

# Bacteria Contamination Assessment and Remediation Program

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the Raisin Region Conservation Authority in support of the St. Lawrence  
River (Cornwall) Remedial Action Plan



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## **Executive Summary**

An *E. coli* source tracking program was implemented in the summer of 2007 in nearshore waters in the vicinity of Westley's Point, near Lancaster, Ontario. The Westley's Point monitoring study fulfills the recommendation to develop and implement a bacteria source tracking plan based on studies of 35 water recreation areas in the St. Lawrence River (Cornwall) Area of Concern in 2003 and 2004. These prior studies monitored for faecal coliforms and/or *E. coli* concentrations, and compared results to the Provincial Water Quality Objectives (PWQOs) and the applicable Remedial Action Plan (RAP) delisting criteria. While the majority of monitored sites showed good water quality, several sites did not meet the PWQOs – a geometric mean of 100 *E. coli* colony forming units (CFU) per 100 mL for at least 5 individual samples. These sites included several locations along the Islands of Akwesasne, Glengarry Park Beach and Westley's Point. As a result, recommendations were put forth to continue monitoring along the Akwesasne and Glengarry Park locations, and to investigate in more detail the potential sources of *E. coli* at Westley's Point water recreational area.

The Westley's Point study area is an approximate 1 km stretch located on the north bank of the St. Lawrence River, approximately 5 km east of Lancaster, Ontario. *E. coli* and other indicator parameters were monitored at selected sites between the months of June and September with an additional sampling event in October 2007. The concentrations of *E. coli* were determined to range from 2 to 940 CFU/100mL over these sampling dates. The *E. coli* concentrations in the waters of the sampling area met the PWQO for most of the summer recreation period between June 25<sup>th</sup> and Labour Day with exception of one sampling event in late August. Some elevated *E. coli* levels were found, at times, at specific sites along the waterfront. Values also increased from offshore to nearshore samples, suggesting nearshore sources along the waterfront and the reduced opportunities for dilution closer to shore. At the October sampling date, *E. coli* levels were consistently elevated throughout the entire sampling, as was specific conductivity and other water mass tracers, most likely indicating of water mass incursions into the area from nearby tributaries (see Figure 1). Water quality data taken at the Lancaster drinking

water intake indicates that main stream St. Lawrence River water contains very low levels of *E. coli*.

Based on the data collected in 2007, the water quality in the Westley's Creek recreational area meets the minimum water quality objective outlined in the current RAP delisting criterion; i.e., at least 75% of the water samples taken during the water recreation period below the PWQO (geometric mean of 100 CFU/100 mL). However, the data collected suggests that several factors may degrade water quality at different times in the Westley Point recreation area. These sources may include: inputs from upstream tributaries (Raisin River, Finney Creek and Ferguson Drain) and/or immediately downstream where Westley's Creek discharges (which have relatively poor water quality) into the Westley's Point recreation area; faulty or overcharged septic systems associated with cottages, or other nearshore discharges associated with the cottage areas along the waterfront; and run-off from an agricultural field upstream of the recreational area. Implementation of remedial measures to address immediate sources, such as inspection of septic systems is recommended and adopting a strategy for diversion of the shoreline agricultural drain would be a good management practice. The data also emphasizes the importance of continued work on restoring tributary water quality, as these sources affect water quality at Westley's Point and other nearshore areas in the St. Lawrence River.

It was recommended to continue monitoring and analyzing potential sources in the water recreation contact areas which exceeded the PWQO (SLRIES 2003). Glengarry Park Beach and Charlottenburg Park data was obtained from the Eastern Ontario Health Unit and analyzed. The RAP delisting criteria states that "at public beaches, no more than 20% of weekly *E. coli* assessment (geometric means of at least 5 samples) exceeds the PWQO during an annual swimming season" (PWQO). Glengarry Park Beach *E.coli* data was analyzed for the 2004 to 2007 swimming seasons it was determined that the 2004 results were above the 20% criteria and the 2007 data below the delisting criteria. In fact an improvement each year has been observed. Charlottenburg Park *E.coli* data was analyzed for the 2005 to 2007 swimming seasons. Charlottenburg Park has been within the delisting criteria (below 20%) since it has been reopened in 2005.

The PWQO was met in the Westley's Point water recreational area in 6 of 7 sampling events during the recreation season with approximately 89% of the water samples below the value of 100 CFU/100 mL. The existing conditions indicate the following four potential sources of *E. coli* to these waters:

- 1) Faulty or overcharged septic systems associated with cottages and other nearshore discharges associated with the cottage areas appears to be a primary source of elevated *E. coli* levels.
- 2) Upstream sources, including the Raisin River, Finney Creek and Ferguson Drain may be significant contributions to the impairment of nearshore water quality sporadically in the Westley's Point embayment. Its relative impact is anticipated to vary depending on meteorological and flow conditions.
- 3) The downstream sources of Westley's Creek has the potential to flow in a westerly direction along the point and may be contributing in a significant manner to water quality issues in the Westley's Point embayment.
- 4) Although this study was unable to confirm that the agricultural drain that currently discharges upstream of the recreational area is contributing to the water quality issues, it remains a potential conduit for contaminants and better management practices are recommended for discussion with the landowner.

Although the water quality results meet the minimum water quality objective of at least 75% of the water samples below the 100 CFU/100 mL levels during the water recreation period and potential sources of bacteria sources have been identified, a pollution control plan for the area is needed to better define the relative inputs and timing of the bacteria sources. The following actions related to the discussed sources are recommended to facilitate the enhancement of the recreational features of the Westley's Point embayment:

- 1) Implementation of a septic system investigation program in the Westley's Point community that provides restoration recommendations.
- 2) Implementation of a nutrient mapping study that better defines the contributions of the upstream tributaries (Raisin River, Finney Creek and Ferguson Drain) to the accumulation of elevated bacteria levels in the Westley's Point embayment.
- 3) Implementation of a nutrient mapping study that better defines the contribution of the Westley's Creek to elevated bacteria levels in the Westley's Point embayment.
- 4) Initiate discussions with the agricultural landowner in the study area to discuss potential options to the direct discharge from his tile drain outlet into the Westley's Point embayment.
- 5) Further investigate the nearby beaches (Glengarry Park, Islands of Akwesasne and Charlottenburg) and their water quality during the swimming season. Determine the factors for the increase or decrease in bacteria at each beach site.

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## 1. 0 Introduction

The Remedial Action Plan (RAP) for the St. Lawrence River (Cornwall) Area of Concern (AOC) identified high faecal bacteria levels as a beneficial use impairment in the AOC, since they limit use of the river for water contact sports, including swimming, at a number of public sites. Over the past decade, elimination and improved control of municipal and industrial effluents and stormwater discharges have reduced direct inputs to the St Lawrence River. To assess the recent status of water quality in the AOC, thirty-five of water recreation areas were monitored for faecal coliforms and/or *E. coli* concentrations in 2003 and 2004, and compared to the Provincial Water Quality Objectives (PWQOs) and the applicable RAP delisting criteria (Moore and Ridal, 2004). Although conditions in general appear to have improved since the 1980s, it was determined that the criterion for *E. coli* in recreational water had not been met in the Area of Concern.

The RAP report (Moore and Ridal, 2004) provided a detailed analysis at the sampling sites where faecal bacteria contamination continue to persist. These sites include Westley's Point, Glengarry Park and areas on Cornwall Island. This report summarizes an investigation of possible *E. coli* sources to the Westley's Point area to provide information so that possible remediation measures may be identified and enacted. Glengarry Park and Cornwall Island sites are monitored by the Eastern Ontario Health Unit and the Akwesasne Department of Health, respectively.

### **Delisting Criteria**

In 2006, the SLRRC adopted revised delisting criteria as follows:

1. At public beaches, no more than 20% of weekly *E. coli* assessments (geometric means of at least 5 samples) exceed the Provincial Water Quality Objective during an annual swimming season (see Note 1). In addition, the main/predominant sources of fecal pollution are known and most of these exceedences are associated in a predictable manner with local events such as significant rainfall or high wind periods.

2. For body contact water recreation areas (see Note 2) other than public beaches, the provincial water quality objective is met during the swimming season at the vast majority of sites (see Note 3). Those sites which exceed objectives are highly localized and exceedences occur only sporadically, i.e. the AOC does not show evidence of widespread or chronic fecal pollution.

3. For the small number of body contact water recreation areas where water quality objective exceedences occur, the main sources of fecal pollution have been identified, pollution control plans have been developed and these plans are being actively implemented.

Notes:

1. The provincial water quality objective is the geometric mean of at least 5 samples taken within a 30 day period from a defined water recreation area may not exceed 100 *E. coli* colony forming units/100 ml. The swimming season coincides with the monitoring timeframe implemented by the Health Unit at provincial beaches (Victoria Day to Labour Day).

2. Body contact water recreation areas are all sites monitored in the 2002-2003 RAP program bacteria surveys except those areas posted as areas prohibited for body contact water recreational activities by the Health Unit or a local municipal authority (e.g. Lamoureux Park). Body contact water recreation activities are those activities where immersion of the head is likely and include diving, swimming, water skiing, wake boarding, and windsurfing.

3. The interpretation of “vast majority” is left to the assessment committee but should be a large percentage of the total number of the body contact recreation sites, i.e. 75% or more.

### **1.1 Purpose of the Study**

The purpose of this study was to monitor and investigate sources of *E. coli* in the Westley's Point area, Figure 1. Bacteria sampling along the St. Lawrence River, in past

work, indicated sporadic high faecal bacteria levels upstream and along the southwest shore of Westley's Point. Homes and cottages are located immediately along the St. Lawrence River at this site, and the residents use this area for water recreation activities and high *E. coli* values may indicate elevated health risks. The 2007 Westley's Point bacteria monitoring was conducted to fulfill this recommendation and provide new recommendations as necessary. This additional information allows for a better characterization of the area including possible sources of the pollution.

## **1.2 Description of the Study Area**

As indicated in Figure 1, the Westley's Point area is located on the north bank of the St. Lawrence River, approximately 5 km east of Lancaster, Ontario. The study area is an approximately 1 km stretch along the river bank. About half the land along this part of the river is occupied by homes and cottages (East side) and the other half (West side) is farm land. Westley's Creek discharges east of Westley's Point. Water circulation along this area, based on visual inspection taken during the course of sampling, appears negligible. Possible sources of faecal contamination in this area include manure runoff, malfunctioning septic systems, agricultural drains and domestic and wild animal wastes.

## **2.0 Methods**

### **2.1 Sampling Locations, Dates, Weather**

Twenty five points were initially selected and sampled on most occasions (see Figure 1). Additional samples were taken east of the recreation area (WP26-WP30) on the July 18 sampling event to investigate the Westley's Creek outflow. Three additional sites added (WP32-34) in August to characterize levels in deeper waters (Figure 1). Exact locations based on global positioning system are provided in Appendix A.

The sampling sites were selected based on proximity to possible sources (cottages, drains, inlets). Sampling sites WP1 through to WP12 were adjacent to cottages with docks in the water and corresponds to the water recreation area identified in previous reports (Moore and Ridal 2004). Sampling sites WP13 to WP22 were adjacent to agricultural fields along the river buffered by vegetation on the edge of the river such as willows, birches, maples, and shrubs. Sites WP23-25 were located at the eastern end of a series of cottages upstream of the study area and adjacent to a small channel

constructed for boat access. There was no perceptible flow in the channel. Sampling sites WP11 and WP20 had rocky bottoms while all the other sites had silty sandy bottoms. WP14 is adjacent to an agricultural drainage pipe about 5 cm in diameter, sampling occurred approximately 1m from where the pipe releases the water.

## **2.2 Sampling Techniques**

Sampling was done on June 25, 2007 through till October 22 2007 including both wet and dry events (See Table 1 for weather conditions and precipitation data). Samples were taken about 2 meters from shore in most cases (approximately 1.5 m depth) except for offshore sites and three sets of transects from deeper to shallow waters (WP4, 5, 6; WP 9,10,11; and WP23, 24, 25).

All grab samples were retrieved from approximately 30 cm depth using a gloved hand from either canoe or boat. Bottles were labeled and kept in a cooler with ice until delivered to the laboratory. Specific conductivity ( $\mu\text{s}/\text{cm}$ ) and temperature ( $^{\circ}\text{C}$ ) were measured in the field using calibrated YSI probes. Downstream samples were taken first; upstream samples were collected last. Sampling position was taken with a portable GPS (Garmin, Legend).

Parameters analyzed in the field were specific conductivity and temperature, parameters analyzed in the lab included *E. coli*, total suspended solids, major ions (3 times), total phosphorous, turbidity and optical brighteners. *E. coli* analysis was the main focus but the other parameters were used as tracers and indicators. Total suspended solids indicate surface runoff tracer, major ions such as sodium have been shown to be a useful tracer for groundwater discharge and septic leaching (TRG 2005). Optical brighteners can indicate the presence of fluorescent whitening agents found in many detergents and thus is an indicator of failing septic systems (Hagedorn et al. 2005), while total phosphorus is an indicator of nutrient inputs from both septic systems and runoff.

## **2.3 Laboratory Methods**

All samples were collected by the St. Lawrence River Institute and the Raisin Region Conservation Authority (RRCA) staff. *E. coli*, total phosphorus were analyzed by the St. Lawrence River Institute; metals were analyzed by Lakefield Laboratories following CAEAL accredited procedures. Bacteria samples were analyzed for *E. coli*

within 24 hours of collection. Total suspended solids analysis followed Standard Methods (Eaton et al, 2006). Turbidity and optical brightness measurements were carried out following using a 2100P HACH turbidimeter and Quantech fluorometer (Dickerson et al., 2007). All samples (other than *E. coli* samples) were analyzed within 7 days of collection.

## **2.4 Meteorological Data**

Precipitation and wind direction data is provided in Table 1 for the sampling day and 48 hours prior to the sampling day. Rainfall was recorded twice a day at Cornwall's purification plant (located in Cornwall) and added to give a daily total. Based on the rainfall data the event was described as wet or dry. It is important to note that the precipitation data may have been different at the Westley's Point area. Wind speed and direction was sourced from Montreal Pierre Trudeau International Airport.

## **3. Results**

### **3.1 *E. coli* Bacteria**

As seen in Table 2, the *E. coli* values ranged from 2 colony forming units (CFU) per 100 mL to 940 CFU/100 mL. Out of the 204 samples tested from June 25/07 to Oct 22/07, 17% (34 samples) exceeded 100 CFU/100 mL. Bacteria results for sampling dates in August (7<sup>th</sup> and 16<sup>th</sup>) are not available because of problems with the laboratory materials used in the analysis. The geometric mean of sites 1-12, corresponding to the Westley's Point water recreation area, ranged from 7-131 CFU/100 mL during the recreation season, while a considerably higher value of 298 CFU/100 mL was found on the October sampling event. On the other hand, the geometric mean of sites 13-15 ranged 13-41 CFU/100 mL during the recreation season and had a value of 289 CFU/100 mL in October.

### **3.2 Chemical Parameters**

Appendix B summarized the chemical and biological results from all the sampling dates. Specific conductivity, Turbidity, TSS, and Optical Brightener (OB) values are compared with the *E. coli* concentrations in Figure 2. Specific conductivity values ranged were consistently between 280 – 305 ( $\mu\text{S}/\text{cm}$ ) with the exception for the October value

which was notably higher at approximately 400  $\mu\text{S}/\text{cm}$ . TSS, turbidity, TP and OB values varied in a similar pattern with sampling date. TSS ranged between <3 mg/L and 33 mg/L and turbidity <0.2 and 30 NTU, respectively. TP values ranged from 0.012 to 0.079 mg/L while OB values ranged from approximately 10 to 50  $\mu\text{g}/\text{L}$  as FB-28. Metals values were relatively consistent on the three sampling occasions (Appendix B) Sodium (Na) is an effective tracer for septic system discharges because of the high use of water softeners in the area (TRG 2005) and had values that ranged between 11.8 and 13.5 mg/L, similar to the offshore value of 12.7 mg/L. There was an increase in Al and Fe values for the August 16<sup>th</sup> samples but these likely correspond to an increase in turbidity and TSS on that sampling date relative to the other dates when metal scans were completed. The water temperature for the sampling period was within the 20 to 25°C range for all the summer sampling dates. On the final sampling date of October 22, 2007, the water temperature had an average value of 15°C.

#### **4. Discussion and Analysis**

##### **4.1 Comparison of *E. coli* Concentrations with Location and Sampling Date**

With respect to the Westley's Point recreation area (geometric mean of samples from sites WP1 to WP12 inclusive), the sampling area met the PWQO for most of the summer recreation period between June 25<sup>th</sup> and Labour Day with exception of the August 29/07 sampling event. Elevated readings at several sites resulted in a geometric mean of 131 CFU/100 mL for the recreational area on Aug 29. By contrast, the geometric mean for the adjacent area west (sites WP13 to WP25) was below the PWQO with a value of 41 CFU/100 mL.

In terms of spatial distributions, elevated *E. coli* levels were found, at times, at specific sites along the waterfront, particularly during the August 29<sup>th</sup> sampling event when the PWQO was exceeded (Figure 3). Values also increased from offshore to nearshore for the transect samples WP4-6 and WP9-11, suggesting nearshore sources along the waterfront and the reduced opportunities for dilution with smaller nearshore flows. On the other hand, values ranged 210 to 410 CFU/100 mL through the entire sampling area for the samples taken October 22/07, a wet sampling event. During this day, winds were strong from the southwest creating an onshore breeze and turbulent conditions throughout the embayment.

#### **4.2 Farming land on the West half of the shoreline**

Sampling sites WP13 to WP25 have farm land on the north shore while sampling sites WP1 to WP12 have cottages and homes. There are no patterns or differences in *E. coli* numbers, or any other parameters, within the area adjacent to the agriculture fields. It appears that water quality in this area is uniform during the sampling periods, and the data do not indicate the presence of point sources.

On the last sampling day, the landowner ran his field drain (WP14) for 3 hours prior to sampling and during the sampling event. Although the *E. coli* levels were elevated during the last event throughout the entire sampling area, it does not appear to be a result of the field drain. A sample taken directly from the pump had *E. coli* levels which were within the PWQO. In fact all the parameters analyzed from the pump were lower than the samples taken from the river. Therefore, the agricultural drain was not shown to be a contamination source on that particular event. The landowner also stated he does not use manure as a fertilizer. However, the drain still represents a potential direct source of contaminants to the water in this recreational area, and it is recommended that remedial options that remove the drain as a direct source to the water should be explored with the landowner.

#### **4.3 Relationship between *E. coli* and Precipitation**

Rainfall was examined in relation to the sampling occasion at the sites where *E. coli* exceeded the PWQO (see Figure 4). There is no consistent pattern with rainfall and bacteria. On Aug 29/07 and Oct 22/07, *E. coli* counts were higher relative to the values for samples taken earlier in the season. October 22 did have the highest rainfall at 38.0 mm (within 48 hours) and *E. coli* counts were well above 100 CFU/100mL, however July 10 also had 38.0 mm of rain and the bacteria levels were well below 100 CFU *E. coli*/100mL. August 29 had elevated *E. coli* counts and there was no precipitation recorded, while August 23 received 26.0 mm and had low *E. coli* counts. The elevated values throughout the entire area on the October sampling date do not suggest a specific point source but suggests general poorer water quality in the nearshore river environment at that time. There is limited information available about *E. coli* levels in the nearshore environment for this time of year. Wetter weather in October, lower temperatures and



decreased sunlight may result in longer bacteria survival times. The Lancaster raw water intake values (Table 3) for *E. coli* (4-5 samples) for June to October ranged from an average of 0.4 to 2 colony forming units. These low values suggest the contamination is likely to be near shore.

#### **4.4 Bacteria Levels Compared to the Other Parameters**

When the bacteria levels are elevated TSS, TP, turbidity, and optical brighteners are also elevated (see Figure 2). The strongest correlation (Figure 5) appears to be between *E. coli* and optical brighteners. There is an obvious relationship observed between these two parameters which may suggest a sewage discharge source of contamination or an incursion of a water source with higher background fluorescence (for instance, the brown waters of a tributary such as the Raisin River). On the final sampling date the bacteria counts exceed the PWQO at every site and are much higher than the previous sampling dates. Specific conductivity is significantly elevated (approx 400  $\mu\text{S}/\text{cm}$ ) on the final sampling date compared to all the other sampling events. (The typical St. Lawrence River value is approximately 300  $\mu\text{S}/\text{cm}$ ). This may suggest the influence of adjacent tributaries (Raisin River, Finney Creek, Ferguson Creek or Westley's Creek) which have higher specific conductivity (and poorer water quality) than mainstream St. Lawrence River. (See Figure 1) The upstream tributaries influence may be significant based on the South West prevailing wind direction for the last 2 sampling dates (see Table 1, Figure 6). Table 4-A and B shows additional data collected during the summer of 2007 from Westley's Creek and the Raisin River during the Tributaries Monitoring program conducted by the RRCA. The data indicates high variability in Westley's Creek water quality with *E. coli* values ranging up to 800 CFU/100 mL and specific conductivity up to 587  $\mu\text{S}/\text{cm}$ . Water quality in Westley's Creek is also influenced by runoff from the nearby 401 highway and by agricultural activities along the watercourse (TRG 2005). In comparison to the St. Lawrence River the Raisin River's water quality is known to have slightly higher TP values and considerably higher conductivity levels, ranging from 300 to 550  $\mu\text{S}/\text{cm}$  (see Table 4-B).

In 1994, an investigation was conducted on the sewage disposal systems in Westley's Point (The Thompson Rosemount Group Inc., 2005). It was determined that

many of the systems were faulty or have degraded to such an extent that they are now failing. It was also discovered that a couple of sump pumps discharged directly into the local watercourse. Phase two of this investigation was completed in 2005 and the specific actions were recommended to fixing this problem, namely upgrading to sewage treatment systems (TRG 2005). At this point, this environmental assessment has not proceeded any further; however a septic system investigation program is currently planned which may help identify specific sources.

#### **4.5 Analysis of Glengarry Park and Charlottenburg Park Bacteria Data**

It was recommended to continue monitoring and analyzing potential sources in the water recreation contact areas which exceeded the PWQO (SLRIES 2003). These locations included Westley's Point, Glengarry Park Beach and several locations along the Islands of Akwesasne. Glengarry Park Beach and Charlottenburg Park data was obtained from the Eastern Ontario Health Unit and analyzed. The RAP delisting criteria states that "at public beaches, no more than 20% of weekly *E. coli* assessment (geometric means of at least 5 samples) exceeds the PWQO during an annual swimming season" (PWQO).

Table 5 provides the Glengarry Park Beach *E.coli* data for the 2004 to 2007 swimming seasons. Figure 6 shows the percent of weeks exceeding the PWQO for 2004 to 2007. The 2007 monitoring year was below the twenty percent and as a result falls within the delisting criteria. Figure 7 shows another approach looking at the total tests done during a swimming season which exceeded the PWQO. This data indicates that the last three years have been below the 20% criteria. Figure 8 shows the total amount of days the beach was closed due to high bacteria counts over the last four years. All three figures illustrate an improvement each year. When comparing bacteria levels to the amount of total precipitation during the swimming season (see Figure 9) there are no apparent relationships observed. The reasons for the improvement in water quality are therefore not apparent from this data. Other factors may be responsible and should be identified.

Charlottenburg Park was reopened for the 2005 swimming season. Table 6 provides the Charlottenburg Park *E.coli* data for 2005 to 2007 swimming season. Figure

11 shows the total tests exceeding the twenty percent criteria at Charlottenburg Park, this figure shows 2006 was slightly over the criteria (22%) and 2007 was below the delisting level (11%). Figure 12 shows the number of weeks exceeding the PWQO, this figure illustrates that Charlottenburg Park has been within the delisting criteria since it has been reopened in 2005.

#### **4.6 Akwesasne Water Recreational Areas**

The work plan to involve the Mohawk community in the development of the Bacteria Tracking Study is a process rather than a product. Approaches have been developed to facilitate their voluntary participation and incorporate their input by way of direct and indirect solicitation:

- The Bacteria Source Tracking Study has been linked to the Source Water Protection Study being prepared by the Raisin Region South Nation Source Protection Committee. In addition to efficiencies and synergies available in working together, the established liaison existing between the committee and the Mohawks is being utilized.
- Stronger ties are being developed with the local fish and game club who have a close working relationship with the Mohawks. Efforts are being made to encourage their influence on our behalf to promote the importance of a community based pollution control plan.
- Although aware that others cannot speak on their behalf, the interpretation of Mohawk perspectives is being solicited from individuals and agencies familiar with their traditions and beliefs.
- Direct communications continue with the Mohawk environmental representative and efforts persist to apprise them of progress. At this current time the Mohawk Council of Akwesasne is temporarily without a health employee who has the responsibility for the releases of information.

#### **4.7 Assessment of Delisting Status and Recommendations**

The PWQO was met in the Westley's Point water recreational area in 6 of 7 sampling events during the recreation season with approximately 89% of the water samples below the value of 100 CFU/100 mL. The existing conditions indicate the following four potential sources of *E. coli* to these waters:

- 1) Faulty or overcharged septic systems associated with cottages and other nearshore discharges associated with the cottage areas appears to be a primary source of elevated *E. coli* levels.
- 2) Upstream sources, including the Raisin River, Finney Creek and Ferguson Drain may be significant contributions to the impairment of nearshore water quality sporadically in the Westley's Point embayment. Its relative impact is anticipated to vary depending on meteorological and flow conditions.
- 3) The downstream sources of Westley's Creek has the potential to flow in a westerly direction along the point and may be contributing in a significant manner to water quality issues in the Westley's Point embayment.
- 4) Although this study was unable to confirm that the agricultural drain that currently discharges upstream of the recreational area is contributing to the water quality issues, it remains a potential conduit for contaminants and better management practices are recommended for discussion with the landowner.

Although the water quality results meet the minimum water quality objective of at least 75% of the water samples below the 100 CFU/100 mL levels during the water recreation period and potential sources of bacteria sources have been identified, a pollution control plan for the area is needed to better define the relative inputs and timing of the bacteria sources. The following actions related to the discussed sources are recommended to facilitate the enhancement of the recreational features of the Westley's Point embayment:

- 1) Implementation of a septic system investigation program in the Westley's Point community that provides restoration recommendations.
- 2) Implementation of a nutrient mapping study that better defines the contributions of the upstream tributaries (Raisin River, Finney Creek and Ferguson Drain) to the accumulation of elevated bacteria levels in the Westley's Point embayment.
- 3) Implementation of a nutrient mapping study that better defines the contribution of the Westley's Creek to elevated bacteria levels in the Westley's Point embayment.
- 4) Initiate discussions with the agricultural landowner in the study area to discuss potential options to the direct discharge from his tile drain outlet into the Westley's Point embayment.
- 5) Further investigate the nearby beaches (Glengarry Park, Islands of Akwesasne and Charlottenburg) and their water quality during the swimming season, to determine the factors for the increase or decrease in bacteria at each beach site.

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We would like to thank those who have assisted in this study including Chris Critoph, Julie Berube and Katherine Beehler from the Raisin Region Conservation Authority, Jason Szwec, Raymond Gauthier from the St. Lawrence River Institute of Environmental Sciences, Adrien Moreau (on internship from University of Poitiers, France), Shawn Killorn from the Lancaster Water Treatment Plant, Idalia Milan from the Eastern Ontario Health Unit and John St. Marseille from the Thompson Rosemount Group.

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**Table 1:** Sampling dates with wind and precipitation data

Sampling Date	Event Type	Rain Fall (mm)						
		48 Hrs Prior	24 Hrs Prior	Sampling Day	Temp. °C	Wind Direction	10's Degrees	Wind Speed km/h
June 25/07	Dry	0.0	0.0	0.6	22.5	21	6	
June 28/07	Wet	0.0	0.0	12.0	32.5	32	13	
July 10/07	Wet	21.2	16.8	0.0	26.0	5	17	
July 18/07	Dry	4.6	0.0	0.0	26.0	21	9	
July 26/07	Dry	0.0	0.0	0.0	28.5	9	19	
Aug 7/07	Dry	0.0	6.6	0.0	28.5	15	24	
Aug 16/07	Wet	0.0	0.0	12.6	25.5	15	15	
Aug 23/07	Wet	15.4	8.0	2.6	20.5	15	17	
Aug 29/07	Dry	0.0	0.0	0.0	28.0	23	20	
Oct 22/07	Wet	37.0	1.0	0.0	26.0	22	17	

**Table 2:** Westley's E.coli (CFU/100mL) results obtained during the monitoring program

Site	June 25/07	June 28/07	July 10/07	July 18/07	July 26/07	Aug 7/07	Aug 16/07	Aug 23/07	Aug 29/07	Oct 22/07
WP1	<10	10	20	34	N/A	N/A	80	40	940	210
WP2	<10	10	10	6	N/A	N/A	80	10	130	350
WP3	10	40	<10	8	N/A	N/A	<10	<10	110	260
WP4	10	20	<10	<10	N/A	N/A	10	<10	22	300
WP5	10	20	<10	18	N/A	N/A	20	<10	50	300
WP6	<10	30	10	8	N/A	N/A	160	20	80	320
WP7	20	10	<10	4	N/A	N/A	10	<10	30	330
WP8	20	40	<10	4	N/A	N/A	<10	10	210	240
WP9	<10	10	20	2	N/A	N/A	10	<10	130	290
WP10	20	20	<10	2	N/A	N/A	<10	40	290	360
WP11	10	50	10	<10	N/A	N/A	10	10	470	410
WP12	10	40	<10	6	N/A	N/A	10	20	190	260
Geomean Sites 1-12	12	21	11	7	N/A	N/A	19	14	131	298
WP13	<10	10	<10	6	N/A	N/A	40	10	10	310
WP14	50	40	<10	4	N/A	N/A	20	20	70	350
WP15	<10	10	<10	2	N/A	N/A	<10	<10	15	220
WP16	10	<10	<10	2	N/A	N/A	<10	20	40	370
WP17	10	10	<10	4	N/A	N/A	<10	30	80	300
WP18	20	10	50	6	N/A	N/A	<10	20	60	230
WP19	10	20	10	4	N/A	N/A	<10	20	50	350
WP20	10	10	<10	<10	N/A	N/A	20	10	40	280
WP21	<10	20	<10	4	N/A	N/A	<10	<10	70	330
WP22	10	20	40	4	N/A	N/A	30	10	70	260
WP23	<10	<10	<10	2	N/A	N/A				190
WP24	20	10	10	2	N/A	N/A				410
WP25	<10	<10	80	<10	N/A	N/A			27	250
Geomean Sites 13-25	13	13	15	4	N/A	N/A	15	15	41	289
WP26				2	N/A	N/A				
WP27				4	N/A	N/A				
WP28				2	N/A	N/A				
WP29				2	N/A	N/A				
WP30				38	N/A	N/A				
WP32					N/A	N/A	<10	<10		
WP33					N/A	N/A	<10	<10		
WP34					N/A	N/A	<10	<10		
Pump										70



**Table 3.** Lancaster Water Treatment Plant Raw Water Intake Data

Month	# of samples	E.coli		
		AVG	Min	Max
Jan	5	0	0	0
Feb	4	1.25	0	3
Mar	4	0.5	0	2
Apr	4	0.25	0	1
May	5	0.2	0	1
Jun	4	2	1	3
Jul	5	0.4	0	2
Aug	4	2	1	4
Sep	4	0.5	0	2
Oct	5	0.8	0	2
Nov	4	0	0	0
Dec	4	1	0	2

**Table 4-A.** Tributaries Study on Westley's Creek (from the RRCA) Note: Samples were taken from Westley's Creek above the 401. UTM location was 0544084E; 5001463N

Date	<i>E. coli</i> (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Specific Conductivity (µS/cm)
12-Jun-07	N/A	7	0.042	587
27-Jun-07	50	27	0.151	484
5-Jul-07	810	8	0.139	326
12-Jul-07	450	30	0.277	474
18-Jul-07	100	9	0.213	466
26-Jul-07	N/A	8	0.106	542
2-Aug-07	N/A	11	0.188	496
9-Aug-07	N/A	15	0.261	239
16-Aug-07	60	<3	0.209	479

**Table 4-B.** Tributaries Study on Raisin River (from RRCA). UTM location 0539809E; 4997334N.

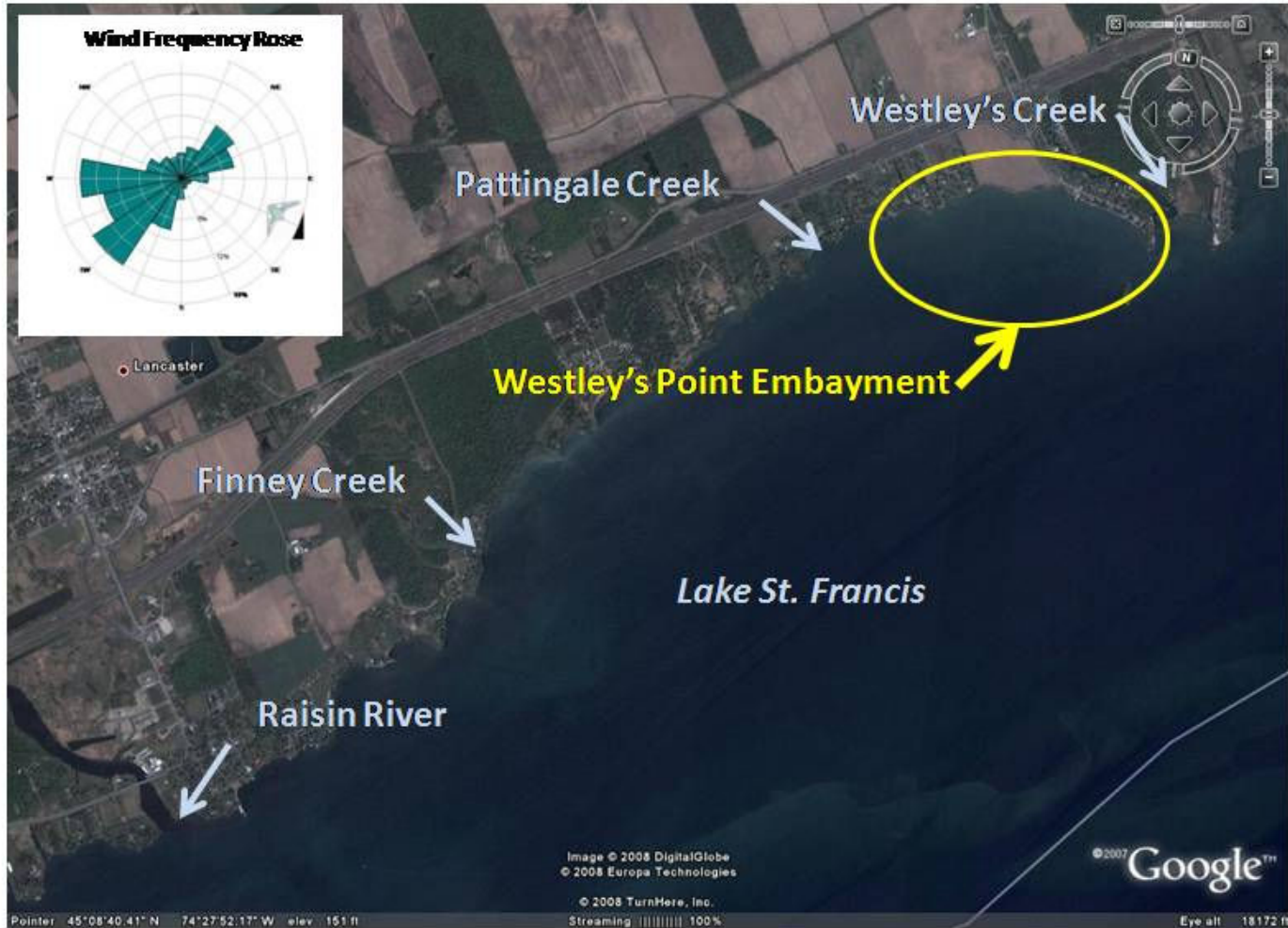
Date	<i>E.coli</i> (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Specific Conductivity (µS/cm)
12-Jun-07	N/A	7	0.048	505
27-Jun-07	<10	<3	0.041	401
5-Jul-07	20	<3	0.053	N/A
12-Jul-07	40	<3	0.064	329
18-Jul-07	10	<3	0.049	362
26-Jul-07	N/A	<3	0.052	421
2-Aug-07	N/A	<3	0.060	436
9-Aug-07	N/A	4	0.072	397
16-Aug-07	28	<3	0.062	358
N/A- Data not available				

**Table 5:** Glengarry Park Beach Bacteria Data

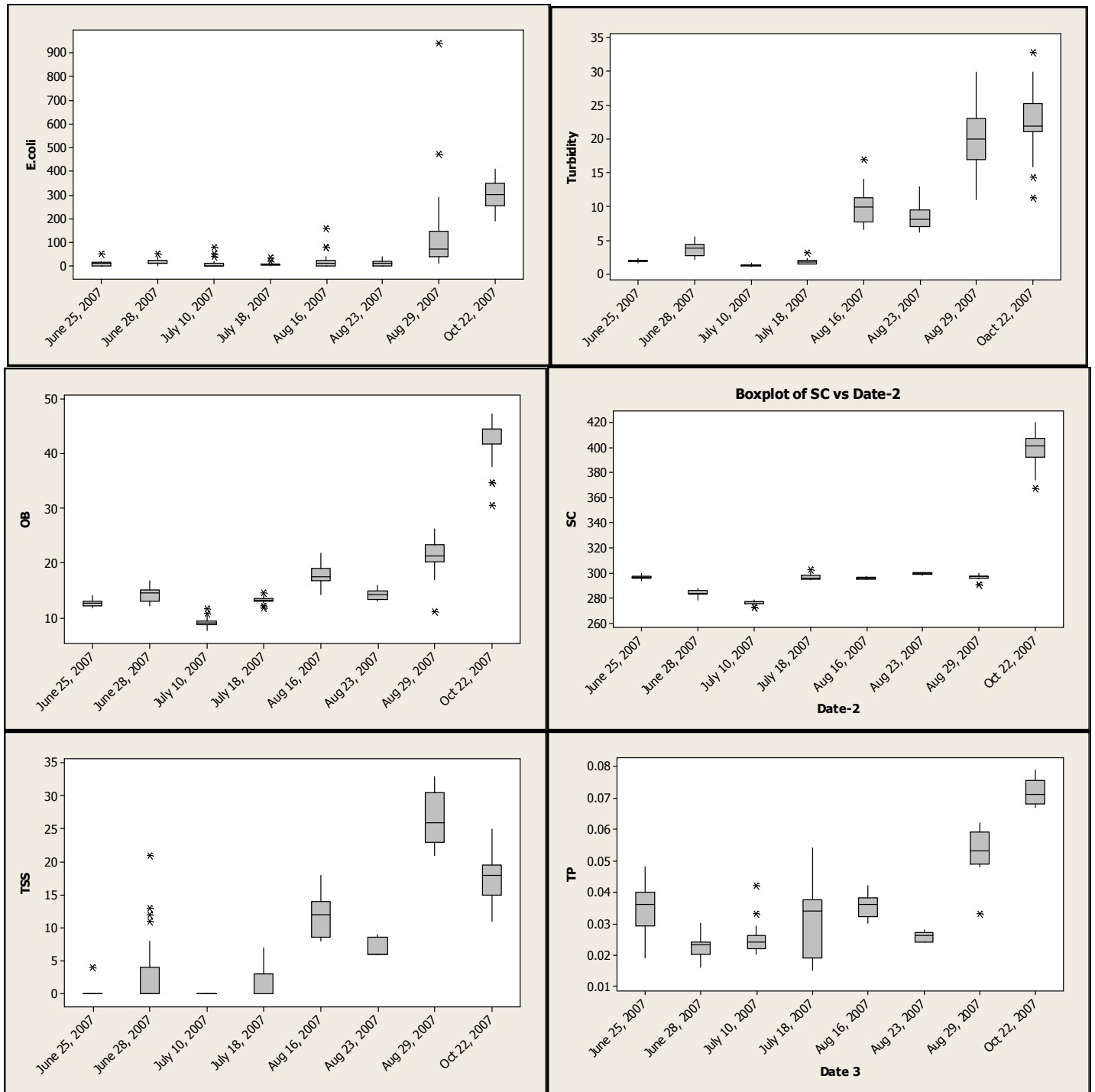
Year	Posted	Opened	Total Days Posted	Total Summer Period in Days	Total Testing Days	Days Exceeding	% Days Exceeding	Total Sampling Weeks	Weeks Exceeding	% Weeks Exceeding	Total Season Rainfall (mm)
2004	8-Jul	20-Aug	44	93	43	11	26%	14	7	50%	290.2
2005	18-Jul	5-Aug	32	89	33	4	12%	13	3	23%	349.7
2006	16-Aug	31-Aug	16	98	32	3	9%	14	3	21%	325.9
2007	12-Jul	18-Jul	7	98	30	4	13%	14	2	14%	269.6

**Table 6:** Charlottenburg Park Bacteria Data

Year	Posted	Opened	Total Days Posted	Total Sampling Weeks	Weeks Exceeding the PWQO	% Weeks Exceeding	Total Test Days	Days Exceeding	% Days Exceeding
2005	Not Posted	Not Posted	0	14	none	0%	12	0	0%
2006	27-Jul	14-Aug	19	15	2	13%	18	4	22%
2007	3-Aug	9-Aug	16	20	2	10%	19	2	11%
2007 Reopened Aug 30		7-Sep							



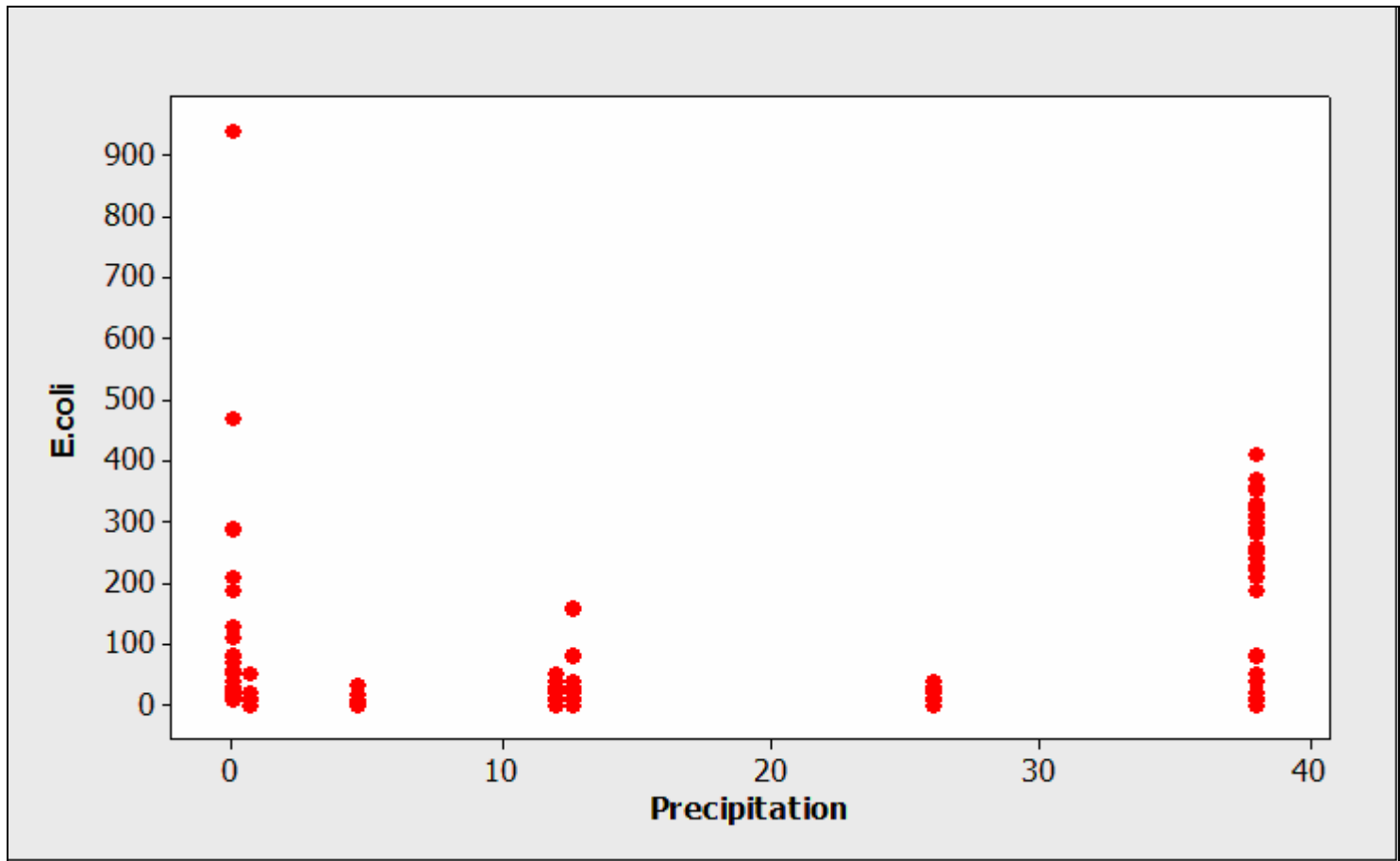
**Figure 1:** Tributaries upstream and downstream of Westley's Point Embayment (monitoring area). Inset shows summertime wind direction frequency.



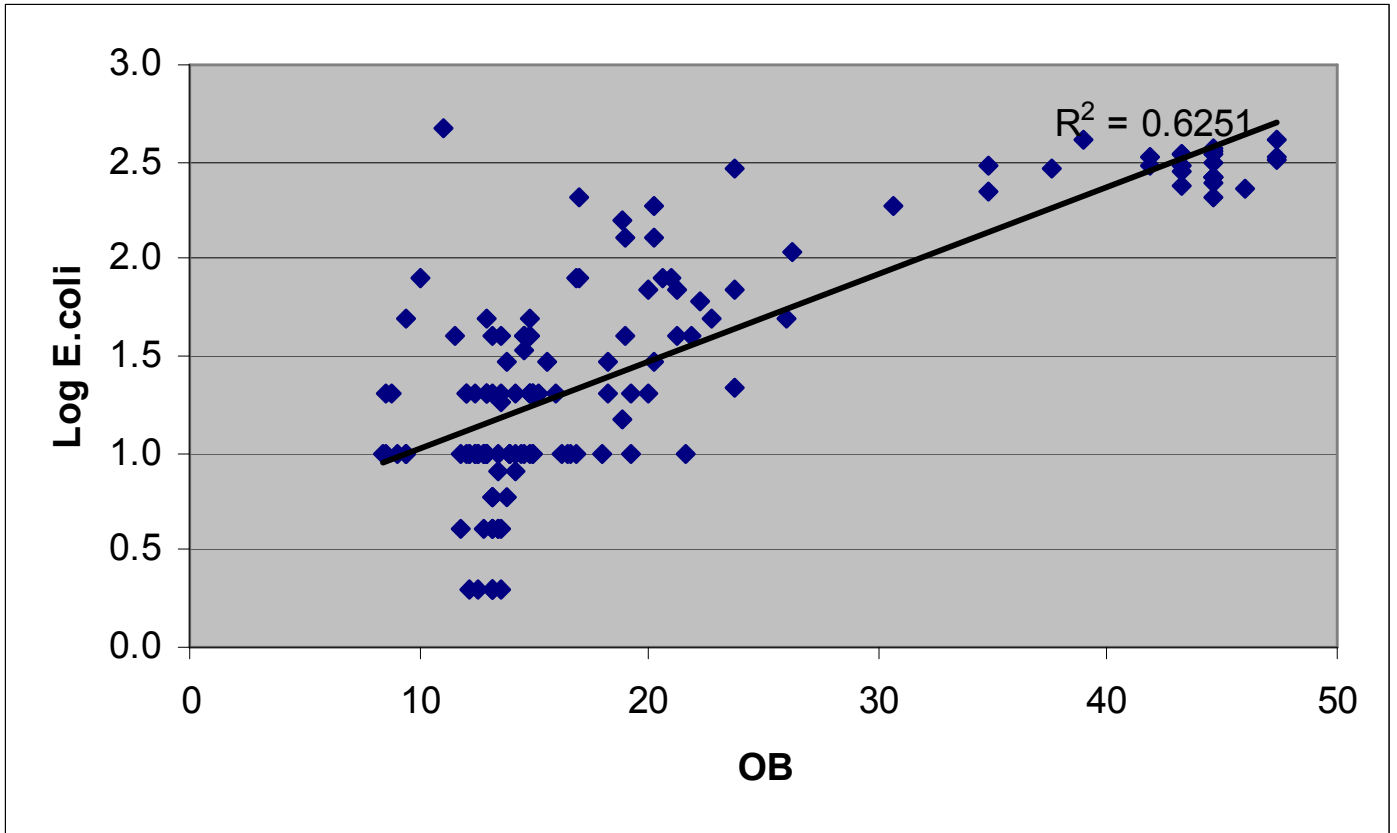
**Figure 2:** Summary of data for *E. coli* (CFU/100 mL), turbidity (NTU), Optical brighteners (OB, µg/L as FB-28), specific conductivity (SC, µS/cm), total suspended solids (TSS, mg/L) and total phosphorus (TB, mg/L). The Figures show boxplots corresponding to each sampling date. The bottom edge of the box represents the first quartile, while the top edge represents the third quartile of the data. The horizontal line drawn through the box represents the median of the data. The lines extending from the box (whiskers) indicate the lowest and highest values in the data set (excluding outliers). Outliers or extreme values are represented by asterisks.



**Figure 3:** *E. coli* values determined at the sampling sites for the August 29, 2007 date – a dry sampling event. Note the instances of high *E. coli* levels at specific sites near cottages along the waterfront.



**Figure 4:** Scatter plot between *E.coli* values and precipitation. There is no apparent relationship between these two parameters during the course of the sampling.

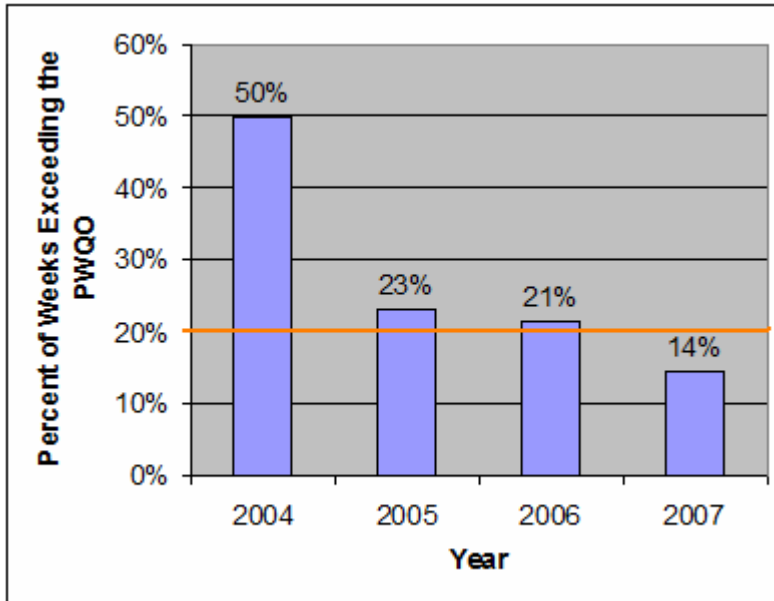


**Figure 5:** Scatter plot showing the relationship between log transformed values for E.coli and optical brighteners.

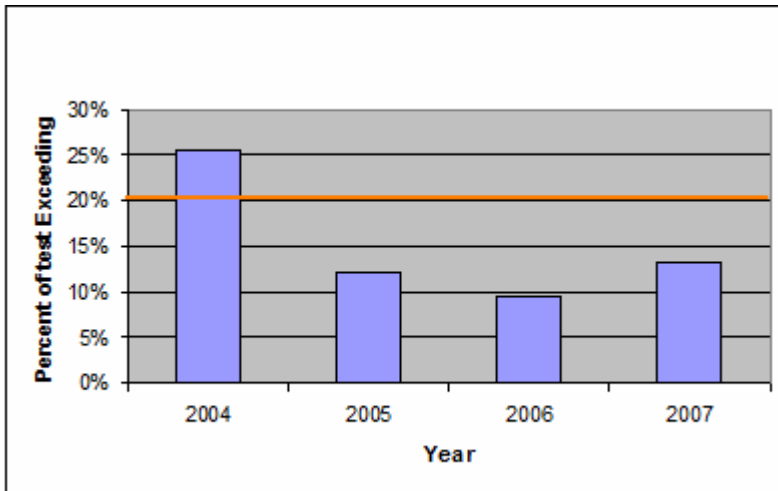




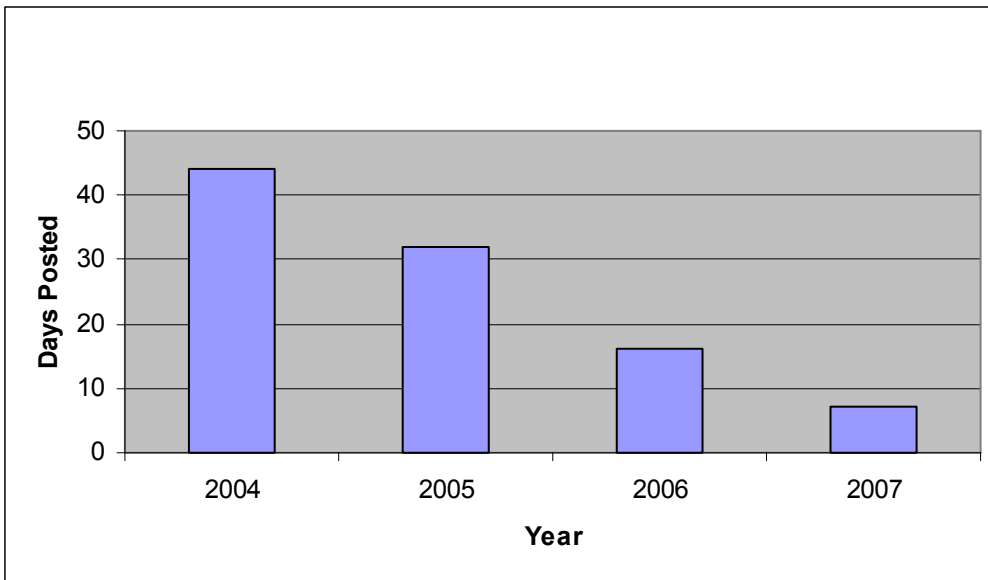
**Figure 6:** Westley's Point embayment aerial photo of the Raisin River outlet showing pronounced plume, affecting nearshore water quality.



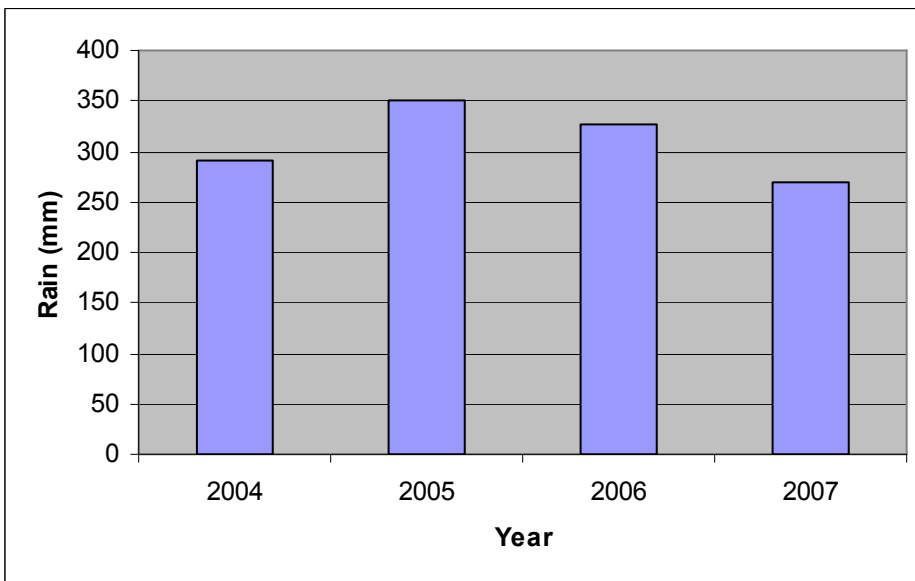
**Figure 7:** Percent of weeks exceeding the PWQO at Glengarry Park Beach. The red line indicates the PWQO for maximum E.coli.



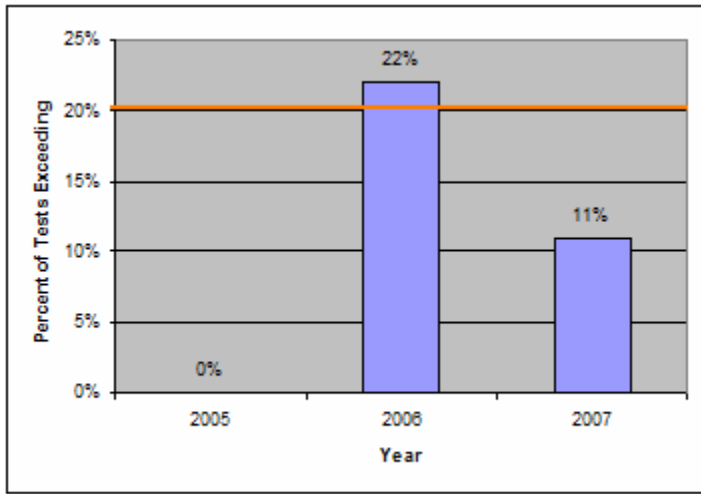
**Figure 8:** Percent of total tests during the swimming season exceeding the PWQO at Glengarry Park Beach. The red line indicates the PWQO for maximum E.coli.



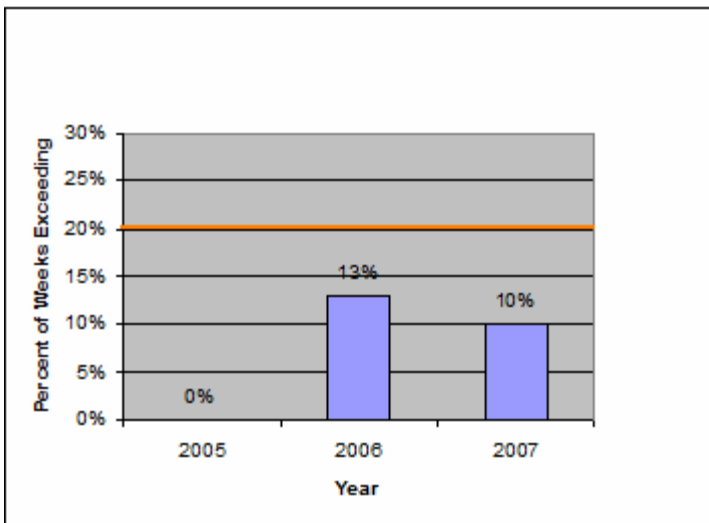
**Figure 9:** Total number of days Glengarry Park Beach was closed during the swimming season due to high E.coli counts.



**Figure 10:** Total rainfall during a swimming season (June to August) at Glengarry Park Beach.



**Figure 11:** Percent of total tests during the swimming season exceeding the PWQO at Charlottenburg Park. The redline indicates the PWQO maximum for E.coli.



**Figure 12:** Percent of weeks during the swimming season exceeding the PWQO at Charlottenburg Park. The redline indicates the PWQO maximum for E.coli.

**Appendix A.**

<b>UTM Coordinates of Sampling Sites</b>		
<b>Site</b>	<b>Easting</b>	<b>Northing</b>
WP1	18T 0544002	5000736
WP2	18T 0544357	5000591
WP3	18T 0544275	5000625
WP4	18T 0544191	5000647
WP5	18T 0544192	5000649
WP6	18T 0544192	5000664
WP7	18T 0544124	5000672
WP8	18T 0544075	5000690
WP9	18T 0544036	5000692
WP10	18T 0544040	5000702
WP11	18T 0544042	5000713
WP12	18T 0543989	5000726
WP13	18T 0543952	5000742
WP14	18T 0543923	5000727
WP15	18T 0543876	5000704
WP16	18T 0543870	5000716
WP17	18T 0543867	5000725
WP18	18T 0543844	5000711
WP19	18T 0543819	5000711
WP20	18T 0543788	5000691
WP21	18T 0543718	5000695
WP22	18T 0543642	5000701
WP23	18T 0543581	5000684
WP24	18T 0543574	5000687
WP25	18T 0543570	5000694
WP26	18T 0543979	5000606
WP27	18T 0544004	5000667
WP28	18T 0544048	5000517
WP29	18 T 0544288	5000132
WP30	18 T 0544484	5000574
WP32	18T 0544028	5000649
WP33	18T 0544004	5000542
WP34	18T 0543897	5000229



Westley's Point Bacteria Monitoring 2007/2008

June 28 results							
Parameter	E.coli (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)
Site							
WP1	10	21	0.026	4.7	15.0	23.5	288.0
WP2	10	<3	0.022	5.5	15.0	23.5	286.0
WP3	40	<3	0.024	5.0	14.6	23.4	285.0
WP4	20	<3	0.024	4.2	15.2	23.2	286.0
WP5	20	<3	0.030	4.6	15.0	23.4	283.0
WP6	30	11	0.024	4.3	15.6	23.4	284.0
WP7	10	<3	0.025	4.1	14.8	23.4	284.0
WP8	40	4	0.024	4.3	14.6	23.3	285.0
WP9	10	<3	0.022	4.2	14.0	23.2	286.0
WP10	20	13	0.027	4.0	14.8	23.2	285.0
WP11	50	<3	0.024	4.4	14.8	23.4	286.0
WP12	40	<3	0.027	4.1	14.8	23.4	285.0
WP13	10	<3	0.021	3.8	16.8	23.4	286.0
WP14	40	<3	0.023	2.2	13.6	23.7	282.0
WP15	10	<3	0.020	2.6	12.2	23.6	284.0
WP16	<10	<3	0.020	2.9	13.2	23.7	283.0
WP17	10	<3	0.024	2.7	12.8	23.6	284.0
WP18	10	8	0.023	2.9	13.0	23.7	283.0
WP19	20	<3	0.020	2.5	15.0	24.3	282.0
WP20	10	12	0.019	2.7	12.8	23.4	284.0
WP21	20	<3	0.017	2.9	13.0	24.5	279.0
WP22	20	<3	0.024	3.2	14.2	24.4	284.0
WP23	<10	<3	0.016	2.4	12.2	23.9	286.0
WP24	10	3	0.017	2.3	13.0	23.9	285.0
WP25	<10	4	0.021	3.1	12.6	24.3	283.0
WP26							
WP27							
WP28							
WP29							
WP30							
WP32							
WP33							
WP34							

Note: Metal scans were not done on this sampling occasion.

Westley's Point Bacteria Monitoring 2007/2008

July 10 results							
Parameter							
Site	E.coli (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)
WP1	20	<3	0.021	1.3	8.8	20.9	279.0
WP2	10	<3	0.022	1.3	8.6	20.7	277.0
WP3	<10	<3	0.024	1.3	8.6	20.8	276.0
WP4	<10	<3	0.024	1.3	8.4	21.0	278.0
WP5	<10	<3	0.022	1.6	8.6	21.1	279.0
WP6	10	<3	0.026	1.4	8.4	20.9	277.0
WP7	<10	<3	0.021	1.4	8.8	20.9	277.0
WP8	<10	<3	0.021	1.3	9.0	21.1	277.0
WP9	20	<3	0.024	1.6	8.6	21.1	276.0
WP10	<10	<3	0.024	1.2	10.8	21.1	277.0
WP11	10	<3	0.028	1.2	9.4	21.1	277.0
WP12	<10	<3	0.023	1.0	7.6	21.2	277.0
WP13	<10	<3	0.022	1.2	9.8	21.3	275.0
WP14	<10	<3	0.024	1.1	9.4	21.4	278.0
WP15	<10	<3	0.026	1.0	8.8	21.2	276.0
WP16	<10	<3	0.020	1.2	9.0	21.3	276.0
WP17	<10	<3	0.025	1.0	8.8	21.2	276.0
WP18	50	<3	0.024	1.5	9.4	21.4	276.0
WP19	10	<3	0.022	1.3	9.4	21.6	273.0
WP20	<10	<3	0.042	1.1	9.2	21.5	273.0
WP21	<10	<3	0.033	1.1	10.4	21.7	276.0
WP22	40	<3	0.029	1.1	11.6	21.6	277.0
WP23	<10	<3	0.020	1.2	8.8	21.5	278.0
WP24	10	<3	0.028	1.3	9.0	21.5	278.0
WP25	80	<3	0.025	1.5	10.0	21.6	276.0
WP26							
WP27							
WP28							
WP29							
WP30							
WP32							
WP33							
WP34							

Note: Metal scans were not done on this sampling occasion.



Westley's Point Bacteria Monitoring 2007/2008

July 18 Results							
Parameter	E.coli (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)
Site							
WP1	34	3	0.018	2.3	14.6	22.3	303.0
WP2	6			2.0	13.8	22.4	301.6
WP3	8	3	0.021	3.1	14.2	22.3	300.2
WP4	<10			1.6	13.0	22.2	298.2
WP5	18	<3	0.018	2.1	13.6	22.2	298.8
WP6	8			2.0	13.4	22.2	299.6
WP7	4	7	0.018	2.1	13.6	22.3	298.7
WP8	4			1.6	13.4	22.3	297.7
WP9	2			1.5	13.2	22.3	296.9
WP10	2	3	0.022	1.9	13.2	22.3	297.0
WP11	<10		0.015	2.3	13.2	22.4	297.8
WP12	6	4	0.015	1.8	13.2	22.3	296.5
WP13	6		0.020	1.4	13.2	22.4	296.4
WP14	4	3	0.020	1.7	13.4	22.4	295.5
WP15	2		0.034	1.5	13.2	22.4	295.7
WP16	2	3	0.034	1.8	13.6	22.4	295.6
WP17	4			1.7	13.2	22.5	296.0
WP18	6			1.9	13.2	22.5	295.8
WP19	4		0.038	1.4	13.2	22.6	295.1
WP20	<10	<3	0.038	1.6	13.0	22.6	295.9
WP21	4			1.4	11.8	22.6	295.3
WP22	4			1.4	12.8	22.7	295.2
WP23	2			1.4	12.2	22.6	294.6
WP24	2	<3	0.037	1.6	12.6	22.7	295.6
WP25	<10			2.1	13.0	22.9	295.2
WP26	2	<3	0.034	1.9	11.2	22.1	301.4
WP27	4	3	0.036	2.6	12.2	22.5	293.7
WP28	2	<3	0.041	1.7	11.6	22.1	301.1
WP29	2	<3	0.033	0.5	7.4	21.6	308.5
WP30	38	3	0.054	2.4	19.6	23.8	308.0
WP32							
WP33							
WP34							

Note: Metal scans were not done on this sampling occasion.

Westley's Point Bacteria Monitoring 2007/2008

July 26 Results							
Parameter	E.coli (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)
Site							
WP1		<3	0.045	1.5	43.6	24.9	341.1
WP2				1.9	39.0	25.2	344.1
WP3		3	0.056	1.4	39.6	24.7	338.1
WP4				1.4	40.6	24.8	346.6
WP5		3	0.065	1.3	39.8	24.7	346.8
WP6				1.4	39.8	24.6	339.3
WP7		<3	0.037	1.3	39.6	24.3	340.2
WP8				1.5	40.0	24.4	341.9
WP9				1.2	40.8	24.5	341.8
WP10		<3	0.048	1.2	41.2	24.5	343.1
WP11				1.5	39.4	24.5	342.7
WP12		<3	0.082	1.2	39.6	24.5	343.9
WP13				1.1	39.4	24.6	339.1
WP14				1.4	41.0	24.6	332.5
WP15		<3	0.065	1.1	41.2	24.4	336.1
WP16				1.1	40.8	24.4	336.8
WP17				1.2	41.6	25.1	335.8
WP18				1.1	40.8	24.7	331.3
WP19				1.0	42.0	24.7	330.1
WP20		<3	0.029	0.9	42.4	24.6	332.8
WP21				1.0	41.8	24.8	331.1
WP22				1.0	41.4	25.6	341.7
WP23				1.0	43.2	24.9	341.2
WP24		<3	0.027	1.1	40.8	25.0	337.4
WP25				1.1	42.0	25.2	334.3
WP26							
WP27							
WP28							
WP29							
WP30							
WP32							
WP33							
WP34							

Note: Metal scans were not done on this sampling occasion.

Aug 7 Results	Parameter		TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Ag (mg/L)	Al (mg/L)	As (mg/L)	Ba (mg/L)	Be (mg/L)	B (mg/L)	Bi (mg/L)	Ca (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	K (mg/L)	Li (mg/L)	Mg (mg/L)	Mn (mg/L)	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (mg/L)	Pb (mg/L)	Sb (mg/L)	Se (mg/L)	Si (mg/L)	Sn (mg/L)	Sr (mg/L)	Ti (mg/L)	Ti (mg/L)	U (mg/L)	V (mg/L)	W (mg/L)	Y (mg/L)	Zn (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)					
WP1			<3	0.01	2.2	18.6	<0.05	0.04	0.00	0.01	<0.00	0.01	<0.00	28.6	<0.02	<0.03	<0.01	<0.00	0.03	1.48	<0.02	8.69	0.00	<0.05	12.6	<0.01	<0.01	<0.05	<0.02	<0.02	0.21	<0.03	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.6	273.0				
WP2			<3	0.02	2.1	18.4	<0.05	0.08	<0.08	0.01	<0.01	0.01	<0.03	28.9	<0.02	<0.03	<0.01	<0.01	0.06	1.51	<0.02	8.86	0.00	<0.05	12.9	<0.01	<0.01	<0.05	<0.02	0.29	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.6	273.0					
WP3			<3	0.02	2.2	18.6	<0.05		<0.08	0.02	<0.01	0.01	<0.03	29.3	<0.02	<0.03	<0.01	0.00			<0.02	8.98	0.00	<0.05		<0.01	<0.01	<0.05	<0.02	0.34	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.6	273.0					
WP4			<3	0.02	1.9	18.4	<0.05	0.09	<0.08	0.02	<0.01	0.01	<0.03	29.3	<0.02	<0.03	<0.01	<0.01	0.08	1.51	<0.02	8.98	0.00	<0.05	13.0	<0.01	<0.01	<0.05	<0.02	0.34	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.5	273.0					
WP5			<3	0.02	2.2	18.6	<0.05	0.06	<0.08	0.02	<0.01	0.01	<0.03	29.6	<0.02	<0.03	<0.01	<0.01	0.05	1.51	<0.02	9.01	0.00	<0.05	13.2	<0.01	<0.01	<0.05	0.04	0.26	<0.03	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.5	273.0					
WP6			<3	0.01	2.0	19.2	<0.05	0.08	<0.08	0.02	<0.01	0.02	<0.03	29.1	<0.02	<0.03	<0.01	<0.01	0.07	1.54	<0.02	8.86	0.00	<0.05	13.0	<0.01	<0.01	<0.05	0.02	0.31	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.4	275.0					
WP7			<3	0.01	2.5	20.0	<0.05		<0.08	0.02	<0.01	0.02	<0.03	29.6	<0.02	<0.03	<0.01	<0.01	0.06	1.51	<0.02	8.99	0.00	<0.05	12.9	<0.01	<0.01	<0.05	<0.02	0.28	<0.03	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.4	275.0					
WP8			<3	0.01	1.8	18.4	<0.05	0.07	<0.08	0.01	<0.01	0.02	<0.03	29.6	<0.02	<0.03	<0.01	<0.01	0.06	1.51	<0.02	8.99	0.00	<0.05	12.9	<0.01	<0.01	<0.05	<0.02	0.28	<0.03	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.4	275.0				
WP9			<3	0.02	1.7	18.2	<0.05	0.08	<0.08	0.02	<0.01	0.02	<0.03	28.5	<0.02	<0.03	<0.01	<0.01	0.06	1.47	<0.02	8.71	0.00	<0.05	12.7	<0.01	<0.01	<0.05	<0.02	0.28	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.4	274.0				
WP10			<3	0.02	2.1	18.4	<0.05	0.06	<0.08	0.02	<0.01	0.02	<0.03	28.5	<0.02	<0.03	<0.01	<0.01	0.05	1.46	<0.02	8.57	0.00	<0.05	12.4	<0.01	<0.01	<0.05	<0.02	0.25	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.3	273.0				
WP11			<3	0.01	2.3	19.0	<0.05	0.08	<0.08	0.02	<0.01	0.02	<0.03	29.6	<0.02	<0.03	<0.01	<0.01	0.07	1.58	<0.02	8.88	0.00	<0.05	12.9	<0.01	<0.01	<0.05	<0.02	0.30	<0.03	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.3	276.0					
WP12			<3	0.01	1.8	18.4	<0.05		<0.08	0.02	<0.01	0.01	<0.03	29.3	<0.02	<0.03	<0.01	<0.01	0.06	1.51	<0.02	8.96	0.00	<0.05	13.0	<0.01	<0.01	<0.05	<0.02	0.29	<0.03	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.3	278.0					
WP13			<3	0.01	1.6	18.4	<0.05	0.07	<0.08	0.03	<0.01	0.08	<0.03	29.3	<0.02	<0.03	<0.01	<0.01	0.06	1.51	<0.02	8.96	0.00	<0.05	13.0	<0.01	<0.01	<0.05	<0.02	0.29	<0.03	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.4	274.0				
WP14			<3	0.01	1.6	18.8	<0.05																																		23.5	273.0					
WP15			<3	0.01	1.5	18.2	<0.05																																			23.3	274.0				
WP16			<3	0.01	1.6	18.2	<0.05																																			23.4	273.0				
WP17			<3	0.01	1.7	18.2	<0.05																																			23.3	273.0				
WP18			<3	0.01	1.7	18.4	<0.05																																			23.2	274.0				
WP19			<3	0.02	1.7	18.6	<0.05																																			23.3	273.0				
WP20			<3	0.02	1.8	18.6	<0.05	0.08	0.00	0.02	<0.01	0.01	<0.03	28.5	<0.02	<0.03	<0.01	<0.01	0.07	1.43	<0.02	8.64	0.00	<0.05	12.8	<0.01	<0.01	<0.05	<0.02	0.31	<0.03	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	23.2	274.0					
WP21			<3	0.01	1.6	18.6	<0.05																																			23.4	273.0				
WP22			<3	0.01	1.5	18.0	<0.05																																			23.4	274.0				
WP23			<3	0.01	1.4	17.0	<0.05																																			23.5	275.0				
WP24			<3	0.01	1.6	19.2	<0.05																																			23.6	276.0				
WP25			<3	0.01	1.7	19.4	<0.05																																			23.4	274.0				
WP26			<3	0.01			<0.05																																								
WP27			<3	0.01			<0.05																																								
WP28			<3	0.01			<0.05																																								
WP29			<3	0.01			<0.05																																								
WP30			<3	0.01			<0.05																																								
WP32			<3	0.01			<0.05																																								
WP33			<3	0.01			<0.05																																								
WP34			<3	0.01			<0.05																																								



Westley's Point Bacteria Monitoring 2007/2008

Aug 23 Results							
Parameter	E.coli (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)
Site							
WP1	40	6	0.027	6.2	13.2	20.1	299.7
WP2	10			7.4	13.0	20.2	299.8
WP3	<10	6	0.027	13.0	15.6	20.2	299.8
WP4	<10			8.2	13.4	20.3	299.9
WP5	<10	8	0.024	12.0	16.0	20.2	300.1
WP6	20			8.1	14.8	20.2	300.2
WP7	<10	9	0.024	12.0	15.2	20.2	300.3
WP8	10			9.2	14.6	20.2	300.3
WP9	<10			8.9	14.2	20.3	300.2
WP10	40	9	0.024	9.9	14.8	20.2	300.3
WP11	10			8.8	14.2	20.2	300.3
WP12	20	8	0.026	10.0	16.0	20.2	300.3
WP13	10			8.1	14.4	20.2	300.2
WP14	20	6	0.025	8.8	14.8	20.3	299.4
WP15	<10			7.1	13.4	20.3	299.1
WP16	20	6	0.028	9.4	15.0	20.3	299.1
WP17	30			7.0	13.8	20.2	299.8
WP18	20			6.8	13.6	20.3	299.0
WP19	20			7.0	13.2	20.3	298.7
WP20	10	6	0.027	7.7	14.0	20.3	298.7
WP21	<10			6.4	13.2	20.3	298.0
WP22	10			6.6	14.0	20.2	299.7
WP23							
WP24							
WP25							
WP26							
WP27							
WP28							
WP29							
WP30							
WP32	<10			8.5	14.0	20.4	300.0
WP33	<10			6.8	13.2	20.3	297.3
WP34	<10	<3	0.012	1.3	7.8	20.6	298.0

Note: Metal scans were not done on this sampling occasion.

Westley's Point Bacteria Monitoring 2007/2008

Aug 29 Results							
Parameter	E.coli (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)
Site							
WP1	940	31	0.062	23.0	23.2	23.2	298.8
WP2	130			16.0	19.0	23.2	298.8
WP3	110	29	0.061	30.0	26.2	23.4	298.1
WP4	22			23.0	23.8	23.4	297.9
WP5	50	33	0.050	29.0	26.0	23.4	296.2
WP6	80			17.0	21.0	23.4	297.6
WP7	30	22	0.033	21.0	20.2	23.2	299.8
WP8	210			13.0	17.0	23.4	297.8
WP9	130			18.0	20.2	23.4	297.6
WP10	290	21	0.048	23.0	23.8	23.5	297.3
WP11	470			11.0	11.0	23.4	297.9
WP12	190	24	0.057	22.0	20.2	23.4	298.3
WP13	10			21.0	21.6	23.5	297.3
WP14	70	30	0.053	25.0	23.8	23.5	295.5
WP15	15			16.0	18.8	23.5	295.3
WP16	40	25	0.053	21.0	21.8	23.5	296.3
WP17	80			18.0	20.6	23.6	297.4
WP18	60			17.0	22.2	23.6	297.7
WP19	50			18.0	22.8	23.6	290.7
WP20	40	26	0.052	21.0	21.2	23.6	297.4
WP21	70			17.0	21.2	23.6	296.8
WP22	70			19.0	20.0	23.6	291.0
WP23							
WP24							
WP25	27			26.0	25.4	23.6	295.9
WP26							
WP27							
WP28							
WP29							
WP30							
WP32							
WP33							
WP34							

Note: Metal scans were not done on this sampling occasion.

Westley's Point Bacteria Monitoring 2007/2008

Oct 22 Results							
Parameter	E.coli (CFU/100mL)	TSS (mg/L)	TP (mg/L)	Turbidity (NTU)	OB (mg/L)	Water Temp. °C	Specific Conductivity (µs/cm)
Site							
WP1	210	25	0.079	29.9	44.6	16.3	393.1
WP2	350			21.4	43.2	15.9	411.6
WP3	260	18	0.069	23.2	44.6	15.7	407
WP4	300			18.2	34.8	15.4	374.5
WP5	300	16	0.067	21.8	41.8	15.6	390.5
WP6	320			27.9	47.4	15.6	406.2
WP7	330	20	0.069	25.4	41.8	15.9	406.7
WP8	240			21.4	43.2	15.8	397.4
WP9	290			15.8	37.6	15.5	383.1
WP10	360	18	0.071	21.9	44.6	15.9	402.4
WP11	410			32.8	47.4	16.2	414.4
WP12	260	16	0.077	21.6	44.6	16.1	399.2
WP13	310			21.0	44.6	16.3	412.2
WP14	350			21.1	44.6	16	407.9
WP15	220	11	0.067	14.3	34.8	15.5	378.8
WP16	370			21.6	44.6	15.9	395.7
WP17	300			25.1	43.2	15.8	399.8
WP18	230			24.5	46.0	16.3	402.4
WP19	350			23.1	43.2	16	400.9
WP20	280	19	0.071	23.2	43.2	15.8	398.1
WP21	330			28.0	47.4	16.3	404.5
WP22	260			23.6	44.6	16.1	407.8
WP23	190			11.3	30.6	15.6	367.7
WP24	410	14	0.074	19.2	39.0	15.8	389.7
WP25	250			28.8	44.6	16	420.1
WP26							
WP27							
WP28							
WP29							
WP30							
WP32							
WP33							
WP34							
Pump	70	26	0.026	25.0	44.6		450.9

Note: Metal scans were not done on this sampling occasion.

