ARMSTRONG WEST EROSION CONTROL WORKS

2007-2008 Monitoring Report

September 2008

Aerial Photo taken April 30, 2007, Kalloon Photography

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September 8, 2008

Mr. Joseph de Laronde
Habitat Biologist
Fisheries and Oceans Canada
Southern Ontario District
73 Meg Drive, London, Ontario N6E 2V2

Re: Armstrong West Erosion Control Works – 2008 Monitoring Program
TSH Project No. 54-22264

Dear Mr. de Laronde:

Please find enclosed two copies of a report summarizing the findings of our 2007-2008 monitoring program for the above noted project. This report fulfills the conditions of the DFO Authorization for Works or Undertakings Affecting Fish Habitat (DFO File No.: SA-06-0975), as stated in a letter from Ken Brant dated November 22, 2006, requiring the following items:

- Assessment of bank stabilization methods including any vegetative plantings (Note: there were no vegetative plantings in the design);
- A photographic record of existing conditions, work phase activities, and post-construction conditions; and
- A written report summarizing monitoring results.

This report also serves as documentation that the Transport Canada – Navigable Waters Protection (NavWaters) requirements for maintaining a navigable channel are achieved.

Further, this report also serves as the Post Construction Monitoring Report that is required as part of the Conservation Ontario Class Environmental Assessment (EA) process. This report includes:

- An assessment of the effectiveness of the undertaking in achieving its desired goals;
- Documentation of follow-up maintenance as necessary;
- A summary of the baseline inventory for the site;
- Documentation of changes in baseline site conditions, including a photographic record;
- Measures that have been or will be taken to address any negative impacts that can be attributed to the remedial work itself; and
- A schedule for ongoing monitoring.

1. Background

The east side of the Armstrong West subdivision, which lies along the west bank of the river braid, is particularly prone to significant erosion and several vacant lots have been permanently submerged and other developed lots are at risk. During periods of average to high lake levels, 1976 to 1999, the average erosion rate along the Armstrong West shoreline was approximately 0.5 m/yr. However, during low lake levels from 1999 to 2006, the average erosion rate was 5.4 m/yr.

The Armstrong West Erosion Control Works project follows the implementation recommendation of the recommended alternative from the Class EA conducted in 2005 according to the Conservation Ontario Class EA study process under its policy category for Remedial Erosion Control Projects. The recommended alternative was a series of bendway weirs; submerged rock structures that are keyed into the bank and extend outward into the river channel to re-establish bank stability. This was the only alternative that met all of the desired selection criteria, namely:

- Provides immediate protection of the bank;
- Maintains navigation requirements for boat passage;
- Provides silt control and re-establishes bank;
- Minimal maintenance requirements; and
- Enhances aquatic habitat as the rock habitat material improves habitat conditions for bass which are also the host species for some of the mussel "species at risk".

The design advantage of bendway weirs is based on their ability to redirect currents particularly during the high flow periods with high erosive energy. Orienting the weirs against the current redirects the flow at a 90-degree angle away from the weir toward the center of the watercourse, thereby reducing erosive velocities along the bank. The bendway weirs also provide a method of sediment management by capturing sediment within the river channel below the navigation traffic, accumulating sediment behind the weir, and re-establishing the bank. For added structural stability, approximately 325 m of rock revetment was installed along the shoreline.

The conceptual design of the erosion control works was developed based on model results using HEC-RAS and further refined based on analysis using a two-dimensional hydraulic model, RMA-2. The final design featured 7 bendway weirs on approximately 40 m centers (each typically 2.5 m high and ranging from 15-30 m in length with an orientation of 60–80 degrees clockwise from shore).

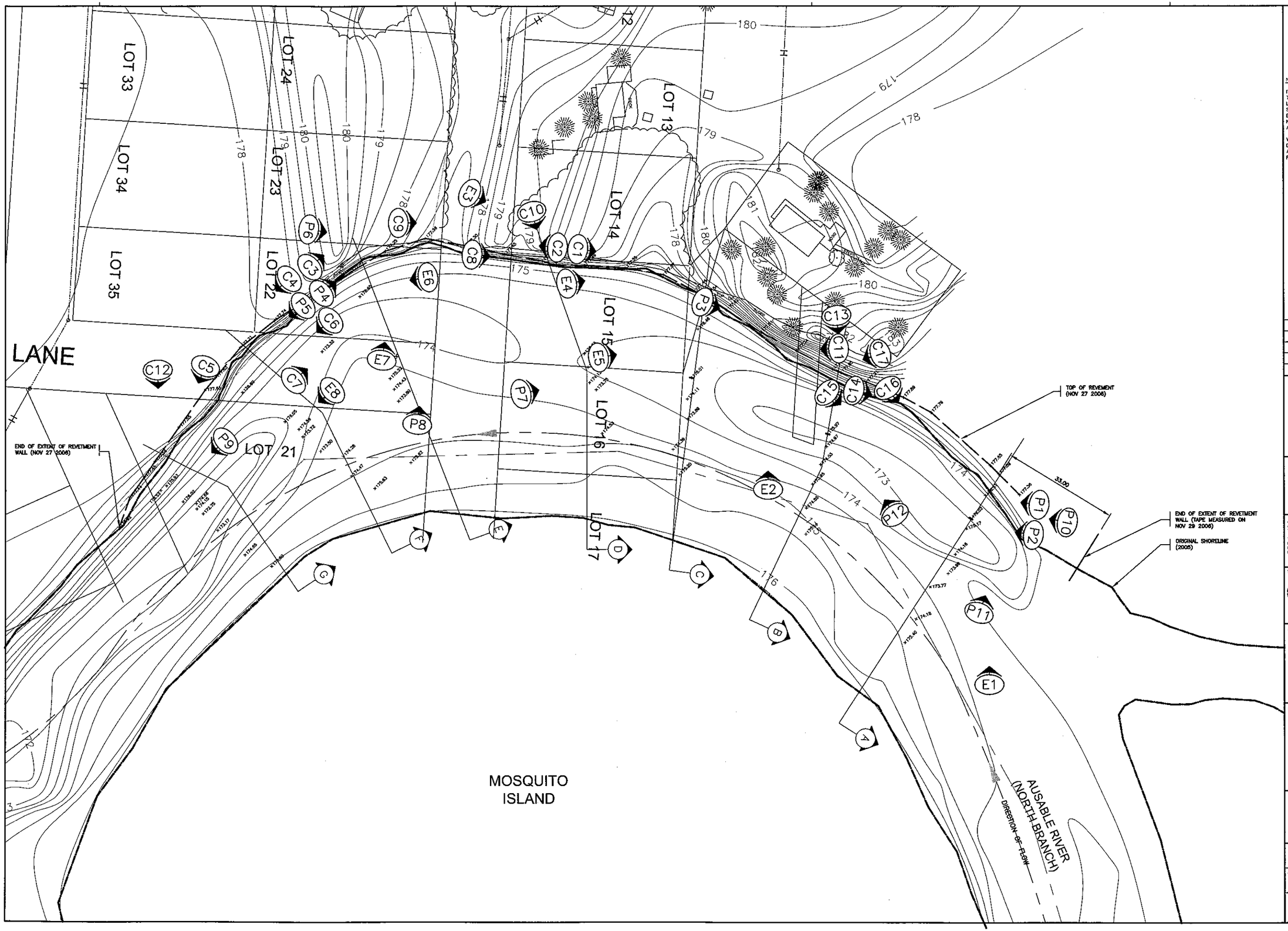
Following the EA process, provincial and federal permitting and approvals agencies commented on the project design including Fisheries and Oceans Canada (DFO), Transport Canada – Navigable Waters Protection (NavWaters), and Ontario Ministry of Natural Resources (MNR). The following key mitigation and compensation measures were identified:

- Rock material to be well-graded, washed and cleaned of fines prior to placement in the water;
- The timing of in-water construction work to be limited to protect local fish populations during their spawning and nursing periods, as well as to avoid recreational boating traffic;
- A monitoring program to be conducted up to 2 years following construction;
- Following construction, a navigable channel measuring 10 m (33 ft) wide by 2 m (6.5 ft) deep is to be maintained in the river during the navigation season; and
- Lighted navigation markers to be installed at the end of each weir and remain in place throughout the boating season.

The construction period lasted between September and November 2006, with the placement of rock in the water during the period of October 19 – November 30. This construction period met the fisheries timing window identified by MNR and also avoided impacting recreational boating traffic through the Labor Day weekend.

2. Monitoring Observations – Photographic Record

Photos documenting before, during, and after construction conditions are included in the attached photographic record. The vantage points for these photos are indicated in **Figure 1**, which shows the project site and orientation of the centerline of the bendway weirs, named A (north end) to G (south end), and the top of the revetment slope. The cover of this report shows an aerial photo of the site taken in April 2007.



NORTH

NOTE:

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LEGEND

- (A) DESIGN WEIR CENTRELINE LOCATION
- NEW TOP OF REVEMENT WALL
- SHORELINE 2005
- (E6) PRE-CONSTRUCTION PHOTO REFERENCE AND DIRECTION OF VIEW
- (C6) CONSTRUCTION PHOTO REFERENCE AND DIRECTION OF VIEW
- (P6) POST-CONSTRUCTION PHOTO REFERENCE AND DIRECTION OF VIEW

No.	DATE	BY	ISSUES / REVISIONS
4	07/12/06	EJ	UPDATE FOR PHOTO FIGURE
3	07/12/06	MM	ISSUE FOR AS BUILT RECORD
2	01/09/06	KV	ISSUE FOR CONSTRUCTION
1	20/06/06	KV	REVISE WEIR/REVETMENT DETAILS

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PARTNER:

HCCL
COASTAL AND RIVER ENGINEERING
WATER RESOURCES AND ENVIRONMENTAL HYDRAULICS

CLIENT:

AUSABLE BAYFIELD CONSERVATION AUTHORITY

PROJECT:

ARMSTRONG WEST EROSION CONTROL

PORT FRANKS, ONTARIO

DRAWING:

PHOTOGRAPHIC VANTAGE POINTS

DRAWN BY:	CHECKED BY:	PROJECT No. :
LC/KV/MM/EJ	MG	54-22264-01
DESIGNED BY:	APPROVED BY:	DRAWING No.
HCCL/MW	RT	FIGURE 1
SCALE: 1:1000	DATE: AUG 2007	

Pre-Construction
Photos E1 through E8 document pre-construction conditions and were taken in August 2005. These photos cover the length of the shoreline in the project site and indicate a highly unstable and eroding slope.

Construction
The rock material featured a combination of graded rock, 100 to 300 mm (4 to 12 in) in diameter, and shot rock, generally 50 to 600 mm (2 to 24 in) in diameter. Shot rock is the unprocessed material taken from a quarry face prior to machining and grading. From a technical stability viewpoint, shot rock was preferred over alluvial embankment material because of the high angularity of the individual pieces and their ability to interlock more tightly in underwater placement. The final quantity of rock was 12,910 metric tons, comprised of approximately 80 percent shot rock and 20 percent graded rock. The graded rock was generally favored in the construction at the top of the rock revetment, given its neater appearance. Also, the largest pieces of shot rock were generally used near the toe of each weir for added scour protection.

It was determined that the only feasible method of construction was to stockpile the material and transport it by barge across the river. Access by road was not possible from the north, as the roads through the Pinery Provincial Park, located north of Armstrong West and the roads within the Armstrong West subdivision were inadequate to support the loading of the haul trucks. The municipal roads that led to the stockpile area on the south shore of the river held up well during the construction period, with only minor repairs needed despite serving as the haul route for 331 truckloads of rock material.

The first two photos show the stockpiled rock in the staging area. In the first photo, the graded rock is shown on the left and the shot rock on the right.

The site was prepared by regrading the dunes and shoreline to provide a construction terrace for excavator access. This is shown in photos C1 through C4. The sequential construction of the rock revetment and bendway weirs is shown in photos C5 through C17. The photo between C10 and C11 shows one of the two barges that were used in the construction. Rock was pulled off the barge and then moved into place by an excavator. With two barges in operation, the contractor was able to place rock at a rate of up to 90 metric tons per hour.

For safety reasons, construction operations were suspended during high flow conditions in the river. Only one such event occurred during the construction period. Photo C12 shows the high water level at weir G following this event in mid-November and gives evidence of the debris that was trapped. The collection of floating debris by the weirs is encouraged as it helps to re-establish bank and also prevents this debris from impacting boaters and property downstream.

Post-Construction (2007)
Photo P1 shows the project site during ice conditions in February 2007. Photos P2 through P6 show the shoreline and weirs following ice-out conditions in March 2007.

As requested by NavWaters, the lighted navigation markers were designed according to the guidelines for private buoys. These markers, as well as additional cautionary buoys and warning signs were installed in April 2007 and are shown in Photos P7 through P10.

The final three photos were taken in August 2007 and show the initial growth of vegetation along the shoreline, which improves the habitat value of the erosion control works.

Post-Construction (2008)
Photos P13 through P24 show the Armstrong West Erosion Control Works viewed from the river in July 2008, working downstream (i.e., south) from the northern end to the southern end of the rock revetment.

These photos confirm that vegetation has been established in the weirs, along the revetment, and in the sand dunes behind the revetment.

Photos P25 through P42 show the project viewed from shore, also working downstream from the northern end to the southern end of the rock revetment. Water levels were higher than normal following recent and heavy rainfall in the Ausable River watershed. As a result the ends of the weirs were submerged.

All seven weirs have established vegetation as indicated in the photos below:

- Weir A: photos P26 and P27
- Weir B: photo P30
- Weir C: photos P31 and P32
- Weir D: photo P34
- Weir E: photos P36 and P37
- Weir F: photos P38 and P39
- Weir G: photo P41

There is also emergent and submergent vegetation between a number of weirs, including lilies and grasses, further increasing the aquatic habitat value of the shoreline (see photo P37). The greatest density of this vegetation is located between Weir C and Weir F, and generally more concentrated on the upstream (north) side of each weir.

Further, the dune grass plugs that were planted in mid-November as well as other dune vegetation has grown well in the sand dunes between Weir A and Weir D (see photo P28). This gives an indication that the banks have been sufficiently stabilized to support such vegetation.

The final three photos highlight an area of concern downstream/south of the revetment. During the December 2007 inspection (see photo P45), there appeared to be excessive bank erosion at this location. However the July 2008 inspection (see photos P43 and P44) did not indicate the bank migration rate has accelerated beyond pre-construction conditions (i.e., greater than 0.5 m/year). Bank erosion and deep scour holes near the shoreline had been noted at this location for many years prior to construction.

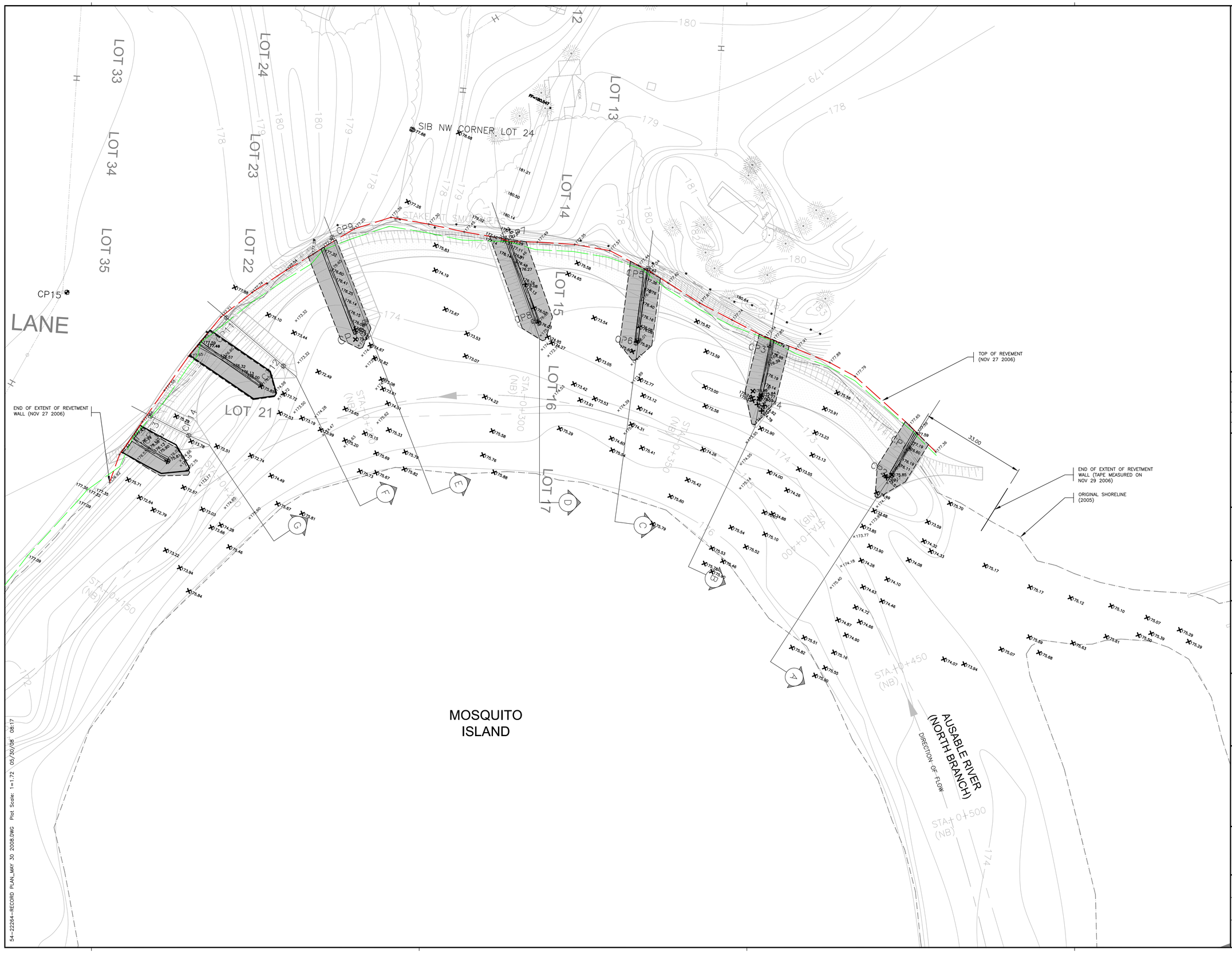
3. Monitoring Observations – Survey

Following construction, a survey of the rock revetment shoreline and bendway weirs was conducted on November 27, 2006 and again on May 22, 2008 in order to produce record drawings for the project. **Drawing RP** shows the Record Plan of these erosion control works. The extent and centerline of the bendway weirs is shown under three scenarios: design conditions, November 2006 and May 2008 survey.

There has been some minor horizontal displacement of rock, most notably at Weir G, and therefore the November 2006 and May 2008 surveys show nearly coincident extent lines on the drawing. The drawing also shows the extent and top of revetment under the same scenarios, and with similar minor displacement since construction.

Some vertical settling of rock (i.e., less than 300 mm or 1ft) has occurred at all weirs. This initial settling is expected and should be monitored (i.e., re-surveyed in 2 years) to confirm further subsidence does not affect design performance. The greatest amount of settling occurred at Weir G.

The November 2006 and May 2008 surveys also included shots within the channel along the base centerline of each weir and between weirs. Survey points are included in Drawing RP. From these surveys, river cross-sections along the weir centerlines are plotted in **Figure 2** through **Figure 8**. The legend for these figures is as follows:



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LEGEND

- WEIR (MAY 2008 SURVEY)
- WEIR (NOV. 2006 SURVEY)
- DESIGN WEIR
- DESIGN REVETMENT EXTENT
- TOP OF REVETMENT (NOV. 2006 SURVEY)
- TOP OF REVETMENT (MAY 2008 SURVEY)
- SHORELINE 2005

No.	DATE	BY	ISSUES / REVISIONS
5	05/09/08	MG	ISSUE FOR 2008 MONITORING REPORT
4	02/06/08	KV	ISSUE FOR AS BUILT RECORD
3	07/12/06	MM	ISSUE FOR AS BUILT RECORD
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CLIENT:

AUSABLE BAYFIELD CONSERVATION AUTHORITY

PROJECT:

ARMSTRONG WEST EROSION CONTROL

PORT FRANKS, ONTARIO

DRAWING:

AS BUILT RECORD MAY 2008

DRAWN BY:	CHECKED BY:	PROJECT No. :
LC/KV/MM	MG	54-22264-01
DESIGNED BY:	APPROVED BY:	DRAWING No.
HCCL/WW	RT	RP
SCALE:	DATE:	
1:500	MAY 2008	

54-22264-RECORD PLAN_MAY 30 2008.DWG Plot Scale: 1=1.72 05/30/08 08:17

ID:- G:\Projects\2002\22264-01 Armstrong West Erosion Control\Drawings\54-22264-Record Plan_Sep05 2008.dwg - Fri, 5 Sep 2008 - 16:29

- Blue line (no markers): This is the average water level during the normal boating season (May 15 – October 15), which is 176.5 m-IGLD;
- Blue box: This represents the NavWaters navigability requirement (a navigable channel that is 2 m deep by 10 m wide);
- Magenta line (square markers): pre-construction profile based on May 2005 bathymetric soundings;
- Blue line (diamond markers): top centerline of bendway weir (design profile) based on May 2005 soundings;
- Green line (asterisk markers): top centerline of bendway weir (as-built profile) and channel cross-section based on November 2006 survey; and
- Red line (circle markers): top centerline of bendway weir and channel cross-section based on May 2008 survey.

Figure 2 – Weir A Cross-Section

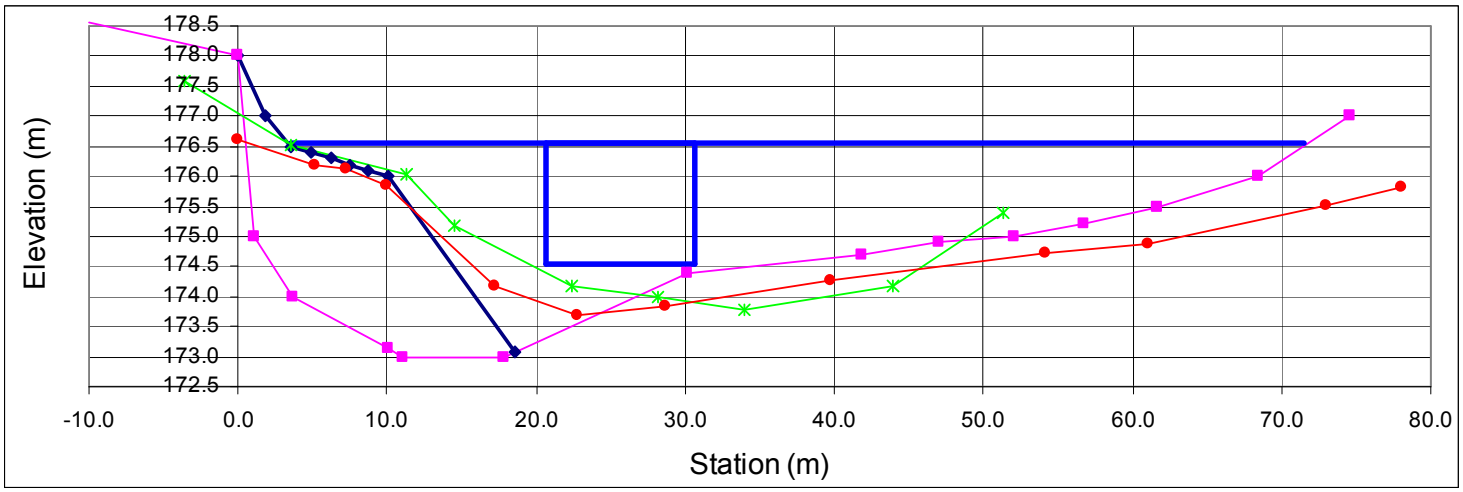


Figure 3 – Weir B Cross-Section

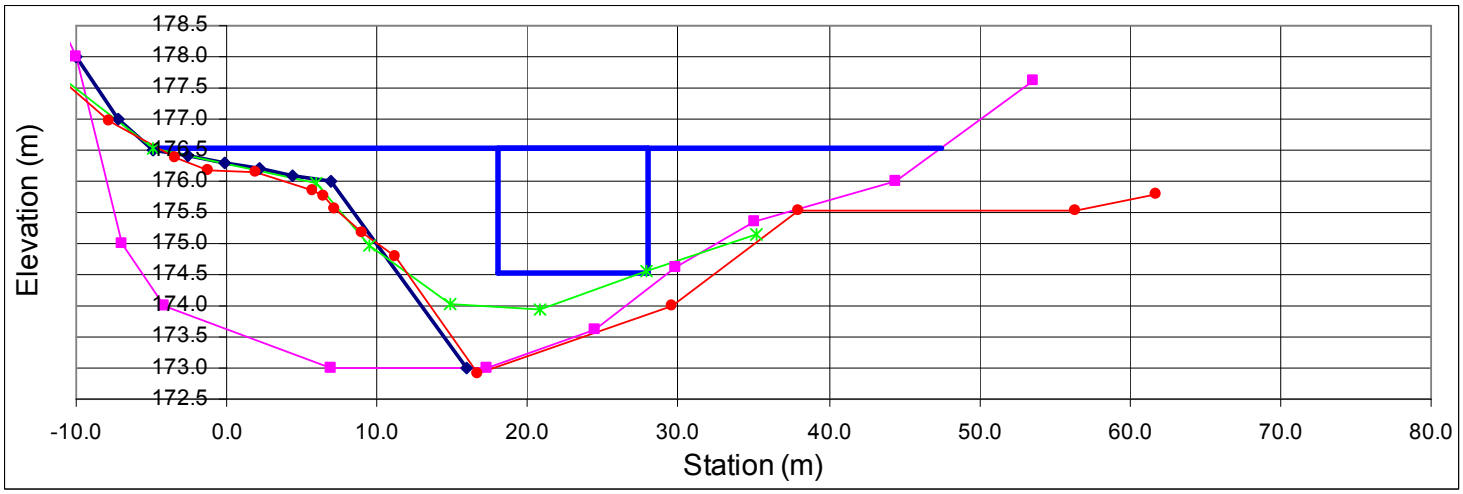


Figure 4 – Weir C Cross-Section

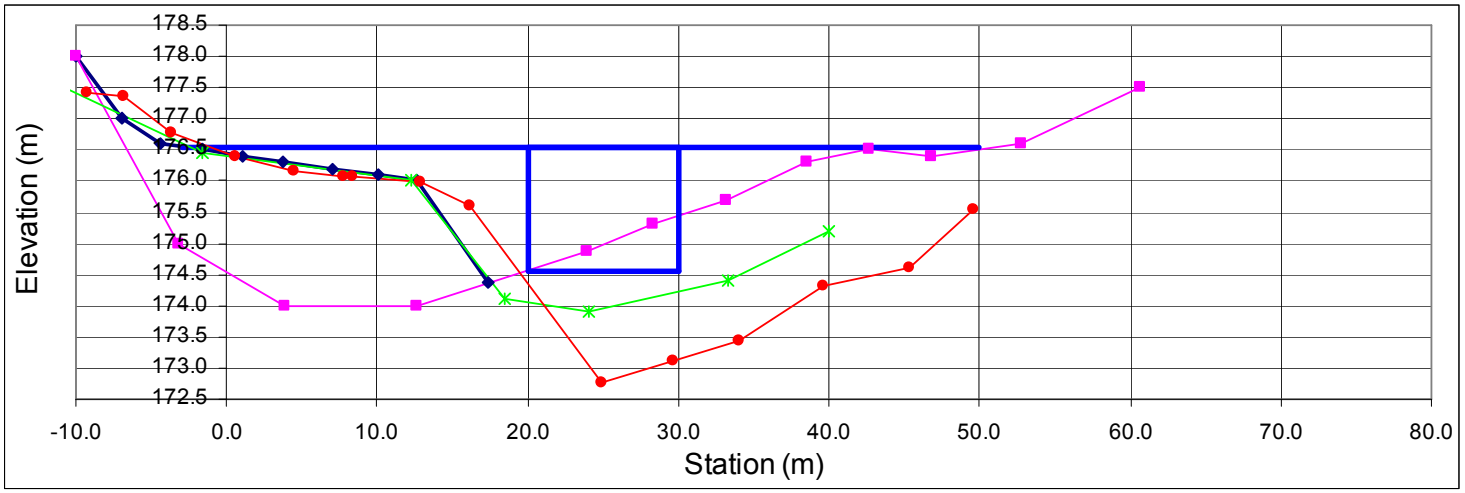


Figure 5 – Weir D Cross-Section

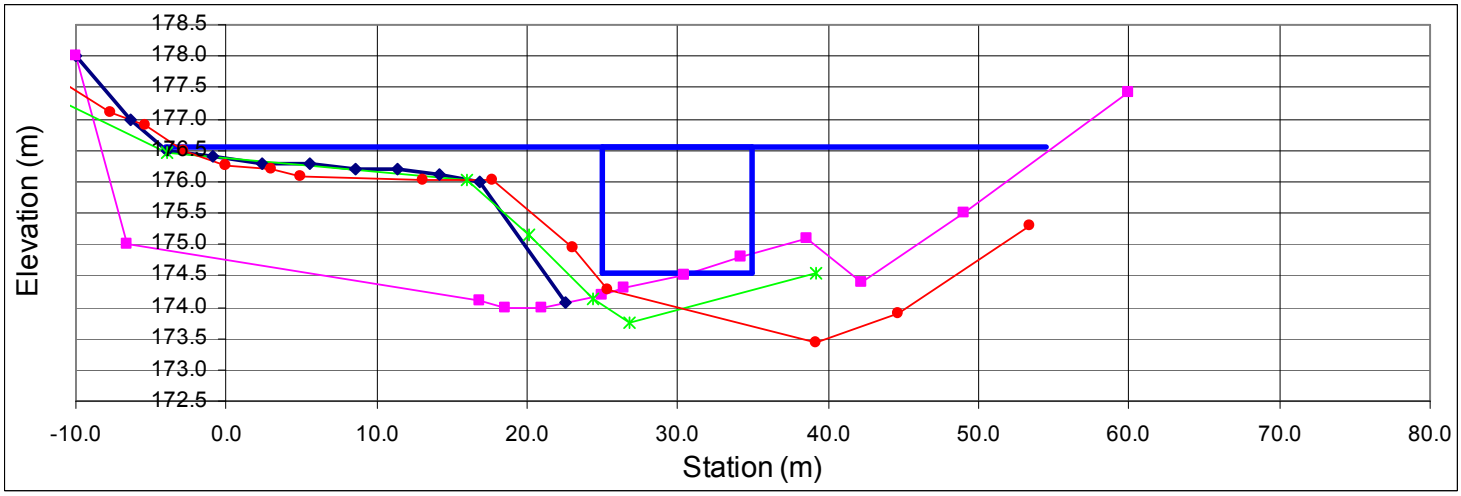


Figure 6 – Weir E Cross-Section

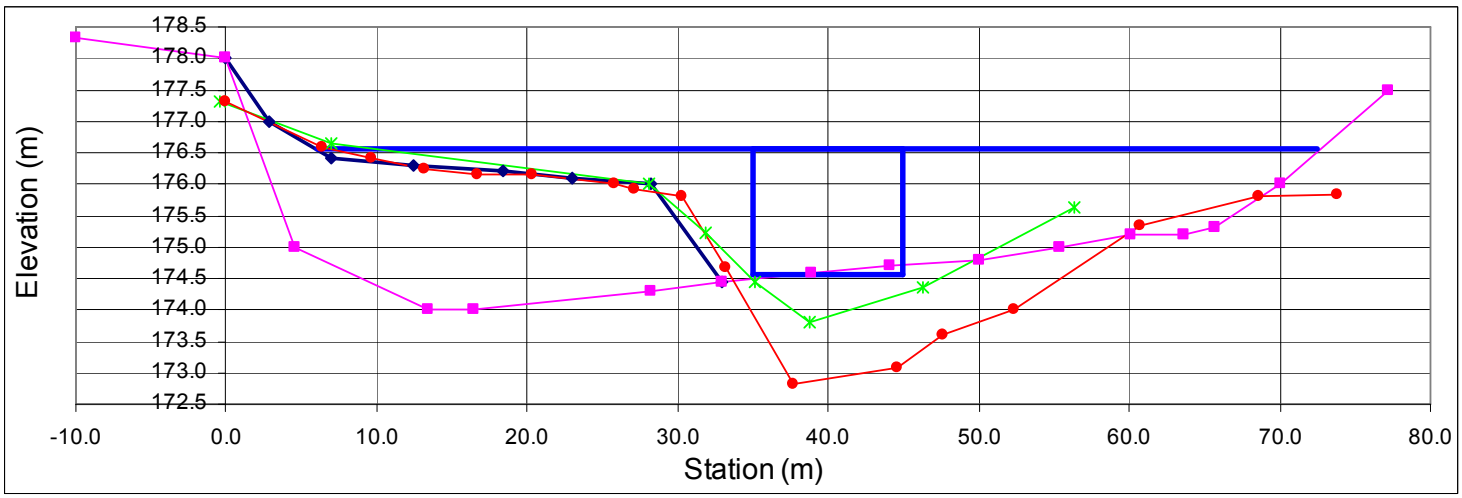


Figure 7 – Weir F Cross-Section

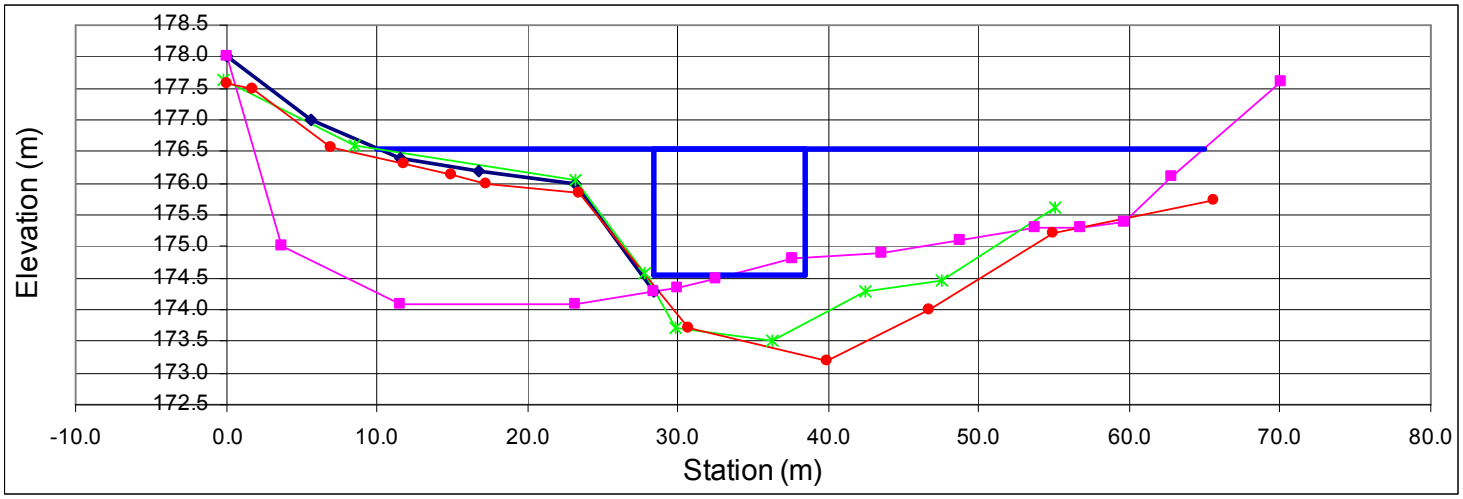
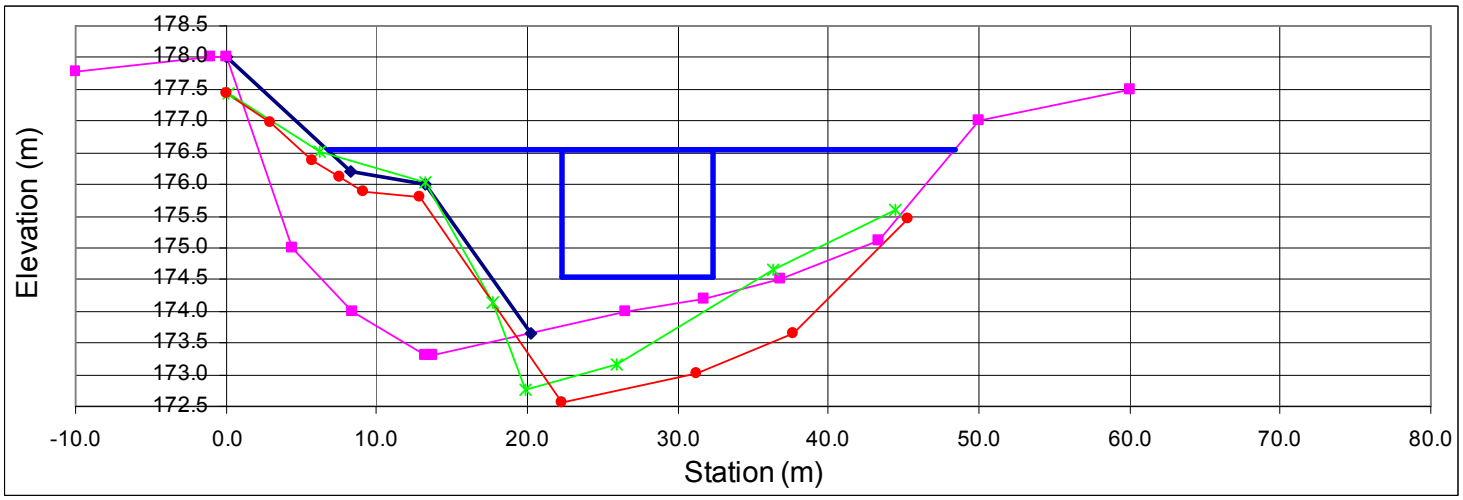


Figure 8 – Weir G Cross-Section



The cross-sections shown above give evidence of each weir's performance in maintaining the navigable channel dimensions. In most cases, that is, Weir B, C, D, and E, the navigable channel dimensions have greatly increased since the as-built survey was conducted in November 2006.

4. Monitoring Observations – Field Inspection Program

Following the construction period, formal field inspections were conducted in December 2007 and July 2008. Copies of the inspection reports are included in this submittal.

These inspections followed the protocols established as part of the long-term inspection program developed to identify regular maintenance needs and verify that the erosion control works are functioning as intended. A copy of the long-term inspection program protocol is also included in this submittal.

Both the December 2007 and July 2008 inspections showed no significant maintenance or areas needing repair.

5. Conclusions

Based on the post-construction inspections performed by TSH, there were no noticeable locations where maintenance was required (e.g., replacement or re-grading of rock material in either the bendway weirs or shoreline protection). Also there were no noticeable locations of erosion behind the rock revetment. In addition, an as-built survey of these erosion control works confirmed the navigable channel requirements specified by NavWaters were achieved.

Overall, the erosion control works and bank stabilization methods held up well for the winter ice and spring freshet events as well as a series of summer storm events over the two-year period since the Armstrong West Erosion Control Works were constructed by ABCA in November 2006. Based on the observations during the monitoring period through August 2008, the project performs and functions as intended.

Please contact the undersigned should there be any questions regarding this project or further clarification is required.

Yours very truly,

Michael A. Gregory, P.Eng.
Project Manager, Water Resources

MAG/mag

cc: Alec Scott, Water and Planning Manager, Ausable Bayfield Conservation Authority
Ross Wilson, Water Resources Technologist, Ausable Bayfield Conservation Authority
Peggy Van Mierlo-West, Director of Community Services, Municipality of Lambton Shores
Suzanne Shea, Navigable Waters Protection Officer; Navigable Waters Protection
Ken Stemmler, Resource Management Technician, Ontario Ministry of Natural Resources

Armstrong West Erosion Control project
TSH Project No. 54-22264

Inspection Report

Date of Inspection:	Thursday, December 13, 2007, 12:45-2:15pm
Report By:	Mike Gregory, TSH
Present:	Ross Wilson, ABCA; Mike Gregory, TSH

Notes/Comments:

- This inspection follows section "A. ANNUAL INSPECTIONS" in the companion document "ArmstrongWest_InspectionProgram.doc"
- The timing of this inspection corresponds to the end of the contractor's warranty period (i.e., 1 year from the date of the Certificate of Substantial Performance). Normally, annual inspections would be conducted between April and October.
- Dune grass plugs were planted in mid-November.

Emergency Repairs or Maintenance Needs:

- No significant maintenance needs for the bendway weirs or rock revetment were identified.

Minor Repairs or Maintenance Needs:

- None noted.

Additional Issues/Observations To Be Monitored and/or Suggested Follow-Up Action Plan:

- Dunes have encroached on the 6 m maintenance access/easement area at two locations (i.e., sand is filling in portions of the revetment above the weirs), at Smugglers Lane and adjacent to Weir B. Re-grading this for future maintenance access may not be necessary however, as access could be achieved from barge or along the revetment.
- There appears to be recent scour of the river bank (approximate depth of 1.5-2m) downstream of the southern extent of the project, approximately 35 m south of weir G (see **Figure 1** on page 2 of this report). It is suggested that the monitoring plan be adapted to include semi-annual monitoring (spring and fall, initially) of the bank to confirm the bank migration rate. Note: Weir G was added to the initial/concept design to address potential erosion at this location and the rock revetment was extended as far south to the point where it was felt that the existing root structure would provide bank stability. If it is found that the bank migration rate here is significant, Weir G can be redesigned and modified (e.g., increase the weir length and/or upstream orientation angle) as an added control measure.
- Minor displacement of rocks in the bendway weirs, which appear to have been moved by local residents in order to facilitate installation of temporary boat docks. Not a concern at this point.

Signature: _____
Inspector

Distribution: File
Ross Wilson, ABCA

Figure 1 – Potential Bank Erosion (approx. 35 m downstream (south) of Weir G, photo looking north)

Armstrong West Erosion Control project
TSH Project No. 54-22264

Inspection Report

Date of Inspection:	Friday, July 25, 2008, 10:00-11:15am
Report By:	Mike Gregory, TSH
Present:	Ross Wilson, ABCA; Mike Gregory, TSH

Notes/Comments:

- This inspection follows section "A. ANNUAL INSPECTIONS" in the companion document "ArmstrongWest_InspectionProgram.doc"
- The timing of this inspection corresponds to the second of two required DFO monitoring inspections. Many photos from this inspection will be included in the 2007-2008 Monitoring Report to be submitted to DFO.
- Water levels noted to be higher than normal (ends of weirs submerged) following recent and heavy rainfall in the Ausable River watershed.
- Vegetation has been established in the weirs and along the revetment.
- There is emergent and submergent vegetation (lilies and grasses) in between a number of weirs. The greatest density of this vegetation is located between Weir C and Weir F, and generally more concentrated on the upstream (north) side of each weir.
- An invasive vine was noted in a number of locations, most evident on Weirs C, E, and F and in each case has established itself on the upstream (north) side of the weirs. It has orange roots that are wrapping around and smothering other weeds and vegetation. New shoots are creeping across the rocks. It appears to have arrived within the past month or so. It is suspected to be Oriental Bittersweet (Celastrus orbiculatus) but not confirmed. **Figure 1** shows this vine on Weir C.
- Dune grass plugs that were planted in mid-November as well as other dune vegetation have grown well in the sand dunes behind the revetment, particularly between Weir A and Weir D. This gives an indication that the banks have been sufficiently stabilized to support such vegetation.
- **Figure 2** and **Figure 3** provide updated photos of the area of concern downstream (south) of the revetment that was noted during the December 2007 inspection. This area was suspected of excessive bank erosion, however it does not appear that the bank migration rate has accelerated beyond pre-construction conditions (i.e., greater than 0.5 m/year). Bank erosion and deep scour holes near the shoreline had been noted at this location for many years prior to construction.

Emergency Repairs or Maintenance Needs:

- No significant maintenance needs for the bendway weirs or rock revetment were identified.

Minor Repairs or Maintenance Needs:

- None noted.

Additional Issues/Observations To Be Monitored and/or Suggested Follow-Up Action Plan:

- As noted in the December 2007 inspection report, dunes have encroached on the 6 m maintenance access/easement area at two locations (i.e., sand is filling in portions of the revetment above the

weirs), at Smugglers Lane and adjacent to Weir B. Re-grading this for future maintenance access may not be necessary however, as access could be achieved from barge or along the revetment.

- There is continuing evidence of local residents displacing rocks in both the revetment and weirs, particularly at the end of Smugglers Lane, between Weir D and Weir E. **Figure 4** shows an example of rocks were rearranged to serve as a step to a boat dock. Although not a concern at this point it is suggested that residents be asked to refrain from this practice.

Signature: _____
Inspector

Distribution: File
Ross Wilson, ABCA

Figure 1 – Invasive vine on Weir C

Figure 2 – Potential Bank Erosion (approx. 35 m downstream (south) of Weir G, photo looking south)

Figure 3 – Potential Bank Erosion (approx. 35 m downstream (south) of Weir G, photo looking north)

Figure 4 – Evidence of Rock Displacement by Local Residents (between Weir D and Weir E)

Armstrong West Erosion Control project
TSH Project No. 54-22264

Inspection Program

The on-going inspection program for the Armstrong West Erosion Control project includes the 3 following inspection types and the associated details. Formal inspections consist of a field inspection, photo documentation and preparation of a written report to document the status of the project. Inspection reports should also include a section outlining emergency repairs, repairs that are required but not immediate and those repairs that simply need to be monitored closely.

INSPECTION TYPE — DETAILS

A. ANNUAL INSPECTIONS

- Purpose is to ensure that:

- *Works* are operating and maintained as designed,
- *Above works area* is stabilizing,
- No adverse impact on *adjacent lands* or *watercourse*,
- Consideration for both *structural* and *habitat* issues.

- Timing of inspections:

- During the period following the spring freshet and before October to allow sufficient time for repair prior to freeze conditions (i.e., *March/April through September*),
- To be conducted when *water levels are low* and relatively *clear visibility*.

- Inspection history:

- September-December 2006, by TSH (construction period)
- August 2007 by TSH
- December 2007 by TSH/ABCA (1-yr substantial completion)
- July 2008 by TSH/ABCA

WORKS (Bendway Weirs and Rock Revetment)

Inspection for:

- Bank erosion
- Sedimentation
  - Inter weir (across centerline)
  - Intra weir (in between)
- Weir rock displacement
  - By ice
  - By water
  - By tree roots
  - By residents
- Weir rock disintegration
- Vegetative stabilization
  - Short with fibrous root desirable
  - Tall, bushy with large roots undesirable
- Snagged detritus (e.g. driftwood)
- Well graded particle size distribution

ABOVE WORKS (Maintenance Easement)

Inspection for:

- Erosion
  - Water
  - Wind
- Sedimentation (dune accretion)
  - Encroachment onto 6 m easement area
- Vegetative stabilization
  - Natural
  - Enhanced

B. 5-YEAR INSPECTIONS/ SURVEY
 	
- Purpose is to ensure that:
• *Works* are evolving without hampering design function,
• *Inter-weir area* is infilling,
• *Thalweg* is being maintained off weir ends,
• *Navigable channel* is maintained (2 m × 10 m),
• *Weir shape* is not shrinking or distorted.
 	
- Timing of inspections:
• When water is *very low* and as *clear* as possible,
• Likely *late summer*.
 	
- Survey history:
• November 2006 and May 2008, total station survey by TSH (for record drawings)
	ALL WORKS
	
	Survey options include:
	• Total station survey of:
	  ○ Inter weir (across centerline)
	  ○ Intra weir (in between)
	  ○ Rock revetment (shoreline and top of slope)
	• Soundings to confirm there is no significant displacement of rock, and underwater structure shape is as designed/built. Options include:
	  ○ Bathymetric soundings
	  ○ Side-scanning
	
	Inspection options (by ABCA biologists) include:
	• Terrestrial habitat investigation.
	• Aquatic habitat investigation.

C. POST MAJOR EVENT INSPECTIONS
 	
- Purpose is to ensure that:
• No major damage was done by major runoff (i.e., < 200 m^3/s) or ice-out event,
• Nature of *emergency repairs*, if any, are determined.
 	
- Timing of inspections:
• Immediately *following the event*, as soon as *safe water level conditions* allow.
	ALL WORKS
	
	Inspection for:
	• Excessive bank erosion
	• Excessive sedimentation/deposition
	  ○ Inter weir
	  ○ Intra weir
	• Weir rock displacement (by water or ice)
	• Weir rock disintegration
	• Snagged detritus (e.g., drift wood)
	
	ADJACENT LANDS
	
	Inspection for:
	• Erosion (bank)
	• Sedimentation (in-stream deposits)
	• Re-location of thalweg

Armstrong West Erosion Control Works

2007-2008 Monitoring Program, Photographic Record

Pre-Construction Photos (2005)

Photo E1 (23-Aug-05): Looking west at north end of project, proposed weir A.

Photo E2 (23-Aug-05): Looking west between proposed weirs B and C.

Photo E3 (23-Aug-05): Looking north from Smugglers Lane.

Photo E4 (23-Aug-05): Looking north from proposed weir D.

Photo E5 (23-Aug-05): Looking north from proposed weir D.

Photo E6 (23-Aug-05): Looking south from Smugglers Lane.

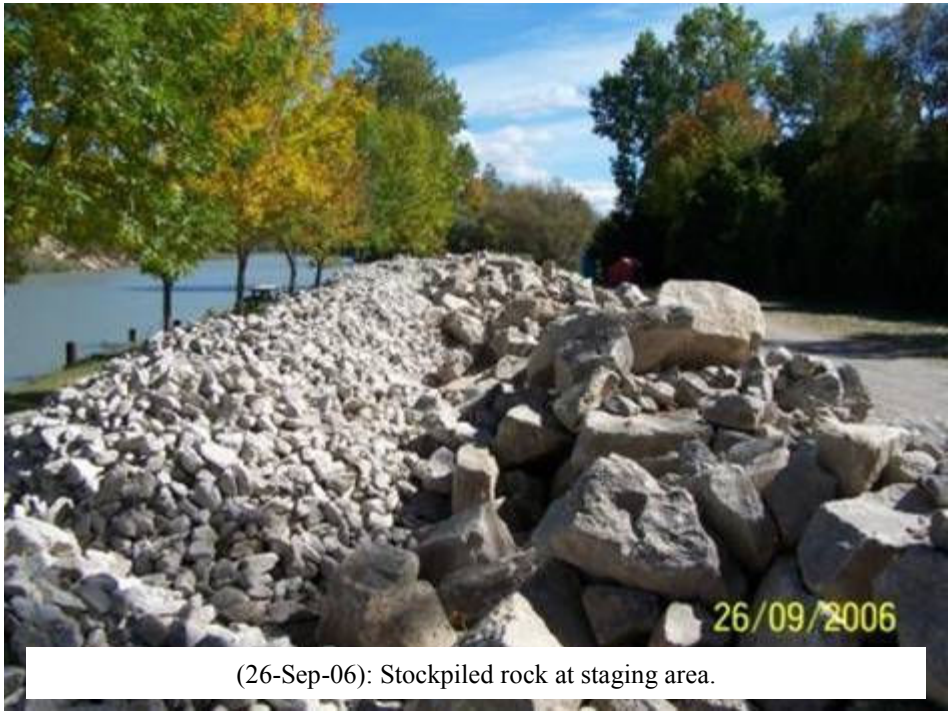
Photo E7 (23-Aug-05): Looking west from proposed weir E.

Photo E8 (23-Aug-05): Looking south from proposed weir F.

Armstrong West Erosion Control Works

2007-2008 Monitoring Program, Photographic Record

Construction Photos (2006)



(26-Sep-06): Stockpiled rock at staging area.

(13-Oct-06): Stockpiled rock at staging area.

Photo C1 (13-Oct-06): Looking north from Lot 14, revetment grading.

Photo C2 (13-Oct-06): Looking south from Lot 14, revetment grading.

Photo C3 (13-Oct-06): Looking north from Lot 22, revetment grading.

Photo C4 (13-Oct-06): Looking south from Lot 22, revetment grading.

Photo C5 (23-Oct-06): Looking south from Clarke Lane, weir G construction.

Photo C6 (26-Oct-06): Looking south from Lot 22, weir F construction.

Photo C7 (26-Oct-06): Looking north from weir F, weir E construction.

Photo C8 (31-Oct-06): Looking north from Smugglers Lane, revetment construction.

Photo C9 (2-Nov-06): Looking north from Lot 23, revetment construction.

Photo C10 (13-Nov-06): Looking east from Lot 14, weir D construction.

(13-Nov-06): Loading barge at staging area.

Photo C11 (16-Nov-06): Looking south from Stevens Lot, weir C construction.

Photo C12 (16-Nov-06): Looking southeast from Clarke Lane, debris trapped at weir G following storm event.

Photo C13 (22-Nov-06): Looking northeast from Stevens Lot, weir B construction.

Photo C14 (22-Nov-06): Looking northeast from weir B, revetment construction.

Photo C15 (24-Nov-06): Looking northeast from weir B, weir A construction.

Photo C16 (29-Nov-06): Looking northeast from weir B, revetment construction.

Photo C17 (29-Nov-06): Looking south from Stevens Lot, weirs C to G.

Armstrong West Erosion Control Works

2007-2008 Monitoring Program, Photographic Record

Post-Construction Photos (2007)

Photo P1 (3-Feb-07): Looking southwest from north end of revetment, weir A in foreground, weirs B to G in background.

Photo P2 (15-Mar-07, ABCA): Looking southwest from north end of revetment.

Photo P3 (15-Mar-07, ABCA): Looking northeast from weir C.

Photo P4 (15-Mar-07, ABCA): Looking north from Lot 22, note ice and debris.

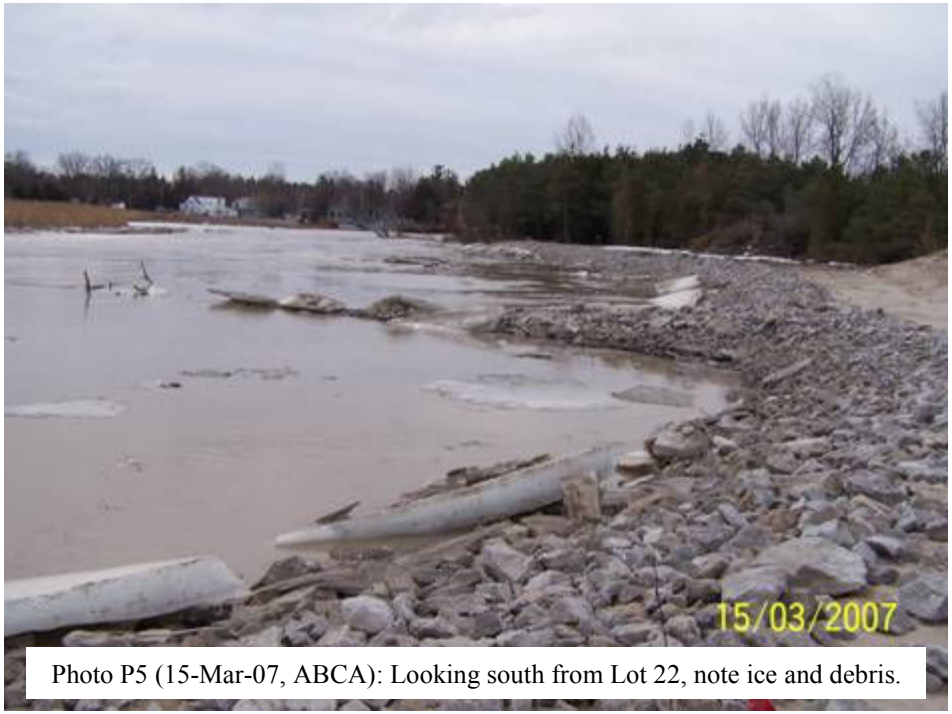


Photo P5 (15-Mar-07, ABCA): Looking south from Lot 22, note ice and debris.

Photo P6 (28-Mar-07, ABCA): Looking north from Lot 22.

Photo P7 (19-Apr-07): Looking north at navigation markers for weirs A to D.

Photo P8 (19-Apr-07): Looking east at navigation marker for weir E.

Photo P9 (19-Apr-07): Looking south at navigation marker for weir G.

Photo P10 (16-May-07, ABCA): Looking southwest from north end of revetment.

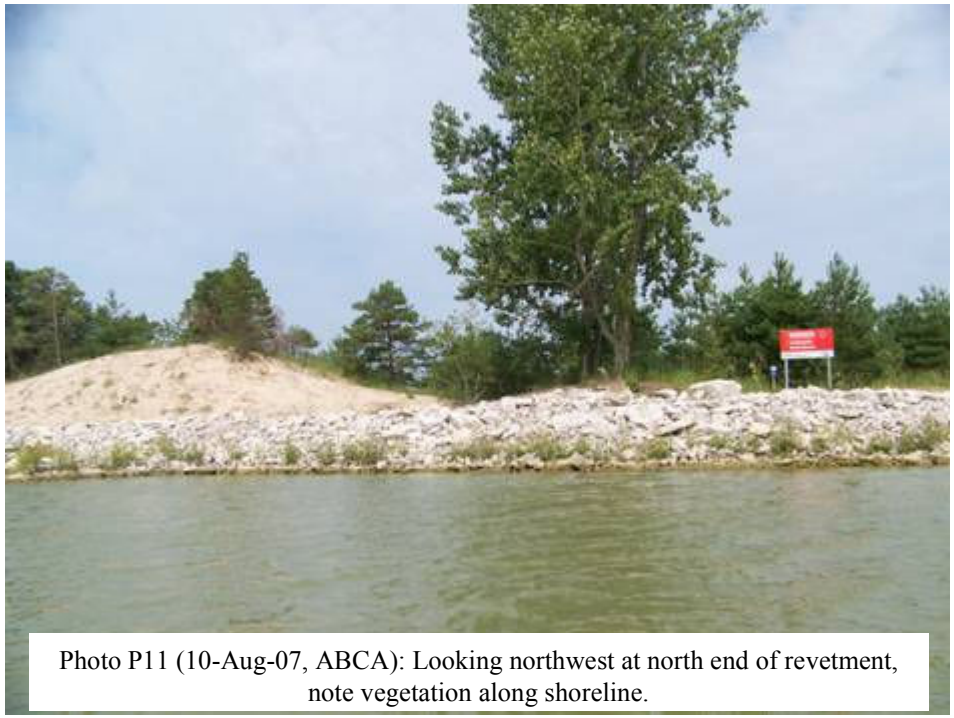


Photo P11 (10-Aug-07, ABCA): Looking northwest at north end of revetment, note vegetation along shoreline.

Photo P12 (10-Aug-07, ABCA):

(10-Aug-07, ABCA): Note vegetation along revetment.

Armstrong West Erosion Control Works

2007-2008 Monitoring Program, Photographic Record

Post-Construction Photos (2008)

Photo P13 (25-Jul-08): Northern end of revetment.

Photo P14 (25-Jul-08): Weir A (vegetated area on right).

Photo P15 (25-Jul-08): Revetment between Weir A and Weir B.

Photo P16 (25-Jul-08): Weir B (vegetated area on right).

Photo P17 (25-Jul-08): Revetment between Weir B and Weir C.

Photo P18 (25-Jul-08): Weir C (vegetated area on right).

Photo P19 (25-Jul-08): Weir D (vegetated area left of center).

Photo P20 (25-Jul-08): Revetment between Weir D and Weir E.

Photo P21 (25-Jul-08): Weir E (vegetated area on right).

Photo P22 (25-Jul-08): Weir F (vegetated area right of center).

Photo P23 (25-Jul-08): Revetment between Weir F and Weir G.

Photo P24 (25-Jul-08): Weir G (vegetated area on right)
and southern end of revetment.

Photo P25 (25-Jul-08): Northern end of revetment.

Photo P26 (25-Jul-08): Weir A.

Photo P27 (25-Jul-08): Weir A.

Photo P28 (25-Jul-08): Vegetated dunes between Weir A and Weir B.

Photo P29 (25-Jul-08): Revetment between Weir A and Weir B.

Photo P30 (25-Jul-08): Weir B.

Photo P31 (25-Jul-08): Weir C.

Photo P32 (25-Jul-08): Weir C.

Photo P33 (25-Jul-08): Revetment between Weir C and Weir D.

Photo P34 (25-Jul-08): Weir D.

Photo P35 (25-Jul-08):Revetment between Weir D and Weir E.

Photo P36 (25-Jul-08): Weir E.

Photo P37 (25-Jul-08): Weir E.

Photo P38 (25-Jul-08): Weir F.

Photo P39 (25-Jul-08): Weir F.

Photo P40 (25-Jul-08): Revetment between Weir F and Weir G
(note: looking upstream/north).

Photo P41 (25-Jul-08): Weir G.

Photo P42 (25-Jul-08): Southern end of revetment to Weir G
(note: looking upstream/north).

Photo P43 (25-Jul-08): Bank erosion downstream/south
of southern end of revetment.

Photo P44 (25-Jul-08): Bank erosion downstream/south
of southern end of revetment.

Photo P45 (13-Dec-07): Bank erosion downstream/south
of southern end of revetment.