

Canadian Consulting Engineering Awards 2015

Scott Street Sewage Pumping Station Upgrades

Renovating a century-old facility: a cost-effective and sustainable solution

Toronto, Ontario



Lead Engineering Consultant: Associated Engineering
Owner/Client: City of Toronto
Other Consultants: SPL Consultants
D. Heldman Consultant
Contractor: Varcon Construction Corporation

Executive Summary



In recent years, development and associated growth in Toronto's downtown core has intensified, placing a strain on existing infrastructure. As a result, the City of Toronto needed to increase capacity of its century-old Scott Street Sewage Pumping Station to meet future growth. Located adjacent to the Sony Centre in the heart of the downtown entertainment and business district, upgrading the pump station was a challenge. To deliver the project, the City retained Associated Engineering to provide design and construction administration services.

The upgrade of the pumping station had to satisfy current and future demand, meet regulatory, code and standards requirements, while maintaining 'live' operation of the facility throughout construction, and minimizing impact on the stakeholders including businesses and residents.

After preliminary assessment, the design team realized that these objectives could be achieved more economically and sustainably by renovating the pumping station, rather than rebuilding it, as originally envisioned.

Renovating this 100-year old pumping station posed significant challenges, with the

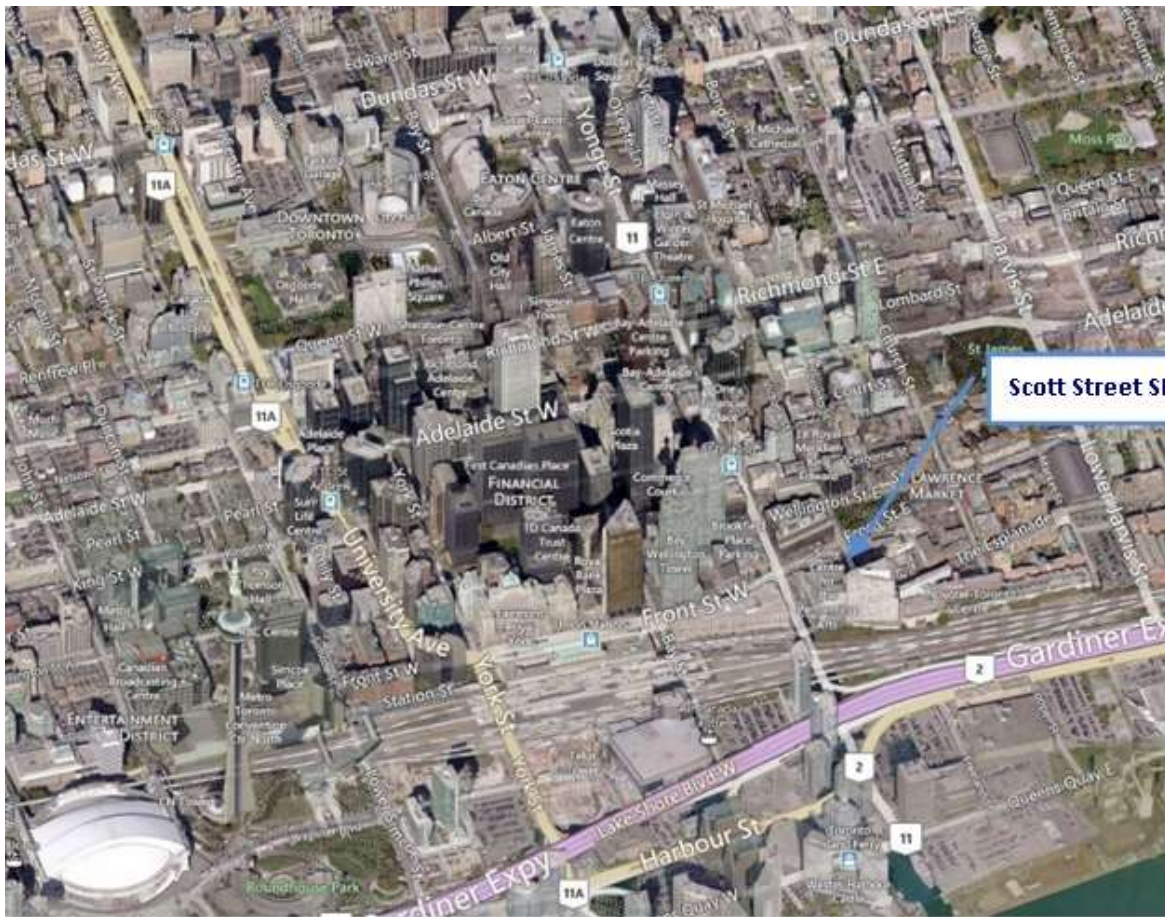
constrained space within the facility and its location below ground in the highly congested business, entertainment, and residential area. Design and construction challenges included a tight site location, a high water table, streetscaping, odour control, a need for continuous wastewater conveyance operations, and minimal disruption to utilities and traffic flow.

Careful planning, proactive communication, and close collaboration between Associated Engineering, the City of Toronto, and the Contractor resulted in success delivery of this challenging project with no interruption to sewage flow, and minimal impact on businesses, traffic, and the public during construction. Completed on budget, the \$3.583 million capital cost was more than \$6 million less than the City's original estimate to replace the pump station.

Commissioned in November 2013, the upgraded Scott Street Sewage Pumping Station will provide secure wastewater collection and pumping services for this portion of Toronto's downtown for the next twenty years.

A cost-effective, sustainable renovation provides Toronto's downtown core with secure wastewater service for the next twenty years.

Introduction



The City of Toronto is the capital of the province of Ontario, the most populous urban centre in Canada, and the fourth largest city in North America. With over 2.6 million residents, Toronto has experienced significant population growth and redevelopment in its downtown core, stressing its existing infrastructure. To accommodate this growth, the City needed to upgrade its wastewater collection system serving downtown Toronto.

The Scott Street Sewage Pumping Station has been an integral component of the downtown core's wastewater collection system for one hundred years. The underground pumping

station was originally built in 1914, in an area that was once close to the original shoreline of Lake Ontario.

Today, the pumping station sits immediately adjacent to the Sony Centre and across the road from the St. Lawrence Centre of Performing Arts, just east of Yonge Street.

The City has a long-term plan to replace the pumping station with a large diameter, deep, gravity relief sewer to service the area. However, until the new sewer is constructed, the City needed to increase the pumping station's capacity to accommodate population growth in the immediate service area.

Project Objectives



Associated Engineering's role as prime consultant on the project was to complete preliminary and detailed design, prepare contract documents, and provide construction administration services to upgrade the capacity of the pump station to meet the future wastewater demands of the area and satisfy regulatory codes and standards.

Project Challenges

Early in the design, Associated Engineering recognized that significant savings, in the order of six million dollars, could be achieved by retrofitting, rather than rebuilding the pump station, as the city originally envisaged. The City of Toronto approved this approach,

on the basis that integrity of the concrete pumping station be verified.

Before proceeding with design, a series of concrete cores of the existing dry well were taken to assess its concrete strength. A closed circuit television investigation of the pumping station's wet well was also undertaken to confirm its structural integrity.

These tests confirmed that a retrofit of this 1914 structure was feasible and design began in April 2012.

The project had numerous challenges and complexities.

- The City wanted flood-proof submersible, dry-pit style pumps, which had to fit into the constrained area of the existing dry well of the pumping station.
- Power supply in the area is limited to 208 volt, 3 phase power, not typical for high power pumps, making sourcing of Canadian Standards Association-approved, large capacity pumps for this voltage problematic.
- The existing electrical equipment, located in the dry well, had to be relocated. There was no space nearby to construct an electrical chamber.





- All of the construction work had to be performed in the Scott Street right-of-way with new works abutting directly to the existing Sony Centre and overtop the existing underground wet well.
- There was uncertainty in actual below-grade facility elements due to multiple retrofits to the Scott Street Sewage Pumping Station since its original construction in 1914.
- The adjacent underground utilities had to be maintained in continuous operation or relocated.
- The extent of underground works was very complex with multiple operational and abandoned utilities, including power duct banks and steam lines.
- The close proximity of existing utilities to each other made placement of test boreholes difficult (e.g. could not find locations to meet minimum setback requirements), and vacuum truck daylighting was often unsuccessful in assisting to establish the underground situation.

- Construction had to be completed while maintaining wastewater collection in the area. A temporary pumping system to maintain sewage flows was difficult to implement due to very limited wet well sump to create suitable pumping conditions.
- Construction activities had to be completed with minimal impact to local businesses, residents, traffic, and the public.

Solution



Due to the age of the facility, the City had originally decided to replace the pump station. Associated Engineering identified a retrofit solution that could save the City significant capital. The City agreed with the renovation plan and asked Associated Engineering to complete design and oversee construction of the renovation.

Structural repairs were made to fix leakage from cracks and spalling concrete, and reinforce walls to enhance integrity. Modifications were made to replace aging equipment, improve access for maintenance,

and bring the pump station up to current codes.

Electrical equipment installed inside the pump station dry well was re-located for safety. A new electrical chamber was constructed below grade on top of the existing wet well, and new access stair from the street level was provided.

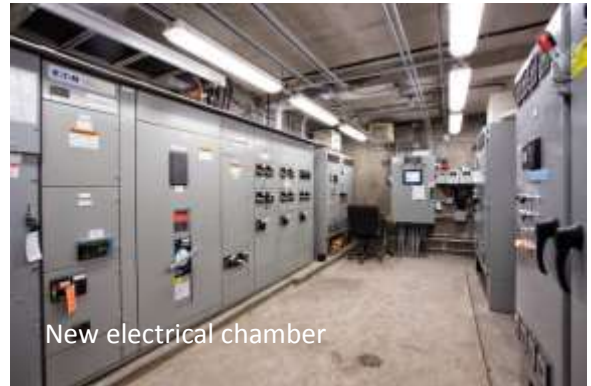
Innovation

Our project team's approach to renovate the existing pump station, rather than building a new pump station, was a novel and sustainable concept, providing significant savings over building a new pumping station.

The team recommended repairing the existing concrete dry well by sandblasting to remove spalling concrete, and adding a rebar web which was shotcreted in place, to re-instate concrete and repair leakage.

The team recommended larger pumps to increase station capacity from 380 to 660 litres per second. Finding pumps that could operate at existing 208 V power supply was a challenge.

With larger pumps, design of pipes and valves to fit the existing inlet and outlet in the small pump station dry well footprint was a challenge. To save space, smaller, knife-type gate valves were installed for pump isolation. Narrow ducting was employed for the ventilation system to preserve access to equipment. Engineers worked closely with the City's operators to ensure the equipment and piping layout was easy for them to operate and maintain in the constrained space.



New electrical chamber



Access to new electrical chamber



Pump controls



Abutting to a major entertainment facility, the Sony Centre, there was no space at grade or within the Sony Centre to locate a chamber for the pump station electrical works. The team devised a clever solution: remove soil from the space above the existing wet well, and use this space for the underground electrical chamber.

At \$3.583 million, renovating the Scott Street Sewage Pumping Station provided significant cost savings over the original \$10 million estimate for pump station replacement.

Renovating pump station was a sustainable solution and provided significant cost savings.

Complexity

Repairing and renovating the 100 year old pump station posed numerous challenges. Larger pumps installed in the existing pump station dry well made piping extremely



challenging. Piping had to be carefully fit between the existing inlet and outlet pipes. Knife gate valves were employed to conserve space.

Temporary pumping was required for eight months to maintain sewage flow during construction. With the limited wet well sump to create suitable pumping conditions, a “dam” was created in the wet well inlet chamber to control pump liquid levels to achieve submergence requirements.





Congested construction site

Proactive communications and coordination with the contractor helped ensure critical events, such as switch-over between existing permanent and temporary pumping systems and then to the new pumping system, were successful, with no interruption in wastewater conveyance. At times, this required the use of dry-suit equipped divers to work within the active wet well.

Contract documents addressed the constrained space above grade for construction equipment; need to maintain traffic; continued operation and access to the entertainment facilities, restaurants and residences; and safety of public who used these facilities and pedestrians who lived or worked in the area.

All of the construction work had to be performed within two fenced lanes of Scott Street, while maintaining two lanes open for vehicle traffic.

Numerous operational and abandoned underground utilities, including power duct banks and steam lines, added to the complexity of design and construction.

To protect existing utilities while constructing the electrical chamber, a virtual zero clearance drilled secant piling shoring system was



Uncertainty in underground utilities

employed. Secant shoring significantly reduced the risk of undermining and damaging adjacent utilities and structures.

Team worked with contractor to overcome uncertain information about the myriad of underground utilities, while maintaining operations and ensuring public safety.

Social and Economic Benefits

The upgraded Scott Street Sewage Pumping Station meets wastewater flow requirements in downtown Toronto for the next 20 years.

By replacing old and obsolete equipment in the facility, the renovated pump station is more reliable and improves safety for operators. Working with operators during the design resulted in a newly renovated facility that is easy to operate and maintain.

The Scott Street Sewage Pump Station is located underground, abutting the Sony Centre and adjacent to the St. Lawrence Centre of Performing Arts, both major entertainment centres located in the heart of downtown Toronto's entertainment and business centre. In addition, the area is

designated as a heritage site. Careful planning, effective coordination, and construction staging minimized impact to these entertainment facilities, neighbouring restaurants, residences, traffic, and the public.

In particular, communication between the engineering team, city, contractor, and the Sony Centre helped avoid closures that could have caused economic impact on the entertainment facility.

Renovating the pump station was a sustainable approach, compared to designing and building a new pump station, which would only have a 15 to 20 year life, since the City plans to replace the pump station with a large diameter gravity relief sewer.

Completed for a capital cost of \$3.583 million, the pump station renovation provided a significant savings for the city, compared to its original \$10 million budget for a new pump station.

Designed with operators in mind, the selected renovation approach provides substantial financial benefits to the client.



Environmental Benefits



Renovating the existing Scott Street Sewage Pumping Station, rather than building a new pump station, was a more environmentally friendly approach, especially as the City of Toronto plans to replace the pump station with a gravity sewer in 15 to 20 years.

The team conducted tests of the pump station's existing concrete structure which confirmed its strength, and thus the viability of repairing the concrete and renovating the pump station, rather than replacing it.

Areas where the concrete was damaged and leaking were repaired. This approach minimized environmental impact of demolition and disposal of waste concrete.

Use of a secant piling shoring system locked into the underlying shale bedrock controlled groundwater infiltration into the excavation, eliminating extraneous drainage discharge to the sewer system.

Employing a bypass pumping system during construction that had both pump and power redundancy maintained continuous wastewater conveyance, without any bypassing of flows during construction.

Meeting Client's Needs



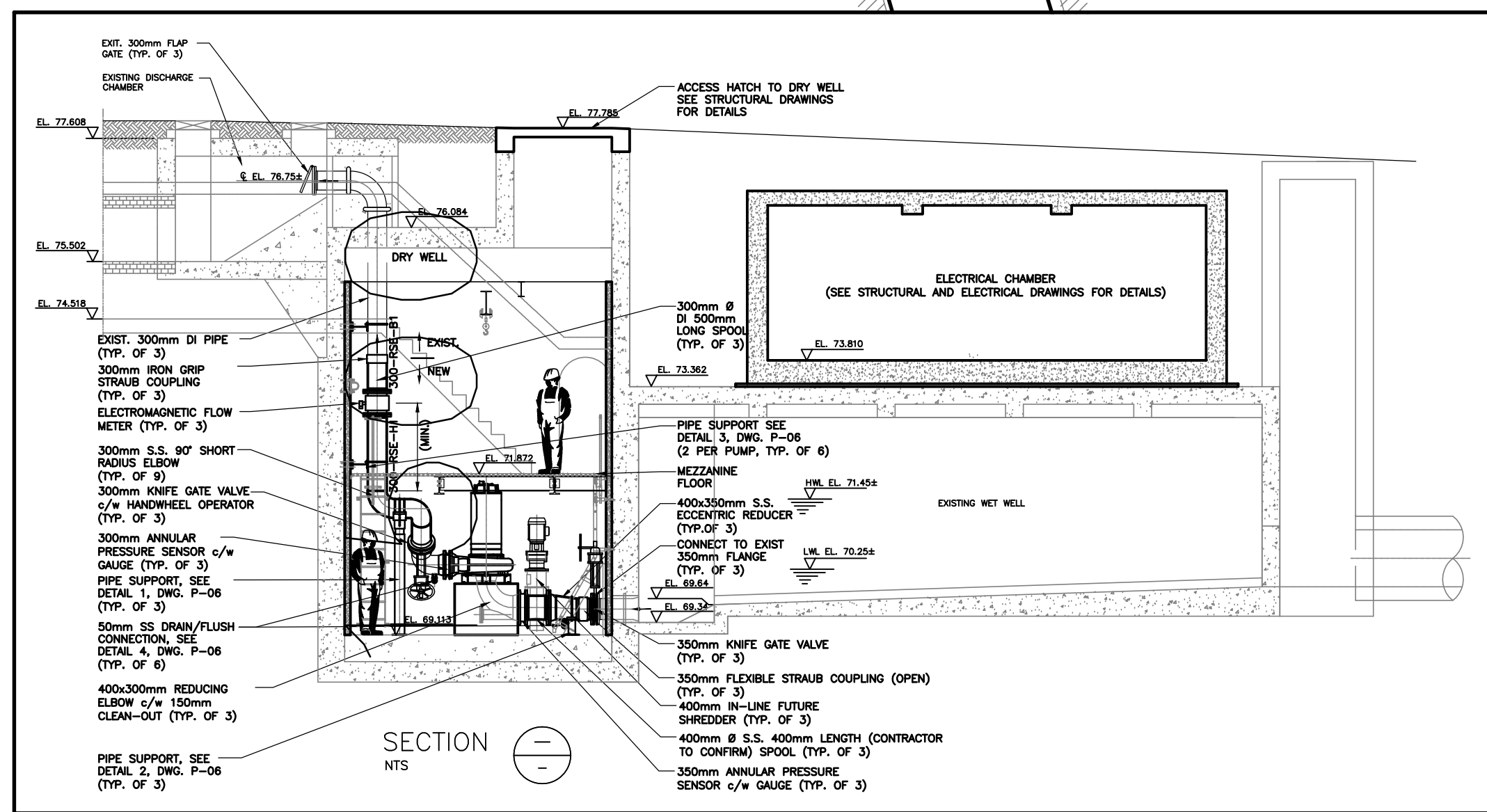
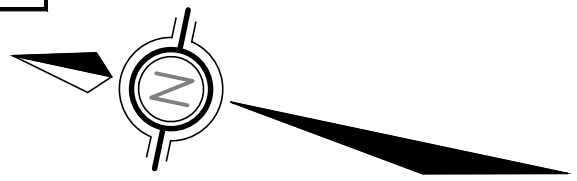
The renovated Scott Street Sewage Pump Station meets the City of Toronto's need for additional wastewater capacity to service the downtown area's future growth. The upgrade replaces aging and obsolete equipment in the pump station, improving the reliability of the pump station, facilitating control through automation of the existing system, and improving safety for operators. The modernized facility allows the City of Toronto to provide dependable service to commercial and residential customers relying on this critical infrastructure.

Associated Engineering's recommendation to renovate rather than replace the pump station saved the City more than \$6 million.

The team worked with the contractor and the city to develop a construction staging plan that allowed construction to proceed in a very constrained site, address challenging site conditions, and minimize impact on existing businesses, residences, traffic, and the general public.

Renovating the Scott Street Sewage Pumping Station provides the City of Toronto with an upgraded, modern and robust facility at a significant cost savings

METRIC
MEASUREMENTS SHOWN ON THESE PLANS
ARE IN METERS UNLESS OTHERWISE NOTED



ACCESS TO EXISTING PARKING GARAGE, SCOTT LANE AND LOADING DOCK ON EAST SIDE OF SCOTT STREET TO BE MAINTAINED AT ALL TIMES. REFER TO CONTRACT SPECIFICATIONS FOR DETAILS.

FOR SITE REMOVALS REFER TO DRAWING No. C-03
CONSTRUCTION BARRIER/FENCE TO BE MOVEABLE INTERLOCKING STEEL BARRIERS/FENCING AROUND ENTIRE WORK ZONE UNTIL CONSTRUCTION ACTIVITIES ARE COMPLETED

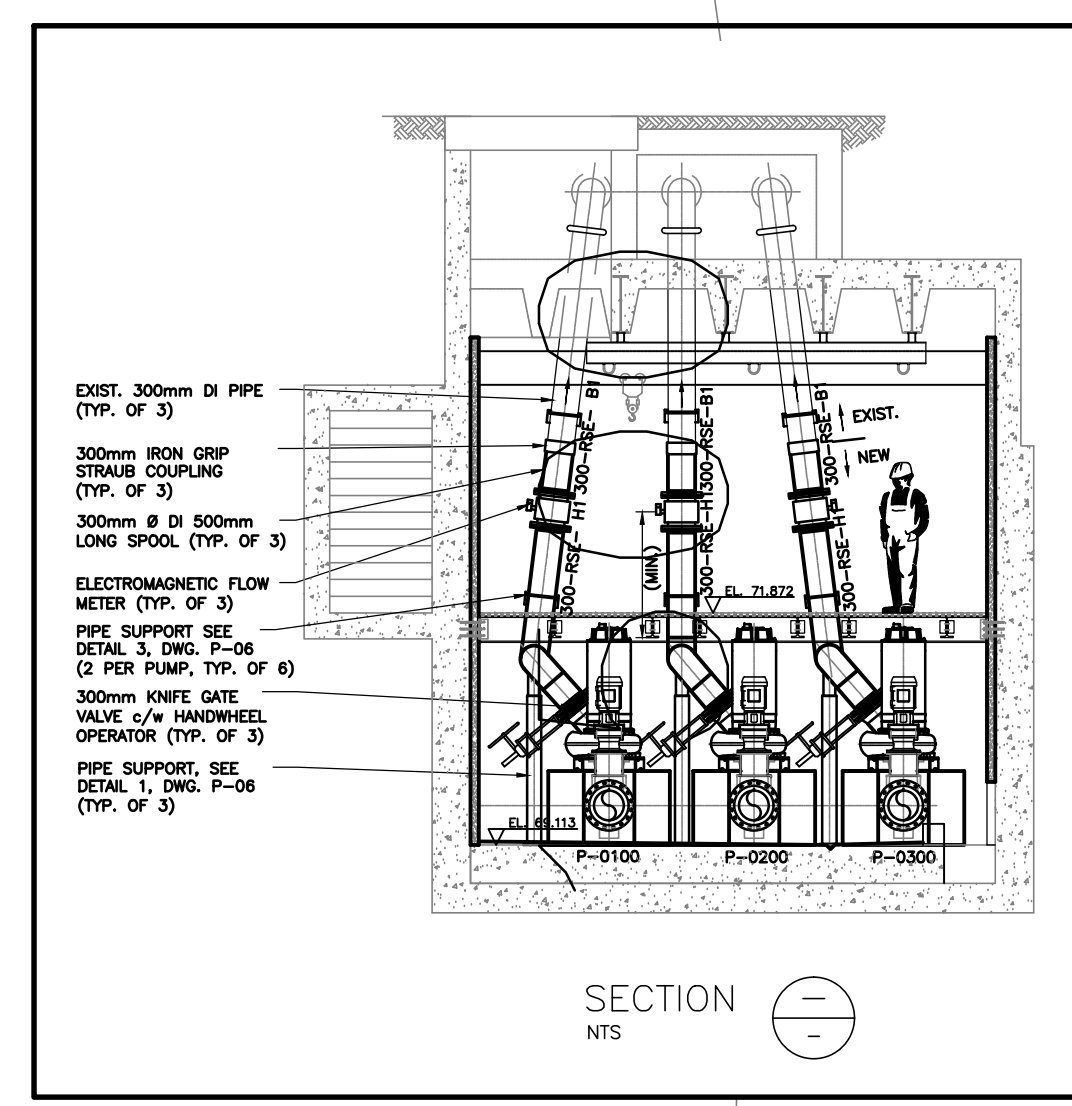
ENTRANCE TO PARKING GARAGE

SCOTT STREET

LANE

FRONT STREET

THE ESPLANADE



SONY CENTRE



- NOTES:
1. REFER TO CONTRACT DRAWINGS C05 & C06 AND CONTRACT SPECIFICATIONS SECTION 01555 FOR TRAFFIC REGULATIONS TO BE ADHERED TO DURING CONSTRUCTION.
 2. VARIOUS ONSITE TRANSPORTATION RESTRICTIONS, INCLUDING TURNING RADIUS, MAINTAINING ENTRANCE TO SONY CENTRE, INTERMITTENT ROAD CLOSURE ON THE ESPLANADE, ETC. MUST BE INCORPORATED INTO THE TRAFFIC MANAGEMENT PLANS AND CONSTRUCTION ACTIVITIES AND SCHEDULE. REFER TO CONTRACT SPECIFICATIONS SECTIONS 01011 AND 01040 FOR DETAILS.

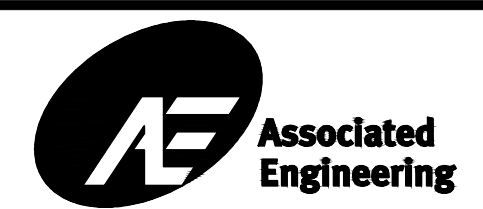
LEGEND

EX. GND ELEVATION

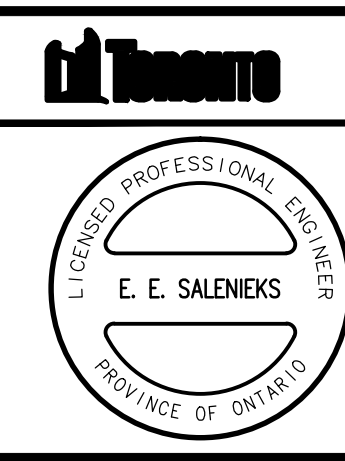
TEMPORARY WORK ZONE AREA

CONSTRUCTION BARRIER/FENCE

REFER TO DWG. C-01 FOR CIVIL LEGEND



No.	DATE	REVISIONS	INITIAL	SIGNED
0	NOV. 26/10	ISSUED FOR TENDER	M.W.	M.W.



TORONTO WATER OPERATIONAL SUPPORT	
LOU DI GIRONIMO GENERAL MANAGER TORONTO WATER	ALEX MARICH DIRECTOR OPERATIONAL SUPPORT

SCOTT STREET SPS PUMPING STATION REHABILITATION SCOTT STREET WORKING AREA					
PLAN - TEMPORARY WORK ZONE AREA					
DESIGN:	M.B.	DRAFTING:	A.L.	CHECK:	E.S.
SCALE:	1:200			DRAWING NUMBER:	1738-2010-00-9
DATE:	AUGUST 2010				C-02