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					soils which will not be conducive to mitigating infiltration. We do not agree that the potential exists for greater infiltration on the site that the water balance predicts. The water balance is based on clay-rich soils (predominantly Soil Type D (~80%), with some Soil Type D (~20%)). The water balance predictions of monthly base flows in the watercourses were identified in the report to be in close agreement with flows measured at the watercourses within the site. Additional investigative techniques such as percolation testing would be carried out during detailed design in the areas where infiltration measures, such as infiltration swales, are specifically proposed along the periphery of the natural environment areas. As noted in the report and in the response above, site grading activities (cut and fill) over much of the developable land area will leave large areas of the site with exposed soils that are not conducive to effective mitigative measures using infiltration.
37	Section 6.3.1.1	**Meander Belt Width, Page 6-2 & Appendix 6.7** • Reach 14W-12A is not included within Table 1 within Appendix 6.7. Staff anticipate that the values provided for this reach in Table 6.1 on Page 6-3 will be acceptable for pre-development conditions based on information available elsewhere in the report but request an update to Table 1 in Appendix 6.7 to verify the recommended value. • This section or another section of the report should provide recommended post-development meander belt widths	2	SVH	• Table 1 in Appendix 6.7 will be modified to include Reach 14W-12A. • Comment noted. • Under the existing condition the reach 14W-12A receives controlled discharge from the existing pond. It should be noted that existing pond (identified as 14W-14A) does not have any outlet locations at the south end. Hence, as the existing pond becomes

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		considering the post-development hydrologic regime for the various watercourses (See Section 7 comments below). • Staff agree that Reach 14W-12A is hydraulically distinct from the remainder of 14W-12, however, we disagree with the statement that Reach 14W-12A will continue to receive controlled discharge from SWM Pond 3 which is proposed to outlet directly to Reach 14W-12.			full, the water in the existing pond backs up and exits the pond via 14W-12A stream corridor.
38	Section 6.3.2	**Regulatory Floodplain, Page 6-3 –** • A digital copy of the hydraulic models for **all** reaches are required to complete our review. Conservation Halton staff will not be providing any further comments on flooding hazards unless digital copies of the models are submitted. • Hard copy model and mapping remains outstanding for Reach 14W-14A. • Reach 14W-11 and 14W-11A floodlines are not shown on Figures 6-2.1A (existing) and 6-2.1B (proposed). • Hard copy model remains outstanding for Reach 14W-11 & 14W-11A. • The hydraulic section locations shown on Figure 6-2.1A do not match those utilized in Appendix 6.1 for Reaches 14-12A, 14W-13, and 14W-14. These should be made consistent to facilitate future reviews and prevent confusion. • See also Comment #55 below regarding Appendix 6.1.	1 & 2	SVH	• To be provided. • Comment noted. • Comment noted. • To be provided. • The hydraulic section location shown in Figure 6-2.1A were found to match the hydraulic sections or river stations shown in Table 6-1.7 for the Pre-Development Condition. Additional clarification on this matter is required. • Will be addressed as #55.
39	Section 6.3.3	**Top of Bank, Page 6-4 –** Conservation Halton staff look forward to receiving the outstanding slope stability assessment for Reach 14W-11. Staff note that there is a typographical error at the end of this section that directs the reader to the incorrect Appendix.	1	SVH	The slope stability analysis has been completed by Exp. Inc. for Reach 14W-11. It report will be submitted in the next submission. However, if the CH wishes to review it now, it can be sent beforehand.
40	Section 6.3.5	**Setback and Buffer Requirements, Page 6-5 –** This section has not been updated to clarify what the proposed setback and buffers are applied to nor does it reflect the correct setbacks. Further, we would like to note that watercourse 14W-11 A meets the definition of Redside Dace habitat in the ESA's Ontario Regulation 293/11. As such, this	2	SVH/MC	Comment noted. Further discussion is required.

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		watercourse should receive an appropriate setback (meander belt width + 30 m).			
41	Section 6.3.6	**Hydrologic Feature 'A', Page 6-5** • The text incorrectly references Reach 14W-12 instead of Reach 14W-16 with respect to one of the Hydrologic Feature 'A's. The potential impacts to this Hydrologic Feature 'A' as a result of the proposed reconstruction of the bankfull channel should be discussed. • See Comment #53 below regarding the riparian flood storage analysis. Staff are not satisfied that the analysis demonstrates to-date that the storage associated with the Hydrologic Feature 'A' associated with Reach 14W-14A has been replicated.	1 & 2	SVH	• Correction will be made to the text and comments noted. • The reach 14W-14A is an existing pond. It should be noted that in the NOCSS (2006) flood plain analysis was conducted for the 14W-14A corridor. We have requested the up-to-date HEC-RAS model from CH to update our analysis.
42	Section 6.3.7	**Corridor Widths, Page 6-6 & Appendix 6.5 –** • Reach 14W-11 details should be included within Table 6.3 on Page 6-6. • Table 6.3 should clarify the 7.5 and 15 metre setback/buffer with respect to what they are based on (fisheries or hazards) and if they are applied to the meander belt, erosion hazard or other. • Staff note that the values in Table 6.3 do not always match those provided in Appendix 6.5 or on Figure 6.3. All three sources should be consistent. • Table 6.3 and Appendix 6.5 should be clarified where corridor widths are being recommended for existing conditions, proposed or both conditions. Table 6.3 appears to be covering existing conditions whereas Appendix 6.5 appears to be covering proposed conditions (though without taking in account the proposed flow regime changes). • Footnote 'b' in the Appendix 6.5 table is incorrect and should reference 3 m instead of 6 metres as Column 7 notes that the Factor of Safety is to be multiplied by 2. • For clarity, it would be helpful if this section noted those areas	1	SVH	Comments noted.

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		where the corridor width must be extended in order to encompass the floodplain/top of bank plus 7.5 metre allowance. • Appendix 6.5 states that a stable top of bank analysis is not required for Reach 14W-11 while the cover response letter and Section 6.3.3 indicates that a stable top of bank assessment will be submitted. Once all of the outstanding issues have been resolved, it should be ensured that the Draft Plan of Subdivision is updated accordingly.			
43	Figure 6.3	**Corridor Delineation –** • 'Top of Bank 7.5 m Buffer' would be more accurately named '7.5 m Hazard Allowance' as it can apply to the flood plain, meander belt or top of bank. Staff noted one location on Reach 14W-11A where the 7.5 metre allowance has not been applied to the Regional Storm floodline. • 'Environmental Setback' would be more accurately named '30m Redside Dace Setback'. • The solid black line should be included within the Legend. We have assumed that this line represents the future limits of the Open Space and SWM Block lines. • A 'Regulated Area Buffer' is not required on Reach 14W-21. This will not be a feature regulated by Conservation Halton in the future. Any buffers required on this reach will be determined by Town of Oakville staff and should be referenced accordingly. • All pond grading within the regulated habitat of Redside Dace must be discussed with the Ministry of Natural Resources.	1 & 2	SVH	While reach 14W-21 was previously proposed as a drainage connection only to redirect flow from reach 14W-13 to reach 14W-22, we are proposing to widen the corridor and have it maintained as a medium constraint corridor and effective extension of reach 14W-22 (which is being managed as a red stream) to offset the drainage density issue. A recommendation on Conservation Authority regulation of this reach should therefore be revisited.
44	Section 6.4.1	**Conceptual Natural Channel Design -** Concerns regarding the inclusion of a step/pool system to enable the passage of fish up the steeper channel reaches as part of the design criteria have not been addressed. It is understood that step/pool systems are not being proposed therefore reference to them should be removed from the report.	1	SVH	Comment noted.

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U	New Comment, Section 6.4.2	**Hydrology, Page 6-7** – The drainage areas listed for Reaches 14W-11A, 14W-16 and 14W-22 are slightly higher than what would be suggested by Figures 7.1 and 7.3. Is this because Hwy 407 drainage areas are included within Table 6.4 but not shown on the figures? Please revisit/correct/clarify.	1	SVH	Comment noted.
45	Section 6.4.3	**Proposed Channel Morphology, Page 6-8 -** It is noted that the average channel slope for 14W-22 is 0.32%. There is concern that this slope is too flat to maintain enough energy in the channel to allow the water flow to continue to scour a clear channel and to prevent the overgrowth of vegetation in the watercourse. If the channel becomes overgrown with vegetation, this will result in a loss of fish passage and fish habitat. It is preferred that the average slope of the channel be a minimum of 0.5%. When the channel slope is too flat, water is observed to remain in the channel in a stagnant form; this situation leads to the overgrowth of algae. It is noted that the average channel slope for 14W-23 is 0.40 %. It is preferred that the channel slopes be steepened to a slope of at least 0.50 %. Please add “meanderbelt width” to the list of parameters in Table 6.5 – Morphological Parameters for Channel Diversion and Rehabilitation. Further, once post-development drainage areas, stormwater management concepts and hydrologic conditions have been finalized and clearly documented, this section of the report will need to be revisited. The specific equations, etc. utilized should be included within the detailed design brief that will be required in conjunction with the detailed design of the channel.	1 & 2	SVH	• The proposed diversion channels 14W-22 and 14W-23 are to be constructed between two fixed channel bottom inverts. Hence there is limited opportunity and flexibility in adjusting the channel gradient. • “Meanderbelt width” will be included in the list of parameters of Table 6.5. • Comment noted.
46	Section 6.4.4	**Road Crossings, Page 6-9** • Conservation Halton staff continue to require the opportunity to review	1 & 2	SVH	• Comment noted. • Digital copy of the hydraulic model to be

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		the proposed location of Avenue 1 and Burnhamthorpe Road relative to the Main Fourteen Mile Creek valley within the field. • A hydraulic analysis has now been submitted for the proposed crossings. **Staff require a digital copy of the hydraulic models in order to complete our review**, however, we provide the following preliminary comments on the information that was provided: 1. **Section 6.4.4.1, Design Criteria** – In addition to meeting MTO design standards, Conservation Halton staff require that all new roads be designed to provide full access and egress under Regional Storm conditions, and preferably flood free access. Staff note that the current design would meet these criteria as no road overtopping is proposed under Regional Storm conditions. Fluvial geomorphological requirements must also be addressed. 2. **Section 6.4.4.2, Modelling & Analysis** – Flow rates utilized in the analysis need to be supported. See Section 7 comments below. 3. **Section 6.4.4.3, Summary** – This section states that the flood lines plotted are based on existing contour lines. Flood lines should be based on proposed grades in those areas where the flood plain is proposed for alterations (i.e. Reaches 14W-22, 14W-23 and potentially Reach 14W-16). • MNR's *Draft Guidance for Development Activities in Redside Dace Protected Habitat* provides the following advice regarding stream crossings in Redside Dace watercourses in unconfined watercourses: The location of new stream crossings should be chosen to: • Minimize the width of the crossings • Cross over straight sections of the stream where there is less likelihood for bank erosion			provided. The preliminary comments are noted. • Comments noted. • Comments noted. • Comments noted.

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		• Cross at areas that have already been disturbed and avoid initiating disturbances in new areas of the stream • For new/replacement crossings in unconfined valleys (i.e., undefined valleys), stream crossings should be open bottom culverts designed to span the meander belt of the stream. The length of the culvert should be minimized by using retaining walls vs. longer culverts to minimize disruption to riparian habitat. • In addition to the BMPs listed above, any construction activity that must occur in the stream should also incorporate the BMPs outlined for indirect habitats (i.e., upstream areas) below. This includes restoring any temporary disturbances within the riparian habitat (i.e., 30 m on each side of the meander belt) by planting native species. • It is requested at detailed design that no armouring of the bed of the watercourses take place under all road crossing structures to enable the creek to self-maintain a dynamically stable thalweg and low flow channel underneath all road crossing structures. Open bottom culverts are requested for all road crossing structures: • To maintain effective fish passage over the long term in the event that downcutting of the watercourse occurs; • To maintain groundwater and surface water interactions (recharge and discharge) to continue to occur within the channels in the road crossing structures; • To allow the creek to self-maintain a dynamic low flow channel underneath the road crossing.			
47	Figures 6.4A to 6.4D	**Alignment and Planform Drawings (Creek Crossings and Block Widths)** • The Block widths shown on these figures will have to be revisited once all of the other comments have been addressed. Staff noted that currently some of the block widths shown don't match exactly the recommended widths elsewhere in the document.	1	SVH	• Comments noted. • Comments noted. • Comments noted.

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		• Channel alignments shown no longer account for proposed culverts. These figures should be updated accordingly as part of the final EIR/FSS though we recognize the final details can be worked out at the detailed design stage. • Please demonstrate that the road layout is such that the creeks cross under the roads where the creek plan form is straight; creek crossings under roads should be designed so the creek crosses under the road at a perpendicular angle to reduce the length of the watercourse that is located under the crossing. Previous comments regarding natural channel design remain outstanding and can be addressed at a forthcoming meeting with the proponent's fluvial geomorphologist and water resources engineer.			
48	Figures 6.4A to 6.4C	**Alignment and Planform Drawings (and Section 6.4.3.2 14W-22 Diversion & Section 6.4.3.3 14W-21 Diversion) –**As noted above and in previous comments, Conservation Halton staff are concerned with the potential for aggradation where the average channel slope is less than 0.5%. The current design proposes an average channel slope of 0.32% for Channel 14W-22 and 0.40% for Channel 14W-23, however, no discussion on the potential impact that this would have on sediment transport within and downstream of the subject reach was provided. As a general rule of thumb, Conservation Halton supports a channel slope in the range of 0.5% to 1.5% for sediment transport, and a minimum channel slope of 0.5% to support fisheries. This information is required prior to staff supporting the proposed channel design concepts.	2	SVH	The average channel slope for section 14W-22 has been determined based on natural channel design procedures based on fluvial geomorphologic principles and is appropriate for the channel form given the available channel elevations between the connection points to Reach 14W-14 and 14W-16. We will investigate methods to maximize the channel grades (such as reducing the amplitude of the designed meanders), but we ask that the Regulatory Authorities acknowledge the limits to this approach. We note several municipal drain watercourses in Ontario, typically located in other jurisdictions, that possess longitudinal grades lower than the indicated 0.5%. While these channel may possess issues in some cases with aggradation, the 0.5% stated minimum slope requirement is typically assigned to storm sewer systems to avoid deposition of suspended sediment in nearly impossible to clean locations. The existing open channels (red streams) cannot have their channel grades altered and the

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					proposed channels incorporate natural channel principles that provide a balance between erosion/aggradation and promotes a watercourse system that preserves the meandering nature of a healthy system. We do not intend to create a system prone to aggradation for the sake of development, however "rule of thumb" guidance on minimum channel grades should be reconsidered as direction on channel design.
49	Figure 6.4E	**Diversion Channel 14W-23 Alignment and Planform** – The resubmission did not demonstrate that there would be no erosion concerns at the sharp bends under higher flow events. Staff suggest that as one possible means of addressing this concern, that it be demonstrated that under Regional Storm conditions, the flood plain velocities and shear forces at the sharp bends in the creek block will be lower than the velocities and shear forces that can be withstood by vegetation.	1 & 2	SVH	Comments noted.
50	Figure 6.5	**Channel Corridor Sections Typical for 14W-22 –**Previous comments remain outstanding. A meeting regarding the channel forms proposed for the channel realignments is requested to take place soon after these comments are received by the proponents. Discussion as to whether "E" Type channel cross sections would be appropriate in the proposed scenarios is requested. There are concerns about the channel depths, channel sides slopes and width to depth ratios. These concerns are with respect to: low flow channels that may be too wide to optimally facilitate fish passage, wide channel bottoms that promote sun infiltration that could cause thermal warming, algae growth and excessive water evaporation. Further, we note that the figure has been revised, relocating the 3:1 side slopes into the meander belt width. The 3:1 side slopes should be relocated outside of the meander belt width and the 100 year erosion allowance similar to the approach utilized in the April 2012 submission.	1 & 2	SVH	Comments noted.

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51	Section 6.4.5	**Hydraulic Analysis, Page 6-14 & Appendix 6.1** a. A digital copy of the modeling remains outstanding. b. Flood plain mapping based on future conditions topography/grading remains outstanding. c. Post-development flow rates need to be clearly documented and supported. See Section 7 comments below. d. See Comment #55 regarding Appendix 6.1 for additional comments. e. Text indicates that the road crossings were not included within the modeling, however, Section 6.4.4. indicates that the culverts were modeled and they do appear to be within the hard copy model results provided in Appendix 6.1 so we assume that this statement is a typographical error.	1	SVH	Comments noted.
52	Section 6.4.6	**Maintenance of Riparian Storage, Page 6-14 & Appendix 6.2** a. Conservation Halton policies and NOCSS requires that flood storage be maintained for a full range of storm events. No loss of flood storage is considered insignificant due to the potential for cumulative impacts. The creek block designs must be modified accordingly. b. The riparian storage associated with Reach 14W-14A must be included within the analysis. It would appear that this may not be the case in the current analysis. c. The riparian storage analysis for Reach 14W-11A must be separated from the riparian storage analysis for Reaches 14W-14, 14W-14A and 14W-16 as it has a different receiving watercourse. d. Further to the last sentence in this section, staff note that Conservation Halton staff do not require the existing riparian storage associated with Reach 14W-13 to be maintained though we also do not allow for any storage within the proposed Reach 14W-21 to be included within the calculations. It would appear from the HEC-RAS output files that these reaches have not been included within the analysis	1 & 2	SVH	Comments noted.

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		however we require confirmation that is the case. Also further to the last sentence, staff note that any challenges created by "eliminating Reach 14W-14" are a result of the alignment/design proposed by the proponent and could be addressed through a redesign of Reach 14W-22 e. The analyses may need to be updated further once the proposed flow regime is clarified. The resubmission should discuss the implications of the proposed changes in flow rates within the subject reaches and undertake additional/modified analyses as necessary.			
53	Section 6.4.7	**Stream Length Requirements** – Conservation Halton staff continue to require the existing length of Reach 14W-14A be included and maintained in the stream length calculations. We also continue to be of the opinion that Reach 14W-21 cannot be utilized within the proposed conditions credits. As such, stream length densities have not been maintained.	1 & 2	SVH	Comments noted.
54	Appendix 6.1	**Regional Floodplain Analysis, 14 Mile Creek** – Submission of a digital copy of the models for all reaches remains outstanding. a. **Regulatory Floodplain** 1. Hard copy model and mapping remains outstanding for Reach 14W-14A. 2. Reach 14W-11 and 14W-11A floodlines are not shown on Figures 6-2.1A (existing) and 6-2.1B (proposed). 3. Hard copy model remains outstanding for Reach 14W-11 & 14W-11A. 4. The cross-section locations shown on the figure within the Appendices do not match those provided on Figures within the main body of the text or as referenced in Table 6.1.6. Staff request that consistency be ensured between these two sections to prevent future confusion. b. **Flood Discharges**	1 & 2	SVH	Comments noted.

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		5. Staff are generally satisfied with the pre-development flow rates provided in Table 6-1.1, however, these will need to be revisited in conjunction with finalizing the issue of the drainage boundary mapping (see Comment 56), which remains partially outstanding. 6. Post-development flow rates need to better documented and supported within the document (see also Section 7 comments below). A summary table of flow rates at all key nodes should be provided along with supporting documentation justifying the flow rates. In developing this summary/documentation staff note the following: • Interim development conditions should be presented if there is potential for higher flow rates as a result of proposed diversions not taking place at the same time. • Flow rates provided in Table 6-1.6 for River Stations 20 to 28 do not seem to reflect the flow rates from Table 6.1.3 for River ID 3, Reach 1 downstream of Hwy 407 (i.e. downstream of Cross-Section 16 as shown in appendix figure as opposed to main text figure). • The flow rates within the hydraulic analysis do not appear to account for proposed pond outlet points and while this would likely result in a conservative result from a flood plain mapping perspective it does mean that the flow rates provided cannot be utilized to assess instream flow changes with respect to fisheries, fluvial geomorphology or terrestrial ecology perspectives. It may also result in inaccurate riparian flood storage analyses. Flow rates should be consistent between Sections 6.0 and 7.0 of the report to prevent future confusion. • Flow rates based on updated hydrologic modeling must be supported by digital copies of all hydrologic models with supporting output file print outs where appropriate to facilitate the review. c. Addressed. d. **Manning's Roughness –** Conservation Halton staff continue to be of			

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		the opinion that a Manning's 'n' of 0.07 for the overbank areas is too low for future vegetative conditions within the creek corridor limits. e. Addressed. f. **Figure 6-2.1, HEC-RAS Cross-Sections** 7. Mapping was provided at 1:2000 and not 1:1000 or better as requested. Only 1 metre contour lines were provided which is typically not sufficient to finalize property limits, particularly, where the lands are flat. 8. From RS7 to RS10.5 there are several locations on Figure 7.1 where the flood line and watercourse line are shown in the same location. This would not be expected unless there is an entrenched channel. Since a digital copy of the model was not provided, staff could not review these areas in detail to gain a better understanding of the system. As such, we request that the mapping and modeling and location of the watercourse be revisited in this area to ensure the drawing accurately reflects the location of the watercourse and flood plain. 9. While cross-sections are shown for Reach 14W-11 and 14W-11A, the floodline is missing on Figures 6.2.1A & B. g. **Results** 10. No grading plans have been submitted for the proposed Open Space Blocks that would support the post-development conditions model. 11. As noted above, there are several outstanding issues with the models submitted to-date that must be addressed. 12. We have assumed that the proponent may be responsible for constructing the Avenue One crossing of Reach 14W-16 as part of their development in order to ensure adequate access to their lands, even though this crossing is located on lands under separate ownership. Staff note that the model results indicate minor increases in the Regional Storm flood elevation on the adjacent lands.			

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		Conservation Halton staff have no objections to these increases, subject to the landowners agreement along with their permission for the road to be constructed within their lands. Staff will require written agreement from the adjacent landowner for any increases on lands remaining within their ownership. h. Addressed.			
V	New Comment – Section 7	**Stormwater Management** a. Conservation Halton staff recommend that the report include greater discussion on how the larger Highway 407 West Area will be serviced that demonstrates that the proposed plan will not place undue constraints on other developments or the Natural Heritage System. Some of the discussion could be provided within existing sub-sections but a standalone subsection may also be warranted. Staff apologize for not identifying this gap in our previous comments. b. Staff have not reviewed in any great detail the proposed stormwater management concepts presented for the east side of the Main Fourteen Mile Creek Natural Heritage System (Core 1) as there is no supporting documentation for the proposed concepts. Figure 8.5 and the text of the document should state very clearly that the stormwater management concepts presented for east of Core 1 have no standing and will have to be revisited in their entirety through the EIR/FSS process when development proceeds in that area. c. Figure 8.5 indicates that a single SWM pond will service lands immediately west of the Main Fourteen Mile Creek Natural Heritage System (Core 1), however, Table 7.3 indicates that flows will be directed to both Culvert FM-D4a and FM-D5, which suggests that a portion of this area will not be directed to the SWM pond but rather to the existing culvert FM-D4a. We anticipate that the details of servicing this block of lands can be dealt with under a future EIR/FSS, however, sufficient	1 & 2	SVH	Comments noted.

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		explanation should be provided in the current document to outline what is being relied on for the current servicing plan and what stormwater management concepts can and/or will have to be determined as part of the future EIR/FSS required for the adjacent lands. d. Staff are satisfied that the lands located between Reaches 11/11A and Core 1 (i.e. Block P3) are best serviced through their own SWM measures as indicated on Figure 8.5.			
55	Section 7.4	**Proposed Stormwater Management Approach, Page 7-4 –** This section should be revisited as necessary in conjunction with addressing the following comments. Please note the following section quoted from MNR's Draft *Guidance for Development Activities in Redside Dace Protected Habitat*: *To maximize the absorption of nutrients and other contaminants and prevent them from entering streams, stormwater management facilities adjacent to Redside Dace habitat should be designed as hybrid extended detention wetlands/wet ponds. These facilities are more effective than traditional ponds at removing pollutants harmful to Redside Dace including nitrates, phosphorous and copper.* As such, it is recommended that end of pipe SWM facilities be designed to meet this criteria. Notwithstanding this recommendation, staff have provided the comments below on the stormwater management pond as currently designed.	1 & 2	SVH	Comments noted.
56	Section 7.4.1	**Existing Drainage Boundaries, Page 7-4 & Figure 7.1 –** a. As previously noted, the Highway 407 ROW should be included in the drainage area delineations (currently it is shown excluded) as well as any portions of the Dundas Street ROW that drain to the upstream side of the road culverts (the current figure is not clear in this regard). b. The drainage areas shown west of Neyagawa Boulevard do not match those provided in the Tremaine and Dundas Secondary Plan Subwatershed Study (Figure 4.1.1) and there is insufficient information provided on Figure 7.1 to verify the proposed revisions in this area. Sufficient contour information	1	SVH	Comments noted.

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		should be provided for this area to support the proposed drainage boundaries.			
57	Section 7.4.3	**Preliminary Grading Plans and Post-Development Drainage Boundaries, Page 7-5 & & Appendix 8.5 -** a. Insufficient grading information has been provided on Drawing G1 (Appendix 8.5). Grading information for all altered Open Space/Natural Heritage System Blocks must be provided. Any grading required beyond the road ROWS within the NHS should be identified. SWM pond inlet and outlet grades for all ponds west of Core #1 should be provided to ensure that the ponds can function as proposed. Use of cross-sections should be considered in key areas adjacent to the Natural Heritage System.	2	SVH	a. Comments noted. b. Comments noted. c. Comments noted. d. The flows from Subcatchment 3050 outlets to the 14W-17 and 14W-16 stream corridor. In the Tremaine and Dundas Secondary Plan Subwatershed Study (2009) a similar drainage pattern was indicated. e. Comments noted. f. Comments noted. g. Comments noted.
		b. Grading of as much as 6 metres is proposed immediately adjacent to the Natural Heritage system within future development lots. 3:1 slopes are proposed. Staff anticipate that landowners may not be willing to lose up to 20 metres of developable lands and as such, the potential requirement/use of retaining walls in these locations should be noted. If not, how these grade changes will affect drainage areas to the various SWM ponds should be taken into consideration as the 3:1 slopes typically slope away from the proposed receiving SWM pond.	1	AW	This is essentially requesting that we provide detailed design for the entire subdivision at this time. We are agreeable to providing inlet and outlet grades on our drawings to confirm that they function as necessary but providing cross-sections for lands which we do not have building and site layouts is an unnecessary exercise. We do not propose to grade into the NHS other than the sloping associated with the road crossings and for the pond outlets.
		c. While approximately 15 ha of FM1102 located west of Tremaine Road **may** be redirected to culvert FM-D1 instead of to FM-D2 according to the Tremaine and Dundas Secondary Plan Subwatershed Study (TDSPSWS) it may not if a number of criteria with respect to downstream impacts and Riparian rights cannot be addressed satisfactorily through the Draft Plan approval process. Section 5.3.6.3 (Stormwater Management Pond Locations) of the TDSPSWS should be referred to for details. This possibility should be identified within Table 7.3 and recognized within the text portion of the section. We note that if	1	AW	The use of retaining walls v.s. sloping is a business decision for our client. We will note the potential use of retaining walls at appropriate locations on the grading plan. We have considered the entire development block in our pond sizing calculations, should sloping be utilized, the drainage area and therefore the storage requirements for each of the ponds will decrease.

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		the diversion west of Tremaine Road does not occur the drainage area to Culvert FM-D2 will be increased by 21 to 22 ha instead of the 6 ha suggested by Table 7.3. d. Where will flows from Subcatchment 3050 (west of Tremaine Road) outlet? e. The report does not verify that the proposed external and internal subcatchment diversions will have no negative impacts on the receiving watercourses, wetlands and natural heritage areas. As such, Conservation Halton cannot endorse the proposed diversions at this time. f. The EIR/FSS does not discuss the potential that the upstream landowner may wish to realign the medium constraint Reach 14W-16 within their lands. While it is recognized that the adjacent landowner will be responsible for demonstrating fully that any proposed realignment on their lands is appropriate, sufficient discussion should be provided within the current EIR/FSS to demonstrate that the proposed alignment of 14W-22 along the west property line as opposed to along the current alignment as shown in the North Oakville West Master Plan will not negatively impact options for future creek realignments of appropriate lengths and gradients on the adjacent lands while ensuring feasible development layouts and SWM servicing options. g. There are concerns that the configuration of stormwater management controls may reduce surface water flows from the pre-construction surface water flow condition. Please note the following section of the Endangered Species Act: Development and infrastructure — Redside Dace 23.1 (1) This section applies to a person who carries out any of the following activities if the activity is likely to kill, harm or harass redside dace or to damage or destroy the habitat of redside dace: If the mitigation report is approved by a district			

No.	EIR/FSS Section(s)	HRCA Issue/Comment	Category	Responsibility (HRCA/MMM)	Response
		manager for the Ministry, the person responsible for carrying out the activity referred to in the report shall comply with all of the following conditions to minimize the effects of the activity on redside dace:1. **The flow of a stream or other watercourse through the habitat of redside dace shall be maintained without interruption.** As such, it is recommended that a section be added to the EIR-FSS outlining how the post construction flow of the watercourses will match the preconstruction surface water flow in the watercourses on the property.			
W	New Comment - Section 7.4.5	**Conveyance of Major Storm Flows, Page 7-6 –** The second paragraph makes reference to a Block C3 which staff could not locate on Figure 8.5	1	SVH	The reference will be clarified in the revised text.
58	Section 7.5	**Post-Development Hydrologic Analysis, Page 7-7 –** a. The Main Channel and Off-Channel travel times (TMC & TOC) utilized in the post-development GAWSER model have been modified significantly from the previous submission. Staff request that calculations be provided to support the proposed TMC and TOC parameters. b. Flow rates at all points of interest should be provided in order to assess potential hydraulic, fluvial geomorphological, fisheries, terrestrial ecology, etc. impacts. Flow rates should be provided for any interim conditions that may exist (for example, just the Subject Lands developed) as well as ultimate conditions. c. Flow rates provided in Table 7.5 for Culvert FM-D2 assume that all potential diversions west of Tremaine Road have been completed. As the feasibility and timing of these potential diversions are unknown, Table 7.5 should be expanded to indicate potential interim flow rates if lands within Subcatchment 3000 proceed to development prior to the lands west of Tremaine Road and/or in the event that the external diversion of	1 & 2	SVH	a. In the first submission (2011) the TMC and TOC values used for the catchment contributing to Pond 3 were 0.15 hr and 0.05 hr, respectively. In the latest submission (2012) the TMC and TOC values used for the catchment contributing to Pond 3 were updated to 0.5 hr and 0.2 hr, respectively. In the first submission the TMC and TOC values that were used were quite low considering the size of the contributing catchment area of approximately 46 ha. Therefore, in the second submission, a more reasonable value which was representative of the size of the catchment was used. Furthermore, a sensitivity analysis of the TMC and TOC values used between the two submissions showed that although the peak values were higher in the first submission, the proposed SWM Pond 3 over controls the peak inflows and generates similar outflows in both conditions.

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		flows are not demonstrated to be appropriate. d. Further to 'c' above, flow rates at Culvert FM-D1 and within the watercourse downstream of the confluence of the FM-D1 and FM-D2 culvert tributaries should be provided to ensure that instream targets are being met fairly between the developments west and east of Tremaine Road. e. Digital copy of the hydrologic model is required.			b. In NOCSS the reference points that were used for flow comparison were the culvert crossings on Highway 407 and Dundas Street. Similar reference points were used in this study for reporting flow rates. c. Comments noted. d. Comments noted. e. Digital copy of hydrologic model has already been provided. However, the copies will be resent.
59	Section 7.6	**Stormwater Management Facilities -** a. Page 7-8 states that no allowance has been made for runoff from Dundas Street. Staff recommend that runoff from Dundas Street and its anticipated widening be provided within the SWM facilities unless it can be demonstrated that it is technically not feasible to do so. b. Staff intend to discuss the future development and servicing of the Future Employment lands located between Reaches 14W-16 and 14W-22 with Town staff at an upcoming NOARM. Additional comments may be provided upon completion of these discussions. c. Table 7.6 indicates a drainage area of 46.1 ha to Pond 3 whereas Figure 7.3 indicates a drainage area of 43.2 ha for Subcatchment 3100, which is the area utilized in the GAWSWER modelling. This discrepancy should be explained or rectified. d. Staff could not reproduce the Target Peak Flow Rates provided within Tables 7.9 and 7.10. An explanation of how these flow rates were determined should be provided. e. Staff appreciate the thought behind the proposed infiltration trench and gravel wetland at the proposed outlet from SWM Pond #3. Staff request that additional conceptual details be provided on a plan view drawing to better illustrate the scope	1 & 2	SVH	a. The approximate road low point elevation of Dundas Street within the study limits is approximately 150 m. At the road low point, the elevation of the edge of travelled lane is approximately 149.79 m (assuming there are 2 east/westbound lanes at 2% slope and 1.5 m shoulder width at 6% slope). The proposed storm sewer at the edge of travelled lane will require approximately 1.8 m cover, resulting in a storm sewer invert of approximately 148 m. An approximately 250 m storm sewer at 1% slope is required to convey the runoff to the proposed SWM Pond 2, resulting in a sewer inlet invert of approximately 145.5 m, which is lower than the SWM Pond 2 permanent pool (PP) elevation of 145.75 m. The PP elevation of SWM Pond 3 is also considerably higher than the proposed storm sewer inlet invert elevation. Therefore, the runoff from proposed Dundas Street cannot be treated by the proposed SWM Pond 2 or SWM Pond 3. Furthermore the Regional water surface elevations in SWM Pond 2 and SWM Pond 3 are also higher than the proposed road elevation at Dundas Street.

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		and scale of the infrastructure. Some preliminary analysis should be provided to demonstrate how effective the size of system currently being proposed will have on polishing and cooling the stormwater management in order to assist in the overall evaluation of the mitigation measures being proposed. f. Staff request that consideration be given to implementing a similar infiltration trench/gravel wetland at the proposed outlet from SWM Pond #2, with the infrastructure all located outside of the Natural Heritage System. g. Inlet and outlet elevation details should be provided as well as existing elevations within the receiving watercourses/NHS areas. Figures 7.4, 7.5 and 8.5 should be updated accordingly. h. Sediment dewatering areas should be shown on Figures 7.4 and 7.5 and their sizing justified in the report.	3 1	AW AW	b. Comments noted. c. Table 7.6 indicates a drainage area of 46.1 ha to Pond 3 whereas Figure 7.3 indicates a drainage area of 43.2 ha for Subcatchment 3100. It should be noted that SWM Pond 3 accommodates runoff from both Subcatchments 3080 (2.9 ha) and 3100 (43.2 ha). Hence the total contributing area to SWM Pond 3 is 46.1 ha. Both Table 7.6 and Figure 7.3 are correct. d. The target peak flow rates in Tables 7.9 and 7.10 were determined by multiplying the unit flow rates reported in Table 7.2 by the appropriate contributing drainage areas. e. Comments noted. f. Comments noted. g. Comments noted. h. Comments noted. Due to the location of SWM Facilities, existing topography and proposed grading, it is not feasible to convey runoff from Dundas Street to the proposed SWM facilities. Additional details will be added to the figures as requested.
X	Section 7.6.3	Water Quality Control: This section needs to include information about how thermal pollution on downstream watercourses will be provided by all proposed SWM facilities. A multifaceted approach included 3.0 meter deep permanent pools, bottom draw outlets, adequately sized cooling trenches and cooling towers are recommended to sufficiently mitigate thermal warming of the downstream watercourses. We note that this recommendation may contradict the MOE Guidelines and Town of Oakville Guidelines, therefore further discussion between Conservation Halton, the MNR,	1	SVH	Comments noted.

No.	EIR/FSS Section(s)	HRCA Issue/Comment	Category	Responsibility (HRCA/MMM)	Response
		MOE and Town staff is required on this item. Pre-construction monitoring of the thermal regimes of the receiving water bodies downstream of the proposed SWM outlets is advised to be initiated as soon as possible in 2013.			
60	Section 7.7 & Appendix 7	**Erosion Control Analysis & Appendix 7 –** a. As identified in Conservation Halton's September 6, 2011 comments, multiple analytical methods should be applied to determine the erosion threshold. As Appendix 7 has not been updated from the previous submission, staff continue to require provision of the results from at least three analytical methods as well as discussion that justifies the final method selected. b. As identified in Conservation Halton's September 6, 2011 comments, the erosion threshold needs to be established for the most sensitive reach downstream of a proposed SWM facility. As such, an erosion threshold should also be established for upstream of Dundas Street and compared with the value determined for downstream of Dundas Street. The more conservative value should then be utilized to determine the necessary erosion controls. c. Greater explanation should be provided on how the Erosion Indices incorporating critical shear were determined. Staff were unclear why the erosion indices were being quoted in hours. d. Table 7.15 on Page 7-20 indicates a 14% increase in the total duration of flows exceeding the erosion threshold value. The same table indicates a 17% increase in the hourly exceedance counts based on an Erosion Indices incorporating critical shear. NOCSS requires that post-development conditions match pre-development conditions with a recognition that results within approximately 5% may be considered acceptable as long as a full and thorough discussion is provided in order to understand the likely effects and implications as well as to determine whether further mitigation, modeling refinement or monitoring is	1 & 2	SVH	Erosion control analysis will be modified followed by additional field investigations.

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		required. As such, it is our opinion that the current stormwater management concept does not meet NOCSS requirements. e. A more comprehensive analysis for downstream of culvert FM-D2 is required prior to any development proceeding on the lands west of the subject property. Staff note that this analysis may be required as part of the current EIR/FSS depending on the final stormwater management concept proposed. In the event that once the final SWM plan is determined, it is reasonable to defer this matter to the development of the adjacent lands, the current EIR/FSS should identify this outstanding issue and the requirement that it be addressed in the future EIR/FSS update supporting the development of the adjacent lands. f. It would appear that the proposed stormwater management scheme would result in extremely significant reductions in flows to Reach 14W-12A, moderate reductions in flows to Reach 14W-11/11A/23, and unknown changes to Reach 14W-12 upstream/downstream of the proposed pond outlets. The impacts of all of these changes have not been analysed in the report. Staff note that an erosion analysis could be performed for these reaches to demonstrate whether or not any proposed changes are appropriate.			
61	Section 7.8 & Appendix 6.4	**Topographic Depression Volumes** – As noted in our August 16, 2012 comments, the Topographic Depression Volume Analysis provided in Appendix 6.4 indicates that depression storage analysis was not undertaken on the Hydrologic Feature 'A' located on Reach 14W-16 (ID 6) as it will be kept in its original condition. The bankfull channel in this location however is proposed for alterations. As such, the EIR/FSS should confirm that either no changes to the depressional storage will be a result of the proposed channel reconstruction or provide clear direction on any mitigation measures that would be required at the detailed design stage to ensure that the topographic depression storage volume will be maintained. The updated EIR/FSS should also demonstrate on its grading plan and/or through other drawings that Hydrologic Features 'B'	1	SVH	Comments noted.

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		ID7 and ID8 will be left undisturbed or the topographical depressional storage analysis should be updated accordingly.			
62	Section 7.9 & Appendix 7.2	**Downstream Impacts for Regional Storm –** It is our understanding that Appendix 7.2 is unchanged from its original submission. As such, our September 6, 2011 comments remain outstanding as follows (minor modifications have been made to provide additional clarity): a. Appendix 7.2 indicates increases in Regional Storm water surface elevations downstream of the QEW. There are known flood damage centres downstream of the QEW where the Regional Storm extends onto private property and overtop of municipal roadways. No increases will be supported in these specific areas. As such, it is the opinion of Conservation Halton staff that based on the information provided the analysis does not demonstrate that there will be no adverse impact on downstream landowners (including private property) or land uses. b. In the event that the proponent wishes to continue to pursue the option of demonstrating that Regional Storm controls are not required, staff note that we will require the following information to be included in any such assessment: • A digital copy of the hydrologic and hydraulic models. • A hard copy of the hydrologic input and output files for post development conditions. • A hard copy of flood plain mapping at a scale that allows for a review of impacts. The mapping must clearly illustrate property limits and existing structures. The mapping should clearly identify all areas of increased flooding as well as the amount of the predicted change. • Unless the assessment demonstrates a zero increase in peak flows and flood elevations, the assessment must be extended to assume that Regional Storm controls will not be provided within any development	1 & 2	SVH	a. To be addressed. b. At cross-section 63 (River 1 and Reach 2), upstream of the Upper Middle Road Bridge Crossing the substantial difference (4.12 m) can be attributed to the convergence error in HEC-2 hydraulic analysis, in which case the HEC-2 software only shows the critical water surface elevation (122.59 m) upstream of the bridge. Whereas, the HEC-RAS hydraulic model does not have that limitation and provides an accurate water surface elevation of 126.71 m. It should be noted that the water surface elevations upstream of the bridge crossing are close to ±126.5 m, which is consistent with the HEC-RAS water surface elevations found upstream of the bridge.

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		upstream of Dundas Street within the Fourteen Mile Creek Watershed to ensure fairness to all developers. • Staff concur that the conversion of HEC-2 models into HEC-RAS can result in substantial changes to WSELs. The predicted increase as predicted at Cross-Section 63 (River 1, Reach 2), upstream of the Upper Middle Road crossing, however is very substantial (4.12 metre increase). Further discussion of this difference is warranted. • The original HEC-2 model for Fourteen Mile Creek has been updated in specific sections as development has proceeded within the watershed. As such, additional model modifications may be required to account for these works. The need for additional revisions will be determined once all of the other above noted concerns have been addressed and more detailed mapping and digital modeling has been provided in order to undertake an initial assessment of whether or not these model upgrades are necessary.			
Y	New Comment, Section 8	**Municipal Servicing –** a. The stormwater management infrastructure drawings and tables provided in Appendix 8.3 and 8.4, including storm sewers and culverts, should be updated accordingly in conjunction with any changes to the stormwater management plan resulting from the comments of all agencies. b. The EIR/FSS should clearly indicate that the proposed culverts, sanitary sewer, watermain and road crossings of the Main Fourteen Mile Creek reaches (Reaches 14W-1A, 14W-2 & 14W-11) as shown on the drawings in Appendix 8.4 have not been reviewed or approved and that they will be subject to modifications through the EIR/FSS approval process for the adjacent lands. c. Staff understands that portions of the watermain and the	1 1 1	AW AW AW	The design of the storm drainage system will be revised to reflect any changes to the overall stormwater management plan. A note will be added to this effect. The sanitary sewer above the existing FM-D4 culvert

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		Sanitary sewer along Dundas Street will be constructed by the proponent. Drawing P11 in Appendix 8.4 indicates an assumption of a minimum 0.4 metre clearance between the invert of the sanitary sewer and the top of the existing FM-D4 culvert. The drawing also indicates a minimum 0.5 metre clearance at Culvert FM-D5 though a clearance of over 2 metres is assumed for the profile. Staff anticipate that the existing culverts will likely have to be replaced with larger culverts or bridges at the time that Dundas Street is widened in the future. As such, staff request that the sanitary sewer servicing for the subject lands should allow for the maximum clearance possible between the tops of the existing culverts relative to the invert of the sanitary sewers in order to allow for maximum flexibility with the future culvert replacements. Staff will require confirmation from both the design proponent and Regional staff that the proposed design provides for maximum future flexibility. Staff apologize for not raising this in our previous comments. d. As noted under Comment # 57, additional grading information is required on Drawing GR1 in Appendix 8.5.			can be raised approximately 0.8m while maintaining minimum cover. This could be achieved by reducing the slope of the sewer on Dundas from Avenue Two to east of the culvert to 0.35% (from 0.5%). The sanitary sewer above Culvert FM-D5 is already at minimum cover and cannot be raised any higher. As noted in the comment, there is already a clearance of approximately 2m provided between the invert of the sewer and the top of the culvert. See response above.
63	Appendix 4.6	**Groundwater and Surface Water Quality** - Comment not addressed. A map of groundwater and surface water quality monitoring locations is still requested. Surface water quality results indicate that uranium, cobalt and zinc levels exceed PWQO at six out of ten sampling locations. These results also show that surface water levels of boron exceed the PWQO at 8 of 10 sampling locations. Please indicate if this situation has been addressed by the Ontario Ministry of Environment. It is noted that nitrates were not one of the parameters tested for with the surface water samples. Given that the previous land use of the property was pig farming, it would be helpful to include nitrates as a surface water parameter of interest.	1	AK	**Comment was addressed, and this wording is highly misleading.** Figure 4.4 shows the location of the surface water monitoring station SG-01 as was requested in the CA's letter dated September 6, 2011 ("*Staff were unable to locate a map depicting locations of surface water chemistry monitoring locations. Please provide these locations on a map*"). This was provided in the 2nd Submission. In response to the new comment stating that a map of groundwater sampling locations is still outstanding, the groundwater samples are identified in the tables by their well Identifications (e.g., MMM-

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					09-19S), and the well locations are shown on Figures 4.3 and 4.4 (and other figures). This information is therefore already available in the 2nd submission. In response to the new comment regarding exceedences of uranium, cobalt, zinc and boron exceeding PWQOs at 6 to 8 out of 10 water sampling locations, we point out that a total of 9 locations were sampled (one twice). Eight of these locations are monitoring wells from which groundwater samples were collected (there are 9 samples shown from these 8 locations as the sample identified as MMM-09-17 (FD-1) is a field duplicate sample collected as part of the QA/QC protocols). There was one surface water sampling location. We note that there is no requirement to notify MOE of these results. Based on our review of the analytical results for both surface water and groundwater, the measured concentrations of metals and inorganic parameters do not pose a significant risk to human health and the environment. Nitrate was analyzed at all 9 sampling locations and the results were provided in Table WQ-2 and in the original laboratory analytical reports in Appendix 4.6.
64	Appendix 5.6	**Water Temperature Monitoring Data -** Comment not addressed to the satisfaction of CH Staff because the STATE analysis was not applied to the temperature data graph.	2	MC	Following numerous attempts to unsuccessfully use the STATE analysis software that was requested by CH we contacted the developer of the software for direction. The developer stated that error/crashing experienced by MMM staff was due to the sample size being shorter than 6 months and they have yet to resolve this issue.

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					As you are aware CH requested in their August 5, 2011 email that water temperature data collection in the farm pond with specific reference to water temperature data collection be initiated as soon as possible to include the month of August and extend to September 15th. This information was relayed by CH in advance of the email in a voicemail message from L. Smith in June and as a result the loggers were in place by June 30, 2011. Although the recording period collected data through the summer months and beyond, it was not sufficient to capture the required timeframe to allow the STATE analysis to work. Furthermore, an analysis of the water temperature was undertaken using 3 other acceptable methods. Water temperature data was initially assessed using the methods in the *Ontario Stream Assessment Protocol (OSAP) (Stanfield, 2005)* and *A Thermal Habitat Classification for Lower Michigan Rivers (Wehrly et al, 1999)*. The general results were presented to CH during a site meeting and CH requested the assessment of the data using the *Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily maximum Air and Water Temperature (Cindy Chu, et. al., 2009)*. This third tool was also used to assess the water temperature data. All three methods yielded relatively consistent results and were presented in the EIR. Given the limitations of the STATE analysis tool, the

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					analysis of the data using other acceptable analysis methods and the relatively consistent results we trust that the temperature data as presented meets the requirements of CH's inquiries and continued analysis of the data is not required given the time/resources spent to date on this specific matter.
65	Appendix 8.3 Figure A	**Comment not addressed -** Figure A-8.3 should be updated to illustrate the proposed pond outlet locations.	1	AW	The figure will be revised as noted.
66	Appendix 8.4	• Drawing P1: There are concerns over the fill placement proposed in the valley surrounding 14W-16 (0 +375 to 0 + 500) located west of the Lazy Pat Property line and just east of the intersection of Avenue One and Avenue 2. There is concern that the watercourse will be disconnected from the floodplain if this fill is placed in this area. This disconnection could lead to in-stream erosion and higher shear stresses in the channel, which would have a negative impact on fish communities and fish habitat in this channel. A bridge structure that spans the meanderbelt width of the watercourse is the preferred crossing structure in this location. A creek crossing structure that meets these criteria would be in accordance with *Endangered Species Act* Guidelines. • Drawing P2: It is requested that the road crossings at 1 + 450 and at 1 + 525 in this drawing be designed as bridges that will span the meanderbelt width of the watercourse in accordance with *Endangered Species Act* Guidelines. • Drawing P2: There are concerns about fill placement in the valley areas where Avenue One crosses two tributaries of the Main Branch of Fourteen Mile Creek, one at 1 + 400 to 1 + 450 and the other at 1 + 500 to 1 + 550. There is concern that the watercourse will be disconnected from the floodplain if fill is placed in this area. Similar to the above, these crossings would need to meet MNR criteria for creek crossings in Redside Dace habitat. To meet this	2	AW	A bridge structure that spans the meander belt is not practical in this situation. We have completed the preliminary calculations to determine the opening requirements to properly convey the channel flows without creating the erosion issues noted here. These calculations will be further refined during the detailed design stage. We will deal directly with the MNR during the detailed design stage to address the requirements for all the crossings with respect to the Endangered Species Act. Wherever practical, watermains and sewer crossings will be made by either over the top of or attached to the structure.

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		criteria, a bridge structure that spans the meanderbelt width of the respective watercourse would be recommended. • Drawing P4: Staff appreciate the inclusion of an open bottom creek crossing structure at this location. Please confirm that the span of the proposed culvert will encompass the meanderbelt width of the watercourse as specified in MNR's Draft Guidance for Development Activities in Redside Dace Protected Habitat document. • Drawing P5: There is concern regarding the Burnhamthorpe Road crossing of the main stem of Fourteen Mile Creek (Reach 14W-1A). It is preferred that a bridge structure that spans the meanderbelt width of the watercourse be placed at this road crossing, which is consistent with the MNR Draft Guidance for Development Activities in Redside Dace Protected Habitat document. It is also preferred that the future watermain crossing be attached to the bridge structure. As no storm or sanitary sewer crossings of this valley are required, staff are satisfied that these details can be worked out in conjunction with the adjacent development; however, the EIR/FSS should clearly indicate that the current design has not been approved.			
67		Discussed in other sections. <u>Technical Memorandum NH # 1 – Reach 14W – 14A Aquatic Habitat Prepared by MMM Group, March 28, 2012:</u>	-	-	-
68	Section 3.1	**Fish Community Survey**: Details on the design and methodology used to collect fish were not provided in the EIR-FSS; comments remain outstanding.	1	MC	Data sent on January 9, 2013 via email. Will resend.
69	Section 3.3	**Supplemental Fish Habitat Documentation:** Water Quality Monitoring, Dissolved Oxygen comments were not addressed, raw data remains outstanding.	1	MC	Data sent on January 9, 2013 via email. Will resend.
70	Section 3.4	**Water Temperature**: Raw surface water temperature data was not provided, previous CH comments remain outstanding.	1	MC	Data sent on January 9, 2013 via email. Will resend.
71	Section 3.5	**Thermal Impacts of Proposed Conversion of Farm Pond to a Storm Water Management Pond**: It is again noted that cooling towers,	1	SVH	Appropriate thermal mitigation measures will be considered for all proposed SWM facilities.

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		vegetated islands and a north-south pond and outlet orientation were suggested by the MMM Group in their March 28, 2012 Technical Memorandum # 1 as methods to mitigate the warming effects of proposed SWM pond # 3. It is suggested that these thermal mitigation measures also be considered for other proposed swm ponds on the property.			
72		No further comment required.	-	-	-
73	Section 3.7	**Sediment Source**: Comment remains outstanding. This comment should be addressed through stream length compensation requested.	2	SVH	This comment is related to the Central SWM pond issue.
74	Section 3.8	**Organic Material Source**: Comment remains outstanding. Organic material can be compensated for by implementation of Conservation Halton's *Landscaping and Tree Preservation Guidelines*. These guidelines will be applicable to all realigned watercourses on the property.	1	MC	Noted. The principles identified in Conservation Halton's *Landscaping and Tree Preservation Guidelines* will be incorporated into the realigned channel reaches thereby contributing to theorganix material source. Once again we maintain that the transport of coarse organic material such as leaves and twigs from the pond, to downstream fish habitat is greatly inhibited by the intermittent connection to downstream fish habitat as well as the dense cattail growth at the inlet/outlet that would physically block the movement of this material.
75		No further comment required.	-	-	-
76	Section 4.0	**Conclusions**: Comment is no longer relevant.	-	-	-
77	Figure 1	**Bathymetric Survey/Approximate Fish Community Sampling Locations**: A fish relocation will be required for fish in the pond. Discussions with CH staff and Aurora District OMNR staff at the detailed design stage will be required to determine an appropriate location for fish present in the existing farm pond.	1	MC	Noted. This element of the project will occur during the detail design phase of the project.
78	Figure 3	**Pond Cross Section**: Comment no longer relevant.	-		
79	Figures 4 – 7	**Water Temperature Comparisons at a Variety of Water Depths**: Comment no longer relevant.	-	-	-
		Draft Plan of Subdivision 14T-11001	-	All	Draft Plan will be revised as part of the 3rd

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		In light of the number of outstanding issues associated with the EIR/FSS, Conservation Halton staff have not undertaken a detailed review of the submitted Draft Plan. Once the limits of the corridors and SWM servicing requirements are finalized within an updated EIR/FSS, the Draft Plan should be revisited and updated accordingly.			Submission.

Mark Cece

From: Jefferis, Samantha (MNR) <Samantha.Jefferis@ontario.ca>
Sent: Thursday, July 25, 2013 2:47 PM
To: Mark Cece
Subject: RE: North Oakville - Lazy Pat Lands
Attachments: LazyPat_RSD_25Jul13.pdf

Hi Mark,

[redacted]

I have attached a map (NOT FOR DISTRIBUTION) that provides a rough outline of which reaches on the Lazy Pat lands are considered occupied Redside Dace reaches (meanderbelt +30m buffer applies) and which may be considered contributing Redside Dace reaches. The map is just a quick representation so do not take the coloured lines as actual watercourse mapping (lines are rough). Additionally, the extent of both the contributing and occupied reach colouring is also drawn on roughly so where the colours extend to and/or converge is not accurate. Please note that this map does not delineate regulated Redside Dace habitat in the sense that it does not map the meanderbelt +30m. As you can see this map confirms what you have illustrated in your below figure.

To confirm:
Occupied reaches: 14W-12 and 14W-16
Potential contributing features: 14W-11, 14W-13 and 14W-14 (14W-14 confirmed as contributing by John Pisapio, as per October 20, 2011 site meeting minutes)

I hope this helps. If you have any questions please don't hesitate to contact me.

Regards,

Sam Jefferis
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Ontario

September 6, 2013

Sonia Rankin
MMM Group
100 Commerce Valley Drive West
Thornhill, Ontario
L3T 0A1

Dear Ms. Rankin:

Please find enclosed a Licence to Collect Fish for Scientific Purposes #1075281. Please print off 2 copies of the licence and conditions, sign both copies and return one signed copy to me via email. Your signature is acknowledgement that you understand and agree to the terms and conditions of the licence. You and your assistants are required to carry a copy of this licence with you at all times while collecting specimens.

As noted in the conditions, you must complete a two-part Mandatory Report for fish collected under this licence. MNR has developed a new electronic report form to facilitate efficient reporting. The Mandatory Report, user guide and field definitions will be sent to you by email. The completed mandatory report for licence #1075281 must be submitted by November 30, 2013 to scp.aurora@ontario.ca.

Please note that all collections and sampling must be in compliance with the best management practices identified in the enclosed technical bulletin. A fish disease known as Viral Hemorrhagic Septicemia (VHS) has been confirmed in the lower Great Lakes and some inland tributaries as well as in Lake Simcoe. A VHS Management Zone for the lower Great Lakes and some inland tributaries as well as a Lake Simcoe Management Zone have been created to slow the spread of VHS and invasive species. A map is attached to assist you in determining the location of your work site(s) in relation to the two VHS management zones where waters are considered to be VHS positive. Please feel free to contact us should you have any questions regarding the definition of VHS positive waters.

Please contact me if you have any questions.

Yours truly,

K. Golby

Karen Golby
Business Services Clerk
Aurora District Office
Tel: (905) 713-7403
Fax: (905) 713-7361

2012 Map of New VHS Zones.pdf

BMP_Sci Coll Permits 2012_Final_December 22 2011.pdf

2012 VHS Risk Assessment - SciCollPerm - final December 22 2011.pdf

Ontario | Ministry of Natural Resources | Ministère des Richesses naturelles

Licence to Collect Fish for Scientific Purposes

Permis pour faire la collecte de poissons à des fins scientifiques

Licence No. / N° de permis	1075281
Local Reference No. / N° de référence local	
Issuer Account No. / N° de compte du délivreur de permis.	7491147

This licence is issued under Part I of the Fish Licensing Regulation made under the Fish and Wildlife Conservation Act, 1997 to:

Ce permis est délivré en vertu de la Partie I du règlement sur la délivrance de permis de pêche formulé conformément à la Loi sur la protection du poisson et de la faune de 1997 à:

Name of Licencee / Nom du titulaire du permis

Last Name / Nom de famille	First Name / Prénom	Middle Name / Second Prénom
Ms. Rankin	Sonia	

Name of Business/Organization/Affiliation (if applicable) / Nom de l'entreprise/de l'organisme/de l'affiliation (le cas échéant)

MMM Group

Mailing address of Licencee / *Adresse postale du titulaire du permis*

Street Name & No./PO Box/RR#/Gen. Del./ N° rue/C.P./R.R./poste restante

100 Commerce Valley Drive West

City/Town/Municipality / Ville/village/municipalité	Province/State Province/État	Postal Code/Zip Code Code Postal/Zip
Thornhill	ON	L3T 0A1

to collect the species, size and quantites of fish from the waters as set out below.
Pour faire la collecte des espèces suivantes (stade et nombre indiqués ci-dessous):

Species Espèces	Eggs Oeuf X	Juvenile Fretin X	Adults Adulte X	Numbers Nombre	Name of Waterbody Nom de l'étendue d'eau
fish		X	X		Stormwater Management Ponds (as per attached Schedule A)

Yes/Oui ☐ Additional species/Waterbody list attached / Liste d'espèces/d'étendue d'eau additionnelles ci-jointe

Purpose of collection / *But de la collecte*: Fish Rescue

Licence Dates / *Dates du permis*

Effective Date / Date d'entrée en vigueur (YYYY-MM-DD)	Expiry Date / Date d'expiration (YYYY-MM-DD)
2013-09-06	2013-10-31

Licence conditions / *Conditions du permis*: This licence is subject to the conditions contained in Schedule A if included. / Ce permis doit respecter les conditions de l'annexe A si celle-ci est jointe.

Yes/Oui ☒ No/Non ☐ Schedule A included. / Annexe A ci-jointe

Issued by (please print) Délivré par (veuillez écrire en caractères d'imprimerie)	Signature of Issuer / Signature du délivreur	Date of Issue/Date de délivrance (YYYY-MM-DD)
Elizabeth Stanley		2013-09-06

Signature of Licencee / Signature du titulaire du permis	Date (YYYY-MM-DD)
	2013-09-06

License to Collect Fish for Scientific Purposes
Permis pour faire la collecte de poissons à des fins scientifiques
Schedule A - Licence Conditions
Annexe A - Conditions du permis

Licence No 1075281
No de permis

This licence is subject to the conditions listed below.

1. Licencee may collect fish in Summerhill North stormwater management pond located between Rushbrook Drive and Bartholomew Drive; Summerhill South stormwater management pond located south of Mulock Drive between McBride Crescent and Columbus Way; Summerhill Woods stormwater management pond located south of William Dunn Crescent in the Town of Newmarket, Regional Municipality of York.

2. All fish captured will be euthanized and will not be returned to the waterbody.

3. This Licence is valid only for the persons, species, numbers, areas and calendar year indicated. A Mandatory Report documenting the sampling conducted under this licence must be submitted to the licence issuer within 30 days of the termination date, but in no case later than January 31 next following the year of issue. The Mandatory Report form (Part 1) must be completed for each sampling program and the Site.Collection Reports (Part 2) must be completed for each collection site. A map clearly indicating the location of each collection site must be attached to the Site Collection Reports. Submit the Mandatory Report (Part 1) and the Site Collection Reports (Part 2 & maps) electronically by email to scp.aurora@ontario.ca. The submission of a satisfactory report is a prerequisite to any subsequent renewals.

4. Before carrying out any operation under the licence in any area the licenced person shall inform the Area Supervisor or Lake Manager of his or her intentions at least a week before commencing work and include information as to the type of operation, location, duration, and the name or names of personnel involved.

5. A copy of the original licence must be carried by the licenced person when working at the designated sites. An assistant of the licenced person who is carrying out activities under this licence during the absence of the licenced person shall carry a copy of the licence on his or her person.

6. All collection gear shall be clearly marked with the licenced person's and the organization's name.

7. This licence is not valid in Provincial Parks, park reserves, or National Parks without the written permission from the authorized person in charge of the area concerned.

8. Capture gear shall be inspected regularly and live holding traps must be inspected at least once daily.

9. **The licencee shall follow the best management practices for the collection, handling, transportation and holding of fish identified in FPS Bulletin 2011 – 01 July 29, 2011 included with the licence in order to minimize the risk of spreading aquatic invasive species and diseases.**

10. Licencee must photograph and release live any redside dace captured. The photographs must be forwarded to MNR's Aurora District office for identification confirmation.

11. Any person, while acting under the authority of this authorization, shall immediately report the capture of any invasive species (eg. Ruffe, tubenose goby,**round goby**, rusty crayfish, Asian carp, etc.) found outside its previously known range (as determined by the distribution information available at http://www.invadingspecies.com/indexen.cfm to the licence issuing office. Any such specimens captured outside of their established range (not already naturalized) **shall be euthanized**, not returned to the water.

12. Licencee may fish with a backpack electrofisher, seine nets, dip nets and minnow traps.

Signature of Licencee / Signature du titulaire du permis **Date**

_______________________________ _______________

License to Collect Fish for Scientific Purposes
Permis pour faire la collecte de poissons à des fins scientifiques
Schedule A - Licence Conditions
Annexe A - Conditions du permis

Licence No 1075281
No de permis

13. Licencee may be assisted by: Joel Smith, Alex Stettler, Mark Cece, Patricia Mohr.

Signature of Licencee / Signature du titulaire du permis **Date**

________________________________ ________________

WORKSHOP MEETING

Lazy Pat Farm Property

Discussion of Key Issues

EIR/FSS 2nd Submission, Dec. 2012

September 10, 2013

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

Bentall Kennedy

MMM GROUP

MMM GROUP

AGENDA

1. Introduction (Mike Reel)
2. Overview of Development Concept and Philosophy (Chris Tyrrell)
3. Approach to Workshop (Chris Tyrrell)
4. Update on Discussions/Site Visit with MNR (Mark Cece)
5. Discussion of Key Issues (#3) (All)
6. Discussion/Clarification of Other Issues (#2 and #1) (All)
7. Next Steps/Schedule (Chris Tyrrell)

MMM GROUP LIMITED

1. INTRODUCTION

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

MMM GROUP

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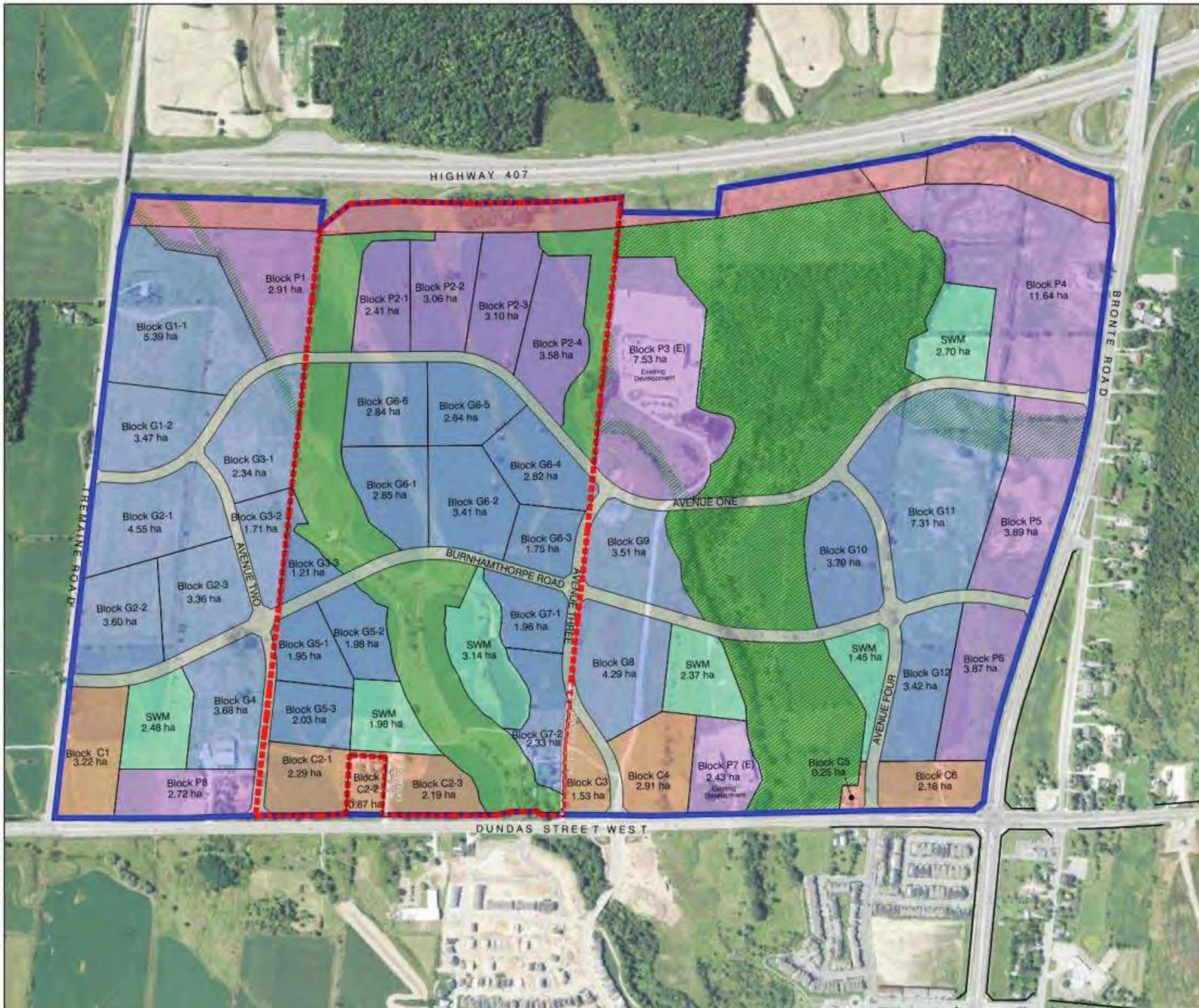
2. OVERVIEW OF DEVELOPMENT CONCEPT AND PHILOSOPHY

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

MMM GROUP

407 West Development Concept (EIR/FSS 2nd Submission)



407 West Employment Area
Lazy Pat Property

Area Concept Plan (INTERNAL USE ONLY)

LEGEND	Area Hectares	Acres
Service Area (Service/Retail/Office)	15.4	37
Light Employment	47.1	117
General Employment	78.1	193
Open Space	68.3	169
Stormwater Management	14.1	35
407 Transitway	12.3	30
Roads	15.7	39
	251.0 ha	620 ac

407 West Employment Area

Subject Lands

Notes:

- For the purposes of our analysis we have made land use assumptions for the entire 407 West Employment Area
- Right-of-way requirements for future 407 Transitway to be determined
- The Natural Heritage System on lands owned by others is conceptual, as shown in the North Oakville West Secondary Plan, and is subject to further study.

Scale 1 : 7500

Client: Bentall Kennedy

Prepared by: MMM GROUP

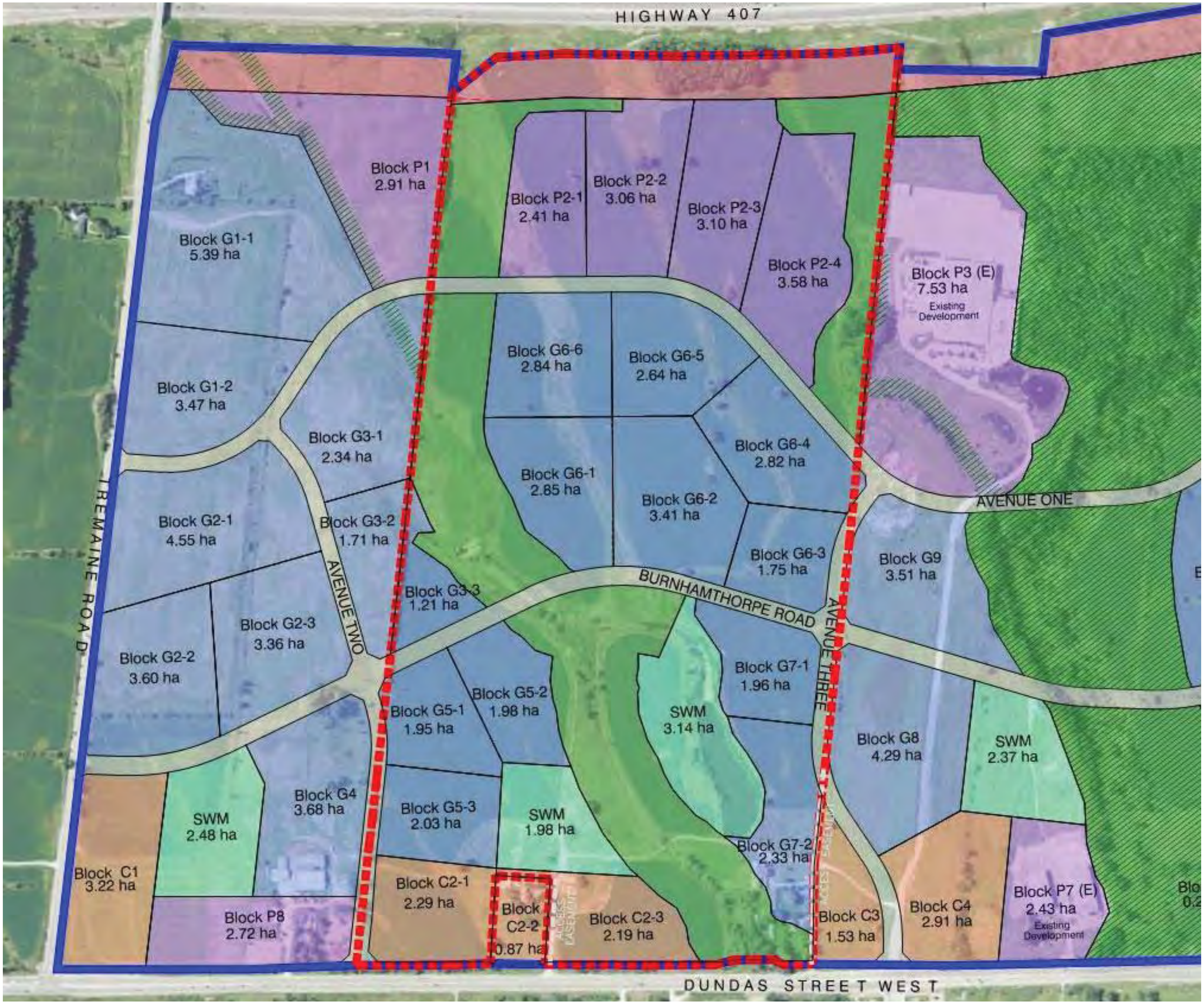
Date: January 25, 2013

Project No. 1409222.001

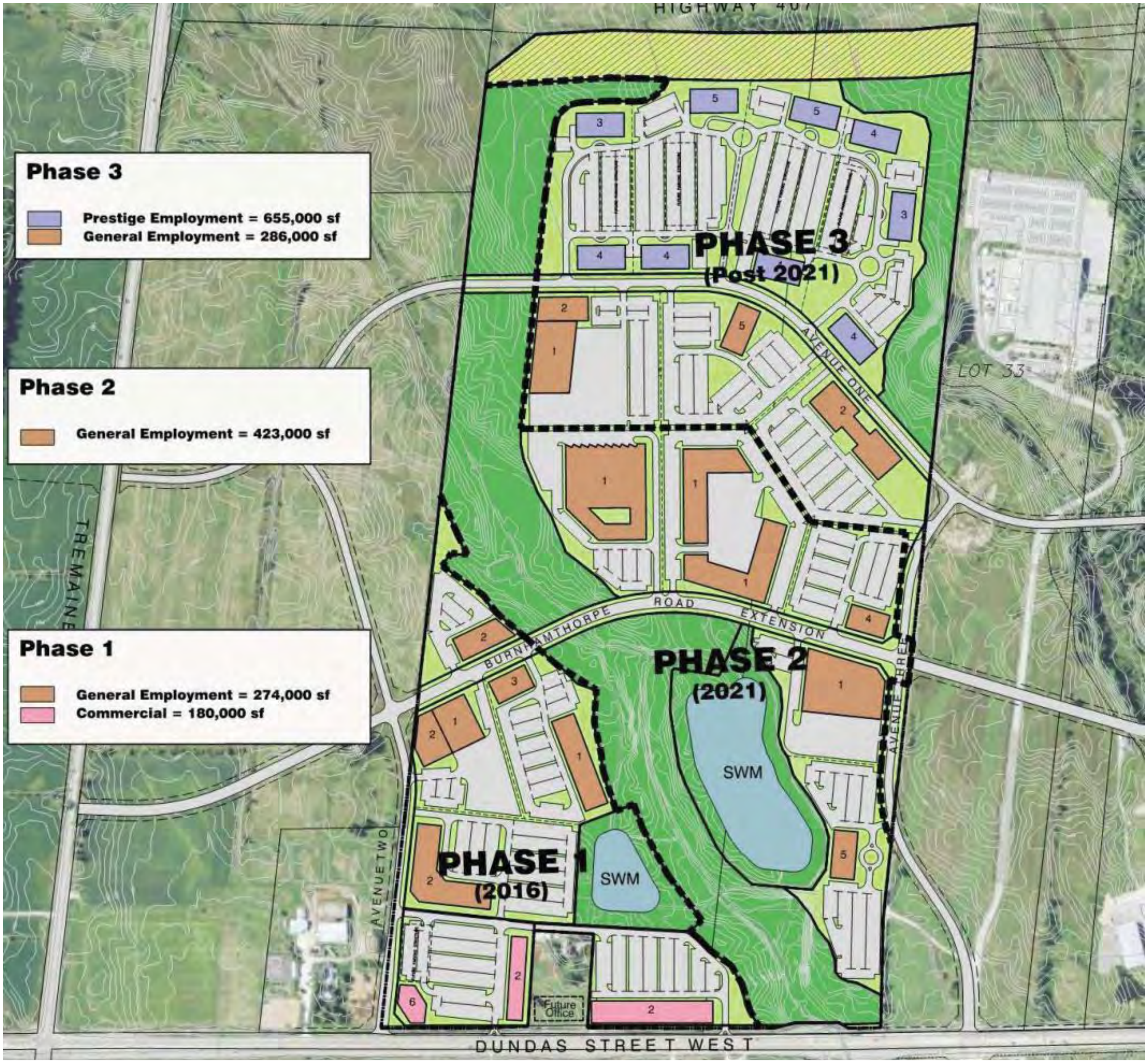
Aerial Photo: © DigitalGlobe 2010, Google 2009

MMM GROUP

Lazy Pat Concept Plan



Lazy Pat Preliminary Master Plan



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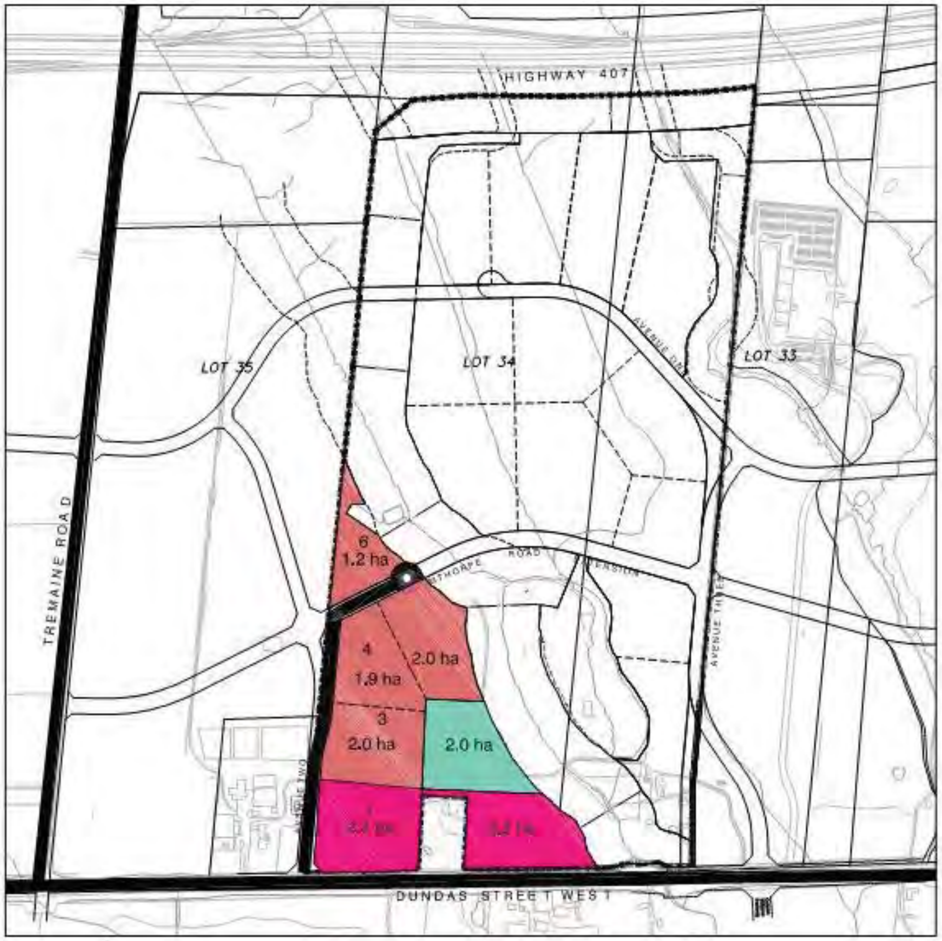
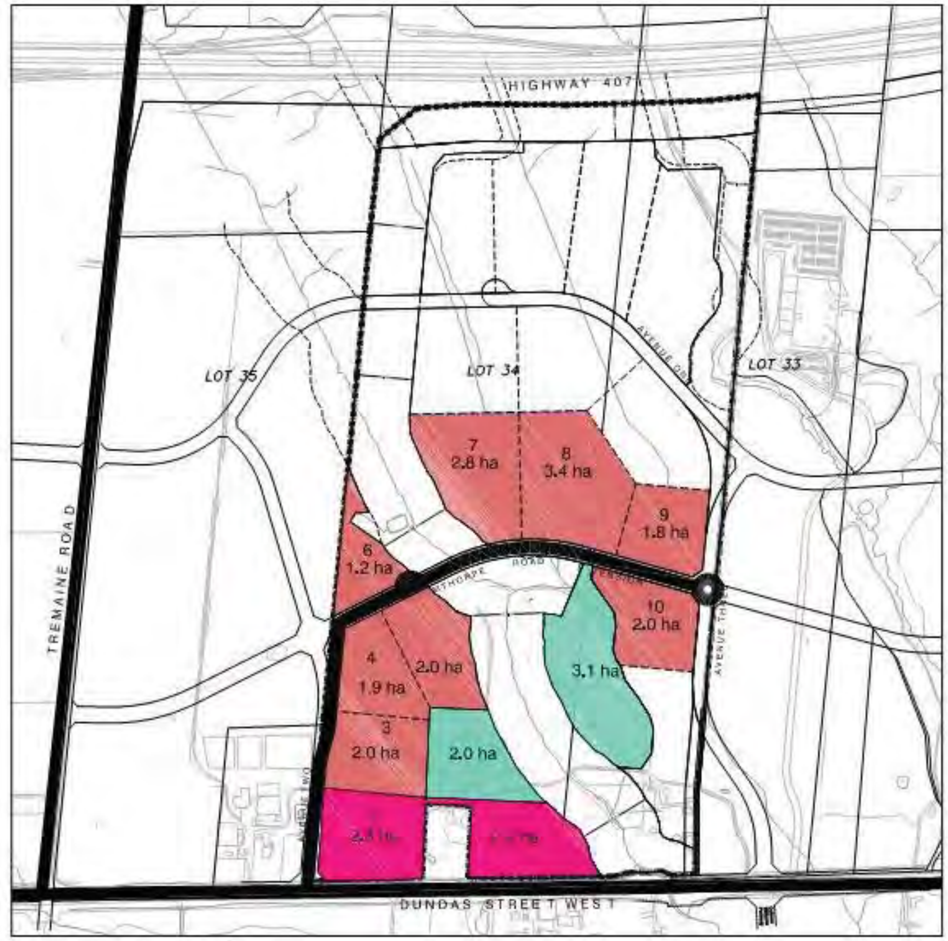
Lazy Pat Preliminary Phasing Plan (Phase 1a and 1b)



Phase 1a
(Before Creek Crossing)

	Service Area (Commercial)	4.5 ha
	General Employment (Industrial)	7.1 ha
	Storm Water Management	2.0 ha



Phase 1b
(Before Second Connection)

	Service Area (Commercial)	4.5 ha
	General Employment (Industrial)	17.1 ha
	Storm Water Management	5.1 ha

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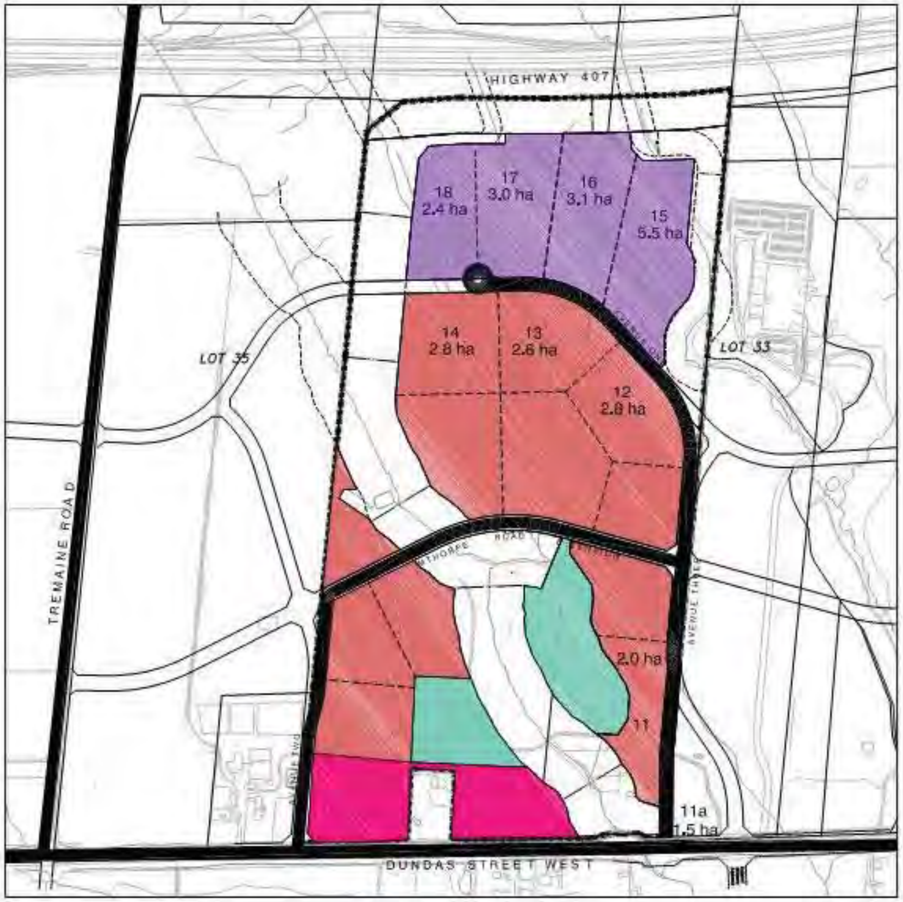
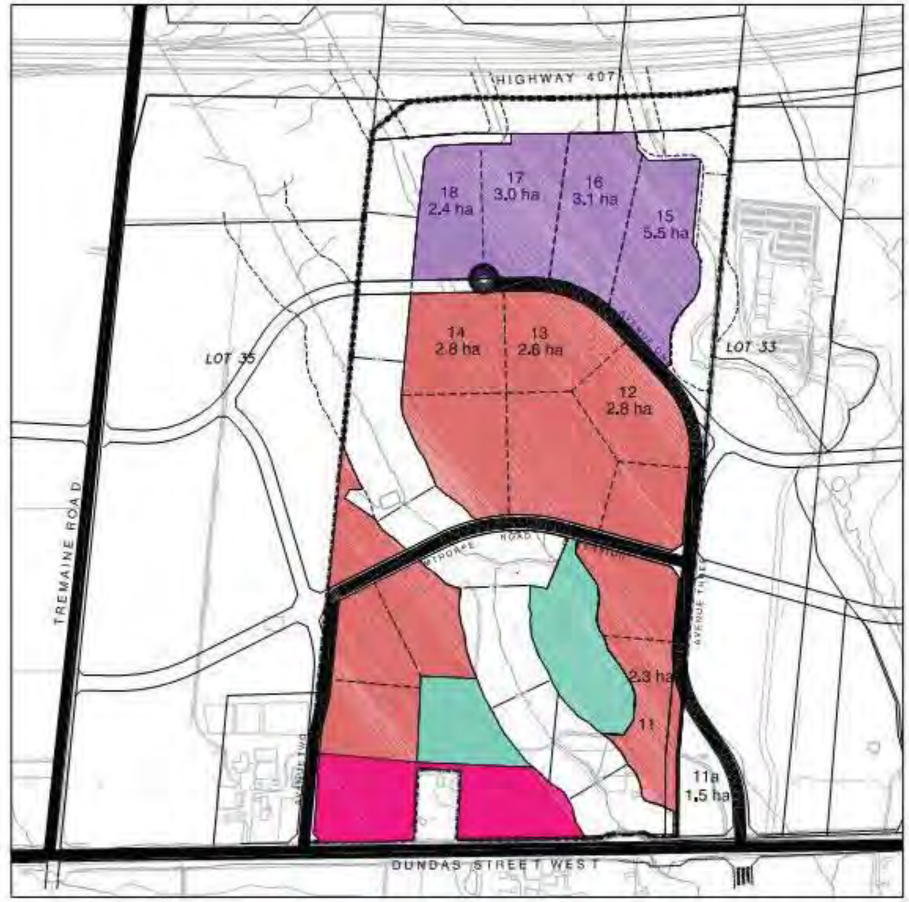
Lazy Pat Preliminary Phasing Plan (Phase 2a and 2b)



Phase 2a

(After Second Connection)

	Service Area (Commercial)	4.5 ha
	General Employment (Industrial)	27.3 ha
	Prestige Employment (Light Industrial)	14 ha
	Storm Water Management	5.1 ha



Phase 2b

(After Second Connection)

	Service Area (Commercial)	4.5ha
	General Employment (Industrial)	27.6 ha
	Prestige Employment (Light Industrial)	14 ha
	Storm Water Management	5.1 ha

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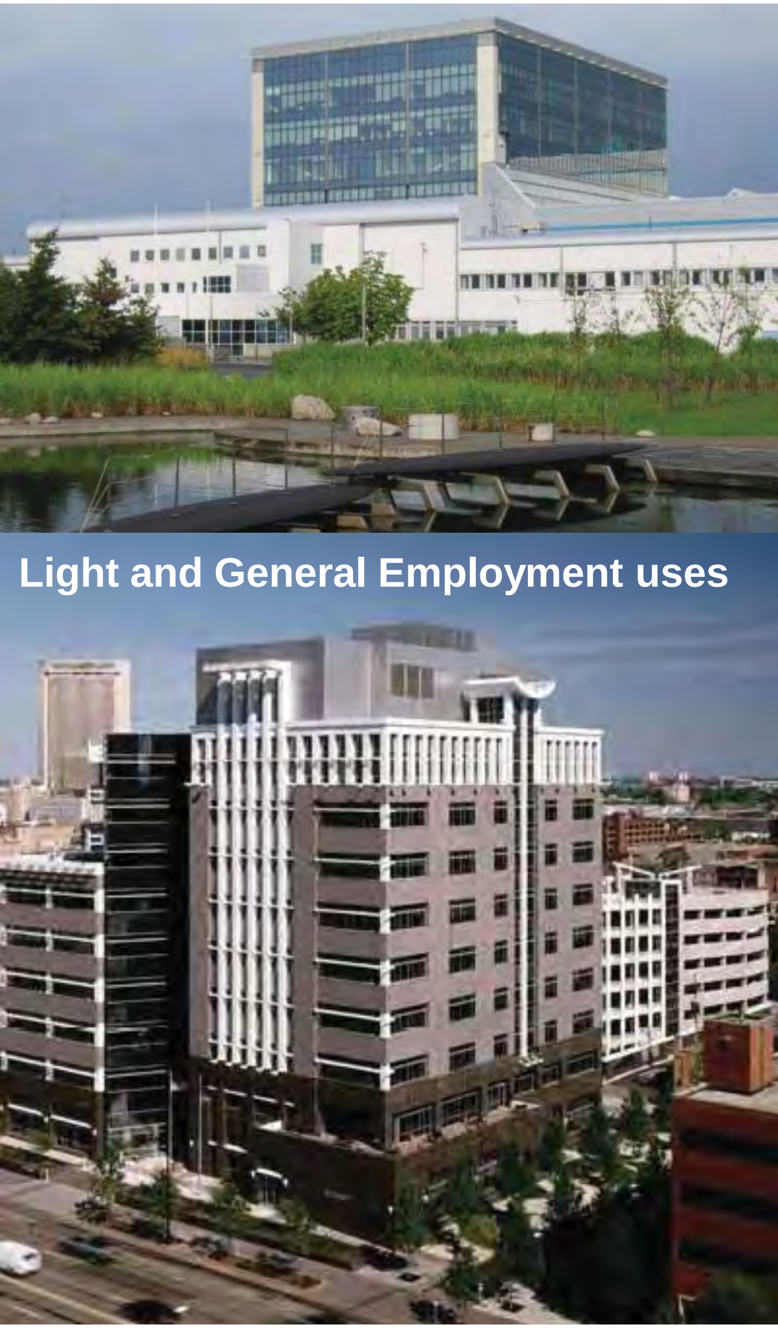
Employment District Built Forms
(North Oakville Urban Design and Open Space Guidelines)



Light and General Employment uses

Office buildings in a campus setting

Campus Design

Bentall Kennedy LP
Precedent Business Park Developments


Financial Drive, Mississauga


Royal Bank, Mississauga


Microsoft Canada, Mississauga


Maple Leaf Foods, Meadowvale, Mississauga


Steeles Technology Campus, Toronto

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3. APPROACH TO WORKSHOP

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

MMM GROUP

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Approach to Workshop

- Implementing policy “on the ground”
- Constructive solutions to address key issues
- Heading to 3rd Submission of EIR/FSS, want to be acceptable to Town and Agencies

MMM GROUP LIMITED

4. UPDATE ON DISCUSSIONS/SITE VISIT WITH MNR

COMMUNITIES

TRANSPORTATION

BUILDINGS

INFRASTRUCTURE

MMM GROUP

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5. DISCUSSION OF KEY ISSUES

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

MMM GROUP

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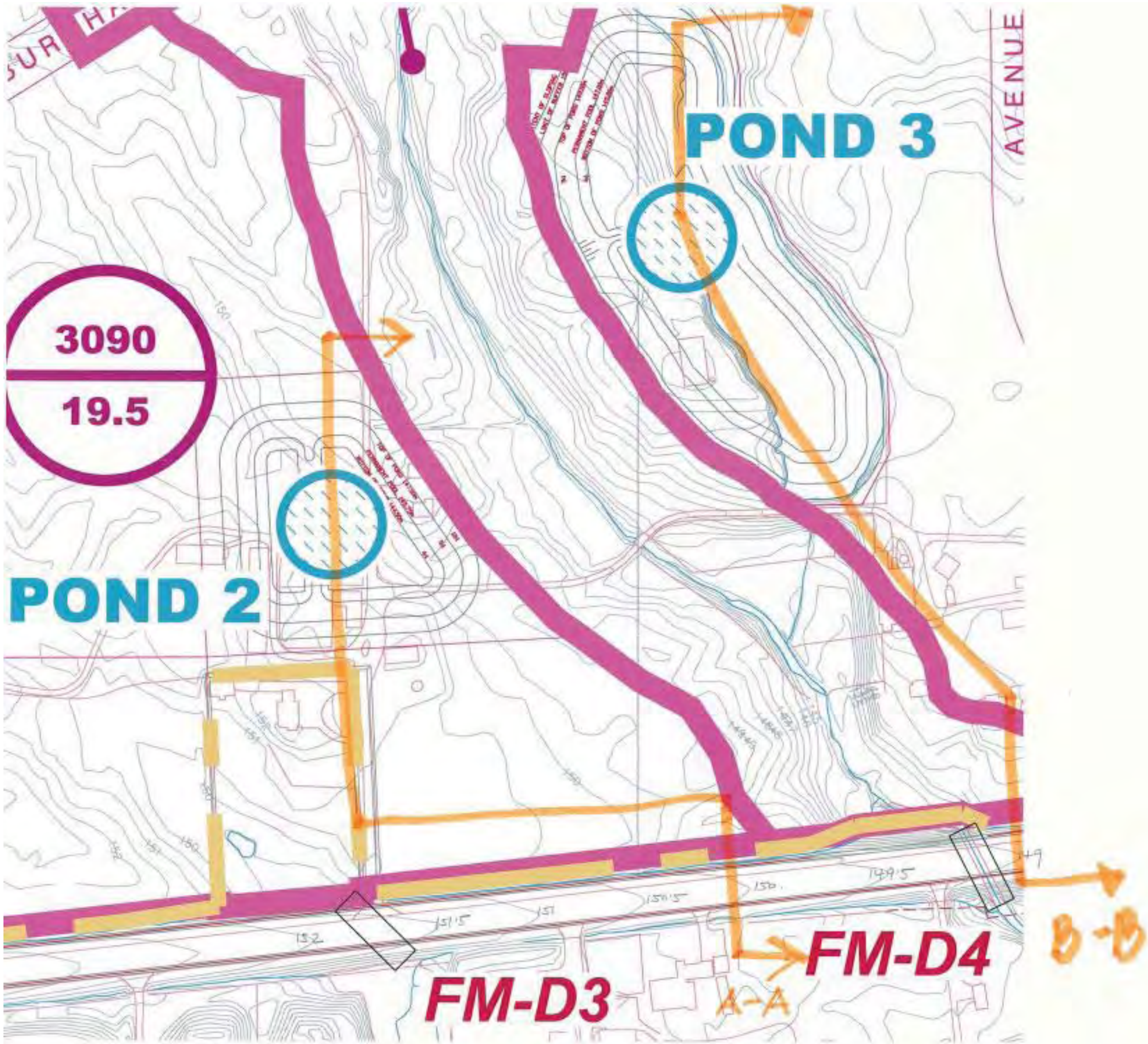
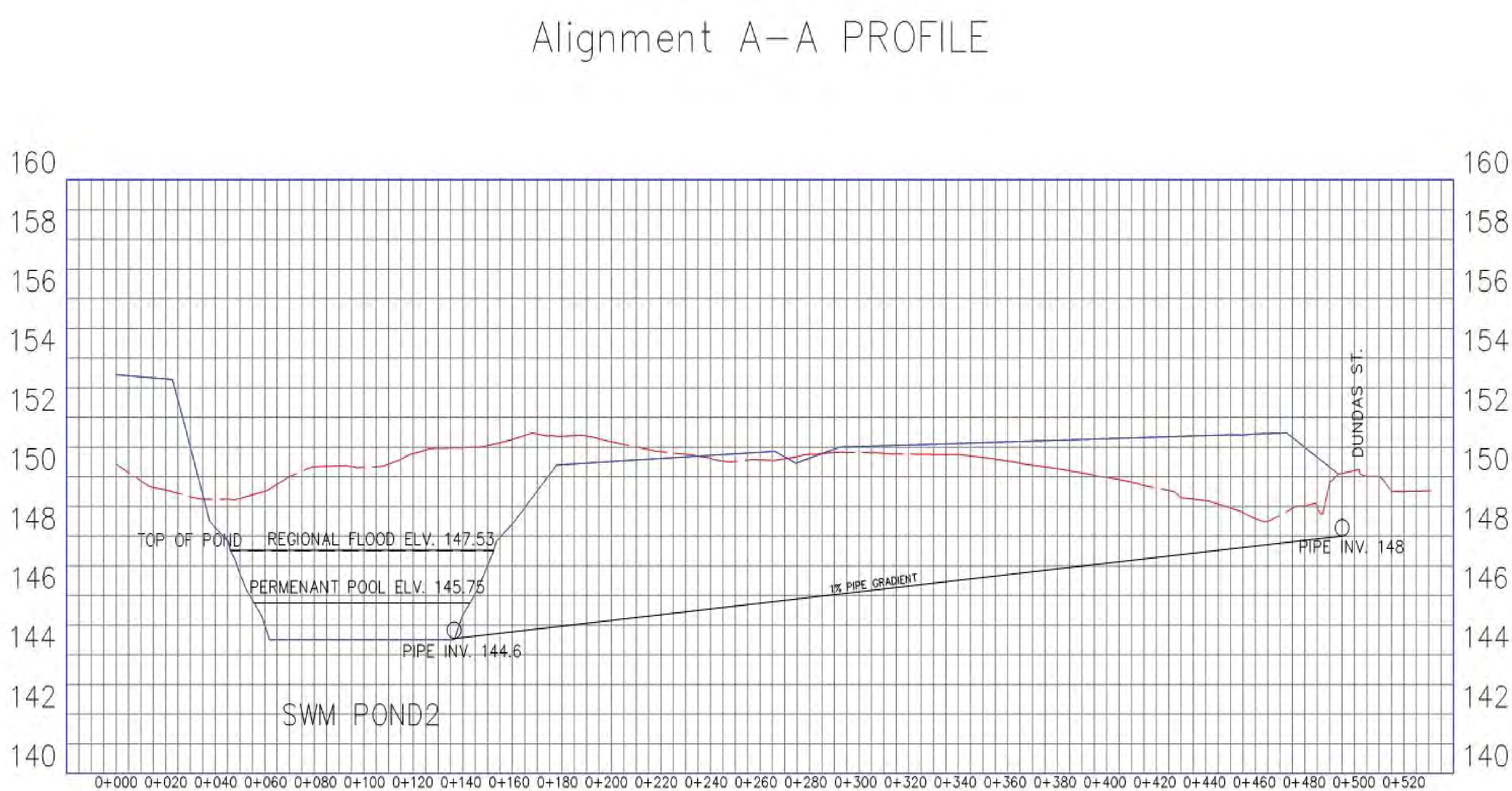
a. Dundas Street Stormwater Runoff and SWM Facility Allowances



Section A-A across Dundas Street and SWM Pond 2



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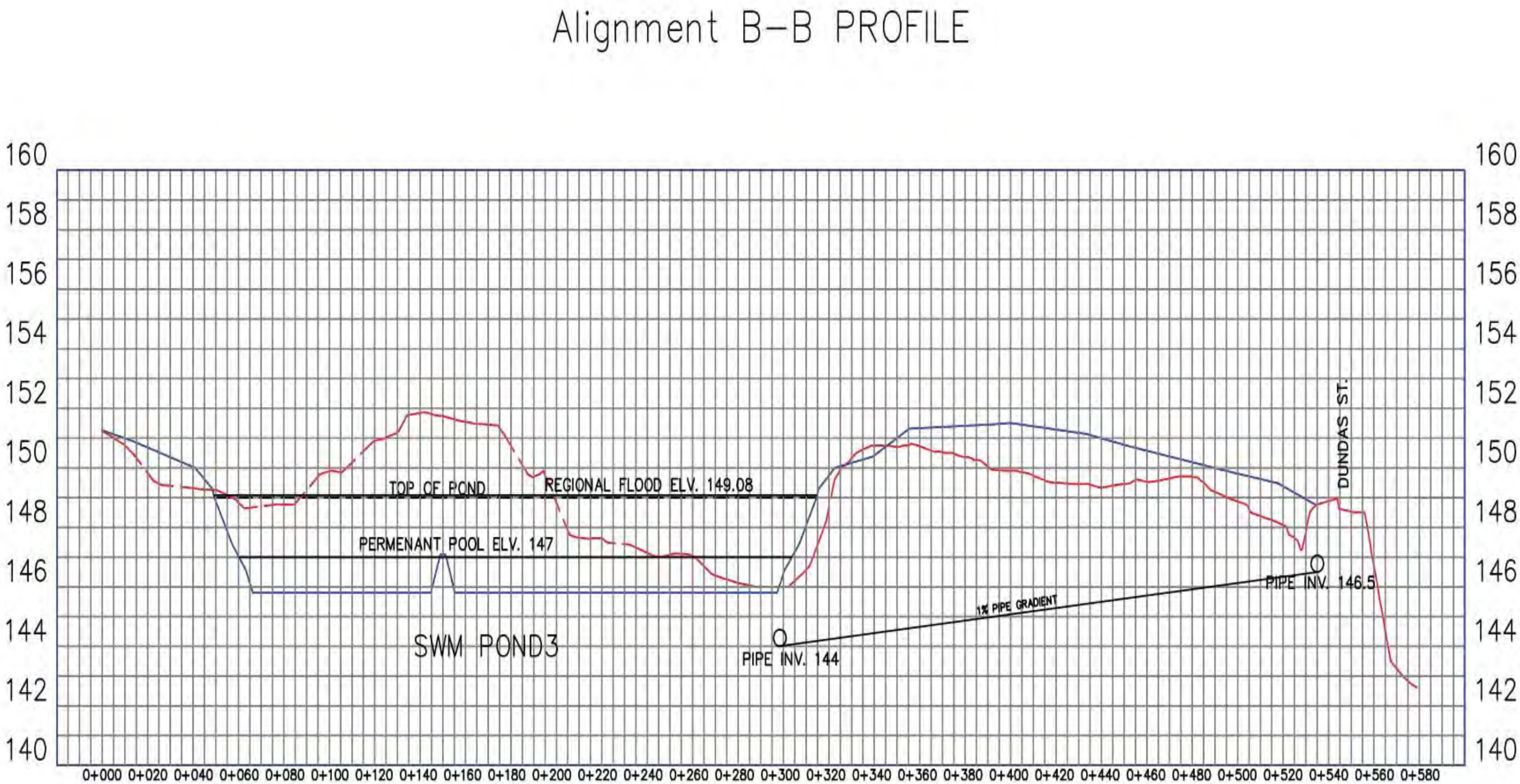
Section B-B across Dundas Street and SWM Pond 3



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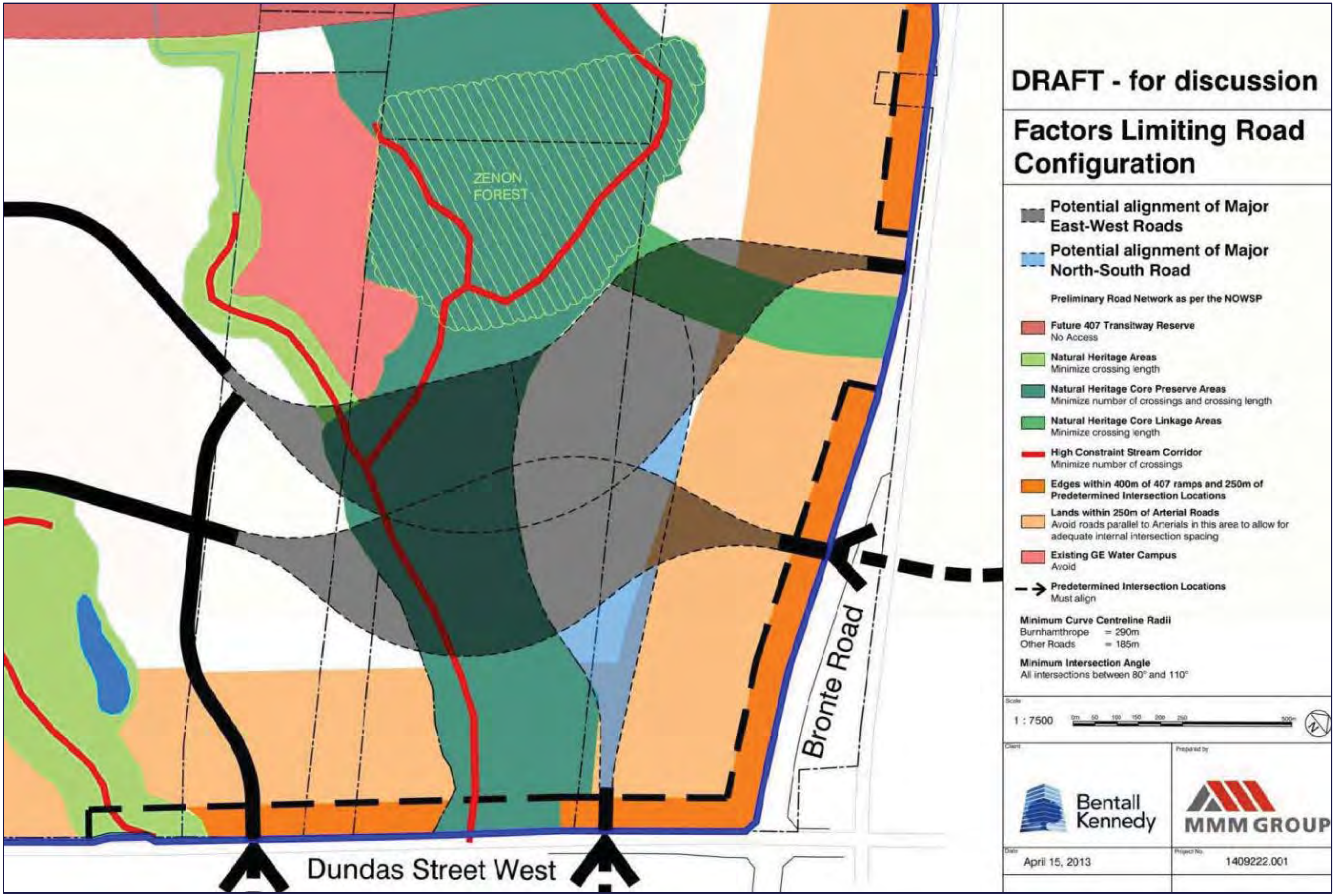
b. 407 West Concept Plan (Avenue 1 Alignment, Sanitary Servicing)

- Sufficient flexibility in road alignment options as they leave the Lazy Pat Farm property.

Avenue One / Burnhamthorpe Road Alignment Options



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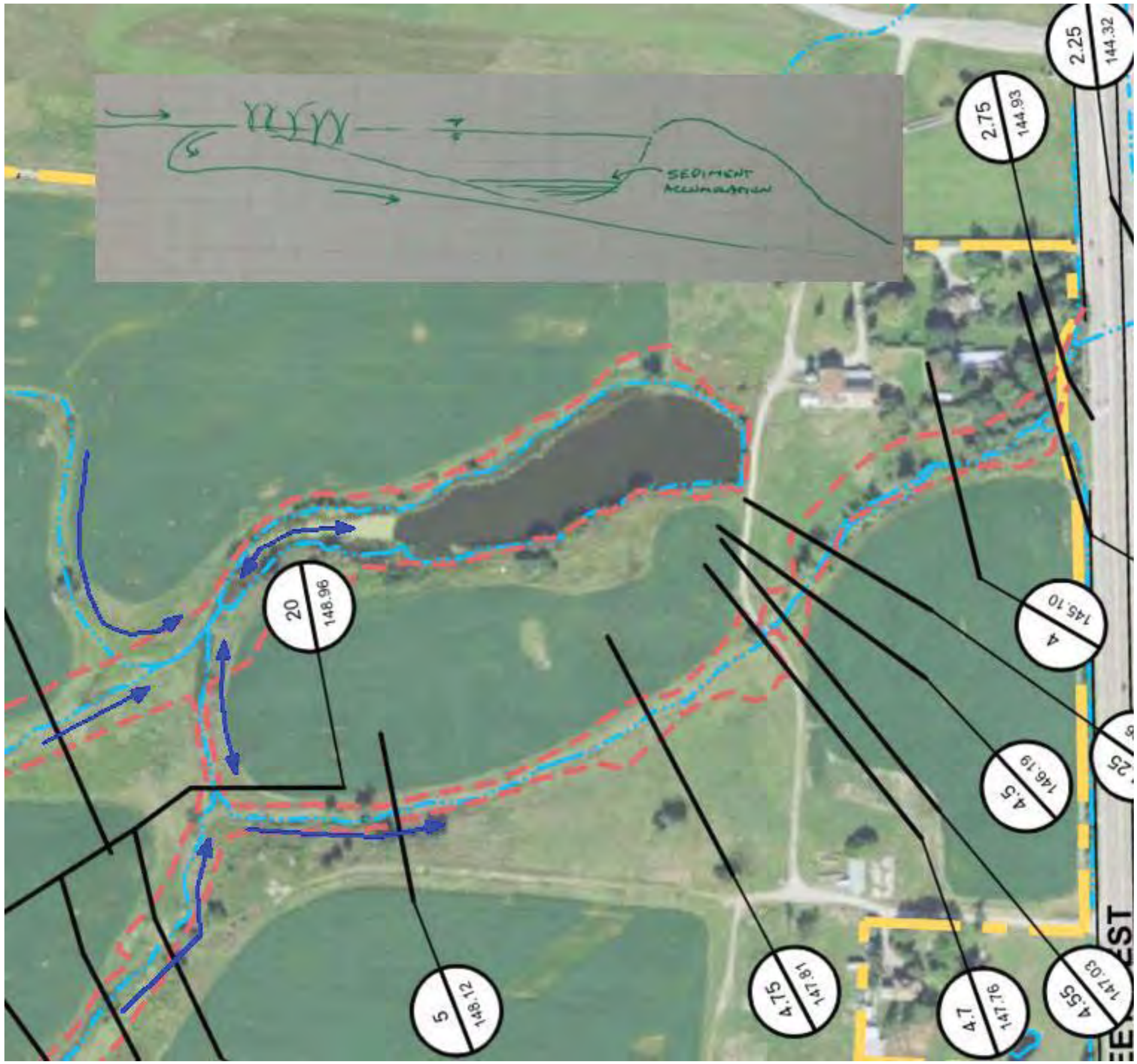
c. Characterization of Existing Pond (14W-14A) and Use as a SWM Facility

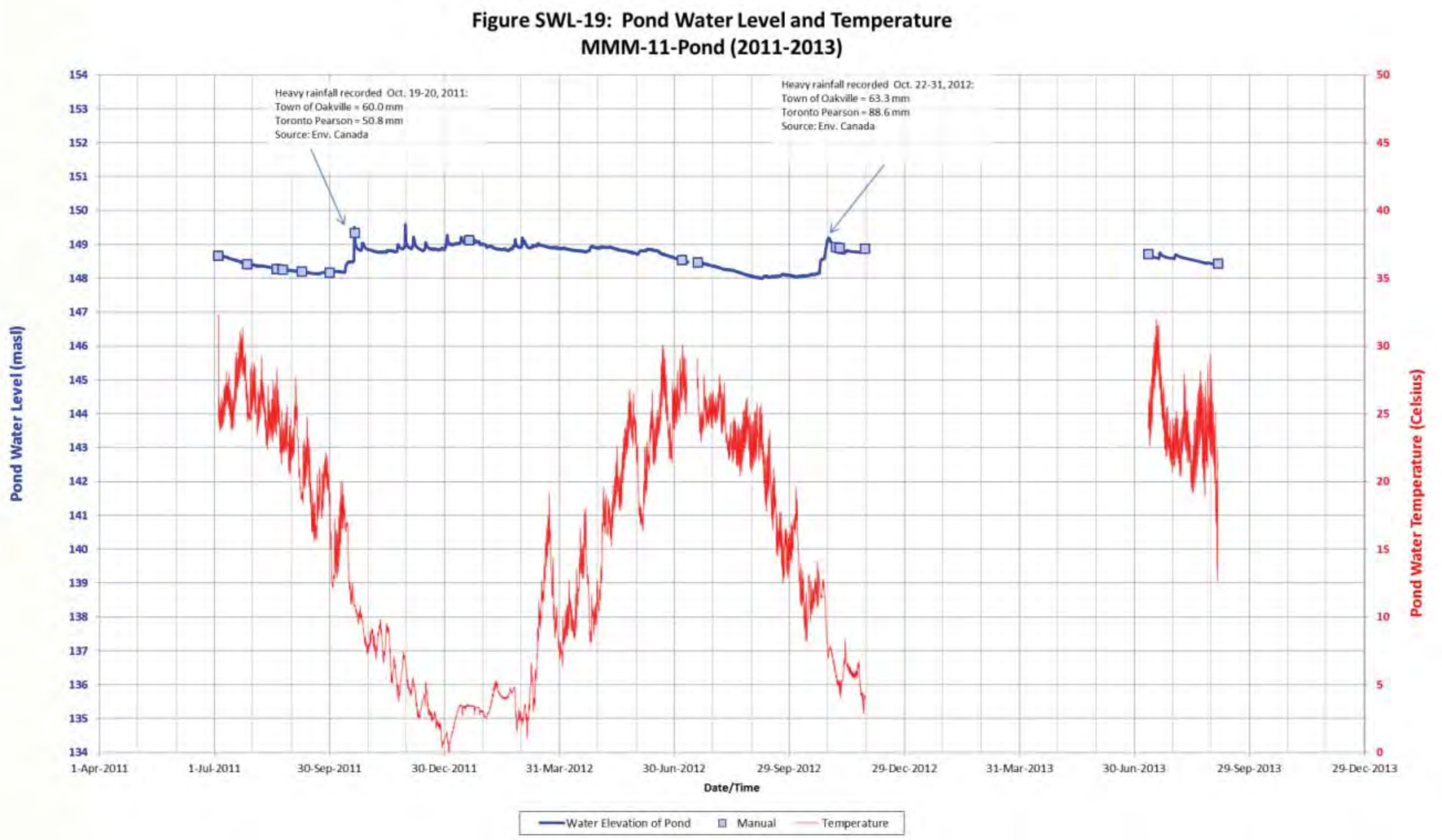
- Pond constructed between 1934 & 1960 for agricultural purposes
- Reach 14W-12A appears at same time (for flow connection back to main creek)
- Possesses thick cattail patch at northern point
  - Diffuse flow enters pond – no inherent circulation path in pond
  - Gross particulates filtered by cattails, fine sediment reaches pond body
  - Thick muck pond bottom due to accumulation of fine sediment
  - No inherent flow path due to obstruction at mouth of pond

c. Characterization of Existing Pond (14W-14A) and Use as a SWM Facility



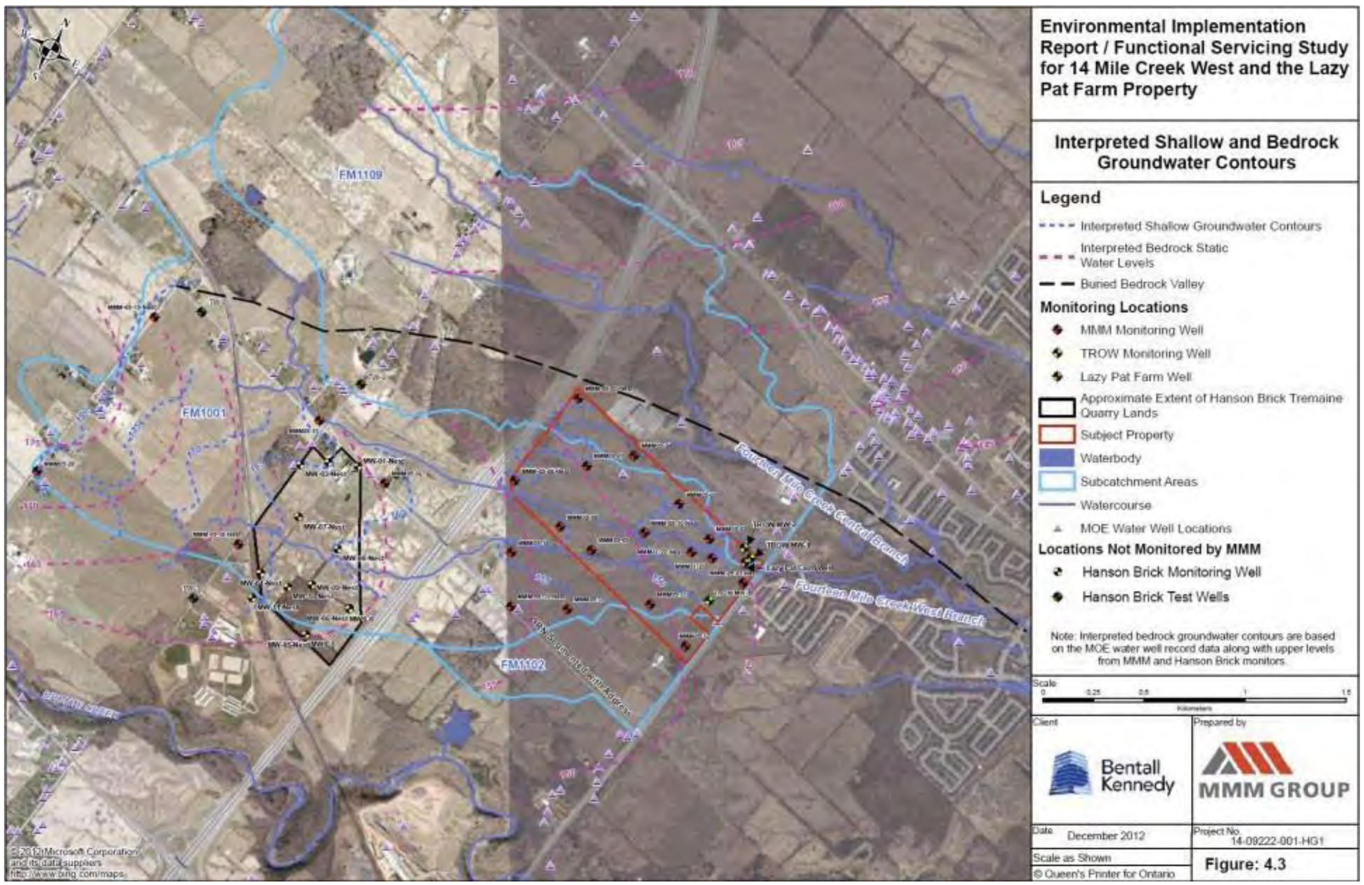
MMM GROUP

Pond Data – Water Levels and Water Temperature



Hydrogeological Conditions

- Halton Till (Silt/Clay) overlying Queenston Shale Bedrock
- Buried Sand and Gravel bedrock valley northeast of site (below GE property)
  - Draws down shallow till/bedrock groundwater to East-Northeast



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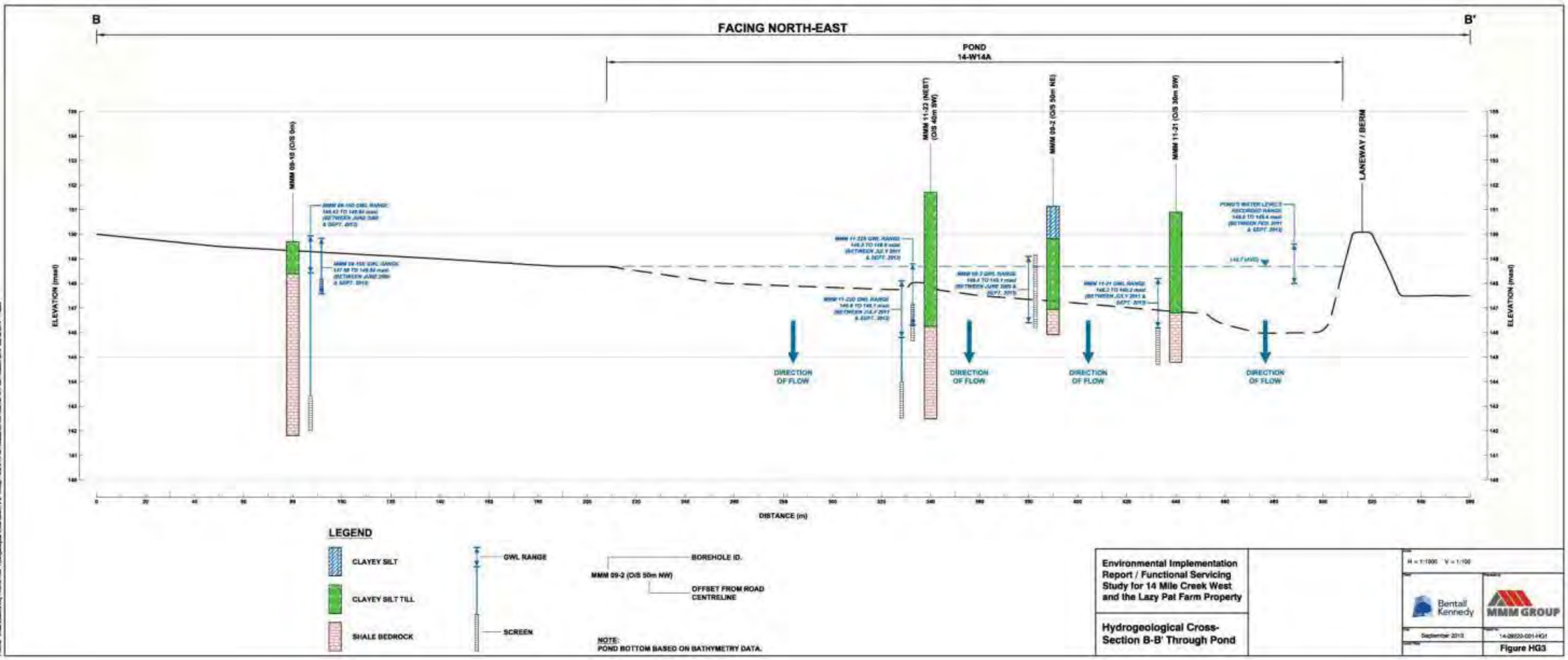
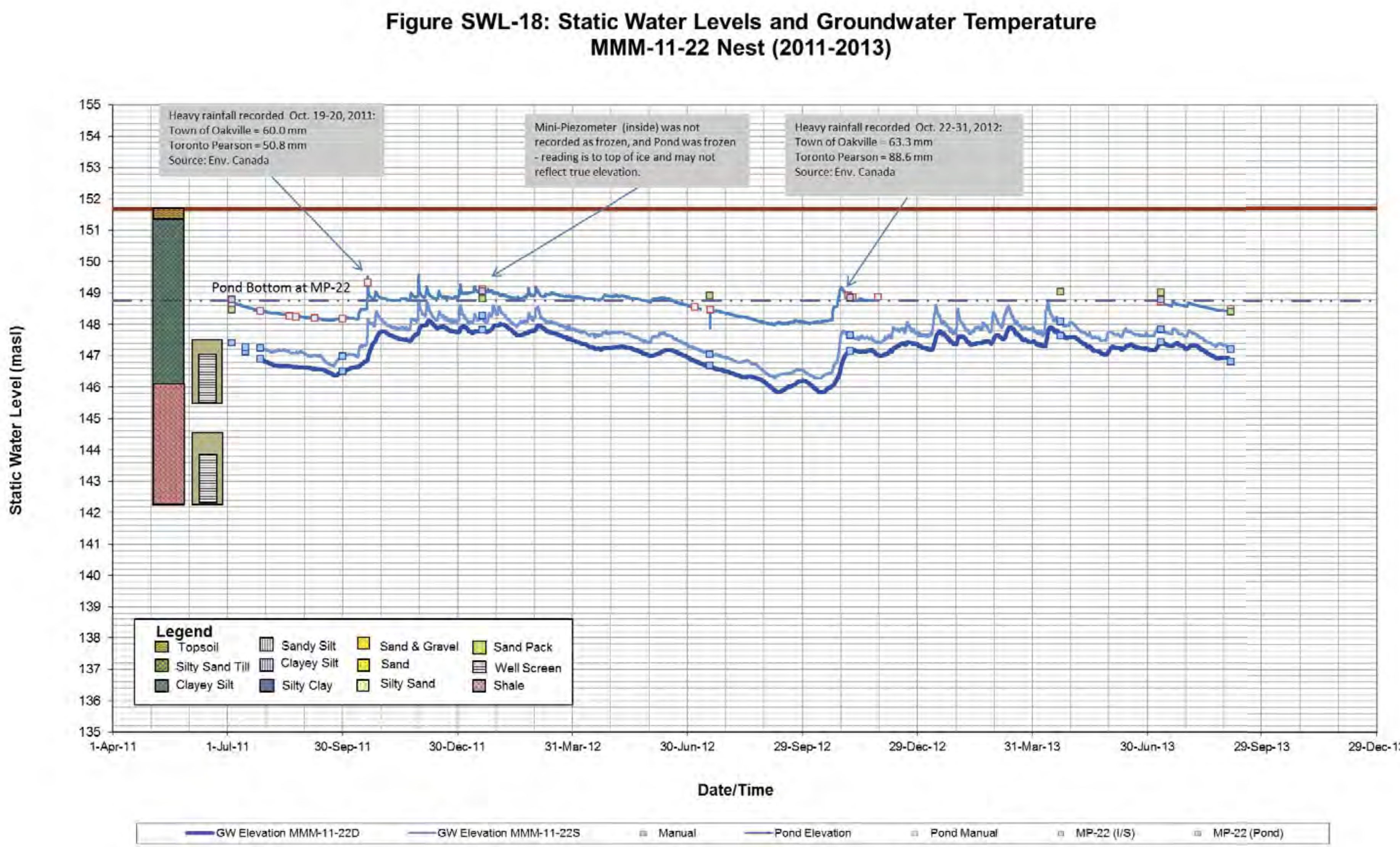
Pond-Groundwater Interaction

- Pond identified as maintained by Surface Water Inflows in 1st Submission
- Additional Studies were requested to confirm the function of the pond (Ecology, Hydrogeology)
  - Groundwater study included installation of new monitoring wells and use of data loggers at surrounding wells and the pond
- Logger data collected between June 2011 and November 2012 (2nd Submission) conclusively showed water levels in pond always higher than the shallow groundwater at adjacent monitoring wells to east and west of pond
  - Pond water temperatures also ranged between 0C to 32C during the 17 month time frame
- Conclusion – Pond is losing water into the ground and is maintained by surface water inflows

Longitudinal Cross Section



Example: Pond Levels vs. Groundwater Levels at Monitoring Well Nest MMM11-22



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d. Drainage Densities

- Goal: Overall Protection of Total Length of Red/Blue Streams
- Contentions:
- Reach 14W-14A designated in NOCSS as a Level 2 (Blue) Feature
  - Implication: Possession of a stream length due to perception of what "Blue" designation imparts.
  - No discussion of stream length on this feature in NOCSS.
- Reach 14W-21 (200m length) cannot be counted toward stream length contribution.

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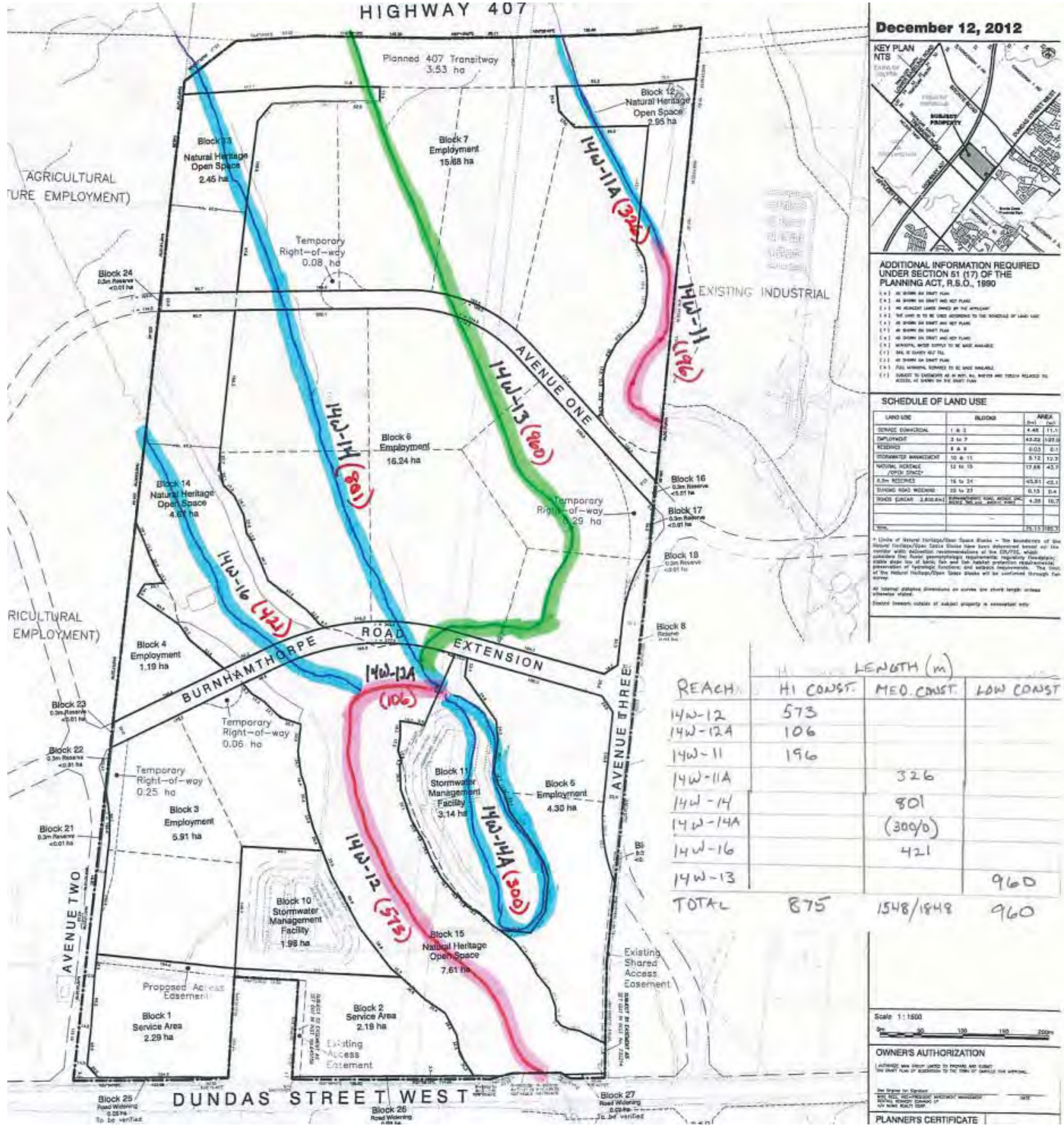
Existing Conditions



REACH	LENGTH (m) HI CONST.	MED. CONST.	LOW CONST
14W-12	573		
14W-12A	106		
14W-11	196		
14W-11A		326	
14W-14		801	
14W-14A		(300/0)	
14W-16		421	
14W-13			960
TOTAL	875	1548/1848	960

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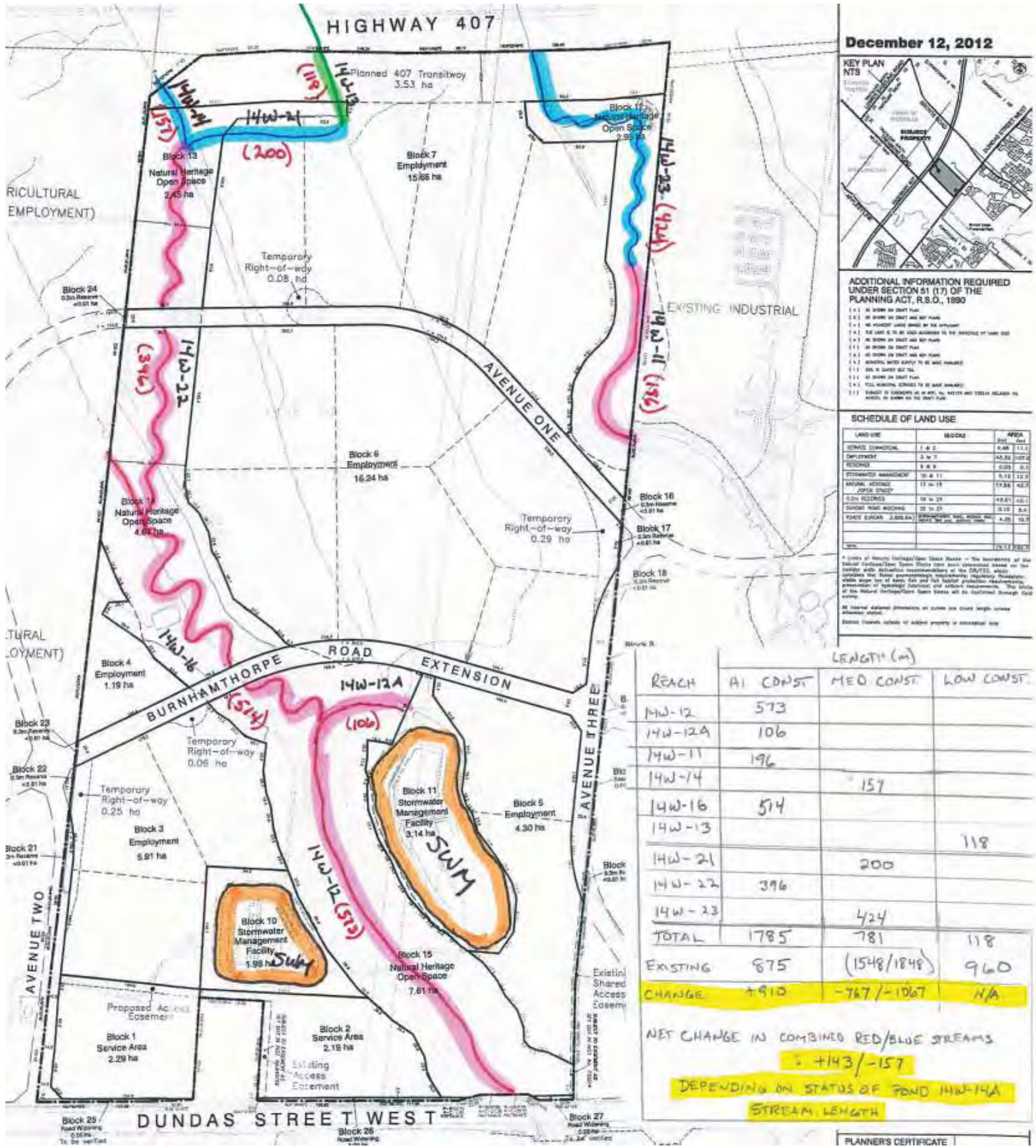
Proposed Conditions



d. Drainage Densities

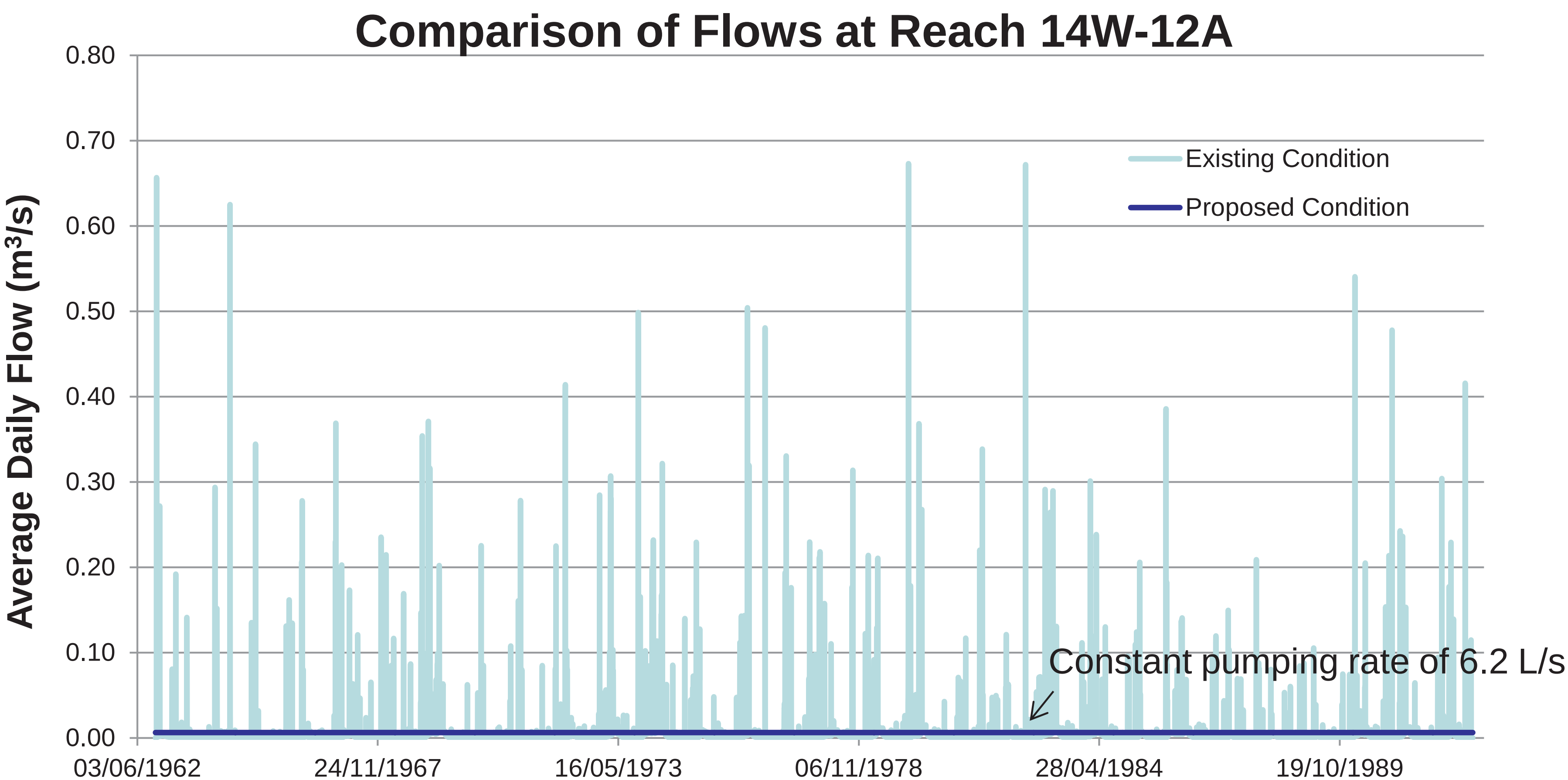
Post Development Drainage Density:

- Total Length, Red Streams (Post-Development):1,785m (+910m)
  Total Length, Blue Streams (Post-Development): 781m (-767 / -1067m)

- Net Change: +143m/-157m depending on status of Pond 14W-14A Stream Length.

e. Consolidation/Relocation of Stream Corridors (channel form, flow regime comparison)

Parameters	Flows (m3/s)	
	Existing	Proposed
Mean	0.00615	0.00620
Standard Deviation	0.03058	0.00000
Maximum	0.67306	0.00620
Minimum	0.00000	0.00620



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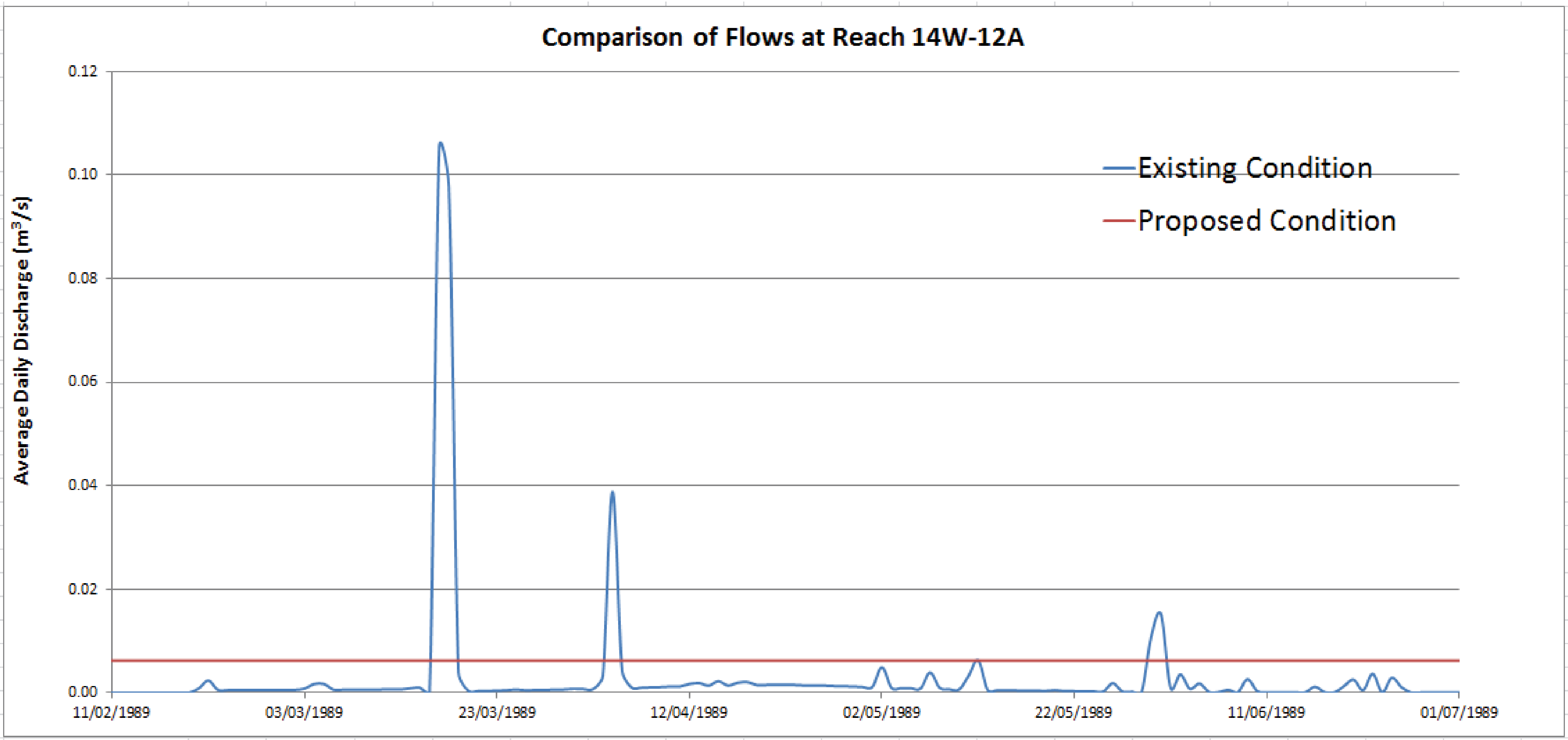
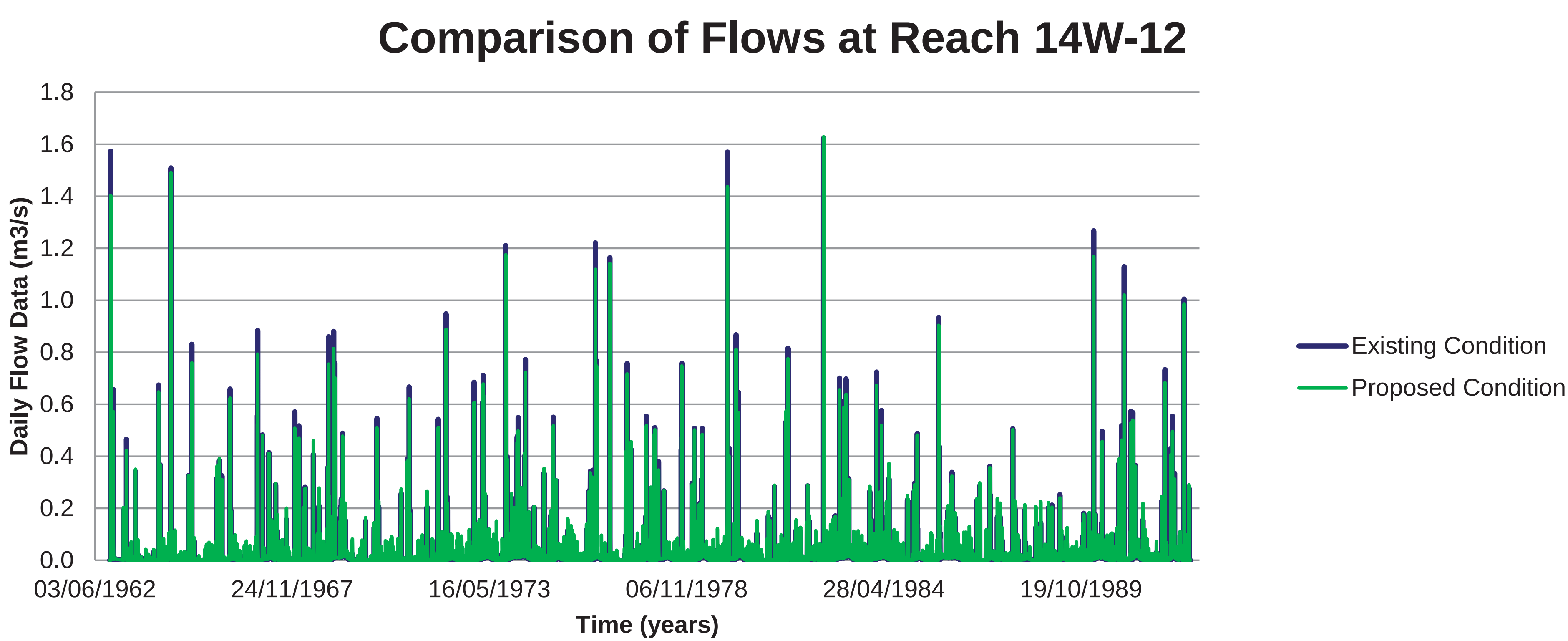
Flow regime comparison (1989)



Flow regime comparison (continued)

Parameters	Flows (m3/s)	
	Existing	Proposed
Mean	0.01438	0.02100
Standard Deviation	0.07318	0.07220
Maximum	1.62333	1.62900
Minimum	0.00000	0.00000



- Marginal increase in daily stream flow data.
- Reduction in standard deviation ensures a healthy baseflow regime.
- Peak flow of the proposed condition is the same as the existing.

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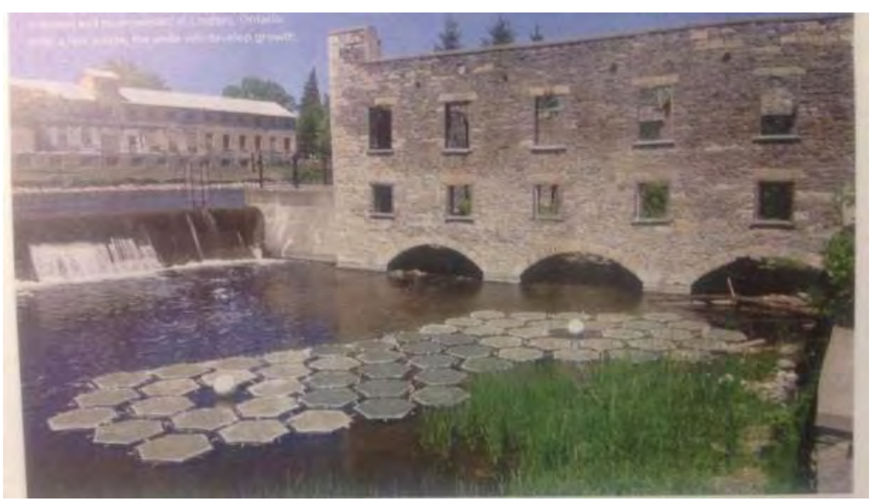
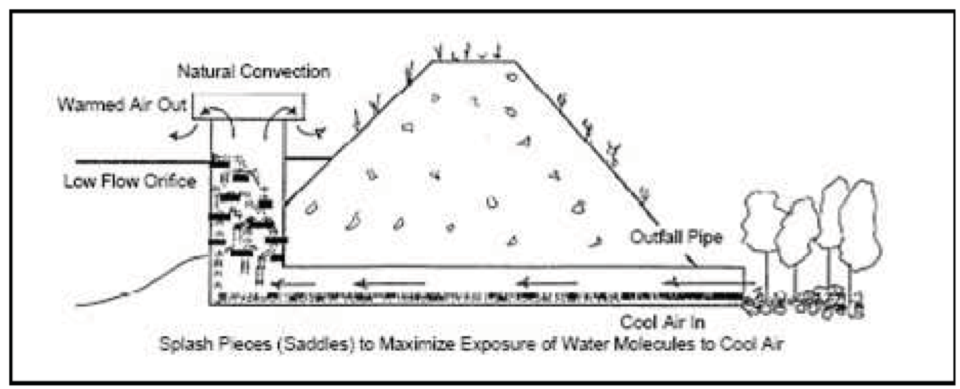
f. Location and Size of SWM Facilities

- Larger ponds more effective than multiple, smaller ponds to treat stormwater
- NOCSS did not account for potential watercourse realignments when locating SWMP locations – the NOWSP anticipates realignments
- Reduced future maintenance burden
- Positioned to preserve Dundas St. corridor (Urban Design Guidelines)
- Need to maintain flow in RSD designated reaches
- Requires pumping to 14W-12A
- Ability to enhance thermal mitigation (cooling towers, floating wetlands, etc.) as a Pilot Project if desired

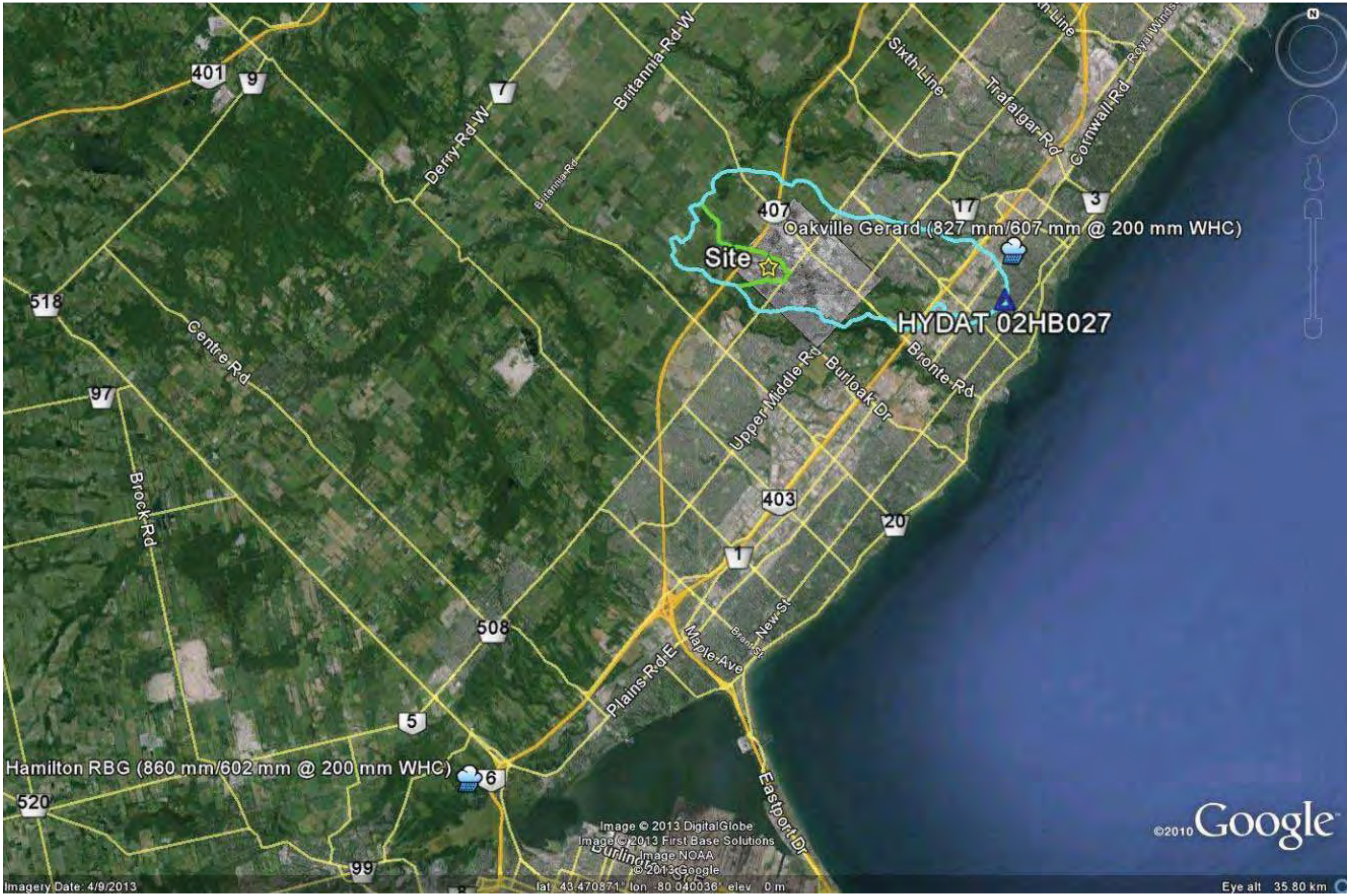




(adapted from Claytor 1993)

Figure 3-2: Schematic of Potential Cooling Tower Design

g. Water Balance (Clarification)



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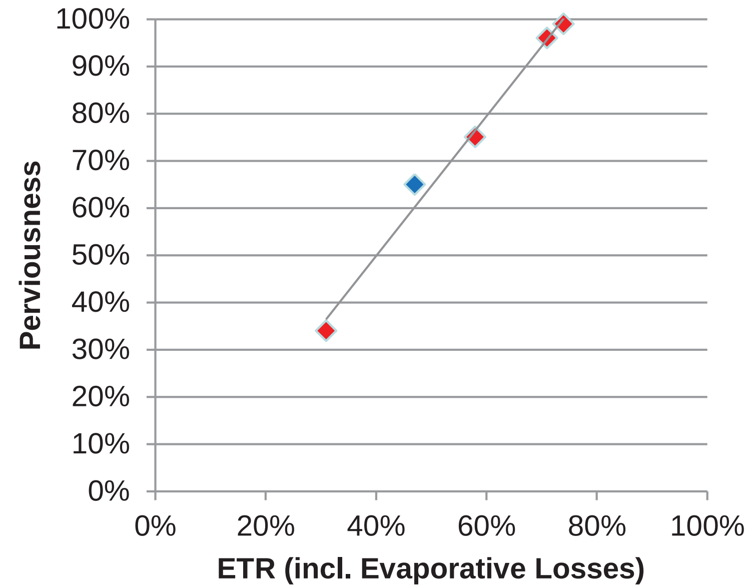
g. Water Balance (Focused in On Site Area)

MMM GROUP

Appropriateness of Water Balance/ Calculated ETRs

- Question whether Water budget data used in Water Balance is appropriate (Oakville Gerard)

Sub-Watershed	Approx. Perviousness	Calculated ETR	Notes
MMM Water Balance (Table 4-8)			
FM-1001 (bcIMC)	99%	74%	Pre-Dev
FM-1001 (All)	96%	71%	Pre-Dev
FM-1001 (bcIMC)	34%	31%	Post-Dev
FM-1001 (All)	75%	58%	Post-Dev
CH Comments			
HYDAT 02HB027	65%	47%	Based on measured stream flow data
MOE SWMP Man'l Table 3.1	N/A	55-59%	Generic Site – somewhere in Ontario



- Site and upgradient watershed ~undeveloped and ETR % is in line with expected values
- As land gets urbanized ETR declines due to reduction in green space
- 47% available ETR based on HYDAT station records is in line with values calculated by MMM (see chart) – therefore no need to revisit water balance

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6. DISCUSSION/CLARIFICATION OF OTHER ISSUES (#2 and #1)

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

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7. NEXT STEPS / SCHEDULE

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

MMM GROUP

WORKSHOP MEETING

Lazy Pat Farm Property

Discussion of Key Issues

EIR/FSS 2nd Submission, Dec. 2012

September 10, 2013

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE

Bentall Kennedy

MMM GROUP

Sonia Rankin

From: Randall Roth
Sent: Friday, September 13, 2013 2:22 PM
To: pbond@hrca.on.ca; Janette Brenner (jbrenner@hrca.on.ca); 'Samantha Mason'; Richard.Clark@halton.ca; 'jane.Devlin@ontario.ca'; 'Thun, Robert'; KParker@oakville.ca; Philip Kelly (PKelly@oakville.ca); Reel, Mike (MReel@Bentallkennedy.com); Mark Cece; Steve VanHaren; 'aquader@mmm.ca'; Andrew Kulin; Alex Williams; Chris Tyrrell
Cc: Charles McConnell (CMcConnell@oakville.ca); 'Najak, Zahir (Zahir.Najak@halton.ca)'; 'samantha.jefferis@ontario.ca'
Subject: Lazy Pat - September 10, 2013 Workshop - Action Items List
Attachments: BK Workshop September 10, 2013 Final.pdf; Meeting Report - Action Items Draft.pdf

Importance: High

Hi,

We would like to thank everyone for their participation at the workshop meeting on September 10, 2013, in relation to the Lazy Pat Farms EIR/FSS 2nd Submission (Dec. 2012) and discussion of key issues. As discussed at the workshop, please find attached a draft of the Action Items, including individual responsibilities and proposed timeframes.

Also attached is a copy of the workshop presentation slides for your information.

We appreciate everyone's efforts in moving forward with the 3rd submission of the EIR/FSS, targeted for this Fall.

Please contact myself or Chris if you have any questions.

Thanks,

Randall Roth, MCIP, RPP
Senior Planner/Project Manager, Associate
Planning & Environmental Design
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MMM GROUP

MEETING REPORT
WITHOUT PREJUDICE

Date:	September 13, 2013	**Project:**	Lazy Pat Farms (EIR/FSS): Bentall Kennedy
Date of meeting:	September 10, 2013	**Project Number:**	14.09222.001
Location:	Town of Oakville	**Author:**	Chris Tyrrell Randall Roth
Purpose:	**Discussion of Key Issues: Action Items**		

Attendees:	**E-Mail**
Paul Bond, HRCA	PBond@hrca.on.ca
Janette Brenner, HRCA	JBrenner@hrca.on.ca
Samantha Mason, HRCA	SMason@hrca.on.ca
Ronald MacKenzie, Region	Ronald.Mackenzie@halton.ca
Richard Clark, Region	Richard.Clark@halton.ca
Jane Devlin, MNR	Jane.Devlin@ontario.ca
Robert Thun, Town	RThun@oakville.ca
Kristina Parker, Town	KParker@oakville.ca
Philip Kelly, Town	PKelly@oakville.ca
Mike Reel, Bentall Kennedy	MReel@Bentallkennedy.com
Mark Cece, MMM	CeceM@mmm.ca
Steve VanHaren, MMM	VanHarenS@mmm.ca
Asif Quader, MMM	AQuader@mmm.ca
Andrew Kulin, MMM	KulinA@mmm.ca
Alex Williams, MMM	WilliamsA@mmm.ca
Chris Tyrrell, MMM	TyrrellC@mmm.ca
Randall Roth, MMM	RothR@mmm.ca

DISTRIBUTION: All Attendees and the following:

Charlie McConnell, Town	CMcConnell@oakville.ca
Zahir Najak, Region	Zahir.Najak@halton.ca
Samantha Jefferis, MNR	Samantha.Jefferis@ontario.ca

ATTACHMENTS: September 10, 2013, Workshop Presentation Slides

Item	Details	Action By	Action Date
4.	**Update on Discussions/Site Visit with MNR**		
	i. MNR to confirm they have the most recent version of the EIR/FSS (2nd Submission dated December, 2012). MNR to review the most recent detailed information on EIR/FSS, and will provide formal comments in response. Timeframe TBD. MC to follow-up with Samantha Jefferis and Jane Devlin on the timeframe and comments. Correspondence on the Species at Risk topic should be cc'd to CH (Paul Bond), Town (Rob Thun) and Region (Richard Clark).	Mark Cece, MNR	MNR to advise

Item	Details		Action By	Action Date
5.	**Discussion of Key Issues and Action Items**			
a.	**Dundas Street Stormwater Runoff and SWM Facility Allowances**			
	i.	MMM to investigate issue of Dundas St. Stormwater Runoff and SWM facility allocations in revised EIR/FSS further, acknowledging that accommodation of Dundas St. drainage in Pond 3 is not feasible, Pond 2 may not be feasible, and that Ponds 1 and 4 (off-site) may be feasible. Follow-up with Matt Krusto is required (Steve VanHaren and Alex Williams) with options to determine if the Region wishes to pursue the matter further. Authorizations from MNR will be required for SWM facilities adjacent to RSD streams subsequent to the approval of the EIR/FSS.	Steve VanHaren, Alex Williams, Region (Matt Krusto)	Oct.
b.	**407 West Concept Plan (Avenue 1 Alignment, Sanitary Servicing)**			
	i.	CH agrees that we do not need a site visit on the main branch of 14 Mile Creek to address the road alignment issue. The alignment provides for sufficient flexibility, and would be confirmed through a subsequent EIR/FSS for the affected lands.	NA	NA
	ii.	ASP and FSS to address the question of directional drilling for sanitary sewers. MMM to justify 2.2 m of cover or provide for 3.0 m of cover in preliminary design. Impact of sanitary sewer on Dundas Street culverts to be addressed in the ASP and EIR/FSS.	Alex Williams, Region	Sept.
c.	**Characterization of Existing Pond (14W-14A) and Use as a SWM Facility**			
	i.	Andrew Kulin to meet with CH hydrogeologist re: data collection, characterization of pond, and water balance. Andrew to report back to Town (Rob), CH (Paul), BK Team (Chris).	Andrew Kulin, CH Hydrogeologist	Sept. / Early Oct.
d.	**Drainage Densities**			
	i.	Steve VanHaren to discuss stream design form and function with Lamoire Alexander (MMM) and provide further justification. MMM to discuss with CH (Samantha and Janette) and MNR prior to submission of the 3rd submission of the EIR/FSS.	Steve VanHaren	Sept. / Early Oct.
	ii.	Town to coordinate a meeting with Parrish Geomorphic (John Parrish) to discuss the original intent of the drainage density provisions of the NOCSS, and specifically discuss MMM's characterization of the Pond (14W-14A) vs. the NOCSS characterization as a blue feature relative to the drainage density provisions. Steve VanHaren has requested to attend the Town's meeting. Pending outcome	Philip Kelly, Kristina Parker, Steve VanHaren	Early Oct.

Item	Details	Action By	Action Date
	without Steve VanHaren present, Steve would like a discussion with Parrish Geomorphic.		
	CH (Janette) to provide additional information to MMM (Steve VanHaren) on this topic, if available.	Janette Brenner	
	iii. CH's position is that 14W-21 cannot be counted towards stream length and drainage density (due to small drainage area, and small flows). Steve VanHaren to discuss with Lamoire Alexander and place a reasoned opinion in front of CH (Janette) and Town, tabled for subsequent discussions with Parrish.	Steve VanHaren, Janette Brenner	End of Sept.
e.	**Consolidation/Relocation of Stream Corridors (channel form, flow regime comparison)**		
	i. Need a stronger justification in the 3rd Submission of EIR/FSS on the forms and functions of the pond being replicated, responding to CH's June 3, 2013 letter. CH and Town staff to review draft response on Page 5 of Issues Table Responses (July 4th) prior to 3rd Submission of EIR/FSS and provide comment.	Steve VanHaren, Mark Cece, CH/Town	Mid Oct.
	ii. How does the pre- vs. post-development Natural Heritage Area compare? MMM to evaluate using identified conceptual NHS in Schedule NOW 2 of the Secondary Plan (subject to the addition of appropriate stream corridor widths and setbacks) as the "pre-" condition and the identified NHS in the development concept as "post-".	Mark Cece	Mid Oct.
	iii. Samantha Mason to provide MMM with recommendations on temperature targets for the SWM outputs to reach 14W-12A. Meeting with CH (Samantha Mason) and MMM (Steve VanHaren) to discuss prior to 3rd Submission of EIR/FSS.	Steve VanHaren, Samantha Mason	End of Sept. for recommendations, meeting end of Oct.
f.	**Location and Size of Stormwater Management Facilities**		
	i. Maintenance of the SWM pumps is key to maintain flow to Redside Dace habitat (14W-12A). The Town does not typically support pumping of stormwater. Further consideration is requested in this unique circumstance. Kristina to take this away to Town management for consideration.	Kristina Parker	
	ii. Justification for pond location to be enunciated clearly in the 3rd submission of the EIR/FSS.	Steve VanHaren, Alex Williams	Address in 3rd Submission of EIR/FSS.
	iii. Town (Kristina) to investigate allowances for roof top storage and respond to MMM (Steve VanHaren).	Kristina Parker	Late Sept.
	iv. Samantha to provide a suitable example of thermal regime calculations to Steve VanHaren for consideration in 3rd submission of EIR/FSS.	Samantha Mason, Steve VanHaren	Late Sept.

Item	Details	Action By	Action Date
g.	**Water Balance (Clarification of Assumptions)**		
	i. As per item c) Andrew Kulin to meet with CH hydrogeologist re: data collection and characterization of pond, and water balance assumptions. Andrew to report back to Town (Rob), CH (Paul), BK Team (Chris).	Andrew Kulin. CH Hydrogeologist	Sept. / Early Oct.
6.	**Discussion/Clarification of Other Issues**		
	i. It was discussed that there remains outstanding items outlined in CH/Town comments, and included in MMM's preliminary Issues List responses dated July 4, 2013. It was discussed that MMM is generally in agreement with these issues/comments and they will be addressed in the 3rd submission of the EIR/FSS.	MMM – Initiate follow-up discussions where required.	Address in 3rd Submission of EIR/FSS.
	ii. CH/Town to provide informal comments on MMM's preliminary Issues List responses dated July 4, 2013, and/or follow-up where necessary.	CH, Town, Region, MMM – Initiate follow-up discussions where required.	End of Sept.
7.	**Next Steps/Schedule**		
	The intent is to prepare next submissions of the EIR/FSS and ASP, that are acceptable to the Town/CH and Region. The critical path items for resubmission are:		
a.	**EIR/FSS and Draft Plan of Subdivision:** 1st Submission, May 2011 2nd Submission, December 2012 3rd Submission, Targeted for December, 2013	MMM	Dec. 2013
b.	**ASP:** 1st Submission, May 2011 2nd Submission, December 2012 3rd Submission, June 2013 4th Submission, Targeted for Early Oct. 2013	MMM	Early Oct.

Sonia Rankin

From: Mark Cece
Sent: Thursday, October 24, 2013 11:06 AM
To: Sonia Rankin
Subject: FW: Bentall - North Oakville

Fyi

[redacted]

From: Devlin, Jane (MNR) [mailto:Jane.Devlin@ontario.ca]
Sent: Thursday, October 24, 2013 9:39 AM
To: Mark Cece
Cc: Jefferis, Samantha (MNR)
Subject: RE: Bentall - North Oakville

Hello Mark,
Thank you for the delivery – yes I received it this morning. I will proceed with review of the most recent submission and compiling comments from MNR.
Also - MNR will not require any further sampling for fish in the farm pond. I will be in touch if I need any further information beyond what was already provided to us.

Thanks,
Jane

From: Mark Cece [mailto:CeceM@mmm.ca]
Sent: October-24-13 8:48 AM
To: Devlin, Jane (MNR)
Cc: Jefferis, Samantha (MNR)
Subject: RE: Bentall - North Oakville

Jane

Further to the email below, a member of our staff delivered 1 hard copy of the most recent EIR (3 binders) to your office yesterday afternoon, it was left with Karen Golby. Can you please confirm you received the delivery and your anticipated time frame to complete your review of the information?

Thanks and let us know whether we can help further in your review of the project.

Mark Cece, B.Sc.
Ecology Manager/Senior Fisheries Biologist
Associate Partner
Ecology Department

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cecem@mmm.ca | www.mmm.ca

From: Mark Cece
Sent: Friday, October 18, 2013 11:32 AM
To: 'Devlin, Jane (MNR)'
Cc: Jefferis, Samantha (MNR)
Subject: RE: Bentall - North Oakville

Jane

We will get you the most up to date version of the reports as possible in order that you can continue your review of the project.

In regards to your statement that you did not say there was no further requirements for fish sampling, I can only state that my recollection and those of my colleagues differ. I recall indicating that I did not see the value of understanding how the presence of more/other fish species (if present) in the deeper area (only 2-2.5 m deep) of the pond at the southeast end would benefit the review of the project in terms of Redside Dace habitat function or review under the ESA. Given that there exists a physical separation of the species by the poor connection at the pond inlet/outlet (seasonal connectivity, dense cattail/emergent growth, diffuse flow (when present) through vegetation) to downstream habitat, the absence of suitable Redside Dace occupied habitat within the pond itself and that at best the pond may function as contributing habitat (although not identified as such on MNR mapping), we felt further sampling was not warranted. Furthermore, I recall requesting that if the MNR did require additional fish community sampling that there be a clear rationale stated as to why additional fish species (if present) in the deeper water would be of value to the evaluation/assessment of the project under the ESA and then asking for confirmation whether the MNR would require further sampling.

Notwithstanding our difference in the recollection of the discussion, if there is a desire from MNR for additional sampling of the fish community within the farm pond for review of the project under ESA I would request the following:

- could you please provide clear and specific rationale as to the need for this additional sampling as it relates to the MNRs review of the project under the ESA, and
- please provide MNR accepted sampling methodology for the farm pond in order that we can develop a suitable sampling program that meets the regulatory review and avoids the need to revisit this topic.

This information will assist us in better understanding the requirements under the ESA as well as provide a clear explanation to the client related to why additional effort/resources are required to once again document the fish community of this farm pond.

Furthermore, for your information the table below identifies the previous fish community sampling that has been undertaken as well as those parties that have undertaken the sampling. I have also included below for your review a screen capture from the Conservation Halton August 16, 2012 Correspondence where CH states that although they would like to have seen sampling of the deeper habitat, they do not require additional fish community sampling and as a result we have met their fish community sampling requirements. A copy of the entire correspondence is attached for your files if you do not have a copy.

Comments on Technical Memorandum NH # 1 – Reach 14\
MMM Group. March 28, 2012.

Staff appreciate the time and effort expended to collect an
report.

68. **Sect. 3.1 Fish Community Survey (Pg. 3)**: Pleas
methodology used to collect fish entitled "pot traps".
sections of the pond were not sampled during the addit
that additional fish species and potentially a significar
may be present in the pond, which has not been iden
sampling. The Department of Fisheries and Oceans ha
not be required for the removal of the pond, as such, fu
not be required.

Once again, thank you for your ongoing dialogue on the project review and for verifying the need for the most recent version of the documents for your review. Please let me know if I can be of further assistance in any way to continue to move this forward.

Mark Cece, B.Sc.
Ecology Manager/Senior Fisheries Biologist
Associate Partner
Ecology Department

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cecem@mmm.ca | www.mmm.ca

From: Devlin, Jane (MNR) [mailto:Jane.Devlin@ontario.ca]
Sent: Wednesday, October 16, 2013 6:12 PM
To: Mark Cece
Cc: Jefferis, Samantha (MNR)
Subject: RE: Bentall - North Oakville

Hi Mark,
Unfortunately the version we have here is May 2011. Was the second submission of Dec 2012 submitted to MNR? I have been looking at an outdated plan, so we will need the Dec 2012 sent in hard copy. However I suspect this will not take much additional time for me to review.

I did not say that there are no further requirements for fish sampling. I only indicated that the sampling conducted so far, using multiple capture techniques, was conducted in the same habitat within the pond and therefore is likely to capture the same fish species across capture gear used. Additional sampling may be required – I can confirm whether or not once reviewing the information provided in the most recent submission.

My apologies for not catching this outdated version sooner!

Jane

From: Mark Cece [mailto:CeceM@mmm.ca]
Sent: October 16, 2013 12:39 PM
To: Devlin, Jane (MNR)
Cc: Jefferis, Samantha (MNR)
Subject: RE: Bentall - North Oakville

Jane

Thanks for the response, I realize there is a lot of information to go through as there was extensive field investigations undertaken by many disciplines. Again, please let us know if you would like us to come in and meet with you to provide some context or clarification related to the data, we will make ourselves available and ensure whatever staff are required (i.e. hydrogeologist) are in attendance.

Perhaps as a first step you can confirm whether you have the most up to date information.

I also wanted to clarify the results of the discussion had at the September 10, 2013 meeting related to the farm pond and fish sampling. It was clear to me that the MNR did not require additional fish community sampling of the pond in order to determine its contribution (if any) to the downstream Redside Dace habitat given that the pond did not function as "Occupied Habitat". I wanted to ensure that my notes and those of my colleagues here were correct.

Thanks again and please do not hesitate to contact me should you have any questions or comments. We look forward to your response related to the information you currently have in your possession and are reviewing to ensure you are not reading outdated material.

Mark Cece, B.Sc.
Ecology Manager/Senior Fisheries Biologist
Associate Partner
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From: Devlin, Jane (MNR) [mailto:Jane.Devlin@ontario.ca]
Sent: Monday, September 30, 2013 5:12 PM
To: Mark Cece
Cc: Jefferis, Samantha (MNR)
Subject: RE: Bentall - North Oakville

Hi Mark,
I will touch base with you later this week. There is a great deal of information to go though, and I will be coordinating a response with Sam as well. I don't know that I can give you a solid timeline for our full detailed response, but I do appreciate that the goal is for the third submission to be completed this fall. I will do my best to provide my detailed comments to you soon.

Regards,

Jane

From: Mark Cece [mailto:CeceM@mmm.ca]
Sent: September 27, 2013 12:10 PM
To: Devlin, Jane (MNR)
Cc: Jefferis, Samantha (MNR)
Subject: Bentall - North Oakville

Jane:

Just touching base with you to see if you had a chance to determine whether you had the most recent/up to date information related to Redside Dace and what your timelines were for reviewing this information and providing comment. Once again I would like to extend the offer of meeting in person to address any of you questions or provide clarification as there is a great deal of data associated with this project. Thanks again for you contribution to the project and look forward to your response.

Mark Cece, B.Sc.
Ecology Manager/Senior Fisheries Biologist
Associate Partner
Ecology Department

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Southern Region
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Aurora, ON   L4G 0L8

Ministry of Natural Resources | **Ministere des Richesses Naturelles**

December 20, 2013

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, ON Canada
L3T 0A1

Attn: Mark Cece

Re: EIR / FSS (2nd Submission - December 2012)
Lazy Pat Farm Property, Town of Oakville

Dear Mr. Cece,

The Ministry of Natural Resources has conducted a review of the above noted study. We have a number of comments and concerns to discuss with you.

We confirm that the following features are designated Redside Dace habitat under section 29.1 of Ontario Regulation 242/08:

- Reach 14W-12 (29.1 subsections i, ii, iii and iv apply)
- Reach 14W-16 (29.1 subsections i, ii, iii and iv apply)
- Reaches 14W-11A, 14W-12A, 14W-13 and 14W-14 (29.1 subsection v applies)
- Pond 14W-14A (29.1 subsection v applies)
- Riparian wetlands, as described on Figure 6.3.4

In reviewing the document we noted that a number of key sections did not reference the Draft Guidance for Development Activities in Redside Dace Protected Habitat (http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/stdprod_082290.pdf). Accordingly we have concerns with the following:

1. Lack of pre-development and post-development water balance calculations
2. Proposed stormwater management facilities and the design criteria used
3. The number of stream crossings proposed in the development site as well as adjacent lands
4. Proposed relocation and alteration of Redside Dace habitat

We would like to discuss these concerns with you, and can accommodate a meeting at our office to review in further detail.

Based on records of Bobolink, MNR has determined the subject property provides habitat for Bobolink. An authorization under the ESA is required for the damage or destruction of Bobolink habitat.

Southern Region
Aurora District Office
50 Bloomington Road West
Aurora, ON   L4G 0L8

Ontario

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Barn swallow has been found breeding on the subject property. An authorization under the ESA is required for the damage or destruction of Barn Swallow habitat. It is recommended that the proponent work with MNR to determine qualification under O.Reg 242/08, Section 23.5 for the removal of the structures on site that support Barn Swallow. Please note, O.Reg 242/08, Section 23.5 only speaks to the removal of buildings or structures that provide habitat for Barn Swallow and *does not cover the damage or destruction of adjacent foraging habitat*. If the adjacent foraging habitat is planned to be removed, damaged and/or destroyed in the future, an ESA 17(2)(c) Permit will be required.

Please provide all available data on the historic bird survey records, which include Eastern Meadowlark.

Recently, the Little Brown Myotis and Northern Long-eared Myotis have been listed on the ESA, 2007, as endangered. These species are now afforded both species and habitat protection under the ESA, 2007. MNR recommends that the site be surveyed for potentially suitable bat habitat (including, but not limited to: forested areas, abandoned buildings, houses, sheds, etc.) and that if any potentially suitable habitat is found on site, bat surveys be conducted prior to the damage or destruction of any habitat which may support bats. This information on potentially suitable bat habitat should be provided to MNR for review.

If you have any questions or comments, please do not hesitate to contact me at 905-713-7387.

Sincerely,

Jane Devlin
Management Biologist
Ontario Ministry of Natural Resources, Aurora District

CC: Paul Bond, Conservation Halton
Rob Thun, Town of Oakville
Richard Clark, Halton Region

MMM GROUP

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January 15, 2013

Jane Devlin
Management Biologist
Ontario Ministry of Natural Resources, Aurora District
50 Bloomington Road West
Aurora, ON L4G 0L8

Subject: **EIR / FSS (2nd Submission - December 2012) Lazy Pat Farm Property, Town of Oakville**

Ms. Devlin:

Further to your comments dated December 20, 2013, we provide the following information in response to the comments/responses presented in the order in which they are provided. Given the time elapsed since we initiated contact with the MNR (initially with Mr. John Pisapio – MNR Area Biologist in 2011) and the extensive information contained within the EIR/FSS, it was our desire that the comments issued from MNR would have provided a greater level of detail in terms of the MNR's position on specific aspects of the development plan (e.g., channel realignment, farm pond removal, etc.) as it relates to Endangered Species Act (ESA). The MNR's input is critical to the continued advancement of the project. Conservation Halton (CH), the Town of Oakville (the Town) and Halton Region (the Region) have reviewed two versions of the EIR/FSS and issued multiple comments resulting in advancement of the plan to a point where fundamental aspects of the plan have been agreed upon and the parties have reached some consensus on critical items such as drainage density, hydrogeology and planning principles.

It would seem that much of the information that forms our responses originates from the EIR/FSS 2nd Submission (MMM Group, December 2012) as well as the associated submissions that were prepared in response to CH, Town and Region comments and resulting from our Workshop meeting on September 10, 2013.

Our client, and ourselves would welcome the opportunity to meet with you to discuss these matters at your earliest convenience. It is our intention to submit the revised EIR/FSS (3rd Submission) in February 2014, in order to have the planning applications essentially completed and approved in 2014. We request that this meeting occur prior to the 3rd Submission of the EIR/FSS so we can better understand MNR's comments and have a strategy for moving forward.

1.0 Ministry of Natural Resources (MNR) Comment: We confirm that the following features are designated Redside Dace habitat under section 29.1 of Ontario Regulation 242/08:

We would like clarification as to the classification of the watercourses and specifically MNR's comment and permitting requirements to the proposed development plan in relation to these watercourse reaches.

i. Reach 14W-12 (29.1 subsections i, ii, iii and iv apply)

MNR Classification: Acknowledged. Originally indicated in North Oakville Creeks Subwatershed Study (NOCSS) and during October 10, 2011 site meeting with MNR, CH and DFO. The application of subsections i, ii, iii, and iv classify this reach as "occupied habitat" or habitat that is (or has been within the last 20 years) inhabited by Redside Dace.

Proposed Interaction with Development Plan: Encroachment associated with the following activities:

- Encroachment into meander belt setback by passive component (earthen berm) of storm water management pond (SWMP) in order to accommodate grading; as well as storm water outlet structures.

  The encroachment associated with the berm currently consists of an active agricultural field. Following construction, the area of the berm within the setback will be vegetated with native herbaceous and woody vegetation species and allowed to naturalize post development.

  The physical disturbance associated with the outlet structures will be minimized with the design of the outlets using principles from the *DRAFT Guidance for Development Activities in Redside Dace Habitat* (MNR, February 2011).

- SWMP discharge into Redside Dace habitat will also take into account the *DRAFT Guidance for Development Activities in Redside Dace Habitat* (MNR, February 2011) in the design phase as well as targeted results. It is important to note that an Ontario Municipal Board hearing mediated agreement issued July 12, 2007 indicates that targets can be based on site specific background data as the baseline conditions may currently exceed the targets identified in the *DRAFT Guidance for Development Activities in Redside Dace Habitat* (MNR, February 2011).

The proposed location of the outlet feature will also result in a minor change to the surface drainage received in Reach 14W-12. The development plan will direct all onsite surface runoff from north/east of the realigned Reach 14W-22 (realigned Reach 14W-14) and 14W-12 to the SWMP with the outlet of this pond located further downstream than the confluence with Reach 14W-12A. This minor change represents 40 ha/10 % of the total drainage area of 14W-12 and is not anticipated to result in a noticeable effect.

Comment requested from MNR related to the SWMP encroachment of the berm and outlet structures as well as discharged storm water to Redside Dace habitat.

ii. Reach 14W-16 (29.1 subsections i, ii, iii and iv apply)

MNR Classification: Acknowledged. Originally indicated in October 10, 2011 site meeting with MNR, CH and DFO. The application of section 29.1 subsections i, ii, iii, and iv of the Act classify this reach as “occupied habitat” or habitat that is (or has been within the last 20 years) inhabited by Redside Dace.

Proposed Interaction with Development Plan: Encroachment associated with the following activities:

- The southern arterial east-west road crossing (Burnhamthorpe Road extension) of this reach is required as indicated in the Secondary Plan. The crossing location and geometry of the road considered measures to minimize potential adverse effects to Redside Dace habitat. Selection of the crossing structure(s) and extent of encroachment through Redside Dace habitat will consider the guidelines set forth in the *DRAFT Guidance for Development Activities in Redside Dace Habitat* (MNR, February 2011).

- As indicated in the EIR/FSS Reach 14W-22 (realigned Reach 14W-14) will result in increased flows into Reach 14W-16 from the southern property limit to its confluence with 14W-12 thereby requiring channel stabilization within this section of the reach. The channel stabilization works will use bioengineering and natural channel design principles to enhance habitat.

  As you are aware a recent concept (December 16, 2013 email) provided to the MNR, CH, Town of Oakville and Halton Region seeks to modify the proposed Reach 14W-16 channel stabilization in the EIR/FSS with the realignment of Reach 14W-16 to allow Reach 14W-22 (realigned Reach 14W-14) to flow parallel to it and therefore increase its length to address CH comments to drainage density. This concept is currently under review with the aforementioned agencies but viewed as a viable alternative by the Town and CH to address drainage density concerns.

In either scenario, modifications to Reach 14W-16 are proposed. Mr. John Pisapio indicated during the October 10, 2011 site meeting that the proposed stabilization of Reach 14W-16 as proposed in the EIR/FSS would provide the opportunity for improved habitat diversity to enhance Redside Dace habitat. As the effect of the recent concept (December 16, 2013 email) would be similar to stabilization works, the benefits will be consistent.

Comment requested from MNR related to the proposed road crossing and Reach 14W-16 modifications.

iii. Reach 14W-11A (29.1 subsection v applies)

MNR Classification: Acknowledged. Although MNR did not visit this reach during the October 10, 2011 site meeting with MNR, CH and DFO. MNR provided mapping supporting this position in an email dated July 25, 2013 with representatives subsequently visiting the reach in September 2013. The application of section 29.1 subsection v. of the Act classifies this reach as "contributing habitat" or habitat that supports Redside Dace "occupied habitat".

Proposed Interaction with Development Plan: Reach 14W-11A will be realigned along the northeastern property limit to its southern limit and transition to Reach 14W-11 within the forested valley. According to NOCSS, the realignment of this reach (considered an Medium Constraint stream in NOCSS) is permitted provided that their function can still be preserved and would provide the opportunity for enhancements. This contributing habitat will continue to function as contributing habitat with natural channel design principles implemented to enhance the function of the reach over the existing habitat that has been altered through agricultural practices. We note that Reach 14W-11 will remain undisturbed.

Comment requested from MNR on the proposed realignment of 14W-11A.

iv. Reach 14W-12A (29.1 subsection v applies)

MNR Classification: Acknowledged. Originally indicated in October 10, 2011 site meeting with MNR, CH and DFO. The application of section 29.1 subsection v. of the Act classifies this reach as "contributing habitat" or habitat that supports Redside Dace "occupied habitat".

Proposed Interaction with Development Plan: Changes to drainage areas to direct storm water to SWMP and proposed removal of the farm pond (Reach 14W-14A) associated with the development concept will result in changes to the surface water contributions to this short reach providing Redside Dace contributing habitat. The flows originally conveyed to this reach from Reaches 14W-14 and 14W-13 will be redirected through Reach 14W-22 (realigned Reach 14W-14) to Reach 14W-16 and will continue to be conveyed to the Redside Dace occupied habitat of Reaches 14W-

12 and 14W-16. Mitigation measures to address this change in flow within Reach 14W-12A have been developed including diversion of flow controlled rooftop drainage from adjacent buildings (which is considered sufficiently clean for direct discharge) via a separate storm sewer system and diversion of approximately 7L/s from the remaining area via a flow splitter for augmentation of base flow and dampening of excessive peak flows. This will result in an average flow of approximately 1.2 L/s with a standard deviation of 2.8 L/s in the 14W-12A channel reach. The proposed average flow rate is less than the average flow rate under current conditions. However, the current average flow rate is heavily influenced by the high peak flow rates in the watercourses, which results in a high standard deviation. Under our proposed condition, the average flow rate is lower, but possesses a smaller standard deviation, which translates to a substantially smoother flow regime with longer periods of sustained flow.

Physical modifications are not proposed for this stream corridor as identified in NOCSS.

Comment requested from MNR related to the specific function(s) of interest in the reach and the proposed redirection of flow as it relates to the mitigation measures discussed.

v. Reach 14W-13 (29.1 subsection v applies)

<u>*MNR Classification:*</u> Mr. John Pisapio did not indicate that this reach was considered Redside Dace habitat during the October 10, 2011 site meeting with MNR, CH and DFO. Subsequently this reach was identified as "*Potential Contributing Redside Dace Habitat*" in a July 25, 2013 e-mail correspondence with final confirmation received in the December 20, 2013 MNR correspondence.

This reach is a low capacity, intermittent stream with a narrow riparian corridor that has been actively modified by agricultural practices. We would request that the MNR specify the function of Reach 14W-13 that is considered to support Redside Dace in order to ensure that the watercourse realignments replicate the function.

As Mr. Pisapio had indicated that the redirection of flow from Reach 14W-13 into Reach 14W-22 (realigned Reach 14W-14) would enhance the habitat of the realigned reach and increase the potential that this habitat would directly support Redside Dace, we trust this proposed activity remains acceptable to the MNR. Please confirm.

The application of section 29.1 subsection v. of the Act classifies this reach as "contributing habitat" or habitat that supports Redside Dace "occupied habitat".

<u>Proposed Interaction with Development Plan:</u> The proposed development plan will result in the elimination of Reach 14W-13, classified as a Low Constraint Stream in NOCSS. NOCSS indicates that these Low Constraint streams can be replaced through infrastructure or SWM. Flows from Reach 14W-13 will be directed into Reach 14W-22 (realigned Reach 14W-14) thereby prolonging flows in the realigned reach and increasing the potential for direct Redside Dace use.

Comment requested from MNR related to the elimination of Reach 14W-13 and redirection of flow to Reach 14W-22 (realigned Reach 14W-14).

vi. Reach 14W-14 (29.1 subsection v applies)

<u>MNR Classification:</u> Acknowledged. Originally indicated in October 10, 2011 site meeting with MNR, CH and DFO. The application of section 29.1 subsection v. of the Act classifies this reach as "contributing habitat" or habitat that supports Redside Dace "occupied habitat".

<u>Proposed Interaction with Development Plan:</u> The implementation of the development plan will result in the realignment of Reach 14W-14 (post development - Reach 14W-22) along the southern property limit with flows from Reach 14W-13 also redirected to this realigned reach. In previous discussions with Mr. John Pisapio- MNR Area Biologist (screen capture of October 2011 meeting minutes below), the MNR indicated that Reach 14W-14 in its current form does not directly support Redside Dace.

Mr. Pisapio further stated that the realignment of the channel using natural design principles as well as the additional flow contribution provided from Reach 14W-13 would potentially result in habitat that could directly support Redside Dace. The realignment of this reach (considered an Medium Constraint stream in NOCSS) is permitted provided that its function can still be preserved. The realignment would also provide the opportunity for enhancements over the existing habitat that has been altered through agricultural practices.

Comment requested from MNR related to the realignment of Reach 14W-14 (post-development Reach 14W-22).

Item	Details	Action By	Action Date

Stream Realignment of Reach 14W-11A

JP was unavailable to visit this area of the property to view the existing conditions in Reach 14W-11A. JP requested to view this feature at a later date when his schedule permits to be coordinated by MMM.

SM indicated that the concept of the realigned section of Reach 14W-11A was very angular. MC indicated that the preliminary alignment is an early conceptual alignment and will be designed to create a stable channel. Furthermore, the block identifies the area in which the channel will be located but does not necessarily indicate that the channel will be subject to a 90 degree turn as it will be a meandering naturalized channel.

RK provided a preliminary assessment of the potential for the proposed works to result in the Harmful Alteration Disruption, Destruction (HADD) of fish habitat. RK indicated that based upon the fish community, permanency/resilience and intensity of the proposed impacts to this feature, the proposed realignment is likely to pose a Low risk of resulting in a HADD and a *Fisheries Act* Authorization is unlikely to be required. SM supported this assessment.

Reach 14W-14

JP indicated that this feature lacks a channel capable of directly supporting Redside Dace, thereby providing contributing Redside Dace habitat. JP and SM were in agreement with the evaluation of this tributary.

Similar to Reach 14W-11A, RK indicated that the proposed realignment is likely to pose a Low risk of resulting in a HADD and a Fisheries Act Authorization is unlikely to be required. SM supported this assessment.

JP indicated that the proposed realignment including the consolidation with Reach 14W-13 would likely result in increased permanence in flow and may result in the channel directly supporting Redside Dace. As a result, the watercourse will be subject to the meanderbelt plus 30 m setback associated with Redside Dace.

Reach 14W-16

JP indicated that the proposed channel stabilization would provide the opportunity for improved habitat diversity suitable to improve habitat for Redside Dace including the increased flow anticipated from the realignment of Reach 14W-14. SM and RK were supportive of this approach.

Similar to Reach 14W-11A, RK indicated that the proposed stabilization is likely to pose a Low risk of resulting in a HADD and a Fisheries Act Authorization is unlikely to be required. SM supported this assessment.

JP also indicated that the entire Reach (14W-16) was considered by the MNR as Redside Dace habitat and as a result, the watercourse is subject to the meanderbelt plus 30 m setback associated with Redside Dace.

vii. Farm Pond/Reach 14W-14A (29.1 subsection v applies)

MNR Classification: Mr. John Pisapio did not indicate that this reach was considered Redside Dace habitat during the October 10, 2011 site meeting with MNR, CH and DFO nor was this reach identified as "*Potential Contributing Redside Dace Habitat*" in subsequent e-mail correspondence of July 25, 2013 that identified both "*Occupied Redside Dace Habitat*" and "*Potential Contributing Redside Dace Habitat*". As a result this classification found in the December 20, 2013 letter is the first indication from MNR that the farm pond is classified as Redside Dace habitat.

For context, this pond is an artificial feature that was constructed as a bypass pond to receive and discharge flow from a shared inlet/outlet. The pond was built over a previously existing watercourse by constructing a berm across the lower end of the reach. Other watercourses on site were subject to modifications to address the changes in hydrology. Specifically Reaches 14W-13 and 14W-14 were joined upstream of the pond inlet/outlet to provide a source of surface water to the pond. Flows enter and leave the pond through the watercourse connection at the west end of the pond and experience a shallow cattail dominated area which filters much of the coarse sediment. Finer sediment laden water enters the main pond area where the zero flow energy environment allows the finer particulates to settle out of solution, accumulating in a loose bottom substrate, commonly referred to as “muck”. As water levels in the watercourse recede, the partially clarified, warmer pond waters near the surface flow backward through the cattails, resuspending some of the previously filtered coarse sediment. Outflow from these reaches and the pond have been directed to Reach 14W-12A, a constructed channel within a trapezoidal “valley” to convey flow to Reach 14W-12 (constructed to replace the channel under the pond). This information as well as the data and analysis supporting the points below are provided in great detail in the EIR/FSS including *Technical Memorandum NH#1* in the EIR/FSS appendices, and was further discussed at our September 10, 2013 workshop meeting.

The pond does not seem to meet the functions and criteria identified in Ontario Regulation 242/08 Section 29.1, subsection v. We would request that the MNR specify how this constructed feature meets the criteria identified below.

29.1 For the purpose of clause (a) of the definition of “habitat” in subsection 2 (1) of the Act, the following areas are prescribed as the habitat of redside dace:

1. Within the cities of Hamilton and Toronto, the counties of Bruce, Grey, Huron, Simcoe and Wellington, the regional municipalities of Durham, Halton, Peel and York, the Townships of St. Joseph, Jocelyn and Hilton, and the Village of Hilton Beach,

    i. any part of a stream or other watercourse that is being used by a redside dace,

    ii. any part of a stream or other watercourse that was used by a redside dace at any time during the previous 20 years and that provides suitable conditions for a redside dace to carry out its life processes,

    iii. the area encompassing the meander belt width of an area described in subparagraph i or ii,

    iv. the vegetated area or agricultural lands that are within 30 metres of an area described in subparagraph iii, and

    v. a stream, permanent or intermittent headwater drainage feature, groundwater discharge area or wetland that augments or maintains the baseflow, coarse sediment supply or surface water quality of a part of a stream or other watercourse described in subparagraph i or ii, provided the part of the stream or watercourse has an average bankfull width of 7.5 metres or less.

- This feature does not meet the definition of a stream, headwater drainage feature, groundwater discharge area or wetland, as addressed in this bullet.

  This pond is not a stream or watercourse, it does not convey flow instead it receives and stores water. The pond has been constructed to receive surface water from Reaches 14W-13 and 14W-14 during spring freshet as well as in response to precipitation events. Water stored in the pond can only be discharged back into Reach 14W-12A (a constructed channel) once water level elevations in Reaches 14W-13 and 14W-14 subside, and therefore the pond does not contribute flow, rather it simply provides storage.

  Generally headwater features/wetlands are associated with groundwater discharge zones that give rise to creeks and streams. Surface water level data from the pond as well as groundwater data from surrounding monitors indicate that the pond does not receive groundwater inputs in sufficient quantities that create discharge into the watercourses, the discharge from the pond is associated with surface water inputs. Groundwater elevations at the surrounding monitoring wells showed the water level at the pond is consistently on the order of 1 to 2 m higher elevation than the groundwater, and therefore the pond is losing water into the ground rather than receiving groundwater inputs[1]. Recent work done at the site (October-November 2013), with installation of a drive-point mini-piezometer (MP-24-D) at the inlet end of the pond indicated that the shallow groundwater elevations here ranged between 0 to 0.1 m above the pond water elevations, and therefore only very minor groundwater discharge potential is present, and is far outweighed by the losses back into the ground over the much larger area of the pond to the east, where the greater head differences are recorded.

  The lack of groundwater inputs is supported by the warmwater thermal regime of the pond. It seems more likely the pond is a 'sink' rather than 'source', receiving surface flows and losing water to both evaporation and into the underlying soils, rather than consistently contributing water from the pond to the downstream watercourse. This lack of groundwater input supports our ongoing position that the pond is not a groundwater controlled feature that augments base flow. This information is provided in great detail in the EIR/FSS.

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[1] Groundwater elevations at a monitoring well nest located approximately 100 m upstream of the pond inlet (alongside Reach 14W-14) indicate groundwater elevations at that location to range between about 0.5 and 1.0 m higher than the surface water levels in the pond located downstream, of this station (further note that during the summer season, groundwater elevations at these monitors would typically decline the base of the channel, so inputs to the channel are not year-round). The data from this monitoring well nest indicated that the area where the potential for groundwater inputs changed to surface water losses would be located near the upstream end of the pond. The data collected at MP-24D further supports this.

While the farm pond shares similar attributes with natural wetland habitat (e.g. wetland vegetation), it was constructed to support agricultural activities and as such should be considered “agricultural infrastructure”. Its wetland attributes are attributed to the lack of management of this pond as “agricultural infrastructure” and its disuse resulting in the establishment of wetland species rather than its function as an ecological feature. The wetland vegetation communities present are common (cattail shallow marsh and duckweed shallow aquatic) and are typical of vegetation associated with stagnant ponds. The vegetation present is not obviously sustained by groundwater inputs to the pond, but rather appears to be sustained by the presence of surface water that occasionally flows into the pond from the watercourses. A similar outcome occurs when SWMP are left to “naturalize” between maintenance events as the wetland community present is typical of those found within SWM facilities in Halton Region. A similar effect can be replicated through standard SWM pond construction and re-vegetation practices.

- The pond also does not supply coarse sediment to downstream reaches. The shared inlet/outlet and to a lesser extent the dense emergent vegetation at the inlet/outlet minimizes the potential transport/supply of coarse sediment. The dense emergent vegetation at the inlet/outlet reduces velocities of flow discharging from Reaches 14W-13 and 14W-14 into the pond, thereby resulting in the settling out of coarse sediment particles prior to entering the pond. Once in the pond, fine sediment still suspended in the water column will continue to settle out as velocities are further reduced. Physical agitation of the pond water due to flow from the contributing reaches are minimal due to the flow dynamics of the shared inlet/outlet and thermal stratification (in the summer) minimizing the potential for fine pond sediment to be re-suspended. Furthermore, given the pond’s size, the potential for wind agitation to re-suspend the pond substrate is also low. As a result the pond appears to function as a sediment sink rather than a source for sediment. Due to the loss of fine sediment, and limited resuspension of coarse sediment, flow from the pond and upstream creeks will reestablish an equilibrium sediment load by scouring the downstream watercourse bed and banks, creating an erosive influence in these reaches.
- A thermal assessment of the pond between July and October 2011 at varying depths indicates that with the exception of the pond at its deepest point (>2 m) the thermal regime is warmwater with a weekly average in July ranging from 25-27°C and maximums ranging from 26-30°C and in August from 24-25°C and maximums ranging from 25-29°C. It is important to note that the “cooler” temperatures recorded in the deepest part of the pond are believed to be attributed to the burial of a temperature logger in the substrate (pulled under by the anchor) rather than the water itself. As a result the temperature logger appears to have been inaccurately recording the soft sediment temperature that is likely cooler than the water temperature due to its connection with the underlying soils as they appear to be in thermal equilibrium with the underlying soils which act as a heat sink.

As would be expected, the higher weekly averages and maximums of July and August 2012 are attributed to the surface waters rather than the deeper waters. In the summer when the pond is connected to Reach 14W-12A during precipitation events, it is this higher temperature water that would be discharged downstream as the flow dynamics of the shared inlet/outlet, thermal stratification observed in the summer and minimal wind agitation would limit the mixing of the differing water temperatures. This discharge of warmer water could result in adverse effects to the downstream habitats, including Redside Dace occupied habitat in Reach 14W-12. The proposed removal of the farm pond is also consistent with the *Examples of Potential Overall Benefit Actions for Redside Dace* in the *DRAFT Guidance for Development Activities in Redside Dace Protected Habitat* (February 2011). This guidance document specifically identifies the "*Decommissioning of artificial ponds connected to occupied streams to improve fish passage and/or water quality (e.g., temperature)*".

- The average width of the pond (Reach 14W-14A) is more than 7.5 m. The pond is approximately 300 m long and is greater than 20 m wide for the majority of its length only reducing to within the range of 7.5 m for a short distance at the shared inlet/outlet.

As indicated, it is uncertain why this pond is being identified as Redside Dace habitat under Ontario Regulation 242/08 Section 29.1, subsection v. and as a result further justification from MNR is required to assist in our understanding.

<u>Proposed Interaction with Development Plan:</u> The proposed development plan will result in the elimination of Reach 14W-14A, and the construction of a SWMP in its location. The function of this reach will be addressed as per the requirements of NOCSS including addressing the "stream" length. Furthermore, CH has provided comment related to the specific functions of the pond they would like replicated in the realigned channel.

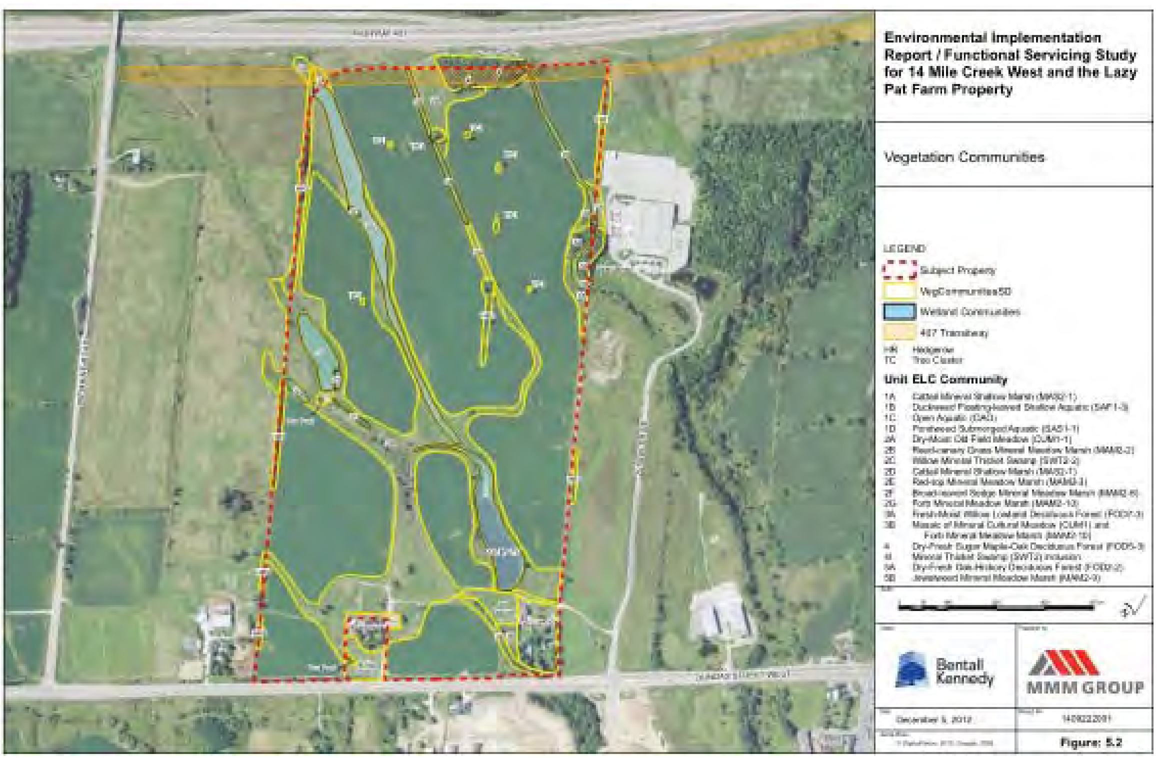
It has been our experience that the removal of pond habitat (i.e., by-pass, on-line), specifically those contributing to cool/coldwater habitats, is a measure often identified to improve thermal regimes related to fish habitat and is frequently used as a means to offset adverse effects to fish and fish habitat. We are currently retained on a project in the MNR - Aurora District jurisdiction where the removal of an online pond on Redside Dace occupied habitat and the removal of an online pond on Redside Dace contributing habitat were proposed and accepted in a Mitigation Plan as suitable measures to address effects to Redside Dace habitat. The proposed Stormwater Management Pond will be constructed with state of the art thermal mitigation measures specifically designed to address the thermal gains currently experienced with the farm pond. Considering the effect of the farm pond (Reach 14W-14) on water quality (water temperature, sediment, etc.) the benefit to Redside Dace associated with the removal of this constructed feature would be a consistent approach.

The NOCSS Implementation Report states that one of its broad level riparian corridor management recommendations to achieve certain targets on a system wide basis includes the removal of online ponds as they are considered detrimental from a temperature moderation perspective. Although the pond in question is not an online feature, its effects are similar and the removal of these adverse effects would be beneficial to the aquatic habitat of downstream reaches and consistent with the subwatershed study.

Comment requested from MNR related to the justification of the inclusion of the farm pond (Reach 14W-14A) as Redside Dace habitat, its removal from the landscape and specific function to be replicated to support Redside Dace (if any).

viii. Riparian Wetlands, as described on Figure 6.3.4

MNR Classification: It is unclear why the author chose to reference the NOCSS ELC mapping (Figure 6.3.4) rather than the mapping provided in the EIR/FSS (Figure 5.2). The NOCSS mapping for the site is based on aerial/satellite photo interpretation while the mapping in the EIR/FSS was based on site specific surveys that provide a greater level of accuracy.



With the exception of the pond (Reach 14W-14A), the remaining wetlands are associated with the stream corridors. These riparian wetlands within the agricultural landscape have been subject to anthropogenic disturbance with the adjacent active agricultural use likely resulting in periodic disturbance (e.g., chemical spraying/vegetation dieback, encroachment due to ploughing, vehicle crossing through riparian habitat). Furthermore, the wetland boundaries likely shift from year to year depending on extent of agricultural land disturbance as well as precipitation. Low botanical quality and health (dominated by non-native grasses and disturbance tolerant species) results in a general low sensitivity to these features.

As previously indicated the wetland attributes identified in the farm pond are associated with the absence of maintenance of this “agricultural infrastructure” and is similar in composition to an unmaintained SWMP. The EIR/FSS indicates that the overall sensitivity and botanical quality of the pond are low (low diversity, common and tolerant wetland species).

We would request that the MNR specify the function of the wetlands that is considered to support Redside Dace in order to ensure that the watercourse realignment designs include enhancement to wetland habitat that meets the desired functions.

Proposed Interaction with Development Plan: The removal of the farm pond (Reach 14W-14A) and channel works associated with Reach 14W-22 (realigned Reach 14W-14), Reach 14W-11A and Reach 14W-16 will result in the removal of the associated wetland components. The proposed realignments provide the opportunity to re-create and potentially enhance the function of the existing wetland features that have been adversely affected by agricultural influences.

Comment requested from MNR related to the re-creation of wetland habitat within the realigned reaches.

2.0 In reviewing the document we noted that a number of key sections did not reference the Draft Guidance for Development Activities in Redside Dace Protected Habitat (http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/stdprod_082290.pdf). Accordingly we have concerns with the following:

i. Lack of pre-development and post-development water balance calculations

The efforts to date associated with the hydrogeological component of the study have met the requirements of the NOCSS with additional studies undertaken in response to requests by CH staff. The EIR/FSS provides detailed, monthly, pre and post development water balance calculations for each of the sub-watersheds found on the Lazy Pat lands. In addition to the numerous references to our water balance calculations made throughout the (Section 4) Hydrogeology section of the EIR/FSS 2nd Submission , Sections 4.4 through to 4.4.4.6 of the submission (pages 4-23 to 4-39 inclusive) are devoted to describing the water balance methodology and results and is supported by twenty pages of spreadsheet calculations in Appendix 4.7. Section 7 of the EIR/FSS's report December 19, 2012 cover letter is titled *Infiltration and Water Balance* and provides a summary of the water balance detailed in the aforementioned section of the EIR/FSS.

A summary of Item 7 (*Infiltration and Water Balance*) of the December 19, 2012 cover letter:

MMM's detailed site-specific studies of the Subject Property did not identify any areas with soils suitable for enhanced infiltration techniques (e.g., sands). The upper weathered zone of the Halton Till (clay-silt soil with low permeability) with its fracturing therefore remains the most viable option for infiltration and following development these soil conditions will be limited to the natural environment areas associated with the watercourses with the principal means of mitigating infiltration losses from infiltration swales constructed along the edges of these watercourse valleys.

Under these less than ideal site conditions, the water balance analysis calculated a reduction in infiltration with mitigation measures following development on the Subject Property improved from a 62% calculated post-development loss with no mitigation measured employed, to a 29% calculated loss with the proposed mitigation measures. This is a significant improvement considering the low permeability of soils and the proposed maximum 90% lot coverage for the developable areas, based on the more urban and intensive employment uses envisaged by the Town, and provided for in the North Oakville Zoning By-law.

MNR's Redside Dace Guidelines state: "Post development water balance (i.e., the hydrogeological cycle of water including the flow and levels of surface and ground water) should match predevelopment water balance in order to protect the natural hydrological functions of Redside Dace streams. Therefore there should be no storm run-off from rainfall events in the range of 5 – 15mm (however, this may depend on the recommendations set forth in the subwatershed plan and on soil permeability)". The MNR guideline does not state that post-development infiltration must 100% match the pre-development infiltration in the vicinity of Redside Dace streams as it recognizes the role of soil permeability in allowing for effective mitigation. Furthermore, the MNR Guideline also defers to the recommendations set forth in local; subwatershed plans, and the North Oakville Creeks Subwatershed Study (NOCSS) does not indicate that 100% post-development infiltration is "required", rather, that using best efforts and best management practices to minimize infiltration reduction is required.

Therefore, in our opinion that the proposed mitigation concepts described in the EIR/FSS with 29% calculated reduction in infiltration meet the stated goals/requirements of the NOCSS and the MNR Redside Dace Guidelines given the soil properties on the lands.

ii. Proposed storm water management facilities and the design criteria used

The proposed storm water management facilities have been designed to comply with the 2003 MOE Stormwater Management Planning and Design Manual and Town of Oakville design guidelines, with modifications to respond to Conservation Halton directions on specific pond performance. The modifications do not alter the compliance with MOE or Town requirements. Due to numerous performance requirements related to water quality treatment, flow control, thermal mitigation, baseflow maintenance, NOCSS recommendations, etc., the proposed pond locations were chosen and scrutinized for suitability as a SWM facility. In all pond blocks, the locations were chosen to balance gravity drainage capacity for the development lands with the ability to contribute flow as far upstream in the affected watercourses as possible. Fewer, larger ponds are preferred over multiple, smaller ones from a municipal planning standpoint to minimize future maintenance burdens and supporting infrastructure requirements.

In terms of Redside Dace consideration, larger ponds are again preferred over smaller ones, as water quality improvement is proportional to hydraulic residence time. In addition, fewer outlet controls (tied to fewer facilities) allows for better flexibility in achieving the overall watershed unit flow rate targets for the 14 Mile Creek watershed as identified by Conservation Halton. This indirectly contributes to on-site and off-site Redside Dace habitats by promoting an increased stability in downstream reaches. This stabilized flow regime will incorporate the pond's discharges which will consist of fully treated (80% TSS removal) stormwater effluent that has passed through thermal mitigation measures to ensure discharge meets all regulatory authority criteria and is of sufficient quality to support the receiving waters as RSD habitat.

iii. The number of stream crossings proposed in the development site as well as adjacent lands

In our cover letter, dated December 19, 2012, accompanying the EIR/FSS 2nd Submission, item 3.0, titled *Reconfiguration of Avenue One and Avenue Two,* outlines the rationale for the east/west road patterns and how these crossings have been aligned to minimize the crossings of Redside Dace habitat. Furthermore, it also indicates how the proposed network is consistent with the North Oakville West Secondary Plan, which identified the need for two major east-west arterial roads to traverse the secondary planning area. In fact, our development plan proposes to shift the Burnhamthorpe Road extension further north (than that identified in the North Oakville West Secondary Plan), in order to minimize the number of crossings and potential impacts on Redside Dace habitat (Reach 14W- 12).

As presented and discussed at the September 10, 2013 workshop meeting, the proposed alignment provides flexibility in the road alignments on the adjacent lands for crossing Redside Dace habitat. It is recognized that the final location of road crossings on adjacent lands would need to be further assessed through EIR/FSS studies for the adjacent lands, and is beyond the scope of our work.

Item 3 (*Reconfiguration of Avenue One and Avenue Two*) of the December 19, 2012 cover letter states:

The comments identified concerns with the proposed road pattern proposed in the Concept Plan, and how they differed from the NOWSP. Of most significance was the additional crossing proposed by the realignment of Avenue Two, its proximity to private property and the constructability without sufficient grading, and landowner coordination matters with respect to the location of Avenue Two

As previously indicated, the conceptual road network identified in the North Oakville West Secondary Plan (NOWSP) does not provide a sufficient network to facilitate the appropriate development of the 407 West Employment Area, based on more detailed study undertaken through this EIR/FSS. MMM has provided various comments to the Town in relation to the NOWSP road pattern, and based on these discussions with the Town it was recognized that the road network is conceptual and may be further refined, this is further supported by the policies of the NOWSP. In our letter dated March 30, 2012, MMM provided further details on the modifications to the road pattern and the existing constraints affecting the road alignments. Modifications to the road network were initially proposed to:

- *minimize the impact on the existing GE Facility site and operations, and extent of the NHS crossing, by shifting Avenue One to the south;*
- *minimize the impacts on the NHS by shifting the Burnhamthorpe Road alignment north of the High Constraint Stream Corridor **(Reach 14W-12A)** and existing pond on the Subject Property; and*
- *modifying the road alignments to accommodate appropriate access to larger sized employment blocks, particularly to the north of the planning area (Avenue One alignment).*

The following modifications have been made to the development plan in response to comments:

- *Avenue Two is proposed to be shifted to the west to straddle the western boundary of the Subject Property in order to provide access to the Subject Property and the adjacent lands to the west. We understand that this addresses concerns raised by the neighbouring landowner to accommodate frontage on this new north-south road. In doing so, the additional crossing of the NHS of Avenue Two has been eliminated, as the road is proposed to extend northwesterly to Avenue One, on the west side of the NHS; and*
- *the Burnhamthorpe Road extension has also been modestly shifted north in the vicinity of the pond, to avoid crossing the existing High Constraint Stream Corridor, and provide a sufficient setback from the 14W-12A High Constraint Stream Corridor. The road crossings through the NHS will be designed to minimize disruption to the streams, through appropriate watercourse crossing construction practices, and minimize encroachment into Redside Dace Habitat.*

In our opinion, the proposed road pattern is consistent with the NOWSP, and follows a modified grid pattern which responds to the existing environmental and site conditions while encouraging accessibility and a viable transit network throughout the 407 West Employment area. Furthermore, the Draft Plan of Subdivision also identifies potential temporary right-of-ways and existing easements (driveways), which are intended to accommodate an appropriate road network and access to the Subject Property until such time as the proposed roads and intersections have been constructed on adjacent lands, where required.

iv. Proposed relocation and alteration of Redside Dace habitat

Although there is much overlap between agency reviews, the intent of the authors was that the EIR/FSS address the specific requirements of the Town and CH, specifically for aquatic habitat it meant ensuring the appropriate treatment of the High, Medium and Low Constraint streams in accordance with NOCSS. As a result, the discussion related to Redside Dace habitat (as well as other species regulated under the ESA was only mentioned within the context of the NOCSS with deferral of the detailed assessment to MNR review. We have implemented this approach with numerous development projects in the province including MNR – Aurora District.

The EIR/FSS is a comprehensive document meant to address specific municipal requirements. A single document to address separate municipal and provincial review of the species and habitat would, in our opinion, be unwieldy and unclear. This is especially the case when the review process and requirements related to the ESA was undefined and would have meant delays in submission to the Town and CH. This is the rationale for the continued attempts to contact MNR directly and obtain comment following the first submission of the EIR/FSS.

As indicated in your letter, we welcome the opportunity to meet with you at your office to review these comments in further detail, at your earliest convenience.

3.0 Based on records of Bobolink, MNR has determined the subject property provides habitat for Bobolink. An authorization under the ESA is required for the damage or destruction of Bobolink habitat.

We would like to have clarification and justification to the rationale for the classification of the subject property as bobolink habitat. Specifically the record referred to and the actual delineation of habitat.

Although there have been anecdotal/incidental recordings of bobolink on site by our study team, formal surveys in accordance with the MNR's transect protocol for bobolink and eastern meadowlark were not undertaken prior to 2013. It has been our experience, specifically with the MNR – Aurora District that the incidental/anecdotal recordings are not solely acceptable as evidence for habitat classification. As mentioned in more recent discussions with MNR staff, the species specific transect surveys were undertaken in Spring 2013. Due to the prescriptive nature of the protocol (transect and point count spacing), in agricultural settings the sampling locations can often be located within unsuitable habitat (e.g., ploughed fields) and other smaller areas of potential habitat lie beyond these prescribed locations (see field notes below). In the 2013 surveys, due to the intensively farmed landscape the established transects and associated point counts were located within ploughed fields with little/no crop cover. As a result additional point count locations beyond transects were also undertaken within potential habitat to supplement data.

The following is a summary of the observations and its assessment:

Timing: Surveys undertaken on May 31, June 11 and July 4, 2013. The time spent surveying each day and the results of the surveys are as follows:

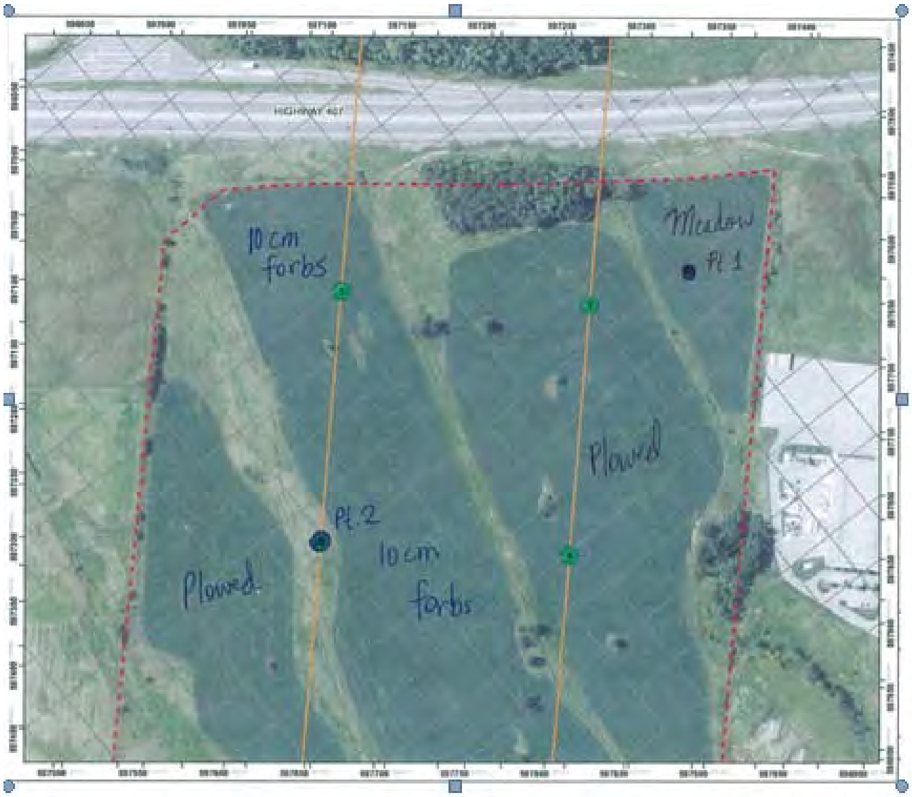
- May 31 – 7:15-7:50 a.m.
- June 11 – 8:50-9:45 a.m.
- July 4 – 7:45-8:30 a.m.

Land Use: Most of the subject lands are croplands with meadow habitat at the extreme northeast corner of the property and within stream corridors.

Most of the cropland was recently plowed with the field in the centre of the property sparsely covered by forbs that were approximately 10 cm in height in May and June.

Three point count locations in addition to the transects were selected where vegetation was well established; meadow habitat in northeast corner and two in the riparian habitat.

Conditions: Air temperatures during survey period ranged between 19°C and 22°C. With the exception of very light sporadic rain on July 4, 2013 at Point Count 1, there was no other rain.


HIGHWAY 407
10 cm
forbs
Meadow
Pt 1
Plowed
Pt. 2
10 cm
forbs
Plowed


10 cm
forbs
Pt. 3
Plowed
Plowed
Plowed
bare
ground
Plowed
Plowed
DUNDAS STREET WEST

Results:

Due to the habitat present at the prescribed transect points including near absence of vegetation cover in the agricultural fields, bare ground and riparian habitat with tree and shrub cover, there was no viable bobolink or eastern meadowlark habitat present, and neither of these species observed.

The additional point count locations established to document areas of greater habitat potential did not result in visual observation or auditory evidence of bobolink or eastern meadowlark presence. A summary of the results are presented below.

<u>Point Count 1 – meadow in northeast corner</u>

- No bobolinks or eastern meadowlark were observed or heard.
- Vegetation was mostly forbs, increasing from about 80% to 95% over the survey period.
- Other bird species recorded include brown cowbird, European starling, red-winged blackbird, American woodcock, cedar waxwing, song sparrow, mourning dove

<u>Point Count 2 – Reach 14W-14 Riparian Corridor</u>

- No bobolinks or eastern meadowlark were observed or heard.
- Vegetation was mostly grass, decreasing from about 95% to 60% over the survey period.
- Other bird species recorded include horned lark, European starling, red-winged blackbird, song sparrow, ring-billed gull, tree swallow, killdeer (10), great blue heron

<u>Point Count 3 – Reaches 14W-14/14W-12A Riparian Corridor</u>

- No bobolinks or eastern meadowlark were observed or heard.
- Vegetation was mostly forbs, increasing from about 80% to 95% over the survey period.
- Other bird species recorded include red-winged blackbird, spotted sandpiper, song sparrow, bank swallow and great blue heron

It appears that the incidental observations of bobolink within the site were likely attributed to the planted crop at the time of observation (e.g., hay, wheat, etc.) and/or movement of individuals through the area. This is supported by the absence of recorded breeding bobolink and eastern meadowlark use during the 2013 species specific surveys. It is anticipated that these species will occasionally be located on site if a suitable crop is present for their use as the non-crop land is limited and would provide marginal habitat due to the relatively small size and orientation (long narrow riparian corridors).

4.0 Barn swallow has been found breeding on the subject property. An authorization under the ESA is required for the damage or destruction of Barn Swallow habitat. It is recommended that the proponent work with MNR to determine qualification under O.Reg 242/08, Section 23.5 for the removal of the structures on site that support Barn Swallow. Please note, O.Reg 242/08, Section 23.5 only speaks to the removal of buildings or structures that provide habitat for Barn Swallow and does not cover the damage or destruction of adjacent foraging habitat. If the adjacent foraging habitat is planned to be removed, damaged and/or destroyed in the future, an ESA 17(2)(c) Permit will be required.

Based on recently completed and ongoing project review by MNR – Aurora District for development projects affecting barn swallow nesting and foraging habitat, it is anticipated that the removal of any structure supporting this species can follow the online registry process for this species. Please confirm. The likely approach will be the installation of artificial nesting structures within the open space/Natural Heritage Systems (NHS) of the site. Furthermore the extent of NHS and Open Space (SWMP) is anticipated to provide sufficient forage habitat given the stream corridors in the vicinity of Dundas Street (greater than 100 m) and with more area available for foraging habitat when accounting for adjacent SWMPs.

In reference to the comment "*Please note, O.Reg 242/08, Section 23.5 only speaks to the removal of buildings or structures that provide habitat for Barn Swallow and does not cover the damage or destruction of adjacent foraging habitat*" it is unclear the manner in which to apply this principle. Forage habitat and nesting habitat are linked with the forage habitat based on proximity to a nest (and associated structure). When a nest/structure are removed (provided an appropriate replacement structure meeting the requirements is installed) following the online registry process, the forage habitat associated with the original structure ceases to function as forage habitat as there is no longer a nest. Please clarify this statement and its actual interpretation in terms of how the proponent is expected to proceed to remove the structures on site.

5.0 Please provide all available data on the historic bird survey records, which include Eastern Meadowlark.

Breeding bird data has already been provided and is detailed in *Section 5.3.6.2 Wildlife Survey Results* and supplemented with a detailed species list in *Appendix 5.2 – Wildlife* in the EIR/FSS. The breeding bird surveys did not record the presence of eastern meadowlark on site. As previously mentioned, the species specific transect surveys for bobolink and eastern meadowlark did not result in the observation of this species. Please provide further clarification related to the data you are specifically referring to.

6.0 ***Recently, the Little Brown Myotis and Northern Long-eared Myotis have been listed on the ESA, 2007, as endangered. These species are now afforded both species and habitat protection under the ESA, 2007. MNR recommends that the site be surveyed for potentially suitable bat habitat (including, but not limited to: forested areas, abandoned buildings, houses, sheds, etc.) and that if any potentially suitable habitat is found on site, bat surveys be conducted prior to the damage or destruction of any habitat which may support bats. This information on potentially suitable bat habitat should be provided to MNR for review.***

As the inclusion of these species for protection under the ESA is relatively "new" and previous records for the area were not known, we will review the potential for these species to be present and the most effective manner to determine their presence/absence. Thank you for the notification.

As is evidenced by the extensive comments above, further justification/clarification is required from the MNR in regards to the classification of habitats with specific reference to the function of the habitat as we do not entirely agree with the statements made in the correspondence. Where indicated we would like to review the data in your possession that is the basis for your position and review in association with our data. Once that is complete we can determine what habitat functions are clearly present and determine the most appropriate manner in which the development plan is advanced and incorporates suitable measures to ensure conformance with the ESA. Furthermore, we would request that the MNR advance their review of the project beyond "what is regulated" and provide comments specifically related to the development plan (i.e., watercourse realignment, encroachment of SWMP into Redside Dace habitat, farm pond removal and functions (if any) to be replicated). It is our view that there is sufficient data and analysis within the EIR/FSS, agency comments/proponent responses and associated documents to address your requirements for baseline conditions and assess potential effects under the ESA. If you require additional data beyond that contained in the EIR/FSS, please advise what information that is not included in the EIR/FSS and we will make every effort to provide it to you in a timely fashion.

Once again, thank you for your continued attention to the review of the project and ask that you contact the undersigned should you have any questions related to this material. We will be in contact shortly to set up an appropriate meeting time to discuss these comments and a strategy for moving forward with MNR.

Yours truly,

MMM Group Limited

Mark Cece, B.Sc.
Manager of Ecology/Senior Fisheries Biologist
Associate Partner
Ecology Department

CC: Paul Bond, Conservation Halton
Rob Thun, Town of Oakville
Richard Clark, Halton Region
Mike Reel, Bentall Kennedy (Canada) LP

M:\Jobs\2009\14.09222.001.P01 - 407 West Employment Area\Ecology\Agency Correspondance\MNR\January 2014 ESA MNR Jan 20 Corresp\Sent to client\CLIENT COMMENTS TO DRAFT response to MNR Dec 20 2013 letter re ESA - Jan 15 2014.doc

MMM GROUP

INTER-OFFICE MEMO

To:	Paul Bond	Date:	February 27, 2014
From:	Chris Tyrrell	Job No.:	14.09222.001.P01
Subject:	Bentall Kennedy (Lazy Pat Lands) Response to Conservation Halton comments, February 13, 2014 email	CC:	Mike Reel Rob Thun Rita Julio Janette Brenner Jacek Strakowski Samantha Mason Lesley Matich

We appreciate your comments in your email of February 13, 2014, and wish to provide the following responses as shown as (***MMM bold and in italics***).

June 3, 2013 CH Letter Regarding 2nd Submission of EIR/FSS

1. Comment addressed. It is noted that ecology staff are still waiting for Oxygen concentration data.

MMM: Information has been electronically sent to Paul Bond via email and will be saved on a flash drive and couriered directly to Mr. Bond.

2. To be addressed in future submission.

MMM: No Further Comment

4. Road Alignment – Conservation Halton staff agree that there is no further action to be taken with respect to the road alignment other than that the additional information provided to demonstrate the future road flexibility should be incorporated into the EIR/FSS document. At the September 10th meeting, however, we also discussed the sanitary sewer servicing under this heading and it was the further actions to be taken with respect to the sanitary sewer servicing that we were referring to.

MMM: The revised sanitary servicing option of the sanitary sewers under the watercourse crossings have been included as part of the recently provided Area Servicing Plan for the 407 West Employment Lands for Conservation Halton's review. This option demonstrates that the sanitary sewers can be installed with a minimum of 3m below the bottom of the existing watercourse as requested by CH.

March 21, 2013 CH Letter

A. There is outstanding concern regarding the proposed size of the proposed SWM pond proposed for the existing 14W-14A pond. The concern lies with the potential for thermal impacts on the downstream fish community and the feasibility of reaching stormwater thermal targets.

MMM: In order to mitigate the potential thermal impact on the downstream fish community, a thermal trench is being designed, which enables a definite portion of the controlled release rate from SWM Pond 3 to attain an optimum temperature for the benefit of the fish community before the runoff is released to the 14W-12 channel reach. The design of the thermal trench has

been undertaken in accordance to the spreadsheet [Thermodynamic model developed by Doug Nuttal (Water Resources Engineer, Mississippi Valley Conservation Authority)] sent by Samantha Mason. The details of the thermal trench and the supporting calculations will be provided in the upcoming EIR/FSS. It should be noted that the size of the thermal trench is limited by available space, the invert of the downstream channel reach, and the invert of the SWM Pond 3 outlet structure.

D. Infiltration and Water Balance – Staff look forward to reviewing further documentation regarding how best efforts to achieve infiltration and water balance on the property in order to help sustain and provide a net benefit to the endangered Redside Dace on the downstream portion of the property.

MMM: As reported many times in the past, the clay-rich soil conditions at the site make achieving a post development water balance very difficult. MMM will review the Elm Drive West bio-swale monitoring data (see below) and adjust our water balance calculations if this real world data is applicable to the Bentall site. Furthermore, MMM will be meeting with the MNR on February 26 to discuss the Redside Dace issue as we understand they now retain full jurisdiction over the ESA.

G. Location and Size of SWM Facilities – Clarification required from Town of Oakville Staff regarding their position on a pipe in a pipe cooling system in terms of acceptance of this approach. Preference would be not to rule out the use of a “pipe in a pipe” approach to thermal cooling until this cooling method has been discussed with Town of Oakville staff. The maximum allowable permanent pool depth for a wet pond as per table 4.6 in the 2003 MOE Stormwater Management Planning and Design Manual is 3.0 m. This table also states that the preferred length to width ratios for wet ponds will be constructed with a 4:1 to 5:1 length:width ratio. It is requested that these length to width ratios be considered for all proposed SWM facilities on the property. Please note the following SWM guidelines provided in the MNR document entitled: DRAFT Guidance for Development Activities in Redside Dace Protected Habitat:

- the discharge of water from urban development stormwater management facilities into Redside Dace habitat should not exceed 25 mg/l of total suspended solids (TSS) above the background stream level of total suspended solids
- Post development water balance (i.e., the hydrological cycle of the water including the flow and levels of surface and ground water) should match predevelopment water balance in order to protect the natural hydrological functions of Redside Dace streams
- To maximize the absorption of nutrients and other contaminants and prevent them from entering streams, stormwater management facilities adjacent to Redside Dace habitat should be designed as hybrid extended detention wetlands/wet ponds
- The above objectives can be achieved by utilizing a low impact development strategy for stormwater management that treats stormwater as close to the source as possible and focuses on runoff prevention. This includes such measures as:
- Site design strategies to minimize runoff which involves:
  - conserving natural features that absorb rainfall (e.g., wetlands, stream buffers, forested areas, permeable soil, etc.)
  - locating and designing buildings/infrastructure to reduce impact (e.g., clustering development in less sensitive areas, reducing footprints of buildings and roadways)
  - Evaporation and infiltration practices (e.g., using native vegetation/trees, green roofs, soak away pits, infiltration trenches, permeable pavement)
  - Rainwater harvesting (e.g., rain barrels, cisterns)

    - Runoff conveyance (e.g., perforated pipe systems or grass channels which treat and infiltrate runoff as it is being transported)
    - Runoff storage (e.g., woodland restoration, constructed wetlands which capture and then release water as evaporation into the air)
- Several of these low impact development measures may be required, which will vary depending on site specific factors including the soil, geology and groundwater level. These measures will reduce the amount of effort required to implement effective end-of-the-pipe solutions.

Please note that these sections of MNR's Guidance for Development in Protected Redside Dace Habitat are provided for the proponent's reference with respect to options that may be required for the cooling of stormwater originating from the Lazy Pat lands that will enter the habitat of Redside Dace.

MMM: MMM is not currently ruling out the "pipe in a pipe" approach, however the application of this approach is new to Ontario, and as design engineers, we have significant reservations about its use. While the concept is similar in principle to a heat exchanger, we have concerns about long-term operation and maintenance of this system, repair/replacement costs, ease of access, etc. We have significantly more experience with cooling trenches and are preparing a cooling trench design consistent with the design guidance provided to MMM by Samantha Mason, based on an analysis from her colleague at the Mississippi Valley Conservation Authority. The design will be presented in the revised EIR/FSS for CH review to show consistency with the OMB mediation item on thermal SWM effluent targets. At this time, we are not professionally supportive of the "pipe in a pipe" approach in a planning document for a project of this nature, unless the Town believes it will provide significant benefits over a cooling trench design and agrees to maintain it after assumption. We also request an example of where this approach has been used successfully in a cold climate location so that we can compare its performance to date to the climate of the current project.

With respect to the allowable permanent pool depth and length to width ratios, we are aware of the maximum allowable depth for wet ponds from the 2003 MOE Stormwater Management Planning and Design Manual (SWMPDM). We also note that MOE's preferred criteria is a maximum 2.5m deep permanent pool with a mean depth of 1.0-2.0m, specifically to avoid the tendency to promote anoxic conditions in the SWM pond and to avoid resuspension of settled pollutants. Providing maximum depth ponds throughout the pond cell will likely increase the probability of a thermocline in the pond, which will prevent mixing of the pond depth layers, promoting anoxic waters and impairing treatment function. We are proposing shallower ponds at the planning stage to ensure sufficient SWM block sizes are reserved to provide the MOE stipulated volumes for active storage and water quality treatment and to ensure a 'preferred' SWM pond treatment capacity. As the EIR/FSS is a planning level document, it is preferable to demonstrate 'preferred' configurations for SWM facilities to allow flexibility (such as deeper areas near the outlets) at the detailed design stage. Once the SWM pond block sizes are confirmed, deep outlet pools can be configured into the detailed design plans to ensure additional thermal treatment by draw off of deeper pond water through effective mixing of shallower pond water with the deep cells via the mixing action of the reversed slope pond outlet pipe. As for the 4:1 to 5:1 length to width ratios, these ratios can be provided by internal berming (i.e. a serpentine design, as shown in figure 4.19 of the SWMPDM) which allows for SWM block shapes that facilitate a favourable subdivision plan (so long as sufficient volume remains in the ponds after displacement by the internal berms. The shallower depths of the pond at the EIR/FSS stage allow for deepening of the ponds in select areas to account for loss of permanent pool by these berms.)

We note the MNR SWM guidelines provided. As the project requires an MNR permit, we will address MNR concerns on the SWM strategy and its effect on Red Side Dace habitat directly with them. MMM is fully supportive of LID measures to promote their respective environmental benefits. However, the Town of Oakville requires an independently effective SWM strategy to avoid the risk of private SWM measures that are not wholly or partially functional. An example of this was seen in the negotiation of diversion of rooftop runoff from buildings adjacent to reach 14W-12A where the Town would not permit a reduction in SWM pond effective storage and quality treatment capacity despite the full diversion of the catchment areas of these rooftops to the affected reach.

H – Staff look forward to seeing maximized channel gradients for the proposed realigned watercourses.

MMM: No further comment.

5. Section 2.2 Permitted Uses in the Natural Heritage System – Staff encourage the use of the bioswales to achieve water balance on the site. Due to the fact that they will require periodic maintenance, it is recommended they be located outside of the Natural Heritage system including Redside Dace habitat.

MMM: As noted above, we will be replacing bio-swales with equivalent infiltration trenches located on the private lots outside of, but adjacent to the Natural Heritage system. Siting these mitigation measures alongside the Natural Heritage system remains the most feasible and effective method to mitigate against site-wide infiltration losses because:

- ***The on-site soils are comprised completely of low conductivity Clay-Silt Halton Till;***
- ***In situ hydraulic conductivity of the Halton Till measured at depth (on-site), in the unweathered zone, results in hydraulic conductivities on the range of 10^{-9} to 10^{-10} m/sec (very low values). These values are in agreement with other published studies for this Till;***
- ***The upper depths of the Till are weathered and fractured. This results in enhanced "secondary" permeability of the upper zone, with this enhanced permeability being found through the fractures and promoting lateral shallow flows towards the watercourses;***
- ***Through the central, developable parts of the site, site grading activities will eliminate this upper secondary permeability because:***
    - ***in areas of Cut grading will remove the upper fractured zone, exposing unweathered Till at surface (10^{-9} to 10^{-10} m/sec hydraulic conductivities); and,***
    - ***In areas of Fill, the fractured zones will be buried, and covered by Clay-Silt rich soils that will be further compacted to engineered fill specifications with resultant low hydraulic conductivity;***
- ***The Natural Heritage areas will remain largely untouched by construction activities and construction traffic, thereby preserving the secondary permeability zone in the upper soils, and thereby providing pathways for water to infiltrate more readily into the ground that will no longer exist in the central areas of the site. Additionally, water infiltrating into the ground along the edges of the Natural Heritage system will be directed towards the watercourses, whereas, water infiltrating into the ground across the central portions of the site may be intercepted by site servicing trenches and redirected elsewhere.***

8. Section 4.4, (Hydrogeology and Geology), Impacts of the Proposed Development – This comment was provided by our Water Resources Engineer further to comments she provided on the original EIR/FSS. The December 2012 (2nd Submission) EIR/FSS discusses the effects of the proposed development on the overall water balance and specifically changes on infiltration to the groundwater system. It also discusses potential impacts of dewatering. While the last sentence in the introduction on Page 4-24 states that the subsequent sections will discuss the potential impacts related to the proposed stream realignments, no further discussion was provided in this portion of the December 2012 report. The July 4, 2013 MMM response table states that the “text associated with the realignments and associated mitigation measures will be addressed in future submissions to the extent required”. Andrew Kulin is welcomed to contact Janette Brenner directly should he wish to clarify this comment further.

MMM: Jeannette Brenner will be contacted.

12. Section 4.4.4.2, Post-Development Water Balance – From an engineering perspective, CH staff have no objections in principle to the Conceptual Flat-Bottomed Infiltration Swales presented in Figures 4.9a and 4.9b. The feasibility of utilizing 2:1 slopes instead of standard 3:1 slopes will be dependent on swale height and volume/velocity of water being directed into the swale, and will need to be confirmed in the EIR/FSS. The final concept will also be dependent on the conceptual grading plan(s) required as part of the EIR/FSS that will demonstrate that the swales will be located outside of Conservation Halton’s regulated area.

MMM: The flat-bottomed infiltration swales (bio-swales) will be replaced with equivalent infiltration trenches located along the lot property lines adjacent to the natural features. This will eliminate the conflict with placing these mitigative measures within the green areas.

12. (Aquatic comments) - Monitoring of bioswales in the City of Mississauga is showing favourable performance of this type of infrastructure in the following functions:

-capturing the first 20mm of runoff events
-improvements to water quality of stormwater
-aesthetically pleasing
-lower maintenance frequency and cost as compared to conventional stormwater infrastructure

As such, it is suggested that this approach be pursued for this land development scenario as a way of keeping runoff out of the conventional SWM facilities, thereby reducing the volume of runoff for which warm temperatures need to be mitigated. The use of bioswales is encouraged as a way to help maintain the existing hydrologic regime under which Redside Dace currently exist. Our original statement was not meant to suggest that the mediation item requires efforts to maximize water balance but rather that our inquiries into means of mitigating thermal impacts indicate that efforts to maximize the water balance (with respect to infiltration/evapotranspiration) as much as possible are going to be necessary in order to meet the mediation item’s thermal SWM effluent target. As such, we appreciate MMM’s efforts to-date to propose the use of infiltration swales.

MMM: MMM will consider the findings from the bio-swale study at Elm Drive West in Mississauga and if applicable, apply the results in our calculations and water balance reporting. However, while we note that additional monitoring information has been posted on Credit Valley Conservation’s web-site, it omits important information and we would require more detailed information to complete our review. We trust that Conservation Halton could provide assistance in obtaining this information from CVC .

24. Staff continue to have an interest in visiting the on-line wetlands in Carlton Creek in 2014. It is suggested that this site visit be arranged to take place in April or May.

MMM: We can coordinate a site visit with CH (Cathedraltown, Markham).

41. Section 6.3.6, Hydrologic Feature 'A' – Staff appreciate the effort taken by the consultant team to update the NOCSS HEC-RAS model. We had made our previous comment because we were concerned that MMM's previous response only indicated that they had obtained the NOCSS HEC-RAS model from CH and did not state that it was going to be updated and we wanted to make sure that was the intent.   We look forward to receiving the updated models/information.

MMM: No further comment.

43. Section 6.3, Corridor Delineation – No concerns with MMM response.

MMM: No further comment.

49. Information regarding the diversion channel 14W-23 alignment and plan form remains outstanding.

MMM: To be provided in next submission.

53. CH comments to be addressed in upcoming EIR/FSS submission.

MMM: No further comment.

59. Section 7.6, Stormwater Management Facilities – No concerns with MMM response.

MMM: No further comment.

X. Section 7.6.3, Water Quality Control - CH comments to be addressed in upcoming EIR/FSS submission.

MMM: No further comment.

Y. Section 8, Municipal Servicing – CH staff are satisfied that this item has been addressed subject to the clarifications outlined in our email dated November 13, 2013. Staff are currently reviewing the recently submitted final ASP document.

MMM: No further comment.

65. Appendix 8.3, Figure A – Staff look forward to receiving the updated figure in the pending EIR/FSS resubmission.

MMM: No further comment.

Sonia Rankin

From:	Paul Bond <pbond@hrca.on.ca>
Sent:	Wednesday, June 11, 2014 10:26 AM
To:	Randall Roth
Cc:	Janette Brenner; Jacek Strakowski; Lesley Matich; Samantha Mason; Rita Juliao; RThun@oakville.ca; Andrew Kulin; Steve VanHaren; Mark Cece; Chris Tyrrell; Reel, Mike (MReel@Bentallkennedy.com); Brenda Axon
Subject:	RE: Bentall - North Oakville

Hi Randall,

Our apologies for the time which has lapsed here. CH staff have completed our review your response submission and note that we are satisfied with all of the responses to our previous comments. Further to our March 21, 2013 CH Letter Comment #8, Andrew Kulin has contacted Janette Brenner and will provide additional discussion in the final EIR/FSS document with respect to the potential hydrogeological impacts associated with the proposed stream realignments.

We look forward to receipt of the EIR/FSS follow up submission and moving the applications forward to completion.

Kind regards,

Paul Bond
Environmental Planner
Conservation Halton
t: 905-336-1158 ext. 2257 | f: 905-336-6684
2596 Britannia Road West
Burlington ON L7P 0G3
e-mail: pbond@hrca.on.ca
www.conservationhalton.ca

From: Randall Roth [mailto:RothR@mmm.ca]
Sent: February 27, 2014 1:09 PM
To: Paul Bond
Cc: Janette Brenner; Jacek Strakowski; Lesley Matich; Samantha Mason; Rita Juliao; RThun@oakville.ca; Andrew Kulin; Steve VanHaren; Mark Cece; Chris Tyrrell; Reel, Mike (MReel@Bentallkennedy.com)
Subject: RE: Bentall - North Oakville

Hi Paul,

We appreciate your comments below on our Dec. 5, 2013 response.
We wish to offer the additional attached responses to the outstanding issues you have raised.

Regards,

Randall Roth, MCIP, RPP
Senior Planner/Project Manager, Associate
Planning & Environmental Design
MMM Group Limited

From: Paul Bond [mailto:pbond@hrca.on.ca]
Sent: February-13-14 11:48 AM

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July 4, 2014
File No. 14.09222.001

Mark Heaton
Area Biologist, Halton/Peel/Toronto
Ontario Ministry of Natural Resources, Aurora District
50 Bloomington Road West
Aurora, ON L4G 0L8

Dear Mr. Heaton,

Subject: Lazy Pat Farm Property, Town of Oakville
February 26, 2014 Meeting Minutes

Further to your June 18, 2014 e-mail we have finalized the February 26, 2014 meeting minutes that included the incorporation of many of your comments/revisions as well as provided further comment/revisions; these are attached for your files. We also provide the following information that supplements these minutes as well as requests for additional information that was identified in the meeting to be provided to MMM Group by the MNR.

1. Provincially Significant Wetlands

The Meeting Minutes reference the presence of Provincially Significant Wetlands (PSW) to the north of Highway 407 that were identified as being hydraulically connected to watercourses in the subject property and therefore contributing to Redside Dace habitat. We would request that this information/mapping be forwarded for our project files.

We would also ask that the MNR provide the confirmation that there are no PSWs present within the subject property limits as was indicated in previous correspondence with Halton Conservation. This confirmation was to be undertaken by MNR staff following the February 26, 2014 meeting.

2. Reference to Draft Guidance for Development Activities in Redside Dace Protected Habitat, MNR, 2011

As indicated in the March 10, 2014 e-mail conveying the Draft Meeting minutes, given that the MNR placed great emphasis on the interpretation of the Best Management Practices (BMP) identified in the Guidelines (Draft Guidance for Development Activities in Redside Dace Protected Habitat, MNR, 2011) additional reference to the actual document was necessary to provide context. As a result, it was felt that the inclusion of the actual Guideline BMPs being referenced in the meeting should be included in the body of the Meeting Minute text (differentiated from meeting summary by italics, bold and/or underlined) for context. This is especially important given that MNR has indicated that these meeting minutes will provide the official record of MNRs position on the project at the EIR/FSS phase and formal comments will not be issued. Yet upon receipt of the Draft Meeting Minutes it was noted that these references to Guideline text had been stricken out by MNR.

Section 4.2 of the Guidelines states that the "*BMPs is not intended to be an exhaustive list, but rather to cover the major construction activities that most commonly have an impact on Redside Dace and their habitat…The <u>BMPs listed for each activity are intended to act as suggested methods or techniques that can be implemented to protect habitat conditions for Redside Dace</u>*" and "*<u>This document is intended to provide guidance</u> to proponents interested in developing lands in and adjacent to protected habitats of Redside Dace."* The Guidelines (p.26) also indicate that the BMPs for Development Activities (including stream crossings and storm water management) are "***intended to act as suggested methods or techniques** that can be implemented to protect habitat conditions for Redside Dace*". The explicit explanation of the purpose of the Guidelines and its application as a source for suggested techniques and guidance to minimize potential adverse effects appears to be in contrast to the "absolute" nature of the comments made by MNR at the meeting when referencing this same document.

Although it is acknowledged that this additional material (i.e. specific quotes to the Guidelines) were not explicitly discussed in the meeting, they were referenced and are relevant to the stated MNR position on water balance and storm water management that were again discussed in somewhat absolute terms. In order to move forward with the finalization of the Meeting Minutes we have removed reference to the Guidelines in the Meeting Minutes (attached) and have instead included them in this correspondence as an accompanying document.

2.1 Stream Crossings

<u>Meeting Minute Text</u>
MNR indicated they do not support the road network and its impacts to significant habitat of endangered species, given the multiple crossings that are proposed over Regulated Habitat (14W-16 and 14W-11). MNR guidelines recommend an average of one stream crossing per kilometre. It was further discussed that although the MNR may have reviewed the Secondary Plan, their review was limited to the Natural Heritage System and not the identification of the road network within the secondary plan. As a result, the MNR feels that the impacts on significant habitat were not sufficiently considered.

Deleted Guidelines Reference
*Executive Summary of the Guideline (p.1) states: "2) Stream Crossings – **development activities should attempt to minimize the number of stream crossings**, and where required, minimize widths, target straight sections of the stream and areas that have been previously disturbed, minimize activity/footprint within regulated habitat, including spanning the meanderbelt, adherence to timing windows, incorporation of effective erosion and sediment control measures, and design in a manner that promotes fish passage;"*

*The Guideline further states (p.26-27): "For all direct Redside Dace habitat, crossings should be designed to avoid/mitigate impacts by adhering to the following: The **proposed road networks for new crossings should be designed to minimize the number of stream crossings** (e.g., stream crossings should **generally be limited to 1 per kilometre of stream**)."*

The intent of these statements are clear, they are to minimize crossings and not specifically intended to match a crossing/km ratio. The secondary plan including road network layout and the number of crossings were carefully developed in consideration of NOCSS (including Redside Dace), the predicted transportation needs and in consultation with the Town thereby appearing to meet the intent of the BMP. BMPs are approaches based on known science that, if followed, should meet the required standard or achieve the desired objective. The apparent intent of this BMP is to minimize the number of crossings, rather than specifically match a certain number of crossings per kilometer ratio. This should not be considered a "hard" number but a general reference point or target to work towards however, as each project is unique requiring the balancing of multiple factors and as a result there is typically an imbedded flexibility in BMPs. We would propose that the intent of this BMP is to ensure that there is careful consideration of the location and number of crossings rather than achieve a perceived target.

Further discussion with the Town and MNR will be required with respect to the road network and stream crossings.

2.2 Stormwater Management - Runoff

Meeting Minute Text
M. Heaton indicated that the *Draft Guidance for Development in RSD Protected Habitat* recommends that 10mm of precipitation should be contained in the tributary subcatchments to avoid excess erosion in receiving watercourses.

Deleted Guideline Reference
*The Guideline (p.34) states: "Post development water balance (i.e., the hydrological cycle of the water including the flow and levels of surface and ground water) should match predevelopment water balance in order to protect the natural hydrological functions of Redside Dace streams. Therefore, there should be no storm run-off from rainfall events in the range of 5 – 15mm (**however, this may depend on the recommendations set forth in the subwatershed plan and on soil permeability**)".*

The NOCSS recognized that the soil conditions in North Oakville will make it difficult to minimize changes to infiltration following development and as a result stated as a guiding principal that “best efforts” and “best management practices” must be used to ”minimize the reduction in infiltration”. Given this recognition, it seems unreasonable to expect that no storm run-off from rainfall events in the range of 5 – 15mm in a post-development scenario could be achieved when this is not seen to occur in the pre-development scenario due to the soils conditions, based on pond level monitoring.

3. Outstanding SAR Information

Barn Swallow

MNR has indicated that the removal of the existing barn (if nests present) would qualify for the new registry process and requires replacement habitat structures which could occur in the natural corridors. MNR further indicated that foraging habitat is likely sufficient in the post-development scenario within the natural corridors, and a permit likely not required. MMM Group requested a correspondence to this effect for the project files.

This confirmation from MNR is outstanding and we request this information or an indication of when it can be expected.

Bobolink

Although recent bobolink specific surveys did not result in the observation of bobolink, previous observations were considered by the MNR to constitute habitat at that time and as such must be addressed through ESA review/permitting. During the meeting the MNR indicated that it would undertake a process to review historic aerial imagery to assist in determining the bobolink habitat extent.

The MNR has yet to provide this assessment or identify the required review/permitting mechanisms associated with the areas of effect and we request this information or an indication of when it can be expected.

MMM GROUP

We appreciate your contributions to the finalization of these meeting minutes and look forward to continuing to move this project forward through its review under the Endangered Species Act. Please call should you have any questions or require clarification on any matters discussed.

Yours truly,

MMM GROUP LIMITED

Mark Cece, B.Sc.
Manager, Ecology Department
Associate Partner

CC: Mike Reel, Bentall Kennedy (Canada) LP
Chris Tyrrell, MMM Group Limited
Rob Thun, Town of Oakville
Paul Bond, Conservation Halton
Samantha Jefferis, MNR Aurora District
Jane Devlin, MNR Aurora District

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MMM GROUP

MEETING REPORT
WITHOUT PREJUDICE

Date:	July 4, 2014	**Project:**	Lazy Pat Farms (EIR/FSS): Bentall Kennedy
Date of meeting:	February 26, 2014	**Project Number:**	14.09222.001
Location:	MNR Offices - 50 Bloomington Rd, Aurora	**Author:**	Mark Cece, MMM

Purpose: **MNR Meeting to Discuss Endangered Species Act**

Attendees:	**E-Mail**
Mark Heaton, MNR	Mark.Heaton@ontario.ca
Jane, Devlin, MNR	Jane.Devlin@ontario.ca
Samantha Jefferis, MNR	Samantha.Jefferis@ontario.ca
Emily Funnell, MNR	Emily.Funnell@ontario.ca
Mike Reel, Bentall Kennedy	MReel@Bentallkennedy.com
Mark Cece, MMM	CeceM@mmm.ca
Steve VanHaren, MMM	VanHarenS@mmm.ca
Andrew Kulin, MMM	KulinA@mmm.ca
Randall Roth, MMM	RothR@mmm.ca

DISTRIBUTION: All Attendees and the following:

Chris Tyrrell, MMM	TyrrellC@mmm.ca

Item **Details** **Action By**

1. **MMM Group to provide background of aquatic habitat on-site**

M. Cece provided a brief description of the fieldwork that was undertaken since 2009, with respect to the aquatic habitat of the watercourses and constructed pond on site.

2. **MMM Group to provide updates to the development plan from the December 2012 (2nd) Submission of the EIR/FSS**

M. Cece highlighted the updates to the development plan since the EIR/FSS 2nd Submission (December 2012), which have included:

- Proposed "dual channel" concept within 14W-16, to address Conservation Halton concerns to accommodate additional drainage length which was based on discussions with John Parish, and generally accepted as a viable option by Conservation Halton and the Town.
- Removal of stormwater management ponds (SWMP) from the meander belt plus 30 m setback area.

3. **MNR to provide Redside Dace (RSD) Habitat Classification**

J. Devlin summarized the RSD habitat classification, which included:

- Occupied Habitat – 14W-12 and 14W-16
- Contributing Habitat – 14W-14, 14W-11A, 14W-13, 14W-14A, 14W-12A

It is MNR's requirement to maintain water quality of the Occupied reaches in accordance with the RSD Guidelines. The function of Contributing reaches must be maintained in accordance with the Endangered Species Act 2007 (ESA 2007) and Ontario Regulation 242/08.

14W-13

While 14W-13 was not previously identified by MNR (J. Pisapio), J. Devlin indicated that while it is altered , it has defined sections and drains a number of Provincially Significant Wetlands (PSWs)north of Highway 407, and due to the classification of RSD habitat in the ESA, it is considered as Contributing Habitat.

14W-14A (Constructed Pond)

J. Devlin noted that the monitoring suggested a small amount of groundwater inputs to the north end of the pond.

M. Cece indicated that while monitoring has suggested that the pond is receiving a very small supply of groundwater at the northern end from a recently installed shallow monitor, these inputs to the pond are not a significant source of groundwater and the pond is losing significantly larger volumes of water into the ground. Furthermore, the pond functions as a sediment sink.

M. Heaton indicated that while some disciplines may interpret as insignificant, the value of small amounts of groundwater can be significant to maintaining Redside Dace habitat in this area.

M. Heaton indicated that the pond was not off-limits to use as a SWMP, but need to demonstrate an overall net benefit to RSD. He stated that although the base flow at the northern end may be very small, it is a function that requires replication.

14W-12A

J. Devlin suggested that the minor amount of groundwater may be contributing to the base flow and thermal regime of this reach (cold water temperatures recorded from May to June).

M. Cece and A. Kulin indicated that this is an intermittent reach and that the contributions are insufficient to maintain base flow and the thermal regime.

J. Devlin indicated that MNR deems the seasonal contributions as supporting RSD habitat.

Stream Road Crossings

MNR expressed concern with respect to the number of stream crossings affecting RSD habitat.

R. Roth provided an overview of the road alignments in relation to the approved North Oakville West Secondary Plan (OPA 289, 2009) that were based on the NOCSS (2006). R. Roth further noted that the road alignments have been shifted to minimize the extent of crossings specifically in Redside Dace habitat as identified in the NOCSS, while maintaining the general road pattern identified in the Secondary Plan and supported by the Town's transportation analysis.

MNR indicated they do not support the road network and its impacts to significant habitat of endangered species, given the multiple crossings that are proposed over Regulated Habitat (14W-16 and 14W-11). MNR guidelines recommend an average of one stream crossing per kilometer. It was further discussed that although the MNR may have reviewed the Secondary Plan, their review was limited to the Natural Heritage System and not the identification of the road network within the secondary plan. As a result, the MNR feels that the impacts on significant habitat were not sufficiently considered.

M.Heaton suggested a meeting with the Town to discuss matters related to the road network. **ALL/TOWN**

4. MMM Group to outline storm water quality/quantity discharge to RSD Occupied Habitat

MNR expressed support for the use of infiltration trenches, wetland features near the top of the proposed SWMP and bottom draw SWMP's. MMM indicated that the infiltration trench/wetland feature at the north end of the SWMP is no longer viable as the Town does not support a pumping solution to maintain flows to Reach 14W-12A, as a result, the concept plan has been modified to utilize roof discharges to augment flows to 14W-12A.

MNR also indicated that any infrastructure associated with SWM, including SWM pond and associated berms, should be located outside of habitat regulated for RSD. A permit under ESA 2007 would be required for damage or destruction of regulated habitat. MMM indicated that the plan has been revised to remove SWMPs from the Regulated Habitat.

S. VanHaren provided a summary of the SWMP designs relative to RSD habitat:

The stormwater management strategy meets all current guidelines for stormwater management facilities in the 2003 Ministry of Environment Stormwater Planning and Design Manual (SWMPDM), and incorporates most of the preferred categories for wet ponds. All SWM facilities have been relocated outside the limits of the RSD Protected Habitat, including the relevant buffers. The preliminary designs for all the facilities incorporate specific measures to accommodate discharge to RSD habitat including bottom draw outlets (for thermal mitigation), rock lined cooling trenches, longer length to width ratios (inside the pond via finger berms to be provided at the detailed design stage) and centralized facilities that provide enhanced treatment through prolonged hydraulic residence times. All facilities are designed to treat runoff to an "Enhanced" level, as defined by the MOE to provide clear surface water important to maintaining habitat for sight feeding fish species (bass, northern pike, lake trout, brook trout).

M. Heaton indicated that the *Draft Guidance for Development in RSD Protected Habitat* recommends that 10mm of precipitation should be contained in the tributary subcatchments to avoid excess erosion in receiving watercourses.

S. Van Haren discussed the specific erosion threshold analyses that are being implemented under policies presented in the NOCSS as part of the Terms of Reference for the EIR/FSS. The intent of the exercise is to match existing erosion indices (a measure of excess stream power under simulated annual precipitation patterns that result in erosion potential) under developed conditions within subwatershed recommended tolerances.

In terms of water quality, the draft guidance document provides a water quality target of 25 mg/l Total Suspended Solids (TSS) over background levels in the receiving streams, which is a challenge to design for, and relies on extrapolation from similar studies (such as the TRCA SWAMP program) based on monitoring. Definitive proof of this level of performance will only be possible through post-construction monitoring, for which recommendations are being presented in the revised EIR/FSS.

M. Heaton indicated a trend to provide deeper SWMP depths of 3.0m, of which the MOE is supportive, with a bottom draw of 0.3m off the bottom. A maximum discharge temperature target of 24 degrees Celsius is required (which typically occurs at pond depths of 1.5m and below). S. VanHaren indicated that this depth was the maximum recommended depth in the SWMPDM and typically the maximum is not recommended during this stage of a project as it does not provide flexibility during detail design and/or construction if changes are required that exceed the designed depth or necessitate a larger SWMP block.

MNR suggested that mitigation techniques should include floodplain wetlands when redesigning the relocated contributing habitat channels, roof top runoff to wetlands/bioswales, and other LID SWM techniques as recommended in the Draft Guidance for Development Activities.

5. MMM Group to outline water balance and description of recommended Low Impact Development (LID) measures

MNR indicated they would like to see water balance closer to zero as opposed to 29%, and would like to see opportunities through the use of LID's. MNR concerned with projected +300% increase in surface water entering Redside Dace occupied reach.

A. Kulin provided an overview of the challenges with respect to maintaining the water balance and improving infiltration. He gave a brief summary of the existing site condition, which is a site covered with clay-rich Halton Till, overlying shale bedrock. Infiltration in the present condition ranges between 65 to 70 mm/year which is low, and most of this water flows laterally in the shallow weathered and fractured zone towards the watercourses, and results in seasonal base flow to the streams. The hydraulic conductivity of the undisturbed/unweathered Till at depth is on the order of 3 cm/year (approximately the width of two fingers, and a very poor soil in which to attempt infiltration measures), whereas in the surficial soils, fracturing results in secondary hydraulic conductivity estimated on the order of 30 to 300 m/year (roughly the same length as the average width to the total length of the central farm pond), with such flows constrained within the fractures themselves. By comparison, hydraulic conductivities of sandy soils, which would be ideal for infiltration based measures, are on the order of 300 to 30 km/year (for context, Hamilton is located about 20 km from the site).

The approximately 2 km of proposed infiltration trenches back onto the natural heritage areas, which are proposed to be left untouched leaving the fracturing intact, and thereby resulting in the best opportunity to put water back into the ground. Siting the infiltration devices along the edges of the lots alongside the watercourse features will also help to ensure that all this water gets directed towards the features where it will do the most good, rather than possibly be intercepted by underground servicing trenches and redirected elsewhere.

And while some lot level LIDs may be incorporated at the detailed site design level, it was pointed out that the exposed soils in the interior of the developed lands will either be comprised of unweathered Halton Till (on order of 3 cm/year hydraulic conductivity) or engineered fill comprised of reworked Till, and which would have a similar hydraulic conductivity. Thus, the implication being that such soils will not pass water very quickly at all into the ground, and that incorporation of certain infiltration based LID measures will lead to failures (see below). The on-site soils in their natural state are not capable to meet the MNR's suggested 5 to 15 mm rainfall retention and in the post-development situation, given the above reasoning, even less so.

M. Cece indicated that the LID measures to address post-development water balance, specifically the infiltration trenches, was identified as a suitable best management practice at this level of study in the planning process. This was not the case for other options as other items would be developed at later stages of the project (i.e. detail design). As a result the EIR/FSS could recommend various LID strategies for consideration during detail design. R. Roth indicated that there was no practical mechanism to commit to additional lot level LIDs at this stage at this stage in the planning process, but would be a further consideration during Site Plan approval and detail design. **ALL/TOWN**

The MNR indicated that they would like to meet with the Town to discuss the commitment to LIDs at this stage in the planning process.

M. Cece indicated that the NOCSS had recognized that the soil conditions in North Oakville limit the ability for the water balance be a net zero in a post-development scenario. A. Kulin indicated that site investigations have not identified any areas with soil conditions that provide any enhanced opportunities for mitigation and effective implementation of many LIDs. MNR recognized the difficulties in matching pre-post infiltration given the tight soils, and suggested some documents for consideration (TRCA LID Guidelines, CVC field studies (storage under parking areas), and the TRCA STEP program (Glen McMillan). **MMM would appreciate the assistance from MNR in identifying and help (if needed) in obtaining copies of the relevant papers that they have reviewed that document successful application of infiltration based LID measures under similar settings**. Should the aforementioned papers provide enough technical details to evaluate and compare the site conditions and sizing of the LID measures to the current site, MMM will examine this information to determine whether it is applicable to the soil conditions at the site and incorporate this into the water balance calculations. **MNR**

MNR recommended infiltration techniques should accommodate a 5-15mm event, and efforts to achieve this target through LID and lot-level controls should be considered. S. Van Haren discussed our current investigations into LID measures. The tight clay soils on the site at the depths of infiltration based LID measures will create stagnant underground pools of water which will lead to odour and settlement issues in the developed areas. The site soils possess native hydraulic conductivities that will not allow for functional LID based infiltration measures. Therefore, attempts to mitigate post-development infiltration losses with LID measures will shift excess runoff volumes toward evapotranspiration. Mitigation of the loss of infiltration with infiltration based LID measures is not feasible given the site characteristics.

6. MMM Group to outline watercourse corridor widths

M. Cece indicated that the development plan included meanderbelt plus 30m setbacks applied to Reaches 14W-12 and 14W-16 as they are considered RSD Occupied Habitat.

Reach 14W-14 is designated Contributing Habitat. A wider corridor than required in the NOCSS document was proposed for realignment and redesign of this reach in the 2nd EIR/FSS submission as the development plan was in a perceived drainage density deficit based on Conservation Halton interpretation and the increased width and channel enhancements were proposed to address the deficit. This approach was not considered acceptable to Conservation Halton. Once the drainage density deficit was addressed with the a 'dual channel' approach (put forth by Parish Geomorphic at a meeting on November 14, 2013)" approach, the corridor width was revised to reflect the NOCSS corridor widths of meanderbelt plus 15m to replicate the channel RSD Contributing Habitat functions from the realigned Reach 14W-14.

M. Heaton indicated that the conversion of the realigned Reach 14W-14 (Reach 14W-22) that is currently functioning as RSD Contributing Habitat to Occupied Habitat through design (refuge habitat, meander belt + 30 m corridor, sediment transfer) has the potential to result in an overall benefit to address other impacts to RSD habitat (i.e. road crossings). M. Cece indicated that the proposed enhancements to RSD habitat identified by the project team included removal of existing crossings with the restoration of channel in their place as well as improve the habitat at the Dundas Street culvert inlet that currently consists of a channel with concrete banks.

S. VanHaren provided an overview and illustration of the dual channel option for discussion.

M. Heaton indicated that MNR is not supportive of the current dual channel option proposed for realigning 14W-16where the realigned channel infringes on the meanderbelt +30m setback requirement. Furthermore, realignments to Occupied Habitat are not supported, in order to minimize the impact and maximize avoidance. **MMM to review revisions to the dual channel option.** **MMM**

There was some discussion as to the status of the wetland in Reach 14W-16. M. Cece indicated that correspondence from Conservation Halton was received that indicated that following MNR consultation, this feature was not considered a PSW. **J. Devlin to review the wetland evaluation and confirm the status of this wetland.** S. VanHaren noted some further discrepancies in the watercourse mapping. **J. Devlin**

7. Species at Risk Discussion

S. Jefferis provided an overview of requirements with respect to additional species at risk.

Barn Swallow:

Removal of habitat (existing barn) under new registry requires replacement habitat structures which could occur in the natural corridors.

S. Jefferis indicated that foraging habitat is likely sufficient in the post-development scenario within the natural corridors, and a permit likely not required.

M. Cece requested a letter of advice from MNR to confirm that foraging habitat replacement would not be required. **S. Jefferis to advise.** **S. Jefferis**

M. Cece noted that surveys were not conducted in the barn, but would be required for the registry. Anticipate that this survey could occur this season.

Eastern Meadowlark:

It was discussed that Eastern Meadowlark has not been identified on site.

Bobolink:

Bobolink sightings were reported in 2004/2005. M. Cece indicated that based on the approved MNR transect survey methodology, no bobolink were identified on the site in 2013. MNR indicated that past records (pre-dating the transect methodology) would need to be considered. If bobolink were observed within the past 5-10 years, then development would result in their permanent removal.

M. Reel expressed concern as to how the species is quantified as the population moves around the broader landscape, as influenced by the types of crops, and the abundance of farming in the area. M. Heaton explained the rationale and approach for identifying the extent of habitat.

MNR to undertake a process to review aerial imagery to assist in determining bobolink habitat extent. MNR to identify required review/permitting mechanisms associated with the areas of effect, however, MNR indicated that a 1:1 ratio of replacement (i.e. privately held lands enhanced to provide suitable bobolink habitat, agreements with Conservation Authorities habitat creation, etc.) could be used to potentially address habitat impacts, if required. **S. Jefferis**

Bats:

Little Brown Myotis and Northern Myotis were flagged, but have not been identified on-site. MNR provided accepted protocols for survey to M. Cece. M. Cece indicated that the site would be screened for potential habitat prior to instituting other survey methods as there may be limited (if any) potential present.

Other:

No other bird species at risk were identified.

8. Next Steps

No further formal comments are anticipated from MNR, prior to EIR/FSS 3rd submission which is anticipated shortly.

Minutes of meeting to be circulated for review and comment, and are intended to express MNR's comments on the EIR/FSS 2nd Submission and development plan at this time.

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Lorraine Adderley

From:	Mark Cece
Sent:	November-10-14 4:04 PM
To:	Lorraine Adderley
Subject:	FW: Bentall Kennedy (Lazy Pat) - North Oakville Meeting - Draft Meeting Minutes
Attachments:	Lazy Pat wetlands 2006.jpg; Lazy Pat PSWs current.jpg

No PSW email from MNR with attachments.

From: Heaton, Mark (MNR) [mailto:mark.heaton@ontario.ca]
Sent: Wednesday, July 23, 2014 2:45 PM
To: Randall Roth
Cc: Funnell, Emily (MNR); Devlin, Jane (MNR); Jefferis, Samantha (MNR); 'Thun, Robert'; pbond@hrca.on.ca; Mark Cece
Subject: RE: Bentall Kennedy (Lazy Pat) - North Oakville Meeting - Draft Meeting Minutes

Hello Randall,

We have checked the wetland mapping for North Oakville. Two images attached:

- Lazy Pat wetlands 2006 – depicts the wetlands that were identified and evaluated including sub-units 2, 3, 4 and 5
- Lazy Pat PSWs current – depicts the wetlands that are part of the approved PSW

Previous units 2, 3, 4 and 5 are not included in the PSW. However, the identified wetlands are considered part of the regulated habitat for Redside Dace as per Ontario Regulation 242/08 29.1 1 (v)

Regards,

Mark Heaton
Fish and Wildlife Biologist
OMNRF Aurora District

-----Original Message-----
From: Randall Roth [mailto:RothR@mmm.ca]
Sent: July 4, 2014 8:14 AM
To: Heaton, Mark (MNR)
Cc: Chris Tyrrell; Steve VanHaren; Reel, Mike; Andrew Kulin; Asif Quader; Funnell, Emily (MNR); Devlin, Jane (MNR); Jefferis, Samantha (MNR); 'Thun, Robert'; pbond@hrca.on.ca; Mark Cece
Subject: RE: Bentall Kennedy (Lazy Pat) - North Oakville Meeting - Draft Meeting Minutes

Hi Mark,

Thanks for your comments, please find attached the finalized meeting minutes for your files.
As discussed at the meeting, and highlighted in the covering letter, we are still awaiting receipt of the outstanding SAR information to be provided by MNR. Please advise when we can expect to receive this information.

Thanks,

Randall Roth, MCIP, RPP
Senior Planner/Project Manager, Associate Planning & Environmental Design MMM Group Limited

-----Original Message-----
From: Heaton, Mark (MNR) [mailto:mark.heaton@ontario.ca]
Sent: June-18-14 8:17 AM
To: Mark Cece
Cc: Chris Tyrrell; Randall Roth; Steve VanHaren; Reel, Mike; Andrew Kulin; Asif Quader; Funnell, Emily (MNR); Devlin, Jane (MNR); Jefferis, Samantha (MNR)
Subject: RE: Bentall Kennedy (Lazy Pat) - North Oakville Meeting - Draft Meeting Minutes

Hello Mark,

The minutes need to be cleaned up a bit - last three pages are unnecessary. Where text has been stricken out - remove it entirely.

MNR met with the Town of Oakville this past Monday and discussed the proposed road network for North Oakville West. The Town will be organizing a meeting of interested parties to discuss road crossings for Endangered Species Act regulated stream corridors. The meeting will also cover stream relocations and stormwater management.

MNR "agreement in principle" in the number of stream crossings, stream relocations and stormwater management is required given that ESA approval will be required in the future.

Regards

Mark Heaton
Fish and Wildlife Biologist
OMNR Aurora District
(905) 713 7406 office
(416) 993 1295 mobile

____
From: Mark Cece [CeceM@mmm.ca]
Sent: Tuesday, April 29, 2014 9:59 AM
To: Heaton, Mark (MNR)
Cc: Chris Tyrrell; Randall Roth; Steve VanHaren; Reel, Mike; Andrew Kulin; Asif Quader; Funnell, Emily (MNR); Devlin, Jane (MNR); Jefferis, Samantha (MNR)
Subject: Bentall Kennedy (Lazy Pat) - North Oakville Meeting - Draft Meeting Minutes

Mark

Please find attached the revised meeting minutes from our February 26, 2014 meeting related to the Lazy Pat Lands in North Oakville. You will note that many of your comments have been incorporated into the minutes. We ask that you please review this revised document that includes some additional revisions/comments made by our team in order that we can finalize. Thank you and as always please advise if you have any question or would like to discuss any of this information further.

____

Mark Cece, B.Sc.
Ecology Manager/Senior Fisheries Biologist Associate Partner Ecology Department MMM Group
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www.mmm.ca<http://www.mmm.ca>

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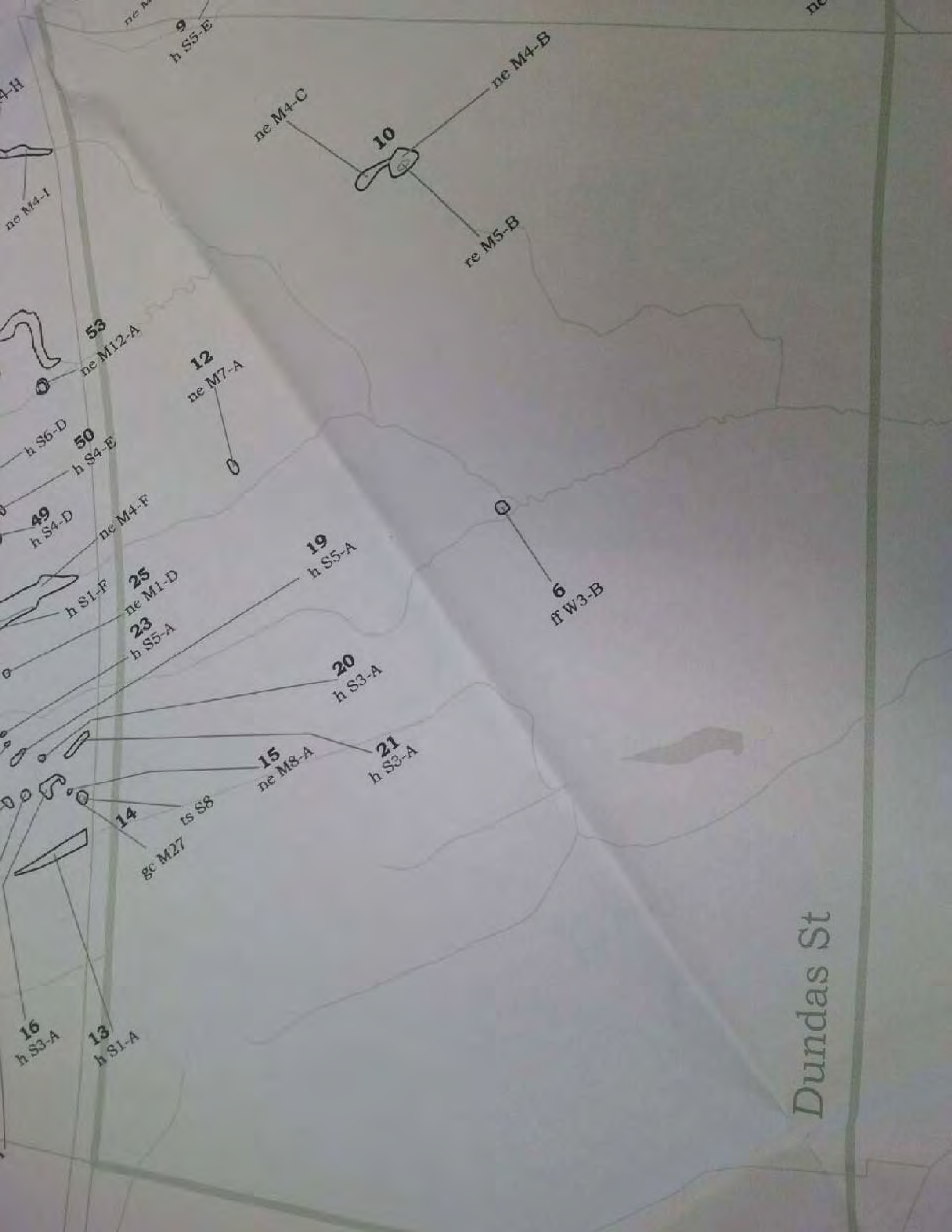
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Appendix 5.9 – Technical Memorandum NH#1 – Reach 14W-14A Aquatic Habitat

MMM GROUP

TECHNICAL MEMORANDUM NH#1 - REACH 14W-14A AQUATIC HABITAT

Job No.: 14.09222.001

Date: March 28, 2012

Author: Mark Cece, B.Sc. – Ecology Department Manager/Senior Fisheries Biologist

1 Introduction

As you are aware MMM Group has been retained by Bentall Kennedy (Canada) LP - Lazy Pat Farms (hereinafter referred to as Lazy Pat lands) to undertake an assessment of the natural environmental features in support of the proposed commercial land development. The results of field investigations and monitoring were documented in the Environmental Impact Report/Functional Servicing Study (March 2011) and submitted to the Town of Oakville (Town) and Conservation Halton (CH) for review. The Town and CH provided comments in an August 5, 2011 e-mail and a subsequent September 6, 2011 correspondence. The majority of the comments are addressed in a response table that has been prepared and submitted under a separate cover. Due to the nature of data collected and the corresponding analysis, the response table format was not considered a suitable format to present detailed information and as a result (this) Memorandum NH#1 – Reach 14W-14A Aquatic Habitat has been prepared and referred to in the response table. This memorandum focuses principally upon information requests associated with Reach 14W-14A also referred to as the "farm pond" and should also be considered an addendum to the EIR/FSS submitted to CH and the Town.

This memorandum details the additional fieldwork undertaken to address undertaken between June and October 2011 and the analysis of the data. Specifically the following information is addressed:

1.1 Fish Community Survey

CH has recommended that at least 2 or 3 gear types be used to sample fish species in the pond based on the rationale that different fish species will utilize different habitats in the pond (i.e. shallow water vs. deep water, shaded water versus open water and the availability of cover).

1.2 Fish Community Classification

CH has indicated that they consider the pond to have a self-sustaining coolwater fish population.

1.3 Supplemental Fish Habitat Documentation

CH has requested supplemental fish habitat surveys to identify habitat features supporting critical life stages, bathymetric surveys and aquatic vegetation surveys.

1.4 Water Temperature Data

CH requested the installation three continuously recording temperature data loggers in the deepest area of the pond at depths of 33%, 66% and near the bottom. In addition to temperature monitoring, sampling for dissolved oxygen and water clarity measurements at these depths should be undertaken.

1.5 Thermal Impacts of Proposed Conversion of Farm Pond to a SWMP

CH has suggested that the conversion of the farm pond to a SWMP will result in an increase to the thermal warming impacts and will cause a less stable thermal regime.

1.6 Phytoplankton/Zooplankton Production

HC has indicated that the pond contributes self-sustaining phytoplankton and zooplankton to downstream watercourses during periods of high flow.

1.7 Sediment Source

HC has indicated that the pond provides a source of sediment to downstream watercourses as a provision for bedload, an important resource to maintain erosion in a state of dynamic equilibrium.

1.8 Organic Material Source

HC has indicated that the pond is a source of organic material in the form of leaves, twigs, etc. to downstream watercourse for downstream watercourses that helps provide a base of the food chain.

1.9 Headwater Wetland Function

HC indicated that the pond can be considered a headwater wetland that provides many functions which are beneficial from a fish community, water quality, water quantity, wildlife habitat and flood regulation standpoint.

1.10 Pond providing Pelagic and Littoral Habitat

CH has indicated that the pond provides pelagic and littoral zone habitat that is adjacent to open water areas; both of which are limited to in the North Oakville area.

2 Existing Conditions

As described in Section 5.3.4.4 (p. 5-26) of the EIR, the farm pond was constructed between 1954 and 1960 as a component of the agricultural operation (likely irrigation) and functions as a by-pass pond with a single inlet/outlet and has an intermittent connection to the receiving watercourse (Reach 14W-12). The source of water for the pond consists of surface water contributions, specifically flow from Reaches 14W-14, 14W-13 and perhaps backflow from 14W-12. Water is stored in the farm pond stores the water until such time as the water level reaches a certain elevation then the pond discharges into Reach 14W-12. Thus the farm pond's connection to Reach 14W-12 is related to the surface water level.

An examination of the groundwater conditions potentially influencing the farm pond were also examined and based on hydrogeological investigations undertaken in support of the development plan, the farm pond is losing water into the ground. As a result the farm pond does not appear to be receiving sufficient groundwater inputs that would moderate thermal impacts and provide a stable thermal regime or maintain a consistent water depth. This assessment is supported by the water temperature data presented in the following sections.

Due to the inlet/outlet feature as well as the minimal groundwater interactions, water discharging from the farm pond will consist of the surface water that during the summer is at its warmest. This water is then discharged into Reach 14W-12 supporting coolwater Redside Dace habitat.

3 Results and Assessment of Additional Data

The following sections respond to the HC comments related to the farm pond (Reach 14W-14A), specifically the request for additional information and their suspected functions of this feature that were outlined in the August 3, 2011 email as well as the September 6, 2011 correspondence. .

3.1 Fish Community Survey

As was identified in the EIR, fish community sampling had been undertaken in 2002 by MMM Group (formerly Marshal Macklin Monaghan Ltd) using minnow traps to obtain baseline fish community data. Fish community sampling was also undertaken in 2002 by Natural Resource Solutions Incorporated (NRSI), a member of the consulting team preparing the NOCSS, using a backpack electroshocking unit. MMM Group replicated these sampling methods in the pond in 2009 to document up to date data in support of the preparation of the EIR. Both of these sampling events used two sampling methods thus meeting the recommended 2-3 methods identified in the HC August 3, 2011 email.

The EIR summarized the fish community data collected in 2002 and 2009 that indicated a fish community made up largely of tolerant fish species. The one exception was the presence of Largemouth Bass that we presume is stocked considering the absence of naturally occurring suitable habitat in the area as well as the artificial nature of the pond that are often stocked by landowners. This data is summarized in Table 1.

Table 1: Summary of Fish Community Sampling (14W-14A, MESP 2003, MMM, 2003 & MMM, 2009)

Common Name	Scientific Name	Number of Individuals
Brook Stickleback	*Culaea inconstans*	2
Brown Bullhead	*Ictalurus nebulosus*	1
Creek Chub	*Semotilus atromaculatus*	*37*
Largemouth Bass	*Micropterus salmoides*	*3*
White Sucker	*Catostomus commersoni*	*7*

In response to the August 3, 2011 CH email, an additional round of sampling was undertaken in 2011. A Licence to Collect for Scientific Purposes (Licence no 1064904) was obtained from the MNR on (September 26, 2011) to undertake the 2011 fish community sampling. Fish community sampling efforts in 2011 involved the use of minnow traps and pot traps set throughout the pond at various locations and water depths to collect fish that are anticipated to use the different habitats within the pond. The nine (9) traps were set between 0915 and1206 hrs on October 6, 2011, for a period of 24 hours (Table 2). It has been our experience (throughout the province) that the use of pot traps in combination with minnow traps have resulted in the capture of a wide range of species including Centrarchidae, Cyprinidae, Gadidae, Percidae, Esocidae and Umbridae various age classes (young-of-the-year, juvenile and adult).

Table 2: Summary 2011 Sampling Methodology/Gear Types

Equipment Type	UTM Coordinate
Pot Trap	17 T 598200 4809169
Minnow Trap	17 T 598203 4809161
Pot Trap	17 T 598195 4809148
Minnow Trap	17 T 598148 4809160
Pot Trap	17 T 598155 4809155
Minnow Trap	17 T 598168 4809209
Minnow Trap	17 T 598076 4809221
Minnow Trap	17 T 598033 4809233
Minnow Trap	17 T 598031 4809218
Minnow Trap	17 T 598067 4809189

The fish community captured in 2011 is similar to the fish captured in previous sampling events and did not revise the previous understanding of the pond as supporting a warmwater community with coolwater tolerant species. Due to the habitat present in the pond, poor connectivity to downstream habitat as well as the thermal regime a more diverse community is unlikely to be supported by the pond. Table 3 summarizes the results of fish community sampling in 2011. These species are consistent with previous sampling efforts in the pond for species composition with the addition of another warmwater species, Pumpkinseed.

Table 3: Summary of Fish Community Sampling (14W-14A, 2011)

Common Name	Scientific Name	Number of Individuals
Brown Bullhead	*Ameiurus nebulosus*	7
Creek Chub	*Semotilus atromaculatus*	7
Largemouth Bass	*Micropterus salmoides*	1
Pumpkinseed (adult & YoY)	*Lepomis gibbosus*	81

As a result the fish community of the farm pond has been surveyed on the following occasions and the approximate locations identified on Figure 1:

- 2002 MMM Group – Minnow Trap (approx. 24 hr set) to obtain background data for site;
- 2002 NRSI – Backpack Electroshocking along the shoreline in support of NOCSS;
- 2009 MMM Group – Minnow Trap (approx. 24 hr set) in support of the EIR;
- 2009 MMM Group – Backpack Electroshocking along the shoreline in support of the EIR
- 2011 MMM Group – Minnow Trap to supplement existing data at request of HC
- 2011 MMM Group – Pot Trap to supplement existing data at request of HC

It is our opinion that the use of 3 sampling gear types as well as two sampling events in each year (2002, 2009 and 2011) at times by two separate parties should be sufficient to characterize the fish community present in this farm pond. Given the effort, cost and the type of habitat present the use of alternative sampling methods suggested by HC including a boat electroshocker are not warranted as it is unlikely that the fish community would differ from that observed during previous sampling of this farm pond.

As requested by CH we have also calculated the catch per unit effort (CPUE) for the sampling events, excluding NRSI data as it is unavailable.

Minnow/Pot Trap

Average fishing time (unit of effort) for the 10 minnow and pot traps set in 2011 is 26 hours for an approximate total fishing time of (10 traps x 26 hrs) 260 total trap hours. The total number of fish captured is 103. Resulting in a catch per unit of effort (CPUE):

CPUE = [# fish / # Total Trap Hours]

= [103 Fish / 260 Total Trap Hours]

= 0.396 Fish / Total Trap Hours

Electrofishing

For the electroshocking we captured 6 fish during 368 shocking seconds within an area sample of approximate 320 m^2.

CPUE = [# fish / Sampling Effort]

= [6 Fish / (320 m^2/ 368 second)]

= [6 Fish / 0.87 m^2/s]

= 6.89 Fish / (m^2/s)

3.2 Fish Community Classification

The species captured as well as their thermal classification (based on thermal preference) is identified in Table 4. The three coolwater species identified in the table have a preference within the coolwater thermal regime; however, they also have a tolerance for warmwater habitat and are commonly found within warmwater habitats. These three species including White Sucker, Creek Chub and Brook Stickleback have a thermal range of 0ºC to 31.2ºC, 1.7ºC to 32.5ºC and 0ºC – 30.6ºC respectively. When examining the warmwater species thermal preferences and ranges of tolerance it would appear that the habitat present is well suited to their thermal requirements.

As a result of the thermal tolerances of the coolwater species and the water temperature data presented in the following sections, it would appear that the classification of this community as a warmwater is more appropriate. This is supported by NOCSS Characterization Report (p.4W-118) that states *"There is a manmade online pond (14W-14A) located in the vicinity of Dundas Street. Shoreline habitat of this pond consists of cattails, stumps and woody debris. Underwater habitat throughout the pond is unknown. Substrate consists of silt and muck. This pond supports a* ***warmwater baitfish and sportfish community*** *(LGL 1999, NRSI 2005). The presence of sportfish indicates that the pond is productive as largemouth bass are the top level predator species requiring a substantive forage base."*

Table 4: THERMAL AND VELOCITY TOLERANCES FOR FISH SPECIES KNOWN TO OCCUR WITHIN THE ZONE OF INFLUENCE*

Fish Species		Live Stage							
Common Name	Scientific Name	Spawning	Egg/Embryo	Larvae/Fry	Juvenile	Adult	Mortality (Adult): Acclimation Temperature	Mortality (Adult): Upper Incipient Lethal Temperature	Preferred Temperature (Table 3, Chu et. al., 2009)
Brook Stickleback	*Culea inconstans*	May – June at 8ºC - 19ºC	Hatch: 8 – 10 days at 16ºC - 17ºC 9 – 11 days at 17ºC - 18ºC Optimum hatching temp.: 18.3ºC max for embryo survival: 21ºC			Thermal range: 0ºC – 30.6ºC	25ºC - 26ºC	30.6ºC	21.3 ºC
Creek Chub	*Semotilus atromaculatus*	April – July Spawning triggered at: 12.8ºC Range: 12.8ºC – 26.7ºC	Hatch in 10 days at 13ºC Temperature range for hatching: 15ºC - 20ºC Optimal temperature range for embryo: 14ºC - 20ºC in spring		Optimal growth range: 12ºC - 24ºC, preferred for growth: 21ºC	Thermal range: 1.7ºC – 32.5ºC	5ºC 10ºC 15ºC 25ºC	24.7ºC 27.3ºC 29.3ºC (lower 0.7ºC) 30.3ºC (lower 4.5ºC)	20.8 ºC
Largemouth Bass	*Micropterus salmoides*	May – June Spawning occurs at: 17ºC - 22ºC	Hatch: 13ºC - 26ºC, optimal: 20ºC - 21ºC low survival >30ºC and <10ºC Upper lethal limits: Acclimated to 20ºC is 36.7ºC Acclimated to 28ºC is 40.1ºC	Larvae: Thermal range: 20ºC - 30ºC Preferred: 27ºC Fry: Thermal range: 17.5ºC – 27.5ºC Preferred: 27ºC Critical limit: >36ºC	Thermal range: 23ºC - 31ºC Preferred: 30ºC Optimal growth: 24ºC - 30ºC Little growth <15ºC	Thermal range: 10ºC - 38ºC Preferred temp.: 30.3ºC	20ºC 25ºC 30ºC	32.5ºC (lower 5.5ºC) 34.5ºC (lower 7ºC) 36.4ºC (lower 11.8ºC)	30.2 ºC
Pumpkinseed	*Lepomis gibbosus*	May – August Spawning occurs at: 20ºC - 28ºC At 11ºC - 13ºC spawning ceases	Hatch: 19ºC - 28ºC, optimum temperature: 28ºC		Thermal range: 24.2ºC - 32ºC Preferred: 30ºC Lower lethal temp.: 2.1ºC when acclimated to 12ºC in summer.	Thermal range: 4.5ºC - 38ºC Preferred: 26ºC Signs of stress begin at 31ºC - 38ºC and < 4.5ºC	5ºC 10ºC 12ºC 20ºC 28ºC 30ºC 32ºC 34ºC	(lower 1.1ºC) (lower 1.2ºC) 28.5ºC (lower 3.6ºC) 31.6ºC (lower 6.4ºC) 31.9ºC (11.3ºC) 34.8ºC (lower 13.4ºC) 33.5ºC 37ºC (lower 16.1ºC)	26 ºC
White Sucker	*Catostomus commersonii*	April – June Spawning migration triggered: 10ºC - 18ºC Spawning occurs: 7ºC - 10ºC	Hatch: 13.9ºC - 20ºC, prefer 11ºC - 16ºC upper lethal temp.: 24ºC lower lethal temp.: 6ºC	Thermal range: 13ºC - 25ºC, preferred 27ºC Upper lethal: 32ºC	Upper lethal temp. 26ºC - 31ºC, lower lethal temp. 21ºC - 6ºC	Thermal range: 0ºC – 31.2ºC Preferred temp.: 22.4ºC	5ºC 10ºC 15ºC 20ºC 25ºC	26.3ºC 27.7ºC 29.3ºC 29.3ºC (lower 2.5ºC) 28.3ºC (lower 6.6ºC)	22.4 ºC
Brown Bullhead	*Ameiurus nebulosus*	May – June Temperature reaches 21.1 ºC	Hatch: 20.6 ºC to 23.3 ºC			Upper Tolerance Temperature: 36.1 ºC	6 ºC 36 ºC	28.6 ºC 37.5 ºC	26 ºC

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3.3 Supplemental Fish Habitat Documentation

The pond to date has not been actively managed by the landowner as anything but a farm pond and in that time the absence of management for its intended function as agricultural function has allowed it to naturalize. HC has requested additional information including the preparation of a bathymetric survey, critical habitat assessment in addition to this request sediment sampling and an attempt to visually assess habitat in the deeper portions of the pond was undertaken. Aquatic habitat was visually assessed from the shoreline and wadeable depths to document near shore habitat as well as aquatic vegetation. Deeper water areas were assessed during field investigations in 2011 from a canoe including the attempted use of an underwater camera. This vantage point allowed staff to view submerged vegetation in the shallow, non-wadeable areas of the pond and to easily document the riparian community along the waterline.

Bathymetric Survey

The bathymetry of the pond is illustrated in Figure 1. The pond is generally shallowest at the northwest end of the pond, with depth increasing fairly uniformly toward the southeast end of the pond. The slope of the pond bottom varies, with some areas having a greater slope than other areas. The most prominent slope occurs along the southeastern end of the pond, parallel to the laneway.

Aquatic Vegetation

The aquatic vegetation associated with the farm pond consists of emergent vegetation, submerged and floating vegetation. Algal growth occurs throughout the pond primarily at the northwest end and along the perimeter of the pond, which consists of dense mats of algae. Similar algae mats were observed in Stream Reaches 14W-16 and 14W-12 over the course of 2009 and 2011 field investigations on the Lazy Pat lands. A detailed species list associated with the pond is presented in the EIR. In addition to the vegetation identified in the EIR, supplemental vegetation investigations were undertaken in 2011 and resulted in the identification of two additional species including:

- Stalk-grain Sedge (Carex stipata)
- Common Hornwort (Ceratophyllum demersum)

Fish Habitat Structure and Function

As previously mentioned the aquatic habitat in the shallower areas of the pond was assessed from the shore as well as wadeable water depths with deeper areas examined from a canoe examining the surface as well as attempting to examine the deeper water areas with an underwater camera. Generally the dense aquatic vegetation appears to provide the greatest amount of cover and habitat for the fish present. Woody debris is scattered along the shoreline in limited quantities owing to the absence of woody vegetation surrounding the pond. Observations of the deeper water area with the underwater camera were unclear owning to the limited clarity in the pond however, there were scattered areas of submerged vegetation stems observed during the examination. It is anticipated that the cover/structure habitat within the deeper water area is limited due to the constructed nature of this feature, its function as a farm pond (fish habitat structured unlikely to have been installed) and the absence of woody debris and/or coarse substrate that would improve habitat complexity. As a result it appears that the main cover habitat within the pond consists of the aquatic vegetation along the fringe of the pond.

The substrate of the pond was also observed using a combination of visual assessments during field investigations as well as using an Ekman Dredge from the canoe. Generally with the exception of the boulders and concrete debris along the laneway, the substrate throughout the pond is dominated by silt and muck which is consistent with observations made in NOCSS.

Fish Habitat Structure and Function

The pond presumably provides suitable specialized habitat for the species present (i.e. spawning habitat, nursery habitat, etc.) however, considering the generalized nature of the species present their requirements are often limited to spawning habitat.

Specialized spawning habitat associated with the Largemouth Bass and Pumpkinseed is likely located in the shallower habitat in the vicinity of the inlet/outlet as well as the gently sloping pond bed in this northern portion of the pond. As the depths increase towards the laneway, the habitat in this area is less likely to provide this type of suitable specialized habitat. The combination of dense aquatic vegetation surrounding the pond shores (for Largemouth Bass) as well as adjacent open water habitat (for Pumpkinseed) would be suitable to fulfill the majority of the habitat needs for these species as it provides cover and forage habitat. It is anticipated that the deeper area within the pond at the south end provides overwintering habitat for this and the other species present.

Extensive spawning habitat is available for Brown Bullhead that requires muddy substrates in close proximity to woody debris/aquatic vegetation and flooded vegetation. The pond provides suitable habitat for this species that is typically found near /on the bottom in shallow, warmwater habitats, in slow moving water (i.e. ponds, small lakes, etc) in association with dense aquatic vegetation, and sand to mud bottoms.

Brook Stickleback spawns on the stems of aquatic or flooded vegetation that are abundant in the area and the habitat in the pond provides suitable habitat for the species as they are often found in wetlands, beaver ponds and pond habitats with aquatic vegetation and are able to withstand periods of low dissolved oxygen. Given the habitat present they are well suited to the pond owing to the dense aquatic vegetation and seasonally flooded shoreline (flooded vegetation).

It would appear that the pond does not provide spawning habitat for Creek Chub as they typically will spawn in riffle habitat with gravel substrate. Creek chub are not typically found within pond habitat, they do occupy small lakes in nearshore areas. Although the farm pond is not its preferred habitat for creek chub they are a very common species and generalists in their habitat needs and as a result does not require additional specialized habitat.

Spawning habitat for White Sucker does not appear to be present in the farm pond as they tend to spawn in shallow flowing water over gravel substrate. In lake environments they will spawn over gravelly/sand shoals subject to wave action, this habitat is not present in the farm pond. White Sucker is also a tolerant species that does not demonstrate a preference for a specialized habitat type beyond spawning, and are tolerant of a wide range of water quality conditions including turbidity and low dissolved oxygen.

Riparian Habitat

Generally the vegetation community results in an open canopy with scattered trees and shrubs. Several mature trees, which include Basswood are growing at the top of the exposed bank, providing the only significant shading for the pond. The vegetation along perimeter of the southern end of the pond consists of purple loosestrife, water plantain, lance-leaved aster, queen anne's lace, cutgrass, and fox sedge. Several shrubs grow along the shoreline adjacent to the laneway amongst the cobble and concrete debris that forms the shoreline. A detailed species list associated with the pond is presented in the EIR.

Water Levels

As discussed the pond receives input from tributaries 14W-13 and 14W-14 at the north end and through surface flows from the relatively small catchment area from the adjacent table lands draining the pond. As a result, water levels can fluctuate by more than a meter during periods of heavy rains. The following pictures show the staff gauge installed at the south end of the pond at the deepest part of the pond. The photo on the left (Plate 1) was taken on (October 6, 2011 when Environment Canada recorded 0 mm of rainfall during the 24 hours prior, (26.5 mm of rain – 7 days prior). The photo on the right (Plate 2) shows the staff gauge on October 20, 2011 with when Environment Canada recorded approximately 60 mm of rainfall during the 24 hours prior (63.5 mm of rain – 7 days prior). The observation suggest that the pond is heavily influenced by the surface water contributions and that once the pond is no longer hydraulically connected to the downstream watercourse, there are no other inputs that assist in maintaining water levels. Instead the water level is decreased through evaporation.

Plate 1: Staff Gauge, October 6, 2011

Plate 2: Staff Gauge, October 20, 2011

Water Quality Monitoring

Water quality monitoring for dissolved oxygen and water clarity was recorded at the approximate location of the water temperature logger strings and at the approximate vertical position of the temperature loggers.

<u>*Dissolved Oxygen*</u>

Dissolved oxygen was sampled using (HANNA HI9146-04N Dissolved Oxygen Meter and was compared against the target of 6 mg/l identified in the OMB Mediation Item: Stormwater Management – Temperature and Dissolved Oxygen Targets. For Fourteen Mile Creek, the conservative DO target is 6 mg/l, which is the Provincial Water Quality Objective for coldwater fisheries associated with a water temperature of 20ºC. Dissolve oxygen measurements taken at the three temperature logger locations, representing the north, middle and south areas of the pond indicate that oxygen levels vary based on depth and the time of the year. As expected and likely due to surface agitation, the DO levels in the pond at the surface meet or exceeding the OMB target. As the depth increases, the DO levels continue to drop with DO levels at depths of 2.0 m or greater below the OMB target of 6 mg/l associated with recorded water temperatures between 20 and 24.3 ºC. This distribution of DO is not unexpected considering the shallow depth of the farm pond and the likelihood of mixing. The reduced DO in the deeper area is likely attributed to less mixing and bacteria activity in the sediment.

Water Clarity

Water clarity was also documented at each of the water temperature logger string locations using a Secchi Disk (Table 5). The Sechi Disk is a black and white circular plastic plate, 20 cm diameter. A measured line is attached to the center of the disk to allow the recorder to note the depth of the disk as it is lowered into the water. The depth at which the disk was no longer visible was recorded. The disk was then lowered slightly and slowly retrieved to a depth at which the disk became visible. This depth was also recorded. The Secchi Disk provides a quantitative way of identifying the level of clarity (transparency determinations) in natural waters. Water that is clear has a high transparency, resulting in a higher secchi depth reading, which indicates lower turbidity. Transparency in freshwater systems typically decreases in the summer when plankton, silt and organic matter are more likely to be prevalent. For reference, the most transparent lakes are usually seepage lakes as this characteristic greatly reduces the amount of silt bearing influents. Drainage lakes carry more silt and usually are less transparent. To minimize errors during the readings, the same observer was used, using the same method and all readings were taken between 10am and 2pm. The weather conditions on each reading were generally the same, with clear sunny skies.

Table 5: Summary of Secchi Depths for Stream Reach 14W-14A (2011)

Date	Sampling Location	Secchi Down (m)	Secchi Up (m)	Clarity Depth (m)
August 19	South Logger	0.75	0.60	0.675
	Middle Logger	0.60	0.50	0.55
	North Logger	0.60	0.60	0.60
August 24	South Logger	0.60	0.40	0.50
	Middle Logger	0.70	0.50	0.60
	North Logger	0.55	0.45	0.50
October 7	South Logger	0.55	0.45	0.50
	Middle Logger	0.54	0.52	0.53
	North Logger	0.52	0.51	0.515

Readings were taken at the approximately at the same time and were based on three separate readings. The water clarity in the pond showed little variation in water clarity throughout the pond and no marked improvement in water clarity during the sampling period. The highest reading was recorded in the deepest part of the pond at the south (0.675 m). However, the difference between the highest and lowest reading is 17.5 cm (0.175 m). This suggests that visibility within the water would range between 0.5 and 0.68 m during sunny, clear sky conditions, near the surface with light levels reaching plants at or below .68 m would be significantly reduced.

This is supported by the observation of submerged vegetation in greater density at the north end of the pond where the water was shallow. Using an underwater camera, visibility was extremely poor at the south end of the pond and although scattered stems of submerged vegetation were observed, the plants were sparse.

The lack of clarity would likely be attributed to a combination of wind action agitating the water thereby maintaining suspended sediments as well as phytoplankton.

3.4 Water Temperature

In recognition that additional water temperature data would likely be required, MMM Group initiated water temperature investigations in advance of receiving the August 5, 2011 e-mail, specifically the installation of water temperature loggers. Water temperature monitoring in the pond was initiated on July 4, 2011 and used water temperature loggers set to record data hourly. A total of nine loggers were installed, three at each string located along the length of the pond (Plate 3 and Figure 2). Each string was set up to record the water temperatures at the bottom, middle and top of the water column. The maximum depth of the bottom loggers (Logger String 1, south end) was approximately 3 m below the water surface at the time of installation (July 4, 2011). The minimum depth of the bottom loggers (Logger String 3, northern end) was 1.5 m below the water surface at the time of installation (July 4, 2011). Although maintaining the same distance from the bottom of the pond, the water depth relative to the surface for the middle and top loggers varied throughout the survey period due to fluctuating water levels. The middle loggers were generally positioned halfway between the surface and bottom loggers, approximately 1.5 m, 1 m, 0.75 m (Logger Strings 1, 2 & 3 respectively).

Although CH requested the installation of three loggers in the deepest part of the pond set at the bottom, 33% and 66% depth, the existing loggers were left in place due to the extent of the data collected and the distribution of a greater number of loggers than requested over varying depths was felt to provide sufficient coverage to cover the intent of the CH recommendation.

Through consultation with CH the water temperature data was analyzed using methods identified in *Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily maximum Air and Water Temperature* (Cindy Chu, et. al., 2009). In the study, the maximum daily water temperature recorded between July 1 and August 31 was plotted against the maximum daily air temperature within the period. Following consultation with CH, the temperature recorded at 4pm was selected as the maximum water temperature for the comparison which is consistent with the study that indicated that water temperature recorded between 4pm and 6pm represent the time during which water temperatures are most likely to be at their maximum. The resulting graph of temperature comparisons provided a tool to determine if the water temperature could be characterized as coldwater, cool-coldwater, coolwater, cool-warmwater or warmwater. The preferred nomogram used by CH staff for this purpose is Figure 7 on pg 1615 of the published study. The approximate temperature ranges for the thermal classifications are summarized in Table 6:

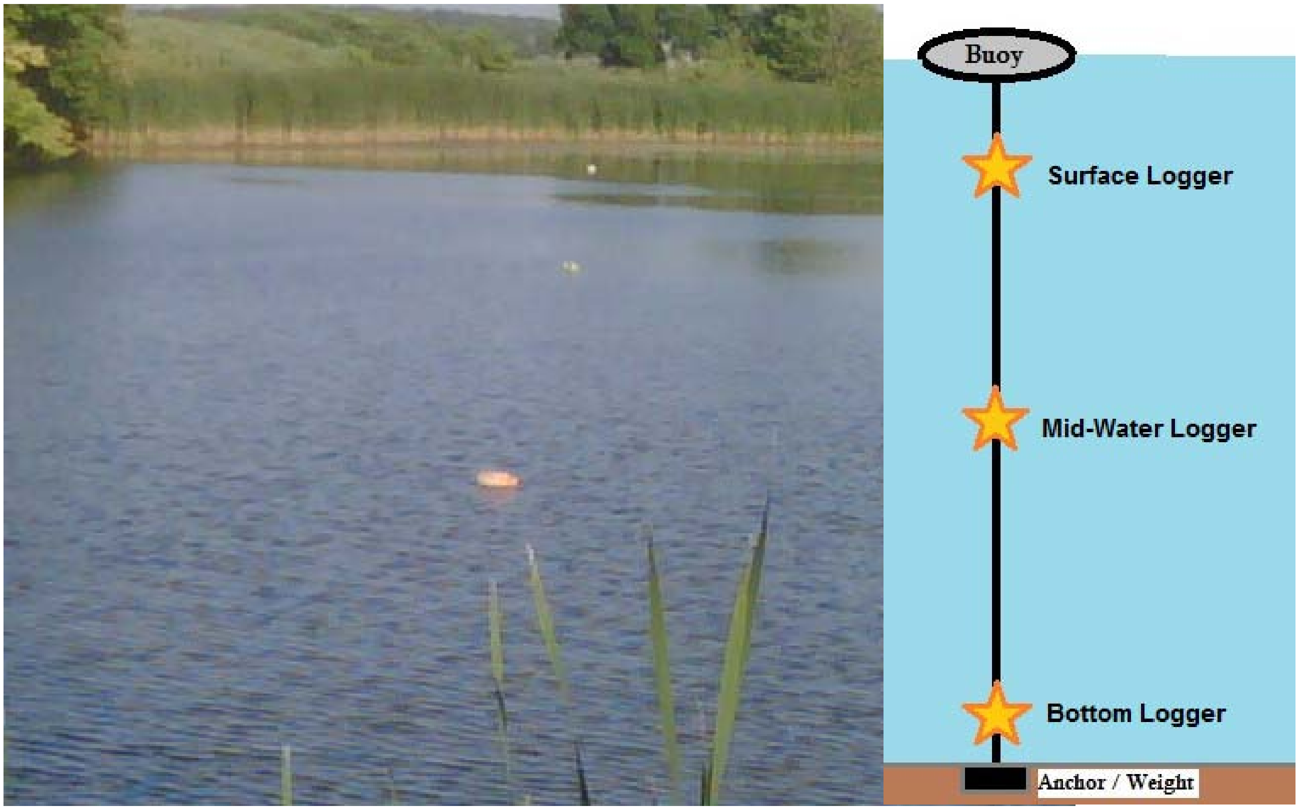

Plate 3: Facing north, showing the location of the temperature logger strings in the pond (left). Vertical position of loggers on each string (right)

Table 6: Approximate Thermal Classification Ranges for Watercourses, Based on Figure 7 Nomogram (Chu. et. al., 2009)

Thermal Classification	Maximum Water temperature Range at 24°C	Maximum Water temperature Range at 36°C	Est. Maximum Water temperature Range at 28 °C
Coldwater	10 °C to 15 °C	10 °C to 16 °C	10 °C to 16 °C
Cold-coolwater	15 °C to 17 °C	16 °C to 20 °C	16 °C to 18 °C
Coolwater	17 °C to 20 °C	20 °C to 24 °C	18 °C to 21 °C
Cool-warmwater	20 °C to 23 °C	24 °C to 28 °C	21 °C to 24 °C
Warmwater	23 °C to 32 °C +	28 °C to 32 °C +	24 °C to 32 °C +

Water temperature sampling was undertaken between July and October, 2011. For the purposes of analysis, only the water temperatures recorded at 4pm between July 4 and August 31, 2011 were used to determine the thermal classification of the pond. The maximum daily air temperatures recorded by Environment Canada for the weather station at Lester B. Pearson International Airport in Mississauga Ontario during the assessment period reported temperatures ranging from 22.3 °C (August 28, 2011) and 37.9 °C (July 21, 2011), with an average temperature of 28.69 °C. A weather station is also located in the Town of Oakville; however, the difference in temperature comparison when using the Town of Oakville air temperature is less than 0.5°C. As such, the use of the weather station at Lester B. Pearson was used as this is consistent with reference data for the EIS/FSS report (2009).

In order to identify the thermal stratification in the pond the temperature loggers were grouped according to the depth range where sampling occurred. These depths represent the surface (0-1 m), mid-water (1-2 m), bottom (2 m+) of the water column. As a result of the pond bathymetry profile, logger string locations, the nine loggers were assigned as follows: due to varying water levels during the season five loggers recorded temperatures at depths at 1 m or less (surface); two loggers occurred at depths between 1 and 2 m (mid-column) and 1 logger recorded at depths greater than 2 m (bottom). Figure 3 illustrates the thermal profile of the pond at 24 ^oC, 36 ^oC and at the average maximum air temperature recorded between July 4 and August 31. A linear trendline was established for each set of data points to determine the thermal classification that best approximates the temperatures recorded for the surface, mid-water and bottom of the water column in the pond, where y = water temperature and x = Air Temperature (^oC).

Surface

The linear trendline equation (Figure 4) for the average data at the surface of the column is:

$y = 0.404x + 15.585$

Based on this equation, the temperatures at 24 ^oC and 36 ^oC are calculated to be 25.28 ^oC and 30.13 ^oC, respectively. Based on the temperature ranges in Table 6, the surface of the pond falls within the warmwater range. Based on the average maximum air temperature the water temperature within the pond at the surface is estimated to be 27.18 ^oC (warmwater). The lowest recorded temperature is 22.74 ^oC, while the maximum temperature is 31.30 ^oC (difference: 8.56 ^oC).

The data for the individual surface loggers are shown in Figure 5.

Mid-Water

The linear trendline equation (Figure 4) for the average data within the mid-water column is:

$y = 0.3226x + 16.136$

Based on this equation, the temperatures at 24 ^oC and 36 ^oC are calculated to be 23.88 ^oC and 27.75 ^oC, respectively. Based on the temperature ranges in Table 6, the mid-water area of the pond falls within the warmwater to cool-warmwater range. Based on the average maximum air temperature the water temperature within the pond at the mid-water depth is estimated to be 25.39 ^oC (warmwater). The lowest recorded temperature is 21.65 ^oC, while the maximum temperature is 29.39 ^oC (difference: 7.74 ^oC).

The data for the individual mid-water loggers are shown in Figure 6.

Bottom

The linear trendline equation for the average data (Figure 4) at the bottom of the water column is:

$y = -0.1173x + 24.607$

Based on this equation, the temperatures at 24 ^oC and 36 ^oC are calculated to be 21.79 ^oC and 20.38 ^oC, respectively. Based on the temperature ranges in Table 6, the bottom of the pond falls within the coolwater to cool-warmwater range. Based on the average maximum air temperature the water temperature within the pond at the bottom of the pond is estimated to be 21.24 ^oC (cool-warmwater). The lowest recorded temperature is 17.4 ^oC, while the maximum temperature is 23.18 ^oC (difference: 5.78 ^oC).The data for the individual bottom logger is shown in Figure 7.

It is important to note that this cool-warmwater designation seems to conflict with the hydrogeological assessment that indicated that the pond is not receiving groundwater inputs that would assist with buffering of the thermal effects. It is suspected that the temperature logger in question was actually embedded in the substrate (pulled under by the anchor) thereby inaccurately recording the soft sediment temperature that is likely cooler than the water temperature. This is further indicated by the absence of buildup of crusts/slimes/filamentous algae as observed on the other loggers that were suspended in the water column. Essentially the general assessment of the pond as a whole remains the same as if this “cooler” water is present at the bottom of the pond it is not directly discharged into the receiving watercourse and detailed hydrogeological assessment confirms an absence of groundwater inputs into the pond during this period.

Table 7 summarizes the calculated temperatures based on the maximum water temperature comparison against maximum daily air temperature. Included in the table are the minimum, maximum and average recorded temperatures.

Table 7: Summary of Calculated Water Temperatures in the Pone (14W-14A) based on the Max Air Temp vs. Max Water Temp Trendline between July 4 and August 31, 2011.

Water Depth	Calc H_2O temp @ 24 ^oC (^oC)	Calc H_2O temp @ 36 ^oC (^oC)	Calc H_2O temp @ 28.69 ^oC (^oC)	Lowest recorded Maximum Water Temp (^oC)	Highest recorded Maximum Water Temp (^oC)	Average recorded Maximum Water Temp (^oC)
Surface (0-1m)	25.28	30.13	27.18	22.74	31.30	27.18
Mid-water (1-2m)	23.88	27.75	25.39	21.65	29.39	25.39
Bottom (2+m)	21.79	20.38	21.24	17.4	23.18	21.24

The water temperature data was also assessed using the protocol set forth in the *Ontario Stream Assessment Protocol* (OSAP) (Stanfield, 2005) and *A Thermal Habitat Classification for Lower Michigan Rivers* (Wehrly et al, 1999). The average weekly maximum and minimum water temperature was calculated for each of the first three weeks in July. This data was then used to calculate the average weekly temperature fluctuation for the watercourse. The watercourses were placed into one of three thermal regimes described by the MNR; coldwater (average maximum summer water temperature from 10°C to 18°C), coolwater (18°C to 25°C) or warmwater (25°C or warmer). Based upon water temperature fluctuations described in Wehrly et al (1999), the pond was then classified into one of three thermal range categories; stable (<5°C), moderately stable (5°C to 10°C) and extreme (> 10°C) (MNR, 2004; Stanfield, 2005; Wehrly et al, 1999). This assessment indicates that with the exception of the pond bottom at its deepest point (greater than 2 m) the thermal regime is moderately stable warmwater with a weekly average in July ranging from 25 to 27°C and maximums ranging from 26 to 30°C and in August from 24 to 25°C and maximums ranging from 25 to 29°C. In both months the higher weekly averages and maximums are attributed to the surface waters, the water that is discharged downstream when flows discharge from the pond.

3.5 Thermal Impacts of Proposed Conversion of Farm Pond to a SWMP

It acknowledged that a larger pond in this setting has the potential to be subject to increased thermal effects due to its size however, the reconfiguration of the pond into a managed Stormwater Management facility provides opportunities to mitigate these effects. The design of preventative thermal measures such as those proposed by the Credit Valley Conservation's study: Thermal Impacts of Urbanization including Preventative and Mitigation Techniques, January, 2011 including 'cooling towers' and floating vegetated islands along with a north-south pond and outlet channel orientation to maximize shading periods would assist in minimizing this effect. Given that the pond currently functions as moderately stable warmwater habitat, the mitigation measures included in the SWMP design have the potential to improve the temperature discharging from the future SWMP.

3.6 Phytoplankton/Zooplankton Production

It is acknowledged that this pond, like most open water habitats including SWM ponds, have self-sustaining phytoplankton and zooplankton populations however, the contributions to downstream habitats are limited due to the relatively small size of the pond as well as the intermittent discharge to downstream habitat during the low flow periods in its existing inlet/outlet configuration. It is anticipated that the production and contribution of zooplankton and phytoplankton in a SWM facility to the downstream fisheries will be similar to existing conditions.

3.7 Sediment Source

The configuration of the pond does not support the provision of sediment or bedload as a resource in the west branch of Fourteen Mile Creek. The intermittent flow in/flow out (through a single connection point) during high flow events only suggests the pond acts as a sediment trap and will act against the concept of dynamic equilibrium by removing sediment from downstream areas, resulting in a less stable bedload, and thereby facilitating downstream erosion when attempting to re-establish a stable bedload. In addition, the top-draw, uncontrolled discharge nature of the pond suggests that high flows may be sustained for longer periods as water flows out of the pond and into the watercourse system, creating extended periods of higher shear stress than naturally occurs.

3.8 Organic Material Source

The transport of coarse organic material such as leaves and twigs, to downstream fish habitat is limited by the intermittent connection to downstream fish habitat as well as the dense cattail growth at the inlet/outlet that would physically block the movement of this material. Furthermore, it is anticipated that if this pond was removed, its contribution can likely be addressed through riparian zone restoration/planting.

3.9 Headwater Wetland Function

Once again we would like to emphasize that this is an agricultural pond that has naturalized over time due to a lack of management as agricultural feature rather than a conscious decision to create/manage it as fish and wildlife habitat.

Generally headwater wetlands are wetlands associated with groundwater discharge zones that give rise to creeks and streams. Water level data from the pond as well as groundwater data indicate that the pond does not receive groundwater inputs in sufficient quantities that create discharge into the watercourses, the discharge from the pond is associated with surface water inputs. The lack of groundwater inputs is supported by the warmwater thermal regime of the pond. It seems more likely the pond is a 'sink' rather than 'source', receiving surface flows and losing water to evaporation rather than consistently contributing water from the pond to the downstream watercourse.

Furthermore the wetland vegetation communities present are common (cattail shallow marsh and duckweed shallow aquatic) and are typical of vegetation associated with stagnant ponds. The vegetation present is not obviously sustained by groundwater inputs to the pond, but rather appears to be sustained by the presence of surface water that occasionally flows into the pond from the watercourses. The wetland community present is typical of those found within SWM facilities in Halton Region, and could be replicated through standard SWM pond construction and re-vegetation practices.

3.10 Pond providing Pelagic and Littoral Habitat

Although the pond may have a secondary function providing pelagic and littoral habitat by its intrinsic function of storing water for agriculture, it is a farm pond that was created to facilitate agricultural activities. The limited availably of this type of habitat in the area is appears to be associated with the absence of naturally occurring open water habitat in North Oakville and the use of a farm pond to bolster a type of habitat that appears to be naturally limited in North Oakville seems unrealistic.

4 Conclusions

Generally the pond appears to function as warmwater habitat that supports a warmwater fish community. Given the current configuration of the pond with a single inlet/outlet feature that is principally influenced by surface water, it appears that this pond functioning as a basin storing water until such time that it overflows into the receiving watercourse. The resulting storage of water, intermittent connection to downstream watercourses and apparent lack of groundwater inputs results in water temperature increasing during the low flow period. This warmer water is then discharged into the receiving watercourse (Reach 14W-12) that supports Redside Dace. As a result of these influences the pond in its current form does not appear to match the intent of the management of the receiving watercourse (Reach 14W-12).

According to the DFO's *Working Around Water? Factsheet Series (Ontario Edition)* by-pass ponds *"… are also prone to dissolved oxygen and water quality problems, increases in water temperature, and sediment accumulation problems. Proposals* ***<u>for bypass ponds on coldwater streams are generally not approved due to the potential that downstream water temperatures may increase beyond levels that coldwater fish need to survive</u>****".* It has been our experience that the removal of pond habitat (i.e. by-pass, on-line), specifically those contributing to cool/coldwater habitats, is a measure often identified to improve water quality (i.e. water temperature) related to fish habitat and is frequently used as a compensation measure used to address a HADD. The *NOSCC Implementation Report* states that one of its broad level riparian corridor management recommendations to achieve certain targets on a system wide basis includes the removal of online ponds as they are considered detrimental from a temperature moderation perspective. Although the pond in question is not an online feature, its effects are similar and the removal of these adverse effects would be beneficial to the aquatic habitat of downstream reaches.

It is acknowledged that the proposal is not merely to remove the pond (Reach 14W-14A) to benefit the natural heritage system; instead it is a replacement of the existing pond with a SWM pond. SWM ponds are necessary to address the post-development flows and although the resulting SWM pond will be larger and likely subject to greater thermal impacts due to its size, there are mitigation measures that can be incorporated into the design that will assist in mitigating these effects. This proposed approach consisting of removing a farm pond that is detrimental to downstream habitat and using the area to construct a necessary SWM pond in its place represents a benefit over the the alternative of maintaining the farm pond (and its effects) and construction additional pond(s) on the landscape.

Notwithstanding the thermal influences of the pond, it is recognized that the pond does support a warmwater fish community and as a result the proposed works are subject to review under the Fisheries Act and Conservation Authorities Act. Due to its proximity and connection to Redside Dace habitat it is also subject to review under the ESA. As a result we request that CH and MNR review this information and provide comment.

We trust this information satisfies the additional information request presented in the August 3, 2011 email as well as the September 6, 2011 written correspondence and request that CH and MNR identify what specific functions of this feature (if any) considered worthy of retention in order that the feasibility of incorporating this type of feature in other locations can be examined.

5 References

- Chu, Cindy, N.E. Jones, A.R. Piggott and J.M. Buttle. Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily Maximum Air and Water Temperatures, North American Journal of Fisheries Management 29: 1605-1619, 2009.
- Wehrly, Kevin; M.J. Wiley & P.W. Seelbach. A Thermal Habitat Classification for Lower Michigan Rivers. Michigan Department of Natural Resources. Fisheries Research Report No. 2038, 1998.

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Environmental Implementation Report / Functional Servicing Study for 14 Mile Creek West and the Lazy Pat Farm Property

Bathymetric Survey / Approximate Fish Community Sampling Locations

LEGEND

Contour Lines

Equipment Type / Sampling Method

Minnow Trap (2011)

Pot Trap (2011)

Trap (MMM - 2002)

Electrofishing

EF-A (2009)

EF-B (2009)

NRSI (2002)

Scale

0 5 10 20 30 40 m

Client

Bentall Kennedy

Prepared by

MMM GROUP

Date

February 2012

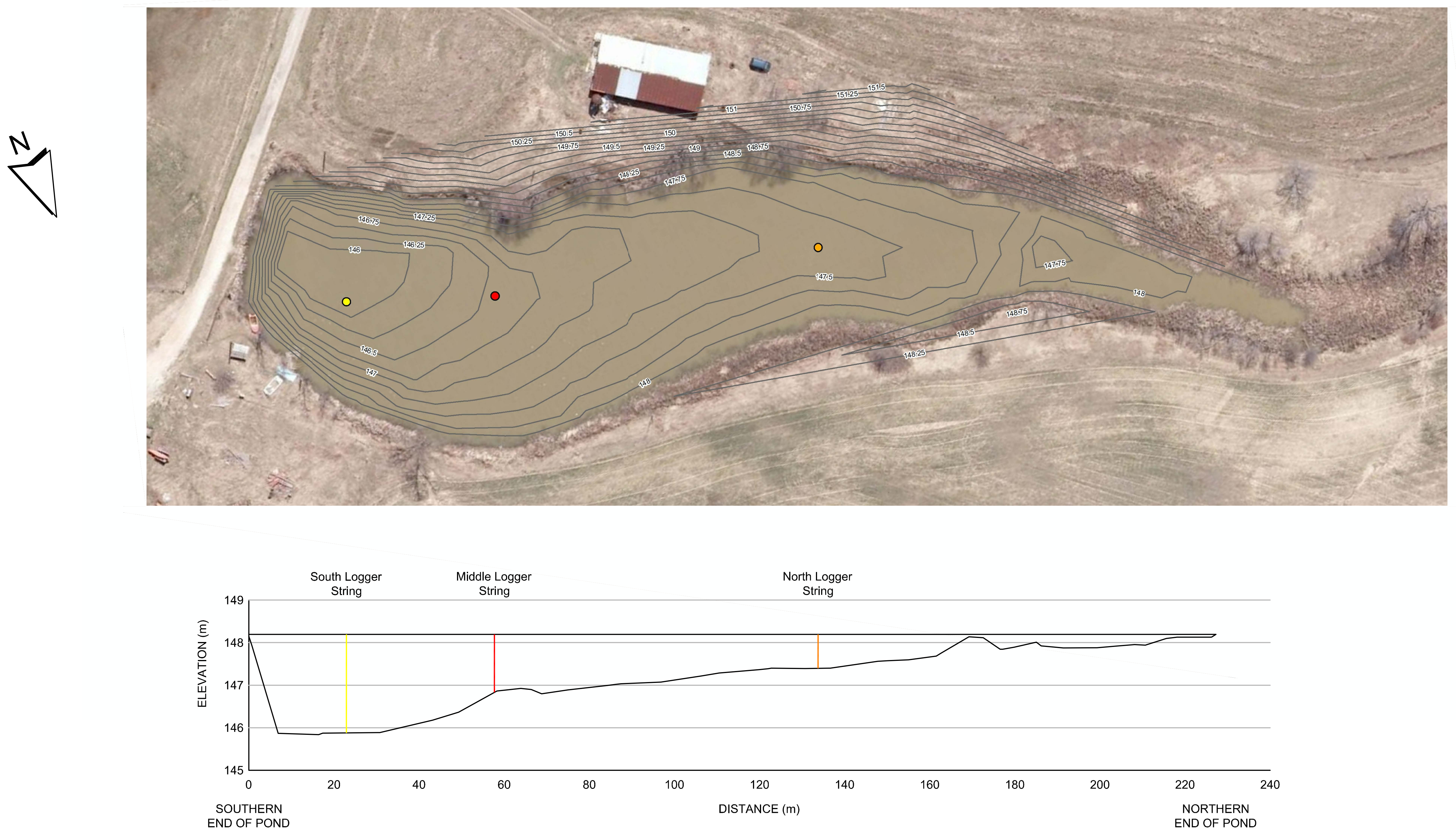
Project No.

1409222001

Aerial Photo

© 2012 Microsoft Corporation Imagery
© Microsoft © 2010 NAVTEQ

Figure: 1



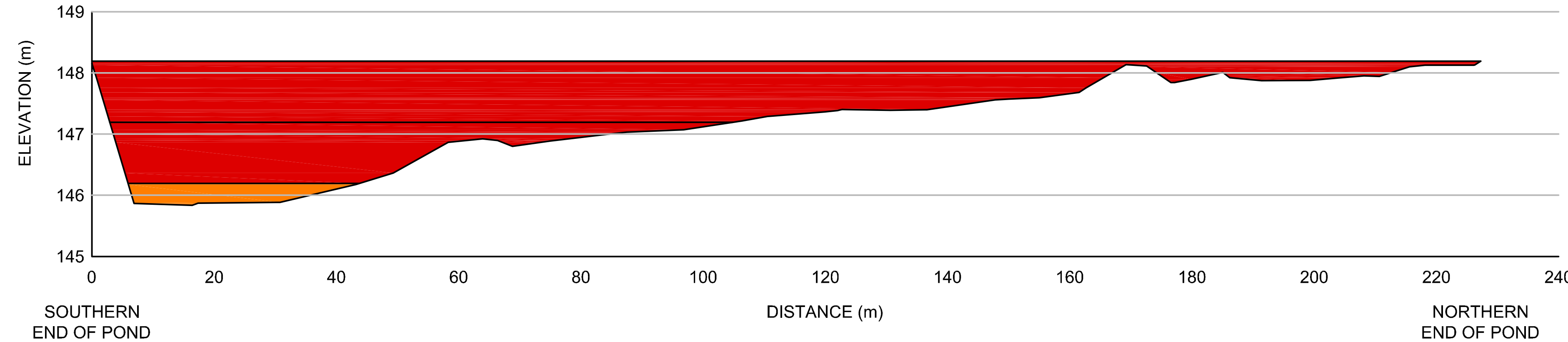
LEGEND

Logger Sampling Locations

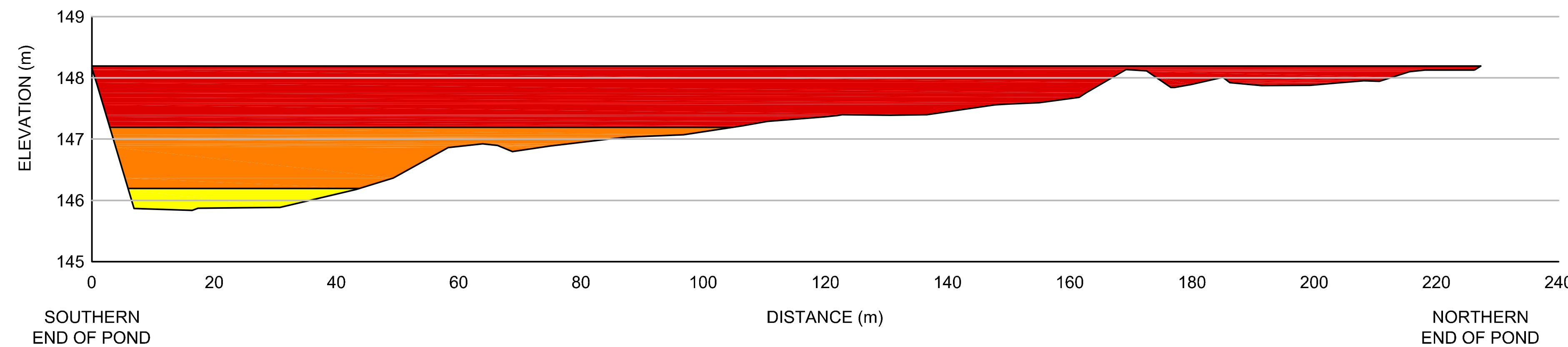
- North Logger String (1-2-3)
- Middle Logger String (4-5-6)
- South Logger String (7-8-9)

Client: BENTALL KENNEDY		
Title: Water Temperature Monitoring (2011) Bathymetric Survey and Profile		
Prepared by: MMM GROUP		
14.09222.001.EN1	Scale: NTS	Review: SR
Date: February 2012	Figure: 2	

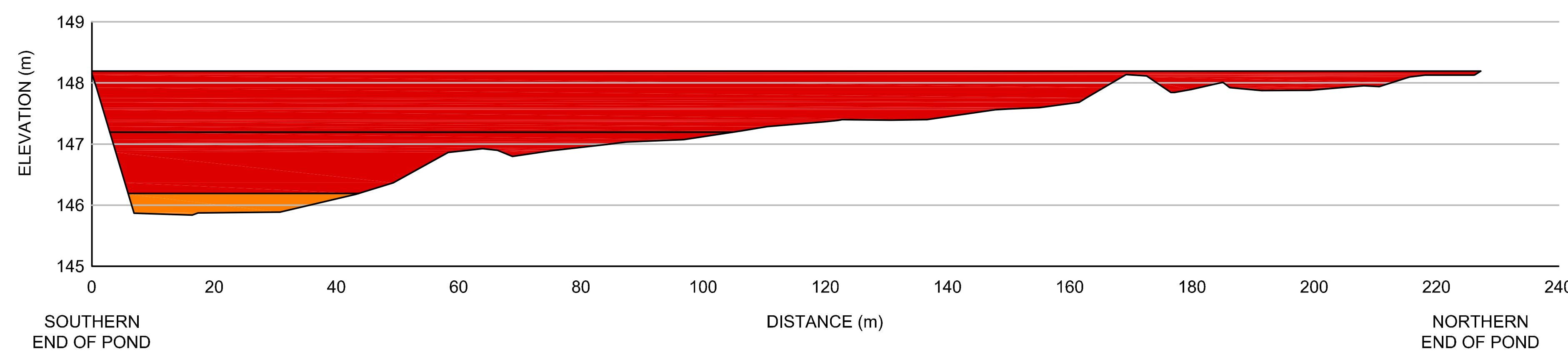
WATER TEMPERATURE AT MAXIMUM AIR TEMPERATURE OF 24°C



WATER TEMPERATURE AT MAXIMUM AIR TEMPERATURE OF 36°C



WATER TEMPERATURE AT MAXIMUM AIR TEMPERATURE OF 28.69°C



Thermal Classification (Colour Code)	Maximum Water Temperature Range at 24°C	Maximum Water Temperature Range at 36°C	Maximum Water Temperature Range at 28°C
Cold Water (BLUE)	0°C to 15°C	0°C to 16°C	0°C to 16°C
Cold - Cool Water (GREEN)	15°C to 17°C	16°C to 20°C	16°C to 18°C
Cool Water (YELLOW)	17°C to 20°C	20°C to 24°C	18°C to 21°C
Cool - Warm Water (ORANGE)	20°C to 23°C	24°C to 28°C	21°C to 24°C
Warm Water (RED)	23°C and higher	28°C and higher	24°C and higher

Client: BENTALL KENNEDY

Title: Pond Cross Section

Prepared by: MMM GROUP

14.09222.001.EN1 | Scale: NTS | Review: SR

Date: February 2012 | Figure: 3

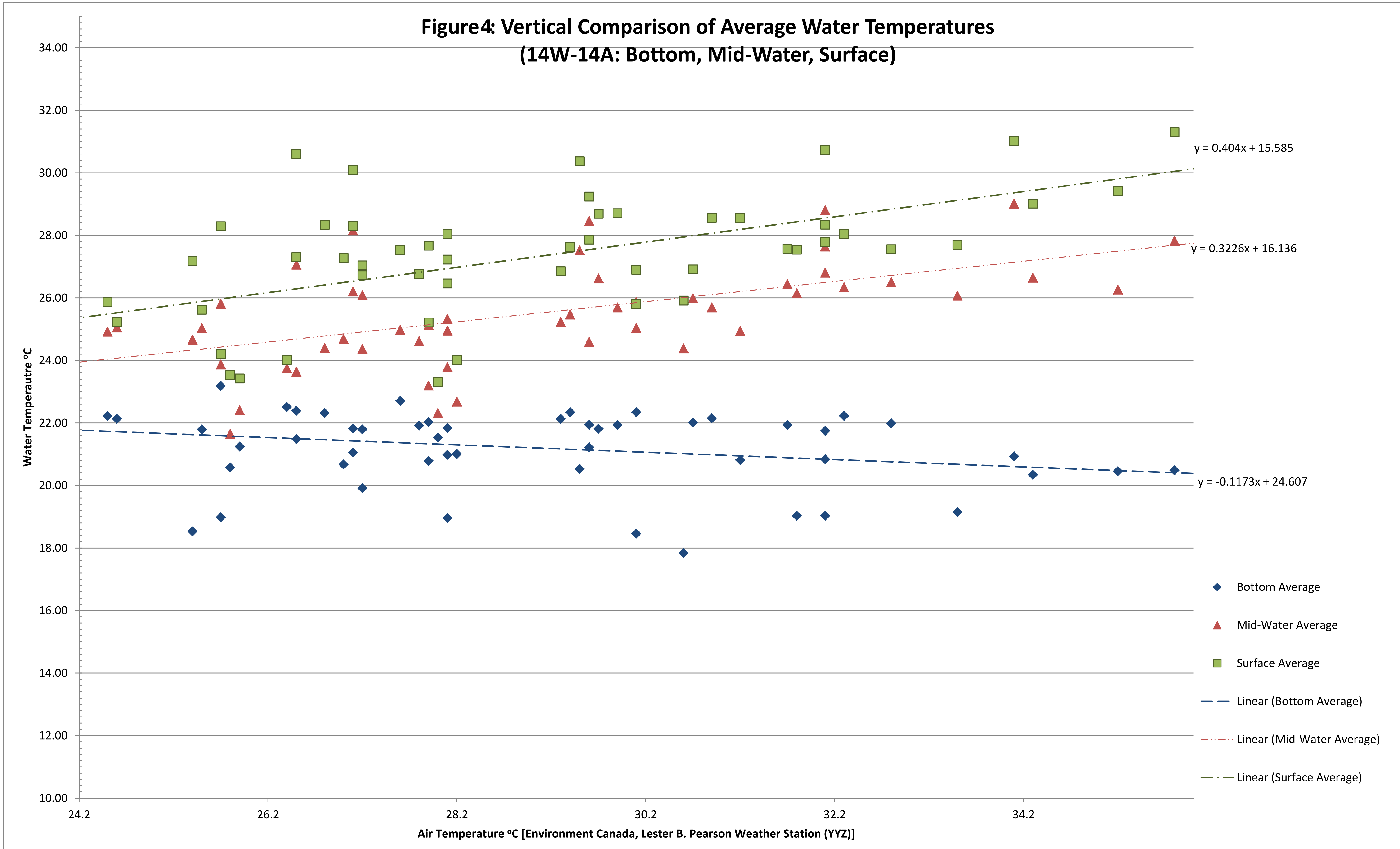


Figure4: Vertical Comparison of Average Water Temperatures
(14W-14A: Bottom, Mid-Water, Surface)
34.00
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
Water Temperautre °C
y = 0.404x + 15.585
y = 0.3226x + 16.136
y = -0.1173x + 24.607
24.2
26.2
28.2
30.2
32.2
34.2
Air Temperature °C [Environment Canada, Lester B. Pearson Weather Station (YYZ)]
Bottom Average
Mid-Water Average
Surface Average
Linear (Bottom Average)
Linear (Mid-Water Average)
Linear (Surface Average)

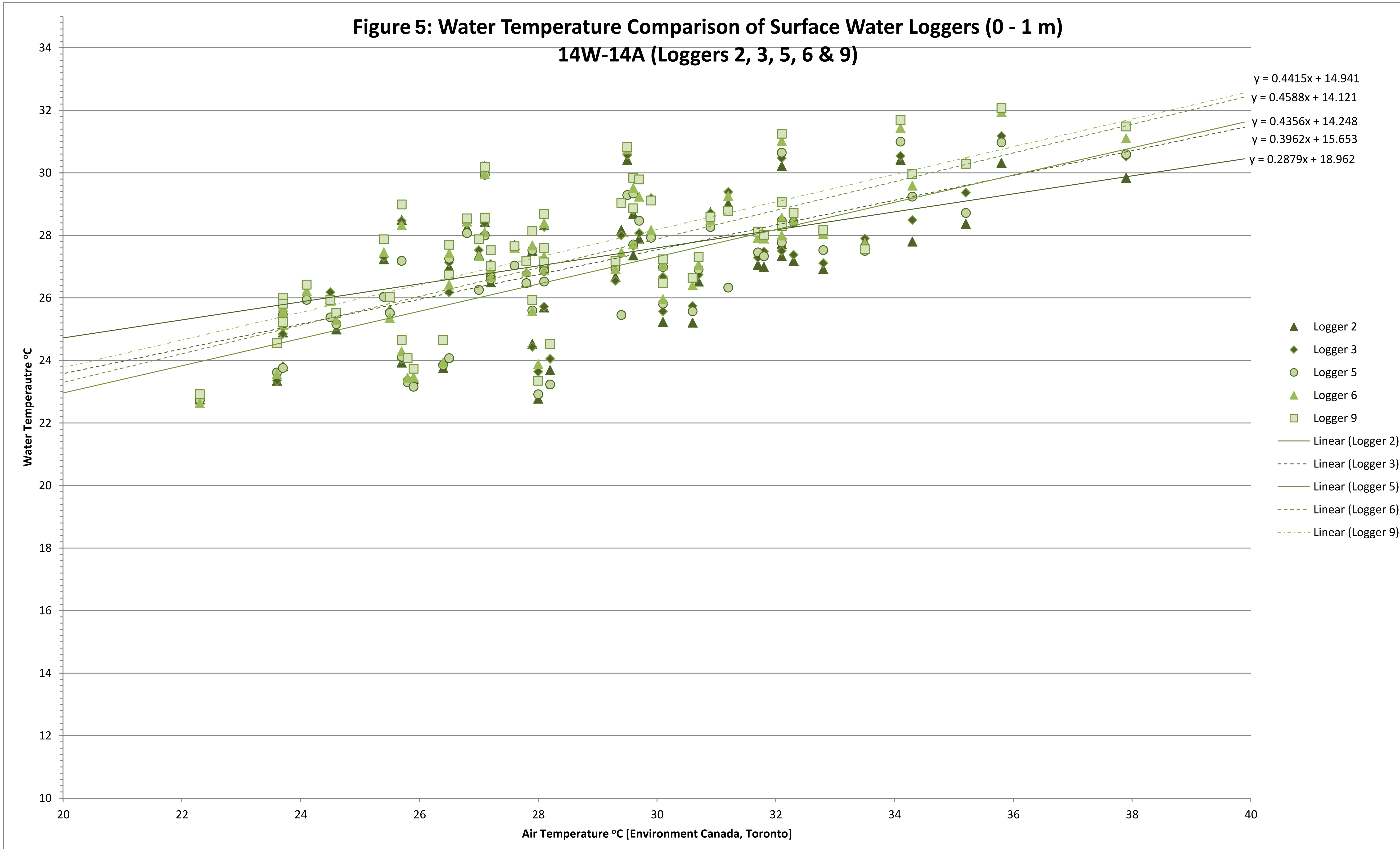


Figure 5: Water Temperature Comparison of Surface Water Loggers (0 - 1 m)
14W-14A (Loggers 2, 3, 5, 6 & 9)
y = 0.4415x + 14.941
y = 0.4588x + 14.121
y = 0.4356x + 14.248
y = 0.3962x + 15.653
y = 0.2879x + 18.962
Water Temperautre ºC
Air Temperature ºC [Environment Canada, Toronto]
Logger 2
Logger 3
Logger 5
Logger 6
Logger 9
Linear (Logger 2)
Linear (Logger 3)
Linear (Logger 5)
Linear (Logger 6)
Linear (Logger 9)

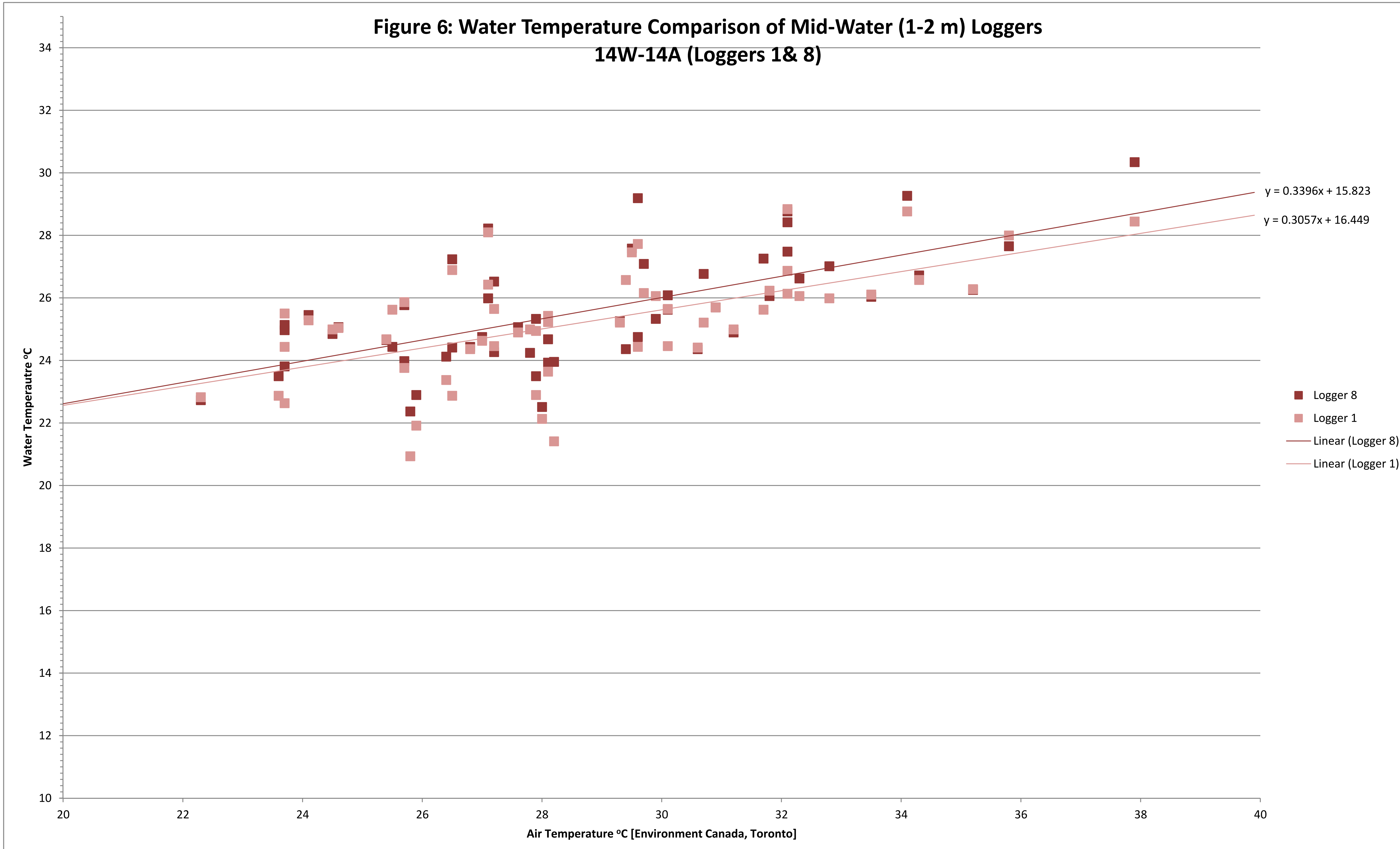


Figure 6: Water Temperature Comparison of Mid-Water (1-2 m) Loggers
14W-14A (Loggers 1& 8)
y = 0.3396x + 15.823
y = 0.3057x + 16.449
Logger 8
Logger 1
Linear (Logger 8)
Linear (Logger 1)
Water Temperautre ºC
Air Temperature ºC [Environment Canada, Toronto]
34
32
30
28
26
24
22
20
18
16
14
12
10
20
22
24
26
28
30
32
34
36
38
40

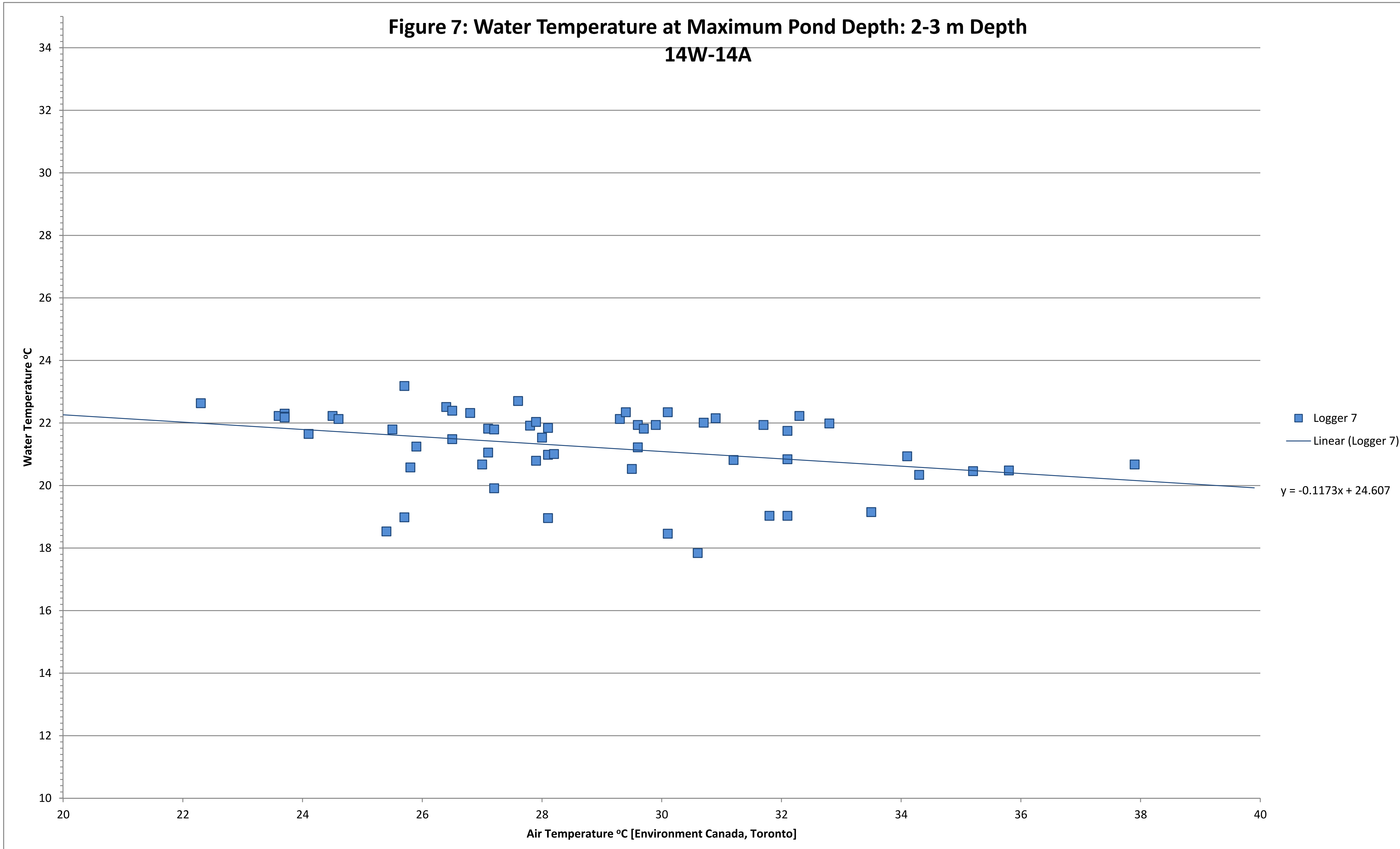


Figure 7: Water Temperature at Maximum Pond Depth: 2-3 m Depth
14W-14A
Water Temperature °C
Air Temperature °C [Environment Canada, Toronto]
34
32
30
28
26
24
22
20
18
16
14
12
10
20
22
24
26
28
30
32
34
36
38
40
Logger 7
Linear (Logger 7)
y = -0.1173x + 24.607

Appendix 6.0

Appendix 6.1 – HEC RAS Results

HEC-RAS Model Results for 14W-16, 14W-14, 14W-12A and 14W-12-------Existing Condition

HEC-RAS Plan: Existing

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2B	231.1	Regional	8.23	148.25	149.80		149.81	0.000200	0.60	46.06	58.53	0.16	0.28
Reach-2B	231.1	100YR	3.20	148.25	149.31		149.31	0.000225	0.48	19.74	44.13	0.16	0.12
Reach-2B	231.1	50YR	2.83	148.25	149.26		149.27	0.000221	0.46	17.78	41.87	0.16	0.11
Reach-2B	231.1	25YR	2.48	148.25	149.21		149.22	0.000217	0.44	15.87	39.55	0.15	0.10
Reach-2B	231.1	10YR	1.94	148.25	149.14		149.14	0.000204	0.41	12.99	35.77	0.15	0.08
Reach-2B	231.1	5YR	1.59	148.25	149.08		149.09	0.000190	0.37	11.13	33.09	0.14	0.07
Reach-2B	231.1	2YR	1.00	148.25	148.98		148.98	0.000151	0.30	7.91	27.79	0.12	0.05
Reach-2B	231	Regional	8.23	148.25	149.80		149.81	0.000201	0.60	46.05	58.52	0.16	0.23
Reach-2B	231	100YR	3.20	148.25	149.31		149.31	0.000225	0.48	19.73	44.12	0.16	0.10
Reach-2B	231	50YR	2.83	148.25	149.26		149.27	0.000221	0.46	17.77	41.86	0.16	0.09
Reach-2B	231	25YR	2.48	148.25	149.21		149.22	0.000218	0.44	15.86	39.54	0.15	0.08
Reach-2B	231	10YR	1.94	148.25	149.14		149.14	0.000205	0.41	12.99	35.76	0.15	0.07
Reach-2B	231	5YR	1.59	148.25	149.08		149.09	0.000191	0.37	11.13	33.08	0.14	0.06
Reach-2B	231	2YR	1.00	148.25	148.98		148.98	0.000151	0.30	7.91	27.79	0.12	0.04
Reach-2A	228	Regional	7.88	153.98	154.23		154.26	0.005679	0.82	9.64	51.91	0.61	9.67
Reach-2A	228	100YR	3.06	153.98	154.12		154.14	0.007080	0.65	4.70	41.99	0.62	4.29
Reach-2A	228	50YR	2.71	153.98	154.11		154.13	0.007245	0.63	4.31	41.21	0.62	3.82
Reach-2A	228	25YR	2.37	153.98	154.11		154.13	0.005918	0.56	4.21	41.02	0.56	3.26
Reach-2A	228	10YR	1.85	153.98	154.09		154.11	0.006451	0.53	3.49	39.53	0.57	2.62
Reach-2A	228	5YR	1.52	153.98	154.08		154.09	0.007092	0.51	2.98	38.45	0.59	2.20
Reach-2A	228	2YR	0.95	153.98	154.06	154.04	154.07	0.008712	0.46	2.06	36.21	0.62	1.47
Reach-2A	227	Regional	7.88	153.04	153.33	153.32	153.43	0.013223	1.41	6.09	33.73	0.95	8.89
Reach-2A	227	100YR	3.06	153.04	153.24	153.22	153.28	0.010626	0.91	3.41	27.18	0.79	3.88
Reach-2A	227	50YR	2.71	153.04	153.23	153.21	153.27	0.010447	0.86	3.16	26.50	0.77	3.45
Reach-2A	227	25YR	2.37	153.04	153.21	153.20	153.25	0.014192	0.90	2.63	24.96	0.87	2.92
Reach-2A	227	10YR	1.85	153.04	153.20	153.18	153.23	0.012560	0.79	2.34	24.04	0.81	2.33
Reach-2A	227	5YR	1.52	153.04	153.19	153.17	153.21	0.011177	0.71	2.13	23.30	0.75	1.94
Reach-2A	227	2YR	0.95	153.04	153.17	153.15	153.18	0.008941	0.57	1.67	21.61	0.66	1.28
Reach-2A	226	Regional	7.88	152.44	152.74		152.77	0.003714	0.76	10.43	45.96	0.51	8.06
Reach-2A	226	100YR	3.06	152.44	152.62		152.63	0.004283	0.59	5.22	37.44	0.50	3.45
Reach-2A	226	50YR	2.71	152.44	152.61		152.62	0.004293	0.56	4.81	36.69	0.50	3.05
Reach-2A	226	25YR	2.37	152.44	152.60		152.62	0.003509	0.50	4.70	36.49	0.45	2.55
Reach-2A	226	10YR	1.85	152.44	152.58		152.59	0.003802	0.48	3.89	34.94	0.46	2.02
Reach-2A	226	5YR	1.52	152.44	152.56	152.52	152.57	0.004079	0.45	3.34	33.85	0.46	1.67
Reach-2A	226	2YR	0.95	152.44	152.53		152.54	0.004792	0.41	2.34	31.69	0.48	1.08
Reach-2A	225	Regional	7.88	151.75	152.28		152.34	0.004966	1.27	12.52	56.45	0.64	6.91
Reach-2A	225	100YR	3.06	151.75	152.12		152.16	0.005177	0.93	5.12	36.80	0.60	2.93
Reach-2A	225	50YR	2.71	151.75	152.10	152.05	152.14	0.005411	0.91	4.48	34.74	0.61	2.58
Reach-2A	225	25YR	2.37	151.75	152.07	152.04	152.11	0.007584	0.98	3.29	31.09	0.71	2.15
Reach-2A	225	10YR	1.85	151.75	152.05	152.01	152.08	0.006966	0.88	2.64	27.52	0.67	1.69
Reach-2A	225	5YR	1.52	151.75	152.03	151.98	152.06	0.006622	0.81	2.19	25.33	0.64	1.39
Reach-2A	225	2YR	0.95	151.75	151.99		152.01	0.005968	0.69	1.38	9.96	0.59	0.90
Reach-2A	224	Regional	7.88	151.25	151.72	151.66	151.81	0.005653	1.48	10.93	40.66	0.70	5.74
Reach-2A	224	100YR	3.06	151.25	151.54	151.50	151.60	0.006213	1.11	4.57	29.00	0.68	2.45
Reach-2A	224	50YR	2.71	151.25	151.53	151.48	151.58	0.005907	1.04	4.19	28.12	0.65	2.15
Reach-2A	224	25YR	2.37	151.25	151.54	151.46	151.57	0.004037	0.88	4.41	28.63	0.54	1.77
Reach-2A	224	10YR	1.85	151.25	151.50	151.43	151.53	0.004450	0.83	3.35	25.94	0.56	1.39
Reach-2A	224	5YR	1.52	151.25	151.47	151.41	151.50	0.004787	0.79	2.69	22.76	0.56	1.15
Reach-2A	224	2YR	0.95	151.25	151.42	151.37	151.44	0.005379	0.69	1.67	17.12	0.57	0.75
Reach-2A	223	Regional	7.88	150.26	151.01	150.99	151.13	0.008351	1.84	10.11	46.66	0.84	4.69
Reach-2A	223	100YR	3.06	150.26	150.83	150.83	150.92	0.007310	1.42	4.09	30.73	0.75	2.01
Reach-2A	223	50YR	2.71	150.26	150.80	150.80	150.90	0.007775	1.41	3.31	30.42	0.76	1.77
Reach-2A	223	25YR	2.37	150.26	150.72	150.72	150.87	0.014149	1.71	1.38	4.64	1.00	1.48
Reach-2A	223	10YR	1.85	150.26	150.67	150.66	150.80	0.013621	1.61	1.15	4.08	0.97	1.17
Reach-2A	223	5YR	1.52	150.26	150.64	150.62	150.75	0.012983	1.50	1.01	3.87	0.94	0.96
Reach-2A	223	2YR	0.95	150.26	150.56	150.54	150.65	0.012720	1.28	0.74	3.56	0.90	0.63
Reach-2A	222	Regional	7.88	149.74	150.34	150.30	150.42	0.005874	1.58	13.28	54.52	0.72	3.52
Reach-2A	222	100YR	3.06	149.74	150.20	150.14	150.25	0.003731	1.02	6.74	42.79	0.54	1.47
Reach-2A	222	50YR	2.71	149.74	150.19	150.12	150.23	0.003668	0.98	5.99	40.92	0.53	1.31
Reach-2A	222	25YR	2.37	149.74	150.17	150.10	150.21	0.003581	0.94	5.26	39.00	0.52	1.14
Reach-2A	222	10YR	1.85	149.74	150.14	150.04	150.17	0.003379	0.85	4.11	35.79	0.50	0.90
Reach-2A	222	5YR	1.52	149.74	150.11	150.00	150.14	0.003313	0.80	3.21	30.63	0.49	0.75
Reach-2A	222	2YR	0.95	149.74	150.04	149.93	150.07	0.003143	0.71	1.61	16.49	0.46	0.51
Reach-2A	221	Regional	7.88	149.23	149.77	149.70	149.86	0.005346	1.49	9.97	39.84	0.69	2.36
Reach-2A	221	100YR	3.06	149.23	149.52	149.52	149.62	0.012499	1.40	2.65	19.86	0.93	1.00
Reach-2A	221	50YR	2.71	149.23	149.50	149.50	149.59	0.013016	1.36	2.31	18.55	0.94	0.89
Reach-2A	221	25YR	2.37	149.23	149.48	149.48	149.57	0.013827	1.32	1.96	16.71	0.95	0.78
Reach-2A	221	10YR	1.85	149.23	149.44	149.44	149.53	0.016076	1.28	1.46	9.96	1.00	0.62
Reach-2A	221	5YR	1.52	149.23	149.42	149.42	149.50	0.017022	1.21	1.25	8.52	1.01	0.53
Reach-2A	221	2YR	0.95	149.23	149.38	149.38	149.43	0.018423	1.07	0.89	7.65	1.01	0.38
Reach-2C	220.3	Regional	8.23	148.25	149.80		149.81	0.000127	0.48	60.38	69.05	0.13	2.02
Reach-2C	220.3	100YR	3.20	148.25	149.31		149.31	0.000159	0.41	27.30	64.44	0.13	0.87
Reach-2C	220.3	50YR	2.83	148.25	149.26		149.27	0.000163	0.40	24.36	63.97	0.13	0.77
Reach-2C	220.3	25YR	2.48	148.25	149.22		149.22	0.000164	0.39	21.43	59.80	0.13	0.68

HEC-RAS Plan: Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2C	220.3	10YR	1.94	148.25	149.14		149.14	0.000157	0.36	17.19	50.87	0.13	0.55
Reach-2C	220.3	5YR	1.59	148.25	149.08		149.09	0.000146	0.33	14.60	44.55	0.12	0.47
Reach-2C	220.3	2YR	1.00	148.25	148.98		148.98	0.000111	0.26	10.54	33.55	0.10	0.34
Reach-2C	220.2	Regional	8.23	148.57	149.41	149.41	149.75	0.009405	2.64	3.92	6.98	0.98	0.27
Reach-2C	220.2	100YR	3.20	148.57	149.07	149.07	149.27	0.011875	1.96	1.81	5.39	0.99	0.07
Reach-2C	220.2	50YR	2.83	148.57	149.04	149.04	149.22	0.012232	1.89	1.64	5.25	0.99	0.06
Reach-2C	220.2	25YR	2.48	148.57	149.02	149.01	149.18	0.011173	1.74	1.55	5.16	0.94	0.05
Reach-2C	220.2	10YR	1.94	148.57	148.98	148.96	149.10	0.010255	1.54	1.35	4.98	0.88	0.04
Reach-2C	220.2	5YR	1.59	148.57	148.95	148.92	149.05	0.009873	1.41	1.19	4.83	0.85	0.04
Reach-2C	220.2	2YR	1.00	148.57	148.88	148.86	148.95	0.010188	1.19	0.87	4.51	0.83	0.03
Reach-2C	220.1	Regional	8.23	148.25	149.15	149.11	149.22	0.004926	1.39	13.87	63.10	0.65	0.04
Reach-2C	220.1	100YR	3.20	148.25	148.91	148.84	148.99	0.006765	1.29	3.05	16.59	0.72	0.01
Reach-2C	220.1	50YR	2.83	148.25	148.87	148.81	148.96	0.007240	1.28	2.53	15.03	0.74	0.01
Reach-2C	220.1	25YR	2.48	148.25	148.84	148.78	148.92	0.007640	1.27	2.07	10.62	0.75	0.01
Reach-2C	220.1	10YR	1.94	148.25	148.79	148.73	148.86	0.007977	1.21	1.61	6.96	0.75	0.01
Reach-2C	220.1	5YR	1.59	148.25	148.75	148.69	148.82	0.008215	1.16	1.37	5.64	0.75	0.01
Reach-2C	220.1	2YR	1.00	148.25	148.67	148.61	148.72	0.008026	1.04	0.96	4.54	0.73	0.00
Reach-2C	220	Regional	8.23	148.25	149.11	149.11	149.21	0.007117	1.62	11.42	61.50	0.77	0.03
Reach-2C	220	100YR	3.20	148.25	148.84	148.84	148.98	0.013104	1.65	2.04	9.97	0.98	0.01
Reach-2C	220	50YR	2.83	148.25	148.81	148.81	148.94	0.013970	1.64	1.76	8.10	1.00	0.01
Reach-2C	220	25YR	2.48	148.25	148.78	148.78	148.91	0.014458	1.60	1.55	6.36	1.01	0.01
Reach-2C	220	10YR	1.94	148.25	148.73	148.73	148.85	0.014804	1.54	1.26	5.28	1.01	0.01
Reach-2C	220	5YR	1.59	148.25	148.69	148.69	148.80	0.015266	1.49	1.07	4.80	1.01	0.01
Reach-2C	220	2YR	1.00	148.25	148.61	148.61	148.71	0.016304	1.37	0.73	3.93	1.01	0.00
Reach-1A	210.5	Regional	8.22	155.11	155.53	155.48	155.55	0.006998	0.70	11.69	92.57	0.63	11.12
Reach-1A	210.5	100YR	3.34	155.11	155.45	155.42	155.46	0.008320	0.62	5.41	59.22	0.65	5.05
Reach-1A	210.5	50YR	2.95	155.11	155.44	155.41	155.46	0.008501	0.60	4.90	56.58	0.65	4.52
Reach-1A	210.5	25YR	2.59	155.11	155.43	155.40	155.45	0.008816	0.59	4.40	53.83	0.66	4.01
Reach-1A	210.5	10YR	2.04	155.11	155.41	155.39	155.43	0.008922	0.55	3.68	49.66	0.65	3.26
Reach-1A	210.5	5YR	1.69	155.11	155.40	155.38	155.42	0.009281	0.53	3.16	46.44	0.65	2.81
Reach-1A	210.5	2YR	1.08	155.11	155.38	155.35	155.39	0.009833	0.50	2.14	35.91	0.66	2.00
Reach-1A	210	Regional	8.22	154.96	155.26	155.21	155.30	0.007361	0.93	8.87	48.03	0.69	10.76
Reach-1A	210	100YR	3.34	154.96	155.16		155.19	0.007570	0.72	4.62	37.04	0.65	4.87
Reach-1A	210	50YR	2.95	154.96	155.15		155.17	0.007569	0.70	4.23	35.83	0.65	4.36
Reach-1A	210	25YR	2.59	154.96	155.14		155.16	0.007419	0.67	3.89	34.73	0.64	3.87
Reach-1A	210	10YR	2.04	154.96	155.12		155.14	0.007571	0.62	3.26	32.63	0.63	3.14
Reach-1A	210	5YR	1.69	154.96	155.11		155.13	0.007413	0.59	2.89	31.28	0.62	2.70
Reach-1A	210	2YR	1.08	154.96	155.08		155.10	0.007391	0.51	2.12	28.37	0.59	1.93
Reach-1A	209	Regional	8.22	154.46	154.74		154.77	0.003402	0.80	15.89	75.38	0.50	9.39
Reach-1A	209	100YR	3.34	154.46	154.63		154.65	0.003394	0.57	8.37	64.87	0.46	4.15
Reach-1A	209	50YR	2.95	154.46	154.62		154.64	0.003384	0.54	7.68	63.21	0.45	3.70
Reach-1A	209	25YR	2.59	154.46	154.61		154.62	0.003406	0.51	7.00	62.08	0.45	3.26
Reach-1A	209	10YR	2.04	154.46	154.59		154.60	0.003367	0.47	5.96	60.57	0.43	2.63
Reach-1A	209	5YR	1.69	154.46	154.58		154.59	0.003404	0.44	5.21	59.45	0.43	2.25
Reach-1A	209	2YR	1.08	154.46	154.56		154.56	0.003358	0.37	3.83	57.34	0.41	1.60
Reach-1A	208.3	Regional	8.22	152.95	153.39	153.39	153.49	0.015529	1.43	5.73	28.20	1.02	7.22
Reach-1A	208.3	100YR	3.34	152.95	153.27	153.27	153.34	0.017277	1.20	2.78	19.29	1.01	3.04
Reach-1A	208.3	50YR	2.95	152.95	153.25	153.25	153.32	0.017668	1.18	2.50	18.22	1.02	2.68
Reach-1A	208.3	25YR	2.59	152.95	153.24	153.24	153.30	0.017639	1.14	2.26	17.23	1.01	2.34
Reach-1A	208.3	10YR	2.04	152.95	153.21	153.21	153.27	0.018454	1.10	1.85	15.36	1.02	1.84
Reach-1A	208.3	5YR	1.69	152.95	153.20	153.20	153.25	0.018459	1.05	1.60	14.28	1.00	1.57
Reach-1A	208.3	2YR	1.08	152.95	153.16	153.16	153.21	0.020123	0.98	1.11	11.82	1.02	1.10
Reach-1A	208.2	Regional	8.22	152.50	152.97		153.02	0.005186	1.01	8.16	29.95	0.62	6.87
Reach-1A	208.2	100YR	3.34	152.50	152.84		152.86	0.003706	0.71	4.73	23.00	0.50	2.85
Reach-1A	208.2	50YR	2.95	152.50	152.83		152.85	0.003354	0.66	4.48	22.44	0.47	2.51
Reach-1A	208.2	25YR	2.59	152.50	152.82		152.84	0.003010	0.61	4.24	21.87	0.44	2.17
Reach-1A	208.2	10YR	2.04	152.50	152.79		152.81	0.002619	0.55	3.74	20.68	0.41	1.70
Reach-1A	208.2	5YR	1.69	152.50	152.78		152.79	0.002247	0.49	3.45	19.94	0.38	1.44
Reach-1A	208.2	2YR	1.08	152.50	152.74		152.75	0.001701	0.39	2.75	18.01	0.32	1.01
Reach-1A	208.1	Regional	8.22	152.50	152.86		152.89	0.002501	0.81	11.61	41.89	0.44	6.52
Reach-1A	208.1	100YR	3.34	152.50	152.68		152.70	0.005502	0.72	4.82	33.67	0.58	2.68
Reach-1A	208.1	50YR	2.95	152.50	152.66	152.62	152.68	0.006636	0.72	4.18	32.79	0.62	2.35
Reach-1A	208.1	25YR	2.59	152.50	152.64	152.61	152.67	0.008196	0.73	3.60	31.97	0.68	2.03
Reach-1A	208.1	10YR	2.04	152.50	152.62	152.60	152.64	0.010360	0.71	2.88	30.91	0.73	1.58
Reach-1A	208.1	5YR	1.69	152.50	152.60	152.59	152.63	0.013743	0.72	2.35	30.12	0.82	1.34
Reach-1A	208.1	2YR	1.08	152.50	152.57	152.57	152.60	0.024560	0.73	1.48	28.59	1.02	0.93
Reach-1A	208	Regional	8.22	151.00	152.20	152.20	152.43	0.009902	2.14	4.77	16.09	0.92	5.70
Reach-1A	208	100YR	3.34	151.00	152.02	151.92	152.11	0.006207	1.31	2.57	8.51	0.68	2.31
Reach-1A	208	50YR	2.95	151.00	152.01	151.88	152.09	0.005402	1.20	2.47	7.88	0.63	2.02
Reach-1A	208	25YR	2.59	151.00	152.00		152.06	0.004645	1.09	2.38	7.35	0.59	1.73
Reach-1A	208	10YR	2.04	151.00	151.95		152.00	0.004357	1.00	2.03	6.19	0.56	1.34
Reach-1A	208	5YR	1.69	151.00	151.91		151.95	0.003944	0.93	1.82	5.72	0.53	1.13
Reach-1A	208	2YR	1.08	151.00	151.83		151.86	0.003012	0.77	1.39	4.66	0.45	0.79

HEC-RAS Plan: Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1A	207	Regional	8.22	150.25	151.04		151.08	0.002429	0.91	17.33	55.67	0.45	3.57
Reach-1A	207	100YR	3.34	150.25	150.82	150.79	150.86	0.006329	0.95	5.71	48.94	0.65	1.50
Reach-1A	207	50YR	2.95	150.25	150.80	150.78	150.85	0.007362	0.97	4.63	48.28	0.69	1.32
Reach-1A	207	25YR	2.59	150.25	150.78	150.76	150.83	0.008847	1.00	3.55	47.59	0.75	1.15
Reach-1A	207	10YR	2.04	150.25	150.75	150.71	150.80	0.009123	0.94	2.40	46.83	0.75	0.90
Reach-1A	207	5YR	1.69	150.25	150.72	150.70	150.77	0.010314	0.94	1.79	12.07	0.78	0.78
Reach-1A	207	2YR	1.08	150.25	150.65	150.65	150.71	0.015785	1.02	1.06	8.62	0.93	0.55
Reach-1A	206.3	Regional	10.29	149.49	150.48	150.46	150.69	0.006476	2.20	9.50	27.72	0.80	2.33
Reach-1A	206.3	100YR	4.18	149.49	150.26	150.13	150.37	0.004526	1.47	4.06	21.39	0.63	1.05
Reach-1A	206.3	50YR	3.71	149.49	150.23	150.09	150.33	0.004340	1.39	3.52	18.83	0.61	0.94
Reach-1A	206.3	25YR	3.26	149.49	150.20	150.06	150.29	0.004170	1.31	3.01	15.64	0.60	0.84
Reach-1A	206.3	10YR	2.57	149.49	150.12		150.20	0.004844	1.25	2.09	7.44	0.62	0.69
Reach-1A	206.3	5YR	2.13	149.49	150.08		150.15	0.004811	1.17	1.83	4.93	0.61	0.60
Reach-1A	206.3	2YR	1.37	149.49	149.98		150.03	0.004522	1.01	1.35	4.31	0.58	0.43
Reach-1A	206.2	Regional	10.29	149.25	150.24		150.35	0.006463	1.50	8.93	27.92	0.74	1.91
Reach-1A	206.2	100YR	4.18	149.25	150.05		150.11	0.005697	1.14	4.07	21.52	0.65	0.86
Reach-1A	206.2	50YR	3.71	149.25	150.02		150.08	0.005549	1.10	3.59	20.86	0.64	0.78
Reach-1A	206.2	25YR	3.26	149.25	150.00		150.05	0.005370	1.05	3.09	10.78	0.63	0.70
Reach-1A	206.2	10YR	2.57	149.25	149.93		149.98	0.004073	1.04	2.47	7.07	0.56	0.58
Reach-1A	206.2	5YR	2.13	149.25	149.90		149.94	0.003604	0.95	2.25	6.75	0.52	0.51
Reach-1A	206.2	2YR	1.37	149.25	149.83		149.86	0.002521	0.74	1.85	6.14	0.43	0.36
Reach-1A	206.1	Regional	10.29	149.00	150.00		150.10	0.004737	1.43	10.08	30.27	0.64	1.48
Reach-1A	206.1	100YR	4.18	149.00	149.78	149.72	149.84	0.006152	1.11	4.19	21.02	0.66	0.67
Reach-1A	206.1	50YR	3.71	149.00	149.76		149.82	0.006234	1.06	3.78	19.63	0.66	0.61
Reach-1A	206.1	25YR	3.26	149.00	149.75		149.80	0.006074	1.00	3.45	18.39	0.64	0.55
Reach-1A	206.1	10YR	2.57	149.00	149.71	149.65	149.75	0.006355	0.92	2.85	15.67	0.64	0.46
Reach-1A	206.1	5YR	2.13	149.00	149.68	149.63	149.72	0.006798	0.88	2.44	14.24	0.65	0.40
Reach-1A	206.1	2YR	1.37	149.00	149.60	149.58	149.65	0.011888	0.95	1.44	10.30	0.81	0.28
Reach-1	205	Regional	19.22	147.24	148.41	148.41	148.77	0.010592	2.63	7.32	10.57	1.01	52.71
Reach-1	205	100YR	7.64	147.24	148.04	148.04	148.25	0.012082	2.06	3.70	8.54	1.00	19.91
Reach-1	205	50YR	6.77	147.24	148.00	148.00	148.20	0.012332	2.00	3.39	8.32	1.00	16.52
Reach-1	205	25YR	5.94	147.24	147.96	147.96	148.15	0.013010	1.95	3.04	8.08	1.02	15.15
Reach-1	205	10YR	4.67	147.24	147.90	147.90	148.07	0.013148	1.81	2.58	7.75	1.00	11.27
Reach-1	205	5YR	3.85	147.24	147.86	147.85	148.00	0.012918	1.69	2.28	7.53	0.98	9.18
Reach-1	205	2YR	2.45	147.24	147.80		147.89	0.009540	1.31	1.87	7.21	0.82	6.60
Reach-1	204.75	Regional	19.22	146.00	147.79		147.92	0.001853	1.62	17.25	28.41	0.46	50.90
Reach-1	204.75	100YR	7.64	146.00	147.29		147.35	0.001808	1.15	7.74	15.04	0.42	19.07
Reach-1	204.75	50YR	6.77	146.00	147.19		147.26	0.002199	1.18	6.34	13.88	0.46	15.80
Reach-1	204.75	25YR	5.94	146.00	147.10		147.17	0.002697	1.21	5.14	11.97	0.49	14.55
Reach-1	204.75	10YR	4.67	146.00	146.95		147.03	0.003674	1.24	3.75	7.48	0.56	10.81
Reach-1	204.75	5YR	3.85	146.00	146.85		146.93	0.004555	1.26	3.05	6.98	0.61	8.79
Reach-1	204.75	2YR	2.45	146.00	146.68		146.76	0.006304	1.26	1.95	5.76	0.69	6.32
Reach-1	204.7	Regional	19.22	145.80	147.75	147.23	147.81	0.000687	1.15	24.50	34.03	0.29	49.34
Reach-1	204.7	100YR	7.64	145.80	147.02	146.57	147.17	0.002359	1.74	4.39	14.52	0.50	18.44
Reach-1	204.7	50YR	6.77	145.80	146.93	146.51	147.07	0.002423	1.67	4.05	13.52	0.50	15.27
Reach-1	204.7	25YR	5.94	145.80	146.83	146.45	146.96	0.002495	1.60	3.71	11.72	0.50	14.11
Reach-1	204.7	10YR	4.67	145.80	146.68	146.36	146.79	0.002633	1.48	3.16	9.39	0.50	10.48
Reach-1	204.7	5YR	3.85	145.80	146.57	146.29	146.67	0.002750	1.38	2.78	8.44	0.50	8.52
Reach-1	204.7	2YR	2.45	145.80	146.37	146.16	146.44	0.003043	1.19	2.06	6.73	0.50	6.15
Reach-1	204.6		Culvert										
Reach-1	204.55	Regional	19.22	145.40	146.83	146.83	147.54	0.009531	3.74	5.14	25.62	1.00	49.14
Reach-1	204.55	100YR	7.64	145.40	146.32	146.17	146.59	0.006478	2.30	3.32	10.02	0.77	18.37
Reach-1	204.55	50YR	6.77	145.40	146.29	146.11	146.52	0.005689	2.11	3.21	9.65	0.71	15.21
Reach-1	204.55	25YR	5.94	145.40	146.25	146.05	146.44	0.005046	1.93	3.08	9.20	0.67	14.06
Reach-1	204.55	10YR	4.67	145.40	146.20	145.96	146.33	0.003873	1.62	2.88	8.86	0.58	10.43
Reach-1	204.55	5YR	3.85	145.40	146.15	145.89	146.25	0.003263	1.42	2.70	8.56	0.53	8.48
Reach-1	204.55	2YR	2.45	145.40	146.04	145.76	146.10	0.002285	1.07	2.29	7.67	0.43	6.12
Reach-1	204.5	Regional	19.22	145.36	146.56	146.52	146.78	0.008143	2.07	10.05	23.76	0.87	48.92
Reach-1	204.5	100YR	7.64	145.36	146.27		146.39	0.006973	1.55	4.94	11.75	0.76	18.27
Reach-1	204.5	50YR	6.77	145.36	146.24		146.35	0.006542	1.49	4.53	10.79	0.74	15.12
Reach-1	204.5	25YR	5.94	145.36	146.19		146.30	0.006201	1.45	4.09	9.77	0.72	13.97
Reach-1	204.5	10YR	4.67	145.36	146.14		146.23	0.005398	1.30	3.60	9.17	0.66	10.36
Reach-1	204.5	5YR	3.85	145.36	146.09		146.17	0.005322	1.23	3.13	8.56	0.65	8.42
Reach-1	204.5	2YR	2.45	145.36	145.96		146.03	0.005747	1.13	2.16	7.06	0.65	6.08
Reach-1	204.25	Regional	19.22	145.11	146.31	146.31	146.56	0.009040	2.45	14.01	30.94	0.93	48.62
Reach-1	204.25	100YR	7.64	145.11	146.02	146.02	146.19	0.009580	1.87	5.92	23.97	0.89	18.14
Reach-1	204.25	50YR	6.77	145.11	145.99	145.99	146.15	0.009680	1.81	5.21	23.09	0.89	15.00
Reach-1	204.25	25YR	5.94	145.11	145.95	145.95	146.11	0.009243	1.80	4.28	19.93	0.87	13.87
Reach-1	204.25	10YR	4.67	145.11	145.84	145.84	146.02	0.011776	1.89	2.61	11.13	0.97	10.28
Reach-1	204.25	5YR	3.85	145.11	145.77	145.77	145.95	0.013458	1.90	2.03	5.70	1.02	8.35
Reach-1	204.25	2YR	2.45	145.11	145.66	145.66	145.81	0.014044	1.72	1.43	4.82	1.01	6.03
Reach-1	204	Regional	19.22	144.05	145.09	145.09	145.38	0.009668	2.87	14.36	25.22	1.01	47.23
Reach-1	204	100YR	7.64	144.05	144.80	144.80	144.97	0.008893	2.05	7.24	23.17	0.90	17.50

HEC-RAS Plan: Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	204	50YR	6.77	144.05	144.76	144.76	144.93	0.009105	1.99	6.47	22.94	0.90	14.44
Reach-1	204	25YR	5.94	144.05	144.72	144.72	144.88	0.010018	1.96	5.51	21.76	0.93	13.40
Reach-1	204	10YR	4.67	144.05	144.66	144.66	144.81	0.010227	1.82	4.37	19.84	0.92	9.95
Reach-1	204	5YR	3.85	144.05	144.63	144.63	144.76	0.010173	1.70	3.65	18.53	0.90	8.09
Reach-1	204	2YR	2.45	144.05	144.54	144.54	144.65	0.011206	1.50	2.22	15.61	0.90	5.86
Reach-1	203	Regional	20.34	142.50	145.01		145.04	0.000412	0.90	36.80	39.21	0.23	45.63
Reach-1	203	100YR	8.16	142.50	143.71	143.71	143.92	0.013003	2.02	4.04	10.00	1.01	17.15
Reach-1	203	50YR	7.22	142.50	143.67	143.67	143.87	0.012975	1.99	3.62	9.08	1.01	14.12
Reach-1	203	25YR	6.34	142.50	143.54	143.54	143.82	0.013101	2.33	2.73	5.32	1.04	13.15
Reach-1	203	10YR	4.99	142.50	143.46	143.46	143.70	0.012524	2.17	2.30	4.81	1.00	9.75
Reach-1	203	5YR	4.10	142.50	143.38	143.38	143.61	0.013015	2.09	1.96	4.44	1.01	7.91
Reach-1	203	2YR	2.61	142.50	143.23	143.23	143.42	0.014042	1.92	1.36	3.70	1.01	5.75
Reach-1	202.75	Regional	20.34	142.43	144.67	143.85	144.95	0.001783	2.36	8.63	35.92	0.50	44.78
Reach-1	202.75	100YR	8.16	142.43	143.65	143.20	143.80	0.002188	1.74	4.69	27.66	0.50	16.93
Reach-1	202.75	50YR	7.22	142.43	143.55	143.14	143.70	0.002248	1.67	4.32	26.88	0.50	13.93
Reach-1	202.75	25YR	6.34	142.43	143.46	143.08	143.59	0.002315	1.60	3.96	25.28	0.50	12.98
Reach-1	202.75	10YR	4.99	142.43	143.31	142.99	143.42	0.002442	1.48	3.38	20.87	0.50	9.62
Reach-1	202.75	5YR	4.10	142.43	143.20	142.92	143.30	0.002552	1.38	2.96	17.89	0.50	7.81
Reach-1	202.75	2YR	2.61	142.43	143.00	142.79	143.07	0.002823	1.19	2.19	14.99	0.50	5.69
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	20.34	142.28	143.69	143.69	144.41	0.015353	3.74	5.44	4.41	1.00	43.84
Reach-1	202.25	100YR	8.16	142.28	143.05	143.05	143.44	0.015075	2.75	2.97	3.85	1.00	16.53
Reach-1	202.25	50YR	7.22	142.28	142.99	142.99	143.35	0.015004	2.64	2.74	3.85	1.00	13.57
Reach-1	202.25	25YR	6.34	142.28	142.93	142.93	143.26	0.014956	2.52	2.51	3.85	1.00	12.67
Reach-1	202.25	10YR	4.99	142.28	142.83	142.83	143.11	0.015154	2.34	2.13	3.85	1.00	9.37
Reach-1	202.25	5YR	4.10	142.28	142.77	142.77	143.01	0.015225	2.19	1.87	3.85	1.00	7.60
Reach-1	202.25	2YR	2.61	142.28	142.70	142.64	142.83	0.009657	1.61	1.62	3.85	0.79	5.54
Reach-1	202	Regional	20.34	142.20	143.24		143.30	0.001777	1.33	29.18	49.31	0.44	43.49
Reach-1	202	100YR	8.16	142.20	142.70	142.70	142.85	0.010594	1.80	6.29	26.77	0.93	16.44
Reach-1	202	50YR	7.22	142.20	142.67	142.67	142.81	0.010874	1.74	5.60	25.20	0.93	13.49
Reach-1	202	25YR	6.34	142.20	142.64	142.64	142.78	0.011881	1.70	4.82	22.43	0.96	12.60
Reach-1	202	10YR	4.99	142.20	142.60	142.60	142.72	0.011592	1.55	4.01	20.98	0.93	9.31
Reach-1	202	5YR	4.10	142.20	142.57	142.57	142.67	0.012252	1.47	3.35	19.88	0.93	7.55
Reach-1	202	2YR	2.61	142.20	142.51	142.51	142.59	0.013697	1.29	2.18	18.14	0.94	5.51
Reach-1	201	Regional	20.34	141.65	143.21		143.25	0.000587	1.03	37.18	39.45	0.27	42.01
Reach-1	201	100YR	8.16	141.65	142.60		142.64	0.000895	0.89	15.07	31.97	0.31	15.94
Reach-1	201	50YR	7.22	141.65	142.53		142.56	0.001027	0.90	12.74	30.78	0.33	13.06
Reach-1	201	25YR	6.34	141.65	142.50		142.53	0.000928	0.83	11.86	30.31	0.31	12.21
Reach-1	201	10YR	4.99	141.65	142.40		142.43	0.001020	0.79	9.02	25.76	0.31	9.00
Reach-1	201	5YR	4.10	141.65	142.34		142.36	0.001004	0.74	7.55	23.14	0.31	7.29
Reach-1	201	2YR	2.61	141.65	142.25		142.27	0.000742	0.57	5.70	19.41	0.26	5.32
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	171	100YR	8.17	141.65	142.44	142.21	142.50	0.002213	1.21	9.98	27.36	0.47	14.77
Reach-1	171	50YR	6.60	141.65	142.36	142.15	142.42	0.002210	1.13	8.15	24.25	0.46	12.09
Reach-1	171	25YR	6.10	141.65	142.34	142.13	142.40	0.002202	1.10	7.58	23.20	0.46	11.30
Reach-1	171	10YR	4.37	141.65	142.25	142.05	142.29	0.002182	0.97	5.57	19.13	0.44	8.32
Reach-1	171	5YR	3.52	141.65	142.19	142.01	142.23	0.002166	0.89	4.59	16.80	0.43	6.72
Reach-1	171	2YR	2.57	141.65	142.12	141.95	142.15	0.002101	0.79	3.54	13.88	0.41	4.88
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	169	100YR	8.17	141.65	142.21	142.21	142.40	0.009752	1.96	4.98	17.76	0.92	14.61
Reach-1	169	50YR	6.60	141.65	142.15	142.15	142.32	0.010567	1.86	3.98	15.15	0.94	11.95
Reach-1	169	25YR	6.10	141.65	142.13	142.13	142.30	0.011146	1.83	3.63	14.16	0.95	11.17
Reach-1	169	10YR	4.37	141.65	142.05	142.05	142.19	0.013010	1.69	2.63	10.71	0.99	8.23
Reach-1	169	5YR	3.52	141.65	142.01	142.01	142.13	0.014215	1.59	2.21	8.88	1.01	6.65
Reach-1	169	2YR	2.57	141.65	141.95	141.95	142.06	0.014892	1.45	1.77	8.23	1.00	4.83
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	164	100YR	8.17	138.30	138.83		138.86	0.002624	0.51	10.37	14.75	0.32	13.27
Reach-1	164	50YR	6.60	138.30	138.74		138.76	0.002349	0.41	9.12	13.62	0.29	10.81
Reach-1	164	25YR	6.10	138.30	138.69		138.72	0.002374	0.38	8.50	12.97	0.29	10.12
Reach-1	164	10YR	4.37	138.30	138.54		138.56	0.002100	0.28	6.77	10.44	0.25	7.41
Reach-1	164	5YR	3.52	138.30	138.46		138.47	0.001886	0.19	5.92	9.30	0.22	5.94
Reach-1	164	2YR	2.57	138.30	138.34		138.36	0.001562	0.07	4.96	7.74	0.16	4.24
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	163	100YR	8.17	137.20	138.08	137.99	138.23	0.009915	1.99	7.75	50.21	0.74	12.04
Reach-1	163	50YR	6.60	137.20	138.02	137.97	138.17	0.010628	1.93	5.32	22.77	0.76	9.83
Reach-1	163	25YR	6.10	137.20	137.99	137.97	138.13	0.010185	1.84	4.82	15.66	0.74	9.21
Reach-1	163	10YR	4.37	137.20	137.90	137.86	138.02	0.009858	1.65	3.61	13.13	0.71	6.70
Reach-1	163	5YR	3.52	137.20	137.84	137.80	137.96	0.010879	1.59	2.82	11.19	0.73	5.34
Reach-1	163	2YR	2.57	137.20	137.74	137.72	137.86	0.015146	1.60	1.81	8.05	0.82	3.77
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	162	100YR	8.17	135.60	136.46		136.55	0.008365	1.65	8.05	23.23	0.67	10.63

HEC-RAS Plan: Existing (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	162	50YR	6.60	135.60	136.42	136.32	136.49	0.007713	1.51	7.02	21.71	0.63	8.72
Reach-1	162	25YR	6.10	135.60	136.39		136.46	0.007886	1.48	6.54	20.96	0.64	8.19
Reach-1	162	10YR	4.37	135.60	136.32		136.38	0.007899	1.34	5.01	18.41	0.62	5.92
Reach-1	162	5YR	3.52	135.60	136.28		136.33	0.007036	1.21	4.42	17.31	0.58	4.68
Reach-1	162	2YR	2.57	135.60	136.25		136.28	0.005238	0.99	3.87	16.23	0.49	3.25
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	161	100YR	8.17	134.10	134.98	134.98	135.07	0.008814	1.68	10.93	62.89	0.67	9.05
Reach-1	161	50YR	6.60	134.10	134.95	134.95	135.03	0.009136	1.64	8.64	54.87	0.68	7.42
Reach-1	161	25YR	6.10	134.10	134.94	134.94	135.02	0.008737	1.59	8.14	52.96	0.66	6.96
Reach-1	161	10YR	4.37	134.10	134.89	134.89	134.97	0.008112	1.44	5.85	43.08	0.63	5.00
Reach-1	161	5YR	3.52	134.10	134.85	134.85	134.93	0.008870	1.43	4.23	34.42	0.65	3.94
Reach-1	161	2YR	2.57	134.10	134.76	134.69	134.87	0.012829	1.52	2.03	16.61	0.76	2.74
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44
Reach-1	160	100YR	8.17	132.50	133.61		133.64	0.002166	0.99	15.54	41.27	0.33	4.97
Reach-1	160	50YR	6.60	132.50	133.54		133.57	0.002221	0.96	12.79	37.14	0.33	4.10
Reach-1	160	25YR	6.10	132.50	133.52	133.29	133.54	0.002198	0.94	11.99	35.85	0.33	3.84
Reach-1	160	10YR	4.37	132.50	133.41		133.44	0.002411	0.92	8.52	29.61	0.34	2.77
Reach-1	160	5YR	3.52	132.50	133.35		133.38	0.002582	0.91	6.73	25.80	0.35	2.23
Reach-1	160	2YR	2.57	132.50	133.28		133.30	0.002499	0.84	5.01	21.54	0.34	1.63

HEC-RAS Model Results for 14W-16, 14W-14, 14W-12A and 14W-12--------Phase 1A Condition (Controlled Flow)

HEC-RAS Plan: Control P1A

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	228	Regional	7.88	153.98	154.23		154.26	0.005679	0.82	9.64	51.91	0.61	9.67
Reach-2A	228	100YR	3.06	153.98	154.12		154.14	0.007080	0.65	4.70	41.99	0.62	4.28
Reach-2A	228	50YR	2.71	153.98	154.11		154.13	0.007245	0.63	4.31	41.21	0.62	3.82
Reach-2A	228	25YR	2.37	153.98	154.11		154.13	0.005918	0.56	4.21	41.02	0.56	3.27
Reach-2A	228	10YR	1.85	153.98	154.09		154.11	0.006451	0.53	3.49	39.53	0.57	2.63
Reach-2A	228	5YR	1.52	153.98	154.08		154.09	0.007092	0.51	2.98	38.45	0.59	2.21
Reach-2A	228	2YR	0.95	153.98	154.06	154.04	154.07	0.008712	0.46	2.06	36.21	0.62	1.48
Reach-2A	227	Regional	7.88	153.04	153.33	153.32	153.43	0.013223	1.41	6.09	33.73	0.95	8.89
Reach-2A	227	100YR	3.06	153.04	153.24	153.22	153.28	0.010626	0.91	3.41	27.18	0.79	3.88
Reach-2A	227	50YR	2.71	153.04	153.23	153.21	153.27	0.010447	0.86	3.16	26.50	0.77	3.45
Reach-2A	227	25YR	2.37	153.04	153.21	153.20	153.25	0.014192	0.90	2.63	24.96	0.87	2.93
Reach-2A	227	10YR	1.85	153.04	153.20	153.18	153.23	0.012560	0.79	2.34	24.04	0.81	2.34
Reach-2A	227	5YR	1.52	153.04	153.19	153.17	153.21	0.011177	0.71	2.13	23.30	0.75	1.96
Reach-2A	227	2YR	0.95	153.04	153.17	153.15	153.18	0.008941	0.57	1.67	21.61	0.66	1.29
Reach-2A	226	Regional	7.88	152.44	152.74		152.77	0.003714	0.76	10.43	45.96	0.51	8.06
Reach-2A	226	100YR	3.06	152.44	152.62		152.63	0.004283	0.59	5.22	37.44	0.50	3.45
Reach-2A	226	50YR	2.71	152.44	152.61		152.62	0.004293	0.56	4.81	36.69	0.50	3.05
Reach-2A	226	25YR	2.37	152.44	152.60		152.62	0.003509	0.50	4.70	36.49	0.45	2.56
Reach-2A	226	10YR	1.85	152.44	152.58		152.59	0.003802	0.48	3.89	34.94	0.46	2.03
Reach-2A	226	5YR	1.52	152.44	152.56	152.52	152.57	0.004079	0.45	3.34	33.85	0.46	1.68
Reach-2A	226	2YR	0.95	152.44	152.53		152.54	0.004792	0.41	2.34	31.69	0.48	1.09
Reach-2A	225	Regional	7.88	151.75	152.28		152.34	0.004966	1.27	12.52	56.45	0.64	6.91
Reach-2A	225	100YR	3.06	151.75	152.12		152.16	0.005177	0.93	5.12	36.80	0.60	2.93
Reach-2A	225	50YR	2.71	151.75	152.10	152.05	152.14	0.005411	0.91	4.48	34.74	0.61	2.59
Reach-2A	225	25YR	2.37	151.75	152.07	152.04	152.11	0.007584	0.98	3.29	31.09	0.71	2.16
Reach-2A	225	10YR	1.85	151.75	152.05	152.01	152.08	0.006966	0.88	2.64	27.52	0.67	1.70
Reach-2A	225	5YR	1.52	151.75	152.03	151.98	152.06	0.006622	0.81	2.19	25.33	0.64	1.41
Reach-2A	225	2YR	0.95	151.75	151.99		152.01	0.005968	0.69	1.38	9.96	0.59	0.91
Reach-2A	224	Regional	7.88	151.25	151.72	151.66	151.81	0.005653	1.48	10.93	40.66	0.70	5.74
Reach-2A	224	100YR	3.06	151.25	151.54	151.50	151.60	0.006213	1.11	4.57	29.00	0.68	2.45
Reach-2A	224	50YR	2.71	151.25	151.53	151.48	151.58	0.005907	1.04	4.19	28.12	0.65	2.15
Reach-2A	224	25YR	2.37	151.25	151.54	151.46	151.57	0.004037	0.88	4.41	28.63	0.54	1.78
Reach-2A	224	10YR	1.85	151.25	151.50	151.43	151.53	0.004450	0.83	3.35	25.94	0.56	1.40
Reach-2A	224	5YR	1.52	151.25	151.47	151.41	151.50	0.004787	0.79	2.69	22.76	0.56	1.16
Reach-2A	224	2YR	0.95	151.25	151.42	151.37	151.44	0.005379	0.69	1.67	17.12	0.57	0.75
Reach-2A	223	Regional	7.88	150.26	151.01	150.99	151.13	0.008351	1.84	10.11	46.66	0.84	4.69
Reach-2A	223	100YR	3.06	150.26	150.83	150.83	150.92	0.007310	1.42	4.09	30.73	0.75	2.01
Reach-2A	223	50YR	2.71	150.26	150.80	150.80	150.90	0.007775	1.41	3.31	30.42	0.76	1.78
Reach-2A	223	25YR	2.37	150.26	150.72	150.72	150.87	0.014149	1.71	1.38	4.64	1.00	1.49
Reach-2A	223	10YR	1.85	150.26	150.67	150.66	150.80	0.013621	1.61	1.15	4.08	0.97	1.18
Reach-2A	223	5YR	1.52	150.26	150.64	150.62	150.75	0.012983	1.50	1.01	3.87	0.94	0.98
Reach-2A	223	2YR	0.95	150.26	150.56	150.54	150.65	0.012720	1.28	0.74	3.56	0.90	0.63
Reach-2A	222	Regional	7.88	149.74	150.34	150.30	150.42	0.005874	1.58	13.28	54.52	0.72	3.52
Reach-2A	222	100YR	3.06	149.74	150.20	150.14	150.25	0.003731	1.02	6.74	42.79	0.54	1.47
Reach-2A	222	50YR	2.71	149.74	150.19	150.12	150.23	0.003668	0.98	5.99	40.92	0.53	1.31
Reach-2A	222	25YR	2.37	149.74	150.17	150.10	150.21	0.003581	0.94	5.26	39.00	0.52	1.15
Reach-2A	222	10YR	1.85	149.74	150.14	150.04	150.17	0.003379	0.85	4.11	35.79	0.50	0.92
Reach-2A	222	5YR	1.52	149.74	150.11	150.00	150.14	0.003313	0.80	3.21	30.63	0.49	0.77
Reach-2A	222	2YR	0.95	149.74	150.04	149.93	150.07	0.003143	0.71	1.61	16.49	0.46	0.52
Reach-2A	221	Regional	7.88	149.23	149.77	149.70	149.86	0.005346	1.49	9.97	39.84	0.69	2.36
Reach-2A	221	100YR	3.06	149.23	149.52	149.52	149.62	0.012499	1.40	2.65	19.86	0.93	1.00
Reach-2A	221	50YR	2.71	149.23	149.50	149.50	149.59	0.013016	1.36	2.31	18.55	0.94	0.90
Reach-2A	221	25YR	2.37	149.23	149.48	149.48	149.57	0.013827	1.32	1.96	16.71	0.95	0.79
Reach-2A	221	10YR	1.85	149.23	149.44	149.44	149.53	0.016076	1.28	1.46	9.96	1.00	0.64
Reach-2A	221	5YR	1.52	149.23	149.42	149.42	149.50	0.017022	1.21	1.25	8.52	1.01	0.54
Reach-2A	221	2YR	0.95	149.23	149.38	149.38	149.43	0.018423	1.07	0.89	7.65	1.01	0.39
Reach-2B	231.1	Regional	8.23	148.25	149.80		149.81	0.000200	0.60	46.06	58.53	0.16	0.28
Reach-2B	231.1	100YR	3.20	148.25	149.31		149.31	0.000225	0.48	19.73	44.11	0.16	0.12
Reach-2B	231.1	50YR	2.83	148.25	149.26		149.27	0.000219	0.46	17.85	41.95	0.15	0.11
Reach-2B	231.1	25YR	2.48	148.25	149.22		149.23	0.000212	0.44	16.06	39.79	0.15	0.10
Reach-2B	231.1	10YR	1.94	148.25	149.15		149.15	0.000196	0.40	13.25	36.13	0.14	0.08
Reach-2B	231.1	5YR	1.59	148.25	149.09		149.10	0.000181	0.37	11.39	33.48	0.14	0.07
Reach-2B	231.1	2YR	1.00	148.25	148.99		148.99	0.000143	0.29	8.13	28.21	0.12	0.05
Reach-2B	231	Regional	8.23	148.25	149.80		149.81	0.000200	0.60	46.05	58.52	0.16	0.23
Reach-2B	231	100YR	3.20	148.25	149.31		149.31	0.000225	0.48	19.72	44.10	0.16	0.10
Reach-2B	231	50YR	2.83	148.25	149.26		149.27	0.000219	0.46	17.84	41.94	0.15	0.09
Reach-2B	231	25YR	2.48	148.25	149.22		149.23	0.000212	0.44	16.05	39.77	0.15	0.08
Reach-2B	231	10YR	1.94	148.25	149.15		149.15	0.000196	0.40	13.24	36.12	0.14	0.07
Reach-2B	231	5YR	1.59	148.25	149.09		149.10	0.000181	0.37	11.39	33.47	0.14	0.06
Reach-2B	231	2YR	1.00	148.25	148.99		148.99	0.000143	0.29	8.13	28.20	0.12	0.04
Reach-2C	220.3	Regional	8.23	148.25	149.80		149.81	0.000127	0.48	60.38	69.05	0.13	2.09
Reach-2C	220.3	100YR	3.20	148.25	149.31		149.31	0.000160	0.41	27.28	64.44	0.13	0.89
Reach-2C	220.3	50YR	2.83	148.25	149.26		149.27	0.000162	0.40	24.46	63.99	0.13	0.80
Reach-2C	220.3	25YR	2.48	148.25	149.22		149.22	0.000160	0.38	21.71	60.35	0.13	0.71

HEC-RAS Plan: Control P1A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2C	220.3	10YR	1.94	148.25	149.15		149.15	0.000150	0.35	17.56	51.71	0.13	0.58
Reach-2C	220.3	5YR	1.59	148.25	149.09		149.10	0.000139	0.32	14.96	45.47	0.12	0.50
Reach-2C	220.3	2YR	1.00	148.25	148.99		148.99	0.000105	0.25	10.80	33.98	0.10	0.36
Reach-2C	220.2	Regional	8.23	148.57	149.41	149.41	149.75	0.009405	2.64	3.92	6.98	0.98	0.33
Reach-2C	220.2	100YR	3.20	148.57	149.11	149.07	149.27	0.008910	1.80	2.00	5.55	0.87	0.09
Reach-2C	220.2	50YR	2.83	148.57	149.09		149.23	0.008103	1.67	1.90	5.47	0.83	0.08
Reach-2C	220.2	25YR	2.48	148.57	149.07	149.01	149.19	0.007587	1.55	1.77	5.36	0.79	0.07
Reach-2C	220.2	10YR	1.94	148.57	149.02		149.12	0.007054	1.38	1.53	5.15	0.75	0.06
Reach-2C	220.2	5YR	1.59	148.57	148.98		149.06	0.006843	1.26	1.35	4.98	0.72	0.05
Reach-2C	220.2	2YR	1.00	148.57	148.91		148.97	0.006874	1.05	0.99	4.63	0.69	0.04
Reach-2C	220.1	Regional	8.23	148.25	149.15	149.11	149.22	0.004926	1.39	13.87	63.10	0.65	0.04
Reach-2C	220.1	100YR	3.20	148.25	148.91	148.84	148.99	0.006765	1.29	3.05	16.59	0.72	0.01
Reach-2C	220.1	50YR	2.83	148.25	148.87	148.81	148.96	0.007239	1.28	2.53	15.03	0.74	0.01
Reach-2C	220.1	25YR	2.48	148.25	148.84	148.78	148.92	0.007639	1.27	2.07	10.63	0.75	0.01
Reach-2C	220.1	10YR	1.94	148.25	148.79	148.73	148.86	0.007976	1.21	1.61	6.96	0.75	0.01
Reach-2C	220.1	5YR	1.59	148.25	148.75	148.69	148.82	0.008209	1.16	1.37	5.64	0.75	0.01
Reach-2C	220.1	2YR	1.00	148.25	148.67		148.72	0.007984	1.04	0.96	4.54	0.72	0.00
Reach-2C	220	Regional	8.23	148.25	149.11	149.11	149.21	0.007117	1.62	11.42	61.50	0.77	0.03
Reach-2C	220	100YR	3.20	148.25	148.84	148.84	148.98	0.013104	1.65	2.04	9.97	0.98	0.01
Reach-2C	220	50YR	2.83	148.25	148.81	148.81	148.94	0.013970	1.64	1.76	8.10	1.00	0.01
Reach-2C	220	25YR	2.48	148.25	148.78	148.78	148.91	0.014458	1.60	1.55	6.36	1.01	0.01
Reach-2C	220	10YR	1.94	148.25	148.73	148.73	148.85	0.014804	1.54	1.26	5.28	1.01	0.01
Reach-2C	220	5YR	1.59	148.25	148.69	148.69	148.80	0.015266	1.49	1.07	4.80	1.01	0.00
Reach-2C	220	2YR	1.00	148.25	148.61	148.61	148.71	0.016304	1.37	0.73	3.93	1.01	0.00
Reach-1A	210.5	Regional	8.22	155.11	155.53	155.48	155.55	0.006998	0.70	11.69	92.57	0.63	11.07
Reach-1A	210.5	100YR	3.34	155.11	155.45	155.42	155.46	0.008320	0.62	5.41	59.22	0.65	5.03
Reach-1A	210.5	50YR	2.95	155.11	155.44	155.41	155.46	0.008501	0.60	4.90	56.58	0.65	4.50
Reach-1A	210.5	25YR	2.59	155.11	155.43	155.40	155.45	0.008816	0.59	4.40	53.83	0.66	3.99
Reach-1A	210.5	10YR	2.04	155.11	155.41	155.39	155.43	0.008922	0.55	3.68	49.66	0.65	3.25
Reach-1A	210.5	5YR	1.69	155.11	155.40	155.38	155.42	0.009281	0.53	3.16	46.44	0.65	2.80
Reach-1A	210.5	2YR	1.08	155.11	155.38	155.35	155.39	0.009833	0.50	2.14	35.91	0.66	2.02
Reach-1A	210	Regional	8.22	154.96	155.26	155.21	155.30	0.007361	0.93	8.87	48.03	0.69	10.71
Reach-1A	210	100YR	3.34	154.96	155.16		155.19	0.007570	0.72	4.62	37.04	0.65	4.86
Reach-1A	210	50YR	2.95	154.96	155.15		155.17	0.007569	0.70	4.23	35.83	0.65	4.34
Reach-1A	210	25YR	2.59	154.96	155.14		155.16	0.007419	0.67	3.89	34.73	0.64	3.85
Reach-1A	210	10YR	2.04	154.96	155.12		155.14	0.007571	0.62	3.26	32.63	0.63	3.13
Reach-1A	210	5YR	1.69	154.96	155.11		155.13	0.007413	0.59	2.89	31.28	0.62	2.69
Reach-1A	210	2YR	1.08	154.96	155.08		155.10	0.007391	0.51	2.12	28.37	0.59	1.94
Reach-1A	209	Regional	8.22	154.46	154.74		154.77	0.003402	0.80	15.89	75.38	0.50	9.34
Reach-1A	209	100YR	3.34	154.46	154.63		154.65	0.003394	0.57	8.37	64.87	0.46	4.14
Reach-1A	209	50YR	2.95	154.46	154.62		154.64	0.003384	0.54	7.68	63.21	0.45	3.68
Reach-1A	209	25YR	2.59	154.46	154.61		154.62	0.003406	0.51	7.00	62.08	0.45	3.25
Reach-1A	209	10YR	2.04	154.46	154.59		154.60	0.003367	0.47	5.96	60.57	0.43	2.62
Reach-1A	209	5YR	1.69	154.46	154.58		154.59	0.003404	0.44	5.21	59.45	0.43	2.25
Reach-1A	209	2YR	1.08	154.46	154.56		154.56	0.003358	0.37	3.83	57.34	0.41	1.61
Reach-1A	208.3	Regional	8.22	152.95	153.39	153.39	153.49	0.015529	1.43	5.73	28.20	1.02	7.17
Reach-1A	208.3	100YR	3.34	152.95	153.27	153.27	153.34	0.017277	1.20	2.78	19.29	1.01	3.02
Reach-1A	208.3	50YR	2.95	152.95	153.25	153.25	153.32	0.017668	1.18	2.50	18.22	1.02	2.66
Reach-1A	208.3	25YR	2.59	152.95	153.24	153.24	153.30	0.017639	1.14	2.26	17.23	1.01	2.32
Reach-1A	208.3	10YR	2.04	152.95	153.21	153.21	153.27	0.018454	1.10	1.85	15.36	1.02	1.83
Reach-1A	208.3	5YR	1.69	152.95	153.20	153.20	153.25	0.018459	1.05	1.60	14.28	1.00	1.56
Reach-1A	208.3	2YR	1.08	152.95	153.16	153.16	153.21	0.020123	0.98	1.11	11.82	1.02	1.12
Reach-1A	208.2	Regional	8.22	152.50	152.97		153.02	0.005186	1.01	8.16	29.95	0.62	6.82
Reach-1A	208.2	100YR	3.34	152.50	152.84		152.87	0.003629	0.70	4.77	23.08	0.49	2.83
Reach-1A	208.2	50YR	2.95	152.50	152.83		152.85	0.003346	0.66	4.48	22.44	0.47	2.49
Reach-1A	208.2	25YR	2.59	152.50	152.82		152.84	0.003003	0.61	4.24	21.88	0.44	2.16
Reach-1A	208.2	10YR	2.04	152.50	152.79		152.81	0.002614	0.54	3.74	20.69	0.41	1.69
Reach-1A	208.2	5YR	1.69	152.50	152.78		152.79	0.002233	0.49	3.46	19.96	0.38	1.44
Reach-1A	208.2	2YR	1.08	152.50	152.74		152.75	0.001701	0.39	2.75	18.01	0.32	1.02
Reach-1A	208.1	Regional	8.22	152.50	152.86		152.89	0.002501	0.81	11.61	41.89	0.44	6.47
Reach-1A	208.1	100YR	3.34	152.50	152.68		152.70	0.005534	0.72	4.81	33.66	0.58	2.66
Reach-1A	208.1	50YR	2.95	152.50	152.66	152.62	152.68	0.006685	0.73	4.17	32.78	0.63	2.33
Reach-1A	208.1	25YR	2.59	152.50	152.64	152.61	152.67	0.008258	0.73	3.59	31.95	0.68	2.01
Reach-1A	208.1	10YR	2.04	152.50	152.62	152.60	152.64	0.010433	0.72	2.87	30.91	0.74	1.57
Reach-1A	208.1	5YR	1.69	152.50	152.60	152.59	152.63	0.014076	0.73	2.33	30.09	0.83	1.33
Reach-1A	208.1	2YR	1.08	152.50	152.57	152.57	152.60	0.024560	0.73	1.48	28.59	1.02	0.95
Reach-1A	208	Regional	8.22	151.00	152.20	152.20	152.43	0.009902	2.14	4.77	16.09	0.92	5.65
Reach-1A	208	100YR	3.34	151.00	152.02	151.92	152.11	0.006153	1.31	2.58	8.56	0.68	2.29
Reach-1A	208	50YR	2.95	151.00	152.01	151.88	152.09	0.005347	1.20	2.48	7.94	0.63	2.00
Reach-1A	208	25YR	2.59	151.00	152.00		152.06	0.004611	1.09	2.39	7.38	0.58	1.72
Reach-1A	208	10YR	2.04	151.00	151.95		152.00	0.004336	1.00	2.04	6.19	0.56	1.33
Reach-1A	208	5YR	1.69	151.00	151.91		151.96	0.003882	0.92	1.83	5.74	0.52	1.12
Reach-1A	208	2YR	1.08	151.00	151.83		151.86	0.003013	0.77	1.39	4.66	0.45	0.80

HEC-RAS Plan: Control P1A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1A	207	Regional	8.22	150.25	151.04		151.07	0.002467	0.92	17.23	55.62	0.45	3.52
Reach-1A	207	100YR	3.34	150.25	150.82	150.79	150.86	0.006400	0.96	5.67	48.92	0.66	1.49
Reach-1A	207	50YR	2.95	150.25	150.80	150.78	150.84	0.007458	0.98	4.60	48.26	0.70	1.31
Reach-1A	207	25YR	2.59	150.25	150.78	150.76	150.83	0.008950	1.00	3.52	47.57	0.75	1.14
Reach-1A	207	10YR	2.04	150.25	150.75	150.71	150.80	0.009192	0.94	2.39	46.82	0.75	0.89
Reach-1A	207	5YR	1.69	150.25	150.72	150.70	150.77	0.010585	0.95	1.77	12.00	0.79	0.77
Reach-1A	207	2YR	1.08	150.25	150.65	150.65	150.71	0.015752	1.02	1.06	8.63	0.93	0.56
Reach-1A	206.3	Regional	10.21	149.49	150.48	150.46	150.68	0.006457	2.19	9.44	27.65	0.80	2.29
Reach-1A	206.3	100YR	4.15	149.49	150.26	150.13	150.36	0.004520	1.46	4.03	21.26	0.63	1.03
Reach-1A	206.3	50YR	3.68	149.49	150.23	150.09	150.33	0.004332	1.38	3.48	18.62	0.61	0.93
Reach-1A	206.3	25YR	3.23	149.49	150.20	150.05	150.29	0.004173	1.30	2.97	15.36	0.60	0.83
Reach-1A	206.3	10YR	2.55	149.49	150.12		150.20	0.004844	1.25	2.07	7.26	0.62	0.68
Reach-1A	206.3	5YR	2.11	149.49	150.08		150.14	0.004801	1.16	1.82	4.91	0.61	0.60
Reach-1A	206.3	2YR	1.36	149.49	149.97		150.03	0.004529	1.01	1.35	4.30	0.58	0.45
Reach-1A	206.2	Regional	10.21	149.25	150.24		150.35	0.006438	1.50	8.89	27.85	0.73	1.87
Reach-1A	206.2	100YR	4.15	149.25	150.04		150.11	0.005656	1.13	4.05	21.50	0.65	0.84
Reach-1A	206.2	50YR	3.68	149.25	150.02		150.08	0.005507	1.09	3.57	20.84	0.64	0.76
Reach-1A	206.2	25YR	3.23	149.25	150.00		150.05	0.005312	1.05	3.08	10.69	0.62	0.69
Reach-1A	206.2	10YR	2.55	149.25	149.93		149.98	0.004045	1.04	2.46	7.06	0.56	0.57
Reach-1A	206.2	5YR	2.11	149.25	149.89		149.94	0.003639	0.95	2.22	6.72	0.53	0.50
Reach-1A	206.2	2YR	1.36	149.25	149.82		149.85	0.002862	0.78	1.75	5.99	0.46	0.37
Reach-1A	206.1	Regional	10.21	149.00	150.00		150.10	0.004858	1.43	9.91	30.05	0.65	1.45
Reach-1A	206.1	100YR	4.15	149.00	149.78	149.71	149.84	0.006258	1.11	4.14	20.84	0.67	0.66
Reach-1A	206.1	50YR	3.68	149.00	149.76		149.82	0.006346	1.06	3.73	19.45	0.66	0.60
Reach-1A	206.1	25YR	3.23	149.00	149.74		149.79	0.006175	1.00	3.41	18.20	0.65	0.54
Reach-1A	206.1	10YR	2.55	149.00	149.71	149.65	149.75	0.006355	0.92	2.84	15.62	0.64	0.46
Reach-1A	206.1	5YR	2.11	149.00	149.69	149.63	149.72	0.006350	0.86	2.48	14.39	0.63	0.40
Reach-1A	206.1	2YR	1.36	149.00	149.64	149.57	149.66	0.006194	0.74	1.85	11.99	0.60	0.29
Reach-1	205	Regional	18.70	147.24	148.40	148.40	148.75	0.010663	2.61	7.16	10.46	1.01	53.06
Reach-1	205	100YR	7.43	147.24	148.03	148.03	148.24	0.012131	2.05	3.63	8.49	1.00	20.58
Reach-1	205	50YR	6.58	147.24	147.99	147.99	148.19	0.012398	1.98	3.32	8.27	1.00	17.25
Reach-1	205	25YR	5.77	147.24	147.95	147.95	148.14	0.013061	1.94	2.98	8.04	1.02	15.96
Reach-1	205	10YR	4.54	147.24	147.89	147.89	148.06	0.013369	1.80	2.52	7.70	1.01	12.08
Reach-1	205	5YR	3.74	147.24	147.85	147.85	148.00	0.013854	1.71	2.19	7.45	1.01	9.97
Reach-1	205	2YR	2.38	147.24	147.76	147.76	147.88	0.015221	1.51	1.58	6.97	1.01	7.28
Reach-1	204.75	Regional	18.70	146.00	147.49		147.54	0.001592	1.25	29.47	31.71	0.41	50.34
Reach-1	204.75	100YR	7.43	146.00	147.00		147.01	0.001403	0.80	16.12	19.49	0.35	19.11
Reach-1	204.75	50YR	6.58	146.00	146.94		146.96	0.001366	0.75	15.08	18.97	0.34	15.89
Reach-1	204.75	25YR	5.77	146.00	146.89		146.90	0.001326	0.70	14.03	18.43	0.33	14.69
Reach-1	204.75	10YR	4.54	146.00	146.79		146.80	0.001250	0.62	12.30	17.36	0.32	10.98
Reach-1	204.75	5YR	3.74	146.00	146.72		146.72	0.001180	0.56	11.07	16.46	0.30	8.98
Reach-1	204.75	2YR	2.38	146.00	146.56		146.57	0.001003	0.44	8.71	14.40	0.27	6.51
Reach-1	204.7	Regional	18.70	145.89	146.92	146.92	147.27	0.009831	2.63	7.43	13.42	0.99	48.95
Reach-1	204.7	100YR	7.43	145.89	146.54	146.54	146.76	0.012164	2.09	3.56	8.13	1.01	18.37
Reach-1	204.7	50YR	6.58	145.89	146.50	146.50	146.71	0.012330	2.03	3.23	7.76	1.01	15.20
Reach-1	204.7	25YR	5.77	145.89	146.45	146.45	146.65	0.012578	1.98	2.91	7.38	1.01	14.05
Reach-1	204.7	10YR	4.54	145.89	146.38	146.38	146.56	0.013043	1.88	2.41	6.80	1.01	10.43
Reach-1	204.7	5YR	3.74	145.89	146.34	146.34	146.50	0.013360	1.79	2.10	6.52	1.01	8.48
Reach-1	204.7	2YR	2.38	145.89	146.24	146.24	146.37	0.014394	1.59	1.50	5.92	1.01	6.13
Reach-1	204.55	Regional	18.70	145.49	146.68	146.56	146.90	0.005984	2.08	9.54	18.63	0.77	48.82
Reach-1	204.55	100YR	7.43	145.49	146.39		146.48	0.004030	1.34	5.56	10.86	0.60	18.29
Reach-1	204.55	50YR	6.58	145.49	146.35		146.43	0.003932	1.29	5.11	10.34	0.59	15.13
Reach-1	204.55	25YR	5.77	145.49	146.30		146.38	0.003831	1.24	4.65	9.79	0.57	13.99
Reach-1	204.55	10YR	4.54	145.49	146.23		146.30	0.003539	1.14	4.00	9.05	0.55	10.38
Reach-1	204.55	5YR	3.74	145.49	146.18		146.24	0.003515	1.06	3.51	8.73	0.54	8.44
Reach-1	204.55	2YR	2.38	145.49	146.06		146.11	0.003660	0.94	2.54	7.92	0.53	6.09
Reach-1	204.5	Regional	18.70	145.36	146.55	146.51	146.77	0.008147	2.05	9.83	23.54	0.87	48.64
Reach-1	204.5	100YR	7.43	145.36	146.26		146.38	0.006872	1.53	4.85	11.53	0.76	18.20
Reach-1	204.5	50YR	6.58	145.36	146.23		146.34	0.006482	1.49	4.42	10.53	0.73	15.04
Reach-1	204.5	25YR	5.77	145.36	146.19		146.29	0.006068	1.43	4.04	9.71	0.71	13.91
Reach-1	204.5	10YR	4.54	145.36	146.13		146.22	0.005354	1.28	3.54	9.09	0.66	10.31
Reach-1	204.5	5YR	3.74	145.36	146.08		146.16	0.005361	1.22	3.06	8.46	0.65	8.38
Reach-1	204.5	2YR	2.38	145.36	145.96		146.02	0.005751	1.13	2.11	6.98	0.65	6.05
Reach-1	204.25	Regional	18.70	145.11	146.30	146.30	146.55	0.009025	2.43	13.72	30.86	0.93	48.34
Reach-1	204.25	100YR	7.43	145.11	146.01	146.01	146.18	0.009613	1.86	5.75	23.76	0.89	18.07
Reach-1	204.25	50YR	6.58	145.11	145.99	145.99	146.14	0.009581	1.79	5.08	22.94	0.88	14.92
Reach-1	204.25	25YR	5.77	145.11	145.94	145.94	146.10	0.009515	1.81	4.04	19.05	0.88	13.81
Reach-1	204.25	10YR	4.54	145.11	145.83	145.83	146.01	0.012078	1.90	2.48	10.00	0.98	10.23
Reach-1	204.25	5YR	3.74	145.11	145.76	145.76	145.94	0.013485	1.89	1.98	5.64	1.02	8.31
Reach-1	204.25	2YR	2.38	145.11	145.65	145.65	145.80	0.014146	1.71	1.39	4.77	1.01	6.01
Reach-1	204	Regional	18.99	144.05	145.08	145.08	145.38	0.009649	2.85	14.24	25.18	1.00	46.97
Reach-1	204	100YR	7.59	144.05	144.79	144.79	144.96	0.008890	2.04	7.20	23.16	0.90	17.44
Reach-1	204	50YR	6.73	144.05	144.76	144.76	144.92	0.009079	1.98	6.45	22.93	0.90	14.37
Reach-1	204	25YR	5.92	144.05	144.72	144.72	144.88	0.010083	1.96	5.48	21.71	0.93	13.36

HEC-RAS Plan: Control P1A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	204	10YR	4.62	144.05	144.66	144.66	144.81	0.010227	1.81	4.32	19.77	0.92	9.91
Reach-1	204	5YR	3.81	144.05	144.62	144.62	144.76	0.010203	1.70	3.60	18.46	0.90	8.05
Reach-1	204	2YR	2.44	144.05	144.54	144.54	144.65	0.011213	1.50	2.21	15.59	0.90	5.84
Reach-1	203	Regional	19.14	142.50	144.90		144.94	0.000475	0.92	32.72	37.83	0.24	45.50
Reach-1	203	100YR	7.68	142.50	143.70	143.70	143.90	0.012664	1.98	3.87	9.64	1.00	17.10
Reach-1	203	50YR	6.81	142.50	143.65	143.65	143.85	0.013127	2.00	3.41	8.59	1.01	14.06
Reach-1	203	25YR	5.99	142.50	143.53	143.53	143.79	0.012593	2.26	2.65	5.22	1.01	13.11
Reach-1	203	10YR	4.67	142.50	143.43	143.43	143.66	0.012670	2.14	2.18	4.69	1.00	9.71
Reach-1	203	5YR	3.85	142.50	143.36	143.36	143.58	0.013272	2.08	1.85	4.32	1.01	7.88
Reach-1	203	2YR	2.45	142.50	143.22	143.22	143.40	0.014164	1.90	1.29	3.60	1.01	5.73
Reach-1	202.75	Regional	19.14	142.43	144.58	143.79	144.85	0.001807	2.31	8.29	35.25	0.50	44.72
Reach-1	202.75	100YR	7.68	142.43	143.60	143.17	143.75	0.002217	1.70	4.51	27.27	0.50	16.89
Reach-1	202.75	50YR	6.81	142.43	143.51	143.11	143.65	0.002278	1.64	4.16	26.53	0.50	13.88
Reach-1	202.75	25YR	5.99	142.43	143.42	143.06	143.55	0.002344	1.57	3.82	24.17	0.50	12.95
Reach-1	202.75	10YR	4.67	142.43	143.27	142.96	143.38	0.002479	1.44	3.23	19.77	0.50	9.59
Reach-1	202.75	5YR	3.85	142.43	143.17	142.90	143.26	0.002588	1.35	2.84	17.43	0.50	7.79
Reach-1	202.75	2YR	2.45	142.43	142.98	142.78	143.05	0.002864	1.17	2.10	14.31	0.50	5.67
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	19.14	142.28	143.64	143.64	144.32	0.015506	3.66	5.23	4.23	1.00	43.83
Reach-1	202.25	100YR	7.68	142.28	143.02	143.02	143.39	0.015082	2.70	2.85	3.85	1.00	16.51
Reach-1	202.25	50YR	6.81	142.28	142.96	142.96	143.31	0.015130	2.59	2.62	3.85	1.00	13.55
Reach-1	202.25	25YR	5.99	142.28	142.91	142.91	143.22	0.014966	2.48	2.42	3.85	1.00	12.66
Reach-1	202.25	10YR	4.67	142.28	142.81	142.81	143.08	0.015110	2.28	2.04	3.85	1.00	9.36
Reach-1	202.25	5YR	3.85	142.28	142.75	142.75	142.98	0.014808	2.12	1.81	3.85	0.99	7.59
Reach-1	202.25	2YR	2.45	142.28	142.69	142.63	142.81	0.009047	1.54	1.59	3.85	0.77	5.53
Reach-1	202	Regional	19.14	142.20	143.23		143.29	0.001599	1.26	29.01	49.28	0.42	43.49
Reach-1	202	100YR	7.68	142.20	142.69	142.69	142.83	0.010783	1.77	5.93	25.95	0.93	16.43
Reach-1	202	50YR	6.81	142.20	142.65	142.65	142.80	0.012701	1.79	4.98	22.79	1.00	13.47
Reach-1	202	25YR	5.99	142.20	142.63	142.63	142.76	0.011815	1.67	4.62	21.93	0.95	12.59
Reach-1	202	10YR	4.67	142.20	142.59	142.59	142.70	0.011723	1.52	3.79	20.61	0.93	9.30
Reach-1	202	5YR	3.85	142.20	142.56	142.56	142.66	0.012111	1.43	3.19	19.62	0.92	7.54
Reach-1	202	2YR	2.45	142.20	142.50	142.50	142.58	0.014174	1.27	2.02	17.74	0.95	5.50
Reach-1	201	Regional	19.14	141.65	143.21		143.24	0.000520	0.97	37.18	39.45	0.26	42.01
Reach-1	201	100YR	7.68	141.65	142.60		142.63	0.000800	0.84	15.01	31.94	0.29	15.94
Reach-1	201	50YR	6.81	141.65	142.53		142.56	0.000925	0.85	12.67	30.74	0.31	13.06
Reach-1	201	25YR	5.99	141.65	142.50		142.53	0.000838	0.79	11.80	30.22	0.29	12.20
Reach-1	201	10YR	4.67	141.65	142.40		142.42	0.000911	0.75	8.94	25.62	0.30	9.00
Reach-1	201	5YR	3.85	141.65	142.34		142.36	0.000904	0.70	7.47	23.00	0.29	7.29
Reach-1	201	2YR	2.45	141.65	142.25		142.26	0.000668	0.54	5.64	19.28	0.24	5.31
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	171	100YR	8.17	141.65	142.44	142.21	142.50	0.002213	1.21	9.98	27.36	0.47	14.77
Reach-1	171	50YR	6.60	141.65	142.36	142.15	142.42	0.002210	1.13	8.15	24.25	0.46	12.09
Reach-1	171	25YR	6.10	141.65	142.34	142.13	142.40	0.002202	1.10	7.58	23.20	0.46	11.30
Reach-1	171	10YR	4.37	141.65	142.25	142.05	142.29	0.002182	0.97	5.57	19.13	0.44	8.32
Reach-1	171	5YR	3.52	141.65	142.19	142.01	142.23	0.002166	0.89	4.59	16.80	0.43	6.72
Reach-1	171	2YR	2.57	141.65	142.12	141.95	142.15	0.002101	0.79	3.54	13.88	0.41	4.88
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	169	100YR	8.17	141.65	142.21	142.21	142.40	0.009752	1.96	4.98	17.76	0.92	14.61
Reach-1	169	50YR	6.60	141.65	142.15	142.15	142.32	0.010567	1.86	3.98	15.15	0.94	11.95
Reach-1	169	25YR	6.10	141.65	142.13	142.13	142.30	0.011146	1.83	3.63	14.16	0.95	11.17
Reach-1	169	10YR	4.37	141.65	142.05	142.05	142.19	0.013010	1.69	2.63	10.71	0.99	8.23
Reach-1	169	5YR	3.52	141.65	142.01	142.01	142.13	0.014215	1.59	2.21	8.88	1.01	6.65
Reach-1	169	2YR	2.57	141.65	141.95	141.95	142.06	0.014892	1.45	1.77	8.23	1.00	4.83
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	164	100YR	8.17	138.30	138.83		138.86	0.002624	0.51	10.37	14.75	0.32	13.27
Reach-1	164	50YR	6.60	138.30	138.74		138.76	0.002349	0.41	9.12	13.62	0.29	10.81
Reach-1	164	25YR	6.10	138.30	138.69		138.72	0.002374	0.38	8.50	12.97	0.29	10.12
Reach-1	164	10YR	4.37	138.30	138.54		138.56	0.002100	0.28	6.77	10.44	0.25	7.41
Reach-1	164	5YR	3.52	138.30	138.46		138.47	0.001886	0.19	5.92	9.30	0.22	5.94
Reach-1	164	2YR	2.57	138.30	138.34		138.36	0.001562	0.07	4.96	7.74	0.16	4.24
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	163	100YR	8.17	137.20	138.08	137.99	138.23	0.009915	1.99	7.75	50.21	0.74	12.04
Reach-1	163	50YR	6.60	137.20	138.02	137.97	138.17	0.010628	1.93	5.32	22.77	0.76	9.83
Reach-1	163	25YR	6.10	137.20	137.99	137.97	138.13	0.010185	1.84	4.82	15.66	0.74	9.21
Reach-1	163	10YR	4.37	137.20	137.90	137.86	138.02	0.009858	1.65	3.61	13.13	0.71	6.70
Reach-1	163	5YR	3.52	137.20	137.84	137.80	137.96	0.010879	1.59	2.82	11.19	0.73	5.34
Reach-1	163	2YR	2.57	137.20	137.74	137.72	137.86	0.015146	1.60	1.81	8.05	0.82	3.77
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	162	100YR	8.17	135.60	136.46		136.55	0.008365	1.65	8.05	23.23	0.67	10.63
Reach-1	162	50YR	6.60	135.60	136.42	136.32	136.49	0.007713	1.51	7.02	21.71	0.63	8.72
Reach-1	162	25YR	6.10	135.60	136.39		136.46	0.007886	1.48	6.54	20.96	0.64	8.19

HEC-RAS Plan: Control P1A (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	162	10YR	4.37	135.60	136.32		136.38	0.007899	1.34	5.01	18.41	0.62	5.92
Reach-1	162	5YR	3.52	135.60	136.28		136.33	0.007036	1.21	4.42	17.31	0.58	4.68
Reach-1	162	2YR	2.57	135.60	136.25		136.28	0.005238	0.99	3.87	16.23	0.49	3.25
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	161	100YR	8.17	134.10	134.98	134.98	135.07	0.008814	1.68	10.93	62.89	0.67	9.05
Reach-1	161	50YR	6.60	134.10	134.95	134.95	135.03	0.009136	1.64	8.64	54.87	0.68	7.42
Reach-1	161	25YR	6.10	134.10	134.94	134.94	135.02	0.008737	1.59	8.14	52.96	0.66	6.96
Reach-1	161	10YR	4.37	134.10	134.89	134.89	134.97	0.008112	1.44	5.85	43.08	0.63	5.00
Reach-1	161	5YR	3.52	134.10	134.85	134.85	134.93	0.008870	1.43	4.23	34.42	0.65	3.94
Reach-1	161	2YR	2.57	134.10	134.76	134.69	134.87	0.012829	1.52	2.03	16.61	0.76	2.74
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44
Reach-1	160	100YR	8.17	132.50	133.61		133.64	0.002166	0.99	15.54	41.27	0.33	4.97
Reach-1	160	50YR	6.60	132.50	133.54		133.57	0.002221	0.96	12.79	37.14	0.33	4.10
Reach-1	160	25YR	6.10	132.50	133.52	133.29	133.54	0.002198	0.94	11.99	35.85	0.33	3.84
Reach-1	160	10YR	4.37	132.50	133.41		133.44	0.002411	0.92	8.52	29.61	0.34	2.77
Reach-1	160	5YR	3.52	132.50	133.35		133.38	0.002582	0.91	6.73	25.80	0.35	2.23
Reach-1	160	2YR	2.57	132.50	133.28		133.30	0.002499	0.84	5.01	21.54	0.34	1.63

HEC-RAS Model Results for 14W-16, 14W-21, 14W-22, 14W-12A and 14W-12 --------Phase 1B Condition (Controlled Flow)

HEC-RAS Plan: Control 1B

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2B	231.1	Regional	0.86	148.25	149.22		149.22	0.000026	0.15	15.98	39.69	0.05	0.79
Reach-2B	231.1	100YR	0.64	148.25	149.00		149.00	0.000055	0.18	8.44	28.77	0.07	0.40
Reach-2B	231.1	50YR	0.57	148.25	148.97		148.97	0.000054	0.18	7.56	27.12	0.07	0.36
Reach-2B	231.1	25YR	0.50	148.25	148.93		148.93	0.000052	0.17	6.71	25.39	0.07	0.32
Reach-2B	231.1	10YR	0.40	148.25	148.88		148.88	0.000051	0.15	5.38	22.47	0.07	0.26
Reach-2B	231.1	5YR	0.33	148.25	148.84		148.84	0.000048	0.14	4.50	20.29	0.07	0.22
Reach-2B	231.1	2YR	0.21	148.25	148.78		148.78	0.000034	0.11	3.36	17.06	0.05	0.16
Reach-2B	231	Regional	0.86	148.25	149.22		149.22	0.000026	0.15	15.98	39.69	0.05	0.77
Reach-2B	231	100YR	0.64	148.25	149.00		149.00	0.000055	0.18	8.44	28.77	0.07	0.39
Reach-2B	231	50YR	0.57	148.25	148.97		148.97	0.000054	0.18	7.56	27.12	0.07	0.35
Reach-2B	231	25YR	0.50	148.25	148.93		148.93	0.000052	0.17	6.71	25.39	0.07	0.32
Reach-2B	231	10YR	0.40	148.25	148.88		148.88	0.000051	0.15	5.38	22.46	0.07	0.26
Reach-2B	231	5YR	0.33	148.25	148.84		148.84	0.000048	0.14	4.50	20.28	0.07	0.22
Reach-2B	231	2YR	0.21	148.25	148.78		148.78	0.000034	0.11	3.36	17.06	0.05	0.16
Reach-2B	220.3	Regional	0.86	148.25	149.22		149.22	0.000019	0.13	21.57	60.08	0.05	0.69
Reach-2B	220.3	100YR	0.64	148.25	149.00		149.00	0.000040	0.16	11.16	34.55	0.06	0.35
Reach-2B	220.3	50YR	0.57	148.25	148.97		148.97	0.000039	0.15	10.11	32.86	0.06	0.31
Reach-2B	220.3	25YR	0.50	148.25	148.93		148.93	0.000038	0.14	9.06	31.08	0.06	0.28
Reach-2B	220.3	10YR	0.40	148.25	148.88		148.88	0.000038	0.13	7.43	28.08	0.06	0.23
Reach-2B	220.3	5YR	0.33	148.25	148.84		148.84	0.000036	0.12	6.31	25.84	0.06	0.19
Reach-2B	220.3	2YR	0.21	148.25	148.78		148.78	0.000026	0.09	4.84	22.53	0.05	0.14
Reach-2B	220.2	Regional	0.86	148.57	149.21		149.21	0.000318	0.39	2.57	6.02	0.17	0.03
Reach-2B	220.2	100YR	0.64	148.57	148.98		148.99	0.001203	0.52	1.31	4.95	0.30	0.01
Reach-2B	220.2	50YR	0.57	148.57	148.95		148.96	0.001377	0.52	1.16	4.80	0.32	0.01
Reach-2B	220.2	25YR	0.50	148.57	148.91		148.93	0.001632	0.52	1.00	4.65	0.34	0.01
Reach-2B	220.2	10YR	0.40	148.57	148.86		148.87	0.002619	0.55	0.75	4.38	0.41	0.00
Reach-2B	220.2	5YR	0.33	148.57	148.81		148.83	0.004583	0.60	0.55	4.17	0.52	0.00
Reach-2B	220.2	2YR	0.21	148.57	148.73	148.73	148.77	0.021129	0.88	0.24	3.10	1.01	0.00
Reach-2A	309	Regional	6.68	154.00	154.79		154.84	0.002893	1.36	15.04	43.81	0.53	11.22
Reach-2A	309	100YR	2.58	154.00	154.55		154.59	0.003291	1.08	6.08	31.12	0.53	3.69
Reach-2A	309	50YR	2.27	154.00	154.53		154.57	0.003397	1.05	5.29	29.75	0.53	3.20
Reach-2A	309	25YR	1.99	154.00	154.50		154.54	0.003518	1.02	4.56	28.42	0.53	2.81
Reach-2A	309	10YR	1.55	154.00	154.46		154.49	0.003707	0.96	3.38	24.04	0.54	2.30
Reach-2A	309	5YR	1.27	154.00	154.42		154.46	0.003825	0.92	2.66	20.91	0.54	1.97
Reach-2A	309	2YR	0.79	154.00	154.36	154.29	154.39	0.003923	0.79	1.51	14.62	0.52	1.37
Reach-2A	308	Regional	6.68	153.50	154.48		154.54	0.005224	1.97	13.04	32.66	0.69	10.11
Reach-2A	308	100YR	2.58	153.50	154.22		154.27	0.005244	1.54	5.89	22.00	0.65	3.22
Reach-2A	308	50YR	2.27	153.50	154.19		154.24	0.005142	1.47	5.32	20.89	0.64	2.78
Reach-2A	308	25YR	1.99	153.50	154.17		154.21	0.005033	1.41	4.79	19.80	0.63	2.44
Reach-2A	308	10YR	1.55	153.50	154.12		154.16	0.004904	1.31	3.90	17.80	0.61	2.02
Reach-2A	308	5YR	1.27	153.50	154.08		154.12	0.004888	1.24	3.28	16.26	0.60	1.74
Reach-2A	308	2YR	0.79	153.50	154.00		154.04	0.005168	1.10	2.08	12.80	0.60	1.22
Reach-2A	307	Regional	6.68	153.00	154.02		154.10	0.005521	2.09	9.91	16.35	0.71	9.19
Reach-2A	307	100YR	2.58	153.00	153.68		153.75	0.007772	1.77	4.51	14.42	0.78	2.80
Reach-2A	307	50YR	2.27	153.00	153.64		153.71	0.008086	1.73	4.04	14.15	0.78	2.40
Reach-2A	307	25YR	1.99	153.00	153.61		153.68	0.008397	1.69	3.62	13.89	0.79	2.10
Reach-2A	307	10YR	1.55	153.00	153.57		153.63	0.008652	1.59	2.96	13.49	0.79	1.73
Reach-2A	307	5YR	1.27	153.00	153.54		153.60	0.008509	1.50	2.55	13.23	0.77	1.50
Reach-2A	307	2YR	0.79	153.00	153.48	153.46	153.53	0.007352	1.26	1.84	12.77	0.70	1.06
Reach-2A	306	Regional	6.68	152.60	153.75		153.81	0.003467	1.80	12.47	20.46	0.57	8.44
Reach-2A	306	100YR	2.58	152.60	153.42		153.45	0.002644	1.21	6.70	15.62	0.47	2.42
Reach-2A	306	50YR	2.27	152.60	153.38		153.41	0.002699	1.17	6.08	15.35	0.47	2.06
Reach-2A	306	25YR	1.99	152.60	153.34		153.37	0.002779	1.14	5.47	15.01	0.47	1.79
Reach-2A	306	10YR	1.55	152.60	153.27		153.30	0.003073	1.10	4.40	14.39	0.48	1.49
Reach-2A	306	5YR	1.27	152.60	153.22		153.24	0.003429	1.08	3.65	13.94	0.50	1.29
Reach-2A	306	2YR	0.79	152.60	153.12		153.15	0.004464	1.05	2.29	13.09	0.55	0.92
Reach-2A	305	Regional	6.68	152.12	153.39	153.32	153.50	0.004074	1.74	10.30	38.89	0.61	7.52
Reach-2A	305	100YR	2.58	152.12	153.11	152.93	153.19	0.004077	1.32	2.48	13.65	0.57	2.05
Reach-2A	305	50YR	2.27	152.12	153.07	152.89	153.15	0.004045	1.26	2.05	10.65	0.56	1.74
Reach-2A	305	25YR	1.99	152.12	153.03	152.85	153.11	0.004092	1.20	1.71	6.79	0.56	1.51
Reach-2A	305	10YR	1.55	152.12	152.96	152.78	153.02	0.004072	1.11	1.40	3.34	0.55	1.26
Reach-2A	305	5YR	1.27	152.12	152.90	152.73	152.96	0.004064	1.05	1.21	3.10	0.54	1.10
Reach-2A	305	2YR	0.79	152.12	152.77	152.62	152.82	0.004049	0.93	0.85	2.60	0.52	0.80
Reach-2A	304	Regional	6.68	151.63	152.88	152.84	153.00	0.004301	1.77	10.02	38.68	0.63	6.30
Reach-2A	304	100YR	2.58	151.63	152.61	152.43	152.69	0.004243	1.34	2.44	14.02	0.58	1.76
Reach-2A	304	50YR	2.27	151.63	152.57	152.39	152.65	0.004241	1.28	2.00	10.41	0.57	1.49
Reach-2A	304	25YR	1.99	151.63	152.53		152.61	0.004239	1.21	1.69	6.76	0.57	1.30
Reach-2A	304	10YR	1.55	151.63	152.46		152.52	0.004238	1.12	1.38	3.34	0.56	1.09
Reach-2A	304	5YR	1.27	151.63	152.40		152.46	0.004240	1.07	1.19	3.10	0.55	0.95
Reach-2A	304	2YR	0.79	151.63	152.27		152.32	0.004243	0.95	0.83	2.59	0.53	0.70
Reach-2A	303	Regional	6.68	151.46	152.73		152.84	0.003856	1.70	10.63	38.77	0.60	5.89
Reach-2A	303	100YR	2.58	151.46	152.44	152.26	152.53	0.004071	1.32	2.53	14.60	0.57	1.66
Reach-2A	303	50YR	2.27	151.46	152.40	152.22	152.48	0.004098	1.26	2.05	10.89	0.57	1.41
Reach-2A	303	25YR	1.99	151.46	152.37		152.44	0.004117	1.20	1.72	7.16	0.56	1.23

HEC-RAS Plan: Control 1B (Continued)

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	Volume (1000 m3)
Reach-2A	303	10YR	1.55	151.46	152.29		152.36	0.004163	1.11	1.39	3.35	0.55	1.03
Reach-2A	303	5YR	1.27	151.46	152.23		152.29	0.004164	1.06	1.20	3.11	0.54	0.91
Reach-2A	303	2YR	0.79	151.46	152.11		152.15	0.004150	0.94	0.84	2.60	0.53	0.67
Reach-2A	302	Regional	6.68	151.29	152.55	152.51	152.67	0.004368	1.78	9.88	38.65	0.63	5.48
Reach-2A	302	100YR	2.58	151.29	152.27	152.09	152.36	0.004411	1.35	2.33	13.07	0.59	1.56
Reach-2A	302	50YR	2.27	151.29	152.23	152.05	152.31	0.004402	1.29	1.93	9.46	0.58	1.33
Reach-2A	302	25YR	1.99	151.29	152.19		152.27	0.004396	1.23	1.65	5.82	0.58	1.17
Reach-2A	302	10YR	1.55	151.29	152.12		152.18	0.004362	1.13	1.37	3.30	0.56	0.98
Reach-2A	302	5YR	1.27	151.29	152.06		152.12	0.004361	1.08	1.18	3.06	0.56	0.86
Reach-2A	302	2YR	0.79	151.29	151.93		151.98	0.004348	0.96	0.82	2.56	0.54	0.63
Reach-2A	301	Regional	6.68	150.79	152.04	152.00	152.16	0.004326	1.78	9.99	38.67	0.63	4.32
Reach-2A	301	100YR	2.58	150.79	151.77	151.59	151.86	0.004142	1.33	2.49	14.37	0.57	1.28
Reach-2A	301	50YR	2.27	150.79	151.73	151.55	151.81	0.004142	1.27	2.04	10.75	0.57	1.10
Reach-2A	301	25YR	1.99	150.79	151.70		151.77	0.004143	1.21	1.71	7.08	0.56	0.97
Reach-2A	301	10YR	1.55	150.79	151.62		151.69	0.004160	1.11	1.39	3.35	0.55	0.82
Reach-2A	301	5YR	1.27	150.79	151.56		151.62	0.004164	1.06	1.20	3.11	0.54	0.72
Reach-2A	301	2YR	0.79	150.79	151.44		151.48	0.004196	0.94	0.84	2.60	0.53	0.53
Reach-2A	300	Regional	6.68	150.40	151.68	151.61	151.79	0.003682	1.67	10.84	38.80	0.58	3.35
Reach-2A	300	100YR	2.58	150.40	151.39	151.21	151.47	0.004098	1.32	2.48	14.12	0.57	1.05
Reach-2A	300	50YR	2.27	150.40	151.35	151.17	151.43	0.004114	1.26	2.02	10.42	0.57	0.91
Reach-2A	300	25YR	1.99	150.40	151.31	151.13	151.39	0.004124	1.20	1.70	6.69	0.56	0.81
Reach-2A	300	10YR	1.55	150.40	151.24	151.06	151.30	0.004113	1.11	1.40	3.33	0.55	0.69
Reach-2A	300	5YR	1.27	150.40	151.18	151.01	151.23	0.004120	1.06	1.20	3.09	0.54	0.61
Reach-2A	300	2YR	0.79	150.40	151.05	150.90	151.10	0.004065	0.93	0.85	2.59	0.52	0.46
Reach-2A	299	Regional	6.68	150.05	151.29	151.27	151.43	0.004787	1.85	9.38	38.58	0.66	2.49
Reach-2A	299	100YR	2.58	150.05	151.03	150.85	151.12	0.004257	1.34	2.40	13.58	0.58	0.84
Reach-2A	299	50YR	2.27	150.05	151.00	150.81	151.08	0.004229	1.28	1.98	10.03	0.57	0.74
Reach-2A	299	25YR	1.99	150.05	150.96		151.03	0.004197	1.21	1.69	6.45	0.56	0.67
Reach-2A	299	10YR	1.55	150.05	150.89		150.95	0.004119	1.11	1.40	3.33	0.55	0.57
Reach-2A	299	5YR	1.27	150.05	150.83		150.88	0.004153	1.06	1.20	3.09	0.54	0.51
Reach-2A	299	2YR	0.79	150.05	150.70		150.74	0.004271	0.95	0.83	2.57	0.53	0.39
Reach-2A	298	Regional	6.68	149.76	151.15	150.98	151.20	0.001853	1.29	15.10	39.45	0.42	1.62
Reach-2A	298	100YR	2.58	149.76	150.79	150.57	150.86	0.003061	1.20	3.16	18.33	0.50	0.64
Reach-2A	298	50YR	2.27	149.76	150.74	150.52	150.81	0.003228	1.17	2.44	13.88	0.51	0.59
Reach-2A	298	25YR	1.99	149.76	150.70		150.77	0.003370	1.13	1.93	9.52	0.51	0.54
Reach-2A	298	10YR	1.55	149.76	150.63		150.68	0.003432	1.04	1.49	3.45	0.50	0.47
Reach-2A	298	5YR	1.27	149.76	150.57		150.62	0.003356	0.98	1.30	3.21	0.49	0.42
Reach-2A	298	2YR	0.79	149.76	150.44		150.48	0.003217	0.86	0.92	2.71	0.47	0.32
Reach-2A	297	Regional	6.68	149.64	150.81	150.81	151.05	0.008189	2.28	4.79	32.95	0.85	1.29
Reach-2A	297	100YR	2.58	149.64	150.44	150.44	150.65	0.014136	2.00	1.29	3.21	1.01	0.58
Reach-2A	297	50YR	2.27	149.64	150.40	150.40	150.60	0.014289	1.95	1.17	3.05	1.01	0.53
Reach-2A	297	25YR	1.99	149.64	150.37	150.37	150.55	0.014327	1.89	1.06	2.90	1.00	0.49
Reach-2A	297	10YR	1.55	149.64	150.30	150.30	150.46	0.014775	1.79	0.86	2.63	1.00	0.43
Reach-2A	297	5YR	1.27	149.64	150.25	150.25	150.40	0.015325	1.73	0.73	2.42	1.00	0.39
Reach-2A	297	2YR	0.79	149.64	150.14	150.14	150.27	0.016254	1.57	0.50	2.01	1.00	0.30
Reach-2A	296.5		Culvert										
Reach-2A	296	Regional	6.68	149.44	150.62	150.62	150.86	0.008167	2.28	4.78	32.69	0.85	0.58
Reach-2A	296	100YR	2.58	149.44	150.25	150.25	150.45	0.013788	1.99	1.30	3.20	1.00	0.12
Reach-2A	296	50YR	2.27	149.44	150.21	150.21	150.40	0.014033	1.94	1.17	3.04	1.00	0.10
Reach-2A	296	25YR	1.99	149.44	150.17	150.17	150.35	0.014252	1.89	1.06	2.89	1.00	0.09
Reach-2A	296	10YR	1.55	149.44	150.10	150.10	150.27	0.014733	1.79	0.86	2.61	1.00	0.07
Reach-2A	296	5YR	1.27	149.44	150.05	150.05	150.20	0.015438	1.74	0.73	2.40	1.01	0.06
Reach-2A	296	2YR	0.79	149.44	149.94	149.94	150.07	0.016360	1.58	0.50	1.99	1.00	0.04
Reach-2C	220.1	Regional	7.29	148.25	149.12	149.09	149.20	0.004736	1.34	12.49	62.20	0.63	0.04
Reach-2C	220.1	100YR	2.90	148.25	148.88	148.81	148.96	0.007102	1.28	2.64	15.37	0.73	0.01
Reach-2C	220.1	50YR	2.56	148.25	148.85	148.78	148.93	0.007558	1.27	2.17	13.53	0.75	0.01
Reach-2C	220.1	25YR	2.24	148.25	148.82	148.76	148.90	0.007832	1.25	1.85	8.76	0.75	0.01
Reach-2C	220.1	10YR	1.75	148.25	148.77	148.71	148.84	0.008059	1.18	1.48	5.87	0.75	0.01
Reach-2C	220.1	5YR	1.43	148.25	148.73	148.67	148.79	0.008128	1.14	1.25	5.26	0.75	0.01
Reach-2C	220.1	2YR	0.90	148.25	148.65		148.70	0.007956	1.01	0.89	4.36	0.72	0.00
Reach-2C	220	Regional	7.29	148.25	149.09	149.09	149.19	0.006899	1.56	10.10	60.61	0.76	0.03
Reach-2C	220	100YR	2.90	148.25	148.81	148.81	148.95	0.014079	1.65	1.79	8.35	1.01	0.01
Reach-2C	220	50YR	2.56	148.25	148.78	148.78	148.92	0.014508	1.62	1.58	6.71	1.01	0.01
Reach-2C	220	25YR	2.24	148.25	148.76	148.76	148.88	0.014972	1.58	1.42	5.74	1.02	0.01
Reach-2C	220	10YR	1.75	148.25	148.71	148.71	148.82	0.015275	1.53	1.15	4.98	1.02	0.01
Reach-2C	220	5YR	1.43	148.25	148.67	148.67	148.78	0.015618	1.46	0.98	4.58	1.01	0.00
Reach-2C	220	2YR	0.90	148.25	148.60	148.60	148.69	0.016581	1.34	0.67	3.75	1.01	0.00
Reach-1A	210.5	Regional	8.11	155.11	155.53	155.48	155.55	0.006966	0.70	11.60	92.30	0.63	11.00
Reach-1A	210.5	100YR	3.29	155.11	155.44	155.42	155.46	0.008332	0.61	5.35	58.90	0.65	4.98
Reach-1A	210.5	50YR	2.92	155.11	155.44	155.41	155.45	0.008507	0.60	4.87	56.37	0.65	4.46
Reach-1A	210.5	25YR	2.56	155.11	155.43	155.40	155.44	0.008844	0.59	4.35	53.59	0.66	3.95
Reach-1A	210.5	10YR	2.02	155.11	155.41	155.39	155.43	0.009015	0.56	3.64	49.42	0.65	3.20
Reach-1A	210.5	5YR	1.67	155.11	155.40	155.38	155.42	0.009298	0.53	3.13	46.25	0.65	2.78

HEC-RAS Plan: Control 1B (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1A	210.5	2YR	1.06	155.11	155.38	155.35	155.39	0.009785	0.50	2.11	35.36	0.66	1.99
Reach-1A	210	Regional	8.11	154.96	155.26	155.21	155.30	0.007366	0.92	8.78	47.83	0.69	10.64
Reach-1A	210	100YR	3.29	154.96	155.16		155.18	0.007573	0.72	4.57	36.89	0.65	4.81
Reach-1A	210	50YR	2.92	154.96	155.15		155.17	0.007577	0.70	4.20	35.73	0.65	4.31
Reach-1A	210	25YR	2.56	154.96	155.14		155.16	0.007397	0.66	3.86	34.64	0.63	3.80
Reach-1A	210	10YR	2.02	154.96	155.12		155.14	0.007491	0.62	3.25	32.59	0.63	3.08
Reach-1A	210	5YR	1.67	154.96	155.11		155.12	0.007414	0.58	2.86	31.19	0.62	2.67
Reach-1A	210	2YR	1.06	154.96	155.08		155.09	0.007364	0.51	2.10	28.28	0.59	1.92
Reach-1A	209	Regional	8.11	154.46	154.74		154.76	0.003402	0.79	15.74	75.27	0.50	9.28
Reach-1A	209	100YR	3.29	154.46	154.63		154.65	0.003391	0.56	8.29	64.67	0.45	4.10
Reach-1A	209	50YR	2.92	154.46	154.62		154.63	0.003379	0.54	7.63	63.09	0.45	3.65
Reach-1A	209	25YR	2.56	154.46	154.61		154.62	0.003403	0.51	6.95	62.00	0.44	3.20
Reach-1A	209	10YR	2.02	154.46	154.59		154.60	0.003398	0.47	5.90	60.48	0.43	2.57
Reach-1A	209	5YR	1.67	154.46	154.58		154.59	0.003404	0.43	5.17	59.39	0.43	2.23
Reach-1A	209	2YR	1.06	154.46	154.56		154.56	0.003357	0.36	3.78	57.26	0.41	1.59
Reach-1A	208.3	Regional	8.11	152.95	153.39	153.39	153.49	0.015561	1.43	5.67	28.04	1.02	7.13
Reach-1A	208.3	100YR	3.29	152.95	153.26	153.26	153.34	0.017328	1.20	2.74	19.16	1.01	2.99
Reach-1A	208.3	50YR	2.92	152.95	153.25	153.25	153.32	0.017687	1.18	2.48	18.13	1.02	2.64
Reach-1A	208.3	25YR	2.56	152.95	153.24	153.24	153.30	0.017704	1.14	2.24	17.13	1.01	2.28
Reach-1A	208.3	10YR	2.02	152.95	153.21	153.21	153.27	0.018109	1.09	1.85	15.36	1.01	1.80
Reach-1A	208.3	5YR	1.67	152.95	153.19	153.19	153.25	0.018536	1.05	1.59	14.20	1.01	1.55
Reach-1A	208.3	2YR	1.06	152.95	153.16	153.16	153.20	0.020156	0.97	1.09	11.73	1.02	1.11
Reach-1A	208.2	Regional	8.11	152.50	152.97		153.02	0.005184	1.00	8.08	29.80	0.62	6.79
Reach-1A	208.2	100YR	3.29	152.50	152.84		152.86	0.003659	0.70	4.70	22.94	0.49	2.81
Reach-1A	208.2	50YR	2.92	152.50	152.83		152.85	0.003316	0.65	4.46	22.40	0.47	2.46
Reach-1A	208.2	25YR	2.56	152.50	152.82		152.83	0.002957	0.61	4.23	21.85	0.44	2.12
Reach-1A	208.2	10YR	2.02	152.50	152.79		152.81	0.002532	0.54	3.76	20.73	0.40	1.66
Reach-1A	208.2	5YR	1.67	152.50	152.78		152.79	0.002200	0.48	3.45	19.93	0.37	1.42
Reach-1A	208.2	2YR	1.06	152.50	152.74		152.75	0.001681	0.39	2.73	17.93	0.32	1.01
Reach-1A	208.1	Regional	8.11	152.50	152.85		152.89	0.002514	0.80	11.47	41.75	0.44	6.44
Reach-1A	208.1	100YR	3.29	152.50	152.67		152.70	0.005638	0.72	4.73	33.55	0.59	2.64
Reach-1A	208.1	50YR	2.92	152.50	152.66	152.62	152.68	0.006807	0.73	4.12	32.71	0.63	2.31
Reach-1A	208.1	25YR	2.56	152.50	152.64	152.61	152.67	0.008583	0.74	3.52	31.85	0.69	1.98
Reach-1A	208.1	10YR	2.02	152.50	152.61		152.64	0.011499	0.73	2.77	30.75	0.77	1.54
Reach-1A	208.1	5YR	1.67	152.50	152.60	152.59	152.62	0.014705	0.73	2.28	30.02	0.84	1.32
Reach-1A	208.1	2YR	1.06	152.50	152.57	152.57	152.60	0.025045	0.73	1.46	28.54	1.03	0.93
Reach-1A	208	Regional	8.11	151.00	152.19	152.19	152.42	0.009978	2.14	4.68	15.93	0.92	5.63
Reach-1A	208	100YR	3.29	151.00	152.02	151.91	152.11	0.006061	1.30	2.56	8.47	0.68	2.27
Reach-1A	208	50YR	2.92	151.00	152.01	151.88	152.08	0.005270	1.19	2.47	7.91	0.63	1.98
Reach-1A	208	25YR	2.56	151.00	152.00		152.06	0.004464	1.07	2.39	7.43	0.57	1.69
Reach-1A	208	10YR	2.02	151.00	151.95		152.00	0.004059	0.97	2.08	6.27	0.54	1.30
Reach-1A	208	5YR	1.67	151.00	151.91		151.96	0.003796	0.91	1.83	5.74	0.52	1.12
Reach-1A	208	2YR	1.06	151.00	151.83		151.86	0.002952	0.77	1.38	4.63	0.45	0.79
Reach-1A	207	Regional	8.11	150.25	151.04		151.07	0.002488	0.91	17.02	55.50	0.46	3.53
Reach-1A	207	100YR	3.29	150.25	150.82	150.79	150.86	0.006474	0.96	5.56	48.85	0.66	1.48
Reach-1A	207	50YR	2.92	150.25	150.80	150.77	150.84	0.007609	0.98	4.50	48.20	0.70	1.30
Reach-1A	207	25YR	2.56	150.25	150.77	150.76	150.82	0.009471	1.02	3.34	47.45	0.77	1.12
Reach-1A	207	10YR	2.02	150.25	150.75	150.71	150.79	0.010367	0.98	2.13	23.09	0.79	0.88
Reach-1A	207	5YR	1.67	150.25	150.72	150.69	150.77	0.011091	0.97	1.73	11.79	0.81	0.77
Reach-1A	207	2YR	1.06	150.25	150.65	150.65	150.70	0.016484	1.04	1.02	8.44	0.95	0.56
Reach-1A	206.3	Regional	10.06	149.49	150.47	150.46	150.68	0.006494	2.19	9.27	27.46	0.80	2.32
Reach-1A	206.3	100YR	4.09	149.49	150.25	150.12	150.36	0.004524	1.45	3.94	20.96	0.63	1.04
Reach-1A	206.3	50YR	3.62	149.49	150.23	150.09	150.32	0.004323	1.37	3.40	18.16	0.61	0.93
Reach-1A	206.3	25YR	3.18	149.49	150.20	150.05	150.28	0.004081	1.29	2.95	15.23	0.59	0.83
Reach-1A	206.3	10YR	2.51	149.49	150.13		150.20	0.004457	1.21	2.12	7.88	0.60	0.68
Reach-1A	206.3	5YR	2.08	149.49	150.08		150.14	0.004677	1.15	1.81	4.91	0.60	0.60
Reach-1A	206.3	2YR	1.33	149.49	149.97		150.02	0.004439	1.00	1.33	4.29	0.57	0.44
Reach-1A	206.2	Regional	10.06	149.25	150.37	150.17	150.42	0.002497	1.11	12.55	33.72	0.48	1.82
Reach-1A	206.2	100YR	4.09	149.25	150.10	149.90	150.14	0.003271	0.92	5.33	23.13	0.50	0.82
Reach-1A	206.2	50YR	3.62	149.25	150.06	149.87	150.10	0.003745	0.94	4.37	21.87	0.53	0.75
Reach-1A	206.2	25YR	3.18	149.25	150.02	149.83	150.07	0.004240	0.95	3.50	20.72	0.56	0.68
Reach-1A	206.2	10YR	2.51	149.25	149.94	149.78	149.99	0.003780	0.97	2.59	7.84	0.54	0.57
Reach-1A	206.2	5YR	2.08	149.25	149.90	149.74	149.94	0.003332	0.92	2.27	6.79	0.51	0.50
Reach-1A	206.2	2YR	1.33	149.25	149.81	149.65	149.84	0.002907	0.78	1.71	5.92	0.46	0.37
Reach-1A	206.15		Bridge										
Reach-1A	206.1	Regional	10.06	149.00	150.01	149.89	150.11	0.004811	1.45	8.12	30.47	0.65	1.46
Reach-1A	206.1	100YR	4.09	149.00	149.78	149.71	149.84	0.006131	1.10	3.92	20.84	0.66	0.65
Reach-1A	206.1	50YR	3.62	149.00	149.76	149.70	149.82	0.005962	1.04	3.64	19.64	0.64	0.59
Reach-1A	206.1	25YR	3.18	149.00	149.74	149.68	149.79	0.006065	0.99	3.31	18.14	0.64	0.54
Reach-1A	206.1	10YR	2.51	149.00	149.71	149.65	149.75	0.006226	0.91	2.81	15.58	0.63	0.45
Reach-1A	206.1	5YR	2.08	149.00	149.68	149.63	149.72	0.006276	0.85	2.46	14.34	0.63	0.39
Reach-1A	206.1	2YR	1.33	149.00	149.64	149.57	149.66	0.005957	0.72	1.84	11.97	0.59	0.29

HEC-RAS Plan: Control 1B (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	205	Regional	18.06	147.24	148.38	148.38	148.72	0.010769	2.59	6.96	10.37	1.01	52.76
Reach-1	205	100YR	7.16	147.24	148.02	148.02	148.23	0.012206	2.03	3.53	8.42	1.00	20.46
Reach-1	205	50YR	6.35	147.24	147.98	147.98	148.18	0.012883	1.99	3.19	8.19	1.02	17.13
Reach-1	205	25YR	5.57	147.24	147.94	147.94	148.13	0.013105	1.92	2.91	7.99	1.01	15.86
Reach-1	205	10YR	4.39	147.24	147.88	147.88	148.05	0.013460	1.79	2.46	7.66	1.01	12.01
Reach-1	205	5YR	3.61	147.24	147.84	147.84	147.99	0.013920	1.69	2.13	7.41	1.01	9.90
Reach-1	205	2YR	2.30	147.24	147.76	147.76	147.87	0.015634	1.50	1.53	6.93	1.02	7.23
Reach-1	204.75	Regional	18.06	146.00	147.47		147.51	0.001590	1.23	28.77	31.33	0.41	50.10
Reach-1	204.75	100YR	7.16	146.00	146.98		147.00	0.001392	0.79	15.80	19.33	0.35	19.02
Reach-1	204.75	50YR	6.35	146.00	146.93		146.94	0.001355	0.74	14.79	18.82	0.34	15.79
Reach-1	204.75	25YR	5.57	146.00	146.87		146.88	0.001315	0.69	13.76	18.26	0.33	14.62
Reach-1	204.75	10YR	4.39	146.00	146.78		146.79	0.001239	0.61	12.08	17.22	0.31	10.93
Reach-1	204.75	5YR	3.61	146.00	146.70		146.71	0.001164	0.55	10.87	16.29	0.30	8.93
Reach-1	204.75	2YR	2.30	146.00	146.55		146.56	0.000989	0.43	8.56	14.25	0.26	6.48
Reach-1	204.7	Regional	18.06	145.89	146.90	146.90	147.24	0.009955	2.60	7.20	13.11	0.99	48.75
Reach-1	204.7	100YR	7.16	145.89	146.53	146.53	146.74	0.012215	2.07	3.46	8.02	1.01	18.29
Reach-1	204.7	50YR	6.35	145.89	146.49	146.49	146.69	0.012412	2.02	3.14	7.66	1.01	15.12
Reach-1	204.7	25YR	5.57	145.89	146.44	146.44	146.64	0.012634	1.97	2.83	7.29	1.01	13.99
Reach-1	204.7	10YR	4.39	145.89	146.37	146.37	146.55	0.013138	1.87	2.35	6.75	1.01	10.38
Reach-1	204.7	5YR	3.61	145.89	146.33	146.33	146.49	0.013454	1.77	2.04	6.47	1.01	8.45
Reach-1	204.7	2YR	2.30	145.89	146.23	146.23	146.36	0.014454	1.57	1.46	5.86	1.01	6.10
Reach-1	204.55	Regional	18.06	145.49	146.67	146.54	146.88	0.005882	2.04	9.33	18.22	0.76	48.62
Reach-1	204.55	100YR	7.16	145.49	146.38		146.47	0.003993	1.32	5.42	10.70	0.59	18.23
Reach-1	204.55	50YR	6.35	145.49	146.34		146.42	0.003873	1.27	5.00	10.21	0.58	15.05
Reach-1	204.55	25YR	5.57	145.49	146.29		146.37	0.003757	1.22	4.56	9.68	0.57	13.93
Reach-1	204.55	10YR	4.39	145.49	146.22		146.29	0.003521	1.12	3.92	8.99	0.54	10.33
Reach-1	204.55	5YR	3.61	145.49	146.17		146.23	0.003523	1.05	3.43	8.67	0.53	8.40
Reach-1	204.55	2YR	2.30	145.49	146.05		146.10	0.003675	0.93	2.48	7.85	0.53	6.07
Reach-1	204.5	Regional	18.06	145.36	146.54	146.50	146.75	0.008141	2.02	9.55	23.26	0.86	48.45
Reach-1	204.5	100YR	7.16	145.36	146.25		146.37	0.006739	1.52	4.72	11.24	0.75	18.13
Reach-1	204.5	50YR	6.35	145.36	146.22		146.33	0.006166	1.45	4.37	10.40	0.72	14.97
Reach-1	204.5	25YR	5.57	145.36	146.18		146.28	0.005754	1.39	4.01	9.68	0.69	13.85
Reach-1	204.5	10YR	4.39	145.36	146.13		146.21	0.005298	1.27	3.46	9.00	0.65	10.27
Reach-1	204.5	5YR	3.61	145.36	146.07		146.14	0.005409	1.22	2.97	8.34	0.65	8.35
Reach-1	204.5	2YR	2.30	145.36	145.95		146.01	0.005782	1.12	2.05	6.87	0.65	6.03
Reach-1	204.25	Regional	18.06	145.11	146.29	146.29	146.53	0.009027	2.40	13.34	30.75	0.93	48.16
Reach-1	204.25	100YR	7.16	145.11	146.00	146.00	146.17	0.009646	1.84	5.52	23.49	0.89	18.00
Reach-1	204.25	50YR	6.35	145.11	145.97	145.97	146.13	0.010180	1.80	4.74	22.50	0.91	14.85
Reach-1	204.25	25YR	5.57	145.11	145.91	145.91	146.09	0.010451	1.86	3.62	17.33	0.92	13.76
Reach-1	204.25	10YR	4.39	145.11	145.82	145.82	146.00	0.012549	1.91	2.34	8.76	0.99	10.19
Reach-1	204.25	5YR	3.61	145.11	145.75	145.75	145.93	0.013507	1.87	1.93	5.57	1.01	8.28
Reach-1	204.25	2YR	2.30	145.11	145.64	145.64	145.79	0.014098	1.69	1.36	4.71	1.01	5.99
Reach-1	204	Regional	18.35	144.05	145.07	145.07	145.36	0.009606	2.81	13.91	25.09	1.00	46.82
Reach-1	204	100YR	7.32	144.05	144.78	144.78	144.95	0.008868	2.02	6.99	23.09	0.89	17.40
Reach-1	204	50YR	6.50	144.05	144.75	144.75	144.91	0.008951	1.95	6.30	22.88	0.89	14.32
Reach-1	204	25YR	5.72	144.05	144.71	144.71	144.87	0.009907	1.93	5.35	21.50	0.92	13.33
Reach-1	204	10YR	4.47	144.05	144.65	144.65	144.80	0.010252	1.79	4.19	19.52	0.91	9.89
Reach-1	204	5YR	3.68	144.05	144.62	144.62	144.75	0.010311	1.68	3.47	18.20	0.90	8.03
Reach-1	204	2YR	2.36	144.05	144.54	144.54	144.64	0.011292	1.48	2.12	15.35	0.90	5.83
Reach-1	203	Regional	18.50	142.50	144.84		144.88	0.000516	0.94	30.57	37.19	0.25	45.43
Reach-1	203	100YR	7.42	142.50	143.68	143.68	143.88	0.013017	2.00	3.71	9.28	1.01	17.07
Reach-1	203	50YR	6.58	142.50	143.58	143.58	143.83	0.011912	2.26	2.92	5.56	0.99	14.04
Reach-1	203	25YR	5.79	142.50	143.52	143.52	143.77	0.012353	2.23	2.60	5.15	1.00	13.09
Reach-1	203	10YR	4.52	142.50	143.41	143.41	143.65	0.013010	2.15	2.11	4.61	1.01	9.69
Reach-1	203	5YR	3.72	142.50	143.35	143.35	143.56	0.013354	2.06	1.80	4.26	1.01	7.87
Reach-1	203	2YR	2.37	142.50	143.21	143.21	143.39	0.014213	1.89	1.26	3.56	1.01	5.72
Reach-1	202.75	Regional	18.50	142.43	144.53	143.76	144.80	0.001821	2.28	8.10	34.89	0.50	44.69
Reach-1	202.75	100YR	7.42	142.43	143.57	143.15	143.72	0.002235	1.69	4.40	27.05	0.50	16.87
Reach-1	202.75	50YR	6.58	142.43	143.49	143.10	143.62	0.002295	1.62	4.06	26.03	0.50	13.87
Reach-1	202.75	25YR	5.79	142.43	143.40	143.04	143.52	0.002362	1.55	3.73	23.52	0.50	12.94
Reach-1	202.75	10YR	4.52	142.43	143.25	142.95	143.36	0.002497	1.43	3.16	19.24	0.50	9.58
Reach-1	202.75	5YR	3.72	142.43	143.15	142.89	143.24	0.002608	1.34	2.78	17.19	0.50	7.77
Reach-1	202.75	2YR	2.37	142.43	142.96	142.77	143.03	0.002885	1.15	2.06	13.96	0.50	5.66
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	18.50	142.28	143.61	143.61	144.28	0.015465	3.60	5.13	4.15	1.00	43.83
Reach-1	202.25	100YR	7.42	142.28	143.01	143.01	143.37	0.014926	2.66	2.79	3.85	1.00	16.50
Reach-1	202.25	50YR	6.58	142.28	142.95	142.95	143.28	0.014965	2.56	2.57	3.85	1.00	13.54
Reach-1	202.25	25YR	5.79	142.28	142.89	142.89	143.20	0.015170	2.46	2.35	3.85	1.00	12.65
Reach-1	202.25	10YR	4.52	142.28	142.80	142.80	143.06	0.015000	2.25	2.01	3.85	1.00	9.35
Reach-1	202.25	5YR	3.72	142.28	142.75	142.74	142.97	0.014073	2.06	1.80	3.85	0.96	7.58
Reach-1	202.25	2YR	2.37	142.28	142.69	142.62	142.80	0.008686	1.51	1.57	3.85	0.75	5.53
Reach-1	202	Regional	18.50	142.20	143.23		143.28	0.001506	1.22	28.92	49.26	0.41	43.48
Reach-1	202	100YR	7.42	142.20	142.68	142.68	142.82	0.010868	1.75	5.74	25.51	0.93	16.42

HEC-RAS Plan: Control 1B (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	202	50YR	6.58	142.20	142.64	142.64	142.79	0.012410	1.75	4.89	22.58	0.98	13.47
Reach-1	202	25YR	5.79	142.20	142.63	142.63	142.75	0.011562	1.63	4.53	21.79	0.94	12.58
Reach-1	202	10YR	4.52	142.20	142.59	142.59	142.70	0.011975	1.51	3.66	20.40	0.93	9.30
Reach-1	202	5YR	3.72	142.20	142.56	142.56	142.66	0.012476	1.42	3.07	19.43	0.93	7.54
Reach-1	202	2YR	2.37	142.20	142.49	142.49	142.58	0.014838	1.27	1.92	15.96	0.97	5.49
Reach-1	201	Regional	18.50	141.65	143.21		143.24	0.000486	0.94	37.17	39.45	0.25	42.01
Reach-1	201	100YR	7.42	141.65	142.60		142.63	0.000751	0.82	14.98	31.92	0.28	15.94
Reach-1	201	50YR	6.58	141.65	142.53		142.56	0.000869	0.83	12.64	30.72	0.30	13.06
Reach-1	201	25YR	5.79	141.65	142.50		142.52	0.000789	0.77	11.76	30.16	0.28	12.20
Reach-1	201	10YR	4.52	141.65	142.39		142.42	0.000861	0.73	8.90	25.56	0.29	9.00
Reach-1	201	5YR	3.72	141.65	142.33		142.36	0.000853	0.68	7.43	22.92	0.28	7.28
Reach-1	201	2YR	2.37	141.65	142.25		142.26	0.000632	0.52	5.61	19.22	0.24	5.31
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	171	100YR	8.17	141.65	142.44	142.21	142.50	0.002213	1.21	9.98	27.36	0.47	14.77
Reach-1	171	50YR	6.60	141.65	142.36	142.15	142.42	0.002210	1.13	8.15	24.25	0.46	12.09
Reach-1	171	25YR	6.10	141.65	142.34	142.13	142.40	0.002202	1.10	7.58	23.20	0.46	11.30
Reach-1	171	10YR	4.37	141.65	142.25	142.05	142.29	0.002182	0.97	5.57	19.13	0.44	8.32
Reach-1	171	5YR	3.52	141.65	142.19	142.01	142.23	0.002166	0.89	4.59	16.80	0.43	6.72
Reach-1	171	2YR	2.57	141.65	142.12	141.95	142.15	0.002101	0.79	3.54	13.88	0.41	4.88
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	169	100YR	8.17	141.65	142.21	142.21	142.40	0.009752	1.96	4.98	17.76	0.92	14.61
Reach-1	169	50YR	6.60	141.65	142.15	142.15	142.32	0.010567	1.86	3.98	15.15	0.94	11.95
Reach-1	169	25YR	6.10	141.65	142.13	142.13	142.30	0.011146	1.83	3.63	14.16	0.95	11.17
Reach-1	169	10YR	4.37	141.65	142.05	142.05	142.19	0.013010	1.69	2.63	10.71	0.99	8.23
Reach-1	169	5YR	3.52	141.65	142.01	142.01	142.13	0.014215	1.59	2.21	8.88	1.01	6.65
Reach-1	169	2YR	2.57	141.65	141.95	141.95	142.06	0.014892	1.45	1.77	8.23	1.00	4.83
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	164	100YR	8.17	138.30	138.83		138.86	0.002624	0.51	10.37	14.75	0.32	13.27
Reach-1	164	50YR	6.60	138.30	138.74		138.76	0.002349	0.41	9.12	13.62	0.29	10.81
Reach-1	164	25YR	6.10	138.30	138.69		138.72	0.002374	0.38	8.50	12.97	0.29	10.12
Reach-1	164	10YR	4.37	138.30	138.54		138.56	0.002100	0.28	6.77	10.44	0.25	7.41
Reach-1	164	5YR	3.52	138.30	138.46		138.47	0.001886	0.19	5.92	9.30	0.22	5.94
Reach-1	164	2YR	2.57	138.30	138.34		138.36	0.001562	0.07	4.96	7.74	0.16	4.24
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	163	100YR	8.17	137.20	138.08	137.99	138.23	0.009915	1.99	7.75	50.21	0.74	12.04
Reach-1	163	50YR	6.60	137.20	138.02	137.97	138.17	0.010628	1.93	5.32	22.77	0.76	9.83
Reach-1	163	25YR	6.10	137.20	137.99	137.97	138.13	0.010185	1.84	4.82	15.66	0.74	9.21
Reach-1	163	10YR	4.37	137.20	137.90	137.86	138.02	0.009858	1.65	3.61	13.13	0.71	6.70
Reach-1	163	5YR	3.52	137.20	137.84	137.80	137.96	0.010879	1.59	2.82	11.19	0.73	5.34
Reach-1	163	2YR	2.57	137.20	137.74	137.72	137.86	0.015146	1.60	1.81	8.05	0.82	3.77
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	162	100YR	8.17	135.60	136.46		136.55	0.008365	1.65	8.05	23.23	0.67	10.63
Reach-1	162	50YR	6.60	135.60	136.42	136.32	136.49	0.007713	1.51	7.02	21.71	0.63	8.72
Reach-1	162	25YR	6.10	135.60	136.39		136.46	0.007886	1.48	6.54	20.96	0.64	8.19
Reach-1	162	10YR	4.37	135.60	136.32		136.38	0.007899	1.34	5.01	18.41	0.62	5.92
Reach-1	162	5YR	3.52	135.60	136.28		136.33	0.007036	1.21	4.42	17.31	0.58	4.68
Reach-1	162	2YR	2.57	135.60	136.25		136.28	0.005238	0.99	3.87	16.23	0.49	3.25
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	161	100YR	8.17	134.10	134.98	134.98	135.07	0.008814	1.68	10.93	62.89	0.67	9.05
Reach-1	161	50YR	6.60	134.10	134.95	134.95	135.03	0.009136	1.64	8.64	54.87	0.68	7.42
Reach-1	161	25YR	6.10	134.10	134.94	134.94	135.02	0.008737	1.59	8.14	52.96	0.66	6.96
Reach-1	161	10YR	4.37	134.10	134.89	134.89	134.97	0.008112	1.44	5.85	43.08	0.63	5.00
Reach-1	161	5YR	3.52	134.10	134.85	134.85	134.93	0.008870	1.43	4.23	34.42	0.65	3.94
Reach-1	161	2YR	2.57	134.10	134.76	134.69	134.87	0.012829	1.52	2.03	16.61	0.76	2.74
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44
Reach-1	160	100YR	8.17	132.50	133.61		133.64	0.002166	0.99	15.54	41.27	0.33	4.97
Reach-1	160	50YR	6.60	132.50	133.54		133.57	0.002221	0.96	12.79	37.14	0.33	4.10
Reach-1	160	25YR	6.10	132.50	133.52	133.29	133.54	0.002198	0.94	11.99	35.85	0.33	3.84
Reach-1	160	10YR	4.37	132.50	133.41		133.44	0.002411	0.92	8.52	29.61	0.34	2.77
Reach-1	160	5YR	3.52	132.50	133.35		133.38	0.002582	0.91	6.73	25.80	0.35	2.23
Reach-1	160	2YR	2.57	132.50	133.28		133.30	0.002499	0.84	5.01	21.54	0.34	1.63

HEC-RAS Model Results for 14W-16, 14W-21, 14W-22, 14W-12A and 14W-12 -------Phase 2 Condition (Controlled Flow)

HEC-RAS Plan: Control 2

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	309	Regional	0.52	154.00	154.33		154.35	0.003014	0.62	1.09	11.42	0.44	9.31
Reach-2A	309	100YR	0.18	154.00	154.20		154.22	0.005856	0.55	0.33	3.23	0.55	2.82
Reach-2A	309	50YR	0.16	154.00	154.19		154.21	0.006014	0.54	0.30	3.08	0.56	2.45
Reach-2A	309	25YR	0.14	154.00	154.18		154.20	0.006168	0.53	0.27	2.91	0.56	2.14
Reach-2A	309	10YR	0.10	154.00	154.16		154.17	0.006776	0.50	0.20	2.52	0.57	1.77
Reach-2A	309	5YR	0.08	154.00	154.14		154.16	0.007334	0.49	0.16	2.29	0.58	1.54
Reach-2A	309	2YR	0.04	154.00	154.11		154.12	0.009221	0.45	0.09	1.69	0.62	1.09
Reach-2A	308	Regional	0.52	153.50	153.93	153.93	153.98	0.008047	1.18	1.16	12.28	0.72	9.22
Reach-2A	308	100YR	0.18	153.50	153.87	153.78	153.89	0.003144	0.63	0.52	8.66	0.43	2.79
Reach-2A	308	50YR	0.16	153.50	153.86	153.76	153.88	0.003113	0.60	0.43	7.46	0.42	2.42
Reach-2A	308	25YR	0.14	153.50	153.84	153.75	153.86	0.003111	0.58	0.34	6.05	0.42	2.12
Reach-2A	308	10YR	0.10	153.50	153.81	153.72	153.83	0.003104	0.51	0.20	2.54	0.41	1.76
Reach-2A	308	5YR	0.08	153.50	153.79	153.70	153.80	0.003065	0.47	0.17	1.16	0.40	1.52
Reach-2A	308	2YR	0.04	153.50	153.73	153.65	153.73	0.002969	0.39	0.10	0.90	0.37	1.08
Reach-2A	307	Regional	0.52	153.00	153.63		153.64	0.000474	0.41	3.88	14.05	0.19	9.01
Reach-2A	307	100YR	0.18	153.00	153.28	153.28	153.35	0.019448	1.17	0.15	1.08	0.99	2.76
Reach-2A	307	50YR	0.16	153.00	153.27	153.27	153.34	0.020779	1.16	0.14	1.02	1.01	2.39
Reach-2A	307	25YR	0.14	153.00	153.26	153.26	153.32	0.021274	1.13	0.12	0.97	1.02	2.10
Reach-2A	307	10YR	0.10	153.00	153.22	153.22	153.28	0.022222	1.06	0.09	0.85	1.01	1.74
Reach-2A	307	5YR	0.08	153.00	153.20	153.20	153.26	0.022798	1.01	0.08	0.78	1.01	1.51
Reach-2A	307	2YR	0.04	153.00	153.16	153.16	153.19	0.024124	0.87	0.05	0.59	1.00	1.08
Reach-2A	306	Regional	0.52	152.60	153.63		153.63	0.000033	0.16	10.05	16.74	0.06	8.54
Reach-2A	306	100YR	0.18	152.60	153.30		153.30	0.000032	0.12	4.82	14.64	0.05	2.60
Reach-2A	306	50YR	0.16	152.60	153.26		153.26	0.000036	0.12	4.27	14.31	0.05	2.25
Reach-2A	306	25YR	0.14	152.60	153.22		153.22	0.000040	0.12	3.71	13.98	0.05	1.97
Reach-2A	306	10YR	0.10	152.60	153.15		153.15	0.000046	0.11	2.73	13.37	0.06	1.65
Reach-2A	306	5YR	0.08	152.60	153.10		153.10	0.000060	0.12	2.06	12.94	0.06	1.44
Reach-2A	306	2YR	0.04	152.60	153.01		153.01	0.000082	0.11	0.91	12.16	0.07	1.05
Reach-2A	305	Regional	6.52	152.12	153.32	153.32	153.49	0.005923	1.99	7.92	35.91	0.73	7.82
Reach-2A	305	100YR	2.51	152.12	153.07	152.92	153.17	0.004948	1.39	2.05	10.64	0.62	2.32
Reach-2A	305	50YR	2.22	152.12	153.04	152.88	153.13	0.004818	1.32	1.76	7.56	0.61	2.01
Reach-2A	305	25YR	1.94	152.12	153.01		153.09	0.004705	1.24	1.57	4.19	0.59	1.76
Reach-2A	305	10YR	1.51	152.12	152.93		153.00	0.004561	1.15	1.32	3.24	0.57	1.49
Reach-2A	305	5YR	1.23	152.12	152.87		152.93	0.004611	1.09	1.12	2.99	0.57	1.31
Reach-2A	305	2YR	0.77	152.12	152.75		152.80	0.004818	0.99	0.78	2.49	0.56	0.98
Reach-2A	304	Regional	6.52	151.63	153.00	152.83	153.06	0.001874	1.28	14.75	39.40	0.42	6.46
Reach-2A	304	100YR	2.51	151.63	152.66	152.42	152.72	0.002820	1.16	3.28	19.07	0.48	2.00
Reach-2A	304	50YR	2.22	151.63	152.61	152.38	152.68	0.002969	1.13	2.56	14.82	0.49	1.75
Reach-2A	304	25YR	1.94	151.63	152.57	152.34	152.63	0.003057	1.09	2.02	10.60	0.49	1.55
Reach-2A	304	10YR	1.51	151.63	152.50	152.28	152.55	0.003106	0.99	1.52	3.53	0.48	1.32
Reach-2A	304	5YR	1.23	151.63	152.44	152.22	152.48	0.003039	0.93	1.32	3.26	0.47	1.17
Reach-2A	304	2YR	0.77	151.63	152.31	152.12	152.35	0.002922	0.82	0.94	2.75	0.45	0.88
Reach-2A	303	Regional	6.67	151.46	152.63	152.63	152.86	0.008279	2.29	4.78	33.18	0.85	6.03
Reach-2A	303	100YR	2.58	151.46	152.27	152.27	152.46	0.013693	1.98	1.31	3.24	0.99	1.91
Reach-2A	303	50YR	2.27	151.46	152.22	152.22	152.41	0.014068	1.93	1.17	3.07	1.00	1.67
Reach-2A	303	25YR	1.98	151.46	152.18	152.18	152.36	0.014324	1.88	1.05	2.91	1.00	1.48
Reach-2A	303	10YR	1.55	151.46	152.12	152.12	152.28	0.014719	1.79	0.87	2.64	1.00	1.27
Reach-2A	303	5YR	1.27	151.46	152.07	152.07	152.22	0.015200	1.72	0.74	2.44	1.00	1.13
Reach-2A	303	2YR	0.79	151.46	151.96	151.96	152.09	0.016533	1.58	0.50	2.01	1.01	0.85
Reach-2A	302.5		Culvert										
Reach-2A	302	Regional	6.67	151.29	152.56	152.46	152.72	0.004972	1.93	5.95	38.75	0.68	5.49
Reach-2A	302	100YR	2.58	151.29	152.27	152.10	152.36	0.004397	1.35	2.33	13.09	0.59	1.55
Reach-2A	302	50YR	2.27	151.29	152.23	152.05	152.31	0.004394	1.29	1.93	9.49	0.58	1.33
Reach-2A	302	25YR	1.98	151.29	152.19	152.02	152.27	0.004389	1.22	1.64	5.70	0.58	1.16
Reach-2A	302	10YR	1.55	151.29	152.12	151.95	152.18	0.004356	1.13	1.37	3.30	0.56	0.98
Reach-2A	302	5YR	1.27	151.29	152.06	151.90	152.12	0.004356	1.08	1.18	3.06	0.56	0.86
Reach-2A	302	2YR	0.79	151.29	151.93	151.79	151.98	0.004345	0.96	0.82	2.56	0.54	0.63
Reach-2A	301	Regional	6.67	150.79	152.04	152.00	152.16	0.004327	1.78	9.97	38.67	0.63	4.29
Reach-2A	301	100YR	2.58	150.79	151.77	151.59	151.86	0.004142	1.33	2.49	14.37	0.57	1.27
Reach-2A	301	50YR	2.27	150.79	151.73	151.55	151.81	0.004142	1.27	2.04	10.75	0.57	1.10
Reach-2A	301	25YR	1.98	150.79	151.69		151.77	0.004143	1.20	1.70	6.94	0.56	0.96
Reach-2A	301	10YR	1.55	150.79	151.62		151.69	0.004160	1.11	1.39	3.35	0.55	0.81
Reach-2A	301	5YR	1.27	150.79	151.56		151.62	0.004164	1.06	1.20	3.11	0.54	0.72
Reach-2A	301	2YR	0.79	150.79	151.44		151.48	0.004196	0.94	0.84	2.60	0.53	0.53
Reach-2A	300	Regional	6.67	150.40	151.68	151.61	151.79	0.003681	1.67	10.82	38.80	0.58	3.32
Reach-2A	300	100YR	2.58	150.40	151.39	151.21	151.47	0.004098	1.32	2.48	14.12	0.57	1.04
Reach-2A	300	50YR	2.27	150.40	151.35	151.17	151.43	0.004114	1.26	2.02	10.42	0.57	0.91
Reach-2A	300	25YR	1.98	150.40	151.31	151.13	151.38	0.004124	1.20	1.69	6.55	0.56	0.80
Reach-2A	300	10YR	1.55	150.40	151.24	151.06	151.30	0.004113	1.11	1.40	3.33	0.55	0.68
Reach-2A	300	5YR	1.27	150.40	151.18	151.01	151.23	0.004120	1.06	1.20	3.09	0.54	0.61
Reach-2A	300	2YR	0.79	150.40	151.05	150.90	151.10	0.004065	0.93	0.85	2.59	0.52	0.45
Reach-2A	299	Regional	6.67	150.05	151.29	151.27	151.43	0.004789	1.85	9.36	38.57	0.66	2.47
Reach-2A	299	100YR	2.58	150.05	151.03	150.85	151.12	0.004257	1.34	2.40	13.59	0.58	0.83

HEC-RAS Plan: Control 2 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	299	50YR	2.27	150.05	151.00	150.81	151.08	0.004229	1.28	1.98	10.03	0.57	0.74
Reach-2A	299	25YR	1.98	150.05	150.96		151.03	0.004197	1.21	1.68	6.31	0.56	0.66
Reach-2A	299	10YR	1.55	150.05	150.89		150.95	0.004119	1.11	1.40	3.33	0.55	0.57
Reach-2A	299	5YR	1.27	150.05	150.83		150.88	0.004153	1.06	1.20	3.09	0.54	0.50
Reach-2A	299	2YR	0.79	150.05	150.70		150.74	0.004271	0.95	0.83	2.57	0.53	0.38
Reach-2A	298	Regional	6.67	149.76	151.15	150.98	151.20	0.001845	1.28	15.11	39.46	0.42	1.60
Reach-2A	298	100YR	2.58	149.76	150.79	150.57	150.86	0.003061	1.20	3.16	18.33	0.50	0.63
Reach-2A	298	50YR	2.27	149.76	150.74	150.52	150.81	0.003226	1.17	2.44	13.89	0.51	0.58
Reach-2A	298	25YR	1.98	149.76	150.70		150.76	0.003365	1.13	1.92	9.40	0.51	0.53
Reach-2A	298	10YR	1.55	149.76	150.63		150.68	0.003431	1.04	1.49	3.45	0.50	0.46
Reach-2A	298	5YR	1.27	149.76	150.57		150.62	0.003353	0.98	1.30	3.21	0.49	0.42
Reach-2A	298	2YR	0.79	149.76	150.44		150.48	0.003217	0.86	0.92	2.71	0.47	0.32
Reach-2A	297	Regional	6.67	149.64	150.81	150.81	151.05	0.008280	2.29	4.76	32.70	0.85	1.27
Reach-2A	297	100YR	2.58	149.64	150.44	150.44	150.65	0.014136	2.00	1.29	3.21	1.01	0.57
Reach-2A	297	50YR	2.27	149.64	150.40	150.40	150.60	0.014289	1.95	1.17	3.05	1.01	0.53
Reach-2A	297	25YR	1.98	149.64	150.36	150.36	150.55	0.014380	1.89	1.05	2.90	1.00	0.49
Reach-2A	297	10YR	1.55	149.64	150.30	150.30	150.46	0.014775	1.79	0.86	2.63	1.00	0.43
Reach-2A	297	5YR	1.27	149.64	150.25	150.25	150.40	0.015325	1.73	0.73	2.42	1.00	0.39
Reach-2A	297	2YR	0.79	149.64	150.14	150.14	150.27	0.016254	1.57	0.50	2.01	1.00	0.30
Reach-2A	296.5		Culvert										
Reach-2A	296	Regional	6.67	149.44	150.62	150.62	150.86	0.008262	2.29	4.75	32.43	0.85	0.56
Reach-2A	296	100YR	2.58	149.44	150.25	150.25	150.45	0.013788	1.99	1.30	3.20	1.00	0.11
Reach-2A	296	50YR	2.27	149.44	150.21	150.21	150.40	0.014033	1.94	1.17	3.04	1.00	0.09
Reach-2A	296	25YR	1.98	149.44	150.17	150.17	150.35	0.014129	1.88	1.05	2.89	0.99	0.08
Reach-2A	296	10YR	1.55	149.44	150.10	150.10	150.27	0.014733	1.79	0.86	2.61	1.00	0.07
Reach-2A	296	5YR	1.27	149.44	150.05	150.05	150.20	0.015438	1.74	0.73	2.40	1.01	0.06
Reach-2A	296	2YR	0.79	149.44	149.94	149.94	150.07	0.016360	1.58	0.50	1.99	1.00	0.04
Reach-2B	231.1	Regional	0.22	148.25	149.20		149.20	0.000002	0.04	15.40	38.95	0.01	0.76
Reach-2B	231.1	100YR	0.09	148.25	148.97		148.97	0.000001	0.03	7.54	27.08	0.01	0.36
Reach-2B	231.1	50YR	0.08	148.25	148.93		148.93	0.000001	0.03	6.70	25.38	0.01	0.33
Reach-2B	231.1	25YR	0.07	148.25	148.90		148.90	0.000001	0.03	5.92	23.69	0.01	0.29
Reach-2B	231.1	10YR	0.06	148.25	148.85		148.85	0.000001	0.03	4.72	20.85	0.01	0.23
Reach-2B	231.1	5YR	0.05	148.25	148.80		148.80	0.000001	0.02	3.88	18.59	0.01	0.19
Reach-2B	231.1	2YR	0.04	148.25	148.72		148.72	0.000002	0.02	2.56	14.37	0.01	0.13
Reach-2B	231	Regional	0.22	148.25	149.20		149.20	0.000002	0.04	15.40	38.95	0.01	0.75
Reach-2B	231	100YR	0.09	148.25	148.97		148.97	0.000001	0.03	7.54	27.08	0.01	0.36
Reach-2B	231	50YR	0.08	148.25	148.93		148.93	0.000001	0.03	6.70	25.38	0.01	0.32
Reach-2B	231	25YR	0.07	148.25	148.90		148.90	0.000001	0.03	5.92	23.69	0.01	0.28
Reach-2B	231	10YR	0.06	148.25	148.85		148.85	0.000001	0.03	4.72	20.85	0.01	0.23
Reach-2B	231	5YR	0.05	148.25	148.80		148.80	0.000001	0.02	3.88	18.59	0.01	0.19
Reach-2B	231	2YR	0.04	148.25	148.72		148.72	0.000002	0.02	2.56	14.37	0.01	0.13
Reach-2B	220.3	Regional	0.22	148.25	149.20		149.20	0.000001	0.04	20.69	58.34	0.01	0.67
Reach-2B	220.3	100YR	0.09	148.25	148.97		148.97	0.000001	0.02	10.08	32.81	0.01	0.32
Reach-2B	220.3	50YR	0.08	148.25	148.93		148.93	0.000001	0.02	9.06	31.07	0.01	0.28
Reach-2B	220.3	25YR	0.07	148.25	148.90		148.90	0.000001	0.02	8.09	29.33	0.01	0.25
Reach-2B	220.3	10YR	0.06	148.25	148.85		148.85	0.000001	0.02	6.59	26.42	0.01	0.20
Reach-2B	220.3	5YR	0.05	148.25	148.80		148.80	0.000001	0.02	5.51	24.10	0.01	0.17
Reach-2B	220.3	2YR	0.04	148.25	148.72		148.72	0.000002	0.02	3.76	19.78	0.01	0.11
Reach-2B	220.2	Regional	0.22	148.57	149.20		149.20	0.000022	0.10	2.54	5.99	0.04	0.03
Reach-2B	220.2	100YR	0.09	148.57	148.96		148.97	0.000027	0.08	1.25	4.89	0.05	0.01
Reach-2B	220.2	50YR	0.08	148.57	148.93		148.93	0.000032	0.08	1.10	4.74	0.05	0.01
Reach-2B	220.2	25YR	0.07	148.57	148.90		148.90	0.000038	0.08	0.95	4.59	0.05	0.01
Reach-2B	220.2	10YR	0.06	148.57	148.85		148.85	0.000069	0.09	0.71	4.34	0.07	0.00
Reach-2B	220.2	5YR	0.05	148.57	148.80		148.80	0.000124	0.10	0.53	4.14	0.08	0.00
Reach-2B	220.2	2YR	0.04	148.57	148.72		148.72	0.000910	0.18	0.22	3.00	0.21	0.00
Reach-2C	220.1	Regional	6.89	148.25	149.11	149.08	149.18	0.004670	1.32	11.84	61.78	0.63	0.04
Reach-2C	220.1	100YR	2.66	148.25	148.86	148.79	148.94	0.007540	1.28	2.28	14.20	0.75	0.01
Reach-2C	220.1	50YR	2.34	148.25	148.83	148.76	148.91	0.007681	1.25	1.95	9.41	0.75	0.01
Reach-2C	220.1	25YR	2.05	148.25	148.80	148.74	148.88	0.007928	1.22	1.70	7.64	0.75	0.01
Reach-2C	220.1	10YR	1.61	148.25	148.75	148.69	148.82	0.008181	1.16	1.39	5.69	0.75	0.01
Reach-2C	220.1	5YR	1.31	148.25	148.71		148.77	0.008039	1.12	1.17	5.05	0.74	0.01
Reach-2C	220.1	2YR	0.83	148.25	148.64		148.69	0.007803	0.99	0.84	4.23	0.71	0.00
Reach-2C	220	Regional	6.89	148.25	149.08	149.08	149.18	0.006687	1.53	9.60	60.26	0.75	0.02
Reach-2C	220	100YR	2.66	148.25	148.79	148.79	148.93	0.014249	1.63	1.65	7.26	1.01	0.01
Reach-2C	220	50YR	2.34	148.25	148.76	148.76	148.89	0.014908	1.60	1.46	5.83	1.02	0.01
Reach-2C	220	25YR	2.05	148.25	148.74	148.74	148.86	0.014820	1.55	1.32	5.49	1.01	0.01
Reach-2C	220	10YR	1.61	148.25	148.69	148.69	148.81	0.015467	1.50	1.07	4.81	1.02	0.01
Reach-2C	220	5YR	1.31	148.25	148.66	148.66	148.76	0.015742	1.44	0.91	4.42	1.01	0.00
Reach-2C	220	2YR	0.83	148.25	148.58	148.58	148.67	0.016802	1.32	0.63	3.63	1.01	0.00
Reach-1A	210.5	Regional	7.95	155.11	155.53	155.48	155.55	0.007070	0.70	11.38	91.64	0.63	11.05
Reach-1A	210.5	100YR	3.23	155.11	155.44	155.42	155.46	0.008353	0.61	5.28	58.51	0.65	4.99
Reach-1A	210.5	50YR	2.86	155.11	155.43	155.41	155.45	0.008552	0.60	4.78	55.93	0.65	4.45
Reach-1A	210.5	25YR	2.51	155.11	155.43	155.40	155.44	0.008845	0.58	4.29	53.24	0.66	3.93

HEC-RAS Plan: Control 2 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1A	210.5	10YR	1.98	155.11	155.41	155.39	155.43	0.008933	0.55	3.60	49.17	0.65	3.19
Reach-1A	210.5	5YR	1.63	155.11	155.40	155.38	155.42	0.009285	0.53	3.08	45.90	0.65	2.76
Reach-1A	210.5	2YR	1.04	155.11	155.38	155.35	155.39	0.009843	0.50	2.06	34.61	0.66	1.99
Reach-1A	210	Regional	7.95	154.96	155.26	155.21	155.30	0.007291	0.92	8.69	47.62	0.68	10.70
Reach-1A	210	100YR	3.23	154.96	155.16		155.18	0.007584	0.72	4.51	36.70	0.65	4.82
Reach-1A	210	50YR	2.86	154.96	155.15		155.17	0.007552	0.69	4.14	35.55	0.65	4.30
Reach-1A	210	25YR	2.51	154.96	155.14		155.16	0.007427	0.66	3.80	34.44	0.64	3.79
Reach-1A	210	10YR	1.98	154.96	155.12		155.14	0.007587	0.62	3.20	32.39	0.63	3.07
Reach-1A	210	5YR	1.63	154.96	155.11		155.12	0.007450	0.58	2.81	31.00	0.62	2.66
Reach-1A	210	2YR	1.04	154.96	155.08		155.09	0.007375	0.50	2.07	28.16	0.59	1.92
Reach-1A	209	Regional	7.95	154.46	154.73		154.76	0.003438	0.79	15.46	75.06	0.50	9.36
Reach-1A	209	100YR	3.23	154.46	154.63		154.64	0.003382	0.56	8.19	64.43	0.45	4.11
Reach-1A	209	50YR	2.86	154.46	154.62		154.63	0.003381	0.53	7.52	62.82	0.45	3.65
Reach-1A	209	25YR	2.51	154.46	154.61		154.62	0.003399	0.51	6.85	61.87	0.44	3.20
Reach-1A	209	10YR	1.98	154.46	154.59		154.60	0.003367	0.46	5.84	60.39	0.43	2.57
Reach-1A	209	5YR	1.63	154.46	154.58		154.59	0.003391	0.43	5.09	59.27	0.43	2.22
Reach-1A	209	2YR	1.04	154.46	154.56		154.56	0.003348	0.36	3.74	57.19	0.40	1.60
Reach-1A	208.3	Regional	7.95	152.95	153.39	153.39	153.49	0.015290	1.41	5.62	27.93	1.01	7.24
Reach-1A	208.3	100YR	3.23	152.95	153.26	153.26	153.33	0.017491	1.20	2.69	18.97	1.02	3.02
Reach-1A	208.3	50YR	2.86	152.95	153.25	153.25	153.32	0.017761	1.17	2.44	17.96	1.02	2.66
Reach-1A	208.3	25YR	2.51	152.95	153.23	153.23	153.30	0.017787	1.14	2.20	16.97	1.01	2.29
Reach-1A	208.3	10YR	1.98	152.95	153.21	153.21	153.27	0.018542	1.10	1.80	15.16	1.02	1.81
Reach-1A	208.3	5YR	1.63	152.95	153.19	153.19	153.25	0.018713	1.05	1.55	14.04	1.01	1.56
Reach-1A	208.3	2YR	1.04	152.95	153.15	153.15	153.20	0.020257	0.97	1.07	11.63	1.02	1.12
Reach-1A	208.2	Regional	8.10	152.50	153.06	152.87	153.09	0.001972	0.82	9.97	35.34	0.41	6.83
Reach-1A	208.2	100YR	3.29	152.50	152.86	152.74	152.88	0.002607	0.63	5.26	24.17	0.42	2.82
Reach-1A	208.2	50YR	2.91	152.50	152.84	152.72	152.86	0.002676	0.60	4.82	23.20	0.42	2.47
Reach-1A	208.2	25YR	2.55	152.50	152.82	152.71	152.84	0.002632	0.58	4.40	22.25	0.42	2.13
Reach-1A	208.2	10YR	2.01	152.50	152.79	152.69	152.81	0.002533	0.54	3.75	20.69	0.40	1.67
Reach-1A	208.2	5YR	1.67	152.50	152.77	152.67	152.78	0.002449	0.50	3.31	19.59	0.39	1.44
Reach-1A	208.2	2YR	1.06	152.50	152.73	152.63	152.74	0.002135	0.42	2.49	17.19	0.36	1.03
Reach-1A	208.15		Bridge										
Reach-1A	208.1	Regional	8.10	152.45	152.90	152.75	152.95	0.002749	0.94	8.65	44.10	0.48	6.53
Reach-1A	208.1	100YR	3.29	152.45	152.69	152.64	152.72	0.005978	0.82	3.99	34.28	0.62	2.67
Reach-1A	208.1	50YR	2.91	152.45	152.67	152.63	152.70	0.007221	0.83	3.50	33.27	0.66	2.33
Reach-1A	208.1	25YR	2.55	152.45	152.65	152.62	152.68	0.009137	0.85	3.02	32.25	0.73	1.99
Reach-1A	208.1	10YR	2.01	152.45	152.62	152.60	152.65	0.012110	0.84	2.40	30.97	0.81	1.55
Reach-1A	208.1	5YR	1.67	152.45	152.60	152.59	152.64	0.015569	0.84	1.99	30.12	0.89	1.33
Reach-1A	208.1	2YR	1.06	152.45	152.57	152.57	152.60	0.022738	0.78	1.35	28.61	1.01	0.95
Reach-1A	208	Regional	8.10	151.00	152.19	152.19	152.42	0.009984	2.14	4.68	15.91	0.92	5.60
Reach-1A	208	100YR	3.29	151.00	152.02	151.91	152.11	0.006043	1.30	2.57	8.49	0.67	2.26
Reach-1A	208	50YR	2.91	151.00	152.01	151.88	152.08	0.005240	1.18	2.47	7.90	0.63	1.97
Reach-1A	208	25YR	2.55	151.00	152.00		152.06	0.004444	1.07	2.39	7.41	0.57	1.67
Reach-1A	208	10YR	2.01	151.00	151.95		152.00	0.004057	0.97	2.07	6.26	0.54	1.29
Reach-1A	208	5YR	1.67	151.00	151.91		151.96	0.003796	0.91	1.83	5.74	0.52	1.11
Reach-1A	208	2YR	1.06	151.00	151.83		151.86	0.002952	0.77	1.38	4.63	0.45	0.79
Reach-1A	207	Regional	8.10	150.25	151.04		151.07	0.002494	0.91	16.99	55.48	0.46	3.51
Reach-1A	207	100YR	3.29	150.25	150.82	150.79	150.86	0.006499	0.96	5.55	48.84	0.66	1.47
Reach-1A	207	50YR	2.91	150.25	150.80	150.77	150.84	0.007642	0.98	4.47	48.18	0.71	1.29
Reach-1A	207	25YR	2.55	150.25	150.77	150.76	150.82	0.009532	1.02	3.30	47.43	0.77	1.11
Reach-1A	207	10YR	2.01	150.25	150.75	150.71	150.79	0.010360	0.98	2.11	22.78	0.79	0.88
Reach-1A	207	5YR	1.67	150.25	150.72	150.69	150.77	0.011091	0.97	1.73	11.79	0.81	0.76
Reach-1A	207	2YR	1.06	150.25	150.65	150.65	150.70	0.016484	1.04	1.02	8.44	0.95	0.55
Reach-1A	206.3	Regional	10.04	149.49	150.47	150.46	150.68	0.006488	2.19	9.26	27.44	0.80	2.30
Reach-1A	206.3	100YR	4.08	149.49	150.25	150.12	150.36	0.004520	1.45	3.93	20.92	0.63	1.03
Reach-1A	206.3	50YR	3.61	149.49	150.23	150.09	150.32	0.004317	1.37	3.39	18.10	0.61	0.92
Reach-1A	206.3	25YR	3.17	149.49	150.20	150.05	150.28	0.004076	1.29	2.94	15.16	0.59	0.82
Reach-1A	206.3	10YR	2.51	149.49	150.13		150.20	0.004457	1.21	2.12	7.87	0.60	0.68
Reach-1A	206.3	5YR	2.08	149.49	150.08		150.14	0.004677	1.15	1.81	4.91	0.60	0.59
Reach-1A	206.3	2YR	1.33	149.49	149.97		150.02	0.004439	1.00	1.33	4.29	0.57	0.44
Reach-1A	206.2	Regional	10.04	149.25	150.37	150.17	150.42	0.002496	1.11	12.53	33.69	0.48	1.80
Reach-1A	206.2	100YR	4.08	149.25	150.10	149.90	150.14	0.003279	0.92	5.31	23.11	0.50	0.81
Reach-1A	206.2	50YR	3.61	149.25	150.06	149.87	150.10	0.003755	0.94	4.35	21.85	0.53	0.74
Reach-1A	206.2	25YR	3.17	149.25	150.02	149.83	150.06	0.004251	0.96	3.48	20.69	0.56	0.67
Reach-1A	206.2	10YR	2.51	149.25	149.94	149.78	149.99	0.003780	0.97	2.59	7.84	0.54	0.56
Reach-1A	206.2	5YR	2.08	149.25	149.90	149.74	149.94	0.003332	0.92	2.27	6.79	0.51	0.50
Reach-1A	206.2	2YR	1.33	149.25	149.81	149.65	149.84	0.002907	0.78	1.71	5.92	0.46	0.37
Reach-1A	206.15		Bridge										
Reach-1A	206.1	Regional	10.04	149.00	150.01	149.89	150.11	0.004917	1.46	8.04	30.32	0.65	1.44
Reach-1A	206.1	100YR	4.08	149.00	149.78	149.71	149.84	0.006212	1.10	3.89	20.74	0.66	0.64
Reach-1A	206.1	50YR	3.61	149.00	149.76	149.70	149.82	0.006065	1.04	3.61	19.52	0.65	0.59
Reach-1A	206.1	25YR	3.17	149.00	149.74	149.68	149.79	0.006176	0.99	3.28	18.00	0.65	0.53

HEC-RAS Plan: Control 2 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1A	206.1	10YR	2.51	149.00	149.71	149.65	149.75	0.006329	0.91	2.79	15.52	0.64	0.44
Reach-1A	206.1	5YR	2.08	149.00	149.68	149.63	149.72	0.006217	0.85	2.47	14.37	0.62	0.39
Reach-1A	206.1	2YR	1.33	149.00	149.64	149.57	149.66	0.005998	0.72	1.84	11.96	0.59	0.28
Reach-1	205	Regional	17.72	147.24	148.37	148.37	148.71	0.010820	2.58	6.86	10.33	1.01	52.60
Reach-1	205	100YR	7.02	147.24	148.01	148.01	148.22	0.012248	2.02	3.48	8.38	1.00	20.39
Reach-1	205	50YR	6.20	147.24	147.97	147.97	148.17	0.012922	1.97	3.14	8.15	1.02	17.04
Reach-1	205	25YR	5.42	147.24	147.93	147.93	148.12	0.013147	1.90	2.85	7.95	1.01	15.78
Reach-1	205	10YR	4.25	147.24	147.87	147.87	148.03	0.013570	1.77	2.40	7.61	1.01	11.94
Reach-1	205	5YR	3.51	147.24	147.83	147.83	147.98	0.014282	1.69	2.08	7.37	1.02	9.85
Reach-1	205	2YR	2.25	147.24	147.75	147.75	147.87	0.015776	1.50	1.50	6.91	1.02	7.20
Reach-1	204.75	Regional	17.72	146.00	147.46		147.50	0.001588	1.22	28.40	31.13	0.41	49.98
Reach-1	204.75	100YR	7.02	146.00	146.97		146.99	0.001386	0.78	15.62	19.24	0.35	18.97
Reach-1	204.75	50YR	6.20	146.00	146.92		146.93	0.001348	0.73	14.59	18.72	0.34	15.72
Reach-1	204.75	25YR	5.42	146.00	146.86		146.87	0.001306	0.68	13.55	18.14	0.33	14.56
Reach-1	204.75	10YR	4.25	146.00	146.76		146.77	0.001228	0.60	11.87	17.09	0.31	10.88
Reach-1	204.75	5YR	3.51	146.00	146.69		146.70	0.001151	0.54	10.71	16.16	0.30	8.90
Reach-1	204.75	2YR	2.25	146.00	146.55		146.55	0.000980	0.43	8.46	14.17	0.26	6.46
Reach-1	204.7	Regional	17.72	145.89	146.89	146.89	147.23	0.010041	2.59	7.07	12.91	0.99	48.64
Reach-1	204.7	100YR	7.02	145.89	146.52	146.52	146.74	0.012222	2.06	3.40	7.96	1.01	18.26
Reach-1	204.7	50YR	6.20	145.89	146.48	146.48	146.68	0.012450	2.01	3.08	7.59	1.01	15.06
Reach-1	204.7	25YR	5.42	145.89	146.44	146.44	146.63	0.012681	1.96	2.77	7.21	1.01	13.95
Reach-1	204.7	10YR	4.25	145.89	146.37	146.37	146.54	0.013218	1.85	2.30	6.70	1.01	10.35
Reach-1	204.7	5YR	3.51	145.89	146.32	146.32	146.48	0.013519	1.76	2.00	6.43	1.01	8.42
Reach-1	204.7	2YR	2.25	145.89	146.23	146.23	146.36	0.014532	1.57	1.44	5.82	1.01	6.09
Reach-1	204.55	Regional	17.72	145.49	146.66	146.54	146.87	0.005820	2.02	9.22	18.01	0.76	48.52
Reach-1	204.55	100YR	7.02	145.49	146.37		146.46	0.003974	1.31	5.35	10.62	0.59	18.19
Reach-1	204.55	50YR	6.20	145.49	146.33		146.41	0.003870	1.26	4.90	10.10	0.58	14.99
Reach-1	204.55	25YR	5.42	145.49	146.29		146.36	0.003718	1.21	4.48	9.58	0.56	13.89
Reach-1	204.55	10YR	4.25	145.49	146.22		146.28	0.003510	1.11	3.83	8.94	0.54	10.30
Reach-1	204.55	5YR	3.51	145.49	146.16		146.22	0.003530	1.04	3.36	8.62	0.53	8.38
Reach-1	204.55	2YR	2.25	145.49	146.05		146.09	0.003695	0.92	2.44	7.80	0.53	6.06
Reach-1	204.5	Regional	17.72	145.36	146.54	146.49	146.74	0.008111	2.00	9.42	23.12	0.86	48.35
Reach-1	204.5	100YR	7.02	145.36	146.25		146.36	0.006665	1.51	4.65	11.08	0.74	18.10
Reach-1	204.5	50YR	6.20	145.36	146.21		146.32	0.006128	1.45	4.28	10.17	0.71	14.91
Reach-1	204.5	25YR	5.42	145.36	146.18		146.27	0.005658	1.37	3.95	9.61	0.68	13.81
Reach-1	204.5	10YR	4.25	145.36	146.12		146.20	0.005270	1.26	3.38	8.90	0.65	10.23
Reach-1	204.5	5YR	3.51	145.36	146.06		146.14	0.005449	1.21	2.90	8.24	0.65	8.32
Reach-1	204.5	2YR	2.25	145.36	145.94		146.01	0.005887	1.12	2.01	6.79	0.66	6.02
Reach-1	204.25	Regional	17.72	145.11	146.28	146.28	146.52	0.009036	2.38	13.14	30.69	0.93	48.06
Reach-1	204.25	100YR	7.02	145.11	146.00	146.00	146.16	0.009665	1.83	5.41	23.35	0.89	17.97
Reach-1	204.25	50YR	6.20	145.11	145.97	145.97	146.12	0.010016	1.78	4.66	22.40	0.90	14.80
Reach-1	204.25	25YR	5.42	145.11	145.90	145.90	146.08	0.010751	1.86	3.43	16.36	0.93	13.72
Reach-1	204.25	10YR	4.25	145.11	145.80	145.80	145.99	0.012925	1.92	2.23	7.66	1.00	10.16
Reach-1	204.25	5YR	3.51	145.11	145.75	145.75	145.92	0.013507	1.86	1.89	5.51	1.01	8.26
Reach-1	204.25	2YR	2.25	145.11	145.64	145.64	145.78	0.013948	1.68	1.34	4.69	1.00	5.97
Reach-1	204	Regional	18.01	144.05	145.06	145.06	145.35	0.009587	2.79	13.73	25.04	1.00	46.75
Reach-1	204	100YR	7.18	144.05	144.78	144.78	144.95	0.008859	2.01	6.89	23.06	0.89	17.38
Reach-1	204	50YR	6.35	144.05	144.74	144.74	144.91	0.009685	1.99	5.95	22.46	0.92	14.29
Reach-1	204	25YR	5.57	144.05	144.71	144.71	144.86	0.009859	1.91	5.23	21.31	0.92	13.31
Reach-1	204	10YR	4.33	144.05	144.65	144.65	144.79	0.010275	1.78	4.06	19.29	0.91	9.87
Reach-1	204	5YR	3.58	144.05	144.61	144.61	144.74	0.010390	1.67	3.37	18.00	0.90	8.02
Reach-1	204	2YR	2.31	144.05	144.53	144.53	144.64	0.011382	1.48	2.07	15.16	0.91	5.82
Reach-1	203	Regional	18.16	142.50	144.81		144.85	0.000541	0.95	29.43	36.89	0.26	45.39
Reach-1	203	100YR	7.27	142.50	143.67	143.67	143.87	0.013060	2.00	3.63	9.11	1.01	17.05
Reach-1	203	50YR	6.43	142.50	143.55	143.55	143.82	0.012872	2.32	2.78	5.39	1.03	14.02
Reach-1	203	25YR	5.64	142.50	143.50	143.50	143.76	0.012463	2.23	2.53	5.07	1.01	13.07
Reach-1	203	10YR	4.38	142.50	143.40	143.40	143.64	0.013022	2.13	2.06	4.55	1.01	9.68
Reach-1	203	5YR	3.62	142.50	143.34	143.34	143.55	0.013427	2.05	1.76	4.21	1.01	7.86
Reach-1	203	2YR	2.32	142.50	143.20	143.20	143.38	0.014270	1.88	1.23	3.53	1.01	5.71
Reach-1	202.75	Regional	18.16	142.43	144.51	143.74	144.77	0.001829	2.27	8.00	34.69	0.50	44.67
Reach-1	202.75	100YR	7.27	142.43	143.56	143.14	143.70	0.002245	1.67	4.34	26.92	0.50	16.85
Reach-1	202.75	50YR	6.43	142.43	143.47	143.09	143.60	0.002307	1.61	4.00	25.56	0.50	13.85
Reach-1	202.75	25YR	5.64	142.43	143.38	143.03	143.50	0.002376	1.54	3.67	23.03	0.50	12.92
Reach-1	202.75	10YR	4.38	142.43	143.23	142.94	143.34	0.002514	1.41	3.10	18.75	0.50	9.57
Reach-1	202.75	5YR	3.62	142.43	143.14	142.88	143.23	0.002624	1.33	2.73	17.00	0.50	7.77
Reach-1	202.75	2YR	2.32	142.43	142.96	142.76	143.02	0.002899	1.14	2.03	13.79	0.50	5.66
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	18.16	142.28	143.59	143.59	144.25	0.015737	3.60	5.05	4.08	1.00	43.82
Reach-1	202.25	100YR	7.27	142.28	142.99	142.99	143.35	0.014995	2.64	2.75	3.85	1.00	16.50
Reach-1	202.25	50YR	6.43	142.28	142.94	142.94	143.27	0.015095	2.54	2.53	3.85	1.00	13.54
Reach-1	202.25	25YR	5.64	142.28	142.88	142.88	143.18	0.015009	2.43	2.32	3.85	1.00	12.65
Reach-1	202.25	10YR	4.38	142.28	142.79	142.79	143.04	0.015106	2.23	1.96	3.85	1.00	9.34
Reach-1	202.25	5YR	3.62	142.28	142.74	142.73	142.95	0.013796	2.03	1.78	3.85	0.95	7.58

HEC-RAS Plan: Control 2 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	202.25	2YR	2.32	142.28	142.69	142.61	142.80	0.008472	1.48	1.57	3.85	0.74	5.52
Reach-1	202	Regional	18.16	142.20	143.23		143.28	0.001458	1.20	28.88	49.26	0.40	43.48
Reach-1	202	100YR	7.27	142.20	142.67	142.67	142.81	0.010884	1.74	5.63	25.27	0.93	16.42
Reach-1	202	50YR	6.43	142.20	142.64	142.64	142.78	0.012481	1.74	4.78	22.33	0.98	13.46
Reach-1	202	25YR	5.64	142.20	142.62	142.62	142.75	0.011478	1.61	4.45	21.67	0.93	12.58
Reach-1	202	10YR	4.38	142.20	142.58	142.58	142.69	0.012071	1.50	3.55	20.23	0.93	9.29
Reach-1	202	5YR	3.62	142.20	142.55	142.55	142.65	0.012248	1.40	3.02	19.37	0.92	7.53
Reach-1	202	2YR	2.32	142.20	142.49	142.49	142.57	0.015247	1.28	1.86	14.86	0.98	5.49
Reach-1	201	Regional	18.16	141.65	143.21		143.24	0.000468	0.92	37.17	39.44	0.24	42.01
Reach-1	201	100YR	7.27	141.65	142.60		142.63	0.000723	0.80	14.96	31.91	0.28	15.94
Reach-1	201	50YR	6.43	141.65	142.52		142.55	0.000834	0.81	12.61	30.71	0.29	13.06
Reach-1	201	25YR	5.64	141.65	142.50		142.52	0.000752	0.75	11.73	30.12	0.28	12.20
Reach-1	201	10YR	4.38	141.65	142.39		142.42	0.000815	0.71	8.86	25.50	0.28	9.00
Reach-1	201	5YR	3.62	141.65	142.33		142.35	0.000815	0.66	7.40	22.87	0.28	7.28
Reach-1	201	2YR	2.32	141.65	142.25		142.26	0.000610	0.51	5.59	19.18	0.23	5.31
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	171	100YR	8.17	141.65	142.44	142.21	142.50	0.002213	1.21	9.98	27.36	0.47	14.77
Reach-1	171	50YR	6.60	141.65	142.36	142.15	142.42	0.002210	1.13	8.15	24.25	0.46	12.09
Reach-1	171	25YR	6.10	141.65	142.34	142.13	142.40	0.002202	1.10	7.58	23.20	0.46	11.30
Reach-1	171	10YR	4.37	141.65	142.25	142.05	142.29	0.002182	0.97	5.57	19.13	0.44	8.32
Reach-1	171	5YR	3.52	141.65	142.19	142.01	142.23	0.002166	0.89	4.59	16.80	0.43	6.72
Reach-1	171	2YR	2.57	141.65	142.12	141.95	142.15	0.002101	0.79	3.54	13.88	0.41	4.88
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	169	100YR	8.17	141.65	142.21	142.21	142.40	0.009752	1.96	4.98	17.76	0.92	14.61
Reach-1	169	50YR	6.60	141.65	142.15	142.15	142.32	0.010567	1.86	3.98	15.15	0.94	11.95
Reach-1	169	25YR	6.10	141.65	142.13	142.13	142.30	0.011146	1.83	3.63	14.16	0.95	11.17
Reach-1	169	10YR	4.37	141.65	142.05	142.05	142.19	0.013010	1.69	2.63	10.71	0.99	8.23
Reach-1	169	5YR	3.52	141.65	142.01	142.01	142.13	0.014215	1.59	2.21	8.88	1.01	6.65
Reach-1	169	2YR	2.57	141.65	141.95	141.95	142.06	0.014892	1.45	1.77	8.23	1.00	4.83
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	164	100YR	8.17	138.30	138.83		138.86	0.002624	0.51	10.37	14.75	0.32	13.27
Reach-1	164	50YR	6.60	138.30	138.74		138.76	0.002349	0.41	9.12	13.62	0.29	10.81
Reach-1	164	25YR	6.10	138.30	138.69		138.72	0.002374	0.38	8.50	12.97	0.29	10.12
Reach-1	164	10YR	4.37	138.30	138.54		138.56	0.002100	0.28	6.77	10.44	0.25	7.41
Reach-1	164	5YR	3.52	138.30	138.46		138.47	0.001886	0.19	5.92	9.30	0.22	5.94
Reach-1	164	2YR	2.57	138.30	138.34		138.36	0.001562	0.07	4.96	7.74	0.16	4.24
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	163	100YR	8.17	137.20	138.08	137.99	138.23	0.009915	1.99	7.75	50.21	0.74	12.04
Reach-1	163	50YR	6.60	137.20	138.02	137.97	138.17	0.010628	1.93	5.32	22.77	0.76	9.83
Reach-1	163	25YR	6.10	137.20	137.99	137.97	138.13	0.010185	1.84	4.82	15.66	0.74	9.21
Reach-1	163	10YR	4.37	137.20	137.90	137.86	138.02	0.009858	1.65	3.61	13.13	0.71	6.70
Reach-1	163	5YR	3.52	137.20	137.84	137.80	137.96	0.010879	1.59	2.82	11.19	0.73	5.34
Reach-1	163	2YR	2.57	137.20	137.74	137.72	137.86	0.015146	1.60	1.81	8.05	0.82	3.77
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	162	100YR	8.17	135.60	136.46		136.55	0.008365	1.65	8.05	23.23	0.67	10.63
Reach-1	162	50YR	6.60	135.60	136.42	136.32	136.49	0.007713	1.51	7.02	21.71	0.63	8.72
Reach-1	162	25YR	6.10	135.60	136.39		136.46	0.007886	1.48	6.54	20.96	0.64	8.19
Reach-1	162	10YR	4.37	135.60	136.32		136.38	0.007899	1.34	5.01	18.41	0.62	5.92
Reach-1	162	5YR	3.52	135.60	136.28		136.33	0.007036	1.21	4.42	17.31	0.58	4.68
Reach-1	162	2YR	2.57	135.60	136.25		136.28	0.005238	0.99	3.87	16.23	0.49	3.25
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	161	100YR	8.17	134.10	134.98	134.98	135.07	0.008814	1.68	10.93	62.89	0.67	9.05
Reach-1	161	50YR	6.60	134.10	134.95	134.95	135.03	0.009136	1.64	8.64	54.87	0.68	7.42
Reach-1	161	25YR	6.10	134.10	134.94	134.94	135.02	0.008737	1.59	8.14	52.96	0.66	6.96
Reach-1	161	10YR	4.37	134.10	134.89	134.89	134.97	0.008112	1.44	5.85	43.08	0.63	5.00
Reach-1	161	5YR	3.52	134.10	134.85	134.85	134.93	0.008870	1.43	4.23	34.42	0.65	3.94
Reach-1	161	2YR	2.57	134.10	134.76	134.69	134.87	0.012829	1.52	2.03	16.61	0.76	2.74
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44
Reach-1	160	100YR	8.17	132.50	133.61		133.64	0.002166	0.99	15.54	41.27	0.33	4.97
Reach-1	160	50YR	6.60	132.50	133.54		133.57	0.002221	0.96	12.79	37.14	0.33	4.10
Reach-1	160	25YR	6.10	132.50	133.52	133.29	133.54	0.002198	0.94	11.99	35.85	0.33	3.84
Reach-1	160	10YR	4.37	132.50	133.41		133.44	0.002411	0.92	8.52	29.61	0.34	2.77
Reach-1	160	5YR	3.52	132.50	133.35		133.38	0.002582	0.91	6.73	25.80	0.35	2.23
Reach-1	160	2YR	2.57	132.50	133.28		133.30	0.002499	0.84	5.01	21.54	0.34	1.63

HEC-RAS Model Results for 14W-16, 14W-21, 14W-22, 14W-12A and 14W-12 -------Ultimate Condition (Controlled Flow)

HEC-RAS Plan: Control Flow Ultiamte

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	309	Regional	0.52	154.00	154.33		154.35	0.003014	0.62	1.09	11.42	0.44	9.04
Reach-2A	309	100YR	0.18	154.00	154.20		154.22	0.005856	0.55	0.33	3.23	0.55	2.74
Reach-2A	309	50YR	0.16	154.00	154.19		154.21	0.006014	0.54	0.30	3.08	0.56	2.38
Reach-2A	309	25YR	0.14	154.00	154.18		154.20	0.006168	0.53	0.27	2.91	0.56	2.10
Reach-2A	309	10YR	0.10	154.00	154.16		154.17	0.006776	0.50	0.20	2.52	0.57	1.74
Reach-2A	309	5YR	0.08	154.00	154.14		154.16	0.007334	0.49	0.16	2.29	0.58	1.50
Reach-2A	309	2YR	0.04	154.00	154.11		154.12	0.009221	0.45	0.09	1.69	0.62	1.07
Reach-2A	308	Regional	0.52	153.50	153.93	153.93	153.98	0.008047	1.18	1.16	12.28	0.72	8.95
Reach-2A	308	100YR	0.18	153.50	153.87	153.78	153.89	0.003144	0.63	0.52	8.66	0.43	2.71
Reach-2A	308	50YR	0.16	153.50	153.86	153.76	153.88	0.003113	0.60	0.43	7.46	0.42	2.35
Reach-2A	308	25YR	0.14	153.50	153.84	153.75	153.86	0.003111	0.58	0.34	6.05	0.42	2.07
Reach-2A	308	10YR	0.10	153.50	153.81	153.72	153.83	0.003104	0.51	0.20	2.54	0.41	1.72
Reach-2A	308	5YR	0.08	153.50	153.79	153.70	153.80	0.003065	0.47	0.17	1.16	0.40	1.49
Reach-2A	308	2YR	0.04	153.50	153.73	153.65	153.73	0.002969	0.39	0.10	0.90	0.37	1.06
Reach-2A	307	Regional	0.52	153.00	153.63		153.63	0.000513	0.42	3.77	13.98	0.20	8.75
Reach-2A	307	100YR	0.18	153.00	153.28	153.28	153.35	0.019448	1.17	0.15	1.08	0.99	2.68
Reach-2A	307	50YR	0.16	153.00	153.27	153.27	153.34	0.020779	1.16	0.14	1.02	1.01	2.33
Reach-2A	307	25YR	0.14	153.00	153.26	153.26	153.32	0.021274	1.13	0.12	0.97	1.02	2.05
Reach-2A	307	10YR	0.10	153.00	153.22	153.22	153.28	0.022222	1.06	0.09	0.85	1.01	1.71
Reach-2A	307	5YR	0.08	153.00	153.20	153.20	153.26	0.022798	1.01	0.08	0.78	1.01	1.48
Reach-2A	307	2YR	0.04	153.00	153.16	153.16	153.19	0.024124	0.87	0.05	0.59	1.00	1.06
Reach-2A	306	Regional	0.52	152.60	153.62		153.62	0.000035	0.16	9.92	16.70	0.06	8.29
Reach-2A	306	100YR	0.18	152.60	153.29		153.29	0.000034	0.12	4.71	14.57	0.05	2.52
Reach-2A	306	50YR	0.16	152.60	153.25		153.25	0.000038	0.12	4.15	14.24	0.05	2.18
Reach-2A	306	25YR	0.14	152.60	153.21		153.21	0.000043	0.12	3.62	13.92	0.06	1.93
Reach-2A	306	10YR	0.10	152.60	153.14		153.14	0.000050	0.12	2.64	13.31	0.06	1.62
Reach-2A	306	5YR	0.08	152.60	153.09		153.09	0.000065	0.12	1.99	12.89	0.07	1.41
Reach-2A	306	2YR	0.04	152.60	153.00		153.00	0.000090	0.12	0.86	12.12	0.07	1.03
Reach-2A	305	Regional	6.35	152.12	153.31	153.31	153.48	0.006054	1.99	7.53	34.78	0.73	7.59
Reach-2A	305	100YR	2.45	152.12	153.07	152.91	153.16	0.004914	1.38	1.98	10.05	0.62	2.25
Reach-2A	305	50YR	2.16	152.12	153.03		153.12	0.004760	1.30	1.72	6.96	0.60	1.95
Reach-2A	305	25YR	1.89	152.12	153.00		153.08	0.004666	1.22	1.54	3.61	0.59	1.72
Reach-2A	305	10YR	1.47	152.12	152.92		152.99	0.004584	1.14	1.29	3.20	0.57	1.47
Reach-2A	305	5YR	1.20	152.12	152.87		152.93	0.004604	1.09	1.10	2.96	0.57	1.29
Reach-2A	305	2YR	0.75	152.12	152.74		152.79	0.004809	0.98	0.76	2.46	0.56	0.97
Reach-2A	304	Regional	6.35	151.63	152.99	152.81	153.04	0.001922	1.29	14.23	39.33	0.43	6.28
Reach-2A	304	100YR	2.45	151.63	152.65	152.41	152.71	0.002856	1.15	3.12	18.19	0.48	1.94
Reach-2A	304	50YR	2.16	151.63	152.60	152.37	152.67	0.002979	1.12	2.44	14.00	0.49	1.70
Reach-2A	304	25YR	1.89	151.63	152.56	152.34	152.62	0.003061	1.08	1.95	9.85	0.49	1.52
Reach-2A	304	10YR	1.47	151.63	152.49	152.27	152.54	0.003080	0.98	1.50	3.47	0.48	1.30
Reach-2A	304	5YR	1.20	151.63	152.43	152.22	152.47	0.003061	0.93	1.29	3.22	0.47	1.15
Reach-2A	304	2YR	0.75	151.63	152.31	152.12	152.34	0.002944	0.82	0.92	2.72	0.45	0.86
Reach-2A	303	Regional	6.50	151.46	152.62	152.62	152.85	0.008190	2.26	4.69	32.46	0.85	5.86
Reach-2A	303	100YR	2.51	151.46	152.26	152.26	152.45	0.013789	1.97	1.28	3.20	1.00	1.86
Reach-2A	303	50YR	2.21	151.46	152.22	152.22	152.40	0.014179	1.93	1.15	3.04	1.00	1.63
Reach-2A	303	25YR	1.93	151.46	152.18	152.18	152.35	0.014439	1.87	1.03	2.88	1.00	1.46
Reach-2A	303	10YR	1.51	151.46	152.11	152.11	152.27	0.014950	1.79	0.85	2.61	1.00	1.25
Reach-2A	303	5YR	1.23	151.46	152.06	152.06	152.21	0.015319	1.71	0.72	2.40	1.00	1.11
Reach-2A	303	2YR	0.77	151.46	151.96	151.96	152.08	0.016138	1.55	0.50	2.00	1.00	0.84
Reach-2A	302.5		Culvert										
Reach-2A	302	Regional	6.50	151.29	152.55	152.45	152.71	0.004899	1.90	5.86	38.70	0.67	5.33
Reach-2A	302	100YR	2.51	151.29	152.26	152.09	152.35	0.004393	1.34	2.24	12.34	0.59	1.50
Reach-2A	302	50YR	2.21	151.29	152.22	152.05	152.31	0.004393	1.28	1.86	8.74	0.58	1.29
Reach-2A	302	25YR	1.93	151.29	152.18	152.01	152.26	0.004388	1.21	1.60	5.00	0.57	1.13
Reach-2A	302	10YR	1.51	151.29	152.11	151.94	152.18	0.004373	1.13	1.34	3.26	0.56	0.96
Reach-2A	302	5YR	1.23	151.29	152.05	151.89	152.11	0.004356	1.07	1.15	3.02	0.55	0.84
Reach-2A	302	2YR	0.77	151.29	151.93	151.79	151.97	0.004313	0.95	0.81	2.54	0.54	0.62
Reach-2A	301	Regional	6.50	150.79	152.03	151.99	152.15	0.004370	1.77	9.64	38.62	0.63	4.17
Reach-2A	301	100YR	2.51	150.79	151.76	151.58	151.85	0.004155	1.32	2.38	13.54	0.57	1.23
Reach-2A	301	50YR	2.21	150.79	151.72	151.55	151.80	0.004142	1.26	1.96	10.00	0.57	1.06
Reach-2A	301	25YR	1.93	150.79	151.69		151.76	0.004144	1.19	1.66	6.24	0.56	0.94
Reach-2A	301	10YR	1.51	150.79	151.62		151.68	0.004112	1.10	1.37	3.32	0.55	0.80
Reach-2A	301	5YR	1.23	150.79	151.55		151.61	0.004165	1.05	1.17	3.07	0.54	0.70
Reach-2A	301	2YR	0.77	150.79	151.43		151.47	0.004198	0.94	0.82	2.57	0.53	0.52
Reach-2A	300	Regional	6.50	150.40	151.68	151.60	151.78	0.003616	1.65	10.63	38.77	0.58	3.23
Reach-2A	300	100YR	2.51	150.40	151.38	151.20	151.47	0.004059	1.31	2.39	13.47	0.57	1.01
Reach-2A	300	50YR	2.21	150.40	151.34	151.16	151.42	0.004116	1.25	1.94	9.65	0.56	0.88
Reach-2A	300	25YR	1.93	150.40	151.30	151.12	151.38	0.004126	1.19	1.65	5.84	0.56	0.79
Reach-2A	300	10YR	1.51	150.40	151.23	151.05	151.29	0.004142	1.11	1.37	3.30	0.55	0.67
Reach-2A	300	5YR	1.23	150.40	151.17	151.00	151.22	0.004121	1.05	1.17	3.05	0.54	0.59
Reach-2A	300	2YR	0.77	150.40	151.05	150.90	151.09	0.004063	0.93	0.83	2.57	0.52	0.45
Reach-2A	299	Regional	6.50	150.05	151.28	151.25	151.42	0.004859	1.85	9.01	38.52	0.66	2.39
Reach-2A	299	100YR	2.51	150.05	151.02	150.85	151.11	0.004270	1.33	2.29	12.75	0.58	0.81

HEC-RAS Plan: Control Flow Ultiamte (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	299	50YR	2.21	150.05	150.99	150.81	151.07	0.004217	1.26	1.91	9.31	0.57	0.72
Reach-2A	299	25YR	1.93	150.05	150.95		151.02	0.004193	1.20	1.64	5.62	0.56	0.65
Reach-2A	299	10YR	1.51	150.05	150.88		150.94	0.004096	1.10	1.37	3.30	0.55	0.56
Reach-2A	299	5YR	1.23	150.05	150.82		150.87	0.004158	1.05	1.17	3.05	0.54	0.50
Reach-2A	299	2YR	0.77	150.05	150.69		150.74	0.004276	0.95	0.81	2.54	0.53	0.38
Reach-2A	298	Regional	6.50	149.76	151.14	150.96	151.19	0.001892	1.29	14.60	39.38	0.42	1.56
Reach-2A	298	100YR	2.51	149.76	150.78	150.56	150.85	0.003105	1.20	2.98	17.33	0.50	0.62
Reach-2A	298	50YR	2.21	149.76	150.73	150.52	150.80	0.003275	1.16	2.31	12.91	0.51	0.57
Reach-2A	298	25YR	1.93	149.76	150.69		150.75	0.003394	1.12	1.84	8.56	0.51	0.52
Reach-2A	298	10YR	1.51	149.76	150.62		150.67	0.003432	1.03	1.47	3.41	0.50	0.46
Reach-2A	298	5YR	1.23	149.76	150.56		150.61	0.003355	0.97	1.27	3.17	0.49	0.41
Reach-2A	298	2YR	0.77	149.76	150.43		150.47	0.003224	0.85	0.91	2.68	0.47	0.32
Reach-2A	297	Regional	6.50	149.64	150.80	150.80	151.04	0.008244	2.27	4.66	31.87	0.85	1.24
Reach-2A	297	100YR	2.51	149.64	150.44	150.44	150.64	0.014024	1.98	1.27	3.18	1.00	0.56
Reach-2A	297	50YR	2.21	149.64	150.40	150.40	150.59	0.014135	1.93	1.15	3.03	1.00	0.52
Reach-2A	297	25YR	1.93	149.64	150.36	150.36	150.54	0.014290	1.87	1.03	2.87	1.00	0.48
Reach-2A	297	10YR	1.51	149.64	150.29	150.29	150.45	0.014723	1.78	0.85	2.60	0.99	0.42
Reach-2A	297	5YR	1.23	149.64	150.24	150.24	150.39	0.015259	1.71	0.72	2.40	1.00	0.38
Reach-2A	297	2YR	0.77	149.64	150.14	150.14	150.26	0.016126	1.55	0.50	1.99	1.00	0.30
Reach-2A	296.5		Culvert										
Reach-2A	296	Regional	6.50	149.44	150.61	150.61	150.84	0.008320	2.27	4.62	31.40	0.85	0.54
Reach-2A	296	100YR	2.51	149.44	150.24	150.24	150.44	0.014035	1.99	1.26	3.16	1.00	0.10
Reach-2A	296	50YR	2.21	149.44	150.20	150.20	150.39	0.014297	1.94	1.14	3.00	1.00	0.09
Reach-2A	296	25YR	1.93	149.44	150.16	150.16	150.34	0.014318	1.87	1.03	2.85	1.00	0.08
Reach-2A	296	10YR	1.51	149.44	150.09	150.09	150.26	0.015015	1.79	0.84	2.58	1.00	0.07
Reach-2A	296	5YR	1.23	149.44	150.04	150.04	150.19	0.015286	1.72	0.72	2.38	1.00	0.06
Reach-2A	296	2YR	0.77	149.44	149.94	149.94	150.06	0.016182	1.56	0.49	1.98	1.00	0.04
Reach-2B	231.1	Regional	0.22	148.25	149.20		149.20	0.000002	0.04	15.18	38.68	0.01	0.71
Reach-2B	231.1	100YR	0.09	148.25	148.96		148.96	0.000001	0.03	7.37	26.74	0.01	0.34
Reach-2B	231.1	50YR	0.08	148.25	148.93		148.93	0.000001	0.03	6.57	25.11	0.01	0.30
Reach-2B	231.1	25YR	0.07	148.25	148.90		148.90	0.000001	0.03	5.78	23.39	0.01	0.27
Reach-2B	231.1	10YR	0.06	148.25	148.84		148.84	0.000002	0.03	4.58	20.50	0.01	0.22
Reach-2B	231.1	5YR	0.05	148.25	148.80		148.80	0.000002	0.02	3.80	18.37	0.01	0.18
Reach-2B	231.1	2YR	0.04	148.25	148.72		148.72	0.000002	0.02	2.48	14.07	0.01	0.12
Reach-2B	231	Regional	0.22	148.25	149.20		149.20	0.000002	0.04	15.18	38.68	0.01	0.70
Reach-2B	231	100YR	0.09	148.25	148.96		148.96	0.000001	0.03	7.37	26.74	0.01	0.33
Reach-2B	231	50YR	0.08	148.25	148.93		148.93	0.000001	0.03	6.57	25.11	0.01	0.30
Reach-2B	231	25YR	0.07	148.25	148.90		148.90	0.000001	0.03	5.78	23.39	0.01	0.26
Reach-2B	231	10YR	0.06	148.25	148.84		148.84	0.000002	0.03	4.58	20.50	0.01	0.21
Reach-2B	231	5YR	0.05	148.25	148.80		148.80	0.000002	0.02	3.80	18.37	0.01	0.18
Reach-2B	231	2YR	0.04	148.25	148.72		148.72	0.000002	0.02	2.48	14.07	0.01	0.12
Reach-2B	220.3	Regional	0.22	148.25	149.20		149.20	0.000001	0.04	20.37	57.70	0.01	0.66
Reach-2B	220.3	100YR	0.09	148.25	148.96		148.96	0.000001	0.02	9.87	32.46	0.01	0.31
Reach-2B	220.3	50YR	0.08	148.25	148.93		148.93	0.000001	0.02	8.89	30.79	0.01	0.28
Reach-2B	220.3	25YR	0.07	148.25	148.90		148.90	0.000001	0.02	7.92	29.02	0.01	0.25
Reach-2B	220.3	10YR	0.06	148.25	148.84		148.84	0.000001	0.02	6.42	26.06	0.01	0.20
Reach-2B	220.3	5YR	0.05	148.25	148.80		148.80	0.000001	0.02	5.41	23.87	0.01	0.17
Reach-2B	220.3	2YR	0.04	148.25	148.72		148.72	0.000002	0.02	3.65	19.46	0.01	0.11
Reach-2B	220.2	Regional	0.22	148.57	149.20		149.20	0.000022	0.10	2.51	5.97	0.04	0.03
Reach-2B	220.2	100YR	0.09	148.57	148.96		148.96	0.000029	0.08	1.22	4.86	0.05	0.01
Reach-2B	220.2	50YR	0.08	148.57	148.93		148.93	0.000034	0.08	1.07	4.72	0.05	0.01
Reach-2B	220.2	25YR	0.07	148.57	148.89		148.90	0.000042	0.08	0.92	4.57	0.05	0.01
Reach-2B	220.2	10YR	0.06	148.57	148.84		148.84	0.000079	0.09	0.68	4.31	0.07	0.00
Reach-2B	220.2	5YR	0.05	148.57	148.80		148.80	0.000139	0.10	0.51	4.12	0.09	0.00
Reach-2B	220.2	2YR	0.04	148.57	148.72		148.72	0.001138	0.19	0.21	2.87	0.23	0.00
Reach-2C	220.1	Regional	6.72	148.25	149.11	149.07	149.18	0.004709	1.32	11.47	61.53	0.63	0.03
Reach-2C	220.1	100YR	2.59	148.25	148.85	148.79	148.93	0.007575	1.28	2.20	13.92	0.75	0.01
Reach-2C	220.1	50YR	2.29	148.25	148.82	148.76	148.90	0.007705	1.25	1.91	9.13	0.75	0.01
Reach-2C	220.1	25YR	2.00	148.25	148.79	148.73	148.87	0.007955	1.22	1.66	7.33	0.75	0.01
Reach-2C	220.1	10YR	1.56	148.25	148.74	148.68	148.81	0.008161	1.15	1.35	5.58	0.75	0.01
Reach-2C	220.1	5YR	1.28	148.25	148.71		148.77	0.008028	1.11	1.15	5.00	0.74	0.01
Reach-2C	220.1	2YR	0.80	148.25	148.63		148.68	0.007792	0.98	0.82	4.17	0.71	0.00
Reach-2C	220	Regional	6.72	148.25	149.07	149.07	149.17	0.006602	1.51	9.38	60.11	0.74	0.02
Reach-2C	220	100YR	2.59	148.25	148.79	148.79	148.92	0.014344	1.62	1.61	6.91	1.01	0.01
Reach-2C	220	50YR	2.29	148.25	148.76	148.76	148.89	0.014973	1.59	1.44	5.79	1.02	0.01
Reach-2C	220	25YR	2.00	148.25	148.73	148.73	148.86	0.014768	1.54	1.30	5.40	1.01	0.01
Reach-2C	220	10YR	1.56	148.25	148.68	148.68	148.80	0.015515	1.49	1.05	4.75	1.02	0.01
Reach-2C	220	5YR	1.28	148.25	148.65	148.65	148.76	0.015823	1.43	0.89	4.37	1.01	0.00
Reach-2C	220	2YR	0.80	148.25	148.58	148.58	148.67	0.016933	1.31	0.61	3.58	1.02	0.00
Reach-1A	210.5	Regional	7.87	155.11	155.53	155.48	155.55	0.007054	0.70	11.30	91.42	0.63	10.49
Reach-1A	210.5	100YR	3.19	155.11	155.44	155.42	155.46	0.008368	0.61	5.22	58.25	0.65	4.85
Reach-1A	210.5	50YR	2.83	155.11	155.43	155.41	155.45	0.008573	0.60	4.74	55.71	0.65	4.36
Reach-1A	210.5	25YR	2.48	155.11	155.42	155.40	155.44	0.008827	0.58	4.26	53.05	0.66	3.87

HEC-RAS Plan: Control Flow Ultiamte (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1A	210.5	10YR	1.96	155.11	155.41	155.39	155.43	0.008936	0.55	3.57	49.00	0.65	3.17
Reach-1A	210.5	5YR	1.62	155.11	155.40	155.38	155.42	0.009192	0.53	3.07	45.88	0.65	2.75
Reach-1A	210.5	2YR	1.03	155.11	155.38	155.35	155.39	0.010006	0.51	2.03	33.99	0.67	1.97
Reach-1A	210	Regional	7.87	154.96	155.25	155.20	155.30	0.007360	0.92	8.60	47.41	0.69	10.14
Reach-1A	210	100YR	3.19	154.96	155.16		155.18	0.007574	0.71	4.47	36.58	0.65	4.69
Reach-1A	210	50YR	2.83	154.96	155.15		155.17	0.007539	0.69	4.11	35.46	0.65	4.20
Reach-1A	210	25YR	2.48	154.96	155.14		155.16	0.007460	0.66	3.76	34.32	0.64	3.73
Reach-1A	210	10YR	1.96	154.96	155.12		155.14	0.007598	0.62	3.17	32.30	0.63	3.06
Reach-1A	210	5YR	1.62	154.96	155.11		155.12	0.007525	0.58	2.79	30.92	0.62	2.65
Reach-1A	210	2YR	1.03	154.96	155.08		155.09	0.007172	0.50	2.08	28.19	0.58	1.90
Reach-1A	209	Regional	7.87	154.46	154.73		154.76	0.003408	0.78	15.40	75.01	0.50	8.81
Reach-1A	209	100YR	3.19	154.46	154.63		154.64	0.003383	0.55	8.11	64.26	0.45	3.99
Reach-1A	209	50YR	2.83	154.46	154.62		154.63	0.003381	0.53	7.46	62.74	0.45	3.56
Reach-1A	209	25YR	2.48	154.46	154.61		154.62	0.003379	0.50	6.81	61.81	0.44	3.14
Reach-1A	209	10YR	1.96	154.46	154.59		154.60	0.003365	0.46	5.80	60.33	0.43	2.56
Reach-1A	209	5YR	1.62	154.46	154.58		154.59	0.003363	0.43	5.08	59.26	0.42	2.21
Reach-1A	209	2YR	1.03	154.46	154.56		154.56	0.003422	0.36	3.68	57.11	0.41	1.58
Reach-1A	208.3	Regional	7.87	152.95	153.38	153.38	153.49	0.015618	1.42	5.53	27.71	1.02	6.71
Reach-1A	208.3	100YR	3.19	152.95	153.26	153.26	153.33	0.017521	1.20	2.67	18.87	1.02	2.91
Reach-1A	208.3	50YR	2.83	152.95	153.25	153.25	153.32	0.017778	1.17	2.42	17.87	1.02	2.57
Reach-1A	208.3	25YR	2.48	152.95	153.23	153.23	153.30	0.018065	1.14	2.17	16.83	1.02	2.24
Reach-1A	208.3	10YR	1.96	152.95	153.21	153.21	153.27	0.018582	1.10	1.79	15.09	1.02	1.80
Reach-1A	208.3	5YR	1.62	152.95	153.19	153.19	153.25	0.019090	1.06	1.53	13.96	1.02	1.55
Reach-1A	208.3	2YR	1.03	152.95	153.16	153.16	153.20	0.019419	0.95	1.08	11.68	1.00	1.10
Reach-1A	208.2	Regional	8.02	152.50	153.05	152.86	153.09	0.001997	0.82	9.86	35.12	0.41	6.30
Reach-1A	208.2	100YR	3.25	152.50	152.86	152.74	152.88	0.002560	0.62	5.25	24.15	0.42	2.71
Reach-1A	208.2	50YR	2.88	152.50	152.84	152.72	152.86	0.002622	0.60	4.82	23.20	0.42	2.39
Reach-1A	208.2	25YR	2.53	152.50	152.82	152.71	152.84	0.002595	0.58	4.40	22.24	0.41	2.08
Reach-1A	208.2	10YR	1.99	152.50	152.79	152.69	152.81	0.002495	0.53	3.74	20.68	0.40	1.66
Reach-1A	208.2	5YR	1.65	152.50	152.77	152.67	152.78	0.002381	0.50	3.32	19.60	0.39	1.43
Reach-1A	208.2	2YR	1.05	152.50	152.73	152.63	152.74	0.002069	0.42	2.51	17.23	0.35	1.01
Reach-1A	208.15		Bridge										
Reach-1A	208.1	Regional	8.02	152.50	152.87	152.75	152.93	0.003732	1.02	7.84	42.62	0.55	6.02
Reach-1A	208.1	100YR	3.25	152.50	152.70	152.65	152.74	0.005217	0.79	4.12	34.90	0.58	2.55
Reach-1A	208.1	50YR	2.88	152.50	152.69	152.64	152.72	0.005463	0.76	3.78	34.18	0.59	2.24
Reach-1A	208.1	25YR	2.53	152.50	152.67	152.63	152.70	0.005714	0.73	3.45	33.50	0.59	1.94
Reach-1A	208.1	10YR	1.99	152.50	152.65	152.61	152.67	0.006469	0.69	2.88	32.30	0.61	1.54
Reach-1A	208.1	5YR	1.65	152.50	152.63	152.60	152.65	0.007208	0.66	2.49	31.50	0.63	1.32
Reach-1A	208.1	2YR	1.05	152.50	152.59	152.58	152.61	0.009958	0.61	1.72	29.90	0.69	0.93
Reach-1A	208	Regional	8.02	151.00	152.27	152.19	152.43	0.005880	1.80	6.07	18.39	0.72	5.10
Reach-1A	208	100YR	3.25	151.00	152.00		152.09	0.007552	1.38	2.36	7.14	0.75	2.15
Reach-1A	208	50YR	2.88	151.00	151.96		152.06	0.007720	1.35	2.13	6.39	0.75	1.88
Reach-1A	208	25YR	2.53	151.00	151.93		152.02	0.007858	1.33	1.91	5.92	0.75	1.61
Reach-1A	208	10YR	1.99	151.00	151.87		151.95	0.007697	1.26	1.58	5.15	0.73	1.27
Reach-1A	208	5YR	1.65	151.00	151.82		151.90	0.007637	1.23	1.34	4.50	0.72	1.09
Reach-1A	208	2YR	1.05	151.00	151.70		151.77	0.007038	1.16	0.91	3.03	0.67	0.77
Reach-1A	207.78*	Regional	8.02	150.83	151.86	151.86	152.07	0.011761	2.06	4.13	13.02	0.99	4.88
Reach-1A	207.78*	100YR	3.25	150.83	151.74	151.62	151.80	0.005475	1.15	2.83	8.85	0.64	2.03
Reach-1A	207.78*	50YR	2.88	150.83	151.72		151.78	0.004781	1.06	2.73	8.63	0.60	1.77
Reach-1A	207.78*	25YR	2.53	150.83	151.71		151.76	0.004084	0.96	2.64	8.42	0.55	1.51
Reach-1A	207.78*	10YR	1.99	150.83	151.66		151.70	0.003907	0.90	2.21	7.48	0.53	1.19
Reach-1A	207.78*	5YR	1.65	150.83	151.63		151.66	0.003519	0.84	1.98	6.90	0.50	1.02
Reach-1A	207.78*	2YR	1.05	150.83	151.55		151.57	0.002792	0.71	1.47	5.42	0.44	0.72
Reach-1A	207	Regional	8.02	150.25	151.02		151.06	0.002787	0.94	16.20	55.05	0.48	3.35
Reach-1A	207	100YR	3.25	150.25	150.81	150.79	150.86	0.006948	0.98	5.30	48.69	0.68	1.42
Reach-1A	207	50YR	2.88	150.25	150.79	150.77	150.84	0.008228	1.00	4.23	48.03	0.73	1.24
Reach-1A	207	25YR	2.53	150.25	150.77	150.76	150.82	0.010208	1.04	3.11	47.30	0.80	1.08
Reach-1A	207	10YR	1.99	150.25	150.75	150.71	150.79	0.010066	0.97	2.13	23.07	0.78	0.86
Reach-1A	207	5YR	1.65	150.25	150.71		150.76	0.011677	0.99	1.67	11.58	0.83	0.74
Reach-1A	207	2YR	1.05	150.25	150.65	150.64	150.70	0.016890	1.05	1.00	8.35	0.96	0.53
Reach-1A	206.3	Regional	9.44	149.49	150.46	150.44	150.65	0.006329	2.13	8.79	26.91	0.79	2.20
Reach-1A	206.3	100YR	3.91	149.49	150.24	150.11	150.34	0.004449	1.42	3.73	20.02	0.62	1.00
Reach-1A	206.3	50YR	3.47	149.49	150.22	150.07	150.31	0.004222	1.34	3.25	17.27	0.60	0.89
Reach-1A	206.3	25YR	3.05	149.49	150.19	150.04	150.27	0.004014	1.26	2.82	14.28	0.58	0.80
Reach-1A	206.3	10YR	2.41	149.49	150.11		150.19	0.004655	1.21	2.01	6.39	0.61	0.66
Reach-1A	206.3	5YR	1.96	149.49	150.06		150.12	0.004635	1.12	1.74	4.82	0.60	0.57
Reach-1A	206.3	2YR	1.24	149.49	149.96		150.00	0.004396	0.98	1.27	4.20	0.57	0.42
Reach-1A	206.2	Regional	9.44	149.25	150.35	150.16	150.40	0.002518	1.08	11.90	32.75	0.48	1.72
Reach-1A	206.2	100YR	3.91	149.25	150.09	149.89	150.13	0.003430	0.92	4.97	22.67	0.51	0.79
Reach-1A	206.2	50YR	3.47	149.25	150.05	149.85	150.09	0.003903	0.95	4.07	21.48	0.54	0.72
Reach-1A	206.2	25YR	3.05	149.25	150.01	149.83	150.05	0.004389	0.96	3.24	20.37	0.57	0.65
Reach-1A	206.2	10YR	2.41	149.25	149.93	149.77	149.98	0.003513	0.96	2.51	7.24	0.52	0.55
Reach-1A	206.2	5YR	1.96	149.25	149.89	149.73	149.93	0.003277	0.90	2.19	6.67	0.50	0.48

HEC-RAS Plan: Control Flow Ultiamte (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1A	206.2	2YR	1.24	149.25	149.80	149.64	149.83	0.002811	0.76	1.64	5.76	0.45	0.35
Reach-1A	206.15		Bridge										
Reach-1A	206.1	Regional	9.44	149.00	149.99	149.88	150.09	0.004879	1.42	7.71	29.77	0.65	1.38
Reach-1A	206.1	100YR	3.91	149.00	149.77	149.71	149.83	0.005986	1.07	3.83	20.47	0.65	0.63
Reach-1A	206.1	50YR	3.47	149.00	149.75	149.69	149.81	0.006067	1.03	3.51	19.09	0.65	0.57
Reach-1A	206.1	25YR	3.05	149.00	149.73	149.67	149.78	0.006171	0.98	3.20	17.58	0.64	0.52
Reach-1A	206.1	10YR	2.41	149.00	149.70	149.64	149.74	0.006196	0.89	2.74	15.32	0.63	0.43
Reach-1A	206.1	5YR	1.96	149.00	149.68	149.62	149.71	0.006042	0.82	2.40	14.10	0.61	0.38
Reach-1A	206.1	2YR	1.24	149.00	149.63	149.57	149.65	0.005956	0.71	1.74	11.59	0.58	0.27
Reach-1	205	Regional	16.97	147.24	148.35	148.35	148.68	0.010927	2.56	6.64	10.22	1.01	50.35
Reach-1	205	100YR	6.78	147.24	148.00	148.00	148.20	0.012701	2.02	3.36	8.30	1.01	19.11
Reach-1	205	50YR	6.00	147.24	147.96	147.96	148.15	0.012968	1.96	3.07	8.10	1.01	15.83
Reach-1	205	25YR	5.27	147.24	147.93	147.93	148.11	0.013169	1.88	2.80	7.91	1.01	14.67
Reach-1	205	10YR	4.17	147.24	147.87	147.87	148.03	0.013705	1.77	2.36	7.59	1.01	10.99
Reach-1	205	5YR	3.40	147.24	147.82	147.82	147.97	0.014521	1.68	2.02	7.33	1.02	8.96
Reach-1	205	2YR	2.17	147.24	147.75	147.75	147.86	0.015641	1.48	1.47	6.81	1.02	6.48
Reach-1	204.75	Regional	16.97	146.00	147.48	147.28	147.67	0.004112	2.00	10.81	17.30	0.66	49.06
Reach-1	204.75	100YR	6.78	146.00	147.09	146.88	147.19	0.003679	1.40	5.03	11.79	0.58	18.50
Reach-1	204.75	50YR	6.00	146.00	147.04	146.84	147.13	0.003625	1.34	4.54	10.20	0.57	15.27
Reach-1	204.75	25YR	5.27	146.00	147.00	146.79	147.08	0.003556	1.28	4.13	7.70	0.56	14.16
Reach-1	204.75	10YR	4.17	146.00	146.92	146.72	146.99	0.003436	1.17	3.55	7.36	0.54	10.55
Reach-1	204.75	5YR	3.40	146.00	146.86	146.67	146.92	0.003347	1.09	3.11	7.03	0.52	8.58
Reach-1	204.75	2YR	2.17	146.00	146.74	146.55	146.79	0.003109	0.94	2.32	6.28	0.49	6.20
Reach-1	204.7	Regional	16.97	145.89	146.87	146.87	147.20	0.010243	2.56	6.80	12.46	0.99	48.41
Reach-1	204.7	100YR	6.78	145.89	146.51	146.51	146.72	0.012233	2.04	3.32	7.86	1.00	18.19
Reach-1	204.7	50YR	6.00	145.89	146.47	146.47	146.67	0.012505	2.00	3.00	7.49	1.01	14.99
Reach-1	204.7	25YR	5.27	145.89	146.43	146.43	146.62	0.012726	1.94	2.71	7.15	1.01	13.91
Reach-1	204.7	10YR	4.17	145.89	146.36	146.36	146.53	0.013232	1.84	2.26	6.67	1.01	10.34
Reach-1	204.7	5YR	3.40	145.89	146.31	146.31	146.47	0.013607	1.74	1.95	6.39	1.01	8.40
Reach-1	204.7	2YR	2.17	145.89	146.22	146.22	146.35	0.014640	1.55	1.40	5.76	1.01	6.07
Reach-1	204.55	Regional	16.97	145.49	146.65	146.52	146.84	0.005687	1.97	8.99	17.52	0.75	48.29
Reach-1	204.55	100YR	6.78	145.49	146.36		146.45	0.003945	1.30	5.22	10.47	0.59	18.12
Reach-1	204.55	50YR	6.00	145.49	146.32		146.40	0.003868	1.25	4.78	9.95	0.58	14.93
Reach-1	204.55	25YR	5.27	145.49	146.28		146.35	0.003686	1.20	4.40	9.47	0.56	13.85
Reach-1	204.55	10YR	4.17	145.49	146.21		146.27	0.003507	1.10	3.79	8.91	0.54	10.29
Reach-1	204.55	5YR	3.40	145.49	146.15		146.21	0.003541	1.03	3.29	8.57	0.53	8.35
Reach-1	204.55	2YR	2.17	145.49	146.04		146.08	0.003712	0.92	2.37	7.71	0.53	6.04
Reach-1	204.5	Regional	16.97	145.36	146.52	146.47	146.72	0.008070	1.97	9.11	22.80	0.85	48.12
Reach-1	204.5	100YR	6.78	145.36	146.24		146.35	0.006540	1.49	4.54	10.81	0.74	18.03
Reach-1	204.5	50YR	6.00	145.36	146.20		146.31	0.006075	1.44	4.15	9.85	0.71	14.85
Reach-1	204.5	25YR	5.27	145.36	146.17		146.27	0.005625	1.36	3.88	9.52	0.68	13.78
Reach-1	204.5	10YR	4.17	145.36	146.11		146.19	0.005269	1.25	3.34	8.84	0.65	10.23
Reach-1	204.5	5YR	3.40	145.36	146.05		146.13	0.005491	1.21	2.82	8.12	0.65	8.30
Reach-1	204.5	2YR	2.17	145.36	145.93		146.00	0.005993	1.12	1.94	6.66	0.66	6.00
Reach-1	204.25	Regional	16.97	145.11	146.27	146.27	146.50	0.009075	2.35	12.67	30.55	0.93	47.85
Reach-1	204.25	100YR	6.78	145.11	145.99	145.99	146.15	0.009701	1.81	5.21	23.10	0.89	17.91
Reach-1	204.25	50YR	6.00	145.11	145.95	145.95	146.11	0.009618	1.83	4.22	19.73	0.89	14.74
Reach-1	204.25	25YR	5.27	145.11	145.89	145.89	146.07	0.010841	1.86	3.28	15.53	0.93	13.69
Reach-1	204.25	10YR	4.17	145.11	145.80	145.80	145.98	0.013077	1.92	2.18	7.09	1.01	10.16
Reach-1	204.25	5YR	3.40	145.11	145.74	145.74	145.91	0.013521	1.84	1.84	5.45	1.01	8.24
Reach-1	204.25	2YR	2.17	145.11	145.63	145.63	145.77	0.013644	1.65	1.32	4.64	0.99	5.96
Reach-1	204	Regional	17.26	144.05	145.05	145.05	145.32	0.009548	2.75	13.32	24.93	0.99	46.57
Reach-1	204	100YR	6.95	144.05	144.77	144.77	144.94	0.008843	1.98	6.70	23.01	0.89	17.33
Reach-1	204	50YR	6.16	144.05	144.73	144.73	144.90	0.009497	1.95	5.84	22.28	0.91	14.26
Reach-1	204	25YR	5.43	144.05	144.70	144.70	144.86	0.009828	1.89	5.12	21.12	0.91	13.29
Reach-1	204	10YR	4.31	144.05	144.65	144.65	144.79	0.010278	1.77	4.04	19.26	0.91	9.86
Reach-1	204	5YR	3.48	144.05	144.61	144.61	144.73	0.010465	1.66	3.26	17.80	0.90	8.00
Reach-1	204	2YR	2.23	144.05	144.53	144.53	144.63	0.011570	1.46	1.97	14.86	0.91	5.80
Reach-1	203	Regional	17.41	142.50	144.74		144.79	0.000602	0.97	26.92	36.01	0.27	45.31
Reach-1	203	100YR	7.04	142.50	143.66	143.66	143.86	0.013112	2.00	3.52	8.85	1.01	17.02
Reach-1	203	50YR	6.24	142.50	143.53	143.53	143.81	0.013375	2.34	2.67	5.25	1.05	14.00
Reach-1	203	25YR	5.49	142.50	143.49	143.49	143.74	0.012385	2.21	2.48	5.01	1.00	13.05
Reach-1	203	10YR	4.37	142.50	143.40	143.40	143.63	0.013021	2.13	2.05	4.55	1.01	9.67
Reach-1	203	5YR	3.52	142.50	143.33	143.33	143.54	0.013109	2.02	1.74	4.19	1.00	7.85
Reach-1	203	2YR	2.25	142.50	143.19	143.19	143.37	0.014335	1.87	1.20	3.48	1.01	5.71
Reach-1	202.75	Regional	17.41	142.43	144.45	143.71	144.71	0.001846	2.24	7.78	34.22	0.50	44.64
Reach-1	202.75	100YR	7.04	142.43	143.53	143.13	143.67	0.002261	1.66	4.25	26.73	0.50	16.83
Reach-1	202.75	50YR	6.24	142.43	143.45	143.07	143.58	0.002323	1.59	3.92	24.96	0.50	13.84
Reach-1	202.75	25YR	5.49	142.43	143.37	143.02	143.48	0.002391	1.52	3.60	22.54	0.50	12.91
Reach-1	202.75	10YR	4.37	142.43	143.23	142.94	143.34	0.002516	1.41	3.09	18.71	0.50	9.56
Reach-1	202.75	5YR	3.52	142.43	143.13	142.87	143.21	0.002641	1.31	2.68	16.81	0.50	7.76
Reach-1	202.75	2YR	2.25	142.43	142.95	142.76	143.01	0.002919	1.13	1.99	13.62	0.50	5.65

HEC-RAS Plan: Control Flow Ultiamte (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	17.41	142.28	143.56	143.56	144.20	0.015842	3.54	4.91	3.97	1.00	43.82
Reach-1	202.25	100YR	7.04	142.28	142.98	142.98	143.33	0.014945	2.61	2.69	3.85	1.00	16.48
Reach-1	202.25	50YR	6.24	142.28	142.93	142.93	143.25	0.014984	2.51	2.48	3.85	1.00	13.53
Reach-1	202.25	25YR	5.49	142.28	142.87	142.87	143.17	0.015129	2.41	2.27	3.85	1.00	12.64
Reach-1	202.25	10YR	4.37	142.28	142.79	142.79	143.04	0.015213	2.24	1.95	3.85	1.00	9.34
Reach-1	202.25	5YR	3.52	142.28	142.74	142.72	142.94	0.013423	1.99	1.77	3.85	0.94	7.57
Reach-1	202.25	2YR	2.25	142.28	142.68	142.61	142.79	0.008222	1.45	1.55	3.85	0.73	5.52
Reach-1	202	Regional	17.41	142.20	143.23		143.28	0.001353	1.15	28.78	49.24	0.39	43.48
Reach-1	202	100YR	7.04	142.20	142.66	142.66	142.81	0.012141	1.78	5.23	24.04	0.98	16.40
Reach-1	202	50YR	6.24	142.20	142.64	142.64	142.77	0.011840	1.69	4.77	22.30	0.96	13.46
Reach-1	202	25YR	5.49	142.20	142.62	142.62	142.74	0.011349	1.59	4.37	21.55	0.93	12.58
Reach-1	202	10YR	4.37	142.20	142.58	142.58	142.69	0.012086	1.50	3.54	20.21	0.93	9.29
Reach-1	202	5YR	3.52	142.20	142.55	142.55	142.64	0.012200	1.39	2.96	19.27	0.92	7.53
Reach-1	202	2YR	2.25	142.20	142.48	142.48	142.57	0.015587	1.27	1.80	13.50	0.99	5.49
Reach-1	201	Regional	17.41	141.65	143.21		143.24	0.000431	0.89	37.16	39.44	0.23	42.01
Reach-1	201	100YR	7.04	141.65	142.60		142.62	0.000681	0.78	14.93	31.90	0.27	15.93
Reach-1	201	50YR	6.24	141.65	142.52		142.55	0.000790	0.79	12.58	30.69	0.29	13.06
Reach-1	201	25YR	5.49	141.65	142.49		142.52	0.000717	0.73	11.70	30.07	0.27	12.20
Reach-1	201	10YR	4.37	141.65	142.39		142.42	0.000812	0.70	8.86	25.49	0.28	9.00
Reach-1	201	5YR	3.52	141.65	142.33		142.35	0.000777	0.64	7.37	22.81	0.27	7.28
Reach-1	201	2YR	2.25	141.65	142.25		142.26	0.000579	0.50	5.57	19.12	0.23	5.31
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	171	100YR	8.17	141.65	142.44	142.21	142.50	0.002213	1.21	9.98	27.36	0.47	14.77
Reach-1	171	50YR	6.60	141.65	142.36	142.15	142.42	0.002210	1.13	8.15	24.25	0.46	12.09
Reach-1	171	25YR	6.10	141.65	142.34	142.13	142.40	0.002202	1.10	7.58	23.20	0.46	11.30
Reach-1	171	10YR	4.37	141.65	142.25	142.05	142.29	0.002182	0.97	5.57	19.13	0.44	8.32
Reach-1	171	5YR	3.52	141.65	142.19	142.01	142.23	0.002166	0.89	4.59	16.80	0.43	6.72
Reach-1	171	2YR	2.57	141.65	142.12	141.95	142.15	0.002101	0.79	3.54	13.88	0.41	4.88
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	169	100YR	8.17	141.65	142.21	142.21	142.40	0.009752	1.96	4.98	17.76	0.92	14.61
Reach-1	169	50YR	6.60	141.65	142.15	142.15	142.32	0.010567	1.86	3.98	15.15	0.94	11.95
Reach-1	169	25YR	6.10	141.65	142.13	142.13	142.30	0.011146	1.83	3.63	14.16	0.95	11.17
Reach-1	169	10YR	4.37	141.65	142.05	142.05	142.19	0.013010	1.69	2.63	10.71	0.99	8.23
Reach-1	169	5YR	3.52	141.65	142.01	142.01	142.13	0.014215	1.59	2.21	8.88	1.01	6.65
Reach-1	169	2YR	2.57	141.65	141.95	141.95	142.06	0.014892	1.45	1.77	8.23	1.00	4.83
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	164	100YR	8.17	138.30	138.83		138.86	0.002624	0.51	10.37	14.75	0.32	13.27
Reach-1	164	50YR	6.60	138.30	138.74		138.76	0.002349	0.41	9.12	13.62	0.29	10.81
Reach-1	164	25YR	6.10	138.30	138.69		138.72	0.002374	0.38	8.50	12.97	0.29	10.12
Reach-1	164	10YR	4.37	138.30	138.54		138.56	0.002100	0.28	6.77	10.44	0.25	7.41
Reach-1	164	5YR	3.52	138.30	138.46		138.47	0.001886	0.19	5.92	9.30	0.22	5.94
Reach-1	164	2YR	2.57	138.30	138.34		138.36	0.001562	0.07	4.96	7.74	0.16	4.24
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	163	100YR	8.17	137.20	138.08	137.99	138.23	0.009915	1.99	7.75	50.21	0.74	12.04
Reach-1	163	50YR	6.60	137.20	138.02	137.97	138.17	0.010628	1.93	5.32	22.77	0.76	9.83
Reach-1	163	25YR	6.10	137.20	137.99	137.97	138.13	0.010185	1.84	4.82	15.66	0.74	9.21
Reach-1	163	10YR	4.37	137.20	137.90	137.86	138.02	0.009858	1.65	3.61	13.13	0.71	6.70
Reach-1	163	5YR	3.52	137.20	137.84	137.80	137.96	0.010879	1.59	2.82	11.19	0.73	5.34
Reach-1	163	2YR	2.57	137.20	137.74	137.72	137.86	0.015146	1.60	1.81	8.05	0.82	3.77
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	162	100YR	8.17	135.60	136.46		136.55	0.008365	1.65	8.05	23.23	0.67	10.63
Reach-1	162	50YR	6.60	135.60	136.42	136.32	136.49	0.007713	1.51	7.02	21.71	0.63	8.72
Reach-1	162	25YR	6.10	135.60	136.39		136.46	0.007886	1.48	6.54	20.96	0.64	8.19
Reach-1	162	10YR	4.37	135.60	136.32		136.38	0.007899	1.34	5.01	18.41	0.62	5.92
Reach-1	162	5YR	3.52	135.60	136.28		136.33	0.007036	1.21	4.42	17.31	0.58	4.68
Reach-1	162	2YR	2.57	135.60	136.25		136.28	0.005238	0.99	3.87	16.23	0.49	3.25
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	161	100YR	8.17	134.10	134.98	134.98	135.07	0.008814	1.68	10.93	62.89	0.67	9.05
Reach-1	161	50YR	6.60	134.10	134.95	134.95	135.03	0.009136	1.64	8.64	54.87	0.68	7.42
Reach-1	161	25YR	6.10	134.10	134.94	134.94	135.02	0.008737	1.59	8.14	52.96	0.66	6.96
Reach-1	161	10YR	4.37	134.10	134.89	134.89	134.97	0.008112	1.44	5.85	43.08	0.63	5.00
Reach-1	161	5YR	3.52	134.10	134.85	134.85	134.93	0.008870	1.43	4.23	34.42	0.65	3.94
Reach-1	161	2YR	2.57	134.10	134.76	134.69	134.87	0.012829	1.52	2.03	16.61	0.76	2.74
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44
Reach-1	160	100YR	8.17	132.50	133.61		133.64	0.002166	0.99	15.54	41.27	0.33	4.97
Reach-1	160	50YR	6.60	132.50	133.54		133.57	0.002221	0.96	12.79	37.14	0.33	4.10
Reach-1	160	25YR	6.10	132.50	133.52	133.29	133.54	0.002198	0.94	11.99	35.85	0.33	3.84
Reach-1	160	10YR	4.37	132.50	133.41		133.44	0.002411	0.92	8.52	29.61	0.34	2.77
Reach-1	160	5YR	3.52	132.50	133.35		133.38	0.002582	0.91	6.73	25.80	0.35	2.23
Reach-1	160	2YR	2.57	132.50	133.28		133.30	0.002499	0.84	5.01	21.54	0.34	1.63

HEC-RAS Model Results for 14W-11 ------Existing\Phase1A\ Phase 1B Condition

HEC-RAS Plan: 00-Existing River: RIVER-1 Reach: Reach-1B

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1B	14	Regional	3.06	155.00	155.31		155.39	0.008674	1.24	2.48	9.78	0.78	15.00
Reach-1B	14	100 Yr	1.53	155.00	155.24		155.27	0.005580	0.85	1.80	8.95	0.61	11.43
Reach-1B	14	50 Yr	1.35	155.00	155.23		155.26	0.005189	0.80	1.69	8.81	0.58	8.01
Reach-1B	14	25 Yr	1.17	155.00	155.23		155.25	0.003898	0.69	1.69	8.81	0.50	5.96
Reach-1B	14	10 Yr	0.91	155.00	155.20		155.22	0.003364	0.60	1.50	8.56	0.46	4.64
Reach-1B	14	5 Yr	0.73	155.00	155.19		155.20	0.002953	0.54	1.36	8.36	0.43	3.98
Reach-1B	14	2 Yr	0.42	155.00	155.15		155.15	0.002286	0.41	1.03	7.89	0.36	2.85
Reach-1B	13	Regional	3.06	154.97	155.24		155.26	0.003339	0.63	4.87	26.12	0.46	14.92
Reach-1B	13	100 Yr	1.53	154.97	155.16		155.18	0.003136	0.50	3.07	22.18	0.43	11.38
Reach-1B	13	50 Yr	1.35	154.97	155.15		155.16	0.003121	0.48	2.82	21.56	0.42	7.96
Reach-1B	13	25 Yr	1.17	154.97	155.10		155.12	0.009534	0.67	1.74	18.65	0.70	5.92
Reach-1B	13	10 Yr	0.91	154.97	155.08		155.10	0.010206	0.63	1.44	17.73	0.71	4.61
Reach-1B	13	5 Yr	0.73	154.97	155.07		155.09	0.011163	0.60	1.21	17.00	0.72	3.95
Reach-1B	13	2 Yr	0.42	154.97	155.05		155.06	0.011109	0.50	0.84	15.79	0.69	2.83
Reach-1B	12.1	Regional	3.06	154.46	154.66	154.65	154.72	0.015778	1.09	2.81	21.24	0.95	14.59
Reach-1B	12.1	100 Yr	1.53	154.46	154.60	154.59	154.64	0.017575	0.92	1.66	17.32	0.95	11.18
Reach-1B	12.1	50 Yr	1.35	154.46	154.59	154.59	154.63	0.017547	0.89	1.52	16.79	0.94	7.78
Reach-1B	12.1	25 Yr	1.17	154.46	154.64	154.58	154.65	0.003566	0.49	2.41	19.95	0.45	5.74
Reach-1B	12.1	10 Yr	0.91	154.46	154.62	154.56	154.63	0.003448	0.45	2.04	18.70	0.43	4.46
Reach-1B	12.1	5 Yr	0.73	154.46	154.61	154.55	154.61	0.003248	0.41	1.78	17.78	0.41	3.83
Reach-1B	12.1	2 Yr	0.42	154.46	154.57		154.58	0.003422	0.35	1.19	15.46	0.41	2.75
Reach-1B	12	Regional	3.06	153.95	154.15	154.08	154.17	0.003316	0.61	5.32	32.39	0.46	14.24
Reach-1B	12	100 Yr	1.53	153.95	154.10	154.04	154.11	0.003108	0.45	3.49	30.71	0.42	10.96
Reach-1B	12	50 Yr	1.35	153.95	154.09	154.04	154.10	0.003084	0.43	3.24	30.46	0.41	7.58
Reach-1B	12	25 Yr	1.17	153.95	154.04	154.03	154.06	0.018384	0.69	1.70	28.96	0.90	5.56
Reach-1B	12	10 Yr	0.91	153.95	154.03	154.03	154.05	0.018796	0.63	1.45	28.71	0.89	4.31
Reach-1B	12	5 Yr	0.73	153.95	154.02	154.02	154.04	0.021098	0.60	1.22	28.48	0.92	3.70
Reach-1B	12	2 Yr	0.42	153.95	154.01	154.00	154.02	0.016608	0.45	0.94	28.19	0.78	2.66
Reach-1B	11.1	Regional	3.06	152.98	153.10	153.10	153.16	0.018353	1.05	3.00	27.89	1.00	13.60
Reach-1B	11.1	100 Yr	1.53	152.98	153.06	153.06	153.10	0.021263	0.83	1.86	26.99	1.00	10.54
Reach-1B	11.1	50 Yr	1.35	152.98	153.06	153.06	153.09	0.021738	0.80	1.71	26.87	1.00	7.19
Reach-1B	11.1	25 Yr	1.17	152.98	153.10	153.05	153.11	0.003021	0.42	2.89	27.80	0.40	5.21
Reach-1B	11.1	10 Yr	0.91	152.98	153.08	153.05	153.09	0.002951	0.37	2.49	27.49	0.39	4.01
Reach-1B	11.1	5 Yr	0.73	152.98	153.07	153.03	153.08	0.002892	0.34	2.18	27.25	0.38	3.43
Reach-1B	11.1	2 Yr	0.42	152.98	153.05	153.02	153.05	0.003245	0.28	1.50	26.70	0.38	2.47
Reach-1B	11	Regional	3.06	152.00	152.76		152.76	0.000034	0.16	22.46	35.52	0.06	11.65
Reach-1B	11	100 Yr	1.53	152.00	152.52		152.52	0.000031	0.12	14.52	31.85	0.05	9.27
Reach-1B	11	50 Yr	1.35	152.00	152.21		152.21	0.000507	0.27	5.35	26.99	0.18	6.64
Reach-1B	11	25 Yr	1.17	152.00	152.06	152.06	152.09	0.022054	0.78	1.52	24.68	1.00	4.87
Reach-1B	11	10 Yr	0.91	152.00	152.05	152.05	152.08	0.023305	0.72	1.28	24.53	1.00	3.71
Reach-1B	11	5 Yr	0.73	152.00	152.05	152.05	152.07	0.024744	0.67	1.10	24.42	1.00	3.18
Reach-1B	11	2 Yr	0.42	152.00	152.04	152.04	152.05	0.017862	0.49	0.87	24.27	0.82	2.28
Reach-1B	10	Regional	3.79	150.20	152.76		152.76	0.000004	0.13	56.28	37.58	0.03	2.35
Reach-1B	10	100 Yr	2.06	150.20	152.52		152.52	0.000002	0.08	47.77	34.95	0.02	1.90
Reach-1B	10	50 Yr	1.82	150.20	152.21		152.21	0.000003	0.08	37.47	31.47	0.02	1.56
Reach-1B	10	25 Yr	1.58	150.20	151.92		151.92	0.000004	0.09	28.70	28.05	0.02	1.27
Reach-1B	10	10 Yr	1.24	150.20	151.63		151.63	0.000005	0.09	21.26	24.44	0.02	1.00
Reach-1B	10	5 Yr	1.01	150.20	151.49		151.49	0.000005	0.08	17.95	22.65	0.02	0.87
Reach-1B	10	2 Yr	0.59	150.20	151.23		151.23	0.000004	0.06	12.47	19.33	0.02	0.65
Reach-1B	9	Regional	3.79	149.70	152.74	150.91	152.75	0.001388	0.49	7.76	30.58	0.31	1.15
Reach-1B	9	100 Yr	2.06	149.70	152.48	150.50	152.51	0.000153	0.81	2.53	28.93	0.16	0.86
Reach-1B	9	50 Yr	1.82	149.70	152.17	150.44	152.20	0.000177	0.81	2.25	26.99	0.16	0.72
Reach-1B	9	25 Yr	1.58	149.70	151.88	150.37	151.91	0.000203	0.80	1.98	25.15	0.17	0.60
Reach-1B	9	10 Yr	1.24	149.70	151.60	150.27	151.63	0.000197	0.72	1.73	23.43	0.17	0.47
Reach-1B	9	5 Yr	1.01	149.70	151.47	150.20	151.49	0.000166	0.63	1.61	22.60	0.15	0.41
Reach-1B	9	2 Yr	0.59	149.70	151.22	150.05	151.23	0.000094	0.43	1.38	21.05	0.11	0.30
Reach-1B	8.5		Culvert										
Reach-1B	8	Regional	3.79	149.30	150.51	150.51	151.13	0.008348	3.47	1.09	24.66	1.00	0.29
Reach-1B	8	100 Yr	2.06	149.30	150.11	150.11	150.52	0.009577	2.83	0.73	20.19	1.01	0.16
Reach-1B	8	50 Yr	1.82	149.30	150.04	150.04	150.42	0.009844	2.72	0.67	19.49	1.01	0.14
Reach-1B	8	25 Yr	1.58	149.30	149.98	149.98	150.32	0.010144	2.59	0.61	18.46	1.00	0.12
Reach-1B	8	10 Yr	1.24	149.30	149.88	149.88	150.17	0.010720	2.39	0.52	16.03	1.01	0.09
Reach-1B	8	5 Yr	1.01	149.30	149.80	149.80	150.06	0.011173	2.23	0.45	14.28	1.00	0.07
Reach-1B	8	2 Yr	0.59	149.30	149.65	149.65	149.83	0.012651	1.87	0.32	10.63	1.01	0.04
Reach-1B	7	Regional	3.79	147.50	147.85	147.77	147.90	0.005406	0.98	3.88	15.42	0.62	
Reach-1B	7	100 Yr	2.06	147.50	147.76	147.69	147.79	0.005407	0.81	2.55	13.51	0.59	
Reach-1B	7	50 Yr	1.82	147.50	147.74	147.68	147.77	0.005407	0.78	2.34	13.03	0.59	
Reach-1B	7	25 Yr	1.58	147.50	147.73	147.66	147.75	0.005406	0.75	2.11	12.52	0.58	
Reach-1B	7	10 Yr	1.24	147.50	147.70	147.64	147.72	0.005405	0.70	1.78	11.72	0.57	
Reach-1B	7	5 Yr	1.01	147.50	147.68	147.62	147.70	0.005400	0.66	1.54	11.12	0.56	
Reach-1B	7	2 Yr	0.59	147.50	147.63	147.59	147.65	0.005409	0.56	1.06	9.78	0.54	

HEC-RAS Model Results for14W-23,14W-11 ------Phase 2 and Ultimate Condition

HEC-RAS Plan: 02-Shifted P River: RIVER-1 Reach: Reach-1B

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1B	14	Regional	2.69	155.00	155.33		155.38	0.005291	1.00	2.68	10.03	0.62	14.46
Reach-1B	14	100 Yr	1.27	155.00	155.23		155.26	0.004206	0.73	1.74	8.88	0.52	7.28
Reach-1B	14	50 Yr	1.12	155.00	155.22		155.24	0.004027	0.69	1.63	8.72	0.51	5.83
Reach-1B	14	25 Yr	0.97	155.00	155.20		155.22	0.003830	0.65	1.50	8.56	0.49	4.96
Reach-1B	14	10 Yr	0.75	155.00	155.18		155.20	0.003468	0.57	1.31	8.29	0.46	4.10
Reach-1B	14	5 Yr	0.60	155.00	155.16		155.18	0.003288	0.52	1.15	8.07	0.44	3.56
Reach-1B	14	2 Yr	0.34	155.00	155.12		155.13	0.002743	0.40	0.85	7.62	0.39	2.55
Reach-1B	13	Regional	2.69	154.97	155.33		155.33	0.000800	0.37	7.30	29.89	0.24	14.35
Reach-1B	13	100 Yr	1.27	154.97	155.21		155.21	0.000921	0.31	4.13	24.67	0.24	7.22
Reach-1B	13	50 Yr	1.12	154.97	155.19		155.20	0.000926	0.30	3.78	23.86	0.24	5.77
Reach-1B	13	25 Yr	0.97	154.97	155.18		155.18	0.000929	0.28	3.41	23.01	0.24	4.91
Reach-1B	13	10 Yr	0.75	154.97	155.16		155.16	0.000904	0.26	2.88	21.72	0.23	4.05
Reach-1B	13	5 Yr	0.60	154.97	155.13		155.14	0.000946	0.25	2.43	20.56	0.23	3.52
Reach-1B	13	2 Yr	0.34	154.97	155.09		155.10	0.000969	0.21	1.64	18.34	0.22	2.52
Reach-1B	12.9	Regional	2.69	154.70	155.20		155.25	0.005081	1.01	2.78	10.72	0.61	14.10
Reach-1B	12.9	100 Yr	1.27	154.70	155.09		155.12	0.005035	0.75	1.73	10.11	0.57	7.07
Reach-1B	12.9	50 Yr	1.12	154.70	155.09		155.11	0.004594	0.69	1.65	10.06	0.54	5.64
Reach-1B	12.9	25 Yr	0.97	154.70	155.07		155.09	0.004485	0.65	1.52	9.99	0.52	4.78
Reach-1B	12.9	10 Yr	0.75	154.70	155.05		155.07	0.004330	0.58	1.31	9.86	0.50	3.95
Reach-1B	12.9	5 Yr	0.60	154.70	155.04		155.05	0.004217	0.53	1.15	9.76	0.48	3.43
Reach-1B	12.9	2 Yr	0.34	154.70	155.00		155.01	0.003695	0.40	0.84	9.58	0.43	2.46
Reach-1B	12.8	Regional	2.69	154.41	154.89		154.95	0.005747	1.05	2.67	10.67	0.65	13.95
Reach-1B	12.8	100 Yr	1.27	154.41	154.79		154.82	0.005789	0.78	1.66	10.08	0.60	6.98
Reach-1B	12.8	50 Yr	1.12	154.41	154.77		154.80	0.006594	0.77	1.47	9.97	0.63	5.55
Reach-1B	12.8	25 Yr	0.97	154.41	154.76		154.79	0.006797	0.74	1.33	9.88	0.63	4.71
Reach-1B	12.8	10 Yr	0.75	154.41	154.74		154.76	0.007258	0.68	1.11	9.75	0.63	3.88
Reach-1B	12.8	5 Yr	0.60	154.41	154.72		154.74	0.007545	0.63	0.96	9.65	0.63	3.37
Reach-1B	12.8	2 Yr	0.34	154.41	154.69		154.70	0.009469	0.54	0.63	9.45	0.66	2.42
Reach-1B	12.7	Regional	2.69	154.11	154.60		154.65	0.004797	1.00	2.83	10.76	0.60	13.80
Reach-1B	12.7	100 Yr	1.27	154.11	154.50		154.53	0.004927	0.75	1.74	10.13	0.56	6.88
Reach-1B	12.7	50 Yr	1.12	154.11	154.50		154.52	0.004069	0.67	1.71	10.11	0.51	5.46
Reach-1B	12.7	25 Yr	0.97	154.11	154.48		154.50	0.003956	0.63	1.58	10.03	0.49	4.63
Reach-1B	12.7	10 Yr	0.75	154.11	154.46		154.48	0.003798	0.56	1.36	9.90	0.47	3.81
Reach-1B	12.7	5 Yr	0.60	154.11	154.45		154.46	0.003567	0.50	1.21	9.81	0.45	3.31
Reach-1B	12.7	2 Yr	0.34	154.11	154.41		154.42	0.003154	0.39	0.89	9.60	0.40	2.38
Reach-1B	12.6	Regional	2.69	153.78	154.24		154.31	0.007007	1.12	2.51	10.58	0.71	13.64
Reach-1B	12.6	100 Yr	1.27	153.78	154.16		154.19	0.006426	0.81	1.60	10.05	0.63	6.78
Reach-1B	12.6	50 Yr	1.12	153.78	154.13		154.17	0.009029	0.85	1.33	9.88	0.73	5.37
Reach-1B	12.6	25 Yr	0.97	153.78	154.12		154.15	0.009419	0.81	1.20	9.80	0.73	4.54
Reach-1B	12.6	10 Yr	0.75	153.78	154.10		154.12	0.010110	0.75	1.01	9.68	0.73	3.74
Reach-1B	12.6	5 Yr	0.60	153.78	154.08		154.11	0.011188	0.71	0.85	9.58	0.75	3.25
Reach-1B	12.6	2 Yr	0.34	153.78	154.05		154.07	0.014114	0.60	0.56	9.38	0.79	2.33
Reach-1B	12.5	Regional	2.69	153.44	153.95	153.85	153.99	0.003836	0.91	3.99	22.48	0.54	13.44
Reach-1B	12.5	100 Yr	1.27	153.44	153.84		153.86	0.004417	0.72	1.87	14.03	0.53	6.68
Reach-1B	12.5	50 Yr	1.12	153.44	153.84		153.86	0.003014	0.61	1.98	14.85	0.44	5.27
Reach-1B	12.5	25 Yr	0.97	153.44	153.83		153.85	0.002927	0.57	1.78	13.26	0.43	4.45
Reach-1B	12.5	10 Yr	0.75	153.44	153.81		153.82	0.002857	0.51	1.49	10.53	0.42	3.67
Reach-1B	12.5	5 Yr	0.60	153.44	153.79		153.80	0.002728	0.46	1.31	9.87	0.40	3.18
Reach-1B	12.5	2 Yr	0.34	153.44	153.75		153.76	0.002537	0.36	0.95	9.64	0.36	2.29
Reach-1B	12.4	Regional	2.69	153.19	153.63	153.60	153.71	0.009614	1.23	2.27	10.44	0.81	13.29
Reach-1B	12.4	100 Yr	1.27	153.19	153.56	153.52	153.60	0.007262	0.84	1.54	10.01	0.67	6.59
Reach-1B	12.4	50 Yr	1.12	153.19	153.51	153.51	153.57	0.018098	1.05	1.08	9.72	0.99	5.19
Reach-1B	12.4	25 Yr	0.97	153.19	153.50	153.50	153.55	0.019351	1.01	0.97	9.65	1.01	4.38
Reach-1B	12.4	10 Yr	0.75	153.19	153.49	153.49	153.53	0.019415	0.91	0.82	9.57	0.98	3.61
Reach-1B	12.4	5 Yr	0.60	153.19	153.47	153.47	153.51	0.021868	0.86	0.69	9.48	1.02	3.13
Reach-1B	12.4	2 Yr	0.34	153.19	153.45	153.45	153.48	0.024730	0.76	0.45	8.04	1.03	2.25
Reach-1B	11.1	Regional	2.69	152.98	153.09	153.09	153.14	0.018872	1.01	2.74	27.69	1.00	13.18
Reach-1B	11.1	100 Yr	1.27	152.98	153.05	153.05	153.08	0.023755	0.80	1.61	26.78	1.03	6.53
Reach-1B	11.1	50 Yr	1.12	152.98	153.10	153.05	153.10	0.002979	0.41	2.82	27.75	0.40	5.11
Reach-1B	11.1	25 Yr	0.97	152.98	153.09	153.04	153.10	0.002962	0.38	2.58	27.57	0.39	4.31
Reach-1B	11.1	10 Yr	0.75	152.98	153.07	153.03	153.08	0.002885	0.34	2.22	27.28	0.38	3.55
Reach-1B	11.1	5 Yr	0.60	152.98	153.06	153.03	153.07	0.002788	0.31	1.96	27.07	0.36	3.08
Reach-1B	11.1	2 Yr	0.34	152.98	153.04	153.02	153.05	0.002614	0.24	1.41	26.62	0.33	2.21
Reach-1B	11	Regional	2.69	152.00	152.73		152.73	0.000031	0.15	21.40	35.05	0.06	11.32
Reach-1B	11	100 Yr	1.27	152.00	152.14		152.15	0.001617	0.37	3.58	25.95	0.31	6.12
Reach-1B	11	50 Yr	1.12	152.00	152.06	152.06	152.09	0.022700	0.78	1.47	24.65	1.01	4.78
Reach-1B	11	25 Yr	0.97	152.00	152.06	152.06	152.08	0.023211	0.74	1.33	24.56	1.00	4.00
Reach-1B	11	10 Yr	0.75	152.00	152.05	152.05	152.07	0.024965	0.68	1.12	24.43	1.01	3.28
Reach-1B	11	5 Yr	0.60	152.00	152.04	152.04	152.06	0.027484	0.64	0.95	24.32	1.03	2.85
Reach-1B	11	2 Yr	0.34	152.00	152.03	152.03	152.04	0.033778	0.54	0.63	24.11	1.07	2.05
Reach-1B	10	Regional	3.38	150.20	152.73		152.73	0.000004	0.11	55.17	37.24	0.02	2.27
Reach-1B	10	100 Yr	1.77	150.20	152.15		152.15	0.000003	0.08	35.44	30.74	0.02	1.50
Reach-1B	10	50 Yr	1.56	150.20	151.90		151.90	0.000004	0.09	28.14	27.80	0.02	1.25
Reach-1B	10	25 Yr	1.35	150.20	151.71		151.71	0.000005	0.09	23.10	25.39	0.02	1.07

HEC-RAS Plan: 02-Shifted P River: RIVER-1 Reach: Reach-1B (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-1B	10	10 Yr	1.06	150.20	151.52		151.52	0.000005	0.08	18.62	23.03	0.02	0.90
Reach-1B	10	5 Yr	0.86	150.20	151.40		151.40	0.000004	0.07	15.98	21.52	0.02	0.79
Reach-1B	10	2 Yr	0.50	150.20	151.17		151.17	0.000004	0.06	11.26	18.51	0.02	0.59
Reach-1B	9	Regional	3.38	149.70	152.71	150.82	152.72	0.001665	0.49	6.84	30.39	0.33	1.10
Reach-1B	9	100 Yr	1.77	149.70	152.10	150.43	152.14	0.000183	0.81	2.19	26.58	0.17	0.69
Reach-1B	9	50 Yr	1.56	149.70	151.86	150.37	151.89	0.000204	0.80	1.96	25.03	0.17	0.59
Reach-1B	9	25 Yr	1.35	149.70	151.67	150.31	151.70	0.000206	0.75	1.79	23.87	0.17	0.51
Reach-1B	9	10 Yr	1.06	149.70	151.50	150.22	151.52	0.000174	0.65	1.63	22.77	0.15	0.42
Reach-1B	9	5 Yr	0.86	149.70	151.38	150.15	151.40	0.000142	0.56	1.53	22.07	0.14	0.37
Reach-1B	9	2 Yr	0.50	149.70	151.16	150.01	151.17	0.000077	0.38	1.33	20.66	0.10	0.27
Reach-1B	8.5		Culvert										
Reach-1B	8	Regional	3.38	149.30	150.42	150.42	150.99	0.008583	3.34	1.01	23.67	1.01	0.26
Reach-1B	8	100 Yr	1.77	149.30	150.03	150.03	150.40	0.009904	2.69	0.66	19.34	1.01	0.13
Reach-1B	8	50 Yr	1.56	149.30	149.97	149.97	150.31	0.010169	2.58	0.60	18.33	1.00	0.12
Reach-1B	8	25 Yr	1.35	149.30	149.91	149.91	150.22	0.010499	2.46	0.55	16.85	1.00	0.10
Reach-1B	8	10 Yr	1.06	149.30	149.82	149.82	150.08	0.011081	2.27	0.47	14.66	1.00	0.08
Reach-1B	8	5 Yr	0.86	149.30	149.75	149.75	149.98	0.011609	2.11	0.41	13.04	1.00	0.06
Reach-1B	8	2 Yr	0.50	149.30	149.61	149.61	149.77	0.013117	1.77	0.28	9.75	1.01	0.04
Reach-1B	7	Regional	3.38	147.50	147.83	147.76	147.88	0.005410	0.94	3.59	15.02	0.62	
Reach-1B	7	100 Yr	1.77	147.50	147.74	147.67	147.77	0.005406	0.77	2.29	12.93	0.59	
Reach-1B	7	50 Yr	1.56	147.50	147.72	147.66	147.75	0.005407	0.74	2.09	12.48	0.58	
Reach-1B	7	25 Yr	1.35	147.50	147.71	147.65	147.73	0.005407	0.71	1.89	11.99	0.57	
Reach-1B	7	10 Yr	1.06	147.50	147.68	147.63	147.70	0.005404	0.67	1.59	11.25	0.56	
Reach-1B	7	5 Yr	0.86	147.50	147.66	147.61	147.68	0.005401	0.62	1.38	10.68	0.56	
Reach-1B	7	2 Yr	0.50	147.50	147.62	147.58	147.63	0.005400	0.53	0.95	9.44	0.53	

HEC-RAS Model Results for 14W-16, 14W-14, 14W-12A and 14W-12-------Phase 1A Condition (Regional Uncontrolled Flow)

HEC-RAS Plan: 1A uncontrol Profile: Regional

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	228	Regional	7.88	153.98	154.23		154.26	0.005679	0.82	9.64	51.91	0.61	9.67
Reach-2A	227	Regional	7.88	153.04	153.33	153.32	153.43	0.013223	1.41	6.09	33.73	0.95	8.89
Reach-2A	226	Regional	7.88	152.44	152.74		152.77	0.003714	0.76	10.43	45.96	0.51	8.06
Reach-2A	225	Regional	7.88	151.75	152.28		152.34	0.004966	1.27	12.52	56.45	0.64	6.91
Reach-2A	224	Regional	7.88	151.25	151.72	151.66	151.81	0.005653	1.48	10.93	40.66	0.70	5.74
Reach-2A	223	Regional	7.88	150.26	151.01	150.99	151.13	0.008351	1.84	10.11	46.66	0.84	4.69
Reach-2A	222	Regional	7.88	149.74	150.34	150.30	150.42	0.005874	1.58	13.28	54.52	0.72	3.52
Reach-2A	221	Regional	7.88	149.23	149.77	149.70	149.86	0.005346	1.49	9.97	39.84	0.69	2.36
Reach-2B	231.1	Regional	8.23	148.25	149.80		149.81	0.000200	0.60	46.06	58.53	0.16	0.28
Reach-2B	231	Regional	8.23	148.25	149.80		149.81	0.000200	0.60	46.05	58.52	0.16	0.23
Reach-2C	220.3	Regional	8.23	148.25	149.80		149.81	0.000127	0.48	60.38	69.05	0.13	2.09
Reach-2C	220.2	Regional	8.23	148.57	149.41	149.41	149.75	0.009405	2.64	3.92	6.98	0.98	0.33
Reach-2C	220.1	Regional	8.23	148.25	149.15	149.11	149.22	0.004926	1.39	13.87	63.10	0.65	0.04
Reach-2C	220	Regional	8.23	148.25	149.11	149.11	149.21	0.007117	1.62	11.42	61.50	0.77	0.03
Reach-1A	210.5	Regional	8.22	155.11	155.53	155.48	155.55	0.006998	0.70	11.69	92.57	0.63	11.07
Reach-1A	210	Regional	8.22	154.96	155.26	155.21	155.30	0.007361	0.93	8.87	48.03	0.69	10.71
Reach-1A	209	Regional	8.22	154.46	154.74		154.77	0.003402	0.80	15.89	75.38	0.50	9.34
Reach-1A	208.3	Regional	8.22	152.95	153.39	153.39	153.49	0.015529	1.43	5.73	28.20	1.02	7.17
Reach-1A	208.2	Regional	8.22	152.50	152.97		153.02	0.005186	1.01	8.16	29.95	0.62	6.82
Reach-1A	208.1	Regional	8.22	152.50	152.86		152.89	0.002501	0.81	11.61	41.89	0.44	6.47
Reach-1A	208	Regional	8.22	151.00	152.20	152.20	152.43	0.009902	2.14	4.77	16.09	0.92	5.65
Reach-1A	207	Regional	8.22	150.25	151.04		151.07	0.002467	0.92	17.23	55.62	0.45	3.52
Reach-1A	206.3	Regional	10.21	149.49	150.48	150.46	150.68	0.006457	2.19	9.44	27.65	0.80	2.29
Reach-1A	206.2	Regional	10.21	149.25	150.24		150.35	0.006438	1.50	8.89	27.85	0.73	1.87
Reach-1A	206.1	Regional	10.21	149.00	150.00		150.10	0.004858	1.43	9.91	30.05	0.65	1.45
Reach-1	205	Regional	18.70	147.24	148.40	148.40	148.75	0.010663	2.61	7.16	10.46	1.01	53.43
Reach-1	204.75	Regional	18.70	146.00	147.49		147.54	0.001592	1.25	29.47	31.71	0.41	50.71
Reach-1	204.7	Regional	18.70	145.89	146.92	146.92	147.27	0.009831	2.63	7.43	13.42	0.99	49.32
Reach-1	204.55	Regional	18.70	145.49	146.68	146.56	146.90	0.005984	2.08	9.54	18.63	0.77	49.19
Reach-1	204.5	Regional	18.70	145.36	146.55	146.51	146.77	0.008147	2.05	9.83	23.54	0.87	49.01
Reach-1	204.25	Regional	18.70	145.11	146.30	146.30	146.55	0.009025	2.43	13.72	30.86	0.93	48.71
Reach-1	204	Regional	20.47	144.05	145.11	145.11	145.42	0.009864	2.95	14.94	25.37	1.02	47.31
Reach-1	203	Regional	20.61	142.50	145.03		145.07	0.000400	0.90	37.72	39.52	0.23	45.66
Reach-1	202.75	Regional	20.61	142.43	144.69	143.86	144.98	0.001778	2.37	8.71	36.06	0.50	44.80
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	20.61	142.28	143.71	143.71	144.42	0.015273	3.75	5.50	4.45	1.00	43.84
Reach-1	202	Regional	20.61	142.20	143.24		143.30	0.001818	1.34	29.22	49.31	0.45	43.49
Reach-1	201	Regional	20.61	141.65	143.21		143.25	0.000603	1.05	37.18	39.45	0.28	42.01
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44

HEC-RAS Model Results for 14W-16, 14W-21, 14W-22, 14W-12A and 14W-12 -------Phase 1B Condition (Regional Uncontrolled Flow)

HEC-RAS Plan: 02U Shifted Phase 1B Profile: Regional

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2B	231.1	Regional	1.03	148.25	149.22		149.22	0.000036	0.18	16.14	39.89	0.06	0.80
Reach-2B	231	Regional	1.03	148.25	149.22		149.22	0.000036	0.18	16.14	39.89	0.06	0.78
Reach-2B	220.3	Regional	1.03	148.25	149.22		149.22	0.000027	0.16	21.82	60.56	0.05	0.70
Reach-2B	220.2	Regional	1.03	148.57	149.21		149.22	0.000457	0.47	2.57	6.01	0.20	0.03
Reach-2A	309	Regional	6.68	154.00	154.79		154.84	0.002893	1.36	15.04	43.81	0.53	11.22
Reach-2A	308	Regional	6.68	153.50	154.48		154.54	0.005224	1.97	13.04	32.66	0.69	10.12
Reach-2A	307	Regional	6.68	153.00	154.02		154.10	0.005521	2.09	9.91	16.35	0.71	9.19
Reach-2A	306	Regional	6.68	152.60	153.75		153.81	0.003467	1.80	12.47	20.46	0.57	8.44
Reach-2A	305	Regional	6.68	152.12	153.39	153.32	153.50	0.004074	1.74	10.30	38.89	0.61	7.53
Reach-2A	304	Regional	6.68	151.63	152.88	152.84	153.00	0.004301	1.77	10.02	38.68	0.63	6.31
Reach-2A	303	Regional	6.68	151.46	152.73		152.84	0.003856	1.70	10.63	38.77	0.60	5.90
Reach-2A	302	Regional	6.68	151.29	152.55	152.51	152.67	0.004368	1.78	9.88	38.65	0.63	5.49
Reach-2A	301	Regional	6.68	150.79	152.04	152.00	152.16	0.004326	1.78	9.99	38.67	0.63	4.32
Reach-2A	300	Regional	6.68	150.40	151.68	151.61	151.79	0.003682	1.67	10.84	38.80	0.58	3.35
Reach-2A	299	Regional	6.68	150.05	151.29	151.27	151.43	0.004787	1.85	9.38	38.58	0.66	2.49
Reach-2A	298	Regional	6.68	149.76	151.15	150.98	151.20	0.001853	1.29	15.10	39.45	0.42	1.63
Reach-2A	297	Regional	6.68	149.64	150.81	150.81	151.05	0.008189	2.28	4.79	32.95	0.85	1.29
Reach-2A	296.5		Culvert										
Reach-2A	296	Regional	6.68	149.44	150.62	150.62	150.86	0.008167	2.28	4.78	32.69	0.85	0.59
Reach-2C	220.1	Regional	7.38	148.25	149.13	149.09	149.20	0.004752	1.35	12.63	62.30	0.64	0.04
Reach-2C	220	Regional	7.38	148.25	149.09	149.09	149.19	0.006944	1.57	10.21	60.68	0.76	0.03
Reach-1A	210.5	Regional	8.11	155.11	155.53	155.48	155.55	0.006966	0.70	11.60	92.30	0.63	11.02
Reach-1A	210	Regional	8.11	154.96	155.26	155.21	155.30	0.007366	0.92	8.78	47.83	0.69	10.66
Reach-1A	209	Regional	8.11	154.46	154.74		154.76	0.003402	0.79	15.74	75.27	0.50	9.31
Reach-1A	208.3	Regional	8.11	152.95	153.39	153.39	153.49	0.015561	1.43	5.67	28.04	1.02	7.16
Reach-1A	208.2	Regional	8.11	152.50	152.97		153.02	0.005184	1.00	8.08	29.80	0.62	6.81
Reach-1A	208.1	Regional	8.11	152.50	152.85		152.89	0.002514	0.80	11.47	41.75	0.44	6.46
Reach-1A	208	Regional	8.11	151.00	152.19	152.19	152.42	0.009978	2.14	4.68	15.93	0.92	5.65
Reach-1A	207	Regional	8.11	150.25	151.04		151.07	0.002488	0.91	17.02	55.50	0.46	3.56
Reach-1A	206.3	Regional	10.06	149.49	150.47	150.46	150.68	0.006494	2.19	9.27	27.46	0.80	2.35
Reach-1A	206.2	Regional	10.06	149.25	150.37	150.17	150.42	0.002498	1.11	12.54	33.71	0.48	1.84
Reach-1A	206.15		Bridge										
Reach-1A	206.1	Regional	10.06	149.00	150.01	149.89	150.12	0.004667	1.43	8.21	30.65	0.64	1.49
Reach-1	205	Regional	18.51	147.24	148.39	148.39	148.74	0.010694	2.61	7.10	10.43	1.01	53.35
Reach-1	204.75	Regional	18.51	146.00	147.48		147.53	0.001592	1.25	29.27	31.60	0.41	50.65
Reach-1	204.7	Regional	18.51	145.89	146.91	146.91	147.26	0.009860	2.62	7.36	13.37	0.99	49.27
Reach-1	204.55	Regional	18.51	145.49	146.67	146.56	146.89	0.005963	2.07	9.47	18.50	0.77	49.14
Reach-1	204.5	Regional	18.51	145.36	146.55	146.51	146.76	0.008146	2.04	9.75	23.45	0.86	48.96
Reach-1	204.25	Regional	18.51	145.11	146.30	146.30	146.54	0.009024	2.42	13.61	30.82	0.93	48.67
Reach-1	204	Regional	20.32	144.05	145.11	145.11	145.42	0.009868	2.94	14.85	25.35	1.02	47.27
Reach-1	203	Regional	20.46	142.50	145.02		145.05	0.000406	0.90	37.21	39.35	0.23	45.64
Reach-1	202.75	Regional	20.46	142.43	144.68	143.85	144.96	0.001781	2.36	8.66	35.98	0.50	44.79
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	20.46	142.28	143.70	143.70	144.41	0.015286	3.74	5.47	4.43	1.00	43.84
Reach-1	202	Regional	20.46	142.20	143.24		143.30	0.001795	1.33	29.20	49.31	0.44	43.49
Reach-1	201	Regional	20.46	141.65	143.21		143.25	0.000594	1.04	37.18	39.45	0.27	42.01
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44

HEC-RAS Model Results for 14W-16, 14W-21, 14W-22, 14W-12A and 14W-12 --------Phase 2 Condition (Regional Uncontrolled Flow)

HEC-RAS Plan: 03U Shifted Phase 2 Profile: Regional

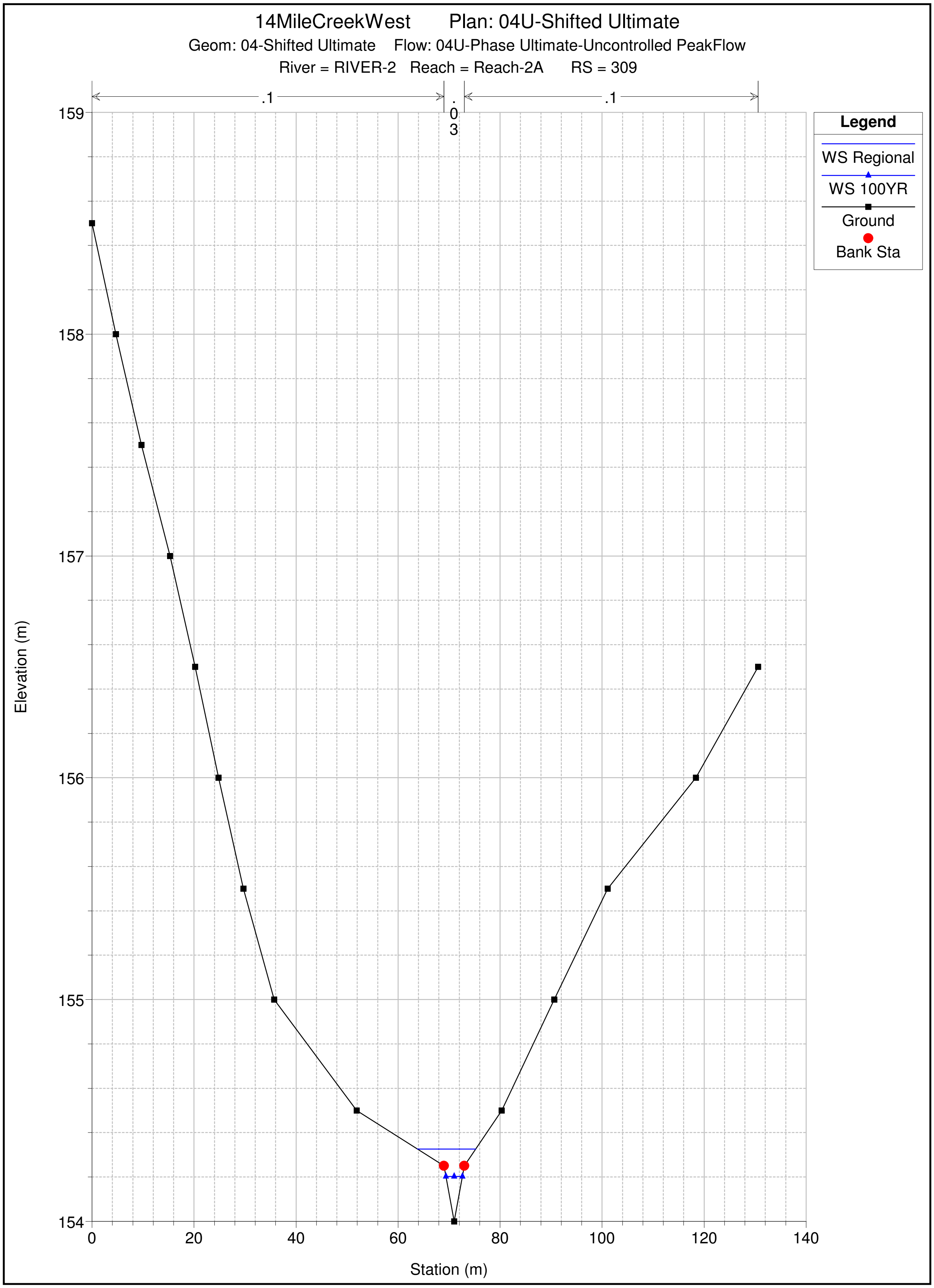
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	309	Regional	0.52	154.00	154.33		154.35	0.003014	0.62	1.09	11.42	0.44	9.31
Reach-2A	308	Regional	0.52	153.50	153.93	153.93	153.98	0.008047	1.18	1.16	12.28	0.72	9.23
Reach-2A	307	Regional	0.52	153.00	153.63		153.64	0.000474	0.41	3.88	14.05	0.19	9.02
Reach-2A	306	Regional	0.52	152.60	153.63		153.63	0.000033	0.16	10.05	16.74	0.06	8.55
Reach-2A	305	Regional	6.52	152.12	153.32	153.32	153.49	0.005923	1.99	7.92	35.91	0.73	7.83
Reach-2A	304	Regional	6.52	151.63	153.00	152.83	153.06	0.001874	1.28	14.75	39.40	0.42	6.47
Reach-2A	303	Regional	6.67	151.46	152.63	152.63	152.86	0.008279	2.29	4.78	33.18	0.85	6.03
Reach-2A	302.5		Culvert										
Reach-2A	302	Regional	6.67	151.29	152.56	152.46	152.72	0.004972	1.93	5.95	38.75	0.68	5.49
Reach-2A	301	Regional	6.67	150.79	152.04	152.00	152.16	0.004327	1.78	9.97	38.67	0.63	4.30
Reach-2A	300	Regional	6.67	150.40	151.68	151.61	151.79	0.003681	1.67	10.82	38.80	0.58	3.33
Reach-2A	299	Regional	6.67	150.05	151.29	151.27	151.43	0.004789	1.85	9.36	38.57	0.66	2.47
Reach-2A	298	Regional	6.67	149.76	151.15	150.98	151.20	0.001845	1.28	15.11	39.46	0.42	1.60
Reach-2A	297	Regional	6.67	149.64	150.81	150.81	151.05	0.008280	2.29	4.76	32.70	0.85	1.27
Reach-2A	296.5		Culvert										
Reach-2A	296	Regional	6.67	149.44	150.62	150.62	150.86	0.008262	2.29	4.75	32.43	0.85	0.57
Reach-2B	231.1	Regional	0.52	148.25	149.21		149.21	0.000010	0.09	15.63	39.24	0.03	0.77
Reach-2B	231	Regional	0.52	148.25	149.21		149.21	0.000010	0.09	15.62	39.24	0.03	0.76
Reach-2B	220.3	Regional	0.52	148.25	149.21		149.21	0.000007	0.08	21.03	59.02	0.03	0.68
Reach-2B	220.2	Regional	0.52	148.57	149.20		149.21	0.000118	0.24	2.56	6.01	0.10	0.03
Reach-2C	220.1	Regional	7.03	148.25	149.12	149.08	149.19	0.004693	1.33	12.07	61.93	0.63	0.04
Reach-2C	220	Regional	7.03	148.25	149.08	149.08	149.18	0.006770	1.54	9.77	60.38	0.75	0.03
Reach-1A	210.5	Regional	8.10	155.11	155.53	155.48	155.55	0.006981	0.70	11.58	92.24	0.63	11.24
Reach-1A	210	Regional	8.10	154.96	155.26	155.21	155.30	0.007345	0.92	8.78	47.83	0.69	10.88
Reach-1A	209	Regional	8.10	154.46	154.74	154.64	154.76	0.003412	0.79	15.71	75.24	0.50	9.53
Reach-1A	208.3	Regional	8.10	152.95	153.39	153.39	153.49	0.015488	1.43	5.67	28.06	1.01	7.38
Reach-1A	208.2	Regional	8.10	152.50	153.06	152.87	153.09	0.001972	0.82	9.97	35.34	0.41	6.96
Reach-1A	208.15		Bridge										
Reach-1A	208.1	Regional	8.10	152.45	152.90	152.75	152.95	0.002749	0.94	8.65	44.10	0.48	6.66
Reach-1A	208	Regional	8.10	151.00	152.19	152.19	152.42	0.009984	2.14	4.68	15.91	0.92	5.74
Reach-1A	207	Regional	8.10	150.25	151.04		151.07	0.002493	0.91	16.99	55.48	0.46	3.65
Reach-1A	206.3	Regional	10.04	149.49	150.47	150.46	150.68	0.006492	2.19	9.25	27.44	0.80	2.44
Reach-1A	206.2	Regional	10.04	149.25	150.37	150.17	150.42	0.002506	1.11	12.51	33.66	0.48	1.94
Reach-1A	206.15		Bridge										
Reach-1A	206.1	Regional	10.04	149.00	150.03	149.89	150.13	0.004163	1.38	8.56	31.32	0.61	1.57
Reach-1	205	Regional	20.11	147.24	148.44	148.44	148.80	0.010550	2.65	7.58	10.75	1.01	54.12
Reach-1	204.75	Regional	20.11	146.00	147.54		147.59	0.001601	1.30	30.96	32.45	0.41	51.25
Reach-1	204.7	Regional	20.11	145.89	146.96	146.96	147.32	0.009406	2.67	7.99	13.85	0.97	49.79
Reach-1	204.55	Regional	20.11	145.49	146.70	146.60	146.94	0.006221	2.16	9.98	19.48	0.79	49.65
Reach-1	204.5	Regional	20.11	145.36	146.58	146.54	146.80	0.008125	2.10	10.45	24.15	0.87	49.46
Reach-1	204.25	Regional	20.11	145.11	146.33	146.33	146.58	0.009089	2.49	14.49	31.08	0.94	49.15
Reach-1	204	Regional	22.00	144.05	145.15	145.15	145.46	0.009822	3.02	15.78	25.60	1.03	47.66
Reach-1	203	Regional	22.15	142.50	145.16		145.19	0.000342	0.87	43.02	41.24	0.21	45.82
Reach-1	202.75	Regional	22.15	142.43	144.80	143.93	145.10	0.001749	2.43	9.13	36.90	0.50	44.87
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	22.15	142.28	143.78	143.78	144.53	0.014924	3.83	5.78	6.10	1.00	43.85
Reach-1	202	Regional	22.15	142.20	143.24		143.31	0.002056	1.43	29.45	49.35	0.48	43.49
Reach-1	201	Regional	22.15	141.65	143.21		143.25	0.000697	1.13	37.16	39.44	0.30	42.01
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44

HEC-RAS Model Results for 14W-16, 14W-21, 14W-22, 14W-12A and 14W-12 --------Ultimate Condition (Regional Uncontrolled Flow)

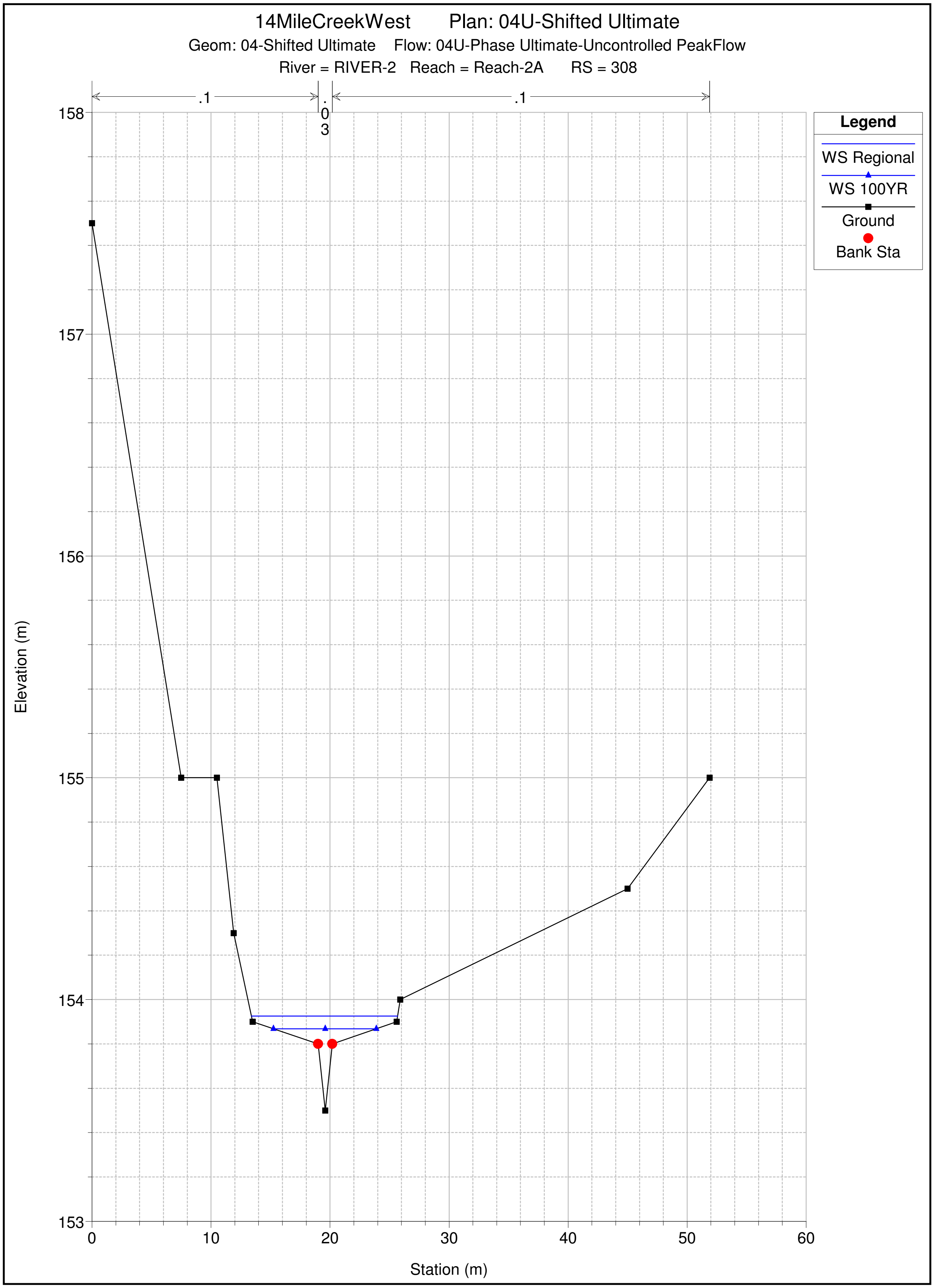
HEC-RAS Plan: 04U-Shifted Profile: Regional

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Volume
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)		(1000 m3)
Reach-2A	309	Regional	0.52	154.00	154.33		154.35	0.003014	0.62	1.09	11.42	0.44	9.05
Reach-2A	308	Regional	0.52	153.50	153.93	153.93	153.98	0.008047	1.18	1.16	12.28	0.72	8.96
Reach-2A	307	Regional	0.52	153.00	153.63		153.63	0.000513	0.42	3.77	13.98	0.20	8.76
Reach-2A	306	Regional	0.52	152.60	153.62		153.62	0.000035	0.16	9.92	16.70	0.06	8.30
Reach-2A	305	Regional	6.35	152.12	153.31	153.31	153.48	0.006054	1.99	7.53	34.78	0.73	7.60
Reach-2A	304	Regional	6.35	151.63	152.99	152.81	153.04	0.001922	1.29	14.23	39.33	0.43	6.29
Reach-2A	303	Regional	6.50	151.46	152.62	152.62	152.85	0.008190	2.26	4.69	32.46	0.85	5.87
Reach-2A	302.5		Culvert										
Reach-2A	302	Regional	6.50	151.29	152.55	152.45	152.71	0.004899	1.90	5.86	38.70	0.67	5.34
Reach-2A	301	Regional	6.50	150.79	152.03	151.99	152.15	0.004370	1.77	9.64	38.62	0.63	4.18
Reach-2A	300	Regional	6.50	150.40	151.68	151.60	151.78	0.003616	1.65	10.63	38.77	0.58	3.24
Reach-2A	299	Regional	6.50	150.05	151.28	151.25	151.42	0.004859	1.85	9.01	38.52	0.66	2.40
Reach-2A	298	Regional	6.50	149.76	151.14	150.96	151.19	0.001892	1.29	14.60	39.38	0.42	1.57
Reach-2A	297	Regional	6.50	149.64	150.80	150.80	151.04	0.008244	2.27	4.66	31.87	0.85	1.25
Reach-2A	296.5		Culvert										
Reach-2A	296	Regional	6.50	149.44	150.61	150.61	150.84	0.008320	2.27	4.62	31.40	0.85	0.55
Reach-2B	231.1	Regional	0.52	148.25	149.20		149.20	0.000010	0.10	15.43	38.99	0.03	0.73
Reach-2B	231	Regional	0.52	148.25	149.20		149.20	0.000010	0.10	15.42	38.99	0.03	0.71
Reach-2B	220.3	Regional	0.52	148.25	149.20		149.20	0.000008	0.08	20.73	58.43	0.03	0.67
Reach-2B	220.2	Regional	0.52	148.57	149.20		149.20	0.000122	0.24	2.53	5.98	0.11	0.03
Reach-2C	220.1	Regional	6.86	148.25	149.11	149.08	149.18	0.004666	1.32	11.79	61.75	0.63	0.04
Reach-2C	220	Regional	6.86	148.25	149.08	149.08	149.18	0.006683	1.53	9.55	60.23	0.74	0.03
Reach-1A	210.5	Regional	8.02	155.11	155.53	155.48	155.55	0.007006	0.70	11.48	91.96	0.63	11.25
Reach-1A	210	Regional	8.02	154.96	155.26	155.21	155.30	0.007349	0.92	8.72	47.69	0.69	10.89
Reach-1A	209	Regional	8.02	154.46	154.73	154.64	154.76	0.003410	0.79	15.60	75.16	0.50	9.55
Reach-1A	208.3	Regional	8.02	152.95	153.39	153.39	153.49	0.015562	1.43	5.62	27.93	1.02	7.42
Reach-1A	208.2	Regional	8.02	152.50	153.05	152.86	153.09	0.001997	0.82	9.86	35.12	0.41	7.01
Reach-1A	208.15		Bridge										
Reach-1A	208.1	Regional	8.02	152.50	152.87	152.75	152.93	0.003732	1.02	7.84	42.62	0.55	6.72
Reach-1A	208	Regional	8.02	151.00	152.27	152.19	152.43	0.005880	1.80	6.07	18.39	0.72	5.80
Reach-1A	207.78*	Regional	8.02	150.83	151.86	151.86	152.07	0.011761	2.06	4.13	13.02	0.99	5.58
Reach-1A	207	Regional	8.02	150.25	151.06		151.09	0.002017	0.85	18.20	56.15	0.41	3.91
Reach-1A	206.3	Regional	11.06	149.49	150.50	150.49	150.72	0.006747	2.28	10.02	28.27	0.82	2.60
Reach-1A	206.2	Regional	11.06	149.25	150.40	150.20	150.46	0.002475	1.14	13.56	35.19	0.48	2.06
Reach-1A	206.15		Bridge										
Reach-1A	206.1	Regional	11.06	149.00	150.06	149.91	150.16	0.004320	1.45	9.09	32.29	0.62	1.67
Reach-1	205	Regional	21.19	147.24	148.47	148.47	148.83	0.010312	2.67	7.95	11.00	1.00	52.43
Reach-1	204.75	Regional	21.19	146.00	147.59	147.40	147.82	0.004303	2.20	12.81	18.62	0.68	50.90
Reach-1	204.7	Regional	21.19	145.89	146.98	146.98	147.36	0.009245	2.71	8.38	14.15	0.97	50.11
Reach-1	204.55	Regional	21.19	145.49	146.72	146.62	146.97	0.006389	2.22	10.32	20.11	0.81	49.96
Reach-1	204.5	Regional	21.19	145.36	146.60	146.56	146.83	0.007866	2.12	11.05	24.74	0.86	49.77
Reach-1	204.25	Regional	21.19	145.11	146.34	146.34	146.61	0.009334	2.56	14.95	31.21	0.96	49.44
Reach-1	204	Regional	23.03	144.05	145.16	145.16	145.49	0.009915	3.07	16.26	25.73	1.03	47.91
Reach-1	203	Regional	23.20	142.50	145.25		145.28	0.000310	0.86	46.69	42.40	0.20	45.93
Reach-1	202.75	Regional	23.20	142.43	144.88	143.98	145.19	0.001731	2.46	9.42	37.45	0.50	44.92
Reach-1	202.5		Culvert										
Reach-1	202.25	Regional	23.20	142.28	143.83	143.83	144.60	0.014764	3.89	5.96	7.20	1.00	43.86
Reach-1	202	Regional	23.20	142.20	143.25		143.32	0.002222	1.49	29.61	49.38	0.50	43.50
Reach-1	201	Regional	23.20	141.65	143.21		143.26	0.000766	1.18	37.14	39.44	0.31	42.01
Reach-1	171	Regional	28.90	141.65	142.97	142.70	143.11	0.002516	1.90	27.97	37.97	0.55	38.99
Reach-1	170		Bridge										
Reach-1	169	Regional	28.90	141.65	142.70	142.70	142.99	0.007134	2.71	18.27	33.54	0.89	38.49
Reach-1	164	Regional	28.90	138.30	139.25		139.39	0.007256	1.51	18.32	23.62	0.61	35.35
Reach-1	163	Regional	28.90	137.20	138.47		138.55	0.005133	1.90	30.33	59.32	0.57	32.03
Reach-1	162	Regional	28.90	135.60	136.76	136.76	137.01	0.016983	3.06	16.52	33.14	1.02	27.93
Reach-1	161	Regional	28.90	134.10	135.30	135.17	135.36	0.005788	1.77	31.56	67.18	0.58	24.00
Reach-1	160	Regional	28.90	132.50	134.02		134.06	0.003131	1.45	37.31	64.17	0.42	13.44

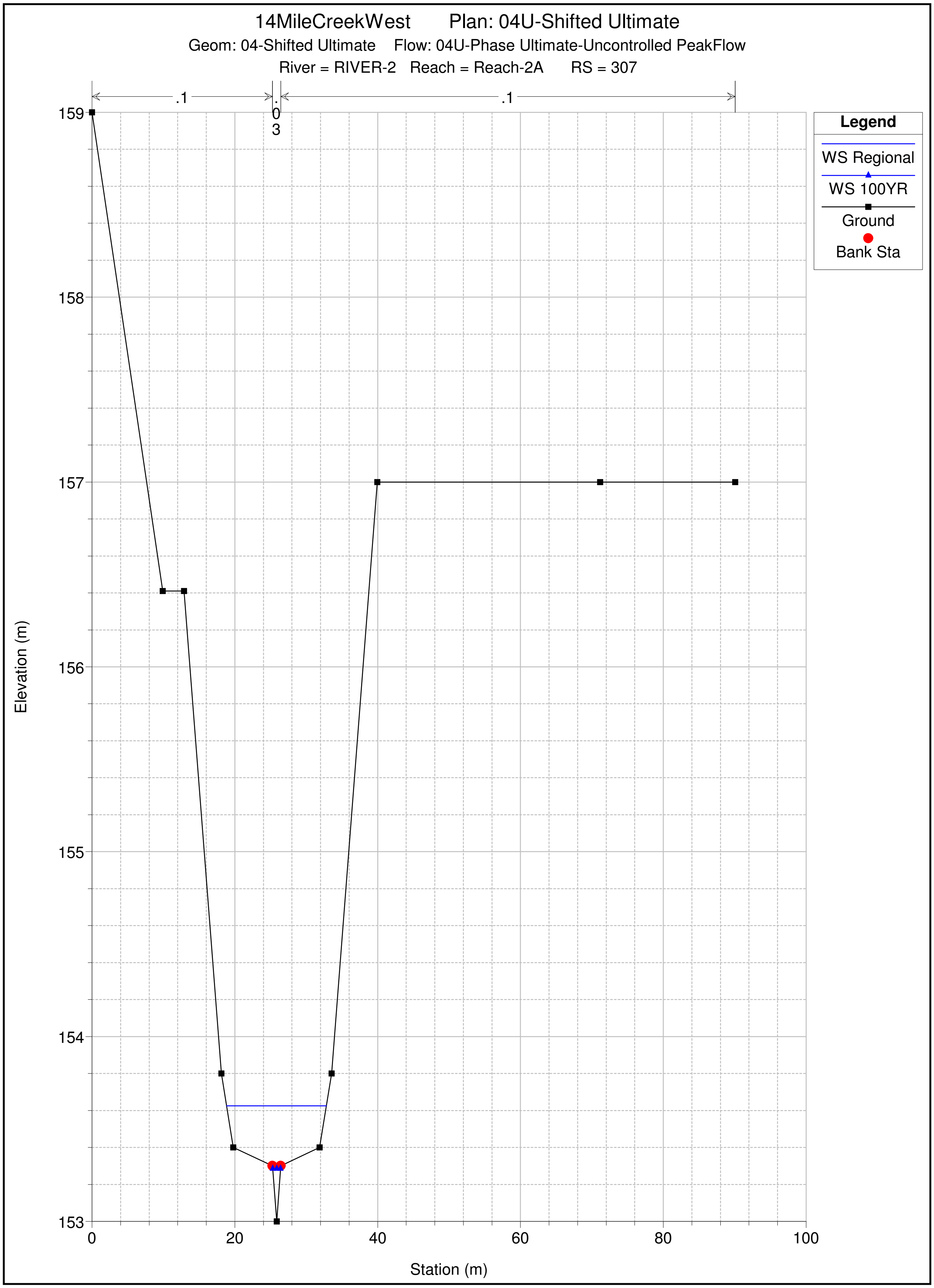
Appendix 6.2 – Proposed Cross Sections

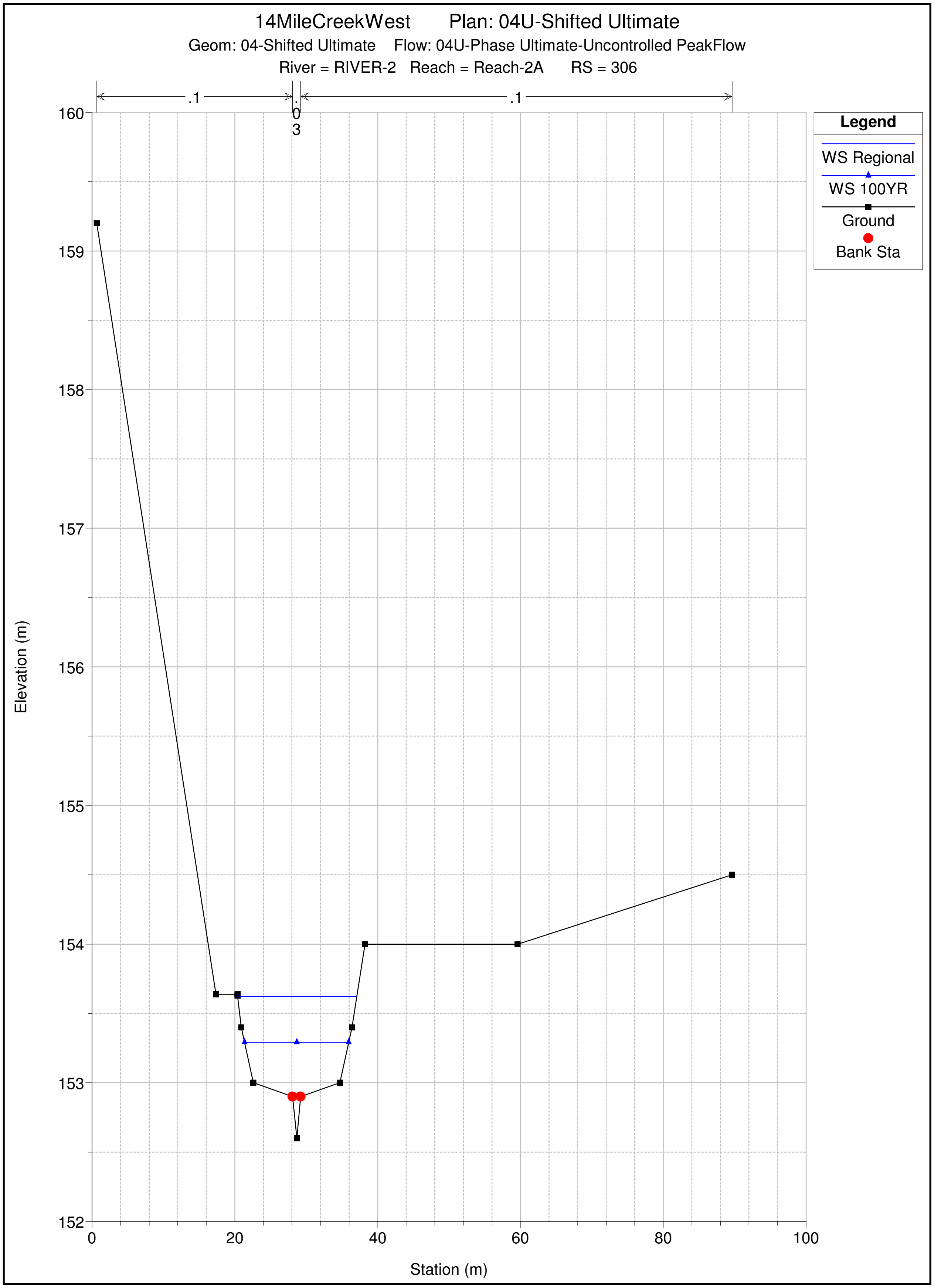


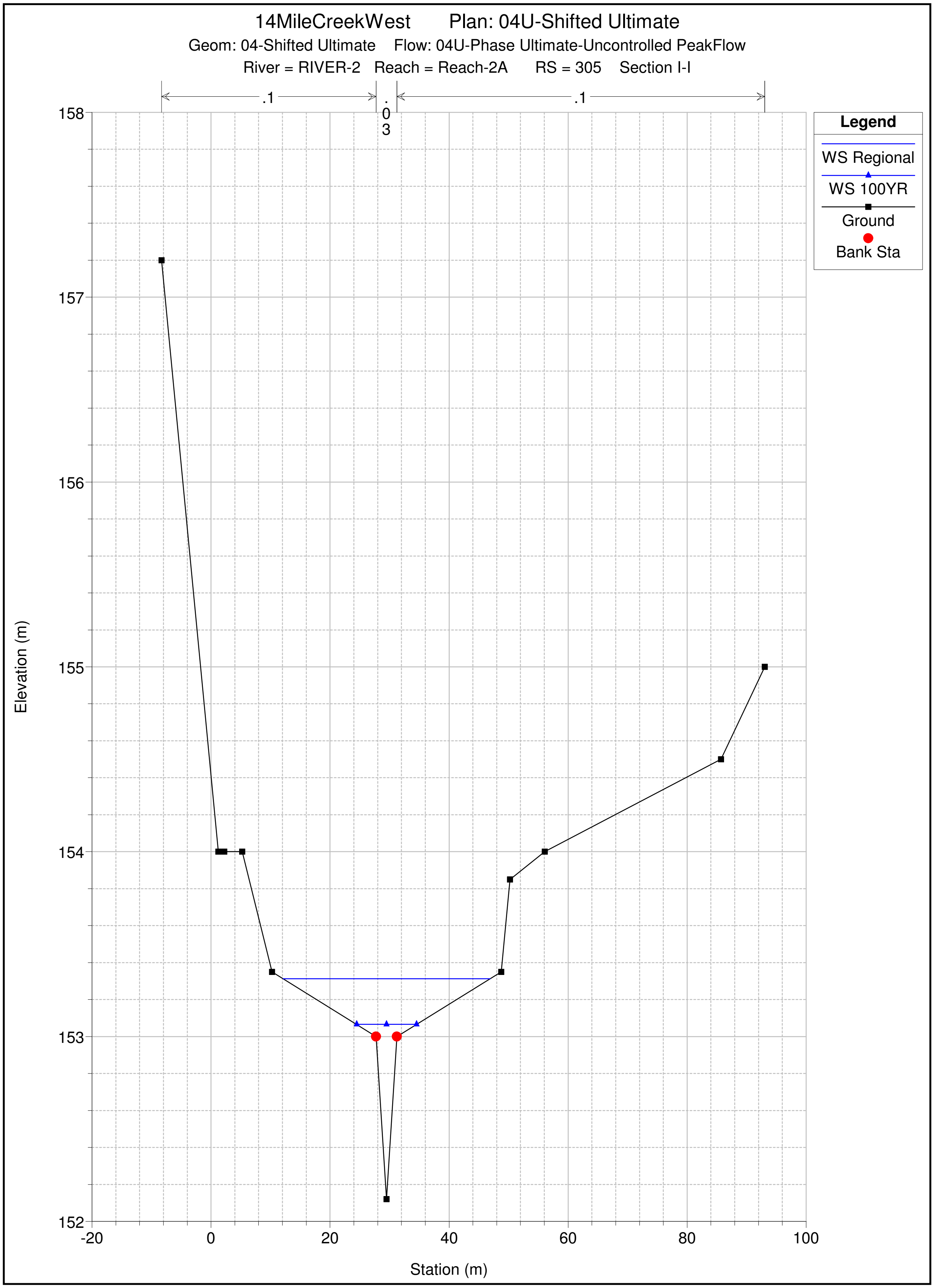
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 309
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
159
158
157
156
155
154
0
20
40
60
80
100
120
140



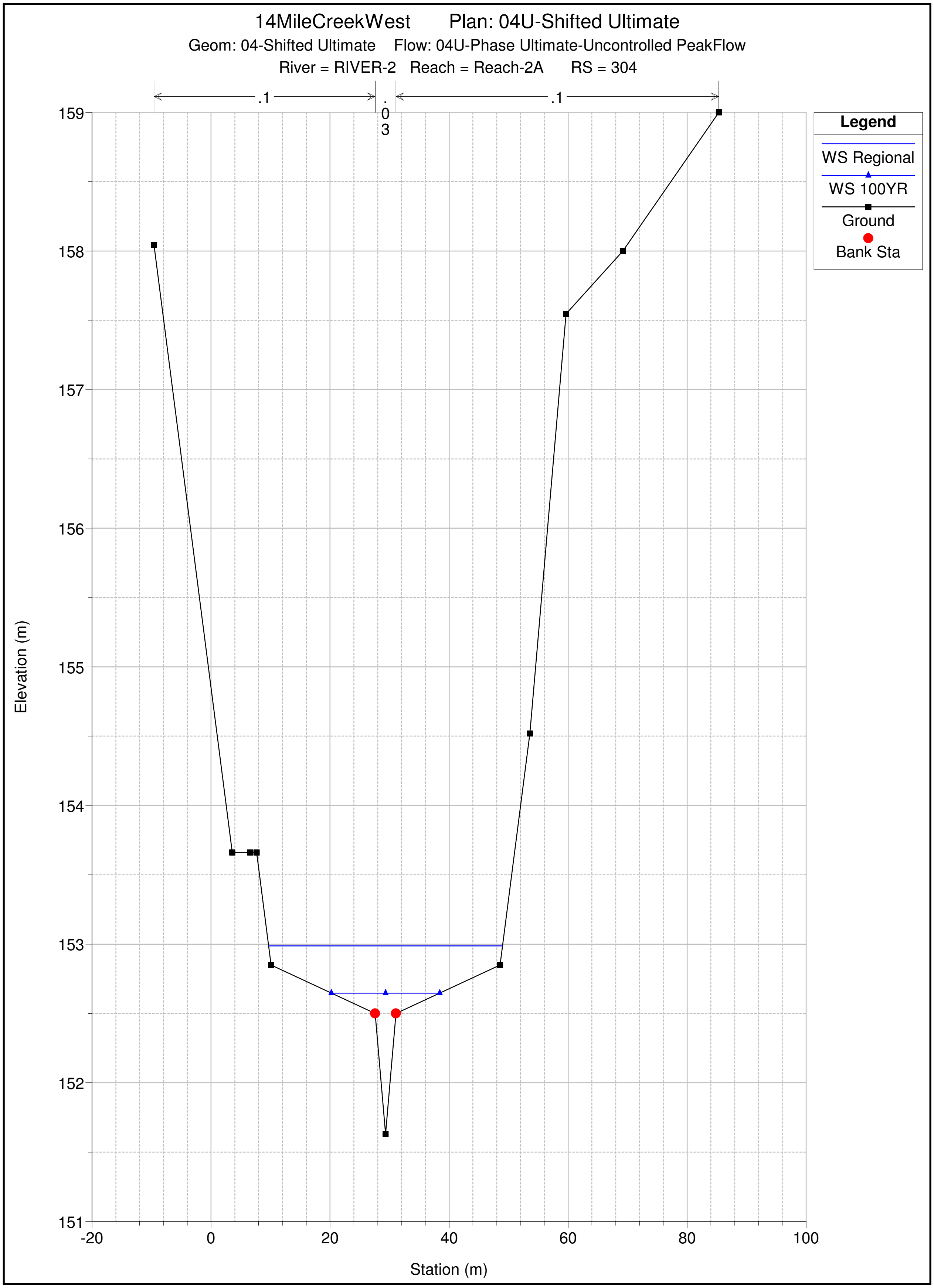
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 308
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
158
157
156
155
154
153
0
10
20
30
40
50
60
Station (m)

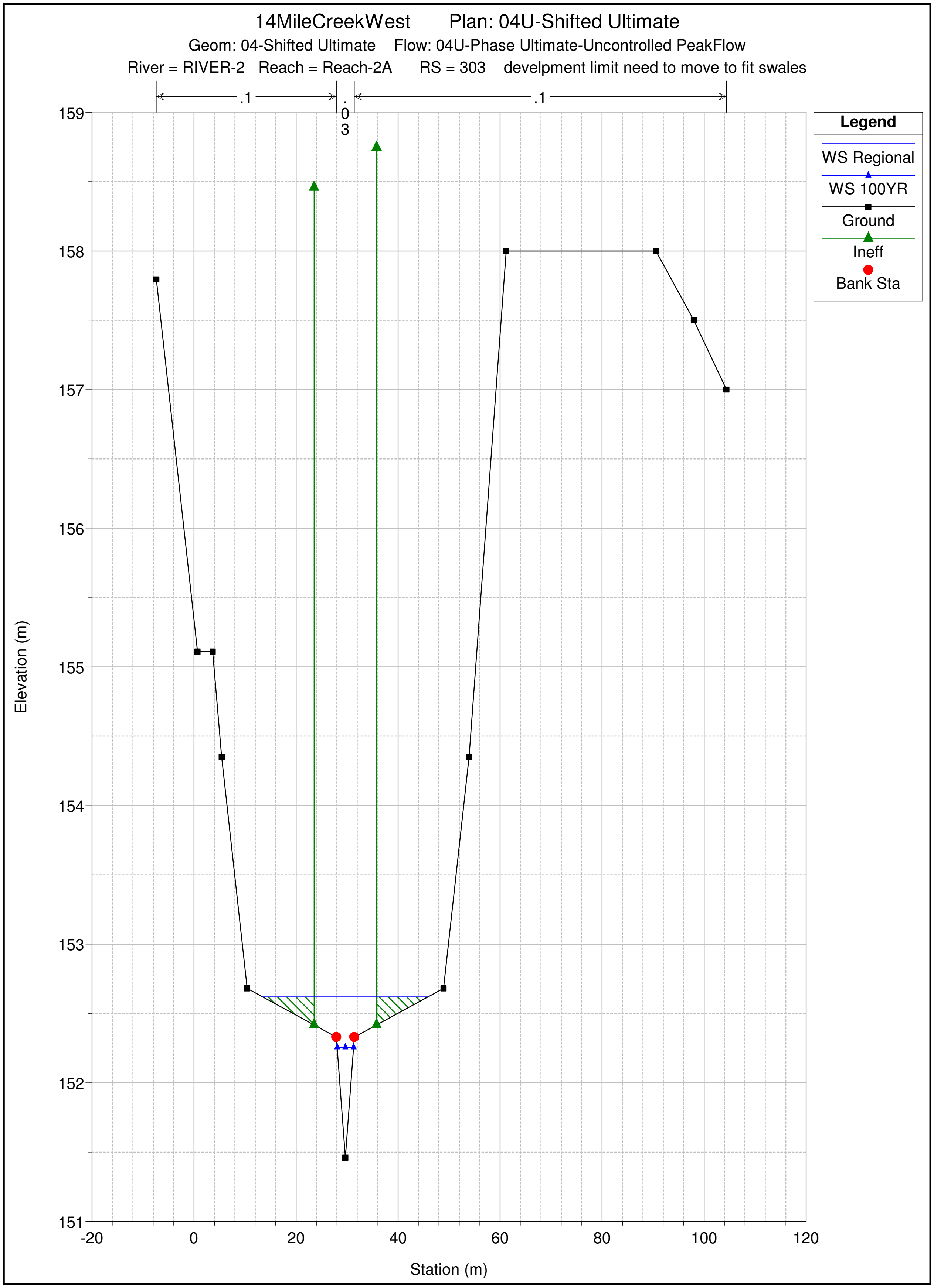

14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 307
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
159
158
157
156
155
154
153
0
20
40
60
80
100
Station (m)


14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 306
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
160
159
158
157
156
155
154
153
152
0
20
40
60
80
100

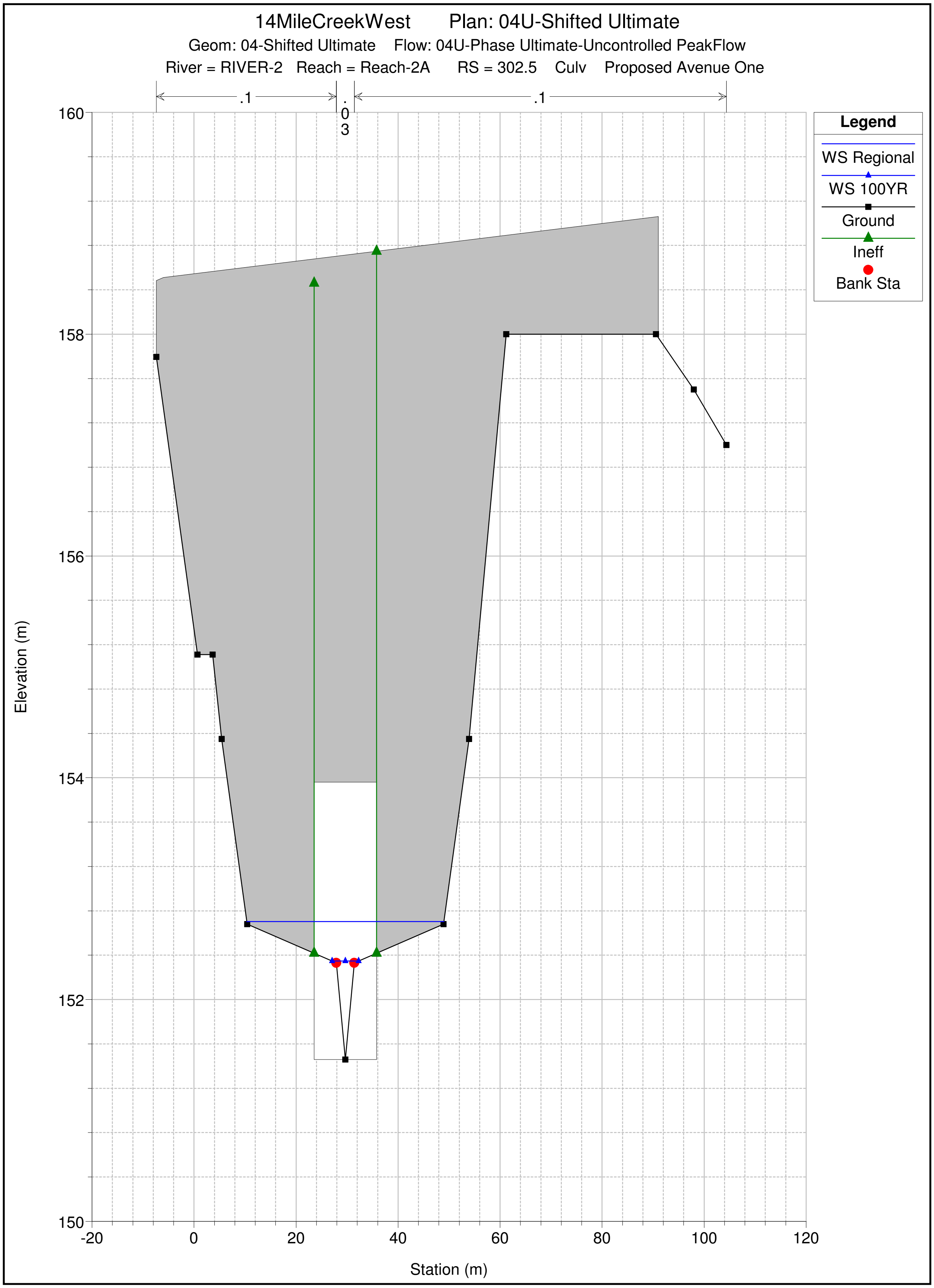


14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 305 Section I-I
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
158
157
156
155
154
153
152
-20
0
20
40
60
80
100

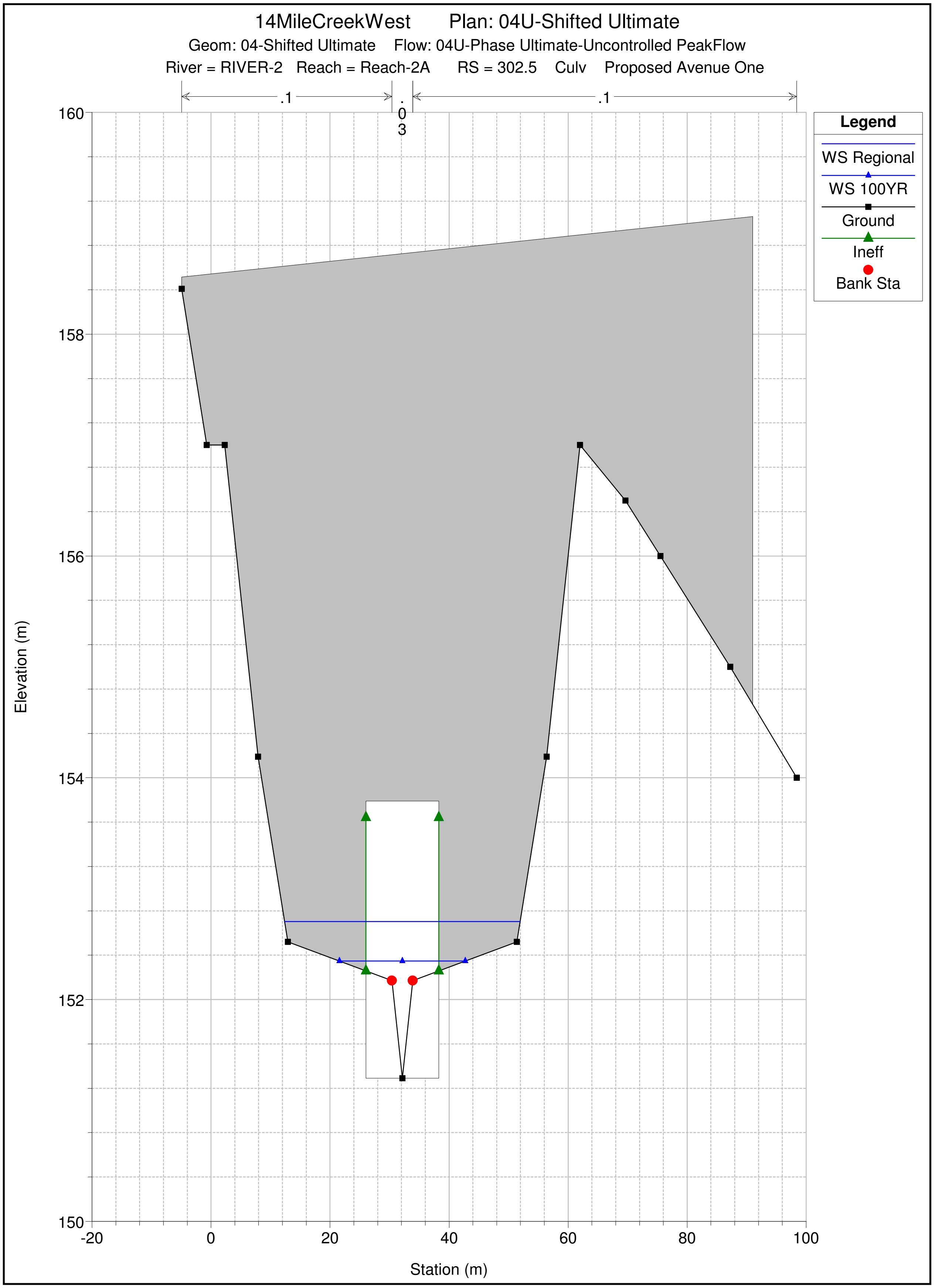

14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 304
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
159
158
157
156
155
154
153
152
151
-20
0
20
40
60
80
100



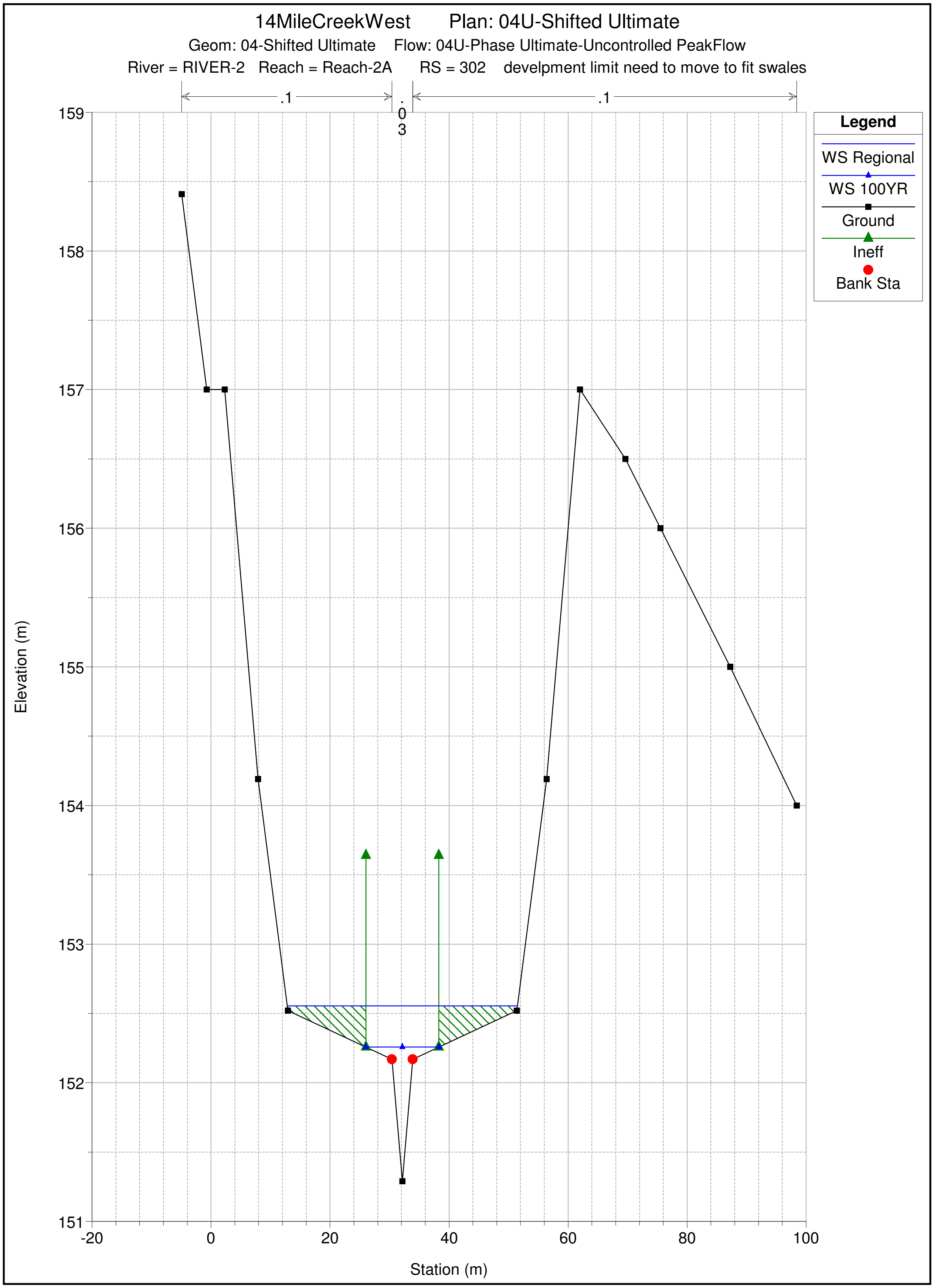
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 303 develpment limit need to move to fit swales
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
159
158
157
156
155
154
153
152
151
-20
0
20
40
60
80
100
120

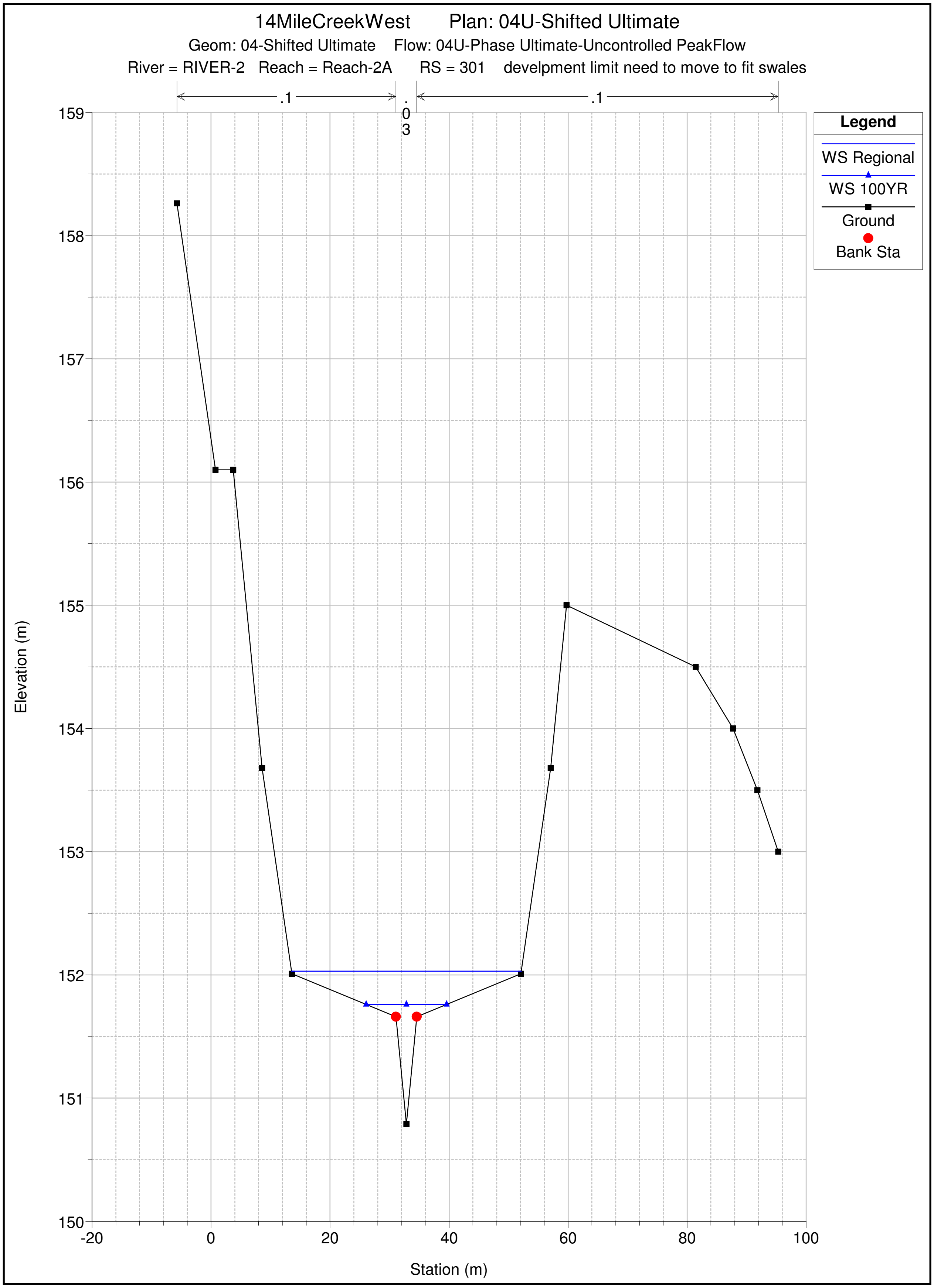


14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 302.5 Culv Proposed Avenue One
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
160
158
156
154
152
150
-20
0
20
40
60
80
100
120

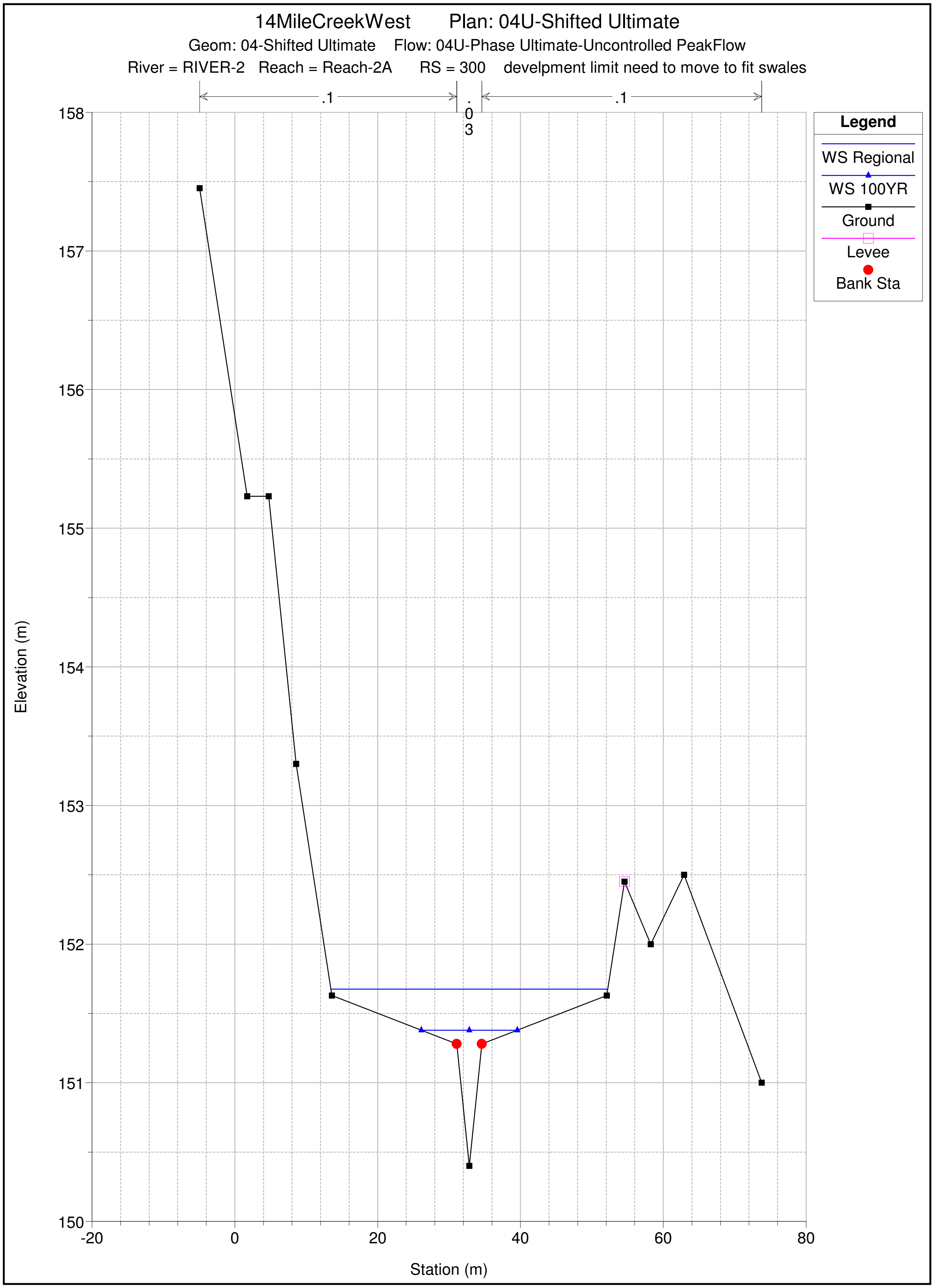


14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 302.5 Culv Proposed Avenue One
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
160
158
156
154
152
150
-20
0
20
40
60
80
100

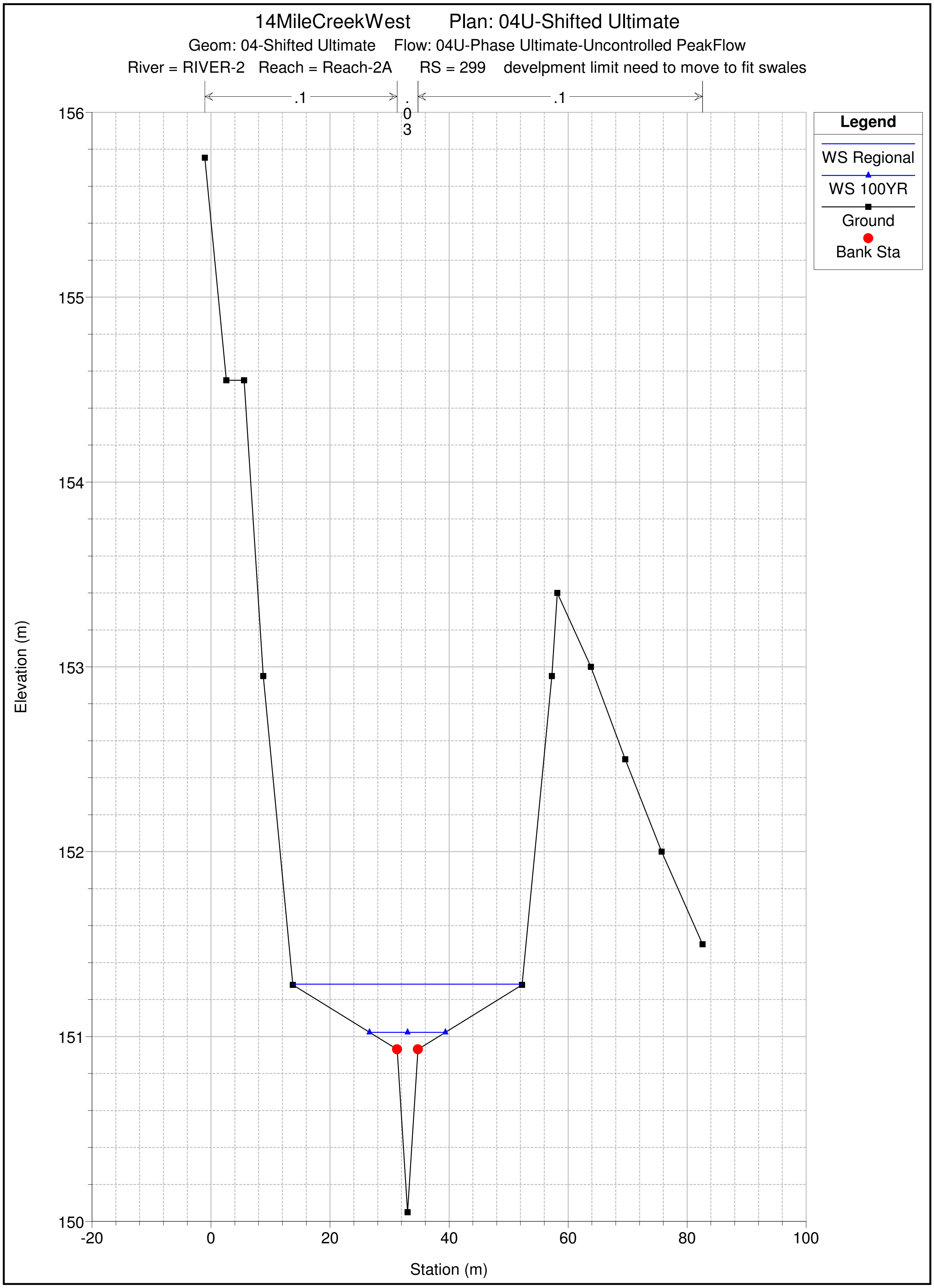

14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 302 develpment limit need to move to fit swales
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
159
158
157
156
155
154
153
152
151
-20
0
20
40
60
80
100



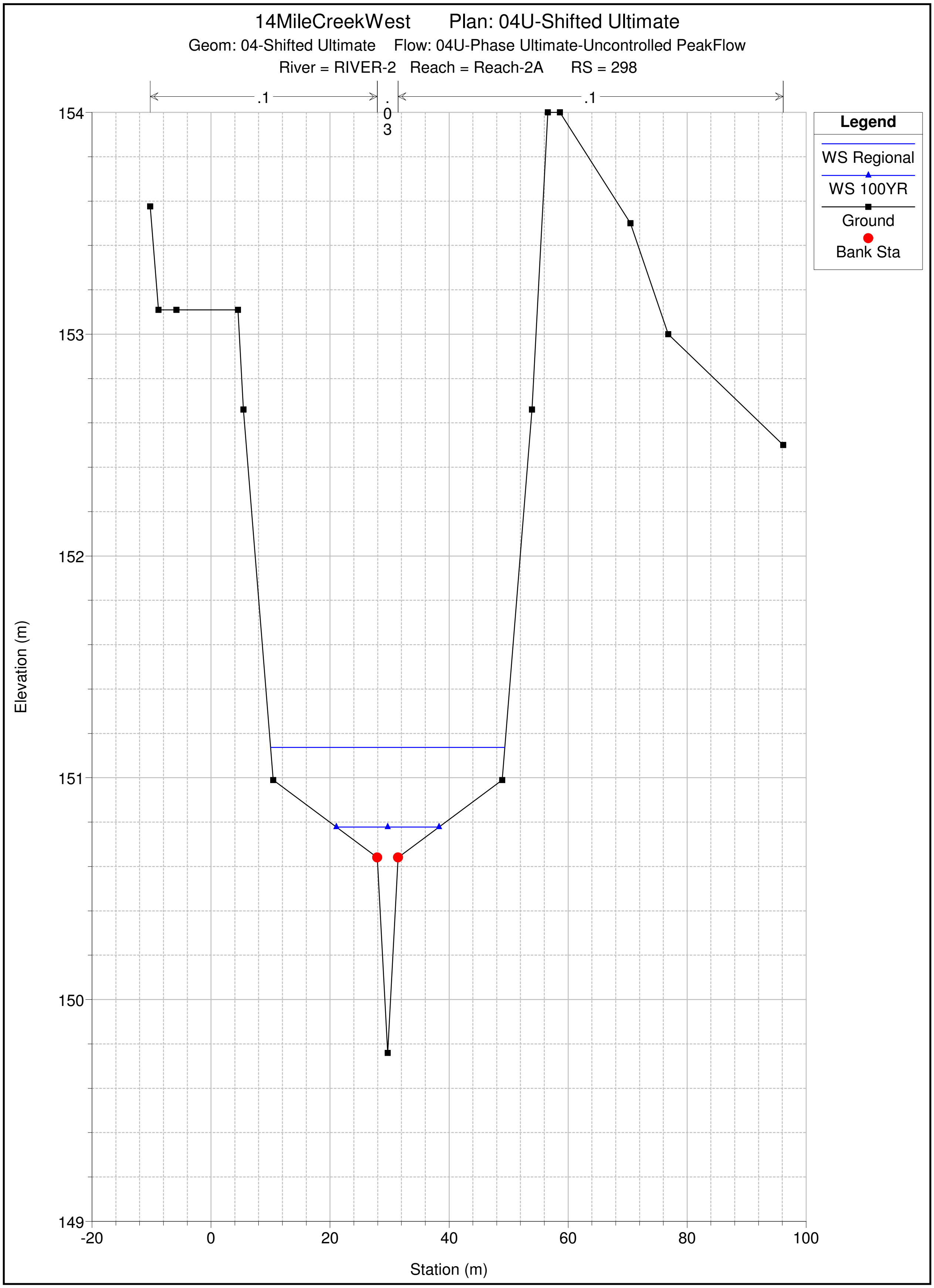
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 301 develpment limit need to move to fit swales
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
159
158
157
156
155
154
153
152
151
150
-20
0
20
40
60
80
100



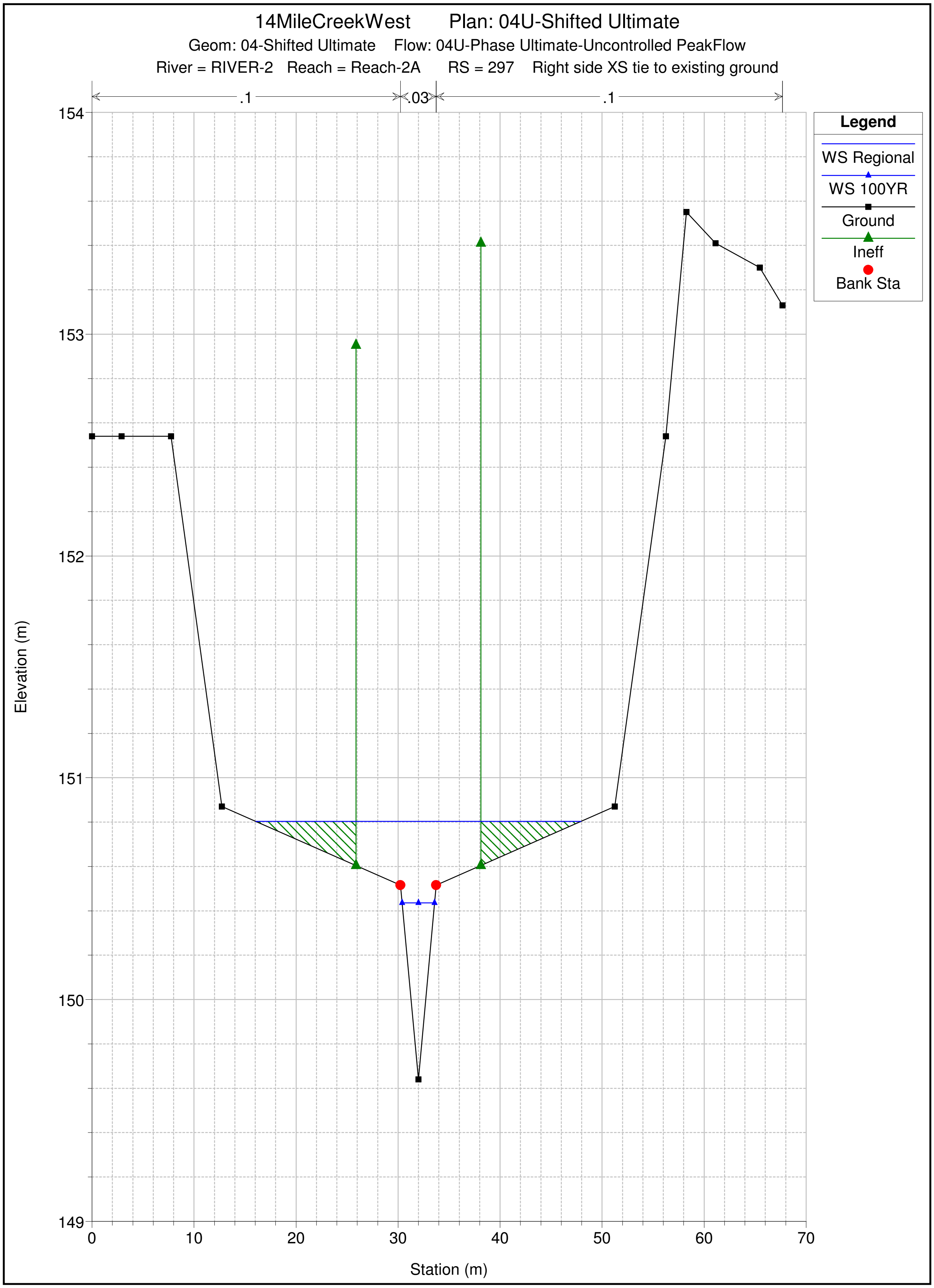
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 300 develpment limit need to move to fit swales
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Levee
Bank Sta
Elevation (m)
Station (m)
158
157
156
155
154
153
152
151
150
-20
0
20
40
60
80



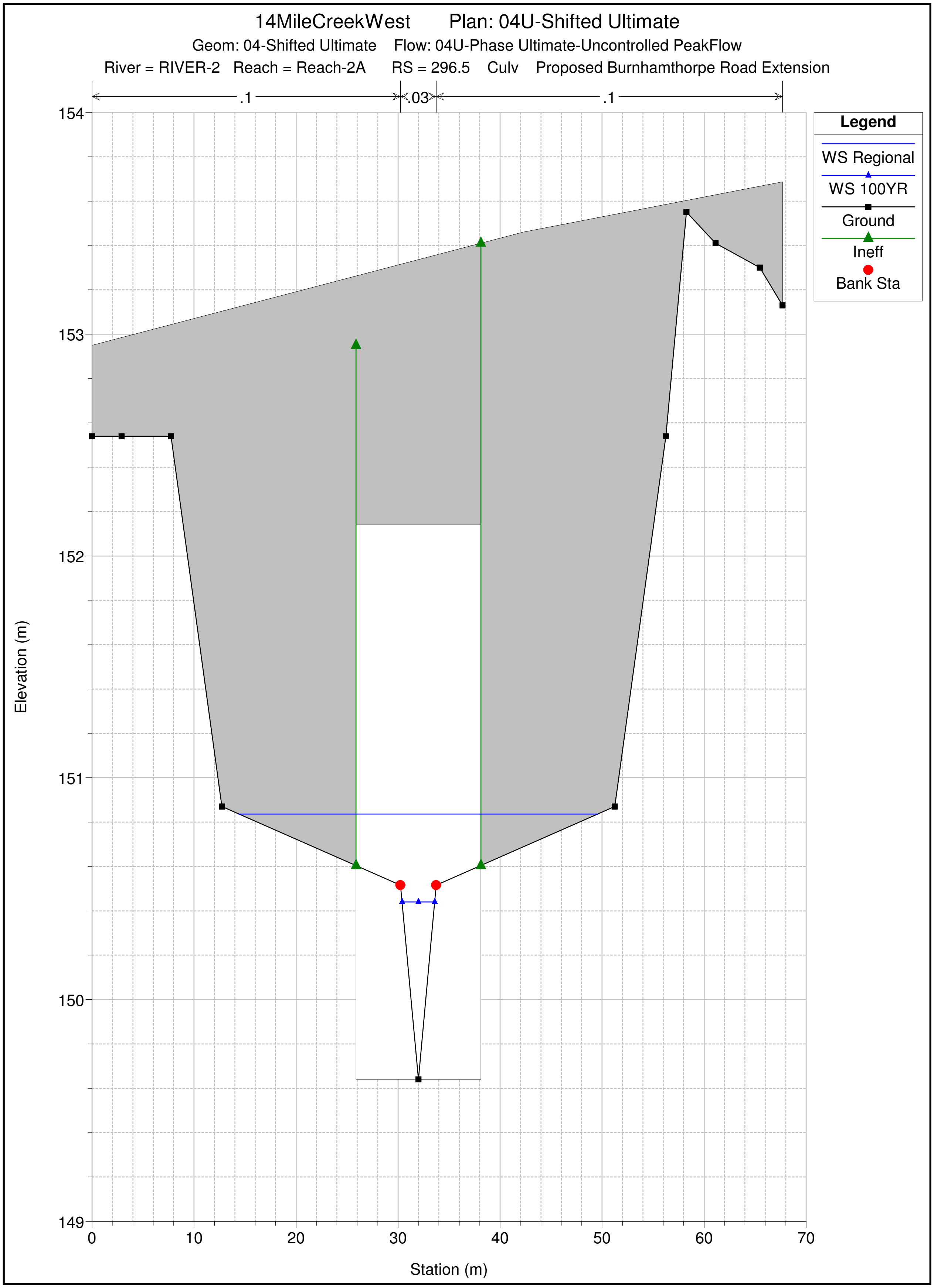
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 299 develpment limit need to move to fit swales
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
156
155
154
153
152
151
150
-20
0
20
40
60
80
100



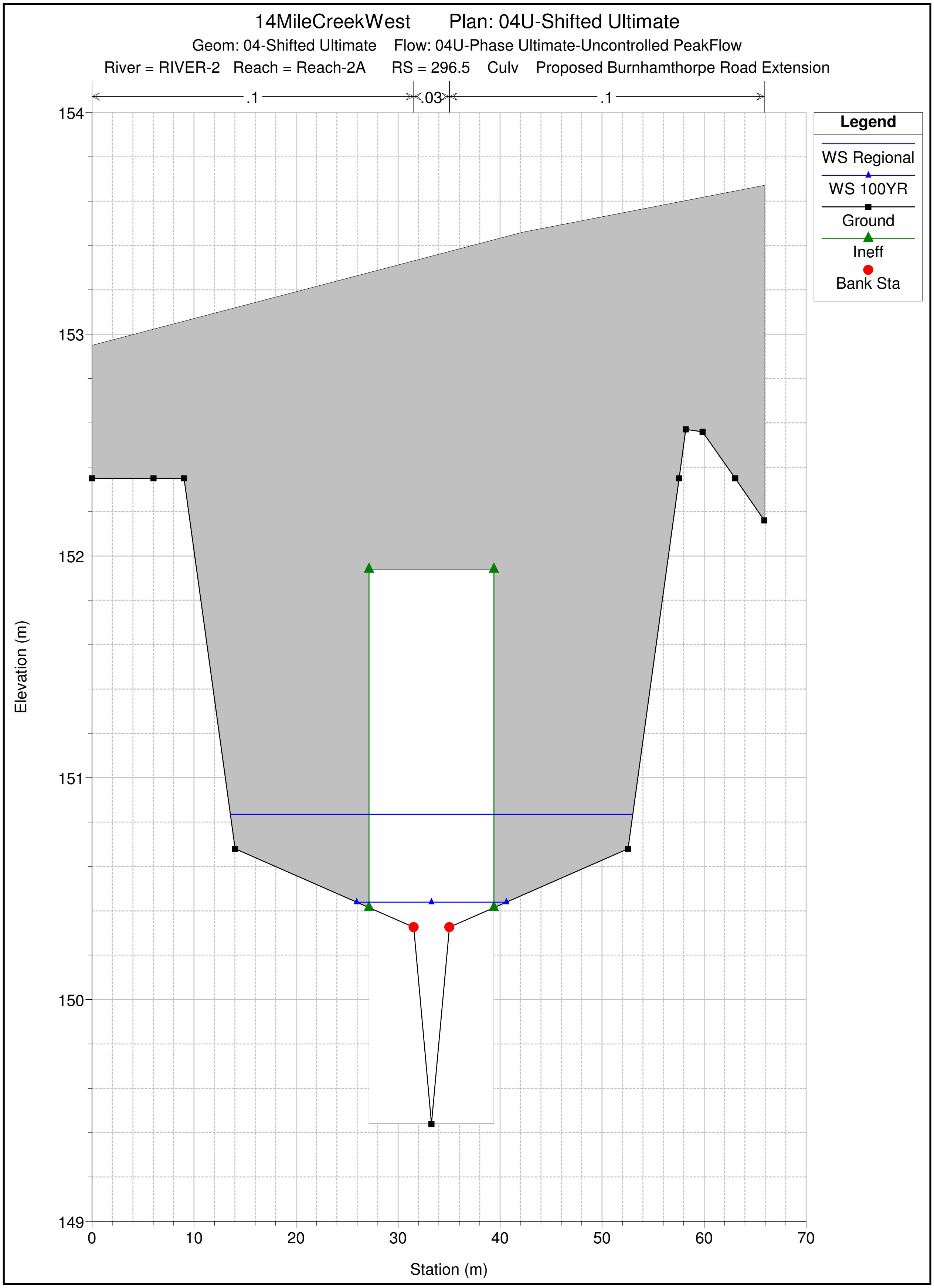
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 298
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
154
153
152
151
150
149
-20
0
20
40
60
80
100

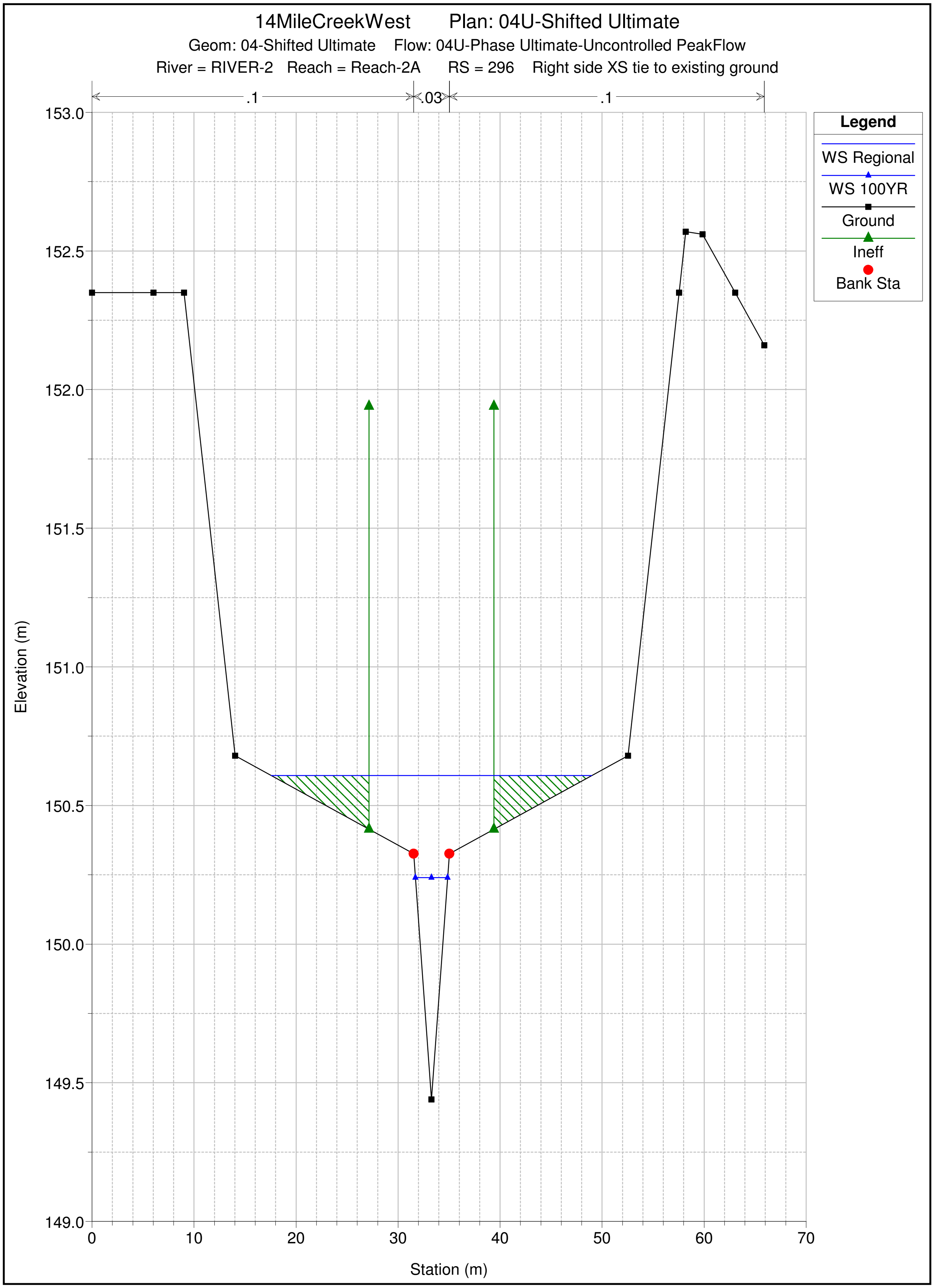


14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 297 Right side XS tie to existing ground
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
154
153
152
151
150
149
0
10
20
30
40
50
60
70

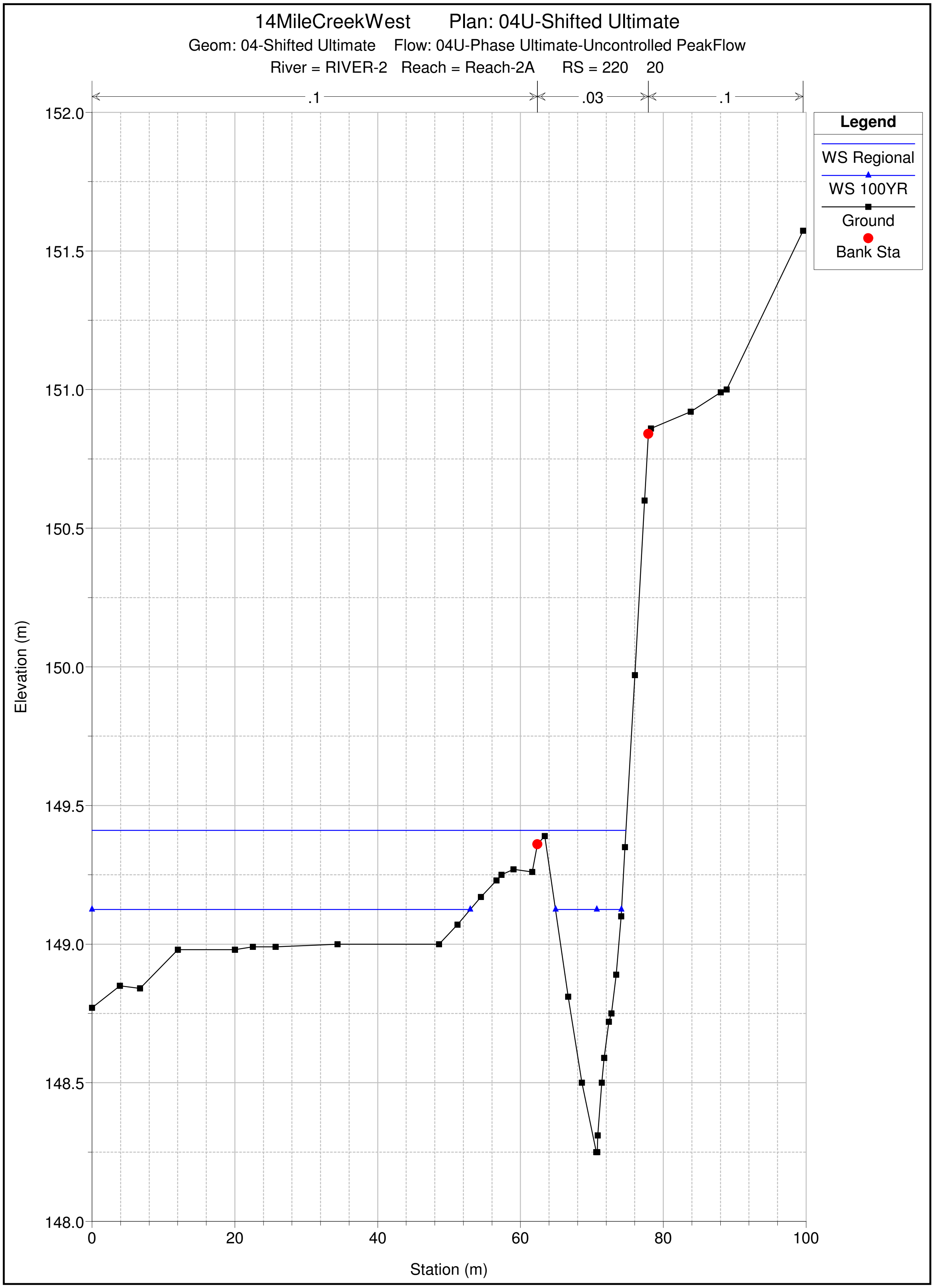


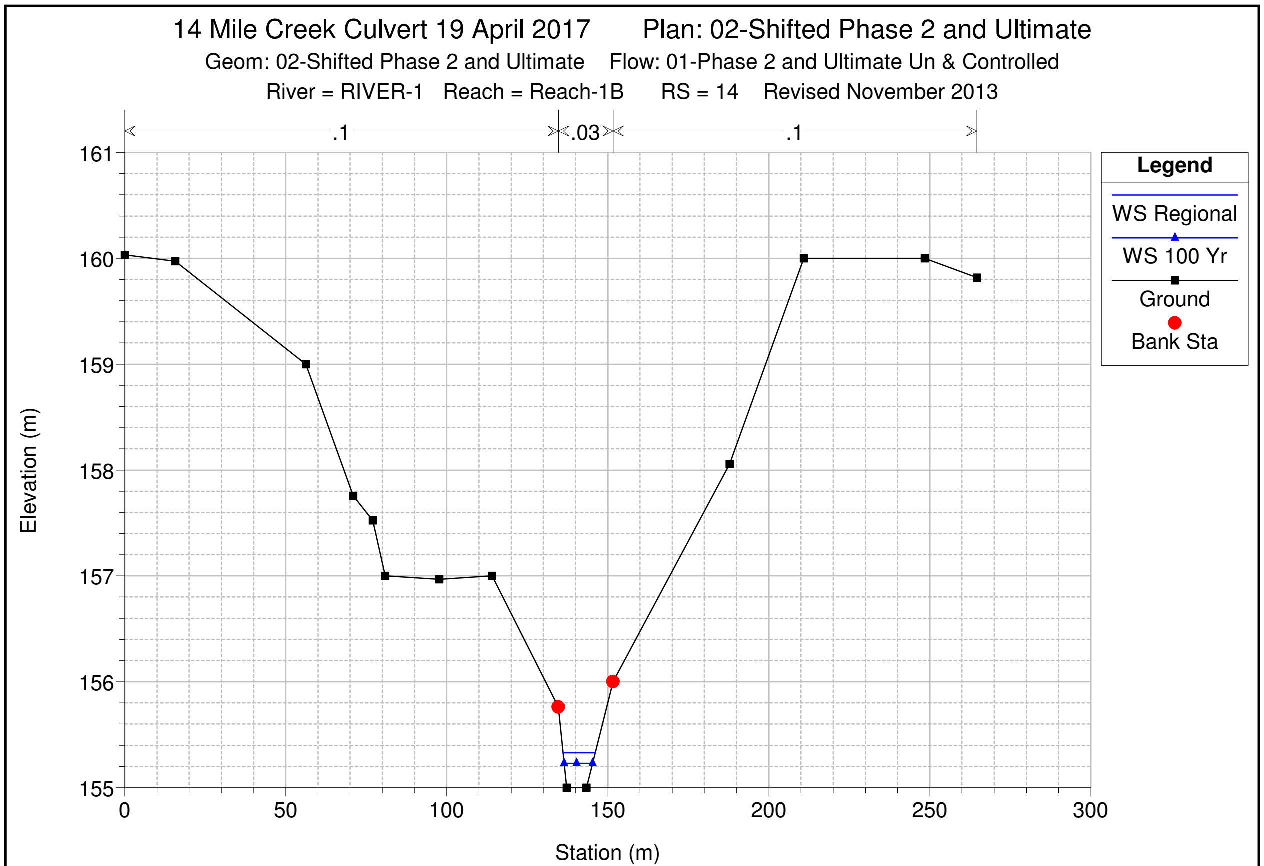
14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 296.5 Culv Proposed Burnhamthorpe Road Extension
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
154
153
152
151
150
149
0
10
20
30
40
50
60
70

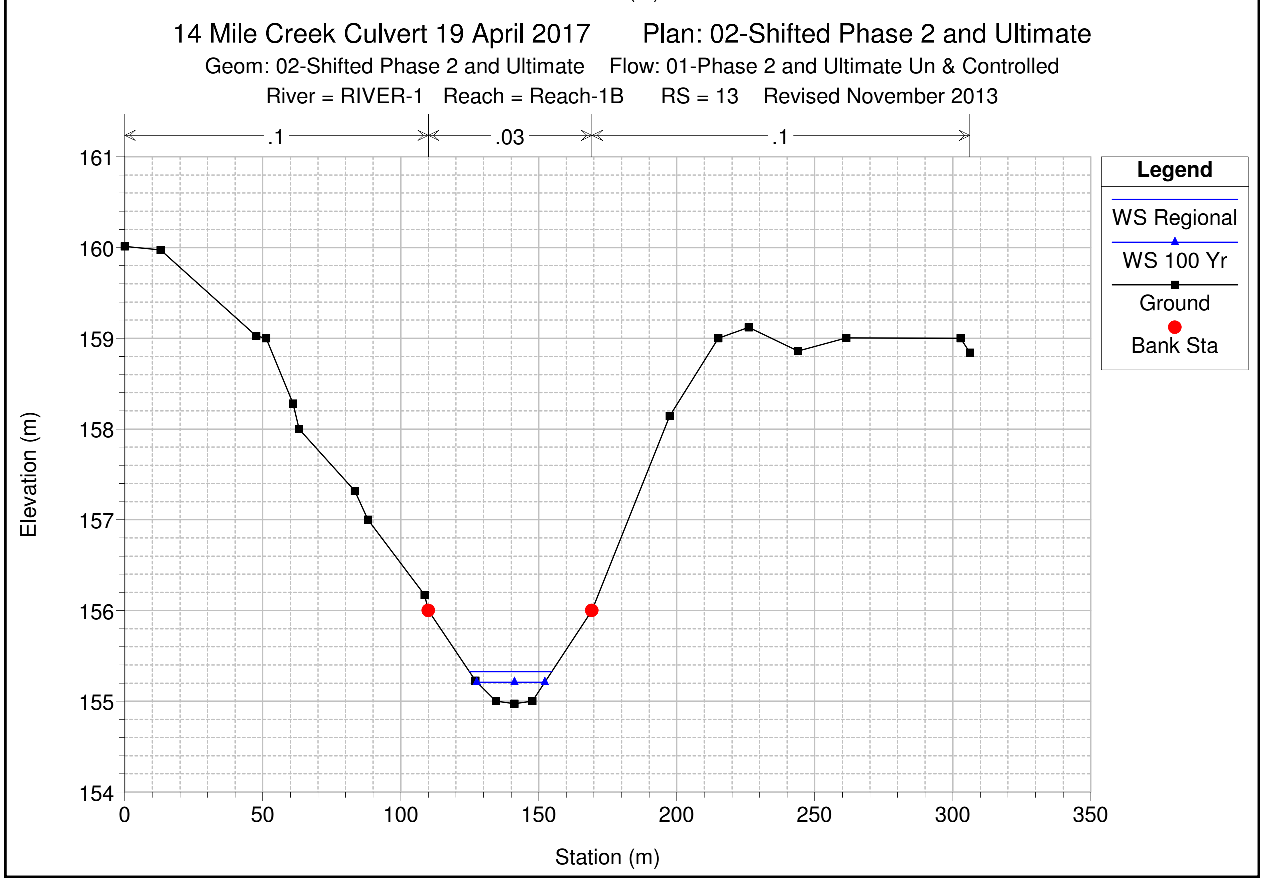

14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 296.5 Culv Proposed Burnhamthorpe Road Extension
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
154
153
152
151
150
149
0
10
20
30
40
50
60
70

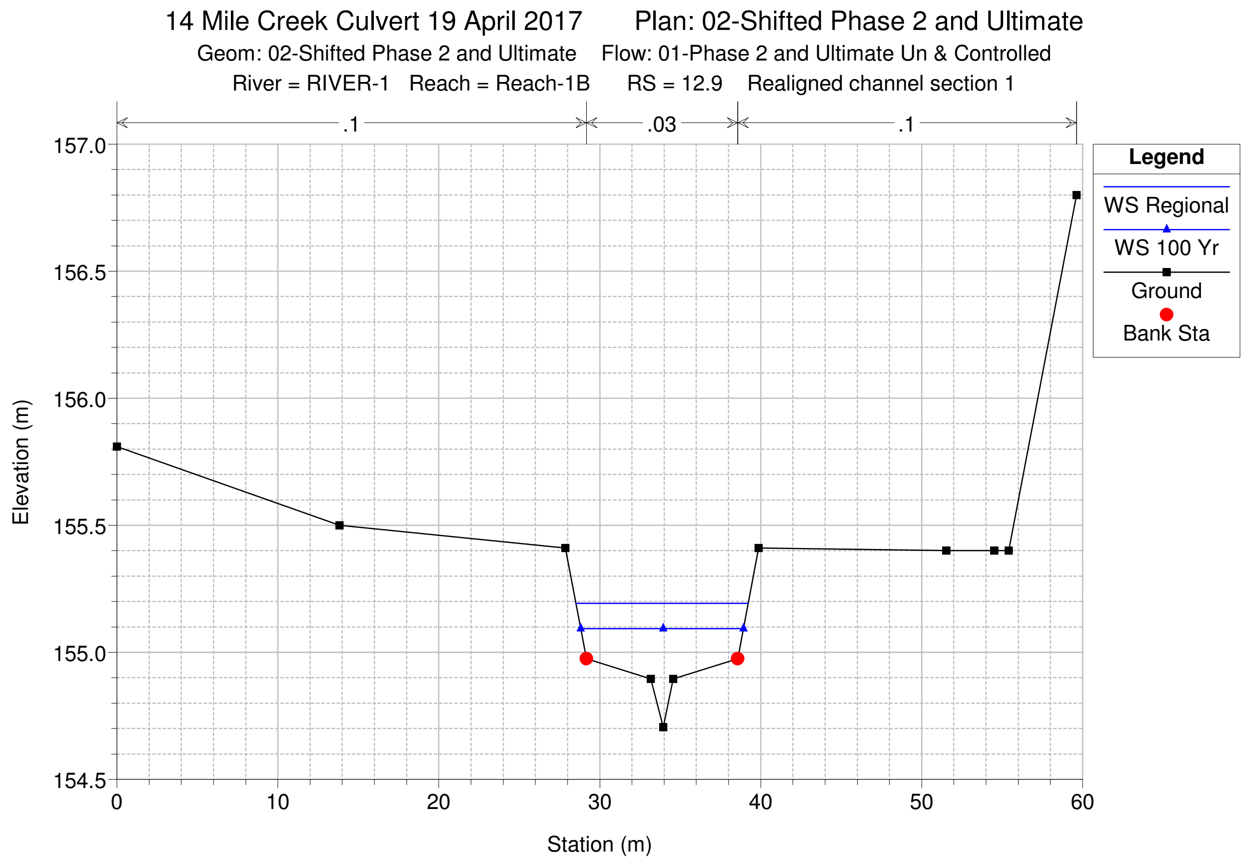


14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 296 Right side XS tie to existing ground
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Ineff
Bank Sta
Elevation (m)
153.0
152.5
152.0
151.5
151.0
150.5
150.0
149.5
149.0
0
10
20
30
40
50
60
70
Station (m)

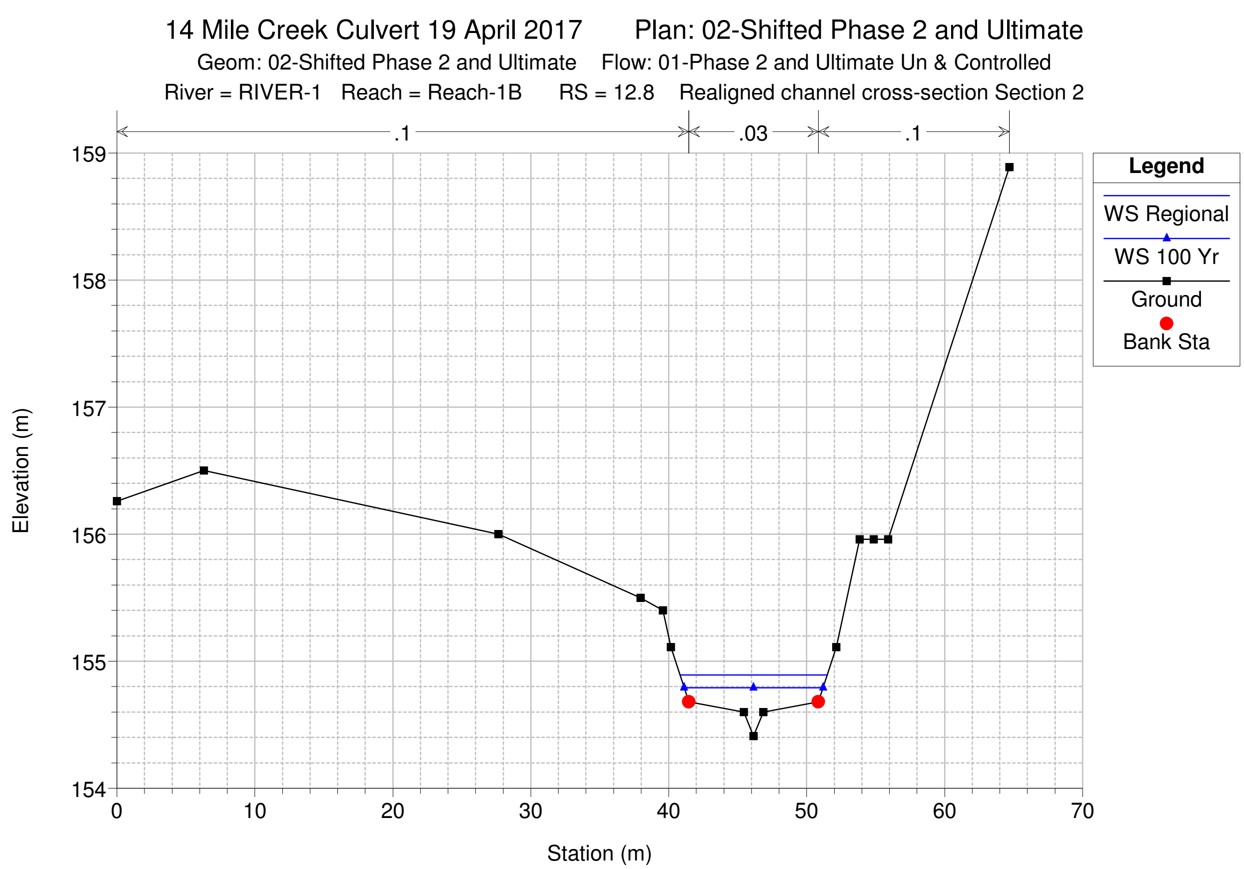

14MileCreekWest Plan: 04U-Shifted Ultimate
Geom: 04-Shifted Ultimate Flow: 04U-Phase Ultimate-Uncontrolled PeakFlow
River = RIVER-2 Reach = Reach-2A RS = 220 20
.1
.03
.1
Legend
WS Regional
WS 100YR
Ground
Bank Sta
Elevation (m)
Station (m)
152.0
151.5
151.0
150.5
150.0
149.5
149.0
148.5
148.0
0
20
40
60
80
100


14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 14 Revised November 2013
.1
.03
.1
Elevation (m)
Station (m)
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
161
160
159
158
157
156
155
0
50
100
150
200
250
300

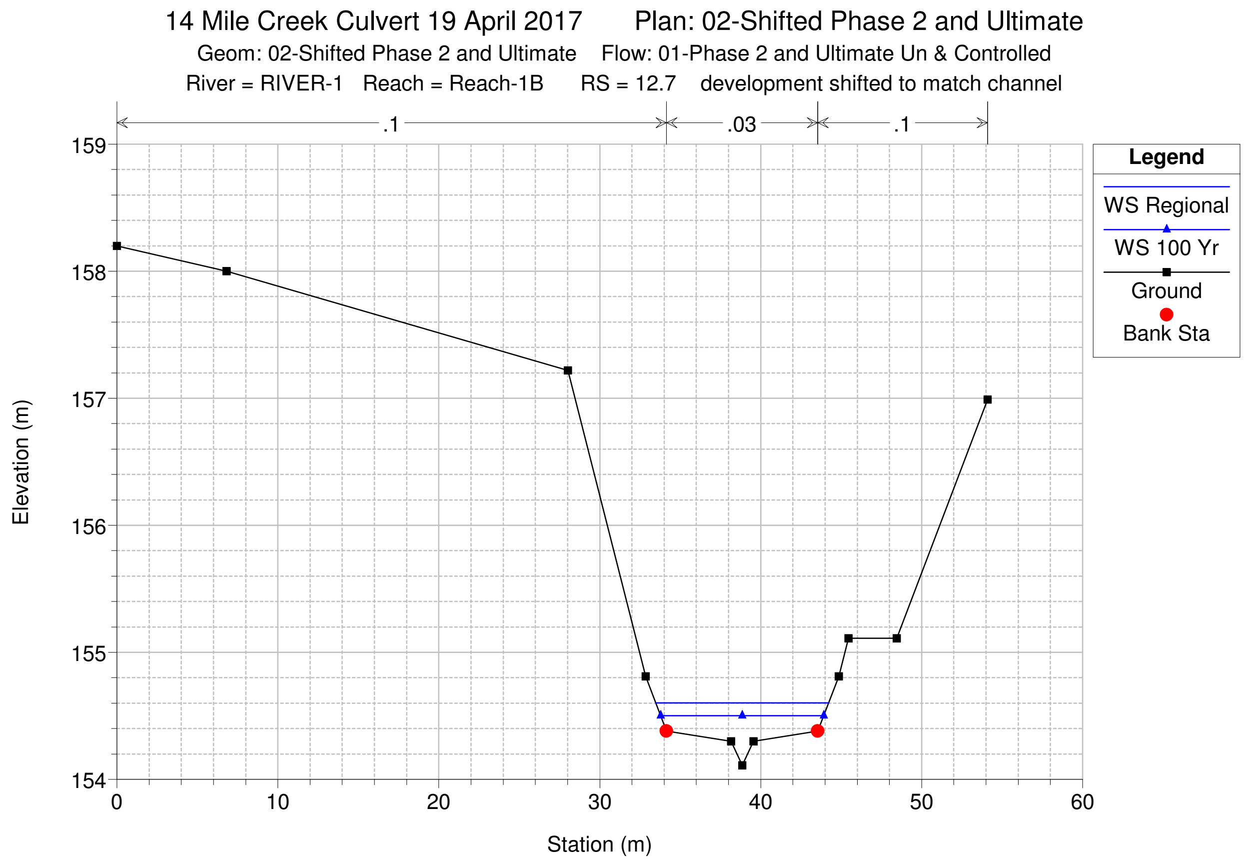

14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 13 Revised November 2013
.1
.03
.1
Elevation (m)
Station (m)
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
161
160
159
158
157
156
155
154
0
50
100
150
200
250
300
350

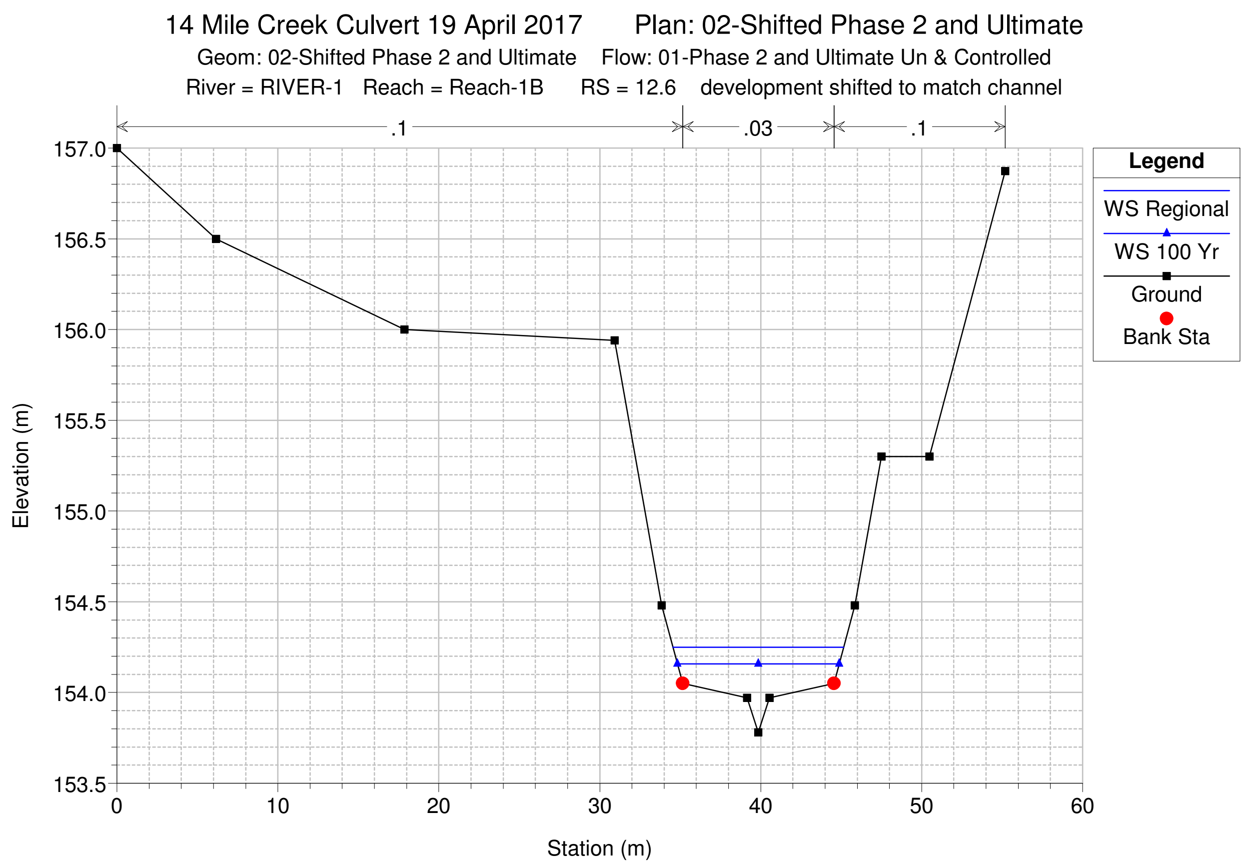


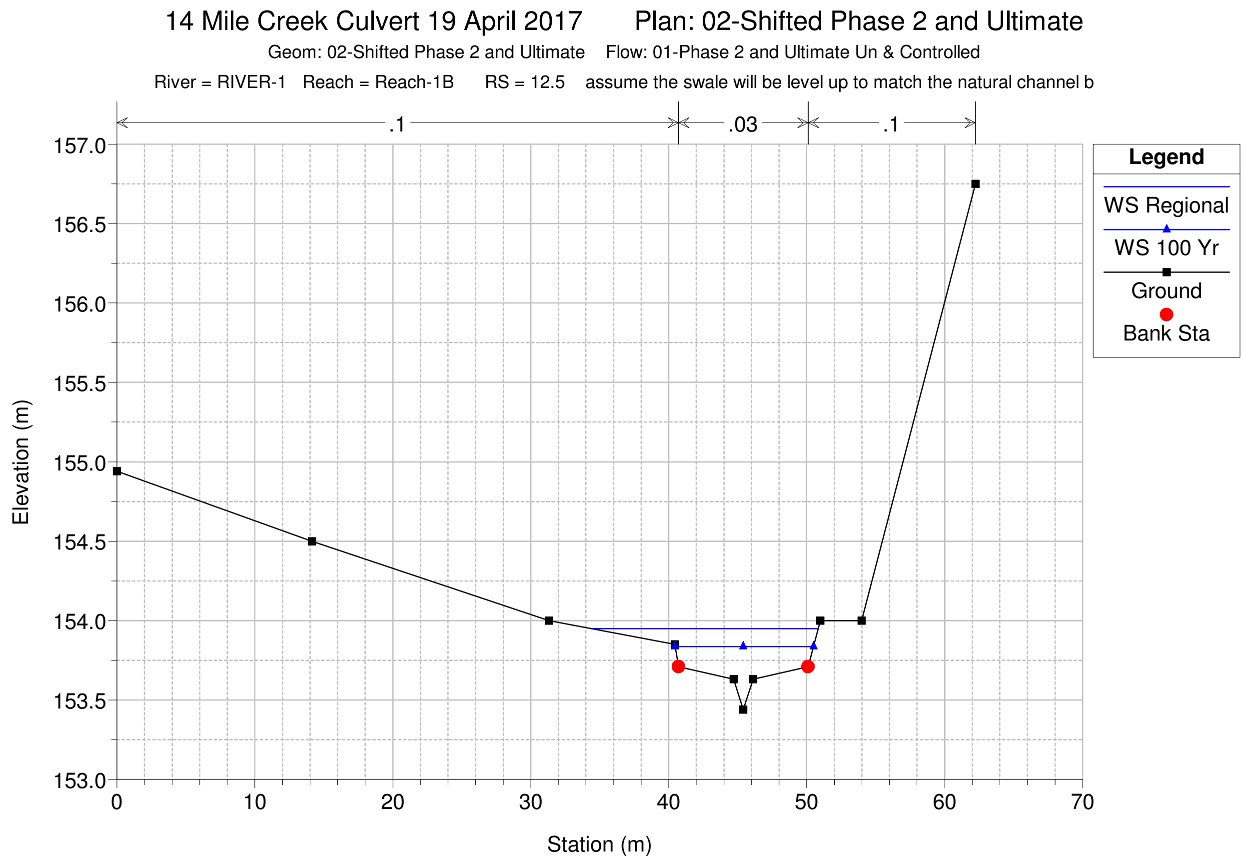
14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 12.9 Realigned channel section 1
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
Elevation (m)
157.0
156.5
156.0
155.5
155.0
154.5
0
10
20
30
40
50
60
Station (m)



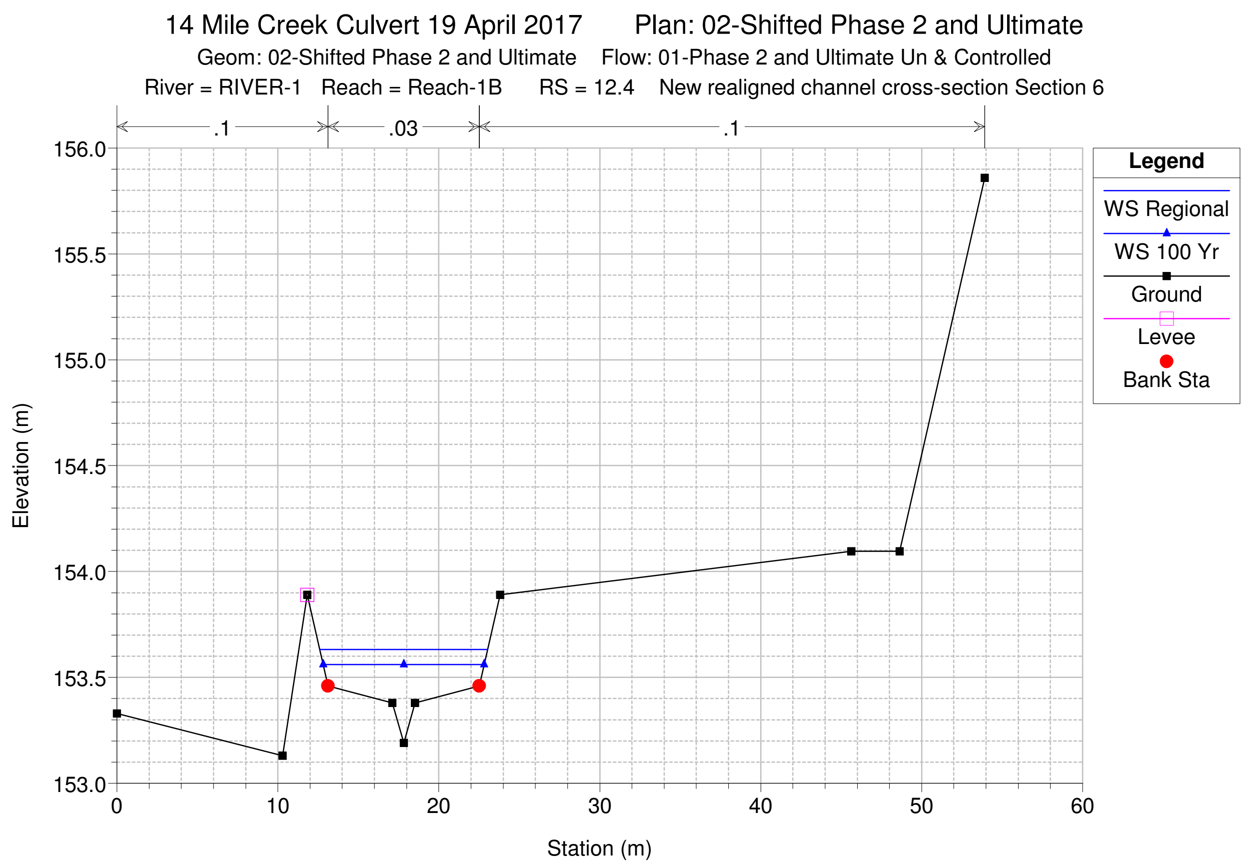
14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 12.8 Realigned channel cross-section Section 2
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
Elevation (m)
159
158
157
156
155
154
0
10
20
30
40
50
60
70
Station (m)


14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 12.7 development shifted to match channel
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
Elevation (m)
Station (m)
159
158
157
156
155
154
0
10
20
30
40
50
60

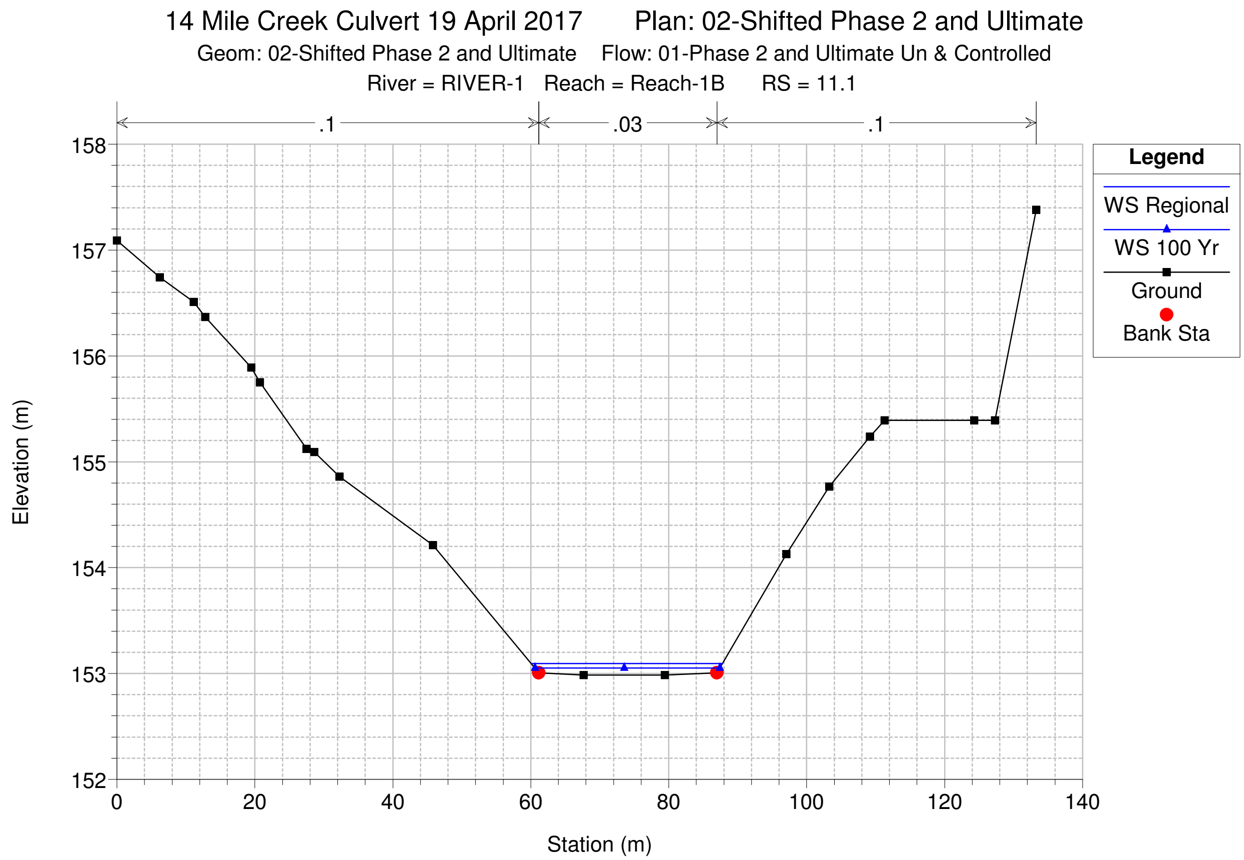

14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 12.6 development shifted to match channel
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
Elevation (m)
Station (m)
157.0
156.5
156.0
155.5
155.0
154.5
154.0
153.5
0
10
20
30
40
50
60

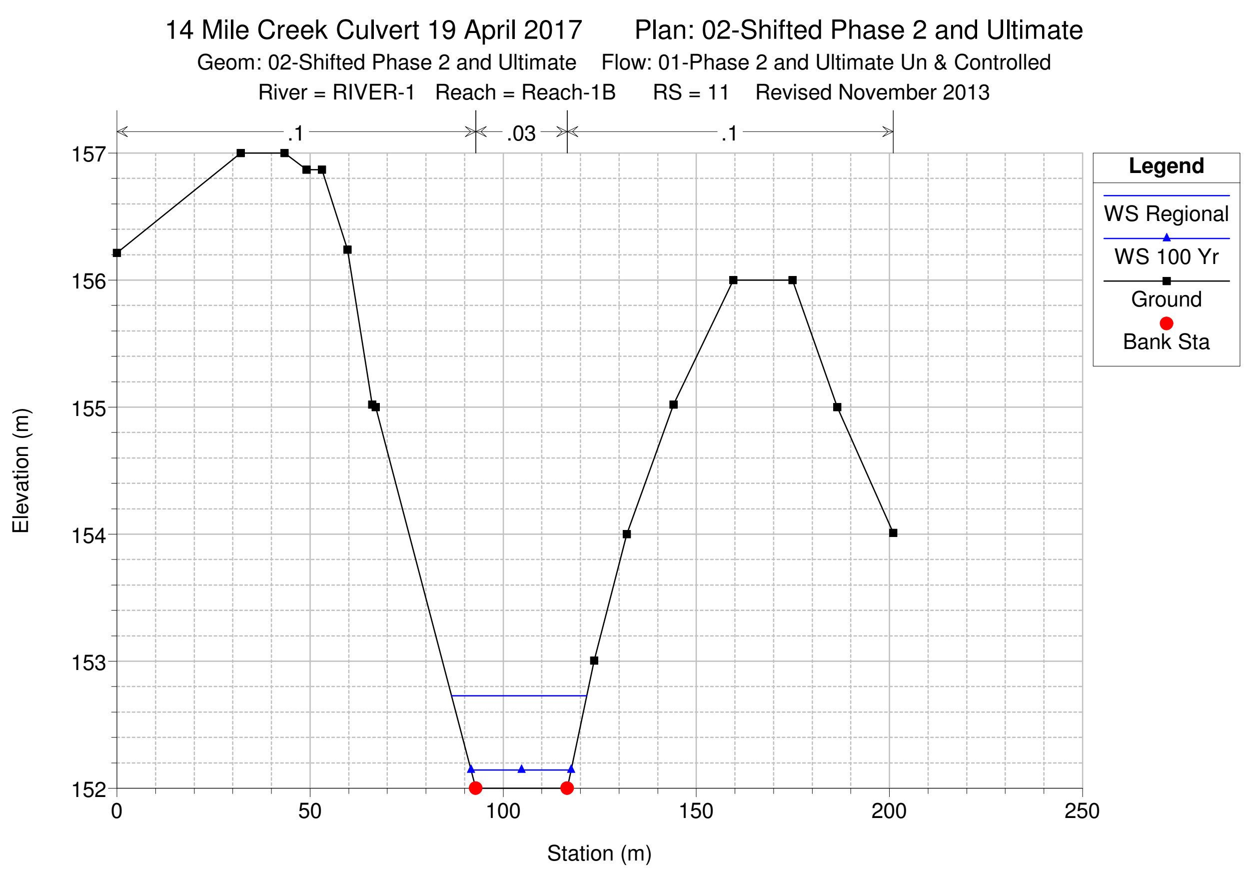


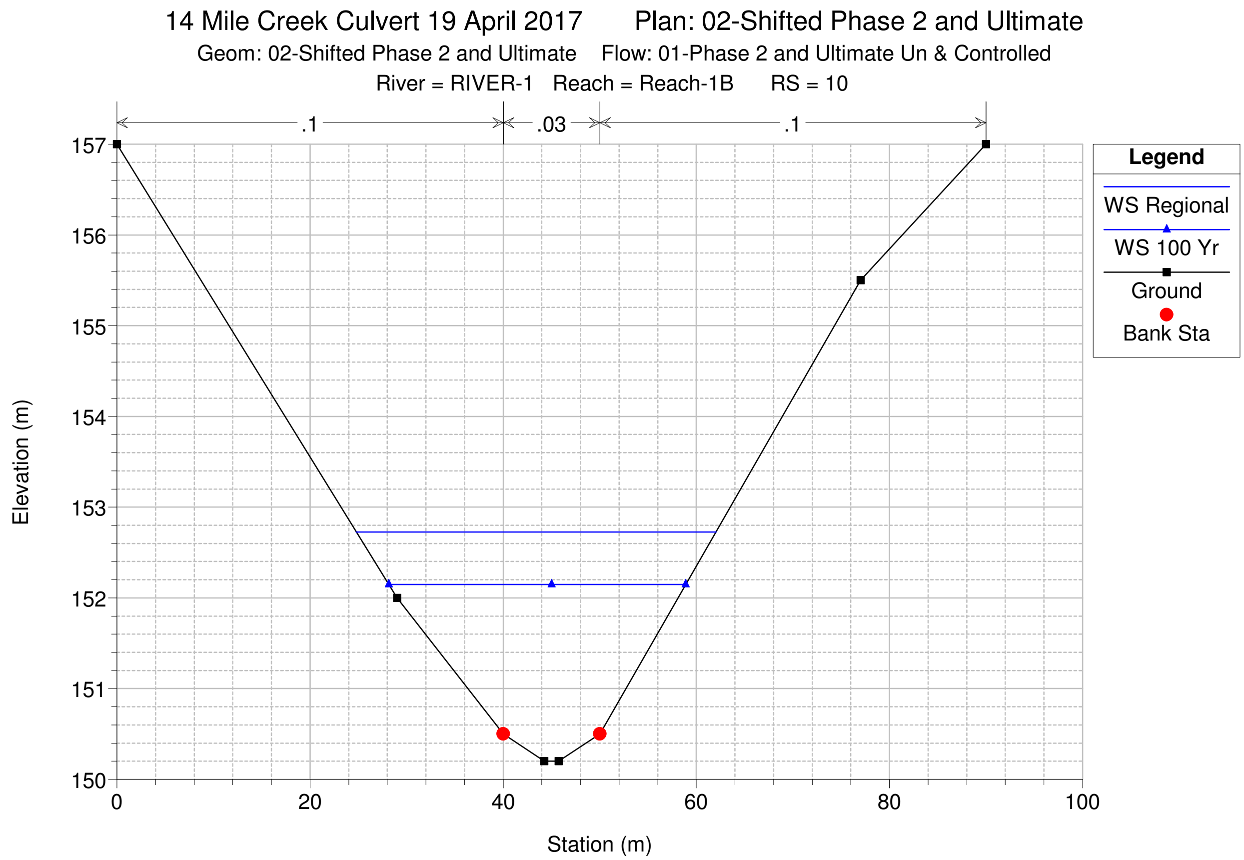
14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 12.5 assume the swale will be level up to match the natural channel b
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
Elevation (m)
Station (m)
157.0
156.5
156.0
155.5
155.0
154.5
154.0
153.5
153.0
0
10
20
30
40
50
60
70

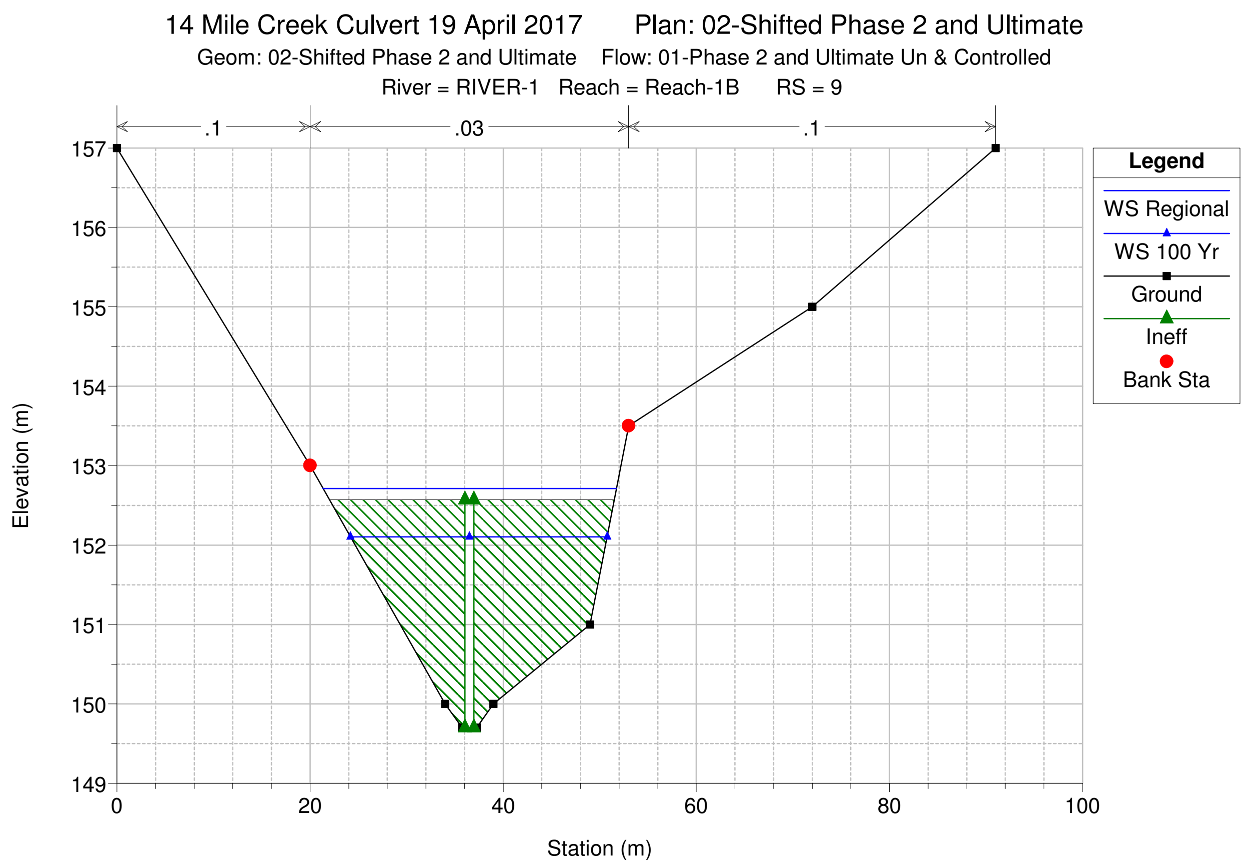


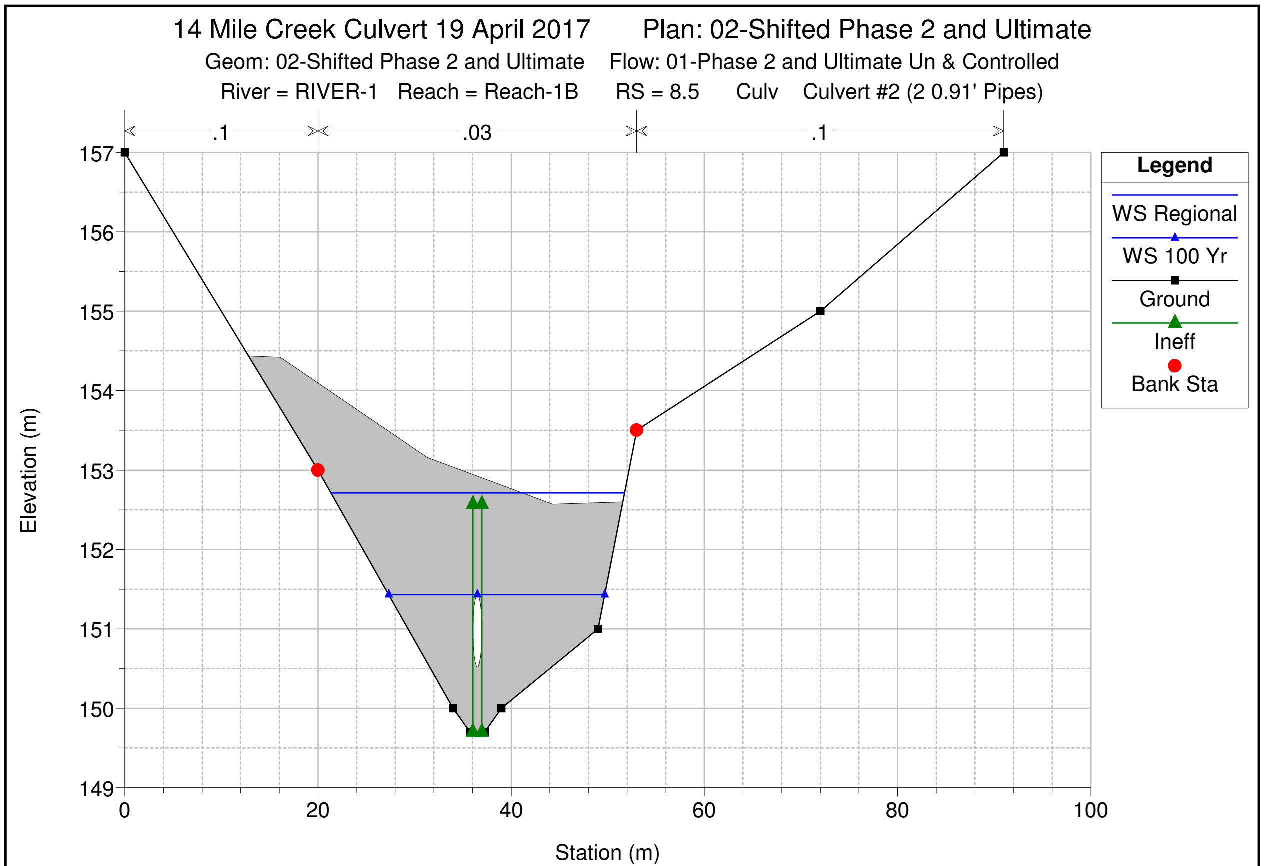
14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 12.4 New realigned channel cross-section Section 6
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Levee
Bank Sta
Elevation (m)
Station (m)
156.0
155.5
155.0
154.5
154.0
153.5
153.0
0
10
20
30
40
50
60

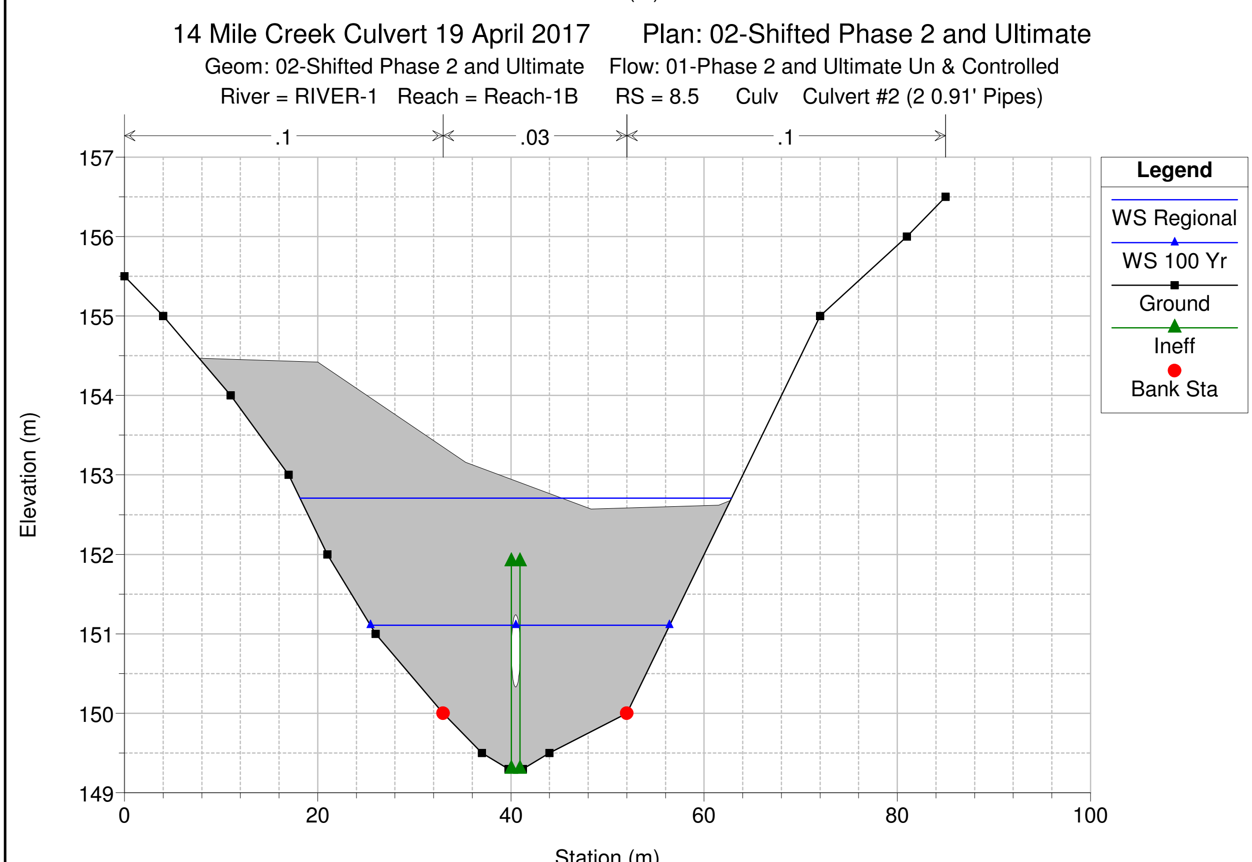

14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 11.1
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
Elevation (m)
Station (m)
158
157
156
155
154
153
152
0
20
40
60
80
100
120
140

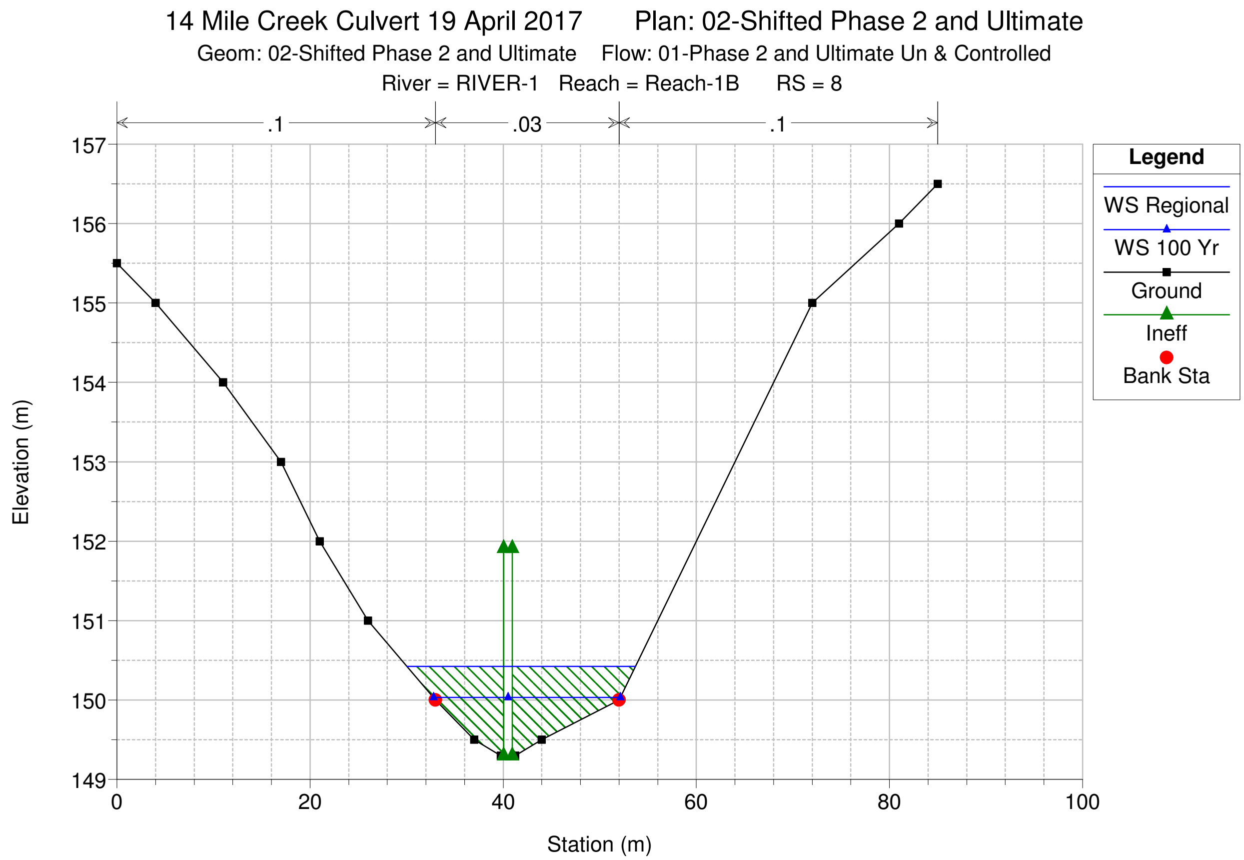

14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 11 Revised November 2013
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta
Elevation (m)
Station (m)
157
156
155
154
153
152
0
50
100
150
200
250


14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 10
.1
.03
.1
Elevation (m)
Station (m)
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta

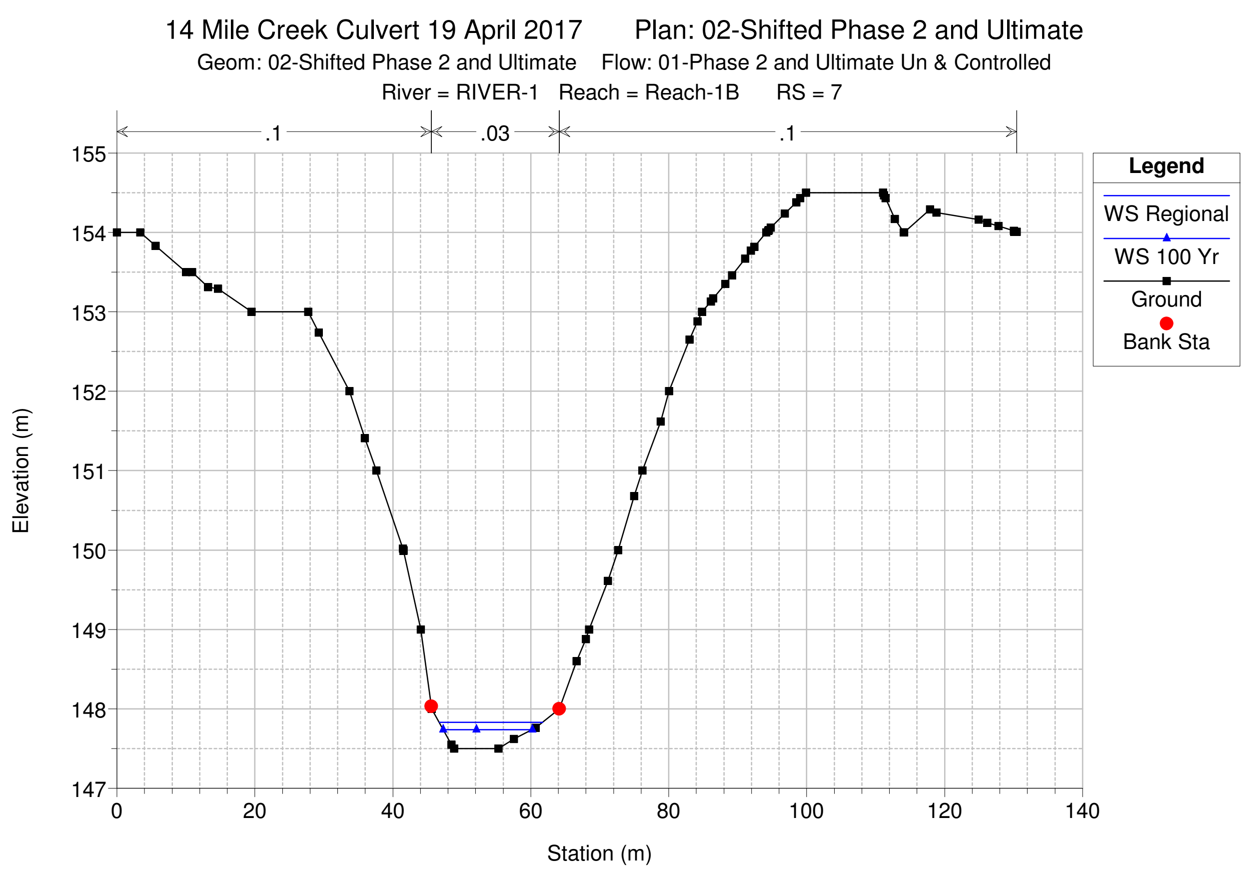

14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 9
.1
.03
.1
Elevation (m)
Station (m)
Legend
WS Regional
WS 100 Yr
Ground
Ineff
Bank Sta


14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 8.5 Culv Culvert #2 (2 0.91' Pipes)
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
157
156
155
154
153
152
151
150
149
0
20
40
60
80
100


14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 8.5 Culv Culvert #2 (2 0.91' Pipes)
.1
.03
.1
Legend
WS Regional
WS 100 Yr
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
157
156
155
154
153
152
151
150
149
0
20
40
60
80
100



14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 8
.1
.03
.1
Elevation (m)
Station (m)
Legend
WS Regional
WS 100 Yr
Ground
Ineff
Bank Sta



14 Mile Creek Culvert 19 April 2017 Plan: 02-Shifted Phase 2 and Ultimate
Geom: 02-Shifted Phase 2 and Ultimate Flow: 01-Phase 2 and Ultimate Un & Controlled
River = RIVER-1 Reach = Reach-1B RS = 7
.1
.03
.1
Elevation (m)
Station (m)
Legend
WS Regional
WS 100 Yr
Ground
Bank Sta

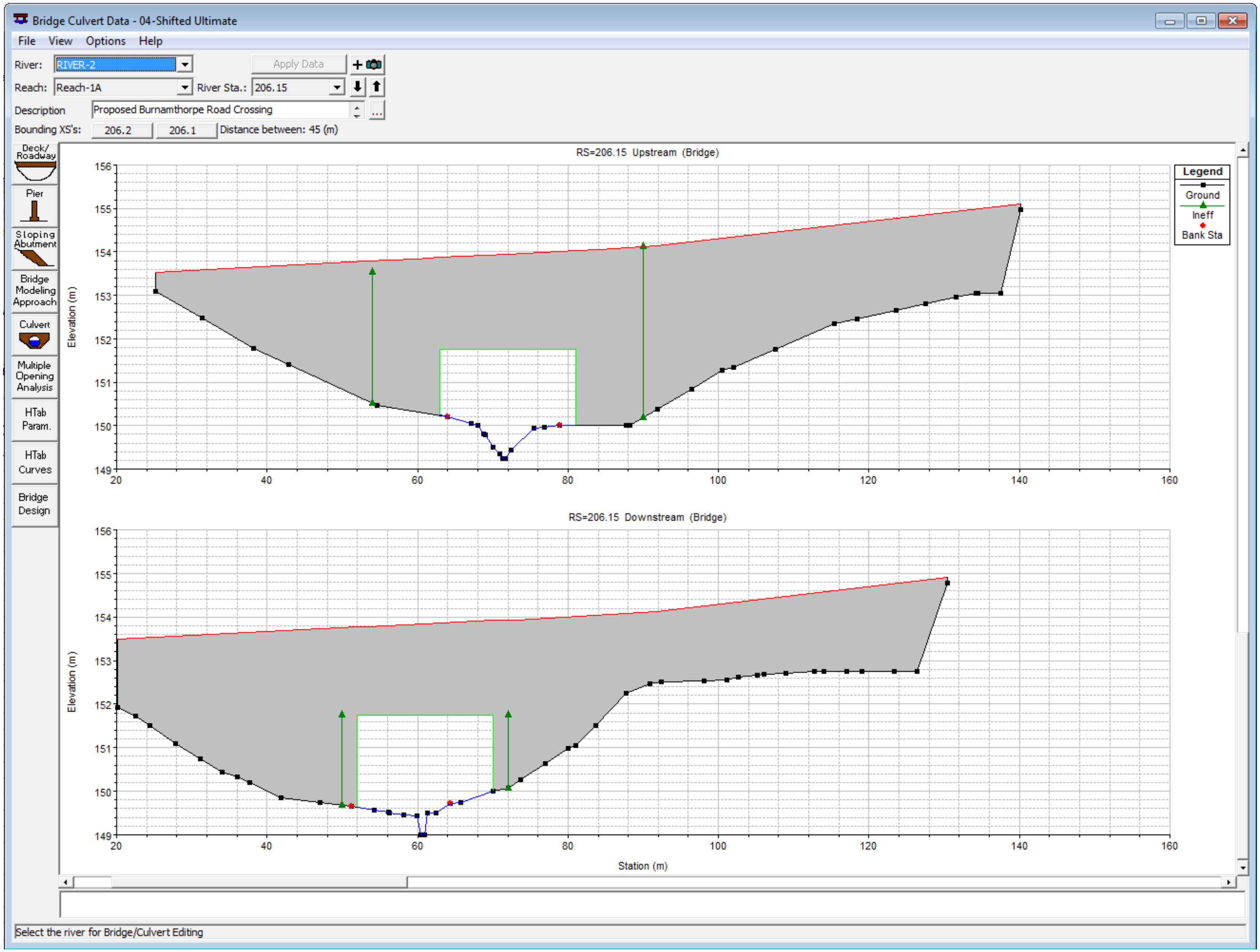
Appendix 6.3 – Proposed Crossings

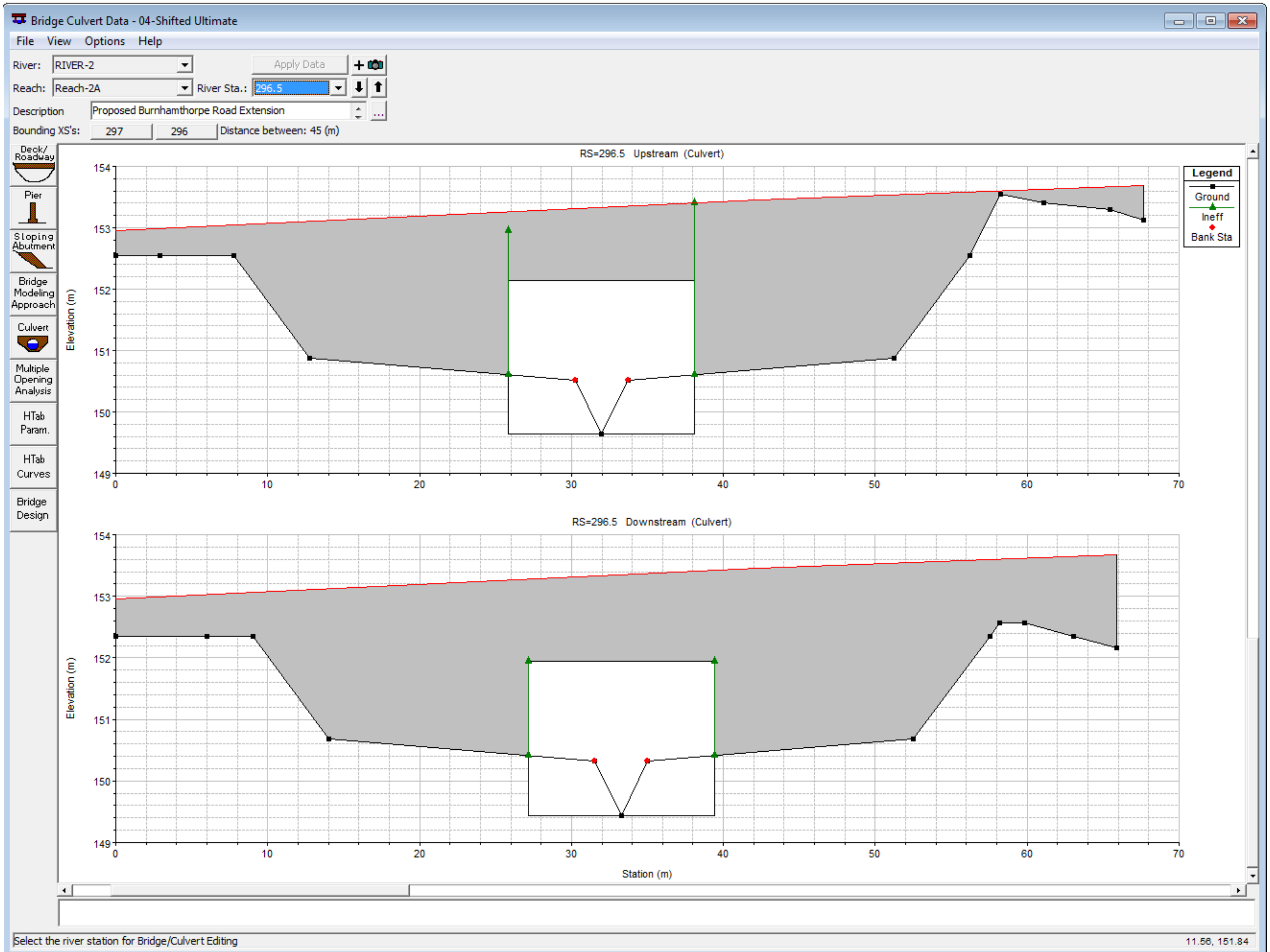
New Burhamthorpe Road Crossings

Crossing ID	River	Reach	EIS/FSSR	Location	Structure	Rise (m)	Span (m)	Length (m)	Upstream and Downstream invert (m)	Upstream and Downstream Obvert (m)
XS 206.15	2	1A	14W-16	Burnhamthorpe Rd Extension	Bridge	2.5	18	28	149.25 / 149.0	151.75 / 151.75
XS 296.5	2	2A	14W-22	Burnhamthorpe Rd Extension	Open Bottom Conc. Box Culvert	2.5	12.25	32	149.64 / 149.44	152.14 / 151.94

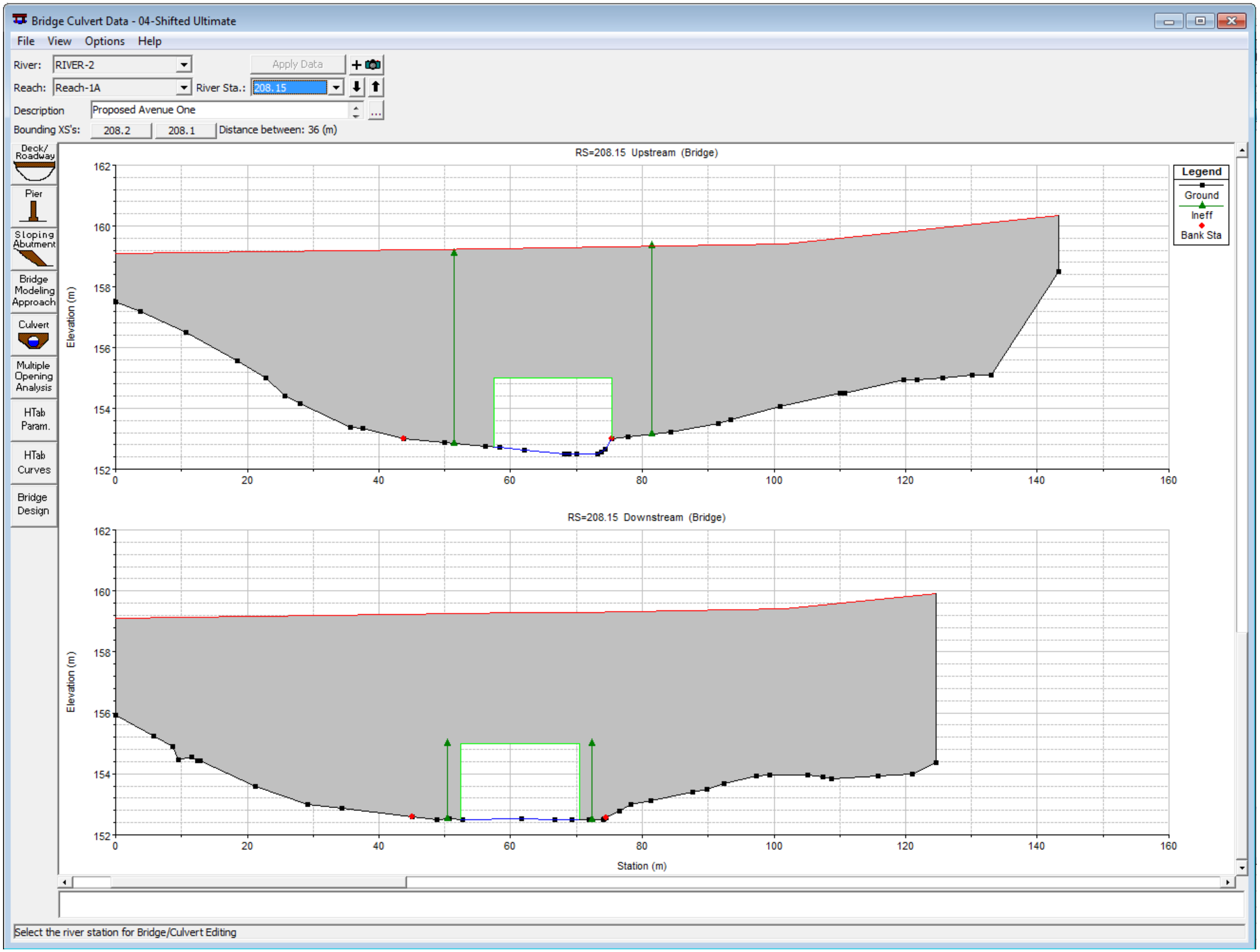
New Avenue One Crossings

Crossing ID	River	Reach	EIS/FSSR	Location	Structure	Rise (m)	Span (m)	Length (m)	Upstream / Downstream invert (m)	Upstream /Downstream Obvert (m)
XS 208.15	2	1A	14W-16	Avenue One	Bridge	2.5	18	22	152.50 / 152.53	155 / 155
XS 302.5	2	2A	14W-22	Avenue One	Open Bottom Conc. Box Culvert	2.5	12.25	22	151.46 / 151.29	153.96 / 153.79

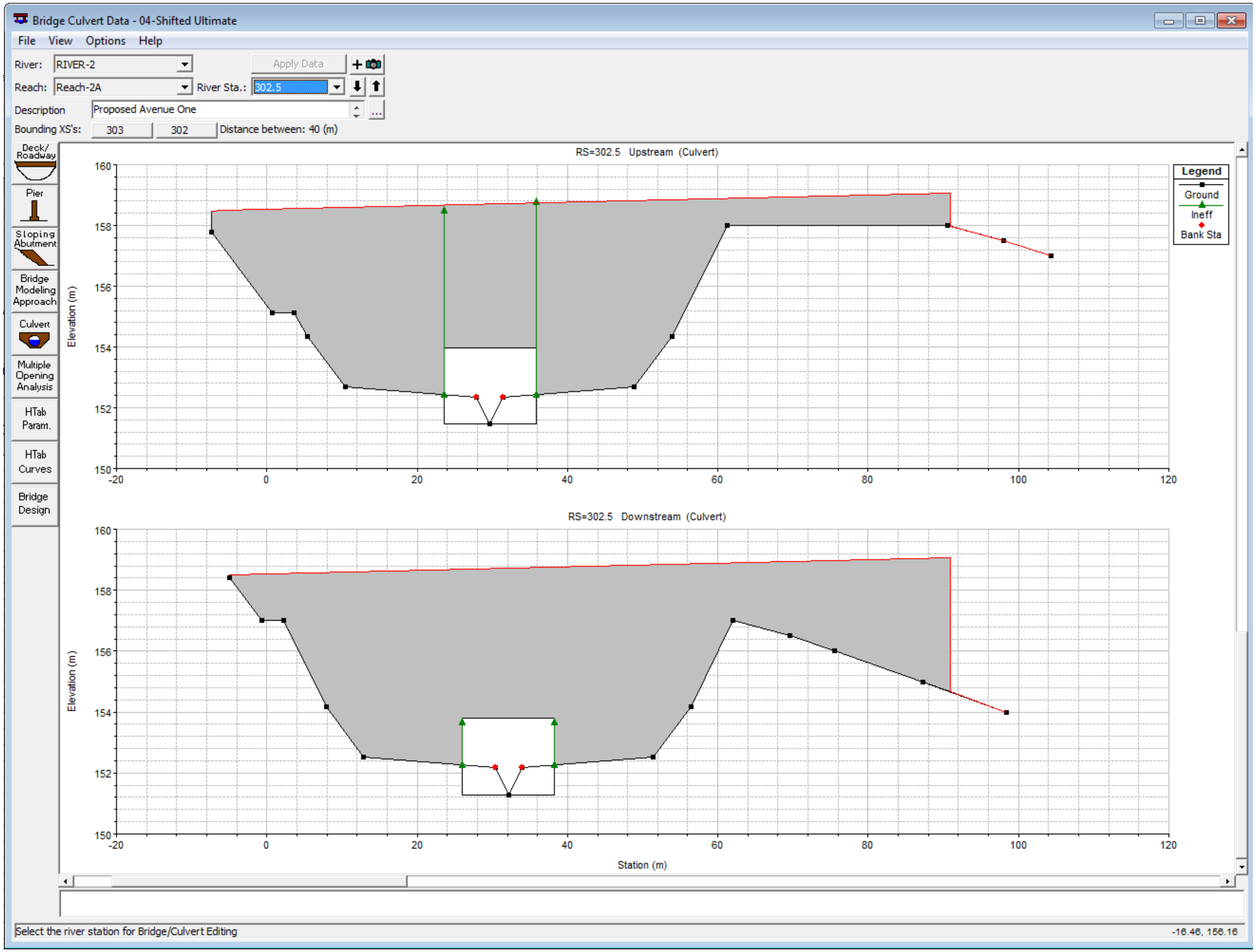

Bridge Culvert Data - 04-Shifted Ultimate
File View Options Help
River: RIVER-2
Apply Data
Reach: Reach-1A
River Sta.: 206.15
Description Proposed Burnamthorpe Road Crossing
Bounding XS's: 206.2 206.1 Distance between: 45 (m)
Deck/Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=206.15 Upstream (Bridge)
Legend
Ground
Ineff
Bank Sta
Elevation (m)
RS=206.15 Downstream (Bridge)
Station (m)
Select the river for Bridge/Culvert Editing



Bridge Culvert Data - 04-Shifted Ultimate
File View Options Help
River: RIVER-2
Apply Data
Reach: Reach-2A
River Sta.: 296.5
Description Proposed Burnhamthorpe Road Extension
Bounding XS's: 297 296 Distance between: 45 (m)
Deck/ Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=296.5 Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (m)
RS=296.5 Downstream (Culvert)
Station (m)
Select the river station for Bridge/Culvert Editing
11.56, 151.84



Bridge Culvert Data - 04-Shifted Ultimate
File View Options Help
River: RIVER-2
Apply Data
Reach: Reach-1A
River Sta.: 208.15
Description
Proposed Avenue One
Bounding XS's: 208.2 208.1 Distance between: 36 (m)
Deck/ Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=208.15 Upstream (Bridge)
Legend
Ground
Ineff
Bank Sta
Elevation (m)
RS=208.15 Downstream (Bridge)
Station (m)
Select the river station for Bridge/Culvert Editing



Bridge Culvert Data - 04-Shifted Ultimate
File View Options Help
River: RIVER-2
Apply Data
Reach: Reach-2A
River Sta.: 302.5
Description Proposed Avenue One
Bounding XS's: 303 302 Distance between: 40 (m)
Deck/ Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=302.5 Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (m)
RS=302.5 Downstream (Culvert)
Station (m)
Select the river station for Bridge/Culvert Editing
-16.46, 156.16

Appendix 6.4 – Corridor Width Delineation

Technical Memorandum – Meander Belt Width Estimation

Meander Belt Width Estimation

All watercourses within the study limit have been significantly altered, presumably to accomadate agricultural practices. Therefore, meander belt widths of the existing streams cannot be determined from the historical movement and they were estimated using the following two empirical methods:

- PARISH Geomorphic Ltd., 2004
- Annable, 1996

The following sections discuss the two methods and the parameters used in each method.

PARISH Geomorphic Method

This procedure uses the following empirical relation that predicts meander belt width from drainage area and stream power of the watercourse:

$$Wb = -14.827 + 8.319\ (\ln SP \times DA) + 2 \times S \qquad \text{Eq.1}$$

$$SP = \Upsilon Qs \qquad \text{Eq.2}$$

Where
SP = stream power (Wm^{-2})
ϒ = specific weight of water (9806 $kg/m^2/s^2$)
Q = 2 year flow (m^3s^{-1})
s = channel gradient (m/m)
Wb = meander belt width (m)
DA = drainage area (km^2)
R^2 = correlation coefficient of regression = 0.73
S = standard error of equation = 8.63

The standard error term (2 x S) in Eq.1 represents a factor of safety to allow for potential under prediction of the actual meander belt width while also allowing for natural migration tendencies and hydrologic regime changes.

The 2 year flow rates for reaches in the study area were estimated based on unit flow rates recommended by the NOCSS and reach drainage areas. The channel gradient for each reach was calculated using the topographic mapping for the study area.

Annable Method

Annable has developed geomorphologic relationships of rural watercourses in Southern Ontario using 47 river data consisting of stream types B, C, E and F. The type of watercourses in the study area could not be identified since it has been significantly altered to accommodate the agricultural practices. Therefore, the following empirical equation for meander belt width developed based on data from all stream types was used:

$$\Gamma = 35.2\, Q^{0.53} \qquad \text{Eq.3}$$

Where Q = bankfull discharge (m^3/s)

The bankfull discharge is estimated as 1.5 year flow based on unit flow rates recommended by the NOCSS and reach drainage areas

Results

The estimated meander belt width for the reaches in the study area is presented in Table 1 which shows reasonable agreement between the two methods.

Table 1 Estimated Meander Belt Widths

Reach	Scenario	Drainage Area (km2)	2 – Year Peak Flow (m3/s)[c]	Bankfull Discharge (m3/s)[b]	Channel Gradient (m/m)	Meander Belt Width (m)		Selected Meander Belt Width (m)
						PARISH Geomorphic	Annable	
14W-12	Existing	3.88	2.33	2.05	0.008	57.0	51.5	**57**
	Post-Development	3.95	2.37	2.09	0.008	57.3	52	
14W-16	Existing	2.22	1.44	1.27	0.0053	45.0	40.0	**45**
	Post-Development	2.22	1.44	1.27	0.0053	45.0	40.0	
14W-14	Existing	1.39	0.82	0.73	0.0028	31.1	29.8	**31**
	Post-Development (14W-22)	1.29	0.71	0.64	0.0041	31.6	27.8	
14W-13	Existing	0.073	0.010	0.003	0.0032	_[a]	1.6	**2**
	Post-Development (14W-21)	0.073	0.010	0.003	0.0032	_[a]	1.6	
14W-12A	Existing	1.7	0.98	0.84	0.006	29	32	32
	Post-Development (14W-12A)	1.71	_	_	0.006	_	_	
14W-11A	Existing	0.45	0.180	0.210	0.006	15.4	15.5	**16**
	Post-Development	0.39	0.150	0.210	0.0053	12.0	15.5	

[a] PARISH empirical relation is not applicable for reaches satisfying the following criteria: 2-Year Discharge (m^3/s) x Channel Slope (m/m) x Drainage Area (km^2) < 6 x 10^{-4}

[b] Bankfull discharges have been determined from Annable's empirical relationships.

[c] The 2-year peak flow rates have been determined by combining the peak flow rates from GAWSER simulations for areas north of Highway 407 and the peak flow rates determined from unit flow rates for areas south of Highway 407. Thereafter the results were cross-checked following the proposed condition hydrologic modelling.

		From Table 1 Appendix 6.7 Submission 3, post dev values; also WE report									WE		
		Refence Node	Area (ha)	Area (km2)	2yr flow	Channel Slope	WE slope	Parish Check (1 is valid)	Parish Method	WE Report Node	Bankful flow (1.5 yr)	Annable Method	Selected Meander Belt Width
Interim P1A	14W-11	5	57.7	0.577	0.59			0	-	-	0.520	24.89	25
	14W-11A	9	49.75	0.4975	0.42	0.0053		1	22.27	-	0.368	20.73	23
	14W-12	3	411.7	4.1169	2.8	0.008	0.0196	1	59.06	XSC2	2.545	57.75	60
	14W-12A	2	174.1	1.741	1.00	0.006	0.0196	1	40.94	XSC2	0.902	33.32	41
	14W-13	2C	166.9	1.6693	0.95	0.0032	0.0071	1	34.94	XSE1	0.855	32.40	35
	14W-14	2C	166.9	1.6693	0.95	0.0041	0.0071	1	37.00	XSE1	0.855	32.40	37
	14W-16	1	203.74	2.0374	1.36	0.0053	0.0071	1	43.78	XSD1	1.235	39.37	44
Interim P1B	14W-11	5	57.7	0.577	0.59			0	-	-	0.520	24.89	25
	14W-11A	9	49.8	0.4975	0.42	0.0053		1	22.27	-	0.368	20.73	23
	14W-12	3	411.4	4.1139	2.78	0.008	0.0196	1	59.00	XSC2	2.532	57.59	59
	14W-12A	2	10.8	0.1081	0.3	0.006	0.0196	0	-	XSC2	0.275	17.76	18
	14W-16	1	200.8	2.008	1.33	0.0053	0.0071	1	43.47	XSD1	1.205	38.86	44
	14W-21	8	11.6	0.116	0.040	0.0071	0.0071	0	-	XSD1	0.033	5.80	6
	14W-22	2B	142.0	1.4199	0.79	0.0071	0.0071	1	38.69	XSD1	0.710	29.36	39
Interim P2	14W-11	5	53.3	0.5329	0.5			0	-	-	0.440	22.78	23
	14W-12	3	418.2	4.1816	3.52	0.008	0.0196	1	61.10	XSC2	3.230	65.53	66
	14W-12A	2	5.7	0.0569	0.18	0.006	0.0196	0	-	XSC2	0.168	13.69	14
	14W-16	1	200.4	2.0041	1.33	0.0053	0.0071	1	43.45	XSD1	1.205	38.86	44
	14W-21	8	11.6	0.116	0.04	0.0071	0.0071	0	-	XSD1	0.033	5.80	6
	14W-22	2B	141.9	1.4185	0.79	0.0071	0.0071	1	38.68	XSD1	0.710	29.36	39
	14W-23	9	45.7	0.4572	0.34			0	-	-	0.297	18.49	19
Ultimate	14W-11	5	53.3	0.5329	0.5			0	-	-	0.440	22.78	23
	14W-12	3	411.5	4.1149	3.98	0.008	0.0196	1	61.98	XSC2	3.663	70.05	71
	14W-12A	2	5.7	0.0569	0.18	0.006	0.0196	0	-	XSC2	0.168	13.69	14
	14W-16	1	198.0	1.9797	1.83	0.0053	0.0071	1	46.01	XSD1	1.673	46.24	47
	14W-21	8	11.6	0.116	0.04	0.0071	0.0071	0	-	XSD1	0.033	5.80	6
	14W-22	2B	138.5	1.3846	0.77	0.0071	0.0071	1	38.26	XSD1	0.693	28.99	39
	14W-23	9	45.72	0.4572	0.34			0	-	-	0.297	18.49	19

Development Phasing	Reach	Refence Node	Corridor Width (m, Interim EIR FSS)	Area (ha)	2yr flow	Parish Method	Annable Method	Selected Meander Belt Width	Factor of Safety	Top of Bank Width	Hazard Allowance	Redside Dace/ widened corridor	Meander Belt with NOCSS Setbacks	Total Corridor Width
Interim P1A	14W-11	5		57.7	0.59	-	24.9	25	3	31	15	0	61	61
	14W-11A	9		49.8	0.42	22.3	20.7	23	3	29	15	0	59	59
	14W-12	3		411.7	2.8	59.1	57.8	60	6	72	15	132	102	132
	14W-12A	2		174.1	1	40.9	33.3	41	4.1	49.2	15	109.2	79.2	109.2
	14W-13	2C		166.9	0.95	34.9	32.4	35	3.5	42	7.5	0	57	57
	14W-14	2C		166.9	0.95	37.0	32.4	37	3.7	44.4	15	0	74.4	74.4
	14W-16	1		203.7	1.36	43.8	39.4	44	4.4	52.8	15	112.8	82.8	112.8
Interim P1B	14W-11	5		57.7	0.59	-	24.9	25	3	31	15	0	61	61
	14W-11A	9		49.8	0.42	22.3	20.7	23	3	29	15	0	59	59
	14W-12	3		411.4	2.78	59.0	57.6	59	5.9	70.8	15	130.8	100.8	130.8
	14W-12A	2		10.8	0.3	-	17.8	18	3	24	15	84	54	84
	14W-16	1		200.8	1.33	43.5	38.9	44	4.4	52.8	15	112.8	82.8	112.8
	14W-21	8		11.6	0.04	-	5.8	6	3	12	7.5	0	27	27
	14W-22	2B		142.0	0.79	38.7	29.4	39	3.9	46.8	15	0	76.8	76.8
Interim P2	14W-11	5		53.3	0.5	-	22.8	23	3	29	15	0	59	59
	14W-12	3		418.2	3.52	61.1	65.5	66	6.6	79.2	15	139.2	109.2	139.2
	14W-12A	2		5.7	0.18	-	13.7	14	3	20	15	80	50	80
	14W-16	1		200.4	1.33	43.5	38.9	44	4.4	52.8	15	112.8	82.8	112.8
	14W-21	8		11.6	0.04	-	5.8	6	3	12	7.5	0	27	27
	14W-22	2B		141.9	0.79	38.7	29.4	39	3.9	46.8	15	0	76.8	76.8
	14W-23	9		45.7	0.34	-	18.5	19	3	25	15	0	55	55
Ultimate	14W-11	5		53.3	0.5	-	22.8	23	3	29	15	0	59	59
	14W-12	3		411.5	3.98	62.0	70.0	71	7.1	85.2	15	145.2	115.2	145.2
	14W-12A	2		5.7	0.18	-	13.7	14	3	20	15	80	50	80
	14W-16	1		198.0	1.83	46.0	46.2	47	4.7	56.4	15	116.4	86.4	116.4
	14W-21	8		11.6	0.04	-	5.8	6	3	12	7.5	0	27	27
	14W-22	2B		138.5	0.77	38.3	29.0	39	3.9	46.8	15	0	76.8	76.8
	14W-23	9		45.7	0.34	-	18.5	19	3	25	15	0	55	55

Appendix 6.5 – EXP Report

The new identity of **Trow Associates**

January 3, 2013

Project: BRM-00603264-A0

Mr. Asif Quader, Ph.D., P.Eng.
McCormick Rankin
2655 North Sheridan Way, Suite 300
Mississauga, Ontario
L5K 2P8

via email: AQuader@mrc.ca

Slope Stability
14 Mile Creek
Oakville, Ontario

Dear Sirs

A slope stability analyses was undertaken for a portion of the 14 Mile Creek tributary located at the north end of Zenon Drive in Oakville, Ontario. The site location is shown on Drawing 1.

The purpose of the slope stability analysis was to determine the Top of Bank for the above site. This project was authorized by Mr. Asif Quader, Ph.D., P.Eng. of McCormick Rankin.

The Top of Bank includes the following allowances:

1. Stable slope allowance
2. Erosion allowance if the creek is within 15 m of the base of the slope

Once the Top of Bank (TOB) is established additional set backs will be required from the TOB by the Halton Conservation Authority. This includes a 6 m set back for Erosion access allowance.

Slope Conditions

The slope at this site is about 6 m high. The elevation of the top of the slope is about 158 m and the elevation of the base is at about 152 m. These elevations were obtained from the site survey supplied by the client and part of this survey is included as Drawing 1.

The top 2 m of the slope are at about 18 degrees to the horizontal and the bottom 4 m are at about 30 degrees to the horizontal.

The slope is covered by mature trees. There are no signs of failures or water seepage from the slope. There is no evidence of creek erosion at the base of the slope. The bankfull width of the creek is approximately 15 m.

Procedure

The fieldwork was carried out on December 10, 2012. At that time two boreholes were advanced to a depth of about 9 m by a drilling subcontractor using solid stem continuous flight augers. The fieldwork was supervised by a geotechnical engineer from exp Services Inc. (**exp**)

Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 750 mm. All samples were logged in the field and then returned to the **exp** laboratory for testing and detailed examination by the project engineer.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Piezometers were installed in the boreholes for long term water level observations.

The borehole locations were laid out by **exp** personnel. The ground surface elevations were referenced to an existing well on the site. The geodetic elevation was supplied by the client.

As well as visual examination in the laboratory, all of the soil samples were tested for natural moisture content and natural unit weight where possible. Two samples were subjected to grain size analyses and tested for Atterberg Limits. The grains size curves for the silt till and Atterberg Limits test results are appended to this report.

Subsurface Conditions

The borehole locations are shown on Drawing 1 and detailed subsurface conditions are presented on the borehole logs, Drawings 2 and 3. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Notes on Sample Description" preceding the borehole logs form an integral part of and should be read in conjunction with this report.

The boreholes encountered about 0.6 m of weathered till consisting of clayey silt with rootlets. This layer was found to be in a loose condition.

Below about 0.6 m, the boreholes encountered sandy silt till. The till contains some clay and a trace to some gravel. It is brown and hard with undrained shear strengths in excess of 225 kPa. The plasticity index of the till ranges from 11 to 14 percent indicating a low plasticity till.

In Borehole 1, very dense red brown shale of the Queenston Formation was found at about 9 m or Elevation 146.0 m.

Groundwater seepage was not observed during drilling and both boreholes were dry and open to almost their complete depths at the completion of drilling. After nine days the water levels in Boreholes 1 and 2 were at 6.9 and 4.3 m respectively. The water levels in the boreholes were below the creek level.

Stability Analysis

The slope stability analysis was undertaken using the PC Slope/W program. This program uses the Bishop's Method for the stability analysis. Effective stress analysis, which is indicative of long term stability, was undertaken.

The steepest section of the slope was used for the analysis and this section is identified as Line A-A on Drawing 1.

The average stratigraphy of the site and the soil properties assumed for the analysis are given on Table 1. The groundwater was assumed to be at the same level of the creek. This is considered to be a conservative assumption.

Table 1: Soil Properties used in Effective Stress Analysis

Material	Unit Weight (kN/m^3)	Shear Strength (kPa)	Phi (degrees)
Silt Till	22.0	5	28
Alluvium	20.0	5	25
Shale	Failure prevented through the shale		

Using the above soil parameters the existing slope was found to have a factor of safety of 1.6 for effective stress analysis The stability analysis is shown on Drawing S1.

Top of Bank

Based on the results of the stability analysis, the existing slope has a factor of safety in excess of 1.5. Therefore the physical top of slope can be assumed to be the location of the stable slope line. The Halton Region Conservation Authority should be contacted to establish the physical top of slope in the field.

As previously mentioned an allowance for erosion by the creek is required for the slope. The erosion allowance is based on the guidelines in the Ontario Ministry of Natural Resources publication: Technical Guide, River & Stream Systems: Erosion Hazard Limit, Table 3. Using this table, the Toe Erosion Allowance is 2 m based on a bank full width of 5 to 30 m and stiff to hard cohesive soil.

Closure

When design and specifications based on the results reported herein are required, **exp** should be retained for a general review to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, **exp** will assume no responsibility for interpretation of the recommendations in the report.

This report has been prepared for and is intended for the exclusive use of McCormick Rankin and its clients and engineers. Any use which a third party makes of this report, or any part thereof, of any reliance on or decision to be made based on it, are the responsibility of such third parties. **Exp** accepts no responsibility for damages, if any, suffered by any third party as a result of decision made or actions based on this report. The contents of this report should not be relied upon by any other party without the express written consent of **exp**. The findings are relevant for the dates of our site visits and should not be relied upon to represent conditions at later dates.

We trust that this report is satisfactory for your purposes. Should you have any questions about this submission, please do not hesitate to contact this office.

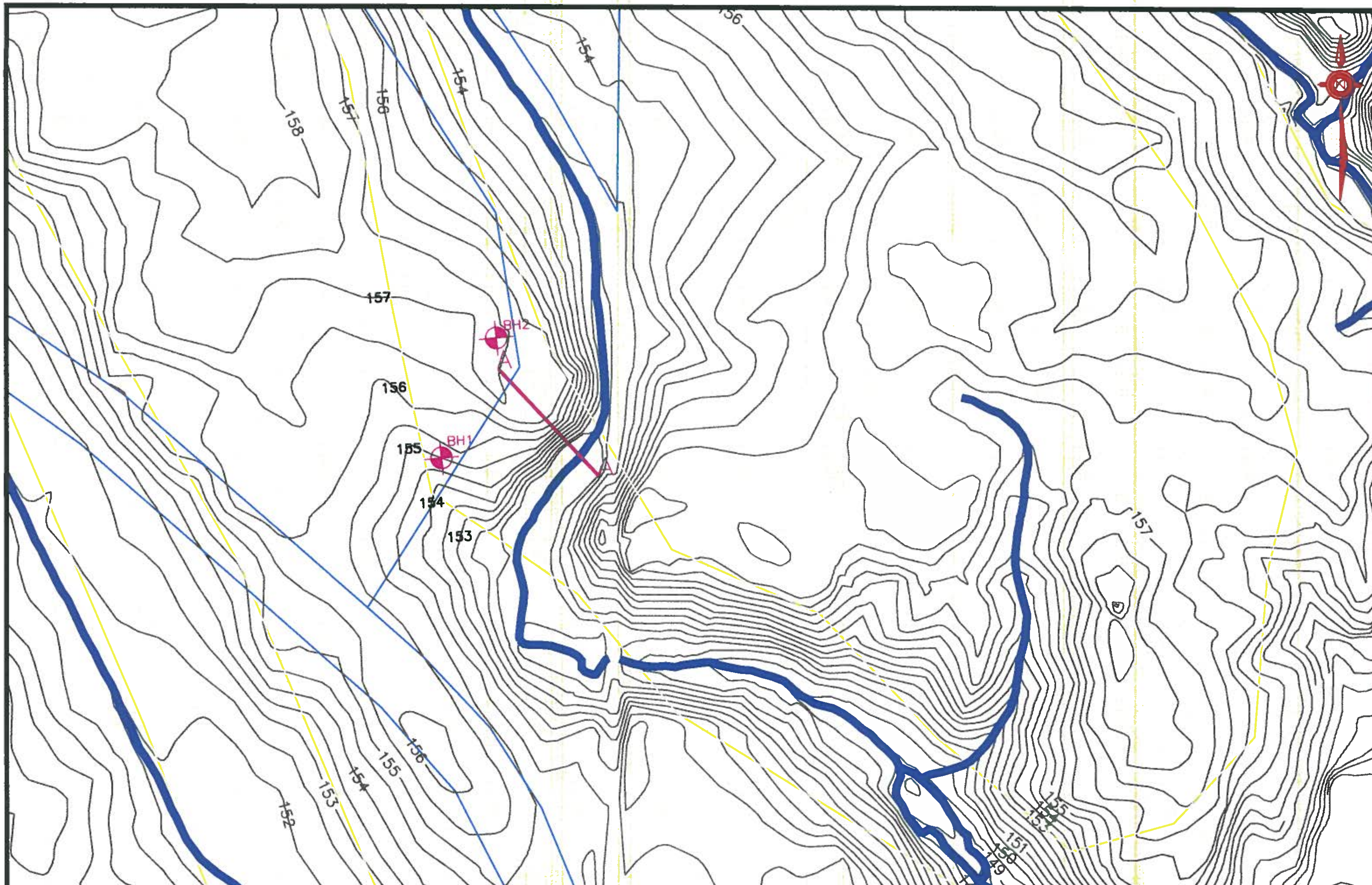
exp Services Inc.

LICENSED PROFESSIONAL ENGINEER
H. LOHSE
Jan 4/12
PROVINCE OF ONTARIO

Holger Lohse, P. Eng.
Senior Project Manager

Stephen S. M. Cheng, P. Eng.
Assistant Manager, Geotechnical Division

Drawings and Laboratory Results



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PROJECT TITLE AND LOCATION:	DRAWING TITLE:	PROJECT NO.: BRM-00603264-A0	DWN.: NW
14 MILE CREEK OAKVILLE, ONTARIO	BOREHOLE LOCATION PLAN	SCALE: NTS	CHK.: HL
		DATE: JANUARY 2013	DWG. No.: 1

Notes On Sample Descriptions **Drawing 1A**

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by exp Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO SILT (NONPLASTIC)	FINE	MEDIUM	CRS.	FINE	COARSE
	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

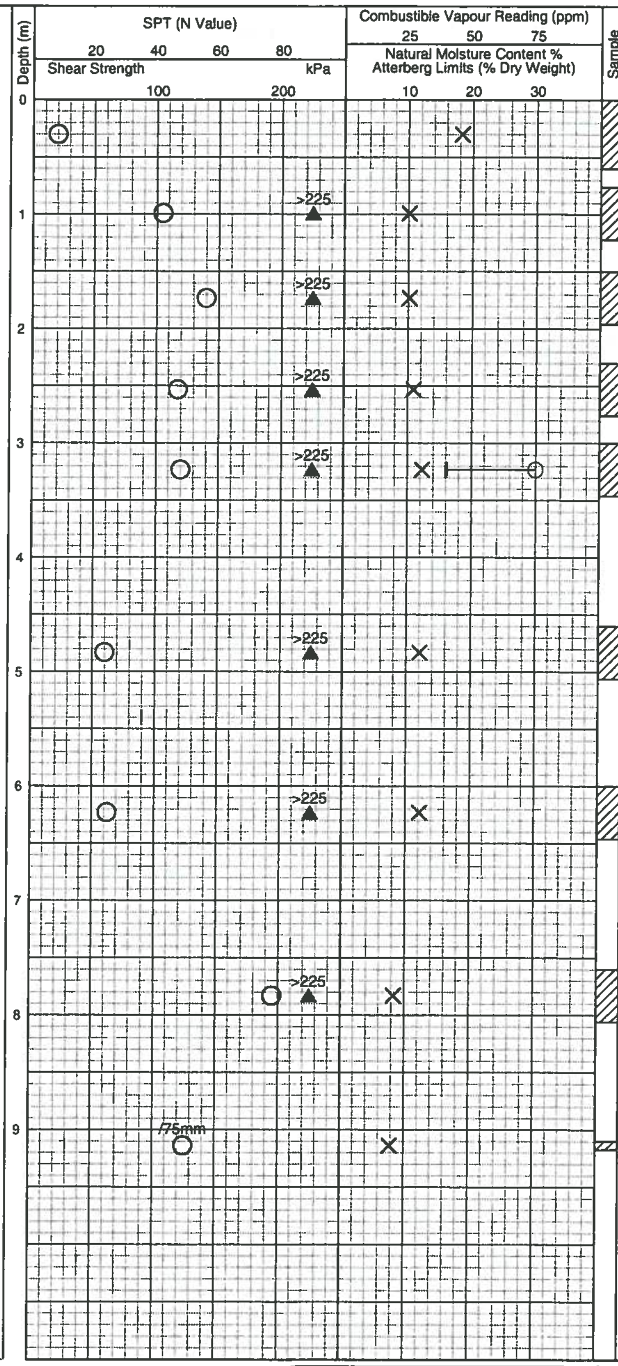
3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole BH 1

Project No.	BRM-00603264-AO	Drawing No.	2
Project:	Stable Slope Line	Sheet No.	1 of 1
Location:	14 Mile Creek at North End of Zenon Drive, Oakville, Ontario		
	Located on west side of creek		
Date Drilled:	December 10, 2012		
Drill Type:	Solid Stem Augers		
Datum:	Geodetic		

Legend		Legend	
Auger Sample	☒	Combustible Vapour Reading	□
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	S	Penetrometer	▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
			155.09	0
		CLAYEY SILT: traces of rootlets and gravel, brown, loose	~154.5	
		SANDY SILT TILL: some clay, trace gravel, brown, hard	~146.0	
		SHALE: redish brown, very dense Auger refusal at 9.3m	~145.9	
		END OF BOREHOLE		



Natural Unit Weight kN/m³
19.9
22.1
22.8
22.5
22.0
21.7
22.8
22.7
22.7

Elapsed Time	Water Level (m)	Hole Open to (m)
Upon Completion	dry	open
Dec 19, 2012	6.91	

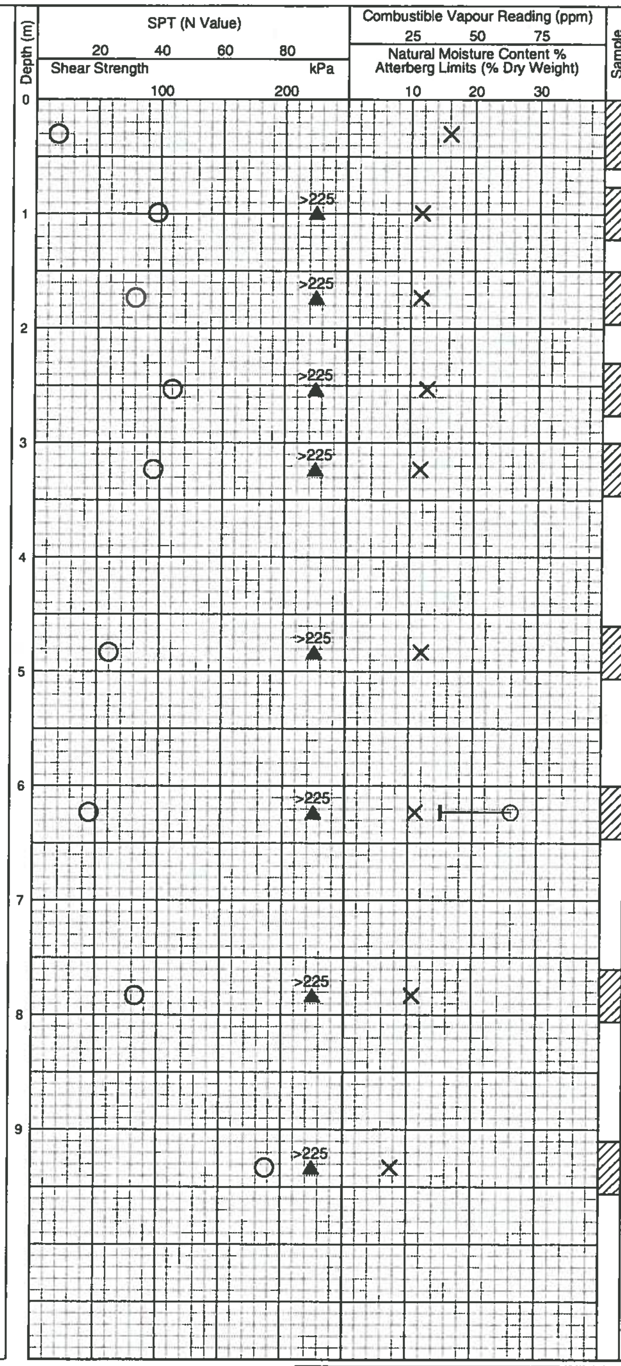
exp.

Log of Borehole BH 2

Project No. BRM-00603264-AO
Drawing No. 3
Project: Stable Slope Line
Sheet No. 1 of 1
Location: 14 Mile Creek at North End of Zenon Drive, Oakville, Ontario
Located on west side of creek
Date Drilled: December 10, 2012
Drill Type: Solid Stem Augers
Datum: Geodetic

Auger Sample	⊠	Combustible Vapour Reading	□
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	S	Penetrometer	▲

Soil Description	ELEV. m
	157.18
CLAYEY SILT: traces of rootlets and gravel, brown, loose	
	~156.6
SANDY SILT TILL: some clay, trace gravel, brown, hard	
	~147.6
END OF BOREHOLE	



Natural Unit Weight kN/m³
21.4
22.5
22.1
22.4
22.3
22.3
22.6
22.8
23.7

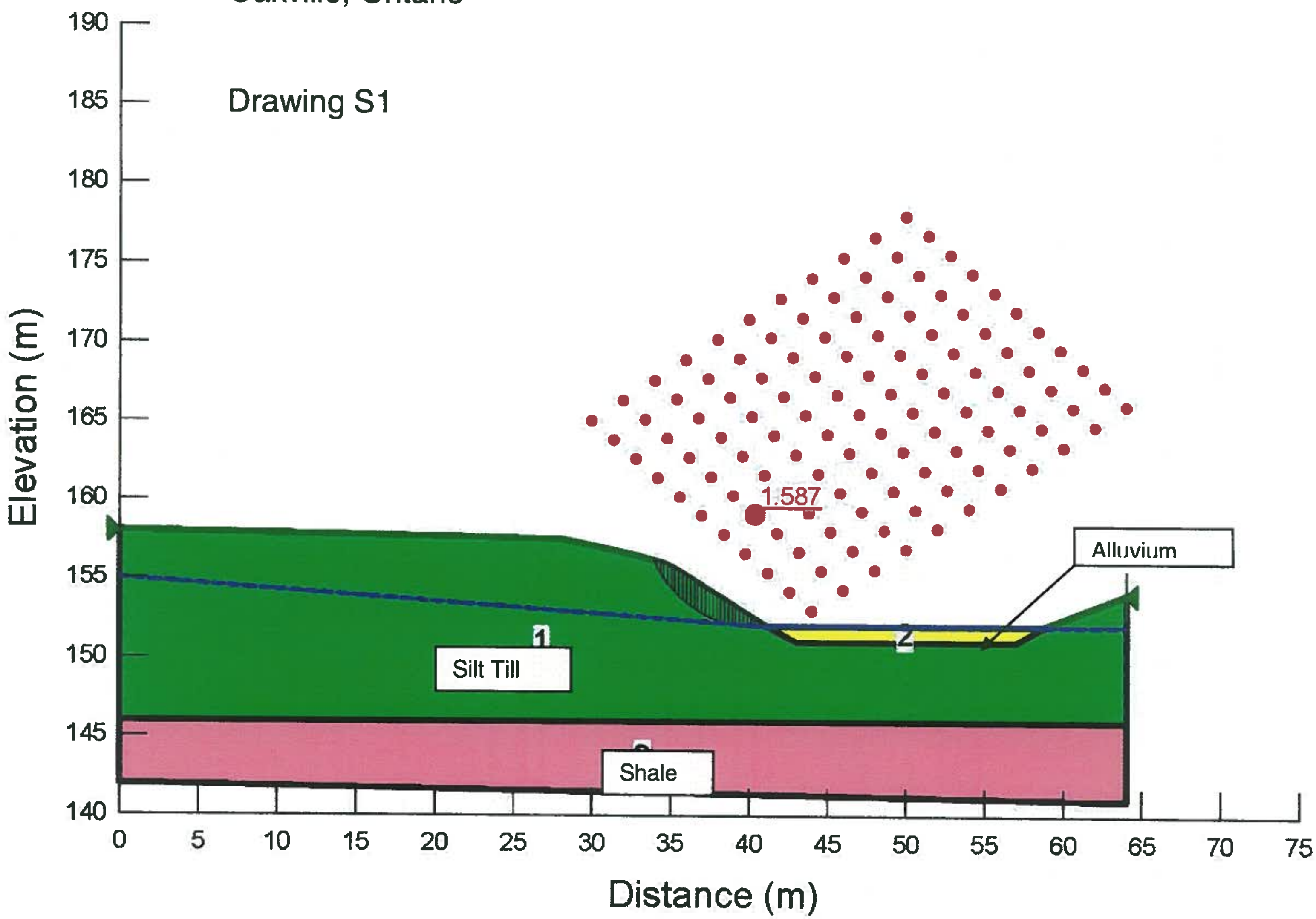
EXPLOGBRAMPTON 14 MILE CREEK BH LOGS.GPJ NEW.GDT 1/3/13

Elapsed Time	Water Level (m)	Hole Open to (m)
Upon Completion	dry	open
Dec 19, 2012	4.31	

exp.

Project BRM-000603264-A0
Stable Slope Line
14 Mile Creek at Zenon Drive
Oakville, Ontario

Drawing S1



exp Services Inc.
1595 Clark Boulevard, Brampton
Ontario, Canada, L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

Grain Size Analysis & Hydrometer Test Report

ST08

Sample Test No.: 186275-2 **Report No.:** 1 **Date Reported:** 17-Dec-12

Project No.: brm-00603264-a0
Project Name: GEO HL - 14 Mile Creek at Zenon Drive, Oakville, Ontario - Slope Stability Analysis

Grain Size Proportion (%)

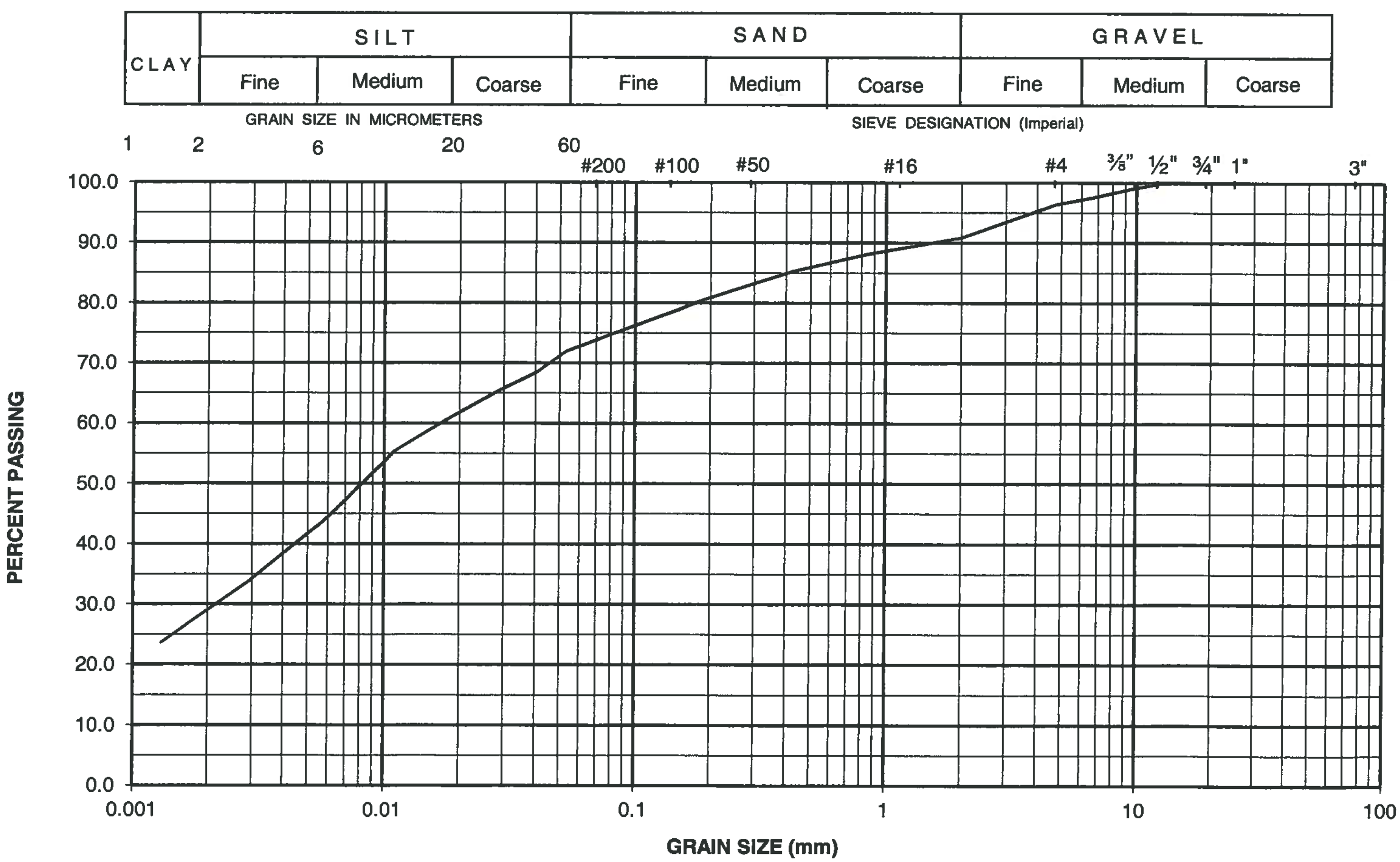
Gravel (> 2.0mm):	9.1
Sand (> 60µm, < 2.0mm):	18.4
Silt (> 2µm), < 60µm):	44.4
Clay (< 2µm):	28.1

Sample Information

Location: BH 1
Sample Method: SS
Sample No.: 5
Depth: 3.0 - 3.5m
Sample Description: Clayey Silt;some Sand;trace Gravel;Brown
Sampled By: Nicole Wyld
Sampling Date: 12/10/2012
Date Received: 12/12/2012
Client Sample ID:
Comments:

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	0.0404	68.5
22.4	100.0	0.0290	65.6
19	100.0	0.0187	61.2
16	100.0	0.0111	55.5
13.2	100.0	0.0080	49.7
12.5	100.0	0.0058	43.9
9.5	99.1	0.0029	33.8
6.7	97.6	0.0013	23.7
4.75	96.5		
2	90.9		
0.85	88.2		
0.425	85.3		
0.25	82.2		
0.18	80.4		
0.15	79.0		
0.075	74.4		
0.053	72.0		

International Society for Soil Mechanics and Foundation Engineering



Project Manager: Holger Lohse **Approved By:** *Original Signed By* Willie Rodych, Lab Supervisor **Date Approved:** 17-Dec-12

exp.

exp Services Inc.
1595 Clark Boulevard, Brampton
Ontario, Canada, L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

Grain Size Analysis & Hydrometer Test Report

ST08

Sample Test No.: 186276-2 **Report No.:** 2 **Date Reported:** 17-Dec-12

Project No.: brm-00603264-a0
Project Name: GEO HL - 14 Mile Creek at Zenon Drive, Oakville, Ontario - Slope Stability Analysis

Grain Size Proportion (%)

Gravel (> 2.0mm):	13.0
Sand (> 60μm, < 2.0mm):	19.5
Silt (> 2μm), < 60μm):	44.2
Clay (< 2μm):	23.3

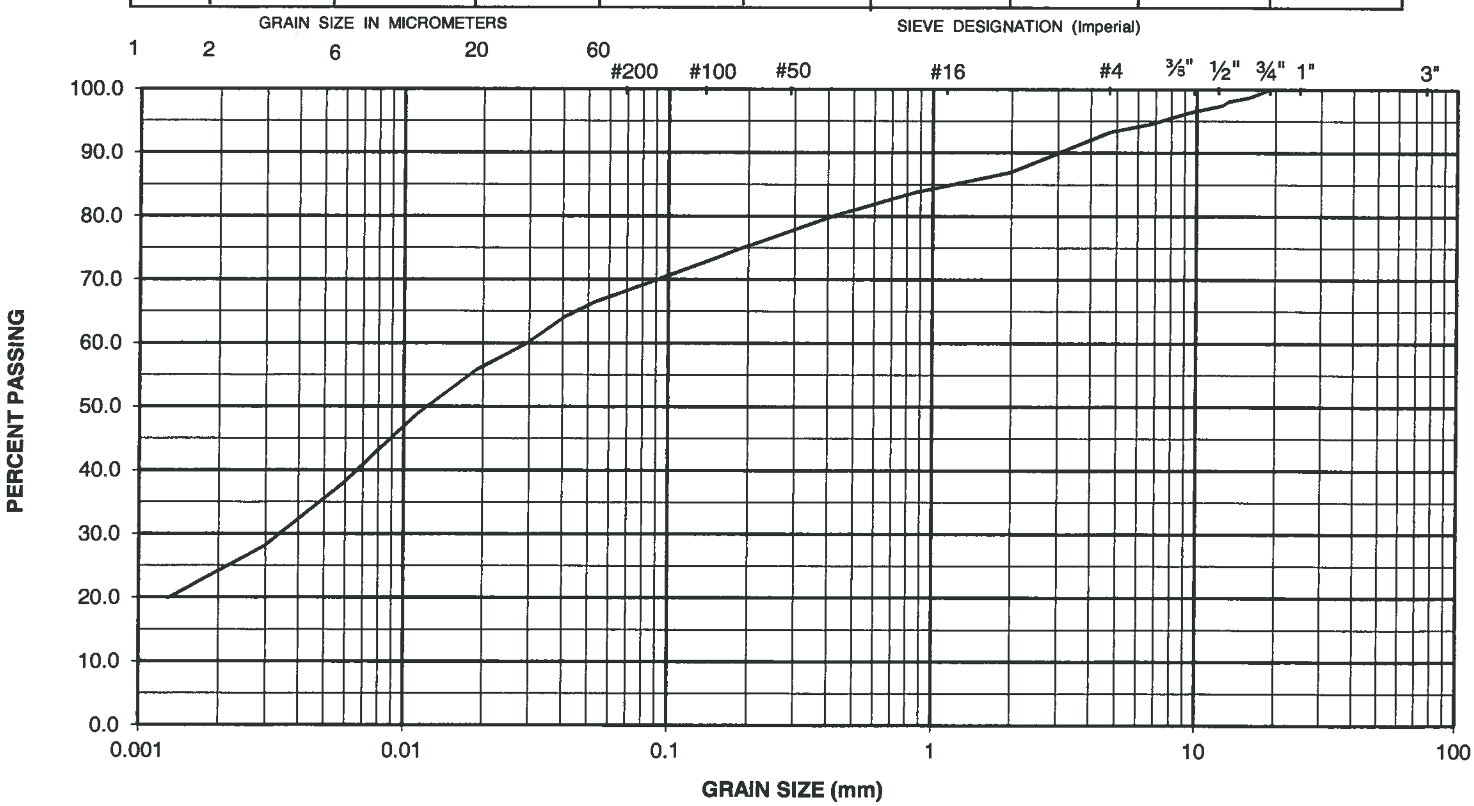
Sample Information

Location: BH 2
Sample Method: SS
Sample No.: 7
Depth: 6.1 - 6.6m
Sample Description: Clayey Silt, some Sand and Gravel; Brown
Sampled By: Nicole Wyld
Sampling Date: 12/10/2012
Date Received: 12/12/2012
Client Sample ID:
Comments:

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	0.0407	64.1
22.4	100.0	0.0294	60.0
19	100.0	0.0189	55.8
16	98.8	0.0113	48.9
13.2	98.1	0.0081	43.4
12.5	97.5	0.0059	37.9
9.5	96.4	0.0030	28.2
6.7	94.6	0.0013	19.9
4.75	93.4		
2	87.0		
0.85	83.7		
0.425	80.2		
0.25	76.7		
0.18	74.6		
0.15	73.3		
0.075	68.8		
0.053	66.5		

International Society for Soil Mechanics and Foundation Engineering

CLAY	SILT			SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse



Project Manager: Holger Lohse **Approved By:** *Original Signed By*
Willie Rodych, Lab Supervisor **Date Approved:** 17-Dec-12

Trow

Trow Associates Inc.
1595 Clark Boulevard, Brampton
Ontario, Canada, L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

Plasticity Index Test Report

ST03

Project No.: Brm-00603264 **Date Reported:** December 17,2012

Sample Number: BH1 SS5 (3.0 - 3.5m)

Sample Info: Date Sampled: 12/10/2012; Date Received: 12/12/2012; Lab.No:

Liquid Limit

Trial Number	1	2	3	4	
Number of Blows	20	16	37	27	
Moisture Tin No.	27	5	11	25	
Mass of Soil and Tin, g	24.921	28.775	26.821	27.260	
Mass of Dry Soil and Tin, g	22.586	25.836	24.571	24.785	
Mass of Tin, g	15.163	16.651	16.745	16.636	
Mass of Water, g	2.335	2.939	2.250	2.475	
Mass of Dry Soil, g	7.423	9.185	7.826	8.149	
Water Content, %	31.5%	32.0%	28.8%	30.4%	

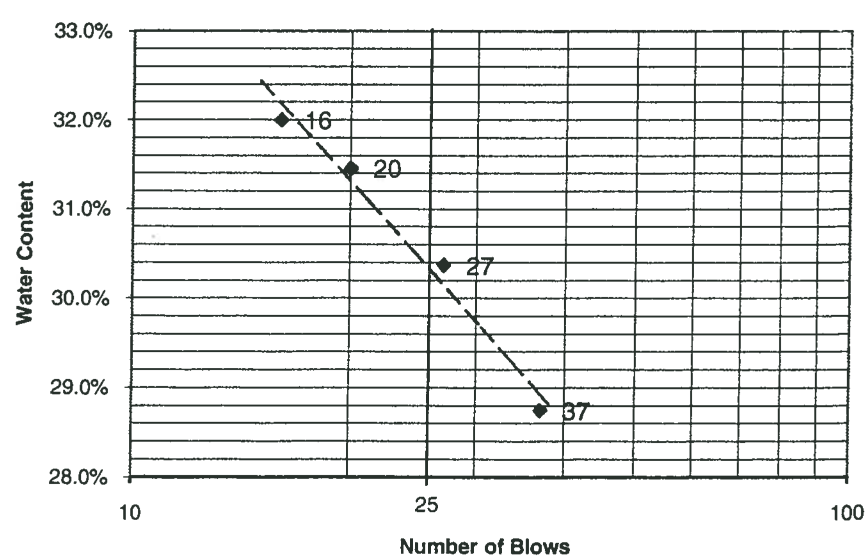
Plasticity Limit

Trial Number	1	2	3
Moisture Tin No.	4	22	2
Mass of Soil and Tin, g	23.592	24.524	23.602
Mass of Dry Soil and Tin, g	22.447	23.415	22.637
Mass of Tin, g	15.505	16.476	16.83
Mass of Water, g	1.145	1.109	0.965
Mass of Dry Soil, g	6.942	6.939	5.807
Water Content, %	16.5%	16.0%	16.6%

Summary of Results

Liquid Limit:	30
Plastic Limit:	16
Plasticity Index:	14

Flow Curve



Project Manager:

Approved By: Willie Rodych
(Lab Supervisor)

Trow

Trow Associates Inc.
1595 Clark Boulevard, Brampton
Ontario, Canada, L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

Plasticity Index Test Report

ST03

Project No.: Brm-00603264 **Date Reported:** December 17,2012

Sample Number: BH2 SS7 (6.1 - 6.6m)
Sample Info: Date Sampled: 12/10/2012; Date Received: 12/12/2012; Lab.No:

Liquid Limit

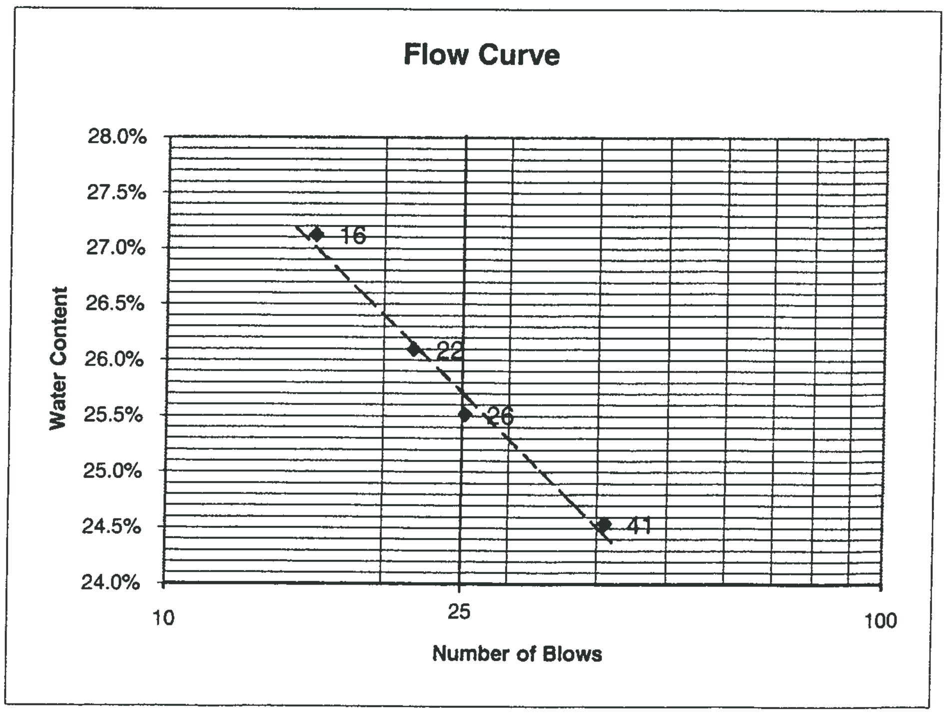
Trial Number	1	2	3	4	
Number of Blows	26	22	16	41	
Moisture Tin No.	17	14	34	16	
Mass of Soil and Tin, g	28.960	27.188	26.220	27.001	
Mass of Dry Soil and Tin, g	26.469	25.014	24.165	24.980	
Mass of Tin, g	16.707	16.684	16.589	16.745	
Mass of Water, g	2.491	2.174	2.055	2.021	
Mass of Dry Soil, g	9.762	8.330	7.576	8.235	
Water Content, %	25.5%	26.1%	27.1%	24.5%	

Plasticity Limit

Trial Number	1	2	3
Moisture Tin No.	21	15	20
Mass of Soil and Tin, g	23.075	24.425	25.341
Mass of Dry Soil and Tin, g	22.101	23.398	24.215
Mass of Tin, g	15.575	16.521	16.686
Mass of Water, g	0.974	1.027	1.126
Mass of Dry Soil, g	6.526	6.877	7.529
Water Content, %	14.9%	14.9%	15.0%

Summary of Results

Liquid Limit:	26
Plastic Limit:	15
Plasticity Index:	11



Project Manager:

Approved By: Willie Rodych
(Lab Supervisor)

Appendix 6.6 – Stream Length and Drainage Density

Stream Length and Density Requirements

The pattern and arrangement of natural stream channels determines the efficiency of the drainage system. Generally, (with all other variables constant), the time required for water to flow a given distance is directly proportional to length. Drainage density affects the magnitude of streamflow from a drainage basin and the relationship between drainage density and streamflow may be expressed as;

$$Q \; \alpha \; (\text{Drainage Density})^n.$$

Therefore, changes in drainage density in a catchment due to stream diversion/rehabilitation will primarily affect the magnitude of stream flow.

Pre-Development Condition

The following stream reaches of the 14 Mile Creek flow generally from north to south direction through the proposed development area as shown in Figure 7.4.5:

Subcatchment-FM-1001

- 14W-12: High Constraint Stream (573 m)
- 14W-16: Medium Constraint Stream (421 m)
- 14W-14: Medium Constraint Stream (801 m)
- 14W-13: Low Constraint Stream (960 m)
- 14W-12A: High Constraint Stream (106 m)
- 14W-14A: Man-Made Pond (300 m) - Considered Medium Constraint by NOCSS.

Subcatchment-FM-1109

- 14W -11: High Constraint Stream (196 m)
- 14W-11A: Medium Constraint Stream (225 m)

Stream lengths shown in parentheses correspond to stream lengths within the site boundary. Overall drainage densities calculated at the Dundas Street culvert catchments are based on the stream lengths provided in Table 5.8.1 of NOCSS and are presented in Table 1.

Table 1 Pre-Development Drainage Densities at Dundas Street Culverts

Subcatchment ID	Outlet	Drainage Area (km^2)	Stream Length (km)[a]	Drainage Density (km/km^2)	Area Weighted Drainage Density (km/km^2)
FM-1001	FM-D4	3.97	18.79	4.73	5.05
FM-1109	FM-D5	3.51	18.88	5.38	

[a] Includes high (red), medium (blue) and low (green) constraint streams

The minimum allowable drainage density of 1.29 km/km^2 is recommended in the NOCSS for the North Oakville subwatersheds. This lower limit represents the regional average drainage density minus one standard deviation.

According to the NOCSS, the North Oakville catchments possess sufficient stream lengths to satisfy the imposed drainage density targets based only on the high and medium constraint streams. Despite individual basins having a deficit, there is an overall subwatershed surplus indicating that the replication of low constraint stream lengths is not necessary.

Post-Development Condition

The medium constraint stream 14W-14 and the low constraint stream 14W-13 of the Fourteen Mile Creek West within the development area proposed to be eliminated to accommodate development. The proposed diversions 14W-21 (low constraint stream) along the Highway 407 will intercept flows from the reaches 14W-13 and 14W-14 just downstream of Highway 407 and divert them 10 m upstream the confluence with the 14W-16 via another proposed diversion 14W-22 (medium constraint stream) along the southwest property limits as shown in Figure 6.1. The existing medium constraint tributary 14W-16 will remain in undisturbed condition. Another medium constraint stream 14W-11A will be realigned along Highway 407 and southeast limits of the property limits (14W-23) to accommodate development. The post-development stream reaches through the site is summarized below:

Subcatchment-FM-1001

- 14W-12: High Constraint Stream (573 m)
- 14W-16: High Constraint Stream (421 m)
- 14W-14: Medium Constraint Stream (157 m)
- 14W-13: Low Constraint Stream (94 m)
- 14W-22: Medium Constraint Stream (780 m)
- 14W - 21: Low Constraint Stream (206 m)
- 14W-12A: High Constraint Stream (86 m)

Subcatchment-FM-ll09(Figure3.6)

- 14W -11: High Constraint Stream (196 m)
- 14W-23: Medium Constraint Stream (446 m)

The pre- and post-development stream lengths are compared in Table 2 for high, medium and low constraint streams within the site boundary. Table 2 compares pre- and post-development drainage density for the proposed development area.

Table 2 Post-Development Densities at Dundas Street Culverts

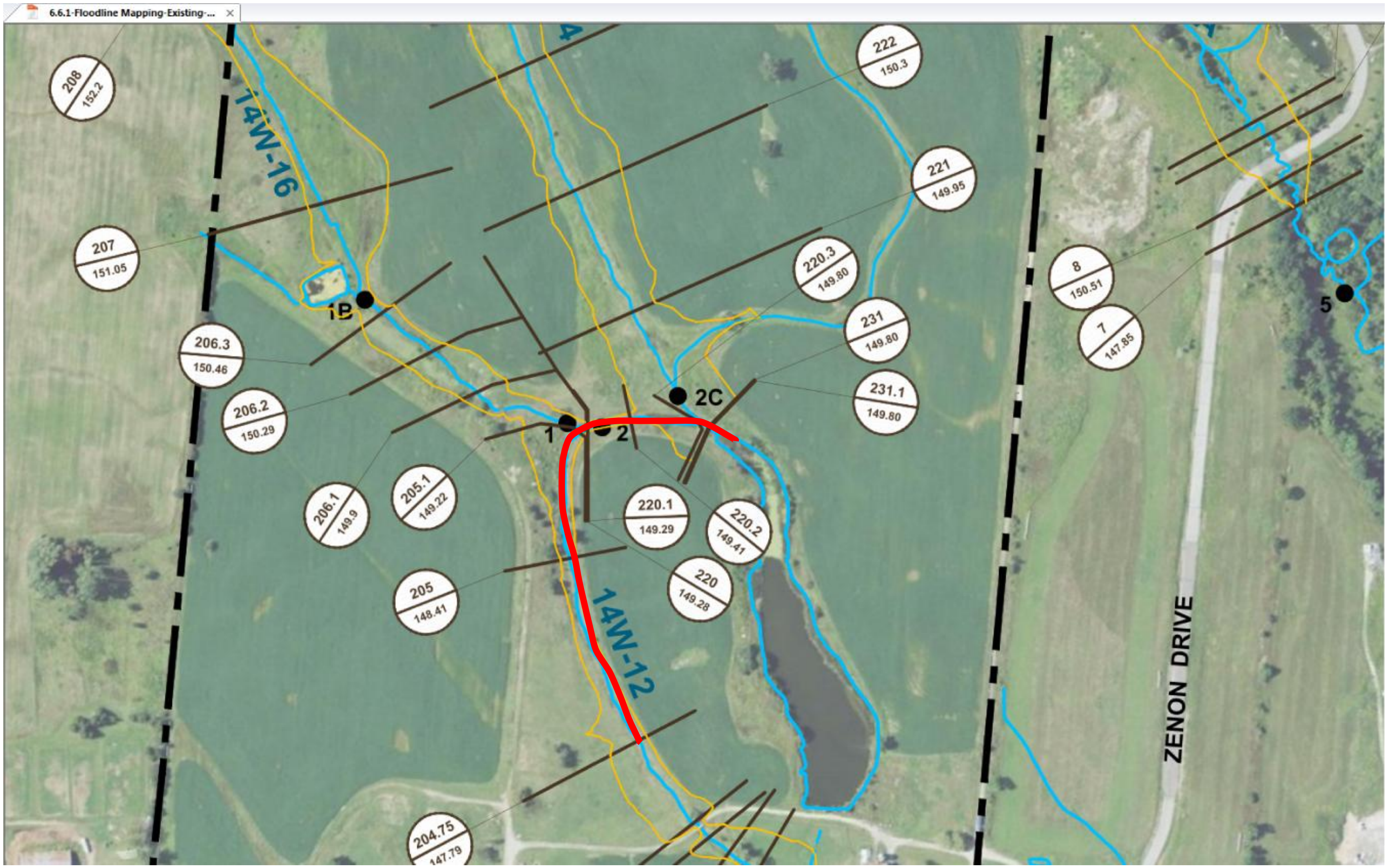
Subcatchment 1D	Outlet	Drainage Area (km^2)	Stream Length (km)[a]	Drainage Density (km/km^2)	Area Weighted Drainage Density (km/km^2)
FM-1001	FM-D4	4.14	18.11	4.37	4.89
FM-1109	FM-D5	3.51	18.98	5.41	

[a] Includes high (red), medium (blue) and low (green) constraint streams

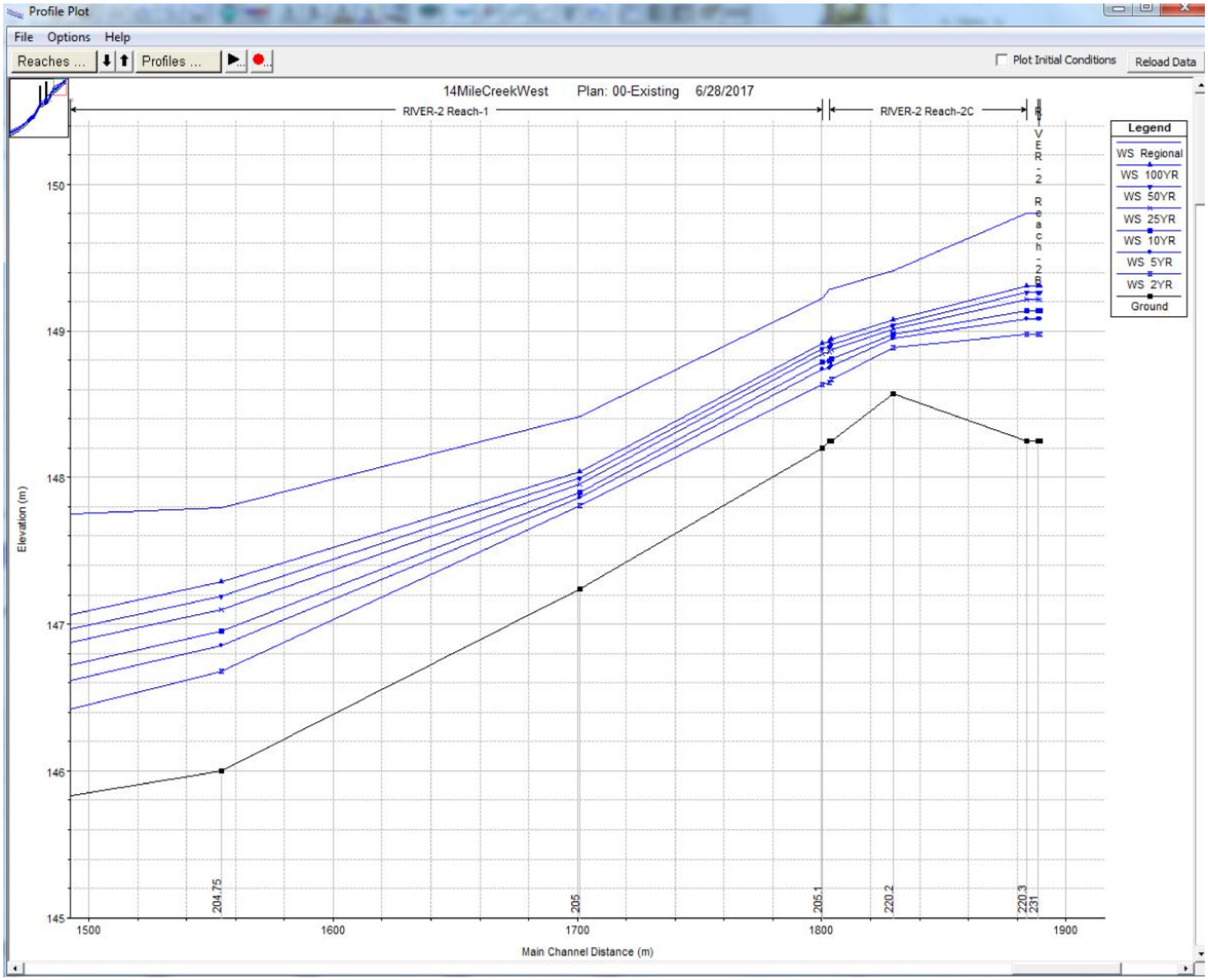
Appendix 6.7 – Water Surface Profiles at Tie in of 14W-22 and 14W-12A

Profile of XS 204.75, 205, 205.1, 220, 220.1, 220.2, 220.3, 231, 231.1

for Existing condition



6.6.1-Floodline Mapping-Existing-...
208
152.2
207
151.05
206.3
150.46
206.2
150.29
206.1
149.9
205.1
149.22
205
148.41
204.75
147.79
220.1
149.29
220.2
149.41
220
149.28
220.3
149.80
231
149.80
231.1
149.80
222
150.3
221
149.95
8
150.51
7
147.85
1B
1
2
2C
5
14W-16
14W-12
ZENON DRIVE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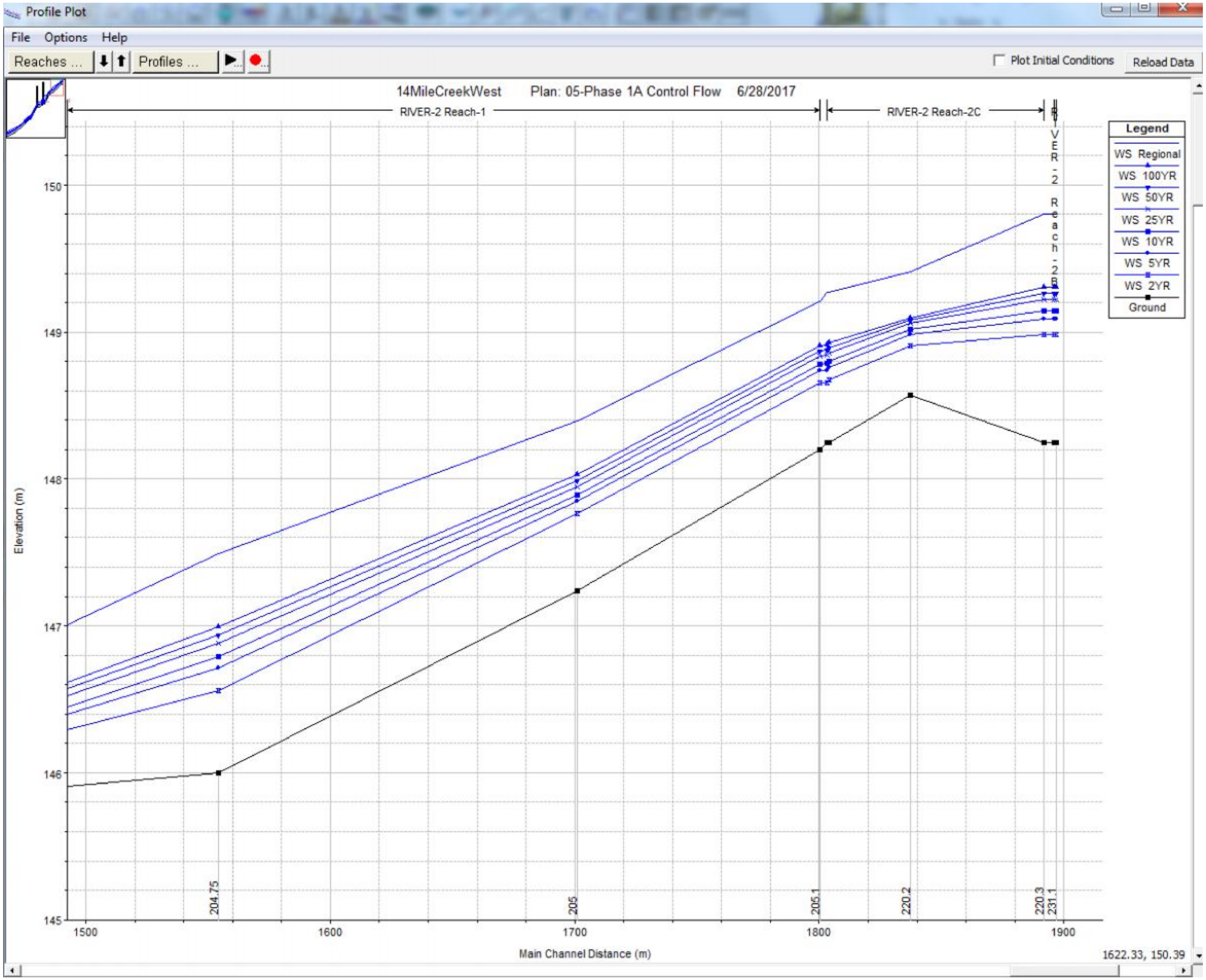
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 00-Existing 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2B
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Elevation (m)
Main Channel Distance (m)
204.75
205
205.1
220.2
220.3
231
145
146
147
148
149
150
1500
1600
1700
1800
1900

Profile of XS 204.75, 205, 205.1, 220, 220.1, 220.2, 220.3, 231, 231.1

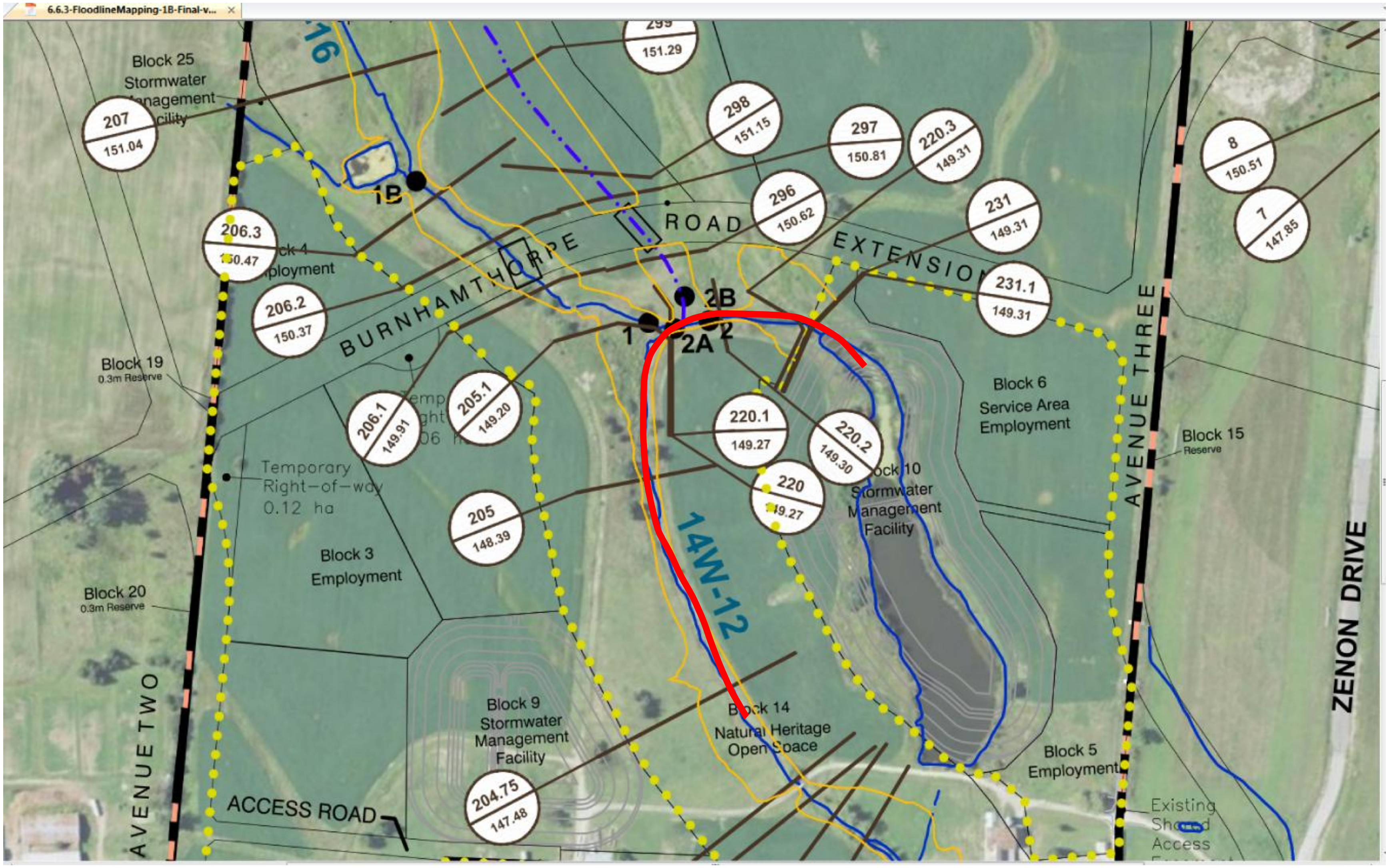
for Phase 1A condition

6.6.2-FloodlineMapping-1A-Final-v...
Employment
222
150.3
208
152.2
14W-16
Block 13
Natural Heritage
Open Space
Temporary
Right-of-way
Block 17
0.3m Reserve
Block 16
0.3m Reserve
221
149.95
Block 25
Stormwater
Management
Facility
207
151.05
220.3
149.80
8
150.51
1B
231
149.80
7
147.85
5
206.3
150.46
Block 4
Employment
ROAD
EXTENSION
BURNHAMTHORPE
206.2
150.29
2C
231.1
149.80
1
2
Block 6
Service Area
Employment
Block 19
0.3m Reserve
206.1
149.9
205.1
149.21
220.1
149.27
220.2
149.41
Block 15
Reserve
AVENUE THREE
Temporary
Right-of-way
0.12 ha
Block 10
Stormwater
Management
Facility
220
149.27
205
148.4
14W-12
ZENON DRIVE
Block 3
Employment
Block 20
0.3m Reserve
Block 9
Stormwater
Management
Facility
Block 14
Natural Heritage
Open Space
Block 5
Employment
AVENUE TWO
ACCESS ROAD
204.75
147.49
Existing
Shed

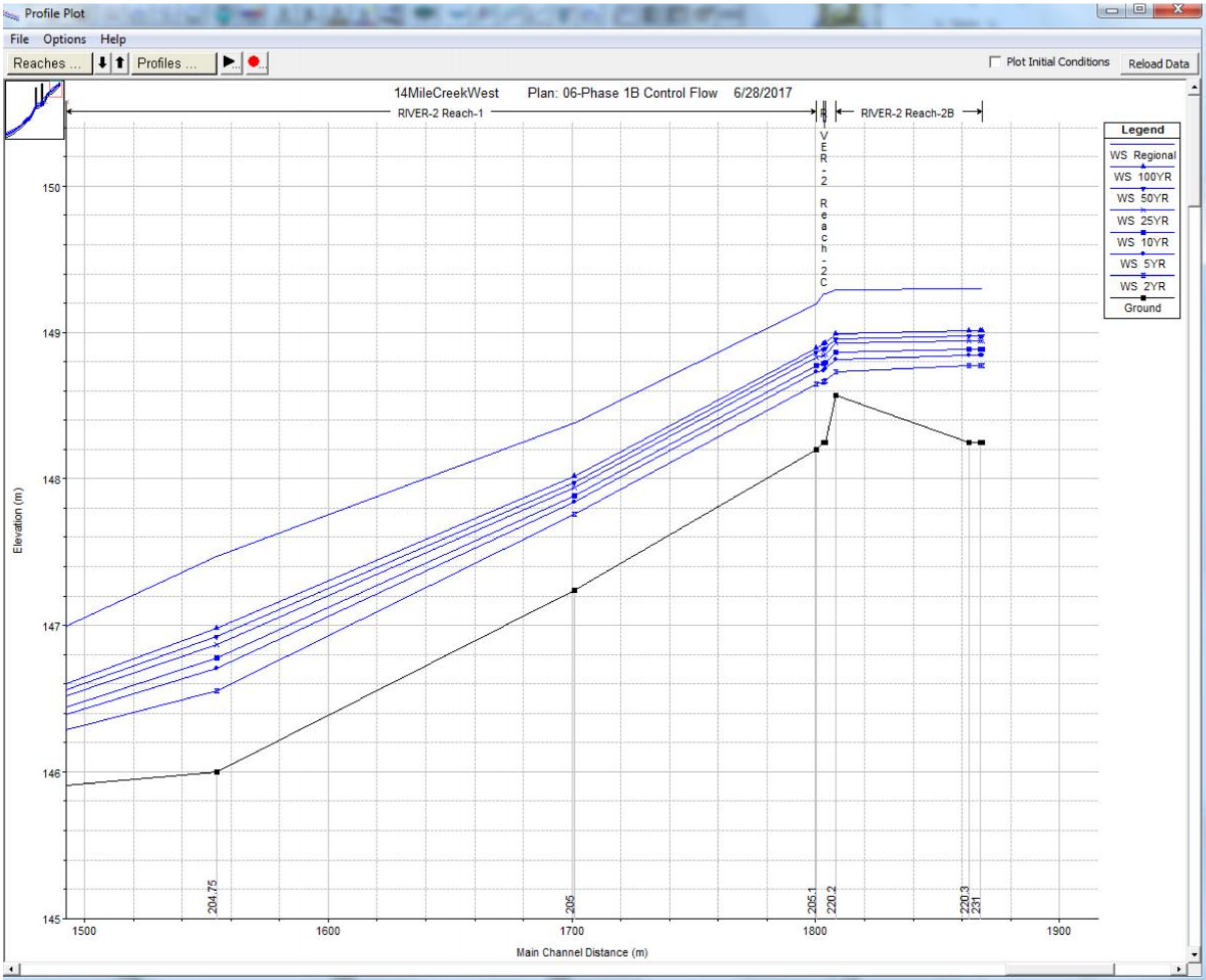

Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 05-Phase 1A Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2B
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Elevation (m)
150
149
148
147
146
145
204.75
205
205.1
220.2
220.3
231.1
1500
1600
1700
1800
1900
Main Channel Distance (m)
1622.33, 150.39

Profile of XS 204.75, 205, 205.1, 220, 220.1, 220.2, 220.3, 231, 231.1

for Phase 1B condition



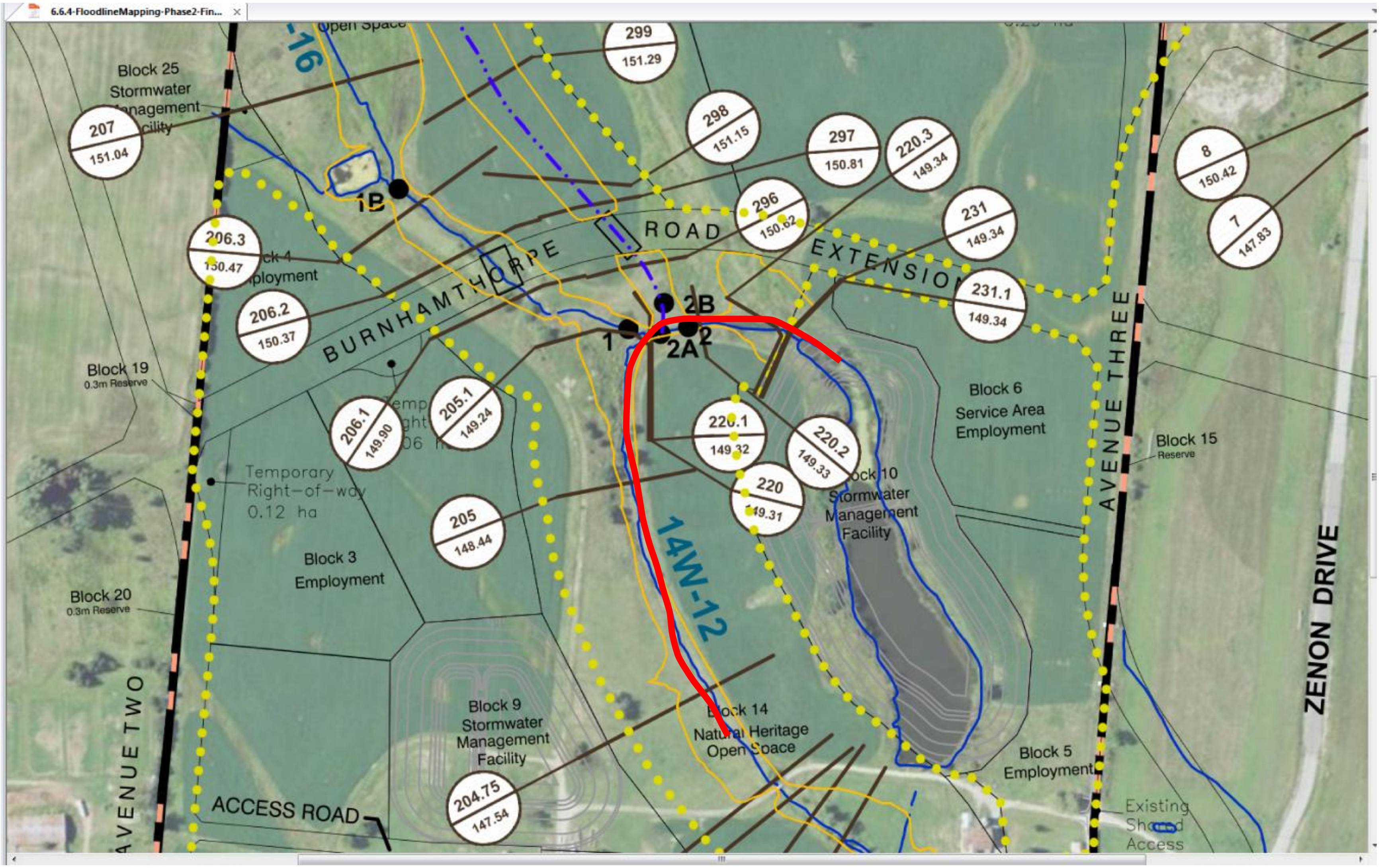
6.6.3-FloodlineMapping-1B-Final-v...
Block 25
Stormwater
Management
Facility
207
151.04
299
151.29
298
151.15
297
150.81
220.3
149.31
296
150.62
231
149.31
231.1
149.31
8
150.51
7
147.85
206.3
150.47
Block 4
Employment
206.2
150.37
1B
1
2A
2B
2
ROAD
BURNHAMTHORPE
EXTENSION
Block 19
0.3m Reserve
206.1
149.91
205.1
149.20
220.1
149.27
220.2
149.30
220
149.27
Temporary
Right-of-way
0.12 ha
205
148.39
Block 3
Employment
14W-12
Block 10
Stormwater
Management
Facility
Block 6
Service Area
Employment
AVENUE THREE
Block 15
Reserve
Block 20
0.3m Reserve
AVENUE TWO
Block 9
Stormwater
Management
Facility
Block 14
Natural Heritage
Open Space
Block 5
Employment
204.75
147.48
ACCESS ROAD
ZENON DRIVE
Existing
Shared
Access

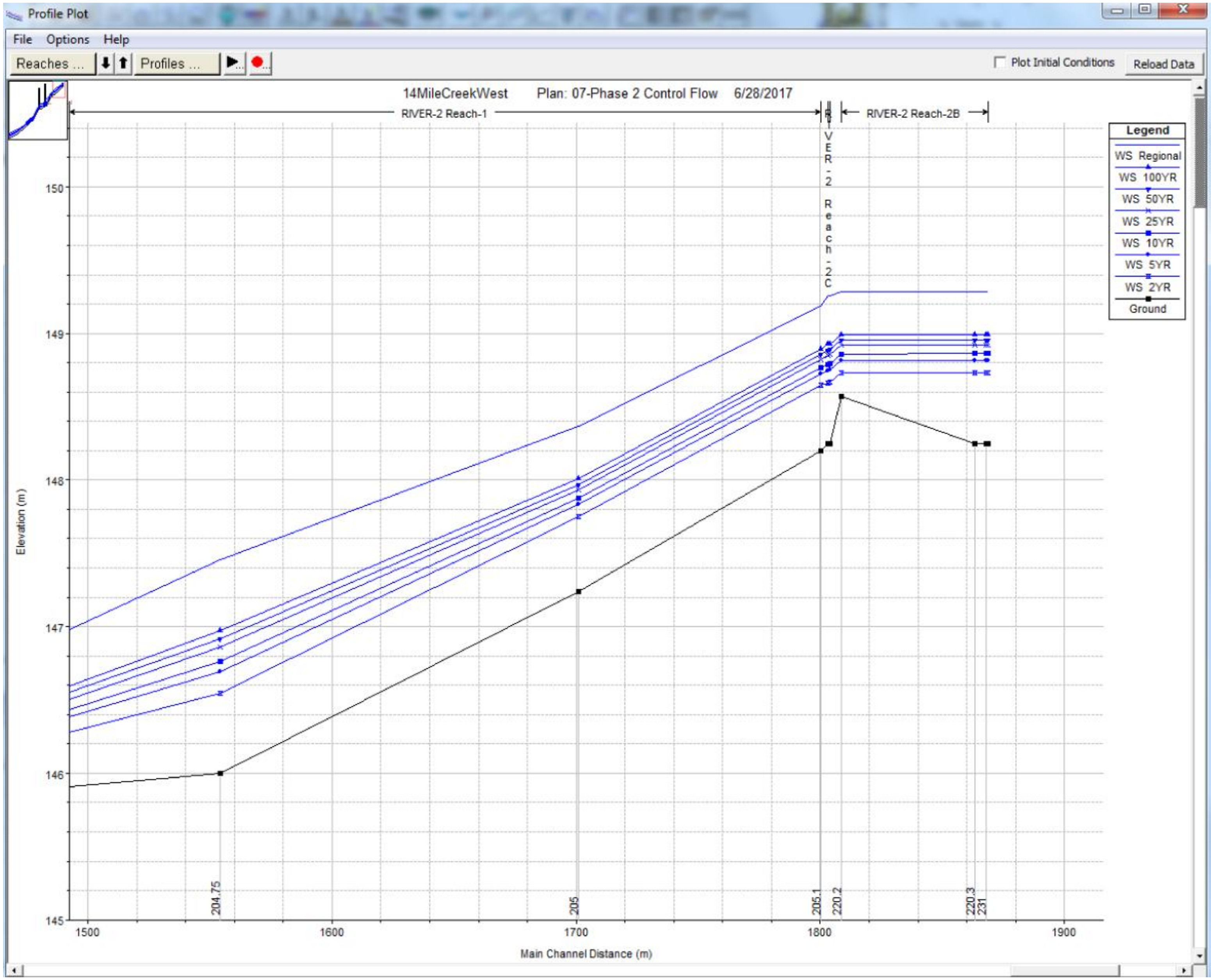


Profile Plot
File Options Help
Reaches ... Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 06-Phase 1B Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2B
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Elevation (m)
145
146
147
148
149
150
1500
1600
1700
1800
1900
204.75
205
205.1
220.2
220.3
231
Main Channel Distance (m)

Profile of XS 204.75, 205, 205.1, 220, 220.1, 220.2, 220.3, 231, 231.1

for Phase 2 condition


6.6.4-FloodlineMapping-Phase2-Fin...
Block 25
Stormwater
Management
Facility
207
151.04
299
151.29
298
151.15
297
150.81
220.3
149.34
296
150.62
231
149.34
231.1
149.34
8
150.42
7
147.83
1B
206.3
150.47
206.2
150.37
BURNHAMTHORPE ROAD EXTENSION
2B
1
2
2A
Block 19
0.3m Reserve
Block 6
Service Area
Employment
206.1
149.90
205.1
149.24
220.1
149.32
220.2
149.33
220
149.31
Block 10
Stormwater
Management
Facility
AVENUE THREE
Block 15
Reserve
Temporary
Right-of-way
0.12 ha
205
148.44
14W-12
Block 3
Employment
Block 20
0.3m Reserve
ZENON DRIVE
AVENUE TWO
Block 9
Stormwater
Management
Facility
Block 14
Natural Heritage
Open Space
Block 5
Employment
204.75
147.54
ACCESS ROAD
Existing
Access

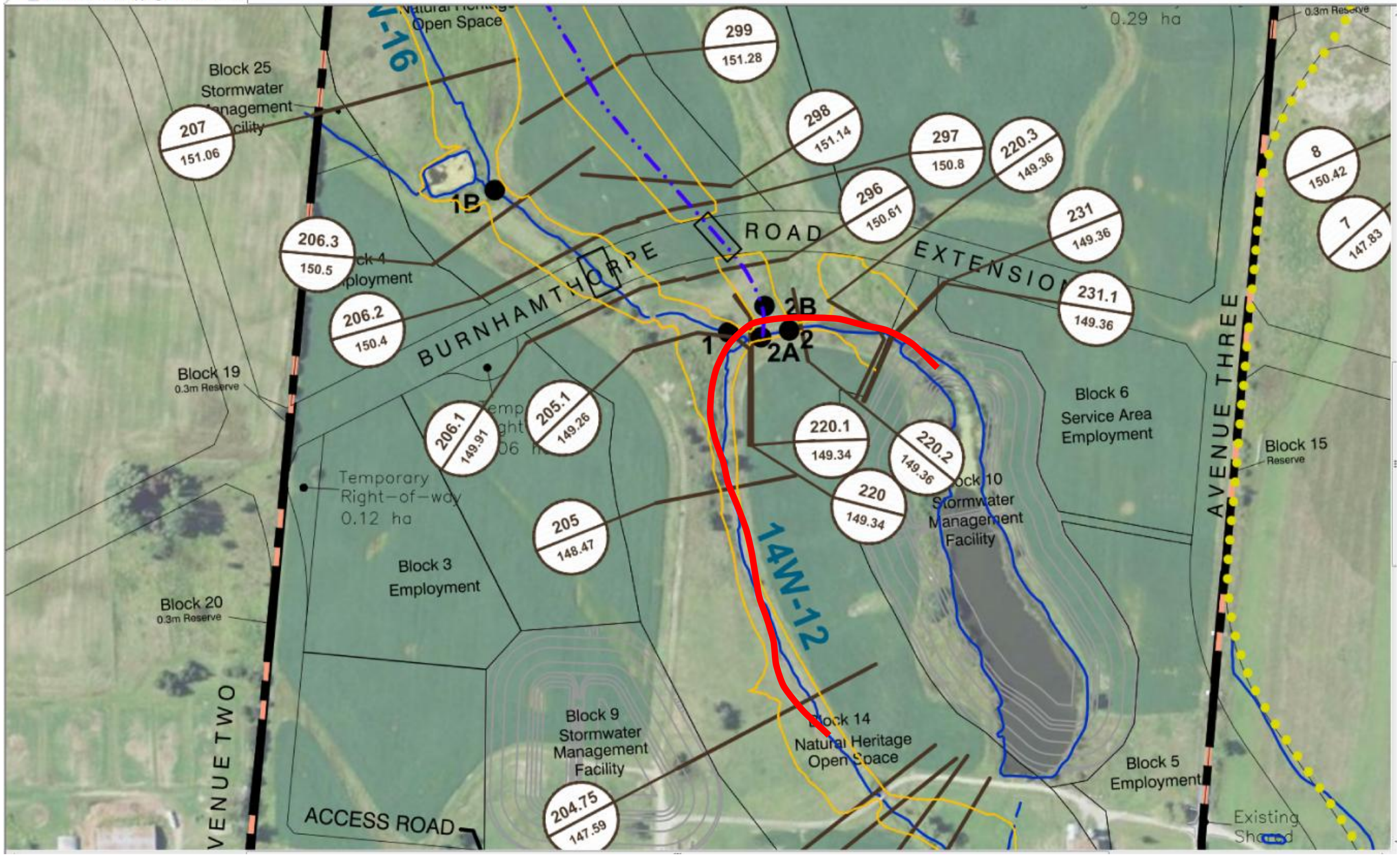


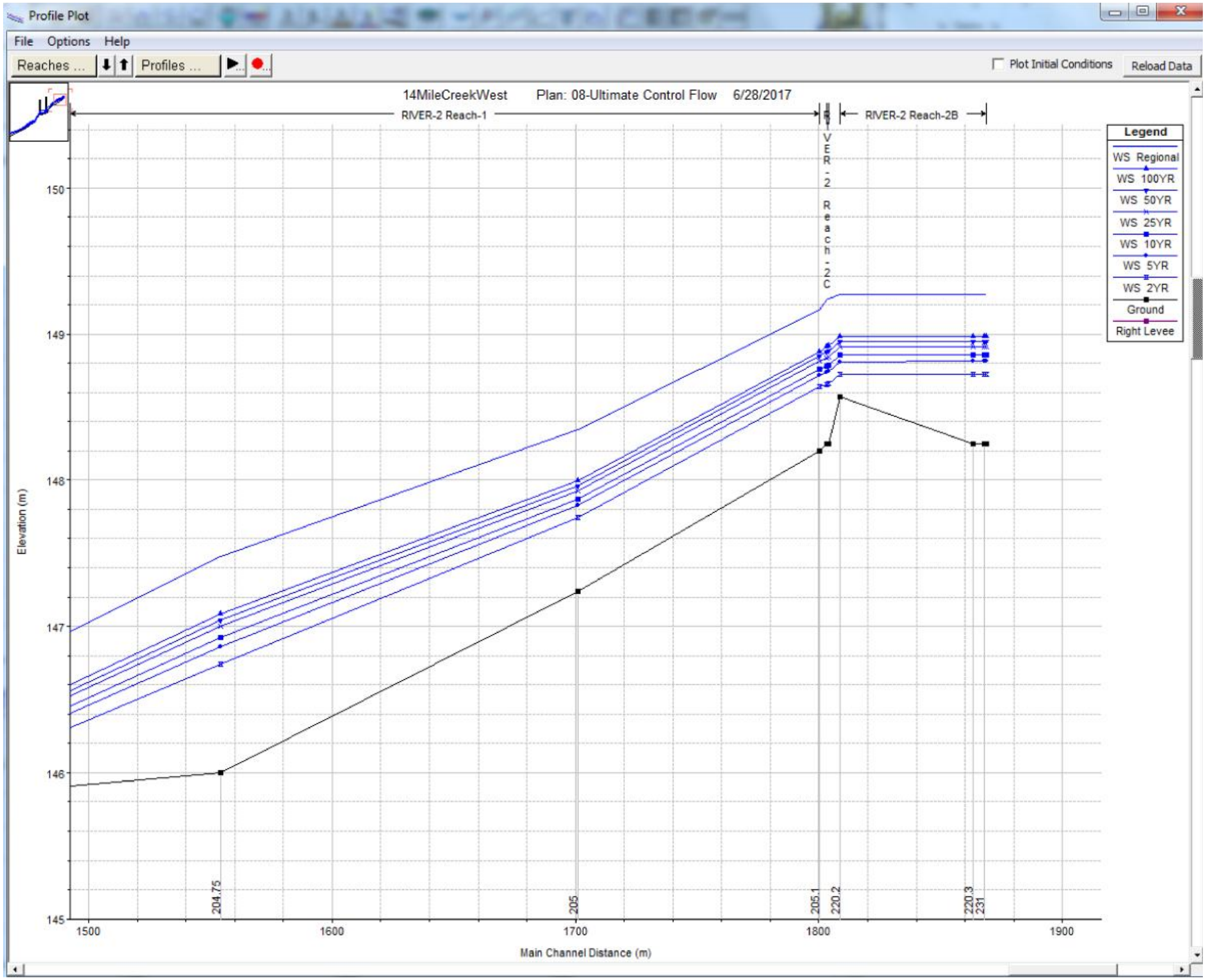
Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 07-Phase 2 Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2B
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Elevation (m)
150
149
148
147
146
145
204.75
205
205.1
220.2
220.3
231
1500
1600
1700
1800
1900
Main Channel Distance (m)

Profile of XS 204.75, 205, 205.1, 220, 220.1, 220.2, 220.3, 231, 231.1

for Ultimate condition

6.6.5-FloodlineMapping-Ultimate-F...

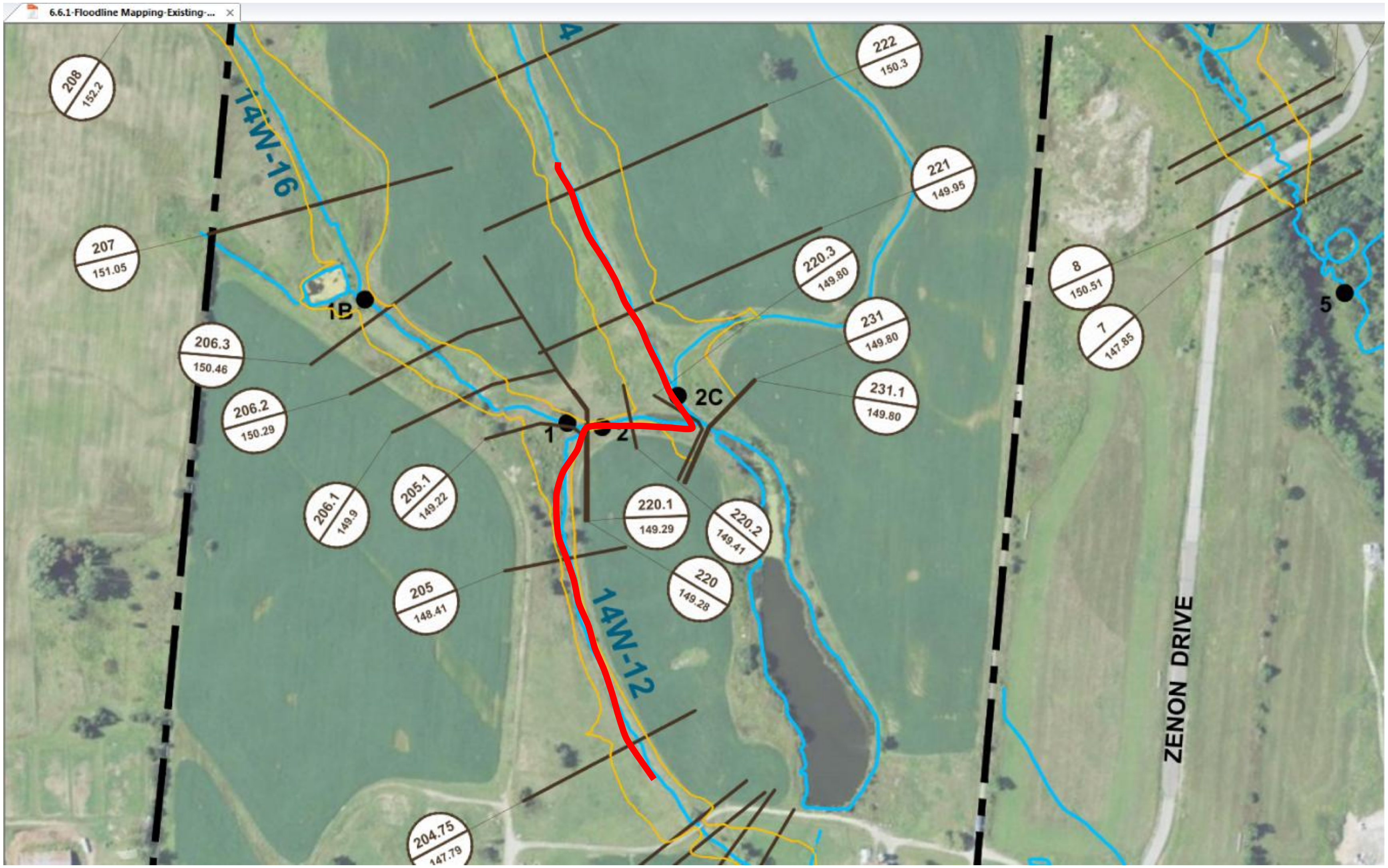




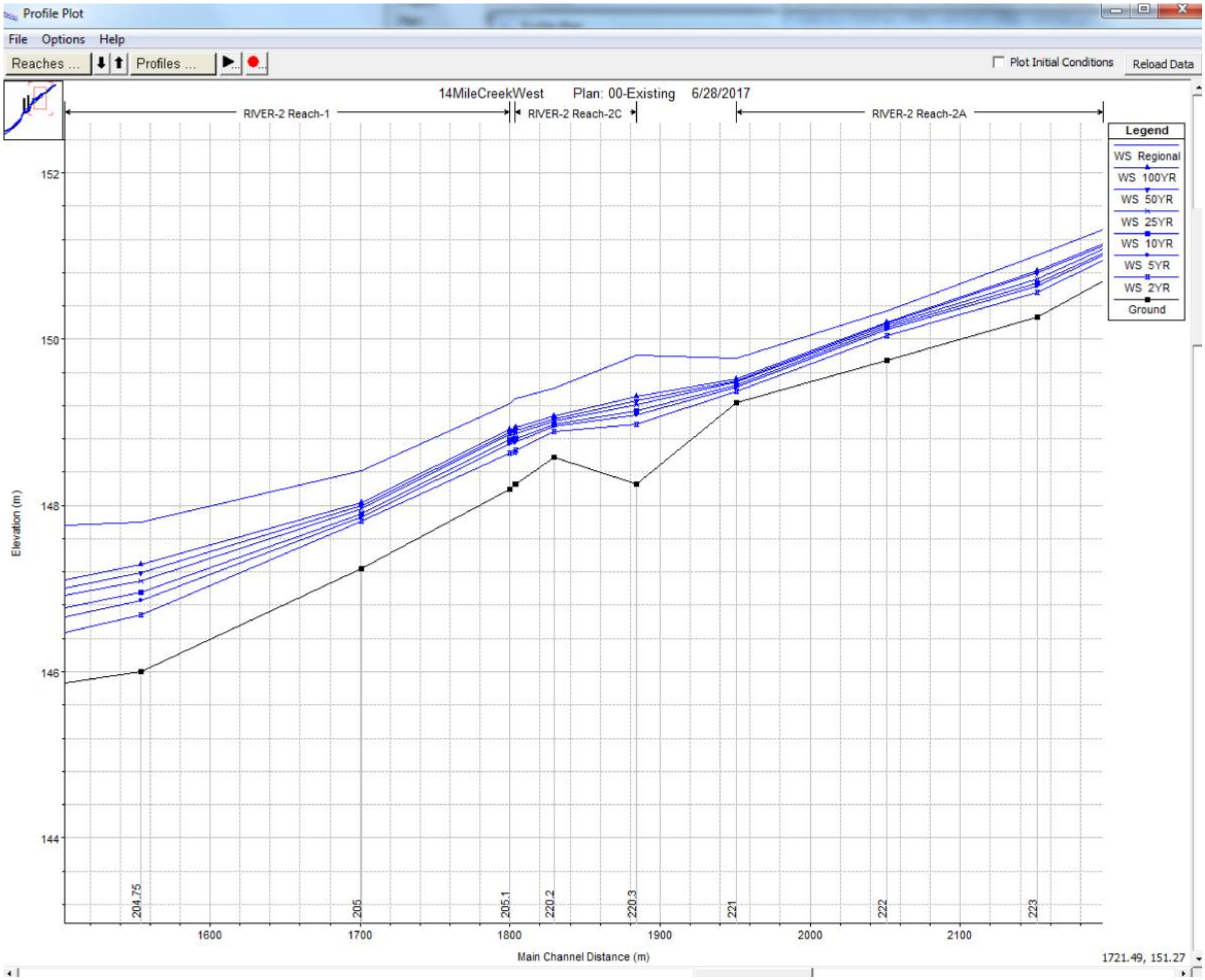
Profile Plot
File Options Help
Reaches ... Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 08-Ultimate Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2B
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Right Levee
Elevation (m)
150
149
148
147
146
145
204.75
205
205.1
220.2
220.3
231
1500
1600
1700
1800
1900
Main Channel Distance (m)

Profile of XS 204.75, 205, 205.1, 220, 220.1, 220.2, 220.3, 221, 222

for Existing condition



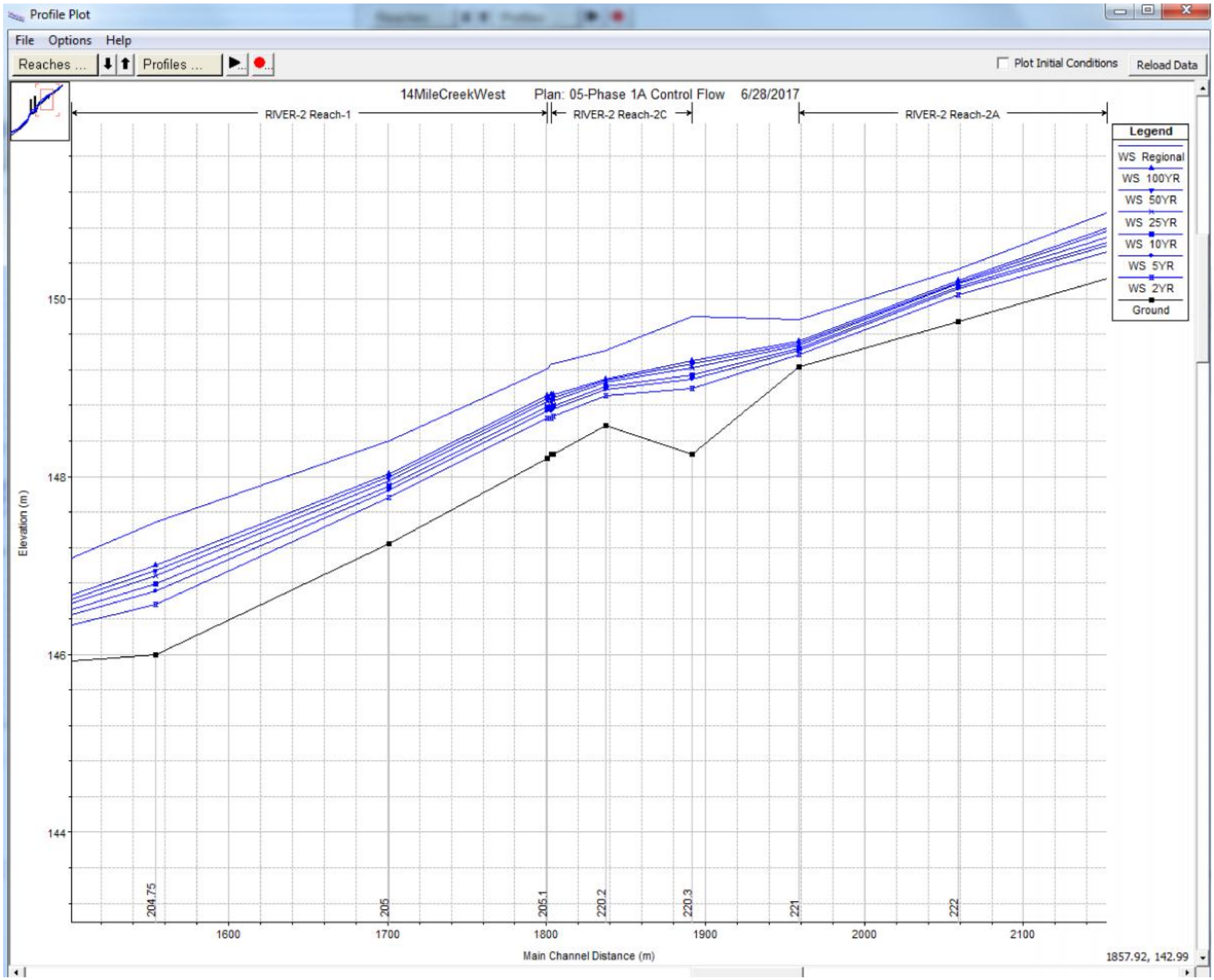
6.6.1-Floodline Mapping-Existing-...
208
152.2
14W-16
222
150.3
221
149.95
207
151.05
220.3
149.80
231
149.80
231.1
149.80
1B
2C
1
2
206.3
150.46
206.2
150.29
206.1
149.9
205.1
149.22
220.1
149.29
220.2
149.41
220
149.28
205
148.41
14W-12
204.75
147.79
8
150.51
7
147.85
5
ZENON DRIVE


Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 00-Existing 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2A
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Elevation (m)
152
150
148
146
144
204.75
205
205.1
220.2
220.3
221
222
223
1600
1700
1800
1900
2000
2100
Main Channel Distance (m)
1721.49, 151.27

Profile of XS 204.75, 205, 205.1, 220, 220.1, 220.2, 220.3, 221, 222

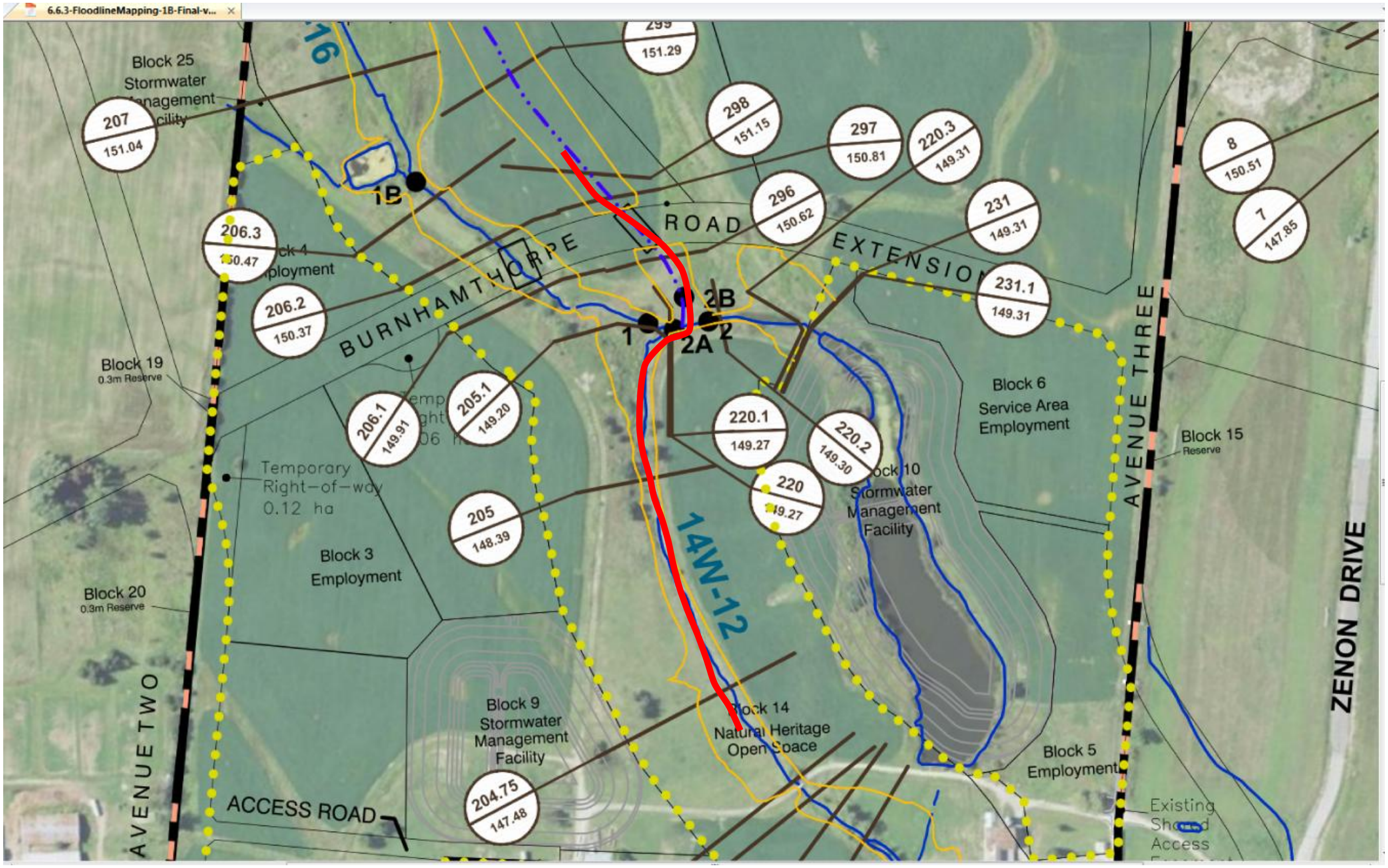
for Phase 1A condition

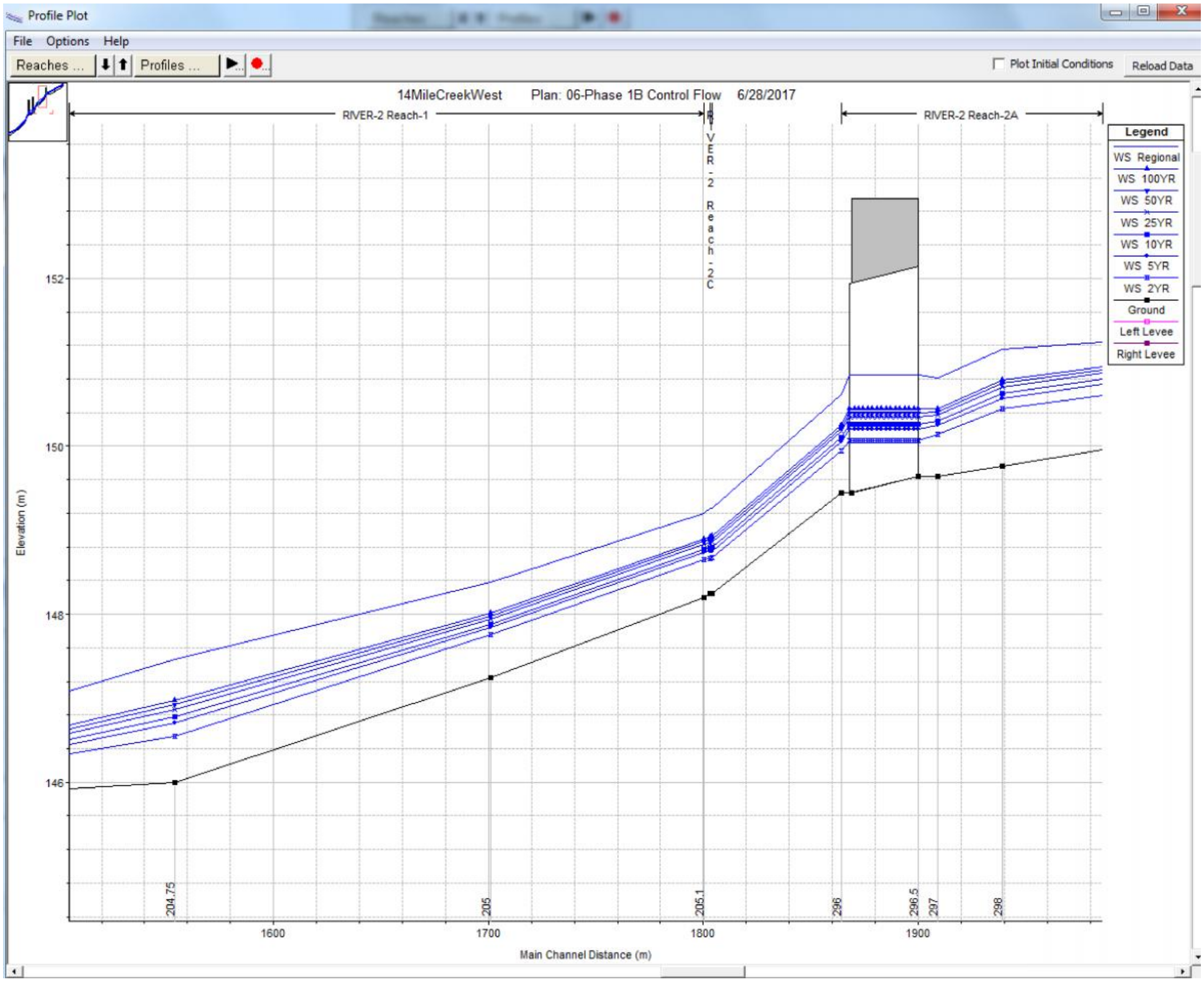
6.6.2-FloodlineMapping-1A-Final-v...


Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 05-Phase 1A Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2A
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Elevation (m)
150
148
146
144
204.75
205
205.1
220.2
220.3
221
222
1600
1700
1800
1900
2000
2100
Main Channel Distance (m)
1857.92, 142.99

Profile of XS 204.75, 205, 205.1, 220, 220.1, 296, 297 and 298

for Phase 1B condition

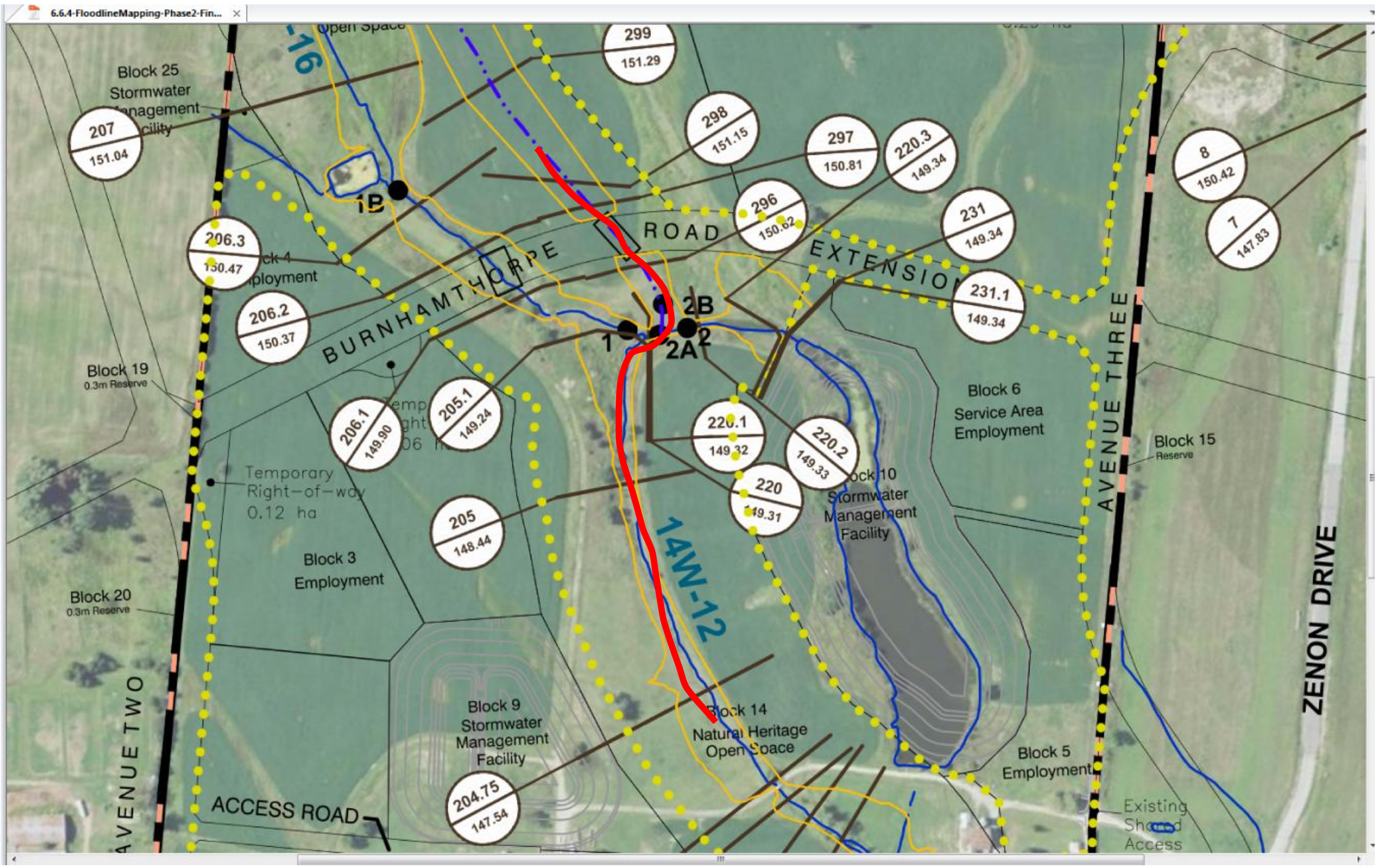

6.6.3-FloodlineMapping-1B-Final-v...
Block 25
Stormwater
Management
Facility
207
151.04
299
151.29
298
151.15
297
150.81
220.3
149.31
296
150.62
231
149.31
231.1
149.31
8
150.51
7
147.85
206.3
150.47
Block 4
Employment
206.2
150.37
BURNHAMTHORPE ROAD EXTENSION
1B
1
2
2A
2B
Block 19
0.3m Reserve
206.1
149.91
205.1
149.20
220.1
149.27
220.2
149.30
220
149.27
205
148.39
Temporary
Right-of-way
0.12 ha
Block 3
Employment
Block 10
Stormwater
Management
Facility
Block 6
Service Area
Employment
Block 15
Reserve
14W-12
AVENUE THREE
ZENON DRIVE
Block 20
0.3m Reserve
Block 9
Stormwater
Management
Facility
204.75
147.48
Block 14
Natural Heritage
Open Space
Block 5
Employment
ACCESS ROAD
AVENUE TWO
Existing
Shared
Access

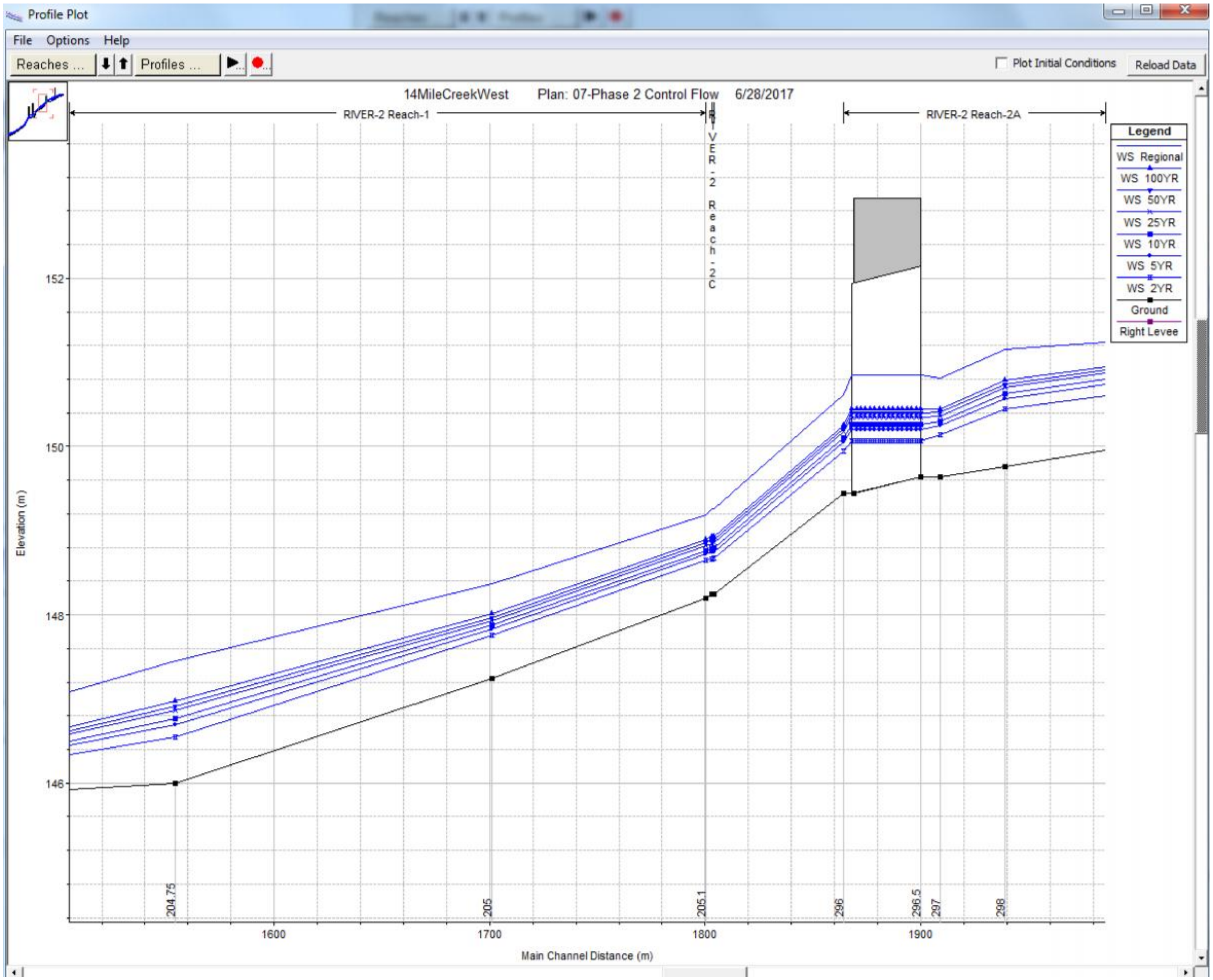


Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 06-Phase 1B Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2A
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Left Levee
Right Levee
Elevation (m)
152
150
148
146
204.75
205
205.1
296
296.5
297
298
1600
1700
1800
1900
Main Channel Distance (m)

Profile of XS 204.75, 205, 205.1, 220, 220.1, 296, 297 and 298

for Phase 2 condition

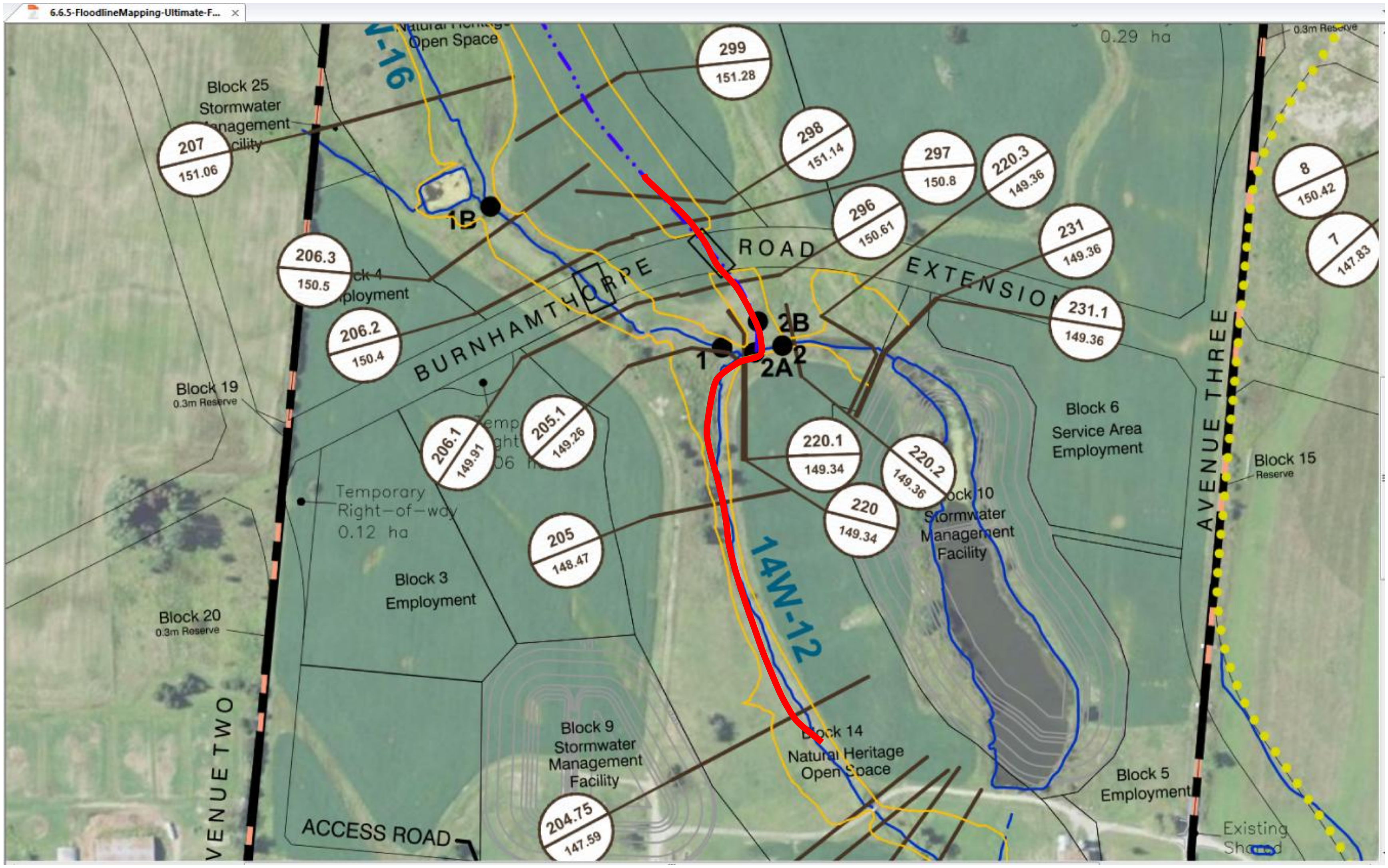

6.6.4-FloodlineMapping-Phase2-Fin...
Open Space
-16
Block 25
Stormwater
Management
Facility
207
151.04
299
151.29
298
151.15
297
150.81
220.3
149.34
296
150.62
231
149.34
8
150.42
7
147.83
1B
206.3
150.47
Block 4
Employment
206.2
150.37
BURNHAMTHORPE
ROAD
EXTENSION
231.1
149.34
2B
1
2
2A
Block 19
0.3m Reserve
206.1
149.90
205.1
149.24
220.1
149.32
220.2
149.33
220
149.31
Block 6
Service Area
Employment
AVENUE THREE
Block 15
Reserve
Temporary
Right-of-way
0.12 ha
Block 10
Stormwater
Management
Facility
205
148.44
14W-12
Block 3
Employment
Block 20
0.3m Reserve
ZENON DRIVE
AVENUE TWO
Block 9
Stormwater
Management
Facility
Block 14
Natural Heritage
Open Space
Block 5
Employment
ACCESS ROAD
204.75
147.54
Existing
Shared
Access

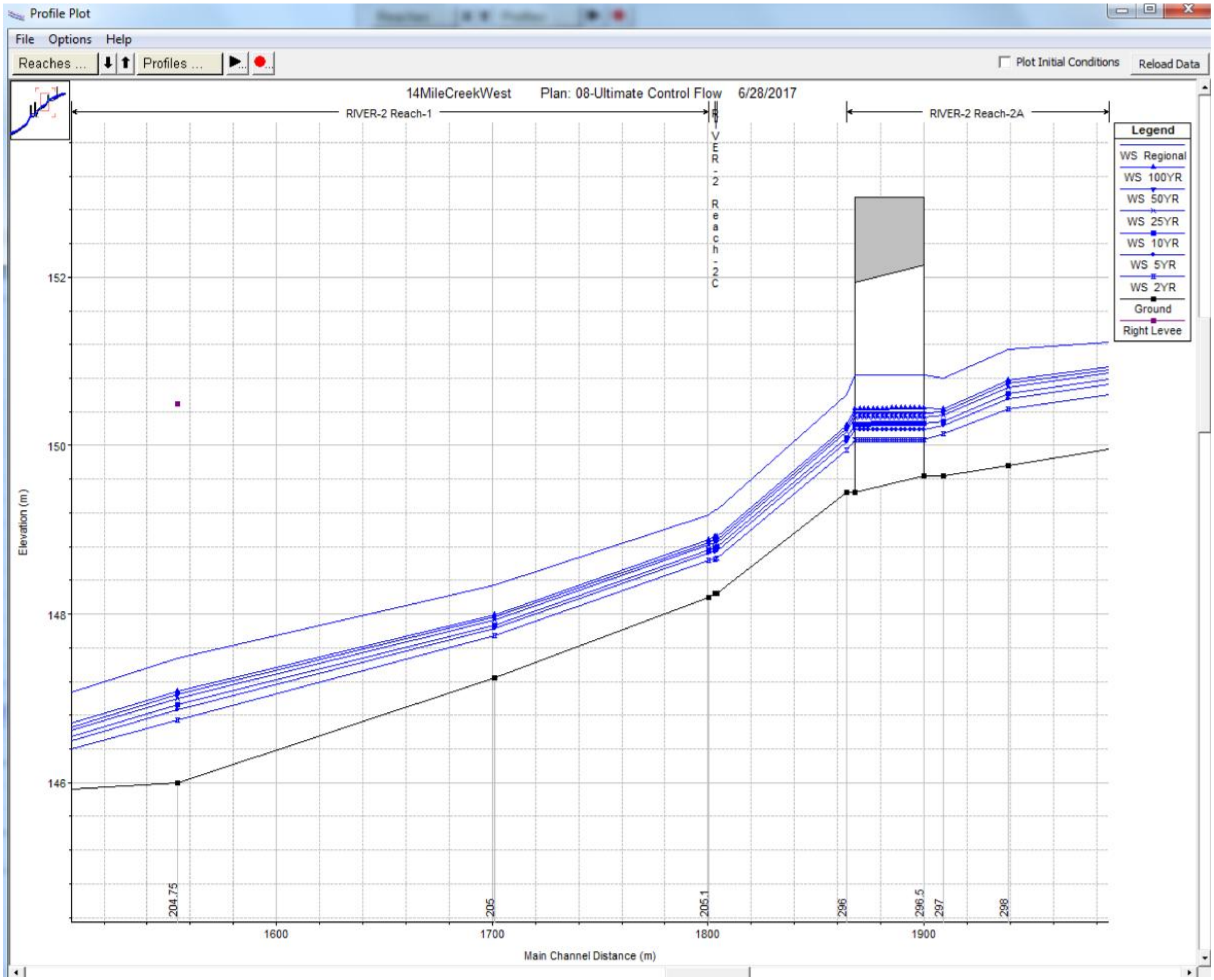


Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 07-Phase 2 Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2A
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Right Levee
Elevation (m)
152
150
148
146
204.75
205
205.1
296
296.5
297
298
1600
1700
1800
1900
Main Channel Distance (m)

Profile of XS 204.75, 205, 205.1, 220, 220.1, 296, 297 and 298

for Ultimate condition


6.6.5-FloodlineMapping-Ultimate-F...
Open Space
Block 25
Stormwater
Management
Facility
299
151.28
298
151.14
297
150.8
220.3
149.36
296
150.61
207
151.06
8
150.42
7
147.83
231
149.36
231.1
149.36
206.3
150.5
206.2
150.4
1B
1
2A
2B
2
BURNHAMTHORPE
ROAD
EXTENSION
Employment
Block 19
0.3m Reserve
Block 6
Service Area
Employment
206.1
149.91
205.1
149.26
220.1
149.34
220.2
149.36
220
149.34
Block 10
Stormwater
Management
Facility
Temporary
Right-of-way
0.12 ha
0.29 ha
0.3m Reserve
205
148.47
14W-12
Block 3
Employment
Block 15
Reserve
Block 20
0.3m Reserve
AVENUE THREE
AVENUE TWO
Block 9
Stormwater
Management
Facility
Block 14
Natural Heritage
Open Space
Block 5
Employment
204.75
147.59
ACCESS ROAD
Existing
Shed



Profile Plot
File Options Help
Reaches ... Profiles ...
Plot Initial Conditions
Reload Data
14MileCreekWest Plan: 08-Ultimate Control Flow 6/28/2017
RIVER-2 Reach-1
RIVER-2 Reach-2C
RIVER-2 Reach-2A
Legend
WS Regional
WS 100YR
WS 50YR
WS 25YR
WS 10YR
WS 5YR
WS 2YR
Ground
Right Levee
Elevation (m)
152
150
148
146
204.75
205
205.1
296
296.5
297
298
1600
1700
1800
1900
Main Channel Distance (m)