CONTINUING THE LEGACY

Flood Protection through the Vedder River and Canal Sediment Removal Program

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Vedder River and Canal System: Now and Then

The Vedder River and Canal, located in the City of Chilliwack and City of Abbotsford, British Columbia, conveys water from the Chilliwack River to the Fraser River. The Chilliwack River originates in North Cascades National Park in Washington State, crosses the US–Canadian border, then enters Chilliwack Lake. The river exits the lake, flows west for 40 kilometres, and changes its name to Vedder River at Vedder Crossing. The river then crosses the floodplain and becomes the Vedder Canal, which joins the Sumas River and flows into the Fraser River.

The entire Vedder River and Canal system is approximately 12 kilometres long, with a Design Flood[1] of 1,470 m^3/s ($Q200^2$). The system provides prime habitat for chinook, chum, coho, pink and sockeye salmon and rainbow and steelhead trout, and is a popular location for fishing.

Today, residents and private properties on both sides of the system in the cities of Abbotsford and Chilliwack are protected by flood control dykes. However, the system differs considerably from what it was a century ago.

In those days, flooding from the Chilliwack and Fraser rivers caused major damage and concern to early settlers and communities. Before 1875, the Chilliwack River flowed north from Vedder Crossing over a broad alluvial fan to the Fraser River. In 1875, heavy rains caused a logjam that diverted the river into two small streams: Vedder Creek flowed west, and Luckakuck Creek flowed north. In 1882, a new logjam formed, causing several streams to shift course westwards to become the Vedder River and flow into what was then Sumas Lake (now Sumas Prairie). In the early 1900s, the river was dyked and channelised.

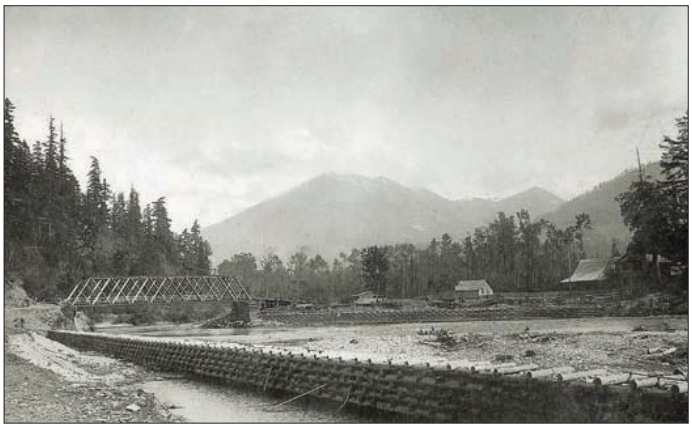
The former Sumas Lake also experienced flooding from the Fraser River during spring freshet. The flow of Vedder River into the lake compounded drainage issues. The lake would swell from 4,050 hectares to 13,000 hectares during spring floods. In the early 1910s, Frederick (Fred) Sinclair, an engineer with the BC Electric Railway, developed a plan for draining Sumas Lake to provide flood control and to take advantage of the fertile soil in the lakebed for farming. As part of the Sinclair Plan, the Vedder Canal was constructed to divert Vedder River into the Sumas River.

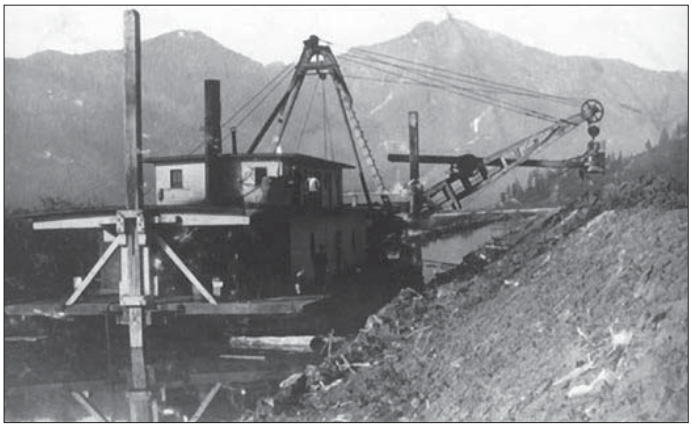
The diversion of Vedder River was completed by 1922. Draining of the lake began in 1923, with water pumped over the dykes into the Fraser River by the old Sumas Station. This facility was upgraded in 1975 and is now known as Barrowtown Pump Station. It is the sole drainage point of the Sumas Lake-bottom area and is one of the largest drainage pump stations in Canada.

Need for River Management

A major flood on December 3, 1975, caused significant damage in the community of Yarrow and the Greendale area within the City of Chilliwack, and a portion of Sumas Prairie in the City of Abbotsford. The flood caused infilling of almost the entire river channel downstream of the Vedder Crossing to the canal. The need for improved river management, including dyking and sediment removal along the Vedder River, became apparent.

As sediment accumulates on the river and canal bottom, conveyance capacity decreases and water levels tend to rise. This sediment aggradation in the Vedder River and Canal can increase the risk of flooding and compromise public safety. In 1976, the river channel was excavated to restore the channel capacity prior to the fall and winter flood season.





Top: Vedder River, early 1900s; Bottom: The canal is dredged to divert Vedder River into the Sumas River.

Subsequent engineering investigations determined that new dykes set back from the watercourse were required for flood protection and to allow sufficient room for natural river processes. In order to accommodate the setback dykes, it was necessary to purchase a number of private properties along the river.

Vedder River Management Plan

The Vedder River Management Plan was adopted in 1983 to "ensure the integrity of the Vedder River floodway while maintaining and enhancing the natural resources of the area and incorporating, where compatible and desirable, recognised historical uses and educational programs for the benefit of the people of British Columbia" (BC Ministry of Environment 1983). The area encompasses lands managed by the cities of Chilliwack and Abbotsford, the provincial government, and private entities.

The Vedder River Management Area Committee (VRMAC) oversees the plan's ongoing implementation. The VRMAC is made up of representatives from the City of Chilliwack, City of Abbotsford, BC Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), and the federal Department of Fisheries and Oceans. It also includes stakeholders such as the Fraser Valley Regional District, First Nations and fishing groups. A technical committee develops and recommends to the VRMAC a sediment removal plan every second year on even years—timing that was established to avoid affecting spawning pink salmon.

The VRMAC has planned and managed sediment removals for flood control purposes annually from 1990 to 1997, and biennially from 1998 to present. Sediment was removed prior to 1990, but those removals were not coordinated by VRMAC.

The Process

Natural river processes carry sediment from the upstream Chilliwack River Basin into the Vedder River and Canal. Historically, approximately 50,000 cubic metres of sediment are deposited, on average, every year. The sediment reduces the channel's capacity to convey the Design Flood Event (DFE) and thereby increases flood threat to surrounding communities. Sediment removal is necessary to maintain the provincially recommended level of flood protection (Q200), and removal sites are selected to preserve sufficient freeboard along the dyking system during the DFE.

The sediment removal program, jointly funded by the cities of Chilliwack and Abbotsford and the MFLNRO, is carried out in two phases: (1) planning, and (2) removal and assessment.

The planning phase begins with a survey. More than 70 permanently established cross-sections along the system are surveyed every second winter to calculate changes in sediment volume over the preceding two years. The collected data are run through a hydraulic model to calculate the DFE water surface profile and to evaluate the change in dyke freeboard.

Sites for sediment removal are then selected, in consultation with a registered professional biologist, to improve the channel's conveyance capacity where it is most required. Other considerations include presence of vegetation, proximity to sensitive and valuable habitat, road or other access for machinery, and potential effects of sediment removal on existing channel features and configurations.

During the removal and assessment phase, the three agencies jointly tender the sediment removal, according to the jurisdiction of each specific removal site. During removal, a registered professional biologist monitors the activities. A survey undertaken after the removal is necessary to determine the actual removal volume. In addition, one year after removal, a biological assessment by a registered professional biologist is conducted to determine impacts on habitat along the river and canal. This assessment concludes the removal and assessment phase.

High water in the Vedder River, November 2006.

Challenges and Solutions

Although the program has been in place for many years, timing remains a major challenge and is dictated by salmon runs and water levels. Sediment removals are permitted to occur only during a specific window—typically a month and a half in late summer—when the river system's salmon stocks would not be affected. This means the planning phase work must be completed early in the year to allow sufficient time for the *Water Act* and *Fisheries Act* environmental reviews and the tendering process.

However, high water levels and velocities, as well as snow on the ground, can delay the planning phase's survey work, which needs to take place in January or February. The Vedder River is subject to fall and winter storm events, with water levels also rising each spring and summer due to snow melt. Water levels in the Vedder Canal are affected by the Vedder River events as well as Fraser River spring and summer freshet events. Overcoming these timeline challenges requires close coordination and cooperation among the three agencies and the consultants who undertake the work.

Sediment removal comes with other challenges. The sediment removals can be delayed or interrupted by increasing water levels, as mentioned above. Removal sites along the river and canal are selected based primarily on the need to provide optimum Design Flood protection, with secondary selection factors considering how to minimise environmental impacts. However, tendering

Sediment is removed, 2014.

of the sediment removal is linked to influences unrelated to the goals of the management plan—namely, the market's capacity to absorb sediment volumes. This capacity fluctuates according to sediment supplies and construction activity in the region and varies depending on the needs of local industries and economies. The difference in sediment quality from one site to another along the Vedder system adds to the tendering process's complexity.

In any given cycle, the agencies may receive no bids, positive bids, or negative bids to remove sediment. Positive bids help subsidise the costs of the studies, but agency funding is still required to cover shortfalls and to cover the costs of negative bids.

Moving Forward

Despite the challenges, the Vedder River and Canal sediment removal program continues to meet its objectives to protect public safety while maintaining and, where possible, enhancing the area's natural resources. For example, in 2014, during the last cycle, approximately 55,000 cubic metres of sediment were removed from six sites during the fisheries window to improve the system's conveyance capacity and reduce flood risk. Habitat-enhancement activities included placement of large woody debris, flow improvements to secondary channels, and management of invasive plants.

Comprehensive planning and monitoring efforts, well-documented outcomes, and long-established relationships among VRMAC members help facilitate the process to achieve continued successes.

The planning phase of another sediment removal cycle began in early 2016, with renewed emphasis on timing, cooperation and coordination. Past experience indicates that this year—and in future years—the Vedder River and Canal sediment removal program will continue furthering Frederick Sinclair's century-old legacy for flood protection, achieving the goals of the Vedder River Management Plan, and protecting the public and the environment. ⊠

[1]Design Flood is a hypothetical flood used for dyke safety design, planning, floodplain management investigations and emergency management. A design flood is typically defined by its probability of occurrence.

[2]Q200 means the return period of a flood might be 200 years; otherwise expressed as its probability of occurring equaling 1/200 or 0.5% in any one year. This does not mean that, if a flood with such a return period occurs, the next will occur in two hundred years' time; instead, it means that, in any given year, there is a 0.5% chance that such a flood will happen, regardless of when the last similar event occurred.

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