Friends of Semiahmoo Bay Society
Eelgrass Transplant Pilot Project
May 6, 2007, Blackie Spit, Surrey, BC.

Eelgrass harvest and transplant- May 6, 2007

Prepared for: Friends of Semiahmoo Bay Society

Prepared by: Ramona C. de Graaf, BSc., MSc., Emerald Sea Research and Consulting

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Executive Summary

On May 6, 2007, 17 volunteers and the field coordinator conducted an eelgrass (*Zostera marina*) transplant at Blackie Spit, Surrey, BC. Four hundred shoots were transplanted at three different locations (southern site, northern site, and lagoon site) in two different sediment types (mud and gravel) and at three depths. On August 13, 2007**,** the southern and northern sites were monitored by walking the low tide line and walking waist deep in the water. No shoots were found. On September 20, 2007, the two subtidal sites were monitored by scuba and freedivers. In total, nine surviving shoots were found. All surviving shoots were located in gravel sediments. The average length of blades (83.2 cm) on surviving shoots, as at September 20, was 22.9 cm greater than the length of the May 6 donor shoots (60.3 cm). Some individual shoots measured on September 20, 2007, were two times the length of the average blade length measured on May 6, 2007. All surviving shoots were in gravel sediment and in the deepest transplant plots.

Results indicate that mud sediment should be avoided when transplanting *Zostera marina* at this location. Overall, 16% of shoots planted in gravel, subtidal plots survived the transplant. Any future transplants within the proposed compensation area should be conducted in gravel sediments at depths below chart datum (or subtidal). Favourable depths for transplanting eelgrass in gravel sediments are -0.3 m to -0.6/-0.8m.

Introduction:

Friends of Semiahmoo Bay Society conducted an eelgrass, *Zostera marina*, transplant at Blackie Spit, Surrey, BC on May 6, 2007. Eelgrass transplants can be conducted to restore environments where eelgrass was once present. Eelgrass transplants are often used for mitigation where eelgrass habitat is lost and proponents are required to restore the hectares lost at compensation areas. Therefore, an inventory of potential compensation/restoration sites is important as part of a larger strategy and Fisheries and Oceans Canada's policy of "no-net loss" of eelgrass in British Columbia. Before large-scale transplants are conducted, sites are accessed for their potential to support *Z. marina* growth. After such an assessment, small test plots of transplanted donor stock are conducted and then monitored. In November of 2006, an assessment of the Blackie Spit area was conducted by Precision Identification Biological Consultants. (Appendix A). The purpose of the FoSBS 2007 transplant was to investigate conditions for growth of *Zostera marina* at Blackie Spit. *Zostera marina* and *Zostera japonica* beds were mapped by FoSBS in 2004 (Figure 1) (see report *Zostera marina* and *Zostera japonica* Sensitive Habitat Inventory: a comparison of seagrass distribution and abundance 1995, 2002, and 2004 Blackie Spit 2004, Crescent Beach, Surrey, British Columbia).

At Blackie Spit, there is an eelgrass bed on the northern corner of the spit but it does not extend beyond the tip of the spit to the south. As part of the restoration and enhancement of habitat for species within the Boundary Bay Wildlife Management Area, expanding eelgrass habitat is an important component of habitat protection and environmental enhancement. The May 6, 2007, pilot transplant project was conducted to test the conditions in the area for eelgrass growth.

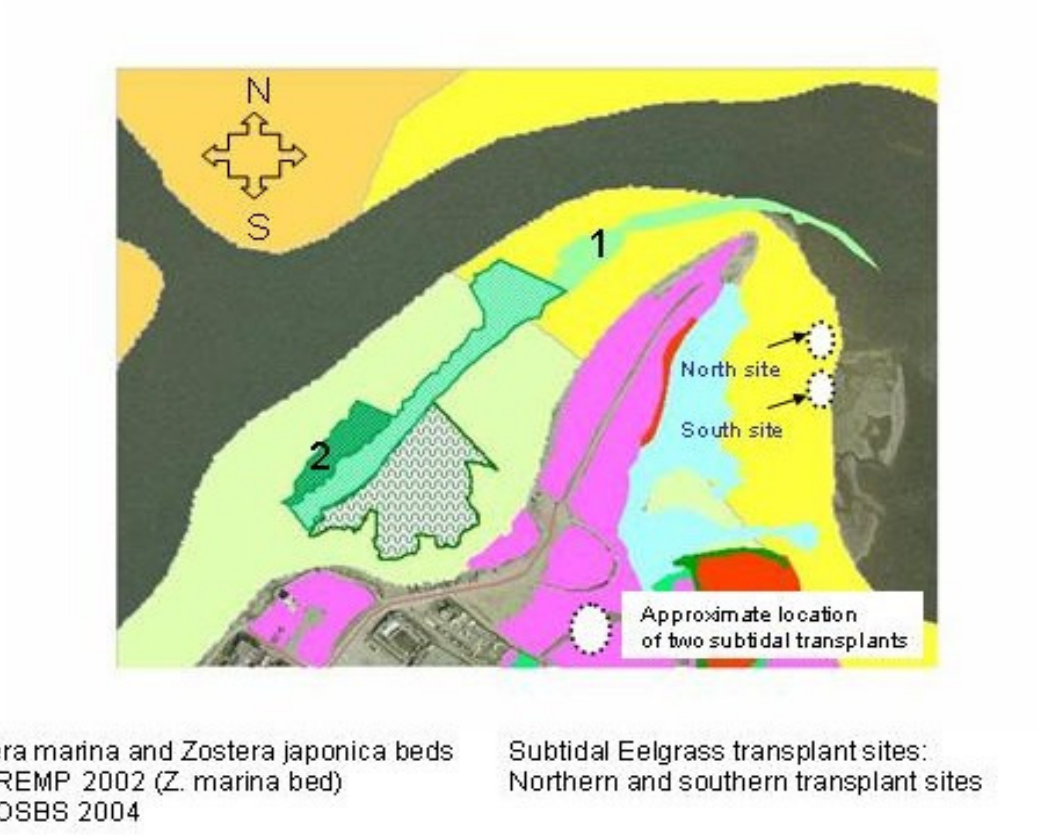

Figure 1: Location of eelgrass beds, Blackie Spit, Surrey, BC.

The Transplant:

On May 6, 2007, 17 volunteers met for an orientation and training session at Blackie Spit. At approximately 12:30 pm, 400 hundred donor shoots were harvested from the extensive *Zostera marina* bed located along the edge of the boat dredge at Crescent Beach. These shoots were brought to Blackie Spit where volunteers attached a 5/8" stainless steel washer to each rhizome and all shoots were transplanted within three hours of being harvested (Appendix B). Length and width measurements of 30 representative donor shoots are given in Table 1. Photos of the transplant process are in Appendix B.

The day was cool and rainy; and as a result, there were very few visitors to the area on the day of the transplant. Approximately 10 individuals were informed of the transplant event and were given copies of the FoSBS eelgrass brochure and a flyer (Appendix C). Appendix D is a copy of the article from the Peace Arch News of two FoSBS events that week.

Within the potential compensation area (Appendix A), two sites were chosen with different sediment conditions (Figure 2). The sediment character at the southern site (site one) progresses from a mud/silt intertidal to a subtidal that is primarily gravel and mud. The sediment character at the northern site (site two) progresses from a gravel intertidal to a subtidal that is primarily mud/silt. The two subtidal sites were less than 100 metres apart.

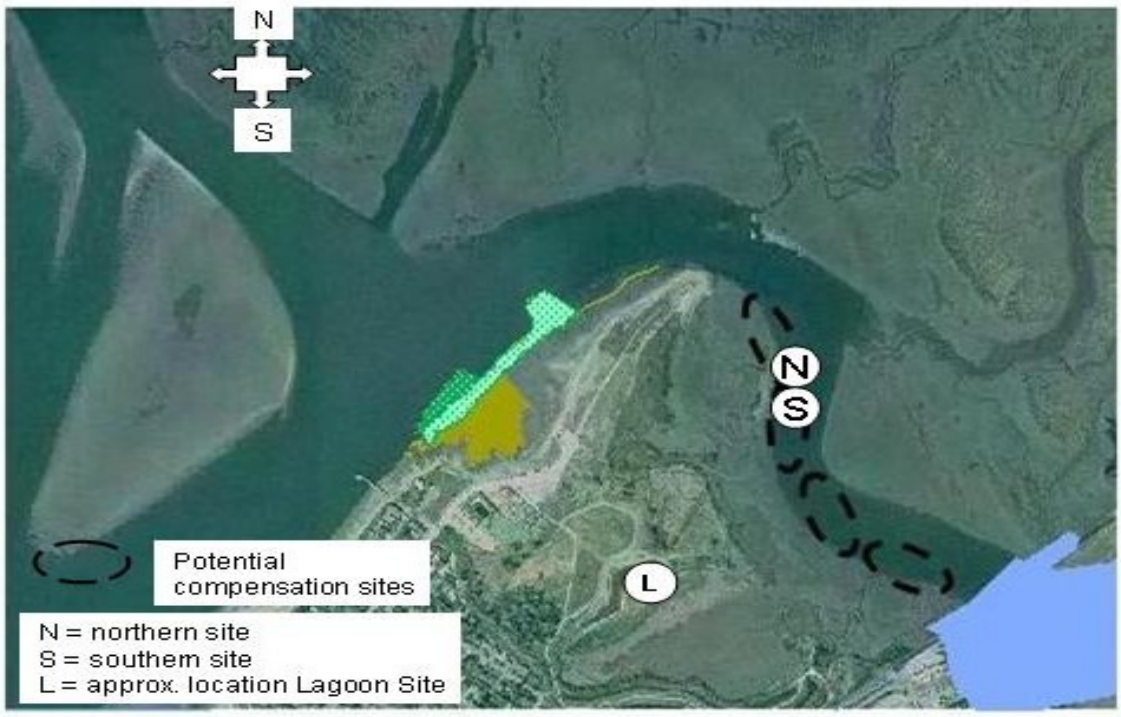

Figure 2: Map of Blackie Spit, Surrey, BC showing transplant site locations.

The total length of each subtidal transplant site was less than 15 metres. The divers commented that transplanting at the northern site was much easier due to the softer sediments relative to the southern site. As well as testing different sediment characteristics, three different tide heights were also tested in three plots at each subtidal site: intertidal +0.6/0.8 m, 0.0 m, and subtidal -0.6/-0.8 m relative to chart datum. Divers depths are subject to errors due to divers' depth gauges and published tide tables to barometric pressure deviation. None of the sediments were anoxic. A third site was planted in the intertidal `mitigation' lagoon.

The southern site was the first planted with the divers commencing at 2:30 p.m., and the shore crew commencing at the low tide line at 3 p.m. Shore-based crews located at the low tide line (+0.**6** m) planted 5 eelgrass "patches" consisting of 10 shoots per patch and placed approximately 1 meter apart. Snorkelers and freedivers planted 5 eelgrass patches (10 shoots per patch) at **0.0** m and -0.**8** m depth.

At the northern site, divers commenced planting at 3:30 p.m. and ended at 4:10 pm; and the shore crew commenced planting at 3 p.m. Shore-based crews located at the low tide line (+0.**8** m) planted 5 eelgrass "patches" consisting of 10 shoots per patch placed approximately 1 metre apart. Snorkelers and freedivers planted 5 eelgrass patches (10 shoots per patch) at 0.0 m and -0.6 m/-0.**8** m depth. At the north site, there was one *Z. marina* shoot located near the low tide mark (+0.5m) in gravel sediment; and 13 shoots were planted around that single shoot.

Also, as part of a plan for a future public education display, at 4:10 – 5:00 p.m., 87 shoots were transplanted in 9 patches (8 patches of 10 shoots; and 1 patch of 7 shoots) in the intertidal `mitigation` lagoon located at the southern edge of Blackie Spit.

In total, 15 patches totaling 150 shoots were transplanted at each subtidal site, 13 additional shoots to reinforce a single shoot already present; and 87 shoots planted at the lagoon site. In total, 400 shoots were transplanted.

Monitoring Results:

On August 13, 2007, all transplant sites were walked to look for transplanted shoots. No shoots were detected using this visual survey. While the tide height of the day did not allow for proper inspection of the 0.0 m and -0.8 m transplant patches, the intertidal patches would have been detectable. One stainless steel washer was recovered at the northern site. The lagoon site was also monitored on foot. No shoots were detected in this shallow lagoon. The surface waters of the lagoon where thick with green algae (*Ulva sps)*. As well, the sediments were noted to be anoxic both near the surface and to approximately 20 cm deep, a condition that would not permit eelgrass growth.

On September 20, 2007, the transplant sites were monitored by divers Sharon Jeffery, Greg Fee and field crew David Jeffery. Using a GPS, and coordinates from the original transplant, the outer edges of the transplant site were marked with floats. Divers searched from 15m north of each transplant site to 15m south of the sites using a grid search with 1m intervals. A depth range of more than 2.0 m was searched which overlapped with the depth the eelgrass was originally planted at (+0.8 to -0.8m). For every plant encountered, the total length, sheath length, width and number of leaves were measured and recorded (Table 2). The location of each plant was also marked with a GPS at the surface (Figure 3). Approximately 45 minutes were spent searching at each site. The kayak stayed close to the divers to record GPS points, and kept a dive flag near them to ward off passing boats.

Eight plants (P3-P10) were found at the southern transplant site corresponding to three of the original transplanted patches. They were all at a depth of -0.3 m relative to chart datum corresponding to the deepest transplant patches (Figure 3). Two of the transplanted patches had three healthy plants each (from the original five transplanted patches with ten shoots in each patch), and the third patch had only two plants. These two plants were broken such that only the sheath remained. The transplanted patches of plants were positioned less than a meter from each other, and the plants within each cluster were very close to one another so that the original planting arrangement of transplanted patches was very obvious. Divers searched carefully in the vicinity of the three patches clusters hoping to find evidence (uprooted shoots, rhizomes, washers etc) of the other plants from the transplant, but nothing was found. Although the dive depth information varies slightly, the depth of the surviving shoots at the southern location correspond to the subtidal transplant plots of May 6, 2007.

At the northern transplant site a single, small and healthy looking plant (P1) was found. It was within the depth range of where the intertidal transplanted plants should have been, but was all alone, and no evidence of other plants or transplant materials (i.e. washers) could be found near it. No evidence of the single plant with 13 donor shoots added to the patch above the low tide line transplant patches was found.

Well outside of either transplant area a single, healthy eelgrass plant was found growing slightly shallower than the transplant areas. This plant was likely not part of the original transplant.

All surviving transplanted shoots were in gravel sediments (northern site having gravel intertidal sediments and the southern site having gravel subtidal sediments).

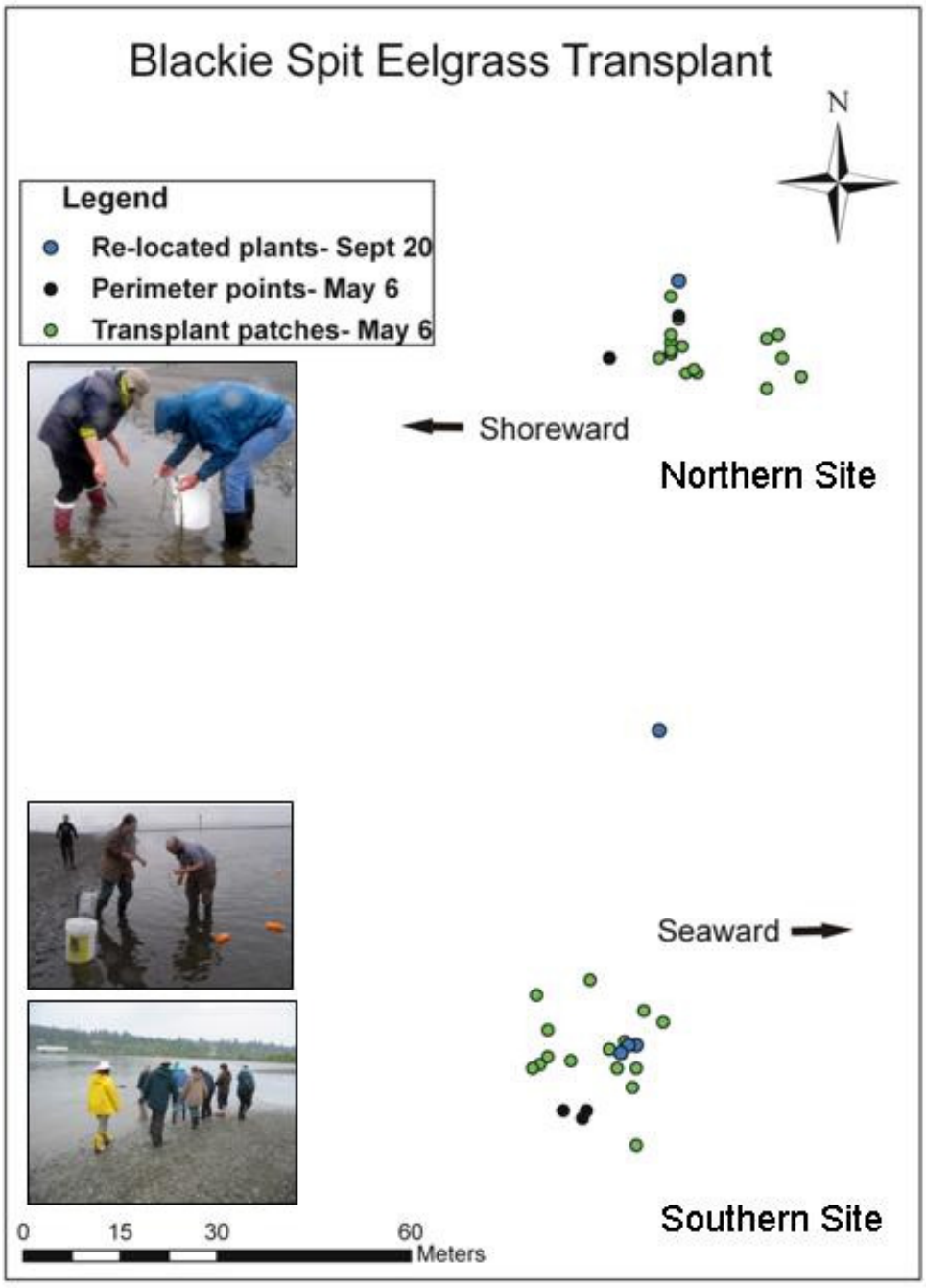

Figure 3: Relative location of May 6, 2007, transplanted eelgrass patches, perimeter markers and surviving transplanted shoots monitored on September 20, 2007.

Blade Measurements:

The average blade length of the transplanted shoots measured on September 20, 2007, (83.2 cm) was 22.9 cm longer than the average lengths measured on May 6, 2007 (60.3 cm). The blade widths were not different. Some individual blades grew to 100, 150 and 160 cm in length (Table 2).

Table 1: Lengths and widths of *Zostera marina* donor stock eelgrass blades, May 6, 2007.

Plant ID	Length (cm)	Width (mm)	Plant ID	Length (cm)	Width (mm)
1	67	3	16	39	2
2	63.3	2.5	17	56	2
3	73	3	18	48	2
4	74	3.5	19	53	3
5	54.4	3	20	62	2
6	73	3.5	21	73	3.5
7	53	3	22	60	2
8	75	2.5	23	47	2
9	85	3.5	24	50	2
10	63	3	25	42	3
11	70	2	26	50	3
12	63	2	27	50	3
13	80	3	28	52	4
14	71	2.5	29	65	3
15	47	3	30	50	2
Average:				60.3	2.7

Table 2: Shoot blade measurements on September 20, 2007.

Plant ID	Waypoint	Total length (cm)	Width (mm)	Sheath length (cm)	Leaf length (cm) (total-sheath)	Number of leaves	Comment
1	6	52	3	6	46	5	north site
2	10	93	3	17	76	4	between transplant sites
3	12	150	4	33	117	4	South site
4	12	100	3	14	86	2	South site
5	12	85	3	21	64		South site
6		160	4	26	134	4	South site
7		90	3	20	70	2	South site
8		42	2	10	32	3	South site
9	13	40	2				South site- Broken plant
10	13	20	2				South site- Broken plant
Average		83.2	2.9	18.4	78.1		

Discussion and Recommendations:

The proposed compensation area is within a dredged boat channel with considerable boat traffic in the summer months and maximum depths are limited to only a few metres below chart datum. The design of this transplant project allowed both sediment and depth parameters to be tested.

Sediments:

The northern transplant site is the closest location to the existing eelgrass bed which extends around the tip of Blackie Spit but ends several hundred metres before the northern transplant site (see FoSBS 2004 report). Knowing the sediment characteristics and light environment of this eelgrass bed would be useful to future transplants.

While light characteristics are likely the same at both the northern and the southern sites, the results from this project show that consideration of benthic sediments is important as all surviving *Zostera marina* shoots were located in gravel sediment. It appears that the subtidal mud sediments at the northern site and the intertidal mud sediment at the southern site did not provide a favourable location for eelgrass growth.

At the intertidal `mitigation` lagoon transplant location, none of the 87 transplanted shoots survived. The lagoon is an unfavourable location for *Zostera marina* growth. This may have been due to the growth of algae at the site which may have blocked sunlight as well as the condition of the sediments.

Depth:

Due to the failure of intertidal eelgrass patches to survive or gain in blade length, conditions within the intertidal zone (+0.6/+0.8 m and 0.0 m relative to chart datum) appear to be unfavourable for *Zostera marina* growth at these specific test locations. As well, the single surviving shoot at the northern site did not show any change in blade length. From the GPS location map (Figure 3), the shoot was likely planted in the intertidal transect plots with a gravel sediment character.

All surviving shoots at the southern site were in the subtidal transplant plot. Eight shoots out of 50 transplanted (or 16 percent) at that depth survived. As the average length of eelgrass blades in the subtidal transplant plot was more than 20 cm longer after six months, the surviving shoots grew very well. Some single shoots measured were two times the length of the average shoot length on May 6 07. However, it should be noted that only 15 donor shoots were measured for length and width arriving at the average shoot length measurement. It is possible that the surviving shoots measured on September 20 were from donor shoots that were already longer than the average shoot length measured on May 6, 2007; and that shoot growth between May and September is less than reported.

Overall, 16 percent of shoots planted in gravel, subtidal plots survived the transplant. Any future transplants within the proposed compensation area should be conducted in gravel sediments at subtidal depths. Favourable depths for transplanting eelgrass in gravel sediments are -0.3 m to -0.6/-0.8m (below chart datum).

Appendix A

Boundary Bay, Blackie Spit

The Friends of Semiahmoo Bay Society (FoSBS) suggested the eastern side of Blackie Spit as a potential eelgrass compensation area. The FoSBS have mapped the intertidal and shallow subtidal eelgrass habitat along the western side of the spit (Figure 3), and observed that the subtidal eelgrass habitat extends well beyond the area that was mapped. The area along the western side of Blackie Spit had not been assessed, however the FOSBS noted that there was not any eelgrass exposed at this location during low tide.

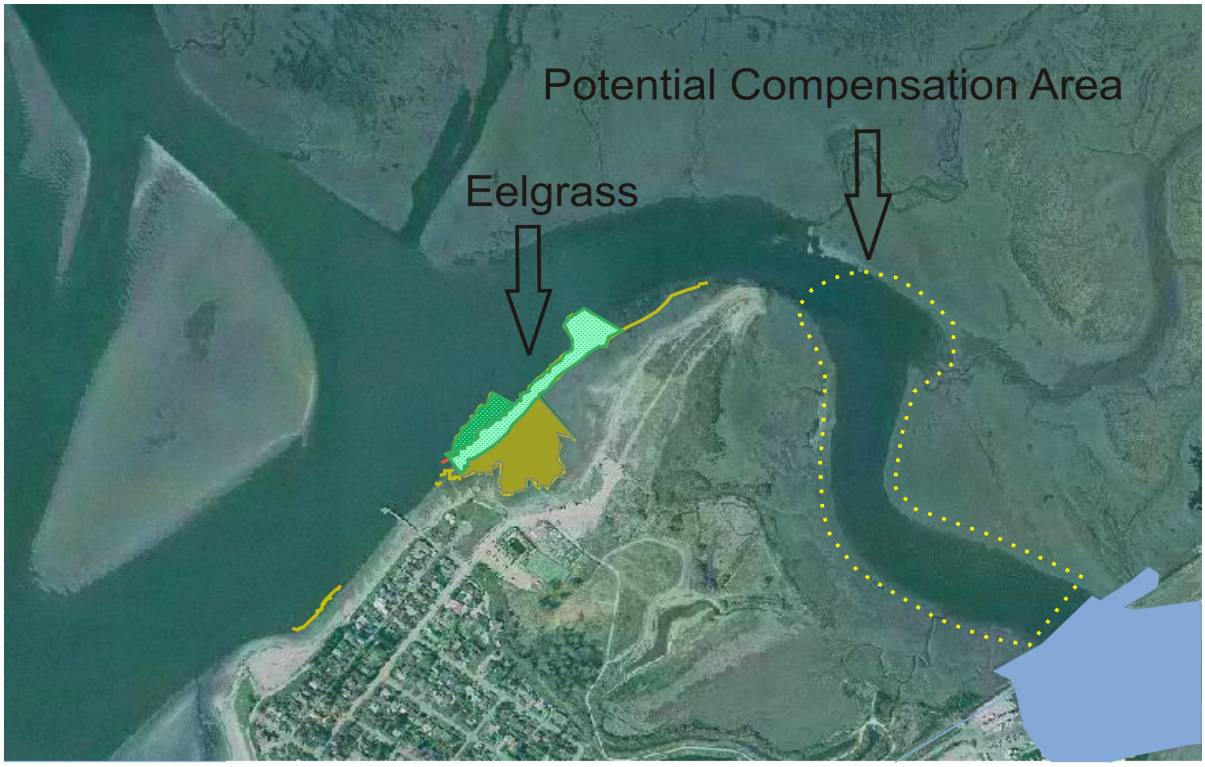

Figure 3. Blackie Spit. The intertidal and shallow subtidal eelgrass beds (*Zostera marina*; dark green and *Z. japonica*; light green and brown) were mapped by the Friends of Semiahmoo Bay. The potential compensation area is located along the banks of the channel within the area delineated by the yellow dotted line.

Blackie Spit was created by pumping dredged material into the slough between Crab Man's Island and a dyke many decades ago.[1] The local community has been actively restoring the upland habitat of the spit by replacing exotic vegetation with native species. A dyke has been breached to create an intertidal lagoon at the mouth of the Nicomekl River, adjacent to the proposed compensation area. The lagoon was developed as compensation for dredging in the area.

[1] http://members.shaw.ca/j.a.brown/CresBeach.html

The Nicomekl River and its tributaries support runs of coho, Chinook, chum, and pink salmon; cutthroat, steelhead, and rainbow trout; as well as red-sided shiners, three-spine stickleback, western lamprey, brown bullhead, carp, and sculpins. A bed of native Olympia oysters replaced by the more common introduced Pacific is located at the mouth of the river[2]. The Nicomekl Estuary also provides intensively utilized migratory bird habitat and is the site of a Purple Martin recovery nest box program.

A dive survey was conducted at the site on November 21, 2006 to determine whether eelgrass has colonized the shallow subtidal area along the eastern side of the spit, and whether the sediment and depth would be suitable for the species. The survey followed several storms and a period of high rainfall; hence the water was extremely turbid with visibility of <1 meter. The divers examined the lower half of the potential compensation area shown in Figure 3. The sediment throughout the shallow subtidal was sandy silt, suitable for eelgrass. The intertidal sediment contained a higher percentage of silt and appeared anaerobic. The subtidal sediment did not appear anaerobic based on colour. The only live species that were noted were bubble snails (*Haminoea* sp). The only vegetation that was observed was drift eelgrass, uprooted from adjacent areas during the recent storms.

The eelgrass beds on the western side of the spit would be able to provide donor stock that is adapted for the local water conditions. However, the area and density of native eelgrass (*Z. marina*) would need to be assessed to ensure that an adequate amount could be removed without damaging the bed. There is an extensive eelgrass slightly south of Blackie Spit that could supply material for transplant if necessary.

There are two possible limitations to eelgrass growth in the proposed compensation area. Light may be limiting at depths suitable for eelgrass. However, the FoSBS have observed that the water clarity tends to be similar on either side of the spit. The other potential problem is the migratory birds. Once established the eelgrass would benefit the birds, however large numbers of birds foraging in recently transplanted eelgrass can have a negative impact. Canada geese and mute swans have removed recently transplanted eelgrass at several locations, and it is likely that other species could have a similar impact. A transplant at this location should be timed to ensure that the transplanted eelgrass has several months to develop prior to the arrival of migratory birds.

It would be advisable to contact Carrie Baron (Surrey Environmental Engineering) to ensure that transplants are not located in areas slated for maintenance dredging.

[2] Lower Fraser Valley Streams Strategic Review, Fraser River Action Plan, Fisheries and Oceans Canada, 1999.

Appendix B:

Orientation and Shoot Harvesting


Harvested shoot


Conditions before shoot transplant


Attaching washer to shoot


Newly transplanted shoots

Shore-based crews attaching washers and planting intertidal shoots

Planting Shoots

Lagoon Transplant Site

Appendix C: Flyer Produced for Public/Visitors to Blackie Spit on May 6 07

WHY TRANSPLANT?

Eelgrass beds have been declining in areas around the world. In British Columbia, eelgrass beds have been lost due to human activities (marinas, dredging, coastal shoreline alteration, pollution, and land-based runoff). We can help offset these losses by transplanting eelgrass. Just like in your home garden, we are underwater gardeners taking plants from a donor area (which has an abundance of plants) and plant new beds where eelgrass has been lost. These transplants have incredible positive benefits by providing fish and crab nursery habitat, foraging habitat for birds and so much more. The area of Blackie Spit has been the focus of large efforts for restoration. Increasing the area of eelgrass beds around Blackie Spit will increase its value for fish and bird habitat.

Appendix D: Press Coverage

A10 - The Peace Arch News • Saturday, May 12, 2007

LIFESTYLES

Boundary Bay book launched

Laura Baziuk
Black Press

Local nature groups led by the Friends of Semiahmoo Bay Society have compiled a one-of-a-kind atlas of Boundary Bay.

The Georgia Basin Habitat Atlas: Boundary Bay was launched on Thursday, May 10 at the White Rock and Surrey Naturalists' meeting, and is a printed version of the ongoing web-based project of the same name.

The online habitat atlas features a larger collection of information, maps and photographs of the southern Georgia Basin area, which runs from Whistler, B.C., over parts of Vancouver Island up to Campbell River, down to Olympia, WA.

It all started when the society started mapping eelgrass habitats in Semiahmoo Bay with other conservation groups five years ago.

"It's an essential habitat for our survival," said Margaret Cuthbert, president of the Friends of Semiahmoo Bay Society, of the eelgrass. Creatures such as salmon, herring and the Dungeness crab depend on eelgrass beds as part of their life cycle, she said. It is also a source of food and protection for countless other fish, shellfish and birds.

The society felt the eelgrass data they collected needed to be gathered into an atlas, with added layers of geography, infrastructure, streams and other wildlife habitats. In partnership with the Community Mapping Network, an online connection of atlases from areas across Canada but focused on B.C., the project was born on the Internet a year later.

Brian Giebelhaus photo

Joe Johnson and other volunteers, under direction from marine biologist Ramona de Graaf, plant eelgrass in Semiahmoo Bay.

The web version serves government agencies as a development planning tool to protect fisheries, bird habitats, aquifers and marine habitats. It now includes information from all corners of the Georgia basin.

The new soft cover atlas, however, is aimed at raising public awareness.

"It's a wonderful book for people to learn about where they live," Cuthbert said.

Its pages carry more than 100 colour photographs and maps that show the geological and ecological features of Boundary Bay, with historical photos supplied by the White Rock Museum, and underwater snapshots by Wes Kozak from Ocean Pro Divers.

The society has been working for two years with the Community Mapping Network and several other contributors to make the book happen.

Anne Murray, author of *A Nature Guide to Boundary Bay*, wrote the book's introduction.

"I think it's very important that people become aware of (Boundary Bay's) habitats and special attributes," she said. "I hope they feel they learn something, they're excited about where they live, and they get out into nature and learn about it," Cuthbert said.

Copies of *The Georgia Basin Habitat Atlas: Boundary Bay* will be available next week. To purchase one, contact the Friends of Semiahmoo Bay Society at 604-536-3552.