Prepared for the

DISTRICT OF OAK BAY

FINAL

November 2015

‘The Uplands’ - Combined Sewer Separation Project
Pre-Design Phase
Technical Memo 1

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OQM | Organizational Quality Management Program

ISO 9001 QUALITY MANAGEMENT

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1. INTRODUCTION

In keeping with our engineering services proposal dated April 17th, 2015, the following is a summary of input data as compiled to date, needed to complete the preliminary design phase. This includes design criteria and boundary conditions we expect to adopt. We would ask that the District review this material and provide commentary, as deemed appropriate.

2. DESIGN CRITERIA, LAND USE PLANNING INFORMATION AND RESULTING FLOW RATES

2.1 SERVICE LIFE

Assume 50 years, to year 2065.

2.2 LAND USE EXPECTATIONS

According to the District's Planner, Oak Bay does not foresee further densification in the Uplands area. Oak Bay will be considering secondary suites in homes, though the Uplands area may be excluded from this option. As such, we will assume no infill density increase of any consequence.

2.3 DESIGN FLOW RATES AND HYDRAULICS

2.3.1 Per Capita/Household Total Average Dry Weather Sanitary Sewer Flow

- MMCD per Capita Flow = 240 l/d/c (metered) or 350 l/d/c (unmetered), use 300 l/d/c.
- Number of Lots to be serviced = 150 (Humber catchment) & 236 (Rutland catchment).
- Average occupancy for the Uplands area = 3 persons per dwelling unit.
- Average Dry Weather Flow (ADWF):
  - Humber: 135,000 l/d or 1.56 l/s
  - Rutland: 212,400 l/d or 2.46 l/s
- There is a need to rationalize past effort by others, who have attempted, on behalf of Oak Bay, to isolate the average day san sewer component of flow during dry weather. This will be reviewed as part of the computer network model calibration process.

2.3.2 Peaking Factor for Sanitary Sewer Component of Flows

- MMCD peaking factor, PF = 3.2 /((P/1000)^0.105), round P to nearest 1000, therefore PF=3.2

- District of Oak Bay refers to: "Manual of Practice for Design and Construction of Sanitary & Storm Sewers by Water Pollution Control Federation (WPCF) & ASCE, manual is from the 1960's, last printed mid 1980's, now out of print.
- Peak Dry Weather Flow (PDWF) = ADWF x PF
  - Humber: 5.0 l/s
  - Rutland: 7.9 l/s

2.3.3 Differing I&I Allowance[s] for San Sewer Flows (if existing system is to be used as san system vs storm)

- CRD – I&I increases with age primarily; not as strongly correlates with diameter or pipe material composition.
- The infiltration component of I&I to be applied to modeled sanitary sewer flows will be significantly higher for options that envision the existing system to be used for sanitary sewer conveyance. This is due to the age, condition and original construction methods used for the existing ungasketted pipe network. Conversely, if we assume a new system is constructed for sanitary sewer conveyance, then I&I allowance will be much lower. For purposes of the predesign SWMM models, we have assumed as follows:

IF EXISTING NETWORK IS USED FOR SANITARY COLLECTION SYSTEM

- Initially, I&I will exceed the MMCD criterion of 0.17 l/s/ha (likely approaching 0.50 l/s/ha). We are assuming the majority of the system is roughly 100 year old, butt jointed clay tile pipe, leading to considerable opportunity for I&I flows. Past KWL tech memos refer to I&I rates for Rutland and Humber catchments, based on their model, but does not identify I&I rates specifically.
- We will also seek information from CRD on I&I rates for the Uplands and typical values for vitrified clay tile pipe sanitary sewer mains in the region.
- Per MMCD: I&I = 0.17 x 53 ha = 9.0 l/s (Humber), 0.17 x 74 ha = 12.6 l/s (Rutland)
- Peak Wet Weather Flow (PWWF) = PDWF + I&I
  - Humber: 14.0 l/s
  - Rutland: 20.5 l/s
- The required rehab or lining % of the overall system, to be remedied incrementally over time, could prove to be higher and/or more urgent than if the existing system is used for storm drainage conveyance.

IF EXISTING NETWORK IS USED FOR STORM CONVEYANCE SYSTEM

- MMCD Sanitary sewer system, I&I allowance for new systems to be 0.06 l/s/ha (above ground water table) and 0.12 l/s/ha (below ground water table). However, we recommend adopting a value applicable to probable longer term operating characteristics = 0.17 l/s/ha.

- The required rehab or lining % of overall system to be remedied per year will likely be lower than if the existing system is used for sanitary sewer. (Details of which are beyond the scope of this assignment.)

2.3.4 Design Storm

- The design storm will be a:
  - 5 year return period for current/present day storm event, and present day conveyance system.
  - 10 year return period for future storm events and future storm conveyance upgrading.
- We believe the preferred course of action for Oak Bay will be adoption of a Q5 design storm criterion for the existing system. As the storm conveyance system is upgraded over time, in the Uplands area, the more conservative Q10 storm design criterion should be applied.
- Mitigating impacts due to possible stormwater runoff storage should be checked and reported on. Ie: Is it cost effective to store water temporarily and thereby avoid otherwise required conveyance system upgrades/replacements?
- Flow will be accommodated within new sections at a hydraulic grade line no greater than the obvert of the pipe (i.e. pipe full). See 2.3.7 below.

2.3.5 Climate Change Issue

- City of Victoria developed a Stormwater Master Plan in 2014. Integral to the plan was the development of IDF curves that have been adjusted to predict the effects of climate change. The following information was used:
  - Base data from Gonzales Heights Weather Station (located in south Oak Bay)
  - Climate change assumptions consistent with Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios, A2 emission scenario.
  - IDF curves adjusted for approximately the year 2050.
  - Forecast 10% increase in monthly fall and winter precipitation.
- The Pacific Climate Impacts Consortium (PCIC) at the University of Victoria has reviewed and assembled 15 different climate change models. The science of climate change is not complete; long-term monitoring of evolving weather patterns required to verify model accuracy. The 15 accepted climate change models used by PCIC provide very different predictions, thus, the approach for Oak Bay will utilizes the Median Climate Change model, out to year 2050.
  - The following information from the PCIC will be input:
    - Emission Scenario: an average scenario for future emission values.
    - Climate Model: an average prediction.
    - The MEDIAN percentile, and:

- Factors derived from the above scenario will used to translate hourly values on a monthly basis. That is, the same adjustment factor will be used for each value within a given month. For example, all hourly rainfall values are to be increased by 6% for the month of January.

2.3.6 Stormwater Management

- There is potential for stormwater management within the project both on private property and within the road rights-of-way.
- Recommendations regarding selection of specific rainwater management standards and design applications is beyond the scope of this assignment. However, as an example of similar effort undertaken in the Capital Region, we would suggest the City of Victoria's recently completed document offers a good example.
  Attached as Appendix C are applicable excerpts from the City's SWMP.
- Stormwater management on private property (onsite) is expected to be voluntary, but the District's policies on this topic are still in development:
  - Where property owners decide to install stormwater management, an overflow connected to the stormwater main would still be required.
- There are several locations where stormwater management in the public rights-of-way would potentially be feasible.
  - Specific locations will be identified in Tech Memo 2, along with options for types of stormwater management that may be suitable for each location.
- Stormwater management facilities can reduce and/or delay the peak flow into stormwater mains. This is particularly true for short duration storm events and when the period between storm events is long enough to allow the impact of the first storm to be dissipated before the next event occurs.
- Stormwater management facilities typically have little impact on mitigating flow in stormwater mains during long duration storms or storms which occur immediately following a previous storm. For this reason, construction of stormwater management facilities can help to reduce overall stormwater runoff volumes, but does not typically reduce the design size of stormwater mains. (We will confirm this past general observation through SWMM modeling.) The goal in this regard would be to store sufficient volume during Q5 or Q10 storms so as to demonstrate a reduced need for capital upgrades.

2.3.7 Pipe Hydraulics

- MMCD pipe friction coefficients are to apply.
- We have assumed that some surcharge will be acceptable within the gravity pipe networks during peak flow events. However, no surcharge causing materially significant backup of service connections should occur, nor overflows at the ground surface.

- Q100 storm events are to be considered in a risk management context, as overland flow inducing, with some localized, nuisance type, flooding expected.

2.4 SEPARATION OF SEWER SERVICES

An important factor in the design and selection of options will be the period of time allowed for private property owners to separate their storm and sanitary services and to connect their separated services to the municipal mains. For the period during which the mains are separated, but services are not, the existing system will continue to function as a combined sewer system. In addition, operational issues can be envisioned where new pipelines are installed and insufficient flow is carried to promote adequate flushing. A decision regarding requirements for residents to separate their services will be required prior to final selection of the preferred option.

3. INFORMATION RECEIVED FROM THE DISTRICT

- Existing cadd files including the following information:
  - KWL Uplands Drawing Set (KWL Proj No. 547.027)
  - Field survey data (Summer 2014)
  - Conceptual Pipe System – Humber (Feb. 2015)
  - Uplands base map in CADD (April 2015)
  - Air Photos (jpg)
  - Easements & legal (shape files)
- CRD Pump station flow, pump hours, diurnal curve logs, output data.
- Existing pipe video condition assessment logs covering catchments. Three DVD's of pipe inspection videos.
- Tabulated data covering existing ground at each dwelling location, existing main floor elevations and calculated minimum habitable service connection target elevations.
- Past studies and reports entitled:
  - Technical Memorandum, Uplands Sewerage System Modelling, September 2006
  - Technical Memorandum, Uplands Sewerage System Modelling Update, February 2008
  - Technical Memorandum, Uplands Sewerage System Modelling Update, February 2009

4. EXISTING PIPE CONDITION ASSESSMENT REVIEW/CATALOGUING

4.1 VIDEO INSPECTION

To date, the District of Oak Bay has conducted video inspection of approximately 60% of the sewer mains in the project area. A portion of the remaining mains to be inspected are located within the road rights-of-way, but the majority remaining are located in easements on private property. The mains on private property can typically be accessed through manholes in the road right-of-way. It is critical to the final plan that all existing mains be inspected to confirm their current condition. It is strongly recommended that all remaining mains be video inspected prior to finalization of the detailed design of the selected sewer separation option. All future inspections should be completed by operators certified in either WRc or PACP (whichever is preferred by Oak Bay).

All available video inspection reports were reviewed by McElhanney. A brief summary was completed for each video reviewed. Summary reports are attached as Appendix A. In general, the pipe is typically in fair to good condition with some root infiltration. In some locations, root infiltration was significant and was causing significant blockage in the main. There was one location of apparent pipe collapse.

4.2 REHABILITATION OR UPGRADE OF EXISTING MAINS

As agreed with the District's Project Manager, the anticipated scope of capital work for this project will not include rehabilitation or upgrade to the existing system. The existing pipes are close to 100 years old and are nearing the end of their expected life. Regardless of option selected for separation of the sewers, the existing system will require replacement or rehabilitation over time. Where the mains have not failed and do not require replacement to increase the capacity, the most cost effective solution will likely be rehabilitation by cured in place pipe lining.

5. DRAWINGS

Plans attached as Appendix B include the following first draft of options drawings:

- Figure 1A: Option 1 – Proposed Sanitary Sewer and Existing Storm Drain Humber Catchment
- Figure 1B: Option 1 – Proposed Sanitary Sewer and Existing Storm Drain Rutland Catchment
- Figure 2A: Option 2 - Proposed Storm Drain and Existing Sanitary Sewer Humber Catchment
- Figure 2B: Option 2 - Proposed Storm Drain and Existing Sanitary Sewer Rutland Catchment
- Figure 3A: Option 3 – Pumped Sanitary Sewer – Humber Catchment
- Figure 3B: Option 3 – Pumped Sanitary Sewer – Rutland Catchment
- Figure 4A: Option 4 – Pumped Storm Drain – Humber Catchment
- Figure 4B: Option 4 – Pumped Storm Drain – Rutland Catchment

- Figure 5A: Option 5 – Gravity & Low Pressure Sewer (Limit Excavation) Humber Catchment
- Figure 5B: Option 5 - Gravity & Low Pressure Sewer (Limit Excavation) Rutland Catchment
- Figure 6A: Options 6 – Gravity & Low Pressure Sewer with Community Lift Station(s), Humber Catchment
- Figure 6B: Options 6 – Gravity & Low Pressure Sewer with Community Lift Station(s), Rutland Catchment

At this preliminary stage, the alignment for new mains is assumed to be parallel to the existing mains and offset by at least 1.0 m. This is schematic only for the purposes of preliminary design. Final alignments will be determined at detailed design stage.

It may prove infeasible to twin the sewers within 10 ft. wide easements and rights of way over private properties.

6. TRIPLE BOTTOM LINE OPTIONS ASSESSMENT METHODOLOGY – CONFIRMATION WITH THE DISTRICT AS TO THE GENERAL APPROACH

During the project coordination meeting held August 6th, 2015, MCSL presented a draft decision matrix for initial review and discussion. Generally speaking, the three major headings were agreed upon, as was the notion of a "points" rating and weighted points allocation system, in turn founded on a series of decision criteria under each of the three categories. Draft criteria lists were discussed, with initial indications as to appropriate re-ordering and some potential consolidation being discussed.

7. CONFIRM INITIAL REVIEW OF ELEMENTS AND COMPONENTS LIKELY TO BE FUNDED BY 'THE PROJECT'

Per discussions with the District's project manager, it has been tentatively decided that all new or improved sewer/storm main works, to be located within the municipal road rights of way or rights of way over private properties, would be paid for by the 'project', i.e.: would be publically funded. By contrast, it has been tentatively agreed that all works required within individual private properties, including service connections extending within easements in favour of one or more private parcels over another, would be funded by the benefitting land owners. Final decisions regarding funding of services from the main to property line have yet to be determined.

8. CLOSURE/ NEXT STEPS

We are actively engaged in gathering the material listed under Activity 2, per our proposal of April, 2015, this being development of the 6 system configuration options. This will culminate in preparation and submission of Tech memo 2.

In addition, we understand the District is planning a public engagement strategy, for which we may be asked to provide technical input, assist with the preparation of public information meeting story boards, etc.

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Attachments:
Appendix A – Video Inspection Reports, attached.
Appendix B – Preliminary Options Drawings
Appendix C – City of Victoria Stormwater Master Plan Excerpts