Rideau Valley Conservation Authority
3889 Rideau Valley Drive, PO Box 599, Manotick, Ontario, Canada | 613-692-3571 | www.rvca.ca

Technical Memorandum

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Subject: **Tay River Flood Risk Mapping from Glen Tay Road to Lower Rideau Lake**

Lead Investigator[1]: Ferdous Ahmed, Ph.D., P.Eng.
Senior Water Resources Engineer

Contributing staff: Stephanie Schreiner, Engineering Assistant
Ewan Hardie, GIS Coordinator
Perry Ghioureliotis, GIS Specialist
Chris Czerwinski, GIS Specialist
Daley Mikalson, Engineering Assistant

Executive Summary

This report provides a summary of the analytical methods used and underlying assumptions applied in the preparation of flood plain mapping for the Tay River from Glen Tay Road to Lower Rideau Lake. The project has been done in accordance with the technical guidelines set out under the Canada-Ontario Flood Damage Reduction Program (FDRP) (MNR, 1986), and the technical guide for the flood hazard delineation in Ontario (MNR, 2002) as laid out by the Ontario Ministry of Natural Resources. The 1:100 year flood lines delineated here are suitable for use in the RVCA's regulation limits mapping (referred to in Section 12 of Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act.

The discharge values derived from long term simulations using the RVCA's Mike11 model of the Tay River watershed are our best estimate, at the present time, of expected flows during flood events of given return periods at given locations within the Tay River watershed, and are recommended for flood risk limit delineation by RVCA.

[1] We gratefully acknowledge the advice and guidance provided by Bruce Reid.

Introduction

This report provides a summary of the analytical methods used and underlying assumptions applied in the preparation of flood plain mapping for the Tay River from Glen Tay Road to Lower Rideau Lake. The project has been done in accordance with the technical guidelines set out under the Canada-Ontario Flood Damage Reduction Program (FDRP) (MNR, 1986), and the technical guide for the flood hazard delineation in Ontario (MNR, 2002) as laid out by the Ontario Ministry of Natural Resources. The 1:100 year flood lines delineated here are suitable for use in the RVCA's regulation limits mapping (referred to in Section 12 of Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act.

Previous Studies

Three flood mapping studies have been done on the Tay River in the past (McCormick Rankin 1971; FENCO 1981; RVCA 2010c). The McCormick Rankin study covered a 5 km reach of the river centered on the Town of Perth and was based on available hydrological and topographical information. In the absence of streamflow data, the historical water level measurements at the Perth Basin (downstream of Gore Street) were analyzed to estimate the 1:100 year flood level and then the 1:100 year flood flow. The flood elevations at other locations upstream and downstream of the Basin were estimated by using the Manning's equation. This type of mapping would be considered "approximate" by today's standards for floodplain delineation for regulation purposes (Conservation Ontario, 2005).

The FENCO study area extended from Glen Tay Road to the upstream end of the Tay Marsh. In the absence of sufficient historical streamflow records, several methods in hydrologic analysis were applied and a conservative estimate of the regulatory (1:100 year) flood discharge was applied. The water surface profile was estimated using hydraulic modeling based on good topographical mapping. The study pre-dated the FDRP program, but the analytical methods used were consistent with the standards to be met by studies done under that program. The McCormick Rankin mapping was superseded by the FENCO mapping, and the latter has been used by RVCA for regulatory purposes for the reach from Glen Tay Road to the Tay Marsh since 1981.

In 2005-06, updated topographic mapping of the Tay River corridor from Gore Street to Christie Lake was acquired under the Mississippi-Rideau Source Water Protection Program for the purpose of delineating intake protection zones associated with the Town of Perth water supply. This, together with RVCA's development of a detailed watershed model of the Tay River watershed in 2007, enabled RVCA to complete engineered flood plain mapping of the Tay River from Christie Lake to Glen Tay Road. This work was completed in 2010 and is documented in a summary report (RVCA (2010c).

The Tay River watershed model, built using the Mike11 program of the Danish Hydraulic Institute (DHI, 2003, 2004) and originally developed in 2007 (RVCA, 2007), was updated and refined in 2008 with new data on cross-sections, bridges and culverts. Estimated discharges associated with flood events with various return periods were derived from the long term synthetic stream flow data generated by the Mike11 model using flood frequency analysis and were considered to be suitable for flood mapping purposes. The resulting flood lines were adopted by the RVCA Board of Directors on December 16, 2010 as the best available estimate of the extent of flooding under regulatory flood conditions for the Tay River form Glen Tay Road to the Christie Lake outlet.

The updated flood lines generated from the present study will replace the FENCO flood plain mapping, and will be used to identify flood hazard areas for the first time on the reach from the upper end of the Tay Marsh, through the Beveridges Dam and downstream to Port Elmsley and Lower Rideau Lake. Additionally, the current study indentifies the flood hazards on a portion of Grants Creek and Jebbs Creek.

In 2008, Parks Canada's Rideau Canal Office retained GENIVAR (2008) to assess the dam safety of some of the dams along the Rideau River and its tributaries, including the Tay River. As part of this work, flood quantiles were estimated by various methods depending on the record length and quality of available data. For the Tay River at Bolingbroke and Beveridges Dams, the computation was based on transposition of longer duration data from other locations within the Rideau Basin.

Study Area

The study area extends from the Glen Tay Road to Lower Rideau Lake (see Figures 1 and 2). At the upstream end (Glen Tay Road), the present mapping was tied to the existing mapping of the Tay River determined in 2010 (RVCA, 2010c). The following streams were included in this study:

- Tay River – from Glen Tay Road to Lower Rideau Lake
- Grants Creek – from Glen Tay Road to the confluence with Tay River
- Jebbs Creek – from the Otty Lake outlet (at Rideau Ferry Road) to the confluence with the Tay River

The area mapped includes lands within the Township of Drummond-North Elmsley, the Town of Perth, and Tay Valley Township, all within Lanark County.

Topographical Mapping

High quality topography is the key to high quality flood risk mapping. For this study, digital elevation models and one metre elevation contours were derived from low altitude aerial photography.

Aerial photo: Two sets of aerial photos were used in this study – one associated with the DTM upstream of Gore Street and the other downstream (Figure 2). The aerial photo upstream of Gore Street up to Glen Tay Road was collected on May 7-8, 2005 at a scale of 1:6,000. This high quality black and white photo clearly shows the rivers, creeks, land use, houses, buildings, roads, infrastructure, vegetation and other details.

The DRAPE imagery was collected in May-July 2008 at a scale of 1:16,667. This high quality colored photo clearly shows the rivers, creeks, land use, houses, buildings, roads, infrastructure, vegetation and other details.

DTM: Base Mapping Company (2007) was commissioned by RVCA to produce a DTM from the aerial photos (Figure 2) in May 2006 for flood mapping purposes according to the specifications of the FDRP program (MNR, 1986). Contour lines were drawn at 1.0 m intervals with 0.5 m interpolated lines. Other standard layers showing houses, roads, depressions, etc. were also produced. This was done upstream of Gore Street.

Downstream of Gore Street, Aeroquest Mapcon (2012) was commissioned by RVCA to produce a DTM from the DRAPE imagery (Figure 2) for flood mapping purposes according to the specifications of the FDRP program (MNR, 1986). Contour lines were drawn at 1.0 m intervals with 0.5 m interpolated lines. Other standard layers showing bridges, depressions, etc. were also produced.

The accuracy of the topographic mapping was checked in the field by RVCA technicians. The true elevations of features on the ground that are identifiable on the mapping were determined using RVCA's survey grade GPS equipment (Trimble R8), and compared with the elevations indicated by the DTM or elevation contours, to determine that any differences between mapped and true elevations were within the accuracy prescribed by the FDRP standards.

In total, 26 spot heights and 43 contour crossings were verified (see Figure 7 and Tables 3 and 4). As described in the FDRP guidelines (MNR 1986), the spot height checks are considered satisfactory when 90% of the data points are within 0.33 m of the field measurement; for contour crossings, it is 0.50 m. As shown in Tables 3 and 4, these criteria have been adequately met.

At the few locations where these criteria are not met, changes to the landscape since the date of air photo have been identified as the probable cause of the discrepancy. Data at these locations were disregarded in the DTM verification.

Hydrological Analysis

A watershed modeling approach[2] has been taken to estimate flood discharges on the Tay River for various flood frequencies (or return periods), based on the following considerations:

- Historical streamflow data are available for the Tay River at Perth and Port Elmsley for only a limited period of record – insufficient for a standard statistical (flood frequency) analysis.
- Stream flows in the study area are influenced by the attenuating effect of natural and artificial storage in lakes and wetlands throughout the Tay River watershed.
- Runoff is contributed to the Tay River from a number of subwatersheds that connect to the river within the study area, each with its own hydrologic characteristics such as runoff volume to drainage area ratio, and hydrograph peakedness.

The RVCA's Mike11 model of the Tay River watershed was used to generate long term synthetic streamflow records at key locations within the watershed. Annual maximum flows were then extracted from the synthetic streamflow record and subjected to a statistical analysis to estimate flows for various flood frequencies at those locations.

An integrated hydrologic/hydraulic model of the Tay Watershed (Figure 3) was originally developed during 2005-2006 as reported in RVCA (2007). During the fall of 2007, sixteen bridges/culverts and a number of low flow channels were surveyed by

[2] Determining design floods using long-term watershed simulation is a relatively new approach that is increasingly being used around the world to estimate flows for ungauged basins where long-term climatic data is available. The advantages of this method and its recent uses are described by Boughton and Droop (2003), DEFRA (2005) and Lamb (2005). Advantages of this method over traditional event-based methods are numerous and varied. The main advantage is the automatic accounting of antecedent moisture condition at every time step, which is taken into account in event-based designs but in a rather arbitrary and/or conservative way. Integrated watershed models, like Mike11 used here, can also account for the heterogeneity of basins, river and lake attenuation, varied response time of basins, water control structures and their operation policies. With the development of sophisticated watershed modeling techniques and increasing computer power, this method is now being increasingly used in Europe, Australia, the United States and South Africa. At RVCA, we have started the use of continuous simulation method, and, in the last few years, have actually used it for floodplain management along the Tay River (RVCA 2010c) and various inland lakes (RVCA 2011a, 2011b, 2012a, 2012b, 2012c). RVCA's approach here is therefore consistent with contemporary works by others.

RVCA technicians. With this data (low flow channel characteristics and water crossing dimensions), the hydrodynamic or “river hydraulics” component of the Mike11 model of the Tay Watershed was updated in 2008. The details of the model are described elsewhere (RVCA, 2007) and are not repeated here.

The rainfall-runoff module of the Mike11 model, generally known as NAM after its Danish name, simulates various processes of runoff generation. The theoretical background and modeling methodology are given in DHI (2004) and DHI (2003) respectively; interested readers are referred to these documents for the full details. Very briefly, NAM represents various components of the runoff-generating phenomenon by continuously accounting for the water content in four different storages, each of which represents a different physical element of the catchment (snow, surface, lower zone and groundwater storage). Rainfall, potential evapotranspiration and temperature are needed to run the model, while nine parameters are used to characterize the physical features of the catchment such as land use, vegetation, soil type, etc. As described in RVCA (2007), the parameters have been determined through autocalibration of the entire Tay Basin at Port Elmsley gauge location, and then adjusted as warranted by local conditions for individual subwatersheds[3]. The snowmelt component of the NAM module – important for cold regions with high spring freshet – uses the simple degree-day method. Snow accumulation and melt are calculated based on the precipitation and temperature.

This updated model (called Update 2008A) was used to simulate the long-term flow series for a period from 1940 through 2007. The hydrodynamic component of the Mike 11 accounts for the hydrologic routing of flow (once it enters the river system) in channels and other significant waterbodies, including those with natural outlets (like Christie Lake) and those with man-made controls at their outlets (Bob’s Lake and the Tay Marsh). For waterbodies with artificial controls, the effect of dam operations was represented in the long-term simulation as follows:

[3] The NAM parameters for Model 2012D are listed in Table 12.

- Beveridges Dam (controls water levels on the Tay Marsh): A typical year (2001) of log operation is assumed to be valid throughout the simulation period[4].
- Bolingbroke Dam: It is assumed that the "rule curve" can be achieved every year throughout the simulation period[5].

These assumptions are considered reasonable and are not expected to skew the statistical analyses using model-generated synthetic flows. Over the long term, the main characteristics of the dams are expected to be fairly represented. This model was successfully used to estimate flood quantiles for the floodplain mapping purposes along the Tay River from the outlet of Christie Lake to Glen Tay Road (2010c).

During 2011-12, the Mike11 model was again updated with the following enhancements:

- The spill section from the Tay River to Grants Creek was included.
- At the outlet of Otty Lake (Rideau Ferry Road), the bridge was included.
- The Haggart Island Dams were included as appropriate structures in the model. The original design drawings of the dam from 1969 (Graham and Berman 1968, 1969) were used for structure dimensions.
- At the Bolingbroke Dam, due to the limitations of the modeling software, the "rule curve" was not being used by the model to set the headwater level, but was (in a crude way) used as the time-varying sill[6] level of the dam. This actually caused the lake water level to be (artificially) higher by up to 0.8 m during flood events; but lacking good record of log operation, we are unable to improve the model at this time. This distorts the simulated water level in Bobs Lake, somewhat distorts the flow released

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[4] 2001 log operations at Beveridges Dam are shown in Figure 13.

[5] The Bobs Lake Rule Curve is shown in Figure 14.

[6] Usually the term 'sill' means the bottom of the dam opening and does not change with time. However, here this term is used to describe the top edge of time-varying log setting, which is treated as the 'sill' level in the Mike11 computation.

through the dam, but the impact quickly diminishes downstream. Tests[7] showed that the effect of fully opening the Bolingbroke Dam results in approximately a 12% reduction in the 1:100 year design flood at Perth. Therefore, using the rule curve is on the conservative side.

- Additional climatic data for 2008-2011 were procured and thus the model was run from 1940 through 2011. Ignoring the first two years to avoid the initial condition effect, the 1942-2011 (70 years) data were used for the statistical analysis.
- Several other minor adjustments involving channel and floodplain roughness, bridge coding, and lateral inflows were also done.

The model computed daily time series of flow and water level along the hydrodynamic network (Figure 3). The flow data[8] were extracted at key locations (Figure 4) and were then subjected to standard flood frequency analysis. The CFA program of Environment Canada (Pilon and Harvey, 1993) was used; various frequency distributions were visually inspected to determine the most appropriate distribution at each flow calculation node. The design floods with various return periods are shown in Tables 1 and 2. The first two years of simulated data were ignored in the statistical analysis to avoid the effects of initial condition, thus leaving 70 years of data (1942 through 2011) for the flood frequency analysis.

When compared to other estimates (Figures 5 and 6), our Mike11 estimates (both 2008A and 2012D) are much lower than the FENCO (1981) estimate and slightly higher than the GENIVAR (2008) estimate. The FENCO estimates of 1:100 year flow, used for the existing Glen Tay Road to Tay Marsh flood plain mapping, was based on a 2-day snowmelt event, which produced very high ratios of peak flow to drainage area (see FENCO catchments in Figure 5). However, the reservoir routing procedure used in the

[7] See Table 13 and Figure 16.

[8] Figure 15 compares the computed and observed annual peaks of the Tay River at Perth gauge location since 2005 (yearly continuous data is available from 2005 to the present). The model both under- and overestimates. However, on the average, the model overestimates by about 12%, indicating that, in estimating the design floods, we are still on the conservative side.

FENCO modeling resulted in very high attenuation[9] (in the order of 85-98%) within the lakes[10] (except at the Beveridges Dam where the attenuation was about 10%). As a result, the FENCO flow estimates along the Tay River are low downstream of lake outlets (e.g., downstream of Bobs Lake at Bolingbroke and Christie Lake) and high elsewhere, especially near the outlet of individual basins (e.g., at Perth and upstream of Beveridges Dam).

The GENIVAR estimates, on the other hand, are based on flow transposition from other streamflow gauge locations within the Rideau watershed. These estimates are roughly 20% lower than our estimates for the 1:100 year event, but matches better for more frequent events (Figure 6). Another estimate of design floods was completed using the regression equations, recommended for flood mapping, from the FDRP (1986). These are somewhat higher than our estimates, but in general show the same trend. The values were taken from a recent report (RVCA, 2010b).

The two Mike11 estimates yield nearly identical values, with the recent version (Update 2012D) giving slightly lower values at Perth.

Taking all this into account, we consider the design flows derived from the Mike11 (2012D) model, as listed in Tables 1 and 2, most suitable for flood hazard mapping within the Tay Watershed. We recommend that these flows be used for flood risk limit delineation by RVCA.

The flows listed in Table 1 have been used in the hydraulic analysis for the flood mapping of the Tay River from Glen Tay Road to Lower Rideau Lake, Grants Creek and Jebbs Creek, as described in the following pages.

MNR (2002) recommends that the attenuating effect of temporarily detained waters upstream of road embankments should not be taken into account for the calculation of flood discharges. Therefore, a Mike11 test simulation was conducted after removing all road crossings from the river model, and the resulting estimates of the 100

[9] Flood attenuation is the reduction of flood flow peak that occurs when the flood passes through a lake or a long river reach. In the case of the lakes, the attenuation is made possible by the large storage provided by the lakes. Attenuation is generally defined as the ratio of flow reduction to the incoming flow.

[10] Dynamic routing by Mike11 indicates only moderate attenuation through lakes (in the order of 5-20%).

year flood discharge were almost identical to those derived from the original model, but slightly lower for the more frequent flood events[11]. Based on this comparison, attenuation of flood discharges and storage above existing road embankments is of little consequence in the regulatory flood analysis for the Tay River.

Hydraulic Computations

Following standard procedures (MNR, 1986; USACE, 1990, 2010), a steady-state hydraulic model of the Tay River, Grants Creek and Jebbs Creek was built. The HEC-RAS model (version 4.1.0) developed by the US Army Corps of Engineers (USACE, 2010) was used. This has the same back water calculation procedure as HEC-2 (USACE, 1990) which has been the industry standard since the 1970s, but with improved data processing and graphical capabilities.

Cross-Sections: River and flood plain cross-sections – the basic building blocks of hydraulic models – were generated from the high quality DTM using standard GIS software. For the most part, this procedure captured the floodplain as well as the low flow channel in sufficient detail to be used in floodplain mapping. However, in some places, a substantial portion of the low flow channel was under water. The channel bed elevation data from the FENCO (1981) study was used when appropriate; otherwise field surveys of the low flow channel were conducted to supplement the DTM-generated profile. The surveying was conducted by RVCA staff between 2009 and 2012. In the vicinity of the Haggart Island Dams, the low flow channel was surveyed by Aquafor Beech as part of a planning and design process for rehabilitation of those structures, with assistance from RVCA staff, on October 6, 2011.

In total, 204 cross-sections were used in the model. Distances between sections along the stream center and left and right overbanks were calculated using GIS software. Bridges and culverts were inserted at appropriate locations.

Channel Roughness: Following standard procedures (Chow, 1959), the resistance of the channel under possible high water conditions was estimated from aerial photos and

[11] See Table 13 and Figure 16.

occasional field inspections. The Manning's roughness coefficient was generally 0.035 in the main channel, and varied from 0.05 to 0.08 for the floodplains. These values were consistent with those found appropriate in earlier studies (FENCO, 1981), and were confirmed by the calibration process.

Measured Flow: As already mentioned, the flow measurements at Perth and Port Elmsley were not directly used in the flood mapping. However, they were used indirectly in the calibration and validation of the watershed model.

High Water Level: During the 2012 spring freshet, measurements of water level at 15 road crossings along the Tay River and Grants Creek were taken (Table 5). These data were used in the calibration of the hydraulic models.

Bridges/Culverts: There are 20 bridges and culverts (Table 6) crossing the streams within the study area. Their physical dimensions and other pertinent data were collected by ground survey, or taken from other sources when appropriate. The survey was conducted by RVCA staff in the summer of 2011 and 2012. The coefficients of contraction and expansion associated with bridges/culverts were estimated from available information using standard procedures (USACE, 1990, 2010).

The design flows from the hydrologic analysis (discussed above), with return periods ranging from 2 to 500 years (Table 7), were used in the HEC-RAS model. The boundary conditions, i.e., water levels (Table 8) at the downstream end (Tay River, Lower Reach, Cross-section 92), were taken or estimated from a recent report on Lower Rideau Lake (RVCA 2012b). As such, the water surface profiles for the Tay River below Port Elmsley are based on an assumption that peak flows during extreme flood events on the Tay River coincide with maximum flood levels on Lower Rideau Lake, and in general, when the Tay River is experiencing a flood event of a given return period, Lower Rideau Lake will also be experiencing a flood event of that return period. All confluences and junctions were designated as internal junctions with matching water levels in accordance with accepted procedures (USACE, 1990, 2010).

Once the model was set up, the computed profiles and other parameters were scrutinized to assess the reasonableness of model outputs. Special attention was given to the computed water level and energy profiles near bridges and culverts. Adjustments of model parameters – mainly the channel resistance and contraction and expansion coefficients – were made as necessary.

Using the measured water level data on March 9, 2012, the model was calibrated, mainly by adjusting the Manning's roughness coefficient (Figure 8 and Table 5). Some mismatch between the observed and computed water level was apparent upstream of Beveridges and the Haggart Island Dams. These differences were subsequently attributed to:

a) the fact that stop logs were in place at the Beveridges Dam during the March 9, 2012 water level measurement, whereas the HEC-RAS model simulated the dam as being fully opened (all stop logs removed from the sluices); and

b) at the Haggart Island Dams, the HEC-RAS model used the original dam geometry (as it was constructed in 1971), while in reality the present deteriorated condition of the dam allows for a lower upstream water level for any given flow rate. Further simulations, using adjusted model inputs regarding the state of the dams at the time of the March 9, 2012 water levels yielded computed water levels matching closely to the measured water levels. Therefore the HEC-RAS model was considered adequately calibrated.

Once calibrated, the model was run with the design floods. The 1:100 year computed water surface elevations and other parameters are shown in Table 9. A few typical water surface profiles and all cross-sections are included in Appendix A.

Computed water surface elevations for various flood events with return periods ranging from 2 to 500 years are presented in Tables 10 and 11. It should be pointed out that the model has been built and calibrated to simulate the 1:100 year flood levels; therefore the water surface elevations for other events – simulated using the same parameters, especially the Manning's roughness coefficient – are only approximate, and should be used with caution. This is because the river roughness varies with flow magnitude, with higher resistance associated with lower flows.

In addition to the calibration using water level data, the validity of the HEC-RAS model was further evaluated in two other ways. First, the computed water levels were checked with those computed by the Mike11 model at several key locations (Figure 9). It should be noted that, in some cases, the locations were not exactly the same. Moreover, HEC-RAS is a steady-state model where the energy equation is solved by the standard step method, whereas Mike11 is a fully unsteady model that solves the full dynamic equation. Considering these important points, the HEC-RAS simulation is seen to be corroborated well by the Mike11 simulation, often by a difference less than 15-20 cm.

Secondly, the stage-discharge relationship at the Perth Gauging Station (02LA024) was assessed (Figure 10). The rating curve (obtained from Environment Canada's Water Survey of Canada office) and the measurements on which the curve is based are compared to the rating curve that can be constructed by plotting the HEC-RAS-generated water levels against flood flows. Also plotted are the rating curves generated by the Mike11 model. Both the HEC-RAS and Mike11 data points reasonably match the WSC rating curve (within 15-20 cm). This indicates that the computational error, if any, is not unacceptably high for the design event. It should be noted that a portion of the differences between the WSC rating curve and the HEC-RAS and Mike11 modeled curves is attributable to the deterioration of the Haggart Island Dams. The HEC-RAS and Mike11 models use the original geometry of the Haggart Island Dams whereas the most recent version of the WSC rating curve reflects the hydraulic characteristics of the structures in their present deteriorated state.

A sensitivity analysis was conducted to determine how much the computed water surface elevations will change with changes in the value used for the 1:100 year discharge. Six flow conditions were tested:

- 1:100 year flow increased by 10%
- 1:100 year flow increased by 20%
- 1:100 year flow increased by 30%
- 1:100 year flow decreased by 10%
- 1:100 year flow decreased by 20%

- 1:100 year flows decreased by 30%

Figures 11 and 12 show the computed water surface profiles and the differences in computed water levels for each condition. Figure 12 indicates that the computed water surface elevations are more sensitive to the discharge value, near the bridges, the increase in water level is minimal, due to the constriction and high velocity, and thus the dominance of inertia in relation to bed resistance. However, the bridge constriction should not be counted on for the subdued change in water level, since the modification or removal of a bridge can cause the water level to bounce back to the “normal position”.

The sensitivity analysis indicates that the computed water level can vary by about 10 to 20 cm for a 20% variation in flow, which is typical in the hydrologic estimation of design flow. For a 30% increase in flow, the water level can go up by 25 to 35 cm at some locations. At Port Elmsley Road Bridge, the water level is very sensitive to the flow, as can be seen by an almost one metre variation.

The sensitivity analysis has demonstrated that the RVCA’s policy of requiring a minimum of 0.30 centimetres of freeboard in the design of flood-proofing measures for buildings and structures within or adjacent to flood prone areas will generally be sufficient. It also provides an indication of the potential effect of changes in the expected flood flows that might result from more gradual trends such as climate change.

Selection of Regulatory Flood Levels

As per Section 3 of the Provincial Policy Statement under the Planning Act (MMAH, 2005), the regulatory flood in Zone 2, which includes the RVCA, is the 1:100 year flood. Depending on the local hydraulic conditions, the computed water surface elevation, the energy grade or a value in between is generally taken as the Regulatory Flood Level (RFL). Engineering judgment is applied to recommend an appropriate value for the regulatory flood level at each cross-section, using the model outputs and considering hydraulic characteristics of the river reach, and the inherent limitations of the numerical model.

When the stream velocity is relatively low and varies only gradually over relatively long river reaches, the water surface can generally be taken as the RFL.

However, near bridges, culverts and other water control structures and on steeper reaches where streamflow velocities are higher, and may change more abruptly, the computed water surface elevation may be substantially lower than the energy grade level, with the possibility that the water level may rise to the energy grade near obstacles and irregularities in the channel profile or cross-section which may not be represented in the hydraulic model. In such cases, the regulatory flood level is generally based on the computed energy grade as a conservative approach, given that the numerical model is less likely to be a true representation of reality in such situations.

Another possible situation arises when the computed water surface profile is undulating, with downstream water levels occasionally higher than upstream levels. When this occurs it is more often an artifact from the simplifying assumptions of the modeling scheme than a reliable prediction of the actual differences in streamflow velocity and depth (and hence energy state) from one cross-section to the next. Accordingly, the regulatory flood level at the upstream cross-section is taken to be equivalent to the downstream water surface elevation in these situations.

In all cases, the RFL is always between the computed water level and energy grade line. Hence, for the sake of simplicity and consistency, the energy grade elevation is often used as the RFL as a standard practice in delineating flood hazard areas.

For the present study, the regulatory flood levels were set equal to the computed energy grade and are tabulated in Table 9, along with the computed water surface elevations and energy grades at each cross-section in the model.

Flood Line Delineation

Once the RFLs are established, the plotting of 1:100 year flood lines or flood risk limits is a relatively straightforward matter. Given the topographical information in the form of contour lines at 0.5 m interval, the inundated area below the RFLs can be easily delineated manually or by using automated computer programs. In the present case, it was done manually because of the complexities of the topography and flow paths. However, this was cross-checked with the flood lines generated using the HEC-GeoRAS program version 4.3.93 (USACE, 2011), which has the ability to plot flood lines on topographical maps. This gave us an additional degree of quality control.

The regulatory flood lines and cross-sections have been incorporated as separate layers in RVCA's Geographical Information System (GIS). In this system, one can view the flood lines, cross-sections, design flow, water level, energy grade, RFL, and other computed parameters. The flood lines can be overlain on the aerial photography or any other base mapping layers that are in the system and at any scale that suits the user's need.

The regulatory flood line layer is maintained, and updated as required according to the established procedures of the RVCA (RVCA 2005).

The regulatory flood levels and associated flood risk limits reported here were estimated for the 'open water' or ice-free conditions. Water surface elevations for a given river discharge can be affected by river ice conditions during the periods of ice formation and break-up, resulting in higher flood levels or more extensive flooded areas. These effects are usually localized, and have not been taken into account in the modeling scheme used for flood plain mapping purposes. In this study area, ice conditions are known by RVCA personnel to have affected water levels at two locations:

a) in the Port Elmsley vicinity:

   upstream of the Port Elmsley Road Bridge, with the accumulation of anchor ice in cold weather and open water conditions, reducing the cross-sectional conveyance capacity of the river and elevated upstream water levels; and

   downstream of the Port Elmsley Bridge, as a result of frazil (slush) ice being deposited on the underside of the ice sheet covering the downstream bay between Port Elmsley and Lower Rideau Lake, and reducing the flow capacity under the ice sheet. When this condition occurs it causes the upstream water level to increase and top flooding of the ice sheet. On occasion the river's flow has been known to find relief via an alternative overland flow route through a nearby subdivision on the south side of the river channel.

b) downstream of Glen Tay Road – elevated water levels causing some overbank flooding have been reported in the past on the reach just downstream of the Glen Tay Road Bridge and are suspected to have resulted from anchor ice and frazil ice generation/deposition on the downstream channel.

Where river ice conditions are known to have contributed to high water levels, appropriate considerations should be given to incorporating additional freeboard allowances in the design of flood-proofing measures for structures near or in flood vulnerable areas, and care should be taken to avoid closing off overland flow routes that are available as alternative relief channels when the main river channel's capacity is compromised due to ice formation.

Public Consultation

An open house was held on December 11, 2012 at the Public Library in Perth. The draft flood maps showing flood risk and regulation limit lines were shown to the public. The technical steps involved in the mapping process were explained. How the flood maps are used by the RVCA and the municipalities was also discussed. The open house was attended by 26 members of the public as well as four RVCA Board Members and three municipal staff. The open house was well received and appreciated by the public. No major issue was identified at the open house. A few helpful suggestions were received and were taken care of afterwards. Several local residents offered anecdotal accounts of high water situations and/or ice-induced flooding situations in the past, which corroborated the validity of our modeling results. In general, the extent of the flood hazard areas identified through this study was considered to be reasonable and consistent with the personal experience and observations of local residents who attended the open house.

Project Deliverables

The key information or knowledge products generated from this project are:

1) The Flood Mapping Report (this Technical Memorandum) – which summarizes the analytical methods that were used and the underlying assumptions

2) The flood risk limit lines in GIS format (shape files) – identifying the extent of lands which are considered to be vulnerable to flooding during a regulatory flood event (1:100 year flood on the Tay River)

3) The HEC-RAS model files (input and output)

   - One file for high flows (50 to 500 year return periods)
   - One file for low flows (2 to 20 year return periods)

4) The position and orientation of cross-sections used in the HEC-RAS model, in GIS format (shape files) – which, when used in conjunction with the HEC-RAS model output files and Table 9, informs the user as to the estimated 1:100 year water surface elevation and the regulatory flood level for any location in the study area

A "documentation folder" containing working notes and relevant background information accumulated during the study process is maintained by the water resources engineering unit within RVCA's Watershed Science and Engineering Services department.

Closure

The discharge values derived from long term simulations using the RVCA's Mike11 model of the Tay River watershed, as listed in Tables 1 and 2, are our best estimate, at the present time, of expected flows during flood events of given return periods at given locations within the Tay River watershed. These flows should be used for flood risk limit delineation by RVCA throughout the Tay Watershed.

The hydrotechnical and cartographic procedures used in this study generally conform to present day standards for flood hazard delineation, as set out in the MNR's Natural Hazards Technical Guide (MNR, 2002). The resulting 1:100 year flood lines are suitable for use in the RVCA's regulation limits mapping (referred to in Section 12 of Ontario Regulation 174/06) and in municipal land use planning and development approval processes under the Planning Act. The water surface profiles generated in the study will also be of valuable use in the flood forecasting and warning services provided by the RVCA.

Ferdous Ahmed, Ph.D., P.Eng.

Senior Water Resources Engineer

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Table 1: Summary of Flood Flows at Various Locations in the Tay Watershed, within the Study Area (Model: Tay Update 2012D)

	Tay River at Glen Tay Road (d/s)	Tay River u/s of 1st Private Crossing (d/s of Glen Tay Rd)	Tay River d/s of Blueberry confluence	Tay River u/s of Grants confluence	Tay River at Perth (WSC gauge: 02LA024)	Tay River d/s of Craig Street	Tay River near Sewage Lagoon	Tay River d/s of Jebbs confluence	Tay River at Beveridges Dam (u/s)	Tay River at Port Elmsley	Grants Creek at Glen Tay Road	Spill Section from Tay to Grants Creek	Grants Creek at outlet	Otty Lake outlet at Rideau Ferry Rd	Jebbs Creek at outlet
Extraction Point ID:	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**GC1**	**Sp1**	**GC2**	**OL**	**JC**
ID (2010 Report):	**T6**	**Point 2**	**Point 3**	**Point 7**	**T7**	**Point 4**	**Point 5**	**Point 6**	**T8**	**T9**	**Point 1**	**Point 8**	**GC**	**OL**	**JC**
Return Period (years)															
1.003	8.4	9.5	10.7	10.7	11.5	11.9	12.4	14.3	16.3	17.0	2.1	-	1.5	1.0	2.0
1.05	15.0	15.6	17.3	17.3	19.7	20.2	20.8	23.1	25.0	25.7	2.9	-	3.1	1.2	2.3
1.25	21.7	21.3	23.6	23.6	27.9	28.4	29.1	31.9	33.7	34.5	3.7	0.1	4.8	1.5	2.7
2	30.6	28.6	31.5	31.5	38.7	39.4	40.3	43.7	45.3	46.3	4.8	2.4	7.4	2.0	3.2
5	42.9	37.9	41.7	41.7	53.5	54.3	55.4	59.9	61.5	62.6	6.1	5.6	11.6	2.6	4.0
10	51.2	43.7	48.1	48.1	63.3	64.3	65.6	70.7	72.4	73.7	6.9	7.7	14.9	3.1	4.6
20	59.3	48.9	54.0	54.0	72.8	73.9	75.5	81.2	83.1	84.5	7.7	9.8	18.5	3.5	5.2
50	70.1	55.4	61.3	61.3	85.2	86.5	88.4	95.0	97.2	98.9	8.6	12.5	23.8	4.1	5.9
100	**78.3**	**60.1**	**66.5**	**66.5**	**94.6**	**96.1**	**98.1**	**105.0**	**108.0**	**110.0**	**9.4**	**14.5**	**28.4**	**4.6**	**6.5**
200	86.6	64.5	71.6	71.6	104.0	106.0	108.0	116.0	119.0	121.0	10.1	16.6	33.6	5.1	7.1
500	97.9	70.1	77.9	77.9	117.0	118.0	121.0	130.0	134.0	136.0	11.0	19.4	41.6	5.7	7.9
9-Mar-12**	12.3	12.8	14.2	14.2	16.2	16.6	17.1	18.9	20.5	21.1	2.4	-	2.5	-	1.9
Adopted Distribution*	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***GEV***	***3PLN***	***3PLN***	***GEV***	***3PLN***	***3PLN***

*Flood frequency distributions used: GEV (Gumbel Extreme Value), 3PLN (Three Parameter Log Normal), LP III (Log Pearson III), and Wakeby (WBY)

**Observed flow recorded at Perth (02LA024) and, for all other locations, proportional flow calculated using the 1.05 yr return period ($Q_{Mar9}=Q_{Mar9@Perth}*Q_{1.05}/Q_{1.05@Perth}$)

Table 2: Summary of Flood Flows at Various Locations in the Tay Watershed, outside of Study Area (Model: Tay Update 2012D)

	Bolingbroke Dam (d/s)	Christie Lake Inlet	Christie Lake Outlet	Tay River u/s of bifurcation (Scotts Snye)	West Branch just after bifurcation	East Branch just after bifurcation	Centre of West Branch	East Branch before source point	Catchment TayC1 outlet (source point)	West bifurcated flow near confluence	East bifurcated flow near confluence	Tay River at confluence (d/s Scotts Snye)	Tay River at OMYA Water Intake	Tay River prior to Rudsdale Creek	Rudsdale Creek Outlet	Crosby Lake outlet	Little Crosby Lake outlet	Pike Lake outlet
Extraction Point ID:	**T**	**T0**	**T1**	**T2**	**T2W**	**T2E**	**T2WC**	**TE1**	**TE2**	**TW3**	**TE3**	**T3**	**T4**	**T5**	**C6**	**CL**	**LC**	**PL**
ID (2010 Report):	**T**	**T0**	**T1**	**T2**	**T2L**	**T2R**	**T2LC**	**TE1**	**TE2**	**T3_**	**TE3**	**T3**	**T4**	**T5**	**C6**	**CL**	**LC**	**PL**
Return Period (years)																		
1.003	9.5	10.2	10.8	11.1	7.5	3.5	7.6	3.6	0.8	7.4	4.7	6.0	6.4	6.5	2.1	0.8	1.2	-
1.05	13.7	14.7	14.9	15.2	10.4	4.8	10.5	4.9	1.1	8.2	5.4	12.2	12.6	12.6	2.9	0.9	1.4	2.1
1.25	17.9	19.2	19.2	19.6	13.5	6.1	13.7	6.1	1.4	11.0	7.2	18.3	18.7	18.8	3.8	1.2	1.8	2.8
2	23.3	25.1	25.0	25.5	17.7	7.8	17.9	7.8	1.8	17.7	9.3	26.5	26.9	27.0	4.8	1.5	2.3	3.6
5	30.3	32.5	32.8	33.5	23.2	10.3	23.4	10.2	2.3	27.6	12.1	37.7	38.1	38.3	6.2	1.9	3.0	4.7
10	34.7	37.2	37.8	38.7	26.8	11.9	27.1	11.9	2.7	33.1	14.1	45.3	45.6	45.8	7.1	2.2	3.4	5.3
20	38.7	41.5	42.6	43.6	30.2	13.6	30.5	13.6	3.0	37.2	16.2	52.6	53.0	53.2	8.0	2.5	3.9	5.9
50	43.8	47.0	48.8	49.9	34.5	15.8	34.9	15.8	3.4	41.2	18.8	62.2	62.7	62.9	9.0	2.9	4.5	6.6
100	**47.5**	**51.0**	**53.4**	**54.6**	**37.7**	**17.5**	**38.2**	**17.6**	**3.7**	**43.4**	**20.8**	**69.5**	**70.0**	**70.2**	**9.8**	**3.2**	**5.0**	**7.2**
200	51.2	54.9	58.0	59.4	41.0	19.2	41.4	19.4	4.0	45.1	22.8	76.8	77.4	77.7	10.5	3.5	5.4	7.7
500	56.1	60.1	64.2	65.7	45.3	21.5	45.8	21.9	4.4	46.7	25.4	86.6	87.4	87.6	11.4	3.9	6.0	8.3
9-Mar-12**	11.2	12.1	12.2	-	-	-	-	-	-	-	-	-	-	10.3	2.4	-	-	-
Adopted Distribution*	***3PLN***	***3PLN***	***3PLN***	***3PLN***	***3PLN***	***GEV***	***3PLN***	***GEV***	***GEV***	***WBY***	***WBY***	***GEV***	***GEV***	***GEV***	***GEV***	***WBY***	***WBY***	***GEV***

*Flood frequency distributions used: GEV (Gumbel Extreme Value), 3PLN (Three Parameter Log Normal), LP III (Log Pearson III), and Wakeby (WBY)

**Observed flow recorded at Perth (02LA024) and, for all other locations, proportional flow calculated using the 1.05 yr return period ($Q_{Mar9}=Q_{Mar9@Perth}*Q_{1.05}/Q_{1.05@Perth}$)

Table 3: Field Verification of Spot Heights

	Contours from 2012 DTM			2012 RVCA Field Survey									
Location ID	X (m)	Y (m)	Z (m)	X (m)	Y (m)	Z (m)	Horizontal Accuracy (m)	Vertical Accuracy (m)	Date/Time	Field Observations	Δ Z (m)	Δ Z (cm)	Δ > 0.33m
4003-1	402187.00	4976770.00	142.84	402186.96	4976770.01	142.90	0.007	0.010	6/25/2012 10:10		0.055	5.5	
4008-1	401556.00	4976000.00	141.58	401556.05	4976000.02	141.81	0.010	0.015	6/25/2012 10:28		0.233	23.3	
3263-1	400944.00	4974770.00	138.64	400943.98	4974770.01	139.01	0.006	0.009	6/25/2012 10:46	Off the road, in the driveway	0.370	37.0	Y
3461-1	400332.00	4973730.00	139.55	400331.99	4973730.00	139.74	0.004	0.007	6/25/2012 11:06		0.187	18.7	
3374-1	401341.00	4973390.00	134.20	401341.01	4973389.98	134.23	0.007	0.011	6/25/2012 11:22		0.026	2.6	
3437-1	400942.00	4973850.00	136.23	400941.99	4973850.00	136.15	0.005	0.008	6/25/2012 11:33		-0.080	-8.0	
3347-1	401628.00	4973640.00	135.75	401628.02	4973640.02	135.72	0.007	0.012	6/25/2012 11:48		-0.034	-3.4	
3369-1	401861.00	4973380.00	133.45	401861.03	4973380.03	133.59	0.006	0.009	6/25/2012 12:02		0.140	14.0	
4189-1	401675.00	4972780.00	132.44	401674.99	4972779.99	132.53	0.007	0.013	6/25/2012 12:19		0.089	8.9	
4342-1	402187.00	4972570.00	132.17	402186.97	4972569.96	132.06	0.010	0.017	6/25/2012 12:36		-0.112	-11.2	
4208-1	402097.00	4972530.00	132.40	402096.99	4972530.02	132.20	0.005	0.007	6/25/2012 12:53		-0.201	-20.1	
4221-1	402122.00	4972340.00	133.86	402122.00	4972339.98	133.79	0.008	0.013	6/25/2012 13:38		-0.072	-7.2	
4242-1	402194.00	4972020.00	135.88	402194.01	4972020.00	136.04	0.010	0.013	6/25/2012 13:55		0.160	16.0	
4279-1	402156.00	4971290.00	139.05	402155.99	4971290.03	138.97	0.008	0.015	6/25/2012 14:17		-0.081	-8.1	
4145-1	401404.00	4972300.00	134.25	401404.03	4972300.01	134.26	0.010	0.018	6/25/2012 15:13		0.006	0.6	
1449-1	411430.00	4971540.00	128.05	411429.88	4971540.06	128.01	0.012	0.020	6/26/2012 11:26	Road resurfaced	-0.045	-4.5	
1445-1	411355.00	4971270.00	130.61	411355.02	4971270.01	130.61	0.008	0.013	6/26/2012 11:44		0.000	0.0	
371-1	410786.00	4969900.00	125.84	410786.00	4969900.03	125.88	0.009	0.017	6/26/2012 12:25		0.035	3.5	
3052-1	408649.00	4970740.00	131.42	408648.98	4970740.01	131.37	0.007	0.011	6/26/2012 13:12		-0.049	-4.9	
343-1	409870.00	4969800.00	135.14	409869.98	4969799.96	135.16	0.012	0.019	6/26/2012 13:32	Road resurfaced	0.022	2.2	
342-1	409816.00	4969730.00	134.85	409816.00	4969730.02	135.03	0.008	0.012	6/26/2012 13:42		0.178	17.8	
613-1	405520.00	4968640.00	140.66	405519.95	4968639.98	140.90	0.011	0.020	6/26/2012 14:38		0.239	23.9	
54-1	404571.00	4968840.00	147.84	404571.01	4968840.01	147.90	0.011	0.017	6/26/2012 15:05		0.055	5.5	
1639-1	404215.00	4969560.00	137.92	404214.96	4969560.01	137.86	0.011	0.015	6/26/2012 15:15		-0.060	-6.0	
1633-1	404384.00	4969170.00	135.78	404384.01	4969170.03	135.93	0.008	0.011	6/26/2012 15:22		0.154	15.4	
105	404715.00	4969630.00	133.91	404705.88	4969634.67	133.81	n/a	n/a	7/2/2010 0:00		-0.102	-10.2	
											Max Δ Z:	**37.0**	1 'Yes' out of 26
											Mean Δ Z:	**4.3**	
											Min Δ Z:	**-20.1**	

Discarded Points

2164-2	403140.00	4970440.00	137.21	403140.03	4970439.96	137.58	0.010	0.019	6/25/2012 14:38	Difficult to locate, dirt road	0.374	37.4	Y
4700-1	404429.00	4973740.00	137.89	404428.97	4973740.02	138.23	0.007	0.010	6/26/2012 10:26	Curb added, new asphalt	0.342	34.2	Y
3234-1	410523.00	4971790.00	132.11	410523.00	4971790.02	131.65	0.009	0.014	6/26/2012 10:56	Spot in grassed area,	-0.464	-46.4	Y
1219-1	409424.00	4969410.00	134.17	409423.99	4969410.02	134.61	0.009	0.014	6/26/2012 14:04	Road Resurfaced	0.436	43.6	Y

Table 4: Field Verification of Contour Crossings

Location ID	Contours from 2012 DTM X (m)	Y (m)	Z (m)	2012 RVCA Field Survey X (m)	Y (m)	Z (m)	Horizontal Accuracy (m)	Vertical Accuracy (m)	Date/Time	Field Observations	Δ Z (m)	Δ Z (cm)	Δ > 0.5m
4003-con			143.5	402207.39	4976822.86	143.496	0.007	0.010	6/25/2012 10:13		-0.004	-0.4	
4008-con-1			141.0	401554.66	4975830.94	140.982	0.007	0.011	6/25/2012 10:35		-0.018	-1.8	
3263-con			139.0	400950.62	4974769.51	139.147	0.005	0.008	6/25/2012 10:51		0.147	14.7	
3461-con			139.5	400335.82	4973730.71	139.739	0.005	0.009	6/25/2012 11:09		0.239	23.9	
3374-con			134.5	401326.64	4973369.92	134.509	0.005	0.009	6/25/2012 11:24		0.009	0.9	
3437-con			137.0	400962.98	4973825.38	136.739	0.005	0.009	6/25/2012 11:35		-0.261	-26.1	
3347-con			135.5	401623.03	4973636.47	135.713	0.007	0.012	6/25/2012 11:49		0.213	21.3	
3369-con			133.5	401813.75	4973433.79	133.604	0.005	0.007	6/25/2012 11:58		0.104	10.4	
4189-con			132.5	401719.42	4972798.91	132.700	0.007	0.014	6/25/2012 12:22		0.200	20.0	
4342-con			132.0	402163.42	4972561.14	132.266	0.007	0.013	6/25/2012 12:39		0.266	26.6	
4342-con-1			132.0	402161.62	4972558.84	132.078	0.007	0.013	6/25/2012 12:40		0.078	7.8	
4342-con-2			132.0	402163.33	4972561.57	132.280	0.007	0.012	6/25/2012 12:40		0.280	28.0	
4342-con-3			132.0	402164.72	4972563.24	132.283	0.007	0.012	6/25/2012 12:41	Goes into a gravel spot/area	0.283	28.3	
4342-con-4			132.0	402166.27	4972565.14	132.256	0.007	0.012	6/25/2012 12:41		0.256	25.6	
4342-con-5			132.0	402167.85	4972567.17	132.181	0.008	0.014	6/25/2012 12:42		0.181	18.1	
4342-con-6			132.0	402169.46	4972568.47	132.152	0.008	0.014	6/25/2012 12:42		0.152	15.2	
4208-con			133.0	402052.37	4972549.66	132.619	0.007	0.010	6/25/2012 12:55		-0.381	-38.1	
4221-con			133.5	402146.00	4972356.99	133.485	0.009	0.012	6/25/2012 13:40		-0.015	-1.5	
4242-con			136.5	402201.06	4972014.67	136.103	0.009	0.012	6/25/2012 13:57		-0.397	-39.7	
4279-con1			139.5	401975.38	4971489.69	139.359	0.009	0.015	6/25/2012 14:21		-0.141	-14.1	
4279-con2			139.5	401974.94	4971491.07	139.388	0.008	0.014	6/25/2012 14:21		-0.112	-11.2	
4279-con3			139.5	401974.47	4971492.19	139.402	0.008	0.014	6/25/2012 14:22		-0.098	-9.8	
4279-con4			139.5	401974.04	4971493.35	139.414	0.008	0.013	6/25/2012 14:22	Slightly away from contour	-0.086	-8.6	
4279-con5			139.5	401973.61	4971494.62	139.409	0.007	0.013	6/25/2012 14:22		-0.091	-9.1	
4279-con6			139.5	401973.16	4971496.06	139.381	0.007	0.012	6/25/2012 14:23		-0.119	-11.9	
4279-con7			139.5	401972.84	4971496.97	139.379	0.007	0.012	6/25/2012 14:23		-0.121	-12.1	
2164-con2			138.0	403110.81	4970412.71	138.185	0.011	0.020	6/25/2012 14:55		0.185	18.5	
4145-con1			135.0	401365.76	4972274.12	135.293	0.011	0.017	6/25/2012 15:16		0.293	29.3	
4700-2			139.0	404382.69	4973708.22	139.002	0.006	0.009	6/26/2012 10:30		0.002	0.2	
3234-con1			132.0	410486.65	4971780.43	132.007	0.009	0.014	6/26/2012 10:58		0.007	0.7	
3234-con2			132.0	410487.75	4971780.49	132.013	0.009	0.014	6/26/2012 10:58		0.013	1.3	
3234-con3			132.0	410488.49	4971780.50	132.015	0.009	0.014	6/26/2012 10:59		0.015	1.5	
3234-con4			132.0	410489.16	4971780.52	132.020	0.009	0.014	6/26/2012 10:59	Slightly away from contour	0.020	2.0	
3234-con5			132.0	410489.75	4971780.46	132.021	0.009	0.014	6/26/2012 11:00		0.021	2.1	
3234-con6			132.0	410490.48	4971780.51	132.021	0.009	0.014	6/26/2012 11:00		0.021	2.1	
3234-con7			132.0	410491.47	4971780.50	132.052	0.009	0.015	6/26/2012 11:01		0.052	5.2	
1449-con1			128.0	411413.17	4971522.35	127.803	0.013	0.020	6/26/2012 11:33		-0.197	-19.7	
1445-con2			130.0	411368.63	4971240.59	129.755	0.009	0.015	6/26/2012 11:47		-0.245	-24.5	
371-con1			125.0	410838.38	4969908.70	124.921	0.009	0.015	6/26/2012 12:28		-0.079	-7.9	
343-con			135.0	409865.87	4969791.88	135.145	0.009	0.015	6/26/2012 13:36		0.145	14.5	
1219-con1			135.0	409405.74	4969386.13	135.176	0.009	0.016	6/26/2012 14:10		0.176	17.6	
1639-con1			140.0	404221.69	4969602.85	139.922	0.010	0.014	6/26/2012 15:16		-0.078	-7.8	
1633-con			136.0	404380.07	4969171.94	136.155	0.009	0.013	6/26/2012 15:22		0.155	15.5	
											Max Δ Z:	29.3	0 'Yes' out of 43
											Mean Δ Z:	2.5	
											Min Δ Z:	-39.7	

Discarded Points

4242-con5			137.0	402208.06	4972004.48	136.295	0.009	0.014	6/25/2012 14:03	Old road (possible re-grading)	-0.705	-70.5	Y
613-con1			140.0	405542.31	4968656.00	140.712	0.010	0.020	6/26/2012 14:44	Dirt road (possible re-grading)	0.712	71.2	Y

Table 5: Observed vs Computed Water Level on March 9, 2012

Location/Structure	Cumulative Channel Length	Surveyed WL at structures on March 9, 2012	Computed WL (HEC-RAS 2013)	$(WL_{HEC-RAS}) - (WL_{Obs})$	Computed EG (HEC-RAS 2013)	$(EG_{HEC-RAS}) - (WL_{Obs})$	Notes
	(m)	WL_{Obs} (m)	$WL_{HEC-RAS}$ (m)	(m)	$EG_{HEC-RAS}$ (m)	(m)	
TAY RIVER							
Lower Rideau Lake	5	123.42	123.42	0.00	123.42	0.00	User-defined boundary condition
Port Elmsley Bridge (d/s)	2012	124.42	124.09	-0.34	124.43	0.01	
Port Elmsley Bridge (u/s)	2030	124.64	124.55	-0.09	124.72	0.08	
Beveridges Dam (u/s)	5960	130.91	130.58	-0.33	130.59	-0.32	Beveridges Dam modelled with no logs in; whereas in reality logs were in place
Craig St Bridge (d/s)	13269	131.21	131.33	0.12	131.33	0.13	
Craig St Bridge (u/s)	13285	131.20	131.33	0.13	131.34	0.13	
Beckwith St Bridge (d/s)	13750	131.20	131.34	0.15	131.35	0.15	
Beckwith St Bridge (u/s)	13760	131.27	131.35	0.09	131.36	0.10	
Drummond St Br (d/s)	13915	131.30	131.37	0.07	131.37	0.07	
Drummond St Br (u/s)	13936	131.16	131.37	0.21	131.37	0.21	
Gore St Bridge (d/s)	14081	131.21	131.37	0.15	131.38	0.17	
Gore St Bridge (u/s)	14102	131.21	131.38	0.16	131.39	0.18	
Roger St Bridge (d/s)	14673	133.26	133.57	0.31	133.57	0.32	Haggart Dams modelled as per 1971 design - actual dam configuration has deteriorated.
Roger St Bridge (u/s)	14700	133.27	133.57	0.30	133.58	0.31	
Peter St Bridge (d/s)	15150	133.32	133.58	0.26	133.61	0.28	
Peter St Bridge (us)	15170	133.35	133.62	0.27	133.62	0.27	
Golf Course Bridge (d/s)	15935	133.46	133.64	0.18	133.64	0.18	
Private Crossing #3 (d/s)	18290	134.20	134.34	0.13	134.40	0.20	
Private Crossing #3 (u/s)	18305	134.23	134.41	0.19	134.47	0.24	
Private Crossing #2 (d/s)	18760	134.24	134.50	0.27	134.53	0.29	
Private Crossing #1 (d/s)	19195	134.16	134.56	0.39	134.57	0.41	
Private Crossing #1 (u/s)	19220	134.18	134.57	0.39	134.58	0.40	
Glen Tay Rd Bridge (d/s)	21358	134.57	134.93	0.35	134.93	0.35	
Glen Tay Rd Bridge (u/s)	21378	134.73	134.96	0.23	135.04	0.32	
GRANTS CREEK							
Glen Tay Road (d/s)	5015	134.20	134.24	0.04	134.28	0.08	

Table 6: Bridges and Culverts

River/Reach	Name/Location	Bridge/ Culvert	Chainage (m)	Bounding Cross Sections	Upstream Invert (m)	Down-stream Invert (m)	Upstream Obvert (m)	Downstream Obvert (m)	Width (m)	Height (m)	Length (m)	Source
Grants Creek/Reach 2	Glen Tay Road	B	880	885 & 860	133.53	133.58	135.78	135.78	17	2.25	6	- Road Profile from McIntosh Perry Drawing (Nov 1, 2002) - Structure surveyed by RVCA (October 27, 2011)
Jebbs Creek/Reach 1	Rideau Ferry Road	B	3308	3329 & 3270	130.996	130.904	133.616	133.616	14	2.712	6	- RVCA Survey, June 10, 2011
Little Tay/Reach 1	Pedestrian Bridge	B	25	33 & 15	130.498	130.498	131.8	131.8	1.5	1.302	6.21	- RVCA Survey, Nov 7, 2011
Little Tay/Reach 1	Drummond Street	C	108	123 & 65	131.63	131.63	133.411	133.529	28	1.7	6	- RVCA Survey, Nov 7, 2011 (with logs in just before culvert; therefore height of culvert has been artificially reduced on the US/DS side)
Little Tay/Reach 1	Gore Street Bridge	C	260	268 & 232	131.323	131.25	134.771	134.583	20	2.6	9	- RVCA Survey, Nov 7, 2011
Little Tay/Reach 2	C. D. Cavers Pedestrian Bridge	B	115	118 & 104	131.41	131.417	133.404	133.404	2	1.994	9	- RVCA Survey, Oct 28, 2011
Tay Bypass/Reach 1	Mill Street Bridge	B	43	47 & 31	130.642	130.792	132.342	132.332	8	1.7	9.75	- RVCA Survey, Nov 7, 2011
Tay Bypass/Reach 1	Pedestrian Bridge	B	196.5	198 & 191	131.001	130.831	132.6	132.6	2	1.769	8	- RVCA Survey, Nov 16, 2012
Tay/Lower Reach	Port Elmsley Road Bridge	B	2112	2128 & 2103	123.315	123.086	123.913	123.799	14	0.713	12	- RVCA Survey, May 1, 2012
Tay/Reach 2	Craig Street Bridge	B	4237	4246 & 4213	128.874	128.93	132.9	132.9	15	4.026	36	- RVCA Survey, Sept 15, 2011
Tay/Reach 2	Beckwith Street Bridge	B	4712	4722 & 4694	128.884	128.844	132.844	132.844	6	4	35	- RVCA Survey, Sept 15, 2011 and Nov 7, 2011
Tay/Reach 3	Drummond Street Bridge	B	14	28 & 1	128.621	128.621	134	134	11	5.379	41	- RVCA Survey, Oct 28, 2011
Tay/Reach 3	Gore Street Bridge	B	178	193 & 146	129.042	129.082	133	133	18	3.958	18	- RVCA Survey, Oct 28, 2011
Tay/Reach 5	Roger Street Bridge	B	109	136 & 101	130.859	130.832	135.57	135.57	13	4.738	20	- RVCA Survey, Oct 28, 2011
Tay/Reach 6	Peter Street Bridge	B	195	203 & 175	131.7	132.148	134.9	134.9	9	3.2	18.29	- Design Drawings (Harmer Podolak Engineering Consultants Inc., 25/06/07) - RVCA Survey, Sept 15, 2011
Tay/Reach 6	WTP Service Bridge (by Golf Course)	B	983	984 & 982	132.744	132.744	134.03	134.03	4	1.286	8.4	- RVCA Survey, June 8, 2010
Tay/Reach 6	Private Crossing (3rd d/s of Glen Tay Rd)	B	3331	3340 & 3312	132.824	133.278	134.5	134.5	5	1.676	12	- RVCA Survey, October 27, 2011
Tay/Reach 6	Private Crossing (2nd d/s of Glen Tay Rd)	B	3803	3815 & 3791	131.914	131.992	134.8	134.8	5	2.886	10	- RVCA Survey, September 15, 2011
Tay/Reach 6	Private Crossing (1st d/s of Glen Tay Rd)	B	4239	4250 & 4225	132.511	131.957	135	135	5	3.043	15.5	- RVCA Survey, October 27, 2011
Tay/Reach 7	Glen Tay Rd Bridge	B	533	544 & 512	133.592	133.935	136.7	136.7	11	3.108	20	- RVCA Survey, Sept 15, 2011

Table 7: Design Flows in HEC-RAS Model

River	Reach	Station ID	Return Period/Event 2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr	9-Mar-12
Grants Creek	**Reach 2**	**1038**	4.8	6.1	6.9	7.7	8.6	9.4	10.1	11.0	2.4
Grants Creek	**Reach 1**	**4747**	7.4	11.6	14.9	18.5	23.8	28.4	33.6	41.6	2.5
Grants Spillway	**Reach 1**	**650**	2.4	5.6	7.7	9.8	12.5	14.5	16.6	19.4	0.0
Jebbs Creek	**Reach 1**	**3506**	3.2	4.0	4.6	5.2	5.9	6.5	7.1	7.9	1.9
Little Tay	**Reach 2***	**347**	19.7	27.2	32.2	37.0	43.3	48.1	53.0	59.0	8.3
Little Tay	**Reach 1***	**390**	9.9	13.6	16.1	18.5	21.6	24.0	26.5	29.5	4.1
Tay Bypass	**Reach 1***	**217**	9.9	13.6	16.1	18.5	21.6	24.0	26.5	29.5	4.1
Tay River	**Reach 7**	**544**	30.6	42.9	51.2	59.3	70.1	78.3	86.6	97.9	12.3
Tay River	**Reach 6**	**5855**	28.6	37.9	43.7	48.9	55.4	60.1	64.5	70.1	12.8
Tay River	**Reach 6**	**4250**	31.5	41.7	48.1	54.0	61.3	66.5	71.6	77.9	14.2
Tay River	**Reach 6**	**2545**	31.5	41.7	48.1	54.0	61.3	66.5	71.6	77.9	14.2
Tay River	**Reach 6**	**80**	31.5	41.7	48.1	54.0	61.3	66.5	71.6	77.9	14.2
Tay River	**Reach 5**	**399**	38.7	53.5	63.3	72.8	85.2	94.6	104.0	117.0	16.2
Tay River	**Reach 4***	**227**	19.7	27.2	32.2	37.0	43.3	48.1	53.0	59.0	8.3
Tay River	**Reach 3***	**321**	29.6	40.7	48.2	55.4	64.9	72.1	79.5	88.5	12.4
Tay River	**Reach 2**	**4842**	39.4	54.3	64.3	73.9	86.5	96.1	106.0	118.0	16.6
Tay River	**Reach 2**	**4213**	40.3	55.4	65.6	75.5	88.4	98.1	108.0	121.0	17.1
Tay River	**Reach 2**	**2450**	43.7	59.9	70.7	81.2	95.0	105.0	116.0	130.0	18.9
Tay River	**Reach 1**	**3360**	45.3	61.5	72.4	83.1	97.2	108.0	119.0	134.0	20.5
Tay River	**Lower Reach**	**5841**	45.3	61.5	72.4	83.1	97.2	108.0	119.0	134.0	20.5
Tay River	**Lower Reach**	**2128**	46.3	62.6	73.7	84.5	98.9	110.0	121.0	136.0	21.1

*** User input displayed - Split Flow Analysis was performed with HEC-RAS therefore computed flows are displayed in the output.**

Table 8: Downstream Boundary Condition at Lower Rideau Lake

Return Period/ Date	Boundary Condition at Lower Rideau Lake (m)	Comment/Source
2	**123.95**	Upper Conservation Level of Big/Lower Rideau Lake - Source: Parks Canada
5	124.08	Interpolated
10	124.18	Interpolated
20	124.28	Interpolated
50	124.41	Interpolated
100	**124.51**	1:100 year Regulatory Flood Level on Big/Lower Rideau Lake - **Source:** Analysis of Regulatory Flood Level on the Shoreline of Big/Lower Rideau Lake, for the purposes of administering Ontario Regulation 174/06, **RVCA 2012**
200	124.61	Extrapolated
500	124.74	Extrapolated
9-Mar-12	123.42	Observed Data from **Parks Canada** gauge (02LA014), Rideau River at Rideau Ferry

Table 9: Regulatory Flood Levels for 1:100 Year Flood Event

River/Creek	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Tay River	Lower Reach	92	110	124.51	124.51	124.51
	Lower Reach	395	110	124.51	124.52	124.52
	Lower Reach	600	110	124.52	124.52	124.52
	Lower Reach	859	110	124.53	124.53	124.53
	Lower Reach	1172	110	124.54	124.54	124.54
	Lower Reach	1508	110	124.55	124.57	124.57
	Lower Reach	1694	110	124.58	124.61	124.61
	Lower Reach	1932	110	124.65	124.68	124.68
	Lower Reach	2016	110	124.53	124.84	124.84
	Lower Reach	2080	110	124.91	124.99	124.99
	Lower Reach	2103	110	125.45	126.48	126.48
	Lower Reach	2112	Port Elmsley Bridge			
	Lower Reach	2128	110	126.66	127.12	127.12
	Lower Reach	2151	108	127.13	127.26	127.26
	Lower Reach	2198	108	127.17	127.35	127.35
	Lower Reach	2280	108	127.39	127.41	127.41
	Lower Reach	2364	108	127.41	127.43	127.43
	Lower Reach	2470	108	127.3	127.56	127.56
	Lower Reach	2603	108	127.82	128.09	128.09
	Lower Reach	2741	108	128.42	128.66	128.66
	Lower Reach	2884	108	128.93	129.06	129.06
	Lower Reach	3075	108	129.27	129.37	129.37
	Lower Reach	3333	108	129.51	129.55	129.55
	Lower Reach	3555	108	129.59	129.61	129.61
	Lower Reach	3740	108	129.46	129.8	129.8
	Lower Reach	3958	108	130.62	130.8	130.8
	Lower Reach	4180	108	131.02	131.09	131.09
	Lower Reach	4602	108	131.28	131.32	131.32
	Lower Reach	5035	108	131.47	131.5	131.5
	Lower Reach	5080	108	131.5	131.53	131.53
	Lower Reach	5259	108	131.57	131.58	131.58
	Lower Reach	5458	108	131.61	131.62	131.62
	Lower Reach	5717	108	131.66	131.67	131.67
	Lower Reach	5774	Beveridges Dam			
	Lower Reach	5841	108	131.7	131.72	131.72
	Reach 1	56	108	131.7	131.72	131.72
	Reach 1	348	108	131.75	131.76	131.76
	Reach 1	850	108	131.79	131.79	131.79
	Reach 1	1396	108	131.82	131.82	131.82
	Reach 1	1778	108	131.84	131.85	131.85

Table 9 Continued...

River/Creek	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Tay River	Reach 1	2330	108	131.89	131.89	131.89
	Reach 1	2682	108	131.9	131.9	131.9
	Reach 1	3153	108	131.91	131.91	131.91
	Reach 1	3360	108	131.92	131.92	131.92
	Reach 2	165	105	131.9	131.95	131.95
	Reach 2	265	105	131.91	132.04	132.04
	Reach 2	356	105	132.02	132.11	132.11
	Reach 2	596	105	132.16	132.17	132.17
	Reach 2	885	105	132.19	132.2	132.2
	Reach 2	1199	105	132.22	132.23	132.23
	Reach 2	1449	105	132.23	132.24	132.24
	Reach 2	1819	105	132.27	132.29	132.29
	Reach 2	2450	105	132.38	132.41	132.41
	Reach 2	2886	98.1	132.46	132.46	132.46
	Reach 2	3415	98.1	132.49	132.51	132.51
	Reach 2	3578	98.1	132.5	132.52	132.52
	Reach 2	3724	98.1	132.52	132.54	132.54
	Reach 2	3916	98.1	132.54	132.56	132.56
	Reach 2	4080	98.1	132.55	132.59	132.59
	Reach 2	4213	98.1	132.57	132.62	132.62
	Reach 2	4237	Craig St Bridge			
	Reach 2	4246	96.1	132.58	132.64	132.64
	Reach 2	4310	96.1	132.62	132.65	132.65
	Reach 2	4386	96.1	132.63	132.66	132.66
	Reach 2	4495	96.1	132.65	132.68	132.68
	Reach 2	4570	96.1	132.66	132.69	132.69
	Reach 2	4694	96.1	132.66	132.74	132.74
	Reach 2	4712	Beckwith Bridge			
	Reach 2	4722	96.1	132.69	132.76	132.76
	Reach 2	4774	96.1	132.71	132.77	132.77
	Reach 2	4842	96.1	132.74	132.79	132.79
	Reach 3	1	85.48	132.77	132.8	132.8
	Reach 3	14	Drummond St Bridge			
	Reach 3	28	85.48	132.78	132.8	132.8
	Reach 3	81	85.48	132.8	132.81	132.81
	Reach 3	146	85.48	132.74	132.88	132.88
	Reach 3	178	Gore Street Bridge			
	Reach 3	193	85.48	132.77	132.91	132.91
	Reach 3	269	85.48	132.89	132.94	132.94
	Reach 3	321	85.48	132.9	132.95	132.95
	Reach 4	28	64.22	132.89	132.97	132.97
	Reach 4	79	64.22	132.93	132.99	132.99

Table 9 Continued...

River/Creek	Reach	Xsec ID #	Q Total (m³/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Tay River	Reach 4	182	64.22	133	133.04	133.04
	Reach 4	202	64.22	133.02	133.04	133.04
	Reach 4	215	Haggart Dam			
	Reach 4	227	64.22	134.26	134.27	134.27
	Reach 5	11	94.6	134.25	134.3	134.3
	Reach 5	56	94.6	134.27	134.31	134.31
	Reach 5	101	94.6	134.25	134.36	134.36
	Reach 5	109	Roger Street Bridge			
	Reach 5	136	94.6	134.28	134.39	134.39
	Reach 5	206	94.6	134.39	134.41	134.41
	Reach 5	320	94.6	134.4	134.43	134.43
	Reach 5	399	94.6	134.41	134.45	134.45
	Reach 6	80	66.5	134.45	134.46	134.46
	Reach 6	175	66.5	134.38	134.57	134.57
	Reach 6	195	Peter St Bridge			
	Reach 6	203	66.5	134.47	134.62	134.62
	Reach 6	342	66.5	134.65	134.65	134.65
	Reach 6	464	66.5	134.65	134.66	134.66
	Reach 6	713	66.5	134.67	134.68	134.68
	Reach 6	878	66.5	134.67	134.7	134.7
	Reach 6	933	66.5	134.69	134.71	134.71
	Reach 6	971	66.5	134.59	134.85	134.85
	Reach 6	981	Golf Course Weir			
	Reach 6	982	66.5	134.82	134.92	134.92
	Reach 6	983	WTP Service Bridge			
	Reach 6	984	66.5	134.93	135	135
	Reach 6	1005	66.5	135	135.02	135.02
	Reach 6	1084	66.5	135.03	135.04	135.04
	Reach 6	1231	66.5	135.05	135.06	135.06
	Reach 6	1524	66.5	135.07	135.08	135.08
	Reach 6	1711	66.5	135.09	135.11	135.11
	Reach 6	1861	66.5	135.12	135.15	135.15
	Reach 6	1965	66.5	135.15	135.16	135.16
	Reach 6	2097	66.5	135.16	135.17	135.17
	Reach 6	2222	66.5	135.17	135.18	135.18
	Reach 6	2373	66.5	135.19	135.21	135.21
	Reach 6	2545	66.5	135.21	135.23	135.23
	Reach 6	2728	66.5	135.25	135.26	135.26
	Reach 6	3159	66.5	135.29	135.29	135.29
	Reach 6	3312	66.5	135.3	135.37	135.37
	Reach 6	3331	Private Crossing - 3rd d/s of Glen Tay Rd			

Table 9 Continued...

River/Creek	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Tay River	Reach 6	3340	66.5	135.59	135.61	135.61
	Reach 6	3422	66.5	135.61	135.62	135.62
	Reach 6	3598	66.5	135.62	135.63	135.63
	Reach 6	3791	66.5	135.64	135.67	135.67
	Reach 6	3803	Private Crossing - 2nd d/s of Glen Tay Rd			
	Reach 6	3815	66.5	135.69	135.72	135.72
	Reach 6	3880	66.5	135.72	135.72	135.72
	Reach 6	4083	66.5	135.73	135.73	135.73
	Reach 6	4225	66.5	135.74	135.74	135.74
	Reach 6	4239	Private Crossing - 1st d/s of Glen Tay Rd			
	Reach 6	4250	66.5	135.74	135.75	135.75
	Reach 6	4304	60.1	135.74	135.75	135.75
	Reach 6	4389	60.1	135.75	135.76	135.76
	Reach 6	4500	60.1	135.75	135.76	135.76
	Reach 6	4606	60.1	135.76	135.77	135.77
	Reach 6	4795	60.1	135.77	135.79	135.79
	Reach 6	4912	60.1	135.73	135.84	135.84
	Reach 6	4989	60.1	135.85	135.88	135.88
	Reach 6	5108	60.1	135.89	135.89	135.89
	Reach 6	5151	60.1	135.88	135.9	135.9
	Reach 6	5277	60.1	135.9	135.91	135.91
	Reach 6	5432	60.1	135.91	135.91	135.91
	Reach 6	5509	60.1	135.91	135.92	135.92
	Reach 6	5700	60.1	135.92	135.93	135.93
	Reach 6	5765	60.1	135.92	135.93	135.93
	Reach 6	5855	60.1	135.93	135.94	135.94
	Reach 7	1	78.3	135.9	135.95	135.95
	Reach 7	190	78.3	136.01	136.05	136.05
	Reach 7	321	78.3	136.06	136.08	136.08
	Reach 7	434	78.3	136.08	136.09	136.09
	Reach 7	512	78.3	135.97	136.21	136.21
	Reach 7	533	Glen Tay Rd Bridge			
	Reach 7	544	78.3	136.13	136.46	Outside Study Limit
Grants Spillway	Reach 1	23	14.5	134.75	134.75	134.75
	Reach 1	151	14.5	134.76	134.76	134.76
	Reach 1	246	14.5	134.79	134.8	134.8
	Reach 1	437	14.5	135.03	135.09	135.09
	Reach 1	503	14.5	135.6	135.91	135.91
	Reach 1	560	14.5	135.94	135.94	135.94
	Reach 1	650	14.5	135.94	135.94	135.94

Table 9 Continued...

River/Creek	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Grants Creek	Reach 1	72	28.4	134.46	134.46	134.46
	Reach 1	186	28.4	134.47	134.47	134.47
	Reach 1	277	28.4	134.47	134.47	134.47
	Reach 1	383	28.4	134.48	134.49	134.49
	Reach 1	497	28.4	134.49	134.49	134.49
	Reach 1	608	28.4	134.49	134.52	134.52
	Reach 1	777	28.4	134.56	134.57	134.57
	Reach 1	985	28.4	134.57	134.57	134.57
	Reach 1	1375	28.4	134.58	134.58	134.58
	Reach 1	1823	28.4	134.58	134.58	134.58
	Reach 1	2644	28.4	134.58	134.58	134.58
	Reach 1	3145	28.4	134.59	134.59	134.59
	Reach 1	3617	28.4	134.6	134.61	134.61
	Reach 1	3992	28.4	134.62	134.63	134.63
	Reach 1	4440	28.4	134.67	134.67	134.67
	Reach 1	4747	28.4	134.74	134.75	134.75
	Reach 2	102	9.4	134.77	134.77	134.77
	Reach 2	416	9.4	134.78	134.78	134.78
	Reach 2	557	9.4	134.78	134.78	134.78
	Reach 2	781	9.4	134.82	134.83	134.83
	Reach 2	860	9.4	134.89	134.98	134.98
	Reach 2	880	Glen Tay Rd Culvert			
	Reach 2	885	9.4	135.04	135.09	135.09
	Reach 2	938	9.4	135.14	135.15	135.15
	Reach 2	1004	9.4	135.19	135.23	135.23
	Reach 2	1038	9.4	135.24	135.25	135.25
Jebbs Creek	Reach 1	215	6.49	131.93	131.93	131.93
	Reach 1	402	6.49	131.98	131.98	131.98
	Reach 1	554	6.49	132.01	132.01	132.01
	Reach 1	721	6.49	132.07	132.07	132.07
	Reach 1	878	6.49	132.16	132.17	132.17
	Reach 1	969	6.49	132.26	132.27	132.27
	Reach 1	1187	6.49	132.3	132.3	132.3
	Reach 1	1661	6.49	132.33	132.33	132.33
	Reach 1	2145	6.49	132.37	132.37	132.37
	Reach 1	2574	6.49	132.39	132.4	132.4
	Reach 1	2804	6.49	132.41	132.41	132.41
	Reach 1	3203	6.49	132.43	132.43	132.43
	Reach 1	3270	6.49	132.44	132.47	132.47
	Reach 1	3308	Rideau Ferry Rd Bridge			
	Reach 1	3329	6.49	132.61	132.64	Outside Study Limit
	Reach 1	3426	6.49	132.67	132.67	
	Reach 1	3506	6.49	132.68	132.68	

Table 9 Continued...

River/Creek	Reach	Xsec ID #	Q Total (m^3/s)	Computed WSEL (m)	EGL (m)	RFL (m)
Little Tay	Reach 1	15	10.62	132.76	132.79	132.79
	Reach 1	25	Pedestrian Bridge under Drummond St			
	Reach 1	33	10.62	132.79	132.82	132.82
	Reach 1	65	10.62	132.8	132.83	132.83
	Reach 1	108	Drummond St Bridge			
	Reach 1	123	10.62	132.96	132.99	132.99
	Reach 1	206	10.62	133.01	133.02	133.02
	Reach 1	232	10.62	133.01	133.03	133.03
	Reach 1	260	Gore St Bridge			
	Reach 1	268	10.62	133.04	133.06	133.06
	Reach 1	287	10.62	133.04	133.08	133.08
	Reach 1	390	10.62	133.1	133.11	133.11
	Reach 2	12	31.88	133.1	133.11	133.11
	Reach 2	74	31.88	133.11	133.11	133.11
	Reach 2	104	31.88	133.1	133.13	133.13
	Reach 2	115	C. Douglas Cavers Pedestrian Bridge			
	Reach 2	118	31.88	133.16	133.26	133.26
	Reach 2	188	31.88	133.3	133.32	133.32
	Reach 2	302	31.88	133.35	133.38	133.38
	Reach 2	332	31.88	133.36	133.4	133.4
	Reach 2	342	Haggart Dam			
	Reach 2	347	31.88	134.26	134.27	134.27
Tay Bypass	Reach 1	16	21.26	132.95	132.96	132.96
	Reach 1	31	21.26	132.93	132.98	132.98
	Reach 1	43	Mill St Bridge			
	Reach 1	47	21.26	132.99	133.03	133.03
	Reach 1	146	21.26	133.04	133.05	133.05
	Reach 1	191	21.26	133.03	133.08	133.08
	Reach 1	196.5	Pedestrian Bridge			
	Reach 1	198	21.26	133.04	133.1	133.1
	Reach 1	209	21.26	133.1	133.1	133.1
	Reach 1	212	Stewart Park Weir			
	Reach 1	217	21.26	133.1	133.11	133.11

NOTE:

RFL - Regulatory Flood Levels
EGL - Energy Grade Elevation
WSEL - Water Surface Elevation

Table 10: Flow and Computed Water Level for 50-Year to 500-Year Flood Events

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Tay River	Lower Reach	92	136	124.74	121	124.61	110	124.51	98.9	124.41
	Lower Reach	395	136	124.75	121	124.61	110	124.51	98.9	124.41
	Lower Reach	600	136	124.75	121	124.62	110	124.52	98.9	124.42
	Lower Reach	859	136	124.77	121	124.63	110	124.53	98.9	124.43
	Lower Reach	1172	136	124.77	121	124.64	110	124.54	98.9	124.44
	Lower Reach	1508	136	124.79	121	124.65	110	124.55	98.9	124.45
	Lower Reach	1694	136	124.82	121	124.69	110	124.58	98.9	124.48
	Lower Reach	1932	136	124.89	121	124.76	110	124.65	98.9	124.54
	Lower Reach	2016	136	124.73	121	124.62	110	124.53	98.9	124.44
	Lower Reach	2080	136	125.17	121	125.02	110	124.91	98.9	124.79
	Lower Reach	2103	136	125.77	121	125.59	110	125.45	98.9	125.31
	Lower Reach	2112	Port Elmsley Bridge							
	Lower Reach	2128	136	127.55	121	126.91	110	126.66	98.9	126.42
	Lower Reach	2151	134	127.98	119	127.4	108	127.13	97.2	126.85
	Lower Reach	2198	134	128	119	127.43	108	127.17	97.2	126.91
	Lower Reach	2280	134	128.16	119	127.63	108	127.39	97.2	127.14
	Lower Reach	2364	134	128.17	119	127.65	108	127.41	97.2	127.17
	Lower Reach	2470	134	128.07	119	127.54	108	127.3	97.2	127.06
	Lower Reach	2603	134	128.35	119	127.98	108	127.82	97.2	127.68
	Lower Reach	2741	134	128.72	119	128.53	108	128.42	97.2	128.32
	Lower Reach	2884	134	129.17	119	129.03	108	128.93	97.2	128.83
	Lower Reach	3075	134	129.52	119	129.38	108	129.27	97.2	129.17
	Lower Reach	3333	134	129.77	119	129.62	108	129.51	97.2	129.4
	Lower Reach	3555	134	129.85	119	129.7	108	129.59	97.2	129.47
	Lower Reach	3740	134	129.81	119	129.61	108	129.46	97.2	129.32
	Lower Reach	3958	134	130.67	119	130.65	108	130.62	97.2	130.57
	Lower Reach	4180	134	131.2	119	131.1	108	131.02	97.2	130.94
	Lower Reach	4602	134	131.49	119	131.37	108	131.28	97.2	131.17
	Lower Reach	5035	134	131.7	119	131.57	108	131.47	97.2	131.37
	Lower Reach	5080	134	131.72	119	131.6	108	131.5	97.2	131.39
	Lower Reach	5259	134	131.79	119	131.67	108	131.57	97.2	131.47
	Lower Reach	5458	134	131.82	119	131.7	108	131.61	97.2	131.51
	Lower Reach	5717	134	131.87	119	131.75	108	131.66	97.2	131.56
	Lower Reach	5774	Beveridges Dam							
	Lower Reach	5841	134	131.92	119	131.8	108	131.7	97.2	131.61
	Reach 1	56	134	131.92	119	131.8	108	131.7	97.2	131.6
	Reach 1	348	134	131.95	119	131.84	108	131.75	97.2	131.66
	Reach 1	850	134	131.99	119	131.87	108	131.79	97.2	131.69
	Reach 1	1396	134	132.02	119	131.9	108	131.82	97.2	131.72
	Reach 1	1778	134	132.04	119	131.93	108	131.84	97.2	131.75

Table 10 Continued...

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Tay River	Reach 1	2330	134	132.07	119	131.97	108	131.89	97.2	131.8
	Reach 1	2682	134	132.08	119	131.98	108	131.9	97.2	131.81
	Reach 1	3153	134	132.09	119	131.98	108	131.91	97.2	131.82
	Reach 1	3360	134	132.1	119	131.99	108	131.92	97.2	131.83
	Reach 2	165	130	132.08	116	131.98	105	131.9	95	131.82
	Reach 2	265	130	132.07	116	131.98	105	131.91	95	131.83
	Reach 2	356	130	132.2	116	132.1	105	132.02	95	131.93
	Reach 2	596	130	132.36	116	132.25	105	132.16	95	132.06
	Reach 2	885	130	132.4	116	132.29	105	132.19	95	132.1
	Reach 2	1199	130	132.43	116	132.31	105	132.22	95	132.13
	Reach 2	1449	130	132.44	116	132.32	105	132.23	95	132.14
	Reach 2	1819	130	132.47	116	132.36	105	132.27	95	132.17
	Reach 2	2450	130	132.59	116	132.47	105	132.38	95	132.29
	Reach 2	2886	121	132.67	108	132.55	98.1	132.46	88.4	132.37
	Reach 2	3415	121	132.69	108	132.58	98.1	132.49	88.4	132.4
	Reach 2	3578	121	132.71	108	132.59	98.1	132.5	88.4	132.41
	Reach 2	3724	121	132.72	108	132.61	98.1	132.52	88.4	132.43
	Reach 2	3916	121	132.74	108	132.63	98.1	132.54	88.4	132.45
	Reach 2	4080	121	132.76	108	132.64	98.1	132.55	88.4	132.47
	Reach 2	4213	121	132.77	108	132.66	98.1	132.57	88.4	132.48
	Reach 2	4237	Craig St Bridge							
	Reach 2	4246	118	132.78	106	132.67	96.1	132.58	86.5	132.49
	Reach 2	4310	118	132.83	106	132.71	96.1	132.62	86.5	132.52
	Reach 2	4386	118	132.85	106	132.73	96.1	132.63	86.5	132.54
	Reach 2	4495	118	132.86	106	132.74	96.1	132.65	86.5	132.55
	Reach 2	4570	118	132.87	106	132.75	96.1	132.66	86.5	132.56
	Reach 2	4694	118	132.87	106	132.76	96.1	132.66	86.5	132.57
	Reach 2	4712	Beckwith Bridge							
	Reach 2	4722	118	132.93	106	132.79	96.1	132.69	86.5	132.59
	Reach 2	4774	118	132.95	106	132.81	96.1	132.71	86.5	132.61
	Reach 2	4842	118	132.98	106	132.84	96.1	132.74	86.5	132.64
	Reach 3	1	104.05	133.02	94.03	132.88	85.48	132.77	76.91	132.66
	Reach 3	14	Drummond St Bridge							
	Reach 3	28	104.05	133.03	94.03	132.89	85.48	132.78	76.91	132.67
	Reach 3	81	104.05	133.05	94.03	132.91	85.48	132.8	76.91	132.68
	Reach 3	146	104.05	132.99	94.03	132.85	85.48	132.74	76.91	132.64
	Reach 3	178	Gore St Bridge							
	Reach 3	193	104.05	133.02	94.03	132.88	85.48	132.77	76.91	132.66
	Reach 3	269	104.05	133.17	94.03	133.01	85.48	132.89	76.91	132.77
	Reach 3	321	104.05	133.18	94.03	133.02	85.48	132.9	76.91	132.78

Table 10 Continued...

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Tay River	Reach 4	28	77.76	133.17	70.44	133.01	64.22	132.89	58.11	132.76
	Reach 4	79	77.76	133.22	70.44	133.05	64.22	132.93	58.11	132.8
	Reach 4	182	77.76	133.28	70.44	133.12	64.22	133	58.11	132.87
	Reach 4	202	77.76	133.3	70.44	133.14	64.22	133.02	58.11	132.89
	Reach 4	215	Haggart Dam							
	Reach 4	227	77.76	134.4	70.44	134.32	64.22	134.26	58.11	134.19
	Reach 5	11	117	134.39	104	134.31	94.6	134.25	85.2	134.18
	Reach 5	56	117	134.41	104	134.34	94.6	134.27	85.2	134.2
	Reach 5	101	117	134.38	104	134.31	94.6	134.25	85.2	134.19
	Reach 5	109	Roger Street Bridge							
	Reach 5	136	117	134.42	104	134.34	94.6	134.28	85.2	134.21
	Reach 5	206	117	134.58	104	134.48	94.6	134.39	85.2	134.31
	Reach 5	320	117	134.58	104	134.48	94.6	134.4	85.2	134.31
	Reach 5	399	117	134.6	104	134.5	94.6	134.41	85.2	134.33
	Reach 6	80	77.9	134.65	71.6	134.54	66.5	134.45	61.3	134.36
	Reach 6	175	77.9	134.57	71.6	134.47	66.5	134.38	61.3	134.3
	Reach 6	195	Peter St Bridge							
	Reach 6	203	77.9	134.66	71.6	134.56	66.5	134.47	61.3	134.38
	Reach 6	342	77.9	134.86	71.6	134.74	66.5	134.65	61.3	134.55
	Reach 6	464	77.9	134.87	71.6	134.75	66.5	134.65	61.3	134.55
	Reach 6	713	77.9	134.88	71.6	134.76	66.5	134.67	61.3	134.57
	Reach 6	878	77.9	134.89	71.6	134.77	66.5	134.67	61.3	134.58
	Reach 6	933	77.9	134.9	71.6	134.78	66.5	134.69	61.3	134.59
	Reach 6	971	77.9	134.67	71.6	134.69	66.5	134.59	61.3	134.49
	Reach 6	981	Golf Course Weir							
	Reach 6	982	77.9	134.93	71.6	134.9	66.5	134.82	61.3	134.74
	Reach 6	983	WTP Service Bridge							
	Reach 6	984	77.9	135.01	71.6	134.98	66.5	134.93	61.3	134.88
	Reach 6	1005	77.9	135.08	71.6	135.05	66.5	135	61.3	134.95
	Reach 6	1084	77.9	135.11	71.6	135.08	66.5	135.03	61.3	134.98
	Reach 6	1231	77.9	135.13	71.6	135.09	66.5	135.05	61.3	135
	Reach 6	1524	77.9	135.16	71.6	135.12	66.5	135.07	61.3	135.03
	Reach 6	1711	77.9	135.19	71.6	135.14	66.5	135.09	61.3	135.05
	Reach 6	1861	77.9	135.21	71.6	135.17	66.5	135.12	61.3	135.07
	Reach 6	1965	77.9	135.25	71.6	135.2	66.5	135.15	61.3	135.1
	Reach 6	2097	77.9	135.26	71.6	135.21	66.5	135.16	61.3	135.11
	Reach 6	2222	77.9	135.27	71.6	135.22	66.5	135.17	61.3	135.12
	Reach 6	2373	77.9	135.29	71.6	135.24	66.5	135.19	61.3	135.14
	Reach 6	2545	77.9	135.32	71.6	135.27	66.5	135.21	61.3	135.16
	Reach 6	2728	77.9	135.36	71.6	135.31	66.5	135.25	61.3	135.19

Table 10 Continued...

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Tay River	Reach 6	3159	77.9	135.4	71.6	135.35	66.5	135.29	61.3	135.23
Tay River	Reach 6	3312	77.9	135.43	71.6	135.37	66.5	135.3	61.3	135.24
Tay River	Reach 6	3331	Private Crossing - 3rd d/s of Glen Tay Rd							
Tay River	Reach 6	3340	77.9	135.6	71.6	135.59	66.5	135.59	61.3	135.55
Tay River	Reach 6	3422	77.9	135.63	71.6	135.61	66.5	135.61	61.3	135.57
Tay River	Reach 6	3598	77.9	135.65	71.6	135.62	66.5	135.62	61.3	135.58
Tay River	Reach 6	3791	77.9	135.67	71.6	135.64	66.5	135.64	61.3	135.6
Tay River	Reach 6	3803	Private Crossing - 2nd d/s of Glen Tay Rd							
Tay River	Reach 6	3815	77.9	135.74	71.6	135.7	66.5	135.69	61.3	135.65
Tay River	Reach 6	3880	77.9	135.77	71.6	135.73	66.5	135.72	61.3	135.68
Tay River	Reach 6	4083	77.9	135.78	71.6	135.74	66.5	135.73	61.3	135.69
Tay River	Reach 6	4225	77.9	135.79	71.6	135.75	66.5	135.74	61.3	135.7
Tay River	Reach 6	4239	Private Crossing - 1st d/s of Glen Tay Rd							
Tay River	Reach 6	4250	77.9	135.79	71.6	135.76	66.5	135.74	61.3	135.7
Tay River	Reach 6	4304	70.1	135.8	64.5	135.76	60.1	135.74	55.4	135.7
Tay River	Reach 6	4389	70.1	135.81	64.5	135.77	60.1	135.75	55.4	135.71
Tay River	Reach 6	4500	70.1	135.81	64.5	135.77	60.1	135.75	55.4	135.71
Tay River	Reach 6	4606	70.1	135.82	64.5	135.78	60.1	135.76	55.4	135.72
Tay River	Reach 6	4795	70.1	135.83	64.5	135.79	60.1	135.77	55.4	135.72
Tay River	Reach 6	4912	70.1	135.78	64.5	135.74	60.1	135.73	55.4	135.69
Tay River	Reach 6	4989	70.1	135.93	64.5	135.88	60.1	135.85	55.4	135.8
Tay River	Reach 6	5108	70.1	135.98	64.5	135.92	60.1	135.89	55.4	135.83
Tay River	Reach 6	5151	70.1	135.97	64.5	135.92	60.1	135.88	55.4	135.83
Tay River	Reach 6	5277	70.1	136	64.5	135.94	60.1	135.9	55.4	135.85
Tay River	Reach 6	5432	70.1	136	64.5	135.94	60.1	135.91	55.4	135.85
Tay River	Reach 6	5509	70.1	136.01	64.5	135.95	60.1	135.91	55.4	135.86
Tay River	Reach 6	5700	70.1	136.01	64.5	135.95	60.1	135.92	55.4	135.86
Tay River	Reach 6	5765	70.1	136.02	64.5	135.96	60.1	135.92	55.4	135.87
Tay River	Reach 6	5855	70.1	136.02	64.5	135.96	60.1	135.93	55.4	135.87
Tay River	Reach 7	1	97.9	135.99	86.6	135.94	78.3	135.9	70.1	135.85
Tay River	Reach 7	190	97.9	136.13	86.6	136.06	78.3	136.01	70.1	135.95
Tay River	Reach 7	321	97.9	136.19	86.6	136.11	78.3	136.06	70.1	135.99
Tay River	Reach 7	434	97.9	136.21	86.6	136.14	78.3	136.08	70.1	136.01
Tay River	Reach 7	512	97.9	136.05	86.6	136	78.3	135.97	70.1	135.91
Tay River	Reach 7	533	Glen Tay Rd Bridge							
Tay River	Reach 7	544	97.9	136.39	86.6	136.22	78.3	136.13	70.1	136.03
Grants Spillway	Reach 1	23	19.4	135.02	16.6	134.87	14.5	134.75	12.5	134.63
Grants Spillway	Reach 1	151	19.4	135.02	16.6	134.88	14.5	134.76	12.5	134.64
Grants Spillway	Reach 1	246	19.4	135.05	16.6	134.9	14.5	134.79	12.5	134.68
Grants Spillway	Reach 1	437	19.4	135.19	16.6	135.09	14.5	135.03	12.5	134.98

Table 10 Continued...

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
Grants Spillway	Reach 1	503	19.4	135.75	16.6	135.67	14.5	135.6	12.5	135.52
	Reach 1	560	19.4	136.13	16.6	136.03	14.5	135.94	12.5	135.85
	Reach 1	650	19.4	136.13	16.6	136.03	14.5	135.94	12.5	135.85
Grants Creek	Reach 1	72	41.6	134.66	33.6	134.55	28.4	134.46	23.8	134.37
	Reach 1	186	41.6	134.67	33.6	134.56	28.4	134.47	23.8	134.37
	Reach 1	277	41.6	134.68	33.6	134.56	28.4	134.47	23.8	134.38
	Reach 1	383	41.6	134.69	33.6	134.57	28.4	134.48	23.8	134.39
	Reach 1	497	41.6	134.71	33.6	134.59	28.4	134.49	23.8	134.4
	Reach 1	608	41.6	134.69	33.6	134.58	28.4	134.49	23.8	134.39
	Reach 1	777	41.6	134.81	33.6	134.67	28.4	134.56	23.8	134.46
	Reach 1	985	41.6	134.82	33.6	134.68	28.4	134.57	23.8	134.47
	Reach 1	1375	41.6	134.82	33.6	134.68	28.4	134.58	23.8	134.47
	Reach 1	1823	41.6	134.82	33.6	134.68	28.4	134.58	23.8	134.47
	Reach 1	2644	41.6	134.83	33.6	134.69	28.4	134.58	23.8	134.47
	Reach 1	3145	41.6	134.84	33.6	134.7	28.4	134.59	23.8	134.48
	Reach 1	3617	41.6	134.86	33.6	134.71	28.4	134.6	23.8	134.5
	Reach 1	3992	41.6	134.88	33.6	134.73	28.4	134.62	23.8	134.51
	Reach 1	4440	41.6	134.93	33.6	134.78	28.4	134.67	23.8	134.55
	Reach 1	4747	41.6	135.01	33.6	134.86	28.4	134.74	23.8	134.62
	Reach 2	102	11	135.02	10.1	134.88	9.4	134.77	8.6	134.65
	Reach 2	416	11	135.03	10.1	134.89	9.4	134.78	8.6	134.66
	Reach 2	557	11	135.03	10.1	134.9	9.4	134.78	8.6	134.67
	Reach 2	781	11	135.06	10.1	134.93	9.4	134.82	8.6	134.72
	Reach 2	860	11	135.1	10.1	134.98	9.4	134.89	8.6	134.81
	Reach 2	880	Glen Tay Rd Culvert							
	Reach 2	885	11	135.23	10.1	135.12	9.4	135.04	8.6	134.96
	Reach 2	938	11	135.32	10.1	135.22	9.4	135.14	8.6	135.06
	Reach 2	1004	11	135.37	10.1	135.27	9.4	135.19	8.6	135.11
	Reach 2	1038	11	135.4	10.1	135.31	9.4	135.24	8.6	135.18
Jebbs Creek	Reach 1	215	7.92	132.11	7.09	132.01	6.49	131.93	5.91	131.84
	Reach 1	402	7.92	132.14	7.09	132.04	6.49	131.98	5.91	131.91
	Reach 1	554	7.92	132.15	7.09	132.07	6.49	132.01	5.91	131.96
	Reach 1	721	7.92	132.19	7.09	132.12	6.49	132.07	5.91	132.04
	Reach 1	878	7.92	132.26	7.09	132.2	6.49	132.16	5.91	132.13
	Reach 1	969	7.92	132.35	7.09	132.3	6.49	132.26	5.91	132.23
	Reach 1	1187	7.92	132.39	7.09	132.34	6.49	132.3	5.91	132.27
	Reach 1	1661	7.92	132.41	7.09	132.36	6.49	132.33	5.91	132.29
	Reach 1	2145	7.92	132.45	7.09	132.4	6.49	132.37	5.91	132.34
	Reach 1	2574	7.92	132.47	7.09	132.43	6.49	132.39	5.91	132.36

Table 10 Continued...

River	Reach	Xsec ID #	Q500	WL500	Q200	WL200	Q100	WL100	Q50	WL50
			Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
Jebbs Creek	Reach 1	2804	7.92	132.49	7.09	132.44	6.49	132.41	5.91	132.37
	Reach 1	3203	7.92	132.51	7.09	132.47	6.49	132.43	5.91	132.4
	Reach 1	3270	7.92	132.52	7.09	132.47	6.49	132.44	5.91	132.41
	Reach 1	3308	Rideau Ferry Rd Bridge							
	Reach 1	3329	7.92	132.72	7.09	132.66	6.49	132.61	5.91	132.56
	Reach 1	3426	7.92	132.79	7.09	132.72	6.49	132.67	5.91	132.62
	Reach 1	3506	7.92	132.8	7.09	132.73	6.49	132.68	5.91	132.63
Little Tay	Reach 1	15	13.95	133.01	11.97	132.87	10.62	132.76	9.59	132.66
	Reach 1	25	Pedestrian Bridge under Drummond St							
	Reach 1	33	13.95	133.04	11.97	132.9	10.62	132.79	9.59	132.68
	Reach 1	65	13.95	133.06	11.97	132.91	10.62	132.8	9.59	132.69
	Reach 1	108	Drummond St Bridge							
	Reach 1	123	13.95	133.23	11.97	133.07	10.62	132.96	9.59	132.85
	Reach 1	206	13.95	133.29	11.97	133.13	10.62	133.01	9.59	132.9
	Reach 1	232	13.95	133.29	11.97	133.13	10.62	133.01	9.59	132.9
	Reach 1	260	Gore St Bridge							
	Reach 1	268	13.95	133.33	11.97	133.16	10.62	133.04	9.59	132.93
	Reach 1	287	13.95	133.33	11.97	133.16	10.62	133.04	9.59	132.93
	Reach 1	390	13.95	133.39	11.97	133.22	10.62	133.1	9.59	132.99
	Reach 2	12	40.24	133.4	35.56	133.23	31.88	133.1	28.39	132.99
	Reach 2	74	40.24	133.4	35.56	133.24	31.88	133.11	28.39	133
	Reach 2	104	40.24	133.4	35.56	133.23	31.88	133.1	28.39	132.98
	Reach 2	115	C. Douglas Cavers Pedestrian Bridge							
	Reach 2	118	40.24	133.41	35.56	133.24	31.88	133.16	28.39	133.14
	Reach 2	188	40.24	133.5	35.56	133.37	31.88	133.3	28.39	133.26
	Reach 2	302	40.24	133.54	35.56	133.41	31.88	133.35	28.39	133.3
	Reach 2	332	40.24	133.55	35.56	133.43	31.88	133.36	28.39	133.31
	Reach 2	342	Haggart Dam							
	Reach 2	347	40.24	134.4	35.56	134.32	31.88	134.26	28.39	134.19
Tay Bypass	Reach 1	16	26.29	133.25	23.59	133.08	21.26	132.95	18.8	132.82
	Reach 1	31	26.29	133.22	23.59	133.06	21.26	132.93	18.8	132.81
	Reach 1	43	Mill St Bridge							
	Reach 1	47	26.29	133.32	23.59	133.13	21.26	132.99	18.8	132.85
	Reach 1	146	26.29	133.37	23.59	133.18	21.26	133.04	18.8	132.89
	Reach 1	191	26.29	133.37	23.59	133.18	21.26	133.03	18.8	132.88
	Reach 1	196.5	Pedestrian Bridge							
	Reach 1	198	26.29	133.38	23.59	133.2	21.26	133.04	18.8	132.91
	Reach 1	209	26.29	133.4	23.59	133.23	21.26	133.1	18.8	132.99
	Reach 1	212	Stewart Park Weir							
	Reach 1	217	26.29	133.4	23.59	133.23	21.26	133.1	18.8	132.99

Table 11 - Flow and Computed Water Level for 2-Year to 20-Year Flood Events

River	Reach	Xsec ID #	Flow (m³/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Tay River	Lower Reach	92	84.5	124.28	73.7	124.18	62.6	124.08	46.3	123.95
	Lower Reach	395	84.5	124.28	73.7	124.18	62.6	124.08	46.3	123.95
	Lower Reach	600	84.5	124.29	73.7	124.19	62.6	124.08	46.3	123.95
	Lower Reach	859	84.5	124.3	73.7	124.2	62.6	124.09	46.3	123.96
	Lower Reach	1172	84.5	124.31	73.7	124.2	62.6	124.1	46.3	123.96
	Lower Reach	1508	84.5	124.32	73.7	124.21	62.6	124.11	46.3	123.97
	Lower Reach	1694	84.5	124.34	73.7	124.24	62.6	124.13	46.3	123.99
	Lower Reach	1932	84.5	124.4	73.7	124.29	62.6	124.18	46.3	124.02
	Lower Reach	2016	84.5	124.32	73.7	124.22	62.6	124.13	46.3	123.99
	Lower Reach	2080	84.5	124.62	73.7	124.49	62.6	124.35	46.3	124.15
	Lower Reach	2103	84.5	125.12	73.7	124.98	62.6	124.81	46.3	124.55
	Lower Reach	2112	Port Elmsley Bridge							
	Lower Reach	2128	84.5	126.1	73.7	125.83	62.6	125.58	46.3	125.22
	Lower Reach	2151	83.1	126.49	72.4	126.2	61.5	125.9	45.3	125.38
	Lower Reach	2198	83.1	126.58	72.4	126.33	61.5	126.1	45.3	125.89
	Lower Reach	2280	83.1	126.83	72.4	126.59	61.5	126.37	45.3	126.12
	Lower Reach	2364	83.1	126.86	72.4	126.63	61.5	126.42	45.3	126.16
	Lower Reach	2470	83.1	126.75	72.4	126.54	61.5	126.34	45.3	126.12
	Lower Reach	2603	83.1	127.51	72.4	127.4	61.5	127.27	45.3	127.03
	Lower Reach	2741	83.1	128.18	72.4	128.07	61.5	127.94	45.3	127.69
	Lower Reach	2884	83.1	128.68	72.4	128.55	61.5	128.42	45.3	128.15
	Lower Reach	3075	83.1	129.01	72.4	128.89	61.5	128.76	45.3	128.5
	Lower Reach	3333	83.1	129.23	72.4	129.1	61.5	128.96	45.3	128.7
	Lower Reach	3555	83.1	129.3	72.4	129.17	61.5	129.02	45.3	128.75
	Lower Reach	3740	83.1	129.12	72.4	128.97	61.5	128.85	45.3	128.65
	Lower Reach	3958	83.1	130.47	72.4	130.37	61.5	130.24	45.3	130
	Lower Reach	4180	83.1	130.8	72.4	130.68	61.5	130.53	45.3	130.27
	Lower Reach	4602	83.1	131.02	72.4	130.88	61.5	130.72	45.3	130.44
	Lower Reach	5035	83.1	131.21	72.4	131.07	61.5	130.9	45.3	130.62
	Lower Reach	5080	83.1	131.23	72.4	131.1	61.5	130.94	45.3	130.66
	Lower Reach	5259	83.1	131.32	72.4	131.2	61.5	131.05	45.3	130.79
	Lower Reach	5458	83.1	131.36	72.4	131.24	61.5	131.1	45.3	130.85
	Lower Reach	5717	83.1	131.41	72.4	131.29	61.5	131.15	45.3	130.9
	Lower Reach	5774	Beveridges Dam							
	Lower Reach	5841	83.1	131.46	72.4	131.35	61.5	131.24	45.3	131.05
	Reach 1	56	83.1	131.46	72.4	131.35	61.5	131.24	45.3	131.05
	Reach 1	348	83.1	131.51	72.4	131.4	61.5	131.28	45.3	131.09
	Reach 1	850	83.1	131.55	72.4	131.43	61.5	131.32	45.3	131.13
	Reach 1	1396	83.1	131.58	72.4	131.47	61.5	131.35	45.3	131.16
	Reach 1	1778	83.1	131.62	72.4	131.51	61.5	131.39	45.3	131.2
	Reach 1	2330	83.1	131.68	72.4	131.58	61.5	131.46	45.3	131.27

Table 11 Continued...

River	Reach	Xsec ID #	Flow (m^3/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Tay River	Reach 1	2682	83.1	131.69	72.4	131.59	61.5	131.48	45.3	131.28
	Reach 1	3153	83.1	131.7	72.4	131.6	61.5	131.48	45.3	131.29
	Reach 1	3360	83.1	131.71	72.4	131.61	61.5	131.49	45.3	131.3
	Reach 2	165	81.2	131.7	70.7	131.61	59.9	131.49	43.7	131.3
	Reach 2	265	81.2	131.72	70.7	131.63	59.9	131.52	43.7	131.33
	Reach 2	356	81.2	131.81	70.7	131.71	59.9	131.59	43.7	131.39
	Reach 2	596	81.2	131.93	70.7	131.82	59.9	131.69	43.7	131.47
	Reach 2	885	81.2	131.97	70.7	131.85	59.9	131.72	43.7	131.51
	Reach 2	1199	81.2	131.99	70.7	131.88	59.9	131.75	43.7	131.54
	Reach 2	1449	81.2	132.01	70.7	131.89	59.9	131.77	43.7	131.55
	Reach 2	1819	81.2	132.04	70.7	131.93	59.9	131.8	43.7	131.59
	Reach 2	2450	81.2	132.15	70.7	132.04	59.9	131.92	43.7	131.7
	Reach 2	2886	75.5	132.23	65.6	132.12	55.4	131.99	40.3	131.77
	Reach 2	3415	75.5	132.26	65.6	132.15	55.4	132.03	40.3	131.82
	Reach 2	3578	75.5	132.27	65.6	132.17	55.4	132.04	40.3	131.83
	Reach 2	3724	75.5	132.29	65.6	132.19	55.4	132.07	40.3	131.85
	Reach 2	3916	75.5	132.31	65.6	132.21	55.4	132.09	40.3	131.87
	Reach 2	4080	75.5	132.33	65.6	132.22	55.4	132.1	40.3	131.88
	Reach 2	4213	75.5	132.35	65.6	132.24	55.4	132.12	40.3	131.9
	Reach 2	4237	Craig St Bridge							
	Reach 2	4246	73.9	132.36	64.3	132.25	54.3	132.12	39.4	131.91
	Reach 2	4310	73.9	132.38	64.3	132.26	54.3	132.14	39.4	131.92
	Reach 2	4386	73.9	132.39	64.3	132.27	54.3	132.14	39.4	131.92
	Reach 2	4495	73.9	132.4	64.3	132.28	54.3	132.15	39.4	131.93
	Reach 2	4570	73.9	132.41	64.3	132.3	54.3	132.17	39.4	131.94
	Reach 2	4694	73.9	132.42	64.3	132.31	54.3	132.17	39.4	131.94
	Reach 2	4712	Beckwith Bridge							
	Reach 2	4722	73.9	132.45	64.3	132.33	54.3	132.19	39.4	131.96
	Reach 2	4774	73.9	132.46	64.3	132.34	54.3	132.2	39.4	131.96
	Reach 2	4842	73.9	132.48	64.3	132.36	54.3	132.22	39.4	131.98
	Reach 3	1	66.56	132.5	58.41	132.38	49.47	132.23	35.02	131.99
	Reach 3	14	Drummond St Bridge							
	Reach 3	28	66.56	132.51	58.41	132.38	49.47	132.24	35.02	131.99
	Reach 3	81	66.56	132.52	58.41	132.39	49.47	132.25	35.02	131.99
	Reach 3	146	66.56	132.48	58.41	132.36	49.47	132.22	35.02	131.98
	Reach 3	178	Gore St Bridge							
	Reach 3	193	66.56	132.51	58.41	132.38	49.47	132.24	35.02	131.99
	Reach 3	269	66.56	132.59	58.41	132.45	49.47	132.3	35.02	132.03
	Reach 3	321	66.56	132.6	58.41	132.46	49.47	132.3	35.02	132.03
	Reach 4	28	50.23	132.59	44.16	132.45	37.74	132.29	28.17	132.02
	Reach 4	79	50.23	132.63	44.16	132.49	37.74	132.33	28.17	132.05
	Reach 4	182	50.23	132.69	44.16	132.55	37.74	132.39	28.17	132.11

Table 11 Continued...

River	Reach	Xsec ID #	Flow (m³/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Tay River	Reach 4	202	50.23	132.72	44.16	132.57	37.74	132.42	28.17	132.15
	Reach 4	215	Haggart Dam							
	Reach 4	227	50.23	134.1	44.16	134.02	37.74	133.94	28.17	133.81
	Reach 5	11	72.8	134.09	63.3	134.02	53.5	133.94	38.7	133.81
	Reach 5	56	72.8	134.11	63.3	134.03	53.5	133.95	38.7	133.82
	Reach 5	101	72.8	134.1	63.3	134.03	53.5	133.95	38.7	133.82
	Reach 5	109	Roger Street Bridge							
	Reach 5	136	72.8	134.12	63.3	134.04	53.5	133.96	38.7	133.82
	Reach 5	206	72.8	134.19	63.3	134.1	53.5	134	38.7	133.85
	Reach 5	320	72.8	134.2	63.3	134.11	53.5	134.01	38.7	133.85
	Reach 5	399	72.8	134.21	63.3	134.12	53.5	134.02	38.7	133.86
	Reach 6	80	54	134.24	48.1	134.14	41.7	134.04	31.5	133.87
	Reach 6	175	54	134.18	48.1	134.1	41.7	134	31.5	133.85
	Reach 6	195	Peter St Bridge							
	Reach 6	203	54	134.26	48.1	134.17	41.7	134.06	31.5	133.89
	Reach 6	342	54	134.41	48.1	134.3	41.7	134.18	31.5	133.98
	Reach 6	464	54	134.42	48.1	134.3	41.7	134.18	31.5	133.98
	Reach 6	713	54	134.43	48.1	134.32	41.7	134.2	31.5	134
	Reach 6	878	54	134.44	48.1	134.33	41.7	134.21	31.5	134.01
	Reach 6	933	54	134.45	48.1	134.34	41.7	134.22	31.5	134.02
	Reach 6	971	54	134.26	48.1	134.17	41.7	134.07	31.5	133.92
	Reach 6	981	Golf Course Weir							
	Reach 6	982	54	134.63	48.1	134.51	41.7	134.4	31.5	134.3
	Reach 6	983	WTP Service Bridge							
	Reach 6	984	54	134.76	48.1	134.63	41.7	134.51	31.5	134.34
	Reach 6	1005	54	134.85	48.1	134.72	41.7	134.6	31.5	134.41
	Reach 6	1084	54	134.88	48.1	134.76	41.7	134.64	31.5	134.45
	Reach 6	1231	54	134.9	48.1	134.77	41.7	134.66	31.5	134.47
	Reach 6	1524	54	134.92	48.1	134.8	41.7	134.69	31.5	134.5
	Reach 6	1711	54	134.94	48.1	134.82	41.7	134.71	31.5	134.52
	Reach 6	1861	54	134.97	48.1	134.85	41.7	134.74	31.5	134.55
	Reach 6	1965	54	134.99	48.1	134.87	41.7	134.76	31.5	134.57
	Reach 6	2097	54	135	48.1	134.89	41.7	134.77	31.5	134.58
	Reach 6	2222	54	135.01	48.1	134.9	41.7	134.78	31.5	134.59
	Reach 6	2373	54	135.03	48.1	134.91	41.7	134.8	31.5	134.61
	Reach 6	2545	54	135.05	48.1	134.93	41.7	134.82	31.5	134.62
	Reach 6	2728	54	135.09	48.1	134.97	41.7	134.85	31.5	134.66
	Reach 6	3159	54	135.13	48.1	135.02	41.7	134.91	31.5	134.72
	Reach 6	3312	54	135.1	48.1	134.92	41.7	134.84	31.5	134.7
	Reach 6	3331	Private Crossing - 3rd d/s of Glen Tay Rd							
	Reach 6	3340	54	135.33	48.1	135.25	41.7	135.19	31.5	135

Table 11 Continued...

River	Reach	Xsec ID #	Flow (m³/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Tay River	Reach 6	3422	54	135.37	48.1	135.3	41.7	135.25	31.5	135.12
	Reach 6	3598	54	135.38	48.1	135.32	41.7	135.25	31.5	135.13
	Reach 6	3791	54	135.4	48.1	135.33	41.7	135.26	31.5	135.13
	Reach 6	3803	Private Crossing - 2nd d/s of Glen Tay Rd							
	Reach 6	3815	54	135.53	48.1	135.46	41.7	135.39	31.5	135.22
	Reach 6	3880	54	135.56	48.1	135.5	41.7	135.42	31.5	135.26
	Reach 6	4083	54	135.57	48.1	135.5	41.7	135.43	31.5	135.26
	Reach 6	4225	54	135.58	48.1	135.51	41.7	135.43	31.5	135.27
	Reach 6	4239	Private Crossing - 1st d/s of Glen Tay Rd							
	Reach 6	4250	54	135.58	48.1	135.52	41.7	135.44	31.5	135.27
	Reach 6	4304	48.9	135.59	43.7	135.52	37.9	135.44	28.6	135.28
	Reach 6	4389	48.9	135.6	43.7	135.53	37.9	135.45	28.6	135.29
	Reach 6	4500	48.9	135.6	43.7	135.53	37.9	135.45	28.6	135.29
	Reach 6	4606	48.9	135.6	43.7	135.53	37.9	135.45	28.6	135.29
	Reach 6	4795	48.9	135.61	43.7	135.54	37.9	135.46	28.6	135.29
	Reach 6	4912	48.9	135.58	43.7	135.52	37.9	135.44	28.6	135.28
	Reach 6	4989	48.9	135.68	43.7	135.6	37.9	135.51	28.6	135.33
	Reach 6	5108	48.9	135.71	43.7	135.63	37.9	135.54	28.6	135.35
	Reach 6	5151	48.9	135.71	43.7	135.63	37.9	135.53	28.6	135.35
	Reach 6	5277	48.9	135.72	43.7	135.64	37.9	135.55	28.6	135.36
	Reach 6	5432	48.9	135.73	43.7	135.64	37.9	135.55	28.6	135.36
	Reach 6	5509	48.9	135.73	43.7	135.65	37.9	135.55	28.6	135.37
	Reach 6	5700	48.9	135.74	43.7	135.65	37.9	135.56	28.6	135.37
	Reach 6	5765	48.9	135.74	43.7	135.66	37.9	135.56	28.6	135.38
	Reach 6	5855	48.9	135.75	43.7	135.66	37.9	135.57	28.6	135.38
	Reach 7	1	59.3	135.73	51.2	135.64	42.9	135.55	30.6	135.37
	Reach 7	190	59.3	135.82	51.2	135.73	42.9	135.63	30.6	135.44
	Reach 7	321	59.3	135.87	51.2	135.78	42.9	135.67	30.6	135.47
	Reach 7	434	59.3	135.88	51.2	135.79	42.9	135.68	30.6	135.48
	Reach 7	512	59.3	135.8	51.2	135.72	42.9	135.63	30.6	135.45
	Reach 7	533	Glen Tay Rd Bridge							
	Reach 7	544	59.3	135.9	51.2	135.8	42.9	135.7	30.6	135.5
Grants Spillway	Reach 1	23	9.77	134.48	7.71	134.36	5.58	134.24	2.39	134.04
	Reach 1	151	9.77	134.49	7.71	134.37	5.58	134.25	2.39	134.05
	Reach 1	246	9.77	134.54	7.71	134.44	5.58	134.33	2.39	134.16
	Reach 1	437	9.77	134.91	7.71	134.87	5.58	134.82	2.39	134.65
	Reach 1	503	9.77	135.41	7.71	135.32	5.58	135.22	2.39	135.01
	Reach 1	560	9.77	135.71	7.71	135.59	5.58	135.44	2.39	135.16
	Reach 1	650	9.77	135.71	7.71	135.59	5.58	135.44	2.39	135.17

Table 11 Continued...

River	Reach	Xsec ID #	Flow (m³/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Grants Creek	Reach 1	72	18.5	134.24	14.9	134.15	11.6	134.04	7.4	133.87
	Reach 1	186	18.5	134.25	14.9	134.15	11.6	134.04	7.4	133.88
	Reach 1	277	18.5	134.25	14.9	134.15	11.6	134.05	7.4	133.88
	Reach 1	383	18.5	134.26	14.9	134.16	11.6	134.05	7.4	133.88
	Reach 1	497	18.5	134.27	14.9	134.17	11.6	134.06	7.4	133.89
	Reach 1	608	18.5	134.27	14.9	134.17	11.6	134.06	7.4	133.89
	Reach 1	777	18.5	134.32	14.9	134.21	11.6	134.09	7.4	133.91
	Reach 1	985	18.5	134.33	14.9	134.22	11.6	134.1	7.4	133.91
	Reach 1	1375	18.5	134.33	14.9	134.22	11.6	134.1	7.4	133.91
	Reach 1	1823	18.5	134.33	14.9	134.22	11.6	134.1	7.4	133.91
	Reach 1	2644	18.5	134.33	14.9	134.22	11.6	134.1	7.4	133.92
	Reach 1	3145	18.5	134.34	14.9	134.23	11.6	134.11	7.4	133.92
	Reach 1	3617	18.5	134.35	14.9	134.24	11.6	134.12	7.4	133.93
	Reach 1	3992	18.5	134.37	14.9	134.26	11.6	134.13	7.4	133.94
	Reach 1	4440	18.5	134.41	14.9	134.29	11.6	134.17	7.4	133.97
	Reach 1	4747	18.5	134.47	14.9	134.35	11.6	134.23	7.4	134.03
	Reach 2	102	7.7	134.5	6.9	134.38	6.1	134.25	4.8	134.06
	Reach 2	416	7.7	134.51	6.9	134.4	6.1	134.28	4.8	134.1
	Reach 2	557	7.7	134.52	6.9	134.41	6.1	134.3	4.8	134.14
	Reach 2	781	7.7	134.6	6.9	134.51	6.1	134.43	4.8	134.32
	Reach 2	860	7.7	134.7	6.9	134.63	6.1	134.56	4.8	134.46
	Reach 2	880	Glen Tay Rd Culvert							
	Reach 2	885	7.7	134.87	6.9	134.79	6.1	134.72	4.8	134.6
	Reach 2	938	7.7	134.96	6.9	134.89	6.1	134.81	4.8	134.68
	Reach 2	1004	7.7	135.02	6.9	134.94	6.1	134.87	4.8	134.74
	Reach 2	1038	7.7	135.1	6.9	135.03	6.1	134.95	4.8	134.81
Jebbs Creek	Reach 1	215	5.16	131.72	4.59	131.62	4.03	131.5	3.21	131.3
	Reach 1	402	5.16	131.84	4.59	131.78	4.03	131.72	3.21	131.63
	Reach 1	554	5.16	131.91	4.59	131.87	4.03	131.84	3.21	131.8
	Reach 1	721	5.16	132	4.59	131.97	4.03	131.95	3.21	131.92
	Reach 1	878	5.16	132.1	4.59	132.07	4.03	132.04	3.21	131.99
	Reach 1	969	5.16	132.19	4.59	132.16	4.03	132.12	3.21	132.06
	Reach 1	1187	5.16	132.23	4.59	132.19	4.03	132.15	3.21	132.09
	Reach 1	1661	5.16	132.25	4.59	132.22	4.03	132.18	3.21	132.12
	Reach 1	2145	5.16	132.29	4.59	132.26	4.03	132.23	3.21	132.17
	Reach 1	2574	5.16	132.32	4.59	132.29	4.03	132.25	3.21	132.2
	Reach 1	2804	5.16	132.33	4.59	132.3	4.03	132.26	3.21	132.21
	Reach 1	3203	5.16	132.36	4.59	132.32	4.03	132.29	3.21	132.23

Table 11 Continued...

River	Reach	Xsec ID #	Flow (m³/s) and Computed WSEL (m) for Different Flood Events							
			Q20	WL20	Q10	WL10	Q5	WL5	Q2	WL2
Jebbs Creek	Reach 1	3270	5.16	132.37	4.59	132.34	4.03	132.3	3.21	132.24
	Reach 1	3308	Rideau Ferry Rd Bridge							
	Reach 1	3329	5.16	132.5	4.59	132.45	4.03	132.4	3.21	132.32
	Reach 1	3426	5.16	132.55	4.59	132.5	4.03	132.44	3.21	132.35
	Reach 1	3506	5.16	132.56	4.59	132.51	4.03	132.45	3.21	132.36
Little Tay	Reach 1	15	7.34	132.5	5.89	132.38	4.83	132.23	4.38	131.98
	Reach 1	25	Pedestrian Bridge under Drummond St							
	Reach 1	33	7.34	132.52	5.89	132.4	4.83	132.25	4.38	131.99
	Reach 1	65	7.34	132.53	5.89	132.4	4.83	132.26	4.38	132
	Reach 1	108	Drummond St Bridge							
	Reach 1	123	7.34	132.66	5.89	132.52	4.83	132.39	4.38	132.28
	Reach 1	206	7.34	132.7	5.89	132.56	4.83	132.42	4.38	132.32
	Reach 1	232	7.34	132.71	5.89	132.56	4.83	132.42	4.38	132.32
	Reach 1	260	Gore St Bridge							
	Reach 1	268	7.34	132.72	5.89	132.57	4.83	132.43	4.38	132.33
	Reach 1	287	7.34	132.73	5.89	132.58	4.83	132.44	4.38	132.34
	Reach 1	390	7.34	132.78	5.89	132.63	4.83	132.48	4.38	132.39
	Reach 2	12	23.67	132.78	20.14	132.63	16.56	132.49	11.23	132.4
	Reach 2	74	23.67	132.79	20.14	132.64	16.56	132.5	11.23	132.4
	Reach 2	104	23.67	132.75	20.14	132.55	16.56	132.39	11.23	132.34
	Reach 2	115	C. Douglas Cavers Pedestrian Bridge							
	Reach 2	118	23.67	133.09	20.14	132.92	16.56	132.71	11.23	132.47
	Reach 2	188	23.67	133.2	20.14	133.08	16.56	132.93	11.23	132.66
	Reach 2	302	23.67	133.23	20.14	133.1	16.56	132.95	11.23	132.69
	Reach 2	332	23.67	133.23	20.14	133.11	16.56	132.96	11.23	132.7
	Reach 2	342	Haggart Dam							
	Reach 2	347	23.67	134.1	20.14	134.03	16.56	133.95	11.23	133.82
Tay Bypass	Reach 1	16	16.33	132.64	14.25	132.49	11.73	132.33	6.84	132.05
	Reach 1	31	16.33	132.63	14.25	132.48	11.73	132.32	6.84	132.05
	Reach 1	43	Mill St Bridge							
	Reach 1	47	16.33	132.66	14.25	132.5	11.73	132.34	6.84	132.06
	Reach 1	146	16.33	132.69	14.25	132.53	11.73	132.36	6.84	132.07
	Reach 1	191	16.33	132.69	14.25	132.54	11.73	132.38	6.84	132.09
	Reach 1	196.5	Pedestrian Bridge							
	Reach 1	198	16.33	132.7	14.25	132.55	11.73	132.38	6.84	132.09
	Reach 1	209	16.33	132.77	14.25	132.6	11.73	132.41	6.84	132.08
	Reach 1	212	Stewart Park Weir							
	Reach 1	217	16.33	132.77	14.25	132.61	11.73	132.46	6.84	132.38

Table 12: NAM Parameters (Mike11 Tay Update 2012D)

Sub-catchment Name	Area (km^2)	Umax (mm) Maximum water content in surface storage	Lmax (mm) Maximum water content in rootzone storage	CQOF (-) Overland flow runoff coefficient	CKIF (hr) Time constant for routing interflow	CK1,2 (hr) Time constant for routing overland flow	TOF (-) Root zone threshold value for overland flow	TIF (-) Root zone threshold value for interflow	TG (-) Rootzone threshold value for GW recharge	CKBF (hr) Time constant for routing baseflow
OTTY	52.2	34.5	184	0.172	931.3	10.5	0.990	0.00145	0.229	501
BLUEBERRY	44.5	34.4	209	0.203	898.3	10.1	0.989	0.000529	0.316	500
TAYB	58.1	34.3	232	0.158	755.7	10.8	0.990	0.000261	0.406	502
TAYA	12.9	34.4	237	0.265	747.9	10.0	0.990	0.00235	0.428	505
RUDSDALE	63.3	34.4	213	0.439	939.8	10.1	0.990	0.00226	0.332	500
CHRISTIE	32.2	30.2	191	0.274	991.8	10.0	0.990	0.00008	0.237	498
GRANTSCR	30.7	34.4	229	0.278	785.5	10.2	0.989	0.00218	0.399	501
ELBOW LAKE	27.0	25.1	216	0.492	861.1	10.3	0.990	0.000384	0.229	502
TAYD	29.6	34.4	188	0.227	912.5	10.2	0.989	0.000504	0.374	503
BOBS LAKE	132.5	22.1	182	0.107	756.2	10.5	0.988	0.00122	0.428	504
CROW LAKE	49.7	34.3	208	0.180	864.6	11.9	0.989	0.00289	0.268	499
CROSBY	38.8	20.2	203	0.293	886.9	10.1	0.989	0.0001	0.159	495
PIKE LAKE	24.0	20.2	188	0.293	886.9	10.1	0.989	0.0001	0.159	495
TAYC1	24.0	33.7	227	0.148	912.1	11.1	0.978	0.004	0.306	499
TAYC2	31.2	33.7	227	0.148	912.1	11.1	0.978	0.004	0.306	499
EAGLE LAKE	33.7	25.1	181	0.492	861.1	10.3	0.990	0.000384	0.229	502
FISH CREEK	28.9	25.1	235	0.492	861.1	10.3	0.990	0.000384	0.229	502
LONG LAKE1	12.1	25.1	199	0.492	861.1	10.3	0.990	0.000384	0.229	502
LONG LAKE2	9.4	25.1	190	0.492	861.1	10.3	0.990	0.000384	0.229	502
LONG LAKE3	62.7	25.1	215	0.492	861.1	10.3	0.990	0.000384	0.229	502

Table 13: Effect of Removing Dams and River Crossings on Flood Quantiles of the Tay River at Perth

			RVCA Mike11 2012D		
Return Period (Years)	**FENCO (1981)**	**Mike11 2008A (RVCA 2010 Report)***	**Mike11 2012D**	**Test 2 (Bolingbroke Dam fully open)**	**Test 5 (Remove all bridges and culverts)**
1.003		11.9	11.5	17.9	18.7
1.05		19.9	19.7	21.2	23.9
1.25		27.9	27.9	24.9	29.3
2		38.7	38.7	30.7	37.3
5		53.4	53.5	40.2	49.6
10		63.3	63.3	47.8	58.7
20		72.9	72.8	56.4	68.4
50		85.5	85.2	69.5	82.3
100	150.4	95.1	94.6	81.1	94
200		105.0	104	94.5	107
500		118.0	117	115	125
Adopted Distribution		***GEV***	***GEV***	***GEV***	***GEV***

*Tay River Flood Risk Mapping from Christie Lake to Glen Tay (RVCA, 2010)

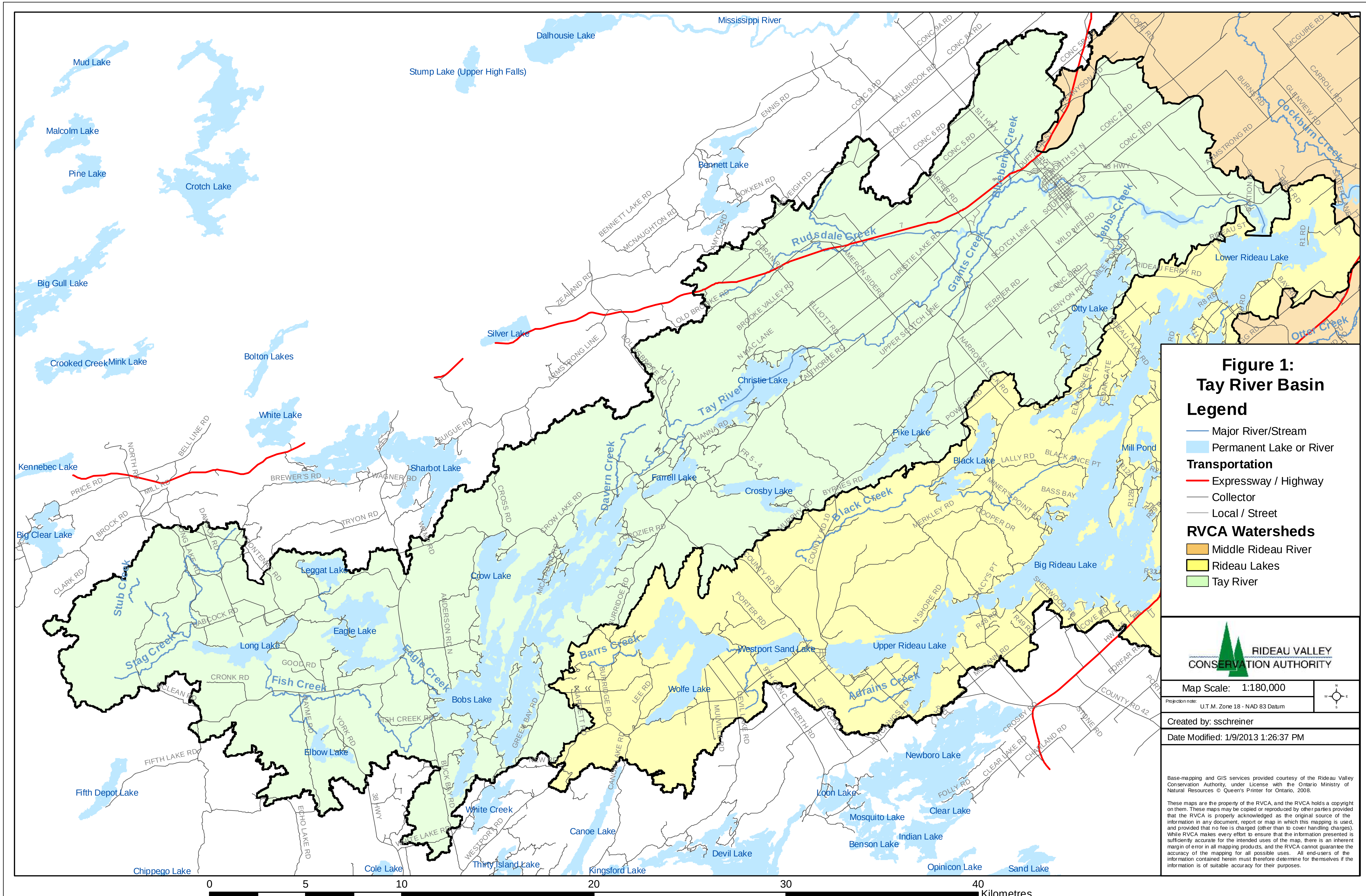

Figure 1: Tay River Basin

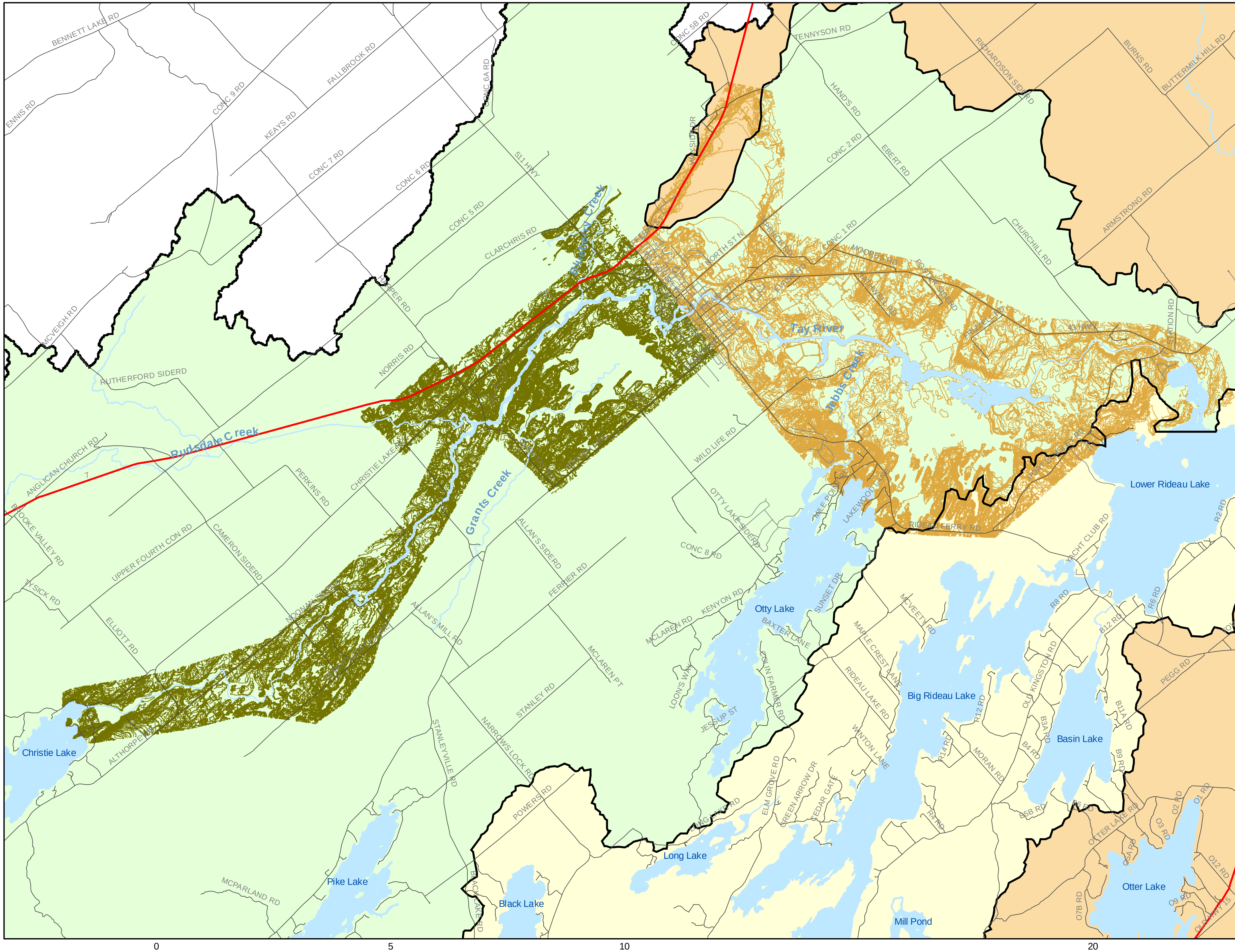

Figure 2: Extent of Aerial Photo

Legend

- 2008 DRAPE
- 2005 Aerial Photo

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:80,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

Created by: sschreiner

Date Modified: 1/9/2013 1:50:24 PM

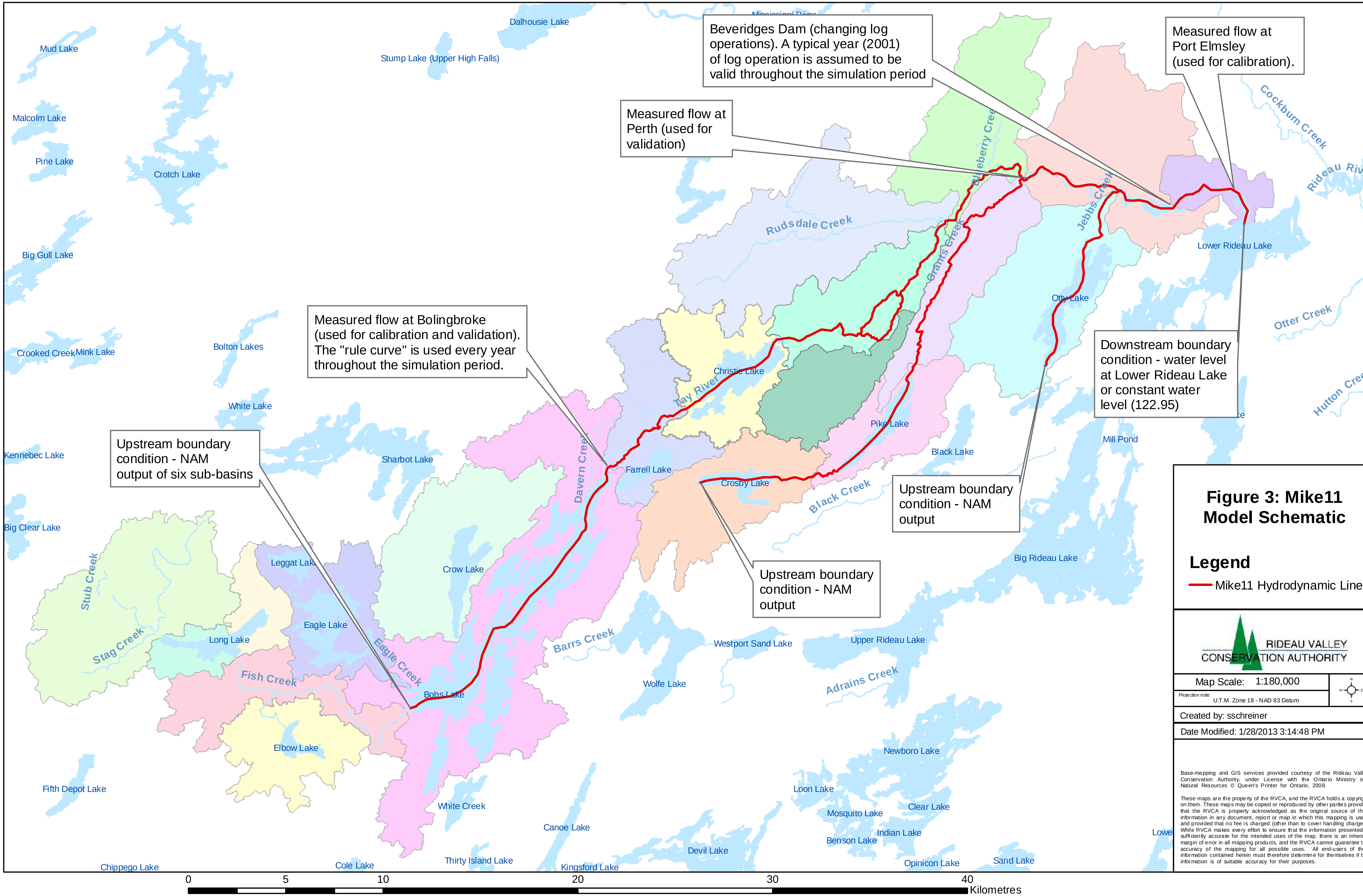
Figure 3: Mike11 Model Schematic
Legend
Mike11 Hydrodynamic Line
RIDEAU VALLEY CONSERVATION AUTHORITY
Map Scale: 1:180,000
Projection note: U.T.M. Zone 18 - NAD 83 Datum
Created by: sschreiner
Date Modified: 1/28/2013 3:14:48 PM
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Beveridges Dam (changing log operations). A typical year (2001) of log operation is assumed to be valid throughout the simulation period
Measured flow at Port Elmsley (used for calibration).
Measured flow at Perth (used for validation)
Measured flow at Bolingbroke (used for calibration and validation). The "rule curve" is used every year throughout the simulation period.
Downstream boundary condition - water level at Lower Rideau Lake or constant water level (122.95)
Upstream boundary condition - NAM output of six sub-basins
Upstream boundary condition - NAM output
Upstream boundary condition - NAM output
Dalhousie Lake
Mud Lake
Stump Lake (Upper High Falls)
Malcolm Lake
Pine Lake
Crotch Lake
Big Gull Lake
Rudsdale Creek
Cockburn Creek
Rideau River
Jebbs Creek
Grants Creek
Lower Rideau Lake
Otty Lake
Otter Creek
Crooked Creek
Mink Lake
Bolton Lakes
Christie Lake
Tay River
White Lake
Kennebec Lake
Sharbot Lake
Farrell Lake
Davern Creek
Pike Lake
Black Lake
Mill Pond
Hutton Creek
Crosby Lake
Black Creek
Big Clear Lake
Stub Creek
Leggat Lake
Crow Lake
Big Rideau Lake
Eagle Lake
Long Lake
Stag Creek
Eagle Creek
Fish Creek
Barrs Creek
Westport Sand Lake
Upper Rideau Lake
Adrains Creek
Bobs Lake
Wolfe Lake
Elbow Lake
Newboro Lake
Fifth Depot Lake
Loon Lake
White Creek
Clear Lake
Mosquito Lake
Canoe Lake
Indian Lake
Benson Lake
Thirty Island Lake
Devil Lake
Chippego Lake
Cole Lake
Kingsford Lake
Opinicon Lake
Sand Lake
0
5
10
20
30
40
Kilometres

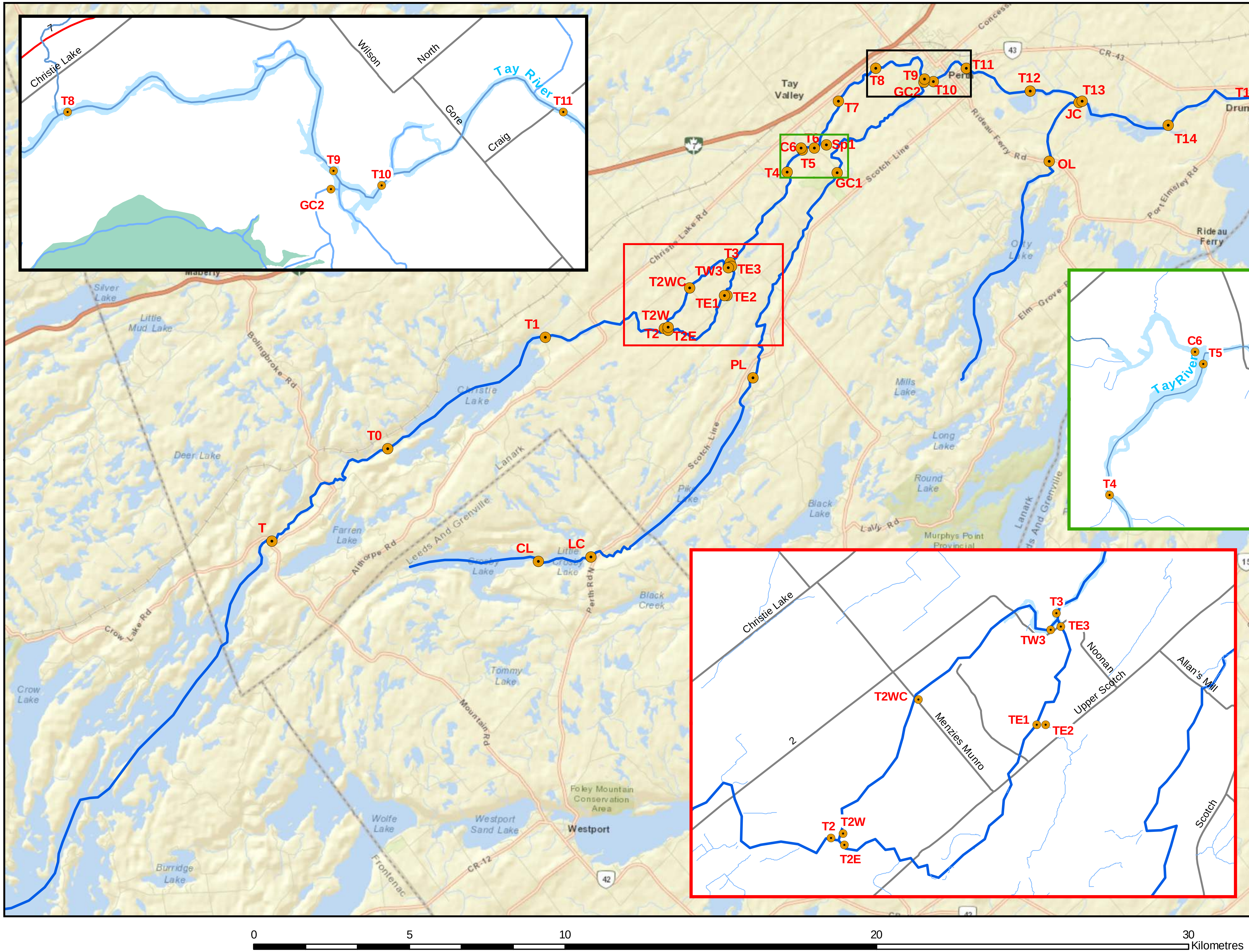


Figure 4: Data Extraction Points

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:120,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

Created by: sschreiner

Date Modified: 1/8/2013 4:42:04 PM

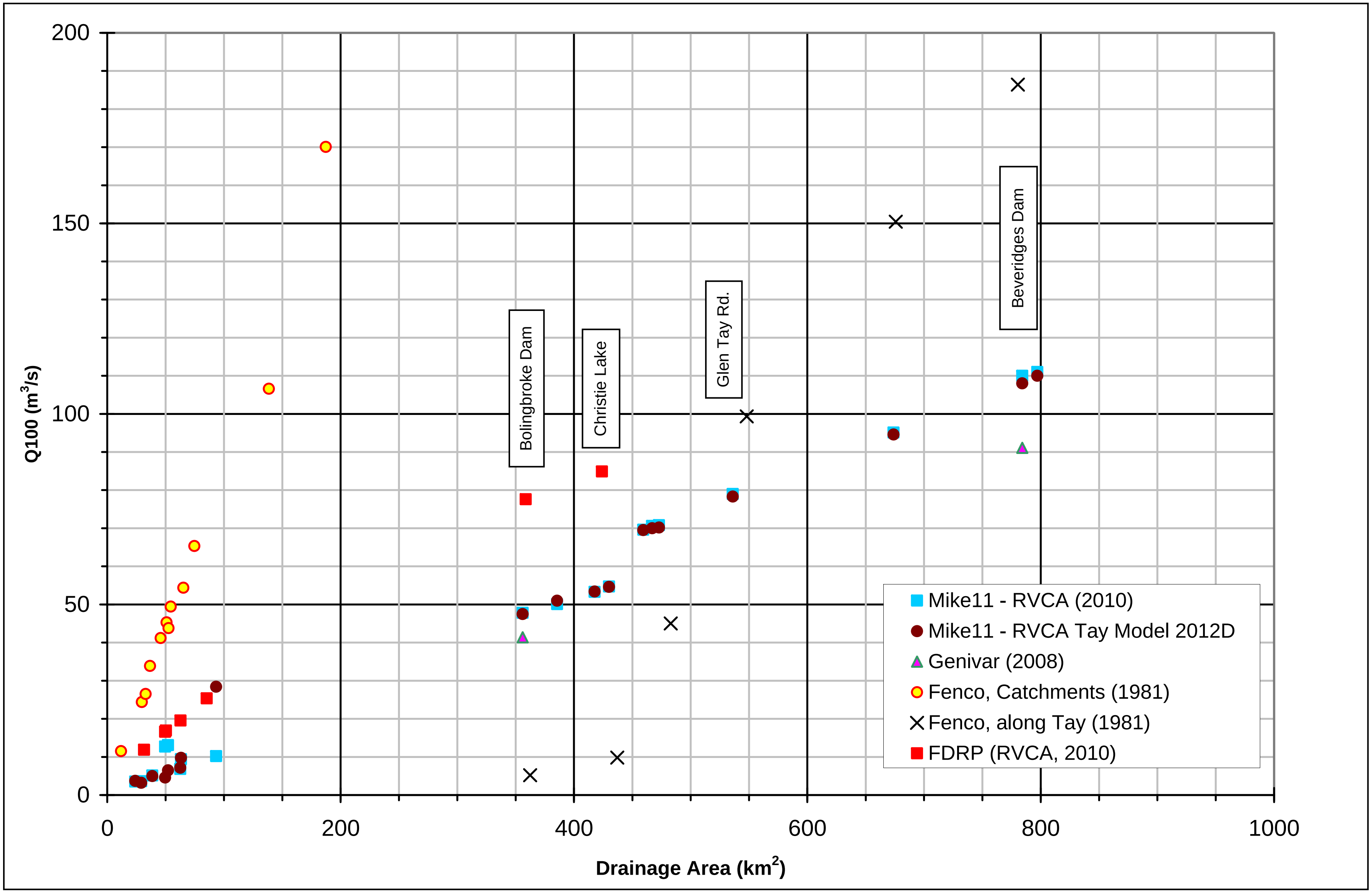


Figure 5: Comparison of 1:100 Year Flow Estimates

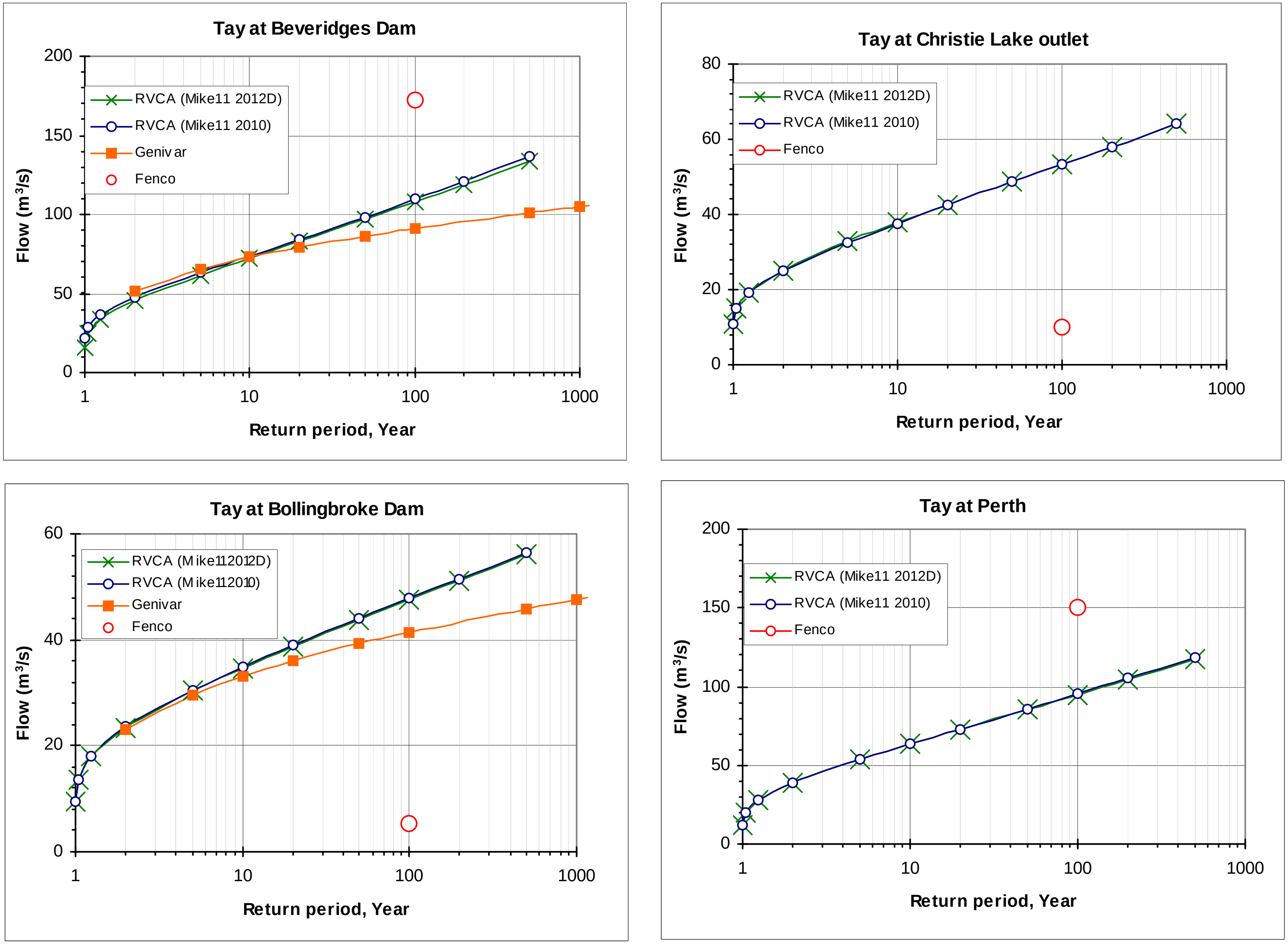


Figure 6: Comparison of Flows

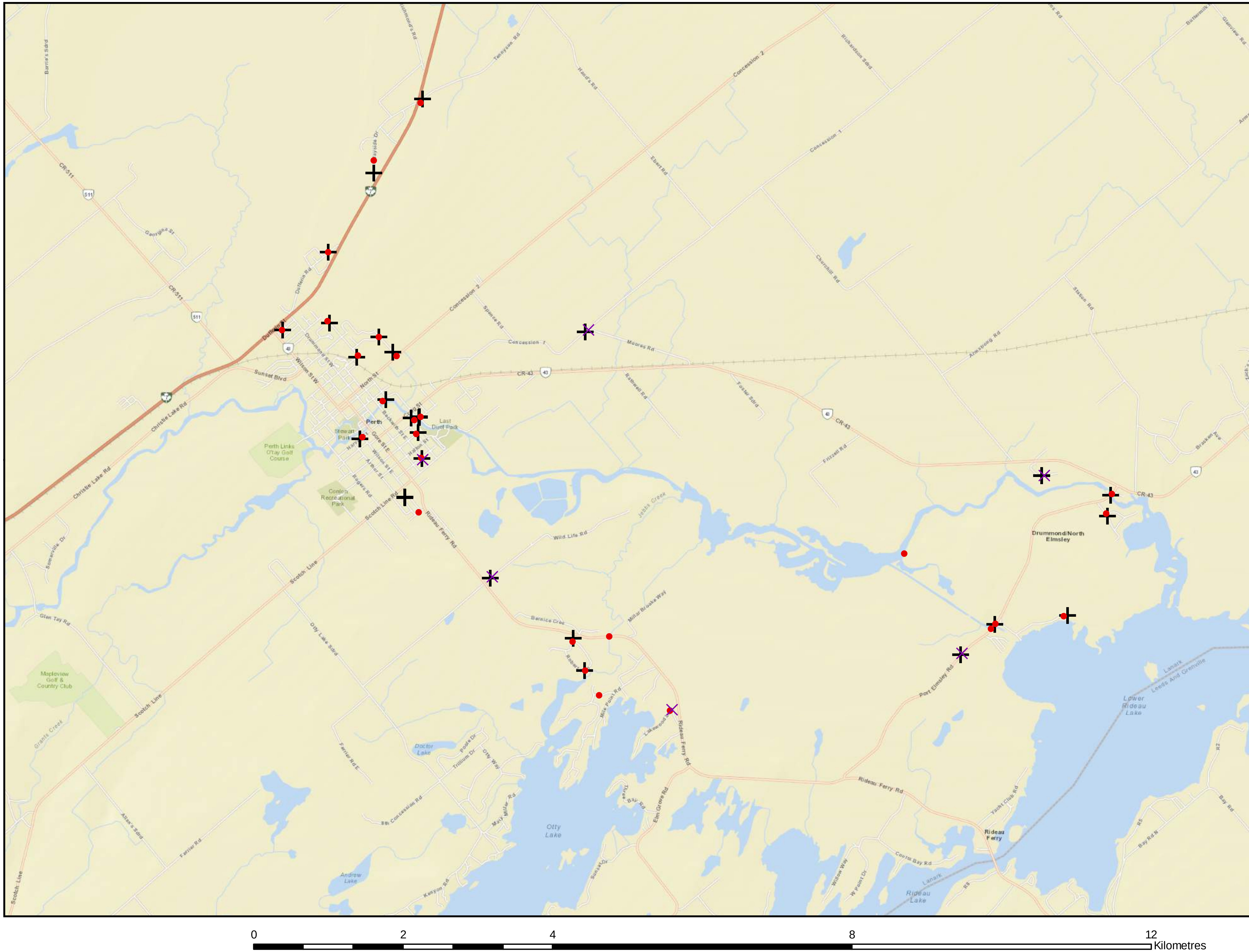


Figure 7: Surveyed Points for DTM Check

Legend

- Spot Heights Checked
- Contours Checked
- Discarded Points

RIDEAU VALLEY CONSERVATION AUTHORITY

Map Scale: 1:50,000

Projection note: U.T.M. Zone 18 - NAD 83 Datum

Created by: sschreiner

Date Modified: 1/17/2013 12:03:43 PM

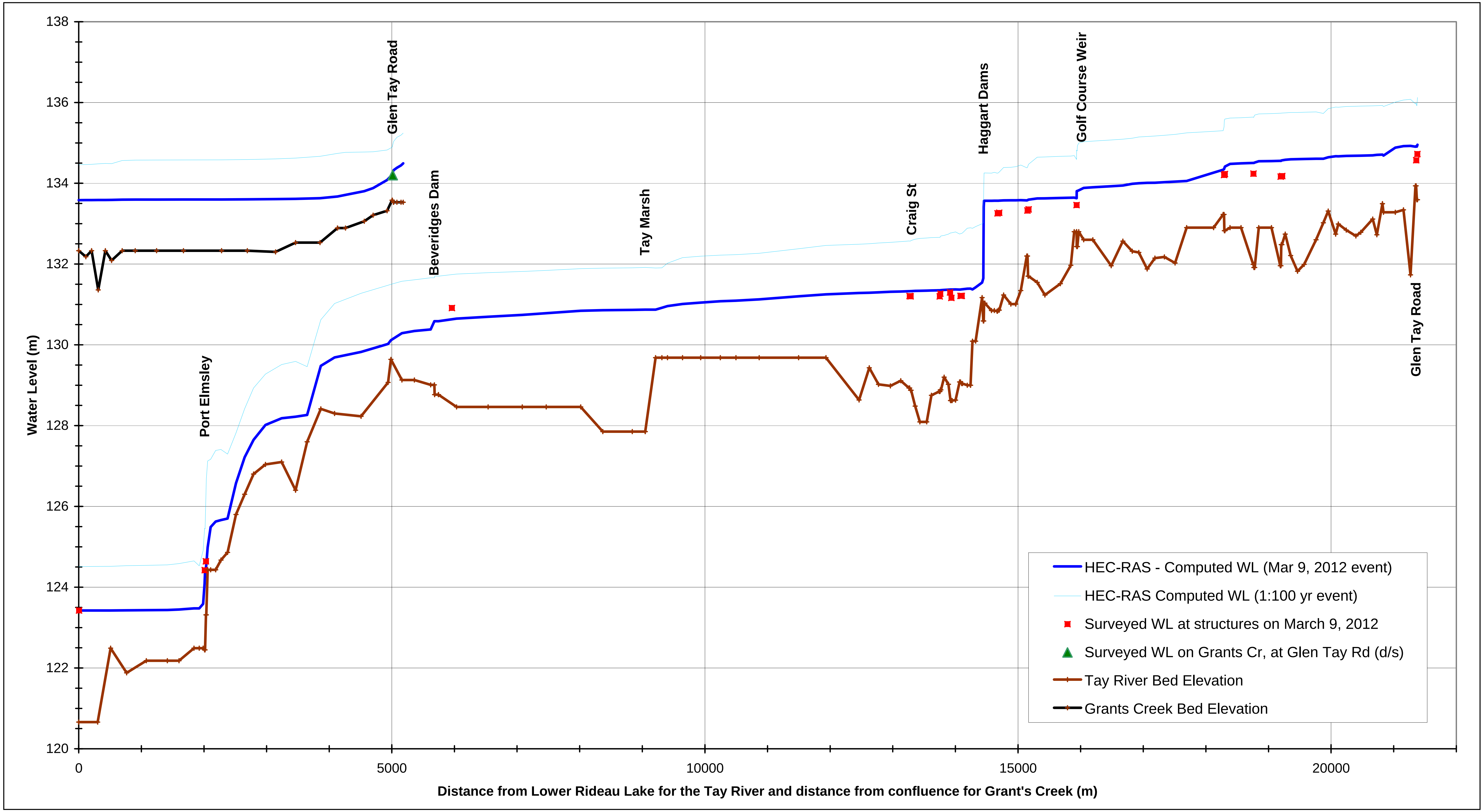


Figure 8: Observed vs Computed Water Level on the Tay River and Grant's Creek

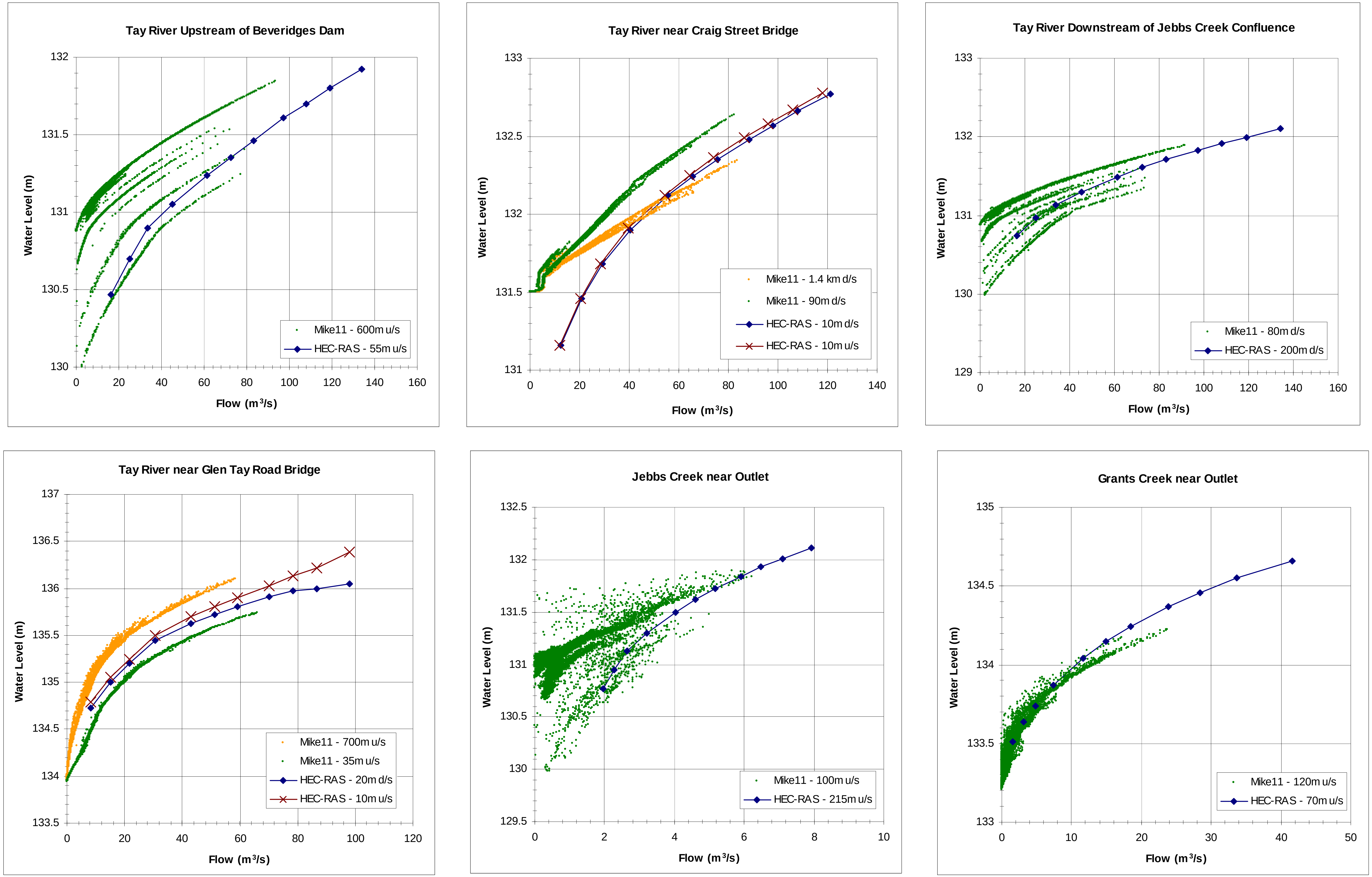


Figure 9: Comparison of Stage-Discharge Relationships

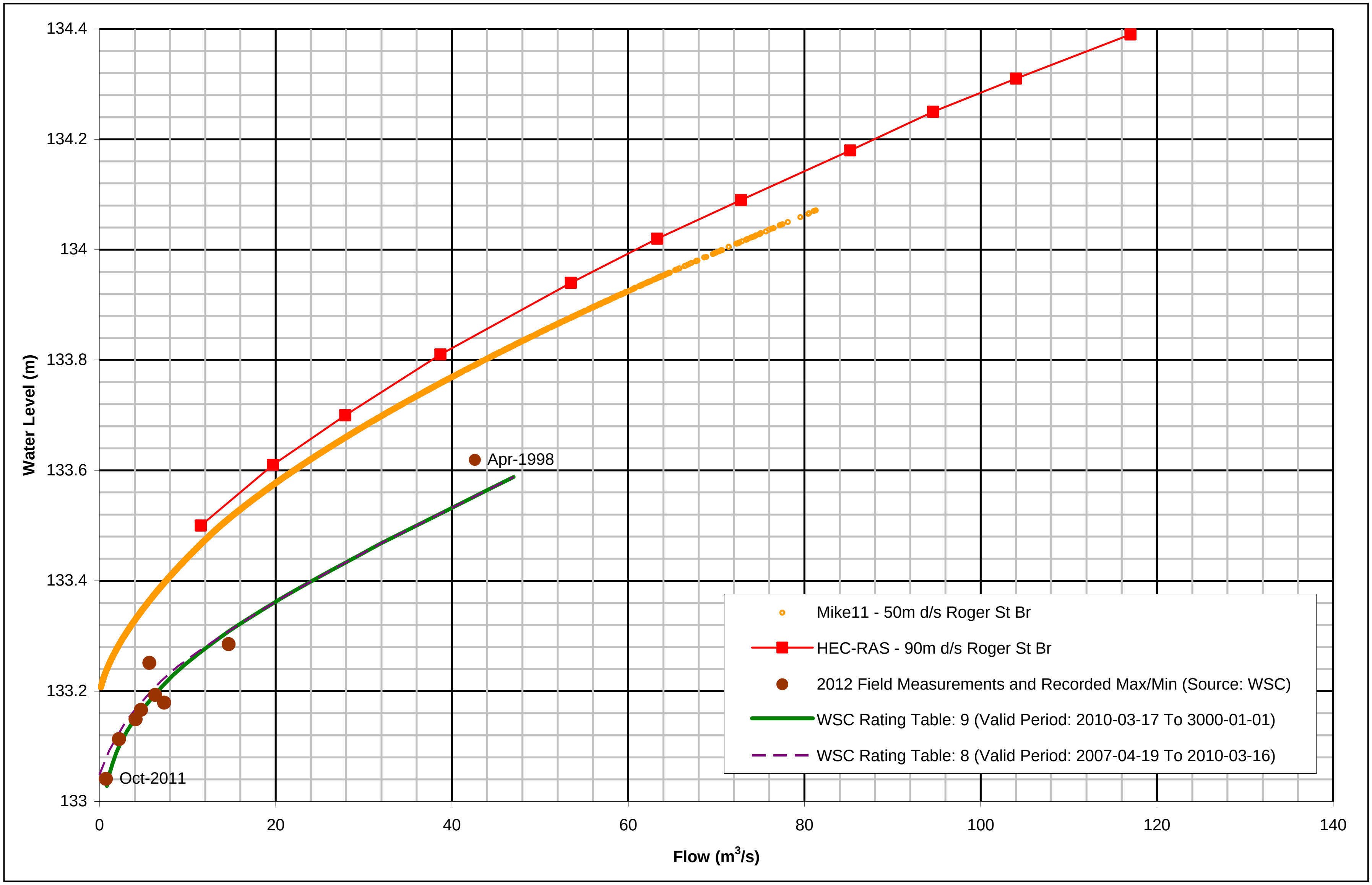


Figure 10: Stage-Discharge Relationship at Perth Gauge (WSC gauge #: 02LA024)

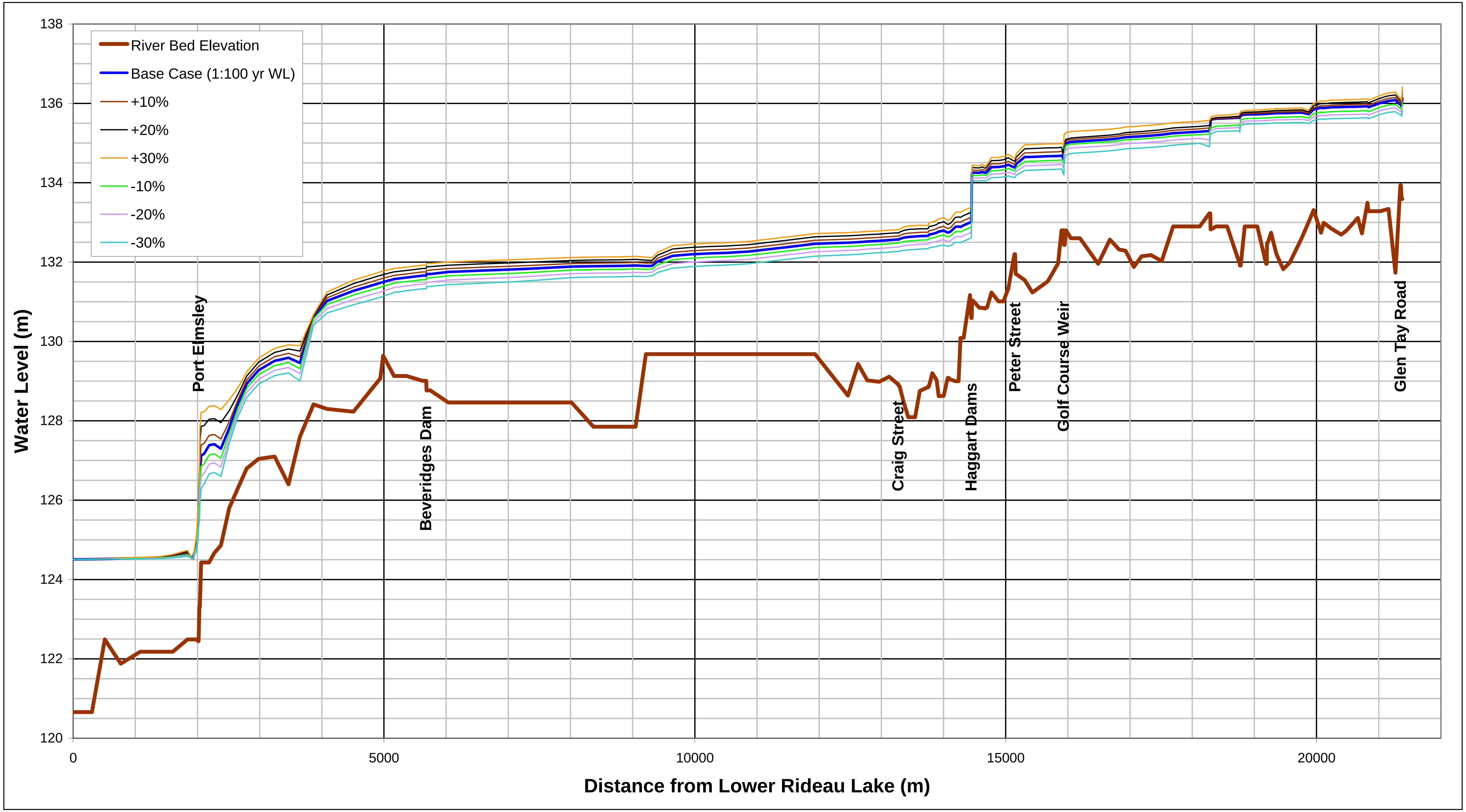


Figure 11: Sensitivity Analysis of Computed Water Level to Design Flow

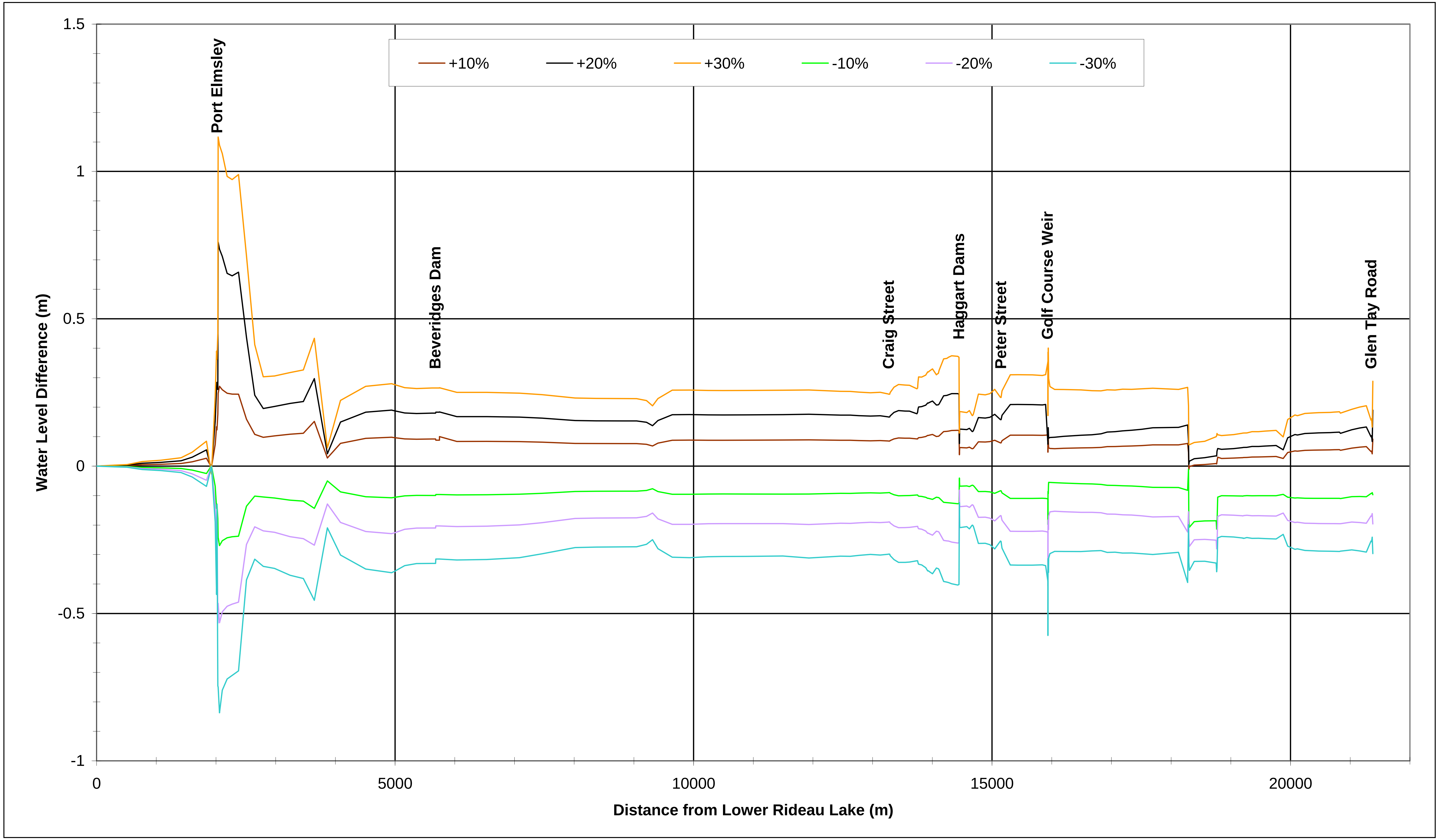


Figure 12: Sensitivity Analysis of Computed Water Level to Design Flow (Water Level Difference)

Figure 13: Beveridges Dam Log Operations for a Typical Year (2001)

Figure 14: Bobs Lake Rule Curve

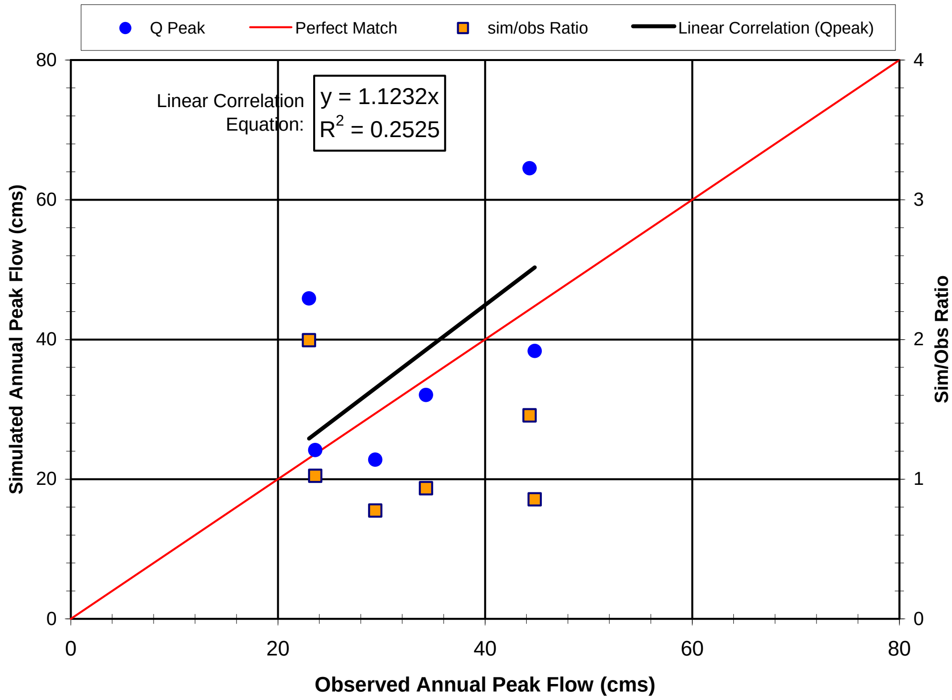


Figure 15: Comparison of Observed and Simulated Flood Peaks

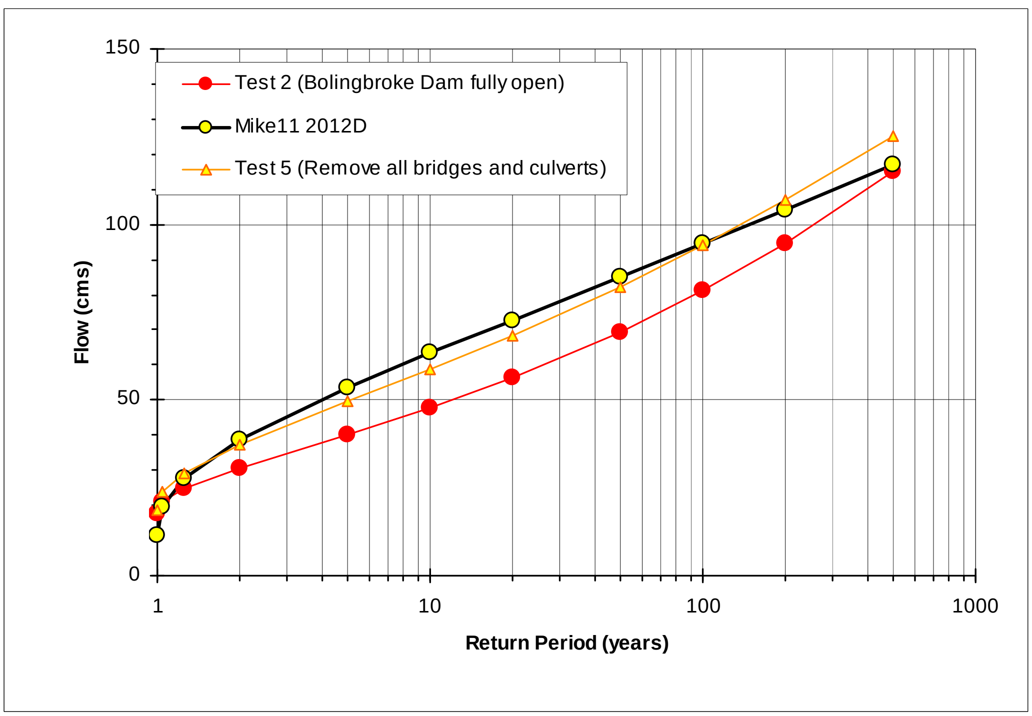


Figure 16: Result of Test 2 (fully open Bolingbroke Dam) and Test 5 (removal of all bridges and culverts) on flood Quantiles for the Tay River at Perth

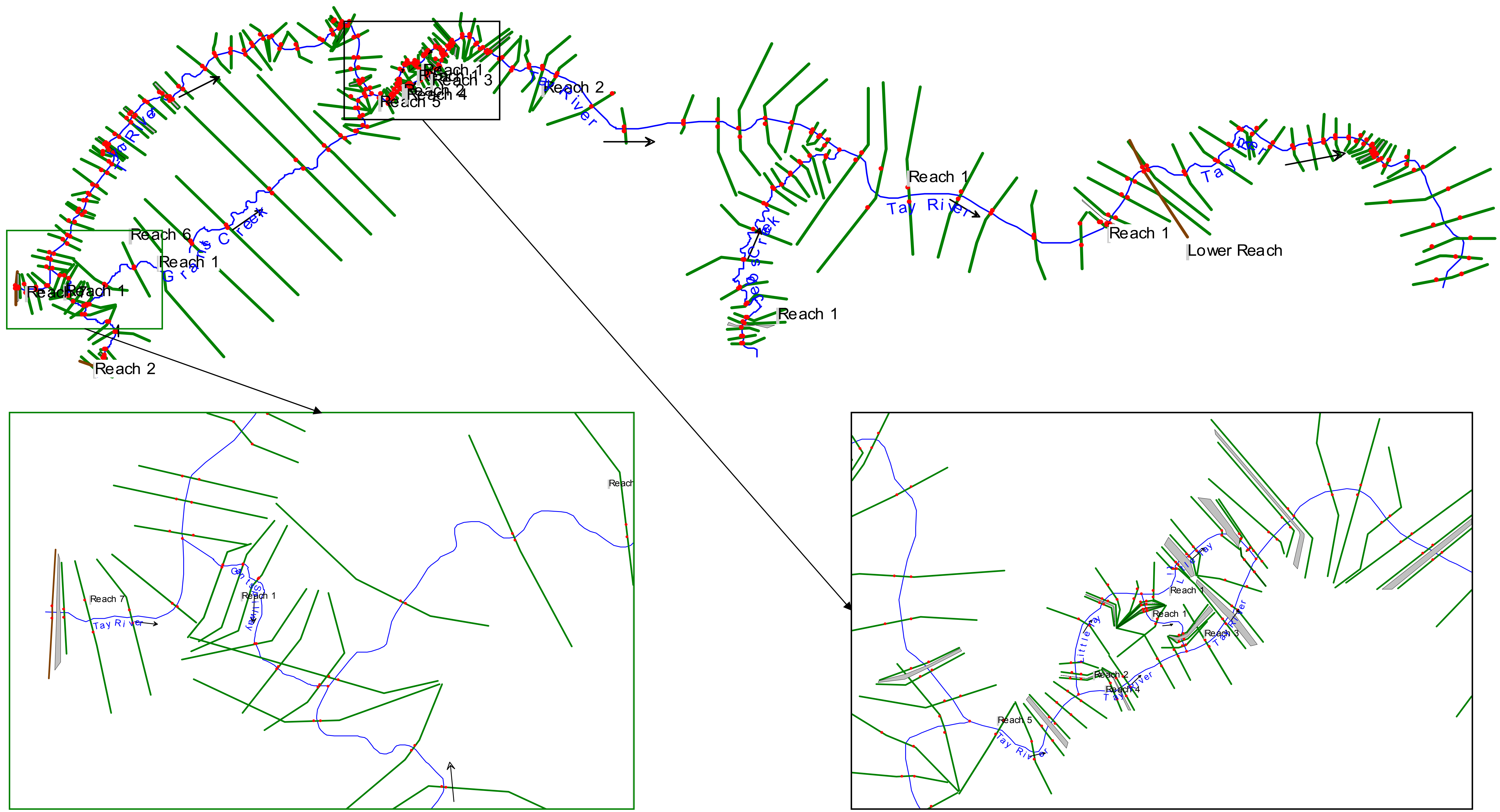
Appendix A

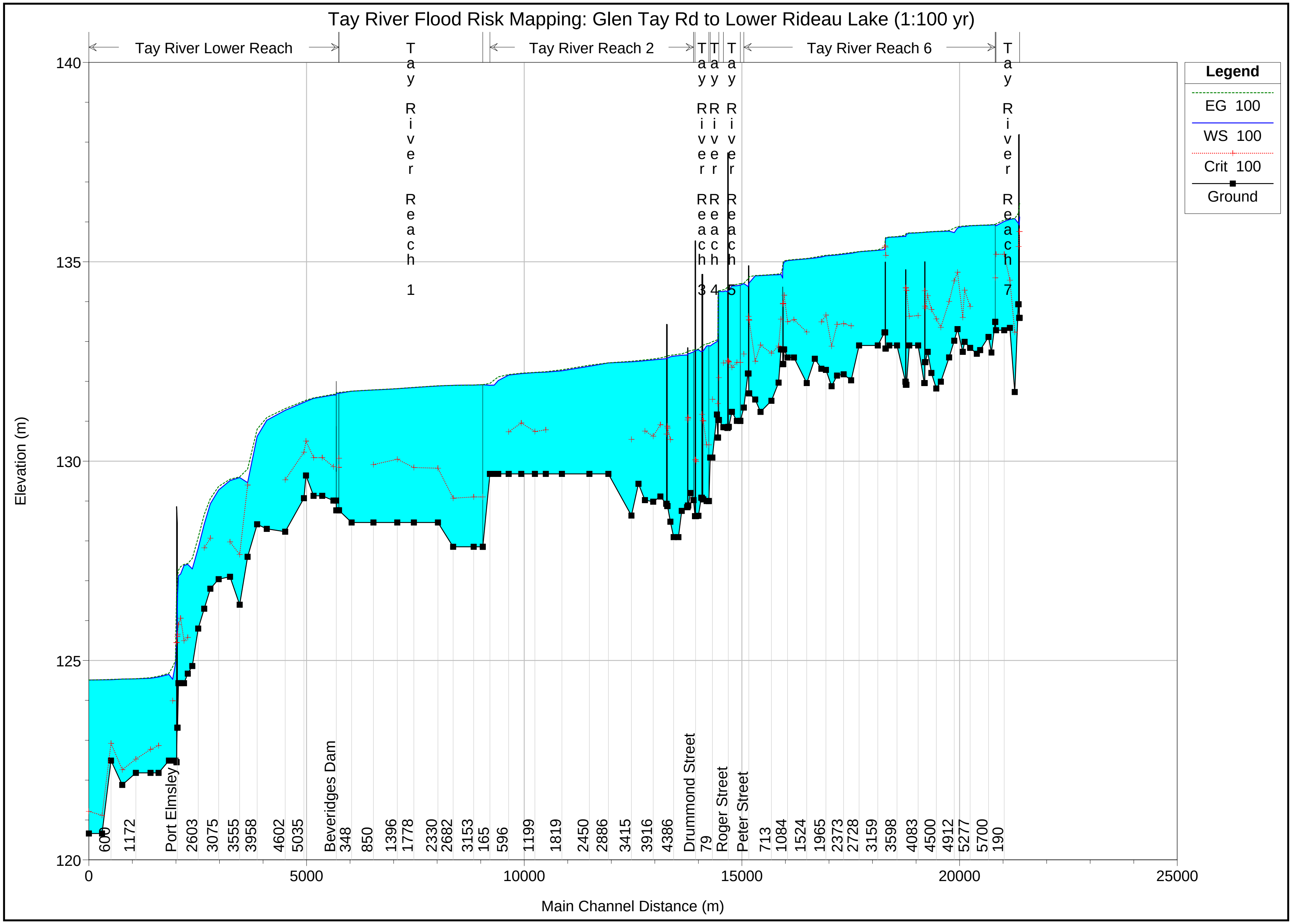
HEC-RAS Model Output

Model Schematic

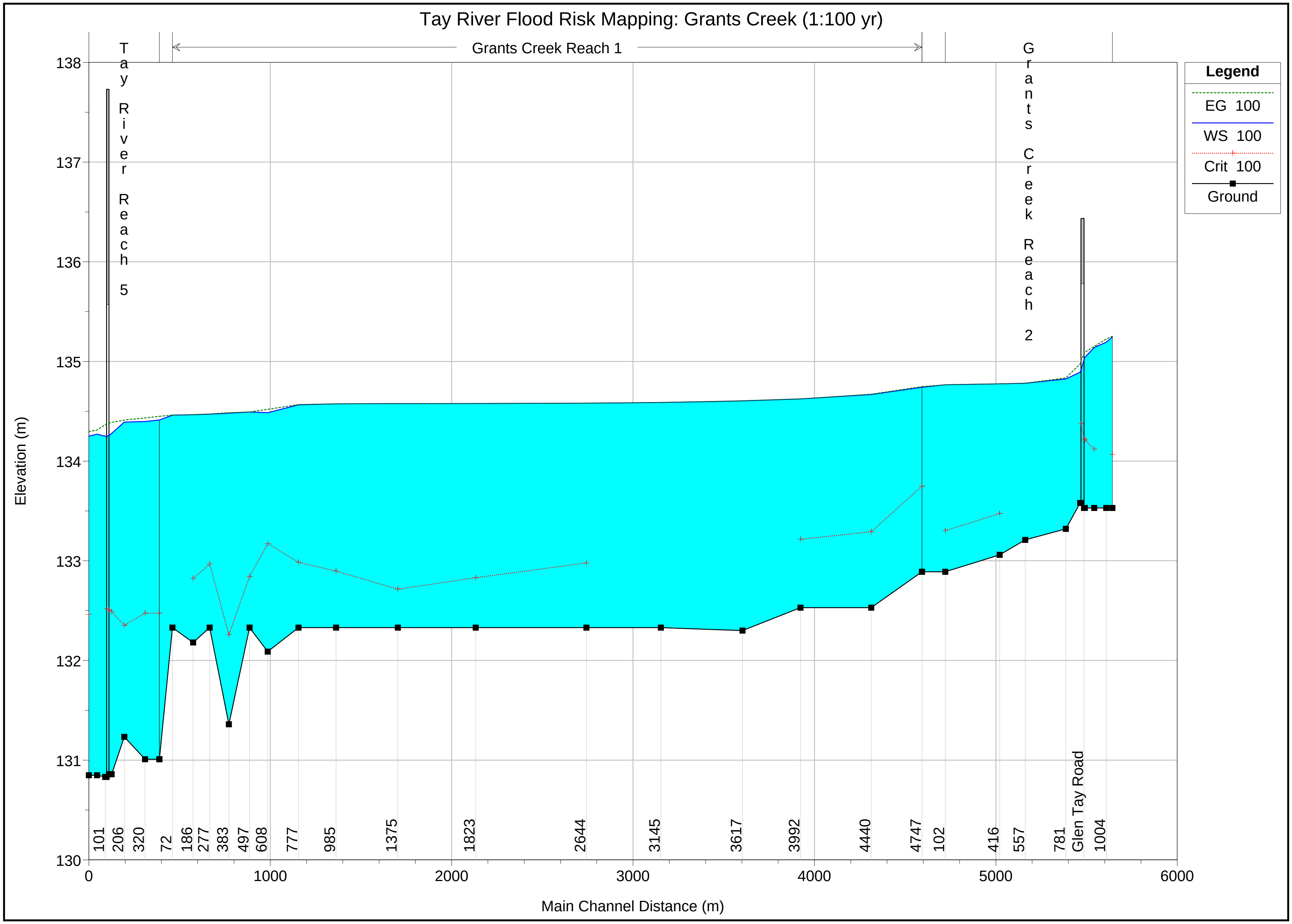
Longitudinal Profiles

Cross-Sections

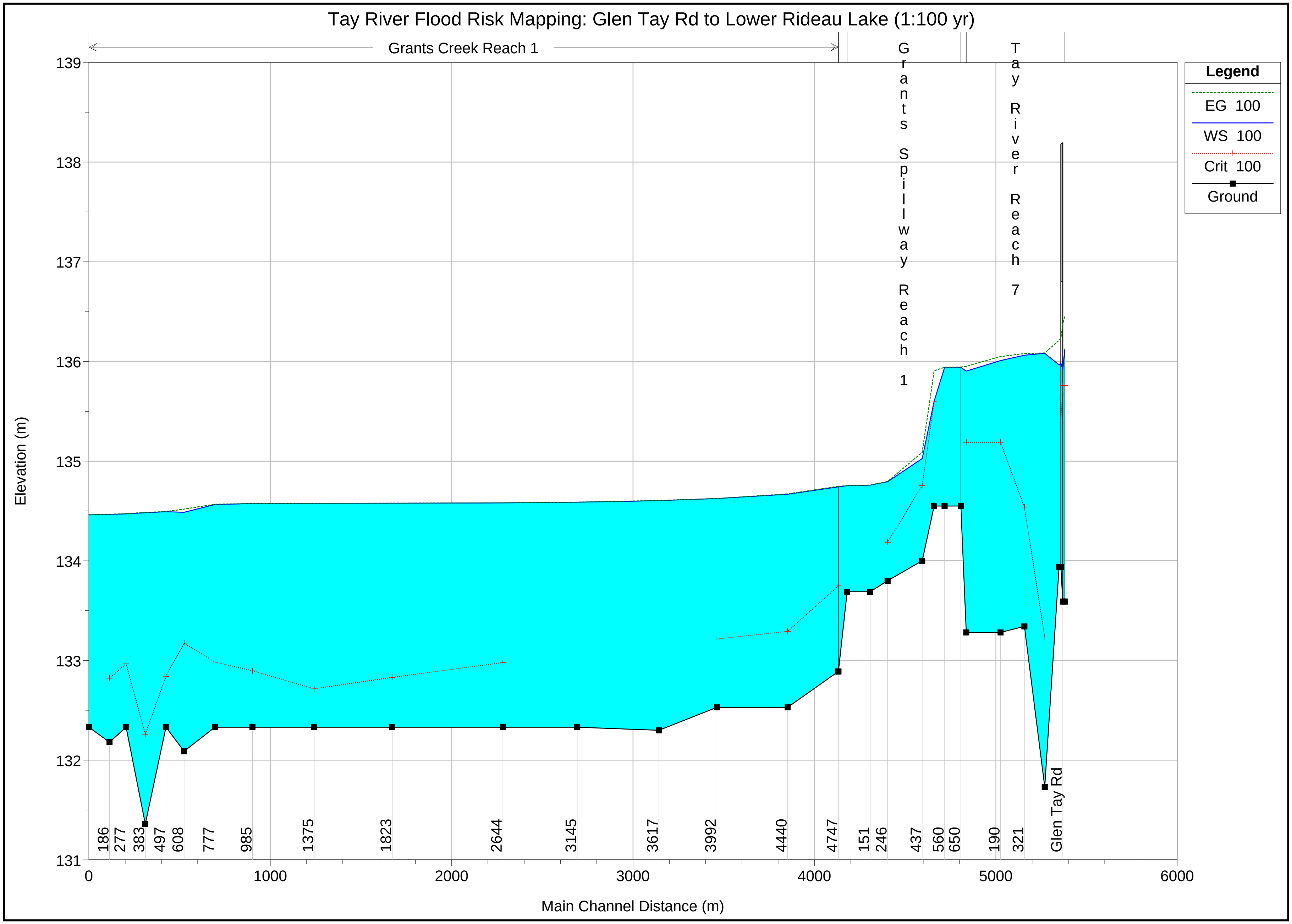

Reach 1
Reach 3
Reach 2
Reach 4
Reach 5
Tay River
Reach 6
Reach 1
Grants Creek
Reach 7
Reach 2
Reach 1
Reach 1
Tay River
Reach 1
Lower Reach
Tay River
Reach 1
Reach 7
Tay River
Grants Creek
Reach 1
Reach
Reach 1
Reach 1
Reach 3
Reach 2
Reach 4
Reach 5
Little Tay
Tay River

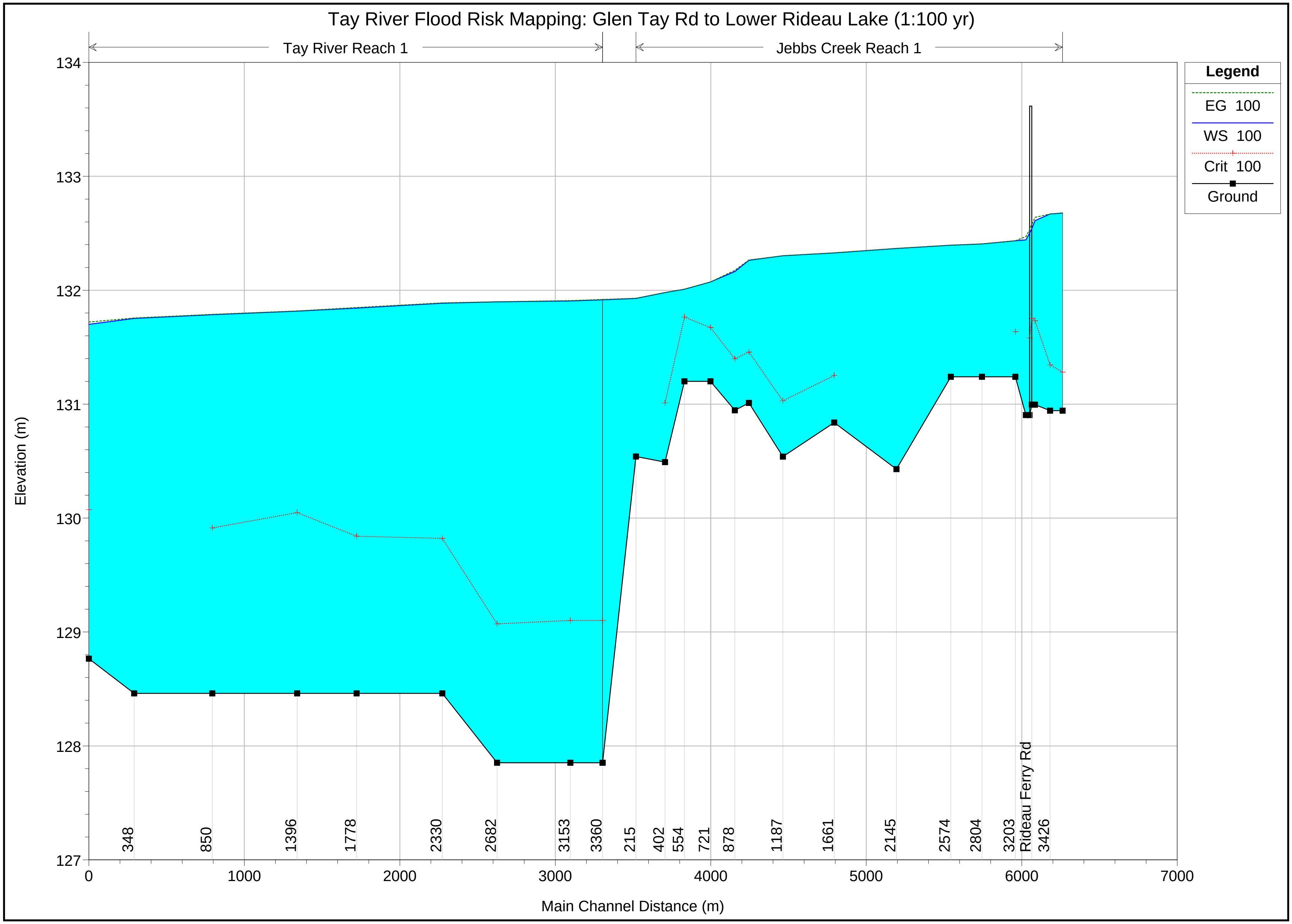


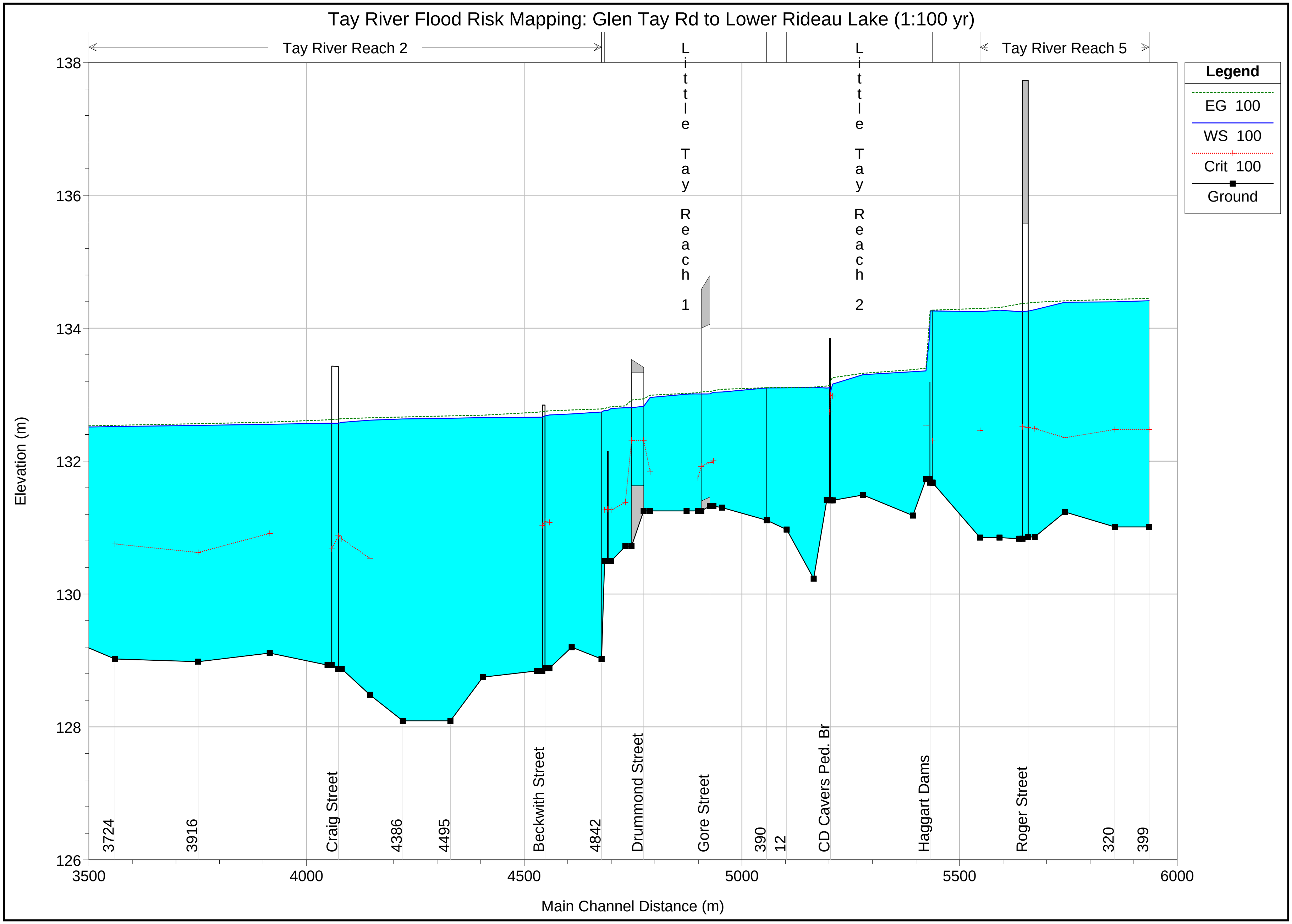
Tay River Flood Risk Mapping: Glen Tay Rd to Lower Rideau Lake (1:100 yr)
Tay River Lower Reach
Tay River Reach 1
Tay River Reach 2
Tay River Reach 3
Tay River Reach 4
Tay River Reach 5
Tay River Reach 6
Tay River Reach 7
Legend
EG 100
WS 100
Crit 100
Ground
Elevation (m)
Main Channel Distance (m)
Port Elmsley
Beveridges Dam
Drummond Street
Roger Street
Peter Street



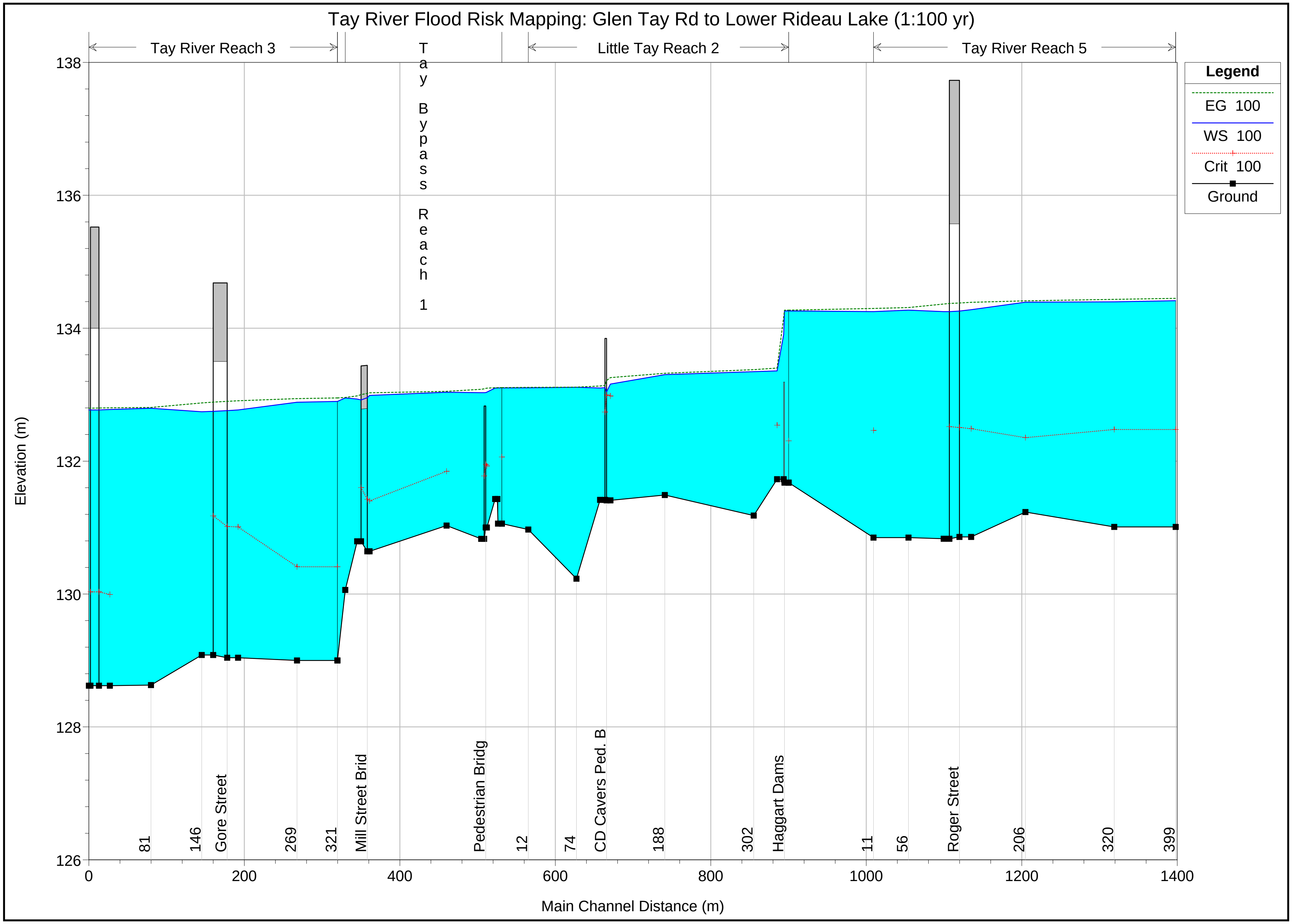
Tay River Flood Risk Mapping: Grants Creek (1:100 yr)
Grants Creek Reach 1
Tay River Reach 5
Grants Creek Reach 2
Legend
EG 100
WS 100
Crit 100
Ground
Elevation (m)
Main Channel Distance (m)
Glen Tay Road
101
206
320
72
186
277
383
497
608
777
985
1375
1823
2644
3145
3617
3992
4440
4747
102
416
557
781
1004


Tay River Flood Risk Mapping: Glen Tay Rd to Lower Rideau Lake (1:100 yr)
Grants Creek Reach 1
Grants Spillway Reach 1
Tay River Reach 7
Legend
EG 100
WS 100
Crit 100
Ground
Elevation (m)
Main Channel Distance (m)
186
277
383
497
608
777
985
1375
1823
2644
3145
3617
3992
4440
4747
151
246
437
560
650
190
321
Glen Tay Rd

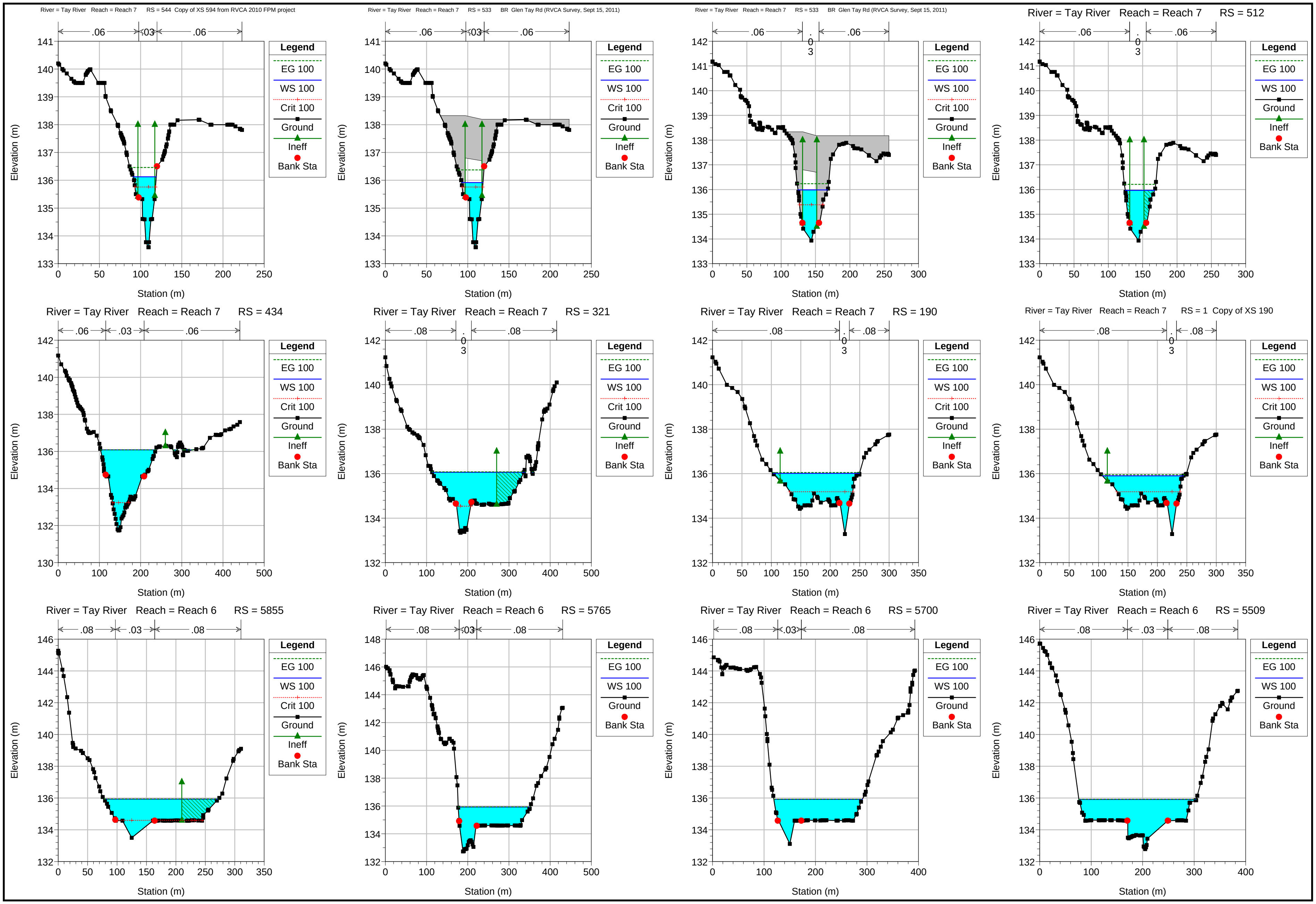

Tay River Flood Risk Mapping: Glen Tay Rd to Lower Rideau Lake (1:100 yr)
Tay River Reach 1
Jebbs Creek Reach 1
Legend
EG 100
WS 100
Crit 100
Ground
Elevation (m)
Main Channel Distance (m)
Rideau Ferry Rd
348
850
1396
1778
2330
2682
3153
3360
215
402
554
721
878
1187
1661
2145
2574
2804
3203
3426

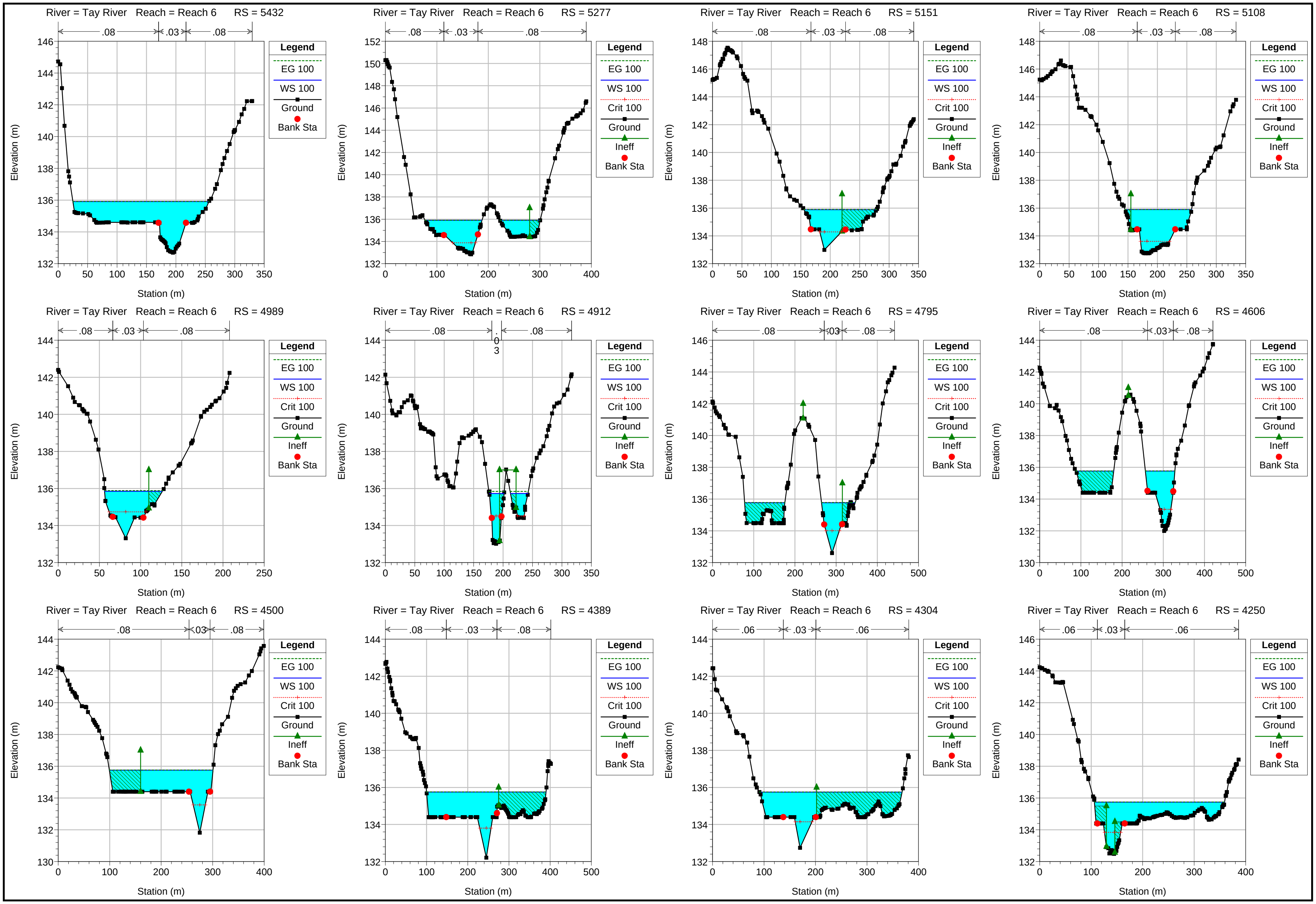


Tay River Flood Risk Mapping: Glen Tay Rd to Lower Rideau Lake (1:100 yr)
Tay River Reach 2
Little Tay Reach 1
Little Tay Reach 2
Tay River Reach 5
Legend
EG 100
WS 100
Crit 100
Ground
Elevation (m)
138
136
134
132
130
128
126
3724
3916
Craig Street
4386
4495
Beckwith Street
4842
Drummond Street
Gore Street
390
12
CD Cavers Ped. Br
Haggart Dams
Roger Street
320
399
3500
4000
4500
5000
5500
6000
Main Channel Distance (m)

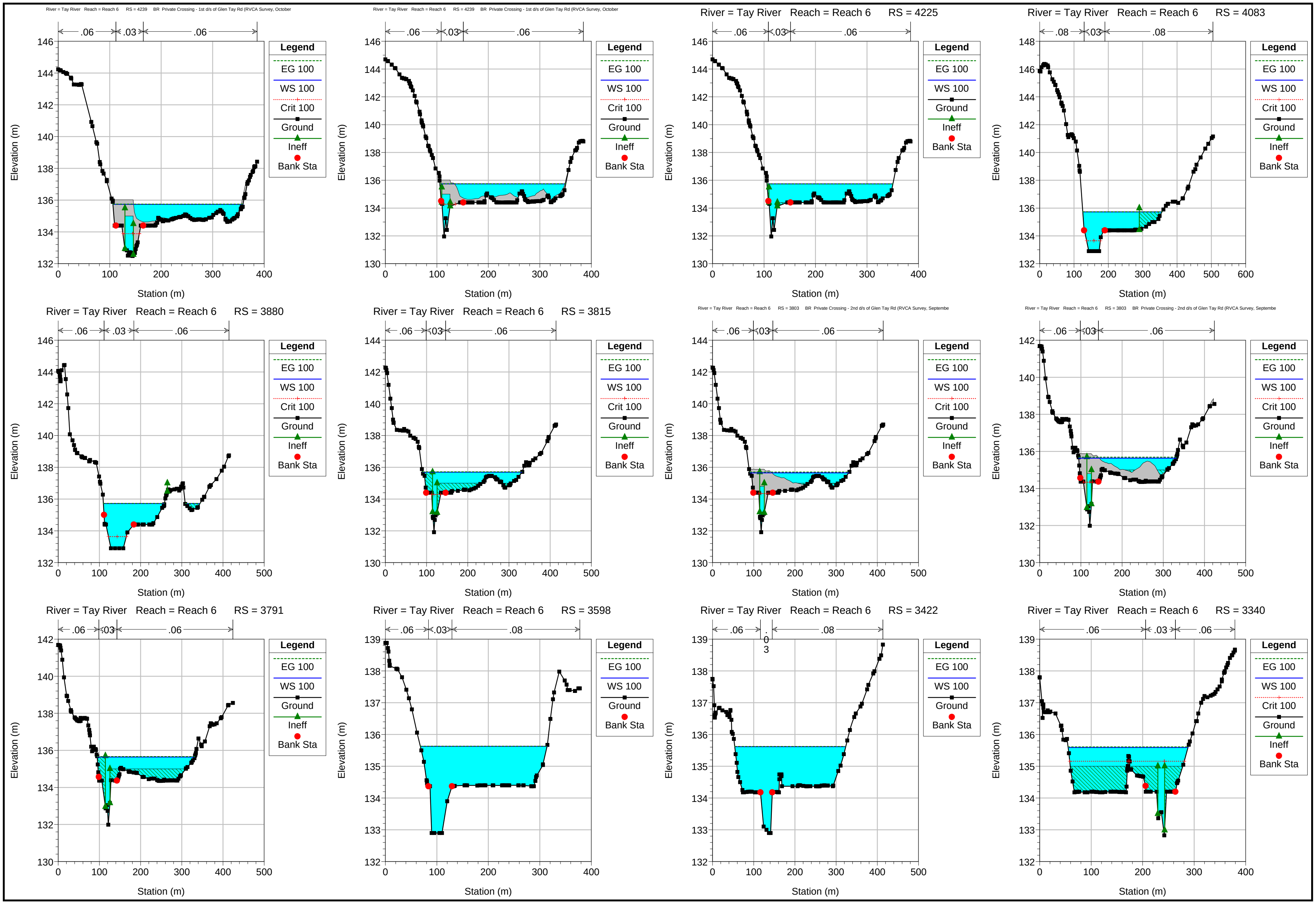


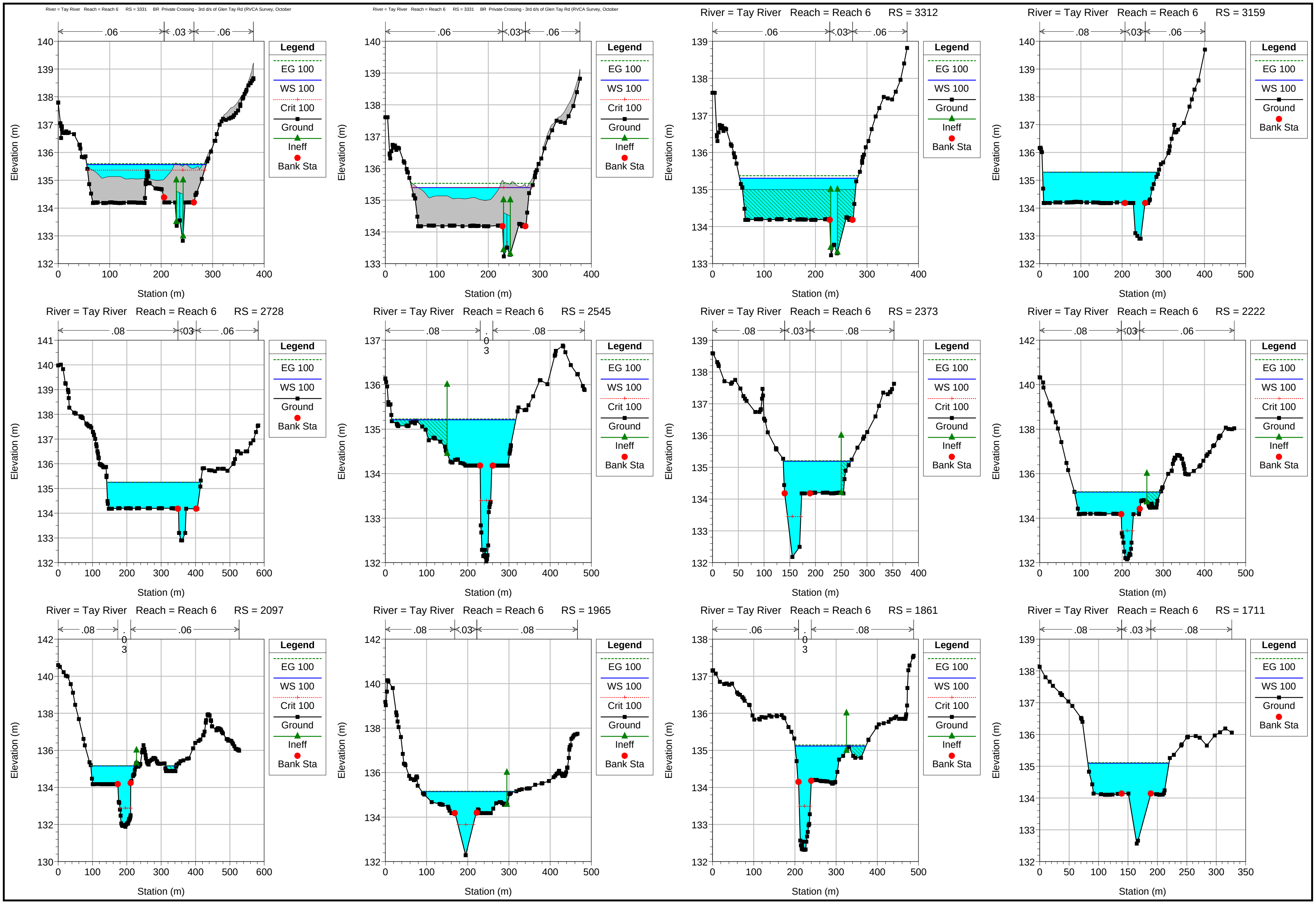
Tay River Flood Risk Mapping: Glen Tay Rd to Lower Rideau Lake (1:100 yr)
Tay River Reach 3
Tay Bypass Reach 1
Little Tay Reach 2
Tay River Reach 5
Legend
EG 100
WS 100
Crit 100
Ground
Elevation (m)
138
136
134
132
130
128
126
81
146
Gore Street
269
321
Mill Street Brid
Pedestrian Bridg
12
74
CD Cavers Ped. B
188
302
Haggart Dams
11
56
Roger Street
206
320
399
0
200
400
600
800
1000
1200
1400
Main Channel Distance (m)

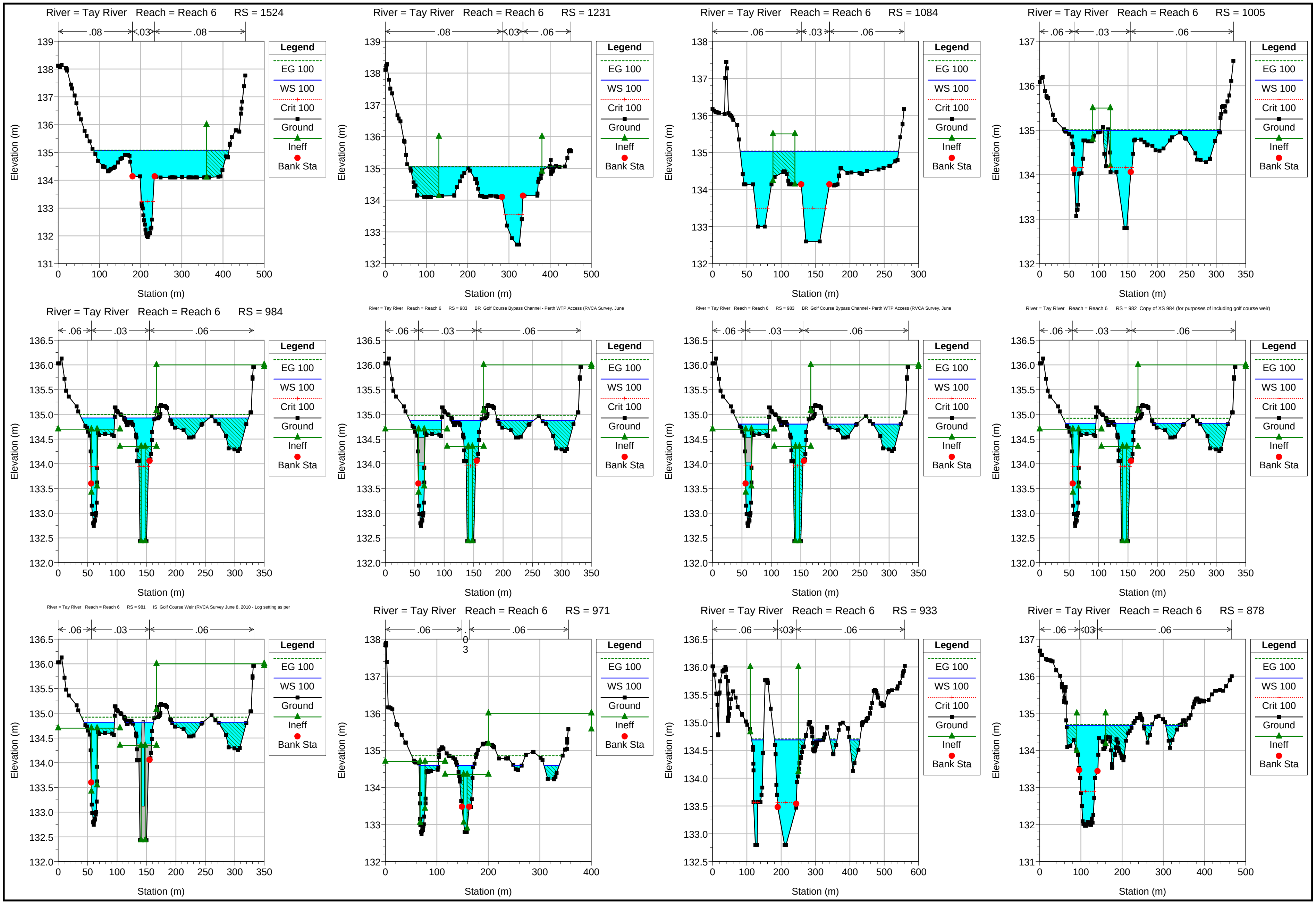

River = Tay River Reach = Reach 7 RS = 544 Copy of XS 594 from RVCA 2010 FPM project
River = Tay River Reach = Reach 7 RS = 533 BR Glen Tay Rd (RVCA Survey, Sept 15, 2011)
River = Tay River Reach = Reach 7 RS = 533 BR Glen Tay Rd (RVCA Survey, Sept 15, 2011)
River = Tay River Reach = Reach 7 RS = 512
River = Tay River Reach = Reach 7 RS = 434
River = Tay River Reach = Reach 7 RS = 321
River = Tay River Reach = Reach 7 RS = 190
River = Tay River Reach = Reach 7 RS = 1 Copy of XS 190
River = Tay River Reach = Reach 6 RS = 5855
River = Tay River Reach = Reach 6 RS = 5765
River = Tay River Reach = Reach 6 RS = 5700
River = Tay River Reach = Reach 6 RS = 5509
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

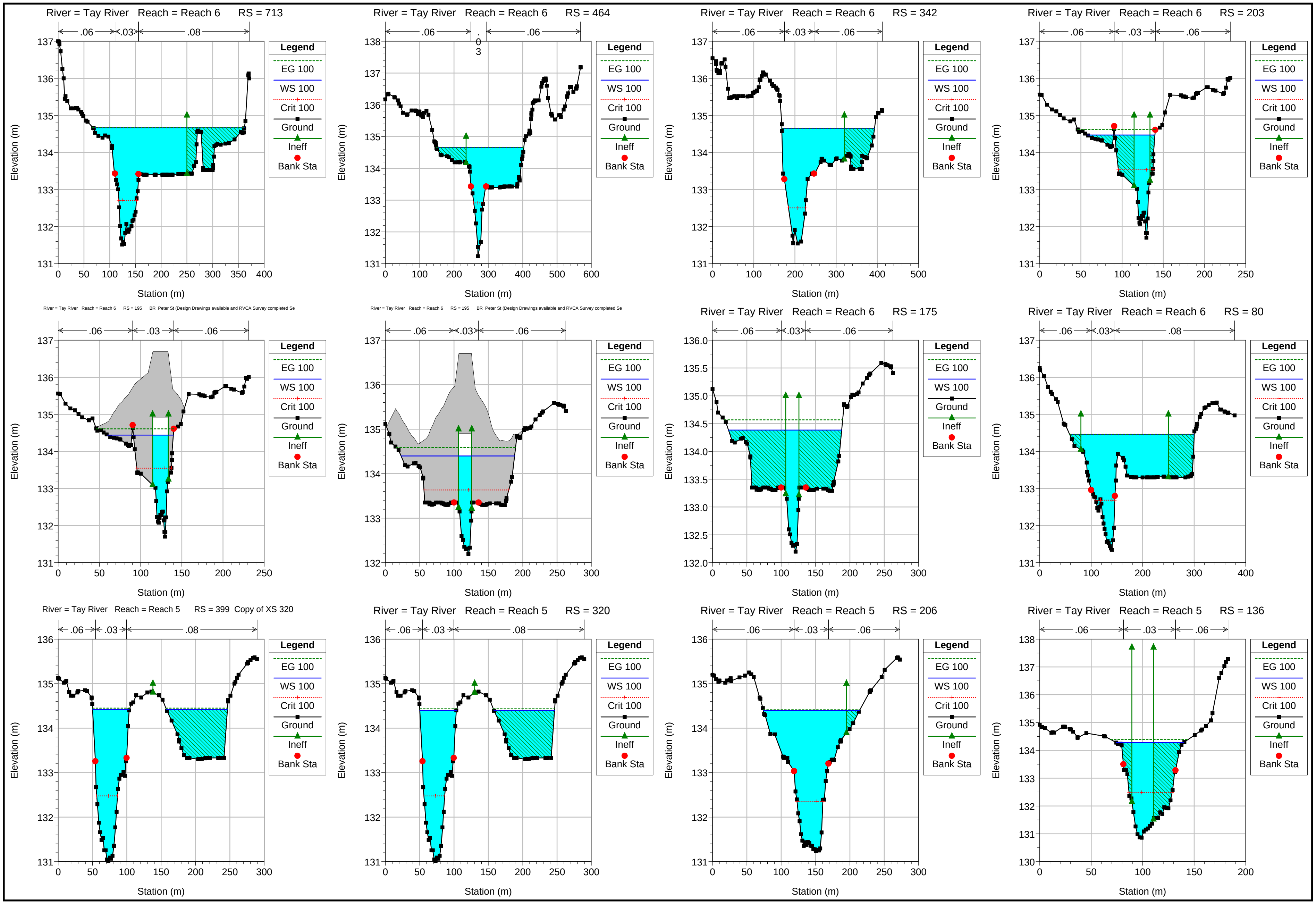


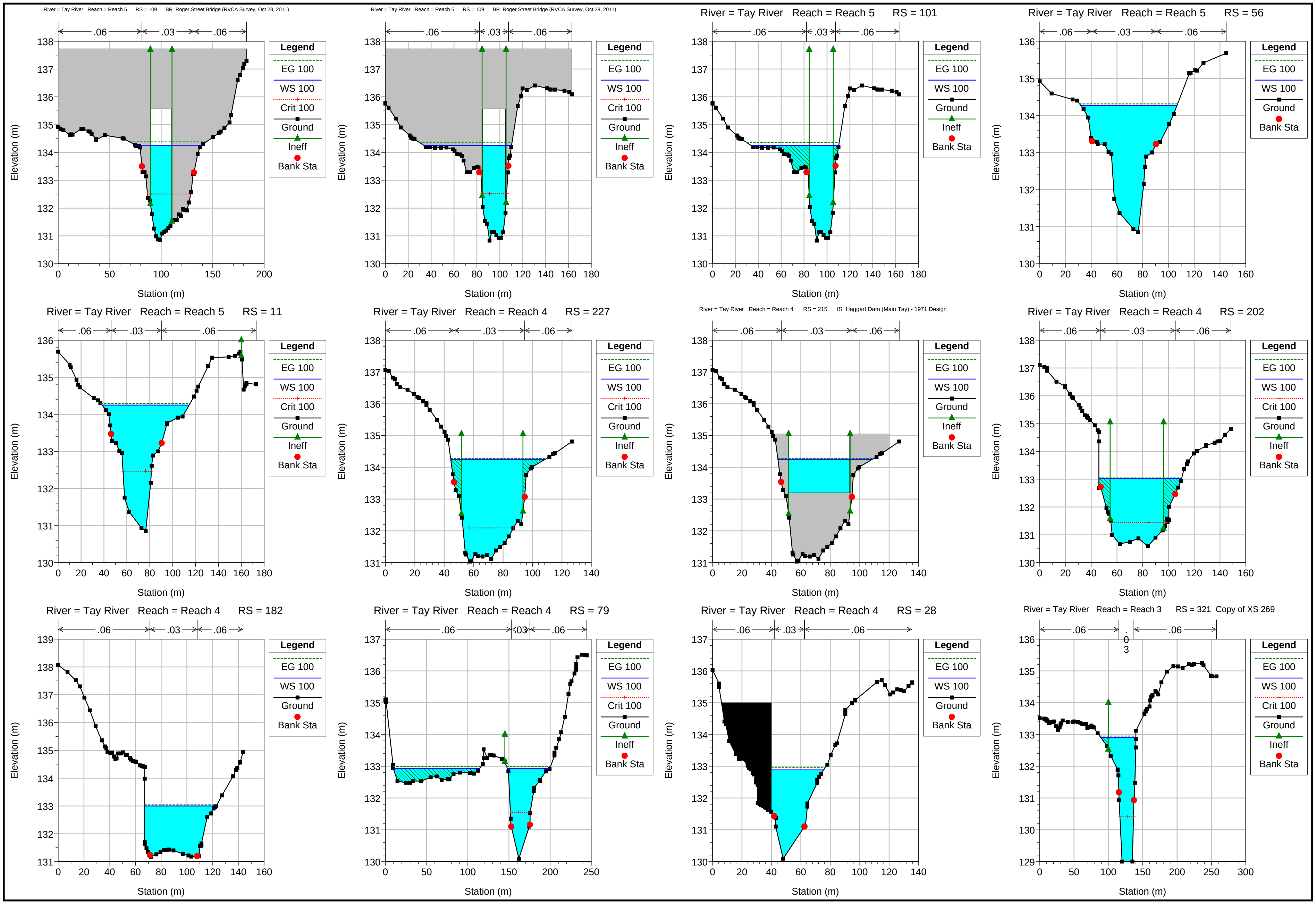
River = Tay River Reach = Reach 6 RS = 5432
River = Tay River Reach = Reach 6 RS = 5277
River = Tay River Reach = Reach 6 RS = 5151
River = Tay River Reach = Reach 6 RS = 5108
River = Tay River Reach = Reach 6 RS = 4989
River = Tay River Reach = Reach 6 RS = 4912
River = Tay River Reach = Reach 6 RS = 4795
River = Tay River Reach = Reach 6 RS = 4606
River = Tay River Reach = Reach 6 RS = 4500
River = Tay River Reach = Reach 6 RS = 4389
River = Tay River Reach = Reach 6 RS = 4304
River = Tay River Reach = Reach 6 RS = 4250
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

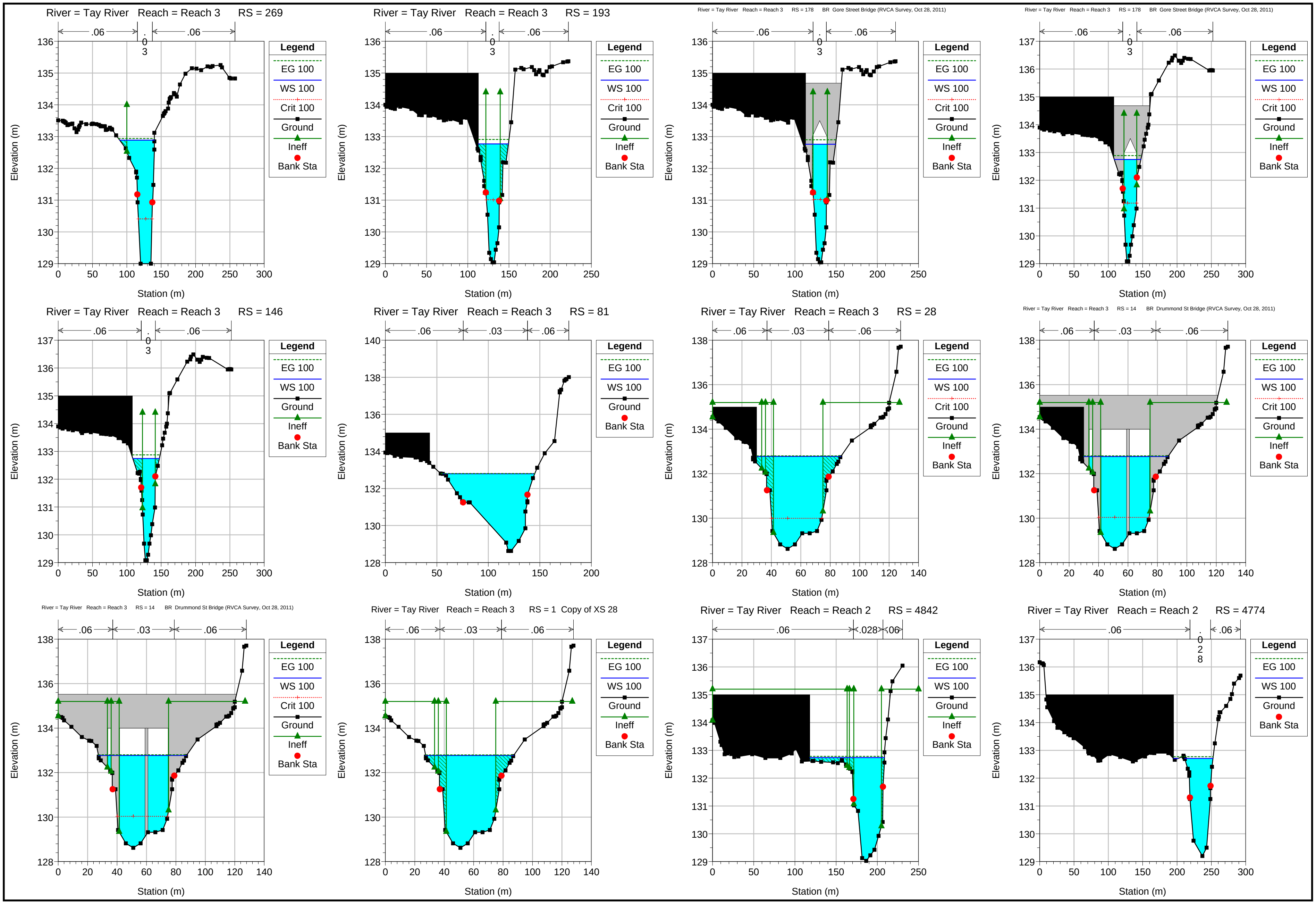

River = Tay River Reach = Reach 6 RS = 4225
River = Tay River Reach = Reach 6 RS = 4083
River = Tay River Reach = Reach 6 RS = 3880
River = Tay River Reach = Reach 6 RS = 3815
River = Tay River Reach = Reach 6 RS = 3791
River = Tay River Reach = Reach 6 RS = 3598
River = Tay River Reach = Reach 6 RS = 3422
River = Tay River Reach = Reach 6 RS = 3340
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

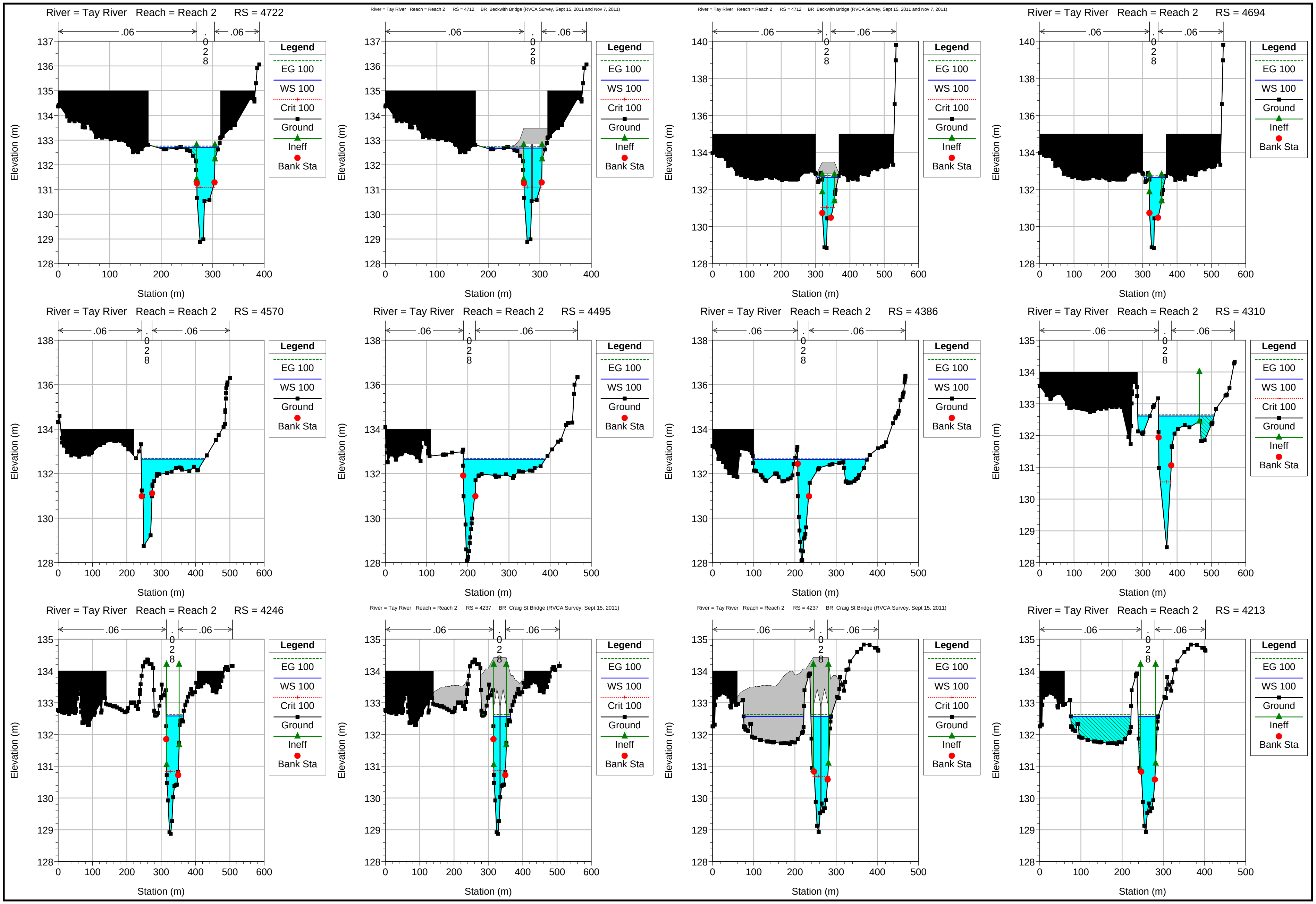

River = Tay River Reach = Reach 6 RS = 3331 BR Private Crossing - 3rd d/s of Glen Tay Rd (RVCA Survey, October
River = Tay River Reach = Reach 6 RS = 3331 BR Private Crossing - 3rd d/s of Glen Tay Rd (RVCA Survey, October
River = Tay River Reach = Reach 6 RS = 3312
River = Tay River Reach = Reach 6 RS = 3159
River = Tay River Reach = Reach 6 RS = 2728
River = Tay River Reach = Reach 6 RS = 2545
River = Tay River Reach = Reach 6 RS = 2373
River = Tay River Reach = Reach 6 RS = 2222
River = Tay River Reach = Reach 6 RS = 2097
River = Tay River Reach = Reach 6 RS = 1965
River = Tay River Reach = Reach 6 RS = 1861
River = Tay River Reach = Reach 6 RS = 1711
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

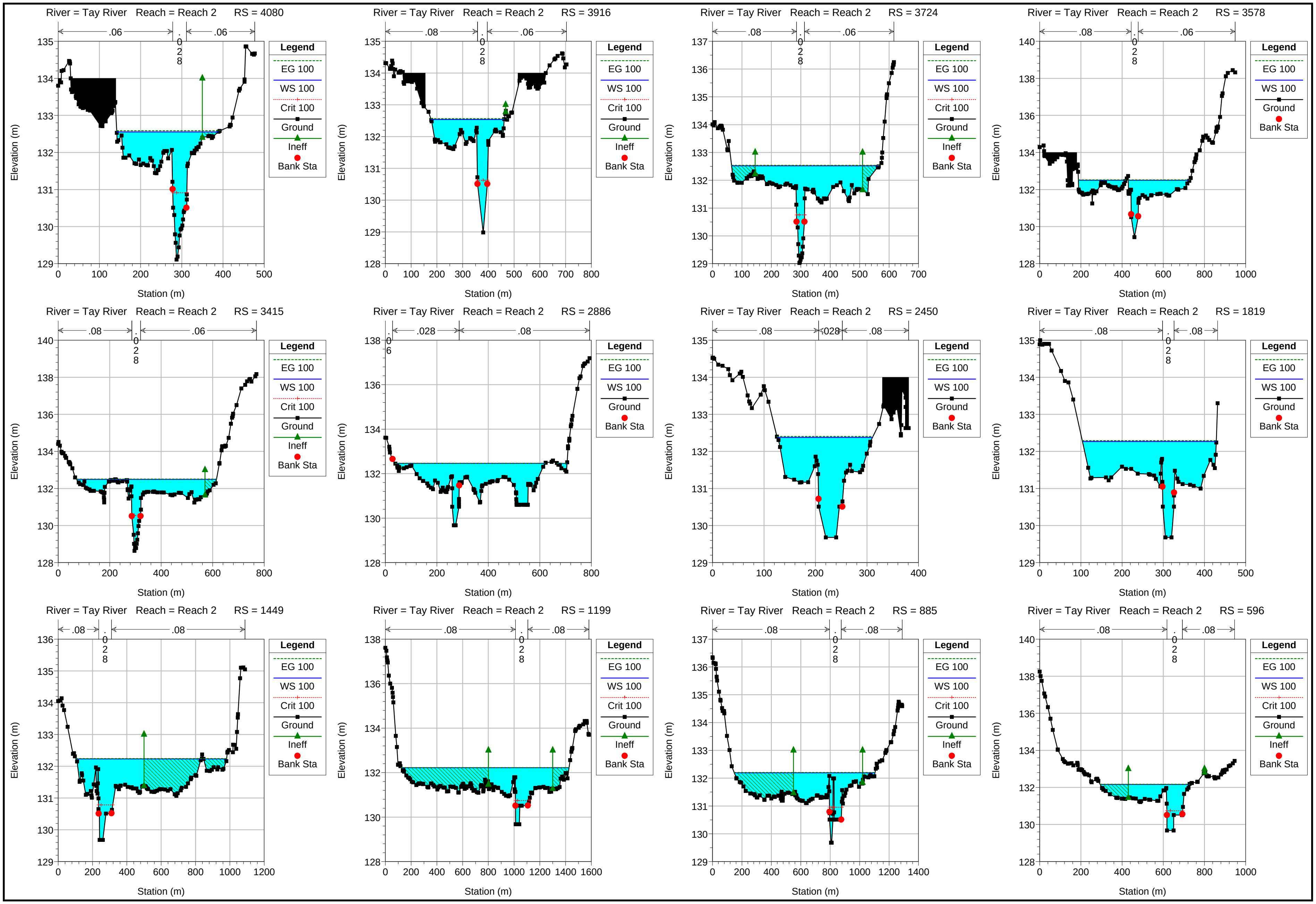

River = Tay River Reach = Reach 6 RS = 1524
River = Tay River Reach = Reach 6 RS = 1231
River = Tay River Reach = Reach 6 RS = 1084
River = Tay River Reach = Reach 6 RS = 1005
River = Tay River Reach = Reach 6 RS = 984
River = Tay River Reach = Reach 6 RS = 983 BR Golf Course Bypass Channel - Perth WTP Access (RVCA Survey, June
River = Tay River Reach = Reach 6 RS = 983 BR Golf Course Bypass Channel - Perth WTP Access (RVCA Survey, June
River = Tay River Reach = Reach 6 RS = 982 Copy of XS 984 (for purposes of including golf course weir)
River = Tay River Reach = Reach 6 RS = 981 IS Golf Course Weir (RVCA Survey June 8, 2010 - Log setting as per
River = Tay River Reach = Reach 6 RS = 971
River = Tay River Reach = Reach 6 RS = 933
River = Tay River Reach = Reach 6 RS = 878
Elevation (m)
Station (m)
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta

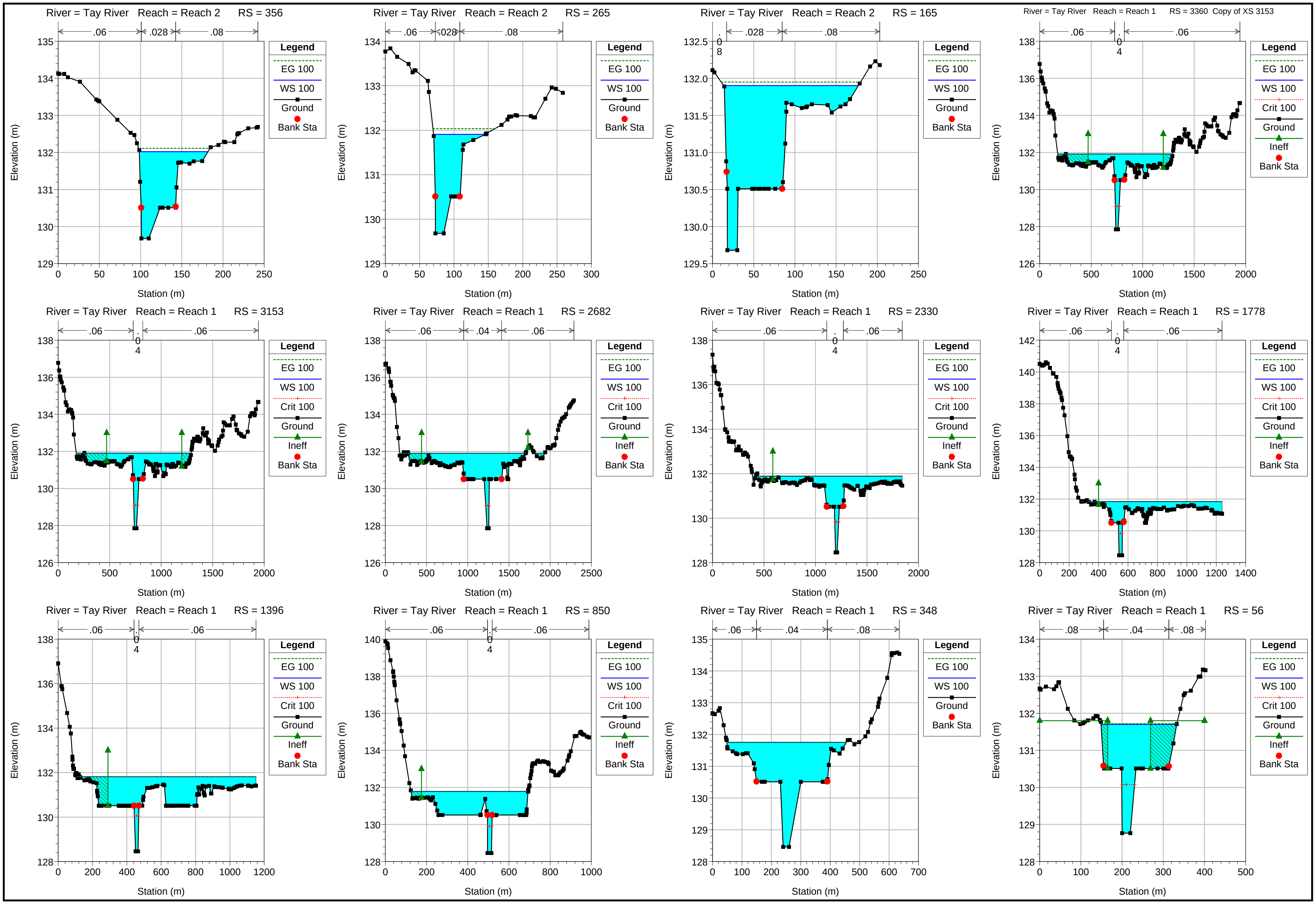

River = Tay River Reach = Reach 6 RS = 713
River = Tay River Reach = Reach 6 RS = 464
River = Tay River Reach = Reach 6 RS = 342
River = Tay River Reach = Reach 6 RS = 203
River = Tay River Reach = Reach 6 RS = 195 BR Peter St (Design Drawings available and RVCA Survey completed Se
River = Tay River Reach = Reach 6 RS = 195 BR Peter St (Design Drawings available and RVCA Survey completed Se
River = Tay River Reach = Reach 6 RS = 175
River = Tay River Reach = Reach 6 RS = 80
River = Tay River Reach = Reach 5 RS = 399 Copy of XS 320
River = Tay River Reach = Reach 5 RS = 320
River = Tay River Reach = Reach 5 RS = 206
River = Tay River Reach = Reach 5 RS = 136
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

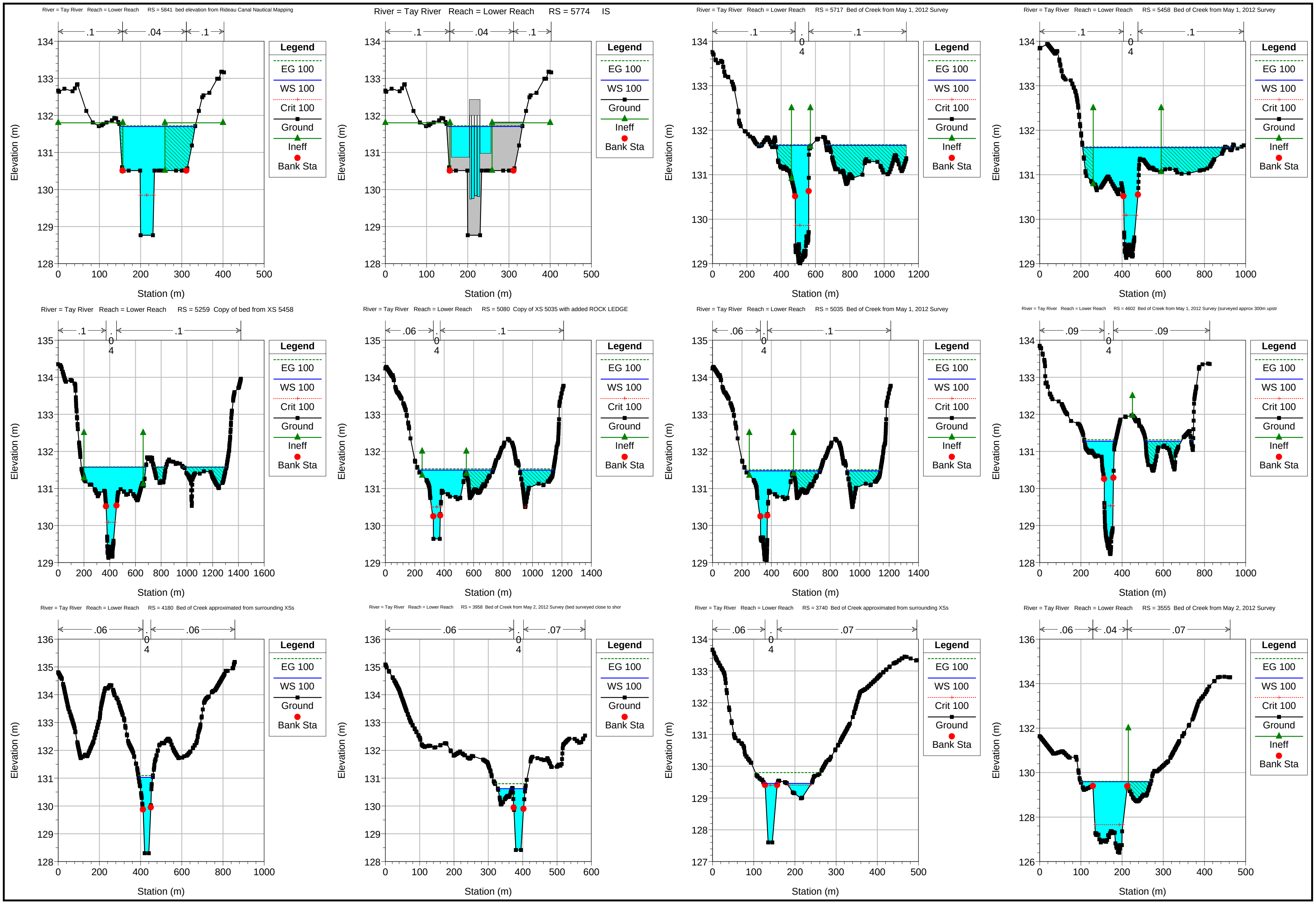

River = Tay River Reach = Reach 5 RS = 109 BR Roger Street Bridge (RVCA Survey, Oct 28, 2011)
River = Tay River Reach = Reach 5 RS = 109 BR Roger Street Bridge (RVCA Survey, Oct 28, 2011)
River = Tay River Reach = Reach 5 RS = 101
River = Tay River Reach = Reach 5 RS = 56
River = Tay River Reach = Reach 5 RS = 11
River = Tay River Reach = Reach 4 RS = 227
River = Tay River Reach = Reach 4 RS = 215 IS Haggart Dam (Main Tay) - 1971 Design
River = Tay River Reach = Reach 4 RS = 202
River = Tay River Reach = Reach 4 RS = 182
River = Tay River Reach = Reach 4 RS = 79
River = Tay River Reach = Reach 4 RS = 28
River = Tay River Reach = Reach 3 RS = 321 Copy of XS 269


River = Tay River Reach = Reach 3 RS = 269
River = Tay River Reach = Reach 3 RS = 193
River = Tay River Reach = Reach 3 RS = 178 BR Gore Street Bridge (RVCA Survey, Oct 28, 2011)
River = Tay River Reach = Reach 3 RS = 178 BR Gore Street Bridge (RVCA Survey, Oct 28, 2011)
River = Tay River Reach = Reach 3 RS = 146
River = Tay River Reach = Reach 3 RS = 81
River = Tay River Reach = Reach 3 RS = 28
River = Tay River Reach = Reach 3 RS = 14 BR Drummond St Bridge (RVCA Survey, Oct 28, 2011)
River = Tay River Reach = Reach 3 RS = 14 BR Drummond St Bridge (RVCA Survey, Oct 28, 2011)
River = Tay River Reach = Reach 3 RS = 1 Copy of XS 28
River = Tay River Reach = Reach 2 RS = 4842
River = Tay River Reach = Reach 2 RS = 4774
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

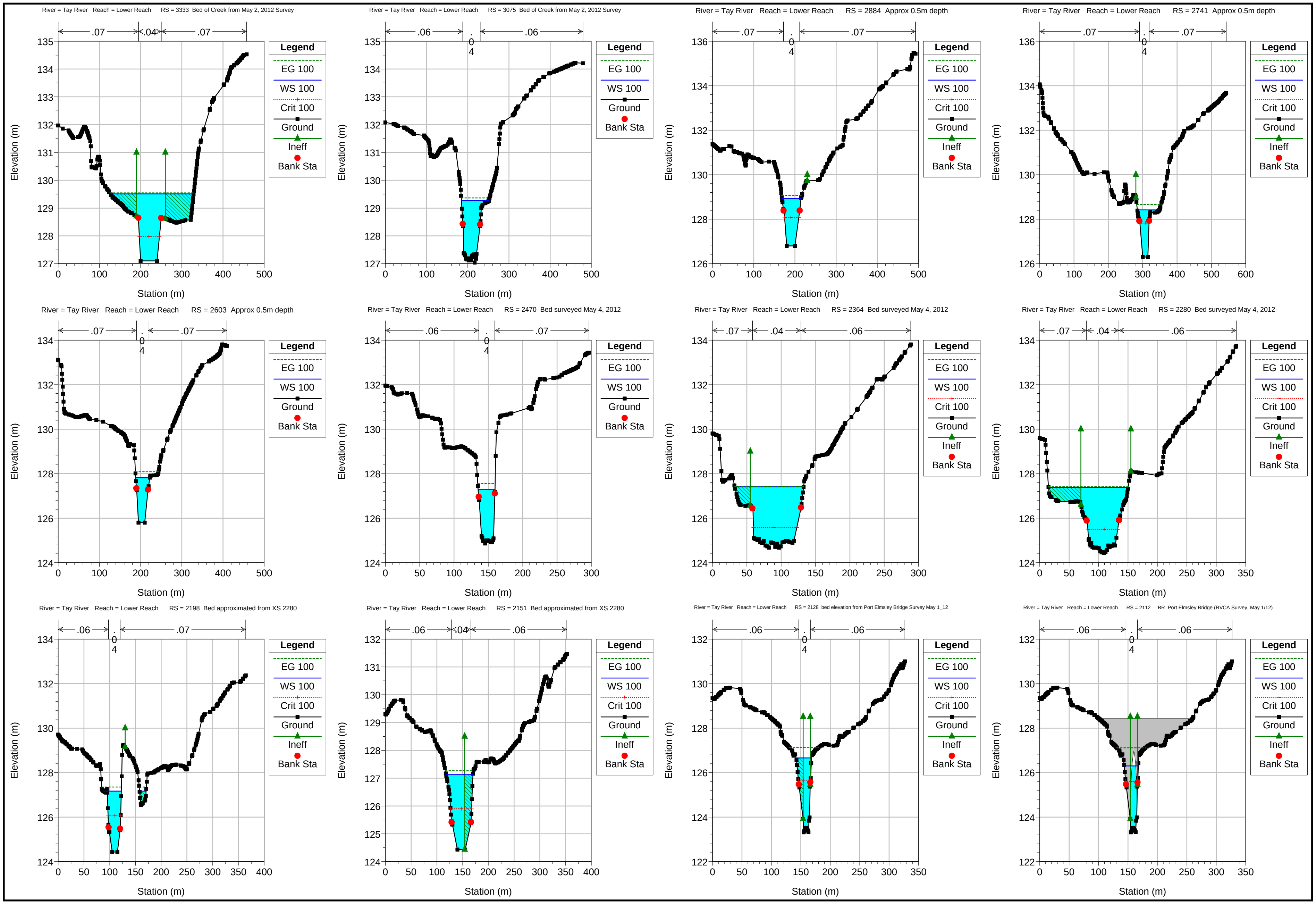

River = Tay River Reach = Reach 2 RS = 4722
River = Tay River Reach = Reach 2 RS = 4712 BR Beckwith Bridge (RVCA Survey, Sept 15, 2011 and Nov 7, 2011)
River = Tay River Reach = Reach 2 RS = 4712 BR Beckwith Bridge (RVCA Survey, Sept 15, 2011 and Nov 7, 2011)
River = Tay River Reach = Reach 2 RS = 4694
River = Tay River Reach = Reach 2 RS = 4570
River = Tay River Reach = Reach 2 RS = 4495
River = Tay River Reach = Reach 2 RS = 4386
River = Tay River Reach = Reach 2 RS = 4310
River = Tay River Reach = Reach 2 RS = 4246
River = Tay River Reach = Reach 2 RS = 4237 BR Craig St Bridge (RVCA Survey, Sept 15, 2011)
River = Tay River Reach = Reach 2 RS = 4237 BR Craig St Bridge (RVCA Survey, Sept 15, 2011)
River = Tay River Reach = Reach 2 RS = 4213
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

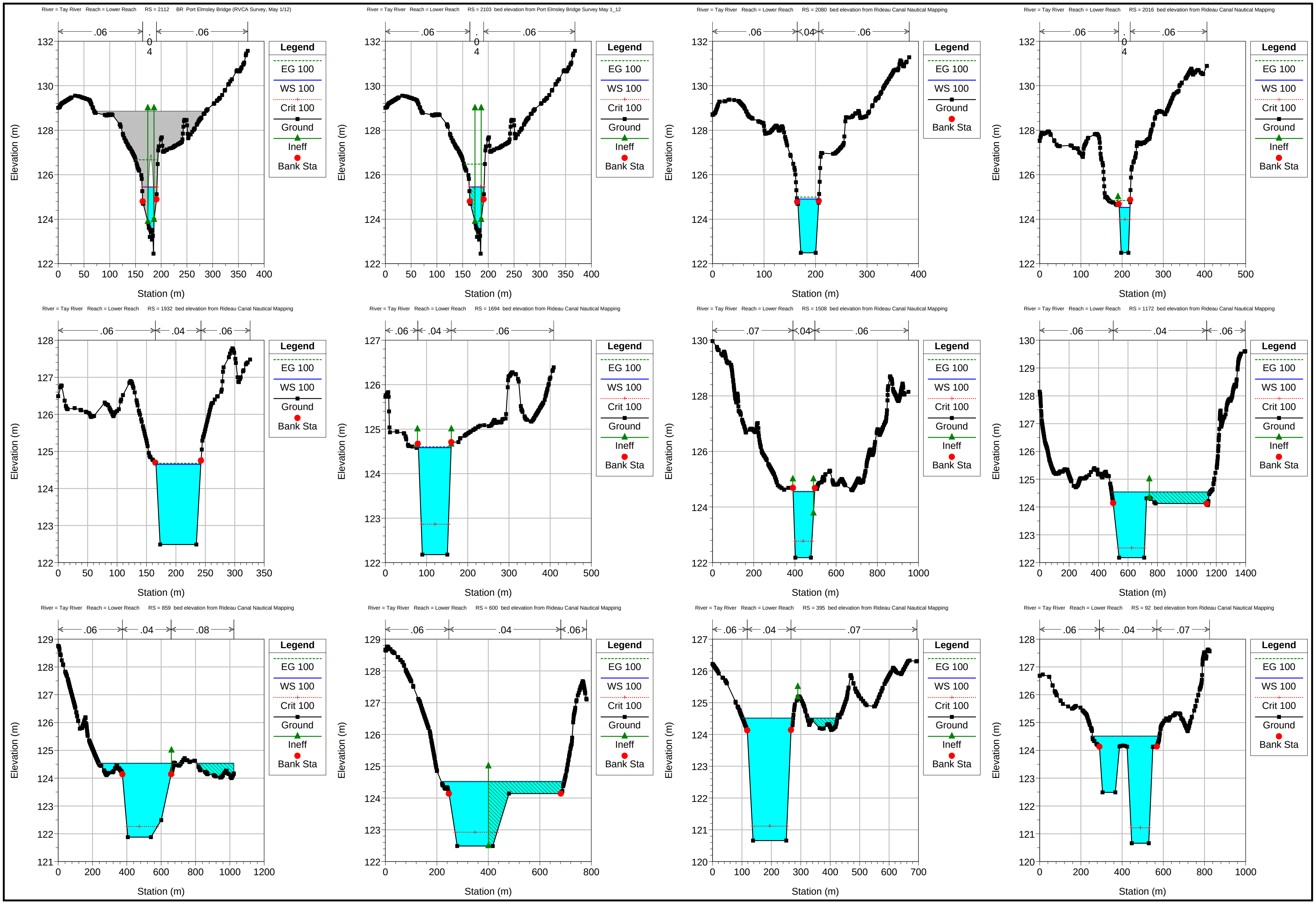

River = Tay River Reach = Reach 2 RS = 4080
River = Tay River Reach = Reach 2 RS = 3916
River = Tay River Reach = Reach 2 RS = 3724
River = Tay River Reach = Reach 2 RS = 3578
River = Tay River Reach = Reach 2 RS = 3415
River = Tay River Reach = Reach 2 RS = 2886
River = Tay River Reach = Reach 2 RS = 2450
River = Tay River Reach = Reach 2 RS = 1819
River = Tay River Reach = Reach 2 RS = 1449
River = Tay River Reach = Reach 2 RS = 1199
River = Tay River Reach = Reach 2 RS = 885
River = Tay River Reach = Reach 2 RS = 596
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

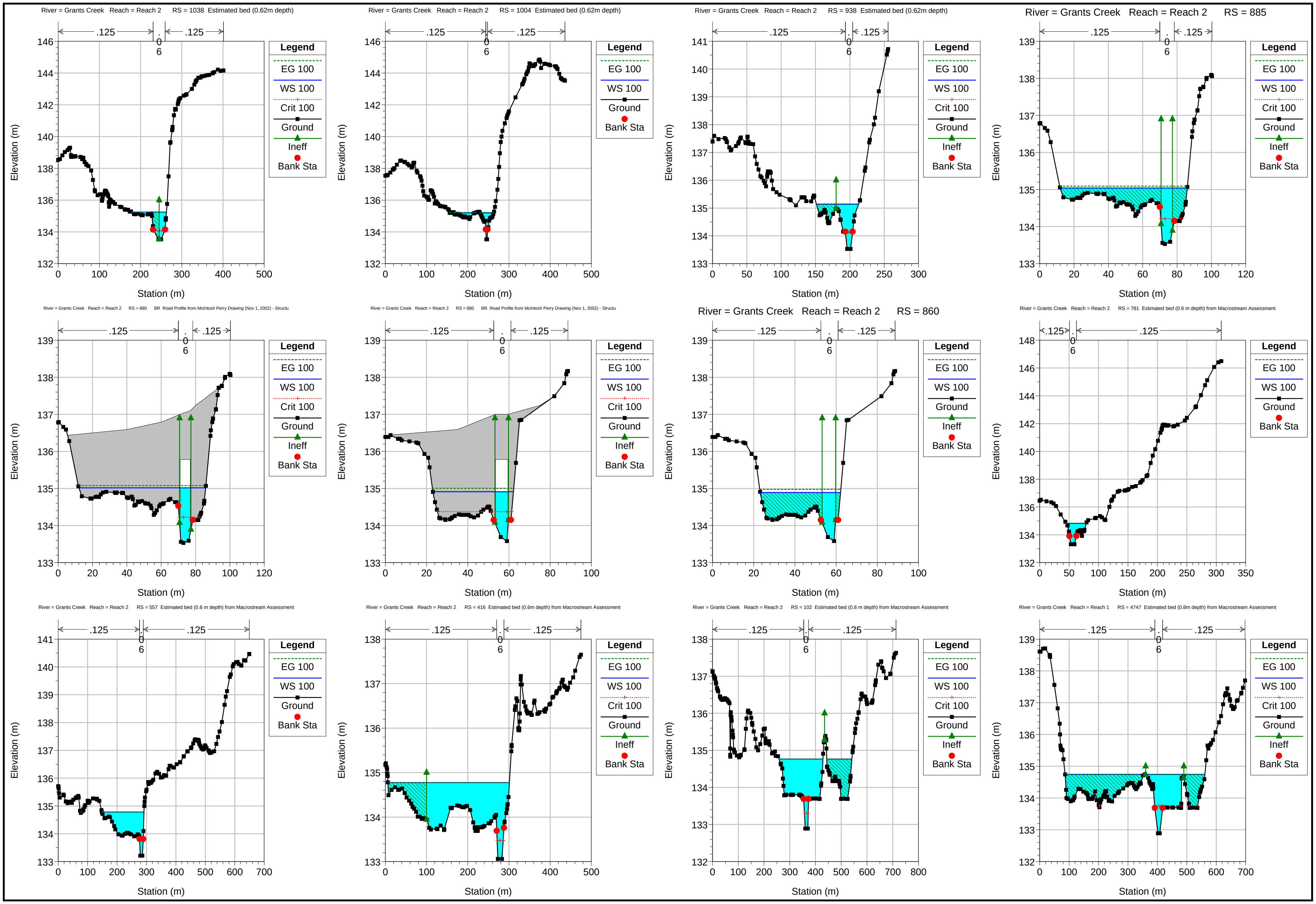

River = Tay River Reach = Reach 2 RS = 356
River = Tay River Reach = Reach 2 RS = 265
River = Tay River Reach = Reach 2 RS = 165
River = Tay River Reach = Reach 1 RS = 3360 Copy of XS 3153
River = Tay River Reach = Reach 1 RS = 3153
River = Tay River Reach = Reach 1 RS = 2682
River = Tay River Reach = Reach 1 RS = 2330
River = Tay River Reach = Reach 1 RS = 1778
River = Tay River Reach = Reach 1 RS = 1396
River = Tay River Reach = Reach 1 RS = 850
River = Tay River Reach = Reach 1 RS = 348
River = Tay River Reach = Reach 1 RS = 56
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

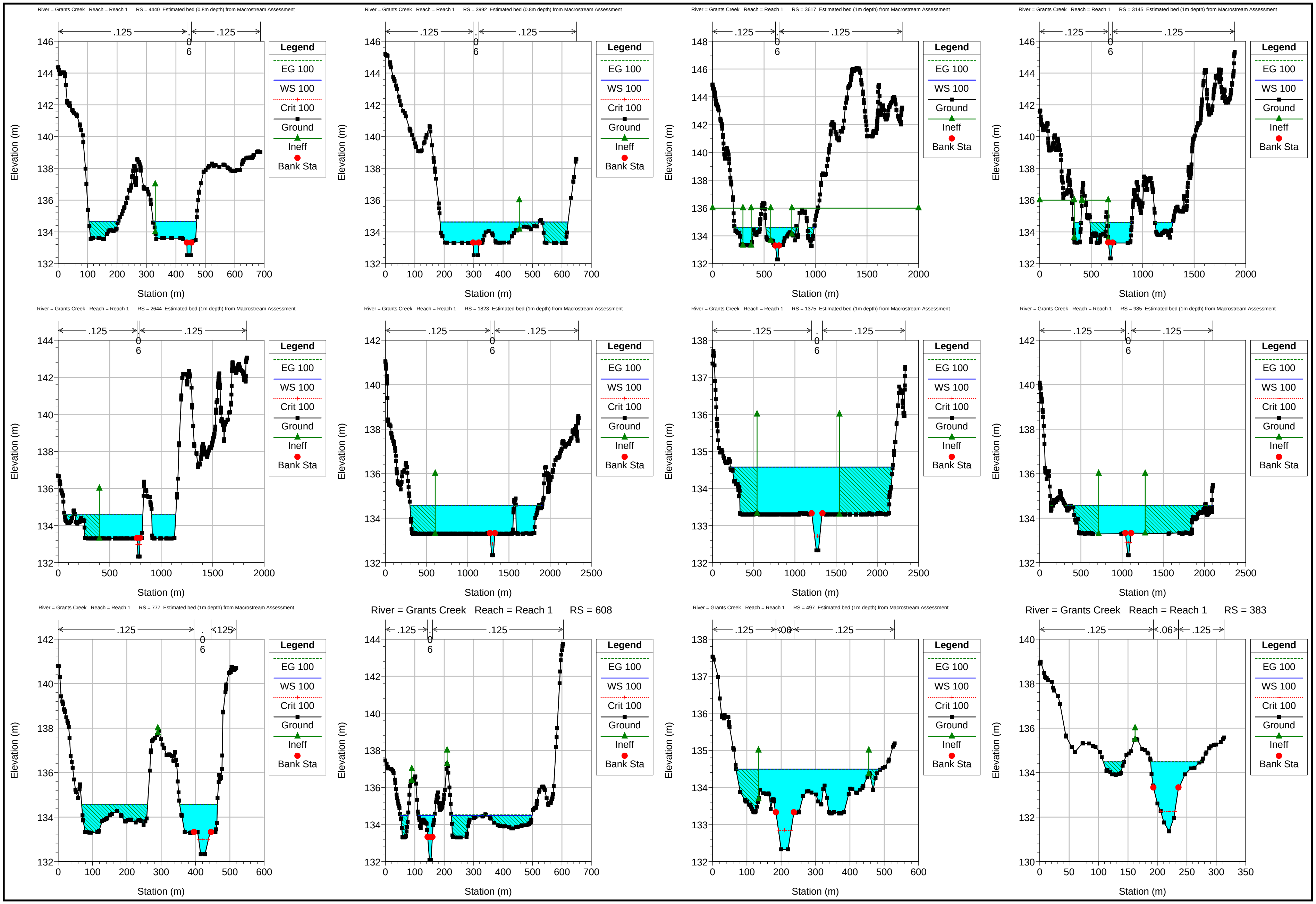


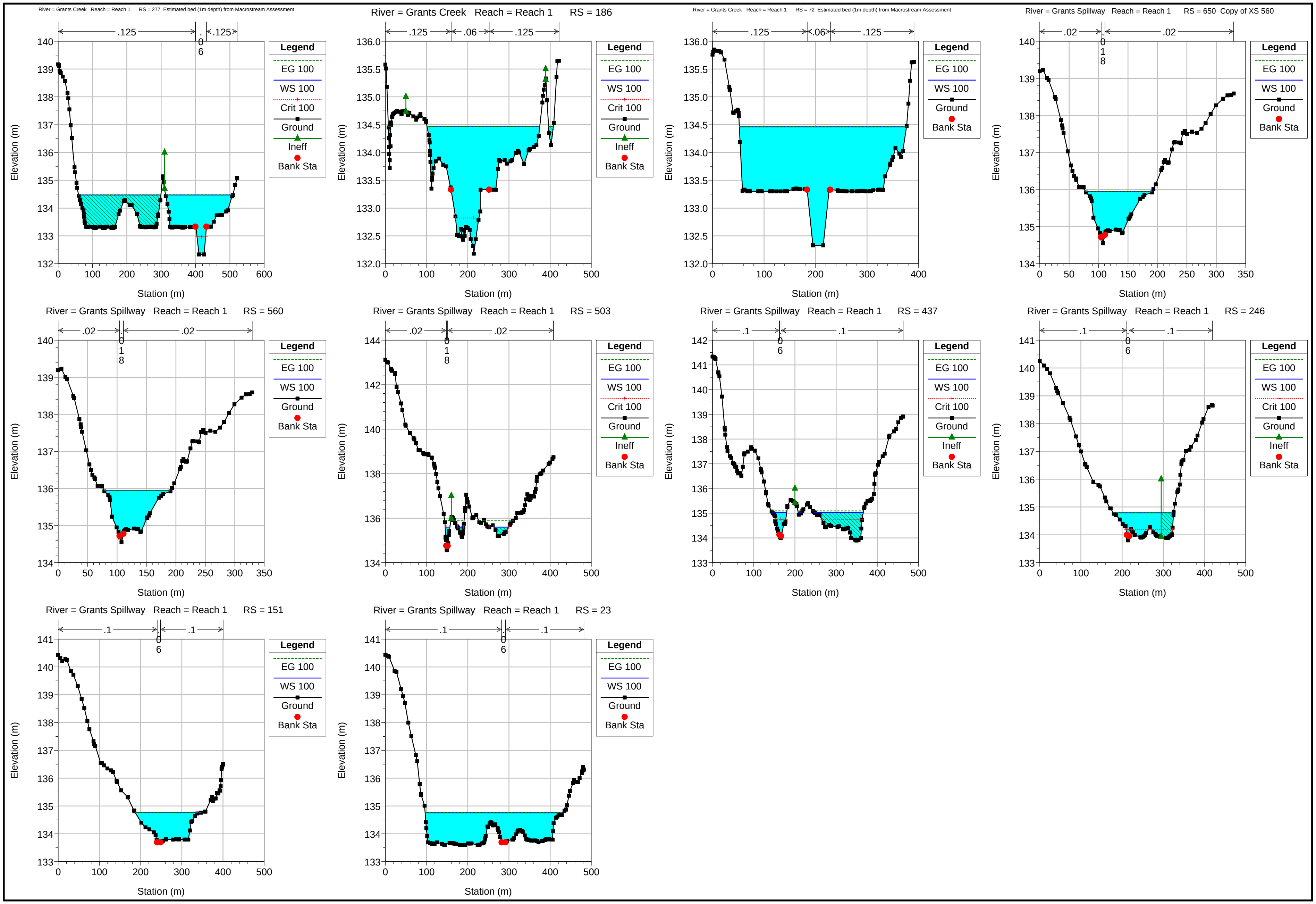
River = Tay River Reach = Lower Reach RS = 5841 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 5774 IS
River = Tay River Reach = Lower Reach RS = 5717 Bed of Creek from May 1, 2012 Survey
River = Tay River Reach = Lower Reach RS = 5458 Bed of Creek from May 1, 2012 Survey
River = Tay River Reach = Lower Reach RS = 5259 Copy of bed from XS 5458
River = Tay River Reach = Lower Reach RS = 5080 Copy of XS 5035 with added ROCK LEDGE
River = Tay River Reach = Lower Reach RS = 5035 Bed of Creek from May 1, 2012 Survey
River = Tay River Reach = Lower Reach RS = 4602 Bed of Creek from May 1, 2012 Survey (surveyed approx 300m upstr
River = Tay River Reach = Lower Reach RS = 4180 Bed of Creek approximated from surrounding XSs
River = Tay River Reach = Lower Reach RS = 3958 Bed of Creek from May 2, 2012 Survey (bed surveyed close to shor
River = Tay River Reach = Lower Reach RS = 3740 Bed of Creek approximated from surrounding XSs
River = Tay River Reach = Lower Reach RS = 3555 Bed of Creek from May 2, 2012 Survey
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

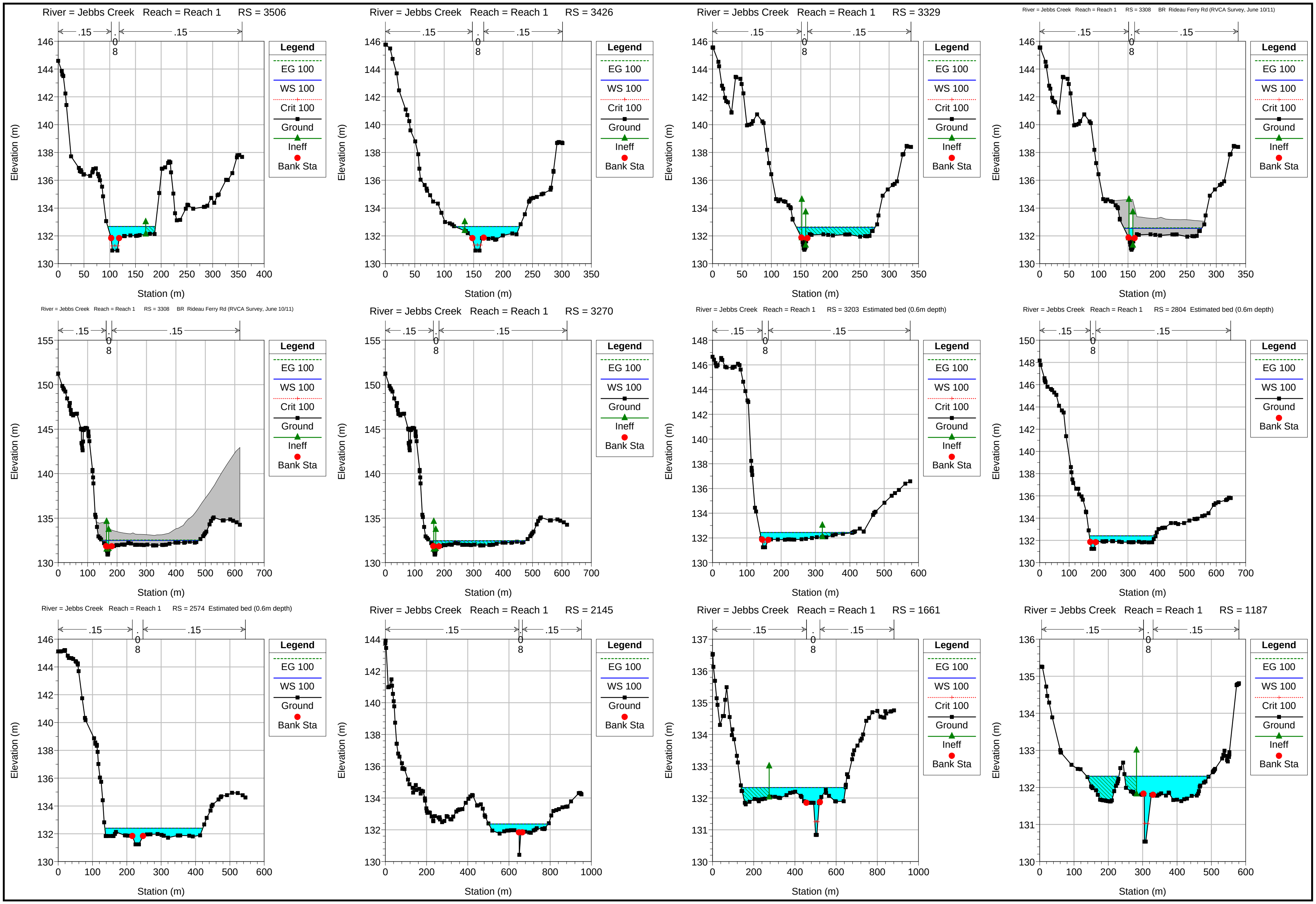

River = Tay River Reach = Lower Reach RS = 3333 Bed of Creek from May 2, 2012 Survey
River = Tay River Reach = Lower Reach RS = 3075 Bed of Creek from May 2, 2012 Survey
River = Tay River Reach = Lower Reach RS = 2884 Approx 0.5m depth
River = Tay River Reach = Lower Reach RS = 2741 Approx 0.5m depth
River = Tay River Reach = Lower Reach RS = 2603 Approx 0.5m depth
River = Tay River Reach = Lower Reach RS = 2470 Bed surveyed May 4, 2012
River = Tay River Reach = Lower Reach RS = 2364 Bed surveyed May 4, 2012
River = Tay River Reach = Lower Reach RS = 2280 Bed surveyed May 4, 2012
River = Tay River Reach = Lower Reach RS = 2198 Bed approximated from XS 2280
River = Tay River Reach = Lower Reach RS = 2151 Bed approximated from XS 2280
River = Tay River Reach = Lower Reach RS = 2128 bed elevation from Port Elmsley Bridge Survey May 1_12
River = Tay River Reach = Lower Reach RS = 2112 BR Port Elmsley Bridge (RVCA Survey, May 1/12)
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

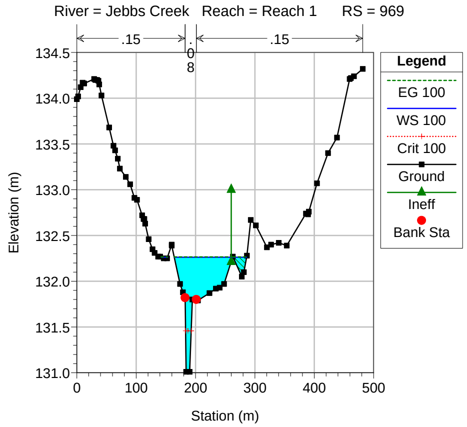

River = Tay River Reach = Lower Reach RS = 2112 BR Port Elmsley Bridge (RVCA Survey, May 1/12)
River = Tay River Reach = Lower Reach RS = 2103 bed elevation from Port Elmsley Bridge Survey May 1_12
River = Tay River Reach = Lower Reach RS = 2080 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 2016 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 1932 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 1694 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 1508 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 1172 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 859 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 600 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 395 bed elevation from Rideau Canal Nautical Mapping
River = Tay River Reach = Lower Reach RS = 92 bed elevation from Rideau Canal Nautical Mapping
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

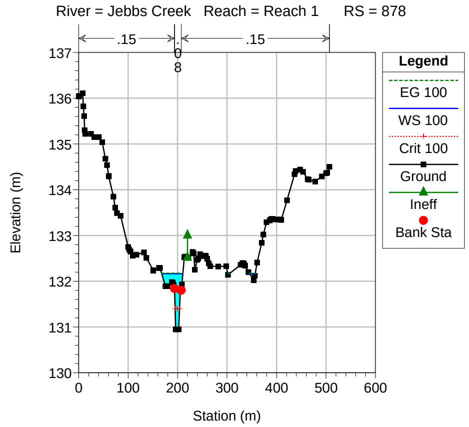

River = Grants Creek Reach = Reach 2 RS = 1038 Estimated bed (0.62m depth)
River = Grants Creek Reach = Reach 2 RS = 1004 Estimated bed (0.62m depth)
River = Grants Creek Reach = Reach 2 RS = 938 Estimated bed (0.62m depth)
River = Grants Creek Reach = Reach 2 RS = 885
River = Grants Creek Reach = Reach 2 RS = 880 BR Road Profile from McIntosh Perry Drawing (Nov 1, 2002) - Structu
River = Grants Creek Reach = Reach 2 RS = 880 BR Road Profile from McIntosh Perry Drawing (Nov 1, 2002) - Structu
River = Grants Creek Reach = Reach 2 RS = 860
River = Grants Creek Reach = Reach 2 RS = 781 Estimated bed (0.6 m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 2 RS = 557 Estimated bed (0.6 m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 2 RS = 416 Estimated bed (0.6m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 2 RS = 102 Estimated bed (0.8 m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 4747 Estimated bed (0.8m depth) from Macrostream Assessment
.125
.06
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

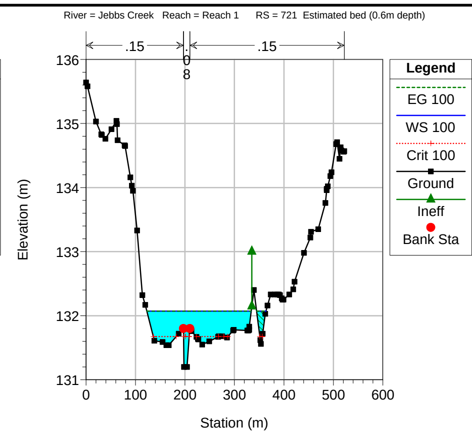

River = Grants Creek Reach = Reach 1 RS = 4440 Estimated bed (0.8m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 3992 Estimated bed (0.8m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 3617 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 3145 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 2644 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 1823 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 1375 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 985 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 777 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 608
River = Grants Creek Reach = Reach 1 RS = 497 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 383
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

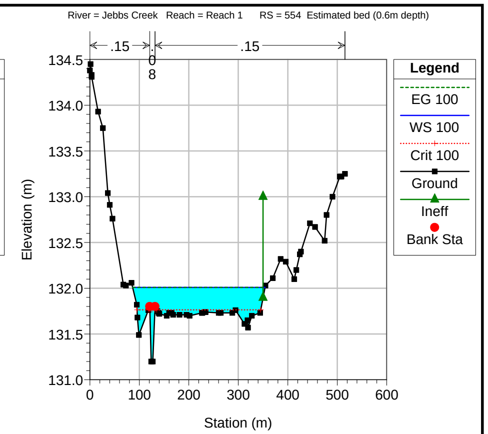

River = Grants Creek Reach = Reach 1 RS = 277 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Creek Reach = Reach 1 RS = 186
River = Grants Creek Reach = Reach 1 RS = 72 Estimated bed (1m depth) from Macrostream Assessment
River = Grants Spillway Reach = Reach 1 RS = 650 Copy of XS 560
River = Grants Spillway Reach = Reach 1 RS = 560
River = Grants Spillway Reach = Reach 1 RS = 503
River = Grants Spillway Reach = Reach 1 RS = 437
River = Grants Spillway Reach = Reach 1 RS = 246
River = Grants Spillway Reach = Reach 1 RS = 151
River = Grants Spillway Reach = Reach 1 RS = 23
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

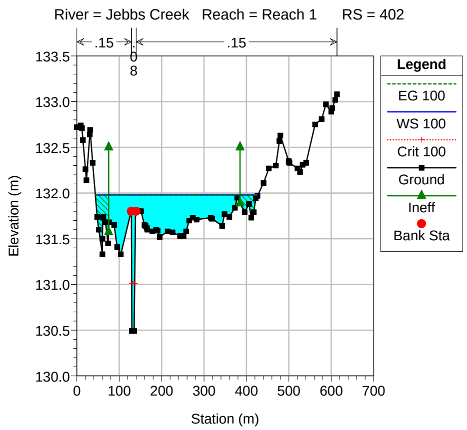

River = Jebbs Creek Reach = Reach 1 RS = 3506
River = Jebbs Creek Reach = Reach 1 RS = 3426
River = Jebbs Creek Reach = Reach 1 RS = 3329
River = Jebbs Creek Reach = Reach 1 RS = 3308 BR Rideau Ferry Rd (RVCA Survey, June 10/11)
River = Jebbs Creek Reach = Reach 1 RS = 3308 BR Rideau Ferry Rd (RVCA Survey, June 10/11)
River = Jebbs Creek Reach = Reach 1 RS = 3270
River = Jebbs Creek Reach = Reach 1 RS = 3203 Estimated bed (0.6m depth)
River = Jebbs Creek Reach = Reach 1 RS = 2804 Estimated bed (0.6m depth)
River = Jebbs Creek Reach = Reach 1 RS = 2574 Estimated bed (0.6m depth)
River = Jebbs Creek Reach = Reach 1 RS = 2145
River = Jebbs Creek Reach = Reach 1 RS = 1661
River = Jebbs Creek Reach = Reach 1 RS = 1187
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

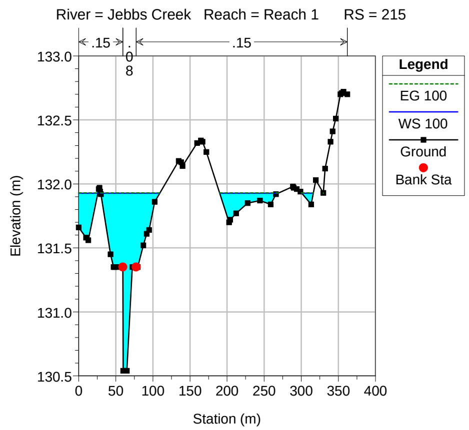

River = Jebbs Creek Reach = Reach 1 RS = 969
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

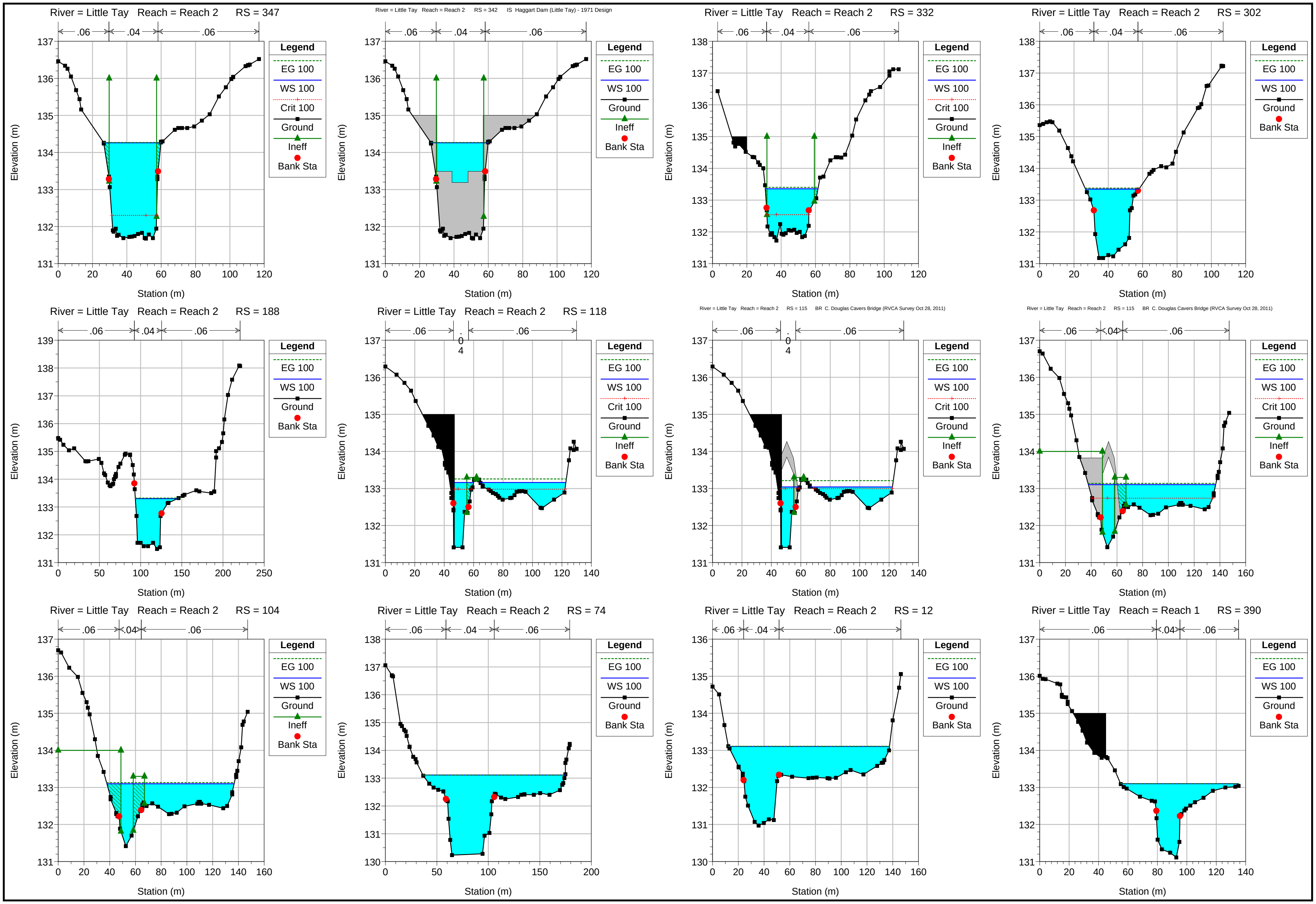

River = Jebbs Creek Reach = Reach 1 RS = 878
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

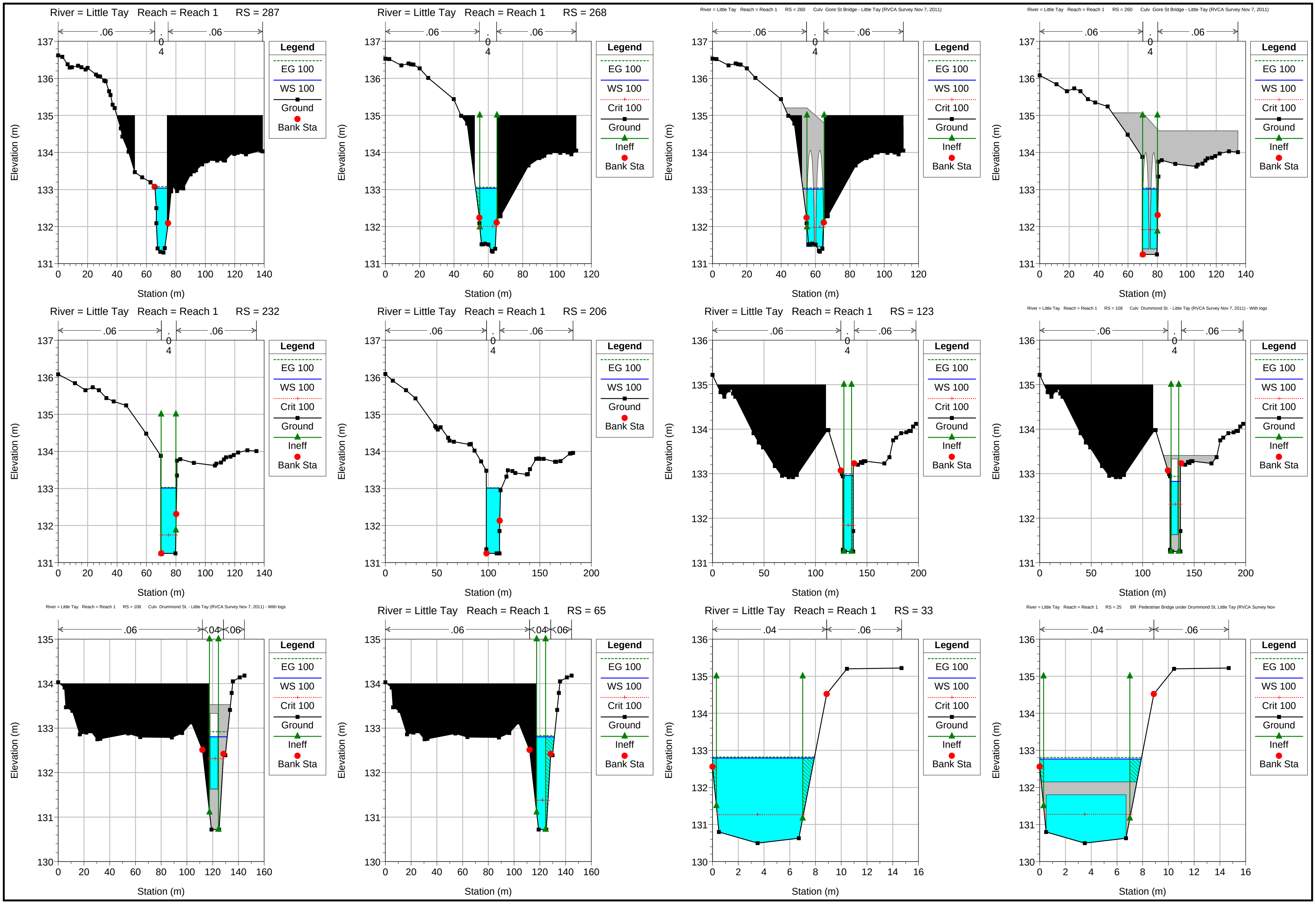

River = Jebbs Creek Reach = Reach 1 RS = 721 Estimated bed (0.6m depth)
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

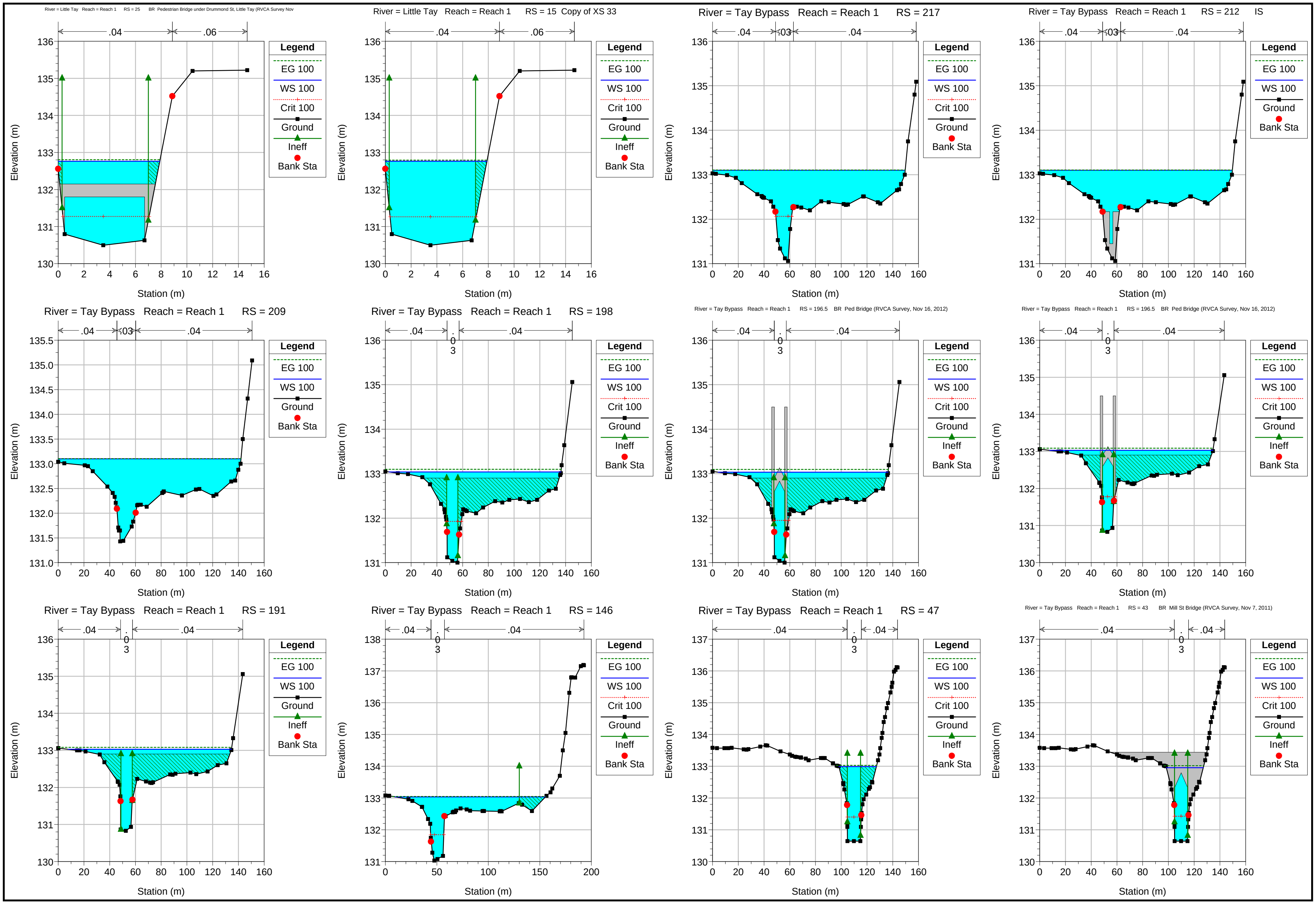

River = Jebbs Creek Reach = Reach 1 RS = 554 Estimated bed (0.6m depth)
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

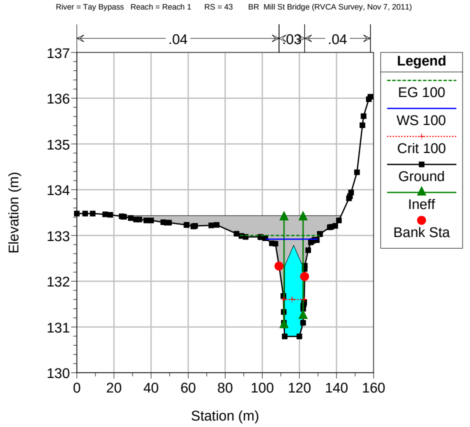

River = Jebbs Creek Reach = Reach 1 RS = 402
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


River = Jebbs Creek Reach = Reach 1 RS = 215
Legend
EG 100
WS 100
Ground
Bank Sta
Elevation (m)
Station (m)

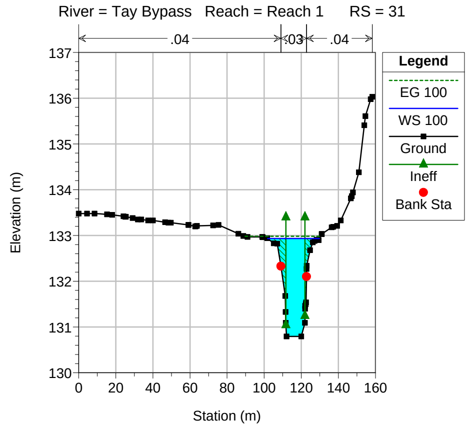

River = Little Tay Reach = Reach 2 RS = 347
River = Little Tay Reach = Reach 2 RS = 342 IS Haggart Dam (Little Tay) - 1971 Design
River = Little Tay Reach = Reach 2 RS = 332
River = Little Tay Reach = Reach 2 RS = 302
River = Little Tay Reach = Reach 2 RS = 188
River = Little Tay Reach = Reach 2 RS = 118
River = Little Tay Reach = Reach 2 RS = 115 BR C. Douglas Cavers Bridge (RVCA Survey Oct 28, 2011)
River = Little Tay Reach = Reach 2 RS = 115 BR C. Douglas Cavers Bridge (RVCA Survey Oct 28, 2011)
River = Little Tay Reach = Reach 2 RS = 104
River = Little Tay Reach = Reach 2 RS = 74
River = Little Tay Reach = Reach 2 RS = 12
River = Little Tay Reach = Reach 1 RS = 390
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


River = Little Tay Reach = Reach 1 RS = 287
River = Little Tay Reach = Reach 1 RS = 268
River = Little Tay Reach = Reach 1 RS = 260 Culv Gore St Bridge - Little Tay (RVCA Survey Nov 7, 2011)
River = Little Tay Reach = Reach 1 RS = 260 Culv Gore St Bridge - Little Tay (RVCA Survey Nov 7, 2011)
River = Little Tay Reach = Reach 1 RS = 232
River = Little Tay Reach = Reach 1 RS = 206
River = Little Tay Reach = Reach 1 RS = 123
River = Little Tay Reach = Reach 1 RS = 108 Culv Drummond St. - Little Tay (RVCA Survey Nov 7, 2011) - With logs
River = Little Tay Reach = Reach 1 RS = 108 Culv Drummond St. - Little Tay (RVCA Survey Nov 7, 2011) - With logs
River = Little Tay Reach = Reach 1 RS = 65
River = Little Tay Reach = Reach 1 RS = 33
River = Little Tay Reach = Reach 1 RS = 25 BR Pedestrian Bridge under Drummond St, Little Tay (RVCA Survey Nov
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)

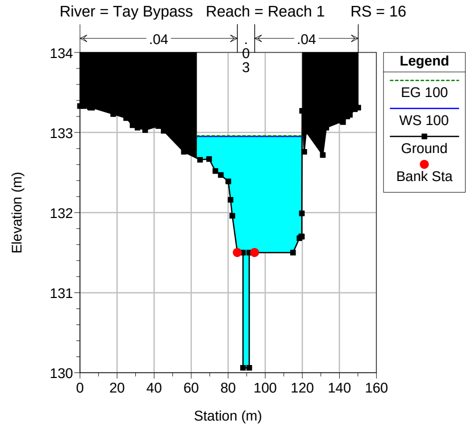

River = Little Tay Reach = Reach 1 RS = 25 BR Pedestrian Bridge under Drummond St, Little Tay (RVCA Survey Nov
River = Little Tay Reach = Reach 1 RS = 15 Copy of XS 33
River = Tay Bypass Reach = Reach 1 RS = 217
River = Tay Bypass Reach = Reach 1 RS = 212 IS
River = Tay Bypass Reach = Reach 1 RS = 209
River = Tay Bypass Reach = Reach 1 RS = 198
River = Tay Bypass Reach = Reach 1 RS = 196.5 BR Ped Bridge (RVCA Survey, Nov 16, 2012)
River = Tay Bypass Reach = Reach 1 RS = 196.5 BR Ped Bridge (RVCA Survey, Nov 16, 2012)
River = Tay Bypass Reach = Reach 1 RS = 191
River = Tay Bypass Reach = Reach 1 RS = 146
River = Tay Bypass Reach = Reach 1 RS = 47
River = Tay Bypass Reach = Reach 1 RS = 43 BR Mill St Bridge (RVCA Survey, Nov 7, 2011)
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)



River = Tay Bypass Reach = Reach 1 RS = 43 BR Mill St Bridge (RVCA Survey, Nov 7, 2011)
.04
.03
.04
Legend
EG 100
WS 100
Crit 100
Ground
Ineff
Bank Sta
Elevation (m)
137
136
135
134
133
132
131
130
0
20
40
60
80
100
120
140
160
Station (m)



River = Tay Bypass Reach = Reach 1 RS = 31
.04
.03
.04
Legend
EG 100
WS 100
Ground
Ineff
Bank Sta
Elevation (m)
137
136
135
134
133
132
131
130
0
20
40
60
80
100
120
140
160
Station (m)



River = Tay Bypass Reach = Reach 1 RS = 16
.04
.
0
3
.04
Legend
EG 100
WS 100
Ground
Bank Sta
Elevation (m)
134
133
132
131
130
0
20
40
60
80
100
120
140
160
Station (m)