4.0 PHYSICAL SETTING

4.1 FRASER DELTA

The modern delta of the Fraser River commences near New Westminster and extends 15-23 km westwards in a broad delta plain encompassing Richmond, Ladner and Tsawwassen (Figure C4-1). The western margin of the delta extends into the Strait of Georgia over a length of approximately 27 km and includes Sturgeon Bank and Roberts Bank. Point Roberts peninsula, near the southern extent of the delta, is a Pleistocene uplands and former island that has become attached to more recent deltaic deposits. Boundary Bay is located on the inactive southern side of the delta, and extends 11.5 km. Mathews et al. (1970) have described the recent tectonic history of the delta area. They suggested that a combination of compaction and local downwarping has resulted in an average subsidence of approximately 1.2 mm/year. Kellerhals and Murray (1969) reported rates of subsidence in Boundary Bay of between 0.4 to 1.7 mm/year. A detailed account of Pleistocene history and evolution is presented in Clague (1998).

4.2 ROBERTS BANK

The main platform of the delta consists of gently sloping tidal flats that extend for a distance of up to 6 km. The tidal flats represent the sub-aqueous top-set beds of the Fraser Delta (Mathews and Shepard, 1962). The width of the tidal flats is governed primarily by the tidal range (approximately 4 m on average), the wave climate and sediment characteristics. The width of the Roberts Bank tidal flats, defined as the distance between the 3.0 m contour and the 0 m contour, increases northward from Point Roberts from a few hundred metres to 5.7 km immediately southeast of Canoe Passage (Figure C4-2). Therefore, as the length of tidal flat increases, the slope decreases and the potential area available to channel formation increases. The average gradient on the tidal flats (between +3 and 0 m) is approximately 0.0011 in the inter-causeway area, 0.0019 on the south side of the B.C. Ferry Terminal Causeway and 0.0004 south of from Canoe Passage.

On Roberts Bank, the flats are generally featureless except for the development of tidal channels. The tidal flats generally consist of medium to fine sand with silty sand (Figure C4-3). The lower
Notes:
Notes:
1) Profiles extracted from 2002 bathymetry data.
2) Profiles are exaggerated vertically 50 times.
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Sediment Composition of
Fraser Delta Surface Sediments

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FIGURE C4-3

Notes:
1) Sediment distribution data from GeoSea consulting, 1995
2) Sediment distribution based on surface sediment samples only.
and middle tidal flats are floored by horizontally bedded fine to medium grained sand, which is commonly bioturbated and contains shell fragments. These relatively clean sands grade into silty sands of the mid to upper tidal flats.

The sediments consist mainly of mud derived from suspended sediment in the Fraser River plume and coarser sand transported by gravity flows down submarine channels or valleys cut into the delta slope. On Sturgeon Bank, there is a sharp transition between the sands on the tidal flats and the finer grained sediment on the fore slope. The decrease in grain size with depth reflects the reduction in current and wave action from the shallow tidal flats into deep water. Roberts Bank is in general covered with medium to fine grained sand extending from the tidal flats down to the fore slope. The scarcity of finer sediments suggests the prevailing currents have prevented the finer sediments from the Fraser River from reaching the southern part of Roberts Bank. This pattern also suggested a net northerly direction of sediment transport (Luternauer and Murray, 1973).

Little or no sediment is being deposited today over most of the Roberts Bank slopes. Previous studies reported dunes have developed off Roberts Bank at depths of 20 to 120 m, with net northwesterly transport. Preliminary assessments stated that these features could be evidence of erosion of the delta front and claimed this could affect the stability of existing port structures on Roberts Bank. Subsequent studies showed this interpretation was incorrect; the sediments were dredged spoil that had been dumped in deep water, not eroded material from the slope.

Retrogressive slope failures and sediment-laden gravity flows have eroded the active deep valley off the mouth of the South Arm near Sandheads and smaller valleys are evident off of Canoe Passage and the North Arm (Christian et al., 1998). There is also a large area of disturbed sediments on the southern side of Roberts Bank termed the “Roberts Bank Failure Complex” by Luternauer et al. (1998). This feature was interpreted to have formed at a former river mouth in a similar manner as is occurring today off Sandheads.
4.3 BIOTIC COMMUNITIES

Habitats on the Fraser delta are broadly divided between marine and terrestrial, with the marine comprising the area below low tide (sub-tidal zone). The inter-tidal zone is transitional between the marine and terrestrial zones.

Figure C4-4 shows a generalized relation between plant species and elevation range (Hutchinson et al, 1998). Portions of the sub-tidal and inter-tidal zones are occupied by eelgrass while the upper portions of the inter-tidal zone support salt and brackish marsh communities.

The distribution of biota on the tidal flats is governed by elevation, which determines the extent to which marine organisms are subject to desiccation and terrestrial organisms to inundation (Hutchinson et al, 1998). Other factors include the salinity, substrate texture and organic content and water clarity. For example, fresh water inflows from the Fraser River reduce the salinity on Surgeon Bank and Roberts Bank in comparison to Boundary Bay where fresh water inflows are minimal. Small differences in ground elevation, tidal submergence, water table depth, substrate composition, salinity and sediment mobility give rise to a variety of habitat.

The seagrass ecosystem of the Fraser delta consists of native eelgrass (Zostera marina) and non-native Zostera japonica. Z. marina grows abundantly on sand flats at sub-tidal to lower inter-tidal ranges and is common on Roberts Bank and in Boundary Bay.

Figure C4-5 shows the present distribution of eelgrass. This map was provided by Precision Identification and is an updated map developed from previous biological studies for FREMP.

4.4 DRAINAGE IN THE INTER-CAUSEWAY AREA

Within the main portions of the Strait of Georgia, the flood tidal stream sets to the northwest. The tidal flows are relatively strong in the southern portion of the Strait of Georgia, and typically decrease to the north of Point Roberts due to the increase in cross sectional area of the channel.

Tides are predominantly mixed, mainly semi-diurnal, with a range of up to 5 m near Tsawwassen. The mean tidal height is about 3.1 m. Table C4-1 summarizes tidal statistics at Point Atkinson.
Notes:

1) Elevation ranges of key taxa in brackish (Sturgeon Bank and north-central Roberts Bank) and saline (Boundary Bay and southern Roberts Bank) areas of the intertidal zone on the Fraser Delta.

Sources: Shepperd, 1981; Hutchinson, 1982; Williams, 1989; Patterson, 1990; Baldwin and Lovvorn, 1994; L. Hutchinson, unpublished data.

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Biotic Communities of the Fraser River Delta

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