Province of British Columbia

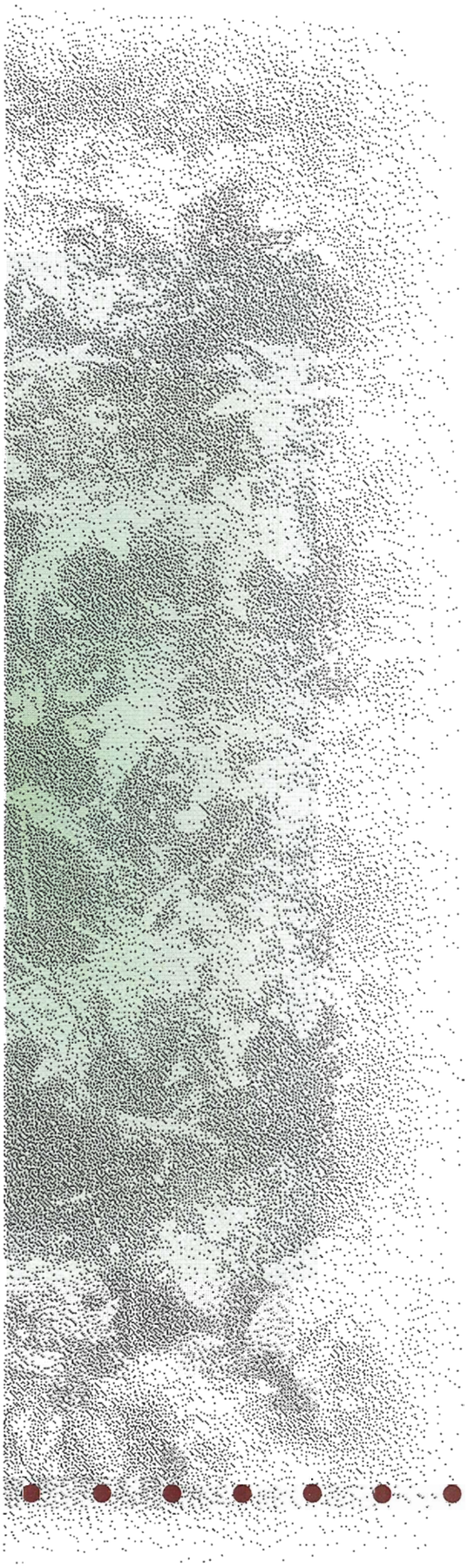
Ministry of Transportation and Highways

ENVIRONMENTAL OVERVIEW

Okanagan Lake Floating Bridge Site

Kelowna, B.C.

March 1996



Highway Environment Branch
Ministry of Transportation and Highways
940 Blanshard Street
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ENVIRONMENTAL OVERVIEW OF THE

OKANAGAN LAKE FLOATING BRIDGE SITE

Kelowna, B.C.

Prepared for:

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Environmental Overview of the Okanagan Lake Floating Bridge Site - Kelowna , B.C.

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Abstract: During the Fall, 1995, an environmental overview of the Okanagan Lake Bridge site was undertaken for the Highway Environment Branch of the Ministry of Transportation and Highways. This project consists of a proposal to widen the Okanagan Lake Bridge which connects Kelowna to Westside. The proposed project may result in realignment to portions of Highway 97 and the Campbell Road intersection in the Tsinstikeptum Indian Reserve No. 10 on the west side of the bridge and a small portion of Highway 97 on the east side of the bridge. The purpose of the overview was to locate, identify, map, record, evaluate and assess all environmental resources located within 100m of the bridge centerline.

Comments: The findings indicated that there are several Environmentally Sensitive Areas (ESA) within the study area and that should construction proceed an Environmental Protection Plan should be developed to protect those ESA's and the surrounding environment.

Key Words: Okanagan Lake Bridge, environmental overview, bio-physical resources, environmentally sensitive areas, Kelowna, Westbank.

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1.0 INTRODUCTION

The Ministry of Transportation and Highways (MOTH) has determined a need to repair and potentially upgrade the Okanagan Lake floating bridge which links the City of Kelowna to the community of Westbank. As one component of this project, Coast River Environmental Services Ltd. (Coast River) was retained to conduct an environmental overview of the aquatic, wildlife and vegetation resources within 100 m of the bridge centreline. This document summarizes the information collected during a review of existing information on the study area and presents the finding of a preliminary field program undertaken from September 25 to 27 and on October 11, 1995. A brief description of the proposed construction works, preferred engineering design options and preliminary mitigation planning has also been presented in this report.

The purpose of the field program was to confirm the accuracy of existing information, to describe the existing biophysical features of the study area and to identify particularly sensitive environmental areas and/or critical habitat elements. Field program activities included:

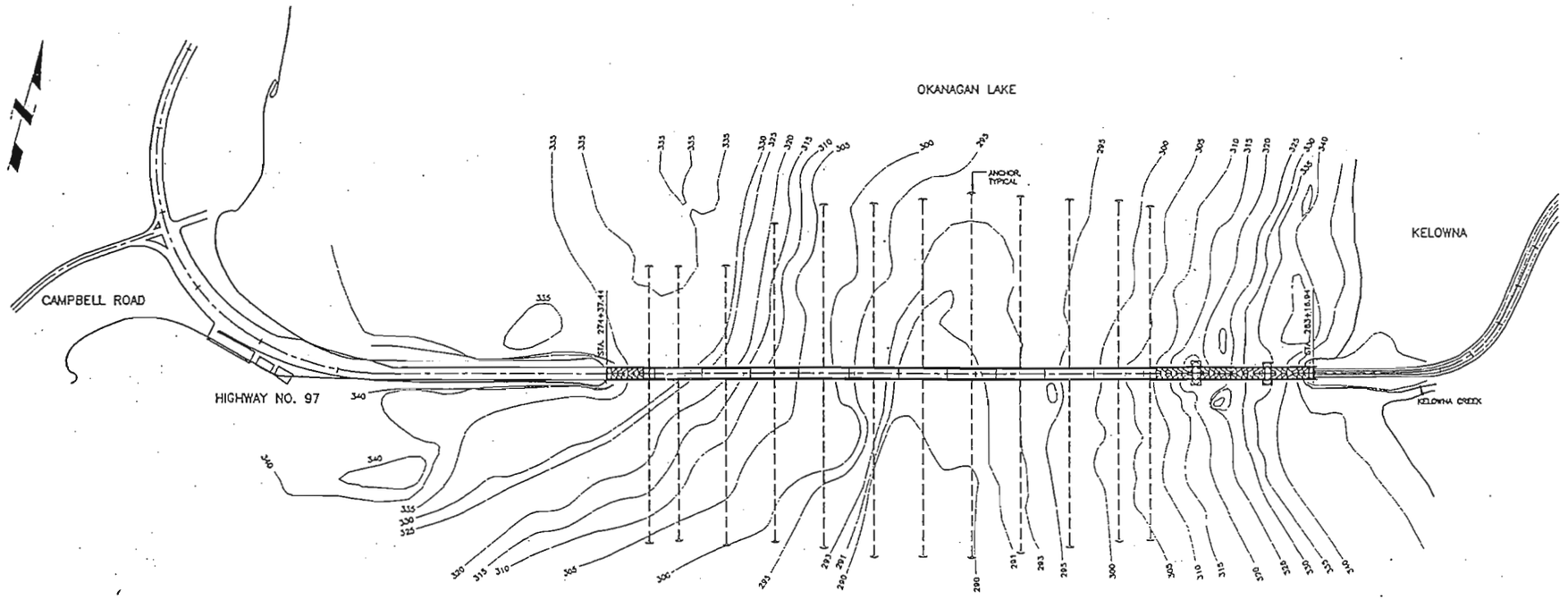
- a detailed vegetation inventory of the study area's terrestrial and aquatic habitats;
- a SCUBA survey along the bridge alignment to document the aquatic characteristics of the site;
- a fish sampling program including minnow trapping, beach seining, and electrofishing at the lower reaches of Mill (Kelowna) Creek and along the shallow littoral margins of Okanagan Lake;
- an aquatic invertebrate sampling program in areas along the causeway;
- observation of incidental wildlife species;
- an inventory of environmentally sensitive areas or habitat elements; and,
- the collection of detailed mapping as provided by the City of Kelowna, Central Okanagan Regional District, and Westbank First Nation.

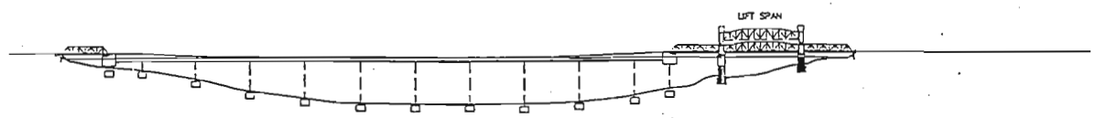
The study area includes both bridge approaches and their adjacent upslope areas, the aquatic environment up to 100 m from centreline of the causeway and to 20 m in depth (including Mill Creek), and the existing floating bridge structure (see **Figure 1** and **Maps 1 and 2**). The west approach extends from Campbell Road Interchange to approximately 150 m onto the floating portion of the bridge. The east span and approach includes approximately 150 m of the eastern end of the floating portion of the bridge to the merging of the proposed lanes with the existing lanes of the highway on the east causeway.

The east side of Okanagan Lake includes an area managed by the City of Kelowna (City Park) as well as privately owned land. The Ministry of Transportation and Highways

manages the Highway 97 right-of-way that traverses both sides of the mainland, as well as the causeway itself. On the west side of the lake the entire area is within Tsinstikeptum Indian Reserve #10 (Westbank First Nation) although significant areas, particularly along the foreshore, have been leased for recreational development.

This report is divided into six sections. Section 1 provides an introduction to the project and outlines the objectives of the study. Section 2 summarizes background environmental information on the study area. Section 3 presents information collected during the field program. Section 4 identifies specific environmentally sensitive areas or habitat elements. Section 5 outlines the proposed construction works, preliminary engineering and mitigation planning and proposed detailed engineering and mitigation design. Finally, Section 6 outlines recommendations on further studies and environmental protection requirements. Five appendices can be found at the end of this report. Appendices 1-3 include a list of contacts, invertebrate sampling data, and photographs of the study area. Appendix 4 includes a description of Options 2a and 4 and general arrangement drawings for Options 2a, 4 and 5. Map sheets 1 and 2 attached to this report present study findings and illustrate the environmentally sensitive elements within the study area.





ELEVATION ON CENTRELINE OF HIGHWAY

NOTES:

1. ELEVATIONS AND CONTOURS FROM M.O.T.H. DRAWING NO. 1458-51.

Fig.1: Study area map

Westmar Consultants Inc.
Consulting Engineers - North Vancouver, B.C., Canada Tel. (604) 985-1456

SCALE 1:2500

DESIGNED DATE
CHECKED DATE
DRAWN DATE

No.	Date	Description	Init.

REVISIONS

Province of British Columbia
MINISTRY OF TRANSPORTATION AND HIGHWAYS
BRIDGE ENGINEERING BRANCH

OKANAGAN DISTRICT
OKANAGAN LAKE BRIDGE NO.1458
EXISTING BRIDGE
GENERAL ARRANGEMENT

PREPARED BY	RECOMMENDED	ACCEPTED FOR CONSTRUCTION
	DIRECTOR OF BRIDGE ENGINEERING	CHIEF HIGHWAY ENGINEER
DATE	DATE	DATE
FILE No.	NEGATIVE No.	REG.

DRAWING No. 001

2.0 BACKGROUND INFORMATION

A review of existing reports and literature revealed that little environmental documentation exists for the study area, although several studies have been completed which discuss the characteristics of Okanagan Lake in general. In addition, several studies have been undertaken to assess water quality, instream habitat, and drainage concerns in Mill Creek. Pertinent studies and background reports are included in the bibliography of this report. The B.C. Conservation Data Centre (CDC) has no record in their database of any rare elements (i.e., rare, threatened, or endangered plant or animal species) within the study area (J. Lee, pers. comm.).

Our research program did not identify any existing reports on the vegetation species and communities which occur in the study area.

2.1 Fisheries

Eighteen species of fish are found in Okanagan Lake, and are be assumed to be present in the study area unless proven otherwise. These are presented in **Table 1** (after Shepherd, 1990; and Shepherd, pers. comm.).

The most important sport fish in Okanagan Lake are kokanee and rainbow trout. Both species utilize Mill Creek for spawning, although studies have shown a significant decrease in stream spawning kokanee in Mill Creek and other Okanagan Lake feeder streams in recent years due to the destruction of spawning grounds and heavy sport fishing pressures (MELP, n.d.). No spawning of rainbow trout or stream spawning kokanee is anticipated within the study area reach of Mill Creek because of the lack of suitable habitat. However, kokanee were observed spawning upstream of the study area near the Water Street crossing where higher gradient riffles occur. Summer low flows, high summer temperatures, and degraded stream habitats pose a constraint to salmonid reproduction in this and other Okanagan Lake feeder streams (Koshinsky, 1972; MELP, n.d.).

The Okanagan Lake kokanee population exhibits two distinct life-history patterns, shore-spawning and stream-spawning stocks. Shoreline spawners use areas of angular cobble (>5 cm) with subsurface flow. No suitable kokanee shoreline spawning areas were identified in the study area during our survey or by previous researchers (MELP, n.d.). Shoreline spawning kokanee have also declined in the past decade in possible response to the introduction of *Mysis*, a freshwater shrimp, and increased stocking of rainbow trout. *Mysis* are a competitor of juvenile kokanee.

It is important to note that upstream extent of anadromous fish access in the Okanagan River is McIntyre Dam which is located downstream of Vaseux Lake on the Okanagan system.

Table 1 Fish Species Present in Okanagan Lake.

Common Name	Scientific Name	Category of Use
Kokanee	*Oncorhynchus nerka*	preferred sportfish
Rainbow trout	*Oncorhynchus mykiss*	
Lake trout	*Salvelenus namaycush*	
Eastern brook trout	*Salvelinus fontalis*	
Mountain whitefish	*Prosopium williamsoni*	minor sportfish
Yellow perch	*Perea fluviatilis*	
Burbot	*Lota lota*	
Lake whitefish	*Coregonus clupeaformis*	
Largescale sucker	*Catostomus macrocheilus*	potential sportfish
Pumpkinseed	*Lepomis gibbosus*	
Longnose sucker	*Catostomus catostomus*	
Carp	*Cyprinus carpio*	
Northern squawfish	*Plychocheilus oregonensis*	
Peamouth chub	*Mylocheilus caurinus*	
Chiselmouth	*Acrocheilus alutaceus*	no sportfish potential
Pygmy whitefish	*Prosopium coulteri*	
Redside shiner	*Richardsonius balteatus*	
Leopard dace	*Rhinichthys falcatus*	
Umatilla dace*	*Rhinichthys umatilla*	
Longnose dace	*Rhinicthys cataractae*	
Prickly sculpin	*Cottus asper*	
Slimy sculpin	*Cottus cognatus*	

* Unconfirmed presence, however, it is important to note that the Umatilla Dace is rated provincially by the B.C. Conservation Data Centre as a red-listed S2 species (imperiled because of rarity).

2.2 Water Quality

There is some published water quality information available for Okanagan Lake and Mill Creek. Historical and recent studies have shown that Okanagan Lake is characterized by morphometry, temperature, oxygen, and macronutrient parameters which are typical of an oligotrophic (nutrient poor) lake. Overall, plankton production is low-medium, and bottom fauna production is low (Clemens et al., 1939; Bryan, 1990). In recent decades there has been an overall increase in macronutrient concentrations from increased agricultural and stormwater run-off from upslope areas. However, macronutrient concentrations have declined slightly since the mid-1980's when sewage treatment plant wastewater was removed at Vernon and upgraded at Kelowna (Bryan, 1990).

Water quality in Mill Creek deteriorates significantly in its lower reaches following heavy rainfall events. Most contamination comes from urban stormwater or agricultural runoff entering the creek, and has resulted in some metal (i.e., aluminum, copper, lead, zinc) concentrations which exceed criteria to protect aquatic life. Also, ammonia and nitrite concentrations can also approach unacceptable levels to protect aquatic life, and bacteriological counts increase to levels which require partial treatment plus disinfection before domestic use (Swain, 1990).

2.3 Wildlife

Several blue-listed wildlife species may utilize habitats within the study area, as indicated in **Table 2**. Blue-listed species are species not currently considered to be at risk but are deemed to be susceptible to large-scale disturbances (BC Environment, 1995). It is important to note that the rank of some species is only associated with breeding occurrences of mobile animals.

Red-listed species are species that are of low abundance in the province and considered to be either threatened or endangered. We are not aware of any red-listed species which may utilize the study area. Although the western grebe (*Aechmophorus occidentalis)* occurs in the study area, this species is only a red-listed species when it is known to breed in an area. There are no known breeding colonies in the study area.

Table 2 Blue-Listed Wildlife Species Which May Utilize Habitats Within the Study Area

Common Name	Scientific Name	Status	Comments
great blue heron	*Ardea herodias*	Blue	Uncommon within study area throughout the year. Small colony once present along Mission Creek.
trumpeter swan	*Cygnus buccinator*	Blue	Infrequent during migration and occasional during winter.
surf scoter	*Melanitta perspicillata*	Blue	May occur during migration in some years.
oldsquaw	*Clangula hyemalis*	Blue	May occur in winter in some years.
California gull	*Larus californicus*	Blue	Occurs in moderate numbers throughout the year.
bald eagle	*Haliaeetus leucocephalus*	Blue	Regular winter resident. Feeds primarily on American coots.
Lewis' woodpecker	*Melanerpes lewis*	Blue	May make some use of cottonwoods in City Park.
painted turtle	*Chrysemys picta*	Blue	May occur in aquatic habitats at west end of the study site.
rubber boa	*Charina bottae*	Blue	Possibly occurs in terrestrial habitats along west slope of study area. Rare.
western yellow-bellied racer	*Coluber mormon*	Blue	Possibly occurs in terrestrial habitats along west slope of study area. Rare.
great basin gopher snake	*Pituophis melanoleucus*	Blue	Possibly occurs in terrestrial habitats along west slope of study area. Rare.

3.0 EXISTING BIOPHYSICAL CONDITIONS

3.1 General

Overall, the upslope, riparian, and aquatic areas within the study area exhibit a high degree of anthropogenic disturbance due to their proximity to urban and recreational development and the Highway 97 right-of-way.

For the purpose of this report, we divided the study area into the following units:

1. *East Side Approach*

    - Upslope Areas
    - Mill Creek and associated riparian areas
    - Okanagan Lake

2. *West Side Approach*

    - Upslope Areas
    - Okanagan Lake

3. *Floating Bridge Structure*

Existing conditions in each habitat unit are described below.

3.2 East Side Approach

The east side of the study area is located within the Kelowna city limits. City Park, which is managed by the City of Kelowna, is located along the foreshore of Okanagan Lake on both sides of Highway 97 and extends more than 100 m from the lake on the north side. Privately owned residential properties and the associated municipal road network are located south of the creek.

3.2.1 Upslope Areas

Apart from a narrow band of Pacific willow around the bridge causeway and mature black cottonwood trees within City Park, the upslope area is characterized by grassed and shrub areas with low habitat value for wildlife. The banks of the causeway, which extend outwards from the historical lake shoreline approximately 40 m, are vegetated with mature Pacific willow trees and several grass and weedy herbaceous species. City Park itself extends along the backshore of the lake on both sides of the causeway, although the majority of the park is found north of Highway 97. The park consists of maintained turf grass lawn with several mature black cottonwoods (*Populus trichocarpa*) and the occasional Douglas maple (*Acer glabrum*), Oregon ash (*Fraxinus latifolia*), and non-native willow (*Salix* sp.). There is evidence of recent beaver damage on several of the trees in the park, although damaged trees have been wrapped with chicken wire to

prevent girdling. A pedestrian/bicycle path passes underneath the causeway and connects City Park to the footbridge which passes over Mill Creek to Lake Avenue as well as the sidewalk which runs along the south side of the floating bridge. Approximately 20 mature cottonwood trees exist adjacent to the causeway at the north end of the pedestrian/bicycle tunnel. There is no evidence of beaver damage on these trees, although the trees may have reached their life expectancy and may become danger trees within 10-15 years (Kunow, pers. comm.). The mature cottonwoods are approximately 80 to 90 years old.

Wildlife observed utilizing upslope habitats of the east causeway include European starling (*Sturnus vulgaris*), rock dove (*Columba livia*) and American crow (*Corvus brachyrhynchos*). The Pacific willow trees located on the slopes of the causeway are likely utilized by some migrants such as warblers and sparrows. Although great horned owls (*Bubo virginianus*) are known to have nested within City Park in recent years (Don Wilson, pers. comm., 1995), there was no indication of nesting in the six mature cottonwood trees adjacent to the causeway. Lewis' woodpeckers (*Melanerpes lewis*; blue-listed by BC Environment, 1995) are known to breed nearby and may make limited use of City Park cottonwoods.

3.2.2 Mill Creek and Associated Riparian Areas

Mill Creek is a moderately sized watercourse which discharges into Okanagan Lake in the study area immediately east of the bridge. The creek's drainage area is 223.5 km^2 (22350 ha), of which 62.9 km^2 is within the City limits (UMA Engineering, 1994). Low flows generally occur in July or August and less frequently in January or February, when seven-day low flows average 0.084 m^3/s (Swain, 1990).

Mill Creek was surveyed from its mouth at Okanagan Lake upstream for approximately 600 m, although detailed information was only collected for a 350 m section within the study area.

The portion of the creek within the study area is typically 3-4 m in width, 0.5-1.2 m in maximum depth, and is dominated by low velocity glides. Substrates are unconsolidated and consist primarily of fines (up to 100%). Instream vegetation is dominated by an unidentified pondweed (*Potamogeton* sp.) with some Eurasian milfoil (*Myriophyllum spicatum* L.). Most native riparian vegetation has been removed and replaced with maintained lawns dominated by turf grass, although Pacific willow (*Salix lasiandra*), reed canary grass (*Phalaris arundinacea*), yellowflag iris (*Iris pseudacorus*), cattail (*Typha latifolia*), smartweed (*Polygonum* spp.) are found in a narrow band along the banks of the stream. Concrete retaining walls have been constructed to prevent bank erosion along both sides of the channel for most of the reach.

A fish sampling program was undertaken at the upstream and downstream ends of the reach. Three baited minnow traps were set near the pedestrian bridge on September 25, 1995 and left for 24 hours. As well, a two pass electroshocking survey was undertaken near the mouth of Mill Creek, upstream of the pedestrian bridge, and at the upstream end of the study area. Our fish sampling program detected the presence of prickly sculpin (*Cottus asper*), largescale sucker (*Catostomus macrocheilus*), redside shiner (*Richardsonius balteatus*), and kokanee (*Oncorhynchus*

nerka) in the creek. Fish sampling results are presented in **Table 3** below.

A preliminary macroinvertebrate sampling program was also undertaken in the downstream section of Mill Creek. Results are presented in **Appendix 2.**

Table 3 Fish Sampling Results for Mill Creek.

Site No.	Location	Species	No.	Fork length (mm)	Capture Method
MT1	pedestrian footbridge	CAS	3	75-95	minnow trap
MT2	15 m upstream of footbridge	CSU CAS	1 1	110 75	minnow trap
MT3	25 m upstream of footbridge	no fish captured			minnow trap
EF1	mouth of creek upstream of mouth	RSC CAS CSU	13 12 3	30-52 35-130 63-130	electroshocker
EF2	200 m upstream of mouth	CAS CSU RSC	2 2 8	31, 33 71, 163 41-115	electroshocker
VO1	bottom 500 m of creek	CSU	>10	up to 150	visual observation
VO2	Mill Creek at Water Street crossing	KO	8	approx. 350-450	visual observation

* kokanee at the Water Street crossing were spawning.

CAS prickly sculpin (*Cottus asper*)
CSU largescale sucker (*Catostomus macrocheilus*)
RSC redside shiner (*Richardsonius balteatus*)
KO kokanee (*Oncorhynchus nerka*)

Incidental wildlife observed during our field program at Mill Creek include muskrat (*Ondatra zibethicus*), mink (*Mustela vison*), unidentified merganser (*Mergus* spp.), glaucous winged gull (*Larus glaucescens*), and mallard (*Anas platyrhynchos*).

3.2.3 Okanagan Lake

The littoral areas of the lake near the east shore are shallow (+/-2 m) although the lake floor drops off to depth (>7 m) approximately half way between the causeway shoreline and the first bridge

abutment (see Figure 1 and accompanying maps for bathymetric contour information). Lake substrates are compact and consist primarily of sand and silt, although isolated patches (<1 m^2) of cobble exist. A cobble beach exists along the south shore of the causeway, especially at the west end of the causeway. The Pacific willow trees located on the slopes of the causeway provide overhanging vegetation in the shallow littoral areas. Aquatic vegetation observed during our SCUBA survey on the east side of the lake is limited, although large patches of Eurasian milfoil and pondweed exist several metres offshore of the north and west side of the causeway shoreline (see accompanying map sheets). No emergent vegetation (i.e., *Scirpus* spp., *Carex* spp.) was observed in the shallow littoral areas.

Our fish sampling program detected the presence of prickly sculpin and northern squawfish (*Ptycheilus oregonensis*) in the vicinity of the east causeway. Fish sampling results are show in **Table 4** below. Fish were associated with patches of aquatic vegetation. Furthermore, we observed several mature largescale suckers in the lake during our SCUBA survey.

Table 4 Fish Sampling Results for East Side Causeway Area.

Site No.	Location	Species	No.	Fork length (mm)	Capture Method
BS1	south side of causeway	CAS	3	20-30	beach seine
BS2	southwest causeway	NSC CAS	60 1	15-40 20	beach seine
BS3	northwest causeway	NSC	23	15-35	beach seine

CAS prickly sculpin (*Cottus asper*)
NSC northern squawfish (*Ptycheilus oregonensis*)

Wildlife observed utilizing aquatic habitats within 100 m of the east causeway during the field program include common loon (*Gavia immer*), western grebe (*Aechmophorus occidentalis*), red-necked grebe (*Podiceps grisegna*), horned grebe (*Podiceps auritus*), American widgeon (*Anas americana*), mallard, common merganser (*Mergus merganser*), ring-billed gull (*Larus delawarensis*), glaucous winged gull, great blue heron (*Ardea herodias*), and belted kingfisher (*Ceryle alcyon*). Several other bird species observed beyond 100 m of the causeway are also expected to make use of habitats within the study area. These species included American coot (*Fulica americana*), canvasback (*Aythya valisineria*), greater scaup (*Aythya marila*) and herring gull (*Larus argentatus*). It is apparent that the shallow littoral areas of the lake along the east shore provide both food and shelter for a variety of wintering waterfowl species.

3.3 West Side Approach

The west side of the study area is encompassed by Tsinstikeptum Indian Reserve #10 (Westbank First Nation lands), although the Highway 97 right-of-way and the causeway are managed by MOTH. Several commercial business are located along the foreshore, including jet ski rental and houseboat charter businesses north of the causeway and a jet ski rental business, a bar, a restaurant and a marina south of the causeway.

3.3.1 Upslope Areas

The backshore and upslope areas on the west side of the study area are highly disturbed and have been cleared for building and road development. Vegetation in these areas is dominated by early successional and invasive species, although less disturbed areas which support tree and shrub vegetation exist adjacent to both sides of the causeway near its west end. The vegetated area on the north side of the causeway is dominated by western dock (*Rumex occidentalis*), horsetail (*Equisetum* sp.), gumweed (*Grindelia* sp.), snowberry (*Symphoricarpos albus*), prickly rose (*Rosa* sp.), western birch (*Betula papyrifera*), Oregon grape (*Mahonia nervosa*), reed canary grass, alfalfa (*Medicago lupulina*) and the occasional beaked hazelnut (*Corylus cornuta*). The less vegetated area on the south side is dominated by introduced willow (*Salix* spp.), beaked hazelnut, ponderosa pine (*Pinus ponderosa*), and several invasive weed species.

The foreshore area of Okanagan Lake on the west side of the study area consists of sand beach. Although the beach areas are largely devoid of vegetation, some organic detrital buildup was observed on the beach face north of the causeway. Vegetation on the slopes of the causeway itself is limited by the predominance of exposed rip-rap and the lack of soil, although isolated trees, shrubs, and grassed areas exist.

3.3.2 Okanagan Lake

The littoral areas of the west side of the lake are shallow (approximately 2 m or less) although the lake floor drops off to > 7 m in depth where the causeway narrows near the bridge maintenance building (see Figure 1 and accompanying maps for bathymetric contour information). Lake substrates in the shallow areas consist of a cobble or angular rip-rap extending approximately 2-4 m offshore from waterline, followed by a 4-5 m band of unconsolidated silts with some sands. This unconsolidated band may be caused by wave action. Offshore of this band, substrates consist of compact silts with some sand and shell fragments. Emergent vegetation has not colonized rip-rap or cobble areas and is confined to soft substrates.

Vegetation in the littoral zone is dominated by large areas (>100 m^2) of hard-stemmed bulrush (*Scirpus lacustris*). Other aquatic vegetation species found in the shallow areas include Eurasian milfoil, several species of pondweed, and an unidentified algae which forms a lake floor carpet of up to 100% cover in places. During our SCUBA survey we observed immature northern squawfish and numerous freshwater mussel siphons and shell fragments on the both sides of the causeway.

Our fish sampling program in the shallow area of the west side detected the presence of prickly sculpin, redside shiner and northern squawfish. Fish sampling results are show in **Table 5**. Macroinvertebrate sampling results from aquatic vegetation and benthic areas is presented in **Appendix 2**.

Table 5 Fish Sampling Results for West Side Causeway Area.

Location	Species	Number	Fork length (mm)	Capture Method
northwest of causeway	CAS	2	15, 25	beach seine
northeast of causeway	CAS	2	10, 15	beach seine
southwest of causeway	CAS RSC	1 7	92 55-75	minnow trap
southwest of causeway	NSC	1	65	minnow trap
southeast of causeway	no fish captured			minnow trap
northeast of causeway	NSC	12	35-110	beach seine
northeast of causeway	CAS	1	25	beach seine
northeast of causeway	NSC CAS	15 2	20-25 25, 30	beach seine

CAS Prickly sculpin (*Cottus asper*)
RSC Redside shiner (*Richardsonius balteatus*)
NSC Northern squawfish (*Ptycheilus oregonensis*)

East of the point where the causeway narrows near the bridge maintenance building the lake deepens to approximately 7 m or greater. Lake substrates in the deeper areas consist primarily of compact silts and sands. Large areas (>100 m^2) of submersed aquatic vegetation exist on both sides of the causeway, including Canada water weed (*Elodea canadensis*), Eurasian milfoil, and several pondweed species (*Potamogeton natans*, *P. gramineus*, *P. pectinatus* (suspected), *P. perfoliatus* spp. *richardsonii*). An unidentified filamentous freshwater algae was observed on the rip rap associated with the causeway. During our SCUBA survey we observed numerous (>25) mature largescale suckers and carp (*Cyprinus carpio*), and abundant (>100) unidentified dace (*Rhinichthys* sp.). We observed that dace are most commonly associated with areas of large rip-rap, and suckers are most abundant on the northwest and northeast corners of the causeway where algae productivity levels are high due to increased localized water currents.

Wildlife observed utilizing aquatic habitats within 100 m of the west causeway included common loon, red-necked grebe, horned grebe, western grebe, mallard and ring-billed gull. The *Scirpus*

marsh and adjacent habitats are known to support numerous other waterfowl species, especially during the winter. This area appears to be particularly important to American coots which form large rafts during the winter. These and other coots on the lake are an important food source for increasing numbers of wintering bald eagles (*Haliaeetus leucocephalus*). Fourteen bald eagles were recorded during the 1993 Kelowna Christmas Bird Count. Several other bird species that can be common in these areas include greater scaup, redhead and pied-billed grebe. Trumpeter swan (*Cygnus buccinator*) may occur on occasion, but primarily during migration (D. Cannings, pers. comm.; D. Wilson, pers. comm.).

Wildlife observed utilizing terrestrial habitats of the west causeway and shoreline include ring-necked pheasant (*Phasianus colchicus*), northern flicker (*Colaptes auratus*), American crow and rock dove. Don Wilson (pers. comm., 1995) indicated that the shallow areas of the west side were once well populated with crayfish. Crayfish are a desired prey species for mink (*Mustela vison*) and river otter (*Lontra canadensis*) which are known to occur along the Okanagan Lake shoreline. Current crayfish populations are not known.

4.0 ENVIRONMENTALLY SENSITIVE ELEMENTS

The most sensitive environmental areas or habitat elements within the study area are identified below and shown on **Maps 1 and 2**. Photographs of these environmentally sensitive elements are included in **Appendix 3**.

Mill Creek

Mill Creek has high environmental values within the study area. This stream is used for spawning by both kokanee and rainbow trout and also supports a diverse fish and wildlife community which is distinct from the adjacent lake environment. Significant efforts should be made to avoid impacting the Mill Creek channel and the adjacent riparian areas.

East side causeway (Kelowna side)

Numerous (>20) mature willow trees (*Salix* spp.) are located on the causeway which provide overhanging riparian cover and are a source of food drop which benefits small fish that frequent this area. A grouping of approximately 20 mature cottonwoods stands in the City Park adjacent to the eastside on-ramp. These areas of vegetation provide some values for birds and wildlife although the proximity of Highway 97 clearly limits wildlife use. Although the removal of some of these trees will be necessary in order to avoid encroachment on Mill Creek, significant efforts should be made to minimize tree removals.

West side causeway (Westbank side)

The submerged rip-rap armouring and its associated freshwater algae cover provides good cover and important feeding areas for dace, largescale suckers, and other fish species. Riparian cover is lacking along the causeway. Areas of varying sized rock or rip-rap should be incorporated into the causeway upgrade.

West side open water marsh

This area is dominated by the *Scirpus* community found on both sides of the causeway. The *Scirpus* provides habitat for aquatic invertebrates, freshwater bivalves, waterbirds and largescale suckers. Where possible, impacts to this community should be minimized as it represents a relatively rare habitat type in the study area.

West side shallow open waters

The shallow open waters on the north side of the causeway east of the *Scirpus* supports a diverse community of pondweeds (*Potamogeton* spp.) which provides important habitat for several fish and waterfowl species. Again, impacts to this community should be minimized as it represents a relatively rare habitat type in the study area.

Our field program identified the following areas have lower habitat values:

- the upland areas of both shores of Okanagan Lake within the study area have low habitat values due to previous disturbance, with the exceptions described above (Mill Creek and the *Salix* spp. fringe on the east side causeway);
- the foreshore sand beach areas on both sides of the lake;
- City Park; and,
- lake bed.

5.0 PROPOSED WORKS AND MITIGATION MEASURES

As the biophysical assessment of the study area was underway, several environmentally sensitive considerations became evident (**Maps 1 and 2**). These environmentally sensitive elements are described in Section 4.0 of this report and are summarized below.

Preliminary design of crossing options was ongoing during our biophysical overview. This situation allowed the environmental study team to interact directly with the preliminary design engineering team and Ministry of Transportation and Highways as options were being developed. As a result, these options evolved rapidly in response to environmental constraints and sensitivities. By this process, many potential impacts have been avoided or mitigated in the preliminary design phase of this project.

5.1 Environmentally Sensitive Areas

For the purposes of discussion, the ESA's with greater fish and wildlife habitat values are identified below.

- fish and aquatic resources of Mill Creek;
- mature trees (willow and cottonwoods) along the causeway and within Kelowna Park;
- submerged rip-rap armouring along both sides of the Westbank causeway which provide feeding and refuge areas for fish;
- open water marsh areas (*Scirpus* community) occur in the littoral area along both sides of the Westbank causeway; and,
- shallow open water pondweed community (*Potamogeton* spp. community) that is established on the north side of the Westbank causeway east of the *Scirpus*.

5.2 Proposed Works

The Ministry of Transportation and Highways (MoTH) proposes to repair and widen the Okanagan Lake Floating Bridge located at Kelowna, B.C. These proposed works have been divided into the following four separate and relatively independent projects by Westmar Consultants Inc. during Phase 2 of their preliminary design for four laning (Westmar Consultants Inc., 1996):

- elimination of interruptions to vehicle traffic during passage of sailboats and other vessels through the bridge crossing;
- elimination of a dangerous level crossing at Campbell Road on the west end of the crossing;
- incorporation of pontoon repairs which are required whether or not four laning proceeds; and,
- provision of four lanes of vehicle traffic.

It is our understanding that the following activities may potentially be undertaken as part of the

bridge repairs and/or upgrading to four lanes:

- preparation of construction staging areas including a dry dock and pontoon assembly areas in an upland or nearshore environment;
- excavation and grading of approach areas;
- dredging and disposal of bottom sediments may be required to create a vessel navigation channel;
- temporary and/or permanent fill to be placed in the lake environment for causeway construction;
- demolition and reconstruction of bridge decks;
- removal of delaminated concrete through hydroblasting, sandblasting or mechanical chipping and replacement with shotcrete on the concrete floating pontoons above the waterline;
- sealing of cracks on the pontoons below water line;
- installation of new pontoon string; and,
- removal of a portion of the existing fill to shorten the Westbank causeway.

5.3 Preliminary Engineering Design Options

Phase I of preliminary design for this project involved the development and selection of a preferred scheme(s) based on a set of criteria including environmental impact, ease of construction, traffic disruption, risk and geotechnical issues (Westmar Consultants Inc., 1995). Care was taken during these early planning stages to avoid or minimize potential construction and operation related impacts on environmentally sensitive areas and elements within the study area. Phase 2 of preliminary design is currently underway and is evaluating two preferred options (Options 2a and 4) for the proposed works. Descriptions and general arrangement drawings of Options 2a and 4 are presented in **Appendix 4** of this report.

Ongoing agency liaison between MoTH and the Ministry of Environment, Lands and Parks (MELP) during Phase I and the risk assessment portion of this project identified several potential environmental impacts which could occur during construction and operation of the Kelowna Bridge. The Department of Fisheries and Oceans (DFO) was initially contacted regarding environmental review of this project and has requested that MELP be the lead environmental agency for project review. As a result of this consultative process, several mitigative measures have already been considered and incorporated within the preliminary design of Options 2a and/or 4. A list of some of these mitigation principles is provided below:

- the Kelowna Bridge approach area has been configured to avoid encroaching on Mill Creek;
- the extent of fill in lake environment is to be minimized. Temporary fill areas which may be required will be removed from the lake environment as soon as practical or following completion of the project;
- the extent of dredging for the proposed navigation channel is to be minimized. Deep water disposal of dredgate beneath the thermocline will be investigated;

- impacts to the natural resources of Kelowna Park are to be minimized;
- extent and location of construction staging areas will be planned to avoid or minimize impact on environmentally sensitive elements;
- amount of debris generated through demolition is to be minimized. Containment of debris from the demolition of concrete will be addressed;
- various construction materials, practices and phasing alternatives are being considered in order to minimize the extent and duration of potential environmental impacts. These construction materials, practices (i.e., application methods) and schedules will be evaluated in detail during the upcoming detailed design and mitigation planning phase of this project; and
- containment of construction materials and sediment generated within lake environment by construction related practices will be undertaken to some degree.

With all options, we note that there is significant opportunity to minimize the potential for environmental impacts resulting from brige pontoon repairs if this work can proceed in tandem with four-laning. Specifically, the volume of shotcrete required for pontoon repairs can be reduced by 50% if the new pontoon sections can serve as a set of outer forms and a gasket seal is used to isolate the pontoon repair area from the lake environment.

In summary, Option 4 has several benefits from both environmental and design standpoints. As discussed in the November 28, 1995 memo, MELP prefers this option due to reduced dredging requirements. In addition, a portion of the existing causeway will be removed to accommodate the proposed navigation channel thus providing additional lake habitat.

Option 5 is currently being considered from the standpoint of technical feasibility by Westmar Consultants Inc. and MoTH. A general arrangement drawing of Option 5 is included in **Appendix 4**. This option relocates the navigation channel to the middle of the pontoon string and eliminates the need for numerous land piers and dredging. Although this option has not yet been accepted as viable from an engineering standpoint, it would avoid the requirement for dredging at the vessel navigation channel.

It is also important to note that the Campbell Road interchange configurations are presently being reviewed and will require an environmental review during the next phase of this project (i.e., erosion and sediment control during construction).

5.4 Detailed Engineering Design and Mitigation Planning Phase

Environmental impact mitigation planning will continue to be incorporated directly into engineering design through the Detailed Design phase of this project. Mitigation measures will be designed as per DFO and MELP's "Land Development Guidelines for the Protection of Aquatic Habitat" and MoTH's standard environmental specifications for highway construction (Section 195). Preferred construction materials will be identified and evaluated based on the estimated quantities required and their toxicity to aquatic life.

An environmental protection plan (EPP) will be developed during the detailed design phase of this project in consultation with MELP to address potential environmental impacts to vegetation, wildlife, fish and fish habitat and water quality within the study area. DFO will be contacted on an as required basis in order to ensure that they are informed of project and agency review status throughout the detailed design and mitigation planning phase. Although DFO is not the lead agency for project review, they retain jurisdiction for any destruction or loss of fish habitat and DFO approval must be obtained prior to construction.

The EPP will include, but not necessarily be limited to, the following:

- sediment and erosion control plans for upland staging areas;
- shoreline erosion control plans for shallow foreshore and nearshore areas to protect sensitive aquatic vegetation;
- noxious weed control (ie., milfoil) plan to prevent spread of noxious weeds;
- sediment control plan for lake environment (i.e., silt curtain containment to prevent silt plumes);
- fish salvage and exclusion procedures;
- hydrocarbon storage and refuelling procedures;
- emissions policy and waste management plan (i.e., local vs. total containment for construction activities);
- spill containment provisions with spill contingency plans for proposed construction works and operation phases of the bridge;
- stormwater management plan for construction and operation phases of the bridge;
- instream and aquatic work windows for Mill Creek and Okanagan Lake;
- regular and emergency reporting protocols and response frameworks.

6.0 RECOMMENDATIONS

Environmental monitoring of construction phase should be undertaken and the level of monitoring required shall be acceptable to both MELP and MoTH. The Environmental Monitor will be responsible for overseeing the implementation of the EPP with a particular emphasis on water pollution monitoring and abatement, spill response training and spill contingency plans.

Additional studies may be required to satisfy the requirements of both MoTH Environment Branch and MELP during the detailed design phase or environmental permitting stages of this project. These studies may include:

- fish utilization of existing bridge structure (i.e., fish soundings along transects to determine fish presence);
- sediment and water quality monitoring program with baseline data collection occurring prior to any construction work;
- environmental assessments of upland areas (i.e., groundwater, soils); and,
- detailed compensation plans to compensate for any perceived loss of habitat due to concrete material settling on lake bottom substrates or fill placement in shallow water areas for causeway construction (static stability).

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Wilson, D. President, Central Okanagan Naturalists Club, Kelowna. Personal communication by telephone with Martin Gebauer, October, 1995.

Appendix 1:
List of Contacts

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Barry McDougall, Manager, Natural Resources Program, Westbank First Nation

Brenda McGregor, Treaty Negotiator, Westbank First Nation

Tim Raybould, Intergovernmental Affairs Coordinator, Westbank First Nation

Ross Hyatt, Civic Properties Superintendent, City of Kelowna

John Kunow, Assistant Parks Supervisor, City of Kelowna

Lloyd Manchester, Executive Director, Canadian Earthcare Society

Don Wilson, President, Central Okanagan Naturalists Club

Mark Watt, Environmental Coordinator, City of Kelowna

Brian Cuthbert, Draftsperson, Central Okanagan Regional District

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Rick Howie, Habitat Technician, Southern Interior Regional Headquarters, MELP

Dick Cannings, UBC Invertebrate Museum

Bob Nijman, Biologist, MELP

Dr. Pat Warrington, Biologist, MELP

Appendix 2:
Invertebrate Sampling Data

APPENDIX 2: INVERTEBRATE SAMPLING DATA

Macroinvertebrates collected from Okanagan Lake and Mill Creek in Sept. 1995
Samples were collected with a 30x30 cm dip net with a 300 micron mesh bag.

		Okanagan Lake										Mill Creek		
		1	2	3	4a	4b	5	6	7	8	TOTAL	1	2	TOTAL
INSECTS														
Ephemeroptera	mayflies													
Baetidae														
Cloeon											0		3	3
Caenidae														
Brachycerus										1	1			0
Ephemeridae														
Hexagenia										1	1			0
Odonata	damselflies													
Coenagriidae														
Ishnura			1		7			1			9	3	5	8
Diptera	true flies													
Chironomidae														
Pupae			4								4		2	2
Orthocladinae		1	76	11	1			1		1	91	24	20	44
Tanytarsini			33	3	1	3		2		3	45	25	10	35
Chironomini		1									1			0
Ceratopogonidae														
P./B./P. *											0	1		1
Trichpotera	caddis flies													
Leptoceridae														
Nectopsyche									1		1			0
HYDRACARINA	mites													
Lebertia		5									5		1	1
Limnesia		2			1	1					4			0
Hygrobates		1									1	2		2
CRUSTACEA														
Amphipoda	scuds													
Talitridae														
Hyalella azteca				2	47	9	6	2	1	4	71			0
Gammaridae														
Gammarus							1				1			0
Cladocera	water fleas													
Chydoridae														
Eurycercus lamellatus			4	2							6		1	1
Sididae														
Sida crystallina			2	2	110			5			119			0
Copepoda	water fleas		1	1				5	1	1	9			0
Ostracoda	seed shrimp		1	1							2			0

APPENDIX 2: INVERTEBRATE SAMPLING DATA

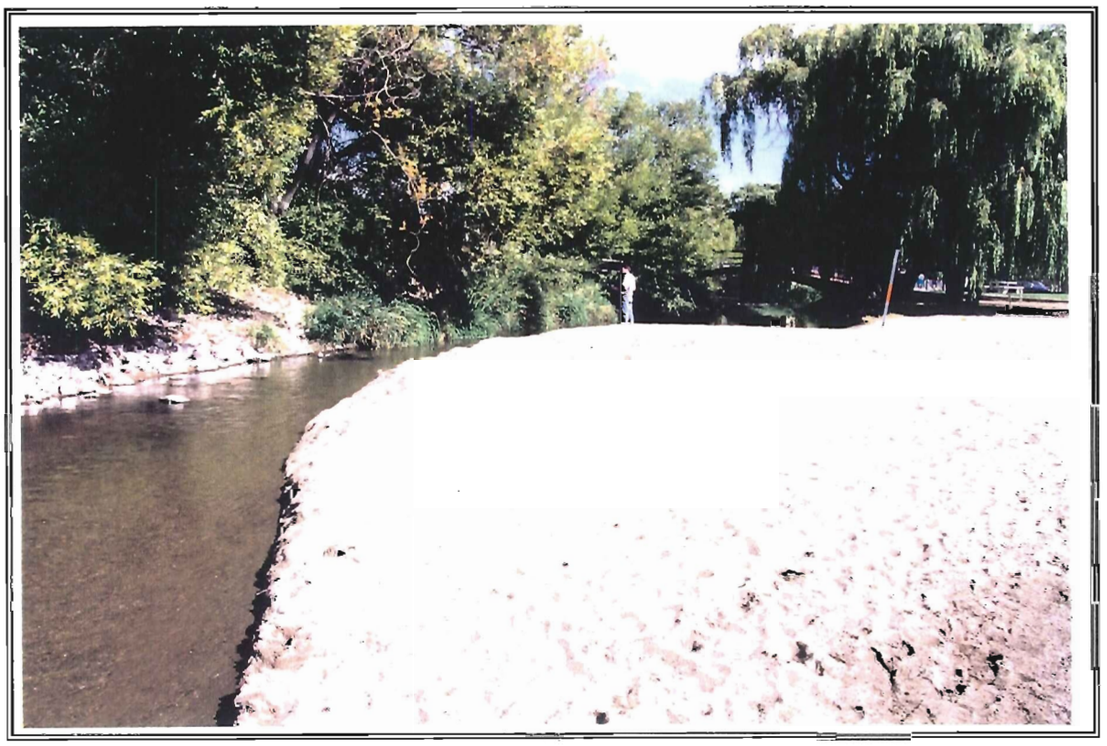
Macroinvertebrates collected from Okanagan Lake and Mill Creek in Sept. 1995
Samples were collected with a 30x30 cm dip net with a 300 micron mesh bag.

		Okanagan Lake										Mill Creek		
		1	2	3	4a	4b	5	6	7	8	TOTAL	1	2	TOTAL
MOLLUSCA														
Gastropoda	snails													
Lymnaeidae														
Lymnaea			1				6				7		2	2
Physidae														
Physa							1				1	1		1
Planorbidae														
Gyraulus											0	3	104	107
Ancylidae	limpets			1							1			0
Pelecypoda	bivalves													
Sphaeriidae														
Musculium						2					2			0
ANNELIDA														
Oligochaeta		4	6	69	15	15		1	6		116	9	21	30
Hirudinea	leaches													
Erpobdellidae														
Erpobdella							1				1			0
Glossophoniidae														
Helobdella							3				3			0
TURBELLARIA														
Turbellaria	flat worms			7	4			2	1	1	15			0

Okanagan Lake #1 - southwest end of east bank causeway. Sept. 25 1995
Okanagan Lake #2 - under bridge, milfoil sweep. Sept. 25 1995
Okanagan Lake #3 - northwest side of causeway, Scirpus sample Sept. 26 1995
Okanagan Lake #4a - northwest side of causeway, pondweed/milfoil. Sept. 26 1995
Okanagan Lake #4b - northwest side of causeway Scirpus sediment. Sept. 26 1995
Okanagan Lake #5 - westide (south) under rock, cobble, large gravel. Sept. 27 1995
Okanagan Lake #6 - westside causeway on south, Scirpus sample. Sept. 26 1995
Okanagan Lake #7 - benthic sample on west side of causeway, south side (sand/gravel). Sept. 26 1995
Okanagan Lake #8 - westside south, benthic sample outside Scirpus. Sept. 27 1995
Mill Creek #1 - outlet of creek. Sept. 25 1995
Mill Creek #2 - footbridge. Sept. 25, 1995

*P./B./P. = Palpomyia, Bezzia, or Probezzia - these three genera not distingished in key

Appendix 3:
Photographs



Mouth of Kelowna Creek. Note the importance of the riparian fringe of willow trees.

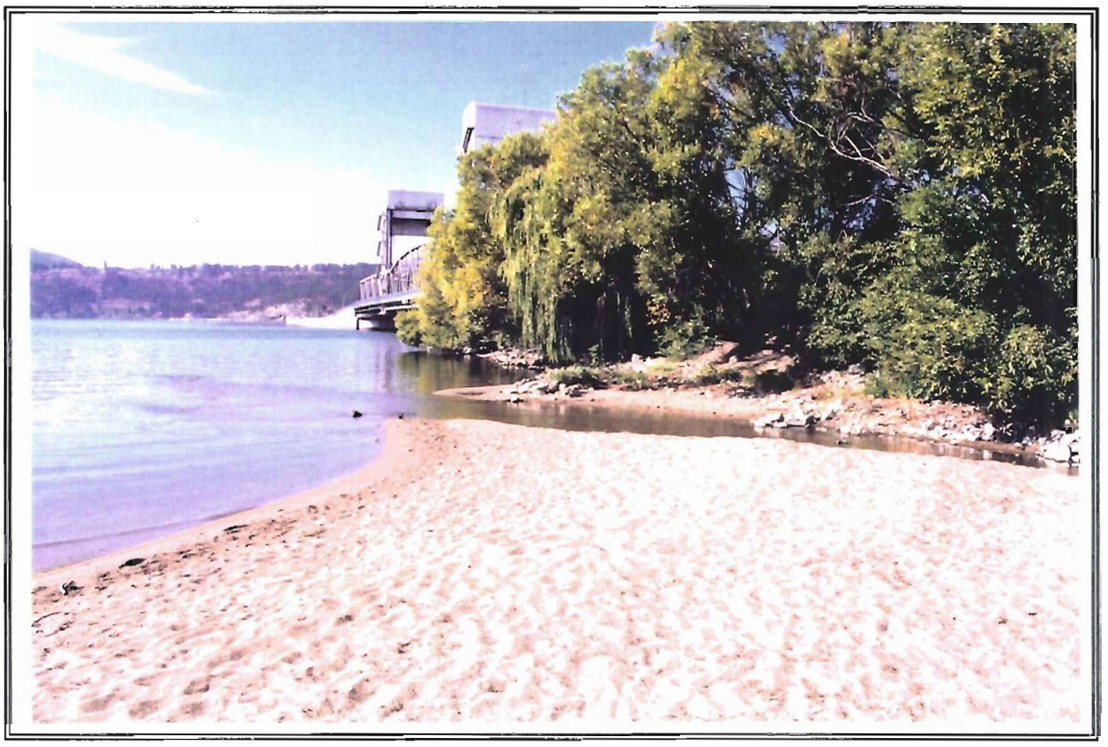
Residential development has encroached into the Kelowna Creek corridor in several locations.

Typical riparian and channel conditions in Kelowna Creek within the study area.

Mouth of Kelown Creek and adjacent pedestrian path.

Park areas adjacent to Kelowna Creek are maintained to top of bank.

Upper section of Kelowna Creek within the study area. Note the retaining walls along both banks of the stream.



Mouth of Kelowna Creek showing adjacent willow trees and extensive sand littoral areas.

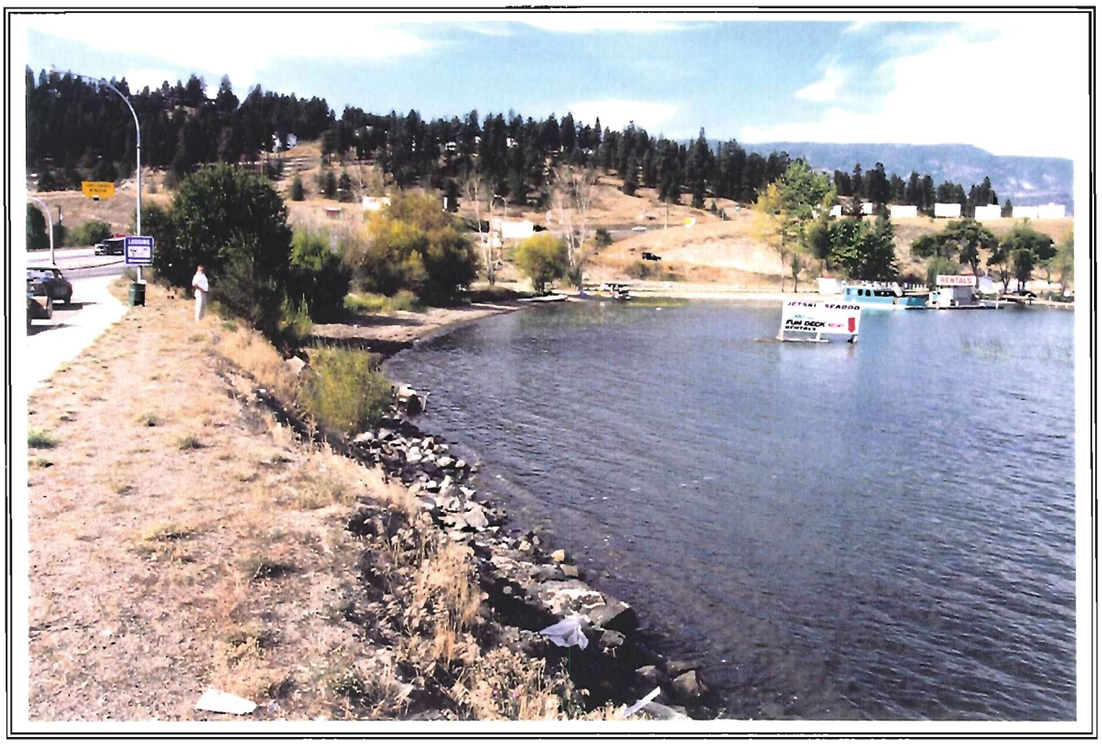
Overview of south bay of eastside causeway.

North bay of eastside causeway showing general conditions in City Park.

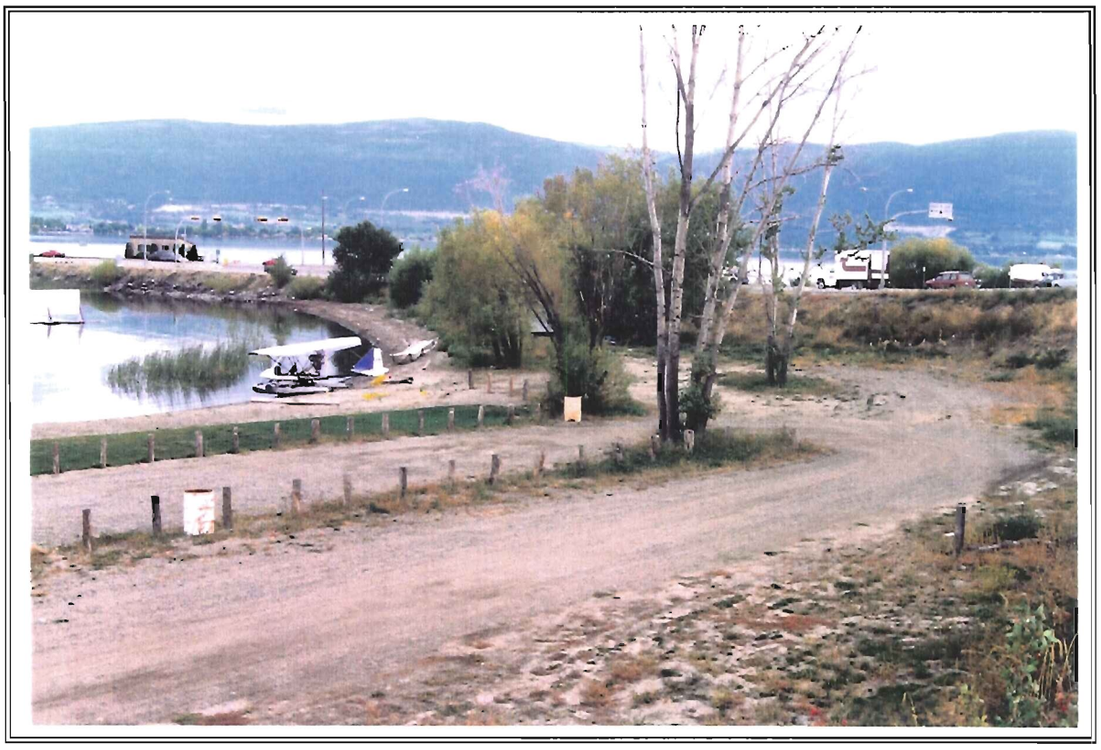
Narrow band of mature willow trees along the north bay of eastside causeway.

Willow trees provide overhanging riparian cover along the lakeshore.

Mouth of Kelowna Creek showing adjacent willow trees and extensive sand littoral areas.

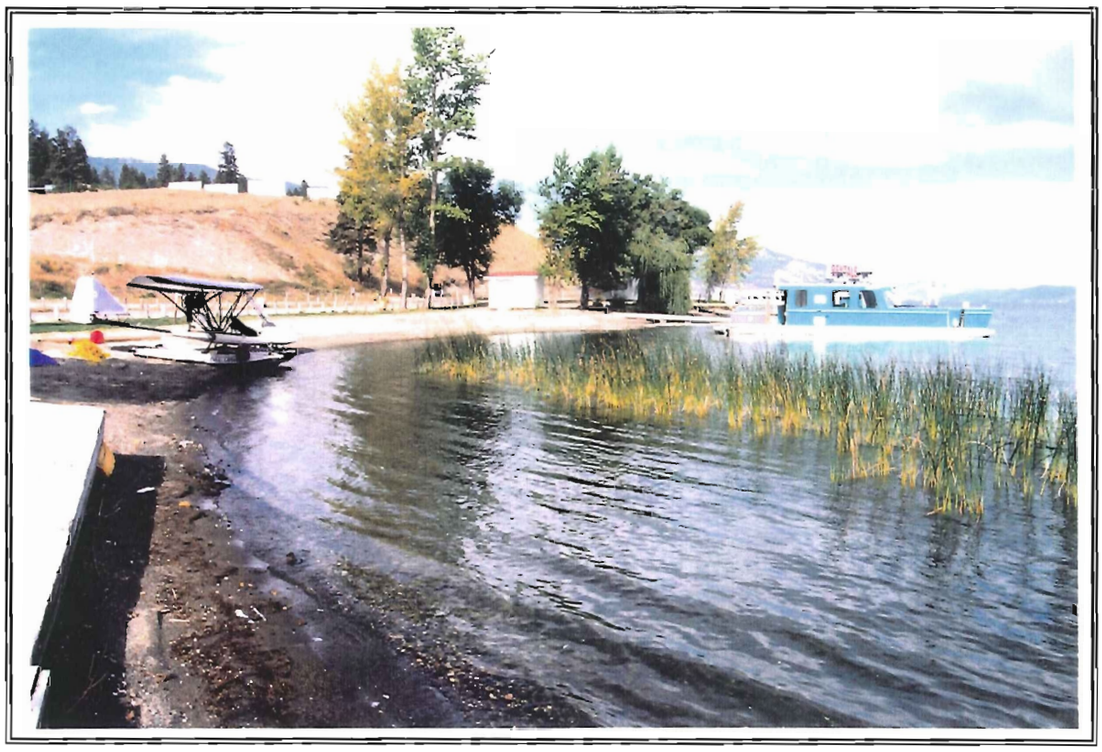


North bay of westside causeway. Note the minimal riparian fringe and adjacent recreational development.

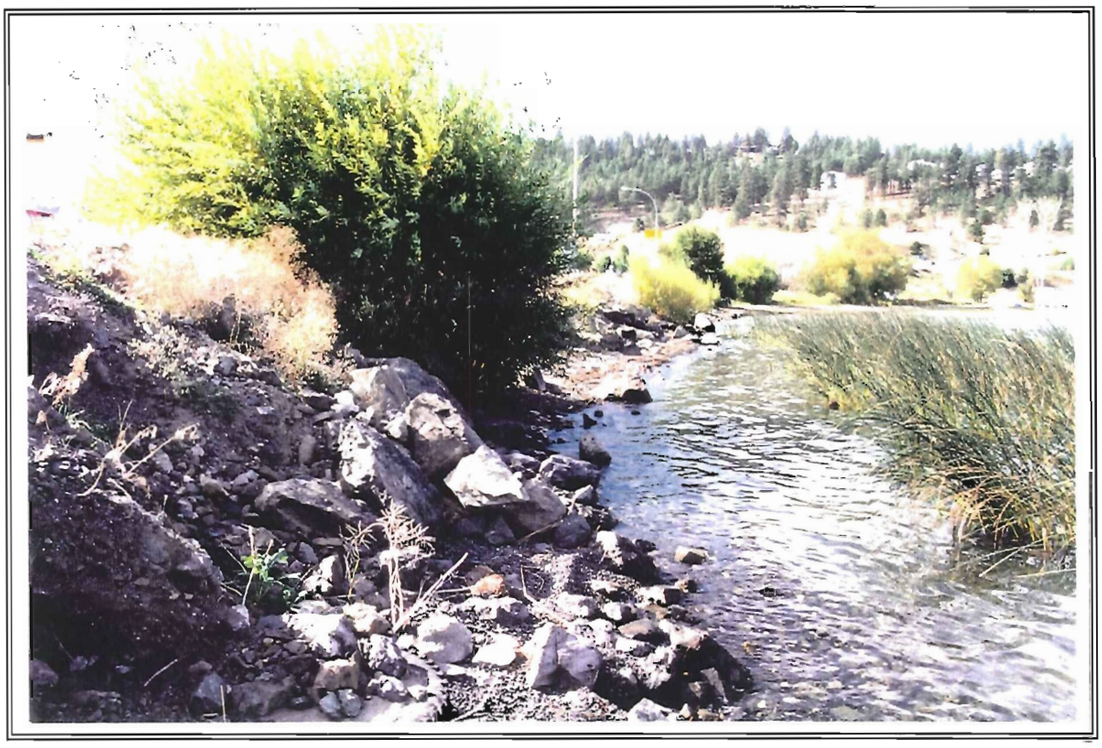


Upslope areas adjacent to the north bay (westside) have been cleared for recreational development.

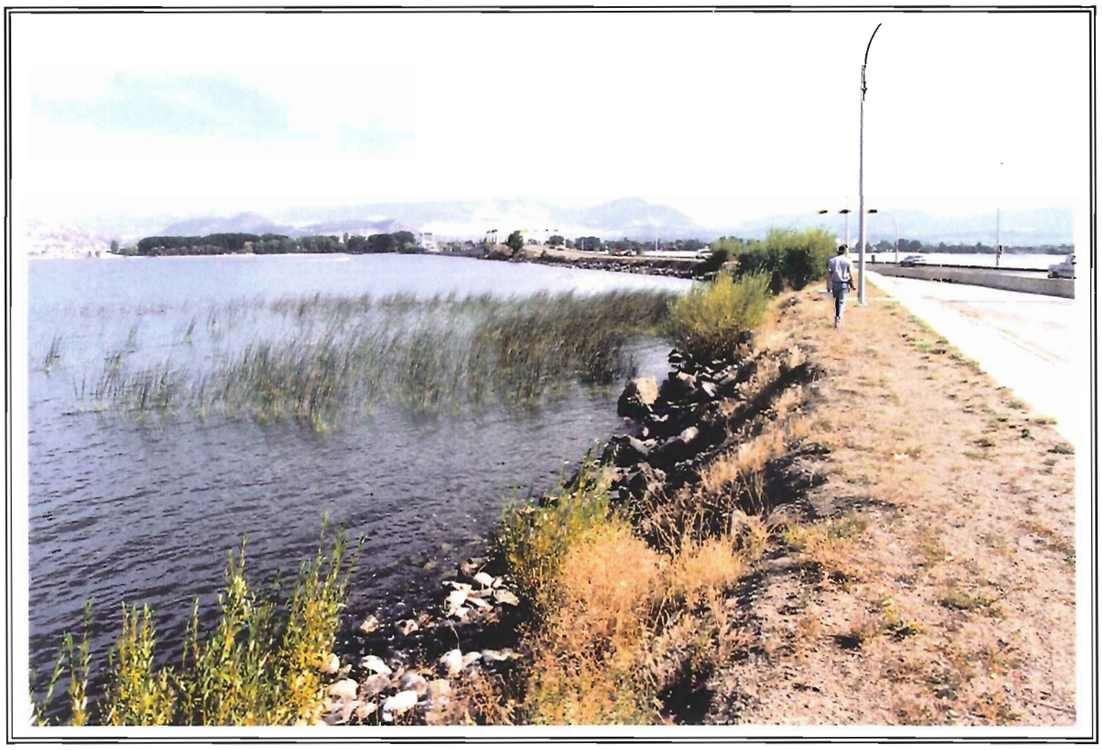
Vegetation in upIsope areas is dominated by weed species typical of disturbed sites.



Pockets of hard-stemmed bulrush are found in heavily used areas of the foreshore.

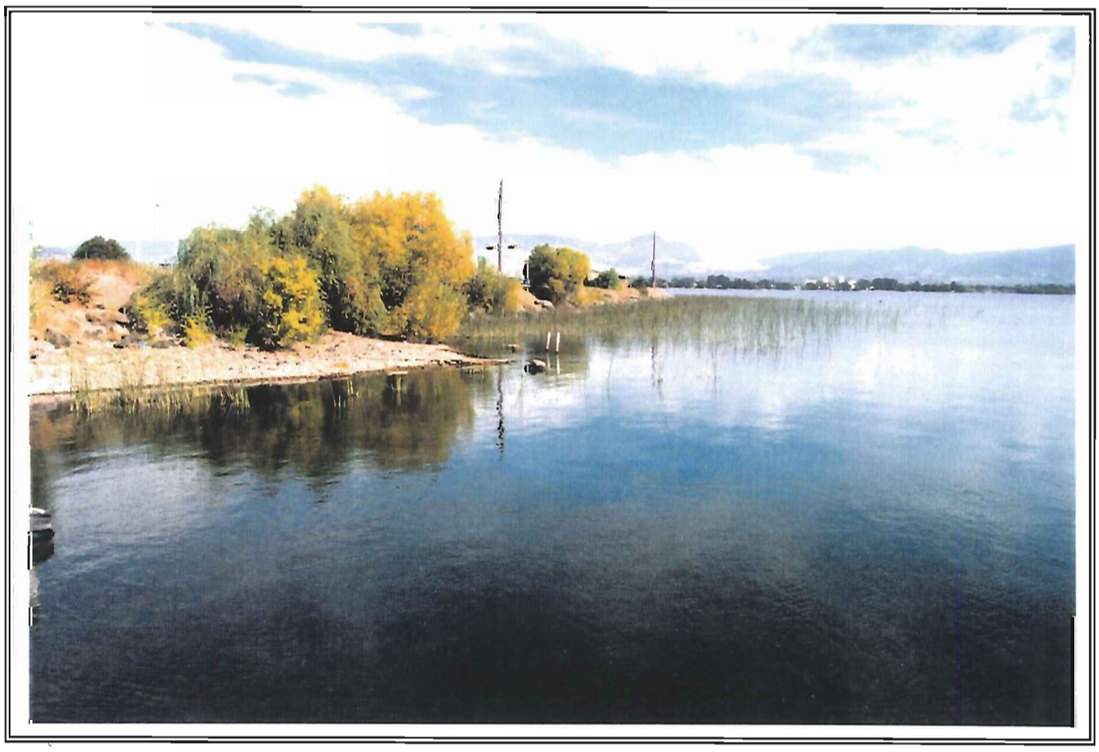


Exposed causeway fill and hard-stemmed bulrush beds along the southbay of the westside causeway.

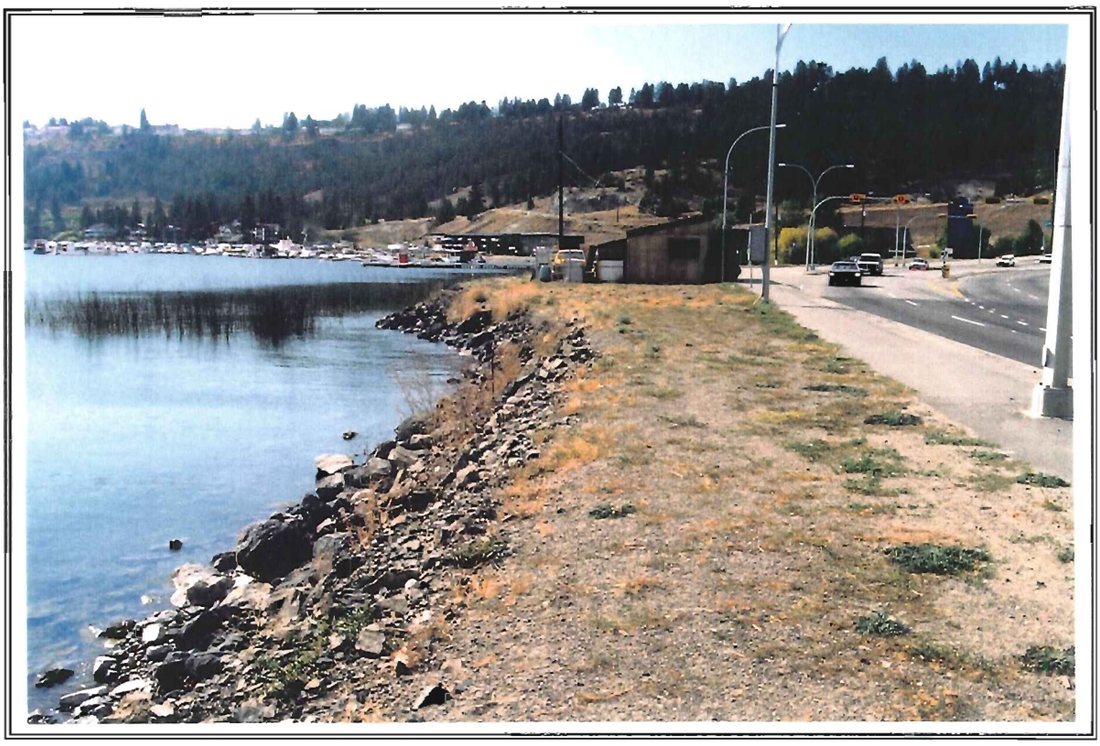


Poorly vegetated riparian area along the south bay of the westside causeway.

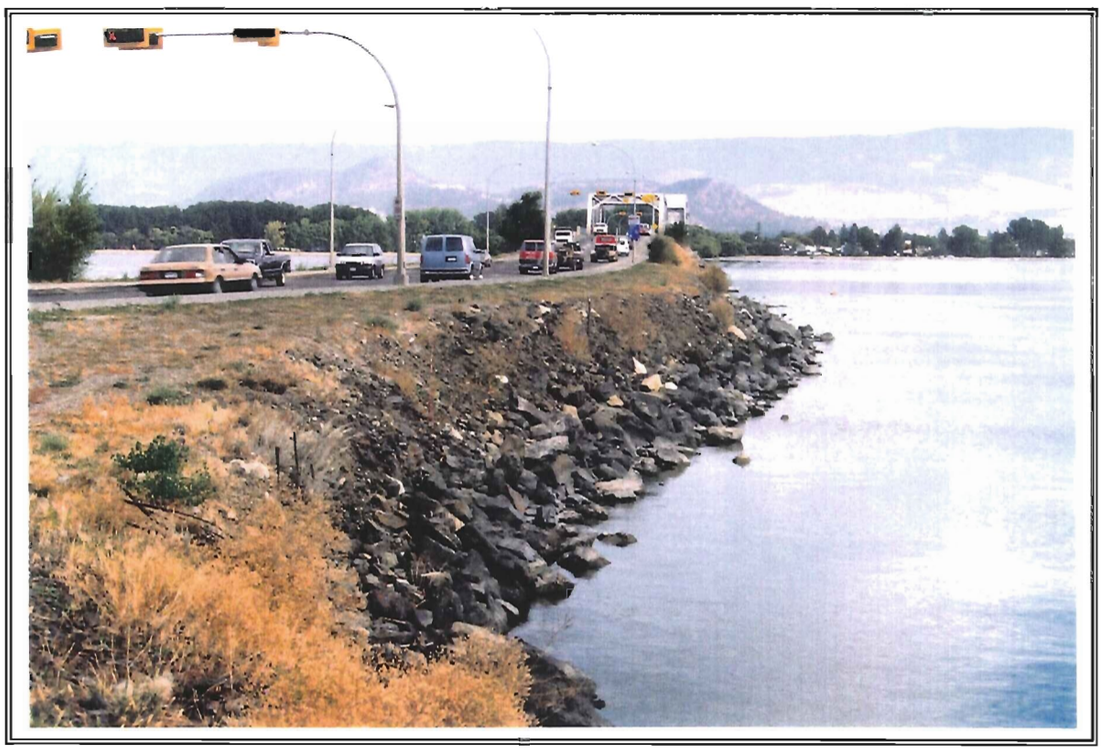
Upslope areas have been cleared for road and parking development.



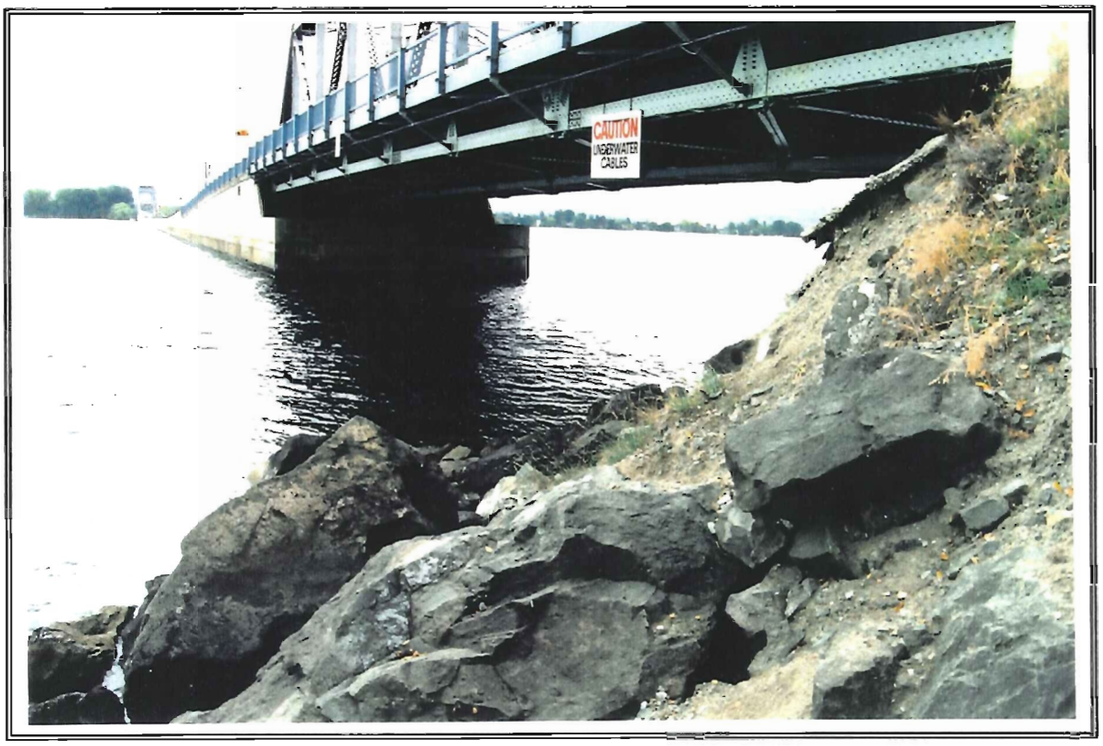
Pockets of riparian trees and shrubs are found along the south bay of the westside causeway.



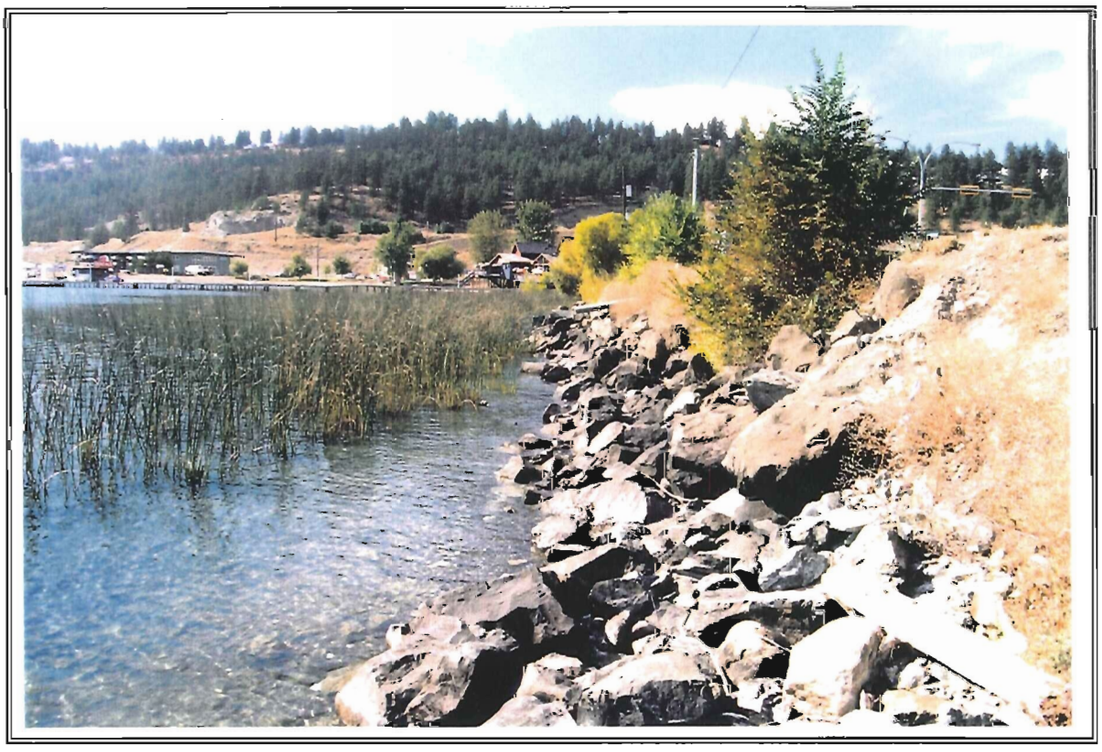
Causeway areas lack riparian trees and shrubs.



Rip rap banks along the causeway lack riparian vegetation.



Large rip rap was used for slope stablization along the banks of the causeway.



Note the unvegetated littoral band between the rock fill slope and the hard-stemmed bulrush.

Appendix 4:

Description of Options 2a and 4
General Arrangement Drawings for
Options 2a, 4 and 5

3.2 Option 2A

Appendix A, which is separate to this volume, is the drawing set for Option 2A. From west to east, the features of the option are:

- Campbell Road Interchange is shown as the third option which has been developed to date. This is being reviewed by the Ministry and has recently been accepted for costing as the preferred option on the basis of technical considerations;

- the high level approach consists of two 10 span ramps, termed the north and south viaducts, with 6% grades and a curved alignment;

- the eastbound on-ramp from Campbell Road extends up the grade of the south viaduct to the vicinity of the top of the ramp over the navigation channel. This requires that the south viaduct be three lanes wide in this area;

- the navigation channel has a 44 m wide navigation clearance with an air draft of 18 m and a depth of 4 m. To reduce dredging quantities, the channel alignment is curved on the north side of the crossing;

- the floating section has 11 new pontoons attached to the north side of the existing pontoon string. These pontoons vary in width, depending on the alignment of the westbound lanes;

- two parallel, two lane structures are provided at the east end. The north viaduct is new construction and will operate temporarily with three lanes of traffic while the south viaduct is retrofitted;

- the towers and counterweights will be removed from the existing piers. This will require modifications to the deck and bearings at the main piers;

- the decks on the existing east approach structures will be demolished and reconstructed;

- the existing east approach road will be modified to provide access to the new westbound lanes; and,

- the existing east approach road may be modified for a 60 km/hr. design speed. This would require that the existing running track in City Parks be relocated.

3.3 Option 4

Appendix B is the drawing set for Option 4. From west to east the features of the option are:

- Campbell Road Interchange is shown as the third option which has been developed to date. This is being reviewed by the Ministry and has recently been accepted for costing as the preferred option on the basis of technical considerations.

- the high level west approach consists of twin 5 span ramps with 6% grades and a straight alignment;

- the navigation channel has a 44 m wide clearance with an air draft of 18 m and a depth of 4 m. The dredging required consists of removing the end of the causeway fill which is granular material. No excavation of the lake bottom material is required;

- the floating section has 11 new pontoons attached to the north side of the existing pontoon string. These pontoons are identical in width, as the westbound lanes have a straight alignment for the full length of the crossing;

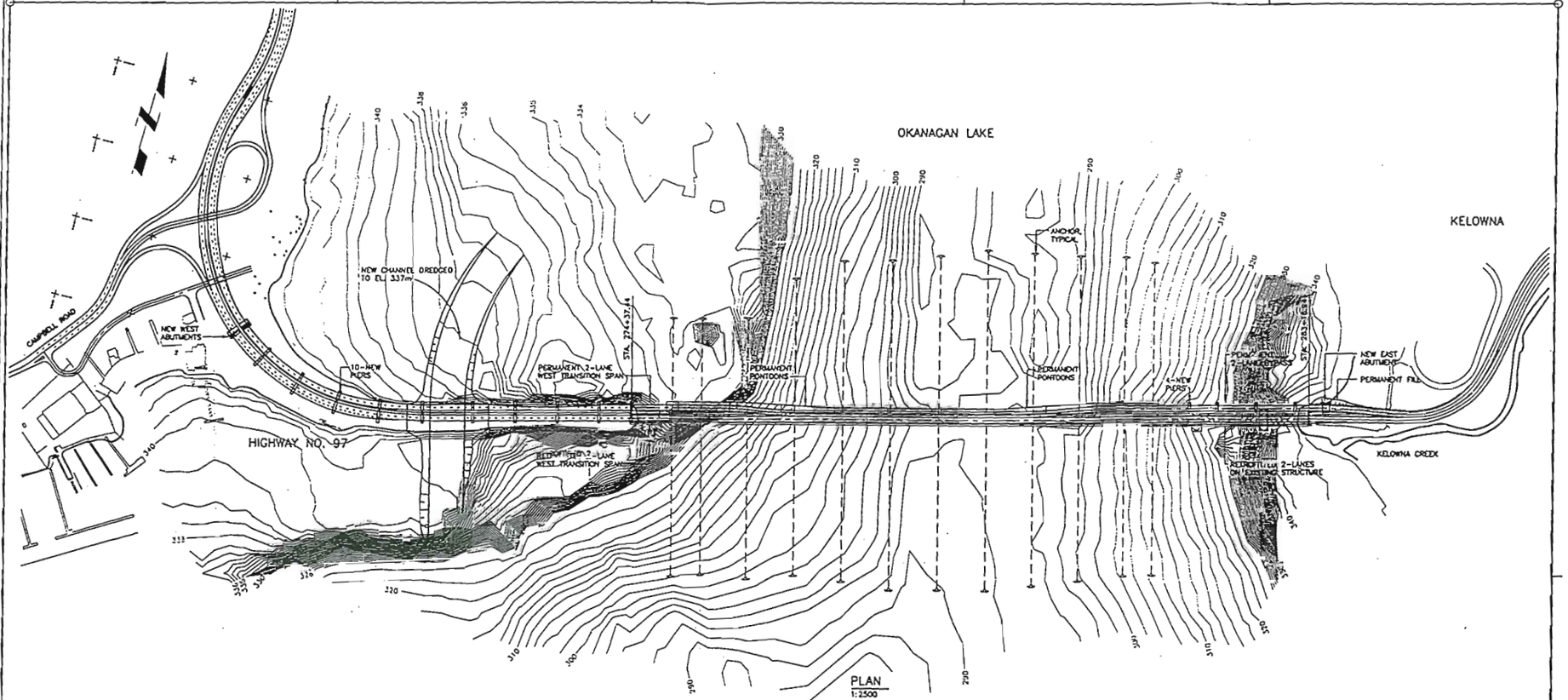
- two parallel, two lane structures are provided at the east end. The north viaduct is new construction and will operate temporarily with three lanes of traffic while the south viaduct is retrofitted;

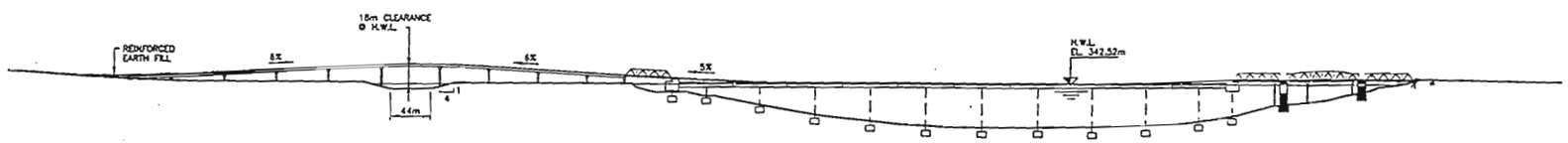
- the towers and counterweights will be removed from the piers. This will require modifications to the deck and bearings at the main piers;

- the decks on the existing east approach structures will be demolished and reconstructed;

- the existing east approach road will be modified to provide access to the new westbound lanes; and,

- the existing east approach road may be modified for a 60 km/hr. design speed. This would require that the existing running track in City Parks be relocated.





ELEVATION ON CENTRELINE OF EXISTING HIGHWAY
1:2500

NOTE: SHOWN WITH WATER LEVEL AT EL. 341.92m.

NOTES:

1. ELEVATIONS AND CONTOURS FROM M.O.T.H. DRAWING NO. OVERVIEW, CAD FILE KELS-DOM, NOVEMBER, 1995.

Westmar Consultants Inc.
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SCALE SHOWN

DESIGNED ____ DATE ____
CHECKED ____ DATE ____
DRAWN ____ DATE ____

Rev.	Date	Description	Init.

REVISIONS

Province of British Columbia
MINISTRY OF TRANSPORTATION AND HIGHWAYS
BRIDGE ENGINEERING BRANCH

OKANAGAN DISTRICT
OKANAGAN LAKE BRIDGE NO. 1458

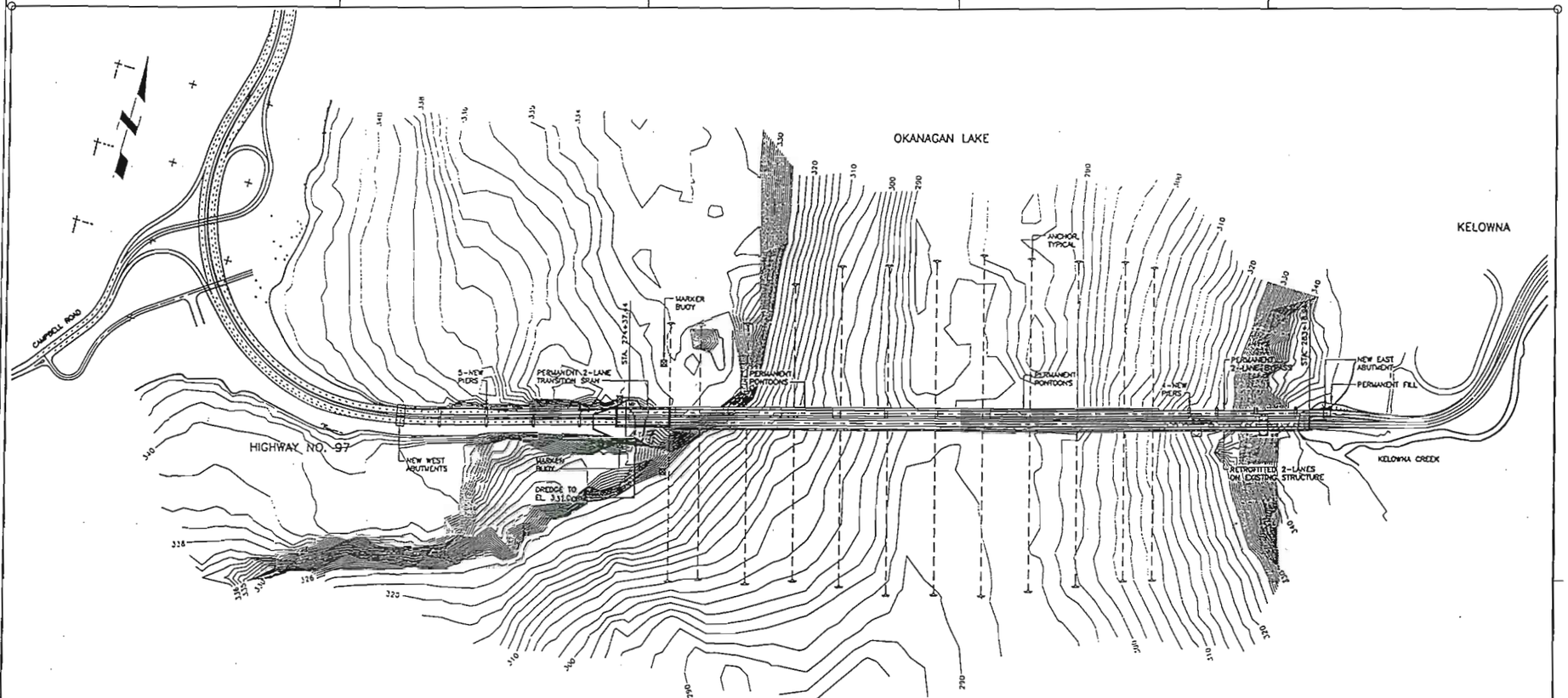
OPTION 2A
GENERAL ARRANGEMENT

PREPARED BY	RECOMMENDED	ACCEPTED FOR CONSTRUCTION
	DIRECTOR OF BRIDGE ENGINEERING	CHIEF HIGHWAY ENGINEER
DATE	DATE	DATE

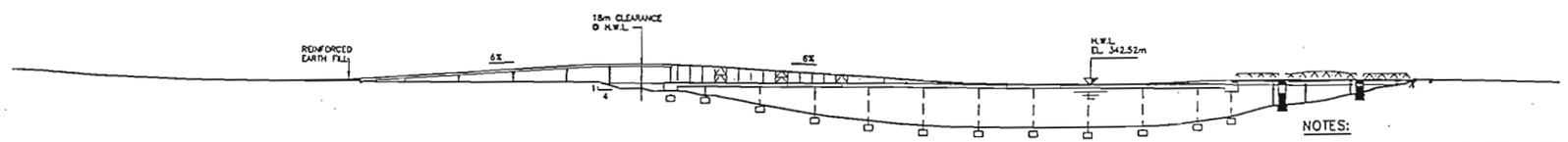
FILE No. ____ NEGATIVE No. ____ REG. ____ DRAWING No. 201

CANCEL PRINTS BEARING PREVIOUS LETTER

File name: P:\1994\94211\DRAWING\211-201.DWG Last edited: 96/03/06 @ 21:24



PLAN
1:2500



ELEVATION ON CENTRELINE OF EAST BOUND LANES
1:2500

NOTE: SHOWN WITH WATER LEVEL AT EL. 341.92m.

NOTES:

1. ELEVATIONS AND CONTOURS FROM M.O.T.H. NO. OVERVIEW, CAD FILE KELS-CON, NOVEMBER, 1995.

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SCALE SHOWN

DESIGNED _____ DATE _____
CHECKED _____ DATE _____
DRAWN _____ DATE _____

Rev.	Date	Description	Init.

REVISIONS

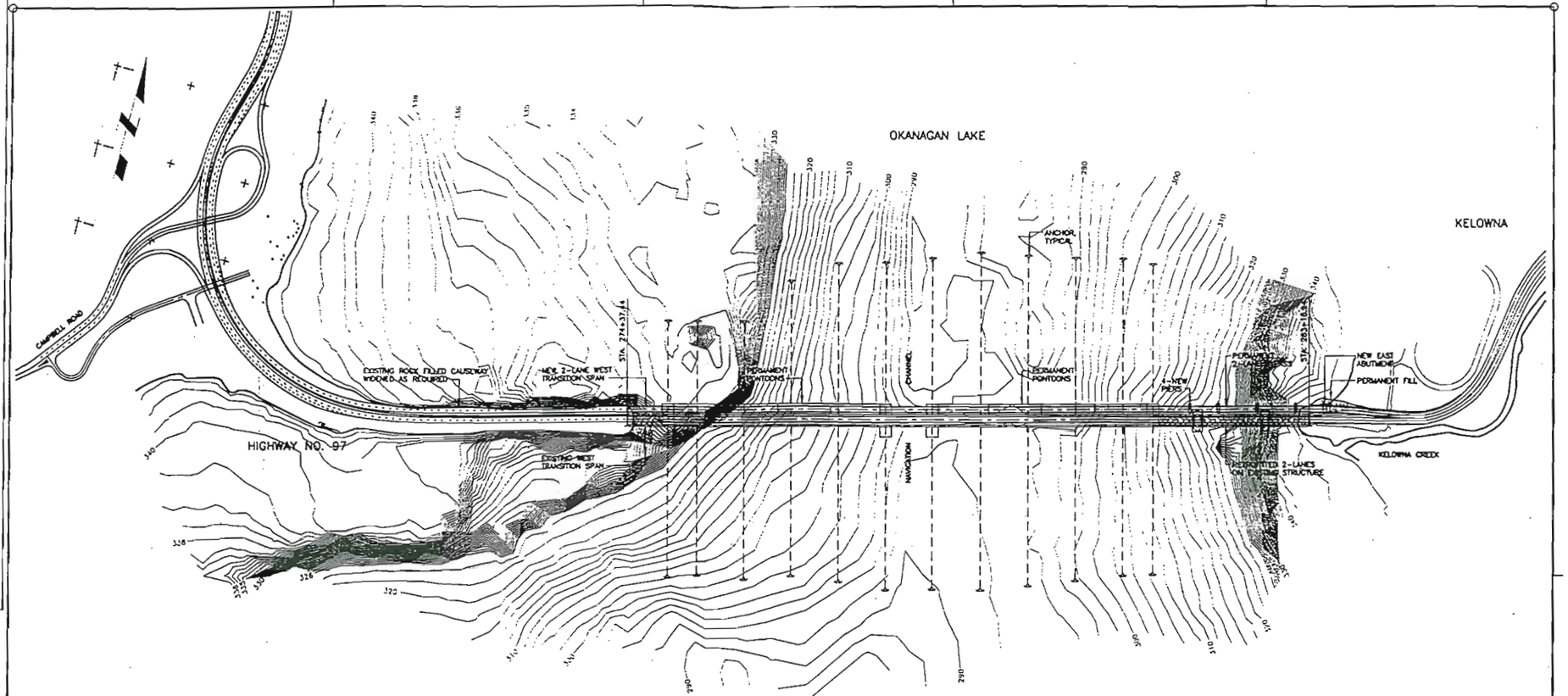
Province of British Columbia
MINISTRY OF TRANSPORTATION AND HIGHWAYS
BRIDGE ENGINEERING BRANCH

OKANAGAN DISTRICT
OKANAGAN LAKE BRIDGE NO. 1458

OPTION 4
GENERAL ARRANGEMENT

PREPARED BY	RECOMMENDED	ACCEPTED FOR CONSTRUCTION
	DIRECTOR OF BRIDGE ENGINEERING	CHIEF HIGHWAY ENGINEER
DATE	DATE	DATE

FILE No. | NEGATIVE No. | REG. | DRAWING No. 401



NOTES:

1. ELEVATIONS AND CONTOURS FROM M.O.T.H. NO. OVERVIEW, CAD FILE KELS-CON, NOVEMBER, 1995.

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Province of British Columbia
MINISTRY OF TRANSPORTATION AND HIGHWAYS
BRIDGE ENGINEERING BRANCH

SCALE SHOWN

DESIGNED ____ DATE ____
CHECKED ____ DATE ____
DRAWN ____ DATE ____

Rev.	Date	Description	Init.

REVISIONS

OKANAGAN DISTRICT
OKANAGAN LAKE BRIDGE NO. 1458

OPTION 5
GENERAL ARRANGEMENT

PREPARED BY	RECOMMENDED	ACCEPTED FOR CONSTRUCTION
	DIRECTOR OF BRIDGE ENGINEERING	CHIEF HIGHWAY ENGINEER
DATE	DATE	DATE

FILE No. | NEGATIVE No. | REG. | DRAWING No. 101

CANCEL PRINTS BEARING PREVIOUS LETTER

File name: C:\CADD\13\DWG\771-101.DWG Last edited: 96/02/12 @ 10:19