RECOMMENDATIONS FOR THE RE-ESTABLISHMENT OF SALMONIDS IN SPANISH BANKS CREEK

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Spanish Banks Creek

Introduction

Spanish Banks Creek is located in Pacific Spirit Park in north-west Point Grey. It drains a watershed approximately 115 hectares in area, and has a channel length of 950 m. A significant portion of the upper watershed has been developed for residential and golf course use and the stream is contained in the storm drain system. The lower stream section is confined to a large ravine in Pacific Spirit Park and was designated an environmentally sensitive area by the GVRD in 1991.

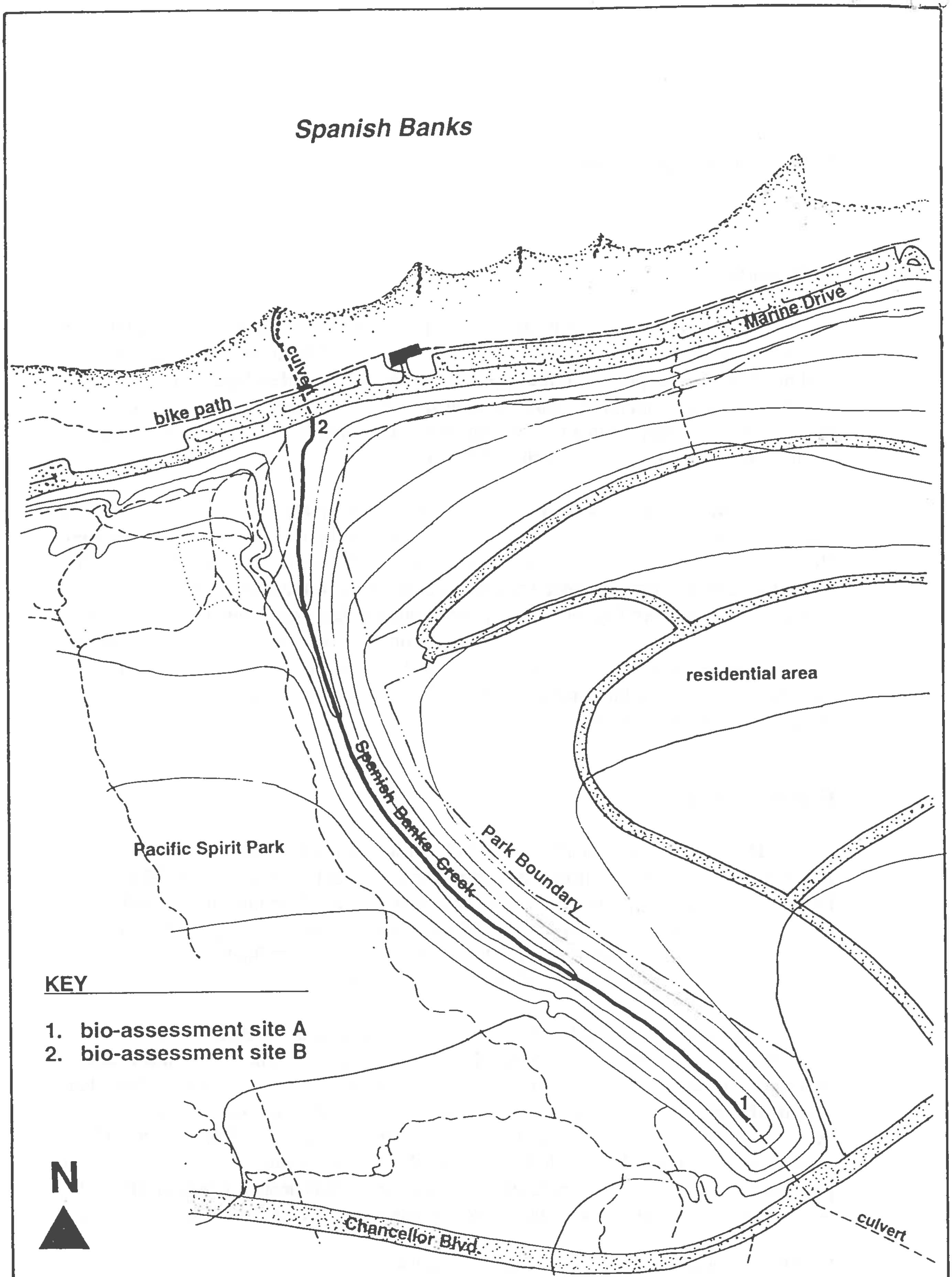
Anecdotal evidence indicates that sixty to seventy years ago Spanish Banks Creek supported populations of coho salmon, cutthroat trout and possibly chum salmon as well. Because of logging, the construction of the culverts at the creek outlet, and water quality problems, salmon were extirpated from the stream. Two community groups, the *Vancouver Salmon and Stream Society* (VSSS) and the *Environmental Youth Alliance* (EYA), have initiated a project to re-establish a run of salmon in the stream by removing a portion of the culvert under the beach at Spanish Banks that currently prevents fish passage and restocking the stream with juvenile coho salmon. This proposal is a continuation of their efforts.

Existing conditions

The portion of the stream that could be utilized by salmonids is located in the forested ravine that extends from Chancellor Boulevard in the south to N.W. Marine Drive in the north (Figure 1). The ravine is approximately 15 hectares in area and is forested with red alder, big-leaf maple, and red cedar. The average slope of the stream is 3 %. Without the culvert under N:W. Marine Drive and Spanish Banks beach,an estimated 550 m of the stream could be utilized by salmonids.

Salmon are prevented from naturally recolonizing Spanish Banks Creek because of an 85 m culvert running from above Marine Drive to part way down Spanish Banks beach. The elevation of the culvert outlet is approximately 4.35 m above Canadian chart datum[1] (Figure 2). Above this culvert the stream is capable of supporting salmonids, as demonstrated by the success of the released juvenile coho in 1991, 1992, and 1993 (M. Johnson pers. comm.). Rearing habitat is typical of small streams in areas that have been previously logged. There are relatively few pools and consequently, a reduced ability to retain water during low flows. Suitable gravel substrate sites for spawning are present.

[1] All tide heights are in meters above Canadian chart datum.



SPANISH BANKS CREEK

SCALE 1 : 5000 CONTOUR INTERVAL 10m

Drawn by Nick Page March 1994

While the stream is capable of supporting juvenile salmonids our analysis found several factors that should be addressed as part of any effort to re-establish a salmon population. Because a significant portion of water in Spanish Banks Creek drains from urban areas, water quality, especially in the upper ravine area is poor. An analysis of water quality using bio-assessment is presented below. This area of Point Grey was logged around 1910 and the riparian zone has not matured enough to provide snags and blown-down trees in sufficient sizes and quantities for the formation of pool habitat. Woody debris is essential in small streams for creating complex habitat, cover, and regulating hydrology (Bisson *et al.* 1987). Artificially adding logs and boulders to the channel, a technique that has been used successfully in many coastal streams, would address this problem (Poulin 1991, Gore 1985).

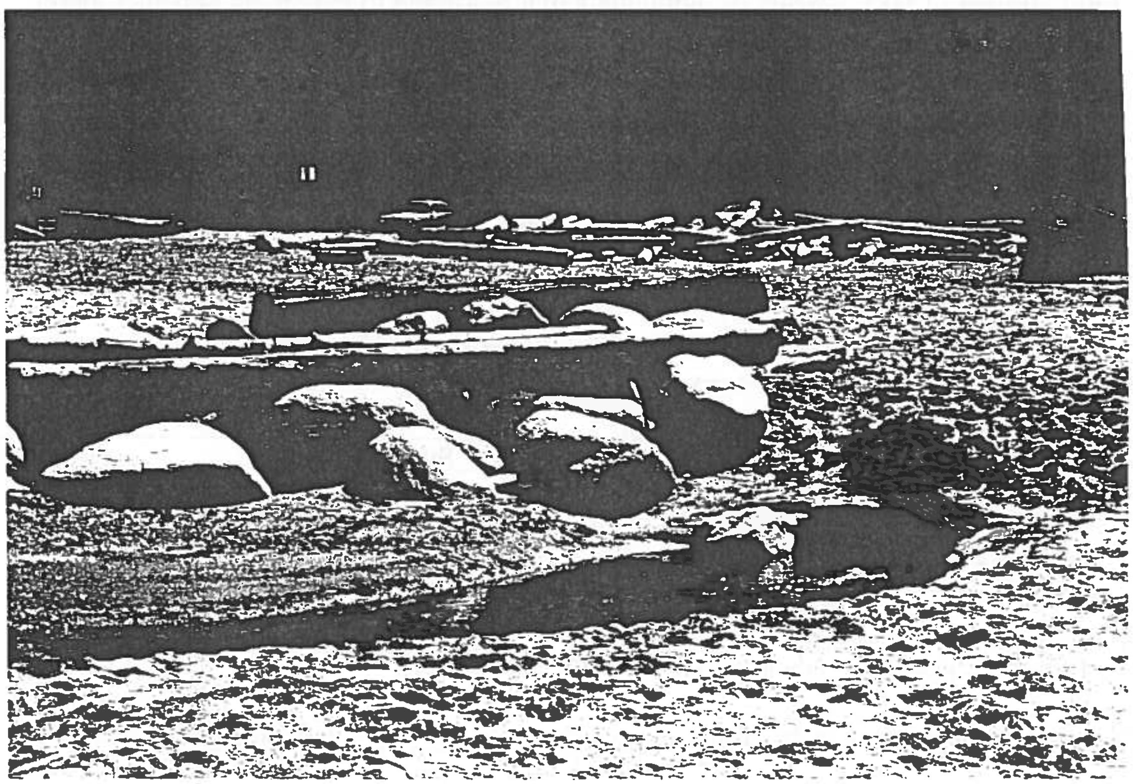


Fig. 2: Existing outlet of Spanish Banks Creek.

Bio-assessment

A macroinvertebrate rapid bio-assessment survey was undertaken in Spanish Banks Creek. We suspected, based on the presence of an orange periphyton film on the substrate for 165 m below the culvert in the upper ravine, and because of a foul smell of the water issuing from the culvert, that water quality was a problem. Three samples of macroinvertebrates were collected within 10 m of the mouth of the culvert (Bio-assessment Site A, Fig. 1), and three more samples were collected just upstream of the

N.W. Marine Drive culvert (Bio-assessmant Site B, Fig. 1). Macroinvertebrates include such organisms as insects, crustaceans and worms, and are an indicator of the water quality of the stream.

Samples were collected with a 0.5 mm mesh surber sampler which is designed to sample the macroinvertebrates in an area of substratum 0.09 m^2 in size. Care was taken to collect from similar microhabitats at each site; in this study collections were taken from gravel or cobble riffles. The collected animals were preserved in 70 % ethyl alcohol, and taken to the laboratory. In the lab they were identified to the lowest convenient taxon, usually genus, using keys in Pennak 1978, Usinger 1956 and McAlpine *et al.* 1981. Oil was observed in sediments during sampling at Site A.

For each sample the following rapid bio-assessment measures were calculated: total number of taxa, percent of individuals that belonged to the orders ephemeroptera (mayflies), plecoptera (stoneflies), and trichoptera (caddisflies) (collectively known as percent EPT individuals), percent pollution tolerant individuals, percent pollution tolerant taxa, and total macroinvertebrate density. Pollution tolerance was determined by consulting the literature, particularly Winget 1985, Hilsenhoff 1988, and Resh and Jackson 1993, and from personal experience. Mean values of the above statistics were calculated for each site. These are reported in Table 1.

Table 1: Rapid Bio-assessment Survey of Spanish Banks Creek Based on Macroinvertebrate Fauna

Rapid Bio-assessment Measures	Site A[1]	Site B[1]
Total # of taxa	7	12
% EPT individuals	0	19
% resistant ind./ sample	99.7	81
% resistant taxa / sample	94	59
Density of macroinvertebrates (ind./ m^2)	1163	322

[1] Site A: below Chancellor Dr. culvert in upper ravine, Site B: above culvert under N.W. Marine Drive.

The analysis of the samples found Site B upstream of N.W. Marine Drive has more taxa, more EPT individuals, lower proportion of resistant individuals, fewer resistant taxa, and a lower density of macroinvertebrates, compared to the site at the culvert in the upper ravine. All of these differences are consistent with the hypothesis that water quality is worse at the upper ravine culvert than at N.W. Marine Drive. We interpret this to mean that the water issuing from the culvert is contaminated, but that the stream's self-cleaning process removes contaminants from the water as it flows toward the ocean. There do not appear to be any sources of contamination between the upper ravine and N.W. Marine Drive.

The macroinvertebrate fauna of the lower reaches of Spanish Banks Creek is impoverished relative to Musqueam and Cutthroat Creeks, the nearest comparable streams. In particular the density of stoneflies is very low (only 5 stoneflies in three samples), and there is a complete absence of larval black flies. Three different genera of black flies can be seen in both Musqueam and Cutthroat Creeks. While comparisons between streams must be drawn with caution, these results suggest that some water quality problems exist, even in the lower reaches of Spanish Banks Creek. This is substantiated by the high percentage of pollution tolerant individuals (81%) and tolerant taxa (59%) in the lower reaches.

Because of the water quality problems of Spanish Banks Creek we believe that some form of mitigation would benefit any salmon enhancement efforts undertaken in the stream. The bio-assessment analysis points to chronic pollution from the storm drain system. The storm drain system is also a potential source of catastrophic single episode fish kills caused by pesticides, swimming pool drainage or in the future, possibly chloramine.

Recommendations for improving water quality

A solution that will reduce the impact of oil on the stream is a oil-water separator augmented with an oleophilic coalescing structure as described in Romano (1990), and available from local distributors. This device will also remove suspended particles, reducing the organic load on the stream. However, large equipment is required for installation and maintenance of an oil-water separator and access may be a problem in the deep ravine. A more practical alternative would be to build one or more retention ponds within the banks of the stream in the upper ravine, to buffer against possible contaminants before they reach salmonid habitat. Retention ponds would impound the water in the upper reaches of the stream, increasing the time available for the natural cleansing processes of the stream to purify the water.

As well, a program of education for the residents of the watershed informing them of materials that may adversely affect the stream should be started in cooperation with the City of Vancouver and the University Endowment Lands administration. An overview of solutions to address urban runoff contaminants is available in *Urban Runoff Quality Control Guidelines for B.C.* (MOE 1992).

Spanish Banks Creek Estuary Proposal

The goal of the restoration initiative is to make Spanish Banks Creek accessible to salmonids by removing the lower culvert, and replacing the wood crib culvert under N.W. Marine Drive with a baffled or box culvert. As well, the restoration initiative was expanded to include the shoreline areas adjacent to the creek, both because the creek is an excellent opportunity to be a high profile demonstration project, and also because of the need to stabilize sandy beach sediment against erosion.

Removing the lowest 38 m of the culvert under Spanish Banks beach and allowing the stream channel to reach an equilibrium as it flows across the sand will provide access at high tides over 4.7 m to both coho salmon and cutthroat trout. At tide heights below 4.7 m upstream access by salmonids would be precluded in moderate flow conditions because of shallow water levels in the stream channel. As well, chum salmon which are suited to streams like Spanish Banks Creek, are notorious for only spawning below long culverts such as the 45 meter section that will remain under the parking lot and Marine Drive. To provide habitat for chum salmon a tidal estuary at the outlet of the creek should be created to provide spawning sites (chum salmon eggs are tolerant of saltwater conditions). The estuary can be designed to provide access to the culvert at a range of tide heights.

A significant problem in allowing the stream to establish its own channel to English Bay is the movement of sand carried eastward from Point Grey by littoral drift (Thomson 1981). Potentially, the existing rock groyne eastward of the creek outlet will continue to trap sand, forcing the stream to remove the additional material from the channel. To create a tidal estuary will require the groyne to be extended to the west of the creek channel where it will prevent the infilling of the pools by sand movement and ensure stability.

Description of estuary proposal

A plan of the proposed estuary are shown in figure 3. The tidal portion of the estuary is approximately 115 m^2. A rock groyne will be situated on the western edge of the stream to prevent infilling by sand. Adjacent to the estuary are two sand areas stabilized with dune grass and other native species (see plant list table 2). The existing culvert elevation at the edge of the parking lot is estimated at 4.75 m (there is no accurate way to measure its elevation without uncovering it). To provide access to this culvert and maintain a water level of 20 cm within the culvert, a series of boulder weirs designed to regulate the water level at the outlet of the estuary will be created (Figure 4). The water level of the outlet pool is designed to be 4.95 m, the second pool 4.7 m, and the third pool 4.45 m. This will provide access to the Spanish Banks Creek during moderate flow conditions, at high tides above 4.30 m. As previously stated, without the outlet weirs the stream channel will preclude fish passage from the ocean to the culvert in moderate flow conditions because of shallow water depths. Approximately 53 % of high tides in the

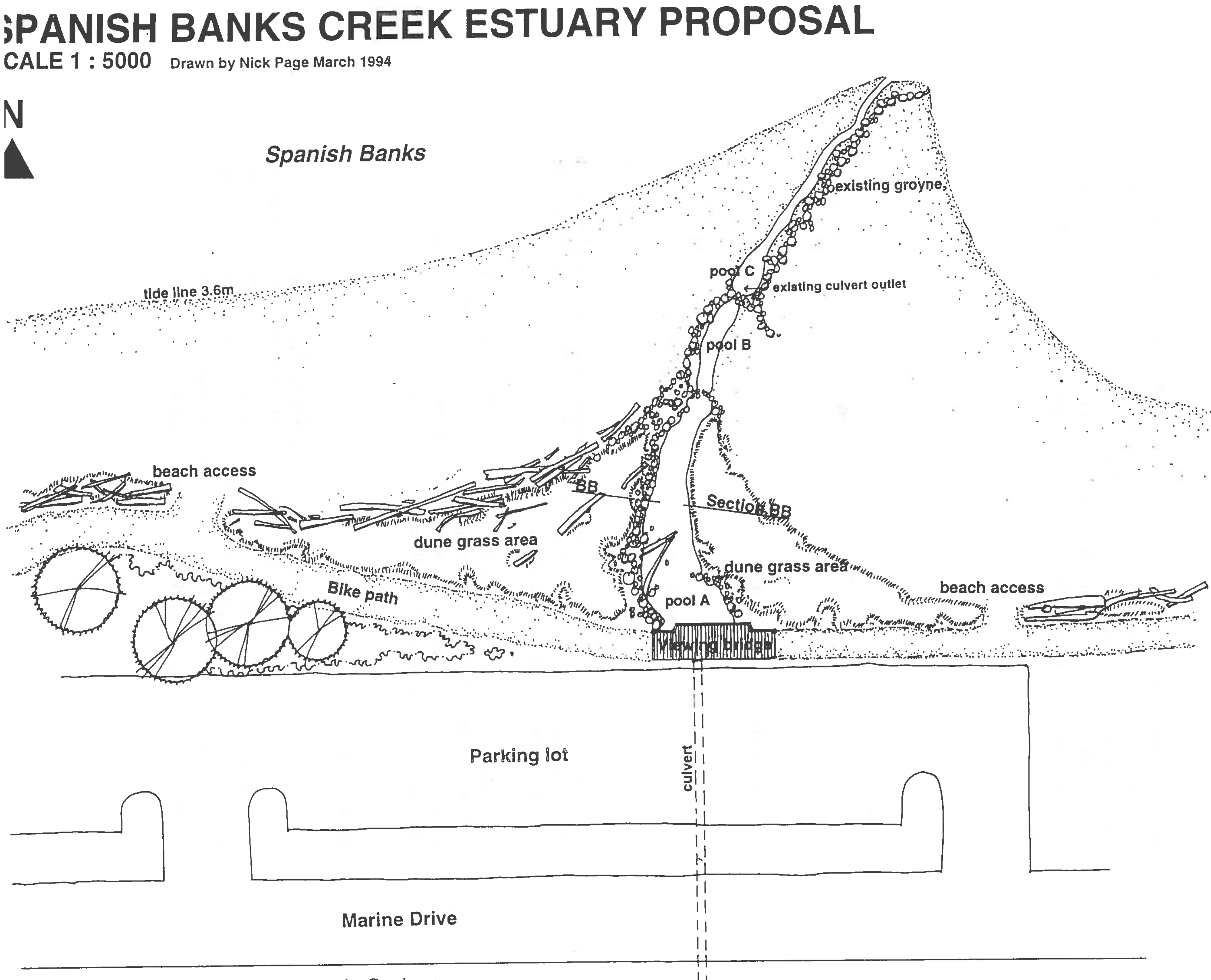
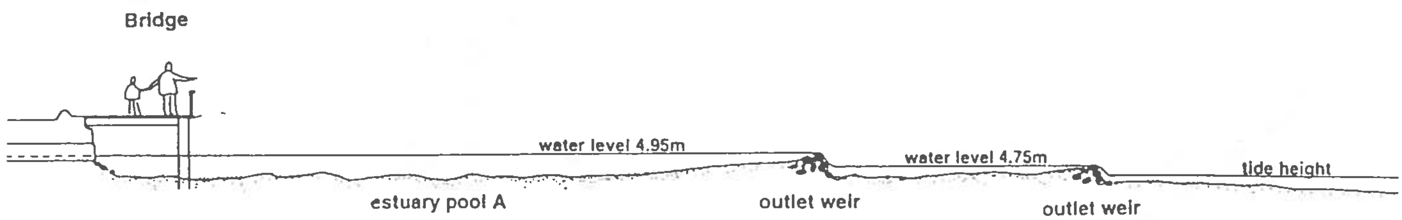


Figure 3: Plan of the proposed Spanish Banks Creek estuary.

period October 1994 to December 1994 will be above 4.30 m rather than the estimated 13 % of tides that would provide access without construction of the estuary and outlet pools. Placement of spawning gravels at sites likely to be utilized by chum salmon should be done after an equilibrium has been established in the estuary. We estimate a period of six months after completion of the weir and groyne structures should be sufficient.



Section AA: Thalweg profile

Fig 4: Channel profile of proposed Spanish Banks Creek estuary.

To maximize the length of culvert that can be removed, a bridge for the bike and pedestrian path will be built. This allows the removal of the culvert to the edge of the parking lot and increases the area available for the estuary.

Access to the beach will be provided on either side of the estuary from the bike path and the parking lot. People walking along the beach will be able to cross the creek at the outlet weirs where the stream channel will be narrow, or simply by jumping across the lower section of the channel that will remain 1 m to 1.5 m in width.

Revegetation

Vegetation has been used extensively to stabilize sand and other substrates against erosion by wind and tides (Levine and Willard 1990, Wiedemann 1984). To ensure the stability of the estuary, planting of native grass (*Elymus mollis*) and other species will be used in conjunction with the groyne protection (Figure 5). Re-establishing native species will also add to the educational opportunity of the restoration effort. The following is a list of native plant species suitable for stabilizing sandy areas.

Botanical Name	Common Name	Propagule
trees and shrubs - beach perimeter		
Picea sitchensis	Sitka spruce	pots
Pinus contorta	Shore pine	pots
Salix hookeriana	Hooker's willow	pots, cuttings
Vaccinium ovatum	Evergreen huckleberry	pots
Symphoricarpus albus	Snowberry	pots
Rosa nutkana	Nootka rose	pots
grasses and forbs - sand stabilization		
Elymus mollis	Dune grass	sprigs, runners
Carex macrocephala	Big-headed sedge	sprigs
Abronia latifolia	Yellow sand verbena	pots
Lupinus littoralis	Seashore lupine	pots
Lathyrus japonica	Beach pea	pots, seed
Grindelia integrifolia	Gum plant	pots
Convolvulus soldanella	Beach morning glory	seeds, pots
Fragaria chiloensis	Beach strawberry	runners, pots

Table 2: Native Plant Species for Stabilizing Sandy Areas (from Kozloff 1983, Wiedemann 1984).

The establishment of plants species within the tidal zone of the estuary will depend on the size and stability of the substrate, the salinity of the water, and the availability of nutrients. Because these factors are difficult to accurately predict, decisions on suitable species and planting strategies should be made after the estuary has reached equilibrium.

Section BB: Estuary pool A

Fig 5: Section of estuary pool A.

Education and the use of demonstration projects

Education of residents and park users about the plight of Spanish Banks Creek is an important part of the long-term restoration of the creek system. We propose that the entire project be used as demonstration site. As was noted in a report on successful riparian restoration projects in the U.S.: *"Demonstration projects provide the most useful educational tool for promotion of restoration projects. When physical proof of the benefits of land restoration is available, people are more likely to support and adopt restoration programs."* (Conin 1991).

We propose that an educational display providing information about the ecology of the creek and the goals of the restoration project should be situated at the bridge overlooking the estuary. Recognition of the funding agencies, organizations, and volunteers who participated in the project will be included in this display.

Because of the fragile nature of the estuary and dune grass areas, signs and other methods of delineating public use areas from the restoration site will be necessary. Specific methods will be left to the operations staff of the Vancouver Parks Board who have experience in these situations.

Schedule of phases

A schedule of phases for the construction of the estuary and replanting of the adjacent area is provided below.

Phase 1 Removal of the section of culvert from the parking lot to the existing outlet.
Construction of the retaining wall and bridge for the pedestrian/bike path.

Phase 2 Two month period to allow short-term equilibrium be established for the stream channel.

Phase 3 Construction of the rock groyne along the western edge of the stream channel and removal of sand from the estuary area.
Placement of boulders to control the outlet height of the estuary.

Phase 4 Planting of dune grass, gum weed, seashore lupin, beach pea, beach morning glory, and beach strawberry to stabilize sand around the slough.

Phase 5 Placement of educational display on the bridge.

Phase 6 Placement of spawning gravels (D = 5-13 cm) at suitable sites for chum salmon.

Phase 7 Monitoring of vegetation success, stability of sand, slough size, salmonid access, and salmonid use (by the DFO, VSSS, EYA, VPB).

Phase 8 Implement measures to compensate for problems (i.e. replanting of failed vegetation,.removal of infilled sand, extending groyne)

Summary of recommendations

1. Remove the lowest portion of the culvert from the parking lot to the existing outlet on Spanish Banks beach.

2. Replace the existing culvert under N.W. Marine Drive with a baffled or box culvert that does not restrict fish passage.

3. Construct an estuary for the stream system to provide better access to the section of the culvert that will remain, create an area where chum salmon may spawn, and provide an opportunity for park users to learn about the stream ecosystem.

4. Use native plant material to stabilize the sandy shoreline adjacent to the estuary, and provide an opportunity for park users to see and learn about shoreline plant species.

5. Begin a program of educating residents of the Spanish Banks Creek watershed about water use, and correct disposal of oil and household toxins. This should be done in conjunction with storm drain marking and leaflet distribution.

6. Encourage the University Endowment Lands administration to investigate potential methods of mitigating storm water that drains to the creek. This includes the use of oil-water separators, retention ponds, and water management programs.

7. Compliment the estuary creation with a program of instream habitat enhancement to provide rearing habitat, retain water, and stabilize sediment movement upstream.

8. Use Spanish Banks Creek as a demonstration project for education purposes, and as an example of the potential for ecological restoration.

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Appendix I

Macroinvertebrates collected in Spanish Banks Creek, March 23, 1994

<u>Site A</u>: Surber samples collected within 10 m of culvert mouth at Chancellor Blvd. (Site A). Showing, for each sample, the taxa, the number of individuals per taxa and, the percent of individuals per sample for each taxon.

Sample 1

*Diptera Chironomide (1) 1%
(true flies)
*Isopoda Asellidae *Asellus* (1) 1%
(aquatic sowbugs)
*Amphipoda Gammaridae (9) 10%
(scuds)
*Oligochaeta (82) 88%
(aquatic earthworms)

Sample 2

Diptera *Chironomidae (4) 4%
*Tipulidae *Dicronata* (1) 1%
Isopoda *Asellidae *Aselus* (1) 1%
Amphipoda *Gammaridae (21) 19%
*Oligochaeta (84) 75%
*Turbellaria (1) 1%
(flatworms)

Sample 3

Diptera *Chironomidae (4) 4%
Isopoda *Aselidae *Aselus* (1) 1%
Amphipoda *Gammaridae (42) 39%
*Oligochaeta (61) 56%
*Turbellaria (1) 1%
Coleoptera Dytiscidae (1) 1%
(beetles)

Site B: Surber samples collected just upstream of North West Marine Drive (Site B). Showing the taxa and the number of individuals per taxa in each sample.

Sample 1	Diptera	*Chironomidae (1) 4%
	Trichoptera (caddisflies)	Rhyacophilidae *Rhyacophila* (1) 4%
	Amphipoda	*Taliridae *Hyalella azteca* (1) 4%
	*Oligochaeta (21) 88%	
Sample 2	Diptera	*Chironomidae (3) 8%
	Trichoptera	*Polycentropidae *Nyctiophylax* (2) 5%
	Ephemeroptera (mayflies)	Heptagenaidae *Cinygma* (3) 8%
		Baetidae *Baetis* (1) 3%
	Plecoptera (stoneflies)	Neumoridae *Malenca* (4) 11%
	Coleoptera	Elmidae *Lara* (1) 3%
	Amphipoda	*Taliridae *Hyallela azteca* (2) 5%
	*Oligochaeta (21) 57%	
	*Turbellaria (1) 3%	
Sample 3	Diptera	*Tipulidae *Dicronata* (1) 4%
	Ephemeroptera	Heptageniidae *Cinygma* (2) 8%
		Baetidae *Baetis* (4) 15%
	Plecoptera	Neumoridae *Malenca* (1) 4%
	Amphipoda	*Gammaridae *Anisogammarus* (1) 4%
		*Taliridae *Hyallela azteca* (1) 4%
	*Oligochaeta (15) 58%	

* indicates taxa resistant to pollution.