

# Macrophyte Biomass and Filamentous Algal Cover South of McPhersons Point after Diversion of the North Gully Tributary (Summer 2008)



Report Submitted to  
The Livingston County Planning Department

By

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## I. Summary

- Over the last ten years, the cove to the south of McPhersons Point (herein referred to as North Gully Cove) has been among the most biologically active in Conesus Lake, having characteristically dense growth of Eurasian watermilfoil and extensive cover of filamentous algae.
- North Gully creek drains into this cove, delivering large amounts of dissolved and particulate nutrients to the shoreline from a 735 ha sub-watershed that is approximately 45% in dairy and row crop agriculture. In February 2008, the North Gully creek channel was diverted northward along the McPhersons Point shoreline, allowing the stream effluent to drain into the more open waters of Conesus Lake away from the macrophyte bed to the south.
- During the summer 2008 we monitored the macrophyte bed in North Gully Cove to determine whether plant growth had been affected by the diversion of the North Gully channel. The size of the macrophyte bed, the density of milfoil plants, and the % cover of filamentous algae were measured during the peak of the growing season. Macrophyte beds at Sutton Point and at Sand Point were monitored as reference sites to account for lake-wide changes in plant growth that might influence trends at North Gully Cove.
- The area dominated by Eurasian milfoil in North Gully Cove was 11,855 m<sup>2</sup>, about 51% the 2000-2007 average for the site. Similarly the areas dominated by milfoil beds at Sand Point and at Sutton Point were 70.6% and 65% of their respective long-term averages, indicating that there may have been a lake-wide decrease in milfoil populations. This conclusion is supported by qualitative observations of other sites in Conesus Lake.
- Within the reduced area of milfoil distribution at North Gully Cove, macrophyte biomass density was  $266 \pm 167$  g dry wt./m<sup>2</sup>. These values are comparable to the 8-year average for this site. At Sand Point and Sutton Point, macrophyte biomass density was 18% and 21% lower than the long-term average.
- The percent cover of filamentous algae was the highest on record for both North Gully Cove and Sand Point, whereas there was zero algal cover in Sutton Point in the southwestern portion of Conesus Lake.
- Overall, macrophyte and filamentous algal growth in North Gully Cove seemed to follow lake-wide trends. We could not identify with certainty any changes that were unique to North Gully Cove and attributable to reductions in tributary loading. These results were not unexpected given the short time elapsed since completion of the diversion project.

## II. Introduction

With a surface area of 735 ha, the North Gully sub-watershed (Fig. 1) is the fourth largest in the Conesus Lake watershed and is one of the main hydrological contributors to tributary flow entering the Lake. Approximately 45% of the watershed is in agriculture, primarily dairy and row crop (SOCL 2001). Makarewicz *et al.* (2001) ranked the North Gully sub-watershed second to Hannah's Creek in terms of average loss of phosphorus per day during event flow and non-event flow. Agricultural fields, particularly those in topographically steep areas, were later identified as the major sources of nutrients and fecal bacterial contaminants that entered Conesus Lake (Makarewicz and Lewis 2002).

Because of the prevailing winds from the southwest and the position of the tributary mouth, North Gully Creek drains primarily into an open cove directly to the south of McPhersons Point (Fig. 2; referred to as North Gully Cove in this report). Over the last ten years, North Gully Cove has been among the most biologically active nearshore areas in Conesus Lake, having characteristically dense growth of Eurasian watermilfoil (*Myriophyllum spicatum*) and extensive cover of filamentous green algae representing a variety of species (Fig. 3). Bosch *et al.* (2009 a, b) have monitored the plant community in North Gully Cove for the past eight summer growing seasons. The large macrophyte bed covers an area of more than 30 thousand m<sup>2</sup> between McPhersons Point and the State boat launch to the south and it contains an estimated biomass of more than 12 thousand Kg in dry weight of Eurasian watermilfoil. (Bosch *et al.* 2009 a). Median percent cover of filamentous algae has been between 30-40% and with many quadrats reaching close to 100% cover in 2005. (Bosch 2009 b)

In February 2008, the North Gully creek channel was diverted northward along the Conesus Lake shoreline to allow dispersal of the stream effluent into the more open waters of the Lake away from the macrophyte bed to the south. Observations of runoff plumes before and after the project indicate that the stream diversion may have been effective in reducing the amount of sediment and nutrient runoff entering North Gully Cove (Figure 4; Personal communication with Gene Bolster).

This research project is the first attempt to determine whether the diversion of North Gully has been effective in reducing the amount of plant growth in North Gully Cove. The size of the macrophyte bed, the density of milfoil plants, and the % cover of filamentous algae were measured during the peak of the growing season in 2008 and compared to the long term record for the site. Macrophyte beds at Sutton Point and at

Sand Point were monitored as reference sites to account for lake-wide changes in plant growth that might influence trends at North Gully Cove.

### III. Methods

Macrophyte composition and biomass, metaphyton coverage, and macrophyte bed areas were determined for the North Gully Cove, Sutton Point, and Sand Point macrophyte beds during the peak of the growing season in August 2008.

To determine aquatic plant species composition and biomass, replicate quadrat samples (3 per depth) were collected at depths of 4m, 3m, and 2m along three transect lines at each site. Transect locations at all three sites were the same as those used in previous studies of Eurasian milfoil in Conesus Lake (Bosch *et al.* 2009a). A total of 27 quadrat samples per site were harvested using a 0.5m x 0.5m quadrat constructed from PVC pipe. Each sample was placed in a numbered plastic collection bag and taken to the laboratory for species sorting and zebra mussel removal. Plant species within each sample were blotted dry with paper towels and weighed separately to the nearest 0.1g with an electronic scale. These wet weights were converted to dry weights using species-specific dry weight conversion factors determined by Bosch *et al.* (2009a).

In addition to characterizing macrophyte biomass, the surface area of the macrophyte beds and the milfoil-dominated area of the beds were mapped at each site using global positioning systems (GPS). To record points, a Trimble Model TSC1 global positioning unit (Trimble Navigation Ltd.) was used by a research assistant aboard a boat while a swimmer indicated points to be mapped as he swam around the perimeter of milfoil dominated areas in each bed. Pathfinder software was used to analyze these maps for surface area and to compare these surface areas to years past.

To determine the over filamentous algae within the macrophyte beds, digital photographs were taken at each site following procedures described by Bosch *et al.* (2009b). For canopied beds at Sand Point Gully and McPhersons Point, photographs (1 to 9 depending on macrophyte presence) were taken from the surface over depths of 1m and 2 m along the same transect lines used for macrophyte sampling. A Canon digital camera, which was secured to a PVC tripod, was attached to a 0.5m x 0.5m PVC-framed quadrat. A fishing line grid woven on the bottom of the quadrat served to compress the canopy during picture taking. The quadrat frame was secured to buoys and pressed onto the surface of canopied beds. For areas at North Gully and Sutton Point where a canopy did not form, photographs were taken underwater at 1m and 2m depths along the same transect lines used for macrophyte sampling. A Sea Life camera

was secured in a waterproof Sea Life underwater case, which was then attached to a 0.5m by 0.5m PVC quadrat complete with a fishing line woven bottom. Surface and underwater photographs were analyzed at the laboratory for percent metaphyton cover using Image J computer software.

#### IV. Results and Discussion

The average macrophyte biomass within the 2-3 m depth zone at North Gully Cove was  $266 \pm 167$  g dry wt./m<sup>2</sup> (Table 1, Figure 5). Eurasian watermilfoil comprised nearly 100% of the plant biomass along the 2 m depth zone and more than 70% of the biomass in the 3 m zone (Table 2). One transect that was an exception to this trend was nearest the stream, where eelgrass (*Vallisneria americana*) and coontail (*Ceratophyllum demersum*) dominate the biomass. This is an area where the bottom is made up of very fine sediment, which is not optimal for milfoil growth. The same pattern is shown in the central transect at Sutton Point where the bottom sediment is primarily fine silt.

At North Gully Cove, the average biomass from 2000-2007 was 250 g dry wt./m<sup>2</sup> (range 151-459 g dry wt./m<sup>2</sup>) (Figure 6A). The 2008 values were not significantly higher because of the high standard deviation around the mean biomass and the wide range of variation in averages over the 8-year period of monitoring.

For the North Gully Cove macrophyte bed, the surface area dominated by milfoil in 2008 was 11,855 m<sup>2</sup> (approximately 2.5 acres). This represents 69% of the total bed surface area (17,098 m<sup>2</sup>; 4.2 acres). Compared to the 2000-2007 average, the milfoil-dominated zone in 2008 was approximately 48% smaller while the overall habitat occupied by all species of macrophytes remained very similar.

In 2008, the total standing crop of milfoil at North Gully Cove was 3149 kg dry wt. This was approximately 46% lower than the long-term average (Figure 6B; also see Table 1). The reduced standing crop is a function of the smaller surface area covered by milfoil (Standing crop = Surface Area (m<sup>2</sup>) \* Biomass (g dry wt./ m<sup>2</sup>)).

It is unlikely that the decreased surface area and consequently the lower standing crop of milfoil could be the result of reductions in nutrient loading achieved by the diversion of North Gully. The areas dominated by milfoil in the Sand Point and in Sutton Point reference sites were also below the long-term averages (70.6% and 65% of their respectively). Moreover our observations of other macrophyte beds throughout Conesus Lake (e.g. Eagle Point, Cottonwood Point, Long Point Cove, Vitale Point) indicate that there was a lake-wide decrease in milfoil populations in 2008. Thus the decreases in North Gully Cove were not unique.

Filamentous algae grow rapidly in response to nutrient availability and may be a better short-term indicator of the magnitude of stream nutrient loading (D'Aiuto et. al. 2006, Makarewicz *et al.* 2007, Bosch *et al.* 2009b). In 2008, the biomass of filamentous algae throughout Conesus Lake was extremely high (Table 3). The high cover developed primarily after a period of very high runoff that occurred from July 18-25, when more than 4.3 inches of rain fell within the watershed (data from Jean Meekin, National Weather Service spotter). In the North Gully Cove and Sand Point macrophyte beds, median filamentous algal cover was 92% and 96%, respectively (Figure 7). The high cover at these sites is consistent with qualitative observations made at many other sites throughout Conesus Lake. Two notable exceptions to this trend were the Sutton Point macrophyte bed (Figure 7) and the bed near Vitale Park in the north end, where algal cover was very limited. Overall the filamentous at North Cove Gully and Sand Point Gully were the highest recorded at these sites (Figure 8).

## **V. Conclusions**

Macrophyte and filamentous algal biomass in North Gully Cove during the 2008 growing season seemed to follow lake-wide trends as indicated by comparisons with data from the Sand Point and Sutton Point macrophyte beds and by observations in other littoral areas of Conesus Lake. We found no definitive evidence that the diversion of North Gully and the expected decrease in nutrient loading had reduced plant growth in the North Gully cove littoral zone. These results were not unexpected given the short time elapsed since completion of the diversion project. Additional monitoring in the next few years should provide better insights on the effectiveness of this effort to manage nutrient runoff.

## **VI. Acknowledgements**

We thank Bill and JoAn Stein for their generosity and kindness in providing a base of operations for our research group; Betsy Beers (Geneseo Class of 1977) for continuing to support our lake research; Todd Shuskey, Chris Ryczek and Brad Cohen for their help with sample collections and S.C.U.B.A. operations. The Livingston County Planning Department provided funding for this research. We acknowledge Gene Bolster, Rusty Ehman and George Coolbaugh of the Conesus Lake Association for their motivation and perseverance in promoting the stream diversion project.

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### VIII. Tables and Figures

Location	Year	Average Biomass grams . m <sup>2</sup>	Surface Area m <sup>2</sup>	Standing Crop Kg Dry Weight
Sutton Point	2000	184 ± 43	---	---
	2001	467 ± 183	8,592	4,017
	2002	71 ± 40	3,688	262
	2003	138 ± 92	11,819	1631
	2004	227 ± 77	11,909	2,703
	2005	197 ± 90	11,995	2,349
	2006	364 ± 208	7,438	2,707
	2007	295 ± 94	10,973	3,232
	2008	190 ± 106	5,985	1,201
North Gully Cove	2000	262 ± 134	23,192	6,192
	2001	459 ± 202	25,783	11,834
	2002	151 ± 74	12,004	1,813
	2003	304 ± 176	19,760	6,007
	2004	186 ± 57	30,099	5,598
	2005	188 ± 105	21,798	4,098
	2006	230 ± 100	22,560	5,178
	2007	225 ± 70	27,850	6,266
	2008	266 ± 167	11,855	3,149
Sand Point	2000	212 ± 29	9,535	2,021
	2001	484 ± 300	9,781	4,730
	2002	325 ± 82	7,354	2,390
	2003	290 ± 126	5,310	1,540
	2004	131 ± 34	8,474	1,110
	2005	191 ± 96	8,349	1,595
	2006	230 ± 92	9,775	2,246
	2007	112 ± 111	9,684	1,084
	2008	201 ± 71	6,022	1,147

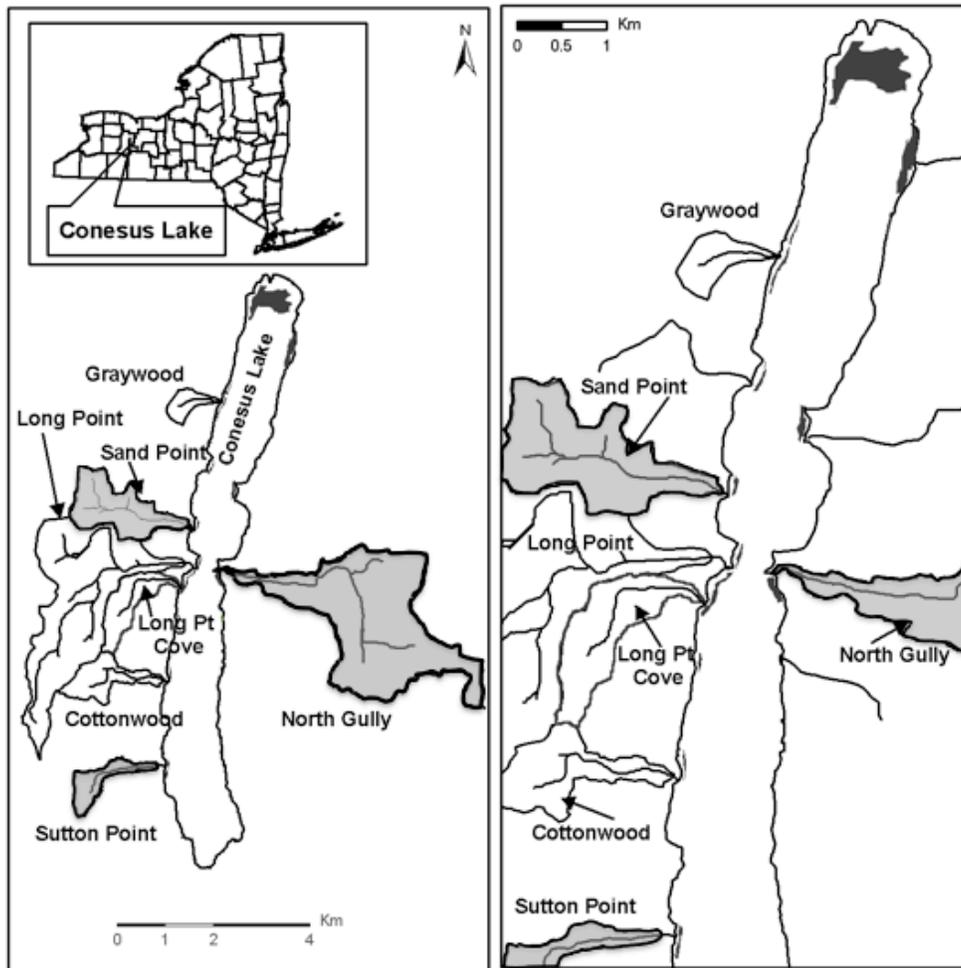
**Table 1.** Long-term record of dry weight biomass, surface area and total biomass (i.e. standing crop) within the milfoil dominated zone at depths of 2-3 m in the Sutton Point, North Gully and Sand Point macrophyte beds.

Transect Sites	Biomass as g/m <sup>2</sup>			% Milfoil		
	2 m	3 m	4 m	2 m	3 m	4 m
<b><i>No. Gully Cove</i></b>						
North Transect	339	75	20	98	0	0
	147	118	0	73	0	-
	183	64	0	98	0	-
Central Transect	417	144	0	99	72	-
	303	72	0	100	81	-
	258	106	0	100	71	-
South Transect	402	449	0	100	93	-
	209	379	0	100	99	-
	402	225	0	100	-	-
<b><i>Sand Point</i></b>						
North Transect	132	171	35	100	100	100
	312	76	0	100	86	-
	241	334	0	100	99	-
Central Transect	315	100	0	100	100	-
	213	54	0	93	97	-
	200	136	0	100	100	-
South Transect	249	164	0	100	100	-
	290	154	16	100	89	100
	342	125	4	100	100	100
<b><i>Sutton Point</i></b>						
North Transect	265	166	134	43	0	0
	179	41	50	57	0	0
	223	36	0	0	-	-
Central Transect	163	466	353	0	0	0
	116	254	172	0	0	0
	65	426	405	0	0	0
South Transect	182	124	311	78	95	0
	195	195	144	32	80	0
	109	220	163	0	68	93

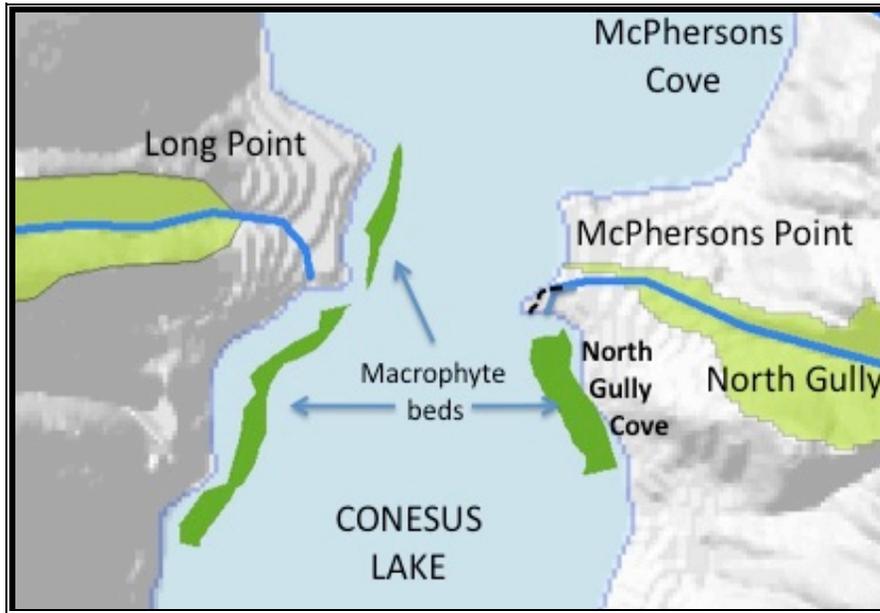
**Table 2.** Macrophyte biomass (as dry weight) and % of macrophyte weight comprised by Eurasian watermilfoil along three transects per study site. Replicate quadrats were taken at each of three depths along each transect. Milfoil was dominant in all but the northern transect at the North Gully site and at Sutton Point Gully. The fine sediment at these locations may be more conducive to growth of coontail and eelgrass, which replace watermilfoil as the dominant species.

Transect Sites	Percent Cover		Percent Cover	
	1 m	1 m	2 m	2 m
<b><i>No. Gully Cove</i></b>				
North Transect	96	100	99	99
	87		100	89
	99		100	
	97		92	
	99	X = 96	97	X = 97
Central Transect	0		67	87
	69		85	91
	28		23	
	8		84	
	44	X = 29	24	X = 66
South Transect	80	100	98	92
	90		98	
	100		98	
	96		91	
	93	X = 93	97	X = 96
<b><i>Sand Point</i></b>				
North Transect	88	90	95	89
	80	100	92	87
	76	95	93	95
	86		90	88
	100	X = 89	89	X = 91
Central Transect	98	98	100	96
	63	94	99	98
	90	99	97	
	93		99	
	95	X = 91	98	X = 98
South Transect	98	95	82	94
	99	90	100	98
	100	95	84	90
	100	100	86	96
	100	X = 97	98	X = 92

**Table 3.** Percent of filamentous algal cover on the macrophyte canopy at the North Gully Cove and Sand Point Gully sites. X is the mean for each area. Each value is based on analysis of one image taken at random over depths of 1 and 2 m along each established transect. See Figure 7 for summary data for 2008. There was no filamentous cover of the macrophyte bed at Sutton Point. Photographic quadrats were recorded for Sutton Point but the values were all zero and are not reported in this table.



**Figure 1.** A map of Conesus Lake showing some of the largest macrophyte beds along the coast the associated sub-watersheds. The study sub-watersheds are marked in gray.



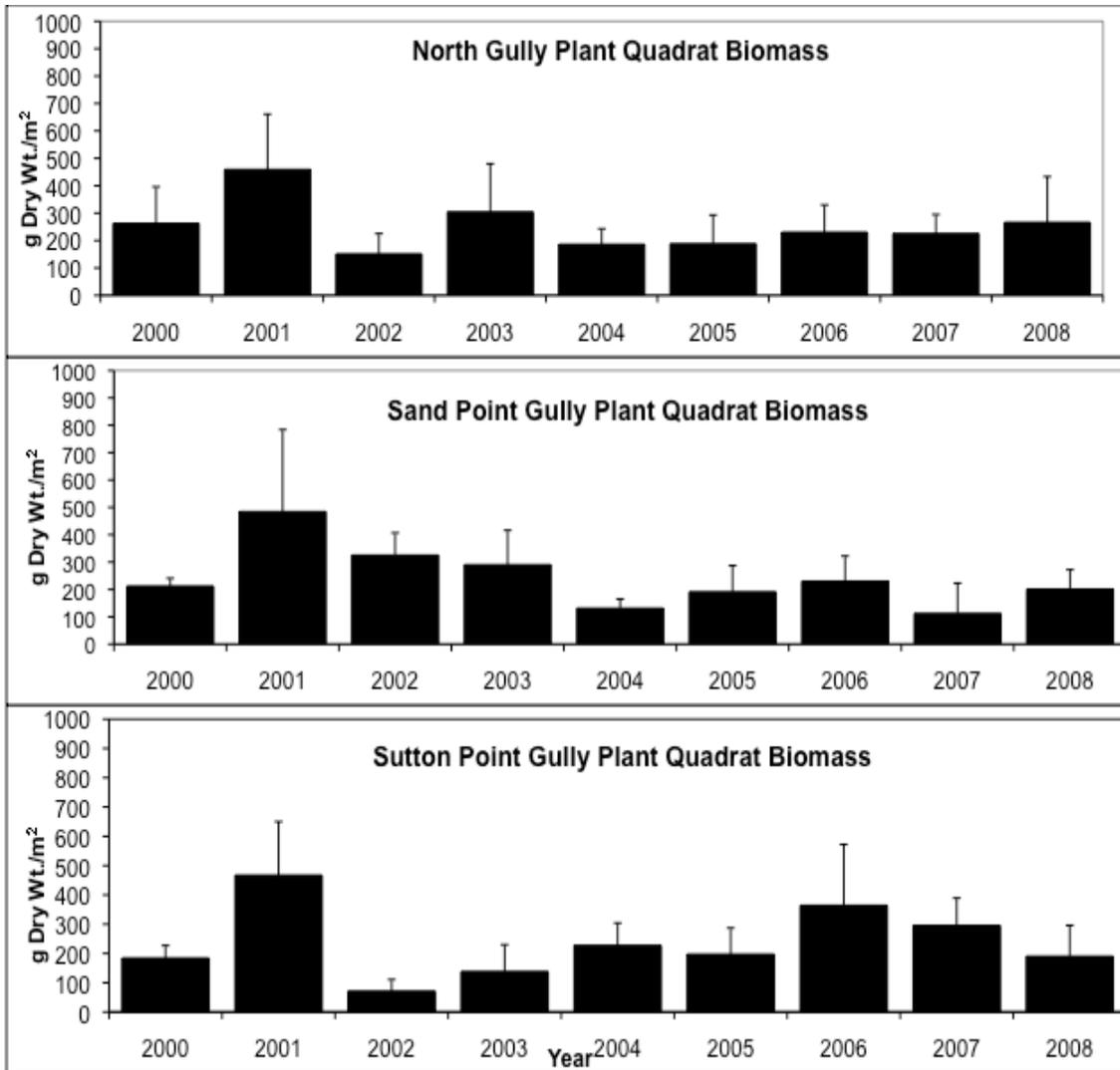
**Figure 2.** Map of the general area around McPhersons Point showing nearby milfoil dominated areas in geo-referenced positions. The previous (solid line) and current (dashed line) positions of the North Gully stream mouth are drawn in by hand.



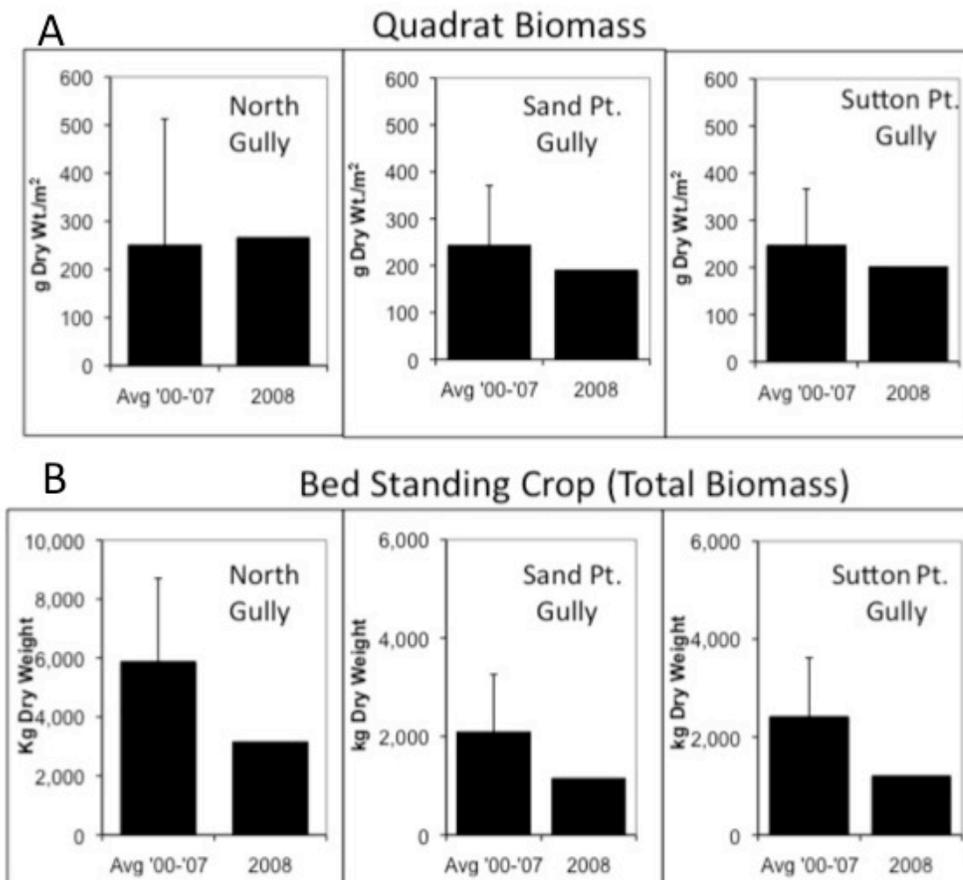
**Figure 3.** Photograph of the southern shore of McPhersons Point and North Gully Cove to the south. A dense mat of filamentous green algae (yellow surface color) covers the macrophytes from the shoreline to a depth of approximately 2 m.



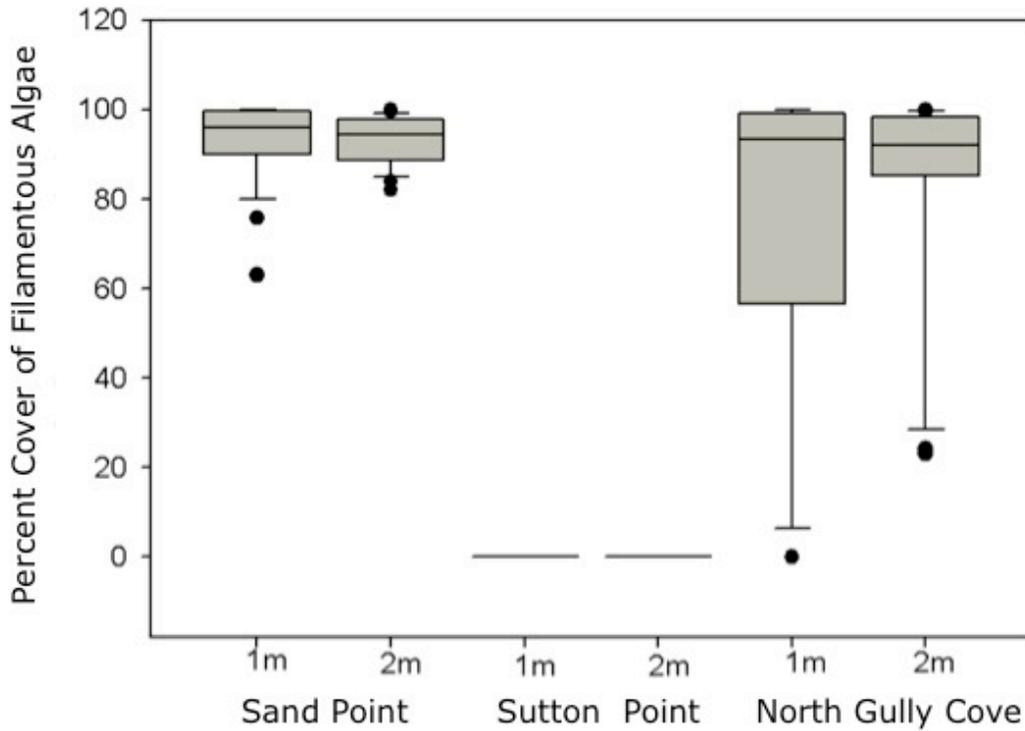
**Figure 4.** Sediment plume runoff from North Gully following rain events in the summer 2004 and 2008. The 2004 photo shows the plume flowing almost directly due south into North Gully Cove and the macrophyte bed. In 2008 the plume is being dispersed offshore and north into open water.



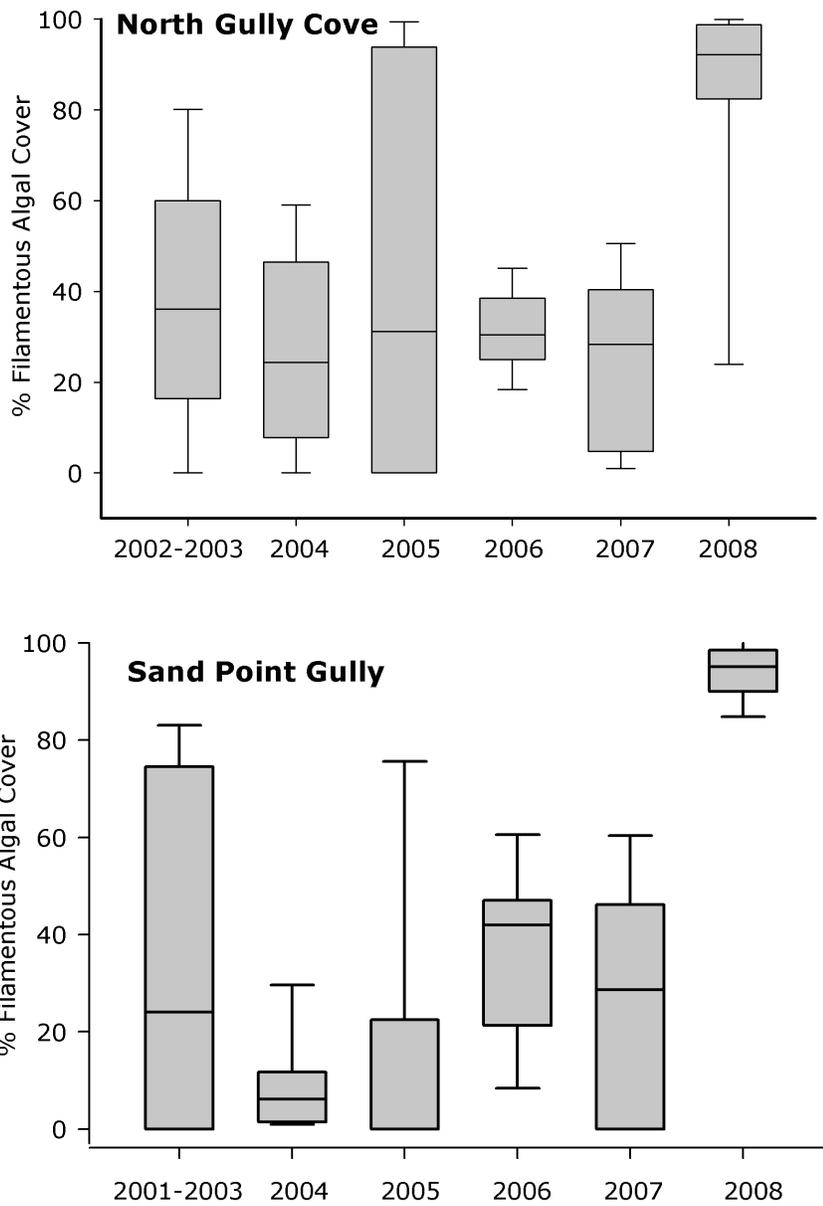
**Figure 5.** Long-term trends of macrophyte density in the 2-3 m zone dominated by Eurasian watermilfoil in the North Gully, Sand Point; and Sutton Point study sites. Note the lower quadrat biomass after 2003 at Sand Point Gully, downstream from a sub-watershed managed by the USDA project (Bosch *et al.*, 2009a).



**Figure 6.** Comparison of long-term trends in quadrat biomass (A) and standing crops (B) for the areas dominated by Eurasian watermilfoil. The means and standard deviations are reported for all the 2000-2007 data (n=8) while a single average for each site is reported for 2008. Biomass density was slightly higher than the long-term average for North Gully Cove whereas at the Sand Point and Sutton Point. Gully sites 2008 values were lower. Bed standing crops were lower than the long-term average at North Gully in 2008, but similar trends were observed at the other study sites, confirming field observations that the milfoil distribution was reduced in 2008.



**Figure 7.** Percent of filamentous algal cover (metaphyton) on the macrophyte canopy at the Sand Point, Sutton Point, and McPherson Point (i.e. North Gully) site. The boxes represent the 25-75% data intervals and the bars are the 5 and 95% intervals. The horizontal line within the box is the median. The filled circles are outliers. Percent cover at Sutton point was zero for 2008. Algal cover was extremely high throughout the Lake. The Sutton Point and the North End (near Vitale Park) macrophyte beds were exceptional for their lack of cover.



**Figure 8.** Long-term trends in filamentous algal cover within the macrophyte beds at North Gully Cove and Sand Point. After heavy rains in July 2008, filamentous cover was exceptionally high along shore throughout most of the Lake.