7 STORMWATER

This chapter summarizes the existing conditions related to campus stormwater management and identifies three main measures for improving management of stormwater on campus as it continues to grow between now and 2050. The goal is to divert 100% of stormwater from the downstream municipal system by capturing, re-using, infiltrating, and storing stormwater on campus lands. The City of Kelowna requires that "a piped drainage network shall be in place to collect and convey a 5-year rainfall event (minor storm). In addition, overland drainage routes must be designed to safely convey and store runoff for up to a 100 year rainfall event (major storm)" (2011 *Stormwater Management Plan*).

Goal

Divert 100% of stormwater from municipal systems.

7.1 SUMMARY OF OVERALL CONDITIONS

Stormwater generation and management on the UBC Okanagan Campus reflects climate, soil, and historical development patterns.

Climate The UBC Okanagan Campus is situated in an arid landscape with a mean annual precipitation (Kelowna Airport) of 298 mm; 34% (102 mm) falls as snow. The size and seasonality of stormwater flows are influenced by the campus arid climate. Most large rainfall events occur during late spring and summer (intense thunderstorms July through August) and the extreme daily precipitation is 34 mm. Winter precipitation often falls as snow which may melt rapidly in the spring.

Soil Conditions Permeability (subsurface water movement) and soil conditions on campus are a challenge from a stormwater management perspective as the soil conditions vary largely throughout the campus area. Previous studies completed by CTQ Consultants revealed a variety of soils, silts, clays, beach sands and cobbles, to name a few. Surface drainage has also been extensively modified within the campus core (e.g., soil compaction, disruption of flow paths, imported soils, etc.) and in other areas of the campus such as the gravel pit. Completion of a comprehensive geotechnical soil report is recommended to better understand where infiltration opportunities exist.

Existing Stormwater Network Currently, the campus maintains all of its stormwater on-site through the existing storm pipe network, overland flow routes, ditches, swales and ponds. The storm pipe network and overland flow routes are designed to convey water within 12 major catchment areas as defined in UBCO's 2011 *Stormwater Management Plan*[1] and shown in Figure 57. This figure does not show the new connection to John Hindle Drive that is in the final stages of development.

1 CTQ Consultants. 2011. UBCO Stormwater Management Plan.

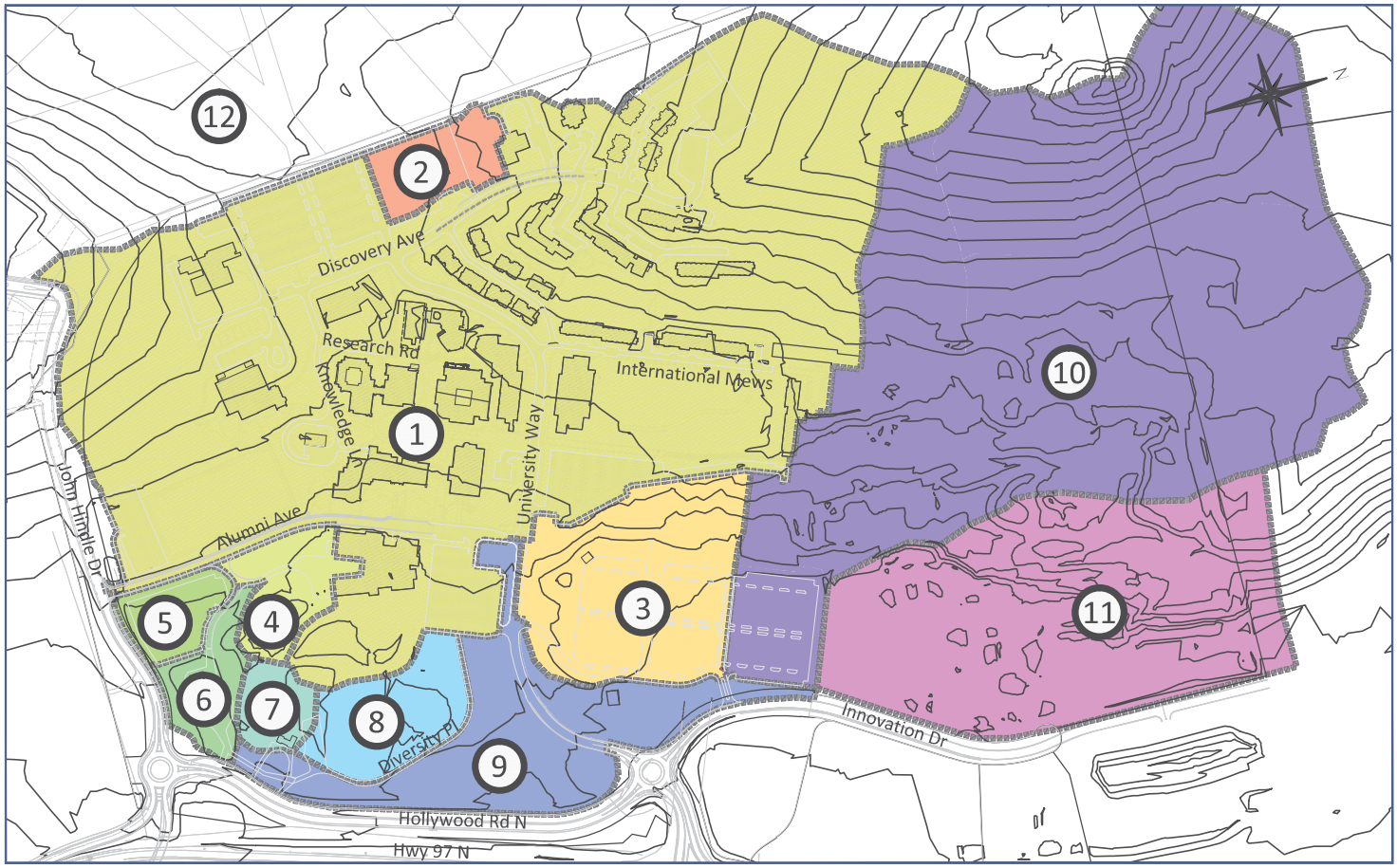


FIGURE 57: 12 STORMWATER CATCHMENT AREAS AS PRESENTED IN 2011 STORMWATER MANAGEMENT PLAN

LEGEND

1. Main Campus
2. Lower Cascades Townhouse—Parking Lot
3. University Way—Main Parking Lot
4. Second Pond
5. Sport Field—Main Parking Lot
6. Maintenance Yard
7. Sustainability House
8. Building W—Okanagan Centre
9. Okanagan Landscape
10. Main Parking Lot—Phase 2
11. Lower Research Park
12. Agricultural Lands

Water and Water Quality Monitoring Low Impact Development (LID) methods are recommended to help address both water quality and water quantity of the stormwater runoff on the campus. However, as identified in the 2011 *Stormwater Management Plan*, a stormwater monitoring program should be implemented to ensure the proper functioning of the overall stormwater system and water quality.

Ecological Values As described in the Ecological Landscape and Biodiversity Section, stormwater sustains wetlands that are important for the campus from a biodiversity, educational, and recreational point of view. Indeed, some of the species at risk, such as Great Basin spadefoot toad, colonize ditches and other small stormwater features which make maintenance more challenging and costly.

Existing Stormwater Management Plan The 2011 *Stormwater Management Plan* addresses future development based on the 2009 UBCO Master Plan. It focused on addressing deficiencies and future growth to meet the requirements of the City of Kelowna's Subdivision, Development, and Servicing Bylaw, which state that stormwater runoff cannot exceed predevelopment rates and the use best practices for stormwater management. It identifies areas on the campus that

need to be modified in order to meet the University's guidelines to control and retain all stormwater on-site.

The 2011 *Stormwater Management Plan* identified that stormwater released into existing systems may need to be controlled in order to accommodate current pipe capacity. It recommends nine specific upgrades along with additional stormwater wetlands to ensure adequate storage.

The Main Pond (identified as Wetland 1 on Figure 58), located at the southeast side of campus, close to the Engineering Management Building, manages stormwater from the main campus area. The Pond, which is currently identified as a wetland habitat area, has a maximum storage capacity of 3,570 m^3 and is designed to overflow into a second pond directly adjacent to the south end of the Main Pond with a capacity of 5,070 m^3 (designed for a 100-year 1-hour storm event). It has been reported that no runoff or discharge from the Main Pond has occurred as the stored water is lost to infiltration, evaporation, and wetland plant evapotranspiration. The Main Pond is also considered an ecological hotspot on campus, providing habitat to a number of different species.

The swales in the north parking lot areas have reported issues with build-up of sand and snow sediments. The drywells and infiltration trenches in that area need to be cleaned out each year. The *Stormwater Management Plan* recommends that snow storage in these stormwater features should be discontinued in order to maintain adequate infiltration and reduce the cost of maintenance.

The *Whole Systems Infrastructure Plan* does not provide an updated stormwater management plan. Rather it references the 2011 *Plan* and provides additional guidance for how low impact development (LID) stormwater strategies could be implemented on campus to manage future stormwater loads associated with campus growth. It is recommended that UBCO update the 2011 *Stormwater Management Plan* to reflect the 2015 Campus Plan and recommendations presented in this Infrastructure Plan.

7.2 ACHIEVING 100% STORMWATER DIVERSION

Managing Stormwater

There are several general approaches to address stormwater on campus:

1. Conventional pipe systems to drain precipitation captured by impervious surfaces and convey it into storage areas or the municipal drainage system;
2. Reduced impervious areas and/or infiltration strategies including LID stormwater measures to slow runoff such as green roofs; and
3. Capture, storage, and re-use system for building use, irrigation, or ecological features.

Proposed Approach

Given the existing stormwater infrastructure on campus, projected development growth, and sustainability goals, the following measures build upon the campus system and continue to divert 100% of stormwater from municipal or off-site drainage systems (see Figure 58 Stormwater Concept Plan):

1. **Collect and filter stormwater** in parking lots and other large impervious areas to enhance an expanded network of wetlands;
2. **Infiltrate runoff, where possible**, from buildings and impervious surfaces in the campus core;
3. **Implement specific stormwater improvements** relative to the *2011 Plan* but giving a higher priority to using LID stormwater management methods where site conditions are suitable; and
4. **Commission an update of the stormwater management plan** to reflect the 2015 Campus Plan and incorporate LID strategies.

More so, these measures will work together in enhancing the ecological landscape of the campus.

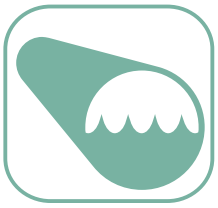
SWM 1—Collect and filter stormwater to enhance wetlands

This measure is based on the approach of collecting and filtering stormwater runoff to enhance and expand a network of wetlands on campus. It provides a dual method for addressing both the stormwater goal for the control and retention of all stormwater on-site and for providing additional natural landscaped areas for enhanced biodiversity functions.

This measure involves a number of components:

1. **Incorporate stormwater filtration** systems into all existing and new parking lots greater than 2,500 m^2 in size. This approach will need to be considered relative to the phasing of building development and lot displacement.
2. **Use swales, sand filters, raingardens**, and/or other surface or shallow subsurface systems to remove sediment and contaminants from stormwater before discharging to constructed wetland ponds.
3. **Develop an enhanced network** of wetland areas on campus (refer to Figure 58). The following outlines an approach to expanding the permanent and seasonal wetland complexes on campus:

    a. *Main Pond (Wetland 1)* Expand the amount of wetland area adjacent to The Pond by 25-50%. The wetland should vary from shallow open water, to marsh, to seasonally flooded (vernal) meadow; riparian areas should also be included. This is a natural area for biodiversity enhancement with no current outflow.



b. *Wetland 2* Create a new permanent wetland complex at the northern end of the lower parking lot that is fed by stormwater from the existing and future parking areas. Wetland 2 expands the *2011 Plan*'s proposed Pond #1 with the recommendation that the design focuses on wetland creation and enhancement of the surrounding landscape. Detailed design options are available, such as terraced wetland cells, to have capacity to meet the retention requirement, while meeting design opportunities for landscape and biodiversity.

c. *Wetland 3 and 4* Create new, permanent wetlands near the entrance to campus (similar to the *2011 Plan* Pond #2). They would be connected to the parking lot wetland complex (Wetlands 2, 3, and 4) as well as to the proposed stormwater swales along University Way/Hollywood Road on the southeast side of the Main parking lot. Note that the location of Pond #2 as per the *2011 Plan* has changed. Wetlands 3 and 4 are similar in form and function.

d. *Wetland 5* This wetland is an emphemeral or seasonally-flooded wetland that receives surface flow infrequently from Wetland 1 (The Pond). This seasonal wetland from a biodiversity perspective, provides important habitats for birds and plants, and from a social sustainability point of view, provides an opportunity to create a seasonal, recreational open space feature.

e. *Wetland 6* This small wetland receives drainage from the western parking lot and adjacent areas. It is more urban than the other wetlands proposed in this plan.

It is recommended that UBCO update its stormwater management plan to integrate these wetland and seasonal pond recommendations, and that wetland sizing must address retention of peak stormwater runoff (see 2011 *Stormwater Management Plan* modelling), as well as typical seasonal flows (to avoid being too large to retain sufficient flow volume).

With the potential installation of a water reuse system, UBCO should consider using reclaimed water supplies to maintain minimum water levels in wetlands during drought periods. Further investigation of whether fertilizers need to be removed from reclaimed water sources will be required.

Stormwater Measure 1 Collect and filter stormwater to enhance wetlands	BIODIVERSITY	WATER	STORMWATER	ENERGY	WASTE

SWM 2—Infiltrate Runoff from Buildings and Impervious Surfaces in the Campus Core

This measure is based on the approach of maximizing infiltration of runoff from buildings and impervious surfaces on campus, where applicable, depending on soil conditions. It is recognized that permeability and soil conditions within the campus core are a challenge. The suggested low impact development (LID) methods listed below should be considered on a case by case basis to help mitigate runoff peak flow rates and volumes, and improve the quality of water that enters the wetlands, while supporting the incorporation of ecological/natural areas in the developed parts of campus.

The 2011 *Stormwater Management Plan* includes a section on "Green Techniques" which listed a number of stormwater management methods to be considered in future developments or retrofit applications, such as, rain gardens, rain barrels, bioswales, green roofs, vegetative strips, and roof storage. This list, referred to in the Plan as "green" stormwater management methods, is now commonly referred to as "Low Impact Development (LID)" stormwater management measures. In addition to these listed green methods in the *2011 Plan*, permeable pavement (i.e., pervious concrete and permeable pavers) is recommended wherever subgrade soil conditions exist on the campus with adequate infiltration capacity to allow for this type of LID method.

LID, a sustainable stormwater practice, is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage, that treats stormwater as a resource rather than a waste product. LID methods use or mimic natural processes to treat, infiltrate, evapotranspirate or reuse stormwater or runoff on the site where it is generated[2].

These LID methods should be considered on a building by building basis, and as specific areas on campus are developed to assist with mitigating stormwater runoff rate and volumes. It is recommended that UBCO update its *Design Guidelines* to reflect these LID stormwater management best practices.

1. Through the use of LID, strive to infiltrate 100% of stormwater runoff from all buildings and impervious areas (depending on site specific soil conditions) into raingardens, drywells, infiltration galleries and landscape features within the campus core, to reduce the need for supplemental watering. Soil infiltration rates greater than 0.25 inch/hour would be suitable for typical types of LID methods. It is recommended that a geotechnical soil investigation be completed to identify suitable areas and infiltration potential on campus.

2 US Environmental Protection Agency. Water: Low Impact Development. water.epa.gov/polwaste/green/ [June 2015]

2. Use permeable pavement (i.e., pervious concrete and permeable pavers) wherever subgrade soil conditions exist with adequate infiltration capacity to allow for this type of LID method. The use of permeable pavements might be a challenge in the campus core since very densely compacted gravel-fill soils are located in this area. A geotechnical evaluation of these compacted gravel areas would determine whether or not adequate infiltration capacity is available and suitable for the use of permeable pavement.
3. Use green roofs on a select number of new buildings to reduce stormwater run-off volume and flow from buildings. Benefits and trade-offs associated with green roofs and evaluation criteria for installation on per project basis are identified in the Ecological Landscape and Biodiversity Section. With the potential installation of a water reuse system, UBCO should consider using reclaimed water to irrigate green roofs to assist with maintenance during summer months. The use of green roofs will need to be considered in the context of also evaluating roofscape for renewable energy technologies, such as solar PV or solar hot water.

Stormwater Measure 2 Infiltrate Runoff from Buildings and Impervious Surfaces in the Campus Core	BIODIVERSITY	WATER	STORMWATER	ENERGY	WASTE

SWM 3—Implement specific stormwater improvements relative to 2011 Plan

The proposed stormwater management measures (SWM-1 and SWM-2) are intended to augment the 2011 *Stormwater Management Plan*. Table 57 summarizes the 2011 measures relative to the proposed SWM-1 and SWM-2 measures and it is recommended that the *2011 Plan* be updated based on the 2015 Campus Plan and *Whole Systems Infrastructure Plan* recommendations SWM-1 and SWM-2. The updated plan would provide for a more detailed stormwater design analysis for site-specific applications of the recommended measures.

Stormwater Measure 3 implement specific stormwater improvements relative to CTQ plan	BIODIVERSITY	WATER	STORMWATER	ENERGY	WASTE