TRIECA CONFERENCE

Great Lakes Chapter

Toronto and Region Conservation for The Living City

3rd Annual TRIECA Conference – March 25 & 26, 2014
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TRIECA CONFERENCE 2014

Low Impact Development (L.I.D.) Case Studies and Lessons Learned

Toronto and Region Conservation for The Living City

Toronto and Region Conservation Authority

March 26, 2014

Mark Schollen
Principal
Schollen & Company Inc.

Why L.I.D.?

– **Effectiveness** in achieving SWM objectives related to infiltration, water quality improvement and water balance

– **Efficiency** in terms of performance and, in most cases, cost

– **Flexibility** to adapt to a range of applications and site specific complexities

L.I.D. Design Essentials

– Comprehensive site inventory data
  - Soil composition
  - Depth to water table
  - Sensitivity of downstream watershed

– Integrated design approach:
  - Collaborative offers amongst:
    - Engineer
    - Architect
    - Planner
    - Landscape architect
    - Ecologist
    - Geoscientist

L.I.D. Design Essentials

– Multi-objective based process
  - Stormwater management
  - Sustainability
  - Utility / function
  - Aesthetics

– Commitment to innovation
  - Every solution is specifically tailored to suit site conditions
  - Unique techniques required to optimize efficacy

L.I.D. Construction Essentials

– Contractor education

– Comprehensive construction supervision

– Contractor education

– Concise implementation / staging strategy

– Contractor education …

– Attentiveness to contractor ideas / advice

PROJECT SAMPLES

Edwards Gardens / TBG Sustainable Parking Lot, Toronto

Objectives:

- **Restore an existing degraded parking lot**
- **Integrate SWM – quality and quantity**
- **Enhance tree canopy**
- **Improve circulation and utility**
- **Position as complementary to TBG programs**

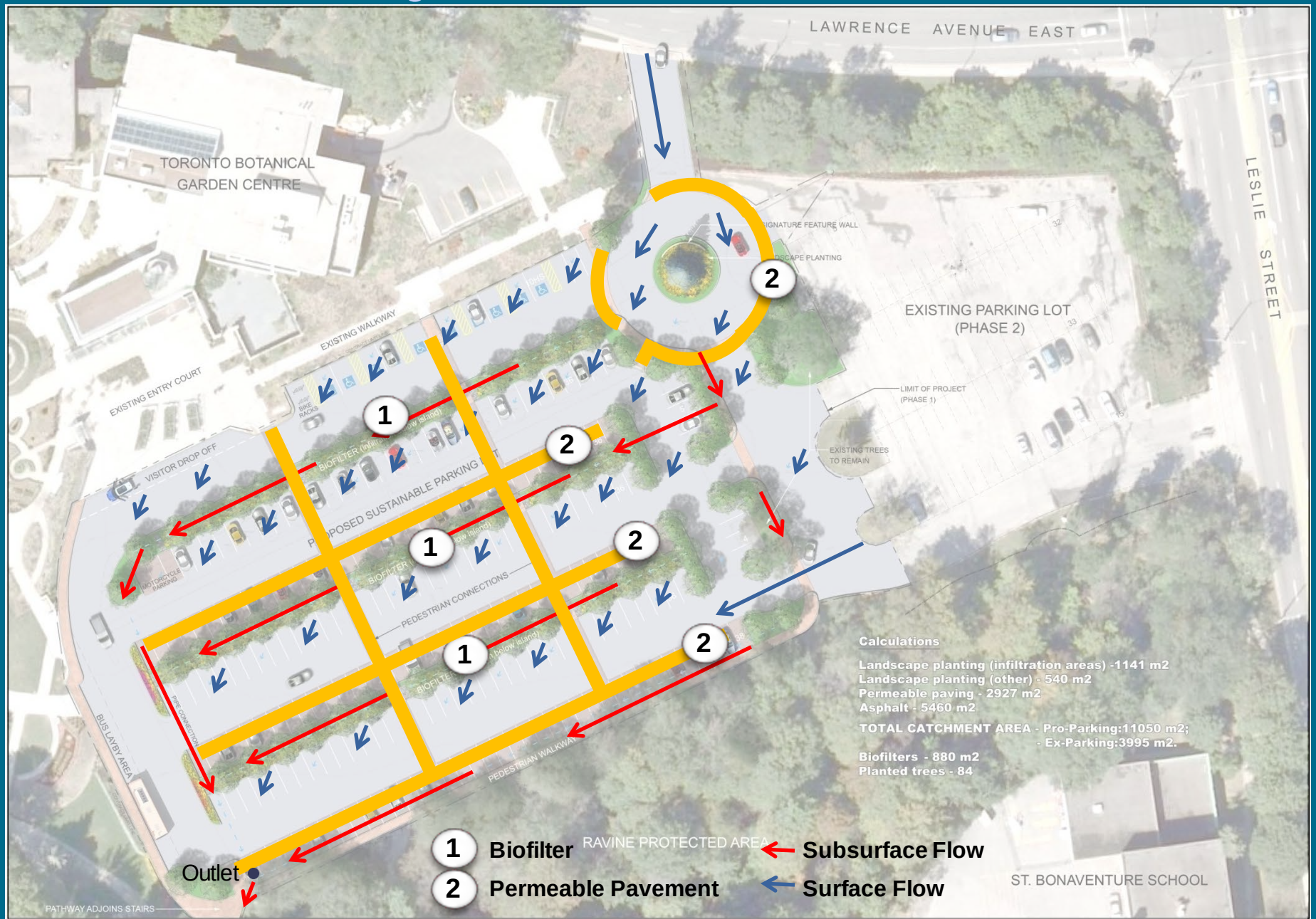
Schollen & Company Inc.
RV Anderson Associates
City of Toronto
Toronto Botanical Garden

Edwards Gardens / TBG Sustainable Parking Lot, Toronto

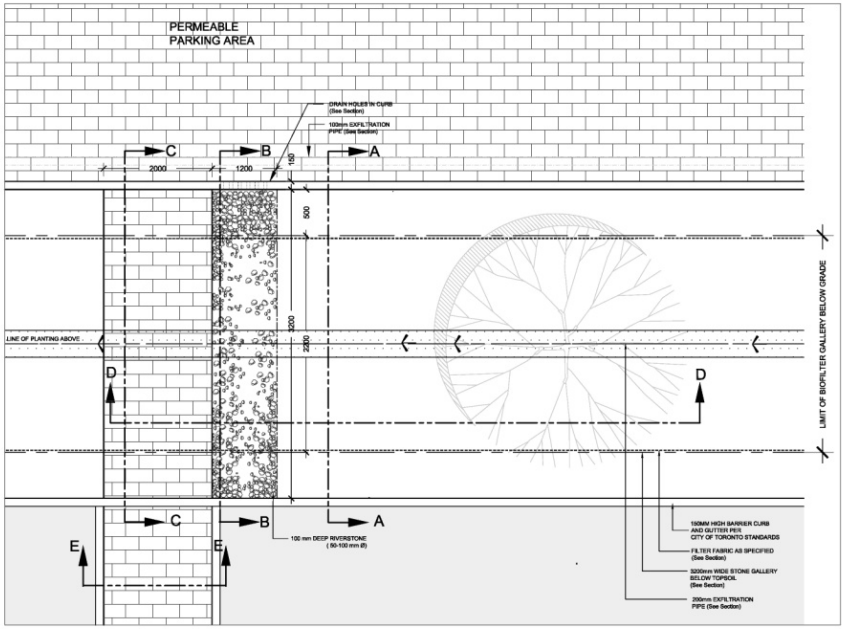
Concept Plan

Edwards Gardens / TBG Sustainable Parking Lot, Toronto

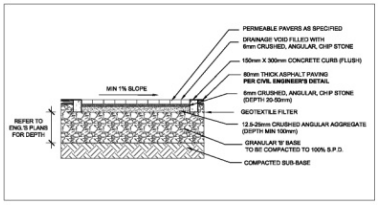
Stormwater Management Plan



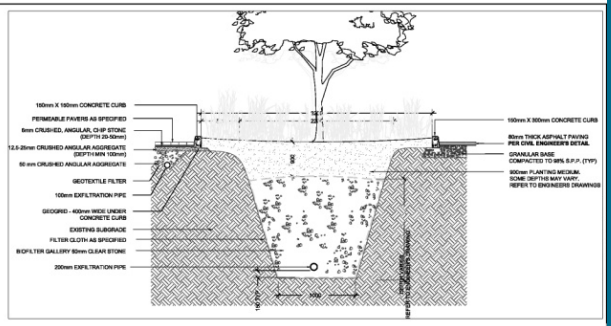
Edwards Gardens / TBG Sustainable Parking Lot, Toronto



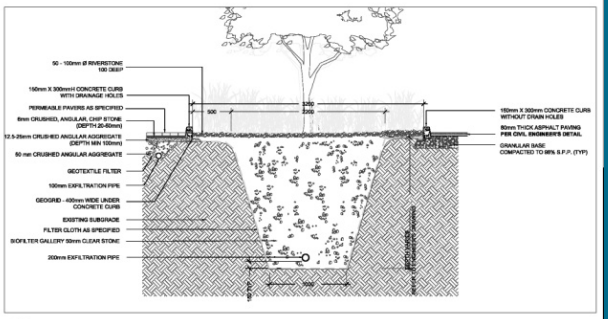
1 LD1 TYPICAL BIOFILTER LAYOUT
PLAN
N.T.S



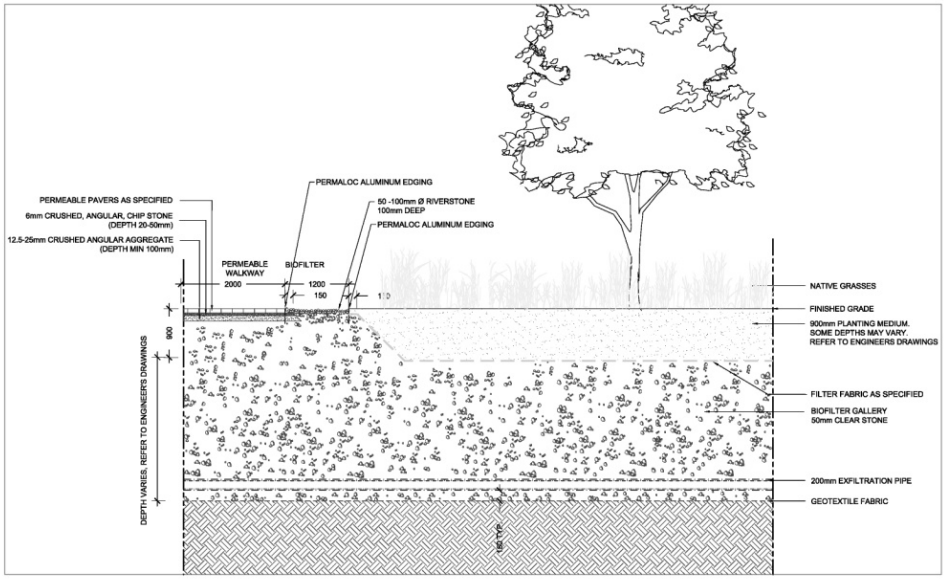
3 LD1 ASPHALT/PERMEABLE PAVING INTERFACE - SECTION E-E
N.T.S



4 LD1 BIOFILTER BENEATH TRAFFIC ISLAND - SECTION A-A
N.T.S



5 LD1 BIOFILTER BENEATH TRAFFIC ISLAND AT WATER INLET - SECTION B-B
N.T.S



2 LD1 BIOFILTER GALLERY BENEATH TRAFFIC ISLAND - SECTION D-D
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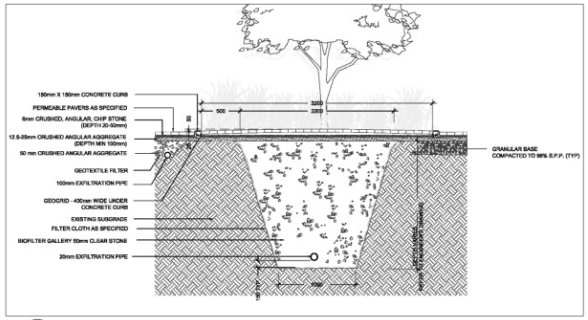
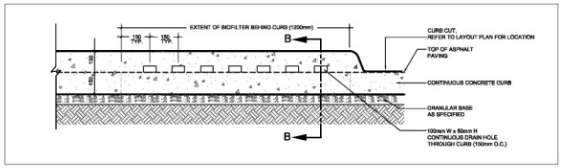
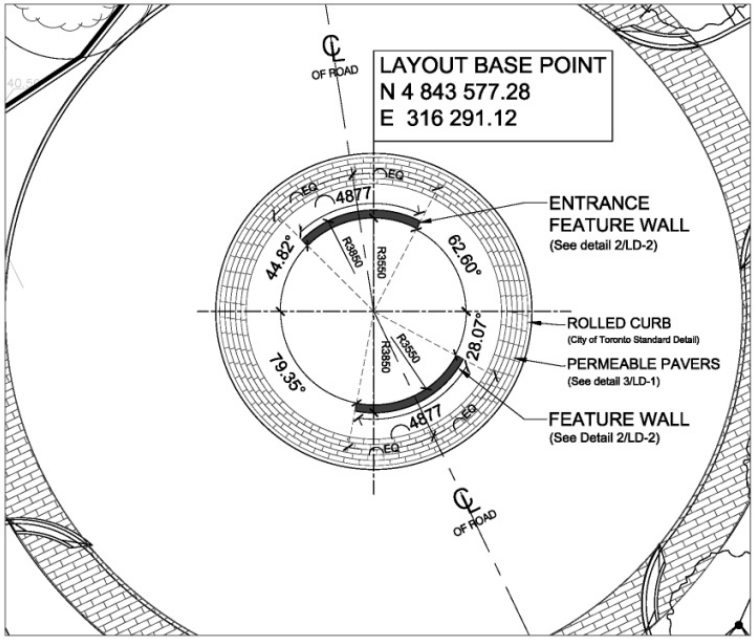


6 LD1 BIOFILTER BENEATH TRAFFIC ISLAND - SECTION C-C
N.T.S

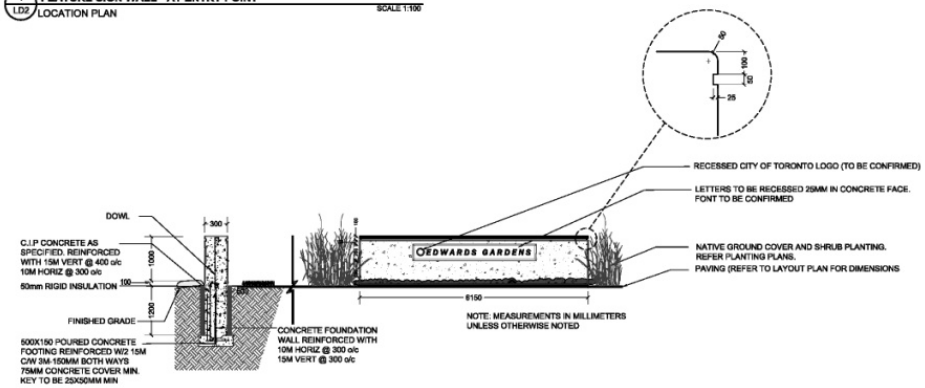


7 LD1 BIOFILTER - FLUSH INLET APRON (SECTION/ELEVATION)
N.T.S

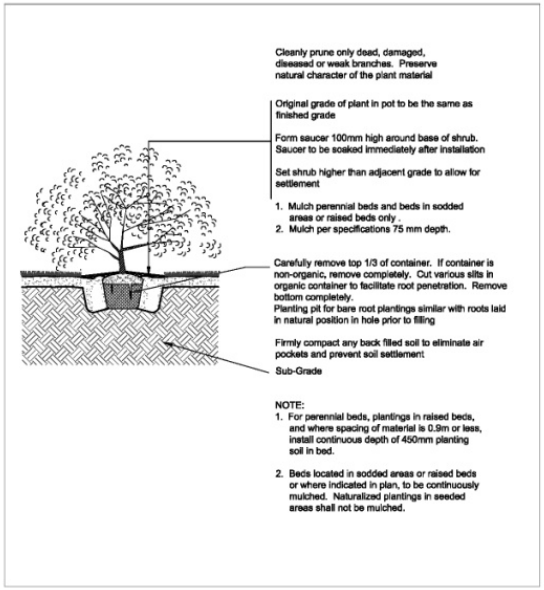
Edwards Gardens / TBG Sustainable Parking Lot, Toronto



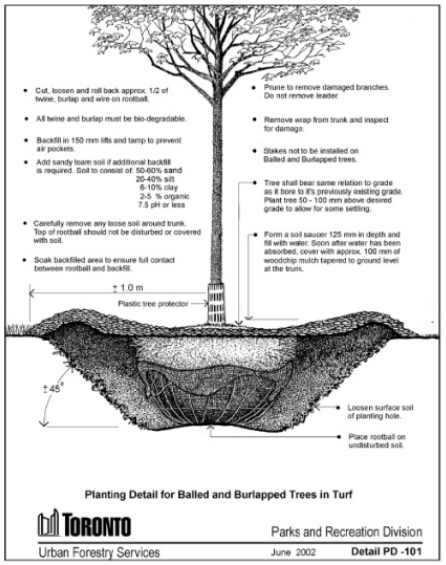
1 LD2 **FEATURE SIGN WALL - AT ENTRY POINT**
LOCATION PLAN
SCALE 1:100



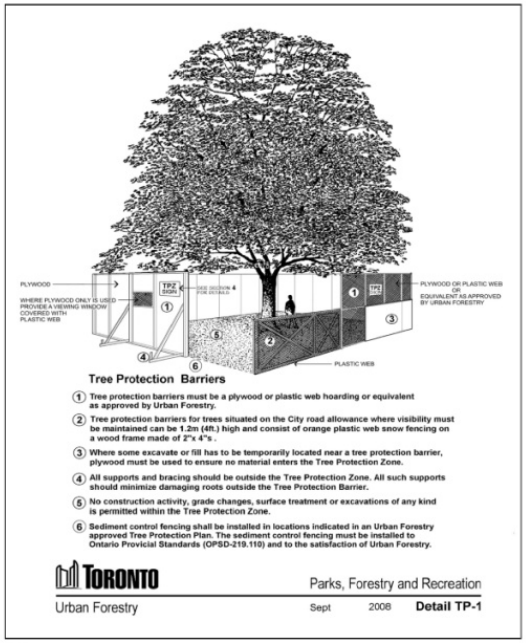
2 LD2 **FEATURE SIGN WALL - AT ENTRY POINT**
SECTION & ELEVATION
N.T.S



3 LD2 **GRASS AND PERENNIAL PLANTING DETAIL**
N.T.S



4 LD2 **BALLED AND BURLAPPED TREE PLANTING IN TURF**
N.T.S



5 LD2 **TREE PROTECTION BARRIER**
N.T.S

Edwards Gardens / TBG Sustainable Parking Lot, Toronto

Construction Process

Biofilter inlet and permeable paver installation

Biofilter installation

Edwards Gardens / TBG Sustainable Parking Lot, Toronto

Completed Installation

Permeable pavement at entrance roundabout

Permeable pavement and biofilter

Edwards Gardens / TBG Sustainable Parking Lot, Toronto

Completed Installation

Permeable pavement parking pads and walkways

Extensive plantings to complement TBG

Edwards Gardens / TBG Sustainable Parking Lot, Toronto

Challenges / Lessons Learned:

– Budget

- Basic resurfacing $800,000
- Sustainable parking lot $1.8 million

– Timing – relative to TBG programs

– Need to maintain parking capacity

– Retrofit project issues

Honda Canada Campus, Markham

Objectives:

- **Minimize reliance on end-of-pipe SWM**
- **Optimize efficiency**
- **Utilize the landscape as a functional system**
- **Address practical considerations**
- **Reflect Honda's corporate mission**
- **Achieve LEED® Certification**

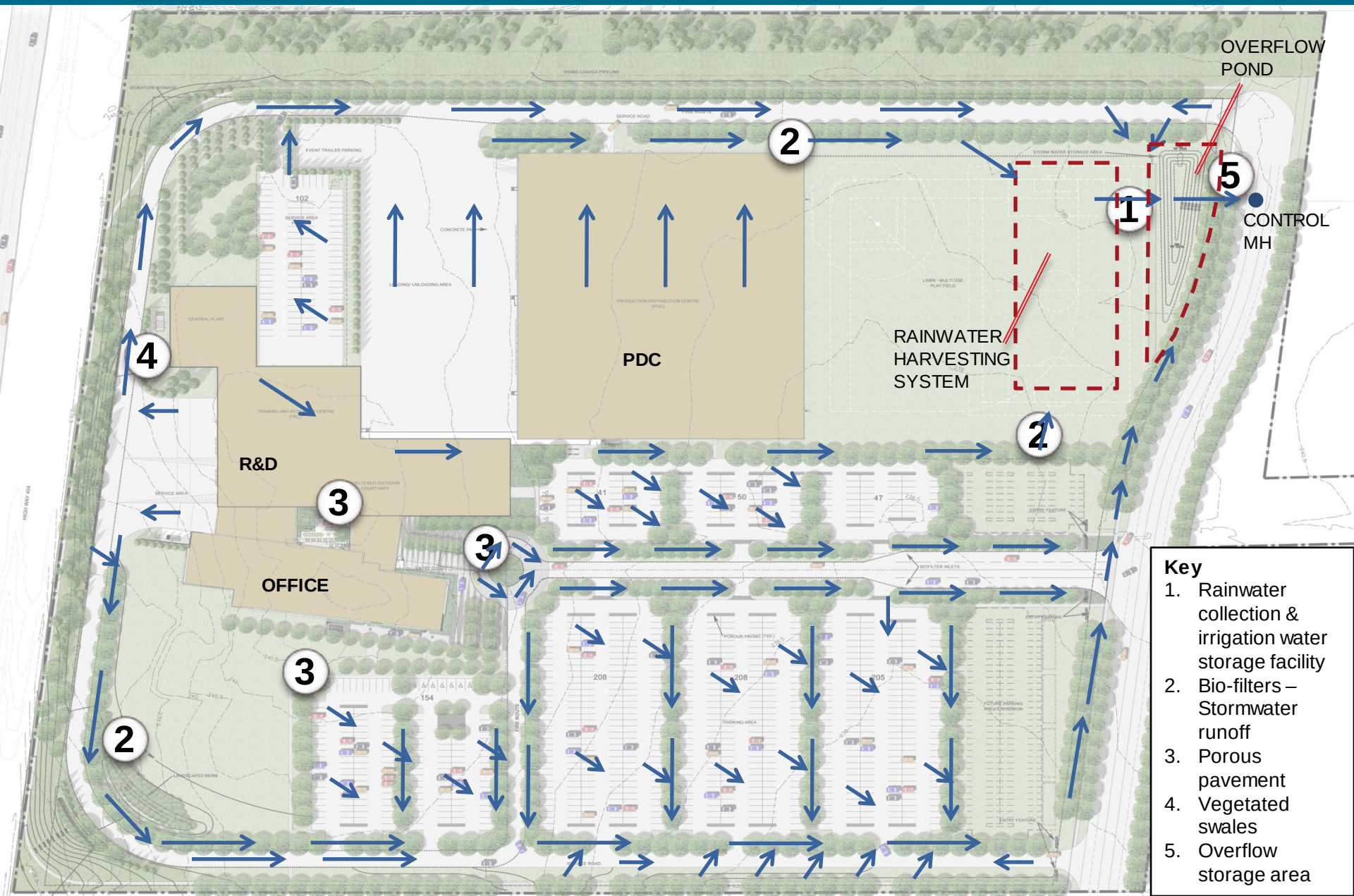
ZAS / HOK Architects
Sabourin Kimble & Associates
Schollen & Company Inc.

Honda Canada Campus, Markham

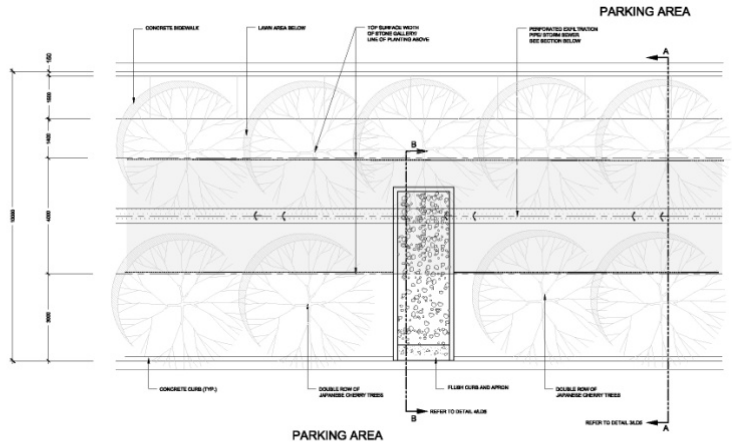
Site Plan

Site Area = approx.27 ha
Building Area = 27,127m²

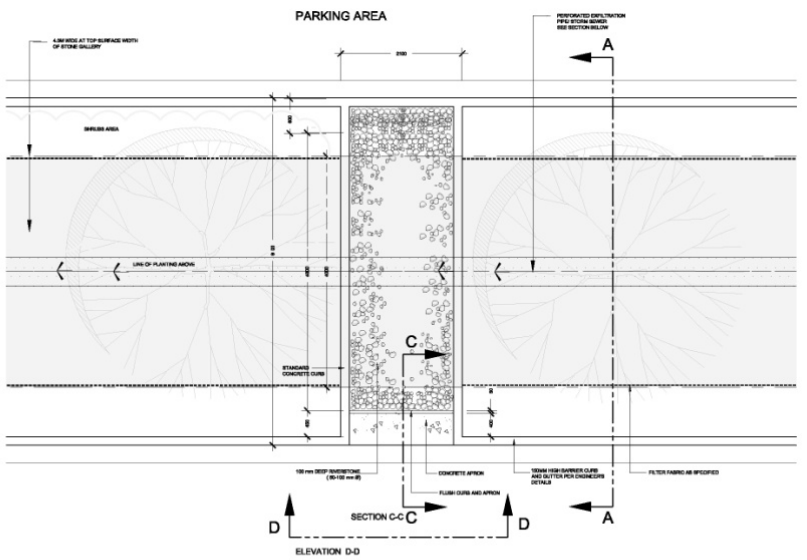
Honda Canada Campus, Markham
Stormwater Management Plan



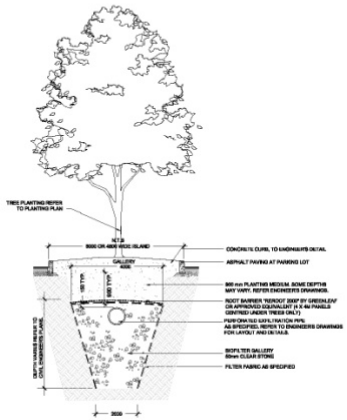
Honda Canada Campus, Markham



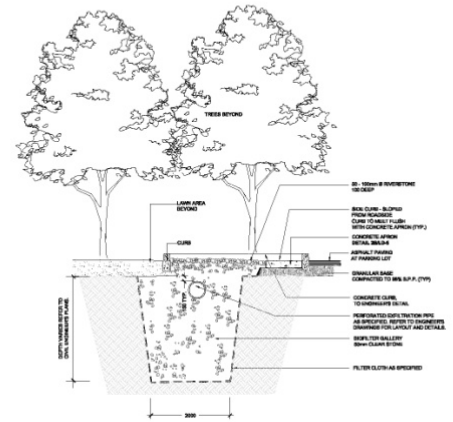
1 L06 BIOFILTER SWALE (10M WIDE PARKING ISLAND)
PLAN ENLARGEMENT
N.T.S



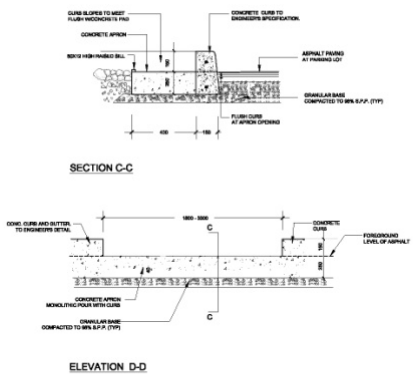
2A L06 BIOFILTER INLET - SINGLE SIDED INLET (6M WIDE PARKING ISLAND)
PLAN ENLARGEMENT
SCALE: 1:30



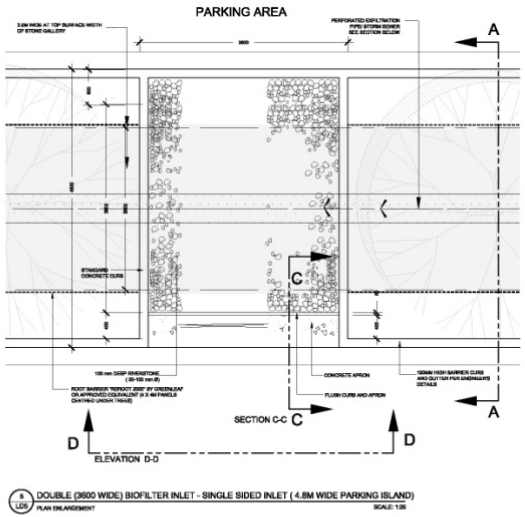
3 L06 BIOFILTER INLET- 6M WIDE PARKING ISLAND
SECTION A-A (REFER DETAIL 3A THIS SHEET)
N.T.S.



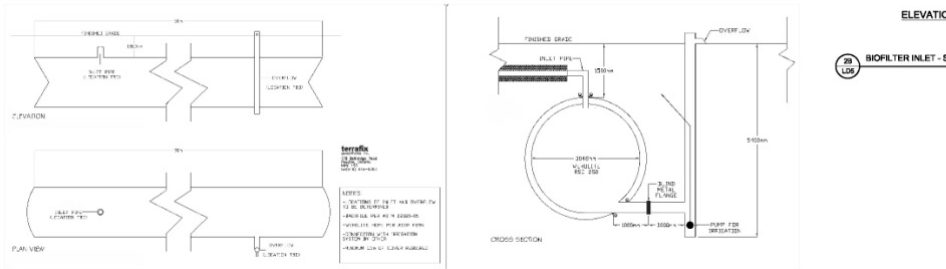
4 L06 BIOFILTER SINGLE SIDED INLET AT 10M WIDE PARKING ISLAND
SECTION B-B (REFER DETAIL 1 THIS SHEET)
N.T.S.



29 L06 BIOFILTER INLET - SINGLE SIDED INLET (6M WIDE PARKING ISLAND) - SECTIONS
SCALE: 1:25



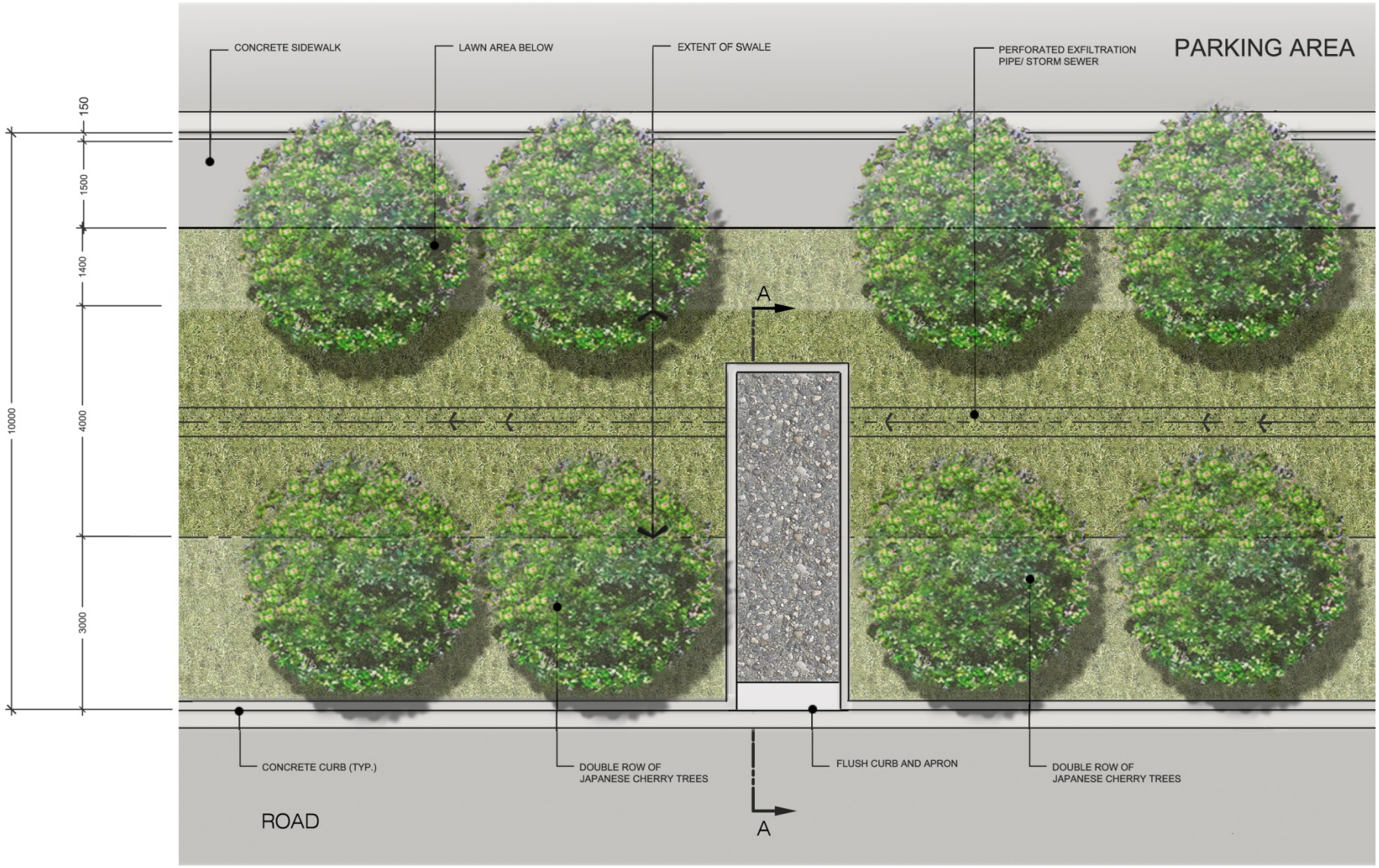
5 L06 DOUBLE (3600 WIDE) BIOFILTER INLET - SINGLE SIDED INLET (4.8M WIDE PARKING ISLAND)
PLAN ENLARGEMENT
SCALE: 1:25



6 L06 SUBSURFACE IRRIGATION WATER STORAGE SYSTEM - TYPICAL SHOP DRAWING BY 'TERRAFIX GEOSYNTHETICS'
SCHEMATIC DESIGN
SCALE: NTS

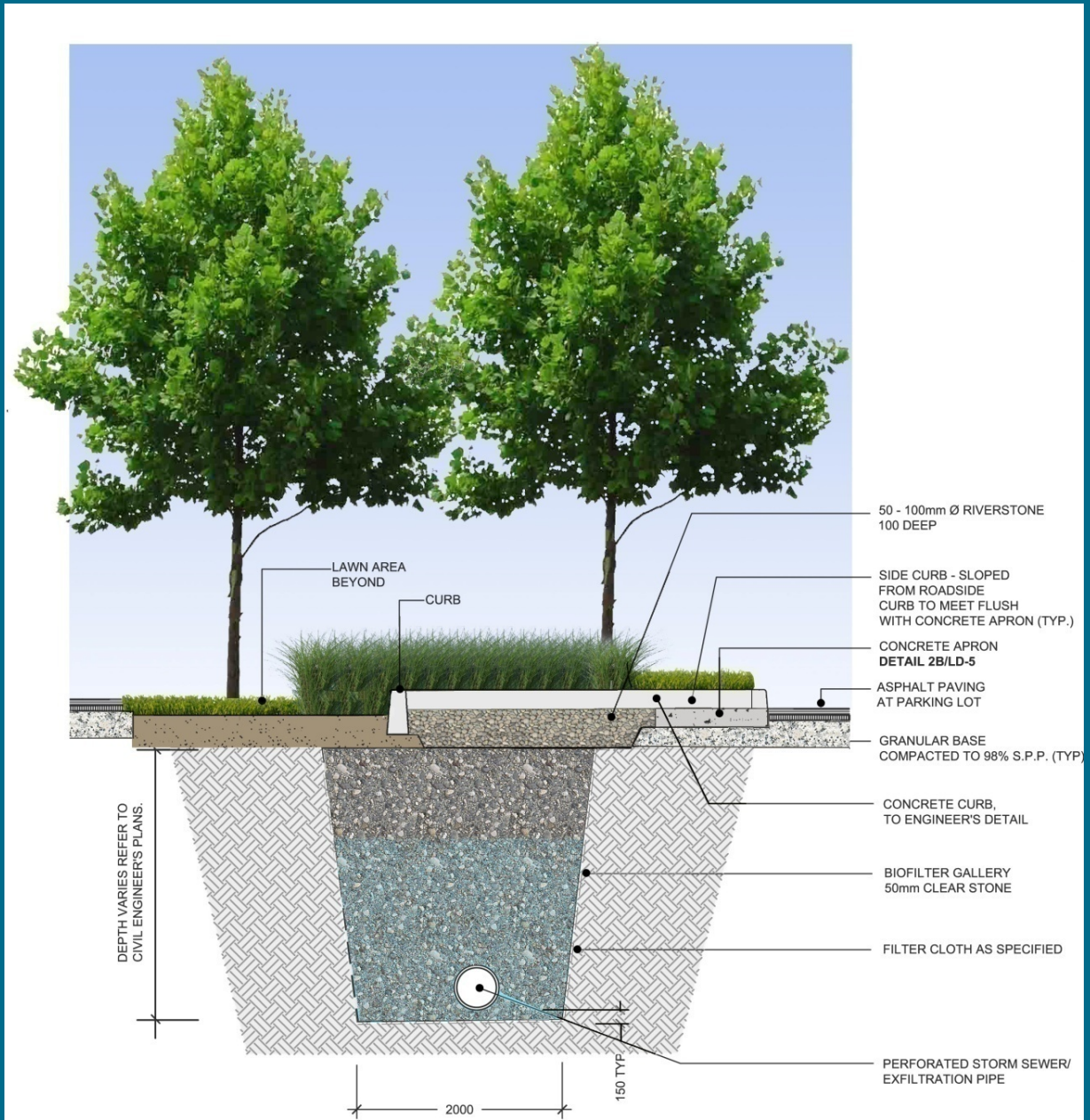
Honda Canada Campus, Markham

Biofilter Plan



Honda Canada Campus, Markham

Biofilter Section



Honda Canada Campus, Markham

Selected Site Photos

Rainwater Harvesting Tank

Natural Drainage

Permeable Pavement in Parking Lot

Permeable Pavement in Forecourt Roundabout

Honda Canada Campus, Markham

Selected Site Photos

Granular Fitness Path and Drainage Swale

Biofilter

Paving and plants in courtyard

Landscaped Outdoor Eating Areas

Challenges / Lessons Learned:

– Contractor education is key

– Integration of utilities and infrastructure is critical

– Maintenance / management program is essential

– System must be protected during construction

Bill Crothers Secondary School, Markham

Objectives:

- **Achieve pre to post development water balance**
- **Address off-site catchment area contribution**
- **Provide water for irrigation**
- **Utilize a treatment-train approach**
- **Enhance the Rouge River corridor**
- **Achieve recreational/educational program requirements**

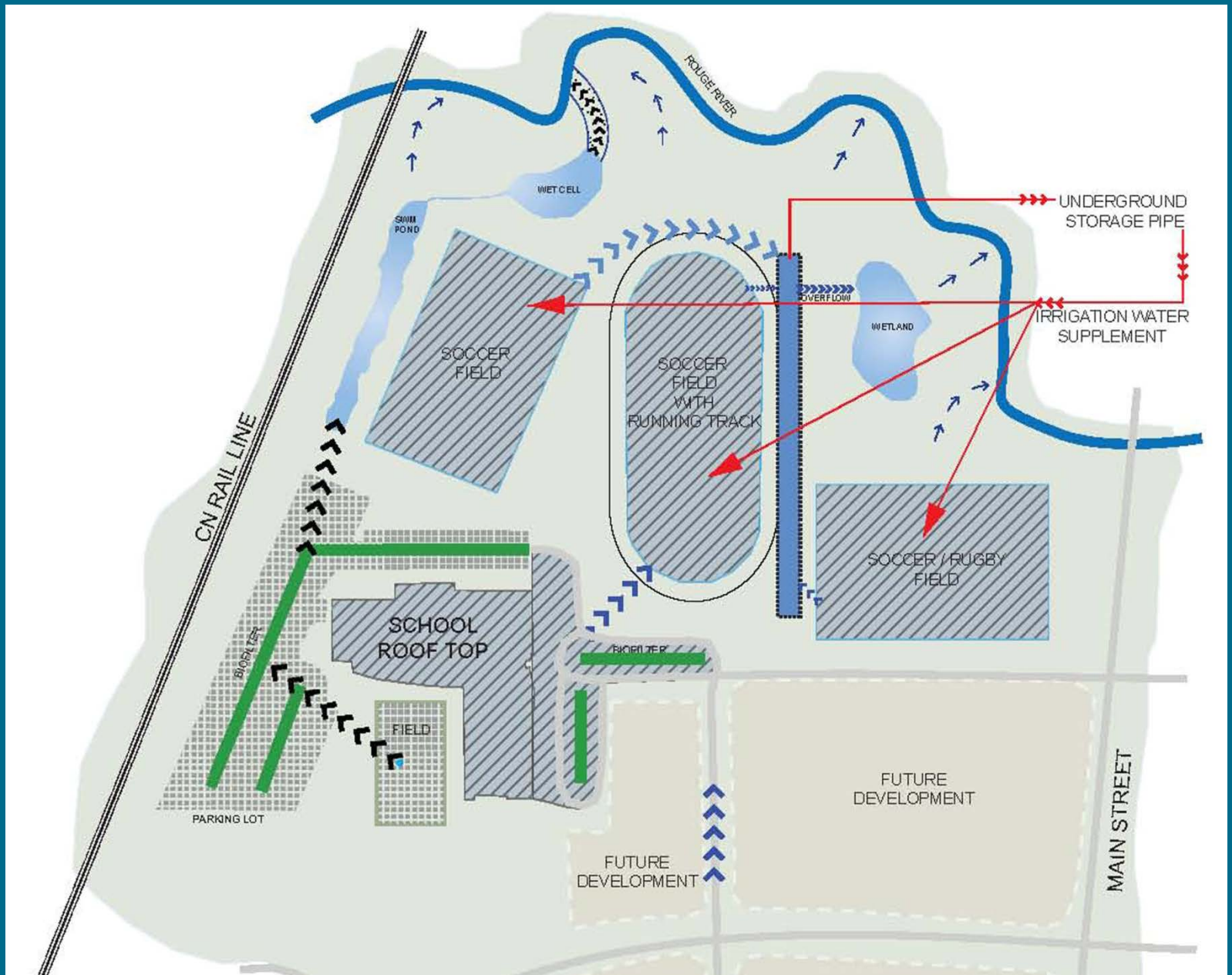
ZAS / HOK Architects
Schaefers Associates
Schollen & Company Inc.

Bill Crothers Secondary School, Markham

Concept Plan

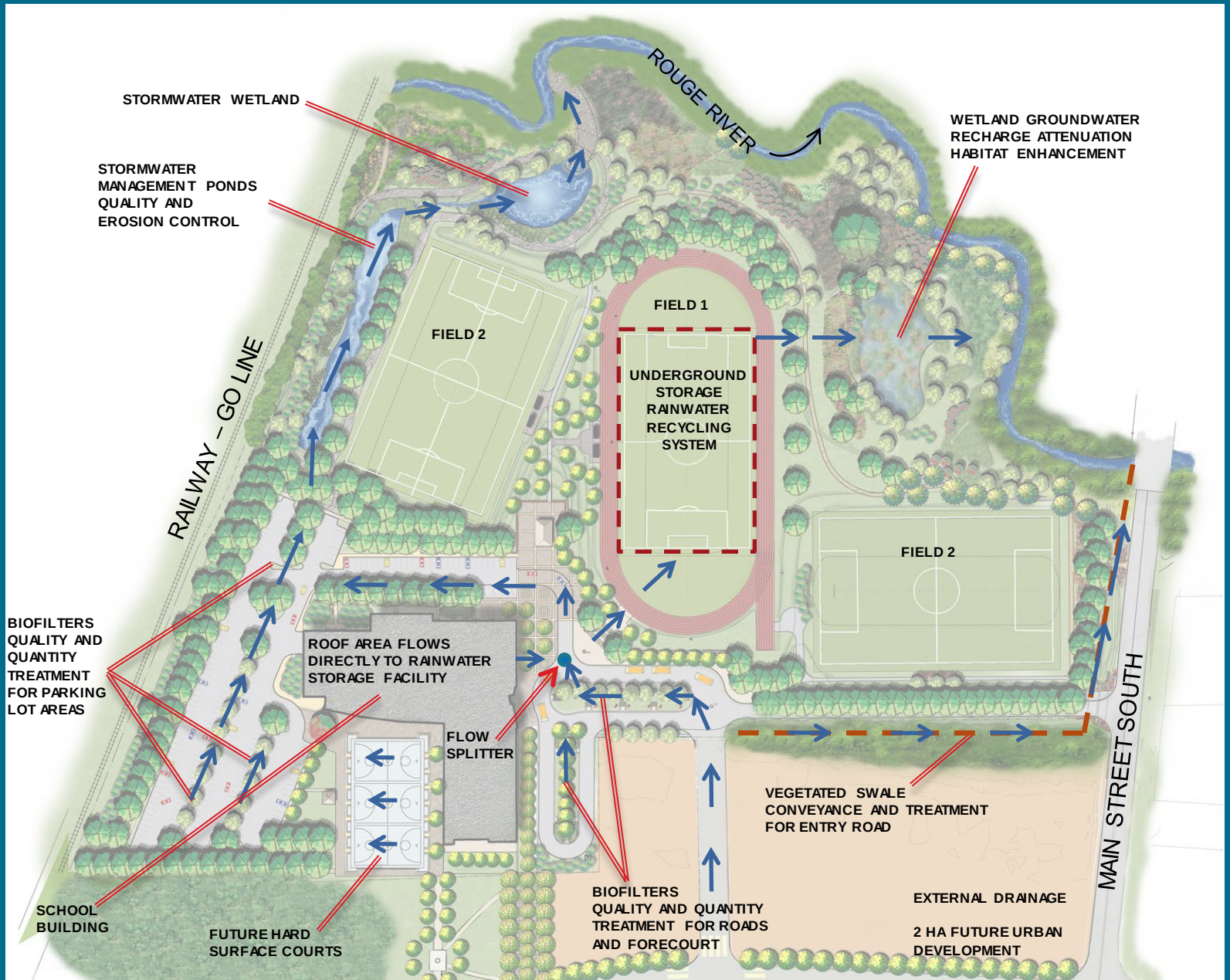
Bill Crothers Secondary School, Markham

Stormwater Management Strategy



Bill Crothers Secondary School, Markham

Stormwater Management Plan



Bill Crothers Secondary School, Markham

Selected Site Photos

Storage Pipe Construction

Biofilter

Parking Lot with Biofilter

Artificial Turf Sports Field and Running Track with Rainwater Harvesting System Beneath

Bill Crothers Secondary School, Markham

Challenges / Lessons Learned:

– Contractor education is key

– Protection of installations during construction is essential

– Maintenance – inadequate maintenance can impact function

– Municipal standards stifle innovation

Dundas Street Commercial Site, Mississauga

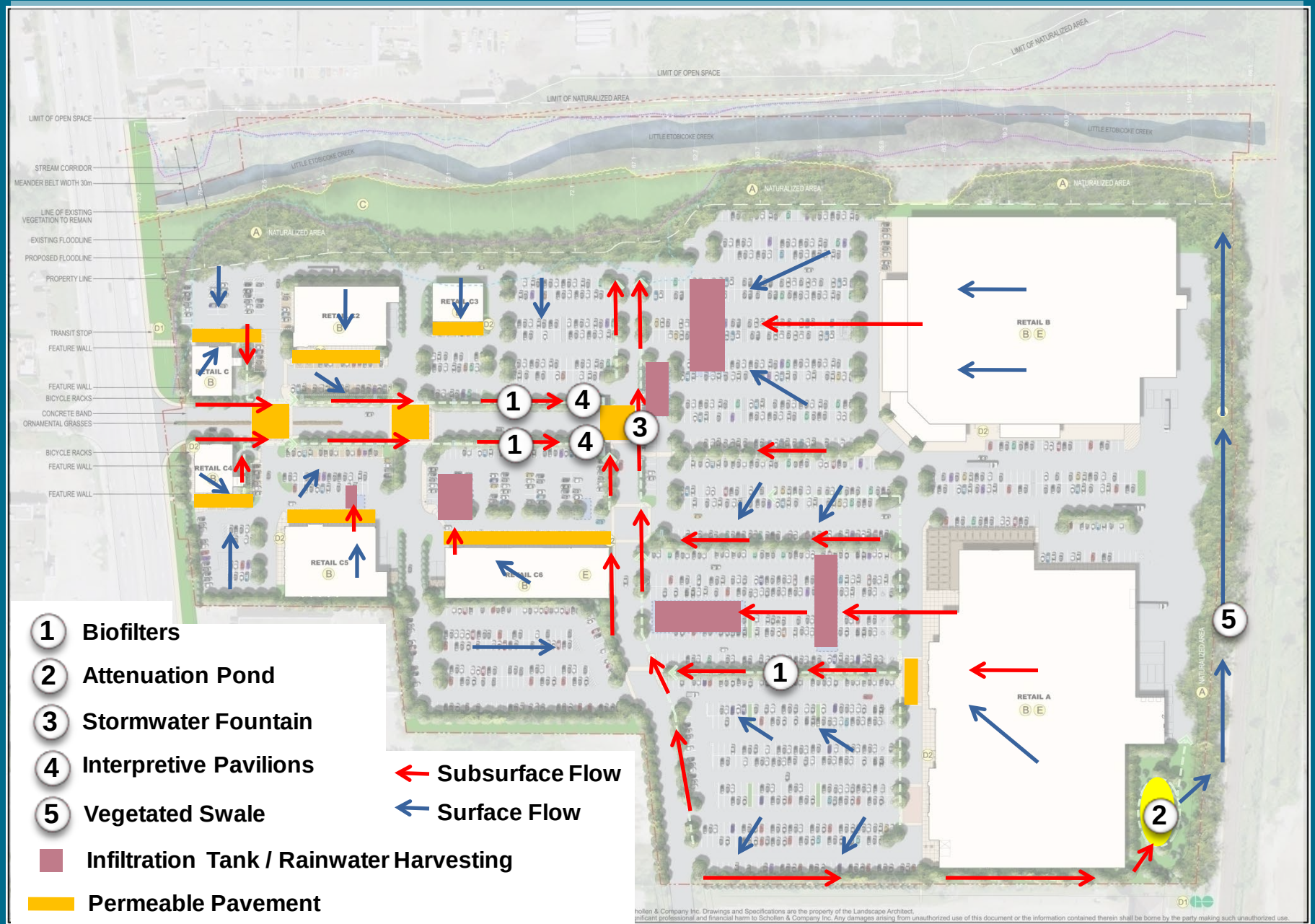
Objectives:

- Improve infiltration potential
- Enhance base flow contribution to Etobicoke Creek
- Improve extent of natural system along stream corridor
- Manifest LID technologies as amenities in the landscape
- Expedite the approval process

Fieldgate Commercial / Smart Centres
Counterpoint Engineering
Schollen & Company Inc.
Terraplan Landscape Architects

Dundas Street Commercial Site, Mississauga
Concept Plan

Dundas Street Commercial Site, Mississauga
Stormwater Management Plan



Dundas Street Commercial Site, Mississauga
The Avenue – Integrated SWM / Streetscape Design

Dundas Street Commercial Site, Mississauga
Storm Fountain Feature – Concept

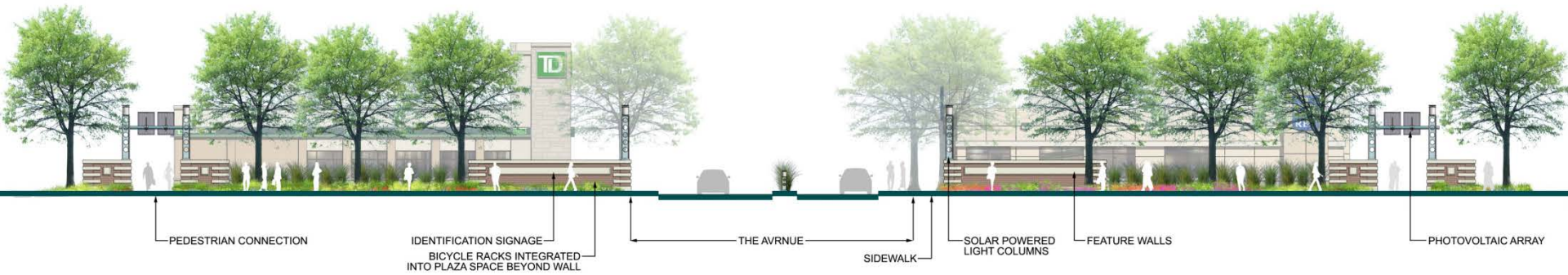
1. BIOFILTER
2. INTERPRETIVE PAVILION
3. PERMEABLE PAVING
4. RAINWATER FOUNTAIN
5. SOLAR ARCADE - PHOTOVOLTAIC PANELS
6. LIGHT COLUMNS
7. FEATURE WALL
8. GRATE / WET WELL / PUMP FOR FOUNTAIN
9. PHOTOVOLTAIC ROOF PANELS
10. INTERPRETIVE SIGNAGE
11. PEDESTRIAN CONNECTION
12. DECORATIVE PAVEMENT

Dundas Street Commercial Site, Mississauga
Selected Site Photos

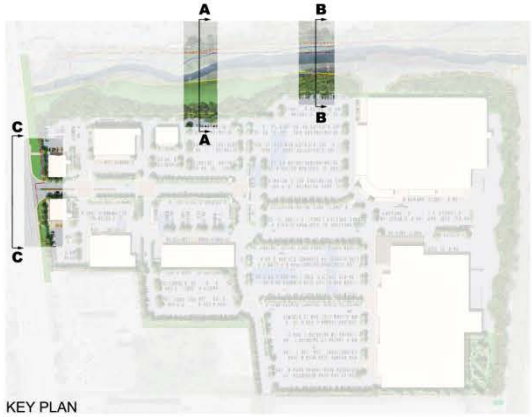
Permeable pavement and biofilter

Storage tank installation

Dundas Street Commercial Site, Mississauga
Sections



ELEVATION C-C' - DUNDAS STREET EAST FRONTAGE LANDSCAPE TREATMENT



KEY PLAN

SECTION B-B' 1:100

SECTION A-A' 1:100

Dundas Street Commercial Site, Mississauga

Challenges / Lessons Learned:

– Reclamation of Brownfields site

- Soil contamination
- Dumped debris

– Extent of impervious cover – parking and building area

– Practical commercial requirements:

- Circulation
- Servicing / loading
- Visibility of retail tenants

Elm Drive L.I.D. Retrofit Project, Mississauga

Objectives:

- **Moderate runoff rates**
- **Enhance infiltration**
- **Improve water quality**
- **Monitor effectiveness of bioretention facilities**

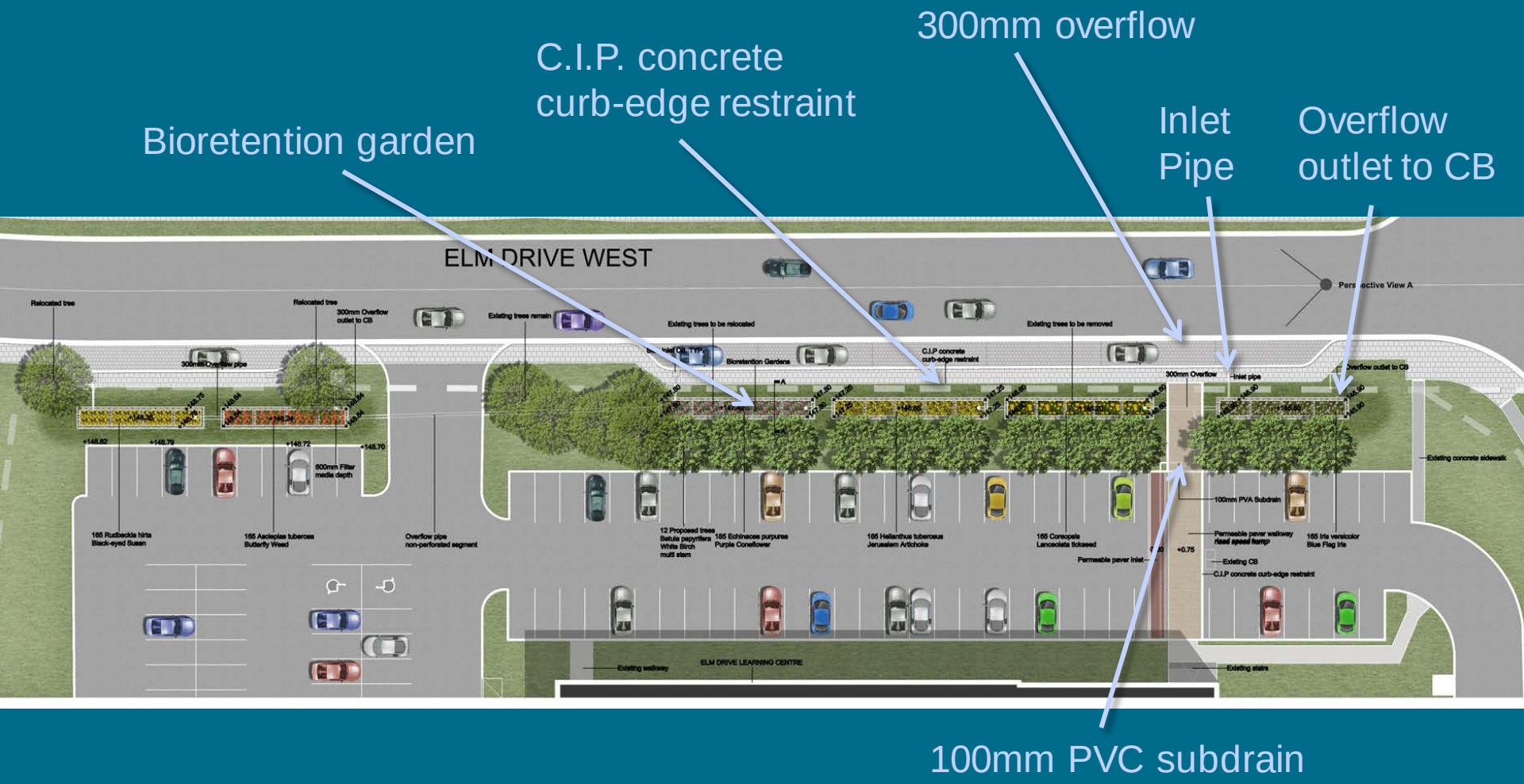
City of Mississauga
Credit Valley Conservation Authority
Peel Region District School Board
The Municipal Infrastructure Group Ltd. (TMIG)
Schollen & Company Inc.

Elm Drive L.I.D. Retrofit Project, Mississauga

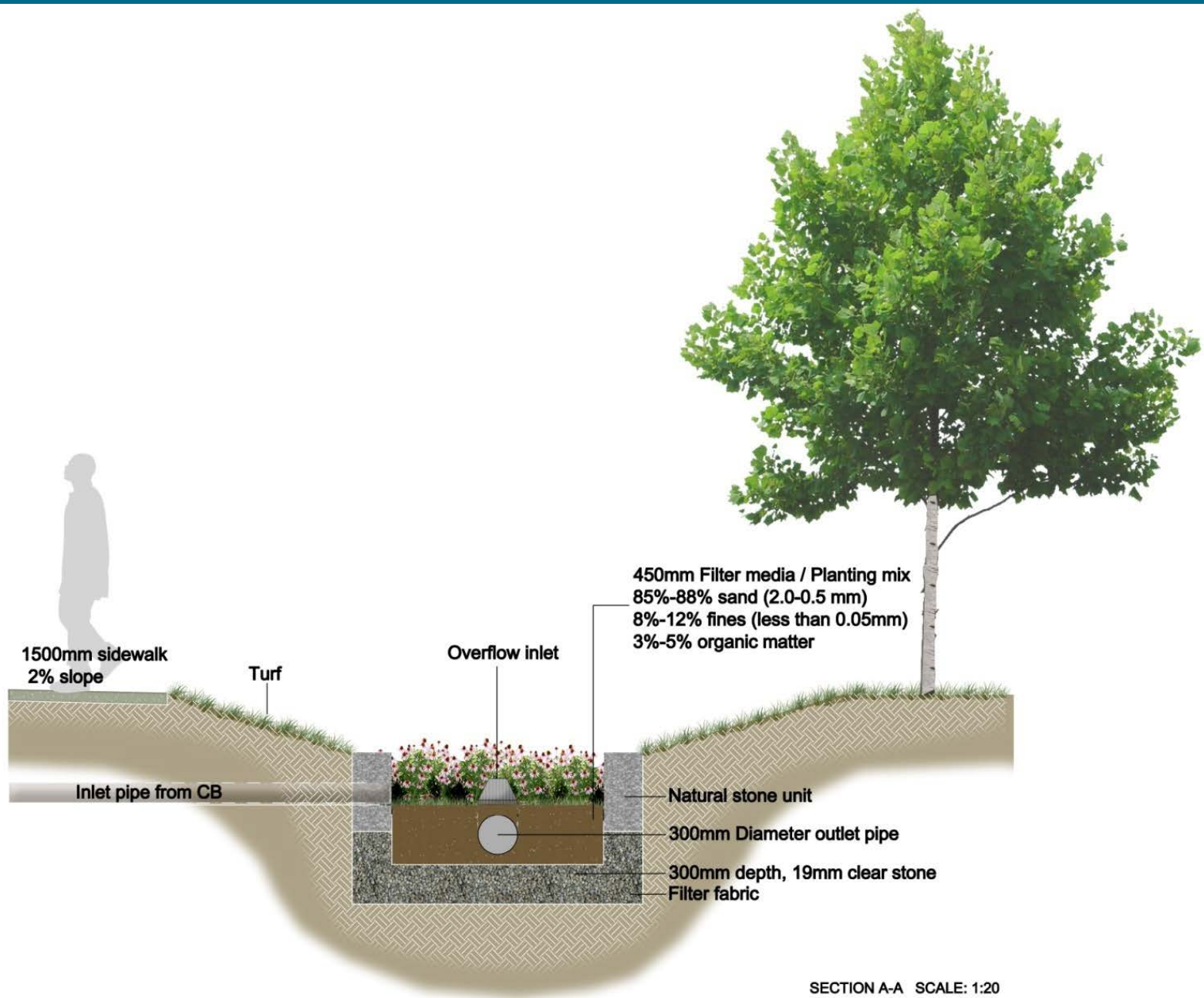
Site Location

Elm Drive L.I.D. Retrofit Project, Mississauga

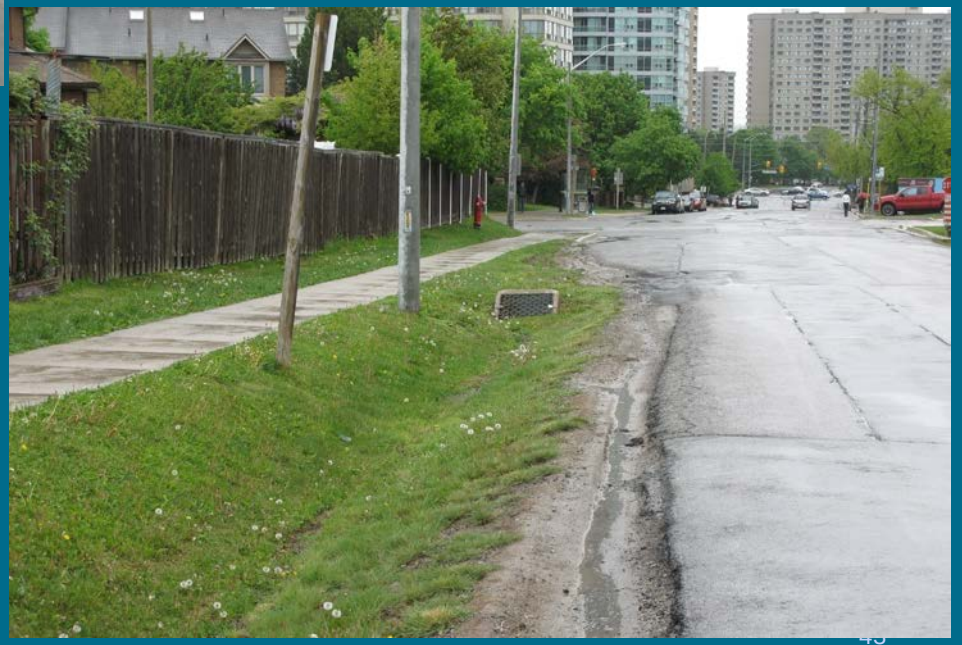
Proposed Design



Elm Drive L.I.D. Retrofit Project, Mississauga
Cross-section



Elm Drive L.I.D. Retrofit Project, Mississauga
Before Construction



Elm Drive L.I.D. Retrofit Project, Mississauga
Perspective

Elm Drive L.I.D. Retrofit Project, Mississauga
Selected Site Photos – During Construction

Planter with Tickseed

Planter with Iris

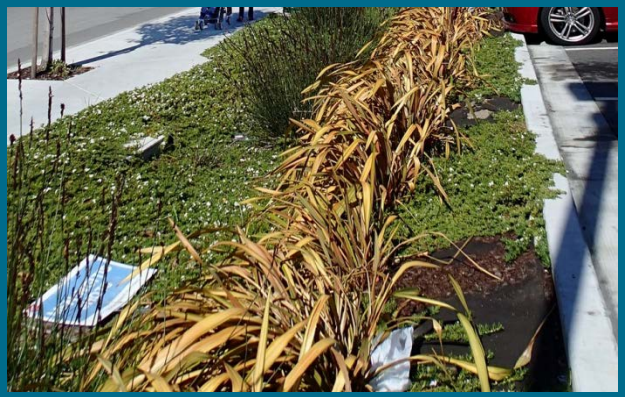
Elm Drive L.I.D. Retrofit Project, Mississauga

Challenges / Lessons Learned:

– Attention to detail during construction is essential

– Plant growth is contingent on frequency of inundation

– Litter removal / maintenance is a concern



Lakeview Community Sustainable SWM Streetscape Project, Mississauga

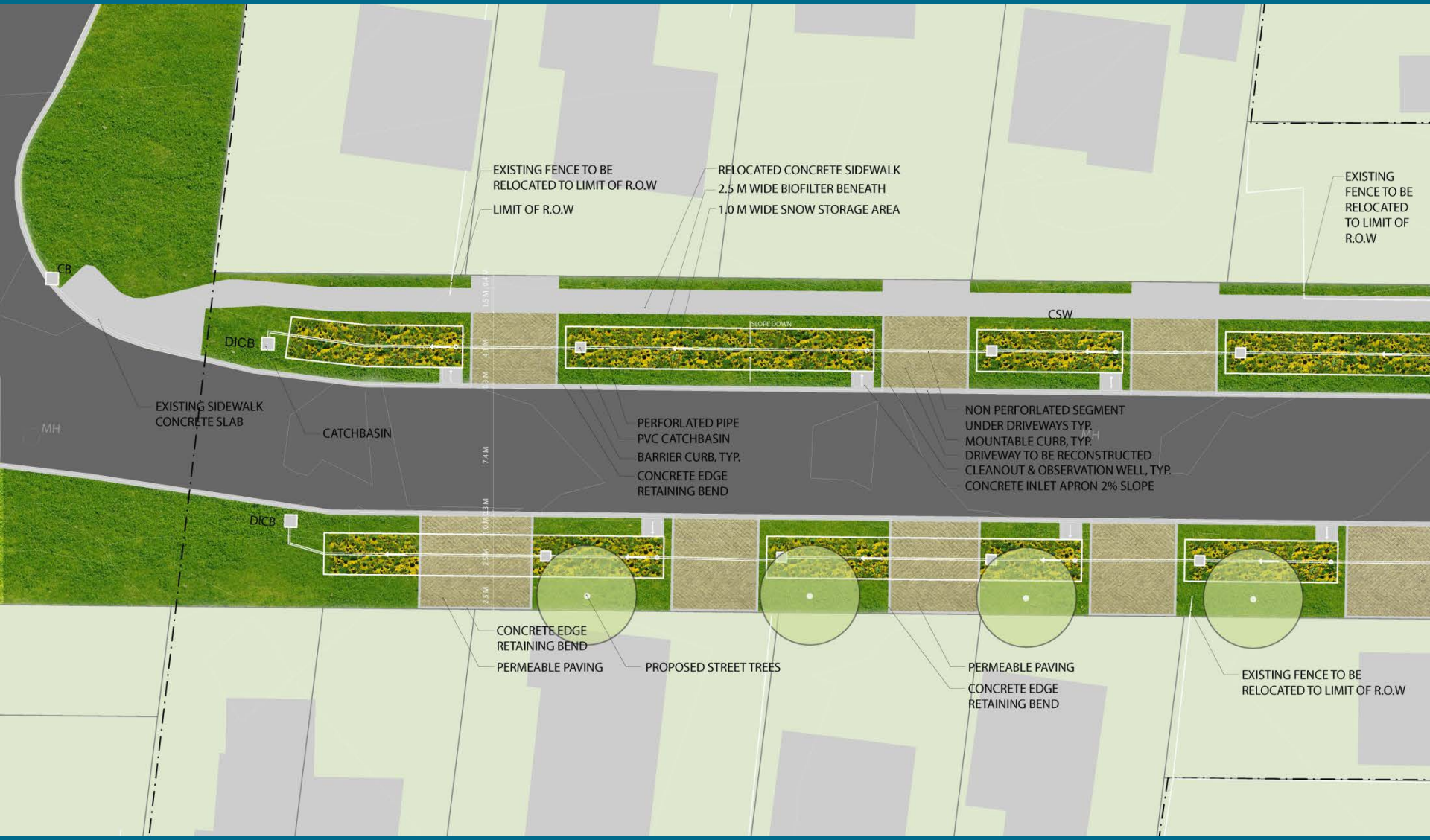
Objectives:

- **Improve water quality**
- **Moderate discharge rates**
- **Reduce flooding**
- **Create a signature streetscape**

City of Mississauga
Schollen & Company Inc.
Aquafor Beech Ltd.

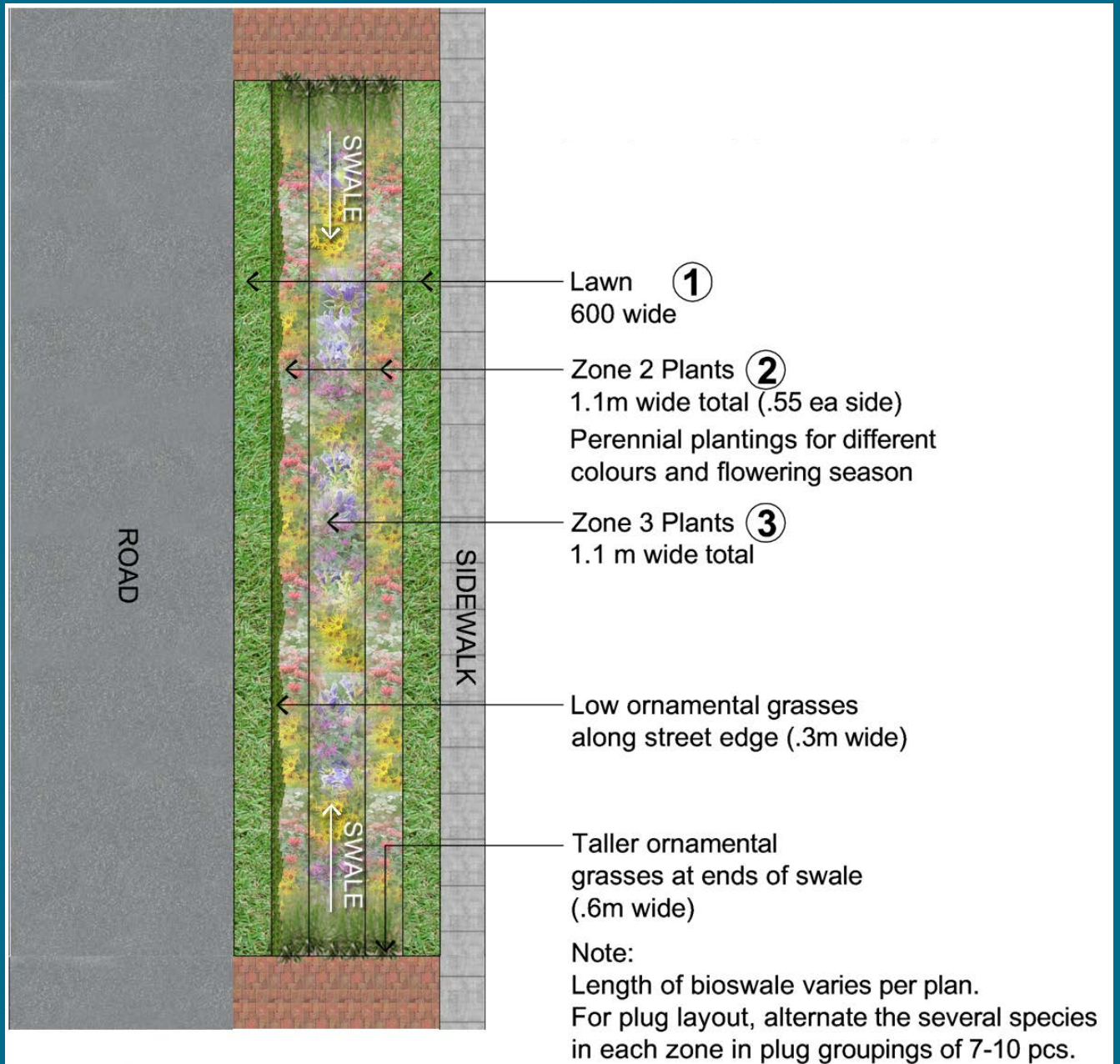
Lakeview Community Sustainable SWM Streetscape Project, Mississauga

Plan



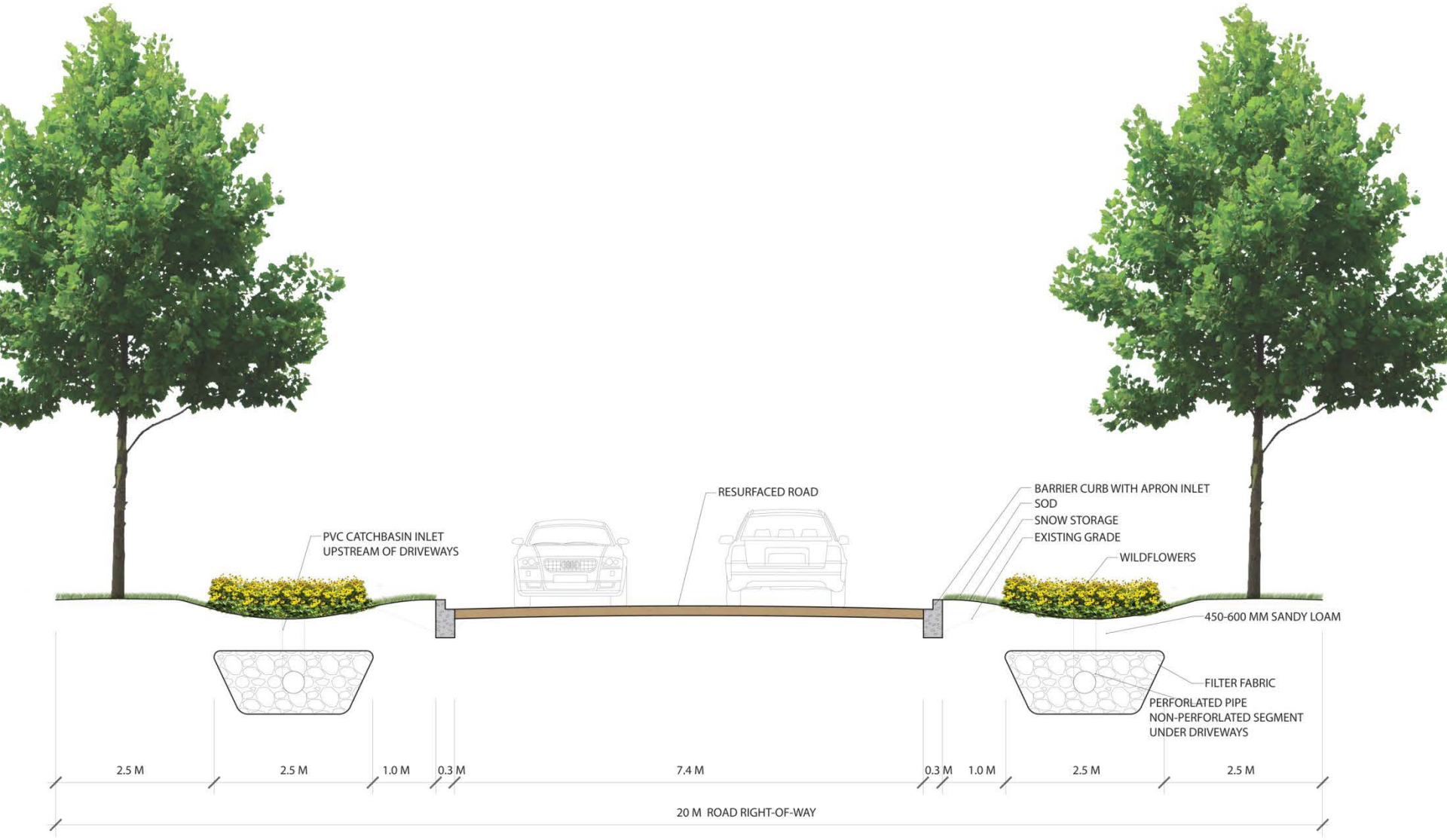
Lakeview Community Sustainable SWM Streetscape Project, Mississauga

Plan View



Lakeview Community Sustainable SWM Streetscape Project, Mississauga

Cross-Section



Lakeview Community Sustainable SWM Streetscape Project, Mississauga

Perspective

Before

Lakeview Community Sustainable SWM Streetscape Project, Mississauga

Selected Site Photos – During Construction

Lakeview Community Sustainable SWM Streetscape Project, Mississauga

Selected Site Photos

After Construction

Lakeview Community Sustainable SWM Streetscape Project, Mississauga

Challenges / Lessons Learned:

– Precision is required in establishing grades to ensure functional performance

– Care needs to be taken when installing permeable pavement

– Plant material growth rates are contingent on precipitation rates

– Maintenance is key to achieving the desired aesthetic

Photo source: CVC website

York University Life Sciences Building, Toronto

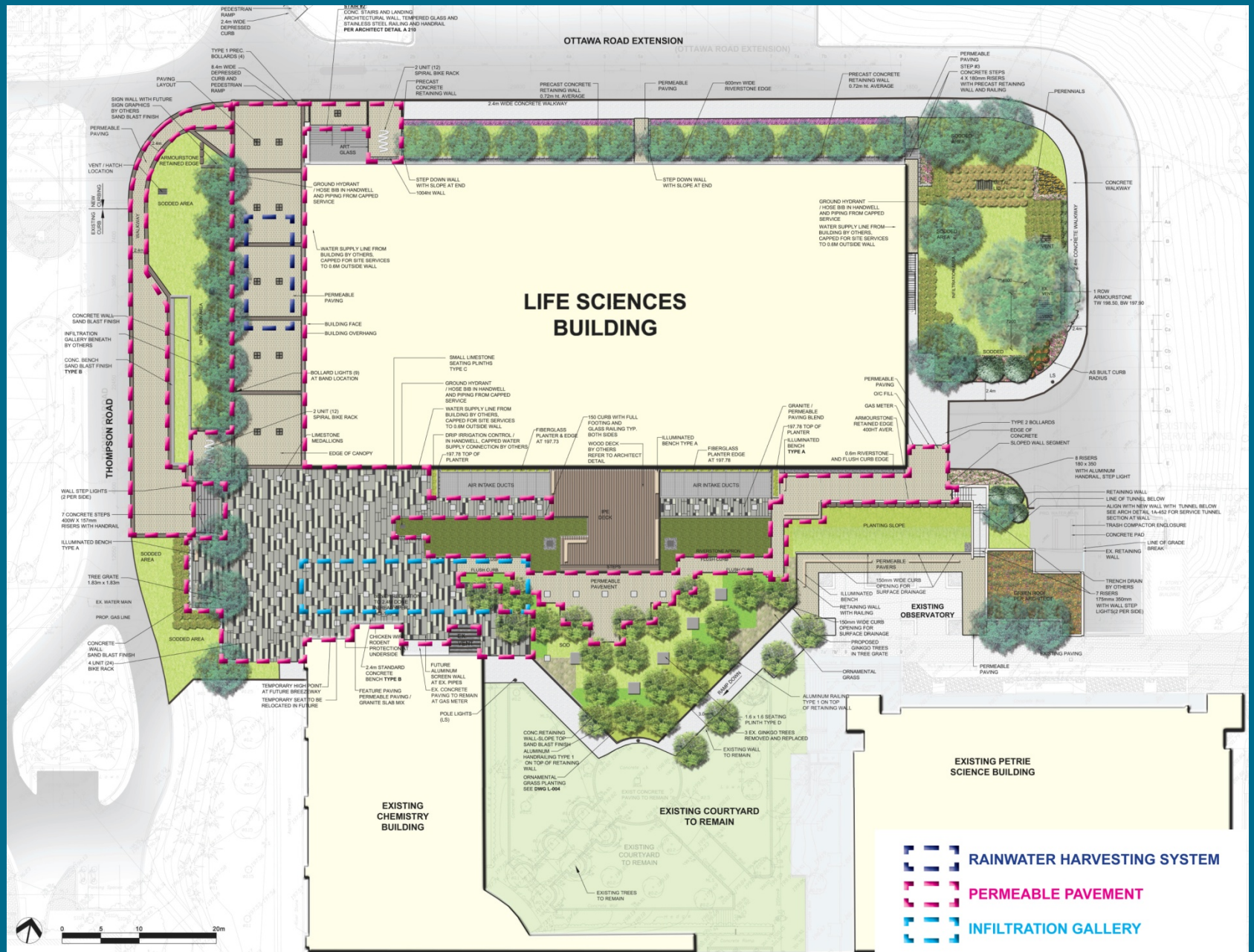
Objectives:

- **Address restricted discharge rate**
- **Encourage infiltration**
- **Provide a source of non-portable water for irrigation and reuse in building**
- **Achieve LEED® requirements**

NXL Architects / SSG Architects
Schollen & Company Inc.
R.V. Anderson Associates

York University Life Sciences Building, Toronto

Concept Plan



York University Life Sciences Building, Toronto
Selected Site Photos – Before Construction

York University Life Sciences Building, Toronto
Selected Site Photos – Before Construction

York University Life Sciences Building, Toronto
Selected Site Photos – After Construction

York University Life Sciences Building, Toronto
Selected Site Photos – After Construction

York University Life Sciences Building, Toronto
Selected Site Photos – After Construction

Permeable pavements over rainwater harvesting tank

Permeable pavements over plaza over infiltration medium

L.I.D. integration with design inspiration

York University Life Sciences Building, Toronto
Selected Site Photos – After Construction

Rainwater Harvesting System - The main pedestrian spine on the west side of the building

Pedestrian walkway forms the spine of the circulation system in the campus

The landscape in south of building incorporates a deck, seating areas and customized planters

The deck in an extension of an interior lounge space

York University Life Sciences Building, Toronto
Selected Site Photos – After Construction

Seating plinths within the landscape

Green roof over top of service area

Stairway leading to green roof over top of the service area for the Physics Building

Solar sculpture on the north face of the building by artist (Sarah Hall)

Challenges / Lessons Learned:

– Utility and sub-surface conflicts

– Retrofit / infill projects present unique challenges

– Coordination amongst all disciplines is essential to success

Potential Low Impact Development (L.I.D.) Options Checklist

POTENTIAL L.I.D./SUSTAINABLE SWM TECHNIQUES & OWNERSHIP, OPERATION AND MAINTENANCE SCENARIOS

Land Use	Potential L.I.D. Technique	Functional Performance		
		Stormwater Management - Quantity Control	Stormwater Management - Quality Control	Water Balance - Enhanced Infiltration
Employment	Rainwater harvesting / cisterns	✓		
	Biofilters in parking areas	✓	✓	✓
	Parking lot storage	✓		
	Permeable pavement	✓	✓	✓
	Roof top storage	✓		
	Increased topsoil depth	✓	✓	✓
	Enhanced tree canopy cover	✓		
Parks/Open Space	Integration of biofilters	✓	✓	✓
	Integration of surface storage	✓		
	Enhanced tree canopy cover	✓		
	Sub-surface storage	✓	✓	✓
	Infiltration galleries	✓	✓	✓
Rights of Way	Enhanced boulevards/greenways to incorporate biofilters, swales or retention storage	✓	✓	✓
	Permeable pavement	✓	✓	✓
	Enhanced tree canopy cover	✓		
	Porous catchbasins	✓	✓	✓
	Porous pipe storm sewers	✓	✓	✓

Potential Low Impact Development (L.I.D.) Options Checklist

POTENTIAL L.I.D./SUSTAINABLE SWM TECHNIQUES & OWNERSHIP, OPERATION AND MAINTENANCE SCENARIOS

Land Use	Potential L.I.D. Technique	Functional Performance	
		Water Balance - Enhanced Evapotranspiration	Water Balance - Baseflow Augmentation
Employment	Rainwater harvesting / cisterns		
	Biofilters in parking areas	✓	✓
	Parking lot storage		
	Permeable pavement		✓
	Roof top storage	✓	
	Increased topsoil depth	✓	✓
	Enhanced tree canopy cover	✓	
Parks/Open Space	Integration of biofilters	✓	✓
	Integration of surface storage	✓	
	Enhanced tree canopy cover	✓	
	Sub-surface storage		✓
	Infiltration galleries		✓
Rights of Way	Enhanced boulevards/greenways to incorporate biofilters, swales or retention storage		✓
	Permeable pavement		✓
	Enhanced tree canopy cover	✓	
	Porous catchbasins		✓
	Porous pipe storm sewers		✓

Potential Low Impact Development (L.I.D.) Options Checklist

POTENTIAL L.I.D./SUSTAINABLE SWM TECHNIQUES & OWNERSHIP, OPERATION AND MAINTENANCE SCENARIOS

Ownership/Operation Key

A. Private ownership provision for 15% failure rate to account for modification by homeowner over time.
B. Private ownership integrated with sump pump system to ensure function.
C. Private ownership – enactment by-law that requires securement of a permit for replacement and requires permeable pavement to be used.
D. Private ownership of system/municipality ownership of control mechanism within public right-of-way
E. Private ownership of trees. Enactment of a tree removal by-law to regulate the removal and require replacement
F. Public ownership and operation by municipality. Operation plan provided by developer as a condition of approval.

Maintenance Requirements Key

1. No maintenance required
2. Pre-treatment to minimize sediment accumulation, periodic (infrequent 5-10 years) sediment/debris removal and maintenance of sump pump.
3. Annual sweeping and periodic (infrequent 5-10 years) topping up of granular jointing material
4. Litter removal and routine weeding/plant maintenance
5. Annual inspection of observation ports and inlets. Seasonal removal of litter from inlets, weeding and plant maintenance cleaning out of inlet aprons (infrequent 5-10 years).
6. Clean out of catchbasin sumps
7. Annual inspection and cleaning of roof drain scuppers
8. Routine removal of litter debris. Infrequent (10 years+) removal of accumulated sediment.

Potential Low Impact Development (L.I.D.) Options Checklist

Land Use	Potential L.I.D. Technique	Ownership/ Operation Scenario	Maintenance Requirements	Potential for Application
Employment	Rainwater harvesting / cisterns	A	2	
	Biofilters in parking areas	D	3	
	Parking lot storage	D	6	
	Permeable pavement	C	3	
	Roof top storage	D	7	
	Increased topsoil depth	A	1	
	Enhanced tree canopy cover	C	1	
Parks/Open Space	Integration of biofilters	F	5	
	Integration of surface storage	F	8	
	Enhanced tree canopy cover	F	1	
	Sub-surface storage	F	8	
	Infiltration galleries	F	5	
Rights of Way	Enhanced boulevards/greenways to incorporate biofilters, swales or retention storage	F	5	
	Permeable pavement	F	3	
	Enhanced tree canopy cover	F	1	
	Porous catchbasins	F	6	
	Porous pipe storm sewers	F	8	

SUMMARY

Key issues with implications on the application of L.I.D.:

– Site conditions

– Integration with municipal standards

– Contractor education

– Maintenance and operation

– Need for monitoring

SUMMARY

L.I.D. Design Essentials:

– Integrated design process

– Multi-disciplinary team

– Iterative / inclusive methodology

– Creativity / innovation

– Perseverance

TRIECA CONFERENCE 2014

Low Impact Development (L.I.D.) Case Studies and Lessons Learned

Toronto and Region Conservation for The Living City

Toronto and Region Conservation Authority

March 26, 2014

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