# Flood Line Delineation Study

## Draft Plan of Subdivision
## 2004 Hamilton Rd, London, Ontario

Project Number: DEL21-035
Date: May 2025

Prepared For:
Kreative Development Inc.

www.deveng.net

LONDON | 519-672-8310
41 Adelaide Street North, Unit 71

PARIS | 519-442-1441
31 Mechanic Street, Unit 301

# Report Prepared By:


Laurence Murray, P.Eng., DCE
*Associate, Sr. Project Engineer*

## Revisions

Preliminary Report, dated: 22 May 2025

## Statement of Qualifications and Limitations

This Report has been prepared for Kreative Development Inc. (Owner) based upon currently available information to support the Commercial Draft Plan of Subdivision application to be filed for the proposed residential development. This report has been prepared for the sole use of the Owner and any reliance upon this information by any third party is made at the risk of that party. Development Engineering (London) Limited assumes no liability for any injury, loss, or damage suffered by any third party based upon decisions made or actions that arise due to that party's reliance upon or interpretation of the contents of this report.

This Statement of Qualifications and Limitations is attached to and forms part of this report; any use of this report is subject to the terms contained herein.

# Table of Contents

# Appendices

# 1.0 Background Information

## 1.1 Introduction

Development Engineering (London) Limited (DevEng) has been retained by Kreative Development Inc. (the owner) to prepare a Flood Line Delineation Study in support of the proposed Draft Plan of Subdivision located at the northwest corner of Veterans Memorial Parkway (VMP) and Hamilton Road, known as M.N. 2004 Hamilton Road.

The proposed Draft Plan of Subdivision as prepared by DevEng (April 2025) covers an area of 45.55 ha with 7.61 ha of the proposed site to be developed through the Plan of Subdivision. The proposed subdivision includes five (5) industrial/commercial blocks (6.80 ha) and two (2) rights-of-ways (0.81 ha) to be developed while the balance of the development includes two (2) open space blocks (33.96 ha), natural heritage buffers (1.61 ha), compensation area (0.99 ha), and road widening dedications of (1.38 ha). Refer to Appendix A for the proposed Draft Plan of Subdivision.

Less than 20% of the proposed site is developable due to the existing Natural Heritage Features, Natural Hazards, the existing drainage feature that runs from south to north bisecting the developable portion of the site, and the associated compensation blocks and buffers. Most of the site is covered by existing vegetation and Natural Heritage features aside from approximately 300m of the southerly portion of the site from Hamilton Road. The existing drainage feature (formerly the Fekete Drain, abandoned under the Drainage Act) which bisects the developable portion of the site will remain in its existing location with minor proposed improvements to remove an accumulation of sediment immediately downstream of Hamilton Road and to provide a Municipal Road crossing over the existing watercourse.

The on-site crossing over the drain is required due to access restrictions imposed on the site, access is prohibited along the entire frontage of VMP, and will not be permitted within 300m of the centerline of the VMP right-of-way, as such, establishes the site access on the west side of the existing drain – refer to the Floodline Delineation Study as prepared by DevEng for additional details regarding pre-development and post-development floodline modeling and delineation, and preliminary sizing of the drain crossing. The proposed development limits have been established based on a combination of studies to delineate the existing Natural Heritage Features, Natural Hazards, updated Floodlines, crossing requirements, and appropriate buffers and compensation blocks to protect the features and hazards.

The purpose of this Flood Line Delineation Study is to determine the existing regulatory flood line to supersede the generic flood line mapping, and to provide technical justification for a proposed roadway crossing and culvert, and address engineering-related concerns in advance of a future Section 28 Permit application. This report includes preliminary sizing of a culvert to suitably convey the Regional Event (250yr), and design coordination for channel geomorphic, environmental, geotechnical/hydrogeological and engineering servicing subdisciplines.

.

# 2.0 Background Information

## 2.1 Previous Consultations

The following pre-consultation comments informs the requirement for the preparation of this report:

- Proposal Review Meeting Summary & Record of Consultation for 2004 Hamilton Road, London, ON – File No. TS2023-003 (City of London, May 10, 2023)

- UTRCA Comments for Proposal Review Meeting of 2004 Hamilton Road, London, ON – (Feb. 23, 2024)

## 2.2 Concurrent Studies and Reports

The following studies and reports were reviewed in the development of this report:

- Geotechnical Investigation, Project No. GE-00519 – (LDS Consultants Inc., Aug. 13, 2021)
- Draft Plan of Subdivision for 2004 Hamilton Road – (DevEng, April, 2025)
- Preliminary Stormwater Management Report – (DevEng, May 2025)
- Plan of Survey, Plan No.8-L-6364-Z – (AGM Ltd., Nov. 6, 2024)
- Environmental Impact Assessment Report - (NRSI, May 2025)
- Geomorphic Assessment - (Momentum Earth, May 2025)
- Geotechnical Investigation & Hydrogeological Assessment - (Stonecairn, May 2025)
- Transportation Impact Study- (Paradigm, May 2025)
- Final Proposal Report - Planning (MHBC, May 2025)

## 2.3 Previous Studies, Supporting Information & Design Specifications

The primary background information utilized for this study:

- Thames Valley Areas Subwatershed Study (1995 Aquafor Beech, information review only)
- Fekete Municipal Drain Map (1999 Spriet) & Abandonment Assessment Letter (2007 City of London)
- UTRCA Flood Line Mapping / Estimation – Methodology Summary
- AECOM Innovation Industrial Park Phases 1-4 Reports / Engineering Drawings (2005 -2008)
    - AECOM HECRAS Model information (incomplete – supplied by City 2024)
- Existing conditions Topographic survey (2021 - 2024) on the site and along the former Fekete Mun. Drain channel from +/-200m upstream of Hamilton Road to +/- 500m downstream of westerly Site Limit (private farm culvert crossing).
- Supplementary Ontario Base Mapping Information (2024) / Southwestern Ontario Orthophotography (SWOOP) topographic data
- City of London GIS As-built / Record Drawing Information / 2025 Design Specification and Requirements Manual (DSRM) Chapter 6.

# 3.0 Approval Agencies

## 3.1 City of London

The application for Draft Approval and any future detailed design applications must be submitted and subject to approval by the City of London. City of London Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) amendment applications are anticipated to be required for any proposed roadway drainage culvert works, associated under S. 53 of the Ontario Water Resources Act (OWRA), which are to be assumed by the City.

## 3.2 Upper Thames River Conservation Authority (UTRCA)

Portions of the site are located within the UTRCA Regulated Area due to downstream sections of the former Fekete Drain and the Hudson Drain running through the site. The Fekete channel runs from south to north, then heads west towards the south branch of the Thames River dividing the southerly portion of the property into two separate development areas on the east and west of the existing drain. The downstream section of the former Hudson Drain outlets to the Fekete Drain north of the proposed development block on the east side of the site.

There is a proposed municipal road crossing over the Fekete channel to connect the east and west portions of the site to be developed since the site will be restricted to a single access connecting to Hamilton Road on the west side of the former Fekete Drain per the City of London consultation comments. The Consulting Team's work includes review of the existing flood lines established by the UTRCA and provide recommended refinements of the flood lines based on the proposed development. The Team's work will also include identification of existing natural hazard features with recommended setbacks. The development of the subject property is subject to approval under Section 28 of the Conservation Authorities Act.

# 4.0 Hydrology

## 4.1 Basin Drainage Characteristics and Topography

The former Fekete Drain is a ~2.2km long channel open channel (reach length along subject study area downstream of Veterans Memorial Parkway, overall length of ~4.2km) which runs through the subject property (centerline elevations ~255.40m upstream to ~252.30m downstream), conveying upstream lands and the site runoff northwest to the Thames River. Upstream of the study area, there are two concrete box culvert crossings (Hamilton /Veterans Memorial) and downstream steel/CSP circular farm crossing culvert to allow conveyance of flow. The Fekete basin drainage area upstream of the subject property at Hamilton Rd. is approximately 2.77 $km^2$ (277 ha), based on previous AECOM report information which is supported by the Ontario Watershed Information Tool (OWIT). The upstream basin is partly developed (Innovation Business Park) with the remainder primarily a mix of agricultural and open space lands.

Southwestern Ontario Orthophotography (SWOOP) topographic data was also utilized, along with three (3) detailed topographic surveys that were conducted to evaluate the existing conditions of the site and its surrounding area. The surveys were completed by Development Engineering (London) Ltd. on April 30, 2021; October 10, 2024; and November 21, 2024, focusing on the southern half of the development area, the Fekete channel, and the Hamilton Road right-of-way, respectively.

The subject property is bound by Hamilton Road along the south, Veterans Memorial Parkway along the east, agricultural lands along the west, and the Thames River to the North. The lands previously contained a residential lot (now removed), surrounded by mix of wooded area and grassed open space. Adjacent land uses are Industrial / employment (business park) to the south, with agricultural use lands east and west of the site.

The property also contains the downstream most section of the smaller Hudson Drain (also a former Municipal Drain) which confluences the former Fekete Drain near the west limit of the site. Only the Fekete channel is in proximity to the proposed development blocks which is proposed to include a local roadway (culvert) crossing, refer to the (former) Municipal Drain Plan markup under Appendix B.

Within the south and central portions of the site, comprising approximately 30.93 ha, the topography generally slopes towards northwest toward the former Fekete and Hudson municipal drains, with an average slope of approximately 1.5%. Geodetic elevations in this area range from approximately ±262.00 m at the south property boundary to ±253.00 m at the bottom of the Fekete channel along the west limit of the site. There is topographic ridge running east-west that divides the remaining 14.62 ha northly portion of the site comprising natural heritage lands. This area drains northward towards the Thames River with geodetic elevations in this area range from approximately ±259.00 m along the to ±242.00 m.

## 4.2 UTRCA Floodplain Mapping and Main Thames Flow Estimates

Pursuant to O.Reg. 41/24, the UTRCA provided preliminary Flood Hazard mapping dated Feb. 2024, to be confirmed through this analysis. For the 250-year regulatory flow (equivalent of 1937 Flood), this can be estimated using the 2006 regression analysis formular in Main Thames River watershed. The UTRCA regression analysis was conducted on previously river gauge flood flow data to create the following formula expressing the relationship between the steady-state peak regional flood flow rate and upstream drainage area:

$$Q_{Main\ Thames} = 2.28.DA^{0.825}$$

Where: DA = Drainage Area ($km^2$)
Q = Flow Rate ($m^3/s$)

The subject site/Fekete channel is located along the south branch of Thames River (main) Basin. The former Fekete Drain has an approximate upstream drainage area of 2.735 $km^2$ (at Veterans Memorial), increasing to approximately 3.63 $km^2$ downstream (west) of the subject land and ultimately 4.027 $km^2$ near the outlet with the Thames River based on the MNRFs Ontario Flow Assessment Tool (generally corresponding to the 2008 AECOM report drainage areas). The corresponding estimated peak flow rates range from 4.39 $m^3/s$ to 7.20 $m^3/s$ for five locations, refer to the appended information in Table in B.

## 4.3 AECOM Innovation Park Reports & Model (2005 & 2008)

The City of London retained AECOM to complete designs for the Innovation Park Industrial Subdivision (Phases 1-4) upstream of the subject lands, on either side of the Veterans Memorial Parkway (formerly Airport Road). This included the following associated works/studies:

- Upstream realignment of the Fekete channel (between Veteran's Memorial and Hamilton Rd) in conjunction with SWMF No.6 (Phase 1, 2005 Report)
- Fekete Drain HECRAS model channel assessment in conjunction with SWMF's No. 3 & 4 (Phase 4, 2008 Report)

Of note, the AECOM reports noted the following key information:

- 2005 Report - Fekete Drain peak flows at Hamilton Rd. were proposed to increase from 8.61cms under pre-dev. conditions to 13.6cms post-dev. conditioned (only 100yr was reported). Along with the proposed channel realignment works (completed), an upgrade to the Hamilton Rd. culvert was also recommended at a future date, although no size or specific timeline was provided.

- 2008 Report – Fekete Drain peak flows at Hamilton Rd. were re-assessed under pre-dev. conditions as 8.7cms (100yr) / 11.5 cms (250yr) and proposed to reduce slightly under post-dev. conditions to 8.5 cms (100yr) / 11.1cms (250yr) respectively. The peak flow listed in the 2008 AECOM report (Table 3.3) are assessed to be applicable to the subject flood study.
- A copy of the HECRAS model completed under that project was provided for review through the City, although the model utilized slightly different flows from those listed in the 2008 report and did not appear to be a final version as it appeared to contain cross-section errors.
- AECOM did not appear to include flood line mapping as part of previous 2008 HECRAS study work. As the model information received was a draft (i.e. coherent flood lines were not extractable). However, AECOM 2008 report did include Figure 3., a high-level Fekete channel Water Elev. Profile.

Key excerpts from these AECOM reports are included in Appendix B.

## 4.4 Hydrologic Assessment

Refer to Appendix A for a comparison of the two sources of flow information (UTRCA / AECOM) from the background review. The 2008 AECOM report modelled flows are greater than the UTRCA calculated flows. As such, these have been assumed to be applicable as an upper bound for the floodline analysis and applied at the various key locations along the Fekete reach. The 2008 AECOM peak flows were compiled into GeoHEC-RAS for a steady-state analysis to assess hydraulic performance and estimate the flood lines for all conditions (pre- and post-development conditions) for the 2yr to 250yr events. It is further noted that both 4hr and 24hr-25mm event peak (low) flows were created in separate PCSWMM model calibrated to the AECOM 2yr event, specifically for use in the Geomorphic channel assessment (Momentum).

# 5.0 Hydraulics

## 5.1 GeoHEC-RAS

The software used for this hydraulics analysis was GeoHEC-RAS, an integration of AutoCAD Civil 3D and HEC-RAS created by CivilGeo. The software allows the user to import surface data and create cross sections at user-specified locations. When HEC-RAS inputs (i.e., roughness values, bank stations, section weirs, boundary conditions, contraction/expansion coefficients, existing and proposed bridge/culvert crossings, ineffective flow areas, steady-state flow, etc.) have been provided, it computes the various open-channel flow equations and provides standard HEC-RAS outputs. The software also projects the water surface elevations at each cross section onto the imported surface data to provide a calculated flood map which can then be imported into Civil3D for use in design.

It is noted GeoHEC-RAS results returns typical warning messages at some cross sections which state that they "may indicate the need for additional cross sections". Several iterations of the model were tested at different levels of detail. The additional sections appear to have a negligible effect on the results. As such, the models utilize an appropriate number of cross sections for the sake of simplicity which is considered appropriate for engineering analysis of this reach of the Fekete channel.

### 5.1.1 Boundary Conditions

Boundary conditions have been provided far enough downstream of the study area to allow for an accurate computation of the normal depth at the development location. To accomplish this, an energy slope, which is

typically approximated by measuring the water surface slope, is input. However, with a mild to moderate hydraulic profile condition, the downstream tailwater was set at the computed normal depth and the initial energy gradient was approximated by computing the average channel bed slope (±1.29%). With sufficient distance between the boundary condition and the study area, a sufficient boundary condition can be projected to the cross sections within the subject site. It should be noted that the largest flow (14.8 cms) was applied at a downstream private culvert (Location T8 per 2008 AECOM report) approximately 500m west of the site limit for a conservative boundary condition, and not at the outlet (Thames River confluence).

### 5.1.2 Modelled Cross Sections

Cross sections were provided at least every 50m, with supplemental intermediate cross sections at closer intervals, as required. The additional cross sections were included at major changes in cross sectional geometry, changes in channel alignment/direction, and at crucial flow areas such as culvert crossings. Manning's 'n' values for the channel and overbanks were established based on the surface roughness and set to 0.032 and 0.045, respectively (ref. Open Channel Hydraulics, Chow, 1959. *Relatively clean and straight main channel; grass with some weeds* and between *cultivated crops / light brush on overbanks*). The downstream-most sections closer to the Thames River outlet had a value of 0.060 applied to overbank sections for heavier vegetation.

### 5.1.3 Contraction and Expansion Coefficients

Contraction and expansion coefficients have been established in accordance with Table 5-2 of the HEC-RAS Reference Manual. Typical contraction and expansion coefficients of 0.1 and 0.3 (respectively) are to be used at standard cross sections, coefficients of 0.5-0.7 (entrance) and 0.9-1.0 (exit) are used at culvert sections where applicable.

### 5.1.4 Steady Flow Data

The GeoHEC-RAS model divides the various drains into four (4) individual 'reaches' shown in Appendix B Figure 1 and listed in Table 1, with four (4) flows applied at the upper end of each. as the downstream most section is at the confluence with the Thame River (refer to S. 3.1.1), generally following the 2008 AECOM report approach. Typically, each 'reach' requires its own flow rate for analysis based on its drainage area (refer to *Drainage Areas* Figure 1 in Appendix B).

# 6.0 Modeled Scenarios

Two different scenarios were modeled to assess the existing (pre-development) conditions and proposed (post-development) conditions including proposed roadway crossing required to facilitate vehicle and pedestrian access.

## 6.1 Existing Conditions Model

The existing conditions model includes cross-sections 1000 to 3212 over a total profile reach length of ~2,212m. This includes three (3) culvert crossings at Verterans Memorial, Hamilton Rd. and a private farm crossing. The subject site includes sections 2109 (upstream west limit) to sections 2701 (south limit at Hamilton Rd.), covering a stretch of roughly 580m. The following are a summary of key items and model findings:

- The exiting Hamilton Rd. Culvert is a 1.7m H x 2.4m wide Box culvert, roughly 22m long with a flat slope (invert ~255.10m at both ends, no fall); AECOM previously recommended (2005 report) that ex. Hamilton Rd. culvert is upsized in the future, although no new sizing or specific timing was proposed.
- The existing Flood Line is generally consistent with UTRCA Flood Line (high-level) mapping information.
- As noted, AECOM did not appear to include flood line mapping (plan) as part of previous 2008 HECRAS study work. However, AECOM's 2008 report did include Figure 3. (high-level) Fekete channel Water Elev. Profile which appears to be very consistent with GEOHERAS hydraulic profile generated.
- Topographic site survey findings confirmed relatively significant channel sedimentation (deposition) downstream of Hamilton Rd. culvert, which may most likely be attributed to both upstream agricultural activities and previous Innovation Industrial Park Phase construction/works (including Fekete channel realignment between Veterans Memorial and Hamilton Rd.).
- For roughly 175m, the existing channel centerline elevation increased by up to ~0.5m above the downstream invert of Hamilton Rd. Culvert; this locally impacts (expands) flood Line on the east side of the channel on the subject site, and also increases the tailwater elevation downstream of Hamilton Rd. Culvert reducing overall conveyance efficiency.
- Average max. 250yr Flood line elevation across site (locally ~125m downstream of Hamilton Rd.) ranges between ~256.72m and ~256.52m, then steadily falls to around 253.60m at the westly site limit (~625m downstream of Hamilton Rd).
- Through the site area, along the east side of the channel there is a depressed overbank area that is inundated under all events from the 5yr to the regional event, but this is largely ineffective flow area (bank overspill), given the low overbank elevation and limited channel conveyance due to deposition.
- The detailed existing conditions flood line (blue line) has been included on the proposed Draft Plan in Appendix A for reference only.

Refer to the schematics, cross section outputs, and detailed summary outputs provided in Appendix C.

## 6.2 Proposed Conditions Model

As shown on the Draft Plan of Subdivision in Appendix A, a 23m wide roadway (ROW) crossing is required to provide vehicle and pedestrian access redundancy, a municipal requirement for draft approval. Provision to extend a local sanitary sewer and watermain across the proposed culvert crossing from the eastly development blocks is required, and also to incorporate local storm drainage outlet works into the culvert design. *It is noted that further discussion with the City regarding the exact ROW section to accommodate the various practical culvert constraints and associated environmental requirements may be required through future detailed design.* The following are a summary of key items and model findings:

- The proposed conditions model flood limits established are based on the 2008 AECOM Innovation Park (Post-Dev.) peak flows for 2yr to 250yr events, as essentially there is no change to site generated peak flows due to proposed on-site stormwater management (SWM) controls.
- The proposed conditions model (steady state analysis) includes removal of sediment deposits downstream of Hamilton Road to reestablish the drain profile with positive slope to provide a consistent centerline elev. (Thalweg) downstream of Hamilton Rd. (~0.3% slope) and locally widen to increase channel conveyance capacity. Natural channel design (fluvial geomorphic) considerations to be included by Momentum Earth Inc. and EIS impacts addressed by NRSI Inc.
- The post-development model includes updated cross sections between 2701 (north side of Hamilton Rd. culvert) to 2487 ~70m downstream of the proposed crossing location. The new sections along

the channel are both upstream and downstream of the new 23m roadway embankment culvert crossing as part of the subject Draft Plan.

- A proposed 1.8m H x 3.9m Wide Concrete Box Culvert (max. length 41.5m), 0.27% slope is currently proposed as the largest size structure for suitable conveyance of the 250yr Regional Flood (final dimensions to be confirmed through detailed design).
- Preliminary Inverts for this structure 254.734m to 254.622m with roadway crossing ~ 258.80m (final elevation to be confirmed through detailed design)
- Average max. 250yr flood line elevation across site (downstream of Hamilton Rd. to new culvert) is lowered slightly and ranges between ~256.46m and ~256.40m, decreases in transition through the culvert to ~256.0m, and continues to steadily fall to ~253.60m at the westly site limit (~625m downstream of Hamilton Rd).
- The proposed culvert will generally conform to the City DSRM requirements Per Chapter 6 (S. 6.5.5 & Table 6.5.5.2.2). The proposed culvert size is anticipated to be able to suitably convey the regional event without overtopping and sufficient freeboard below the culvert soffit (underside obvert ~256.53m), which meets or exceeds the MNR typical requirements for safe access as typically required by UTRCA for crossings within the regulated area. Details for culvert will be provided through the detail design including headwall/wingwalls structures, integration with site SWM/storm drainage (outlet) features and any environmental/fluvial geomorphic requirements/recommendations.
- The improved site channel conveyance locally reduced the flood elevation and largely contains flows within the main channel, with some continued (lowered) overbank spill on the east side (similar to existing conditions), but only above the 10yr event.
- The anticipated post-development conditions flood line (thin dark green line) has been incorporated into the proposed Draft Plan in Appendix A and has informed the development block limits. *It is noted the line appears to overlap the top of the roadway crossing, but this is due to graphical software plan interpolation only (detailed water elevation is below the top of the culvert).* Refinement of the proposed flood line will be completed through the detailed engineering design stage.

Refer to the Appendix D for post-development model schematics, cross section outputs, and detailed summary outputs. The proposed roadway crossing meets the access redundancy requirements and the modeling indicates the proposed culvert can facilitate regional flood flow conveyance without impact to upstream flood lines. From a hydraulic (engineering) perspective, the proposed solution addresses the servicing, transportation access, and flood conveyance requirements for the proposed development. Future detailed design will confirm and refine roadway embankment elevations and culvert geometry/specifications and any associated channel conveyance improvements in conjunction with natural channel design features and other environmental considerations.

# 7.0 Culvert / Channel Design Coordination Elements

For the proposed development design, with respect to the channel and culvert crossing related elements, the following preliminary coordination overview is provided:

## 7.1 Downstream Erosion and Naturalized Channel Design

The current proposed culvert size does not impact the downstream erosion potential, based on a review of the existing and proposed velocities for more frequent flow events. Natural channel design techniques will be applied upstream and downstream of the proposed crossing location to improve/remediate the current condition following cleanout of accumulated sediment with consideration for channel stability and in-stream

hydraulics along identified reaches. This may include features such as a runs and pool, flow dissipation strategies, substrate/embankment material improvements and aquatic habitat enhancements. Local site storm drainage outlets (sizing to be confirmed through future detailed design) are anticipated to be incorporated into or adjacent the downstream wing-walls of the proposed culvert crossing, complete with either baffle blocks or similar type flow dissipation measures (e.g. plunge pools or naturalized baffles). These are to be further outlined during the future detailed design stage. Refer to the Report by Momentum Earth for details.

The proposed development stormwater management (SWM) strategy and culvert design are anticipated to implement various features for erosion and scour protection of the Fekete channel. Refer to the Preliminary SWM report (DevEng) for discussion/details on the following:

- Proposed Erosion protection storage attenuation volume (150m$^3$/ha) will be provided for the overall subdivision, primarily through private SWM control on each development block.
- Scour protection around the storm outlets will be suitably integrated with the culvert (downstream wingwalls) and natural channel design components.
- Temporary erosion and sediment control (ESC) requirements during construction. Detailed ESC plans will be provided for review by the City of London at the detailed engineering stage and in particular for the roadway culvert crossing and any channel improvements (including in-water works and dewatering considerations). Further Geotechnical/Hydrogeological design coordination is required but deferred to the detailed engineering stage once the overall culvert design strategy is accepted.

## 7.2 Channel Geomorphic Recommendations

The strategy outlined in the previous section generally satisfies proposed culvert crossing design requirements of the geomorphic study, whereby considerations for natural channel design techniques through the proposed culvert crossing design is to also be considered in conjunction with terrestrial and aquatic passage recommendations.

Further natural channel design techniques (Momentum Earth) will be applied upstream and downstream of the proposed crossing location to improve/remediate the current condition following cleanout of accumulated sediment with consideration for critical erosion (velocity) thresholds along identified reaches. This may include features such as a plunge pool, flow dissipation strategies, substrate/embankment material improvements and aquatic habitat enhancements, although these are to be further outlined during the future detailed design stage. Refer to the Report by Momentum Earth for details.

## 7.3 EIS Recommendations

EIS recommendations (NRSI) have been primarily incorporated into the overall layout of the development (Draft Plan) including development setbacks, NHS buffers and delineation of key open space/compensation areas along the channel and other site features (wetland pockets).

However, with specific regard to SWM/drainage, NRSI will defer primarily to Momentum/DevEng on the minor storm outlet locations and practicalities related to the proposed culvert crossing. From an ecological perspective, it is understood the outlet(s) within the box culvert (wingwalls) would be the best approach, as it would eliminate the need for an additional disturbance of a separate headwall within the valley corridor. For discharge flow rates, targeting pre-development conditions is proposed for the overall site by incorporating

SWM quantity control as applicable, with consideration for flow routing along the channel and water balance mitigation strategies for recharge to localised wetlands along the drain. Considerations for terrestrial and aquatic passage through the proposed culvert crossing design is to also be considered in conjunction with geomorphic recommendations. Refer to the reports by NRSI and Momentum Earth for further details.

## 7.4 Water Balance / Low-Impact Development

Developments within the South Thames Subwatershed as outlined in the *Thames Valley Areas Study* in Section 2.2, outlines the criteria for 20 mm of roof runoff infiltration, subject to feasibility confirmation at the area plan/site plan stage. However, given the largely low-permeability silt-till subsoil, infiltration opportunities (recharge) across the site are anticipated to be constrained (as noted in Section 4.2). An overall water balance analysis has been completed by Stonecairn Consulting Inc. to review the infiltration deficit under post-development conditions. The summary table notes a slight decrease in the total site post-development infiltration component (79% of pre-development) without any recharge mitigation. A feature-based wetland water balance mitigation approach may be adopted to maintain post-development within 10% of pre-development conditions for specific wetland pockets flanking the drain. Refer to the report by Stonecairn for details of the water balance and proposed targets for localized recharge, considering the site soil conditions.

Where practical, infiltration measures will be implemented at site-level on a best-efforts basis for the purpose of maintaining groundwater discharge to the local streams, minimizing the impact to groundwater supply. This could be achieved through the routing of clean roof and landscaped area runoff into Low Impact Development (LID) measures and directed to key wetland pockets flanking the drain. The location, design and sizing of any LID system(s) to support the initiative is to be completed during the future detailed design stage. Furthermore, given the limited length of roadway, opportunities for incorporating any LID measure in the ROW's is also anticipated to be very constrained. However, review during detailed design will confirm practicalities of collecting and conveying storm drainage to the outlet and what, if any, opportunities for further recharge could be available along the ROWs. Recharge measures are not anticipated to be in the immediate vicinity of the proposed culvert crossing or have any impact on these works.

# 8.0 Summary Conclusions

Based on the preceding information, the following summary conclusions are provided with regards to the Flood Line Delineation and proposed channel crossing design:

- Existing conditions and post-development models are completed to assess the localized change in flood line for subject site with proposed channel cleanout (remediation) and culvert crossing works to safely convey the Regional Event (250yr).
- Event peak flows were taken from the 2008 AECOM Innovation Park (Post-Dev.) peak flows for 2yr to 250yr events.
- The post-development model includes the proposed roadway crossing embankment with culvert and the results show the regional flood is generally contained within the channel slopes except for localised depressed overbank areas.
- The proposed 1.8m H x 3.9m W box culvert has adequate flow capacity to safely convey the regional flood flow without adverse impacts and in combination with the restored channel profile and improved conveyance sections, lowers flood line elevations across the site.

- The anticipated post-development conditions flood line has been incorporated into the proposed Draft Plan in Appendix A and has informed the development block limits.
- Preliminary design coordination to address geomorphic, environmental, geotechnical and hydrogeological (water-balance) considerations has been completed. Future detailed design will confirm the roadway embankment/culvert geometry and any associated channel conveyance improvements in conjunction with natural channel design features and other required environmental considerations.

We trust this report adequately addresses the outlined design constraints and proposed solutions related to Flood Line Delineation and the proposed channel culvert crossing in support of the Draft Approval, and in advance of future detailed engineering design and Section 28 Permit application. If there are any questions, please contact the Engineer of Record who has sealed this report.

Respectfully submitted,

**DEVELOPMENT ENGINEERING (LONDON) LIMITED**