# PRELIMINARY INTEGRATED RAINWATER MANAGEMENT PLAN (IRMP)

## 5163 – 5187 JOYCE STREET

## 1128587 BC LTD

VECTOR PROJECT NO.: 19-2460-20
REV. 0, JULY 28, 2020

150-6450 Roberts Street, Burnaby, BC V5G 4E1 604-298-2333

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## 1.0 INTRODUCTION

Vector Engineering Services Ltd has been retained to provide civil engineering and Integrated Rainwater Management Plan design on behalf of 1128587 BC Ltd. for the property located at 5187 Joyce Street, in Vancouver, BC. The subject site is located along the west side of Joyce Street, south of Vanness Avenue (see aerial photo in Appendix 1).

As a condition of development, the City of Vancouver has requested an Integrated Rainwater Management Plan for the site. In response to this requirement, Vector Engineering Services Ltd. was retained to provide analysis of the site drainage and establish an Integrated Rainwater management strategy for the proposed new development. The hydrologic calculations and storm modeling of the site are summarized in this report and are hereby submitted for review.

## 2.0 EXISTING CONDITIONS

The subject site is approximately 0.16 hectares in area, consisting of commercial lots. The current groundcover condition at the site is 92% impervious. The site currently slopes in a south to south-east direction.

## 3.0 PROPOSED DEVELOPMENT

The development plan calls for construction of a mixed-use 32-storey high-rise building with 4 storeys of parking underground. With the proposed development of the site, the total overall impervious site coverage will decrease to 85%. The impervious areas will consist of building roofs, pedestrian rest areas, parkade ramp and hard landscaped areas. The remainder of the site will consist of a variety of landscaped areas, above the parkade roof slab. (See Appendix 2).

## 4.0 STORM WATER MANAGEMENT OBJECTIVES AND BMPS

To improve the quality of the rainwater runoff and improve the health of natural water bodies, the City of Vancouver has adopted a City Wide Integrated Rainwater Management Plan and a Rezoning Policy for Sustainable Large Developments. This plan requires all new developments requiring rezoning to incorporate rainwater management measures to control post development runoff rates and to improve the quality of rainwater runoff using Best Management Practices.

The rainwater management system for this site has been designed in accordance with the City Wide Integrated Rainwater Management Plan criteria, the Rezoning Policy for Sustainable Large Developments requirements, and the amendment to Building Bylaw

regarding Water Use in Buildings: Enhanced Public Safety, Efficiency and Long-Term Resiliency Measures adopted in January 2019.

As per City of Vancouver Rainwater Management criteria we have considered several options to reduce the stormwater discharge, reduce the peak runoff flow rate, and treat surface runoff to reduce contaminants.

The measures proposed are required to meet the following targets:

- Post-development peak runoff rate = Pre-development peak runoff rate for the five-year 24-hour duration storm.
- Capture and retain 24mm of rainfall in 24 hours from all areas, including rooftops, paved areas and landscape.

Additional references include the Metro Vancouver Stormwater Source Control Design Guidelines and the Land Development Guidelines for the Protection of Aquatic Habitat which was developed jointly by the Department of Fisheries and Oceans Canada and the British Columbia Ministry of Environment, Lands and Parks (M.O.E.).

The source controls adopted for this development consist of several measures to be implemented onsite as well as offsite. The source controls are shown on the attached drawing, Integrated Rainwater Management Concept Plan and are summarized below.

### 4.1 Tier 1 Priority Green Infrastructure Practices – Rain Water Harvesting for Reuse

The primary purpose of rainwater harvesting is to reduce domestic water demand and runoff from impermeable surfaces. Rainwater harvesting involves collecting rainwater and storing it for non-potable uses.

The City criteria for using rainwater harvesting is to use the harvested rainwater within a 96-hour period all year round. The use of harvested rainwater for irrigation, non-potable water use, cannot meet this criterion or is very costly at this design stage and therefore the rainwater harvesting source control option has been disregarded.

### 4.2 Tier 2 Priority Green Infrastructure Practices – Retention within Non-Infiltrating Landscape

The primary purpose of the absorbent landscaping is to reduce runoff from impermeable surfaces by intercepting and retaining rainwater. The target is to retain the first 24 mm per day (24 hours) of rainfall.

To implement this practice, we are proposing to install absorbent topsoil with thicknesses between 450mm and 750mm in the proposed tree areas, underlain by a system of Permavoid cells on top of the underground parkade. The surface and roof runoff will be directed into the topsoil and Permavoid cells prior to discharge into the municipal system. The Permavoid cell area is 75% of the total of absorbent soil area in each of the planter zones.

The drainage runoff will be directed into the Permavoid cells, which will be provided with overflow discharge into the building storm system as follows:

**HARD LANDSCAPING AREA DRAINS AND ROOF DRAINAGE:**

PRIMARY:

Divert water to Permavoid / planter media by opening normally closed (n.c.) solenoid valve (low level pipe connection).

SECONDARY:

Upon water detection (soil saturation level or overflow sensor through building bms system) - close solenoid valve; this will divert water to the storm drainage via a pipe connection above the solenoid valve.

EMERGENCY FAIL:

Planter solenoid fails closed. If it does not close, planter storage cell overflow goes to drain tile sump pumps in the foundation until maintenance corrects. This is to prevent accidentally over-saturating the soil, impacting trees.

**24 mm OF RAINFALL RETAINING MODELING RESULTS:**

The entire site area was divided into sub catchment areas that identify the hardscaping and roof areas tributary to each absorbent soil and Permavoid cell area.

The required rainfall volume to be retained onsite was calculated for each subcatchment area, respecting the target of retaining the first 24mm of rainfall in 24 hours. This was then compared to the absorbent soil capacity and volume provided by each Permavoid cell associated with the absorbent soil areas.

For the purpose of this application a soil absorbency capacity of 20% was considered.

A summary is provided in the Table 1 below and detailed calculations are shown on the Proposed Post-Development Integrated Rainwater Management Plan attached in Appendix 2.

**Table 1**

| Sub catchment Areas | Retention Volume Required | Total Retention Volume Provided | Volume Provided by "Permavoid" | Volume Provided by Absorbent Soil |
|---|---|---|---|---|
| A1 | 25.87 $m^3$ | 50.51 $m^3$ | 25.87 $m^3$ | 24.64 $m^3$ |
| A2 | 13.44 $m^3$ | 21.03 $m^3$ | 10.89 $m^3$ | 10.14 $m^3$ |
| **Total** | **39.30 $m^3$** | **71.54 $m^3$** | | |

The post-development site area including rooftops, paved areas and landscaping is approximately 1638 $m^2$.

24mm of rainfall volume = 1638 $m^2$ x 24mm = 39.3 $m^3$.

The post-development site layout will have a total landscape area of 260.36 $m^2$ consisting of areas of absorbent soils with thicknesses between 450mm and 750mm over the parkade slab

The landscaping plan calls for absorbent landscaping areas with soil thickness varying from 450mm in shrub landscaped areas to 750mm in treed areas.

The total soil volume provided is 185.86 $m^3$ which will have a rainfall volume retaining capacity of 37.17 $m^3$.

The hard landscaping such as walkways, pedestrian rest areas and other hard landscaping will be graded to drain towards the adjacent soft landscaped areas, which will be provided with an overflow catch basin tied into the site drainage system inside the underground parkade structure.

The water storage will be consolidated on Level 1 where the trees and planting along the breezeway can take advantage of the stored water. The 40 cubic meters of water storage required for the project will cover a footprint of 150 square meters at a depth of 267mm. A HDPE or similar liner will be used to store the water in a void space created by Permavoid or a similar system. Soil will be installed above the reservoir in planters and in a layer of soil cells under the paving to allow water to wick up from below. Soil moisture sensors and a smart controller will be used to disengage these

irrigation zones when the soil moisture levels are maintained adequately by wicking from the reservoir.

The roof runoff will be directed into the site drainage system inside the underground parkade structure.

## 4.3 Tier 3 Priority Green Infrastructure Practices – Detention Storage with Treatment and Slow Release

### 4.3.1 Water Quality

The on-site stormwater drainage system is designed to separate clean runoff from the roof and landscaped areas from the contaminated first flush runoff on the roadways and parking areas. Water from the roof and landscaped areas will be routed to the proposed detention tank located along the east side of the site. Runoff from areas subject to vehicular access will be routed to a series of stormwater treatment features. Primary treatment of stormwater from parking areas and roadways is derived from hooded catch basins and a conventional oil-water separator to retain sediment as well as oil and hydrocarbons leaking from vehicles accessing the subject site.

Secondary treatment of stormwater for hydrocarbons, heavy metals and suspended solids will be provided by the soft landscaping soils and planting as the entire site drainage will go through the absorbent soils.

### 4.3.2 Stormwater Detention

As outlined previously in Section 4.0 of this report, the criterion used for the stormwater analysis is to limit the five-year 24-hour (2100 IDF curve) post-development peak runoff to the five-year 24-hour (2014 IDF Curve) pre-development peak runoff.

Detention tanks collect and store stormwater runoff during a storm event, then release it at controlled rates to the downstream drainage system, thereby attenuating peak discharge rates from the site.

The modeling results show that there is no detention volume required to meet the City of Vancouver peak runoff reduction to the to the five-year 24-hour (2014 IDF Curve) pre-development level. However, a flow control manhole with a discharge rate of 9.4 l/sec will be provided upstream of the site connection to municipal system.

The proposed development is not anticipated to have an adverse effect on the downstream conveyance and stream channel capacity.

Details of the flow control manhole and orifice calculations are shown on Appendix 2.

## 5.0 HYDROLOGIC MODEL AND ANALYSIS

The following drainage modeling and analysis was used for design of the Stormwater Management System for this project.

### 5.1 Rainfall Data

The rainfall data used in the hydrologic analysis was based on the five-year return period rainfall, as per the City's Stormwater Management Design Criteria and City of Vancouver Rainwater Management Bulletin dated July 2018.

The City of Vancouver IDF curve (2014), AES rainfall data for pre-development conditions and IDF curve (2100), AES rainfall data for post-development conditions have been modeled and tabulated for storms of 5 year 24-hour duration, was selected for the hydrologic analysis (Appendix 3).

### 5.2 Existing Runoff

To simulate the two-year stormwater runoff for the existing condition, the relative impervious and pervious areas were analyzed and hydrologic models were computed using the Illudas method from a computer program "HYDSYS for Drainage". For the purpose of establishing a release rate for comparison between pre and post development conditions, soil type C (slow infiltration rates) was input into all drainage models.

In accordance with the City Vancouver Integrated Rainwater Management Design Criteria, the pre-development computer model simulations were completed for five-year storms with durations of 24 hours for the City of Vancouver IDF curve (2014), AES rainfall data.

Based on the described parameters above, the peak runoff value and volume for the five-year 24 hour rainfall event was calculated to be as follows:

Five year 24 hour existing peak flow and total rain volume

Existing Site $Q_{5yr,\ 24hr} = 9.4$ l/sec
Total rain volume V5yr, 24hr= 142 $m^3$

Allowable Release Rate

In accordance with the City Vancouver Integrated Rainwater Management Design Criteria, allowable release rate = Existing $Q_{5year24hour}$

Max. $Q_{5yr,\ prop}$ = 9.4 l/sec

A copy of the modeling results for existing pre-development conditions has been attached in Appendix 3.

### 5.3 Post Development Runoff

The post development stormwater runoff was also analyzed and hydrologic models were computed using the same HYDSYS software. The models were adjusted to reflect the change in total site areas and impervious surface areas between the pre-development and post development conditions. The soil type and overland flow parameters are the same as for the existing condition, however the impervious site coverage has decreased from the estimated 92% to 85%.

Based on the described parameters above, the peak runoff value and volume for the five-year 24 hour rainfall event for the City of Vancouver IDF curve (2100), AES rainfall data was calculated to be as follows:

Five year 24 hour post development peak flow and volume

Proposed Site $Q_{5yr,\ 24hr}$ = 11.1 l/s
Total rain volume V5yr, 24hr= 146 $m^3$

## 6.0 Maintenance Guidelines

The absorbent landscaping is a key component of the proposed Stormwater Management Plan for this development. It has been designed as a permanent low-maintenance system requiring regular monitoring and periodic maintenance.

Monitoring and maintenance of individual components of the system will consist of the following measures described below:

**Catchbasins and Oil-Water Separators**

- Inspect oil-water separator and all catch basins for debris and sediment accumulation.
- Remove grate/lid.

- Remove debris as found.
- Remove accumulated sediment and oil using truck mounted suction pump equipment with storage tank when sediment reaches ½ of the sump depth.
- Sediment shall be disposed offsite at an approved landfill.
- Replace grate/lid.
- All catchbasins to be recharged with clean water after silt/sediment removal.

**Landscaping**

**Monitoring (annually by Landscape Architect):**

- Inspect plants for die-back, for growth and for general health.
- Observe extent of yearly dieback.
- Forward growing medium sample to laboratory for testing if general plant health in question.
- Inspect plants for signs of pests or diseases.
- Inspect plants for breakage or wind damage.
- Review lawn maintenance operations.
- Observe plant and planter maintenance, weed and debris removal.
- Observe growing medium settlement.
- Review planter edging, flashing, gravel borders.
- Inspect for standing water, saturation or other indications of poor drainage.
- Review irrigation system function and coverage where applicable.
- Prepare annual report.

**Maintenance Operations (by maintenance contractor):**

- Perform establishment maintenance operations to BCSLA/BCLNA BC Landscape Standard, latest edition for 55 days from Substantial Performance.
- Perform general maintenance operations to BCSLA/BCLNA BC Landscape Standard, latest edition after 55 days from Substantial Performance.
- Replace dead or dying plant materials regularly.
- Fertilize plant materials per plant requirements.
- Respond to laboratory soil test recommendations if indicated.
- Perform pest/disease management as required.
- Prune dead, diseased or broken branches, prune shrubs and trees for form and to optimize flowering yearly.
- Perform standard lawn maintenance operations regularly.
- Stabilize trees or shrubs where indicated.
- Remove weeds, debris and cultivate growing medium regularly.
- Add soil amendment where soil settlement has occurred yearly.

- Maintain and repair edging, flashing, and gravel borders as required.
- Observe, report and perform drainage improvements where indicated.
- Adjust irrigation system regularly for coverage.
- Repair irrigation system leaks immediately.
- Perform winterization and spring start-up procedures.
- Document maintenance operations regularly.

## 7.0 CONCLUSION

Peak flow attenuation will be provided by the construction of a flow control sump structure with a release rate equal with the 5-year 24-hour (2014 IDF Curve) pre-development storm peak flow.

Volume reduction will be provided with the installation of absorbent topsoil, 450 mm and 750 mm thick, in the proposed landscaped areas This will be underlain by a system of 150mm thick Permavoid cells on top of the underground parkade. The surface and roof runoff will be directed into them prior to discharge into the municipal system. This will provide the retention of the 24mm rainfall from the total site area in 24 hours.

Stormwater treatment will be provided by the separation of the first flush flow. Runoff from the roadway access and surface parking areas will be directed to oil separators. Conventional oil/water separators will be installed within the parkade and connected to the sanitary sewer system.

Runoff from the building roof hard surfaces and landscaped area will be directed to the absorbent soils and Permavoid cells for rainwater retention. The overflow from the absorbent soils and Permavoid cells will be directed to the stormwater flow control sump.

The rainwater management system for this site has been designed in accordance with the City Wide Integrated Rainwater Management Plan criteria and the Rezoning Policy for Sustainable Large Developments requirements.

A copy of the proposed Integrated Rainwater Management Plan has been attached in Appendix 2. Copies of the drainage model printout for pre-development and post development conditions have been attached in Appendix 3.

Should you require additional information please contact the undersigned.

Reviewed by:

Dan Diaconu, P.Eng.
Project Engineer

Robin Uren, P.Eng.
Project Engineer

CC J+S Architect Attn: Jeff Shen

# APPENDIX 1

## AERIAL PHOTO OF SITE & SURROUNDING AREA

CONTRACTOR TO USE EXTREME CAUTION WHEN WORKING IN THE VICINITY OF A RETAINING WALL AND/OR ADJACENT STRUCTURE. THE CONTRACTOR IS REQUIRED UNDER PART 20.78 OF THE WORKSAFE BC REGULATIONS TO ENGAGE THE SERVICES OF A QUALIFIED REGISTERED PROFESSIONAL WHEN EXCAVATING ADJACENT TO AN EXISTING STRUCTURE. NO WORK IS TO PROCEED IN THE VICINITY OF THE STRUCTURE WITHOUT WRITTEN INSTRUCTIONS FROM THE QUALIFIED REGISTERED PROFESSIONAL AND SUCH COPY SUBMITTED TO CONTRACT ADMIISTRATOR.

IMPORTANT:
CONTRACTOR IS RESPONSIBLE TO SCOPE AND EXPOSE EX. UTILITIES/SERVICES, AND RECORD LOCATION, SIZE & INVERT ELEVATIONS AT PROP. OR POTENTIAL CROSSINGS PRIOR TO CONSTRUCTION. THE AS-BUILT UNDERGROUND INFORMATION SHOWN ON THIS DRAWING IS DERIVED FROM THIRD PARTY RECORDS AND VECTOR ENGINEERING IN NO WAY WARRANTS ITS ACCURACY. REPORT ANY DISCREPANCIES AND/OR CONFLICTS TO CONTRACT ADMINISTRATOR PRIOR TO CONSTRUCTION.

THE CITY OF BURNABY REQUIRES THAT ALL EXCAVATIONS UTILIZE PROPER SHORING PROCEDURES AS PER PART 20 OF THE OCCUPATIONAL HEALTH AND SAFETY REGULATIONS TO THE WORKERS COMPENSATION ACT FOR ALL EXCAVATIONS DEPTH OF 1.2 METERS AND OVER. TRENCH CERTIFICATION BY A QUALIFIED PROFESSIONAL WILL NOT BE ACCEPTABLE.

THE SEAL ON THIS DRAWING SIGNIFIES CERTIFICATION OF CIVIL ENGINEERING ASPECTS OF THIS SITE, BUT DOES NOT SIGNIFY RESPONSIBILITY FOR GEOTECHNICAL OR ENVIRONMENTAL ENGINEERING DESIGN. IN NO WAY DOES VECTOR ENGINEERING SERVICES LTD. OR ITS EMPLOYEES ACCEPT LIABILITY OR WARRANTY THE WORK WITH RESPECT TO THE EFFECT OF SETTLEMENT ON THE CIVIL WORKS.

DATUM-GEODETIC
BENCHMARK: MON. V-3531
ALBERNI ST. & CARDERO ST.
ELEV = 13.247m

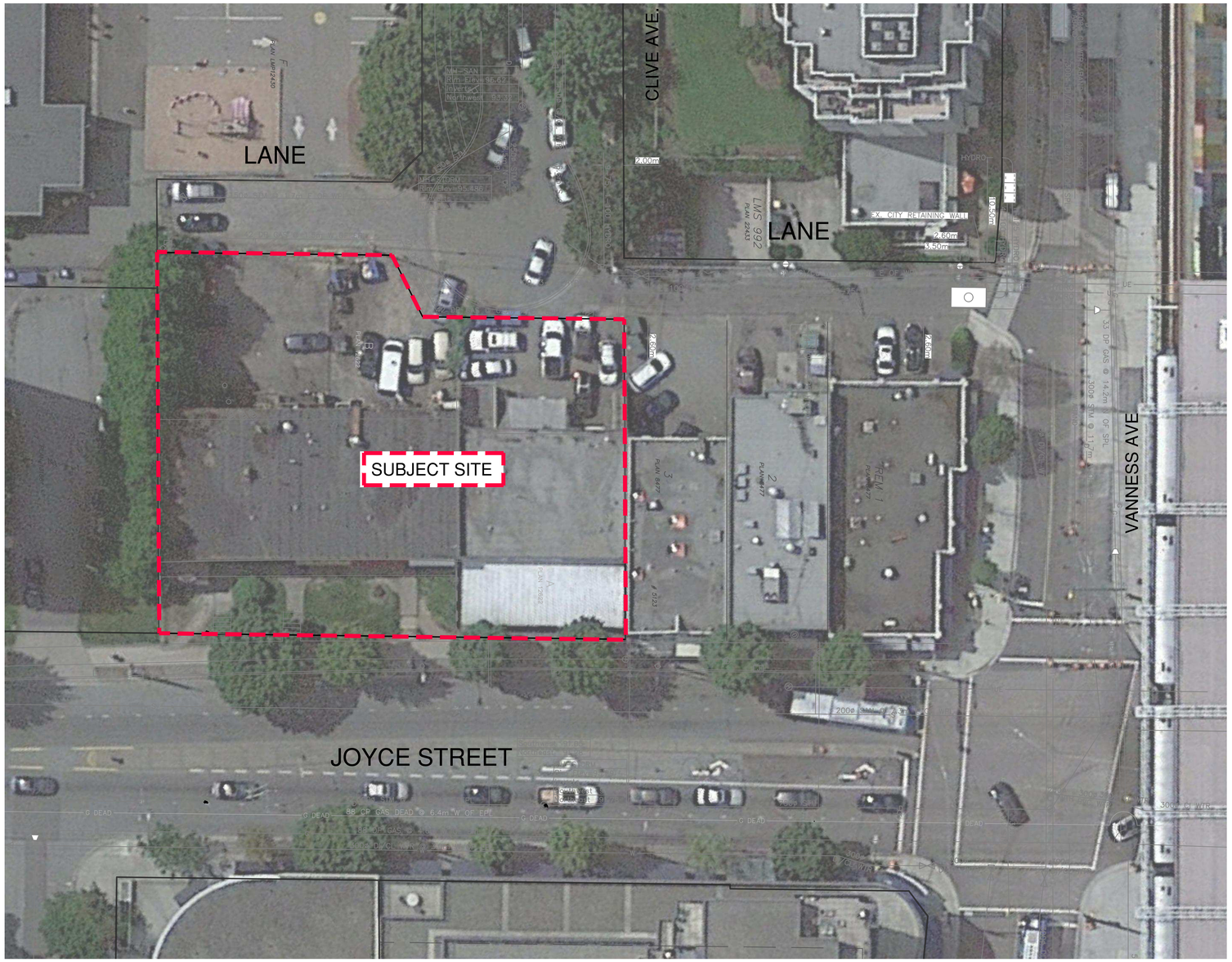
## LEGEND

PHASE BOUNDARY

**PRE - DEVELOPMENT AREAS**

| | AREA [m²] | % |
|---|---|---|
| IMPERVIOUS | 1,509 m² | 92.0% |
| PERVIOUS | 131 m² | 8.0% |
| TOTAL: | 1640 m² | 100% |

D.L. 37




PLOT DATE: July 28, 2020

*DESIGN*

| REV NO | REVISIONS | DATE | DRAWN | DESIGN |
|---|---|---|---|---|
| 1 | FIRST SUBMISSION | 2020-07-27 | AM | DD |

CITY OF VANCOUVER

SWM

# PRE DEVELOPMENT PLAN
5163 & 5187 JOYCE STREET

Vector ENGINEERING
vectoreng.ca
604 298-2333

| | | | |
|---|---|---|---|
| SCALE | 1:250H 1:25V (24"X34" PAPER) | START DATE | NOV 2019 |
| DRAWN BY | AM | DESIGN BY | DD |
| CHECKED BY | RU | APPROVED BY | APPROVED |
| VECTOR JOB NO. | 19-2460-20 | CLIENT | 1128587 BC LTD FELIX LIU |

DWG. NO. 2 OF 3
REV. 1

DESTROY ALL PRINTS BEARING PREVIOUS NO.

# APPENDIX 2

## PROPOSED INTEGRATED RAINWATER MANAGEMENT PLAN

IMPORTANT:
CONTRACTOR IS RESPONSIBLE TO SCOPE AND EXPOSE EX. UTILITIES/SERVICES, AND RECORD LOCATION, SIZE & INVERT ELEVATIONS AT PROP. OR POTENTIAL CROSSINGS PRIOR TO CONSTRUCTION. THE AS-BUILT UNDERGROUND INFORMATION SHOWN ON THIS DRAWING IS DERIVED FROM THIRD PARTY RECORDS AND VECTOR ENGINEERING IN NO WAY WARRANTS ITS ACCURACY. REPORT ANY DISCREPANCIES AND/OR CONFLICTS TO CONTRACT ADMINISTRATOR PRIOR TO CONSTRUCTION.

THE SEAL ON THIS DRAWING SIGNIFIES CERTIFICATION OF CIVIL ENGINEERING ASPECTS OF THIS SITE, BUT DOES NOT SIGNIFY RESPONSIBILITY FOR GEOTECHNICAL OR ENVIRONMENTAL ENGINEERING DESIGN. IN NO WAY DOES VECTOR ENGINEERING SERVICES LTD. OR ITS EMPLOYEES ACCEPT LIABILITY OR WARRANTY THE WORK WITH RESPECT TO THE EFFECT OF SETTLEMENT ON THE CIVIL WORKS.

| SITE CATCHMENT AREAS | SOFT LANDSCAPING | ROOF | HARD LANDSCAPING | TOTAL SITE AREA |
|---|---|---|---|---|
| POST-DEVELOPMENT | 260.4 $m^2$ | 650 $m^2$ | 743.5 $m^2$ | 1638 $m^2$ |

PRE-DEVELOPMENT 2014 IDF CURVE - 5 YEAR 24 HOURS RUNOFF RATE = 0.0094 $m^3$/sec
ALOWABLE RELEASE RATE = 0.0094$m^3$/sec

POST-DEVELOPMENT 2100 IDF CURVE - 5 YEAR 24 HOURS RUNOFF RATE = 0.011$m^3$/sec

POST-DEVELOPMENT IRMP SOURCE CONTROL SUMMARY:

1. ONSITE RAINWATER DETENTION:

TARGET: RELEASE POST DEVELOPMENT 5 YEAR STORM EVENT (2100 IDF CURVES) AT THE PRE-DEVELOPMENT 5 YEAR STORM EVENT (2014 IDF CURVES)

ALOWABLE RELEASE RATE = 0.0094$m^3$/sec

DETENTION VOLUME REQUIRED = 0$m^3$

DATUM-GEODETIC
BENCHMARK: MON. V-3531
ALBERNI ST. & CARDERO ST.
ELEV = 13.247m

3. TIER 2 - ABSORBENT LANDSCAPING ON PODIUM

TARGET: RETAIN ONSITE FIRST 24mm OF RAINFALL IN 24 HOURS
RETAINED VOLUME REQUIRED = 1638$m^2$x 0.024m = 39.3$m^3$

SUBCACHMENT AREA A1 - LEVEL 5

TOTAL SUBCACHMENT AREA = 239.5$m^2$ HARDSCAPING + 650$m^2$ ROOF + 188.5$m^2$ LANDSCAPING = 1078 $m^2$

RETAINED VOLUME REQUIRED = 1078$m^2$ X 0.024m = 25.87 $m^3$

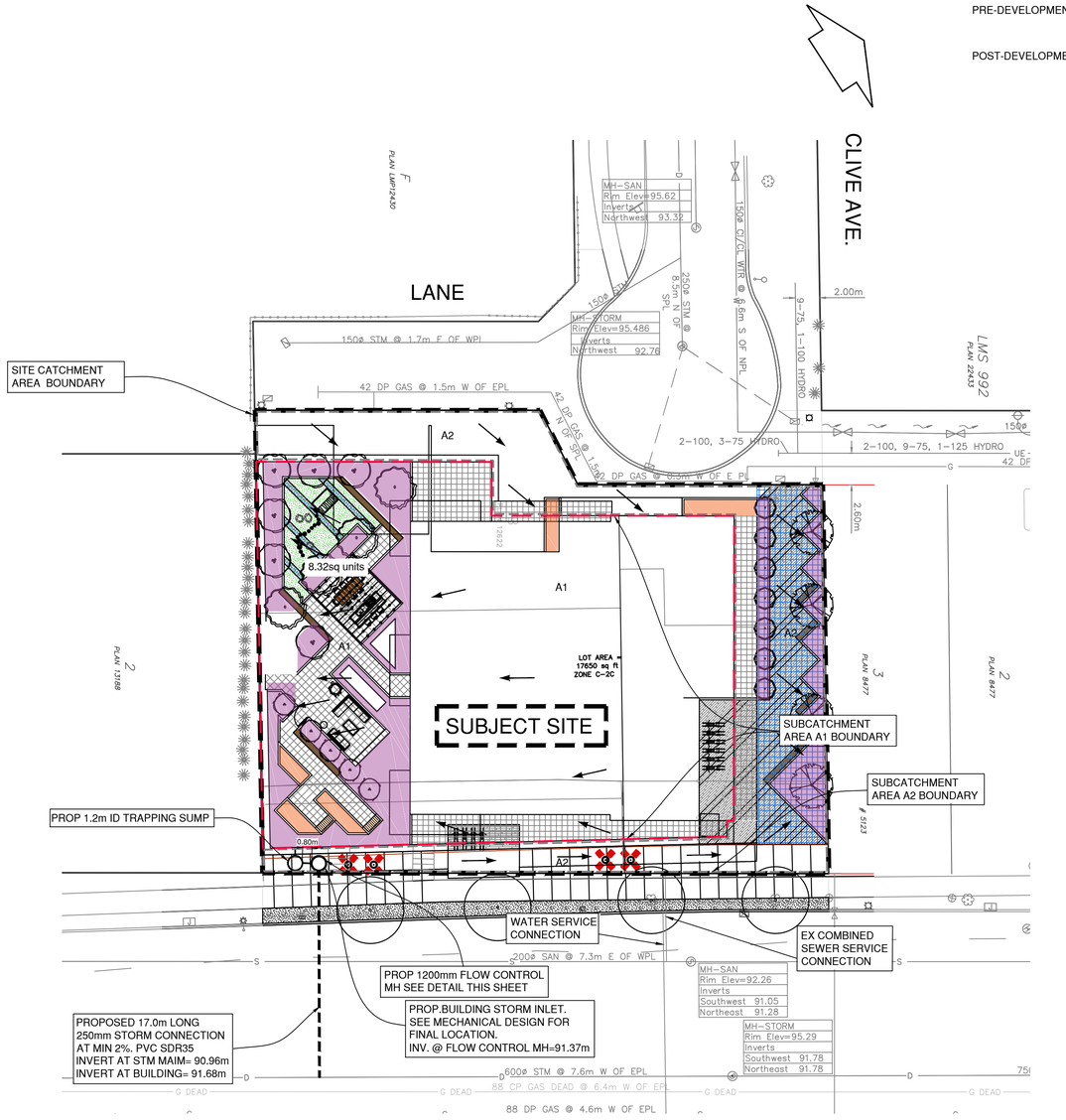
"PERMAVOID" CELLS VOLUME = 188.46$m^2$ x 0.15m = 28.27 $m^3$
SOIL VOLUME AVAILABLE = 169.24$m^2$ x 0.75m + 19.22$m^2$ x 0.45m = 135.58 $m^3$
SOIL ABSORBENCY CAPACITY = 123.23$m^3$ x 20% = 27.12 $m^3$
RETENTION VOLUME PROVIDED = 28.27$m^3$ + 27.12$m^3$ = 55.39 $m^3$ > 25.87 $m^3$

SUBCACHMENT AREA A2

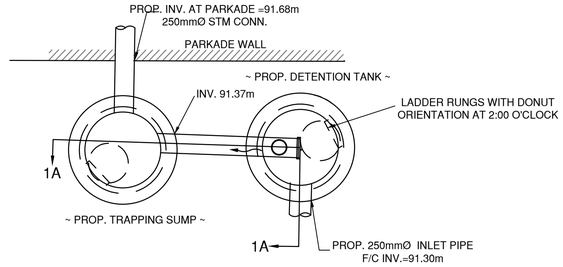
TOTAL SUBCACHMENT AREA = 488.1$m^2$ HARDSCAPING + 71.9$m^2$ LANDSCAPING = 560 $m^2$

RETAINED VOLUME REQUIRED = 560$m^2$ X 0.024m = 13.44$m^3$

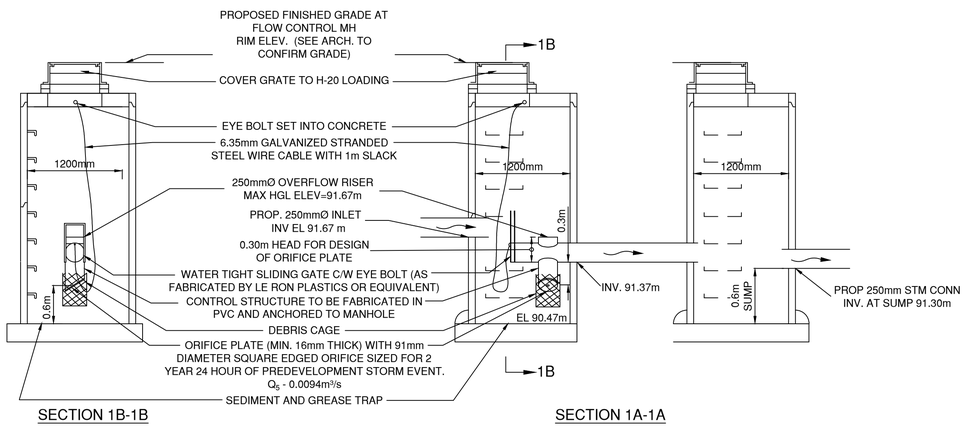
"PERMAVOID" CELLS VOLUME = 71.9$m^2$ x 0.15m = 10.79$m^3$
SOIL VOLUME AVAILABLE = 59.74$m^2$ x 0.75m + 12.16 x 0.45m = 50.28 $m^3$
SOIL ABSORBENCY CAPACITY = 50.28$m^3$ x 20% = 10.06 $m^3$
RETENTION VOLUME PROVIDED = 10.79$m^3$ + 10.06$m^3$ = 20.85$m^3$ > 13.44 $m^3$




JOYCE STREET




PLAN VIEW




SECTION 1B-1B SECTION 1A-1A

1200mm FLOW CONTROL MANHOLE & 1200mm TRAPPING SUMP
N.T.S

LEGEND

750mm (30") GROWING MEDIUM ON FILTER CLOTH ON 150mm (6") "PERMAVOID" CELLS

450mm (18") GROWING MEDIUM ON FILTER CLOTH ON 150mm (6") "PERMAVOID" CELLS

SITE CATCHMENT AREA BOUNDARY

SUBCATCHMENT AREA A1 BOUNDARY

SUBCATCHMENT AREA A2 BOUNDARY

OVERLAND FLOW DIRECTION

## SOIL DEPTH DIAGRAM

| BUILDING LEVEL | 750mm (30") GROWING MEDIUM ON FILTER CLOTH ON 150mm (6") "PERMAVOID" CELLS | 450mm (18") GROWING MEDIUM ON FILTER CLOTH ON 150mm (6") "PERMAVOID" CELLS | TOTAL SOFT LANDSCAPING |
|---|---|---|---|
| GROUND LEVEL | 59.74 $m^2$ | 12.16 $m^2$ | 71.90 $m^2$ |
| LEVEL 5 | 169.24$m^2$ | 19.22 $m^2$ | 188.46 $m^2$ |
| TOTAL AREA | 228.98$m^2$ | 31.38 $m^2$ | 260.36 $m^2$ |
| TOTAL VOLUME | 171.74 $m^3$ | 14.12 $m^3$ | 185.86 $m^3$ |

| SUBCATCHMENT AREAS | RETENTION VOLUME REQUIRED | RETENTION VOLUME PROVIDED | RETENTION PROVIDED BY | |
|---|---|---|---|---|
| | | | PERMAVOID CELLS | ABSORBENT SOIL |
| A1 | 25.87 $m^3$ | 50.72 $m^3$ | 25.87 $m^3$ | 24.64 $m^3$ |
| A2 | 13.44 $m^3$ | 21.03 $m^3$ | 10.89 $m^3$ | 10.14 $m^3$ |
| TOTAL | 39.31 $m^3$ | 71.75 $m^3$ | | |

ORIFICE AREA CALCULATION

Ao = ORIFICE AREA ($m^2$)
C = COEFFICIENT FOR SQUARE-EDGED ORIFICE (0.6)
g = GRAVITATIONAL ACCELERATION (m/$sec^2$)
h = DESIGN HEAD (m)
D = ORIFICE DIAMETER (m)
Q = ALLOWABLE RELEASE RATE ($m^3$/s) (PREDEVELOPMENT 5 YEAR STORM)
Ao = Q / (C x SQRT(2gh))
Ao = 0.0094 / (0.6 x SQRT(2 x 9.81 x 0.30) = 0.006$m^2$
D = SQRT(4Ao / PI)
D = SQRT(4 x 0.005 / PI) = 0.091m = 91mm

PLOT DATE: July 27, 2020

| REV NO | REVISIONS | DATE | DRAWN | DESIGN |
|---|---|---|---|---|
| 1 | FIRST SUBMISSION | 2020-07-27 | AM | DD |

CITY OF VANCOUVER

SWM

# POST DEVELOPMENT PLAN
5163 & 5187 JOYCE STREET


Vector ENGINEERING
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604 298-2333


| | | | |
|---|---|---|---|
| SCALE | 1:250H 1:25V (24"X34" PAPER) | START DATE | NOV 2019 |
| DRAWN BY | DP/AM | DESIGN BY | DD |
| CHECKED BY | | APPROVED BY | APPROVED |
| VECTOR JOB NO. | 19-2460-20 | CLIENT | 1128587 BC LTD FELIX LIU |

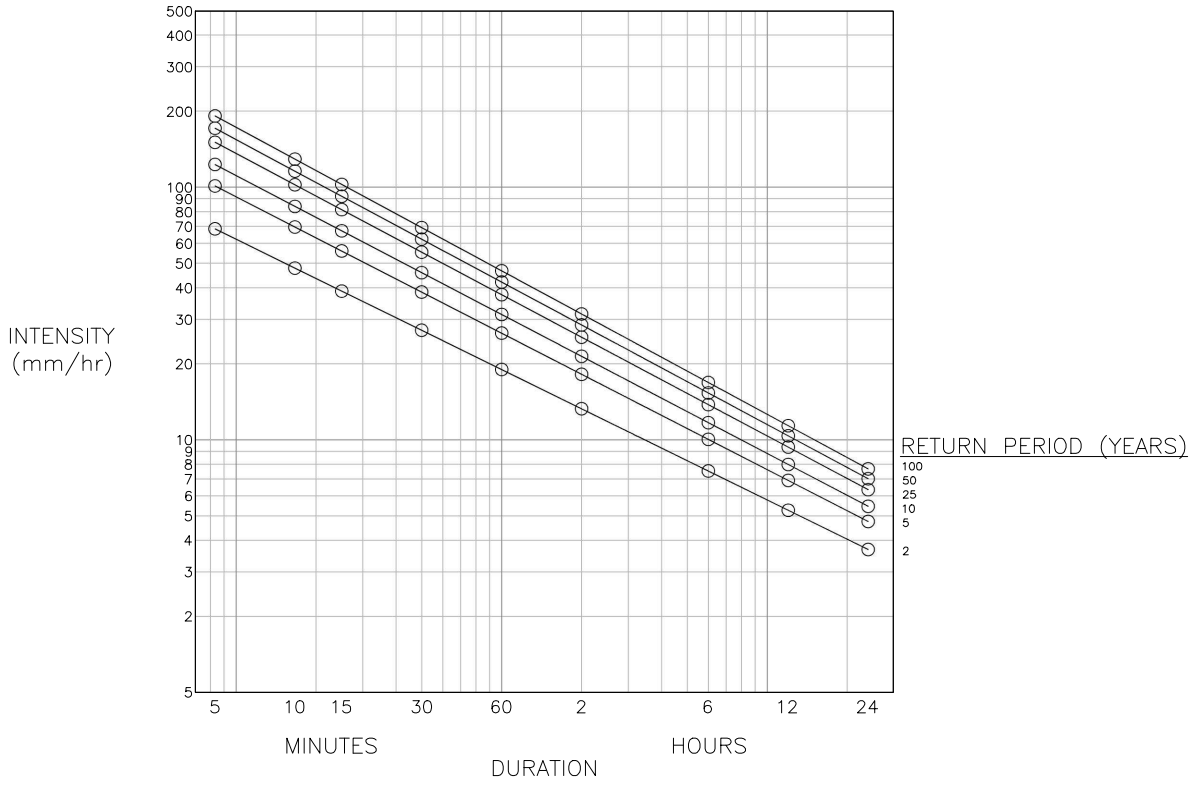
DWG. NO. 3 OF 3
REV. 1

DESTROY ALL PRINTS BEARING PREVIOUS NO.

# APPENDIX 3

## CITY OF VANCOUVER RAINFALL IDF CURVES (2014) AND (2100)
## HYETOGRAPHS, HYDROGRAPHS & MODEL RESULTS

CITY OF VANCOUVER – IDF CURVES (2100)




## INTENSITY DURATION FREQUENCY (IDF) EQUATION INTERPOLATION COEFFICIENTS (2100)

$R = A * T^{B}$

WHERE:
T = TIME IN HOURS
A,B = COEFFICIENTS
R – RAINFALL INTENSITY IN mm/hr

| RECURRANCE INTERVAL | PROBABILITY | A | B |
|---|---|---|---|
| 1 IN 2 YR | 50% | 18.96 | –0.516 |
| 1 IN 5 YR | 20% | 26.41 | –0.540 |
| 1 IN 10 YR | 10% | 31.32 | –0.550 |
| 1 IN 25 YR | 4% | 37.51 | –0.559 |
| 1 IN 50 YR | 2% | 42.09 | –0.564 |
| 1 IN 100 YR | 1% | 46.64 | –0.568 |

SOURCE:
"VANCOUVER RAINFALL STUDY AND IDF UPDATE,"
URBAN SYSTEMS LTD, VANCOUVER BC,
PS20150252, DECEMBER 2015.

## APPLICATION

25 YEAR – TRIBUTARY AREA GREATER THAN 40.5ha (100acres)
10 YEAR – DESIGN, BUSINESS, COMMERCIAL AND INDUSTRIAL AREAS.
5 YEAR – DESIGN, RESIDENTIAL AREAS, INVESTIGATIONS

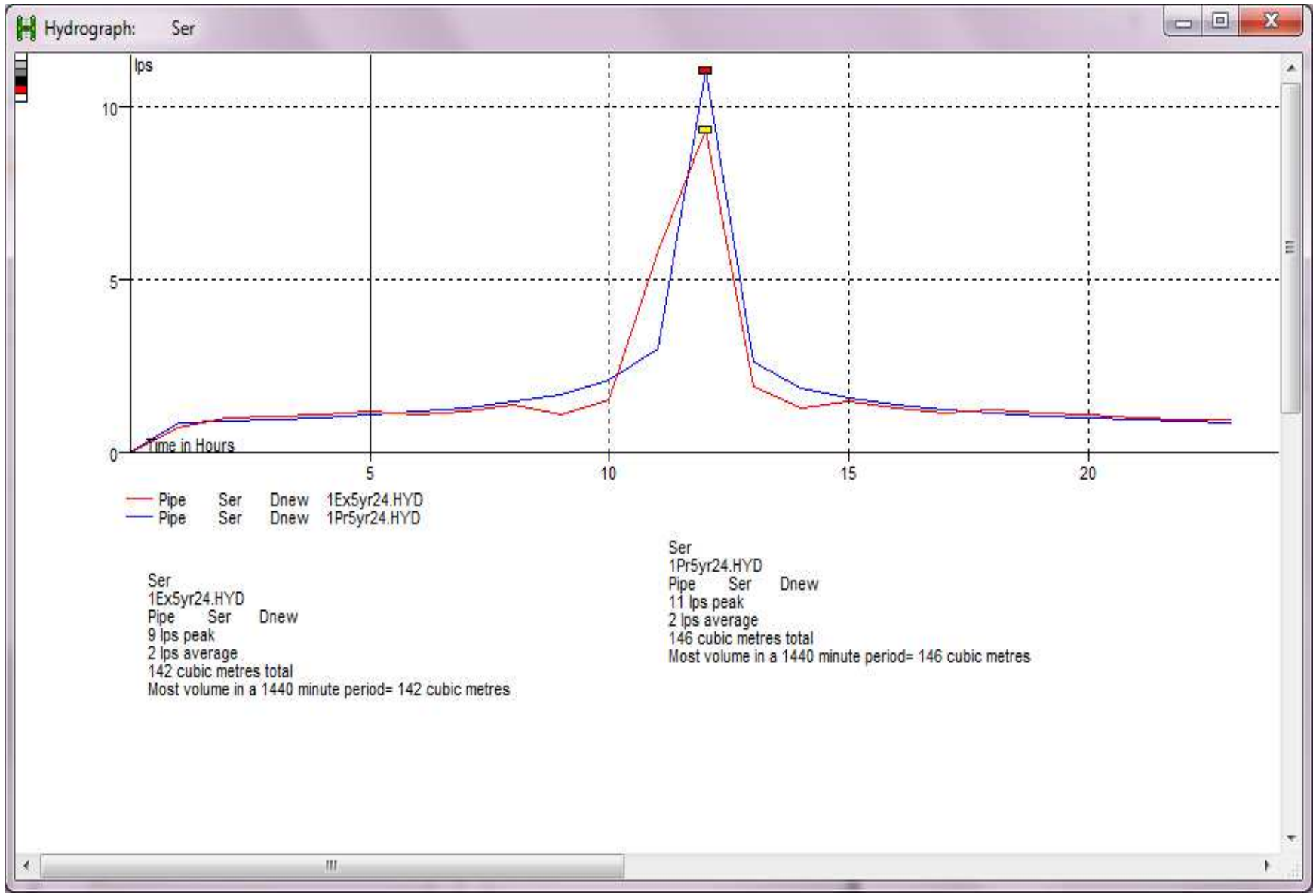
## MINIMUM INLET TIME

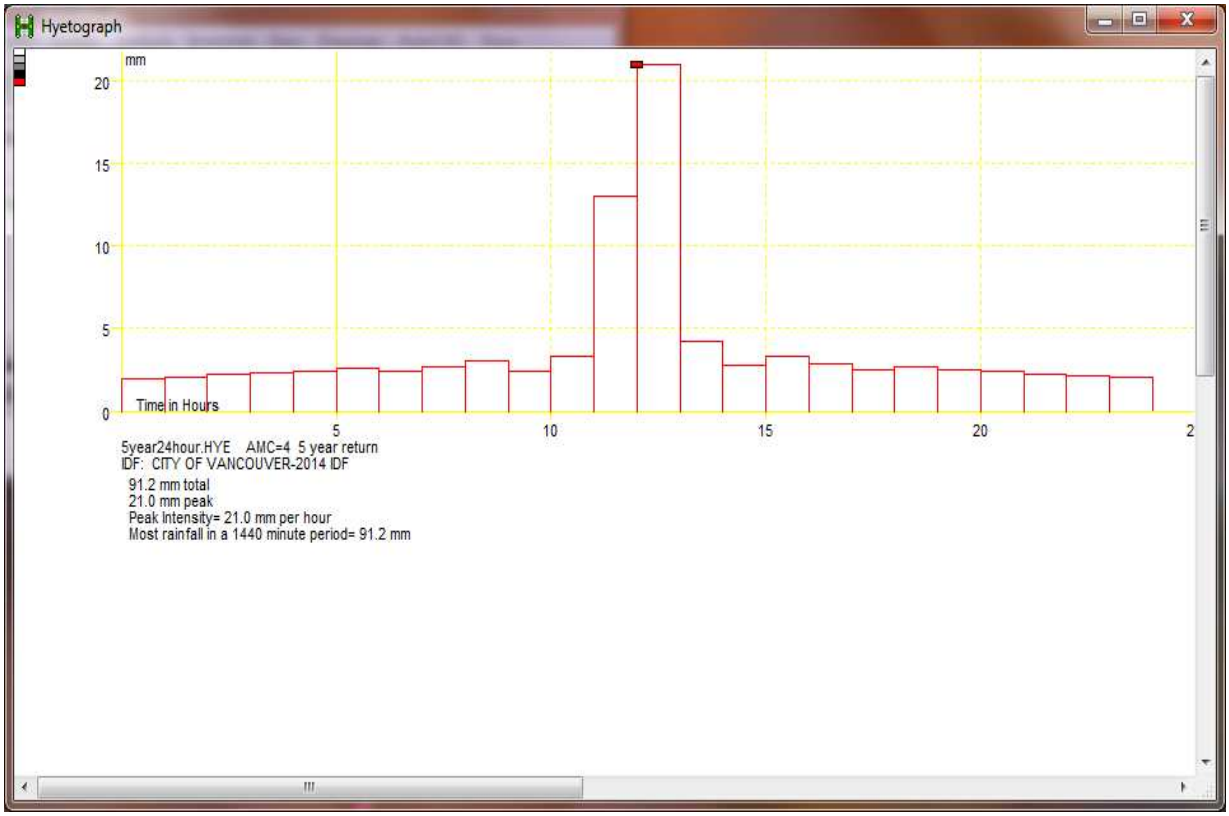
| | |
|---|---|
| RESIDENTIAL AREA | 10 MINS. |
| BUSINESS | 5 MINS. |
| CENTRAL BUSINESS DISTRICT & WEST END | 5 MINS. |

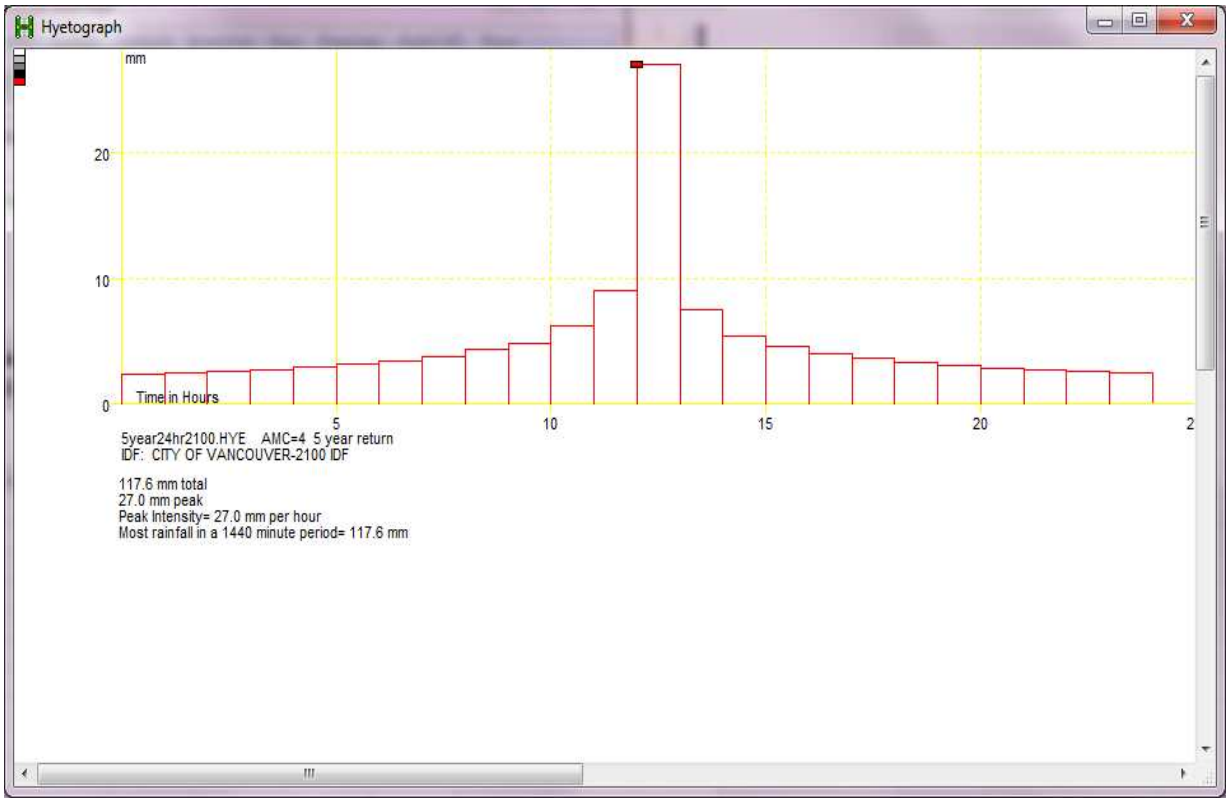
## ENGINEERING SERVICES - CITY OF VANCOUVER

| | | | |
|---|---|---|---|
| CITY OF VANCOUVER | SEWERS & DRAINAGE DESIGN BRANCH | SEWER – STANDARDS<br>RAINFALL INTENSITY EQUATION<br>2100 IDF CURVE | SCALE: N.T.S. |
| | DRAWN BY: SP | | STANDARD SECTION |
| | DESIGN: | | |
| | REFERENCES: | | REVISION:..... |

PLOTTED: October–19–17 1:41:56 PM
FILE: Y:\SEWER_DESIGN\Procedures & Forms\Sewer Design Manual\Sewer Design Manual – STANDARD DRAWINGS\S–COMPILATION\STANDARD DRAWINGS PAGE 1–20.dwg
THIS PRINT SUPERSEDES ALL PRINTS OF THIS DRAWING BEARING PREVIOUS REVISION NUMBERS


Hydrograph: Ser
lps
10
5
0
Time in Hours
5
10
15
20
Pipe Ser Dnew 1Ex5yr24.HYD
Pipe Ser Dnew 1Pr5yr24.HYD
Ser
1Ex5yr24.HYD
Pipe Ser Dnew
9 lps peak
2 lps average
142 cubic metres total
Most volume in a 1440 minute period= 142 cubic metres
Ser
1Pr5yr24.HYD
Pipe Ser Dnew
11 lps peak
2 lps average
146 cubic metres total
Most volume in a 1440 minute period= 146 cubic metres


Hyetograph
mm
20
15
10
5
0
Time in Hours
5
10
15
20
5year24hour.HYE AMC=4 5 year return
IDF: CITY OF VANCOUVER-2014 IDF
91.2 mm total
21.0 mm peak
Peak Intensity= 21.0 mm per hour
Most rainfall in a 1440 minute period= 91.2 mm


Hyetograph
mm
20
10
0
Time in Hours
5
10
15
20
5year24hr2100.HYE AMC=4 5 year return
IDF: CITY OF VANCOUVER-2100 IDF
117.6 mm total
27.0 mm peak
Peak Intensity= 27.0 mm per hour
Most rainfall in a 1440 minute period= 117.6 mm

Design Criteria: C:\Users\Daniel\Desktop\Documents\Documents\CivilSys\Models\2460-Joice\1Ex5y24hr.DCT
Drainage Model: C:\Users\Daniel\Desktop\Documents\Documents\CivilSys\Models\2460-Joice\1Ex5y24hr.HYN
Rainstorm: C:\Users\Daniel\Desktop\Documents\Documents\CivilSys\Rain Data\Vancouver\5year24hour.HYE
Storm description: IDF: CITY OF VANCOUVER-2014 IDF

60 min increment, AMC= 4 5 yr return
ILLUDAS ** ILLINOIS STATE WATER SURVEY ** ILAG82 August, 1997
Time Shift Routing Activated.

Design Mode

RAINFALL PATTERN

0.079 0.082 0.086 0.091 0.096 0.103 0.095 0.105 0.120 0.095
0.131 0.512 0.827 0.168 0.110 0.130 0.112 0.100 0.106 0.099
0.093 0.088 0.084 0.080

| RUN NUMBER | BASIN AREA ACRES | TIME INCREMENT MINUTES | SOIL GROUP 1234=ABCD |
|---|---|---|---|
| 1 | 0.4 | 60.0 | 3 |

| TOTAL RAIN INCHES | FREQUENCY YEARS | DURATION MINUTES | AMC | PAVED ABS. INCHES | GRASS ABS. INCHES |
|---|---|---|---|---|---|
| 3.59 | 5 | 1380.0 | 4 | 0.10 | 0.20 |

Pipe Ser Dnew Branch 1 Reach 0 28-Jul-20 11:34

PAVED ENTRY TIME= 2.9 MIN

ACCUM CONTRIBUTING AREAS: CPA=0.4, SPA=0.0, CGA=0.0

TRAVEL TIME SO SMALL THAT ROUTED =DESIGN HYDRO.

| LENG FT | SLP PCT | N | HT FT | BW FT | V/H INS | DIA CFS | CAPAC FPS | VEL Q-CFS | DESIGN Q-CFS | INLET CUBIC FT | DETENTION REQUESTED | STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | 1.00 | 0.013 | 0.00 | 0.00 | 0.00 | 12 | 3.40 | 4.48 | 0.00 | 0.0 | 0 | |
| REQUIRED PIPE = | | | | | | 8 | 1.21 | 3.46 | 0.33 | 0.33 | 0.00 | |

***EXISTING PIPE HAS ADEQUATE CAPACITY***

OUTFALL HYDROGRAPH IN CFS, ACCUMULATED RUNOFF IN CU FT= 5029

0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.1 0.2 0.3 0.1 0.0 0.1 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0

THE JOB IS FINISHED

Design Criteria: C:\Users\Daniel\Desktop\Documents\Documents\CivilSys\Models\2460-Joice\1Pr5y24hr.DCT
Drainage Model: C:\Users\Daniel\Desktop\Documents\Documents\CivilSys\Models\2460-Joice\1Pr5y24hr.HYN
Rainstorm: C:\Users\Daniel\Desktop\Documents\Documents\CivilSys\Rain Data\Vancouver\5year24hr2100.HYE
Storm description: IDF: CITY OF VANCOUVER-2100 IDF

60 min increment, AMC= 4 5 yr return
ILLUDAS ** ILLINOIS STATE WATER SURVEY ** ILAG82 August, 1997
Time Shift Routing Activated.

Design Mode

RAINFALL PATTERN

0.095 0.099 0.104 0.110 0.117 0.126 0.137 0.151 0.170 0.192
0.245 0.354 1.063 0.294 0.214 0.184 0.160 0.143 0.131 0.121
0.114 0.107 0.102 0.097

| RUN NUMBER | BASIN AREA ACRES | TIME INCREMENT MINUTES | SOIL GROUP 1234=ABCD |
|---|---|---|---|
| 1 | 0.4 | 60.0 | 3 |

| TOTAL RAIN INCHES | FREQUENCY YEARS | DURATION MINUTES | AMC | P INCHES | AVED ABS. INCHES | GRASS ABS. |
|---|---|---|---|---|---|---|
| 4.63 | 5 | 1380.0 | 4 | 0.10 | 0.20 | |

Pipe Ser Dnew Branch 1 Reach 0 28-Jul-20 11:35

PAVED ENTRY TIME= 2.9 MIN

ACCUM CONTRIBUTING AREAS: CPA=0.3, SPA=0.0, CGA=0.1

GRASSED ENTRY TIME= 23.0 MIN

TRAVEL TIME SO SMALL THAT ROUTED =DESIGN HYDRO.

| LENG FT | SLP PCT | N | HT FT | BW FT | V/H INS | DIA CFS | CAPAC FPS | VEL Q-CFS | DESIGN Q-CFS | INLET CUBIC FT | DETENTION REQUESTED | STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | 1.00 | 0.013 | 0.00 | 0.00 | 0.00 | 12 | 3.40 | 4.48 | 0.39 | 0.39 | 0.00 | |
| REQUIRED PIPE = | | | | | | 8 | 1.21 | 3.46 | 0.00 | 0.0 | 0 | |

OUTFALL HYDROGRAPH IN CFS, ACCUMULATED RUNOFF IN CU FT= 5169

0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.1
0.1 0.1 0.4 0.1 0.1 0.1 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0

THE JOB IS FINISHED

# APPENDIX 4

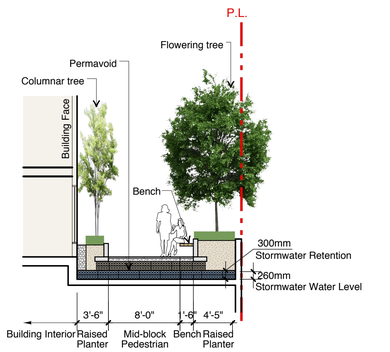
## LANDSCAPING SITE PLANS

## LEGEND

- SHRUB PLANTING
- HEDGE
  Privacy Screening
- CAST IN PLACE CONCRETE PAVING (PEDESTRIAN ONLY)
  Light broom finish with sawcut control joints
- ENTRY PAVING
  Special paving
- PATIO PAVING
  18"x18" Hydrapressed slabs
- POURED IN PLACE RUBBERIZED PLAY SURFACE
  Colours and layout to be designed
- PERMAVOID
  Modular Interlocking Plastic System for Stormwater Retension

## FURNITURE LEGEND

- METAL BIKE RACK
- WOOD BENCH




01 L-1.1 **SECTION THROUG MID-BLOCK PEDESTRIAN**
SCALE: 1/8" = 1'-0"

ADJACENT SITE

CLIVE AVENUE

JOYCE STREET

LANE

RAISED PLANTING BED
01 L-1.2
COLUMNAR TREE
LARGE SHADE TREE
FEATURE PAVING
CUSTOM BENCH
PERMAVOID SYSTEM BELOW (BLUE GRID HATCH)
PROPERTY LINE 104.86'
8' WIDE MID-BLOCK PEDESTRIAN
PROPERTY LINE 66.03'
PROPERTY LINE 76.94'
PROPERTY LINE 2'2.51'
PROPERTY LINE 2.47'-4" (POSSIBLE SETBACK 0'-6")
PROPERTY LINE 152.71'
OUTLINE OF L2 ABOVE
OUTLINE OF CANOPY ABOVE
LINE OF BALCONY ABOVE
LINE OF BUILDING ABOVE
CENTRELINE OF LANE
PLAZA
LIBRARY ENTRY
LIBRARY LOBBY
C.R.U ENTRY
C.R.U #1
C.R.U #2
FFE 313.50'
FFE 313.25'
RAMP
EXIT CORRIDOR
BICYCLE STORAGE (2)
REFUSE & RECYCLING
TYPE: RESIDENTIAL
ELEV #1
ELEV #2
ELEV #3
ELEV #4
PARTITION WALL
O/H DOOR
F.F.
xt9;RESIDENTIAL LOADING
COMMERCIAL LOADING
COMMERCIAL LOADING
3'-6" HIGH CONCRETE WALL
CORRIDOR
RESIDENTIAL LOBBY & COMMON
VEST.
MAIL ACCESS
STORAGE
REFUSE & RECYCLING
TYPE: COMMERCIAL
DEDICATED BIKE RAMP DOWN TO L1 @10%
DEDICATED BIKE RAMP UP DOWN L1 @15%
RAMP DOWN TO P1 @10%
RAMP DOWN TO P1 @15%
ENTRY GATE
BICYCLE STORAGE (40)
EXIT STAIR #2
EXIT CORRIDOR
S.R.W. FROM JOYCE 19'-0"
EXISTING STREES TO BE RETAINED
METAL BIKE RACK
6 RACKS = 12 BIKE PARKING
RESERVED FOR E-SCOOTER PARKING
Existing Lamp Standard
METAL BIKE RACK
4 RACKS = 8 BIKE PARKING
Existing Sign Post
Existing Lamp Standard

N

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Notes: Drawings are to be read in conjunction with each other. Any discrepancies on the drawings are to be reported to the designer before initiating work, purchase of products and/or manufacturing for construction or installation.

It is the responsibility of the Contractor to ensure all work is fulfilled in accordance to the requirements of the latest edition of both the BC Building Code, and the city Zoning and Development By-law.

J+S ARCHITECT

Durante Kreuk Ltd.
102 - 1637 West 5th Avenue
Vancouver BC V6J 1N5
t: 604 684 4611
f: 604 684 0577
www.dkl.bc.ca

Issues:

| | |
|---|---|
| 191203 | ISSUED FOR REVIEW |
| 200724 | ISSUED FOR REZONING |

| | |
|---|---|
| Drawn by: | LF |
| Checked by: | DC |
| Date: | JUL 24, 2020 |
| Scale: | 1/8" = 1'-0" |
| Project No.: | 19071 |

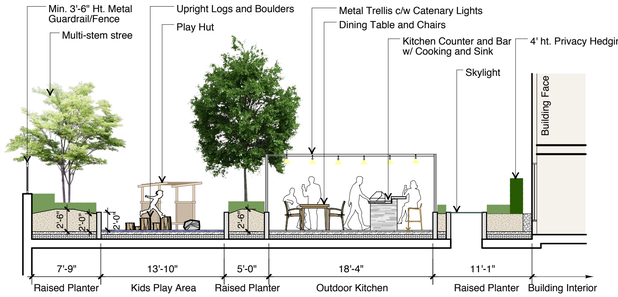
Mixed-Use
32-Storey HighRise

Project Address
5163-5187
Joyce Street,
Vancouver BC

Drawing Title
**Landscape Plan**

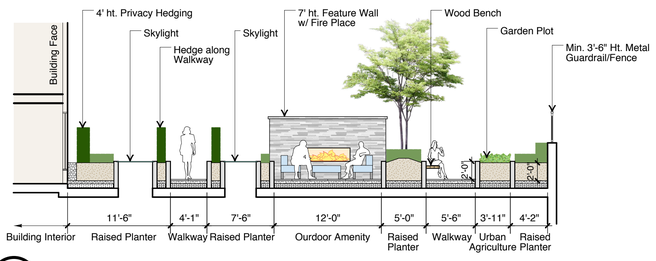
**Level 1**

# L - 1.1



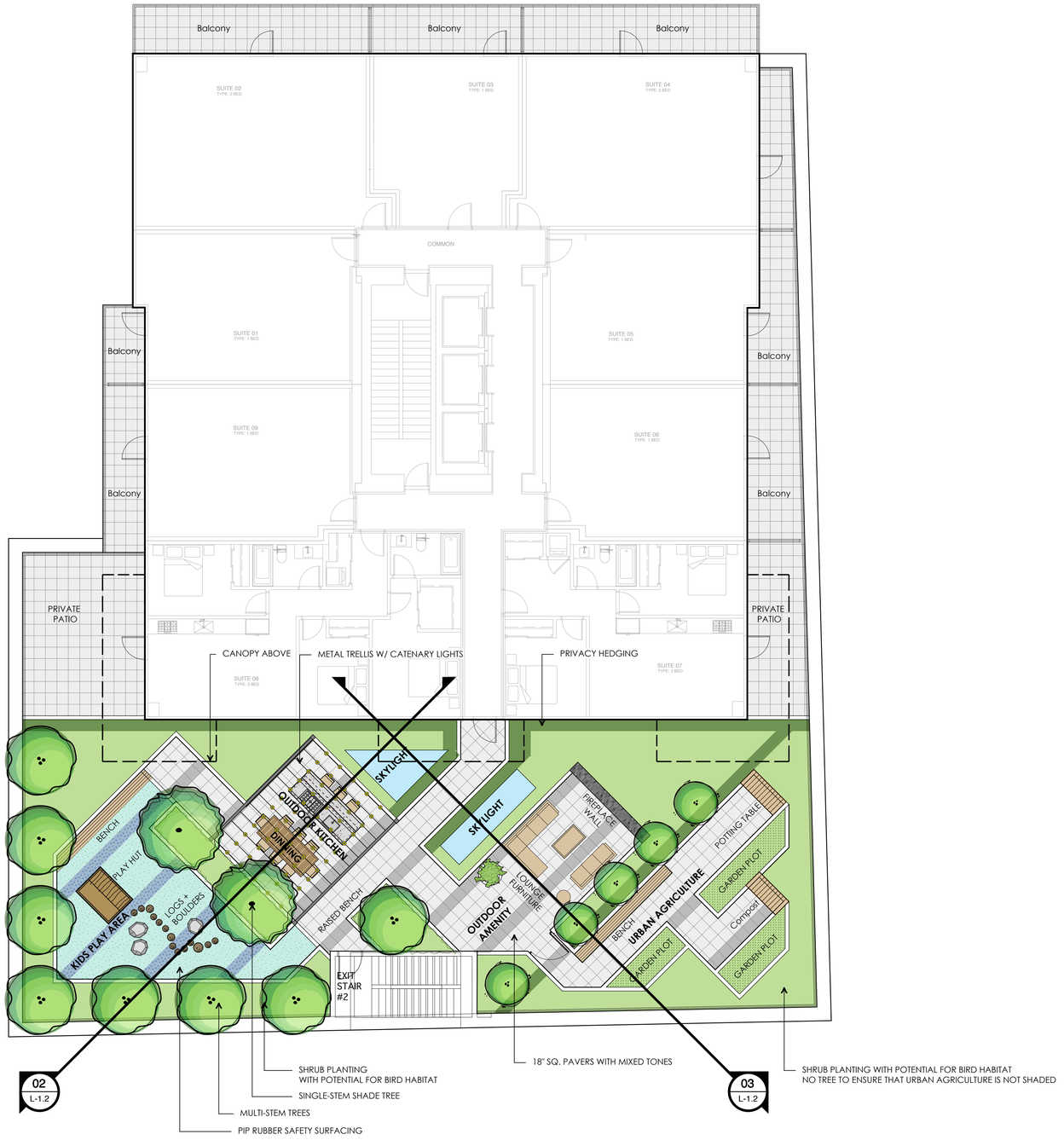

02 L-1.2 **SECTION THROUGH PODIUM WEST SIDE**

SCALE: 1/8" = 1'-0"




03 L-1.2 **SECTION THROUGH PODIUM EAST SIDE**

SCALE: 1/8" = 1'-0"




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Issues:

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| 191203 | ISSUED FOR REVIEW |
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| | |
|---|---|
| Drawn by: | LF |
| Checked by: | DC |
| Date: | JUL 24, 2020 |
| Scale: | 1/8" = 1'-0" |
| Project No.: | 19071 |

Mixed-Use
32-Storey HighRise

Project Address

5163-5187
Joyce Street,
Vancouver BC

Drawing Title

**Landscape Plan**

**Level 5**

**L - 1.2**