Rideau Valley Conservation Authority

Engineering and Regulations – Witness Statement

June 6, 2024

From: Tyler Bauman, B.Eng., P.Eng., Water Resources Engineer (Flood Management)

Subject: **Engineering Opinion related to development within the floodplain at 141 Peter Street**

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1. My name is Tyler Bauman. I am a Water Resources Engineer for the Rideau Valley Conservation Authority (RVCA). I have been in engineering roles for the RVCA since September 2017. I am a Licensed Professional Engineer. My Curriculum Vitae and Acknowledgment of Expert' s Duty are included with this statement as Appendix A.
2. I have been asked to provide my opinion from a flood management perspective on the proposed Plan of Subdivision by Caivan (Perth GC) within the Town of Perth, specifically within the project area known as the Perth Golf Course (09-T-22001).
3. In this memo I set out the expert testimony I expect to provide relating to the topic of regulatory floodplains and summarize the contents of previous communications with J.F. Sabourin and Associates (JFSA) Technical Staff regarding reports submitted in support of Caivan's plan of subdivision. Throughout my involvement with this file, I have provided comments regarding the regulatory floodplain; most directly on the process that should be followed to refine the floodplain delineation through the RVCA's amendment process.

Location and Regulatory Floodplain

4. The Perth Golf Course is located at 141 Peter Street in the Town of Perth (also known as the Western Annex Lands) and is subject to regulatory floodplains from two distinct but related sources: the Tay River and Grants Creek. The floodplains for both watercourses were produced through an engineering study completed by the RVCA in December 2012.
5. The RVCA is provincially mandated to identify and regulate the 100-Year Flood Event Standard within our jurisdiction, which the RVCA achieves through engineered and peer-reviewed mapping of the 1:100 year floodplain. The extent of the 1:100 year floodplain is statistically expected to occur or be exceeded every 100 years, also described as having a 1% annual chance of exceedance.
6. The RVCA's base policies for the engineered 1:100 floodplain reference the One-Zone Concept for Floodplain Hazard Limits, and therefore development is restricted within the entire regulatory floodplain. Although there are considerations within the RVCA's policies that apply the Two-Zone

Concept to the management of the regulatory floodplain (i.e. through identifying the flood fringe), no floodplain mapping projects have identified these additional extents.

7. The regulatory floodplain at 141 Peter Street in the Town of Perth is wholly subject to the development prohibitions and restrictions applicable to the RVCA's One-Zone Regulatory Floodplain.

8. A primary function of floodplain mapping is to guide development away from locations where people and property will be at risk due to an identified flood hazard. The costs associated with riverine flooding, which is the form of flooding depicted through floodplain mapping, is significant and increasing. Ontario is the second-highest flood-prone region in Canada, with an average annual loss of $805.1 million. It is estimated that in Canada alone, annual flood costs could exceed US$14 billion by 2050. Regulatory floodplains are an effective tool to minimize these costs to both individuals and society.

File Summary

9. The initial submission by JFSA to support Caivan's proposed development of the Western Annex Lands did not contain sufficient information regarding the quality and accuracy of the base topographic information, nor the mapping techniques, used to delineate their proposed floodplain amendment. The RVCA produced a Technical Memo that requested more information and explanations such that technical staff could make an informed assessment of the proposed floodplain amendment to ensure that it would meet required standards and guidance and be the best refinement currently possible. This Technical Memo dated June 22, 2023 is attached as Appendix B.

10. JFSA supplied a second submission in response to RVCA comments, including the topographic data used for their mapping exercise. The RVCA reviewed the second submission and concluded that an amendment based on Light Detection and Ranging (LiDAR)-derived topography recently acquired by the RVCA would provide a floodplain refinement with higher accuracy and thus greater confidence. This was conveyed through another Technical Memo where the RVCA strongly suggested the open data for this high-quality product be used for a proposed floodplain amendment on the subject lands. The second Technical Memo dated April 30, 2024 is attached as Appendix C.

11. Throughout all the communications, RVCA staff have noted that early collaboration would help identify the datasets, techniques, and processes that would be acceptable to the RVCA.

12. On May 31st, 2024, the RVCA received a document from JFSA entitled "Perth Golf Course – Proposed Floodplain Mapping Amendment." This document and its attached GIS files are understood to contain a proposed floodplain mapping amendment that accounts for the comments found in Appendix C. RVCA staff have not yet had the time to review the submitted work; appropriate staff will do so within a reasonable amount of time dependent upon their existing tasks and work schedules.

Floodplain Amendment

13. Refining floodplain extents with the best available information is the preferred way to accurately determine natural hazards on a project site, to guide development away from identified hazards. The process for refining regulatory floodplain extents needs to be through an amendment process

steered by the organization with the mandated responsibility of floodplain management for a given jurisdiction. This ensures that organization with the responsibility of managing the hazard can assess the quality of a proposed refinement, ensuring that the regulatory floodplain continues to meet technical guidelines and confidence in the product is retained.

14. Through the RVCA's amendment process, technical staff will review the topographic information the proposed floodplain refinement is based upon as well as the methods for interpolating a continuous water surface on top of the topography. The RVCA will review the submitted topography as a stand-alone product, by reviewing Quality Assurance/Quality Control reports that provide statistical accuracy values that need to meet or exceed guidance thresholds. The RVCA will also review the submitted topography comparatively against other topographic datasets; considering the date of acquisition, the techniques of acquisition, and visual inspections.

15. Only the best-available topography will be approved for use in a proposed floodplain amendment, to ensure that it is a true refinement with the purpose of improving the accuracy of regulatory floodplain extents. Once a topography is approved, a floodline will be delineated by RVCA staff and compared with that provided by the proponent. Assuming no major discrepancies, the RVCA will limit the floodplain amendment to the project site and seek internal sign-offs before regulatory implementation.

Summary

16. 141 Peter Street in the Town of Perth is wholly subject to the development prohibitions and restrictions applicable to the RVCA's One-Zone Regulatory Floodplain.

17. The RVCA has the mandated responsibility to manage the Regulatory Floodplain. A proposed floodplain amendment must meet technical standards and the RVCA must be confident the proposed revision provides an improvement in accuracy.

18. The proposed floodplain amendment by JFSA, on behalf of Caivan, has received multiple revisions and is an ongoing process. The latest submission, received on May 31st, 2024, will be reviewed when RVCA technical staff has availability.

19. If approved by technical staff, there is a process that needs to be followed regarding sign-offs and implementation. The RVCA is presently not able to provide more information regarding expected outcomes or timelines on the matter.

Respectfully,

Tyler Bauman, B.Eng., P.Eng.
Water Resources Engineer
Engineering and Regulations
Rideau Valley Conservation Authority

Appendix A

CV and Acknowledgment

Tyler Bauman, P.Eng.

3889 Rideau Valley Drive, Manotick, Ontario K4M 1A5
tyler.bauman@rvca.ca (613) 692-3571

Work Experience

Water Resources Engineer (Flood Management)

Rideau Valley Conservation Authority – *Regulations and Engineering*
December 2022 – Present

- Responsible for all the duties and activities that were assigned as an Engineering Assistant.
- Developed a recently approved 6-year workplan for floodplain mapping studies.
- Initiated Data Acquisition projects for the City of Ottawa and Rideau Lakes, retaining and managing consultants to produce data that will support future floodplain mapping studies.
- Developed proposal for a new flood forecasting and warning model, retaining and managing a consultant for the ongoing project.
- Provided technical memos regarding proposed floodplain modifications or other related proposed work.
- Continued technical work on two floodplain mapping projects being conducted in-house.

Engineering Assistant

Rideau Valley Conservation Authority – *Regulations and Engineering*
September 2017 – December 2022

Notable Achievements

- Completed and obtained regulatory status of the following projects: Bilberry Creek, Becketts Creek, Mud Creek, and Mosquito Creek.
- Provided internal review for the Upper Jock River, which obtained regulatory status.
- Attended open houses for additional floodplain mapping projects that obtained regulatory status: Rideau River, Nichols Creek, Kings Creek, Hobbs Drain, and Flowing Creek.

Floodplain Mapping

- Under supervision of project lead, developed hydrologic (SWMHYMO and HEC-HMS) and hydraulic (HEC-RAS) models for use in floodplain mapping.
- Determined appropriate flow calculation points for hydrologic modeling and carefully assessed resulting watershed delineations.
- Selected appropriate hydrologic modeling methods based on data availability, the landscape and channel to be modeled, and past institutional experience.
- Estimated rural and urban geospatial parameters for hydrologic modeling, such as the percent imperviousness, SCS Curve Number, and Time of Concentration.
- Determined representative channel properties for hydrologic routing guided by data in hydraulic models, this included shape, slope and roughness coefficients.

- Cut hydraulic cross sections throughout the modeled domain to appropriately capture the landscape from a hydraulic perspective, taking into account grade changes, areas of expansion and contraction, and flow restriction locations.
- Integrated bathymetric data into hydraulic cross-sections, where available.
- Identified and assigned manning's 'n' roughness coefficients for cross-sections, alongside hydraulic parameters such as expansion and contraction coefficients.
- Surveyed hydraulic structures, confirming their as-built drawings, integrated the structures into HEC-RAS, assigned roughness parameters based on material used, and selected structure modeling methods using an iterative approach.
- Assigned ineffective flow areas and blocked obstructions for cross-sections based on local features and guidance from technical documentation.
- Scrutinized hydrologic and hydraulic model outputs for errors or unexpected behaviour, troubleshooting and performing modifications as needed.
- Worked with GIS staff to generate floodplain extents from hydraulic outputs, providing final say on hydraulic connectivity and elevations for level pools areas.
- Generated tables, figures, and maps for inclusion in floodplain mapping reports.
- Provided internal review and additional content for floodplain mapping report text.
- Attended open houses and provided public consultation for floodplain mapping studies seeking, or having recently obtained, regulatory approval.
- Provided detailed internal review and technical suggestions for additional floodplain mapping projects being undertaken by the RVCA.
- Provided technical support to other departments, such as confirming and/or supplying accurate information on regulatory elevations.

Flood Forecasting and Warning

- Implemented incremental improvements to the RVCA's flood forecasting model to improve accuracy and minimize need for subjective considerations.
- Maintained the RVCA's flood forecasting and warning model during the spring freshet, a critical operation period.
- Provided model insights and messaging advice during the spring freshet.
- Communicated forecasted flows to partner municipalities to support their emergency response.
- Provided feedback and support for identification of weather station deployment locations.
- Collected high water measurements and flood observations during peak flows.
- Integral in the initiation and continued management of the Jock River Monitoring Program.

Senior Environmental Field Labourer

Toronto and Region Conservation Authority – *Restoration and Infrastructure – Restoration Projects*
May 2008 – August 2017

- Lead crews for tasks such as aquatic, riparian, and terrestrial planting, mechanically preparing sites for planting, small-scale habitat construction, and environmental monitoring.
- Responsible for crew safety and performance, equipment maintenance and proper usage, project ledgers, update photography, and daily coordination with project management.
- Assessed landscapes for a number of Habitat Implementation Program initiatives and developed digital copies of project maps in ArcGIS (for planting and/or construction purposes).

- Wide range of field experience on small and large restoration projects at various stages of construction, developing informed opinions on their design and implementation.

Education

January 2013 - 2017

Bachelor of Engineering (Water Resources) - *University of Guelph*

September 2004 – April 2010

Bachelor of Arts (Maj. Environmental Science, Min. Geography, Min. Economics) – *University of Toronto*

Highlights

- Developed a MatLAB program to create distinct unit and output hydrographs for a given set of land parcels, utilizing the Holtan Method.
- Created a method to analyze ecological data layers within ArcGIS to determine routes of least environmental-cost in case of a hazardous waste spill.
- Utilized HEC-RAS to develop an ecologically-conscious site plan to compensate for the loss of flood control after the removal of a dam.
- Developed a LID-reliant storm water management plan in EPASWMM for a subdivision, achieving surface runoff outputs closely resembling those from pre-development settings.
- Project and technical lead in a highly successful Design I final project, one of two groups to achieve a “skills” target in the Teddy Bear Wheelchair Olympics (out of 44 groups).
- Project and technical lead in a Design III final project that was short-listed to be one of four presentations in front of industry representatives (out of 56 groups).

Additional Details

Credentials

- **Licensed Professional Engineer:** Obtained from Professional Engineers of Ontario on October 31st, 2022; License #100568080.

Ontario
Ontario Land Tribunal

ACKNOWLEDGMENT OF EXPERT'S DUTY

Case Number	Municipality
OLT-23-000534	Town of Perth

1. My name is Tyler Bauman. I live in the City of Ottawa in the Province of Ontario

2. I have been engaged by or on behalf of the Town of Perth to provide evidence in relation to the above-noted OLT proceeding.

3. I acknowledge that it is my duty to provide evidence in relation to this proceeding as follows:

    a. to provide opinion evidence that is fair, objective and non-partisan;

    b. to provide opinion evidence that is related only to matters that are within my area of expertise; and

    c. to provide such additional assistance as the OLT may reasonably require, to determine a matter in issue.

    d. not to seek or receive assistance or communication, except technical support, while under cross examination, through any means including any electronic means, from any third party, including but not limited to legal counsel or client.

4. I acknowledge that the duty referred to above prevails over any obligation which I may owe to any party by whom or on whose behalf I am engaged.

Date April 15, 2023 _____
Signature

Appendix B

Technical Review Memorandum

Western Annex Lands, Town of Perth

June 22, 2023

Rideau Valley Conservation Authority

Watershed Science and Engineering Services - Technical Review Memorandum

June 22, 2023

To: Sarah Macleod-Neilson, Planner, Planning and Watershed Science, RVCA

From: Tyler Bauman, Water Resources Engineer, RVCA

RE: Western Annex Lands, Town of Perth

Floodplain Modification

In this memo, the RVCA has identified the technical issues associated with the proposed site-specific refinement of the floodplain extent on the subject lands and proposed floodplain modifications of the Tay River and Grants Creek at the subject lands. Under O. Reg. 174/06 the Rideau Valley Conservation Authority is mandated to regulate floodplains to the 100 Year Flood Event Standard. The delineation of regulated floodplain must be conducted to the highest professional standards, presently the best official guidance for floodplain delineation is through NRCan's Federal Flood Mapping Guidelines Series. The principal source of technical information reviewed for this memo was the following report:

- Report entitled "Caivan Perth Development – Hydrologic and Hydraulic Conditions Report," by Jonathon Burnett, P.Eng. of J. F. Sabourin and Associates, dated February 2023.

RVCA comments are as follows:

1. The application of acquired airborne LiDAR data for Floodplain Mapping must meet the requirements stated within Table 1 of the Federal Airborne LiDAR Data Acquisition Guideline V2.0 (NRCan, 2018). Considering a relatively large proportion of the currently regulated floodline on the subject lands is in highly vegetated areas, the Vegetated Vertical Accuracy will be of equally large importance. **Please provide a full QA/QC report for the LiDAR to ensure its suitability for Floodplain Mapping.**

2. Field verification of LiDAR needs to be more transparent. As stated in Section 5.1.4 of the Federal Geomatics Guidelines for Flood Mapping V1.0 (NRCan, 2019): "Checkpoints must be different from control points and evenly distributed across the check area." Section 4.1 of the JFSA report states that the DTM used is "capable of producing 0.25m contours and map accuracies of +/- 12cm at a 95% confidence level on well-defined, easily visible objects within the imagery." This is insufficient. **Please provide a map showing the distribution of checkpoints and control points.**

3. Floodplain regulation is a mandated responsibility of the RVCA. For the RVCA to accept the proposed floodplain refinement, we need to better understand the tools and processes used in its delineation, specifically what software package and toolset were used? **Please provide details regarding the tools and processes used to delineate the proposed floodplain.**

4. Floodplain mapping using existing elevations should not require the model to be rerun. Running the model would make sense if the proposed floodplain was generated with advanced features of HEC-RAS (RASmapper). In such a scenario, the RVCA needs to know what version of HEC-RAS was used to run the model. If it is not the same version as used in the original model (HEC-RAS v4.1.0) then any changes required to run the model must be stated. **Please provide details on why the HEC-RAS model was run, confirm the version of HEC-RAS used, and state any changes required for its operation.**

5. The RVCA has concerns that the regulatory flood levels were not used to map the proposed floodline. The expectation is for the location of the 2 cm Contours in Figure C3 to be coincident with Regulatory Floodplain Cross-Sections that have matching elevations. Furthermore, the position of 2 cm Contours without a related Regulatory Floodplain Cross-Section should fit logically between bounding Cross-Sections. Details for some examples are noted in the following table:

2cm Contour	Nearest Regulatory Cross-Section	Regulatory Flood Level	2cm Contour Location	Expected Location
135.20 m	XS 2373	135.21 m	Upstream	Downstream
135.18 m	XS 2222	135.18 m	Downstream	Coincident
135.14 m	XS 1861	135.15 m	Upstream	Downstream
135.08 m	XS 1524	135.08	Downstream	Coincident

These examples suggest the noted discrepancy is not an issue of rounding and needs to be thoroughly explained. **Please provide an explanation for the discrepancy between Regulatory Flood Levels and those presented in Figure C3.**

6. For floodplain delineation of 1D hydraulic models, techniques familiar to the RVCA generally use an interpolated continuous water level surface TIN between 1D cross-sections. Such techniques are unlikely to produce the 2 cm Contours found in Figure C3. From the RVCA's experience, the shape of the 2 cm Contours in Figure C3 implies the use of a 2D model to generate the proposed floodplain. **Please provide clarification whether a 2D Hydraulic model was used at any point in the development of the proposed floodplain.**

7. The RVCA notes that there appears to be potential conflicts between the 2 cm Contours in Figure C3 and comments in Section 4 of the Report that state: "Note that no modifications have been made to the existing hydraulic model produced by the RVCA in 2013, simply the topography that the flood elevations have been mapped on has been updated…" As noted in RVCA Comment #5, the 2 cm Contours do not align with Regulatory Cross-Sections in the

cases where they should. This conflicts with the quote from Section 4 of the Report. As noted in RVCA Comment #6, the shape of 2 cm Contours implies the use of a 2D model. This also conflicts with the quote from Section 4. **Please provide more information regarding the mapping process that can rectify the quote from Section 4 of the Report with these specific conflicts.**

8. **Based on RVCA Comments #1-7, RVCA staff cannot approve or even recommend the adoption of the proposed floodline.** Likewise, any designs based on the proposed floodline cannot be approved or recommended by RVCA staff. Where redefining the regulatory floodplain is a requirement for a design plan, the topic should be addressed through an amendment before undertaking preliminary design efforts. Only after the amendment process has concluded, regardless of its adoption, should any preliminary design efforts be undertaken using the regulated floodplain at that time. Following this process will ensure that costly efforts are not wasted.

I trust this is satisfactory for your present purpose. Please call if you have any questions.

Respectfully,

Tyler Bauman, B.Eng., P.Eng.
Water Resources Engineer

RVCA Watershed Sciences and Engineering Services

Appendix C

Technical Review Memorandum

Western Annex Lands, Town of Perth – Response to JFSA Comments

April 30, 2024

Rideau Valley Conservation Authority

Engineering and Regulations - Technical Review Memorandum

April 30, 2024

Attention: Eric Lalande, Senior Planner, Planning and Watershed Science, RVCA

Subject: Western Annex Lands, Town of Perth – Response to JFSA Comments

Floodplain Modification

In this memo, the Rideau Valley Conservation Authority (RVCA) has considered the responses and additional information that J. F. Sabourin and Associates (JFSA) has provided in their "Response to RVCA comments" associated with the proposed floodplain amendment for the Tay River and Grants Creek at the subject lands. Under O. Reg. 41/24 the Rideau Valley Conservation Authority is mandated to regulate floodplains to the 100 Year Flood Event Standard. The delineation of regulated floodplain must be conducted to the highest professional standards, based on the best information available while undertaking a project or amendment. Technical guidance for floodplain mapping has been reviewed and considered, as it is currently spread across several documents: the MNRF's Technical Guide River & Stream Systems: Flooding Hazard Limit (2002), the MNRF's Technical Bulletin – Flooding Hazards: Data Survey and Mapping Specifications (2023), and NRCan's Federal Flood Mapping Guidelines Series (2018-2023). The principal source of submitted technical information reviewed for this memo were the following items:

- Document entitled "Response to RVCA comments: Western Annex Lands, Town of Perth, June 22, 2023," by Jonathon Burnett, P.Eng. of J. F. Sabourin and Associates, dated April 9, 2024.
- Topography entitled "20220112-BaseMapping.tif" as part of the geospatial data submitted within the zipped folder entitled "20240409-RVCA GIS Package", last modified January 12, 2022.

The RVCA has reviewed our procedures regarding balanced cut and fill applications. At their core, the procedures start with the current regulatory floodplain and culminate with a floodplain amendment based on as-built grades from an approved, balanced, and completed cut and fill application. The RVCA considers the submission from JFSA to be a floodplain amendment proposal and understands the submission's purpose is to support a planned cut and fill application by JFSA. The RVCA carefully reviewed all available information to ensure that, if any floodplain amendment were to proceed on the subject lands, confidence in the regulated floodplain's accuracy was to be maintained.

RVCA's final responses regarding the topic are as follows:

1. The RVCA appreciates the efforts that JFSA has gone through to address and rectify the issues noted in the RVCA's June 22, 2023 technical review memorandum titled "RE: Western Annex Lands, Town of Perth." One of the primary goals of those comments was to bring more transparency to JFSA's approach so the RVCA could effectively assess the proposed floodplain

amendment to ensure it met their requirements and aligned with the RVCA's standard procedures. As noted in the 2023 comments, pre-consultation for the proposed floodplain amendment would have been beneficial to the process. To this note, the RVCA's floodplain mapping program has plans to develop new models and hazard mapping for the Tay River and Grants Creek within the next 5 years. **Early collaboration would help avoid unnecessary project expenditures through the identification of datasets, techniques, and processes that would be acceptable to the RVCA; and for external parties to be aware of planned technical work by the RVCA that should be taken into consideration.**

2. The RVCA would like to note that the original JFSA approach still has not been well explained and the information sought has not been provided. This is most evident with the responses to items #4 and #6, reproduced below with RVCA [clarifications], where JFSA responses reference their "latest floodplain mapping" and not the earlier submission for which the comments were made.
   - "Noted, [JFSA's] latest floodplain mapping has been created using only GIS processes."
   - "At no point has a 2D model been used for floodplain mapping for this area. As mentioned above [JFSA's] latest floodplain mapping uses only GIS processes and no additional hydraulic modelling."

   Although JFSA's responses are acceptable with respect to their latest submission, these responses do not address our comments on the original submission. It only conveys that JFSA has changed its approach, but without explanation.

3. The language used in JFSA's response to comments is not accurate with respect to our standard practices and procedures for undertaking changes to the regulatory floodplain. The RVCA has been requested to consider a proposal and any reference to the submitted work representing "the latest floodplain mapping" is inaccurate. Likewise, there are no "updated floodplain extents…", as the regulatory floodplain remains unchanged, instead what has been supplied by JFSA are "*proposed floodplain amendment* extents…". Such wording would be more accurate with respect to the status of the submission. For future reference, a floodplain update would be a new project while a refinement would relate to mapping on new topography and the integration of such a refinement is through an amendment. **Until an amendment is approved it should be clearly referred to as a *proposed floodplain amendment* to respect the provincially mandated responsibilities of the RVCA. The RVCA manages the regulatory floodplain within their jurisdiction and can accept or deny a proposed floodplain amendment.**

4. The linear-interpolation process outlined and used by JFSA seems to closely align with RVCA floodplain mapping procedures and aligns with RVCA floodplain amendment procedures by limiting the proposed floodplain changes to the subject property. The topographic product JFSA used in their proposed floodplain amendment was acquired by JD Barnes via stereoscopic triangulation of digital aerial photography collected by First Base Solutions on November 7th, 2021. The topography appears to be a good product, considering the collection methods, although it has not been sufficiently shown to meet technical requirements (see item #6). Airborne Imaging Inc., however, conducted LiDAR acquisition flights over the subject lands as part of a broader data acquisition project between April 18-30th, 2022 on the behalf of the RVCA. This LiDAR-derived topography meets requirements and disagrees with JFSA's topography in critical areas. **JFSA's proposed floodplain amendment will not be further pursued by the RVCA. This is justified through the availability of more recent and higher quality topography on the subject lands.**

5. From the experience of RVCA staff, LiDAR-derived topography is generally considered to be a better product than topography produced through stereoscopic triangulation of digital aerial photography. In open areas both methods can produce comparable results, however, the higher resolution generally afforded through LiDAR produces a more nuanced and detailed final product. LiDAR is also better able to penetrate through vegetation and capture true ground returns, this is especially relevant where proposed floodplain extents have been identified in areas thick with vegetation. **Critically considering the acquisition techniques, LiDAR is deemed more suitable for the subject lands where much of the floodplain limit aligns with heavy vegetation.**

6. The RVCA requested a full QA/QC report for the topography, but this has not been satisfactorily met. Two key statistical values used to assess product accuracy are Non-Vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA). There was no satisfactory NVA data submitted by JFSA, as verification check points must be independent from calibration ground control points. The method used to calculate VVA was problematic, a 95% confidence level value was provided instead of the 95th percentile. The percentile method is used for VVA as the accuracy test does not follow a normal distribution, which can be confirmed through JFSA's statistical summary sheet. Processing the JFSA data in Attachment B, Table 1, a VVA 95th-percentile of 0.333 m was calculated while 0.238 m was estimated through ordered data (see Table 2). This would meet the Level 2 standard in Table 3-1 of the MNRF's Technical Bulletin (2023) but mixed performance at the Level 1 standard. The 37 VVA points exceed the 5 needed, however, the MNRF states that points should proportionally represent vegetated land covers in the study area. From JFSA's Attachment B, Figure 1, this does not appear to be the case. Therefore, the First Base Solutions product has not been shown to pass either the NVA nor VVA tests detailed in the MNRF's Technical Bulletin. Airborne Imaging Inc.'s QA/QC report for the LiDAR-derived topography states a NVA RMSE of 0.039 m (0.076 m at 95%) and a VVA 95th-percentile of 0.147 m. These meet the High Flood Risk Category LiDAR standard (see Table B2 of NRCan, 2018), which is more stringent than the MNRF's Level 1 standard. **Comparing the two topographic products, the RVCA is more confident in the LiDAR-derived topography acquired by Airborne Imaging Inc.**

7. The RVCA has delineated an alternative proposed floodplain amendment based on the 2022 LiDAR-derived topography. The proposed extents can be examined in Figure 1. The differences between the current regulatory floodplain and the RVCA's proposed amendment can be seen in Figure 2. These figures provide the basis for the RVCA's disagreement with certain JFSA statements:
    a. The RVCA considers the floodplain banks to be well-defined in select areas, instead of generally true as suggested by JFSA. This distinction is important, as JFSA's language suggests the floodplain to be more well confined than RVCA's mapping suggests.
    b. The RVCA has determined that two overland connections between the Tay River and Grants Creek exist on the subject lands, facilitated by hydraulic connections confirmed by JFSA through surveyed invert elevations noted within Figure C3 of the Hydrologic and Hydraulic Conditions Report (February 2023). These overland connections would need to be maintained under Section 2.0 Policies Regarding the Placing of Fill of the RVCA's Interim Policy for the Administration and Implementation of Ontario Regulation 41/24.

    The extent of the current regulatory floodplain would be largely unchanged through the proposed floodplain amendment based on the 2022 LiDAR-derived topography. Overland connections exist between the Tay River and Grants Creek through the unconfined floodplain on the subject lands.

8. If the RVCA's proposed floodplain amendment is adopted, the RVCA would like to clarify that this is not considered a floodplain mapping update nor is it part of a floodplain mapping project. The RVCA does have plans to update floodplain mapping for the Tay River, as part of the Six Year Natural Hazard Mapping Strategy approved by the RVCA Board of Directors on October 26th, 2023. Under this strategy, it is estimated that the hydraulics, geomorphology, and regulatory mapping of the Tay River between Christie Lake and Lower Rideau Lake will occur throughout 2027. Likewise, Grants Creek will be part of a similar project expected to occur throughout 2029. **The RVCA intends to use this LiDAR-derived topography in future floodplain mapping projects. As such, proposed floodplain amendments should be based on this product where it is available. The RVCA's LiDAR-derived topography can be accessed from the Government of Canada's Open Data Portal, under the Ontario Digital Terrain Model (Lidar-Derived) product, specifically the Eastern Ontario 2021-2022 DTM 13 package for this project site.**

9. The planned regulatory mapping update for the Tay River will use the 2022 LiDAR-derived topography. **Using this same dataset to refine the floodplain through the amendment process is logical and the suggested solution to inform the floodplain hazard extent on the subject property and protect the functions of both the Tay River and Grants Creek floodplains.**

RVCA's final summary statements on the topic is as follows:

The RVCA will not pursue adoption of JFSA's proposed floodplain amendment, instead proposing an alternative floodplain amendment based on LiDAR acquired by Airborne Imaging Inc. for the RVCA. As the organization with the mandated responsibility of floodplain management, the Rideau Valley Conservation Authority has the duty to approve for regulation only those floodplain extents with which it is confident in. Through a deep dive into the topographic data supplied by JFSA to support their proposed floodplain amendment, RVCA staff determined that a more recent and higher-quality topographic dataset already existed within RVCA possession and its use would be more appropriate. In terms of product accuracy, a floodplain amendment based on the RVCA's LiDAR-derived topography would be the most technically confident option presently available. Taking the RVCA's Six Year Natural Hazard Mapping Strategy into account, pursuing a floodplain amendment based on the RVCA's LiDAR-derived topography would be the most logical course of action.

Respectfully,

Tyler Bauman, B.Eng., P.Eng.
Water Resources Engineer

Rideau Valley Conservation Authority
Engineering and Regulations

Rideau Valley Conservation Authority

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

Date Modified: 18/Apr/2024

Figure 1
Western Annex Lands
Proposed Floodplain Amendment - RVCA

Caivan Lands Boundary

Proposed Floodline

Proposed Floodplain

N
W E
S

0 50 100 150 200 250

Meters

Rideau Valley Conservation Authority

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

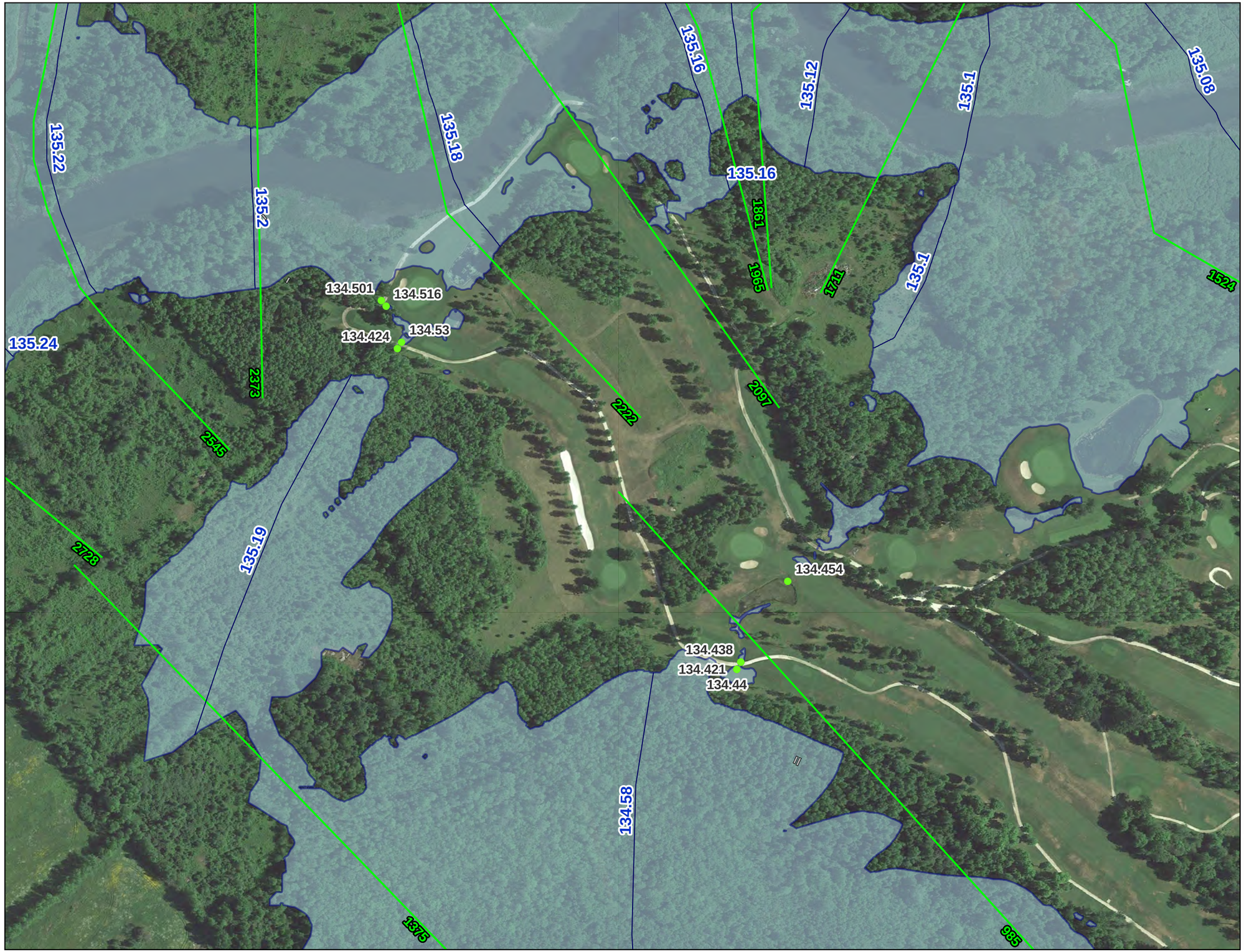
Date Modified: 18/Apr/2024

Figure 2
Western Annex Lands
Proposed Floodplain Amendment - Comparison

- Caivan Lands Boundary
- Regulatory Floodline
- Proposed Floodline
- Regulatory Floodplain
- Proposed Floodplain

N
W E
S

0 50 100 150 200 250
Meters



N

Legend

- 2022 JFSA Floodplain
- 2 cm Contours (m)
- RVCA Cross Sections
- Culvert Invert Elevation (m)

SCALE: 1:3000

0 50 100 m

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CAIVAN COMMUNITIES

Perth Golf Course

Figure C3: JFSA Flood Plain
and Culvert Invert Elevations

PROJECT	2118-21
DRAWN	MP
DATE	MAR 2022

Table 1 - Vegetated Surface Ground Truthing

ID	X	Y	Z	CODE	DTM	Difference
2221	400689.1	4971850.8	133.133	VE_VEG	133.289	0.156
2222	400692.8	4971837.3	133.208	VE_VEG	133.281	0.073
2251	400376.3	4971679.8	133.339	VE_VEG	133.383	0.044
2252	400347.5	4971674.6	133.349	VE_VEG	133.391	0.042
2253	400325.9	4971667.8	133.319	VE_VEG	133.359	0.040
2225	400659.7	4971797.2	133.241	VE_VEG	133.266	0.025
2197	400658.8	4972141.1	133.111	VE_VEG	133.133	0.022
2234	400603.1	4971763.8	133.155	VE_VEG	133.148	-0.007
2241	400557.8	4971735.2	133.357	VE_VEG	133.336	-0.021
2250	400405.0	4971677.3	133.354	VE_VEG	133.328	-0.026
2233	400601.4	4971775.7	133.167	VE_VEG	133.133	-0.034
2249	400419.8	4971674.5	133.379	VE_VEG	133.336	-0.043
2236	400607.5	4971758.7	133.240	VE_VEG	133.195	-0.045
2232	400604.7	4971791.3	133.221	VE_VEG	133.164	-0.057
2229	400616.5	4971795.8	133.190	VE_VEG	133.133	-0.057
2211	400618.3	4971951.4	133.201	VE_VEG	133.141	-0.060
2242	400544.9	4971728.3	133.371	VE_VEG	133.305	-0.066
2205	400579.1	4972079.1	133.205	VE_VEG	133.133	-0.072
2247	400426.6	4971673.8	133.444	VE_VEG	133.336	-0.108
2254	400287.1	4971655.0	133.332	VE_VEG	133.156	-0.176
2255	400272.8	4971645.6	133.328	VE_VEG	133.148	-0.180
2149	400409.7	4972845.0	134.232	NA_TOPSL	134.375	0.143
2166	400473.2	4972893.1	134.630	NA_TOPSL	134.711	0.081
2137	400351.2	4972808.6	133.920	NA_TOPSL	134.000	0.080
2145	400393.1	4972837.3	134.360	NA_TOPSL	134.438	0.077
2152	400429.2	4972859.7	134.337	NA_TOPSL	134.391	0.054
2141	400357.6	4972809.3	133.947	NA_TOPSL	133.984	0.037
2160	400461.2	4972886.0	134.851	NA_TOPSL	134.883	0.032
2132	400294.9	4972724.7	134.700	NA_TOPSL	134.719	0.019
2165	400481.8	4972891.6	134.601	NA_TOPSL	134.617	0.016
2167	400497.6	4972894.5	134.193	NA_TOPSL	134.172	-0.021
2128	400277.7	4972685.6	134.751	NA_TOPSL	134.688	-0.064
2136	400325.4	4972786.8	134.116	NA_TOPSL	134.000	-0.116
2153	400442.5	4972868.9	134.826	NA_TOPSL	134.570	-0.256
2134	400305.2	4972753.7	134.513	NA_TOPSL	134.219	-0.294
2130	400284.7	4972701.3	134.403	NA_TOPSL	134.641	0.238
2148	400395.1	4972840.9	134.222	NA_TOPSL	134.438	0.215

Table 2 – Vegetated Vertical Accuracy (VVA) for Orthophoto DTM

Rank	ID	X	Y	Z	DTM	Difference	Error	cum prob (%)
1	2234	400603.1	4971764	133.155	133.148	-0.007	0.007	2.70
2	2165	400481.8	4972892	134.601	134.617	0.016	0.016	5.41
3	2132	400294.9	4972725	134.7	134.719	0.019	0.019	8.11
4	2241	400557.8	4971735	133.357	133.336	-0.021	0.021	10.81
5	2167	400497.6	4972895	134.193	134.172	-0.021	0.021	13.51
6	2197	400658.8	4972141	133.111	133.133	0.022	0.022	16.22
7	2225	400659.7	4971797	133.241	133.266	0.025	0.025	18.92
8	2250	400405	4971677	133.354	133.328	-0.026	0.026	21.62
9	2160	400461.2	4972886	134.851	134.883	0.032	0.032	24.32
10	2233	400601.4	4971776	133.167	133.133	-0.034	0.034	27.03
11	2141	400357.6	4972809	133.947	133.984	0.037	0.037	29.73
12	2253	400325.9	4971668	133.319	133.359	0.04	0.04	32.43
13	2252	400347.5	4971675	133.349	133.391	0.042	0.042	35.14
14	2249	400419.8	4971675	133.379	133.336	-0.043	0.043	37.84
15	2251	400376.3	4971680	133.339	133.383	0.044	0.044	40.54
16	2236	400607.5	4971759	133.24	133.195	-0.045	0.045	43.24
17	2152	400429.2	4972860	134.337	134.391	0.054	0.054	45.95
18	2232	400604.7	4971791	133.221	133.164	-0.057	0.057	48.65
19	2229	400616.5	4971796	133.19	133.133	-0.057	0.057	51.35
20	2211	400618.3	4971951	133.201	133.141	-0.06	0.06	54.05
21	2128	400277.7	4972686	134.751	134.688	-0.064	0.064	56.76
22	2242	400544.9	4971728	133.371	133.305	-0.066	0.066	59.46
23	2205	400579.1	4972079	133.205	133.133	-0.072	0.072	62.16
24	2222	400692.8	4971837	133.208	133.281	0.073	0.073	64.86
25	2145	400393.1	4972837	134.36	134.438	0.077	0.077	67.57
26	2137	400351.2	4972809	133.92	134	0.08	0.08	70.27
27	2166	400473.2	4972893	134.63	134.711	0.081	0.081	72.97
28	2247	400426.6	4971674	133.444	133.336	-0.108	0.108	75.68
29	2136	400325.4	4972787	134.116	134	-0.116	0.116	78.38
30	2149	400409.7	4972845	134.232	134.375	0.143	0.143	81.08
31	2221	400689.1	4971851	133.133	133.289	0.156	0.156	83.78
32	2254	400287.1	4971655	133.332	133.156	-0.176	0.176	86.49
33	2255	400272.8	4971646	133.328	133.148	-0.18	0.18	89.19
34	2148	400395.1	4972841	134.222	134.438	0.215	0.215	91.89
35	**2130**	**400284.7**	**4972701**	**134.403**	**134.641**	**0.238**	**0.238**	**94.59**
36	2153	400442.5	4972869	134.826	134.57	-0.256	0.256	97.30
37	2134	400305.2	4972754	134.513	134.219	-0.294	0.294	100.00