CHAMPLAIN
COLLEGE

Champlain College
Stormwater Master Plan

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table of contents

I. OVERVIEW

EXECUTIVE SUMMARY

As Champlain College plans for the future, an important issue will be the proper management of storm water. This report summarizes the nature of storm water the campus experiences, identifies specific opportunities for storm water management, proposes general campus guidelines and lists known storm water issues on the campus. Also included is a summary of storm water permitting that will likely be required for projects of significance and a storm water maintenance plan.

While many of the opportunities and improvements proposed are located solely on campus owned land, some depend on the purchase of property or acquiring of easements to enact. Likewise, there are other entities, such as Burlington Planning and Zoning and the Department of Public Works which will need to be consulted with as these improvement concepts are further developed and evaluated.

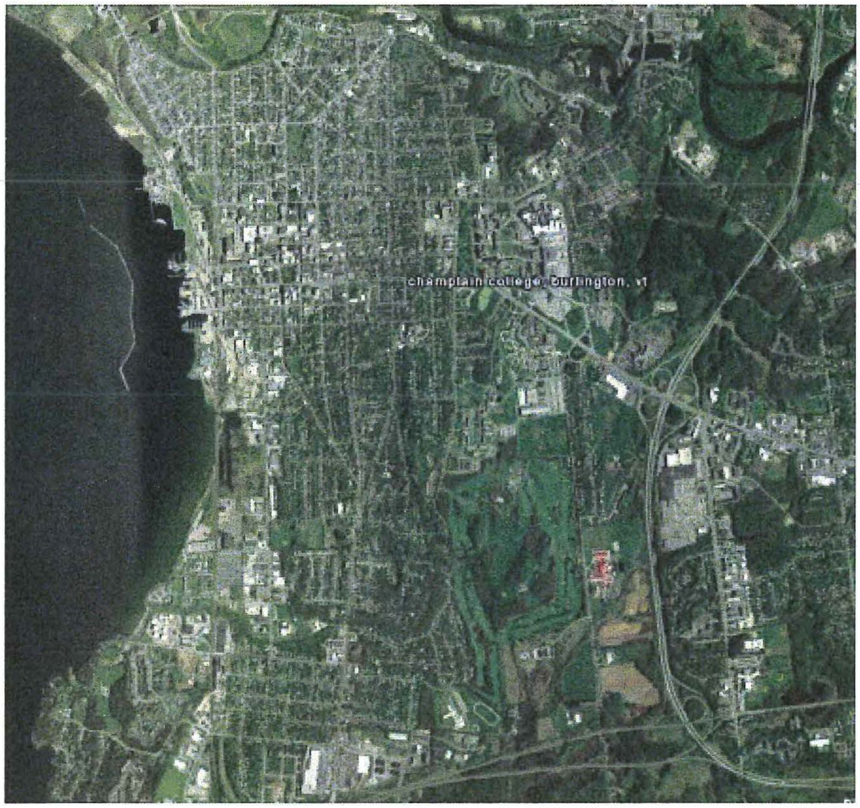
PURPOSE

Develop a master plan approach to managing storm water on the campus of Champlain College as follows:

- Work with the master plan team and College to identify alternative potential storm water management opportunities.
- Develop campus standards for storm water maintenance practices and future improvement projects at the College.
- Work with College staff to develop a list of specific storm water issues. Prioritize the list and work with the College to address the issues.
- Summarize storm water and related permit considerations.
- Summarize storm water maintenance plan considerations.

THE CAMPUS AND ITS WATERSHED

Champlain College is located on a hill near downtown Burlington less than a mile from Lake Champlain. The Lake and the College are linked in name, in image and in many other ways. Generally, storm water runoff from this area of the city discharges into the municipal combined sewer system, which terminates at the main waterfront wastewater treatment facility. Treated wastewater from this facility is discharged into the Burlington Bay portion of Lake Champlain. During significant rain events, the collection system and treatment facility are frequently overtopped, and untreated storm water and wastewater discharges directly into the lake. Many areas of Lake Champlain are already impaired by PCBs and Mercury, which are damaging to the fish population. Currently Lake Champlain is not impaired by storm water, and it is important that everyone living and operating within the Lake Champlain Watershed contribute to protecting and improving the quality of the lake.



The annual precipitation that falls on Burlington is as follows:

<u>NOAA climate data for Burlington, VT:</u>

Average Annual Precipitation: 1971-2000: 36.05in

Average Monthly Precipitation:

January	2.22in
February	1.67in
March	2.32in
April	2.88in
May	3.32in
June	3.43in
July	3.97in
August	4.01in
September	3.83in
October	3.12in
November	3.06in
December	2.22in

Based on a campus size of 21.8acres, a little more than 21 million gallons of precipitation falls on the Champlain College campus annually.

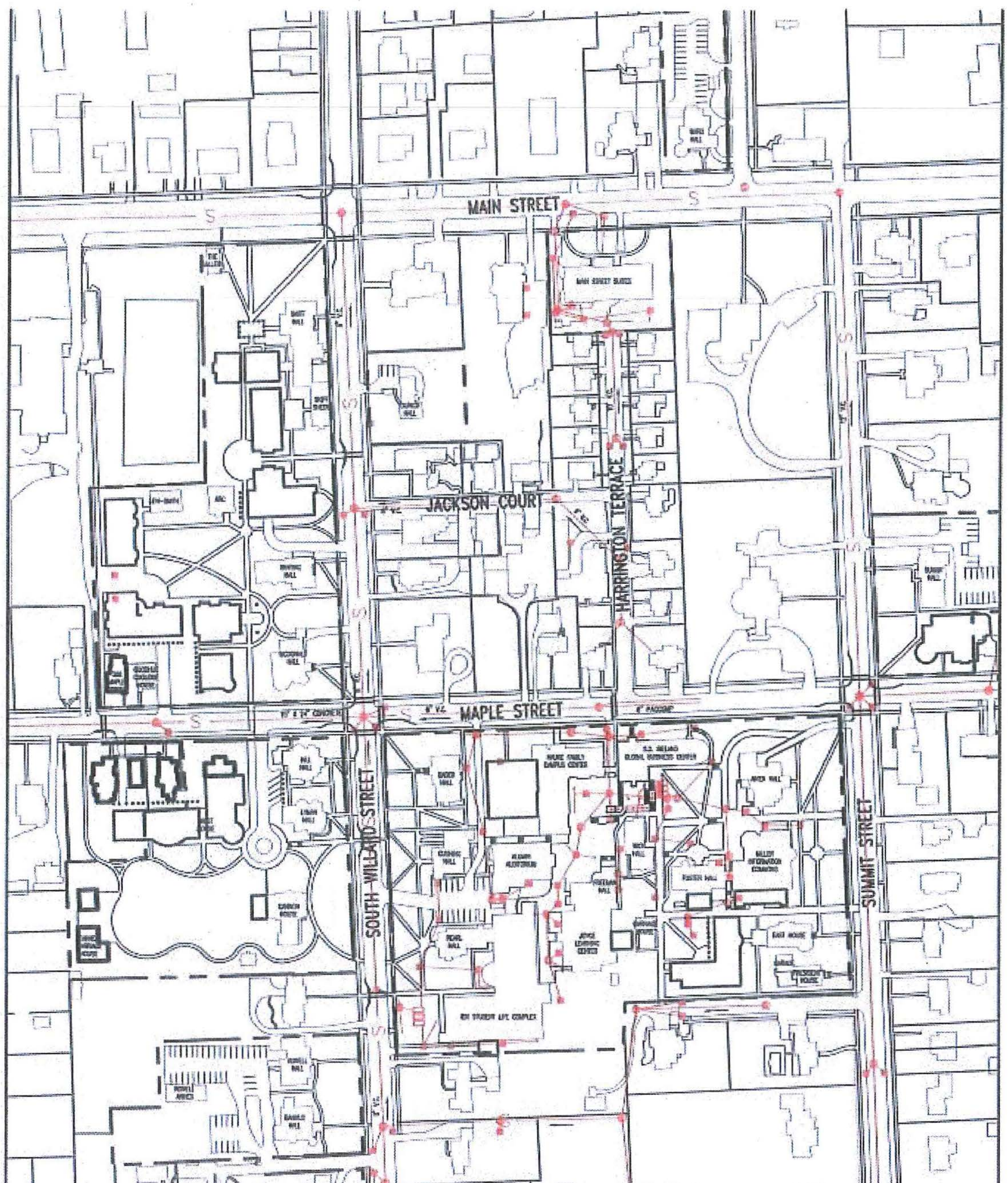
Existing Campus Conditions

The campus is located in an historic neighborhood in the City of Burlington. The campus is a mix of renovated historic buildings converted to College use and newer buildings built specifically for College use. The campus is roughly 21.8 acres spread over several parcels. Of this, roughly 46% of the campus is impervious cover (buildings, parking, walks etc).

Storm water collection consists of a range of on-site collection systems to surface sheet flow to municipal streets to natural infiltration. There are some isolated buried stormwater retention tanks that attenuate storm water flows from recently constructed projects. Existing storm water treatment on the Campus is generally limited to directing flows through grass lined swales. The adjacent municipal system consists of combined sanitary and storm sewers which all flow to the main waterfront sewage treatment plant.

Proposed Campus Conditions (Per Champlain College Master Plan)

The current draft master plan for the campus will have some impacts on the future management of stormwater on the campus. There is some potential to add property area to the campus (by acquiring up to one additional acre of land). The plan indicates a potential increase of impervious area from 46% cover to 47% cover. Most significantly, related to stormwater runoff quality, is the proposed replacement of several surface parking areas with buildings, thus reducing the likely sediment loss from the site as well as potential from contaminants from vehicles. Additionally, there is the opportunity to incorporate new storm water treatment and management approaches as the College looks broadly to the future.



MUNICIPAL COMBINED SANITARY SEWER AND CAMPUS STORM SEWER SYSTEMS

II. CAMPUS STORM WATER OPPORTUNITIES

CAMPUS STORM WATER CHARACTERISTICS FOR FIVE STORM WATER AREAS

In evaluating campus storm water opportunities, the campus has been divided into five distinct storm water areas. These areas parallel the areas of the same name and letter from the masterplan documents. These five areas include more than 70% of the acreage of the campus. While the other, smaller areas of the campus are not specifically included below, the general guidelines in Chapter 3 and specific issues in Chapter 4 apply, and should be considered in long term storm water management of these areas.

The five storm water areas are as follows:

Area:	Description of area:
A:	Core Campus within S Willard, Maple, Summit
B1:	W of S Willard, S of Maple (inc Hill, Lyman, Perry, West Halls & Perry Carriage House)
B2:	W of S Willard, S of Maple (inc Rowell, Bankus Halls and Rowell Annex
B3:	W of S Willard, S of Maple (parcel with 2 houses that college intends on buying)
C:	Core Campus W of S Willard, N of Maple

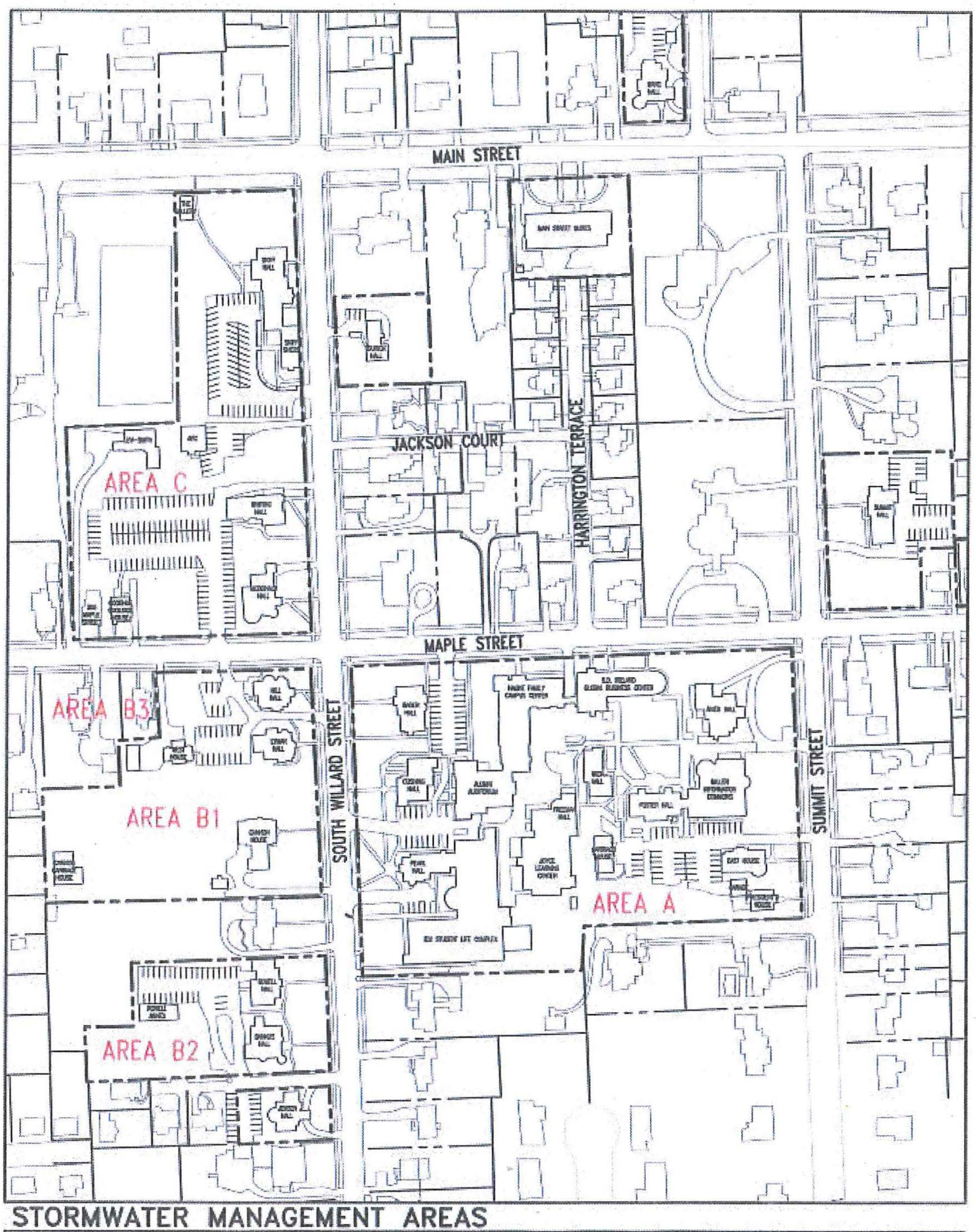
The size and lot coverage of these areas under existing and assumed proposed conditions are:

Existing areas:

Area:	Total Area (sf)	Building(sf)	Sidewalk(sf)	Road/Parking(sf)	Total Impervious (sf)
A:	357,116	100,428	46,755	46,839	194,022
B1:	144,025	11,643	5,592	19,684	36,919
B2:	72,415	6,998	3,640	16,066	26,704
B3:	31,764	4,952	587	3,387	8,926
C:	210,665	25,113	6,626	71,420	103,159

Proposed areas:

Area:	Total Area (sf)	Building(sf)	Sidewalk(sf)	Road/Parking(sf)	Total Impervious (sf)
A:	357,116	120,113	57,420	21,229	198,762
B1:	144,025	32,707	4,292	6,160	43,159
B2:	72,415	9,736	3,419	23,095	36,250
B3:	31,764	7,052	331	1,345	8,728
C:	210,665	65,980	33,712	5,227	104,919



STORMWATER MANAGEMENT AREAS

Using this data, simplified hydrology and sediment loss models were developed with the following results:

Hydrology analysis (using HydroCad v8.0):

	Water Quality Storm		2-Year Storm		10-Year Storm	
Area:	Ex(cfs)	Prop(cfs)	Ex(cfs)	Prop(cfs)	Ex(cfs)	Prop(cfs)
A:	2.29	2.29	16.89	16.89	27.84	27.84
B1/B3:	0.11	0.22	4.43	5.79	8.36	10.69
B2:	0.19	0.39	2.71	3.24	4.81	5.44
C	1.12	1.12	9.43	9.43	15.81	15.81

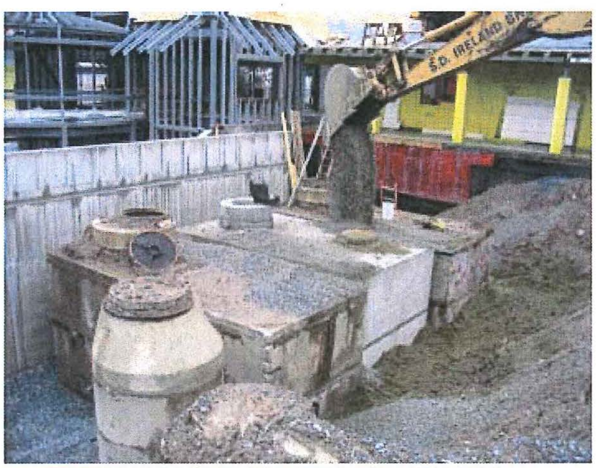
Sediment Load Analysis (using the Simple method)

Area:	Existing (lbs/yr)	Proposed (lbs/yr)	Proposed with 80%TSS removal (lbs/yr)
A:	2472	2089	418
B1:	704	324	65
B2:	527	694	139
B3:	114	56	11
C:	2045	1050	210

STORM WATER ATTENUATION

One general stormwater opportunity on the campus is to attenuate (reduce the peak) flows of stormwater leaving the site. The benefit of this approach is that downhill systems, including municipal drains and the treatment plant they connect to receive water at a more steady rate. This can be done in many ways, including increasing the time of travel of storm water and storage in underground tanks and pipe/crushed stone systems (more common in urban areas) or above ground detention ponds (more common in suburban areas). In Area A, there are currently six buried 5,000 gallon attenuation tanks (three each at the Business Center and the Student Center).

Generally, the proposed conditions result in minimal to no increase in impervious area for these five areas of the campus. This typically results in little to no increase in resulting peak flows from the various precipitation events noted above, depending on specifically how the stormwater is routed. However, including methods of attenuation in future projects as the campus evolves (likely required by State permitting) will certainly help to reduce these peak flows.



STORMWATER RETENTION TANKS

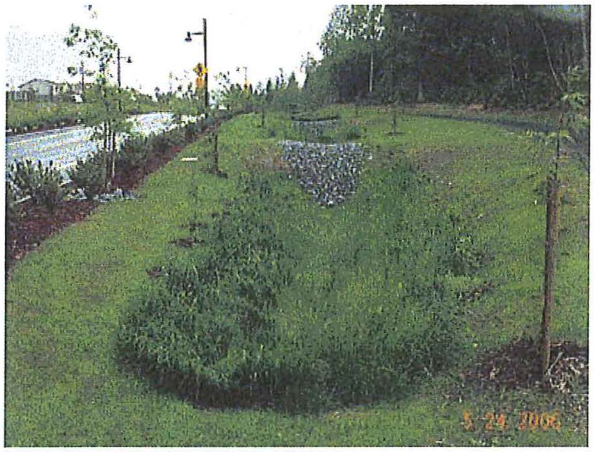
STORMWATER DETENTION POND

STORMWATER BIORETENTION POND

STORM WATER TREATMENT

Existing storm water treatment on the Campus is generally limited to grass-lined swales. As indicated in the Sediment Load Analysis table, by comparing Existing and Proposed sediment loss, the proposed changes in the master plan will result in a reduction in sediment loss from the site. This is due mostly to the proposed replacement of paved areas with buildings and roof impervious area results in less sediment loss than paved areas.

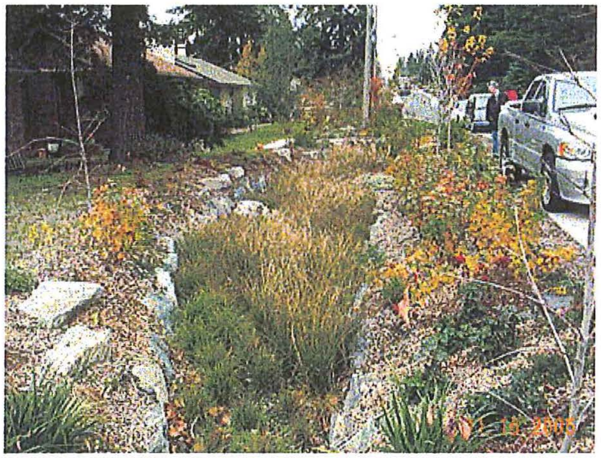
There will be an opportunity (and a likely requirement by State permitting) to install storm water treatment measures as the campus evolves. These will typically consist of additional grass-lined swales, bio-retention swales, small pocket ponds and manufactured, buried structures to remove total suspended solids (TSS) and other storm water pollutants (as shown in the sediment load analysis table above below "Proposed with 80% TSS removal").



GRASS TREATMENT SWALE

DRY DETENTION POND

STORMWATER TREATMENT STRUCTURE



BIO-RETENTION SWALE

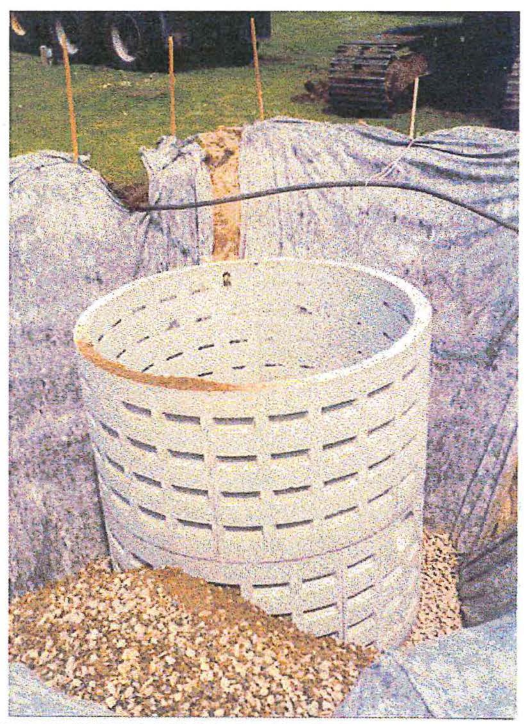
STORM WATER INFILTRATION

Another opportunity is to provide storm water infiltration. This practice re-introduces the collected storm water into the ground. This can result in less runoff from the site and re-charge groundwater. The challenge with this measure at the Campus is that there are several areas that have existing groundwater related issues in the nearby proximity of buildings and basements may preclude this approach from being viable. However, there may be a few areas of the campus (such as the lower Perry Lawn) where this measure is practical and appropriate.

STORM WATER INFILTRATORS

INFILTRATORS WITH TANK

INFILTRATORS IN LAWN AREA

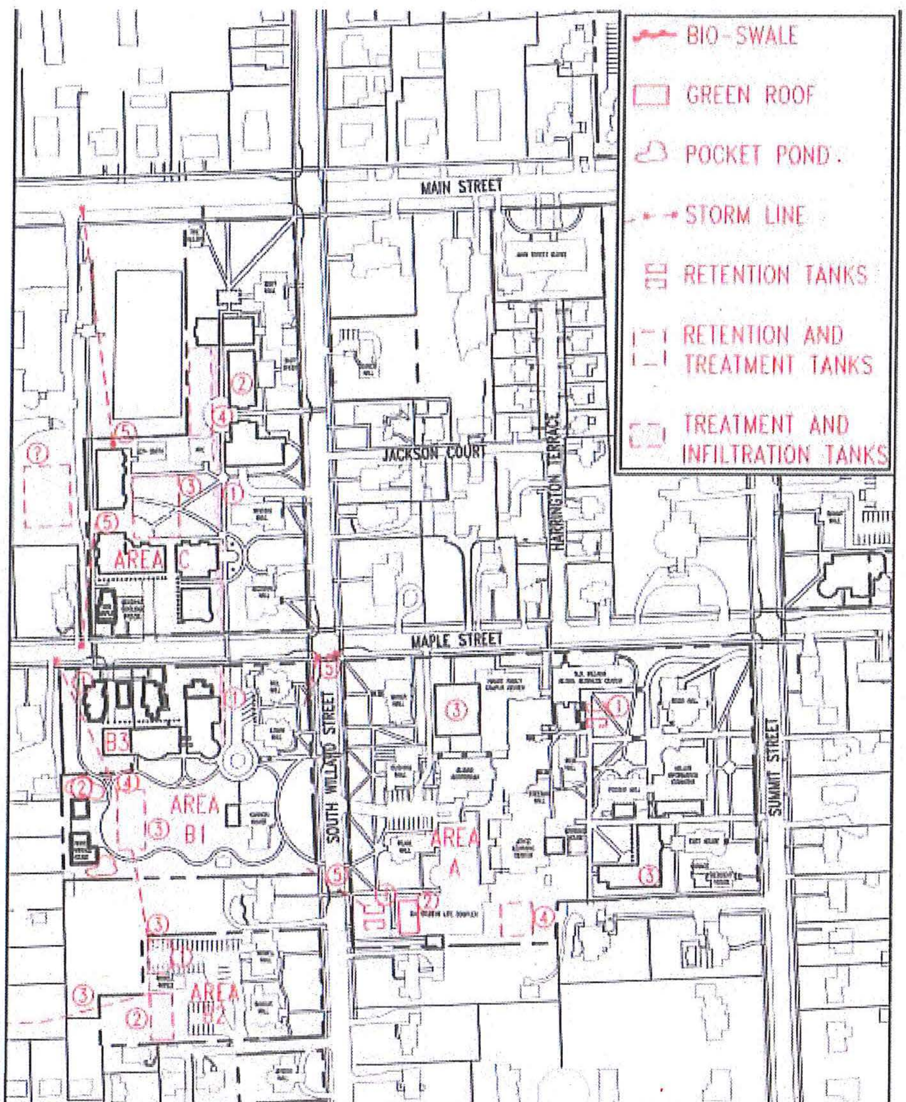


DRY-WELL INFILTRATION

Opportunities by Campus Area:

The following are stormwater improvements highlighted for each campus area, some completed, some stand alone projects and others that would be integral with future building projects. As is the nature of stormwater, many of these improvements are inherently linked to others, such that certain improvements must be made as a pre-requisite before subsequent ones can be made.

Generally speaking, it is recommended that improvements proposed at lower elevations (such as Areas B1 and B2) should be made prior to other related improvements in higher elevations (such as Area A). That being said, more detailed analysis and design may be required for the higher elevation areas to properly design and adequately size the lower elevation improvements.

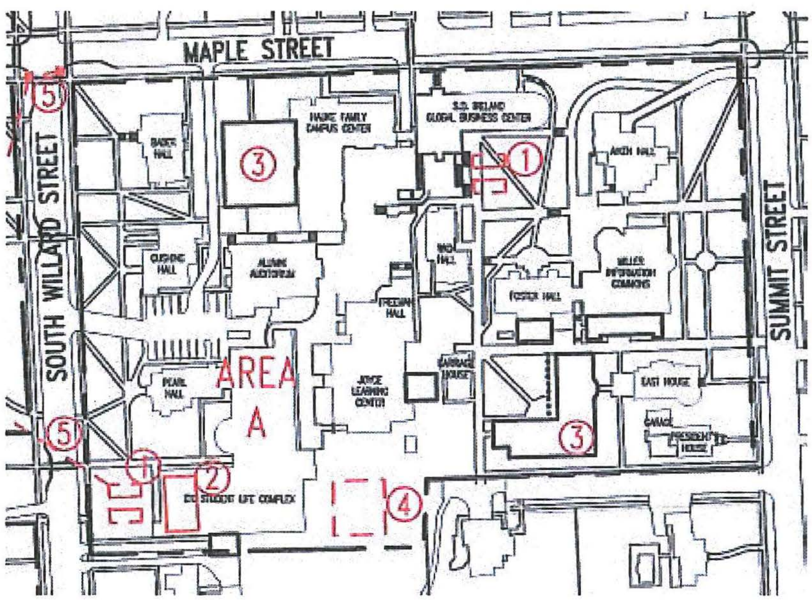


STORMWATER IMPROVEMENTS

<u>AREA A</u> OPPORTUNITIES (Core Campus within S Willard, Maple, Summit)

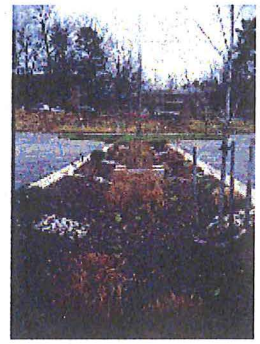
1. Install buried storm water storage tanks (completed)
2. Install green roof on Student Life Center (completed)
3. Replace parking areas with buildings.
4. Create a storm water treatment and/or attenuation area east of the Student Center
5. Disconnect storm water from municipal sewer lines at the corner of Maple and Willard and connect to a new stormwater system in Area B1 by crossing Willard St. (*only after related improvements to Area B1 have been made*).
6. Disconnect storm water from municipal sewer lines in front of the Student Center and connect to a new stormwater system in Area B1 by crossing Willard St. (*only after related improvements to Area B1 have been made*).


GREEN ROOF PLANTINGS



<u>AREA B1</u> OPPORTUNITIES (including Hill, Lyman, Perry, West Halls & Perry Carriage House)

1. Create a bio-swale along the north south pedestrian access.
2. Create a stormwater treatment and/or attenuation area in the lower Perry Lawn
3. Potentially create an infiltration area in the lower Perry Lawn
4. Connect to the municipal combined system on Maple Street by crossing Area B3, potentially pick-up flows from Area A and Area B2 (*only after related improvements to Area B3 have been made*).



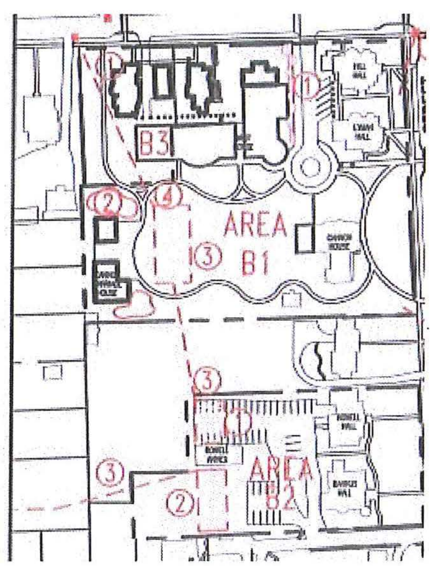
BIO-SWALE

<u>AREA B2</u> OPPORTUNITIES (including Rowell, Bankus Halls and Rowell Annex)

1. Create a stormwater treatment and/or attenuation area below or west of the Rowell Hal Annex parking or in the lawn south of Rowell Hall Annex.
2. Potentially create an infiltration area below the Rowell parking, or south of Rowell Hall.
3. Connect to the municipal combined system on Maple Street or Union Street by obtaining easements and crossing neighboring properties with stormwater piping (*only after related improvements to Area B1 have been made*).

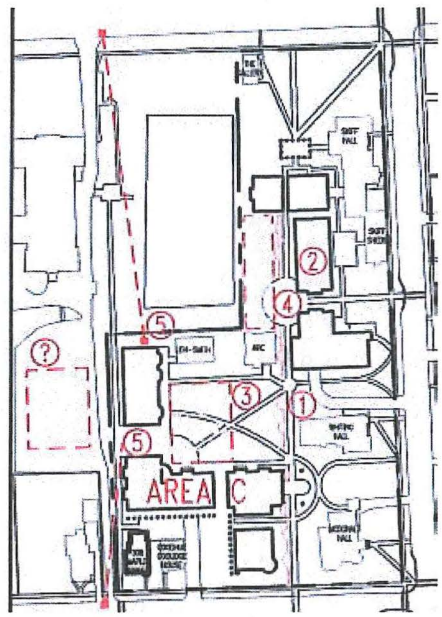
<u>AREA B3</u> OPPORTUNITIES (parcel with existing 2 houses that college intends on acquiring)

1. Discharge stormwater runoff from "upstream" Areas B1, B2 and A through a new connection to the municipal combined system on Maple Street pending further review with Burlington DPW (*note that many of the improvements proposed on areas B1, B2 and A require this or a similar municipal connection (likely via easement) to enact.*



<u>AREA C</u> OPPORTUNITIES (Core Campus West of South Willard, North of Maple)

1. Create a bio-swale along the north south pedestrian access.
2. Replace parking areas with buildings
3. Create a stormwater treatment and/or attenuation area in the proposed Quad.
4. Potentially create an infiltration area east of the proposed buildings, west of Edmunds.
5. Connect to the municipal combined system on Maple Street or Main Street.



OPPORTUNITIES BEYOND THE CAMPUS

Precipitation does not acknowledge property lines when if falls and runs across the land. There are likely many opportunities for the College to work with entities beyond the campus limits to improve stormwater management. A few specifics include:

- Working with the Edmunds School to incorporate a stormwater management system for the parking lot off of Maples Street
- Working with the Fraternity property on Main Street (west of the Main Street Suites regarding stormwater management for the north end of Harrington Terrace
- Coordinating with the City and other larger campuses to create an incentive to separate stormwater from sanitary sewers, and
- Improving stormwater and lake health education in conjunction with the Lake Champlain Basin Program.

III. GENERAL STORM WATER GUIDELINES

General Issues

- Impervious Cover
  - Existing impervious cover = 46%
  - Future impervious cover = 47%
  - Max. allowable impervious cover = 50%

- Known Active Groundwater Locations
  - Sump pumps in basements of several buildings

- Municipal Combined Sewer System with Limited Inlets
  - Concentration and velocity of stormwater flows causes more erosion, carries more sediment
  - Stormwater unnecessarily being treated at municipal wastewater treatment facility, and during storm events, added stormwater results in overflow.

- Reactive Maintenance Policy
  - Stormwater system cleaning is only performed annually, rather than more frequently if necessary
  - Stormwater system maintenance is only performed when a problem is discovered

General Recommendations

- Impervious Cover
  - Do not add significant quantities of impervious area
  - Incorporate green roofs on future buildings
  - Discreetly attenuate flows before discharging runoff from impervious surfaces
    - Currently there are at least two existing groups of below grade storage tanks for attenuation (adjacent to the Ireland Global Business building and below the IDX Student Life building).

- Groundwater
  - Appropriately locate underdrains for buildings, paved areas, and provide water stops in all new utility trenches.
  - Future site development designs should preclude stormwater infiltration systems in areas of high groundwater

- Minimize impacts on municipal combined sewer system
  - Keep storm and sanitary sewer flows separate to edge of property and work with the City and other larger campuses to create incentive for and/or promote separated sanitary sewer and stormwater systems.
  - Where possible, attenuate flows to reduce peak.

- Introduce infiltration practices where appropriate, i.e. where groundwater conditions permit
- Implement stormwater reuse methods such as for irrigation, toilet flushing with separated plumbing systems etc.

- Maintenance
  - Develop and implement a comprehensive Stormwater Maintenance Plan and Maintenance Schedule

FUTURE GUIDELINES

- New Development
  - Buildings should have drip strips.
  - Utility trenches should allow for drainage of trenches or use clay collars.
  - Disconnect impervious surfaces
    - Increases infiltration
    - Decreases runoff
    - Improves water quality
  - Disconnect rooftop runoff

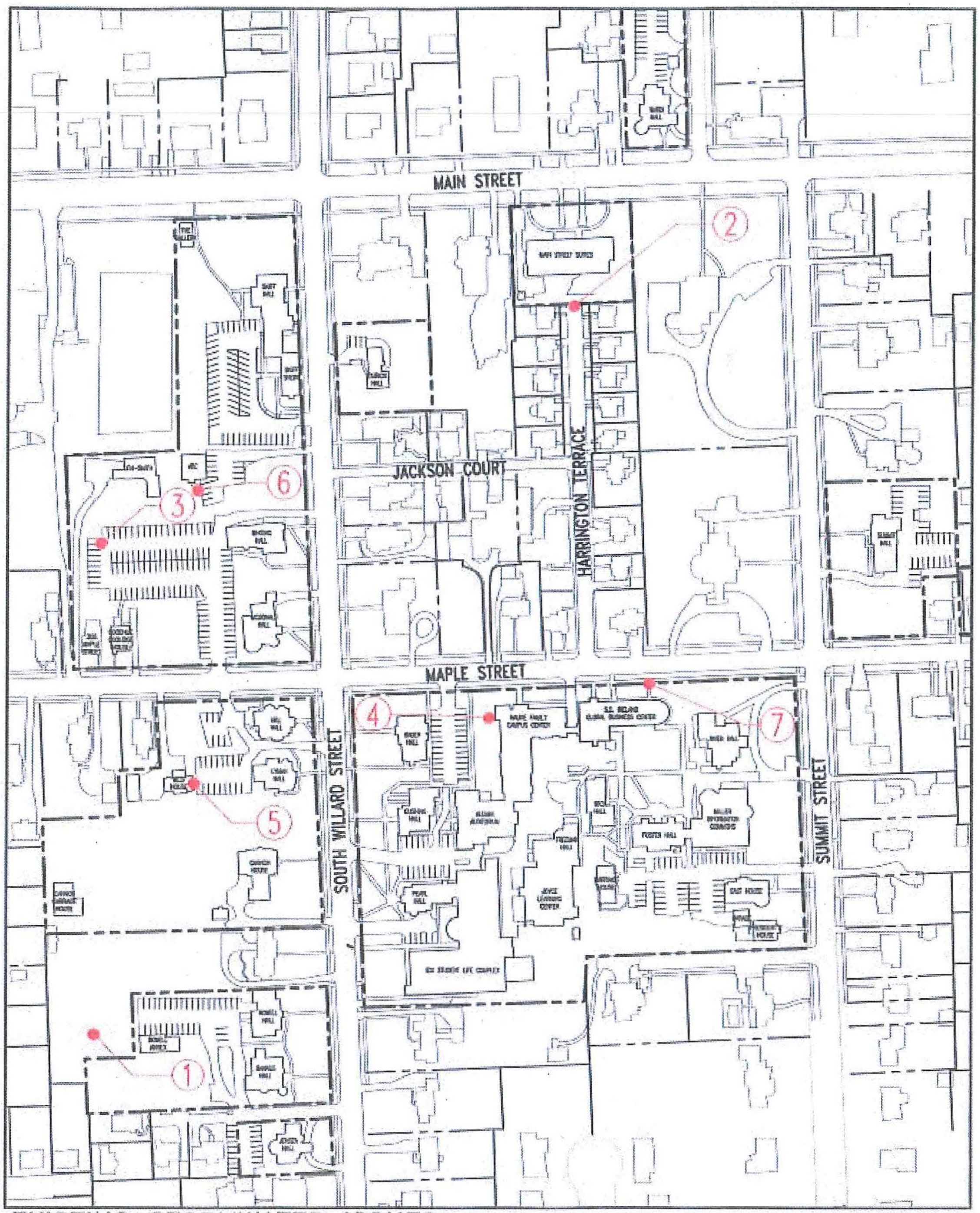
- Redevelopment
  - Replace parking lots with buildings or structured parking
  - Disconnect impervious surfaces

- Low Impact Development (LID)
  - Where possible, follow the recommendations of this stormwater design approach which promotes dispersed and integrated stormwater features that attempt to reproduce natural environment storm water management systems.
  - Disconnect impervious surfaces

IV. SPECIFIC CAMPUS STORMWATER ISSUES

Based on a site walk of the Campus on December 22, 2006, by Lewis Barnes of Champlain College and Kevin Worden and Kristy Blade of Engineering Ventures.

1. Rowell Annex – concentrated flows and erosion from paved areas
2. Main Street Suites – concentrated flows and erosion from Harrington Terrace
3. McDonald Hall/Whiting Hall parking lot – large impervious area, grades, clogged CBs
4. Hauke Family Campus Center – erosion along eaves
5. West House – basement infiltration
6. ARC building – basement infiltration
7. S.D. Ireland Global Business Center – erosion along sidewalks



EXISTING STORMWATER ISSUES

V. STORMWATER PERMITTING SUMMARY

There are two state stormwater-related permits that will likely be needed for any campus development or redevelopment project. It should be noted that state permit requirements and related regulations are periodically updated and the following information is subject to change. Champlain College personnel should verify the current status of state and local stormwater permitting requirements and regulations prior to the commencement of any on-site construction work.

In summary the two state storm water related permits are required for the following conditions:

CONSTRUCTION GENERAL PERMIT 3-9020 :
This permit is required for earth disturbance on the campus with an aggregate area of greater than 1 acre at any given time (multiple projects included).

STORM WATER DISCHARGES FROM NEW AND REDEVELOPMENT – GENERAL PERMIT 3-9015
This permit is required when new or replaced (re-developed) impervious surfaces such as pavement, walks and buildings are proposed such that the total impervious surface on a lot will be greater than one acre. The permit requirements will typically apply to the new or re-developed impervious area, not the pre-existing impervious areas. Small proposed impervious areas less than 5,000sf (referred to as diminimus) do not typically require a permit.

The following detailed summary has been taken from the ANR permitting website (spring 2007).

CONSTRUCTION GENERAL PERMIT 3-9020
This general permit was made effective on September 13, 2006. Coverage under this permit must be obtained for stormwater discharges from construction activities that result in a total land disturbance of equal to or greater than one acre, where those discharges enter waters of the State or a conveyance leading to waters of the State, subject to the conditions set forth in this permit. This coverage includes construction activities when the disturbance is less than one acre, but is part of a larger "common plan of development", if this larger common plan will ultimately result in the disturbance of one or more acres. Permitting requirements vary depending upon the risk factor for the project site.

- Low Risk Construction Activities
  - A project shall not be considered low risk if it will involve disturbance of greater than seven (7) acres at any one time.
  - Projects that qualify as Low Risk are required to implement the applicable practices detailed in the *Low Risk Site Handbook for Erosion Prevention and Sediment Control.* To obtain coverage under General Permit 3-9020 as a Low Risk project, applicants must submit the following to DEC:
    - 1. A completed Notice of Intent form for General Permit 3-9020;
    - 2. A completed Appendix A;
    - 3. The required processing fee.
- Moderate Risk Construction Activities
  - Generally, land disturbance at any one time is limited to five (5) acres.

- Winter Construction Activities require the identification and installation of erosion and sediment control measures for use during the winter season. As defined by ANR, the winter season is October 15th – April 15th.
- Projects that qualify as Moderate Risk are required to implement a site-specific Erosion Prevention and Sediment Control (EPSC) Plan that conforms to *The Vermont Standards and Specifications for Erosion Prevention and Sediment Control.* To obtain coverage under General Permit 3-9020 as a Moderate Risk project, applicants must submit the following to DEC:
  - 1. A completed Notice of Intent form for General Permit 3-9020;
  - 2. A completed Appendix A;
  - 3. A site-specific EPSC Plan;
  - 4. A certification by the plan preparer that the EPSC Plan conforms to *The Vermont Standards and Specifications for Erosion Prevention and Sediment Control;*
  - 5. The required processing fee.

STORMWATER DISCHARGES FROM NEW AND REDEVELOPMENT – GENERAL PERMIT 3-9015

This general permit was made effective as of March 24, 2003. The permitting guidelines below were taken from the 2005 Vermont Stormwater Management Rule.

Coverage is required for the following discharges of regulated stormwater runoff to all Waters of the State of Vermont that are not principally impaired by collected stormwater runoff:

- A discharge from new development equal to or greater than one (1) acre;
- A discharge from the expansion of an existing impervious surface, such that the total resulting impervious surface is equal to or greater than one (1) acre, except that a permit is not required for an expansion that meets the exemption in the Stormwater Management Rule;
- A discharge from the redevelopment of an existing impervious surface if the redeveloped portion of the existing impervious surface is equal to or greater than one (1) acre;
- A discharge from a combination of expansion and redevelopment of an existing impervious surface, such that the total resulting impervious surface is equal to or greater than one (1) acre, except that a permit is not required if the exemptions in the Stormwater Management Rule are met;
- A discharge from any size of impervious surface if the Secretary determines that treatment is necessary to reduce the adverse impacts of the discharge due to the size of the impervious surface, drainage pattern, hydraulic connectivity, installation or modification of drainage or conveyance structures, location of the discharge, existing stormwater treatment, or other factors identified by the Secretary; and
- A discharge from an existing impervious surface of equal to or greater than one (1) acre if the Secretary has previously issued an individual stormwater discharge permit or individual temporary pollution permit for the discharge or has previously granted coverage for the discharge under a stormwater discharge general permit.

No state stormwater discharge permit is required for:

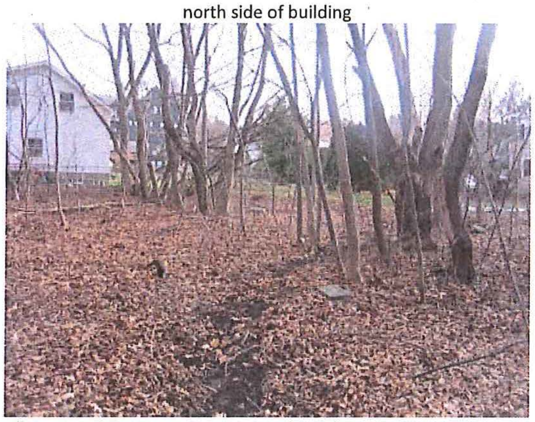
- Discharges of regulated stormwater runoff from new development, redevelopment, or expansion of impervious surfaces if the discharge did not require a stormwater discharge permit prior to the effective date of the Stormwater Management Rule, provided that:
  - A technically complete application for all local, state, and federal permits, except NPDES construction activities permits, related to either the regulation of land use or a discharge to state waters has been submitted as of the effective date of this Stormwater Management Rule, the applicant does not subsequently file an application for permit amendment that would have an adverse impact on water quality, and substantial construction (e.g. construction of roads and drainage infrastructure) of the project commences within two years of July 1, 2005;
  - All local, state, and federal permits, except NPDES construction activities permits, related to either the regulation of land use or a discharge to state waters has been obtained as of the effective date of this Stormwater Management Rule, and substantial construction (e.g. construction of roads and drainage infrastructure) of the project commences within two years of July 1, 2005;
  - No local, state, or federal permit, except NPDES construction activities permits, related to either the regulation of land use or a discharge to state waters is required, and substantial construction (e.g. construction of roads and drainage infrastructure) of the project commences within two years of July 1, 2005; or
  - The new development, redevelopment, or expansion is a linear project, and an order of necessity has been issued or right-of-way acquisition has been substantially completed as of July 1, 2004, and construction of the project commences within five years after July 1, 2004;
- The expansion of an existing impervious surface, such that the total resulting impervious surface is equal to or greater than one (1) acre, if:
  - the increase or addition of impervious surface is less than 5,000 square feet; and
  - the expansion is made to existing impervious surfaces created prior to June 1, 2002; and
  - This exemption may be used for consecutive expansions of an existing impervious surface up to a cumulative total of 5,000 square feet. When the cumulative total expansion exceeds 5,000 square feet, the expanded impervious surface in excess of 5,000 square feet must comply with the treatment standard in the Stormwater Management Rule.
- The redevelopment of an existing impervious surface if the redeveloped portion of the existing impervious surface is less than one (1) acre;
- Discharges of regulated stormwater runoff into a water that is not a stormwater-impaired water from impervious surfaces in existence as of January 1, 1978;
- Discharges of regulated stormwater runoff into a water that is not a stormwater-impaired water from impervious surfaces of less than one (1) acre regardless of when constructed;

VII. APPENDICES

Stormwater Related Campus Photographs

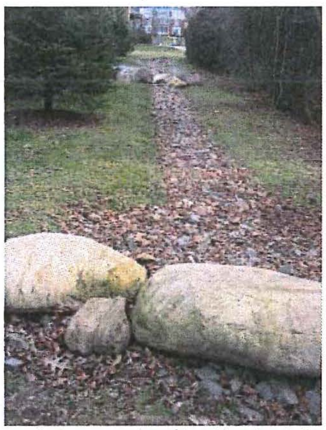
Rowell Annex: Off-site erosion as a result of channeled runoff, from the north side of building

Rowell Annex: Off-site erosion as a result of channeled runoff, combined from north, south



Rowell Annex: Off-site erosion as a result of channeled runoff, from south side of building

Rowell Annex: On site lawn area adjacent to building



Stone drainage swale w/ boulder check dams

Trench drain collecting runoff to discharge into stone drainage swale

Discharge pipe to stone drainage swale

Tower Terrace Entrance (High point of drive is at pedestrian crossing of entrance)

Side yard of Perry Hall (formerly Cannon House): Possible area for storm water attenuation/treatment facility

Driveway behind Hill Hall: Undulations in pavement, artificial low point corner of building

West house (wet basement at times)

Goodhue-Coolidge House (wet basement at times)

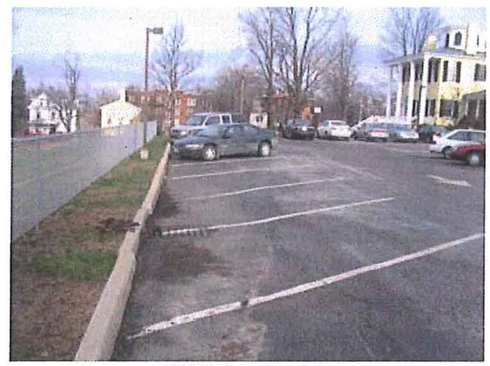
McDonald Hall/Whiting Hall parking lot: Large impervious area w/ no CB's or disconnection of runoff

CB in corner completely buried by leaves and sediment

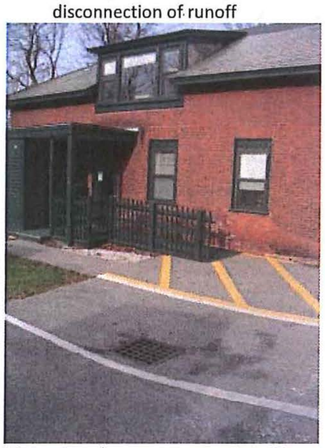
Runoff leaves parking lot (no curb) and continues toward Coolidge House

CB grate filled in with leaves

Adjacent Edmunds School parking lot: Large impervious area w/ no CB's or disconnection of runoff

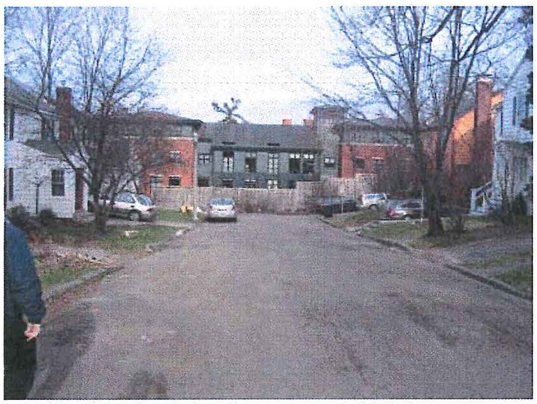


Skiff Hall parking lot



ARC building: CB w/ no apparent outlet; fills up during rain events, water seeps into basement

Skiff Hall parking lot



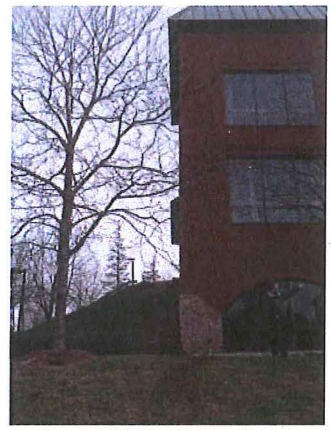
Looking down Harrington Terrace towards Main Street Suites;
Road slopes downhill towards building

Behind Main Street Suites: Paved walkway showing evidence of erosion

Catch basin at end of Harrington Terrace

Break-away fence at end of Harrington Terrace:
Build-up of leaves and sediment pushing up against fence, damaging hinges

Slope beside Hauke Family Campus Center:
Rooftop runoff/foot traffic causing erosion of slope



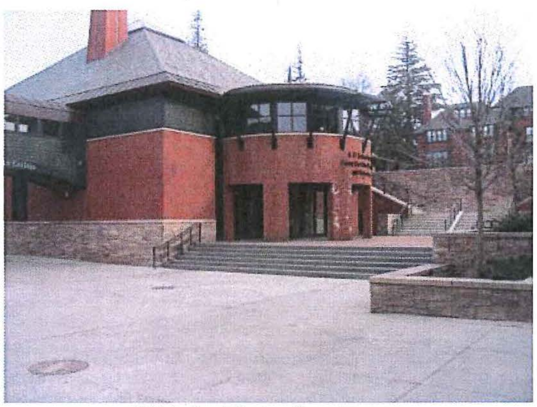
Corner of Hauke Campus Center

Ground area around Hauke Family Campus Center:
Rooftop runoff causing erosion of ground area and sediment build-up

Ground area around Hauke Family Campus Center:
Rooftop runoff causing erosion of ground area and sediment build-up

Terrace behind Bader Hall:
Large impervious area w/ no disconnection of runoff

Behind Joyce Learning Center
Slope erosion due to foot traffic



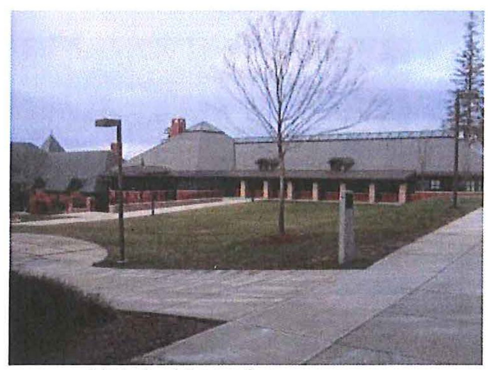
S.D. Ireland Center, from terrace

Stairs behind Freeman Hall
Slope erosion due to foot traffic, uncollected storm water runoff

Area near Carriage House
Poorly graded area

Catch basin near Carriage House, behind Joyce/Freeman
CB in non-functional location

Wick Hall, looking towards S.D. Ireland Center
Site sloping towards SD Ireland Center, Freeman Hall; more foot traffic erosion



S.D. Ireland Center, from campus green

Ground area around/behind Aiken Hall
-sediment build-up around CB, more foot traffic erosion

Yard behind Perry Hall/ Cannon House
-large grass area; possible location for storm water attenuation/treatment area

Entrance walk to S.D. Ireland Center, Maple Street side
-Ties-in high point in city sidewalk causing storm water to flow toward building

Yard behind Perry Hall/Cannon House
-large grassy area; possible location for storm water attenuation/treatment area

SAMPLE STORM WATER MANAGEMENT PLAN GUIDELINES
(Excerpted from the magazine STORMWATER September/October 2005)

- Establish a Stormwater Maintenance Plan
    - Approaches to Maintenance
        - *Reactive maintenance* involves emergency and complaint response. It involves the assumption that damage has already occurred prior to maintenance activity. In the past, many maintenance programs have conducted only reactive maintenance due to funding shortages and lack of a coherently developed public infrastructure program.
        - *Periodic maintenance* involves routine, periodic maintenance activities driven by a predetermined schedule (such as mowing three times in the growing season, cleaning catch basins twice a year, and so on). The success of this type of maintenance depends on having sufficient data and experience to manage the system without inspections or complaints. Periodic maintenance can be very efficient if the data and understanding of the system are good, or it can be inefficient if the cyclic periods do not match the need.
        - *Predictive maintenance* is driven by an inspection report or work order; an inspector periodically checks portions of the drainage system using metrics designed to catch problems before they either become overly expensive to fix (for example, a ditch over 33% full will trigger a cleaning work order) or cause damage to adjacent property. The goal of this type of maintenance is to find the knee in the infrastructure aging curve when repairs are most cost-effective, done by balancing repair frequency and cost against the risk of damage if maintenance is deferred.
        - *Proactive maintenance* is the practice of using study and background research to define the root causes of chronic problems. It might involve changing a development policy, a design standard, an equipment type, or a maintenance procedure. For example, the use of a certain pipe material may be banned after a study shows that it has poor performance or a short life span. This proactive step then saves the local government thousands of dollars in pipe replacement costs. Or an erosion control program may be enhanced to reduce sediment buildup in systems. Proactive maintenance establishes design standards and specifications as an adjunct to levels of service.
    - Life-Cycle Maintenance
        - *Routine maintenance* simply cleans what's there. It can be complaint-, schedule-, inspection-, or research-driven.
            - When the system component is rated excellent" or good" by inventory or inspection information, the maintenance approach is routine maintenance.

- *Remedial maintenance* (often called remedial or minor construction) fixes what's there, restoring it as nearly as possible to its original capacity or condition.
    - When the condition eventually deteriorates to poor," the response is to rehabilitate the system using the remedial maintenance program
- *Capital construction* involves planning, design, and replacement of the system, usually resizing it for current or future conditions or improved design criteria standards.
    - Finally, when the segment deteriorates to an unacceptable" rating, either through physical deterioration or increased demand on the system that renders it undersized, it is placed into the capital improvement program—either as part of a system- or neighborhood-wide plan, or as a priority using pay-as-you-go funding.

- Developing Maintenance Policy
    - *Consider it a priority to develop and articulate consistent maintenance program policies.* Maintenance program policies help ensure the long-term stability of maintenance programs and provide a measure of defense against both legal challenges and outside pressures to perform services not in line with written policy. Decisions about how a stormwater system maintenance program is conducted must be purposefully thought through and defined rather than happen by default. For a maintenance program to be effective, the roles for each responsible party and for each stormwater system component must be clearly defined by the college. Infrastructure falls into disrepair when it is unclear who owns and is responsible for the component parts of the system.

    - *Determine which combination of Extent and Level of Service best suits its capabilities, both physically and financially.* The program must sustain the stormwater infrastructure while staying within the college's resources. The process the college follows is to define and follow an orderly path of transition from an understanding that stormwater is essentially a private responsibility in which the municipality intervenes only in emergency situations to one where stormwater is considered a public infrastructure management program with both public and private responsibility.

    - *Implementation of the maintenance policy starts with identification of critical systems and implementation of a high-priority maintenance program to keep these systems functional or to restore flow capacity.* Through a process of adding information and prioritization based on past history, and/or field inspection and supplemental modeling, certain segments are moved into appropriate categories and priorities.

- *Any new policy will require time to implement, and will change as experience is gained.* The following steps are recommended to help ensure the new maintenance policies are successful and gain public support:

    - Perform an inventory of the drainage system, collecting necessary information for the defined uses of the inventory data. Specific information might include size, type, location, condition, connectivity, ownership, and maintenance category.
    - Place the inventory information into a geographic information system with sufficient programming to allow, at a minimum, for simple queries and searches of the information. Develop an ability to generate maps of areas easily.
    - Over time, define the drainage system, dividing it into the categories contained in the matrix.
    - Implement a work-order system integrating the inventory information as applicable.
    - Ensure that the college has the manpower and equipment and the institutional, legal, and financial resources necessary to fully implement the policies. For example, set inspection schedules in accordance with available resources.
    - Develop written policies for each of the matrix blocks. Ensure they are legal.
    - Train inspectors and maintenance crews in the different responsibilities and how to articulate them to the public.
    - Develop a complaint-response procedure that incorporates the policies.
    - Develop policy brochures to support the maintenance policies. For example, develop a brochure that tells the public what their and the college's responsibilities are for a given drainage system type.
    - Advertise the new policies to the municipality and the public.

WINTER MAINTENANCE RELATED TO STORMWATER

- Winter Maintenance
  - Snow and ice removal from pedestrian ways (i.e. sidewalks and stairs)
    - Currently using NaturaLawn® of America's Natural Alternative® Ice Melt
    - Campus Director of Maintenance should re-evaluate ice melt product being used at least every five years
  - Snow and ice removal from vehicular travel ways (i.e. parking lots and driveways)
    - Currently using Road Salt (sodium chloride), which is considered to be environmentally harmful
    - Alternative products (i.e. Calcium Magnesium Acetate, Potassium Acetate) should be researched by campus maintenance staff for possible campus applications and informational purposes
    - Road salt costs about $40/ton, most common alternatives cost about $600/ton
    - Vermont Water Quality Division's current position on deicing practices is "use less salt"
    - Winter maintenance personnel should be trained in "Sensible Salting"
    - The Salt Institute provides extensive information and training guidelines for proper salt management, which can be found online at www.saltinstitute.org.
    - Campus Director of Maintenance should reevaluate deicing product being used at least every five years.

Stormwater Management Facilities and Permanent Erosion Controls:

1. **Steep Slopes**
   Steep slopes require vegetation and ground cover, including grass, to minimize erosion and to maintain slope stability. The slope should be free of erosion. Erosion may occur when the vegetation and ground cover are sparse or non-existent. Erosion of steep slopes will produce gullies down the slope washing away soil and vegetation that is vital to the stability of the slope.

2. **Grass and Stone Lined Swales**
   Swales convey stormwater to energy dissipaters, headwalls, flared end sections and inlets. Swales should be free of sediment, debris and obstructions (including trash and vegetative debris) in the channel. The channel should be in good shape and free of erosion. It should be evident that runoff has been contained within the channel and that it has not created a new path outside the swale. Grass lined swales should have adequate growth of grass and mown when needed to maintain a height of 4-6 inches. Riprap in stone lined swales should be in good shape and evenly distributed along the channel.

3. **Check Dams**
   Check dams are used in steep swales to help reduce the velocity of the stormwater runoff traveling down the channel. Check dams should be free of sediment, debris and obstructions (including trash and vegetative debris) at the upstream toe. The downstream toe should be in good shape and free of erosion. It should be evident that runoff has been contained within the channel and that it has not created a new path outside the channel around the check dam.

4. **Headwalls and Flared End Sections**
   Headwalls and flared end sections are used at the inlet and outlet of pipe runs. The surrounding area, including the soil to the left, right and top, should be free of erosion. The structure should not be undermined, as to threaten the stability of the structure. It should be evident that runoff has been contained within the channel leading to the structure and not created a new path outside the channel around the structure. The structure opening should be free of sediment, debris and obstructions (including trash and vegetative debris). The structure should be free of large cracks, damage or shifting.

5. **Pipe Runs**
   Drainage pipe conveys stormwater runoff between structures including headwalls, flared end sections, catch basins, outlet structures and manholes. The pipe should be free of sediment, debris and obstructions (including trash and vegetative debris) that could block flow. The pipe should be free of large cracks, damage or shifting (horizontal or vertical).

6. **Emergency Spillways**
   Spillways convey stormwater from ponds to other ponds and energy dissipaters and will typically be lined with riprap. Spillways should be free of sediment, debris and

obstructions (including trash and vegetative debris). The riprap should be in good shape and evenly distributed along the length. The spillway should be structurally sound and free of erosion. It should be evident that runoff has been contained within the spillway and that it has not created a new path outside the spillway.

7. **Pond Slopes**
The pond slopes provide the extended detention of stormwater runoff. The pond slopes should be free of debris and obstructions (including trash and vegetative debris). The pond slopes should be free of water or wet spots.

8. **Outlet Structures**
Outlet structures are used to control water exiting the stormwater treatment ponds. The area surrounding the cover should be free of erosion. The structure should be free of sediment in the sump and free of debris and obstructions (including trash and vegetative debris) that could block the low flow orifice or overflow weir. The structure should be free of large cracks, damage or shifting.

9. **Embankments**
Embankments are manmade earthen berms that are used to create stormwater treatment ponds. Embankments require vegetation and ground cover, including grass, to minimize erosion and to maintain slope stability. The embankment should be free of erosion. Erosion may occur when the vegetation and ground cover are sparse or non-existent. Erosion of will produce gullies down the slope washing away soil and vegetation that is vital to the stability of the slope. The embankment should be free of animal burrows as well as leaks or seeping. It is vital that the embankment remain structurally sound and free of cracking, bulging or sliding at the upstream and downstream toe.

CHAMPLAIN COLLEGE
STORMWATER OPERATIONS AND MAINTENANCE
INSPECTION CHECKLIST

Date: ________________
Time: ________________
Inspector: ________________
Reason: ________________

Maintenance Item	Satisfactory (Y or N)	Comment	Action Taken (if "N")

1. **Steep Slopes**
   a. Vegetation and ground cover ☐ ________________
   b. Slope is free of erosion ☐ ________________
   c. Jute mesh is in good condition ☐ ________________
   d. Silt fencing is free of silt and in good working condition ☐ ________________

2. **Grass/Stone Lined Swales**
   a. Clean of sediment and debris ☐ ________________
   b. Channel is free of erosion ☐ ________________
   c. Flow has been contained within the channel ☐ ________________
   d. Rip-rap in good condition ☐ ________________
   e. Mowing done when needed ☐ ________________

3. **Check Dams**
   a. Clean of Sediment and debris ☐ ________________
   b. Downstream toe free of erosion ☐ ________________
   c. Flow has not gone around the check dam ☐ ________________

4. **Headwalls/Flared End Sections**
   a. Flow has not gone around the structure ☐ ________________

a. Surrounding area is free of erosion ☐ ______________________

b. There is no undermining of the structure ☐ ______________________

c. Inlet/Outlet free of sediment and debris ☐ ______________________

d. Structure free of large cracks, damage or shifting ☐ ______________________

5. **Pipe Runs**
   a. Pipe is free of sediment and debris ☐ ______________________

   b. Structure free of large cracks, damage or shifting ☐ ______________________

6. **Principal/Emergency Spillways**
   a. Spillway is free of erosion ☐ ______________________

   b. Flow has not gone around the spillway ☐ ______________________

   c. Spillway and riprap are in good condition and free of debris and obstructions ☐ ______________________

7. **Pond Slopes**
   a. Pond slopes free of debris and sediment ☐ ______________________

   b. Pond slopes free of standing water or wet spots ☐ ______________________

8. **Outlet Structures**
   a. The structure is free of sediment and debris ☐ ______________________