Kenny Drain Stormwater Management
OS-09-182-11-OS

Environmental Study – Update Report

Volume 1 of 2

Final - December 2011

Prepared for:
City of Owen Sound
808 – 2nd Avenue East
Owen Sound, ON N4K 2H4

Prepared by:
GENIVAR Inc.
1450 1st Avenue West, Suite 101
Owen Sound, Ontario N4K 6W2

Project No. OS-09-182-11-OS

GENIVAR

OS-09-182-11-OS

December 19, 2011

Mr. Chris Webb, P. Eng., Manager of Engineering Services
City of Owen Sound
1900 - 20th Street East
OWEN SOUND, ON
N4K 5N3

Re: Environmental Study – Final Update Report (December 2011)
Kenny Drain Stormwater Management

Dear Mr. Webb:

Please find enclosed one (1) copy of the completed Environmental Study – Update Report for the Kenny Drain Stormwater Management.

This study report will enable the City of Owen Sound to proceed with the approval of the proposed improvement works as part of the Environmental Assessment process for this project.

We at Genivar's Owen Sound office are very pleased to have undertaken this study on behalf of Owen Sound and are available to assist with the future implementation of the project works.

Should you have any questions or require additional information, please contact me at your convenience.

Yours truly,

GENIVAR Inc.

George L. Prentice, P. Eng.
Senior Civil Engineer
Transportation - Urban Infrastructure
GLP/lem
Encl.

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Appendices (Volume 2 of 2)

1.0 INTRODUCTION AND BACKGROUND

In accordance with the Municipal Class Environmental Assessment process, the previously completed Environmental Study Report (ESR), completed in June 1993 (completed by Henderson Paddon & Associates Limited), requires to be updated due to the expiration of the 5 year approval time period in accordance with this Environmental Assessment approval planning process.

Following a meeting with City officials on September 10, 2009, GENIVAR Consultants LP have been engaged to review the previously completed ESR and works completed to date on the Kenny Drain system and the recently completed East Side Master Servicing Study – Stormwater Management Study (February 2008), in order to update this ESR such that improvement works can be proposed and this planning process is in place accordingly and this review of the 1993 ESR references the 2008 Master Servicing Study completed by R. J. Burnside & Associates Ltd.

2.0 PROJECT UNDERTAKING

The previously completed ESR report of June 1993 and the East Side Master Servicing Study (ESMSS) - Stormwater Management Study (SMS) (February 2008), have been reviewed in detail, in particular with the recommendation of improvement works and the hydrology and hydraulic analysis completed with those reports.

It was concluded in the recommendations of the ESMS-SMS that the previously referred to west branch of the Telfer Creek is more properly an unnamed tributary of Bothwell Creek. This unnamed branch is now removed from the Kenny Drain watershed, as it was previously included in the original ESR report of June 1993. As such, this study shall proceed with the review of the Kenny Drain watershed only (**Figure 1**).

Hydrology (storm run-off) and hydraulic flow analysis have been completed for the Kenny Drain watershed with analysis results being summarized and recommendations concluded for implementation of improvement works. This shall enable the City to propose such improvement works as part of the project planning to accommodate increased run-off as future development occurs in the Kenny Drain watershed area. Additional to the proposed work in this study, individual on-site storm water management control shall still be required and implemented to the extent required to meet City approvals.

Flood plain mapping has been completed similar to that of the previously completed Study ESMS and SMS updated and based on this report's existing and proposed work conditions. Floodplain mapping for both the 100 year and Regional (Timmins) storm events has been determined and is shown in this report for both existing and proposed improvement conditions on figures herein.

(REVISED AUG. 30, 2011
CATCHMENT BOUNDARY)

REGISTERED PROFESSIONAL ENGINEER
9/13/11
G. L. PRINCE
PROVINCE OF ONTARIO

KENNY DRAIN WATERSHED-GENERAL PLAN
KENNY DRAIN STORMWATER MANAGEMENT ENVIRONMENTAL STUDY UPDATE REPORT
CITY OF OWEN SOUND

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DESIGN	G L P
DRAWN	T J J
APPROVED	G L P
DATE	JAN 2010
SCALE	1:20,000
FILE No.	OS-09-182-11-OS
FIG. No.	1

3.0 METHODOLOGY

The complete watershed is subdivided into sub-catchment areas similar to those of the previously completed studies (**Figure 2** – Kenny Drain Watershed – Catchment Areas). This shall enable analysis to be completed and results compared to those previously reported for both stormwater flows and hydraulic flow analysis of the channel and roadway crossing structures.

The previously proposed stormwater management design components of the 1993 ESR (**Table A1** in **Appendix C**) shall be updated for works completed and not completed. Improvement works proposed to be reported in this study shall include those previously reported that have not been completed, confirming their status to remain as proposed or revised with modification and/or new works to be added.

The MIDUSS hydrologic computer model program shall be utilized to complete the hydrologic and hydraulic flow analysis to be reported and compared to those of the previous study results.

In the past, the Kenny Drain has been modelled using the SWMHYMO modelling program. For the sake of consistency, catchments and parameters will be kept the same between these two models. It is expected that the MIDUSS model will produce slightly higher flows due to the fact that it is a rational method-based modelling program. We propose to use the MIDUSS modelling program because we feel that the results will provide design criteria which will include a factor of safety allowing for any changing conditions expected in the future. While there is no documented scientific proof that the climate is changing, several key members of the City staff have noted increasing problems with drainage in the Owen Sound area over the last number of years. Modelling in MIDUSS will allow for a higher overall flow, which will account for the potential of harsher and more intense, yet shorter duration storm events, which have become more and more common in the Owen Sound drainage catchment area.

In addition, the MIDUSS model is prepared utilizing revised IDF curve numbers developed by the City of Owen Sound, which seek to more accurately represent future conditions for the Kenny Drain basin as well as the Owen Sound area. These IDF curve values develop more intense storm events, which in turn, develops higher flow rates.

Flood plain mapping, to be completed and reported in this study, shall be determined using HEC-RAS (4.0) computer model.

Waterway cross sections have been determined after review of those previously reported and contours were developed from the recent aerial photography provided by the City. This being the case, no topographic or elevation surveys were undertaken for the completion of this study.

The Environmental Approval process referenced in Section 4.0 was followed during the undertaking for the completion of this study report.

4.0 AGENCY AND PUBLIC CONSULTATION

In accordance with the Municipal Class EA (MCEA) approval document, Phase II, Schedule B Screening is followed since the project is an activity as a Wastewater Management Project identified under Item 2, 16, 18 and 19, Page 1 – 14 and 15, Project Schedule Appendix, in the MCEA document. This Schedule B Screening Process requires 2 points of public consultation; one (1) at the process initiation, inviting input comments and a second after completion of the Study before proceeding to construction.

Appendix A of this report provides a summary of the Class Environmental Assessment process.

The screening process is a consultation opportunity for the review agency, stakeholders and public to be involved with the project and this screening process is discussed in more detail in Section A.3 of the MCEA document.

During the Study undertaking, the Grey Sauble Conservation Authority (GSCA) review agency have been contacted with meetings and discussions have taken place since they are a major agency and their involvement and approval is essential for the proposed study outcome and their issuance of work permits prior to the construction implementation stage of recommended works is required.

The First Mandatory Public Contact, Phase II, Notice that included a public meeting and is enclosed in **Appendix B-1**, as well as a sample letter to the agencies in **Appendix B**. The review agencies notified by this letter with Public Notification/Meeting Notice attached are as follows:

Table 1

Agencies Contact List

Mr. Ron Griffiths and Mr. Bill Armstrong	Ministry of Environment, London Office
Mr. Rick Chappell, District Manager	Ministry of Environment, Owen Sound Office
Mr. Randy Scherzer, Director of Planning & Economic Development	Grey County
Mr. John Bittorf	Grey Sauble Conservation Authority
Mr. Kevin Hawthorne	Ministry of Natural Resources
Mr. Michael Johnson	Ministry of Culture
Mr. Mark Wright	Transport Canada

Additional to agencies, the directly affected and adjacent property owners were notified by means of the Public Notice and Public Meeting being mailed to the registered owner (sample copy attached with owner's list) – in Appendix B-1.

A copy of the Public Meeting attendees of February 16, 2011 is enclosed in **Appendix B-1**.

Other agencies notified that included providing the initial draft study report are:

- Mr. Malcolm Dixon, Métis Organization of Ontario
- Mr. Alden Barty, Georgian Bay Métis Council
- Ms. Teresa Wagner, Ministry of Tourism and Culture

The comments received from the agencies and public, together with reply correspondence are included in **Appendix B-2**.

The Second Mandatory Public Contact, Phase II Notice of Study Completion is included in **Appendix B-1** as well as sample letters that were sent to the agencies, property owners and public who responded to the First Notice.

The comments received from the agencies and public, together with reply correspondence are included in **Appendix B-2** listed as follows:

- D. McNeil, lawyers for PPG Property owner, e-mail reply to phone call November 17, 2011.
- Dennis Wiseman, President, Sydenham Sportsmen's Association, November 23, 2011.
- Grey County Planning and Development, November 29, 2011
- Ron Radbourne, R. K. Radbourne Building Ltd., property owner, November 29, 2011.

It should be noted that no further comments have been received from the Ministry of Tourism and Culture or Ministry of the Environment during the 30 day review period for the Second Notice. Any issues or concerns that they might raise shall be addressed at the detailed design and construction stages for any part(s) of the improvement works.

As part of the public and agency consultation, a project file that includes this report (initial November 2010 – Draft Report) and the Final Draft Report (August, 2011), has been made available to the public and is on the City's website. This document is now being updated and the Final (December 2011) report shall be published and available on the City's website.

5.0 PREVIOUS ESR PROPOSED WORKS

5.1 Status Review – Completed Works

Following the completion of the June 1993 ESR, the City, through its development of the east side, has undertaken a considerable portion of the improvement works for the Kenny Drain system in accordance with that report (**Table A1 – Appendix C**). Such completed improvement works include the following:

- Construction of stormwater management ponds south of 16th Street East (Highway 26), for the Canadian Tire, Wal-Mart and Home Depot developments.
- Construction of storm sewer on 16th Street East (Highway 26) and 16th Avenue East, north of 16th Avenue East to north of 17th Street East and 17th Street East (east of 16th Avenue East).
- Construction of the Stormwater Quality and Quantity Pond north of the CP Rail right-of-way, east of 9th Avenue East.
- The construction of new roadway crossing culverts, East Bayshore Road (now County Road 5) and 23rd Street East between 16th Avenue and 18th Avenue in the City's Industrial Park.
- The outlet channel protection erosion control from 9th Avenue East to East Bayshore Road and to the Georgian Bay outlet.
- Channelization CPR crossing culvert outlet ditch westerly to the stormwater quality/quantity pond.

These recently completed works have been noted as "completed" and updated as to recent city street/avenue changes. A new subtotal for incomplete works is revised to $2,052,000.

5.2 Status Review – Incomplete Works

The remaining proposed works in **Table A1**, not completed, are the subject of this study.

A review of these works together with alternative and additional improvements has been presented with modifications and some new works proposed.

Environmental impacts for these previously reported works were reviewed for natural, social and economic impact considerations as part of the ESR undertaking.

6.0 STORMWATER MANAGEMENT

6.1 Hydrology (Storm Run-off) and Hydraulic Flow Analysis

Prior to commencing modelling for the Kenny Drain Watershed, the ESMS-SMS (2008) was reviewed in detail to establish if catchment parameters utilized in that study model were still relevant for the current site conditions within the watershed. Through this review, it was deemed that the catchment parameters utilized in the 2008 study were still applicable to today's conditions. The ESMS-SMS proposed the utilization of stormwater management ponds in particular locations throughout this watershed. Some of these stormwater management ponds have been constructed and will remain in the model for this updated report. Some of the hypothetical proposed ponds have been removed in order to provide a worst case model intended for design purposes.

In addition, the east side Master Servicing Study utilized SWMM-HYMO, which has some additional hydrologic modelling tools that MIDUSS does not. However, the MIDUSS modelling software utilizes the rational method in an advanced form and tends to provide an additional factor of safety for design conditions. In order for comparison purposes and due to the review described above, the SWMM-HYMO model from the east side Master Servicing Study will be utilized to provide catchment parameters for each of the catchments within the Kenny Drain watershed. The catchments utilized were from the SWMM-HYMO model labelled "Without Ponds" from the aforementioned report.

The MIDUSS computer modelling input parameters for the individual catchment are shown in **Table 2**. These parameters reflect existing land use and future land use developed conditions.

Computer runs were completed for the 2, 5, 25 and 100 year and regional storm events for both the existing conditions of the waterway channel, crossing structures and upstream ponds for existing and proposed future development south of 16th Street East.

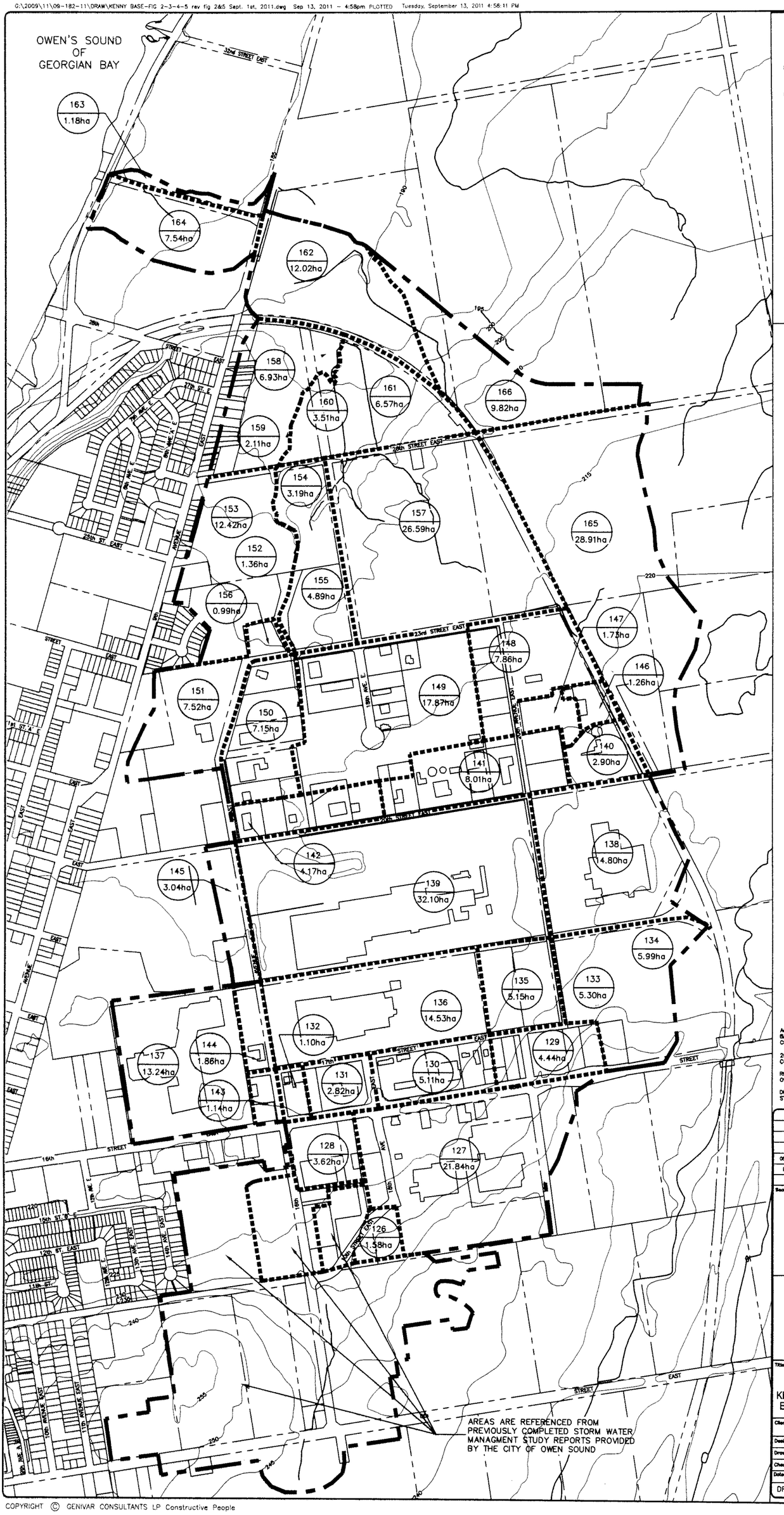
The second set of computer runs is for the proposed improvement works case including proposed stormwater ponds, diversion channel, culvert crossings and channelization within the Kenny Drain.

The detailed print out for both sets of modelling runs are in **Appendix D** and **Appendix E** respectively. Due to the complexity of the model, schematic flow charts were developed shown in **Figures 3** and **4** for each MIDUSS model (existing conditions and proposed improvement works). The nodes shown in these flow charts are established, similar to those for the previously completed studies that enable flow comparisons to be made reasonably, and are presented herein.

TABLE 2 - MIDUS INPUT PARAMETERS - KENNY DRAIN PROPOSED CONDITION									
AREA NO.	AREA (ha)	CN	IMP	SLPP	LGP	MNP	SLPI	LGI	MNI
127	20.72	78	0.65	4.2	130	0.25	1.1	371	0.013
126	1.58	78	N/A	N/A	N/A	N/A	N/A	N/A	N/A
128	3.62	76	0.95	3	33	0.25	1.3	273	0.013
137	13.24	76	0.89	1.3	120	0.25	0.2	293	0.013
146	1.26	76	0.74	1.9	26	0.25	0.7	73	0.013
147	1.73	76	0.9	1.4	37	0.25	0.4	120	0.013
124	1.1	76	0.95	1	10	0.25	2	115	0.013
156	0.99	76	0.22	1.3	15	0.25	1.3	90	0.013
129	4.44	76	0.9	6.7	30	0.25	3.4	149	0.013
135	5.15	76	0.75	3.3	30	0.25	2.2	227	0.013
130	5.11	76	0.66	7.1	28	0.25	0.4	248	0.013
131	2.82	76	0.81	5	40	0.25	0.8	118	0.013
144	1.86	76	0.8	2.1	24	0.25	0.7	69	0.013
136	14.53	76	0.44	2.1	73	0.25	0.3	466	0.013
138	16.85	69	0.47	1.5	103	0.25	1.4	289	0.013
145	3.04	76	0.75	1.7	30	0.25	0.6	87	0.013
139	32.1	76	0.4	0.7	135	0.25	0.7	539	0.013
140	2.9	63	0.38	0.6	82	0.25	0.4	130	0.013
141	8.01	76	0.94	1.7	80	0.25	1.1	95	0.013
148	7.85	75	0.43	1.6	96	0.25	1.7	207	0.013
149	17.87	76	0.75	1.7	30	0.25	1.2	427	0.013
142	4.18	76	0.36	3	82	0.25	0.7	270	0.013
150	7.16	74	0.64	1.1	175	0.25	0.6	80	0.013
151	7.52	74	0.35	1.1	175	0.25	1.8	111	0.013
152	1.36	74	N/A	N/A	N/A	N/A	N/A	N/A	N/A
153	12.42	77	0.55	1.7	30	0.25	1.8	221	0.013
154	3.15	74	N/A	N/A	N/A	N/A	N/A	N/A	N/A
155	4.89	76	0.75	1.7	30	0.25	2	500	0.013
157	26.59	76	0.75	1.7	30	0.25	1	661	0.013
158	6.93	76	0.55	1.7	30	0.25	3.8	263	0.013
159	2.11	79	N/A	N/A	N/A	N/A	N/A	N/A	N/A
160	3.51	76	0.55	1.7	30	0.25	2.4	246	0.013
161	6.57	79	N/A	N/A	N/A	N/A	N/A	N/A	N/A
165	28.91	79	N/A	1.1	1050	0.25	N/A	N/A	N/A
166	51.22	79	N/A	1.5	1100	0.25	N/A	N/A	N/A
162	12.02	78	N/A	N/A	N/A	N/A	N/A	N/A	N/A
163	1.18	74	N/A	N/A	N/A	N/A	N/A	N/A	N/A
164	7.54	76	0.75	1.7	30	0.25	0.5	194	0.013

AREA	The total catchment area (ha)
CN	The composite SCS Curve Number
IMP	The ratio of impervious area
SLPP	The average pervious surface slope over which runoff travels (%)
LGP	The average lot depth or pervious length over which surface water travels along the longest flow path (m)
MNP	The representative roughness coefficient for the pervious surface
SLPI	The average impervious surface slope over which runoff travels (%)
LGI	The impervious travel length of the longest flow path (m)
MNI	The average roughness coefficient for the impervious surface over which water travels

G:\2009\11\09-182-11\DRAW\KENNY BASE-FIG 2-3-4-5 rev fig 2&5 Sept. 1st, 2011.dwg Sep 13, 2011 - 4:58pm PLOTTED Tuesday, September 13, 2011 4:58:11 PM



LEGEND

- EXTERNAL BOUNDARY
- INTERNAL BOUNDARY
- MAJOR CONTOURS (25m INTERVAL)
- MINOR CONTOURS (5m INTERVAL)
- 165 / 28.91ha — CATCHMENT NUMBER / AREA
- BUILDING
- PARCEL FABRIC
- RIVERS AND STREAMS

ACKNOWLEDGMENTS
BASE MAPPING – PARCELS AND 5m CONTOURS PROVIDED BY COUNTY OF GREY GIS MAPPING. JAN 2010 SHAPEFILES.

2006 GEODETIC ARIEL PHOTO (S.W.O.O.P.) PROVIDED BY COUNTY OF GREY GIS MAPPING.

RIVERS, STREAM AND WATER BODIES PROVIDED BY CITY OF OWEN SOUND.

DRAINAGE AREAS DERIVED FROM PREVIOUS E.S.M.S.-S.W.M. STUDY BY CITY OF OWEN SOUND.

DATE	DESCRIPTION
08/30/11	CATCHMENT BOUNDARY

REVISION / ISSUE

Seal not valid unless signed and dated

REGISTERED PROFESSIONAL ENGINEER
G.L. Prentice
PROVINCE OF ONTARIO

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Title:

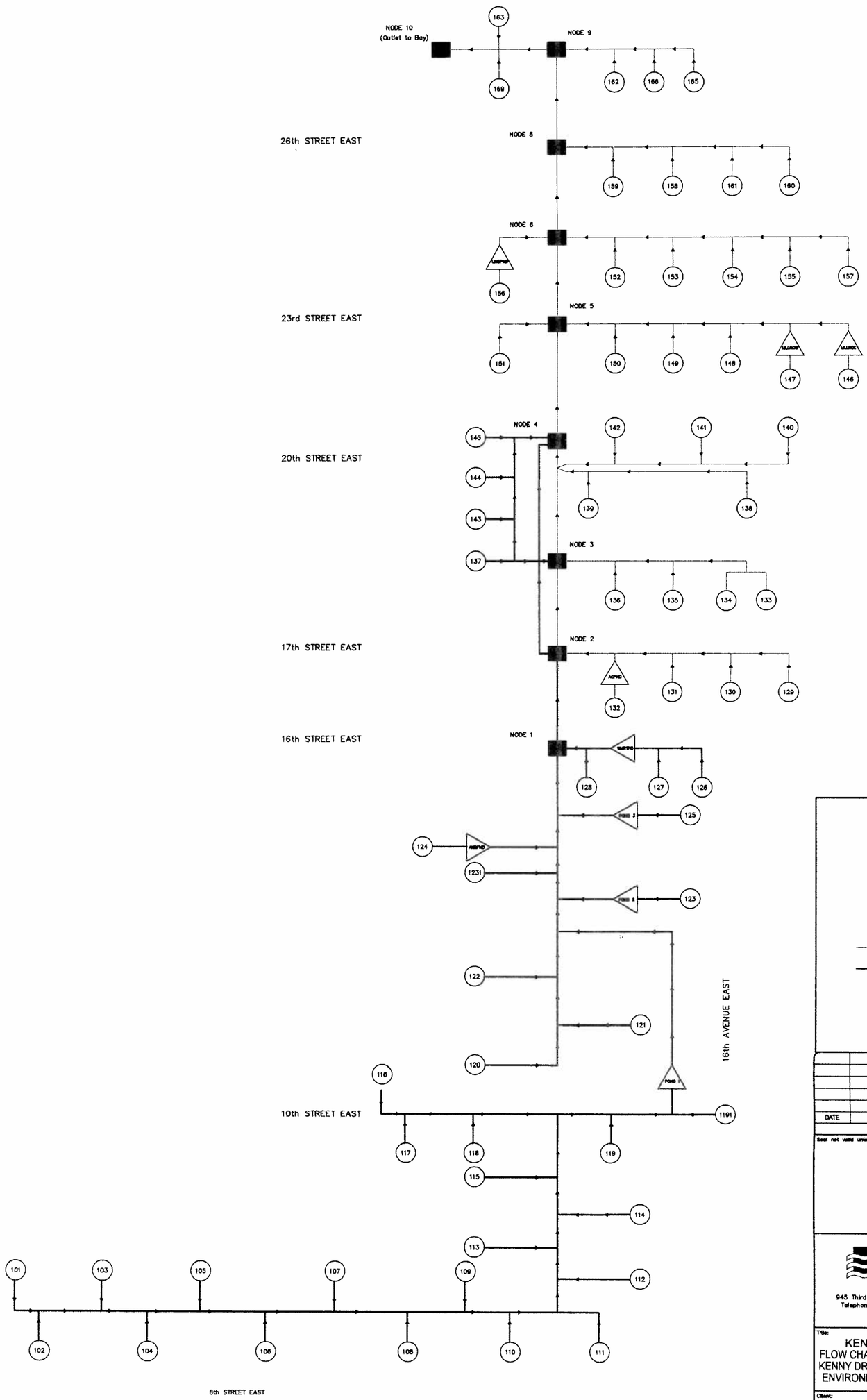
KENNY DRAIN WATER SHED CATCHMENT AREA PLAN
KENNY DRAIN STORMWATER MANAGEMENT ENVIRONMENTAL STUDY UPDATE REPORT

Client: CITY OF OWEN SOUND

Design:	K G S	Scale:	1:5000
Drawn:	T J J	Approved:	
Checked:	G L P		
Date:	JAN 2010		Design Engineer

DRAWING No. OS-09-182-11-OS FIG 2

STORM WATER FLOW CHART EXISTING CONDITIONS
MODEL INCLUDING FUTURE DEVELOPMENT



LEGEND

- 100 CATCHMENT
- FLOW NODE
- ROUTE RESERVOIR
- ROUTE CHANNEL
- ROUTE PIPE

DATE	DESCRIPTION
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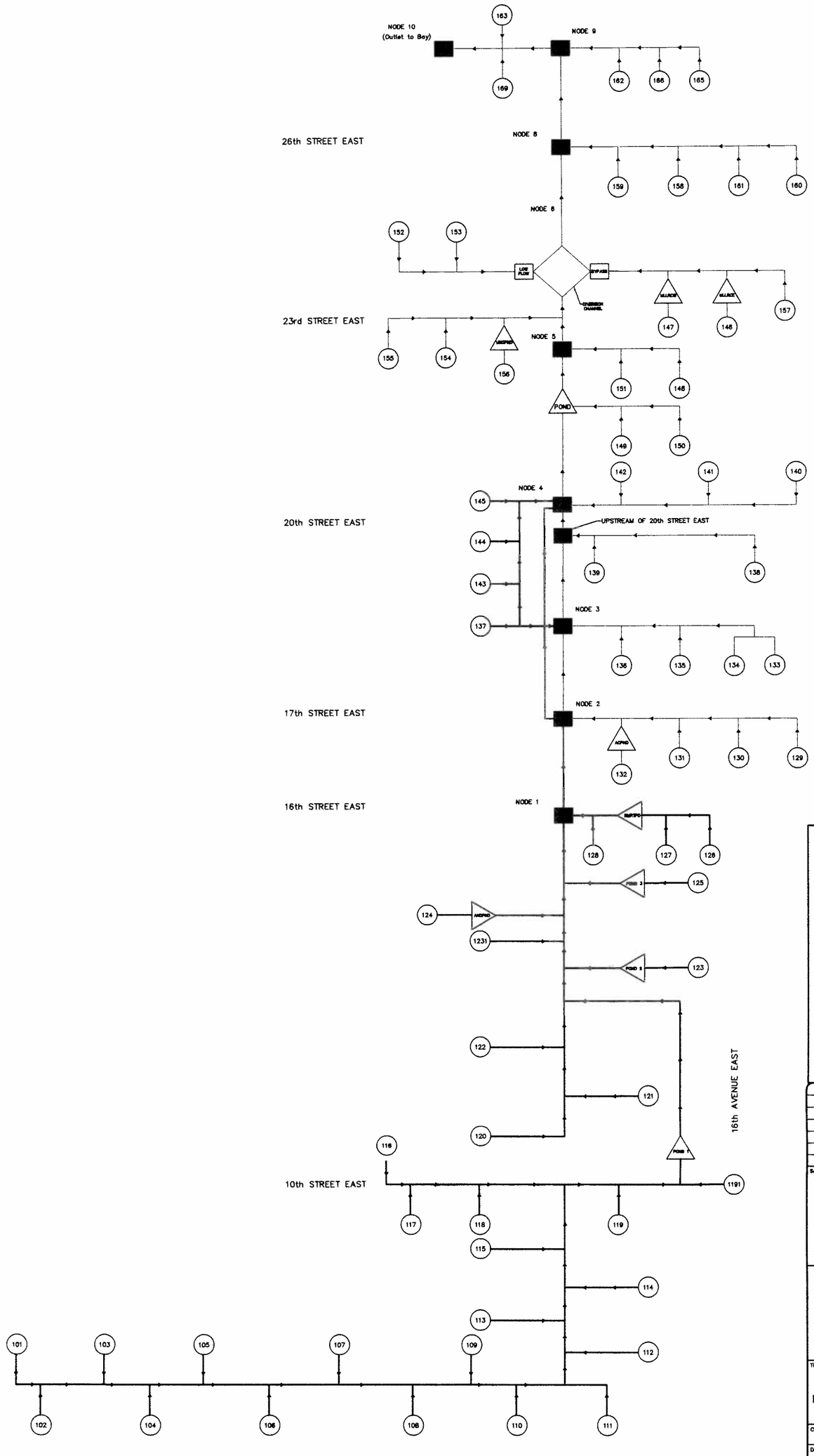
KENNY DRAIN WATER SHED
FLOW CHART SCHEMATIC-WITHOUT PONDS
KENNY DRAIN STORMWATER MANAGEMENT
ENVIRONMENTAL STUDY UPDATE REPORT

Client: CITY OF OWEN SOUND

Design: K G S	Scale: N/A
Drawn: T J J	Approved:
Checked: G L P	
Date: JAN 2010	Design Engineer

DRAWING No. OS-09-182-11-08 FIG 3

STORM WATER FLOW CHART EXISTING CONDITIONS MODEL INCLUDING FUTURE DEVELOPMENT AND PROPOSED IMPROVEMENT



LEGEND

- 100 — CATCHMENT
- FLOW NODE
- ROUTE RESERVOIR
- ROUTE CHANNEL
- ROUTE PIPE

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ENVIRONMENTAL STUDY UPDATE REPORT

Client: CITY OF OWEN SOUND

Design: K G S	Scale: N/A
Drawn: T J J	Approved:
Checked: G L P	
Date: JAN 2010	Design Engineer

DRAWING No. OS-09-182-11-08 FIG 4

It should be clarified that the existing conditions model is based on the existing Kenny Drain layout including proposed future development within the catchment area for Owen Sound.

The flow results of these computer outputs are summarized in **Tables 3** and **4**. It is noted that for some sections (nodes), flows for the 1:100 year and one for the 25 year storm exceed that of the Regional Storm Event and this shall explained in the discussion section herein.

Table 5 (Flow Comparison Summary) is prepared for comparison purposes between the 100 year and regional storm flows to those previously reported in the 1993 ESR and the 2008 ESMS-SWM studies.

6.2 Discussion

In Table 3, the MIDUSS model flows shown for all storm events are consistent, increasing for each storm event to the regional due to the highly urbanized catchments of Nodes 1 & 2. However, progressing downstream during the higher intensity rainfall of the 1:100 year and to a similar degree for the 1:25 year, these storm flows exceed that for the regional storm.

In Table 4, proposed works model results, the extended soaking effect of rainfall of the Timmins (regional) storm event fills the storm water basins prior to the peak with the peak flow passing through the pond. The pond basins existing and proposed were sized to attenuate the 1:100 storm, but are not equipped to deal with the volume of runoff water that is experienced during the regional event. The fact that the soaking rainfall fills the pond prior to the storm peaking means that the peak of the Timmins event passes through the ponds with minimal attenuation, leaving the peak flow essentially unchanged.

Within **Table 5**, the comparable columns to the original ESR flows are the ESMS SWMM-HYMO flows from the post with and without pond column and the updated report (ESR-UR) of existing and proposed improvements for both 1:100 and Regional storm events. A comparison of these columns appears to indicate that during the upstream end of the MIDUSS model, they are comparable with the original ESR flow rates. But, as flow progresses downstream, the discrepancy between the ESR-UR, the ESR and the post "Without Pond" column becomes more apparent.

A side-by-side comparison of the ESMS SWMM-HYMO model and the updated report MIDUSS model, provides a variety of reasons for this discrepancy.

The completed MIDUSS modelling do not include any of the hydrograph shifts to that of the SWMHYMO (ESMS) modeling. For example, the "shift-hyde" command takes a hydrograph from a particular

TABLE 3: SUMMARY OF EXISTING CONDITIONS MODEL RESULTS
August, 2011

OS-09-182-11-OS

Frequency Event	Flow Rate (m^3/sec.)								
	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 8	Node 9	Node 10
2 Yr.	1.68	3.12	5.17	8.23	10.51	13.33	13.29	13.32	13.48
5 Yr.	2.32	4.34	8.17	11.94	15.57	19.59	20.34	19.93	20.31
25 Yr.	3.51	6.51	13.38	19.27	25.10	32.19	32.45	32.69	32.81
100 Yr.	4.33	8.28	17.39	25.41	32.37	41.73	43.28	42.56	43.58
Regional	7.97	9.48	13.38	20.40	24.87	29.97	31.80	33.99	34.75

TABLE 4: SUMMARY OF PROPOSED WORKS MODEL RESULTS

Frequency Event	Flow Rate (m^3/sec.)								
	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 8	Node 9	Node 10
2 Yr.	1.68	3.12	5.17	8.23	5.43	6.77	7.02	4.73	4.80
5 Yr.	2.32	4.34	8.17	11.94	8.39	10.54	11.08	7.71	7.81
25 Yr.	3.51	6.51	13.38	19.27	13.52	16.83	17.86	12.70	12.82
100 Yr.	4.33	8.28	17.39	25.41	18.00	22.61	24.14	17.46	17.64
Regional	7.97	9.48	13.38	20.40	21.69	27.25	28.91	31.10	31.79

TABLE 5
FLOW COMPARISON SUMMARY – (100 YEAR AND REGIONAL) – ESR, ESMS AND ES-UR
August, 2011

Node	ESR (m^3/sec.)	ESMS-SWMHYMO 100 YEAR		ESR-UR – MIDUSS 100 YEAR		ESR-UR – MIDUSS Regional	
		Post Without Pond (m^3/sec.)	Post With Pond (m^3/sec.)	Existing With Future (m^3/sec.)	Proposed Improvements (m^3/sec.)	Existing With Future (m^3/sec.)	Proposed Improvements (m^3/sec.)
1	N/A	5.05	5.05	4.33	4.33	7.97	7.97
2	8.4	6.43	5.97	8.28	8.28	9.48	9.48
3	10.1	8.27	5.86	17.39	17.39	13.38	13.38
4	N/A	17.60	16.15	25.41	25.41	20.40	20.40
5	30.8	21.31	19.01	32.37	18.00	24.87	21.69
6	N/A	28.37	20.39	41.73	22.61	29.97	27.25
8	33.4	30.30	21.76	43.28	24.14	31.80	28.91
9	36.0	30.69	22.46	42.56	17.46	33.99	31.10
10	36.3	31.31	22.94	43.58	17.64	34.75	31.79

catchment and allows you to shift the peak time forward in storm time, which helps propagate flow downstream when a channel does in particular not exist. Therefore, if a particular catchment drains onto another catchment or over an extended length of grass or flat surface, the shift-hyde command would allow you to propagate the hydrograph into the future, therefore, anticipating the amount of time that flow would take to flow from one catchment to the outlet. MIDUSS does not allow this particular tool to be incorporated within the model. Therefore, there are numerous catchments within the MIDUSS version of the model, which align peaks to be very close proximity to each other. This provides an elevated peak flow rate to that of the SWMM-HYMO model dealt with shifting the hydrograph, resulting in a harsher model with higher peaks. In addition, the MIDUSS model is a rational method based model, which generally provides higher peak flows than other hydrologic modelling programs. During the 100 year storm model run, the MIDUSS model produced flows at the downstream nodes to be 12 +/- m^3/sec. higher than the SWMM-HYMO version and 6 to 10 m^3/sec and higher than the original (ESP) rational based calculation under existing conditions.

It is noted that this discrepancy is reduced when comparing the ESR-UR regional storm flows for existing conditions to ESMS-SWHYMO ESR Regional Storm Flows.

As mentioned in the Methodology section, the City of Owen Sound has experienced several larger intensity, shorter duration storm events that have caused significant flooding drainage issues and surcharging of existing storm sewer systems. When comparing the three (3) models, it is evident that the SYMM-HYMO version is an average approximation. However, when designing for future conditions and considering the recent trends from a storm event standpoint, it should be considered that designing future stormwater works, the MIDUSS version of the model be utilized, to ensure that such new systems are designed for the worst case scenario. While we are in no way debating the accuracy of the SWYMM-HYMO model, it is felt that the MIDUSS version of the stormwater management model will accommodate the harsher environment in future. Hence, these works shall function as designed for such future conditions.

It is noted in Table 4 that the 2 year storm flows are greatly reduced for the proposed improvement controls to that of Table 3 for notes 5 to 10. When compared to existing conditions, these 2 year storm flows could be considered minimum base flows that should be maintained as much as possible without negatively impacting the existing adjacent and downstream channels. As such, the design of the improvements must maintain the base flow in a channel as a bypass or through the proposed pond and attenuation is to accommodate higher flows.

Similarly, base flows must be maintained in a natural channel south of the existing CPR Trail culvert crossing that is proposed to be re-routed to outlet to the new culvert location westerly from the existing.

The new channel and culvert must be designed and constructed to allow fish passage. The existing culvert shall be removed with embankment area stabilized and naturally rehabitated.

6.3 Proposed Stormwater Management Improvement Works

The design flow for the proposed improvement work is based on the MIDUSS modeling of the 100 year storm event.

Table 6 summarizes the proposed improvement works starting at the 9th Avenue East roadway crossing, then progressing upstream to 16th Avenue East just north of 17th Street East. The nodes for the flow schematic chart are identified as well as the works location numbers. The Environmental Impact Considerations are also detailed with cost estimates in the Economic column.

The proposed improvement works are shown on **Figure 5**.

The following is a discussion of other previously proposed works of the 1993 ESR that are modified and included in the foregoing, identified in **Table A1** under items:

1. Channelization along east side of 16th Avenue East, upstream of 20th Street East is proposed as new works (No. 7) to be constructed in the proposed road (land) widening acquisition by the City. A proposed new diversion channel No. 5 (outlet to proposed stormwater management pond #3) and No. 6 (proposed re-routed channel – south side of 20th Street East) in **Table 6** provides relief to the flooding issue in this location (16th Avenue East and 20th Street East intersection), and replace 2 existing CSP-PA culverts with 1 – 1.2 m diameter concrete culvert (same location) and extend existing C.P. storm sewer northerly at the 20th Street East/16th Avenue East (East Side) intersection.

2. 18th Avenue East and 20th Street East (K-5) culvert structure placement is addressed by No. 6 in **Table 6**, relocated westerly (approximately 180 m east of 16th Avenue East).

3. 18th Avenue East and 23rd Street East (K-4) culvert structure placement of 2 – (CSP-PA) – 0.91 m x 0.6 m x 20 m is still required and is No. 8 added to **Table 6**.

4. 20th Avenue East (K-7) culvert structure placement 2 – (CSP-PA) – 0.68 m x 0.50 m x 20 m is still required and is No. 9 added to **Table 6**.

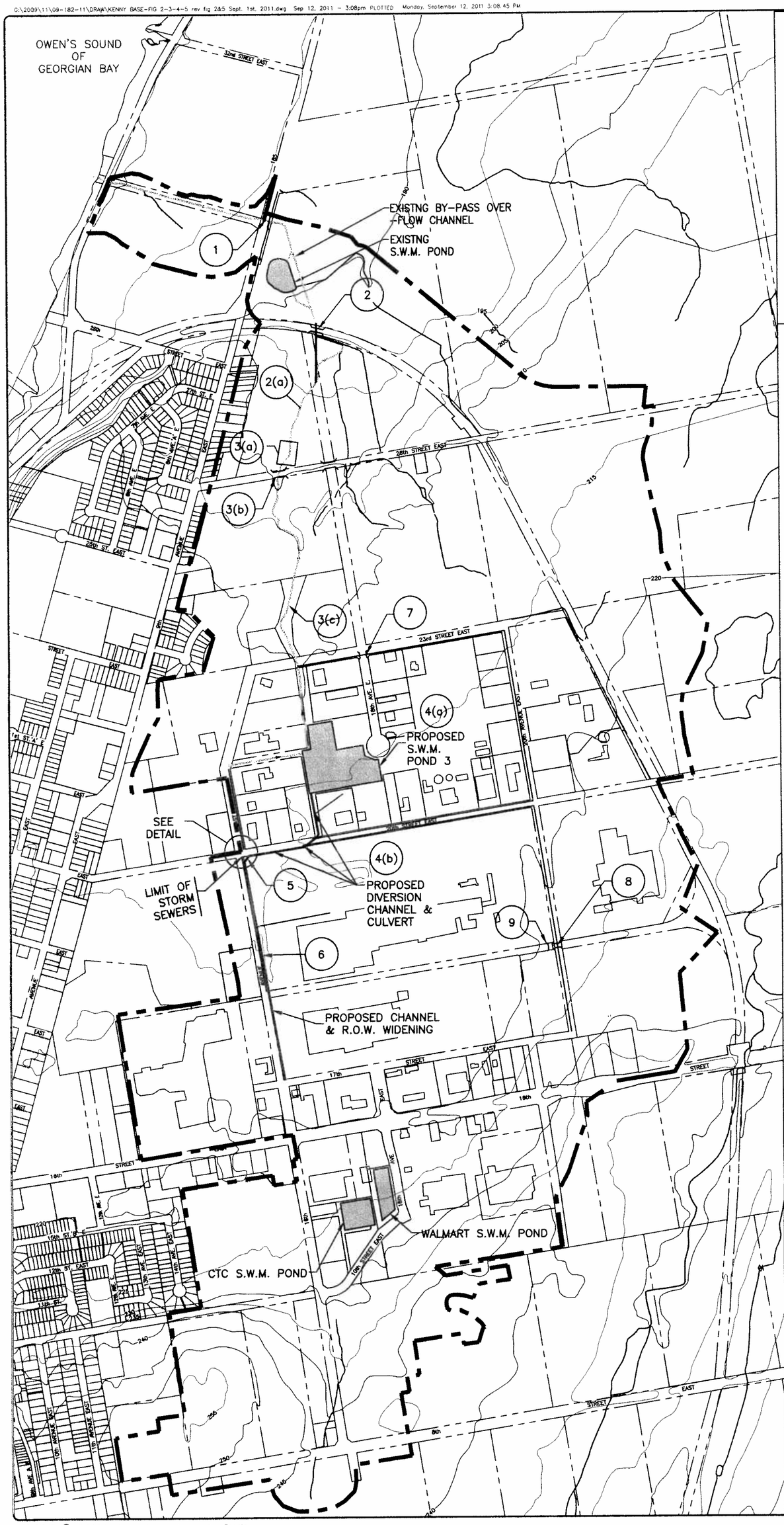
TABLE 6
SUMMARY - PROPOSED SWM IMPROVEMENT WORKS

OS-09-182-11-OS

Flow Chart Node	Works No.	Stormwater Management Works	Environmental Impacts Consideration			
			Natural	Social	Economic	Priority
9	1a	9th Ave. E. culvert replacement (2 - 1.2 m dia. CP & 1 - 600 mm dia. CMP) with a new 6 m x 1.8 x 20 m precast concrete culvert	- Increased capacity will eliminate flooding of roadway, soccer fields, complex and industrial buildings/area. - Open bottom will improve fish habitat	- Reduce flooding to 9th Ave. E. and soccer field complex area and Industrial Plant property. - Maintains secondary access for industrial building along 9th Ave. E. and soccer field complex uses	$350,000	Low
8	2	Relocate CP rail crossing in line with pond ditch right of way. Replace existing culvert with 6m x 1.8m x 20 m precast concrete culvert relocated westerly and small (low flow) culvert same location.	- Increased capacity of the Quickspan Culvert will eliminate the potential of Stormwater overtopping at the western end of the CP Rail trail. - Open bottom culvert will improve fish habitat - Relocation of culvert will reduce erosion down stream	- Reduction in overall sedimentation flowing to Georgian Bay - Safe crossing access of CP Rail Trail reinstated	$400,000	High
	2a	Reconstruct existing channel between 26th St. E road crossing and CP Rail line incorporating erosion protection.	- Reduction in current sediment load on Georgian bay outlet.	- Improved visual appeal from 26th St. E	$400,000	High
6	3a	Stilling Basin downstream 26th Street E. existing culvert & culvert outlet protection.	- Continued prevention of erosion		$100,000	High
	3b	Remove and replace the existing 26th St. E. culverts with either Two 3.0 m x 1.5m precast Concrete Box Culverts or one concrete pipe arch culvert with equivilant capacity (preferred).	-The reduction in exit velocity provided by the increased flow area will reduce the erosive potential of these culverts.	-Culvert replacement will help prevent downstream erosion and promote fish passage	$350,000	High
	3c	Construct erosion mediation measures of existing waterway between 23rd St. E. and 26th St. E.	- Decrease erosion and decrease the overall sediment volume flowing downstream to Georgian Bay	- Stabilized channel will have a reduced floodplain and health and safety risk.	$400,000	High
5	4a	Construct 25,000 m^3 SWM Pond #3 bounded by 16th Ave E., 18th Ave. E., 23rd St. E., and 20th St. E. on the West side of the City owned lot.	- Reduce Peak outflow from the Kenny Drain to ensure that the 100 yr Flood does not breach the capacity of the 23rd St. E Road crossing. (2 - 1.2m x 2.4m Concrete Box Culvert) - Reduced erosion potential for Downstream channel during significant rainfall events - Capture of Sediment in forbay and reduction of Contaminants being released to Georgian Bay	- Reduction in developable land within industrial park area but a significant reduction in flood plain impact on the downstream areas and local area flooding. - Pond will be fenced to restrict access - Located in Existing City owned Industrial Park on unused land	$500,000	High
3 & 4	4b	Diversion channel east of 16th Ave. E. and 20th St. E. northerly to proposed SWM pond along existing City owned land to new Pond #3. Re-route 16th Ave. E. ditch in an easterly direction along the south side of 20th St. E (approx. 180 m East of 16th Avenue E) and construct a new 1.22 m x 2.44 concrete box (20th St. E.) road crossing to align with proposed diversion channel north to the proposed SWM pond.	- Within existing urbanized Industrial park - Increased fish habitat area. - Erosion protection reduces silt/sedimentation.	- Reduced flooding potential at the intersection of 16th Ave. E and 20th St. E. and local area industrial/commercial.	$450,000	High
3	5	Replace the two (2) existing CSP-PA culverts with 1.2 m CP culvert (same location) and extend the existing storm sewers (north side) 20th St. E with erosion end protection.	- Erosion protection reduces silt/sedimentation.	- Reduced flooding potential at the intersection of 16th Ave. E and 20th St. E. and local area industrial/commercial.	$100,000	Medium
2	6	Construct new channel east side of 16th Ave. E. (17th St. E. to 20th St. E.) right-of-way widening (east side).	- Reduce road shoulder erosion and flooding - Within existing industrial park right-of-way widening to be acquired to enhance, improve and slope erosion of existing drainage ditches.	- Acquire industrial owned land to City ownership for continuous regular channel maintenance. Reduces unsitely drainage ditches to one well designed channel providing flood protection of industrial buildings and public roadway.	$350,000	Medium
5	7	18th Avenue East and 23rd Street East (K4) culvert - 2 (CSP-PA) vinyl lined 0.91 m x 0.66 m x 20 m long.	- Rip rap treatment to prevent erosion. - Installation in summer to reduce erosion during construction period. - Alignment parallel with channel to reduce entrance losses. - Culvert ends outside of fill slope.	- Protect local road from washout during 1:10 year event. - Structure within Industrial Park. - Reduces floodplain area and potential flood damage.	$10,000	Low
	8	20th Avenue East (K7) culvert - 2 (CSP-PA) vinyl lined 0.68 m x 0.5 m x 20 m long.	- Rip rap treatment to prevent erosion. - Installation in summer to reduce erosion during construction period. - Alignment parallel with channel provides better hydraulics and reduced backwash (flooding). - Culvert ends outside of fill slope "except alignment angled to reduce entrance losses".	- Reduce flooding during infrequent events west of 16th Ave. E. between 16th St. E. and 20th St. E. - Protect local road from washout during 1:10 year event.	$7,500	Low
	9	CPR (Spurline) 20th Ave. E. (K-6) culvert 2 - (CSP-PA) vinyl lined 0.68 m x 0.50 m x 20 m long.	- Rip rap treatment to prevent erosion - Installation in summer to reduce erosion during construction period. - Alignment parallel with channel provides better hydraulics and reduced backwash (flooding). - Culvert ends outside of fill slope.	- Protects local road from washout during 1:10 year event. - Reduce flooding during infrequent events west of 16th Ave. E. between 16th St. E. and 20th St. E.	$7,500	Low
				Total Cost Estimate	**$3,425,000**	

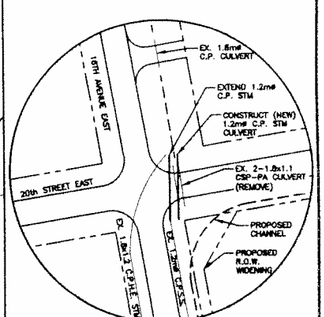
Note: Estimated costs shown are preliminary and exclude land acquisition costs.

O:\2009\11\09-182-11\DRAW\KENNY BASE-FIG 2-3-4-5 rev fig 2&5 Sept. 1st. 2011.dwg Sep 12, 2011 - 3:08pm PLOTTED Monday, September 12, 2011 3:08:45 PM



LEGEND

- EXTERNAL BOUNDARY
- EXISTING KENNY DRAIN
- PROPOSED KENNY DRAIN
- MAJOR CONTOURS (25m INTERVAL)
- MINOR CONTOURS (5m INTERVAL)
- BUILDING
- PARCEL FABRIC
- DITCHES AND STREAMS
- 9 — PROPOSED WORKS IDENTIFICATION No



20TH ST. E./16TH AVE. E.
INTERSECTION DETAIL
N.T.S.

ACKNOWLEDGMENTS
BASE MAPPING - PARCELS AND 5m CONTOURS PROVIDED BY COUNTY OF GREY GIS MAPPING. JAN 2010 SHAPEFILES.

2008 GEODETIC ARIEL PHOTO (S.W.O.O.P.) PROVIDED BY COUNTY OF GREY GIS MAPPING.

RIVERS, STREAM AND WATER BODIES PROVIDED BY CITY OF OWEN SOUND.

DRAINAGE AREAS DERIVED FROM PREVIOUS E.S.M.S.-S.W.M. STUDY BY CITY OF OWEN SOUND.

DATE	DESCRIPTION
08/30/11	CATCHMENT BOUNDARY

REVISION / ISSUE

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REGISTERED PROFESSIONAL ENGINEER
G.L. Prentice
PROVINCE OF ONTARIO

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Title:

KENNY DRAIN WATER SHED
PROPOSED IMPOVEMENT WORKS-PLAN
KENNY DRAIN STORMWATER MANAGEMENT ENVIRONMENTAL STUDY UPDATE REPORT

Client: CITY OF OWEN SOUND

Design:	K G S	Scale:	1:5000
Drawn:	T J J	Approved:	
Checked:	G L P		
Date:	JAN 2010		Design Engineer

DRAWING No. OS-09-182-11-OS FIG 5

5. CPR spurline at 20th Avenue East (K-6) culvert structure placement – 2 – (CSP-PA) – 0.68 m x 0.50 m long is not required since this spurline has been abandoned. However, this culvert is shown since the spurline rail bed is existing and is proposed to be used for future vehicle access, as No. 10 added to **Table 6**.

It is noted that base flows in a natural channel (as previously identified in Section 6.2) must be maintained. It is also pointed that new and replacement culverts be placed to best address flow and erosion concerns, i.e. 26th Street East culvert replacement is suggested to be relocated to the west of the existing. All such issues shall be addressed and included during the detailed design prior to implementation of the improvement works.

The order of priority of implementation (high, medium, low) of the proposed works is shown to be confirmed by the public EA process. However, from an analysis of the proposed improvements, it is evident that the greatest cost/benefit ratio is gained through the addition of the 25,000 m^3 stormwater management pond #3 located westerly behind the Public Works building including the diversion channel from 20th Street East, east of 16th Avenue East. This pond significantly reduces flow rates in the downstream sections of the Kenny Drain and provides significant benefits in reduction to erosion and road overtopping. Implementation and detail design of this pond will require additional survey information of the proposed site as well as a more in-depth site specific soil investigation and analysis of the flow control structure, which will be required to attenuate increased storm run-off in excess of the 2 year existing flows that are considered base flow that shall bypass through this pond or adjacent to this pond.

The selection of proposed additional works, together with the above noted changes to the previously completed study is needed as part of the public/agency consolation process undertaking. From the comments/input, priorities shall then be confirmed. The estimated construction costs are provided in the Economic column are preliminary in 2011 dollars totalling $3,425,000.

7.0 FLOOD PLAIN MAPPING

The HEC-RAS (Version 4.0) computer model program has been utilized to determine the flood plain mapping in **Figure 6** (Existing Conditions) for the 100 year and regional storm and **Figure 7** (Proposed Improvements) for the 100 year and regional storm event flows previously computed and shown in **Tables 3 & 4**.

The cross-sections previously determined and others established using the City's topographic mapping was utilized to arrive at the flood levels shown. These sections are available in **Appendix F**.

As noted previously in this report, the MIDUSS model utilized to evaluate the hydrologic flow conditions, generates flow rates higher than the previously modelled East Side Master Servicing Study flows reported. These new modelled flows are input of HEC-RAS, shown in **Appendix F** and includes flow (data characteristics - water surface elevations, minimum channel elevations and energy grade profile).

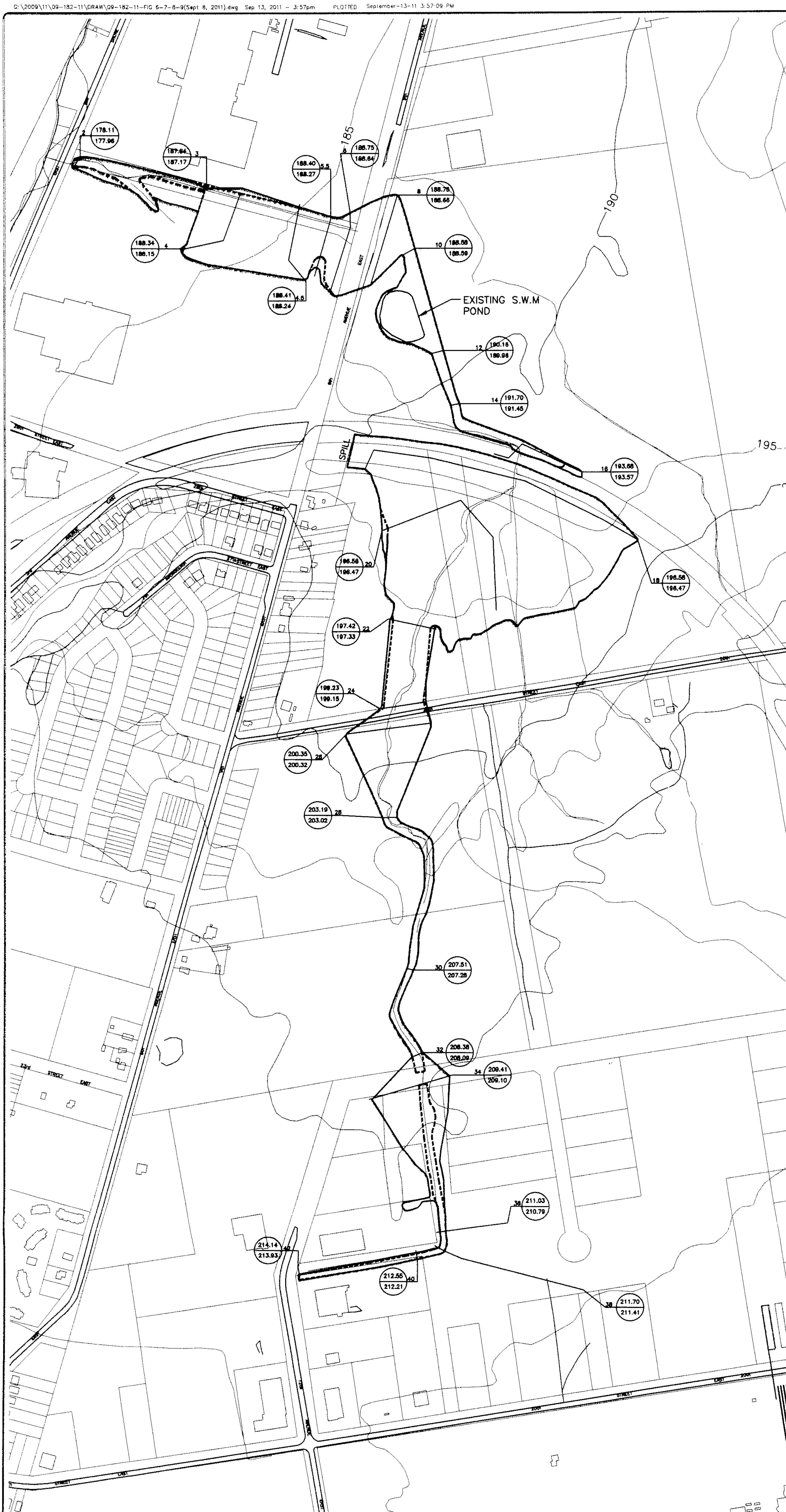
It is noted that some warnings are normal during the creation and running of the HEC RAS model, although there were initially some technical serious warnings that were addressed and eliminated for the final model runs.

The detention area upstream of the CPR Trail north of 26th Street East for the calculated flood plain mapping is considered as a natural pond with no spillway to the west (also as previously shown in the ESMS-SWM study). Under existing conditions, the flood level is such that a spillway occurs in a westerly direction along the south embankment of the CPR Trail. New or replacement culverts crossing this CPR Trail should not restrict, or increase such spillway occurrence conditions.

This floodplain mapping for both these storm events is presented to avoid any future confusion should re-calculation be producted at some future time.

In review of the floodplain, it is pointed out (by GSCA) that upstream controls cannot be factored as future safety of any downstream development that would become dependent on these controls. Hence, these downstream back water concerns for the non-controlled event are included and should be applied for site development approvals.

C:\2009\11\09-182-11\DRAW\09-182-11-FIG 6-7-8-9(Sept 8, 2011).dwg Sep 13, 2011 - 3:57pm PLOTTED September-13-11 3:57:09 PM



LEGEND

CROSS SECTION ID

32 (208.38 / 207.77) — CROSS SECTION ID — 100yr EXISTING FLOOD ELEVATION — REGIONAL EXISTING FLOOD ELEVATION

195 — CONTOUR LINE

100yr FLOOD LINE (EXISTING)

REGIONAL FLOOD LINE (EXISTING)

CAUTION:
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

DATE	REVISION / ISSUE
08/30/11	CATCHMENT BOUNDARY
YY/MM/DD	DESCRIPTION

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G. L. Pentiuc

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Title:
EXISTING CONDITIONS
FLOOD PLAIN MAPPING
100 YEAR & REGIONAL STORMS
OWEN SOUND, ONTARIO

Client: CITY OF OWEN SOUND

Design:	K G S	Scale:	1:2500
Drawn:	A A G		
Checked:	G L P	Approved:	
Date:	JUNE 2010		Design Engineer

DRAWING No. OS-09-182-11-OS FIG 6

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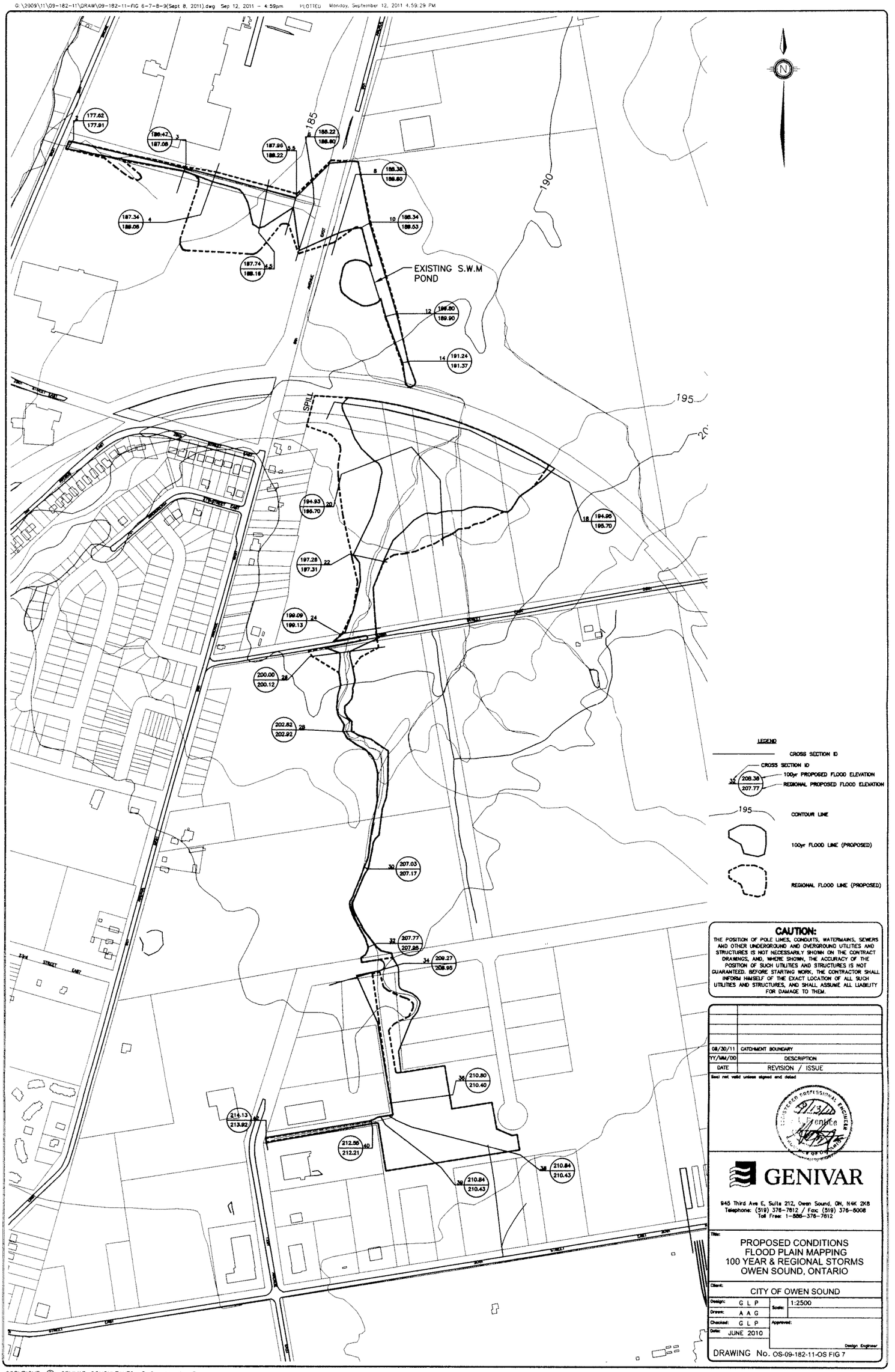

LEGEND

- CROSS SECTION ID
- CROSS SECTION ID
- 208.38 / 207.77 — 100yr PROPOSED FLOOD ELEVATION / REGIONAL PROPOSED FLOOD ELEVATION
- 195 — CONTOUR LINE
- 100yr FLOOD LINE (PROPOSED)
- REGIONAL FLOOD LINE (PROPOSED)

CAUTION:
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

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08/30/11	CATCHMENT BOUNDARY
DATE	REVISION / ISSUE

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Title:
PROPOSED CONDITIONS
FLOOD PLAIN MAPPING
100 YEAR & REGIONAL STORMS
OWEN SOUND, ONTARIO

Client: CITY OF OWEN SOUND

Design:	G L P	Scale:	1:2500
Drawn:	A A G		
Checked:	G L P	Approved:	
Date:	JUNE 2010		Design Engineer

DRAWING No. OS-09-182-11-OS FIG 7

8.0 CONCLUSIONS

Based on the foregoing, the previously completed (1993) ESR Kenny Drain Stormwater Management is updated by this report which includes the review comparison to that of the 2008 ESMS-SWM report.

The MIDUSS flow analysis has been completed and reported for the 5, 10, 25, 100 and regional (Timmins) storm year return storm events for both existing and proposed improvement work accommodating run-off of existing land use and future development land use conditions.

The stormwater management improvement works are proposed as summarized in **Table 6** that shall be prioritized on completion of the EA consolidation process. **The total costs of these proposed improvement works is estimated at $3,425,000 (2011 dollars).**

The floodplain mapping reported and shown on **Figures 6 and 7** is based on the 1:100 year and regional storm event flows and the worse-case flood scenario can be utilized as a basis to establish setback requirements for future development and land use of adjacent lands within the Kenny Drain Watershed.

It is noted and recommended that setback for development needs to consider erosion setbacks, natural heritage issues, water quality considerations, etc. Also, to ensure future safety of any downstream development, downstream backwater concerns should still be included without factoring in upstream controls.

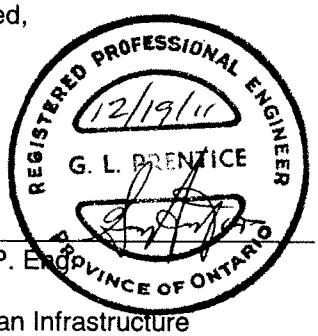
Subject to the completion of public and agency consultation MCEA (Schedule B) process as outlined in the foregoing and approval of applicable government agencies, final detailed design of the proposed improvement work can be undertaken including permit(s) acquired from the GSCA to be then followed by construction implementation by the City of Owen Sound.

It is also noted that, any changes resulting from these improvements to this system will require a permit(s) from GSCA under Ontario Regulation 151/06 – Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

Depending on the improvements detailed design, it is identified that the Kenny Drain is a fish habitat and any changes to this system may require approval from Fisheries and Oceans Canada.

Respectfully submitted,

GENIVAR Inc.



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Tom Wylie, EIT
Urban Infrastructure