84.81	17.833	2.01	23.83	1.34
6.000	1.79	12.000	123.20	18.000	2.01	24.00	1.34

Unit Hyd Qpeak (cms)= 1.419

PEAK FLOW (cms)= 1.519 (i)
TIME TO PEAK (hrs)= 12.667

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     RUNOFF VOLUME     (mm)=  55.330
     TOTAL RAINFALL    (mm)= 111.612
     RUNOFF COEFFICIENT   =    .496

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB             |
| NASHYD    (0006) |   Area     (ha)=  13.70   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .77

     Unit Hyd Qpeak  (cms)=    .680

     PEAK FLOW       (cms)=    .738 (i)
     TIME TO PEAK    (hrs)=  12.667
     RUNOFF VOLUME     (mm)=  55.332
     TOTAL RAINFALL    (mm)= 111.612
     RUNOFF COEFFICIENT   =    .496

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB             |
| NASHYD    (0007) |   Area     (ha)=   4.90   Curve Number    (CN)= 72.0
|ID= 1 DT=10.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=    .44

     Unit Hyd Qpeak  (cms)=    .425

     PEAK FLOW       (cms)=    .387 (i)
     TIME TO PEAK    (hrs)=  12.333
     RUNOFF VOLUME     (mm)=  55.267
     TOTAL RAINFALL    (mm)= 111.612
     RUNOFF COEFFICIENT   =    .495

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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 FINISH
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Appendix C:

Hydraulic Analysis of Dingman Creek

ORIGINAL
EXISTING SCENARIO

HEC-RAS Plan: existing River: Dingman Creek Reach: Reach-9 Profile: 1:250 Existing

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)	(1000 m3)	(1000 m3)	(1000 m3)
Reach-9	36.9135	1:250 Existing	26.70	260.20	262.53		262.58	0.000582	1.12	36.99	64.25	0.24	139.66	115.67	217.49	472.81
Reach-9	36.7485	1:250 Existing	26.70	260.30	262.47		262.49	0.000410	0.89	50.35	83.13	0.20	136.38	113.86	215.44	465.67
Reach-9	36.5735	1:250 Existing	26.70	260.20	262.42		262.44	0.000246	0.71	56.38	74.85	0.16	132.14	111.63	212.72	456.49
Reach-9	36.5615	1:250 Existing	26.70	260.20	262.38	260.93	262.42	0.000346	0.89	29.87	104.92	0.19	131.79	111.30	212.60	455.70
Reach-9	36.5575		Bridge													
Reach-9	36.5535	1:250 Existing	29.40	260.20	262.38	260.98	262.43	0.000215	0.99	29.84	104.77	0.21	131.55	111.30	212.60	455.46
Reach-9	36.4865	1:250 Existing	29.40	260.10	262.37		262.39	0.000322	0.85	58.69	91.44	0.18	129.75	110.60	211.05	451.40
Reach-9	36.3115	1:250 Existing	29.40	259.80	262.23		262.30	0.000930	1.32	32.06	39.44	0.29	126.17	107.50	209.92	443.59
Reach-9	36.1465	1:250 Existing	29.40	259.70	262.10		262.15	0.000840	1.22	41.42	66.76	0.27	123.59	105.34	208.78	437.71
Reach-9	35.9765	1:250 Existing	29.40	259.60	262.01		262.03	0.000500	0.85	65.11	110.92	0.20	121.27	100.29	206.28	427.84
Reach-9	35.8065	1:250 Existing	29.40	259.50	261.92		261.94	0.000585	0.93	53.83	88.66	0.22	118.68	95.79	204.64	419.12
Reach-9	35.6165	1:250 Existing	29.40	259.40	261.72		261.78	0.001133	1.31	31.83	44.44	0.32	115.38	90.98	204.14	410.50
Reach-9	35.3965	1:250 Existing	29.40	259.20	261.54		261.58	0.000834	1.21	40.75	61.89	0.27	111.91	89.48	202.43	403.82
Reach-9	35.2315	1:250 Existing	29.40	259.10	261.08		261.31	0.003286	2.27	16.28	23.35	0.53	109.79	89.11	199.74	398.64
Reach-9	35.0415	1:250 Existing	29.40	258.90	261.01		261.05	0.000677	1.09	57.72	124.06	0.25	107.05	88.90	199.30	395.26
Reach-9	34.9415	1:250 Existing	32.40	258.80	260.94		260.99	0.000700	1.11	47.40	44.17	0.26	105.22	87.65	197.97	390.84
Reach-9	34.7265	1:250 Existing	32.40	258.60	260.76		260.83	0.001156	1.36	40.76	51.97	0.32	101.33	86.74	196.77	384.84
Reach-9	34.5515	1:250 Existing	32.40	258.40	260.68		260.72	0.000552	1.01	51.34	88.79	0.23	97.58	86.50	196.54	380.62
Reach-9	34.3515	1:250 Existing	32.40	258.30	260.59		260.61	0.000474	0.83	62.85	90.01	0.20	92.96	85.33	191.41	369.70
Reach-9	34.1815	1:250 Existing	32.40	258.20	260.59		260.59	0.000073	0.39	144.90	155.52	0.08	89.04	83.30	189.97	362.31
Reach-9	34.1665	1:250 Existing	32.40	258.35	260.49	259.18	260.55	0.000575	1.10	29.36	98.93	0.24	88.62	83.19	188.83	360.65
Reach-9	34.1615		Bridge													
Reach-9	34.1565	1:250 Existing	32.40	258.35	260.49	259.18	260.55	0.000295	1.11	29.29	98.88	0.24	88.33	83.19	188.83	360.36
Reach-9	34.1425	1:250 Existing	32.40	258.20	260.49		260.51	0.000356	0.85	69.14	98.92	0.19	88.00	83.01	188.33	359.34
Reach-9	33.9725	1:250 Existing	32.40	258.00	260.31		260.40	0.001484	1.32	28.84	46.61	0.35	84.36	83.00	184.00	351.36
Reach-9	33.9485	1:250 Existing	32.40	258.11	260.26	259.09	260.37	0.000870	1.41	23.05	50.40	0.31	83.79	82.76	183.95	350.50
Reach-9	33.9465		Bridge													
Reach-9	33.9445	1:250 Existing	32.40	258.11	260.26	259.09	260.36	0.000446	1.41	23.02	50.14	0.31	83.70	82.76	183.95	350.41
Reach-9	33.9235	1:250 Existing	32.40	258.00	260.26		260.30	0.000559	1.03	83.01	97.03	0.23	83.25	82.01	183.83	349.09
Reach-9	33.7285	1:250 Existing	32.40	257.80	260.17		260.19	0.000512	0.80	97.50	174.15	0.21	78.51	71.54	180.72	330.77
Reach-9	33.5385	1:250 Existing	32.40	257.70	259.90		260.02	0.001573	1.60	32.24	41.07	0.38	74.03	63.99	179.08	317.09
Reach-9	33.3635	1:250 Existing	32.40	257.60	259.78		259.82	0.000668	1.05	80.45	125.27	0.25	70.55	62.93	173.00	306.47
Reach-9	33.0835	1:250 Existing	32.40	257.50	259.39		259.49	0.002616	1.53	36.46	77.47	0.46	64.96	62.82	164.23	292.01
Reach-9	32.8085	1:250 Existing	32.40	257.20	259.05		259.09	0.000970	1.15	83.70	150.77	0.29	60.06	62.40	156.34	278.80
Reach-9	32.5785	1:250 Existing	32.40	256.90	258.77		258.84	0.001346	1.28	38.17	54.25	0.34	55.79	61.36	148.19	265.33
Reach-9	32.3335	1:250 Existing	32.40	256.60	258.52		258.57	0.001084	1.09	41.19	62.99	0.30	50.42	60.58	147.05	258.05
Reach-9	32.1335	1:250 Existing	32.40	256.40	258.28		258.34	0.001391	1.16	47.50	122.82	0.34	45.91	58.88	145.38	250.16
Reach-9	32.1155	1:250 Existing	32.40	256.39	258.20	257.24	258.29	0.001009	1.35	24.05	115.75	0.32	45.50	58.81	144.99	249.30
Reach-9	32.1045		Bridge													
Reach-9	32.0935	1:250 Existing	35.30	256.39	258.18	257.29	258.29	0.000632	1.48	23.80	114.20	0.35	44.97	58.81	144.99	248.77
Reach-9	32.0805	1:250 Existing	35.30	256.30	258.08		258.24	0.003092	1.82	19.86	27.56	0.51	44.69	58.76	144.88	248.34
Reach-9	32.0305	1:250 Existing	35.30	256.10	257.91	257.33	258.09	0.003239	1.84	19.22	14.61	0.51	43.73	58.76	144.87	247.36
Reach-9	31.8905	1:250 Existing	35.30	255.50	257.77		257.83	0.000920	1.17	48.30	98.80	0.29	40.52	57.49	144.59	242.60
Reach-9	31.7355	1:250 Existing	35.30	255.30	257.66		257.70	0.000705	1.05	74.42	162.91	0.26	36.59	53.08	143.42	233.09
Reach-9	31.5405	1:250 Existing	35.30	255.30	257.65		257.66	0.000085	0.42	236.51	382.89	0.09	30.97	42.04	134.44	207.45
Reach-9	31.4105	1:250 Existing	35.30	255.00	257.63	256.23	257.64	0.000192	0.62	173.91	522.53	0.14	26.85	30.58	121.10	178.53
Reach-9	31.3865	1:250 Existing	35.30	254.95	257.60	255.91	257.63	0.000392	0.85	92.00	264.93	0.17	26.11	29.65	118.85	174.62
Reach-9	31.381		Culvert													
Reach-9	31.3755	1:250 Existing	35.30	254.95	257.61	255.91	257.62	0.000136	0.50	225.91	540.01	0.10	25.11	29.65	118.85	173.62
Reach-9	31.3375	1:250 Existing	35.30	254.90	257.60	256.39	257.61	0.000479	0.54	139.21	533.15	0.19	23.76	29.55	113.37	166.68
Reach-9	31.2015	1:250 Existing	35.30	254.90	257.52		257.55	0.000374	0.96	86.47	222.75	0.20	19.46	28.77	102.97	151.19
Reach-9	31.0765	1:250 Existing	35.30	254.80	257.50		257.51	0.000183	0.54	158.63	292.28	0.13	16.83	25.32	94.55	136.70
Reach-9	30.9835	1:250 Existing	35.30	254.90	257.47		257.49	0.000346	0.83	150.40	538.80	0.16	15.09	20.01	86.44	121.54
Reach-9	30.9805	1:250 Existing	35.30	254.90	257.47		257.48	0.000348	0.83	149.81	538.14	0.17	15.03	19.84	86.22	121.09

HEC-RAS Plan: existing River: Dingman Creek Reach: Reach-9 Profile: 1:250 Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)	(1000 m3)	(1000 m3)	(1000 m3)
Reach-9	30.9265	1:250 Existing	35.30	254.60	257.47		257.48	0.000040	0.33	321.76	560.46	0.06	13.72	15.28	79.36	108.36
Reach-9	30.7765	1:250 Existing	35.30	254.40	257.47		257.47	0.000041	0.33	238.88	242.25	0.07	9.16	6.18	49.08	64.41
Reach-9	30.6265	1:250 Existing	35.30	254.80	257.46		257.46	0.000064	0.42	198.75	221.13	0.08	4.85	2.79	11.96	19.59
Reach-9	30.5955	1:250 Existing	35.30	254.40	257.43	255.12	257.45	0.000111	0.63	55.98	215.72	0.12	3.58	1.85	1.06	6.49
Reach-9	30.5805		Bridge													
Reach-9	30.5655	1:250 Existing	35.30	254.40	257.42	255.12	257.44	0.000057	0.63	55.95	215.63	0.12	2.01	1.85	1.06	4.92
Reach-9	30.5155	1:250 Existing	35.30	254.10	257.41		257.44	0.000234	0.88	77.78	139.02	0.16				

THIG EXISTING REVISED SCENARIO

HEC-RAS Plan: Ex TMIG River: Dingman Creek Reach: Reach-9 Profile: 1:250 Existing

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)	(1000 m3)	(1000 m3)	(1000 m3)
Reach-9	36.9135	1:250 Existing	26.70	260.20	262.53		262.58	0.000586	1.12	36.86	64.23	0.24	139.91	116.75	216.65	473.31
Reach-9	36.7485	1:250 Existing	26.70	260.30	262.46		262.49	0.000413	0.90	50.14	83.00	0.20	136.63	114.95	214.61	466.19
Reach-9	36.5735	1:250 Existing	26.70	260.20	262.41		262.43	0.000248	0.71	56.16	74.78	0.16	132.40	112.74	211.90	457.04
Reach-9	36.5615	1:250 Existing	26.70	260.20	262.38	260.93	262.42	0.000348	0.90	29.83	104.70	0.19	132.05	112.41	211.79	456.25
Reach-9	36.5575		Bridge													
Reach-9	36.5535	1:250 Existing	29.40	260.20	262.38	260.98	262.43	0.000216	0.99	29.80	104.55	0.21	131.81	112.41	211.79	456.01
Reach-9	36.4865	1:250 Existing	29.40	260.10	262.36		262.39	0.000325	0.86	58.42	91.25	0.19	130.01	111.72	210.25	451.98
Reach-9	36.3115	1:250 Existing	29.40	259.80	262.23		262.30	0.000939	1.33	31.89	39.22	0.29	126.44	108.64	209.12	444.20
Reach-9	36.1465	1:250 Existing	29.40	259.70	262.09		262.14	0.000861	1.23	40.93	66.42	0.27	123.86	106.51	208.00	438.37
Reach-9	35.9765	1:250 Existing	29.40	259.60	262.00		262.02	0.000523	0.87	63.88	109.79	0.21	121.56	101.57	205.55	428.67
Reach-9	35.917	1:250 Existing	29.40	259.55	261.97		261.99	0.000402	0.83	73.98	160.12	0.19	120.64	99.65	204.86	425.15
Reach-9	35.8065	1:250 Existing	29.40	259.50	261.92		261.94	0.000585	0.93	53.83	88.66	0.22	118.68	95.79	204.64	419.12
Reach-9	35.6165	1:250 Existing	29.40	259.40	261.72		261.78	0.001133	1.31	31.83	44.44	0.32	115.38	90.98	204.14	410.50
Reach-9	35.3965	1:250 Existing	29.40	259.20	261.54		261.58	0.000834	1.21	40.75	61.89	0.27	111.91	89.48	202.43	403.82
Reach-9	35.2315	1:250 Existing	29.40	259.10	261.08		261.31	0.003286	2.27	16.28	23.35	0.53	109.79	89.11	199.74	398.64
Reach-9	35.0415	1:250 Existing	29.40	258.90	261.01		261.05	0.000677	1.09	57.72	124.06	0.25	107.05	88.90	199.30	395.26
Reach-9	34.9415	1:250 Existing	32.40	258.80	260.94		260.99	0.000700	1.11	47.40	44.17	0.26	105.22	87.65	197.97	390.84
Reach-9	34.7265	1:250 Existing	32.40	258.60	260.76		260.83	0.001156	1.36	40.76	51.97	0.32	101.33	86.74	196.77	384.84
Reach-9	34.5515	1:250 Existing	32.40	258.40	260.68		260.72	0.000552	1.01	51.34	88.79	0.23	97.58	86.50	196.54	380.62
Reach-9	34.3515	1:250 Existing	32.40	258.30	260.59		260.61	0.000474	0.83	62.85	90.01	0.20	92.96	85.33	191.41	369.70
Reach-9	34.1815	1:250 Existing	32.40	258.20	260.59		260.59	0.000073	0.39	144.90	155.52	0.08	89.04	83.30	189.97	362.31
Reach-9	34.1665	1:250 Existing	32.40	258.35	260.49	259.18	260.55	0.000575	1.10	29.36	98.93	0.24	88.62	83.19	188.83	360.65
Reach-9	34.1615		Bridge													
Reach-9	34.1565	1:250 Existing	32.40	258.35	260.49	259.18	260.55	0.000295	1.11	29.29	98.88	0.24	88.33	83.19	188.83	360.36
Reach-9	34.1425	1:250 Existing	32.40	258.20	260.49		260.51	0.000356	0.85	69.14	98.92	0.19	88.00	83.01	188.33	359.34
Reach-9	33.9725	1:250 Existing	32.40	258.00	260.31		260.40	0.001484	1.32	28.84	46.61	0.35	84.36	83.00	184.00	351.36
Reach-9	33.9485	1:250 Existing	32.40	258.11	260.26	259.09	260.37	0.000870	1.41	23.05	50.40	0.31	83.79	82.76	183.95	350.50
Reach-9	33.9465		Bridge													
Reach-9	33.9445	1:250 Existing	32.40	258.11	260.26	259.09	260.36	0.000446	1.41	23.02	50.14	0.31	83.70	82.76	183.95	350.41
Reach-9	33.9235	1:250 Existing	32.40	258.00	260.26		260.30	0.000559	1.03	83.01	97.03	0.23	83.25	82.01	183.83	349.09
Reach-9	33.7285	1:250 Existing	32.40	257.80	260.17		260.19	0.000512	0.80	97.50	174.15	0.21	78.51	71.54	180.72	330.77
Reach-9	33.5385	1:250 Existing	32.40	257.70	259.90		260.02	0.001573	1.60	32.24	41.07	0.38	74.03	63.99	179.08	317.09
Reach-9	33.3635	1:250 Existing	32.40	257.60	259.78		259.82	0.000668	1.05	80.45	125.27	0.25	70.55	62.93	173.00	306.47
Reach-9	33.0835	1:250 Existing	32.40	257.50	259.39		259.49	0.002616	1.53	36.46	77.47	0.46	64.96	62.82	164.23	292.01
Reach-9	32.8085	1:250 Existing	32.40	257.20	259.05		259.09	0.000970	1.15	83.70	150.77	0.29	60.06	62.40	156.34	278.80
Reach-9	32.5785	1:250 Existing	32.40	256.90	258.77		258.84	0.001346	1.28	38.17	54.25	0.34	55.79	61.36	148.19	265.33
Reach-9	32.3335	1:250 Existing	32.40	256.60	258.52		258.57	0.001084	1.09	41.19	62.99	0.30	50.42	60.58	147.05	258.05
Reach-9	32.1335	1:250 Existing	32.40	256.40	258.28		258.34	0.001391	1.16	47.50	122.82	0.34	45.91	58.88	145.38	250.16
Reach-9	32.1155	1:250 Existing	32.40	256.39	258.20	257.24	258.29	0.001009	1.35	24.05	115.75	0.32	45.50	58.81	144.99	249.30
Reach-9	32.1045		Bridge													
Reach-9	32.0935	1:250 Existing	35.30	256.39	258.18	257.29	258.29	0.000632	1.48	23.80	114.20	0.35	44.97	58.81	144.99	248.77
Reach-9	32.0805	1:250 Existing	35.30	256.30	258.08		258.24	0.003092	1.82	19.86	27.56	0.51	44.69	58.76	144.88	248.34
Reach-9	32.0305	1:250 Existing	35.30	256.10	257.91	257.33	258.09	0.003239	1.84	19.22	14.61	0.51	43.73	58.76	144.87	247.36
Reach-9	31.8905	1:250 Existing	35.30	255.50	257.77		257.83	0.000920	1.17	48.30	98.80	0.29	40.52	57.49	144.59	242.60
Reach-9	31.7355	1:250 Existing	35.30	255.30	257.66		257.70	0.000705	1.05	74.42	162.91	0.26	36.59	53.08	143.42	233.09
Reach-9	31.5405	1:250 Existing	35.30	255.30	257.65		257.66	0.000085	0.42	236.51	382.89	0.09	30.97	42.04	134.44	207.45
Reach-9	31.4105	1:250 Existing	35.30	255.00	257.63	256.23	257.64	0.000192	0.62	173.91	522.53	0.14	26.85	30.58	121.10	178.53
Reach-9	31.3865	1:250 Existing	35.30	254.95	257.60	255.91	257.63	0.000392	0.85	92.00	264.93	0.17	26.11	29.65	118.85	174.62
Reach-9	31.381		Culvert													
Reach-9	31.3755	1:250 Existing	35.30	254.95	257.61	255.91	257.62	0.000136	0.50	225.91	540.01	0.10	25.11	29.65	118.85	173.62
Reach-9	31.3375	1:250 Existing	35.30	254.90	257.60	256.39	257.61	0.000479	0.54	139.21	533.15	0.19	23.76	29.55	113.37	166.68
Reach-9	31.2015	1:250 Existing	35.30	254.90	257.52		257.55	0.000374	0.96	86.47	222.75	0.20	19.46	28.77	102.97	151.19
Reach-9	31.0765	1:250 Existing	35.30	254.80	257.50		257.51	0.000183	0.54	158.63	292.28	0.13	16.83	25.32	94.55	136.70
Reach-9	30.9835	1:250 Existing	35.30	254.90	257.47		257.49	0.000346	0.83	150.40	538.80	0.16	15.09	20.01	86.44	121.54

HEC-RAS Plan: Ex TMIG River: Dingman Creek Reach: Reach-9 Profile: 1:250 Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)	(1000 m3)	(1000 m3)	(1000 m3)
Reach-9	30.9805	1:250 Existing	35.30	254.90	257.47		257.48	0.000348	0.83	149.81	538.14	0.17	15.03	19.84	86.22	121.09
Reach-9	30.9265	1:250 Existing	35.30	254.60	257.47		257.48	0.000040	0.33	321.76	560.46	0.06	13.72	15.28	79.36	108.36
Reach-9	30.7765	1:250 Existing	35.30	254.40	257.47		257.47	0.000041	0.33	238.88	242.25	0.07	9.16	6.18	49.08	64.41
Reach-9	30.6265	1:250 Existing	35.30	254.80	257.46		257.46	0.000064	0.42	198.75	221.13	0.08	4.85	2.79	11.96	19.59
Reach-9	30.5955	1:250 Existing	35.30	254.40	257.43	255.12	257.45	0.000111	0.63	55.98	215.72	0.12	3.58	1.85	1.06	6.49
Reach-9	30.5805		Bridge													
Reach-9	30.5655	1:250 Existing	35.30	254.40	257.42	255.12	257.44	0.000057	0.63	55.95	215.63	0.12	2.01	1.85	1.06	4.92
Reach-9	30.5155	1:250 Existing	35.30	254.10	257.41		257.44	0.000234	0.88	77.78	139.02	0.16				

PROPOSED SCENARIO

HEC-RAS Plan: pond River: Dingman Creek Reach: Reach-9 Profile: 1:250 Existing

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)	(1000 m3)	(1000 m3)	(1000 m3)
Reach-9	36.9135	1:250 Existing	26.70	260.20	262.53		262.58	0.000588	1.12	36.78	64.22	0.24	139.88	116.90	216.56	473.35
Reach-9	36.7485	1:250 Existing	26.70	260.30	262.46		262.49	0.000416	0.90	49.99	82.91	0.20	136.60	115.12	214.53	466.25
Reach-9	36.5735	1:250 Existing	26.70	260.20	262.41		262.43	0.000249	0.71	56.01	74.72	0.16	132.38	112.92	211.83	457.13
Reach-9	36.5615	1:250 Existing	26.70	260.20	262.38	260.93	262.42	0.000349	0.90	29.80	104.55	0.19	132.03	112.59	211.72	456.34
Reach-9	36.5575		Bridge													
Reach-9	36.5535	1:250 Existing	29.40	260.20	262.37	260.98	262.42	0.000216	0.99	29.78	104.40	0.21	131.79	112.59	211.72	456.10
Reach-9	36.4865	1:250 Existing	29.40	260.10	262.36		262.39	0.000327	0.86	58.23	91.11	0.19	129.99	111.90	210.19	452.08
Reach-9	36.3115	1:250 Existing	29.40	259.80	262.22		262.29	0.000946	1.33	31.78	39.06	0.29	126.43	108.83	209.07	444.33
Reach-9	36.1465	1:250 Existing	29.40	259.70	262.09		262.14	0.000877	1.24	40.59	66.17	0.27	123.85	106.72	207.96	438.53
Reach-9	35.9765	1:250 Existing	29.40	259.60	261.99		262.01	0.000541	0.88	63.01	108.97	0.21	121.55	101.86	205.54	428.95
Reach-9	35.917	1:250 Existing	29.40	259.55	261.97	261.01	261.99	0.000316	0.74	78.44	139.06	0.17	120.64	99.85	204.86	425.35
Reach-9	35.8065	1:250 Existing	29.40	259.50	261.92		261.94	0.000585	0.93	53.83	88.66	0.22	118.68	95.79	204.64	419.12
Reach-9	35.6165	1:250 Existing	29.40	259.40	261.72		261.78	0.001133	1.31	31.83	44.44	0.32	115.38	90.98	204.14	410.50
Reach-9	35.3965	1:250 Existing	29.40	259.20	261.54		261.58	0.000834	1.21	40.75	61.89	0.27	111.91	89.48	202.43	403.82
Reach-9	35.2315	1:250 Existing	29.40	259.10	261.08		261.31	0.003286	2.27	16.28	23.35	0.53	109.79	89.11	199.74	398.64
Reach-9	35.0415	1:250 Existing	29.40	258.90	261.01		261.05	0.000677	1.09	57.72	124.06	0.25	107.05	88.90	199.30	395.26
Reach-9	34.9415	1:250 Existing	32.40	258.80	260.94		260.99	0.000700	1.11	47.40	44.17	0.26	105.22	87.65	197.97	390.84
Reach-9	34.7265	1:250 Existing	32.40	258.60	260.76		260.83	0.001156	1.36	40.76	51.97	0.32	101.33	86.74	196.77	384.84
Reach-9	34.5515	1:250 Existing	32.40	258.40	260.68		260.72	0.000552	1.01	51.34	88.79	0.23	97.58	86.50	196.54	380.62
Reach-9	34.3515	1:250 Existing	32.40	258.30	260.59		260.61	0.000474	0.83	62.85	90.01	0.20	92.96	85.33	191.41	369.70
Reach-9	34.1815	1:250 Existing	32.40	258.20	260.59		260.59	0.000073	0.39	144.90	155.52	0.08	89.04	83.30	189.97	362.31
Reach-9	34.1665	1:250 Existing	32.40	258.35	260.49	259.18	260.55	0.000575	1.10	29.36	98.93	0.24	88.62	83.19	188.83	360.65
Reach-9	34.1615		Bridge													
Reach-9	34.1565	1:250 Existing	32.40	258.35	260.49	259.18	260.55	0.000295	1.11	29.29	98.88	0.24	88.33	83.19	188.83	360.36
Reach-9	34.1425	1:250 Existing	32.40	258.20	260.49		260.51	0.000356	0.85	69.14	98.92	0.19	88.00	83.01	188.33	359.34
Reach-9	33.9725	1:250 Existing	32.40	258.00	260.31		260.40	0.001484	1.32	28.84	46.61	0.35	84.36	83.00	184.00	351.36
Reach-9	33.9485	1:250 Existing	32.40	258.11	260.26	259.09	260.37	0.000870	1.41	23.05	50.40	0.31	83.79	82.76	183.95	350.50
Reach-9	33.9465		Bridge													
Reach-9	33.9445	1:250 Existing	32.40	258.11	260.26	259.09	260.36	0.000446	1.41	23.02	50.14	0.31	83.70	82.76	183.95	350.41
Reach-9	33.9235	1:250 Existing	32.40	258.00	260.26		260.30	0.000559	1.03	83.01	97.03	0.23	83.25	82.01	183.83	349.09
Reach-9	33.7285	1:250 Existing	32.40	257.80	260.17		260.19	0.000512	0.80	97.50	174.15	0.21	78.51	71.54	180.72	330.77
Reach-9	33.5385	1:250 Existing	32.40	257.70	259.90		260.02	0.001573	1.60	32.24	41.07	0.38	74.03	63.99	179.08	317.09
Reach-9	33.3635	1:250 Existing	32.40	257.60	259.78		259.82	0.000668	1.05	80.45	125.27	0.25	70.55	62.93	173.00	306.47
Reach-9	33.0835	1:250 Existing	32.40	257.50	259.39		259.49	0.002616	1.53	36.46	77.47	0.46	64.96	62.82	164.23	292.01
Reach-9	32.8085	1:250 Existing	32.40	257.20	259.05		259.09	0.000970	1.15	83.70	150.77	0.29	60.06	62.40	156.34	278.80
Reach-9	32.5785	1:250 Existing	32.40	256.90	258.77		258.84	0.001346	1.28	38.17	54.25	0.34	55.79	61.36	148.19	265.33
Reach-9	32.3335	1:250 Existing	32.40	256.60	258.52		258.57	0.001084	1.09	41.19	62.99	0.30	50.42	60.58	147.05	258.05
Reach-9	32.1335	1:250 Existing	32.40	256.40	258.28		258.34	0.001391	1.16	47.50	122.82	0.34	45.91	58.88	145.38	250.16
Reach-9	32.1155	1:250 Existing	32.40	256.39	258.20	257.24	258.29	0.001009	1.35	24.05	115.75	0.32	45.50	58.81	144.99	249.30
Reach-9	32.1045		Bridge													
Reach-9	32.0935	1:250 Existing	35.30	256.39	258.18	257.29	258.29	0.000632	1.48	23.80	114.20	0.35	44.97	58.81	144.99	248.77
Reach-9	32.0805	1:250 Existing	35.30	256.30	258.08		258.24	0.003092	1.82	19.86	27.56	0.51	44.69	58.76	144.88	248.34
Reach-9	32.0305	1:250 Existing	35.30	256.10	257.91	257.33	258.09	0.003239	1.84	19.22	14.61	0.51	43.73	58.76	144.87	247.36
Reach-9	31.8905	1:250 Existing	35.30	255.50	257.77		257.83	0.000920	1.17	48.30	98.80	0.29	40.52	57.49	144.59	242.60
Reach-9	31.7355	1:250 Existing	35.30	255.30	257.66		257.70	0.000705	1.05	74.42	162.91	0.26	36.59	53.08	143.42	233.09
Reach-9	31.5405	1:250 Existing	35.30	255.30	257.65		257.66	0.000085	0.42	236.51	382.89	0.09	30.97	42.04	134.44	207.45
Reach-9	31.4105	1:250 Existing	35.30	255.00	257.63	256.23	257.64	0.000192	0.62	173.91	522.53	0.14	26.85	30.58	121.10	178.53
Reach-9	31.3865	1:250 Existing	35.30	254.95	257.60	255.91	257.63	0.000392	0.85	92.00	264.93	0.17	26.11	29.65	118.85	174.62
Reach-9	31.381		Culvert													
Reach-9	31.3755	1:250 Existing	35.30	254.95	257.61	255.91	257.62	0.000136	0.50	225.91	540.01	0.10	25.11	29.65	118.85	173.62
Reach-9	31.3375	1:250 Existing	35.30	254.90	257.60	256.39	257.61	0.000479	0.54	139.21	533.15	0.19	23.76	29.55	113.37	166.68
Reach-9	31.2015	1:250 Existing	35.30	254.90	257.52		257.55	0.000374	0.96	86.47	222.75	0.20	19.46	28.77	102.97	151.19
Reach-9	31.0765	1:250 Existing	35.30	254.80	257.50		257.51	0.000183	0.54	158.63	292.28	0.13	16.83	25.32	94.55	136.70
Reach-9	30.9835	1:250 Existing	35.30	254.90	257.47		257.49	0.000346	0.83	150.40	538.80	0.16	15.09	20.01	86.44	121.54

HEC-RAS Plan: pond River: Dingman Creek Reach: Reach-9 Profile: 1:250 Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)	(1000 m3)	(1000 m3)	(1000 m3)
Reach-9	30.9805	1:250 Existing	35.30	254.90	257.47		257.48	0.000348	0.83	149.81	538.14	0.17	15.03	19.84	86.22	121.09
Reach-9	30.9265	1:250 Existing	35.30	254.60	257.47		257.48	0.000040	0.33	321.76	560.46	0.06	13.72	15.28	79.36	108.36
Reach-9	30.7765	1:250 Existing	35.30	254.40	257.47		257.47	0.000041	0.33	238.88	242.25	0.07	9.16	6.18	49.08	64.41
Reach-9	30.6265	1:250 Existing	35.30	254.80	257.46		257.46	0.000064	0.42	198.75	221.13	0.08	4.85	2.79	11.96	19.59
Reach-9	30.5955	1:250 Existing	35.30	254.40	257.43	255.12	257.45	0.000111	0.63	55.98	215.72	0.12	3.58	1.85	1.06	6.49
Reach-9	30.5805		Bridge													
Reach-9	30.5655	1:250 Existing	35.30	254.40	257.42	255.12	257.44	0.000057	0.63	55.95	215.63	0.12	2.01	1.85	1.06	4.92
Reach-9	30.5155	1:250 Existing	35.30	254.10	257.41		257.44	0.000234	0.88	77.78	139.02	0.16				

Appendix D:

SWM Calculations

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

VO2 Data Calculation (Post Development Conditions)

North Pond

Total area to North SWM Pond **Controlled Areas**	**Area (ha)**	**Runoff Coefficient**	**Imperviousness**
Parks, Open Space and SWM Pond	2.21	0.2	0%
Residential - Townhouse	3.20	0.65	64%
Residential - Family/Semi Detached	9.16	0.5	43%
Residential - Apartments	0.00	0.67	67%
Commercial, Institutional and Industrial	0.00	0.8	86%
Roads	6.34	0.9	100%
Lands to be retained by Owner	4.58	0.8	86%
Total Controlled Area	***25.49***	-	-
Weighted Average	-	0.65	64%

Total Area Tributary to North SWM Pond = 25.49 ha
Overall Weighted Imperviousness = 64%

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

VO2 Data Calculation (Post Development Conditions)

Southwest Pond

Total area to Southwest SWM Pond	**Area (ha)**	**Runoff Coefficient**	**Imperviousness**
Controlled Areas			
Parks, Open Space and SWM Pond	0.88	0.2	0%
Residential - Townhouse	0.00	0.65	64%
Residential - Family/Semi Detached	3.27	0.5	43%
Residential - Apartments	0.00	0.67	67%
Commercial, Institutional and Industrial	0.00	0.8	86%
Roads	1.34	0.9	100%
Lands to be retained by Owner	2.12	0.8	86%
Total Controlled Area	***7.60***	-	-
Weighted Average	-	0.62	60%

Total Area Tributary to South SWM Pond = 7.60 ha
Overall Weighted Imperviousness = 60%

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

VO2 Data Calculation (Post Development Conditions)

Southeast Pond

Total area to Southeast SWM Pond **Controlled Areas**	**Area (ha)**	**Runoff Coefficient**	**Imperviousness**
Parks, Open Space and SWM Pond	0.70	0.2	0%
Residential - Townhouse	0.46	0.65	64%
Residential - Family/Semi Detached	1.97	0.5	43%
Residential - Apartments	0.00	0.67	67%
Commercial, Institutional and Industrial	0.00	0.8	86%
Roads	0.63	0.9	100%
Lands to be retained by Owner	1.81	0.8	86%
Total Controlled Area	***5.57***	-	-
Weighted Average	-	0.62	60%

Total Area Tributary to South SWM Pond = 5.57 ha
Overall Weighted Imperviousness = 60%

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

North SWM Pond Water Quality Storage Volume

Table A.1 – MOE Water Quality Storage Requirements (SWMP 2003)*

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

* Values in table for Wet Ponds and Wetlands include 40m^3/ha of extended detention storage.

SWM Type = Wet Pond
Level of Protection = Normal

Drainage Area = 25.49 ha
Area-Weighted Imperviousness = 64%

Permanent Pool Unit Volume Requirement = 81.65 m^3/ha
Total Water Quality Storage Volume Required = 2,081 m^3

Total Water Quality Storage Volume Provided = 6,083 m^3

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Southwest SWM Pond Water Quality Storage Volume

Table A.1 – MOE Water Quality Storage Requirements (SWMP 2003)*

Protection Level	SWMP Type	Storage Volume (m³/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

* Values in table for Wet Ponds and Wetlands include 40m^3/ha of extended detention storage.

SWM Type = Wet Pond
Level of Protection = Normal

Drainage Area = 7.60 ha
Area-Weighted Imperviousness = 60%

Permanent Pool Unit Volume Requirement = 76.54 m^3/ha
Total Water Quality Storage Volume Required = 582 m^3

Total Water Quality Storage Volume Provided = 1,477 m^3

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Southeast SWM Pond Water Quality Storage Volume

Table A.1 – MOE Water Quality Storage Requirements (SWMP 2003)*

Protection Level	SWMP Type	Storage Volume (m³/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

* Values in table for Wet Ponds and Wetlands include 40m^3/ha of extended detention storage.

SWM Type = Wet Pond
Level of Protection = Normal

Drainage Area = 5.57 ha
Area-Weighted Imperviousness = 60%

Permanent Pool Unit Volume Requirement = 76.07 m^3/ha
Total Water Quality Storage Volume Required = 424 m^3

Total Water Quality Storage Volume Provided = 779 m^3

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Erosion Control Volume and Release Rate

North Pond

Input:

Area = 25.49 (ha)

R.V = **15.117** (mm)

Draw Down Time = 72 (hrs)

Calculations:

Storage = 3,853 (m^3)

Average Outflow = 0.015 (m^3/s)

Peak Outflow = 0.022 (m^3/s) -Estimated at 1.5 times Average Outflow

Summary Hydrograph Data

Run Number : 1

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
4	0.083	25.500	1.458	1.583	15.117	0.000

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Erosion Control Volume and Release Rate

Southwest Pond

Input:

Area = 7.60 (ha)

R.V = **14.049** (mm)

Draw Down Time = 72 (hrs)

Calculations:

Storage = 1,068 (m^3)

Average Outflow = 0.004 (m^3/s)

Peak Outflow = 0.006 (m^3/s) -Estimated at 1.5 times Average Outflow

Summary Hydrograph Data

Run Number : 7

	NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
	5	0.083	7.600	0.512	1.500	14.049	0.000

GREEN VALLEY ESTATES INC.
City of London, Ontario

Project # : 12116
Date: OCTOBER 2013

Erosion Control Volume and Release Rate

Southeast Pond

Input:

Area = 5.57 (ha)

R.V = **14.049** (mm)

Draw Down Time = 72 (hrs)

Calculations:

Storage = 782 (m^3)

Average Outflow = 0.003 (m^3/s)

Peak Outflow = 0.005 (m^3/s) -Estimated at 1.5 times Average Outflow

Summary Hydrograph Data

	NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
	8	0.083	5.600	0.386	1.500	14.049	0.000

North SWM Pond Storage Calculations

Project#: 12116

Oct-13

POND CHARACTERISTICS

Base of Pond:	260.90	
N.W.L.:	261.90	masl
Increment for Volume:	0.1	m
Required Permanent Pool Volume:	582	m^3
Permanent Pool Volume Provided:	6083	m^3

VOLUME

Known Water Level:	261.90	
	INCL. P.P.	ACTIVE ONLY
Lower Known Elevation:	261.9	
Lower Known Volume:	6083.2123	
Upper Known Elevation:	262.7	
Upper Known Volume:	13270.7055	
Volume of Known W.L. Elevation:	6083	0
Erosion Control Storage Required:		
Active Storage Required:		3250

Water Level of Known Volume

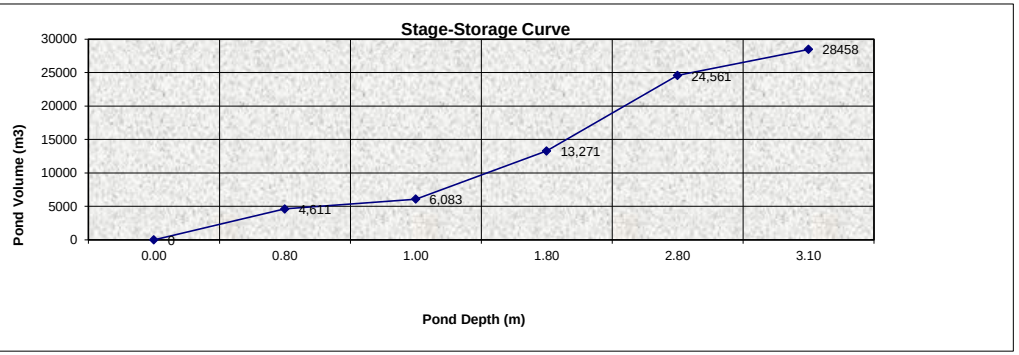
Known Volume:		5900
	INCL. P.P.	ACTIVE ONLY
Lower Known Elevation:	#N/A	261.90
Lower Known Volume:	#N/A	0.00
Upper Known Elevation:	#N/A	262.70
Upper Known Volume:	#N/A	7187.49
W.L. Elevation of Known Volume:	#N/A	262.56

Required Volumes:

Permanent Pool	582	cum
Active Storage	4500	cum

STAGE / STORAGE INFORMATION

	Elevation (m)	Stage (m)	Area (m^2)	Area 2 (m^2)	Total Area (m^2)	Avg. Area (m^2)	Incremental Storage (m^3)	Cumulative Storage (m^3)	Cumulative Storage above Permanent Pool (m^3)
Pond Base:	260.90	0.00	1609	3143	4752		0		
	261.70	0.80	2479	4296	6775	5764	4611	**4,611**	**0**
nwl	261.90	1.00	2944	5004	7947	7361	1472	**6,083**	**0**
	262.70	1.80	10021		10021	8984	7187	**13,271**	**7,187**
hwl 100yr	263.70	2.80	12560		*12560*	*11290*	*11290*	***24,561***	***18,478***
	264.00	3.10	13416		*13416*	12988	3896	**28458**	**22374**



Southwest SWM Pond Storage Calculations

Project#: 12116

Oct-13

POND CHARACTERISTICS

Base of Pond:	261.00	
N.W.L.:	262.00	masl
Increment for Volume:	0.1	m
Required Permanent Pool Volume:	582	m^3
Permanent Pool Volume Provided:	1477	m^3

VOLUME

Known Water Level:	262.00	
	INCL. P.P.	ACTIVE ONLY
Lower Known Elevation:	262	
Lower Known Volume:	1476.8017	
Upper Known Elevation:	262.5	
Upper Known Volume:	3050.5347	
Volume of Known W.L. Elevation:	1477	0
Erosion Control Storage Required:		
Active Storage Required:		3250

Water Level of Known Volume

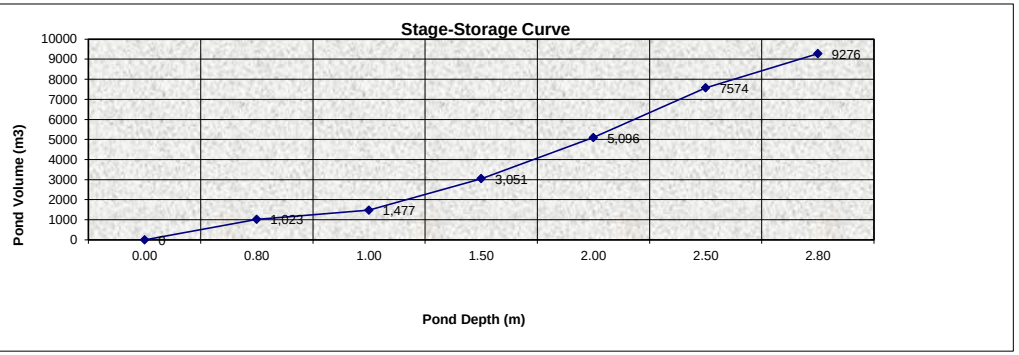
Known Volume:		1700
	INCL. P.P.	ACTIVE ONLY
Lower Known Elevation:	#N/A	262.50
Lower Known Volume:	#N/A	1573.73
Upper Known Elevation:	#N/A	263.00
Upper Known Volume:	#N/A	3619.22
W.L. Elevation of Known Volume:	#N/A	262.53

Required Volumes:

Permanent Pool	582	cum
Active Storage	4500	cum

STAGE / STORAGE INFORMATION

	Elevation (m)	Stage (m)	Area (m^2)	Area 2 (m^2)	Total Area (m^2)	Avg. Area (m^2)	Incremental Storage (m^3)	Cumulative Storage (m^3)	Cumulative Storage above Permanent Pool (m^3)
Pond Base:	261.00	0.00	132	518	650		0		
	261.80	0.80	490	1418	1908	1279	1023	1,023	0
nwl	262.00	1.00	713	1912	2625	2267	453	1,477	0
	262.50	1.50	3670		3670	3147	1574	3,051	1,574
	263.00	2.00	4512		*4512*	*4091*	*2045*	***5,096***	***3,619***
hwl 100yr	263.50	2.50	5400		*5400*	4956	2478	**7574**	**6097**
	263.80	2.80	5945		*5945*	5672	1702	**9276**	**7799**



Southeast SWM Pond Storage Calculations

Project#: 12116

Oct-13

POND CHARACTERISTICS

Base of Pond:	261.30	
N.W.L.:	262.30	masl
Increment for Volume:	0.1	m
Required Permanent Pool Volume:	424	m^3
Permanent Pool Volume Provided:	779	m^3

VOLUME

Known Water Level:	263.80	
	INCL. P.P.	ACTIVE ONLY
Lower Known Elevation:	263.8	
Lower Known Volume:	4781.72015	
Upper Known Elevation:	264.1	
Upper Known Volume:	5943.59945	
Volume of Known W.L. Elevation:	4782	4003
Erosion Control Storage Required:		
Active Storage Required:		3250

Water Level of Known Volume

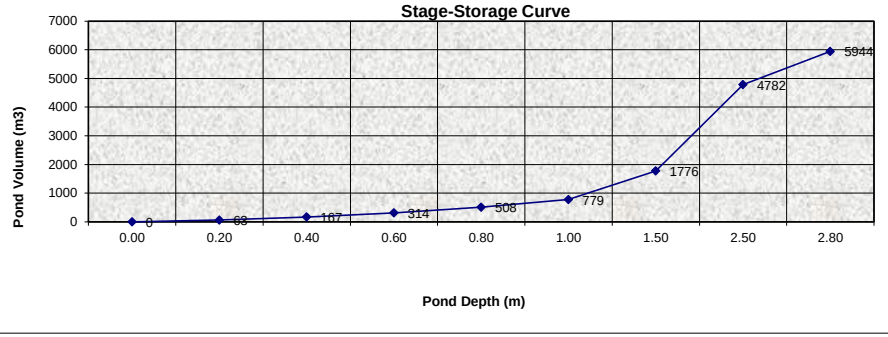
Known Volume:	424	1220
	INCL. P.P.	ACTIVE ONLY
Lower Known Elevation:	261.9	262.80
Lower Known Volume:	314.2004	996.83
Upper Known Elevation:	262.1	263.80
Upper Known Volume:	507.7937	4002.87
W.L. Elevation of Known Volume:	262.01	262.87

Required Volumes:

Permanent Pool	424	cum
Active Storage	3250	cum

STAGE / STORAGE INFORMATION

	Elevation (m)	Stage (m)	Area (m^2)	Area 2 (m^2)	Total Area (m^2)	Avg. Area (m^2)	Incremental Storage (m^3)	Cumulative Storage (m^3)	Cumulative Storage above Permanent Pool (m^3)
Pond Base:	261.30	0.00	80	130	210		0		
	261.50	0.20	140	278	417	314	63	**63**	**0**
	261.70	0.40	207	419	626	522	104	**167**	**0**
	261.90	0.60	280	565	845	736	147	**314**	**0**
	262.10	0.80	367	*724*	*1091*	*968*	*194*	***508***	***0***
nwl	262.30	1.00	552	*1067*	*1619*	1355	271	**779**	**0**
	262.80	1.50	2368		*2368*	1994	997	**1776**	**997**
100 yr wl	263.80	2.50	3644		*3644*	3006	3006	**4782**	**4003**
	264.10	2.80	4102		*4102*	3873	1162	**5944**	**5165**



INFILTRATION CALCULATIONS - North

London GE I and GEII

Project # : 12116

STEP 1:

Pre-development Conditions:

Based on Table 3.1 MOE SWM Planning and Design Manual, with B soil group and moderately rooted crops, the landscape area has the following hydrologic characteristic:

Hydrologic Cycle Component Values:

Precipitation =	957	mm/yr	* London International Airport Precipitation Data (1941-2001)
Evapo-transpiration =	549	mm/yr	
Infiltration =	163	mm/yr	
Runoff =	245	mm/yr	

Tributary Area =	25.49	ha
Pre-development Runoff Coefficient =	0.20	
Pre-development Imperviousness =	0.00	
Pre-development Pervious Area for Infiltration =	**25.49**	**ha**

Therefore, the pre-development infiltration volume is:

Total Annual Infiltration Volume = Annual Infiltration Depth x Pervious Site Area

4,152 = 163 mm/yr x 25.49 ha

41,522 = 163 mm/yr X 254900 m2

= ***41,522 m^3/yr ……..…….…….. (1)***

STEP 2:

Post Development Conditions:

Based on Table 3.1 MOE SWM Planning and Design Manual, with B soil group and urban lawns, the landscape area has the following hydrologic characteristic:

The post-development infiltration volume is equal to that occurring on the pervious area, as follows:

Precipitation =	957	mm/yr	* London International Airport Precipitation Data (1941-2001)
Evapo-transpiration =	534	mm/yr	
Infiltration =	190	**mm/yr**	
Runoff =	232	mm/yr	

Tributary Area =	25.49	ha
Post-development Runoff Coefficient =	0.65	
Post-development Imperviousness =	0.64	
Post-development Pervious Area for Infiltration =	**9.10**	**ha**

Therefore, the post development infiltration volume is:

Total Annual Infiltration Volume = Annual Infiltration Depth x Pervious Site Area

1733 = 190 mm/yr x 9.1 ha

17332 = 190 mm/yr X 91000 m2

= ***17,332 m^3/yr ……..…….…….. (2)***

Annual Infiltration Deficit Volume = Pre-development Infiltration Volume - Post-development Infiltration Volume

= 41522 m3/yr - 17332 m3/yr

= ***24,190 m^3/yr ……..…….…….. (3)***

INFILTRATION CALCULATIONS - Southwest

London GE I and GEII

Project # : 12116

STEP 1:

Pre-development Conditions:

Based on Table 3.1 MOE SWM Planning and Design Manual, with B soil group and moderately rooted crops, the landscape area has the following hydrologic characteristic:

Hydrologic Cycle Component Values:

Precipitation =	957	mm/yr	* London International Airport Precipitation Data (1941-2001)
Evapo-transpiration =	549	mm/yr	
Infiltration =	163	mm/yr	
Runoff =	245	mm/yr	

Tributary Area =	7.60	ha
Pre-development Runoff Coefficient =	0.20	
Pre-development Imperviousness =	0.00	
Pre-development Pervious Area for Infiltration =	**7.60**	**ha**

Therefore, the pre-development infiltration volume is:

Total Annual Infiltration Volume = Annual Infiltration Depth x Pervious Site Area

1,238 = 163 mm/yr x 7.6 ha

12,380 = 163 mm/yr X 76000 m2

= ***12,380 m^3/yr ……..…….…….. (1)***

STEP 2:

Post Development Conditions:

Based on Table 3.1 MOE SWM Planning and Design Manual, with B soil group and urban lawns, the landscape area has the following hydrologic characteristic:

The post-development infiltration volume is equal to that occurring on the pervious area, as follows:

Precipitation =	957	mm/yr	* London International Airport Precipitation Data (1941-2001)
Evapo-transpiration =	534	mm/yr	
Infiltration =	190	**mm/yr**	
Runoff =	232	mm/yr	

Tributary Area =	7.60	ha
Post-development Runoff Coefficient =	0.62	
Post-development Imperviousness =	0.60	
Post-development Pervious Area for Infiltration =	**3.04**	**ha**

Therefore, the post development infiltration volume is:

Total Annual Infiltration Volume = Annual Infiltration Depth x Pervious Site Area

579 = 190 mm/yr x 3.04 ha

5788 = 190 mm/yr X 30400 m2

= ***5,788 m^3/yr ……..…….…….. (2)***

Annual Infiltration Deficit Volume = Pre-development Infiltration Volume - Post-development Infiltration Volume

= 12380 m3/yr - 5788 m3/yr

= ***6,592 m^3/yr ……..…….…….. (3)***

INFILTRATION CALCULATIONS - Southeast

London GE I and GEII

Project # : 12116

STEP 1:

Pre-development Conditions:

Based on Table 3.1 MOE SWM Planning and Design Manual, with B soil group and moderately rooted crops, the landscape area has the following hydrologic characteristic:

Hydrologic Cycle Component Values:

Precipitation =	957	mm/yr	* London International Airport Precipitation Data (1941-2001)
Evapo-transpiration =	549	mm/yr	
Infiltration =	163	mm/yr	
Runoff =	245	mm/yr	

Tributary Area =	5.57	ha
Pre-development Runoff Coefficient =	0.20	
Pre-development Imperviousness =	0.00	
Pre-development Pervious Area for Infiltration =	**5.57**	**ha**

Therefore, the pre-development infiltration volume is:

Total Annual Infiltration Volume = Annual Infiltration Depth x Pervious Site Area

907 = 163 mm/yr x 5.57 ha

9,073 = 163 mm/yr X 55700 m2

= ***9,073 m^3/yr ……..…….…….. (1)***

STEP 2:

Post Development Conditions:

Based on Table 3.1 MOE SWM Planning and Design Manual, with B soil group and urban lawns, the landscape area has the following hydrologic characteristic:

The post-development infiltration volume is equal to that occurring on the pervious area, as follows:

Precipitation =	957	mm/yr	* London International Airport Precipitation Data (1941-2001)
Evapo-transpiration =	534	mm/yr	
Infiltration =	190	**mm/yr**	
Runoff =	232	mm/yr	

Tributary Area =	5.57	ha
Post-development Runoff Coefficient =	0.62	
Post-development Imperviousness =	0.60	
Post-development Pervious Area for Infiltration =	**2.23**	**ha**

Therefore, the post development infiltration volume is:

Total Annual Infiltration Volume = Annual Infiltration Depth x Pervious Site Area

424 = 190 mm/yr x 2.23 ha

4242 = 190 mm/yr X 22300 m2

= ***4,242 m^3/yr ……..…….…….. (2)***

Annual Infiltration Deficit Volume = Pre-development Infiltration Volume - Post-development Infiltration Volume

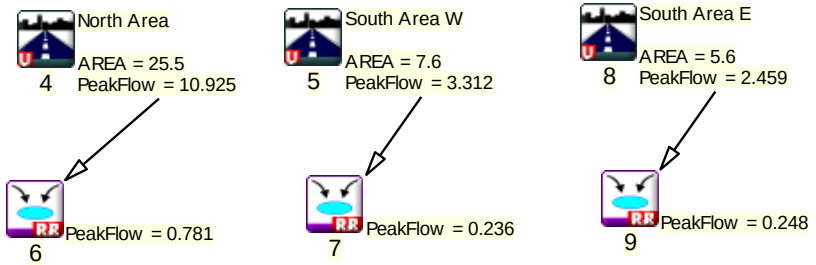
= 9073 m3/yr - 4242 m3/yr

= ***4,831 m^3/yr ……..…….…….. (3)***

Appendix E:

VO2 Modelling Output –

Post Development Hydrology



Summary Hydrograph Data

	NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
	6	0.083	25.500	0.021	4.250	14.604	0.000
	6	0.083	25.500	0.113	1.167	16.885	0.000
	6	0.083	25.500	0.246	1.083	27.297	0.000
	6	0.083	25.500	0.368	1.000	34.184	0.000
	6	0.083	25.500	0.491	0.917	43.015	0.000
	6	0.083	25.500	0.629	0.917	49.610	0.000
	6	0.083	25.500	0.781	0.917	56.207	0.000

Summary Hydrograph Data

	NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
	7	0.083	7.600	0.006	4.167	13.453	0.000
	7	0.083	7.600	0.024	1.167	16.158	0.000
	7	0.083	7.600	0.074	1.000	26.562	0.000
	7	0.083	7.600	0.107	1.000	33.433	0.000
	7	0.083	7.600	0.150	0.917	42.263	0.000
	7	0.083	7.600	0.190	0.917	48.851	0.000
	7	0.083	7.600	0.236	0.833	55.442	0.000

Summary Hydrograph Data

	NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
	9	0.083	5.600	0.005	4.167	13.339	0.000
	9	0.083	5.600	0.034	1.000	16.043	0.000
	9	0.083	5.600	0.076	1.000	26.448	0.000
	9	0.083	5.600	0.106	0.917	33.318	0.000
	9	0.083	5.600	0.158	0.833	42.157	0.000
	9	0.083	5.600	0.200	0.833	48.755	0.000
	9	0.083	5.600	0.248	0.833	55.352	0.000

```
================================================================================================================
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       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM, Version 2.0
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O   Licensed To: TMIG
        OOO     T      T    H   H    Y    M   M   OOO                VO2-0145

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                    *****  D E T A I L E D   O U T P U T *****


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VO2 Sept 2013\Proposed 1hr AES.out
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VO2 Sept 2013\Proposed 1hr AES.sum


DATE: 09/12/2013                          TIME: 11:53:51 AM

USER:


COMMENTS: _____________________________________________________

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|                   |               GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                   |              25MM4HR.STM
| Ptotal= 25.00 mm  |    Comments: Twenty-Five mm Four Hour Chicago Storm
---------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.07 |  1.17    5.70 |  2.17    5.19 |  3.17    2.80
                 .33    2.27 |  1.33   10.78 |  2.33    4.47 |  3.33    2.62
                 .50    2.52 |  1.50   50.21 |  2.50    3.95 |  3.50    2.48
                 .67    2.88 |  1.67   13.37 |  2.67    3.56 |  3.67    2.35
                 .83    3.38 |  1.83    8.29 |  2.83    3.25 |  3.83    2.23
                1.00    4.18 |  2.00    6.30 |  3.00    3.01 |  4.00    2.14

--------------------------------------------------------------------------------


---------------------
| CALIB             |
| STANDHYD  (0004)  |   Area     (ha)=  25.50
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
---------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       16.32          9.18
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        1.00          2.00
```

```
     Length            (m)=     412.30        40.00
     Mannings n          =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    2.07 | 1.083    5.70 | 2.083    5.19 |  3.08    2.80
               .167    2.07 | 1.167    5.70 | 2.167    5.19 |  3.17    2.80
               .250    2.27 | 1.250   10.78 | 2.250    4.47 |  3.25    2.62
               .333    2.27 | 1.333   10.78 | 2.333    4.47 |  3.33    2.62
               .417    2.52 | 1.417   50.21 | 2.417    3.95 |  3.42    2.48
               .500    2.52 | 1.500   50.21 | 2.500    3.95 |  3.50    2.48
               .583    2.88 | 1.583   13.37 | 2.583    3.56 |  3.58    2.35
               .667    2.88 | 1.667   13.37 | 2.667    3.56 |  3.67    2.35
               .750    3.38 | 1.750    8.29 | 2.750    3.25 |  3.75    2.23
               .833    3.38 | 1.833    8.29 | 2.833    3.25 |  3.83    2.23
               .917    4.17 | 1.917    6.30 | 2.917    3.01 |  3.92    2.14
              1.000    4.18 | 2.000    6.29 | 3.000    3.01 |  4.00    2.14

     Max.Eff.Inten.(mm/hr)=      50.21         4.80
               over (min)        10.00        35.00
     Storage Coeff.  (min)=       7.87 (ii)   31.65 (ii)
     Unit Hyd. Tpeak (min)=      10.00        35.00
     Unit Hyd. peak  (cms)=        .13          .03
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.44          .06          1.458 (iii)
     TIME TO PEAK    (hrs)=       1.58         2.00           1.58
     RUNOFF VOLUME    (mm)=      24.00         1.80          15.12
     TOTAL RAINFALL   (mm)=      25.00        25.00          25.00
     RUNOFF COEFFICIENT   =        .96          .07            .60


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .3720      .8100
                          .0220      .3853    |    .5394     1.1000
                          .1146      .4200    |    .6744     1.2000
                          .2502      .6600    |    .8190     1.3500

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      1.46      1.58      15.12
     OUTFLOW: ID= 1 (0006)     25.50       .02      4.25      14.60

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.44
                   TIME SHIFT OF PEAK FLOW         (min)=160.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .3667

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope    (%)=       1.00         2.00
     Length           (m)=     225.10        40.00
     Mannings n         =       .013         .250

     Max.Eff.Inten.(mm/hr)=      50.21         5.12
               over (min)         5.00        30.00
     Storage Coeff.  (min)=       5.48 (ii)   28.65 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=        .20          .04
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .51          .02           .512 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.92           1.50
     RUNOFF VOLUME    (mm)=      24.00         1.90          14.05
     TOTAL RAINFALL   (mm)=      25.00        25.00          25.00
     RUNOFF COEFFICIENT   =        .96          .08            .56


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
        (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
             THAN THE STORAGE COEFFICIENT.
       (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1092      .2400
                          .0060      .1068    |    .1584      .3100
                          .0336      .1300    |    .1980      .3500
                          .0750      .1910    |    .2406      .3900

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60       .51      1.50      14.05
     OUTFLOW: ID= 1 (0007)     7.60       .01      4.17      13.45

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.12
                   TIME SHIFT OF PEAK FLOW         (min)=160.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .1018

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope    (%)=       1.00         2.00
     Length           (m)=     193.20        40.00
     Mannings n         =       .013         .250

     Max.Eff.Inten.(mm/hr)=      50.21         5.12
               over (min)         5.00        30.00
     Storage Coeff.  (min)=       5.00 (ii)   28.17 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=        .21          .04
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .38          .02           .386 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.92           1.50
     RUNOFF VOLUME    (mm)=      24.00         1.90          14.05
     TOTAL RAINFALL   (mm)=      25.00        25.00          25.00
     RUNOFF COEFFICIENT   =        .96          .08            .56

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
```

```
       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |   .1152      .1800
                          .0050      .0782    |   .1668      .2200
                          .0354      .0880    |   .2082      .2500
                          .0792      .1400    |   .2532      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60       .39      1.50      14.05
     OUTFLOW: ID= 1 (0009)     5.60       .00      4.17      13.34

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.23
                  TIME SHIFT OF PEAK FLOW          (min)=160.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .0746

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  ****************************
  ** SIMULATION NUMBER:   2 **
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--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             1hrAES\AES2yr.stm
| Ptotal= 24.25 mm |    Comments: City of London AES 2Yr 1-Hour Distributi
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42   71.19 |   .75    3.81 |  1.08     .08
                 .17   17.80 |   .50   70.33 |   .83    1.44 |
                 .25   35.59 |   .58   26.60 |   .92     .54 |
                 .33   53.39 |   .67   10.06 |  1.00     .21 |

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--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=     16.32         9.18
     Dep. Storage     (mm)=      1.00         1.50
     Average Slope     (%)=      1.00         2.00
     Length            (m)=    412.30        40.00
     Mannings n           =      .013         .250

     Max.Eff.Inten.(mm/hr)=     71.19        50.49
                over (min)       5.00        20.00
     Storage Coeff.  (min)=      6.85 (ii)   16.12 (ii)
     Unit Hyd. Tpeak (min)=      5.00        20.00
     Unit Hyd. peak  (cms)=       .18          .06
                                                      *TOTALS*
     PEAK FLOW       (cms)=      2.67          .47        2.884 (iii)
     TIME TO PEAK    (hrs)=       .50          .67          .50
     RUNOFF VOLUME    (mm)=     23.25         8.65        17.41
     TOTAL RAINFALL   (mm)=     24.25        24.25        24.25
     RUNOFF COEFFICIENT   =       .96          .36          .72
```

```
       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |   .3720      .8100
                          .0220      .3853    |   .5394     1.1000
                          .1146      .4200    |   .6744     1.2000
                          .2502      .6600    |   .8190     1.3500

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)    25.50      2.88       .50      17.41
     OUTFLOW: ID= 1 (0006)    25.50       .11      1.17      16.89

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  3.91
                  TIME SHIFT OF PEAK FLOW          (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .4195

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      4.56         3.04
     Dep. Storage     (mm)=      1.00         1.50
     Average Slope     (%)=      1.00         2.00
     Length            (m)=    225.10        40.00
     Mannings n           =      .013         .250

     Max.Eff.Inten.(mm/hr)=     71.19        51.49
                over (min)       5.00        15.00
     Storage Coeff.  (min)=      4.76 (ii)   13.97 (ii)
     Unit Hyd. Tpeak (min)=      5.00        15.00
     Unit Hyd. peak  (cms)=       .22          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=       .78          .19          .899 (iii)
     TIME TO PEAK    (hrs)=       .50          .67          .50
     RUNOFF VOLUME    (mm)=     23.25         8.81        16.75
     TOTAL RAINFALL   (mm)=     24.25        24.25        24.25
     RUNOFF COEFFICIENT   =       .96          .36          .69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |   .1092      .2400
                          .0060      .1068    |   .1584      .3100
```

```
                          .0336      .1300   |    .1980      .3500
                          .0750      .1910   |    .2406      .3900

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)      7.60       .90       .50      16.75
     OUTFLOW: ID= 1 (0007)      7.60       .02      1.17      16.16

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  2.63
                   TIME SHIFT OF PEAK FLOW         (min)= 40.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .1216

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      71.19        51.49
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.34 (ii)   13.55 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .23          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .58          .14          .670 (iii)
     TIME TO PEAK    (hrs)=        .50          .67           .50
     RUNOFF VOLUME    (mm)=      23.25         8.81         16.75
     TOTAL RAINFALL   (mm)=      24.25        24.25         24.25
     RUNOFF COEFFICIENT   =        .96          .36           .69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1152      .1800
                          .0050      .0782    |    .1668      .2200
                          .0354      .0880    |    .2082      .2500
                          .0792      .1400    |    .2532      .2800

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)      5.60       .67       .50      16.75
     OUTFLOW: ID= 1 (0009)      5.60       .03      1.00      16.04

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.10
                   TIME SHIFT OF PEAK FLOW         (min)= 30.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .0877

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  ****************************
  ** SIMULATION NUMBER:   3 **
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--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              1hrAES\AES5yr.stm
| Ptotal= 35.09 mm |    Comments: City of London AES 5 Yr 1-Hour Distribut
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  102.99 |   .75    5.51 |  1.08     .11
                 .17   25.75 |   .50  101.75 |   .83    2.08 |
                 .25   51.49 |   .58   38.48 |   .92     .79 |
                 .33   77.24 |   .67   14.56 |  1.00     .30 |

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--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     102.99        86.34
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       5.91 (ii)   13.39 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .19          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=       4.00         1.13          4.845 (iii)
     TIME TO PEAK    (hrs)=        .50          .58           .50
     RUNOFF VOLUME    (mm)=      34.09        18.52         27.86
     TOTAL RAINFALL   (mm)=      35.09        35.09         35.09
     RUNOFF COEFFICIENT   =        .97          .53           .79


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .3720      .8100
                          .0220      .3853    |    .5394     1.1000
                          .1146      .4200    |    .6744     1.2000
                          .2502      .6600    |    .8190     1.3500

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      4.84       .50      27.86
     OUTFLOW: ID= 1 (0006)     25.50       .25      1.08      27.30

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.07
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .6520

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| CALIB            |
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```
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     102.99        87.79
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.11 (ii)   11.54 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .24          .09
                                                    *TOTALS*
     PEAK FLOW       (cms)=       1.15          .41         1.462 (iii)
     TIME TO PEAK    (hrs)=        .50          .58          .50
     RUNOFF VOLUME    (mm)=      34.09        18.69        27.16
     TOTAL RAINFALL   (mm)=      35.09        35.09        35.09
     RUNOFF COEFFICIENT   =        .97          .53          .77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1092      .2400
                           .0060      .1068   |    .1584      .3100
                           .0336      .1300   |    .1980      .3500
                           .0750      .1910   |    .2406      .3900

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      1.46       .50      27.16
     OUTFLOW: ID= 1 (0007)     7.60       .07      1.00      26.56

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.09
                   TIME SHIFT OF PEAK FLOW         (min)= 30.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .1903

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     102.99        87.79
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.75 (ii)   11.18 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .25          .09
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .85          .31         1.088 (iii)
     TIME TO PEAK    (hrs)=        .50          .58          .50
     RUNOFF VOLUME    (mm)=      34.09        18.69        27.16
     TOTAL RAINFALL   (mm)=      35.09        35.09        35.09
     RUNOFF COEFFICIENT   =        .97          .53          .77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1152      .1800
                           .0050      .0782   |    .1668      .2200
                           .0354      .0880   |    .2082      .2500
                           .0792      .1400   |    .2532      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60      1.09       .50      27.16
     OUTFLOW: ID= 1 (0009)     5.60       .08      1.00      26.45

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.03
                   TIME SHIFT OF PEAK FLOW         (min)= 30.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .1370

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  ***************************
  ** SIMULATION NUMBER:   4 **
  ***************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              1hrAES\AES10yr.stm
| Ptotal= 42.24 mm |    Comments: City of London AES 10Yr 1-Hour Distribut
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .08     .00 |   .42  123.99 |   .75    6.63 |  1.08     .14
                .17   31.00 |   .50  122.50 |   .83    2.51 |
                .25   62.00 |   .58   46.33 |   .92     .95 |
                .33   92.99 |   .67   17.53 |  1.00     .36 |

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--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     123.99       110.02
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       5.48 (ii)   12.28 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
```

```
     Unit Hyd. peak  (cms)=        .20          .09
                                                        *TOTALS*
     PEAK FLOW       (cms)=       4.88         1.57          6.092 (iii)
     TIME TO PEAK    (hrs)=        .50          .58            .50
     RUNOFF VOLUME    (mm)=      41.24        25.05          34.76
     TOTAL RAINFALL   (mm)=      42.24        42.24          42.24
     RUNOFF COEFFICIENT   =        .98          .59            .82


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .3720      .8100
                          .0220      .3853    |    .5394     1.1000
                          .1146      .4200    |    .6744     1.2000
                          .2502      .6600    |    .8190     1.3500

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      6.09       .50      34.76
     OUTFLOW: ID= 1 (0006)     25.50       .37      1.00      34.18

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.04
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .8060

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     123.99       111.76
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.81 (ii)   10.56 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .25          .09
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.39          .57          1.837 (iii)
     TIME TO PEAK    (hrs)=        .50          .58            .50
     RUNOFF VOLUME    (mm)=      41.24        25.21          34.03
     TOTAL RAINFALL   (mm)=      42.24        42.24          42.24
     RUNOFF COEFFICIENT   =        .98          .60            .81

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1092      .2400
                          .0060      .1068    |    .1584      .3100
                          .0336      .1300    |    .1980      .3500
                          .0750      .1910    |    .2406      .3900

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      1.84       .50      34.03
     OUTFLOW: ID= 1 (0007)     7.60       .11      1.00      33.43

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.80
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2363

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     123.99       111.76
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.48 (ii)   10.23 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .26          .09
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.03          .43          1.366 (iii)
     TIME TO PEAK    (hrs)=        .50          .58            .50
     RUNOFF VOLUME    (mm)=      41.24        25.21          34.03
     TOTAL RAINFALL   (mm)=      42.24        42.24          42.24
     RUNOFF COEFFICIENT   =        .98          .60            .81

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1152      .1800
                          .0050      .0782    |    .1668      .2200
                          .0354      .0880    |    .2082      .2500
                          .0792      .1400    |    .2532      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60      1.37       .50      34.03
     OUTFLOW: ID= 1 (0009)     5.60       .11       .92      33.32

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.76
                  TIME SHIFT OF PEAK FLOW         (min)= 25.00
```

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                  MAXIMUM  STORAGE   USED       (ha.m.)=  .1699

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  ***************************
  ** SIMULATION NUMBER:   5 **
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--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |               GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              1hrAES\AES25yr.stm
| Ptotal= 51.29 mm |    Comments: City of London AES 25Yr 1-Hour Distribut
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  150.54 |   .75    8.05 |  1.08     .16
                 .17   37.64 |   .50  148.73 |   .83    3.04 |
                 .25   75.27 |   .58   56.25 |   .92    1.15 |
                 .33  112.91 |   .67   21.28 |  1.00     .44 |

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--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     150.54       139.89
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       5.07 (ii)    9.96 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .21          .11
                                                    *TOTALS*
     PEAK FLOW       (cms)=       5.99         2.40          8.327 (iii)
     TIME TO PEAK    (hrs)=        .50          .58            .50
     RUNOFF VOLUME    (mm)=      50.29        33.60          43.61
     TOTAL RAINFALL   (mm)=      51.29        51.29          51.29
     RUNOFF COEFFICIENT   =        .98          .66            .85


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .3720      .8100
                           .0220      .3853   |    .5394     1.1000
                           .1146      .4200   |    .6744     1.2000
                           .2502      .6600   |    .8190     1.3500

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      8.33       .50      43.61
     OUTFLOW: ID= 1 (0006)     25.50       .49       .92      43.02

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.89
                  TIME SHIFT OF PEAK FLOW         (min)= 25.00
                  MAXIMUM  STORAGE   USED       (ha.m.)= 1.0172

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     150.54       141.97
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.53 (ii)    9.66 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .26          .11
                                                    *TOTALS*
     PEAK FLOW       (cms)=       1.70          .82          2.495 (iii)
     TIME TO PEAK    (hrs)=        .50          .58            .50
     RUNOFF VOLUME    (mm)=      50.29        33.80          42.87
     TOTAL RAINFALL   (mm)=      51.29        51.29          51.29
     RUNOFF COEFFICIENT   =        .98          .66            .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1092      .2400
                           .0060      .1068   |    .1584      .3100
                           .0336      .1300   |    .1980      .3500
                           .0750      .1910   |    .2406      .3900

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      2.49       .50      42.87
     OUTFLOW: ID= 1 (0007)     7.60       .15       .92      42.26

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  5.99
                  TIME SHIFT OF PEAK FLOW         (min)= 25.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2974

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250
```

```
     Max.Eff.Inten.(mm/hr)=     150.54       141.97
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.22 (ii)    9.35 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .27          .12
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.26          .61         1.854 (iii)
     TIME TO PEAK    (hrs)=        .50          .58          .50
     RUNOFF VOLUME    (mm)=      50.29        33.80        42.87
     TOTAL RAINFALL   (mm)=      51.29        51.29        51.29
     RUNOFF COEFFICIENT   =        .98          .66          .84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1152      .1800
                          .0050      .0782    |    .1668      .2200
                          .0354      .0880    |    .2082      .2500
                          .0792      .1400    |    .2532      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60      1.85       .50      42.87
     OUTFLOW: ID= 1 (0009)     5.60       .16       .83      42.16

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.53
                    TIME SHIFT OF PEAK FLOW         (min)= 20.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  .2139

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  ****************************
  ** SIMULATION NUMBER:   6 **
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--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             1hrAES\AES50yr.stm
| Ptotal= 57.95 mm |    Comments: City of London AES 50Yr 1-Hour Distribut
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  170.09 |   .75    9.09 |  1.08     .19
                 .17   42.52 |   .50  168.04 |   .83    3.44 |
                 .25   85.04 |   .58   63.56 |   .92    1.30 |
                 .33  127.57 |   .67   24.04 |  1.00     .49 |

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--------------------                                                    |
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     170.09       161.48
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.83 (ii)    9.48 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .22          .12
                                                      *TOTALS*
     PEAK FLOW       (cms)=       6.82         2.85         9.622 (iii)
     TIME TO PEAK    (hrs)=        .50          .58          .50
     RUNOFF VOLUME    (mm)=      56.95        40.12        50.21
     TOTAL RAINFALL   (mm)=      57.95        57.95        57.95
     RUNOFF COEFFICIENT   =        .98          .69          .87

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .3720      .8100
                          .0220      .3853    |    .5394     1.1000
                          .1146      .4200    |    .6744     1.2000
                          .2502      .6600    |    .8190     1.3500

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      9.62       .50      50.21
     OUTFLOW: ID= 1 (0006)     25.50       .63       .92      49.61

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.54
                    TIME SHIFT OF PEAK FLOW         (min)= 25.00
                    MAXIMUM  STORAGE   USED       (ha.m.)= 1.1667

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     170.09       163.83
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.36 (ii)    9.15 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .26          .12
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.92          .97         2.882 (iii)
     TIME TO PEAK    (hrs)=        .50          .58          .50
     RUNOFF VOLUME    (mm)=      56.95        40.32        49.46
     TOTAL RAINFALL   (mm)=      57.95        57.95        57.95
     RUNOFF COEFFICIENT   =        .98          .70          .85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
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```
       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1092      .2400
                           .0060      .1068   |    .1584      .3100
                           .0336      .1300   |    .1980      .3500
                           .0750      .1910   |    .2406      .3900

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)      7.60      2.88       .50      49.46
     OUTFLOW: ID= 1 (0007)      7.60       .19       .92      48.85

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.58
                   TIME SHIFT OF PEAK FLOW         (min)= 25.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .3419

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     170.09       163.83
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       3.07 (ii)    8.86 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .27          .12
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.42          .72         2.141 (iii)
     TIME TO PEAK    (hrs)=        .50          .58          .50
     RUNOFF VOLUME    (mm)=      56.95        40.32        49.46
     TOTAL RAINFALL   (mm)=      57.95        57.95        57.95
     RUNOFF COEFFICIENT   =        .98          .70          .85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1152      .1800
                           .0050      .0782   |    .1668      .2200
                           .0354      .0880   |    .2082      .2500
                           .0792      .1400   |    .2532      .2800

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)      5.60      2.14       .50      49.46
     OUTFLOW: ID= 1 (0009)      5.60       .20       .83      48.75

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.34
                   TIME SHIFT OF PEAK FLOW         (min)= 20.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .2443

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  ****************************
  ** SIMULATION NUMBER:   7 **
  ****************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              1hrAES\AES100yr.stm
| Ptotal= 64.61 mm |    Comments: City of London AES 100Yr 1-Hour Distribu
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .08     .00 |   .42  189.64 |   .75   10.14 |  1.08     .21
                 .17   47.41 |   .50  187.35 |   .83    3.83 |
                 .25   94.82 |   .58   70.86 |   .92    1.45 |
                 .33  142.23 |   .67   26.80 |  1.00     .55 |

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--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     189.64       183.07
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       4.63 (ii)    9.08 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .22          .12
                                                      *TOTALS*
     PEAK FLOW       (cms)=       7.64         3.31        10.925 (iii)
     TIME TO PEAK    (hrs)=        .50          .58          .50
     RUNOFF VOLUME    (mm)=      63.61        46.64        56.82
     TOTAL RAINFALL   (mm)=      64.61        64.61        64.61
     RUNOFF COEFFICIENT   =        .98          .72          .88

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .3720      .8100
```

```
                          .0220      .3853   |    .5394     1.1000
                          .1146      .4200   |    .6744     1.2000
                          .2502      .6600   |    .8190     1.3500

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50     10.93       .50      56.82
     OUTFLOW: ID= 1 (0006)     25.50       .78       .92      56.21

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.15
                  TIME SHIFT OF PEAK FLOW         (min)= 25.00
                  MAXIMUM  STORAGE   USED       (ha.m.)= 1.3120

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     189.64       185.69
                 over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.22 (ii)    8.03 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .27          .13
                                                    *TOTALS*
     PEAK FLOW       (cms)=       2.15         1.16         3.312 (iii)
     TIME TO PEAK    (hrs)=        .50          .50          .50
     RUNOFF VOLUME    (mm)=      63.61        46.84        56.06
     TOTAL RAINFALL   (mm)=      64.61        64.61        64.61
     RUNOFF COEFFICIENT   =        .98          .73          .87

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1092      .2400
                          .0060      .1068    |    .1584      .3100
                          .0336      .1300    |    .1980      .3500
                          .0750      .1910    |    .2406      .3900

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      3.31       .50      56.06
     OUTFLOW: ID= 1 (0007)     7.60       .24       .83      55.44

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.14
                  TIME SHIFT OF PEAK FLOW         (min)= 20.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .3872

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     189.64       185.69
                 over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.94 (ii)    7.75 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .28          .13
                                                    *TOTALS*
     PEAK FLOW       (cms)=       1.59          .87         2.459 (iii)
     TIME TO PEAK    (hrs)=        .50          .50          .50
     RUNOFF VOLUME    (mm)=      63.61        46.84        56.06
     TOTAL RAINFALL   (mm)=      64.61        64.61        64.61
     RUNOFF COEFFICIENT   =        .98          .73          .87

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1152      .1800
                          .0050      .0782    |    .1668      .2200
                          .0354      .0880    |    .2082      .2500
                          .0792      .1400    |    .2532      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60      2.46       .50      56.06
     OUTFLOW: ID= 1 (0009)     5.60       .25       .83      55.35

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.08
                  TIME SHIFT OF PEAK FLOW         (min)= 20.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2769

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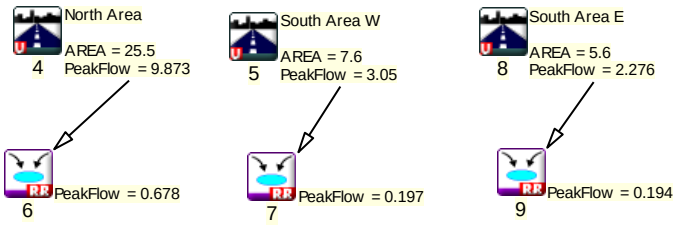

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
6	0.083	25.500	0.021	4.250	14.604	0.000
6	0.083	25.500	0.149	2.417	21.688	0.000
6	0.083	25.500	0.302	1.917	32.206	0.000
6	0.083	25.500	0.399	1.833	38.633	0.000
6	0.083	25.500	0.508	1.750	45.552	0.000
6	0.083	25.500	0.595	1.750	50.810	0.000
6	0.083	25.500	0.678	1.750	56.062	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
7	0.083	7.600	0.006	4.167	13.453	0.000
7	0.083	7.600	0.042	2.333	20.479	0.000
7	0.083	7.600	0.088	1.833	30.856	0.000
7	0.083	7.600	0.116	1.750	37.199	0.000
7	0.083	7.600	0.147	1.750	44.030	0.000
7	0.083	7.600	0.172	1.667	49.252	0.000
7	0.083	7.600	0.197	1.667	54.467	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
9	0.083	5.600	0.005	4.167	13.339	0.000
9	0.083	5.600	0.040	2.083	20.365	0.000
9	0.083	5.600	0.084	1.750	30.741	0.000
9	0.083	5.600	0.107	1.667	37.088	0.000
9	0.083	5.600	0.141	1.583	43.929	0.000
9	0.083	5.600	0.169	1.583	49.155	0.000
9	0.083	5.600	0.194	1.583	54.377	0.000

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================================================================================
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       V     V   I    SSSSS  U   U    A    L
       V     V   I    SS     U   U   A A   L
        V   V    I     SS    U   U  AAAAA  L
         V V     I      SS   U   U  A   A  L
          VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO    TTTTT  TTTTT  H   H  Y   Y  M   M   OOO     TM, Version 2.0
       O   O     T      T    H   H   Y Y   MM MM  O   O
       O   O     T      T    H   H    Y    M M M  O   O   Licensed To: TMIG
        OOO      T      T    H   H    Y    M   M   OOO                 VO2-0145

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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
  Output  filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR
Calcs\VO2\12116 VO2 Sept 2013\Proposed Chicago.out
  Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR
Calcs\VO2\12116 VO2 Sept 2013\Proposed Chicago.sum


DATE: 09/12/2013                          TIME: 12:17:02 PM

USER:


COMMENTS: ____________________________________________________________

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  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              25MM4HR.STM
| Ptotal= 25.00 mm |    Comments: Twenty-Five mm Four Hour Chicago Storm
--------------------
                TIME     RAIN |  TIME     RAIN |  TIME     RAIN |  TIME     RAIN
                 hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr |   hrs    mm/hr
                 .17     2.07 |  1.17     5.70 |  2.17     5.19 |  3.17     2.80
                 .33     2.27 |  1.33    10.78 |  2.33     4.47 |  3.33     2.62
                 .50     2.52 |  1.50    50.21 |  2.50     3.95 |  3.50     2.48
                 .67     2.88 |  1.67    13.37 |  2.67     3.56 |  3.67     2.35
                 .83     3.38 |  1.83     8.29 |  2.83     3.25 |  3.83     2.23
                1.00     4.18 |  2.00     6.30 |  3.00     3.01 |  4.00     2.14
```

CALIB			
STANDHYD (0004)	Area (ha)= 25.50		
ID= 1 DT= 5.0 min	Total Imp(%)= 64.00	Dir. Conn.(%)= 60.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	16.32	9.18
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	412.30	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	2.07	1.083	5.70	2.083	5.19	3.08	2.80
.167	2.07	1.167	5.70	2.167	5.19	3.17	2.80
.250	2.27	1.250	10.78	2.250	4.47	3.25	2.62
.333	2.27	1.333	10.78	2.333	4.47	3.33	2.62
.417	2.52	1.417	50.21	2.417	3.95	3.42	2.48
.500	2.52	1.500	50.21	2.500	3.95	3.50	2.48
.583	2.88	1.583	13.37	2.583	3.56	3.58	2.35
.667	2.88	1.667	13.37	2.667	3.56	3.67	2.35
.750	3.38	1.750	8.29	2.750	3.25	3.75	2.23
.833	3.38	1.833	8.29	2.833	3.25	3.83	2.23
.917	4.17	1.917	6.30	2.917	3.01	3.92	2.14
1.000	4.18	2.000	6.29	3.000	3.01	4.00	2.14

Max.Eff.Inten.(mm/hr)=	50.21	4.80		
over (min)	10.00	35.00		
Storage Coeff. (min)=	7.87 (ii)	31.65 (ii)		
Unit Hyd. Tpeak (min)=	10.00	35.00		
Unit Hyd. peak (cms)=	.13	.03		
			TOTALS	
PEAK FLOW (cms)=	1.44	.06	1.458 (iii)	
TIME TO PEAK (hrs)=	1.58	2.00	1.58	
RUNOFF VOLUME (mm)=	24.00	1.80	15.12	
TOTAL RAINFALL (mm)=	25.00	25.00	25.00	
RUNOFF COEFFICIENT =	.96	.07	.60	

(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
Fo (mm/hr)= 50.00 K (1/hr)= 2.00
Fc (mm/hr)= 7.50 Cum.Inf. (mm)= .00
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0006)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.4056	.8200
	.0220	.3853	.5178	.9500
	.1536	.4900	.6084	1.0500
	.3048	.6900	.6978	1.1500

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	25.50	1.46	1.58	15.12
OUTFLOW: ID= 1 (0006)	25.50	.02	4.25	14.60

PEAK FLOW REDUCTION [Qout/Qin](%)= 1.44
TIME SHIFT OF PEAK FLOW (min)=160.00
MAXIMUM STORAGE USED (ha.m.)= .3667

CALIB			
STANDHYD (0005)	Area (ha)= 7.60		
ID= 1 DT= 5.0 min	Total Imp(%)= 60.00	Dir. Conn.(%)= 55.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	4.56	3.04
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	225.10	40.00
Mannings n	=	.013	.250
Max.Eff.Inten.(mm/hr)=		50.21	5.12
over (min)		5.00	30.00
Storage Coeff. (min)=		5.48 (ii)	28.65 (ii)
Unit Hyd. Tpeak (min)=		5.00	30.00
Unit Hyd. peak (cms)=		.20	.04

				TOTALS
PEAK FLOW	(cms)=	.51	.02	.512 (iii)
TIME TO PEAK	(hrs)=	1.50	1.92	1.50
RUNOFF VOLUME	(mm)=	24.00	1.90	14.05
TOTAL RAINFALL	(mm)=	25.00	25.00	25.00
RUNOFF COEFFICIENT	=	.96	.08	.56

(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
Fo (mm/hr)= 50.00 K (1/hr)= 2.00
Fc (mm/hr)= 7.50 Cum.Inf. (mm)= .00
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0007)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.1206	.2400
	.0060	.1068	.1536	.2800
	.0456	.1400	.1794	.3100
	.0906	.2000	.2064	.3400

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0005)	7.60	.51	1.50	14.05
OUTFLOW: ID= 1 (0007)	7.60	.01	4.17	13.45

```
                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.12
                  TIME SHIFT OF PEAK FLOW          (min)=160.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .1018

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      50.21         5.12
                 over (min)        5.00        30.00
     Storage Coeff.  (min)=       5.00 (ii)   28.17 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=        .21          .04
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .38          .02          .386 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.92          1.50
     RUNOFF VOLUME    (mm)=      24.00         1.90         14.05
     TOTAL RAINFALL   (mm)=      25.00        25.00         25.00
     RUNOFF COEFFICIENT   =        .96          .08           .56

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1182      .1800
                           .0050      .0782   |    .1506      .2000
                           .0432      .1000   |    .1770      .2200
                           .0882      .1450   |    .2028      .2400

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)      5.60       .39      1.50      14.05
     OUTFLOW: ID= 1 (0009)      5.60       .00      4.17      13.34

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.23
                  TIME SHIFT OF PEAK FLOW          (min)=160.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .0746

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  ** SIMULATION NUMBER:   2 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 724.690
| Ptotal= 33.29 mm |                          B=   5.500
--------------------                          C=    .800
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  3.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =   .33

               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .17    3.02 |  1.00   80.89 |  1.83    5.36 |  2.67    2.88
                .33    3.72 |  1.17   24.52 |  2.00    4.54 |  2.83    2.65
                .50    4.95 |  1.33   12.70 |  2.17    3.95 |  3.00    2.46
                .67    7.61 |  1.50    8.64 |  2.33    3.51 |
                .83   18.60 |  1.67    6.59 |  2.50    3.16 |


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--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    3.02 |  .833   18.60 | 1.583    6.59 |  2.33    3.51
               .167    3.02 |  .917   80.89 | 1.667    6.59 |  2.42    3.16
               .250    3.72 | 1.000   80.89 | 1.750    5.36 |  2.50    3.16
               .333    3.72 | 1.083   24.52 | 1.833    5.36 |  2.58    2.88
               .417    4.95 | 1.167   24.52 | 1.917    4.54 |  2.67    2.88
               .500    4.95 | 1.250   12.70 | 2.000    4.54 |  2.75    2.65
               .583    7.61 | 1.333   12.70 | 2.083    3.95 |  2.83    2.65
               .667    7.61 | 1.417    8.64 | 2.167    3.95 |  2.92    2.46
               .750   18.60 | 1.500    8.64 | 2.250    3.51 |  3.00    2.46

     Max.Eff.Inten.(mm/hr)=      80.89        47.13
                 over (min)        5.00        20.00
     Storage Coeff.  (min)=       6.51 (ii)   16.04 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=        .18          .06
                                                      *TOTALS*
     PEAK FLOW       (cms)=       2.85          .42          3.004 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.25          1.00
     RUNOFF VOLUME    (mm)=      32.29         7.21         22.26
     TOTAL RAINFALL   (mm)=      33.29        33.29         33.29
```

```
     RUNOFF COEFFICIENT   =        .97          .22           .67

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .4056      .8200
                          .0220      .3853    |    .5178      .9500
                          .1536      .4900    |    .6084     1.0500
                          .3048      .6900    |    .6978     1.1500

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      3.00      1.00      22.26
     OUTFLOW: ID= 1 (0006)     25.50       .15      2.42      21.69

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.96
                  TIME SHIFT OF PEAK FLOW         (min)= 85.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .4864

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      80.89        48.37
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.52 (ii)   13.96 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .23          .08
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .86          .17          .946 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.17          1.00
     RUNOFF VOLUME    (mm)=      32.29         7.37         21.08
     TOTAL RAINFALL   (mm)=      33.29        33.29         33.29
     RUNOFF COEFFICIENT   =        .97          .22           .63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1206      .2400
                          .0060      .1068    |    .1536      .2800
                          .0456      .1400    |    .1794      .3100
                          .0906      .2000    |    .2064      .3400

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60       .95      1.00      21.08
     OUTFLOW: ID= 1 (0007)     7.60       .04      2.33      20.48

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.45
                  TIME SHIFT OF PEAK FLOW         (min)= 80.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .1370

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      80.89        48.37
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.13 (ii)   13.57 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .24          .08
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .64          .13          .709 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.17          1.00
     RUNOFF VOLUME    (mm)=      32.29         7.37         21.08
     TOTAL RAINFALL   (mm)=      33.29        33.29         33.29
     RUNOFF COEFFICIENT   =        .97          .22           .63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
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DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.1182	.1800
	.0050	.0782	.1506	.2000
	.0432	.1000	.1770	.2200
	.0882	.1450	.2028	.2400

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0008)	5.60	.71	1.00	21.08
OUTFLOW: ID= 1 (0009)	5.60	.04	2.08	20.36

PEAK FLOW REDUCTION [Qout/Qin](%)= 5.60
TIME SHIFT OF PEAK FLOW (min)= 65.00
MAXIMUM STORAGE USED (ha.m.)= .0980

**** SIMULATION NUMBER: 3 ****

CHICAGO STORM
Ptotal= 45.35 mm

IDF curve parameters: A=1330.310
B= 7.938
C= .855
used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	3.43	1.00	112.71	1.83	6.69	2.67	3.25
.33	4.38	1.17	36.59	2.00	5.51	2.83	2.95
.50	6.09	1.33	17.98	2.17	4.69	3.00	2.70
.67	10.04	1.50	11.61	2.33	4.08		
.83	27.27	1.67	8.50	2.50	3.61		

CALIB STANDHYD (0004)
ID= 1 DT= 5.0 min

Area (ha)= 25.50
Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	16.32	9.18
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	412.30	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	3.43	.833	27.27	1.583	8.50	2.33	4.08
.167	3.43	.917	112.71	1.667	8.50	2.42	3.61
.250	4.38	1.000	112.71	1.750	6.69	2.50	3.61
.333	4.38	1.083	36.59	1.833	6.69	2.58	3.25
.417	6.09	1.167	36.59	1.917	5.51	2.67	3.25
.500	6.09	1.250	17.98	2.000	5.51	2.75	2.95
.583	10.04	1.333	17.98	2.083	4.69	2.83	2.95
.667	10.04	1.417	11.61	2.167	4.69	2.92	2.70
.750	27.27	1.500	11.61	2.250	4.08	3.00	2.70

				TOTALS
Max.Eff.Inten.(mm/hr)=		112.71	85.82	
over (min)		5.00	15.00	
Storage Coeff. (min)=		5.70 (ii)	13.20 (ii)	
Unit Hyd. Tpeak (min)=		5.00	15.00	
Unit Hyd. peak (cms)=		.20	.08	
PEAK FLOW	(cms)=	4.14	1.00	4.642 (iii)
TIME TO PEAK	(hrs)=	1.00	1.17	1.00
RUNOFF VOLUME	(mm)=	44.35	15.49	32.80
TOTAL RAINFALL	(mm)=	45.35	45.35	45.35
RUNOFF COEFFICIENT	=	.98	.34	.72

(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
Fo (mm/hr)= 50.00 K (1/hr)= 2.00
Fc (mm/hr)= 7.50 Cum.Inf. (mm)= .00
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0006)
IN= 2---> OUT= 1

DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.4056	.8200
	.0220	.3853	.5178	.9500
	.1536	.4900	.6084	1.0500
	.3048	.6900	.6978	1.1500

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	25.50	4.64	1.00	32.80
OUTFLOW: ID= 1 (0006)	25.50	.30	1.92	32.21

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.51
TIME SHIFT OF PEAK FLOW (min)= 55.00
MAXIMUM STORAGE USED (ha.m.)= .6869

CALIB STANDHYD (0005)
ID= 1 DT= 5.0 min

Area (ha)= 7.60
Total Imp(%)= 60.00 Dir. Conn.(%)= 55.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	4.56	3.04
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	225.10	40.00
Mannings n	=	.013	.250

```
     Max.Eff.Inten.(mm/hr)=     112.71        87.54
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.96 (ii)   11.41 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .24          .09
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.23          .36     1.413 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.17      1.00
     RUNOFF VOLUME    (mm)=      44.35        15.69     31.45
     TOTAL RAINFALL   (mm)=      45.35        45.35     45.35
     RUNOFF COEFFICIENT   =        .98          .35       .69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1206      .2400
                          .0060      .1068    |    .1536      .2800
                          .0456      .1400    |    .1794      .3100
                          .0906      .2000    |    .2064      .3400

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      1.41      1.00      31.45
     OUTFLOW: ID= 1 (0007)     7.60       .09      1.83      30.86

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.24
                   TIME SHIFT OF PEAK FLOW         (min)= 50.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .1969

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     112.71        87.54
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.62 (ii)   11.06 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .25          .09
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .92          .27     1.057 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.17      1.00
     RUNOFF VOLUME    (mm)=      44.35        15.69     31.45
     TOTAL RAINFALL   (mm)=      45.35        45.35     45.35
     RUNOFF COEFFICIENT   =        .98          .35       .69

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1182      .1800
                          .0050      .0782    |    .1506      .2000
                          .0432      .1000    |    .1770      .2200
                          .0882      .1450    |    .2028      .2400

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60      1.06      1.00      31.45
     OUTFLOW: ID= 1 (0009)     5.60       .08      1.75      30.74

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.93
                   TIME SHIFT OF PEAK FLOW         (min)= 45.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .1407

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  ****************************
  ** SIMULATION NUMBER:   4 **
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| CHICAGO STORM    |    IDF curve parameters: A=1497.190
| Ptotal= 52.57 mm |                          B=   7.188
--------------------                          C=    .850
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  3.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    3.99 |  1.00  133.46 |  1.83    7.67 |  2.67    3.78
                 .33    5.07 |  1.17   41.53 |  2.00    6.35 |  2.83    3.44
                 .50    7.00 |  1.33   20.35 |  2.17    5.42 |  3.00    3.16
                 .67   11.44 |  1.50   13.20 |  2.33    4.73 |
                 .83   30.92 |  1.67    9.71 |  2.50    4.20 |

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| CALIB            |
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| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    3.99 |  .833   30.92 | 1.583    9.71 | 2.33    4.73
               .167    3.99 |  .917  133.45 | 1.667    9.71 | 2.42    4.20
               .250    5.07 | 1.000  133.46 | 1.750    7.67 | 2.50    4.20
               .333    5.07 | 1.083   41.53 | 1.833    7.67 | 2.58    3.78
               .417    7.00 | 1.167   41.53 | 1.917    6.35 | 2.67    3.78
               .500    7.00 | 1.250   20.35 | 2.000    6.35 | 2.75    3.44
               .583   11.44 | 1.333   20.35 | 2.083    5.42 | 2.83    3.44
               .667   11.44 | 1.417   13.20 | 2.167    5.42 | 2.92    3.16
               .750   30.91 | 1.500   13.20 | 2.250    4.73 | 3.00    3.16

     Max.Eff.Inten.(mm/hr)=     133.46       110.62
               over (min)         5.00        15.00
     Storage Coeff.  (min)=       5.33 (ii)   12.10 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .21          .09
                                                    *TOTALS*
     PEAK FLOW       (cms)=       4.99         1.36      5.676 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.17       1.00
     RUNOFF VOLUME    (mm)=      51.57        20.75      39.24
     TOTAL RAINFALL   (mm)=      52.57        52.57      52.57
     RUNOFF COEFFICIENT   =        .98          .39        .75

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .4056      .8200
                          .0220      .3853    |    .5178      .9500
                          .1536      .4900    |    .6084     1.0500
                          .3048      .6900    |    .6978     1.1500

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)    25.50      5.68      1.00      39.24
     OUTFLOW: ID= 1 (0006)    25.50       .40      1.83      38.63

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  7.02
                    TIME SHIFT OF PEAK FLOW          (min)= 50.00
                    MAXIMUM  STORAGE   USED        (ha.m.)=  .8113

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     133.46       112.80
               over (min)         5.00        15.00
     Storage Coeff.  (min)=       3.70 (ii)   10.43 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .25          .09
                                                    *TOTALS*
     PEAK FLOW       (cms)=       1.47          .49       1.723 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.17        1.00
     RUNOFF VOLUME    (mm)=      51.57        20.97       37.80
     TOTAL RAINFALL   (mm)=      52.57        52.57       52.57
     RUNOFF COEFFICIENT   =        .98          .40         .72

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1206      .2400
                          .0060      .1068    |    .1536      .2800
                          .0456      .1400    |    .1794      .3100
                          .0906      .2000    |    .2064      .3400

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      1.72      1.00      37.80
     OUTFLOW: ID= 1 (0007)     7.60       .12      1.75      37.20

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.74
                    TIME SHIFT OF PEAK FLOW          (min)= 45.00
                    MAXIMUM  STORAGE   USED        (ha.m.)=  .2342

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| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     133.46       112.80
               over (min)          5.00        15.00
     Storage Coeff.  (min)=       3.38 (ii)   10.10 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .26          .10
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.10          .37        1.287 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.17         1.00
     RUNOFF VOLUME    (mm)=      51.57        20.97        37.80
     TOTAL RAINFALL   (mm)=      52.57        52.57        52.57
     RUNOFF COEFFICIENT   =        .98          .40          .72

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |    (cms)     (ha.m.)
                          .0000      .0000    |    .1182      .1800
                          .0050      .0782    |    .1506      .2000
                          .0432      .1000    |    .1770      .2200
                          .0882      .1450    |    .2028      .2400

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60      1.29      1.00      37.80
     OUTFLOW: ID= 1 (0009)     5.60       .11      1.67      37.09

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.35
                   TIME SHIFT OF PEAK FLOW          (min)= 40.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .1675

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  ***************************
  ** SIMULATION NUMBER:   5 **
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| CHICAGO STORM    |    IDF curve parameters: A=1455.000
| Ptotal= 60.35 mm |                          B=   5.000
--------------------                          C=    .820
                          used in:   INTENSITY =  A / (t + B)^C

                          Duration of storm  =  3.00 hrs
                          Storm time step    = 10.00 min
                          Time to peak ratio =   .33

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    4.97 |  1.00  157.93 |  1.83    9.00 |  2.67    4.74
                 .33    6.18 |  1.17   43.82 |  2.00    7.58 |  2.83    4.35
                 .50    8.28 |  1.33   21.99 |  2.17    6.56 |  3.00    4.02
                 .67   12.92 |  1.50   14.73 |  2.33    5.80 |
                 .83   32.88 |  1.67   11.14 |  2.50    5.21 |


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--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .083    4.97 |  .833   32.88 | 1.583   11.14 |  2.33    5.80
                .167    4.97 |  .917  157.93 | 1.667   11.14 |  2.42    5.21
                .250    6.18 | 1.000  157.93 | 1.750    9.00 |  2.50    5.21
                .333    6.18 | 1.083   43.82 | 1.833    9.00 |  2.58    4.74
                .417    8.28 | 1.167   43.82 | 1.917    7.58 |  2.67    4.74
                .500    8.28 | 1.250   21.99 | 2.000    7.58 |  2.75    4.35
                .583   12.92 | 1.333   21.99 | 2.083    6.56 |  2.83    4.35
                .667   12.92 | 1.417   14.73 | 2.167    6.56 |  2.92    4.02
                .750   32.88 | 1.500   14.73 | 2.250    5.80 |  3.00    4.02

     Max.Eff.Inten.(mm/hr)=     157.93       140.85
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       4.98 (ii)    9.77 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .22          .11
                                                        *TOTALS*
     PEAK FLOW       (cms)=       5.98         2.06        7.743 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08         1.00
     RUNOFF VOLUME    (mm)=      59.35        26.40        46.17
     TOTAL RAINFALL   (mm)=      60.35        60.35        60.35
     RUNOFF COEFFICIENT   =        .98          .44          .77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
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      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .4056      .8200
                          .0220      .3853    |    .5178      .9500
                          .1536      .4900    |    .6084     1.0500
                          .3048      .6900    |    .6978     1.1500

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      7.74      1.00      46.17
     OUTFLOW: ID= 1 (0006)     25.50       .51      1.75      45.55

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.56
                  TIME SHIFT OF PEAK FLOW         (min)= 45.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .9390

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     157.93       143.48
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       3.46 (ii)    9.57 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .26          .11
                                                    *TOTALS*
     PEAK FLOW       (cms)=       1.75          .70     2.355 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08      1.00
     RUNOFF VOLUME    (mm)=      59.35        26.66     44.64
     TOTAL RAINFALL   (mm)=      60.35        60.35     60.35
     RUNOFF COEFFICIENT   =        .98          .44       .74

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
           Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1206      .2400
                          .0060      .1068    |    .1536      .2800
                          .0456      .1400    |    .1794      .3100
                          .0906      .2000    |    .2064      .3400

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      2.35      1.00      44.64
     OUTFLOW: ID= 1 (0007)     7.60       .15      1.75      44.03

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.25
                  TIME SHIFT OF PEAK FLOW         (min)= 45.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2723

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     157.93       143.48
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       3.16 (ii)    9.27 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .27          .12
                                                    *TOTALS*
     PEAK FLOW       (cms)=       1.31          .52     1.759 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08      1.00
     RUNOFF VOLUME    (mm)=      59.35        26.66     44.64
     TOTAL RAINFALL   (mm)=      60.35        60.35     60.35
     RUNOFF COEFFICIENT   =        .98          .44       .74

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
           Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
           Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1182      .1800
                          .0050      .0782    |    .1506      .2000
                          .0432      .1000    |    .1770      .2200
                          .0882      .1450    |    .2028      .2400
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	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0008)	5.60	1.76	1.00	44.64
OUTFLOW: ID= 1 (0009)	5.60	.14	1.58	43.93

PEAK FLOW REDUCTION [Qout/Qin](%)= 8.01
TIME SHIFT OF PEAK FLOW (min)= 35.00
MAXIMUM STORAGE USED (ha.m.)= .1941

** SIMULATION NUMBER: 6 **

CHICAGO STORM	Ptotal= 66.08 mm

IDF curve parameters: A=1499.060
B= 4.188
C= .809
used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = .33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.17	5.60	1.00	175.35	1.83	9.92	2.67	5.35
.33	6.91	1.17	46.15	2.00	8.41	2.83	4.92
.50	9.16	1.33	23.48	2.17	7.33	3.00	4.56
.67	14.05	1.50	15.95	2.33	6.51		
.83	34.80	1.67	12.19	2.50	5.86		

CALIB STANDHYD (0004)	ID= 1 DT= 5.0 min

Area (ha)= 25.50
Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	16.32	9.18
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	412.30	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	5.60	.833	34.80	1.583	12.19	2.33	6.51
.167	5.60	.917	175.35	1.667	12.19	2.42	5.86
.250	6.91	1.000	175.35	1.750	9.92	2.50	5.86
.333	6.91	1.083	46.15	1.833	9.92	2.58	5.35
.417	9.16	1.167	46.15	1.917	8.41	2.67	5.35
.500	9.16	1.250	23.48	2.000	8.41	2.75	4.92
.583	14.05	1.333	23.48	2.083	7.33	2.83	4.92
.667	14.05	1.417	15.95	2.167	7.33	2.92	4.56
.750	34.80	1.500	15.95	2.250	6.51	3.00	4.56

				TOTALS
Max.Eff.Inten.(mm/hr)=	175.35	163.49		
over (min)	5.00	10.00		
Storage Coeff. (min)=	4.77 (ii)	9.37 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	.22	.12		
PEAK FLOW (cms)=	6.70	2.42		8.819 (iii)
TIME TO PEAK (hrs)=	1.00	1.08		1.00
RUNOFF VOLUME (mm)=	65.08	30.96		51.43
TOTAL RAINFALL (mm)=	66.08	66.08		66.08
RUNOFF COEFFICIENT =	.98	.47		.78

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
Fo (mm/hr)= 50.00 K (1/hr)= 2.00
Fc (mm/hr)= 7.50 Cum.Inf. (mm)= .00
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0006)	IN= 2---> OUT= 1	DT= 5.0 min

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
.0000	.0000	.4056	.8200
.0220	.3853	.5178	.9500
.1536	.4900	.6084	1.0500
.3048	.6900	.6978	1.1500

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	25.50	8.82	1.00	51.43
OUTFLOW: ID= 1 (0006)	25.50	.60	1.75	50.81

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.75
TIME SHIFT OF PEAK FLOW (min)= 45.00
MAXIMUM STORAGE USED (ha.m.)= 1.0361

CALIB STANDHYD (0005)	ID= 1 DT= 5.0 min

Area (ha)= 7.60
Total Imp(%)= 60.00 Dir. Conn.(%)= 55.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	4.56	3.04
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	225.10	40.00
Mannings n	=	.013	.250

Max.Eff.Inten.(mm/hr)=	175.35	166.61	
over (min)	5.00	10.00	
Storage Coeff. (min)=	3.32 (ii)	8.28 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	.26	.13	

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                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.96          .86          2.726 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08           1.00
     RUNOFF VOLUME    (mm)=      65.08        31.27          49.87
     TOTAL RAINFALL   (mm)=      66.08        66.08          66.08
     RUNOFF COEFFICIENT   =        .98          .47            .75

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1206      .2400
                          .0060      .1068    |    .1536      .2800
                          .0456      .1400    |    .1794      .3100
                          .0906      .2000    |    .2064      .3400

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)    7.60      2.73      1.00      49.87
     OUTFLOW: ID= 1 (0007)    7.60       .17      1.67      49.25

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.31
                  TIME SHIFT OF PEAK FLOW         (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .3017

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     175.35       166.61
               over (min)          5.00        10.00
     Storage Coeff.  (min)=       3.03 (ii)    7.99 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .27          .13
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.46          .64          2.036 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08           1.00
     RUNOFF VOLUME    (mm)=      65.08        31.27          49.87
     TOTAL RAINFALL   (mm)=      66.08        66.08          66.08
     RUNOFF COEFFICIENT   =        .98          .47            .75

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1182      .1800
                          .0050      .0782    |    .1506      .2000
                          .0432      .1000    |    .1770      .2200
                          .0882      .1450    |    .2028      .2400

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)    5.60      2.04      1.00      49.87
     OUTFLOW: ID= 1 (0009)    5.60       .17      1.58      49.16

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.31
                  TIME SHIFT OF PEAK FLOW         (min)= 35.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2143

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  ****************************
  ** SIMULATION NUMBER:   7 **
  ****************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1499.530
| Ptotal= 71.76 mm |                          B=   3.297
--------------------                          C=    .794
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  3.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =   .33

               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                .17    6.35 |  1.00  192.17 |  1.83   10.97 |  2.67    6.07
                .33    7.76 |  1.17   47.73 |  2.00    9.37 |  2.83    5.61
                .50   10.16 |  1.33   24.88 |  2.17    8.21 |  3.00    5.22
                .67   15.26 |  1.50   17.22 |  2.33    7.33 |
                .83   36.28 |  1.67   13.33 |  2.50    6.64 |


--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0004) |   Area    (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32         9.18
```

```
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     412.30        40.00
     Mannings n           =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                         ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    6.35 |  .833   36.28 | 1.583   13.33 |  2.33    7.33
               .167    6.35 |  .917  192.17 | 1.667   13.33 |  2.42    6.64
               .250    7.76 | 1.000  192.17 | 1.750   10.97 |  2.50    6.64
               .333    7.76 | 1.083   47.73 | 1.833   10.97 |  2.58    6.07
               .417   10.16 | 1.167   47.73 | 1.917    9.37 |  2.67    6.07
               .500   10.16 | 1.250   24.88 | 2.000    9.37 |  2.75    5.61
               .583   15.26 | 1.333   24.88 | 2.083    8.21 |  2.83    5.61
               .667   15.26 | 1.417   17.22 | 2.167    8.21 |  2.92    5.22
               .750   36.28 | 1.500   17.22 | 2.250    7.33 |  3.00    5.22

     Max.Eff.Inten.(mm/hr)=     192.17       185.49
               over (min)         5.00        10.00
     Storage Coeff.  (min)=      4.60 (ii)    9.03 (ii)
     Unit Hyd. Tpeak (min)=      5.00        10.00
     Unit Hyd. peak  (cms)=       .23          .12
                                                    *TOTALS*
     PEAK FLOW       (cms)=      7.40         2.76      9.873 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.08       1.00
     RUNOFF VOLUME    (mm)=     70.76        35.59      56.69
     TOTAL RAINFALL   (mm)=     71.76        71.76      71.76
     RUNOFF COEFFICIENT   =       .99          .50        .79

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .4056      .8200
                          .0220      .3853    |    .5178      .9500
                          .1536      .4900    |    .6084     1.0500
                          .3048      .6900    |    .6978     1.1500

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)    25.50      9.87      1.00      56.69
     OUTFLOW: ID= 1 (0006)    25.50       .68      1.75      56.06

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.87
                  TIME SHIFT OF PEAK FLOW         (min)= 45.00
                  MAXIMUM  STORAGE   USED       (ha.m.)= 1.1286

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     192.17       188.88
               over (min)         5.00        10.00
     Storage Coeff.  (min)=      3.20 (ii)    7.99 (ii)
     Unit Hyd. Tpeak (min)=      5.00        10.00
     Unit Hyd. peak  (cms)=       .27          .13
                                                    *TOTALS*
     PEAK FLOW       (cms)=      2.15          .98       3.050 (iii)
     TIME TO PEAK    (hrs)=      1.00         1.08        1.00
     RUNOFF VOLUME    (mm)=     70.76        35.93       55.09
     TOTAL RAINFALL   (mm)=     71.76        71.76       71.76
     RUNOFF COEFFICIENT   =       .99          .50         .77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1206      .2400
                          .0060      .1068    |    .1536      .2800
                          .0456      .1400    |    .1794      .3100
                          .0906      .2000    |    .2064      .3400

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      3.05      1.00      55.09
     OUTFLOW: ID= 1 (0007)     7.60       .20      1.67      54.47

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  6.45
                  TIME SHIFT OF PEAK FLOW         (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .3295

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
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```

```
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     192.17       188.88
               over (min)         5.00        10.00
     Storage Coeff.  (min)=       2.92 (ii)    7.71 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .28          .13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       1.60          .73          2.276 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08           1.00
     RUNOFF VOLUME    (mm)=      70.76        35.93          55.09
     TOTAL RAINFALL   (mm)=      71.76        71.76          71.76
     RUNOFF COEFFICIENT   =        .99          .50            .77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1182      .1800
                           .0050      .0782   |    .1506      .2000
                           .0432      .1000   |    .1770      .2200
                           .0882      .1450   |    .2028      .2400

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)      5.60      2.28      1.00      55.09
     OUTFLOW: ID= 1 (0009)      5.60       .19      1.58      54.38

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.51
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  .2332

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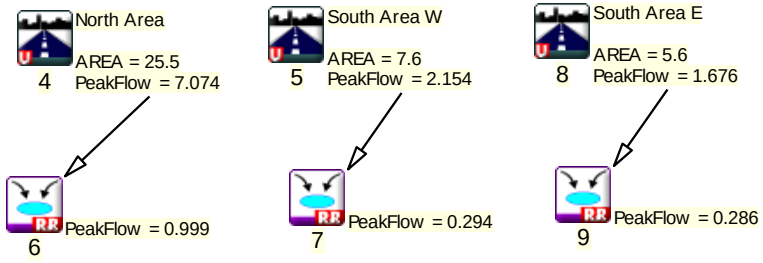

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
6	0.083	25.500	0.021	4.250	14.604	0.000
6	0.083	25.500	0.256	12.750	33.531	0.000
6	0.083	25.500	0.378	12.667	42.936	0.000
6	0.083	25.500	0.501	12.667	51.786	0.000
6	0.083	25.500	0.696	12.583	64.599	0.000
6	0.083	25.500	0.837	12.583	73.163	0.000
6	0.083	25.500	0.999	12.583	82.948	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
7	0.083	7.600	0.006	4.167	13.453	0.000
7	0.083	7.600	0.074	12.667	31.614	0.000
7	0.083	7.600	0.112	12.583	40.724	0.000
7	0.083	7.600	0.148	12.583	49.379	0.000
7	0.083	7.600	0.205	12.583	61.829	0.000
7	0.083	7.600	0.246	12.583	70.186	0.000
7	0.083	7.600	0.294	12.583	79.751	0.000

Summary Hydrograph Data

NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
9	0.083	5.600	0.005	4.167	13.339	0.000
9	0.083	5.600	0.073	12.583	31.706	0.000
9	0.083	5.600	0.109	12.500	40.826	0.000
9	0.083	5.600	0.145	12.500	49.490	0.000
9	0.083	5.600	0.200	12.500	61.949	0.000
9	0.083	5.600	0.239	12.500	70.312	0.000
9	0.083	5.600	0.286	12.417	79.883	0.000

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       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM, Version 2.0
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M M M  O   O   Licensed To: TMIG
        OOO     T      T    H   H    Y    M   M   OOO                 VO2-0145

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                    *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
  Output  filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\12116
VO2 Sept 2013\Proposed 24hr SCS.out
  Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\12116
VO2 Sept 2013\Proposed 24hr SCS.sum

DATE: 09/12/2013                          TIME: 12:41:23 PM

USER:


COMMENTS: ____________________________________________________________

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------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************


---------------------
|    READ STORM     |    Filename: G:\Projects\2012\12116 - TSI London
|                   |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                   |              25MM4HR.STM
| Ptotal= 25.00 mm  |    Comments: Twenty-Five mm Four Hour Chicago Storm
---------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .17    2.07 |  1.17    5.70 |  2.17    5.19 |  3.17    2.80
                 .33    2.27 |  1.33   10.78 |  2.33    4.47 |  3.33    2.62
                 .50    2.52 |  1.50   50.21 |  2.50    3.95 |  3.50    2.48
                 .67    2.88 |  1.67   13.37 |  2.67    3.56 |  3.67    2.35
                 .83    3.38 |  1.83    8.29 |  2.83    3.25 |  3.83    2.23
                1.00    4.18 |  2.00    6.30 |  3.00    3.01 |  4.00    2.14

--------------------------------------------------------------------------------

---------------------
| CALIB             |
| STANDHYD  (0004)  |   Area     (ha)=  25.50
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
---------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       16.32          9.18
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        1.00          2.00
```

```
     Length            (m)=     412.30        40.00
     Mannings n          =       .013         .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .083    2.07 | 1.083    5.70 | 2.083    5.19 |  3.08    2.80
               .167    2.07 | 1.167    5.70 | 2.167    5.19 |  3.17    2.80
               .250    2.27 | 1.250   10.78 | 2.250    4.47 |  3.25    2.62
               .333    2.27 | 1.333   10.78 | 2.333    4.47 |  3.33    2.62
               .417    2.52 | 1.417   50.21 | 2.417    3.95 |  3.42    2.48
               .500    2.52 | 1.500   50.21 | 2.500    3.95 |  3.50    2.48
               .583    2.88 | 1.583   13.37 | 2.583    3.56 |  3.58    2.35
               .667    2.88 | 1.667   13.37 | 2.667    3.56 |  3.67    2.35
               .750    3.38 | 1.750    8.29 | 2.750    3.25 |  3.75    2.23
               .833    3.38 | 1.833    8.29 | 2.833    3.25 |  3.83    2.23
               .917    4.17 | 1.917    6.30 | 2.917    3.01 |  3.92    2.14
              1.000    4.18 | 2.000    6.29 | 3.000    3.01 |  4.00    2.14

     Max.Eff.Inten.(mm/hr)=      50.21         4.80
               over (min)        10.00        35.00
     Storage Coeff.  (min)=       7.87 (ii)   31.65 (ii)
     Unit Hyd. Tpeak (min)=      10.00        35.00
     Unit Hyd. peak  (cms)=        .13          .03
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.44          .06      1.458 (iii)
     TIME TO PEAK    (hrs)=       1.58         2.00       1.58
     RUNOFF VOLUME    (mm)=      24.00         1.80      15.12
     TOTAL RAINFALL   (mm)=      25.00        25.00      25.00
     RUNOFF COEFFICIENT   =        .96          .07        .60


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .5030      .8930
                          .0220      .3853    |    .6990     1.0960
                          .2580      .5970    |    .8390     1.2260
                          .3810      .7510    |   1.0020     1.3720

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      1.46      1.58      15.12
     OUTFLOW: ID= 1 (0006)     25.50       .02      4.25      14.60

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.44
                  TIME SHIFT OF PEAK FLOW         (min)=160.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .3667

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n          =       .013         .250

     Max.Eff.Inten.(mm/hr)=      50.21         5.12
               over (min)         5.00        30.00
     Storage Coeff.  (min)=       5.48 (ii)   28.65 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=        .20          .04
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .51          .02         .512 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.92        1.50
     RUNOFF VOLUME    (mm)=      24.00         1.90       14.05
     TOTAL RAINFALL   (mm)=      25.00        25.00       25.00
     RUNOFF COEFFICIENT   =        .96          .08         .56


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1490      .2580
                          .0060      .1068    |    .2070      .3190
                          .0760      .1710    |    .2490      .3580
                          .1130      .2160    |    .2970      .4010

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60       .51      1.50      14.05
     OUTFLOW: ID= 1 (0007)     7.60       .01      4.17      13.45

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.12
                  TIME SHIFT OF PEAK FLOW         (min)=160.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .1018

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n          =       .013         .250

     Max.Eff.Inten.(mm/hr)=      50.21         5.12
               over (min)         5.00        30.00
     Storage Coeff.  (min)=       5.00 (ii)   28.17 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=        .21          .04
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .38          .02         .386 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.92        1.50
     RUNOFF VOLUME    (mm)=      24.00         1.90       14.05
     TOTAL RAINFALL   (mm)=      25.00        25.00       25.00
     RUNOFF COEFFICIENT   =        .96          .08         .56

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
```

```
           Fc    (mm/hr)=  7.50     Cum.Inf.    (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1460      .1820
                          .0050      .0782    |    .2020      .2230
                          .0750      .1220    |    .2420      .2500
                          .1100      .1530    |    .2890      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60       .39      1.50      14.05
     OUTFLOW: ID= 1 (0009)     5.60       .00      4.17      13.34

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.23
                  TIME SHIFT OF PEAK FLOW         (min)=160.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .0746

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   2 **
  ****************************


--------------------
|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             SCS Type II - London\2yrSCSTypeII24hr.stm
| Ptotal= 51.56 mm |    Comments: 2-Year 24 hour SCS Type II: London Airpo
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .25     .57 |  6.25    1.03 | 12.25    7.43 | 18.25     .93
                 .50     .57 |  6.50    1.03 | 12.50    7.43 | 18.50     .93
                 .75     .57 |  6.75    1.03 | 12.75    3.82 | 18.75     .93
                1.00     .57 |  7.00    1.03 | 13.00    3.82 | 19.00     .93
                1.25     .57 |  7.25    1.03 | 13.25    2.68 | 19.25     .93
                1.50     .57 |  7.50    1.03 | 13.50    2.89 | 19.50     .93
                1.75     .57 |  7.75    1.03 | 13.75    2.17 | 19.75     .93
                2.00     .57 |  8.00    1.03 | 14.00    2.17 | 20.00     .93
                2.25     .67 |  8.25    1.39 | 14.25    1.55 | 20.25     .62
                2.50     .67 |  8.50    1.39 | 14.50    1.55 | 20.50     .62
                2.75     .67 |  8.75    1.39 | 14.75    1.55 | 20.75     .62
                3.00     .67 |  9.00    1.39 | 15.00    1.55 | 21.00     .62
                3.25     .67 |  9.25    1.65 | 15.25    1.55 | 21.25     .62
                3.50     .67 |  9.50    1.65 | 15.50    1.55 | 21.50     .62
                3.75     .67 |  9.75    1.86 | 15.75    1.55 | 21.75     .62
                4.00     .67 | 10.00    1.86 | 16.00    1.55 | 22.00     .62
                4.25     .82 | 10.25    2.37 | 16.25     .93 | 22.25     .62
                4.50     .82 | 10.50    2.37 | 16.50     .93 | 22.50     .62
                4.75     .82 | 10.75    3.20 | 16.75     .93 | 22.75     .62
                5.00     .82 | 11.00    3.20 | 17.00     .93 | 23.00     .62
                5.25     .82 | 11.25    4.95 | 17.25     .93 | 23.25     .62
                5.50     .82 | 11.50    4.95 | 17.50     .93 | 23.50     .62
                5.75     .82 | 11.75   21.45 | 17.75     .93 | 23.75     .62
                6.00     .82 | 12.00   56.93 | 18.00     .93 | 24.00     .62

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| CALIB            |
| STANDHYD  (0004) |   Area     (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
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                           IMPERVIOUS    PERVIOUS (i)

Surface Area     (ha)=      16.32         9.18
Dep. Storage     (mm)=       1.00         1.50
Average Slope     (%)=       1.00         2.00
Length            (m)=     412.30        40.00
Mannings n           =       .013         .250

    NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                    ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
       hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
      .083     .57 | 6.083    1.03 |12.083    7.43 | 18.08     .93
      .167     .57 | 6.167    1.03 |12.167    7.43 | 18.17     .93
      .250     .57 | 6.250    1.03 |12.250    7.43 | 18.25     .93
      .333     .57 | 6.333    1.03 |12.333    7.43 | 18.33     .93
      .417     .57 | 6.417    1.03 |12.417    7.43 | 18.42     .93
      .500     .57 | 6.500    1.03 |12.500    7.43 | 18.50     .93
      .583     .57 | 6.583    1.03 |12.583    3.82 | 18.58     .93
      .667     .57 | 6.667    1.03 |12.667    3.82 | 18.67     .93
      .750     .57 | 6.750    1.03 |12.750    3.82 | 18.75     .93
      .833     .57 | 6.833    1.03 |12.833    3.82 | 18.83     .93
      .917     .57 | 6.917    1.03 |12.917    3.82 | 18.92     .93
     1.000     .57 | 7.000    1.03 |13.000    3.82 | 19.00     .93
     1.083     .57 | 7.083    1.03 |13.083    2.68 | 19.08     .93
     1.167     .57 | 7.167    1.03 |13.167    2.68 | 19.17     .93
     1.250     .57 | 7.250    1.03 |13.250    2.68 | 19.25     .93
     1.333     .57 | 7.333    1.03 |13.333    2.89 | 19.33     .93
     1.417     .57 | 7.417    1.03 |13.417    2.89 | 19.42     .93
     1.500     .57 | 7.500    1.03 |13.500    2.89 | 19.50     .93
     1.583     .57 | 7.583    1.03 |13.583    2.17 | 19.58     .93
     1.667     .57 | 7.667    1.03 |13.667    2.17 | 19.67     .93
     1.750     .57 | 7.750    1.03 |13.750    2.17 | 19.75     .93
     1.833     .57 | 7.833    1.03 |13.833    2.17 | 19.83     .93
     1.917     .57 | 7.917    1.03 |13.917    2.17 | 19.92     .93
     2.000     .57 | 8.000    1.03 |14.000    2.17 | 20.00     .93
     2.083     .67 | 8.083    1.39 |14.083    1.55 | 20.08     .62
     2.167     .67 | 8.167    1.39 |14.167    1.55 | 20.17     .62
     2.250     .67 | 8.250    1.39 |14.250    1.55 | 20.25     .62
     2.333     .67 | 8.333    1.39 |14.333    1.55 | 20.33     .62
     2.417     .67 | 8.417    1.39 |14.417    1.55 | 20.42     .62
     2.500     .67 | 8.500    1.39 |14.500    1.55 | 20.50     .62
     2.583     .67 | 8.583    1.39 |14.583    1.55 | 20.58     .62
     2.667     .67 | 8.667    1.39 |14.667    1.55 | 20.67     .62
     2.750     .67 | 8.750    1.39 |14.750    1.55 | 20.75     .62
     2.833     .67 | 8.833    1.39 |14.833    1.55 | 20.83     .62
     2.917     .67 | 8.917    1.39 |14.917    1.55 | 20.92     .62
     3.000     .67 | 9.000    1.39 |15.000    1.55 | 21.00     .62
     3.083     .67 | 9.083    1.65 |15.083    1.55 | 21.08     .62
     3.167     .67 | 9.167    1.65 |15.167    1.55 | 21.17     .62
     3.250     .67 | 9.250    1.65 |15.250    1.55 | 21.25     .62
     3.333     .67 | 9.333    1.65 |15.333    1.55 | 21.33     .62
     3.417     .67 | 9.417    1.65 |15.417    1.55 | 21.42     .62
     3.500     .67 | 9.500    1.65 |15.500    1.55 | 21.50     .62
     3.583     .67 | 9.583    1.86 |15.583    1.55 | 21.58     .62
     3.667     .67 | 9.667    1.86 |15.667    1.55 | 21.67     .62
     3.750     .67 | 9.750    1.86 |15.750    1.55 | 21.75     .62
     3.833     .67 | 9.833    1.86 |15.833    1.55 | 21.83     .62
     3.917     .67 | 9.917    1.86 |15.917    1.55 | 21.92     .62
     4.000     .67 |10.000    1.86 |16.000    1.55 | 22.00     .62
     4.083     .82 |10.083    2.37 |16.083     .93 | 22.08     .62
     4.167     .82 |10.167    2.37 |16.167     .93 | 22.17     .62
     4.250     .82 |10.250    2.37 |16.250     .93 | 22.25     .62
     4.333     .82 |10.333    2.37 |16.333     .93 | 22.33     .62
     4.417     .82 |10.417    2.37 |16.417     .93 | 22.42     .62
     4.500     .82 |10.500    2.37 |16.500     .93 | 22.50     .62
     4.583     .82 |10.583    3.20 |16.583     .93 | 22.58     .62
     4.667     .82 |10.667    3.20 |16.667     .93 | 22.67     .62
     4.750     .82 |10.750    3.20 |16.750     .93 | 22.75     .62
     4.833     .82 |10.833    3.20 |16.833     .93 | 22.83     .62
     4.917     .82 |10.917    3.20 |16.917     .93 | 22.92     .62
     5.000     .82 |11.000    3.20 |17.000     .93 | 23.00     .62
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              5.083     .82 |11.083    4.95 |17.083     .93 | 23.08     .62
              5.167     .82 |11.167    4.95 |17.167     .93 | 23.17     .62
              5.250     .82 |11.250    4.95 |17.250     .93 | 23.25     .62
              5.333     .82 |11.333    4.95 |17.333     .93 | 23.33     .62
              5.417     .82 |11.417    4.95 |17.417     .93 | 23.42     .62
              5.500     .82 |11.500    4.95 |17.500     .93 | 23.50     .62
              5.583     .82 |11.583   21.45 |17.583     .93 | 23.58     .62
              5.667     .82 |11.667   21.45 |17.667     .93 | 23.67     .62
              5.750     .82 |11.750   21.45 |17.750     .93 | 23.75     .62
              5.833     .82 |11.833   56.92 |17.833     .93 | 23.83     .62
              5.917     .82 |11.917   56.93 |17.917     .93 | 23.92     .62
              6.000     .83 |12.000   56.93 |18.000     .93 | 24.00     .62

     Max.Eff.Inten.(mm/hr)=      56.93        48.35
               over (min)        5.00        20.00
     Storage Coeff.  (min)=       7.49 (ii)   16.93 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=        .17          .06
                                                      *TOTALS*
     PEAK FLOW       (cms)=       2.20          .53          2.505 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.17         12.00
     RUNOFF VOLUME    (mm)=      50.56        10.04         34.35
     TOTAL RAINFALL   (mm)=      51.56        51.56         51.56
     RUNOFF COEFFICIENT   =        .98          .19           .67


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .5030      .8930
                          .0220      .3853    |    .6990     1.0960
                          .2580      .5970    |    .8390     1.2260
                          .3810      .7510    |   1.0020     1.3720

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      2.51     12.00      34.35
     OUTFLOW: ID= 1 (0006)     25.50       .26     12.75      33.53

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.22
                  TIME SHIFT OF PEAK FLOW         (min)= 45.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .5954

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      56.93        49.26
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       5.21 (ii)   14.58 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .21          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .64          .21          .806 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08         12.00
     RUNOFF VOLUME    (mm)=      50.56        10.24         32.42
     TOTAL RAINFALL   (mm)=      51.56        51.56         51.56
     RUNOFF COEFFICIENT   =        .98          .20           .63


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1490      .2580
                          .0060      .1068    |    .2070      .3190
                          .0760      .1710    |    .2490      .3580
                          .1130      .2160    |    .2970      .4010

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60       .81     12.00      32.42
     OUTFLOW: ID= 1 (0007)     7.60       .07     12.67      31.61

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.19
                  TIME SHIFT OF PEAK FLOW         (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .1693

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| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      56.93        49.26
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.75 (ii)   14.12 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .22          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .47          .16           .601 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08         12.00
     RUNOFF VOLUME    (mm)=      50.56        10.24         32.42
     TOTAL RAINFALL   (mm)=      51.56        51.56         51.56
     RUNOFF COEFFICIENT   =        .98          .20           .63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
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DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.1460	.1820
	.0050	.0782	.2020	.2230
	.0750	.1220	.2420	.2500
	.1100	.1530	.2890	.2800

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0008)	5.60	.60	12.00	32.42
OUTFLOW: ID= 1 (0009)	5.60	.07	12.58	31.71

PEAK FLOW REDUCTION [Qout/Qin](%)= 12.14
TIME SHIFT OF PEAK FLOW (min)= 35.00
MAXIMUM STORAGE USED (ha.m.)= .1208

****
** SIMULATION NUMBER: 3 **
****

READ STORM | Filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\VO2\Storm\SCS Type II - London\5yrSCSTypeII24hr.stm
Ptotal= 63.35 mm | Comments: 5-Year 24 hour SCS Type II: London Airpo

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.70	6.25	1.27	12.25	9.12	18.25	1.14
.50	.70	6.50	1.27	12.50	9.12	18.50	1.14
.75	.70	6.75	1.27	12.75	4.69	18.75	1.14
1.00	.70	7.00	1.27	13.00	4.69	19.00	1.14
1.25	.70	7.25	1.27	13.25	3.29	19.25	1.14
1.50	.70	7.50	1.27	13.50	3.55	19.50	1.14
1.75	.70	7.75	1.27	13.75	2.66	19.75	1.14
2.00	.70	8.00	1.27	14.00	2.66	20.00	1.14
2.25	.82	8.25	1.71	14.25	1.90	20.25	.76
2.50	.82	8.50	1.71	14.50	1.90	20.50	.76
2.75	.82	8.75	1.71	14.75	1.90	20.75	.76
3.00	.82	9.00	1.71	15.00	1.90	21.00	.76
3.25	.82	9.25	2.03	15.25	1.90	21.25	.76
3.50	.82	9.50	2.03	15.50	1.90	21.50	.76
3.75	.82	9.75	2.28	15.75	1.90	21.75	.76
4.00	.82	10.00	2.28	16.00	1.90	22.00	.76
4.25	1.01	10.25	2.91	16.25	1.14	22.25	.76
4.50	1.01	10.50	2.91	16.50	1.14	22.50	.76
4.75	1.01	10.75	3.93	16.75	1.14	22.75	.76
5.00	1.01	11.00	3.93	17.00	1.14	23.00	.76
5.25	1.01	11.25	6.08	17.25	1.14	23.25	.76
5.50	1.01	11.50	6.08	17.50	1.14	23.50	.76
5.75	1.01	11.75	26.35	17.75	1.14	23.75	.76
6.00	1.01	12.00	69.93	18.00	1.14	24.00	.76

CALIB
STANDHYD (0004) | Area (ha)= 25.50
ID= 1 DT= 5.0 min | Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	16.32	9.18
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	412.30	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.70	6.083	1.27	12.083	9.13	18.08	1.14
.167	.70	6.167	1.27	12.167	9.12	18.17	1.14
.250	.70	6.250	1.27	12.250	9.12	18.25	1.14
.333	.70	6.333	1.27	12.333	9.12	18.33	1.14
.417	.70	6.417	1.27	12.417	9.12	18.42	1.14
.500	.70	6.500	1.27	12.500	9.12	18.50	1.14
.583	.70	6.583	1.27	12.583	4.69	18.58	1.14
.667	.70	6.667	1.27	12.667	4.69	18.67	1.14
.750	.70	6.750	1.27	12.750	4.69	18.75	1.14
.833	.70	6.833	1.27	12.833	4.69	18.83	1.14
.917	.70	6.917	1.27	12.917	4.69	18.92	1.14
1.000	.70	7.000	1.27	13.000	4.69	19.00	1.14
1.083	.70	7.083	1.27	13.083	3.29	19.08	1.14
1.167	.70	7.167	1.27	13.167	3.29	19.17	1.14
1.250	.70	7.250	1.27	13.250	3.29	19.25	1.14
1.333	.70	7.333	1.27	13.333	3.55	19.33	1.14
1.417	.70	7.417	1.27	13.417	3.55	19.42	1.14
1.500	.70	7.500	1.27	13.500	3.55	19.50	1.14
1.583	.70	7.583	1.27	13.583	2.66	19.58	1.14
1.667	.70	7.667	1.27	13.667	2.66	19.67	1.14
1.750	.70	7.750	1.27	13.750	2.66	19.75	1.14
1.833	.70	7.833	1.27	13.833	2.66	19.83	1.14
1.917	.70	7.917	1.27	13.917	2.66	19.92	1.14
2.000	.70	8.000	1.27	14.000	2.66	20.00	1.14
2.083	.82	8.083	1.71	14.083	1.90	20.08	.76
2.167	.82	8.167	1.71	14.167	1.90	20.17	.76
2.250	.82	8.250	1.71	14.250	1.90	20.25	.76
2.333	.82	8.333	1.71	14.333	1.90	20.33	.76
2.417	.82	8.417	1.71	14.417	1.90	20.42	.76
2.500	.82	8.500	1.71	14.500	1.90	20.50	.76
2.583	.82	8.583	1.71	14.583	1.90	20.58	.76
2.667	.82	8.667	1.71	14.667	1.90	20.67	.76
2.750	.82	8.750	1.71	14.750	1.90	20.75	.76
2.833	.82	8.833	1.71	14.833	1.90	20.83	.76
2.917	.82	8.917	1.71	14.917	1.90	20.92	.76
3.000	.82	9.000	1.71	15.000	1.90	21.00	.76
3.083	.82	9.083	2.03	15.083	1.90	21.08	.76
3.167	.82	9.167	2.03	15.167	1.90	21.17	.76
3.250	.82	9.250	2.03	15.250	1.90	21.25	.76
3.333	.82	9.333	2.03	15.333	1.90	21.33	.76
3.417	.82	9.417	2.03	15.417	1.90	21.42	.76
3.500	.82	9.500	2.03	15.500	1.90	21.50	.76
3.583	.82	9.583	2.28	15.583	1.90	21.58	.76
3.667	.82	9.667	2.28	15.667	1.90	21.67	.76
3.750	.82	9.750	2.28	15.750	1.90	21.75	.76
3.833	.82	9.833	2.28	15.833	1.90	21.83	.76
3.917	.82	9.917	2.28	15.917	1.90	21.92	.76
4.000	.82	10.000	2.28	16.000	1.90	22.00	.76
4.083	1.01	10.083	2.91	16.083	1.14	22.08	.76
4.167	1.01	10.167	2.91	16.167	1.14	22.17	.76
4.250	1.01	10.250	2.91	16.250	1.14	22.25	.76
4.333	1.01	10.333	2.91	16.333	1.14	22.33	.76
4.417	1.01	10.417	2.91	16.417	1.14	22.42	.76
4.500	1.01	10.500	2.91	16.500	1.14	22.50	.76
4.583	1.01	10.583	3.93	16.583	1.14	22.58	.76
4.667	1.01	10.667	3.93	16.667	1.14	22.67	.76
4.750	1.01	10.750	3.93	16.750	1.14	22.75	.76
4.833	1.01	10.833	3.93	16.833	1.14	22.83	.76
4.917	1.01	10.917	3.93	16.917	1.14	22.92	.76
5.000	1.01	11.000	3.93	17.000	1.14	23.00	.76
5.083	1.01	11.083	6.08	17.083	1.14	23.08	.76
5.167	1.01	11.167	6.08	17.167	1.14	23.17	.76
5.250	1.01	11.250	6.08	17.250	1.14	23.25	.76
5.333	1.01	11.333	6.08	17.333	1.14	23.33	.76
5.417	1.01	11.417	6.08	17.417	1.14	23.42	.76
5.500	1.01	11.500	6.08	17.500	1.14	23.50	.76
5.583	1.01	11.583	26.35	17.583	1.14	23.58	.76
5.667	1.01	11.667	26.35	17.667	1.14	23.67	.76
5.750	1.01	11.750	26.35	17.750	1.14	23.75	.76

```
              5.833    1.01 |11.833   69.93 |17.833    1.14 | 23.83     .76
              5.917    1.01 |11.917   69.93 |17.917    1.14 | 23.92     .76
              6.000    1.01 |12.000   69.93 |18.000    1.14 | 24.00     .76

     Max.Eff.Inten.(mm/hr)=      69.93        64.93
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       6.90 (ii)   15.28 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=        .18          .07
                                                      *TOTALS*
     PEAK FLOW       (cms)=       2.75          .84      3.320 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.17      12.00
     RUNOFF VOLUME    (mm)=      62.35        15.91      43.77
     TOTAL RAINFALL   (mm)=      63.35        63.35      63.35
     RUNOFF COEFFICIENT   =        .98          .25        .69


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .5030      .8930
                          .0220      .3853    |    .6990     1.0960
                          .2580      .5970    |    .8390     1.2260
                          .3810      .7510    |   1.0020     1.3720

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      3.32     12.00      43.77
     OUTFLOW: ID= 1 (0006)     25.50       .38     12.67      42.94

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.37
                TIME SHIFT OF PEAK FLOW         (min)= 40.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  .7471

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area     (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      69.93        66.03
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.80 (ii)   13.13 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .22          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .79          .33      1.080 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08      12.00
     RUNOFF VOLUME    (mm)=      62.35        16.10      41.54
     TOTAL RAINFALL   (mm)=      63.35        63.35      63.35
     RUNOFF COEFFICIENT   =        .98          .25        .66

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1490      .2580
                          .0060      .1068    |    .2070      .3190
                          .0760      .1710    |    .2490      .3580
                          .1130      .2160    |    .2970      .4010

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      1.08     12.00      41.54
     OUTFLOW: ID= 1 (0007)     7.60       .11     12.58      40.72

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.33
                TIME SHIFT OF PEAK FLOW         (min)= 35.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  .2143

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area     (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      69.93        66.03
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.38 (ii)   12.71 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .23          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .59          .25       .804 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08      12.00
     RUNOFF VOLUME    (mm)=      62.35        16.10      41.54
     TOTAL RAINFALL   (mm)=      63.35        63.35      63.35
     RUNOFF COEFFICIENT   =        .98          .25        .66

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1460      .1820
                          .0050      .0782    |    .2020      .2230
                          .0750      .1220    |    .2420      .2500
                          .1100      .1530    |    .2890      .2800

                               AREA     QPEAK     TPEAK       R.V.
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                            (ha)      (cms)      (hrs)       (mm)
     INFLOW : ID= 2 (0008)      5.60       .80      12.00      41.54
     OUTFLOW: ID= 1 (0009)      5.60       .11      12.50      40.83

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 13.51
                  TIME SHIFT OF PEAK FLOW          (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .1521

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  ***************************
  ** SIMULATION NUMBER:   4 **
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|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             SCS Type II - London\10yrSCSTypeII24hr.stm
| Ptotal= 73.97 mm |    Comments: 10-Year 24 hour SCS Type II: London Airp
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.81	6.25	1.48	12.25	10.65	18.25	1.33
.50	.81	6.50	1.48	12.50	10.65	18.50	1.33
.75	.81	6.75	1.48	12.75	5.47	18.75	1.33
1.00	.81	7.00	1.48	13.00	5.47	19.00	1.33
1.25	.81	7.25	1.48	13.25	3.85	19.25	1.33
1.50	.81	7.50	1.48	13.50	4.14	19.50	1.33
1.75	.81	7.75	1.48	13.75	3.11	19.75	1.33
2.00	.81	8.00	1.48	14.00	3.11	20.00	1.33
2.25	.96	8.25	2.00	14.25	2.22	20.25	.89
2.50	.96	8.50	2.00	14.50	2.22	20.50	.89
2.75	.96	8.75	2.00	14.75	2.22	20.75	.89
3.00	.96	9.00	2.00	15.00	2.22	21.00	.89
3.25	.96	9.25	2.37	15.25	2.22	21.25	.89
3.50	.96	9.50	2.37	15.50	2.22	21.50	.89
3.75	.96	9.75	2.66	15.75	2.22	21.75	.89
4.00	.96	10.00	2.66	16.00	2.22	22.00	.89
4.25	1.18	10.25	3.40	16.25	1.33	22.25	.89
4.50	1.18	10.50	3.40	16.50	1.33	22.50	.89
4.75	1.18	10.75	4.59	16.75	1.33	22.75	.89
5.00	1.18	11.00	4.59	17.00	1.33	23.00	.89
5.25	1.18	11.25	7.10	17.25	1.33	23.25	.89
5.50	1.18	11.50	7.10	17.50	1.33	23.50	.89
5.75	1.18	11.75	30.77	17.75	1.33	23.75	.89
6.00	1.18	12.00	81.66	18.00	1.33	24.00	.89

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| CALIB            |
| STANDHYD  (0004) |   Area     (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      16.32          9.18
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     412.30         40.00
     Mannings n           =       .013          .250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
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TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.81	6.083	1.48	12.083	10.66	18.08	1.33
.167	.81	6.167	1.48	12.167	10.65	18.17	1.33
.250	.81	6.250	1.48	12.250	10.65	18.25	1.33
.333	.81	6.333	1.48	12.333	10.65	18.33	1.33
.417	.81	6.417	1.48	12.417	10.65	18.42	1.33
.500	.81	6.500	1.48	12.500	10.65	18.50	1.33
.583	.81	6.583	1.48	12.583	5.47	18.58	1.33
.667	.81	6.667	1.48	12.667	5.47	18.67	1.33
.750	.81	6.750	1.48	12.750	5.47	18.75	1.33
.833	.81	6.833	1.48	12.833	5.47	18.83	1.33
.917	.81	6.917	1.48	12.917	5.47	18.92	1.33
1.000	.81	7.000	1.48	13.000	5.47	19.00	1.33
1.083	.81	7.083	1.48	13.083	3.85	19.08	1.33
1.167	.81	7.167	1.48	13.167	3.85	19.17	1.33
1.250	.81	7.250	1.48	13.250	3.85	19.25	1.33
1.333	.81	7.333	1.48	13.333	4.14	19.33	1.33
1.417	.81	7.417	1.48	13.417	4.14	19.42	1.33
1.500	.81	7.500	1.48	13.500	4.14	19.50	1.33
1.583	.81	7.583	1.48	13.583	3.11	19.58	1.33
1.667	.81	7.667	1.48	13.667	3.11	19.67	1.33
1.750	.81	7.750	1.48	13.750	3.11	19.75	1.33
1.833	.81	7.833	1.48	13.833	3.11	19.83	1.33
1.917	.81	7.917	1.48	13.917	3.11	19.92	1.33
2.000	.81	8.000	1.48	14.000	3.11	20.00	1.33
2.083	.96	8.083	2.00	14.083	2.22	20.08	.89
2.167	.96	8.167	2.00	14.167	2.22	20.17	.89
2.250	.96	8.250	2.00	14.250	2.22	20.25	.89
2.333	.96	8.333	2.00	14.333	2.22	20.33	.89
2.417	.96	8.417	2.00	14.417	2.22	20.42	.89
2.500	.96	8.500	2.00	14.500	2.22	20.50	.89
2.583	.96	8.583	2.00	14.583	2.22	20.58	.89
2.667	.96	8.667	2.00	14.667	2.22	20.67	.89
2.750	.96	8.750	2.00	14.750	2.22	20.75	.89
2.833	.96	8.833	2.00	14.833	2.22	20.83	.89
2.917	.96	8.917	2.00	14.917	2.22	20.92	.89
3.000	.96	9.000	2.00	15.000	2.22	21.00	.89
3.083	.96	9.083	2.37	15.083	2.22	21.08	.89
3.167	.96	9.167	2.37	15.167	2.22	21.17	.89
3.250	.96	9.250	2.37	15.250	2.22	21.25	.89
3.333	.96	9.333	2.37	15.333	2.22	21.33	.89
3.417	.96	9.417	2.37	15.417	2.22	21.42	.89
3.500	.96	9.500	2.37	15.500	2.22	21.50	.89
3.583	.96	9.583	2.66	15.583	2.22	21.58	.89
3.667	.96	9.667	2.66	15.667	2.22	21.67	.89
3.750	.96	9.750	2.66	15.750	2.22	21.75	.89
3.833	.96	9.833	2.66	15.833	2.22	21.83	.89
3.917	.96	9.917	2.66	15.917	2.22	21.92	.89
4.000	.96	10.000	2.66	16.000	2.22	22.00	.89
4.083	1.18	10.083	3.40	16.083	1.33	22.08	.89
4.167	1.18	10.167	3.40	16.167	1.33	22.17	.89
4.250	1.18	10.250	3.40	16.250	1.33	22.25	.89
4.333	1.18	10.333	3.40	16.333	1.33	22.33	.89
4.417	1.18	10.417	3.40	16.417	1.33	22.42	.89
4.500	1.18	10.500	3.40	16.500	1.33	22.50	.89
4.583	1.18	10.583	4.59	16.583	1.33	22.58	.89
4.667	1.18	10.667	4.59	16.667	1.33	22.67	.89
4.750	1.18	10.750	4.59	16.750	1.33	22.75	.89
4.833	1.18	10.833	4.59	16.833	1.33	22.83	.89
4.917	1.18	10.917	4.59	16.917	1.33	22.92	.89
5.000	1.18	11.000	4.59	17.000	1.33	23.00	.89
5.083	1.18	11.083	7.10	17.083	1.33	23.08	.89
5.167	1.18	11.167	7.10	17.167	1.33	23.17	.89
5.250	1.18	11.250	7.10	17.250	1.33	23.25	.89
5.333	1.18	11.333	7.10	17.333	1.33	23.33	.89
5.417	1.18	11.417	7.10	17.417	1.33	23.42	.89
5.500	1.18	11.500	7.10	17.500	1.33	23.50	.89
5.583	1.18	11.583	30.77	17.583	1.33	23.58	.89
5.667	1.18	11.667	30.77	17.667	1.33	23.67	.89
5.750	1.18	11.750	30.77	17.750	1.33	23.75	.89
5.833	1.18	11.833	81.65	17.833	1.33	23.83	.89
5.917	1.18	11.917	81.66	17.917	1.33	23.92	.89
6.000	1.18	12.000	81.66	18.000	1.33	24.00	.89

```
Max.Eff.Inten.(mm/hr)=      81.66        79.63
          over (min)         5.00        15.00
Storage Coeff.  (min)=       6.48 (ii)   14.21 (ii)
Unit Hyd. Tpeak (min)=       5.00        15.00
```

```
     Unit Hyd. peak  (cms)=        .18          .08
                                                      *TOTALS*
     PEAK FLOW       (cms)=       3.25         1.20          4.317 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08         12.00
     RUNOFF VOLUME    (mm)=      72.97        22.12         52.63
     TOTAL RAINFALL   (mm)=      73.97        73.97         73.97
     RUNOFF COEFFICIENT   =        .99          .30           .71


       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .5030      .8930
                          .0220      .3853    |    .6990     1.0960
                          .2580      .5970    |    .8390     1.2260
                          .3810      .7510    |   1.0020     1.3720

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      4.32     12.00      52.63
     OUTFLOW: ID= 1 (0006)     25.50       .50     12.67      51.79

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.60
                  TIME SHIFT OF PEAK FLOW         (min)= 40.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .8910

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      81.66        80.89
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.51 (ii)   12.19 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .23          .09
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .93          .43          1.320 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08         12.00
     RUNOFF VOLUME    (mm)=      72.97        22.37         50.20
     TOTAL RAINFALL   (mm)=      73.97        73.97         73.97
     RUNOFF COEFFICIENT   =        .99          .30           .68

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1490      .2580
                          .0060      .1068    |    .2070      .3190
                          .0760      .1710    |    .2490      .3580
                          .1130      .2160    |    .2970      .4010

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      1.32     12.00      50.20
     OUTFLOW: ID= 1 (0007)     7.60       .15     12.58      49.38

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 11.21
                  TIME SHIFT OF PEAK FLOW         (min)= 35.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2568

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      81.66        80.89
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.11 (ii)   11.80 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .24          .09
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .69          .32           .982 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08         12.00
     RUNOFF VOLUME    (mm)=      72.97        22.37         50.20
     TOTAL RAINFALL   (mm)=      73.97        73.97         73.97
     RUNOFF COEFFICIENT   =        .99          .30           .68

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1460      .1820
                          .0050      .0782    |    .2020      .2230
                          .0750      .1220    |    .2420      .2500
                          .1100      .1530    |    .2890      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60       .98     12.00      50.20
     OUTFLOW: ID= 1 (0009)     5.60       .14     12.50      49.49

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 14.73
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .1811
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  ****************************
  ** SIMULATION NUMBER:   5 **
  ****************************


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|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |             SCS Type II - London\25yrSCSTypeII24hr.stm
| Ptotal= 89.53 mm |    Comments: 25-Year 24 hour SCS Type II: London Airp
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```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.98	6.25	1.79	12.25	12.89	18.25	1.61
.50	.98	6.50	1.79	12.50	12.89	18.50	1.61
.75	.98	6.75	1.79	12.75	6.63	18.75	1.61
1.00	.98	7.00	1.79	13.00	6.63	19.00	1.61
1.25	.98	7.25	1.79	13.25	4.66	19.25	1.61
1.50	.98	7.50	1.79	13.50	5.01	19.50	1.61
1.75	.98	7.75	1.79	13.75	3.76	19.75	1.61
2.00	.98	8.00	1.79	14.00	3.76	20.00	1.61
2.25	1.16	8.25	2.42	14.25	2.69	20.25	1.07
2.50	1.16	8.50	2.42	14.50	2.69	20.50	1.07
2.75	1.16	8.75	2.42	14.75	2.69	20.75	1.07
3.00	1.16	9.00	2.42	15.00	2.69	21.00	1.07
3.25	1.16	9.25	2.87	15.25	2.69	21.25	1.07
3.50	1.16	9.50	2.87	15.50	2.69	21.50	1.07
3.75	1.16	9.75	3.22	15.75	2.69	21.75	1.07
4.00	1.16	10.00	3.22	16.00	2.69	22.00	1.07
4.25	1.43	10.25	4.12	16.25	1.61	22.25	1.07
4.50	1.43	10.50	4.12	16.50	1.61	22.50	1.07
4.75	1.43	10.75	5.55	16.75	1.61	22.75	1.07
5.00	1.43	11.00	5.55	17.00	1.61	23.00	1.07
5.25	1.43	11.25	8.60	17.25	1.61	23.25	1.07
5.50	1.43	11.50	8.60	17.50	1.61	23.50	1.07
5.75	1.43	11.75	37.25	17.75	1.61	23.75	1.07
6.00	1.43	12.00	98.84	18.00	1.61	24.00	1.07

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| CALIB            |
| STANDHYD  (0004) |   Area     (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
--------------------
```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	16.32	9.18
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	412.30	40.00
Mannings n	=	.013	.250

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        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
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---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.98	6.083	1.79	12.083	12.90	18.08	1.61
.167	.98	6.167	1.79	12.167	12.89	18.17	1.61
.250	.98	6.250	1.79	12.250	12.89	18.25	1.61
.333	.98	6.333	1.79	12.333	12.89	18.33	1.61
.417	.98	6.417	1.79	12.417	12.89	18.42	1.61
.500	.98	6.500	1.79	12.500	12.89	18.50	1.61
.583	.98	6.583	1.79	12.583	6.63	18.58	1.61
.667	.98	6.667	1.79	12.667	6.63	18.67	1.61
.750	.98	6.750	1.79	12.750	6.63	18.75	1.61
.833	.98	6.833	1.79	12.833	6.63	18.83	1.61
.917	.98	6.917	1.79	12.917	6.63	18.92	1.61
1.000	.98	7.000	1.79	13.000	6.63	19.00	1.61
1.083	.98	7.083	1.79	13.083	4.66	19.08	1.61
1.167	.98	7.167	1.79	13.167	4.66	19.17	1.61
1.250	.98	7.250	1.79	13.250	4.66	19.25	1.61
1.333	.98	7.333	1.79	13.333	5.01	19.33	1.61
1.417	.98	7.417	1.79	13.417	5.01	19.42	1.61
1.500	.98	7.500	1.79	13.500	5.01	19.50	1.61
1.583	.98	7.583	1.79	13.583	3.76	19.58	1.61
1.667	.98	7.667	1.79	13.667	3.76	19.67	1.61
1.750	.98	7.750	1.79	13.750	3.76	19.75	1.61
1.833	.98	7.833	1.79	13.833	3.76	19.83	1.61
1.917	.98	7.917	1.79	13.917	3.76	19.92	1.61
2.000	.99	8.000	1.79	14.000	3.76	20.00	1.61
2.083	1.16	8.083	2.42	14.083	2.69	20.08	1.07
2.167	1.16	8.167	2.42	14.167	2.69	20.17	1.07
2.250	1.16	8.250	2.42	14.250	2.69	20.25	1.07
2.333	1.16	8.333	2.42	14.333	2.69	20.33	1.07
2.417	1.16	8.417	2.42	14.417	2.69	20.42	1.07
2.500	1.16	8.500	2.42	14.500	2.69	20.50	1.07
2.583	1.16	8.583	2.42	14.583	2.69	20.58	1.07
2.667	1.16	8.667	2.42	14.667	2.69	20.67	1.07
2.750	1.16	8.750	2.42	14.750	2.69	20.75	1.07
2.833	1.16	8.833	2.42	14.833	2.69	20.83	1.07
2.917	1.16	8.917	2.42	14.917	2.69	20.92	1.07
3.000	1.16	9.000	2.42	15.000	2.69	21.00	1.07
3.083	1.16	9.083	2.87	15.083	2.69	21.08	1.07
3.167	1.16	9.167	2.87	15.167	2.69	21.17	1.07
3.250	1.16	9.250	2.87	15.250	2.69	21.25	1.07
3.333	1.16	9.333	2.87	15.333	2.69	21.33	1.07
3.417	1.16	9.417	2.87	15.417	2.69	21.42	1.07
3.500	1.16	9.500	2.87	15.500	2.69	21.50	1.07
3.583	1.16	9.583	3.22	15.583	2.69	21.58	1.07
3.667	1.16	9.667	3.22	15.667	2.69	21.67	1.07
3.750	1.16	9.750	3.22	15.750	2.69	21.75	1.07
3.833	1.16	9.833	3.22	15.833	2.69	21.83	1.07
3.917	1.16	9.917	3.22	15.917	2.69	21.92	1.07
4.000	1.16	10.000	3.22	16.000	2.69	22.00	1.07
4.083	1.43	10.083	4.12	16.083	1.61	22.08	1.07
4.167	1.43	10.167	4.12	16.167	1.61	22.17	1.07
4.250	1.43	10.250	4.12	16.250	1.61	22.25	1.07
4.333	1.43	10.333	4.12	16.333	1.61	22.33	1.07
4.417	1.43	10.417	4.12	16.417	1.61	22.42	1.07
4.500	1.43	10.500	4.12	16.500	1.61	22.50	1.07
4.583	1.43	10.583	5.55	16.583	1.61	22.58	1.07
4.667	1.43	10.667	5.55	16.667	1.61	22.67	1.07
4.750	1.43	10.750	5.55	16.750	1.61	22.75	1.07
4.833	1.43	10.833	5.55	16.833	1.61	22.83	1.07
4.917	1.43	10.917	5.55	16.917	1.61	22.92	1.07
5.000	1.43	11.000	5.55	17.000	1.61	23.00	1.07
5.083	1.43	11.083	8.59	17.083	1.61	23.08	1.07
5.167	1.43	11.167	8.60	17.167	1.61	23.17	1.07
5.250	1.43	11.250	8.60	17.250	1.61	23.25	1.07
5.333	1.43	11.333	8.60	17.333	1.61	23.33	1.07
5.417	1.43	11.417	8.60	17.417	1.61	23.42	1.07
5.500	1.43	11.500	8.60	17.500	1.61	23.50	1.07
5.583	1.43	11.583	37.24	17.583	1.61	23.58	1.07
5.667	1.43	11.667	37.25	17.667	1.61	23.67	1.07
5.750	1.43	11.750	37.25	17.750	1.61	23.75	1.07
5.833	1.43	11.833	98.84	17.833	1.61	23.83	1.07
5.917	1.43	11.917	98.84	17.917	1.61	23.92	1.07
6.000	1.43	12.000	98.84	18.000	1.61	24.00	1.07

Max.Eff.Inten.	(mm/hr)=	98.84	100.59	
over	(min)	5.00	15.00	
Storage Coeff.	(min)=	6.00 (ii)	13.05 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	.19	.08	
				TOTALS
PEAK FLOW	(cms)=	3.98	1.63	5.456 (iii)
TIME TO PEAK	(hrs)=	12.00	12.08	12.00
RUNOFF VOLUME	(mm)=	88.53	30.82	65.45
TOTAL RAINFALL	(mm)=	89.53	89.53	89.53
RUNOFF COEFFICIENT	=	.99	.34	.73

```
       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .5030      .8930
                          .0220      .3853    |    .6990     1.0960
                          .2580      .5970    |    .8390     1.2260
                          .3810      .7510    |   1.0020     1.3720

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      5.46     12.00      65.45
     OUTFLOW: ID= 1 (0006)     25.50       .70     12.58      64.60

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 12.77
                  TIME SHIFT OF PEAK FLOW         (min)= 35.00
                  MAXIMUM  STORAGE   USED       (ha.m.)= 1.0941

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      98.84       102.07
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.18 (ii)   11.18 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .24          .09
                                                        *TOTALS*
     PEAK FLOW       (cms)=       1.13          .58        1.666 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08        12.00
     RUNOFF VOLUME    (mm)=      88.53        31.04        62.66
     TOTAL RAINFALL   (mm)=      89.53        89.53        89.53
     RUNOFF COEFFICIENT   =        .99          .35          .70

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1490      .2580
                          .0060      .1068    |    .2070      .3190
                          .0760      .1710    |    .2490      .3580
                          .1130      .2160    |    .2970      .4010

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     7.60      1.67     12.00      62.66
     OUTFLOW: ID= 1 (0007)     7.60       .20     12.58      61.83

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 12.31
                  TIME SHIFT OF PEAK FLOW         (min)= 35.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .3170

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=      98.84       102.07
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.81 (ii)   10.81 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .25          .09
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .84          .43        1.238 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08        12.00
     RUNOFF VOLUME    (mm)=      88.53        31.04        62.66
     TOTAL RAINFALL   (mm)=      89.53        89.53        89.53
     RUNOFF COEFFICIENT   =        .99          .35          .70

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1460      .1820
                          .0050      .0782    |    .2020      .2230
                          .0750      .1220    |    .2420      .2500
                          .1100      .1530    |    .2890      .2800

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)     5.60      1.24     12.00      62.66
     OUTFLOW: ID= 1 (0009)     5.60       .20     12.50      61.95

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 16.18
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2218

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  ***************************
  ** SIMULATION NUMBER:   6 **
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|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
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|                    |              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                    |             SCS Type II - London\50yrSCSTypeII24hr.stm
| Ptotal= 99.98 mm |    Comments: 50-Year 24 hour SCS Type II: London Airp
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```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	1.10	6.25	2.00	12.25	14.40	18.25	1.80
.50	1.10	6.50	2.00	12.50	14.40	18.50	1.80
.75	1.10	6.75	2.00	12.75	7.40	18.75	1.80
1.00	1.10	7.00	2.00	13.00	7.40	19.00	1.80
1.25	1.10	7.25	2.00	13.25	5.20	19.25	1.80
1.50	1.10	7.50	2.00	13.50	5.60	19.50	1.80
1.75	1.10	7.75	2.00	13.75	4.20	19.75	1.80
2.00	1.10	8.00	2.00	14.00	4.20	20.00	1.80
2.25	1.30	8.25	2.70	14.25	3.00	20.25	1.20
2.50	1.30	8.50	2.70	14.50	3.00	20.50	1.20
2.75	1.30	8.75	2.70	14.75	3.00	20.75	1.20
3.00	1.30	9.00	2.70	15.00	3.00	21.00	1.20
3.25	1.30	9.25	3.20	15.25	3.00	21.25	1.20
3.50	1.30	9.50	3.20	15.50	3.00	21.50	1.20
3.75	1.30	9.75	3.60	15.75	3.00	21.75	1.20
4.00	1.30	10.00	3.60	16.00	3.00	22.00	1.20
4.25	1.60	10.25	4.60	16.25	1.80	22.25	1.20
4.50	1.60	10.50	4.60	16.50	1.80	22.50	1.20
4.75	1.60	10.75	6.20	16.75	1.80	22.75	1.20
5.00	1.60	11.00	6.20	17.00	1.80	23.00	1.20
5.25	1.60	11.25	9.60	17.25	1.80	23.25	1.20
5.50	1.60	11.50	9.60	17.50	1.80	23.50	1.20
5.75	1.60	11.75	41.59	17.75	1.80	23.75	1.20
6.00	1.60	12.00	110.37	18.00	1.80	24.00	1.20

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| CALIB            |
| STANDHYD  (0004) |   Area     (ha)=  25.50
|ID= 1 DT= 5.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  60.00
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		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	16.32	9.18
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	412.30	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	1.10	6.083	2.00	12.083	14.41	18.08	1.80
.167	1.10	6.167	2.00	12.167	14.40	18.17	1.80
.250	1.10	6.250	2.00	12.250	14.40	18.25	1.80
.333	1.10	6.333	2.00	12.333	14.40	18.33	1.80
.417	1.10	6.417	2.00	12.417	14.40	18.42	1.80
.500	1.10	6.500	2.00	12.500	14.40	18.50	1.80
.583	1.10	6.583	2.00	12.583	7.40	18.58	1.80
.667	1.10	6.667	2.00	12.667	7.40	18.67	1.80
.750	1.10	6.750	2.00	12.750	7.40	18.75	1.80
.833	1.10	6.833	2.00	12.833	7.40	18.83	1.80
.917	1.10	6.917	2.00	12.917	7.40	18.92	1.80
1.000	1.10	7.000	2.00	13.000	7.40	19.00	1.80
1.083	1.10	7.083	2.00	13.083	5.20	19.08	1.80
1.167	1.10	7.167	2.00	13.167	5.20	19.17	1.80
1.250	1.10	7.250	2.00	13.250	5.20	19.25	1.80
1.333	1.10	7.333	2.00	13.333	5.60	19.33	1.80
1.417	1.10	7.417	2.00	13.417	5.60	19.42	1.80
1.500	1.10	7.500	2.00	13.500	5.60	19.50	1.80
1.583	1.10	7.583	2.00	13.583	4.20	19.58	1.80
1.667	1.10	7.667	2.00	13.667	4.20	19.67	1.80
1.750	1.10	7.750	2.00	13.750	4.20	19.75	1.80
1.833	1.10	7.833	2.00	13.833	4.20	19.83	1.80
1.917	1.10	7.917	2.00	13.917	4.20	19.92	1.80
2.000	1.10	8.000	2.00	14.000	4.20	20.00	1.80
2.083	1.30	8.083	2.70	14.083	3.00	20.08	1.20
2.167	1.30	8.167	2.70	14.167	3.00	20.17	1.20
2.250	1.30	8.250	2.70	14.250	3.00	20.25	1.20
2.333	1.30	8.333	2.70	14.333	3.00	20.33	1.20
2.417	1.30	8.417	2.70	14.417	3.00	20.42	1.20
2.500	1.30	8.500	2.70	14.500	3.00	20.50	1.20
2.583	1.30	8.583	2.70	14.583	3.00	20.58	1.20
2.667	1.30	8.667	2.70	14.667	3.00	20.67	1.20
2.750	1.30	8.750	2.70	14.750	3.00	20.75	1.20
2.833	1.30	8.833	2.70	14.833	3.00	20.83	1.20
2.917	1.30	8.917	2.70	14.917	3.00	20.92	1.20
3.000	1.30	9.000	2.70	15.000	3.00	21.00	1.20
3.083	1.30	9.083	3.20	15.083	3.00	21.08	1.20
3.167	1.30	9.167	3.20	15.167	3.00	21.17	1.20
3.250	1.30	9.250	3.20	15.250	3.00	21.25	1.20
3.333	1.30	9.333	3.20	15.333	3.00	21.33	1.20
3.417	1.30	9.417	3.20	15.417	3.00	21.42	1.20
3.500	1.30	9.500	3.20	15.500	3.00	21.50	1.20
3.583	1.30	9.583	3.60	15.583	3.00	21.58	1.20
3.667	1.30	9.667	3.60	15.667	3.00	21.67	1.20
3.750	1.30	9.750	3.60	15.750	3.00	21.75	1.20
3.833	1.30	9.833	3.60	15.833	3.00	21.83	1.20
3.917	1.30	9.917	3.60	15.917	3.00	21.92	1.20
4.000	1.30	10.000	3.60	16.000	3.00	22.00	1.20
4.083	1.60	10.083	4.60	16.083	1.80	22.08	1.20
4.167	1.60	10.167	4.60	16.167	1.80	22.17	1.20
4.250	1.60	10.250	4.60	16.250	1.80	22.25	1.20
4.333	1.60	10.333	4.60	16.333	1.80	22.33	1.20
4.417	1.60	10.417	4.60	16.417	1.80	22.42	1.20
4.500	1.60	10.500	4.60	16.500	1.80	22.50	1.20
4.583	1.60	10.583	6.20	16.583	1.80	22.58	1.20
4.667	1.60	10.667	6.20	16.667	1.80	22.67	1.20
4.750	1.60	10.750	6.20	16.750	1.80	22.75	1.20
4.833	1.60	10.833	6.20	16.833	1.80	22.83	1.20
4.917	1.60	10.917	6.20	16.917	1.80	22.92	1.20
5.000	1.60	11.000	6.20	17.000	1.80	23.00	1.20
5.083	1.60	11.083	9.60	17.083	1.80	23.08	1.20
5.167	1.60	11.167	9.60	17.167	1.80	23.17	1.20
5.250	1.60	11.250	9.60	17.250	1.80	23.25	1.20
5.333	1.60	11.333	9.60	17.333	1.80	23.33	1.20
5.417	1.60	11.417	9.60	17.417	1.80	23.42	1.20
5.500	1.60	11.500	9.60	17.500	1.80	23.50	1.20
5.583	1.60	11.583	41.59	17.583	1.80	23.58	1.20
5.667	1.60	11.667	41.59	17.667	1.80	23.67	1.20
5.750	1.60	11.750	41.59	17.750	1.80	23.75	1.20
5.833	1.60	11.833	110.37	17.833	1.80	23.83	1.20
5.917	1.60	11.917	110.37	17.917	1.80	23.92	1.20
6.000	1.60	12.000	110.37	18.000	1.80	24.00	1.20

Max.Eff.Inten.	(mm/hr)=	110.37	114.19	
over	(min)	5.00	15.00	
Storage Coeff.	(min)=	5.75 (ii)	12.44 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	.20	.08	
				TOTALS
PEAK FLOW	(cms)=	4.47	1.91	6.216 (iii)
TIME TO PEAK	(hrs)=	12.00	12.08	12.00
RUNOFF VOLUME	(mm)=	98.98	36.58	74.02
TOTAL RAINFALL	(mm)=	99.98	99.98	99.98
RUNOFF COEFFICIENT	=	.99	.37	.74

(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
Fo (mm/hr)= 50.00 K (1/hr)= 2.00
Fc (mm/hr)= 7.50 Cum.Inf. (mm)= .00
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .5030      .8930
                          .0220      .3853    |    .6990     1.0960
                          .2580      .5970    |    .8390     1.2260
                          .3810      .7510    |   1.0020     1.3720

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      6.22     12.00      74.02
     OUTFLOW: ID= 1 (0006)     25.50       .84     12.58      73.16

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 13.47
                  TIME SHIFT OF PEAK FLOW         (min)= 35.00
                  MAXIMUM  STORAGE   USED       (ha.m.)= 1.2243

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--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     110.37       115.79
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.00 (ii)   10.65 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .24          .09
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.26          .68      1.896 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08        12.00
     RUNOFF VOLUME    (mm)=      98.98        36.85        71.02
     TOTAL RAINFALL   (mm)=      99.98        99.98        99.98
     RUNOFF COEFFICIENT   =        .99          .37          .71

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1490      .2580
                          .0060      .1068    |    .2070      .3190
                          .0760      .1710    |    .2490      .3580
                          .1130      .2160    |    .2970      .4010

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)      7.60      1.90     12.00      71.02
     OUTFLOW: ID= 1 (0007)      7.60       .25     12.58      70.19

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 12.99
                  TIME SHIFT OF PEAK FLOW         (min)= 35.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .3558

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--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     110.37       115.79
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.65 (ii)   10.30 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .25          .09
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .93          .51        1.408 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08        12.00
     RUNOFF VOLUME    (mm)=      98.98        36.85        71.02
     TOTAL RAINFALL   (mm)=      99.98        99.98        99.98
     RUNOFF COEFFICIENT   =        .99          .37          .71

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          .0000      .0000    |    .1460      .1820
                          .0050      .0782    |    .2020      .2230
                          .0750      .1220    |    .2420      .2500
                          .1100      .1530    |    .2890      .2800

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)      5.60      1.41     12.00      71.02
     OUTFLOW: ID= 1 (0009)      5.60       .24     12.50      70.31

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 16.96
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  .2480

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  ** SIMULATION NUMBER:   7 **
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|    READ STORM    |    Filename: G:\Projects\2012\12116 - TSI London
|                  |               GE1 & GE2\Design\FSR Calcs\VO2\Storm\
|                  |              SCS Type II - London\100yrSCSTYPEII124HR.stm
| Ptotal=111.61 mm |    Comments: 100-Year 24 hour SCS: London Airport
--------------------
                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .25    1.23 |  6.25    2.23 | 12.25   16.07 | 18.25    2.01
                 .50    1.23 |  6.50    2.23 | 12.50   16.07 | 18.50    2.01
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.75	1.23	6.75	2.23	12.75	8.26	18.75	2.01
1.00	1.23	7.00	2.23	13.00	8.26	19.00	2.01
1.25	1.23	7.25	2.23	13.25	5.80	19.25	2.01
1.50	1.23	7.50	2.23	13.50	6.25	19.50	2.01
1.75	1.23	7.75	2.23	13.75	4.69	19.75	2.01
2.00	1.23	8.00	2.23	14.00	4.69	20.00	2.01
2.25	1.45	8.25	3.01	14.25	3.35	20.25	1.34
2.50	1.45	8.50	3.01	14.50	3.35	20.50	1.34
2.75	1.45	8.75	3.01	14.75	3.35	20.75	1.34
3.00	1.45	9.00	3.01	15.00	3.35	21.00	1.34
3.25	1.45	9.25	3.57	15.25	3.35	21.25	1.34
3.50	1.45	9.50	3.57	15.50	3.35	21.50	1.34
3.75	1.45	9.75	4.02	15.75	3.35	21.75	1.34
4.00	1.45	10.00	4.02	16.00	3.35	22.00	1.34
4.25	1.79	10.25	5.13	16.25	2.01	22.25	1.34
4.50	1.79	10.50	5.13	16.50	2.01	22.50	1.34
4.75	1.79	10.75	6.92	16.75	2.01	22.75	1.34
5.00	1.79	11.00	6.92	17.00	2.01	23.00	1.34
5.25	1.79	11.25	10.71	17.25	2.01	23.25	1.34
5.50	1.79	11.50	10.71	17.50	2.01	23.50	1.34
5.75	1.79	11.75	46.42	17.75	2.01	23.75	1.34
6.00	1.79	12.00	123.20	18.00	2.01	24.00	1.34

CALIB	
STANDHYD (0004)	Area (ha)= 25.50
ID= 1 DT= 5.0 min	Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	16.32	9.18
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m)=	412.30	40.00
Mannings n	=	.013	.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	1.23	6.083	2.23	12.083	16.08	18.08	2.01
.167	1.23	6.167	2.23	12.167	16.07	18.17	2.01
.250	1.23	6.250	2.23	12.250	16.07	18.25	2.01
.333	1.23	6.333	2.23	12.333	16.07	18.33	2.01
.417	1.23	6.417	2.23	12.417	16.07	18.42	2.01
.500	1.23	6.500	2.23	12.500	16.07	18.50	2.01
.583	1.23	6.583	2.23	12.583	8.26	18.58	2.01
.667	1.23	6.667	2.23	12.667	8.26	18.67	2.01
.750	1.23	6.750	2.23	12.750	8.26	18.75	2.01
.833	1.23	6.833	2.23	12.833	8.26	18.83	2.01
.917	1.23	6.917	2.23	12.917	8.26	18.92	2.01
1.000	1.23	7.000	2.23	13.000	8.26	19.00	2.01
1.083	1.23	7.083	2.23	13.083	5.80	19.08	2.01
1.167	1.23	7.167	2.23	13.167	5.80	19.17	2.01
1.250	1.23	7.250	2.23	13.250	5.80	19.25	2.01
1.333	1.23	7.333	2.23	13.333	6.25	19.33	2.01
1.417	1.23	7.417	2.23	13.417	6.25	19.42	2.01
1.500	1.23	7.500	2.23	13.500	6.25	19.50	2.01
1.583	1.23	7.583	2.23	13.583	4.69	19.58	2.01
1.667	1.23	7.667	2.23	13.667	4.69	19.67	2.01
1.750	1.23	7.750	2.23	13.750	4.69	19.75	2.01
1.833	1.23	7.833	2.23	13.833	4.69	19.83	2.01
1.917	1.23	7.917	2.23	13.917	4.69	19.92	2.01
2.000	1.23	8.000	2.23	14.000	4.69	20.00	2.01
2.083	1.45	8.083	3.01	14.083	3.35	20.08	1.34
2.167	1.45	8.167	3.01	14.167	3.35	20.17	1.34
2.250	1.45	8.250	3.01	14.250	3.35	20.25	1.34
2.333	1.45	8.333	3.01	14.333	3.35	20.33	1.34
2.417	1.45	8.417	3.01	14.417	3.35	20.42	1.34
2.500	1.45	8.500	3.01	14.500	3.35	20.50	1.34
2.583	1.45	8.583	3.01	14.583	3.35	20.58	1.34
2.667	1.45	8.667	3.01	14.667	3.35	20.67	1.34
2.750	1.45	8.750	3.01	14.750	3.35	20.75	1.34
2.833	1.45	8.833	3.01	14.833	3.35	20.83	1.34
2.917	1.45	8.917	3.01	14.917	3.35	20.92	1.34
3.000	1.45	9.000	3.01	15.000	3.35	21.00	1.34
3.083	1.45	9.083	3.57	15.083	3.35	21.08	1.34
3.167	1.45	9.167	3.57	15.167	3.35	21.17	1.34
3.250	1.45	9.250	3.57	15.250	3.35	21.25	1.34
3.333	1.45	9.333	3.57	15.333	3.35	21.33	1.34
3.417	1.45	9.417	3.57	15.417	3.35	21.42	1.34
3.500	1.45	9.500	3.57	15.500	3.35	21.50	1.34
3.583	1.45	9.583	4.02	15.583	3.35	21.58	1.34
3.667	1.45	9.667	4.02	15.667	3.35	21.67	1.34
3.750	1.45	9.750	4.02	15.750	3.35	21.75	1.34
3.833	1.45	9.833	4.02	15.833	3.35	21.83	1.34
3.917	1.45	9.917	4.02	15.917	3.35	21.92	1.34
4.000	1.45	10.000	4.02	16.000	3.35	22.00	1.34
4.083	1.79	10.083	5.13	16.083	2.01	22.08	1.34
4.167	1.79	10.167	5.13	16.167	2.01	22.17	1.34
4.250	1.79	10.250	5.13	16.250	2.01	22.25	1.34
4.333	1.79	10.333	5.13	16.333	2.01	22.33	1.34
4.417	1.79	10.417	5.13	16.417	2.01	22.42	1.34
4.500	1.79	10.500	5.13	16.500	2.01	22.50	1.34
4.583	1.79	10.583	6.92	16.583	2.01	22.58	1.34
4.667	1.79	10.667	6.92	16.667	2.01	22.67	1.34
4.750	1.79	10.750	6.92	16.750	2.01	22.75	1.34
4.833	1.79	10.833	6.92	16.833	2.01	22.83	1.34
4.917	1.79	10.917	6.92	16.917	2.01	22.92	1.34
5.000	1.79	11.000	6.92	17.000	2.01	23.00	1.34
5.083	1.79	11.083	10.71	17.083	2.01	23.08	1.34
5.167	1.79	11.167	10.71	17.167	2.01	23.17	1.34
5.250	1.79	11.250	10.71	17.250	2.01	23.25	1.34
5.333	1.79	11.333	10.71	17.333	2.01	23.33	1.34
5.417	1.79	11.417	10.71	17.417	2.01	23.42	1.34
5.500	1.79	11.500	10.71	17.500	2.01	23.50	1.34
5.583	1.79	11.583	46.42	17.583	2.01	23.58	1.34
5.667	1.79	11.667	46.42	17.667	2.01	23.67	1.34
5.750	1.79	11.750	46.42	17.750	2.01	23.75	1.34
5.833	1.79	11.833	123.19	17.833	2.01	23.83	1.34
5.917	1.79	11.917	123.20	17.917	2.01	23.92	1.34
6.000	1.79	12.000	123.20	18.000	2.01	24.00	1.34

Max.Eff.Inten.(mm/hr)=	123.20	128.85		
over (min)	5.00	15.00		
Storage Coeff. (min)=	5.50 (ii)	11.88 (ii)		
Unit Hyd. Tpeak (min)=	5.00	15.00		
Unit Hyd. peak (cms)=	.20	.09		
			TOTALS	
PEAK FLOW (cms)=	5.02	2.22	7.074 (iii)	
TIME TO PEAK (hrs)=	12.00	12.08	12.00	
RUNOFF VOLUME (mm)=	110.61	43.61	83.81	
TOTAL RAINFALL (mm)=	111.61	111.61	111.61	
RUNOFF COEFFICIENT =	.99	.39	.75	

(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
Fo (mm/hr)= 50.00 K (1/hr)= 2.00
Fc (mm/hr)= 7.50 Cum.Inf. (mm)= .00
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR (0006)				
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	.0000	.0000	.5030	.8930
	.0220	.3853	.6990	1.0960

```
                          .2580      .5970   |    .8390     1.2260
                          .3810      .7510   |   1.0020     1.3720

                                AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0004)     25.50      7.07     12.00      83.81
     OUTFLOW: ID= 1 (0006)     25.50      1.00     12.58      82.95

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 14.13
                    TIME SHIFT OF PEAK FLOW         (min)= 35.00
                    MAXIMUM  STORAGE   USED       (ha.m.)= 1.3705

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0005) |   Area    (ha)=   7.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       4.56         3.04
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     225.10        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     123.20       130.60
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.82 (ii)   10.17 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=        .25          .10
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.41          .79      2.154 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.08        12.00
     RUNOFF VOLUME    (mm)=     110.61        43.90        80.59
     TOTAL RAINFALL   (mm)=     111.61       111.61       111.61
     RUNOFF COEFFICIENT   =        .99          .39          .72

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0007) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1490      .2580
                           .0060      .1068   |    .2070      .3190
                           .0760      .1710   |    .2490      .3580
                           .1130      .2160   |    .2970      .4010

                                AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)      7.60      2.15     12.00      80.59
     OUTFLOW: ID= 1 (0007)      7.60       .29     12.58      79.75

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 13.66
                    TIME SHIFT OF PEAK FLOW         (min)= 35.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  .3992

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0008) |   Area    (ha)=   5.60
|ID= 1 DT= 5.0 min |   Total Imp(%)=  60.00   Dir. Conn.(%)=  55.00
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```
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       3.36         2.24
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     193.20        40.00
     Mannings n           =       .013         .250

     Max.Eff.Inten.(mm/hr)=     123.20       130.60
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.49 (ii)    9.83 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=        .26          .11
                                                      *TOTALS*
     PEAK FLOW       (cms)=       1.05          .63       1.676 (iii)
     TIME TO PEAK    (hrs)=      12.00        12.00        12.00
     RUNOFF VOLUME    (mm)=     110.61        43.90        80.59
     TOTAL RAINFALL   (mm)=     111.61       111.61       111.61
     RUNOFF COEFFICIENT   =        .99          .39          .72

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=   .00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           .0000      .0000   |    .1460      .1820
                           .0050      .0782   |    .2020      .2230
                           .0750      .1220   |    .2420      .2500
                           .1100      .1530   |    .2890      .2800

                                AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0008)      5.60      1.68     12.00      80.59
     OUTFLOW: ID= 1 (0009)      5.60       .29     12.42      79.88

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 17.05
                    TIME SHIFT OF PEAK FLOW         (min)= 25.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  .2782

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Appendix F:

Storm Sewer Design Sheets

The MUNICIPAL INFRASTRUCTURE Group

PROJECT: Green Vally Estate I & II
LOCATION: City Of London
JOB NO: 12116

STORM SEWER DESIGN SHEET
CITY OF LONDON

SUBMISSION: FSR
M.B.
REVIEWED BY: B.A
DATE: September 2013

2- year storm A = 724.69 B =5.5 C =0.8
100 - year storm A = 1499.53 B =3.297 C =0.794
Initial Tc = : 19
Manning's n= 0.013

Street	Area No.	UPSTREAM MH	UPSTREAM INV	DOWNSTREAM MH	DOWNSTREAM INV	NO. OF HECTARES EXTERNAL AREA	NO. OF HECTARES CONTRI. AREA	NO. OF HECTARES TOTAL	AREA x STORM CO-EFF. 0.25	0.50	0.65	0.90	TOTAL A x C	TIME IN PIPE (min)	TIME TOTAL (min)	I_2 mm/hr	I_{100} mm/hr	FLOW=2.78ACI/1000 Q_2 m3/s	Q_{100} m3/s	DESIGN FLOW	PIPE LENGTH (m)	PIPE SIZE (mm)	PIPE GRADE (%)	PIPE CAP. (m3/s)	PIPE VEL. (m/s)	PIPE TIME (min)	PIPE CLASS	(NOTE 1) ROAD TYPE	ROAD GRADE	% CAPACITY	ACTUAL VEL(m^3/s)
NORTH PART																																
		MH1		MH6			3.33				2.16		2.16		19.00	56.08		0.34		0.34	375.00	675	0.35	0.498	1.39	4.50				67.83	1.55
		MH3		MH6			1.65					1.49	1.49		19.00	56.08		0.23		0.23	135.00	525	0.50	0.304	1.40	1.60				76.10	1.60
		MH4		MH6			2.72			1.360			1.36		19.00	56.08		0.21		0.21	290.00	525	0.50	0.304	1.40	3.44				69.69	1.58
		MH6		MH9			0.19			0.095			5.10		23.50	49.01		0.70		0.70	80.00	900	0.35	1.071	1.68	0.79				64.91	1.86
		MH7		MH9			2.60			1.300			1.30		19.00	56.08		0.20		0.20	270.00	525	0.50	0.304	1.40	3.20				66.62	1.56
		MH9		MH12			0.19			0.095			6.50		24.29	47.96		0.87		0.87	80.00	975	0.35	1.326	1.78	0.75				65.34	1.96
		MH10		MH12			2.36			1.180			1.18		19.00	56.08		0.18		0.18	210.00	525	0.50	0.304	1.40	2.49				60.47	1.51
		MH12		MH14			0.19			0.095			7.77		25.04	47.02		1.02		1.02	30.00	1050	0.35	1.616	1.87	0.27				62.87	2.04
		MH13		MH14			2.93				1.90		1.90		19.00	56.08		0.30		0.30	300.00	675	0.50	0.595	1.66	3.01				49.93	1.66
		MH14		MH17			0.00			0.000			9.68		25.31	46.69		1.26		1.26	50.00	1200	0.35	2.308	2.04	0.41				54.44	2.11
		MH16		MH17			1.68			0.840			0.84		19.00	56.08		0.13		0.13	150.00	450	0.50	0.202	1.27	1.97				64.93	1.40
		MH17		MH18			0.00				0.00		10.52		25.72	46.20		1.35		1.35	50.00	1200	0.35	2.317	2.05	0.41				58.30	2.18
		MH18		HW2			0.00			0.000			10.52	0.41	26.12	45.72		1.34		1.34	30.00	1200	0.35	2.308	2.04	0.25				57.94	2.16
		MH19		MH21			0.49				0.32		0.32		19.00	56.08		0.05		0.05	60.00	300	0.50	0.068	0.97	1.03				72.59	1.10
		MH20		MH21			1.54			0.770			0.77		19.00	56.08		0.12		0.12	135.00	450	0.50	0.202	1.27	1.78				59.52	1.36
		MH21		MH25			0.41				0.27		1.36		20.78	53.03		0.20		0.20	80.00	525	0.50	0.304	1.40	0.95				65.66	1.55
		MH22		MH25			1.71			0.855			0.86		19.00	56.08		0.13		0.13	210.00	450	0.50	0.202	1.27	2.76				66.09	1.40
		MH25		MH26			0.35				0.23		2.44		21.76	51.49		0.35		0.35	50.00	675	0.50	0.595	1.66	0.50				58.67	1.77
		MH26		HW1			0.00						2.44	0.50	22.26	50.74		0.34		0.34	40.00	675	0.50	0.595	1.66	0.40				57.82	1.76

The MUNICIPAL INFRASTRUCTURE Group

PROJECT: Green Vally Estate I & II
LOCATION: City Of London
JOB NO: 12116

STORM SEWER DESIGN SHEET
CITY OF LONDON

SUBMISSION: FSR
M.B.
REVIEWED BY: B.A
DATE: September 2013

2- year storm A = 724.69 B =5.5 C =0.8
100 - year storm A = 1499.53 B =3.297 C =0.794
Initial Tc = : 19
Manning's n= 0.013

Street	Area No.	UPSTREAM MH	UPSTREAM INV	DOWNSTREAM MH	DOWNSTREAM INV	NO. OF HECTARES EXTERNAL AREA	NO. OF HECTARES CONTRI. AREA	NO. OF HECTARES TOTAL	AREA x STORM CO-EFF. 0.25	0.50	0.65	0.90	TOTAL A x C	TIME IN PIPE (min)	TIME TOTAL (min)	I_2 mm/hr	I_{100} mm/hr	FLOW=2.78ACI/1000 Q_2 m3/s	Q_{100} m3/s	DESIGN FLOW	PIPE LENGTH (m)	PIPE SIZE (mm)	PIPE GRADE (%)	PIPE CAP. (m3/s)	PIPE VEL. (m/s)	PIPE TIME (min)	PIPE CLASS	(NOTE 1) ROAD TYPE	ROAD GRADE	% CAPACITY	ACTUAL VEL(m^3/s)
SOUTH PART																															
		MH27		MH29			1.04			0.520			0.52		19.00	56.08		0.08		0.08	75.00	375	0.50	0.124	1.12	1.11				65.36	1.24
		MH28		MH29			0.43			0.215			0.22		19.00	56.08		0.03		0.03	70.00	300	0.30	0.053	0.75	1.56				63.26	0.82
		MH29		MH32			1.63			0.815			1.55		20.56	53.38		0.23		0.23	160.00	600	0.30	0.336	1.19	2.24				68.37	1.33
		MH32		MH35			0.42				0.27		1.82	2.24	22.80	49.97		0.25		0.25	70.00	600	0.30	0.336	1.19	0.98				75.27	1.36
		MH35		MH37			0.62				0.40		2.23	0.98	23.78	48.63		0.30		0.30	125.00	675	0.30	0.461	1.29	1.62				65.33	1.42
		MH33		MH36			0.48				0.31		0.31		19.00	56.08		0.05		0.05	125.00	300	0.50	0.068	0.97	2.15				71.11	1.09
		MH36		MH37			0.30				0.20		0.51	2.15	21.15	52.43		0.07		0.07	60.00	450	0.50	0.202	1.27	0.79				36.64	1.08
		MH37		HW5			0.00				0.00		2.73		25.40	46.58		0.35		0.35	65.00	675	0.30	0.461	1.29	0.84				76.83	1.47
		MH42		MH43			1.16			0.580			0.58		19.00	56.08		0.09		0.09	90.00	375	0.50	0.124	1.12	1.34				72.90	1.27
		MH43		MH44			0.21			0.105			0.69	1.34	20.34	53.75		0.10		0.10	20.00	450	0.50	0.202	1.27	0.26				50.75	1.27
		MH44		MH45			0.61			0.305			0.99	0.26	20.60	53.32		0.15		0.15	90.00	450	0.50	0.202	1.27	1.18				72.75	1.44
		MH39		MH45			1.19			0.595			0.60		19.00	56.08		0.09		0.09	160.00	375	0.50	0.124	1.12	2.38				74.79	1.28
		MH45		MH50			0.23			0.115			1.70		21.78	51.46		0.24		0.24	50.00	525	0.50	0.304	1.40	0.59				79.93	1.61
		MH39		MH49			1.27			0.635			0.64		19.00	56.08		0.10		0.10	160.00	375	0.50	0.124	1.12	2.38				79.82	1.29
		MH49		MH50			0.00			0.000			0.64	2.38	21.38	52.08		0.09		0.09	25.00	375	0.50	0.124	1.12	0.37				74.12	1.28
		MH50		HW4			0.00			0.000			2.34		22.38	50.58		0.33		0.33	25.00	600	0.50	0.434	1.54	0.27				75.59	1.75
		MH51		MH54			0.69				0.45		0.45		19.00	56.08		0.07		0.07	100.00	375	0.30	0.096	0.87	1.92				72.78	0.99
		MH53		MH54			0.32				0.21		0.21		19.00	56.08		0.03		0.03	65.00	300	0.50	0.068	0.97	1.12				47.40	0.94
		MH54		MH56			0.90				0.59		1.24		20.92	52.80		0.18		0.18	170.00	525	0.30	0.236	1.09	2.60				77.33	1.24
		MH55		MH56			0.16				0.10		0.10		19.00	56.08		0.02		0.02	30.00	300	0.50	0.068	0.97	0.52				23.70	0.63
		MH56		HW3			0.00				0.00		1.35		23.52	48.98		0.18		0.18	25.00	525	0.30	0.236	1.09	0.38				77.74	1.24

PIPE

ROAD TYPE

NOTES

Appendix G:

Sanitary System Calculations

Wastewater Flow Calculation

Green Valley Estates Inc. and Green Valley Estates II - London

Date November 2013

Ultimate Condition

Building Type	Condo Apartments	Townhouse	Condo Townhomes	Semi-Detached	Detached	Total	
No. of Units	285	112	239	36	284	956	Estimated Apartments / Lots
Average Population Density (residents per unit)	1.6	2.4	2.4	3.0	3.0		
Total Population	**456**	**269**	**574**	**108**	**852**	2,259	
Per Capita Flow (Lpcd)	250	250	250	250	250	250	City of London Engineering Standards
Average Flow (L/s)	**1.3**	**0.8**	**1.7**	**0.3**	**2.5**	**6.5**	
Peaking Factor	3.99	4.1	3.94	4.23	3.84	3.54	City of London Engineering Standards
Peak Flow (L/s)	**5.2**	**3.3**	**6.7**	**1.3**	**9.6**	**23.1**	
Site Area (ha)						34.26	
Infiltration Allowance (L/ha/s)						0.1	City of London Engineering Standards
Infiltration Flow (L/s)						**3.4**	
Total Flow (L/s)	**5.2**	**3.3**	**6.7**	**1.3**	**9.6**	**26.5**	

Wastewater Flow Calculation - Commercial

Green Valley Estates Inc. and Green Valley Estates II - London

Date November 2013

Ultimate Condition

Building Type	Commercial	
Total Site Area (ha)	0.4	
Average Day Commercial Flow (m^3/ha/day)	25	City of London Engineering Standards (100pp/ha x 250 Lpcd)
Average Flow (L/s)	**0.12**	
Equivalent Population	42	Base on 250 Lpcd (City of London Standard)
Peaking Factor	4.33	
Peak Flow (L/s)	**0.52**	
Site Area (ha)	0.4	
Infiltration Allowance (L/ha/s)	0.1	City of London Engineering Standards
Infiltration Flow (L/s)	**0.04**	
Total Flow (L/s)	**0.56**	

Appendix H:

Water Demand Calculations

Water Demand Calculation

Green Valley Estates Inc. and Green Valley Estates II - London

Date November 2013

Ultimate Condition

Building Type	Condo Apartments	Townhouse	Condo Townhomes	Semi-Detached	Detached	Total	
No. of Units	285	112	239	36	284	956	Estimated Apartments / Lots
Average Population Density (residents per unit)	1.6	2.4	2.4	3.0	3.0		(Number of Bedrooms + 1; Building Code)
Total Population	**456**	**269**	**574**	**108**	**852**	**2,259**	
Per Capita Demand (Lpcd)	270	270	270	270	270	270	MOE Guidelines
Average Demand (L/s)	**1.4**	**0.8**	**1.8**	**0.3**	**2.7**	**7.1**	
Peak Hour Factor	7.8	7.8	7.8	7.8	7.8	7.8	MOE Guidelines
Peak Hour Demand (L/s)	**10.9**	**6.2**	**14.0**	**2.3**	**21.1**	**55.4**	
Maximum Day Factor	3.5	3.5	3.5	3.5	3.5	3.5	MOE Guidelines
Maximum Day Demand	**4.9**	**2.8**	**6.3**	**1.1**	**9.5**	**24.9**	
Fire Protection Demand (L/s)	**38**	**38**	**38**	**38**	**64**	**101**	MOE Design Guideline Table 8-1

Water Demand Calculation - Commercial

Green Valley Estates Inc. and Green Valley Estates II - London

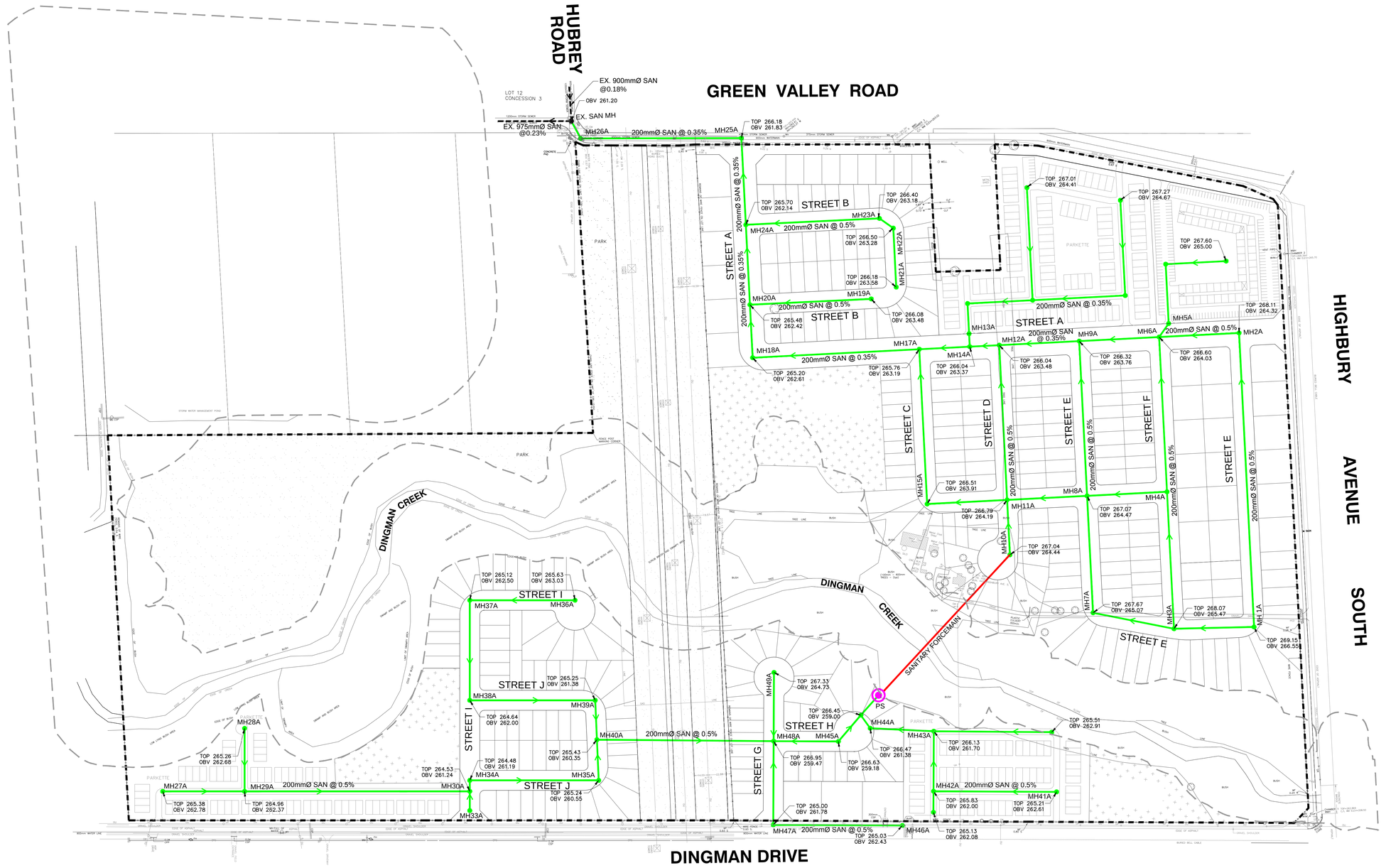
Date November 2013

Ultimate Condition

Building Type	Commercial	
Total Site Area (ha)	0.4	
Average Day Commercial Flow (m^3/ha/day)	28	MOE Guidelines
Average Demand (L/s)	**0.13**	
Equivalent Population	42	Base on 270 Lpcd
Peaking Hour Factor	7.80	City of London Design Standards
Peak Hour Demand (L/s)	**1.0**	
Maximum Day factor	3.50	City of London Design Standards
Maximum Day demand	**0.46**	
Fire Protection Demand (L/s)	**38.0**	MOE Design Guideline Table 8-1

Appendix I:

Drawings



LEGEND:

- PROPOSED LOCAL SAN SEWER
- EXISTING SAN SEWER
- PROPOSED SEWER PUMPING STATION
- PROPOSED SANITARY FORCEMAIN

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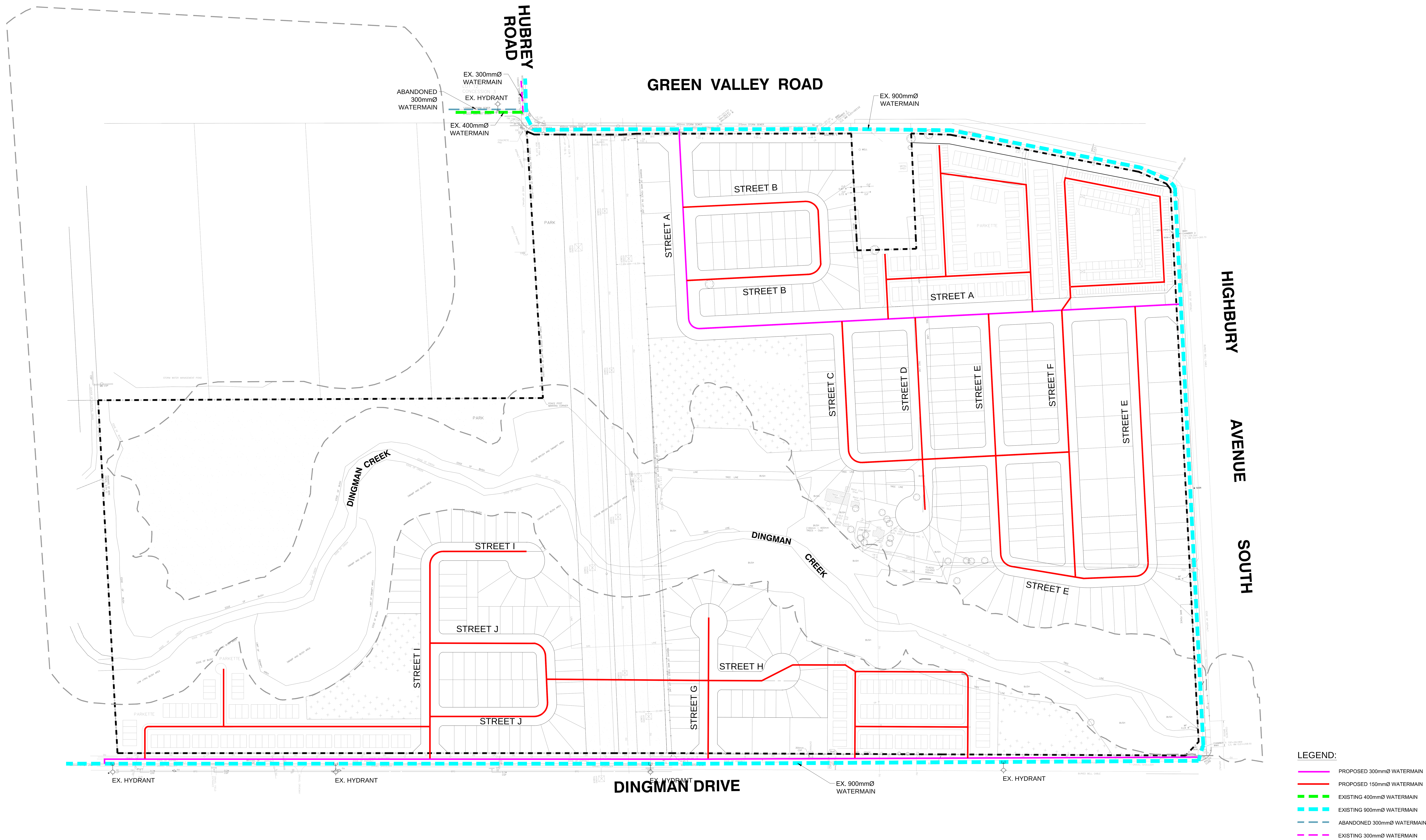
GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON
PROPOSED SANITARY SEWER PLAN

DATE: DECEMBER 2013

PROJECT No. 12116

SCALE: 1:2000

DRAWING No. SAN01



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GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON
PROPOSED WATERMAIN PLAN

DATE: DECEMBER 2013	PROJECT No. 12116
SCALE: 1:2000	DRAWING No. WM01

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GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON
PROPOSED STORM DRAINAGE SEWER PLAN

DATE:	PROJECT No.
DECEMBER 2013	12116
SCALE: 1:2000	DRAWING No. STM01

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GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II
CITY OF LONDON
GRADING PLAN

DATE:	DECEMBER 2013
PROJECT No.	12116
SCALE:	1:2000
DRAWING No.	GR01