PLANNING & PRELIMINARY ENGINEERING DESIGN REPORT FOR WHISTLE BEND FUTURE AREAS & TOWN SQUARE

FEBRUARY 2020

IN ASSOCIATION WITH:
ASSOCIATED ENGINEERING, TETRA TECH, & JOHN GLYNN-MORRIS

205-133 INDUSTRIAL RD
WHITEHORSE, YUKON Y1A 2V2
T +1 867 668 2525
WSP.COM

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1 INTRODUCTION

1.1 BACKGROUND

Planning for Whistle Bend began in 2006 with the Porter Creek Bench Charrette. This extensive charrette consisted of a four-day event and included professionals, key stakeholders, and members of the public. The charrette explored various options / concepts and helped shape future planning and design for Whistle Bend.

In 2008, the City of Whitehorse hired AECOM to develop a master plan for the entire neighbourhood. Among other things, the Whistle Bend Master Plan provided the blueprint for a multi-phase development, which when completed, would house approximately 10,000 people. AECOM's scope of work included preliminary design for Phases 1 and 2. City Council approved the subdivision plans for Phases 1 and 2 of Whistle Bend in August 2009. Later in November 2009, the City of Whitehorse submitted Phase 1 and 2 for review by the Yukon Environmental and Socio-Economic Assessment Board (YESAB) Whitehorse Designated Office.

Neighbourhood design for Phases 3-7 was undertaken by Golder and Morrison Hershfield in 2011 and resulted in a lot layout and infrastructure pre-design. Phases 3-7 were submitted for review by YESAB Whitehorse Designated Office in October 2013. Since then, the City of Whitehorse and Government of Yukon have made some revisions to the design and have re-evaluated some aspects of the Whistle Bend phasing. Phases 3, 4, and 5 are currently under construction, and the sale of lots for these phases continues. The City of Whitehorse and the Government of Yukon are presently working on zoning and subdivision approval for Phases 5 to 7. No further planning has occurred since the Master Plan process in 2008. As the planned portions of Whistle Bend are beginning to near completion, the City of Whitehorse and Government of Yukon have decided to move forward with the planning work of the Future Areas.

Whistle Bend has evolved since its original conception. During construction of Phase 1 and 2, revisions to the original master plan were made to ensure adequate lot and site drainage, reduce overall flood risk, and to meet regulatory requirements. Changes that were made to Phases 3-7 include revisions to the street layout and overall land uses. As a result, the population projections for the number of units and residents in each phase are no longer accurate.

The current total population of Whistle Bend is largely unknown. Whitehorse residents are assigned to a subdivision based on their addresses in various administrative files. However, the mailing address of some Whistle Bend residents is identified as a Whitehorse post office box and information on municipal address is not available in administrative files. As a result, Associated Engineering updated the population projections based on the revised number of units projected by the City of Whitehorse for Phases 1-7. The current updated population projected at the end of Phase 7 is 5,740 (Table 1-1).

Housing Type	Persons/ unit[1]	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Total
Single family / duplex	3.10	326	471	171	453	136	313	264	1,305
Suites (20%)	1.20	25	36	13	35	11	24	20	101
Townhouse	2.50	0	125	123	68	165	148	0	313
Multiple family	2.50	730	248	938	488	300	113	0	586
Total		1,081	880	1,244	1,043	612	597	284	5,740

Table 1-1: Projected population for Whistle Bend subdivision by phase.

1.2 PROJECT OVERVIEW

In 2018, the City of Whitehorse hired WSP to undertake planning and pre-design work for the remaining areas in the Whistle Bend neighbourhood, and to prepare a design concept for the town square in the heart of the neighbourhood. The Planning & Preliminary Engineering Design Report for Whistle Bend Future Areas and town square outlines a detailed vision for planning, design and engineering servicing of Future Areas A, B, and C, as well as the town square. It builds on the Whistle Bend Master Plan and incorporates extensive community input, and lessons learned from Phases 1 to 7.

More specifically, this project involved preparing a land use plan (housing mix and block design), undertaking the engineering pre-design, and developing a concept for a town square located on Keno Way (Future Area A). Development potential of the Future Areas was assessed based on existing land uses, policies, geotechnical conditions, existing services, access and transportation, topography, and other relevant information, however additional studies will ultimately be required. The assessment considered the overall development capacity of the existing infrastructure already in Whistle Bend. While the concepts developed considered existing planning policy and regulatory frameworks, the City of Whitehorse Official Community Plan (OCP) provided the high-level guidance for the formulation of the concept.

1.3 STUDY AREA

The study area, as shown in Figure 1-1, encompasses Future Areas A, B, and C (including the town square). While the total area for all three Future Areas is approximately 129.7 hectares, the total developable area is approximately 94.11 ha (total area minus existing parks, green / open space, and 30 m geotechnical setbacks). Future area A is located south of Keno Way, west of the Continuing Care facility. It is accessed via Taranhe Way as well as Casca Boulevard. The area encompasses 27.8 hectares of undeveloped land. Future area B is located north of Phase 3C and currently excludes the Ta'an Kwäch'än Council Settlement Parcel C-9B. Future Area C consists of an undeveloped 56.3 ha site located in the northwestern corner of Whistle Bend.

[1] Persons-per-unit values based on 2013 design report for Phases 3-7 (Golder Associates Ltd.) – results in an overall average of 2.61 persons per unit.

1.4 GEOTECHNICAL CONDITIONS

Soil information and terrain constraints information were summarized by Tetra Tech in a Desktop Geotechnical Memo for Future Areas A, B, and C and based on following information:

- Previous analysis of boreholes and Geotechnical Evaluation by EBA (August 2009)
- Geotechnical data for evaluation purposes comes from the Yukon Outdoor Sports Complex by Tetra Tech (12 testpits were excavated throughout the portion of Area A north of Casca Boulevard)
- The Whistle Bend Continuing Care site used a Cone Penetration Test (CPT) as part of a detailed geotechnical evaluation
- Other testholes that were completed in and around Area A during other phases of Whistle Bend development

A supplemental geotechnical evaluation utilizing drilling methodologies should be conducted once a conceptual design has been determined to verify the geotechnical design parameters of the proposed roadway design as well as buildings and septic fields.

1.4.1.1 *FUTURE AREA A*

A moderately steep slope (more than 10%) covers much of the area west of Casca Boulevard. The soils along this slope consist of glaciofluvial sand and gravels. Proceeding downslope towards the east side of Area A, the thickness of glaciofluvial soil cover decreases and the fine grained glaciolacustrine soils are typically encountered at depths less than 1.0 m.

The underlying glaciolacustrine soils can be problematic due to frost susceptibility. Tetra Tech routinely recommends 1.7 m of non-frost susceptible soil below concrete and asphalt surfaces to minimize potential for damage caused by seasonal frost heave. Therefore, significant quantities of granular borrow may be required. Foundation design and construction is also affected. In general, the underlying fine-grained soils become wet and soft with depth, therefore, perimeter insulation around foundations is very important.

The surficial glaciofluvial soils along the slope on the west side can be considered for structural fill if pregrading is performed. That and a small terrain feature along the west side of the old Horse and Rider facility are the only on-site sources of structural fill.

The two testholes completed in the area near the town square established that very little glaciofluvial or eolian sand exists over the underlying glaciolacustrine silt. Knowledge of the immediate area has also established that the fine-grained soils underlying this site become wet and soft below 6 m. There is likely to be various surfaces (asphalt, concrete, decorative paving stones, etc.) constructed for the venues constructed within the Town Square area so frost susceptibility of

the underlying soils becomes the biggest concern. As well, proper protection of structural elements with perimeter insulation around foundations must be addressed on a project by project basis.

1.4.1.2 *FUTURE AREA B*

No site-specific geotechnical data exists for this area. However, based on geotechnical evaluation work completed along Casca Boulevard and recently in Whistle Bend Phase 5 (site drilled on April 22, 2018), it can be assumed that conditions are consistent with those encountered throughout the majority of the Whistle Bend area.

The underlying glaciolacustrine soils could be problematic due to frost susceptibility and consistency. As mentioned above, Tetra Tech routinely recommends 1.7 m of non-frost susceptible soil below concrete and asphalt surfaces to minimize potential for damage caused by seasonal frost heave. Therefore, significant quantities of granular borrow may be required. Foundation design and construction could also be affected. In general, the underlying fine-grained soils become wet and soft with depth, therefore, perimeter insulation around foundations is very important.

Some surficial glaciofluvial sand soils were noted across the top of Phase 5 but to determine the potential for borrow as structural fill, additional geotechnical work should be performed in advance of final design.

There is a small depression in the topography in the western section of Future Development Area B. A 30-metre geotechnical setback should be observed relative to the top of the slope, and has been incorporated into the land use plan.

1.4.1.3 *FUTURE AREA C*

Future Area C is generally flat with little surface expression. The only micro terrain feature consists of an esker formation located just east of the decommissioned sludge pond area. Although the site is flat, it is located along the toe of a long slope that extends up to Porter Creek (this portion of Porter Creek is underlain by coarse glaciofluvial gravels with cobble and boulders). Surface run-off along this slope should end on Area C and may require ditching along the toe of slope to direct surface runoff away from the site.

The most important development constraint within this area is the previous land use as a sewage treatment site. Assurances that proper decommissioning protocols have been followed will be required. There is very little sand overlying the glaciolacustrine soils in this area so again, problems due to frost susceptibility and consistency will have to be overcome.

To reiterate, Tetra Tech routinely recommends 1.7 m of non-frost susceptible soil below concrete and asphalt surfaces to minimize potential for damage caused by seasonal frost heave. Non-frost susceptible structural fill is required under roadways and other paved surfaces. Foundation design and construction will also be affected. In general, the underlying fine-grained soils become wet and soft with depth, therefore, perimeter insulation around foundations is very important.

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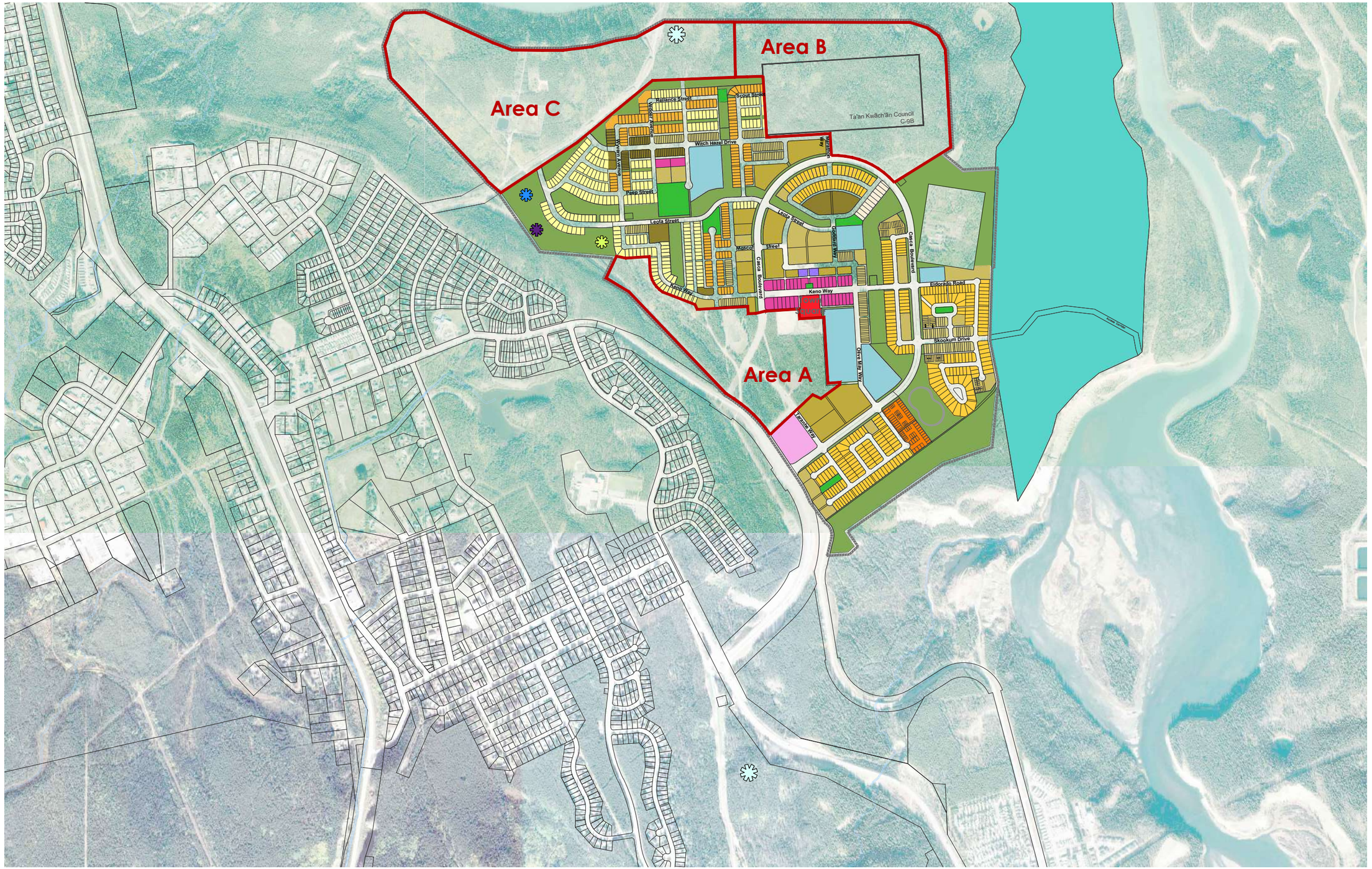

Whistle Bend Boundary
CNC - Comprehensive Neighbourhood Commercial
CNC2 - Comprehensive Neighbourhood Commercial
CR - Commercial Recreation
PE - Environmental Protection
PG - Greenbelt
PR - Parks and Recreation
PS - Public Service
PU - Public Utilities
RCM - Comprehensive Residential Multiple Family
RCM2 -Comprehensive Residential Multiple Family 2
RCM3 - Cottage Cluster Homes
RCS - Comprehensive Residential Single Family
RCS2 - Comprehensive Residential Single Family 2
RCS3 - Comprehensive Residential Single Family 3
RCT - Comprehensive ResidentialTownhouses
RR - Restricted Residential Detached
CPG - Commercial Parking Garage
Snow Storage
Stormwater Dry Pond
Dog Park
Substation

WHISTLE BEND

Figure 1-1 Study Area - Context

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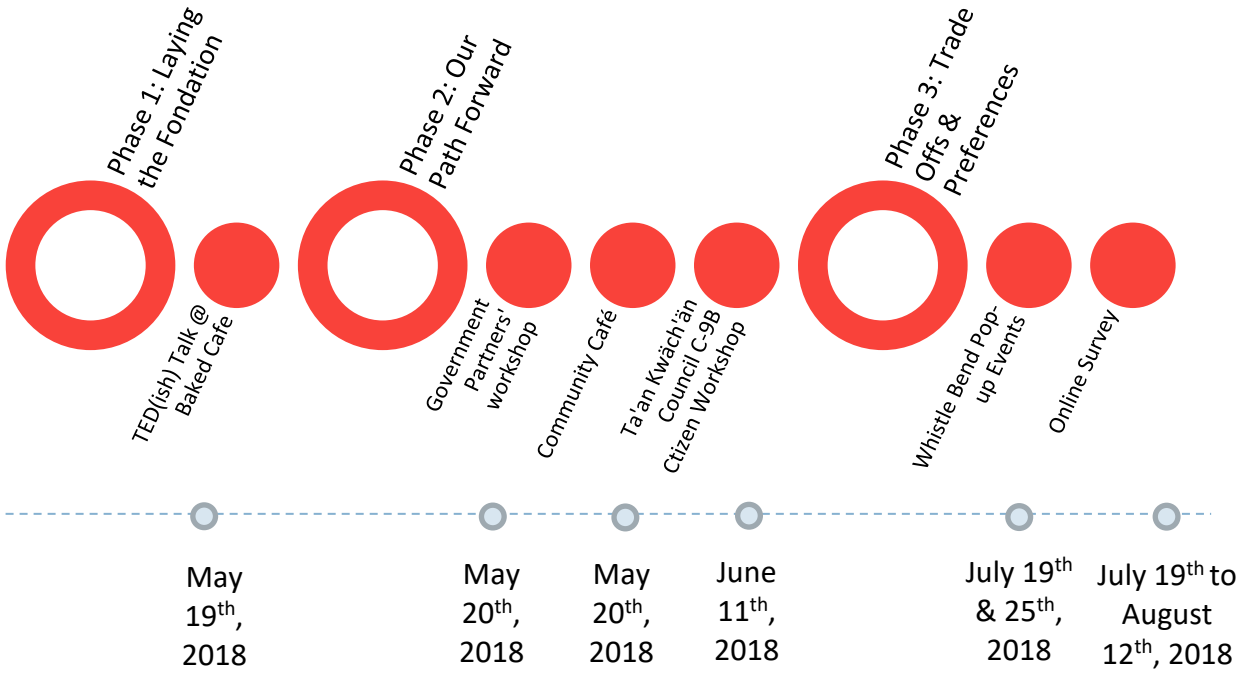
1.5 COMMUNITY ENGAGEMENT PROCESS

Planning includes undertaking technical, economic, social, and environmental studies, conducting collaborative, community and stakeholder engagement, establishing planning principles, and developing a detailed concept plan as the basis for the policies and design guidelines. The engagement process and timeline are summarized below:



Engagement Process

The public engagement process focused on creating opportunities for meaningful engagement and on building relationships with governments, organizations, stakeholders, and the public. The engagement goals included:

- Understanding citizens' values and expectations, and developing an understanding of opportunities and challenges;
- Building awareness, excitement, credibility, and trust in the conversation with the hopes of increasing overall community pride and participation; and
- Strengthening relationships with TKC through good processes in the spirit of reconciliation.

The following engagement opportunities where provided:

1. Ted(ish) Talk;
2. Community Café;
3. City of Whitehorse, Ta'an Kwäch'än Council, & Government of Yukon Workshop;
4. Ta'an Kwäch'än Council Workshop;
5. Whistle Bend Community Popup Events; and
6. One Online survey and several interviews.

Detailed engagement reports were created for each opportunity and are available on the City of Whitehorse and Ta'an Kwäch'än Council websites for reference.

Public engagement activities included a government partners' workshop, a workshop with Ta'an Kwäch'än Council and Administration, one-on-one meetings, an online survey, two community conversations with Whistle Bend residents, and two popup events in Whistle Bend. This following section provides a summary of the engagement process and key outcomes. More detailed engagement reports were created for each step and are available on the City of Whitehorse and Ta'an Kwäch'än Council websites for reference.

TKC has elected to defer planning and design work on C-9B and has chosen to postpone including C-9B as part of this submission to YESAB. TKC intends to engage in additional planning and design to investigate various development scenarios prior to moving forward. However, a joint decision was made to continue with planning and design for the Future Areas and submit the project to YESAB for review.

The City of Whitehorse and Government of Yukon collaborated closely with TKC staff to create a land use framework and servicing plan that would suite their vision for the area and for parcel C-9B. The proposed development concept and servicing plan was designed to ensure that the proposed land uses on non-settlement land do not significantly impact the use of adjacent Settlement Land, as per Section 25.1.2 of the TKC Self-Government Agreement. C-9B was considered during the entire planning and design to ensure infrastructure tie-ins as well as adequate servicing capacity in the future.

1.5.1 TED(ISH) TALK

The purpose of TED(ish) Talk was to create a shared understanding of the Whistle Bend "story", build excitement, and lay the foundation for the planning and design of the town square. Presentations were made by the members of the planning team about the Whistle Bend history and context, Ta'an Kwäch'än Council cultural perspectives, and a global tour of town squares to inspire and create a shared understanding of various town square experiences. The purpose was to inform, engage, build excitement for the project.

TED(ish) Talk at Baked Café

1.5.2 COMMUNITY CAFÉ

A 'Community Café' was held at the Mountain Golf Course in Whistle Bend the following day. The planning team selected the 'Community Café' model to understand citizen values, hopes, and aspirations to inform design considerations into the town square. This type of engagement creates equal space for all participants to share, listen, and learn with each other with the intention of seeking common ground. Participants were led through a series of questions and participants were mixed through multiple question rounds.

City of Whitehorse & Yukon government workshop

1.5.3 TA'AN KWÄCH'ÄN COUNCIL WORKSHOP

A focus group workshop with Ta'an Kwäch'än Council Citizens and Administration was held on June 11th, 2018. The purpose was to discuss Ta'an Kwäch'än Council Settlement Land Parcel C-9B and work with citizens to explore and develop options and opportunities. The outcome was to understand what the planning team should consider in and adjacent to C-9B to ensure future synchronism to the greatest sextent possible. Participants included:

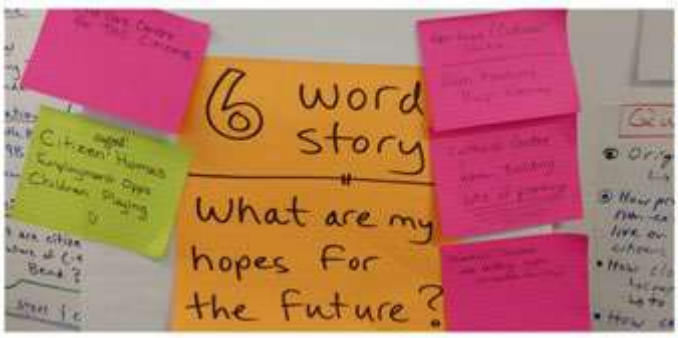
- Members of the Ta'an Kwäch'än Chief and Council

- Members of the Ta'an Kwäch'än Council's Administration and Land and Resource Department
- The Da Daghay Development Corporation's CEO
- Ta'an Kwäch'än Council citizens
- City of Whitehorse (Planning Department) and Yukon government (Community Services)

Ta'an Kwäch'än Council Citizens workshop

1.5.4 CITY OF WHITEHORSE, TA'AN KWÄCH'ÄN COUNCIL, & GOVERNMENT OF YUKON WORKSHOP

WSP facilitated a technical workshop with government partners with the objective of sharing project background information and elucidating expectations, roles, and responsibilities around key project issues and opportunities. The purpose of the workshop was to discuss the technical elements of Future Areas A, B, C, as well as the town square. The outcome provided coordinated, diverse, and



strategic guidance on what WSP should consider in developing concepts. Participants included representatives from the following organizations and departments:

- City of Whitehorse: Planning and Sustainability Services, Transit, Water and Waste Services, Engineering Services, Land and Building Services, and Parks and Community Development
- Ta'an Kwäch'än Council, Department of Lands, Resources, and Heritage
- Yukon government departments of Community Services, Highways and Public Works, Economic Development, and Tourism and Culture

1.5.5 WHISTLE BEND COMMUNITY POPUP EVENTS

The planning team worked with the City to develop a series of pop-up events in Whistle Bend. The pop-up was strategically located by the park near the pond. The purpose was to present the draft concepts to the community and gather further input. The planning team was able to validate draft ideas and revise concepts using feedback. An online survey was circulated, which allowed further input into the proposed concepts for Future Areas A, B, and C as well as the town square.

Whistle Bend community popup engagement

2 TOWN SQUARE CONCEPT

2.1 CREATING A 'SENSE OF PLACE'

The town square has been planned and designed to be the focal point of Whistle Bend and in the traditional sense, should help shape its character and community identity. As in Figure 3-1, the town square should be designed as a universally accessible four-season destination, a gathering place for families, children, young adults and older generations, a place for entertainment, festivals, markets, recreation and leisure, and a centre for commerce, civic and community services. It could become the 'heart' of Whistle Bend. The design team has taken care to consider the context of the town square, pedestrian circulation and connectivity to community services, points of interest and community parks and neighbourhoods. These connecting pathways have been designed to be 'Story Telling' journeys complete with themed 'Way Finding', themed landscaping treatment and opportunities for the display of public art.

Traditionally the town square was comprised of a public open space with a central focal element, complete with an 'active edge'. Building form and massing around the square is intended to maximize solar exposure into the central open space and to frame mountain views. The architecture reflects a built environment which support uses that promote social interaction and promote business, recreational, entertainment, and cultural opportunities, ultimately contributing to the 'Joie de Vivre' of the town square.

The square is designed based on Universal Accessibility principles. All areas, including the tiered seating areas, will be accessible by wheelchair. The town square offers a seamless connection with the Continuing Care Facility to the southeast and Future Area A to the south. The grading plan is designed to integrate with the overall grading plan of the surrounding areas. Should any adjustments to the grading be required, the design of the town square could accommodate these adjustments during the detail design phase. The interface between the finished grade of the town square and the Continuing Care facility is shown in drawings D1 and D2 in Appendix A.

Pedestrians are be able to access the south plaza without the need for stairs or ramps. The north plaza is also directly accessible without the need for stairs and ramps by way of the Northeast corner of the continuing care facility. Access is also provided between the North and South plazas by way of accessible ramps within the square.

2.2 LANDSCAPE ARCHITECTURE CONCEPT

The landscape architecture concept (Figure 2-1) addresses human comfort, provides a varied aesthetic and a presents a variety of flexible open spaces. Strategic plantings of deciduous and coniferous trees create windbreaks in the winter and provide shade relief from the sun in summer. Formal tree planting and shrub beds complement the built edge and define different pedestrian realms, activity zones, and circulation routes. Open grass areas allow for informal recreation and leisure activities. The more random 'Garden' like terraced ornamental planting area showcases

seasonal plant variation, texture and form. It is featured as an area for quiet reflection and contemplation.

The town square features hard and soft elements, and provides ample space for crowds along with mixed tree and shrub planting in defined areas throughout. Plantings and the construction of landscape elements are designed to be robust and low-maintenance. Given the northern climatic conditions, site furnishings, construction materials and techniques, paving and plants have been chosen to for their hardiness, resistance to the elements and with longevity and project life cycle costs in mind.

2.3 UPPER PLAZA

The upper plaza is bound to the north by Keno Way, the main street access route and primary point of entry to the 'town square'. The east and west sides are bordered by mixed use commercial / retail buildings complete with a covered pedestrian arcades, patios, planters and seating areas. The finished floor and covered pedestrian arcade elevation of these buildings are approximately 1.5 metres above street grade at Keno Way. The plaza slopes up at 3% in a southerly direction; as a result, over this distance the 1.5 metres of elevation difference is absorbed, and access to the building and arcade is flush with grade at the top of the terraces.

This elevated 'Active Edge' provides covered circulation and access to the commercial / retail frontage, provides patios and terraces for social interaction, relaxation and provides a raised vantage point to observe activities taking place in the square. Barrier free access is provided at the Keno Way and along the route, between the patios and terraces and through a series of combined planter / sitting spots and stair access points.

The central area of the upper plaza is a combination of a hard surface paved area surrounding a large seasonally dynamic sculpture / water feature, flanked by areas of open lawn, evergreen and shade producing trees. The hard surface area is flexible space programmed for craft fairs, farmers markets and other similar events; the open grass areas are available for picnics and other informal low impact recreational and leisure activities in summer and snow storage / snow sculpture and snow play for families in winter.

The south edge of the upper plaza is a 'Garden' edge comprised of a series of landscaped terraces and seat walls interspersed with expanded areas for group seating and which could contain gas supplied fire pits. The terraces are approximately 600 mm in height, picking up approximately 2.0 metres of grade change between the upper and lower square. The south facing terraces act as a sun catch, extending seasonal use, providing an increased level of human comfort and facilitating audience seating for events and activities that take place in the lower square. In keeping with the concept of universal access, there are stairs and ramps on either side of the terraces at each level.

Upper Plaza

2.4 LOWER PLAZA

The lower plaza is bordered to the south by an ‘Active Edge’ of buildings intended for community services and civic facilities. Its east side will be flanked by commercial / retail and food and beverage buildings, some of which could have blank exterior walls dedicated to graffiti art and tagging. The west side will be defined by a small footprint commercial / retail buildings containing equipment rentals, public restrooms and food and beverage services. In both locations, these structures will be combined with planting areas creating small entry plazas, which act as outdoor rooms for public gathering, and connect the town square to its surrounding context.

The centre and focal point of the lower square is the skating rink / entertainment stage and band shell, which is located at the base of the terraced seating walls. This element is planned to facilitate summer and shoulder season concerts and cultural festivals, plays, and other entertainment events, and functions as a skating rink in winter. Permanent skateboard and parkour elements are introduced around the perimeter of the rink. Four-season night-time use lighting is also planned for the stage and rink.

Lower Plaza

2.5 POCKET PARK NORTH OF KENO WAY

The pocket park to the north is comprised of a meandering path, berms, seating areas and mixed plantings. It is intended to function as a threshold for the larger square when approaching from the parking areas to the north. It can also be an attractive green space to be viewed from the neighbouring buildings on Keno Way, and a pleasant place to sit and enjoy the weather or eat lunch. The meandering path is designed to reference the Yukon River and its evolving path over time. The wooden cultural feature at Keno Way is also intended to be vertical and act as a gateway and focal point. Local artists or craftspeople could potentially be involved in the detailed design and fabrication. The feature on the north side of the parkette should be constructed of cut and scorched logs. Its design is inspired by the look of old docks that have been reclaimed by the river, referencing the deeper history of the place. Acting as both an entry feature and art piece, the feature would also provide casual sitting and leaning opportunities for people to stop and chat.

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WHISTLE BEND

Figure 2-1 Landscape Design Concept

2.5.1 PUBLIC SAFETY

Public safety, health, and welfare have been carefully considered. The off-site connection and the Keno Way crossing to the pocket park and public parking area to the north are clearly defined by a change in material and special paving pattern. Traffic calming measures including a raised crosswalk and a narrowing of the laneway give priority to pedestrians and encourage a reduced vehicle speed. Clear sight lines, town square entry features in the design (wayfinding element designed by local artists) and a variation in street tree species and spacing improve visibility and identify this part of the street as pedestrian friendly. Emergency access to the upper square and building frontage is achieved along a 6.0-metre-wide paved area which runs the length of the plaza adjacent the raised pedestrian arcades on both sides. Service corridor laneways provide emergency access to the lower square and service access to the commercial retail developments to the north.

To ensure the town square meets Crime Prevention Through Environmental Design (CPTED) standards and safety codes, we have considered a landscape design which ensures clear sight lines, eliminates places for people to hide and provides routes of escape and egress should residents need to leave the area quickly. The light concept supports this approach and should clearly identify major entries, paths of circulation, areas of congregation, and emergency services. The garden areas should be lit in a much more creative way to enhance the nighttime experience and celebrate unique planting. Specific lighting equipment and locations will be specified in the detailed design stage. Public washrooms and power outlets will also be provided.

Off-site connection and the Keno Way crossing

2.6 FINANCING, MANAGEMENT, & STEWARDSHIP

2.6.1 FINANCING

Financing, management, and stewardship of the town square involve numerous levels of complexity beyond the scope of this study. While financing for the town square will likely involve significant capital, potential sources of funding for the construction have not yet been identified. It should be noted that the underlying financial feasibility of the town square was a key principle underpinning the conceptual design.

2.6.2 MANAGEMENT & STEWARDSHIP

Success of the town square requires implementing an effective management plan, stewardship model, and programming plan. For the town square to become active and remain clean, accessible, and inviting, varying degrees of upkeep and management should occur. This could be anything from fixing furniture to organizing special events and clearing the skating rink. While there is a significant variation in tasks and the frequency at which they occur, each call for either financial or in-kind support and coordination. While a Management Plan is essential to achieving the final vision and to establishing solid operating performance over the long term, a stewardship model could help foster capacity building with community partners and allow the City and the Government of Yukon to leverage support and external funding.

3 FUTURE AREAS CONCEPT

3.1 GUIDING PRINCIPLES

The 2009 Whistle Bend Master Plan was the product of extensive public engagement. At the heart of planning and design is a desire to create vibrant, people focused cities through careful planning and shaping of neighbourhoods, streets, buildings, and public amenities. The aim of guiding principles is to harness community aspirations and provide the necessary tools to co-create a highly livable city. Building guiding principles for the planning and design of Whistle Bend was the first step in an extremely comprehensive and extensive public engagement process. These principles were used to provide guidance in the creation of a livable, sustainable, and vibrant Whistle Bend. The following guiding principles were derived from the 2006 Whistle Bend Charette and adapted to meet the planning and design work of the Future Areas:

1. Provide a mix of civic, commercial and residential uses and densities within the neighbourhood
2. Develop at a density that promotes walking while preserving surrounding natural space and design pedestrian-friendly streetscapes and trail linkages
3. Design Future Areas to minimize their footprint and maximize surrounding green amenity space
4. Create a well-connected street grid to promote route choices and traffic dispersal
5. Offer strong visual and open space connections to the Yukon River

3.2 LAND USES: FUTURE AREAS A, B, & C

As shown in Figure 1-1, Future Areas A, B, and C cover approximately 129.7 ha of undeveloped land. The proposed concepts for Areas A, B, and C provide a range of land uses and housing mix. At complete build-out, the population for area A, B, and C could reach approximately 4,371 people. This estimate could change depending on the type of housing form and mix of land uses developed, and the final population count could vary depending on market supply and demand as well as overall population growth. The forecasted timeframe to reach complete build-out is approximately 15 years, encompassing eight new development phases.

The concept plan prioritizes a mix of land uses to provide residents with the opportunity to live, work, play, and learn within Whistle Bend. It includes a diversity of residential housing opportunities including single-detached and duplex housing, as well as multi-family housing and mixed-use residential housing. The plan respects and follows a land use and housing mix similar to the previous phases of Whistle Bend. A breakdown of the proposed land uses for each area is provided in Table 3-1 below.

The plan prioritizes trails and greenspaces protecting sensitive areas, environmental reserves, and wildlife corridors and by incorporating a substantial amount of parks and open space. This contributes to the overall walkability as well as the provision of recreational opportunities for Whistle Bend and beyond. Together, parks, greenbelts, and open spaces contribute an additional 39.7 hectares (30.6% of the total area) of natural areas. The proposed system of trails and corridors contribute to a net increase of approximately 6,084 metres of new recreational trails.

Overall, the concept plan supports a range of residential forms including low and medium density housing with a variety of housing types including single-detached housing, duplex, townhomes, and apartments in mixed-used buildings. In total, residential land use accounts for 32.2% of the total area and contributes an additional 41.7 hectares of residential housing opportunities. The principal residential land use consists of low-density residential housing which accounts for 19.7% of the total area and contributes an additional 25.6 hectares of single-detached or duplex housing. Medium density residential is the second most predominant residential use. Medium density housing includes a mix of townhomes and apartments provided in key strategic locations. With an additional 6.6 hectares of land allocated to townhomes and 4.8 hectares of apartments, medium density housing contributes a total of 11.4 hectares land within or in proximity to the core and corridors, or as a transition between higher density sites and adjacent low residential areas. Finally, a 4.8-hectare parcel designated as residential mixed-use is planned in Area A and contributes ground-floor commercial and residential opportunities (3.7% of the total area).

Areas designated as mixed-use commercial and civic mixed-use are intended to complement the town square to create a vibrant community hub. The mixed-use commercial and civic mixed-use designations provide pedestrian-friendly environments and promote social connectedness and inclusivity for people of all ages and abilities. A 0.9-hectare mixed-used commercial designation allows for the provision of general commercial uses such as retail, service and office spaces. Residential mixed use is primarily residential with opportunities for commercial on the main floor, while commercial mixed use is primarily commercial, with opportunity for residential above. These mixes are explained further in section 2.4 through precedent images and text. A similarly sized parcel designated as civic mixed-use integrates seamlessly with the town square to create a strong community hub. It is intended to accommodate the provision of a range of public uses included but not limited to a library, a community centre, and arts hub.

Table 3-1: Land use calculations and % of total area.

	Future Area A, B, & C	
Land Uses	**Area (ha)**	**% of Total Area**
Park Space	2.7	2.1
Greenbelt / Open Space	37.0	28.5
Low Density Residential	25.6	19.7
Medium Density Residential (Townhomes)	6.6	5.1
Medium Density Residential (Apartments)	4.8	3.7
Residential Mixed Use	4.8	3.7
Commercial Mixed Use	0.9	0.7
Civic Mixed Use	0.9	0.7
Public Service	5.0	3.9
Public Utility	6.6	5.0
Roads	15.0	11.6
Ta'an Kwäch'än Council C-9B	20.0	15.4
Totals	129.7	100.0

N.T.S.

AREA A

AREA B

AREA C

PHASE 1

PHASE 2

PHASE 3A

PHASE 3B

PHASE 3C

PHASE 3D/E

PHASE 4

PHASE 6

PHASE 7

Ta'an Kwäch'än Council C-9B

Holland Parcel

Town Square

Future Area Boundary

Whistle Bend Boundary

Please Note: All roadway connections to the Ta'an Kwäch'än Council C-9B parcel are conceptual and will be confirmed at the time of land use planning for this Parcel.

WHISTLE BEND

Figure 3-1 Overall Plan

MODIFIED DATE: 2020.02.20
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3.3 FUTURE AREA A

As shown on Figure 3-2, Future Area A prioritizes a diversity of land uses and the creation of a compact, complete, and connected mix of housing forms. At 27.8 hectares, Future Area A is the smallest area of the three Future Areas. Because of its proximity to the core, Area A prioritizes medium density housing with apartments and townhomes housing units and mixed-use residential buildings over low-density residential housing (Table 3-3). With an average density of 30-50 units per hectare, the area could accommodate approximately 1,017 people (Table 2-4).

In total, approximately one third of the area is designated as medium density housing. The area south of the town square is intended to complement the Continuing Care Facility and existing commercial uses situated along Keno Way. A civic parcel and a similarly sized commercial mixed-use area (0.9-hectare respectively) is planned immediately south of the town square. These two large areas are intended to activate the town square and promote synergies between activities in the square and the buildings adjacent. Moving east and south from the town square, an additional 4.8 hectares of land is designed as mixed-use residential and intended to provide a suite of housing units focused on residential uses with some opportunities for ground-floor commercial.

Parcels further away from the town square and Keno Way have a gradually increased residential focus, while prioritizing medium density residential. A 1.4-hectare area situated north of the school site supports townhome housing units. Finally, a large 2.1-hectare area is intended to provide apartment units. The area affords access to public transit on Casca Boulevard and direct access to Whistle Bend Way.

A secondary school site is located along Casca Boulevard and provides convenient vehicle access and offers strong walking and cycling connectivity to the north and east. The proposed school site was selected during the previous Master Planning exercise. The site is centrally located within walking distance of the town square and surrounding residential neighbourhoods. A fire hall is located on a double-fronting lot, to provide clear emergency access to both the Whistle Bend neighbourhood to the north and the remainder of Whitehorse via Whistle Bend Way.

Area A creates an authentic sense of place centred around a town square and a 1.2-hectare park space and 7 hectares of greenbelt and open space. This focus on natural space is intended to support a sustainable lifestyle and to protect a large environmentally sensitive area. Approximately 12% of the area is dedicated to neighbourhood collector and arterial streets, lanes, and trails.

Table 3-2: Summary of land use within Future Area A and % of Area

Land Uses	Area (ha)	% of Area
Park Space	1.2	4.3
Greenbelt / Open Space	7.0	25.2
Low Density Residential	0.0	0.0
Medium Density Residential (Townhomes)	1.4	5.0
Medium Density Residential (Apartments)	2.1	7.6
Residential Mixed Use	4.8	17.3
Commercial Mixed Use	0.9	3.2
Civic Mixed Use	0.9	3.2
Public Service	5.0	18.0
Public Utility	1.2	4.3
Roads	3.3	11.9
Totals	**27.8**	**100.0**

Table 3-3: Population estimates for Future Area A

Land Use	Population Estimate
Low Density (Single detached 320 m^2/unit)	0
Medium Density (Townhouse 30 units/ha)	106
Medium Density (Apartments 50 units/ha)	861
Commercial Mixed Use	50
Total	**1,017**

N.T.S.

Keno Way

Idlarod Avenue

Evelyn Avenue

Gleaner Avenue

Casca Boulevard

Olive May Way

Keno Way

Keno Way

Olive May Way

±6.05ha.

30m Development Setback

±0.19ha.

±0.9ha.

±0.29ha.

±0.91ha.

±0.94ha.

±0.92ha.

School Site
±5.0ha.

±1.31ha.

±1.53ha.

±1.04ha.

±1.26ha.

±2.09ha.

Fire Hall
±1.21ha.

Whistle Bend Way

Tarahne Way

Area Boundary
Medium Density (Townhomes/Apartments)
Medium Density (Apartments)
Residential Mixed Use

Commercial Mixed Use
Civic Mixed Use
Public Service
Public Utility

Greenbelt/ Open Space
Park Space
Lift Station
Local Paved Pedestrian Trail

Perimeter Paved Trail

WHISTLE BEND

Figure 3-2 Area A - Land Use Plan

MODIFIED DATE: 2019.12.09
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3.4 FUTURE AREA A – BUILT FORM & CHARACTER

Commercial Mixed Use:

- Small office or commercial uses on ground floor; residential above.
- Oriented toward street & greenway
- Two storeys to maximize solar gain
- 25 residential units/ha

Residential Mixed Use:

- Focused on residential uses with some opportunities for ground-floor commercial
- Oriented toward streets & greenway
- Up to four storeys
- 30-50 residential units/ha

Medium Density Residential (Townhouses / Apartments):

- Residential uses only
- Two storeys to complement surrounding development
- Townhouses: 30-40 units/ha
- Apartments: 50-75 units/ha

Medium Density Residential (Apartments):

- Residential uses only
- Oriented toward streets & greenway
- Up to four storeys
- 50-75 units/ha

Civic / Mixed Use:

- Range of public uses (e.g. library or community centre)
- Oriented toward the town square (2-3 storeys)

3.5 FUTURE AREA B

The 45.6-hectare area is planned to integrate fully into the existing neighbourhood fabric to the south (Phase 3C / Phase 3B). Future Area B encompasses TKC Settlement Land Parcel C-9B. The 20-hectare parcel of Settlement Land was excluded from this phase of planning and design. Even though TKC participated as a partner and provided valuable input and feedback during the entire planning process, it elected to engage in additional internal planning prior to moving forward with design. However, C-9B which accounts for 43.8% of the area, was considered during the entire planning and design process to ensure that future servicing and roadway connections can be accommodated and development potential for the parcel can be fully realized.

As shown in Figure 3-3, Future Area B has been planned as a low-density residential area that is fully integrated with the existing street network to the south and to the west. 6.5 hectares of low-density single-detached and duplex residential housing account for approximately 14.2% of the area (Table 3-4). An additional 1.2-hectare area is designated as medium density apartment housing and accounts for 2.6% of Area B. Approximately 4.5% of the area is designated as streets and lanes. At full build out, the area could accommodate a population of approximately 945 people (Table 3-5).

With 35% of Area B designated as green space, Area B contributes an additional 16 hectares of greenbelt and park space (15.5 hectares and 0.5 hectares respectively) to the overall greenspace network. The northern portion of Area B was previously designated as greenbelt and open space in the Whistle Bend Master Plan in order to preserve and protect key natural features and environmentally sensitive areas. This large reserve of greenbelt and open space provides easy access to recreation opportunities and provides for the protection and preservation of environmentally sensitive areas, wildlife habitat, and other significant natural features.

Table 3-4: Summary of land use within Future Area B

Land Uses	Area (ha)	% of Area
Park Space	0.5	1.1
Greenbelt / Open Space	15.5	33.9
Low Density Residential	6.5	14.2
Medium Density Residential (Townhomes)	0.0	0.0
Medium Density Residential (Apartments)	1.2	2.6
Residential Mixed Use	0.0	0.0
Commercial Mixed Use	0.0	0.0
Civic Mixed Use	0.0	0.0
Public Service	0.0	0.0
Public Utility	0.0	0.0
Roads	2.0	4.5
Ta'an Kwäch'än Council C-9B	20.0	43.8
Totals	**45.7**	**100.0**

Table 3-5: Population estimates for Future Area B

Land Use	Population Estimate
Low Density (Single detached 320 m^2/unit)	747
Medium Density (Townhouse 30 units/ha)	53
Medium Density (Apartments 50 units/ha)	145
Total	**945**

N.T.S.

30m Development Setback

Greenbelt/Open Space

Ta'an Kwäch'än Council
C-9B

10m Development Setback

±1.2ha.

Park Space
±0.50ha.

Reliance Street

Reliance Street

Chance Lane

Greenstreet North

Gypsy Queen Lane

Chance Lane

Greenstreet North

Gypsy Queen Lane

Witch Hazel Drive

Vedder Avenue

Rampart Street

Lane

Lane

Sadie Lane

Greenstreet East

Luella Lane

Lane

Lane

Tyrell Crescent

Eugene Avenue

Marathon Way

Sybil Circle

Fulton Lane

Greenstreet West

Breadwinner Lane

- Area Boundary
- Ta'an Kwäch'än Council C-9B
- Low Density (Single Detached/Duplex)
- Medium Density (Apartments)
- Park Space
- Greenbelt/Open Space
- Public Service
- Perimeter Paved Pedestrian Trail
- Local Paved Pedestrian Trail
- Lift Station

Please Note: All roadway connections to the Ta'an Kwäch'än Council C-9B parcel are conceptual and will be confirmed at the time of land use planning for this Parcel.

WHISTLE BEND

Figure 3-3 Area B - Land Use Plan

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3.6 FUTURE AREA C

Future Area C is the largest of the three areas with a total of 56.3 hectares. This area has been planned around a street network that connects seamlessly to existing development to the east and respects the topography as well as steep slope running along the western portion of the area.

Part of Area C overlaps with the area initially identified as the “Fin” in the original Whistle Bend Concept Greenspace Map. The Whistle Bend Concept Greenspace Map was created as part of the Porter Creek Bench Charrette, which was held over five days in November 2006. It was intended that the new residential footprint would be minimized through increased residential density, which would in turn help to maximize the area of surrounding greenspace.

The proposed concept plan for Future Area C continues to prioritize greenspace. As shown in Figure 3-4, the area retains a large corridor of open space along the northern edge of the area. This environmentally sensitive area provides protection to key wildlife habitats and the opportunity for this significant natural environment to be appreciated and enjoyed through the provision of a pedestrian trail. In total, 15.5 hectares of greenbelt and open space was retained, which accounts for 27.5% of the area. A prominent 1-hectare park space at the north end of the main north-south entrance road provides a spectacular vista to terminate the road and overlooks the Yukon River. The park is located along the northern portion to allow for uninterrupted views of the Yukon River and mountains beyond.

As shown in Figure 3-4, Area C is located further away from public transit on Casca Boulevard, Whistle Bend Way, and is served primarily by a local road network. In consideration of its location, access to transit, and to minimize the amount of traffic generated by Areas C flowing through Phases 4, 6, and 7, Area C is designed as a predominantly low-density residential area with easy walking distance to parks and open space. In total, 19.1 hectares of single-detached and duplex residential housing accounts for approximately 33.9% of the area (Table 3-6).

Medium density residential focusing on a mix of townhomes and apartment housing types (5.2 hectares and 1.5 hectares respectively) is distributed throughout the area at strategic locations. Combined, medium density residential accounts for 11.9% of the area (Table 3-6). The rest of the area is dedicated to accommodating local traffic. Approximately 9.7 hectares (17.2% of the area) is oriented towards predominantly local roads, with a network of collector roads and four lanes to provide vehicle access (Table 3-6). At full build out, the area could accommodate a population of approximately 2,409 people (Table 3-7).

Table 3-6: Summary of land use within Future Area C

Land Uses	Area (ha)	% of Area
Park Space	1.0	1.8
Greenbelt / Open Space	14.5	25.8
Low Density Residential	19.1	33.9
Medium Density Residential (Townhomes)	5.2	9.2
Medium Density Residential (Apartments)	1.5	2.7
Residential Mixed Use	0.0	0.0
Commercial Mixed Use	0.0	0.0
Civic Mixed Use	0.0	0.0
Public Service	0.0	0.0
Public Utility	5.4	9.5
Roads	9.7	17.2
Totals	**56.3**	**100.0**

Table 3-7: Population estimates for Future Area C

Land Use	Population Estimate
Low Density (Single detached 320 m^2/unit)	1,832
Medium Density (Townhouse 30 units/ha)	387
Medium Density (Apartments 50 units/ha)	190
Total	**2,409**

N.T.S.

30m Development Setback

30m Development Setback

30m Development Setback

±0.61ha.

±0.71ha.

Park Space
±1.0ha.

±0.45ha.

±1.53ha.

Greenbelt/Open Space

Reliance Street

Reliance Street

Lane

Chance Lane

Chance Lane

Vedder Avenue

Rampart Street

Greenstreet North

Greenstreet North

Ellwood Street

Wyvern Avenue

Gypsy Queen Lane

Gypsy Queen Lane

Witch Hazel Drive

Fulton Lane

Lane

Greenstreet West

Breadwinner Lane

Wyvern Avenue

LITTLE SNUG AVENUE

QUICK STREET

7m LANE

PEEP STREET

Eugene Avenue

6m Cl

Area Boundary

Low Density (Single Detached/Duplex)

Medium Density (Townhomes/Apartments)

Medium Density (Apartments)

Park Space

Greenbelt/Open Space

Public Utility

Perimeter Paved Pedestrian Trail

Local Paved Pedestrian Trail

Lift Station

Snow Storage

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WHISTLE BEND

Figure 3-4 Area C - Land Use Plan

3.7 RESIDENTIAL ROAD NETWORK

The proposed street network for Future Areas A, B, and C includes one main arterial, four primary collector streets, and local streets with blocks with and without lanes. Figure 3-5 illustrates the overall circulation network for the Future Areas. Each street type is designed to support multiple modes of transportation. All street typologies should shadow the existing Whistle Bend topologies and continue to accommodate pedestrians with sidewalks and include landscaped boulevards.

Road access to Future Areas A and B is achieved via Casca Boulevard. Road access to Future Area C is achieved via two new collector roads connected to a local roadway and a new connection to Area B on the west side of the development via a local road. Roads and streets design intent and standards, servicing, grading and traffic control plans should remain consistent with Phases 1 – 7.

The potential for creating a new connection between Future Area C and the Alaska Highway north of MacDonald Road area in Porter Creek was discussed at the government partners workshop. A connection would strengthen connectivity between Whistle Bend and areas to the north and provide for Whistle Bend's future role as a commercial hub. A potential connection to the Alaska Highway may be feasible but would require extensive planning and technical analysis outside the scope of this study. The route connecting to the Alaska Highway would encounter steep slopes, several wet areas, and other significant terrain constraints. Future investigations starting with a transportation impact assessment should be conducted to evaluate the feasibility of connecting Area C with the Alaska Highway.

The transportation analysis completed for this study area consisted of a qualitative review and did not include traffic modelling. Further analysis is required to better understand the potential impacts of Area C on the overall transportation network.

- Area Boundary
- 30.0m Arterial Road
- 22.0m Collector Road
- 18.0m Local Road
- 14.0m Local Road
- 10.0m Private Road
- 10.0m Service Road
- 6.5m -7.0m Lane
- Perimeter Paved Trail
- Trail Paved Local Trail

wsp

Whitehorse

WHISTLE BEND

Figure 3-5 Transportation

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3.8 PHASING

Figures 3-6 illustrates the proposed phasing for the Future Areas in the context of the existing phases within Whistle Bend. Based on servicing considerations and the housing forms allowed within Area C, it is the most logical area for continuation of development. This is followed by Area A and Area B respectively. The sequence of phases is also based on an overall cut/fill balance to minimize the double handling and importation of material required to achieve lot grading. It is recommended the phasing within each Area be reconfirmed at the detail design stage, to ensure a smooth construction transition from each phase, and to reduce the number of potential conflicts between different phases when constructing the water, sanitary, storm and electrical servicing.

Area C is divided into three phases (Phases 8, 9 and 10) based on the conceptual sanitary system design. The Phase 8 storm and sanitary systems will flow into Phases 7 and 5 of the existing systems. No lift station will be required during this phase. Phases 9 and 10 require Lift Station C and its corresponding forcemain to be constructed prior to the completion of these phases. As a majority of the sanitary forcemain options need to pass through at least two phases, the phasing order between 9 and 10 will depend on the forcemain that is selected for construction.

Area A is divided into two phases (Phases 11 and 12) based on the conceptual sanitary system design. Phase 12 relies on the construction of Lift Station A to be completed. It is therefore recommended that Phase 11 be constructed first.

Area B is divided into three phases (Phases 13, 14, and 15) based on the conceptual sanitary and storm system design. Phase 13 does not require the forcemain and lift station to be developed beforehand, as the sanitary will flow into Casca Boulevard to the existing East Lift Station, and the storm will drain into the bioswale at the south end. Phase 14 will require completion of the forcemain and lift station. Phase 15 will rely on development of Ta'an Kwäch'än Council parcel C-9B since routing for servicing is limited to flow towards the east. From an overall planning and servicing perspective, it is recommended that development within Area B be withheld until land use planning for Ta'an Kwäch'än Council parcel C-9B is completed. Once the land uses and transportation network for the entire Area B are determined, a logical and cost-feasible development phasing should be completed.

N.T.S.

AREA C

Phase 9

Phase 8

Phase 10

Phase 8

Phase 15

AREA B

Phase 14

Ta'an Kwäch'än Council C-9B

Phase 13

Phase 6

Phase 7

Phase 3C

Phase 4

Mascot Street

Phase 3D/E

Phase 3B

Town Square

Phase 2

Phase 3A

Phase 11

AREA A

Phase 12

PHASE 1

Whistle Bend Boundary

Future Area Boundary

Proposed Lift Station

WHISTLE BEND

Figure 3-6 Overall Phasing

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N.T.S.

Phase 7

Phase 4

Mascot

Street

Phase 3D/E

Phase 3B

Town Square

Phase 2

Phase 3A

Phase 11

Phase 12

PHASE 1

Future Area Boundary

Proposed Lift Station

WHISTLE BEND

Figure 3-7 Area A Phasing

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N.T.S.

EASEMENT
UTILITY
82127 CLSR

Phase 15

Phase 14

Ta'an Kwäch'än Council
C-9B

Phase 13

Phase 6

Phase 3C

Phase 7

Future Area Boundary

Proposed Lift Station

WHISTLE BEND

Figure 3-8 Area B Phasing

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N.T.S.

82127 CLSR

Phase 8

Phase 9

Phase 8

Phase 10

Phase 6

Phase 7

Phase 4

Mascot

Future Area Boundary

Proposed Lift Station

WHISTLE BEND

Figure 3-9 Area C Phasing

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3.9 SNOW STORAGE AREAS

The City of Whitehorse Transportation Department routinely clears and removes snow from public roads within the city. This snow is taken to several snow storage locations spread out throughout different neighbourhoods. These sites are normally flat with good soils for drainage and exfiltration and are large enough to create berms to control run-off during snow melt to protect creeks and other watercourses. It is beneficial to locate snow storage near neighbourhoods as it reduces haul distances and keeps labour costs down.

While one snow storage area has been planned in Future Area B, a second area has been planned at the intersection of Mountainview Drive and Whistle Bend Way.

3.9.1 SNOW STORAGE AREA: FUTURE AREA B

As shown on Figure 1-1, this site would be located north of Future Area B and could be accessed directly from the existing Forcemain road. The area proposed for snow storage would be approximately 1 ha in size and would be near an existing depression that could collect, and hold melt water to control drainage and direct it away from developed areas, City infrastructure, and the Yukon River. Development of the site would include clearing and grading of the site, as well as development of berms where necessary to control runoff. Snow collection from Phases 4-7, as well as Future Areas B and C could be accommodated at this site.

3.9.2 SNOW STORAGE AREA: OFF-SITE SNOW STORAGE AREA

This off-site snow storage area would be located along an existing City waterline, south of the intersection of Mountainview Drive and Whistle Bend Way. The proposed area for snow storage would be approximately 3.5 ha in size and is located in a flat area near an existing ATCO substation. Access to the site would need to be developed as a new entry/exit to the existing traffic circle on Mountainview Drive. A public parking area could also be developed in conjunction with the snow storage area for members of the public wishing to utilize trails in McIntyre Creek Park.

The site has appropriate soils for exfiltration of melt water and is large enough to be able to control run-off on site through grading and berm construction. Development of the site would include clearing and grading of the site, including berm construction, and creation of a new access point into the existing traffic circle. Snow collection from Phases 1-3, as well as eastern portions of Porter Creek, such as Tamarack Crescent, could be accommodated at this site.

Additional geotechnical work is required to evaluate the current snow storage locations and should be completed as part of the pre-design work.

4 SERVICING REQUIREMENTS

The following sections provides a detailed description of the conceptual servicing plan for the municipal infrastructure required for Future Areas A, B and C. The sections include water, wastewater infrastructure, fire protection, drainage, power, and telecommunications. Each section describes the design criteria, the analysis and modelling process, major and minor systems, components required for the systems and recommendations for future design. The following information is based on the conceptual design presented in Section 2 and 3 of this report and should not be considered a detailed design. Future Area B conceptual design does not include the development of TKC Settlement Land Parcel C-9B but includes the area in the infrastructure sizing calculations.

4.1 WATER

The proposed on-site water servicing for Future Areas A, B and C is shown in Figure 4-1. Water supply for Future Areas A, B and C will originate from main lines off Range Road and Whistle Bend Way (off-site) through the existing phases of Whistle Bend (on-site). Based on the locations of the Future Areas surrounding the existing and designed phases, Areas B and C will require recirculation and heating pumphouses due to their separation from the primary water supply along Casca Boulevard. Future Area A is set within the existing phases of Whistle Bend and should not require an additional recirculation and heating pumphouse, as the current phases designs included the possibility of Future Area A being developed. Due to the proximity varying terrain elevation along the Yukon River, Future Area C will likely require a pressure release valve based on the difference between its minimum and maximum elevations throughout the area which is approximately 14 meters.

4.1.1 ON-SITE WATER DISTRIBUTION

The following sections discuss the design criteria used in the water system analysis, in addition to the water infrastructure required for the Future Areas A, B and C based on their locations and supply through the existing phases of Whistle Bend. Conceptual level water modelling was completed to analyze the water distribution system. Additional water modeling is recommended during the preliminary design stage to confirm assumptions in this report and to incorporate final lot types and associated population densities.

4.1.1.1 *WATER DEMAND*

The projected population for existing Phases 1-7, has been calculated to be approximately 5,740 people, while the predicted population for Future Areas A, B and C are expected to reach a total of 4,371 people. Based on these numbers, the total design population for Whistle Bend used in the following analysis is 10,111 people, as detailed in the table below:

Table 4-1 Population by Phase

Phase	Population
Phases 1 -7	5,740
Future Area A	1,017
Future Area B	945
Future Area C	2,409
Subtotal of Future Areas	4,371
Total	10,111

Based on previous assessments of the existing phases of Whistle Bend, it is known that water consumption has been far less than the standard City of Whitehorse design criteria amount of 500 L/person/day. Similar to previous phases of Whistle Bend planning, this conceptual design continues to use the 375 L/person/day for the analysis and modelling. Based on a total population of 10,111 people, the average consumption of 49.3 L/s is applied.

4.1.1.2 *DESIGN CRITERIA*

Based on the City of Whitehorse Servicing Standards Manual, the following design criteria has been used for this analysis:

Average Daily Demand (ADD)	375 L/person/day 43.9 L/s
Maximum Daily Demand (MDD)	2 x ADD
Peak Hourly Demand (PHD)	3 x ADD
Night Fill Demand (NFD)	0.1 x ADD
Minimum Allowable Velocity	0.15 m/s at ADD (or determined through Thermal Analysis)
Maximum Allowable Velocity	3.00 m/s at MDD plus Fire Flow
Minimum Pressures	280 kPa [40 psi] at PHD (ground level) 140 kPa [20 psi] at MDD plus Fire Flow (ground level)
Maximum Pressures	550 kPa [80 psi] 700 kPa [100 psi] (max with PRV's on affected services)
Minimum Fire Flow	100 L/s (Residential) 125 L/s (Multi-family row housing) 250 L/s (Commercial and Institutional)
Maximum Fire Flow	300 L/s (based on Fire Fighting Capacities)

Minimum Pipe Diameter for Mains	150 mm
Minimum Depth of Bury (looped systems and un-insulated mains)	3.0 m (obvert to finished grade)
Services	2.4 m minimum (obvert to finished grade at property line) 3.5 m maximum (obvert to finished grade at property line)
Ground Heat Transfer	3.1 W/m C (dry sand and silt)
Design Ground Temperature	3 Celsius (for lower bench area)
Pipe Heat Transfer	50 W/m C (ductile iron)

4.1.1.3 *WATER SYSTEM ANALYSIS*

To comprehend the demand that will be implemented on the water system, the table below demonstrates the number of lots and number of people per Future Area per the density targets associated with each land use zone. The values shown in this table were found by using a consistent number of units per hectare (for medium density) or square meters per unit (for low density). These numbers are shown to be on the middle to high end of the predicted range of total units. In future design, it is recommended, while zoning is being refined, that populations, number of units and number of lots are re-calculated to retain a more precise quantity.

Table 4-2 Population and Land Use Future Areas A, B and C

Area A, B, & C				Future Areas					
				Area A		Area B		Area C	
Land Use	#Lots	Pop.	P/Lot	#Lots	Pop.	#Lots	Pop.	#Lots	Pop.
Low Density (Single detached 320 m²/unit)	832	2,579	3.1	0	0	241	747	591	1,832
Medium Density (Townhouse 30 unit/ha)	218	546	2.5	42	106	21	53	155	387
Medium Density (Apartments 50 units/ha)	8 (478 units)	1,196	149.5	6 (344 units)	861	1 (58 units)	145	1 (76 units)	190
Park Space	2	0	0	0	0	1	0	1	0
Public Service	1	0	0	1	0	0	0	0	0
Civic Mixed Use	1	0	0	1	0	0	0	0	0
Public Utility	5	0	0	1	0	0	0	4	0
Commercial Mixed Use	1 (20 units)	50	50	1 (20 units)	50	0	0	0	0
Total	**1,068 (1,548 units)**	**4,371**		**52 (406 units)**	**1,017**	**264 (320 units)**	**945**	**752 (822 units)**	**2,409**

Note: This table assumes a maximum population for density (units per hectare). It is also assumed that the low density (single detached) and medium density (townhouse) are one unit per lot.

Table 4-2 uses an average population of 3.1 people / unit for low density and 2.5 people / unit for medium density. Based on the above, Future Area C has the highest a population of 2,409 people and a total of 752 lots (822 housing units).

Area A has fewer lots than Area C, at 52 lots (406 housing units), and a slightly lower population at 1,017 people. Future Area B has the lowest projected population with 945 people and a total of 264 lots (420 units).

Using the population data from Table 4-2 the average daily demand (ADD), maximum daily demand (MDD), peak hourly demand (PHD) and night fill demand (NFD) for water can be calculated. These

values are shown in below. The conceptual water system designs are shown in Figures A-4, B-5 and C-5 in Appendix A: Civil Drawings.

Table 4-3 Water Flow Areas A, B and C

	Area A	Area B	Area C
lpcd	375	375	375
Population	1,017	945	2,409
ADD (m3/day)	381.38	354.38	900.38
ADD (L/s)	4.41	4.10	10.46
MDD (L/s)	8.83	8.20	20.91
PHD (L/s)	13.24	12.30	31.37
NFD (L/s)	0.44	0.41	1.05

ADD means Average Daily Demand. MDD means Maximum Daily Demand. PHD means Peak Hourly Demand. NFD means Night Fill Demand.

4.1.1.4 *WATER SYSTEM RECOMMENDATIONS*

Based on the conceptual water system that was completed, the recommended on-site water system improvements include:

- Installation of a new 350, 300, 250, 200 and 150 mm looped watermain system in the proposed expansion areas, with forced circulation provided from the new circulation pumphouse provided in Future Areas C and B.
- Construction of watermain system to be completed as staged developments as each Future Area incorporates multiple phases.
- Installation of recirculation and heating pumphouse in Future Area C.
- Installation of fire hydrants at regular spaced intervals to provide 75 m radius coverage for all single-family residential lots and 45 m radius coverage for all commercial, institutional and multi-family lots. These hydrants should be installed in-line with the watermain with bends to the hydrant locations. Insulated service stubs should be provided to each lot.
- Minimum residential service to be insulated recirculating services with 25 mm supply / 20 mm return.
- Minimum commercial services to be insulated recirculating services with 50 mm supply / 20 mm return.
- All watermain construction should be as per the City of Whitehorse Servicing Standards Manual, latest edition.

4.1.1.5 *WATER RECIRCULATION PUMPHOUSE*

Future Area C requires a recirculation and heating pumphouse based on its location and distance from the existing phases of Whistle Bend. This pumphouse would be located in the north park space in Future Area C, a location at which the pumphouse would be able to connect to the main loop of Area C. Further analysis during detailed design will determine if a recirculation and heating pumphouse will be required in Area B. It is assumed that the Area B will not require a recirculation and heating pumphouse during Phases 1 and 2.

4.1.1.6 *OFF-SITE WATER SYSTEM*

The Whistle Bend Neighbourhood Phases 3-7 Planning, Design & Preliminary Engineering Servicing Report, produced by Morrison Hershfield (August 2013), considered the Off-Site Servicing Report, produced by AECOM and Quest Engineering in 2008, to assess what extensions or changes should be made to the current system before Future Phases can be further developed. Based on the Off-Site Servicing Report the calculated PHD and ADD for a population of 10,000 people were 130.21 L/s and 43.40 L/s, respectively. Comparatively, the projected total population for Whistle Bend is now to be 10,111 people, and the total PHD and ADD was calculated to be 131.65 L/s and 43.88 L/s, respectively. The newly calculated PHD and ADD are 1% more than those calculated in 2008 when the Off-Site Servicing Report was conducted. With the Range Road Water Main and the extension of the Porter Creek supply main installed, the available fire flows are 290 L/s which is higher than the calculated PHD of 131.65 L/s. The Future Areas A, B and C has been calculated to have adequate water supply for the planned housing based on a preliminary review of the existing supply main infrastructure. It is recommended that an additional review be undertaken during the next level of design to confirm these findings and pressure area reservoir sizing.

4.2 FIRE PROTECTION

According to the City of Whitehorse Servicing Standards Manual, the maximum allowable spacing between fire hydrants for each zoning area is listed in Table 4-4 below. Because of a high number of multiple-family residential units in proximity, these areas require hydrants to be closer together as compared to single-family residential areas. Hydrants in single-family residential areas have a coverage radius of 75 m while hydrants in commercial, institutional and multi-family areas have a coverage radius of 45 m.

Table 4-4 Maximum Allowable Hydrant Spacing

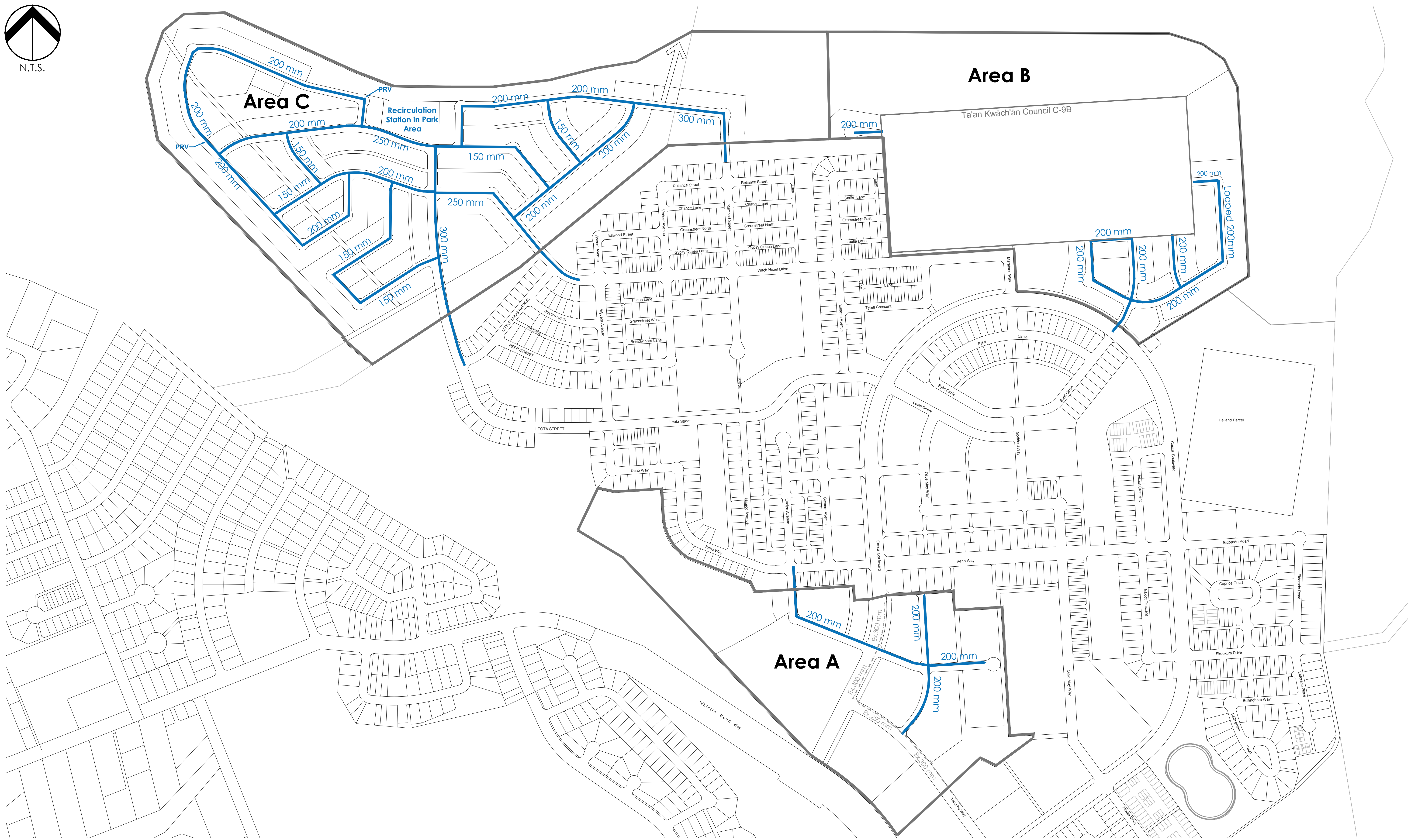
Zone	Hydrant Spacing (m)
Single-Family Residential	150
Multiple-Family Residential School Hospitals Industrial-Commercial Public Areas	90

A minimum fire flow of 100L/sec is required by the City of Whitehorse Servicing Standards Manual in residential areas. The minimum fire flow varies depending on the hydrant location, whether it is around a single-family residential area, a multiple-family residential area or a school. These minimum fire flows are depicted in Table 4-5 below.

Table 4-5 Minimum Fire Flow

Zone	Minimum Fire Flow (L/sec)
Single-Family Residential	100
Multiple-Family Residential	125
School Hospitals Industrial-Commercial Public Areas	250

Where single-family residential and multiple-family residential or other zones mix, the lowest hydrant spacing will be taken and the highest fire flow will be required as the minimum.



Area Boundary
Proposed Water Pipe
Existing Water Pipe

Please Note: Servicing is conceptual and detailed engineering drawings should be used for construction purposed.

WHISTLE BEND

Figure 4-1 Water Servicing

wsp

Whitehorse

MODIFIED DATE: 2020.02.20
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4.3 WASTEWATER INFRASTRUCTURE

The sanitary sewer system for Future Areas A, B and C consists of on-site and off-site components. On-site wastewater servicing is shown in Figure 4-2. Components that are considered on-site are within the development limits of each area. Off-site components were not part of the scope for this conceptual design; therefore, they were not calculated for future required capacity.

4.3.1 ON-SITE SANITARY SEWER SERVICING

All sanitary piping follows the designed roadway alignments. As each Future Area will discharge to separate existing sanitary mains or forcemains, the sanitary mains should not exceed more than 300mm in diameter. Each Future Area will require a lift station that will service their designated area. The average domestic flow rate is designed to be 90% of the average daily demand for water. In this case, the average daily demand taken for water was 375 L/person/day, resulting in an average domestic flow of 337 L/person/day. With a design population of 10,111 people, the average flow will result in 39.5 L/s for the subdivision as a whole.

4.3.1.1 *DESIGN CRITERIA*

Based on the City of Whitehorse Servicing Standards Manual, the following design criteria has been used for this analysis:

Average Domestic Flow (ADF) 90% of Water Consumption	337 L/person/day 39.5 L/s
Peaking Factor	3.5
Infiltration	6,000 L/ha/day
Minimum Velocity	0.70 m/s
Maximum Velocity	3.0 m/s
Minimum Sanitary Sewer Slope (200mm dia)	0.4 %
Manning's Pipe Roughness Coefficient	0.013
Maximum Manhole Spacing	110 m
Minimum Depth of Bury (un-insulated mains)	2.8 m (obvert to finished grade)

Note: When considering commercial areas as an example, this includes industrial and institutional areas.

4.3.1.2 *SANITARY FLOWS*

The conceptual design of the sanitary sewer system is based on the proposed land use and population density, displayed in Table 4-2. Using the data referred to in this table, the sanitary flows were then calculated per phase based on number of lots and population density of each area. The sanitary flows for each Future Area are displayed in Table 4-6 below. The designed sanitary system is required to manage peak flows and infiltration, this is also known as Peak Wet Weather Flow (PWWF). The PWWF for each Future Area is calculated in Table 4-6 below.

Table 4-6 Sanitary Flow Areas A, B and C

	Area A	Area B	Area C
lpcd	337	337	337
Population	1,017	945	2,409
ADWF (m3/day)	342.73	318.47	811.83
ADWF (L/s)	3.97	3.69	9.40
Peaking Factor	3.50	3.50	3.50
PDWF (L/s)	13.88	12.90	32.89
Area (ha)	16.33	9.57	25.60
Inflow and Infiltration	1.13	0.66	1.78
PWWF (L/s)	15.02	13.57	34.66

Each Future Area requires a lift station due to terrain features and to avoid excessive sanitary main depth. While it may be possible to direct sanitary flows from the Future Areas into the existing sanitary system, for the simplicity of calculations and as a safeguard against under-sizing the lift stations, for the purpose of this report it has been assumed that all sanitary flows in each area are collected in that area's lift station.

A future sanitary stub has been provided in anticipation of a lift station in Future Area A. It is located within the school parcel on the corner of Casca Boulevard and road A-100. The lift station for Area A services all sanitary sections east of Casca Boulevard and the proposed school site. Due to this being a conceptual design, all sanitary flows assumed from Area A should be required to flow to the lift station to discharge to the existing system. This assumption was made in the event of any design changes to the road alignments or grading that affects the sanitary system grades. The conceptual sanitary system design is shown in Figure A-3 in Appendix A: Civil Drawings. The breakdown of the PWWF affecting Area A lift station is shown in Table 4-7 below.

Table 4-7 Sanitary Flow Area A Lift Station Catchment

	Area A
lpcd	337
Population	1,017
ADWF (m3/day)	342.73
ADWF (L/s)	3.97
Peaking Factor	3.50
PDWF (L/s)	13.88
Area (ha)	16.33
Inflow & Infiltration	1.13
PWWF (L/s)	15.02

A lift station is proposed for Future Area B in the greenbelt in the north-east quadrant, just outside the TKC Settlement Land Parcel C-9B parcel. This lift station is required for the sanitary system in a portion of Area B and may be required for all future development on TKC Settlement Land Parcel C-9B. A section of Area B is able to be serviced by a connection to the existing sanitary main on Casca Boulevard and a section of Area B (approx. population of 84 people) is reliant on Phase 5 for sanitary discharge. The conceptual sanitary system design is shown in Figure B-3 in Appendix A: Civil Drawings. The sanitary flow for the Area B lift station catchment is shown in Table 4-8 below.

Table 4-8 Sanitary Flow Area B Lift Station Catchment

	Area B
lpcd	337
Population	394
ADWF (m^3/day)	132.78
ADWF (L/s)	1.54
Peaking Factor	3.50
PDWF (L/s)	5.38
Area (ha)	4.08
Inflow & Infiltration	0.28
PWWF (L/s)	5.66

A lift station is proposed in the north-west greenbelt located in Area C, surrounded by roads C-313 and C-305. The south and east sections of Area C flow to the existing phases and tie-in at the intersection of Wyvern Avenue and Witch Hazel Drive. For simplicity, the lift station in Area C is assumed to service all sanitary sections in Area C, with the exception of the eastern section that flows through Phase 5. The conceptual sanitary system design is shown in Figure C-3 in Appendix A: Civil Drawings. The breakdown of the PWWF affecting Area C lift station is shown in Table 4-9 below.

Table 4-9 Sanitary Flow Area C Lift Station Catchment

	Area C
lpcd	337
Population	2,286
ADWF (m3/day)	770.38
ADWF (L/s)	8.92
Peaking Factor	3.50
PDWF (L/s)	31.21
Area (ha)	24.14
Inflow & Infiltration	1.68
PWWF (L/s)	32.88

4.3.1.3 PIPE SIZING

Sewer main sizes for Phases 3 and 4 were designed to accommodate Future Area A. The connection to the existing main for Area A is planned to be at the existing manhole on road A-100 / Keno Way, the existing manhole to the north on Casca Boulevard and the existing manhole to the south on Taranhe Way.

Sewer main sizes along Casca Boulevard were designed to accommodate Future Area B. The connection to the existing main for Area B is planned to be at the existing manhole on Casca Boulevard / road B-201.

Sewer mains in Phases 6 and 7 did not account for the population numbers proposed in Future Area C during the initial design, however conceptual calculations have confirmed the sizing is adequate to handle additional flows from Area C. The connection to the existing main for Area C will be at the existing manhole on Wyvern Avenue / Witch Hazel Drive. A spreadsheet model was used to size the sanitary pipes for each future area to calculate a conceptual cost, shown in Table 6-1 (Section 0). The conceptual sanitary system designs are shown in Figures A-3, B-3 and C-3 in Appendix A: Civil Drawings. Manning's equation, shown below, was used to calculate the peak flows based on population per area to find the required diameter of pipe.

Manning's equation: $$Q = VA = \left(\frac{1.00}{n}\right) AR^{\frac{2}{3}}\sqrt{S} \quad [SI]$$

Note: Where Q is the flow rate (m^3/s), V is the velocity (m/s), A is the flow area (m^2), n is the Manning's roughness coefficient, R is the hydraulic radius (m) and S is the channel slope (m/m).

4.3.1.4 LIFT STATION CAPACITY

Lift stations are required at low elevation points in Future Areas A, B and C. The following table (Table 4-10) uses information from Table 4-4 to calculate the total peak flow and total population that will be serviced by the Lift Stations in Future Areas A, B and C.

Table 4-10 Summary of Sanitary Flows for Future Areas A, B and C

Description	Units	Area A	Area B	Area C
Peak Flow	L/s	15.02	13.57	32.89
Population	People	1,017	945	2,409
Discharge/Lift Station	-	A	B	C
Total Peak Flow	L/s	15.02	5.66	32.88
Total Population	People	1,017	394	2,286

The total peak sanitary flow from Area A travelling to Lift Station A is 15.02 L/s while servicing 1,017 people. The total peak sanitary flow from Area B travelling to Lift Station B is 5.66 L/s while servicing a total of 394 people. The total peak sanitary flow from Area C travelling to Lift Station C is 32.88 L/s while servicing 2,286 people.

4.3.1.5 *LIFT STATION A*

A lift station is proposed for Area A. It is located near the center of this phase, on the corner of Taranhe Way and Casca Boulevard within the institutional parcel. The sanitary forcemain for this lift station will have an alignment located along Casca Boulevard discharging to the existing manhole to the north, shown in Figure A-4 in Appendix A: Civil Drawings. The length of this forcemain will be 98 m, costing approximately $34,300.00. This lift station will be relatively smaller than those that will be installed in Area C comparatively with the size of area and population to be serviced. Lift Station A will cost approximately a total of $784,300.00, including the cost of the sanitary forcemain. This cost estimate is shown in the Table 6-1 (Section 6) of this report.

4.3.1.6 *LIFT STATION B*

A lift station is proposed for Area B. It is located at the north-east quadrant in the greenbelt, just outside the TKC Settlement Land Parcel C-9B. The sanitary forcemain for this lift station will align back along road B-206 to the sanitary manhole at the intersection of road B-206/Scout Road, shown in Figure B-4 in Appendix A: Civil Drawings. The worst-case cost will be used to complete the cost estimate in Table 6-1 (Section 6) of this report.

The first option for the lift station will service only Area B. The length of this forcemain will be 460m, costing approximately $160,000.00. This lift station will be of similar size to the Area A lift station. Option 1 for Lift Station B will cost approximately a total of $500,000.00, including the cost of the sanitary forcemain. An additional station would be required to service TKC Settlement Land Parcel C-9B. The pros and cons associated with Option 1 are shown in Table 4-11 below.

Table 4-11 Option 1 Pros and Cons

Pros	Cons
Short forcemain run.	2nd lift station required if TKC chooses to develop
Smaller lift station.	Lift station will only service 394 people.

The second option is to install a lift station with adequate capacity to service Area B and TKC Settlement Land Parcel C-9B in the future. In this option, the lift station and forcemain is oversized for servicing the first few phases of Area B. We assumed the forcemain length would remain the same as option 1. Based on a gravity main at a depth of 3.0m from the small section of Area B to the west running through TKC Settlement Land Parcel C-9B at a grade of 0.5%, the gravity main would reach a depth of 9m at the lift station. As the depth of the lift station is significantly deeper than option 1, option 2 would result in a costlier solution initially. Option 2 for Lift Station B would cost approximately a total of $3,500,000.00, including the cost of the forcemain. The pros and cons associated with Option 2 are shown in Table 4-12 below.

Table 4-12 Option 2 Pros and Cons

Pros	Cons
Not required to build a second lift station.	Forcemain is oversized during the time that TKC Settlement Land Parcel C-9B is not developed.
Easy to upgrade parts for the lift station when TKC Settlement Land Parcel C-9B is developed.	Large initial cost.

Table 4-13 below summarizes the forcemain costs for each option for Future Areas B. The lift station option used in the design and cost estimate in Table 6-1 consist of Option 2, due to its high cost and assuming a worst-case scenario for the estimate. The total cost for Lift Station B will be $3,500,000.00, including the cost of the forcemain.

Table 4-13 Summary of Forcemain Option Costs

Options	Area B
Option 1	$500,000.00
Option 2	$3,500,000.00

4.3.1.7 *LIFT STATION C*

A lift station is being proposed for Area C. The lift station is located north-west of the greenbelt, surrounded by roads C-313 and C-305. When determining this location for the lift station, there were multiple options considered for the location of the alignment for the forcemain. The following tables (Table 4-14 to Table 4-18) describe the pros and cons of each alignment option, shown in Figure C-4 (Appendix A: Civil Drawings), and their corresponding estimated cost. The worst-case cost will be used to complete the cost estimate in Table 6-1 (Section 6) of this report.

The first option for the sanitary forcemain alignment will leave east of the Lift Station C and run along the greenbelt, then travel south through the park space and tie-in to the gravity sanitary line on road C-302 / road C-301 within area C. The total length of this forcemain would be 560 m, costing at approximately $196,000.00. The pros and cons associated with Option 1 are shown in Table 4-14 below.

Table 4-14 Option 1 Pros and Cons

Pros	Cons
Shorter run.	Higher congestion with other underground infrastructure
Simple connection.	Connection would add additional flows to existing West Lift station in Phase 4
	Communication between 2 lift stations.
	15m elevation gain from Lift Station C to manhole at road C-307 / road C-300

The second option for the sanitary forcemain alignment follows the same alignment as Option 1 but continues along road C-300 alignment and eventually ties-in to the existing forcemain from the East and West Lift Stations. The total length of this forcemain would be 1,100 m, costing at approximately $385,000.00. The pros and cons associated with Option 2 are shown in Table 4-15 below.

Table 4-15 Option 2 Pros and Cons

Pros	Cons
Connects to existing forcemain, so no communication is required with existing lift stations.	Higher congestion with other underground infrastructure along the line.
Follows the road alignment.	Long run.
	Larger pumps required to overcome head in existing forcemain.

The third option for the sanitary forcemain alignment would leave the south side of Lift Station C and run along the green space, then enter the PUL, continue to run south-west along the PUL, and finally tie-in to the Porter Creek Flush Tank Outfall. The total length of this forcemain would be 770 m, costing approximately $269,500.00. The pros and cons associated with Option 3 are shown in Table 4-16 below.

Table 4-16 Option 3 Pros and Cons

Pros	Cons
Minimizes congestion with other proposed underground infrastructure	Long run.
Uses the PUL.	Costly tie in to existing forcemain.
Connects to Porter Creek Flush Tank Outfall.	Requires excavation along the existing slope (15-20% slope).

The fourth option for forcemain alignment would follow the same alignment as Option 3 but would continue past the Porter Creek Flush Tank Outfall, where Option 3 would connect, and finally tie-in to the existing forcemain from the East and West Lift Stations. The total length of this forcemain would be 1,020 m, costing approximately $357,000.00. The pros and cons associated with Option 4 are shown in Table 4-17 below.

Table 4-4 Option 4 Pros and Cons

Pros	Cons
Connects to existing forcemain.	Long run.
Uses the PUL.	Larger pumps required to overcome head in existing forcemain.
	Costly tie in to existing forcemain.
	Requires excavation along the existing slope (15-20% slope).

The fifth option for forcemain alignment would follow the same alignment as Option 1 but instead of heading south through the park space, the alignment would continue east, and finally tie-in to the Porter Creek Flush Tank Outfall. The total length of this forcemain would be 860 m, costing at approximately $301,000.00. The pros and cons associated with Option 5 are shown in Table 4-18 below.

Table 4-18 Option 5 Pros and Cons

Pros	Cons
Connects to Porter Creek Flush Tank Outfall.	Existing terrain could pose challenges.
Short run.	Disturbance of natural area.

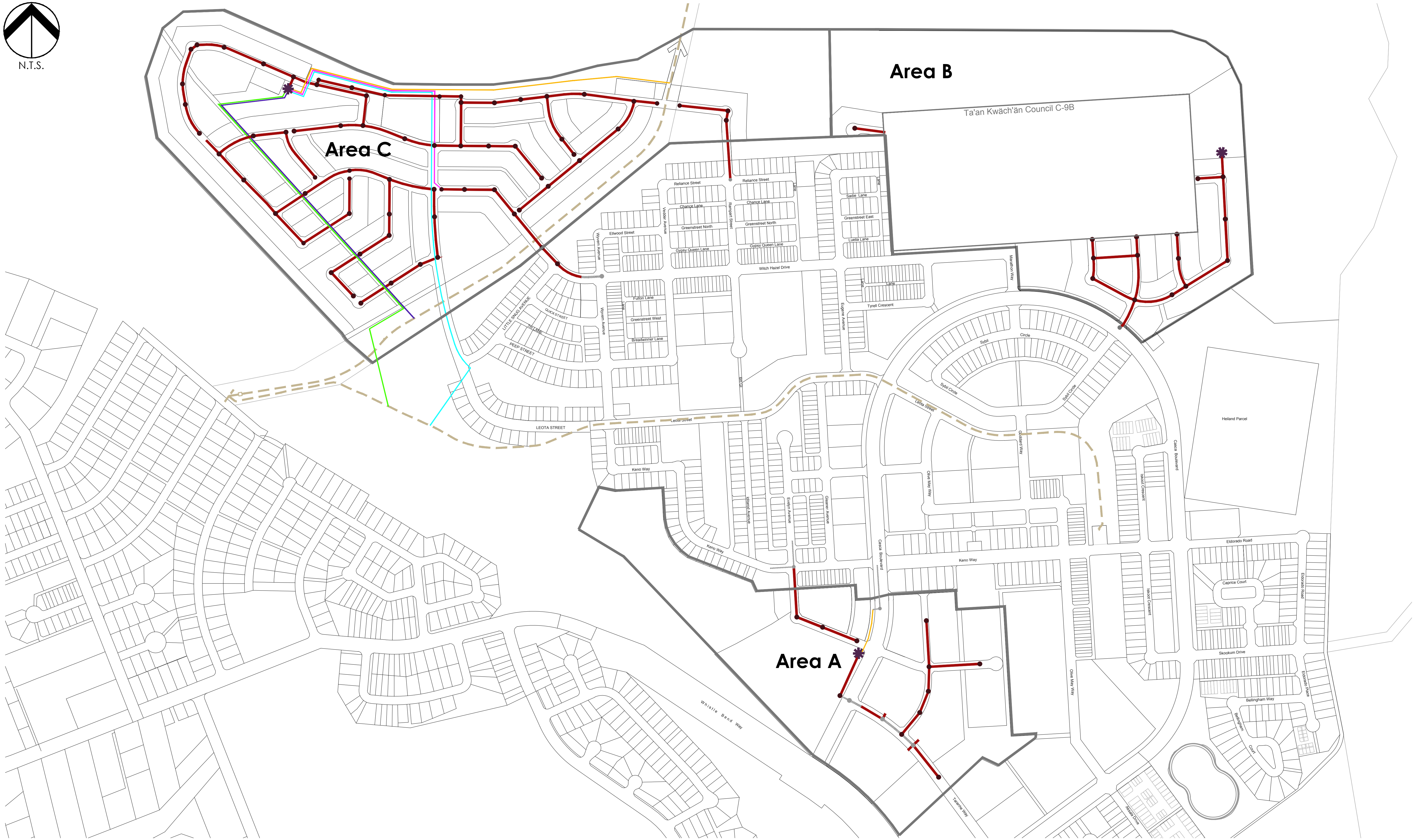
Table 4-19 below summarizes the forcemain costs for each option for Future Areas B and C. The forcemain alignment that would be used in this design, and the cost estimate in Table 6-1, consist of Option 4 due to its high cost and assuming a worst-case scenario for the estimate. The total cost for Lift Station C would be $3,585,000.00, including the cost of the forcemain.

Table 4-5 Summary of Forcemain Option Costs

Options	Area C
Option 1	$196,000.00
Option 2	$385,000.00
Option 3	$269,500.00
Option 4	$357,000.00
Option 5	$301,000.00

4.3.2 OFF-SITE SANITARY SYSTEM

The off-site sanitary system consists of the Porter Creek Flush Tank gravity forcemain that connects to the Livingston Trail Environmental Control Facility lagoons, north of Whistle Bend Subdivision on the other side of the river. The off-site system will need to be investigated further to identify the possible expansions and upgrades that may be necessary in the near future to account for the additional flow from the future areas in concert with the overall development of the City.



Area Boundary
Proposed Manhole
Proposed Lift Station
Proposed Sanitary Pipe
Existing Sanitary Pipe
Existing Manhole
Proposed Forcemain Options
Existing Forcemain

Please Note: Servicing is conceptual and detailed engineering drawings should be used for construction purposed.

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WHISTLE BEND

Figure 4-2 Wastewater Servicing

MODIFIED DATE: 2019.12.10
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4.4 DRAINAGE

4.4.1 BACKGROUND

The existing storm drainage system is designed to limit the outflow to pre-development flows. The system uses a combination of underground storm mains, storm retention ponds and overland bio-swales to limit the flow rate. Ongoing work within current phases of the Whistle Bend Development continue to refine the storm water approach for the entire subdivision. As part of this conceptual design, two bio-swales will convey storm water to existing depressions, one to the east side of the subdivision and one to the north. The ultimate plan is to dispose of storm water through a combination of infiltration and discharge to the Yukon River. Concept work for storm water management for Areas A, B and C consider these ongoing efforts.

4.4.2 EXISTING DRAINAGE PATTERNS

In Area A the major road, Casca Boulevard, splits the region. Along Casca Boulevard the existing drainage is to the southwest. West of Casca Boulevard at the proposed school site, there is a low spot that collects runoff from the surrounding roads. This low spot would have to be infilled in order to convey runoff to the north-west where it drains to the storm drainage ditches in Phase 4, and eventually drain west of Phase 7.

Area B drains to the north depression and to the east depression. However, a large portion of TKC Settlement Land Parcel C-9B will collect water with no outlet unless significant site grading is completed.

Area C naturally drains north to the Yukon River, along several existing flow paths.One of these was created by the City of Whitehorse with the construction of the Porter Creek Flush Tank. There are two existing lagoons located in Area C that the City is in the process of remediating.

4.4.3 STORM WATER MANAGEMENT COMPONENTS & DESIGN CRITERIA

According to the City of Whitehorse Servicing Standards Manual, storm water mains shall be no less than 300 mm in diameter and installed with a minimum depth of cover of 1.2 m. Mains shall be offset from the curb or property line at a distance no less than 3.0 m. Storm manholes conform to the same design criteria as the sanitary manhole. Manholes are to be located at the end of each line and at all changes in pipe sizes, material, grade and alignment. The distance between manholes shall not exceed 110 m. Catch basin leads shall be no less than 300 mm in diameter and not have a grade less than 1.0%.

For estimating rainfall intensity, the most current Intensity-Duration-Frequency (IDF) curves available from the Environment Canada gauge at the Whitehorse Airport will be used. These curves were developed from rainfall data from 1960-2001, so this data does not reflect the full range of rainfall conditions through to the present. As discussed in Section 4.4.3.3, climate change should cause an increase in rainfall in Whitehorse over the design life of the infrastructure. To address the lack of current data to 2018, and account for the impacts of climate change on the stormwater

system, a percent increase in rainfall due to climate change was estimated and applied to the rainfall intensity values used in the conceptual design.

A maximum inlet time of 15 minutes and minimum duration of 5 minutes is used.

4.4.3.1 *MINOR SYSTEM*

The minor system will be designed to convey a 1 in 5-year storm event with no ponding on the surface, except at catch basin inlets. Design flows should not exceed 90% of pipe capacity. Due to the minimum pipe size requirement by the City of Whitehorse and the preference to use Ultra-flo storm pipe, the capacity of the storm system is generally oversized at the beginning of the main run.

Catch basins in previous phases of Whistle Bend have been located based on a maximum asphalt area, as well as at all low points. The maximum asphalt area used to dictate the spacing has been 500 m^2 on roads with gutter slope of less than 3.0% and 350 m^2 on roads with a gutter slope of 3.0% or greater. The catch basins spacing should be decreased to account for increased flows due to climate change upon final design.

4.4.3.2 *MAJOR SYSTEM*

The major system will be designed to convey a 1 in 100-year storm event. The major system consists of overland drainage paths and collection features including roadways, ditches, and bio-swales, which travel around the perimeter of the future areas, and eventually drain to outfall points or ponds.

The major system flows will combine with minor system flows at outfalls or ponds.

4.4.3.3 *CLIMATE INPUT DATA*

The City of Whitehorse can expect significant increases in winter and summer temperatures (2°C-6°C) and precipitation (10-45% increase) due to the impacts of climate change through the year 2070 (PCIC, 2008). As the design life of the storm system extends well into this time horizon, the storm system design for the Future Areas should reflect this increase in rainfall. Existing intensity-duration-frequency (IDF) curves produced by Environment Canada only include data through 2001 for Whitehorse, which does not reflect the existing impacts due to climate change through the year 2018 or any future impacts.

The University of Western Ontario's online IDF-CC tool was used to provide insight into impacts to rainfall due to climate change. The tool uses downscaled global climate models to modify historic IDF data and derive new curves for future conditions under various emission scenarios. Data was reviewed from the Whitehorse Airport station (ID: 2101300) under the highest emissions scenario (RCP 8.5) for the years 2006 to 2100. Under these conditions, the output from IDF-CC provides an average increase in precipitation intensity over the given time range. As the tool does not go beyond 2100, the estimated increases to precipitation for 2100 is likely underestimated based on the averaging technique of the tool. From the tool, it is estimated that the rainfall could increase by 35% for both the 5-year and 100-year event towards the end of this time period. To reflect this in

the stormwater design, a 35% percent increase will be applied to the rainfall intensities when calculating stormwater pipe sizing, catchment spacing, and major system drainage components, including catch basins, during detailed design stages of this project. It is expected that the snowmelt volume or melt rates will likely increase due to climate change, but these impacts were not quantified for the purpose of designing the stormwater systems in Whistle Bend.

This estimated 35% increase in rainfall, and corresponding design flows, will be felt over the course of the design life of the infrastructure. This proactive strategy for addressing climate change in the storm design may increase initial infrastructure costs by a small fraction. However, an increase in costs would be offset by the potential future cost savings from possible avoided damages or premature system upgrades down the line, by designing a system that is resilient over its full design life.

Considerations for climate change impacts best included during the next phases of design as this will be more specific to individual pipe sizes and catch basin locations.

4.4.3.4 METHODOLOGY FOR SIZING MAJOR AND MINOR STORMWATER INFRASTRUCTURE

The rational method, equation shown below, was used to estimate stormwater runoff flow rates.

$$Q = \frac{CIA}{360}$$

In the equation above, Q is the runoff flow rate (m^3/s), I is the intensity of rainfall (mm/hr), A is the contributing area (ha) and C is the runoff coefficient. The runoff coefficients that will be used for estimating flow rates are shown in Table 4-20 below.

Table 4-20 Runoff Coefficients

Description	Run-off Coefficient
Open Space	0.15
Parks	0.15
Residential – Low Density	0.35
Residential – Medium Density	0.50
Residential – High Density	0.70
Commercial	0.70
Institutional / School	0.70
Community Use	0.70
Pavement	0.90

A spreadsheet model was used to size the storm pipes based on the design event. This model takes areas per zone and per different type of surface, their corresponding run-off coefficients (shown in

Table 4- above), and calculates a weighted average runoff coefficient for the length of storm pipe between two manholes with catch basins. The intensity of rainfall was estimated by using the

Whitehorse Airport intensity-duration-frequency (IDF) curve, for the design flow (5-year return period). Using the intensity of rainfall, the peak flow at design (5-year return period) was then determined. The ratio of peak flow at design and flow at capacity was then compared, if below 90% the section was adequate, otherwise the section was required to be increased.

4.4.3.5 *STORMWATER DISPOSAL*

Future Areas A and B will eventually drain to the north and east depressions, see Figures A-2 and B-2 in Appendix A: Civil Drawings. A portion of Future Area C will drain to the north limit of Phase 7, and the remaining area will drain south to the detention pond at the outlet of Phases 6 and 7, see Figure C-2 in Appendix A: Civil Drawings. Pipe diameters displayed in Figures A-2, B-2 and C-2 represent the City of Whitehorse IDF standard criteria without the introduction of climate change. When considering climate change, a select number of pipes are required to be increased to the next size. Increasing these pipe sizes will result in a minor increase in cost that would be covered as part of the contingency cost. As part of a separate project under the broader scope of Whistle Bend stormwater management, continuous simulation modelling of the full stormwater system will be completed to assess whether or not the north and east depressions have sufficient infiltration capacity to fully infiltrate stormwater flows. Based on our previous study of the infiltration capacity of the north and east depressions, we expect gravity outfalls will likely be required to drain high water levels in these depressions. Work on the overall storm water management for the subdivision is ongoing however will consider the Future Areas.

Surface runoff will either drain to a nearby catch basin or off to overland drainage, which will consist of ditches, bio-swales and culverts. Future Area A will have overland drainage towards the north-west area from the school site. Future Area B will drain to the north depression towards the greenbelt and to the east depression towards Casca Boulevard. Future Area C will drain away from the subdivision area and towards the north and south with some of the drainage being captured by the dry pond west of phase 7. See Figures A-1, B-1 and C-1 in Appendix A: Civil Drawings.

4.4.3.5.1 *PRE-DEVELOPMENT RUNOFF RATES*

Based on the Whistle Bend Neighbourhood Phases 3-7 Planning, Design & Preliminary Engineering Servicing Report, completed by Morrison Hershfield Consultants Ltd. in August 2013, the pre-development rates were found through their continuous model.

Table 4-21 Predevelopment Discharge Rates

Return Period (years)	Unit Area Discharge (L/s/ha)
200	3.0
100	2.4
50	1.9
25	1.4
10	0.9
5	0.6
3	0.4
2	0.3

4.4.4 STORMWATER RECOMMENDATIONS

Based on the above methodology, the stormwater system should accommodate expected flows over the design life of the infrastructure. Stormwater mains will range in diameter from 450 mm to 1500 mm, the larger diameter pipes will be at or in proximity to the outfall locations to the bioswales. It is recommended that water quality be considered in future designs for the Whistle Bend Subdivision.

Area Boundary
Proposed Manhole
Storm Pond
Proposed Storm Pipe
Existing Storm Pipe
Outfall

Please Note: Servicing is conceptual and detailed engineering drawings should be used for construction purposed.

wsp

Whitehorse

WHISTLE BEND

Figure 4-3 Drainage Servicing

4.5 POWER & TELECOMMUNICATIONS

4.5.1 POWER

ATCO Electric Yukon is currently servicing the existing phases of Whistle Bend for power and is expected to continue their services into the Future Areas. As with previous phases of Whistle Bend, power runs underground, with the use of overhead limited to corridors supplying the existing and any proposed substations. The power utilities follow the road alignments. Utility easements or rights-of-way must be acquired when the power services are located outside of the road limits. The power distribution requires a looped system to ensure that there is no loss of service. Prices from previous phases of Whistle Bend were used for the cost estimate, shown in Table 6-1.

4.5.2 TELECOMMUNICATIONS

NorthwesTel is currently servicing the existing phases of Whistle Bend for telephone and cable, NorthwesTel is expected to continue their services into the Future Areas. As with previous phases of Whistle Bend, power runs underground. The telephone and cable utilities also follow the road alignments. Utility easements or rights-of-way must be acquired when the power services are located outside of the road limits. Prices from previous phases of Whistle Bend were used for the cost estimate.

5 ENGINEERING CONSIDERATIONS

5.1 EXISTING / FUTURE TRANSPORTATION NETWORK

5.1.1 BACKGROUND

The Whistle Bend Phases 3-7 Transportation Impact Assessment (TIA) completed in 2015 estimated the traffic impacts of the:

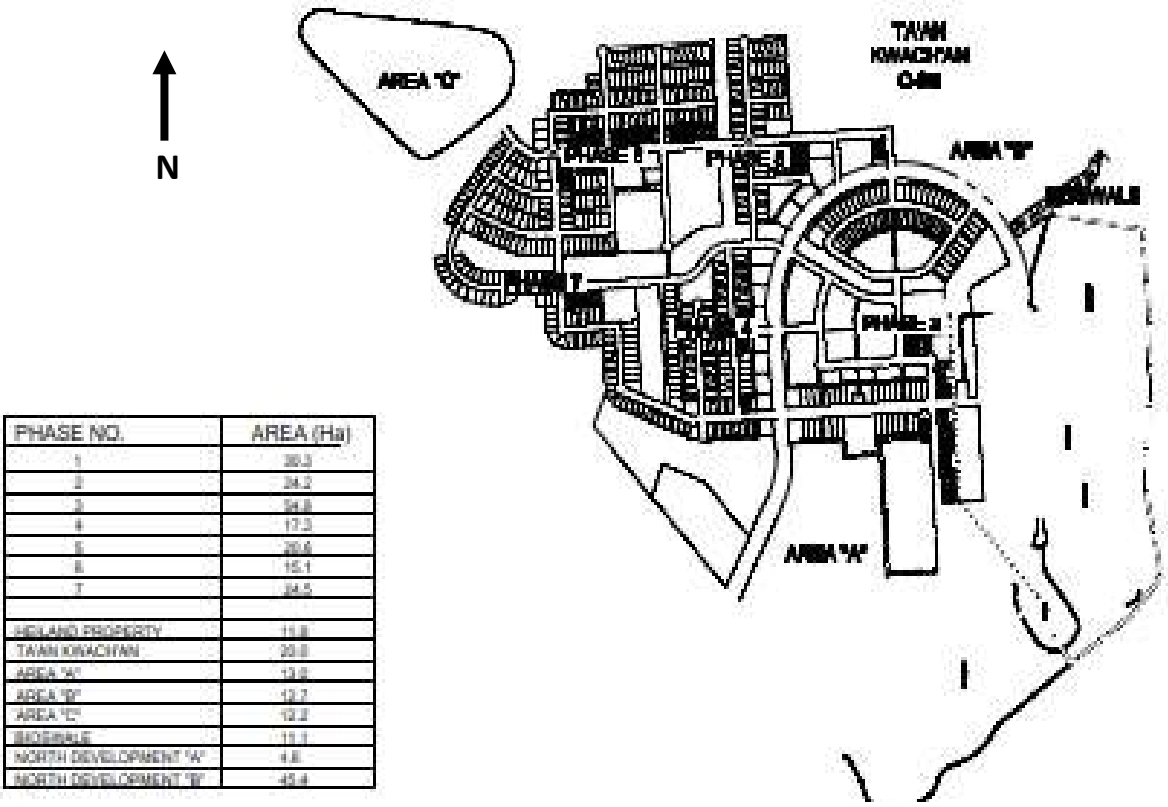
- Phases 1 and 2 (already completed);
- Planned land uses for Phases 3-7; and
- Planned land uses for Future Areas A, B, and C.

Recognizing that development plans are subject to change, the 2015 TIA recommended that the traffic impact analysis be updated with each major stage of the Whistle Bend development. Since that time, the planned land uses in the Whistle Bend development have been updated, and preliminary land use plans for Future Areas A, B and C have been identified.

This section investigates at a high-level the potential implications on roads, transit, and trails resulting from the changes in the proposed land use and identifies the recommended next steps. This review is based on the Whistle Bend land use plans and information available to date.

5.1.2 LAND USE

Land use type and size affect the number of trips generated by a development. This section compares at a high-level the land use plans from the 2015 TIA with the updated land use plan. Figure 5-1 shows the land use plans for Phases 3-7 from the 2015 TIA, while Figure 5-2 shows the Phases 5 to 7 updated land use plans. Figures 2-2 and 2-3 show the updated land use plans for Future Areas A and B respectively. This information is used as an indicator of the potential changes in trips generated by the development. Development trips are not quantified. The planned land uses in Whistle Bend include commercial, recreation, schools, residential, mixed use, and community, such as parks, churches, day cares and community centres. A visual comparison of 2015 land uses with current land uses indicates that Phases 3 to 7, Future Area A, and Future Area B should remain mainly unchanged from the 2015 TIA. Phases 1 and 2 are complete, which means that the number of trips generated by this part of the development are not expected to change significantly.



PHASE NO.	AREA (Ha)
1	30.3
2	34.2
3	34.8
4	17.3
5	20.6
6	15.1
7	24.5
HEILAND PROPERTY	11.8
TAMAN KHACHYAN	20.8
AREA "A"	13.8
AREA "B"	12.7
AREA "C"	12.2
BIOSWALE	11.1
NORTH DEVELOPMENT "A"	4.8
NORTH DEVELOPMENT "B"	45.4

Figure 5-1 Phases 3-7 Land Use Plan from 2015 TIA

Figure 5-2 Phases 3-7 Updated Land Use Plan

Future Area C is planned to have residential, park / green space, and public utility land uses, shown in Figure 2-4. A majority of the residential area is expected be low-density single-family units, some smaller areas are planned to be medium density housing, such as townhouses, and one small area is planned to be medium density apartment housing. Future Area C should increase the overall trips generated by Whistle Bend (Phases 1-7, Future Areas A and B).

5.1.3 ROADS

The location of Area C is in the northwest corner of Whistle Bend. Based on the preliminary plans Area C will have access from Jet Power Road, Witch Hazel Drive. Area C will have access to Casca Boulevard from Leota Street, Marathon Way[2], and Keno Way. The 2015 TIA estimates that all three intersections with Casca Boulevard will operate with an overall acceptable level of service at full

[2] Goddard Way in 2015 TIA

buildout (Phases 1-7, Area A and Area B). This indicates that there may be spare capacity to accommodate some or all the Area C trips.

5.1.4 ACTIVE TRANSPORTATION

Active transportation is a key strategy in cities across North America in decreasing vehicle travel and improving the health of their residents. The City of Whitehorse adopted the Bicycle Network Plan in 2018 to establish a long-term vision for cycling and increase transportation choices. It focuses on providing facilities that are comfortable for people of all ages and abilities (AAA). The plan recommends that new developments are designed to incorporate cycling infrastructure.

A number of short-term bicycle network priority projects have been identified in the neighbourhood of Whistle Bend in the Bicycle Network Plan. All the cycling facilities in Whistle Bend are proposed to have AAA standard, which includes multi-use pathways, separated bicycle paths, and neighbourhood greenways to provide a high standard of safety and comfort to riders. The proposed cycling network in Whistle Bend would provide connectivity for local trips, and to the larger Whitehorse cycling network. Future Areas B and C are be located adjacent to the proposed cycling network, which would provide residents access to high quality cycling facilities and support the goals of the Whitehorse Bicycle Network Plan.

5.1.5 TRANSIT

At present, Whitehorse Transit serves Whistle Bend hourly, Monday – Friday from approximately 7 AM to 7 PM, with no service on the weekend. Transit stops are currently located on the intersections of Casca Boulevard / Olive May Way and Casca Boulevard / Iskoot Crescent. Figure 5-3 shows the current Route 6, Ingram – Granger – Porter Creek – Whistle Bend route. This route includes opportunities to transfer to all other transit routes in Whitehorse. The City of Whitehorse adopted a new Transit Master Plan in April 2018. This plan includes a reorganization of routes designed to increase service frequency, make transit routes more direct, and encourage the use of cycling in combination with transit. This Transit Master Plan recognizes the population growth expected in Whistle Bend.

The Transit Master Plan proposes an hourly route circulating the core of Whistle Bend following Casca Boulevard, continuing to the area of Hillcrest, the Canada Games Centre and the Erik Nielsen Whitehorse International Airport (YXY). This routing includes opportunities to connect with all other transit routes in Whitehorse. A new peak-hours only, twice hourly, route circulating the core of Whistle Bend to Yukon College is also proposed. The combination of these two transit routes would improve transit opportunities in the area, with three buses an hour during peak times, compared to the current one bus per hour. Figure 5-4 shows the proposed future transit routes.

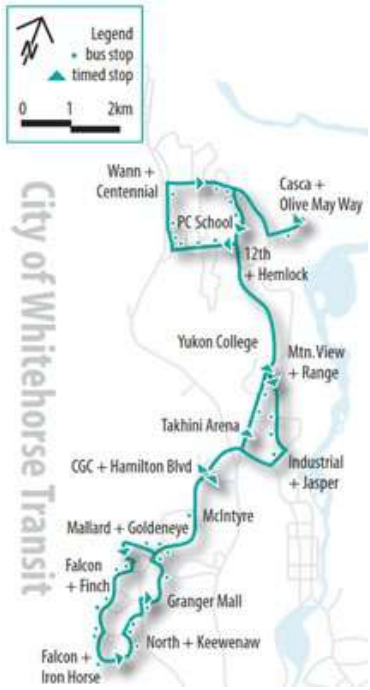


Figure 5-3 Current Transit Service in to Whistle Bend [3]

Figure 5-4 Proposed Future Transit Route Network in Whitehorse [4]

The future transit routes are proposed to travel along Skookum Drive, Eldorado Drive, and Casca Boulevard, which are located on the east side of Whistle Bend. A common standard for willingness to walk to transit is 400 metres. The majority of Whistle Bend, including Future Areas A, B, and C would be located further than 400 metres from transit. This may reduce the uptake of transit by Whistle Bend residents, unless the transit routes through Whistle Bend are reconsidered by Whitehorse Transit.

5.1.6 TRAILS

The City of Whitehorse has an extensive trail network that is managed following the 2007 City of Whitehorse Trail Plan. This plan was most recently updated in 2012. In 2015 a Motorized Multi-Use (MMC) Trail Map was published by the City. MMU trails are intended for use by pedestrians, cyclists, and in appropriate seasons, snowmobiles and ATVs. Figure 5-5 shows the 2015 MMU Trail Map in the area of Whistle Bend.

[3] Whitehorse Transit, December 2018

[4] City of Whitehorse Transit Master Plan, April 2018, https://www.whitehorse.ca/departments/transit/transit-master-plan-background-reference-information

Figure 5-5 Whitehorse MMU Trail Map in the Area of Whistle Bend [5]

A series of pedestrian and cyclist trails within Whistle Bend have been planned. These pedestrian trails link the various land uses and are intended to support active transportation through the neighbourhood.

Whistle Bend also has access to the MMU trail network in the southeast quadrant. Consideration should be given to connectivity of the pedestrian and cyclist trails within Whistle Bend to the MMU trail network.

5.1.7 NEXT STEPS

This section investigated the potential implications on roads, transit, and trails resulting from the updated land use plans and development information available to date. A Traffic Impact Assessment (TIA) update is an appropriate recommended next step to estimate the impacts of the proposed land use on the road network and key intersections.

Further consideration into the transit network in Whistle Bend is required to ensure that transit stops are located appropriately to serve the residents. Having transit stops within 400 metres of the majority of homes decreases barriers to transit use.

[5] https://www.whitehorse.ca/home/showdocument?id=4210

5.2 ESTIMATED CUT & FILL VOLUMES

After the conceptual lot grading was completed, the cut and fill volume balances were calculated. Based on the preliminary lot grading, a high amount of fill material will be required to bring the school lot and lots along Tarahne Way in Future Area A to grade.

These cut and fill volumes are presented in Table 5-1 below, and are shown in Figure A-6, B-7, and C-7 in Appendix A: Civil Drawings. Out of the total amount of fill required for Future Area A, the school site requires 77% of the total fill volume.

The following criteria and assumptions were used to calculate cut and fill volumes:

- Proposed roads will have a sub excavation of 1.7 metres below top of asphalt to allow for a road structure that contains non-frost susceptible materials, this sub excavation will be continued to 0.3 metres behind all concrete sidewalks.
- Sub excavation material from roads will be suitable for lot grading.
- Lots will be pre-graded to within +/- 0.3 metres of final lot grades.

Table 5-1 Cut and Fill Balances for Area A

Lots	Cut (m3)	Fill (m3)	Total (m3)	
Lots	51,900	180,100	Fill	128,200
Roads	26,000	400	Cut	25,600
Total	77,900	180,500	Fill	102,600
School Site	800	79,600	Fill	78,800

Future Area B has an excess amount of cut material left, as depicted in Table 5-2 below. The excess amount of cut material is shown to be from tying the roads and lots to the TKC Settlement Land Parcel C-9B, as shown below in Table 5-2.

Table 5-2 Cut and Fill Balances for Area B

Lots	Cut (m3)	Fill (m3)	Total (m3)	
Lots	38,000	3,000	Cut	35,000
Roads	28,800	0	Cut	28,800
Total	66,800	3,000	Cut	63,800

Assuming the two existing lagoons have been left as is and are required to be graded down, the excess re-usable material would be used to fill the north-east quadrant of Area C where there is a major drop in elevation. Overall, Area C requires imported material to bring the entire area up to finished grade, as shown in Table 5-3.

Table 5-3 Cut and Fill Balances for Area C

Lots	Cut (m^3)	Fill (m^3)	Total (m^3)	
Lots	75,000	118,400	Fill	43,400
Roads	119,100	3,000	Cut	116,100
Total	194,100	121,400	Cut	72,700
Existing Lagoons	28,800	9,600	Cut	19,198

Overall the Future Areas have a total of excess cut. It was assumed that Area A would use the excess cut material from Areas B and C for fill.

5.3 LOT CLEARING

Based on previous phasing in Whistle Bend, all road rights-of-way are cleared 10m into adjacent lots, and all lane and PUL right of ways are cleared 3m into adjacent lots. Lot clearing is typically completed at the start of the design phase in order to facilitate an existing ground survey, while LiDAR is used to fill in the remaining areas. Additional clearing is generally included during construction to facilitate pre-grading and overall storm water management.

Greenbelts and parks may be cleared based on final lot grades and overland drainage paths. While it is generally preferable not to clear and to maintain a natural buffer between lots and phases, it is sometimes unavoidable.

Clearing and grubbing should take place no more than 1 construction season before work commences to avoid excessive erosion and material migration. Previous phases have been cleared and left untouched for several years resulting in large amounts of fine material being blown around. If an area needs to be cleared, the grubbing should be left until construction begins. General clearing plans are shown in Figures A-8, B-8 and C-8 in Appendix A: Civil Drawings.

6 COST ESTIMATES

6.1 COST ESTIMATE: FUTURE AREAS A, B, & C

Based on the assessments and analysis conducted in this report the cost estimate was conducted for each Future Area. The cost estimate for Future Area B excludes TKC Settlement Land Parcel C-9B. The cost for siteworks includes mobilization and demobilization; clearing, salvage, and decking (provisional); and grubbing, stripping and disposal (provisional). Area A fill is assumed to come from excess cut of Area B and C.

Table 6-1 Cost Estimate by Area

	Area A	Area B	Area C	Total
Siteworks	$3,025,700.00	$2,187,600.00	$6,729,200.00	**$11,942,500.00**
Water Works	$838,350.00	$972,850.00	$2,853,275.00	**$4,664,475.00**
Sanitary Sewers	$300,350.00	$806,800.00	$2,432,400.00	**$3,539,550.00**
Storm Sewers and Overland Drainage	$555,025.00	$696,950.00	$3,831,000.00	**$5,082,875.00**
Water and Sewer Service Connections	$175,000.00	$3,287,500.00	$9,337,500.00	**$12,800,000.00**
Road Works	$1,664,919.75	$2,005,867.50	$11,617,783.50	**$15,288,570.75**
Shallow Utilities	$492,000.00	$1,146,200.00	$3,623,600.00	**$5,261,800.00**
Lift Station	$784,300.00	$3,500,000.00	$3,585,000.00	**$7,869,300.00**
Recirculation and Heating Pumphouse	-	-	$1,300,000.00	**$1,300,000.00**
Sub-Total	**$7,835,644.75**	**$14,603,767.50**	**$45,309,758.50**	**$67,749,170.75**
Contingency and Estimating Allowance (+35%)	$2,742,475.66	$5,111,318.63	$15,858,415.48	**$23,712,209.76**
Engineering (+10%)	$783,564.48	$1,460,376.75	$4,530,975.85	**$6,774,917.08**
Total (Rounded to the nearest thousand)	**$11,362,000.00**	**$21,175,000.00**	**$65,699,000.00**	**$98,236,000.00**

6.2 COST ESTIMATE: TOWN SQUARE & LANDSCAPING

Table 6-2 Town square construction and landscaping cost estimate

Item	Description	Units	Quantity	Unit Price	Amount
1	**Softscape**				
1.1	Turf (sod) – supply and install on 100mm depth Topsoil	m^2	3150	$16.00	$50,400.00
1.2	Shrub Beds – supply and install including shrubs/perennials, and 100mm depth bark mulch over 450mm depth soil mix	m^2	1150	$105.00	$120,750.00
1.3	Trees – 60mm Cal./2.5m Ht. – supply and install including 1000mm depth soil mix and 100mm depth bark mulch tree wells	ea.	110	$800.00	$88,000.00
				Softscape Sub-Total:	$259,150.00
2	**Hardscape**				
2.1	Standard Concrete Plaza	m^2	4775	$320.00	$1,528,000.00
2.2	Coloured Concrete Plaza	m^2	2050	$385.00	$789,250.00
2.3	Concrete Pavers (Crosswalk)	m^2	270	$175.00	$47,250.00
2.4	Rubble Seating Wall	lin.m.	750	$750.00	$562,500.00
				Hardscape Sub-Total:	$2,927,000.00
3	**Site Amenities & Miscellaneous Items**				
3.1	Benches & Site Furnishings – supply and install	ls.	1	$100,000.00	$100,000.00
3.2	Lighting Allowance	ls.	1	$100,000.00	$100,000.00
3.3	Water Feature – supply and install	ls.	1	$670,000.00	$670,000.00
3.4	Totem Poles/Art Feature(s) – supply and install	ls.	1	$25,000.00	$25,000.00
				Site Amenities and Miscellaneous Items Sub-Total:	$895,000.00
4	**Landscape Maintenance**				
4.1	Landscape Maintenance – 1-year maintenance period from CCC to FAC, includes warranty of plant material only, regular mowing and weed control. Contractor to provide maintenance schedule program and ensure site meets City standard prior to commencement of FAC process. Contractor to provide monthly maintenance slips as a requirement for FAC. We have assumed a value of 15% of soft landscaping costs for annual rate.	Year	1	15%	$38,872.50
5	**Town Square Civil Engineering & Servicing**				
5.1	Subcut cost	m^3	21,000	$15.00	$315,000.00
5.2	Pit run cost	m^3	12,000	$25.00	$300,000.00
5.3	Servicing: 280m of 150mm water main loop, 110m of sanitary, 3 sanitary manholes, service connections (wtr/sewer), 2 fire hydrants, 1 metering manhole, 1 rock pit for storm drainage				$350,000.00
				Town Square Civil Engineering & Servicing Sub-Total:	$965,000
				Town Square Softscape, Hardscape, Site Amenities, Landscape Maintenance, & Civil Engineering / Servicing Cost Sub-Total	$5,046,150
				Contingency 15%	$756,922.50
				Total Estimate	$5,803,072.50

The cost estimate above is based on the design concept submitted in this report.

6.3 COST ESTIMATE NOTES

- Unit rates shown are based on 2018 landscape tender prices (where applicable). Prices reflect the Yukon market.
- All amenity pricing(s) to be confirmed with contractor / supplier.
- Quantities do not include plaza buildings, Keno Way boulevard trees, or parking facilities.

7 REFERENCES

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Morison, McKenna, and Davies. 1982, Southern Lakes Surficial Geology Maps (1982).

APPENDIX A: CIVIL DRAWINGS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

LEGEND

- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- 678.84 — EXISTING ROAD SPOT ELEVATION
- 678.84 / 678.839 — PROPOSED SPOT ELEVATION w/ EXISTING ELEVATION

PROPOSED SCHOOL LOT WILL REQUIRE AN OVERALL GRADING AND DRAINAGE PLAN THAT TAKES INTO ACCOUNT THE MAJOR OVERLAND STORM DRAINAGE FROM EXISTING PHASES 1-4.

PHASE 4
PHASE 3
PHASE 1
PORTER CREEK
KENO WAY
OLIVE MAY WAY
CASCA BOULEVARD
WHISTLE BEND WAY
TARANHE WAY
LIMIT OF AREA "A"
A-100
A-101

677.70
677.30
679.80
678.84
678.32 / 679.299
677.25 / 678.382
677.98 / 678.630
678.34 / 678.845
679.22 / 679.220
678.69 / 678.700
678.90 / 678.900
678.20 / 679.380
679.40 / 680.338
679.10 / 679.798
681.00 / 680.433
679.00 / 679.986
679.00 / 679.167
681.00 / 680.750
680.99 / 681.000
680.37 / 680.500
680.87 / 680.055
678.02 / 678.470
680.71 / 681.500
680.49 / 681.300
680.18 / 681.250
678.28 / 680.283
681.10 / 681.100

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DWG PATH: p:\20182255\00_civil_land_planning\working_dwgs\100_civil\20255-00-c-cmp-align-area a.dwg

Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1500
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

A-1

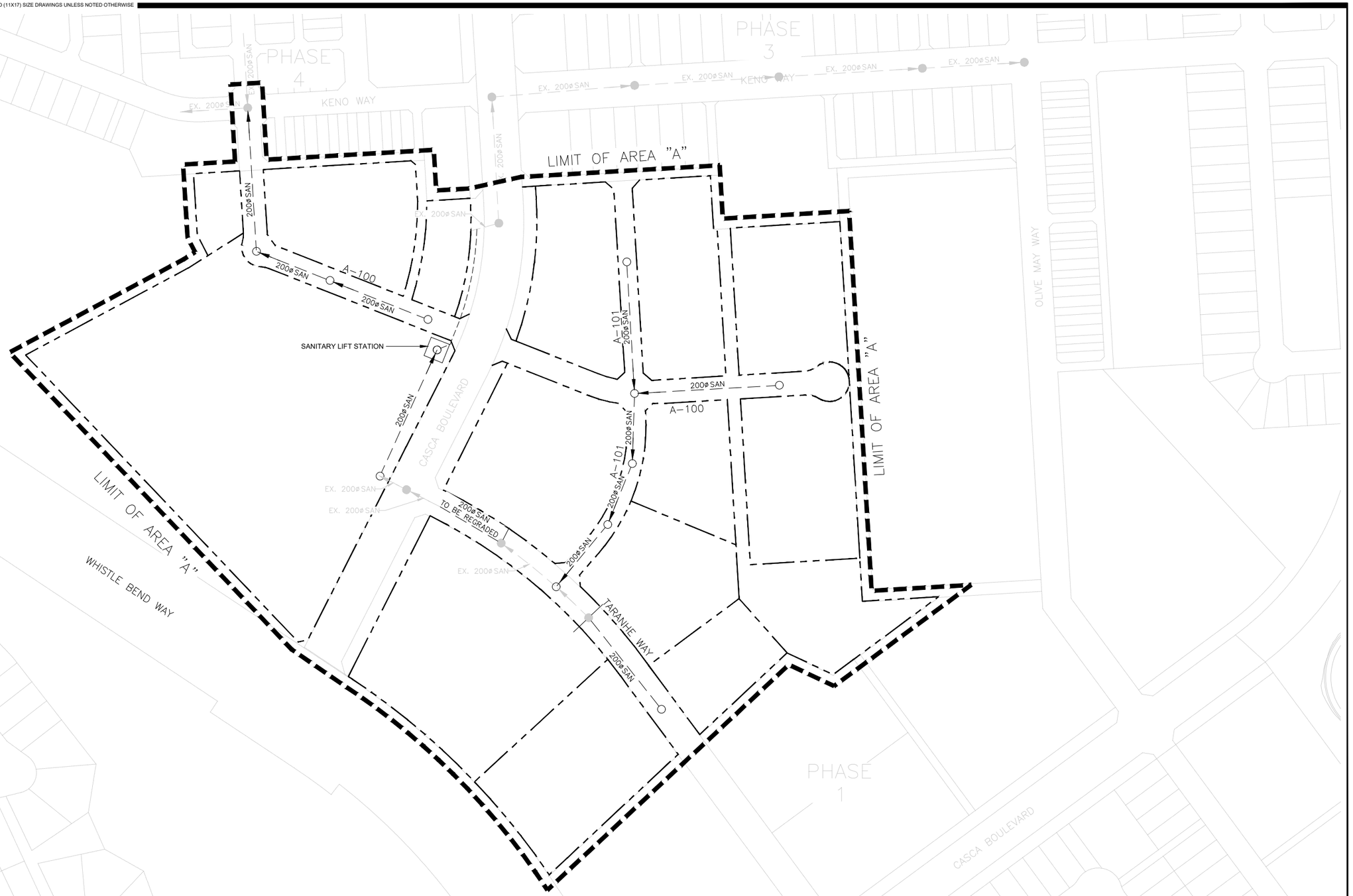
YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'A'
ROAD GRADES & STORM WATER FLOW ROUTES

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

ON TARANHE WAY THE SANITARY SYSTEM HAS ALREADY BEEN INSTALLED UP TO MANHOLE S40504 AS PART OF PHASE 1. A NEW MANHOLE WILL HAVE TO BE INSTALLED OVER TOP OF THE EXISTING MAIN FOR CONNECTIONS TO THE SANITARY NORTH OF TARANHE WAY.
THE MAIN WILL ALSO HAVE TO BE EXTEND SOUTH EAST IN ORDER TO SERVE THE TWO LOTS AT THE EDGE OF AREA "A".
THE MAIN WILL ALSO HAVE TO BE REGRADED FROM MANHOLE S40503 TO S31000.
NEW SERVICE CONNECTIONS WILL HAVE TO BE INSTALLED FOR LOTS ON TARANHE WAY.



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Associated Engineering
BEST MANAGED COMPANIES

AE PROJECT No.	20182255-00
SCALE	1:1500
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

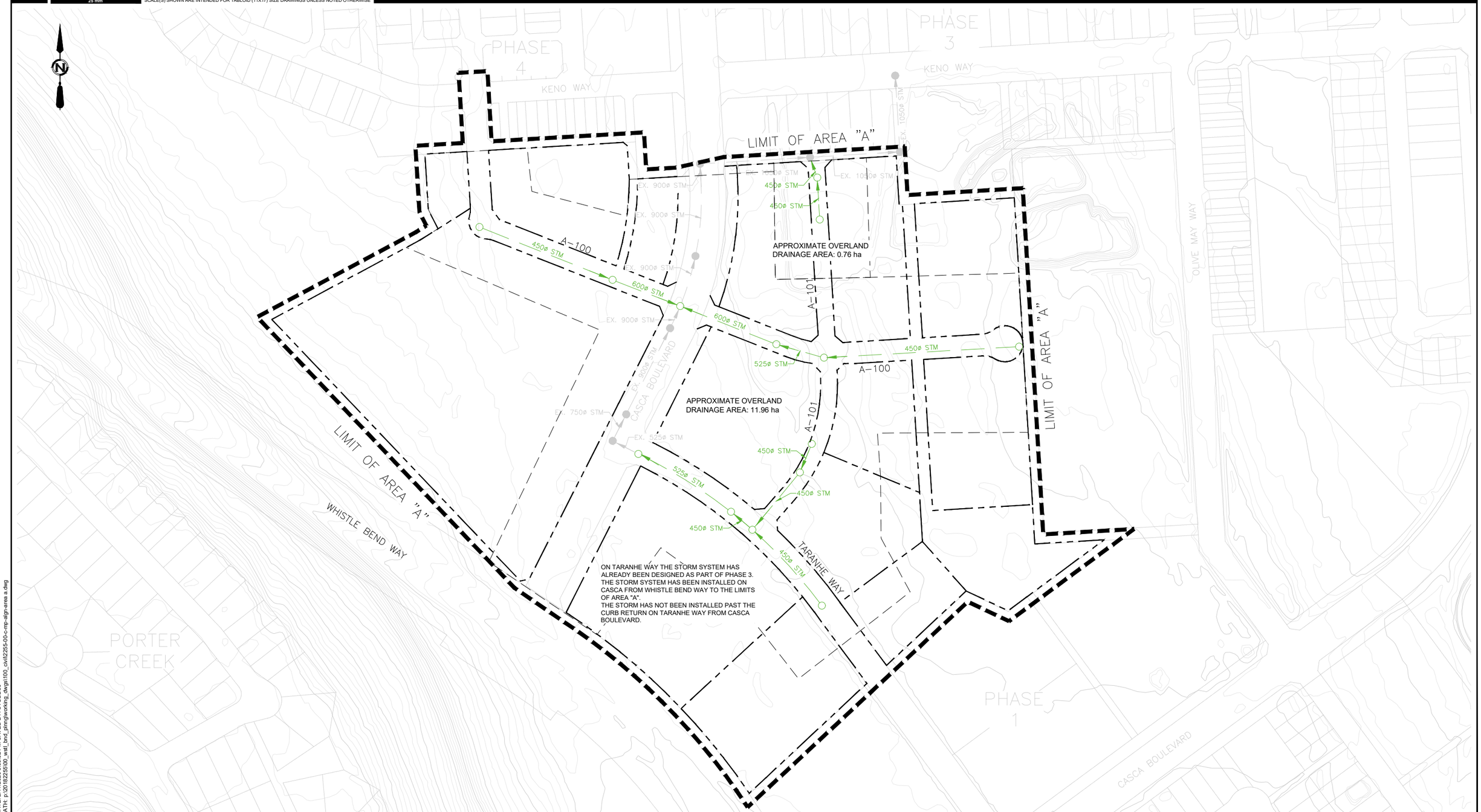
A-2

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'A'
SANITARY SEWERS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1500
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

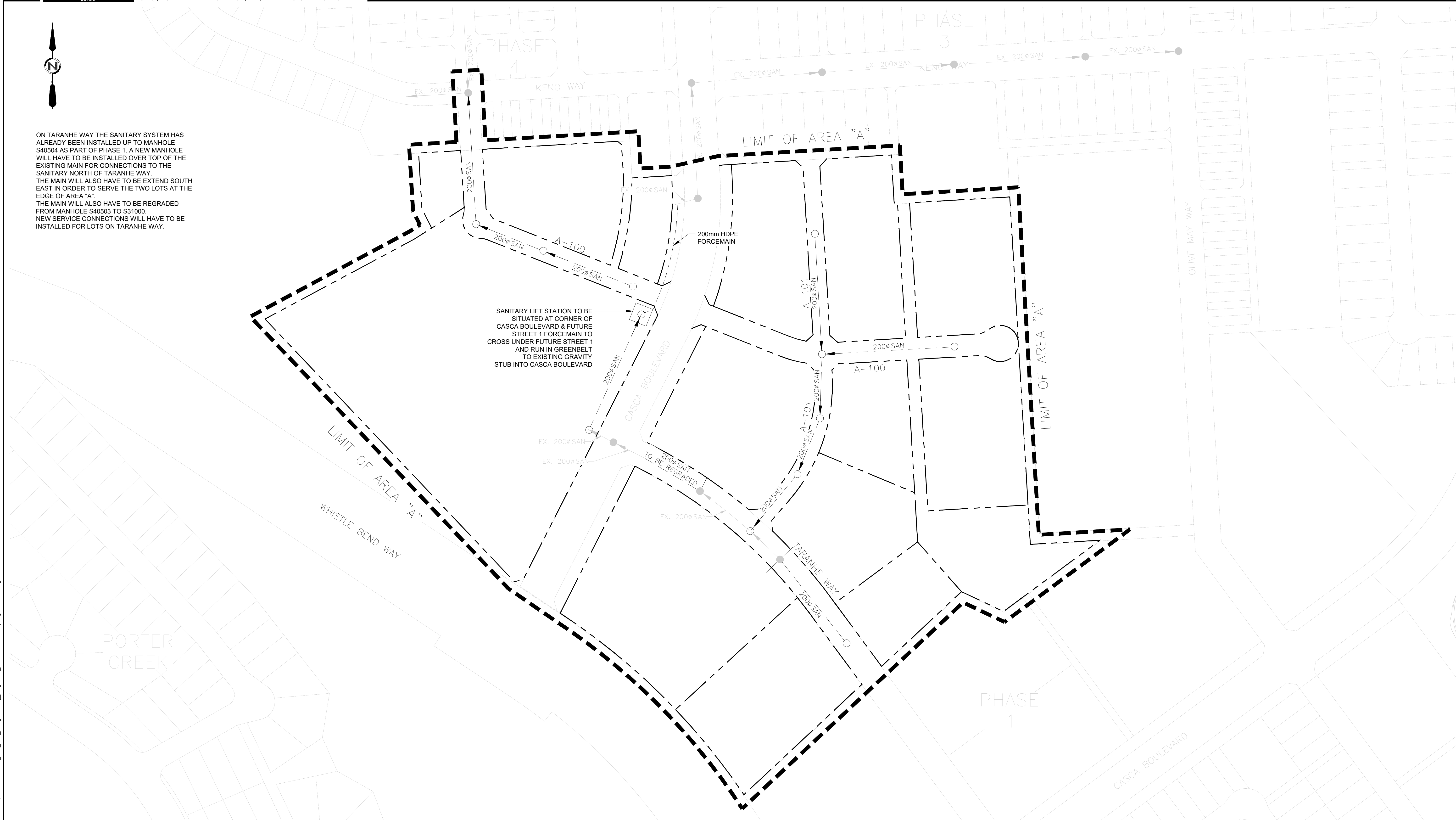
A-3

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'A'
STORM SEWERS

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

ON TARANHE WAY THE SANITARY SYSTEM HAS ALREADY BEEN INSTALLED UP TO MANHOLE S40504 AS PART OF PHASE 1. A NEW MANHOLE WILL HAVE TO BE INSTALLED OVER TOP OF THE EXISTING MAIN FOR CONNECTIONS TO THE SANITARY NORTH OF TARANHE WAY.
THE MAIN WILL ALSO HAVE TO BE EXTEND SOUTH EAST IN ORDER TO SERVE THE TWO LOTS AT THE EDGE OF AREA "A".
THE MAIN WILL ALSO HAVE TO BE REGRADED FROM MANHOLE S40503 TO S31000.
NEW SERVICE CONNECTIONS WILL HAVE TO BE INSTALLED FOR LOTS ON TARANHE WAY.



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Associated Engineering
CANADA'S BEST MANAGED COMPANIES Platinum member

AE PROJECT No.	20182255-00
SCALE	1:1500
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

A-4

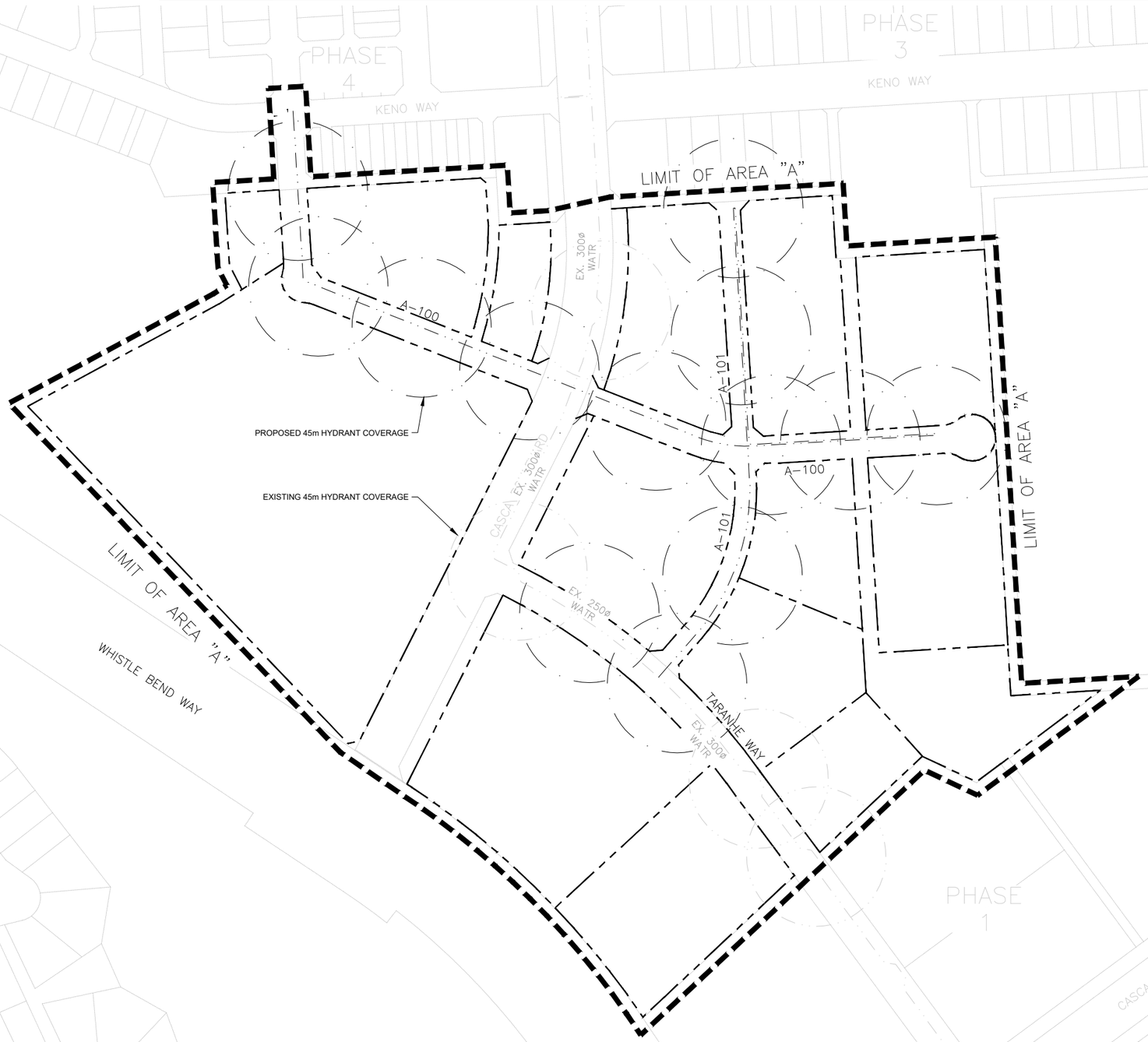
YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'A'
SANITARY FORCEMAIN

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

ALL WATERMAINS IN
AREA "A" 200mm



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Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1500
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

A-5

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'A'
WATERMAINS

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

PLOT DATE: 2/18/2020 9:22:01 AM
SAVE DATE: 2/17/2020 3:58:32 PM SAVED BY: STOBBSJ
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Associated Engineering

CANADA'S BEST MANAGED COMPANIES Platinum member

AE PROJECT No.	20182255-00
SCALE	1:1500
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

A-6

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'A'
CUT/FILL FROM EXISTING

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

PHASE 4

PHASE 3

KENO WAY

LIMIT OF AREA "A"

A-100

CASCA BOULEVARD

A-100

A-100

A-100

LIMIT OF AREA "A"

OLIVE MAY WAY

LIMIT OF AREA "A"

WHISTLE BEND WAY

TARANTEE WAY

PORTER CREEK

PHASE 1

CASCA BOULEVARD

LEGEND

AREA TO BE CLEARED, GRUBBED AND STRIPPED 5.2Ha

PLOT DATE: 2/18/2020 9:22:12 AM
SAVED DATE: 2/17/2020 5:32:32 PM SAVED BY: STOBBS.I
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Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1500
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

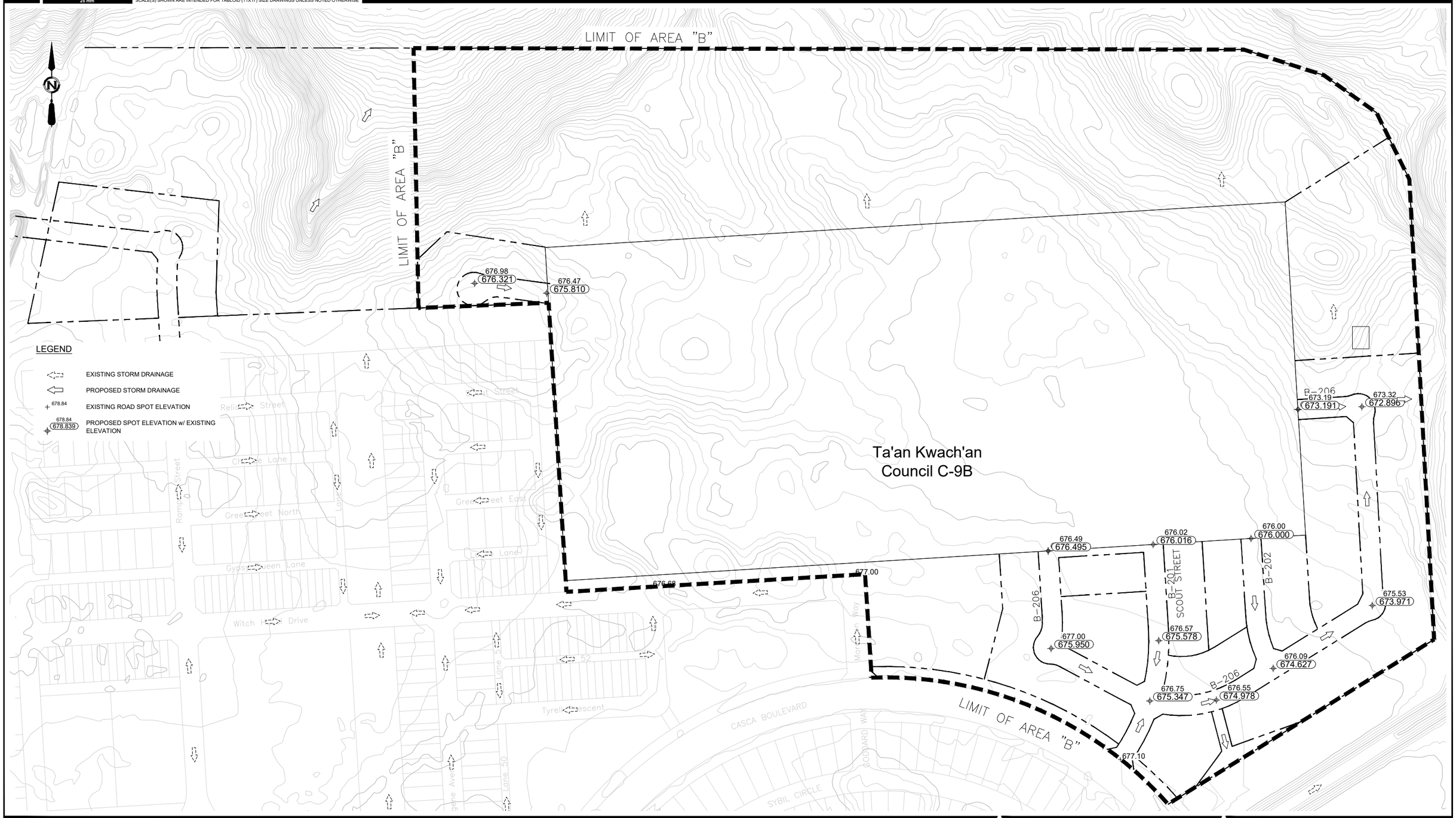
A-7

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'A'
INITIAL CLEARING PLAN

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1600
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

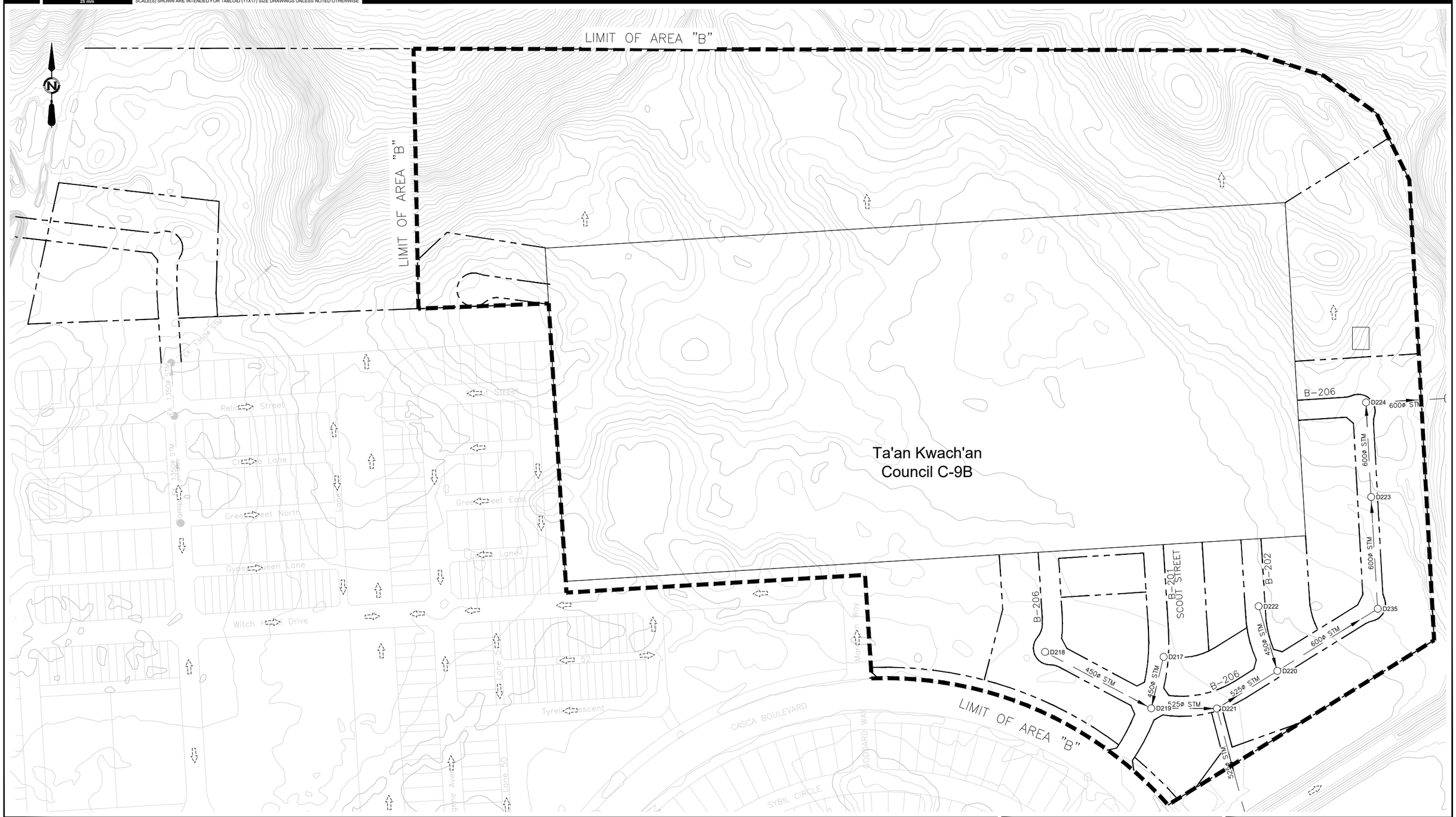
B-1

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'B'
ROAD GRADES & STORM WATER FLOW ROUTES

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering
CANADA'S BEST MANAGED COMPANIES Platinum Member

AE PROJECT No.	20182255-00
SCALE	1:1600
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

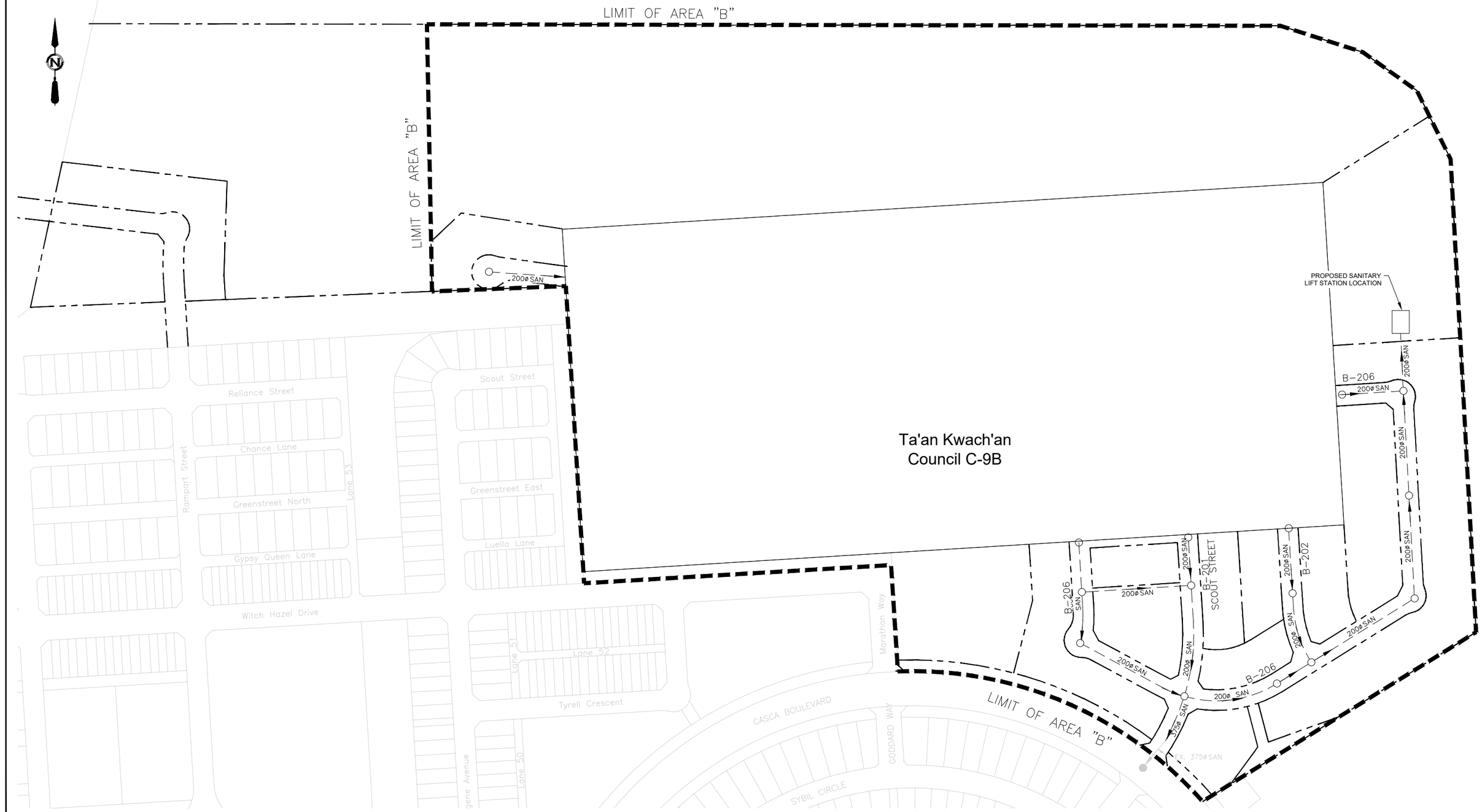
B-2

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'B'
STORM SEWERS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1600
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

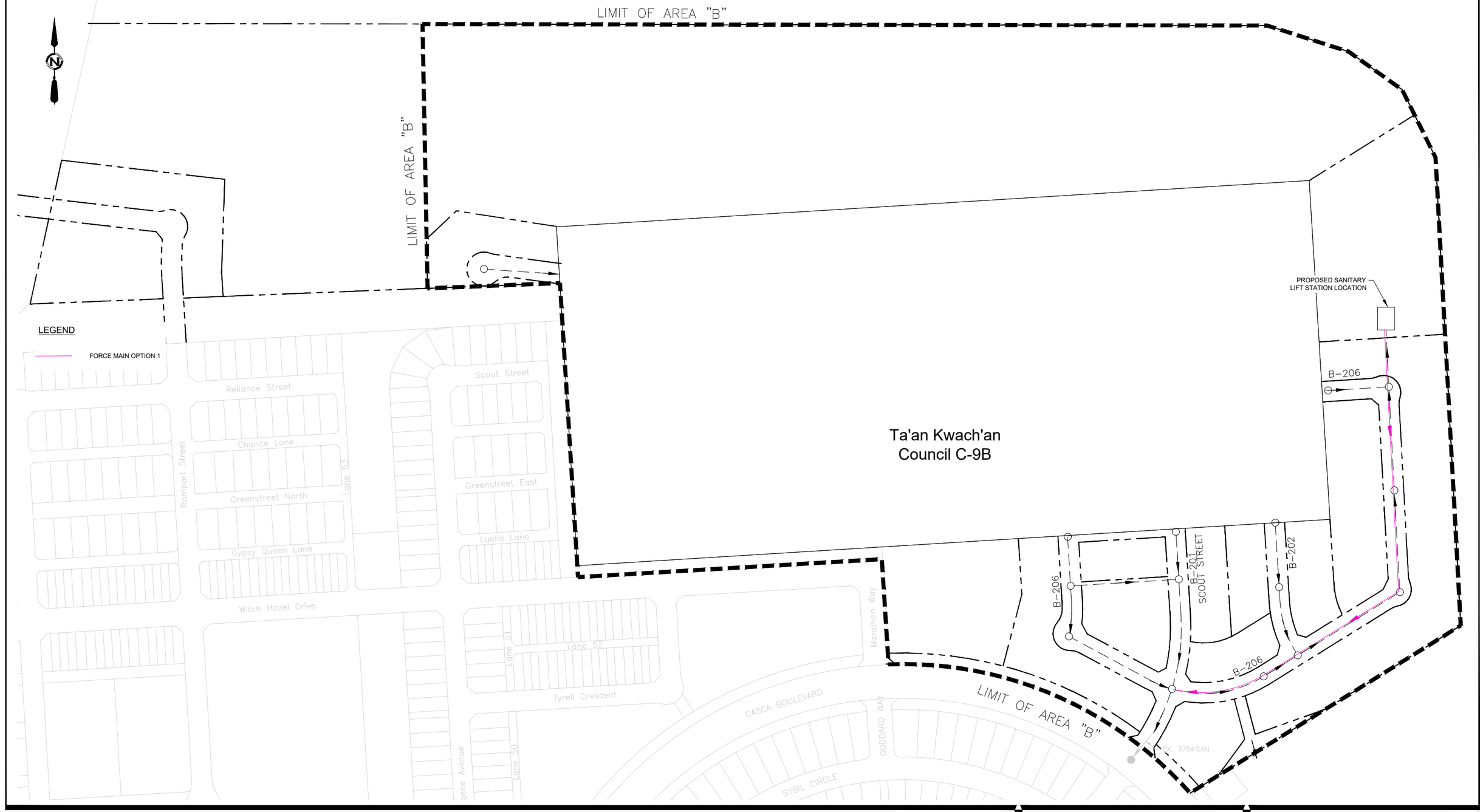
B-3

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'B'
SANITARY SEWERS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1600
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

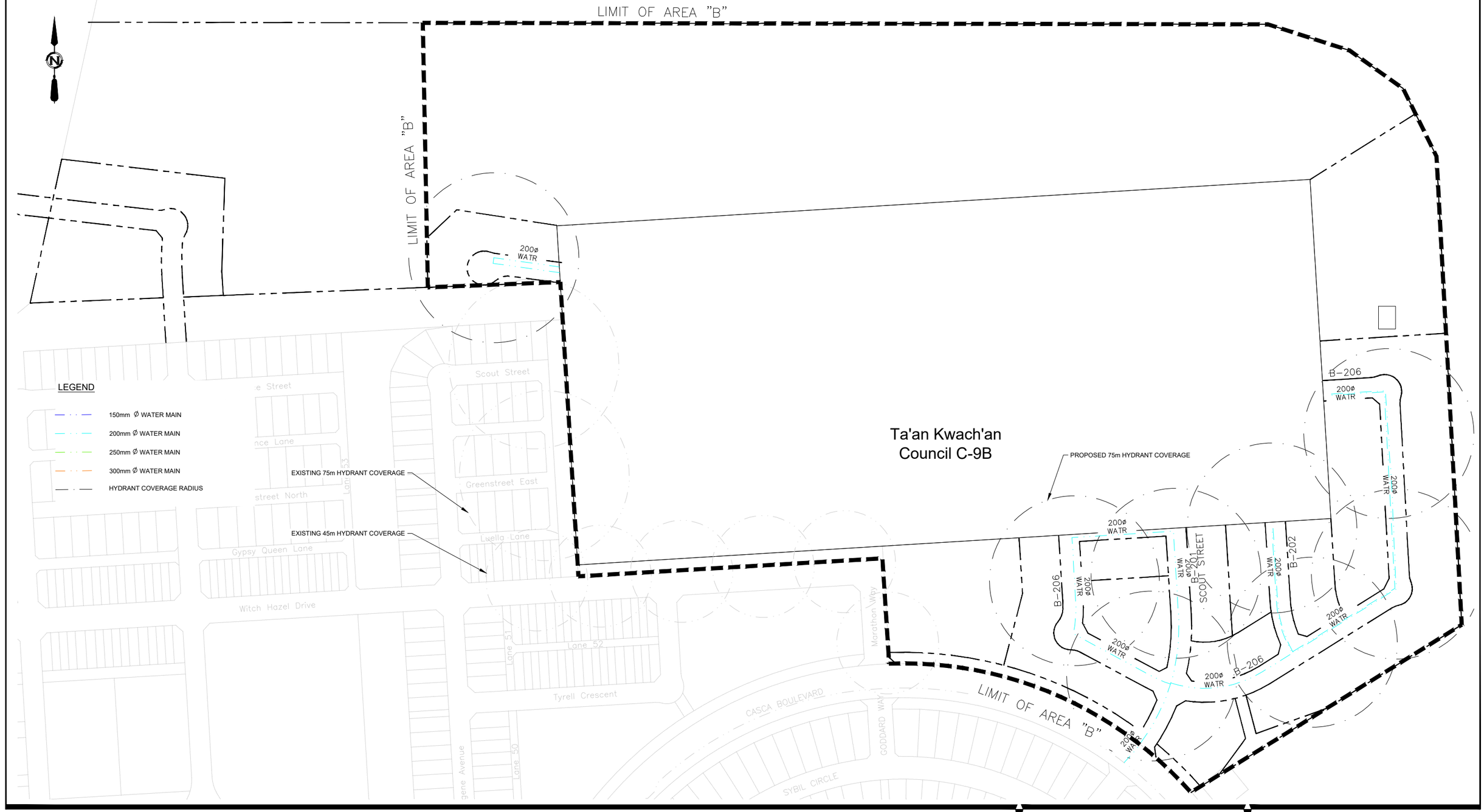
B-4

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'B'
SANITARY FORCEMAIN OPTIONS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

BEST MANAGED COMPANIES

AE PROJECT No.	20182255-00
SCALE	1:1600
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

B-5

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'B'
WATERMAINS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

LIMIT OF AREA "B"

LIMIT OF AREA "B"

Ta'an Kwach'an
Council C-9B

B-206

B-201
SCOUT STREET

B-202

B-205

B-206

LIMIT OF AREA "B"

Reliance Street

Chance Lane

Greenstreet North

Gypsy Queen Lane

Witch Hazel Drive

Rampart Street

Lane 53

Scout Street

Greenstreet East

Luella Lane

Lane 51

Lane 52

Tyrell Crescent

Lane 50

Marathon Way

CASCA BOULEVARD

GODDARD WAY

SYBIL CIRCLE

CUT/FILL LEGEND	
AREA OF CUT	TOTAL CUT - 66,800m³
AREA OF FILL	TOTAL FILL - 3,000m³

Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1600
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

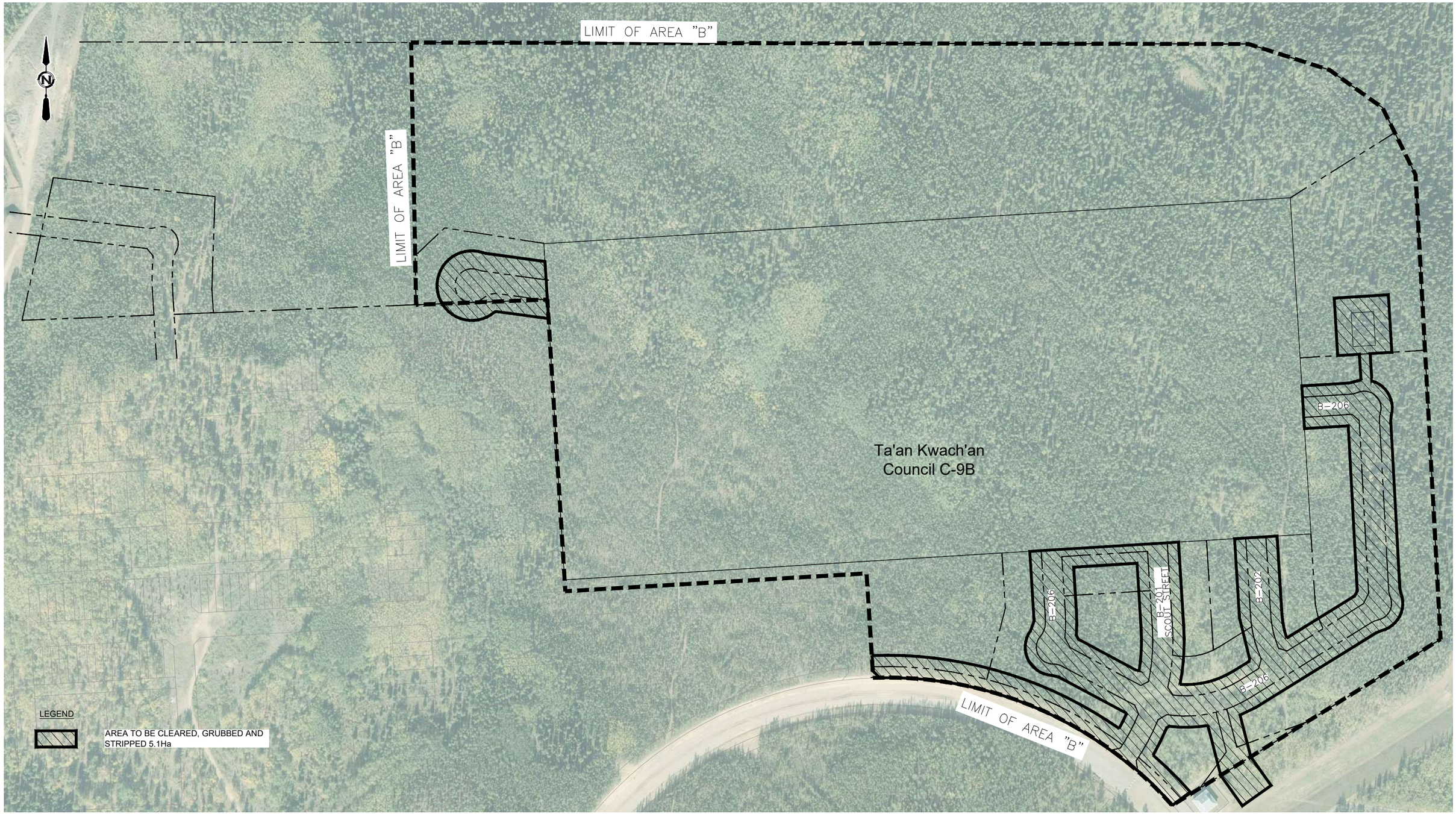
B-6

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'B'
CUT/FILL FROM EXISTING

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1600
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

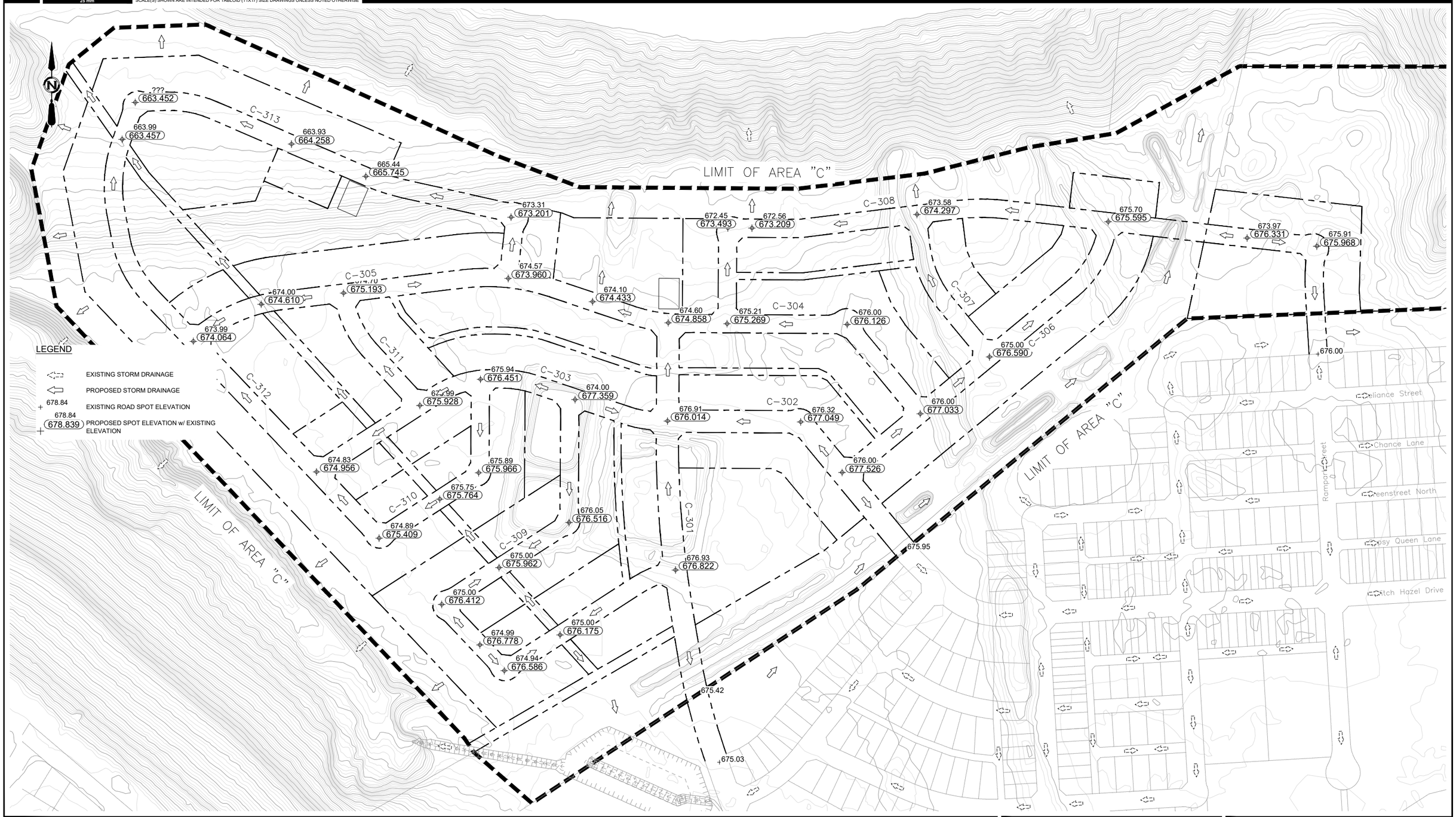
B-7

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'B'
INITIAL CLEARING PLAN

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



LEGEND

- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- 678.84 EXISTING ROAD SPOT ELEVATION
- 678.84 (678.839) PROPOSED SPOT ELEVATION w/ EXISTING ELEVATION

Associated Engineering

WEST MANAGED COMPANIES

AE PROJECT No.	20182255-00
SCALE	1:1750
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

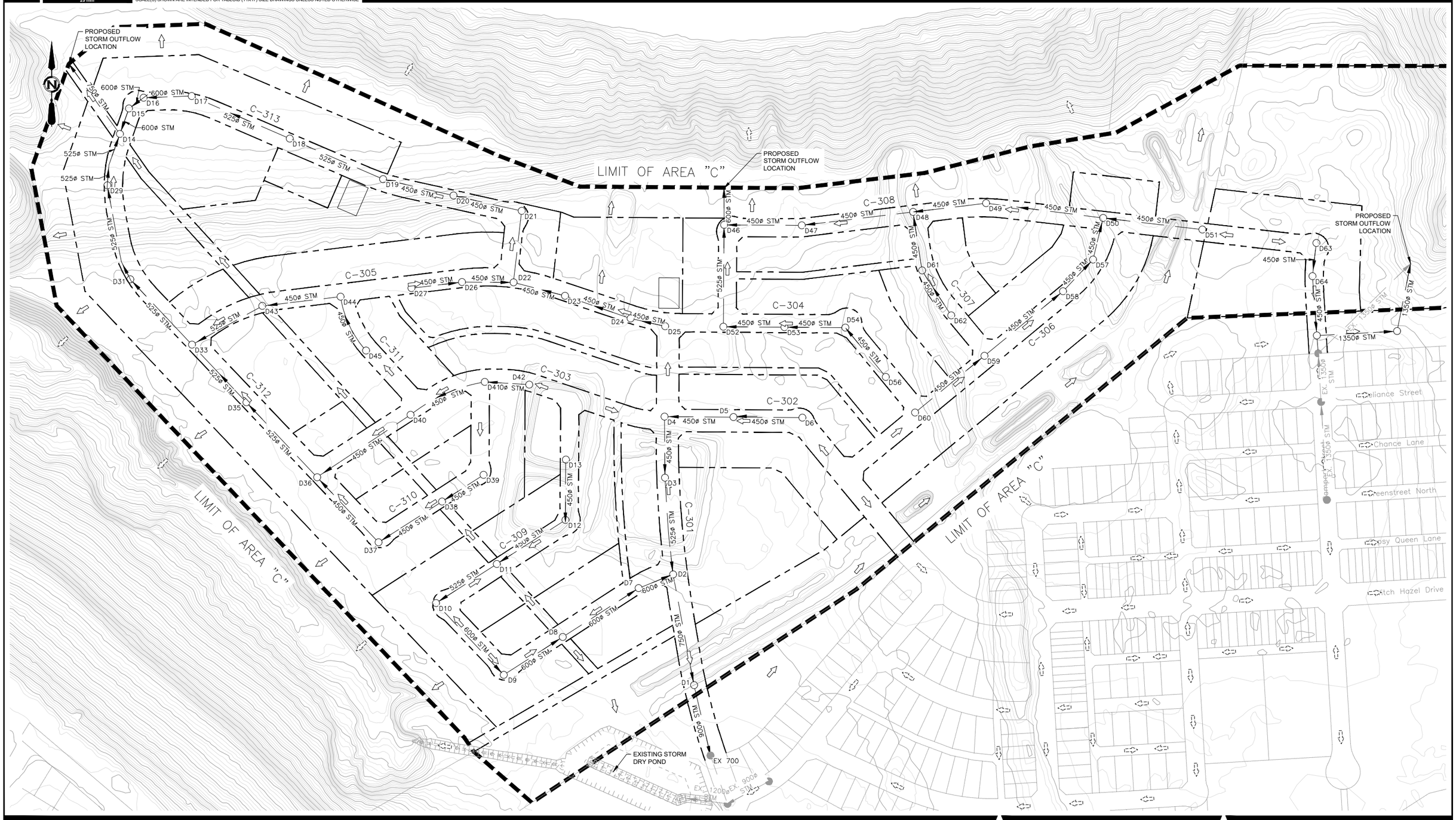
C-1

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'C'
ROAD GRADES & STORM WATER FLOW ROUTES

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1750
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

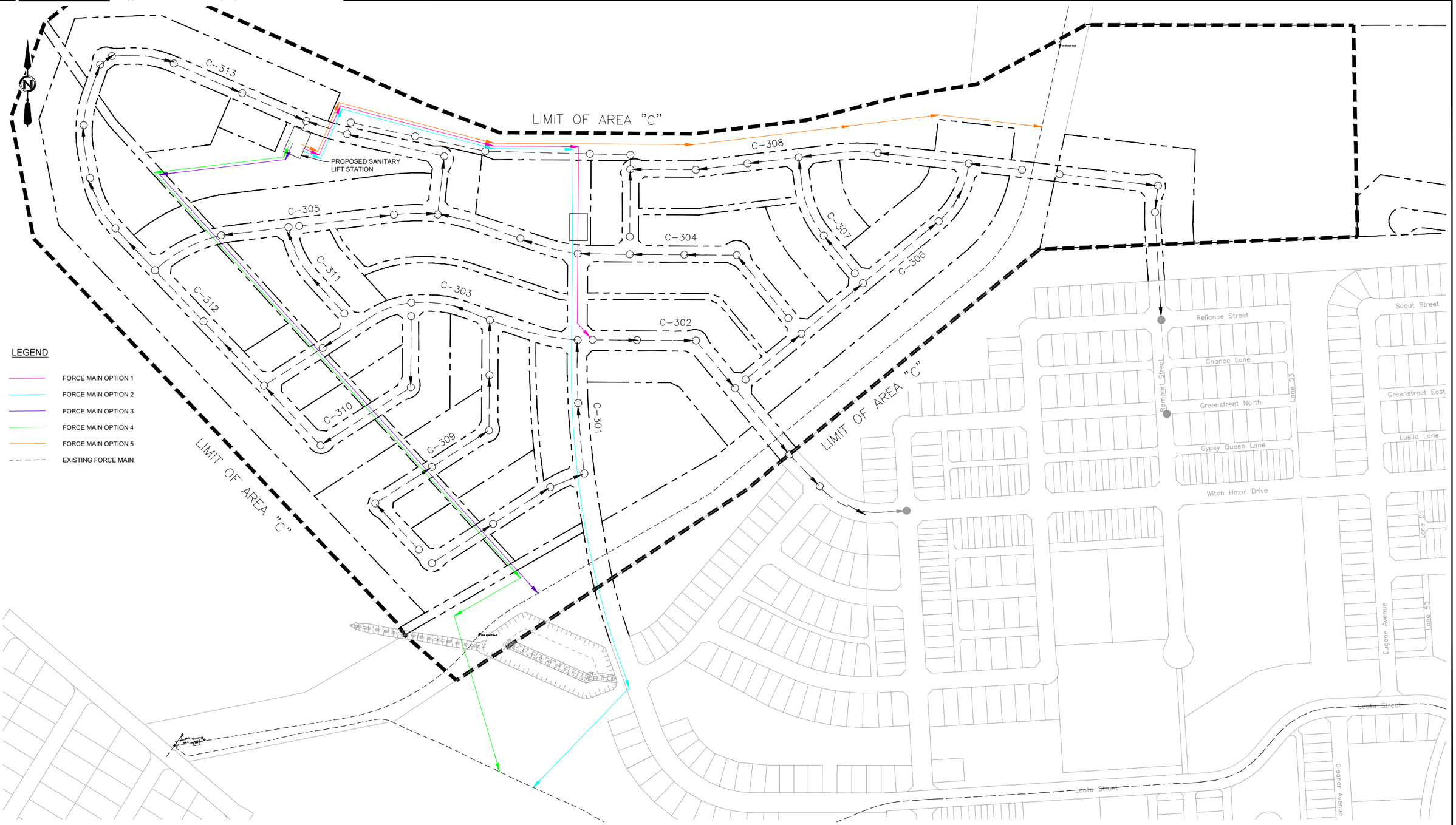
C-2

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'C'
STORM SEWERS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:2000
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

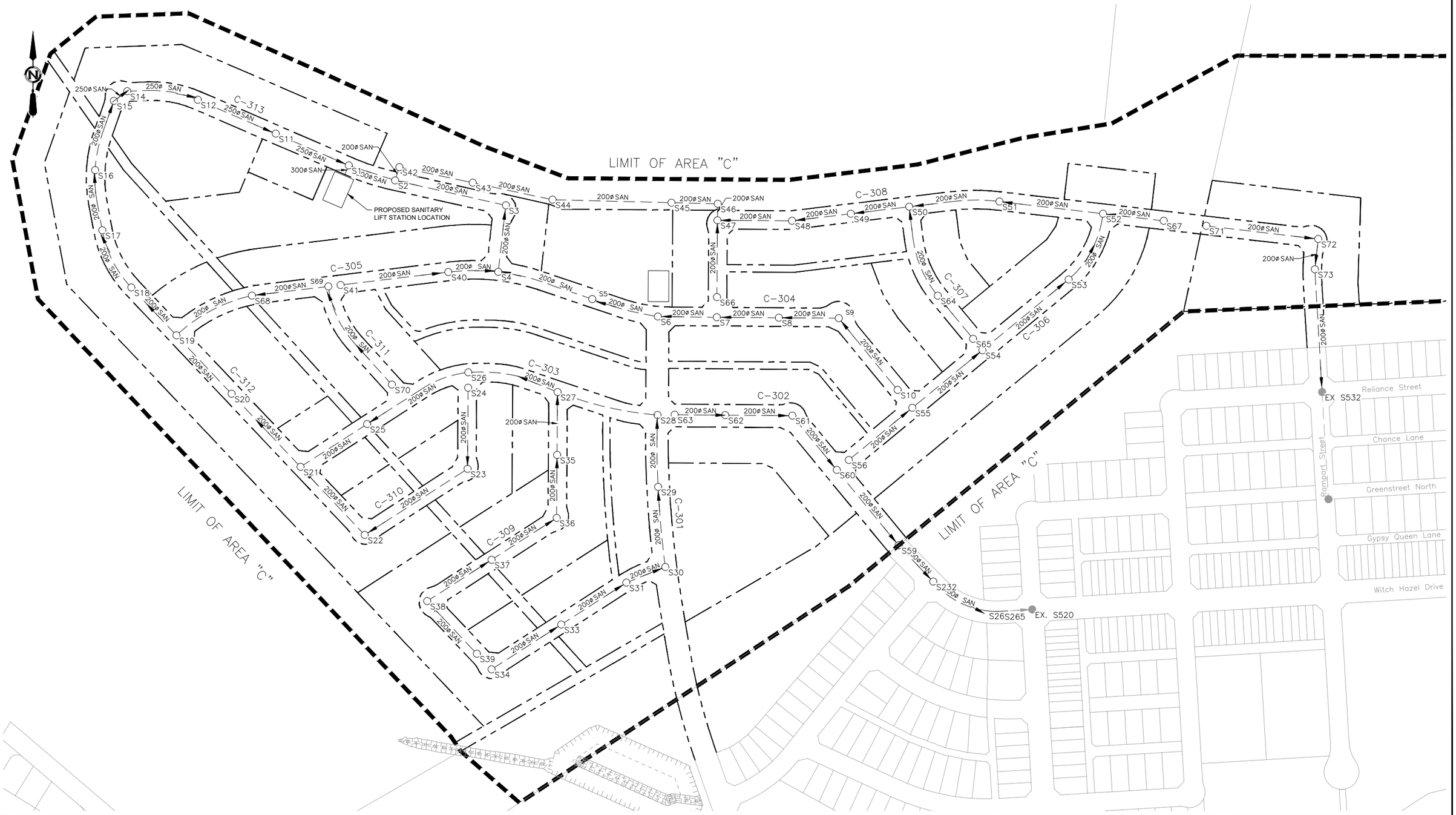
C-3

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'C'
SANITARY FORCEMAIN OPTIONS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1750
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

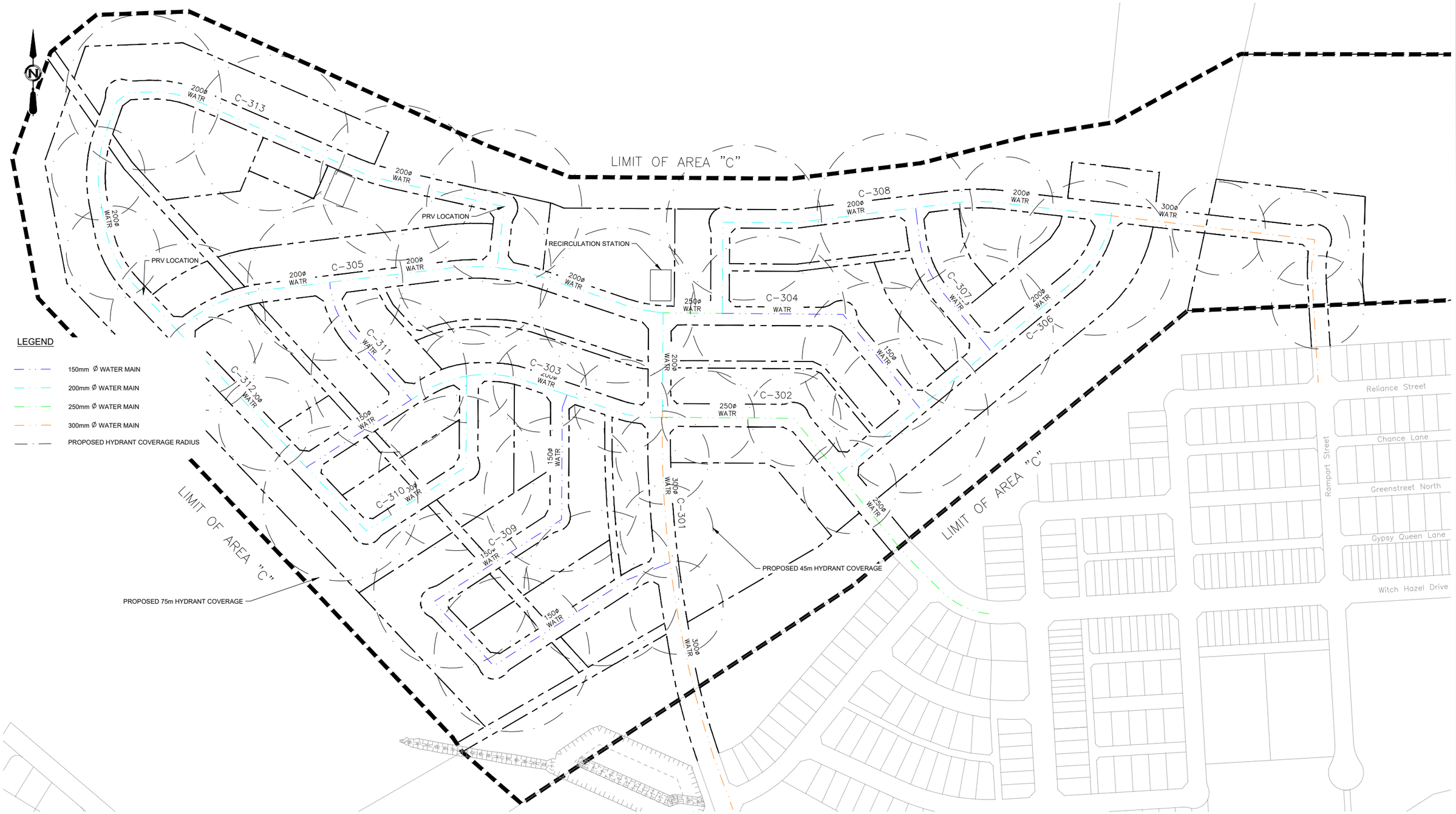
C-4

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'C'
SANITARY SEWERS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1750
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

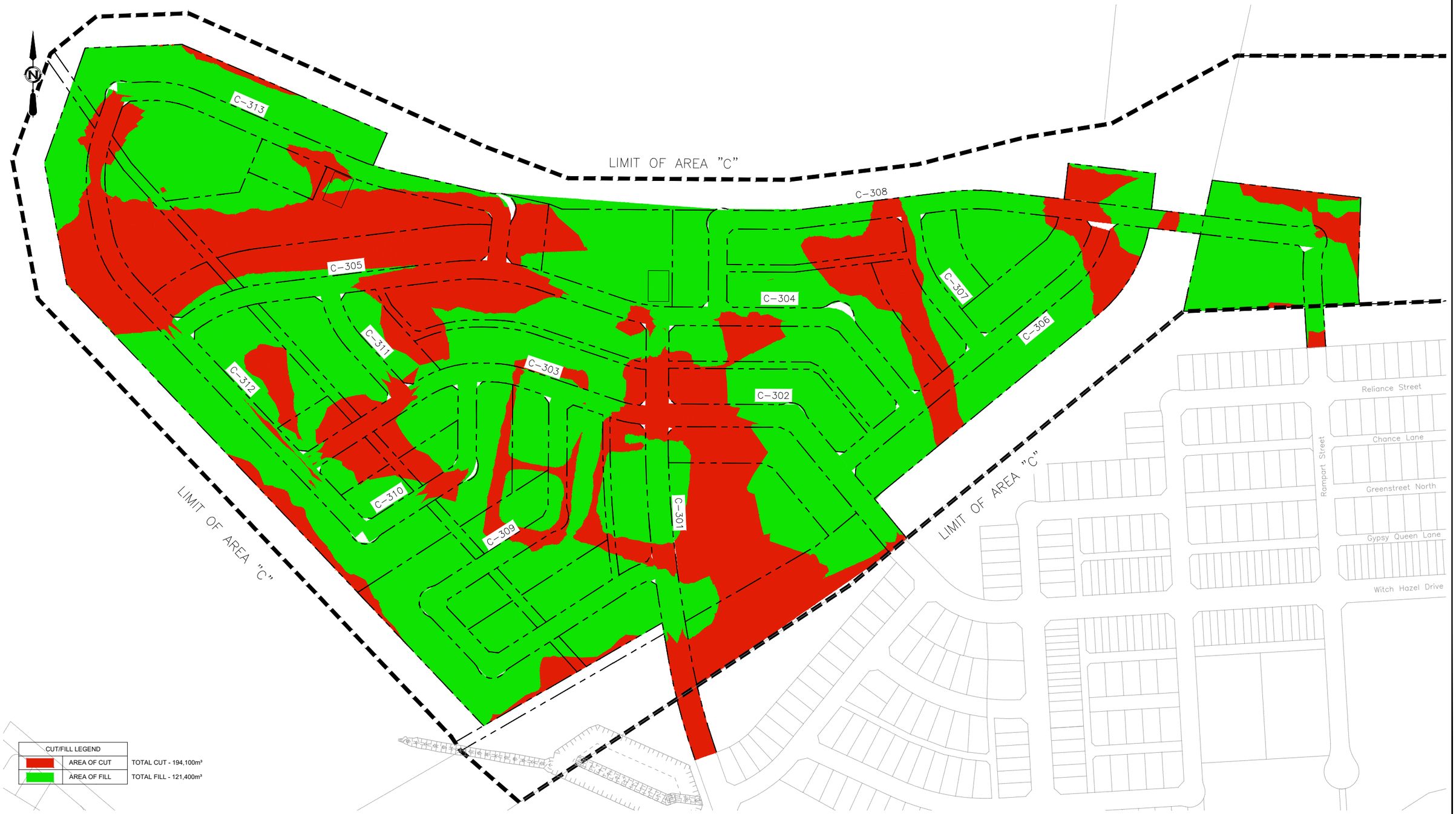
C-5

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'C'
WATERMAINS

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



CUT/FILL LEGEND		
	AREA OF CUT	TOTAL CUT - 194,100m³
	AREA OF FILL	TOTAL FILL - 121,400m³

Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1750
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

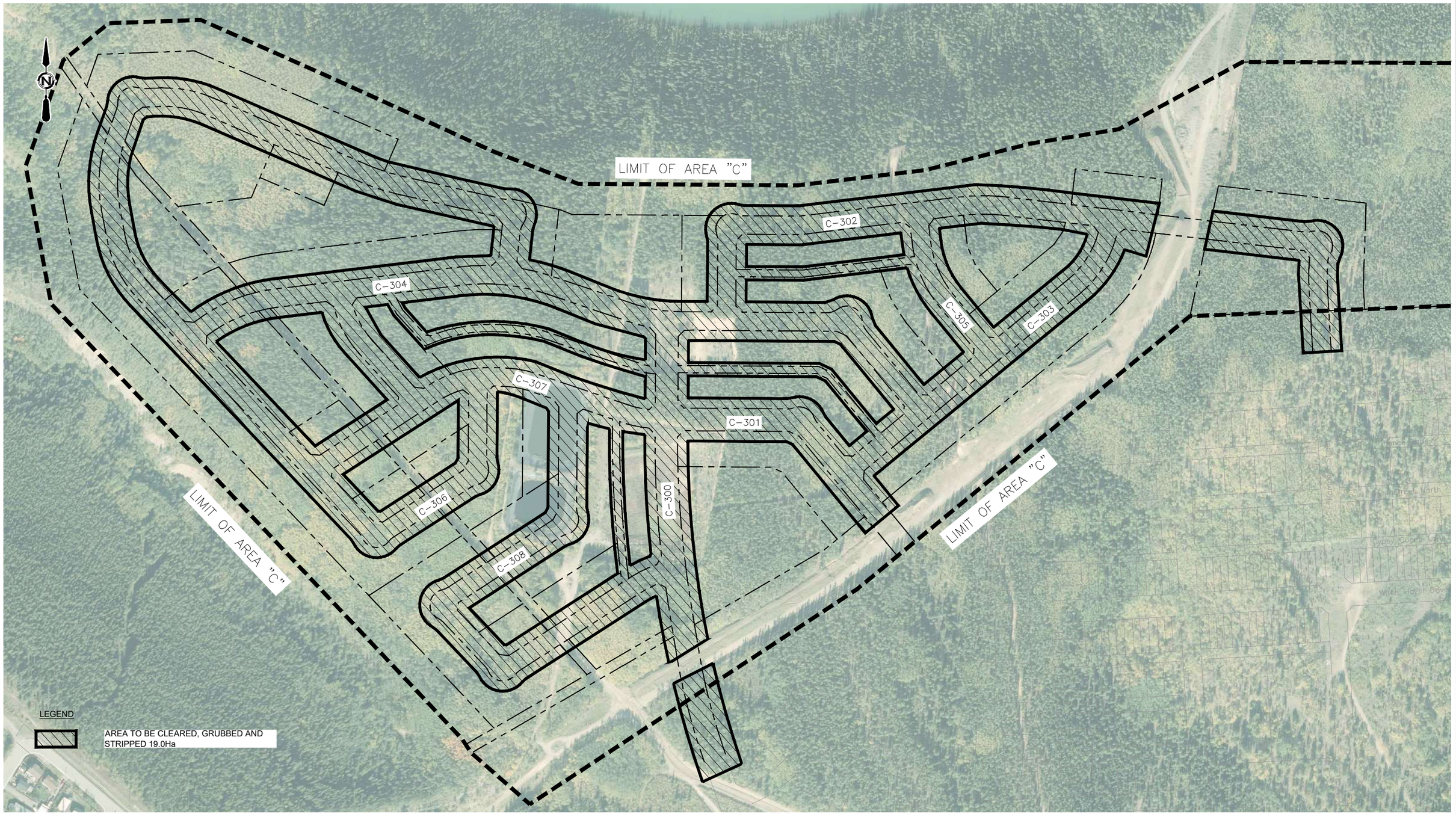
C-6

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'C'
CUT/FILL FROM EXISTING

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:1750
APPROVED	S. BARTSCH
DATE	2019DEC13
REV	B
DESCRIPTION	ISSUED FOR FINAL REPORT

C-7

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
FUTURE AREA 'C'
INITIAL CLEARING PLAN

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:500
APPROVED	S. BARTSCH
DATE	2019APR08
REV	A
DESCRIPTION	ISSUED FOR DRAFT REPORT

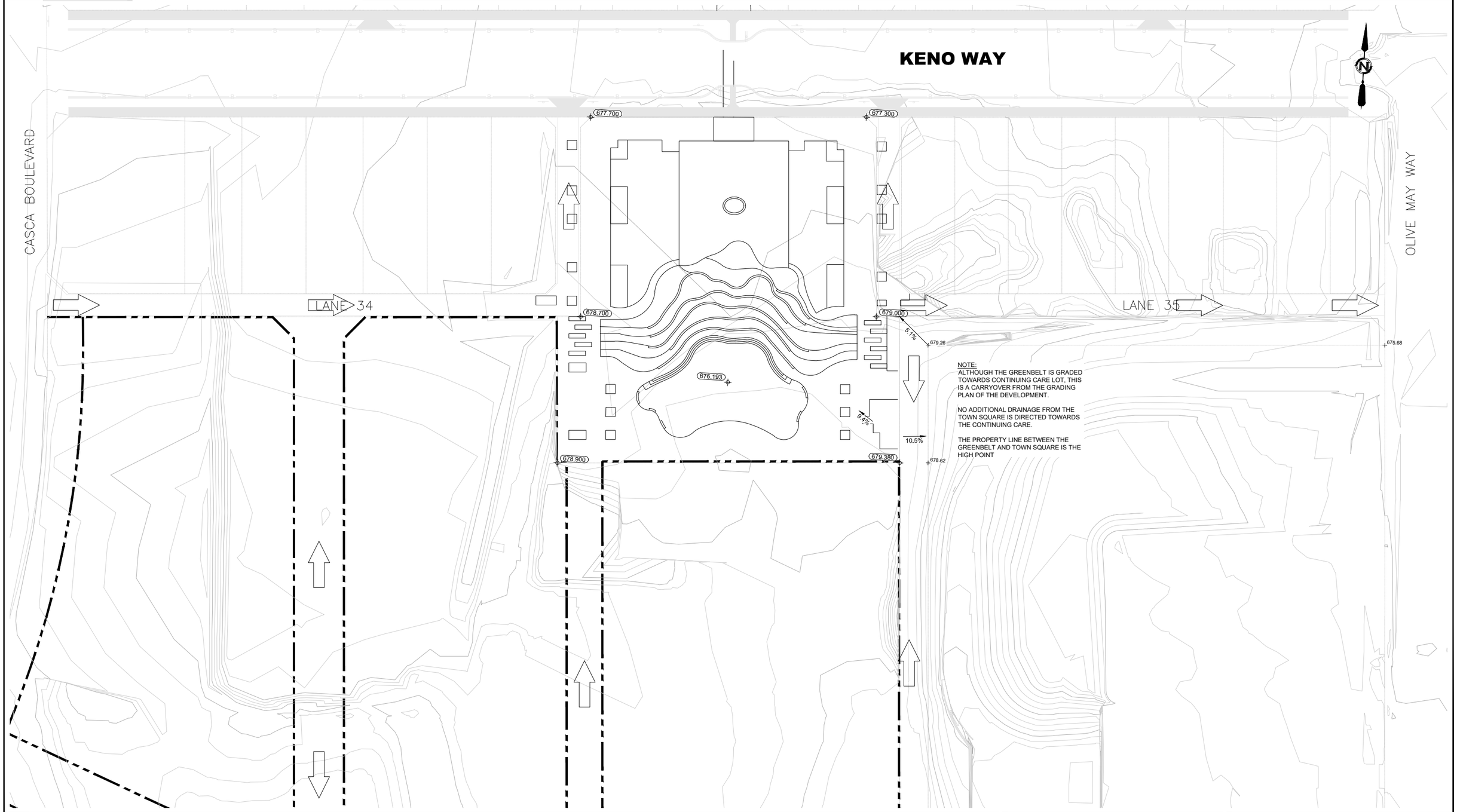
D-1

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
TOWN SQUARE
CUT-FILL

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



Associated Engineering

AE PROJECT No.	20182255-00
SCALE	1:500
APPROVED	S. BARTSCH
DATE	2019APR08
REV	A
DESCRIPTION	ISSUED FOR DRAFT REPORT

D-2

YUKON GOVERNMENT
LAND DEVELOPMENT BRANCH

CIVIL
TOWN SQUARE
GRADING TIE IN TO CONTINUING CARE