Town of Colchester

Permit Application for:

General Permit 3-9014
National Pollutant Discharge Elimination System (NPDES)
Number: VTR040000

For:

Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (MS4's)

Submitted to:

Vermont Agency of Natural Resources
Department of Environmental Conservation
Watershed Management Division
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Montpelier, Vermont 05620-3522

Submitted by:

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Date Submitted:

May 24, 2013

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Storm Water Management Program

The following represents the Town of Colchester's Storm Water Management Program, (SWMP) as required by the State of Vermont, Agency of Natural Resources, Department of Environmental Conservation, National Pollutant Discharge Elimination System, (NPDES), General Permit 3-9014 (2012) for Storm Water discharges from Small Municipal Separate Storm Sewer Systems. The SWMP contains measurable goals for the development and implementation of the six minimum measures described in Subparts IV.F and G of the permit, and additional measures necessary to protect water quality described in Part IV of the permit.

WATER QUALITY BASED REQUIREMENTS

Pursuant to Clean Water Act 402(p)(3)(B)(iii), the permit includes provisions which require the permittee to reduce the discharge of pollutants to the maximum extent practicable, protect water quality, and to satisfy the Clean Water Act.

REQUIREMENTS TO MEET WATER QUALITY STANDARDS

Discharges shall not cause or contribute to an exceedance of applicable water quality standards for the receiving water. Applicable water quality standards are the Vermont Water Quality Standards that are in place upon the effective date of the permit.

Except for discharges addressed by part IV.C.1 of the permit, if at any time the Town becomes aware that a discharge causes or contributes to an exceedance of applicable water quality standards, the Town shall within 60 days of becoming aware of the situation eliminate the conditions causing or contributing to the exceedance of water quality standards. If elimination within 60 days is infeasible the Town shall document in its SWMP measures and anticipated timeframes to eliminate the conditions causing or contributing to the exceedance. Within 30 days of eliminating the condition, the Town shall document the measures used to correct the condition in the SWMP. The Town shall include in its annual report a description of any such discharges identified during the reporting period; a description of measures taken to eliminate conditions during the reporting period or the basis of a finding that elimination is infeasible; and a timeframe for completion of all steps necessary to eliminate such discharges. The Town shall comply with any additional requirements or schedules established by the Secretary, including any requirements to submit additional information concerning the potential cause of the exceedance.

DISCHARGES TO IMPAIRED WATERS

The Vermont Agency of Natural Resources has identified both the Morehouse and Sunderland Watersheds as being impaired by storm water. The Town of Colchester intends to achieve compliance through the implementation of the Storm Water Management Plan, (SWMP) contained on the following pages, to include specific actions outlined within the six minimum control measures.

The Vermont Agency of Natural Resources considers several of the unnamed tributaries into Malletts Bay, as well as Smith Hollow Brook and Crooked Creek to be impaired by e-coli based upon the Town's past monitoring efforts. To minimize this pollutant, the Town's SWMP contains several strategies aimed at controlling e-coli contamination. These strategies include controlling sediment through the implementation of Construction Site Storm Water Runoff Controls, and Post-Construction Storm Water Management in New Development and Redevelopment. The plan also works toward the control of illicit discharges through the implementation of the Town's Illicit Discharge Detection and Elimination Program. The Town also intends to continue existing programs associated with animal control to facilitate the removal of dead animals from the roadway system, and, programs to minimize dog waste in Town parks and along multi-use paths. The Town will also continue its Water Quality Monitoring Program which has been in existence now for almost two decades, to continue improving the Town's understanding of e-coli contamination in Malletts Bay. These efforts have been supplemented by a Microbial Source Tracking Program completed as part of the Town's Integrated Water Resources Management Plan.

DISCHARGES TO IMPAIRED WATERS WITH AN APPROVED TMDL

Flow Restoration Plans - The Town shall develop and submit a comprehensive Flow Restoration Plan (FRP) for the impaired portions of the Sunderland and Morehouse Brook watersheds within the Town's boundaries. It is the Town's intention to partner with the Town and Village of Essex for the Sunderland Brook Watershed, and the City of Winooski for the Morehouse Brook Watershed. The Town shall submit the FRP's to the Secretary no later than three years after the date of issuance of an authorization to discharge to the Town under this permit. The FRP shall contain the following;

- An identification of the suite of necessary storm water BMP's that will be used to achieve the flow restoration targets.
- A design and construction schedule for the storm water BMP's that has been identified as necessary to achieve the flow restoration targets.
- A financing plan that estimates the cost of implementing the FRP.

- A regulatory analysis that identifies and describes what, if any, additional regulatory authorities will be needed to implement the FRP.
- An identification of regulatory assistance that will be needed to implement the FRP.
- An identification of any third party that is responsible for implementation of the FRP.

Plan to Address Expired Permits – Within six months following the date of issuance of an authorization to discharge, the Town shall submit a plan for addressing expired state permits discharging to the MS4 system to ensure that all permitted facilities demonstrate compliance with the existing expired permit.

Landowner Technical Assistance – Two years after the issuance of an authorization, the Town shall develop a program to identify opportunities for and provide technical assistance to landowners in the implementation by landowners of low impact BMP's. Working through the Town's Conservation Commission, a Do-It-Yourself Rain Barrel Workshop was conducted in April of 2012. In addition to building their own rain barrels for home use, the 19 participants received information on how rain barrels help conserve water, save money and protect waterways. The materials, including the rain barrels were purchased and delivered to the site by the Public Works Department, where the Town's Conservation Commission conducts the necessary training and guidance. Similar efforts are currently taking place in 2013 and the Public Works Department expects to continue this partnership with the Conservation Commission to provide landowners with technical assistance for low impact BMP's.

Protection and Regulation of Development in Stream Corridors – The Town has previously developed and submitted a plan to the VANR outlining options for enhanced protection of stream corridors of storm water impaired waters. The plan includes a map of stream corridors depicting areas that have been converted to impervious surface and areas that are undeveloped or have not been converted to impervious surface, (updated for this application), a Stream Corridor Buffer Ordinance and other applicable Zoning Regulations, and the development and adoption of Storm Water Control Ordinances. The preparation of the plan was developed after review of the riparian buffer and stream fluvial geomorphological information provided by the VANR as a result of the Agency's preparation of TMDL's as set forth in 10 V.S.A § 1264 (f)(3).

Flow and Precipitation Monitoring Program – The Town shall implement or otherwise fund a flow and precipitation monitoring program, subject to approval by the Secretary, within its watersheds impaired by storm water.

Six Minimum Control Measures – The Town has developed a SWMP which contains the required Six Minimum Control Measures to reduce pollutants to the Maximum Extent Practical.

DISCHARGES TO IMPAIRED WATERS WITHOUT AN APPROVED TMDL

Erosion Controls - Within the Town's SWMP, erosion controls have been adopted. Past efforts have included the design and construction of a storm water outfall treatment structure which collects sediment before storm water is discharged to Malletts Bay, two large river bank stabilization projects on the lower Winooski River located at the Heineberg Access off Heineberg Drive, and along River Road in Colchester, and eight storm water outfall upgrade projects located in the Indian Brook, Colchester Pond Brook, Winooski River, Inner Malletts Bay and Sunderland Watersheds. In 2009, a large storm water outfall project was constructed in Fort Ethan Allen within the Sunderland Watershed.

Gravel Road Maintenance - Although Colchester's limited gravel road system represents only about 25% of the state average, the Town has taken several steps to minimize the runoff from this portion of the transportation system. The Town has developed an alternative methodology to perform Traffic and Engineering studies on gravel roads for the establishment of speed limits. This allows the Town to post speed limits that do not exceed 35 mph along gravel roads, which in turn, significantly reduces the degradation of the gravel surface. Our equipment operators continue to receive regular training on the proper grading of gravel roads which allows less gravel to be applied to the roadways, and minimizes the amount of gravel that enters roadside ditches. The technical specifications of the Town's equipment have been revised to facilitate these proper grading procedures. The Town has also completed several erosion control projects along gravel roads to reinforce roadside ditches to minimize erosion of the ditch lines and the edge of the roadways during periods of high runoff. As a part of new development, the Town's design review process includes assessing the adequacy of storm water culverts, both public and private to avoid flood damage due to high runoff. The Town also cleans roadside ditches of debris and buildup on an as needed basis to ensure that blockages do not result in washouts within the drainage system. Finally, the Town's gravel road system serves primarily agricultural areas, where the Town has taken deliberate steps to preserve this land use, which generally prevents high density development within these areas.

Riparian Buffers - Several years ago, the Town of Colchester developed and adopted a stream bank protection ordinance. Generally, the ordinance does not allow development within 85 feet of major streams and tributaries throughout the community. Supplemental information for this ordinance has been developed and submitted to the ANR. The Town has also developed a Street Tree Master Plan which is aimed at re-establishing the community's urban forest. All new development in Colchester is required to submit for review and approval, a vegetation and landscape plan.

Impervious Surface Minimization - The Town has adopted revisions to its Technical Roadway Standards. The revised standards allow for most roadways to be constructed at a narrower width, and as well, allow increased options for open drainage systems to promote pre-treatment of storm water runoff. New standards have been developed to support High Density Mixed-Use Development, which requires that pedestrian areas contain a minimum of 25% green space. The Town has also revised its Zoning Regulations reducing the allowable impervious surfaces in front yards from 50% to 30%.

Six Minimum Control Measures – The Town has developed a SWMP which contains the required Six Minimum Control Measures to reduce pollutants to the Maximum Extent Practical.

MINIMUM CONTROL MEASURES

Public Education and Outreach on Storm Water Impacts

BMP 1-1 *Maintain Storm Water Web Site* - The Town of Colchester has developed a storm water website which contains local storm water information. The Department's site will be updated as needed to include general, as well as locally relevant information relating to storm water and water quality. The Town's web site is located at www.colchestervt.gov.

BMP 1-2,3,4 *Participate in RSEP* - The Town of Colchester will continue to participate in the regional storm water education and outreach strategy described in the 2013 Memorandum of Understanding between designated MS4's, and the Chittenden County Regional Planning Commission. A copy of this MOU associated with this regional initiative is contained within the appendix of this application.

Public Involvement and Participation

BMP 2-4 *Catch Basin Stenciling* - The Town has formed a partnership with both the Boy Scouts and Cub Scouts in Colchester. Building on the Boy Scouts of America, "Leave No Trace" program, the partnership intends to work toward annual stenciling of the Town's storm water basins as part of their regular and ongoing curriculum. While stenciling is being done in each neighborhood, other scouts focus on distributing educational materials regarding their efforts as well as other storm water related issues. These materials also serve to direct citizens to the

RSEP web site for further information. The Town provides all materials including program training for the scouts. Training materials have included products from RSEP as well as a stenciling training video developed by the Colchester Public Works Department. This video may be viewed on the storm water page of the department's web site. Select; "Education" and then; "Catch Basin Stenciling". The goal is to develop a long-term relationship of public involvement and participation, and more importantly, involve younger citizens to more effectively create an improved and sustainable understanding of storm water related issues within our community. During the summer of 2012, the Scouts stenciled a total of 243 catch basins throughout the community, which represents approximately 13% of the total structures.

BMP 2-5 *Community Stream Corridor Cleanup* – As a part of the Town's Green Up Day activities, the Town works with its Conservation Commission to specifically target its cleanup efforts toward high priority areas. These high priority areas include a total of 25 significant stream crossings of the Town's transportation system. The Town intends to continue supporting and coordinating these significant public involvement initiatives.

BMP 2-6 *Storm Water Watch Groups* – The Town has previously identified and mapped all eleven sub-watersheds within Colchester. This past summer, the services of three additional community volunteers were secured to serve on our watershed watch groups. This brings the total number of volunteers serving in this capacity to fifteen. The volunteers live in a total of eleven different sub-watersheds, resulting in 100% coverage. Initial educational materials were provided to each of the volunteers to help them understand the types of conditions that can contribute to water quality problems. Information is periodically sent to them on an as needed basis. Future efforts will include the continuing support of this citizen network.

Rationale

The Best Management Practices, (BMP's) identified under this minimum control measure are aimed primarily at improving total species numbers and species density in receiving waters through the reduction of toxins in storm water runoff.

Other alternative BMP's that were considered, yet not adopted under this minimum control measure include a citizen storm water advisory panel, a water quality monitoring program involving citizen volunteers, an on-going public workshop series on storm water awareness, and an "adopt a stream" program. It is anticipated that the selected BMP's will involve a larger percentage of the public then a Citizen Water Advisory Panel. Although the Town does have a long standing water quality monitoring program, it would likely be difficult to locate available volunteers considering the scheduling requirements of such a program. On-going public

workshops would not likely attract significant numbers of residents, or a diverse audience. An "adopt a stream" program presents too many organizational and logistical challenges whereby simpler BMP's would be equally as effective.

The BMP's for this measure are designed to reach and involve a diverse cross section of the community's residents. Included are young children as well as adults, home owners, business owners and professionals.

Implementation of the selected BMP's will require a behavioral change within the community which could be characterized by an improved level of awareness of what storm water pollution is, and how it occurs. It will also require an increased desire by citizens to become actively involved in the solution of storm water pollution.

The expected water quality outcomes under this minimum control measure are improvements in total species numbers and species density within receiving waters through the reduction of toxins in storm water runoff.

Illicit Discharge Detection and Elimination

BMP 3-1 *Develop and enforce a program to detect and eliminate illicit discharges* – The Town has previously developed a program to detect and eliminate illicit discharges. The program elements include the development and maintenance of a GIS map of the storm sewer system, the development of an illicit discharge ordinance, an illicit discharge detection plan, a public informational component, a mechanism to address specific categories of illicit discharges if necessary, and an annual reporting process.

BMP 3-2 *Develop and maintain a storm sewer GIS or AutoCAD map* – This activity will be an ongoing process for the Town as additional development and associated storm water infrastructure is added. To maintain this data base, a three tiered approach has been developed to document 1) existing storm water infrastructure, 2) additional storm water infrastructure added through the Town's maintenance efforts and/or capital improvement projects, and 3) additional storm water infrastructure associated with new development.

Existing Storm Water Infrastructure - The Town has been the recipient of a $1.5 million EPA Demonstration Grant. One of the many activities contained within the scope of work is a comprehensive update of the Town's storm water system mapping. This work is now completed and can be viewed on the Town's project website at www.colchesterwaters.net.

Future Town Installed Storm Water Infrastructure – As a part of the previously listed EPA Demonstration Grant, the Department of Public Works has purchased a GIS based Asset Management Program including GPS data collection equipment. This will allow the Town to electronically update its infrastructure mapping as new infrastructure is installed or altered.

Future Developer Installed Storm Water Infrastructure - The Town has approved amendments to its sub-division regulations to require that developers provide the Town with as-built information associated with new development, in digital form.

BMP 3-3 *Develop and implement an Illicit Discharge Ordinance* – The Town has developed and implemented an Illicit Discharge Ordinance. The ordinance regulates the contribution of pollutants to the MS4 from storm water discharges by any user, prohibits illicit connections and discharges to the MS4, and establishes legal authority to carry out the IDDE Plan, including conducting inspections, monitoring, and enforcement procedures to ensure compliance with the ordinance. The ordinance was adopted by the Colchester Select Board on July 26, 2005.

BMP 3-4 *Develop and implement an illicit discharge detection plan, focus on impaired waters and random dumping* – The Town developed a IDDE Plan in 2008 containing the following sections;

Sec. 1.0 Introduction
Sec. 2.0 Illicit Discharges Defined
Sec. 3.0 Additional Exemptions
Sec. 4.0 Illicit Discharge Ordinance
Sec. 5.0 Development of Storm Sewer Map
Sec. 6.0 Locating Priority Areas
Sec. 7.0 Tracing the Source of an Illicit Discharge
Sec. 8.0 Removing the source of an Illicit Discharge
Sec. 9.0 Evaluation of the IDDE Program
Sec. 10.0 Outreach to Employees, Businesses, and the General Public
Sec. 11.0 BMP's and Measurable Goals

BMP 3-5 *Inform public of illicit discharge and disposal hazards* – Section 10.0 of the Town's IDDE plan outlines the Town's efforts to address this requirement. On an annual basis, the Town's maintenance employees receive training relating to Pollution Prevention/Good Housekeeping for Municipal Operations as part of the Town's Phase II plan. The Department of Public Works has developed an informational brochure designed for local businesses to improve their understanding of illicit discharges. The Public Works Department has partnered

with the Boy Scouts on an annual storm water stenciling program. The Town is a member of RSEP, which provides informational campaigns targeted at the general public covering a wide variety of storm water issues. The Town maintains its own storm water web site providing additional storm water education materials to the community. The Town has also created a citizen storm water watch group in several watersheds throughout the community.

BMP 3-6 *Address specific categories of Illicit Discharges, if necessary* – The Town has not found the list of non-storm water discharges contained in the permit to be a significant contributor of pollutants to the MS4, and therefore have not addressed these categories within the IDDE plan.

BMP 3-7 *Prepare annual report of monitoring and corrective actions taken* - The Town has established files to maintain all documents relating to the management of illicit discharges. A complaint system has also been established to receive citizen complaints through a storm water hotline. The hotline is posted on the Town's web site. Annual monitoring of pre-selected outfalls as outlined in the Town's IDDE plan are performed and reported in the Town's annual report to the DEC. When illicit discharges are detected through this program, or come to be known by the Town through other means, the Town takes the appropriate steps to address them under the authority of local ordinances.

Rationale

The BMP's identified under this minimum control measure are aimed primarily at improving total species numbers and species density in receiving waters through the reduction of toxins in storm water runoff.

There were no major alternative BMP's examined under this minimum control measure.

The implementation of this measure will require the support of both the community and its legislative body to support the enforcement of a local ordinance to regulate and prohibit illicit discharges.

The expected water quality outcomes under this minimum control measure are improvements in total species numbers and species density within receiving waters through the reduction of toxins in storm water runoff.

Construction Site Storm Water Runoff Control

BMP 4-1 *Develop and implement procedures to ensure MS4 construction activities are properly permitted.* - The Town will continue to perform plan review of all projects involving land disturbance as a part of the site plan review process and the issuance of building permits. All land disturbances will require a permit from the Town. All permits issued from the Planning and Zoning Office are evaluated by staff, either as an Administrative Review, or through the Town's Development Review Process. Through the permit application process, a determination will be made by the Planning and Zoning Office regarding the total area of land disturbance. This office will determine whether the one-acre and five-acre state regulatory thresholds are met, and report such activities to the Secretary of the Agency of Natural Resources to assure all such projects are properly permitted.

BMP 4-2 *Review existing MS4 regulations for effectiveness in managing construction related E & S and consistency with state construction permits* - The Town relies upon the technical specifications within the Public Works Ordinance and the Town's Storm Water Ordinance as the mechanism to require erosion and sediment controls at construction sites. The language within these documents works to ensure effectiveness in managing construction related erosion and sediment and other wastes generated from construction activities that may cause adverse impacts to water quality. These documents also ensure consistency with the requirements of the Secretary's general permits for storm water runoff from large and small construction sites. The erosion control requirements within these documents apply to all land disturbances requiring a permit as required in the Town's Zoning Regulations. Currently, all land disturbances require a permit. Inspection responsibilities for all such permits issued are assigned to the Town's inspectors. Any local violations would be noticed by the inspectors, with enforcement action, if necessary, taken by the Town of Colchester based upon the construction site erosion control requirements within the Town's Public Works and Storm Water Ordinances. The Town will endeavor to inspect all construction sites as often as possible, with emphasis on larger projects, and those projects that are located in areas where run off to receiving waters is more likely. Inspections will also be targeted at phases of the construction that may be more susceptible to problems relating to construction site run off. During regular inspections, Town inspectors will inspect for obvious signs of non-compliance such as eroding soils and turbid waters on state permitted projects. Town inspectors will report any suspected violations on these projects to the Vermont Agency of Natural Resources.

BMP 4-2a *Adopt E & S requirements that are at least as stringent as state requirements* – The Town has developed a storm water ordinance which contains a section on construction erosion control requirements that is at least as stringent as state requirements.

BMP 4-3 *Develop and implement an erosion control ordinance that regulates development not subject to state permitting* – The Town has developed a storm water ordinance which contains a section on construction erosion control requirements that effectively regulates development activities that are not subject to state or federal erosion control requirements.

Rationale

The BMP's identified under this minimum control measure are aimed primarily at improving the nutrient index within receiving waters by reducing the discharge of phosphorous and nitrogen, improving clean water species counts by reducing storm water runoff volume during construction before storm water controls are completed, and improving total number of species and species density by reducing the discharge of sediment and toxins that are generated by construction activities.

There were no major alternative BMP's under this minimum control measure.

The implementation of this measure will require the support of both the community and its legislative body to support the enforcement of local ordinances to regulate run off from construction sites.

The expected water quality outcomes under this minimum control measure are improvements in the nutrient index, clean water species, total species numbers, and species density within receiving waters through the reduction of phosphorus, nitrogen, sediment and toxins in storm water runoff.

Post-Construction Storm Water Management in New Development and Redevelopment.

BMP 5-1 *Review existing MS4 regulations for effectiveness in managing storm water runoff and consistency with state operational permits* - The Town performs plan review of all projects involving land disturbance as a part of the site plan review process and the issuance of building permits. All permit conditions associated with projects involving land disturbance are included in the approved Findings of Fact and Order approved by the Development Review Board. This document becomes the instrument for enforcing the Board's approval.

The Town relies upon the technical specifications within the Public Works Ordinances and the Town's Storm Water Ordinances as the mechanism to address post-construction runoff from new development and redevelopment that result in a land disturbance of greater than one acre and that have less than one acre of impervious surface. The Ordinances contain a combination of structural and non-structural BMP's which are appropriate for the community and consistent with the Agency's 2002 Vermont State Storm Water Management Manual (and any amendments thereto). Additionally, the Ordinances ensure consistency with the requirements of the Secretary's general permits regulating storm water runoff from new development and redevelopment projects that have one or more acres of impervious surface. These post-construction storm water controls and requirements apply to all land disturbances requiring a permit as required in the Town's Zoning Regulations.

BMP 5-1a *Assess changes to regulations to support LID* – The Town has taken several steps in support of Low Impact Development. These include the design of parking lots, roadways, the development of stream bank buffer ordinances, homeowner educational efforts through RSEP, as well as offering and/or coordinating public workshops associated with the use and construction of rain barrels, rain gardens and other LID strategies. The Town will continue to assess other opportunities to promote Low Impact Development.

BMP 5-1b *Assess changes to regulations to minimize impervious surfaces through street & parking design* – The Town has made significant revisions to its technical specifications for public infrastructure allowing significantly reduced roadway widths for smaller scale development, as well as allowing the option of open drainage plans to promote improved treatment of storm water runoff. Within the Town's Zoning Regulations, the Town requires the design and construction of parking areas to promote storm water management through the use of trees, vegetation and storm water filtration areas all intended to reduce the amount of impervious services and improve overall storm water treatment. The Town will continue to assess other improvements to these and other regulations to determine whether additional improvements can be made.

BMP 5-1c *Adopt requirements that are at least as stringent as state requirements* – Through the Town's Public Infrastructure Ordinances, Storm Water Ordinances, Sub-division Regulations and Zoning Ordinances, the Town's requirements related to Post Construction Runoff Control are at least as stringent as state requirements.

BMP 5-2 *Develop and implement procedures to identify development* – The Town's Zoning Regulations require all ground disturbing activities to obtain a permit. Through the review of permit applications, the Planning and Zoning Office identifies and records the area of land disturbance and imperious surfaces for all projects requiring local permits. This information is reported to the State each year as a part of the MS4 Annual Report.

BMP 5-3 *Develop and implement an ordinance that regulates development* – The Town has developed a storm water ordinance that regulates post construction runoff controls for new development or redevelopment projects that disturb greater than or equal to one acre that are part of a larger common plan of development or sale and may not be subject to regulation under the Agency's post-construction storm water management permit program.

BMP 5-4 *Develop and implement inspection procedures for development* - The Town utilizes multiple mechanisms to accomplish reasonable and effective site inspection and enforcement of control measures for projects falling under both local and state jurisdiction. These include the following:

- The Town's full time Building Inspector position spends the majority of its time in the field inspecting new construction or re-construction in progress. Traveling to inspections throughout all areas of the community allows this position to make observations of storm water problems throughout the community.

- The Town's full time Life Safety Inspector position also spends the majority of its time in the field. This position performs several functions that result in extensive travel and observation throughout the community. These duties include post construction inspection of all new development or re-development to ensure compliance to all applicable fire codes, annual health and safety inspections of all rental housing units, and regular inspection of all on-site wastewater systems.

- The Town's Highway Division spends virtually all of its time on the Town's transportation system traveling throughout the community, which involves in many cases, performing maintenance on the public storm water system.

- As a part of this SWMP, the Town has organized Storm Water Watch Groups that provide the opportunity for substantial observation and feedback regarding storm water controls throughout the community.

- Also as a part of this SWMP, the Town has implemented a regular inspection program for storm water outfalls throughout the MS4 designated area. Considering that ultimately all storm water drains to these outfalls, this creates the opportunity to identify up stream storm water control problems that can be traced, identified and addressed appropriately.

In each case, these activities provide multiple opportunities for the Town to observe and react to storm water control problems for both new development and re-development, and report the observations to the appropriate jurisdiction.

BMP 5-5 *Develop and implement procedures to ensure MS4 development activities are properly permitted.* - The Town will continue to perform plan review of all projects involving land disturbance as a part of the site plan review process and the issuance of building permits. All land disturbances will require a permit from the Town. All permits issued from the Planning and Zoning Office are evaluated by staff, either as an Administrative Review, or through the Town's Development Review Process. Through the permit application process, a determination will be made by the Planning and Zoning Office regarding the total area of land disturbance. This office will determine whether the one-acre and five-acre state regulatory thresholds are met, and report such activities to the Secretary of the Agency of Natural Resources to assure all such projects are properly permitted.

Rationale

The BMP's identified under this minimum control measure are aimed primarily at improving clean water species counts by reducing or attenuating storm water runoff volume and by reducing the effects of storm water scouring and flooding.

There were no major alternative BMP's under this minimum control measure.

The implementation of this measure will require the support of both the community and its legislative body to support the enforcement of local ordinances to regulate post-construction storm water runoff.

The expected water quality outcomes under this minimum control measure are improvements to the clean water species by reducing or attenuating storm water runoff volume and by reducing the effects of storm water scouring and flooding.

The regulatory mechanisms used by the Town to address post-construction runoff from new development and re-development include the Public Works Specification and Standards, the Colchester Storm Water Ordinance, the Town's Sub-Division Regulations and the Town's Zoning Regulations. These mechanisms were selected as the most effective approach to managing post construction runoff.

All land disturbances require a permit from the Town. Through the issuance of a permit, the appropriate conditions are attached to the permit, that require the post-development landowner to perform the proper long-term operation and maintenance of the BMP's required through the review and approval process that are not taken under public ownership.

The Town has developed and will continue to use local Zoning Regulations to provide the legal authorities and strategies to protect and regulate development in the stream corridors of storm water impaired waters as defined by 10 V.S.A § 1264 (a)(13).

The Town has developed and submitted a plan to the VANR outlining options for enhanced protection of stream corridors of storm water impaired waters. The plan includes a map of stream corridors depicting areas that have been converted to impervious surface and areas that are undeveloped or have not been converted to impervious surface. The preparation of the plan was developing after review of riparian buffer and stream fluvial geomorphological information provided by the VANR as a result of the Agency's preparation of TMDL's as set forth in 10V.S.A § 1264 (f)(3).

For those areas of stream corridors that have been developed or otherwise converted to impervious surfaces, the plan for enhanced protection of stream corridors of storm water impaired waters identifies options for stream corridor restoration as outlined.

The Town of Colchester, through both its Public Works Department and Planning and Zoning Department are responsible for the overall management and implementation of the post-construction storm water management program. The Directors from these departments have the primary responsibilities, with specific tasks delegated to the Public Works Operations Manager, Town Engineer, Town's inspectors, and citizen storm water watch groups.

The success of this minimum measure will be evaluated through developing and achieving measurable goals. The selection of measurable goals has been completed in a manner that allows the Town to gauge program effectiveness. Additionally, the measurable goals have been based upon the needs and characteristics of the Town and the area served. Finally, they have been selected to ensure an integrated approach that fully addresses the requirements and intent of this minimum control measure.

Pollution Prevention/ Good Housekeeping for Municipal Operations

BMP 6-1 *Describe operation and maintenance program for reducing pollutant runoff from MS4 operations.* – The Town of Colchester has four municipal functions that are impacted by our operation and maintenance program. These include the following:

Highway Maintenance:

Snow Removal Activities: - The Town's snow and ice removal procedures are designed to minimize the use of de-icers and abrasives that may ultimately enter receiving waters. Colchester does not have a "bare roads" policy. The application of de-icers is limited to specific phases of storms and types of weather conditions. During snow events, de-icers are applied when precipitation is beginning to prevent compaction and bonding of snow to the roadway. Under ordinary circumstances, de-icers will not be applied again until the storm has ended to restore the paved surface. To avoid excessive use of de-icers, these materials are not applied at temperatures below their optimal effectiveness range. During freezing rain, or ice storms, de-icers are applied as needed throughout the entire storm event.

The use of abrasives is limited to non-paved roads in rural sections of the community, and paved roads when temperatures are too low for de-icers. The application of abrasives on paved roads is typically limited to critical areas such as steep grades, sharp corners and roadway intersections.

All primary snow removal equipment operated by the Town is equipped with on-board computers that control and regulate the application rates of materials. The Town operates no snow storage areas.

De-icers are stored in an enclosed facility. Abrasives are stored in an open pile on the ground at the Public Works Maintenance Facility. Minimal amounts of de-icers are added to the stock pile to prevent freezing. A silt fence is erected and maintained around the stock pile and an earthen berm and vegetative buffer strip has been constructed at the downstream end of the site.

Street Sweeping – The Town owns its own street sweeper. The equipment removes debris from the roadways by vacuum which reduces airborne dust. Town roads are cleaned both in the spring and fall of the year.

Basin Cleaning – Storm water basins are currently cleaned on an as needed basis. Emphasis is placed on storm water basins located on steep grades, and structures located near outfalls to receiving waters. Basins are inspected during cleaning.

Storm Water Outfalls – The Town has inventoried, assessed and mapped all of its storm water outfall structures. These structures have been placed on a regular inspection schedule as outlined in the Town's Storm Water Outfall Assessment Program. Inspection forms are used to record any damage or signs of failure. Observations of flow characteristics are also recorded.

Drainage Ways – Roadside ditches and drainage ways are inspected routinely during other highway maintenance operations such as street sweeping, grading of gravel roads and roadside mowing. Solid wastes are removed from these drainage ways annually as a part of the Town's Green-up day activities. Roadside mowing is completed 3-4 times per year, or as needed, to keep the drainage ways clear. Regrading of drainage ways is only done on an as-needed basis to minimize any unnecessary soil disturbance.

Dust Control – Dust control material for gravel roads is limited to one application per year. Diluted liquid chloride is used for dust control. Applications are carefully applied to avoid any overspray into roadside drainage ways. The application of dust control material is coordinated with weather conditions to avoid excessive runoff into drainage ways.

Material Storage – Construction materials are stored within the Public Works Maintenance Facility yard. An earthen berm and vegetative buffer strip has been constructed at the lower end of the site to prevent any runoff or discharge of sediment from the site.

Buildings and Grounds Maintenance:

Sanitary Facilities and Wastes – All Town facilities and primary parks are equipped with bathroom facilities. All facilities are served by on-site wastewater systems, which are pumped and inspected every two to three years depending on the facility and size of tank.

Solid Wastes – All solid wastes from Town facilities are removed regularly on a contractual basis. Solid wastes from park lands are collected daily by Town maintenance crews. All solid wastes are properly disposed of in approved landfills.

Storm Water Runoff – Most Town facilities are located on relatively flat ground where no concentrated discharge occurs. On facilities that have concentrated discharges, a mixture of BMP's including grass lined swales, storm water ponds,

storm water control berms and vegetative buffer strips are used. These controls are monitored regularly during grounds maintenance operations.

Fertilization – All types and quantities of fertilizers applied to Town owned grounds are in compliance to all state and federal guidelines regulating the use of fertilizers. To prevent over application of phosphorus, soil tests are conducted in advance of applications. Nitrogen is controlled through the use of slow release materials which allow the nitrogen to be used by the soil before reaching ground water. Fertilizers are applied primarily to athletic fields with general open space receiving only limited applications. Any over spray of fertilizers onto impervious surfaces are swept off after each application. Fertilizers are only purchased on an as-needed basis, and are stored inside under cover within approved containers before application.

Pesticides – All types and quantities of pesticides applied to Town owned grounds are in compliance to all state and federal guidelines regulating the use of pesticides. The Town uses Integrated Pest Management within its pesticide program for Town owned grounds. This involves testing of soils before applications to determine whether the application of pesticides is necessary.

Any over spray of pesticides onto impervious surfaces are swept off after each application. Pesticides are only purchased on an as-needed basis, and are stored inside under cover within approved containers before application.

Animal Waste – Town parks and recreational paths are equipped with supplies to allow pet owners to remove and dispose of pet waste within Town parks.

Equipment Maintenance:

Equipment Repair – All Town owned equipment is maintained and repaired within the Town's Public Works Maintenance Facility. Waste oils are collected and burned within an approved waste oil furnace within the maintenance facility. Coolants are recycled through equipment at the facility. All uniforms and rags that may be contaminated with oils, greases and other materials are collected within approved containers and cleaned on a contractual basis by an industrial cleaner. All other solid wastes, including batteries, discarded parts, and oil absorption materials, are collected and stored in approved containers, and disposed of at the appropriate facilities. Where fluids are stored that may be subject to accidental spills, double containment is provided. Aerosol products are managed to minimize the number of containers actively in use within the shop area.

Equipment Storage – The majority of the Town's equipment is stored inside. The Town operates a Capital Equipment Program that allows all equipment to be replaced on a regular basis. Together with the facilities computerized work order and maintenance systems, the Town's equipment is in very good condition, and is generally free of fluid leaks, rust, paint flakes and other possible contaminates that may be washed from the site during storm water flow conditions.

Equipment Washing – The facilities floor drains are connected to an oil and grease/water separator, which is connected to a holding tank. The tank is pumped on an as-needed basis, with the material disposed of in the Town's sewer system. The washing area outside is located such that wash water runs to a vegetated area and dissipates into the ground. Total outside equipment washing does not exceed thirty vehicles per week. There is no steam cleaning or engine degreasing performed during outside equipment washing.

Fueling Facility – The Town's fueling facility is served by two UST's with secondary containment. The facility is covered by a fueling canopy to avoid the collection of rain water and subsequent run off from the fueling pad. The fueling pad is slightly elevated to avoid contact from any other site run off that may be directed to the pad. The overall site is graded such that runoff is not directed toward the pad. The fueling system is equipped with both spill and vapor recovery systems. The system is also equipped with an electronic monitoring system that automatically reports fuel levels on a daily basis, and is equipped with an audible alarm connected to a leak detection system.

Wastewater System Maintenance:

Overflow Controls – All Town wastewater pumping stations are equipped with either auxiliary power capability, or emergency storage to prevent overflow conditions. All waste water pumping stations are inspected daily. In the event of an over flow, all practical steps are taken to prevent a discharge including but not limited to, erecting containment systems, flow diversion or emergency pumping and tanker truck operations.

Chemical Pre-treatment – All pumping stations equipped with chemical pre-treatment systems store their chemicals in above ground double containment tanks. All waste water pumping stations are inspected daily to ensure both the normal operation of the facilities, as well as the integrity of chemical storage tanks and other systems. Any problems are either repaired immediately by maintenance personnel, or if immediate repairs are not possible, reported to the Public Works Operations Manager to develop and implement a repair plan.

BMP 6-1a *New construction and land disturbance* - New construction and land disturbance associated with municipal operations shall be addressed through the provisions of Measure 4 and Measure 5 of this permit.

BMP 6-1b *Maintenance of fleet and buildings, all municipal garages, parks, open space, construction and maintenance practices for gravel roads, snow disposal and storm water systems* – See BMP 6-1

BMP 6-1c *Training, maintenance schedules, and inspection procedures for long-term structural controls* - Town maintenance crews shall receive annual training associated with the correct procedures to minimize the discharge of sediments, toxins, phosphorus, nutrients and other harmful contaminates, that may be caused through the Town's municipal operations. Training exercises shall contain at a minimum, an understanding of the location and characteristics of the natural resources that may be vulnerable to municipal operations, sources of contamination that may be generated from the municipal operations, and how they may impact natural resources, procedures to minimize the potential effects of municipal operations on natural resources, and the specific requirements and conditions of the Town's Phase II permit. See BMP 6-1 for maintenance schedules and inspection procedures for long-term structural controls.

BMP 6-1d *For municipal facilities where fertilizers are applied, prohibit the use of fertilizers containing phosphorus unless warranted by a soil test* - All types and quantities of fertilizers applied to Town owned grounds are in compliance to all state and federal guidelines regulating the use of fertilizers. To prevent over application of phosphorus, soil tests are conducted in advance of applications. Nitrogen is controlled through the use of slow release materials which allow the nitrogen to be used by the soil before reaching ground water. Fertilizers are applied primarily to athletic fields with general open space receiving only limited applications. Any over spray of fertilizers onto impervious surfaces are swept off after each application. Fertilizers are only purchased on an as-needed basis, and are stored inside under cover within approved containers before application.

BMP 6-2 *For municipal garages, an MS4 may participate in ANR's Municipal Compliance Assistance Program* - On September 19, 2010, John Daly, Environmental Assistance Specialist within the Vermont Department of Environmental Conservation, conducted an inspection of the Town's Public Works Maintenance Facility. The Town is in compliance with each of the Direct Compliance Issues identified in the report. Spent diesel and gas fuel filters are being disposed of as outlined. The Town discontinued the use of clay absorbents several years ago. The Town has previously tested its sand blast waste for heavy metals with negative results. No changes in procedures or materials have been made since that

time. Debris from both street sweeping and catch basin cleaning is currently being stored on site at the maintenance facility. The charges from landfills to accept the material as cover material have become cost prohibitive. Subsequently, the Town has had these materials tested and determined that they can be safely disposed of at alternative sites. The Town intends to continue working with the MCAP to ensure continued compliance.

BMP 6-3 *Provide a list of all industrial facilities that the MS4 owns or operates that are subject to the MSGP* – Currently there are none. The Town understands from the VANR Legal Council that MSGP's are not required for Public Works Garages. The Town has however completed several improvements which would be required under a MSGP if one were required. These include the covering of construction materials such as asphalt, manhole frames and covers, and scrap metal. The sand blasting area has been paved to facilitate the cleanup of the waste material after each occurrence. A holding tank has been installed which is connected to the floor drains within the maintenance facility to capture wash water associated with cleaning equipment. The waste water is periodically removed and discharged into the Town's municipal sewer system. Voters of Colchester approved bonds to allow improvements to several Town buildings, including $750,000 for the Public Works Maintenance Facility. As a part of this project, a 3,720 square foot cold storage facility has been constructed, allowing much of the Town's equipment and construction materials to be placed under cover. This project also included the replacement of an aging salt storage facility.

Rationale

The BMP's identified under this minimum control measure are aimed primarily at improving the nutrient index within receiving waters by reducing the discharge of phosphorous and nitrogen, and improving the total number of species and species density by reducing the discharge of sediment and toxins that can be generated by municipal operations.

There were no major alternative BMP's under this minimum control measure.

The implementation of this measure will require an increased level of awareness on the part of public employees of how the Town's municipal operation can contribute to water quality both positively and negatively.

The expected water quality outcomes under this minimum control measure are improvements in the nutrient index, total species numbers, and species density within receiving waters through the reduction of phosphorus, nitrogen, sediment and toxins in storm water runoff.

CHITTENDEN COUNTY
REGIONAL STORMWATER EDUCATION PROGRAM
MEMORANDUM OF UNDERSTANDING
FOR THE PERIOD MARCH 10, 2013 THROUGH MARCH 9, 2018

This Memorandum of Understanding ("MOU") establishes an agreement among the Parties (as specified in Section 1) for a group of Municipal Separate Storm Sewer Systems ("MS4s") to contract to operate a Regional Stormwater Education Program ("Program") that conforms with and satisfies the relevant requirements regarding Minimum Control Measure One ("Public Education and Outreach") of the Phase II NPDES Permit for Program Years 2013--2018), as established in General Permit 3-9014 (2012) (MS4 Permit") as continued or renewed by the Vermont Department of Environmental Conservation ("VTDEC").

1. **Parties to the MOU** – The parties to this agreement are:

   a. **MS4s** – the undersigned municipalities and other entities and any other MS4 that may execute this agreement following approval of that MS4's inclusion as a party to this MOU by a 2/3^{rds} majority of the voting members of the Steering Committee and

   b. **Lead Agency** – the Chittenden County Regional Planning Commission ("CCRPC"), unless a majority of the Steering Committee favors a different lead agency or the CCRPC no longer wishes to act as the Lead Agency.

2. **Steering Committee**

   a. **Composition** – The voting members of the Steering Committee shall consist of one representative from each of the MS4s who are signatory to this Agreement as designated by each MS4. The voting members may, by a 2/3^{rds} majority vote, invite one or more other organizations to each appoint a representative to serve as a new member, a non-voting member or as an advisory member of the Steering Committee. Such organizations may include, but not be limited to, the Lake Champlain Committee, the Champlain Water District, the Chittenden Solid Waste District, other MS4s, or other municipalities.

   b. **Duties** – The voting members of the Steering Committee shall advise the Lead Agency on the development and performance of Program Services and on matters bearing on the administration of this agreement. The Steering Committee will endeavor to meet, quarterly or more often as needed.

3. **Lead Agency**

   a. **Duties** – The Lead Agency will provide Administrative Services in terms of administering this MOU and agreements with contractors (including executing contracts, receiving and disbursing funds, and monitoring the provision of services) on behalf of the MS4s. The Lead Agency shall not provide services related to this program for entities outside of the MS4 signatories. Additional coordination shall be only at the direction of the Steering Committee or its chair. The Lead Agency may also provide other Non-Administrative services (including, but not limited to, public education and outreach activities, public relations, grant writing, web site editing, etc.) as

directed by the Steering Committee and at a level consistent with each year's Program Budget as described in Section 6.a. The Lead Agency is not a guarantor that services will be performed.

b. **Compensation** – The MS4s agree to compensate the Lead Agency for the actual costs of performing Administrative and Non-Administrative duties defined in Section 3.a. Compensation shall be for hourly wages, appropriate overhead and expenses. Compensation for Administrative Duties shall not exceed ten (10%) percent of the Program Budget as specified in Section 6 without prior approval of a simple majority of the Steering Committee present at the time of the vote or by email response. Personnel costs for Lead Agency staff engaged in Administrative or Non-Administrative Duties shall be calculated at a rate of salary plus fringe. The Lead Agency shall submit invoices no more frequently than monthly. Invoices shall provide a description of work tasks completed by the Lead Agency for that billing period with sufficient detail to the satisfaction of the steering committee.

4. **Selection of Contractors** – In general, the Steering Committee shall competitively bid for contract(s) for Program Services that collectively satisfy the requirements for Minimum Control Measure One ("Public Education and Outreach") of the Phase II NPDES Permit for Program Years 2013 – 2018 as established by the MS4 Permit and as defined in Section 5. All contracts shall be awarded based on qualifications, price, and the ability of the entity to provide services that meet the relevant MS4 Permit requirements. However, upon consent of the majority of the voting members of the Steering Committee present, the RSEP may waive the bid process for select contracts. Contracts may be up to 5 years in length and shall include, but not be limited to, language specifying the right of the RSEP to cancel a contract if services are not being adequately provided and language specifying that payments to contractors shall be made only for services rendered.

5. **Program Services** – The Steering Committee, assisted by the Lead Agency and contractors, will implement a media advertising campaign and provide stormwater education services that satisfy the requirements of Minimum Control Measure One ("Public Education and Outreach") of the Phase II NPDES Permit for Program Years 2013 – 2018), as established by the MS4 Permit, in accordance with Section 5.a..

a. **Program Content** – The Program Content for each Program Year will be as defined in the Communications Plan for that year as approved by a majority of the Steering Committee. Annual Program elements will include, at a minimum: 1) operation of the Program's website, www.smartwaterways.org or its equivalent, 2) the hosting of occasional educational seminars open to the public concerning stormwater pollution prevention and related topics, and 3) advertisements in various media.

6. **Program Budget, Costs, and Payments**

a. **Program Budget**

1) The annual Program Budget shall consist of the sum of the annual $5,000 payments for a given Program Year made by participating MS4s plus any Public Participation payment as described below in Sections 6b and 6c, respectively.

2) Prior to March 1st of every year, the Steering Committee shall adopt a Program Budget governing expenditures for the subsequent program year. Budget categories shall include, but not be limited to: Lead Agency Administrative Duties, Lead Agency Non-Administrative Duties, Media Advertising Purchases, Media Marketing Consulting Services, and Other Contractual Services.

b. **Participating MS4 Maximum Annual Costs and Payments** – Except as otherwise provided for in this section or in section 12c, each MS4 that is a party to this MOU shall by July 30 of each program year make a single annual payment of $5,000 to pay for Program Services (as defined in Section 5) and Lead Agency services (as defined in Section-3.a.). In the event that costs are less than anticipated or that grants or other funding sources become available, a majority of the voting members of the Steering Committee may decide to reduce each MS4's payment by an equal amount. The Steering Committee may require additional dues from new members joining after March 9, 2013 to help defray program development costs incurred since the Program's inception.

c. **Public Participation Payments** – Any payments made by an MS4 (regardless of whether or not the MS4 is a Party to this MOU) to the Lead Agency as a part of compliance with Section 4.2.2.1 of the MS4 Permit (governing payments in lieu of undertaking specific Public Involvement/Participation Activities) shall pay for Program Services as defined in Section 5.

d. **Other Funds** – Any funds made available to the Program other than Participating MS4 Costs and Payments (pursuant to Section 6.b.) or Public Participation Payments (pursuant to Section 6.c.) shall be dedicated to reducing the annual costs of each MS4 participating in the Program, except as a majority of the voting members of the Steering Committee may decide.

e. **Excess Funds** – Any funds remaining at the end of a Program Year, less any earmarked set aside funds (such as survey funds, etc), shall be carried over to the next Program Year, unless a 2/3^{rds} majority of the voting members of the Steering Committee decides otherwise. Following the payment for all Program Services and Lead Agency services at the end of Program Year 2018, any funds remaining shall be carried forward for successive years where program services continue under successive agreements. Any funds refunded to the MS4s participating in this MOU shall be refunded based upon a prorated portion depending upon the number of months of participation by that MS4, except that any additional payments made by a member beyond its $5,000 annual payments shall be first refunded in full, except for payments made in lieu of performance of Minimum Measure #2.

f. **In-Kind Services** – Program Services (as defined in Section 5) that are provided by a member may be used to offset the Participating MS4 Costs and Payment of that member by such amount as may be determined by a majority of the voting members of the Steering Committee.

7. **Contracts Required** – All contracts with Contractors to provide Program Services shall be conditioned upon approval by a 2/3^{rds} majority of the voting members of the Steering Committee.

8. **Withdrawal Prohibited** – No MS4 that is a party to this MOU may withdraw from this MOU, except for early termination as defined in Section 9 of this MOU. Early termination of a signatory may be considered by the Steering Committee with 12 months' notice of withdrawal for cause and with a 2/3^{rds} majority approval of the voting members of the Steering Committee

9. **Early Termination** – This MOU shall become null and void with no further obligation of the parties if:
   a. a majority of the voting members of the Steering Committee does not approve one or more contracts for the provision of Program Services within 90 days after execution of this MOU or

b. VTDEC determines that the Program outlined in this MOU does not meet the requirements for minimum control measure #1 ("Public Education and Outreach") of the Phase II NPDES Permit for Programs Years 2013 – 2018) and the parties to this MOU are unable to craft a Program to satisfy VTDEC.
c. alternate contractual arrangements for MM1 compliance are developed and a vote to dissolve this MOU is approved by a 2/3^{rds} majority approval of the voting members of the Steering Committee.

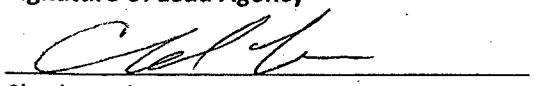
10. **Automatic Termination** – This MOU will terminate at the end of Program Year 2018.

11. **Amendment** – Unless a specific section of this MOU provides otherwise, this MOU may be amended only upon the unanimous consent of all of the Parties.

12. **Adding New MS4 Entities** – New MS4 entities shall be allowed to become party to this MOU with a 2/3^{rds} majority approval of the voting members of the Steering Committee. The new party agrees to:
    a. pay for costs directly associated with re-evaluation and reconfiguration of the Program's existing Communications Plan to ensure that planned media advertising purchases appropriately cover the geographic area served by their MS4, unless waived by a 2/3^{rds} majority approval of the voting members of the Steering Committee. The new MS4 shall coordinate this work with the Lead Agency and RSEP Chair using existing RESP program contractors.
    b. The new MS4 obtains approval from the permitting agency indicating that their participation in the established Program would satisfy their requirements under minimum control measure #1 ("Public Education and Outreach") of the Phase II NPDES Permit for Programs Years 2013 – 2018)
    c. The new MS4 makes five additional annual payments of $ 500.00 to the Program in recognition of Program development costs incurred since the program's inception.

13. **Counterparts** – This MOU may be executed in multiple counterparts, each of which is deemed an original and all of which constitute one and the same document. Each such counterpart may be a facsimile copy and such facsimile copy shall be deemed an original.

Signature of Lead Agency



Charles Baker, Executive Director
Chittenden County Regional Planning Commission

5/1/13
Date

Signatures of Members

Gene Richards, Interim Director of Aviation
Burlington International Airport — Date

Steven Goodkind, Director of Public Works
The City of Burlington Department of Public Works — Date

Bryan K. Osborne, Director of Public Works
The Town of Colchester — 4/23/13 Date

Dennis E. Lutz, PE, Public Works Dir. / Town Engineer
The Town of Essex — Date

Authorized Signer
The Village of Essex Junction — Date

Brian M. Palaia, Town Manager
The Town of Milton — Date

Dean Pierce, Director of Planning and Zoning
The Town of Shelburne — Date

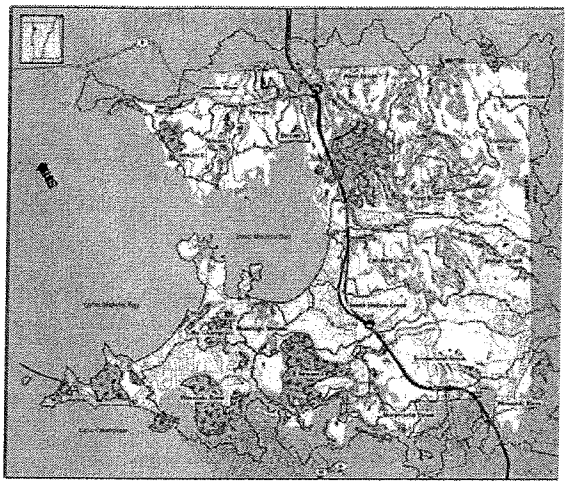
Bob Rusten, Interim Temporary City Manager
The City of South Burlington — Date

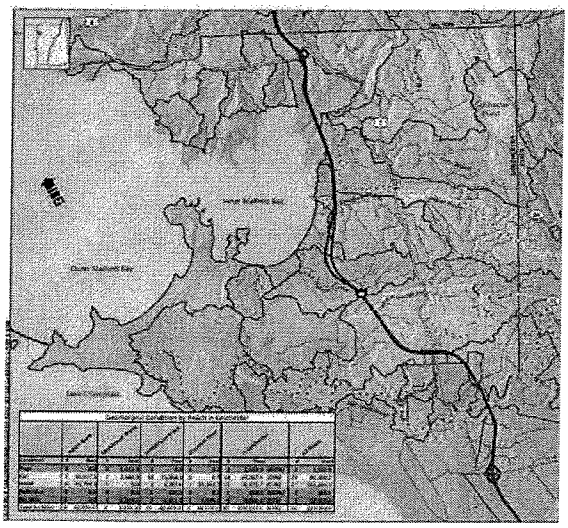
Brian Searles, Secretary of Transportation
The Vermont Agency of Transportation — Date

Linda Seavey, Director, Campus Planning Services
The University of Vermont — Date

Richard McGuire, Town Manager
The Town of Williston — Date

Katherine Decarreau, City Manager
The City of Winooski — Date





Synoptic Survey of Stream Phosphorus Concentrations in Colchester, Vermont

INTEGRATED WATER RESOURCES MANAGEMENT PROGRAM—TASK 2

VOLUME 2 OF 2

TOWN OF COLCHESTER, VERMONT

Project ID 051694-G

February 18, 2011

This project is funded by a US EPA National Decentralized Wastewater Demonstration Grant.

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EXECUTIVE SUMMARY

Nutrient enrichment is the leading cause of water quality impairment in Lake Champlain and phosphorus is the nutrient of greatest concern. Under most conditions, the supply of phosphorus limits the growth of suspended algae and higher aquatic plants – if the concentration of phosphorus is increased, the productivity of these organisms increases, occasionally forming undesirable algae blooms.

The Town of Colchester has a long-standing interest in water quality protection and improvement in Lake Champlain. The Town voluntarily initiated a survey of stream phosphorus concentrations to help inform its water resources management decisions. This survey of stream phosphorus is part of the Town's wider Integrated Water Resources Management Project.

Thirteen stream locations were monitored on three wet weather and two dry weather dates between March and October, 2010. The sampling locations were intended to represent the range of land uses in Colchester watersheds. The first conclusion to draw from these results is that major land uses are controlling stream phosphorus concentrations under most conditions. This conclusion is supported by the finding that streams draining watersheds with a greater percentage of agricultural land generally had higher phosphorus concentrations than streams draining primarily forested watersheds. Streams draining watersheds with higher population density generally had higher phosphorus concentrations than streams draining watersheds with lower population density. The watershed that was almost entirely forested (a headwater tributary of Malletts Creek at Brigham Hill Road) had the lowest dissolved and total phosphorus concentrations on all sampling dates. The second conclusion is that during the two high flow events, high total phosphorus concentrations were due to sediment transport; at high flows land use had less impact on sediment and total phosphorus concentrations than other (not quantified) factors. This conclusion is supported by the strong correlation documented between turbidity and total phosphorus concentrations and by especially weak associations between total phosphorus and land use on these high flow events. Stream channel erosion may be a major source of peak sediment and phosphorus concentrations under high flow conditions.

Segments of streams potentially impacted by onsite wastewater treatment systems (septic systems) and animal wastes were identified where possible. The Village Drive area sampling location (site VI) had substantially elevated dissolved phosphorus during low flow conditions. Elevated dissolved phosphorus concentrations are of more certain and immediate concern than total phosphorus concentrations, because most dissolved forms of phosphorus are immediately available for uptake by algae and aquatic plants, contributing to eutrophic conditions in receiving waters. We did not conclusively establish the cause of the elevated dissolved phosphorus at this site, but we speculate that malfunctioning onsite wastewater treatment systems may contribute dissolved phosphorus to the Village Drive stormdrain. This speculation is supported by elevated *E. coli* levels (reported separately) and ammonia concentrations at the outfall. The sampling location in the Pond Brook tributary at Route 7 (site EH) immediately north of Pond Brook

also had moderately elevated dry weather dissolved phosphorus concentrations; livestock impacts observed immediately upstream may have contributed to these elevated concentrations.

The water quality benefit of stormwater treatment was indirectly apparent in the sampling results. The Champlain Drive sampling location on a southern tributary of Sunderland Brook (site CD) is an interesting example of a highly impervious watershed with relatively low total and dissolved phosphorus concentrations and turbidity on the sampling dates. This watershed is mainly commercial and industrial; the residential population density is low. Many of the commercial properties have stormwater treatment systems and wetlands are present along much of the stream channel length. Although prevalence of stormwater treatment systems was not considered in watershed statistical models and wetland area was rarely a significant variable in these models, the raw water quality data suggest that stormwater management and riparian wetlands may reduce peak flows and sediment and phosphorus transport from this watershed. The dissolved and total phosphorus concentration data at site CD were substantially lower than at another small tributary to Sunderland Brook (site SBT) that lacks stormwater treatment.

Agricultural land and population density appear to control phosphorus transport under low and moderate flow conditions. A whole range of agricultural and urban best management practices may be implemented to reduce these contributions. Most agricultural management practices related to water quality protection are implemented through state and federal programs, with less involvement by municipal government. However, one critical agricultural practice that the Town of Colchester could affect is livestock exclusion from stream channels, which may be required and enforced under municipal law. The study was not able to adequately characterize phosphorus concentrations in the large area of drained cropland in the Winooski River floodplain on and surrounding Pine Island; therefore, additional monitoring in this area is recommended. Strong, positive associations were found between population density and dissolved phosphorus concentration under all monitored flow conditions and between population density and total phosphorus under low flow conditions. Among the three small urban watersheds, high phosphorus concentrations were only found at the Village Drive stormwater outfall, which has a similar percentage of impervious surface to the other two small urban watershed sites but a higher population density. The Village Drive site represents a critical phosphorus source area and the source of the elevated phosphorus (and *E. coli* and ammonia) concentrations should be investigated further, due to the potential public health and ecologic risks.

Overall, the results are consistent with expected results in Lake Champlain tributaries. The findings documented herein reinforce the prevailing scientific understanding of stormwater processes in the basin:

- Streams draining watersheds dominated by agricultural and/or higher density residential land tend to have elevated phosphorus concentrations relative to reference (forested) conditions.
- Runoff during wet weather events may be mitigated by increased implementation of stormwater treatment systems in developed areas and best management practices for agricultural land.

The results also suggest that stream channel adjustment may be a dominant source of total phosphorus under high flow conditions.

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1. INTRODUCTION

Nutrient enrichment is the leading cause of water quality impairment in Lake Champlain. Under most conditions, phosphorus is the limiting nutrient in Lake Champlain—if the concentration of phosphorus is increased, the growth of living organisms, particularly algae, increases as well. The Town of Colchester has 30 miles of shoreline on Lake Champlain, with 10 miles surrounding inner Malletts Bay. Several streams discharge to Malletts Bay, however, prior to the study described herein, the contribution of phosphorus from Colchester streams to the lake had not been investigated.

The Town of Colchester voluntarily initiated this survey of stream phosphorus concentrations to help inform its water resources management decisions. With the exception of Malletts Creek and Pond Brook, the streams sampled in this study were quite small (3-600 hectares or 9-1,400 acres). There is little phosphorus data available at this scale in Vermont with which to compare these data, nor was this type of comparison the intent of the study.

This survey of stream phosphorus is part of the Town's wider Integrated Water Resources Management Project. Although the discussion in this report is limited to phosphorus, it should be viewed within the larger context of local land use, existing water infrastructure, and other indicators of surface water quality in Colchester.

1.1. The Role of Phosphorus in Surface Waters

Phosphorus pollution is not unique to Vermont. We are interested in phosphorus because pollution of surface waters (such as streams, rivers, ponds and lakes) with nutrients accelerates eutrophication, the process by which the biological productivity of these waterbodies increases in response to increased nutrient concentrations (Vollenweider, 1968; Horne and Goldman, 1994). Associated with increased biological productivity are changes in aquatic food web structure and species composition (Tilman et al., 1982; Pace and Funke, 1991), and impairment of recreational and water supply uses of surface waters (Sharpley et al., 1994; U.S. Environmental Protection Agency, 1995). In temperate regions, phosphorus (P) is the nutrient primarily responsible for accelerating the eutrophication of freshwaters, because P is usually the nutrient in limited supply relative to plant demand (Schindler, 1977; Hecky and Kilham, 1988). Lakes rich in phosphorus tend to have low water clarity, taste and odor problems, and large fluctuations in dissolved oxygen, which can impact fish and other aquatic life.

Phosphorus pollution from point sources has been substantially abated in the United States since passage of the Clean Water Act in 1972, but comparatively little progress has been made in controlling P pollution from diffuse, or nonpoint, sources (Pucket, 1995). Controlling nonpoint source P is inherently difficult because most land surface exports some amount of P, and the flow-dependent, intermittent nature of nonpoint sources confounds regulation. Management of P increasingly involves prioritizing watersheds based on their potential or actual P contribution to receiving waters in order to ensure effective use of limited funds (Sharpley et al., 1994; Pucket, 1995; U.S. Environmental Protection Agency, 1995).

Native soils in Vermont contain phosphorus in greater or lesser amounts. Surface runoff erodes soil, transporting soil and soil-bound phosphorus to surface waterbodies. Stream channels are also a large source of soil-bound phosphorus, as sediments are scoured from the channel bed and banks as the stream adjusts its course over time. Even without applying phosphorus in any form, humans can dramatically increase phosphorus loading to surface waters by accelerating soil erosion. Application of commercial fertilizer, animal manure, domestic wastewater or septage, or process wastes to agricultural land and use of lawn fertilizer will increase soil phosphorus concentrations and impart additional phosphorus in runoff.

1.2. Field Study Rationale

This field study involves collection of water quality samples and laboratory analysis. This type of data is generally known as empirical data. Another form of data is derived from the literature, extrapolation of data collected in other locations, or estimates of typical ranges of results for a given set of conditions. Empirical water quality data is of greater use to managers than predictions based on literature values (Stanford and Ward, 1992). Because specific land use practices and land cover types, local geology, topography, soils, and climate all influence P concentrations and export rates (Dillon and Kirchner, 1975; Beaulac and Reckhow, 1982), literature values typically span a range of more than an order of magnitude between study areas (Loehr, 1974; Beaulac and Reckhow, 1982; Budd and Meals, 1994). Mean literature values do not reflect this spatial variability in P concentrations and export rates in the landscape.

Empirical assessments of phosphorus concentrations in small watersheds can help to identify watersheds with relatively high P concentrations and time periods or flow conditions when concentrations are highest. Information about the P contribution from different land uses and the periods when greatest P losses occur can be used to select appropriate management practices and to target critical areas in the landscape in which to implement these practices.

2. OBJECTIVES

The study objectives were as follows:

- Identify subwatersheds in Colchester drained by streams with relatively high phosphorus concentrations (hot spots).
- Assess the relative contributions of phosphorus among differing land uses (e.g., agricultural, forested, impervious cover, developed lands, and wetlands).

There are presently no water quality data for Colchester streams that are adequate to meet these objectives. Locating "hot spots" with elevated phosphorus concentrations will enable Colchester to focus management efforts in these areas. Describing relationships between phosphorus levels and land use will enable Colchester to focus management on certain land classes. This study has been designed and executed as a preliminary analysis to begin to understand the relationships between land use and phosphorus concentrations.

3. METHODS

To accomplish the study objectives within the available resources, a synoptic survey (rather than an extensive, long-term monitoring program) was designed to acquire data at critical locations in the landscape and at critical times. Selection of sampling sites, sampling and water analysis methods, spatial analysis, and statistical analysis are described in the following sections.

3.1. Site Selection

Monitoring locations were selected in consultation with the Town of Colchester, Department of Public Works based on fieldwork performed under Task 1; water resource mapping completed under Task 2; review of existing orthophotography, hydrography, and storm sewer mapping; and targeted field reconnaissance. Thirteen sites were selected for the study, which is near the minimum number of sites typically required to enable the intended statistical analyses. A 14th site was added at the mouth of Crooked Creek for the final sampling event to make up for the inability to sample site S4. The sampling sites are shown in Figure 1 and are described in Table 1. The criteria for selection of monitoring sites included stream size (order), watershed land use, and proximity to Malletts Bay. The primary consideration in selecting these sites was to represent watersheds of differing land use composition, including primarily agricultural, forested, and developed land. Selected sites were generally accessed from public roadways.

Table 1. Stream sampling site descriptions

Site ID	Site Description
BH	Headwater tributary of Malletts Creek at Brigham Hill Road
CC	Crooked Creek outlet
CD	Sunderland Brook tributary at Champlain Drive
EH	Pond Brook tributary at Route 7 immediately north of Pond Brook
MC	Malletts Creek at Route 7
MS	Moorings Stream outlet
PB	Pond Brook at Route 7
PI	Stream 4 at Pine Island Road
PP	Stormwater outfall near the intersection of Route 127 and Porters Point Road
S4	Stream 4 outlet at Macrea Farm Park
SB	Sunderland Brook at Route 7
SBT	Sunderland Brook tributary at Route 7 immediately north of Sunderland Brook
SC	Smith Hollow Creek at East Lakeshore Drive
VI	Village Drive/Linden Drive stormwater outfall

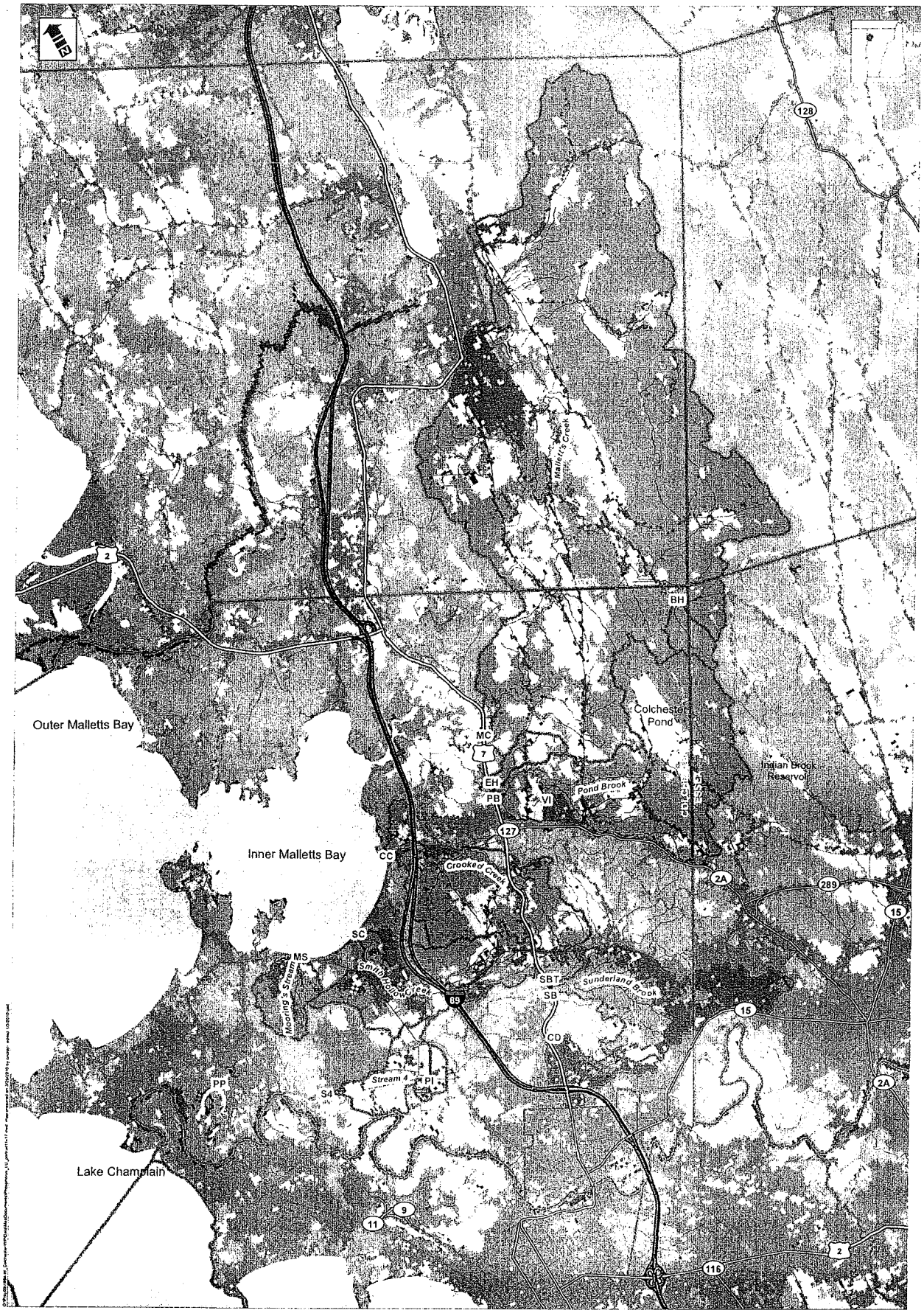

Figure 1. Land Use for Phosphorus Sampling Locations

Integrated Water Resources Management Program

Town of Colchester, Vermont

XX Sampling Locations
Watershed Boundaries
Corn
Soybeans
Sunflowers
Sweet Corn
Barley
Winter Wheat
Oats
Alfalfa
Other Hays
Vegetables/Fruits
Fallow/Idle Cropland
Pasture/Grass
Christmas Trees
Other Tree Nuts
Open Water
Developed - Open Space
Developed - Low Intensity
Developed - Medium Intensity
Developed - High Intensity
Barren
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrubland
Woody Wetlands
Herbaceous Wetlands
Pumpkin

0 0.5 1 Miles

Sources: VCGI: Streams, Roads
USDA: Land Use

The land cover data for Colchester was extracted from USDA's 2009 NASS dataset. The NASS dataset is part of an annual time series in which several states are categorized annually based on the extensive field observations collected during the annual NASS June Agricultural Survey. The imagery was collected between the dates of 03/01/1997 and 09/14/2006. (USDA/NRCS)

This project's funding was provided by an US EPA Demonstration Grant # XP-83232201-1

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3.2. Sample Collection

Individual samples of surface water collected at discrete locations are called "grab samples". Grab samples were collected at monitoring sites during three wet weather events and two dry weather periods in 2010. Timing of wet weather runoff sampling is critical. In small streams, the majority of phosphorus transport in a given year can occur during short periods of high flow (for example, in less than a week). Our goal was to sample immediately following three of the largest rain events between March and August 2010. A high flow event was sampled in March, 2010, but with the exception of two major events in June that were missed due to unavoidable conflicts, there were no more large events (approaching or exceeding 1-inch of rainfall) until September 30. Because the end of the proposed monitoring period was approaching, a moderate wet weather event was sampled on August 3 after 0.74 inches of rain was recorded at the Burlington International Airport the previous day. Afterward, a decision was made to extend the monitoring period until a large event, approaching or exceeding 1-inch of rainfall, could be sampled.

The timing of dry weather events is less critical. A sampling event was considered to be representative of dry weather conditions as long as there were at least two days of dry weather preceding the sampling date.

Sampling was initiated in March 2010. The monitoring dates are given in Table 2 below. At each site, duplicate samples were collected for total phosphorus (TP) and dissolved phosphorus (DP) analysis by DEC's LaRosa Laboratory. Samples were collected in 50-mL glass digestion vials supplied by the LaRosa Laboratory. A second set of samples was collected at 1-2 sites during each event for quality control purposes, to ensure duplicate analysis of approximately 10 percent of all samples. On August 3, no samples were collected for DP analysis due to an oversight by the sampling team. Site PI on Stream 4 at Pine Island Road was dry on three of the five events.

Table 2. Sampling dates

Date	Event Type	Parameters Measured
3/23/10	Wet weather event	TP, DP, ammonia, and turbidity. No flow measurement or *E. coli*.
5/24/10	Dry weather event	TP, DP, *E. coli*, ammonia, turbidity, and flow rate.
8/3/10	Wet weather event	TP, *E. coli*, ammonia, turbidity, and flow rate. No DP.
8/19/10	Dry weather event	TP, DP, *E. coli*, ammonia, turbidity, and flow rate.
10/1/10	Wet weather event	TP, DP, ammonia, turbidity, and flow rate. No *E. coli*.

Turbidity, ammonia concentration, and flow rate were measured at the time of sample collection. Flow measurements were made using a Global Water Flow Probe to measure current velocity and a field tape measure and ruler to measure the cross-sectional area of the flow stream. It was not always possible to measure streamflow. At sites MC, PI, and S4, measuring flow rate at the sampling site was not possible due to deep water (sites MC and S4) and/or lack of a bridge at the sampling station (sites PI and S4). Considering sample holding times and laboratory hours, there was insufficient time during a sampling

event to make exacting flow measurements, which typically take 30-40 minutes in wadeable streams by USGS methods. Approximately 5 minutes was allowed per stream flow measurement in this study, to enable samples to be taken at all sites to capture the wet weather event.

For the May 24, August 3, and August 19 events, samples were also collected for *E. coli* analysis by Endyne Laboratories, Inc. to complement data collection for the bacteria source tracking study. These data will be presented separately. Samples collected for *E. coli* analysis were collected in sterile, 100-mL plastic bottles preserved with sodium thiosulfate.

3.3. Water Analysis

Samples were field-tested for ammonia concentration immediately upon collection using Aquacheck ammonia test strips. Turbidity was measured in the field using a LaMotte 2020e portable turbidity meter. The high turbidity standard used in meter calibration was 100 NTU; measured turbidity values greater than 100 NTU may be less accurate than values within the calibrated range. Total and dissolved phosphorus analyses were conducted by DEC's LaRosa Laboratory using Standard Methods, 20th edition, method 4500-P H. For the dissolved phosphorus analysis, the sample was filtered in the laboratory using a 0.45 µM, 47-mm diameter membrane filter prior to persulfate digestion in the glass sample vial. For the total phosphorus analysis, the entire sample was digested in the glass sample vial.

3.4. Spatial Analyses

The Town of Colchester has a wealth of information regarding the natural and cultural landscape and land uses that has been digitized and incorporated into a Geographic Information System (GIS). The analysis of this GIS data is referred to as spatial analysis. The objective of the spatial analysis component of the study was to define characteristics of the study watersheds that were expected to be associated with water quality variables in the sampled streams. The watershed characteristics defined include watershed area, land use composition, impervious area, and population. The derivation of these watershed characteristics involved delineating the watershed boundary corresponding with each sampling point and intersecting these boundaries with available land use, impervious surface, and population datalayers. These operations were performed in ArcGIS version 9.3.

3.4.1. Sampling Points and Watershed Boundaries

The first steps in the analysis were to digitize the sampling locations and define the watershed boundary corresponding to each sampling location. Table 3 lists the data sources used for these tasks:

Table 3. Spatial datasets used in delineation of study watersheds

Dataset
Imagery: 2004 Chittenden County 1:1250 color infrared ortho-rectified imagery
Topography: 2-foot contour interval topography data developed by USGS from bare earth LiDAR data capture performed in 2004; available from the Vermont Center for Geographic Information
Hydrography: Vermont 1:5000 hydrography dataset, published in 2004; available from the Vermont Center for Geographic Information
Colchester watershed boundaries: Developed by Stone Environmental in 2009 for the Town of Colchester (as part of this study)
Colchester stormwater infrastructure: Developed by Stone Environmental in 2009 for the Town of Colchester (as part of this study)
Bridge and culvert data: Transtruc dataset maintained by the Vermont Agency of Transportation. The Town of Colchester owned culverts were inventoried by Stone Environmental in 2009 (as part of this study)

Sample locations were defined by digitizing points over the high resolution imagery. The watershed corresponding to each sample point was then defined by combining the existing Colchester Watershed Boundaries layer with heads-up digitization at the watershed outlet and in any other areas where the boundary was not defined in the Colchester Watershed Boundaries datalayer. Adjustments were then made in places where transportation and stormwater drainage infrastructure clearly alter the topographically-defined boundary. The watershed delineation process was as follows:

1. From the Colchester Watershed Boundaries datalayer, select watershed boundary segments that are consistent with the study watershed boundaries. In the large study watersheds, this entailed merging smaller subwatersheds from the Colchester Watershed Boundaries datalayer.
2. Using the high resolution topography, perform heads-up digitization of the watershed boundary near the watershed outlet and in any other areas where the boundary was not defined in the Colchester Watershed Boundaries datalayer. The digitized segments of the study watershed boundaries were intersected with the selected segments from the Colchester Watershed Boundaries datalayer. The combined boundaries were then checked for consistency with the stream networks defined in the Vermont Hydrography dataset.
3. In developed areas, the watershed boundaries defined in steps #1 and #2 above were overlain on the high resolution imagery to identify areas where transportation infrastructure determines flow paths. Stormwater infrastructure data from Stone Environmental's comprehensive infrastructure mapping work for the Town and culvert locations in VTrans' Transtruc dataset were also reviewed. Watershed areas bisected by roadways were evaluated and were either included or removed from a study watershed based on the evident drainage pattern. In certain areas the actual flow path could be determined from the presence of road crossing culverts. Where road crossing culverts or closed drainage systems were not present, the watershed boundary was generally interpreted to follow the road centerline. In many cases road ditches and other shallow channels could be observed in the imagery. Particularly

in the PI (Pine Island Road) and S4 (Stream 4) watersheds, which have very little slope, field ditches, contiguous areas of saturated soils, and/or open water courses apparent in the imagery were used to guide the watershed boundary delineation.

The final study watershed boundaries (Figure 1) were used to compute the land area draining to each sampling site.

3.4.2. Land Use Analysis

The Study Watershed Boundaries datalayer was used in combination with a recent land use dataset to calculate the extent of different land uses in each watershed. The land use dataset used was the 2009 Vermont Cropland Data Layer (CDL) produced by the National Agricultural Statistics Service (NASS) from satellite imagery. The NASS datalayer includes 24 land use classes among the study watersheds. The original 56-meter grid size was maintained throughout the spatial analysis. The land use composition of the study watersheds was tabulated using the Tabulate Area tool in ArcGIS 9.3. Table 7 summarizes these land use data.

3.4.3. Impervious Cover Analysis

Impervious surfaces include roofs, roads, sidewalks, driveways, and other structures that prevent rainfall and snow-melt from directly infiltrating into the soil, and concentrate runoff along the edge of the structure or in stormwater drainage systems. The Study Watershed Boundaries datalayer was used in combination with a recent land cover dataset developed by the Spatial Analysis Laboratory at the University of Vermont (UVM) to calculate the impervious cover area in each watershed. The UVM land cover dataset was based primarily on the LiDAR imagery flown in 2004 for Chittenden County; supplementary data sources included the State of Vermont's E-911 Esite point dataset and Chittenden County road polygons. The UVM land cover dataset has seven land cover classes. Stone reclassified the UVM dataset to derive an impervious cover datalayer using the scheme presented in Table 4.

Table 4. Reclassification of land cover classes in the UVM datalayer

Code	Classification	Reclassification
1	Tree Canopy	non-impervious
2	Grass/Shrub	non-impervious
3	Bare Soil	non-impervious
4	Water	non-impervious
5	Buildings	Impervious
6	Roads/Railroads	Impervious
7	Other Paved Surface	Impervious

Due to the large size of the dataset, the gridded land cover data was converted to a polygon feature class before any spatial analyses were run. The land cover feature class was then "unioned" with the Study

Watershed Boundaries datalayer. The impervious cover values were than summarized for each study watershed.

An additional step was required to calculate the impervious cover area of the Malletts Creek watershed because a small portion (193 ha or 478 acres) of the watershed lies outside the extent of the impervious cover datalayer, in the Town of Milton. The extent of impervious cover in this portion of the watershed was estimated as 0.78 ha (1.9 acres). This estimate was based on there being one Class-3 road, 1,372 m (4,500 feet) in length, and approximately 10 houses in the outlying area. The road area was calculated as the road length multiplied by an assumed road width of 5 m (16 feet), which is based on previous observations of Colchester's Class 3 roads. The impervious cover area associated with the houses was calculated based on an assumed footprint of 111 square meters (1,200 square feet) multiplied by the number of houses. The estimated impervious and non-impervious areas outside the extent of the impervious surface datalayer were then included in the totals for the Malletts Creek watershed.

3.4.4. Population Analysis

The Study Watershed Boundaries datalayer was used in combination with the E-911 Esite datalayer available from the Vermont Center for Geographic Information to estimate the population in each study watershed. An average household population of 2.5 was used for the population density calculation. This figure was taken from a 2010 report by M.J. Munson titled *Colchester, Vermont Recreation Facility Impact Fee Analysis*. The E-911 datalayer includes six residential unit classes. Table 5 shows the population per unit that was assumed for each class.

Table 5. Assumed population per residential unit in the E-911 Esites datalayer

Code	Classification	Households	Population
R1	Single family home	1	2.5
R2	Multi-family home	5	12.5
R3	Mobile home	1	2.5
R4	Other residential	1	2.5
R5	Seasonal single family	0.5	1.25
R6	Seasonal home	0.5	1.25

By calculating the number of units in each class in each watershed and multiplying this number by the assumed population per unit, a population total was estimated for each study watershed.

3.5. Statistical Analysis

The objective of the statistical analysis was to define and evaluate how land use may influence water quality. In this section the major statistical tools used are referred to as regression models. These models are used to test the strengths of relationships between water quality measurements and land uses.

Relationships between water quality variables and land use were examined for each sampling date through stepwise regression and standard least squares multiple linear regression analysis. The dependent variables used were DP and TP concentration on each sampling date. The independent variables evaluated for their ability to explain variation in the dependent variables were population density, impervious surface percentage, and various combinations of land use categories, expressed in percent of watershed area. Given the small number of sampling sites, a maximum of three independent variables could be used in any given regression model. Therefore, certain specific land use/cover classes were combined into broader classes prior to analysis if they were expected to have similar function with respect to phosphorus transport. For example, deciduous forest, evergreen forest, mixed forest, and shrubland were combined into one "Forest/shrub" category. Similarly, the 12 subclasses of agricultural land in the original data (including crops such as feed corn, sweet corn, alfalfa, pumpkins, and pasture/grass) were combined into three classes prior to analysis: 1) hay/pasture, 2) cultivated land, and 3) all agricultural land. Note that the land area planted in Christmas trees was not included in the "All Agricultural Land" class because this is an atypically low intensity use of land as compared with other types of farmland. Developed land and wetland classes were included in statistical models either as general classes ("All Developed Land" and "All Wetlands") or as distinct subclasses (such as "Herbaceous Wetlands", "Woody Wetlands", "Low Density Developed Land", "High Density Developed Land", et cetera).

Land use variable sets were tested in regression models for each sampling date in order to determine which combination of variables was the best predictor of total and dissolved P concentrations. The levels of the dependent (phosphorus concentration) variables were different for every sampling date, while the levels of the explanatory (land use) variables were assumed to remain constant. Initial multiple regression models were developed through a stepwise procedure. Of all the independent variables, All Agricultural Land and Population Density entered the stepwise regression models most consistently. Therefore, these variables were fixed in all regression models and various third variables were tested to improve the model fit.

The degree to which each combination of land use variables explained the variation in the dependent variable on a given date was assessed by comparing the regression R^2 values among models. Because all models contained the same number of explanatory variables (three), the R^2 values for all models on all sampling dates could be compared directly. Logarithmic transformations of the dependent variables invariably improved the fit of some models, while causing models on other dates to fit less well. Because there was no consistent improvement made by logarithmic transformation of the dependent variables, these data were not transformed.

Independent variables were not used together in final regression models if they were determined to be correlated. Pairs of independent variables were judged to be correlated if the Pearson product-moment correlations between the variables exceeded 0.50. Correlation was only tested among variables that were significant in one or more models. Among significant variables, All Agricultural Land was correlated

with Herbaceous Wetland (Pearson's r= 0.78). Therefore, Herbaceous Wetland was excluded from models containing the All Agricultural Land variable, which was the stronger of the two variables.

To regression models containing the All Agricultural Land and Population Density variables, other independent variables were added one at a time to assess how the third variable affected the model fit. Herbaceous Wetland percentage, Impervious Surface percentage, and Forest/shrub percentage were the only variables to significantly affect the fit of one of more models. The Herbaceous Wetland variable was excluded because it is correlated with All Agricultural Land, although this variable improved the fit of the DP model on the May 24 event, in which it was significant at $p < 0.10$. In most models, inclusion of the Impervious Surface percentage variable reduced the significance of the All Agricultural Land variable and/or the Population Density variable, and it was only significant ($p < 0.10$) in two cases: DP on August 19 and TP on May 24. The only good candidate for a third explanatory variable was Forest/shrub percentage. Although the Forest/shrub percentage variable was only significant at $p < 0.10$ in two models (DP on August 19 and TP on May 24), inclusion of this variable tended to improve the overall fit of most models and increased the significance of the All Agricultural Land and Population Density variables. Based on these considerations, the final multiple regression models for DP and TP on each date included the Forest/shrub variable in addition to All Agricultural Land and Population Density.

4. RESULTS AND DISCUSSION

Measurements and findings of the phosphorus sampling program and above data analysis are presented in this section of the report. Potential implications of these findings are discussed in Section 5.

4.1. Spatial analysis

The estimated population of each watershed upstream of the sampling point is presented in Table 6. The Malletts Creek watershed (MC) is the most populous among the study watersheds, with an estimated population of 3,128 (Table 6). The next most populous watersheds are Sunderland Brook (SB) at Route 7 (2,028), Pond Brook (PB) at Route 7 (1,795), and Smith Creek (SC; 1,086), in that order. Stream 4 at Pine Island Road (PI) has zero population. Because the Malletts Creek watershed is primarily rural and is much larger than the other study watersheds, its population density is actually quite low, only 0.26 people per acre. The watersheds with the highest population densities are small urban drainages; VI (17.84 people per acre) is the Village Drive stormwater outfall and PP (3.36 people per acre) is the outfall near the intersection of Route 127 and Porters Point Road.

Table 6. Population and population density in study watersheds

Study Watershed	Households	Population	Area (ha)	Area (acres)	Population Density (person/ha)	Population Density (person/acre)
BH	2	5	67.5	166.7	0.07	0.03
CC	356	890	567.6	1402.5	1.57	0.63
CD	6	15	135.4	334.5	0.11	0.04
EH	24	60	63.9	157.9	0.94	0.38
MC	1251	3128	4835.0	11947.4	0.65	0.26
MS	137	343	139.8	345.6	2.45	0.99
PB	718	1795	1022.6	2526.9	1.76	0.71
PI	0	0	37.8	93.4	0.00	0.00
PP	12	30	3.6	8.9	8.31	3.36
S4	46	115	196.8	486.3	0.58	0.24
SB	811	2028	494.1	1220.8	4.10	1.66
SBT	42	105	43.8	108.2	2.40	0.97
SC	435	1086	478.5	1182.3	2.27	0.92
VI	180	450	10.2	25.2	44.08	17.84

Table 7 presents the land use composition of the study watersheds. The calculated land use data confirm the judgments made during selection of the sampling sites. Watersheds PI and S4 are the most agricultural among the study watersheds. Watershed EH, a northern tributary of Pond Brook, is approximately 50% agricultural, but it has comparatively little land in cultivation. The CD (Sunderland Brook tributary at Champlain Drive), SB (Sunderland Brook at Route 7), PP (storm sewer discharging at the Route 127 and Porters Point intersection), and VI (Village Drive storm sewer outfall) watersheds are the most urbanized. These watersheds have the highest percentage of developed land (Table 7) and impervious surface (Table 8). Watershed BH is entirely forested, with the exception of one or two houses; it is a useful point of comparison in evaluating water quality data from the more developed and agricultural watersheds.

Table 7. Land use areas in study watersheds as a percentage of watershed area

Study Watershed	Cultivated Land	All Agricultural Land	Developed Open Space	All Developed Land	Forest/ shrubland	Wetland	Open Water
BH	0.0	0.0	0.0	0.0	100.0	0.0	0.0
CC	3.0	19.8	8.9	15.1	61.3	3.7	0.0
CD	2.6	9.6	15.5	76.6	8.3	5.5	0.0
EH	0.5	48.4	6.4	8.2	41.6	0.9	0.9
MC	1.9	22.4	4.7	8.0	67.6	1.7	0.3
MS	1.3	6.1	13.8	17.6	69.0	7.3	0.0
PB	1.4	14.1	6.2	9.8	66.5	2.1	7.4
PI	82.3	83.1	0.0	0.0	9.2	7.7	0.0

Study Watershed	Cultivated Land	All Agricultural Land	Developed Open Space	All Developed Land	Forest/ shrubland	Wetland	Open Water
PP	0.0	0.0	7.7	92.3	7.7	0.0	0.0
S4	57.7	78.6	0.0	0.1	10.2	10.3	0.7
SB	0.8	6.8	17.4	48.2	42.6	2.3	0.1
SBT	4.6	7.9	16.6	28.5	58.9	3.3	1.3
SC	9.4	19.6	15.9	31.3	45.5	3.6	0.0
VI	0.0	0.0	29.4	94.1	5.9	0.0	0.0

The extent of impervious cover in a watershed has been shown to be strongly associated with stream condition indicators such as aquatic insect diversity and abundance (Allan 2004). As the percentage of impervious cover in a watershed increases, stormwater volume and peak flow rates increase, which often accelerate or precipitate stream channel adjustments to accommodate the increased flows. Sediments eroded from the channel bed and banks impair aquatic habitat and carry phosphorus and other sediment-bound contaminants to receiving waters. Wash off of sediment from impervious surfaces is also a source of phosphorus and a cause of aquatic habitat degradation. 10% impervious cover in the watershed is often cited as a threshold above which the biotic integrity of streams is typically impaired (Allan 2004). No similar threshold is recognized with respect to phosphorus transport, but many of the same mechanisms apply: increases in impervious surface result in more runoff, which destabilizes stream channels, resulting in more sediment and phosphorus loading from the stream.

Table 8. Impervious surface area in study watersheds

Study Watershed	Impervious Area (ha)	Impervious Area (acres)	Non-impervious Area (ha)	Non-impervious Area (acres)	Total Area (ha)	Total Area (acres)	Impervious Percentage
BH	0.1	0.3	67.4	166.5	67.5	166.7	0.17
CC	27.6	68.1	540.0	1,334.4	567.6	1402.5	4.86
CD	46.5	114.8	88.9	219.7	135.4	334.5	34.32
EH	3.4	8.4	60.5	149.5	63.9	157.9	5.34
MC	169.6	419.0	4,665.5	11,528.4	4,835.0	11947.4	3.51
MS	7.2	17.9	132.6	327.7	139.8	345.6	5.18
PB	48.8	120.5	973.8	2,406.4	1,022.6	2526.9	4.77
PI	0.2	0.5	37.6	92.9	37.8	93.4	0.56
PP	1.6	4.0	2.0	4.9	3.6	8.9	45.21
S4	4.2	10.3	192.6	476.0	196.8	486.3	2.12
SB	112.6	278.2	395.9	978.3	508.5	1256.5	22.14
SBT	3.0	7.3	40.8	100.9	43.8	108.2	6.75
SC	43.5	107.5	435.0	1,074.9	478.5	1182.3	9.09
VI	3.8	9.3	6.4	15.9	10.2	25.2	36.82

4.2. Water quality data

The five monitoring dates are given in Table 9, with event precipitation totals from a cooperating weather station (Weather Underground network station KVTCOLCH4) on Belaire Drive in Colchester. The precipitation totals in Table 9 are for the day of and the day prior to sampling. On October 1, 2010, approximately 0.45 inches of rain fell between collection of the first sample at 08:50 and the last sample at 14:10. An insignificant amount of rain (<0.01 inch) was recorded on October 1, 2010 after sampling was completed.

The events of March 23 and October 1, 2010 were major events. The one-year return interval, 24-hour rainfall total for Colchester is 1.91 inches (Northeast Climate Data Center, 2011). Rainfall on March 23rd (1.43 inches) approached this amount and wet spring conditions and approximately 0.46 inches of rain on March 22 added to the streamflow. Local flooding was evident in the Winooski River floodplain and along Malletts Creek. On March 23, floodwaters from the Winooski River inundated the sampling station on Stream 4 in Macrea Farm Park (S4). The October 1 event rainfall total (2.00 inches) exceeded the one-year return interval, 24-hour rainfall total and over 1 inch of rain on the preceding day added to the streamflows. The National Weather Service station at the Burlington International Airport recorded more than an inch of rain on eight days in 2010 and four days during the monitoring period.

The wet weather event on August 3 was minor in comparison to the March 23 and October 1 events. Negligible rainfall was recorded in the week prior to each dry weather sampling event.

Table 9. Sampling dates and antecedent precipitation totals

Sampling Date	Start Time (1st sample)	Event Type	Sampling Day Rain Total (in.)	Prior Day Rain Total (in.)
3/23/10	13:30	Wet weather	1.43	0.45
5/24/10	10:05	Dry weather	0.00	0.00
8/3/10	10:29	Wet weather	0.29	0.41
8/19/10	08:41	Dry weather	0.00	0.00
10/1/10	08:50	Wet weather	2.00*	1.10

*Approximately 0.45 inches of rain fell during sampling

Total and dissolved phosphorus concentration data for the five monitoring events are presented in Table 10 and Figure 2. Summary statistics for total phosphorus concentrations on each date are provided in Appendix A. On average, wet weather total phosphorus concentrations were substantially higher than dry weather total phosphorus concentrations. The total phosphorus concentration was highest on October 1 for eight of the sites. The mean total phosphorus concentration among sampled sites on this date was 684 µg/L. The sites with exceptionally high (>1,000 µg/L) total phosphorus concentrations on October 1 were SBT (2,540 µg/L), EH (2,300 µg/L), and SB (1,200 µg/L). The date with the second highest mean total phosphorus concentration, 359 µg/L, was March 23. The site with the highest total phosphorus concentration on March 23 was SBT (1,010 µg/L). Total phosphorus concentrations at sites SC (705

µg/L), EH (575 µg/L), MC (462 µg/L), and SB (439 µg/L) were also quite high on this date. The lowest total phosphorus concentrations were measured on the two dry weather sampling dates. The mean total phosphorus concentration among sampled sites on May 24 and August 19 were 85 and 87 µg/L, respectively (Appendix A).

Site BH, the forest stream, had the lowest total phosphorus concentration of all sites on all five sampling dates. Site PP, the stormwater outfall at the intersection of Route 127 and Porters Point Road, and site CD, the Sunderland Brook tributary at Champlain Drive, also has relatively low total phosphorus concentrations on most sampling dates.

Table 10. Total and dissolved phosphorus concentrations by sampling date

Study Watershed	P Fraction (µg/L)	3/23/2010	5/24/2010	8/3/2010	8/19/2010	10/1/2010
BH	DP	9.83	7.01	NS	19.4	15.6
	TP	27.3	11.6	15.3	10.5	52.5
CD	DP	12.5	10.3	NS	15.7	19.3
	TP	35.3	19.3	30.3	34.8	145
EH	DP	45.3	70.4	NS	54.8	70
	TP	575	113	252	104	2300
MC	DP	29.7	13.8	NS	31.3	55.1
	TP	462	65.45	108	37.1	344
MS	DP	24.1	9.36	NS	18.7	110
	TP	298	71.5	134	38.2	493
PB	DP	15.6	16.2	NS	17.8	127
	TP	244	44.2	64.2	49.2	440
PP	DP	19.7	<5	NS	9.47	18
	TP	33.4	13.1	48.4	25	56
S4	DP	12.5*	46.4	NS	34.5	NS
	TP	260*	116	NS	66.3	NS
SB	DP	18.45	18.2	NS	32.4	29.1
	TP	439	70.8	163	31.7	1200
SBT	DP	26.6	25.9	NS	29.2	31.8
	TP	1010	66.1	144	45	2540
SC	DP	25.8	14	NS	22.8	54
	TP	705	27	40.6	17.4	660
VI	DP	94.1	240	NS	515	104
	TP	254	400	428	582	151
CC	DP	NS	NS	NS	NS	74.1
	TP	NS	NS	NS	NS	238
PI	DP	34.7	Dry	Dry	Dry	152
	TP	324	Dry	Dry	Dry	266

NS = no sample collected; * = mixed with Winooski River floodwaters

Dissolved phosphorus concentrations were generally low during wet and dry weather events except at site VI, the Village Drive stormwater outfall. Appendix B provides summary statistics for dissolved phosphorus concentrations on each sampling date. Dissolved phosphorus concentrations at site VI, Village Drive, were markedly higher than at other sites and revealed a different pattern, highest during dry weather and lower during the major storm events on March 23 and October 1. These data suggest a dilution effect. The highest dissolved phosphorus concentration (515 µg /L) was seen at site VI during the August 19 event, when conditions were driest. On this date the dissolved fraction constituted 88% of the total phosphorus concentration at site VI. Site PI on October 1 had a dissolved phosphorus concentration of 152 µg /L. It is difficult to interpret this high dissolved phosphorus concentration because this site was dry three events out of five; however, the fact that the PI watershed has no inhabitants, little impervious surface, and is more than 80% cultivated land suggests that some agricultural practice applied prior to the October 1 sampling may have caused the result.

The dissolved phosphorus fraction is of particular environmental concern because the primary forms of dissolved phosphorus are readily available for uptake by aquatic plants. This contrasts with particulate phosphorus, which is chemically bound to sediment particles or contained within organic matter. The particulate phosphorus fraction may be calculated as the difference between the total and dissolved fractions. Over time, phosphorus in particulate forms may be released to the water column as dissolved phosphorus or it may remain in unavailable, particulate forms essentially indefinitely, such as when it becomes buried in deep lake sediments.

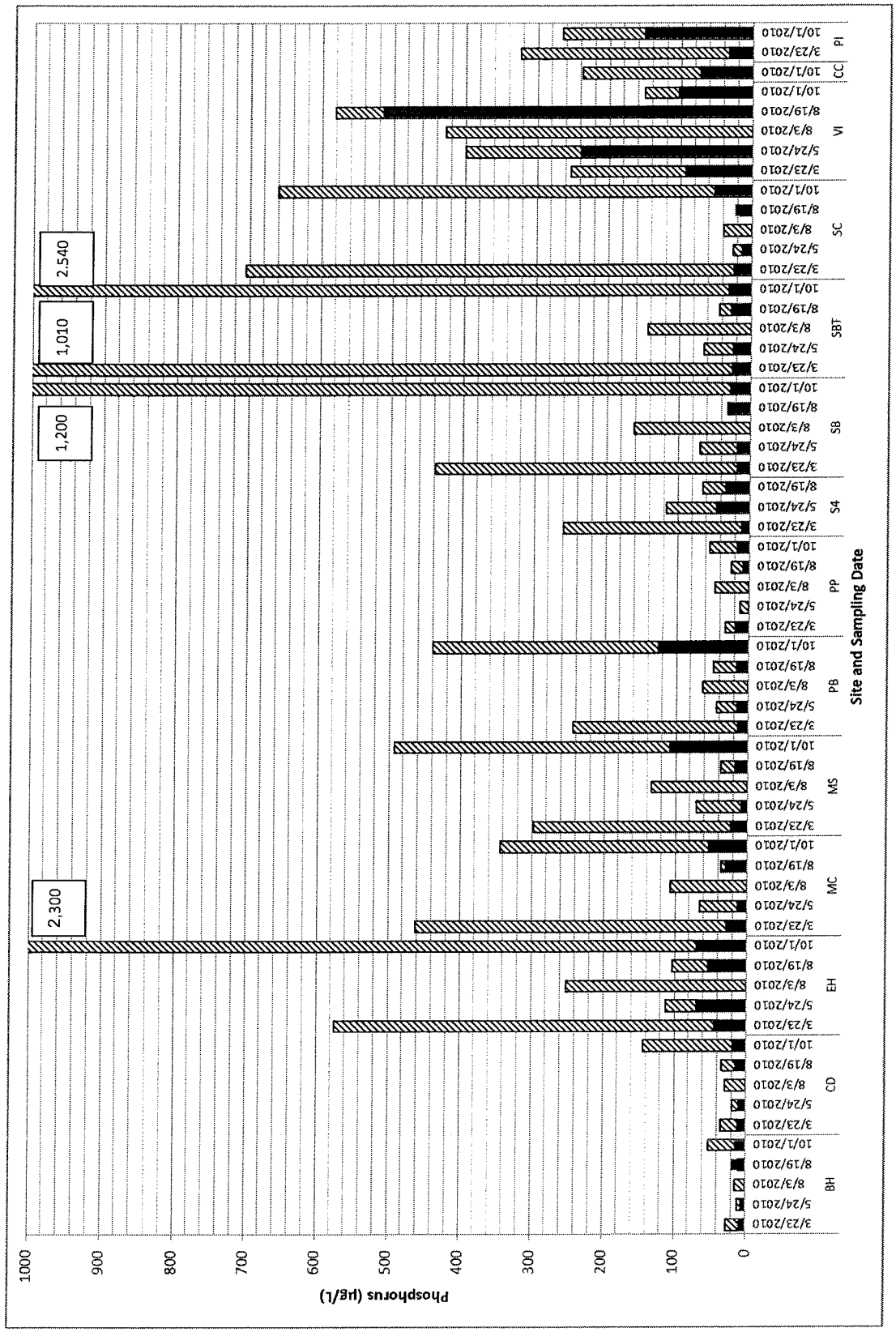

Figure 2: Dissolved and total phosphorus by site and date

Notes: TP is shown as crosshatched columns and DP is shown as superimposed solid black columns. No DP samples were collected on the August 3, 2010 event.

Table 11 presents turbidity data collected in the field on each sampling date. Turbidity levels were very high at certain sites on March 23 and October 1. The mean turbidity levels across all sites on these dates were 172 and 243 nephelometric turbidity units (NTU), respectively (Appendix C). For comparison, the mean turbidity levels on the dry weather events were 8 NTU on May 24 and 9 NTU on August 19. The mean turbidity level for the relatively minor wet weather event sampled on August 3 was intermediate, 27 NTU. The Sunderland Brook tributary sampled at Route 7 (SBT) and the Pond Brook tributary sampled at Route 7 (EH) had substantially higher turbidity than other sites on March 23 (745 and 647 NTU, respectively) and October 1 (1,242 and 1,340 NTU, respectively). These streams appeared very muddy. Channel erosion is evident in the vicinity of both sampling points. Figure 3 is a photograph illustrating turbid streamflow, taken at SBT the week prior to the March 23 sampling event.

Table 11. Turbidity by sampling date

Study Watershed	3/23/2010	5/24/2010	8/3/2010	8/19/2010	10/1/2010
BH	2.54	0.81	1.98	1.21	9
CD	9.14	0.79	5.09	4.39	7.45
EH	647	15.9	74.3	6.27	1340
MC	159	7.53	35.2	7.33	83.1
MS	130	24.6	92.7	37.3	87.9
PB	74.1	6.59	7.98	6.64	48.9
PP	3.77	2.99	10.32	3.31	8.78
S4	111*	15.8	NS	24.6	NS
SB	78.5	8.92	36.4	5.38	129
SBT	745	13.6	29.9	7.61	1242
SC	150	0.63	4.19	0.35	71
VI	5.04	3.68	2.63	4.86	3.43
CC	NS	NS	NS	NS	40.8
PI	127	Dry	Dry	Dry	83.2

NS = no sample collected; * = mixed with Winooski River floodwaters

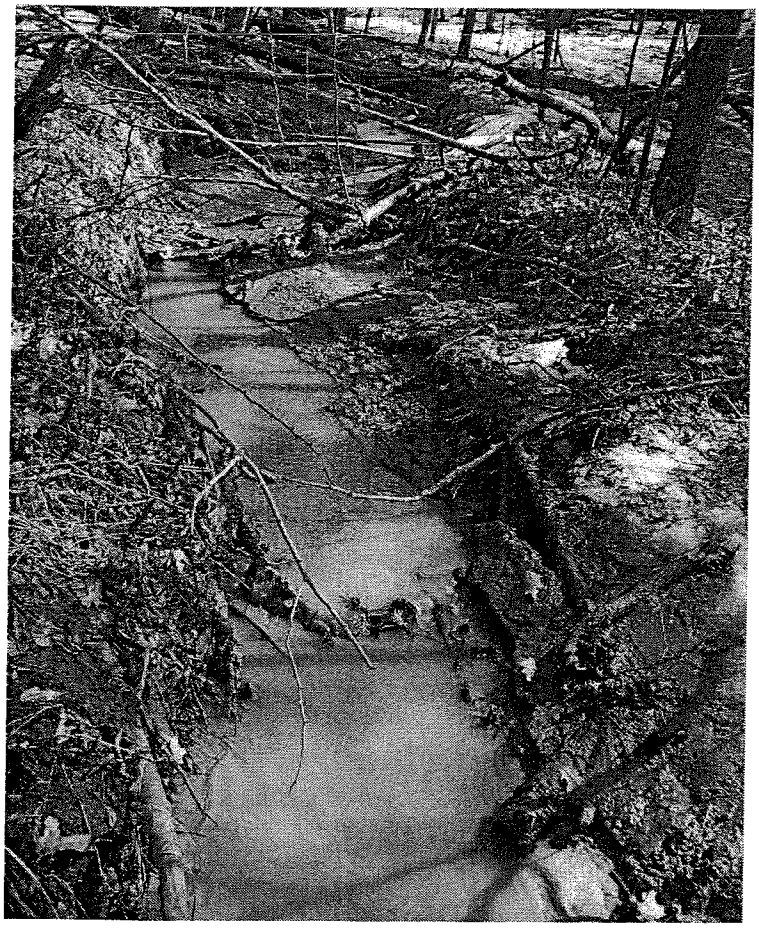

Figure 3. Turbid streamflow upstream of site SBT

Because phosphorus at all sampling sites except site VI is primarily in the particulate form, we can expect to find a positive relationship between total phosphorus and turbidity. Figure 4 illustrates the strong relationship between paired total phosphorus and turbidity data across all sampling dates. To linearize these data, the data were transformed to their base 10 logarithms. For all sites except VI, this linear relationship could be used to approximate total phosphorus concentration from turbidity readings. On all five sampling dates, the site VI data are clearly outliers. This is consistent with the fact that the dissolved phosphorus fraction is high and turbidity was always very low at this site. As stated in the Executive Summary, we believe there is an explanation for this data, which warrants further investigation.

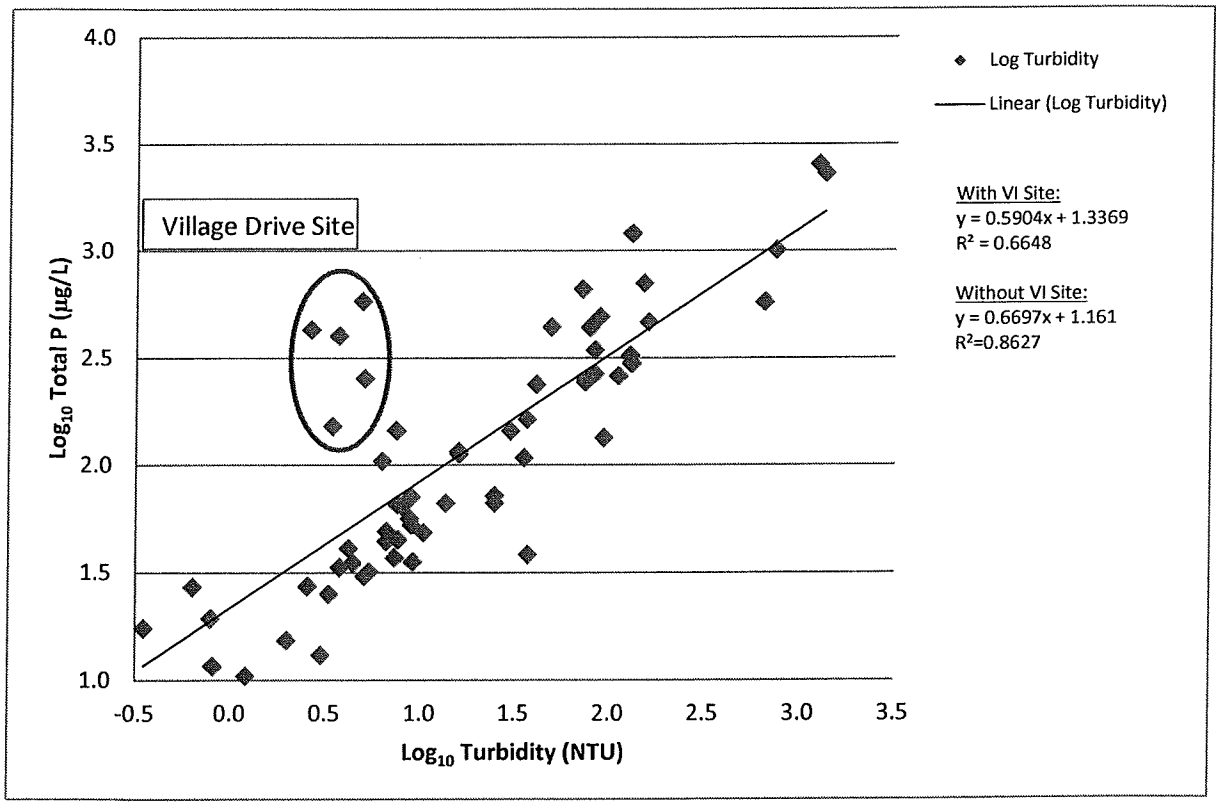

Figure 4. Regression on paired measurements of total phosphorus and turbidity

As described in the methods, the ammonia test performed during sample collection is an insensitive test strip method with a minimum detection limit of 0.25 mg/L; therefore we were not expecting to find detectable levels of ammonia in natural streams using this method. Table 12 presents ammonia concentration data for all sampling dates. No detectable ammonia was measured on the March 23 sampling date; however, detectable levels were found at site VI on the remaining four dates. Elevated levels were also found at site MS (the outlet of Mooring's Stream). The levels could be associated with a wastewater contribution or decomposition of organic nitrogen in the wetlands upstream of both sampling points.

Table 12. Ammonia concentration data (mg/L)

Study Watershed	3/23/10	5/24/10	8/3/10	8/19/10	10/1/10
BH	<0.25	<0.25	<0.25	<0.25	<0.25
CC	NS	NS	NS	NS	<0.25
CD	<0.25	<0.25	<0.25	<0.25	<0.25
EH	<0.25	<0.25	<0.25	<0.25	<0.25
MC	<0.25	<0.25	<0.25	<0.25	<0.25
MS	<0.25	<0.25	0.5	1.0	<0.25
PB	<0.25	<0.25	<0.25	<0.25	<0.25
PI	<0.25	Dry	Dry	Dry	<0.25
PP	<0.25	<0.25	<0.25	0.3	<0.25
S4	<0.25*	<0.25	NS	0.25	NS
SB	<0.25	<0.25	<0.25	<0.25	<0.25
SBT	<0.25	<0.25	<0.25	<0.25	<0.25
SC	<0.25	<0.25	<0.25	<0.25	<0.25
VI	<0.25	1.0	1.0	1.0	0.25

NS = no sample collected: * = mixed with Winooski River floodwaters

The study did not adequately characterize phosphorus concentrations in the large area of drained cropland in the Winooski River floodplain on and surrounding Pine Island. The primary stream in this area is referred to as Stream 4. This stream was sampled at site PI on Pine Island Road and at site S4 in Macrea Farm Park. Unfortunately site PI was dry on the summer sampling dates and site S4, a low gradient slough, was a problematic site due to backwater conditions and stagnant water impounded by beaver dams. We found no other publically accessible sampling locations to this stream. The only samples collected at site PI, on March 23 and October 1, had moderately high TP and DP concentrations. Based on these results, further monitoring of this stream during high groundwater conditions in the spring may be warranted.

4.3. Statistical associations between phosphorus concentrations and land use

Table 13 summarizes the statistical fit of the multiple regression models and provides estimates for each term in the multiple regression equations.

Comparison of R^2 (coefficient of determination) values among regression models suggested that no set of land use variables tested in this study was consistently the best predictor of DP and TP concentrations. The two variables that were most often significant among the models tested were All Agricultural Land (%) and Population Density. Inclusion of the Forest/shrub variable with All Agricultural Land and Population Density resulted in marginal improvement in the models for most dates. With these three independent variables, the multiple regression equation can be written as:

DP or TP conc. = Intercept + β_1 x All Agricultural Land + β_2 x Forest/Shrub + β_3 x Population Density + ε,
where β_1, β_2, and β_3 are the regression coefficients (partial slopes) for the three independent variables and ε is the statistical error.

The percentage of All Agricultural Land, percentage of Forest/shrub, and Population Density explained 54% of the variation in DP concentration on October 1 and more than 90% of the variation on March 23, May 24, and August 19 (Table 13). These variables explained 95% of the variation in TP concentration on May 24, 84% on August 3, and 97% on August 19. However, the variables failed to explain the variation in TP concentration on March 23 ($R^2 = 0.10$) and October 1 ($R^2 = 0.06$), the two wet weather flow events. No combination of land use variables had power to explain the variation in TP concentration on these dates. This result and the exceedingly high turbidity readings at certain sites on these dates suggest that the source of total phosphorus on these dates was not primarily runoff from the contributing watersheds. **During these high flow events, total phosphorus concentration in the stream may be more a function of stream channel erosion than surrounding land use.**

Table 13. Summary of fit and parameter estimates for regression models

Parameter estimates in bold are significant at $p < 0.10$. Estimates in bold and underlined are significant at $p < 0.05$.

Response DP (µg/L) on 3/23/10 Summary of Fit		Parameter Estimates				
RSquare	0.93	Term		Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	0.90	Estimate	5.64	**0.44**	0.12	**1.98**
Root Mean Square	7.23	Std Error	6.22	0.10	0.09	0.22
Mean of Response	29.70	t Ratio	0.91	4.16	1.32	8.88
Observations	12	Prob>|t|	0.3911	0.0032	0.2242	<0.0001
Response TP (µg/L) on 3/23/10 Summary of Fit		Parameter Estimates				
RSquare	0.10	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	-0.24	Estimate	167.56	3.58	2.83	2.04
Root Mean Square	327.91	Std Error	282.21	4.75	4.02	10.14
Mean of Response	367.25	t Ratio	0.59	0.75	0.70	0.20
Observations	12	Prob>|t|	0.5691	0.4722	0.5010	0.8452
Response DP (µg/L) on 5/24/10 Summary of Fit		Parameter Estimates				
RSquare	0.95	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	0.93	Estimate	-25.46	**1.02**	0.31	**5.88**
Root Mean Square	17.44	Std Error	15.03	0.26	0.21	0.54
Mean of Response	39.51	t Ratio	-1.69	3.91	1.47	10.89
Observations	12	Prob>|t|	0.1287	0.0045	0.1801	<0.0001
Response TP (µg/L) on 5/24/10 Summary of Fit		Parameter Estimates				
RSquare	0.95	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	0.93	Estimate	-30.09	**1.85**	**0.65**	**9.55**
Root Mean Square	27.11	Std Error	23.36	0.41	0.33	0.84
Mean of Response	84.84	t Ratio	-1.29	4.54	1.95	11.40
Observations	12	Prob>|t|	0.2337	0.0019	0.0867	<0.0001
Response TP (µg/L) on 8/3/10 Summary of Fit		Parameter Estimates				
RSquare	0.84	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	0.77	Estimate	-5.27	**4.07**	0.55	**9.80**
Root Mean Square	58.84	Std Error	50.98	1.41	0.73	1.83
Mean of Response	129.80	t Ratio	-0.10	2.89	0.75	5.36
Observations	11	Prob>|t|	0.9205	0.0233	0.4763	0.001
Response DP (µg/L) on 8/19/10 Summary of Fit		Parameter Estimates				
RSquare	0.97	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	0.96	Estimate	**-50.76**	**1.08**	**0.64**	**12.52**
Root Mean Square	26.87	Std Error	23.15	0.40	0.33	0.83
Mean of Response	66.76	t Ratio	-2.19	2.67	1.93	15.06
Observations	12	Prob>|t|	0.0597	0.0282	0.0892	<0.0001
Response TP (µg/L) on 8/19/10 Summary of Fit		Parameter Estimates				
RSquare	0.97	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	0.95	Estimate	-44.05	**1.52**	0.59	**13.87**
Root Mean Square	33.98	Std Error	29.28	0.51	0.42	1.05
Mean of Response	86.77	t Ratio	-1.50	2.99	1.41	13.20
Observations	12	Prob>|t|	0.1709	0.0173	0.1973	<0.0001
Response DP (µg/L) on 10/1/10 Summary of Fit		Parameter Estimates				
RSquare	0.54	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	0.39	Estimate	1.10	**1.60**	0.53	**2.28**
Root Mean Square	35.27	Std Error	30.35	0.51	0.43	1.09
Mean of Response	66.15	t Ratio	0.04	3.14	1.24	2.09
Observations	13	Prob>|t|	0.9720	0.0119	0.2463	0.0657
Response TP (µg/L) on 10/1/10 Summary of Fit		Parameter Estimates				
RSquare	0.06	Term	Intercept	Agriculture (%)	Forest/shrub (%)	Pop. density (#/ha)
RSquare Adj	-0.26	Estimate	444.77	5.64	3.71	-5.81
Root Mean Square	931.00	Std Error	801.05	13.46	11.29	28.79
Mean of Response	683.50	t Ratio	0.56	0.42	0.33	-0.20
Observations	13	Prob>|t|	0.5923	0.6850	0.7498	0.8444

Comparing the significance of regression coefficients is another way to assess the explanatory power of the independent variables. In Table 13, coefficients in bold face are significant at $p < 0.10$ and coefficients in bold and underlined are significant at $p < 0.05$. Coefficients for both the All Agricultural Lands and the Population Density variables were significant in all four regression models using DP concentration as the dependent variable and in three of the five models using TP concentration as the dependent variable. With the exception of the very poor model for TP concentration on October 1, coefficients for both All Agricultural Lands and Population Density were positive in every case, meaning that an increase in either the agricultural land area or the population density is associated with an increase in DP and TP. The Forest/shrub variable was never statistically significant at the $p < 0.05$ level and was only significant at $p < 0.10$ in two models, TP concentration on May 24 and DP concentration on August 19. Whether a significant variable or not, the sign of the coefficient for Forest/shrub was positive in all nine models described in Table 13, indicating that increase in the forest land area is associated with increased DP and TP. While positive, the Forest/shrub coefficient was substantially lower that the All Agricultural Land coefficient in all nine models, which indicates that **a given percentage of watershed area in agriculture is associated with a higher phosphorus concentration that the same percentage of land area in forest.** Stated differently, both agricultural land and forest land are sources of phosphorus, but **streams draining watersheds with more agricultural land have higher phosphorus concentrations than streams draining more forested watersheds.**

The coefficients for the Population Density variable are not directly comparable to the coefficients for All Agricultural Land and Forest/shrub. The sign of the Population Density coefficient is positive in every case except the model for TP concentration on October 1. This indicates that **streams draining watersheds with higher population density have higher phosphorus concentrations.** This result must be interpreted with some caution, because **there are many related factors not captured in the final models that are presumably correlated with population density, such as construction activities, impacts of roads (alteration of runoff flow paths, erosion of road ditches, increased impervious surface area), density of onsite wastewater systems, stream channel alteration, et cetera.** The Population Density variable is an overall measure of the intensity of residential development. With many more sampling sites the multitudinous impacts of land development might be separately resolved, but in this study Population Density was the only variable related to development that had reasonable statistical power.

Finally, in the exploratory, step-wise regression analysis wetland variables were significant in several of the models. Herbaceous Wetlands and All Wetlands Plus Open Water (lakes and ponds) entered more step-wise models than Forested Wetlands, Open Water alone, or other combinations. Because Herbaceous Wetlands were correlated with All Agricultural Land and because the power of the wetland variables were highly inconsistent across sampling dates, wetland variables were not included in the final models presented in Table 13. However, **there was some support in these data for the finding by some researchers that wetlands can act as a sink for P in the landscape under certain conditions** (Windhausen et al, 2003; Jordan et al., 1986; Nixon and Lee, 1986; Johnston, 1991). Where a wetland

variable entered the step-wise model, the sign of the coefficient was usually negative (except for the poor TP model on October 1), which suggests that an increase in wetlands area is associated with decreased DP and TP concentrations. A more extensive sampling program would be required to resolve the net impact of wetlands on stream phosphorus concentrations in Colchester.

5. MANAGEMENT IMPLICATIONS OF FINDINGS

During the dry weather events and for the moderate wet weather event of August 3, 2010 strong associations were found between total phosphorus concentrations and agricultural land and population density. The main conclusion to draw from these results is that **it appears major land uses are controlling stream phosphorus concentrations under most conditions.** However, the highest total phosphorus concentrations measured in this study occurred during the high flow events of March 23 and October 1 and land use variables were poor predictors of total phosphorus concentrations on these events.

During the March 23 and October 1 high flow events, the turbidity was very high in the small tributaries of Pond Brook (site EH) and Sunderland Brook (site SBT) sampled at Route 7. Turbidity was moderately high at sites MC, MS, S4, SB, SC, and PI. Dissolved phosphorus concentrations were small fractions of the total at these sites on these dates, except for site PI on October 1 where DP was elevated. A strong correlation was documented between turbidity and total phosphorus concentration at all sites except VI. Therefore, a second general conclusion is that **high total phosphorus concentrations measured during the spring and fall high flow events were due to sediment transport, and that other (not quantified) factors had greater impact on sediment and total phosphorus concentrations than land use during high flow events.** The factors contributing to high turbidity and high total phosphorus concentration during high flow events could not be investigated in this study. However, we suspect that stream channel adjustments are a major source of the phosphorus under high flow conditions. Figure 5 shows active channel adjustment in unconsolidated sediments of Sunderland Brook upstream of the Route 7 crossing. Whether from historic or modern sources, there is evidentially a great deal of sediment storage in this reach and the lack of vegetation along the active channel makes these sediments prone to erosion. These conditions may contribute sediment and phosphorus to the stream for many years to come.

Figure 5. Sunderland Brook upstream of the Route 7 crossing

While total phosphorus can contribute to water quality impairment after release from sediments and organic matter in the receiving environment, elevated dissolved phosphorus concentrations are of more certain and immediate concern, because most forms of dissolved phosphorus are immediately available for uptake by algae and aquatic plants, contributing to eutrophic conditions in receiving waters. Dissolved phosphorus concentrations in streams should be low, especially under dry weather conditions when stream baseflows are sustained by groundwater discharge. The stormwater outfall from the Village Drive neighborhood (site VI) had very high dissolved phosphorus concentration during the dry weather sampling dates, 240 µg /L on May 24 and 515 µg /L on August 19. We did not establish the cause of the elevated dissolved phosphorus at this site, but we speculate that malfunctioning onsite wastewater treatment systems may contribute dissolved phosphorus to the Village Drive stormdrain. This speculation is supported by elevated *E. coli* levels (reported separately) and ammonia concentrations at the outfall. Site EH also had moderately elevated dry weather dissolved phosphorus concentrations; livestock impacts observed immediately upstream may have contributed to these elevated concentrations.

The Champlain Drive (CD) sampling location on a southern tributary of Sunderland Brook is an interesting example of a highly impervious watershed (34%) with relatively low total and dissolved phosphorus concentrations and turbidity on the sampling dates. Site CD is illustrated in Figure 6. This watershed is mainly commercial and industrial; the residential population density is low (0.11 person/hectare). Many of the commercial properties have stormwater ponds and there are wetlands present along much of the stream channel length. Although stormwater ponds were not considered in the watershed statistical analysis and wetland areas were rarely significant in regression models, based on these data **we suspect that stormwater management practices and riparian wetlands are dampening peak flows and reducing sediment and phosphorus transport from this watershed. The DP and TP**

concentration data at this site were substantially lower than at site SBT, which is also a small tributary to Sunderland Brook, but which lacks stormwater ponds.

Figure 6. Sunderland Brook Tributary at Champlain Drive (site CD)

Given the preliminary nature of this study, we cannot recommend highly specific management actions based on these results. **Agricultural land and population density appear to control phosphorus transport under low and moderate flow conditions. A whole range of agricultural and urban best management practices may be implemented to reduce these contributions.** Most agricultural management practices related to water quality protection are implemented through state and federal programs, with less involvement by municipal government. However, **one critical agricultural practice that the Town of Colchester could affect is livestock exclusion from stream channels, which is a problem near site EH and likely in other areas as well.** Livestock exclusion improves stream habitat and can reduce animal wastes and phosphorus discharge to the stream (Meals, 2001). Livestock exclusion may be required and enforced under municipal law. The study was not able to adequately characterize phosphorus concentrations in the large area of drained cropland in the Winooski River floodplain on and surrounding Pine Island; therefore, further monitoring in this area is recommended.

Strong associations were found between population density and dissolved phosphorus concentration under all monitored flow conditions and between population density and total phosphorus under low flow conditions. While this is a meaningful scientific result, it is not a particularly useful result from the standpoint of water quality management. Among the three small urban watersheds (sites CD, PP, and VI), high phosphorus concentrations were only found at site VI; site VI has a similar percentage of impervious surface (37%) to sites CD and PP but a higher population density. **Site**

VI represents a phosphorus critical source area and the source of the elevated phosphorus (and *E. coli* and ammonia) concentrations should be investigated.

The generally low phosphorus concentrations measured at site CD suggest that conventional stormwater management and naturally occurring wetlands and ponds in this watershed are mitigating the effects of stormwater runoff. Although not supported by exhaustive data, this is a recommendation for stormwater treatment. However, **an equally important result occurred during site selection when it became obvious that there were no streams to sample west of Church Road. Precipitation and most of the collected stormwater in this area infiltrates the ground. Successfully infiltrating stormwater eliminates urban runoff and the associated loading of phosphorus and other contaminants to surface waterbodies.**

Overall, the results, although not definitively conclusive, are consistent with expected results in Lake Champlain tributaries. The detailed findings documented herein reinforce the prevailing scientific understanding of stormwater processes in the basin: that **streams draining watersheds dominated by agricultural and/or higher density residential land uses tend to have elevated phosphorus concentrations relative to reference (forested) conditions.** The results also suggest that **stream channel adjustment may be a dominant source of total phosphorus under high flow conditions. Runoff during wet weather events may be mitigated by increased application of stormwater treatment systems in developed areas and best management practices for agricultural land.**

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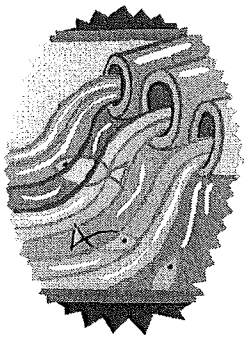
Town of Colchester, Vermont

ILLICIT DISCHARGE DETECTION AND ELIMINATION PLAN



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April, 2005

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1.0 INTRODUCTION

1.1 Although the quality of the Nation's waters has improved greatly since the passage of the Clean Water Act in 1972, many water bodies are still impaired by pollution. According to the U.S. Environmental Protection Agency's (EPA's) 2000 National Water Quality Inventory, 39 percent of assessed river and stream miles, 46 percent of assessed lake acres, and 51 percent of assessed estuarine square miles do not meet water quality standards. The top causes of impairment include siltation, nutrients, bacteria, metals (primarily mercury), and oxygen-depleting substances. Polluted storm water runoff, including runoff from urban/suburban areas and construction sites, is a leading source of this impairment. To address this problem, EPA has put into place a program that regulates certain storm water discharges.

1.2 In 1990, EPA promulgated Phase I of its storm water program under the National Pollutant Discharge Elimination System, (NPDES) permit provisions of the Clean Water Act. Phase I addressed storm water runoff from "medium" and "large" municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or greater, construction activity that would disturb five or more acres of land, and 10 categories of industrial activity. To further reduce the adverse effects of storm water runoff, EPA instituted its Storm Water Phase II Final Rule on December 8, 1999.

1.3 The Phase II storm water program is part of EPA's NPDES program, which in many states is delegated to state authorities to administer. The State of Vermont is authorized to serve as a NPDES permitting authority. EPA Region 1 serves as the permitting authority for federal facilities in the State of Vermont.

1.4 Phase II regulates discharges from small MS4's located in "urbanized areas", as delineated by the Census Bureau in the most recent census, and from additional small MS4s designated by the permitting authority. Phase II also regulates construction activities that would disturb between one and five acres of land.

1.5 MS4s are typically operated by municipalities, but the Phase II definition of "municipal separate storm sewer systems" includes storm sewer systems owned or operated by other public bodies such as states, departments of transportation, etc. EPA also notes that an MS4 is not always just a system of underground pipes; it can include roads with drainage systems, gutters and ditches.

1.6 EPA's Phase II rule specifies that permitting authorities must issue general permits for "automatically designated" small MS4s. The rule requires that operators of these automatically designated small MS4s apply for NPDES permit coverage. To obtain this coverage, an MS4 operator must develop, implement, and enforce a storm water management program that is designed to reduce the discharge of pollutants to the maximum extent practicable, protect water quality, and satisfy the applicable water quality requirements of the Clean Water Act.

EPA's Storm Water Phase II Final Rules states that this storm water management program must include the following six minimum control measures.

- Public education and outreach on storm water impacts.
- Public involvement and participation.
- **Illicit discharge detection and elimination (IDDE)**
- Construction site storm water runoff control
- Post-construction storm water management in new development and redevelopment
- Pollution prevention and good housekeeping for municipal operations.

1.7 As part of an application for permit coverage, MS4 operators must identify the best management practices they will use to comply with each of the six minimum control measures and the measurable goals they have set for each measure.

2.0 ILLICIT DISCHARGE DEFINED

2.1 The term "illicit discharge" is defined in the EPA's Phase II storm water regulations as "any discharge to a municipal separate storm sewer that is not composed entirely of storm water, except discharges pursuant to a NPDES permit and discharges resulting from fire fighting activities"

2.2 Illicit discharges can be categorized as either direct or indirect.

2.2.1 Examples of Direct Discharges:

a. Sanitary wastewater piping that is directly connected from a home to the storm drain catch basin.
b. Materials (e.g., used motor oil) that have been dumped illegally into a storm drain catch basin.
c. A shop floor drain that is connected to the storm sewer.
d. A cross-connection between the municipal sewer and storm sewer systems.

2.2.2 Examples of Indirect Discharges:

a. An old and damaged sanitary sewer line that is leaking fluids into a cracked storm sewer line.
b. A failing septic system that is leaking into a cracked storm sewer line or causing surface discharge into the storm sewer.

3.0 ADDITIONAL EXEMPTIONS

3.1 The EPA's Phase II storm water regulations require that an illicit discharge detection and elimination program need only address the following categories of non-storm water discharges if the operator of a small MS4 identifies them as significant contributors of pollutants to the MS4.

- Water line flushing
- Landscape irrigation
- Diverted stream flows
- Rising ground waters
- Uncontaminated ground water infiltration
- Uncontaminated pumped ground water
- Discharges from potable water sources
- Foundation drains
- Air conditioning condensation
- Irrigation water
- Springs
- Water from crawl space pumps
- Footing drains
- Lawn watering
- Individual residential car washing
- Flows from riparian habitats and wetlands
- De-chlorinated swimming pool discharges
- Street wash water

4.0 ILLICIT DISCHARGE ORDINANCE

4.1 The IDDE Plan is authorized by an Illicit Discharge and Storm Water Connection Ordinance, approved and adopted by the Colchester Select Board on _____. The Ordinance has been created to comply with the EPA's Phase II Storm Water Regulations. The ordinance contains a prohibition of illicit discharges, establishes the legal authority for the Town of Colchester to inspect properties suspected of releasing contaminated discharges into the storm sewer system, and, contains an enforcement mechanism to ensure compliance to the ordinance.

5.0 DEVELOPMENT OF STORM SEWER MAP

5.1 This IDDE Plan utilizes GIS based Storm Sewer Maps to better understand the intake and discharge areas of the system. The maps aid in the determination of the extent of discharged dry weather flows, the possible sources of the dry weather flows, and the particular water bodies these flows may be affecting.

5.2 The mapping includes such features as manholes, catch basins, piping, culverts, outfalls and storm water ponds. An inventory has also been completed that includes the identification of the type of structure, its location and the assignment of an identification number. As a management tool, the map allows for the correlation and evaluation of the physical features related to the Town's infrastructure, the various land uses throughout the community, and the associated water sheds for purposes of detecting and eliminating illicit discharges.

5.3 The Town is steadily increasing and improving its GIS mapping capabilities in order to maintain and update data layers such as the storm water map. Additionally, under the Town's land use regulations, developers are now required to provide site plan information in digital format which will be used to regularly update the Town's maps with new information.

6.0 LOCATING PRIORITY AREAS

6.1 The process of locating priority areas shall consist of three steps. These include:

a. The identification of potential hot spots.
b. Conducting dry-weather field screening to identify non-storm water discharges.
c. Conducting water quality tests to determine if any identified non-storm water discharges may be illicit discharges.

6.2 The identification of potential hot spots - "Hot Spots" are areas that are considered to be likely sources of illicit discharges, based on available information. These include certain types of zoning districts, older areas of the community, areas where there have been repeated complaints, and locations where water quality sampling have identified high levels of contaminates. The IDDE plan will rely upon several resources to identify these areas.

6.2.1 The mapping within the plan identifies current land uses through GIS zoning overlays. The IDDE plan shall focus primarily on social, institutional, infrastructure, industrial, manufacturing, waste, shopping, business and trade related land use activities.

6.2.2 Complaints or concerns from the public regarding possible illicit discharges or other water quality issues will be received through the establishment of a Storm Water Hotline. The line will be checked daily during normal business hours, and all messages will be reported to the Department of Public Works Operations Manager, and entered into a computer data base. Additional input may be received from Storm Water Watch Groups that have been established through the Public Involvement and Participation measure of the Town's Phase II Plan.

6.2.3 Information will also be collected from available water quality data. Extensive data has been collected by both the Town and State for waters in Colchester. This information will be used to identify priority areas for conducting dry-weather outfall and manhole surveys. The reference resources for this section are located in the plans appendix.

6.3 Conducting dry-weather outfall and manhole surveys – Visual observations of outfalls within priority areas will be made during dry weather. For purposes of this plan, dry weather shall be defined as no rain within the preceding 48 hours. Dry weather observations shall be completed for all outfalls within the prioritized areas two times each year. Dry-weather flows shall be observed for color, odor, turbidity, and floatable matter. Outfalls will also be observed for deposits and stains, vegetation, and damage to the outfall structure. This information shall be used to begin the preliminary process of determining the presence of a possible illicit discharge. The process may then be expanded to include water quality testing if a dry-weather flow is detected. All information collected through this phase of the plan will be recorded on field inspection logs and maintained within a central file or data base.

6.4 Conducting Water Quality Tests – When dry-weather flow is observed, visual or odor observations may provide sufficient information to determine that a discharge is illicit and identify the likely source. If not, water quality sampling shall be used to determine whether the flow is likely to have resulted from an illicit discharge. Certain water quality parameters can serve as indicators of the likely presence or absence of a specific type of discharge. This IDDE plan shall primarily use the following water quality test parameters to determine if dry-weather flows are illicit discharges.

a. **pH** - Extreme pH values (low or high) may indicate commercial or industrial flows.
b. **Optical Brighteners** – Used to indicate presence of laundry detergents.
c. **Bacteria** – Used to indicate the presence of sanitary wastewater.

7.0 TRACING THE SOURCE OF AN ILLICIT DISCHARGE

7.1 Once storm drain outlets with evidence of illicit discharges have been identified, various methods can be used to pinpoint the exact source of the discharge. These include manhole observations, video inspection, smoke testing, dye testing, aerial infrared and thermal photography, and tracking illegal dumping. This IDDE plan will generally proceed with the following procedures, yet may elect to use other techniques if necessary.

7.1.1 Manhole Observations – This initial step involves following dry-weather flows upstream along the conveyance system to bracket the location of the source. Using the storm water system map as a guide, the next upstream manhole will be located and inspected to determine if a discharge is present. This process will be repeated until a junction is found with no evidence of a discharge. Further efforts are then concentrated between the junction with no discharge, and the next downstream manhole.

7.1.2 Smoke Testing - This step involves injecting non-toxic smoke into the storm sewer lines and then noting the emergence of smoke from sanitary sewer vents in illegally connected buildings or from cracks and leaks in the storm sewer lines. Prior to performing this test, building owners and occupants within the area will be provided with advance notice. Public safety officials will also be notified of the test.

7.1.3 Dye Testing – Once the presence of an illegal connection has been identified through the smoke testing, dye testing shall be used to confirm the illegal connection. This technique involves flushing non-toxic dye into toilets and sinks and observing storm sewer and sanitary sewer manholes and storm sewer outfalls for the presence of the dye. Prior to performing these tests, building owners and occupants will be given advance notice and permission for entry shall be gained.

8.0 REMOVING THE SOURCE OF AN ILLICIT DISCHARGE

8.1 There may be several different sources of illicit discharges. Subsequently, there will likely be various responses or actions the Town may take to address the illicit discharge. These actions will generally consist of the following:

8.1.1 Compliance Assistance and Enforcement for Illegal Connections to Homes and Businesses. – Through this IDDE plan, the Town will respond to the discovery of an illegal connection in a graduated manner. Often, home or business owners are not aware of the existence of illegal connections between their buildings and the storm sewer system. The initial step will involve providing the responsible party with information about the connection, its environmental consequences, the applicable regulations, and how the problem may be corrected in an effort to secure voluntary compliance. In the event that voluntary compliance can not be secured, the Town will move to enforcement provisions as outlined within the IDDE Ordinance.

8.1.2 Proper Construction and Maintenance of MS4's – Some illicit discharge problems may be the responsibility of the Town. These problems may include cross connections within the municipal sanitary sewer and storm sewer systems, or infiltration into damaged or deteriorating storm sewer pipes. In these instances, the Town will immediately make the necessary corrections to the system.

Additionally, the Town shall maintain accurate maps of the sanitary sewer system and the storm sewer system to prevent the creation of cross connections during new construction. The Town will also periodically inspect and properly maintain these systems to keep them in good repair.

8.1.3 Preventing and Responding to Illegal Dumping – It is often difficult to identify and locate the individuals responsible for illegal dumping. Subsequently, this IDDE plan focuses on prevention, backed up by enforcement to the extent possible. The following strategies shall be used:

8.1.3.1 Site Maintenance and Controls – Storm-drain stenciling programs have been implemented as part of the Public Involvement and Participation measure of the Town's Phase II plan. This program will be continued on an annual or as needed basis in the future. The Town, through its public safety departments, maintains an operational readiness through regular training associated with hazardous material incidents.

8.1.3.2 Community Outreach and Involvement – A storm water hotline has been established to receive public concerns or complaints relating to illegal dumping or other water quality issues. An information brochure on illicit discharges has been developed and distributed to local businesses through the Town's Economic Development Office. The Town also provides other outreach materials to the general public relating to waste disposal options, such as oil recycling and household hazardous waste collections through a website developed through the Chittenden County Regional Education Program, (RSEP).

8.1.3.3 Targeted Enforcement – An IDDE ordinance has been developed and adopted by the Select Board. Training of municipal employees is conducted annually on identifying and detecting illicit discharges.

9.0 EVALUATION OF THE IDDE PROGRAM

9.1 The annual evaluation of the IDDE plan will include documentation of actions taken to locate and eliminate illicit discharges. Documentation shall include such information as the number of outfalls screened, complaints received and investigated, feet of storm sewers investigated for illicit discharges, numbers of tests conducted and number of illicit discharges detected and eliminated. Additionally, information shall be collected from existing ongoing water quality monitoring programs and correlated with information collected through the IDDE plan. This information will then be used to assess the overall effectiveness of various IDDE strategies. Specific evaluations will include:

a. The number of possible illicit discharges that were detected using different detection methods, to determine which detection methods are most effective.
b. The number of illicit discharges eliminated using different possible enforcement and compliance measures.
c. Any changes in water quality data at ongoing sampling sites within areas where illicit discharges have been detected and eliminated.
d. The efficiency and feasibility of various procedures or the practical difficulties encountered with a particular approach.

10. OUTREACH TO EMPLOYEES, BUSINESSES, AND THE GENERAL PUBLIC

10.1 This section of the IDDE Plan describes the Town's current and ongoing efforts toward informing public employees, businesses, and the general public of the hazards associated with illegal discharges and improper disposal of waste.

10.1.1 Public Employees – On an annual basis, the Town's maintenance employees receive training relating to Pollution Prevention/Good Housekeeping for Municipal Operations as a part of the Town's Phase II plan. The training provides a basic understanding of how municipal operations can result in the discharge of contaminates, basic knowledge of illicit discharges, including detection and elimination, and what steps can be taken to prevent these discharges from municipal operations.

10.1.2 Businesses – The Department of Public Works has developed an informational brochure designed for local businesses to improve their understanding of illicit discharges. Several hundred of the brochures were produced and distributed to local businesses through the Colchester Community Development Office. The Town will continue to provide this information to the Community Development Office for distribution to local businesses.

10.1.3 General Public – The Colchester Public Works Department has partnered with several local residents on a storm-drain stenciling program. Area residents, together with neighborhood children, worked together with the Town to stencil approximately 800 storm-drains throughout the community. The materials and training were provided by the Town. Local papers covered the story printing pictures of the kids performing the work and learning about good water resource management.

10.1.3.1 The Town of Colchester is a member of the Regional Storm Water Education Program, (RSEP). This regional consortium of Chittenden County MS4's has hired a professional Marketing Firm to create a marketing campaign to educate the public on a variety of storm water issues.

RSEP annually creates several radio, television and print advertisements, and manages a "drive to web" campaign. The RSEP website contains a variety of waste management and reduction information for the public.

10.1.3.2 The Town of Colchester, Department of Public Works, maintains its own web site which hosts a variety of storm water information and associated links for the general public to learn more about water quality issues and illicit discharges.

10.1.3.3 The Colchester Department of Public Works partnered with local residents on stream corridor cleanup projects in conjunction with Greenup Day. An engineering consultant was retained to perform a field reconnaissance of an impaired water shed within the community, and to identify any illegal waste sites. Sites were located with GIS coordinates and mapped. The department worked with the local residents to educate them on the hazards associated with illegal dumping, and cleaning up the stream corridor.

10.1.3.4 The Department has also established a storm water hotline that can be contacted by the public to report illicit discharges or any other concerns regarding water quality in Colchester. The telephone number is advertised on the Town's website. The line is checked daily during normal business hours, and complaints are forwarded to the Public Works Operations Manager for follow up. All calls, complaints and actions are recorded within a computer data base for future reference.

10.1.3.5 The Department has established several Storm Water Watch Groups in various watersheds throughout the community. These citizens serve as additional eyes and ears for the Town, looking for signs of illicit discharges and other water quality issues. Initially, basic educational materials are provided to assist them in their duties, with periodic updates as required.

11.0 BMPS AND MEASUREABLE GOALS

11.1 BMP's and measurable goals associated with the Town's efforts toward Illicit Discharge Detection and Elimination, are outlined in Section 4.2.3 of the Town's Phase II plan, authorized by the VANR under General Permit 3-9014, NPDES Number VTR040000. The creation and implementation of this IDDE plan is itself, a feature goal identified in the Town's Phase II plan.

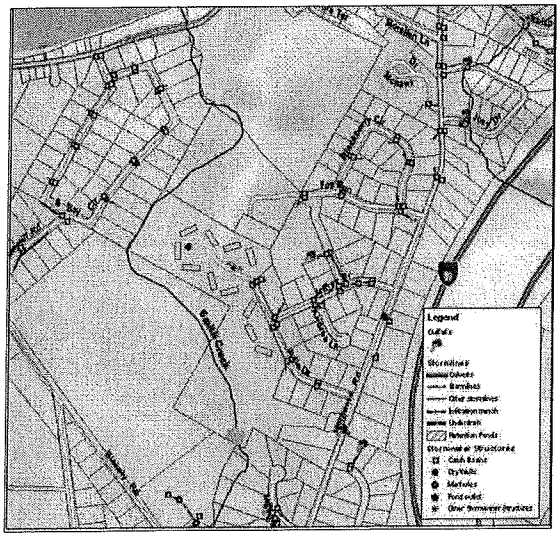
Infrastructure Inventory

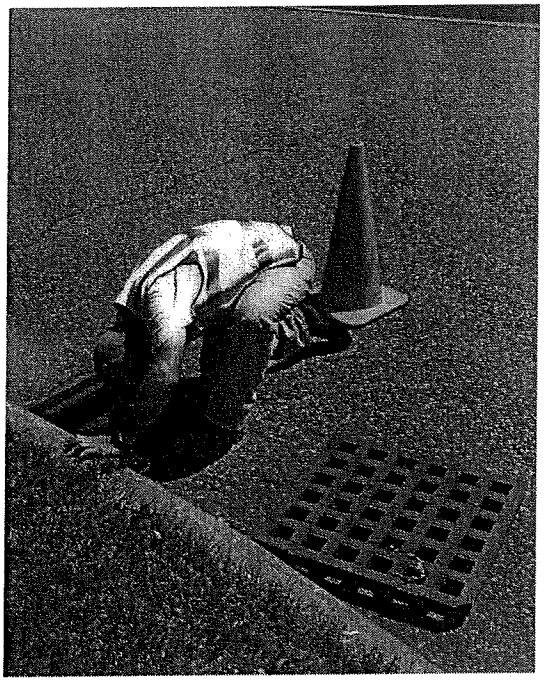
INTEGRATED WATER RESOURCES MANAGEMENT PROGRAM: TASK 1

TOWN OF COLCHESTER, VERMONT

Project ID 05-1694-G

April 2011





This project's funding was provided by an US EPA Demonstration Grant (XP-83232201-1)

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ACKNOWLEDGEMENTS

This report was prepared by Amy Macrellis, Dave Braun, Katie Budreski, Christine DeLeo, and David Healy. They were aided in the field inventory and information compilation efforts for this report by Colin Willard, Charles Evans, and Brent Toth. We want to thank the staff of the Colchester Department of Public Works and Department of Planning and Zoning, and the staff of the Town Clerk's Office, for their tireless assistance in locating files, transferring databases and image files, and answering numerous questions.

We are appreciative of project oversight, suggestions, and review by Bryan Osborne, Director of Public Works; Sarah Hadd, Director of Planning and Zoning; and Brad Aldrich of Aldrich + Elliot, P.C.

EXECUTIVE SUMMARY

During 2009, Stone Environmental completed a comprehensive infrastructure inventory and mapping effort to support the development of Colchester's Integrated Water Resources Management Plan (IWRMP). This project was funded as a demonstration project with funding from the U.S. Environmental Protection Agency (EPA), with the goal of improving overall management of non-point source pollution control infrastructure, resulting in a plan that can be supported by the community at large.

The comprehensive infrastructure inventory and mapping effort included stormwater infrastructure (catch basins, culverts, piping, swales, detention basins, and outfalls); onsite wastewater permitting information; and private water supply locations and status. Our work for each type of infrastructure inventory included both desktop and field data collection efforts.

This report describes the inventory; methods and processes used; and descriptions of the databases developed to support the Integrated Water Resources Management Program. This inventory data provides the foundation for conducting the town-wide and detailed onsite wastewater needs assessment (Tasks 3 and 4 of the EPA demonstration grant workplan).

Infrastructure information extracted from town data files and from the field inventory is summarized below.

Stormwater Inventory Summary

A town-wide stormwater GIS database inventory was completed. The stormwater inventory includes the following components:

Outfalls	254
Catch Basins	1,526
Dry Wells	357
Manholes	138
Retention Ponds	44
Other Structures	22

Stormwater permits for parcels or areas in Town were recorded by permitting status, as follows:

State Permitted	96
Expired Permits	17
Unpermitted Sites	34
Stormwater Easements	22

Onsite Wastewater System Permits and Inventory

A parcel-by-parcel inventory that includes the type of wastewater system serving each property (individual onsite system, shared onsite system, or sewered with centralized municipal service) was developed. Permits and associated information from multiple and sometimes overlapping data sources were combined to create an inventory of permits, legal easements, design plans, and other ancillary electronic records where such information was available. The types of wastewater service for each property included:

Individual Onsite	5171
Shared Onsite	89
Sewer Service	219
None	757

Water Supply Inventory

One of the critical elements of assessing onsite wastewater capacity is making sure enough land exists on a parcel to site both a drinking water supply and a wastewater treatment system under current regulations. Although a significant number of properties in Colchester are served by municipal water, about 750 properties have individual or shared private wells, the locations of which were mostly unknown. A field inventory of private water supply sources was conducted on a voluntary basis to fill this data gap. Stone was able to obtain permission to locate 284 private water supplies which support a total of 483 properties. An additional four water supplies included in the database are shared drilled wells which are permitted as "Non-Transient Community Water Supplies;" these wells serve a total of 75 properties. A parcel-by parcel inventory of the type of water supply service was compiled, and included:

Municipal	4,733
Individual Drilled Well	564
Individual Shallow Well/Spring	27
Individual Drilled and Shallow Wells	1
Shared Drilled Well	102
Shared Shallow Well/Spring	1
Shared shallow and drilled wells	1
Lake Water	47
None	760

GIS Databases and Map Application

Another key part of the task was to build a GIS database container for all of the information collected, including the field data collection applications used to build the infrastructure inventories. Complete metadata for each type of infrastructure was developed to document data collection processes and other

relevant details. The GIS infrastructure location information was tied to town and state data records whenever possible, and the GIS inventory databases were delivered to the Town as an interim data deliverable. Town staff members are now able to click on a feature in the GIS and bring up ancillary information about the feature, such as permit information, drawings, and other documents.

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1. INTRODUCTION

The Town of Colchester secured a demonstration grant from the U.S. Environmental Protection Agency (EPA) for development of an Integrated Water Resource Management Plan (IWRMP) with a goal to improve the overall management of non-point source pollution control infrastructure, and that can be supported by the community at large. This plan has a technical component that includes the development of a sufficient knowledge base of the town's distributed infrastructure to support the creation of a comprehensive plan sufficient to address the community's needs and concerns, an educational component to convince the community that the plan is necessary, and finally the forging of a public private partnership, including a funding strategy to make the plan economically feasible. These three components are intricately linked and are therefore dependent of one another, and are all critical to the successful implementation of the Town's overall program.

This report represents a summary of the first sub-components of this goal:

During the spring and summer of 2009, Stone Environmental Inc. (Stone) conducted a comprehensive inventory and mapping of the Town of Colchester's of public and private stormwater infrastructure (catch basins, culverts, piping, swales, detention basins and outfalls); septic system wastewater facilities; and private water supplies. This effort was part of Task 1 of the town's comprehensive Integrated Water Resources Management Program project funded by the U.S. Environmental Protection Agency. This report describes the inventory; methods and processes used; and descriptions of the databases developed to support the development of Colchester's Integrated Water Resources Management Program. The information compiled will be used to conduct a townwide assessment and to support townwide water resources management.

- Stormwater Collection Systems:
  - catch basins
  - culverts
  - piping
  - detention basins, and
  - outfalls
- Onsite Wastewater Systems
- Private Water Supply Systems.

Stone conducted the inventory based on: a protocol developed for the Task; the project goal of "development of a knowledge-base relating to the location, capacity and status of the Town's decentralized wastewater and storm water systems..."; an examination of existing information resources; and a cost-effective approach for building the inventory.

For each component, a description of the process(es) and methods used for data collection is provided. A summary assessment for each inventory component was conducted from existing file and field data. All the inventoried information is now available in easy to access databases with direct links to the original permit file information by physical location using the town's GIS system. This inventory provides the town with the most complete collection of all information for every component and the base for conducting the remaining tasks for the IWRMP. The Appendices contain: Metadata for each of the inventory items; specific inventory procedures used; field inventory form samples; Stormwater User Guide for Field Data Collection; and a listing of all databases developed and used as part of the inventory task.

2. STORMWATER INFRASTRUCTURE INVENTORY

To aid in the integration of water resource management on a town-wide basis, a stormwater data inventory was conducted during the 2009 field season for the Town of Colchester, Vermont. The inventory included a comprehensive field data collection of both municipal and private (where permission was granted) stormwater infrastructure, as well as a review of stormwater discharge permits required by the Vermont Department of Environmental Conservation (DEC) and associated site plans. Additionally, site plans for developed areas within the town that were not associated with stormwater permits were reviewed.

The resulting databases developed include a geographic information system (GIS) inventory of stormwater structures, general locations of site plans with stormwater discharge permits, general locations of site plans without stormwater discharge permits, and locations of stormwater easements. All stormwater discharge permits, site plans, easement documents, and co-applicant maintenance agreements associated with properties within the Town of Colchester have been digitally catalogued and associated with a spatial location, where possible. These datasets can be used to maintain and manage stormwater infrastructure in the Town of Colchester.

The stormwater inventory involved several phases of data collection, compilation, and review in order to construct as complete a dataset as possible. These phases included an initial computer desktop review of existing Chittenden County Regional Planning Commission (CCRPC) data, stormwater discharge permit and site plan review, field data collection, and a final desktop quality control review. The methodology used for each phase is briefly outlined below. The detailed methodology and process description is contained in the metadata contained in Appendix A.

2.1. Initial Computer Desktop Review

Prior to field mapping, we performed a comprehensive review of the CCRPC data to reposition stormwater structures based on features visible in high resolution imagery. Points were moved for approximately 1,000 catch basin and manhole locations that were slightly off to the visible catch basin

grate or manhole cover. This enabled the field crew to confirm structure locations in many instances rather than GPS a new location.

2.2. Permit and Plan Review

Stormwater discharge permits and associated site plans were compiled. The goal of this effort was two-fold. First, these documents were assembled in order to have a near complete set of regulatory documents to aid in the management of non-point source pollution. Second, these documents were used to strengthen the field inventory efforts, especially where stormwater structure design was difficult to interpret on the ground. Electronic copies of stormwater discharge permits and associated site plans were obtained from the DEC and CCRPC. These documents were organized into directories under the permit number, except for plan sheets that could not be located in any electronic files. The town's paper files were inventoried to locate missing plan sheets as well as plan sheets with no associated stormwater discharge permit (unpermitted site plans). Many permitted site plans were rescanned by the Town, where electronic versions of plan sheets were unreadable or missing. Each permit directory also includes the current stormwater permit; any referenced expired permits; and a co-applicant agreement between the Town and private entity, if made.

Following the compilation of electronic permits and site plans, site plans were reviewed and compared with the GIS stormwater inventory, noting any discrepancies and digitizing missing stormwater structures. Unpermitted paper site plans with stormwater structures were also reviewed in the Town offices, using the same methods. This process coincided with the 2009 field collection. Where site plan review preceded the 2009 field mapping, the field crew generally confirmed the accuracy of the digitized features. Where site plan review came after the 2009 field mapping, overall it confirmed the accuracy of the field mapping, but raised a list of discrepancies which were subsequently rechecked in the field.

As part of this process, a GIS layer of permit points was created, symbolized in the Stormwater ArcMap document with a "P" symbol. Clicking on the point brings up an attribute table containing hotlinks to the permit document, associated plans, and the co-applicant agreement, if applicable.

We acquired Colchester's ACS land records database from 2002 to 2009 related to stormwater. All the records in this timeframe have been searched to identify easements for stormwater infrastructure. A layer of "easement" points containing the general location of each easement, parcel number, volume-page-number, street address, and a hotlink to the easement document has been developed as an attribute to each infrastructure feature. Currently, twenty-two (22) easements have been identified in the Town of Colchester through the ACS database. Electronic records from ACS related to stormwater were downloaded for the May 1995-2002 time range in July 2010, these records are not included in the stormwater inventory that was delivered to the Town in April 2010. If the Town desires, this dataset can be revisited and older easements added to the inventory during the development of management program options.

Permit number IDs identified during the permit and plan review processes were recorded in a field of the feature datasets of the stormwater personal geodatabase. The step of assigning permit number ID to all stormwater features was completed to the extent possible. Only stormwater features which were either added or reviewed during the permit and plan review process have the permit number ID field populated. Features added during the post permit and plan reviews do not have a recorded permit number.

2.3. Field Inventory

Stormwater features including stormlines, culverts, catch basins, drywells, outfalls, and retention ponds along with their associated attributes were confirmed in the field, edited, or created using CCRPC data and site plan review information as additional references.

In addition to stormwater features, all culverts that were not originally mapped as part of the stormwater infrastructure inventory were also inventoried. Our inventory verified and updated the existing local inventory feature class in VCGI's "Transtruc" geodatabase which was last updated in 2003 by the CCRPC. Due to the large number of attributes associated with the Transtruc geodatabase, only the required fields, as well as a few fields Stone found pertinent to the inventory, were recorded. Stone updated 175 culvert records and added an additional twelve to the "Transtruc" database. Once the Local Inventory feature class was updated, it was passed off to the CCRPC to update VTrans' Vermont Online Bridge and Culvert Inventory Tool (VOBCIT).

The field inventory was completed using ArcPad 7.1.1 on a Trimble GeoXT. An ArcPad application was created to assist in the inventory process. The application employed a number of features, such as drop-down menus and warning prompts to ensure quality data and expedite the data collection process. Appendix B contains the *Stormwater Field Inventory Application User Manual,* which provides more detail about how stormwater infrastructure was collected with the application. The manual is intended for use by the town to maintain the inventory.

2.4. Desktop Quality Control Check

The desktop quality control check took place after each field day with the purpose of catching any entry errors and clarifying any unclear observations. The first step of the two step process was to verify the spatial relationship between the stormwater structures. The individual infrastructures' GPS locations were checked against high resolution imagery and the locations as an entire system were looked over for integrity. A data overview was done to complete the quality control check. Any obvious entry errors were identified and clarified during this step. Structures were flagged where there were discrepancies between field observations and site plan observations. These discrepancies were re-visited and reconciled in the field. The quality control check was primarily completed by the field personnel who collected the stormwater structure data for that day.

A GIS topology was created for the stormwater features in the stormwater data inventory database for the purpose of a spatial integrity quality control check. The rules established by the topology enforce the

integrity of the stormwater network between all the stormwater features. The topology only applies to "Stormlines," "Stormwater Structures," and "Outfalls" features. The "Retention Ponds" feature class was not incorporated into the topology. The rules enforced by the topology were:

- "Stormlines" are not multipart
- "Stormwater Structures" and "Outfalls" are connected to a "Stormline."

Some exceptions do apply to these rules and are so established in the topology. The topology was created primarily for a quality control check and was deleted once the topological errors were corrected.

2.5. Stormwater Data Inventory Database

The final result of the stormwater data inventory is a geospatial database (geodatabase) of all stormwater structures and associated attributes. The geodatabase is in the ArcGIS 9.3 personal geodatabase format. The geodatabase contains feature classes for stormwater infrastructure including outfalls, stormlines, stormwater structures, and retention ponds. Additionally, the geodatabase has permit and easement feature classes. These include point locations of stormwater permits as permitted by DEC, expired stormwater permits, site plans where no permit exists referred to as Unpermitted Site Plans, and stormwater easements. Table 1 summarizes the geodatabase feature databases and associated feature classes compared with the original CCRPC data. All feature classes are in Vermont State Plane meters projection, NAD83. Table 2 contains a summary of the features inventories and their permit status.

Table 1. Stormwater Geodatabase Feature Datasets and Feature Classes

Feature Dataset	Feature Class	Description	2009 Count	CCRPC Count
Stormwater_Structures (with topology)	Outfalls09	Outfall point locations. Attributes of interest include discharge type, diameter, and condition.	279	130
	Stormline09	Stormline line features. Lines include stormlines, underdrains, infiltration pipes, culverts, and roof drains. Other attributes of interest include material type and diameter.	2,282	888
	Structures09	Stormwater structure point locations. Structures include catch basins, dry wells, manholes, and clean outs. Other attributes of interest include discharge type and condition.	2,095	1,189
Stormwater_Features	RetentionPonds09	Retention pond polygons.	53	3
Permits_Easements	StormwaterPermits	Point locations of permitted stormwater discharge. Permits are managed by DEC under the Vermont Stormwater Program.	108	107
	UnpermittedSitePlans	Point locations of site plans with no stormwater permit under the Vermont Stormwater Program.	34	NA
	StormwaterEasements	Point locations of Town of Colchester stormwater easements.	22	NA

Table 2. Permitted and Non-Permitted Stormwater Structures Summary

Feature Class	Feature Type	Permitted	Percent of Count	Non-Permitted w/ Plan	Percent of Count	Non-Permitted w/o Plan	Percent of Count	Count
Outfalls		99	35%	7	3%	173	62%	279
Stormwater Structures		818	39%	134	6%	1143	55%	2,095
	Catch Basins	663	38%	112	6%	952	55%	1,727
	Dry Wells	36	26%	11	8%	92	66%	139
	Manholes	56	41%	8	6%	72	53%	136
	Other Structures	63	68%	3	3%	27	29%	93
Stormwater Lines		907	40%	130	6%	1245	55%	2,282
	Stormlines	743	37%	101	5%	1154	58%	1,998
	Culverts	78	48%	7	4%	76	47%	161
	Other Lines	86	70%	22	18%	15	12%	123
Retention Ponds		44	83%	0	0%	9	17%	53
Total Features		1853		272		2583		4,708

A geometric network was built using ArcInfo 9.3 for the stormwater infrastructure and is stored in the Stormwater personal geodatabase. The network was built based on outfalls, stormwater structures and stormlines. Retention ponds were not included in the geometric network. Simulating the natural flow of water, outfalls were established as sinks in the network. This designation directs all flow to travel down the system of connected stormlines and other structures to the outfall. The following connectivity rules were established for the network:

- Stormline connects with Outfalls and Stormwater Structures

The stormwater flow network can be used to identify flow direction of a system. The user has the option of displaying an arrow which points in the direction of flow. Various traces can also be run on the network. Some of the traces include finding an upstream or downstream path or finding the upstream accumulation at a specified location in the system.

3. WASTEWATER TREATMENT INFRASTRUCTURE INVENTORY

The wastewater and private water infrastructure inventory consisted of four efforts: collection, assessment, and integration (as feasible) of multiple town and State of Vermont databases and paper records; creation of GIS and field data collection applications; field inventory of private water wells; and a data inventory quality control effort.

3.1. Existing Data Records Collection and Assessment

The Town already maintains several sources of information relevant to the wastewater and water supply inventory and which will be useful in the needs assessment processes. The status of each of these data sources, and their relevance to inventory and needs assessment tasks, is described below.

3.1.1. Assessor's Database

The Assessor database provides a wealth of information that aids both planning-level and detailed needs assessments. This database contains records for commercial parcels (6,694 unique records for 463 accounts) and residential parcels (7,284 unique records for 6,486 accounts); in total, there are 6,949 unique accounts in the Assessor's database. The parcel boundary feature class for the Town (originally from 2007, and then from 2009) was joined to the Assessor's data by account number, and instances where the parcel and/or account numbers did not match were corrected wherever possible. The total unique accounts in the Assessor's database will always be a larger number than the number of unique parcel features with account numbers (for instance, the Assessor's database has 6,949 unique accounts while the parcels feature class only has 6,236 unique records). This is due to the presence of multiple account numbers in the Assessor's database which relate to the same parcel of land, as is the case for condominium developments and mobile homes on leased land. These parcel polygons were further condensed for the Town-wide wastewater needs assessments described in the Task 3 report. For the screening needs assessments, polygons that represent condo or apartment footprints were merged with the surrounding common land (see Section 2.5 of the Task 3 report).

Utilities

The Assessor's database contains information recorded about utilities on the property, including information about water supply and wastewater service. This information was used as a starting point for the water supply and wastewater treatment system inventories, but was modified significantly to reflect current conditions. Table 3 summarizes the number of parcels with type of water or wastewater service as currently listed in the water supply/wastewater treatment system inventory.

Table 3. Summary of Water and Wastewater Services by Parcel

Water Service Type	Wastewater Service Type	Total Accounts
Individual Drilled and Shallow Wells	Onsite	1
Individual Drilled Well	Onsite	564
Individual Shallow Well/Spring	Onsite	27
Shared Drilled Well	Onsite	79
Shared Drilled Well	Shared Onsite	23
Shared shallow and drilled wells	Shared Onsite	1
Shared Shallow Well/Spring	Onsite	1
Lake Water	Onsite	47
Municipal	Onsite	4,449
Municipal	Shared Onsite	65
Municipal	Sewer	219
None	Onsite	3
None	None	583
2009 parcels not in 2007 parcel feature class, not characterized		174
TOTAL PARCELS		**6,236**

Source: Town of Colchester Assessor's data with Stone Environmental modifications, 2009-2010

Parcel/Structure Use and Zoning

All properties listed in the Assessor's database are assigned a "class" code describing how the property is used. All accounts are assigned a property use code in the database (Table 4). However, the linkage between spatial parcel polygons and accounts in the Assessor's database is not perfect; the discrepancies are outlined in the table below.

Table 4. Property Use Summarized by Land Use Category, Account, and Parcel.

Description	Town Property Use Code	Total Accounts	Total Parcels
Commercial Property	C	416	332
Farm Land Over 6 Acres	X	29	29
Farm Land Under 6 Acres	W	3	2
Farm Property	F	17	17
Government Property	G	108	104
Industrial Property	I	21	21
Mobile Home on Leased Land	B	634	246
Mobile Home on Owned Land	D	16	16
Religious, Charitable, Non-Profit	L	57	50
Residential Condominium	J	938	762

Table 4. Property Use Summarized by Land Use Category, Account, and Parcel (continued).

Description	Town Property Use Code	Total Accounts	Total Parcels
Residential Over 6 Acres	A	206	205
Residential Under 6 Acres	R	3,500	3,475
Travel Trailer	T	132	0
Undeveloped Over 6 Acres	P	104	101
Undeveloped Under 6 Acres	M	388	354
Utility (Cable TV)	Y	2	0
Utility (Electric)	H	6	3
Utility (Other)	K	2	0
Vacation (Seasonal) Over 6 Acres	N	6	5
Vacation (Seasonal) Under 6 Acres	V	364	350
Rights of way, water, and other polygons with no parcel number			54
Parcel polygons (apartment buildings) with no corresponding record in Assessor database			37
Common or shared land associated with condominiums or camps, no record in Assessor's database corresponding to parcel polygon			56
Other parcel polygons with no matching account in Assessor database			17
TOTAL		**6,949**	**6,236**

All properties in the Assessor's database are also assigned a zoning code. Currently, all but seven accounts have a zoning designation (Table 5), while the same issues that affect the linkage between the parcel polygons and the Assessor's database in the land use information shown above also affect the zoning designations.

Residential Structure Dimensions

Information about the footprints of residential dwellings and outbuildings associated with residences is available from the Assessor's database. While this information cannot be placed spatially on individual parcels, for a planning-level needs assessment it will be possible to use a database operation to subtract the square footages of dwelling and outbuilding footprints from the total area available for siting an onsite wastewater treatment system (OWTS). While data on the spatial locations of impervious surfaces, including driveways and structures, will be available separately for use in planning level and other analyses, the structure dimensions may provide a useful cross-check on the accuracy of areal calculations. A summary of the total numbers of accounts containing information about dwelling and associated garage or porch dimensions, organized by property use class, is shown in Table 6. Information about the dimensions of mobile homes and travel trailers is notably absent from this table; however, dimensional information about these structures is recorded as for outbuildings.

Table 5. Zoning Designations Summarized by Accounts and Parcels.

Description	Town Zoning Code	Total Accounts	Total Parcels
Residential One	R1	1,298	1,249
Residential Two	R2	1,588	1,530
Residential Three	R3	1,942	1,874
Residential Five	R5	139	136
Residential Ten	R10	43	43
Mobile Home Park	MHP	631	255
General Development One	GD1	302	167
General Development Two	GD2	209	121
General Development Three	GD3	110	100
General Development Four	GD4	89	60
Commercial	COM	290	207
Industrial	IND	67	65
Agricultural	AGR	129	124
Floodplain	FP	104	102
Governmental	GOV	1	1
Utility Accounts with no Zoning code		7	
Parcel polygons with no Zoning code			202
TOTAL		**6,949**	**6,236**

Table 6. Summary of Accounts Containing Structure Dimensions by Property Use Class

CLASS	Description	Total Accounts	Total Accounts With Square Footage Data				
			Ground Floor Living Area	Enclosed Porches	Wood Decks	Attached Garages	Detached Garages
X	Farm Land Over 6 Acres	29	0	0	0	0	1
F	Farm Property	17	16	8	7	3	8
G	Government Property	108	3	0	0	1	2
B	Mobile Home on Leased Land	634	0	0	0	0	2
D	Mobile Home on Owned Land	16	0	0	0	0	5
J	Residential Condominium	938	938	73	535	448	125
A	Residential Over 6 Acres	206	203	46	132	91	56
R	Residential Under 6 Acres	3,500	3,492	769	2,455	2,016	446
P	Undeveloped Over 6 Acres	104	5	0	4	3	1
M	Undeveloped Under 6 Acres	388	5	0	1	2	6
N	Vacation (Seasonal) Over 6 Acres	6	6	2	3	0	0
V	Vacation (Seasonal) Under 6 Acres	364	363	149	181	6	33
TOTAL		**6,310**	**5,031**	**1,047**	**3,318**	**2,570**	**684**

Information about residential outbuilding types and dimensions is recorded in the Assessor's database in a table separate from residential dwelling data. "Outbuildings" may include sheds, additional garages, barns, agricultural structures, swimming pools, and—significantly—mobile homes and travel trailers. Up to seven different types of outbuildings and sets of dimensions may be recorded on a single account. Table 7 summarizes the number of accounts in each residential property use class for which outbuilding dimensions are available.

Table 7. Summary of Accounts Containing Residential Outbuilding Dimensions by Property Use Class

CLASS	Description	Total Accounts	Total Accounts with Outbuilding Square Footage						
			OBY 1	OBY 2	OBY 3	OBY 4	OBY 5	OBY 6	OBY 7
X	Farm Land Over 6 Acres	29	3	1	1	1	1	1	0
F	Farm Property	17	17	17	15	12	10	8	4
G	Government Property	108	3	2	2	1	1	0	0
B	Mobile Home on Leased Land	634	631	583	398	209	82	18	3
D	Mobile Home on Owned Land	16	15	13	11	9	5	4	1
J	Residential Condominium	938	340	114	20	8	10	4	1
A	Residential Over 6 Acres	206	173	108	58	26	8	5	2
R	Residential Under 6 Acres	3,500	2,151	716	182	43	10	2	0
T	Travel Trailer	132	62	21	2	1	0	0	0
P	Undeveloped Over 6 Acres	104	8	3	3	1	1	0	0
M	Undeveloped Under 6 Acres	388	30	12	5	3	0	0	0
N	Vacation (Seasonal) Over 6 Acres	6	5	2	0	0	0	0	0
V	Vacation (Seasonal) Under 6 Acres	364	225	52	14	2	1	0	0
TOTAL		**6,442**	**3,660**	**1,643**	**710**	**315**	**128**	**41**	**11**

Residential Design Flow Basis Data

Almost all residential properties in the Assessor's database have data recorded for number of bedrooms, which will enable estimation of design flows for residences using OWTS for wastewater service (see Table 8). There are a few discrepancies, including the 8 undeveloped properties which nevertheless have bedrooms recorded, and relatively minor disagreements in totals between accounts with bedrooms and total accounts in some land use classes. For the Task 3 town-wide needs assessments, properties classed as "undeveloped" were assumed to have zero bedrooms and no wastewater flows. Developed residential properties with no bedrooms recorded in the Assessor's database were assigned the average number of bedrooms of the respective property use class.

Table 8. Summary of Residential Accounts Containing Design Flow Basis Data by Use Class

CLASS	Description	Accounts With Bedrooms	Total Accounts
F	Farm Property	16	17
G	Government Property	3	108
J	Residential Condominium	937	938
A	Residential Over 6 Acres	203	206
R	Residential Under 6 Acres	3,489	3,500
P	Undeveloped Over 6 Acres	5	104
M	Undeveloped Under 6 Acres	3	388
N	Vacation (Seasonal) Over 6 Acres	6	6
V	Vacation (Seasonal) Under 6 Acres	361	364
TOTAL		**5,023**	**5,139**

Residential Property Age Data

Information is recorded for many residential parcels about the year in which the property was developed. Plotting the year that residential structures were built versus the number of structures built in that year (Figure 1) shows that, prior to about 1965, many of the construction dates recorded in the Assessor's database are likely estimated. Years ending in "5" and "0" show rather uncharacteristic peaks, and it appears that the year 1900 may have been used as a default value if the year of construction was not known. However, even estimated information about structure age will be useful in understanding the type of OWTS that may be present on a parcel, and in estimating the age of an OWTS if no permit or other information is available. It is notable that about 37% of the residential structures for which information is available were constructed before 1970, when the first state-level OWTS rules were implemented.

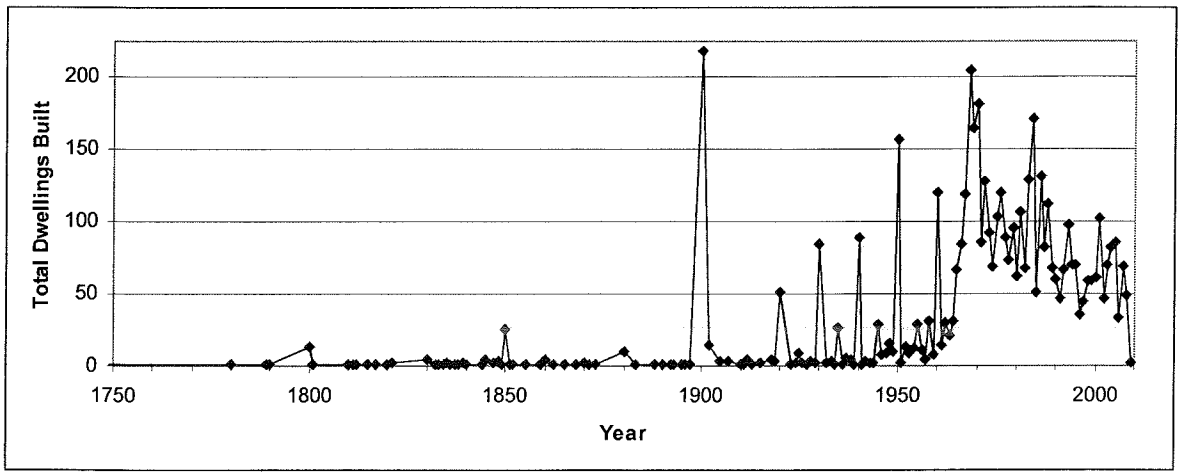


Figure 1. Residential Structure Construction Dates vs. Total Dwellings Built Per Year

Commercial Property Structure and Outbuilding Data

Information about the footprints of commercial structures and associated outbuildings is available from the Assessor's database. Again, this information cannot be placed spatially on individual parcels, but may provide a useful cross-check on the accuracy of areal calculations. A summary of the total numbers of accounts containing information about structure and outbuilding dimensions, organized by property use class, is shown in Table 9.

Table 9. Summary of Accounts Containing Commercial Structure and Outbuilding Dimensions.

CLASS	Description	Total Accounts	Total Accounts With Square Footage Data	
			Structures	Outbuildings
C	Commercial	416	339	272
G	Government Property	108	4	2
I	Industrial Property	21	12	10
TOTAL		**545**	**355**	**284**

Commercial Property Design Flow Basis Data

Limited information was available from the Assessor's database that may be useful in estimating design flows for commercial properties that use OWTS for wastewater service. About 100 commercial structures contain one or more residential apartments (Table 10). For these properties, the number of apartment units and the number of bedrooms in each identical unit can be utilized to calculate a wastewater design flow, at least for the proportion of the commercial property that consists of apartment units. Often, however, the commercial development on each property consists of multiple uses—such as offices, retail, or convenience stores—with one or two apartment units.

No other information was available from the Assessor's database that could be used to estimate wastewater design flows for commercial properties. More precise methods for determining design flows for commercial properties, and thus the land area required to site a potential replacement onsite wastewater treatment system, were implemented during the Task 3 needs assessment work (see Section 2.3 of the Task 3 report).

Table 10. Summary of Design Flow Basis Information for Commercial Apartment Structures.

CLASS	Description	Total Parcels with Apartments	Total Units of Each Apartment Type			
			Efficiency	One-Bedroom	Two-Bedroom	Three-Bedroom
C	Commercial Property	103	43	220	537	27
G	Government Property	0				
I	Industrial Property	0				

Commercial Structure Age Data

As with residential properties, information is also recorded for many commercial parcels about the year in which the property was developed. Plotting the year that commercial properties were developed versus the number of properties developed in that year (Figure 2) shows that, again, prior to about 1965, many of the construction dates recorded in the Assessor's database are likely estimated. About 38% of the commercial development for which information is available were constructed before 1970, when the first state-level OWTS rules were implemented.

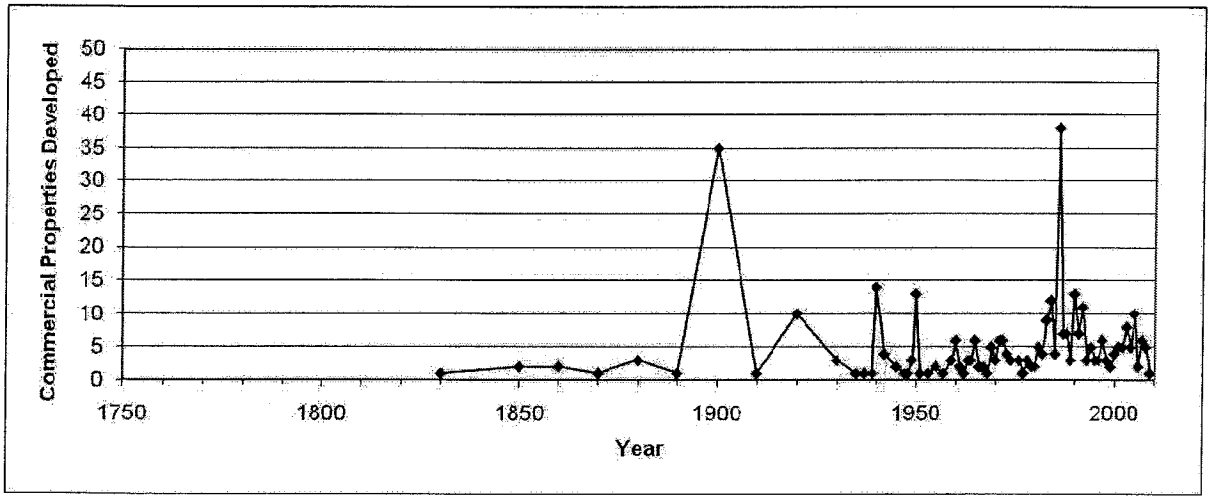


Figure 2. Commercial Property Development Dates vs. Total Commercial Properties Developed Per Year.

3.1.2. Planning and Zoning Permits Database

The Planning and Zoning Department maintains a Microsoft Access database application that contains records for all permits issued through the town, including all building and septic permits. The database contains septic permit records, which are recorded by parcel ID, the date the permit was issued, and in some cases, the type of system or a description of the work performed. This data provides a broad overview of where permitted systems are found, and in some cases, may be useful in highlighting parcels with potentially inadequate systems. Other than the Vermont DEC's online permit database for onsite systems, this is the only database location where detailed information on whether the permit was issued to repair or replace a malfunctioning system is consistently stored. (Scanned images of permit documents are also recorded in the ACS Land Records database and in the Canon imageWARE application, as described below.)

Permits issued by the Town or DEC since December 2005 are also recorded in the planning and zoning permits database, including all permits issued by the Town since taking delegation of the OWTS permitting program from DEC. These permits are classified as "SWP" or "State Water Permit" in the planning and zoning permits database. There is no overlap between the "State Water Permits" recorded in

the Planning and Zoning database and the listing of State permits by DEC "project ID" in DEC's online permit database; however, all related documents are available in the Town's imageWARE and/or ACS document management system datasets.

The parcel ID numbers listed in the original PERMITS table often referred to multiple parcels or were not complete. However, the field "ParcelRecNo" served as an index between the PERMITS and Parcel Data tables in the database, and the parcel ID and account number fields in the ParcelData table were generally accurate. This linkage was utilized to assign account numbers directly to permit records prior to importing the planning and zoning permits data into the wastewater permits geodatabase. Other fields, such as permit type, land use class, structure type, and permitting decision, were also cleaned up and standardized as applicable and feasible to allow for clearer summarization prior to importing the table into the wastewater permits geodatabase.

There is a narrative attribute that describes the reason for permit. In the case of septic systems, descriptions often include "system replacement" or "new system", but there is currently no standard language. For permits issued after November 1995, this narrative field often contains sufficient information to determine whether the permit was issued for a new system, connection to a community system, or for repair or replacement of a component (tank, pump, leachfield, etc.). Prior to December 1995, this field is often blank. We made an early attempt to create a standardized description field that would be easier to summarize, but often the information contained in the existing description was not sufficient to understand and categorize the reason for permit issuance.

Although the reason for permitting is sometimes stated, particularly for permits issued after November 1995, system design flow is almost never stated in the reason for permitting. In some cases, additional information exists in the table about the number of bedrooms/bathrooms in existence at the time of permit approval. Where applicable, it may be reasonable to use this information instead of the information in the Assessor's database to determine design flows at the time the systems were installed or repaired.

The oldest septic system permit record is from May 1971. There is some indication that a number of the older records have been entered over time, as older paper files were pulled for review. The Planning/Zoning department had a policy to this effect from 2005 through approximately 2009; staff still enter older records as resources are available but this is no longer a standard operating procedure when older files are pulled for review. Thus, while this database is likely the most complete electronic record of septic permitting activity in the Town, it should not be considered authoritative.

There are 5,850 records in the database with Septic Permit activity information on a total of 4,092 unique account numbers (3,416 unique parcel IDs). There are an additional 197 records in the database with State Water Permit activity on 166 unique parcels. This leaves a total of about 2,000 parcels (including undeveloped land) with no electronically available Town-level wastewater permit information. Of the residential parcels, about 1,150 appear to be developed according to the Assessor's database, but have no Town-issued wastewater permit recorded in the Planning and Zoning database. The same holds for about

500 properties of all other classifications (though this includes government, religious/charitable/non-profit, and farm property which may not be developed).

Table 11 summarizes the information in the planning and zoning permits database by permit type. Metadata for the planning and zoning permits database are included in Appendix C.

Table 11. Planning and Zoning Permits Summary

Permit Class	Description	Number of Records	Number of Properties
Town (SPT)	Permits issued under the Town's wastewater permitting programs.	5,850	4,092
State-delegated Wastewater (SWP)	Permits issued by the Town under delegation from DEC.	197	166

3.1.3. ACS Land Records Database

This database contains land records and associated documents that are intended to run with the land, including permits and easements. While the Planning and Zoning Permit database contains general information on permits, the ACS database contains scanned copies of the permits themselves. This higher level of detail provided in the actual wastewater permits will be particularly important when evaluating parcels in priority areas of town where a more careful evaluation is required. All wastewater permits issued by the Town under delegation from the DEC since 2006 are available in the ACS system, as are some older permits issued by ANR. Within ACS, land records can be indexed by account number and document type.

The Town is still actively working to include land records in this database. Data was exported from ACS on two separate occasions by Stone staff over the course of the project to capture all possible data as it was being compiled by the Town. Currently, images and associated indexing information are available for records from December 1998-July 2009.

The Town completed preliminary consolidation of document categories within ACS to facilitate retrieval (particularly of wastewater- and stormwater-related records). Stone staff visited the Town offices in July 2009 and exported a subset of records from the ACS system, dating from November 2002 to July 2009. Another export was completed in July 2010 to capture documents dating from May 1995 to November 2002. Essentially, any record was exported whose document category included the words "water", "wastewater", "subdivision", "stormwater", or "easement". A complete listing of the original categories exported is available upon request.

A total of 2,875 unique records were exported from ACS. Of these, 1,045 documents were related to wastewater or water supply, and 262 were already linked to an account number (leaving 783 documents without an associated account number). The document categories initially contained in the index were further standardized as appropriate, and then an attempt was made to assign account numbers to each record in cases where the account number was not included in the ACS system. The account number

included in the index was linked to the GIS parcels shapefile in the wastewater permits geodatabase to check for discrepancies. Images available to Stone that were missing an account number were opened and the account identified. The DEC website (http://www.anr.state.vt.us/dec/ww/wwdocs/cfm/permitgetform.cfm) was used to help identify the property location and account number for some of the more challenging records. Any changes made are recorded in a log which is available upon request.

Stone was able to assign account numbers to many of the records in the ACS database; however, 164 records remain for which no account number could be assigned. Table 12 summarizes permit documents from the ACS document management system by document or permit type. Metadata for the ACS document index is included as Appendix C.

Table 12. ACS Document Index Summary

Document Class	Total Index Entries (May 1995 to Jul. 2009)
Sewer Agreement	15
Subdivision Exemption	1
Subdivision Permit	344
Wastewater Correspondence	8
Wastewater Permit	596
Water Agreement	5
Water Supply Permit	10
Waterline Easement	4
Water-Sewer Agreement	1
Well Shield Easement	61
TOTAL	1045

3.1.4. Canon imageWARE System

The Canon imageWARE system is an additional electronic document repository maintained by the Planning and Zoning Department. This system contains scanned copies of some older wastewater permits (pre-2006) on file in the town offices. Between 2005 and approximately 2009, any time a request was made to pull a permit file for a parcel, the Planning and Zoning department scanned the contents of the file and imported them to the imageWARE system. While the ACS Land Records database generally only contains images of permit or easement documents, images recorded in the imageWARE system often include design drawings, engineering reports, and other associated information.

The town commissioned the development of a software application to facilitate export of documents stored in the imageWARE system. Documents are stored within imageWARE in a combination of file formats (TIF images, Adobe PDF documents, and 'binders' containing both file formats). TIF and binder

files can be converted to Adobe PDF format within the imageWARE application—and, in order for the export tool to work, 'binders' were converted to Adobe PDF prior to export. Use of the export tool is straightforward, and the tool allows for the inclusion of multiple index fields in the name of the files being exported. However, the index itself could not be exported from imageWARE as a table or database.

Stone used the export tool to complete the file conversion and export process for building permits, town septic permits, and state wastewater permits. All index fields stored within imageWARE were included in the file names of the exported files, and were used to create preliminary spreadsheet indices for the town and state wastewater permits. These indices and the related documents were checked for any duplication (a permit was considered duplicate if the Permit Number, Parcel ID, and Location were the same). Duplicate permits were visually verified by opening the image files. Duplicate images were removed from the main dataset and corresponding index records were deleted from the spreadsheet. The clean index file was imported to the wastewater permits geodatabase and was used to link PDF files from imageWARE to parcels by parcel ID, or to additional permit information stored in the planning and zoning permits database (by permit or parcel ID).

Table 13 summarizes the imageWARE permit documents and associated information by document type. The imageWARE document management system has not been implemented for the same length of time as the Planning and Zoning Department's permitting database (Section 3.1.2), so the total records stored in the imageWARE system will always be a smaller number than the total permits recorded in that database. Metadata for the imageWARE index and images are included as Appendix C.

Table 13. imageWARE Document Index Summary

Permit Class	Description	Count
Town	PDF files of permits, applications, and other supplemental documents related to the Town's wastewater permitting programs, particularly those issued under the local sewage ordinance.	3,142
State	PDF files of permits, applications, and other supplemental documents related to the Town's wastewater permitting programs as delegated by DEC. Includes many recent large-format design drawings.	129

3.1.5. Paper Files: Plan Sheets and File Cabinets

The town maintains significant file archives containing historic building and wastewater permits, subdivision records, planning and zoning permits, correspondence, and other records. The paper files are located in cabinets on the first floor and in the basement of the Town offices. The paper files are generally organized by tax map and parcel number. Though historic paper files are scanned into the imageWARE document system whenever a file is pulled for review, the majority of these records have not been digitized. There are well over 350 linear feet of historic paper files stored at the Town offices.

The town also maintains archives of large-format documents, including plan files for subdivisions, centralized wastewater systems, decentralized system designs (primarily for cluster and commercial

systems) and water systems (primarily municipal water mains and transmission lines). Some of these files are housed in the Planning and Zoning offices, while most others are located in the basement. The Town also maintains an Excel spreadsheet listing the maps and their locations; many of which have not been scanned into imageWARE or ACS document management systems. No action regarding the scanning of additional design drawings or other paper files was taken during the construction of this initial data inventory.

3.1.6. Vermont Department of Environmental Conservation GIS and Permit Files

Several electronic datasets relevant to water supply and wastewater treatment investigations are available from the DEC. Each dataset and its relevance are briefly described below.

3.1.6.1. Public Water Supplies and Wellhead Protection Areas

A GIS shapefile of public water supply well and wellhead protection area locations throughout the state was obtained from DEC. There are several shared drilled wells located along the northern border of Colchester that are permitted as Public Community Water Systems, each associated with a planned development. The locations of these wells were added to the water supply inventory (see Section 4).

3.1.6.2. Private Water Supply Wells

A GIS shapefile of private well locations throughout the state was obtained from DEC. While this dataset is useful as a screening tool, it is somewhat dated (ca. 2003) and many of the wells are screen-digitized from 1:24,000 topographic maps, so locations are generally not accurate. Only about 20 private wells in this dataset within the Town were located using a GPS, and thus can be considered to be reasonably accurate. The GPS-located points were incorporated into the water supply inventory database (see Section 4).

3.1.6.3. Regional Office Document Search Database

DEC maintains a website through which individuals may access permits, documents, and other information related to Regional Office permitting activities (primarily Act 250 and the Wastewater System and Potable Water Supply Rules) at http://www.anr.state.vt.us/dec/ww/wwdocs/index.cfm. In May 2009, Stone staff created a spreadsheet containing all records within this database that were listed as being within the Town of Colchester. The table includes all the fields within DEC's database, including owner name at the time of permit issuance, project ID (permit number), project location, applicant or purchaser if different from owner name, and project description. No information about the date on which the permits were issued is included in the database. For many older records, the location information provided is insufficient to quickly link the permit with a specific property. Where possible, and particularly for more recent permits, we were able to relate these permits to account numbers; if needed, new corresponding records were added to the planning and zoning permits table to allow a linkage between the permits table and the DEC document index table based on permit number. Hyperlinks by

which DEC's online permit document results for each permit, if any, can be accessed were added to each permit record. The resulting table was imported to the wastewater permits geodatabase.

Table 14 summarizes the information available from DEC's online database by type of permit. Appendix C contains the related metadata for this table in the wastewater permits geodatabase.

Table 14. DEC Regional Office Permits Summary

Permit Class	Description	Count	Count With Account Number Assigned
30 or 4C	Act 250 Land Use Permit	153	82
AM	Limited Amnesty	15	0
D or DE	Deferral of Permit	273	0
EC	Subdivision Permit	473	365
HB	Home Business	1	0
HD	Agency of Transportation Road Improvement	2	0
HE	Homestead Exemption	45	0
MH	Mobile Home Park Permit	1	0
PB	Public Building Permit	224	31
TT	Campground Permit	2	0
WW	Wastewater System and Potable Water Supply Permit	569	470

3.1.7. Champlain Water District Service Area and Use Records

As described in Section 3.1.1, a majority of the properties in Town are served by municipal water, which is supplied by the Champlain Water District to the six fire districts that operate within the Town's boundaries. Water use records for individual properties or accounts are retained by the Fire Districts, not by Champlain Water District. As part of the water supply inventory process, Stone staff confirmed the extent of municipal water service areas with representatives from each fire district (Section 4.1). Water use records for unsewered commercial properties in the Town of Colchester were evaluated as part of the town-wide onsite wastewater needs assessments (see Section 2.3 of the Task 3 report).

3.1.8. Centralized Sewer Service Areas

A GIS layer of areas in the Town served by centralized sewers was obtained from the Chittenden County Regional Planning Commission. Generally, the boundaries of these service areas correspond reasonably well with designations of wastewater service on an account basis within the Assessor's database. The inventory of wastewater permits and documents, coupled with this sewer service area GIS layer, was utilized to update records of wastewater service by parcel that originated in the Colchester Assessor's database.

3.2. Data Reduction Process(es)/Methods

The town has relatively comprehensive, but often overlapping, sources of information about both centralized and decentralized wastewater and water supply infrastructure. We conducted a three-step effort for develop the inventory of parcel-based data regarding this infrastructure:

1. **Inventory and organize existing information.** We used the existing electronic datasets described above to develop an initial inventory of core information.
2. **Limited file review** to fill inventory gaps. When we began the wastewater systems inventory, we set priorities for paper file review in the following order: parcels in the Lakeshore Drive area, then commercial parcels and parcels served by cluster systems for which no electronic documentation is available, then lots of less than 0.5 acres in size served by onsite OWTS and water supply wells. As the inventory effort progressed, it became clear that paper file review, if any, would be best conducted once the initial planning level needs assessment was complete and priority areas were more clearly and completely identified.
3. **Field location** of private water supply wells upon completion of Step 2 above, with particular attention to parcels where no electronic information currently exists regarding wastewater or water supply infrastructure.

The basic data reduction and quality control processes that were undertaken for each dataset are described in Section 2.1 above.

3.3. Wastewater Permits and Infrastructure Inventory Database

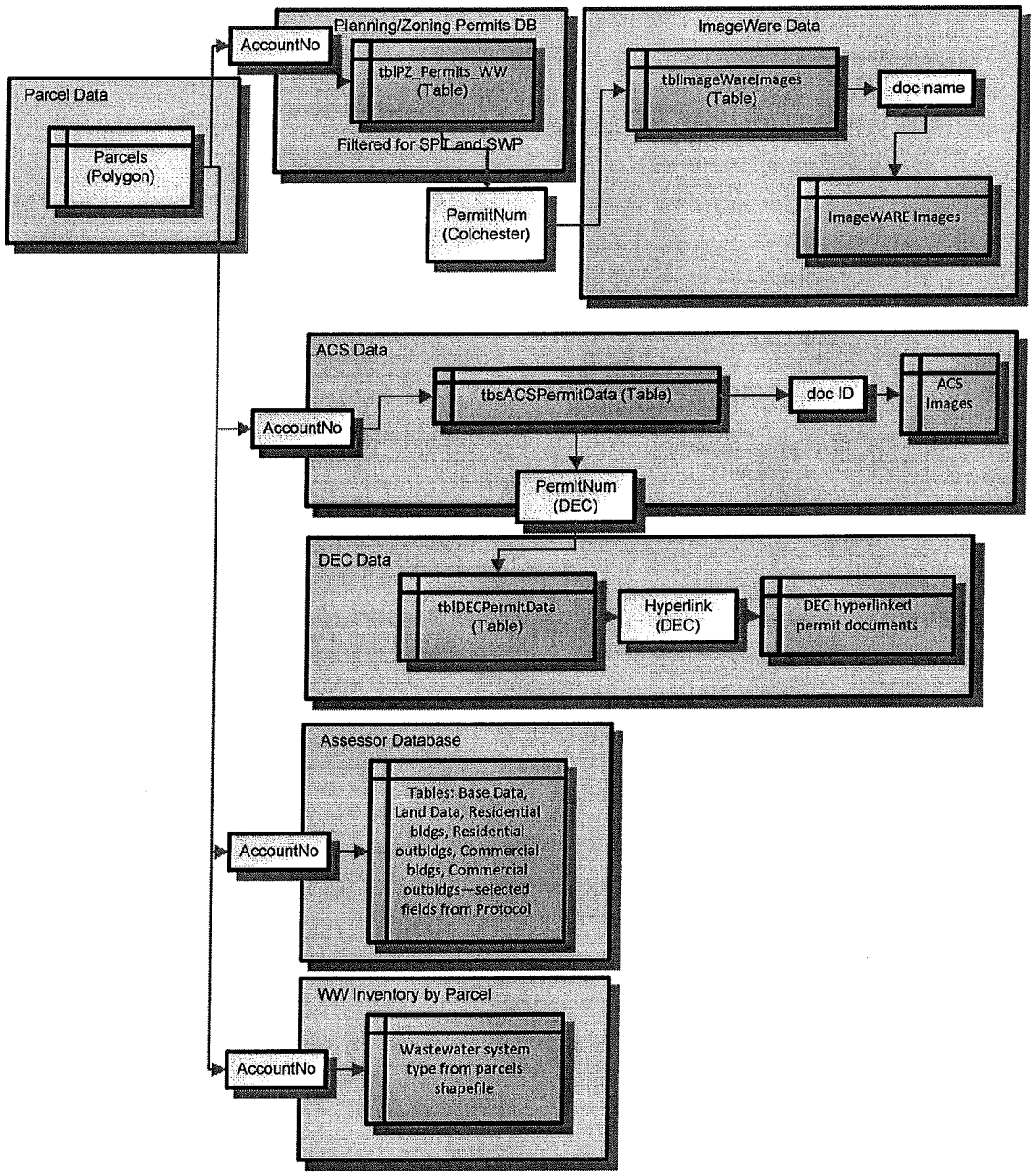
A single onsite inventory geodatabase and ArcMap project was used to collect, store, analyze, and report information regarding distributed wastewater infrastructure in Colchester. Where applicable and whenever possible, this information was linked to individual lots by account number. At a minimum, all accounts contain parcel-specific information sufficient to conduct a town-wide, planning level needs assessment as described in Task 3 of the 2007 Grant Proposal. This inventory includes:

- Basic property information from the Assessor's database (owner, address/location, use, zoning, design flow basis, structure square footages)
- Permit history as available from Planning and Zoning database
- Digitized private water supply locations
- Supplemental electronic permit history and scanned design drawings, perc test results, soils information from VTDEC permits (and from ACS and imageWARE where available) (linked by permit number or account number as appropriate in geodatabase)
- Scanned permits, plans, and as-built drawings from Town paper files (linked by account number in geodatabase)

The last two categories of data listed above are intended to provide additional detailed/best-available information for the lot-by-lot investigations to be completed in Task 4.

Figure 3 provides a graphical description of the datasets and relationships within the wastewater permits and infrastructure inventory geodatabase. Metadata and field attribute descriptions for each of the feature classes are included in the Appendices of this report.

Figure 3. Wastewater Geodatabase Structure



4. WATER SUPPLY INFRASTRUCTURE INVENTORY

The water supply inventory had several elements. We conducted an initial computer desktop review of existing data. Based on that review we developed an approach for conducting the field inventory. During and following the field inventory, quality control checks were completed. The water supply inventory was done to support analyses of onsite wastewater capacity. Vermont's *Wastewater System and Potable Water Supply Rules* have specific requirements for horizontal isolation distances between water supply wells and onsite wastewater treatment systems, so understanding the geographic locations of individual and small shared water supplies is a particularly important piece of the overall water infrastructure picture on an individual property. The water supply sources identified during the inventory included drilled wells, springs, and Lake Champlain (both as the supply for individual camps and as the main supply of municipal water).

4.1. Initial Computer Desktop Review

A desktop review of wastewater treatment related data sources, including the Town Assessor's database, the Planning/Zoning permits database, and the Vermont DEC's GIS databases of public and private water supply well locations (see Section 2), indicated that consistent electronic information about the locations and types of private water supply wells in the Town of Colchester was generally not available. This data gap potentially precluded the accurate assessment of wastewater treatment needs at the town-wide planning level, and so a field mapping effort was undertaken to create a current and accurate water supply inventory.

4.2. Field Inventory of Private Water Supplies

The water supply field inventory effort was conducted during the summer of 2009. Field staff visited each parcel that was outside the three Fire District water service areas (Fire District 1, 2, and 3) and was denoted in the Assessor's database as having a well. Field staff identified and located potable water supplies on private property in accordance with the protocol and the Study Specific Procedure (SSP) developed by Stone staff and approved by the Town (**Error! Reference source not found.**). Care was taken in the field to only collect precise information where permission was granted by the property owner. If a property owner was not present, Stone staff left a flyer explaining the inventory effort and requesting permission to locate infrastructure on the property (Appendix E). The type of water supply and the quality of the location, as well as date of visit and type of permission granted were all recorded by the field staff.

The field inventory was completed using ArcPad 7.1.1 on a Mobile Mapper 6. An ArcPad application was created to assist in the inventory process. Appendix F contains a description of the field forms used for this data collection effort. The application employed a number of features, such as drop-down menus and warning prompts, to ensure quality data and expedite the data collection process.

4.3. Private Water Supply Mapping Desktop Quality Control Check

At the end of each field day, Stone staff uploaded any new data from the ArcPad application to the project geodatabase. Several quality control and completeness checks were completed on a regular basis, including:

- Each mapped water supply was associated with a parcel number, and the corresponding parcel was associated with the correct well ID;
- The field personnel, date of visit, and status of each parcel visited was updated properly
- If a parcel was posted property or was on a gated/private road, that status was noted properly in the Parcels shapefile
- The water supply type in each parcel record matched the type of water supply actually serving the parcel (especially if a property was recorded as having a well in the Assessor's database, but had recently been connected to municipal water).

4.4. Private Water Supply Inventory Database

The final result of the private water supply data inventory is a geospatial database (geodatabase) of all water supply structures and associated attributes. The geodatabase is in the ArcGIS 9.3 file geodatabase format. The geodatabase contains the parcels and water supply points feature classes (Table 15). A one-to-many relationship was established between the wells and parcel feature classes. All feature classes are in the Vermont State Plane, meters projection. Metadata for the water supply inventory are included as Appendix G. Below is a table of all geodatabase feature classes.

Table 15. Water Supply Geodatabase Feature Classes

Feature Class	Description	Count
Parcels	The town parcel layer joined with Colchester Assessor's data, as updated during the water supply mapping exercise. Attributes of interest include owner, type of water and wastewater service by parcel, and well IDs where known.	6,236
Water Supply	Point locations of wells and shallow springs. Attributes of interest include account number and type of water supply.	284

4.5. Private Water Supply Inventory Summary

Of the estimated 750 properties with private water supplies in the town, Stone was able to obtain permission to locate 284 private water supplies. These private water supplies support 483 properties. An additional four water supplies included in the database are shared drilled wells which are permitted as "Non-Transient Community Water Supplies;" these wells serve a total of 75 properties. Table 16 provides a summary of water supplies located during the field inventory by type.

Table 16. Water Supply Sources Inventoried by Type

Water Supply Type	Count
Individual Drilled Well	221
Individual Shallow Well or Spring	37
Lake Water	6
Shared Drilled Well	18
Shared Shallow Well or Spring	2
Total	**284**

Source: Stone Environmental, Inc Field Inventory, Summer 2009

5. BUILDING FOOTPRINTS

Stone contracted with the Spatial Analysis Laboratory (SAL) at the University of Vermont to develop digital building footprints for Colchester, VT. The building footprints were manually digitized based on the Vermont 2007 panchromatic orthophotos, with 0.5 meter resolution supplemented by the 0.16 meter resolution CCMPO true color orthophotos and the "bird's eye imagery" from Bing Maps. Edits were made at a zoom scale of 1:1,700 and included both major and minor buildings (such as sheds and garages). The resulting building footprint information (Figure 4) will be used as part of the available area analysis in town-wide screening assessments of onsite wastewater treatment capacity. According to SAL staff, there is sufficient elevation data available to convert the footprints into three-dimensional buildings if the town so desired for visualization projects. Stone added the parcel account number as an attribute to each building footprint.

6. IMPERVIOUS SURFACES

The SAL also developed a Land Cover GIS data layer for Chittenden County that was used as the source for a detailed impervious surface data layer for the Town of Colchester. Stone clipped this data to the Colchester watershed boundary layer created for this project, and created a new data layer that contains only the impervious land cover classifications. This data set will be a useful input into subsequent assessments of stormwater runoff.

The primary sources used to derive this land cover layer were the 2004 Chittenden County color infrared imagery and LiDAR. Ancillary data sources included the E911 points layer and Chittenden County road polygons. Seven land cover classes were mapped: (1) tree canopy, (2) grass/shrub, (3) bare earth, (4) water, (5) buildings, (6) roads, and (7) other paved surfaces. The minimum mapping unit for the delineation of features was set at 10 square meters. The land cover dataset is considered current as of 2004.

Object-based image analysis techniques (OBIA) were employed to extract land cover information using the best available remotely sensed and vector GIS datasets. OBIA systems work by grouping pixels into meaningful objects based on their spectral and spatial properties, while taking into account boundaries imposed by existing vector datasets. Within the OBIA environment a rule-based expert system was designed to effectively mimic the process of manual image analysis by incorporating the elements of image interpretation (color/tone, texture, pattern, location, size, and shape) into the classification process. A series of morphological procedures were employed to insure that the end product is both accurate and cartographically pleasing.

The dataset was developed as part of the Urban Tree Canopy (UTC) Assessment for Chittenden County, VT. As such, it represents a "top down" mapping perspective in which tree canopy overhanging other features is assigned to the tree canopy class. At the time of its creation, this dataset represents the most detailed and accurate land cover dataset for the area.

Stone's Impervious Surface Data Layer contains an attribute for impervious surface type. The land cover classifications considered to be impervious were (5) buildings, (6) roads, and (7) other paved surfaces. Figure 5 provides an illustration of the percentage of land surface in each of the town's watersheds that is impervious.

Figure 4. Building Footprints

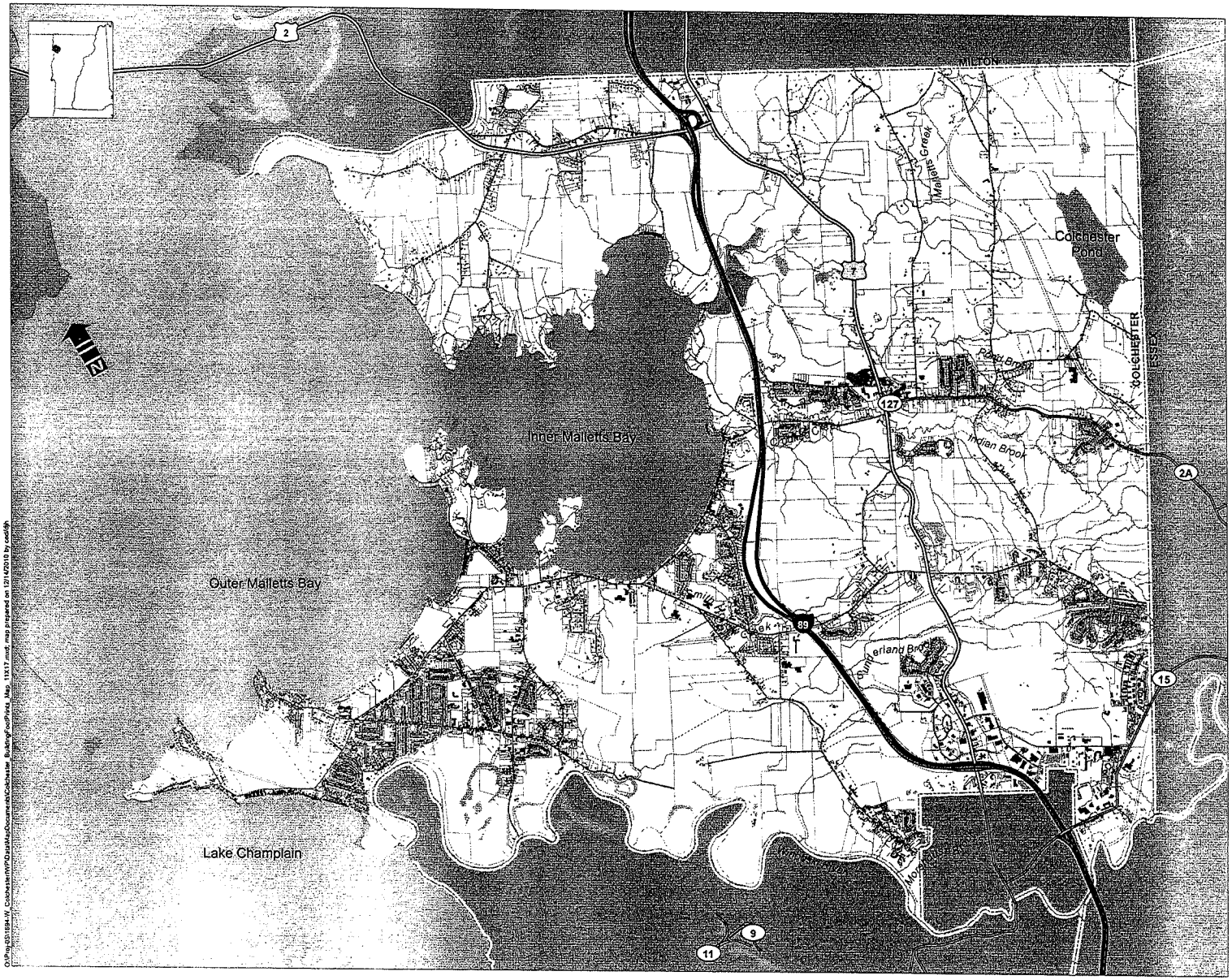


Figure 4.
Building Footprints

Integrated Water Resources Management Program

Town of Colchester, Vermont

Building Footprints (2007)

Colchester Parcels (2009)

0 0.5 1 Miles

Sources: VCGI: Streams, Roads

Building footprints for Colchester, VT current as of spring 2007. Building footprints were manually digitized based on the Vermont 2007 panchromatic othophotos, with a 0.5 meter resolution supplemented by the 0.16m resolution CCMPO true color orthophotos and the "brids eye imagery" from Bing Maps. Edits were made at a zoom scale of 1:1,700 and included both major and minor buildings, such as sheds and garages.

This project's funding was provided by an US EPA Demonstration Grant # XP-83232201-1

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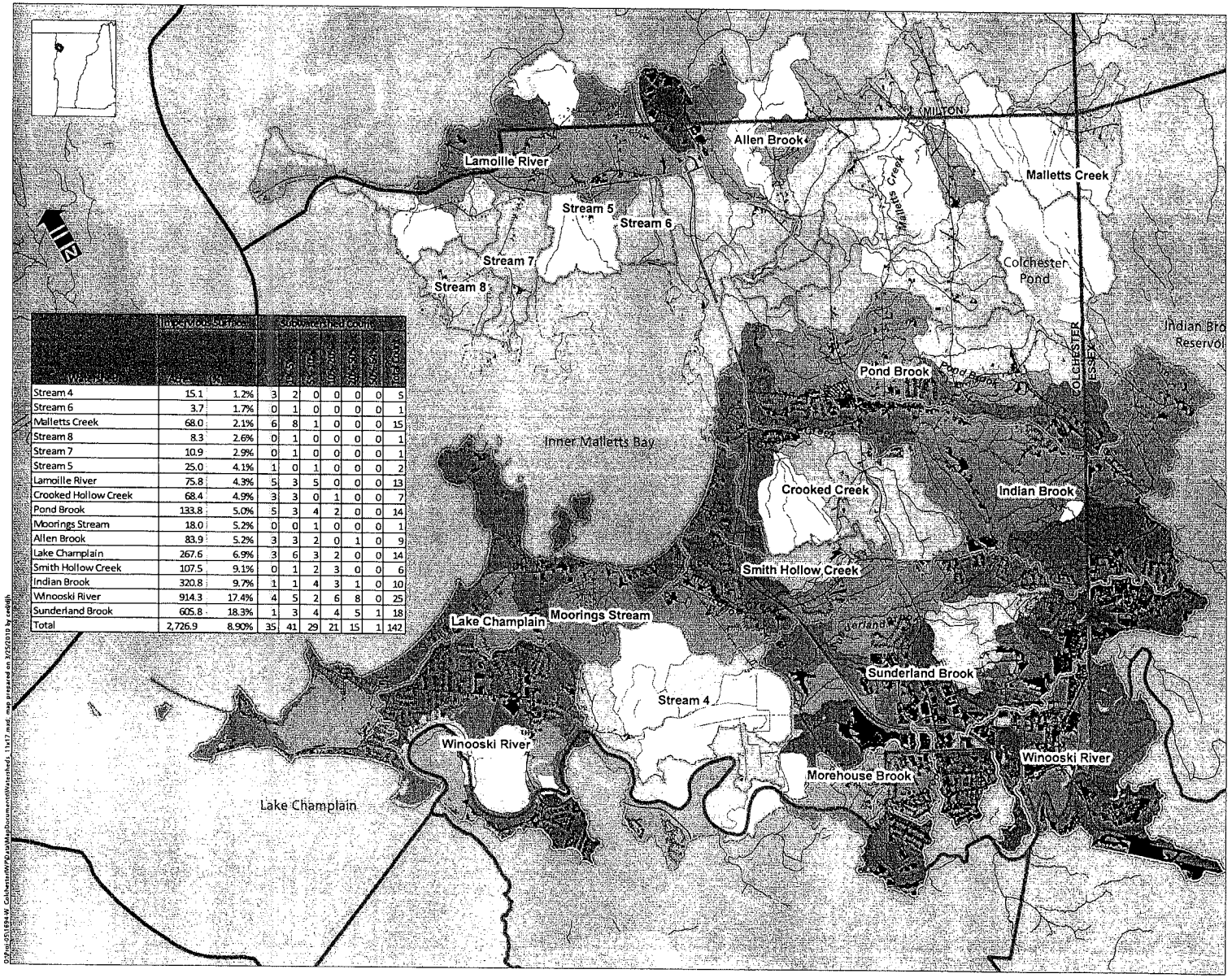
Figure 5. Impervious Surfaces by Subwatershed

Integrated Water Resources Management Program

Town of Colchester, Vermont



Watershed	Impervious Surface Acres	Impervious Surface (%)	Subwatershed Counts 0%-5%	5%-10%	10%-20%	20%-50%	50%-64%	Total Count
Stream 4	15.1	1.2%	3	2	0	0	0	5
Stream 6	3.7	1.7%	0	1	0	0	0	1
Malletts Creek	68.0	2.1%	6	8	1	0	0	15
Stream 8	8.3	2.6%	0	1	0	0	0	1
Stream 7	10.9	2.9%	0	1	0	0	0	1
Stream 5	25.0	4.1%	1	0	1	0	0	2
Lamoille River	75.8	4.3%	5	3	5	0	0	13
Crooked Hollow Creek	68.4	4.9%	3	3	0	1	0	7
Pond Brook	133.8	5.0%	5	3	4	2	0	14
Moorings Stream	18.0	5.2%	0	0	1	0	0	1
Allen Brook	83.9	5.2%	3	3	2	0	1	9
Lake Champlain	267.6	6.9%	3	6	3	2	0	14
Smith Hollow Creek	107.5	9.1%	0	1	2	3	0	6
Indian Brook	320.8	9.7%	1	1	4	3	1	10
Winooski River	914.3	17.4%	4	5	2	6	8	25
Sunderland Brook	605.8	18.3%	1	3	4	4	5	18
Total	2,726.9	8.90%	35	41	29	21	15	142

Impervius Surface

Subwatershed Impervious Surface

- <1%
- 1% - 5%
- 5% - 10%
- 10% - 20%
- 20% - 50%
- 50% - 64%
- Watershed Boundaries

0 0.5 1 Miles

Sources: VCGI: Streams, Roads; UVM: Impervious Surface data

The Impervious Surface data is a product of the Land Cover analysis performed by the Spatial Analyst Lab at the University of Vermont. Object based image analysis was used on the 2004 LiDAR imagery to produce a land cover raster. The land cover dataset was reclassified to extract impervious surfaces. The following classes were assigned to the Impervious class: 'Buildings', 'Roads/Railroads', and 'Other Paved Surfaces'.

This project's funding was provided by an US EPA Demonstration Grant # XP-83232201-1

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In coordination with:

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Research & Consulting Services

C.L. Davis Consulting Associates

This report was developed in the offices of Engineered Solutions, Inc. in Burlington, Vermont and published in February, 2003 on recycled paper.

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INTRODUCTION

Water quality is the result of a complex mixture of natural and human influences. By collecting and transporting stormwater runoff via ditches, drain pipes, etc. we, as a society, have inserted ourselves into the flow of nature. Thus, because we have taken the responsibility for the collection of waters, we must also responsibly dispose of them. Through this Project, the Town of Colchester has begun the process of taking on this responsibility by assessing the condition of existing outfalls and developing guidance for the improvement of stormwater discharge from outfalls in the Town.

This Project attempts to satisfy two general goals. First, provide a snapshot of the conditions of stormwater outfalls. Second, establish a protocol and data infrastructure that supports the future management of stormwater outfalls. By addressing these two goals, this Project aids the Town in satisfying the management measures required by the EPA Phase II Stormwater Regulations (for MS-4 communities) and establishes protocols for continued compliance.

Specifically, the content/data and recommendations developed are a major step towards directly satisfying the requirements of *Measure 6: Pollution Prevention/Good Housekeeping.* Additionally, the protocols for inspection and ongoing data collection developed by the Project create the infrastructure that can help to detect illicit discharges; thus supporting efforts under *Measure 3: Illicit Discharge Detection and Elimination.*

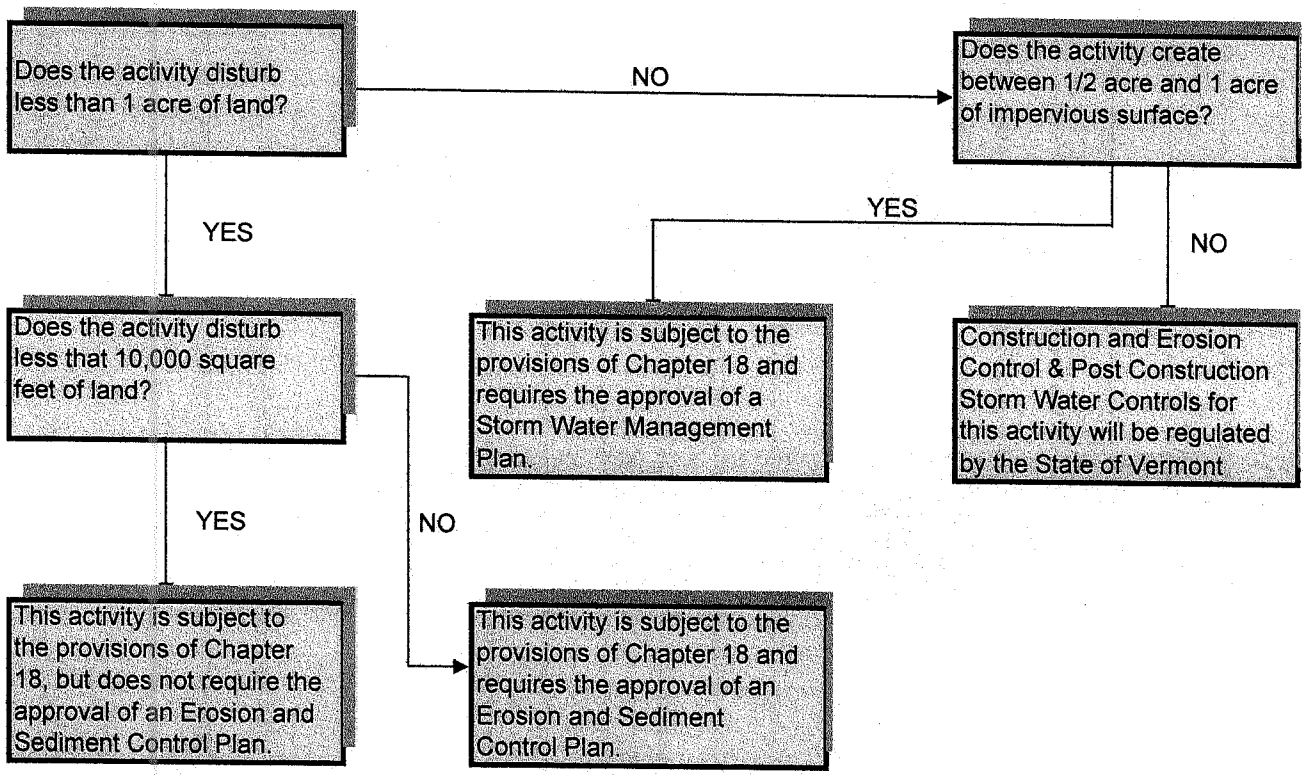
This Project Report contains three volumes that document the data, conclusions and recommendations of the Project. This volume, Volume 1: *Assessment Report* summarizes the approach, methods and conclusions developed during the execution of the Project. Whereas Volume 1 is a narrative, Volumes 2 and 3 primarily present raw and processed data and mapping. Volume 2: *Mapping and Data* contains the raw data and analysis developed by the Project, a variety of maps, outfall photographs, etc. and a CD-ROM containing Project data. Volume 3: *Outfall Fact Sheets* contains individual fact sheets for each outfall assessed by this report which summarize the existing conditions, and, where appropriate, propose improvements and the priority for improvement actions. All three volumes work together to provide a snap shot of existing conditions and provide a guide for future actions by the Town.

The Project was executed in three phases:

Phase I)	Field Identification and Assessment
Phase II)	Data Analysis and Prioritization
Phase III)	Prevention and Inspection

During Phase I the Project Team identified, reviewed and assessed the condition of known stormwater outfalls. Phase II involved the collation of field data into a project database and the development of analysis techniques to extract information and develop priorities. Phase III presents inspection and management approaches that strive to improve and maintain the health of the waters of Colchester.

Town of Colchester
Storm Water Permitting Requirements
For Development and Land Disturbances



Town of Colchester
Erosion and Sediment Control Plan Application

The submission of an Erosion and Sediment Control Plan is required under the Colchester Code of Ordinances, Chapter 18 Storm Water, Article V, Erosion and Sediment Control, Sec. 18-21 Permits, for any land disturbance activities of less than 1 acre, except as exempted under the Ordinance. When applicable, the approval of an Erosion and Sediment Control Plan is required before the issuance of a Building Permit or Septic Permit for any land disturbance activities regulated under the Storm Water Ordinance.

The Erosion and Sediment Control Plan must address at a minimum; (1) construction access route, (2) winter shutdown, (3) stabilization of denuded areas, (4) protection of adjacent properties, and (5) maintenance. The plan shall be prepared by or under the direction of a licensed professional engineer or a certified erosion control technician. The Erosion and Sediment Control Plan shall demonstrate conformance to the Storm Water Ordinance. **All erosion and sediment control devices must be installed and stabilized before the start of construction.** The erosion and sediment control plan shall contain both narrative and map(s) that clearly provide the following information:

Item 1 – Contact Information

1. Applicants Name: _____
2. Mailing Address: _____
3. Tax Map and Parcel ID# for affected property: _____
4. Telephone: _____
5. Fax: _____
6. E-Mail: _____

Item 2 – General Description

A general description of the project including a map identifying the location of the property and parcel boundaries.

Item 3 – Natural Resources

A map of existing on site natural resources including soil type, types and location of vegetative covering, natural drainage ways, brooks, streams, ponds, wetlands and other surface waters, including any surface waters within 300 feet from the site.

Item 4 – Grading Plan

A grading plan at a minimum scale of 1" = 40'. The grading plan shall include existing and proposed contours at maximum intervals of 5 feet. The grading plan shall also include the location of the temporary construction entrance and any soil stockpiles that will be maintained on the site.

Item 5 – Infrastructure

A map identifying existing infrastructure both on and adjacent to the site, including roads, driveways, culverts, drainage structures, roadside ditches, etc.

Item 6 – BMP's

A description of each of the best management practices to be used on site, and a map identifying the locations where each of the best management practices will be installed and maintained.

Item 7 - Applicant Certification

I, _____, hereby certify that the application as submitted is accurate to the best of my knowledge, and that I will take all steps necessary to comply with the erosion and sediment controls as required as a condition of approval by the Town, including all inspection requirements as outlined below.

Applicant Signature: _____ Date: _____

_____ Approved as submitted
_____ Approved with conditions as attached

Approved by: _____ Date: _____

Inspection Requirements

A professionally licensed engineer; or a state certified erosion control technician shall make inspections as hereinafter required and certify in writing, compliance to the erosion and sediment control plan as approved:

1. Start of construction
2. Installation of sediment and erosion control measures
3. Completion of site clearing
4. Completion of rough grading
5. Completion of final grading
6. Close of construction season
7. Completion of final landscaping

"All erosion and sediment control devices must be installed and stabilized before the start of construction."

Town of Colchester
Storm Water Management Plan Application

The submission of a Storm Water Management Plan is required under the Colchester Code of Ordinances, Chapter 18 Storm Water, Article VI, Storm Water Management, Sec. 18-32 Permits, for any land disturbance activities that are equal to or greater than 1 acre, and, create between ½ acre and 1 acre of impervious surface, except as exempted under the Ordinance. When applicable, the approval of a Storm Water Management Plan is required before the issuance of a Building Permit for any land disturbance activities regulated under the Storm Water Ordinance.

The Storm Water Management Plan must address at a minimum; (1) water quality treatment, (2) channel protection, (3) groundwater recharge, (4) over bank flood protection, and (5) extreme flood protection. The Storm Water Management Plan shall be prepared and signed by a licensed, professional engineer who shall verify and demonstrate conformance to the applicable water quality treatment standards and storm water management design criteria contained within the Ordinance. The Storm Water Management Plan shall contain both narrative and map(s) that clearly provide the following information:

Item 1 – Contact Information

1. Applicants Name: _____
2. Mailing Address: _____
3. Tax Map and Parcel ID# for affected property: _____
4. Telephone: _____
5. Fax: _____
6. E-Mail: _____

Item 2 – Site Plan

A map indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural storm water management and sediment control facilities. The map will also clearly show proposed land use with tabulation of total lot size in acres, percentage of surface areas to be disturbed, percentage of both existing and proposed impervious surfaces, drainage patterns, locations of utilities, limits of clearing and grading, and all easements, including those easements necessary for required maintenance of all storm water treatment practices.

Item 3 – Base Map

A 1" = 200' topographic base map of the site which extends a minimum of 100' beyond the limits of the proposed development and indicates existing surface water drainage including streams, ponds, culverts, ditches, and wetlands and current land use including all existing buildings, utilities, roads, and significant natural and manmade features not otherwise shown.

Item 4 – Calculations

Sufficient engineering analysis to show that the proposed storm water treatment practices are capable of controlling runoff from the site in compliance with the ordinance and the storm water design manual. The analysis shall also include hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in the Public Works Specifications and Standards. Post-development storm water runoff flows shall be limited to equal to or less than pre-development storm water runoff flows for a minimum twenty-five years storm, twenty-four hour storm event.

Item 5 – Soils Report

If a storm water treatment practice depends on hydrologic properties of soils, such as infiltration basins, then a soils report shall be submitted. The soils report shall be based on on-site boring logs or soil pit profiles.

Item 6 – Maintenance and Repair Plan

The design and planning of all storm water management facilities shall include detailed maintenance and repair procedures to ensure their continued function. These plans will identify the parts or components of a storm water management facility that needs to be maintained. The maintenance plan shall also include:

a) A landscape plan for the management of vegetation at the site after construction is finished, including who will be responsible for the maintenance of vegetation at the site and what practices will be employed to ensure that adequate vegetation cover is preserved.

b) Maintenance easements to ensure access to all storm water treatment practices at the site for the purpose of inspection and repair. These easements shall be recorded in the land records before the issuance of a Building Permit and will remain in effect even with transfer of title to the property.

c) Maintenance agreements shall be required binding all subsequent owners of land served by an on-site storm water management measure. The maintenance agreement shall be recorded in the land records before the issuance of a Building Permit and shall specify the required maintenance for all storm water treatment practices, along with a maintenance schedule specifying when and how often maintenance is performed on the storm water treatment practices.

d) A statement from the applicant that maintenance records shall be maintained for a period of 3 years that verify that all required maintenance was performed in conformance to the approved storm water management plan, and that these records will be made available to the Town upon request.

Item 7 – Applicant Certification

I, _____, hereby certify that the application as submitted is accurate to the best of my knowledge, and that I will take all steps necessary to comply with the storm water management plan as required as a condition of approval by the Town, including all inspection requirements as outlined below.

Applicant Signature: _____ Date: _____

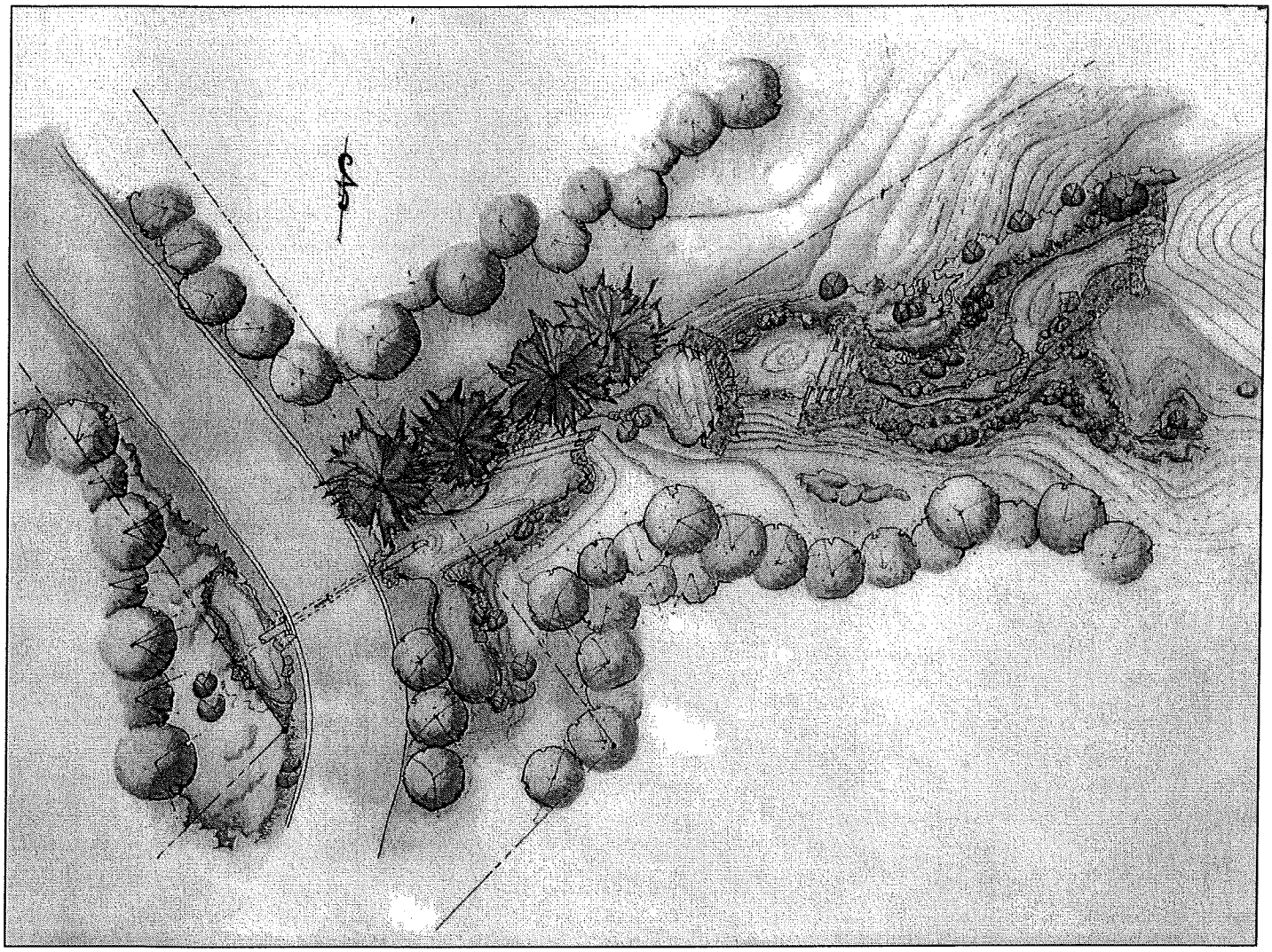
_____ Approved as submitted
_____ Approved with conditions as attached

Approved by: _____ Date: _____

Inspection Requirements

The Town shall make inspections on a regular basis and either approve that portion of the work completed or shall notify the applicant wherein the work fails to comply with the storm water management plan as approved. To obtain inspections, the applicant or their representative shall contact the Town at 264-5603, or 264-5600 at least two working days in advance.

Department of Public Works
Specifications and Standards



Amended March 2012

Town of Colchester, Vermont

A Community of People, Business, Industry and Resources working for a better Town

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PREFACE

The "Town of Colchester Public Works Specifications and Standards" are applicable to all new construction and reconstruction of infrastructure due to obsolescence or deterioration. Variations from these standards and specifications will not be permitted except as provided for herein. In cases where the design of a facility is not governed by these standards and specifications, the latest design methods shall be used and included on the plans for acceptance by Town Officials. All engineering design shall be based on the latest methods and technology when determining sizes, strengths, and amounts. All plans and specifications shall have the following note stating, "All work shall be performed in accordance with the Town of Colchester Public Works Specifications and Standards".

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4.1 GENERAL

This Section includes information regarding measures and materials for the design and the construction of infrastructure used to treat, collect, and convey stormwater runoff.

4.2 PROJECT REQUIREMENTS

A. COMPLIANCE

The Developer shall be responsible for complying with the latest revisions of Vermont Water Quality Standards and protection of adjacent properties from degradation due to stormwater runoff. In addition, the Contractor shall comply with relevant local and state regulations governing the control of stormwater, which may include Chapter 18, Article VI of the Town of Colchester Ordinances and the State of Vermont's Stormwater Management Rule.

B. STORMWATER MANAGEMENT PLAN

For projects that disturb greater than 1 acre and create between one-half and one acre of impervious surfaces, a Stormwater Management Plan shall be submitted to the Town Engineer for review and approval prior to the issuance of a Building Permit and/or Septic Permit. See Chapter 18; Section 18-37 of the Town of Colchester Ordinances for specific Plan requirements.

4.3 STANDARD TREATMENT PRACTICES

A. COMPLIANCE

The standard treatment practices (STP) to be used for the purpose of providing the necessary water quality, channel protection, groundwater recharge, and/or flood control for a given project shall comply with the STP measures contained within the latest edition of the Vermont Storm Water Management Manual (Volumes I and II). These measures may include ponds, wetlands, infiltration practices, filters, and open channels.

B. ANALYSIS AND SIZING

The storm water collection system shall be properly sized to convey storm water flows in an efficient and effective manner to the required STP measures.

In addition to the 10-yr and 100-yr storm events analyzed for flood control, a downstream analysis (as described in Section 1.2 of the Vermont Storm Water Management Manual Vol. 1) of the project site may be required by the Town Engineer on a case-by-case basis depending on the magnitude of the project, the level of risk to downstream public and private infrastructure, or other issues such as past drainage or flooding problems.

Any culvert with a drainage area greater than 0.25 sq. miles (160 acres) will require a hydraulic engineering study. Culverts will be designed to convey the Q25 design storm with minimal surcharge. All bridges, (structures with spans greater than 6 feet) and open bottom structures will require a hydraulic engineering study. Structures will be designed to convey the Q25 design storm and allow for passage of ice and debris.

The following minimum pipe diameters shall apply to new construction and replacement of existing structures:

- Driveway culvert – 15-inch diameter
- Roadway culvert – 18-inch diameter
- Closed drainage system – 15-inch diameter
- Underdrains and Infiltration Systems – varies (see UNDERDRAINS)

4.4 MATERIALS AND PRODUCTS

A. TYPES OF PIPE

Types of pipe which may be used for storm drain lines are Reinforced Concrete Pipe (RCP), Corrugated Polyethylene Pipe (PE) and Polyvinyl Chloride Pipe (PVC). Types of pipe which may be used for culverts are Reinforced Concrete Pipe (RCP) and Corrugated Polyethylene Pipe (PE).

REINFORCED CONCRETE PIPE (RCP)

Pipe shall conform to the Vermont Standard Specifications for Construction, Section 710, and AASHTO, M170. RCP shall be used where there is not sufficient cover for other pipe materials to structurally support the loads of passing traffic.

CORRUGATED POLYETHYLENE PIPE (PE)

Pipe shall conform to AASHTO M294-90, Type S.

POLYVINYL CHLORIDE PIPE (PVC)

Pipe shall conform to ASTM Specification D-3034 or F679, (PVC) Sewer Pipe and Fittings, SDR35, or Perma-Loc sewer pipe and fittings in compliance with ASTM F794.

PVC pipe shall not be installed when the temperature drops below 32°F or goes above 100°F. During cold weather, the flexibility and impact resistance of PVC pipe is reduced.

Extra care is required when handling PVC pipe during cold weather. PVC pipe shall not be stored outside and exposed to prolonged periods of sunlight as pipe discoloration and reduction in pipe impact strength will occur. Canvas or other opaque material shall be used to cover PVC pipe stored onsite.

CORRUGATED GALVANIZED METAL PIPE (CGM)

This pipe material is not allowed for construction under municipally owned roadways, rights-of-way, or easements.

B. MANHOLES

Where indicated on the plans, the Contractor shall furnish and install manholes, which meet the requirements of the sanitary sewer manholes of these specifications. Precast sections shall be coated with dampproofing or shall be cast with a waterproofing concrete admixture. Frame and covers shall say DRAIN on the cover and otherwise meet the requirements of frames and covers as described in the Sewer section of these specifications.

C. CATCH BASINS

Catch basins shall be constructed of reinforced concrete and shall be provided with ductile iron or grey cast iron frames and grates, and rated to carry a minimum design load of AASHTO H-20. Ductile iron frames and grates shall be REXUS gratings, as manufacturered by CertainTeed Corporation of Valley Forge, PA. Grey cast iron frames and grates shall be a R-3210-ALM or R-3210-LLM as manufactured by Neenah Foundry, Neenah, Wisconsin. Frames and grates shall be hinged and open to a minimum 100-degrees with a hold open mechanism at 90-degrees that will prevent accidental closure. The frames in curbed areas shall be set to final grade only after the curbs have been completed.

Precast risers and base sections shall conform to the Vermont Standard Specifications for Construction, Section 604, or as periodically amended. Frames shall be brought to grade with rubber grade rings by Infra-Riser. Precast risers and bases for manholes shall conform to ASTM Specifications C-361. Precast sections shall be coated with dampproofing or shall be cast with a waterproofing concrete admixture.

The pipe opening in the precast manhole riser shall have a cast-in-place flexible gasket or an equivalent system for pipe installation as approved by the Town Engineer. Joints between manhole risers shall be rubber "O" ring seals or soft Butyl joint sealer (rope form).

Catch basins shall have a minimum 24-inch sump.

D. DRAINAGE SWALES

Drainage swales and ditches that are being used to convey (but not provide treatment of) stormwater shall conform to Figures 4.5 and 4.6.

E. UNDERDRAINS

Perforated Polyvinyl Chloride (PVC): PVC SDR35 pipe shall conform to AASHTO M278 and ASTM F75B. For pipe sizes 6", and 8" perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 4 rows spaced at 90 degrees and 150 degrees. For pipe sizes 10" and larger perforations shall be 1/4" diameter holes, 3 1/4" on center, with a total of 6 rows spaced at 90 degrees, 125 degrees, and 160 degrees.

4.5 CONSTRUCTION METHODS

A. LAYING PIPE

Storm drains and culverts shall be constructed in accordance with the Vermont Standard Specifications for Construction, Section 601, or as periodically amended; and on a trench bottom, they shall be prepared and bedded as shown on Figure 4.3. Each pipe shall be checked just prior to laying to ensure that it is clear of all dirt and debris. It shall be laid true to line and grade as indicated on the contract drawings. All joints shall be tight, and inverts shall be continuous.

PE pipe shall be firmly joined as recommended by the manufacturer, concrete pipe joints shall be a rubber-gasket type, and PVC pipe shall be joined with standard push-on type using elastomeric gaskets.

Storm drains and culverts shall be designed to have a minimum slope of 0.5%, a maximum slope of 20%, and designed based on project-specific requirements and as accepted by the Town Engineer.

B. PIPE BEDDING

Reinforced concrete pipe shall be bedded with material excavated from the trench having no stones larger than one and a half inches (1 ½") in the longest dimension. Should no

excavated material be suitable, sand or gravel shall be used. Sand and Gravel shall meet the current Vermont Agency of Transportation Standard Specifications for Construction for these items.

PVC and PE pipe shall be bedded with fine graded crushed stone. Fine graded crushed stone shall meet the current Vermont Agency of Transportation Standard Specifications for Construction for this item and then backfilled with material excavated from the trench having no stones larger than one and a half inches (1 ½") in the longest dimension. Sand or gravel shall be used if no excavated material is suitable.

C. BACKFILL

Trenches shall be backfilled to subgrade with, wherever possible, material excavated from the trench, and shall be done only after the approval of the Design/Project Engineer. Material for backfilling shall be free of roots, stumps, and frost. Backfill shall not be placed on frozen material. Materials used for backfilling trenches shall be free of stones weighing more than thirty (30) pounds. No stones measuring over three inches (3") in the longest dimension shall be placed within one foot (1') of the pipeline being backfilled. Stones found in the trench shall be removed for a depth of at least six inches (6") below the bottom of the pipe. Use of blasted rock, as trench backfill will not be permitted.

Backfill material shall be tamped in layers around the pipe to a sufficient height above the pipe to adequately support and protect the pipe. Backfill for pipelines under roadways shall be placed in six inch (6") lifts, each lift being compacted to not less than 95% of maximum dry density as determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. Pipelines outside of roadways or in cross country routes shall be compacted to 90% maximum density as determined by ASTM D1557 / AASHTO T180 Method A (Modified Proctor) test. If conditions warrant, the backfilling of trenches shall be done with mechanical equipment. Particular precautions shall be taken in the placement and compaction of the backfill material in order not to damage the pipe, pipe coating or structure. Backfilling in all public roadways shall be so compacted as to leave no depression in the road. Additional backfill requirements may apply within State Highway Right-Of-Ways. All public road surfaces shall be restored to a condition at least equal to that, which existed prior to the start of construction. Precautions shall be taken against undue damage to existing surface materials.

No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions are taken as may be necessary to obtain proper compaction.

Surplus excavated materials shall be disposed of in a satisfactory manner. Surplus material or spoil shall be removed promptly and disposed of in accordance with applicable

State and local permits.

Trenches that have been improperly backfilled, enclosed or covered before inspection of fittings and joints shall be reopened and re-backfilled at the Contractor's expense.

D. HEADWALLS

The Contractor shall construct pipe headwalls at the outfall end of all storm lines as shown on the plans. Headwalls shall be specifically designed Polyethylene end sections, concrete, or rubble masonry construction.

If constructed of concrete or masonry rubble, headwalls shall conform to the Vermont Agency of Transportation Standard Specifications for Construction, Section 602. All concrete utilized for the purpose shall meet the requirements for Class B concrete as per the Vermont Standard Specifications for Construction, Section 501. End sections shall conform to the Vermont Agency of Transportation Standard Specifications for Construction, Section 711, or as periodically amended.

E. PIPE OUTFALLS

Stormwater outfall pipes shall be constructed to minimize the discharge velocity. The last 20' of pipe slope shall not exceed 2 %. This may require the use of drop manholes in the outfall. All outfalls will be properly lined with heavy stone appropriately sized to withstand the velocity of water when the pipe is running full. See Figure 4.4.

F. CATCH BASINS

Catch basins shall be installed on a compacted base of sand or fine graded crushed stone. The base material shall be covered with one layer of subgrade geotextile before placement of the structure. See Figure 4.1.

G. ACCESS ROAD

All necessary access routes shall have at least a fourteen foot (14') wide improved travel way capable of supporting the weight of a two-axle, forty thousand (40,000) pound vehicle and have an adequate turnaround at the end. See Figure 4.7.

H. CHAIN LINK FENCE

Stormwater ponds shall either be fenced to protect against hazards or the contours of the pond shall be benched to eliminate drop-offs or other safety hazards.

- Fabric – Chain link, 2" mesh, #9 gauge (0.148" diameter) wire. Top selvage shall be knuckled and bottom selvage shall be barbed.
- Line Posts – 1.9" diameter, nominal pipe, schedule 40.
- Terminal Posts – End, Corner and Pull Posts to be 2.375" diameter, nominal pipe, schedule 40.
- Post Spacing – Posts shall be spaced equidistant on a maximum of 8 feet center to center, except gate posts which shall be spaced according to the required gate opening.
- Post Footings – All posts shall be set to a depth of 34" in a 10" cylindrical shaped hole 42" deep filled with concrete.
- Tension Wire – A tension wire (0.192" diameter) shall be attached 1" below the top selvage and 2" above the bottom selvage of fabric with hog ring fasteners.
- Fabric Ties – Fabric to be fastened to posts and gate frames with (0.148" diameter) wire or tie bands.
- Truss Rods – To be 3/8" diameter (diagonal) bars with turnbuckle.
- Stretcher Bars – ¼" x ¾" flat bars with square edges.
- Gates – Gate frames to be 1.9" diameter nominal pipe, schedule 40, assembled by welding, riveting, or bolting, and shall be furnished complete with fittings. Gate posts shall be 2.875" diameter, nominal pipe, schedule 40. See Figure 4.8.

Refer to the Vermont Stormwater Treatment Standards for pond design information regarding pond benches (2.7.1.E Pond Landscaping).

END OF SECTION

SECTION 8. EROSION, DUST AND WATER CONTROL

8.1 GENERAL

This Section includes information regarding measures and materials for the design and construction of measures used to control soil erosion, dust, and water pollution during construction.

8.2 PROJECT REQUIREMENTS

A. COMPLIANCE WITH LOCAL & STATE REGULATIONS

The Contractor shall be responsible for complying with the Vermont Water Quality Standards and protecting adjacent properties from degradation due to erosion or sedimentation during the course of construction activities. In addition, the Contractor shall comply with relevant local and state regulations governing the control of erosion and sedimentation, which may include Chapter 18, Article V of the Town of Colchester Ordinances, the Town of Colchester Stormwater Management Plan (MS4 General Permit 3-9014, VTR040000), and the State of Vermont's Construction General Permit 3-9020.

B. EROSION PREVENTION & SEDIMENT CONTROL PLAN

The Contractor shall develop a plan to prevent erosion and control sediment that at a minimum, implements the practices required by the State of Vermont's Low Risk Site Handbook for Erosion Prevention and Sediment Control.

For projects disturbing more than 10,000 square feet but less than 1 acre, the Erosion Prevention and Sediment Control Plan shall be submitted to the Town Engineer for review and approval prior to the issuance of a Building Permit and/or Septic Permit. See Section 18-24 of the Town of Colchester Ordinances for specific Plan requirements.

C. DUST CONTROL

The Contractor shall be responsible for ensuring that the dust created as a result of construction activities does not create a nuisance or a safety hazard. Where and when deemed necessary by the Municipality, the Contractor will be required to wet sections of the construction area with water, or apply calcium chloride, or sweep the roadway with a wetted power broom as dust control measures.

D. PROTECTION OF WATER COURSES

The Contractor shall carry out his or her operations in such a manner to give adequate protection of watercourses and minimize soil erosion. The Town Engineer, Building

Inspector and Design/Project Engineer have the authority to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations and to order the Contractor to implement immediate erosion control measures to prevent contamination of adjacent streams or other watercourses, and areas of water impoundments. These measures shall include but not be limited to, dumped stone check dams, straw/mulch matting, silt fencing, and temporary construction entrances.

Unless otherwise approved in writing, mechanized equipment shall not be operated in live streams except as may be required to construct changes in channel and permanent or temporary structures. Rivers, streams and impoundments shall, as soon as construction will allow, be cleared of all falsework, piling and debris caused by the construction operations.

E. INSPECTIONS

The applicant or their agent shall make regular inspections of all control measures in accordance with the inspection schedule outlined on the approved Erosion and Sediment Control Plan and as outlined in Section 18-27 of the Town of Colchester Ordinances.

8.3 MATERIALS, PRODUCTS & BMPS

Unless specified otherwise, the Contractor shall use Erosion Prevention and Sediment Control practices, including materials, products, and Best Management Practices (BMPs), that comply with The Vermont Standards & Specifications for Erosion Prevention & Sediment Control (VSSEPSC).

Some of the most commonly used practices are as follows:

A. PERIMETER FENCE

Safety/Barrier fence shall be machine produced plastic or fabric, high visibility, break resistant fence used for crowd control, tree protection, and work limits definition. The openings shall be rectangular or diamond pattern and the stakes shall be hardwood. The height shall be a minimum of 36 inches.

B. STABILIZED CONSTRUCTION ENTRANCES

A stabilized pad of aggregate underlain with geotextile located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way. The purpose of stabilized construction entrance is to reduce or eliminate the tracking of sediment onto the public right-of-way. See Figure 8.1 and the VSSEPSC for specific guidelines on the size, geometry, and materials required for stabilized construction entrances.

C. MULCH

Applying coarse plant residue or chips, or other suitable materials, to cover the soil surface. The primary purpose is to provide initial erosion control while a seeding or shrub planting is establishing. See Figure 8.2 and the VSSEPSC for guidelines on the appropriate materials and application rates for various mulching methods.

D. EROSION CONTROL BLANKETS

Erosion control blankets shall be machine produced, 100% degradable mats with a straw matrix. The specific blanket type (including netting, thread, anchor staples, and degradation rates) to be selected based on manufacturer's recommendations for the given application. The purpose of this practice is to protect the soil surface from raindrop impacts and overland flow during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation.

E. STONE CHECK DAMS

Small barriers or dams constructed of stone, bagged sand or gravel, or other durable material across a drainage way. The purpose of stone check dams are to reduce erosion in a drainage channel by restricting the velocity of flow in the channel. See Figure 8.3 and the VSSEPSC for specific requirements for stone check dams.

F. SILT FENCE

Silt fences shall be commercially produced product, composed of 3 ft. hardwood posts, supporting a geotextile fabric designed to filter water and trap sediment. Prefabricated silt fence shall be Envirofence by Mirafi.

G. INLET PROTECTION

A temporary, somewhat permeable barrier, installed around inlets in the form of a fence, berm or excavation around an opening, trapping water and thereby reducing the sediment content of storm water by settling. Their purpose is to prevent heavily sediment laden water from entering a storm drain system through inlets. See the VSSEPSC for specific requirements on various types of inlet protection. For MS4 catch basins in the traveled way, the Design/Project Engineer shall seek approval from Town Engineer or Building Inspector prior to selection of the approved method.

H. POLLUTION PREVENTION

Construction sites are required to be kept reasonably free of grease, oils, concrete, and other potential pollutants. For projects with cast-in-place concrete, concrete truck wash areas shall be included in the erosion control plan.

8.4 METHODS FOR INSTALLATION & EXECUTION

The installation and maintenance of all practices shall comply with The Vermont Standards & Specifications for Erosion Prevention & Sediment Control (VSSEPSC).

Some of the most commonly used practices are as follows:

A. PERIMETER FENCE

Barrier fence shall be installed prior to the start of construction phases where protection and delineation are required and shall be removed upon completion of the work.

B. STABILIZED CONSTRUCTION ENTRANCES

Stabilized construction entrances shall be installed in accordance with the VSSEPSC and Figure 8.1. The stabilized construction entrance is installed prior to the start of construction and removed upon completion of the roadway base. The entrance shall be maintained in a condition which will prevent tracking of sediment onto the public right-of-way. This may require periodic top dressing with additional aggregate. All sediment spilled, dropped, or washed onto the public-right-of-way must be removed immediately.

When necessary, wheels must be cleaned to remove sediment prior to entrance onto the public right-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment-trapping devise. All sediment shall be prevented from entering storm drains, ditches, or watercourses.

C. MULCH

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems. Slope, grade and smooth the site to fit the needs of selected mulch products. Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required. Apply mulch after soil amendments and planting are accomplished or simultaneously if hydroseeding is used. See Figure 8.2 and the VSSEPSC for guidelines on the appropriate application methods and installation criteria for various mulching methods.

D. EROSION CONTROL BLANKETS

Erosion control blankets shall be placed on disturbed areas that have been smoothly graded and cleared of debris such as rocks and roots, such that the blanket is in close and continuous contact with the ground. Erosion control blankets shall be placed loosely over the ground surface without folds or stretching. Blankets shall be securely attached per the manufacturer's recommendation with the proper number and spacing of anchoring mechanisms.

E. STONE CHECK DAMS

Dumped stone check dams shall be installed in accordance with Figure 8.3 and the VSSEPSC. Dumped stone check dams are installed during construction as needed to control runoff and are removed prior to permanent seeding.

F. SILT FENCE

Silt fence shall be installed in accordance with Figure 8.4 and the VSSEPSC prior to the start of construction. The silt fence shall be maintained during the project and any accumulated sediment or debris shall be removed regularly to keep the silt fence functional. The silt fence shall be removed after permanent restoration has been established and at the direction of the Design/Project Engineer.

G. INLET PROTECTION

Inlet protection shall be installed in accordance with one of the methods outlined in the VSSEPSC. Inlet protection is installed after catch basins have been installed and maintained during construction. In the case of existing MS4 catch basins, every effort shall be made by the Contractor to contain run-off to within the project limits or inlet protection shall be installed. Inlet protection shall be removed once permanent stabilization of the surrounding area is established.

H. POLLUTION PREVENTION

Construction sites are required to be kept reasonably free of grease, oils, concrete, and other potential pollutants. Contractors shall be required to use equipment that is in reasonably good repair. Where equipment drips are anticipated, drip oil and grease shall be collected and properly removed from the site. For projects with cast-in-place concrete, concrete truck wash areas shall be controlled such that wet cement is not washed into the MS4 or waters of the State of Vermont.

I. PERMANENT STABILIZATION

At completion of grading, slopes, ditches, and all disturbed areas shall be smooth and free of pockets with sufficient slope to ensure drainage. All disturbed areas shall receive a minimum of four inches (4") of topsoil and shall be seeded, fertilized, limed, and mulched.

J. REMOVAL OF TEMPORARY CONTROLS

Erosion control measures shall be continued until the permanent drainage facilities have been constructed and until grass on seeded slopes or specially installed shrubbery is established sufficiently to be an effective deterrent against erosion. With approval of the Town Engineer or Building Inspector, temporary erosion controls shall be removed, and any

accumulated sediment or debris disposed of to provide a pleasing appearance.

END OF SECTION

SECTION 9. LANDSCAPING & PERMANENT EROSION CONTROLS

9.1 GENERAL

This Section includes information regarding measures and materials for the design and construction of measures used to plant grasses and landscaping plantings within the public right-of-way as well as other disturbed areas.

9.2 PROJECT REQUIREMENTS

A. PERMANENT STABILIZATION OF DISTURBED AREAS

At completion of grading, slopes, ditches, and all disturbed areas shall be smooth and free of pockets with sufficient slope to ensure drainage. All disturbed areas shall receive a minimum of four inches (4") of topsoil and shall be seeded, fertilized, limed, and mulched in accordance with Section 9.3, below.

Lawns and Street Limits

Seed mixture in lawn areas around dwellings and within street limits shall be urban mix conforming to the following Table. For seeding between September 1 and October 15, winter rye shall be used in addition to the urban mix at an application rate of 100 pounds per acre.

All Other Disturbed Areas

Seed mixture in all other disturbed areas shall be conservation mix conforming to the following Table. For seeding between September 1 and October 15, winter rye shall be used in addition to the conservation mix at an application rate of 100 pounds per acre.

B. DELIVERY, STORAGE, AND HANDLING

Grass Seed

Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

Plants

Deliver plant life materials immediately prior to placement. Keep plants moist.

Fertilizer

Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

9.3 MATERIALS

A. SEEDING REQUIREMENTS

Reseeding must be done with one of the approved seed mixes accompanied by placement of straw mulch of sufficient coverage to control erosion until such time as the cover crop is established over ninety (90%) of the seeded area.

URBAN MIX GRASS SEED

% By Weight	Lbs. Live Seed Per Acre	Type of Seed
37.5	45	Creeping Red Fescue
31.25	37.5	Kentucky Bluegrass
31.25	37.5	Winter Hardy, Perennial Rye

CONSERVATION MIX GRASS SEED

% By Weight	Lbs. Live Seed Per Acre	Type of Seed
35	35	Creeping Red Fescue
23	23	Kentucky Bluegrass
15	15	Annual Rye
11	11	Winter Hardy, Perennial Rye
6	6	White Clover
10	10	Highland Benthgrass

B. TREES, SHRUBS, AND BUSHES

Tree species and sizes shall be identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

Trees, shrubs, and bushes shall be planted in the locations indicated on the approved plans and in accordance with the any planting details and specifications. Plantings shall be in accordance with the **Colchester Street Tree Master Plan** (see Appendix D). Replanting with native woody and herbaceous vegetation must be accompanied by placement of straw mulch or its equivalent of sufficient coverage to control erosion until the plantings are established and are capable of controlling erosion.

C. TOPSOIL

Excavated from site; or

Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0.

D. SOIL AMENDMENT MATERIALS

Fertilizer

Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis.

Peat Moss

Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4 to 5; moisture content of 30 percent.

Bone Meal

Raw, finely ground, commercial grade, minimum of 3 percent nitrogen and 20 percent phosphorous.

Lime

Ground limestone, dolomite type, minimum 95 percent carbonates

Water

Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

E. MULCH MATERIALS

Landscaping Mulching: wood shavings, free of growth or germination inhibiting ingredients.

F. ENVIRONMENTAL REQUIREMENTS

Temperature Requirements: Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

Wind Restrictions: Do not install plant life when wind velocity exceeds 30 mph.

9.4 METHODS

A. PREPARATION OF SUBSOIL

Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

B. PLACING TOPSOIL

Spread topsoil to a minimum depth of 4 inches over area to be planted. Rake smooth.

Place topsoil during dry weather and on dry unfrozen subgrade.

Remove vegetable matter and foreign non-organic material from topsoil while spreading.

Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

C. FERTILIZING

Apply fertilizer in accordance with manufacturer's instructions.

Apply after initial raking of topsoil.

Mix thoroughly into upper 2 inches of topsoil.

Lightly water to aid the dissipation of fertilizer.

D. SEEDING

Apply seed at a rate indicated in the seeding requirement table. Apply seed evenly in two intersecting directions. Rake in lightly.

Do not seed areas in excess of that which can be mulched on same day.

No seeding shall be performed after October 15, in accordance with the State of Vermont Erosion Control Manual.

Do not sow immediately following rain, when ground is too dry, or during windy periods.

Roll seeded area with roller not exceeding 112 lbs.

Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

E. HYDROSEEDING

Apply seeded slurry with a hydraulic seeder.

Do not hydroseed area in excess of that which can be mulched on same day.

Immediately following seeding, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

F. SEED PROTECTION

Identify seeded areas with stakes and string around area periphery. This temporary seed protection measure shall be removed following germination and prior to acceptance by the Town.

Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 12-inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

Secure outside edges and overlaps at 36-inch intervals with stakes.

Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

G. PLANTING

Set plants vertical.

Remove non-biodegradable root containers.

Set plants in pits or beds, partly filled with prepared plant mix

Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6-inch layers. Maintain plant life in vertical position.

Saturate soil with water when the pit or bed is half full of topsoil and again when full.

See Figure 9.1.

H. PLANT RELOCATION AND RE-PLANTING

Relocate plants as indicated by approved plans.

Replant plants in pits or beds, partly filled with prepared topsoil mixture.

Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6-inch layers. Maintain plant materials in vertical position.

Saturate soil with water when the pit or bed is half full of topsoil and again when full.

I. PLANT SUPPORT

Brace plants vertically with Arbortie material and stakes as indicated in Figure 9.1.

J. TREE PRUNING

Perform pruning of trees as recommended in ANSI A300.

Prune newly planted trees as required to remove dead, broken, and split branches.

9.5 QUALITY CONTROL

Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

9.6 MAINTENANCE

Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition. Maintain plant life immediately after placement and until plants are well established and exhibit a vigorous growing condition. Continue maintenance until termination of warranty period.

END OF SECTION

INTRODUCTION

These Specifications and Standards present updated design parameters for improved or new streets in Colchester. They apply to the design of four types of roadways: minor collectors, commercial / industrial streets, residential streets, and rural roads. Arterials and major collectors are not included in these standards as they consist of major state and town highways designed using applicable State and Federal design standards.

1. Minor Collector Street
   A minor collector is defined as a street serving as a connection between a residential, commercial or industrial street and a major collector or arterial.

2. Commercial / Industrial Street
   Commercial / industrial streets provide access primarily to commercial and/or industrial lots

3. Residential Street
   Residential streets are local streets within subdivisions including single family and duplex houses.

4. Rural Road
   The rural road standard will apply to the construction of unpaved gravel roads.

MINOR COLLECTOR STREET STANDARDS

1. PAVEMENT WIDTHS

Required pavement widths for a minor collector will vary from 26-30 ft wide depending on the required travel lane width, paved shoulder width and drainage configuration as discussed below. Minor collector streets serving commercial / industrial areas shall be designed using the commercial / industrial street standards in the next section.

Travel Lane Widths

Travel lanes shall be 11 ft wide on minor collector streets in residential areas.

Paved Shoulder Widths

Four-inch wide painted white lines will be required along both sides of minor collector streets to delineate the paved shoulder. The paved shoulder width varies from 2-4 ft based on the projected daily traffic volumes and the presence of a separated multi-use path. Table 1 provides a reference for the various cross-section scenarios shown on the following pages.

Table 1
Minor Collector Street
Cross-Section Scenarios

Projected Daily Traffic Volume	**With Multi-Use Path**	**Without Multi-Use Path**
500 – 2,000 vpd	#1	#2
>2,000 vpd	#3	#4

On-Street Parking

On-street parking shall not be permitted along minor collector streets.

2. DRAINAGE OPTIONS

Closed Drainage

Curbed streets shall be constructed using the typical cross-section detail shown on Figure 3.1 in Appendix C.

Open Drainage (Standard)

Standard open drainage may not be used on minor collector streets where a multi-use path or sidewalk is to be constructed. Uncurbed streets with standard drainage swales shall be constructed using the typical cross-section shown on Figure 3.2 in Appendix C.

Open Drainage (Shallow Swale)

Uncurbed streets with open drainage using shallow swales shall be constructed using the typical cross-section shown on Figure 3.3 in Appendix C.

3. BORDER OPTIONS

The border is defined as the area between the paved roadway and the right-of-way line where sidewalks, multi-use paths and / or planting strips are located.

Sidewalks

A 5 ft wide sidewalk may be constructed along one or both sides of minor collector streets, as required by the Town Engineer. Sidewalks shall be located with a 1 ft clearance to the right-of-way line.

Multi-Use Path

Multi-use paths shall normally be 10 ft wide to accommodate both pedestrians and bicyclists. A minimum 8 ft width will be permitted only when the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Good horizontal and vertical alignment provides safe and frequent passing opportunities.
- The path will not be subjected to maintenance vehicle loading conditions that would cause damage to the edge of the pavement.
- The path will be less than 1,000 ft long.

Construction of a multi-use path is required along one side of minor collector streets located in a bicycle path planning corridor (refer to the Town of Colchester Bike Path Master Plan).

Multi-use paths shall be located with 3 ft clearance to the right-of-way line.

Planting Strips

A minimum 7 ft wide green belt / planting strip shall be provided between the roadway and a sidewalk or multi-use path.

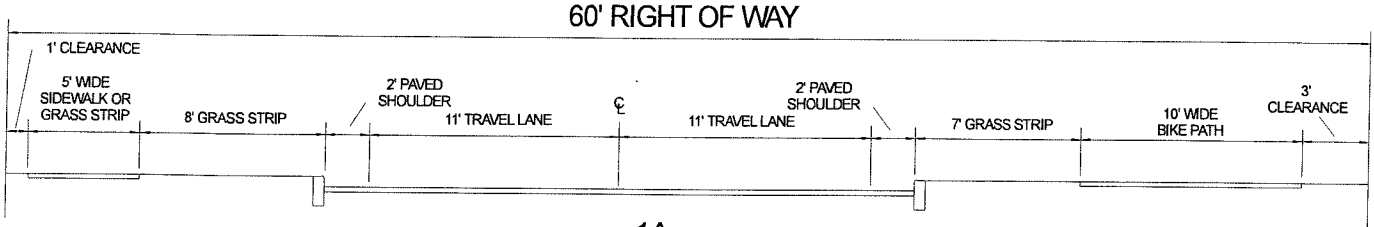
4. CORNER RADII

Corner radii at roadway and drive intersections on a minor collector shall be designed to accommodate a WB-62 design vehicle, unless serving a commercial or industrial area in which case a WB-67 design vehicle shall be accommodated.

5. RIGHT-OF-WAY

Right-of-way widths on minor collector streets will vary from a minimum of 60 ft to a maximum of 71 ft, depending on the cross-section scenario.

CROSS-SECTION #1 SCENARIOS

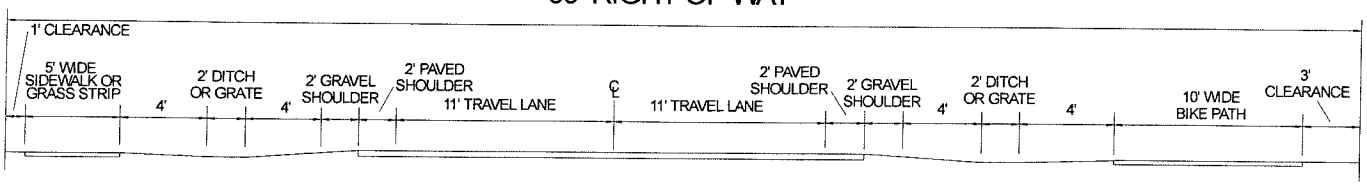


1A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)



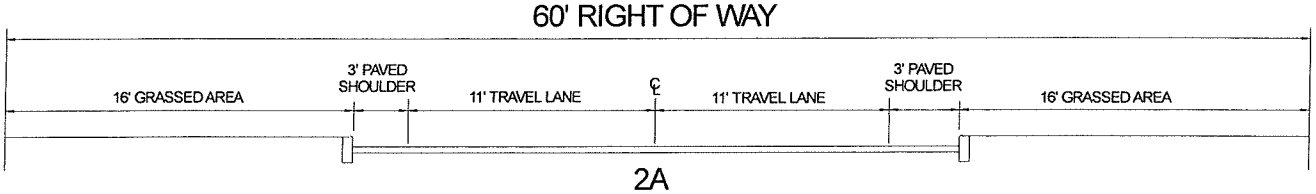
1B

OPEN DRAINAGE (SHALLOW SWALE)

MINOR COLLECTOR STREET STANDARDS

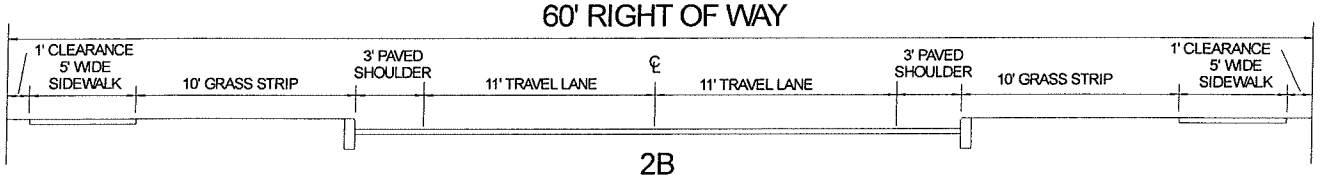
CROSS-SECTION #2 SCENARIOS

60' RIGHT OF WAY



2A

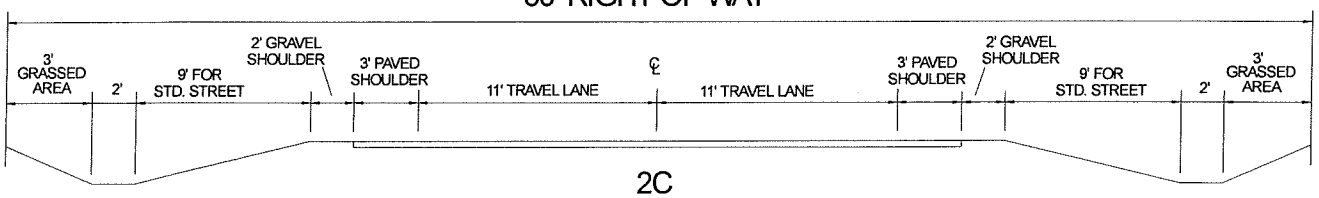
60' RIGHT OF WAY



2B

CLOSED DRAINAGE

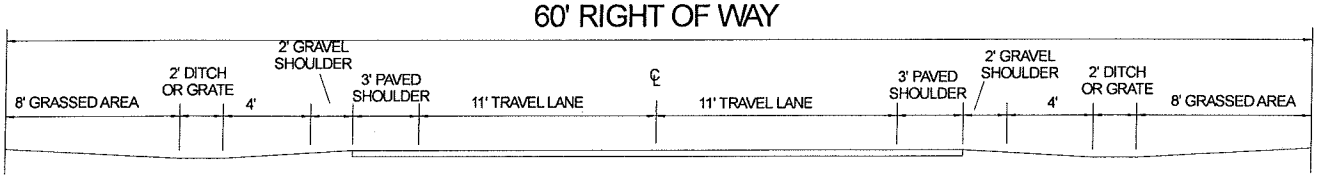
60' RIGHT OF WAY



2C

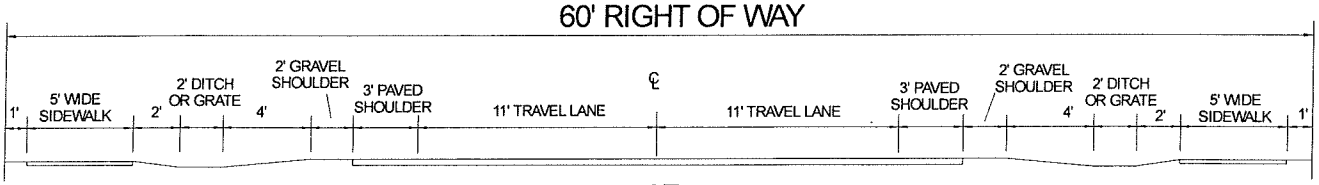
OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



2D

60' RIGHT OF WAY



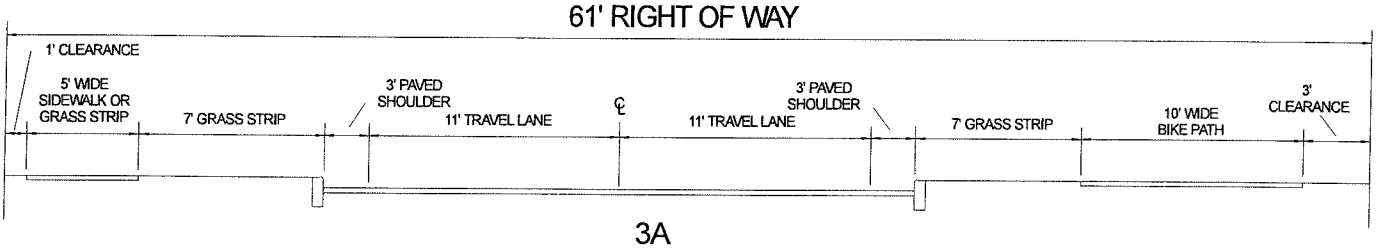
2E

OPEN DRAINAGE (SHALLOW SWALE)

MINOR COLLECTOR STREET STANDARDS

CROSS-SECTION #3 SCENARIOS

61' RIGHT OF WAY



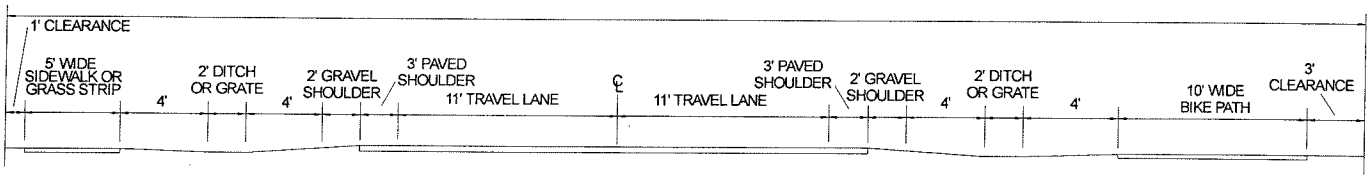
3A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)

71' RIGHT OF WAY



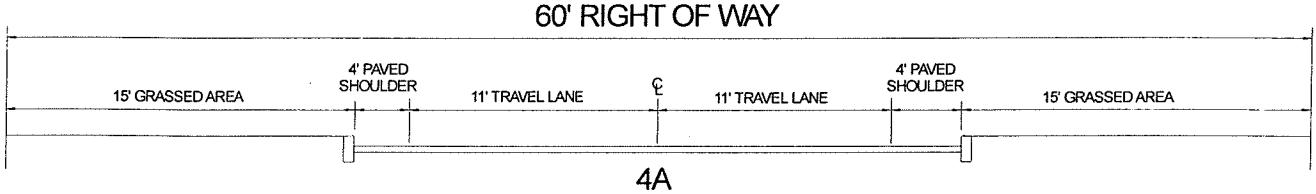
3B

OPEN DRAINAGE (SHALLOW SWALE)

MINOR COLLECTOR STREET STANDARDS

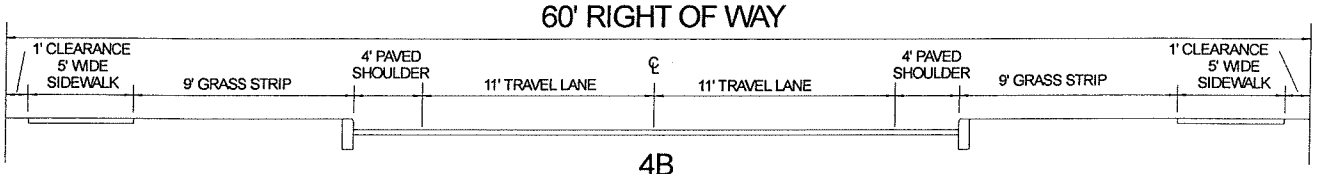
CROSS-SECTION #4 SCENARIOS

60' RIGHT OF WAY



4A

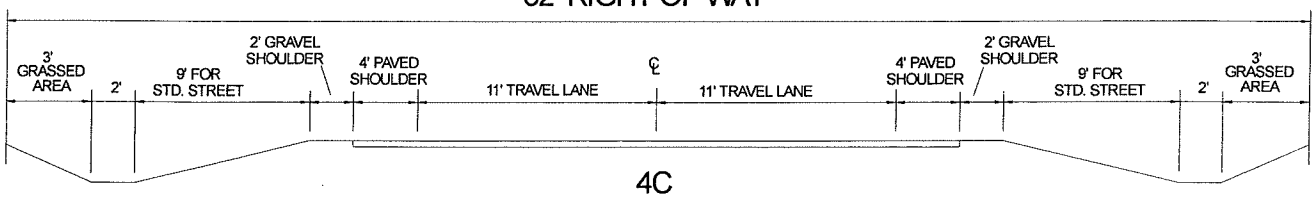
60' RIGHT OF WAY



4B

CLOSED DRAINAGE

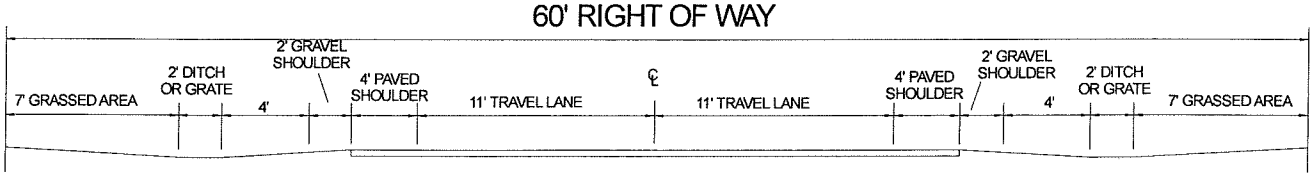
62' RIGHT OF WAY



4C

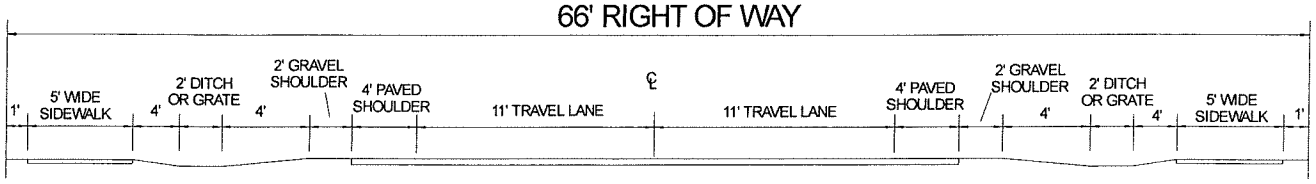
OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



4D

66' RIGHT OF WAY



4E

OPEN DRAINAGE (SHALLOW SWALE)

MINOR COLLECTOR STREET STANDARDS

COMMERCIAL / INDUSTRIAL STREET STANDARDS

1. PAVEMENT WIDTHS

Required pavement widths for commercial / industrial streets will vary from 28-32 ft, depending on the required travel lane width, paved shoulder width and drainage configuration as discussed below.

Travel Lane Widths

Travel lanes shall be 12 ft wide on commercial / industrial streets.

Paved Shoulder Widths

Four-inch wide, painted, white lines will be required along both sides of commercial / industrial streets to delineate the paved shoulder which may vary in width from 2-4 ft based on projected daily traffic volumes and the presence of a separated multi-use path. Table 2 provides a reference for the various cross-section scenarios provided on the following pages.

Table 2
Commercial / Industrial Street
Cross-Section Scenarios

Projected Daily Traffic Volume	With Multi-Use Path	Without Multi-Use Path
<500 vpd	#5	#6
500-2,000 vpd	#7	#8
>2,000 vpd	#9	#10

On-Street Parking

On-street parking shall not be permitted along commercial / industrial streets.

2. DRAINAGE OPTIONS

Closed Drainage

Curbed streets shall be constructed using the typical cross-section detail shown on Figure 3.1 in Appendix C.

Open Drainage (Standard)

Standard open drainage may not be used on commercial / industrial streets where a multi-use path or sidewalk is to be constructed. Uncurbed streets with standard drainage swales shall be constructed using the typical cross-section shown on Figure 3.2 in Appendix C.

Open Drainage (Shallow Swale)

Uncurbed streets with open drainage using shallow swales shall be constructed using the typical cross-section shown on Figure 3.3 in Appendix C.

3. BORDER OPTIONS

The border is defined as the area between the paved roadway and the right-of-way line where sidewalks, multi-use paths and / or planting strips are located.

Sidewalks

A 5 ft wide sidewalk may be constructed along one or both sides of commercial / industrial streets, as required by the Town Engineer. Sidewalks shall be located with a 1 ft clearance to the right-of-way line.

Multi-Use Path

Multi-use paths shall normally be 10 ft wide to accommodate both pedestrians and bicyclists. A minimum 8 ft width will be permitted only when the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Good horizontal and vertical alignment provides safe and frequent passing opportunities.
- The path will not be subjected to maintenance vehicle loading conditions that would cause damage to the edge of the pavement.
- The path will be less than 1,000 ft long.

Construction of a multi-use path is required along one side of commercial / industrial streets which are located in a bicycle path planning corridor (refer to the Town of Colchester Bike Path Master Plan).

Multi-use paths shall be located with a 3 ft clearance to the right-of-way line.

Planting Strips

A minimum 7 ft wide green belt / planting strip shall be provided between the roadway and a sidewalk or multi-use path.

4. CORNER RADII

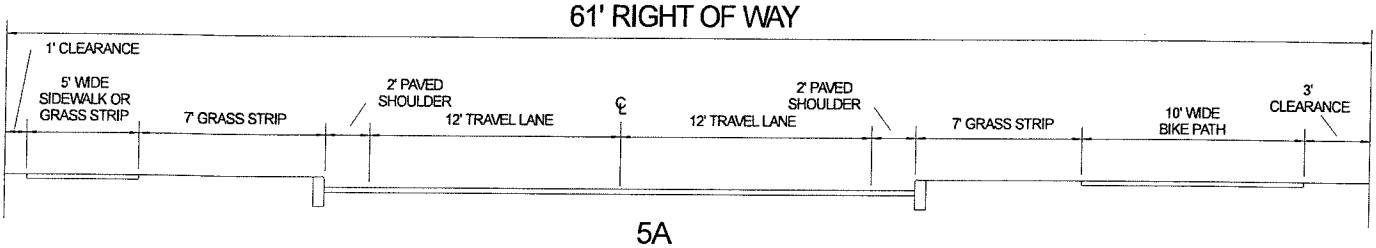
Corner radii at roadway and drive intersections on commercial / industrial streets shall be designed to accommodate a WB-67 design vehicle.

5. RIGHT-OF-WAY

Right-of-way widths on commercial / industrial streets will vary from a minimum of 60 ft to a maximum of 75 ft, depending on the cross-section scenario.

CROSS-SECTION #5 SCENARIOS

61' RIGHT OF WAY



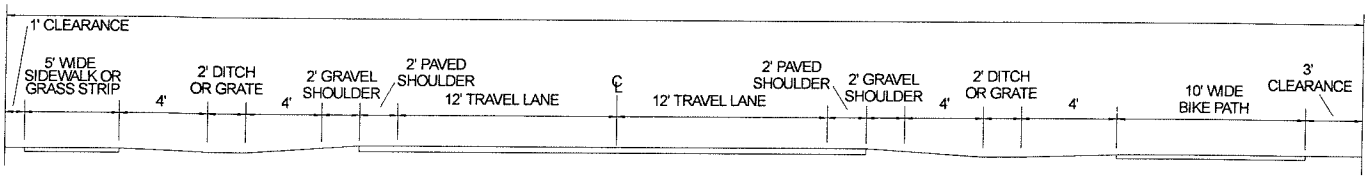
5A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)

71' RIGHT OF WAY



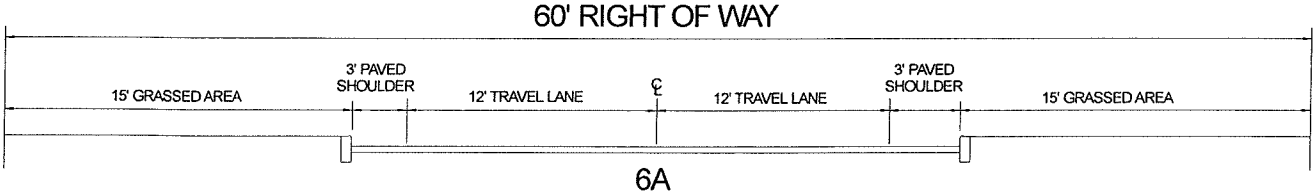
5B

OPEN DRAINAGE (SHALLOW SWALE)

COMMERCIAL / INDUSTRIAL STREET STANDARDS

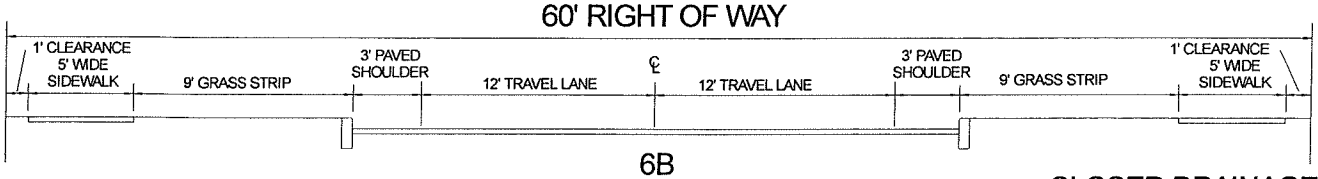
CROSS-SECTION #6 SCENARIOS

60' RIGHT OF WAY



6A

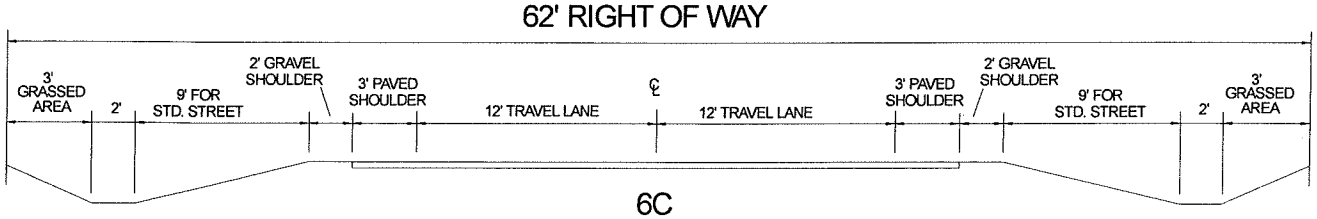
60' RIGHT OF WAY



6B

CLOSED DRAINAGE

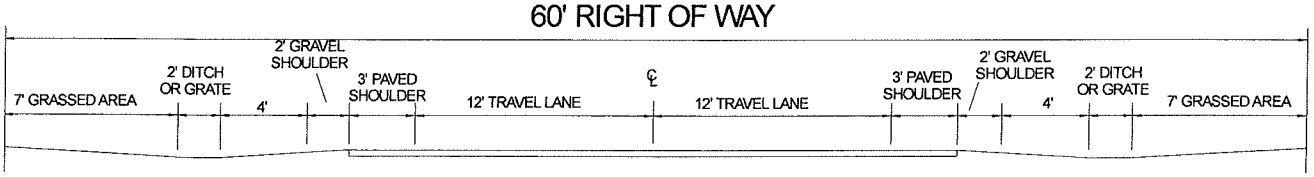
62' RIGHT OF WAY



6C

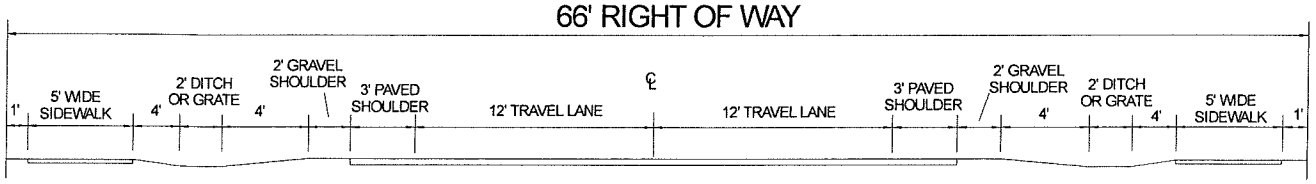
OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



6D

66' RIGHT OF WAY



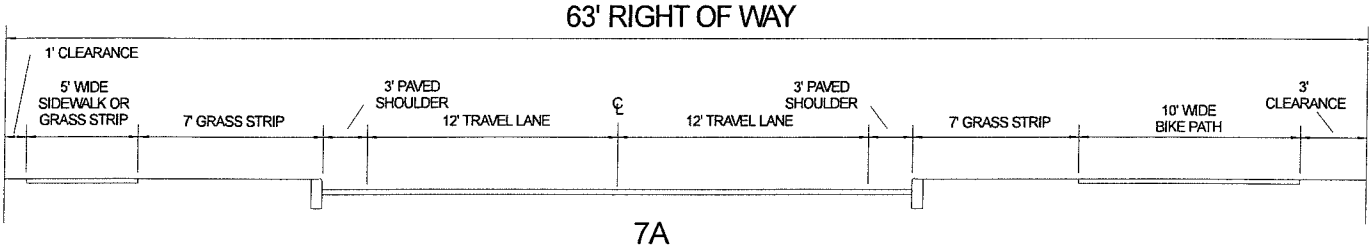
6E

OPEN DRAINAGE (SHALLOW SWALE)

COMMERCIAL / INDUSTRIAL STREET STANDARDS

CROSS-SECTION #7 SCENARIOS

63' RIGHT OF WAY



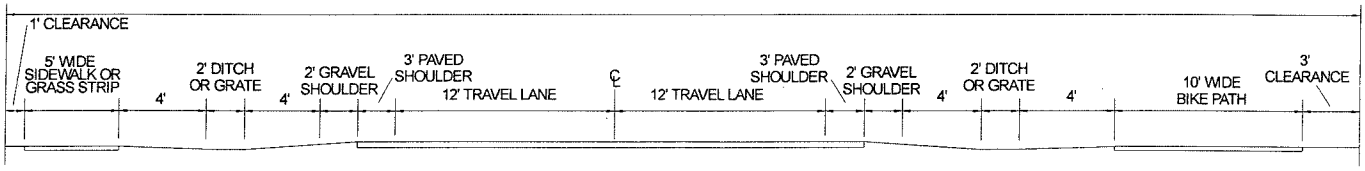
7A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)

73' RIGHT OF WAY



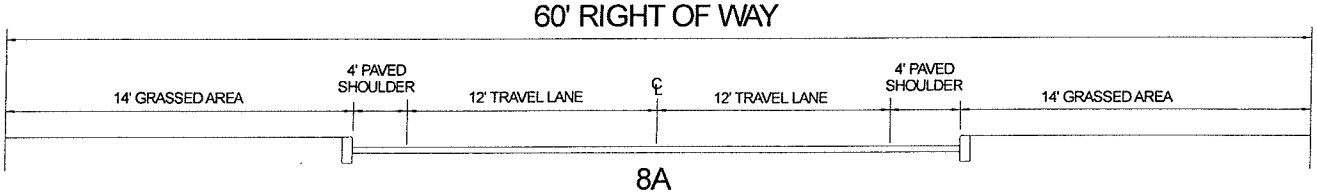
7B

OPEN DRAINAGE (SHALLOW SWALE)

COMMERCIAL / INDUSTRIAL STREET STANDARDS

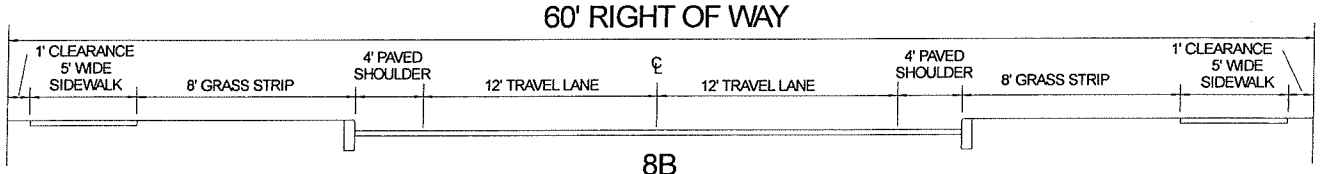
CROSS-SECTION #8 SCENARIOS

60' RIGHT OF WAY



8A

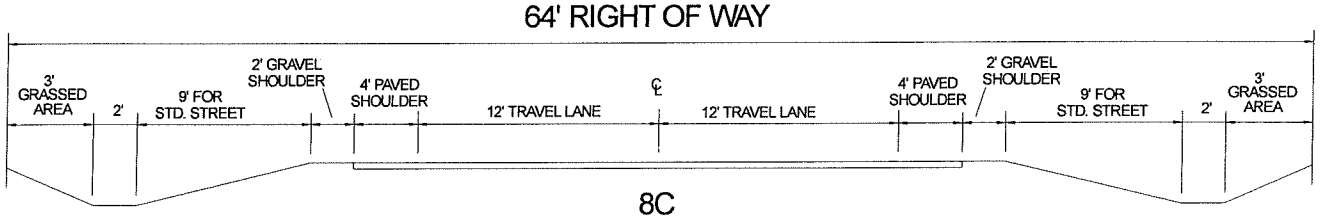
60' RIGHT OF WAY



8B

CLOSED DRAINAGE

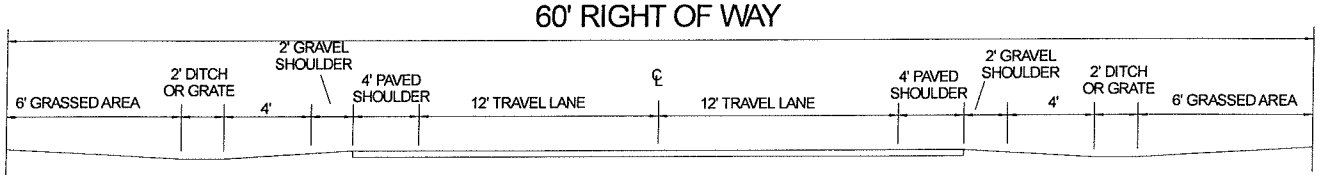
64' RIGHT OF WAY



8C

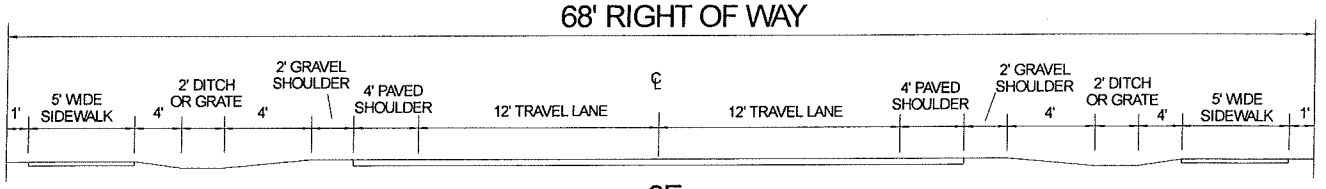
OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



8D

68' RIGHT OF WAY



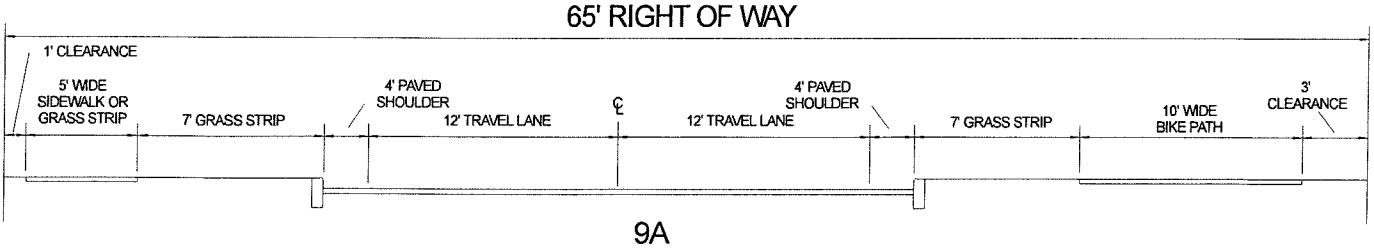
8E

OPEN DRAINAGE (SHALLOW SWALE)

COMMERCIAL / INDUSTRIAL STREET STANDARDS

CROSS-SECTION #9 SCENARIOS

65' RIGHT OF WAY



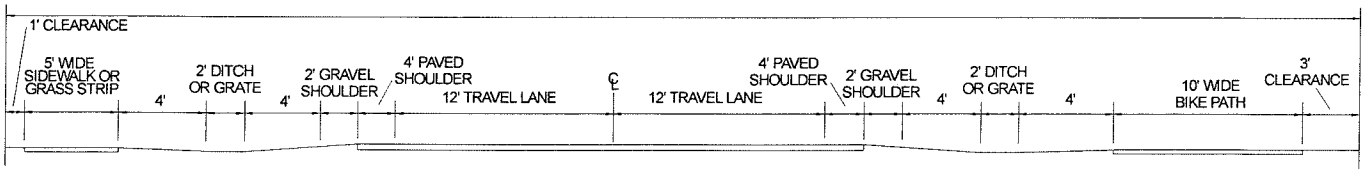
9A

CLOSED DRAINAGE

NOT AN OPTION WITH A BIKE PATH

OPEN DRAINAGE (STANDARD)

75' RIGHT OF WAY



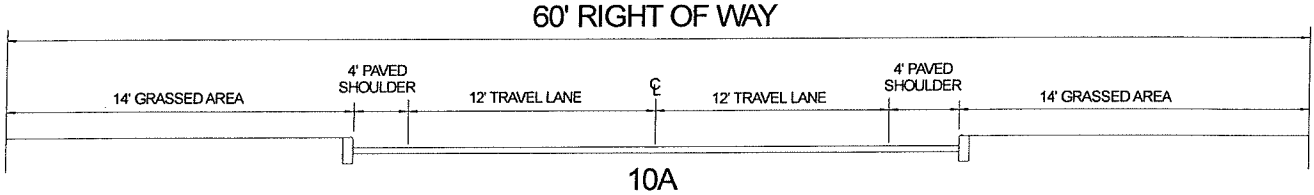
9B

OPEN DRAINAGE (SHALLOW SWALE)

COMMERCIAL / INDUSTRIAL STREET STANDARDS

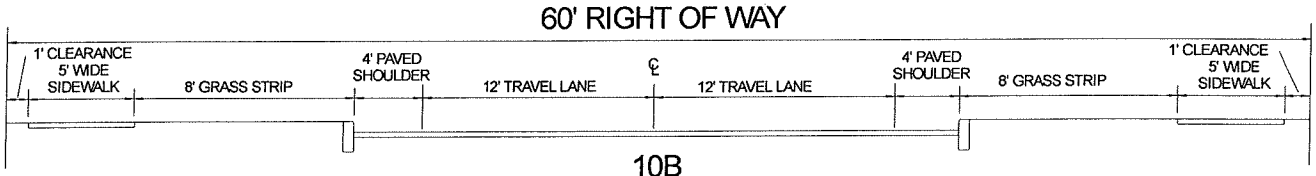
CROSS-SECTION #10 SCENARIOS

60' RIGHT OF WAY



10A

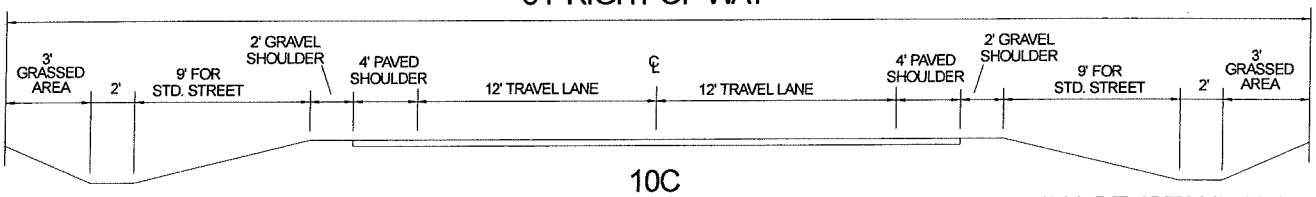
60' RIGHT OF WAY



10B

CLOSED DRAINAGE

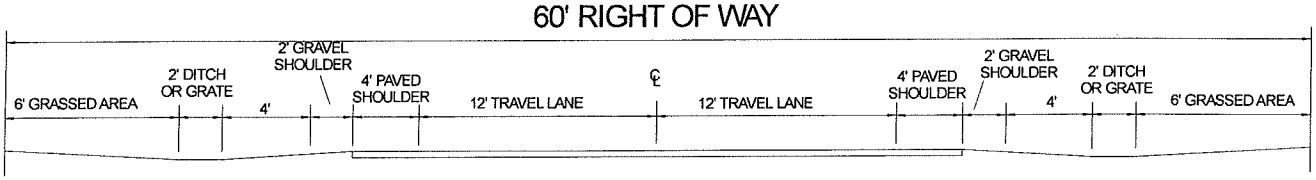
64' RIGHT OF WAY



10C

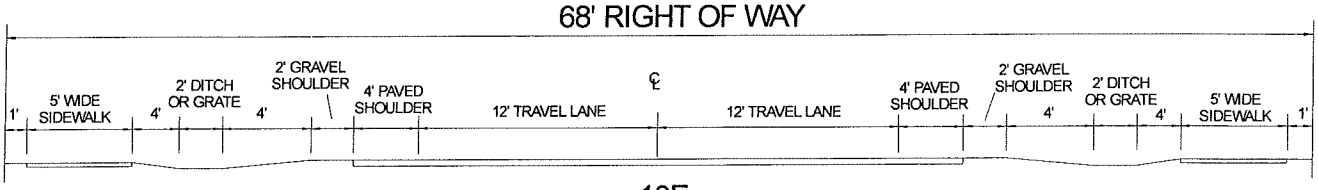
OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



10D

68' RIGHT OF WAY



10E

OPEN DRAINAGE (SHALLOW SWALE)

COMMERCIAL / INDUSTRIAL STREET STANDARDS

RESIDENTIAL STREET STANDARDS

1. PAVEMENT WIDTHS

Required pavement widths for residential streets will vary from 22-30 ft wide depending on the required travel lane width, paved shoulder width and drainage configuration as discussed below.

Travel Lane Widths

Travel lanes shall be 11 ft wide on residential streets.

Shoulder Widths

Paved shoulders (1 to 4-ft wide) will be required on streets with projected daily traffic volumes over 100 vehicles per day. Four inch wide painted white lines will be required on both sides of the street to delineate shared use paved shoulders on streets without a multi-use path. Table 3 provides a reference to the various cross-section scenarios for residential streets.

Table 3
Residential Street
Cross-Section Scenarios

Projected Daily Traffic Volume	With Multi-Use Path	Without Multi-Use Path
<100 vpd	#11	#12
100-500 vpd	#13	#14
500-2,000 vpd	#15	#16

On-Street Parking

Unmarked, on-street parking will be allowed on residential streets unless otherwise restricted. Parking will be restricted to one-side only on streets less than 28 ft wide.

2. DRAINAGE OPTIONS

Closed Drainage

Curbed streets shall be constructed using the typical cross-section detail shown on Figure 3.1 in Appendix C. When closed drainage is used, the minimum pavement width shall be 26 ft (11 ft travel lanes plus 2 ft paved shoulders).

Open Drainage (Standard)

Standard open drainage shall not be used on residential streets where a multi-use path or sidewalk is to be constructed.

Open Drainage (Shallow Swale)
Uncurbed streets with open drainage using shallow swales shall be constructed using the typical cross-section shown on Figure 3.3 in Appendix C.

3. BORDER OPTIONS

The border is defined as the area between the paved roadway and the right-of-way line.

Sidewalks
A 5 ft wide sidewalk shall be provided along at least one side of all new residential streets located with a 1 ft clearance to the right-of-way line. Sidewalks shall be provided along both sides of the street, when required by the Town Engineer.

Multi-Use Path
Multi-use paths shall normally be 10 ft wide to accommodate both pedestrians and bicyclists. A minimum 8 ft width will be permitted only when the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Good horizontal and vertical alignment provides safe and frequent passing opportunities.
- The path will not be subjected to maintenance vehicle loading conditions that would cause damage to the edge of the pavement.
- The path will be less than 1,000 ft long.

A multi-use path is required along one side of all new residential streets with daily traffic volumes over 1,000 vehicles per day and along streets which are in a bicycle path planning corridor (refer to the Town of Colchester Bike Path Master Plan).

Multi-use paths shall be located with a 3 ft clearance to the right-of-way line.

Planting Strips
A minimum 7 ft wide green belt / planting strip shall be provided between the roadway and a sidewalk or multi-use path.

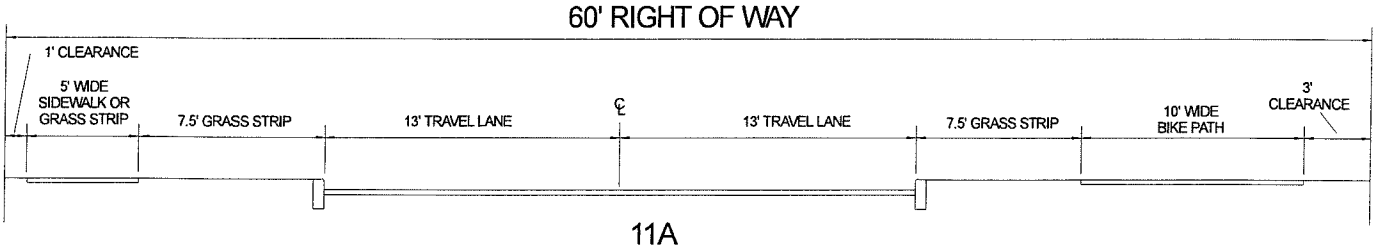
4. CORNER RADII

Corner radii at roadway intersections on residential streets shall be a minimum of thirty feet (30') and designed to accommodate the Towns fire equipment.

5. RIGHT-OF-WAY

Right-of-ways on residential streets will vary from a minimum of 60 ft to a maximum of 71 ft.

CROSS-SECTION #11 SCENARIOS

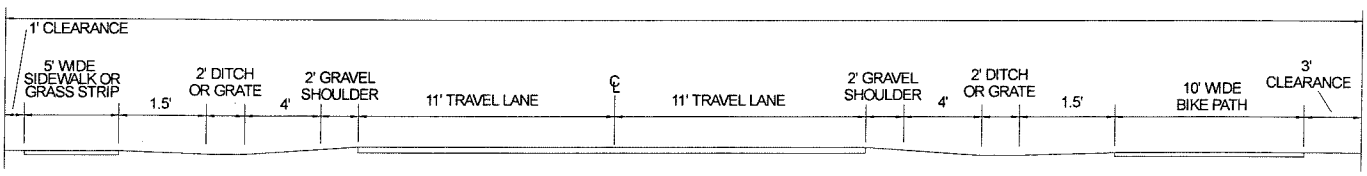


11A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)



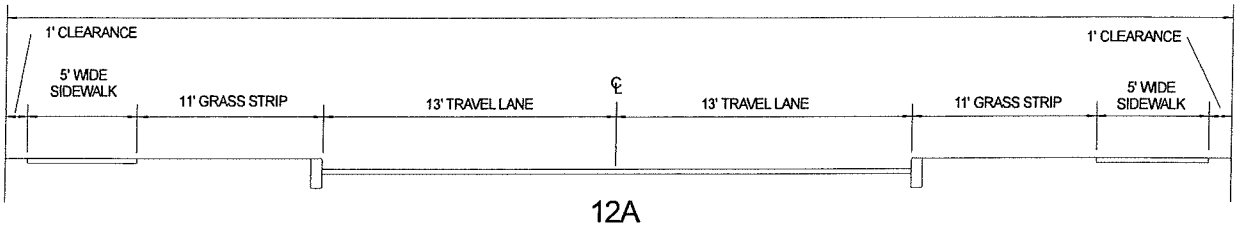
11B

OPEN DRAINAGE (SHALLOW SWALE)

RESIDENTIAL STREET STANDARDS

CROSS-SECTION #12 SCENARIOS

60' RIGHT OF WAY



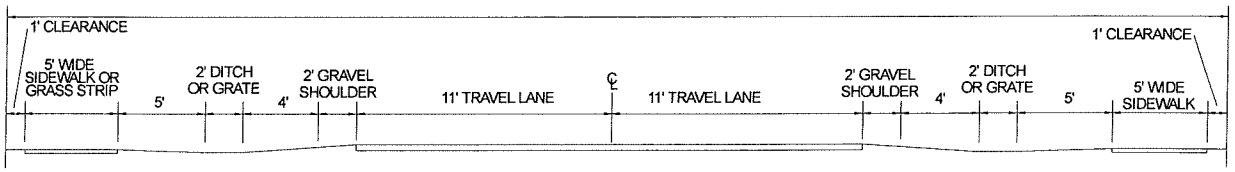
12A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY



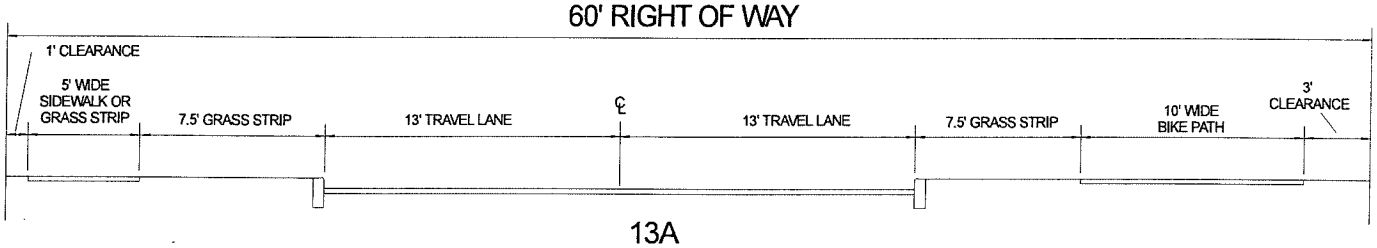
12B

OPEN DRAINAGE (SHALLOW SWALE)

RESIDENTIAL STREET STANDARDS

CROSS-SECTION #13 SCENARIOS

60' RIGHT OF WAY



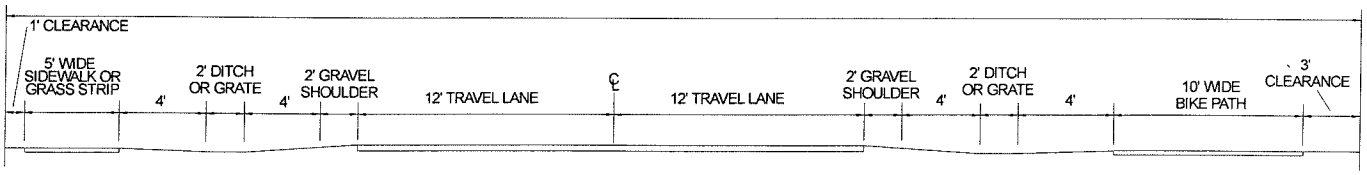
13A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

67' RIGHT OF WAY



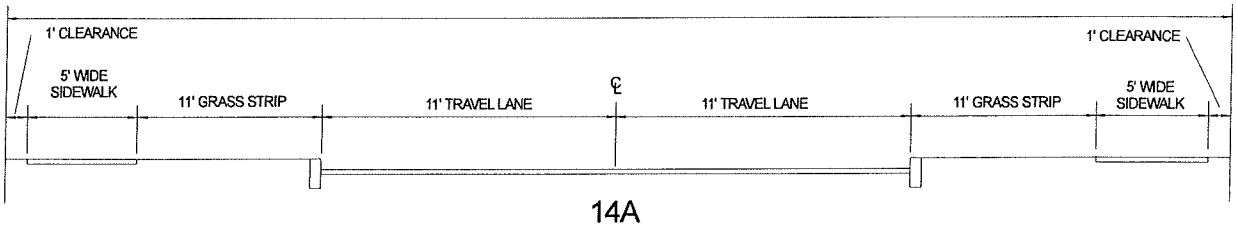
13B

OPEN DRAINAGE (SHALLOW SWALE)

RESIDENTIAL STREET STANDARDS

CROSS-SECTION #14 SCENARIOS

60' RIGHT OF WAY



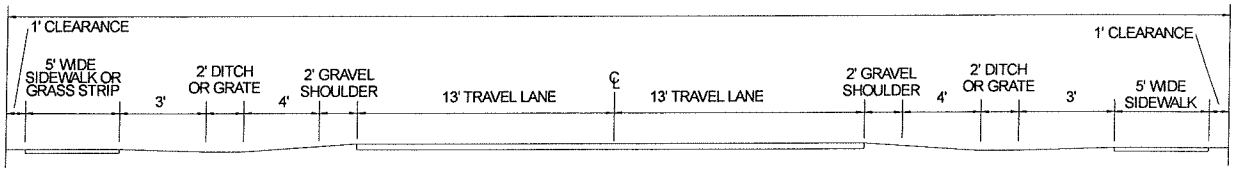
14A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

60' RIGHT OF WAY

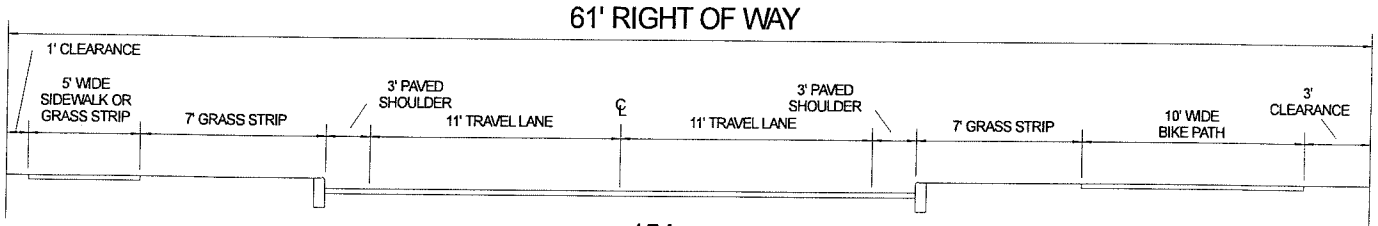


14B

OPEN DRAINAGE (SHALLOW SWALE)

RESIDENTIAL STREET STANDARDS

CROSS-SECTION #15 SCENARIOS

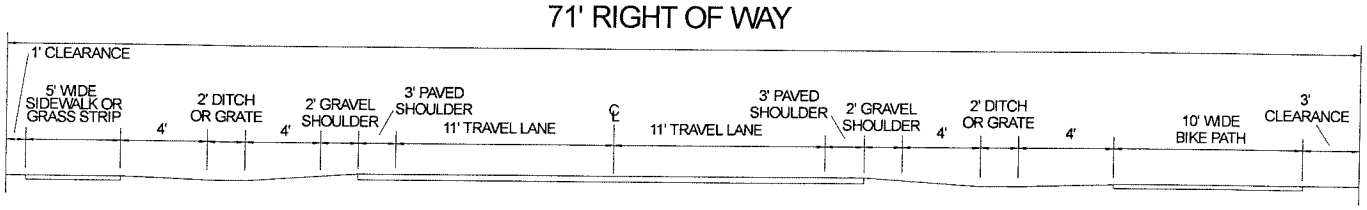


15A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)



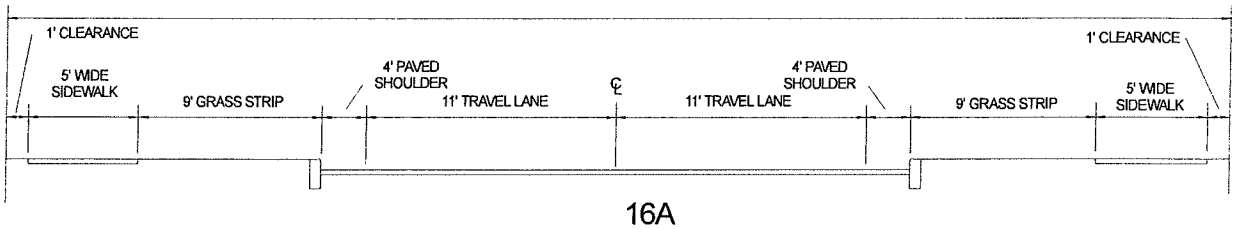
15B

OPEN DRAINAGE (SHALLOW SWALE)

RESIDENTIAL STREET STANDARDS

CROSS-SECTION #16 SCENARIOS

60' RIGHT OF WAY



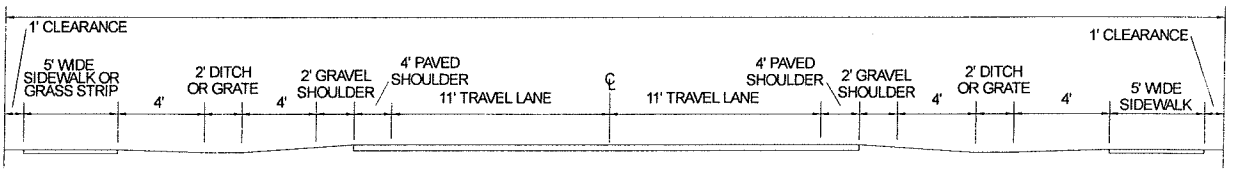
16A

CLOSED DRAINAGE

NOT AN OPTION IN RESIDENTIAL AREAS

OPEN DRAINAGE (STANDARD)

66' RIGHT OF WAY



16B

OPEN DRAINAGE (SHALLOW SWALE)

RESIDENTIAL STREET STANDARDS

RURAL ROAD STANDARDS

1. ELIGIBILITY / DEFINITION

An unpaved road will be permitted for construction when the following conditions are met:

1. Shall connect to an existing unpaved road.
2. The Town has no plans to pave the existing unpaved road.
3. Shall serve as access to no more than six (6) dwelling units.
4. Shall be located in a residential area.
5. Shall be limited in length to 1,000 ft.
6. The grade of the proposed road shall not exceed 6%.

2. DESIGN

Rural roads shall have a 24 ft wide travel way with 2 ft wide stabilized shoulders, and shall be constructed using the typical cross-section detail shown on Figure 3.4 in Appendix C.

3. RIGHT-OF-WAY WIDTH

Rural roads shall have a 60 ft wide right-of-way.

ARTICLE 10: DEVELOPMENT STANDARDS

10.01 Off Street Parking, Loading, & Circulation
10.02 Outdoor Illumination
10.03 Outside Storage & Display
10.04 Landscaping, Screening, and Street Trees
10.05 Utility Cabinets and Similar Structures
10.06 Trash Containers
10.07 Numbering Systems
10.08 Solar Collectors
10.09 Wind Turbines
10.10 Telecommunications Towers & Commercial Satellite Dishes
10.11 Satellite Dishes Other than Commercial Satellite Dishes.
10.12 Bus Shelters
10.13 Home Occupations & Businesses
10.14 Seasonal Dwelling Unit Conversion

10.01 Off Street Parking, Loading, and Circulation

A. Purpose. In order to minimize traffic congestion, air pollution, and the risk of motor vehicle and pedestrian accidents, as well as to promote other elements of sound community planning, parking, loading spaces, circulation, and access shall be required of all structures and land uses. Parking spaces, aisles, and circulation shall be provided and kept available as an accessory use to all permitted and conditional uses of structures, lots, and land in amounts not less than those specified in Section O. The requirements of this section shall apply under the following circumstances:

1. All new structures erected for use on a property.
2. Any structure which is hereafter altered or enlarged.
3. All new uses of a property.
4. Any use of a property which is hereafter altered or enlarged.
5. The property is located outside of the General Development Three District.

B. Location of Off Street Parking, Loading, and Vehicle Entrances.

1. Except as provided in Section F, off street parking and loading that is required for a use or uses under this section shall be located entirely on the property on which the use or uses exist. The Development Review Board may approve required off street parking that is located off the property on which a use or uses exist, according to Section E.
2. The location, aisle widths, and layout of interior drives shall provide for efficient interior circulation and the safety of pedestrians and vehicles.
3. The location of parking areas and loading docks shall prevent conflicts with entering and exiting traffic onto a public street and prevent conflicts between vehicles and pedestrians. The distance between access points and parking areas shall be adequate to minimize blockage and to prevent back-ups onto the public street.
4. All loading and unloading shall be provided off-street. To this end, no commercial or industrial use overhead doors, loading or unloading shall be permitted on the front side of properties except as provided herein. All loading and unloading should occur

within the rear or side yard. Within the Industrial and Business Districts, overhead doors may be permitted on the front of buildings provided that the following are provided:

(a) the location of the overhead doors is not out of character with the neighborhood

(b) adequate parking and circulation can be provided

(c) the unloading and loading area is adequately screened from the street and adjacent properties.

(d) Overhead doors on the front of buildings shall not be allowed along arterial or collector roads.

5. The location of parking areas shall not detract from the design of proposed buildings and structures or from the appearance of the existing neighboring buildings, structures and landscape.
6. Pedestrian Safety. Insofar as practical, pedestrian and bicycle circulation shall be separated from motor vehicle circulation. Safe and convenient pedestrian circulation, including appropriate sidewalks, shall be provided on the site and its approaches. The pedestrian circulation plan shall be designed to minimize conflicts with vehicular traffic.
7. Vehicle Entrance. Clearly marked ingress and egress for vehicles to the site shall be provided. No curb cuts or vehicle entrance from any public street shall be constructed or maintained except in conformance with all applicable standards of the Colchester Code of Ordinances Chapter 14 and Vermont Agency of Transportation. Curb cuts shall generally be limited to one per property or project.

C. Layout Requirements for Parking Spaces, Aisles, and Circulation. All parking spaces and maneuvering lanes shall be surfaced with asphalt or concrete paving and shall be striped to delineate parking spaces and lanes as per Appendix B. If weather conditions preclude paving or striping, a temporary occupancy permit may be issued for a period not to exceed six (6) months. The layout of parking spaces and aisles shall comply with the following requirements:

1. Internal Landscaping of Parking Areas.

Except for parking spaces accessory to a one-family or two-family dwelling, all off-street parking areas subject to review by the Development Review Board, shall be landscaped with appropriate trees, shrubs, and other plants including ground covers, as approved by the Development

Review Board. The Development Review Board shall consider the adequacy of the proposed landscaping to assure the establishment of a safe, convenient, and attractive parking area and the privacy and comfort of abutting properties.

(a) In all off-street parking areas containing twenty or more parking spaces, at least ten percent of the interior of the parking area shall be landscaped with trees, shrubs, and other plants. At least one (1) major deciduous shade tree, whose caliper is equal to or greater than three (3) inches, shall be provided within each parking area for every three thousand (3,000) square feet of paved area or every ten (10) parking spaces, whichever is greater. The trees shall be spaced evenly throughout the lot interior to provide shade and reduce glare. Overall, there shall be a mix of large canopy tree species.

(b) Planting islands

1. Planting islands shall be provided. Such islands and the landscaping within them shall be designed and arranged in such a way as to define major circulation aisles, entrances, and exits, to channel internal traffic flow, to prevent indiscriminate diagonal movement of vehicles, and to provide relief from the visual monotony and shade-less expanse of a large

parking area. All islands shall be landscaped with trees, shrubs, grasses, and/or ground covers. Plant materials judged to be inappropriate by the Development Review Board will not be approved.

2. Islands should be constructed that promote stormwater treatment or a stormwater management plan. Curbs of such islands shall be constructed of concrete, stone, or bituminous material and shall be designed to facilitate surface drainage and prevent vehicles from overlapping sidewalks and damaging the plants. At the Development Review Board's discretion, curb-less parking areas and planting islands may be allowed where these specifically provide for stormwater run-off into vegetated areas for treatment.

3. Maintenance and responsibility. All planting shown on an approved site plan shall be maintained by the property owner in a vigorous growing condition throughout the duration of the use. Plants not so maintained shall be replaced with new plants at the beginning of the next immediately following growing season.

4. Snow storage areas must be specified and located in an area that minimizes the potential for erosion and contaminated runoff into any adjacent or nearby surface waters.

(c) Screening shall be provided where headlights from vehicles on site may be visible and project parallel to a public street.

2. Parking areas shall provide convenient access to building entrances and shall minimize conflict between pedestrian and vehicle circulation.

3. The storage of merchandise, motor vehicles for sale, unregistered motor vehicles, commercial trucks, or the repair of vehicles within designated parking spaces is hereby prohibited.

4. The placement of parking within front yards is discouraged. Except for parking spaces accessory to a one-family or two-family dwelling, no parking shall be permitted within the front yard setback. All parking within the front yard should be screened from the road. At no point should the majority of parking spaces on the site be located within the front yard. Within the GD1 District, existing parking areas within the front yard may remain if the following conditions are met:

(a) Parking areas shall not be located within 15 feet of the edge of the right-of-way.

(b) Suitable landscaping of the parking area shall be provided as herein required in these regulations.

(c) The extent of existing development is greater than the amount of the lot that is being redeveloped.

5. Connections between adjacent lots are encouraged where feasible to minimize street traffic for short trips. The Development Review Board should require an applicant to construct a connection to an adjacent lot and / or provide an easement for a future connection.

6. Parking spaces, aisles, and circulation and other associated driveways shall be setback five feet from the property boundaries unless a shared drive or shared parking is proposed.

D. Determination of Parking and Loading Spaces.

1. All structures and land uses shall be provided with a sufficient amount of off-street parking to meet the needs of persons employed at or making use of such structures or land uses, and sufficient off-street loading facilities to meet the needs of such structures or land uses, but not less than the minimum standards of Section O.

2. No certificate of occupancy or certificate of compliance shall be issued for any structure or land use until the required off-street parking and/or loading spaces have been established. Required off-street parking and/or loading facilities shall be maintained as long as the use of structure exists which the facilities are designed to serve.
3. The following methods shall be used to determine the number of required off-street parking and loading spaces:

(a) The requirement for a single use shall be determined directly from the schedule of such requirements in Section O.

(b) The requirement for a combination use made up of several component uses (e.g., a restaurant and bar; or a retail store combined with an office building or a storage area) shall be determined by establishing the requirement for each component use from the schedule in Section O of such requirements and adding them together.

(c) When the required number of spaces is determined to result in a fraction, it shall be increased to the next highest whole number.

(d) If the use is not specifically listed in the schedule of such requirements, the requirements shall be the same as for the most similar use listed, as determined by the Administrative Officer.

(e) When the schedule requires the number of spaces to be calculated per employee and employees are on the site in shifts, the number to be used is the number of employees present during the largest shift. In all other cases it shall mean the total number of employees on the site or who will use the site for parking at any one time.

(f) A garage or a carport may be used to meet the requirements of this section. A driveway may only be used to meet the requirements of this section where it serves a one-family or two-family dwelling provided that the parking is not stacked.

(g) Uses which require Development Review Board approval pursuant to Article 8 may be required to provide off-street parking spaces in excess of the requirements of this section Table 10-2.

4. The number of parking spaces on a property shall not exceed 110% of the required number of parking spaces.
5. Properties with a required number of parking spaces exceeding 250 spaces shall be classified large scale parking facilities. New construction or any change to existing uses that requires additional parking on site will require the applicant employ parking mitigation to reduce the number of surface parking spaces. Qualifying parking mitigation shall include but not be limited to: structured parking, parking shuttles, employee carpool plans, incentives for employees to use alternative transportation such as bicycles, a mass transportation plan for employees such as purchasing bus or train passes for employees, telecommuting plans for employees, shared parking, and other similar plans. The Development Review Board shall have the discretion to require parking mitigation for large scale facilities as appropriate taking into consideration stormwater, surface water impairment, the character of the neighborhood, traffic, pedestrian safety, landscaping, and circulation.

E. Shared Parking on Two or More Lots.

1. Required parking and loading spaces shall normally be provided upon the same lot as the use or structure to which they are accessory. However, shared parking may be allowed where a parking area or parking space is used jointly for more than one use.
2. Off-street parking spaces required for structures or land uses on two or more adjacent lots may be provided in a single common facility on one or more of said lots provided

that the Development Review Board approves a plan meeting the regulations of this sub-section.

3. As a matter of public policy, the Town of Colchester finds that the coordination of off-street parking areas between adjoining nonresidential sites is desirable to allow for traffic circulation between sites rather than having all traffic entering and exiting the existing road system to proceed from site to site. This coordination can take various forms, from a simple paved connection to a more elaborate plan to provide both a connection and shared parking arrangements. Such connection and shared parking are not to be considered a parking waiver, but an agreement between the landowners and the Town of Colchester to effect an overall circulation and parking plan and provide the required number of parking spaces in accordance with the applicable provisions of Section O for the respective use(s). For these reasons, in its review of a site plan, the Development Review Board may, at its discretion, allow for parking spaces to be provided both on and off site, provided that:

(a) The applicant(s) provides an acceptable overall design and an accurate site plan for all properties affected by the shared parking proposal. Such design and plan shall be approved by the Development Review Board. The owner or owners of the property where the off-site parking will be provided are co-applicants to the site plan application.

(b) The lots shall be adjacent. However at its discretion, the Development Review Board may consider a shared parking plan where the parking serves a Planned Unit Development, college, or hospital use.

(c) The applicant shall record appropriate legal documents to ensure that the off-site parking spaces shall be available for use by the user or users for which the off-site parking spaces are being sought. Such legal documents shall be acceptable to the Town Attorney in form and content. The Town of Colchester shall be a party to the legal document.

(d) Such legal documents shall assure the continued existence of the parking lot or facility to serve said structures or land uses as long as they may exist. Such agreement shall also guarantee that upon termination of such joint use, each subsequent use of the premises will provide off-street parking for its own use in accordance with the requirements of this section and Section O.

(e) The required number of parking spaces is to be provided and spaces that are paved must be striped and must be shown on an approved plan. The number of required parking spaces may be reduced provided that a reserved parking plan is approved as per Section H.

(f) In no event shall parking and loading spaces for a non-residential use be located in any residential district.

F. Shared Parking on a Single Lot. Where the Development Review Board determines that a proposed development consisting of two or more uses located on a single parcel will generate different hourly, daily and/or seasonal parking demand due to the varied hours of operation of each use and frequencies of customer and employee occupancy of available parking spaces, the Development Review Board may approve a site plan utilizing shared parking. The applicant shall provide the parking space count and justification analysis. Approved shared parking requires the present construction of a lesser number of spaces, provided that:

1. The applicant shall provide the Development Review Board with a shared parking plan which shall be based upon the following:

(a) A complete and accurate description of the proposed uses, floor areas devoted to such uses, the number of seats or rooms assigned to each use, and the days and hours of operation of each use for each day of the week and for any seasonal

variations in operations.

(b) A complete and accurate description of the number of employees and their respective shifts.

(c) A complete and accurate description of the projected total peak hour or daily period of occupancy by patrons for each proposed use during weekdays, Saturday, Sunday and any seasonal variations in peak hour or period of occupancy.

2. In all cases, at least two-thirds (2/3s) of the number of required parking spaces shall be provided. A reserved parking plan shall be required. The Zoning Administrator may order the property owner to construct the reserved parking spaces if need arises as per Section H.

3. The approval of such shared parking shall be automatically terminated upon the termination of the operation of any of the involved uses.

H. Reserved Parking. In the event that an applicant can demonstrate to the Development Review Board that its present parking needs do not necessitate the construction of the number of parking spaces required herein, the Development Review Board may approve a site plan requiring the present construction of a lesser number of spaces. In such an event, the site plan shall show sufficient spaces reserved for future parking requirements with the combined number of spaces being not less than that required by Appendix B, Figure VII. In all cases, at least two-thirds (2/3s) of the number of required parking spaces shall be provided. The remaining reserved space shall remain unpaved or kept pervious until such time as it is needed, unless the reserved area is used for internal circulation. The reserved area shall be shown on any site plan. The Zoning Administrator may order the property owner to install the reserved parking spaces if the need for additional spaces arises. For example, a change in the use(s) or the ownership of the parcel may be enough to require the installation of the parking spaces. In the event that the owner fails to install the additional parking spaces within one hundred twenty (120) days of being so ordered, the Administrative Officer shall revoke the certificate of occupancy for the premises, and the Town Attorney may take appropriate action in a court of competent jurisdiction to restrain the use of said premises. When this subsection is utilized, the site plan shall contain a statement, signed by the applicant in such a form as shall be approved by the Town Attorney, consenting to the provisions contained herein. In addition, the property owner shall be required to submit a covenant, for filing in the Town Clerk's office, in such a form as shall be approved by the Town Attorney indicating consent to the provisions of this subsection.

I. Handicapped –Accessible Parking Spaces. Parking spaces for handicapped persons shall be provided for all non-residential uses. The size, number, and location of spaces shall comply with the ADA Accessibility Guidelines. Handicap accessible spaces are required to be eight feet (8'0") wide, with an adjacent access aisle five feet (5'0") wide. One in every six (6) accessible spaces must have an access aisle eight feet (8'0") wide and must be signed "van accessible". The number of accessible spaces required is shown in Table 10-1 below. Handicapped parking spaces and aisles shall be level with surface slopes not exceeding 1:48 in all directions.

Table 10-1 Minimum Number of Accessible Parking Spaces Required

Total parking spaces in lot	Number of accessible spaces in lot
1 to 25	1
26 to 50	2

51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total number
1,001 and over	20, plus 1 for every 100, *or fraction thereof,* over 1,000

J. Recreational Vehicles. Parking or storage facilities for recreational vehicles shall be provided in all multi-family residential developments of eighteen (18) units or more. Recreational vehicles shall not be stored on any common open lands other than those specifically approved for such purpose by the DRB through the review process. The Development Review Board may waive this provision only upon demonstration by the applicant that the storage and parking of recreational vehicles shall be prohibited within all private and common areas of the development. Commercial properties shall only park recreational or utility vehicles in approved display or storage areas. On a residential property, no person shall park, store, or use a recreational vehicle, or utility vehicle, or similar vehicular equipment unless the following requirements are met:

1. Such vehicular equipment shall be stored in rear or side yard. Minimum five (5) foot side yard setback.
2. Such vehicular equipment is stored or parked on private property no closer than eighteen inches to any proposed or existing public sidewalk and so as not to project into the public right-of-way;
3. On corner lots, any such vehicular is not parked in the triangular area formed by the three points established by the intersection of property lines at the corner and the points thirty feet back from this intersection along each property line;
4. No recreational or utility vehicle is used for the conduct of business or for living or housekeeping purposes except when located in an approved mobile home park or in a campground providing adequate sanitary facilities.
5. Any recreational or utility vehicle parked or stored out-of-doors is adequately blocked or tied down or otherwise secured so that such vehicle does not roll off the lot and is not moved about by high winds; and
6. No vehicular equipment regulated by this section is stored out-of-doors on a residential lot unless it is in condition for safe and effective performance of the functions for which it is intended.
7. Office trailers, office/storage trailers and semi-van trailers may be allowed as temporary facilities for construction projects when approved with a building permit from the Zoning Administrator. No other uses of trailers shall be allowed except as a special emergency facility when approved by the Development Review Board as a conditional use.

K. Bicycle Parking or Storage Facility. A bicycle parking or storage facility shall be provided for properties with twenty (20) or greater parking spaces. One bicycle parking space should be provided for each twenty (20) car spaces required by these regulations.

L. Structured Parking. Structured parking may be required by the Development Review Board in conjunction with approval of a site plan or PUD. Structured parking shall be

defined as any structure consisting of more than one level and used to store motor vehicles. The parking structure may be stand-alone or may be part of or attached to another structure. Such structures typically comprise parking decks, garages, or roof-top parking areas. The Development Review Board may require design elements for parking structures that specifically address safety, security, lighting, landscaping, and visual aesthetics as conditions for approval.

M. Commercial Vehicles on Residential Properties. Parking of one (1) commercial vehicle per property shall be permitted subject to the following limitations:

1. The parking or storage of any garbage truck, tractor and/or trailer of a tractor-trailer truck, dump truck, construction equipment, cement-mixer truck, or moving/hauling van is prohibited on any residential property.
2. Any commercial vehicle parked in a residential district shall be owned and/or operated only by an occupant of the property at which it is parked.
3. The commercial vehicle must be parked off-street in a garage, carport or driveway. The commercial vehicle shall not be located in the front yard.
4. The length of the commercial vehicle shall be less than 22' and its height shall be less than 7'.

N. Exemptions, Waivers, and Modifications of Requirements.

1. Exemptions. Existing buildings and uses are exempt as follows:

(a) Structures and land uses lawfully in existence or in use or for which zoning permits have been approved by December 21, 2004 shall not be subject to the parking or loading space requirements set forth in this section and in Section O.

(b) However, no structure or lot lawfully in use prior to December 21, 2004 shall be enlarged unless the off-street parking and truck loading space requirements of this section are complied with to the same extent as would be required if the entire pre-existing structure or use and the proposed enlargement were being submitted as if they were a new application. The Development Review Board shall require additional off-street parking and truck loading spaces with respect to the proposed enlargement, but at its discretion may not require additional spaces with respect to the preexisting part of the structure or use.

2. Waivers. Where the Development Review Board determines that a proposed land use or structure is adequately served by existing or proposed public parking facilities, the Development Review Board may waive the off-street parking space requirements stipulated in Section O, by no more than thirty-three percent (33%) provided that a reserved parking plan is approved as per Section H.

3. Modifications of Requirements. Where the Development Review Board determines that unique usage or special conditions exist, it may require off-street parking spaces and loading areas greater than the requirements of this section and Section O. The Development Review Board may reduce the requirements of Section O for the number of off-street parking spaces and loading areas for non-residential uses and structures if it determines that overlapping use of parking spaces or other unique characteristic cause the requirement to be unnecessarily stringent provided a reserved parking plan is provided as per Section H.

O. Parking Requirements.

Notes applicable to Table 10-2:

1. Any spaces required as part of the operational function, such as display, storage or queuing spaces at the transfer station or service station, are in addition.
2. Parking need varies according to type of facility and will be determined during site plan approval.
3. Definitions applicable to Tables 10-2: "Employee" means the number of employees working at the specific location on the main shift plus any overlap from prior or later shifts.

Table 10-2: Parking Requirements

Use	Parking Space Requirement	Notes
Single-Family Dwelling	2 spaces per dwelling	
Two-Family Dwelling	2 spaces per dwelling plus 1 space for every four units	
Multi-Family Dwelling	2 spaces per dwelling plus 1 space for every four units	
Accessory Apartment	1 space per dwelling	
Community Care Home & Halfway House	1 space per sleeping room plus 2 spaces	
Congregate Housing	1.2 spaces per dwelling plus 1 space for every 4 units	
Boarding House and Bed & Breakfast	1.5 per guest bedroom plus 2 spaces	
Hotel & Motel	1 space per room plus .33 spaces per max occupancy in meeting & banquet rooms	
Extended Stay Hotel	1 per room plus 1 per employee	
Campground	N/A	2
Home Occupation	1 space per employee plus 1	
Home Business	1 space per employee plus two	
Convenience Store	4 spaces per 1,000 SF GFA	
Shopping Center	5 spaces per 1,000 SF GFA if GFA is 400,000 SF or less; 5.5 per 1,000 SF GFA if more than 400,000 SF	
General Merchandise w/o	4 spaces per 1,000 SF	

for approval of exterior lighting shall include at least the following:

1. A site plan showing the area to be illuminated and the location of all fixtures and mounting heights.
2. A point by point analysis of anticipated illumination levels in the area to be illuminated based on use of the proposed fixtures, lamps, and mounting heights.
3. The maximum, minimum and average illumination levels shall be shown for each area illuminated.
4. Specifications of the fixtures to be used, including documentation of cut-off classification, horizontal and vertical light distribution patterns, and the lamp to be used in each.
5. If vertical surfaces are to be illuminated, a point by point distribution of vertical illumination levels shall be provided, along with an indication of the maximum illumination level to be generated.

P. Waiver of Lighting Standards. The Development Review Board shall have the authority to, when reasonable, modify these lighting standards provided the lighting otherwise meets the intent of the standards herein.

10.03 Outside Storage & Display

A. General Requirements. Outside storage of goods, materials, vehicles, and equipment shall be subject to the following provisions:

1. Any outside storage and/or display shall be appurtenant to the primary use of the property and shall be allowed only in nonresidential districts and upon approval of the Development Review Board in conjunction with a site plan, conditional use and/or PUD application.
2. The Development Review Board may deny requests for outside storage for uses that do not customarily have outside storage.
3. The Development Review Board may require that outside storage areas in connection with commercial or industrial uses be enclosed and/or screened.
4. Storage of scrap, salvage/junk material, junk motor vehicles, trash, refuse, automotive dismantling, salvage or recycling facilities, and the storage of more than one motor vehicle without valid Vermont State Inspection stickers may be permitted only in connection with approved automotive repair use, automotive sales, salvage yard use, or contractor's yard use.
5. Farm equipment normally on farm land and equipment involved in construction and which is kept on an active construction site shall be excluded from this section.

10.04 Landscaping, Screening, & Street Trees

A. Purpose. The Town of Colchester recognizes the importance of trees, vegetation, and well-planned green spaces and using these as a resource in promoting the health, safety, and welfare of town residents through improved drainage, water supply recharge, air quality, sun control, shade, and visual relief. Landscaping and screening shall be required for all uses subject to Development Review Board review. Street tree plantings shall be required for all streets in accordance with the Colchester Street Tree Master Plan. In evaluating landscaping and screening requirements, the Development Review Board shall promote the retention of existing trees while encouraging the use of a variety of plant species. At its discretion, the Development Review Board may refer to *Recommended Trees for Vermont Communities: A Guide to Selecting and Purchasing Street, Park, and Landscape Trees*, published by Vermont Urban

and Community Forestry Program to guide landscaping and screening decisions.

B. Screening or buffering. The Development Review Board will require landscaping, fencing, land shaping and/or screening along property boundaries (lot lines) whenever it determines that a) two adjacent sites are dissimilar and should be screened or buffered from each other, or b) a property's appearance should be improved, which property is covered excessively with pavement or structures or is otherwise insufficiently landscaped, or c) a commercial, industrial, and multi-family use abuts a residential district or institutional use.

1. All off-street parking areas, off-street loading areas, outdoor storage areas, refuse and recycling areas, and utility improvements such as transformer(s), external heating and cooling equipment shall be effectively screened.
2. Such screening shall be a permanently maintained landscape of evergreen or a mix of evergreen and deciduous trees and shrubs, and/or a solid fence.
3. The landscaping shall be designed to minimize erosion and stormwater runoff, and to protect neighboring residential properties from the view of uses and parking areas on the site. The landscaping shall be of such type, height, and spacing, as in the judgment of the Development Review Board, will effectively screen the activities on the lot from the view of persons standing on adjoining properties. The plan and specifications for such planting shall be filed with the approved plan for the use of the lot.
4. A solid wall or fence, of location, height, and design approved by the Development Review Board, may be substituted for the required planting.
5. Modifications. Where the existing topography and/or landscaping provides adequate screening or would render the normally required screening inadequate, the Development Review Board may modify the planting and/or buffer requirements by, respectively, decreasing or increasing the requirements.
6. Recreational vehicle parking areas shall be screened with evergreen trees and shrubs and such landscaping plan shall be part of the application.
7. Additional landscaping above and beyond the formula may be required for the purpose of adding a buffer strip along I-89 and 289 to properly screen development from the highway.

C. Front Yards of Non-Residential and Multi-Family Uses. In the case of non-residential and multi-family uses, the required front yard shall be suitably landscaped and maintained in good appearance.

D. Site Restoration. Grading or seeding shall be required to restore the condition of any portion of a site that is disturbed during construction.

E. Landscaping Plan. Landscaping plans shall be prepared by a landscape architect, master gardener, nursery professional, arborist, professional landscape designer, or other landscape professional. Such plans shall be included with the site plan and shall consist of the following:

1. A list of existing vegetation, with the location, type, and size of existing trees of six inches or greater in caliper.
2. The location of existing natural features, such as streams, wetlands, and rock outcroppings.
3. All proposed physical improvements, such as buildings, walls, parking areas, sidewalks, etc.
4. Proposed landscaping materials, including vegetation to remain, types of new plant materials, identified by common name and botanical name, sizes of all new plant materials by height and/or diameter at time of planting and at maturity, quantities of each of the planting materials, and treatment of the ground surface (paving, seeding, or groundcover).
5. A landscape phasing plan. Construction phasing shall be shown on the landscape plan with landscaping and construction activities correlated.
6. Street trees shall be depicted on the plans in accordance with the Colchester Street Tree Master Plan.

F. Landscaping Budget Requirements. The Development Review Board shall require minimum planting costs for all site plans: three percent of the construction or improvement cost. In evaluating landscaping requirements, some credit may be granted for existing trees or for site improvements other than tree planting as long as the objectives of this section are not reduced. The landscaping budget shall be prepared by a landscape architect or professional landscape designer. Prior to obtaining a building permit for the project, the applicant shall provide a suitable escrow, letter of credit, or similar form of surety to guarantee the performance and completion of all planting required pursuant to the Section for a period of no less than five years.

G. Inspection. Prior to the issuance of the certificate of occupancy, the Town shall inspect all landscaping and screening. The Town shall identify all trees, shrubs, and other plants that are not in a healthy and vigorous condition or have been removed and provide a list of replacement requirements and a deadline for re-planting to the project owner. If the project owner does not comply with the replacement and re-planting requirement by said deadline the Town may utilize the surety provided by the applicant to complete replacement and re-planting. If all landscaping is in healthy and vigorous condition and planted as per the approved landscaping plan, the Town may reduce the surety by half at the time of issuance of a certificate of occupancy.

10.05 Utility Cabinets and Similar Structures

A. General Requirements. The construction of a utility cabinet shall only be permitted according to the following regulations.

B. Specific Standards for Utility Cabinets and Similar Structures.

1. The facility shall serve the Town of Colchester and/or immediately adjacent communities.
2. If the parcel containing the facility is landlocked, there shall be a recorded easement or permission granting access to the utility or owner of the facility.
3. There shall be suitable fencing to protect the public and sufficient landscaping with evergreens of sufficient height and density to screen effectively the facility from surrounding property.
4. There shall be adequate off-street parking for maintenance, service, or other vehicles.
5. The location of the facility shall be shown on all relevant site plans.
6. The Development Review Board may require setbacks or attach other conditions in order to prevent any hazard to the public or noise nuisance to surrounding property.
7. A facility that would be a nuisance to surrounding properties due to smoke, gas, heat, odor, noise, or vibration shall not be permitted in any district.

10.06 Trash Containers

A. General Requirements. All commercial, industrial, and multi-family dwelling unit trash containers shall be centrally located on a concrete pad and enclosed with an opaque screen that is the minimum height of the containers. The location of the trash containers shall not be in a visually prominent area and shall generally be behind a building and not visible from the right-of-way. Trash containers shall be located so as to not interfere with circulation on the site. Where feasible the trash container screening shall also include a latching gate.

Chapter 18

Storm Water

Article I - General

Sec. 18-1. Purpose.

Under the authority set forth in 24 V.S.A § 2291, specifically subsection (14), these Storm Water Regulations define what constitutes a public nuisance relating to illicit discharges, soil erosion and storm water management related to land disturbance activities. These regulations also provide procedures for the abatement or removal of such public nuisance as the public health, safety or welfare may require. This Ordinance also establishes methods for controlling the discharge of sediment, storm water and non-storm water discharges into the MS4, and/or surface or ground water in order to comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) permit process, and General Permit No. 3-9014 as issued by the State of Vermont.

Sec. 18-2. Applicability.

This Ordinance shall apply to all property within the Town of Colchester, and shall apply specifically as indicated in Articles within this Ordinance.

Sec. 18-3. Responsibility for Administration.

The Director of Public Works shall administer, implement, and enforce the provisions of this Ordinance. Any powers granted to or duties imposed upon the Director of Public Works may be delegated by the Director to persons or entities acting in the beneficial interest of or in the employ of the Town of Colchester.

Sec. 18-4. Severability.

The provisions of this Ordinance are hereby declared to be severable. If any provision, clause, sentence, or paragraph of this Ordinance or the application thereof to any person, establishment, or circumstances shall be held invalid, it shall not affect the validity or application of other provisions of this Ordinance.

Sec. 18-5. Relation to other Ordinances of the Town of Colchester.

If the provisions of these regulations conflict with the provisions of any other valid and enforceable Colchester Ordinance(s), the stricter shall prevail.

Sec. 18-6. Ultimate Responsibility.

The standards set forth herein and promulgated pursuant to this Ordinance are minimum standards; therefore this Ordinance does not intend nor imply that compliance by any Person will ensure that there will be no contamination, pollution, nor unauthorized discharge or discharge of pollutants.

Sec. 18-7. Documents Incorporated by Reference.

A. Town of Colchester Subdivision Regulations.
B. Town of Colchester Zoning Regulations.
C. Town of Colchester Specifications and Standards for Construction.
D. Vermont Storm Water Management Manual, Volumes I and II.
E. Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites.

Chapter 18

Storm Water

Article II - Definitions

Sec. 18-8. Definitions.

For the purposes of this Ordinance, the following shall mean:

"Agent" shall mean a person authorized to act in the place of another person.

"Applicant" shall mean a property owner or duly designated representative who files an application for a land disturbance activity.

"Best Management Practices", or, "(BMPs)" shall mean a schedule of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce water pollution.

"Building Inspector" shall mean the Building Inspector for the Town of Colchester.

"Building Permit" shall mean a permit approved by both the Zoning Administrator and Building Inspector which authorizes any land disturbance activities in the Town of Colchester.

"Clearing" shall mean any activity that removes the vegetative surface cover.

"Construction" shall mean land-disturbing activity associated with development, including land preparation such as clearing, grading, and filling; installation of streets and walkways; excavation for basements, footings, piers, or foundations; erection of temporary forms; and installation of accessory buildings such as garages.

"Construction Activity" shall mean activities subject to NPDES Construction Permits. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolition.

"Construction Season" shall mean the period of time between May 1 and October 14 when land disturbance activities are permitted under this Ordinance.

"Department of Public Works" shall mean the employees or designees of the Director of Public Works.

"Designated Enforcement Officer" shall mean either the Town of Colchester's Building Inspector or Health Officer, or other town officers as may be designated by the Colchester Select Board.

"Development Review Board" shall mean the Development Review Board for the Town of Colchester.

"*Director*" shall mean the Director of Public Works for the Town of Colchester

"Drainage Way" shall mean any channel that conveys surface runoff throughout the Site.

"Erosion Control" shall mean a measure that prevents erosion.

"Erosion and Sediment Control Plan" shall mean a set of plans prepared by or under the direction of a licensed professional engineer or a certified erosion control technician indicating the specific measures and sequencing to be used to control sediment and erosion on a development site during and after construction.

"Grading" shall mean any excavation or fill of material, including the resulting conditions thereof.

"Hazardous Materials" shall mean any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

"Illegal Discharge" shall mean any direct or indirect non-storm water discharge to the MS4, except as exempted in Article IV of this Ordinance.

"Illicit Connections" shall mean any drain or conveyance, whether on the surface or subsurface, which allows an illegal discharge to enter the MS4, including but not limited to any conveyances which allow any non-storm water discharge including sewage, process wastewater, and wash water to enter the MS4, and any connections to the MS4, from indoor drains and sinks, regardless of whether said drain or connection had been previously allowed, permitted, or approved by the Director.

"Impervious Surface" shall mean those surfaces that can not effectively infiltrate rainfall (e.g., building rooftops, pavement, sidewalks, driveways, etc.)

"Industrial Activity" shall mean activities subject to NPDES Industrial Permits as defined in 40 CFR, Section 122.26 (b) (14).

"Infiltration Basin" shall mean any structure or device designed to infiltrate retained water to the subsurface.

"Land Disturbance Activities" shall mean any land disturbance that requires a Building Permit or approval under any regulation or ordinance of the Town of Colchester that disturbs or breaks the topsoil or results in the movement of earth on land.

"Maintenance Agreement" shall mean a legally recorded document that acts as a property deed restriction, and which provides for long-term maintenance of storm water management practices.

"Manager" shall mean the Town Manager for the Town of Colchester.

"*Municipal Authority*" shall mean the Colchester Select Board.

"Municipal Separate Storm Sewer System", or "(MS4)", shall mean a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains): (i)owned or operated by the Town of Colchester that discharges to surface waters or ground water.; (ii) designed or used for collecting or conveying storm water; (iii) which is not a combined sewer; and (iv) which is not part of a Publicly Owned Treatment Works (POTW) as defined in 40 CFR, Section 122.2

"National Pollutant Discharge Elimination System (NPDES) Storm Water Discharge Permit" shall mean a permit issued by EPA (or by the State of Vermont under authority delegated pursuant to 33 USC § 1342(b)) that authorizes the discharge of pollutants to waters of the United States, whether the permit is applicable on an individual, group, or general area-wide basis.

"Non-point Source Pollution" shall mean pollution from any source other than from any discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from mining, construction, subsurface disposal and urban runoff sources.

"Non-Storm Water Discharge" shall mean any discharge to the MS4 that is not composed entirely of storm water.

"Person" shall mean any individual, association, organization, partnership, firm, corporation or other entity recognized by law and acting as either the owner, the owner's agent, or the operator of a premises.

"On-site Sewage Official" shall mean the Town's On-site Sewage Official or their designee.

"Pollutant" shall mean anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; oil and other automotive fluids; non-hazardous liquid and solid wastes and yard wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects, and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; hazardous substances and wastes; sewage, fecal coli form and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; and noxious or offensive matter of any kind.

"Premises" shall mean any building, lot, parcel of land, or portion of land whether improved or unimproved including adjacent sidewalks and parking strips.

"Sediment" shall mean soil, sand, and minerals washed from land into surface waters or onto other lands.

"Sediment Control" shall mean measures that prevent eroded sediment from leaving the Site.

"Septic Permit" shall mean a State Wastewater System & Potable Water Supply Permit, or an Town Water and Wastewater Permit.

"Site" shall mean a parcel of land or a contiguous combination thereof, where grading work is performed as a single unified operation.

"Site Development" shall mean construction or alteration of the ground, improvements and structure installation.

"Soil Erosion" shall mean when land or soil is diminished or worn due to wind or water.

"Stabilization" shall mean the use of accepted practices that prevent exposed soil from eroding.

"Start of Construction" shall mean the first land-disturbing activity associated with a development, including land preparation such as clearing, grading, and filling; installation of streets and walkways; excavation for basements, footings, piers, or foundations; erection of temporary forms; and installation of accessory buildings such as garages.

"Storm Water" shall mean precipitation and snowmelt that does not infiltrate into the soil, including material dissolved or suspended in it, but does not include discharges from undisturbed natural terrain.

"Storm Water Management" shall mean the use of structural or non-structural practices that are designed to reduce storm water runoff pollutant loads, discharge volumes, peak flow discharge and detrimental changes in stream temperature that affect water quality and habitat.

"Storm Water Runoff" shall mean flow on the surface of the ground, resulting from precipitation.

"Storm Water Treatment Practices" shall mean measures, either structural or nonstructural, that are determined to be the most effective, practical means of preventing or reducing point source or non-point source pollution inputs to storm water runoff and water bodies.

"*Surface Waters"* shall mean any receiving waters existing on the surface of the ground, including but not limited to; brooks, streams, rivers, wetlands, ponds, or lakes.

"Wastewater" shall mean any water or other liquid, other than uncontaminated storm water, discharged from premises.

"Watercourse" shall mean any body of water, including, but not limited to lakes, ponds, rivers, streams, and bodies of water delineated by the Town of Colchester.

"*Waterway*" shall mean a channel that directs surface runoff to a watercourse or to the public storm drain.

"Zoning Administrator" shall mean the Zoning Administrator for the Town of Colchester.

Chapter 18

Storm Water

Article III - Enforcement

Sec. 18-9. Enforcement Remedies.

The Town, by and through its authorized agents, shall have the authority to enforce the provisions of this Ordinance, and any orders, violation notices, or enforcement orders issued hereunder, and may pursue all civil and criminal remedies in connection with any violation hereunder.

A. Remedies not Exclusive.

The remedies set forth herein are not exclusive of any other remedies available, including criminal prosecution, under any applicable federal, state or local law. Election of one remedy shall not preclude pursuing other remedies and nothing herein shall prohibit the Town from seeking multiple remedies.

B. Judicial Bureau Municipal Civil Complaint Ticket.

Pursuant to 24 V.S.A., Chapters 59 and 61 and 4 V.S.A., Chapter 29, a Designated Enforcement Officer may commence prosecution in the Judicial Bureau for any violation of this Ordinance by serving two copies of a municipal civil complaint ticket either in person or by first class mail on the alleged offender, and thereafter promptly filing the original with the Judicial Bureau. The issuing officer shall follow the procedure set forth by the Judicial Bureau for municipal complaint tickets. The first offense ticketed for a violation shall be punishable by a fine of one hundred dollars ($100.00), the waiver fee shall be fifty dollars ($50.00); a second offense ticketed for the same violation shall be punishable by a fine of two hundred dollars ($200.00), the waiver fee shall be one hundred dollars ($100.00); a third offense ticketed for the same violation shall be punishable by a fine of five hundred dollars ($500.00), the waiver fee shall be two hundred and fifty dollars ($250.00). Upon the fourth offense, the Town may request that the case be transferred to the Superior Court, or any other court of competent jurisdiction.

C. Other Enforcement Remedies Generally; Fines, Injunctive Relief.

(1) Fines - Any person violating any of the provisions of this ordinance shall be subject to fines as outlined in Section 18-9 (B). In addition to any other penalty authorized by this section, any person, partnership, or corporation convicted of violating any of the provisions of this Ordinance shall be required to bear the expense of such restoration.

(2) Injunctive Relief - An action, injunction, or other enforcement proceeding may be instituted by the Town to prevent, restrain, correct, or abate any violation or activity causing a violation. The relief sought may include the right to enter onto private property to

abate or correct the violation, to restrain any activity that would create further violations, or to compel a person or persons to perform abatement or remediation of the violation; and to seek damages for all costs, including reasonable attorney's fees, incurred by the Town in pursuing and obtaining such relief. In addition to any other remedies authorized in law or equity, the Town may seek an order specifically requiring:

a.) The elimination of illicit connections and/or non-storm water discharges to the MS4;
b.) The discontinuance of practices, activities, or operations that lead to violations of this Ordinance;
c.) The abatement or remediation of storm water pollution or contamination hazards and the restoration of any affected property;
d.) The implementation of source control or treatment through the use of best management practices;
e.) The performance of monitoring, analysis, and reporting.

D. Stop Work Order; Revocation of Permit

In the event that any person holding a Building Permit approved by the Zoning Administrator, or a Septic Permit approved by the On-site Sewage Officer or their designee, for land disturbance activities, violates the terms of this Chapter or alters a site in such a manner as to adversely affect the public health, safety or welfare, the Designated Enforcement Officer may issue a Stop Work Order and/or suspend or revoke the permit.

Chapter 18

Storm Water

Article IV - Illicit Discharge and Storm Water Connection

Sec. 18-10. Purpose/Intent.

Under the authority set forth in 24 V.S.A § 2291, specifically subsection (14), and to provide for the public health, safety, welfare and convenience, it is hereby declared that it shall be a public nuisance for anyone to contribute pollutants, illegally connect, or illegally discharge into the Municipal Separate Storm Sewer System, (MS4), or to otherwise discharge non-storm water in violation of the requirements of this Ordinance. It is the purpose of this Article to provide procedures for the regulation of non-storm water discharges to the MS4, and where required by public health, safety, or welfare, to provide for the abatement or removal of any public nuisance related thereto. This Article establishes methods for controlling the introduction of pollutants into the MS4 in order to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process, and General Permit No. 3-9014 as issued by the State of Vermont. The objectives of this Article are:

(1) To regulate the introduction of pollutants to the MS4 from non-storm water discharges by any user;

(2) To prohibit illicit connections and illegal discharges to the MS4;

(3) To establish legal authority to carry out all inspection, monitoring, and enforcement procedures necessary to ensure compliance with this Article.

Sec. 18-11. Applicability.

This Article applies to all properties within the jurisdictional area of this Ordinance.

Sec. 18-12. Prohibitions.

A. Solid Waste Disposal

No person shall throw, deposit, leave, maintain, keep, or permit to be thrown, deposited, left, or maintained, in or upon any premise, public or private property, driveway, parking area, street, alley, sidewalk, component of the MS4, or any surface water of Colchester, any object or material, including but not limited to; refuse, rubbish, garbage, animal waste, litter, yard waste, or other discarded or abandoned objects, articles, and accumulations, so that the same may cause or contribute to pollution, or interfere with the operation, maintenance and access to the MS4.

Wastes deposited in streets in proper waste receptacles for the purposes of collection are exempted from this prohibition.

B. Illicit Connections

(1) The construction, use, maintenance or continued existence of illicit connections to the MS4 are prohibited.

(2) This prohibition expressly includes, without limitation, illicit connections made in the past, regardless of whether the connection was permissible under law or practices applicable or prevailing at the time of connection.

C. Illegal Discharges

No person shall discharge or cause to be discharged into the MS4, any materials, including but not limited to pollutants or waters containing any pollutants, other than storm water, or any materials that may impede the natural flow of storm water or the functionality of the MS4.

Sec. 18-13. Exemptions.

The commencement or continuance of any illegal discharge to the MS4 is prohibited except as described as follows:

(1) Water line flushing or other potable water sources, landscape irrigation or lawn watering, approved stream flow diversions, rising ground water, ground water infiltration to storm drains, uncontaminated pumped ground water, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, springs, non-commercial washing of vehicles, natural riparian habitat or wetland flows, swimming pool draining (if dechlorinated - typically less than one PPM chlorine), fire fighting activities, and any other water source not containing Pollutants.

(2) Discharges specified in writing by the Director as being necessary to protect public health and safety.

(3) Dye testing is an allowable discharge, but requires a verbal notification to the Department of Public Works prior to the time of the test.

(4) The prohibition shall not apply to any non-storm water discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the Federal Environmental Protection Agency, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for any discharge to the MS4 by the Director.

Sec. 18-14. Industrial or Construction Activity Discharges.

Any person subject to an industrial or construction activity NPDES storm water discharge regulation, and/or permit shall comply with all provisions of such regulation and/or permit. Proof of compliance with said regulation and/or permit may be required in a form acceptable to the Director prior to the allowing of discharges to the MS4.

Sec. 18-15. Monitoring of Discharges.

A. Applicability.

This section applies to all premises that have storm water discharges associated with industrial activity, including construction activity.

B. Access to Premises.

(1) The Department of Public Works shall be permitted to enter and inspect any premise subject to regulation under this Article as often as may be necessary to determine compliance with this Article. If a person has security measures in force which require proper identification and clearance before entry into its premise, the person shall make the necessary arrangements to allow access to representatives of the Department of Public Works.

(2) A person shall allow the Department of Public Works ready access to all parts of the premises for the purposes of inspection, sampling, examination and copying of records that must be kept under the conditions of an NPDES permit to discharge storm water, and the performance of any additional duties as defined by state and federal law.

(3) The Department of Public Works shall have the right to set up on any permitted premises such devices as are necessary in the opinion of the Director to conduct monitoring and/or sampling of the premises storm water discharge.

(4) The Director has the right to require a person to install monitoring equipment as necessary. The sampling and monitoring equipment shall be maintained at all times in a safe and proper operating condition by the owner or operator of the premise at their own expense. All devices used to measure storm water flow and quality shall be calibrated to ensure their accuracy. The owner or operator of the premise shall demonstrate calibration techniques and satisfactory operation of the devices to the Department of Public Works upon request.

(5) Any temporary or permanent obstruction to safe and easy access to the premises to be inspected and/or sampled shall be promptly removed by the owner or operator of the premise at the written or oral request of the Department of Public Works and shall not be replaced. The costs of clearing such access shall be borne by the owner or operator of the premise.

(6) Unreasonable delays in allowing the Department of Public Works access to permitted premises are a violation of this Article. A person who is the operator of a premise with a NPDES permit to discharge storm water associated with industrial activity commits an offense if the person denies the Department of Public Works reasonable access to the permitted premises for the purpose of conducting any activity authorized or required by this Article.

(7) If the Department of Public Works has been refused access to any part of the premises from which storm water is discharged, and he/she is able to demonstrate probable cause to believe that there may be a violation of this Article, or that there is a need to inspect and/or sample as part of a routine inspection and sampling program designed to verify compliance with this Article or any order issued hereunder, or to protect the overall public health, safety, and

welfare of the community, then the Director may seek issuance of a search warrant from any court of competent jurisdiction.

Sec. 18-16. Requirement to Prevent, Control, and Reduce Storm Water Pollutants by the use of Best Management Practices.

The owner or operator of a commercial or industrial establishment shall provide, at their own expense, reasonable protection from accidental discharge of prohibited materials or other wastes into the MS4 through the use of structural and non-structural BMPs.

Further, any person responsible for a property or premise, which is, or may be, the source of an illicit discharge, may be required to implement, at said person's expense, additional structural and non-structural BMPs to prevent the further discharge of pollutants to the MS4. Compliance with all terms and conditions of a valid NPDES permit authorizing the discharge of storm water associated with industrial activity, to the extent practicable, shall be deemed compliance with the provisions of this section.

Sec. 18-17. Notification of Spills.

Notwithstanding other requirements of law, as soon as any person responsible for a premises or operation, or responsible for emergency response for a premises or operation has information of any known or suspected release of materials which are resulting or may result in illegal discharges or pollutants discharging into the MS4, said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release. In the event of such a release of hazardous materials said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of non-hazardous materials, said person shall notify the Department of Public Works either in person, by phone, or facsimile no later than the next business day. Notifications in person or by phone shall be confirmed by written notice addressed and mailed to the Department of Public Works within three business days of the phone notice.

If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge, steps taken to remediate said illicit discharge, and the actions taken to prevent its recurrence. Such records shall be retained on-site by the owner or operator for at least three years.

Chapter 18

Storm Water

Article V - Erosion and Sediment Control

Sec. 18-18. Purpose/Intent.

Under the authority set forth in 24 V.S.A. § 2291, specifically subsection (14), and to provide for the public health, safety, welfare and convenience, it is hereby declared that it shall be a public nuisance for anyone to discharge sediment into the Municipal Separate Storm Sewer System, (MS4), and/or surface waters, as a result of soil erosion caused by land disturbance activities, or to otherwise discharge sediment in violation of the requirements of this Ordinance. It is the purpose of this Ordinance to provide procedures for the regulation of sediment discharged to the MS4 and/or surface waters, and where required by public health, safety, or welfare, to provide for the abatement or removal of any public nuisance related thereto. This Ordinance establishes methods and procedures for controlling the introduction of sediment into the MS4 and/or surface waters in order to comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) permit process, and General Permit No. 3-9014 as issued by the State of Vermont. The objectives of this Ordinance are:

(1) To regulate the contribution of sediment to the MS4 and/or surface waters from soil erosion caused by land disturbance activities.

(2) To control the design, construction, use, and maintenance of land disturbance activities.

(3) To establish legal authority to carry out all inspection and enforcement procedures necessary to ensure compliance to this Ordinance.

Sec. 18-19. Applicability of Erosion and Sediment Control.

This Article applies to any land disturbance activities within the jurisdictional area of this Ordinance that result in less than 1 acre of clearing, grading, construction or land disturbance activity, unless otherwise exempted under Section 18-22 of this Article.

Sec. 18-20. Prohibitions.

No person required to obtain a Building Permit, Septic Permit or any other form of Town approval for land disturbance activities, shall cause, allow or permit the release of any sediment created by soil erosion resulting from these activities, to any other property, the MS4 and/or surface waters.

Sec. 18-21. Permits.

No person shall be granted a Building Permit, Septic Permit or approval for any land disturbance activities regulated under this Ordinance without the approval of an Erosion and Sediment Control Plan by the Department of Public Works or its designee.

Sec. 18-22. Exemptions.

The discharge of any sediment from land disturbance activities approved by the Town to any other property, the MS4 and/or surface waters is prohibited except as described as follows:

(A) Any emergency activity that is immediately necessary for the protection of life, property or natural resources.

(B) Any nursery and/or agricultural operations as a permitted main or accessory use.

The approval of an Erosion and Sediment Control Plan for an approved land disturbing activity is not required for those projects disturbing equal to or less then 10,000 square feet.

Sec. 18-23. Erosion and Sediment Control Requirements.

(A) *Construction Access Route* - land disturbing activities subject to the provisions of this Ordinance shall require the installation of a stabilized temporary construction access. Construction sites regulated under this Ordinance shall have no more than one construction access route.

(B) *Winter Shutdown*- Earthwork shall be scheduled for completion and the site stabilized no later than October 15. By the end of the growing season, perennial cover shall be established and non-vegetated protection measures installed by October 15. There shall be no land disturbance activities allowed between the dates of October 15, and April 30. A waiver of this requirement may be granted by the Director of Public Works, or his designee, following the submittal and approval of a Winter Construction Erosion Control Plan consistent with the Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites.

(C) *Stabilization of Denuded Areas* - Soil may be exposed for a maximum of 10 business days between the dates of May 1 and October 14. Denuded areas must be stabilized in conformance with this section by implementing soil covering best management practices such as, but not limited to; mulching, straw matting, plastic covering, sodding, etc. Construction shall be planned to limit the amount of exposed area, and to avoid grading activities during rainy periods. Clearing limits shall be clearly marked and kept as small as possible.

(D) *Protection of Adjacent Properties* – All sediment from land disturbing activities shall be kept on site through the use of cover practice BMP's, structural BMP's and construction management measures. Where possible, a vegetative buffer strip shall be preserved and maintained around the site boundary. All soil stock piles on site shall be placed as far as possible from any and all drainage ways including storm drains systems and roadside ditches and swales. All soil piles on site shall also be covered with plastic or some other suitable cover practice BMP until the soil is either used or removed from the site.

(E) *Maintenance* – All construction access routes, cover practice BMP's and structural BMP's shall be inspected weekly, and immediately following each rain event causing runoff to ensure they are functioning properly. Any maintenance that is required to ensure

the proper operation and performance of these BMP's shall be completed immediately.

Sec. 18-24. Erosion and Sediment Control Plan.

A. Review and Approval

The Department of Public Works, or its designee, will review each Erosion and Sediment Control Plan to determine its conformance with the provisions of this regulation, unless explicitly exempted within this Ordinance. Within 30 days after receiving a plan, the Department of Public Works, or its designee, shall in writing:

(1) Approve the plan;

(2) Approve the plan subject to such reasonable conditions as may be necessary to secure substantially the objectives of this regulation, and require that the issuance of the Building Permit or Septic Permit be subject to these conditions; or

(3) Disapprove the plan, indicating the reason(s) and procedure for submitting a revised plan.

B. Plan Requirements

The Erosion and Sediment Control Plan shall prepared by or under the direction of a licensed professional engineer or a certified erosion control technician, and demonstrate conformance to the erosion and sediment control requirements contained in Section 18-23 of this Ordinance. All erosion and sediment control devices must be installed and stabilized before the start of construction. The Erosion and Sediment Control Plan shall contain both narrative and map(s) that clearly provide the following information:

(1) *Contact Information* – The name, address, and telephone number of all persons having a legal interest in the property and the tax reference number and parcel number of the property or properties affected.

(2) *General Description* - A general description of the project including a map identifying the location of the property and parcel boundaries.

(3) *Natural Resources* - A map of existing on site natural resources including soil type, types and location of vegetative covering, natural drainage ways, brooks, streams, ponds, wetlands and other surface waters, including any surface waters within 300 feet from the site.

(4) *Grading Plan* – A grading plan at a minimum scale of 1" = 40'. The grading plan shall include existing and proposed contours at maximum intervals of five feet. The grading plan shall also include the location of the temporary construction entrance and any soil stockpiles that will be maintained on the site.

(5) *Infrastructure* - A map identifying existing infrastructure both on and adjacent to the site, including roads, driveways, culverts, drainage structures, roadside ditches, etc.

(6) *BMP's* - A description of each of the best management practices to be used on the site, and a map identifying the locations where each of the best management practices will be installed and maintained.

Sec. 18-25. Design Requirements.

All erosion control practices, sediment control practices, waterway and watercourse protection practices and construction site access practices shall meet the design criteria set forth in the Vermont Handbook for Erosion Prevention and Sediment Control, latest version, the Department of Public Works Specifications and Standards, latest version, and the Colchester Zoning Regulations, latest version, and shall be adequate to prevent transportation of sediment from the site to the satisfaction of Department of Public Works. In the event of conflicting design criteria within these standards, the stricter shall prevail

Sec. 18-26. Access to Land Disturbance Activities.

The Department of Public Works shall be permitted to enter and inspect any land disturbance activities subject to regulation under this Article as often as may be necessary to determine compliance with this Article.

Sec. 18-27. Inspection Requirements.

The Department of Public Works shall make inspections as hereinafter required and either shall approve that portion of the work completed or shall notify the permittee wherein the work fails to comply with the Erosion and Sediment Control Plan as approved. To obtain inspections, the applicant or their agent shall notify the Department of Public Works at least two working days before the following:

1. Start of construction.
2. Installation of sediment and erosion control measures.
3. Completion of site clearing.
4. Completion of rough grading.
5. Completion of final grading.
6. Close of construction season.
7. Completion of final landscaping.

Sec. 18-28. Inspection Certifications.

In lieu of the requirements outlined in Section 18-27 of this Article, The Department of Public Works may allow or require that the applicant or their agent provide a written certification from a professionally licensed engineer, or a state certified erosion control technician, certifying compliance to the Erosion and Sediment Control Plan as approved.

The applicant or their agent shall make regular inspections of all control measures in accordance with the inspection schedule outlined on the approved Erosion and Sediment Control Plan.

Chapter 18

Storm Water

Article VI –Storm Water Management

Sec. 18-29. Purpose/Intent.

Under the authority set fourth in 24 V.S.A. § 2291, specifically subsection (14), and to provide for the public health, safety, welfare and convenience, it is hereby declared that it shall be a public nuisance for anyone to improperly manage storm water runoff created by land disturbance activities, or to otherwise manage storm water runoff caused by land disturbance activities in violation of the requirements of this Ordinance. It is the purpose of this Ordinance to provide procedures for the regulation of storm water runoff caused by land disturbance activities, and where required by public health, safety, or welfare, to provide for the abatement or removal of any public nuisance related thereto. This Ordinance establishes minimum storm water management requirements and controls associated with land disturbance activities in order to comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) permit process, and General Permit No. 3-9014 as issued by the State of Vermont. The objectives of this Ordinance are:

(1) To minimize increases in storm water runoff from land disturbance activities in order to reduce flooding, siltation, increases in stream temperature, and stream bank erosion and maintain the integrity of stream channels;
(2) To minimize increases in non-point source pollution caused by storm water runoff from land disturbance activities which would otherwise degrade local water quality;
(3) To minimize the total annual volume of surface water runoff which flows from any specific site during and following land disturbance activities to not exceed the pre-development hydrologic regime to the maximum extent practicable;
(4) To reduce storm water runoff rates and volumes, soil erosion and non-point source pollution, through storm water treatment practices and to ensure that these management controls are properly maintained and pose no threat to public safety.
(5) To establish legal authority to carry out all inspection and enforcement procedures necessary to ensure compliance to this Ordinance.

Sec. 18-30. Applicability of Storm Water Management.

This Article applies to any land disturbance activities within the jurisdictional area of this Ordinance that result in greater then or equal to 1 acre of clearing, grading, construction or land disturbance activity, and creates less than 1 acre of impervious surface, unless otherwise exempted under Section 18-33 of this Article.

Sec. 18-31. Prohibitions.

No person required to obtain a Building Permit or any other form of Town approval for land disturbance activities shall improperly manage storm water runoff associated with these activities, and/or fail to conform to the requirements of this Article.

Sec. 18-32. Permits.

No person shall be granted a Building Permit or approval for any land disturbance activities regulated under this Ordinance without the approval of a Storm Water Management Plan by the Department of Public Works or designee.

Sec. 18-33. Exemptions.

The following activities shall be exempt from the provisions of this Article:

(A) Any emergency activity that is immediately necessary for the protection of life, property or natural resources.
(B) Any nursery and/or agricultural operations as a permitted main or accessory use.
(C) Any land disturbance activity that creates less than ½ acre of impervious surface.

Sec. 18-34. Storm Water Manual.

The storm water manual as referenced in this Article refers to the technical analysis and design standards specified in the Vermont Storm Water Management Manual (Volumes I and II), latest revision.

Sec. 18-35. Storm Water Treatment Standards.

The following storm water treatment standards may apply to land disturbance activities regulated under this Article, and where applicable, shall be applied as required and outlined in the Vermont Storm Water Management Manual, (Volumes I and II), latest revision.

(A) Water Quality Treatment Standards
(B) Channel Protection Treatment Standards
(C) Groundwater Recharge Treatment Standards
(D) Over bank Flood Protection Treatment Standards
(E) Extreme Flood Protection Treatment Standards

Sec. 18-36. Storm Water Treatment Practice Design Criteria.

All storm water treatment practices shall meet the design criteria set forth in the Vermont Storm Water Management Manual, (Volumes I and II) latest version, the Department of Public Works Specifications and Standards, latest version, and the Colchester Zoning Regulations, latest version, and shall be adequate to achieve the required storm water treatment standards contained within the Vermont Storm Water Management Manual, (Volumes I and II), latest version. In the event of conflicting design criteria within these standards, the stricter shall prevail.
Sec. 18-37. Storm Water Management Plan.

A. Review and Approval

The Department of Public Works, or its designee, will review each Storm Water Management Plan to determine its conformance with the provisions of this regulation,

unless explicitly exempted within this Ordinance. Within 30 days after receiving a plan, the Department of Public Works, or its designee, shall in writing:

(1) Approve the plan;

(2) Approve the plan subject to such reasonable conditions as may be necessary to secure substantially the objectives of this regulation, and require that the issuance of the Building Permit be subject to these conditions; or

(3) Disapprove the plan, indicating the reason(s) and procedure for submitting a revised plan.

B. Plan Requirements

The Storm Water Management Plan shall be prepared and signed by a licensed, professional engineer who shall verify and demonstrate conformance to the applicable water quality treatment standards and storm water management design criteria contained in this Article. The Storm Water Management Plan shall contain both narrative and map(s) that clearly provide the following information:

(1) *Contact Information* - The name, address, and telephone number of all persons having a legal interest in the property and the tax reference number and parcel number of the property or properties affected.

(2) *Site Plan* - A map indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural storm water management and sediment control facilities. The map will also clearly show proposed land use with tabulation of total lot size in acres, percentage of surface areas to be disturbed, percentage of both existing and proposed impervious surfaces, drainage patters, locations of utilities, limits of clearing and grading, and all easements, including those easements necessary for required maintenance of all storm water treatment practices.

(3) *Base Map* - A 1" = 200' topographic base map of the site which extends a minimum of 100' beyond the limits of the proposed development and indicates existing surface water drainage including streams, ponds, culverts, ditches, and wetlands and current land use including all existing buildings, utilities, roads, and significant natural and manmade features not otherwise shown.

(4) *Calculations* - Sufficient engineering analysis to show that the proposed storm water treatment practices are capable of controlling runoff from the site in compliance with this ordinance and the storm water design manual. The analysis shall also include hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in the Public Works Specifications and Standards, herein incorporated by reference. Post-development storm water runoff flows shall be limited to equal to or less than pre-development storm water runoff flows for a minimum twenty-five year, twenty-four hour storm event.

(5) *Soils Report* - If a storm water treatment practice depends on the hydrologic properties of soils, such as infiltration basins, then a soils report shall be submitted. The soils report

shall be based on on-site boring logs or soil pit profiles.

(6) *Maintenance and Repair Plan* – The design and planning of all storm water management facilities shall include detailed maintenance and repair procedures to ensure their continued function. These plans will identify the parts or components of a storm water management facility that needs to be maintained. The maintenance and repair plan shall also include:

a) *A Landscape Plan* – The applicant must present a detailed plan for the management of vegetation at the site after construction is finished, including who will be responsible for the maintenance of vegetation at the site and what practices will be employed to ensure that adequate vegetation cover is preserved.

b) *Maintenance Easements* – The applicant must ensure access to all storm water treatment practices at the site for the purpose of inspection and repair by securing all of the maintenance easements needed on a permanent basis. These easements shall be recorded in the land records before the issuance of a Building Permit and will remain in effect even with transfer of title to the property.

c) *Maintenance Agreement* – The applicant must execute a maintenance agreement binding on all subsequent owners of land served by an on-site storm water management measure. The maintenance agreement shall be recorded in the land records before the issuance of a Building Permit and shall specify the required maintenance for all storm water treatment practices, along with a maintenance schedule specifying when and how often maintenance is performed on the storm water treatment practices.

d) *Maintenance Records* - The applicant shall be required to maintain records that verify that all required maintenance was performed in conformance to the approved Storm Water Management Plan. The records shall be maintained for a period of three (3) years, and shall be made available to the Department of Public Works upon request.

Sec. 18-38. Access to Storm Water Treatment Practices.

The Department of Public Works shall be permitted to enter and inspect any land disturbance activities where storm water treatment practices are being, or have been constructed subject to regulation under this Article as often as may be necessary to determine compliance with this Article.

Sec. 18-39. Inspection Requirements.

The applicant must notify the Department of Public Works or their designee in advance before the start of construction. The Department of Public Works shall make regular inspections of the construction of storm water treatment practices. If any violations are found, the property owner shall be notified in writing of the nature of the violation and the required corrective actions. No additional work shall proceed until any violations are corrected and all work previously completed has received approval from the Department of Public Works.

Sec. 18-40. Inspection Certifications.

In lieu of the requirements outlined in Section 18-39 of this Article, The Department of Public Works may allow or require that the applicant or their agent provide a written certification from a professionally licensed engineer certifying compliance to the Storm Water Management Plan as approved.

Sec. 18-41. Landscaping and Stabilization Requirements.

Any area of land for which the natural vegetative cover has been either partially or wholly cleared or removed by land disturbance activities shall be revegetated within ten (10) business days from the substantial completion of such clearing and construction. The following requirements apply:

(A) Reseeding must be done with an annual or perennial cover crop accompanied by placement of straw mulch or its equivalent of sufficient coverage to control erosion until such time as the cover crop is established over ninety (90%) of the seeded area.

(B) Replanting with native woody and herbaceous vegetation must be accompanied by placement of straw mulch or its equivalent of sufficient coverage to control erosion until the plantings are established and are capable of controlling erosion.

(C) Any area of revegetation must exhibit survival of a minimum of seventy-five percent (75%) of the cover crop throughout the year immediately following revegetation. Revegetation must be repeated in successive years until the minimum seventy-five percent (75%) survival for one (1) year is achieved.

Passed and Adopted this 28th day of March, 2006

Effective April 18, 2006

COLCHESTER SELECT BOARD

L. Richard Paquette	**Edward Ploof, Jr.**
Marc Landry	**Chris Conant**
Roger Derby	

Passed and Adopted this 28th day of March, 2006

Effective April 18, 2006

COLCHESTER SELECT BOARD

L Richard Paquette

L. Richard Paquette

Edward Ploof, Jr.

Marc Landry

Chris Conant

Roger Derby

7.02 General Development Four Openspace District GD4OS

A. Purpose. To conserve open spaces of particular importance to viewscapes within the General Development Four District.

B. Municipal Plan. These regulations hereby implement the relevant provisions of the Town of Colchester adopted municipal plan and are in accord with the policies set forth therein.

C. Permitted Uses. Those uses allowed as permitted uses in the General Development Four District may be permitted in the GD4OS Overlay District in accordance with the provisions of Section 4.04 herein.

D. Conditional Uses. Those uses allowed as conditional uses in the General Development Four District may be permitted in the GD4C Overlay District in accordance with the provisions of Section 4.04 herein.

E. Area, Density, and Dimensional Requirements. In the GD4OS District, all structures shall be subject to the area, density and dimensional requirements of the General Development Four District as set forth in Section 4.04 and Table A-2, Dimensional Standards of these regulations.

F. Additional Standards. In addition to the Site Plan, Conditional Use, Planned Unit Development criteria, all development in the GD4OS District shall also be subject to the following standards:

1. For all properties within the GD4OS 30% of the total acreage of any parcel to be developed shall be designated as open space. If all of the GD4OS area on a property is designated as restricted open space with covenants to keep said space open in perpetuity, the Development Review Board may increase total lot coverage by 10% beyond that permitted in General Development Four District as set forth in Section 4.04 and Table A-2.
2. Structures within the GD4OS District shall be limited to ten feet in height. The Development Review Board may increase the height of a building up to the height for the GD4 District designated in if 50% or more of the GD4OS on a property is designated as restricted open space with covenants to keep said space open in perpetuity in Section 4.04 and Table A-2.
3. The Development Review Board may approve use of the GD4OS for septic systems and stormwater treatment/detention systems, provided all GD4OS area on a property is designated as restricted open space with covenants to keep said space open in perpetuity.

7.03 Shoreland District SD

A. Purpose. To preserve the natural growth and cover of the shorelines, to preserve water quality, to prevent pollution, to regulate development and appearance of the shorelines, to prevent erosion, to prevent nuisance, and to preserve the property rights of the shoreline property owners. The boundaries of the Shoreland District shall include all lands within 500 feet from the mean watermark of Colchester Pond, Winooski River, Lamoille River, and Lake Champlain. This district overlays all other districts along the shoreline.

B. Municipal Plan. These regulations hereby implement the relevant provisions of the Town of

Colchester adopted municipal plan and are in accord with the policies set forth therein.

C. Permitted Uses. The following uses are permitted in the Shoreland District in accordance with the provisions of this Section 7.03 and Table A-2, Dimensional Standards.

1. Those uses which are permitted in the underlying zoning district.
2. Piers, docks and other structures attached to the shore and extending beyond the mean water mark are exempt from these Regulations, provided that such piers, docks and other structures comply with all state and federal regulations pertaining to such encroachments and are not integrated with other structures regulated herein.
3. Pumphouses designed and of a size for ordinary residential or seasonal camp use.
4. Repair and reconstruction of existing residential structures including the installation of full basements that complies with the setbacks required in Chapter Eight of the Colchester Code of Ordinances.
5. Enlargement of residential structures that does not increase the degree of encroachment within 100 feet from the mean water mark.
6. Shore based facilities for pumping and/or disposing of wastes from boats (subject to applicable Town and State Health Regulations).
7. Recreational uses such as picnic ground, parks, playgrounds, swimming areas (beaches), natural areas and hunting and fishing.
8. Seawalls, retaining walls and similar structures detached from and not an integral part of a building.
9. Stairs and associated landings detached from and not an integral part of a building.
10. Boat launching ramps.
11. Fences.

D. Conditional Uses. The following uses are allowed in the Shoreland District as conditional uses subject to approval by the Development Review Board in accordance with the provisions of this Section 7.03 and Table A-2, Dimensional Standards.

(1)
Enlargement of residential structures that increases the degree of encroachment within the 100 feet from the mean water mark. Such portion of the structure encroaching shall not exceed 10% of the building as measured from the exterior face of exterior walls excluding appurtenances such as decks, porches, overhangs, and stairs in existence at the time of application within a 10 year period.

E. Area, Density, and Dimensional Requirements. In the Shoreland District structures shall be subject to the following area, density and dimensional requirements:

(1) Except for those uses specified in Section 7.03C & D all buildings and structures shall be setback 100 feet from the mean water mark.
(2) All buildings, structures, and lots shall comply with the minimum lot, dimensional, coverage, and height requirements of the underlying district.

F. Additional Standards. In addition to the Site Plan, Conditional Use, Planned Unit Development criteria, all development in the Shoreland District shall also be subject to the following standards:

1. If piers, docks and other structures under Section 7.03C(2) are integrated with structures requiring approval hereunder, including but not limited to seawalls, retaining walls, stairs or landings, such integrated portions of the pier, dock or other structure under 7.03C(2) located landward of the mean water mark are subject to this Section 7.03F.
2. Existing natural shoreline vegetation should be incorporated into the project when

reasonably possible. Native plants and wildlife habitat should be considered and preserved to the greatest extent possible. No more than 25% of existing trees one inch caliper or greater shall be removed along the shoreline for a distance of 100 ft from the mean water mark within a ten year period. The Development Review Board may permit up to 40% of existing trees of one inch caliper or greater to be removed if it is determined that the removal of the trees will not have adverse impact on shoreline stability and the character of the area. Removal of dead trees or trees of immediate threat to human safety as well as reasonable pruning of existing trees is permitted. Removal of more than 40% of existing trees may be approved by the Development Review Board in conjunction with a permitted or conditional use as stated herein.

3. The proposal for filling, grading or erection of any structure within 100 ft. inland of the mean water mark shall require site plan review and approval by the Development Review Board per Article Eight and Section 2.13. Specifically exempt from this requirement shall be those uses listed in Section 7.03C (4), (5), (9), and (11).

4. Requests for seawalls and similar structures under Section 7.03C(8) shall require site plan approval by the DRB as specified in Article Eight. In addition to the requirements of Section 7.03F, the DRB shall apply the following standards to the construction of seawalls and similar structures permitted under Section 7.03C (8):

(a) The applicant shall prove the required need of said seawall or similar structure. Required needs include threat to personal property, excessive erosion, or imminent threat to water quality. Expansion of usable property shall not constitute need. All seawalls shall be constructed in a structurally sound manner fully complying with building codes in effect.

(b) The seawall or similar structure shall be designed by a Professional Engineer or Landscape Architect. Exceptions may be made by the Board where Bio-Engineered solutions are proposed.

(c) The seawall or similar structure shall, to the extent structurally feasible, follow the existing contour of the shoreline and be located along the toe of the slope minimizing backfill and land disturbance. The structure shall be scaled to meet the need and not larger than structurally required. The Shoreline Stabilization Handbook, as amended from time to time, shall be consulted for project design. Full design plans including a site plan with property boundary lines, contours including the 95 foot, 98 foot, and 102 foot elevations shall be submitted with the application including a scaled cross-section of the wall, descriptions of material to be used, a drainage plan, a construction access plan, and soil erosion / site stabilization plan. Existing conditions shall be documented through site plans as well as photographs of the site from the waterbody.

(d) Visually massive structures are discouraged. The project design should mitigate the visual impact of the structure as viewed from the water. To this end, terracing, landscape plantings, and other aesthetic measures should be integrated into the structural solution.

(e) Whenever feasible, a coordinated solution to localized erosion problems should be taken amongst effected property owners.

5. The review of any proposed construction of shore-based facilities shall consider the following:

(a) Will not adversely affect water quality or be a source of nuisance by reason of noise or fumes.

(b) Will not interfere with or prevent use of adjacent shoreland property or its access to and from the water.

(c) Will be compatible with adjacent land uses.

(d) That necessary and adequate sanitary public utilities and parking facilities are

available or will be made available.

(e) Will not create an adverse vehicle traffic condition.

6. Stairs shall be no more than 44 inches in width with associated platforms being no more than 44 inches in width and 48 inches in length. All stairs shall have a handrail on at least one side. Flexibility will be exercised with regard to the rise and run of stairs permitted under this section to accommodate pedestrian access yet minimize visibility from the lake and preservation of natural features.

7. All stairs shall minimally disturb existing contours on the site and where possible follow existing contour lines. Stairs shall make use of the natural vegetation and topography to blend with the shoreline. All stairs shall be screened from the water body through the use of landscaping.

8. The Department of Water Resources and the U.S. Army Corps of Engineers may be requested to review, comment on, or approve all applications for construction below the 98 foot elevation prior to issuance of a building permit for said construction. The Development Review Board and the Department of Planning and Zoning may utilize the recommendations of the Department of Water Resources and the U.S. Army Corps of Engineers in its decision whether or not to issue a building permit for said construction.

9. Enlargement of a residential structure that increases encroachment within the 100 feet from the mean water mark shall demonstrate that said enlargement can not reasonably be accomplished without further encroachment due to topography, shape of the lot, or interior floor plan layout. Enlargement that results in additional encroachment shall be adequately screened from the water body, shall make use of existing topography, shall utilize earth-tone colors, and shall make use of the natural vegetation and topography to blend with the shoreline.

10. Legal encroachments per Section 7.03 shall not be subject to the time limits established under Section 2.12B(2).

11. Requests for boat launching ramps under Section 7.03C(10) shall require site plan approval by the DRB as specified in Article Eight. In addition to the requirements of Section 7.03F(1), (2), and (3), the DRB shall apply the standards of 7.03F(4)(b)-(d) to the construction of ramps.

7.04 Water Protection District WPD

A. Purpose. It is the purpose of this Section to provide for the protection and improvement of the surface waters and wetland within the Town of Colchester. These regulations and standards are intended to lead to the establishment and protection of natural areas along the Town's surface waters and wetlands to provide improved protection for water quality and the provision of open space areas and wildlife habitat. It is the further purpose of this Section to provide for the retention of preexisting residential neighborhoods located along surface waters and streams in a manner consistent with the resource protection goals of this Section and the Municipal Plan.

B. Municipal Plan. These regulations hereby implement the relevant provisions of the Town of Colchester adopted municipal plan and are in accord with the policies set forth therein.

C. Surface Water Buffer Standards ("Stream Buffers")

1. Applicability. The requirements of this Section shall apply to all lands not developed with a single-family dwelling or duplex dwelling as of December 21, 2004, and not under the jurisdiction of the Development Review Board, and described as follows:

(a) All land within eight-five (85) feet horizontal distance of the center of the main

TOWN OF Colchester
ESTABLISHED • 1763

Planning & Zoning Department

Select Board
Nadine Scibek
Herbert Downing
Marc Landry
Thomas Mulcahy
Kathrine R. Niquette

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264-5501

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May 17, 2013

Christy Witters
Vermont Department of Environmental Conservation
Water Quality Division
1 National Life Dr., Main 2
Montpelier, VT 05602-3522

RE: General Permit 3-9014, NPDES Number
Stream Corridor Buffer Report

Dear Ms. Witters,

The Town of Colchester wishes to provide a report in support of General Permit 3-9014, NPDES Number VTR040000.

In 1999, the Town of Colchester amended its Zoning Regulations to include wetland buffers and stream bank buffer requirements for all streams within Colchester. These provisions are currently codified as the Water Protection Overlay District in Section 7.04 of the Zoning Regulations (see enclosed). The District provides a restrictive 85-foot buffer from the centerline of streams and a 50-foot buffer from the edge of Class I and II wetlands. Predating the Water Protection District is the is the Shoreland Overlay District, Section 7.03 of the Zoning Regulations, which provides a restrictive 100-foot buffer from the mean water mark of Colchester Pond, the Winooski River, the Lamoille River and Lake Champlain (see enclosed). These regulations combine to provide inclusive protection of Colchester's water resources from land development.

Phase II Stream Geomorphic Assessments for Sunderland Brook and Morehouse Brook were completed in 2006. The Sunderland Brook analysis confirmed that bank erosion within the stream channel is contributing to the impairment of Tributary Eight of Sunderland Brook. The Sunderland Brook analysis notes that mitigation of the hydrologic regime of the watershed zone needs to occur before it will be feasible to restore the stream channel geometry of Tributary Eight. The current 85-foot stream bank buffer prohibits land development within the stream corridor and therefore assists in mitigation of the hydrologic regime of the watershed zone and helps to maintain native vegetative cover necessary to improve habitat.

The Morehouse Brook analysis for the portions of the brook contained in Colchester, M01 and M02.2, recommended addressing local reach conditions and watershed hydrologic departure. It further concludes that the pervasive impacts of upslope urban runoff from Winooski may hinder attempts to address the altered hydrologic regime of the entire watershed. Recommendations are made for the City of Winooski and the State to intervene; however, no recommendations are made for improvements within the portion of Morehouse Brook within Colchester.

While the Town has an established stream bank buffer of 85-feet from centerline, several exemptions are provided for, including exemptions for pre-existing single-family and duplex dwellings. Subject to the public process outlined in 24 VSA. §117, the Town Planning

Commission and Legislative Body could propose amending the Section 7.04 of the Zoning Regulations to eliminate or reduce exemptions from the stream bank buffer. Enclosed is a draft of Section 7.04 of the Zoning Regulations that would eliminate exemptions for pre-existing single-family and duplex properties. Although this represents an option to ensure enhanced protection of stream corridors, the public and its elected officials have previously rejected this idea during the Town's original adoption of the current stream bank buffer ordinance. Additionally, it is the Town's position that the current ordinances are adequate to achieve this goal.

Aerial photography of Sunderland and Morehouse Brooks' watersheds (enclosed) show natural vegetative cover and area converted to impervious surface as of April 2012. These maps depict conditions within these impaired watersheds fourteen years after the implementation of the stream bank buffer regulations.

The Sunderland and Morehouse Brooks' stream corridors that have not been developed or otherwise converted to impervious surface are now under the jurisdiction of the Water Protection Overlay District Section 7.04 of the Zoning Regulations (enclosed) that includes 85-foot buffers and setbacks from the centerline of the stream and 50-foot setbacks from the edge of Class I and II wetlands. The current Zoning Regulations prohibits new development from occurring within the buffer areas and therefore have the effect of an 85-foot setback for streams and 50 feet for wetlands. These protections are sufficient to enhance protection of undeveloped stream corridors.

In closing, the Town remains committed to fulfilling the obligations of this Memorandum of Decision. Should you have any questions, please contact me.

Sincerely,

Sarah H. Hadd
Director of Planning and Zoning

natural vegetation and topography to blend with the shoreline. All stairs shall be screened from the water body through the use of landscaping.

8. The Department of Water Resources and the U.S. Army Corps of Engineers may be requested to review, comment on, or approve all applications for construction below the 98 foot elevation prior to issuance of a building permit for said construction. The Development Review Board and the Department of Planning and Zoning may utilize the recommendations of the Department of Water Resources and the U.S. Army Corps of Engineers in its decision whether or not to issue a building permit for said construction.

9. Enlargement of a residential structure that increases encroachment within the 100 feet from the mean water mark shall demonstrate that said enlargement can not reasonably be accomplished without further encroachment due to topography, shape of the lot, or interior floor plan layout. Enlargement that results in additional encroachment shall be adequately screened from the water body, shall make use of existing topography, shall utilize earth-tone colors, and shall make use of the natural vegetation and topography to blend with the shoreline.

7.04 Water Protection District WPD

A. Purpose. It is the purpose of this Section to provide for the protection and improvement of the surface waters and wetland within the Town of Colchester. These regulations and standards are intended to lead to the establishment and protection of natural areas along the Town's surface waters and wetlands to provide improved protection for water quality and the provision of open space areas and wildlife habitat. It is the further purpose of this Section to provide for the retention of preexisting residential neighborhoods located along surface waters and streams in a manner consistent with the resource protection goals of this Section and the Municipal Plan.

B. Municipal Plan. These regulations hereby implement the relevant provisions of the Town of Colchester adopted municipal plan and are in accord with the policies set forth therein.

C. Surface Water Buffer Standards ("Stream Buffers")

1. Applicability. The requirements of this Section shall apply to all lands ~~not developed with a single-family dwelling or duplex dwelling as of December 21, 2004, and not under the jurisdiction of the Development Review Board, and~~ described as follows:

(a) All land within eight-five (85) feet horizontal distance of the center of the main channel of Allen Brook, Indian Brook, Malletts Creek, Pond Brook and Sunderland Brook and from the center of all tributaries of the above named streams and all other minor streams which shall be subject to the provisions of (b) below.

(b) Initial assessment of a stream location can be made by consulting the Overlay District Map. In the case of a conflict with the map, final assessment will be made by a wetland/aquatic biologist. The origin of a stream or tributary is defined as the point where an intermittent stream forms a distinct channel, as indicated by the presence of a streambed and/or high water marks.

2. General standards. It is the objective of these standards to promote the establishment of heavily vegetated areas of native vegetation and trees in order to reduce the impact of stormwater runoff, reduce sedimentation, and increase infiltration and base flows in the Town's watercourses. Therefore, except as specifically permitted below and in Section 7.04C3 & 4, all lands within a required stream buffer defined above shall be left in an undisturbed, naturally vegetated condition. Supplemental planting and landscaping with appropriate species of vegetation to achieve these objectives shall be permitted. The specific standards for the vegetation and maintenance of stream buffers are as follows:

(a) No more than 25% of existing trees one inch caliper or greater shall be removed within 85 feet from the centerline of the stream within a ten year period. The Development Review Board may permit up to 40% of existing trees of one inch caliper or greater to be removed if it is determined that the removal of the trees will not have adverse impact on the character of the area. Removal of dead trees or trees of immediate threat to human safety as well as reasonable pruning of existing trees is permitted. Removal of more than 40% of existing trees may be approved by the Development Review Board in conjunction with a permitted or conditional use within underlying districts.

(b) Any areas within a required stream buffer that are not vegetated or that are disturbed during construction shall be seeded with a naturalized mix of grasses rather than standard lawn grass, and shall not be mowed more than one (1) time per calendar year after establishment.

(c) The creation of new lawn areas within stream buffers is not permitted after December 21, 2004.

~~(d) Accessory residential structures which do not exceed 120 square feet and residential pools that do not exceed 500 square feet are hereby exempted provided the primary structure is in existence on December 21, 2004.~~

~~(e) Enlargement, repair and reconstruction of residential structures in existence on December 21, 2004 are hereby exempted.~~

~~(f) Residential fences where the primary structure is in existence on December 21, 2004 are hereby exempt.~~

3. Expansion of pre-existing structures within stream buffers. The expansion of pre-existing structures within stream buffers~~, except as provided in Section 7.04C2 above,~~ shall be permitted only in accordance with the standards for noncomplying structures in Section 2.12 of these Regulations.

4. New uses and encroachments within stream buffers. The encroachment of new land development activities into the Town's stream buffers is discouraged. The

DRB may authorize the following as conditional uses within stream buffers, subject to the standards and conditions enumerated for each use.

(a) Agriculture in accordance with Vermont Department of Agriculture Acceptable Agricultural Practices, horticulture and forestry including the keeping of livestock, provided that any building or structure appurtenant to such uses is located outside the stream buffer.

(b) Clearing of vegetation and filling or excavating of earth materials, only to the extent directly necessitated for the construction or safe operation of a permitted or conditional use on the same property and where the DRB finds that:

(1) There is no practicable alternative to the clearing, filling or excavating within the stream buffer; and

(2) The purposes of this Section will be protected through erosion controls, plantings, protection of existing vegetation, and/or other measures.

(c) Encroachments necessary to rectify a natural catastrophe for the protection of the public health, safety and welfare.

(d) Encroachments necessary for providing for or improving public facilities.

(e) Public recreation paths and bridges.

(f) Stormwater treatment facilities meeting the Vermont Agency of Natural Resources stormwater treatment standards, and routine maintenance thereof, including necessary clearing of vegetation and dredging. Evidence of a complete application to the VANR for coverage under the applicable permitting requirements shall be required to meet this criterion for encroachment into a stream buffer. The conveyance of treated stormwater to a stream through a pipe or open channel shall occur at the invert elevation of the streambed, wherever possible, and shall be stabilized by a stone outfall. A maintenance schedule for permanent stormwater best management practices shall be submitted and approved by the Town Engineer. A performance bond may be required for said improvements.

(g) Roadways or access drives for purposes of crossing a stream buffer area to gain access to land on the opposite side of the buffer, or for purposes of providing safe access to an approved use, in cases where there is no feasible alternative for providing safe access. Roadways, access drives, and associated improvements shall meet the following standards:

(1) Wherever practicably feasible, the crossing shall occur at right-angle to the stream channel and the roadway or access drive should be located at least ten (10) feet from the edge of channel of the surface water.

(2) Unless otherwise approved by the Town Engineer, for streams up to 6 feet wide, arch (squashed) culverts with baffles or box culverts with baffles shall be used. In either case, the invert of the structure shall be at grade with the streambed. For streams 6 feet wide or greater, bottomless Plate Arches or bridges will be used to

ensure passage of water during dry periods and minimize barriers to fish. All roadway bridges or plate arches shall be capable of passing a 50-year peak discharge.

(3) Unless otherwise approved by the Town Engineer, for culvert headers there should be 4' of scour protection (below streambed) or a minimum of 1/2 culvert diameter. Headers and wing walls should be high enough to retain road fills and provide for adequate roadway width. Wing configuration shall be as necessary to retain fill slopes and control inlet and outlet erosion.

(h) Utility lines, including power, telephone, cable, sewer and water, to the extent necessary to cross or encroach into the stream buffer where there is no feasible alternative for providing or extending utility services. Underground utility crossings should be located at least 3 feet below the streambed, so that future channel erosion does not expose them.

(i) Outdoor recreation not involving the uses of mowed fields provided any building or structure (including parking and driveways however except bridges and boardwalks) appurtenant to such use is located outside the stream buffer.

(j) Research and educational activities provided any building or structure (including parking and driveways) appurtenant to such use is located outside the stream buffer.

(k) Hydro-electric power generation

D. Wetland Buffer Standards

1. Applicability. The requirements of this Section shall apply to all of the following lands:

(a) Lands designated as Class I and II wetlands

(b) All lands within fifty (50) feet horizontal distance of the edge of a Class I and II wetland

(c) Initial assessment of a wetland location can be made by consulting the National Wetland Inventory map and the Overlay District Map. In the case of a conflict with the map, final assessment will be made by a wetland/aquatic biologist.

2. General standards. It is the objective of these standards to promote the establishment of heavily vegetated areas of native vegetation and trees in order to reduce the impact of stormwater runoff, reduce sedimentation, and increase infiltration and base flows in the Town's wetlands. Therefore, except as specifically permitted below, all lands within wetlands and required wetland buffers defined above shall be left in an undisturbed, naturally vegetated condition:

(a) Encroachment into Class I and II wetlands is permitted by the Town only in conjunction with issuance of a Conditional Use Determination (CUD) by the Vermont Department of Environmental Conservation and positive findings by the DRB pursuant to the criteria in Section 7.04D2(b) below.

(b) Encroachment into Class I and II wetland buffers may be permitted by the DRB upon finding that the proposed project's overall development, erosion control, stormwater treatment system, provisions for stream buffering, and landscaping plan achieve the following standards for wetland protection:

(1) The encroachment(s) will not adversely affect the ability of the property to carry or store flood waters adequately;

(2) The encroachment(s) will not adversely affect the ability of the proposed stormwater treatment system to reduce sedimentation according to state standards;

(3) The impact of the encroachment(s) on the specific wetland functions and values identified in the field delineation and wetland report is minimized and/or offset by appropriate landscaping, stormwater treatment, stream buffering, and/or other mitigation measures.

(4) There shall be no adverse affect to soils or vegetation, impairment of the quantity and quality of surface and ground water, or soil erosion.

(5) Excavation of earth materials or filling with earth materials or other substances will be permitted only to the extent necessitated by a permitted or conditional use.

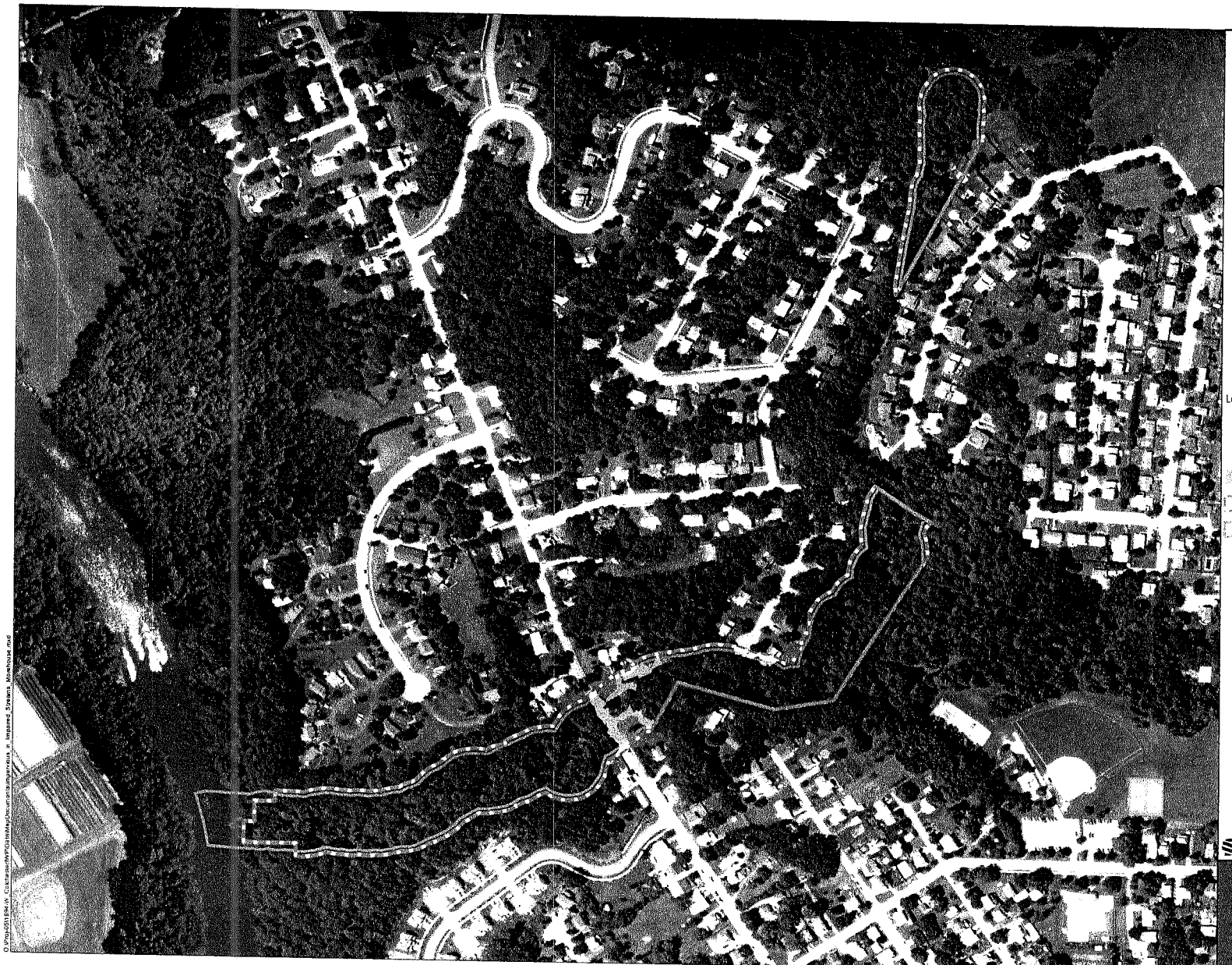
7.05 Historic Preservation District HPD

A. Purpose. To encourage the preservation and rehabilitation of historic structures within the Fort Ethan Allen National Register Historic District. Development should be sensitive to Colchester's historic and archaeological sites and structures as these serve as visible reminders of the community's past. Changes to historic structures should be sympathetic to the structure, and to the extent possible, in accordance with the Secretary of Interior's Standards for the Treatment of Historic Properties.

B. Municipal Plan. These regulations hereby implement the relevant provisions of the Town of Colchester adopted municipal plan and are in accord with the policies set forth therein.

C. Permitted Uses. Those uses allowed as permitted uses in the underlying zoning districts as specified in Table A-1 may be permitted in the HPD Overlay District in accordance with the provisions of Section 7.05 herein.

D. Conditional Uses. Those uses allowed as conditional uses in the underlying zoning districts as specified in Table A-1 may be allowed in the HPD in accordance with the provisions of Section 7.05 and Article 8, Conditional Uses, herein.



N

0 100 200 400 Feet

Legend

- Impervious in both State Stream Corridor and Town Setback (0.3 acres)
- Impervious in State Stream Corridor Only (0.1 acres)
- Impervious in Town Setback Only (0 acres)
- State Stream Corridor, Generally 100 Feet
- Town Stream Setback, 85 Feet

Sources: Impervious Cover: VT ANR; Hydrography: NHD.

STONE ENVIRONMENTAL INC

Impervious Area in Morehouse Brook Impaired Stream Buffer

N

0 250 500 1,000 Feet

Legend

- Impervious in both State Stream Corridor and Town Setback (3.4 acres)
- Impervious in State Stream Corridor Only (1.4 acres)
- Impervious in Town Setback Only (2.9 acres)
- State Stream Corridor, Generally 100 Feet
- Town Stream Setback, 85 Feet

Sources: Impervious Cover: VT ANR; Hydrography: NHD.

STONE ENVIRONMENTAL INC.

Impervious Area in Sunderland Brook Impaired Stream Buffer