Appendix D – Additional Work Directed by the District

ADDITIONAL WORK DIRECTED BY THE DISTRICT

LINING [OR REHAB] OF EXISTING PIPE NETWORK – TIMING

Based on the CRD's core area LWMP, the District needs to separate the entirety of the system and work toward eliminating all CSOs as well as reduce stormwater flows into the CRD system.

In order to do this, the District needs a sanitary sewer pipe system that does not leak excessively. They also need all sewer and storm service connections to be separated upon conclusion of the project.

Lining, or other rehabilitation, of the existing combined pipe network will be needed to reduce groundwater infiltration. It has been agreed that rehabilitation of the existing pipe network is **not** part of this sewer separation project scope, as it is seen as an on-going maintenance activity, required regardless of the separation mandate.

Video surveys reviewed early in the project schedule revealed the existing system to be intact, but leaky. It is concluded that lining is needed, but that this could be deferred for some as yet indeterminate duration [from a structural integrity perspective – but not a hydraulic loading perspective].

More recently completed videos of remaining combined sewers, within the easements, suggests a higher degree of deterioration and some structural issues.

We recommend that in-stream flow monitoring be undertaken during wet weather, such that the infiltration component of I&I can be established, [i.e.: how much groundwater is leaking into the old pipes themselves, as opposed to surface water runoff entering the system]. This will help to inform the degree of urgency with which pipe lining will need to be tackled, toward achieving the CSO reduction target.

Confirming the feasibility of deferring lining/rehabilitation of the existing pipe network, but still proceeding with a new storm pipe network option [Options 2 and 4], implies an understanding of existing pipe network function. As a check, it would be reasonable to assume a target for peak infiltration and inflow rate of 0.17 l/s/ha for the newly repurposed sanitary sewer network. This is typically considered the upper bound of acceptable performance, for older sanitary pipe networks in reasonable condition.

Combined with the peak sanitary loading as modeled, typical I&I rates would result in peak flows to the two CRD pumping stations as shown in the following table:

Catchment	I&I flow at 0.17 l/s/ha [l/s]	I&I flow at 0.50 l/s/ha [l/s]	Peak sanitary flow [l/s]	Total Wet Weather flow [l/s]
Humber	7		25	32
Humber		20	25	45
Rutland	12		40	52
Rutland		35	40	75

Per above, even with average I&I rates of 0.5 l/s/ha, representative of an older, dedicated sanitary sewer network in very poor condition, the total flows to the two CRD pumping stations would be **considerably less than the stated pumping capacity of 90 l/s each**. This assumes the majority of inflow from directly connected surface runoff sources [both from public and private lands] will be redirected away from the now re-purposed sanitary sewer network.

A check was then made as to the extent to which surface water runoff and groundwater would need to be re-directed from a re-purposed existing pipe network, in order to just meet the capacity of the existing CRD pumping stations. We modeled an interim scenario, wherein only the runoff from roadways were to be redirected to a new storm system. If it is assumed, for purposes of an initial assessment, that rapid runoff/impervious roadway areas represent 10% of the overall Uplands surface area, and these areas alone were re-directed to a new shallow storm network, then the peak flow into the two CRD stations is expected to be reduced by roughly 25%.

Expressed another way, roughly 75% of rainfall runoff entering the existing system during the design storm event has been modeled to originate from within private properties [being 90% of the gross surface area, but more pervious]. Based on the partially calibrated models prepared to date, re-routing of runoff water from roadway areas alone will not come close to achieving the desired reduction in CSOs in either catchment, under options 2 and 4.

Not known at this time is the magnitude of the infiltration component of I&I, resulting from leaky pipes and manholes, vs the inflow component of I&I, being the rapid response flow increases directly resulting from rainfall events. Instream flow monitoring data is needed [at the influent point to the two CRD stations and at strategically selected points upstream within the pipe network].

With this flow monitoring data in hand, it would then be possible to better understand how much runoff from private properties is presently making its way into the pipe network as a rapid response to rainfall events, as compared to a slower and steadier base flow during wet weather. This will tend to vary by catchment and sub-catchment, depending on the average age of housing, number of directly connected roofs, etc.

Knowing this will allow the District to plan, more strategically, for a phased program of stormwater separation, resulting in lower flows to the now re-purposed sanitary network, under options 2 and 4.

Based on discussions with other local municipalities, a budget of roughly $3 million for lining of the existing Uplands area system appears appropriate. This is based on a rough budget of $250 per metre with some contingency for root cutting and flushing. This would not include the potential cost of prior excavating and repairing sections of failed or distorted or badly cracked pipe, discovered via video surveys. The work could be undertaken in phases, in conjunction with phased adjoining new pipe construction.

EASEMENTS OVER PRIVATE PROPERTIES – OPPORTUNITY TO ADD A PIPE WITHIN THESE

An evaluation was made as to the potential for installation of a second pipe within existing easements, via a number of alternative installation methods.

A. CONVENTIONAL TRENCH EXCAVATION METHOD

All existing easements which presently contain a combined sewer pipe were investigated in the field. The intent was a more exhaustive initial assessment of feasibility to construct a second pipe within these easements, and determination of the resulting reduction in the number of private pumps otherwise required.

Maps of the two catchments were prepared, with numbering of the easements and rights of way over private lands, assigned as R-1 though R10 and H1 through H7, inclusive, covering the Rutland and Humber catchments respectively.

A photo record and tabulation of initial field observations was provided, along with initial cost estimates and a construction feasibility screening matrix. The results of this investigation was provided to the District via separate memo, and discussed during a coordination meeting in early December 2015. In summary, the following was highlighted:

- Geotechnical detail is not yet available, and the presence of rock, within the easements is not yet known. It is not known what method was used to install the original pipes within these easements, where rock was encountered at the time and what blast rock surrounding these pipes might exist.

- Many of the easements are encumbered by large trees, major ornamental screening vegetation, private property improvements and overhead hydro wires. Many will have very tight working room as a result.
- Easements are typically only 10 feet wide. Additional encumbrance over abutting private properties would be required in order to render a conventional excavation installation method viable. Sketches were produced which demonstrate this reality.
- It was preliminarily concluded that it would be feasible to install a second pipe by conventional open cut trenching in some limited, site specific cases.
    - This is predicated on acquisition of additional right of way width in all cases, either as a permanent widening of the easement, as temporary construction room, or both.
    - It was noted that benefit would result, through reducing the number of pumps, as compared to deep sewer Options 1 or 2. However, importantly, the preliminary cost estimates for new pipe installation in the easements far exceeds the savings in resultant pump reduction.
- Drawing SK-4 outlines the issues expected were conventional excavation to be attempted within a 10 ft. wide existing easement.
- Following the receipt of all information, the District decided to eliminate the use of existing easements for a second pipe alignment.

Use of back 'lanes', [being road dedication in favour of the District], for purposes of twinning sewers, may be more feasible than the use of the existing easements. The advantage of lanes for alignment of new sewer infrastructure should be investigated in greater detail at the time of detailed design.

B. DIRECTIONAL DRILLING OR OTHER TRENCHLESS INSTALLATION METHOD

As a sub task, we considered the feasibility of directional drilling and pipe bursting, as possible opportunities for upgrading of existing combined sewer pipes within the easements. We discussed the options of trenchless installation with three contractors who specialize in this field. We conveyed drawings and photographs, so as to ensure the contractor[s] were aware of site conditions. Contractors we spoke with were Kamloops Auguring in Kamloops, BC, PW Trenchless in Surrey, BC and Direct Horizontal out of Alberta. The results of this investigation is as follows:

Pipe bursting would provide for additional capacity as well as structural integrity improvement and attendance to I&I issues. However, pipe bursting will not provide for a second pipe within the easements. Good line and grade control can be achieved with this technology.

Some have attempted to pipe burst and then pull two smaller diameter pipes thought the hole. Grade control is essentially not possible using this method. Not suitable for gravity sewers.

We gave consideration to stringing a small diameter HDPE sanitary sewer within a larger storm drain, to be installed via pipe bursting. However, the contractors noted that re-connection of services to existing dwellings along the route of such an installation would require frequent conventional excavation and cutting into both pipes. This might be an option worth exploring at time of detailed design.

Directional drilling would allow for a second pipe within the 10 foot easements, at least in theory. We have been advised by contractors knowledgeable in this field, however, that the likelihood of success is dependent upon a number of factors:

- Sub-surface geotechnical conditions is the single most important factor in determining viability of directional drilling.
- Small machines can be used for geotech investigations down to about 3 metres depth, without devastating property damage resulting.
- We are told that drilling in fractured rock or cobble will not be successful. Drilling in loose sands and gravels will also be problematic. These problems stem from:
  - The inability to maintain drilling mud [bentonite] pressure at the cutting-head, and loss of bentonite volume into the surrounding soils, sometimes reaching the ground surface.
  - Rule of thumb is pipe depth needs to exceed roughly 15 times pipe diameter, to avoid slurry from surfacing. [i.e.: 3 metres for a 200mm diameter sanitary.]
  - The resultant inability to remove and convey cuttings back to the launch pit
  - The inability of the bentonite slurry to support the open circular cross section until such time as the carrier pipe is drawn back through the hole.
- Drilling though bedrock is possible, but will be very expensive.
- Drilling through variable soils, intermittently good and bad, will be very expensive and has a high probability of overall installation failure.
- Directional drilling requires a large launch pit and a similarly sized receiving pit, at either end of the pipeline segment. We foresee issues with access to rear yards in particular, where the contractor would need to reach with the full length of fused HDPE pipe, to be drawn back though the reamed hole, and from which point they may need to commence drilling the next segment further upstream.
- Launching pits are typical in the range of 5 metres wide by10 metres long for pipes of the diameter expected for the Uplands project.
- Directional drilling contractors stressed that pipe bursting would be more feasible in this Uplands application. However, again, service re-connections along the line will then require frequent excavation by conventional means.

- Contractors noted that they need a run-out distance at either end of the drilled section, where the pipe will need to deviate from intended line and grade, back to the ground surface. For 8-inch butt fused HDPE pipe, this would be in the order of 10 to 15 metres length at either end, wherein conventional excavation and pipe laying would be needed to achieve intended grade.
- It will be necessary to understand the position [line and grade] of the existing pipe with a high degree of accuracy, given the narrow easements [3 metres total] and the need for some separation of the two pipes. One metre of clear separation is recommended.
- Boulders or inconsistent bedrock will almost certainly cause unacceptable deviations in line and/or grade of the installed pipe.
- Trenchless technology will be more suitable for smaller diameter service connections.

The principal at PW Trenchless, Surrey, BC, attended as an invited guest to a District Council meeting in mid-2016. As a result, Council has resolved not to attempt to install a second pipe within these easements. The chances of success, as measured by cost effective installation with little disruption of immediately affected residents and land owners, is very low.

Lining via insitu form or equal is a method of rehabilitating existing sewers, adding structural strength and modest improvement in hydraulic characteristics. We note that the District will also need to gain access to some rear yard easement areas, in order to proceed with any such rehabilitation program, particularly, where the existing pipes in easements deflect 90 degrees along the routes between adjoining streets.

DEEPER GRAVITY MAINS – AS NEEDED TO AVOID PRIVATE PUMPS ALTOGETHER [OPTION 7]

Many residents indicated an aversion or a reluctance to install pumps on their own properties.

We investigated the costs to install gravity sewers throughout the Uplands area, sufficiently deep so as to avoid private pumps while at the same time avoiding the need to align new sewers within existing easements over private properties. The resulting separate technical memo dated 05 January, 2016, is summarized as follows:

- A roughly 50% increase in the overall capital cost to the District, as compared to deeper gravity sewer Option 1, would result, in order to avoid new private pumps in their entirety, and stay clear of existing easements and rights of way over private properties.
  - The increased likelihood of bedrock at greater depths leads to greater financial risk.
  - Increasing pipe depths from 5 metres will require a benched or stepped excavation at very high cost per metre of trench.
- Costs incurred by land owners, in re-connecting via a gravity service to a very deep gravity main in the roadway, may be higher than for provision of a private pumped service. This is

particularly true along the low side of the road, where deep gravity sewers would result in deep gravity service connections across private properties.

Partial gravity & pumped private servicing

In response to the public engagement process, we also investigated providing for gravity service to the main floor of low side of road dwellings while the basement or lower floors of these same units would require a smaller, internally located pump. The idea was primarily to address sanitary servicing to dwellings indicated as requiring a pump under Options, 1, 5 and 6. The attached 11x17 sketch, SK3 overleaf, indicates the issues we have considered, associated with this idea.

Similarly, under Options 2 and 4, a gravity connection for roof drains, with pumped perimeter drains, may eventually prove to be a solution for specific dwelling sites.

This opportunity will be evaluated further at the detailed design stage.

As part of the detailed design phase, the District should consider preparation of a standardized set of data regarding connection options and provide this to each property owner. These may differ by property location. It may also provide options for partial gravity and pumped servicing within private properties, were a new storm network option to be pursued [gravity roof drains and pumped perimeter drains, for example].