APPENDIX C: Tables and Attachments

1. E-mail thread (August 11 to 24, 2010): responses to preliminary comments on re- posted Class EAs
2. Table 1 - Policy/Guideline/Standard Practices: Criteria not Achieved by CRRP
3. Table 2 – 25 year event model output provided by City on August 23rd, 2010
4. Table 3 – Comparison of pre-and post–development peak flows (2to 100 year events)
5. Table 4 – Comparison of existing and future (restored condition) ‘n’ values
6. Table 5 - Summary of Approach to Assigning Manning’s ‘n’ Values for Channel and Overbanks
7. Representative photograph of existing Carp River overbank vegetation
8. Representative CRRP landscaping plan (2007)
9. Table 6 – 100 year peak flow and velocity summary
10. Excerpt from GFCI Request for Proposal
11. Slides from GFCI Open House May 19, 2010
12. Table 7 – SWM pond elevations

darlene conway

From: "darlene conway" <darleneconway@sympatico.ca>
To: "Herweyer, Don" <Don.Herweyer@ottawa.ca>
Cc: "Burns, Steve (ENE)" <Steve.Burns@ontario.ca>; <Cindy.Batista@ontario.ca>; <plehman@mvc.on.ca>; "Moser, John" <John.Moser@ottawa.ca>; "Lindensmith, Dave (MTO)" <Dave.Lindensmith@ontario.ca>; "Farghaly, Hani (MTO)" <Hani.Farghaly@ontario.ca>; <Marianne.Wilkinson@ottawa.ca>; "Feltmate, Peggy" <Peggy.Feltmate@ottawa.ca>; <Shad.Qadri@ottawa.ca>
Sent: August 24, 2010 10:50 PM
Attach: Future 25 DC Request Aug 2010.pdf
Subject: Re: Reply to D Conway Concerns (Notice of Completion - Kanata West Class EAs: preliminary comments)

Don - a further note: there are obvious problems with the modeling in the vicinity of sections 41789.8 to 41349.4. For the 25 year event specifically, negative flows are indicated (resulting in, for example, 25 year flood levels equal to or greater than 100 year levels) and, in a number of locations, impossibly high flows and water levels.This is a further example of why full documentation of modeling results is a critical and standard step in reporting: it firstly provides a self-checking function for the consultant and secondly facilitates efficient and informed review by others.

Without the modeling files, I am uncertain whether correcting this problem will have any significant bearing on the other events, but this should obviously be confirmed and the final modeling results revised as required.

Regards,

Darlene Conway, P. Eng.

----- Original Message -----

> **From:** darlene conway
> **To:** Herweyer, Don
> **Cc:** Burns, Steve (ENE) ; Cindy.Batista@ontario.ca ; plehman@mvc.on.ca ; Moser, John ; Lindensmith, Dave (MTO) ; Farghaly, Hani (MTO) ; Marianne.Wilkinson@ottawa.ca ; Feltmate, Peggy ; Shad.Qadri@ottawa.ca
> **Sent:** Tuesday, August 24, 2010 3:48 PM
> **Subject:** Re: Reply to D Conway Concerns (Notice of Completion - Kanata West Class EAs: preliminary comments)
>
> Thanks for this, Don, but the response is inadequate to address my concerns. In the interest of continuing to try to resolve differences, I have provided some further brief responses below, however, given the lateness in the review period, I have concluded it will be necessary to file a Part II Order request. Also, most if not all of the responses you provide consist of engineering opinions or advice that has been provided, I presume, by a professional engineer - but that is not explicit given the information has been provided under your name. I would appreciate if you could confirm the professional engineer whose opinions you have conveyed in this response. Please note I have also copied MTO

representatives as they were copied on my original comments earlier in this thread.

1. It appears the summary table indicating riparian volumes was derived from modeling output that included all structures. Riparian storage is, by definition, the storage available within the corridor without the structures in place. I had presumed your consultant would be aware of this as it is a well-known criterion to be met for channelization projects to avoid cumulative impacts to riparian owners, and was an issue that was dealt with at length and documented in the original 2006 Class EAs.
2. In terms of the travel times provided, there is close to a 2 hour reduction in travel time for the future 100 year event. This is an impact on downstream riparian owners that is a direct result of significantly "smoothening" the future corridor (compared to existing conditions). There is considerably more to stormwater and floodplain management than merely ensuring existing flood levels are not exceeded (although even this criterion has not been met), but that appears to have been the overiding focus of updated modeling since the missing hydrographs came to light over two years ago. It is not clear to me why the travel time criterion had to be met in 2006 and not in 2010. (Note: while the Lakes and Rivers Improvement Act no longer applies to channelizations for areas with CA jurisdictions, the intent of this change was to eliminate overlap and duplication. This does not negate the need to ensure riparain landowners are not negatively impacted, nor the need to avoid cumulative impacts.)
3. In terms of confirming the engineer(s) who reviewed and approved the latest version of the hydraulic modeling, this is a clear requirement of MNR's Technical Guidelines that I trust MVC can confirm for you if you are unable to comment on its applicability. From the public record of agency consultation, it is my understanding that both MNR and MTO engineers have declined to review the model in any detail or at all. With respect to MVC and City engineers, I would appreciate confirmation that these engineers both reviewed and approved the latest version (May 2010) of the hydraulic modeling, as well as who those engineers were fulfilling that role. You may be unaware that the act of reviewing and approving the modeling is, by definition, professional engineering, and hence requires that those engineers be accountable for their (review and approval) work, just as the engineer(s) of record must be accountable for the design.
4. That the pools and ponds are "deep" is not an adequate response to my request for a reference from the literature supporting the use of such an excessively low 'n' value in these locations.
5. The justification for allowing a 10cm increase on the basis of "model tolerance" confuses model accuracy in the absolute sense with the role of modeling as a tool to assess the relative impacts of change - there is no comparing these two very different purposes of modeling.
6. The response regarding why roughness values have been further reduced over a significant portion of the reach (where there are no SWM ponds or pools) does not acknowledge the facts and history of this file as were documented previously by me (March 2, 2010 correspondence) for which no response was ever provided. The selective lowering of roughness values in the post-development condition while maintaining higher roughness values in the same location for the existing condition model is not a reasonable approach, calibration or no calibration. This issue is also unrelated to interim safeguards.
7. You indicate the information I requested (tabulation of Manning's 'n' values, riparian storage volumes, travel times, peak flows for the 2 to 100 year event, etc.) was "*tabulated in the TPR*." This is incorrect or you have misunderstood the request. The only thing tabluated in the TPR was 100 year water levels. None of the other items were documented, although all of this information was provided in the original 2006 Class EA documentation. This information is essential to be able to review and understand the modeling results - hence, these items are a standard requirement of documentation for projects of this nature. I am concerned that apparently none of the other professional engineers who reviewed and approved this modeling requested this information.
8. I do not follow the emphasis that the Widening Report was for a 100 year scenario.Provision of all events is a standard requirement and was explicitly requested in the Third Party Review Terms of Reference. This information was also provided in the original 2006 Class EA documentation. Significant changes have occurred to the modeling since 2006, hence this information should have been provided in the final reporting as a matter of course.
9. You indicate that, " *By lowering the manning's n under bridge structures, the flows experienced less routing at the structures as you have indicated with higher peak flows. Locally at structures with lower manning's n values the velocities are higher and are also reflected in this model......The issue of the manning's n values will be resolved with the subsequent validation exercise that the City's Model Keeper will assist with once there is monitored data to be provided by MVC as results become available*.
The excessively high 'n' values used at bridge structures are unrelated to future calbration/validation. There is no justification for the use of an 'n' value representative of a stand of timber through a bridge structure, particularly when such 'n' values were used only in the post-development model. The MNR Technical Guide also precludes the use of structures to rout flows.
10. With respect to dependence on the Carp River Watershed/Subwatershed Plan, this Class EA was approved in January 2005 and has now lapsed. Regardless of

that detail, the findings of that study are based upon completely outdated modeling which showed only marginal increases in peak flows when quantity control was not provided. Further, the watershed/subwatershed study itself recommended that the modeling be completely redone - which it was, but with very different results - yet somehow the original criterion has been maintained. To summarize: obsolete and uncalibrated modeling results from the watershed/subwatershed study are being used to justify a criterion that, when implemented in the current modeling, grossly exceeds the objective of no or minimal increases in peak flows that the original criterion achieved. If such excessive peak flow increases had resulted with the original subwatershed modeling, it is a virtual certainty that post- to pre-development controls (or, if necessary, some amount of overcontrol) would have been recommended. There is no justification for the continued dependence on the watershed/subwatershed study for the quantity control criterion. Finally, the Class EA process itself requires that a reasonable range of alternatives be considered. Evaluating a standard requirement of development across the province (provision of sufficient stormwater management controls to match pre-development peak flows) must surely be considered a reasonable alternative for SWM control.

11. The Manning's 'n' value reductions at the bridges are corrections to reasonable values unlike the excessively high values that should not have relied upon to mitigate flood level increases in the first place. Likewise, delaying the resolution of fundamental shortcomings of the current modeling (excessive peak flow, velocity and water level increases, significant reduction in travel time, inconsistency in the assignment of 'n' values in the existing and future condtions, etc.) until the model is calibrated is not justified.

Regards,

Darlene Conway, P. Eng.

----- Original Message -----

From: Herweyer, Don
To: darlene conway
Cc: Steve.Burns@ontario.ca ; Cindy.Batista@ontario.ca ; Wilkinson, Marianne ; Feltmate, Peggy ; Qadri, Shad ; plehman@mvc.on.ca ; Moser, John
Sent: Monday, August 23, 2010 3:23 PM
Subject: FW: Reply to D Conway Concerns

Ms Conway,

In addition to the information below, responses to your correspondence dated August 11 and 15, 2010 are noted in **green** within the body of your e-mail(s).

The tabulated Manning's n for each section for the existing TPR model and the future widening scenario are attached. The Manning's n under Richardson Side Road is changed from the TSH Mar 2009 model(n=0.075 that had been reduced from 0.40) and was set to the channel values (0.035 on upstream side and 0.060 on the downstream side).

A summary table of the 100 year riparian volume and travel time parameter is attached (both have been provided since the 2006 report only provided tvl time ch) for your convenience.

We have also provided a HECRAS table including the volume, travel time (ch and avg), vel in channel and left and right overbanks. The peak flow at each section is also included.

As stated before, the focus has been on the widening solution. Therefore, we had only provided the 100 year event. The channel change is at the far extremity of the overbank that may or may not have any bearing on lower return period events. The 2,5,10 and 25 year runs are also provided as per your request.

In terms of your August 16, 2010 e-mail re approval by a P.Eng, the City won't comment on the applicability of the reference to the MNR Technical Guide but I can confirm Professional staff at the MVC, including P. Eng's (John Price & Paul Lehman) and the City (PGM and ISD) were provided with and have reviewed the updated modelling and the Widening Report. In addition, the actual updates were prepared by the City's Model Keeper (also a P.Eng). City and Conservation Authority Staff concur with the reposting of the EAs.

I cannot speak to the extent of the review undertaken by MTO and MOE Engineers but they have been provided the data and the results of the modelling were presented to them in a meeting (i.e Feb 11, 2010 meeting for which you obtained presentation materials). There were also follow up discussions and conference calls with Ministry (MOE) staff on the modelling results so I would presume there was significant review undertaken. In summary, the widening alternatives have been reviewed with several City staff over the fall and winter. John Price from the MVC was involved in the earlier review when the strategy was set up and Paul Lehman assumed John's role upon his departure from MVC. The issue pertaining to Manning's selection has also been reviewed extensively with MVC, MOE and MTO. Their concerns/questions were addressed and on that basis the City has proceeded to repost the Notices of Completion.

Sincerely,

Don Herweyer, Program Manager
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Don - here is a copy of the Technical Guide from which the quote below is excerpted.

DEC
----- Original Message -----
From: darlene conway
To: Herweyer, Don
Sent: Monday, August 16, 2010 10:09 PM
Subject: Re: Notice of Completion - Kanata West Class EAs: preliminary comments - approval by a P. Eng.?

Hi, Don. No need to document input and review - I was just requesting confirmation of the P.Eng. that reviewed and approved the modeling specifically on behalf of the City, in other words, taking professional responsibility for that review and approval. MTO and MNR engineers are on the record as not having reviewed the modeling in any detail or at all and the departure of John Price from MVC (this winter, I believe?) presumably precluded his review of the latest version of the modeling - but if not, please confirm otherwise, or indicate the other P.Eng. providing that function for the City.

I don't believe there is a link but the document is: Technical Guide: River and Stream Systems: Flooding Hazard Limit (MNR, 2002) and the reference is on p.8:

The municipality making these decisions should ensure that flood plain management studies are undertaken by a Professional Engineer and resulting flood lines, flood proofing standards are examined and approved by a Professional Engineer using accepted engineering principles.

Are you able to provide the correspondence wherein the Ministry confirmed it was not necessary to provide a response to my March 2nd, 2010 comments? If this was only a verbal indication, please advise from whom it came and I will follow up directly with that person.

I cannot meet next week as I am now on vacation, only returning to work on August 30th. I will be away most of next week but will have access to e-mail. The nature of my comments can readily be responded to in writing, however, if there is any clarification required, please let me know immediately. A prompt response would be appreciated given less than two weeks remain of the 30 day review period, and the comments were provided last Wednesday. Finally, while the City has refused release of the modeling, I trust there is no objection to providing the tabulations of parameters and results I have requested below? No objection – see results attached. If there is an objection to providing the requested tabulations, please provide the rationale for that objection.

Thanks,

Darlene Conway, P. Eng.

----- Original Message -----
From: Herweyer, Don
To: darlene conway
Sent: Monday, August 16, 2010 2:59 PM
Subject: RE: Notice of Completion - Kanata West Class EAs: preliminary comments - approval by a P. Eng.?

Darlene:

I will briefly document the extensive input and review (including P.Eng) in my formal response back to you. Could you please provide the actual reference or link to the policy and guidelines you mention in your e-mail. I would like to ensure my response is as complete as possible.

I can confirm that the Ministry advised the City that additional input from the City was not required re follow up to your March 2 correspondence. I am unaware of any further correspondence from the Ministry back to you beyond the March 11/12, 2010 letter(s) to the City and yourself from the MOE . I see you have followed up with Steve Burns on this matter – there was no written correspondence to this effect – the City was verbally advised that no further information was required from the City in relation to your March 2, 2010 e-mail.

Given the time constraints please also let me know whether you would be willing and able to meet with City Staff and Greenland next week to resolve some of your outstanding concerns. Certainly a few of your points can be easily clarified.

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From: darlene conway [mailto:darleneconway@sympatico.ca]
Sent: August 15, 2010 9:41 AM
To: Herweyer, Don
Cc: Magierowicz, Marc
Subject: Re: Notice of Completion - Kanata West Class EAs: preliminary comments - approval by a P. Eng.?

Hi, Don. Further to my preliminary comments below, can you please identify the Professional Engineer that examined and approved (on behalf of the City) the floodplain modeling work completed by Greenland Engineering? I am in the process of documenting inconsistencies with established policies and guidelines, one of which (MNR's) requires review and approval of such work by a P. Eng. - I can exclude this from the list if the work has, in fact, been reviewed and approved by a P. Eng. for the City.

Thanks,

Darlene Conway, P. Eng.

----- Original Message -----
From: darlene conway
To: Herweyer, Don
Cc: Garcia-Wright, Agatha (ENE) ; Dixon, Millicent (ENE) ; Burns, Steve (ENE) ; Gayla.Campney@ontario.ca ; Marianne.Wilkinson@ottawa.ca ; Feltmate, Peggy ; Shad.Qadri@ottawa.ca ; les.pataky@ontario.ca ; dan.marinigh@ontario.ca ; Farghaly, Hani (MTO) ; Lindensmith, Dave (MTO) ; plehman@mvc.on.ca
Sent: Wednesday, August 11, 2010 8:27 AM
Subject: Notice of Completion - Kanata West Class EAs: preliminary comments

Hi, Don. In the interest of resolving concerns such that a Part II Order request may be avoided, I wish to follow up on my correspondence of March 2nd, 2010 (copy attached), that was provided in response to the City's consultant's correspondence dated February 17th, 2010. Also, I note the March 12, 2010 MOE correspondence to the City indicating MOE staff would be contacting you to discuss this matter further. There is, however, no documentation in the Public Consultation Update of this further contact with a public agency. Can you advise when or if a response to the issues raised in my correspondence of March 2nd, 2010 will be provided? For example:

i) Please provide support from the literature for the use of an excessively low n value of 0.001 over a significant portion of the reach; This n value relates to open water in portions of the SWM facilities and habitat pools that were deep. The shallow banks of these facilities were assumed to have the impact of vegetation and n=0.08 was applied in those locations. The overbank is an averaged value with multiple calculations applied.

ii) What is the rationale for apparently accepting flood level increases up to 10cm and as high as 16cm (see below) – an approach that is inconsistent with the avoidance of cumulative impacts and the jurisprudence represented by Ontario Mining and Lands Commissioner decisions? This issue is clearly documented in the TPR as an acceptance of 10 cm within model tolerance and not an acceptance of flood level increases. The rationale comes from attempting to physically measure water levels in the field in proximity to structures where there would be more than a 10 cm change in water level with localized turbulence.

iii) The justification for reducing 'n' values to 0.04 over a further 10% of the reach (some 500 meters) that would appear to be inconsistent with the objectives of naturalizing the corridor and significantly increasing riparian vegetation (by definition, not manicured or actively maintained)? The overbank area with the n=0.04 includes the transition areas between two new bridge crossings (future transitway and Campeau Drive). This area is proposing grasses. The City's Model Keeper is on record questioning the selection of Manning's n in the calibrated CH2MHill model but until there is data from the MVC monitoring gauges to use as validation exercises, your suggestions, CH2MHill original numbers, or any suggestion on our part will have to wait until this exercise is completed. This is why the effort was placed on safeguards during the interim period. All development has to provide post to pre controls and there is the pro-rated deficit volume that is also being addressed.

Further, in your e-mail of July 30, 2010, indicating that the City would not release the modeling, you advised that, *"Appendix 4 of the Carp River Restoration Plan – Widening Alternatives contains the output files of the new HEC_RAS Future Corridor Model and figures showing geo-referenced section locations that give a better reference for the public review of the tabulated data."* I have now reviewed Appendix 4 in some detail and this is clearly not the case. The output file included provides minimal information in terms of supporting the further changes in flood levels and peak flows that have occurred since the results (likewise insufficiently documented) provided in the Third Party Review (March 2009). This is in contrast to the supporting documents for the original 2006 Class EAs that provided transparent documentation of all relevant results and parameters, including detailed tabulations of peak flows for all events, Manning's 'n' values at all locations, and riparian storage volumes. This lack of transparency in documentation is concerning, the more so given City staff's acknowledgement in May 2009 of the "Lessons Learned" resulting from the discovery of the egregious modeling error: (http://www.ottawa.ca/calendar/ottawa/citycouncil/pec/2009/05-11/1-ACS2009-ICS-CSS-0005%20-%20Carp%20River.htm):

Lessons Learned

1. *Requiring that documentation for all model runs include a concise hydrologic summary report that relies upon simple catchment maps, plotted hydrographs of key points and tributaries, plotted water surface profiles showing watercourse features, bridges and crossings, and* ***summaries of flows and volumes and all parameters in tabular format.***" (emphasis added)

The information has been tabulated in the TPR. The widening report is specifically prepared to address the City staff recommendation that 25% of the deficit volume be applied as a permanent widening. The model has been quasi georeferenced and set up for clearer reference of a location with available mapping. This assisted with reviewing with affected landowners the widening scheme. The change in riparian storage volumes from the earlier documents is strictly the 25% deficit volume that has been added and the volume that was affected by reducing the Manning's n under the bridge structures in the TSH March 2009 HEC-RAS model.

In this regard, while I await the Minister's response to my request for assistance in obtaining a digital copy of the modeling, please provide a tabulation of the following input parameters and modeling results:
i) Manning's 'n' values assigned at all locations (channel, overbanks, and bridges). More specifically, I note that in Table 2-3 in the Widening Alternatives report (May 2010) which documents final 'n' values at the bridges, the 'n' value for Richardson Road has not been included. Please provide that 'n' value as well; The n value is the same as placed in the TSH Mar 2009 model at Richardson Side Road. Table 2-3 was originally for a generic alternative that similar n values under bridges were applied in the final run in widening report. A full n table for the overbanks will be provided to demonstrate that the only changes were under bridge structures.
ii) Peak flows (i.e., maximum flow during the simulation) for all events (2 to 100 year inclusive) at all cross-sections (interpolated sections not required); see above
iii) Riparian storage volumes (pre- and post-development); see above
iv) Travel time for the study reach for the 2 to 100 year events (i.e., the output value Trvl Time Avg, in particular for the 100 year and lower frequency events, not Trvl Time Chl). From the limited output provided with the re-posting, velocities have further increased throughout most of the reach, suggesting a reduction in travel time, clearly not an acceptable downstream impact.

Please be advised that the Widening report was for a <u>100 year scenario</u> to confirm that the volume was achieved with the alternative being proposed. The 2,5,10 and 25 year events are attached per your request.

With respect to other concerning results documented in the Widening Alternative report (May 2010), I note that peak flows have further increased throughout the reach (25% to almost 100%), suggesting even more areas have been assigned lowered 'n' values than what was documented in February 2010. As an example, peak flows at the 417 have now been increased in the future condition by some <u>60%</u> over existing conditions and the future velocities at the 417 (2.3 m/s) have increased by almost <u>70%</u>. Has the scour analysis I understand was previously completed at MTO's request been updated to assess the impact of such excessive increases in velocities at the structures?

By lowering the manning's n under bridge structures, the flows experienced less routing at the structures as you have indicated with higher peak flows. Locally at structures with lower manning's n values the velocities are higher and are also reflected in this model. The model in question has been reviewed by MTO and they are satisfied that the velocities are still in an acceptable range. The issue of the manning's n values will be resolved with the subsequent validation exercise that the City's Model Keeper will assist with once there is monitored data to be provided by MVC as results become available.

Further, given the excessive increases in future peak flows documented, why has an alternative that matches pre-development peak flows not been evaluated (rather than depending on a design that may require a considerable annual maintenance effort in perpetuity and for which no information, financial or otherwise, has been documented in the re-posting)? This is a standard requirement of development and has been for decades. Surely, the Class EA process requires that such a standard alternative (post to pre control) be evaluated? Or, the further alternative of overcontrol, if required?

As you are aware, the Class EA that recommended the strategy of releasing post development flows with only water quality control had previously been approved (Carp River Watershed/Subwatershed Plan. The principle of allowing higher peak flows was established during that process.

By implementing the strategy that is presently being employed for all Carp River development and reviewed with the development community, the City has ensured sufficient safeguards until the Manning's n matter and the higher peak flows can be resolved with a validated model. The development community understands that the post to pre alternative could be a possible final outcome but are hopeful that the model will reflect the present situation.

How can the long-term financial and environmental impacts of a largely maintained corridor be assessed without consideration of these other obvious alternatives? This apparent approach is also inconsistent with the documentation in the re-posted 2006 restoration plan Class EA (p.90) that calls for:

> *Riparian plantings would generally consist of three components. First, creek watercourses would be planted to ensure a 5m band of red osier dogwood (Cornus stolonifera) and speckled alder (Alnus rugosa) (50/50 mix) to provide overhanging shade. Second, valley side slopes and valley floors would be planted with clusters of white cedar (Thuja occidentalis). Third, top of valley tableland plantings would include white spruce (Picea glauca). Detailed landscape plans will be prepared as part of detailed design and other planting materials such as willow will be considered.*

The 5 metre band is on the overbank outside the portion of the section that is to contain the low flow channel as defined in the HEC-RAS model. This portion of the channel section is significantly different than the existing channel. It will be shallow with gravel substrate. Also the overbank areas are only to contain clusters of white cedar. As mentioned, the final adjustment of manning's n will be confirmed with the validation exercise.

The figures of the corridor provided in Appendix 4 of the Widening Alternatives report (May 2010) appear to indicate that the footprints of many habitat ponds have been greatly increased – doubled or tripled in size? Am I interpreting these figures correctly? If so, it leads to me wonder whether this is a river restoration plan or a pond creation project? Are there similar reaches in the Carp River downstream that have such a preponderance of these types of off-line ponds?

The adjustments that have been made were done to quasi geo reference the model so that it is easier to determine where you are on a map. Once this was done, the habitat pools (as recorded in the TSH model) exhibit much larger foot prints once transferred with the appropriate georeferencing. This has a significant bearing on the argument for the selection of Manning's n over open water. These pools are to be quite deep.

Also, Table 4-1 in the Widening Alternatives report (100 year levels for New Future HEC-RAS Model) provides a very limited number of cross-sections and, in particular, tabulates no results showing increases greater than 10cm. A review of the output provided shows 100 year flood level increases exceed 10cm hundreds of meters downstream of Richardson (39202: 11cm, 38697: 12cm; 38236: 12cm, etc.). Just as concerning is the lack of sufficient documentation upstream of Richardson. In the March 2009 results (Table 3-6, Third Party Review), cross-section 40092 is included in the table. In the May 2010 results (Table 4-1), the section upstream of Richardson documented is 40071.5, which shows a future increase of only 6cm, but section 40092 is not tabulated at all. The output provided in the Appendix shows a 16cm future increase just upstream of Richardson at 40092, and increases above 10 cm (12, 13, 14cm, etc.) occurring hundreds of meters upstream of Richardson (see attached summary table). Why have these results not been transparently tabulated for the public, members of which may be unable to readily interpret hydraulic modeling output? And why have such flood level increases and impacts on downstream riparian owners not been mitigated? (As per my comments of March 2nd, 2010, I do not concur with the suggestion that 10cm represents an acceptable increase due to "model tolerance.")

We have reviewed your observations for the comparisons through the whole corridor and concur with the water level differences. The reduction in Manning's n under the bridges has resulted in a more efficient flow through these structures and has resulted in the water level changes between the future transitway and Huntmar Rd. The timing with input from Feedmill Cr and Huntley Cr would have a bearing on this (since the water levels are virtually the same from Huntmar Rd to the Village of Carp. The adjustment of manning's n to a higher value under the bridges would abate some of this effect, however the Model Keeper believes that prior to doing any further adjustments to the hydraulic model, it would be more important to confirm the timing of input hydrographs. The gauge network that is in place will eventually provide data that will give an insight into the timing of these hydrographs and enable a validation exercise to be completed. In the interim, the Implementation Plan is very clear how any development is to proceed and the understanding that the validated model may require some adjustments to development scenarios.

Based upon the issues raised in my March 2nd correspondence and the above preliminary comments on the re-posted documents, I anticipate I will be filing a Part II Order Request. In the interest of avoiding such an outcome, I would appreciate receiving a prompt response to the preliminary comments above and the issues raised in my March 2nd letter, along with the requested tabulation of parameters and results.

Regards,

Darlene Conway, P. Eng.

Table 1: Policy/Guideline/Standard Practices: Criteria not Achieved by CRRP

STORMWATER and FLOODPLAIN MANAGEMENT		
Agency: Reference	**Policy/Guideline/Practice, etc.**	**Description of failure to meet criterion** (*Note: unless otherwise noted, all references below as per Carp River Restoration Plan - Widening Alternatives Final Report, Greenland, May 2010.*)
MOE: **Stormwater Management Planning and Design Manual, 2003** http://www.ene.gov.on.ca/envision/gp/4329eindex.htm	p.3-23: *The impacts of increased peak flow rates include increased risks to life and property. Stormwater management must minimize these risks.* *3.5.1 Peak Flow Rate Criteria* *Generally, accepted criteria are that maximum peak flow rates must not exceed pre-development values for storms with return periods ranging from 2 to 100 years.*	As summarized in Tables 3 and 6, Appendix C, post-development 2 to 100 year peak flow rates exceed pre-development values at virtually every location within the study reach by some 25% to almost 100%. (Pre-development modeling provided by City of Ottawa in November 2009; post-development peak flow summaries provided by City of Ottawa on August 23, 2010.)
	p.3-24: *3.5.2 Potential Impacts of Attenuated Runoff* *Controlling post-development peak flow rates through storage to values less than predevelopment conditions (overcontrol) may be required to maintain existing downstream watershed peak flow rates. Downstream rates can increase, although site runoff is controlled to pre-development levels. The timing of detained runoff peaks from specific points of a watershed may result in the coincidence of peaks. Providing site storage in the lower or mid portions of a basin will probably increase downstream peak flow rates as attenuated runoff will peak near the same time as upstream runoff. Controlling runoff in the upper portions may reduce downstream peak flow rates as the peaking times are significantly different. The potential impacts of site attenuated runoff on downstream watershed peaks should be calculated on a site by site basis.*	The SWM quantity control criterion applied to the Carp River Restoration Plan and adjacent developments can be traced from the Carp River Watershed/Subwatershed Study (Robinson Consultants, Dec. 2004, p.143, http://www.mvc.on.ca/water/carpriver.pdf) which recommended against any quantity control for post-development runoff. Controls up to and including the 10 year event only were subsequently adopted with the original 2006 Class EA postings (Post-Development Flow Characterization and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek, CH2MHill, June 2006). Notwithstanding a completely different/much less detailed model was used in the subwatershed study and that the 2006 modeling was flawed by the exclusion of all runoff from the entirety of the Kanata West development, the subsequent Third Party Review (Greenland, March 2009, p.73) did not revisit the assumed SWM quantity control criterion but maintained it, noting the previously expressed concerns regarding the potential for increased flood levels

		to result from coincident peaks if post- to pre-development controls were implemented - neither documenting nor commenting on the excessive post-development peak flow increases that did result with 10 year controls only. Rather, the Third Party Review (p.73) disregarded such evidence of inadequate SWM controls, delaying any review of SWM criteria until additional monitoring data is available: "*The argument for not providing additional control at the SWM facilities can be investigated with this additional data, once available.*" The Third Party Review undertook no analysis of the actual effects of applying post- to pre-control or overcontrol of future runoff, overlooking the standard industry practice used to determine and defend recommended quantity control criteria.
	p.4-5: *End-of-pipe SWMPs should normally be located outside of the floodplain (above the 100 year elevation). If the facility is multi-purpose in nature (e.g., providing quantity control in addition to quality and erosion control) it must be located above the highest design flood level. The outlet invert elevation of the SWMP should be higher than the 2 year floodline and the overflow elevation must be above the 25 year floodline.*	All Kanata West SWM facilities draining directly to the Carp River are multi-purpose and located in the floodplain (ponds 1 to 5). None of these facilities meet the required criteria. As per Table 7, Appendix C, the bottom of the active storage level of all facilities is 0.5m or more below the future 10 year flood elevation (i.e., effectively locating the facility within the highest design flood level for which they are proposed to provide attenuation) and the outlets for ponds 4 and 5 are located well below (0.2 to 0.4m) the 2 year future floodline.
MTO: **MINISTRY DIRECTIVE** **Program: Provincial Highway Management Directive: B-014** Date of Issue: 23 August 2007 SUBJECT: Ministry of Transportation	*POLICY FRAMEWORK:* *The following statements are overriding policies for the management of highway drainage systems.* *3. Where a highway crossing of the provincial highway system is located on the flow route of a catchment area, it is not the fundamental purpose of this structure to convey water that would not naturally flow to this structure.* *POLICY AREA 2: DRAINAGE OF LANDS OWNED BY OTHERS* *2. Permission for Use of the Ministry Right of Way or*	Post-development 100 year peak flows exceed pre-development values at the Highway 417 crossings by 60% (see Table 6, Appendix C). Post-development 100 year velocities exceed pre-

Table 1

Drainage Management Policy and Practice http://www.mto.gov.on.ca/english/engineering/drainage/directives/b014.pdf	*Drainage System by an Outside Party* *(iii) The Ministry's permission is only for conveying stormwater runoff from a proposed development through the highway right of way to a sufficient outlet. Permission will be conditional upon the outside party demonstrating that stormwater runoff from a proposed development will not negatively impact either the highway drainage system or other areas downstream of the highway.*	development values by almost 70% at the 417 crossings (see Table 6, Appendix C). Post-development 100 year flood levels exceed pre-development levels by up to 16cm for hundreds of meters upstream and downstream of Richardson Side Road (all downstream of the 417).

MTO: **Stormwater Management Requirements for Land Development Proposals** http://www.mto.gov.on.ca/english/engineering/drainage/stormwater/index.shtml	*<u>Checking the Design Capacity of the Highway Bridge or Culvert</u>* *The SWM report must document if the capacity of the highway bridge or culvert will be exceeded because of stormwater runoff discharging from the proposed land development. Review the following conditions and report the results in the SWM report. If the capacity is exceeded, an impact should be identified in the SWM report. Proceed to <u>Identifying Impacts to the Receiving Drainage System</u> for further details.* *Where the pre-development peak flow (calculated in a)* ***is greater than*** *the design flow capacity; or the pre-development headwater level (calculated in a)* ***is greater than*** *the allowable headwater level, the capacity of the highway bridge or culvert is not exceeded if:* • *the* ***post-development peak flow rates*** *(calculated in b and d) are less than or equal to the* ***pre-development peak flow rates*** *(calculated in a and c); and* • *the* ***post-development headwater levels*** *(calculated in b and d) are less than or equal to the* ***pre-development headwater levels*** *(calculated in a and c); and* • *the* ***post-development flow velocity*** *(calculated in b) is less than or equal to the* ***pre-development flow velocity*** *(calculated in a); and* • *fish passage (for highway culverts only), river ice, and debris flow are not affected (refer to chapter 5 of the "Drainage Management Manual" (MTO 1997): fish passage in culverts on page 66, river ice on page 78 and debris flow on page 93).*	100 year post-development peak flow rate at 417 exceeds pre-development peak flow rate by 60% (see Table 6, Appendix C). 100 year post-development velocity exceeds pre-development velocity at 417 by almost 70% (see Table 6, Appendix C).
	<u>Identifying Impacts to the Receiving Drainage System</u> *Impacts to the receiving drainage system will occur and mitigation may be required by MTO if the analysis of the receiving drainage system determined that the proposed*	

	land development does not satisfy either of the conditions noted above. ***Recommending Mitigative Works*** *The SWM report should clearly present an assessment of the identified impacts with regards to risk. Each impact should be compared against the risk criteria listed below.* ***Risk Criteria:*** *where each of the identified impacts do not satisfy all of the following risk criteria, MTO will require that mitigation be provided for that impact (the required level of mitigation must then be established):* • *damage will not occur to the property of riparian landowners located upstream or downstream of the highway right-of-way;* • *the structural integrity of the highway right-of-way will not be threatened; or* • *the safety of the travelling public will not be threatened.* ***The Level of Mitigation:*** *the SWM report must clearly present the following;* • *the level to which peak flows are reduced using stormwater management controls to restore water surface elevations and/or flow velocities, at the reference points and range of frequencies specified in Table 7, to a level(s) that will satisfy the risk criteria; and/or* • *the level to which peak flows are reduced using stormwater management controls to restore the capacity of the highway drainage system to a level(s) that will satisfy the risk criteria; and/or* • *modifications that are proposed to the receiving drainage system, including erosion protection works, to restore water surface elevations and/or flow velocities, at the reference points and range of frequencies*	Two of the above-noted conditions have not been met (post-development peak flows and velocities greatly exceed pre-development values). The supporting study (May 2010) does not acknowledge or document these impacts and provides no comparison against MTO's risk criteria. Study provides no information. Study provides no information. Study provides no information. The study maintains a relaxed SWM criterion of providing only 10 year control that results in excessive increases in future 100 year velocities (almost 70%) and peak flows (60%) at the 417. No results are documented in the report re: higher frequency events (although output files were provided by the proponent on August 23, 2010). Lowered Manning's 'n' values are proposed over a large proportion of the restored/future overbanks and 100% 0f the restored low flow channel which maintains the pre-development 100 year flood at the 417 crossings (notwithstanding excessive peak flow increases). See section Appendix B for more details re: lowered 'n' values.

	specified in Table 7, to a level (s) that will satisfy the risk criteria. *Where a conflict with future highway works has been identified, the SWM report must document how the conflict was resolved, which may only be achieved by applying one of the methods presented above.*	No modifications to mitigate increases in peak flows and velocities are recommended.

	Assessing the Potential for Scour *An assessment of scour is completed as part of the hydraulic analysis of the bridge or culvert. Scour may undermine the foundations of a structure, possibly leading to its failure. Particular attention should be given to the natural stream characteristics. A stream may be unstable due to meandering, degradation or aggradation.* *The flow velocities calculated as part of the hydraulic analysis for culverts and bridges serve as an input to the scour analysis.* *Structure scour protection requirements should be designed for the design flood andmodified, if necessary, to ensure that structural failure will not occur as a result of the check flood. (Reference: Ontario Highway Bridge Design Code, 1991). Reliance on protection measures, such as gabions or riprap for the full lifetime of the structure is not recommended.*	A scour analysis was completed in 2006 by the City (see July 24, 2006 correspondence from the City to MTO in Kanata West 2010 Public Consultation Update, Delcan). Since that time, post-development 100 year velocities at the 417 have increased by almost 70%, however, there is no documentation that an updated scour analysis was provided. The City has advised that, *"The model in question has been reviewed by MTO and they are satisfied that the velocities are still in an acceptable range"* (see Attachment 1, Appendix C).
	Providing Stormwater Management Controls ***Selecting the Level of Water Quantity Control*** *The level to which peak flows will be reduced depends upon the level of mitigation that is required, and the degree to which MTO is exposed to risk. MTO reserves the right to impose a higher level of control upon the land development proposal (i.e. as compared to the requirements of other regulatory agencies). In such cases an MTO drainage representative should be contacted for clarification. Peak flows must be reduced to a level that will restore:* • *water surface elevations and/or flow velocities, at the reference points and range of frequencies specified in Table 7, to a level(s) that will satisfy the risk criteria; and/or* • *the capacity of the highway drainage system to a*	The supporting study recommends an almost 70% increase in the post-development 100 year flow velocity at the 417 with no analysis of potential impacts to the structure and no recommendations for mitigating impacts.

	level(s) that will satisfy the risk criteria.	
MNR: **Technical Guide: River and Stream Systems: Flooding Hazard Limit**	*p.8: The municipality making these decisions should ensure that flood plain management studies are undertaken by a Professional Engineer and resulting flood lines, flood proofing standards are examined and approved by a Professional Engineer using accepted engineering principles.*	To date (August 28, 2010), the professional engineer(s) who reviewed and approved the preparation of floodline information on behalf of the City of Ottawa has not been confirmed by the City.

(2002)	*p. 8: The management of flood susceptible lands involves a combination of three main program components:* *i) Prevention, by land use planning and regulation of development;* *ii) Protection, by applying structural and non-structural measures and acquisition; and* *iii) Emergency response, by flood forecasting/warning and flood/erosion disaster relief.* *Over the long-term prevention is the preferred method for the management of flood plain lands.* *p.10: 2.2 Provincial Interests - Flooding Hazards* *The overall interests and expectations of the Province of Ontario in flood plain management along river and stream systems are described here:* *• All land use planning and resource management bodies within the Province will have regard to the implications of their actions respecting the creation of new or aggravation of existing flood plain management problems;* *• Municipalities and planning boards will recognize the flood and erosion susceptibility and environmental integrity of flood plains at the various stages of the land use planning process for which they have jurisdiction; and* *• Municipalities and planning boards will direct new development to areas outside of the flood and erosion hazard areas.*	Kanata West is a greenfield development area, the planning of which had the opportunity to direct development away from flood hazard areas and provide for SWM measures that mitigate the impacts of urbanization on existing peak flows, water levels and velocities, i.e., to follow prevention, the Province's *"preferred method for the management of flood plain lands."* Instead, the creation of developable land from some 28 hectares of floodplain is proposed in conjunction with relaxed SWM controls resulting in excessive peak flow, velocity and flood level increases (see Tables 1 and 6, Appendix C), creating the potential for new hazards (increased flooding and erosion). .
	p.17: Dams and dykes can reduce flood risk downstream or behind a dyke, but they do not eliminate the risk. The purpose of a dam or dyke is to protect existing development, but not to free up additional land for new development. *Reduced peak flows based on the operation of the dam is*	From correspondence dated February 17, 2010 from the Third Party Reviewer (p.3) on behalf of the City, the use of significantly lowered Manning's 'n' values (in comparison to existing conditions) is explicitly proposed in an (ostensibly) naturalized river corridor for *"the purpose of ....efficient control/conveyance"* of flood flows. This design assumption will inevitably require regular maintenance

	not always in the public interest, since funds to maintain and replace the structure in the future cannot be assured. Also, projected flood peak attenuation may not be achieved as a result of ice, debris or sediment accumulation that affect storage, operating problems that alter discharge capacity, or floods that vary from the design event in terms of timing, volume and hydrograph shape. The use of peak flows resulting from a dam failure is the most conservative option, and the recommended option where public safety is the issue. The preferred approach is the use of unregulated flow to identify flood hazard limits downstream of a dam. *It must be remembered that the function of a flood control dam is to hold back upstream flood waters. Whatever the type or design of dam, these structures are not a floodproofing option for downstream developments. Through construction, design and operational errors, and deterioration of the structure, dams cannot be completely relied upon and new construction in flood hazard areas should not be permitted through reliance on control works. Similarly, stormwater management facilities should not be relied upon in the establishment of flood hazard limits.* *Dykes and flood walls are not regarded as permanent flood control structures and the land behind the dykes and flood walls should continue to require protection to the revised (increased) flood standard.*	(removal of vegetation, manicuring to preclude succession from occurring, etc.) just as any dam or berm requires regular maintenance - or future flood levels will inevitably increase considerably above what has been proposed. Dependence on regular human intervention in perpetuity to maintain lower flood levels is not consistent with the Technical Guide.
	p.17: 4.2 Bridges and Culverts - *Bridges and culverts are primarily designed based on economic consideration. Roadway crossings are not intended to act as dams although the design often has to accommodate temporary ponding behind the structure. This could increase the flood plain limits upstream and*	

Table 1

	reduce the flood peaks; hence, the flood hazard downstream may be reduced to some extent. When the structure is enlarged or removed, the temporary backwater ponding is reduced or eliminated, thereby potentially changing both the upstream and downstream flood lines. It is recommended that the upstream flood line should make allowance for the backwater effects caused by the structure. Where this assumption results in unacceptable conditions the culvert should be replaced, or alternatively, where feasible, the two zone concept should be introduced. Under the two zone concept minor filling would be permitted in shallow areas, provided the filling would create no adverse flooding or environmental impacts upstream or downstream. *Downstream of the culvert or bridge, the natural flood line should be used for delineating the flood hazard, making no allowance for the temporary upstream ponding.*	There appears to be considerable routing occurring upstream of Richardson Side Road (see reduction in peak flow immediately downstream of Richardson, Table 6, Appendix C). According to the Technical Guide, the unrouted flow should be used downstream of crossings, recognizing the difficulty, if not the practical impossibility of guaranteeing that future structures will not be enlarged. There is no indication that an analysis has been competed with unrouted flows. This condition would be expected to further increase flood levels downstream of Richardson. The resulting impacts of unrouted flows downstream of Richardson should be analyzed.
	p.65: It is a current policy of the Ministry of Natural Resources to base flood profile computations, for flood hazard mapping purposes, upon existing structural and hydraulic conditions along the river. Where a structure may be replaced in future, or upon inspection of preliminary hydraulic results, a structure may prove to be unstable or breach on overtopping in such cases, additional hydraulic analyses of the resulting downstream flood wave should be carried out.	See comment directly above regarding the effect of the existing Richardson Sideroad crossing on peak flows downstream of the crossing. Flood levels documented in Class EAs are based upon the used of routed flows downstream of structures.
	p.50: 3. LAND USE *Future extent of urbanization should be extracted from Official Plans or other Municipal land use planning documents and the planning horizon should preferably extend 20 years into the future.* *Where stormwater management facilities, existing or future, can affect the magnitude and/or timing of the flows, the cumulative effects of these structures should be*	An additional 200 hectares of development known as the Fernbank lands (located immediately upstream of Kanata West) remain unaccounted for in the final hydraulic modeling supporting the re-posting of the Kanata West Class EAs some 5 years after the Fernbank lands were brought into the urban boundary and a year since master planning studies for Fernbank (including stormwater management works) were approved by the City of Ottawa.

	incorporated in the flood plain studies.	As such, the cumulative effect of this additional large development area has not been accounted for. Given the relaxed quantity control criterion adopted by the Fernbank lands (10 year controls only for the majority of the development) upon the recommendation of the Third Party Review (Greenland, March 2009), it is a virtual certainty that peak flows and velocities will further increase over those documented in the Widening Alternatives report (May 2010). From a practical perspective, the Class EA is not yet approved but the supporting modeling is already outdated. The Technical Guide requires that the modeling be updated to account for the impacts of the Fernbank lands in a developed condition.
	p.83: TECHNICAL REPORT *The report should present the studies in sufficient detail that specialists in this field can determine the adequacy of the work and its conformance to the procedures outlined in this document. The draft submission should include the following material:* *All the data used in the investigation, whether measured or estimated, should be fully described. The source of the data should be given and background information must be provided for any assumed values to enable an assessment of their validity.* *Present flows in tabular form for different events and locations.* *For the river system describe the roughness coefficients and starting water levels used.* *Tables and hydrographs to provide summary of discharges, elevations and mean velocities with a cross section reference.* *Input data and output summary should be presented in*	The Third Party Review and Widening Alternatives report fail to adequately document input values, data, and modeling results that would allow "*specialists in this field [to] determine the adequacy of the work and its conformance to the procedures outlined in this document.*" The TPR did not document peak flows (for any frequency) or roughness coefficients. There is further no documentation of the significant changes to Manning's 'n' values in the future condition or the use of an extremely low 'n' value for pond/pool surfaces. The Widening Alternatives report did not tabulate and compare pre- and post-development peak flows for all

Table 1

	Appendices.	events (2 to 100 year), although 100 year post-development peak flows are provided in an output file in Appendix 4.
MNR: Lakes and Rivers Improvement Act Technical Guidelines - Criteria and Standards for Approval, Draft June 2004	*p.10: 4.5 ASSESSMENT OF DOWNSTREAM IMPACTS WITHIN ZONE OF INFLUENCE* *Channelization works are often proposed to improve drainage by increasing the conveyance capacity and reducing local flooding impacts. Such works shall not increase flooding damage upstream and downstream of the channel and shall not lower river levels detrimentally from those under natural conditions. To meet this criterion, the hydraulic characteristics of the natural river channel and its flood plain must be maintained. This applies to all lengths and sizes of diversions and channelization to prevent a cumulative effect of increased flood levels and erosion rates. The following hydraulic characteristics of the natural river channel shall remain the same in the proposed channel:* *1) travel time (not to be decreased); and* *2) the stage storage and stage discharge relationships of the natural river and its flood plain are to be maintained (evaluated in 0.3 m elevation increments from the channel bed to the flood level per Provincial Natural Hazards Technical Guide, 2002).* *These criteria maintain a flood plain area in the channelized reach identical to that of the original watercourse. The strength of these criteria is that they are straightforward to apply and easily verified by the approving agency. However, their strict application may be inhibiting. Exceptions may be considered where the following objectives of the criteria are met:* *1) the cumulative impacts of all future works in the watershed are quantified through sub-watershed*	Note: Notwithstanding recent changes that no longer require Land and Rivers Improvement Act approval for channelization works in jurisdictions having a Conservation Authority, the criteria describing the need to maintain existing hydraulic characteristics remain relevant in ensuring no unacceptable impacts upstream or downstream of channelization works. From the EBR posting regarding the changes (http://www.ebr.gov.on.ca/ERS-WEB-External/displaynoticecontent.do?noticeId=Mjc0MzI=&statusId=Mjc0MzI=&language=en): *“Response 2: MNR has issued comprehensive technical support documents to ensure consistent application of CA regulations that account for all the purposes of the Act. MNR will also be issuing updated LRIA Technical Guidelines that are currently under review by CAs.”* The 100 year travel time in the restoration reach has been reduced by 1.88 hours or over 20%. 1) The cumulative impacts of all future works (known and unknown) in the watershed have not – and cannot be - accounted for, given the urban boundary can/likely will

	studies and are considered insignificant; *2) there are no downstream impacts (i.e., channel outlets to one of the Great Lakes);* *3) the discharge storage relationship of the water course is maintained on an incremental basis for all* *floods from the 2 year return flood to the flood per provincial standards for defining natural hazards; and* *4) routing calculations are provided which conclusively demonstrate that there would be no increase in downstream peak flows and total storage has been maintained or increased.*	expand in future. Even the impact of the Fernbank lands have not yet been accounted for in the modeling. 2) The Carp River is not a large receiver in this context. There are documented downstream impacts as per Tables 1 and 6, Appendix C. . 3) Unknown – no analysis of riparian storage (structures removed) provided. 4) Unknown – no documentation provided.
	p.11: 4.5.2 FLOODING AND EROSION *1) A dam, water crossing, or channelization shall not cause permanent or periodic flooding or erosion on land located downstream owned by others on which the applicant does not have the legal authority to flood or erode above that which would occur under existing conditions as a result of the location, design, construction, state of repair, and/or operation of the works.* *2) The hazard potential from flooding and erosion damage to downstream property or loss of life due to failure of a dam at the proposed location must be minimized. The larger the downstream property damage and/or hazard potential for loss of life that would be caused by failure of a dam, the higher the design requirements must be for the dam. Refer to Section 5.3.2 for further information.* *3) Downstream flood levels and flood line maps should not be altered because of new structures.*	Post-development 100 year flood levels have increased by 10 to 16 cm for hundreds of meters downstream of the urban boundary (the northern limit of Kanata West). There appears to be considerable routing of flows behind Richardson Sideroad as a result of the use of dynamic hydraulic modeling that should the structure be improved in future could result in increased flooding impacts downstream. The impacts of post-development flows without the routing effects of Richardson Sideroad should

		be assessed.
City of Ottawa: Stormwater Management Policies http://ottawa.ca/calendar/ottawa/citycouncil/occ/2007/09-12/arac/ACS2007-PTE-POL-0037.htm	*The City will: Require the implementation of stormwater management measures, where required, that will ensure no increase in the regulatory flood elevation resulting from changes in land use.*	Post-development 100 year flood level increases of up to 16cm are recommended hundreds of meters upstream and downstream of Richardson Sideroad.
	The City will: Ensure that the planning and implementation of SWM systems is consistent with Provincial floodplain policies and guidelines.	The use of a “smoothened” river corridor to artificially reduce flood levels, notwithstanding post-development peak flows that increase from 25% to almost 100%, is not consistent with MNR’s Technical Guide that precludes the use of stormwater management facilities in the establishment of flood hazard limits.

HEC-RAS Plan: F25W3.8mFCE River: Carp River Reach: Upper Reach Profile: Max WS

Reach	River Sta	Profile	Q Total (m3/s)	W.S. Elev (m)	Vel Chnl (m/s)	Vel Left (m/s)	Vel Right (m/s)	Trvl Tme Cl (hrs)	Trvl Tme A' (hrs)	Volume (1000 m3)
Upper Rea	44953	Max WS	9.34	94.56	0.2	0.08		15.84	31.51	3360.2
Upper Rea	44948.1*	Max WS	9.34	94.56	0.21	0.08		15.83	31.5	3359.94
Upper Rea	44943.3*	Max WS	9.34	94.56	0.21	0.08		15.83	31.5	3359.68
Upper Rea	44938.4*	Max WS	9.33	94.56	0.21	0.08		15.82	31.49	3359.42
Upper Rea	44933.6*	Max WS	9.33	94.56	0.21	0.08		15.82	31.48	3359.17
Upper Rea	44928.7*	Max WS	9.33	94.56	0.21	0.08		15.81	31.47	3358.92
Upper Rea	44923.9*	Max WS	9.33	94.56	0.21	0.08		15.8	31.46	3358.66
Upper Rea	44919.0*	Max WS	9.33	94.56	0.21	0.09		15.8	31.45	3358.41
Upper Rea	44914.2*	Max WS	9.32	94.56	0.21	0.09		15.79	31.45	3358.17
Upper Rea	44909.3*	Max WS	9.32	94.56	0.21	0.09		15.79	31.44	3357.92
Upper Rea	44904.5*	Max WS	9.32	94.56	0.21	0.09		15.78	31.43	3357.67
Upper Rea	44899.6*	Max WS	9.32	94.56	0.21	0.09		15.77	31.42	3357.42
Upper Rea	44894.8*	Max WS	9.31	94.56	0.2	0.09		15.77	31.41	3357.18
Upper Rea	44890	Max WS	9.31	94.56	0.2	0.09		15.76	31.4	3356.93
Upper Rea	44885.0*	Max WS	9.31	94.56	0.2	0.09		15.75	31.39	3356.6
Upper Rea	44880.0*	Max WS	9.3	94.55	0.21	0.09		15.75	31.38	3356.28
Upper Rea	44875.1*	Max WS	9.3	94.55	0.21	0.09		15.74	31.37	3355.95
Upper Rea	44870.1*	Max WS	9.3	94.55	0.21	0.09		15.73	31.36	3355.63
Upper Rea	44865.1*	Max WS	9.29	94.55	0.21	0.09		15.73	31.35	3355.31
Upper Rea	44860.2*	Max WS	9.29	94.55	0.21	0.09		15.72	31.34	3354.99
Upper Rea	44855.2*	Max WS	9.29	94.55	0.21	0.09		15.71	31.33	3354.68
Upper Rea	44850.2*	Max WS	9.29	94.55	0.22	0.09		15.71	31.32	3354.36
Upper Rea	44845.3*	Max WS	9.28	94.55	0.22	0.09		15.7	31.31	3354.05
Upper Rea	44840.3*	Max WS	9.28	94.55	0.22	0.09		15.7	31.31	3353.73
Upper Rea	44835.3*	Max WS	9.16	94.55	0.22	0.09		15.69	31.3	3353.42
Upper Rea	44830.4*	Max WS	9.16	94.55	0.22	0.09		15.68	31.29	3353.11
Upper Rea	44825.4*	Max WS	9.16	94.55	0.22	0.09		15.68	31.28	3352.8
Upper Rea	44820.5*	Max WS	9.16	94.55	0.22	0.09		15.67	31.27	3352.49
Upper Rea	44815.5*	Max WS	9.16	94.55	0.22	0.09		15.66	31.26	3352.19
Upper Rea	44810.5*	Max WS	9.16	94.54	0.22	0.09		15.66	31.25	3351.88
Upper Rea	44805.6*	Max WS	9.15	94.54	0.22	0.09		15.65	31.24	3351.57

Upper Rea	41799.0*	Max WS	31.81	93.78	0.29	0.15	0.18	12.22	26.19	2929.78
Upper Rea	41794.4*	Max WS	31.81	93.78	0.29	0.15	0.18	12.21	26.19	2928.98
Upper Rea	41789.8*	Max WS	-1.42	93.78	-0.01	-0.01	-0.01	12.2	26.17	2928.17
Upper Rea	41785.2*	Max WS	-1.96	93.78	-0.02	-0.01	-0.01	12.2	26.17	2927.37
Upper Rea	41780.6*	Max WS	-2.49	93.78	-0.02	-0.01	-0.01	12.2	26.17	2926.56
Upper Rea	41776	Max WS	-3.02	93.78	-0.03	-0.02	-0.02	12.2	26.17	2925.76
Upper Rea	41769	Max WS	-3.55	93.78	-0.03	-0.02	-0.02	12.2	26.17	2924.96
Upper Rea	41764.8*	Max WS	-3.85	93.78	-0.03	-0.02	-0.02	12.2	26.17	2924.17
Upper Rea	41760.6*	Max WS	-4.4	93.78	-0.03	-0.02	-0.02	12.2	26.17	2923.34
Upper Rea	41756.5*	Max WS	-4.97	93.78	-0.04	-0.02	-0.02	12.2	26.17	2922.51
Upper Rea	41752.3*	Max WS	-5.54	93.78	-0.04	-0.02	-0.02	12.2	26.17	2921.67
Upper Rea	41748.1*	Max WS	-6.1	93.78	-0.04	-0.02	-0.02	12.2	26.17	2920.82
Upper Rea	41744	Max WS	-6.65	93.78	-0.04	-0.02	-0.02	12.2	26.17	2919.96
Upper Rea	41743	Max WS	-6.78	93.78	0		0	12.2	26.17	2919.79
Upper Rea	41738	Fut Transitwa	Bridge							
Upper Rea	41725.5	Max WS	-7.37	93.79	-0.15			12.2	26.17	2919.79
Upper Rea	41720.5*	Max WS	-7.71	93.79	-0.03	-0.02	-0.02	12.2	26.17	2918.5
Upper Rea	41715.5*	Max WS	-8.3	93.79	-0.04	-0.02	-0.02	12.2	26.17	2917.23
Upper Rea	41710.6*	Max WS	-8.88	93.79	-0.04	-0.02	-0.03	12.2	26.17	2916
Upper Rea	41705.6*	Max WS	-9.43	93.79	-0.05	-0.03	-0.03	12.2	26.17	2914.84
Upper Rea	41700.7*	Max WS	-9.94	93.79	-0.06	-0.03	-0.03	12.2	26.17	2913.76
Upper Rea	41695.7*	Max WS	-10.42	93.79	-0.06	-0.03	-0.04	12.2	26.17	2912.75
Upper Rea	41690.8*	Max WS	-10.86	93.79	-0.07	-0.04	-0.04	12.2	26.17	2911.81
Upper Rea	41685.8*	Max WS	-11.27	93.79	-0.08	-0.05	-0.05	12.2	26.17	2910.95
Upper Rea	41680.9*	Max WS	-11.65	93.79	-0.09	-0.06	-0.06	12.2	26.17	2910.15
Upper Rea	41675.9*	Max WS	-11.99	93.79	-0.1	-0.07	-0.07	12.2	26.17	2909.45
Upper Rea	41671	Max WS	-12.29	93.79	-0.13	-0.08	-0.08	12.2	26.17	2908.82
Upper Rea	41668.1*	Max WS	-0.83	93.79	-0.01	-0.01	-0.01	12.2	26.17	2908.17
Upper Rea	41665.2*	Max WS	-1.16	93.79	-0.01	-0.01	-0.01	12.2	26.17	2907.5
Upper Rea	41662.4*	Max WS	-1.48	93.79	-0.01	-0.01	-0.01	12.2	26.17	2906.8
Upper Rea	41659.5*	Max WS	-1.81	93.79	-0.02	-0.01	-0.01	12.2	26.17	2906.09
Upper Rea	41656.6*	Max WS	-2.13	93.79	-0.02	-0.01	-0.01	12.2	26.17	2905.36
Upper Rea	41653.8*	Max WS	-2.45	93.79	-0.02	-0.01	-0.01	12.2	26.17	2904.61
Upper Rea	41650.9*	Max WS	-2.77	93.79	-0.02	-0.01	-0.01	12.2	26.17	2903.85

Upper Rea(	41648.0*	Max WS	-3.09	93.79	-0.02	-0.02	-0.02	12.2	26.17	2903.06
Upper Rea(	41645.2*	Max WS	-3.41	93.79	-0.02	-0.02	-0.02	12.2	26.17	2902.26
Upper Rea(	41642.3*	Max WS	-3.73	93.79	-0.03	-0.02	-0.02	12.2	26.17	2901.44
Upper Rea(	41639.5*	Max WS	-4.05	93.79	-0.03	-0.02	-0.02	12.2	26.17	2900.61
Upper Rea(	41636.6*	Max WS	-4.37	93.79	-0.03	-0.02	-0.02	12.2	26.17	2899.75
Upper Rea(	41633.7*	Max WS	-4.68	93.8	-0.03	-0.02	-0.02	12.2	26.17	2898.89
Upper Rea(	41630.9*	Max WS	-5	93.8	-0.03	-0.02	-0.02	12.2	26.17	2898
Upper Rea(	41628.0*	Max WS	-5.31	93.8	-0.03	-0.02	-0.02	12.2	26.17	2897.1
Upper Rea(	41625.1*	Max WS	-5.63	93.8	-0.03	-0.02	-0.02	12.2	26.17	2896.18
Upper Rea(	41622.3*	Max WS	-5.94	93.8	-0.03	-0.02	-0.02	12.2	26.17	2895.25
Upper Rea(	41619.4*	Max WS	-6.25	93.8	-0.03	-0.02	-0.02	12.2	26.17	2894.3
Upper Rea(	41616.5*	Max WS	-6.57	93.8	-0.04	-0.03	-0.02	12.2	26.17	2893.34
Upper Rea(	41613.7*	Max WS	-6.88	93.8	-0.04	-0.03	-0.02	12.2	26.17	2892.36
Upper Rea(	41610.8*	Max WS	-7.18	93.8	-0.04	-0.03	-0.02	12.2	26.17	2891.37
Upper Rea(	41608	Max WS	-7.38	93.8	0			12.2	26.17	2890.37
Upper Rea(	41602	Future Campe Bridge								
Upper Rea(	41572	Max WS	-7.99	93.8	-0.13			12.2	26.17	2890.37
Upper Rea(	41567.5*	Max WS	-8.06	93.81	-0.13			12.2	26.17	2889.3
Upper Rea(	41563.0*	Max WS	-8.13	93.81	-0.12			12.2	26.17	2888.25
Upper Rea(	41558.5*	Max WS	-8.2	93.81	-0.11			12.2	26.17	2887.21
Upper Rea(	41554.0*	Max WS	-8.27	93.81	-0.11			12.2	26.17	2886.18
Upper Rea(	41549.5*	Max WS	-8.35	93.81	-0.1			12.2	26.17	2885.15
Upper Rea(	41545.1*	Max WS	-8.42	93.81	-0.1			12.2	26.17	2884.14
Upper Rea(	41540.6*	Max WS	-8.5	93.81	-0.1			12.2	26.17	2883.13
Upper Rea(	41536.1*	Max WS	-8.57	93.81	-0.09			12.2	26.17	2882.14
Upper Rea(	41531.6*	Max WS	-8.65	93.81	-0.09			12.2	26.17	2881.15
Upper Rea(	41527.1*	Max WS	-8.78	93.81	-0.09		-0.07	12.2	26.17	2880.18
Upper Rea(	41522.7*	Max WS	-8.96	93.81	-0.09		-0.07	12.2	26.17	2879.22
Upper Rea(	41518.2*	Max WS	-9.14	93.81	-0.09		-0.07	12.2	26.17	2878.26
Upper Rea(	41513.7*	Max WS	-9.31	93.81	-0.09		-0.07	12.2	26.17	2877.32
Upper Rea(	41509.2*	Max WS	-9.47	93.81	-0.09		-0.07	12.2	26.17	2876.39
Upper Rea(	41504.7*	Max WS	-9.63	93.81	-0.09		-0.07	12.2	26.17	2875.48
Upper Rea(	41500.2*	Max WS	-9.78	93.81	-0.09		-0.06	12.2	26.17	2874.57
Upper Rea(	41495.8*	Max WS	-9.93	93.81	-0.1		-0.06	12.2	26.17	2873.68

Upper Rea(	41491.3*	Max WS	-10.07	93.82	-0.1		-0.06	12.2	26.17	2872.79
Upper Rea(	41486.8*	Max WS	-10.2	93.82	-0.1		-0.06	12.2	26.17	2871.93
Upper Rea(	41482.3*	Max WS	-10.32	93.82	-0.1		-0.06	12.2	26.17	2871.07
Upper Rea(	41477.8*	Max WS	-10.44	93.82	-0.1		-0.06	12.2	26.17	2870.23
Upper Rea(	41473.4*	Max WS	-10.55	93.82	-0.1		-0.06	12.2	26.17	2869.4
Upper Rea(	41468.9*	Max WS	-10.64	93.82	-0.1		-0.06	12.2	26.17	2868.58
Upper Rea(	41464.4*	Max WS	-10.73	93.82	-0.11		-0.06	12.2	26.17	2867.77
Upper Rea(	41459.9*	Max WS	-10.8	93.82	-0.11		-0.06	12.2	26.17	2866.98
Upper Rea(	41455.4*	Max WS	-10.86	93.82	-0.11	-0.08	-0.06	12.2	26.17	2866.2
Upper Rea(	41450.9*	Max WS	-10.91	93.82	-0.11	-0.08	-0.06	12.2	26.17	2865.44
Upper Rea(	41446.5*	Max WS	-10.94	93.82	-0.11	-0.08	-0.06	12.2	26.17	2864.69
Upper Rea(	41442.0*	Max WS	7.13	93.82	0.07	0.05	0.04	12.2	26.17	2863.95
Upper Rea(	41437.5*	Max WS	6.25	93.83	0.07	0.05	0.04	12.18	26.15	2863.23
Upper Rea(	41433.0*	Max WS	5.35	93.85	0.06	0.04	0.03	12.16	26.12	2862.51
Upper Rea(	41428.5*	Max WS	4.44	93.87	0.05	0.03	0.03	12.13	26.08	2861.79
Upper Rea(	41424.1*	Max WS	3.48	93.89	0.04	0.03	0.02	12.1	26.04	2861.08
Upper Rea(	41419.6*	Max WS	2.46	93.92	0.03	0.02	0.01	12.06	25.98	2860.37
Upper Rea(	41415.1*	Max WS	1.38	93.97	0.01	0.01	0.01	11.99	25.89	2859.65
Upper Rea(	41410.6*	Max WS	0.19	94.03	0	0	0	11.83	25.66	2858.91
Upper Rea(	41406.1*	Max WS	-1.16	94.15	-0.01	-0.01	-0.01	11.83	25.66	2858.14
Upper Rea(	41401.6*	Max WS	-2.52	94.34	-0.02	-0.01	-0.01	11.83	25.66	2857.31
Upper Rea(	41397.2*	Max WS	-4.06	94.83	-0.03	-0.02	-0.02	11.83	25.66	2856.3
Upper Rea(	41392.7*	Max WS	-5.92	96.94	-0.02	-0.01	-0.01	11.83	25.66	2854.58
Upper Rea(	41388.2*	Max WS	-2.7	93.82	-0.04	-0.02	-0.02	11.83	25.66	2853.16
Upper Rea(	41383.7*	Max WS	55.07	93.59	1.23	0.64	0.52	11.83	25.66	2852.69
Upper Rea(	41379.2*	Max WS	49.04	111.78	0	0	0	11.83	25.66	2822.78
Upper Rea(	41374.8	Max WS	-8.66	96.18	-0.03	-0.02	-0.02	11.83	25.66	2792.17
Upper Rea(	41370.3*	Max WS	31.7	96.09	0.05	0.03	0.03	11.63	25.28	2788.65
Upper Rea(	41365.9*	Max WS	28.3	97.97	0.02	0.01	0.01	11.59	25.21	2778.72
Upper Rea(	41361.4*	Max WS	-13.74	95.51	-0.02	-0.01	-0.02	11.59	25.21	2769.28
Upper Rea(	41357	Max WS	-22.79	97.1	-0.02	-0.01	-0.01	11.59	25.21	2761.19
Upper Rea(	41353.2*	Max WS	96.71	93.55	0.55	0.1	0.39	11.58	25.21	2754.98
Upper Rea(	41349.4	Max WS	90.64	93.55	0.28	0.06	0.27	11.58	25.2	2753.57
Upper Rea(	41345.6*	Max WS	34.43	93.4	0.13	0.02	0.12	11.57	25.19	2752.01

Table 3: Comparison of pre- and post-development peak flows

1. Pre-development flows from TPR model of record March 2009 (provided by City of Ottawa in November 2009).
2. Post-development flows provided by City of Ottawa August 23rd, 2010.

Cross-section			2-year			5-year			10-year		25-year			100-year		
			Pre	Post	% change	Pre	Post	% change	Pre	Post	Pre	Post	% change	Pre	Post	% change
Glen Cairn		44953	4.70	5.60	19	5.90	7.92	34	n/a	7.60	7.33	9.34	27	9.89	12.32	25
Hazeldean	u/s	44325	4.77	7.25	52	8.00	11.33	42	n/a	13.70	12.21	17.15	40	15.95	22.50	41
	d/s	44302	4.52	6.48	43	7.24	10.74	48	n/a	13.70	11.61	17.09	47	15.41	22.17	44
Maple Grove	u/s	43375	5.13	7.07	38	8.33	11.99	44	n/a	12.95	13.18	16.95	29	17.42	22.61	30
	d/s	43364	5.13	6.78	32	8.33	11.04	33	n/a	12.07	13.17	14.76	12	17.42	20.16	16
Palladium	u/s	42890	8.91	13.81	55	14.46	23.27	61	n/a	32.06	24.64	40.19	63	34.25	54.92	60
	d/s	42855	8.91	13.67	53	14.40	22.71	58	n/a	32.05	24.63	40.05	63	34.25	53.40	56
Hwy 417	u/s	42124	9.13	13.45	47	14.42	22.54	56	n/a	32.01	24.99	33.33	33	34.62	54.85	58
	d/s	42097	9.13	13.32	46	14.43	22.54	56	n/a	32.01	24.84	33.25	34	34.23	54.85	60
Fut Transitway	u/s	41743	9.29	13.28	43	14.59	22.98	58	n/a	32.93	25.15	-6.78	-127	34.63	54.91	59
	d/s	41725	9.29	13.29	43	14.58	23.05	58	n/a	32.93	25.15	-7.37	-129	34.63	55.26	60
Fut Campeau	u/s	41609.2	10.82	14.80	37	17.93	26.7	49	n/a	38.80	30.94	-7.38	-124	43.24	64.54	49
	d/s	41570	10.82	14.80	37	17.92	26.7	49	n/a	38.17	30.81	-7.99	-126	42.31	49.38	17
Richardson	u/s	40071	9.26	10.33	12	14.99	18.47	23	n/a	27.18	25.76	35.79	39	25.22	51.92	106
	d/s	40050	9.26	10.30	11	14.99	18.72	25	n/a	27.33	25.76	36.23	41	25.22	17.08	-32
Huntmar	u/s	37894	13.36	13.70	3	21.20	22.05	4	n/a	30.46	34.80	36.7	5	44.74	42.25	-6
	d/s	37869	12.87	13.14	2	19.76	20.25	2	n/a	26.81	31.88	32.31	1	42.29	39.29	-7

Notes:
1. Flows are provided at maximum water level and are not necessarily the maximum flow during the simulation.
2. 25 year results indicate instability in the vicinity of Transitway/Campeau: model should be corrected/revised as required.

Table 4: Comparison of Existing and Future Condition Manning's 'n' Values

		Existing						Future		
River Station		n #1	n #2	n #3		River Station		n #1	n #2	n #3
44953	n	0.075	0.06	0.075		44953	n	0.075	0.06	0.075
44890	n	0.075	0.06	0.075		44890	n	0.075	0.06	0.075
44751	n	0.075	0.06	0.075		44751	n	0.075	0.06	0.075
44548	n	0.0675	0.06	0.0675		44548	n	0.0675	0.06	0.0675
44325	n	0.0675	0.06	0.0675		44325	n	0.0675	0.06	0.0675
44324 Hazeldean Culver	Culvert					44324 Ha	Bridge			
44302	n	0.06	0.06	0.075		44302	n	0.06	0.035	0.075
						44218	n	0.04	0.035	0.075
						44193	n	0.04	0.035	0.075
44153	n	0.0675	0.06	0.075		44153	n	0.04	0.035	0.075
						44093	n	0.04	0.035	0.075
						44068	n	0.04	0.035	0.075
						44044.2	n	0.04	0.035	0.075
						44013.6	n	0.04	0.035	0.04
43966	n	0.0675	0.06	0.075		43966	n	0.0675	0.035	0.04
						43954	n	0.04	0.035	0.04
						43946	n	0.04	0.035	0.04
						43938	n	0.04	0.035	0.04
						43852	n	0.04	0.035	0.0793
						43822	n	0.04	0.035	0.0803
						43813	n	0.04	0.035	0.0806
43764	n	0.0675	0.0525	0.0825		43764	n	0.04	0.035	0.0825
43582	n	0.0675	0.0525	0.075		43582	n	0.04	0.035	0.075
						43572.4	n	0.04	0.035	0.075
43375	n	0.0675	0.0525	0.075		43375	n	0.04	0.035	0.075
43370 Maple Grove Culv	Culvert					43370 M	Bridge			
43364	n	0.075	0.0525	0.0675		43364	n	0.075	0.035	0.0675
43223	n	0.075	0.0525	0.0675		43223	n	0.075	0.035	0.04
						43180.6	n	0.075	0.035	0.04
43173	n	0.075	0.0525	0.0675		43173	n	0.04	0.035	0.04

						43163.8	n	0.04	0.035	0.0675
						43100	n	0.04	0.035	0.0675
43072	n	0.075	0.0525	0.0675		43072	n	0.04	0.035	0.04
						42975	n	0.04	0.035	0.04
						42970.1	n	0.04	0.035	0.04
42890	n	0.075	0.0525	0.0675		42890	n	0.04	0.035	0.04
						42889	n	0.04	0.035	0.04
42885 Palladium Drive	Bridge					42885 Pa	Bridge			
42855	n	0.06	0.0525	0.0825		42855	n	0.06	0.035	0.05
42686	n	0.06	0.0525	0.0825		42686	n	0.06	0.035	0.0825
42558	n	0.06	0.0525	0.0825		42558	n	0.06	0.035	0.0825
42410	n	0.06	0.0525	0.0825		42410	n	0.06	0.035	0.0825
42212	n	0.06	0.0525	0.0825		42212	n	0.06	0.035	0.0825
42182	n	0.06	0.0525	0.0825		42182	n	0.06	0.035	0.0825
42172 Highway 417 Sout	Bridge					42172 Hi	Bridge			
42154	n	0.06	0.0525	0.0825		42154		0.06	0.035	0.0825
42134	n	0.06	0.0525	0.0825		42134		0.06	0.035	0.0825
42124	n	0.06	0.0525	0.0825		42124		0.06	0.035	0.0825
42119 Highway 417 Nort	Bridge					42119 Highway				
42097	n	0.0675	0.06	0.06		42097		0.04	0.035	0.06
42075	n	0.0675	0.06	0.06		42075		0.04	0.035	0.04
						42036		0.04	0.035	0.04
42002	n	0.0675	0.06	0.06		42002		0.04	0.035	0.04
41896	n	0.0675	0.06	0.06		41896		0.04	0.035	0.04
						41836		0.04	0.035	0.04
						41776		0.04	0.035	0.04
						41769		0.04	0.035	0.04
						41744		0.04	0.035	0.04
41743	n	0.0675	0.06	0.06		41743		0.04	0.035	0.04
						41738	Fut bridge			
						41725.5		0.04	0.035	0.04
41671	n	0.09	0.06	0.09		41671		0.04	0.035	0.04
						41608		0.04	0.035	0.04

						41602 Fu	Bridge	0.04	0.035	0.04
						41572	n	0.04	0.035	0.04
						41374.8	n	0.04	0.035	0.04
41357	n	0.09	0.06	0.09		41357	n	0.09	0.035	0.04
						41349.4	n	0.09	0.035	0.04
						41338	n	0.09	0.035	0.04
						41320	n	0.09	0.035	0.04
						41198	n	0.09	0.035	0.04
						41180	n	0.04	0.035	0.04
						41125.4	n	0.04	0.035	0.04
41117	n	0.09	0.06	0.09		41117	n	0.04	0.035	0.04
						41071	n	0.04	0.035	0.04
						40965.2	n	0.04	0.035	0.04
						40956	n	0.09	0.035	0.09
						40919.2	n	0.0406	0.035	0.09
40910	n	0.09	0.06	0.09		40910	n	0.04	0.035	0.04
40703	n	0.09	0.06	0.09		40703	n	0.09	0.035	0.04
						40688.5	n	0.09	0.035	0.09
40505	n	0.09	0.06	0.09		40505	n	0.09	0.035	0.09
						40423.5	n	0.09	0.035	0.09
						40415	n	0.09	0.035	0.04
						40348.1	n	0.09	0.035	0.04
						40339.7	n	0.09	0.035	0.04
40298	n	0.09	0.06	0.09		40298	n	0.09	0.035	0.04
40092	n	0.09	0.06	0.09		40092	n	0.09	0.035	0.04
						40071.5	n	0.09	0.035	0.09
40070 Richardson Side	Culvert					40070 Ri	Culvert			
40050	n	0.09	0.06	0.09		40050	n	0.09	0.06	0.09
Future Manning's 'n' values										
		pond/pool area								
		low flow channel								
		manicured area								

Table 5: Summary of Approach to Assigning Manning's 'n' Values for Channel and Overbanks (2005 to 2010)

Document	Reference	Excerpt
Flow Characterization and Flood Level Analysis: Carp River, Feedmill Creek and Poole Creek (CH2MHill, October 2005)	Insert at front of report	MVC comment: *Since the calibration of water levels to the September 9, 2004 flood shows that using Manning's n values 1.5 times typical values (sic), these increased values should be used for all subsequent scenarios…*
	p. 3-2 to 3-3	*The roughness coefficient, or Manning n values, were determined for the main channel as well as over-bank areas by reviewing the vegetation cover characteristics as exhibited on air photography and investigated in the field. Most of the Carp River is straight, earthen channel containing dense weeds and other aquatic plants within a deep channel containing a depth of organic silt along the bottom. Therefore, a Manning coefficient of 0.035 was selected for the channel…. The over-bank, or over-bank areas along the Carp River contain some cultivated fields as well as light brush and heavy weed growth area; indicating an n value varying from 0.04 to 0.07.*
	p. 3-4	*A sensitivity analysis was completed to determine the effect the Mannings n roughness coefficient value has on the simulated water levels…..The water levels simulated using 1.5n produced levels closest to the observed levels.* *The calibrated n values (i.e. Manning n increased by 50%) are representative of the conditions on September 9th due to the fact that vegetation had reached a peak at the end of the summer season. The calibrated n values were applied to all subsequent water surface profile runs.*
Post-Development Flow Characterization and Flood Level Analysis for Carp River, Feedmill Creek and Poole Creek (CH2MHill, June 2006)	p.19	*Manning's roughness coefficients were modified to reflect the vegetation cover that would be representative of the proposed channel restoration project, and are equivalent to the modified flood elevations determined from the September 9, 2004 flood event which was completed as part of the Flow Characterization and Flood Level Analysis report (October 2005 CH2MHill).*

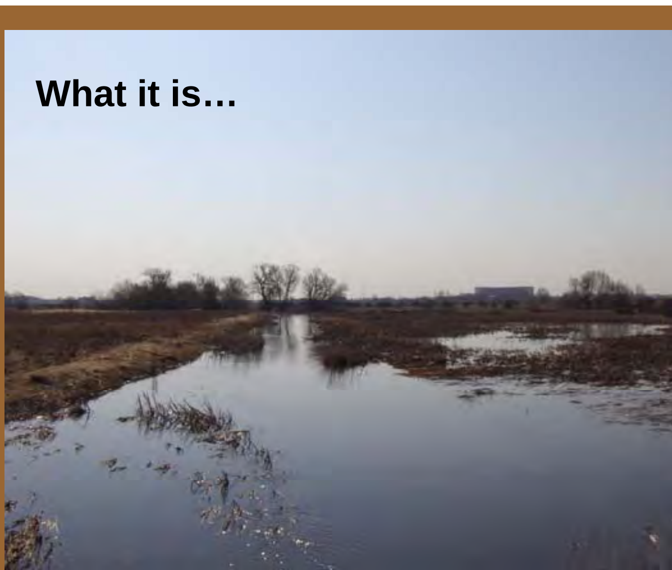
Carp River, Poole creek and Feedmill Creek Restoration Class EA (Totten Simms Hubicki et.al., June 2006)	p.88	*A major component of the Carp River restoration plan is riparian plantings along the corridor. A 70% riparian cover target along the length of the corridor (Appendix C) has been set.*
	p.90	*Riparian plantings would generally consist of three components. First, creek watercourses would be planted to ensure a 5m band of red osier dogwood (Cornus stolonifera) and speckled alder (Alnus rugosa) (50/50 mix) to provide overhanging shade. Second, valley side slopes and valley floors would be planted with clusters of white cedar (Thuja occidentalis). Third, top of valley tableland plantings would include white spruce (Picea glauca). Detailed landscape plans will be prepared as part of detailed design and other planting materials such as willow will be considered.*
	p.91	*Riparian plantings would increase habitat diversity for birds, small mammals, and deer. In addition, riparian plantings within and outside the flood plain may enhance the riparian corridor linkage functions within the creek systems.*
Third Party Review - Carp River Restoration Plan (Greenland, March 2009) **<u>(emphasis added)</u>** (Note: no mention of lowered overbank 'n' values at habitat and SWM ponds in this document.)	p.31	*The model parameter values for the most part are within standard ranges suggested by the User Manual. The manual gives a range of values to be applied for Manning's "n". Typically, adjusting these "n" values by less than 50% gives a very little change to flow conditions.*
	p.51	*Adjusting the starting conditions at the Palladium gauge location in the HEC-RAS model to match the measured water level (vertically adjusted) at the start of the storm event would remove some of this missing volume as well. The existing conditions XPSWMM model has been updated to account for the missing volume from the conduits. These hydrologic inputs would also assist in balancing what has been identified as missing volume.* ***<u>With these datum and starting conditions adjustments and revised hydrologic model inputs, the Manning's n adjustment in the CH2MHill calibration HEC-RAS model may not be required to match water levels with the measured results. This Manning's n adjustment is not a critical component in the establishment of the calibrated model since the original and adjusted parameters fall within a normal range for the vegetation and channel type as well as seasonal changes in vegetation.</u>***
	p.51	*Any additional efforts with the calibration exercise will be more useful incorporating these changes and substantiating the models once additional*

		monitored data is collected at other locations that have been previously recommended in the corridor. Specifically, the data being collected from the monitor recently installed in Poole Creek will address the timing of flows through the corridor thereby using input hydrograph adjustments to achieve the water level match with measurements from gauges on the Carp River. ***<u>It is anticipated that only minor adjustments in Manning's values would be subsequently made with this validation process.</u>***
Feb. 17/10 Greenland response to Jan.18/10 correspondence from Darlene Conway, P. Eng.	p.3	*The selection of 0.035 for the low flow channel was done since the new channel was to be a shallow (0.6 m deep) channel with a gravel substrate and light vegetation along the immediate banks. The US Army Corps of Engineers recommends in the HEC-RAS model software for dredged channels with stony bottom and weedy banks n values ranging from 0.025 to 0.040. TSH used 0.035 as opposed to the 0.060 suggested by Ms. Conway. The vegetative buffer of shrubs that are proposed to be planted are set back from the low flow channel and stretching into the overbank areas. TSH determined that the vegetation in the low flow channel would be so inundated during a major flood event that it would have a negligible impact on the main flood flow therefore warranting the low end of the acceptable range of values (telephone conversation with Mr. Paul Frigon, P. Eng., TSH/AECOM).*
	p.3	*During the TPR, Greenland reviewed several locations throughout the corridor to confirm whether an overbank n value of 0.040 could be applied by TSH in the vicinity of ponds and habitat pools. For conservatism, in the vicinity of pools, we assumed that all non pond/pool locations in the overbank were planted with brush (n=0.08) including pond slopes and floodplain slopes. The actual pool comprising water an n value of 0.001 was taken and an average n value computed for the entire overbank. In each case the average n value was less than the 0.040 value used by TSH with the exception of section 43582 where we computed a value of 0.046.*
	p.3	*There is only 9.3% where there can be any debate on the selection of the n value. The locations where there can be some debate compare n values of 0.04 to 0.06 and some areas to 0.0675 or 0.09. The 0.04 value is defendable if the area is to have light brush or pasture grasses.*
Carp River Restoration Plan – Widening	p.6	*There were some datum issues with the water levels recorded by the field*

Alternatives (Greenland, May 2010) **<u>(emphasis added)</u>**		*monitors during the calibration exercise for the existing conditions HEC-RAS model, and the overall volume of water being generated by the hydrology model as input into the HEC-RAS model.* ***<u>The original assessment of multiplying the Manning's n values by 1.5 proposed by CH2MHill could be revisited once more monitored data was available.</u>***

The Carp River

What it is…



This is a view of the Carp River, in the spring of 2008, looking south from Richardson Side Road.

What it could be.

Restoring the Carp River will create a functioning channel and floodplain area conducive to a healthy water system, vibrant fish and wildlife habitats and aesthetically pleasing recreational areas.

All about the Carp River

The Carp River watershed is located in the northwest portion of the City of Ottawa within the former townships of West Carleton and Goulbourn, and the City of Kanata.

The headwaters of the system originate in the upper portion of the watershed within the urban areas of Glen Cairn. It flows northward where it empties into the Ottawa River.

It is approximately 41 km in length and drains into an area of about 306 km^2
The Carp River's main tributaries include Poole, Feedmill, Huntley and Corkery Creeks.

The land use is predominantly urban at the headwaters and with the remainder of the watershed primarily rural

The rural villages of Carp, Kinburn, and Fitzroy Harbour are situated at various locations along the river within the former Township of West Carleton

Existing conditions of the Carp River and Floodplain

Over the years, the Carp River has been dredged—bottom sediments gathered up and disposed of at a different location—relocated and straightened.
The flood plain is partially disconnected from the low flow channel.
Bed grade of the river is very low resulting in slow flow velocities.
The existing flood plain is flat and shallow—extent of the flood plain is due to the flat topography, not the need to convey large flows
The velocities in the flood plain for the 100 year flood in the order of 0.1 metres per second
The increasing sediment in the river impacts conveyance capacity and flood levels could increase in the future
Mono-culture fish habitat

Restoration of the Carp River is non-negotiable

There is a misconception that stopping development in Kanata West is going to "save" the Carp River. This is not the case. The implementation of the Carp River Restoration Plan will restore the Carp River to its original purpose as a functioning channel and floodplain system.

In working with the City of Ottawa and the Kanata West Owners Group, MVC has ensured that the health and functionality of the Carp River has not been neglected in the development plans. Making the restoration plan an indelible condition of development in the flood fringe of the Carp River not only opens up the opportunity for restoration, it enables the Carp River to become a recreational and aesthetic benefit to the community.

The Carp River must be restored regardless of whether or not this land is developed. Neglecting the Carp River floodplain in an effort to "save" the Carp trivializes a complex technical situation.

The unique characteristics of the Carp River calls for the consideration of planning concepts that are not regularly used but still conform to provincial accepted floodplain management policies and address public safety issues.

What has become known as a two-zone concept with regard to Kanata West development is better described as the elevating of shallow flood fringe areas to raise them above 1:100 year peak flood before development occurs. The design also maintains the existing flood plain storage.

The Carp River Watershed/Subwatershed Study

In 2004 the City of Ottawa, in partnership with Mississippi Valley Conservation, the Ministry of Natural Resources, Ministry of Agriculture and Rural Affairs and Ministry of Environment completed the Carp River Watershed/Sub-watershed Study. Watershed and Sub-watershed planning is a cooperative effort of stakeholders, municipalities and government agencies to create a long-term management plan for resources within the watershed. Community input and support is critical to success of the plan.

One of the key limitations within the watershed is a lack of baseflow—the portion of streamflow that comes from groundwater and not runoff—in the Carp River and many of its tributaries

One of the most serious problems observed within the Carp River and some of its tributaries is the accumulation of sediment. The watercourses do not have enough power to push sediment through the system

Over 80% of the Carp River is experiencing this condition, particularly evident in the Carp River upstream of the Village of Carp

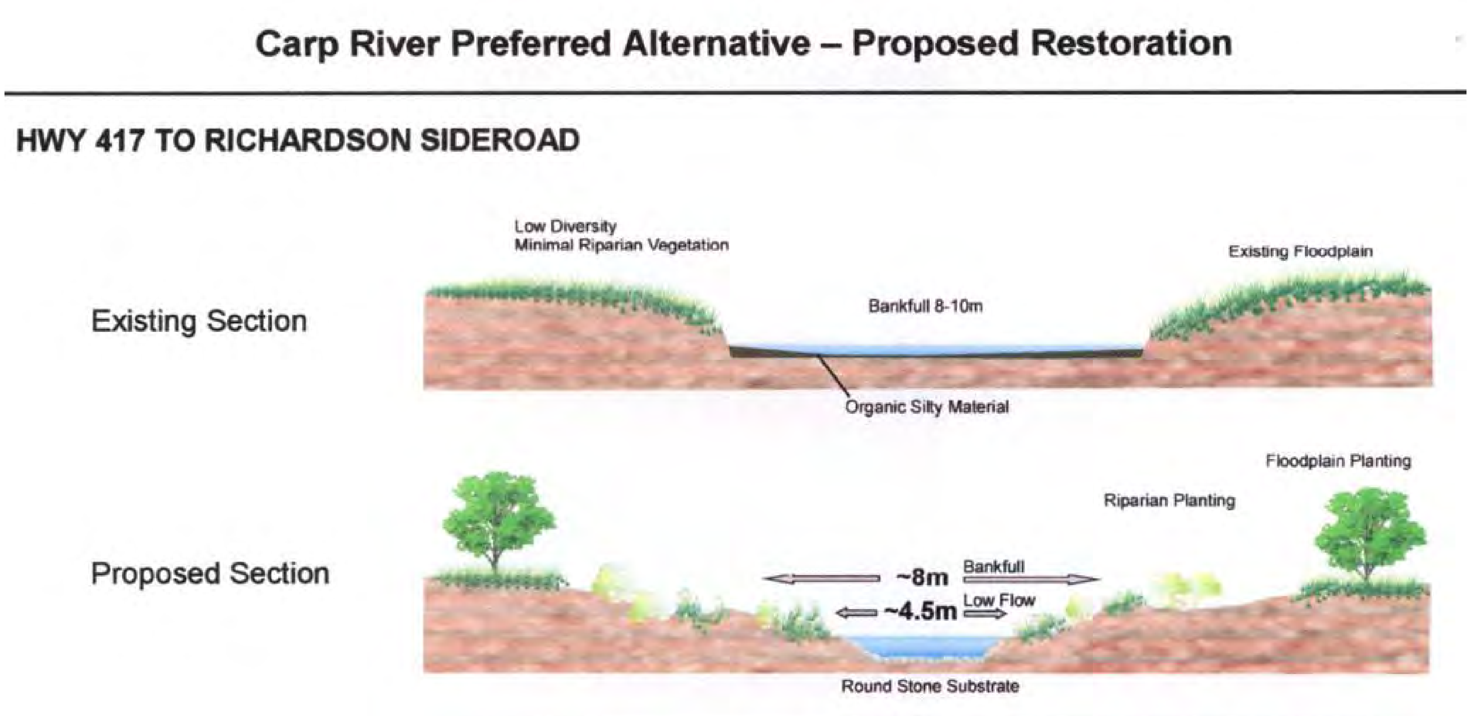
The stream adjusts to this condition by widening and straightening, further contributing to the sediment buildup.

Accumulated sediment contributes to degraded water quality, reduced conveyance capacity and degraded fish habitat

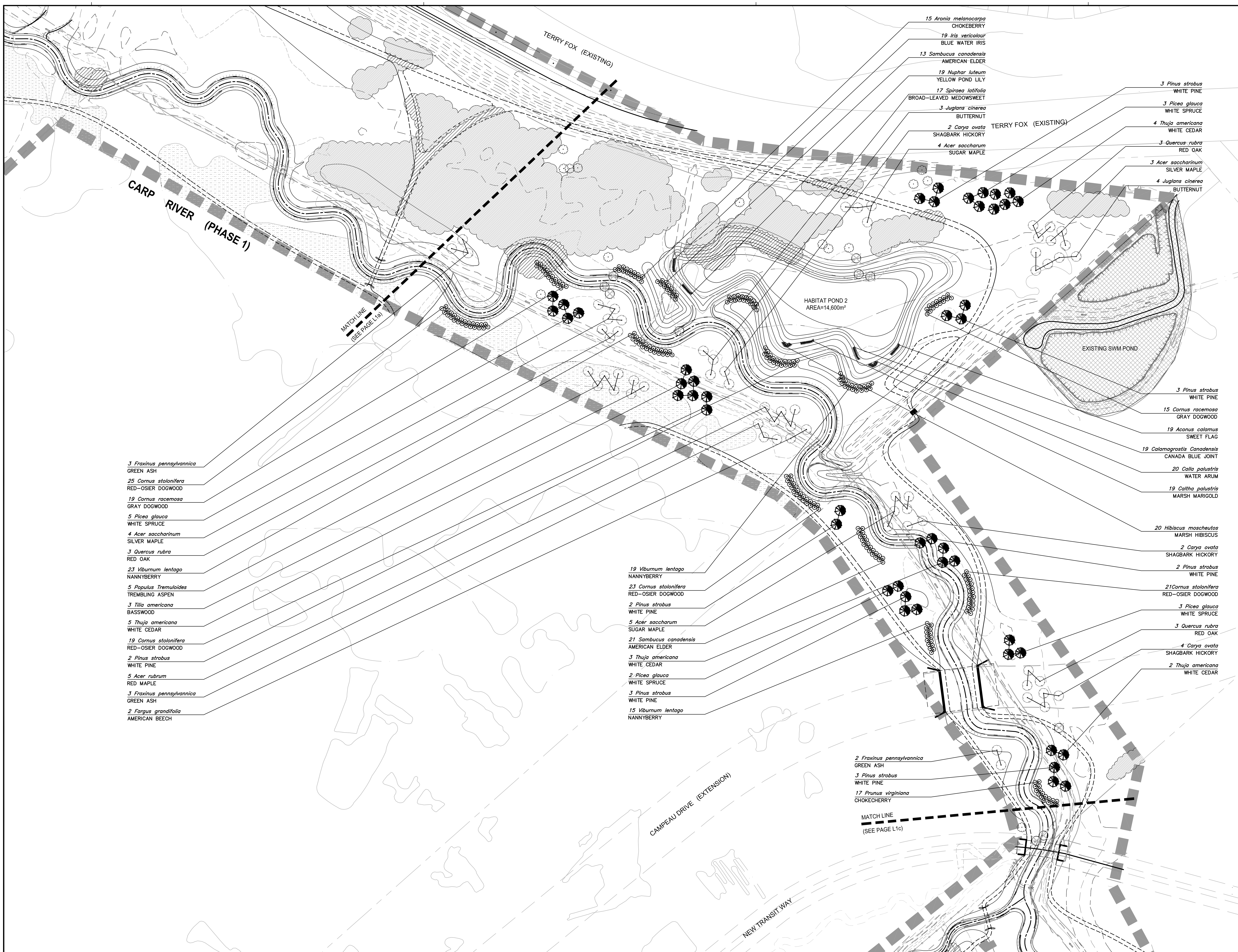
About the Restoration Plan

A conceptual restoration plan for the reach of the Carp River within the Kanata West area has been developed to solve the issues identified in the watershed/subwatershed study. The main objectives of the restoration plan are to maintain a sediment balance and to enhance and diversify fish habitat. The following bullets outline key points of the restoration concept:

- The restoration plan can be accommodated within a 100 metre corridor
- The estimated cost of project is $5 to $6 million
- 70% of restoration of costs are covered by the Kanata West Owners Group through contingencies built into the development process
- To assist in the implementation of the project of the City of Ottawa is proposing to employ the floodway/ flood fringe concept for the Carp River between Richardson Side Road and Hazeldean Road
- The restoration plan also results in a reconnected, functioning flood plain
- The floodway/flood fringe concept is being appropriately employed in a wide shallow flood plain in an urbanizing area
- Hydrological and hydraulic analysis was included in the Carp River watershed/subwatershed study



This illustration shows how the restoration process will narrow and deepen the Carp River to alleviate sedimentation problems through faster moving waters and deeper channels. The plan also allows for shoreline rehabilitation through riparian plantings.



NORTH

NOTE :

IT IS THE RESPONSIBILITY OF THE CONTRACTORS TO INFORM THEMSELVES OF THE EXACT LOCATION OF, AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES, SERVICES AND STRUCTURES WHETHER ABOVE GROUND OR BELOW GRADE BEFORE COMMENCING THE WORK. SUCH INFORMATION IS NOT NECESSARILY SHOWN ON THE DRAWING, AND WHERE SHOWN, THE ACCURACY CANNOT BE GUARANTEED.

WITH THE SOLE EXCEPTION OF THE BENCHMARK(S) SPECIFICALLY DESCRIBED FOR THIS PROJECT, NO ELEVATION INDICATED OR ASSUMED HEREON IS TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

LEGEND

- PROPOSED CONIFEROUS TREE
- PROPOSED DECIDUOUS TREE
- PROPOSED SHRUB
- PROPOSED WETLAND PLANT
- EXISTING VEGETATION TO REMAIN
- EXISTING VEGETATION TO BE REMOVED
- EXISTING VEGETATED GROUPING TO REMAIN
- EXISTING VEGETATED GROUPING TO BE REMOVED
- EXISTING CHANNEL TO BE FILLED
- EXISTING MARSH LAND AREA
- PROPERTY LINE
- CORRIDOR LIMIT
- EXISTING CONTOURS
- EXISTING DITCH LINE
- CONSTRUCTION LIMIT
- PROPOSED CREEK ALIGNMENT
- EXISTING CENTERLINE OF CREEK
- PROPOSED PATHWAY (CONSTRUCTION ACCESS)

No.	DATE	BY	ISSUES / REVISIONS
1			

TSH engineers architects planners
Totten Sims Hubicki Associates (1997) Limited
72 Victoria St. S., Suite 202
Kitchener, Ontario
N2G 4Y9
TEL: 519-886-2160
FAX: 519-886-1697
E-mail: waterloo@tsh.ca
www.tsh.ca

CLIENT: Ottawa

PROJECT: CARP RIVER RESTORATION

DRAWING: PHASE ONE LANDSCAPE PLAN

DRAWN BY: MM	CHECKED BY:	PROJECT No.: 54-22214
DESIGNED BY:	APPROVED BY:	DRAWING No. L1b
SCALE: 1 : 1250	DATE: 01/07	

Table 6: 100 year event peak flow and velocity summary

Ex TPR Mar 09: existing condition peak flows from modeling received from City of Ottawa in November 2009.
Fut WA May 10: future condition peak flows provided by City on August 23rd, 2010

		Ex TPR Mar 09			Fut WA May 10			WSEL	Peak flow
Location	Station	W.S. Elev	Qtotal	Vch	W.S. Elev	Qtotal	Vch	difference	increase
		(m)	(m3/s)	(m/s)	(m)	(m3/s)	(m/s)	(m)	%
d/s of Glen Cairn SWM pond	44953	94.92	9.89	0.13	94.81	12.31	0.17	-0.11	24.5
	44751	94.91	9.80	0.17	94.80	12.28	0.19	-0.11	25.3
	44548	94.90	16.06	0.15	94.77	20.58	0.18	-0.13	28.1
u/s Hazeldean Road	44325	94.87	15.95	1.09	94.74	22.49	0.55	-0.13	41.0
d/s Hazeldean Road	44302	94.53	15.41	1.18	94.49	22.16	0.86	-0.04	43.8
	44267.4	94.54	15.41	0.24	94.50	22.19	0.37	-0.04	44.0
	44218	94.54	15.40	0.22	94.50	22.20	0.18	-0.04	44.2
	43966	94.53	15.37	0.14	94.49	22.13	0.18	-0.04	44.0
	43764	94.52	16.82	0.15	94.49	23.16	0.16	-0.03	37.7
	43582	94.51	17.08	0.16	94.48	23.89	0.19	-0.03	39.9
u/s Maple Grove Road	43375	94.44	17.42	1.27	94.44	22.71	0.85	0.00	30.4
d/s Maple Grove Road	43364	94.43	17.42	1.14	94.42	20.14	0.78	-0.01	15.6
	43173	94.44	17.38	0.17	94.43	21.16	0.08	-0.01	21.7
	43072	94.43	34.26	0.34	94.42	47.14	0.22	-0.01	37.6
u/s Palladium Drive	42889	94.36	34.25	0.83	94.34	54.88	1.57	-0.02	60.2
d/s Palladium Drive	42855	94.33	34.25	0.83	94.25	53.29	1.52	-0.08	55.6
	42558	94.29	34.24	0.46	94.25	53.46	0.61	-0.04	56.1
	42410	94.25	34.68	0.52	94.19	54.69	1.14	-0.06	57.7
u/s Hwy 417 South	42182	94.18	34.66	1.34	93.94	54.65	2.12	-0.24	57.7
d/s Hwy 417 South	42154	94.13	34.66	1.32	93.85	54.66	2.13	-0.28	57.7
u/s Hwy 417 North	42124	94.08	34.62	1.38	93.77	54.66	2.30	-0.31	57.9
d/s Hwy 417 North	42097	94.00	34.23	1.46	93.72	54.65	2.11	-0.28	59.7
	42002	94.02	34.47	0.32	93.83	54.65	0.32	-0.19	58.5
	41836	93.99	34.77	0.36	93.81	56.15	0.46	-0.18	61.5
u/s Future Transitway	41743	93.98	34.63	0.29	93.74	55.36	1.54	-0.24	59.9
d/s Future Transitway	41 725.5	93.97	34.63	0.33	93.76	55.67	1.14	-0.21	60.8
	41671	93.95	34.26	0.79	93.78	56.24	0.58	-0.17	64.2
u/s Future Campeau Drive	41608	93.84	43.24	1.02	93.73	64.57	1.11	-0.11	49.3
d/s Future Campeau Drive	41572	93.79	42.31	0.98	93.71	64.15	1.11	-0.08	51.6
	41357	93.60	37.41	0.32	93.67	48.83	0.52	0.07	30.5
	41117	93.57	36.09	0.23	93.67	49.11	0.35	0.10	36.1
	40910	93.55	35.33	0.21	93.67	50.28	0.15	0.12	42.3
	40703	93.53	34.28	0.22	93.66	50.25	0.18	0.13	46.6
	40505	93.51	32.12	0.22	93.65	51.74	0.34	0.14	61.1
	40298	93.49	28.57	0.16	93.64	51.67	0.13	0.15	80.9
	40092	93.48	26.57	0.24	93.64	52.07	0.35	0.16	96.0
u/s Richardson Side Road	40071.5	93.45	25.22	1.11	93.51	16.79	0.70	0.06	-33.4
d/s Richardson Side Road	40050	93.44	25.22	1.08	93.51	17.14	0.66	0.07	-32.0
	39892	93.44	25.35	0.26	93.51	17.34	0.16	0.07	-31.6
	39202	93.39	22.16	0.16	93.50	16.34	0.09	0.11	-26.3
	38697	93.38	21.97	0.08	93.50	16.31	0.05	0.12	-25.8
	38236	93.37	21.92	0.12	93.49	16.29	0.08	0.12	-25.7
u/s Huntmar Drive	37894	93.36	44.74	0.19	93.46	42.30	1.13	0.10	-5.5
d/s Huntmar Drive	37869.5	92.97	42.40	1.64	92.96	39.33	1.53	-0.01	-7.2

-
Note: the % increases are for Qtotal (at max. water level) not Qpeak (the max. peak flow achieved), hence, % decreases downstream of Richardso
are a result of lagging through the structure.

Request for Proposal
Professional Engineering Services

Glen Cairn Flooding Investigation

Note: Consultants (including sub-consultants) who have been involved in the following work within the past fifteen (15) years would not be considered:

- **Carp River or Glen Cairn Flooding Analysis**
- **Carp River Environmental Assessment Study**
- **Kanata West Development**
- **Fernbank Community Design Plan**

Requirement:
The City of Ottawa, hereinafter referred to as the *City* is seeking proposals from Consulting Engineering firms hereinafter referred to as the *Consultant* to provide professional engineering services as described in the Project Information and General Terms of Reference attached as Annex "A".

Period of Proposed Contract:
The proposed period of contract is from date of award to 31 August 2010.

Project Authority:
The services provided will be subject to review and acceptance by the Project Authority hereby identified as the Director, Infrastructure Services Department.

Inquiries:
All inquiries regarding this Request for Proposal (RFP) are to be directed to the Contracting Authority specified herein. Inquiries must be received in writing (e-mail) no later than **Wednesday, 28 October 2009.** All inquiries received, and the answers as provided by the Project Authority will be provided to all Consultants by way of written addendum, no later than **Friday, 30 October 2009** without naming the source of the inquiry.

Order of Precedence:
The documents listed below form part of the Request for Proposal (RFP) and will be incorporated into any resulting contract. If there is a discrepancy between the wording of one document and the wording of any other document which, appears on the list, the wording of the document which appears first on the list shall take precedence:

Request for Proposal
Annex A - Project Information and General Terms of Reference
Annex B - Financial Proposal and Contractual Acknowledgement
Annex C - General Conditions - Engineering Services – April 2009
Annex D - Conflict of Interest – Declaration Form

Content of Submission:
Your proposal must not exceed ***ten (10) single sided pages*** in 10-point font (Times New Roman) including spreadsheets, which can be submitted in 11" X 17" format and will count as *one (1) page*. Any documentation exceeding the maximum ten (10) pages will not be considered.

Résumés must be attached to the Content of Submission in the form of appendices. Any other supplemental documentation that does not respond directly to the Terms of Reference and Evaluation Criteria, such as corporate literature, must be submitted on CD or DVD. The City will not consider supplemental documentation submitted on CD or DVD in the evaluation of submissions.

Provide **six (6)** copies of your service proposal, and **two (2) sealed** copies of your financial proposal.

detail is required for the entire sewershed. Surface ponding at a street-by-street level will need to be included (if applicable) in the analysis. The model must be at a level of detail that would generate flows and water levels both within the neighbourhoods as well as along the Carp River between the Glen Cairn pond and Eagleson Road. Given the lack of flow monitoring data, calibration of minor system flows will not be required, however the location of flooded homes as well as measured water levels along the Carp River shall be used to determine the validity of the model. Runoff hydrographs for several design storms (2, 5, and 100 years) as well as three historical storms (Including July 24th, 2009) are to be generated. For the July 24, 2009 event, the consultant will be required to review the calibrated radar rainfall data (to be provided by the City) and make recommendations regarding the use of aerial rainfall distribution as compared to a uniformly distributed rainfall over the sewershed. The City will provide al historical storm data. There are approximately 600 storm pipe segments and 564 manholes in the study area, for total sewer length of approximately 33 Km.

- As noted earlier, boundary conditions at the Glen Cairn stormwater management pond as well as water levels along the Carp River within the Glen Cairn community for the July 24th, 2009 event, will be provided by the City for evaluation of HGL elevations along the storm sewer system.

2.6 Utilize Computer Model

- The computer models described above will be used to assess the existing level of service as well as various conceptual servicing alternatives that will be developed as part of this study. The simulations will determine if an adequate major system exists in the sewershed and what improvements can be achieved through the development of various alternatives. The models will also be used to assess the service level of the minor system as well as the capacity of the sanitary sewer system as well as overflow alternatives for the Hazeldean pumping station. The models will be used in conceptual and functional servicing alternatives.

~~2.9~~2.7 Conceptual Servicing Alternatives

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- Develop conceptual servicing alternatives that fulfill the level of service requirements. These alternatives should consider opportunities for over-control of flow to the minor system, SWM ponds (storage), new major system outlets, and increased pipe capacity (if required). Any pipe capacity assessment would be based on the free flow capacity of the minor storm system and the sanitary system as determined by the dynamic models. The City will provide outlet boundary conditions along the Carp River for the storm system as well as HGL elevations at the Stittsville Trunk Sanitary sewer. The solution should take full advantage of dual drainage opportunities, resulting in the installation/modification of inlet control devices, as well as the modification of overland flow routes if necessary. Sanitary system improvements (i.e. local bottlenecks) shall also be studied. Should undue constraints to improved system performance be imposed by water levels on the river or in the Glen Cairn Pond, opportunities to address this constraint would also have to be addressed.

- Climate change impacts should also be considered when developing alternatives.

- Clearly identify major constraints, concerns and cost implications to servicing alternatives. Reply to comments and questions from city staff.

- Carry out screening of alternatives in order to develop a short-list for detailed evaluation.

Welcome

Glen Cairn Flood Investigation Study
Public Open House #1

Holy Trinity Catholic High School
May 19th, 2010
6:00 PM to 9:00 PM (Presentation at 7:00 PM)

Storm Drainage System

Conclusions from modeling analysis

The high water levels in the Glen Cairn pond restricted the flow from the storm sewer system during the July 24, 2009 storm particularly in the southwest area of Glen Cairn.

Potential Solutions: Modify Glen Cairn SWM Pond to provide lower operating levels, divert flow to Monahan Drain, pump flow, modify Carp River, etc.

Table 7: SWM pond elevations

SWM Pond	HEC-RAS section no.	A 2 yr. flood elev.	B 10 yr flood elev.	C Bottom of active storage	C-B	C-A
		(m)	(m)	(m)	(m)	(m)
1	41117	92.74	93.22	92.70	-0.52	-0.04
2	41743	92.96	93.39	92.90	-0.49	-0.06
3	41896	92.99	93.45	92.90	-0.55	-0.09
4	43072	93.58	93.98	93.20	-0.78	-0.38
5	43582	93.65	94.05	93.44	-0.61	-0.21

Notes:
1. 2 and 10 year flood elevations from model output provided by City of Ottawa on August 23rd, 2010.
2. Bottom of active storage elevations from Master Servicing Study, Stantec, 2006, Volume 1, dwg. nos. P-1 to P-4.