

FOR RECOMMENDATION

PUBLIC

OPEN SESSION

TO: Planning & Budget Committee

SPONSOR: Scott Mabury, Vice President, Operations and Real Estate Partnerships

CONTACT INFO: 416-978-2031, scott.mabury@utoronto.ca

PRESENTER: Ron Saporta, Chief Operating Officer, Property Services & Sustainability

CONTACT INFO: 416-978-5098, ron.saporta@utoronto.ca

DATE: January 4, 2021 for January 13, 2021

AGENDA ITEM: 3

ITEM IDENTIFICATION:

Capital Project: Utility Services – Devonshire-Bloor Expansion

JURISDICTIONAL INFORMATION:

Pursuant to section 4.2.3. of the Terms of Reference of the Planning and Budget Committee, "...the Committee considers reports of project planning committees and recommends to the Academic Board approval in principle of projects (i.e. space plan, site, overall cost and sources of funds)."

Under the *Policy on Capital Planning and Capital Projects*, "...Capital projects over \$5 million and up to \$20 million will be considered by the Planning and Budget Committee for projects at the St. George campus and by the respective Campus Affairs Committees and Campus Councils for projects at University of Toronto Mississauga and University of Toronto Scarborough and recommended to the Academic Board for consideration. It is expected that such projects will be placed on the Board's consent agenda and be confirmed by the Executive Committee of the Governing Council. Execution of such projects is approved by the Business Board. [...] If the project will require financing as part of the funding, the project proposal must be considered by the Business Board."

GOVERNANCE PATH:

Project Approval

1. **Planning and Budget [for recommendation] (January 13, 2021)**
2. Academic Board [for approval] (January 28, 2021)
3. Executive Committee [for confirmation] (February 25, 2021)

Execution of the Project:

4. Business Board [for approval] (February 3, 2021)

PREVIOUS ACTION TAKEN:

On January 31, 2020, CaPS Executive Committee approval to engage consultants to initiate design services for the Utility Services – Devonshire-Bloor Expansion project was confirmed. Through a subsequent proposal call, ARUP was selected as the engineering consultant for both the feasibility study and design phase.

HIGHLIGHTS:

As part of meeting the University of Toronto’s Carbon Reduction Commitment, the University's district energy system must be extended to reach all of our new and existing buildings. The Utility Services - Devonshire-Bloor Expansion project allows the proposed developments in that precinct to participate in the transformation to a low carbon future.

University of Toronto’s Carbon Reduction Commitment

Universities have a crucial and unique role to play in helping to meet the challenge of climate change. The University of Toronto (U of T) continues to strengthen its local, regional, and global partnerships to accelerate climate solutions and build community resilience. In 2018, U of T was one of the first universities to join the [University Climate Change Coalition](#)—a group of over 20 leading research universities in North America dedicated to reducing greenhouse gas emissions on their own campuses and in their communities. In 2019, we were the inaugural partner for [the City of Toronto’s Green Will Initiative](#), fulfilled our commitment with the Province of Ontario to complete significant greenhouse gas (GHG) emissions reduction projects—worth over \$50-million in investment, and continued our participation in the [U7 Alliance](#), (an international partnership that brings together leading universities to tackle the most pressing global challenges).

The University of Toronto has a long-standing commitment to social responsibility, environmental stewardship, and operational sustainability that continues to grow in momentum. As part of our commitment to take immediate action on climate change, U of T has set a goal to reduce greenhouse gas emissions by 37 per cent from 1990 levels by the year 2030. The St. George campus—U of T’s largest and oldest campus, responsible for more than 80% of U of T’s carbon footprint—has also initiated a Net Zero Carbon Campus Master Plan (also referred to as the Site Utility Master Plan) that will put the campus on track to achieving carbon neutrality by 2050, in line with peer and regional targets.

In recent years, U of T has made great strides in reducing its carbon footprint across its three campuses, reducing its energy and water usage through various retrofits and sustainability initiatives. For example, despite a 26 per cent growth in floor space and a 50 per cent increase in the number of students, U of T lowered its total greenhouse gas emissions by 32 per cent from 2008 to 2019. Further to this, in 2020 U of T was named one of Canada’s greenest employers – for the seventh time.

To put U of T on a path towards achieving a low-carbon future, a series of initiatives have been implemented. Highlights from the past year include:

- Launched and began implementing our [Low-Carbon Action Plan \(2019-2024\)](#) to put us on a path to achieving our tri-campus carbon reduction goal: a 37% reduction in GHG emissions by 2030, below 1990 levels.
- The St. George campus—responsible for more than 80% of U of T’s carbon footprint—initiated a Net Zero Carbon Infrastructure Master Plan that will put the campus on track to achieving carbon neutrality by 2050.
- Created U of T’s very own Energy Modelling Building Standard that will define superior energy efficient and low-carbon performance. The standard will apply to all new buildings and major renovations across our three campuses to help responsibly manage growth.
- Set the groundwork for major expansion of low-carbon geexchange technology to reduce our building footprint—one such U of T project will mark [Canada’s largest urban geexchange system](#) (the King’s College Circle geexchange system that will heat and cool the buildings surrounding our historic core on our downtown Toronto St. George campus). The Robert Street Field Geexchange System, will also play a key role in transforming the Huron-Sussex Neighbourhood and expanding west-side St. George campus.

These initiatives and projects are projected to reduce U of T’s greenhouse gas emissions by 45,000 tonnes of eCO₂ annually by 2024—more than 80% towards our 2030 goal. As part of reaching these targets, the University’s district energy system must be extended to reach all of our new and existing buildings.

Utility Services – Devonshire-Bloor Expansion

The University is planning to significantly renovate and develop underutilized sites located within the Devonshire-Bloor utility precinct. Specifically:

1. Replacement of Kruger Hall with Woodsworth Academic Building
2. Construction of the Academic Wood Tower as planned over the north section of the Goldring High Performance Sports Complex
3. Construction of a Rotman Commerce Academic Building immediately south of the Goldring Building on an existing parking lot
4. Capacity for future growth in the precinct

The current central utilities servicing this area are inadequate to provide heating to these buildings. The University’s Utilities Department has undertaken an internal analysis to determine a direction on how to best service these buildings, while also efficiently managing both capital and operating costs and participate in the transformation of the St. George campus to a low carbon future.

Options

Two primary options were evaluated with respect to providing the necessary heating and cooling into these projects:

- **Decentralized local infrastructure:** This option would require the construction of larger mechanical spaces in each project, and the installation of a boiler plant in each building.

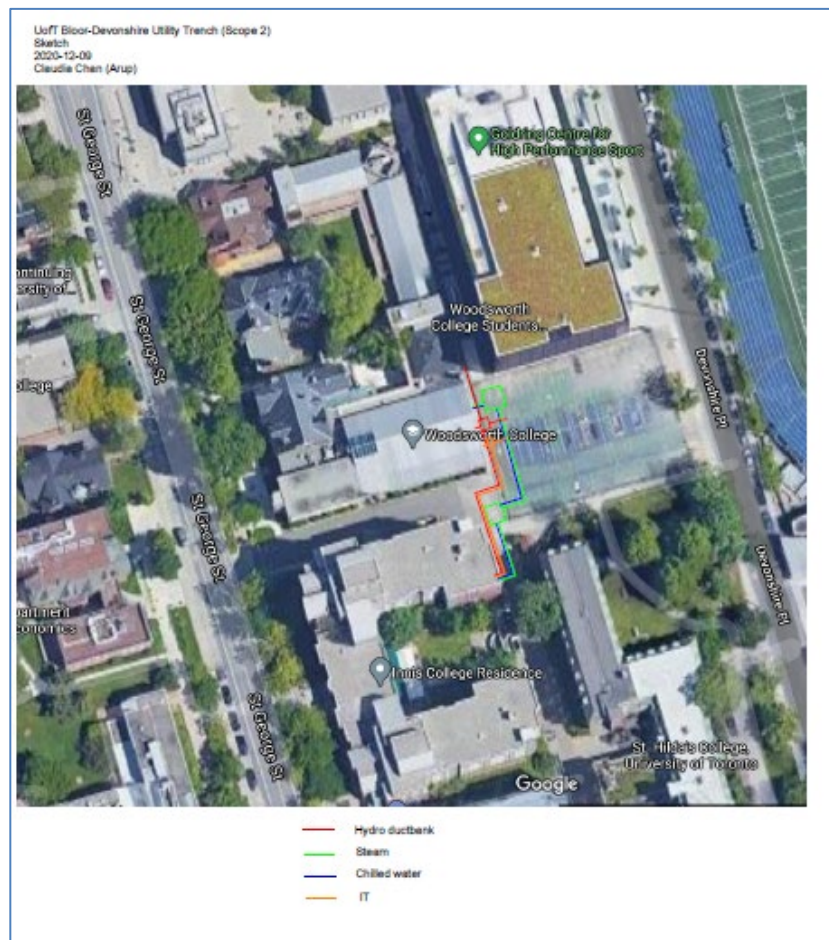
- **Connect to central utility plant:** This option would utilize the university’s central utility plant and extended infrastructure to provide heating and back up cooling. To accommodate this, the distribution network for both steam and chilled water would need to be expanded northwards..

After considering both capital and operating cost implications, proceeding with the central utility plant connection was determined to be the preferred option. Anticipated capital expansion will also require increased capacity for existing IT infrastructure, that will be coordinated as part of this project.

The project will see the expansion of the district energy system from Innis College Residence north to the Goldring High Performance Sports Complex through:

- Installation of an inverted trench from the north end of the Innis College Residence garage to the Goldring High Performance Sports Complexcentre
- Introduction of a prefabricated utilities chamber location to the east of the new Woodsworth Academic Building
- Incorporation of thermal, electrical and IT distribution pathways

Figure 1: Layout of proposed Devonshire-Bloor Utility Expansion



University of Toronto
Devonshire Utilities – Woodsworth
Academic Enabling Works
Issued for Tender Basis of Design

Rev. 7 | July 16, 2020



UNIVERSITY OF
TORONTO

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

JN 273660-00

Arup Canada Inc.
121 Bloor Street East
Suite 900
Toronto ON M4W 3M5
Canada
www.arup.com

ARUP

Contents

	Page	
1	Introduction	2
1.1	Background Information	3
1.2	LiDAR Scanning	3
2	Basis of Design – Bloor-Devonshire Trench	5
2.1	Mechanical	5
2.2	Civil	9
2.3	Electrical	12
2.4	Structural	12
2.5	Geotechnical	14
2.6	IT - Communications	16
3	Key Design Assumptions	22
4	Impact on Campus Buildings	23

1 Introduction

The purpose of this basis of design report is to provide the University of Toronto (UT) with a description of the Arup mechanical, electrical, civil, structural, and IT design for the Bloor-Devonshire Precinct Utilities Upgrade project.

Arup's scope includes the design of four independent but related projects, Bloor-Devonshire Trench (BDT), Trinity T trench (TT), Fitzgerald low temperature upgrade (FLT), and the new Central IT and Rotman AV inter-building backbone fibre line. This basis of design report will focus on the BDT and the new Central IT and Rotman AV scope.

Arup initially provided Design Development documents for the BDT on May 12, 2020. On UT's request on June 6, 2020 the trench system to connect the existing steam, condensate and chilled water services from the existing Innis College Residence parking garage to the utilities tunnel located in the Woodsworth College Building was removed from the scope. Arup will be providing the civil, structural, mechanical, electrical and plumbing (SMEP) design for the following scope:

As part of this scope, the routing and requirements for a back-up Bypass fibre line will be provided to allow for the construction of the proposed Woodsworth Addition building that is currently in the construction documentation (CD) design phase. Our work includes design coordination with the proposed Woodsworth Addition building design team to understand the spatial constraints between the construction zone shoring and the new service trench, mechanical and electrical system interface requirements, logistics, and project schedule, etc. The design is based on the following:

- Extend a new direct buried 150mm (6in.) dia. steam line, 75mm (3in.) dia. condensate return, lines from the Innis College Residence up to the Goldring Centre foundation wall as a temporary bypass.
- Extend a new 150mm (6in.) dia. steam line, 65mm (3 inc.) dia. condensate return above grade on a racking system from the Goldring Centre foundation wall to the Woodsworth College utility tunnel as a temporary bypass.
- Provide two (4) 150mm dia. PVC conduits for high voltage (HV) cables in a concrete ductbank from a new pull chamber up to the Woodsworth Addition construction zone.
- Design of one (1) pull chamber for the HV cables.
- Provide a fibre optic bypass line in a buried ductbank to accommodate the construction of the proposed Woodsworth Addition building.

1.1 Background Information

The following data was provided by UT:

- Existing topographic survey;
- Existing site servicing (utilities) for St. George campus;
- Existing Goldring Centre (and steam tunnel) design drawings;
- Existing floor plans for Innis Parking Garage, Woodsworth College, Woodsworth Annex, Robarts Library and Goldring Centre;
- Existing Woodsworth College Buildings 38 and 130;
- Existing underground fibre layouts within the project area;
- Existing structural drawings for Goldring Centre, Woodsworth College Building 130;
- City of Toronto's Digital Map Owners Group (DMOG) drawings used for the proposed Woodsworth Addition design;
- Proposed Academic Wood Tower Mechanical Design Brief;
- Proposed Woodsworth Addition design drawings;
- Functional Servicing and Stormwater Management Report for proposed Woodsworth Addition; and
- Proposed Margaret Fletcher renovation design drawings.

1.2 LiDAR Scanning

To supplement the data listed in Section 1.1, a LiDAR scan was completed by the Arup team on various dates in February 2020. Existing steam pipes, chilled water, fire line, heating water and conduits were located within the existing Woodsworth utility tunnel and Innis Residence parking garage and inserted into the Revit model. A sample of the results of the scanning are seen in the below photographs.



Figure 1 – LiDAR Scan of the Existing Steam Tunnel in Woodsworth College

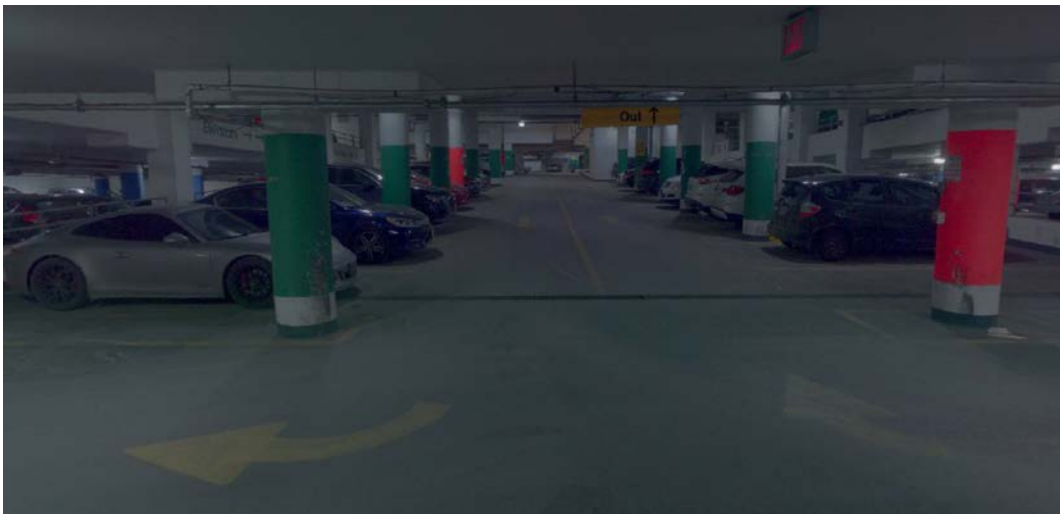


Figure 2 – LiDAR Scan of the Existing Innis Residence Underground Parking

2 Basis of Design – Bloor-Devonshire Trench

The following sections will describe design parameters of each discipline related to the design of the proposed Bloor-Devonshire utility trench. This report should be read in conjunction with Attachment 1 – Design Drawings.

2.1 Mechanical

2.1.1 Applicable Codes, Regulations and Standards

Mechanical system design will conform to the requirements as specified in the RFP and shall comply with, but not limited to, the following codes, regulations and standards stated in the MEP and Civil specifications.

2.1.2 Piping

There are two mechanical services that must be routed from the existing parking garage located in the Innis Residence to a service tunnel located in the basement of the Woodsworth building. The services are initially directly buried to a pre-fabricated chamber and transition to an above grade pipe rack, and then indoors in the Woodsworth the existing Woodsworth building. Connections will be provided in the existing utility tunnel for the future Woodsworth Addition. The services are as follows:

- Steam 1,380 kPa (200psig) 150mm (6 in.) dia., 75mm (3 in.) dia. pumped condensate, from the Innis Parking Garage to a pre-fabricated chamber located on the east side of the Woodsworth Addition.
- Steam 1,380 kPa (200psig) 150mm (6in) dia., and 75mm (3 in.) dia. pumped condensate from the pre-fabricated chamber travelling north above grade along the Goldring path, through Woodsworth College, and into the existing utility tunnel.

The proposed Woodsworth Addition will be serviced from connections provided in the existing utility tunnel. The following indicates future estimated loads which have been provided by the Woodsworth Addition design team, Mechanical Report 19234.000.M.001 (dated 2019-11-18):

- Steam 1,380 kPa (200 psig): 1,364 kg/hr (3,000 lbs/hr)
- Pumped Condensate: 0.37 lps (6 gpm)

The corresponding connection sizes for the proposed Woodsworth Addition building services are as follows:

- Steam 1,380 kPa (200 psig): 50mm (2 in) dia.

- Pumped Condensate: 38mm (1.5 in) dia.

All piping steam and condensate piping shall be welded and manufactured using the materials described in Table 1. Chilled water can be welded, grooved, or screwed.

Table 1 – Pipe Characteristics of Steam, Condensate and Chilled Water

Service	Pressure kPa (psig)	Pipe Size (NPS)	Material Type
Steam	1,380 (200)	Up to 1 ¼	ASTM A106 Schedule 80 carbon steel, seamless
Steam	1,380 (200)	1 ½ and above	ASTM A53 Grade B Schedule 40 carbon steel, Seamless
Pumped Condensate	< 1,035 (150)	All sizes	ASTM A106 Schedule 80 carbon steel, seamless

2.1.3 Pipe Insulation

All service piping will be insulated according to Table 2 below.

Table 2 – Pipe Insulation Thickness Requirements

Service	Fluid Temperature °C (°F)	Insulation Type	Nominal Pipe Size (NPS)				
			Up to 1	1 to 1 ¼	1 ½ to 3	4 to 6	8 and above
Steam (exterior)	208 (406)	Foamglas	2 1/2	3	3	4	4
Pumped Condensate (exterior)	< 121 (250)	Foamglas	1 ½	1 ½	2	2	4
Steam and Condensate (direct buried)	208 (406)	Mineral Wool	1	1	1	2	NA
Steam (interior)	208 (406)	Molded Mineral Wool	2 1/2	3	3	4	4

Service	Fluid Temperature °C (°F)	Insulation Type	Nominal Pipe Size (NPS)				
			Up to 1	1 to 1 ¼	1 ½ to 3	4 to 6	8 and above
Pumped Condensate (interior)	< 121 (250)	Molded Mineral Wool	1 ½	1 ½	2	2	4

2.1.4 Pipe Supports, Guides, Anchors, and Expansion Compensators

The above ground piping system will consist of pipe supports, pipe guides, pipe anchors and expansion compensators.

Pipe supports suspended from a ceiling shall be an adjustable steel yoke pipe roll similar to Anvil Fig.181. Pipe guides shall be a hot-dip galvanized spider type clamped to the pipe. The pipe guides shall be bolted to the concrete trench floor with zinc plated bolts and nuts.

Pipe anchors shall be fabricated out of structural steel angles, channels, or gusset plates welded to the piping. Above grade anchors will be secured to the concrete building structure unless otherwise shown. Direct buried anchors shall be according to manufacturer's recommendations. Typically, it's a welded steel plate that is embedded in a poured concrete block.

Flexible hose expansion loops shall be provided as shown. The loop shall be constructed of double-braided stainless steel with weld ends.

2.1.5 Condensate

Based on a discussion with the chief operating engineer on May 1, 2020, the main condensate distribution line collects pumped condensate from the various buildings condensate receivers. High pressure drip lines empty into the pumped condensate line and is allowed to flash within the distribution network. There will be elevation changes within the piping network due to the location of the valve chambers and new bypass line. Any existing upstream condensate receivers need to be capable overcoming the elevation changes and should be confirmed by the University. High pressure drip lines for this project will be connected into the pumped condensate piping system as per the existing operation.

2.1.6 Drainage

Drainage will be provided for the pre-fabricated chamber. The pre-fabricated chamber floor shall be sloped to one end towards a sump. Two submersible type

pumps shall be located inside the sump. Sumps will come with floats and a control panel. High level alarm signal will connect to the closest BAS controller located inside the Innis Parking garage. Emergency power will be provided to the sump pumps from the nearest available power source (location TBD). The sanitary water discharge from the pumps will be connected to the sanitary drainage line located in the P2 level of Innis Garage. Drain lines shall be provided at the end point of the direct buried pipe in pipe system entering the building as per the manufacturer's recommended installation detail. The drain lines are capped to alleviate any water that may enter the space between the outer pipe and the interior carrier pipe.

2.1.7 Phasing

The following Devonshire will occur in two stages:

Stage 1:

Steam and condensate connections need to occur in the Innis Residence parking garage and the Woodsworth service tunnel first. The installation is only allowed to occur during the Central Utility Plant's shutdown period from August 24 to August 26 (3 days). Isolation valves shall be provided in the Innis Residence parking garage for the 150mm (6 in.) bypass steam and 75mm (3 in.) condensate line and for a future 200mm (8 in.) steam and 100mm (4 in.) condensate for a future trench. Capped and valved connections shall be provided inside the Woodsworth service tunnel to allow for the initial 150mm (6 in.) bypass steam and 75mm (3 in.) condensate line. In addition, a 50mm (2 in.) steam line and 40 mm (1 ½ in.) condensate valved and capped connections shall be provided in room 17. The lines will be extended into the Woodsworth utility tunnel in Stage 2 to allow for a future connection to the Woodsworth Addition. Contractor is required to have the necessary valves and pipe sections pre-fabricated to minimize on site welding. Refer to drawings M-100, M-104, M-200, M-201, and M-300 for location of connection points.

Stage 2:

The direct buried piping shall be constructed from the Innis Residence parking Level 1 to a pre-fabricated chamber located east of the future Woodsworth Addition (refer to drawing M-010). The pipe sizes from the Innis Residence parking to the valve chamber is 150mm (6 in.) steam and 75mm (3 in.) condensate. The valve chamber shall contain an anchor and steam traps.

The 150mm (6 in.) steam and 75mm (3 in.) bypass line will leave the chamber below grade and rise above grade. The above grade piping shall be supported on an outdoor pipe rack and will travel north and will drop down into Room 17 inside the Woodsworth building B1 level (refer to drawings M-010, M-201, and M-402). Piping shall travel across the ceiling space of the Woodsworth basement and will tie into the valve connections inside of the utility tunnel provided in stage 1. A 50mm (2 in.) steam line and 40 mm (1 ½ in.) condensate line will be

extended into the Woodsworth utility tunnel and capped for a future Woodsworth Addition connection (Refer to drawing M-104).

Steam and condensate piping shall be cleaned and flushed prior to commissioning.

2.2 Civil

The following section will describe the existing utilities, proposed chamber and IT bypass line.

2.2.1 Applicable Codes, Regulations and Standards

The following local codes and standards will be applied.

- City of Toronto, Standard Construction Specifications and Drawings for Sewers, Watermains and Roads;

2.2.2 Existing Utilities

A plan has been developed to show existing utilities based on the data provided by UT, refer to “Existing Conditions – Utilities Plan,” drawing C-101 in Attachment 1. A summary of the existing utilities and future proposed utilities are discussed below.

Laneway Between Goldring Centre and Woodsworth College

As seen on drawing C-101, it is possible that an existing underground hydro ductbank, hydro chamber and communications line are located along the existing laneway/proposed alignment of the utility trench (running north-south). Currently, these existing utilities appear to be in direct conflict with the proposed utility trench. Upon completion of the SUE field investigation, Arup can confirm whether a conflict exists and the extent of removal and relocation required. It was confirmed by UT during the meeting held on March 4, 2020 that these existing hydro ducts are empty. Since the SUE field investigation has been delayed due to Covid-19 restrictions, the existing hydro ductbank and chamber have been labelled to be removed in the drawings for the portion where it is in direct conflict with the proposed utility trench and the proposed hydro ductbank.

Laneway Between Woodsworth College and Innis Residence

There is an existing 150mm diameter storm sewer located along the existing laneway (running east-west) between Woodsworth College and Innis Residence, just north of the ramp to the underground parking. This storm sewer will be replaced by a new 300mm diameter PVC storm sewer (by the proposed Woodsworth Addition team).

Southwest Corner of Woodsworth College

There is also an existing 100mm dia. sanitary sewer exiting the southwest corner of Woodsworth College that connects to an existing maintenance hole (MH), which then connects to the existing 750mm x 1125mm combined sewer on St. George St. The existing sanitary sewer connection will be replaced by a new 200mm dia. PVC sanitary sewer (by the proposed Woodsworth Addition team).

West Side of Woodsworth College, Just South of Industrial Relations and Human Resources Library

Additionally, there is an existing 50mm dia. domestic watermain service connection located on the west side of Woodsworth College, just south of Industrial Relations and Human Resources Library that will be replaced by a new 200mm dia. PVC watermain (by the proposed Woodsworth Addition team). It should be noted that all services tie into the existing sewers and watermains on St. George St.

It is understood that all utility works related to the Woodsworth Residence Addition will occur after the construction of the proposed utility trench related to this scope. Thus, the proposed utility trench design will consider these utility works and shall coordinate with the Woodsworth Addition team to avoid any potential conflicts related to this project area.

Confirmation of the existing utilities and their location will be provided from an upcoming SUE field investigation. Once the investigation is complete, the Arup team will update drawing C-101 and advise the number of conflicts and requirements for potential protection/relocation. Due to the restrictions of Covid-19, all site investigations including the SUE field investigation have been delayed. As the existing utilities have not been field verified at Design Development, there may be potential design changes in the next design phase as a result.

2.2.3 Proposed Works

Chamber

There is one proposed prefabricated chamber located to the east of Woodsworth College as shown in the drawings and Figure 3. Refer to the drawings for dimensions and depth. It should be noted that the proximity, depth and conditions of the existing foundations of Woodsworth College are not known at this time. To continue the design, it has been assumed that the existing foundations of Woodsworth College is consistent with the Margaret Fletcher building.

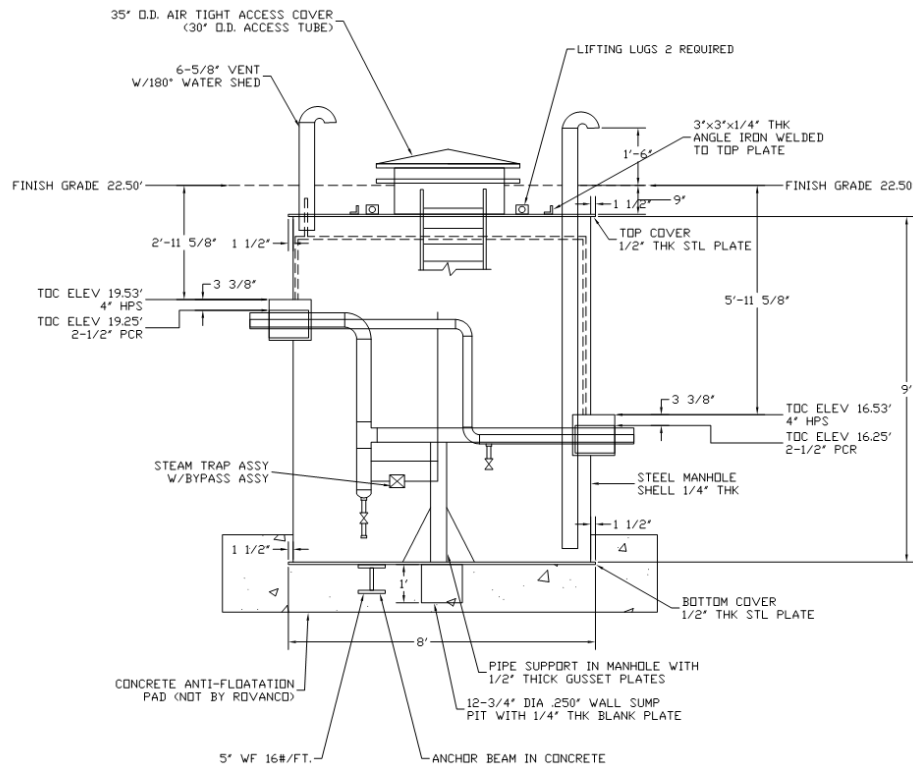


Figure 3 – Proposed Prefabricated Chamber

IT Bypass Line

The proposed IT bypass line is located on UT’s property just west of Woodsworth College from Innis Residence to Woodsworth College Block A. It has been proposed that Horizontal Directional Drilling (HDD) will be used to install this line. The feasibility and assessment of this construction method is currently in progress. The following should be noted:

- Location of the drill areas are to be in the softscape areas to avoid hardscape and surface disruption.
- Open trenching as an alternative to HDD may also remain as a feasible means of installation pending confirmation of surface constraints and coordination with UT and the proposed Woodsworth Addition team.
- Potential conflicts exist with both existing services and the future proposed services. A total of 7 utility crossings (existing and future) are anticipated. There are lots of trees in the work area which will constrain the HDD rig working zone location and receiving pit.
- Depending on HDD alignment, the Innis College driveway may need to be closed to accommodate working area.

- Working space for HDD rig, equipment, laydown, hoarding will be constrained and will be in close proximity or conflict with tree protection zones.
- Each conduit bend must have a sweep and a maximum of two 90 degree bends are allowed between pull chambers.

2.2.4 Data Collection and Investigations

The Arup team is currently working with UT to obtain the following supplemental data required to complete the design:

- An additional subsurface utility engineering (SUE) quality level B (QL-B) and QL-C field investigation has been requested to verify all existing utilities within the project area. This will include locates and obtaining information (i.e. inverts, pipe size, material, etc.) from catch basins (CB) and maintenance holes (MH).
- One test pit to expose the existing foundation of Woodsworth College to determine the exact location and depth.

2.3 Electrical

A ductbank and maintenance hole system will be provided between Woodworth College to the area of Woodworth College Expansion for future high voltage wiring. All routing and sizing have been per UT project team request. All high voltage wiring to be supplied by others.

All underground services will meet UT standards with the exception of the manhole outside of Woodsworth college, which will be smaller due to space limitations. This has been flagged with the UT project team and noted as variance on the UT design standards checklist. Refer to Attachment 2 for UT Design Standards Checklists. Furthermore, the UT project team has flagged an existing conduit crossing in said area. In the absence of record drawings, the contractor has been instructed to verify exact location of existing underground services.

2.4 Structural

2.4.1 Existing Building Conditions

There are several penetrations from services through existing and new buildings. New pipe penetrations into tunnels and buildings will be below ground level and therefore not have any impact on the exterior architecture. The engineering proposals made in connection with the rerouting of the mechanical pipework and associated runs relate to two existing buildings and one proposed new structure. These buildings are as follows:

Innis Residence Garage

The Innis Residence Garage is below grade parking garage. The piping travels along P2 level and rises up to P1 through a reinforced concrete slab and then pierces the upper part of the perimeter retaining wall at level P1. An inspection of the original structural drawings has been undertaken to review the impact of the new openings. It has not been possible to review the present arrangement on site and this should be undertaken prior to construction in order to check that no new openings have been constructed in these areas since the time of original construction.

The floor slab appears to be a simple flat slab construction. The slab is continuously connected to the perimeter wall. As the new openings are close to this support, the impact on the slab is minor, and no external reinforcement of the slab is considered necessary. Notwithstanding this, the new openings have been placed as far apart as possible within the slab 'middle strip' to minimize impacts.

The retaining wall appears to consist of a vertically spanning retaining wall. The wall spans from floor to floor. The wider spacing of the holes assumed for the floor penetration has been adopted for the wall, again to reduce impact. External reinforcement in the form of two steel channel sections has been added in order to assist with lateral transfer of the wall forces around the holes.

Waterproofing of the new openings in the wall has not been considered as part of the structural assessment.

Existing Woodsworth Building – (Steam and Condensate bypass line)

A temporary diversion of the steam and condensate will be undertaken. In order to reconnect the utilities, a new connection through the basement of the existing Woodsworth building will be required.

The pipework will enter the building below grade through the foundation wall directly into the basement. From here it will run under the suspended first floor to the below ground service trench adjacent.

As in the case of the Innis Building, the structural assessment has been based on an inspection of the original construction drawings only. Due to Covid 19, on-site inspections have not been possible. This inspection should be carried out prior to construction, in order to check for any later modifications to the building that are not reflected in the original construction drawings.

The building consists of load bearing masonry walls supporting one way spanning hollow core pre-cast concrete planks. The new openings required will be a small distance below the bearing of these planks onto the masonry, and as such the planks must be fully propped during the formation of the new opening.

New steel lintels have been proposed. These must be supported on solid masonry. The space above the new lintel must be solidly packed with solid masonry to provide support to the precast concrete planks prior to removal of any propping.

Fire protection of the new opening between the utilities tunnel and the basement has not been considered. Waterproofing of the new external opening has not been considered.

New Woodsworth Building

The redirected utilities will enter the new building via an opening to be designed by the Woodsworth addition engineering team. The utilities will exit the Woodsworth addition via a new vertical service shaft, again to be designed and constructed by the Woodsworth engineering team.

At the head of this new vertical shaft the utilities will turn to run horizontally. The redirected utilities will then enter the end of the existing service utility tunnel. The head of the shaft and bend in the utilities will be accommodated by a short extension of the utility tunnel. This will be constructed to mimic the construction of the existing tunnel, consisting of parallel load bearing walls to either side of the trench with short precast concrete planks forming the lid.

The archive drawings inspected show that the planks only span from side to side of the service utility tunnel, and as a result the end wall appears to be non load bearing. As such, removal of the end wall to permit the redirected services to enter the trench will be straightforward.

2.5 Geotechnical

2.5.1 General

The geotechnical design of the proposed utility upgrade is based on the information provided in the following geotechnical investigation:

- Geotechnical Investigation, 119 St. George Street, Toronto (EXP Services Inc., dated July 5, 2019)
- Final Hydrogeological Investigation Report, 119 St. George Street, Toronto, (EXP Services Inc., dated September 17, 2019)
- Geotechnical Investigation, Goldring Centre for High Performance Sport, St. George Campus University of Toronto, (Terraprobe Inc., dated February 29, 2012)

2.5.2 Ground Condition

Beneath the existing asphalt pavement (approximately 125mm in thickness) and granular fill (extending to depths between 1.0m and 1.4m), a layer of silty sand deposit was encountered overlaying the clay silt deposit.

The silty sand deposit extended to depths of 2.0 mbgs to 2.4 mbgs below ground surface and was brown to grey in color with SPT-N values ranging from 10 to 17 blows/0.3m and moisture content ranging from 20% to 22%. The silty sand was wet and in a compact condition.

The clayey silt deposit extended to depths of 12.0 mbgs to 12.2 mbgs below ground surface and was grey in color with SPT-N values ranging from 11 to 19 blows/0.3m and moisture content ranging from 21% to 26%. The clayey silt was moist with some wet seams and in stiff to very stiff consistency.

2.5.3 Bearing Capacity and Subgrade Condition

The proposed utility chamber and duct will likely bear on clayey silt deposit at approximately 3.5 mbgs to 4.9 mbgs with estimated SLS and factored ULS bearing capacities of 200kPa and 300kPa, respectively.

Where organic/deleterious materials and soft or loose deposits were encountered at the subgrade level, they shall be replaced with suitable backfill materials and properly recompacted prior to placement of bedding.

2.5.4 Excavation and Groundwater Control

Based on the current utility duct geometry, the proposed utility chamber and trench excavation should be approximately 3.5m to 4.9m deep. OSHA regulations require that all excavations 1.2m and deeper must be sloped and/or braced in accordance with OSHA requirements. Based on the OSHA classification, the soils encountered at the proposed utility trench excavation can be classified as type 3, and the associated excavation requirement is summarized in Table 3.

Table 3: Excavation Side-Slope Gradient based on OSHA

Soil Deposit	Type	Base of Slope	Max. Side Slope
Fill, Silty Sand and Clayey Silt	3	From bottom of excavation	1H:1V

Based on the available data, the groundwater level measured in the monitoring wells near the proposed utility trench ranged from 8.7 mbgs to 14 mbgs, which is below the proposed utility chamber and trench excavation, approximately 3.5 mbgs to 4.9 mbgs. However, some seepage of free water perched in the fill or the silty sand deposit should be anticipated during utility trench excavation, which may possibly be controlled and removed by temporary sump pumps and ditches.

2.5.5 Backfill and Compaction

Fills and compaction requirements will be in accordance with NMS 31 23 10 Excavating, Trenching and Backfilling.

2.5.6 Environmental Consideration

It should be noted that environmental soil sampling and testing has been carried out, and the test results and recommendations for disposal of excess soil during construction was presented in a separate environmental assessment carried out by EXP Services Ltd.; however, this environmental assessment was not available at the time of this report preparation and should be reviewed to determine criteria for disposal of excess soil.

2.6 IT - Communications

2.6.1 Introduction

This Basis of Design Report will use RFP IT requirements as the foundation and will further develop deliverables as per project feasibility. The main requirement for this project phase is a new Bypass IT inter-building backbone fibre line design. Bypass line will provide network continuity between Innis Residence and Woodsworth College, enabling future Devonshire construction work (Figure 4).

After the IT pathway is built, fibre optic cables will be installed connecting Innis Residence garage and Woodsworth College with Goldring Centre, and Block A with Woodsworth College.

As the Bypass line becomes fully operational, Devonshire Communication cables will be decommissioned from end to end.

The following sections will describe the design intent, and infrastructure arrangements.

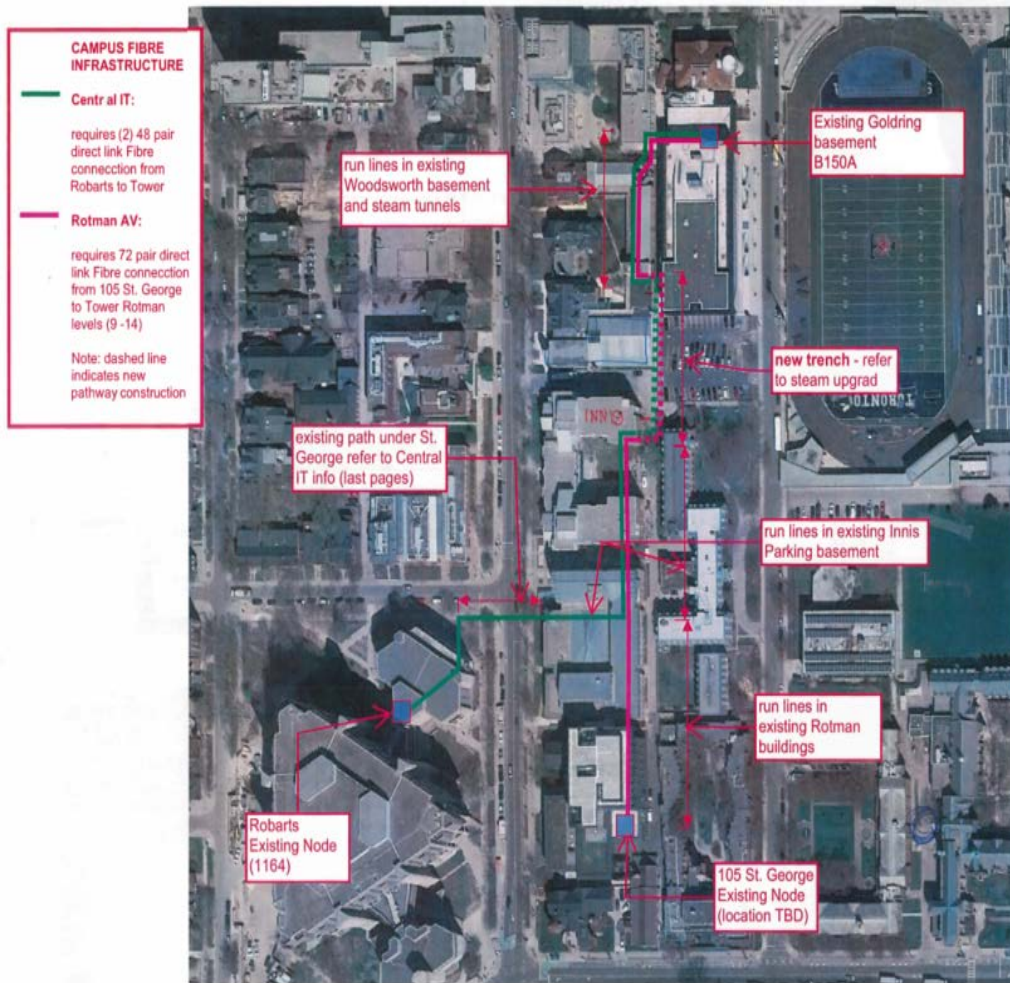


Figure 4 - RFP Communications scope of work

2.6.2 Applicable Codes, Regulations and Standards

Communications system design will conform to the requirements as specified in the RFP and will be complying but not limited to the following codes, regulations, and standards:

- ANSI/TIA-568.1-D Commercial Building Telecommunications Cabling Standard
- ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard
- ANSI/TIA-569-D Telecommunications Pathways and Spaces
- ANSI/TIA-606-C Administration Standard for the Telecommunications Infrastructure
- ANSI/TIA-598-C Optical Fiber Cable Color Coding

- ANSI/TIA-526-7-A Test procedure for installing single-mode fiber cable plant
- CSA C22.2 No. 232-M Fiber Optic Cables
- TIA-758-B Customer Owned Plant Telecommunications Infrastructure Standard
- CSA-C22.2 No.214-94 Communications Cables
- CAN/ULC/LC S101 and CAN/ULC S115 Standard Methods of Fire Endurance Tests of Building Construction

2.6.3 Design Approach

The primary IT design goal is to provide IT Bypass line which includes the following deliverables:

- Communications Field Investigation Terms of Reference (ToR). The Communications Investigation Term of Reference will be provided in the background documents;
- Bypass underground IT pathway between Innis Residence garage and Block A basement;
- In-building conduit routing: Innis Residence, Block A, utility chase, utility service tunnel, and Woodsworth College;
- Cable installation;
- Devonshire Communication cables decommissioning;

2.6.3.1 Communications Field Investigation Terms of Reference

Arup undertook a site visit in February 2020 to determine the feasibility of the work. The results of the site visit to determine the condition of the existing pathways were uncertain. Existing conduit pathways between Goldring Centre TR-B150A and Woodsworth College TR-25A to be confirmed by the Contractor (TBD*).

**Additional investigation is needed for the IT scope of work – ToR provided in the background documents*

2.6.3.2 Bypass underground IT pathway between Innis Residence garage and Block A basement

The purpose of the Bypass line (Figure 4) is to provide continuous IT services and space for future development. The main challenge is to provide an IT pathway with two (2) 103 mm underground conduits from the Innis Residence garage (North-West: 119 St. George Street) to Block A basement (119 St. George Street). This underground route is within the UT's property line. To avoid street public area excavation, the mainline between two (2) new manholes will be done by directional drilling method. Manholes will then connect with building structures by using open trench. This underground IT line installation will become permanent recourse for the UT.

Due to uncertain cable routing, Arup will provide UT the Communications Field Investigation Terms of Reference, which will provide necessary guidance what information the Contractor shall provide about the existing pathway.

2.6.3.3 In-Building conduit routing

In-building conduit routing will provide necessary IT pathways for (Figure 4):

- Innis Residence garage B1 level:
 - Connect Bypass line North-West penetration point with the existing Communications room TR-124 using two (2) 103 mm conduits;
- Block A basement:
 - Use the existing conduit pathway between the basement penetration point to the Communications room TR-3B;
 - Provide underground pathway between the TR-3B and the utility chase;
 - Connect utility chase with the utility service tunnel using two (2) 103 mm conduits;
- Woodsworth College utility service tunnel:
 - Use the existing Communication pathway though the utility service tunnel;
 - Connect utility service tunnel with the Communication room TR-25A using two (2) 103 mm conduits;

2.6.3.4 Cable installation

After the Bypass pathway is established from Innis Residence garage TR-124 to Goldring Centre TR-B150A, IT fibre optics cables will be installed. Cables and routes to be used are:

- One (1) 48-strand single-mode OS2 indoor/outdoor loose tube, dry water block, armored jacket fibre optic cable from Innis Residence garage TR-124 to Goldring Centre TR-B150A in one straight run without splices. This cable will pass through Block A TR-3B, utility chase, utility service

tunnel, and Woodsworth College TR-25A. From TR-25A this cable will run through the existing three (3) 53mm conduits with the Goldring Centre (TBD*);

- One (1) 48-strand single-mode OS2 indoor/outdoor loose tube, dry water block, armored jacket fibre optic cable from Block A TR-3B to Woodsworth College TR-25A in one straight run without splices. This cable will pass through utility chase and service utility tunnel;
- One (1) 96-strand single-mode OS2 indoor/outdoor loose tube, dry water block, armored jacket fibre optic cable from Woodsworth College TR-25A to Goldring Centre TR-B150A in one straight run without splices;

2.6.3.5 Removal of the existing Telecommunications services

After the Bypass fibre line is fully operational and with UT's IT department confirmation, the existing Devonshire Communication cables will be decommissioned (fibre, copper, etc.) as part of this scope. These cables are currently located on the same route as the proposed Bloor-Devonshire future utility trench construction work (Figure 4). All Telecommunications cables found will be removed completely, end to end.

**Additional investigation is needed for the IT scope of work – ToR provided in the background documents*

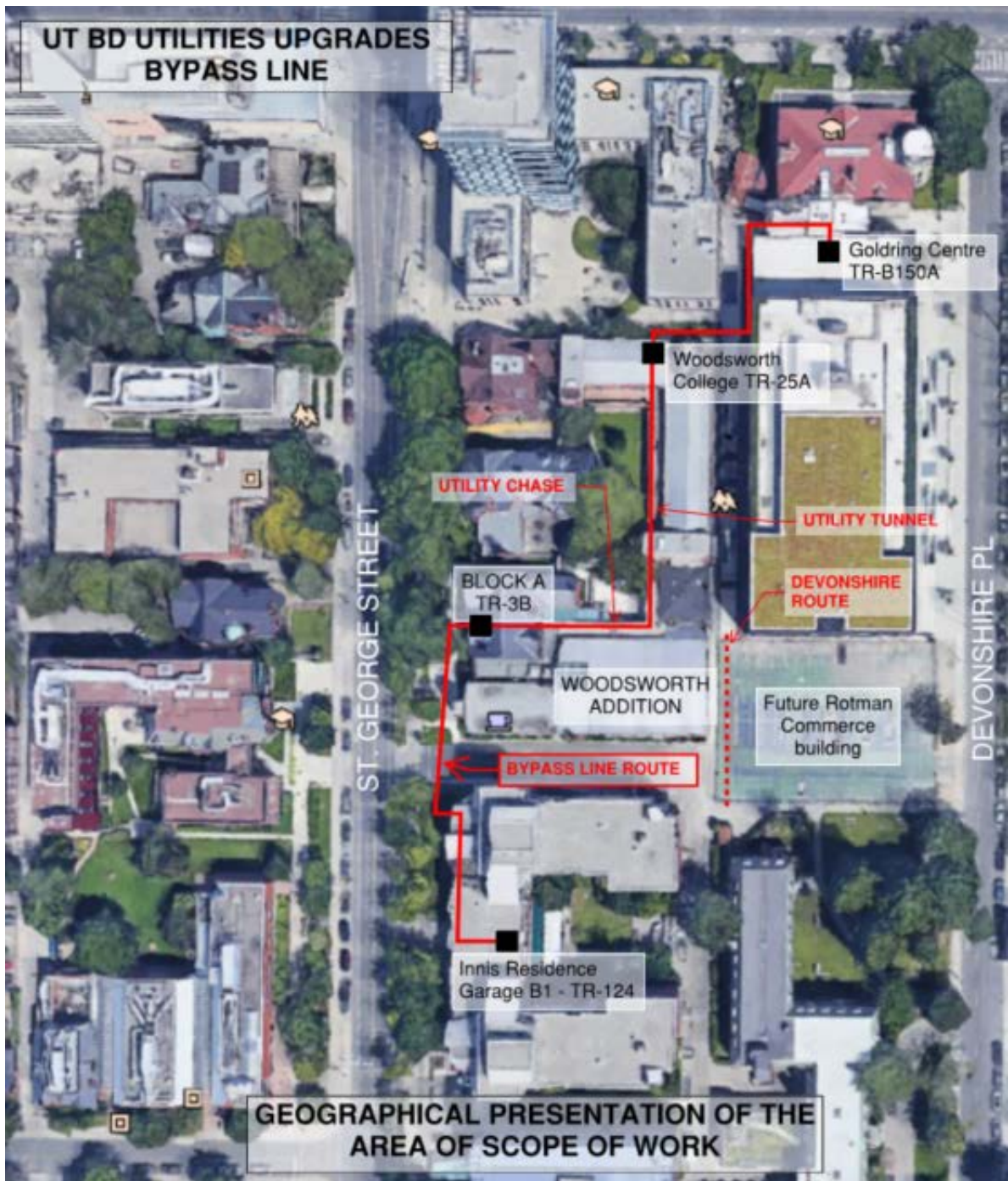


Figure 5 – Bypass line cable routing

3 Key Design Assumptions

The following describes the assumptions made as part of the design of the proposed utility trench:

- The alignment of the proposed direct buried lines has been assumed and will be refined as results from upcoming investigations (e.g. SUE) will provide further confirmation.
- Electrical conduits will end on the north side of the proposed Margaret Fletcher renovation.
- The Woodsworth Addition team will need to extend the electrical ductbank to their building.
- Electrical conduits inside the Woodsworth utility tunnel are to remain until further detail is provided by the proposed Woodsworth Addition design team.
- It was confirmed by UT during the meeting held on March 4, 2020 that the existing hydro ducts and chamber located within the existing laneway between Goldring and Woodsworth are empty. The SUE field investigation will provide verification.
- Structural perforations will not adversely impact existing structures. All structural elements will be repaired to existing conditions with additional support if required.
- For HDD of the new IT bypass line, it is assumed that two pull chambers are needed, one for launch pit and one at receiving end. HDD will accommodate the two (2) 103 mm conduits.
- The Woodsworth Addition team will likely need to adjust their servicing design to accommodate the new IT bypass line which will be a new constraint on their design. The proposed MH2 will very likely need to be shifted.
- The Woodsworth Addition team will need to confirm that the new IT bypass line does not impose a constraint on their future permanent and temporary building works and construction methodologies.
- Following the installation of the new pipework in the opening, the remaining sections of the opening are to be infilled with concrete masonry, mortared into place. Compressible material is to be installed around the pipework to allow for radial expansion and any longitudinal movement. At the Innis building, a hydrophilic strip should be provided around the pipework and the edges of the opening. Resin-fixed 15M bars should be drilled into the edges of the opening to both faces and then the remaining opening infilled with concrete.
- Restoration to existing conditions has been assumed at this time.
- Fencing shall be provided to protect the above grade piping system.

4 Impact on Campus Buildings

1. The proposed Bloor-Devonshire utilities will impact the accessibility to the Goldring Centre. The above grade steam and condensate system will possibly provide interference to the south west entrance to the building. The pipe rack system will be elevated to allow for pedestrians to travel underneath and egress during normal and emergency periods.
2. The B1 level of Woodsworth may require some relocation of existing equipment to accommodate the installation of the bypass steam and condensate lines. The room is currently being utilized as an office/storage room.
3. Preliminary work zone during construction of the proposed utility trench; building access and operations will need to be reviewed with UT (e.g. building maintenance concerns, egress analysis, etc.). A portion of the existing parking lot south of Goldring Centre (future Rotman building) will need to be used for construction equipment and lay-down areas.
4. The proposed direct buried piping and chamber will be a constraint for the future Rotman building, planned to be located within the existing parking lot south of Goldring Centre. Rotman will be required to remove the piping and chamber once the permanent installation occurs.
5. Existing local drainage just outside of Innis Residence may be impacted and may require relocation. Arup has requested this information and waiting for UT to provide.
6. There may be an existing hydro chamber and hydro duct located along the proposed utility trench alignment (within the existing laneway between Goldring and Woodsworth). The existence and, if applicable, the location of these hydro assets will be confirmed with the upcoming SUE field investigation. Once the investigation is complete, any conflicts will be confirmed and if necessary, relocation design will be initiated.
7. The Innis Residence driveway may need to be temporarily closed to accommodate the working area of the HDD alignment for the proposed IT bypass line.