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1. BACKGROUND

The Bay of Quinte Remedial Action Plan (BQRAP) Stage 2 report "Time to Act" sets out 80 recommendations.

1.1 BQRAP recommendation for PCP Development

Recommendations No. 21 to 34 were focused on overcoming the Bay of Quinte's bacterial contamination problems.

Recommendation No. 23 is as follows:

- "The municipalities of Belleville, Deseronto, Picton, Napanee and Trenton should undertake Pollution Control Planning studies to identify, and where required, implement actions to eliminate the sources of bacterial contamination and other pollutants along their respective waterfronts."

The rationale for this recommendation was that urban beaches in the identified municipalities often experience bacteriological contamination in both wet and dry weather, restricting swimming and other water-contact recreation.

The "Time To Act" report notes the following with respect to causes of bacterial contamination:

- "During the summer months, Bay of Quinte beaches are posted periodically, particularly in urban areas and after storm events. Combined-sewer overflows, sewage by-passing, urban runoff and other uncontrolled sources contribute to the problem in the urbanized areas." ("Time to Act", P. 77)

- "The spatial pattern of contamination around Quinte municipalities suggests that urban discharge and runoff are primary sources of in-bay bacterial contamination. Few combined storm and sanitary sewer collector systems remain. Where combined sewers persist, adequate sewage treatment plant capacity to avoid overflows generally exists. Combined sewer overflows are therefore infrequent and therefore not a major factor. "

1.2 Related BQRAP Recommendations

Other RAP recommendations deal with related issues. These are summarized in Table 1. They target specific sources of bacterial pollution, namely:

1. Sewer system overflows
2. Pet litter wash-off
3. Wildlife
4. Discharges from pleasure boats
5. Faulty or substandard septic systems

Table 1 Summary of Bay of Quinte RAP recommendations related to control of stormwater runoff and sources of bacterial contamination	
RAP recommendation	Summary
24	Disconnect roof drains and sump pumps from sanitary sewer system
25	Implement long-range strategies for sewer system inspection, maintenance and rehab
26	Implement water conservation
27	Enforce domestic pet litter bylaws
28	Take measures to discourage presence of gulls and control dog access at swimming beaches.
29	Routine street cleaning and catchbasin cleaning
30	Ensure pleasure craft on Trent Severn waterway comply with plumbing and boating regs
31	Storm sewers and drainage ditches should be investigated for sources of dry-weather bacterial contamination
32	Proper disposal of human wastes and litter generated by ice-fishing on the Bay
33	Stormwater quality control for new urban development
34	Ontario's Subwatershed Planning Process should be used as input to municipal Secondary Plans (for new urban development areas).
38	Investigate septic systems on properties fronting on the Bay and take corrective measures where needed

1.3 Focus of PCPs

Accordingly, the Pollution Control Planning studies (PCPs) called for in Recommendation #23 are most appropriately targeted at diffuse sources from the urban areas. In particular, surface drainage and stormwater runoff should be the focus of PCP development.

Urban stormwater runoff represents not only a source of bacterial contamination but also represents a source of nutrient loadings to the Bay of Quinte. As well, urban stormwater typically carries sediment, grit and debris, along with a range of other contaminants including metals and persistent toxics washed off urban surfaces.

In other words, urban stormwater contributes not only to the bacterial contamination problem, but also has impacts on shoreline aesthetics and on aquatic life and aquatic habitat. Furthermore, urban drainage contributes to build-up of persistent toxics within the Bay of Quinte.

2. GENERAL CONSIDERATIONS FOR PCP DEVELOPMENT

This section reviews various considerations and requirement that will dictate how to develop a practical Pollution Control Plan that focuses on the stormwater issue.

2.1 Compare Stormwater Pollutant Loads to Other Sources

Within the PCP process, the contaminant loadings delivered to the Bay by urban land drainage need to be compared to other sources and processes affecting conditions in the Bay. This comparative approach is needed to ensure a balanced perspective. Depending on location and other factors, urban drainage may represent a significant problem in terms of local water quality or habitat impacts, or it may represent a relatively minor source.

2.2 Emphasize Source Control

The sources of urban runoff pollution need to be carefully considered. These sources will be various processes or activities that deposit contaminants on urban surfaces. Obvious examples include automotive vehicles and resulting contaminant deposition (metals, oil & grease) on asphalt roadways.

A source control strategy is a fundamental component of any PCP:

1. All reasonable and practical measures need to be taken to reduce sources of urban drainage contamination. Relatively simple measures such as better housekeeping practices on industrial/commercial properties, and better compliance with pet-litter control bylaws, can provide benefits at relatively modest cost.

2. Eliminate sewer cross-connections and illegal connections. Cross-connections between the sanitary sewer system and the storm sewer system can occur as a result of incorrect pipe connections during construction projects, or as a result of pipe damage allowing flow to leak from one system to the other. Also, individual property service connections can sometimes get incorrectly connected. Such problems can result in significant sources of sewage contamination entering the storm pipe system. A systematic approach to searching out and eliminating cross-connections is needed, starting with investigations to determine if dry-weather flows at storm outfalls are contaminated.

3. Minimize runoff at the source. Existing drainage systems need to be reviewed to see if some simple at-source measures can be taken to reduce the amount of urban runoff. This could include programs to ensure that roof downspouts drain out onto grassed areas instead of draining onto paved driveways. As well, there may be opportunities to divert drainage from municipal roadways onto grassed park areas to allow it to soak away. Identifying such opportunities requires a reasonably detailed assessment of the

existing drainage system and surface drainage routes, possibly including the need for detailed local ground surveys to confirm drainage directions and feasibility of redirecting surface flows to soak-away areas.

With respect to eliminating sewer cross-connections, it should be noted that this can require considerable investigative effort. If dry-weather outfall sampling indicates contaminated flow, then the investigation needs to proceed upstream through the tributary storm pipe network to try to pinpoint the source. This can be time-consuming and expensive. The process will typically require manhole-to-manhole sampling and testing of dry-weather flow, followed by dye-testing or smoke-testing of individual private service connections (with cooperation of home and business owners) to determine if plumbing connections are the source. In some cases, the investigations may not conclusively identify the source of storm sewer contamination.

2.3 Develop a Source Control Strategy

A structured review of source control opportunities is needed as an essential component of any PCP. This program should adhere to the above principles. It should consist of a systematic review of the existing surface drainage system and land-use practices to identify all reasonable opportunities; assess feasibility, costs and expected benefits; and then provide a recommended source-control action plan.

2.4 Consider End-of-Pipe Treatment If and Where Necessary

In many urban areas, there may be limited opportunities for source control to substantially reduce pollutant wash-off or volume of runoff. Source-control feasibility may be limited by the fact that adequate drainage of urban properties must be maintained. As well, there are public health concerns such as those related to West Nile virus that may be at odds with source control practices that would increase the extent or duration of any ponded water within the urban environment.

Also, there may be challenges in urban areas serviced by curbed roadways with conventional catchbasin-to-sewer drainage systems. In such areas, it may be difficult to reduce the amount of runoff and wash-off from roadway and parking surfaces. These surfaces often account for the bulk of contaminants carried by urban runoff.

Where it is determined that source control may be of limited feasibility or of limited effect, alternative measures need to be considered for reducing the contaminant load carried by urban drainage to local watercourses and water bodies such as the Bay of Quinte. For example, in areas served by storm sewers, some form of “end of pipe” stormwater treatment is an option. Various types of stormwater treatment can be considered including

1. Settling ponds
2. Constructed wetlands
3. Underground settling tanks

4. Oil/grit separators: Specially designed chambers for capturing oil and grit

All of these options require some land area at the end of the storm sewer pipe --- at pipe outfalls that are often located along the waterfront shoreline or along tributary creeks and rivers. End-of-pipe treatment will involve a significant capital cost. Also, there will be considerable ongoing operational costs associated with maintaining end-of-pipe facilities, including the costs of routine clean-out and disposal of accumulated sediments collected within these facilities.

The requirement for available land area and the significant costs for end-of-pipe stormwater treatment are the main reasons for ensuring that all possible measures for source control have been examined. The end-of-pipe option needs to be considered as the method of last resort.

2.5 Assess the Benefits and Costs of Various Alternatives

The final PCP will consist of various components including a source-control strategy (which itself may have a number of component measures), new drainage infrastructure such as end-of-pipe facilities, and institutional arrangements needed to ensure implementation, ongoing monitoring and adjustment when needed.

The source-control strategy may include a number of "non-structural" measures such as intensified street sweeping and sewer cleaning, by-law enforcement and public education initiatives. New drainage infrastructure such as treatment ponds or modifications to surface flow patterns can be considered as "structural" measures.

The PCP will therefore consist of various structural and non-structural measures, each with its associated costs and benefits. Various combinations of structural and non-structural measures could be considered in an effort to develop an "optimized" plan that provides maximum benefit at least cost.

However, in practical reality, physical constraints and opportunities will often limit the range of distinct options that are feasible. For example, there may be a limited number of storm outfalls at which there is sufficient land available for installing end-of-pipe treatment as a retrofit measures. Another consideration in developing the final PCP is that it may be difficult to precisely quantify the benefits of some measures.

Nonetheless, it is important that a final set of recommended measures that form the PCP be arrived at through consideration of all available options and opportunities, and analysis of relative benefits and costs of each. In part, this is necessary for the eventual implementation of individual components through processes such as the Municipal Class Environmental Assessment.

2.6 Clearly Define How the PCP Gets Implemented

The technical solution to the problem of stormwater pollution is only one aspect of the final PCP. If the PCP is to be practical, it is fundamental to define how the technical solutions can and will get implemented. Implementation issues are:

1. Who will pay?
2. How can the general public be involved?
3. Who will act as proponent for various components such as developing the source-control strategy or constructing end-of-pipe treatment facilities?
4. What are the regulatory approval requirements for individual PCP components?
5. What performance monitoring is needed to determine if the PCP is working?

the local municipality is responsible for the storm drainage system, land development approvals and land-use planning. Therefore, it will generally be the case that the local municipality is responsible for coordinating the implementation of the PCP. Regulatory agencies such as Quinte Conservation and the Ontario Ministry of Environment will also play an important role. It is therefore important that these agencies be involved in developing the PCPs for individual urban centres such as Picton, Napanee and Deseronto.

3. OVERVIEW OF PCP PROCESS

Preparing a Pollution Control Plan that focuses on urban stormwater impact mitigation is described here as a three-stage process, as follows:

Stage 1: Information Assembly and Analysis

Stage 2: Stormwater Control Strategy

Stage 3: Implementation Plan

The following diagram summarizes the tasks involved in each stage. Details on each task are described in the following sections 4, 5 and 6. This is a generalized description of what needs to be done in each of Picton, Deseronto and Napanee. Subsequent sections of this report discuss specific details and issues for each of the Towns.

ADVANCEMENT OF POLLUTION CONTROL PLANS FOR
PICTON, NAPANEE AND DESERONTO

PCP PROCESS DIAGRAM

STAGE 1

INFORMATION ASSEMBLY and ANALYSIS

- 1.1 Assemble drainage system information
- 1.2 Assemble drainage catchment information
- 1.3 Confirm sewer separation status
- 1.4 Review recent surface water quality data
- 1.5 Dry-weather Outfall Field Survey
- 1.6 Sewage pumping station review
- 1.7 Assess other loadings sources
- 1.8 Consduct Loadings Analysis
- 1.9 Identify Priority Catchments and Outfalls

STAGE 2

STORMWATER CONTROL STRATEGY

- 2.1 Target Setting
- 2.2 Prepare Source-Control Action Plan
- 2.3 Prepare end-of-pipe treatment strategy
- 2.4 Review policies for new development
- 2.5 Benefit/Cost analysis of alternatives
- 2.6 Recommended Stormwater Control Plan

STAGE 3

IMPLEMENTATION PLAN

- 3.1 Confirm Component Costs
- 3.2 Set Priorities
- 3.3 Identify Public Participation Opportunities
- 3.4 Confirm Component Approval Requirements
- 3.5 Define Roles and Responsibilities

4. STAGE 1: INFORMATION ASSEMBLY, REVIEW AND ANALYSIS

4.1 Assemble drainage system information

A basic requirement is to assemble the following information on the storm drainage system. Table 2 provides a summary of what is needed.

Table 2

Summary of Drainage System Information Requirements

Information Item	Description	Notes
Drainage conveyance system details	Mapping of the location of all storm sewers, including all manhole locations and ideally all catchbasin locations	Best consolidated within a GIS framework that is designed to allow for addition of information gathered from routine condition assessments of structures, as well as information gathered during routine maintenance and inspection activities
Outfall locations and elevations	Mapping of all locations of outfalls (outlets) to watercourses and waterbodies (local watercourse or the Bay of Quinte); also need information of elevation of the outfall.	Accurate location mapping and elevation information needed to help with assessing alternative for mitigation; and to assist with routine inspection.
Drainage catchment information	Details on the land area draining to each outfall.	Needed to assess potential runoff volume and potential pollutant loadings to area watercourses. See below for details

Drainage system information is primarily map-based spatial information. It is therefore best consolidated in a GIS framework. This allows information from various sources to be consolidated and presented in a consistent map-based environment. The GIS will also allow for system information to be easily and routinely updated. Another significant advantage is that GIS technology will allow for information on system condition assessments or routine inspection/maintenance activities to be stored and integrated with the map-based network information.

4.2 Assemble drainage catchment information

The town area needs to be divided into a number of discrete drainage sub-areas, each with a mapped boundary. The drainage outlet for each sub-area (i.e. location to which of the sub-area drains) needs to be defined.

The purpose of this delineation is to assist with a systematic analysis of the stormwater volumes and pollutant loadings associated with individual storm outlets to the receiving

waterbodies; and to assist with identifying opportunities, area by area, for source control or for retrofit end-of-pipe stormwater treatment.

Some judgement will be needed is delineating the town area into a number of drainage sub-areas. In general

- Each storm outlet (i.e. storm pipe outfall, drainage ditch outlet, etc.) should have an associated drainage sub-area mapped out. This is essential for determining the loadings to the Bay from that outlet.
- Each sub-area should generally be of relatively homogeneous land-use. For example, industrial zones should, if possible, be delineated separately from residential areas, since runoff loadings and control opportunities may be quite different.
- Each sub-area should be large enough that it is at an appropriate scale for developing source-control strategies or end-of-pipe retrofit strategies that are specific to the sub-area.

Once the town area's drainage system has been mapped out, it will generally be a straightforward matter to map out the boundaries of the drainage sub-areas using various types of information including topographic mapping, previous drainage studies, land-use mapping, aerial photography and ground survey.

Table 3 outlines the information required.

Table 3 **Drainage Catchment Information Requirements**	
Information Item	**Description**
Land area	Total area in hectares
Existing land use	Percentage of area within general categories: residential, industrial, commercial, parkland, agricultural (cultivated, pasture), wood lot.
Imperviousness	Percentage of total area that is impervious: including roads, parking areas, walkways, roofs or any other impervious surfaces. An assessment of what percentage of the impervious area is directly connected to (i.e. drains immediately into) the primary drainage system (storm sewer or ditch system) is also need --- see below.
Type of drainage system	Roadside ditches, storm sewers with catchbasins
Drainage outlet	ID of final drainage outlet to Bay or local creek or river. Each outlet (storm pipe outfall, ditch outfall) should be assigned a unique ID.
Internal lot drainage characteristics and connectivity	Where does roof drainage generally go? Onto grassed areas or onto paved areas? Connected to sewer system?
Surficial soil characteristics	Is local soil well drained? What is textural classification (clay, silt, sand)?
Known drainage problems	Are there problems with prolonged surface ponding, known flooding problems?
FUTURE LAND DEVELOPMENT POTENTIAL	Information on which land parcels may be subject to development or redevelopment that will bring bout a significant change in site runoff. The information should be based on review of • Municipal Official Plan and any approved or draft Secondary Plans • Existing Zoning By-Law For each development area or site, the following information is required • Type of proposed development • Estimated future site imperviousness • Probable type of drainage system • Planning status: Is there an applicable Master Drainage Plan, Stormwater Design Plan already submitted to the Municipality?

4.3 Confirm Sewer Separation Status

Once the sewer system has been reviewed, it is necessary to confirm that the Town area is served by separated storm and sanitary sewers. In particular, it is necessary to confirm that the sanitary sewer system is not receiving any direct surface drainage flows via catchbasins or other structures; that is, that the sanitary sewer system is in fact a separated system and not a combined system.

The BQRAP Stage 2 report "Time to Act" 1993 notes that "Where combined sewers persist, adequate sewage treatment plant capacity to avoid overflows generally exists. Combined sewer overflows are therefore infrequent and therefore not a major factor."

For Picton, Napanee and Deseronto, the Town areas are served by nominally separated sanitary sewers; no portion of the respective sewer systems is considered to be a combined system. Nonetheless, within the older portions of these Town areas, there remains some possibility that some catchbasin or roof downspout connections to sanitary pipes may still exist.. It is important to determine if this is so, or whether some field investigation is needed to determine if the sanitary sewers are truly separated in all areas.

The step requires input from municipal staff that are most familiar with the sewer system. The outcome should be a list of any specific locations that need further investigation to confirm connectivity.

4.4 Review recent data on receiving water quality

Information on receiving water quality (surface water quality) is needed to help define the impacts of existing stormwater discharges and to assist with assessing the potential benefits of stormwater pollutant load reduction.

The BQRAP recommendations related to stormwater impact mitigation and bacterial contamination reduction were based on a significant amount of data gathering in the 1980s and early 1990s within the Bay of Quinte and tributary areas. Based on this earlier BQRAP work, the impacts of existing stormwater discharges on the Bay are reasonably well understood. Furthermore, there have been numerous studies throughout North America that have quantified pollutant loads carried by urban stormwater and the associated impacts on water quality and aquatic life. In other words, the amount and type of pollutants carried by runoff from various types of urban areas and urban surfaces are now well understood and documented in various research. Given this perspective and the known water-quality impairments in the Bay of Quinte, it is reasonable to state that PCPs for urban areas fronting on the Bay can be prepared without having to spend significant resources on gathering and analyzing more data on stormwater pollution or its local impact.

Nonetheless, the PCP process should include some effort to gather and review any readily available surface water quality data that may help confirm current conditions. Generally, there is expected to be only limited available data on surface water quality in and around the Towns of Picton, Napanee and Deseronto. A review of possible data sources include those listed in Table 4. These sources will provide limited data and it may be difficult to correlate observed water quality with storm events (due to limited sampling frequency and the fact that the sampling was not specifically meant to measure storm impacts).

Table 4 **Sources of Surface Water Quality Data**	
Data Source	**Type of Information**
Public Health Units: Prince Edward Hastings and Kingston-Frontenac Lennox & Addington	Bacteria sampling of surface waters at recreational use areas such as municipal waterfront parks
Ontario Ministry of Environment Provincial Water Quality Monitoring Network	Monthly sampling of standard water-quality parameters at selected locations
Quinte Conservation	Various surface water data and observation from ongoing programs
Local Municipality	Data from raw water intakes for municipal water treatments plants

4.5 Dry-weather Field Survey of Storm Outfalls

A field survey of all storm outlets should be carried out. The scope of this investigation is as follows:

Table 5 **Dry-Weather Outfall Investigation** **Scope of Investigation**	
A	**Outfall Inspection** 1. Confirm location (e.g. using GPS to take coordinates) 2. Confirm pipe type, pipe material and pipe elevation 3. General condition assessment 4. Measure depth of sediment build-up 5. Record whether there is any blockage due to debris 6. Record any other problems or concerns
B	**Dry-weather Flow Measurement** 1. Is there a noticeable dry-weather outflow from the pipe? 2. Estimate flowrate by measuring depth of flow and flow velocity if possible
C	**Dry-weather Flow Sampling and Testing** 1. Record presence of any debris, visible sheen or foul odours 2. Sample for lab analysis 3. Submit to alb for E.coli and BOD analysis

The overall objective of the dry-weather outfall survey is to determine which outfalls, if any, have a significant outflow during dry weather; and whether the flow is contaminated by E.coli

(an indicator of sewage contamination). Measuring BOD, total phosphorus and ammonia nitrogen can also provide insight into the possible source of any observed bacteriological contamination.

This outfall survey will address BQRAP Recommendation #31. The results will provide the information needed to design a program to seek out and eliminate sources of dry-weather contamination such as sewer cross-connections. This would be part of the PCP's source control program (see below).

4.6 Sewage Pumping Station Review

Operational data for all sewage pumping stations need to be reviewed with respect to frequency and magnitude of any overflows that may have happened in wet weather.

Municipal sewage pumping stations are typically designed with a high-flow bypass or overflow structure to allow sewage to overflow to the surface drainage system in case of an emergency (e.g. power failure, or extreme precipitation event causing flows to exceed pumping capacity). The frequency and magnitude of overflow at each pumping station will depend on how "leaky" the tributary sanitary sewers are; in other words, how much groundwater infiltration or direct surface inflow can get into the sanitary sewer pipes in wet weather.

For each pumping station the following information should be itemized:

Table 6
Sewage Pumping Station Review

Inflow capacity	Diameter and estimated capacity of influent sewer
Pumping capacity	Number of duty pumps and rated capacity of each pump Total pumping capacity under normal operating conditions
Ministry of Environment Certificate of Approval	Date of construction of pumping station C. of A. number and date of issue What are the C. of A. requirements for reporting?
Overflow Structure	Is there an inflow bypass or overflow structure in place? Where does the overflow discharge to? (E.g. does it go to storm sewer or to local watercourse?)
Overflow History	Recent history of overflows: how many per year, what time of year or weather conditions cause overflow
Cause of Overflow	Known or probable causes of overflow: identify which areas within the sewer system are known to be leaky or contribute high flows during wet weather.

4.7 Assess Other Loading Sources

Other sources also need to be reviewed, including

- Municipal sewage treatment plant discharges
- Industrial discharges
- Runoff from local "non-point source" areas such as agricultural lands adjacent to the Town area, or any other areas which may drain through the Town area

Information of discharges from municipal sewage plants will be available from the plant operators (Picton STP operated by Prince Edward County; Deseronto and Napanee STPs operated by Greater Napanee Utilities Commission).

Table 7
Summary Information for
Picton, Napanee and Deseronto Sewage Treatment Plants

STP	Summary
Picton Operated by P.E. County	Expanded in 1994 from rated capacity of 4.43 MLD to 5.40 MLD. At the time, trickling filter serving Prince Edward Heights was decommissioned and flows diverted to Picton STP. The 1994 C. of A. did not incorporate RAP effluent TP limit of 0.3 mg/L; compliance based on monthly average of 1.0 mg/L. Plant consistently in compliance with TP limit and within RAP objective on average annual basis. Plant experiences high wet-weather inflows due to high level of extraneous inflow into collection system. P.E.C. has recently initiated Class EA for full plant upgrade.
Napanee Operated by G.N.U.	This plant was subject to Comprehensive Performance Evaluation under Great Lakes Sustainability Fund STP optimization program circa 1994 (plant then operated by OCWA). Current C. of A. has monthly average compliance limit for TP of 0.3 mg/L and target TP loading of 2.73 kg/day. Data for 1998-2000 indicated that concentration limit was achieved on average annual basis and loading was about 50% of RAP target.
Deseronto Operated by G.N.U.	Upgraded to provide tertiary level of treatment by installation of Actiflo process for effluent polishing. Current C. of A. incorporates RAP objective of TP of 0.3 mg/L as compliance limit.

For industrial discharges, the MOE District or Regional offices may be able to provide information.

In the case of non-point sources such as adjacent agricultural or undeveloped land, hydrologic analysis will be necessary to estimate land runoff volumes and associated pollutant loads.

4.8 Conduct Loading Analysis

Once the above information is in hand, analysis is carried out to estimate the pollutant loads associated with urban stormwater from the Town area, and compare with estimated loads from other sources. This will place stormwater in context and will help to determine whether the stormwater issue is locally as significant as other sources, in terms of the following

1. potential impact on bacteria concentrations in local watercourses
2. total annual or seasonal nutrient (especially phosphorus) loading to the local watercourse and the Bay of Quinte
3. total load of other pollutants of concern such as metals.

As noted above, the BQRAP recommendation for PCP preparation for Picton, Napanee and Deseronto was based on previous investigations that concluded that urban stormwater is having significant local impact especially on bacterial pollution of surface water. It is expected that a loading analysis for each Town will confirm this.

It should also be noted that this analysis could require some assessment of the so-called "assimilative capacity" of local watercourses or waterways such as Picton Bay or the Napanee River. This analysis would be geared towards determining the net impact of various pollutant loadings on pollutant concentrations within the watercourse or waterbody. The need for such analysis should be determined at the time that the loading analysis is done. It will depend on the magnitude of loadings relative to the flow volume and dilution capacity of the local watercourse. The loading estimates and some relatively straightforward dilution calculations may immediately reveal that substantial loading reductions are needed to achieve acceptable receiving water quality. Or, on the other hand, the initial estimates may indicate that in-stream impacts could be marginal, in which case are more sophisticated analysis of local in-stream impacts is needed to determine whether significant stormwater load reduction will bring about any substantial improvement in local surface water quality.

The initial loadings analysis should provide estimates of the annual and seasonal loadings from the various identified sources. This outcome should be reviewed with Quinte Conservation and the Ontario Ministry of Environment to determine what, if any, analysis of local assimilative capacity may be warranted or required to develop a PCP.

4.9 Identify Priority Catchments and Outfalls

The results of the loading analysis should include comparison of individual storm outfalls and their respective catchment areas in terms of annual and seasonal loadings of indicator bacteria (E. coli), phosphorus and other contaminants of concern within the BQRAP area.

This will lead directly to identifying which existing storm drainage areas and outlets should be considered as priorities for mitigation measures. A ranking of priorities should be developed to assist with development of the PCP's source control plan and end-of-pipe treatment strategy. Development of these strategies is discussed below.

5. STAGE 2: STORMWATER CONTROL STRATEGY

Developing a strategy for controlling pollutant loads from urban stormwater for each of Picton, Napanee and Deseronto is the central task in developing a PCP for each Town that fulfills BQRAP Recommendation #23.

5.1 Target Setting

The first step is to develop targets for stormwater pollutant load reduction for each Town.

The loadings analysis will have provided estimates of the total annual and seasonal loads for contaminants of concern. Targets for load reduction need to be based on what is required to meet the BQRAP objectives.

In the case of pollutant loadings from urban stormwater, targets for load reduction can be based on the updated BQRAP Stormwater Management Guidelines (see Appendix A; under review as of December 2005). The BQRAP SWM guidelines reflect MOE's "Stormwater Management Planning and Design Manual" (March 2003).

The general requirement is that new stormwater discharges be designed based on providing the "Enhanced" level (formerly "Level 1") of stormwater treatment. This corresponds to long-term average annual removal of total suspended solids of 80% (as an indicator of overall stormwater pollutant load control). The BQRAP guidelines state that this level should be achieved where possible when installing retrofit measures on existing storm outfalls; and that "Normal" level of treatment (70% TSS removal) may be acceptable if local constraints and conditions make the "Enhanced" level impractical or not feasible.

On this basis, the general target that should be adopted in PCPs is to achieve long-term stormwater pollutant load reduction corresponding to 70% to 80% of suspended solids reduction. Previous analysis such as those carried out for the City of Belleville Pollution Control Planning Study (1997) have shown that this can result in similar bacteria load reduction.

Furthermore, recent research has shown that end-of-pipe stormwater treatment in the form of facilities such as settling ponds or tanks, is capable of providing 30% to 80% reduction is total phosphorus load (See Appendix B). A reasonable target for the PCP process is to achieve 50% reduction in urban stormwater TP load.

In summary, it is being recommended here that targets be as follows:

1. For existing built-up areas within Napanee, Picton and Deseronto, the management target should be to reduce stormwater runoff volume and pollutant concentrations so as to achieve 70% to 80% reduction in bacteria load, and 50% reduction in phosphorus load. The ways and means of achieving such reductions will generally bring about reductions of a similar scale in other contaminants such as metals.

2. For new development areas within each Town, stormwater treatment must be provided to comply with the updated BQRAP Stormwater Management Guidelines.

These are targets that are intended to apply equally to each of Picton, Napanee and Deseronto. These targets are "presumptive" in nature, in the sense that they are based on the presumption that by meeting these load-reduction targets, each municipality will be doing what it needs to do in the way of stormwater impact control to help achieve the RAP objectives. The same targets are applied to each Town regardless of the individual circumstances and local receiving water issues, in order that there be a consistent level of stormwater control across the BQRAP area.

5.2 Prepare source-control action plan

The PCP needs to include, as an important first step, a structured review of source control opportunities within each Town's built-up area. This should consist of a systematic review of the existing surface drainage system and land-use practices to identify all reasonable opportunities; assess feasibility, costs and expected benefits. The outcome will be a recommended source-control action plan.

Source control is all about minimizing runoff and minimizing potential for contamination of runoff. Measures that need to be considered include:

- Roof downspout disconnection: rain barrels or divert onto grassed areas
- Optimization of street-sweeping and catchbasin cleaning programs
- Review of pet-litter control measures
- Review of housekeeping practices on industrial and commercial properties to minimize runoff from potential contaminated areas
- Systematic review of municipal road rights-of-way and park areas to find opportunities to reduce runoff

The final source control plan will depend largely on local conditions. Depending on the existing drainage system, development density, urban imperviousness and local soil/drainage conditions, source control may be of limited applicability or may provide only marginal reduction in stormwater runoff.

Once a final source control plan has been prepared, it is necessary to develop an estimate of how much stormwater reduction and pollutant load reduction will result. This information is needed to determine whether further actions are necessary to achieve the desired reduction in the amount of pollutants discharged to local waterways.

5.3 Prepare End-of-pipe Storm Treatment Strategy

For Picton, Napanee and Deseronto, it is likely that the loading and source-control analysis will conclude that some form of end-of-pipe stormwater treatment for existing storm outlets is needed to meet the load-reduction targets and the BQRAP objectives.

A component of the final PCP for each Town will therefore likely be a strategy for retrofitting selected storm outfalls with some form or type of end-of-pipe treatment.

Developing such a strategy will require careful assessment of which outfalls should be considered as priorities, based on comparison of estimated runoff volumes and pollutants form each respective catchment area.

Another critical input to this strategy is determining at which outfalls end-of-pipe treatment is a feasible and practical possibility. This depends on a number of factors including:

- Is there municipally-owned land available at the outfall site, and is there sufficient area available to construct and operate and end-of-pipe treatment facility?
- Will such a facility be compatible with adjacent property use?
- Does use of the available land represent the best use of what may be valuable municipal waterfront property?

Ultimately, implementation of end-of-pipe treatment facilities such as settling ponds or underground tanks will need to proceed via the Municipal Class EA process. The above questions will need to be addressed during this process.

In developing an end-of-pipe stormwater strategy, the final strategy should as much as possible be structured to accommodate future urban development. The general approach should be to try to minimize the number of separate stormwater treatment facilities. This will help reduce the operational complexity and cost of maintaining the system, and will also lead to greater chance of optimum system performance.

Proposed end-of-pipe facilities should as much as possible be situated and designed to accommodate foreseeable urban expansion. This approach will provide the advantage of facilitating development design and approvals, and will provide the municipality with greater assurance that the overall stormwater system is being planned and designed for maximum cost efficiency.

Further discussion on how the PCP should be structured for new urban development is provided below.

5.4 Review Policies and Requirements for New Urban Development

BQRAP Recommendation #33 defines the need for stormwater quality control for new urban development; and recommendation #34 defines the requirement for appropriate Watershed or Subwatershed Planning to assist with stormwater infrastructure planning as part of Secondary Plans for new development areas.

The PCP needs to assist the municipality with fulfilling these recommendations.

A number of issues need to be taken into consideration, as follows.

5.4.1 BQRAP Stormwater Guidelines Update:

The stormwater quality control requirements for new development in the BQRAP Implementation Area have been defined in a guideline document prepared in 1993, and which is now in the process of being updated (as of December 2005). An initial "draft for discussion" version of the updated guidelines is attached to this document as Appendix A.

This proposed update has been undertaken to

- help clarify technical and submission requirements for development proponents
- make the BQRAP guidelines consist with the Province-wide guidelines set out in MOE's current "Stormwater Management Planning and Design Manual" (March 2003)

The guidelines require that new development be designed to include stormwater management measures that provide MOE "Enhanced" level (formerly "Level 1") stormwater treatment. Direct disinfection of stormwater discharges is not required, unless there is a reasonable expectation that the stormwater discharge location will have a direct impact on a recreational use area such as a swimming beach. Development proponents are obliged to consult with Quinte Conservation to confirm site-specific requirements.

The new guidelines place emphasis on designing new urban development to minimize the amount of surface runoff and associated pollutant wash-off. In other words, the guidelines encourage a design philosophy in which source control is considered from the outset.

5.4.2 Benefits of Master Planning:

The BQRAP recommendation #34 encourages Watershed/Subwatershed Planning as a means on integrating stormwater planning into the land development approval process via Secondary Plans.

There are significant advantages to local municipalities in adhering to this approach. Most importantly, this approach helps to define stormwater management requirements and infrastructure needs prior to final approval applications for individual development properties. This allow for a more rational and cost-effective design of the overall drainage and treatment

system that can focus on minimizing the number of separate facilities and associated operational and maintenance costs.

At this stage, the final framework for PCP development will be developed after consultation with each municipality to define where current land development pressures are or are expected to be. This will allow the final PCP framework for each of Picton, Napanee and Deseronto to be tailored to each Town's unique situation. An expected outcome is definition of which areas should be identified as requiring preparation of a master stormwater plan or subwatershed plan, to enable the municipality and Quinte Conservation to deal in a timely and efficient manner with new development as it arises.

5.5 Benefit/Cost Analysis of Alternatives

The foregoing tasks could potentially result in a number of distinct alternatives that could be implemented over time to achieve pollutant load-reduction targets.

The source-control strategy together with the end-of-pipe strategy will encompass various structural and non-structural measures, each with its associated costs and benefits. Various combinations of structural and non-structural measures could be considered in an effort to develop an "optimized" plan that provides maximum benefit at least cost.

However, within each Town area, there will be a number of physical constraints and a limited range of opportunities for retrofit measures. For example, there may be a limited number of storm outfalls at which there is sufficient land available for installing end-of-pipe treatment. Another consideration in developing the final PCP is that it may be difficult to precisely quantify the benefits of some measures.

Because of the various constraints and limited retrofit opportunities within the existing built-up Town areas, there may in fact not be a significant number of discrete alternatives to consider. Nonetheless, the final set of recommended actions that form the PCP for each Town should be arrived at through comparative cost-versus-benefit analysis of feasible options and opportunities. In part, this is necessary for the eventual implementation of individual components through processes such as the Municipal Class Environmental Assessment.

5.6 Recommended Stormwater Control Plan

The final recommended stormwater control plan needs to be clearly defined. Each measure or set of measures that can be implemented separately or independently of the others should be identified as a separate component. Estimated costs for implementing each component need to be defined, along with estimated pollutant load reduction that will be effected by each component. The component breakdown is needed to assist with defining priorities and developing the Implementation Plan: see below.

6. STAGE 3: IMPLEMENTATION PLAN

Stage 3 of the PCP preparation is development of an Implementation Plan. This is an important part of the PCP since it describes how the various recommendations will actually be put into action.

The Implementation Plan is developed as follows:

- Confirm costs for each component
- Define priorities
- Identify opportunities for public involvement
- Confirm regulatory approval requirements
- Define institutional roles and responsibilities for each component

6.1 Confirming Costs:

The PCP will consist of a number of components, including a source-control strategy and an end-of-pipe strategy. Each of these two "sub-strategies" will have a number of individual components.

Final costs for each component need to be confirmed so that the municipality can develop necessary financial plans, make appropriate funding applications to other government agencies, or make appropriate decisions regarding future development planning.

The final costs need to include full "life cycle" cost assessment for each component so that proper planning for expected annual operational costs can be made.

6.2 Setting Priorities

Cost-benefit analysis needs to include an assessment for each component. This will lead to determining which components provide most benefit at least cost. These components should be implemented as top priorities.

Other factors that will affect priority definition will be current versus future opportunities. For example, a proposed end-of-pipe stormwater pond may provide a very favourable benefit-cost ratio, but it may be that implementation should not or cannot proceed until a future urban expansion area is ready to be developed. In this case, the priority for this facility may be delayed until the future development schedule becomes better defined.

6.3 Identify Public Education and Participation Opportunities

Certain components of the recommended plan may benefit from or require public acceptance, public involvement and more effort to educate the public about urban stormwater issues. Examples include the implementation of a roof leader disconnection program or rain-barrel program: Acceptance and participation by home-owners is needed.

The PCP should identify those measures that will rely on public acceptance and participation, and suggest ways to ensure that this happens based on local experience. It is expected that local municipal staff may be in the best position to help with this aspect of the PCP.

6.4 Confirm Regulatory Approval Requirements

The PCP will likely include various measures that require specific regulatory approvals. Examples include:

1. Any proposed stormwater treatment facilities will require final design approval by Ontario Ministry of Environment under the Ontario Water Resources Act.

2. Stormwater facilities must also be planned and designed in accordance with Ontario's Municipal Class Environmental process. Within this process, the PCP will fulfil the role of a "master planning" study by defining the need for the proposed facility and providing the options analysis (i.e. analysis of alternative solutions) that led to the recommendation for the facility. The Class EA will complete the planning and design process by fulfilling additional requirements for public and governmental consultation, analysis of design alternatives and selection of final design configuration.

3. Depending on design and location details, individual proposed facilities could require additional approvals from the Conservation Authority with respect to floodplain issues or aquatic habitat protection requirements. To the extent possible at the time, the PCP should define these requirements.

Other components of the PCP may not require any specific regulatory approval, but may require approval by Municipal Council. Municipal staff should be asked to review all PCP recommendations to ensure that the final PCP document properly describes implementation requirements.

6.5 Define Roles and Responsibilities

A fundamental component of the Implementation Plan is defining who is responsible for implementing each component of the PCP.

As noted above, the local municipality will generally be responsible for coordination, since it is the owner/operator of the drainage system, and is responsible for land development approvals and planning issues.

Quinte Conservation will also play an important role by assisting the local municipality with stormwater planning and design issues, and with acquiring final regulatory approvals for specific works.

The municipality's role needs to be clearly defined for each component of the PCP. For each component, there needs to be clear definition of which municipal department is responsible, and how implementation can best be integrated within existing procedures and operations. It needs to be recognized that the local municipalities may have limited resources to allocate to additional requirements that may be imposed by the PCP. Therefore, as the PCP is being formulated and finalized, close consultation with each Municipality is needed to ensure that the Implementation Plan is practical and feasible for the municipal departments affected.

7. TOWN OF NAPANEE

7.1 Current Status on Information Gathering

To help provide a base of information for development of a PCP for the Town of Napanee, XCG has proceeded to gather and consolidate in a GIS various information related to the storm drainage and sewer infrastructure in the Town.

The information entered into the GIS includes the following:

- Storm sewer pipe network, including each manhole and sewer pipe as a separate entity, including a database with information on pipe size and pipe materials.
- Similar information for the sanitary sewer system.
- Mapping and database for all storm outfalls.
- The land-use schedule (Schedule C) from the current Official Plan for Greater Napanee.
- Delineation of drainage catchment for each outfall, and database with catchment characteristics. This information was presented in XCG's Interim Project Report (March 15, 2005)

Figure 1 presents GIS mapping of storm outfalls and drainage catchment areas within Napanee.

7.2 Municipal Input and Current Issues

XCG Consultants held a meeting with Greater Napanee Public Works Department on Thursday, December 15, 2005. In summary the meeting was as follows:

1. The draft update to the BQRAP stormwater Management Design Guidelines (Appendix A) was provided to GN staff, with the request that they review the proposed guidelines and provide any comments to Mr. Bryon Keene of Quinte Conservation.
2. The GIS information assembled by XCG with respect to sewer and drainage infrastructure within the Town of Napanee was presented, including sample mapping of storm and sanitary sewers, and the Official Plan land use layer and a map overlay. Staff noted that they are just now embarking on implementing GIS and are quite interested is seeing how the base information being collected for the PCP project can be integrated with their initiative.
3. Current land development pressures were briefly reviewed. GN staff indicated that the main development pressure is the block of land west of Centre Street North and south of Selby Creek, immediately west of the existing commercial development (Canadian Tire store, etc) along the west side of Centre Street. GN staff indicated that a Secondary Plan is to be developed to support development in this area. GN staff noted that they

recognize the need for some stormwater management planning to hopefully minimize the number of separate stormwater management facilities.

4. XCG also presented an initial draft of the proposed PCP template and requested that GN staff review the document and provide comments to Bryon Keene of Quinte Conservation.

7.3 Next Steps

Much of the information needed to complete a specific PCP template for Napanee has been assembled. The next steps for Napanee are as follows:

1. Receive any comments from Greater Napanee staff by end of January 2006 on the proposed BQRAP stormwater management guidelines, and on the initial draft template for PCP development.

2. Finalize a template for PCP preparation for Napanee as follows:

   - Confirm priorities for planning for new development through further discussions with GN staff.

   - Define specific information requirements needed to support PCP development, based on identifying gaps in the information collected to date. Some immediate information requirements include GIS mapping of property fabric including identification of municipally owned parcels.

   - Prepare initial estimates of pollutant loads for all catchment areas shown in Figure 1 and develop an initial set of priority areas that the PCP should pay particular attention to.

8. TOWN OF PICTON

8.1 Current Status on Information Gathering

Outfall locations and preliminary mapping of outfall drainage areas has been completed (Figure 2), along with development of a GIS database with catchment characteristics. Refer to XCG's Interim Project Report, March 2005.

The primary information item required is details of the storm sewer and drainage infrastructure within the Town. As previously reported by XCG, there appears to be no available paper or electronic mapping of the storm piping system, although further discussions with PEC staff are needed to confirm.

Information that has been made available through the PEC GIS includes property ownership and lot boundaries, zoning and planning information and topography.

8.2 Municipal Input and Current Issues

At this stage, a meeting with PEC staff is needed to focus efforts as needed to complete a practical PCP template for the Town of Picton.

A particular issue affecting PCP development is ongoing work and analysis that PEC has done to support the Class EA for a new sewage plant for the Town. PEC staff need to be consulted with respect to the scope and extent of any analysis that the County has done with respect to reducing wet-weather inflows to the sewage plant, and how this affects total plant loading to Picton Bay, both in term of treated plant effluent, plant bypass and/or increased stormwater discharges due to sewer system improvements or modifications.

9. TOWN OF DESERONTO

9.1 Current Status on Information Gathering

As previously reported (March 2005) the available drainage system information for Deseronto is quite limited. As with Picton, there appears to be no available paper or electronic mapping of the storm piping system, although further investigations through Greater Napanee Utilities are needed.

The information gathered to date does include full mapping of the sanitary sewer system.

As well, field investigation and Ontario Base Mapping have been used to identify some storm outlet locations and delineate larger-scale drainage areas. See Figure 3.

9.2 Municipal Input and Current Issues

At this stage, the main issue with respect to stormwater management in Deseronto is to obtain a better understanding and mapping of the storm drainage system, together with mapping of municipal property parcels so that a strategy for mitigating the impact of existing outlets can be formulated.

Also note that there are land development proposals pending within the Town of Deseronto. Stormwater management in accordance with the updated BQRAP Stormwater Management Guidelines (Appendix A) will be required by Quinte Conservation. A PPCP for Deseronto should address the need for a strategic approach to stormwater management for the Town that could potentially include retrofit treatment of existing outlets that also accommodates new land development.

APPENDIX A

BQRAP STORMWATER MANAGEMENT DESIGN GUIDELINES UPDATE

MARCH 2006

QUINTE CONSERVATION
LOWER TRENT CONSERVATION
CATARAQUI REGION CONSERVATION AUTHORITY

BAY OF QUINTE REMEDIAL ACTION PLAN IMPLEMENTATION AREA STORMWATER MANAGEMENT DESIGN GUIDELINES

REVISED – MARCH 2006

1. INTRODUCTION

This document provides guidance on requirements for planning, design and approvals of new urban stormwater management systems in new urban development areas in the BQRAP Implementation Area (see Figure 1). It also provides guidance with respect to design and approvals of retrofit stormwater treatment facilities within existing built-up areas. This document is intended to assist development proponents and local municipalities by helping define approval requirements.

This document supercedes and replaces the previous BQRAP SWM guidelines document of May 1993.

2. STORMWATER MANAGEMENT IN THE MUNICIPAL CONTEXT

It is widely recognized that effective stormwater management involves a hierarchy of planning and management techniques.

The need for environmental protection, including water quality protection, is generally spelled out in a municipal Official Plan. To ensure proper planning of drainage infrastructure as part of land development planning, watershed plans or subwatershed plans are required for development areas. Watershed/subwatershed plans help support the development of secondary plans.

To identify the necessary stormwater control measures or works within a designated development area, a master drainage plan is required. This provides design guidelines and defines proposed locations and estimated costs for any centralized stormwater control facilities. In general, planning of drainage systems for new development areas should strive to minimize the number of separate stormwater facilities, since the proliferation of relatively small on-site facilities can significantly increase the costs to local municipalities for monitoring and maintenance.

Once a plan is in place, municipalities typically set up a “cash-in-lieu” fund to allow the municipality to accumulate the funds needed to build the required stormwater facilities as needed. A policy of allowing a percentage of the development area to proceed in advance of facility construction can be implemented by the municipality, provided that regulatory agencies such as the Ontario Ministry of Environment provide approval of such an arrangement.

Since the original BQRAP stormwater guidelines (1993) have been in effect, a number of issues related to stormwater planning have been identified. For example, not all Official Plans for Bay of Quinte municipalities contain the foregoing provisions, and the Master Drainage Plan/cash-in-lieu approach is not consistent. Most smaller municipalities are allowing development with small on-site facilities, and this may be creating unforeseen maintenance requirements and unforeseen costs. A consistent and comprehensive approach for stormwater management is needed for new development areas in the BQRAP area, and these guidelines reflect that need.

3. GENERAL STORMWATER DRAINAGE GUIDELINES

3.1 Role of the Local Municipality

1. Municipal Official Plans should recognize stormwater management in the hierarchy of planning and management techniques for new development and contain provisions for watershed plans, sub-watershed plans and master drainage plans as part of secondary plans.
2. Having identified strategies for accommodating new development via centralized stormwater facilities, municipalities should establish "cash-in-lieu" arrangements to support the construction of the required facilities when needed.

3.2 Development Design Requirements

1. Adhere to the guidelines provided in the most recent version of the Ontario Ministry of Environment's "Stormwater Management Planning and Design Manual" (current version dated March 2003).
2. New developments should be designed to incorporate all reasonable and practical means of minimizing direct surface runoff, including:
   - Minimize the amount of impervious area
   - Maximize the amount of existing vegetated area (treed areas, grassed areas) that is retained within the development design, to help maximize opportunity for infiltration (soak away) of surface water.
   - Roof drainage should be diverted on vegetated areas to give the water opportunity to soak into the ground.
3. Drainage systems for new development should be designed using the "minor and major system" approach. The minor system typically conveys all drainage flows generated by precipitation events up to the 5-year return period, and may include ditches, culverts, catchbasins and storm sewers. The major system conveys flows in excess of the capacity of the minor system in such a way as to minimize risk to life or property. The major system may include ditches, swales and other overland flow paths (including roadways).
4. Development proponents are responsible for ensuring that the design of the drainage system complies with current municipal design standards of the local municipality.
5. Small on-site facilities are discouraged and contribution to centralized works as identified in Watershed or Master Drainage Plans are encouraged.

4. STORMWATER QUALITY CONTROL

This section applies to all developments of an area equal to or greater than one hectare.

4.1 New Urban or Rural Development

1. The development proponent is responsible for checking with the local municipality and with the conservation authority to ensure that the design of the drainage system is consistent with applicable Watershed Plans, Subwatershed Plans or Master Drainage Plans.
2. Plan and design the new development in accordance with the MOE SWM Manual, including the following steps:
   - Define and describe the type of development in terms of land use, total imperviousness, directly-connected imperviousness (i.e. how much of the total impervious area will drain directly into the minor system, versus the amount of impervious area that will drain onto vegetated area).
   - Define physical site constraints affecting drainage design and quality control options. These may include geotechnical properties of the local soil including permeability, depth to bedrock, and high water table levels.
   - To address stormwater quality concerns, follow the "treatment train" approach. Examine options for source control, conveyance control and, if necessary, end-of-pipe controls. The MOE SWM Manual provides considerable guidance on options to consider and how to evaluate them.
3. Where the development will include curbed roadways or paved parking areas drained by catchbasins and storm sewers, or otherwise includes collection of surface drainage in pipe systems, then end-of-pipe treatment of the storm sewer outflows will be needed.
4. Any required end-of-pipe stormwater treatment facilities must be designed as follows:
   - Examine options for end-of-pipe treatment using guidance provided in the MOE SWM Manual.
   - Design the end-of-pipe facility in accordance with the MOE SWM Manual. **End-of-pipe stormwater facilities must be designed to provide MOE "Enhanced" level of stormwater treatment (formerly referred to as "Level 1") as defined in the MOE SWM Manual (March 2003).**
   - If the end-of-pipe facility is to be a treatment pond, then it must be designed to allow routine clean-out of accumulated sediment and debris, including vehicle access to allow the clean-out operation and removal of sediments for off-site disposal. The pond should be designed such it can be hydraulically isolated to allow it to be pumped out if necessary to allow maintenance or clean-out.
   - As a general requirement in the BQRAP Implementation Area, end-of-pipe stormwater facilities do not need to include active effluent disinfection using UV technology or equivalent technology.
   - If the storm pipe outfall to local watercourse or waterbody can reasonably be expected to have a direct impact on water quality at a swimming beach, then active effluent disinfection may be required at the outfall. The development proponent is responsible for determining if disinfection is required through consultation with the conservation authority and the MOE Regional Office.

4.2 Retrofit Measures in Existing Built-Up Areas

1. In general, it is expected that local municipalities will be the proponents in any undertakings to implement retrofit stormwater treatment within existing built-up areas.
2. Planning and design of retrofit strategies should adhere to the same guidelines as listed above for new development situations, with the following exception:
   - Retrofit end-of-pipe treatment facilities should be designed to provide the MOE "Enhanced" (Level 1) treatment level if possible and practical. Designing to achieve the MOE "Normal" (Level 2) treatment level will generally be considered as an acceptable option. Lower levels of treatment may also be considered if the proposed location for retrofit installation poses specific site constraints or issues that make Level 1 or Level 2 treatment not feasible or practical to implement.
3. Retrofit strategies should be developed in close consultation with the conservation authority and the Ontario Ministry of Environment to ensure that final designs are acceptable from the regulatory standpoint.

5. STORMWATER QUANTITY CONTROL FOR NEW DEVELOPMENT

1. Stormwater quantity control is necessary to ensure that flows released from the development property do not have any adverse downstream impacts on flooding or watercourse erosion.
2. New developments must be designed to adhere to the requirements of the Provincial Policy Statement (March 1, 2005) under Section 3 of the Planning Act. The Policy Statement includes requirements for protecting public health and safety by restricting land development within areas affected by flood hazards, erosion hazards or dynamic beach hazards. Refer to the Policy Statement for specific definitions and requirements.
3. Unless there is in place a Watershed Plan, Subwatershed Plan or Master Drainage Plan that stipulates otherwise, peak flows released from the development property are not to exceed the "pre-development" peaks flows released from the site, for all return periods from 2 years to 100 years. The Regional Storm in the Quinte Conservation and Cataraqui Region Conservation Authority jurisdictions is the 100-year storm. Developments in the Lower Trent Conservation jurisdiction must also safely pass the Timmins Regional Storm.
4. If the development proponent believes that higher peak flows can be released from the site without any adverse upstream or downstream impacts on flood risk or watercourse erosion, then the development proponent will be responsible for conducting all necessary hydrologic and hydraulic studies to prove that this is so to the satisfaction of regulatory authorities including the local municipality and the conservation authority. Prior to making any such submission, the development proponent should consult with the conservation authority to determine the specific technical analyses that will be required to support higher site release flows.

6. APPROVAL SUBMISSIONS AND PROCESS

1. Application for approval of proposed drainage systems for new land developments must be made to the local municipality as part of the overall development approval process administered by the municipality.
2. The conservation authority will assist the municipality by reviewing proposed development plans with respect to drainage and stormwater management requirements set out in these guidelines.
3. Additional approvals may be required depending on the specific design and type of drainage system being proposed. See below.
4. Submissions to the municipality with respect to the proposed development's drainage system must include the following information:
   a) Design and location of the "minor" drainage system and the "major" drainage system. Plans and drawings showing the engineering design, location and elevation or elevation profile of all system components including ditches, culverts, catchbasins, pipes, manholes and other structures, in accordance with the local municipalities design standards. The development proponent is responsible for obtaining and understanding the local municipal design standards.
   b) Plan showing all contributing drainage areas and showing drainage direction for all impervious areas, including all paved surfaces, roofs and other impervious surfaces. Indicate where roof drains will discharge. Indicate surface drainage direction along roadways and within commercial/industrial parking areas.
   c) In the case of the major drainage system, provide details including: Location of all overland flow routes including locations of outlet to storage facilities or outlets to local watercourses or waterbodies; information on estimated flow depth and flow velocity at peak flow in the 25-year, 100-year and Regional Storm events, at critical locations within the major system including road intersections or other critical locations within the development area.
   d) Clear description of how pre-development peak flows were determined or calculated.
   e) A plan or plans showing any and all proposed facilities for controlling site release flows to the pre-development level, including location and size of any runoff storage facilities. Provide information on maximum water storage volume and water levels in such facilities at each of the design return periods including the Regional Storm event.
5. For proposed facilities for end-of-pipe stormwater treatment, the following requirements apply:
   a) Generally, ownership and operation end-of-pipe stormwater facilities will be assumed by the local municipality once the facility has been completed to the municipality's satisfaction and all necessary approvals for operation of the facility have been acquired. The development proponent must confirm specific requirements with the local municipality.
   b) The development proponent is responsible for obtaining any and all necessary approvals on behalf of the local municipality as the eventual owner/operator. These approvals will include but are not necessarily limited to Ontario Ministry of Environment approval (Section 53 approval under Ontario Water Resources

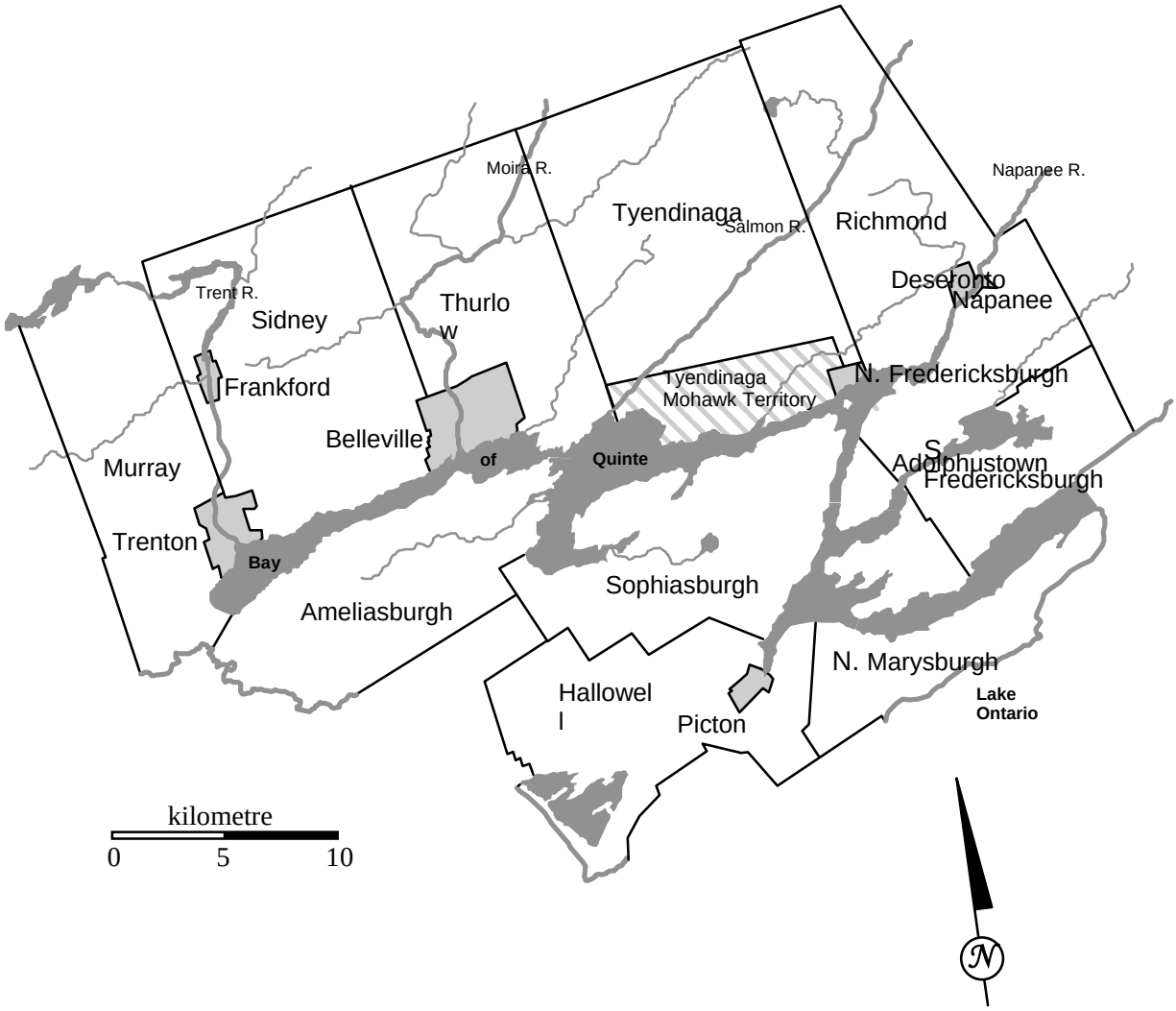
Act). The development proponent is responsible for determining approval requirements through discussion with the conservation authority, the local municipality, and the Ontario Ministry of Environment.

c) The MOE s.53 OWRA approval will result in MOE issuing a Certificate of Approval to the municipality for the proposed facility. Generally, the MOE C. of A. will define specific monitoring and reporting requirements. Prior to making application to MOE for this approval, the development proponent is responsible for "pre-consultation" with the MOE Regional office to determine the likely C. of A. conditions. Prior to making the C. of A. application, the development proponent must advise the local municipality of the outcome of the MOE pre-consultation and obtain the local municipality's authorization to proceed with the C. of A. application.

d) The development proponent is responsible for completing any necessary environmental assessment (EA) that may be required under the Ontario Environmental Assessment Act or the Canadian Environmental Assessment Act. The development proponent is responsible for determining what EA requirements apply to the project.

e) Prior to final acceptance of the facility by the municipality, the development proponent must submit to the municipality an Operations & Maintenance Manual for the facility. This manual must clearly describe all operational and maintenance requirements, including all procedures needed to maintain compliance with the MOE C. of A. The manual should include details of any required sampling or testing of facility effluent or facility performance as may be required by the C. of A., and provide standard forms for recording and reporting necessary information. As well, the O&M Manual must include any and all relevant user manuals for any equipment necessary for operation and maintenance of the SWM facility.

Figure 1: Bay of Quinte Stormwater Management Implementation Area



APPENDIX B

EXPECTED PHOSPHORUS REDUCTION BY STORMWATER TREATMENT

BAY OF QUINTE REMEDIAL ACTION PLAN
ADVANCEMENT OF POLLUTION CONTROL PLANNING FOR PICTON, NAPANEE AND DESERONTO

EXPECTED PHOSPHORUS REDUCTION BY STORMWATER TREATMENT

1. INTRODUCTION

As part of the PCP advancement project, the stormwater guidelines for the BQRAP Implementation Area are being updated.

In part, the new guidelines are intended to emphasize the benefits of stormwater management in helping reduce phosphorus inputs to the Bay of Quinte and its tributary watercourses. As well, PCP preparation for urban areas fronting the Bay (per BQRAP Recommendation #23) requires development of targets for phosphorus load reduction for stormwater. Information on what degree of phosphorus load reduction is possible through proven stormwater management techniques is useful for the target setting process.

XCG Consultants has undertaken a review of readily available research sources to provide a summary of typical or average observed phosphorus removal efficiency by stormwater management facilities.

2. SOURCES

The following sources of recent research results have been consulted:

- The ASCE's urban stormwater best management practice (BMP) database, as available through www.bmpdatabase.org. A database query was carried out by XCG in September 2005.

- A recent ASCE report (ASCE et al., 2000) that provides an evaluation and summary of recent data on stormwater facility performance, primarily for end-of-pipe stormwater retention ponds and wetlands.

- Correspondence from Mr. Tim Van Seters of Toronto Region Conservation Authority, consisting of draft tables summarizing performance for seven facilities in the TRCA watershed area that were investigated as part of the Province's SWAMP program. These tables were provide in a draft form and are still under review by TRCA as part of preparation a summary report expected to be available in early 2006.

With respect to the ASCE database and report, it should be noted that the ASCE information represents a comprehensive compilation and consolidation of research results from various researchers throughout North America, including some of the Ontario SWAMP results.

3. SUMMARY OF FINDINGS:

The attached table provides summary of observed total phosphorus (TP) removal efficiencies for individual facilities as taken from the ASCE sources.

In general, the ASCE sources indicate a wide range of observed TP removal in stormwater facilities, with values ranging from less than 10% to over 80%. The majority of observed facility efficiencies are in the range of 30% to 80%.

The TRCA's SWAMP data summary similarly indicates a wide range of TP removal efficiency, from 22% to as high as 87%. The arithmetic average of all reported TP removal efficiencies is approximately 60% over all seasons; 67% in summer/fall; 54% in winter/spring.

4. CONCLUSION

Based on this review of summary information, it appears reasonable to assume for planning purposes that end-of-pipe stormwater management facilities such as settling ponds and tanks, are capable of long-term average TP load reduction of 50% to 60%. A conservative value of 50% is recommended for use in PCP development in the BQRAP area.

5. REFERENCES CITED

ASCE et al., 2000. Determining Urban Stormwater Best Management Practice (BMP) Removal Efficiencies: Task 3.4 – Final Data Exploartion and Evaluation Report, prepared by GeoSyntec Consultants and Urban Water Resources Research Council of ASCE in cooperation with Office of Water, U.S. Environmental Protection Agency.

ASCE at al., 2005. International Stormwater BMP Database query, available at www.bmpdatabase.org, sponsored by Water Environment Research Foundation, U.S. EPA, U.S. Federal Highway Administration, ASCE Environmental and Water Resources Institute (EWRI), database maintained by Wright Water Engineers, Inc. and GeoSyntec Consultants.

Toronto Region Conservation Authority, 2005. Draft summary tables of performance of seven stormwater facilities in the TRCA jurisdictional area, as provided by Mr. Time Van Seters of TRCA on September 27, 2005 to XCG Consultants.

Project 1-1751-01-03
Title Bay of Quinte RAP - Advancement of PCPs for Picton, Deseronto and Napanee; and Review of PCPs for Belleville and Trenton
Client Bay of Quinte RAP Implementation Council c/o Lower Trent Conservation Authority
Contact Barry Jones, BQRAP Implementation Coordinator, Lower Trent Conservation Authority

Subject Update to SWM Guidelines
Review of potential phosphorus load reduction provided by end-of-pipe stormwater treatment
Review of reports from query of International Stormwater BMP Database www.bmpdatabase.org
for wet retention ponds and wetlands

	SWM FACILITY	LOCATION			TYPE	PP Volume m^3	Surface Area ha	REPORTED LOAD REMOVALS in summary report						LOAD REMOVALS from detailed stats report (based on mean inflow and outflow EMCs)					
								TSS	TP	Pb	Cu	Cd	Zn	TSS	TP	Pb	Cu	Cd	Zn
1	Debary Detention with Filtration Pond	Debary	FL	USA	Retention pond (wet)	1,410		98%	61%	70%	40%	50%	90%						
2	The Tampa Office Pond	Tampa	FL	USA	Retention pond (wet)	2,008		71% to 94%	62% to 90%			55% to 87%	56% to 86%						
3	Taver Creek Detention Basin	Ann Arbour	MI	USA	Retention pond (wet)	14,498	2.7	0 - 34%	25% - 62%										
4	The Seattle Metro Site	Bellevue	WA	USA	Retention pond (wet)	4	0	n/a	n/a	n/a	n/a	n/a	n/a						
5	Lake Ridge Detention Pond	Woodbury	MN	USA	Retention pond (wet)	2,467	0.4	n/a	n/a	n/a	n/a	n/a	n/a						
6	Phantom Lake Pond C	Bellevue	WA	USA	Retention pond (wet)														
7	McKnight Basin Detention Pond	Maplewood	MN	USA	Retention pond (wet)	16,282	2.2	n/a	n/a	n/a	n/a	n/a	n/a						
8	La Costa WB	Encinitas	CA	USA	Retention pond (wet)	777	0.11	n/a	n/a	n/a	n/a	n/a	n/a						
9	Silver Star Rd Detention Pond	Orlando	FL	USA	Retention pond (wet)	1,948	0.1	65%	21%	41%	n/a	n/s	37%						
10	Silver Star Rd Wetland	Orlando	FL	USA	Retention pond (wet)	n/a		66%	19%	75%			50%						
11	Lake Munson	Tallahassee	FL	USA	Retention pond (wet)	1,258,152	103.2	95%	64%	91%	72%	n/a	n/a						
12	Carver Ravine Wetland	Woodbury	MN	USA	Retention pond (wet)	n/a		n/a	n/a	n/a	n/a	n/a	n/a						
13	Carver Ravine Detention Pond	Woodbury	MN	USA	Retention pond (wet)	987	0.2	n/a	n/a	n/a	n/a	n/a	n/a						
14	Pinellas Park Detention Pond	Pinellas Park	FL	USA	Retention pond (wet)	35,396	10.6	7% to 11%	2% to 52%	25% to 60%	25% to 60%	25% to 60%	25% to 60%						
15	Duvall County Pond 1	Jacksonville	FL	USA	Retention pond (wet)	74	0.2	n/a	n/a	n/a	n/a	n/a	n/a						
16	DUST Marsh System C, System A and Debris Basin	Fremont	CA	USA	Wetland - Channel with wetland bottom			64%	56%	88%	31%	n/a	33%						
17	Pittsfield Retention Pond	Ann Arbor	MI	USA	Retention pond (wet)	25,903	n/a	10% to 85%	0% to 82%	43% to 90%	n/a	n/a	n/a						
18	Lakeside (LS), Runaway Bay (RB) and Waterford (WF) Ponds	Charlotte	NC	USA	Retention pond (wet)	69,001	4	70%	45%	n/a	n/a	n/a	40%						
19	Lake McCarrons Wetland	Roseville	MN	USA	Wetland - Channel with wetland botto	n/a		n/a	n/a	n/a	n/a	n/a	n/a						
20	Lake McCarrons Sedimentation Basin				Retention pond (wet)	3,454	1.2	n/a	n/a	n/a	n/a	n/a	n/a						
21	Waverly Retention Basin	Lansing	MI	USA	Retention pond (wet)	n/a	n/a	n/a	57%	90%	72%	60%	72%						
22	Central Park Wet Pond	Austin	TX	USA	Retention pond (wet)	7,731	5.4	n/a	n/a	n/a	n/a	n/a	n/a	5%					
23	Shawnee Ridge Retention Pond	Suwanee	GA	USA	Retention pond (wet)	16,135	0.9	n/a	n/a	n/a	n/a	n/a	n/a	93%	73%				
24	Cockroach Bay Wet pond	Ruskin	FL	USA	Retention pond (wet)	74198.2	5.8	n/a	n/a	n/a	n/a	n/a	n/a	35%	64%				
25	Commonwealth South Central Stormwater facility	Tallahassee	FL	USA	Retention pond (wet)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a						
26	Shop Creek Wetland (90-94)	Aurora	CO	USA	Wetland - Channel with wetland botto	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a						
27	Shop Creek Pond (90-94)	Aurora	CO	USA	Retention pond (wet)	5,649	0.57	n/a	n/a	n/a	n/a	n/a	n/a						
28	Phanton Lake Pond A	Bellevue	WA	USA	Retention pond (wet)	1,000	0.2	n/a	n/a	n/a	n/a	n/a	n/a		15%				
29	Heritage Estates Stormwater Management Pond	Richmond Hill	ON	CAN	Retention pond (wet)	6,886	n/a							90%	80% diss P				
30	Shop Creek Pond (1995-97)	Aurora	CO	USA	Retention pond (wet)	5,649	0.57												
31	Shop Creek Wetland (95-97)	Aurora	CO	USA	Wetland - Channel with wetland botto	n/a													
32	Wet detention pond, Monroe Street	Madison	WI	USA	Retention pond (wet)	873	5.7	87%	n/a	n/a	n/a	n/a	n/a		70%				
33	Lake Ellyn	Glen Ellyn	IL	USA	Retention pond (wet)	55,507	1.66	88% to 94%	32% to 64%	84% to 92%	77% to 88%	n/a	76% to 88%						
34																			