SUSTAINABLE DESIGN STRATEGY

2715 West 12th Avenue
Proposed Residential Development

Prepared for:

MCMP Architects
Suite 1900 – 1066 West Hastings Street
Vancouver, BC V6E 3X1

JTA Development Consultants
Suite 1280- 333 Seymour Street
Vancouver, BC V6B 5A6

Developed by:

Integral Group
Suite 180 - 200 Granville Street
Vancouver, BC V6C 1S4

02,08, 2017

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OVERVIEW

As a part of the Rezoning Application package, the following Sustainable Design Strategy has been developed to provide confirmation the project design submitted is on target to meet the requirements as dictated by the Green Buildings Policy for Rezonings 2016, option B. Low Emissions Green Building, effective May 1, 2017.

The following narrative includes preliminary strategies explored by the design team, with the aim to achieve the various requirements of the Low Emissions Green Building pathway, along with all required supporting evidence at this stage, as listed:

- Item B.2: Brief summary of strategies and measures to achieve performance limits for energy use, heat loss, and greenhouse gas emissions, including;
  - Preliminary Zero Emissions Building Plan (ZEBP) Energy Checklist, completed by the project energy modeller, showing that the project meets the performance limits for energy use (TEUI), heat loss (TEDI), and greenhouse gas emissions (GHGI), together with key inputs;
  - 2-4 page summary of detailed energy model inputs for detailed and/or 3rd party review.

- Item B.6.2: Preliminary embodied emissions calculations, and a description of specific measures that will be explored during design to reduce embodied emissions;

- Item B.10: The site IRMP, describing the chosen strategies and green and grey infrastructure measures included in the landscape and building design. The IRMP describes;
  - How these measures contribute to the city-wide IRMP targets for water volume reduction and quality treatment, and
  - Include preliminary site and volume calculations to compare site performance to the City-wide targets;
  - Landscape/Architectural Site Plans highlighting the green and grey infrastructure measures described in the site IRMP as also provided.

- A commitment by the owner to meet the requirements of the Green Buildings Policy for Rezonings with documentation to be submitted at a later project phase, including:

  - B.3: design, build, and test to meet an airtightness target of 2.0 L/s/m² @ 75 Pa;
  - B.4: complete an enhanced commissioning process;
  - B.5: design and build to include building metering and sub-metering of energy, and to enter into agreement on energy reporting, including assistance for building future owners;
  - B.6.1: complete refrigerant emissions calculations;
  - B.7: design and build a direct ventilation system;
  - B.8: design and build with low-emitting materials;
  - B.9: test indoor air quality prior to occupancy;
  - B.11: design and build a resilient potable water access point.

B.1: LEED GOLD - BUILDING DESIGN + CONSTRUCTION

As the project is over 50% residential, LEED registration, design and certification is not required.

B.2: PERFORMANCE LIMITS

At this stage, the project is still in concept design where the building shape/massing and suite layout are subject to City approval and other changes. Additionally, the mechanical, electrical and envelope design are not fully defined, but instead, under exploration. As there is no district energy system (DES) available in proximity to the project site, the project does not plan on connecting to a DES and assumes this is not mandated.

A preliminary energy model has been conducted to identify building design parameters required to be in compliance with the performance limits for Residential Low-Rise buildings (not connected to a City-recognized low carbon energy system), TEUI 100 kWh/m^2 and GHGI 5 kgCO_2/m^2. As per specialized conversations conducted with the city, the project has elected to meet some prescriptive requirements in lieu of meeting the new rezoning policy TEDI requirements of 15 kWh/m2. The project will aim to satisfy or exceed the following requirements in lieu of the TEDI requirements:

- Walls, Roof, etc: meet or exceed the 2018 prescriptive code requirements (such as R-22eff. walls, R-30eff. roof, etc.)
- Airtightness: meet or exceed Passive House levels of airtightness (ie: 0.6 ACH50)
- HRVs: Passive House Certified
- Windows and sliding glass: Passive House Certified, with installation details to minimize thermal bridging
- Mechanical systems: explore approaches consistent with Passive House design

This solution was identified in close coordination with the City of Vancouver to ensure the satisfaction of the City of Vancouver's Rezoning intent.

B.3: AIRTIGHTNESS TESTING

Whole-building and suite airtightness testing and reporting is required for this residential building. The project owner has committed to meet this requirement – please see appended *Letter of Commitment*.

B.4: ENHANCED COMMISSIONING

An enhanced commissioning process is required for all building energy systems. The project owner has committed to meet this requirement – please see appended *Letter of Commitment*.

B.5: ENERGY SYSTEM SUB-METERING + REPORTING

Separate master metering for each energy utility, along with sub-metering of all major energy end-uses and major space uses is required. The building owner must enter an agreement with the City of Vancouver to share utility data for minimum three (3) years and provide assistance for building future owners. The project owner has committed to meet this requirement – please see appended *Letter of Commitment*.

B.6: REFRIGERANT EMISSIONS + EMBODIED EMISSIONS

Preliminary embodied emissions calculations for all major building materials have been conducted based on the building's rezoning concept design. Various floor, wall and roof areas have been confirmed through the preliminary energy model. As current designs do not include detailed structural information, various comparable mixed-use developments in Vancouver were referenced. From these reference buildings, applicable details related to column quantity, span, load and typical wall assemblies have been applied to the various floor, wall, and roof lengths and areas for this building. As more detailed information is available specific to this project, the life cycle assessment model will be refined and updated.

The total building height is 37.5 m and will include only 3 parking spaces at the ground level with no intention of introducing a parkade below the building. Other major concept design assumptions include:

Concept Design Assumptions	Parkade	Above Grade
Floor Area	53.8 m2 on grade	1,273 m2
Building Footprint	N/A	371 m2
Columns & Beams	N/A	Type: Wood Frame Height (m): 2.9
Foundations	N/A	Concrete Footings
Interior Walls	N/A	Type: Wood Frame ½inch fire rated Drywall
Exterior Walls	N/A	1,056 m2 total wall area Wood Stud, 30% Brick and 70% Stucco, Mineral Fiber Batt Insulation
Floors	N/A	1,273 m2 total floor area Wood I Joists 10”
Roof		723 m2 Dimensional Wood Joist, Polystyrene Extruded Insulation
Glazing		103 m2 total glazing area Vinyl Frame, Double Glazed hard coated air

The Athena Impact Estimator for Buildings software was utilized, which is in compliance with EN 15978. A 60 year building life expectancy was modeled. The following outputs represent the overall embodied emissions associated with these assumed structural and enclosure components:

6.2 Embodied Emissions LCA Measures	Unit	Total
Global Warming Potential	kg CO2 eq	1.85E+05
Stratospheric Ozone Depletion	kg CFC-11 eq	3.25E-03
Acidification of land & water	kg SO2 eq	1.38E+03
Eutrophication	kg N eq	9.38E+01
Tropospheric Ozone Formation	kg O3 eq	2.02E+04

Substitutions favouring lower embodied emissions will be explored during design development to reduce the deleterious impact of building materials and refrigerants. The thickness, type and volume of concrete required for floor slabs, columns, beams and footings will be evaluated.

During design development, the same exercise will be conducted should the building heating and cooling system selections have a capacity of equipment containing refrigerants 35 kW or greater. Once mechanical systems have been selected, emissions from refrigerants will been calculated using the following formula: kgCO2e/m2 = [GWPr*Rc*(0.02*L+0.1+)] / (L*A). Outputs representing the overall refrigerant emissions associated with the building’s mechanical components will be provided to the City of Vancouver.

Upon Building Permit Application, the project team will provide embodied emissions calculations representing the building permit stage design and a description of what measures, if any, were taken to reduce embodied emissions.

B.7: VERIFIED DIRECT VENTILATION

The building’s ventilation system will provide outdoor air directly to all occupiable spaces, in the quantities defined by code. The project owner has committed to meet this requirement – please see appended *Letter of Commitment*.

B.8: LOW EMITTING MATERIALS

All interior finishes will be selected to minimize volatile organic compounds and added urea formaldehyde to improve the indoor environmental quality. The project owner has committed to meet this requirement – please see appended *Letter of Commitment*.

B.9: INDOOR AIR QUALITY TESTING

Prior to occupancy, testing for formaldehyde, particulates, ozone, total volatile organic compounds and carbon monoxide will be conducted. The results will be compared to City targets and will be reported for occupancy permit. The project owner has committed to meet this requirement – please see appended *Letter of Commitment*.

B.10: INTEGRATED RAINWATER MANAGEMENT + GREEN INFRASTRUCTURE

In consultation with the City of Vancouver's Best Management Practice Toolkit, the project site Integrated Rainwater Management Plan includes green and grey infrastructure measures considered appropriate for the building type, design, project location and surrounding area. Landscape/Architectural Site Plans highlighting the green and grey infrastructure measures described in the site IRMP has been included with this Rezoning Application Package – please see appended *Integrated Rainwater Management Plan & Site Plan*.

B.11: RESILIENT DRINKING WATER ACCESS

The building's design will provide access to potable water which utilizes City operated system pressure (not electrically aided). As it is currently design each suite should be able to utilize water at the pressure provided by the local municipal supply. **No** additional pumping or electricity will be needed to bring water to the suites in line with the city's intent. The project owner has committed to meet this requirement – please see appended *Letter of Commitment*.

SUMMARY

The above noted strategies support a holistic approach to addressing the requirements of the City of Vancouver's Green Building Policy for Rezoning 2016. Implementing these strategies through design and construction will produce a sustainable and resilient building capable of delivering optimum building performance, while also improving indoor environmental quality for occupants.

2715 W12th Ave.
City of Vancouver Rezoning Energy Modeling Input Summary Table

<table>
<tr><th></th><th>Proposed Design Model Characteristics</th></tr>
<tr><td colspan="2">General</td></tr>
<tr><td>Location</td><td>Vancouver, BC</td></tr>
<tr><td>Simulation Weather File</td><td>Vancouver (CWEC)</td></tr>
<tr><td>Climate Zone</td><td>ASHRAE Climate Zone 5C</td></tr>
<tr><td>Modeling Software</td><td>eQUEST 3.64</td></tr>
<tr><td>Building Area</td><td>Residential: 13,708 ft²</td></tr>
<tr><td>Envelope surface area to floor area ratio</td><td>103%</td></tr>
<tr><td>Hours of Operation</td><td>Based on ENERGY MODELLING GUIDELINES section 2.1 Schedules</td></tr>
<tr><td colspan="2">Envelope Performance</td></tr>
<tr><td>Overall Roof U-value (BTU/h·ft²·°F)</td><td>U-0.033 (R-30) (as required by the prescriptive path of the Part 9 of VBBL)</td></tr>
<tr><td>Overall Wall U-value (BTU/h·ft²·°F)</td><td>U-0.045 (R-22) (includes all thermal bridges per CoV’s ENERGY MODELLING GUIDELINES) (as required by the prescriptive path of the Part 9 of VBBL)</td></tr>
<tr><td>Percentage Glazing</td><td>10%</td></tr>
<tr><td>Overall Glass U-value including frame (BTU/h·ft²·°F), and Solar Heat Gain Coefficient (SHGC)</td><td>U-0.15 (overall including fixed, operable and sliding doors)
SHGC-0.50
(Passive House certified)</td></tr>
<tr><td>Infiltration</td><td>0.60 ACH at 50 Pa (Passive House certified)</td></tr>
<tr><td colspan="2">Internal Loads</td></tr>
<tr><td>Occupancy</td><td>Residential: People = no. bedrooms + 1
(based on ASHRAE 62.1-2001 Table 2)</td></tr>
<tr><td>Lighting Power Density (LPD) (W/ft²)</td><td><table><tr><th>Space by Space Method</th><th>Proposed Lighting Power Density [W/ft²]</th></tr><tr><td>Residential Suite</td><td>0.464</td></tr></table></td></tr>
<tr><td>Plug-Loads</td><td>Residential: 0.464 W/ft2
(as per Based on ENERGY MODELLING GUIDELINES section 2.2.1 Residential Suites)</td></tr>
<tr><td>Domestic Hot Water Consumption</td><td>Residential: 0.025 gpm/person
(as per Based on ENERGY MODELLING GUIDELINES section 2.2.1 Residential Suites)</td></tr>
<tr><td colspan="2">Mechanical Systems</td></tr>
<tr><td>Indoor Design Temperature for Conditioned Areas</td><td>Based on ENERGY MODELLING GUIDELINES section 2.1 Schedules</td></tr>
<tr><td>System Description and Efficiency</td><td>Dwelling Units: Heating by electric baseboard and ventilation by in-suite heat recovery ventilator (HRV) with ECM motors (Passive House certified)
ERV fan power: 39 W
Bathroom fan power: 13.6 W
Ventilation fans on continuously</td></tr>
<tr><td>Minimum Ventilation Rates</td><td>Living areas: 0.35 air changes per hour but not less than 15 cfm per person
(Outdoor air is calculated by ASHRAE 62-2001)</td></tr>
<tr><td>Heat Recovery</td><td>Dwelling Units – HRV (Passive House certified)
Sensible effectiveness: 82%</td></tr>
<tr><td>Domestic Water Heater and Efficiency</td><td>Electric DHW heater</td></tr>
</table>

Zero Emissions Building Plan Energy Checklist

Please complete all fields that apply to the project, using information that represents the current stage of design. For fields that do not apply or for which there is no information yet, please enter "N/A".

Project Information (enter all that apply)

Project Address	2715 W12th Ave.
Secondary Address	N/A
Project Working Title	2715 W12th Ave.
Rezoning Application Number	N/A
Rezoning Application Date	N/A
Development Permit Number	N/A
Building Permit Number	N/A
Gross Floor Area indicated on Arch. Drawings (m²)	1,273
Parkade Area (m²)	-

Building Information and Performance Limits

For building types with Performance Limits, enter this information in this section

Building Type(s)	Modelled Floor Area (m²)	City-Recognized Low C Energy System?	Targets TEUI	TEDI	GHGI
Residential Low-Rise (< 7 storeys)	1,273	No	100	15	5
			0	0	0
			0	0	0

For other building types, create a baseline energy model to establish a TEUI limit, and enter this information in this section

Building Type	Modelled Floor Area (m²)

Enter Other Building Type Baseline Model Performance	Energy (kWh)	Em. Factor	Emissions (kgCO2e)		TEUI	TEDI	GHGI
Total Annual Electricity Use		0.011	-	Baseline:	0	N/A	0
Total Annual Natural Gas Use		0.185	-	Target:	0	N/A	0
Total Annual District Energy Use		0.070	-				
Total	-		-				

			TEUI	TEDI	GHGI
Total Modelled Floor Area (m²)	1,273	**Whole-Building Performance Limits**	**100.0**	**15.0**	**5.0**
Modelled Floor Area within 5% of Gross Floor Area?	Yes				

Modelled Building Performance

	Energy (kWh)	Fuel Type	Em. Factor	Emissions (kgCO2e)	TEUI	GHGI
Interior Lighting	13,001	Electricity	0.011	143.011	10.2	0.1
Exterior Lighting	-	Electricity	0.011	0		0.0
Heating	22,969	Electricity	0.011	252.659	18.0	0.2
Cooling	-	Electricity	0.011	0		0.0
Pumps	-	Electricity	0.011	0		0.0
Fans	5,146	Electricity	0.011	56.606	4.0	0.0
Domestic Hot Water	39,381	Electricity	0.011	433.191	30.9	0.3
Plug Loads	26,396	Electricity	0.011	290.356	20.7	0.2
Enter other end use here						
Enter other end use here						
Enter other end use here						

Total Annual Electricity Use	106,893	0.011	1,176
Total Annual Natural Gas Use	-	0.185	-
Total Annual District Energy Use	-	0.070	-
Total	106,893		1,176
Total Electricity Generated On-Site (kWh)	-	% of Use	0.0%
Total Purchased Renewable Electricity (kWh)	-	% of Use	0.0%
Total Purchased Renewable Natural Gas (kWh)	-	% of Use	0.0%
Note: purchaes renewables must be secured to satisfaction of AHJ			
Adjusted Electricity Emissions Factor (kgCO2e/kWh)	0.011		
Adjusted Natural Gas Emissions Factor (kgCO2e/kWh)	0.185		

Total Annual Heat Demand - for TEDI (kWh)	22,974	18.0 kWh/m²			
Total Annual Cooling Demand - *for info only* (kWh)	-	0.0 kWh/m²			
			TEUI	TEDI	GHGI
		Modelled Whole-Building Performance	**84.0**	**18.0**	**0.9**

Corridor Pressurization Adjustment

			TEUI	TEDI	GHGI
Number of Suite Doors Pressurized	0				
Airflow for Pressurization per Door (L/s/door)	0				
Area of Corridors Pressurized (m²)	0				
Make-Up Air Fuel Type	Electricity				
Make-Up Air Emissions Factor	0.011	Adjustments for Corridor Pressurization	-	-	-
Suite-level Metering for Space Heating	Yes	Adjustments for Suite Submetering of Heating	-		

Note: select yes if the energy used for heating is metered at the suite level

Adjusted Whole-Building Performance for Compliance	**84.0**	**18.0**	**0.9**

Modelled Inputs

Modelled Above-Ground Wall Area (m²)	1,057	Wall-to-Floor Area Ratio (WFA, measure of exposure)	0.83
Window-to-Wall Area Ratio (WWR)	10%	Window-to-Floor Area Ratio	0.08
Average Infiltration Rate (L/s/m²$_{fac}$)	0.0179		
Opaque Envelope Effective R-Value (m²K/W)	3.9 (0.69 Btu/ft²hr°R)	Average Floor Edge Psi-Value (W/m°K)	N/A
Average Window Effective U-Value (W/m²°K)	0.9 (4.8 ft²hr°R/Btu)	Avg. Window Transition Psi-Value (W/m°K)	N/A
Occupant Density (m²/pers)	No people = no. bedroom + 1	Average Lighting W/m²	5 (suite)
Average Suite Ventilation Rate (L/s)	14.1509434	DHW Low-Flow Savings	0%
Average HRV Effectiveness	82%	DHW Drain Heat Recovery Effectiveness	0%
Heating System Type (fuel, plant, distribution, etc.)	Electric baseboard		
Cooling System Type (fuel, plant, distribution, etc.)	None		
DHW System Type (fuel, plant, distribution, etc.)	Electric baseboard		

Modeller Information

Modeller Name	Lam Pang
☑	*These results have been created using the COV Energy Modelling Guidelines version:* 1
Company	Integral Group
Phone Number	604-687-1800
Email	lpang@integralgroup.com

July 5, 2017

Planning, Urban Design + Sustainability Department
City of Vancouver
453 West 12th Avenue
Vancouver, BC V5Y 1V4
Email: planning@vancouver.ca

Re: 2715 W 12th Street Rezoning Application
Commitment to meet the requirements of the Green Buildings Policy for Rezonings

As a part of the Rezoning Application package for 2715 W 12th Street, Form Projects (west 12th) Inc. hereby commits to meet the requirements of the Green Buildings Policy for Rezonings, and commits to providing the required documentation at time of Development Permit Application, Building Permit Application and Occupancy Permit Application. At this concept stage of design, in addition to the measures identified previously in the Sustainable Design Strategy section of the Rezoning Application package, Form Projects (west 12th) Inc. commit to the following requirements:

- B.3: Airtightness Testing: design, build, and test to meet an airtightness target of 2.0 L/s/m² @ 75 Pa;
- B.4: Enhanced Commissioning: complete an enhanced commissioning process;
- B.5: Energy System Sub-Metering and Reporting: design and build to include building metering and sub-metering of energy, and to enter into agreement on energy reporting, including assistance for building future owners;
- B.6.1: Refrigerant Emissions and Embodied Emissions: complete refrigerant emissions calculations;
- B.7: Verified Direct Ventilation: design and build a direct ventilation system;
- B.8: Low-Emitting Materials: design and build with low-emitting materials;
- B.9: Indoor Air Quality Testing: test indoor air quality prior to occupancy;
- B.11: Resilient Drinking Water Access: design and build a resilient potable water access point.

The design team and future operations team will coordinate to incorporate the measures required to meet all requirements of the Green Buildings Policy for Rezonings.

Yours truly,

Form Projects (west 12th) Inc.
Derick Fluker
Director

Form Retail Advisors Inc.
1280 - 333 Seymour Street, Vancouver, BC V6B 5A6

T 604 638 2121 F 604 638 2122
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INTEGRATED RAINWATER MANAGEMENT PLAN

At Concept Stage Design

2715 West 12th Avenue

Proposed Residential Development

Prepared for:

MCMP Architects
Suite 1900 – 1066 West Hastings Street
Vancouver, BC V6E 3X1

JTA Development Consultants
Suite 1280- 333 Seymour Street
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Developed by:

Integral Group
Suite 180 - 200 Granville Street
Vancouver, BC V6C 1S4

06, 07, 2017

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1. INTRODUCTION

The following report includes the explored measures for the management of the 2715 W12th street development site's rainfall through integrated rainwater management and green infrastructure.

Volume I: Vision, Principles and Action of the City-wide Integrated Rainwater Management Plan has been referenced in development of Main & Union's Integrated Rainwater Management Plan. It has been accepted that the data presented in Volume I, along with Volume II: Best Management Practice Toolkit's green infrastructure and integrated rainwater management solutions are acceptable and desirable design solutions in regards to rainwater management by the City of Vancouver.

2. LIMITING CONDITIONS

This report has been prepared for JTA Development Consultants based on information gathered by Integral Group Consulting (BC) LLP (Integral Group) over the rezoning application consultant meeting and available concept stage design information provided by representatives of JTA Development Consultants on behalf of the owner, MCMP Architects and Durante Kreuk prior to and after the rezoning application consultant meeting.

At the concept stage design, Integral Group's integrated rainwater management review is intended to be an examination of suitable measures for the management of the project site's rainfall through integrated rainwater management and green infrastructure, for the purposes and objectives stated herein. This study is not intended to represent a comprehensive detailed inspection or assessment of the project site, and should not be considered to replace any other inspections. Integral Group is not responsible for identifying defects and deficiencies which are not reasonably apparent in the rezoning stage design and supporting assumptions

The recommendations presented in this report represent professional opinions of Integral Group in light of the terms of reference, scope of work, and any limiting conditions noted herein. Any use of the report, reliance on the report, or decisions based upon the report, by a third party are the responsibility of those third parties unless authorized in writing by Integral Group. The JTA Development Consultants has copy-right permission for reproduction and distribution of this report.

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3. Site Description

The project site is located at the corner of Stephen Street and West 12th Avenue with a site area of 872m2. The site is a triangular shape with City of Vancouver sidewalks to the South and East, and a laneway to the North. The building will feature sloped roof spaces suggesting the total roof area will be larger than the buildings footprint of 371 m2. The project will not include a parkade but will include 3 parking spaces in the North East corner of the property. Vegetation will be provided on the ground level and consist primarily of pollinator gardens and a variety of other plantings. This sites shape combined with the proposed building's fit allows for approximately 278m2 of vegetated infiltration space at grade

Preliminary Site Calculations

The following preliminary site and rainwater volume calculations have been provided to compare the currently considered site performance to the City-wide targets:

Preliminary Site Calculations	
Site Area	9,387ft2/ 872m2
Extent of Slab	4,002ft2/ 371 m2
Rainwater Infiltration Capacity, the first 24 mm within 24 hours	20,900 L/ 20.9 m3
Quality Management Capacity, the next 24 mm within 24 hours	20,900 L/ 20.9 m3
Conveyance from Site, rainwater surpassing 48 mm in 24 hours	>41,800 L/ 41.9 m3

4. Integrated Rainwater Management and Green Infrastructure

In consultation with the Best Management Practice Toolkit, the project's current site Integrated Rainwater Management Plan includes green and grey infrastructure measures considered appropriate for the building type, design, project location and surrounding area. The rainwater infiltration and quality management measures under consideration, along with their contribution to the city-wide IRMP targets for water volume reduction and quality treatment include the following:

4.1 **Rainwater Infiltration** of first 24 mm (1") within 24 hours

The project includes a good amount of permeable space due to the site's layout. Where hardscapes are proposed the project will investigate opportunities to continue infiltration through the potential use of permeable paving in the parking area and play area. Infiltration opportunities will be explored and created where possible, including the following considered options as suggested by landscape and mechanical teams:

1. Rainwater Infiltration through Vegetation

   All ground level planting will have a minimum soil depth of 600mm. Beyond the proposed soil level, the grounds natural infiltrations properties should allow for additional infiltration of rainwater. The total area of the ground level vegetation is 278m2. This equates to 169.5 cubic metres of soil, which would be **capable of storing about 39.1 cubic metres of water** depending on the plant species selected. The proposed landscape design would reduce peak flows and stormwater volume.

Ground Level Polinator Gardens	Imp.	Metric
Ground Level Vegetated Areas (SF/m2)	2347.0	218.0
Vegetation Square Root	48.4	14.8
Soil Depth (ft./mm)	2.0	609.6
Soil Volume (ft3/m3)	4694.0	132.9
Rainwater Retention (ft3/m3) (+15% assumed, based on plant list)	**1079.6**	**30.6**

Hedges	Imp.	Metric
Ground Level Vegetated Areas (SF/m2)	357.0	33.2
Vegetation Square Root	18.9	5.8
Soil Depth (ft./mm)	2.0	609.6
Soil Volume (ft3/m3)	714.0	20.2
Rainwater Retention (ft3/m3) (+15% assumed, based on plant list)	**164.2**	**4.7**

Ground Level Turf Grass	Imp.	Metric
Ground Level Vegetated Areas (SF/m2)	289.0	26.8
Vegetation Square Root	17.0	5.2
Soil Depth (ft./mm)	2.0	609.6
Soil Volume (ft3/m3)	578.0	16.4
Rainwater Retention (ft3/m3) (+10% assumed, based on plant list)	**127.2**	**3.8**

2. Rainwater Infiltration through Permeable Paving

To further support the infiltration of water, the project will also be investigating the use of permeable paving to allow for the infiltration of rainwater. Assuming the 54m2 space will allow for the infiltration of water into a minimum 150mm infiltration medium below the surface, the inclusion of the permeable paving system is expected **to retain a minimum of 1.6 m3 of rainwater**.

Permeable Paving	Imp.	Metric
Permeable Paving Area (SF/m2)	581.0	54.0
Paving Square Root	24.1	7.3
Infiltration Layer Depth (ft/mm)	0.5	150.0
Soil Volume (ft3/m3) (assumed 6")	290.5	8.1
Rainwater Retention (ft3/m3) (+15% assumed, based on plant list)	**58.1**	**1.6**

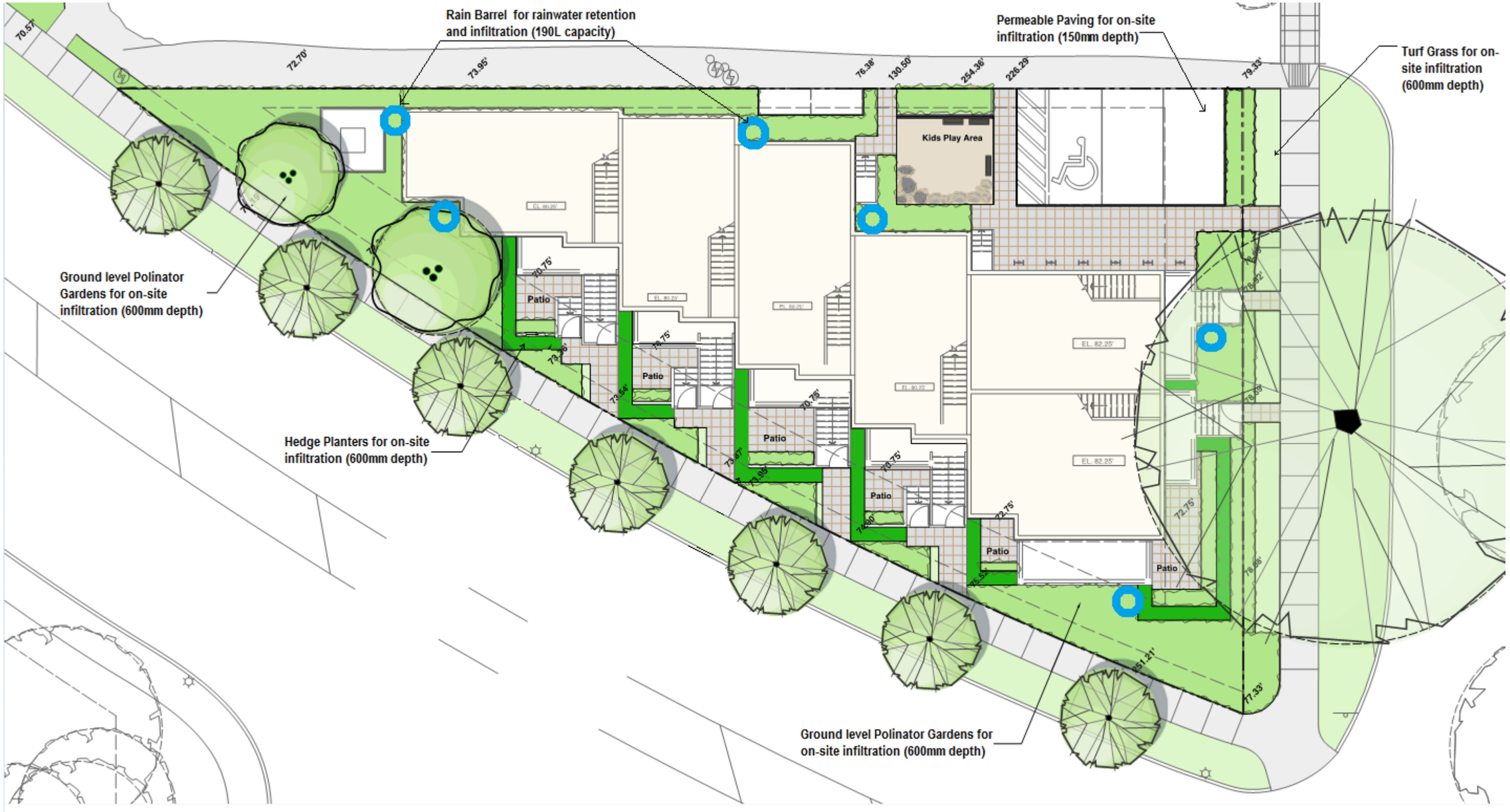
4.2 **Rainwater Quality Management** of the next 24 mm (1”), (up to first 48 mm in 24 hours)

Should the combination of hedges, gardens, and permeable paving be maintained by the design team the combined capacity should be sufficient to satisfy the majority of the retention requirements and still allow for the significant infiltration of water for quality management. To satisfy the quality management requirements for that which cannot be immediately infiltrated, the project will utilize localized rainwater retention in the form of rain barrels as a means of retaining water during rainfall events to be later infiltrated into the landscape. The project will propose the use of 6 to 7 190L capacity rain barrels around the property where the roof drainage can be connected to the barrels. This will allow for the **retention of an additional 1.2 m2 of rainwater**. Combined with the 39.1m3 of vegetation infiltration and permeable paving infiltration, the combined capacity is enough to infiltrate a total of 41.8m3 rainwater during a 48mm 24 hour rainfall event.

4.3 **Runoff routes for Conveyance away from Building** storm events surpassing 48 mm (2”) in 24 hours

For storm events which exceed 48 mm (2”) of precipitation within 24 hours, runoff routes including pipes and overflow will be included in the project site design with the objective to safely convey this rainwater in pipes, surface routes or channels that minimize the damage to buildings or property. These extreme cases will be considered by Vector Engineering and the system of surface gutters along Main and Union Street edges, channels and overflows.

5. SITE PLAN WITH IRMP


Rain Barrel for rainwater retention and infiltration (190L capacity)
Permeable Paving for on-site infiltration (150mm depth)
Turf Grass for on-site infiltration (600mm depth)
Kids Play Area
Ground level Polinator Gardens for on-site infiltration (600mm depth)
Hedge Planters for on-site infiltration (600mm depth)
Patio
Patio
Patio
Patio
Patio
Ground level Polinator Gardens for on-site infiltration (600mm depth)

CONCLUSIONS

The above noted strategies support a holistic approach to developing integrated rainwater management for the 2715 W 12th site. The integrated rainwater management strategies under consideration meet the required quantity management for both infiltration and quality treatment.

Considered Strategies for Project Rainwater Retention/Treatment Capacity	L	m3	%
Rainwater Retention (ft3/m3) (+15% assumed, based on plant list)	38986	39.0	93%
Permeable Paver Infiltration (ft3/m3)	1619	1.6	4%
Localized Rainwater Detention (ft3/m3)	1200	1.2	3%
TOTAL	**41805.4**	**41.8**	**100%**

Preliminary calculations will be reviewed by the project Landscape Consultant, Durante Kreuk, and will be further developed through design development. The site conditions including building form and expected rainfall have been evaluated in comparison to the City-wide IRMP Volume I: Vision, Principles and Action, and Volume II: Best Management Practice Toolkit.

Implementing these green infrastructure and rainwater management strategies through design and construction will result in a robust integrated rainwater management plan for the 2715 W12th development.