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







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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	

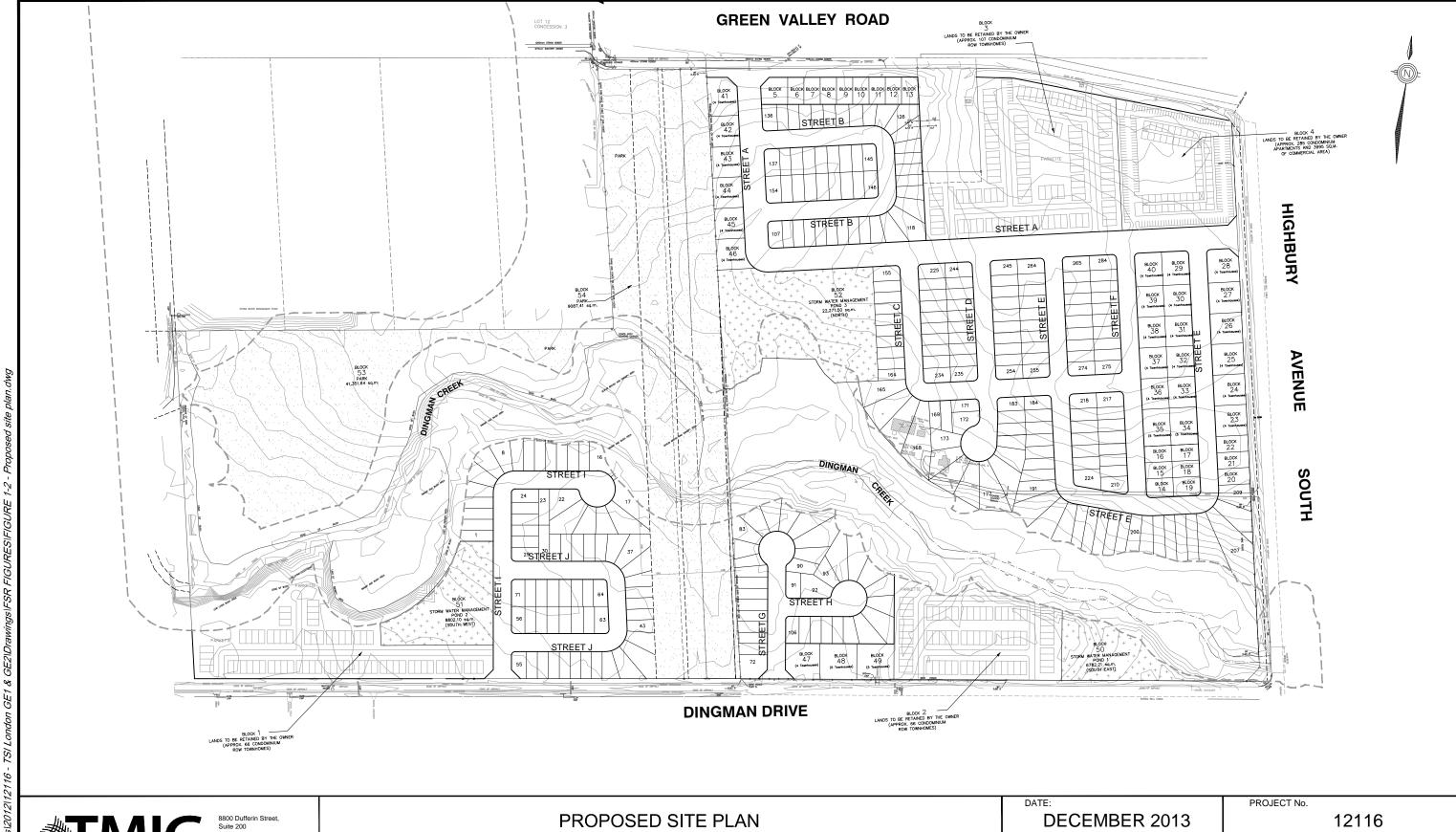
The remainder of the site area is comprised of valley lands associated with Dingman Creek and are not proposed to be developed.

1.4 Background Information / Supporting Reports

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

- <u>Dingman Creek Subwatershed Study Update: Volume 1 Main Report</u>
 Prepared by Delcan Corporation, Stantec Consulting Limited and Cummings Cockburn Limited, April 2005
- <u>Dingman Creek Subwatershed Study Update: Volume 2 Tributary Fact Sheets</u>
 Prepared by Delcan Corporation, April 2005
- <u>City of London Design Specifications & Requirements Manual</u>
 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**.



GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II

CITY OF LONDON

SCALE:

NTS

FIGURE No.

1-2

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 OTTHYMOTM 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)

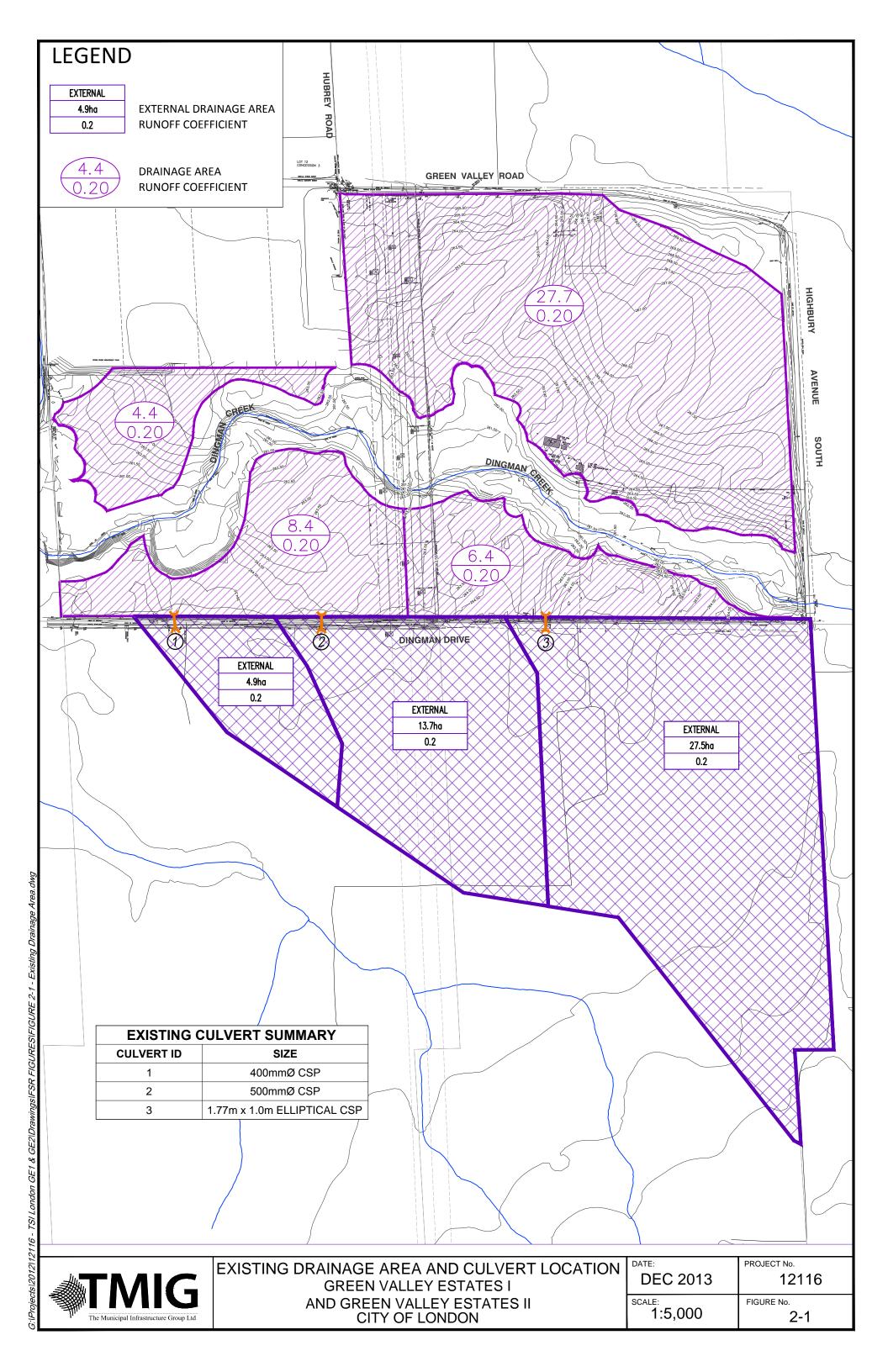
	Pre-development Peak Flow (m³/s)				
Storm Event	North Pond (Drainage Area = 27.7 ha)	Southwest Pond (Drainage Area = 8.4 ha)	Southeast Pond (Drainage Area = 6.4 ha)		
25 mm	0.106	0.032	0.029		
2-year	0.256	0.076	0.072		
5-year	0.508	0.151	0.147		
10-year	0.676	0.201	0.197		
25-year	0.863	0.256	0.251		
50-year	1.014	0.299	0.295		
100-year	1.163	0.344	0.338		

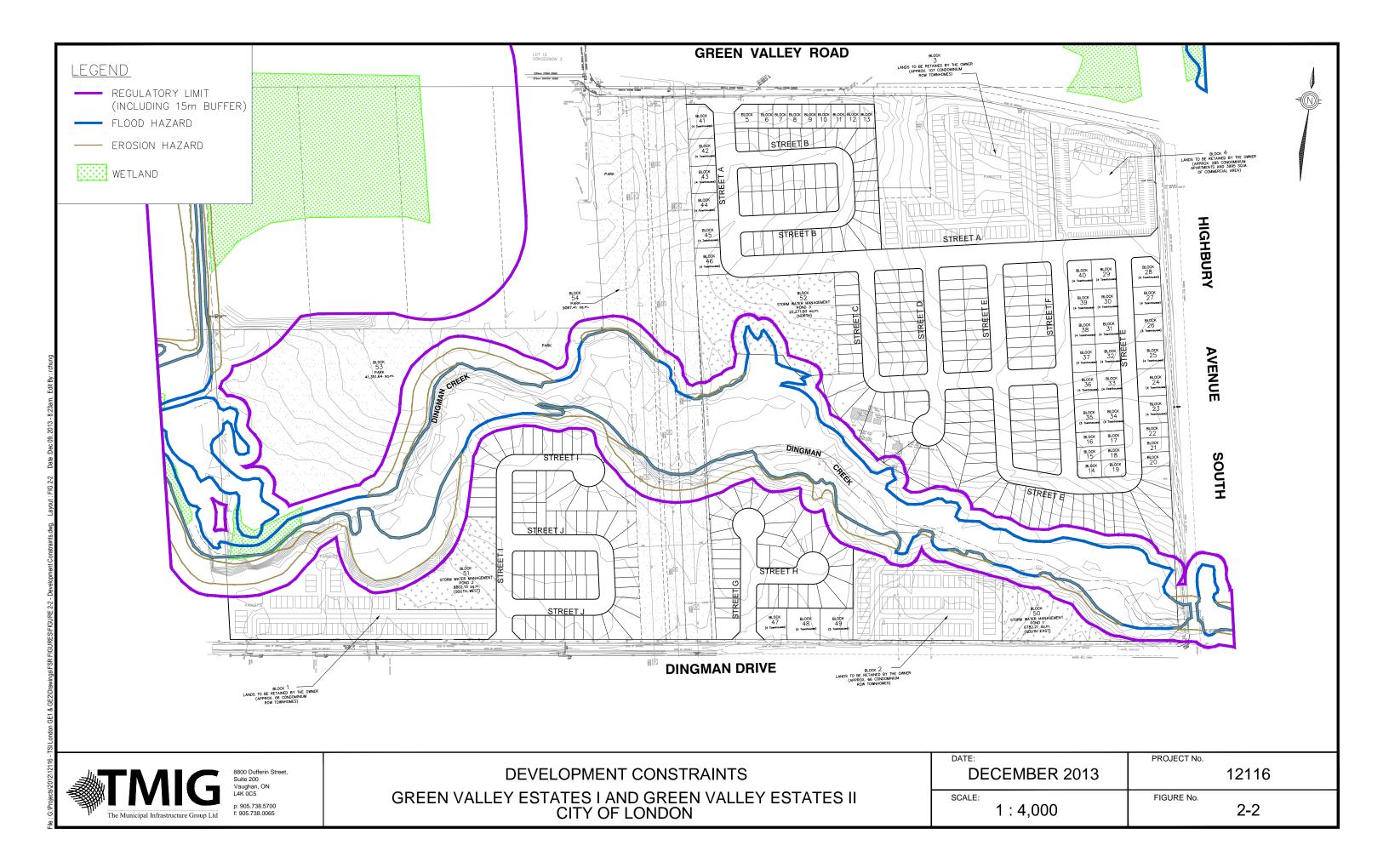
Table 2-2: Pre-development Peak Flow Rates (24-hour SCS Type II storm)

	Pre-development Peak Flow (m³/s)				
Storm Event	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)

	Pre-development Peak Flow (m³/s)				
Storm Event	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		





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 (m³/s)	W.S. Elev (m)	Volume (1000 m³)
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 (m³/s)	W.S. Elev (m)	Volume (1000 m³)
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 m³. However, this area could be compensated for by a balancing cut area, which would provide an additional floodplain volume of 180 m³.

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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.

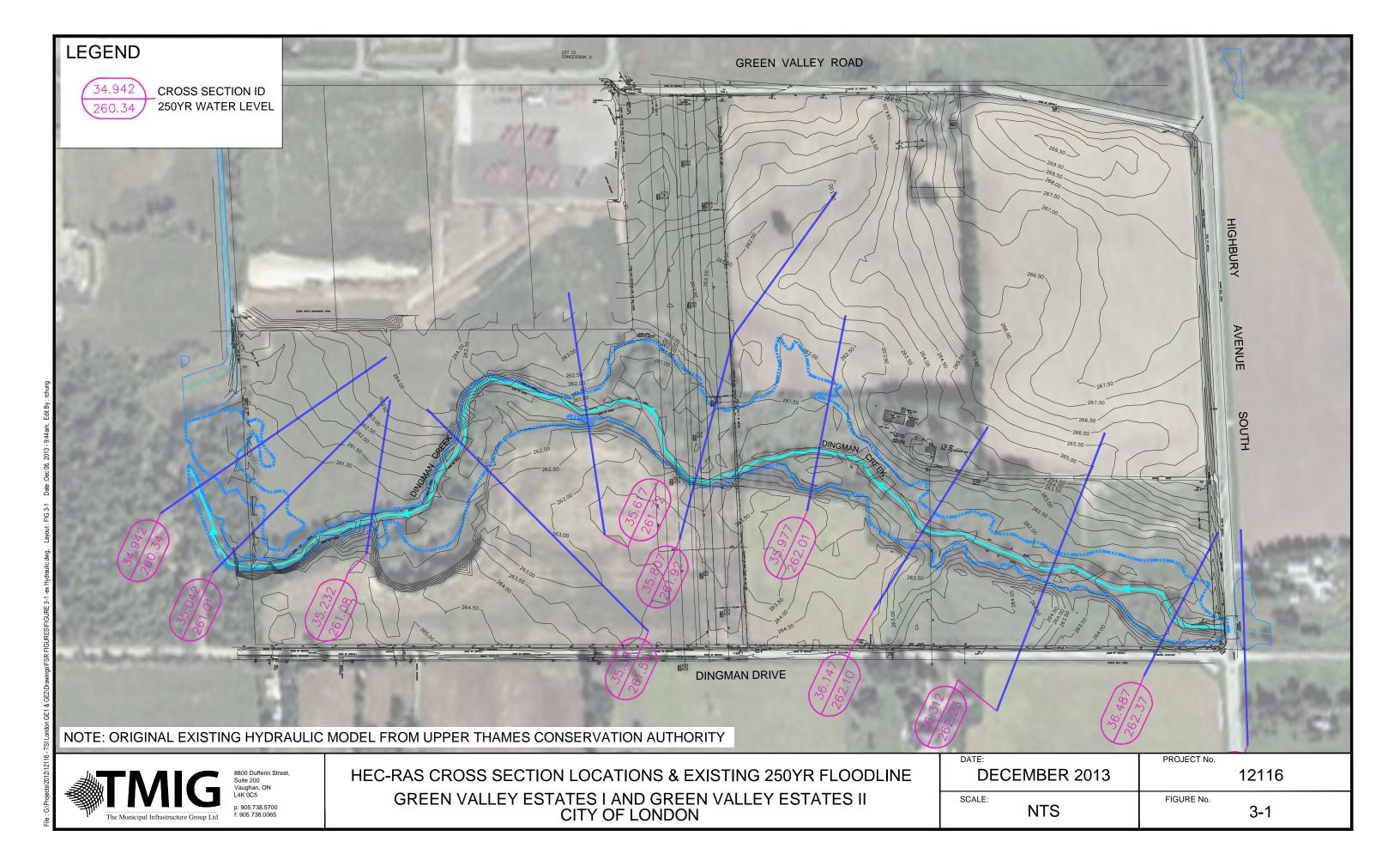
The output from the proposed hydraulic model of Dingman Creek is summarized in Table 3-3.

Table 3-3 Proposed Hydraulic Modeling Output

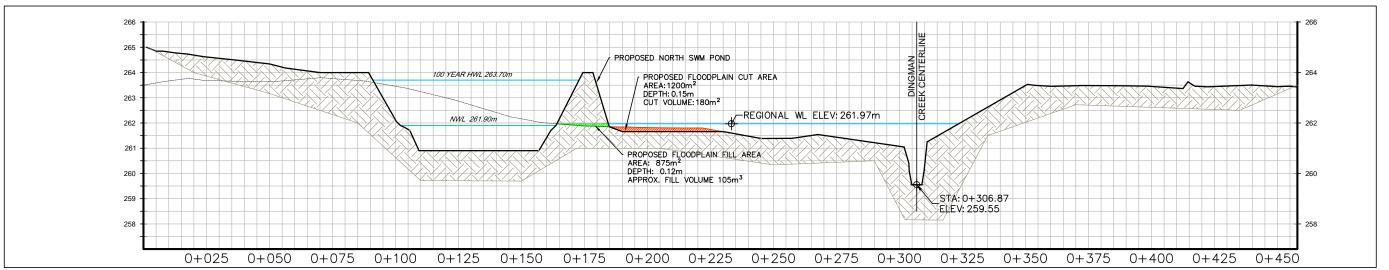
Reach	River Sta.	Profile	Q Total (m³/s)	W.S. Elev (m)	Volume (1000 m ³)
Reach-9	36.9135	1:250 Existing	26.7	262.53	473.35
Reach-9	36.7485	1:250 Existing	26.7	262.46	466.25
Reach-9	36.5735	1:250 Existing	26.7	262.41	457.13
Reach-9	36.5615	1:250 Existing	26.7	262.38	456.34
Reach-9	36.5575		Bridge		
Reach-9	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 m³ under existing conditions and 61,240 m³ 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**.



PROFILE ALONG XS 35.917





CUT AND FILL BALANCE AT HEC-RAS CROSS SECTION 35.917

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II

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DATE:	PROJECT No.
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SCALE: NTS	FIGURE No. 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 OTTHYMOTM 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**.

	Target Release Rates (m³/s)		
Storm Event	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)

	Target Release Rates (m³/s)		
Storm Event	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

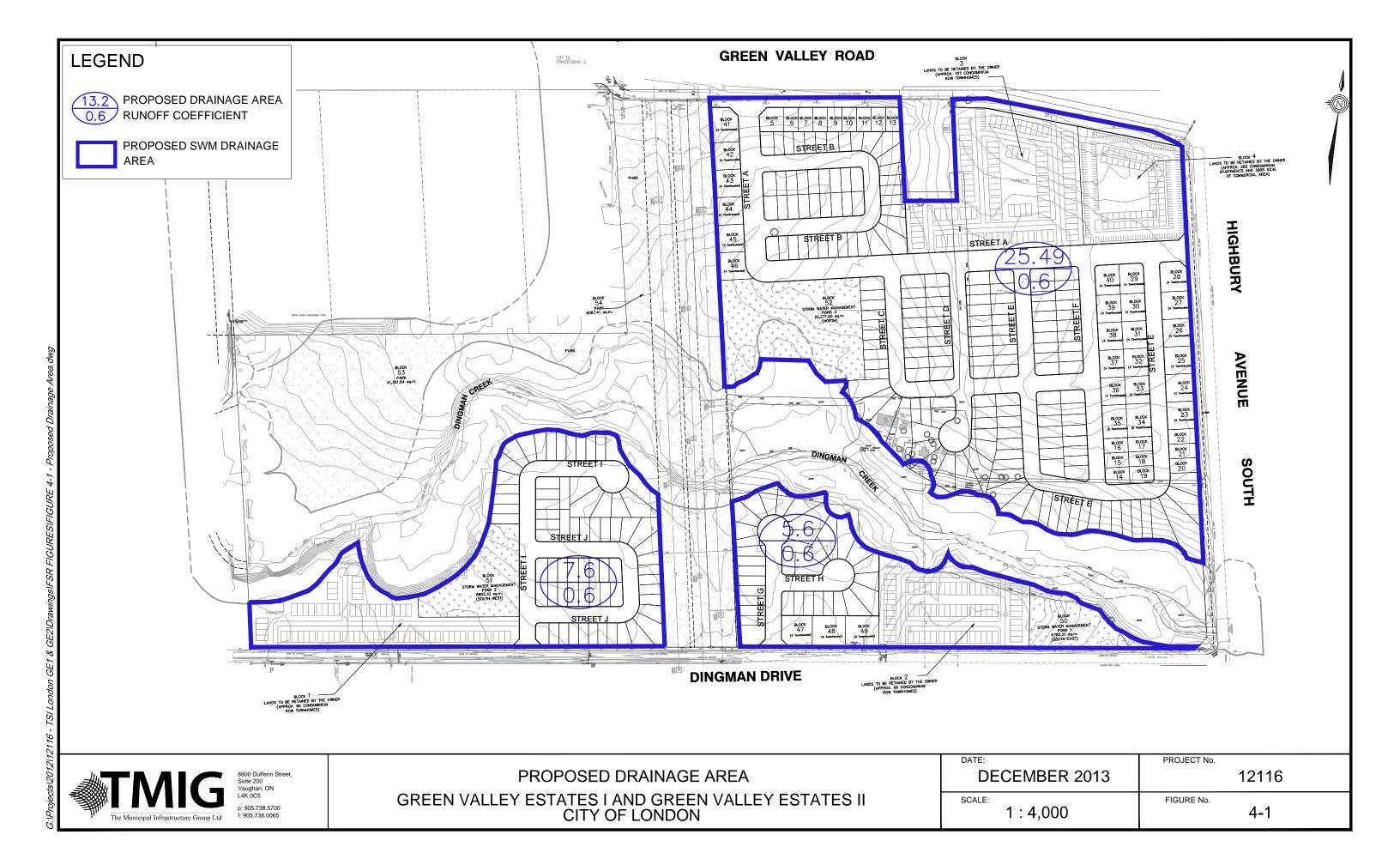
Table 4-3: Target Release Rates (1-hour AES Storms)

	Target Release Rates (m³/s)		
Storm Event	North Pond (Drainage Area = 27.7 ha)	Southwest Pond (Drainage Area = 8.4 ha)	Southeast Pond (Drainage Area = 6.4 ha)
2	,	,	,
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**.

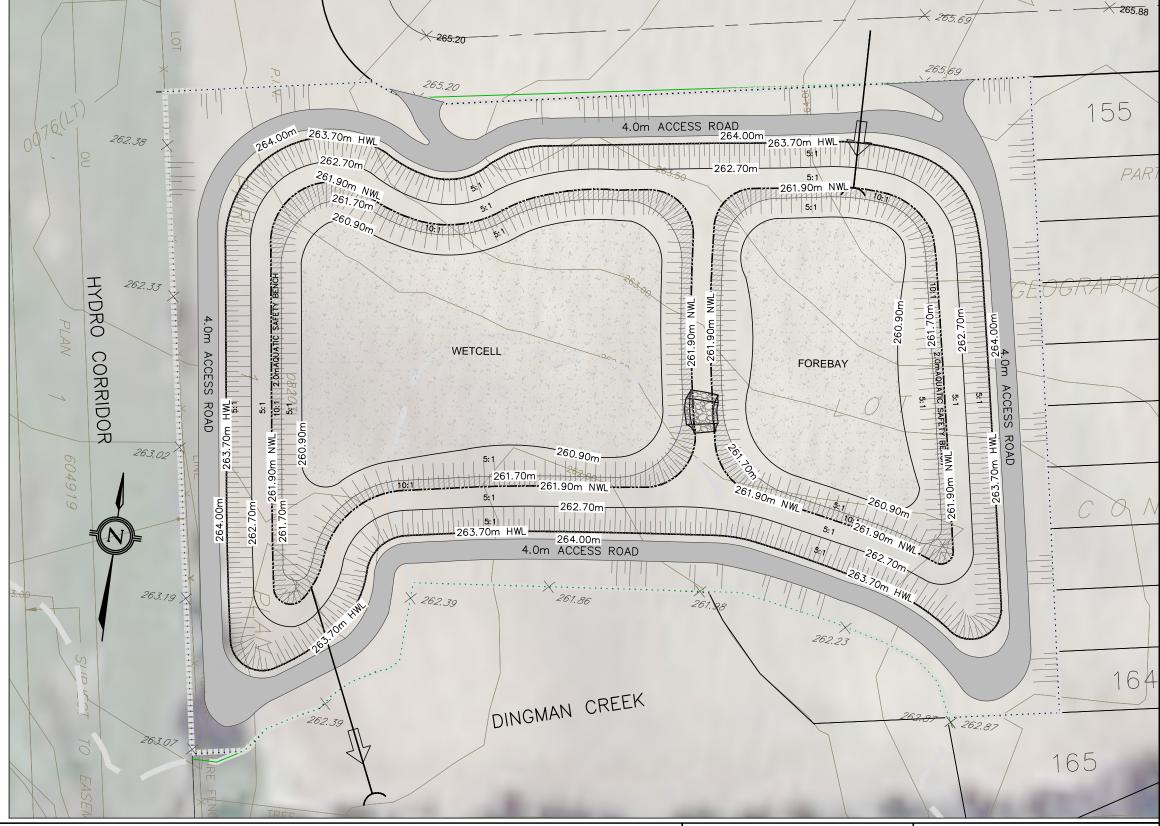
The proposed SWM ponds will be designed as normal quality wet ponds servicing post development flows from the subject site, and will provide quality, quantity and erosion control. Flows will inlet to the SWM ponds via storm sewers and overland flow routes, with attenuated and controlled discharge outletting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



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)	13,705 m ³	18,478 m 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

DECEMBER 2013 PROJECT No. 12116

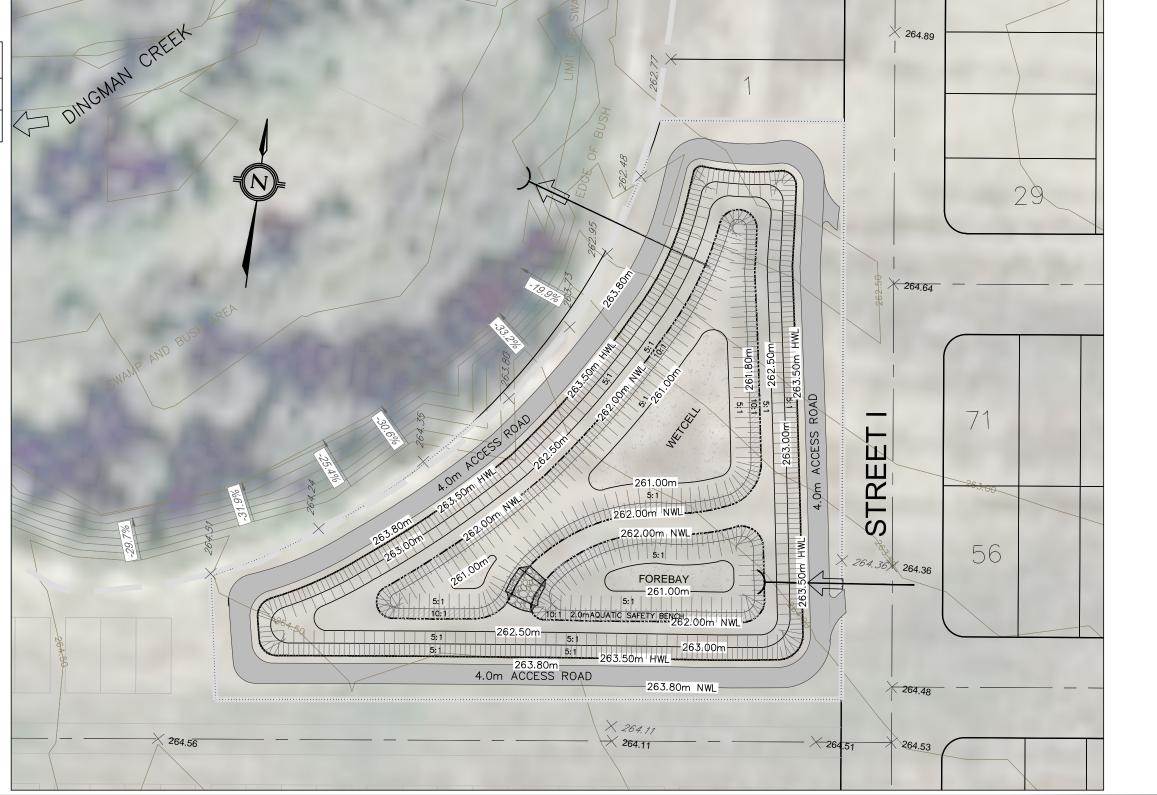
SCALE: FIGURE No. 4-2

The Mu

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	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 260.80m





CONCEPTUAL DESIGN - SOUTHWEST POND

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II

CITY OF LONDON

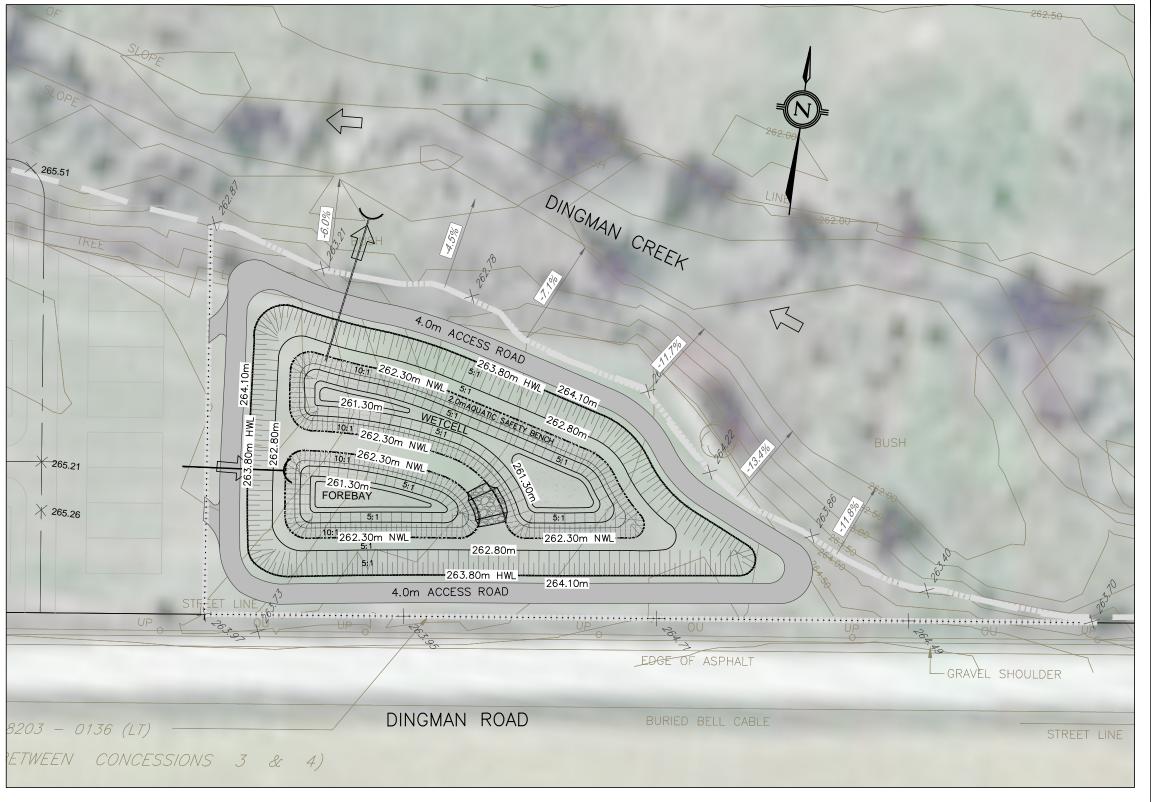
DATE:	PROJECT No.
DECEMBER 2013	12116
scale: 1:750	FIGURE No. 4-3

si2012/12116 - TSI London GE1& GEZIDrawingsIFSR FIGURESIFIGURE 4-2 to 4-4-pond concepts dwg, Layout : figure 4-3 WEST POND Date: Dec 09, 2013 - 12:59pm,

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





CONCEPTUAL DESIGN - SOUTHEAST POND

GREEN VALLEY ESTATES I AND GREEN VALLEY ESTATES II

CITY OF LONDON

DATE:	PROJECT №.
DECEMBER 2013	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 m³
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 OTTHYMOTM 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	North SWM Pond*	
Component	Release Rate	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)

0	Target	North SW	M Pond*
Component	Release Rate	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)

0	Target		North SWM Pond*	
Component	Release Rate	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	$0.378 \text{ m}^3/\text{s}$	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)

Commonant	Target	Southwest S	SWM Pond*
Component	Release Rate	Peak Flow	Storage
Permanent Pool	N/A	N/A	582 m ³
Erosion Control	0.006 m ³ /s	$0.006 \text{m}^3/\text{s}$	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)

Commonant	Target	Southwest SWM Pond*	
Component	Release Rate	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)

0	Target		Southwest SWM Pond*	
Component	Release Rate	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)

0	Target	Southeast S	WM Pond*
Component	Release Rate		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)

C	Target	Southeast S	WM Pond*
Component	Release Rate	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).

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

0	Target	Southeast S	WM Pond*
Component	Release Rate	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 (m³)	Required Storage Volume (m³)
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**.

Drainage Area	Pre-Development Annual Infiltration Volume	Post Development Annual Infiltration Volume	Annual Infiltration Volume Deficit
North	41,522 m ³ /yr	17,332 m³/yr	24,190 m ³ /yr
Southwest	12,380 m ³ /yr	5,788 m³/yr	6,592 m ³ /yr
Southeast	9,073 m ³ /yr	4,242 m ³ /yr	4,831 m ³ /yr

Table 4-20: Preliminary Analysis of Annual Infiltration Volumes

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 predevelopment 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 Spec	cifications & 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 m³/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.





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

DECEMBER 2013	PROJECT №. 12116
SCALE: NTS	FIGURE No. 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**.

City of London

Average Day Domestic Demand

270 Lpcd

Average Day Commercial Demand

28 m³/ha/day

Maximum Day Demand Factor

7.80

Table 6-1: Water System Design Criteria

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**.

 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

Table 6-2: Water Demands Requirements

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:

Reviewed By:

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David F. Ashfield, P. Eng.

Partner

Green Valley Estates Inc. and Green Valley Estates II Inc. FSR CITY OF LONDON

Appendix A:

Geotechnical Report



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

Submitted to:

Greenvalley Estates Canada Inc./
TSI International-Grandtag A2A GEII Inc.

Suite 960 1 Robert Speck Parkway Mississauga, Ontario, L4Z 3M3 Canada

Submitted by:

AMEC Environment & Infrastructure, a Division of AMEC Americas Limited 104 Crockford Boulevard

104 Crockford Boulevard Scarborough, Ontario M1R 3C3 Canada

24 May 2012

TT123014



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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)

			Grain Size Distribution			
Borehole No.	Sample No.	Depth (m)	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 $0.3\,\mathrm{m}$, 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)

			Grain Size Distribution			
Borehole No.	Sample No.	Depth (m)	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		rater Levels in Boreholes ompletion of Drilling (25 April 2012)	Groundwater Levels in Installed Monitoring Wells Two Weeks After Drilling (9 May 2012)		
No.	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)
	Stiff Silt	0.8 m to 1.0 m (±)	268.0 m to 267.8 m (±)	100	150
BH 1	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
5110	Very Stiff Silty Clay Till	Below 2.3 m (±)	Below 260.6 m (±)	200	300



				Geotechnical	Factored
Borehole Number	Foundation Soil Strata	Depth Below Existing Grade	Geodetic Elevation (m)	Reaction at SLS (kPa)	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
	Compact Sand	2.3 m to 3.5 m (±)	260.5 m to 259.4 m (±)	150	225
BH 7	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
i. 8	Loose Silt	0.8 m to 1.5 m (±)	263.5 m to 262.9 m (±)	100	150
BH 8	Dense to Compact Sand	1.5 m to 3.0 m (±)	262.9 m to 261.3 m (±)	150	225
Biro	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
	Compact Silt	0.8 m to 1.4 m (±)	262.0 m to 261.4 m (±)	200	300
BH 9	Compact Sand	1.4 m to 2.1 m (±)	261.4 m to 260.7 m (±)	200	300
Bito	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
DIL 40	Compact Silt	0.8 m to 1.4 m (±)	262.5 m to 261.9 m (±)	100	150
BH 10	Very Stiff Silty Clay/Clayey Silt Till	below 1.4 m (±)	below 261.9 m (±)	150	225
	Very Stiff Silty Clay Till	0.8 m to 2.1 m (±)	263.5 m to 262.2 m (±)	150	225
BH 11	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
BH 12	Dense Sandy Silt Very Stiff Silty Clay	Below 4.4 m (±) Below 0.8 m (±)	Below 259.9 m (±) Below 262.2 m (±)	250 200	325 300
1 (1)	Till	` ,	_ = ===================================		

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:

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 noncohesive 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/m³

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

.../... Page 14



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 (\pm 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)	рН	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 μ g/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 μ g/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.

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Sincerely,

AMEC Environment & Infrastructure, a Division of AMEC Americas Limited W.G. FARAH 90374968

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REPORT LIMITATIONS

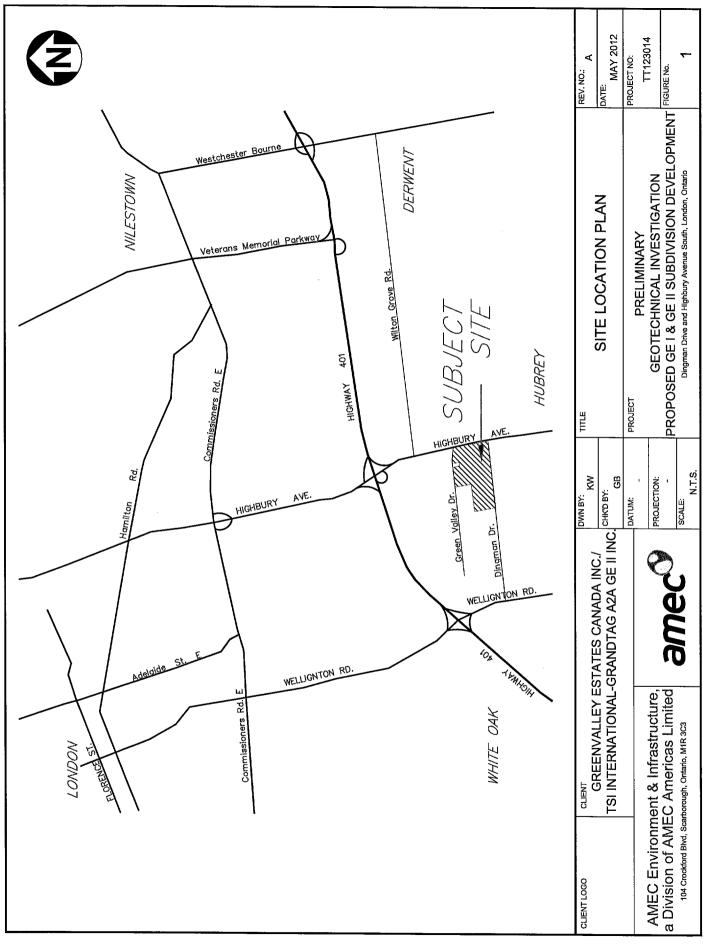
The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the 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.



2.\Projects\2012\T123014_Mainline_Dingman Drive Development, London\Drawings\T123014 - 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 Plat

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):

Compact	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	Undrained Shear Strength				
Conesive Soils	<u>kPa</u>	<u>psf</u>			
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			

Soli Samplina

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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Rev 5 Nov '06

MODIFIED "UNIFIED CLASSIFICATION SYSTEM FOR SOILS
"The soil of each straim is described using the Unified Soil Classification System (Technical Mamorancom 38-357
present of Waterways Ersement Station, Vilosoring, Mississipp, Corps of Enginess U.S. Army, Vol. 1
March 1953) included using the Soil is no long-select layer of Ymerium districtly is recorded.

Martin 1953.) intellibed bignilly so that an incognolo clay of "medium of articity" is escoprized.							
	MAJOR DIVISION		OHOUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CHITERIA		
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VEIGILE	ORAVELS MORE THAN HALF THE COMINE FRACTION LARGERTHAN 4.750111	(TRACE OR NO FINES)	G P	POORLY GRACIED GRAVELS, GRAVEL-SAVID MIXTURES, LITTLE OR NO PINES	NOT MEETING ABOVE REQUIREMENTS		
ALF BY 1	FELS MO	DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LEATS BELOW "A" LINE OR P. I MORE THAN 4		
THAN H 75µm)	8 ± 3	WORE FINES)	GC	CLAYEY GRAVELS, GRAVEL-BAND-CLAY (#XTURES	Attenberg lrate below 'a' line or 7.1 More that t		
COARSE GRANNED SOILS (MORE THAN HALF BY WEKLIT LARGER) THAN 75µm)	ALF THE	CLEAN SANDS	SV/	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FMES	C ₂ = D ₂₂₋₂ 0; C ₂ = (D ₂₁) ² = 1 to 3 D ₁₄		
PED SOIL	THAN HA TTON SM	FINES)	8p	PDORLY GRADEO GRAVELS, GRAVEL- SAND VIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS		
SE GRAN	SANDS MÖRE THAN HALF TI IE COARSE FRACTON SWALLER THAN 4.75smm	DIRTY SANDS (WITH SOME OR	53,(BILTY SANOS, SANO-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR PLIMORE THAN 4		
COARS		MORE FINES)	şc.	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS BELOW "A" LUNE OR P.I MORE THAN 7		
MALLER THAN	SILTS BELOW'A". LNE NESLIGIBLE OPIGANIC CONTENT	W _L < 50%	AL	INORGANIC SLTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SUGHT PLASTICITY			
WEGHT		₩ _L < 50%	ЯH	EVORGANIC BILTS, MICACECUR OR DIATOMACEOUS, FINE 64NDY OR SILTY SOLS	CI ASSIFICATION IS BASED UPON PLASTICITY CHART		
134.F 8Y	CLAYS ABOVE 'v' LRIE NEOLIGIBLE ORGANIC GONTENT	₩_ ¢30%	GL	norganic clays of low plasticity, gravelly, sandy or silty clays, lean clays	(SEE BELOW)		
FNE-GRAINED BOILS (MORE THAN HALF BY WEIGHT BMALLER THAN 75 mm)	ABOVE ISIBLE OF CONTEN	30% < W _L < 50%	Ci	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS			
		W _L <50%	CH	Inorganic clays of high plasticity, fat clays			
AINEO SC	ELITS &	W _L < 51%	OL.	GRGANIC SLTS AND ORGANIC BILTY DLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT		
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	HIGH ORGANIC SOILS		Pi	PEAT AND OTHER HIGHLY ORGANIC SOLLS	BETRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE		

SCILGOMPGNENTS													
FRACTION	U.S.STANDARO S	HEVE SIZE	DEFINING PANGES OF PERCENTAGE BY WEIGHT O MINOR COMPONENTS										
		PASSING	RETAINED	PERCENT	DESCRIPTOR								
SRAVEL	GOARSE	78 mm	19 mm	35-60 20-35	AND Y/EY								
-	FINE	19 may	₹75 mat	19-20	SOME								
	COARSE	4,75 mm	2.00 mm	1-4B	TRAGE								
GNA9	MEDINA	2.10 ma	425 pm										
	EINE	425 pm	75 pari										
	OFICLAY BASED ON LASTICITY)	75 pins											

ROS COMPONICATES

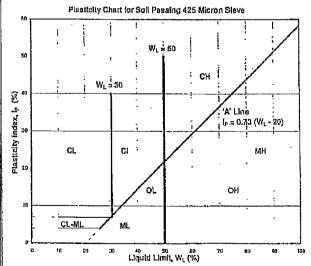
OVERSIZED MATERIAL

ROUNCED OR SUBROUNDED; COBBLES 78 mm TO 208 mm BOULDERS > 200 mm NOT ROUNDED: FICK FRAGMENTS > 78 mm FICKS > 0.76 CUBIC METRE WI VOLUME

AMEC Earth & Environmental 104 Crockford Boulevard Scarborough, ON M1R 3C3 Ph: (416) 751-6565 Fax: (416) 751-7592

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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

R	ECORD	OF BORE	HOLE N	o.	BH1	L C	o-Oı	rd. <u>I</u>	E 48	5807, N	N 475224	<u>18</u>		am	ec®
l	ject Number:									g Location:	See Figure 1	<u> </u>		_ Logged by:	SD
	ject Client:	Greenvalley Esta	ates Canada In	c./TS	Interr	nationa	ıl-Gran	dtag	_ Drilling	g Method:	100 mm So	lid Stem Auger		_ Compiled by:	SS
Project Name: Proposed GE I and GE II Subdiv							Drilling Machine:		Track Mount	ted Drill		_ Reviewed by	PB		
Pro	ject Location:	Dingman Drive 8	& Highbury Ave	nue S	outh, L	_ondo	1 ON.		Date 9	Started:	Apr 24, 12	_ Date Completed: Apr 2	4, 12	Revision No.:	0, 5/24/12
	LITH	OLOGY PROFI	LE	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING			
					L				Ê	Penetra O SPT	etionTesting DCPT	Atterberg Limits W _P W W _L	NSTALLATION		
Plot		DESCRIPTION	I	ype	nmpe	(%)	alne	Ē		MTO Vane*	Nilcon Vane*	Plastic Liquid	TION	COMME	STV
Lithology Plot				Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (I	ELEVATION	△ Intact ▲ Remould	♦ Intact♦ Remould	* p.p (TSF) Unit Weight (KN/CM) Moisture Content (%)	ALLA		
Ţ.	Geodetic Groun Silty TOPSOIL	d Surface Elevation:		Sarr	San	Zeg.	SPT	E		20 40	60 80	* Undrained Shear Strength (kPa) 20 40 60 80	INST		
111	L_'		brown 					-							
	SILT, trace cla stiff	у	0.3 brown					_							
								Ē	268 _		1 1				
	SILTYCLAYT		<u>267.7</u>	SS	1	50	10	_ 1		0		o ¹⁶			
	stiff to very	ILL	brown					-							
	Suii							Ē							
				SS	2	100	18	-	267	0		o ²⁰			
17	SILTYSAND							2							
	compact		brown					<u>-</u>	-			40			
				SS	3	80	10	-		0		o ¹² : : :			
								- - 3	266 _						
			İ	ss	4	100	24	F.,	-			₀ 20			
					-	100	24	-	-	10	: :				
								Ė	265						
				SS	5	100	33	4	-			₀ 24			
	dense		264.4					- 2	7						
	SAND, trace s	iit —————	4.4					-	= :						
	dense		brown	SS	6	100	32	-	264 _	0		₀ 23			
			-			-		_ _ 5 _	-						
											: :				
								-	-						
									263 _						
	some silt							— 6 - -							
			262.2	SS	7	100	35	-	-	0		o ²⁰			
	END OF BOR	EHOLE	6.6		•			-	262 _						
								_ — 7	-						
								-	=						
									-		:				
		•							261 _						
								- 8	-						
								_	-						
								-	-						
								-	260						
								— 9 _	-						
								-	-						
								-	-						
									259		<u> </u>				
a Di		& Infrastructure, Americas Limited est	∑ Groundwa	ater dep	th on co	mpletio	n of drill	ing: <u>4.</u>	<u> </u>			■ Cave in depth recorded	f on completio	n of drilling: 4.3.	
Lon- Tel:	don Ontario, N5\ 519-681-2400		Borehole details	g proces	nted do-	not const	itute = 4-	orough	undaret	nding of all	atial acceliate	sent. Also, borehole information s			
	519-668-1754		read in conjunction	n with th	e report	for which	it was c	ommisi	oned.	rang or all poter	nual conditions pre	>વાત. ભારત, porenole information sl	noula be		Scale 1: 45
_ *****	v.amec.com													I P	age: 1 of 1

Proj	ect Number: TT123014							g Location;	See Figure	1		Logged by:	SD	
	ect Client: Greenvalley Estates C A2A GE II Inc.					ıdtag	_ Drilling Method:		200 mm H	ollow Stem Auger		Compiled by:	ss	
	ect Name: Proposed GE I and GE								g Machine:	Track Mour			Reviewed by:	PB
Proj	ect Location: Dingman Drive & High	ibury Ave						_ Date S	Started:	Apr 25, 12	Date Completed: Apr 2	5, 12	Revision No.:	<u>0, 5/2</u>
\neg	LITHOLOGY PROFILE		SC	OIL SA	MPLI	NG		-	-	TESTING	LAB TESTING	z		
Lithology Plot	DESCRIPTION Geodefic Ground Surface Elevation: 264.2 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	O SPT MTO Vane* △ Intact ▲ Remould 20 40	■ DCPT Nilcon Vane* Intact Remould 60 80	Atterberg Limits W _P W V _L Plastic Liquid ** p.p. (TSF) ◆ Unit Weight (KN/CM) ○ Moisture Cortent (%) ** Undrained Shear Strength (kPa) 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENT	rs
	Silty TOPSOIL	brown 263.9					F	264 _						
Ш	SILT, trace sand	0.3 brown 263.6					Ė	-						
	SILTY CLAY TILL, some sand and gravel	0.6					ŧ	-				₩ № 9-	2.4 m RISER1-BENT	ONIT
	very stiff	brown	SS	1	100	22	-1	-			o ¹⁶) - 6.1 m SCREEN	טוי
							£ :	▼ 263 _ =						
							Ę	-] : :	: :				
			SS	2	100	28	-		0		o ¹¹⁷			
		ļ					- 2 -	262 _						
	hard	grey	ss	3	100	36	<u> </u>			1	o15			
					100	30	<u> </u> -	:	0.	:				
					_		_ 							
	very stiff	grey	SS	4	100	24	-	261 _			o16			
							-			i :				
		ŀ					Ė	-	1					
			SS	5	100	17	<u> </u>	260	0		20			
					*****		-			: :				
			ss		400	40	F				o18			
				6	100	18	_ 5		0					
							-	259 _	1					
							-					1000 PRO 4		
							- - -							
							— 6 -	258 _						
		257.6	SS	7	100	18	-		0 :		019			
	END OF BOREHOLE	6.6					-							
	Groundwater level on: 9 May, 2012 was 1.22 m depth 23 May, 2012 was 1.40 m depth						7							
	23 May, 2012 Was 1.40 M deput						F	257 _						
							Ė							
							Ė							
							8	256 _						
							F							
							F							
							- 9		1					
							-	255 _						
							-	•						
							E			:				
	C Environment & Infrastructure,	Groundwa					<u>. — 10</u>		<u> </u>	- : :	<u> </u>	LL_		

R	ECORD	OF BORE	HOLE N	o. <u> </u>	BH3	Co	o-Or	d. <u>E</u>	<u>48</u>	5221,	N 47522	<u> 235</u>			an	nec®
Proj	ect Number:	TT123014							Drilling	Location:	See Figure	1			Logged by	: <u>SD</u>
Proj	ect Client:	Greenvalley Esta	tes Canada In	c. / TS	l Interr	ationa	il-Gran	dtag	_ Drilling Method:		100 mm Solid Stem Auger				Compiled b	oy: <u>SS</u>
Project Name: Proposed GE I and GE II Subd		nd GE II Subdi	vision	Devel	opmen	t		Drilling	g Machine:	Track Mou	Track Mounted Drill			Reviewed	by: <u>PB</u>	
Proj	ject Location:	Dingman Drive &	Highbury Ave	nue S	outh, L	.ondor	ON.		Date 9	Started:	Apr 25, 12	Date C	ompleted: Apr 2	5, 12	Revision N	o.: <u>0, 5/24/12</u>
	LITH	OLOGY PROFIL	.E	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB	TESTING			
										I .	ationTesting		rberg Limits W W	NO		
ᇦ		DESCRIPTION		e O	mber	(%	en En	_	E N	O SPT MTO Vane	DCPTNilcon Vane	W _P ■ Plastic	W W _L Liquid	ATNI	COMM	ENTS
Lithology Plot				Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	Œ) H	ELEVATION	Δ Intact ▲ Remould	Intact	* p.p (• Unit \	rsF) Veight (KN/CM) ure Content (%)	INSTRUMENTATION INSTALLATION		
Lithol	Geodetic Ground	d Surface Elevation: 2	:66.5 m	Samp	Samp	Reco	SPT '	DEPTH	ELEV	20 4	0 60 80	O Moist * Undrained	ure Content (%) Shear Strength (kPa) 40 60 80	NSTA NST/		
	Silty TOPSOIL		brown 266.2					-				1				
Ш	SANDY SILT loose		0.3 brown					-	266 _							
	10030		DIOWII					-								
				SS	1	80	4	[- 1				₀ 20	1			
								Ęź	Z 265 _							
Щ	Sandy SILTY		<u>264.7</u> 1.8	SS	2	60	7	-		0		o ¹⁷				
	firm to very	OLAT TILL	brown					_ 2		1	i i -					
	3011															
				SS	3	50	16	-	264 _	0		o ¹²				
								-								
			grey	SS	4	400	00	<u> </u> 3 - -				o11				
					4	100	26	-	263 _			0				
	SILTY CLAY 1	TLL, some sand and g	gravel 262.8 3.7					_				1				
				SS	5	40	21	- 4				19				
								F								
	very stiff							Ē	262			1				
	,			SS	6	100	22	-		Ö		o ²²				
								<u> </u>)					
								Ė	261 _			:				
			260.7					-								
	SILTY SAND dense		5.8 grey					- - 6								
				SS	7	20	35	Ē				022			% Gravel = 0 % Sand = 64	
	END OF BOR	EHOLE	259.9 6.6						260			:			% Silt and clay = 36	6
	LIND OF BOIL		0.0					-								
								- 7								
								Ē	259 _							
						!		-	259 _							
								- - - 8								
								F $$:				
								E	258 _			:				
								-				1		'		
								9		<u> </u>			· · · · · · · · · · · · · · · · · · ·			
								-								
								F	257 _			:				
			:					F		1						
AMEC Environment & Infrastructure, a Division of AMEC Americas Limited 7-1940 Oxford St. East									<u></u>							
Tel	don Ontario, N5 519-681-2400 .519-668-1754	V 4L8	Borehole details	as prese	nted, do	not cons	titute a ti	norough	understa	nding of all po	tential conditions	present. Also, k	orehole information	should be		01- : :5
	v.amec.com		read in conjunction	on with t	ne report	tor whic	n It was	commisi	ioned.							Scale 1: 45 Page: 1 of 1

R	ECORD OF BORE	EHOLE N	О.	BH4	4 C	0- 0	rd.	E 48	5264, N	N 475198	<u>81</u>		amec
1	oject Number: TT123014				····			_	g Location:	See Figure	1		Logged by: SD
1	AZA GE ILIDO		Inc. / TSI International-Grandtag Drilling Method:								olid Stem Auger	Compiled by: SS	
	pject Name: Proposed GE I								g Machine:	Track Moun	-		Reviewed by: PB
PIC	pject Location: <u>Dingman Drive</u>						_ Date	Started:	Apr 25, 12	Date Completed: Apr 2	5, 12	Revision No.: 0, 5/24/12	
	LITHOLOGY PROF	ILE	SC	DIL SA	MPLI	NG			FIELD	TESTING	LAB TESTING		
Plot	DESCRIPTION	N	eg.	Sample Number	(%)	lge lge	-	(m) Ni	Penetra O SPT MTO Vane*	ationTesting DCPT Nilcon Vane*	Atterberg Limits W _P W W _L Plastic Liquid	INSTRUMENTATION INSTALLATION	COMMENTS
Lithology Plot			Sample Type	ple N	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION	△ Intact ▲ Remould	♦ Intact ♦ Remould	* p.p (TSF) • Unit Weight (KN/CM) ○ Moisture Content (%)	N C C C C C C C C C C C C C C C C C C C	
I.S.	Geodetic Ground Surface Elevation: Silty TOPSOIL		Sam	Sam	Reco	SPT	E E	ELE	20 40	60 80	* Undrained Shear Strength (kPa) 20 40 60 80	INST INST/	
M	SILTY CLAY, some sand and grav	brown 262.8 /el 0,2					E		1				
	very stiff	brown					-						
			SS	1	70	18	-1 -1	262 _	0		o16		
							-						
			SS	2	100	26	2	261 _	0		o ¹⁵		
		greyish brown	SS	3	70	25	-		0		o18		
							<u> </u>	260 _			9,		
		grey	SS	4	100	18	. → 3 - - -		0		o18		
							- - - -						İ
			ss	5	100	19	- 4	259 _	0		o19		
			SS	6	100	04	-				17		
			33		100	21	- - 5 -	258 _	0		o ¹⁷		
							-						
				_			- - - 6	257					
	END OF BOREHOLE	256.4	ss	7	100	21	-	-	0		o18		
	END OF BOREHOLE	6.6						256 _					
			i				-						
							-	-					
				ĺ			- 8	255 _					
		!					-	-					
							- - - 9	254					
							-	-					
		<u> </u>					- - - - 10-	253_					
a Div 7-19 Lond	C Environment & Infrastructure, vision of AMEC Americas Limited 40 Oxford St. East Ion Ontario, N5V 4L8	ter dept	h on coi	mpletior	of drilli	ng: <u>Dr</u>	Y .						
Fax	i19-681-2400 519-668-1754 .amec.com	Borehole details a read in conjunction	s present	ted, do n report f	ot consti for which	tute a the	orough i	understar oned,	ding of all potent	tial conditions pres	sent. Also, borehole information sh	ould be	Scale 1: 45
													Page: 1 of 1

	r														
	ECORD	OF BORE	HOLE N	o.	BH(<u>5</u> Co	o-O	rd. j		5470, N	V 475200 See Figure 1			am	
Pro	ject Client:	ates Canada In	c. / TS	l Inter	nationa	al-Gran	ndtag		-		lid Stem Auger		Logged by: Compiled by:	SD	
Pro	ject Name:	A2A GE II Inc	N2A GE II Inc. Proposed GE I and GE II Subdivision Development								Track Moun			Reviewed by:	
Pro	ject Location:	Dingman Drive	& Highbury Ave	enue South, London ON.					Date	Started:	Apr 25, 12		5, 12	Revision No.:	
	LITH	OLOGY PROFI	LE	SC	DIL SA	MPLI	NG	T	T	FIELD	TESTING	LAB TESTING			
										-	tionTesting	Atterberg Limits	NO O		
Lithology Plot	Geodetic Groun	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	O SPT MTO Vane* △ Intact ▲ Remould 20 40	 Intact Remould 	W, W W, ■ O Liquid * p.p. (TSF) • Unit Weight (KN/CM) ○ Moisture Content (%) • Undrained Shear Strength (kPa) 20 40 60 80	INSTRUMENTATION	COMMEN	тѕ
	Silty TOPSOIL		brown 					F							
	CLAYEY SILT firm	TILL	0.3 brown					[- - -	262 _						
				SS	1	100	8	F 1	202 _	0		014			
	Sandy CLAYE stiff	Y SILT TILL	<u>261.4</u> 1.5	SS	2	100	15	-	261 _	0		o ¹⁰	- 100		
Ø)			260.6					- 2							
	SILTY CLAY 1 very stiff	TILL.	2.3 grey	SS	3	60	24			0		014			
				SS	4	100	20	_ 3 	260 _	0		o ¹⁷			
			-					- - - - -	259						į
			-	SS	5	100	16	- 4		0		_o 18			
			-	ss	6	100	19		258 _	0		_o 19			
								- - - - - -	257 _						
	hard		-					- 6	-						
	END OF BOR	EHOLE	256.3 6.6	SS	7	100	37		-	0		o ¹⁹			
								- - - 7 - - -	256						
								- - - - - 8	255						
								-	-						
								- - 9 - -	254						
								- - - -	253						
a Di 7-19 Lon	vision of AMEC A 340 Oxford St. Ea don Ontario, N5\		∑ Groundwa											·	
Fax	519-681-2400 519-668-1754 v.amec.com		Borehole details a read in conjunction	s preser n with th	nted, do ne report	not const for which	itute a th	orough commisi	understar oned.	nding of all poter	ntial conditions pre	sent. Also, borehole information s	nould be	I	Scale 1: 45 ge: 1 of 1

RE	CORD	OF BORE	HOLE N	o. j	BH6	<u> C</u>	o-Or	d. <u>I</u>	E 48	<u>5847, N</u>	N 475207	<u>73</u>		aı	mec®
Proj	ect Number:	TT123014								Location:	See Figure 1	1		Logged b	oy: <u>SD</u>
Proj	ect Client:	Greenvalley Esta	tes Canada In	c. / TS	Interr	nationa	l-Gran	dtag	_ Drilling	Method:	100 mm So	olid Stem Auger		Compiled	by: <u>SS</u>
Proj	ect Name:	Proposed GE I ar	nd GE II Subdi	vision	Devel	opmen	t		Drilling	Machine:	Track Moun	ted Drill		Reviewe	d by: PB
Proj		Dingman Drive &							_ Date \$	Started:	Apr 24, 12	Date Completed: Apr 2	4, 12	Revision	No.: <u>0, 5/24/12</u>
	LITH	OLOGY PROFIL	E	SC	IL SA	MPLI	NG			FIELD	TESTING	LAB TESTING			
Lithology Plot		DESCRIPTION		уре	Sample Number	(%)	SPT 'N' Value	(m)	ON (m)	O SPT MTO Vane*	ationTesting ■ DCPT Nilcon Vane*	Atterberg Limits W _P W W _L Plastic Liquid	INSTRUMENTATION	COM	MENTS
ogo				Sample Type	ble 7	Recovery (%)	ž	H (ELEVATION	△ Intact ▲ Remould	 Intact Remould 	 ※ p.p (TSF) ❖ Unit Weight (KN/CM) ○ Moisture Content (%) 	ALL		
Ë	Geodetic Groun	d Surface Elevation: 2	67.7 m	Sam	Sam	Rec	SPT	DEPTH	E E	20 40	60 80	* Undrained Shear Strength (kPa) 20 40 60 80	TSNI		
	Silty TOPSOIL		brown 267.5								1				
	SAND, some	.114	0.2 brown 266.9					-	267 _						
	compact	olir.	0.8 light brown	SS	1	100	15	- 1 -		0		o ¹⁷			
									•						
				SS	2	100	26	-	266 _	0		o ¹⁴	9	% Gravel = 0 % Sand = 84 % Silt and clay =	16
								- 2 - -							
	dense			SS	3	100	38		265 _	0		o ²¹			
								_ _ 3				10			
				SS	4	100	38	- - -	264 _			o ¹⁹			
					5	100	37	4	204 _	0		₀ 23			
	trace silt compact		brown	SS	6	100	25	- 5	263 _	0		o ²⁴			
	SILT, trace sa	nd — — — — —						-							
	dense							- - -	262 _						
								- - -				24			
Щ	END OF BOR	EHOLE	261.1 6.6	SS	7	100	32		261 _	0		o ²⁴			
								- - 7							
								<u>-</u> - -							
									260 _						
	,							- 8 - - -							
								-	259 _						
								_ 9 _ -							
									258 _						
				L				<u> </u>		1					
a Di ¹ 7-19		t & Infrastructure, Americas Limited ast V 4L8	∑ Groundw	ater dep	oth on c	ompletic	n of dril	10 lling: <u>3</u>	5 <u>.4</u> ,			☐ Cave in depth records	d on compl	letion of drilling:	<u>3.4</u> .
Tel 5	519-681-2400 519-668-1754		Borehole details read in conjuncti	as prese	nted, do	not cons	titute a th	norough	n understa	nding of all pote	ential conditions pr	resent. Also, borehole information	should be		Scale 1: 45
	.amec.com		Zona in conjuncti	≈ıı ıvıUl I	героп	. IOI WINC	was (-on HIUS	auneu.						Page: 1 of 1

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RI	ECORD	OF BORE	HOLE N	o. j	BH7	<u>′</u> Co	o-Or	d. <u>E</u>	<u> 48</u>	<u>5926, N</u>	<u> 1 475179</u>	<u> </u>		ame	;c
	ect Number:	TT123014								Location:	See Figure 1			Logged by: S	SD
	ect Client:	Greenvalley Estat						dtag	Drilling	g Method:	200 mm Ho	llow Stem Auger		Compiled by: S	s
	ject Name:	Proposed GE I ar							-	g Machine:	Track Mount			Reviewed by: P	B
Pro		Dingman Drive &							Date 8	Started:	Apr 24, 12	_ Date Completed: Apr 2	4, 12	Revision No.: 0	, 5/24/12
1	LITH	OLOGY PROFIL	E	SC	IL SA	MPLI	NG_			l	TESTING	LAB TESTING	z		
Lithology Plot	Goodetia Groun	DESCRIPTION 1 Surface Elevation: 2	62.0 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetra O SPT MTO Vane* △ Intact ▲ Remould 20 40	■ DCPT Nilcon Vane* Intact Remould	Atterberg Limits W _P W W _t Plastic Liquid * p.p.(TSF) - Unit Weight (KNVCM) - Moisture Content (%) * Undrained Shear Strength (RPa) 20 40 60 80	NSTRUMENTATION NSTALLATION	COMMENTS	5
_	Silty TOPSOIL	a duriace Elevation: Zi	brown		. 0,	ш.	- 0,	-	<u>, w</u>	20 40	: :	20 40 80 80			
	SAND AND S loose	[T	<u>262.6</u> 0.3 brown	SS	1	20	5	- - - - - 1	262	0		o ²⁶	₩ ₩ 1.5 -	5 m RISER1-BENTO 3.0 m RISER1-SAND 6.1 m SCREEN	ONITE O
	SAND, trace of	ravel and silt	<u> </u>				_	ĒŽ	Z .						
	loose		brown	SS	2	20	9	- <u>-</u> - 2	261 _	0		o ¹⁶			
	trace silt compact			ss	3	100	19	-	-	0		o ²⁶			
								- - - 3	260 _						
			259.4	ss	4	100	18	-		0		o ²⁶			
	SILT, trace sa compact	na	3.5 light brown					-	259						
				SS	5	100	20	4	200	0		c ²⁶			
	SILTY SAND		<u>257.9</u> 5.0	ss	6	100	16	- - - - - - 5	258	0		o ²⁶			
	compact		light brown			,			257 _						
	END OF BOR	EHOLE	256.3 6.6	SS	7	100	13	6	-	0		_o 24			
	Groundwater 9 May, 2012 v 23 May, 2012	evel on: /as 1.34 m depth was 1.41 m depth						- - - 7 - - -	256 _						
								- - - 8 -	255						
								9	254						
								- - -	253 _						
a Di 7-19	vision of AMEC 340 Oxford St. E		⊈ Groundwa							VF 12	<u> </u>	L	11		
Lon- Tel	don Ontario, N5' 519-681-2400		Borehole details	as prese	nted, do	not cons	titute a th	orough	understa		ntial conditions pre	esent. Also, borehole information	should be		
	519-668-1754 v.amec.com		read in conjunction	on with t	he report	for whic	h it was d	ommisi	oned.			,		1	e: 1 of 1

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RECORD OF BOREHOLE No. BH8 Co-Ord. E 485685, N 4751886 Project Number: TT123014 Drilling Location: <u>Greenvalley Estates Canada Inc. / TSI International-Grandtag</u> Drilling Method: A2A GE II Inc. Project Client: 200 mm Hollow Stem Auger Compiled by: SS Proposed GE I and GE II Subdivision Development Project Name: Drilling Machine: Track Mounted Drill Reviewed by: PB Project Location: Dingman Drive & Highbury Avenue South, London ON. Date Started: Apr 25, 12 Date Completed: Apr 25, 12 Revision No.: 0, 5/24/12 LITHOLOGY PROFILE SOIL SAMPLING **FIELD TESTING** LAB TESTING INSTRUMENTATION INSTALLATION Atterberg Limits V_P W W_L astic Liquid PenetrationTesting Ê SPT sample Number COMMENTS DESCRIPTION Plot 'N' Value Plastic Recovery (%) MTO Vane* Nilcon Vane* ELEVATION Ê * p.p (TSF) • Unit Weight (KN/CM) • Moisture Content (%) Undrained Shear Strength (kPa) 20 40 60 80 Intact Remould DEPTH (Geodetic Ground Surface Elevation: 264.3 m TOPSOIL 60 264 SILT, trace sand loose brown SS 70 9 262.9 1.4 263 SAND, trace gravel and siit dense SS 100 32 0 Ä 262 o¹⁴ compact SS 3 100 SILTY CLAY TILL o¹³ SS 20 261 Ö very stiff SS 5 100 13 O 260 259.9 4.4 SAND, some silt compact light brown SS 6 100 22 Ö 259 258.2 6.1 6 SILTY SAND % Gravel = 0 258 % Sand = 57 % Silt and clay = 43 compact light brown 100 25 0 257,7 END OF BOREHOLE 257 256 255 AMEC Environment & Infrastructure, $\stackrel{\textstyle igsqrup}{=}$ Groundwater depth on completion of drilling: 2.1. ■ Cave in depth recorded on completion of drilling: 2.1. a Division of AMEC Americas Limited 7-1940 Oxford St. East London Ontario, N5V 4L8 Tel 519-681-2400 Borehole details as presented, do not constitute a thorough understanding of all potential conditions present. Also, borehole information should be read in conjunction with the report for which it was commissioned. Fax 519-668-1754 Scale 1: 45 www.amec.com Page: 1 of 1

	ECORD OF BORE	HOLE N	o.]	BHS	<u>9</u> Co	o-Oı	rd. Į	E 48	<u>5603, N</u>	N 47516	<u> 685</u>			ar	nec®
	ject Number: TT123014							_	g Location:	See Figure				Logged by	
ŀ	ject Client: Greenvalley Esta A2A GE II Inc. ject Name: Proposed GE I a						natag		g Method: g Machine:	Track Mou	Solid Stem	Auger		Compiled	
1	ject Location: <u>Dingman Drive 8</u>							_	Started:			ompleted: Apr 2	4, 12	Reviewed Revision N	No.: <u>0, 5/24/12</u>
	LITHOLOGY PROFIL	LE	SC	IL SA	MPLI	NG			FIELD	TESTING	LAE	TESTING			
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: :	262.8 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetra ○ SPT MTO Vane* △ Intact ▲ Remould	♦ Intact♦ Remould	e* Plastic * p.p.(* Unit O Mois	briberg Limits W W, G Iquid TSF) Weight (KN/CM) ture Content (%) Shear Strength (kPa) 40 60 80	INSTALLATION INSTALLATION	COMN	MENTS
1	TOPSOIL, grass SILT, some sand	dark brown 					Ė		<u>-</u>						
	compact	brown						262 _							
			SS	1	25	22	- 1		-		_o 24				
	SAND, trace silt compact							<u> </u>			. 23				
			SS	2	100	29	- 2	261 _	- 0		o ²³				
Ш	SANDY SILT compact	<u>260.7</u> 2.1 greyish					ļ								
	Соприс	brown	SS	3	100	27		260 _	0		o ¹⁹				
	SAND, some silt						_ 3								
	dense	light brown	SS	4	100	30	-				o ¹⁹				
							Ē	259 _							
			SS	5	100	32	- 4		0		o19				
							[
			SS	6	100	35	-	258 _	0		₀ 21				
							- 5 - -								
							-								
							Ė.,	257 _			:				
				_			<u> </u>				17				
	END OF BOREHOLE	256.2 6.6	SS	7	100	43	E				017				
	END OF BORLHOLL	0,0					-	256 _							
							- 7 -								
							-								
							-	255 _							
							— 8 								
							-	254 _							
							_ _ 9								
]						
							-	253 _			:				
	 EC Environment & Infrastructure,	∑ Groundw	ater den	oth on o	ompletic	on of dri	L 10	4	1	: :	. Co	ve in denth records	d on comple	tion of delline	
7-1	ivision of AMEC Americas Limited 940 Oxford St. East Idon Ontario, N5V 4L8	_ Sideriuw	uch	. 41 011 0	-mpiout	or uff	y. <u>I</u>	<u>.4</u> .			<u>⊾a</u> Ca	ve in depth recorde	u on comple	uon or aniling:	1.4.
Tel	519-681-2400 : 519-668-1754	Borehole details read in conjuncti	as prese on with ti	nted, do he repor	not cons t for whic	titute a ti h it was	horough commis	understa	nding of all pote	ntial conditions	present. Also, t	porehole information s	should be		Scale 1: 45
ww	w.amec.com	L												1	Page: 1 of 1

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R	ECORD	OF BORE	EHOLE N	o.	BH1	<u>10</u> C	2o-C	Ord.	<u>E 4</u>	<u>85303,</u>	N 47516	<u> </u>		am	$ec^{\mathbb{O}}$
Pro	oject Number:	TT123014							Drillin	g Location:	See Figure 1			_ Logged by:	SD
	oject Client:	Greenvalley Est A2A GE II Inc.						ıdtag			200 mm Ho	llow Stem Auger		_ Compiled by:	SS
	oject Name:	Proposed GE I								g Machine:	Track Mount			_ Reviewed by:	
_		OLOGY PROF							Date	Started:	Apr 24, 12		24, 12	Revision No.:	0, 5/24/12
		JLOG1 PROF	ILE	_50	IL SA	MPLI	NG	ļ -	┼		TESTING	LAB TESTING	z		
Lithology Plot		DESCRIPTION	V .	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	O SPT MTO Vane* △ Intact ▲ Remould	■ DCPT Nilcon Vane* ♦ Intact • Remould	Atterberg Limits W _I , W W _L Plastic Liquid * p.p (TSF) C Unit Weight (KN/CM) Moisture Content (%)	INSTRUMENTATION INSTALLATION	COMMEN	TS
=	Geodetic Ground	d Surface Elevation:	263,3 m brown	San	San	Rec	SPT	<u> </u>		20 40	60 80	* Undrained Shear Strength (kPa) 20 40 60 80	TSNI		
Ш	SILT, trace cla							- -	263						
	compact		brown -		_			- - - - -					₩ 2.7 -	2.7 m RISER1-BEN - 3.0 m RISER1-SA	TONITE ND
	CLAYEY SILT	TILL — — — —	<u> 261.9</u>	SS	1	50	12	- 1 - - -	262 _	0		o ¹³	3.0 -	- 6.1 m SCREEN	
	very stiff		grey	SS	2	100	19	-	-	0		o ¹²			
	SILTY CLAY TO very stiff	<u></u>	26 <u>1.2</u> 2.1 grey	SS	3	100	19	- 2 - - - -	261	0		o ¹⁴			
			<u>.</u>					- - - - - 3							
			-	SS	4	100	20	- - - -	260	0		o ¹⁵			
			<u>-</u>	SS	5	100	20	- 4 	259 _	0		o ¹⁶			
			-	SS	6	100	17		-	O		c ¹⁸			
					:				258						
	stiff		-	SS	7	100	14	- 6 <u>¥</u>	257	0		₀ 22			
77	END OF BORE Groundwater le 9 May, 2012 wa		256.7 6.6					- - - - - 7	-						
	23 May, 2012 w	vas 5.54 m depth						_ `	256 _						
							-	- - 8 -	255						
			:	į				- - - 9 - -	254						İ
AME	EC Emvironment	9 Inforcebrace						- - - - - 10 —	-						
a Di		Environment & Infrastructure, ion of AMEC Americas Limited 0 Oxford St. East n Ortrario. NSV 41.8													
Lond Tel 5 Fax	don Ontario, N5V 519-681-2400 519-668-1754			s present	ted. do no	ot constit	tute a tho	rough ur	ndoretan		ial conditions pres	ent. Also, borehole information s	hould be		Scale 1: 45
www	/.amec.com		<u></u>											ı	ge: 1 of 1

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	A2A GE II In	Estates Canada Inc c. E I and GE II Subdiv										id Stem Auger			Compiled by	
l	eject Location: Dingman Dr								Machine: Started:	Track M Apr 24,			ed: Apr 2	4. 12	Reviewed by Revision No.	_
_	LITHOLOGY PRO				MPLI			Π		TESTIN		LAB TEST			T COVIDION 140.	
Lithology Plot	DESCRIPT	ON	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetra O SPT MTO Vane* △ Intact ▲ Remould	■ DCPT Nilcon V Intact Remo	i f ane* puld	Atterberg Lin	nits W _L	INSTRUMENTATION INSTALLATION	СОММЕ	NTS
	Geodetic Ground Surface Elevati Silty TOPSOIL	brown 264.1	<u>σ</u>	S	_ œ	S		-	20 40	60 8	0	20 40 60	80	_		
\$.\\	SILTY CLAY TILL	brown 0.2 brown 263.7					- - - -	264								
	very stiff	brown .	SS	1	100	16	1	263	0			o ¹⁸				
		202.0	SS	2	100	24	 - - - - - 2	- - - - -	0			o ¹⁴				
	SILT, some sand very dense to dense		SS	3	100	51		262		0		o ¹⁸				
		-	60	,	40-	4.5	3	-				18				
	SILTY SAND		SS	4	100	49		261		0 : :		o ¹⁸				
	dense	light brown259.9	SS	5	100	34	4	260 _	0			21				
	SANDY SILT dense	4.4 _ light brown	ss	6	100	38	- - - - - 5	-	0			_o 22				
		,						259								
-	SILT, trace sand dense		SS	7	100	48	- - 6 -	258 _		0		022				
	END OF BOREHOLE	257.7 6.6					- - - - - - 7	-								
							-	257								
							- - - - - - -	256								
							- - - - - - 9	- - - -								
								255								
	EC Environment & Infrastructurivision of AMEC Americas Limited		ter dep	th on co	mpletio	n of dril	10 ling: 3.7			: :		☑ Cave in dept	h recorded	d on comple	tion of drilling: 3.7	

	RECORD OF BOREHOLE N		HOLE N	o. į	BH1	12	Co-C	Ord.					<u> </u>		amec
	ect Client:	Greenvalley Estat	tes Canada In	c. / TS	l Inter	nationa	al-Gran	dtaa		g Location: g Method:	See Figure		Stem Auger		Logged by: SD Compiled by: SS
	ect Name:	A2A GE II Inc. Proposed GE I an						<u>_</u>		g Machine:	Track Mou				Reviewed by: PB
Pro	ject Location:	Dingman Drive &	Highbury Ave	nue S	outh, I	Londo	ON.		Date	Started:	Apr 24, 12		Date Completed: Apr 2	1, 12	Revision No.: 0, 5/24/12
	LITH	OLOGY PROFIL	E	SC	IL SA	MPLI	NG			FIELD	TESTING	Т	LAB TESTING		
										1	tionTesting		Atterberg Limits	NOI	
Lithology Plot		DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	O SPT MTO Vane* △ Intact ▲ Remould	● DCPT Nilcon Vane ◇ Intact ◆ Remould		W _n W W _t Plastic Liquid # p.p. (TSF) Unit Weight (KN/CM) O Moisture Content (%) Indrained Shear Strength (kPa) 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
5	Geodetic Groun Silty TOPSOIL	d Surface Elevation: 26	brown	တိ	Sa	8	R	ä	<u> </u>	20 40	60 80	+	20 40 60 80	žž	·
	SILTY CLAY	rill	<u>262.7</u> 0.2 brown												
				SS	1	100	18	- - 1	262 _	0			o ¹⁶		
				SS	2	100	20	-					o ¹⁵		
								_ 2 	261 _						
				SS	3	100	26		260	0			o ¹⁷		
				ss	4	100	27	- 3 - -		0			₀ 22		
			greyish brown	ss	5	100	22	- 4	259 _				₀ 17		
			grey												
			givy	SS	6	100	17	- - - - - 5	258 _	0			o ¹⁸		
							į	- - - -							
				SS	7	100	18	- - 6 -	257 _				o ¹⁵		
	END OF BOR	EHOLE	256.3 6.6					- - - - -	256 _						
			:					- ' - - -							
								- - - 8 -	255 _						
								9	254 _						
								- - - - - -	253 _						
a Di 7-19 Lon	EC Environment vision of AMEC 040 Oxford St. Edon Ontario, N5	th on c	ompletic	on of dril	ling: D	ry.									
Fax	519-681-2400 519-668-1754 v.amec.com		Borehole details read in conjunction	as prese on with t	nted, do ne repor	not cons t for whic	titute a th h it was o	norough commisi	understa oned.	nding of all pote	ntial conditions	preser	nt. Also, borehole information s	hould be	Scale 1: 45 Page: 1 of 1

R	ECORD	OF BORE	HOLE N	o. j	BH1	<u> 13</u> C	o-C	Ord.	<u>E 4</u>	<u>85029,</u>	N 47518	<u>841</u>		am	ec^{\odot}
	ect Number:	TT123014		_						g Location:	See Figure 1	-		Logged by:	SD
Proj	ect Client:	Greenvalley Esta A2A GE II Inc.	ates Canada In	c. / TS	l Intern	nationa	l-Grar	ndtag	Drilling	g Method:	200 mm Ho	llow Stem Auger		Compiled by:	SS
Proj	ect Name:	Proposed GE I a	nd GE II Subdi	vislon	Devel	opmen	t	-	Drilling	g Machine:	Track Mount	ed Drill		_ Reviewed by:	РВ
Proj	ect Location:	Dingman Drive 8	k Highbury Ave	nue S	outh, l	_ondor	ON.		Date :	Started:	Apr 25, 12	_ Date Completed: Apr 2	5, 1 <u>2</u>	Revision No.:	0, 5/24/12
	LITH	DLOGY PROFII	LE	SC	IL SA	MPLI	NG	L		FIELD	TESTING	LAB TESTING			
									=		ationTesting	Atterberg Limits W _P W W _L	NOL		
Plot		DESCRIPTION		ed.	- Imper	(%)	alue	(m)	(m)	O SPT MTO Vane*	 DCPT Nilcon Vane* 	■ 	ATOIT	COMMEN	TS
Lithology Plot				Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	E	EVATION	△ Intact ▲ Remould	♦ Intact♦ Remould	# p.p (TSF) Dunit Weight (KN/CM) Moisture Content (%)	INSTALLATION		
Ë		Surface Elevation:		Sam	Sam	Reco	SPT	DEPTH	ELE	20 40	60 80	* Undrained Shear Strength (kPa) 20 40 60 80	INST INST		
	Silty TOPSOIL		brown 262.6					E							
	SILTY CLAY I	LL, some sand and	_					-							
	Call		brown					-	262					2.4 m RISER1-BEN - 2.7 m RISER1-SA	
				SS	1	100	11	- 1	202 _	0		o ¹⁴	2.7	- 5.8 m SCREEN	
NA A				-				Ė,							
	very stiff		-		_			Ė				_o 15			
				SS	2	100	20	- 2	261	0		010			
								- 1							
	hard		grey	SS	3	100	32	Ē		1 0		o ¹⁴	$\bowtie \bowtie$		
			-					Ē							
								- - 3	260 _						
	very stiff		grey	SS	4	100	22	- -		0		o ¹⁹			
	SANDY SILT dense to		259.4 3.5					Ę							
	compact		grey						Z 259 _						
				SS	5	100	32	- 4		0		21			
								Ė			: :				
	sand lenses compact		grey	SS	6	100	26	-		0		o ²¹			
								5	258 _						
								-			: :				
								-							
								E .	257 _						
	SILT, trace sar	d	<u>256.8</u> 6.1					- 6 -							
Ш	compact		grey 256.3	SS	7	100	14	-		0		o ²¹			
	END OF BORI		6.6					<u> </u>							
	Groundwater le 9 May, 2012 w 23 May, 2012	as 3.83 m depth vas 3.79 m depth						- 7	256 _						
	,							-					-		
								-							
									255						
								8 - -	-						
								- - -							
								-	-						
								- - 9	254 _						
								E	-						
								-	-						
								-	253						
		& Infrastructure,	∑ Groundwa	ter den	th on co	mpletio	n of drill	L 10 lina: 3 :		L :			L	· · · · · · · · · · · · · · · · · · ·	
7-19	Division of AMEC Americas Limited -1940 Oxford St. East ondon Ontario, N5V 4L8									f. <u>3.8</u> .					
Tel 5	19-681-2400 519-668-1754	,		s preser	nted. do r	ot const	itute a th	orough	understa		ntial conditions pre	sent. Also, borehole information s	hould be		Sople 4: 4E
	.amec.com				. sport										Scale 1: 45 ige: 1 of 1

Pro	ject Number: ject Client:	Greenvalley Esta							Drilling	g Location:	See Figure		uger		Logged by: SD Compiled by: SS
Pro	ject Name:	A2A GE II Inc. Proposed GE I ar	nd GE II Subd	ivision	Devel	opmer	nt		Drilling	g Machine:	Track Mour	nted Drill			Reviewed by: PE
Pro	ject Location:	Dingman Drive &	Highbury Ave	enue S	outh,	Londo	n ON.		_ Date :	Started:	Apr 25, 12	Date Con	npleted: Apr 2	25, 12	Revision No.: 0,
	LITH	OLOGY PROFIL	E	SC	DIL SA	MPLI	NG			FIELD	TESTING	LAB T	ESTING		•
Lithology Plot	Goodstie Ground	DESCRIPTION	62 F m	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	O SPT MTO Vane* △ Intact ▲ Remould	■ DCPT Nilcon Vane* Intact Remould	W _P Plastic # p.p (TSF • Unit We O Moisture	erg Limits W U Liquid i) ght (KN/CM) Content (%) ar Strength (kPa) 60 80	INSTRUMENTATION INSTALLATION	COMMENTS
Ē	Silty TOPSOIL		brown 262.3	- 07	0,	ш.	"	-	<u> </u>	20 40	60 80	20 40	60 80		
	SILTY CLAY 1	TLL, some sand and g	ravel 0.2 brown			_			262					9-	2.4 m RISER1-BENTON I - 3.0 m RISER1-SAND
				SS	1	100	10	- - 1 - - -		0		o ¹⁷		3.0	0 - 6.1 m SCREEN
	very stiff			ss	2	100	28		261 _	0		o ¹⁵			
	hard			SS	3	100	35	I	260	0		o ¹³			
	SILTY SAND							3 ⁷	Z :						
	dense to compact		light brown	SS	4	100	31		259 _	0		022			
			258.1	SS	5	100	12	- - 4		0		o19			
	SILT, trace sa SILTY CLAY 1 stiff	nd, TLL, some sand and g	grey 25 4.4 ravel 4.6 grey	ss	6	100	15	- 5	258	0		o ¹⁶			
									257						
			255.0	ss	7	80	17	6	256 _	0		o ¹⁵			
7.712	END OF BOR Groundwater 9 May, 2012 v 23 May, 2012		255.9 6.6					- - - - - 7	230						
	,								255 _						
				:				- 8 						-	
									254 _						
								- 9 - - -	253					,	
ДВЯТ	FC Environment	& Infrastructure,	<u> </u> Groundwa					- - 10	-						



APPENDIX B



SIEVE ANALYSIS REPORT (No Specs)

LABORATORY TEST INFORMATION

CLIENT:

Greenvalley Estates Canada Inc. TSI International-Grandtag A2A GE II Inc.

New Subdivision Development

LOCATION: Highbury Avenue South, London ON.

SOURCE:

PROJECT:

Borehole Samples

JOB NUMBER:

TT123014

SAMPLE NUMBER: BH8-SS7

DATE SAMPLED:

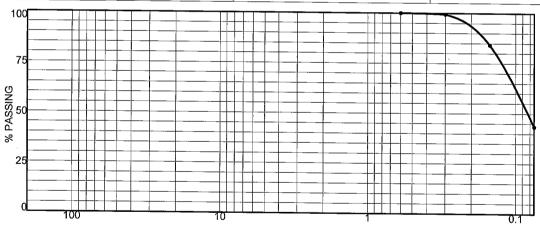
April 25, 2012

TESTED BY:

Sven Dahlberg

TEST RESULTS

SIEVE	SIZE	PERCENT PASSING	SPECIFICATION
	OIZL	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	



SIEVE SIZE (mm)

REMARKS

AMEC ENVIRONMENT & INFRASTRUCTURE

1940 Oxford St. E. Unit 7, London, Ontario, N5V 4L8 Phone: (519) 681-2400 Fax: (519) 668-1754

5/8/2012



SIEVE ANALYSIS REPORT (No Specs)

LABORATORY TEST INFORMATION

CLIENT:

Greenvalley Estates Canada Inc. TSI International-Grandtag A2A GE II Inc. New Subdivision Development

PROJECT: LOCATION:

Highbury Avenue South, London ON.

SOURCE:

Borehole Samples

JOB NUMBER: TT123014

SAMPLE NUMBER: BH6-SS2

DATE SAMPLED:

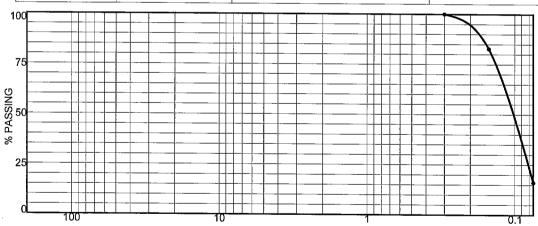
April 24, 2012

TESTED BY:

Sven Dahlberg

TEST RESULTS

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



SIEVE SIZE (mm)

REMARKS

AMEC ENVIRONMENT & INFRASTRUCTURE

1940 Oxford St. E. Unit 7, London, Ontario, N5V 4L8 Phone: (519) 681-2400 Fax: (519) 668-1754

5/8/2012



SIEVE ANALYSIS REPORT (No Specs)

LABORATORY TEST INFORMATION

CLIENT:

Greenvalley Estates Canada Inc. TSI International-Grandtag A2A GE II Inc. New Subdivision Development

PROJECT: LOCATION:

Highbury Avenue South, London ON.

SOURCE:

Borehole Samples

JOB NUMBER:

TT123014

SAMPLE NUMBER: BH3-SS7

DATE SAMPLED:

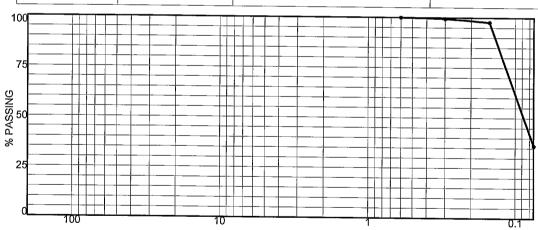
April 25, 2012

TESTED BY:

Sven Dahlberg

TEST RESULTS

SIEVE	SIZE	PERCENT PASSING	SPECIFICATION
9.5 mm 4.75 mm 2.36 mm	3/8" #4 #8		Specs Not Available
1.18 mm 0.6 mm 0.3 mm 0.15 mm	#0 #16 #30 #50 #100 #200	100 99.4 97.7 36.1	



SIEVE SIZE (mm)

REMARKS

AMEC ENVIRONMENT & INFRASTRUCTURE

1940 Oxford St. E. Unit 7, London, Ontario, N5V4L8 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

		Date	Date	Method
Analyses	Quantity	Extracted	Analyzed Laboratory 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



AMEC Environment & Infrastructure

Client Project #: TT123014

Site Location: HIGHBURY AVE SOUTH SUBDIVISON LONDON ONTARIO

Sampler Initials: SD

-2-

Encryption Key

Marijane Cruz

Throng

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



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

Maxxam ID		0628HN	NH8791		
Sampling Date		2012/04/24	2012/04/25		
	Units	BH1-SS2	BH8-SS2	RDL	OC 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	Hd	7.56	7.82		2841946
Soluble (20:1) Sulphate (SO4)	b/bn	<20	<20	20	2848613
Subcontracted Analysis					
Redox Potential	Λm	+91	+71		2841577

RDL = Reportable Detection Limit QC Batch = Quality Control Batch



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

Collected 2012/04/24 Shipped

Received 2012/05/02

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Conductivity	COND	2848699	N/A	2012/05/14	
Moisture	BAL	2847324	N/A	2012/05/11	_
PH CaCl2 EXTRACT		2841946	2012/05/08	2012/05/08	XUANHONG QIU
Resistivity of Soil		2838509	2012/05/14	2012/05/14	-
Sulphate (20:1 Extract)	AC/EC	2848613	N/A	2012/05/15	
Redox Potential	PH	2841577	2012/05/07	2012/05/14	Rick Mastrojanni

Maxxam ID NH8791 Sample ID BH8-SS2 Matrix Soil

Collected 2012/04/25 Shipped

Received 2012/05/02

DEONARINE RAMNARINE Analyst NEIL DASSANAYAKE XUANHONG QIU EWA PRANJIC Rick Mastrolanni PHILIP MAST 2012/05/11 2012/05/08 2012/05/14 2012/05/14 2012/05/15 2012/05/14 Analyzed 2012/05/08 2012/05/14 2012/05/07 Extracted N/A N/A ¥ 2841946 2838509 2848613 2848699 2847324 2841577 Batch Instrumentation AC/EC COND BAL ЬН Sulphate (20:1 Extract) PH CaCI2 EXTRACT **Test Description** Resistivity of Soi Redox Potential Conductivity Moisture

Maxxam ID NH8791 Dup Sample ID BH8-SS2

Matrix Soil

Collected 2012/04/25 Shipped

Received 2012/05/02

scription	Instrumentation	Batch	Extracted	Analyzed	Analyst
0:1 Extract)	AC/EC	2848613	N/A	2012/05/15	DEONARINE RAMNARINE
ntial	Hd	2841577	2012/05/07	2012/05/14	Rick Mastrojanni



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

GENERAL COMMENTS

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

22.0°C

Package 1

Page 5 of 8



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

QUALITY ASSURANCE REPORT

			Matrix Snike	inike	Sniked Blank	Blank	Method Blank	3lank	RPD	Ĕ	OC Standard	dard
										1		
QC Batch	QC Batch Parameter	Date	% Recovery	QC Limits	% Recovery QC Limits % Recovery QC Limits	QC Limits	Value	Units	Value (%)	QC Limits	Units Value (%) QC Limits % Recovery QC Limits	QC Limits
2841577	2841577 Redox Potential	2012/05/14					+266, RDL=	mV	9.4	N/A	+243	238 - 248
2847324	2847324 Moisture	2012/05/11							5.5	20		
2848613	2848613 Soluble (20:1) Sulphate (SO4) 2012/05/15	2012/05/15	97	75 - 125	95	85 - 115	<20	6/6n	NC	35		
2848699	2848699 Conductivity	2012/05/14					<2	mo/oqun	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 recoveny.

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. Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.



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).

Gue Harman E

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

GRACE SISON, Repried 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.

CHAIN OF CUSTODY RECORD

Page

Maxxa

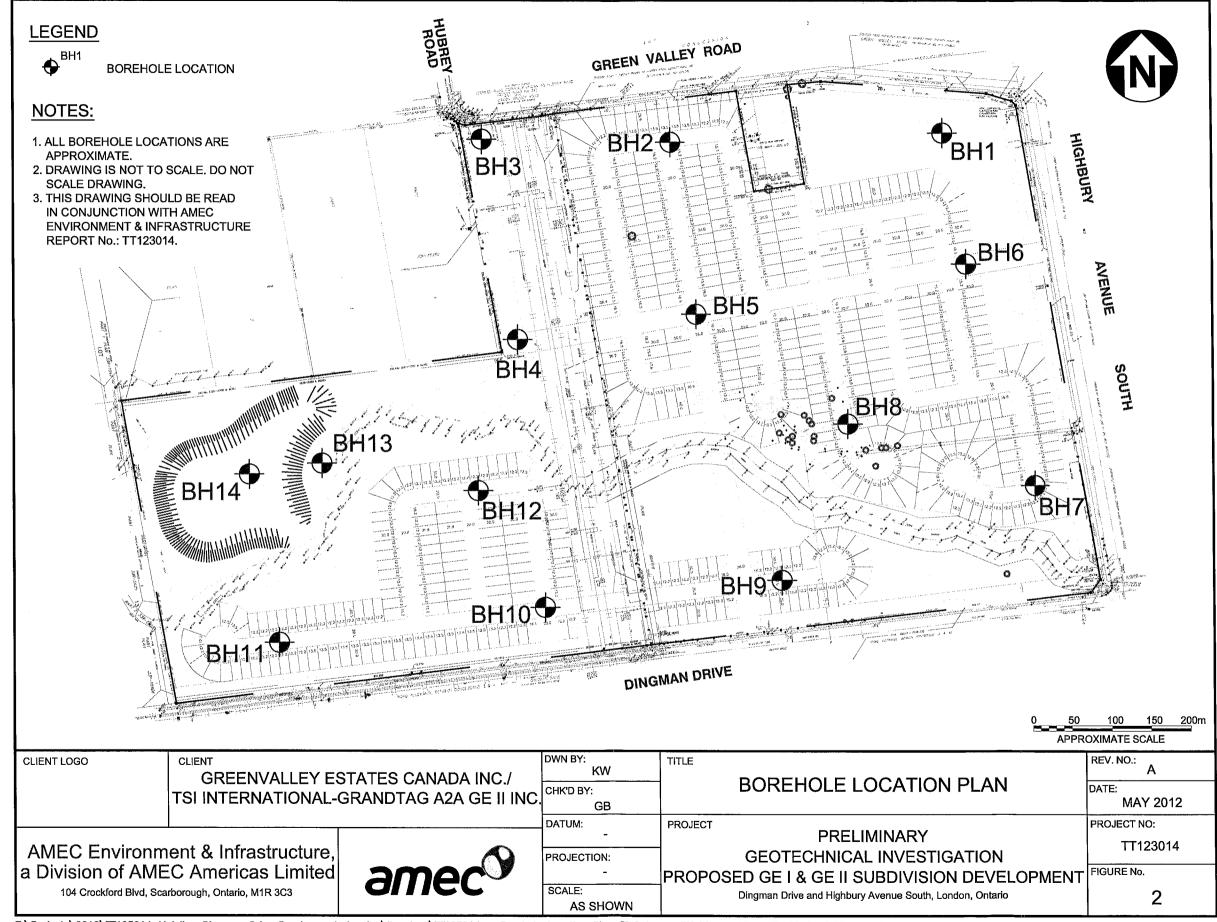
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1 6740 Campobello Road Mississauga, ON L5N 2L8	Phone: 905-817-5700
Mississauga, ON L5N;	Fax: 905-817-5777
21.8	Fax: 905-817-5777 Toll Free; (800) 563-6266

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

Page 8 of 8

White Majoram Yellow Mail Purk Chert



Green Valley Estates Inc. and Green Valley Estates II Inc. FSR CITY OF LONDON

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	70
unimproved land	

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

CN to CN* (AMC II) Conversion

Assumption:

(from VO2 24hrs 100-year SCS storm)

CN	CN					CN*	CN*
(AMC II)	(AMC III)	S	Q	IA*	S*	(AMC III)	(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

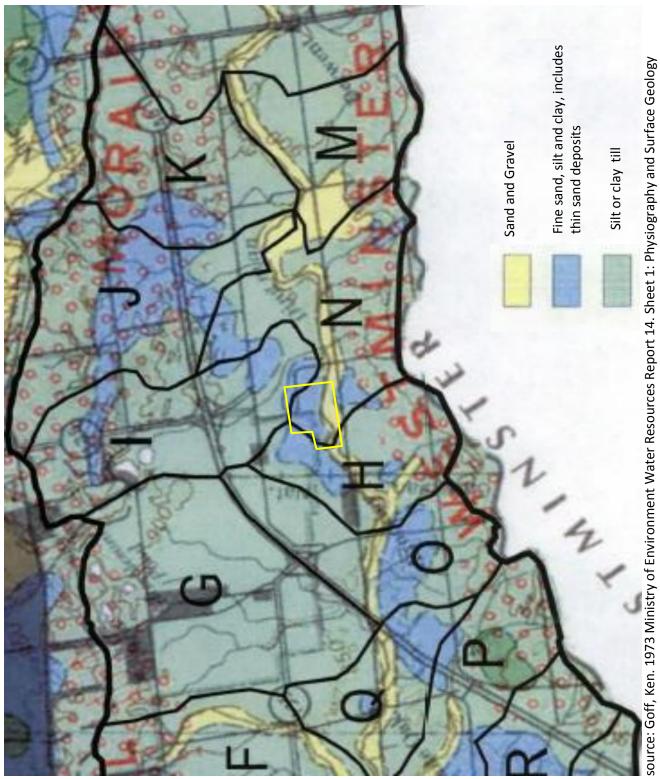
Source 2: MTO Drainage Management Manual, 1997, Design Chart 1.09

Formulas:

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

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

$$CN^* = \frac{25400}{(254 + S *)}$$



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

= <u>0.99</u>hr

 $t_p = 0.67 * t_c$

where:

where:

 t_p = time to peak, hr

C = runoff coefficient

L = watershed length, m $S_w =$ watershed sloe, %

 t_c = time of concentration, minutes

= <u>0.66</u> 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 %

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

where:

 t_{c} = time of concentration, minutes

$$\label{eq:continuous} \begin{split} C &= \text{ runoff coefficient } \\ L &= \text{ watershed length, m} \\ S_w &= \text{ watershed sloe, \%} \end{split}$$

4.00 - 1--

61.0 min

= <u>1.02</u> hr

 $t_{p} = 0.67 * t_{c}$

where:

t_p = time to peak, hr

= <u>0.68</u>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 %

+ - 3.26 * (1.1.0) * 1.0.5 * 9.0.33

min

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

where:

 t_{c} = time of concentration, minutes

C = runoff coefficient L = watershed length, m S_w = watershed sloe, %

 $t_{D} = 0.67 * t_{C}$

where:

 t_p = time to peak, hr

= <u>0.48</u> hr

43.0

0.72 hr

GREEN VALLEY ESTATES INC.

City of London, Ontario

Project #: 12116 Date: OCTOBER 2013

Time of Concentration & Time to Peak Calculation - Upland Method

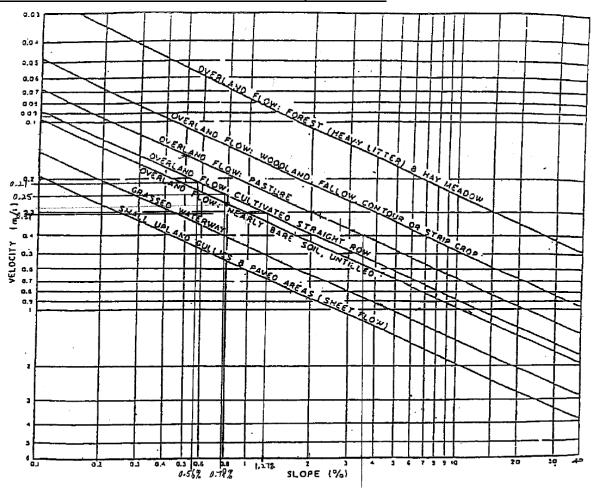


Figure A.5.2: Upland Method for Estimating Time of Concentration (SCS National Engineering Handbook, 1971)

North SWM Pond

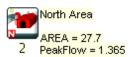
Area (ha)	27.70
Length (m)	477
Slope (%)	1.26
Velocity (m/s)	0.35
N	3
Tc (hr)	0.379
Tp (hr)	0.252

Southwest SWM Pond

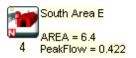
Area (ha)	8.40
Length (m)	318
Slope (%)	0.63
Velocity (m/s)	0.21
N	3
Tc (hr)	0.421
Tp (hr)	0.280

Southeast SWM Pond

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









1	Summary Hydrograph Data											
Ī	<u> </u>											
		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				

PM :	🔊 Summary Hydrograph Data										
13											
	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				

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*************** ** SIMULATION NUM ************************** READ STORM Ptotal= 25.00 mm TI h	********** BER: 1 ** ********** - Filenam Comment - RAIN rs mm/hr 17 2.07 33 2.27 50 2.52	me: G:\Pr GE1 25MM4 s: Twent TIME hrs 1.17 1.33 1.50	& GE2\Des HR.STM y-Five mr RAIN mm/hr 5.70 10.78 50.21	m Four F TIME hrs 2.17 2.33 2.50	R Calcs\VC Hour Chica RAIN mm/hr 5.19 4.47 3.95	190 Storm 190 St	RAIN mm/hr 2.80 2.62 2.48	
DMMENTS: ***************** ** SIMULATION NUM **************** READ STORM Ptotal= 25.00 mm	********* BER: 1 ** ********* -	me: G:\Pr GE1 25MM4 s: TWent TIME hrs 1.17 1.33 1.50 1.67	& GE2\Des HR.STM y-Five mr RAIN mm/hr 5.70 10.78 50.21 13.37	m Four F TIME hrs 2.17 2.33 2.50 2.67	R Calcs\VC Hour Chica RAIN mm/hr 5.19 4.47 3.95 3.56	190 Storm 190 St	RAIN mm/hr 2.80 2.62 2.48 2.35	
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	********* BER: 1 ** ********* -	me: G:\Pr GE1 25MM4 s: TWent TIME hrs 1.17 1.33 1.50 1.67	& GE2\Des HR.STM y-Five mr RAIN mm/hr 5.70 10.78 50.21 13.37	m Four F TIME hrs 2.17 2.33 2.50 2.67	R Calcs\VC Hour Chica RAIN mm/hr 5.19 4.47 3.95 3.56	190 Storm 190 St	RAIN mm/hr 2.80 2.62 2.48 2.35	
**************************************	********** BER: 1 ** ********** - Filenam Comment Comment 2.07 3.3 2.27 1.50 2.52	me: G:\Pr GE1 25MM4 s: TWent TIME hrs 1.17 1.33 1.50 1.67	& GE2\Des HR.STM y-Five mr RAIN mm/hr 5.70 10.78 50.21 13.37	m Four F TIME hrs 2.17 2.33 2.50 2.67	R Calcs\VC Hour Chica RAIN mm/hr 5.19 4.47 3.95 3.56	190 Storm 190 St	RAIN mm/hr 2.80 2.62 2.48 2.35	
OMMENTS: *************** ** SIMULATION NUM **************** READ STORM Ptotal= 25.00 mm TI h	********** BER: 1 ** ********** - Filenam Comment Comment 2.07 3.3 2.27 1.50 2.52	me: G:\Pr GE1 25MM4 s: TWent TIME hrs 1.17 1.33 1.50 1.67	& GE2\Des HR.STM y-Five mr RAIN mm/hr 5.70 10.78 50.21 13.37	m Four F TIME hrs 2.17 2.33 2.50 2.67	R Calcs\VC Hour Chica RAIN mm/hr 5.19 4.47 3.95 3.56	190 Storm 190 St	RAIN mm/hr 2.80 2.62 2.48 2.35	
************** *** SIMULATION NUM **************** READ STORM Ptotal= 25.00 mm TI h	********** BER: 1 ** ********** - Filenam Comment - KAIN 2.07 33 2.27 50 2.52 67 2.88 83 3.38 00 4.18	TIME hrs 1.17 1.33 1.50 1.67 1.83 2.00	& GE2\De: HR.STM y-Five mr RAIN mm/hr 5.70 10.78 50.21 13.37 8.29 6.30	TIME hrs 2.17 2.33 2.50 2.67 2.83 3.00	R Calcs\VC Hour Chica RAIN mm/hr 5.19 4.47 3.95 3.95 3.56 3.25 3.01	72\Storm 190 Storm	RAIN mm/hr 2.80 2.62 2.48 2.35 2.23 2.14	

```
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
                        .032 (i)
   PEAK FLOW
                 (cms) =
   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.
I CALTR
 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\
                           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
                           .42
                                71.19 | .75
                                             3 81 I 1 08
              0.8
                    0.0
                                                           0.8
              .17 17.80 | .50 70.33 | .83
                                               1.44 |
                   35.59 | .58 26.60 | .92
              .25
                                               .54 |
              .33 53.39 | .67 10.06 | 1.00
                                               .21 I
| 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
             hrs mm/hr | hrs
                              mm/hr | hrs mm/hr | hrs
             .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.
I CALTB
NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
----- U.H. Tp(hrs) = .68
   Unit Hyd Qpeak (cms) = .472
   PEAK FLOW
                (cms) = 0.56 (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.
        (0004) | Area (ha) = 6.40 Curve Number (CN) = 72.0
----- U.H. Tp(hrs) = .48
   Unit Hyd Qpeak (cms) = .509
                (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 **
 ********
-----
                 Filename: G:\Projects\2012\12116 - TSI London
   READ STORM |
                          GE1 & GE2\Design\FSR Calcs\VO2\Storm\
                          1hrAES\AES5vr.stm
| Ptotal= 35.09 mm | Comments: City of London AES 5 Yr 1-Hour Distribut
_____
            TIME RAIN | TIME RAIN | TIME
                                           RAIN | TIME
                 mm/hr | hrs
                             mm/hr | hrs
                                           mm/hr | hrs
                                                       mm/hr
             hrs
                         .42 102.99 I
                                     .75
                   .00 |
             .08
                                           5.51 | 1.08
             .17
                 25.75 | .50 101.75 | .83
                                            2.08 |
                  51.49 |
                         .58 38.48 |
                                      .92
                                            .79 |
                 77.24 | .67 14.56 | 1.00
             .33
                                            .30 I
```

```
NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0
----- 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
              .333 64.37 | .667 26.52 | 1.000
                                               .54 |
    Unit Hyd Opeak (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.
| 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
                 (cms) = .125 (i)
    PEAK FLOW
    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.
| 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\
```

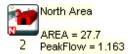
```
1hrAES\AES10yr.stm
| Ptotal= 42.24 mm | Comments: City of London AES 10Yr 1-Hour Distribut
               TIME RAIN | TIME RAIN | TIME
                                                  RAIN | TIME
               hrs mm/hr | hrs mm/hr | hrs
                                                  mm/hr | hrs mm/hr
                      .00 | .42 123.99 | .75 6.63 | 1.08 .14
                .17
                     31.00 | .50 122.50 | .83
                                                   2.51
                    62.00 | .58 46.33 | .92
                .25
                                                    .95 |
                .33 92.99 | .67 17.53 | 1.00
                                                    .36 |
| 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
               .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.
| NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
----- 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.
| 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.
```

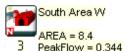
```
** SIMULATION NUMBER: 5 **
 ********
 READ STORM | Filename: G:\Projects\2012\12116 - TSI London
                            GE1 & GE2\Design\FSR Calcs\VO2\Storm\
                            1hrAES\AES25yr.stm
| Ptotal= 51.29 mm | Comments: City of London AES 25Yr 1-Hour Distribut
_____
             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 |
                                               3.04 |
               .33 112.91 | .67 21.28 | 1.00
                                               .44 |
I CALTB
 NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0
----- 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
                   18.82 | .500 149.63 | .833 5.54 | 1.17 .08
              .333 94.09 | .667 38.76 | 1.000
                                               .79 |
    Unit Hyd Opeak (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
                 (cms) = .264 (i)
    PEAK FLOW
    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.
| 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
```

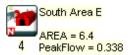
```
PEAK FLOW (cms) = .278 (i)
TIME TO PEAK (hrs) = .833
    RUNOFF VOLUME (mm) = 14.756
TOTAL RAINFALL (mm) = 51.288
    RUNOFF COEFFICIENT = .288
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
 ** SIMILATION NUMBER: 6 **
 ******
 READ STORM | Filename: G:\Projects\2012\12116 - TSI London
                  GE1 & GE2\Design\FSR Calcs\V02\Storm\
                            1hrAES\AES50vr.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
                     .00 | .42 170.09 | .75 9.09 | 1.08 .19
                   42.52 | .50 168.04 | .83
                                               3.44 |
               .25 85.04 | .58 63.56 | .92
                                               1.30 I
               .33 127.57 | .67 24.04 | 1.00
                                               .49 |
| 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
.... U.H. Tp(hrs) = .68
    Unit Hyd Qpeak (cms) = .472
                         .330 (i)
    PEAK FLOW
                 (cms) =
    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.
```

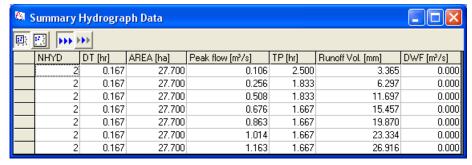
```
______
| CALIB
| NASHYD (0004) | Area (ha) = 6.40 Curve Number (CN) = 72.0
| \text{ID} = 1 \text{ DT} = 10.0 \text{ min} | \text{Ia} \quad (mm) = 5.00 \# \text{of Linear Res.} (N) = 3.00
----- U.H. Tp(hrs) = .48
    Unit Hyd Qpeak (cms) = .509
    PEAK FLOW
                  (cms) = .347 (i)
    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
.25 94.82 | .58 70.86 | .92
                                                 3.83 |
                                                1.45 |
                                                 .55
               .33 142.23 | .67 26.80 | 1.00
I CALTE
 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
.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
| MASHYD (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
                    (cms) = .422 (i)
    PEAK FLOW
    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.
```









M 9	Summary Hydrograph Data											
₽ .	<u> </u>											
	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					



SSSSS U U A V SS U U A A V V SS U U AAAAA L V V I SS U U A A L VV SSSSS UUUUU A A LLLLL 000 TTTTT TTTTT Н H Y Y M M OOO TM, Version 2.0 H YY MM MM O O 0 0 Т T Н 0 T Т Н Н Y M M O O Licensed To: TMIG 000 Н Y M M 000 VO2-0145 Developed and Distributed by Greenland International Consulting Inc. Copyright 1996, 2001 Schaeffer & Associates Ltd. All rights reserved. ***** DETAILED OUTPUT ***** 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: ** 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 mm/hr | mm/hr | hrs mm/hr | mm/hr hrs hrs hrs .17 2.07 I 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 I 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

```
I CALTB
| NASHYD (0002) | Area
                       (ha) = 27.70 Curve Number (CN) = 72.0
| \text{ID} = 1 \text{ DT} = 10.0 \text{ min} | \text{Ia}  (\text{mm}) = 5.00 \text{ # of Linear Res.} (N) = 3.00
----- U.H. Tp(hrs) = .66
   Unit Hyd Qpeak (cms) = 1.603
                (cms) = .106 (i)
   PEAK FLOW
   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.
I CALTB
| NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
----- U.H. Tp(hrs) = .68
   Unit Hyd Qpeak (cms) = .472
                (cms) =
   PEAK FLOW
                       .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.
I CALTB
| 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
                  B= 5.500
| Ptotal= 33.29 mm |
_____
                                    C=
                                         .800
                  used in: INTENSITY = A / (t + B)^C
```

```
Duration of storm = 3.00 \text{ hrs}
                 Storm time step = 10.00 \text{ min}
                 Time to peak ratio = .33
                 RAIN | TIME RAIN | TIME RAIN | TIME
                 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
                  3.72 | 1.17 24.52 | 2.00 4.54 | 2.83
             .33
                                                      2 65
                 4.95 | 1.33 | 12.70 | 2.17 | 3.95 | 3.00
                                                      2.46
             . 50
                 7.61 | 1.50
                            8.64 | 2.33 3.51 |
             . 67
             .83 18.60 | 1.67 6.59 | 2.50 3.16 |
I CALTB
| NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0
----- 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.
| NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
----- U.H. Tp(hrs) = .68
   Unit Hyd Qpeak (cms) = .472
   PEAK FLOW
               (cms) = .076 (i)
              (hrs) = 1.833
   TIME TO PEAK
   RUNOFF VOLUME (mm) = 6.297
   TOTAL RAINFALL (mm) = 33.291
   RUNOFF COEFFICIENT = .189
   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
 NASHYD (0004) | Area (ha) = 6.40 Curve Number (CN) = 72.0
----- 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 \text{ 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
                    3.43 | 1.00 112.71 | 1.83
              .17
                                              6.69 | 2.67
                                                            3.25
                    4.38 | 1.17 36.59 | 2.00
                                              5.51 | 2.83
              .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
----- 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.
| 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)=
   Unit Hyd Qpeak (cms) = .472
    PEAK FLOW
                 (cms) = .151 (i)
               (hrs) = 1.833
    TIME TO PEAK
    RUNOFF VOLUME (mm) = 11.697
    TOTAL RAINFALL (mm) = 45.346
    RUNOFF COEFFICIENT = .258
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
CALTB
 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
                (cms) = .147 (i)
   PEAK FLOW
   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 \text{ hrs}
                   Storm time step = 10.00 min
                   Time to peak ratio = .33
             TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
                  mm/hr | hrs mm/hr | hrs mm/hr | hrs
             .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
                  7.00 | 1.33 20.35 | 2.17 5.42 | 3.00
              5.0
                                                         3 16
              .67
                  11.44 | 1.50 | 13.20 | 2.33
                                            4.73 |
                  30.92 | 1.67 9.71 | 2.50 4.20 |
 NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0
----- 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.
```

```
| 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 Opeak (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.
______
I CALTB
| 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
| \  \, \text{Ptotal= 60.35 mm} \, \, | \\ \  \, \text{B= } \quad \, 5.000
                                   C= .820
                  used in: INTENSITY = A / (t + B)^C
                  Duration of storm = 3.00 \text{ hrs}
                  Storm time step = 10.00 \text{ min}
                  Time to peak ratio = .33
                  RAIN | TIME RAIN | TIME RAIN | TIME
             hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
                  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 |
| NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0
```

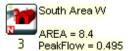
```
----- U.H. Tp(hrs) = .66
   Unit Hyd Opeak (cms) = 1.603
               (cms) = .863 (i)
   PEAK FLOW
               (hrs) = 1.667
   TIME TO PEAK
   RUNOFF VOLUME (mm) = 19.870
   TOTAL RAINFALL (mm) = 60.347
   RUNOFF COEFFICIENT = .329
   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
 NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
----- 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.
| NASHYD (0004) | Area (ha) = 6.40 Curve Number (CN) = 72.0
----- 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 \text{ hrs}
                  Storm time step = 10.00 \text{ min}
                  Time to peak ratio = .33
```

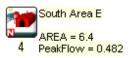
```
TIME
                 RAIN | TIME RAIN | TIME RAIN | TIME RAIN
                  mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
             hrs
             .17
                  5.60 | 1.00 175.35 | 1.83 9.92 | 2.67
                                                       5.35
                   6.91 | 1.17 46.15 | 2.00
                                           8.41 | 2.83
                                                        4 92
                  9.16 | 1.33 23.48 | 2.17
                                           7.33 | 3.00
                                                       4.56
                  14.05 | 1.50 | 15.95 | 2.33
                                           6.51 I
             .83
                 34.80 | 1.67 12.19 | 2.50 5.86 |
______
| NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0
----- 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.
| 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
                (cms) = .299 (i)
   PEAK FLOW
   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.
| 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.
                                                                  I CALTB
                                                                 | NASHYD
```

```
********
 ** 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 \text{ hrs}
                 Storm time step = 10.00 \text{ 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
                 7.76 | 1.17 47.73 | 2.00 9.37 | 2.83
             .33
                                                      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 |
| NASHYD (0002) | Area (ha)= 27.70 Curve Number (CN)= 72.0
----- 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.
 NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
----- 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.
        (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)
              (hrs) = 1.500
   TIME TO PEAK
   RUNOFF VOLUME
              (mm) = 26.898
   TOTAL RAINFALL (mm) = 71.759
   RUNOFF COEFFICIENT = .375
   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
FINISH
______
```







M S	Summary	Hydrogra	ph Data				
12):		>>					
	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

1	M S	ummary	Hydrogra	ph Data				
Ī	9 [<u>***</u>	> >					
		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



V V I SS V V I SS V V I S	SSS U U A U A A S U U AAAAA SS U U A A		
O O T O O T OOO T Developed and Distribut		MM MM O O M M O O M M OOO ternational Con	TM, Version 2.0 Licensed To: TMIG VO2-0145 sulting Inc.
Copyright 1996, 2001 Sc. All rights reserved.	haeffer & Associat	es Ltd.	
***	* DETAILED	ОИТРИТ	****
Input filename: C:\ Output filename: G:\ Calcs\VO2\12116 VO2 Sep Summary filename: G:\ Calcs\VO2\12116 VO2 Sep	Projects\2012\1211 t 2013\Existing 24 Projects\2012\1211	6 - TSI London hr SCS.out 6 - TSI London	GE1 & GE2\Design\FSR
DATE: 23/10/2013		TIME: 3:48:17	PM
USER:			
COMMENTS:			

** SIMULATION NUMBER:			
READ STORM	Filename: G:\Proj GE1 & 25MM4HR Comments: Twenty-	GE2\Design\FSR .STM	Calcs\VO2\Storm\
TIME hrs .17 .33 .50 .67	mm/hr hrs m 2.07 1.17 2.27 1.33 1 2.52 1.50 5 2.88 1.67 1	5.70 2.17 0.78 2.33	RAIN TIME RAIN mm/hr hrs mm/hr 5.19 3.17 2.80 4.47 3.33 2.62 3.95 3.50 2.48 3.56 3.67 2.35 3.25 3.83 2.23

1.00

4.18 | 2.00

6.30 | 3.00

3.01 | 4.00

2.14

	Ptotal= 51.56 mm	Comments: 2-Ye	ar 24 hour SCS T	ype II: I	London A	irpo
CALIB	TIME hrs .25 .50 .75	RAIN TIME mm/hr hrs .57 6.25 .57 6.50 .57 6.75 .57 7.00	RAIN TIME mm/hr hrs 1.03 12.25 1.03 12.50 1.03 12.75 1.03 13.00	mm/hr 7.43 7.43 3.82	TIME hrs 18.25 18.50 18.75 19.00	RAIN mm/hr .93 .93 .93
Unit Hyd Qpeak (cms)= 1.603	1.25 1.50	.57 7.25 .57 7.50	1.03 13.25 1.03 13.50	2.68	19.25 19.50	.93
PEAK FLOW (cms) = .106 (i) TIME TO PEAK (hrs) = 2.500 RUNOFF VOLUME (mm) = 3.365 TOTAL RAINFALL (mm) = 24.996 RUNOFF COEFFICIENT = .135	1.75 2.00 2.25 2.50 2.75 3.00	.57 7.75 .57 8.00 .67 8.25 .67 8.50 .67 8.75 .67 9.00	1.03 13.75 1.03 13.75 1.03 14.00 1.39 14.25 1.39 14.50 1.39 15.00	2.17 2.17 1.55 1.55	19.75 20.00 20.25 20.50 20.75 21.00	.93 .93 .62 .62 .62
(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.	3.25 3.50 3.75	.67 9.25 .67 9.50 .67 9.75	1.65 15.25 1.65 15.50 1.86 15.75	1.55	21.25 21.50 21.75	.62 .62 .62
CALIB	4.00 4.25 4.50	.67 10.00 .82 10.25 .82 10.50	1.86 16.00 2.37 16.25 2.37 16.50	1.55	22.00 22.25 22.50	.62 .62 .62
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	4.75 5.00 5.25 5.50	.82 10.75 .82 11.00 .82 11.25 .82 11.50	3.20 16.75 3.20 17.00 4.95 17.25 4.95 17.50	.93 .93 .93	22.75 23.00 23.25 23.50	.62 .62 .62
PEAK FLOW (cms) = .032 (i) TIME TO PEAK (hrs) = 2.500 RUNOFF VOLUME (mm) = 3.365 TOTAL RAINFALL (mm) = 24.996 RUNOFF COEFFICIENT = .135	5.75 5.00	.82 11.75 .82 12.00	21.45 17.75 56.93 18.00	.93	23.75 24.00	.62 .62
(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.	CALIB	Area (ha) = Ia (mm) = U.H. Tp(hrs) =				
CALIB	NOTE: RAINFA	LL WAS TRANSFORM	ED TO 10.0 MIN.			
0.1.1 - p (1126)	TIME	RAIN TIME	RAIN TIME		TIME	RAIN
Unit Hyd Qpeak (cms) = .509	hrs	mm/hr hrs	mm/hr hrs	mm/hr		mm/hr
DDW 7707 () () () ()	.167	.57 6.167	1.03 12.167		18.17	.93
PEAK FLOW (cms) = .029 (i) TIME TO PEAK (hrs) = 2.167	.333	.57 6.333 .57 6.500	1.03 12.333 1.03 12.500		18.33 18.50	.93 .93
RUNOFF VOLUME (mm) = 3.363	.667	.57 6.667	1.03 12.667		18.67	.93
TOTAL RAINFALL (mm) = 24.996	.833	.57 6.833	1.03 12.833	3.82	18.83	.93
RUNOFF COEFFICIENT = .135	1.000	.57 7.000	1.03 13.000		19.00	.93
(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.	1.167 1.333	.57 7.167 .57 7.333	1.03 13.167 1.03 13.333		19.17	.93 .93
(I) IDER IDON DODO NOI INCHODE DADELEON II ANI.	1.500	.57 7.500	1.03 13.500		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		19.83	.93
** SIMULATION NUMBER: 2 ** *********************************	2.000	.57 8.000	1.03 14.000		20.00	.93
	2.167 2.333	.67 8.167 .67 8.333	1.39 14.167 1.39 14.333		20.17	.62 .62
	2.500	.67 8.500	1.39 14.500		20.50	.62
	2.667	.67 8.667	1.39 14.667		20.67	.62
READ STORM Filename: G:\Projects\2012\12116 - TSI London	2.833	.67 8.833	1.39 14.833		20.83	.62
GE1 & GE2\Design\FSR Calcs\V02\Storm\ SCS Type II - London\2yrSCSTypeII24hr.stm	3.000	.67 9.000	1.39 15.000	1.55	21.00	.62
	3.167	.67 9.167	1.65 15.167	1	21.17	.62

```
.67 | 9.333 | 1.65 | 15.333 | 1.55 | 21.33
                                                           .62
                    .62
                    ** SIMULATION NUMBER: 3 **
             3.667
                                                             .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
                     .82 |10.167
                                2.37 |16.167
                                              .93 | 22.17
             4 167
                                                             .62
                     .82 |10.333
                                2.37 |16.333
                                              .93 | 22.33
             4.333
                                                             .62
             4.500
                     .82 |10.500
                                2.37 |16.500
                                              .93 | 22.50
                                                                                          Filename: G:\Projects\2012\12116 - TSI London
                                                             62
                                                                        READ STORM |
                                              .93 | 22.67
                                                                      | GE1 & GE2\Design\FSR Calcs\VO2\Storm\
             4.667
                     .82 |10.667
                                 3.20 | 16.667
                                                             .62
                     .82 |10.833
                                 3.20 |16.833
                                               .93 | 22.83
                                                                                                 SCS Type II - London\5yrSCSTypeII24hr.stm
             4.833
                                                             .62
                     .82 |11.000
                                 3.20 |17.000
                                               .93 | 23.00
                                                                      | Ptotal= 63.35 mm |
                                                                                          Comments: 5-Year 24 hour SCS Type II: London Airpo
             5.000
                                                             .62
                     .82 |11.167
                                 4.95 | 17.167
                                               .93 | 23.17
             5.167
                                                             .62
             5.333
                     .82 | 11.333
                                 4.95 | 17.333
                                               .93 | 23.33
                                                             . 62
                                                                                   TIME
                                                                                          RAIN | TIME RAIN | TIME
                                                                                                                    RAIN | TIME
             5.500
                     .82 | 11.500
                                 4.95 | 17.500
                                               .93 | 23.50
                                                             .62
                                                                                     hrs
                                                                                          mm/hr | hrs
                                                                                                       mm/hr | hrs mm/hr | hrs
                                                                                                                                  mm/hr
             5.667
                     .82 |11.667
                                 21.45 | 17.667
                                               .93 | 23.67
                                                                                           .70 | 6.25
                                                                                                        1.27 | 12.25
                                                                                                                    9.12 | 18.25
                                                             . 62
                                                                                     .25
                                                                                                                                   1 14
                    .82 |11.833 39.19 |17.833
                                              .93 | 23.83
                                                             .62
                                                                                                        1.27 | 12.50
                                                                                                                    9.12 | 18.50
             5.833
                                                                                            .70 | 6.50
                                                                                     .50
                                                                                                                                   1.14
                    .82 | 12.000 56.93 | 18.000 .93 | 24.00
                                                             .62
                                                                                     .75
                                                                                           .70 | 6.75
                                                                                                       1.27 | 12.75
                                                                                                                    4.69 | 18.75
             6.000
                                                                                                                                   1.14
                                                                                           .70 | 7.00
                                                                                                       1.27 | 13.00
                                                                                    1 00
                                                                                                                    4 69 | 19 00
                                                                                                                                   1 14
    Unit Hyd Qpeak (cms) = 1.603
                                                                                           .70 | 7.25
                                                                                                       1.27 | 13.25
                                                                                                                     3.29 | 19.25
                                                                                    1.25
                                                                                                                                   1.14
                                                                                                       1.27 | 13.50
                                                                                    1.50
                                                                                           .70 | 7.50
                                                                                                                     3.55 | 19.50
                 (cms) = .430 (i)
                                                                                    1.75
                                                                                           .70 | 7.75
                                                                                                       1.27 | 13.75
                                                                                                                     2.66 | 19.75
    PEAK FLOW
    TIME TO PEAK
                 (hrs) = 12.500
                                                                                    2.00
                                                                                          .70 | 8.00
                                                                                                       1.27 | 14.00
                                                                                                                     2.66 | 20.00
                                                                                                                                   1 14
    RUNOFF VOLUME (mm) = 14.913
                                                                                    2.25
                                                                                          .82 | 8.25
                                                                                                       1.71 | 14.25 | 1.90 | 20.25
                                                                                                                                   .76
                                                                                          .82 | 8.50
                                                                                                       1.71 | 14.50
                                                                                                                     1.90 | 20.50
                                                                                                                                    .76
    TOTAL RAINFALL (mm) = 51.563
                                                                                    2.50
                                                                                           .82 | 8.75
                                                                                                       1.71 | 14.75
                                                                                                                     1.90 | 20.75
                                                                                                                                    .76
    RUNOFF COEFFICIENT = .289
                                                                                    2 75
                                                                                          .82 | 9.00
                                                                                                                                    .76
                                                                                    3.00
                                                                                                       1.71 | 15.00
                                                                                                                     1.90 | 21.00
                                                                                           .82 | 9.25
                                                                                                       2.03 | 15.25
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                    3.25
                                                                                                                     1.90 | 21.25
                                                                                                                                    76
                                                                                                        2.03 | 15.50
                                                                                    3.50
                                                                                            .82 | 9.50
                                                                                                                      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
I CALTB
                                                                                    4.25
                                                                                           1.01 | 10.25
                                                                                                        2.91 | 16.25
                                                                                                                      1.14 | 22.25
                                                                                                                                    .76
| NASHYD (0003) | Area
                        (ha) = 8.40 Curve Number (CN) = 72.0
                                                                                    4.50
                                                                                           1.01 | 10.50
                                                                                                        2.91 | 16.50
                                                                                                                     1.14 | 22.50
                                                                                                                                    .76
                                                                                                        3.93 | 16.75
                                                                                                                     1.14 | 22.75
4.75
                                                                                           1.01 | 10.75
                                                                                                                                    .76
----- U.H. Tp(hrs)=
                                                                                           1.01 | 11.00
                               . 68
                                                                                    5.00
                                                                                                        3.93 | 17.00
                                                                                                                    1.14 | 23.00
                                                                                                                                    .76
                                                                                                        6.08 | 17.25 | 1.14 | 23.25
                                                                                                                                    .76
                                                                                    5.25
                                                                                           1.01 | 11.25
    Unit Hyd Qpeak (cms) = .472
                                                                                     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
    PEAK FLOW
                 (cms) = .127 (i)
                                                                                     6.00 1.01 | 12.00 69.93 | 18.00 1.14 | 24.00
                                                                                                                                   .76
    TIME TO PEAK (hrs) = 12.500
    RUNOFF VOLUME (mm) = 14.914
    TOTAL RAINFALL (mm) = 51.563
    RUNOFF COEFFICIENT = .289
                                                                       | CALIB |
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                       | 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
| CALIB
                                                                             NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.
| 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)=
                                                                                                ---- TRANSFORMED HYETOGRAPH ----
                                .48
                                                                                          RAIN | TIME RAIN | TIME RAIN | TIME
                                                                                    TIME
    Unit Hyd Qpeak (cms) = .509
                                                                                          mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                                                     hrs
                                                                                                                                  mm/hr
                                                                                            .70 | 6.167
                                                                                                       1.27 | 12.167
                                                                                                                    9.12 | 18.17
                                                                                                                                   1.14
                                                                                     . 167
                                                                                                       1.27 | 12.333
    PEAK FLOW
                 (cms) = .125 (i)
                                                                                     .333
                                                                                            .70 | 6.333
                                                                                                                    9.12 | 18.33
                 (hrs) = 12.333
                                                                                            .70 | 6.500
                                                                                                       1.27 |12.500
                                                                                                                    9.12 | 18.50
    TIME TO PEAK
                                                                                    .500
    RUNOFF VOLUME
                 (mm) = 14.903
                                                                                    .667
                                                                                            .70 | 6.667
                                                                                                       1.27 |12.667
                                                                                                                     4.69 | 18.67
                                                                                                                                   1.14
    TOTAL RAINFALL (mm) = 51.563
                                                                                     .833
                                                                                            .70 | 6.833
                                                                                                       1.27 |12.833
                                                                                                                     4.69 | 18.83
                                                                                                                                   1 14
                                                                                                       1.27 |13.000
                                                                                                                     4.69 | 19.00
    RUNOFF COEFFICIENT = .289
                                                                                    1.000
                                                                                            .70 | 7.000
                                                                                                                                   1.14
                                                                                                                     3.29 | 19.17
                                                                                            .70 | 7.167
                                                                                                       1.27 | 13.167
                                                                                    1 167
                                                                                                                                   1 14
                                                                                    1.333
                                                                                            .70 | 7.333
                                                                                                       1.27 | 13.333 3.42 | 19.33
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                                                   1.14
                                                                                    1.500
                                                                                            1 14
```

```
1 667
                    .70 | 7.667 | 1.27 | 13.667 | 2.66 | 19.67 | 1.14
                                                                       Unit Hyd Qpeak (cms) = .509
                   .70 | 7.833 | 1.27 | 13.833 | 2.66 | 19.83 | 1.14
            1.833
                    .70 | 8.000 | 1.27 | 14.000 | 2.66 | 20.00
            2.000
                                                        1.14
                                                                       PEAK FLOW
                                                                                    (cms) = .184 (i)
            2.167
                    TIME TO PEAK (hrs) = 12.333
            2.333
                    .82 | 8.333 | 1.71 | 14.333 | 1.90 | 20.33
                                                           .76
                                                                       RUNOFF VOLUME (mm) = 21.646
                    .82 | 8.500
                              TOTAL RAINFALL (mm) = 63.346
            2.500
                                                           .76
                    .82 | 8.667
                               1.71 | 14.667 | 1.90 | 20.67
                                                           .76
                                                                       RUNOFF COEFFICIENT = .342
            2.667
                    .82 | 8.833
                               1.71 | 14.833 | 1.90 | 20.83
            2 833
                                                           .76
                                            1.90 | 21.00
            3.000
                    .82 | 9.000
                               1.71 |15.000
                                                           .76
                                                                       (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                2.03 |15.167
            3.167
                    .82 | 9.167
                                             1.90 | 21.17
                                                           .76
                    .82 | 9.333
                                2.03 | 15.333
                                            1.90 | 21.33
            3.333
                                                           .76
                    .82 | 9.500
                                2.03 | 15.500
                                             1.90 | 21.50
            3.500
                                                           .76
            3.667
                    .82 | 9.667
                                2.28 | 15.667
                                             1.90 | 21.67
                                                           .76
                                                                     ** SIMULATION NUMBER: 4 **
            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
                   1.01 | 10.333
            4.333
                               2.91 | 16.333
                                            1.14 | 22.33
                                                           .76
            4.500
                   1.01 |10.500
                               2.91 |16.500
                                                                     READ STORM |
                                                                                       Filename: G:\Projects\2012\12116 - TSI London
                                            1.14 | 22.50
                                                           .76
                                                                                       GE1 & GE2\Design\FSR Calcs\VO2\Storm\
            4.667
                   1.01 | 10.667
                               .76
                                                                                             SCS Type II - London\10yrSCSTypeII24hr.stm
            4 833
                  1.01 |10.833
                               3.93 | 16.833 | 1.14 | 22.83
                                                           .76
                   1.01 |11.000
                               | Ptotal= 73.97 mm | Comments: 10-Year 24 hour SCS Type II: London Airp
            5.000
            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
                                                                                TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
                  1.01 | 11.500
                               .76
                                                                                hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs
            5.500
                                                                                                                             mm/hr
                  1.01 | 11.667 26.35 | 17.667 1.14 | 23.67
                                                                                 .25
            5 667
                                                           .76
                                                                                      1 33
                                                          .76
                                                                                 .50
                                                                                       .81 | 6.50
                                                                                                   1.48 | 12.50 | 10.65 | 18.50
            5.833 1.01 | 11.833 48.14 | 17.833 1.14 | 23.83
                                                                                                                              1.33
                                                                                       .81 | 6.75
                                                                                                   1.48 | 12.75 5.47 | 18.75
                                                                                 .75
            6.000 1.01 | 12.000 69.93 | 18.000 1.14 | 24.00
                                                         .76
                                                                                                                              1 33
                                                                                                   1.48 | 13.00
                                                                                       .81 | 7.00
                                                                                 1.00
                                                                                                                 5.47 | 19.00
                                                                                                                              1.33
                                                                                        .81 | 7.25
                                                                                                                 3.85 | 19.25
    Unit Hyd Qpeak (cms) = 1.603
                                                                                 1.25
                                                                                                    1.48 | 13.25
                                                                                                                              1 33
                                                                                        .81 | 7.50
                                                                                 1.50
                                                                                                    1.48 | 13.50
                                                                                                                 4.14 | 19.50
    PEAK FLOW
                (cms) = .635 (i)
                                                                                 1.75
                                                                                        .81 | 7.75
                                                                                                    1.48 | 13.75
                                                                                                                 3.11 | 19.75
                                                                                                    1.48 | 14.00
    TIME TO PEAK
               (hrs) = 12.500
                                                                                 2.00
                                                                                        .81 | 8.00
                                                                                                                 3.11 | 20.00
                                                                                                                              1 33
                (mm) = 21.660
                                                                                                   2.00 | 14.25
                                                                                                                 2.22 | 20.25
    RUNOFF VOLUME
                                                                                 2.25
                                                                                         .96 | 8.25
                                                                                                                              .89
   TOTAL RAINFALL (mm) = 63.346
                                                                                                   2.00 | 14.50
                                                                                 2.50
                                                                                        .96 | 8.50
                                                                                                                 2.22 | 20.50
                                                                                                                               .89
                                                                                        .96 | 8.75
                                                                                                   2.00 | 14.75 2.22 | 20.75
    RUNOFF COEFFICIENT = .342
                                                                                 2.75
                                                                                                                               .89
                                                                                 3.00
                                                                                        .96 | 9.00 2.00 | 15.00 2.22 | 21.00
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                3 25
                                                                                        .96 | 9.25 2.37 | 15.25 2.22 | 21.25
                                                                                                                               89
                                                                                                  2.37 | 15.50 2.22 | 21.50
                                                                                3.50
                                                                                       .96 | 9.50
                                                                                3.75
                                                                                        .96 | 9.75 2.66 | 15.75 2.22 | 21.75
                                                                                4.00
                                                                                        .96 | 10.00
                                                                                                   2.66 | 16.00 | 2.22 | 22.00
                                                                                4.25 1.18 | 10.25
                                                                                                  .89
                                                                                       1.18 | 10.50
                                                                                                   | NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
                                                                                4.50
                                                                                                                               .89
                                                                                       1.18 | 10.75
                                                                                                   4.59 | 16.75 | 1.33 | 22.75
| \text{ID} = 1 \text{ DT} = 10.0 \text{ min } | \text{ Ia}  (\text{mm}) = 5.00 \text{ # of Linear Res.(N)} = 3.00 
                                                                                 4.75
                                                                                                                               .89
----- U.H. Tp(hrs) = .68
                                                                                       1.18 | 11.00
                                                                                                   5.00
                                                                                                                               89
                                                                                 5.25
                                                                                       1.18 | 11.25
                                                                                                    . 89
   Unit Hyd Qpeak (cms) = .472
                                                                                 5.50
                                                                                       1.18 | 11.50
                                                                                                    .89
                                                                                       1.18 | 11.75 | 30.77 | 17.75
                                                                                 5.75
                                                                                                                 1.33 | 23.75
                                                                                                                               . 89
                                                                                       1.18 | 12.00 | 81.66 | 18.00 | 1.33 | 24.00
    PEAK FLOW
                (cms) =
                       .188 (i)
                                                                                 6.00
    TIME TO PEAK
                (hrs) = 12.500
    RUNOFF VOLUME
                (mm) = 21.661
    TOTAL RAINFALL (mm) = 63.346
    RUNOFF COEFFICIENT = .342
                                                                    I CALTB
                                                                    | NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                    |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.
| NASHYD (0004) | Area (ha) = 6.40 Curve Number (CN) = 72.0
----- U.H. Tp(hrs) = .48
                                                                                             ---- TRANSFORMED HYETOGRAPH ----
                                                                                 TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
```

```
mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
                       .81 | 6.167
                                    1.48 | 12.167 | 10.65 | 18.17
                                                                                   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                       .81 | 6.333
                                    1.48 | 12.333 | 10.65 | 18.33
                                                                   1.33
                       .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
                                    1.48 | 12.833
                                                   5.47 | 18.83
               .833
                        .81 | 6.833
                                                                   1.33
                                     1.48 | 13.000
                                                    5.47 | 19.00
                                                                               | NASHYD (0004) | Area (ha)= 6.40 Curve Number (CN)= 72.0
              1.000
                        .81 | 7.000
                                                                   1.33
                        .81 | 7.167
                                     1.48 | 13.167
                                                    3.85 | 19.17
              1 167
                                                                   1 33
                                                                               |ID= 1 DT=10.0 min | Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
              1.333
                        .81 | 7.333
                                     1.48 | 13.333
                                                    3.99 | 19.33
                                                                               ----- U.H. Tp(hrs)=
                                                                                                                    .48
                                                                   1.33
              1.500
                        .81 | 7.500
                                     1.48 | 13.500
                                                    4.14 | 19.50
                                                                   1.33
                       .81 | 7.667
                                     1.48 | 13.667
              1.667
                                                    3.11 | 19.67
                                                                   1.33
                                                                                   Unit Hyd Opeak (cms) =
                        .81 | 7.833
                                     1.48 | 13.833
              1.833
                                                    3.11 | 19.83
                                                                   1.33
              2.000
                        .81 | 8.000
                                     1.48 | 14.000
                                                    3.11 | 20.00
                                                                   1.33
                                                                                   PEAK FLOW
                                                                                                   (cms) =
                                                                                                            .243 (i)
              2.167
                        .96 | 8.167
                                     2.00 | 14.167
                                                    2.22 | 20.17
                                                                    .89
                                                                                   TIME TO PEAK
                                                                                                   (hrs) = 12.333
              2.333
                        .96 | 8.333
                                     2.00 |14.333
                                                    2.22 | 20.33
                                                                                   RUNOFF VOLUME
                                                                     .89
                                                                                                   (mm) = 28.329
              2.500
                                                                    .89
                                                                                   TOTAL RAINFALL (mm) = 73.968
                        .96 | 8.500
                                     2.00 |14.500
                                                    2.22 | 20.50
              2.667
                                     2.00 | 14.667
                                                                    .89
                        .96 | 8.667
                                                    2.22 | 20.67
                                                                                   RUNOFF COEFFICIENT =
              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
                                                                                   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                    . 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
                                                                                ********
              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
                                                                                 ** SIMULATION NUMBER: 5 **
                       .96 | 9.833
                                    2.66 |15.833
                                                    2.22 | 21.83
                                                                    .89
                                                                                 *******
              3.833
              4 000
                       .96 |10.000
                                    2.66 |16.000
                                                    2.22 | 22.00
                                                                     .89
                                                                    .89
              4.167
                      1.18 |10.167
                                    3.40 |16.167
                                                    1.33 | 22.17
              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
                                                                                  READ STORM |
                                                                                                     Filename: G:\Projects\2012\12116 - TSI London
              4.667
                      1.18 | 10.667
                                     4.59 | 16.667
                                                    1.33 | 22.67
                                                                    89
                                                                                                               GE1 & GE2\Design\FSR Calcs\VO2\Storm\
              4.833
                      1.18 | 10.833
                                     4.59 |16.833
                                                    1.33 | 22.83
                                                                    .89
                                                                                                               SCS Type II - London\25yrSCSTypeII24hr.stm
              5.000
                      1.18 |11.000
                                     4.59 | 17.000
                                                    1.33 | 23.00
                                                                    .89
                                                                               | Ptotal= 89.53 mm |
                                                                                                     Comments: 25-Year 24 hour SCS Type II: London Airp
              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
                                                                                              TIME
                                                                                                      RAIN | TIME
                                                                                                                   RAIN | TIME
                                                                                                                                  RAIN | TIME
                                     7.10 |17.500
              5.500
                      1.18 | 11.500
                                                    1.33 | 23.50
                                                                                                     mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                                    .89
                                                                                               hrs
                                                                                                                                                  mm/hr
                                     30.77 | 17.667
                      1.18 |11.667
                                                                    .89
                                                                                               .25
                                                                                                      .98 | 6.25
              5.667
                                                    1.33 | 23.67
                                                                                                                    1.79 | 12.25 | 12.89 | 18.25
                                                                                                                                                   1.61
              5.833
                      1.18 | 11.833
                                     56.22 | 17.833 | 1.33 | 23.83
                                                                    .89
                                                                                               .50
                                                                                                       .98 | 6.50
                                                                                                                    1.79 | 12.50 | 12.89 | 18.50
              6 000
                     1.18 | 12.000 | 81.66 | 18.000 | 1.33 | 24.00
                                                                                               75
                                                                                                       .98 | 6.75
                                                                                                                    1.79 | 12.75
                                                                                                                                  6.63 | 18.75
                                                                                               1.00
                                                                                                       .98 | 7.00
                                                                                                                    1.79 | 13.00
                                                                                                                                   6.63 | 19.00
                                                                                                                                                   1.61
                                                                                                                                  4.66 | 19.25
    Unit Hyd Qpeak (cms) = 1.603
                                                                                               1.25
                                                                                                       .98 | 7.25
                                                                                                                    1.79 | 13.25
                                                                                               1.50
                                                                                                       .98 | 7.50
                                                                                                                    1.79 | 13.50
                                                                                                                                    5.01 | 19.50
                                                                                                                    1.79 | 13.75
                                                                                                                                    3.76 | 19.75
    PEAK FLOW
                   (cms) = .839 (i)
                                                                                               1.75
                                                                                                       .98 | 7.75
                                                                                                                                                   1.61
    TIME TO PEAK
                   (hrs) = 12.500
                                                                                                                                    3.76 | 20.00
                                                                                               2.00
                                                                                                       .98 | 8.00
                                                                                                                    1.79 | 14.00
                                                                                                                                                   1.61
                                                                                                      1.16 | 8.25
                                                                                                                                    2.69 | 20.25
    RUNOFF VOLUME
                   (mm) = 28.348
                                                                                               2.25
                                                                                                                    2.42 | 14.25
                                                                                                                                                   1 07
                                                                                                      1.16 | 8.50
                                                                                                                    2.42 | 14.50
                                                                                                                                    2.69 | 20.50
    TOTAL RAINFALL (mm) = 73.968
                                                                                               2.50
                                                                                                                                                   1 07
                                                                                               2.75
                                                                                                      1.16 | 8.75
                                                                                                                     2.42 | 14.75
                                                                                                                                    2.69 | 20.75
    RUNOFF COEFFICIENT = .383
                                                                                                                                                   1.07
                                                                                               3.00
                                                                                                      1.16 | 9.00
                                                                                                                     2.42 | 15.00
                                                                                                                                    2.69 | 21.00
                                                                                                                                                   1.07
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                               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
                                                                                               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
                                                                                              4.25
                                                                                                      1.43 | 10.25
                                                                                                                     4.12 | 16.25
                                                                                                                                    1.61 | 22.25
                                                                                                                                                   1.07
| NASHYD (0003) | Area
                           (ha) = 8.40 Curve Number (CN) = 72.0
                                                                                              4.50
                                                                                                      1.43 | 10.50
                                                                                                                     4.12 | 16.50
                                                                                                                                    1.61 | 22.50
                                                                                                                                                   1.07
|ID= 1 DT=10.0 min | Ia
                           (mm) = 5.00 \# of Linear Res.(N) = 3.00
                                                                                              4.75
                                                                                                      1.43 | 10.75
                                                                                                                     5.55 | 16.75
                                                                                                                                    1.61 | 22.75
                                                                                                                                                   1 07
----- U.H. Tp(hrs)=
                                                                                                      1.43 | 11.00
                                                                                                                    5.55 | 17.00
                                                                                                                                    1.61 | 23.00
                                                                                               5.00
                                                                                                                                                   1.07
                                                                                               5.25
                                                                                                      1.43 | 11.25
                                                                                                                     8.60 | 17.25
                                                                                                                                    1.61 | 23.25
                                                                                                                     8.60 | 17.50
    Unit Hvd Opeak (cms) =
                           .472
                                                                                               5.50
                                                                                                      1.43 | 11.50
                                                                                                                                    1.61 | 23.50
                                                                                                                                                   1.07
                                                                                               5.75
                                                                                                      1.43 | 11.75
                                                                                                                   37.25 | 17.75 | 1.61 | 23.75
    PEAK FLOW
                           .248 (i)
                                                                                                     1.43 | 12.00 98.84 | 18.00 1.61 | 24.00
                   (cms) =
    TIME TO PEAK
                   (hrs) = 12.500
    RUNOFF VOLUME
                    (mm) = 28.349
    TOTAL RAINFALL (mm) = 73.968
    RUNOFF COEFFICIENT = .383
```

```
| CALIB
                                                                       | ID= 1 DT=10.0 min | Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
                                                                        ----- U.H. Tp(hrs)=
                         (ha) = 27.70 Curve Number (CN) = 72.0
| NASHYD (0002) | Area
                                                                                                        . 68
|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) =
                                                                                                 .472
       NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.
                                                                           PEAK FLOW
                                                                                         (cms) = .345 (i)
                                                                           TIME TO PEAK
                                                                                        (hrs) = 12.500
                                                                           RUNOFF VOLUME
                                                                                         (mm) = 38.974
                         ---- TRANSFORMED HYETOGRAPH ----
                                                                           TOTAL RAINFALL (mm) = 89.534
                                                                           RUNOFF COEFFICIENT = .435
              TIME
                    RAIN | TIME
                                 RAIN | TIME RAIN | TIME RAIN
                    mm/hr | hrs mm/hr | hrs mm/hr | hrs
              hrs
                                                            mm/hr
                     .98 | 6.167
                                 1.79 | 12.167
                                              12.89 | 18.17
                                                                           (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
              .167
                                                             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
                                                                       | CALIB
                                               6.63 | 18.83
                                                             1.61
                                 1.79 |13.000
             1.000
                     .98 | 7.000
                                               6.62 | 19.00
                                                                       | NASHYD (0004) | Area (ha) = 6.40 Curve Number (CN) = 72.0
                                                             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
                                                                       ----- U.H. Tp(hrs)=
                                                             1.61
                                                                                                        .48
                                1.79 |13.500
                                               5.01 | 19.50
             1 500
                     .98 | 7.500
             1.667
                     .98 | 7.667 1.79 |13.667
                                               3.76 | 19.67
                                                                           Unit Hyd Qpeak (cms) =
                                                             1.61
                                                                                                 .509
             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
                                                                           PEAK FLOW
                                                                                         (cms) = .337 (i)
             2.167
                    1.16 | 8.167 2.42 | 14.167
                                               2.69 | 20.17
                                                            1.07
                                                                           TIME TO PEAK
                                                                                         (hrs) = 12.333
             2.333
                    1.16 | 8.333
                                2.42 |14.333
                                               2.69 | 20.33
                                                            1.07
                                                                           RUNOFF VOLUME (mm) = 38.947
                                 2.42 |14.500
                                                            1.07
             2.500
                    1.16 | 8.500
                                               2.69 | 20.50
                                                                           TOTAL RAINFALL (mm) = 89.534
             2.667
                    1.16 | 8.667
                                 2.42 | 14.667
                                               2.69 | 20.67
                                                             1.07
                                                                           RUNOFF COEFFICIENT = .435
             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
                                                                            (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
             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
                                                                         *******
                    1.16 | 9.667
                                 3.22 | 15.667
                                                                         ** SIMULATION NUMBER: 6 **
             3.667
                                               2.69 | 21.67
                                                             1.07
                                 3.22 |15.833
             3.833
                    1.16 | 9.833
                                               2.69 | 21.83
                                                             1.07
                    1.16 | 10.000
                                 3.22 |16.000
                                               2.69 | 22.00
             4.000
                                                             1.07
                   1.43 | 10.167 | 4.12 | 16.167 | 1.61 | 22.17
             4.167
                                                             1.07
                   1.43 | 10.333 | 4.12 | 16.333 | 1.61 | 22.33
             4.333
                                                             1 07
                   1.43 | 10.500 4.12 | 16.500 1.61 | 22.50
                                                                                            Filename: G:\Projects\2012\12116 - TSI London
             4.500
                                                             1.07
                                                                       | READ STORM |
             4.667
                    GE1 & GE2\Design\FSR Calcs\VO2\Storm\
             4.833
                   1.43 | 10.833 5.55 | 16.833 1.61 | 22.83
                                                            1.07
                                                                                                    SCS Type II - London\50yrSCSTypeII24hr.stm
                   1.43 | 11.000 5.55 | 17.000 1.61 | 23.00
                                                                       | Ptotal= 99.98 mm |
                                                                                            Comments: 50-Year 24 hour SCS Type II: London Airp
             5.000
                                                            1.07
                    1.43 | 11.167 | 8.60 | 17.167 | 1.61 | 23.17
             5.167
                                                            1.07
                    1.43 | 11.333 | 8.60 | 17.333 | 1.61 | 23.33
                                                            1.07
             5 333
                                                                                           RAIN | TIME RAIN | TIME RAIN | TIME
                                                                                    TIME.
                    1.43 | 11.500
                                 1.07
                                                                                      hrs
                                                                                            mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                                                                                                    mm/hr
             5 500
                                                                                     .25
             5.667
                    1.43 | 11.667 37.25 | 17.667 1.61 | 23.67
                                                                                            1.10 | 6.25
                                                                                                         1.80
                                                             1.07
                                 68.05 | 17.833
                                               1.61 | 23.83
                                                                                      .50
                                                                                                         5.833
                    1.43 | 11.833
                                                            1.07
                                                                                            1.10 | 6.50
                                                                                                                                     1 80
             6.000 1.43 | 12.000 98.84 | 18.000 1.61 | 24.00
                                                                                            1.10 | 6.75
                                                                                                          2.00 | 12.75
                                                                                                                       7.40 | 18.75
                                                            1.07
                                                                                      .75
                                                                                                                                     1.80
                                                                                      1.00
                                                                                            1.10 | 7.00
                                                                                                          2.00 | 13.00
                                                                                                                       7.40 | 19.00
    Unit Hyd Qpeak (cms) = 1.603
                                                                                      1.25
                                                                                            1.10 | 7.25
                                                                                                         2.00 | 13.25
                                                                                                                       5.20 | 19.25
                                                                                                                                     1.80
                                                                                            1.10 | 7.50
                                                                                      1.50
                                                                                                          2.00 | 13.50
                                                                                                                       5.60 | 19.50
                                                                                                                                     1.80
                 (cms) = 1.165 (i)
                                                                                      1.75
                                                                                            1.10 | 7.75
                                                                                                         2.00 | 13.75
                                                                                                                       4.20 | 19.75
    PEAK FLOW
                                                                                                                                     1 80
                 (hrs) = 12.500
                                                                                      2.00
                                                                                            1.10 | 8.00
                                                                                                         2.00 | 14.00
                                                                                                                       4.20 | 20.00
    TIME TO PEAK
                                                                                                                                     1.80
                 (mm) = 38.973
                                                                                      2.25
                                                                                            1.30 | 8.25
                                                                                                         2.70 | 14.25
                                                                                                                       3.00 | 20.25
    RUNOFF VOLUME
                                                                                                                                     1 20
    TOTAL RAINFALL (mm) = 89.534
                                                                                      2.50
                                                                                            1.30 | 8.50
                                                                                                         2.70 | 14.50
                                                                                                                       3.00 | 20.50
                                                                                                                                     1.20
                                                                                                         2.70 | 14.75
    RUNOFF COEFFICIENT = .435
                                                                                      2.75
                                                                                            1.30 | 8.75
                                                                                                                       3.00 | 20.75
                                                                                            1.30 | 9.00
                                                                                                         2.70 | 15.00
                                                                                                                       3.00 | 21.00
                                                                                      3.00
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                     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
                                                                                            1.30 | 9.75
                                                                                                        3.60 | 15.75
                                                                                                                       3.00 | 21.75
                                                                                                                                     1.20
______
                                                                                    3.75
                                                                                                        3.60 | 16.00
                                                                                                                       3.00 | 22.00
                                                                                    4.00
                                                                                            1.30 | 10.00
                                                                                                                                     1 20
                                                                                    4.25
                                                                                                        4.60 | 16.25 | 1.80 | 22.25
                                                                                            1.60 | 10.25
                                                                                                                                    1.20
I CALTB
                                                                                     4.50 1.60 | 10.50 4.60 | 16.50 1.80 | 22.50
| NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
                                                                                                                                    1.20
```

```
1.60 | 10.75
                                     6.20 | 16.75
                                                    1.80 | 22.75
                                                                                   RUNOFF VOLUME (mm) = 46.547
                                    6.20 | 17.00
                      1.60 | 11.00
                                                  1.80 | 23.00
                                                                   1.20
                                                                                   TOTAL RAINFALL (mm) = 99.981
                                     9.60 | 17.25
               5.25
                      1.60 | 11.25
                                                   1.80 | 23.25
                                                                   1.20
                                                                                   RUNOFF COEFFICIENT = .466
                                    9.60 | 17.50
                      1.60 | 11.50
                                                   1.80 | 23.50
                                                                   1.20
               5.75
                     1.60 | 11.75 | 41.59 | 17.75
                                                   1.80 | 23.75
                                                                   1.20
                                                                                   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
               6.00
                     1.60 | 12.00 | 110.37 | 18.00
                                                  1.80 | 24.00
                                                                                CALTB
                                                                                NASHYD (0003) | Area
                                                                                                           (ha) = 8.40 Curve Number (CN) = 72.0
                                                                                                            (mm) =
| CALIB
                                                                               |ID= 1 DT=10.0 min | Ia
                                                                                                                   5.00
                                                                                                                         \# of Linear Res.(N) = 3.00
                            (ha) = 27.70 Curve Number (CN) = 72.0
                                                                               ----- U.H. Tp(hrs)=
NASHYD
         (0002) | Area
|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) =
                                                                                                           .472
       NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.
                                                                                   PEAK FLOW
                                                                                                  (cms) =
                                                                                                           .415 (i)
                                                                                   TIME TO PEAK
                                                                                                  (hrs) = 12.500
                                                                                   RUNOFF VOLUME
                                                                                                  (mm) = 46.549
                            ---- TRANSFORMED HYETOGRAPH ----
                                                                                                  (mm) = 99.981
                                                                                   TOTAL RAINFALL
               TIME
                      RAIN | TIME
                                    RAIN | TIME RAIN | TIME
                                                                                   RUNOFF COEFFICIENT =
                                    mm/hr | hrs mm/hr | hrs
                     mm/hr | hrs
               .167
                      1.10 | 6.167
                                     1 80
                                                                                   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
               .333
                     1.10 | 6.333
                                    1.80
                     1.10 | 6.500
                                    2.00 |12.500
                                                   14.40 | 18.50
                                                                   1.80
               .500
                      1.10 | 6.667
               .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
                                                                               I CALTB
              1.000
                      1.10 | 7.000
                                     2.00 | 13.000
                                                    7.40 | 19.00
                                                                   1.80
                                                                               | NASHYD (0004) |
                                                                                                            (ha) = 6.40 Curve Number (CN) = 72.0
                                                                                                   Area
              1.167
                      1.10 | 7.167
                                     2.00 | 13.167
                                                    5.20 | 19.17
                                                                   1.80
                                                                               |ID= 1 DT=10.0 min | Ia
                                                                                                            (mm) =
                                                                                                                   5.00 # of Linear Res.(N) = 3.00
              1.333
                      1.10 | 7.333
                                     2.00 | 13.333
                                                    5.40 | 19.33
                                                                   1 80
                                                                               ----- U.H. Tp(hrs) =
                                                                                                                   4.8
              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
                                                                                   Unit Hyd Qpeak (cms) =
              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
                                                                                   PEAK FLOW
                                                                                                  (cms) =
                                                                                                           .404 (i)
              2.167
                      1.30 | 8.167
                                     2.70 |14.167
                                                    3.00 | 20.17
                                                                   1.20
                                                                                   TIME TO PEAK
                                                                                                  (hrs) = 12.333
                                                                                   RUNOFF VOLUME
                                     2.70 |14.333
                                                    3.00 | 20.33
              2.333
                      1.30 | 8.333
                                                                   1.20
                                                                                                  (mm) = 46.516
              2.500
                      1.30 | 8.500
                                     2.70 |14.500
                                                   3.00 | 20.50
                                                                   1.20
                                                                                   TOTAL RAINFALL (mm) = 99.981
              2.667
                      1.30 | 8.667
                                     2.70 | 114.667
                                                   3.00 | 20.67
                                                                   1 20
                                                                                   RUNOFF COEFFICIENT = .465
                                     2.70 |14.833
              2.833
                      1.30 | 8.833
                                                   3.00 | 20.83
                                                                   1.20
              3.000
                      1.30 | 9.000
                                     2.70 |15.000
                                                   3.00 | 21.00
                                                                                   (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
              3.167
                      1.30 | 9.167
                                     3.20 | 15.167
                                                    3.00 | 21.17
                                                                   1.20
                      1.30 | 9.333
                                     3.20 | 15.333
                                                   3.00 | 21.33
              3.333
                                                                   1.20
                      1.30 | 9.500
                                     3.20 |15.500
                                                    3.00 | 21.50
              3.500
                                                                   1.20
              3.667
                      1.30 | 9.667
                                     3.60 | 15.667
                                                    3.00 | 21.67
                                                                                 ** SIMULATION NUMBER: 7 **
                                                                   1 20
                                                                                 ******
              3.833
                      1.30 | 9.833
                                     3.60 | 15.833
                                                    3.00 | 21.83
                                                                   1 20
              4.000
                      1.30 | 110.000
                                     3.60 | 16.000
                                                    3.00 | 22.00
                                                                   1.20
                      1.60 | 10.167
              4.167
                                     4.60 | 116.167
                                                    1.80 | 22.17
                                                                   1.20
                      1.60 | 10.333
                                     4.60 | 16.333
                                                    1.80 | 22.33
              4.333
                                                                   1.20
              4.500
                      1.60 | 10.500
                                     4.60 | 16.500
                                                    1.80 | 22.50
                                                                   1.20
                                                                                                     Filename: G:\Projects\2012\12116 - TSI London
              4.667
                      1.60 | 10.667
                                     6.20 | 16.667
                                                    1.80 | 22.67
                                                                   1.20
                                                                                                              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
              4.833
                      1.60 | 10.833
                                     6.20 | 16.833
                                                    1.80 | 22.83
                                                                   1.20
                                                                                                              SCS Type II - London\100yrSCSTYPEII124HR.stm
                                                                               | Ptotal=111.61 mm |
              5.000
                      1.60 | 11.000
                                     6.20 | 17.000
                                                                                                     Comments: 100-Year 24 hour SCS: London Airport
                                                    1.80 | 23.00
                                                                   1.20
                      1.60 | 11.167
                                     9.60 | 17.167
                                                    1.80 | 23.17
              5.167
                                                                   1.20
                                                                               -----
                      1.60 | 11.333
                                                                                                     RAIN | TIME
              5 333
                                     9.60 | 17.333
                                                    1.80 | 23.33
                                                                   1.20
                                                                                              TIME
                                                                                                                    RAIN | TIME
                                                                                                                                  RAIN | TIME
                                                                                                                                                   RATN
              5.500
                      1.60 | 11.500
                                     9.60 | 17.500
                                                    1.80 | 23.50
                                                                                                     mm/hr | hrs
                                                                                                                   mm/hr | hrs mm/hr | hrs
                                                                                                                                                 mm/hr
                                                                   1.20
                                                                                              hrs
                                                                                                                    2.23 | 12.25 | 16.07 | 18.25
              5.667
                      1.60 | 11.667
                                    41.59 | 17.667
                                                    1.80 | 23.67
                                                                   1.20
                                                                                              .25
                                                                                                     1.23 | 6.25
                      1.60 | 11.833
                                    75.98 | 17.833
                                                                                                     1.23 | 6.50
                                                                                                                    2.23 | 12.50
                                                                                                                                 16.07 | 18.50
                                                    1.80 | 23.83
                                                                   1.20
                                                                                              .50
                                                                                                                                                   2.01
              6.000
                      1.60 | 12.000 110.37 | 18.000
                                                   1.80 | 24.00
                                                                                              .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
                                                                                                     1.23 | 7.25
                                                                                                                   2.23 | 13.25
                                                                                                                                   5.80 | 19.25
                                                                                                                                                   2.01
    Unit Hyd Qpeak (cms) = 1.603
                                                                                              1.25
                                                                                                                                   6.25 | 19.50
                                                                                              1.50
                                                                                                     1.23 | 7.50
                                                                                                                   2.23 | 13.50
                                                                                                                                                  2 01
                   (cms) = 1.399 (i)
                                                                                              1.75
                                                                                                     1.23 | 7.75
                                                                                                                   2.23 | 13.75
                                                                                                                                   4.69 | 19.75
                                                                                                                                                  2 01
    PEAK FLOW
                                                                                                                                   4.69 | 20.00
    TIME TO PEAK
                   (hrs) = 12.500
                                                                                              2.00
                                                                                                     1.23 | 8.00
                                                                                                                   2.23 | 14.00
                                                                                                                                                  2.01
```

```
1.45 | 8.25 3.01 | 14.25 3.35 | 20.25 1.34
     1.45 | 8.50 3.01 | 14.50 3.35 | 20.50 1.34
     1.45 | 8.75 3.01 | 14.75 3.35 | 20.75
2.75
                                           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
                  5.13 | 16.25 2.01 | 22.25
4.25
     1.79 | 10.25
                                            1.34
                  5.13 | 16.50
                               2.01 | 22.50
4 50
      1.79 | 10.50
                                             1.34
      1.79 | 10.75
                  6.92 | 16.75
                               2.01 | 22.75
4.75
                                             1.34
      1.79 | 11.00
                  6.92 | 17.00
                               2.01 | 23.00
5.00
                                             1.34
      1.79 | 11.25 | 10.71 | 17.25 | 2.01 | 23.25
5.25
                                             1.34
      5.50
                                             1.34
     1.79 | 11.75 | 46.42 | 17.75 | 2.01 | 23.75
                                           1.34
5.75
    1.79 | 12.00 | 123.20 | 18.00 | 2.01 | 24.00 | 1.34
6.00
```

----- U.H. Tp(hrs) = .66

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

| NASHYD (0002) | Area (ha) = 27.70 Curve Number (CN) = 72.0

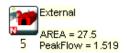
---- TRANSFORMED HYETOGRAPH ----

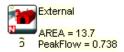
```
RAIN | TIME RAIN | TIME RAIN | TIME RAIN
      mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
 .167
      1.23 | 6.167
                   2.23 | 12.167 | 16.07 | 18.17
                                              2.01
                   2.23 | 12.333 | 16.07 | 18.33
.333
      1.23 | 6.333
                                              2.01
      1.23 | 6.500
                   .500
                                              2.01
      1.23 | 6.667 2.23 | 12.667
                               8.26 | 18.67
.667
                                              2.01
      1.23 | 6.833 | 2.23 | 12.833 | 8.26 | 18.83
.833
                                              2.01
1.000
      1.23 | 7.000 2.23 | 13.000 8.26 | 19.00
                                              2.01
      1.23 | 7.167 2.23 | 13.167 5.80 | 19.17
1.167
                                               2.01
1.333
      2.01
1.500
      1.23 | 7.500 2.23 | 13.500 6.25 | 19.50
                                              2.01
      1.23 | 7.667 2.23 | 13.667 4.69 | 19.67
1.667
                                              2.01
      1.23 | 7.833 2.23 | 13.833 4.69 | 19.83
1.833
                                              2.01
      1.23 | 8.000 2.23 | 14.000 4.69 | 20.00
2 000
                                              2.01
2.167
      1.45 | 8.167
                   3.01 | 14.167 3.35 | 20.17
                                             1.34
      1.45 | 8.333
2.333
                   3.01 | 14.333 3.35 | 20.33
                                             1.34
                   3.01 |14.500
                                3.35 | 20.50
2.500
      1.45 | 8.500
                                              1.34
       1.45 | 8.667
                    3.01 | 14.667
                                 3.35 | 20.67
2.667
                                              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
                    3.57 | 15.167
3.167
       1.45 | 9.167
                                 3.35 | 21.17
                                               1.34
                   3.57 | 15.333
                                3.35 | 21.33
3.333
      1.45 | 9.333
                                              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
                   4.02 | 16.000
4.000
      1.45 | 10.000
                                3.35 | 22.00
                                              1.34
      1.79 | 10.167
                   5.13 | 16.167
                                 2.01 | 22.17
4.167
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
      1.79 | 10.667 6.92 | 16.667
                                 2.01 | 22.67
4.667
                                             1.34
                   6.92 | 16.833 2.01 | 22.83
4 833
      1.79 | 10.833
                                             1.34
      1.79 | 11.000 6.92 | 17.000 2.01 | 23.00
5.000
                                             1.34
5.167
```

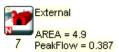
```
5.333 1.79 | 11.333 10.71 | 17.333 2.01 | 23.33
           5.500 1.79 | 11.500 10.71 | 17.500 2.01 | 23.50
            5.667 1.79 | 11.667 46.42 | 17.667 2.01 | 23.67
                                                          1.34
            5.833 1.79 | 11.833 84.81 | 17.833 2.01 | 23.83 1.34
            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.
I CALTB
| NASHYD (0003) | Area (ha) = 8.40 Curve Number (CN) = 72.0
----- 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.
```

Green Valley Estates Inc. and Green Valley Estates II Inc. FSR CITY OF LONDON

Existing External Flows

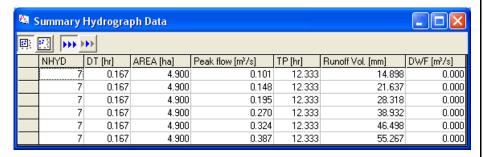








M S	ummary	Hydrogra	ph Data				
	***	••					
	NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
	6	0.167	13.700	0.191	12.667	14.915	0.000
	6	0.167	13.700	0.281	12.667	21.663	0.000
	6	0.167	13.700	0.371	12.667	28.351	0.000
	6	0.167	13.700	0.515	12.667	38.977	0.000
	6	0.167	13.700	0.618	12.667	46.553	0.000
	6	0.167	13.700	0.738	12.667	55.332	0.000



```
V V I
                  SSSSS U U A L
              I
                   SS
                        U U A A
       77 77
                        AAAA II II
             Т
                    SS
                         U U A A L
                     SS
                   SSSSS UUUUUU A
       OOO TTTTT TTTTT H H Y Y M M OOO
                                                     TM, Version 2.0
      0 0 T
                         H H Y Y MM MM O O
                    Т
      0 0
                     т
                          H H
                                 Y
                                      M M O O
                                                     Licensed To: TMIG
                                                                 VO2-0145
                          H H
                                          M 000
Developed and Distributed by Greenland International Consulting Inc.
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All rights reserved.
                  ***** DETAILED OUTPUT *****
 Input filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
Output filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\V02\12116
VO2 Sept 2013\Existing 24hr SCS - External.out
 Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\V02\12116
VO2 Sept 2013\Existing 24hr SCS - External.sum
DATE: 23/10/2013
                                       TIME: 3:52:21 PM
USER:
COMMENTS:
 ********
 ** SIMULATION NUMBER: 1 **
 ********
                      Filename: G:\Projects\2012\12116 - TSI London
    READ STORM |
                                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
                        .57 | 7.00
               1.00
                                      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
                        .57
               1.75
                              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
                                                     1.55 | 20.50
                                      1.39 | 14.50
                                                                     .62
               2.75
                        .67 | 8.75
                                      1.39 | 14.75
                                                     1.55 | 20.75
               3.00
                        .67 | 9.00
                                      1.39 | 15.00
                                                     1.55 | 21.00
                                                                     .62
               3 25
                        .67 | 9.25
                                      1 65 I 15 25
                                                     1 55 I 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
                        .82 | 11.00
                                      3.20 | 17.00
                                                      .93 | 23.00
                                                                     .62
```

```
Hydrologic Model Output - External Area - Existing Conditions (SCS 24 hour storms) 2 yr, 5 yr, 25yr, 50yr and 100 yr
                        .82 | 11.25 4.95 | 17.25
                                                      .93 | 23.25
               5.50
                        .82 | 11.50
                                     4.95 | 17.50
                                                      .93 | 23.50 .62
.93 | 23.75 .62
               5 75
                        .82 | 11.75 | 21.45 | 17.75
                                                      .93 | 23.75
                       .82 | 12.00 56.93 | 18.00
                                                      .93 | 24.00
I CALTB
 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
                      RAIN | TIME RAIN | TIME RAIN | TIME RAIN
                      mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
                .167
                        .57 | 6.167
                                     1.03 | 12.167
                                                     7.43 | 18.17
                                                                     .93
                                    1.03 |12.333
                .333
                        .57 | 6.333
                                                     7.43 | 18.33
                                                                     93
                .500
                       .57 | 6.500
                                    1.03 | 12.500 7.42 | 18.50
                .667
                       .57 | 6.667
                                    1.03 |12.667
1.03 |12.833
                                                     3.82 | 18.67
                                                                     . 93
                       .57 | 6.833
                833
                                                     3.82 | 18.83
                                                                     93
               1.000
                       .57 | 7.000
                                     1.03 |13.000
                                                     3.82 | 19.00
               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
                        .57 | 7.833
               1.833
                                     1.03 | 113.833
                                                     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
               2.667
                        .67 | 8.667
                                     1.39 | 14.667
                                                     1.55 | 20.67
                                                                     .62
                                     1.39 |14.833
                        .67 | 8.833
               2 833
                                                     1.55 | 20.83
                                                                     .62
               3.000
                       .67 | 9.000
                                     1.39 | 15.000
                                                     1.55 | 21.00
               3.167
                        .67 | 9.167
                                      1.65 | 15.167
                                                     1.55 | 21.17
                                                                     .62
                                     1.65 | 15.333
               3 333
                        .67 | 9.333
                                                     1.55 | 21.33
                                                                     62
               3.500
                       .67 | 9.500
                                     1.65 |15.500
                                                     1.55 | 21.50
               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
                                     1.86 |16.000
               4.000
                       .67 |10.000
                                                     1.55 | 22.00
               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
               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
    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.
______
I CALTE
| NASHYD (0006) | Area (ha) = 13.70 Curve Number (CN) = 72.0
| \mbox{ID= 1 DT=10.0 min} | \mbox{Ia} \mbox{ (mm)= } 5.00 \mbox{ \# of Linear Res.(N)= } 3.00 \\ ----- \mbox{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.
| 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)=
   Unit Hyd Qpeak (cms) = .425
    PEAK FLOW
                           .101 (i)
                  (cms) =
    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 RAIN | TIME RAIN | TIME RAIN | TIME
               hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                               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
                .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
              1.50
                      .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
              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
              3.00
                      .82 | 9.00
                                   1.71 | 15.00
                                                  1.90 | 21.00
                                                                 .76
              3.25
                                    2.03 | 15.25
                      .82 | 9.25
                                                  1.90 | 21.25
                                                                  .76
              3.50
                      .82 | 9.50
                                   2.03 | 15.50
                                                  1.90 | 21.50
               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
               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
                                                                 .76
               5.50
                      1.01 | 11.50
                                   6.08 | 17.50
                                                  1.14 | 23.50
               5.75
                     1.01 | 11.75
                                   26.35 | 17.75
                                                 1.14 | 23.75
              6.00
                    1.01 | 12.00 69.93 | 18.00 1.14 | 24.00
                                                                  76
| CALIB |
----- U.H. Tp(hrs)=
```

```
NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.
                             ---- TRANSFORMED HYETOGRAPH ----
                      RAIN | TIME RAIN | TIME RAIN | TIME
               TIME
                                                                  RATN
                hrs
                      mm/hr | hrs mm/hr | hrs mm/hr | hrs
                .167
                       .70 | 6.167
                                     1.27 | 12.167
                                                    9.12 | 18.17
                                                                    1.14
                                     1.27 |12.333
                .333
                        .70 | 6.333
                                                    9.12 | 18.33
                                                                    1.14
               .500
                       .70 | 6.500
                                    1.27 |12.500
                                                    9.12 | 18.50
                                                                    1.14
                       .70 | 6.667
               .667
                                     1.27 | 12.667
                                                    4.69 | 18.67
                                                                    1.14
                                     1.27 |12.833
                                                    4.69 | 18.83
                .833
                       .70 | 6.833
                                                                    1.14
              1.000
                       .70 | 7.000
                                     1.27 |13.000
                                                    4.69 | 19.00
              1.167
                        .70 | 7.167
                                     1.27 | 13.167
                                                    3.29 | 19.17
                                                                    1.14
                        .70 | 7.333
              1.333
                                     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
              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
              2.667
                       .82 | 8.667
                                     1.71 | 14.667
                                                    1.90 | 20.67
                                                                     .76
              2 833
                                    1.71 |14.833
                                                    1.90 | 20.83
                       .82 | 8.833
                                                                     76
                                                    1.90 | 21.00
              3.000
                       .82 | 9.000
                                     1.71 |15.000
              3.167
                       .82 | 9.167
                                     2.03 | 15.167
                                                    1.90 | 21.17
                                                                     .76
                       .82 | 9.333
                                     2.03 |15.333
                                                                     .76
              3.333
                                                    1.90 | 21.33
              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
              4.667
                      1.01 |10.667
                                     3.93 |16.667
                                                    1.14 | 22.67
                                                                     .76
                      1.01 |10.833
                                    3.93 |16.833
              4 833
                                                    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
                                     48.14 | 17.833
                                                                     .76
              5.833
                      1.01 |11.833
                                                    1.14 | 23.83
              6.000 1.01 | 12.000
                                    69.93 |18.000
                                                    1.14 | 24.00
    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.
______
 NASHYD (0006) | Area (ha) = 13.70 Curve Number (CN) = 72.0
| \text{ID} = 1 \text{ DT} = 10.0 \text{ min} | \text{Ia} \quad (mm) = 5.00 \text{ # 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
                   (mm) = 21.663
    RUNOFF VOLUME
    TOTAL RAINFALL (mm) = 63.346
    RUNOFF COEFFICIENT = .342
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

```
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)=
   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 =
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
 ** SIMILATION 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 RAIN | TIME RAIN | TIME RAIN | TIME
              hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                             mm/hr
               .25
                     .81 | 6.25
                                  1.48 | 12.25
                                               10.65 | 18.25
                                                              1.33
               .50
                     .81 | 6.50
                                 .75
                                  1.48 | 12.75
                                                5.47 | 18.75
                      .81 | 6.75
                                                              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
              1.50
                      .81 | 7.50
                                  1.48 | 13.50
                                                4.14 | 19.50
                                                              1.33
                                  1.48 | 13.75
              1.75
                     .81 | 7.75
                                                3.11 | 19.75
              2.00
                     .81 | 8.00
                                 1.48 | 14.00
                                                3.11 | 20.00
              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 1 20 50
                                                               89
              2.75
                     .96 | 8.75
                                  2.00 | 14.75
                                                 2.22 | 20.75
                     .96 | 9.00
              3.00
                                  2.00 | 15.00
                                                 2.22 | 21.00
                                                               .89
                     .96 | 9.25
              3.25
                                  2.37 | 15.25
                                                 2.22 | 21.25
              3.50
                     .96 | 9.50
                                  2.37 | 15.50
                                                 2.22 | 21.50
              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
              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
              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
_______
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)=
       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
                                 1.48 | 12.167 | 10.65 | 18.17
                     .81 | 6.167
                                                              1 33
              167
              .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
```

```
.81 | 7.000
                                   1.48 |13.000
                                                   5.47 | 19.00
              1.167
                       .81 | 7.167
                                    1.48 | 13.167
                                                   3.85 | 19.17
                                                                                               (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                  1.33
              1.333
                       .81 | 7.333
                                    1.48 | 13.333
                                                   3.99 | 19.33
                                                                  1.33
                       .81 | 7.500
                                   1.48 | 13.500
                                                   4.14 | 19.50
              1.500
              1.667
                       .81 | 7.667
                                    1.48 |13.667
                                                   3.11 | 19.67
                                                                  1.33
                       .81 | 7.833
                                   1.48 |13.833
                                                                                            ** SIMILATION NUMBER: 4 **
              1 833
                                                   3.11 | 19.83
              2.000
                      .81 | 8.000
                                    1.48 |14.000
                                                   3.11 | 20.00
                                                                                           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
              2.667
                       .96 | 8.667
                                    2.00 | 14.667
                                                   2.22 | 20.67
                                                                   . 89
                                                                                            READ STORM | Filename: G:\Projects\2012\12116 - TSI London
                                    2.00 |14.833
                                                   2.22 | 20.83
                                                                   .89
              2.833
                       .96 | 8.833
                                                                                                                         GE1 & GE2\Design\FSR Calcs\VO2\Storm\
              3.000
                      .96 | 9.000
                                    2.00 |15.000
                                                   2.22 | 21.00
                                                                                                                         SCS Type II - London\25yrSCSTypeII24hr.stm
                                                                   .89
              3.167
                       .96 | 9.167
                                     2.37 | 15.167
                                                   2.22 | 21.17
                                                                   .89
                                                                                          | Ptotal= 89.53 mm | Comments: 25-Year 24 hour SCS Type II: London Airp
                       .96 | 9.333
              3.333
                                    2.37 | 15.333
                                                   2.22 | 21.33
                                                                   . 89
                                                                                          -----
              3.500
                      .96 | 9.500
                                    2.37 |15.500
                                                   2.22 | 21.50
                                                                   .89
                                                                                                         TIME RAIN | TIME RAIN | TIME RAIN | TIME
              3.667
                       .96 | 9.667
                                    2.66 | 15.667
                                                   2.22 | 21.67
                                                                                                         hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                                   .89
                                                                                                                                                            mm/hr
                                                                                                          .25
              3.833
                       .96 | 9.833
                                    2.66 | 15.833
                                                   2.22 | 21.83
                                                                   .89
                                                                                                                .98 | 6.25
                                                                                                                              1.79 | 12.25 | 12.89 | 18.25
                                                                                                                                                            1 61
              4.000
                       .96 |10.000
                                   2.66 | 16.000
                                                   2.22 | 22.00
                                                                                                          .50
                                                                                                                 .98 | 6.50 1.79 | 12.50 12.89 | 18.50
              4.167
                      1.18 |10.167
                                    3.40 | 16.167
                                                   1.33 | 22.17
                                                                   .89
                                                                                                          .75
                                                                                                                 .98 | 6.75
                                                                                                                              1.79 | 12.75 6.63 | 18.75
                                                                                                                                                             1.61
                                                                                                                              1.79 | 13.00
                                                                                                                 .98 | 7.00
              4 333
                      1.18 | 10.333
                                    3.40 |16.333
                                                   1.33 | 22.33
                                                                   89
                                                                                                         1.00
                                                                                                                                              6.63 | 19.00
                                                                                                                                                            1 61
              4.500
                     1.18 | 10.500
                                   3.40 |16.500
                                                   1.33 | 22.50
                                                                   .89
                                                                                                         1.25 .98 | 7.25
                                                                                                                              1.79 | 13.25 4.66 | 19.25
              4.667
                      1.18 | 10.667
                                   4.59 |16.667
4.59 |16.833
                                                   1.33 | 22.67
                                                                                                         1.50
                                                                                                                 .98 | 7.50
                                                                                                                              1.79 | 13.50
1.79 | 13.75
                                                                                                                                              5.01 | 19.50
                                                                   . 89
                                                                                                                                                            1.61
              4 833
                     1.18 | 10.833
                                                   1.33 | 22.83
                                                                                                         1.75
                                                                                                                 .98 | 7.75
                                                                                                                                              3.76 | 19.75
                                                                   89
                                                                                                                                              3.76 | 20.00
              5.000
                     1.18 | 11.000
                                   4.59 | 17.000
                                                   1.33 | 23.00
                                                                                                         2.00
                                                                                                                 .98 | 8.00
                                                                                                                              1.79 | 14.00
              5.167
                      1.18 | 11.167
                                    7.10 | 17.167
                                                   1.33 | 23.17
                                                                   .89
                                                                                                         2.25
                                                                                                                 1.16 | 8.25
                                                                                                                               2.42 | 14.25
                                                                                                                                              2.69 | 20.25
                                                                                                                                                             1.07
              5.333
                                    7.10 |17.333
                                                   1.33 | 23.33
                                                                                                         2.50
                                                                                                                                              2.69 | 20.50
                     1.18 | 11.333
                                                                   .89
                                                                                                                 1.16 | 8.50
                                                                                                                               2.42 | 14.50
                                                                                                                                                             1.07
              5.500
                     1.18 | 11.500
                                    7.10 |17.500
                                                   1.33 | 23.50
                                                                  .89
                                                                                                         2.75
                                                                                                                1.16 | 8.75
                                                                                                                               2.42 | 14.75
                                                                                                                                              2.69 | 20.75
              5.667
                      1.18 | 11.667
                                    30.77 | 17.667
                                                   1.33 | 23.67
                                                                   .89
                                                                                                         3.00
                                                                                                                 1.16 | 9.00
                                                                                                                               2.42 | 15.00
                                                                                                                                              2.69 | 21.00
                                                                                                                                                             1.07
              5.833
                     1.18 |11.833
                                   56.22 | 17.833
                                                   1.33 | 23.83
                                                                   .89
                                                                                                         3.25
                                                                                                                1.16 | 9.25
                                                                                                                               2.87 | 15.25
                                                                                                                                              2.69 | 21.25
                                                                                                                                                             1.07
              6.000
                    1.18 |12.000
                                   81.66 |18.000
                                                   1.33 | 24.00
                                                                                                         3.50
                                                                                                                1.16 | 9.50
                                                                                                                              2.87 | 15.50
                                                                                                                                              2.69 | 21.50
                                                                   . 89
                                                                                                         3.75
                                                                                                                 1.16 | 9.75
                                                                                                                               3.22 | 15.75
                                                                                                                                              2.69 | 21.75
                                                                                                                                                             1.07
    Unit Hyd Qpeak (cms) = 1.419
                                                                                                         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
    PEAK FLOW
                   (cms) = .765 (i)
                                                                                                         4.50
                                                                                                                 1.43 | 10.50
                                                                                                                              4.12 | 16.50
                                                                                                                                             1.61 | 22.50
                                                                                                                                                            1.07
    TIME TO PEAK (hrs) = 12.667
                                                                                                         4.75
                                                                                                                 1.43 | 10.75
                                                                                                                              5.55 | 16.75
                                                                                                                                              1.61 | 22.75
                                                                                                                                                            1 07
    RUNOFF VOLUME (mm) = 28.351
                                                                                                         5.00 1.43 | 11.00
                                                                                                                              TOTAL RAINFALL (mm) = 73.968
                                                                                                         5.25
                                                                                                                 1.43 | 11.25
                                                                                                                               8.60 | 17.25
                                                                                                                                              1.61 | 23.25
                                                                                                                                                            1.07
    RUNOFF COEFFICIENT = .383
                                                                                                                 1.43 | 11.50
                                                                                                         5 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
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                         6.00
                                                                                                               1.43 | 12.00 98.84 | 18.00 1.61 | 24.00
                                                                                                                                                            1.07
 NASHYD (0006) | Area (ha) = 13.70 Curve Number (CN) = 72.0
                                                                                                    (0005) | Area
|ID= 1 DT=10.0 min | Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
                                                                                          | NASHYD
                                                                                                                     (ha) = 27.50 Curve Number (CN) = 72.0
----- U.H. Tp(hrs)= .77
                                                                                          |ID= 1 DT=10.0 min | Ia
                                                                                                                     (mm) = 5.00 \# of Linear Res.(N) = 3.00
                                                                                          ----- U.H. Tp(hrs)=
    Unit Hyd Qpeak (cms) = .680
                                                                                                  NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.
    PEAK FLOW
                   (cms) = .371 (i)
    TIME TO PEAK
                  (hrs) = 12.667
                  (mm) = 28.351
    RUNOFF VOLUME
                                                                                                                       ---- TRANSFORMED HYETOGRAPH ----
    TOTAL RAINFALL (mm) = 73.968
                                                                                                         TIME RAIN | TIME RAIN | TIME RAIN | TIME
                                                                                                                                                            RAIN
    RUNOFF COEFFICIENT = .383
                                                                                                          hrs
                                                                                                               mm/hr | hrs mm/hr | hrs
                                                                                                                                             mm/hr | hrs
                                                                                                                                                            mm/hr
                                                                                                          .167
                                                                                                                 .98 | 6.167
                                                                                                                              1.79 | 12.167
                                                                                                                                             12.89 | 18.17
                                                                                                                                                            1.61
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                         .333
                                                                                                                 .98 | 6.333
                                                                                                                              1.79 | 12.333 | 12.89 | 18.33
                                                                                                          .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
I CALTR
                                                                                                         1.000
                                                                                                                 .98 | 7.000
                                                                                                                               1.79 |13.000
                                                                                                                                              6.62 | 19.00
                                                                                                                                                             1.61
| NASHYD (0007) | Area (ha) = 4.90 Curve Number (CN) = 72.0
                                                                                                         1.167
                                                                                                                 .98 | 7.167
                                                                                                                               1.79 | 13.167
                                                                                                                                              4.66 | 19.17
                                                                                                                                                             1.61
| ID= 1 DT=10.0 min | Ia (mm) = 5.00 \# of Linear Res.(N) = 3.00
                                                                                                         1.333
                                                                                                                 .98 | 7.333
                                                                                                                               1.79 |13.333
                                                                                                                                             4.84 | 19.33
----- U.H. Tp(hrs) = .44
                                                                                                         1.500
                                                                                                                 .98 | 7.500
                                                                                                                               1.79 |13.500
                                                                                                                                              5.01 | 19.50
                                                                                                                                                             1.61
                                                                                                                 .98 | 7.667
                                                                                                         1 667
                                                                                                                               1.79 | 13.667
                                                                                                                                              3.76 | 19.67
                                                                                                                                                             1 61
    Unit Hyd Qpeak (cms)=
                           .425
                                                                                                         1.833
                                                                                                                 .98 | 7.833
                                                                                                                              1.79 | 13.833 3.76 | 19.83
                                                                                                         2.000
                                                                                                                  .98 | 8.000
                                                                                                                               1.79 |14.000
                                                                                                                                              3.76 | 20.00
                                                                                                                                                             1.61
    PEAK FLOW
                   (cms) = 195 (i)
                                                                                                         2 167
                                                                                                                 1.16 | 8.167
                                                                                                                               2.42 | 14.167
                                                                                                                                              2.69 | 20.17
                                                                                                                                                             1 07
    TIME TO PEAK
                  (hrs) = 12.333
                                                                                                         2.333
                                                                                                                 1.16 | 8.333
                                                                                                                               2.42 | 14.333 | 2.69 | 20.33
                                                                                                                                                             1.07
    RUNOFF VOLUME
                   (mm) = 28.318
                                                                                                         2.500
                                                                                                                 1.16 | 8.500
                                                                                                                               2.42 | 14.500
                                                                                                                                              2.69 | 20.50
                                                                                                                                                            1.07
    TOTAL RAINFALL (mm) = 73.968
                                                                                                         2.667
                                                                                                                 1.16 | 8.667
                                                                                                                               2.42 | 14.667
                                                                                                                                              2.69 | 20.67
                                                                                                                                                             1.07
    RUNOFF COEFFICIENT = .383
                                                                                                                 1.16 | 8.833
                                                                                                                               2.42 | 14.833
                                                                                                                                              2.69 | 20.83
```

```
1.16 | 9.000 2.42 | 15.000
                                                 2.69 | 21.00
                                                                                                                    SCS Type II - London\50yrSCSTypeII24hr.stm
             3.167
                     1.16 | 9.167
                                   2.86 | 15.167
                                                 2.69 | 21.17
                                                                                       | Ptotal= 99.98 mm | Comments: 50-Year 24 hour SCS Type II: London Airp
                                                               1.07
             3.333
                     1.16 | 9.333
                                  2.87 | 15.333
                                                 2.69 | 21.33
                                                               1 07
                                                                                       _____
                     1.16 | 9.500
                                  2.87 |15.500
                                                2.69 | 21.50
                                                                                                     TIME RAIN | TIME RAIN | TIME RAIN | TIME
             3.500
             3.667
                     1.16 | 9.667
                                  3.22 | 15.667
                                                 2.69 | 21.67
                                                                                                      hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                                                                                                                      mm/hr
                                                               1.07
                                  3.22 | 15.833 2.69 | 21.83
                    1.16 | 9.833
             3.833
                                                               1 07
                                                                                                      .25
                                                                                                            1.10 | 6.25
                                                                                                                         2.00 | 12.25 | 14.40 | 18.25
                                                                                                                                                      1 80
                    1.16 |10.000
             4.000
                                  3.22 |16.000
                                                 2.69 | 22.00
                                                                                                            1.10 | 6.50
                                                                                                                         4.167
                     1.43 | 10.167
                                  4.12 | 16.167
                                                 1.61 | 22.17
                                                               1.07
                                                                                                      .75
                                                                                                            1.10 | 6.75
                                                                                                                          2.00 | 12.75
                                                                                                                                         7.40 | 18.75
                                                                                                                                                       1.80
             4.333
                     1.43 |10.333
                                  4.12 |16.333
                                                 1.61 | 22.33
                                                               1.07
                                                                                                     1.00
                                                                                                            1.10 | 7.00
                                                                                                                          2.00 | 13.00
                                                                                                                                         7.40 | 19.00
                                                                                                                                                       1.80
                                                 1.61 | 22.50
             4.500
                     1.43 | 10.500
                                  4.12 | 16.500
                                                               1.07
                                                                                                     1.25
                                                                                                            1.10 | 7.25
                                                                                                                          2.00 | 13.25
                                                                                                                                        5.20 | 19.25
                                                                                                                          2.00 | 13.50
             4.667
                     1.43 | 10.667
                                   5.55 | 16.667
                                                 1.61 | 22.67
                                                               1.07
                                                                                                     1.50
                                                                                                            1.10 | 7.50
                                                                                                                                         5.60 | 19.50
                                                                                                                                                       1.80
             4.833
                                                                                                     1.75
                                   5.55 |16.833
                                                                                                            1.10 | 7.75
                                                                                                                          2.00 | 13.75
                     1.43 | 10.833
                                                 1.61 | 22.83
                                                               1.07
                                                                                                                                         4.20 | 19.75
             5.000
                    1.43 |11.000
                                  5.55 |17.000
                                                 1.61 | 23.00
                                                               1.07
                                                                                                     2.00
                                                                                                            1.10 | 8.00
                                                                                                                          2.00 | 14.00
                                                                                                                                         4.20 | 20.00
                                                                                                     2.25
              5.167
                     1.43 | 11.167
                                   8.60 | 17.167
                                                 1.61 | 23.17
                                                               1.07
                                                                                                            1.30 | 8.25
                                                                                                                          2.70 | 14.25
                                                                                                                                         3.00 | 20.25
                                                                                                                                                       1.20
                                                                                                                          2.70 | 14.50
             5.333
                     1.43 |11.333
                                   8.60 I17.333
                                                 1.61 | 23.33
                                                               1.07
                                                                                                     2.50
                                                                                                            1.30 | 8.50
                                                                                                                                         3.00 | 20.50
                                                                                                                                                       1.20
             5.500
                    1.43 |11.500
                                  8.60 |17.500
                                                 1.61 | 23.50
                                                               1.07
                                                                                                     2.75 1.30 | 8.75
                                                                                                                          2.70 | 14.75
                                                                                                                                         3.00 | 20.75
                                                                                                                                                       1.20
             5.667
                     1.43 | 11.667
                                  37.25 | 17.667
                                                 1.61 | 23.67
                                                               1.07
                                                                                                     3.00
                                                                                                            1.30 | 9.00
                                                                                                                          2.70 | 15.00
                                                                                                                                         3.00 | 21.00
                                                                                                                                                       1.20
             5.833 1.43 |11.833
                                  68.05 | 17.833 | 1.61 | 23.83
                                                                                                     3.25
                                                               1 07
                                                                                                            1.30 | 9.25
                                                                                                                          3.20 | 15.25
                                                                                                                                         3.00 | 21.25
                                                                                                                                                       1 20
             6.000 1.43 | 12.000 98.84 | 18.000 1.61 | 24.00
                                                                                                     3.50 1.30 | 9.50 3.20 | 15.50 3.00 | 21.50
                                                                                                     3.75
                                                                                                            1.30 | 9.75
                                                                                                                         3.60 | 15.75
3.60 | 16.00
                                                                                                                                         3.00 | 21.75
                                                                                                                                                       1.20
    Unit Hyd Qpeak (cms) = 1.419
                                                                                                     4.00 1.30 | 10.00
                                                                                                                                         3.00 | 22.00
                                                                                                                                                       1 20
                                                                                                     4.25 1.60 | 10.25
                                                                                                                         4.60 | 16.25 | 1.80 | 22.25
                                                                                                     4.50 1.60 | 10.50
4.75 1.60 | 10.75
                                                                                                            1.60 | 10.50
                                                                                                                         4.60 | 16.50 | 1.80 | 22.50
                  (cms) = 1.062 (i)
                                                                                                                                                       1.20
    PEAK FLOW
    TIME TO PEAK (hrs) = 12.667
                                                                                                                          6.20 | 16.75 | 1.80 | 22.75
    RUNOFF VOLUME (mm) = 38.976
                                                                                                      5.00
                                                                                                            1.60 | 11.00
                                                                                                                          6.20 | 17.00 | 1.80 | 23.00
                                                                                                            1.60 | 11.25
    TOTAL RAINFALL (mm) = 89.534
                                                                                                      5.25
                                                                                                                          9.60 | 17.25
                                                                                                                                         1.80 | 23.25
                                                                                                                                                       1.20
                                                                                                      5.50
                                                                                                                          9.60 | 17.50
                                                                                                                                         1.80 | 23.50
    RUNOFF COEFFICIENT = .435
                                                                                                            1.60 | 11.50
                                                                                                                                                       1.20
                                                                                                      5.75
                                                                                                          1.60 | 11.75
                                                                                                                         41.59 | 17.75 | 1.80 | 23.75
                                                                                                                                                       1.20
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                     6.00 1.60 | 12.00 110.37 | 18.00 1.80 | 24.00
                                                                                                                                                      1.20
I CALTR
 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
                                                                                       NASHYD
                                                                                                (0005) | Area
                                                                                                                 (ha) = 27.50 Curve Number (CN) = 72.0
----- U.H. Tp(hrs)= .77
                                                                                       ----- U.H. Tp(hrs) = .74
    Unit Hyd Qpeak (cms) = .680
                                                                                              NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.
    PEAK FLOW
                  (cms) = .515 (i)
    TIME TO PEAK
                 (hrs) = 12.667
    RUNOFF VOLUME (mm) = 38.977
                                                                                                                  ---- TRANSFORMED HYETOGRAPH ----
    TOTAL RAINFALL (mm) = 89.534
                                                                                                      TIME RAIN | TIME RAIN | TIME RAIN | TIME
    RUNOFF COEFFICIENT = .435
                                                                                                      hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                                                                                                                      mm/hr
                                                                                                      .167
                                                                                                                         2.00 | 12.167 | 14.40 | 18.17
                                                                                                            1.10 | 6.167
                                                                                                                                                      1.80
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                      .333 1.10 | 6.333
                                                                                                                          .500
                                                                                                            1.10 | 6.500
                                                                                                                          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
                                                                                                     1.000
                                                                                                            1.10 | 7.000
                                                                                                                          2.00 |13.000
                                                                                                                                        7.40 | 19.00
I CALTR
                                                                                                                                                       1.80
| NASHYD (0007) | Area (ha) = 4.90 Curve Number (CN) = 72.0
                                                                                                     1.167
                                                                                                            1.10 | 7.167
                                                                                                                          2.00 | 13.167
                                                                                                                                        5.20 | 19.17
                                                                                                                                                       1 80
| \text{ID} = 1 \text{ DT} = 10.0 \text{ min} | \text{Ia} \quad (\text{mm}) = 5.00 \text{ \# of Linear Res.(N)} = 3.00
                                                                                                     1.333 1.10 | 7.333
                                                                                                                         ----- U.H. Tp(hrs) = .44
                                                                                                     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
   Unit Hyd Qpeak (cms) = .425
                                                                                                     2.000
                                                                                                            1.10 | 8.000
                                                                                                                          2.00 |14.000
                                                                                                                                         4.20 | 20.00
                                                                                                                                                       1.80
    PEAK FLOW
                  (cms) =
                          .270 (i)
                                                                                                     2.167
                                                                                                            1.30 | 8.167
                                                                                                                           2.70 |14.167
                                                                                                                                         3.00 | 20.17
                                                                                                                                                       1.20
    TIME TO PEAK (hrs) = 12.333
                                                                                                     2.333
                                                                                                            1.30 | 8.333
                                                                                                                          2.70 |14.333
                                                                                                                                         3.00 | 20.33
    RUNOFF VOLUME
                  (mm) = 38.932
                                                                                                     2.500
                                                                                                            1.30 | 8.500
                                                                                                                           2.70 |14.500
                                                                                                                                         3.00 | 20.50
                                                                                                                                                       1.20
    TOTAL RAINFALL (mm) = 89.534
                                                                                                     2.667
                                                                                                            1.30 | 8.667
                                                                                                                          2.70 |14.667
                                                                                                                                         3.00 I 20.67
                                                                                                                                                       1.20
    RUNOFF COEFFICIENT = .435
                                                                                                     2.833
                                                                                                            1.30 | 8.833
                                                                                                                          2.70 |14.833
                                                                                                                                         3.00 | 20.83
                                                                                                     3.000
                                                                                                            1.30 | 9.000
                                                                                                                           2.70 |15.000
                                                                                                                                         3.00 | 21.00
                                                                                                                                                       1.20
                                                                                                            1.30 | 9.167
                                                                                                                          3.20 | 15.167
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                     3.167
                                                                                                                                         3.00 I 21.17
                                                                                                                                                       1.20
                                                                                                     3.333
                                                                                                            1.30 | 9.333
                                                                                                                          3.20 |15.333
                                                                                                                                         3.00 | 21.33
                                                                                                     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
 ** SIMILATION NUMBER: 5 **
                                                                                                     3.833
                                                                                                            1.30 | 9.833
                                                                                                                         3.60 | 15.833 | 3.00 | 21.83
 ********
                                                                                                     4.000
                                                                                                            1.30 |10.000
                                                                                                                          3.60 |16.000
                                                                                                                                         3.00 | 22.00
                                                                                                                                                       1.20
                                                                                                                                        1 80 | 22 17
                                                                                                     4 167
                                                                                                            1.60 | 10.167
                                                                                                                          4.60 | 16.167
                                                                                                                                                       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
                    Filename: G:\Projects\2012\12116 - TSI London
                                                                                                     4.667
                                                                                                            1.60 |10.667
   READ STORM |
                                                                                                                          6.20 |16.667
                                                                                                                                        1.80 | 22.67
                                                                                                                                                       1.20
                    GE1 & GE2\Design\FSR Calcs\VO2\Storm\
                                                                                                     4.833
                                                                                                            1.60 | 10.833
                                                                                                                          6.20 | 16.833
                                                                                                                                       1.80 | 22.83
```

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1.60 | 11.000 6.20 | 17.000 1.80 | 23.00
                                                                                                    2.00 1.23 | 8.00 2.23 | 14.00 4.69 | 20.00
             5.167
                     1.60 |11.167
                                   9.60 | 17.167
                                                 1.80 | 23.17
                                                                                                    2.25
                                                                                                           1.45 | 8.25
                                                                                                                         3.01 | 14.25
                                                              1.20
                                                                                                                                       3.35 | 20.25
                                                                                                                                                     1.34
             5 333
                     1.60 | 11.333
                                  9.60 | 17.333
                                                1.80 | 23.33
                                                              1 20
                                                                                                    2.50
                                                                                                           1.45 | 8.50
                                                                                                                         3.01 | 14.50
                                                                                                                                       3.35 | 20.50
                                                                                                                                                     1 34
                   1.60 |11.500
                                  9.60 | 17.500 1.80 | 23.50
                                                                                                    2.75 1.45 | 8.75
                                                                                                                        3.01 | 14.75
                                                                                                                                       3.35 | 20.75
                                                              1.20
             5 667
                     1.60 |11.667
                                 41.59 | 17.667
                                                1.80 | 23.67
                                                               1.20
                                                                                                    3.00
                                                                                                           1.45 | 9.00
                                                                                                                         3.01 | 15.00
                                                                                                                                       3.35 | 21.00
                                                                                                                                                     1.34
             5.833 1.60 |11.833 75.98 |17.833 1.80 | 23.83
                                                                                                    3.25 1.45 | 9.25
                                                                                                                         3.57 | 15.25
                                                              1 20
                                                                                                                                       3.35 | 21.25
                                                                                                                                                     1 34
             6.000 1.60 | 12.000 110.37 | 18.000 1.80 | 24.00
                                                                                                     3.50
                                                                                                           1.45 | 9.50
                                                                                                                        3.57 | 15.50
                                                                                                                                        3.35 | 21.50
                                                                                                    3.75
                                                                                                           1.45 | 9.75
                                                                                                                         4.02 | 15.75
                                                                                                                                        3.35 | 21.75
                                                                                                                                                     1.34
    Unit Hyd Qpeak (cms) = 1.419
                                                                                                    4.00
                                                                                                           1.45 | 10.00
                                                                                                                         4.02 | 16.00
                                                                                                                                        3.35 | 22.00
                                                                                                                                                     1.34
                                                                                                           1.79 | 10.25
                                                                                                     4.25
                                                                                                                         5.13 | 16.25
                                                                                                                                        2.01 | 22.25
                                                                                                           1.79 | 10.50
    PEAK FLOW
                  (cms) = 1.274 (i)
                                                                                                     4.50
                                                                                                                         5.13 | 16.50
                                                                                                                                        2.01 | 22.50
                                                                                                                                                     1.34
    TIME TO PEAK (hrs) = 12.667
                                                                                                     4.75
                                                                                                           1.79 | 10.75
                                                                                                                         6.92 | 16.75
                                                                                                                                        2.01 | 22.75
                                                                                                                                                     1.34
    RUNOFF VOLUME (mm) = 46.552
                                                                                                     5.00
                                                                                                           1.79 | 11.00
                                                                                                                         6.92 | 17.00
                                                                                                                                        2.01 | 23.00
    TOTAL RAINFALL (mm) = 99.981
                                                                                                     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
    RUNOFF COEFFICIENT = .466
                                                                                                                                                     1.34
                                                                                                     5.75
                                                                                                           1.79 | 11.75
                                                                                                                        46.42 | 17.75
                                                                                                                                     2.01 | 23.75
                                                                                                                                                     1.34
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                    6.00
                                                                                                          1.79 | 12.00 | 123.20 | 18.00 | 2.01 | 24.00
                                                                                                                                                     1.34
______
                                                                                      ______
I CALTR
                                                                                      | CALIB
| NASHYD (0006) | Area (ha) = 13.70 Curve Number (CN) = 72.0
                          (mm) = 5.00 \# of Linear Res.(N) = 3.00
                                                                                      | NASHYD (0005) | Area (ha) = 27.50
|ID= 1 DT=10.0 min | Ia (mm) = 5.00
                                                                                                                (ha) = 27.50 Curve Number (CN) = 72.0
ITD= 1 DT=10.0 min | Ta
----- U.H. Tp(hrs) = .77
                                                                                                                             # of Linear Res.(N) = 3.00
                                                                                      ----- U.H. Tp(hrs)=
   Unit Hyd Qpeak (cms) = .680
                                                                                              NOTE: RAINFALL WAS TRANSFORMED TO 10.0 MIN. TIME STEP.
    PEAK FLOW
                  (cms) = .618 (i)
    TIME TO PEAK
                 (hrs) = 12.667
    RUNOFF VOLUME (mm) = 46.553
                                                                                                                 ---- TRANSFORMED HYETOGRAPH ----
    TOTAL RAINFALL (mm) = 99.981
                                                                                                     TIME RAIN | TIME RAIN | TIME RAIN | TIME
    RUNOFF COEFFICIENT = .466
                                                                                                     hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs
                                                                                                                                                    mm/hr
                                                                                                     .167
                                                                                                          1.23 | 6.167
                                                                                                                        2.23 | 12.167 | 16.07 | 18.17
                                                                                                                                                     2 01
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                     .333 1.23 | 6.333
                                                                                                                        .500 1.23 | 6.500
.667 1.23 | 6.667
                                                                                                                        2.01
                                                                                                                                                     2 01
                                                                                                     .833 1.23 | 6.833 2.23 | 12.833 8.26 | 18.83
                                                                                                    1.000
                                                                                                           1.23 | 7.000
                                                                                                                        2.23 |13.000
                                                                                                                                       8.26 | 19.00
                                                                                                                                                     2.01
                                                                                                    1.167 1.23 | 7.167
| NASHYD (0007) | Area (ha) = 4.90 Curve Number (CN) = 72.0
                                                                                                                        2.23 |13.167
                                                                                                                                       5.80 | 19.17
                                                                                                                                                     2 01
|ID= 1 DT=10.0 min | Ia (mm) = 5.00 # of Linear Res.(N) = 3.00
                                                                                                    1.333 1.23 | 7.333
                                                                                                                        2.23 |13.333
                                                                                                                                       6.03 | 19.33
                                                                                                           1.23 | 7.500
                                                                                                                         2.23 |13.500
----- U.H. Tp(hrs) = .44
                                                                                                    1.500
                                                                                                                                       6.25 | 19.50
                                                                                                                                                     2.01
                                                                                                    1.667
                                                                                                           1.23 | 7.667
                                                                                                                                       4.69 | 19.67
                                                                                                                         2.23 |13.667
                                                                                                           1.23 | 7.833
                                                                                                                        2.23 |13.833
                                                                                                    1.833
                                                                                                                                       4.69 | 19.83
    Unit Hyd Qpeak (cms) = .425
                                                                                                    2.000
                                                                                                           1.23 | 8.000
                                                                                                                         2.23 |14.000
                                                                                                                                       4.69 | 20.00
                                                                                                                                                     2.01
    PEAK FLOW
                  (cms) = .324 (i)
                                                                                                    2.167
                                                                                                           1.45 | 8.167
                                                                                                                                        3.35 | 20.17
                                                                                                                         3.01 | 14.167
                                                                                                                                                     1.34
    TIME TO PEAK (hrs) = 12.333
                                                                                                    2.333
                                                                                                           1.45 | 8.333
                                                                                                                         3.01 |14.333
                                                                                                                                       3.35 | 20.33
    RUNOFF VOLUME
                  (mm) = 46.498
                                                                                                    2.500
                                                                                                           1.45 | 8.500
                                                                                                                         3.01 |14.500
                                                                                                                                       3.35 | 20.50
                                                                                                                                                     1.34
    TOTAL RAINFALL (mm) = 99.981
                                                                                                           1.45 | 8.667
                                                                                                    2.667
                                                                                                                         3.01 | 14.667
                                                                                                                                       3.35 | 20.67
                                                                                                                                                     1 34
    RUNOFF COEFFICIENT = .465
                                                                                                    2.833 1.45 | 8.833
                                                                                                                        3.01 | 14.833 3.35 | 20.83
                                                                                                    3.000
                                                                                                           1.45 | 9.000
                                                                                                                         3.01 |15.000
                                                                                                                                       3.35 | 21.00
                                                                                                                                                     1.34
    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                    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
 ** SIMILATION NUMBER: 6 **
                                                                                                    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
                                                                                                    4.500
                                                                                                           1.79 | 10.500
                                                                                                                         5.13 |16.500
                                                                                                                                        2.01 | 22.50
                                                                                                                                                     1.34
                                                                                                           1.79 |10.667
 READ STORM |
                   Filename: G:\Projects\2012\12116 - TSI London
                                                                                                    4.667
                                                                                                                         6.92 | 16.667
                                                                                                                                        2.01 | 22.67
                                                                                                                                                     1.34
                  GE1 & GE2\Design\FSR Calcs\V02\Storm\
                                                                                                    4.833 1.79 | 10.833
                                                                                                                        6.92 |16.833
                                                                                                                                       2.01 | 22.83
                            SCS Type II - London\100yrSCSTYPEII124HR.stm
                                                                                                    5.000
                                                                                                           1.79 |11.000
                                                                                                                         6.92 |17.000
                                                                                                                                       2.01 | 23.00
                                                                                                                                                     1.34
                                                                                                           1.79 |11.167
| Ptotal=111.61 mm | Comments: 100-Year 24 hour SCS: London Airport
                                                                                                    5.167
                                                                                                                        10.71 | 17.167
                                                                                                                                       2.01 | 23.17
                                                                                                                                                     1.34
                                                                                                    5.333 1.79 | 11.333
                                                                                                                        10.71 | 17.333
                                                                                                                                      2.01 | 23.33
_____
              TIME
                    RAIN | TIME RAIN | TIME RAIN | TIME RAIN
                                                                                                    5.500
                                                                                                           1.79 |11.500
                                                                                                                        10.71 | 17.500
                                                                                                                                       2.01 | 23.50
                                                                                                                                                     1.34
                                                                                                    5.667 1.79 |11.667
                                                                                                                                      2.01 | 23.67
               hrs
                    mm/hr |
                            hrs mm/hr | hrs mm/hr | hrs
                                                              mm/hr
                                                                                                                        46.42 | 17.667
                                                                                                                                                     1 34
               .25
                     1.23 | 6.25 2.23 | 12.25 16.07 | 18.25 2.01
                                                                                                    5.833 1.79 | 11.833 84.81 | 17.833 2.01 | 23.83
               .50
                     1.23 | 6.50
                                   2.01
                                                                                                    6.000
                                                                                                           1.79 | 12.000 | 123.20 | 18.000 | 2.01 | 24.00
                                   2.23 | 12.75
               75
                     1 23 | 6 75
                                                8.26 | 18.75
                                                               2 01
              1.00
                     1.23 | 7.00
                                   2.23 | 13.00
                                                 8.26 | 19.00
                                                              2.01
                                                                                          Unit Hyd Qpeak (cms) = 1.419
              1.25
                     1.23 | 7.25
                                   2.23 | 13.25
                                                 5.80 | 19.25
                                                               2.01
                                   2.23 | 13.50
                                                 6.25 | 19.50
                                                                                                        (cms) = 1.519 (i)
              1.50
                     1.23 | 7.50
                                                               2.01
                                                                                          PEAK FLOW
                     1.23 | 7.75
                                   2.23 | 13.75
                                                 4.69 | 19.75
                                                                                          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.
| CALIB
| NASHTD (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.
| 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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Green Valley Estates Inc. and Green Valley Estates II Inc. FSR CITY OF LONDON

Appendix C:

Hydraulic Analysis of Dingman Creek

HEC-RAS PI	lan: existing Riv	HEC-RAS Plan: existing River: Dingman Creek Reach: Reach-9 Profile: 1.250 Existing	Reach: Reach	h-9 Profile: 1:2	250 Existing	S W P	П Б	anolis:	Vel Chal	Flow Area	Top Width	Fraude # Chi	VolChan	the Lov	Vol Right	emilo/
צפפע	NIVEL CIE	25	(m3/s)] []	(E)	e E	(E)	(m/m)	(s/u)	(m2)	(E)	5	(1000 m3)	(1000 m3)	(1000 m3)	(1000 m3)
Reach-9	36.9135	1:250 Existing	26.70	260.20		,	262.58	0.000582		36.99	64.25	0.24	139.66	1	217.49	472.81
Reach-9	36.7485	1:250 Existing	26.70				262.49	0.000410		50.35	83.13		136.38		215.44	465.67
Reach-9	36.5735	1:250 Existing	26.70	260.20			262.44	0.000246		56.38	74.85	0.16	132.14	111.63	212.72	456.49
Reach-9	36.5615	1:250 Existing	26.70		262.38	260.93	262.42	0.000346	0.89	29.87	104.92	0.19	131.79		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		29.84	104.77	0.21	131.55		212.60	455.46
Reach-9	36.4865	1:250 Existing	29.40				262.39	0.000322		58.69	91.44	0.18	129.75		211.05	451.40
Reach-9	36.3115	1:250 Existing	29.40				262.30	0.000930		32.06	39.44	0.29	126.17		209.92	443.59
Reach-9	36.1465	1:250 Existing	29.40				262.15	0.000840		41.42	92.99	0.27	123.59		208.78	437.71
Reach-9	35.9765	1:250 Existing	29.40				262.03	0.000500		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		53.83	88.66	0.22	118.68	95.79	204.64	419.12
Reach-9	35.6165	1:250 Existing	29.40				261.78	0.001133		31.83	44.44	0.32	115.38	86'06	204.14	410.50
Reach-9	35.3965	1:250 Existing	29.40				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			1	261.31	0.003286	2.27	16.28	23.35	0.53	109.79		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				260.99	0.000700	1.11	47.40	44.17	0.26	105.22		197.97	390.84
Reach-9	34.7265	1:250 Existing	32.40				260.83	0.001156		40.76	51.97	0.32	101.33		196.77	384.84
Reach-9	34.5515	1:250 Existing	32.40				260.72	0.000552	1.01	51.34	88.79	0.23	85.78		196.54	380.62
Reach-9	34.3515	1:250 Existing	32.40				260.61	0.000474		62.85	90.01	0.20	95.96		191.41	369.70
Reach-9	34.1815	1:250 Existing	32.40		260.59		260.59	0.000073	0.39	144.90	155.52	0.08	89.04		189.97	362.31
Reach-9	34.1665	1:250 Existing	32.40			259.18	260.55	0.000575		29.36	98.93	0.24	88.62		188.83	360.65
Reach-9	34.1615		Bridge													
Reach-9	34.1565	1:250 Existing	32.40	258.35		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		260.49			0.000356		69.14	98.92	0.19	88.00		188.33	359.34
Reach-9	33.9725	1:250 Existing	32.40				260.40	0.001484	1.32	28.84	46.61	0.35	84.36		184.00	351.36
Reach-9	33.9485	1:250 Existing	32.40			259.09		0.000870		23.05	50.40	0.31	83.79		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		183.95	350.41
Reach-9	33.9235	1:250 Existing	32.40				260.30	0.000559	1.03	83.01	97.03		83.25		183.83	349.09
Reach-9	33.7285	1:250 Existing	32.40				260.19	0.000512	08:0	97.50	174.15	0.21	78.51	71.54	180.72	330.77
Reach-9	33.5385	1:250 Existing	32.40				260.02	0.001573		32.24	41.07	0.38	74.03	63.99	179.08	317.09
Reach-9	33.3635	1:250 Existing	32.40				259.82	0.000668		80.45	125.27	0.25	70.55		173.00	306.47
Reach-9	33.0835	1:250 Existing	32.40				259.49	0.002616	1.53	36.46	77.47	0.46	64.96	28.29	164.23	292.01
Reach-9	32.8085	1:250 Existing	32.40				259.09	0.000970	1.15	83.70	150.77	0.29	90.09		156.34	278.80
Reach-9	32.5785	1:250 Existing	32.40				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	65.99	0:30	50.42	60.58	147.05	258.05
Reach-9	32.1335	1:250 Existing	32.40				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			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			257.29		0.000632		23.80	114.20	0.35	44.97	58.81	144.99	248.77
Reach-9	32.0805	1:250 Existing	35.30				258.24	0.003092		19.86	27.56	0.51	44.69		144.88	248.34
Reach-9	32.0305	1:250 Existing	35.30		257.91	257.33	258.09	0.003239		19.22	14.61	0.51	43.73		144.87	247.36
Reach-9	31.8905	1:250 Existing	35.30	255.50			257.83	0.000920		48.30	98.80	0.29	40.52		144.59	242.60
Reach-9	31.7355	1:250 Existing	35.30				257.70	0.000705		74.42	162.91	0.26	36.59		143.42	233.09
Reach-9	31.5405	1:250 Existing	35.30		257.65			0.000085		236.51	382.89	60.0	30.97		134.44	207.45
Reach-9	31.4105	1:250 Existing	35.30				257.64	0.000192		173.91	522.53	0.14	26.85		121.10	178.53
Reach-9	31.3865	1:250 Existing	35.30		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				١	0.000136		225.91	540.01	0.10	25.11		118.85	173.62
Reach-9	31.3375	1:250 Existing	35.30	254.90		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				257.55	0.000374		86.47	222.75	0.20	19.46		102.97	151.19
Reach-9	31.0765	1:250 Existing	35.30				257.51	0.000183		158.63	292.28		16.83		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				257.48	0.000348		149.81	538.14) r.o	15.03	19.84	36.22	121.09
								•								

Reach	River Sta	Profile	Q Total	Min Ch Ei	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vet Chnl	Flow Area	Top Width	Fronde # Chi	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(<u>u</u>)	Œ	Œ	(E)	(m/m)	(s/m)	(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	0.45	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				

THIS EXISTING REVISED SCENARIO

0.00 CROWN	Profile	Q Total	Q Total Min Ch El W.S.	>	Crit W.S.	E.G. Elev	E.G. Slope	Vet Chril	Flow Area	Top Width	Fronde # Chi	Vol Chan	Vol Left	Vol Right	Volume
782-64 782-64 0.004-64 0.014-70 86.14 6.74 0.014 1.12.4 2.14.50 2.14.50 782-64 782-64 0.004-64 0.014 0.02 0.02 1.12.4 2.14.50 2.14.50 782-24 0.0002-69 0.02 0.0	1-250 Existing 26 70 26		9	٦	Œ	(m) 262.58		(m/s)	(m2)	(m) 64 23		5 8	(1000 m3)	(1000 m3) 216.65	(1000 m3) 473.31
202.28 202.28 0.000048 0.07 56.16 74.78 0.06 112.74 27.139 27.02 112.74 27.139 27.02 112.74 27.139 27.02 112.74 27.139 27.02 112.74 27.139 27.02 112.74 27.139 27.02 112.74 27.139 27.02 112.74 27.139 27.02 112.74 27.139 27.02 27.02 112.74 27.139 27.02 <th< td=""><td>26.70</td><td></td><td>ျွန္တ</td><td></td><td></td><td>262.49</td><td></td><td></td><td>50.14</td><td>83.00</td><td></td><td></td><td></td><td>214.61</td><td>466.19</td></th<>	26.70		ျွန္တ			262.49			50.14	83.00				214.61	466.19
262.28 260.08 260.44 0.00 26.84 104.70 0.19 152.44 112.44 211.24	26.70		60.2			262.43			56.16	74.78				211.90	457.04
266.28 266.28 266.28 0.09 28.80 1144.56 0.02 115.44 21.17	26.70		90.		260.93				29.83	104.70				211.79	456.25
202. 28 202. 58 202. 58 0.02	Bridge														
262.28 262.28 CROSS <			260.2		260.98				29.80	104.55			112.41	211.79	456.01
26.2.23 28.2.24 C0.000688 1.3.5 9.18 st 9.8.2.2 C0.2.2 1.0.5 st 10.5 st 20.2.0 C0.2.2 st 10.5 st 10.5 st 20.2.0 C0.2.2 st 10.5 st 10.5 st 20.0 st 20.0 st 20.0 st 10.5 st 10.5 st 10.5 st 20.0 st 20.0 st 20.0 st 10.5 st 10.5 st 10.5 st 20.0 st 20.0 st 20.0 st 10.5 st 10.5 st 20.0 st 20.0 st 20.0 st 10.5 st 10.5 st 20.0 st 20.0 st 20.0 st 10.5 st 20.0 st 20.0 st 10.0 st 20.0 st 10.0 st 20.0 st 10.0 st 20.0 st 20.0 st 10.0 st		Ş	260			262.39			58.42	91.25				210.25	451.98
202.10 202.20 CODODES 1.73 4.05 6.04.20 0.27 17.1.50 17.05.51 220.56.50 202.10 202.20 CODODES 1.73 4.04.60 0.22 17.1.71 17.05.51 220.56.50 206.17.2 202.20 CODODES 0.73 1.74.71 17.1.71 17.1.71 20.56.50 20.56.50 206.17.2 20.50 CODODES 0.73 1.74.71 17.1.71 20.56.50 20.50 20.50 17.1.71 20.50 20.50 20.50 20.50 20.50 17.1.71 20.50 20.50 20.50 20.50 20.50 20.50 20.50 20.50 20.50 20.50 20.50 17.11 20.50	1:250 Existing 29.40	Q	259.8			262.30			31.89	39.22	0.29			209.12	444.20
28.2 (0) 28.2 (0)	1:250 Existing 29.40	.	259.7			262.14			40.93	66.42				208.00	438.37
261.97 261.99 261.99 77.38 66.0 20.2 718.06 69.0 20.44 20.44 20.2 718.06 69.0 20.44 20.44 20.2 718.06 69.0 20.44 20.44 20.2 718.0 69.0 20.44 20.2 718.0 69.0 20.44 20.2 718.0 69.0 20.44 20.2 718.0 69.0 20.44 20.2 718.0 69.0 20.44 20.2 718.0 69.0 20.44 69.0 20.44 69.0 20.44 69.0 20.44 69.0 20.44 69.0 20.44 69.0 20.44 69.0 69.0 20.44 69.0 20.44 69.0	1:250 Existing 29.40	Ot	259.6			262.02			63.88	109.79				205.55	428.67
2011 22 2014 22 2014 22 2014 22 2014 22 2014 22 2014 22 2014 22 2014 24 <t< td=""><td></td><td>10</td><td>259.5</td><td></td><td></td><td>261.99</td><td></td><td></td><td>73.98</td><td>160.12</td><td></td><td></td><td></td><td>204.86</td><td>425.15</td></t<>		10	259.5			261.99			73.98	160.12				204.86	425.15
2011 2 2011 3 2011 3 41 44 0.02 114 5 60.89 204.4 2011 M 2011 M 2011 3 41 5 61.89 0.02 114 5 60.90 204.4 2011 M 2011 M 2011 M 41 5 61.89 0.02 114 5 60.90 204.4 2011 M 2011 M 2011 M 41 7 11.00 77.2 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 11.00 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02		Q.	259.5			261.94			53.83	99.88	22.0			204.64	419.12
281 14 281 15 0.0002084 1,271 4,075 6,084 0.025 1,11 19 88-44 200.00 281 101 281 103 0.0002084 1,271 40,78 0.053 109.77 68-91 198.73 280 101 281 101 281 102 0.000208 0.000208 1,111 47.76 68-90 198.93 198.93 280 101 280 102 0.000208 0.000707 1,111 47.76 0.000 111 47.76 68-90 198.93 198.93 280 102 280 102 200.000 0.000077 0.			259.4			261.78			31.83	44.44			86.08	204.14	410.50
281 08 281 08 281 08 282 08 100 00 282 08 100 00<	29.40		259.2			261.58			40.75	61.89			89.48	202.43	403.82
261 OH 261 OH 261 OH 77.72 74.4 OH 77.24 OH 77.24 OH 77.24 OH 77.25	29.40		259.1			261.31	-		16.28	23.35				199.74	398.64
260.24 260.98 260.98 100.700 111 47.40 44.17 0.29 105.22 67.19 68.74 14.97 260.58 260.58 0.000159 1.98 60.71 0.22 10.13 66.90 165.54 260.58 260.58 0.000179 1.08 62.85 60.01 0.20 60.00 66.90 165.52 10.13 66.90 165.52 10.13 66.90 165.52 10.13 66.90 165.52 10.00 165.50	29.40		8			261.05			57.72	124.06				199.30	395.26
200.78 200.08 10.00116 1.36 40.76 61.97 0.22 101.33 80.74 10.92	32.40		8			260.99			47.40	44.17			87.65	197.97	390.84
260.14 260.17 0.000562 1,71 51.34 88.79 0.23 97.59 86.50 156.54 260.59 260.54 0.000474 0.08 444.90 165.62 0.09 82.99 86.50 165.54 166.54 260.59 260.54 0.000474 0.08 1.11 29.29 166.52 0.09 82.99 168.53 161.41 260.59 260.54 0.0000475 1.10 29.96 169.69 0.02 68.30 168.83 161.41 260.49 260.59 0.000046 1.11 29.29 96.89 0.02 68.30 168.83 260.26 260.00 0.000046 1.11 29.29 96.89 0.24 68.30 168.83 260.26 260.00 0.00046 1.41 20.00 20.91 68.30 168.83 168.83 260.26 260.00 260.00 260.00 260.00 260.40 0.35 60.41 168.83 168.83 168.83 174.46	32.40		۳.			260.83			40.76	51.97	0.32		86 74	196 77	384 84
200.59 200.59 200.59 62.55 90.01 0.00 65.30 15.44 10.00 <	32.40		112			260.72			5134	88 79	0.23			196 54	380.62
260.18 280.18 280.18 280.18 280.18 88.20 88.20 88.20 18.10 18.80 260.18 280.18 280.18 280.18 280.18 280.18 88.20 88.20 88.20 18.80	55.50		٠,۱,۰			2000			10.10	2.00	070			10000	20.000
260.549 259.18 260.559 0.0000073 1.03 144.39 155.25 0.05 88.67 88.10 88.10 188.91 188.91 260.49 259.18 260.55 0.0000075 1.10 22.39 98.92 0.14 88.00 88.10 188.10 188.93 260.49 250.49 260.55 0.000048 1.32 28.84 48.61 188.90 88.00 184.00 188.93 260.24 250.40 0.000448 1.32 28.84 48.61 0.35 84.30 88.00 184.00 188.30 260.25 250.00 260.35 0.000448 1.41 22.02 80.14 88.90 0.31 88.00 88.00 184.00 183.35 88.00 88.00 185.01 188.33 88.00 185.01 188.33 88.00 185.01 188.33 88.00 185.01 188.33 88.00 185.01 188.33 88.00 185.01 188.33 88.00 185.01 188.33 88.00	32.40					260.61			62.85	90.01				191.41	369.70
260.49 259.16 260.56 0.000575 1.10 29.36 98.33 0.24 88.62 83.19 188.83 260.49 250.49 250.49 260.49 0.24 88.62 83.19 188.83 260.49 250.44 250.44 26.61 0.05 86.14 46.61 0.35 86.39 83.19 188.39 260.49 250.40 200.04 0.000446 1.47 23.05 60.41 6.01 83.01 188.39 260.26 250.30 0.000446 1.41 23.05 60.41 0.31 88.70 82.76 183.36 260.26 250.30 0.000446 1.41 23.02 80.01 1.40 183.86 82.70 183.36 260.27 250.26 0.000446 1.41 23.02 80.01 1.40 82.70 183.36 183.70 82.70 183.36 260.27 250.26 0.000446 1.41 23.02 80.41 40.41 0.31 82.70	32.40		: 3						144.90	155.52				189.97	362.31
260.149 259.148 260.15 00000266 1,11 292.29 98.89 0.24 68.33 63.14 188.83 260.149 250.14 200.51 0.000056 0.66 69.14 66.22 0.19 66.00 68.00 1.19 188.30 183.01 188.30 260.14 260.14 200.51 0.000056 0.06 65.14 66.20 0.19 68.00 183.00 184.00 184.00 260.25 260.20 200.00469 1.02 25.04 0.31 68.70 82.70 183.30 82.70 183.30 260.26 250.00 200.00659 1.03 85.01 0.23 83.25 82.70 183.83 260.27 250.28 0.000669 1.05 85.01 77.41 0.23 82.20 183.83 183.83 260.28 200.00 0.000699 1.05 85.01 47.41 0.23 48.27 82.01 183.83 260.28 200.00 200.00669 1.	1:250 Existing 32.40 258.				259.18		0.000575		29.36	98.93	0.24	88.62	83.19	188.83	360.65
260.49 259.18 260.55 0.000226 1.11 22.29 96.88 0.24 88.39 83.19 188.59 260.40 260.40 260.40 0.000266 1.11 22.05 96.88 0.24 88.39 83.19 188.59 260.20 260.40 0.000440 1.32 28.84 46.61 0.35 84.36 83.00 184.00 260.26 260.40 0.00440 1.41 22.05 50.40 0.31 83.70 82.76 183.56 260.26 260.36 0.00446 1.41 22.02 50.14 0.31 83.70 82.76 183.56 260.17 260.17 260.20 0.00446 1.41 22.02 41.07 0.32 83.70 82.76 183.56 260.18 260.18 0.00047 1.60 22.24 41.07 0.32 83.70 82.76 183.86 260.18 260.18 0.00046 1.60 22.24 41.07 0.32 82.76 <t< td=""><td>Bridge</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Bridge														
260.46 260.51 0.000366 0.85 69.14 96.92 0.19 98.00 68.01 198.39 260.26 260.26 260.51 0.000466 1.41 2.20.84 46.61 0.51 88.00 88.01 188.39 260.26 260.26 260.37 0.000470 1.41 2.20.2 60.41 0.31 83.79 82.76 183.36 260.26 260.26 260.30 0.000469 1.41 2.20.2 50.14 0.21 83.79 82.76 183.36 260.26 260.26 260.30 0.000469 1.41 2.20.2 50.14 0.22 83.25 83.25 83.26 17.16 183.70 183.70 183.83 17.20 183.83 17.20 183.70 183.70 183.83 17.20 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 183.83 <td>32.40</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>98.88</td> <td></td> <td></td> <td>83.19</td> <td>188.83</td> <td>360.36</td>	32.40									98.88			83.19	188.83	360.36
260.241 260.440 1.32 28.64 6.6 ft 0.55 64.36 88.00 184.00 260.25 260.240 0.000464 1.41 23.05 50.40 0.31 88.70 82.76 183.96 260.26 260.26 260.30 0.00046 1.41 23.02 50.14 0.31 88.70 82.76 183.96 260.26 260.36 0.000469 1.41 23.02 97.00 1.42 0.31 88.70 82.76 183.96 286.76 260.37 0.000473 1.60 97.50 174.15 0.23 74.05 82.90 175.00 286.77 0.000473 1.60 97.50 174.15 0.23 74.05 82.90 175.00 286.78 0.000468 1.05 90.45 174.75 0.02 76.60 82.20 174.05 82.20 174.05 82.20 174.05 82.20 174.05 82.20 174.15 82.20 174.05 82.20 174.14 82.20						260.51				98.92				188.33	359.34
260.26 259.06 260.37 0.00070 1.41 22.05 60.40 0.31 68.70 62.70 183.85 260.26 259.06 260.38 0.000446 1.41 22.02 50.14 0.31 68.70 62.01 183.85 260.26 260.26 260.30 0.000542 1.02 68.01 7.41 0.21 7.85 7.01 183.85 260.71 260.72 0.000572 1.02 68.04 1.02 0.22 62.01 183.85 256.83 0.000567 1.02 69.04 1.02 0.22 62.01 183.83 256.83 0.000568 1.05 7.41 0.24 4.10 0.32 62.02 173.00 256.87 0.000568 1.05 7.41 0.24 4.10 0.24 4.10 0.24 6.28 7.05 6.28 173.00 256.87 0.00194 1.15 83.71 1.25.27 0.24 6.29 1.46 1.25 1.46						260.40			28.84	46.61				184.00	351.36
260.26 259.06 260.36 0.0004540 1.41 23.01 60.14 0.23 68.70 0.23 68.70 163.85 260.26 260.26 260.30 0.000546 1.43 28.01 97.03 0.23 83.25 82.01 183.85 260.27 260.26 260.30 0.000542 1.68 83.01 174.15 0.23 83.26 82.01 183.83 260.37 260.30 0.000542 1.68 32.24 41.07 0.23 74.05 62.89 175.06 256.36 256.36 2.266.22 0.000547 1.68 32.24 41.07 0.23 74.05 62.89 175.06 256.36 2.266.26 0.000567 1.15 88.70 15.27 0.26 62.86 175.06 175.06 256.36 2.268.27 0.000567 1.18 83.71 15.27 0.23 82.81 143.89 175.06 256.28 2.269.24 0.0001346 1.28 38.44 17			22		259.09				23.05	50.40				183.95	350.50
260.26 269.08 269.08 269.09 269.09 269.09 269.09 269.09 269.09 269.09 141 23.02 50.14 0.31 68.70 82.76 163.09 82.76 163.09 82.76 163.09 82.76 163.09 82.76 163.09 82.76 163.09 82.76 163.09 82.76 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 163.09 173.00 <th< td=""><td>Bridge</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	Bridge														
260.26 260.30 0.000659 1.03 68.01 97.03 68.25 82.01 188.83 260.17 260.19 0.000672 0.80 95.01 174.45 0.21 78.51 71.54 160.72 2569.78 260.02 0.000668 1.05 80.45 174.45 0.25 70.55 62.93 173.00 2569.78 269.82 0.000688 1.05 80.45 17.47 0.28 70.55 62.93 173.00 2569.78 256.72 256.72 0.22 74.77 0.28 70.55 62.93 173.00 2569.76 256.72 256.72 0.00148 1.05 80.45 77.47 0.28 60.58 173.00 2568.75 256.72 256.72 262.99 0.03 50.42 60.58 173.00 2568.76 250.001 1.16 41.19 62.99 0.33 45.91 46.99 62.99 174.59 2568.76 256.74 256.74 256.74			œ						23.02	50.14				183.95	350.41
260.17 260.19 0.000612 0.00 97.50 174.15 0.21 78.51 77.54 180.72 259.90 259.90 250.00 0.000668 1.06 282.4 41.07 0.28 74.08 62.89 175.08 259.90 259.90 0.000668 1.05 88.46 77.47 0.46 64.96 62.80 175.08 259.05 259.06 0.000670 1.15 88.70 150.77 0.26 62.80 165.34 258.77 258.77 0.001084 1.15 88.70 150.77 0.26 62.80 165.34 258.28 0.001084 1.15 88.71 47.50 0.34 45.91 60.56 62.80 147.18 258.29 2.001084 1.16 47.50 122.82 0.34 45.91 60.56 62.80 144.19 258.20 2.001381 1.16 47.50 112.8 24.05 114.20 0.34 45.91 144.89 258.20	32.40		58.0			260.30			83.01	97.03				183.83	349.09
258.90 260.02 260.02 0.001573 1.60 32.24 41.07 0.38 74.03 65.99 179.08 259.78 0.000688 1.05 80.45 125.7 0.25 62.93 173.00 259.38 0.000688 1.05 80.45 125.7 0.26 62.98 173.00 258.07 258.08 0.000670 1.15 88.70 150.77 0.29 60.06 62.40 166.34 258.27 258.08 0.000704 1.16 88.70 150.77 0.29 60.06 62.04 166.34 258.27 258.28 0.001084 1.09 47.50 1228 0.34 66.78 60.08 62.84 146.18 258.29 258.24 0.001084 1.05 44.57 62.94 60.58 146.18 258.29 258.24 0.001093 1.35 24.05 112.28 44.57 46.50 66.88 147.50 258.13 258.24 0.000003 1.44			257.8			260.19			97.50	174.15				180.72	330.77
259.78 259.82 0.000666 1.05 80.45 125.27 0.25 70.56 62.39 173.00 259.39 259.49 0.0002616 1.53 38.46 77.47 0.46 64.96 62.20 164.23 259.35 259.05 0.0002616 1.15 38.77 45.77 0.29 60.06 62.40 165.34 258.72 258.87 0.001391 1.16 47.50 122.82 0.39 50.42 60.58 147.05 258.22 258.22 258.24 0.001391 1.16 47.50 122.82 0.39 50.42 60.58 147.05 258.22 258.24 0.001094 1.16 47.50 122.82 0.39 50.42 60.58 147.05 258.28 257.24 258.24 0.001099 1.35 24.05 115.75 0.32 45.50 58.81 144.89 258.08 257.29 258.24 0.001099 1.32 14.61 0.32 58.81 144.89 <td>32.40</td> <td></td> <td>257.7</td> <td></td> <td></td> <td>260.02</td> <td></td> <td></td> <td>32.24</td> <td>41.07</td> <td>88'0</td> <td></td> <td></td> <td>179.08</td> <td>317.09</td>	32.40		257.7			260.02			32.24	41.07	88'0			179.08	317.09
259.39 259.49 0.002616 1.53 36.46 77.47 0.46 64.96 62.82 164.23 259.05 259.09 0.000370 1.15 83.70 150.77 0.29 60.06 62.40 156.34 258.77 258.28 0.001346 1.28 83.77 52.29 0.34 65.79 60.58 147.05 258.28 258.24 0.001340 1.16 47.19 62.99 0.30 60.46 62.40 148.19 258.29 258.24 0.001039 1.35 24.05 115.75 0.32 45.91 58.81 144.99 258.20 256.29 0.001039 1.35 24.05 115.75 0.32 45.91 58.81 144.99 258.08 257.24 258.29 0.000632 1.48 23.80 114.20 0.35 44.97 58.81 144.89 258.08 257.24 258.24 0.000632 1.48 19.22 14.81 25.91 144.81 144.81	32.40		257.6			259.82			80.45	125.27	0.25		62.93	173.00	306.47
256.05 258.06 258.06 0.000970 1.15 88.70 150.77 0.29 60.06 62.40 156.34 258.77 258.77 258.84 0.001346 1.28 38.17 54.25 0.34 55.79 61.36 148.19 258.28 258.24 0.001084 1.16 47.19 62.39 0.34 55.79 61.36 148.19 258.20 258.24 2.001084 1.16 47.50 122.82 0.34 45.50 68.81 144.39 258.20 256.24 2.001099 1.35 24.05 0.32 45.50 68.81 144.39 258.08 257.24 258.24 0.000632 1.82 1186 27.56 0.51 44.97 58.81 144.88 258.08 257.24 0.000632 1.82 19.86 27.56 0.51 44.97 58.76 144.87 257.64 257.65 0.000632 1.82 19.86 27.56 0.51 44.97 58.76	1:250 Existing 32.40	Q.	257.5			259.49			36.46	77.47				164.23	292.01
258.77 258.84 0.001346 1.28 38.17 54.26 0.34 55.79 61.36 148.19 258.28 258.24 0.001341 1.00 41.19 62.39 0.34 45.91 60.58 147.05 258.28 258.24 0.001391 1.16 47.50 112.82 0.32 65.45 60.58 147.05 258.28 257.24 258.24 0.001391 1.16 47.50 115.75 0.32 45.50 58.81 144.39 258.08 257.29 258.24 0.000532 1.48 228.60 114.20 0.32 44.97 58.81 144.89 258.08 258.24 0.000532 1.82 186 27.56 0.51 44.97 58.81 144.89 258.08 257.70 0.000532 1.82 184 19.86 27.56 0.51 44.97 58.87 144.89 257.65 257.86 0.000232 1.82 184 19.82 27.56 0.51	•	9	257.2			259.09			83.70	150.77				156.34	278.80
288.52 258.57 0.001084 1.09 41.19 62.99 0.30 50.42 60.85 147.05 258.28 258.24 0.001084 1.16 47.50 122.82 0.34 45.91 58.81 145.38 258.20 257.24 258.24 0.001009 1.35 24.05 115.75 0.32 45.90 58.81 144.99 258.08 257.29 258.24 0.000092 1.82 19.86 27.56 0.51 44.69 58.81 144.89 257.71 257.83 2.000392 1.84 19.22 14.61 0.51 44.69 58.76 144.87 257.74 257.84 0.000392 1.84 19.22 14.61 0.51 44.69 58.76 144.87 257.75 256.28 0.000392 1.84 19.22 14.61 0.51 44.69 58.76 144.87 257.75 257.86 0.000392 1.84 19.22 14.61 0.51 44.69 58.76	32.40		256			258.84			38.17	54.25				148.19	265.33
288.28 258.24 0.001091 1.16 47.50 122.82 0.34 45.91 58.81 144.39 258.20 257.24 258.29 0.001099 1.35 24.05 115.76 0.32 45.50 58.81 144.39 258.18 257.24 258.29 0.000032 1.48 23.80 114.20 0.35 44.97 58.81 144.39 258.08 258.29 0.000032 1.82 19.86 27.56 0.51 44.97 58.81 144.89 257.01 256.08 0.000323 1.84 19.22 11.42 0.51 44.97 58.87 144.89 257.77 257.86 0.000320 1.17 48.30 98.80 0.29 40.52 57.49 144.59 257.66 257.64 0.000020 1.05 74.42 162.91 0.26 50.50 50.00 144.59 257.65 257.64 0.000020 0.42 256.51 382.89 0.04 30.58 144.59	32.40		256 6	"		258.57			41.19	62 99			60.58	147.05	258.05
288.0 257.24 258.29 0.001009 1.35 24.05 115.75 0.32 45.50 58.81 144.99 258.18 257.24 258.29 0.000632 1.48 23.80 114.20 0.35 44.97 58.81 144.99 258.08 258.29 0.000632 1.48 23.80 114.20 0.55 44.97 58.81 144.88 257.71 258.29 0.000632 1.84 19.22 14.81 0.51 44.69 58.76 144.87 257.70 257.86 0.000523 1.16 74.42 162.91 0.26 40.52 57.49 144.87 257.66 257.70 0.000705 1.05 74.42 162.91 0.26 30.57 42.04 134.4 257.66 257.64 0.000705 0.42 236.51 32.89 0.09 30.97 42.04 134.4 257.65 256.29 0.00032 0.42 236.51 32.89 0.09 30.97 42.04	32.40		256 4			258.34			47.50	122.82			58 88	145.38	250.16
258.18 257.29 258.29 0.000632 1.48 23.80 114.20 0.55 44.97 58.81 144.39 258.08 257.29 258.24 0.000632 1.82 19.86 27.56 0.51 44.97 58.76 144.88 257.71 257.34 2.58.09 0.000232 1.84 19.2 1.46 0.51 44.97 58.76 144.88 257.77 257.80 0.000202 1.74 48.30 98.80 0.29 40.52 57.49 144.87 257.65 257.70 0.000705 1.05 7.42 182.89 0.09 30.97 42.04 134.44 257.66 257.67 0.000705 0.62 173.91 522.53 0.09 30.97 42.04 134.44 257.66 256.51 257.68 0.000132 0.62 173.91 525.53 0.09 30.97 42.04 134.44 257.60 256.51 257.62 0.000132 0.62 173.91 252.53 </td <td>32.40</td> <td></td> <td>ij</td> <td></td> <td>257 24</td> <td></td> <td></td> <td></td> <td>24 05</td> <td>115.75</td> <td></td> <td></td> <td></td> <td>144 99</td> <td>249 30</td>	32.40		ij		257 24				24 05	115.75				144 99	249 30
286.18 257.29 258.29 0.0000632 1.48 223.80 114.20 0.35 44.97 58.81 144.99 256.06 256.06 256.24 0.003092 1.82 19.86 27.56 0.51 44.69 58.76 144.89 257.71 257.83 0.000239 1.84 19.84 19.84 0.51 46.99 58.76 144.87 257.77 257.86 0.000239 1.17 48.30 98.80 0.29 46.59 57.49 144.59 257.65 257.86 0.000705 1.05 74.2 162.83 0.09 56.59 55.06 144.49 257.65 256.23 257.64 0.000192 0.42 228.51 382.89 0.09 30.97 42.04 144.49 257.65 257.64 0.000192 0.62 173.91 522.53 0.14 26.85 30.58 112.10 257.65 256.29 256.29 256.29 256.29 256.39 0.04 138.44<	Bridge														
258.08 258.24 0.003092 1.82 19.86 27.56 0.51 44.69 58.76 144.88 257.71 257.38 256.09 0.003239 1.84 19.22 14.61 0.51 44.69 58.76 144.87 257.77 257.89 0.000320 1.17 48.30 98.80 0.29 40.52 57.46 144.87 257.65 257.66 0.000035 0.42 258.81 0.02 30.57 42.04 134.44 257.60 256.21 257.62 0.000032 0.62 173.91 522.53 0.04 42.04 134.44 257.62 256.23 257.64 0.000132 0.62 173.91 522.53 0.04 26.86 121.10 257.60 256.54 257.63 0.00032 0.85 92.00 264.39 0.07 26.86 118.85 257.60 256.54 257.63 0.00032 0.85 92.00 264.39 0.17 26.11 26.86 118.85 <td>1:250 Existing 35.30</td> <td>, Q</td> <td>256.3</td> <td></td> <td>257.29</td> <td></td> <td>0.000632</td> <td></td> <td>23.80</td> <td>114.20</td> <td></td> <td></td> <td></td> <td>144.99</td> <td>248.77</td>	1:250 Existing 35.30	, Q	256.3		257.29		0.000632		23.80	114.20				144.99	248.77
257.34 257.38 2.0003239 1.84 19.22 14.61 0.51 43.73 58.76 144.87 257.77 257.88 0.000320 1.17 48.30 98.80 0.29 40.52 57.49 144.59 257.66 257.70 0.000705 1.05 74.42 162.91 0.26 36.59 53.08 143.44 257.66 256.23 257.64 0.000702 0.62 173.91 522.53 0.04 26.85 30.97 40.04 143.44 257.61 256.54 257.64 0.000702 0.62 173.91 522.53 0.04 30.97 42.04 118.85 257.61 256.54 257.64 0.000032 0.62 256.53 0.01 26.13 0.04 30.54 118.85 257.61 256.54 257.62 0.000032 0.85 256.33 0.01 25.11 256.51 118.85 257.62 256.54 257.61 0.000047 0.54 139.21 530.	35.30		256.2				0.003092		19.86	27.56				144.88	248.34
257.77 257.88 0.000920 1.17 48.30 98.80 0.29 40.52 57.49 144.59 257.66 257.76 0.000705 1.05 74.21 162.31 98.80 0.26 36.59 57.49 144.59 257.67 257.68 0.000085 0.42 238.51 382.83 0.09 30.97 42.04 134.44 257.60 255.91 257.64 0.000192 0.62 173.91 522.53 0.14 26.85 30.58 118.85 257.61 255.91 257.62 0.000132 0.65 252.53 0.17 26.85 118.85 257.61 256.91 257.62 0.000138 0.50 225.91 540.01 0.10 25.11 29.65 118.85 257.62 256.32 0.000479 0.50 255.91 540.01 0.10 25.11 29.65 118.85 257.62 257.61 0.000479 0.54 139.21 533.15 0.19 23.76 29.5			256.		257.33				19.22	14.61				144.87	247.36
257.66 257.70 0.000705 1.05 74.42 162.91 0.26 36.59 55.08 143.42 257.65 257.66 0.000085 0.42 236.51 382.89 0.09 30.97 42.04 134.44 257.63 256.23 256.23 0.04 30.97 42.04 134.44 134.44 257.64 250.0032 0.62 173.91 522.53 0.14 26.86 121.10 257.61 256.24 25.00032 0.85 25.00 264.39 0.17 26.11 29.65 118.85 257.61 256.24 25.00032 0.85 25.25 0.07 264.39 0.17 26.11 29.65 118.85 257.61 256.24 0.000479 0.54 139.21 540.01 0.19 25.1 29.65 118.85 257.52 257.51 0.000479 0.54 139.21 522.75 0.29 19.46 28.7 102.97 257.52 257.51 0.000479	35.30		255.5			257.83			48.30	98.80				144.59	242.60
257.65 26.27.66 0.000068 0.42 236.51 382.89 0.09 30.97 42.04 134.44 257.63 256.23 257.64 0.000192 0.62 173.91 522.55 0.14 26.86 30.97 42.04 113.44 257.64 256.54 0.000132 0.62 173.91 522.55 0.14 26.86 30.66 118.85 257.61 256.54 257.62 0.000136 0.50 225.91 540.01 0.10 25.11 29.65 118.85 257.60 256.39 257.61 0.000479 0.54 139.21 563.16 0.19 25.11 29.65 118.85 257.50 257.51 0.000479 0.54 139.21 563.16 0.19 23.76 29.55 113.37 257.52 257.51 0.000479 0.54 186.47 222.75 0.20 19.46 28.77 102.97 257.52 257.51 0.000479 0.54 168.63 282.28 <	35.30		55.5			257.70			74.42	162.91	0.26			143.42	233.09
257.62 256.28 256.28 257.64 0.000192 0.62 173.91 522.53 0.14 26.86 30.58 121.10 257.60 255.91 255.91 257.63 0.000392 0.85 92.00 264.99 0.17 26.11 29.65 118.85 257.60 256.91 257.61 0.000479 0.54 139.21 540.01 0.10 25.11 29.65 118.85 257.50 256.39 257.61 0.000479 0.54 139.21 533.15 0.19 23.76 118.85 257.52 257.51 0.000479 0.54 139.21 532.75 0.19 23.76 102.97 257.52 257.51 0.000479 0.54 138.63 222.75 0.09 19.46 28.77 102.97 257.52 257.51 0.000479 0.54 138.63 222.75 0.00 19.46 28.77 102.97 257.73 257.74 0.000478 0.54 45.04 260.29 <t< td=""><td>35.30</td><td></td><td>255.3</td><td> ,,</td><td></td><td>257.66</td><td></td><td></td><td>236.51</td><td>382.89</td><td></td><td></td><td>45.04</td><td>134.44</td><td>207.45</td></t<>	35.30		255.3	,,		257.66			236.51	382.89			45.04	134.44	207.45
257.60 255.91 257.62 256.59 257.62 0.000392 0.85 92.00 264.38 0.17 26.11 29.65 118.85 257.61 255.91 256.39 256.39 540.01 0.10 25.11 29.65 118.85 257.62 256.39 257.61 0.000479 0.54 139.21 533.15 0.19 25.76 29.65 113.37 257.52 257.51 0.000479 0.54 139.21 532.75 0.20 19.46 28.77 102.97 257.52 257.51 0.00043 0.54 158.63 222.75 0.20 19.46 28.77 102.97 257.52 257.51 0.00043 0.54 158.63 222.75 0.00 13.46 28.77 102.97 257.52 257.51 0.00043 0.54 158.63 292.28 0.13 16.83 25.32 94.55	35.30		255.(173.91	522.53			30.58	121.10	178.53
257.61 255.91 256.59 256.91 540.01 0.10 25.11 29.65 118.85 257.62 256.39 256.39 540.01 0.10 25.11 29.65 118.85 257.60 256.39 257.61 0.000479 0.54 139.21 533.15 0.19 23.76 29.55 113.37 257.52 257.51 0.000374 0.96 88.47 222.75 0.20 19.46 28.77 102.97 257.50 257.51 0.000378 0.54 158.63 292.28 0.13 16.83 25.32 94.55 257.54 0.000378 0.50 16.64 158.63 292.28 0.13 16.83 25.32 94.55		30	254.5						92.00	264.93			29.65	118.85	174.62
257.61 255.91 257.61 257.61 257.61 257.61 257.62 0.000138 0.50 225.91 540.01 0.10 25.11 29.65 118.85 257.62 256.39 256.39 540.01 633.15 0.19 25.76 29.55 113.37 257.52 257.51 0.000374 0.56 186.3 282.75 0.20 13.46 28.77 102.97 257.53 0.000438 0.54 158.63 292.28 0.13 14.60 26.32 94.55		3rt													
257.60 256.39 257.61 0.000479 0.54 1392.21 553.15 0.19 23.76 29.55 113.37 257.52 257.51 0.000574 0.56 186.7 222.75 0.20 19.46 28.77 102.97 257.50 257.51 0.000578 0.54 186.83 292.28 0.13 16.83 25.32 94.56 257.73 0.000548 0.54 4.56 0.73 16.83 25.32 94.56	1:250 Existing 35.30	8	254.5						225.91					118.85	173.62
257.52 257.54 257.55 0.000374 0.96 86.47 222.75 0.20 19.46 28.77 102.97 257.50 257.51 0.000183 0.54 186.53 292.28 0.13 16.83 25.82 94.56 257.73 0.00048 0.54 4.64.01 258.22 0.13 16.83 25.82 94.56		20	254.9			3			139.21					113.37	166.68
25/30 25/31 0.000/183 0.54 158.63 292.28 0.13 16.83 25.32 94.55 32 32.22 0.13 16.83 25.32 94.55 32 32.22 32 32 32 32 32 32 32 32 32 32 32 32 3		စ္က	254			257.55	1		86.47					102.97	151.19
357 47 0 0000 460 460 40 0000 1000 1000 1000 1	1:250 Existing 35.30	3 5	254.			16.762			156.65					SE. 25	136.7U

Reach	River Sta	Profile	Q Total	Min Ch Ei	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chni	Flow Area	Top Width	Fronde # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	Œ	(m)	(m)	(m/m)	(s/w)	(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				

HEC-RAS Pla	in: pond River.	HEC-RAS Plan: pond River: Dingman Creek Reach: Veach-9 River Sta Profile O Total	Keach: Keach-9	Min Ch El W.S. Elev	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnt	Flow Area	Top Width	Froude # Chl	Vol Chan	Vol Left	Vol Right	Volume
			(m3/s)	(m)	(ii)	(m)	(m)	(m/m)	(m/s)	(m2)	Œ)		(1 0 0 1	(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		0.24		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			115.12	214.53	466.25
Reach-9	36.5735	1:250 Existina	26.70	260.20	262.41		262.43	0.000249	0.71	56.01	74.72	0.16		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	06.0	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		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		0.19		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		0.29		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		0.27		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			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				204.86	425.35
Reach-9	35.8065	1:250 Existing	29.40		261.92		261.94	Ì		53.83					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		0.32		90.98	204.14	410.50
Reach-9	35.3965	1:250 Existing	29.40		261.54		261.58	0.000834	1.21	40.75	61.89				202.43	403.82
Reach-9	35.2315	1:250 Existing	29.40		261.08		261.31	0.003286	72.2	16.28					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	`			88.90	199.30	395.26
Reach-9	34.9415	1:250 Existing	32.40		260.94		260.99	0.000700	1.11	47.40			105.22	87.65	197.97	390.84
Reach-9	34.7265	1:250 Existing	32.40		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		260.68		260.72	0.000552	1.01	51.34	88.79	0.23		86.50	196.54	380.62
Posch o	34 3515	1-250 Existing	32.40		260.59		260.61	0.000474	0.83	62.85	90.01	0.20	95.96	85.33	191.41	369.70
Reach-9	34 1815	1.250 Existing	32.40		260.59		260.59	0.000073	0.39	144.90	155.52	80.0	89.04	83.30	189.97	362.31
Reach-9	34 1665	1:250 Existing	32.40		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			188.83	360.36
Reach-9		1-250 Existing	32.40		260.49		260.51	0.000356	0.85	69.14	98.92	0.19			188.33	359.34
Reach-9		1-250 Existing	32.40		260.31		260.40			28.84	46.61	0.35		83.00	184.00	351.36
Reach-9	1	1:250 Existing	32.40		260.26	259.09	260.37	0.000870		23.05		0.31	83.79		183.95	350.50
Reach-9	33.9465		Bridge			İ										
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				183.95	350.41
Reach-9	33.9235	1:250 Existing	32.40		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		260.17		260.19	0.000512		97.50	174.15			71.54	180.72	330.77
Reach-9	33,5385	1:250 Existing	32.40		259.90		260.02	0.001573				0.38	74.03	63.99	179.08	317.09
Reach-9	33,3635	1:250 Existing	32.40		259.78		259.82	0.000668	1.05	80.45	125.27	0.25			173.00	306.47
Reach-9	33.0835	1:250 Existing	32.40		259.39		259.49	0.002616				0.46			164.23	292.01
Reach-9	32.8085	1:250 Existing	32.40		259.05		259.09	0.000970		83.70	`			62.40	156.34	278.80
Reach-9	32.5785	1:250 Existing	32.40		258.77		258.84	0.001346							148.19	265.33
Reach-9	32.3335	1:250 Existing	32.40		258.52		258.57	0.001084	1.09	41.19				60.58	147.05	258.05
Reach-9	32.1335	1:250 Existing	32.40		258.28		258.34			47.50				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		258.18	257.29		0.000632			Ì				144.99	248.77
Reach-9	32.0805	1:250 Existing	35.30		258.08	١	258.24					0.57	44.09	38.70	144.00	240.34
Reach-9	32.0305	1:250 Existing	35.30		257.91	257.33	258.09		!	19.22	14.61				144.07	247.30
Reach-9	31.8905	1:250 Existing	35.30		257.77		257.83	0.000920	1.17				40.32		143.42	242.00
Reach-9	31.7355	1:250 Existing	35.30		90.762		237.70	0.0000		ľ					134 44	207.45
Reach-9	31.5405	1.250 Existing	35.30	722.30	20.702			1							121 10	178 53
Reach-9	31.4105	1.250 Existing	35.30	1	257.53	230.23			0.02	00.00	264.03		26.02	20.00	118 85	174.62
Reach-9	31.3865	1:250 Existing	35.30	254.95	09.7¢2			0.000382							2	
Reach-9	31.381	1	Culver		00100	l	02.730	36,1000	08.0	225.04	540.04	0 10	25.11	29.65	118.85	173 62
Reach-9	31.3755	1:250 Existing	35.30			233.91		0.000130							113.37	166.68
Reach-9	31.3375	1:250 Existing	35.30		257.60			1							102.97	151 19
Reach-9	31.2015	1:250 Existing	35.30				257.35	0.000074	0.50	158 63	292.28			25.32	94.55	136.70
Keach-9	30.05	1:250 Existing	35.30	254.00			257.49								86.44	121,54
Keach-6	30.3835	1.250 Existing	00.00				24:107									

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnt	Flow Area	Top Width	Fronde # Chl	Vol Chan	VolLeft	Vol Right	Volume
			(m3/s)	Œ	10	Ē	Œ	(m/m)	(s/m)	(m2)	Œ		(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	90.0	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	0.45	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
seach-9	30.5805		Bridge													
seach-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

Project #: 12116 Date: OCTOBER 2013

VO2 Data Calculation (Post Development Conditions)

North Pond

Total area to North SWM Pond		Runoff	
Controlled Areas	Area (ha)	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%

Project #: 12116 Date: OCTOBER 2013

VO2 Data Calculation (Post Development Conditions)

Southwest Pond

Total area to Southwest SWM Pond		Runoff	Imperviousness	
Controlled Areas	Area (ha)	Coefficient		
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%

Project #: 12116 Date: OCTOBER 2013

VO2 Data Calculation (Post Development Conditions)

Southeast Pond

Total area to Southeast SWM Pond		Runoff		
Controlled Areas	Area (ha)	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%

Project #: 12116 Date: OCTOBER 2013

North SWM Pond Water Quality Storage Volume

Table A.1 - MOE Water Quality Storage Requirements (SWMP 2003)*

		Stor	ne (m³/ha) ous Level		
Protection Level	SWMP Type	35%	55%	70%	85%
Enhanced	Infiltration	25	30	35	40
80% long-term S.S. removal	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal	Infiltration	20	20	25	30
70% long-term S.S. removal	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic	Infiltration	20	20	20	20
60% long-term S.S. removal	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

 $^{^{\}star}$ Values in table for Wet Ponds and Wetlands include $40 \mathrm{m}^3$ /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 m³/ha **Total Water Quality Storage Volume Required = 2,081** m³

Total Water Quality Storage Volume Provided = 6,083 m³

Project # : 12116 Date: OCTOBER 2013

Southwest SWM Pond Water Quality Storage Volume

Table A.1 - MOE Water Quality Storage Requirements (SWMP 2003)*

		Storage Volume (m²/ha) for Impervious Level			
Protection Level	SWMP Type	35%	55%	70%	85%
Enhanced	Infiltration	25	30	35	40
80% long-term S.S. removal	Wetlands	80	105	120	140
S.S. Telloval	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal	Infiltration	20	20	25	30
70% long-term S.S. removal	Wetlands	60	70	80	90
J.J. Tellioval	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic	Infiltration	20	20	20	20
60% long-term S.S. removal	Wetlands	60	60	60	60
S.S. Telloval	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

 $^{^{\}star}$ Values in table for Wet Ponds and Wetlands include $40 \mathrm{m}^3 / \mathrm{ha}$ 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 = $76.54 \text{ m}^3/\text{ha}$ **Total Water Quality Storage Volume Required =** 582 m^3

Total Water Quality Storage Volume Provided = 1,477 m³

Project #: 12116 Date: OCTOBER 2013

Southeast SWM Pond Water Quality Storage Volume

Table A.1 - MOE Water Quality Storage Requirements (SWMP 2003)*

		Sto	for .		
Protection Level	SWMP Type	35%	55%	70%	85%
Enhanced	Infiltration	25	30	35	40
80% long-term S.S. removal	Wetlands	80	105	120	140
5.5. 70	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal	Infiltration	20	20	25	30
70% long-term S.S. removal	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic	Infiltration	20	20	20	20
60% long-term S.S. removal	Wetlands	60	60	60	60
S.S. ICHIOTHI	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

 $^{^{\}star}$ Values in table for Wet Ponds and Wetlands include $40 \mathrm{m}^3/\mathrm{ha}$ of extended detention storage.

SWM Type = Wet Pond Level of Protection = Normal

Drainage Area = 5.57 ha Area-Weighted Imperviousness = 60%

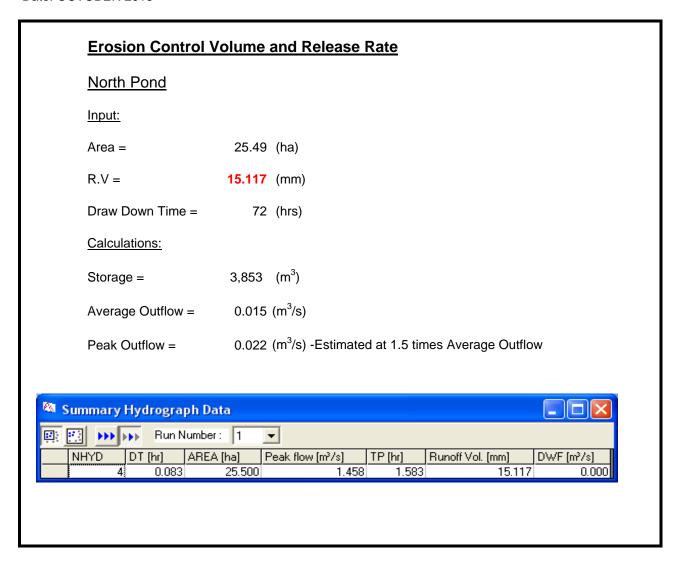
Permanent Pool Unit Volume Requirement = $76.07 \text{ m}^3/\text{ha}$ **Total Water Quality Storage Volume Required =** 424 m^3

Total Water Quality Storage Volume Provided = 779 m³

GREEN VALLEY ESTATES INC.

City of London, Ontario

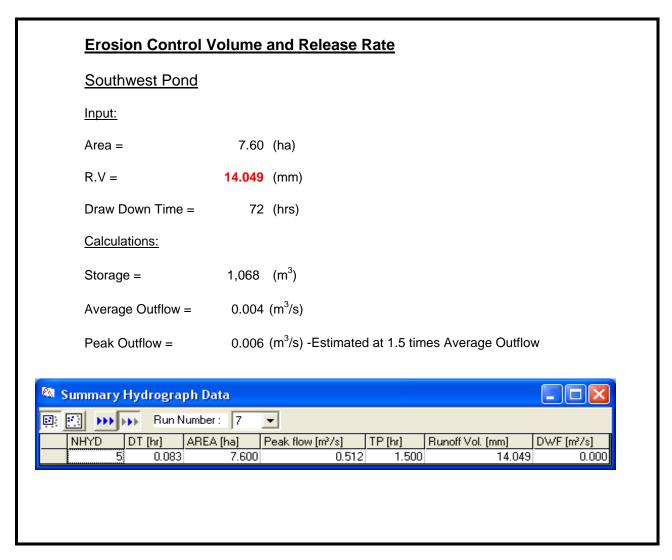
Project #: 12116 Date: OCTOBER 2013



GREEN VALLEY ESTATES INC.

City of London, Ontario

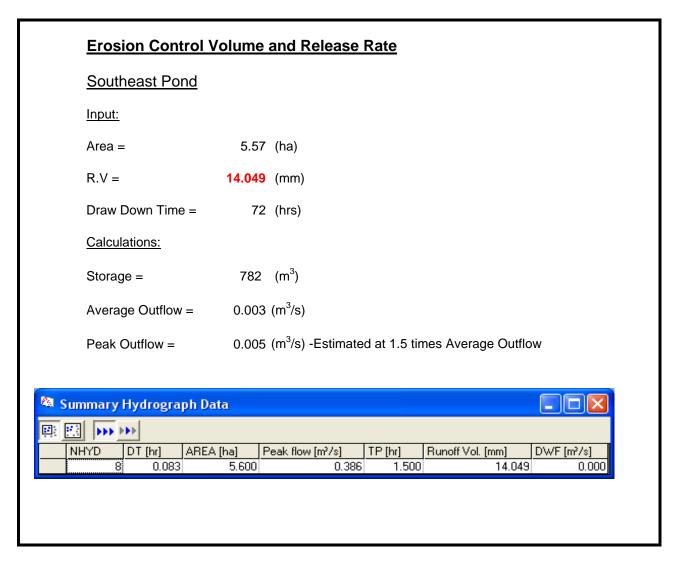
Project #: 12116 Date: OCTOBER 2013



GREEN VALLEY ESTATES INC.

City of London, Ontario

Project #: 12116 Date: OCTOBER 2013



		STAGE / STOR	NAGE IN ON	INITION							
			Elevation	Stage	Area	Area 2	Total Area	Avg. Area	Incremental Storage	Cumulative Storage	Cumulative Storage above Permanent Poo
			(m)	(m)	(m²)	(m²)	(m²)	(m ²)	(m ³)	(m ³)	(m ³)
		Pond Base:	260.90	0.00	1609	3143	4752		0		
260.90			261.70	0.80	2479	4296	6775	5764	4611	4,611	0
261.90	masl	nwl	261.90	1.00	2944	5004	7947	7361	1472	6,083	0
			262.70	1.80	10021		10021	8984	7187		7,187
		hwl 100yr		2.80	12560		12560	11290	11290		18,478
6083	m ³		264.00	3.10	13416		13416	12988	3896	28458	22374
261.90	ACTIVE ONLY										
	ACTIVE ONLY										
6083.2123											
262.7											
13270.7055											
6083	0										
	3250										
	3250										
INCL P.P.	5900										
INCL. P.P. #N/A											
#N/A #N/A	5900 ACTIVE ONLY 261.90 0.00										
#N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70										
#N/A #N/A	5900 ACTIVE ONLY 261.90 0.00										
#N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70	30000 1				Si	age-Storage	Curve		A 29450	
#N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49	30000 - 25000 -				Si	age-Storage	Curve	× 24,561	28458	
#N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49					Sc	age-Storage	Curve	24,561	28458	
#N/A #N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49 262.56	25000 - 20000 -				Si	age-Storage	Curve	24,561	28458	
#N/A #N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49 262.56	25000 - 20000 -				Si	age-Storage	Curve	24,561	28458	
#N/A #N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49 262.56	25000 - 20000 -				Si			24,561	28458	
#N/A #N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49 262.56	25000 - 20000 -			4.611	Si	age-Storage		24,561	28458	
#N/A #N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49 262.56	25000 - 20000 -			4,611	Si			24,561	28458	
#N/A #N/A #N/A #N/A #N/A	5900 ACTIVE ONLY 261.90 0.00 262.70 7187.49 262.56	25000 - 20000 - 15000 - 10000 - 5000 - 20000 -	0.00		4,611	St	6,083		24.561	3.10	
	261.90 0.1 582 6083 261.90 INCL. P.P. 261.9 6083.2123 262.7 13270.7055	261.90 masl 0.1 m 582 m³ 6083 m³ 261.90 INCL. P.P. ACTIVE ONLY 261.9 6083.2123 262.7 13270.7055	260.90 261.90 masl nwl 0.1 m 582 m³ hwl 100yr 6083 m³ 261.90 INCL. P.P. ACTIVE ONLY 261.9 6083.2123 262.7 13270.7055	260.90 261.90 masl 0.1 m 261.90 6083 m³ 261.90 INCL. P.P. 261.90 6083.2123 262.7 13270.7055 Pond Base: 260.90 261.70 nwl 261.90 hwl 100yr 263.70 hwl 100yr 263.70 264.00	260.90 261.90 masl 0.1 m 582 m³ 6083 m³ 261.90 INCL. P.P. 261.9 6083.2123 262.7 13270.7055 6083 Pond Base: 260.90 0.00 261.70 0.80 261.90 1 yes 262.70 1.80 262.70 1.80 264.00 3.10	Pond Base: 260.90	math math	Pond Base: 260.90	Pond Base: 260.90	Color Colo	Column C

Southwest SWM Pond Storage Calculations

Project#: 12116	
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Oct-13

		ſ		TORAGE INFO		Area	Area 2	Total Area	Avg. Area	Incremental Storage	Cumulative Storage	Cumulative Storage above Permanent Poo
OND CHARACTERISTICS				(m)	(m)	(m²)	(m²)	(m²)	(m²)	(m ³)	(m³)	(m ³)
			Pond Ba	se: 261.00	0.00	132	518	650		0		
Base of Pond:	261.00			261.80	0.80	490	1418	1908	1279	1023	1,023	0
N.W.L.:	262.00 m	nasl	1	nwl 262.00	1.00	713	1912	2625	2267	453	1,477	0
Increment for Volume:	0.1 m			262.50	1.50	3670		3670	3147	1574	3,051	1,574
Required Permanent Pool Volume:	582 m			263.00	2.00	4512		4512	4091	2045	5,096	3,619
Permanent Pool Volume Provided:	1477 m	1 ³	hwl 10		2.50	5400		5400	4956	2478	7574	6097
				263.80	2.80	5945		5945	5672	1702	9276	7799
OLUME												
Known Water Level:	262.00											
		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										
/ater Level of Known Volume												
Known Volume:	INCL. P.P.	1700 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	100				St	age-Storage (Curve			
			90	THE RESIDENCE OF THE PARTY OF	Modell.	may y	SALES OF	and the same of			9276	3
			80	00						757	1	100
			70	\$150, 10 to \$1, 10 to \$						151		(C)
equired Volumes:			ි 60 ම			35/6/17/5		Account to	5.00			
	E00 a	um	50 <u>س</u> 40 و		S 195 (A)	2012529			5,0	96		K.)
Permanent Pool	582 cเ		₽ 40	A 12 A 2 A 2 A 2 A 2 A 2 A 2 A 2 A 2 A 2			Wally Desc	3,051	THE WORLD		MIND STATE	N.
	4500 cu	um	= 30					. 0,001				
Permanent Pool		um	50 20					1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	THE RESERVE TO SERVE THE PARTY OF THE PARTY			20
Permanent Pool		um	in 30 20 pu 10	00		1,023	1,477					36 70
Permanent Pool		um	> 20	00 00 00		1,023		The state of	2.00	2.50	2.80	
Permanent Pool		um	Nov 20	00	0.	1,023	1.00	1.50	2.00	2.50	2.80	
Permanent Pool		um	Nond Volu	00 00 00	0.	1, 023		The state of	2.00	2.50	2.80	

Southeast SWM Pond Storage Calculations

FIUJECI#. IZIIO	Project#:	12116
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Oct-13

				Elevation	Stage	Area	Area 2	Total Area	Avg. Area	Incremental Storage	Cumulative Storage	Cumulative Storage above Permanent Poo
POND CHARACTERISTICS				(m)	(m)	(m²)	(m²)	(m²)	(m ²)	(m ³)	(m ³)	(m ³)
			Pond Base:	261.30	0.00	80	130	210		0		
Base of Pond:	261.30			261.50	0.20	140	278	417	314	63	63	0
N.W.L.:	262.30 r			261.70	0.40	207	419	626	522	104	167	0
Increment for Volume:	0.1 r			261.90	0.60	280	565	845	736	147	314	0
Required Permanent Pool Volume:	424 r			262.10	0.80	367	724	1091	968	194	508	0
Permanent Pool Volume Provided:	779 r	m ³	nwl	262.30	1.00	552	1067	1619	1355	271	779	0
			100 yr wl	262.80 263.80	1.50 2.50	2368 3644		2368 3644	1994 3006	997 3006	1776 4782	997 4003
/OLUME			100 yr wr	264.10	2.80	4102		4102	3873	1162	5944	5165
Known Water Level:	263.80			204.10	2.00	4102		1102	0070	1102	0044	0100
	INCL. P.P.	ACTIVE ONLY										
Lower Known Elevation:	263.8											
Lower Known Volume:	4781.72015											
Upper Known Elevation: Upper Known Volume:	264.1 5943.59945											
opper renown volume.	3343.33343											
Volume of Known W.L. Elevation:	4782	4003										
Erosion Control Storage Required:												
Active Storage Required:		3250										
Vater Level of Known Volume												
Vater Level of Known Volume Known Volume:	424	1220										
Known Volume:	INCL. P.P.	ACTIVE ONLY										
Known Volume: Lower Known Elevation:	INCL. P.P. 261.9	ACTIVE ONLY 262.80										
Known Volume: Lower Known Elevation: Lower Known Volume:	INCL. P.P. 261.9 314.2004	ACTIVE ONLY 262.80 996.83										
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation:	INCL. P.P. 261.9	ACTIVE ONLY 262.80										
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume:	INCL. P.P. 261.9 314.2004 262.1 507.7937	ACTIVE ONLY 262.80 996.83 263.80 4002.87						\$4				
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation:	INCL. P.P. 261.9 314.2004 262.1	ACTIVE ONLY 262.80 996.83 263.80	7000 -				Si	age-Storage	Curve		way a series	
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume:	INCL. P.P. 261.9 314.2004 262.1 507.7937	ACTIVE ONLY 262.80 996.83 263.80 4002.87	7000 - 6000 -				Si	age-Storage	Curve		\$ 59	144
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume:	INCL. P.P. 261.9 314.2004 262.1 507.7937	ACTIVE ONLY 262.80 996.83 263.80 4002.87	6000 -				Si	age-Storage	Curve		\$ 59	14
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume:	INCL. P.P. 261.9 314.2004 262.1 507.7937	ACTIVE ONLY 262.80 996.83 263.80 4002.87	6000 - 5000 -				Si	age-Storage	Curve		¥4782	14
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume:	INCL. P.P. 261.9 314.2004 262.1 507.7937 262.01	ACTIVE ONLY 262.80 996.83 263.80 4002.87 262.87	6000 - 5000 -				Si	age-Storage	Curve		59	14
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume: Required Volumes: Permanent Pool	INCL. P.P. 261.9 314.2004 262.1 507.7937 262.01	ACTIVE ONLY 262.80 996.83 263.80 4002.87 262.87 cum	6000 - 5000 -				Si	age-Storage	Curve		▼ 4782	14
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume:	INCL. P.P. 261.9 314.2004 262.1 507.7937 262.01	ACTIVE ONLY 262.80 996.83 263.80 4002.87 262.87 cum	6000 - 5000 -				Si	age-Storage	Curve	1776	58	14
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume: Required Volumes: Permanent Pool	INCL. P.P. 261.9 314.2004 262.1 507.7937 262.01	ACTIVE ONLY 262.80 996.83 263.80 4002.87 262.87 cum	6000 - 5000 -				Si			1776	59	111
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume: Required Volumes: Permanent Pool	INCL. P.P. 261.9 314.2004 262.1 507.7937 262.01	ACTIVE ONLY 262.80 996.83 263.80 4002.87 262.87 cum	6000 - 5000 -		. ♦ 63	• 10	Si Si	age-Storage	Curve	1776	59	14
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume: Required Volumes: Permanent Pool	INCL. P.P. 261.9 314.2004 262.1 507.7937 262.01	ACTIVE ONLY 262.80 996.83 263.80 4002.87 262.87 cum	6000 - 5000 - 4000 - 3000 - 1000 -	0.00	◆ 83 0.20	0.40	S(59 4782 50 2.80	14
Known Volume: Lower Known Elevation: Lower Known Volume: Upper Known Elevation: Upper Known Volume: W.L. Elevation of Known Volume: Required Volumes: Permanent Pool	INCL. P.P. 261.9 314.2004 262.1 507.7937 262.01	ACTIVE ONLY 262.80 996.83 263.80 4002.87 262.87 cum	6000 - 5000 -	0.00	◆ 83 0.20	0.40	, * 3	14 ◆ 508	779			44

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 m³/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 m³/yr.....(2)

Annual Infiltration Deficit Volume = Pre-development Infiltration Volume - Post-development Infiltration Volume

= 41522 m3/yr - 17332 m3/yr

= 24,190 m³/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:

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 m³/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 m³/yr.....(2)

Annual Infiltration Deficit Volume = Pre-development Infiltration Volume - Post-development Infiltration Volume

= 12380 m3/yr - 5788 m3/yr

6,592 m³/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 m³/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 m³/yr.....(2)

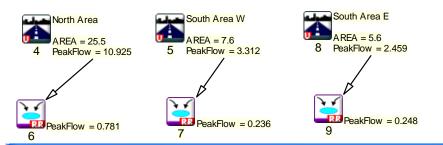
Annual Infiltration Deficit Volume = Pre-development Infiltration Volume - Post-development Infiltration Volume

= 9073 m3/yr - 4242 m3/yr

= 4,831 m³/yr(3)

Appendix E:

VO2 Modelling Output – Post Development Hydrology Summary Hydrograph Data



	,	, ,					
[<u>***</u>	>>					
	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
ľ	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

	OM S	ummary	Hydrogra	ph Data				
į	₽ } [**	>>					
I		NHYD	DT [hr]	AREA [ha]	Peak flow [m³/s]	TP [hr]	Runoff Vol. [mm]	DWF [m³/s]
ı		7	0.083	7.600	0.006	4.167	13.453	0.000
ı		7	0.083	7.600	0.024	1.167	16.158	0.000
ı		7	0.083	7.600	0.074	1.000	26.562	0.000
ı		7	0.083	7.600	0.107	1.000	33.433	0.000
ı		7	0.083	7.600	0.150	0.917	42.263	0.000
ı		7	0.083	7.600	0.190	0.917	48.851	0.000
ı		7	0.083	7.600	0.236	0.833	55.442	0.000

	M S	Summary Hydrograph Data												
Ī														
		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						

```
I
                 SSSSS U U A
                 SS U U AA L
     V V
            Т
      V V I
                 SS U U AAAAA L
            I
                   SS U U A A L
            I SSSSS UUUUU A A LLLLL
       VV
      OOO TTTTT TTTTT H H Y Y M M OOO
                                                TM, Version 2.0
     O O T T H H YY MM MM O O
      0 0 T
                   T H H Y M M O O Licensed To: TMIG
                   T H H Y M M OOO
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Copyright 1996, 2001 Schaeffer & Associates Ltd.
All rights reserved.
                ***** DETAILED OUTPUT *****
 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 1hr AES.out
 Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\V02\12116
VO2 Sept 2013\Proposed 1hr AES.sum
DATE: 09/12/2013
                                   TIME: 11:53:51 AM
USER:
COMMENTS:
 ** 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)
                        (ha) = 25.50
                   Area
|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
                             1.00
                                        2.00
    Average Slope
                   (%)=
```

Lengt Manni	ih Lngs n	(m) = =	412.30		40.00				
		NFALL WAS TE				TIME STEP.			
		ME RAIN rs mm/hr 83 2.07 67 2.07 55 2.27 17 2.52 83 2.88 67 2.88 53 3.38 17 4.17 00 4.18	TIME	RAIN		RAIN			
Max.E Stora Unit Unit	Eff.Inten. ove age Coeff. Hyd. Tpea Hyd. peak	(mm/hr) = r (min) (min) = k (min) = (cms) =	50.21 10.00 7.87 10.00	(ii)	4.80 35.00 31.65 (ii) 35.00 .03				
		(cms) = (hrs) = (mm) = (mm) = IENT =				*TOTAI 1.45 1.5 15.1 25.0	8 (iii 8 2 0)	
(ii)	Fo (m Fc (m TIME STE THAN THE	EQUATION SEI m/hr)= 50.00 m/hr)= 7.50 P (DT) SHOUI STORAGE COE W DOES NOT) Cum D BE SMAI SFFICIENT	K (.Inf. LLER OF	1/hr) = 2. (mm) = . EQUAL				
RESERVOI	IR (0006) -> OUT= 1) min	Į.	OW STOI (ha 00 .0 00 .0 16 .0	RAGE .m.) 0000 3853 4200 6600	OUTFLOW (cms) 3720 5394 6744	V STORA (ha.m) .81 1 1.10 1 1.20 1 1.35	GE (.) 00 00 00 00		
INFLO OUTFI		(0004) (0006)	AREA (ha) 25.50 25.50	QPEAK (cms) 1.46	TPEAF (hrs) 1.58	R. (m 3 15.	V. m) 12		
		PEAK FLOW TIME SHIFT (MAXIMUM ST(F PEAK FI	LOW SED	(min) (ha.m.)	= 1.44 =160.00 = .3667			
STANDHYI		Area Total Ir -					00		
Surfa Dep.	ace Area Storage	(ha) = (mm) =	4.56 1.00	S PE	3.04 1.50				

Average Slope Length Mannings n			2.00 40.00 .250	
Max.Eff.Inten.(mm// over (m Storage Coeff. (m Unit Hyd. Tpeak (m Unit Hyd. peak (co	hr) = in) in) = in) = ms) =	50.21 5.00 5.48 (ii) 5.00 .20	5.12 30.00 28.65 (ii) 30.00 .04	*TOTALS*
PEAK FLOW (CI TIME TO PEAK (h RUNOFF VOLUME (i TOTAL RAINFALL (I RUNOFF COEFFICIENT	ms) = rs) = nm) = nm) =	.51 1.50 24.00 25.00 .96	.02 1.92 1.90 25.00	.512 (iii) 1.50 14.05 25.00
(ii) TIME STEP (D' THAN THE STO (iii) PEAK FLOW DO)= 50.00)= 7.50 I) SHOULD RAGE COEFI	Cum.Inf. BE SMALLER OF FICIENT. CLUDE BASEFLOV	(1/hr) = 2.00 (mm) = .00 R EQUAL W IF ANY.	
RESERVOIR (0007)				
IN= 2> OUT= 1 DT= 5.0 min	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	STORAGE (ha.m.) .0000 .1068 .1300 .1910	(cms)	(ha.m.)
	.0060	.1068	1 .1584	.3100
	.0336	.1300	1 .1980	.3500
	.0750	.1910	.2406	.3900
	Ī	AREA QPEAR (ha) (cms) 7.60 .51 7.60 .01	K TPEAK	R.V.
INFLOW : ID= 2 (00	15)	(ha) (cms)	(hrs)	(mm) 14.05
OUTFLOW: ID= 1 (00	07)	7.60 .01	4.17	13.45
TIME	FLOW SHIFT OF	REDUCTION [Qo PEAK FLOW AGE USED	out/Qin](%)= (min)=16	1.12
CALIB	Area (1 Total Imp	na) = 5.60 (%) = 60.00	Dir. Conn.(%)	= 55.00
	IMI	PERVIOUS PE	ERVIOUS (i)	
Surface Area () Dep. Storage ()	na)= mm)=	3.36 1.00	2.24	
Average Slope	(%)=	1.00	2.00	
Surface Area (Dep. Storage (Average Slope Length Mannings n	(m) = :	193.20 .013	40.00	
		·		
Max.Eff.Inten.(mm/ over (m Storage Coeff. (m Unit Hyd. Tpeak (m Unit Hyd. peak (co	nr)= in)	50.21	5.12	
Storage Coeff. (m	in)=	5.00 (ii)	28.17 (ii)	
Unit Hyd. Tpeak (m	in)=	5.00	30.00	
onic nya. peak (c	,		.01	*TOTALS*
PEAK FLOW (CI TIME TO PEAK (h RUNOFF VOLUME (I TOTAL RAINFALL (I RUNOFF COEFFICIENT	ns)= rs)=	.38	.02	.386 (iii) 1.50
RUNOFF VOLUME (I	nm)=	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) |
| TN= 2---> OUT= 1 |
| DT= 5.0 min |
                      OUTFLOW STORAGE | OUTFLOW
                                                     STORAGE
                       (cms)
                                (ha.m.)
                                        (cms)
                                                     (ha.m.)
                                .0000
                                            .1152
                                                      .1800
                       0000
                        .0050
                                 .0782
                                             .1668
                                                       .2200
                                 .0880
                                             .2082
                        .0354
                                                       .2500
                        .0792
                                 .1400 I
                                             .2532
                                                       .2800
                            AREA
                                    OPEAK
                                             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
                MAXIMIM STORAGE USED
                                            (ha.m.) = .0746
 ** SIMILATION NUMBER: 2 **
 *******
                     Filename: G:\Projects\2012\12116 - TSI London
  READ STORM |
                               GE1 & GE2\Design\FSR Calcs\VO2\Storm\
                              1hrAES\AES2vr.stm
| Ptotal= 24.25 mm |
                     Comments: City of London AES 2Yr 1-Hour Distributi
              TIME
                     RAIN | TIME
                                   RAIN | TIME
                                                  RAIN | TIME
               hrs
                     mm/hr |
                             hrs
                                  mm/hr | hrs mm/hr | hrs mm/hr
                                           .75
               .08
                      .00 |
                             .42
                                   71.19 |
                                                  3.81 | 1.08
                .17
                     17.80 |
                             .50
                                   70.33 |
                                           .83
                                                   1.44 |
                2.5
                     35 59 I
                             .58
                                  26 60 L
                                           .92
                                                   .54
                .33 53.39 | .67 10.06 | 1.00
                                                   .21 |
 STANDHYD (0004) | Area (ha) = 25.50
|ID= 1 DT= 5.0 min | Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00
______
                           TMPERVIOUS
                                       PERVIOUS (i)
    Surface Area
                   (ha) =
                             16.32
                                         9.18
                                         1.50
    Dep. Storage
                   (mm) =
                             1.00
    Average Slope
                   (%)=
                             1.00
                                         2.00
    Length
                    (m) =
                           412.30
                                         40.00
    Mannings n
                             .013
                                         .250
    Max.Eff.Inten.(mm/hr)=
                             71.19
            over (min)
                                         20.00
                             5.00
    Storage Coeff. (min) =
                              6.85 (ii) 16.12 (ii)
    Unit Hyd. Tpeak (min) =
                              5.00
    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
                                                       .72
    RUNOFF COEFFICIENT =
                              .96
                                          .36
```

```
(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
-----
                       (cms)
                                (ha.m.) | (cms)
                                                      (ha.m.)
                                             .3720
                       .0000
                                 .0000
                                                       .8100
                       .0220
                                 .3853
                                             .5394
                                                      1.1000
                       .1146
                                 .4200
                                            .6744
                                                     1.2000
                        .2502
                                 .6600 |
                                             .8190
                                                      1.3500
                            AREA
                                              TPEAK
                                                        R.V.
                                    OPEAK
                            (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
______
| 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
                                          1.50
    Dep. Storage
                   (mm) =
                              1.00
    Average Slope
                    (%)=
                              1.00
                                         2.00
    Length
                    (m) =
                            225.10
                                         40.00
    Mannings n
                             .013
                                         .250
    Max.Eff.Inten.(mm/hr) =
                             71.19
        over (min)
                             5 00
                                         15 00
    Storage Coeff. (min) =
                              4.76 (ii) 13.97 (ii)
    Unit Hyd. Tpeak (min) =
                              5.00
    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
                                        I OUTFLOW
                                                     STORAGE
_____
                       (cms)
                                            (cms)
                                (ha.m.)
                                                      (ha.m.)
                        .0000
                                 .0000
                                             .1092
                                                       .2400
                        .0060
                                 .1068
                                             .1584
                                                       .3100
```

					.3500 .3900	
<pre>INFLOW : ID= OUTFLOW: ID=</pre>	2 (0005) 1 (0007)	AREA (ha) 7.60 7.60	QPEAK (cms) .90 .02	TPEAK (hrs) .50 1.17	R.V. (mm) 16.75 16.16	
	PEAK FLOW TIME SHIFT MAXIMUM ST	W REDUC OF PEAK FORAGE	TION [Qou	t/Qin](%)= (min)=	2.63	
CALIB						
STANDHYD (0008) D= 1 DT= 5.0 min					%) = 55.00	
		IMPERVIC	US PER	VIOUS (i)		
Surface Area	(ha) = (mm) =	3.36		2.24		
Average Slope	(%)=	1.00		2.00		
Surface Area Dep. Storage Average Slope Length Mannings n	(m) = =	193.20 .013	4	0.00		
Max.Eff.Inten ov Storage Coeff Unit Hyd. Tpe Unit Hyd. pea	. (mm/hr) =	71.19	5	1.49		
ov Storage Coeff	er (min) =	4.34	(ii) 1	5.00 3.55 (ii)		
Unit Hyd. Tpe	ak (min)=	5.00	1	5.00		
					TOTALS	
PEAK FLOW	(cms) =	.58		.14	.670 (i:	ii)
TIME TO PEAK	(hrs)=	.50		.67	.50	
TOTAL RAINFAL	(mm) = L (mm) =	24.25	2	4.25	16.75 24.25	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFAL RUNOFF COEFFI	CIENT =	.96		.36	.69	
*** WARNING: STO	RAGE COEFF.	IS SMALL	ER THAN T	IME STEP!		
	EQUATION SI					
FC (mm/hr) = 50.0 mm/hr) = 7.5	50 Cu	m.Inf.	(mm) = 2.0	0	
(ii) TIME ST	EP (DT) SHOW E STORAGE CO			EQUAL		
(iii) PEAK FL				IF ANY.		
RESERVOIR (0009)						
TM= 2> OUT= 1	1					
DT= 5.0 min	OUTF	LOW ST	ORAGE	OUTFLOW (cms)	STORAGE	
	.00	000	.0000	.1152	.1800	
	.01	050	.0782	.1668	.2200	
	.0	792	.1400	.2532	STORAGE (ha.m.) .1800 .2200 .2500 .2800	
		(ha)	(cms)	(hrs)	(mm)	
<pre>INFLOW : ID= OUTFLOW: ID=</pre>	2 (0008) 1 (0009)	5.60 5.60	.67 .03	.50 1.00	(mm) 16.75 16.04	
	PEAK FLO	W REDUC	TION [Qou	t/Qin](%)=		
		OF PEAK				
	TIME SHIFT MAXIMUM S	TORAGE	USED	(ha.m.)=	.0877	
	MAXIMUM S	TORAGE			.0877	

READ STORM	Filenam	GE1 8	GE2\Des	ign\FSF	Calcs\VO2\	Storm\
Ptotal= 35.09 mm	Comment	s: City o	of London	AES 5	Yr 1-Hour I	istribut
	- ME RATNI	TIME	RATN I	TIME	RATN I T	TME DAT
hi	s mm/hr	hrs	mm/hr	hrs	mm/hr	hrs mm/h
. (.00	.42 1	.02.99	.75	5.51 1	.08 .1
• ;	17 25.75	.50 1	.01.75	.83	2.08	
	ME RAIN cs mm/hr 08 .00 17 25.75 25 51.49 33 77.24	.67	14.56	1.00	.30	
CALIB						
STANDHYD (0004) D= 1 DT= 5.0 min	Area	(ha) = 25	5.50		(0) 60 6	0
	_					10
Surface Area Dep. Storage Average Slope Length Mannings n	ı, ı	MPERVIOUS	PERV	TOUS (i	.)	
Surface Area	(ha) = (mm) =	16.32	1	50		
Average Slope	(%)=	1.00	2	.00		
Length	(m) =	412.30	40	.00		
Mannings n	=-	.013		250		
Max.Eff.Inten. over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	(mm/hr)=	102.99	86	.34		
ove	(min)	5.00	15	.00		
Storage Coeff.	(min) =	5.91	(ii) 13	.39 (ii	.)	
Unit Hyd. Tpeak	(min) =	,19	15	.08		
inic nya. peak	, 5 ,	•=>			*TOTALS	*
PEAK FLOW	(cms) =	4.00	1	.13	4.845	
TIME TO PEAK	(hrs) =	.50	1.0	.58	.50 27.86	
TOTAL RATNEALL	(mm) =	35.09	35	.09	35.09	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFIC:	ENT =	.97	30	.53	.79	
(i) HORTONS H	EQUATION SEL	ECTED FOR	R PERVIOU	S LOSSE		
Fo (mr	n/hr) = 50.00 n/hr) = 7.50		K (1/	hr) = 2	.00	
rc (mr (ii) TIME STE	n/nr)= /.5U P (DT) SHOUL	Cum. D BE SMAT	INI. (mm) =	.00	
THAN THE	STORAGE COE	FFICIENT.		_		
(iii) PEAK FLOW	N DOES NOT I	NCLUDE BA	ASEFLOW I	F ANY.		
	 -					
RESERVOIR (0006) IN= 2> OUT= 1						
DT= 5.0 min	OUTFLO	W STOR	RAGE	OUTFLO	W STORAG	E
	(cms)	(ha.	m.)	(cms)	(ha.m.)
	.000	0 .0	0000	.372	.810	0
	.022	u .3	1200	.539	4 1.100	10
	.250	2 .6	600	.819	STORAG (ha.m. 0 .810 4 1.100 4 1.200 0 1.350	0
	10001	(ha)	(cms)	(hrs	(mn	1)
INFLOW : ID= 2 OUTFLOW: ID= 1	(0004)	25.50 25.50	4.84 .25	1.0	0 27.8 18 27.3	0
	PEAK FLOW					
-						
<u>-</u>	TIME SHIFT O	RAGE US	SED	(ha.m.)= .6520	

STANDHYD (0005) ID= 1 DT= 5.0 min	Area Total I	(ha) = 7.60 mp(%) = 60.00) Dir. Conn.(%	(i) = 55.00
	=	1 117		
		IMPERVIOUS	PERVIOUS (i)	
Surface Area Dep. Storage Average Slope Length Mannings n	(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. over Storage Coeff. Unit Hyd. Tpeal Unit Hyd. peak	(1)	100 00	07.70	
Max.Eff.Inten.	(mm/hr)=	102.99	87.79	
ovei	(min)	5.00	15.00	
Storage Coeff.	(min)=	4.11 (ii)) 11.54 (ii)	
Unit Hyd. Tpeal	(min)=	5.00	15.00	
Unit Hyd. peak	(cms)=	.24	.09	+=0====0+
DD3.11 DT 011	, ,	1 15	4.1	*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
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFIC	ENT =	.97	.53	.77
**** WARNING: STOR				
WALLING: STURA	OD CUBER.	TI Adddans Ut	.unv iirub OibF!	
(i) HORTONS H	QUATION SE	LECTED FOR PE	ERVIOUS LOSSES:	
Fo (mr	n/hr) = 50.0	0 I	K (1/hr) = 2.00	1
Fc (mr	n/hr) = 7.5	0 Cum.In:	(1/hr) = 2.00 f. $(mm) = .00$	1
(ii) TIME STE	DT) SHOU	LD BE SMALLER	R OR EQUAL	
		EFFICIENT.		
(iii) PEAK FLOW			FLOW IF ANY.	
RESERVOIR (0007)				
IN= 2> OUT= 1				
DT= 5.0 min	OUTFL	OW STORAGE	E OUTFLOW	STORAGE
	cms (cms) (ha.m.)) (cms)	(ha.m.)
	.00	.0000	0 .1092	.2400
	.00	60 .1068	3 .1584	.3100
	.03	36 .1300	0 .1980	.3500
	.07	50 .1910	E OUTFLOW (cms) (1092 1584 1980 12406	.3900
		AREA QI	PEAK TPEAK	R.V. (mm) 27.16
		(ha) (d	cms) (hrs)	(mm)
INFLOW : ID= 2	(0005)	7.60	1.46 .50	27.16
OUTFLOW: ID= 1	(0007)	7.60	PEAK TPEAK (hrs) (hrs) 1.46 .50 .07 1.00	26.56
			[Qout/Qin](%)=	
	IME SHIFT	OF PEAK FLOW	(min) =	30.00
1	MUMIKAI	OKAGE USED	(ha.m.)=	.1903
	_			
CALIB				
	7203	(ha) = 5.60)	
STANDHYD (0008)	ALEa	(IIa) - 5.00		\ EE 00
STANDHYD (0008) ID= 1 DT= 5.0 min	Total I	mp(%) = 60.00	Dir. Conn.(%	() = 55.00
STANDHYD (0008) ID= 1 DT= 5.0 min				55.00
	=	TMDEDITOTIC	DEDITIONS (1)	5) = 55.00
	=	TMDEDITOTIC	DEDITIONS (1)	5) = 55.00
	=	TMDEDITOTIC	DEDITIONS (1)	;)= 55.00
	=	TMDEDITOTIC	DEDITIONS (1)	;)= 55.00
	=	TMDEDITOTIC	DEDITIONS (1))= 55.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250)= 55.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250)= 55.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250)= 55.00
STANDHYD (0008) ID= 1 DT= 5.0 min Surface Area Dep. Storage Average Slope Length Mannings n Max.Eff.Inten. OVE	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250)= 55.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250)= 55.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250)= 55.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250	
	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250	*TOTALS* 1.088 (iii)

```
TIME TO PEAK (hrs) =
                                                   .50
                                                 27.16
    RUNOFF VOLUME (mm) =
                           34.09
                                     18.69
    TOTAL RAINFALL (mm) =
                           35.09
                                     35.09
                                                  35.09
    RUNOFF COEFFICIENT =
                           .97
                                     .53
**** 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.)
                                        .1152
                                                 .1800
                     .0000
                             .0000
                     .0050
                              .0782
                                         .1668
                                                  .2200
                              .0880
                                         .2082
                     .0354
                                                  .2500
                      .0792
                            .1400 |
                                         .2532
                                                  .2800
                                          TPEAK
                         AREA
                                 OPEAK
                                                  R 17
                          (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
 *******
 ** 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
                    .00 | .42 123.99 | .75
              .08
                                              6.63 | 1.08
              .17 31.00 | .50 122.50 | .83
                                             2.51 L
              .25 62.00 | .58 46.33 | .92
                                               .95 |
              .33 92.99 | .67 17.53 | 1.00
                                               .36 |
______
| 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
                  (%)=
                  (m) = 412.30
                                     40.00
   Length
    Mannings n
                         .013
                                     .250
                         123.99
                                    110.02
    Max.Eff.Inten.(mm/hr)=
            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 COEFFICI	ENT =	.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) | | TN= 2---> OUT= 1 | | DT= 5.0 min | OUTFLOW STORAGE | OUTFLOW STORAGE (cms) (ha.m.) | (cms) (ha.m.) .3720 .0000 .8100 .0000 1.1000 .0220 .3853 | .5394 .4200 | .6744 .6600 | .8190 .1146 1.2000 1.3500 .2502 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

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.04
TIME SHIFT OF PEAK FLOW (min)= 30.00
MAXIMUM STORAGE USED (ha.m.)= .8060

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.(m	nm/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 COEFFICIE	ENT =	.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 ST (cms) (h .0000 .0060 .0336 .0750	a.m.) (d .0000 .1068 .1300)
TIME	AREA (ha) 7.60 7.60 FLOW REDUC SHIFT OF PEAK	(cms) 1.84 .11 TION [Qout/Qir	1.00 33.43 n](%)= 5.80 (min)= 30.00	3
CALIB			Conn.(%)= 55.00)
Surface Area (h Dep. Storage (n Average Slope (Length Mannings n	IMPERVIO (aa) = 3.36 (bm) = 1.00 (%) = 1.00 (m) = 193.20 (m) = .013	PERVIOUS 2.24 1.50 2.00 40.00 .250	3 (i)	
Max.Eff.Inten.(mm/h over (mi Storage Coeff. (mi Unit Hyd. Tpeak (mi Unit Hyd. peak (cm	(r) = 123.99 (n) 5.00 (n) = 3.48 (n) = 5.00 (s) = .26	111.76 15.00 (ii) 10.23 15.00	(ii)	
PEAK FLOW (cn TIME TO PEAK (hr RUNOFF VOLUME (n TOTAL RAINFALL (n RUNOFF COEFFICIENT			*TOTALS* 1.366 .50 34.03 42.24 .81	
***** WARNING: STORAGE ((i) HORTONS EQUAT FO (mm/hr) Fc (mm/hr) (ii) TIME STEP (DI)	COEFF. IS SMALL CION SELECTED F = 50.00 = 7.50 Cu C) SHOULD BE SM RAGE COEFFICIEN	ER THAN TIME S OR PERVIOUS LO K (1/hr)= m.Inf. (mm)= HALLER OR EQUAL T.	DSSES: = 2.00 = .00	
RESERVOIR (0009) IN= 2> OUT= 1 DT= 5.0 min	.0050 .0354 .0792	.0782 .0880 .1400 .	FFLOW STORAGE ms) (ha.m.) .1152 .1800 .1668 .2200 .2082 .2500 .2532 .2800)
INFLOW: ID= 2 (000 OUTFLOW: ID= 1 (000	AREA (ha) 5.60 (9) 5.60	QPEAK 1	TPEAK R.V. (hrs) (mm) .50 34.03 .92 33.32	3
	FLOW REDUC	TION [Qout/Qir		

!	MAXIMUM STOR	AGE USED	(ha.m.)=	.1699
***************** ** SIMULATION NUM ****************	BER: 5 **			
READ STORM Ptotal= 51.29 mm	 	GE1 & GE2 1hrAES\AES	323 YI . 3 CIII	alcs\VO2\Storm\
h	rs mm/hr	hrs mm/l	nr hrs m 54 .75	RAIN TIME RAIN mm/hr hrs mm/hr 8.05 1.08 .16 3.04 1.15 .44
CALIB STANDHYD (0004) ID= 1 DT= 5.0 min	- Area (P Total Imp	ha)= 25.50 (%)= 64.00	Dir. Conn.(%) = 60.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	16.32 1.00 1.00 412.30 .013	PERVIOUS (i) 9.18 1.50 2.00 40.00 .250	
Max.Eff.Inten. ove Storage Coeff. Unit Hyd. Tpea Unit Hyd. peak	(mm/hr) = 1 r (min) (min) = k (min) = (cms) =	150.54 5.00 5.07 (ii) 5.00 .21	139.89 10.00 9.96 (ii) 10.00 .11	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFIC			2.40 .58 33.60 51.29 .66	*TOTALS* 8.327 (iii) .50 43.61 51.29 .85
FO (m FC (m (ii) TIME STE THAN THE (iii) PEAK FLO		K Cum.Inf BE SMALLER FICIENT.	(1/hr) = 2.0 (mm) = .0 OR EQUAL	0 0
RESERVOIR (0006) IN= 2> OUT= 1 DT= 5.0 min	- OUTFLOW - (cms) .0000 .0220 .1146 .2502	(ha.m.) .0000 .3853 .4200	OUTFLOW (cms) .3720 .5394 .6744 .8190	(ha.m.) .8100 1.1000 1.2000
INFLOW : ID= 2 OUTFLOW: ID= 1	(0004) 25 (0006) 25	AREA QPI (ha) (cr 5.50 8	EAK TPEAK (hrs) .33 .50 .49 .92	R.V. (mm) 43.61 43.02

PEAK FLOW REDUCTION TIME SHIFT OF PEAK FLOW MAXIMUM STORAGE USED	[Qout/Qin](%)= 5.89 (min)= 25.00 (ha.m.)= 1.0172
CALIB	Dir. Conn.(%)= 55.00
Surface Area (ha) = 4.56 Dep. Storage (mm) = 1.00 Average Slope (%) = 1.00 Length (m) = 225.10 Mannings n = .013	3.04 1.50 2.00 40.00 .250
Max.Eff.Inten.(mm/hr) = 150.54 over (min) 5.00 Storage Coeff. (min) = 3.53 (ii) Unit Hyd. Tpeak (min) = 5.00 Unit Hyd. peak (cms) = .26	141.97 10.00 9.66 (ii) 10.00 .11
	TOTALS .82 2.495 (iii) .58 .50 33.80 42.87 51.29 51.29 .66 .84
(i) HORTONS EQUATION SELECTED FOR PEI FO (mm/hr) = 50.00 K FC (mm/hr) = 7.50 Cum.Inf (ii) TIME STEP (DT) SHOULD BE SMALLER THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEF.	(1/hr)= 2.00 . (mm)= .00 OR EQUAL
RESERVOIR (0007) IN= 2> OUT= 1 DT= 5.0 min OUTFLOW STORAGE	OUTFLOW STORAGE (cms) (ha.m.) .1092 .2400 .1584 .3100 .1980 .3500 .2406 .3900
AREA QP: (ha) (c) INFLOW: ID= 2 (0005) 7.60 2 OUTFLOW: ID= 1 (0007) 7.60	EAK TPEAK R.V. ms) (hrs) (mm) .49 .50 42.87 .15 .92 42.26
PEAK FLOW REDUCTION TIME SHIFT OF PEAK FLOW MAXIMUM STORAGE USED	[Qout/Qin](%)= 5.99 (min)= 25.00 (ha.m.)= .2974
CALIB	Dir. Conn.(%) = 55.00
Surface Area (ha) = 3.36 Dep. Storage (mm) = 1.00 Average Slope (%) = 1.00 Length (m) = 193.20 Mannings n = .013	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250

	,			
Max.Eff.Inten.(mm/hr) =	150.54	141.97		
over (min)	5.00	10.00		
Storage Coeff. (min)=	3.22 (11)	9.35 (11)	
<pre>Max.Eff.Inten.(mm/hr) =</pre>	27	10.00		
			TOTALS	
PEAK FLOW (cms) = TIME TO PEAK (hrs) = RUNOFF VOLUME (mm) = TOTAL RAINFALL (mm) = RUNOFF COEFFICIENT =	1.26	.61	1.854 (ii	i)
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. I	e ematted mi	IAM DIME ODER	1	
***** WARNING: STORAGE COEFF. I	5 SMALLER IN	IAN TIME STEP	1	
(i) HORTONS EQUATION SEL	ECTED FOR PE	RVIOUS LOSSE	S:	
Fo $(mm/hr) = 50.00$	K	(1/hr) = 2	.00	
Fo $(mm/hr) = 50.00$ Fc $(mm/hr) = 7.50$	Cum.Inf	(mm) =	.00	
(ii) TIME STEP (DT) SHOUL		OR EQUAL		
THAN THE STORAGE COE				
(iii) PEAK FLOW DOES NOT I	NCLUDE BASEF	LOW IF ANY.		
RESERVOIR (0009)				
TN= 2> OTTT= 1				
DT= 5.0 min OUTFLO	W STORAGE	OUTFLO	W STORAGE (ha.m.) 2 .1800	
(cms)	(ha.m.)	(cms)	(ha.m.)	
.000	0 .0000	.115	2 .1800	
.003				
.035	9 1/100	208	2 .2500 2 .2800	
.073	.1100			
	AREA QF	EAK TPEA	K R.V.	
	(ha) (c	ms) (hrs		
	5.60 1	.85 .5	0 42.87	
OUTFLOW: ID= 1 (0009)	5.60	.16 .8	3 42.16	
PEAK FLOW	DEDUCETON	[0	_ 0 E2	
PEAR FLOW	REDUCTION	(min)= 8.55	
TIME SHIFT O	RAGE USED	(ha.m.)= .2139	
		,	,	

** SIMULATION NUMBER: 6 **				

READ STORM Filenam	e: G:\Projec	ts\2012\1211	6 - TSI London	
1	GE1 & GE	2\Design\FSR	Calcs\VO2\Stor	m\
		S50yr.stm		
	s: City of I	ondon AES 50	Yr 1-Hour Distr	ibut
TIME RAIN	TIME RA	IN TIME	מואדים ו מדאים	RAIN
hrs mm/hr	hrs mm/	hr I hrs	RAIN TIME	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	mm/hr hrs 9.09 1.08 3.44 1.30 .49	
CALIB				
STANDHYD (0004) Area	(ha) = 25.50	1		
STANDHYD (0004) Area ID= 1 DT= 5.0 min Total Im	p(%)= 64.00	Dir. Conn	. (%) = 60.00	
Surface Area (ha) = Dep. Storage (mm) = Average Slope (%) =				
[]	MPERVIOUS	PERVIOUS (i	.)	
Den Storage (mm) =	1 00	9.18 1.50		
Average Slope (%)=	1.00	2.00		
crage prope (0)-	1.00	2.00		

```
Length
                    (m) =
                            412.30
                                         40.00
    Mannings n
                              .013
                                         .250
                                        161.48
    Max.Eff.Inten.(mm/hr)=
                            170.09
                              5.00
                                         10.00
             over (min)
    Storage Coeff. (min) =
                              4.83 (ii)
                                         9.48 (ii)
    Unit Hyd. Tpeak (min) =
                              5.00
                                        10.00
                              .22
    Unit Hyd. peak (cms)=
                                          .12
                                                     *TOTALS*
    PEAK FLOW
                              6.82
                                         2.85
                                                      9.622 (iii)
                  (cms) =
    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
                                                       .87
                                          .69
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
      (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
                                     K (1/hr) = 2.00
          Fo (mm/hr) = 50.00
          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
                                       I OUTFLOW
                                                     STORAGE
-----
                       (cms)
                                (ha.m.) | (cms)
                                                      (ha.m.)
                        .0000
                                 .0000
                                             .3720
                                                      .8100
                       .0220
                                 .3853
                                             .5394
                                                      1.1000
                        .1146
                                 .4200 |
                                             .6744
                                                      1.2000
                        .2502
                                 .6600 |
                                                      1.3500
                                             .8190
                            AREA
                                    QPEAK
                                             TPEAK
                                                        R.V.
                            (ha)
                                    (cms)
                                             (hrs)
                                                        (mm)
    INFLOW : ID= 2 (0004)
                           25.50
                                                       50.21
                                     9.62
                                              .50
    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)
                                          3.04
    Surface Area
                   (ha)=
                              4.56
                   (mm) =
                              1.00
                                          1.50
    Dep. Storage
    Average Slope
                    (%)=
                             1.00
                                         2.00
    Length
                    (m) =
                            225.10
                                         40.00
                             .013
                                         .250
    Mannings n
    Max.Eff.Inten.(mm/hr)=
                            170.09
                                        163.83
                                        10.00
            over (min)
                             5 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
                              1.92
                                          .97
                                                      2.882 (iii)
                  (cms) =
    TIME TO PEAK
                  (hrs) =
                              . 50
                                          .58
                                                       . 50
    RUNOFF VOLUME
                  (mm) =
                             56.95
                                         40.32
                                                      49.46
                                                      57.95
    TOTAL RAINFALL
                   (mm) =
                             57.95
                                         57.95
                              .98
                                                       .85
    RUNOFF COEFFICIENT =
                                          .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) |
 TN= 2---> OUT= 1 |
| DT= 5.0 min |
                      OUTFLOW
                               STORAGE | OUTFLOW
                                                      STORAGE
                       (cms)
                                 (ha.m.)
                                         (cms)
                                                       (ha.m.)
                                 .0000
                                              .1092
                                                       .2400
                        0000
                        .0060
                                 .1068
                                              .1584
                                                        .3100
                                  .1300
                        .0336
                                              .1980
                                                         .3500
                        .0750
                                  .1910 I
                                              .2406
                                                         .3900
                             AREA
                                     OPEAK
                                              TPEAK
                                                         R.V.
                             (ha)
                                     (cms)
                                              (hrs)
                                                         (mm)
                                               .50
    INFLOW : ID= 2 (0005)
                             7.60
                                      2.88
                                                         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
I CALTR
 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
                    (mm) =
                               1.00
                                          1.50
    Dep. Storage
    Average Slope
                    (%)=
                               1.00
                                          2.00
    Length
                    (m) =
                             193.20
                                          40.00
    Mannings n
                             .013
    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) =
                                         10 00
                              5.00
                              .27
    Unit Hyd. peak (cms) =
                                                      *TOTALS*
    PEAK FLOW
                   (cms) =
                              1.42
                                          .72
                                                       2.141 (iii)
                                          .58
                                                         .50
    TIME TO PEAK (hrs)=
                               .50
    RUNOFF VOLUME
                   (mm) =
                              56.95
                                         40.32
                                                        49.46
    TOTAL RAINFALL (mm) =
                              57.95
                                         57.95
                                                       57.95
    RUNOFF COEFFICIENT =
                                                         .85
                              .98
**** 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
                               Cum.Inf. (mm) = .00
          Fc (mm/hr) = 7.50
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
         THAN THE STORAGE COEFFICIENT
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
| TN= 2---> OUT= 1 |
| DT= 5.0 min |
                      OUTFLOW
                                STORAGE
                                            OUTFLOW
                                                       STORAGE
```

```
AREA
                                    OPEAK
                                             TPEAK
                                                       R.V.
                            (ha)
                                    (cms)
                                                       (mm)
    INFLOW : ID= 2 (0008)
                            5.60
                                    2.14
                                              .50
                                                       49.46
    OUTFLOW: TD = 1 (0009)
                           5.60
                                     .20
                                              .83
                                                      48.75
                PEAK FLOW REDUCTION [Oout/Oin](%) = 9.34
                                           (min) = 20.00
                TIME SHIFT OF PEAK FLOW
                MAXIMUM STORAGE USED
 *********
 ** SIMULATION NUMBER: 7 **
                    Filename: G:\Projects\2012\12116 - TSI London
                              GE1 & GE2\Design\FSR Calcs\VO2\Storm\
                             1hrAES\AES100vr.stm
| Ptotal= 64.61 mm |
                    Comments: City of London AES 100Yr 1-Hour Distribu
              TIME
                   RATN | TIME RATN | TIME
                                                RATN I TIME
                   mm/hr | hrs mm/hr | hrs mm/hr | hrs
               hrs
               .08
                      .00 |
                             .42 189.64 |
                                           .75
                                                 10.14 | 1.08
               .17
                     47.41 I
                             .50 187.35 | .83
                                                 3 83 1
               .25 94.82 | .58 70.86 | .92
                                                  1.45 |
               .33 142.23 | .67 26.80 | 1.00
                                                  .55 |
______
I CALTE
 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
                           412.30
    Length
                    (m) =
                                        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) =
                                                    *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
                                                       .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) |
| TN= 2---> OUT= 1 |
| DT= 5.0 min |
                      OUTFLOW
                               STORAGE | OUTFLOW
                                                     STORAGE
                      (cms)
                               (ha.m.)
                                        (cms)
                                                     (ha.m.)
                                .0000
                                           .3720
                       .0000
                                                     .8100
```

(ha.m.)

.0000

.0782

.0880

.1400

(cms)

.0050

.0354

.0792

(cms)

.1152

.1668

.2082

.2532

(ha.m.)

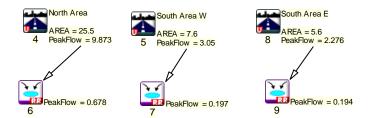
.1800

.2200

.2500

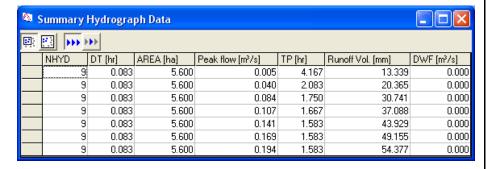
Trydrologic Model Odiput -	Froposed Conditions	(1 Hour ALS	31011113) 23111111, 2	z yı, 5 yı, 25yı, 50yı a	nu roo y
	.0220	.3853	.5394 .6744 .8190	1.1000	
	.1146	.4200	.6744	1.2000	
	.2502	.6600	.8190	1.3500	
	AREA (ha) (0004) 25.50 (0006) 25.50	A QPEAR	TPEAK	R.V.	
	(ha)	(cms)	(hrs)	(mm)	
INFLOW : ID= 2	(0004) 25.50	10.93	.50	56.82	
OUTFLOW: ID= 1	(0006) 25.50	.78	.92	56.21	
P	EAK FLOW REI IME SHIFT OF PEA AXIMUM STORAGE	OUCTION [Qo	out/Qin](%)=	7.15	
T	IME SHIFT OF PEA	K FLOW	(min)=	25.00	
M	AXIMUM STORAGE	USED	(na.m.)=	1.3120	
CALIB					
STANDHYD (0005)	Area (ha)=	7 60			
STANDHYD (0005) ID= 1 DT= 5.0 min	Total Imp(%)=	. 60 00	Dir Conn (S	k) = 55 00	
				55.00	
	TMPERV	TOUS PE	RVIOUS (i)		
Surface Area	IMPERV (ha) = 4. (mm) = 1. (%) = 1. (m) = 225. = .0	56	3.04		
Dep. Storage	(mm) = 1	00	1.50		
Average Slope	(%) = 1	00	2.00		
Length	(m) = 225	10	40 00		
Mannings n	= 223.	113	250		
Mainizings ii		113	.230		
May Eff Inten	mm/hr) = 189. (min) 5. (min) = 3. (min) = 5. (cms) = .	64 1	85 69		
over	(min) 5	00	10 00		
Storago Cooff	(min) = 3	22 (11)	8 03 (44)		
Unit Hud Thoak	(min) = 5.	00	10.00 (11)		
Unit Hyd noak	(mill) - J.	27	13		
				TOTALS	
DEAK ELOW	(cms) = 2	15	1 16	3.312 (iii)	
TIME TO DEAK	(bna) = 2.	10	1.10	.50	
DINORE VOLUME	(IIIS) - 62	61	16 01	56.06	
RONOFF VOLUME	(mm) = 64	61	64 61	64.61	
DINORE CORRECT	(cms) = 2. (hrs) = . (mm) = 63. (mm) = 64. ENT = .	0.0	72	.87	
RONOFF COEFFICE	ENI -	90	. / 3	.0/	
**** WARNING: STORA	GE COEFF IS SMA	T.T.ER THAN	TIME STEP!		
manino. Dioini	00 00011. 10 011				
(i) HORTONS E	QUATION SELECTED	FOR PERVI	OUS LOSSES.		
Fo (mm	/hr) = 50.00	K	(1/hr) = 2.00)	
Fc (mm	/hr) = 50.00 /hr) = 7.50	Cum. Inf.	(mm) = .00)	
(ii) TIME STEP	(DT) SHOULD BE	SMALLER OF	R EOUAL		
	STORAGE COEFFICI		~ -		
(iii) PEAK FLOW	DOES NOT INCLUI	E BASEFLOV	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	
	OUTFLOW (cms) .0000 .0060 .0336 .0750	1910	2406	3900	
	AREA	OPEAR	(TPEAK	R.V.	
	(ha)	(Cms)	(hrs)	(mm)	
INFLOW : TD= 2	AREA (ha) (0005) 7.60 (0007) 7.60	3.31	. 50	56.06	
OUTFLOW: ID= 1	(0007) 7.60	. 24	1 .83	55.44	
111120 12 1	,.,.,	. 2 -			
P	EAK FLOW REI	OUCTION [Oc	out/Oinl(%)=	7.14	
T T	IME SHIFT OF PEA	K FLOW	(min)=	20.00	
M	IME SHIFT OF PEA AXIMUM STORAGE	USED	(ha.m.)=	.3872	
	01011101		,/		
CALIB					
STANDHYD (0008)		5.60			
	/				

ID= 1 DT= 5.0 min To	tal Tmp(%)= 60 00	Dir Conn (%)	= 55 00
	-		33.33
Surface Area (ha Dep. Storage (mm Average Slope (% Length (m Mannings n	IMPERVIOUS	PERVIOUS (i)	
Den Storage (mm)= 3.36)= 1.00	1 50	
Average Slope (%)= 1.00	2.00	
Length (m)= 193.20	40.00	
Mannings n	= .013	.250	
W 766 7 1 / /1	100.64	105 60	
Max.EII.Inten.(mm/nr)= 189.64	10.00	
Storage Coeff. (min) = 2.94 (ii)	7.75 (ii)	
Unit Hyd. Tpeak (min)= 5.00	10.00	
Max.Eff.Inten.(mm/hr over (min Storage Coeff. (min Unit Hyd. Tpeak (min Unit Hyd. peak (cms)= .28	.13	
DEAK BLOW /	1 50	0.7	*TOTALS*
PEAK FLOW (CMS)= 1.59)= 50	.87	2.459 (iii) .50
PEAK FLOW (cms TIME TO PEAK (hrs RUNOFF VOLUME (mm TOTAL RAINFALL (mm) = 63.61	46.84	56.06
TOTAL RAINFALL (mm)= 64.61	64.61	64.61
RUNOFF COEFFICIENT	= .98	.73	.87
**** WARNING: STORAGE CO	יים משודותם דכ משק	AN TIME CTED!	
WARNING: STORAGE CO	DIE. 10 OMALLER TH	ON TIME SIEF!	
(i) HORTONS EQUATI	ON SELECTED FOR PE	RVIOUS LOSSES:	
	50.00 K		
Fc (mm/hr)= (ii) TIME STEP (DT)	7.50 Cum.Inf		
	SHOULD BE SMALLER GE COEFFICIENT.	OK EQUAL	
(iii) PEAK FLOW DOES		LOW IF ANY.	
RESERVOIR (0009)			
IN= 2> OUT= 1			
DT= 5.0 min	OUTFLOW STORAGE	OUTFLOW	STORAGE
	(cms) (ha.m.)	(CMS)	(ha.m.) .1800
	.0050 .0782	1 .1668	.2200
	.0354 .0880	.2082	.2500 .2800
	OUTFLOW STORAGE (cms) (ha.m.) .0000 .0050 .0050 .0782 .0354 .0880 .0792 .1400	.2532	.2800
	AREA QP.	EAK TPEAK ms) (hrs)	K.V. (mm)
INFLOW : ID= 2 (0008) 5.60 2	.46 .50	56.06
INFLOW : ID= 2 (0008 OUTFLOW: ID= 1 (0009	5.60	.25 .83	55.35
	FLOW REDUCTION		
IMTXAM	HIFT OF PEAK FLOW M STORAGE USED	(ha.m.)=	.2769
		(/	
FINISH			



M S	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		

Ø _k	Summary Hydrograph Data							
13	<u>₽</u>							
	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	



```
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                           U AA L
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                        U U AAAAA L
      V V
             Т
                   SS
                        U U A A L
       VV
                  SSSSS UUUUU A A LLLLL
                                                  TM, Version 2.0
      000
            TTTTT TTTTT H H Y Y M M OOO
      0 0
            T
                   T
                        H H Y Y MM MM O O
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                        H H Y M M O O
                                                 Licensed To: TMIG
                        H H Y M M OOO
                                                             VO2-0145
      000
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                ***** DETAILED OUTPUT *****
 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:
 ** 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 I
                            1.17
                                    5.70 I 2.17
                                                  5.19 I
                                                         3.17
                                                                2.80
                                   10.78 | 2.33
                                                  4.47 | 3.33
               .33
                      2.27 | 1.33
                                                                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
```

	.0220 .3853 .5178 .9500 .1536 .4900 .6084 1.0500 .3048 .6900 .6978 1.1500
CALIB STANDHYD (0004) Area (ha) = 25.50 ID= 1 DT= 5.0 min Total Imp(%) = 64.00 Dir. Conn.(%) = 60.00	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
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	PEAK FLOW REDUCTION [Qout/Qin](%) = 1.44 TIME SHIFT OF PEAK FLOW (min)=160.00 MAXIMUM STORAGE USED (ha.m.) = .3667
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	CALIB
TIME RAIN 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) =	IMPERVIOUS PERVIOUS (i)
(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
RESERVOIR (0006) IN= 2> OUT= 1 DT= 5.0 min	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

RAIN

2.88

2.65

2.46

RAIN

3.51

3.16

3.16

2.88

2.88

2.65

2.65

2.46 2.46

mm/hr

TOTALS 3.004 (iii) 1.00 22.26 33.29

mm/hr

PEAK FLOW REDUCTION [Qout/Qin](%) = 1.12 TIME SHIFT OF PEAK FLOW (min)=160.00	** SIMULATION NUMBER: 2 ** *********************************
MAXIMUM STORAGE USED (ha.m.) = .1018	CHICAGO STORM IDF curve parameters: A= 724.690 Ptotal= 33.29 mm B= 5.500
CALIB	used in: INTENSITY = A / (t + B)^C
STANDHYD (0008) Area (ha) = 5.60 ID= 1 DT= 5.0 min Total Imp(%) = 60.00 Dir. Conn.(%) = 55.00	Duration of storm = 3.00 hrs Storm time step = 10.00 min
IMPERVIOUS PERVIOUS (i)	Time to peak ratio = .33
Surface Area (ha)= 3.36 2.24 Dep. Storage (mm)= 1.00 1.50	TIME RAIN TIME RAIN TIME RAIN TIME
Average Slone (%) = 1.00 2.00	hrs mm/hr hrs mm/hr hrs mm/hr hrs
Length $(m) = 193.20 40.00$.17 3.02 1.00 80.89 1.83 5.36 2.67
Mannings n = .013 .250	.33 3.72 1.17 24.52 2.00 4.54 2.83 .50 4.95 1.33 12.70 2.17 3.95 3.00
Max.Eff.Inten.(mm/hr) = 50.21 5.12	.67 7.61 1.50 8.64 2.33 3.51
over (min) 5.00 30.00	.83 18.60 1.67 6.59 2.50 3.16
Storage Coeff. (min) = 5.00 (ii) 28.17 (ii) Unit Hyd. Tpeak (min) = 5.00 30.00	
Unit Hyd. Tpeak (min) = 5.00 30.00 Unit Hyd. peak (cms) = .21 .04	
momatc	
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	CALIB
TIME TO PEAK (hrs) = 1.50 1.92 1.50	STANDHYD (0004) Area (ha) = 25.50
RUNOFF VOLUME (mm) = 24.00 1.90 14.05 TOTAL RAINFALL (mm) = 25.00 25.00 25.00	ID= 1 DT= 5.0 min Total Imp(%) = 64.00 Dir. Conn.(%) = 60.00
TOTAL RAINFALL (mm) = 25.00 25.00 25.00 RUNOFF COEFFICIENT = .96 .08 .56	IMPERVIOUS PERVIOUS (i)
RUNOFF COEFFICIENT90 .00 .50	Surface Area (ha) = 16.32 9.18
**** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!	
	Dep. Storage (mm) = 1.00 1.50 Average Slope (%) = 1.00 2.00
(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:	Length (m) = 412.30 40.00
Fo $(mm/hr) = 50.00$ K $(1/hr) = 2.00$	Mannings n = .013 .250
FC (mm/hr)= 7.50 Cum.Inf. (mm)= .00 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.	NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.	
	TRANSFORMED HYETOGRAPH
	TIME RAIN TIME RAIN TIME RAIN TIME
RESERVOIR (0009)	hrs mm/hr hrs mm/hr hrs mm/hr hrs .083 3.02 .833 18.60 1.583 6.59 2.33
IN= 2> OUT= 1	.167 3.02 .917 80.89 1.667 6.59 2.42
DT= 5.0 min OUTFLOW STORAGE OUTFLOW STORAGE	.250 3.72 1.000 80.89 1.750 5.36 2.50
(cms) (ha.m.) (cms) (ha.m.)	.333 3.72 1.083 24.52 1.833 5.36 2.58
.0000 .0000 .1182 .1800	.417 4.95 1.167 24.52 1.917 4.54 2.67
.0050 .0782 .1506 .2000	.500 4.95 1.250 12.70 2.000 4.54 2.75
.0432 .1000 .1770 .2200 .0882 .1450 .2028 .2400	.583 7.61 1.333 12.70 2.083 3.95 2.83
.0882 .1450 .2028 .2400	.667 7.61 1.417 8.64 2.167 3.95 2.92 .750 18.60 1.500 8.64 2.250 3.51 3.00
AREA OPEAK TPEAK R.V.	.730 10.00 1.300 0.04 2.230 3.31 3.00
(ha) (cms) (hrs) (mm)	Max.Eff.Inten.(mm/hr) = 80.89 47.13
INFLOW: ID= 2 (0008) 5.60 .39 1.50 14.05	over (min) 5.00 20.00
OUTFLOW: ID= 1 (0009) 5.60 .00 4.17 13.34	Storage Coeff $(min) = 6.51 (ii) 16.04 (ii)$
	Unit Hyd. Tpeak (min) = 5.00 20.00 Unit Hyd. peak (cms) = .18 .06
PEAK FLOW REDUCTION [Qout/Qin] (%) = 1.23	Unit Hyd. peak (cms) = .18 .06 *TOTALS*
TIME SHIFT OF PEAK FLOW (min)=160.00 MAXIMUM STORAGE USED (ha.m.)= .0746	
PRATEON STORGE USED (Hd.H.)0/40	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
***********	RUNOFF VOLUME (mm) = 32.29 7.21 22.26 TOTAL RAINFALL (mm) = 33.29 33.29 33.29
	•

RUNOFF COEFFICI	ENT =	.97	.22	.67	
Fo (mm Fc (mm (ii) TIME STEF	/hr) = 50.00 /hr) = 7.50 (DT) SHOULD STORAGE COE	K Cum.Inf D BE SMALLER FFICIENT.		00	
RESERVOIR (0006) IN= 2> OUT= 1 DT= 5.0 min		W STORAGE	OUTFLOW	STORAGE	
IN= 2> OUT= 1 DT= 5.0 min	.000 .022	(ha.m.) 0 .0000 0 .3853	(cms) .4056 .5178	(ha.m.) .8200 .9500	
<pre>INFLOW : ID= 2 OUTFLOW: ID= 1</pre>	(0004)	AREA QF (ha) (c 25.50 3	EAK TPEAK ms) (hrs) .00 1.00	R.V. (mm) 22.26	
р Т М	EAK FLOW IME SHIFT OF	REDUCTION F PEAK FLOW RAGE USED	[Qout/Qin](%)= (min)= (ha.m.)=	= 4.96	
CALIB STANDHYD (0005) ID= 1 DT= 5.0 min	Area Total Imj	(ha) = 7.60 p(%) = 60.00	Dir. Conn.	(%) = 55.00	
	II	MPERVIOUS	PERVIOUS (i)		
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	4.56 1.00 1.00 225.10	3.04 1.50 2.00 40.00		
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	(min) = (min) = (cms) =	5.00 4.52 (ii) 5.00	15.00 13.96 (ii) 15.00		
	(*TOTALS*	
PEAK FLOW	(cms) =	.86	.17	.946 (iii) 1.00	
RUNOFF VOLUME	(mm) =	32.29	7.37	21.08 33.29	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI	(mm) = ENT =	33.29 .97	33.29 .22	33.29 .63	
**** WARNING: STORA	GE COEFF. I	S SMALLER TH	AN TIME STEP!		
(i) HORTONS E Fo (mm	QUATION SELI	ECTED FOR PE	RVIOUS LOSSES: (1/hr) = 2.0 (mm) = .0	:	
Fc (mm (ii) TIME STEP	/hr) = 7.50 (DT) SHOUL	Cum.Inf D BE SMALLER	OR EQUAL	00	

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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 | .1206
                       .0000
                                                      .2400
                        .0060 .1068 | .1536
                                                       .2800
                        .0456 .1400 | .1794
                                                       .3100
                        .0906 .2000 | .2064 .3400
                            AREA QPEAK TPEAK R.V.
                            (ha) (cms) (hrs)
    INFLOW : ID= 2 (0005)
                            7.60
                                   .95 1.00
                                                       21.08
                                  .04
    OUTFLOW: ID= 1 (0007) 7.60
                                            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
| 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
TIME TO PEAK (hrs) = 1.00 1.17
RUNOFF VOLUME (mm) = 32.29 7.37
                                                      .709 (iii)
                                                       1.00
                                                     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 (0009) |
| IN= 2---> OUT= 1 |
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,		(o nour onloage o	,	, - , . , - , . , ,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	•
DT= 5.0 min	OUTFLC (cms) .000 .005 .043	W STORAGI (ha.m.) 0 .0000 0 .0782 2 .1000 2 .1450	E OT OT OT OT OT OT OT O	UTFLOW (cms) .1182 .1506 .1770 .2028	STORAGE (ha.m.) .1800 .2000 .2200 .2400	
INFLOW : ID= 2	2 (0008) 1 (0009)			TPEAK (hrs) 1.00 2.08	R.V. (mm) 21.08 20.36	
	PEAK FLOW TIME SHIFT C MAXIMUM STC	F PEAK FLOW RAGE USED	(1	(min) = 65 na.m.) = .	.00 0980	
**************************************	MBER: 3 **					
CHICAGO STORM Ptotal= 45.35 mm	 	ve paramete:	C=	7.938 .855	c	
	Storm t	n of storm ime step peak ratio	= 10.00			
<u>}</u>	hrs mm/hr l	1.00 112 1.17 36 1.33 17	/hr 1 .71 1 .59 2	nrs mm/h: .83 6.6 .00 5.5 .17 4.6	r hrs 9 2.67 1 2.83 9 3.00	mm/hr
CALIB STANDHYD (0004) ID= 1 DT= 5.0 min	Area Total Im			Conn.(%)=	60.00	
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) =	MPERVIOUS 16.32 1.00 1.00 412.30 .013	PERVIOU 9.18 1.50 2.00 40.00	3		
NOTE: RA	INFALL WAS TR	ANSFORMED TO	5.0 1	MIN. TIME	STEP.	
T: 1 . (IME RAIN hrs mm/hr 083 3.43 167 3.43	TRANSF(TIME RA hrs mm, .833 27 .917 112	AIN T	IME RAII	N TIME	RAIN mm/hr 4.08 3.61

						October 2013
.250 .333 .417 .500 .583 .667	4.38 4.38 6.09 6.09 10.04 10.04 27.27	1.000 1 1.083 1.167 1.250 1.333 1.417 1.500	112.71 36.59 36.59 17.98 17.98 11.61 11.61	1.750 1.833 1.917 2.000 2.083 2.167 2.250	6.69 2.50 6.69 2.58 5.51 2.67 5.51 2.75 4.69 2.83 4.69 2.92 4.08 3.00	3.61 3.25 3.25 2.95 2.95 2.70 2.70
Max.Eff.Inten.(mm over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICIEN					*TOTALS* 4.642 (ii. 1.00 32.80 45.35 .72	i)
(i) HORTONS EQUENT FO (mm/r) FC (mm/r) (ii) TIME STEP THAN THE ST (iii) PEAK FLOW I	ar)= 50.00 ar)= 7.50 (DT) SHOULD CORAGE COEF DOES NOT IN	Cum. BE SMAI FICIENT. CLUDE BA	K () .InfLLER ORASEFLOW	1/hr) = 2.0 (mm) = .0 EQUAL IF ANY.	00	
RESERVOIR (0006) IN= 2> OUT= 1 DT= 5.0 min	OUTFLOW (cms) .0000 .0220 .1536 .3048	STOF (ha	RAGE .m.) 0000 8853 1900	OUTFLOW (cms) .4056 .5178 .6084 .6978	STORAGE (ha.m.) .8200 .9500 1.0500	
1IT	0004) 2 0006) 2 AK FLOW ME SHIFT OF	REDUCTI PEAK FI	ION [Qoi	ut/Qin](%): (min):	= 6.51 = 55.00	
CALIB	Area (Total Imp	ha) = 7	7.60).00	Dir. Conn.	(%) = 55.00	
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	4.56 1.00 1.00 225.10 .013	S PE	RVIOUS (i) 3.04 1.50 2.00 40.00 .250		

Max.Eff.Inten.(mm/hr) = 112.71 87.54	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.
(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
RESERVOIR (0007) IN= 2> OUT= 1 DT= 5.0 min	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	**************************************
CALIB	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
PEAK FLOW (cms) = .92 .27 **TOTALS** 1.057 (iii)	CALIB

	,	Ü	, , , , ,	, , , , ,	
I STANDHYD (0004) I	Area (h	a) = 25 50			
STANDHYD (0004) ID= 1 DT= 5.0 min	Total Imp(%) = 64.00	Dir. Conn.	(%) = 60.0	00
	TME				
0		ERVIOUS P			
Surface Area	(ha)=	16.32	9.18		
Dep. Storage Average Slope	(mm) =	1.00	1.50		
Average Slope	(%)=	1.00	2.00		
Length	(m) = 4		40.00		
Mannings n	=	.013	.250		
NOTE: RAINF	ALL WAS TRAN	SFORMED TO	5.0 MIN. T	IME STEP.	
		TRANSFORM	ED HAEMOCDY	DU	
ттмг		TIME RAIN			TME BAIN
hre	mm/hr	hre mm/hr	l hre	mm/hr	hre mm/hr
083	3 99 1	hrs mm/hr .833 30.92	1 1 583	9 71 1 2) 33 / / 73
167	3 99 1	917 133 45	1 1 667	9 71 2	2 42 4 20
250	5 07 1	.917 133.45 .000 133.46 .083 41.53	1 1 750	7 67 1 2	2.12 1.20
333	5.07 1	083 41 53	1 1 833	7.67 2	2.50 4.20
.333	7 00 1 1	167 41.53	1 1 017	6 35 1 3	2.50 3.70
500	7.00 1	250 20 35	1 2 000	6 35 2	2.07 3.70
583	11 44 1	333 20.33	1 2 083	5 42 2	2.73 3.44
667	11 // 1 1	417 13 20	1 2 167	5 42 2	2 92 3 16
750	30 91 1	.167 41.53 .250 20.35 .333 20.35 .417 13.20 .500 13.20	1 2 250	173 2	3.16
					3.10
Max.Eff.Inten.(m over Storage Coeff.	m/hr) = 1	33.46	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. Tpeak Unit Hyd. peak	(cms) =	.21	.09		
				*TOTALS	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME	(cms) =	4.99	1.36 1.17 20.75 52.57		5 (iii)
TIME TO PEAK	(hrs) =	1.00 51.57 52.57	1.17	1.00	
RUNOFF VOLUME	(mm) =	51.57	20.75	39.24	
TOTAL RAINFALL	(mm) =	52.57	52.57	52.57	
RUNOFF COEFFICIE	NT =	.98	.39	.75	5
(i) HORTONS EQ	UATION SELEC	TED FOR PERV	IOUS LOSSES	:	
Fc (mm/	hr) = 7.50	K Cum.Inf.	(mm) = .	00	
(ii) TIME STEP					
	TORAGE COEFF				
(iii) PEAK FLOW			W IF ANY.		
RESERVOIR (0006)					
IN= 2> OUT= 1					
DT= 5.0 min	OTTORET ON	STORAGE		QTIOD NO	≟₽
DI- 0.0 MIII	(cms)	(ham)	(cms)	(ha m) -
 _	(CIIIS)	0000	1 (CIIIS)	, III. a . III.	10
	0000	(ha.m.) .0000 .3853 .4900	1 5170	.020	10
	1536	4900	1 6004	1 050	10
	.1000	. 4 5 0 0	.0004	1.000	, ,

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PEAK FLOW REDUCTION [Qout/Qin](%) = 7.02
                 TIME SHIFT OF PEAK FLOW (min) = 50.00
                 MAXIMUM STORAGE USED
                                             (ha.m.) = .8113
| 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
    Average Slope (%) = 1.00
    Length (m) = 225.10 40.00 Mannings n = .013 .250
                   = .013
                                      112.80
    Max.Eff.Inten.(mm/hr) = 133.46
      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
                             .25
                                                       *TOTALS*
    PEAK FLOW (cms) = 1.47
TIME TO PEAK (hrs) = 1.00
                                           .49
                                                      1.723 (iii)
1.00

      PEAK FLOW
      (cms) =
      1.47
      .49

      TIME TO PEAK
      (hrs) =
      1.00
      1.17

      RUNOFF VOLUME
      (mm) =
      51.57
      20.97

                                                      37.80
    TOTAL RAINFALL (mm) = 52.57 52.57
                                                      52.57
    RUNOFF COEFFICIENT =
                              .98
                                                        .72
                                          .40
***** 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 | .1206
                                                       .2400
                        .0000
                        .0060 .1068 | .1536
                        .0456 .1400 | .1794
                                                      .3100
                        .0906 .2000 | .2064
                           AREA OPEAK TPEAK R.V.
                             (ha)
                                   (cms) (hrs)
    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
```

AREA

(ha)

25.50

25.50

INFLOW : ID= 2 (0004)

OUTFLOW: ID= 1 (0006)

.3048 .6900 | .6978

OPEAK

(cms)

5.68

.40

1.1500

R.V.

(mm)

39.24

38.63

TPEAK

(hrs)

1.00

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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)
                            3.36
                                      2.24
    Surface Area
                  (ha) =
    Dep. Storage
                  (mm) =
                            1.00
                                       1.50
    Average Slope
                 (%)=
                           1.00
                                       2.00
                   (m) =
                        193.20
                                      40 00
    Length
                          .013
                                     .250
    Mannings n
                  =
    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
                 (mm) =
    RUNOFF VOLUME
                           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
                             (ha.m.) | (cms)
                                                  (ha.m.)
                     (cms)
                                                  .1800
                      .0000
                             .0000
                                          .1182
                               .0782 |
                                          .1506
                      .0050
                                                   .2000
                               .1000 |
                      .0432
                                          .1770
                                                    .2200
                      0882
                                .1450
                                          .2028
                                                    .2400
                          AREA
                                 OPEAK
                                          TPEAK
                                                    R V
                                  (cms)
                           (ha)
                                           (hrs)
                                                    (mm)
    INFLOW : ID= 2 (0008)
                                   1.29
                                           1.00
                          5.60
                                                    37.80
    OUTFLOW: ID= 1 (0009)
                          5 60
                                  1.1
                                           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
______
 ******
 ** SIMULATION NUMBER: 5 **
 ********
| CHICAGO STORM |
                   IDF curve parameters: A=1455.000
| Ptotal= 60.35 mm |
                                  B= 5.000
```

```
used in: INTENSITY = A / (t + B)^C
                     Duration of storm = 3.00 \text{ hrs}
                     Storm time step = 10.00 \text{ min}
                     Time to peak ratio = .33
               TIME.
                     RAIN | TIME
                                   RAIN | TIME
                                                  RAIN | TIME
               hrs
                     mm/hr | hrs mm/hr | hrs
                                                  mm/hr |
                                                          hrs
                                                                mm/hr
                     4.97 | 1.00 157.93 | 1.83
                                                  9 00 1
                                                         2 67
                                                                4 74
                17
                .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
                     5 80 I
                .83
                     32.88 | 1.67 11.14 | 2.50
                                                  5.21 I
| CALIB
| STANDHYD (0004) | Area (ha) = 25.50
|ID= 1 DT= 5.0 min | Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00
                          IMPERVIOUS
                                     PERVIOUS (i)
                   (ha) =
                             16.32
                                         9.18
    Surface Area
    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
                     mm/hr | hrs mm/hr | hrs mm/hr | hrs
                     4.97 | .833 32.88 | 1.583 11.14 | 2.33
               .083
                     4.97 | .917 157.93 | 1.667 11.14 | 2.42
                                                                 5 21
               .167
               .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
                                   43.82 | 1.917
               .417
                      8.28 | 1.167
                                                  7.58 | 2.67
                                                                 4.74
                                   21.99 | 2.000
                                                  7.58 | 2.75
                                                                 4.35
               .500
                     8.28 | 1.250
                     12.92 | 1.333
                                   21.99 | 2.083
                                                   6.56 |
                                                         2.83
                                                                 4.35
               .583
               .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
                            157.93
                                        140.85
    Max.Eff.Inten.(mm/hr) =
             over (min)
                            5.00
                                        10.00
    Storage Coeff. (min) =
                            4.98 (ii) 9.77 (ii)
    Unit Hyd. Tpeak (min) =
                              5.00
                                         10.00
                             .22
    Unit Hyd. peak (cms) =
                                         .11
                                                     *TOTALS*
    PEAK FLOW
                   (cms) =
                          5.98
                                       2.06
                                                      7.743 (iii)
    TIME TO PEAK
                   (hrs) =
                             1.00
                                        1.08
                                                      1 00
    RUNOFF VOLUME
                             59.35
                   (mm) =
                                         26.40
                                                      46.17
    TOTAL RAINFALL (mm) =
                             60.35
                                         60.35
                                                      60 35
                             .98
    RUNOFF COEFFICIENT =
                                         .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
```

C=

| RESERVOIR (0007) |

(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
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
CALIB
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
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
(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.

```
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
                    OUTFLOW STORAGE | OUTFLOW
                                                  STORAGE
                            (ha.m.) | (cms)
.0000 | .1206
                     (cms)
                                                  (ha.m.)
                      .0000
                                                  .2400
                      .0060
                              .1068 |
                                          .1536
                                                    .2800
                             .1400 | .1794
2000 | .2064
                      .0456
                                                    .3100
                      .0906
                                                   .3400
                          AREA
                                  QPEAK
                                          TPEAK
                                                    R.V.
                                                    (mm)
                          (ha)
                                  (cms)
                                          (hrs)
    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
I CALTB
| 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
                 (%)=
                           1.00
                                     2.00
    Average Slope
                 (m) = 193.20
                                    40.00
    Length
    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*
                (cms) = 1.31 .52
(hrs) = 1.00 1.08
(mm) = 59.35 26.66
    PEAK FLOW
                                                 1.759 (iii)
    TIME TO PEAK (hrs)=
                                                  1.00
    RUNOFF VOLUME (mm) =
                                                  44.64
                                    60.35
                           60.35
                                                  60.35
    TOTAL RAINFALL (mm) =
    RUNOFF COEFFICIENT =
                           .98
                                                   .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.
| RESERVOIR (0009) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
                    OUTFLOW STORAGE | OUTFLOW
                                                 STORAGE
-----
                     (cms)
                            (ha.m.) | (cms)
                                                  (ha.m.)
                             .0000
                      .0000
                                          .1182
                                                  .1800
                              .0782
                      .0050
                                          .1506
                                                    .2000
                               .1000 |
                      .0432
                                          .1770
                                                    .2200
                      .0882
                               .1450
                                          .2028
                                                    .2400
```

, d. o.o.g. c	0.000.20
AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (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 **********************************	.750 34.80 1.500 15.95 2.250 6.51 3.00 4.56 Max.Eff.Inten.(mm/hr) = 175.35 163.49
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	***** 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.
TIME RAIN TIME RAIN TIME RAIN TIME RAIN TIME mm/hr hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr 1.7	RESERVOIR (0006) IN= 2> OUT= 1 DT= 5.0 min
CALIB	AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (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
TIME RAIN TIME RAIN TIME RAIN TIME RAIN TIME RAIN hrs mm/hr hrs mr/hr hrs mm/hr hrs mm	IMPERVIOUS PERVIOUS (i)

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!	***** 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.
(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
RESERVOIR (0007) IN= 2> OUT= 1 DT= 5.0 min	.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
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	**************************************
CALIB	used in: INTENSITY = A / (t + B)^C Duration of storm = 3.00 hrs Storm time step = 10.00 min Time to peak ratio = .33
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	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
Unit Hyd. peak (cms) = .27 .13 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	CALIB

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 ----

		114	IIVDI OIUIDD	III DI OOIU	11.		
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs i	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.(m	m/hr)=	192.17	185	5.49			
over	(min)	5.00	10	0.00			
Storage Coeff.	(min) =	4.60	(ii) S	9.03 (ii)			
Unit Hyd. Tpeak	(min) =	5.00	10	0.00			
Unit Hyd. peak	(cms) =	.23		.12			
					TOTA	LS	
PEAK FLOW	(cms) =	7.40	2	2.76	9.8	73 (iii)	
TIME TO PEAK	(hrs) =	1.00		L.08	1.0	0.0	
RUNOFF VOLUME	(mm) =	70.76	3.5	5.59	56.	69	
TOTAL RAINFALL	(mm) =	71.76	7:	L.76	71.	76	
RUNOFF COEFFICIE	INT =	.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) = 2.00Fc (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) | | TN= 2---> OUT= 1 | | DT= 5.0 min | OUTFLOW STORAGE | OUTFLOW (ha.m.) | (cms) (ha.m.) (cms) .0000 | .4056 .0220 .3853 | .5178 .1536 .4900 | .6084 .3048 .6900 | .6978 1.1500 QPEAK AREA TPEAK R V (cms) (ha) (hrs) (mm) 9.87 INFLOW : ID= 2 (0004) 25.50 1.00 56.69 .68 56.06 OUTFLOW: ID= 1 (0006) 25.50 1.75 PEAK FLOW REDUCTION [Qout/Qin](%) = 6.87 TIME SHIFT OF PEAK FLOW (min) = 45.00 MAXIMUM STORAGE USED (ha.m.) = 1.1286

```
I CALTB
 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
                           1.00
                                     1.50
                 (mm) =
                 (%) = 1.00
                                     2.00
    Average Slope
                  (m) = 225.10
                                    40.00
   Length
                 = .013
    Mannings n
                                     .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
                          .27
    Unit Hyd. peak (cms) =
                                                 *TOTALS*
                         2.15
                                                 3.050 (iii)
    PEAK FLOW
                 (cms) =
                                       .98
    TIME TO PEAK
                (hrs) =
                           1.00
                                      1.08
                                                   1.00
    RUNOFF VOLUME
                 (mm) =
                           70.76
                                      35.93
                                                  55.09
                                    71.76
    TOTAL RAINFALL (mm) =
                           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 |
                    OUTFLOW STORAGE | OUTFLOW
| DT= 5.0 min |
                                                STORAGE
                            (ha.m.) | (cms)
.0000 | .1206
                     (cms)
                                                 (ha.m.)
                      .0000
                                                  .2400
                      .0060
                               .1068
                                         .1536
                                                   .2800
                               .1400 |
                      .0456
                                         .1794
                                                   .3100
                      .0906
                               .2000 |
                                        .2064
                                                   .3400
                          AREA
                                 OPEAK
                                        TPEAK
                                                   R V
                          (ha)
                                          (hrs)
                                                   (mm)
                                 (cms)
   INFLOW : ID= 2 (0005)
                          7.60
                                3.05
                                         1.00
                                                   55 09
    OUTFLOW: ID= 1 (0007)
                          7.60
                                        1.67
               PEAK FLOW REDUCTION [Qout/Qin] (%) = 6.45
               TIME SHIFT OF PEAK FLOW (min) = 40.00
               MAXIMUM STORAGE USED
                                        (ha.m.) = .3295
I CALTB
| STANDHYD (0008) | Area (ha) = 5.60
|ID= 1 DT= 5.0 min | Total Imp(%)= 60.00 Dir. Conn.(%)= 55.00
```

	(ha) = (mm) = (%) = (m) =		2.24 1.50 2.00	(i)	
Max.Eff.Inten.(n over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	(min) (min) = (min) =		10.00 (ii) 7.71	(ii)	
	(cms) = (hrs) = (mm) = (mm) = ENT =	1.60 1.00 70.76 71.76 .99	.73 1.08 35.93 71.76 .50		*TOTALS* 2.276 (iii) 1.00 55.09 71.76 .77

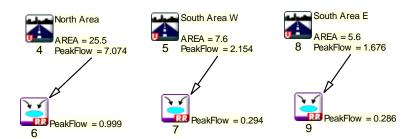
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (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
	ARE	A QPEAK	TPEAK	R.V.
	(ha) (cms)	(hrs)	(mm)
INFLOW : ID= 2	(0008) 5.6	0 2.28	1.00	55.09
OUTFLOW: ID= 1	(0009) 5.6	0 .19	1.58	54.38
T	EAK FLOW RE IME SHIFT OF PE AXIMUM STORAGE	AK FLOW	<pre>(/Qin](%)= (min)= 3 (ha.m.)=</pre>	5.00

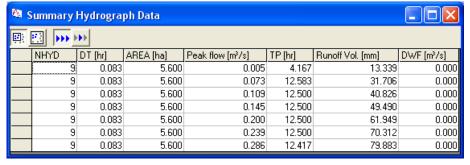
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FINISH



1	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				



V I SSSSS U U A L I SS U U A A L U U AAAAA U T SS V V I SS U U A A L SSSSS UUUUU A A LLLLL OOO TTTTT TTTTT H H Y Y M M OOO TM, Version 2.0 O O MM MM Y Y H H T O O 0 0 H H Y M M O O Licensed To: TMIG T 000 T H H Y M M OOO VO2-0145 Developed and Distributed by Greenland International Consulting Inc. Copyright 1996, 2001 Schaeffer & Associates Ltd. All rights reserved. ***** DETAILED OUTPUT ***** Input filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat Output filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\V02\12116 VO2 Sept 2013\Proposed 24hr SCS.out Summary filename: G:\Projects\2012\12116 - TSI London GE1 & GE2\Design\FSR Calcs\V02\12116 VO2 Sept 2013\Proposed 24hr SCS.sum DATE: 09/12/2013 TIME: 12:41:23 PM COMMENTS: ******* ** SIMULATION NUMBER: 1 ** Filename: G:\Projects\2012\12116 - TSI London READ STORM | 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 80 2 07 | 1 17 5 70 I 2 17 5 19 I 3 17 .33 2.27 | 1.33 10.78 | 2.33 4.47 | 3.33 2.62 2.52 | 1.50 50.21 | 2.50 3.95 | 3.50 2.48 67 2 88 1 1 67 13 37 | 2 67 3 56 1 3 67 2 35 83 3.38 | 1.83 8.29 | 2.83 3.25 | 3.83 2.23 4.18 | 2.00 6.30 | 3.00 3.01 | 4.00 | CALIB STANDHYD (0004) | (ha) = 25.50Area |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 (%)=

RUNOFF COEFFICIENT =

Surface Area

Average Slope

Dep. Storage (mm) =

RAIN

mm/hr

2.80

2.48

2.48

2.35

2.35

2.23

2.23

2.14

2.14

TOTALS 1.458 (iii) 1.58 15.12

.60

16 London GE I a			CS 24 hou	ır storms) 25r	nm, 2 yr, 5 yr, 25yr, 5
Length Mannings n	(m) = =	412.30		40.00	
NOTE: RAI	NFALL WAS	TRANSFORM	ED TO	5.0 MIN.	TIME STEP.
		TRA	ANSFORMI	ED HYETOGR	APH
TI	ME RAII	N TIME	RAIN	TIME	RAIN TIME
		r hrs		hrs	
		7 1.083		2.083	
		7 1.167		2.167	
		7 1.250		2.250	
		7 1.333		2.333	
				2.417	
		_ :		2.500	
				2.583	
	67 2.88 50 3.38			2.667 2.750	
	33 3.38			2.730	
		7 1.917		2.917	
1.0		3 2.000		3.000	
Max.Eff.Inten.		50.21		4.80	
	r (min)	10.00		35.00	
Storage Coeff.			(ii)	31.65 (ii)
Unit Hyd. Tpea				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		25.00		25.00	25.00
DIMORE CORRETO	. ,			23.00	23.00

(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES: Fo (mm/hr) = 50.00 K (1/hr) = 2.00Fc (mm/hr) = 7.50Cum.Inf. (mm) = .00

.96

.07

- (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 .5970 | .8390 1.0960 1.2260 .2580 .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) = 160.00MAXIMUM STORAGE USED (ha.m.) = .3667CALIB | STANDHYD (0005) | Area (ha) = 7.60

|ID= 1 DT= 5.0 min | Total Imp(%) = 60.00 Dir. Conn.(%) = 55.00

4.56

1.00 1.00

(ha) =

(%)=

Length Mannings n	(m) = =	225.10 .013	40.00 .250		
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	mm/hr) = (min) (min) = (min) = (cms) =	50.21 5.00 5.48 (i 5.00 .20	5.12 30.00 i) 28.65 (30.00 .04	ii)	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI					
(ii) TIME STEP	/hr)= 50.0 /hr)= 7.5 (DT) SHOU STORAGE CO	00 50 Cum.I: JLD BE SMALL: DEFFICIENT.	K (1/hr) = nf. (mm) = ER OR EQUAL	2.00	
RESERVOIR (0007) IN= 2> OUT= 1 DT= 5.0 min	OUTFI (cms .00 .00 .07			COW STORAGE s) (ha.m.) 490 .2580 770 .3190 490 .3580 370 .4010	
INFLOW: ID= 2 OUTFLOW: ID= 1 P T M	EAK FLOW	REDUCTION	QPEAK TP (cms) (h: .51 1 .01 4 N [Qout/Qin] W (m: D (ha.:	(%) = 1.12	
CALIB STANDHYD (0008) ID= 1 DT= 5.0 min	Area Total I	(ha) = 5.	60	nn.(%)= 55.00	
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	3.36 1.00 1.00 193.20 .013	PERVIOUS 2.24 1.50 2.00 40.00 .250		
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	mm/hr) = (min) (min) = (min) = (cms) =	50.21 5.00 5.00 (i 5.00	5.12 30.00 i) 28.17 (30.00 .04	ii) *TOTALS*	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI	(cms) = (hrs) = (mm) = (mm) = ENT =	.38 1.50 24.00 25.00 .96	.02 1.92 1.90 25.00	.386 (iii) 1.50 14.05 25.00 .56	
**** WARNING: STORA (i) HORTONS E	QUATION SE	LECTED FOR		SES:	

K (1/hr) = 2.00

Fo (mm/hr) = 50.00

IMPERVIOUS PERVIOUS (i)

3.04 1.50

RATN

mm/hr

. 93

93

93

93

93

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Fc (mm/hr) = 7.50 Cum.Inf. (mm) = .00
                                                                                                Surface Area
                                                                                                                (ha)=
                                                                                                                         16.32
                                                                                                                                     9 18
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
                                                                                                Dep. Storage
                                                                                                                (mm) =
                                                                                                                          1.00
                                                                                                                                      1.50
         THAN THE STORAGE COEFFICIENT
                                                                                                Average Slope
                                                                                                                (%)=
                                                                                                                          1 00
                                                                                                                                      2 00
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
                                                                                                Length
                                                                                                                 (m) =
                                                                                                                         412.30
                                                                                                                                      40.00
                                                                                               Mannings n
                                                                                                                          013
                                                                                                                                      250
                                                                                                 NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.
| RESERVOIR (0009) |
| TN= 2---> OUT= 1 |
| DT= 5.0 min |
                      OUTFLOW
                              STORAGE | OUTFLOW
                                                                                                                        ---- TRANSFORMED HYETOGRAPH ----
                       (cms)
                                (ha.m.) | (cms)
                                                       (ha.m.)
                                                                                                           TIME
                                                                                                                 RAIN | TIME RAIN | TIME RAIN | TIME
                                 .0000
                                                       .1820
                                                                                                                                              mm/hr | hrs
                                              .1460
                                                                                                           hrs
                                                                                                                 mm/hr | hrs
                                                                                                                                mm/hr | hrs
                        .0050
                                 .0782
                                              .2020
                                                       .2230
                                                                                                           .083
                                                                                                                  .57 | 6.083
                                                                                                                                1.03 | 12.083
                                                                                                                                               7.43 | 18.08
                        .0750
                                  .1220
                                              .2420
                                                         .2500
                                                                                                           .167
                                                                                                                   .57 | 6.167
                                                                                                                                 1.03 | 12.167
                                                                                                                                                7.43 | 18.17
                                                                                                                   .57 | 6.250
                        .1100
                                              .2890
                                                         .2800
                                                                                                           . 250
                                                                                                                                1.03 | 112.250
                                                                                                                                                7.43 | 18.25
                                 .1530 I
                                                                                                           .333
                                                                                                                   .57 | 6.333
                                                                                                                                1.03 |12.333
                                                                                                                                               7.43 | 18.33
                             AREA
                                     QPEAK
                                              TPEAK
                                                         R.V.
                                                                                                           .417
                                                                                                                   .57 | 6.417
                                                                                                                                1.03 | 12.417
                                                                                                                                                7.43 | 18.42
                             (ha)
                                     (cms)
                                               (hrs)
                                                         (mm)
                                                                                                           500
                                                                                                                   .57 | 6.500
                                                                                                                                1.03 | 12.500
                                                                                                                                               7.43 | 18.50
    INFLOW : ID= 2 (0008)
                           5.60
                                     .39
                                               1.50
                                                         14.05
                                                                                                          .583
                                                                                                                   .57 | 6.583
                                                                                                                                1.03 | 12.583 3.82 | 18.58
    OUTFLOW: ID= 1 (0009)
                            5.60
                                      0.0
                                               4 17
                                                         13 34
                                                                                                           .667
                                                                                                                   .57 | 6.667
                                                                                                                                 1.03 |12.667
                                                                                                                                                3.82 | 18.67
                                                                                                                   .57 | 6.750
                                                                                                                                1 03 112 750
                                                                                                          .750
                                                                                                                                               3 82 I 18 75
                 PEAK FLOW REDUCTION [Qout/Qin](%) = 1.23
                                                                                                          .833
                                                                                                                   .57 | 6.833
                                                                                                                                1.03 | 12.833 3.82 | 18.83
                 TIME SHIFT OF PEAK FLOW (min)=160.00
                                                                                                           .917
                                                                                                                   .57 | 6.917
                                                                                                                                1.03 |12.917
                                                                                                                                                3.82 | 18.92
                 MAXIMIM STORAGE USED
                                             (ham) = 0.746
                                                                                                          1 000
                                                                                                                   57 i 7 000
                                                                                                                                1.03 |13.000
                                                                                                                                               3 82 | 19 00
                                                                                                          1.083
                                                                                                                   .57 | 7.083
                                                                                                                                1.03 |13.083
                                                                                                                                                2.68 | 19.08
                                                                                                          1.167
                                                                                                                   .57 | 7.167
                                                                                                                                 1.03 |13.167
                                                                                                                                                2.68 | 19.17
                                                                                                                   .57 | 7.250
                                                                                                          1.250
                                                                                                                                1.03 | 113.250
                                                                                                                                                2.68 | 19.25
 ** SIMULATION NUMBER: 2 **
                                                                                                          1.333
                                                                                                                   .57 | 7.333
                                                                                                                                1.03 |13.333
                                                                                                                                                2.89 | 19.33
 ********
                                                                                                          1.417
                                                                                                                   .57 | 7.417
                                                                                                                                 1.03 | 13.417
                                                                                                                                                2.89 | 19.42
                                                                                                                   .57 | 7.500
                                                                                                          1.500
                                                                                                                                1.03 | 113.500
                                                                                                                                                2.89 | 19.50
                                                                                                          1.583
                                                                                                                   .57 | 7.583
                                                                                                                                1.03 |13.583
                                                                                                                                                2.17 | 19.58
                                                                                                          1.667
                                                                                                                   .57 | 7.667
                                                                                                                                1.03 |13.667
                                                                                                                                                2.17 | 19.67
 READ STORM | Filename: G:\Projects\2012\12116 - TSI London
                                                                                                                   .57 | 7.750
                                                                                                         1 750
                                                                                                                                1.03 | 13.750
                                                                                                                                               2 17 I 19 75
                    GE1 & GE2\Design\FSR Calcs\VO2\Storm\
                                                                                                         1.833
                                                                                                                   .57 | 7.833
                                                                                                                                1.03 |13.833 2.17 | 19.83
                              SCS Type II - London\2yrSCSTypeII24hr.stm
                                                                                                         1.917
                                                                                                                   .57 | 7.917
                                                                                                                                1.03 |13.917
                                                                                                                                                2.17 | 19.92
| Ptotal= 51.56 mm | Comments: 2-Year 24 hour SCS Type II: London Airpo
                                                                                                                   .57 | 8.000
                                                                                                         2 000
                                                                                                                                1 03 114 000
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                                                                                                         2.083
                                                                                                                  .67 | 8.083
                                                                                                                                1.39 |14.083
                                                                                                                                               1.55 | 20.08
               TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
                                                                                                         2.167
                                                                                                                   .67 | 8.167
                                                                                                                                 1.39 |14.167
                                                                                                                                                1.55 | 20.17
               hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
                                                                                                                   67 I 8 250
                                                                                                                                1 39 114 250
                                                                                                                                               1 55 I 20 25
                                                                                                         2 250
                      .57 | 6.25 1.03 | 12.25 7.43 | 18.25
                                                                                                         2.333
                                                                                                                   .67 | 8.333
                                                                                                                                1.39 | 14.333
                                                                                                                                                1.55 | 20.33
                .50
                       .57 | 6.50
                                     1.03 | 12.50
                                                    7.43 | 18.50
                                                                   .93
                                                                                                          2.417
                                                                                                                   .67 | 8.417
                                                                                                                                 1.39 | 14.417
                                                                                                                                                1.55 | 20.42
                       .57 | 6.75
                                                                                                          2.500
                                                                                                                   .67 | 8.500
                . 75
                                    1.03 | 12.75
                                                    3.82 | 18.75
                                                                                                                                1.39 |14.500
                                                                                                                                                1.55 | 20.50
                                                                    . 93
               1.00
                      .57 | 7.00
                                    1.03 | 13.00
                                                    3.82 | 19.00
                                                                                                          2.583
                                                                                                                   .67 | 8.583
                                                                                                                                1.39 |14.583
                                                                                                                                                1.55 | 20.58
                                                                    .93
               1.25
                       .57
                              7.25
                                     1.03 | 13.25
                                                    2.68 | 19.25
                                                                    .93
                                                                                                          2.667
                                                                                                                   .67 | 8.667
                                                                                                                                 1.39 | 14.667
                                                                                                                                                1.55 | 20.67
                       .57 i
                                                                                                                   .67 | 8.750
               1.50
                             7.50
                                     1.03 | 13.50
                                                    2.89 | 19.50
                                                                    . 93
                                                                                                          2.750
                                                                                                                                1.39 | 14.750
                                                                                                                                                1.55 | 20.75
               1.75
                       .57 | 7.75
                                    1.03 | 13.75
                                                    2.17 | 19.75
                                                                    . 93
                                                                                                          2.833
                                                                                                                   .67 | 8.833
                                                                                                                                1.39 |14.833
                                                                                                                                                1.55 | 20.83
                                     1.03 | 14.00
               2.00
                       .57 |
                             8.00
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                                                                    . 93
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                                                    1.55 | 20.25
                                                                                                         3.000
                                                                                                                  .67 | 9.000
               2 25
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               2.75
                       .67 | 8.75
                                     1.39 | 14.75
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                                                                                                                                 1.65 | 15.167
                                                                                                                                                1.55 | 21.17
               3 00
                       .67 | 9.00
                                    1 39 | 15 00
                                                    1 55 I 21 00
                                                                   62
                                                                                                         3 250
                                                                                                                   .67 | 9.250
                                                                                                                                1 65 115 250
                                                                                                                                               1 55 I 21 25
               3.25
                       .67 | 9.25
                                    1.65 | 15.25
                                                    1.55 | 21.25
                                                                   .62
                                                                                                         3.333
                                                                                                                  .67 | 9.333
                                                                                                                                1.65 | 15.333
                                                                                                                                                1.55 | 21.33
               3.50
                       .67 | 9.50
                                     1.65 | 15.50
                                                    1.55 | 21.50
                                                                    .62
                                                                                                          3.417
                                                                                                                   .67 | 9.417
                                                                                                                                1.65 | 15.417
                                                                                                                                                1.55 | 21.42
                       .67 | 9.75
                                                                                                                   .67 | 9.500
               3.75
                                                    1.55 | 21.75
                                    1.86 | 15.75
                                                                                                          3.500
                                                                                                                                1.65 | 15.500
                                                                                                                                                1.55 | 21.50
                                                                    .62
                       .67 | 10.00
               4.00
                                    1.86 | 16.00
                                                    1.55 | 22.00
                                                                    .62
                                                                                                         3.583
                                                                                                                  .67 | 9.583
                                                                                                                                1.86 | 15.583
                                                                                                                                                1.55 | 21.58
               4.25
                       .82 | 10.25
                                     2.37 | 16.25
                                                     .93 | 22.25
                                                                    .62
                                                                                                          3.667
                                                                                                                   .67 | 9.667
                                                                                                                                 1.86 | 15.667
                                                                                                                                                1.55 | 21.67
                                     2.37 | 16.50
                                                     .93 | 22.50
                                                                                                                   .67 | 9.750
               4.50
                       .82 | 10.50
                                                                    .62
                                                                                                          3.750
                                                                                                                                1.86 | 115.750
                                                                                                                                                1.55 | 21.75
               4.75
                       .82 | 10.75
                                     3.20 | 16.75
                                                    .93 | 22.75
                                                                                                         3.833
                                                                                                                   .67 | 9.833
                                                                                                                                1.86 | 15.833
                                                                                                                                                1.55 | 21.83
                                                                   .62
                                     3.20 | 17.00
               5.00
                       .82 | 11.00
                                                     .93 | 23.00
                                                                   .62
                                                                                                          3.917
                                                                                                                   .67 | 9.917
                                                                                                                                 1.86 | 15.917
                                                                                                                                                1.55 | 21.92
                       .82 | 11.25
                                     4.95 | 17.25
                                                     .93 | 23.25
                                                                                                                   .67 |10.000
               5.25
                                                                    . 62
                                                                                                          4.000
                                                                                                                                1.86 | 16.000
                                                                                                                                                1.55 | 22.00
               5.50
                       .82 | 11.50
                                    4.95 | 17.50
                                                     .93 | 23.50
                                                                   .62
                                                                                                         4.083
                                                                                                                   .82 |10.083
                                                                                                                                2.37 |16.083
                                                                                                                                                .93 | 22.08
               5.75
                       .82 | 11.75
                                    21.45 | 17.75
                                                     .93 | 23.75
                                                                    .62
                                                                                                         4.167
                                                                                                                   .82 |10.167
                                                                                                                                 2.37 |16.167
                                                                                                                                                 .93 | 22.17
                                    56.93 | 18.00
                                                                                                                   .82 |10.250
                                                                                                                                 2.37 [16.250]
               6.00
                      .82 | 12.00
                                                     .93 | 24.00
                                                                   . 62
                                                                                                         4.250
                                                                                                                                                .93 | 22.25
                                                                                                         4.333
                                                                                                                   .82 |10.333
                                                                                                                                2.37 |16.333
                                                                                                                                                .93 | 22.33
                                                                                                         4.417
                                                                                                                   .82 |10.417
                                                                                                                                 2.37 |16.417
                                                                                                                                                 .93 | 22.42
                                                                                                                   .82 |10.500
                                                                                                                                2 37 116 500
                                                                                                          4 500
                                                                                                                                                93 | 22 50
                                                                                                          4.583
                                                                                                                   .82 |10.583
                                                                                                                                3.20 | 16.583
                                                                                                                                                .93 | 22.58
| CALIB
                                                                                                          4.667
                                                                                                                   .82 |10.667
                                                                                                                                 3.20 |16.667
                                                                                                                                                 .93 | 22.67
| STANDHYD (0004) | Area (ha) = 25.50
                                                                                                          4 750
                                                                                                                   .82 |10.750
                                                                                                                                3.20 | 16.750
                                                                                                                                                .93 | 22.75
|ID= 1 DT= 5.0 min | Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00
                                                                                                          4.833
                                                                                                                   .82 |10.833
                                                                                                                                3.20 |16.833
                                                                                                                                                .93 | 22.83
                                                                                                          4.917
                                                                                                                   .82 |10.917
                                                                                                                                 3.20 | 16.917
                                                                                                                                                .93 | 22.92
                                                                                                          5.000
                                                                                                                   .82 |11.000
                                                                                                                                3.20 |17.000
                           TMPERVIOUS PERVIOUS (i)
                                                                                                                                                .93 | 23.00
```

<u> </u>	•	•			ı, 2 yr, 5 yr, 25yr, 50yı	
5.083				17.083		.62
5.167				17.167		.62
5.250				17.250		.62
				17.333		
				17.417		
				17.500		
				17.583		
				17.667		
				17.750		
5.833	.82	11.833	56.92	17.833	.93 23.83	.62
5.917	.82	11.917	56.93	17.917 18.000	.93 23.92	.62
6.000	.83 [12.000	56.93	18.000	.93 24.00	.62
Max.Eff.Inten.(m						
	(min)					
Storage Coeff.						
Unit Hyd. Tpeak						
Unit Hyd. peak	(cms) =	.17		.06		
					TOTALS	
PEAK FLOW					2.505 (iii)	
TIME TO PEAK				12.17	12.00	
RUNOFF VOLUME	(mm) =	50.56		10.04	34.35	
TOTAL RAINFALL	(mm) =	51.56		51.56	51.56	
RUNOFF COEFFICIE	NT =	.98		.19	.67	
	hr)= 50.00 hr)= 7.50 (DT) SHOULI TORAGE COE	Cun D BE SMA FFICIENT	K n.Inf. ALLER OI	(1/hr) = 2.0 (mm) = .0 R EQUAL	0	

| RESERVOIR (0006) | | IN= 2---> OUT= 1 | | DT= 5.0 min | OUTFLOW STORAGE | OUTFLOW STORAGE (cms) (ha.m.) (cms) (ha.m.) .0000 .0000 .5030 .8930 1.0960 .0220 .3853 .6990 .2580 .5970 .8390 .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) 12.75 25.50 33.53 .26 PEAK FLOW REDUCTION [Qout/Qin](%) = 10.22 TIME SHIFT OF PEAK FLOW (min) = 45.00MAXIMUM STORAGE USED (ha.m.) = .5954

	NDHYD (0005)						
ID= 3	1 DT= 5.0 min	Total	Imp(%)=	60.00	Dir.	Conn.(%)=	55.00
			IMPERVIO	DUS	PERVIOU	S (i)	
2	Surface Area	(ha) =	4.56	5	3.04		
1	Dep. Storage	(mm) =	1.00)	1.50		
Ž	Average Slope	(%)=	1.00)	2.00		
1	Length	(m) =	225.10)	40.00		
1	Mannings n	=	.013	3	.250		
1	Max.Eff.Inten.(m	m/hr)=	56.93	3	49.26		
	over	(min)	5.00)	15.00		
2	Storage Coeff.	(min) =	5.21	(ii)	14.58	(ii)	
Ţ	Unit Hyd. Tpeak	(min) =	5.00)	15.00		
Ţ	Unit Hyd. peak	(cms) =	.21		.08		
						*	TOTALS*
]]] (Length Mannings n Max.Eff.Inten.(m over Storage Coeff. Unit Hyd. Tpeak	(m) = = = = = = = = = = = = = = = = = = =	225.10 .013 56.93 5.00 5.21 5.00) 3 3 3) (ii)	40.00 .250 49.26 15.00 14.58 15.00	(ii)	TOTALS*

PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICE	(cms) = (hrs) = (mm) = (mm) = ENT =	.64 12.00 50.56 51.56 .98	.21 12.08 10.24 51.56 .20	.806 12.00 32.42 51.56	(iii)
(ii) TIME STEP	/hr)= 50.00 /hr)= 7.50 (DT) SHOULD STORAGE COEF	Cum.Inf BE SMALLEF FICIENT.	(1/hr) = (mm) = OR EQUAL	2.00	
RESERVOIR (0007) IN= 2> OUT= 1 DT= 5.0 min				LOW STORAGE s) (ha.m.) 490 .258 070 .3190 490 .3580 970 .4010	
INFLOW: ID= 2 OUTFLOW: ID= 1		REDUCTION	.07 12 [Oout/Oin]	EAK R.V. rs) (mm) .00 32.42 .67 31.61 (%) = 9.19	
CALIB STANDHYD (0008) ID= 1 DT= 5.0 min	Area (Total Imp	ha) = 5.60 (%) = 60.00	Dir. Co	nn.(%)= 55.00	
Surface Area Dep. Storage Average Slope Length Mannings n	TM	DEDUTAGE	DEBUTORE		
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak				ii) *TOTALS*	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI				.601 12.00 32.42 51.56	
(ii) TIME STEP	QUATION SELE /hr)= 50.00 /hr)= 7.50 (DT) SHOULD STORAGE COEF	CTED FOR PE K Cum.Inf BE SMALLEF FICIENT.	RVIOUS LOS (1/hr)= (mm)=	SES: 2.00 .00	
RESERVOIR (0009) IN= 2> OUT= 1					

DT= 5.0 min	TRANSFORMED HYETOGRAPH
(cms) (ha.m.) (cms) (ha.m.)	TIME RAIN TIME RAIN TIME RAIN TIME RAIN
.0000 .0000 .1460 .1820	hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
.0050 .0782 .2020 .2230	
.0750 .1220 .2420 .2500	.167 .70 6.167 1.27 12.167 9.12 18.17 1.14
.1100 .1530 .2890 .2800	.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
AREA QPEAK TPEAK R.V.	.417 .70 6.417 1.27 12.417 9.12 18.42 1.14
(ha) (cms) (hrs) (mm)	.500 .70 6.500 1.27 12.500 9.12 18.50 1.14
INFLOW: ID= 2 (0008) 5.60 .60 12.00 32.42	.583 .70 6.583 1.27 12.583 4.69 18.58 1.14
OUTFLOW: ID= 1 (0009) 5.60 .07 12.58 31.71	.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
PEAK FLOW REDUCTION [Qout/Qin](%) = 12.14	.833 .70 6.833 1.27 12.833 4.69 18.83 1.14
TIME SHIFT OF PEAK FLOW (min) = 35.00	.917 .70 6.917 1.27 12.917 4.69 18.92 1.14
MAXIMUM STORAGE USED (ha.m.)= .1208	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
***********	- 1.167 .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
** SIMULATION NUMBER: 3 **	1.230 .70 7.230 1.27 13.230 3.29 19.23 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
READ STORM Filename: G:\Projects\2012\12116 - TSI London	1.750 .70 7.750 1.27 13.750 2.66 19.75 1.14
GE1 & GE2\Design\FSR Calcs\V02\Storm\	1.833 .70 7.833 1.27 13.833 2.66 19.83 1.14
SCS Type II - London\5yrSCSTypeII24hr.stm	1.917 .70 7.917 1.27 13.917 2.66 19.92 1.14
Ptotal= 63.35 mm Comments: 5-Year 24 hour SCS Type II: London Airpo	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
TIME RAIN TIME RAIN TIME RAIN TIME RAIN	2.167 .82 8.167 1.71 14.167 1.90 20.17 .76
hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr	2.250 .82 8.250 1.71 14.250 1.90 20.25 .76
.25 .70 6.25 1.27 12.25 9.12 18.25 1.14	2.333
.50 .70 6.50 1.27 12.50 9.12 18.50 1.14	2.417
.75 .70 6.75 1.27 12.75 4.69 18.75 1.14	2.500 .82 8.500 1.71 14.500 1.90 20.50 .76
1.00 .70 7.00 1.27 13.00 4.69 19.00 1.14	2.583
1.25 .70 7.25 1.27 13.25 3.29 19.25 1.14	2.667
1.50 .70 7.50 1.27 13.50 3.55 19.50 1.14	2.750 .82 8.750 1.71 14.750 1.90 20.75 .76
1.75 .70 7.75 1.27 13.75 2.66 19.75 1.14	2.833 .82 8.833 1.71 14.833 1.90 20.83 .76
2.00 .70 8.00 1.27 14.00 2.66 20.00 1.14	2.917 .82 8.917 1.71 14.917 1.90 20.92 .76
2.25 .82 8.25 1.71 14.25 1.90 20.25 .76	3.000 .82 9.000 1.71 15.000 1.90 21.00 .76
2.50 .82 8.50 1.71 14.50 1.90 20.50 .76	3.083 .82 9.083 2.03 15.083 1.90 21.08 .76
2.75 .82 8.75 1.71 14.75 1.90 20.75 .76	3.167 .82 9.167 2.03 15.167 1.90 21.17 .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	3.250 .82 9.250 2.03 15.250 1.90 21.25 .76
	3.333
3.50	3.417
4.00 .82 10.00 2.28 16.00 1.90 22.00 .76	3.583 .82 9.583 2.28 15.583 1.90 21.50 .76
4.25 1.01 10.25 2.91 16.25 1.14 22.25 .76	3.667 .82 9.667 2.28 15.667 1.90 21.67 .76
4.50 1.01 10.50 2.91 16.50 1.14 22.50 .76	3.750 .82 9.750 2.28 15.750 1.90 21.75 .76
4.75 1.01 10.75 3.93 16.75 1.14 22.75 .76	3.833 .82 9.833 2.28 15.833 1.90 21.83 .76
5.00 1.01 11.00 3.93 17.00 1.14 23.00 .76	3.917 .82 9.917 2.28 15.917 1.90 21.92 .76
5.25 1.01 11.25 6.08 17.25 1.14 23.25 .76	4.000 .82 10.000 2.28 16.000 1.90 22.00 .76
5.50 1.01 11.50 6.08 17.50 1.14 23.50 .76	4.083 1.01 10.083 2.91 16.083 1.14 22.08 .76
5.75 1.01 11.75 26.35 17.75 1.14 23.75 .76	4.167 1.01 10.167 2.91 16.167 1.14 22.17 .76
6.00 1.01 12.00 69.93 18.00 1.14 24.00 .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
CALIB	4.667 1.01 10.667 3.93 16.667 1.14 22.67 .76
STANDHYD (0004) Area (ha) = 25.50	4.750 1.01 10.750 3.93 16.750 1.14 22.75 .76
ID= 1 DT= 5.0 min Total Imp(%)= 64.00 Dir. Conn.(%)= 60.00	4.833 1.01 10.833 3.93 16.833 1.14 22.83 .76
IMPERVIOUS PERVIOUS (i)	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
IMPERVIOUS PERVIOUS (1) Surface Area (ha)= 16.32 9.18	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
Surface Area (na) = 16.32 9.18 Dep. Storage (mm) = 1.00 1.50	5.083 1.01 11.083 6.08 17.083 1.14 23.08 ./6 5.167 1.01 11.167 6.08 17.167 1.14 23.17 .76
Average Slope (%)= 1.00 2.00	5.250 1.01 11.250 6.08 17.250 1.14 23.25 .76
Length (m)= 412.30 40.00	5.333 1.01 11.333 6.08 17.333 1.14 23.23 .76
Mannings n = .013 .250	5.417 1.01 11.417 6.08 17.417 1.14 23.42 .76
. , 1200	5.500 1.01 11.500 6.08 17.500 1.14 23.50 .76
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	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
	•

2116 London GE I and odrologic Model Output – F			CS 24 hou	ır storms) 25m	m, 2 yr, 5 yr, 25yr, 50y	r and 10
5.833 5.917 6.000	1.01 1.01 1.01	11.833 11.917 12.000	69.93 69.93 69.93	17.833 17.917 18.000	1.14 23.83 1.14 23.92 1.14 24.00	.76 .76
Max.Eff.Inten.(n over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	(cms)=	.10		.07	*TOTALS*	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICIE	(cms) = (hrs) = (mm) =	2.75 12.00 62.35 63.35 .98		.84 12.17 15.91 63.35 .25	3.320 (iii) 12.00 43.77 63.35 .69	
(i) HORTONS EQ Fo (mm) Fc (mm/ (ii) TIME STEP THAN THE S (iii) PEAK FLOW	hr) = 50.0 hr) = 7.5 (DT) SHOU TORAGE CO	00 50 Cur JLD BE SM DEFFICIEN	K m.Inf. ALLER OI F.	(1/hr) = 2. (mm) = . R EQUAL	00	
 RESERVOIR (0006)						
IN= 2> OUT= 1 DT= 5.0 min	OUTFI	LOW STO	ORAGE	OUTFLOW	STORAGE	
	(cms .00 .02 .25	s) (ha 000 220 580	a.m.) .0000 .3853 .5970 .7510	(cms) .5030 .6990 .8390	STORAGE (ha.m.) .8930 1.0960 1.2260 1.3720	
INFLOW: ID= 2 (OUTFLOW: ID= 1 (0004)	25.50 25.50	3.32	12.00 12.67	43.77	
PE	AK FLOW	REDUC'	rion [Qo	out/Qin](%) (min) (ha.m.)	= 11.37	
CALIB STANDHYD (0005) D= 1 DT= 5.0 min	Area Total 1	(ha) = Imp(%) = (7.60 60.00	Dir. Conn.	(%) = 55.00	
Surface Area Dep. Storage Average Slope Length Mannings n	(ha)=	IMPERVIOU 4.56	JS PI	ERVIOUS (i) 3.04		
Max Eff Inten (m						

Max.Eff.Inten.(mm/hr)= 69.93 66.03 over (min) 5.00 15.00 4.80 (ii) 13.13 (ii) Storage Coeff. (min) = Unit Hyd. Tpeak (min) = 5.00 15.00 Unit Hyd. peak (cms) = .22 .08 *TOTALS* .33 PEAK FLOW (cms) = .79 1.080 (iii) TIME TO PEAK (hrs) =12.00 12.08 12.00 RUNOFF VOLUME 62 35 (mm) = 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
                                                        .3190
                        .0060
                                 .1068
                                              .2070
                                 .1710
                                                       .3580
                        .0760
                                              .2490
                        .1130
                                  .2160 |
                                              .2970
                                                        .4010
                                              TPEAK
                            AREA
                                     OPEAK
                                                         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
| 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 0.0
                                          2 00
    Length
                     (m) =
                            193.20
                                         40.00
    Mannings n
                             .013
    Max.Eff.Inten.(mm/hr)=
                             69.93
                                         66.03
             over (min)
                              5.00
                                         15.00
                              4.38 (ii) 12.71 (ii)
    Storage Coeff. (min) =
    Unit Hyd. Tpeak (min) =
                              5.00
                                         15.00
    Unit Hyd. peak (cms) =
                              .23
                                         .08
                                                      *TOTALS*
    PEAK FLOW
                   (cms) =
                               .59
                                                       .804 (iii)
                             12.00
                                         12.08
                                                       12.00
    TIME TO PEAK
                  (hrs) =
    RUNOFF VOLUME (mm) =
                             62.35
                                         16.10
                                                       41.54
    TOTAL RAINFALL (mm) =
                              63.35
                                         63.35
                                                       63.35
    RUNOFF COEFFICIENT =
                              .98
                                                        .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 (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 OPEAK
                                              TPEAK
                                                         R.V.
```

· · · · · · · · · · · · · · · · · · ·					
	500	04 1 5 500	4 40 140 500	40 55 1 40 50	4 00
(ha) (cms) (hrs) (mm)	.500	.81 6.500	1.48 12.500	10.65 18.50	1.33
INFLOW: ID= 2 (0008) 5.60 .80 12.00 41.54	.583	.81 6.583	1.48 12.583	5.47 18.58	1.33
OUTFLOW: ID= 1 (0009) 5.60 .11 12.50 40.83	.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
PEAK FLOW REDUCTION [Qout/Qin](%)= 13.51	.833	.81 6.833	1.48 12.833	5.47 18.83	1.33
TIME SHIFT OF PEAK FLOW (min) = 30.00	.917	.81 6.917	1.48 12.917	5.47 18.92	1.33
MAXIMUM STORAGE USED (ha.m.)= .1521	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
** SIMULATION NUMBER: 4 **	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
READ STORM Filename: G:\Projects\2012\12116 - TSI London	1.750	.81 7.750	1.48 13.750	3.11 19.75	1.33
GE1 & GE2\Design\FSR Calcs\VO2\Storm\	1.833	.81 7.833	1.48 13.833	3.11 19.83	1.33
SCS Type II - London\10yrSCSTypeII24hr.stm	1.917	.81 7.917	1.48 13.917	3.11 19.92	1.33
Ptotal= 73.97 mm Comments: 10-Year 24 hour SCS Type II: London Airp	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
TIME RAIN TIME RAIN TIME RAIN TIME RAIN	2.167	.96 8.167	2.00 14.167	2.22 20.17	.89
hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr	2.250	.96 8.250	2.00 14.250	2.22 20.25	.89
.25 .81 6.25	2.333	.96 8.333	2.00 14.333	2.22 20.33	.89
.50 .81 6.50 1.48 12.50 10.65 18.50 1.33	2.417	.96 8.417	2.00 14.417	2.22 20.42	.89
.75 .81 6.75 1.48 12.75 5.47 18.75 1.33	2.500	.96 8.500	2.00 14.500	2.22 20.50	.89
1.00 .81 7.00 1.48 13.00 5.47 19.00 1.33	2.583	.96 8.583	2.00 14.583	2.22 20.58	.89
1.25 .81 7.25 1.48 13.25 3.85 19.25 1.33	2.667	.96 8.667	2.00 14.667	2.22 20.67	. 89
1.50 .81 7.50 1.48 13.50 4.14 19.50 1.33	2.750	.96 8.750	2.00 14.750	2.22 20.75	.89
1.75 .81 7.75 1.48 13.75 3.11 19.75 1.33	2.833	.96 8.833	2.00 14.833	2.22 20.83	.89
2.00 .81 8.00 1.48 14.00 3.11 20.00 1.33	2.917	.96 8.917	2.00 14.917	2.22 20.92	.89
2.25 .96 8.25 2.00 14.25 2.22 20.25 .89	3.000	.96 9.000	2.00 15.000	2.22 21.00	.89
2.50 .96 8.50 2.00 14.50 2.22 20.50 .89	3.083	.96 9.083	2.37 15.083	2.22 21.08	.89
2.75 .96 8.75 2.00 14.75 2.22 20.75 .89	3.167	.96 9.167	2.37 15.167	2.22 21.17	.89
3.00 .96 9.00 2.00 15.00 2.22 21.00 .89	3.250	.96 9.250	2.37 15.250	2.22 21.25	.89
3.25 .96 9.25 2.37 15.25 2.22 21.25 .89	3.333	.96 9.333	2.37 15.333	2.22 21.33	.89
3.50 .96 9.50 2.37 15.50 2.22 21.50 .89	3.417	.96 9.417	2.37 15.417	2.22 21.42	. 89
3.75 .96 9.75 2.66 15.75 2.22 21.75 .89	3.500	.96 9.500	2.37 15.500	2.22 21.50	.89
4.00 .96 10.00 2.66 16.00 2.22 22.00 .89	3.583	.96 9.583	2.66 15.583	2.22 21.58	.89
4.25 1.18 10.25 3.40 16.25 1.33 22.25 .89	3.667	.96 9.667	2.66 15.667	2.22 21.67	.89
4.50 1.18 10.50 3.40 16.50 1.33 22.50 .89	3.750	.96 9.750	2.66 15.750	2.22 21.75	.89
4.75 1.18 10.75 4.59 16.75 1.33 22.75 .89	3.833	.96 9.833	2.66 15.833	2.22 21.73	.89
5.00 1.18 11.00 4.59 17.00 1.33 23.00 .89	3.917	.96 9.917	2.66 15.917	2.22 21.03	.89
5.25 1.18 11.25 7.10 17.25 1.33 23.25 .89	4.000	.96 10.000	2.66 16.000	2.22 21.32	.89
5.50 1.18 11.50 7.10 17.50 1.33 23.50 .89	4.000	1.18 10.083	3.40 16.083	1.33 22.08	.89
5.75 1.18 11.75 30.77 17.75 1.33 23.75 .89	4.167	1.18 10.063	3.40 16.167	1.33 22.17	.89
6.00 1.18 12.00 81.66 18.00 1.33 24.00 .89	4.250	1.18 10.167	3.40 16.250	1.33 22.17	.89
0.00 1.10 12.00 01.00 10.00 1.33 24.00 .09	4.333	1.18 10.230	3.40 16.333	1.33 22.23	.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 22.42	.89
	4.583	1.18 10.583	4.59 16.583	1.33 22.58	.89
CALIB	4.667	1.18 10.565	4.59 16.667	1.33 22.67	.89
STANDHYD (0004)	4.750	1.18 10.750	4.59 16.750	1.33 22.75	.89
ID= 5.0 min Total Imp(%) = 64.00 Dir. Conn.(%) = 60.00	4.833	1.18 10.833	4.59 16.833	1.33 22.83	.89
12D 1 D1 - 3.0 min 10tal imp(%) - 04.00 D11. Colin. (%) - 00.00	4.917	1.18 10.917	4.59 16.917	1.33 22.92	.89
IMPERVIOUS PERVIOUS (i)	5.000	1.18 11.000	4.59 17.000	1.33 22.92	.89
Surface Area (ha) = 16.32 9.18	5.083	1.18 11.083	7.10 17.083	1.33 23.08	.89
Dep. Storage (mm) = 1.00 1.50	5.167	1.18 11.167	7.10 17.167	1.33 23.17	.89
Average Slope (%) = 1.00 2.00	5.250	1.18 11.250	7.10 17.107	1.33 23.25	.89
Length (m) = 412.30 40.00	5.333	1.18 11.333	7.10 17.230	1.33 23.23	.89
Mannings n = .013 .250	5.333	1.18 11.333	7.10 17.333	1.33 23.42	.89
mainings ii – .013 .230	5.500	1.18 11.500	7.10 17.417	1.33 23.42	.89
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	5.583	1.18 11.583	30.77 17.583	1.33 23.58	.89
NOTE. RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	5.583	1.18 11.583	30.77 17.583	1.33 23.58	.89
	5.750	1.18 11.750	30.77 17.750	1.33 23.67	.89
TRANSFORMED HYETOGRAPH	5.750	1.18 11.750	81.65 17.833	1.33 23.75	.89
TIME RAIN TIME RAIN TIME RAIN TIME RAIN	5.833	1.18 11.833	81.66 17.917	1.33 23.83	.89
TIME RAIN TIME RAIN TIME RAIN TIME RAIN hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr	6.000	1.18 11.917	81.66 18.000	1.33 23.92	.89
.083 .81 6.083 1.48 12.083 10.66 18.08 1.33	0.000	1.10 12.000	01.00 10.000	1.33 24.00	.09
.005 .81 6.105 1.40 12.105 10.00 10.00 1.33	Max.Eff.Inten.(mm/	hr)= 81.66	79.63		
	over (m		15.00		
.230 .81 0.230 1.40 12.230 10.00 10.23 1.33	Storage Coeff. (m		(ii) 14.21 (ii	1	
. 333 . 61 6.333 1.46 12.333 10.05 16.33 1.33 1.47 1.48 12.417 1.65 18.42 1.33	Unit Hyd. Tpeak (m		15.00		
.317 .01 0.317 1.30 12.317 10.00 10.32 1.33	Juite myd. ipeak (III	,	13.00		

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.	
RESERVOIR (0006) IN= 2> OUT= 1 DT= 5.0 min	
CALIB	

L DECERTIOIR (0007)				
RESERVOIR (0007) IN= 2> OUT= 1	1			
DT= 5.0 min	I OUTFLOW S	TORAGE O	UTFLOW S	TORAGE
DT= 5.0 min	- (cms) (ha.m.)	(cms)	ha.m.)
	.0000	.0000	.1490	.2580
	.0060	.1068	.2070	.3190
	.0760	.1710	.2490	.3580
	OUTFLOW S (cms) (.0000 .0060 .0760 .1130	.2160	.2970	.4010
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2	(0005) 7.60	1.32	12.00	50.20
OUTFLOW: ID= 1	(0007) 7.60	QPEAK (cms) 1.32 .15	12.58	49.38
	PEAK FLOW REDU	CTION [Qout/Q	in](%)= 11.	21
	TIME SHIFT OF PEAK MAXIMUM STORAGE	HISED ((IIIII) = 33.	568
	MAXIMUM SICKAGE	ODED (.500
	-			
CALIB				
STANDHYD (0008) ID= 1 DT= 5.0 min	Area (ha)=	5.60	G (8)-	EE 00
				55.00
	IMPERVI (ha) = 3.3 (mm) = 1.0 (%) = 1.0 (m) = 193.2 = .01	OUS PERVIO	US (i)	
Surface Area	(ha) = 3.3	6 2.2	4	
Dep. Storage	(mm) = 1.0	0 1.5	0	
Average Slope	(%) = 1.0	0 2.0	D	
Length	(m) = 193.2	0 40.0	0	
Mannings n	= .01	3 .25	U	
Max.Eff.Inten.	(mm/hr) = 81.6 r (min) 5.0 (min) = 4.1 k (min) = 5.0 (cms) = .2	6 80.8	9	
ove	r (min) 5.0	0 15.0	Ď	
Storage Coeff.	(min) = 4.1	1 (ii) 11.8	0 (ii)	
Unit Hyd. Tpea	k (min) = 5.0	0 15.0	D	
Unit Hyd. peak	(cms) = .2	4 .0	9	10777.04
DEAK FLOW	(cms) = 6	a 3	2	OTALS* .982 (iii)
TIME TO PEAK	(hrs) = 12.0	0 12.0	B .	12.00
RUNOFF VOLUME	(mm) = 72.9	7 22.3	7	50.20
TOTAL RAINFALL	(mm) = 73.9	7 73.9	7	73.97
RUNOFF COEFFIC	(cms) = .6 (hrs) = 12.0 (mm) = 72.9 (mm) = 73.9 IENT = .9	9 .3	D	.68
**** WARNING: STOR				
AAAAA WARNING: STOR	AGE COEFF. IS SMAL	LER THAN TIME	STEP!	
(i) HORTONS	EQUATION SELECTED	FOR PERVIOUS	LOSSES:	
Fo (m	m/hr) = 50.00 m/hr) = 7.50 C	K (1/hr) = 2.00	
Fc (m	m/hr) = 7.50 C	um.Inf. (mm) = .00	
	P (DT) SHOULD BE S		AL	
	STORAGE COEFFICIE W DOES NOT INCLUDE		7 777	
(III) PEAK FLO	M DOES NOT INCLUDE	BASEFLOW IF .	ANI.	
RESERVOIR (0009)	I			
IN= 2> OUT= 1				
DT= 5.0 min	OUTFLOW S	TORAGE O	J'I'F'LOW S	TORAGE
	- (CMS) (0000	1460	1820
	.0050	.0782	.2020	.2230
	.0750	.1220	.2420	.2500
IN= 2> OUT= 1 DT= 5.0 min	.1100	.1530	.2890	.2800
	AREA	QPEAK	TPEAK	R.V.
TNETON . TD- 2	(ha)	(cms)	(hrs)	(mm)
OUTFLOW: ID= 2	AREA (ha) (0008) 5.60 (0009) 5.60	.90	12.00	49 49
OOTEHOW. ID- I	(5005) 5.00	.17	-2.00	13.13
	PEAK FLOW REDU	CTION [Qout/Q	in](%)= 14.	73
	TIME SHIFT OF PEAK MAXIMUM STORAGE	FLOW	(min) = 30	00
			1 1	011
	MAXIMUM STORAGE	USED (na.m.)=	.011

**************************************	R: 5 **							1.167 1.250 1.333 1.417 1.500	.98 3 .98 7 .98 0 .98	7.500	1.79 1.79 1.79	9 13.167 9 13.250 9 13.333 9 13.417 9 13.500	4.66 5.01 5.01 5.01	19.17 19.25 19.33 19.42 19.50	1.61 1.61 1.61 1.61 1.61
								1.583				9 13.583 9 13.667		19.58 19.67	1.61 1.61
READ STORM	Filena	ne: G:\P	ojects\2	2012\121	16 - TSI	London		1.750		7.750		9 13.750		19.75	1.61
i i					R Calcs\			1.833	.98	7.833		13.833		19.83	1.61
1					\25yrSCS'			1.917		7.917		13.917		19.92	1.61
Ptotal= 89.53 mm	Commen	ts: 25-Ye	ear 24 ho	our SCS	Type II:	London	Airp	2.000		8.000 8.083		9 14.000 2 14.083		20.00	1.61
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN	2.167		8.167		114.003		20.00	1.07
hrs			mm/hr		mm/hr		mm/hr	2.250		8.250		2 14.250		20.25	1.07
.25				12.25	12.89		1.61	2.333		8.333		2 14.333		20.33	1.07
.50 .75	.98 .98			12.50 12.75	12.89	18.50	1.61	2.417		8.417 8.500		2 14.417		20.42	1.07
1.00	.98			13.00		19.00	1.61	2.583		8.583		2 14.583		20.58	1.07
1.25	.98	7.25	1.79	13.25	4.66	19.25	1.61	2.667	7 1.16	8.667	2.42	114.667		20.67	1.07
1.50	.98			13.50		19.50	1.61	2.750		8.750		114.750		20.75	1.07
1.75 2.00	.98 .98			13.75		19.75	1.61	2.833		8.833 8.917		2 14.833		20.83	1.07
2.00				14.00		20.00	1.01	3.000		9.000		2 14.917		20.92	1.07
2.50			2.42	14.50		20.50	1.07	3.083		9.083	2.87	7 15.083		21.08	1.07
2.75				14.75		20.75	1.07	3.167		9.167		7 15.167		21.17	1.07
3.00 3.25				15.00 15.25		21.00	1.07	3.250 3.333		9.250 9.333		7 15.250 7 15.333		21.25	1.07
3.50	1.16			15.25		21.25	1.07	3.417		9.333		7 15.333		21.33	1.07
3.75				15.75		21.75	1.07	3.500		9.500		7 15.500		21.50	1.07
4.00		10.00		16.00		22.00	1.07	3.583		9.583		2 15.583		21.58	1.07
4.25		10.25		16.25		22.25	1.07	3.667		9.667		2 15.667		21.67	1.07
4.50 4.75		10.50 10.75		16.50 16.75		22.50	1.07	3.750 3.833		9.750		2 15.750 2 15.833	2.69	21.75	1.07
5.00		11.00		17.00		23.00	1.07	3.917		9.917		2 15.917	2.69	21.03	1.07
5.25	1.43	11.25	8.60	17.25	1.61	23.25	1.07	4.000	1.16	10.000	3.22	116.000	2.69	22.00	1.07
5.50		11.50		17.50		23.50	1.07	4.083		10.083		2 16.083		22.08	1.07
5.75 6.00		11.75		17.75 18.00		23.75	1.07	4.167 4.250		10.167 10.250		2 16.167 2 16.250		22.17	1.07
6.00	1.43	12.00	30.04	1 10.00	1.01	24.00	1.07	4.230		110.230		2 16.333		22.23	1.07
								4.417		10.417		2 16.417		22.42	1.07
								4.500		10.500		2 16.500		22.50	1.07
CALIB								4.583		10.583 10.667		5 16.583 5 16.667		22.58	1.07
STANDHYD (0004)	Area	(ha) = 2	25.50					4.750		110.750		116.750		22.75	1.07
ID= 1 DT= 5.0 min	Total I			Dir. Con	n.(%)=	60.00		4.833		10.833		116.833		22.83	1.07
								4.917		10.917		116.917		22.92	1.07
0 6 3		IMPERVIO		RVIOUS (i)			5.000		11.000		117.000		23.00	1.07
Surface Area Dep. Storage	(ha) = (mm) =	16.32		9.18 1.50				5.083 5.167		11.083 11.167) 17.083) 17.167		23.08	1.07
Average Slope	(%)=	1.00		2.00				5.250		11.250		117.250		23.25	1.07
Length	(m) =	412.30	4	40.00				5.333		11.333		17.333		23.33	1.07
Mannings n	=	.013		.250				5.417		11.417) 17.417		23.42	1.07
NOTE: RAINFA	ат.т. блас т	RANGFORM	י חיד מי	5 0 MTN	TIME ST	7 D		5.500 5.583		11.500 11.583) 17.500 1 17.583		23.50	1.07
NOID. IGIINI	TELL WITE I	.41101 01411	JD 10 .	J.0 1111V.	TIPE OT	·		5.667		111.667		17.667		23.67	1.07
								5.750		11.750		117.750		23.75	1.07
					RAPH			5.833		11.833		1 17.833		23.83	1.07
TIME hrs		TIME hrs		TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	5.917		11.917 12.000		1 17.917 1 18.000		23.92	1.07
.083		6.083		112.083	12.90		1.61	3.000	, 1.73	,12.000	20.04	. 110.000	1.01	, 27.00	1.07
.167	.98	6.167	1.79	12.167	12.89	18.17	1.61	Max.Eff.Inten.(m	nm/hr)=	98.84		100.59			
.250		6.250		12.250		18.25	1.61		(min)	5.00		15.00			
.333		6.333		12.333 12.417	12.89		1.61	Storage Coeff.		6.00 5.00		13.05 (ii) 15.00			
.417	.98 .98			112.41/	12.89 12.89		1.61	Unit Hyd. Tpeak Unit Hyd. peak		.19		.08			
.583				112.583		18.58	1.61	onic nya. peak	, 00 /	• ± 2		.00	*T0	TALS*	
.667	.98	6.667	1.79	12.667	6.63	18.67	1.61	PEAK FLOW	(cms)=	3.98		1.63		.456 (iii	Ĺ)
	.98			12.750		18.75	1.61	TIME TO PEAK	(hrs)=	12.00 88.53		12.08 30.82		2.00	
.750	0 -							RUNOFF VOLUME	(mm) =	88 23					
.833	.98			112.833	6.63		1.61							5.45	
	.98	6.833 6.917 7.000	1.79	12.833 12.917 13.000	6.63	18.83 18.92 19.00	1.61	TOTAL RAINFALL RUNOFF COEFFICIE	(mm) =	89.53		89.53	8	5.45 9.53 .73	

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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 (0006) |
| TN= 2---> OUT= 1 |
| DT= 5.0 min |
                     OUTFLOW STORAGE | OUTFLOW
                                                    STORAGE
                     (cms)
                               (ha.m.) | (cms)
                                                    (ha.m.)
                                           .5030
                               .0000
                                                     .8930
                        .0220
                               .3853 | .6990
                                                   1.0960
                              .5970 | .8390 1.2260
.7510 | 1.0020 1.3720
                        .2580
                        3810
                            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
                                           (ha.m.) = 1.0941
                MAXIMUM STORAGE USED
 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
                           1.00
                                        1.50
    Dep. Storage
                   (mm) =
    Average Slope
                   (%)=
                             1.00
                                         2.00
                   (m) = 225.10
    Length
                                       40 00
    Mannings n
                            98.84
                                       102.07
    Max.Eff.Inten.(mm/hr)=
                             5.00
           over (min)
                                       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
                                                     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
                                        .35
    RUNOFF COEFFICIENT =
                             .99
                                                      .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) |
| TN= 2---> OUT= 1 |
| DT= 5.0 min |
                     OUTFLOW STORAGE | OUTFLOW STORAGE
                      (cms)
                               (ha.m.) | (cms)
                                                    (ha.m.)
                                           .1490
                                .0000
                       0000
                                                     .2580
                                                     .3190
                        .0060
                                .1068 | .2070
                               .1710
.2160
                                       | .2490
| .2970
                                                    .3580
.4010
                       .0760
                       .1130
```

```
QPEAK
                                            TPEAK
                           AREA
                                                      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
                PEAK FLOW REDUCTION [Qout/Qin](%) = 12.31
                TIME SHIFT OF PEAK FLOW
                                            (min) = 35.00
                MAXIMUM STORAGE USED
                                           (ha.m.) = .3170
 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
                    (m) =
                           193.20
    Lenath
                                       40 00
    Mannings n
                            .013
                                        .250
    Max.Eff.Inten.(mm/hr)=
                            98 84
         over (min)
                             5.00
    Storage Coeff. (min) =
                             3.81 (ii) 10.81 (ii)
    Unit Hyd. Tpeak (min) =
                             5.00
                                       15.00
    Unit Hyd. peak (cms) =
                             .25
                                        .09
                                                   *TOTALS*
                                        .43
    PEAK FLOW
                 (cms) =
                              . 84
                                                    1.238 (iii)
    TIME TO PEAK (hrs)=
                            12.00
                                       12.08
                                                    12.00
                            88.53
    RUNOFF VOLUME (mm) = TOTAL RAINFALL (mm) =
                                       31.04
                                                    62.66
                            89.53
                                       89.53
                                                    89.53
    RUNOFF COEFFICIENT =
                             .99
***** 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) |
| TN= 2---> OUT= 1 |
| DT= 5.0 min |
                     OUTFLOW STORAGE | OUTFLOW STORAGE
                             (ha.m.) | (cms)
                     (cms)
                                                    (ha.m.)
                              .0000
                       .0000
                                           .1460
                                                    .1820
                       .0050
                              .0782 | .2020
                                                    .2230
                       .0750
                              .1220 | .2420
.1530 | .2890
                                                     .2500
                       .1100
                                           .2890
                                                     .2800
                           AREA
                                   OPEAK
                                            TPEAK
                                                      R.V.
                           (ha)
                                   (cms)
                                            (hrs)
                                                      (mm)
    INFLOW : ID= 2 (0008)
                         5.60
                                  1.24
                                            12.00
                                                     62.66
                                  .20
    OUTFLOW: ID= 1 (0009)
                           5.60
                                            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
 ** SIMILATION NUMBER: 6 **
 *******
| 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	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
TIME RAIN TIME RAIN TIME RAIN TIME RAIN	2.083
hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr .25	2.250
.50 1.10 6.50 2.00 12.50 14.40 18.50 1.80	2.417 1.30 8.417 2.70 14.417 3.00 20.42 1.20
.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	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
1.25 1.10 7.25 2.00 13.25 5.20 19.25 1.80	2.667 1.30 8.667 2.70 14.667 3.00 20.67 1.20
1.50	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
2.00 1.10 8.00 2.00 14.00 4.20 20.00 1.80	2.917 1.30 8.917 2.70 14.917 3.00 20.92 1.20
2.25	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
2.75 1.30 8.75 2.70 14.75 3.00 20.75 1.20	3.167 1.30 9.167 3.20 15.167 3.00 21.17 1.20
3.00	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
3.50	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
3.75	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
4.25	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
4.75 1.60 10.75 6.20 16.75 1.80 22.75 1.20	3.833 1.30 9.833 3.60 15.833 3.00 21.83 1.20
5.00	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
5.50 1.60 11.50 9.60 17.50 1.80 23.50 1.20	4.083 1.60 10.083 4.60 16.083 1.80 22.08 1.20
5.75	4.167
	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
CALIB	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
STANDHYD (0004) Area (ha) = 25.50	4.750 1.60 10.750 6.20 16.750 1.80 22.75 1.20
ID= 1 DT= 5.0 min Total Imp(%) = 64.00 Dir. Conn.(%) = 60.00	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
IMPERVIOUS PERVIOUS (i)	5.000 1.60 11.000 6.20 17.000 1.80 23.00 1.20
Surface Area (ha) = 16.32 9.18 Dep. Storage (mm) = 1.00 1.50	5.083
Average Slope (%) = 1.00 2.00 Length (m) = 412.30 40.00	5.250
Mannings n = .013 .250	5.417 1.60 11.417 9.60 17.417 1.80 23.42 1.20
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	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
TRANSFORMED HYETOGRAPH	5.750
TIME RAIN TIME RAIN TIME RAIN TIME RAIN hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr	5.917
.083 1.10 6.083 2.00 12.083 14.41 18.08 1.80	
.167	Max.Eff.Inten.(mm/hr) = 110.37 114.19 over (min) 5.00 15.00
.333 1.10 6.333 2.00 12.333 14.40 18.33 1.80	Storage Coeff. (min) = 5.75 (ii) 12.44 (ii)
.417	Unit Hyd. Tpeak (min) = 5.00 15.00 Unit Hyd. peak (cms) = .20 .08
.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	*TOTALS* PEAK FLOW (cms) = 4.47 1.91 6.216 (iii)
.750 1.10 6.750 2.00 12.750 7.40 18.75 1.80	TIME TO PEAK (hrs) = 12.00 12.08 12.00
.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	RUNOFF VOLUME (mm) = 98.98 36.58 74.02 TOTAL RAINFALL (mm) = 99.98 99.98 99.98
1.000 1.10 7.000 2.00 13.000 7.40 19.00 1.80	RUNOFF COEFFICIENT = .99 .37 .74
1.083	
1.250	(i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES: Fo (mm/hr) = 50.00 K (1/hr) = 2.00
1.417 1.10 7.417 2.00 13.417 5.60 19.42 1.80	Fc $(mm/hr) = 7.50$ Cum.Inf. $(mm) = .00$
1.500	(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
1.667 1.10 7.667 2.00 13.667 4.20 19.67 1.80	(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
1.750 1.10 7.750 2.00 13.750 4.20 19.75 1.80	I

RESERVOIR (0006) IN= 2> OUT= 1 DT= 5.0 min	1	LOW SI s) (h 000 220	ORAGE a.m.) .0000 .3853	OUTFLOW (cms) .5030 .6990 .8390 1.0020	STORAGE (ha.m.) .8930 1.0960	
	.25	580 310	.5970 .7510	.8390 1.0020	1.2260 1.3720	
INFLOW : ID=	2 (0004) 1 (0006)	AREA (ha) 25.50 25.50	QPEAK (cms) 6.22 .84	TPEAK (hrs) 12.00 12.58	R.V. (mm) 74.02 73.16	
	PEAK FLOW TIME SHIFT MAXIMUM ST	N REDUC	TION [Qout	/Qin](%)=	13.47	
CALIB		(ha)=	7 60			
CALIB STANDHYD (0005) D= 1 DT= 5.0 min	Total :	[mp(%)=	60.00 Di	r. Conn.(%)= 55.00	
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) =	IMPERVIO 4.56 1.00 1.00 225.10	US PERV 3 1 2 40	.04 .50 .00		
Mannings n	=	.013		250		
Max.Eff.Inten ov. Storage Coeff Unit Hyd. Tpe Unit Hyd. pea	. (mm/hr) = er (min) . (min) = ak (min) =	110.37 5.00 4.00 5.00	115 15 (ii) 10 15	.79 .00 .65 (ii)		
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFAL RUNOFF COEFFI				.68 .08 .85 .98	*TOTALS* 1.896 (iii) 12.00 71.02 99.98 .71	
**** WARNING: STO					• , 1	
(i) HORTONS FO (i) FC (ii) TIME ST	EQUATION SI mm/hr) = 50.0 mm/hr) = 7.3 EP (DT) SHOW E STORAGE CO	ELECTED F 00 50 Cu JLD BE SM DEFFICIEN	OR PERVIOU K (1/ m.Inf. (ALLER OR E	S LOSSES: hr) = 2.00 mm) = .00 QUAL		
RESERVOIR (0007)						
IN= 2> OUT= 1 DT= 5.0 min	OUTF	LOW SI	ORAGE	OUTFLOW (cms)	STORAGE (ha.m.)	
	.01	760 130		OUTFLOW (cms) .1490 .2070 .2490 .2970		
<pre>INFLOW : ID= OUTFLOW: ID=</pre>	2 (0005)	AREA (ha) 7.60 7.60	QPEAK (cms) 1.90 .25	TPEAK (hrs) 12.00 12.58	R.V. (mm) 71.02 70.19	

	MAXIMUM	STORAGE	USED	(ha.m.)= .3558	
CALIB STANDHYD (0008) ID= 1 DT= 5.0 min	Area Total	(ha) = . Imp(%) =	5.60 60.00	Dir. Conr	1.(%)= 55.00	
	_	IMPERVI	OUS	PERVIOUS (i	.)	
Surface Area Dep. Storage	(ha) = (mm) =		6 0	2.24 1.50		
Average Slope	(%)=	1.0	0	2.00		
Length Mannings n	(mm) = (%) = (m) = =	193.2 .01	0 3	40.00 .250		
Max.Eff.Inten.	(mm/hr)=	110.3		115.79		
ove	r (min)	5.0	0	15.00	,	
Storage Coeff. Unit Hyd. Tpea	(min) = k (min) =	5.0	5 (ii) 0	10.30 (ii 15.00	.)	
Unit Hyd. peak	(cms) =	.2	5	.09		
PEAK FLOW	()	0	2	.51	*TOTALS* 1.408 (ii	2 \
TIME TO PEAK	(cms) = (hrs) =	.9 12.0	0	12.08	12.00	Τ)
TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL	(mm) =	12.0 98.9	8	12.08 36.85	71.02	
TOTAL RAINFALL RUNOFF COEFFIC	. ,		8	99.98 .37	99.98 .71	
**** WARNING: STOR						
(i) HORTONS	EQUATION	SELECTED	FOR PEF	VIOUS LOSSE	S:	
Fc (m	m/hr)= 7	7.50 C	um.Inf.	(1/hr) = 2 (mm) =	.00	
(ii) TIME STE	P (DT) SH	HOULD BE S	MALLER	OR EQUAL		
THAN THE (iii) PEAK FLO		COEFFICIE		OW TE ANV		
(III) IBM IBO	W DODD NO	/I INCHODE	DIIODII			
RESERVOIR (0009)						
IN= 2> OUT= 1						
DT= 5.0 min	OUI	FLOW S	TORAGE	OUTFLO	W STORAGE (ha.m.)	
		0000	.0000	1 .146	1820	
		0050	.0782	.202	.2230	
		0750 1100	.1220	(cms) .146 .202 .242 .289	.2500	
	•	1100	.1000			
		AREA				
INFLOW : ID= 2	(0008)	(ha) 5.60	(cm	/1 12 0	(mm) 0 71.02	
OUTFLOW: ID= 1		5.60		24 12.5		
	מבאע ביו	OM DEDII		[Qout/Qin] (%	.) = 16 96	
				mir) (mir		
	MAXIMUM	STORAGE	USED	(ha.m.)= .2480	

** SIMULATION NUM						
READ STORM		name. G.\	Project	·s\2012\1211	.6 - TSI London	
	1 1116				Calcs\VO2\Stor	m\
	I	SCS	Type I	I - London	100yrSCSTYPEII1	24HR.stm
Ptotal=111.61 mm	Comm	nents: 100	-Year 2	4 hour SCS:	London Airport	
		N TIME		N TIME	RAIN TIME	RAIN
	rs mm/h	ır hrs	mm/h	ır hrs	mm/hr hrs	mm/hr
	25 1.2 50 1.2	23 6.25 23 6.50	2.2	13 12.25	16.07 18.25 16.07 18.50	2.01 2.01
•	JU 1.2	0.30	۷.۷		10.07 10.30	2.U1

.75 1.00 1.25 1.50	1.23 1.23 1.23 1.23	6.75 7.00 7.25 7.50 7.75	2.23 12.75 2.23 13.00 2.23 13.25 2.23 13.50 2.23 13.75	8.26 18.75 8.26 19.00 5.80 19.25 6.25 19.50 4.69 19.75	2.01 2.01 2.01 2.01 2.01
2.00	1.23	8.00	2.23 14.00	4.69 20.00	2.01
2.25	1.45	8.25 8.50	3.01 14.25 3.01 14.50	3.35 20.25 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		3.01 15.00	3.35 21.00	1.34
3.25	1.45		3.57 15.25	3.35 21.25	1.34
3.50	1.45		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) (ha) =16.32 9.18 Surface Area 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.

			TF	RANSFORME	ED HYETOG	GRAPH			
TIME	RAIN		TIME	RAIN	TIME	RAIN		TIME	RAIN
hrs	mm/hr		hrs	mm/hr	hrs	mm/hr		hrs	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	1	18.67	2.01
.750	1.23	-	6.750	2.23	12.750	8.26	1	18.75	2.01
.833	1.23	-	6.833	2.23	12.833	8.26	1	18.83	2.01
.917	1.23	1	6.917	2.23	12.917	8.26	1	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	1	19.08	2.01
1.167	1.23	-	7.167	2.23	13.167	5.80	1	19.17	2.01
1.250	1.23	-	7.250	2.23	13.250	5.80	1	19.25	2.01
1.333	1.23	1	7.333	2.23	13.333	6.25	1	19.33	2.01
1.417	1.23	1	7.417	2.23	13.417	6.25	1	19.42	2.01
1.500	1.23	1	7.500	2.23	13.500	6.25	1	19.50	2.01
1.583	1.23	1	7.583	2.23	13.583	4.69	1	19.58	2.01
1.667	1.23	1	7.667	2.23	13.667	4.69	1	19.67	2.01
1.750	1.23	1	7.750	2.23	13.750	4.69	1	19.75	2.01
1.833	1.23	1	7.833	2.23	13.833	4.69	1	19.83	2.01
1.917	1.23	1	7.917	2.23	13.917	4.69	1	19.92	2.01
2.000	1.23	1	8.000	2.23	14.000	4.69	1	20.00	2.01
2.083	1.45	1	8.083	3.01	14.083	3.35	1	20.08	1.34
2.167	1.45	1	8.167	3.01	14.167	3.35	1	20.17	1.34
2.250	1.45	1	8.250	3.01	14.250	3.35	1	20.25	1.34
2.333	1.45	ī	8.333	3.01	14.333	3.35	1	20.33	1.34
2.417	1.45	1	8.417	3.01	14.417	3.35	1	20.42	1.34

```
2.500 1.45 | 8.500 3.01 | 14.500 3.35 | 20.50
               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
               3.083
                       1.45 | 9.083
                                       3.57 | 15.083
                                                      3.35 | 21.08
                                                                     1.34
                                       3.57 |15.167
               3.167
                       1.45 | 9.167
                                                      3.35 | 21.17
                                                                     1.34
               3.250
                       1.45 | 9.250
                                       3.57 |15.250
                                                      3.35 | 21.25
               3.333
                       1.45 | 9.333
                                       3.57 | 15.333
                                                      3.35 | 21.33
                                                                     1.34
                                       3.57 | 15.417
               3.417
                       1.45 | 9.417
                                                      3.35 | 21.42
                                                                     1.34
               3.500
                       1.45 | 9.500
                                       3.57 |15.500
                                                      3.35 | 21.50
               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
                       1.45 | 9.917
               3.917
                                       4.02 | 15.917
                                                      3.35 | 21.92
                                                                     1 34
               4.000
                       1.45 | 10.000
                                      4.02 | 16.000
                                                      3.35 | 22.00
               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 1 22 42
                                                                     1 34
               4.500 1.79 | 10.500
                                      5.13 |16.500
                                                      2.01 | 22.50
               4.583
                       1.79 | 10.583
                                      6.92 | 16.583
                                                      2.01 | 22.58
                                                                     1.34
                       1.79 |10.667
               4.667
                                       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
                       1.79 |10.917
               4.917
                                       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
                       1.79 | 11.417
               5.417
                                     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
                                                      2 01 | 23 67
                                     46.42 | 17.667
                                                                     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
    Max.Eff.Inten.(mm/hr)=
                              123.20
                                          128.85
               over (min)
                              5.00
                                          15.00
                                5.50 (ii) 11.88 (ii)
    Storage Coeff. (min) =
    Unit Hyd. Tpeak (min) =
                                5.00
                                           15.00
    Unit Hyd. peak (cms)=
                             .20
                                                        *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
      (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
                                          | .5030
| .6990
                         .0000
                                                          .8930
                         .0220
                                                         1.0960
                                   .3853
```

.5970 | .8390 .7510 | 1.0020 1.2260 1.3720

.2580 .3810

	(0004) (0006) PEAK FLOW FIME SHIFT (REDUCTI	ON [Qout/Q	in](%)= 14	
A	MAXIMUM STO	DRAGE US	ED (ha.m.) = 1.	3705
CALIB STANDHYD (0005) ID= 1 DT= 5.0 min	Area Total In				55.00
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) = = =	MPERVIOUS 4.56 1.00 1.00 225.10 .013	PERVIO 3.0 1.5 2.0 40.0 .25	US (i) 4 0 0 0 0	
Max.Eff.Inten. over Storage Coeff. Unit Hyd. Tpeal Unit Hyd. peak	(mm/hr) = (min) (min) = (min) = (cms) =	123.20 5.00 3.82 5.00 .25	130.6 15.0 10.1 15.0 .1	0 0 7 (ii) 0 0	TOTALS*
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICE	(cms) = (hrs) = (mm) = (mm) = IENT =	1.41 12.00 110.61 111.61 .99	.7 12.0 43.9 111.6	9 8 0 1 9	2.154 (iii) 12.00 80.59 111.61 .72
(ii) TIME STEI THAN THE (iii) PEAK FLOW	EQUATION SEI a/hr)= 50.00 a/hr)= 7.50 P (DT) SHOUL STORAGE CON M DOES NOT	LECTED FOR Cum. D BE SMAI FFICIENT. INCLUDE BA	PERVIOUS K (1/hr Inf. (mm LER OR EQU	LOSSES:)= 2.00)= .00 AL	
RESERVOIR (0007) IN= 2> OUT= 1 DT= 5.0 min	OUTFLG - (cms) .000 .006 .076	DW STOF (ha. 00 .0 50 .1 50 .1	MAGE Om.)	UTFLOW (cms) .1490 .2070 .2490 .2970	STORAGE (ha.m.) .2580 .3190 .3580 .4010
INFLOW: ID= 2 OUTFLOW: ID= 1		AREA (ha) 7.60 7.60	QPEAK (cms) 2.15 .29	TPEAK (hrs) 12.00 12.58	R.V. (mm) 80.59 79.75
	PEAK FLOW FIME SHIFT (MAXIMUM STO		OW SED (
CALIB STANDHYD (0008) ID= 1 DT= 5.0 min	_			Conn.(%)=	55.00

Surface Area Dep. Storage Average Slope Length Mannings n Max.Eff.Inten.(r	(ha) = (mm) = (%) = (m) = =	3.36 1.00 1.00 193.20 .013	PERVIOUS (i) 2.24 1.50 2.00 40.00 .250 130.60		
Max.Eff.Inten.(r over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	(min) (min) = (min) = (cms) =	5.00 3.49 (ii) 5.00 .26	10.00 9.83 (ii) 10.00 .11	*TOTALS*	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI	(cms) = (hrs) = (mm) = (mm) = ENT =	1.05 12.00 110.61 111.61 .99	.63 12.00 43.90 111.61 .39	1.676 (iii) 12.00 80.59 111.61 .72	
***** WARNING: STORAG (i) HORTONS EG FO (mm, FC (mm,	GE COEFF. : QUATION SET ('hr) = 50.00 ('hr) = 7.50	IS SMALLER TH LECTED FOR PE) F) Cum.Inf	AN TIME STEP! CRVIOUS LOSSES: ((1/hr) = 2.0 ((mm) = .0	0	
(ii) TIME STEP THAN THE S (iii) PEAK FLOW	STORAGE COI DOES NOT :	EFFICIENT. INCLUDE BASEF	TLOW IF ANY.		
RESERVOIR (0009) IN= 2> OUT= 1 DT= 5.0 min	OUTFL((cms) .000 .009 .079	DW STORAGE (ha.m.) 00 .0000 50 .0782 50 .1220	C OUTFLOW (cms) 1460 .1460 .2020 .2420 .2890	STORAGE (ha.m.) .1820 .2230 .2500 .2800	
INFLOW : ID= 2 OUTFLOW: ID= 1	(0008)	AREA QE	PEAK TPEAK (hrs) (hrs)68 12.00 .29 12.42	R.V.	
T: Mi	ME SHIFT (OF PEAK FLOW DRAGE USED	(ha.m.)=	25.00	
FINISH					

Appendix F:

Storm Sewer Design Sheets



PROJECT: Green Vally Estate I & II

JOB NO: 12116

LOCATION: City Of London

STORM SEWER DESIGN SHEET CITY OF LONDON

SUBMISSION: FSR M.B.

2- year storm A = 724.69 100 - year storm A = 1499.53 B = 3.297

B =5.5

C = 0.8

CAPACITY VEL(m³/s)

ACTUAL

REVIEWED BY: B.A

Initial To

Tc = :	19	

C =0.794

MUNICIPAL INFRASTRUCTU Group	JRE														DATE:			September	2013		Mannin	g's n=	0.013						
Street	Area No.	UPSTF MH	REAM INV	DOWNSTR MH I	EAM INV	NO. OF HE EXTERNAL AREA	CTARES CONTRI. AREA	TOTAL	A x STOR 0.50	0.65		TOTAL A x C		IME TOTAL (min)	l ₂ mm/hr	I ₁₀₀ mm/hr	FLOW=2.78 Q ₂ m3/s	8ACI/1000 Q ₁₀₀ m3/s	DESIGN FLOW	LENGTH (m)	SIZE (mm)	PIPI GRADE (%)	CAP. (m3/s)		TIME (min)		(NOTE 1) ROAD TYPE GRADE		
NORTH PART																													1
NOKIIII AKI																			1										
		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.
		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
		IVII IS		IVII IO			1.05				1.43	1.43		19.00	30.00		0.23		0.23	133.00	323	0.30	0.304	1.40	1.00			70.10	
		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
		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
		IVII IO		IVII 19			0.19		0.093			3.10		23.30	49.01		0.70		0.70	00.00	900	0.33	1.071	1.00	0.75			04.91	
		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
		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
		IVII 19		IVIIIIZ			0.19		0.093			0.30		24.23	47.30		0.67		0.07	00.00	913	0.33	1.320	1.70	0.75			00.04	
		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
		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
		IVIIIIZ		WIIII4			0.19		0.093			7.77		25.04	47.02		1.02		1.02	30.00	1030	0.33	1.010	1.07	0.21			02.07	
		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
		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
		IVIII 14		IVITI 17			0.00		0.000			9.00		20.51	40.09		1.20		1.20	30.00	1200	0.33	2.306	2.04	0.41			34.44	
		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
		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
		MH18		HW2			0.00		0.000	0.00		10.52	0.41	26.12	45.72		1.34		1.34	30.00	1200	0.35	2.308	2.03				57.94	
		MUMO		MUIOA			0.40			0.32		0.00		40.00	50.00		0.05		0.05	00.00	200	0.50	0.000	0.07	4.00			72.59	1
		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	
		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
		141104		MUOS			0.44			0.07		4.00		00.70	50.00		0.00		0.00	20.00	505	2.50	0.004	4.40	0.05			05.00	1
		MH21		MH25			0.41			0.27		1.36	1	20.78	53.03		0.20		0.20	80.00	525	0.50	0.304	1.40	0.95			65.66	1
		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
		141:22		NU IO C			0							04 ==	F4 :-					50.00	0==	0.77	0	4.50	0			50.65	-
		MH25 MH26		MH26 HW1			0.35			0.23		2.44 2.44	0.50	21.76 22.26	51.49 50.74		0.35 0.34		0.35 0.34		675 675	0.50	0.595 0.595	1.66				58.67 57.82	1
		WII 120		. 1 V V 1	-		0.00	1		1		2.44	0.50	22.20	30.74	-	0.34		0.34	70.00	0/0	0.50	0.555	1.00	0.70	1	 	57.02	



PROJECT: Green Vally Estate I & II

LOCATION: City Of London

STORM SEWER DESIGN SHEET CITY OF LONDON

SUBMISSION: FSR M.B.

2- year storm A = 724.69 100 - year storm A = 1499.53 B = 3.297

B =5.5 C = 0.8

C =0.794

ACTUAL CAPACITY VEL(m³/s)

The MUNICIPAL	MUNICIPAL			CITT OF EGINDON					REVIEWED BY: B.A			Initial Tc = : 19																			
INFRASTRUCTU Group	INFRASTRUCTURE Group									DATE: September 2013				Manning's n= 0.013																	
Street	Area No.	UPSTR MH		DOWN:	STREAM INV	NO. OF HI EXTERNAL AREA		TOTAL		0.50			TOTAL A x C		IME TOTAL (min)	I ₂ mm/hr	I ₁₀₀ mm/hr	FLOW=2.7 Q ₂ m3/s	8ACI/1000 Q ₁₀₀ m3/s	DESIGN FLOW	LENGTH (m)	SIZE (mm)	PIPE GRADE (%)					(NOTE 1) TYPE			
SOUTH PART																														-	
GOOTH FAIRT																															
		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 10	2 24				68.37	1.33
		MH32		MH35			0.42			0.013	0.27	1			22.80	49.97		0.25		0.25			0.30	0.336	1.19					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		21.15			0.07		0.07	60.00		0.50	0.202	1.27					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
		1411 107		11110			0.00				0.00		2.70		20.40	40.00		0.00		0.00	00.00	070	0.00	0.401	1.20	0.04				7 0.00	
		MH42		MH43			1.16			0.580			0.58		10.00	56.08		0.09		0.09	90.00	375	0.50	0.124	1.12	1 2/			-	72.90	1.27
		MH43		MH44			0.21			0.105			0.69					0.09		0.10			0.50	0.202	1.27					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			56.08		0.10		0.10	160.00	375	0.50	0.124						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	ļ			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	l		1	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	1	10.00	56.08		0.02		0.02	30.00	300	0.50	0.068	0.97	0.52				23.70	0.63
																				0.02											
		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 (m³/ha/day)	25
Average Flow (L/s)	0.12
Equivalent Population	42
Peaking Factor	4.33
Peak Flow (L/s)	0.52
Site Area (ha)	0.4
Infiltration Allowance (L/ha/s)	0.1
Infiltration Flow (L/s)	0.04
Total Flow (L/s)	0.56

City of London Engineering Standards (100pp/ha x 250 Lpcd)

Base on 250 Lpcd (City of London Standard)

City of London Engineering Standards

Green Valley Estates Inc. and Green Valley Estates II Inc. FSR CITY OF LONDON

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 (m³/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

Green Valley Estates Inc. and Green Valley Estates II Inc. FSR CITY OF LONDON

Appendix I:

Drawings

