2.5 Downtown Flood Risk

2.5.1 Overview

This section examines effects of the four management alternatives on flood risk in downtown Olympia. Flooding impacts to other structures (e.g., utility lines and roadways) were described in Section 2.4. Two reports were reviewed to prepare this analysis. The *Capitol Lake Alternatives Analysis Low-Lying Infrastructure*[123] report focuses on sea level rise and possible flooding effects in downtown Olympia. The *Capitol Lake Alternatives Analysis Hydraulic Modeling*[124] report compares scenarios in which the Capitol Lake basin would start to flood under the various alternatives.

Flooding in Downtown Olympia, circa 1975

The descriptions of impacts focus on existing conditions in terms of sea level and sea level rise scenarios of 1 and 2 feet. The 2-year (frequent, smaller flood events) and 100-year (infrequent large events) are used to frame the analysis presented here.

To understand the potential for flooding in downtown Olympia it is important to first understand the existing condition. A significant portion of downtown Olympia lies below an elevation that under natural conditions would result in frequent flooding.[125] However, the existing stormwater conveyance system protects the downtown area from most of the flooding that would normally occur. Furthermore, there are a series of recommended changes to the stormwater conveyance system that would further reduce the flood risk. This situation is not related to how the Capitol Lake basin is ultimately managed. It is assumed that the infrastructure needed to control this flooding would be installed no matter which alternative is selected, and therefore the impacts of this flooding are not considered project related impacts and are not described or compared in this summary.

Another important element for protecting the downtown area from flooding is the berm that has been built within Heritage Park along the eastern shore of the north basin. This berm sets the effective flood elevation for downtown at 11.5 feet.[126] Therefore, in the following summaries, predicted changes in flood risk are not based on land or structure elevations, but on the berm elevation.

For the Status Quo and Managed Lake Alternatives, flooding is caused by large rainfall events that cause the Deschutes River to flood. Flood levels in the lake basin can be affected somewhat by the management of the Capitol Lake dam;[127] lake levels can be lowered in anticipation of a storm event thereby creating more flood storage capacity. The dam was not designed as a flood control structure and therefore has limited value for alleviating flooding. In recent years dam operations have been optimized to reduce predicted flood events, but there are limits to its ability to store flood waters. In this comparative analysis, it is assumed that lake levels would continue to be manually lowered via dam operations, prior to major storm events. For the full range of modeled flood events (2-year through 100-year magnitudes) flooding for the Status Quo and Managed Lake Alternatives did not threaten downtown Olympia.

For the Estuary Alternatives, peak floods would be driven by tidal elevations. Tidally driven flood elevations are higher than flood elevations for the existing lake condition. It was estimated that under existing tidal conditions, a 2-year flood event will result in flood elevations that are 1.4 feet higher than with the dam and lake in place.[128] The impact of tides is muted for larger events, so that the difference in peak flood elevations for the 100-year event is only 0.4 feet higher under the Estuary Alternatives than what occurs now under current conditions.[129] For the full range of modeled flood events (2-year through 100-year magnitudes) flooding for the Estuary Alternatives did not threaten downtown Olympia.

A global rise in sea level would increase flood frequencies in the Estuary and Lake Alternatives. If climate change brings both sea level rise and increased peak flows in the Deschutes River, then the impacts to Olympia in terms of flood risk will increase substantially.[130]

2.5.2 Impacts of Alternatives

2.5.2.1 Status Quo Alternative

Near-Term Status-Quo Condition

In the near-term (the next 50 years), sediment would continue to accumulate in Capitol Lake, however, this would not be expected to result in significant flood storage loss. Flooding events would continue to be driven by inputs from the Deschutes River and Percival Creek. Lowering of water levels at Capitol Lake prior to major storm events through dam operations can reduce flooding, but only if Deschutes River flooding is limited to one or two tide cycles. In this analysis it is assumed that, as now, dam operations would be optimized to reduce flooding conditions.

- Peak flood elevations and therefore flood frequencies would be the same as under existing conditions.
- At existing sea levels, a peak flood during even a 100-year event would be at approximately 10.6 feet and therefore well below the elevation of the berm that protects the downtown area.[131] Consequently, flood risk in the downtown area would not be expected to notably increase.

- With a global sea level rise of 1 foot, the flood elevation during a 100-year event is estimated at 11.3 feet. This is still below the elevation of the protective berm and therefore would not result in flooding or the immediate need to raise the berm.[132]

Long-Term Status Quo Condition

Under the Status Quo Alternative, over the long-term (beyond 50 years), the lake would fill with sediment and convert to a wetland system. This conversion would remove much of the lake's water storage capacity and would result in a loss of flood control capacity that is currently provided by the operation of the dam. The peak elevation for the condition where 6 feet of sediment is allowed to build-up in the existing lake was evaluated in the hydraulic study.

- Peak flood elevations would be approximately 0.3 feet higher than under the current condition, for more frequent (2-year) events and for less frequent, larger floods (100-year events).[133]

- At existing sea levels, a peak flood event of 100 years would reach an elevation of approximately 10.7 feet,[134] below the elevation of the berm that protects the downtown area. Therefore, the flooding frequency in the downtown area would not increase notably.

- At a sea level rise of 1 foot, the peak flood elevation for a large, infrequent flood (100-year) is estimated at 11.6 feet and would result in flooding of downtown.[135] However, it is assumed that the protective berm would be raised prior to this sea-level rise to protect the downtown area.

2.5.2.2 Managed Lake Alternative

Under this alternative, the north and middle basins of Capitol Lake would be dredged to remove existing sediments and routinely dredged in the future to maintain the Managed Lake condition. As under the Status Quo Alternative, flooding events under the Managed Lake Alternative would be driven by inflow from the Deschutes River and Percival Creek. It was assumed that manual lowering of water levels at the Capitol Lake dam prior to major storm events would continue to be implemented. Modeling results indicate that dredging has no impact on flood elevations.[136] This is because the vast majority of the dredging occurs where the lake bed elevations are below the level that would provide an effective storage volume. Because the dredging would have little impact on ultimate flood elevations, the impacts for this alternative are considered to be essentially the same as for the Near-Term Status Quo Condition.

- Modeling results indicate that dam operations (i.e., lake lowering before a storm event) can be somewhat effective at decreasing the more frequent flood events (i.e., 2-year events), resulting in a decrease in peak flood elevations by as much as 0.6 feet,[137] depending upon how the dam is operated. At lower flood frequencies, (i.e., the 100-year event), lake

lowering has relatively little effect on flooding; peak flood elevations decrease by only 0.1 to 0.2 feet.[138] For more extreme events, when high flows in the Deschutes River span two or more tidal cycles, lowering lake levels is relatively ineffective after the first tide that coincides with high river flows.[139]

- At existing sea levels, a peak flood event of 100 years would reach an elevation of approximately 10.4 feet,[140] below the elevation of the berm that protects the downtown area. Therefore, the flooding frequency in the downtown area would not increase notably.

- At a sea level rise of 1 foot, the peak flood elevation for a large, infrequent flood (100-year) is estimated at 11.3 feet, just below the elevation of the protective berm and therefore would not immediately require raising the berm to protect downtown from flooding.[141]

2.5.2.3 Estuary Alternative

Under the Estuary Alternative, the Capitol Lake dam would be removed and Capitol Lake would return to tidally-driven estuary condition. Under the Estuary Alternative, the entire Capitol Lake basin would be open to tidal flushing and water levels would be primarily influenced and determined by the tides.

- Under existing sea levels and frequently occurring flood events (i.e., 2-year events), the flood elevations would be approximately 1.4 feet higher than under existing conditions.[142] At low frequency events (100-year) this difference is muted and the increase in peak flood elevations is predicted to be 0.4 feet higher than under the lake alternatives.[143] It is important to note that these predicted differences in peak flood elevations between lake and estuary conditions may be overestimated. Assumptions in the modeling may slightly increase the flood elevation for the lake conditions and slightly decrease the flood elevations for the estuary conditions.[144]

- At existing sea levels, the berm provides protection up to a flood elevation of 11.5 feet. With stormwater system controls in place, the downtown area would be protected from flooding up to the 100-year flood event.

- The Estuary Alternatives would respond directly with a global rise in sea level; increasing by 1 foot with every 1-foot rise in sea level. At a sea level rise of 1 foot, the peak flood elevation for a large, infrequent flood (100-year) is estimated at 12.0 feet, which is above the elevation of the protective berm.[145] However, as with the other alternatives, this flooding would be prevented through raising the height of and/or extending the berm that currently protects downtown Olympia.

2.5.2.4 Dual-Basin Estuary Alternative

Under the Dual-Basin Estuary Alternative, a barrier would be constructed in the north basin, creating a calm basin adjacent to Heritage Park. Saltwater in the eastern reflecting basin would fluctuate by a few feet with the tidal cycles. The analysis of future risk from flooding indicates that peak flood elevations are essentially the same for both the Estuary Alternative and Dual-Basin Estuary Alternative.[146]

2.5.3 Comparison of Alternatives

Under existing sea levels and commonly occurring flood events (i.e., 2-year events), estuary flood elevations are predicted to be up to 1.4 feet higher than under the lake conditions. However, downtown Olympia is protected from high river flows and tidally induced flooding by the constructed berm around Heritage Park.

The downtown area would become increasingly vulnerable to flooding with an increasing rise in sea level. While a sea level rise would increase peak flood elevations for all of the alternatives, the Estuary Alternatives would respond more directly, increasing by 1 foot with every 1-foot rise in sea level. For the lake alternatives, a sea level rise would be tempered slightly by the dam; a 1-foot rise in sea level would result in approximately a 0.75-foot flood elevation increase during commonly occurring flood events. The engineering study which predicted flood elevations for the alternatives suggests that the difference between lake and estuary alternatives may be slightly overestimated.

The existing berm that protects downtown would need to be raised sooner under the Estuary Alternatives than the Status Quo and Lake Alternatives. Using current tide levels and the 100-year flood event as an upper boundary, under the estuary conditions the flood elevation is predicted to be 0.5 feet below the berm height. However, under Estuary Alternatives, the downtown area would become vulnerable to flooding at lower increases in sea level. The berm would not need to be raised until a sea level rise of approximately 0.5 feet. Under the Status Quo and Lake Alternatives, the berm would need to be raised at a sea level rise of approximately 1.2 feet.

If climate change brings both sea level rise and increased peak flows in the Deschutes, then the impacts to Olympia in terms of flood risk will increase substantially.

2.6 Long-term Costs

2.6.1 Overview

This section identifies the long-term costs of implementing the different management alternatives. The primary document used to prepare this chapter was the *Community Economic Values for the Capitol Lake Basin*[147] report, which was developed using input from community stakeholders as well as economic information derived from earlier technical reports including the *Capitol Lake Dam Conditional Assessment and Life Expectancy* report and the *Engineering*