Community Development Department

Memorandum

TO: Lake Oswego Planning Commission

FROM: Paul Espe, Associate Planner and
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DATE: June 19, 2008

SUBJECT: Flood Mitigation Strategies Work Session (PP 08-0010)

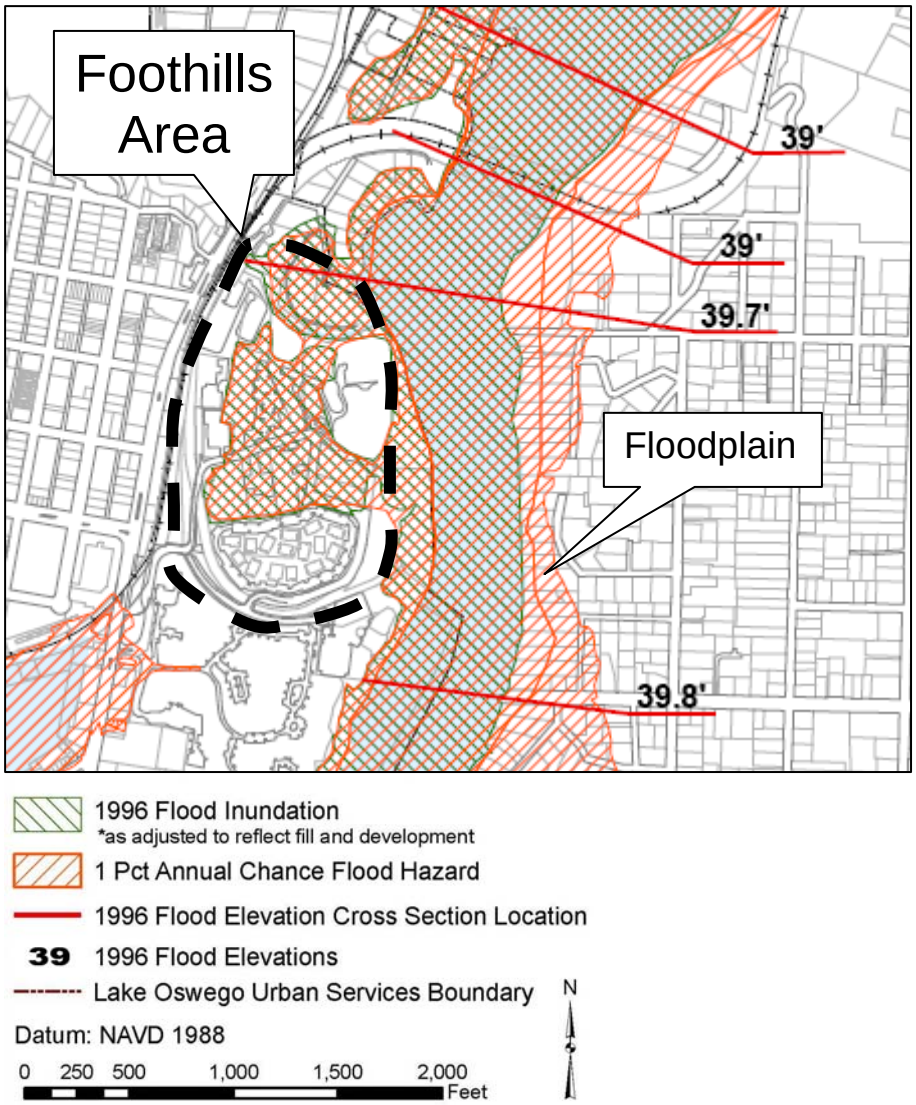
On June 3, 2008 the City Council adopted a new Flood Management Area Map and amended Article 50.44 (Flood Management Area) of the Community Development Code to comply with the Federal Emergency Management Agency (FEMA) regulations relating to flood insurance. The amendments did not address the physical changes that could help to reduce the risk of flooding in the community. This memorandum describes a range of flood mitigation options for the floodplain areas in the Foothills District and around Oswego Lake.

FOOTHILLS DISTRICT

Foothills Development Opportunities - The Foothills area is currently zoned for industrial use but it represents a key opportunity site for future downtown area development. With easy transit access and a possible streetcar stop, the area offers an ideal location for a mix of higher density housing and commercial uses.

Flood Hazards - Redevelopment of the Foothills area presents a number of challenges including the fact that most of the area is located within the FEMA floodplain. The FEMA Flood Insurance Rate Map identifies about 75% of the Foothills area as being located within an area that has a 1% chance of flooding in any given year. Additionally, much of the area was flooded in 1996 and subsequently, it is subject to the floodplain requirements of Title 3 of the Metro Urban Growth Functional Plan. Title 3 requires any fill in the floodplain to be balanced with a corresponding cut. When the Foothills area flooded in 1996, it was inundated by water from Tryon Creek and the Willamette River on the north and east, and by water flowing downhill from Oswego Lake and First Addition from the west.

In 1996, flood levels in the Foothills area reached an elevation of 39.7 feet (NAVD 1988). This is about 2.5 feet higher than the FEMA 100 year floodplain (1% chance of flooding) for the area. As a point of reference, the 1964 flood reached an elevation of about 44 feet (NAVD 1988).



In response to the 1996 flood, the City worked with property owners along Foothills Road to install a pump station to discharge flood waters to the Tryon Creek. The station sits near the north end of the Toklat property and it has the capacity to pump up to 5,000 gallons per minute from the area. The full capacity of the pumping station has not been tested in a real flood situation. The pumping station is of value to surrounding properties to help reduce the risk of flood damage, but the installation of the pump did not result in the area being removed from the related floodplain regulations.

Foothills Park - Completed in 2006, Foothills Park occupies the site of the former Georgia Pacific wood chip facility along the Willamette River. Foothills Park was developed so that there would be no net increase in flood elevation. The west portion of the site where the parking lot and buildings are located, is above the base flood elevation. The ground surface was recontoured in this area to create a partial berm that may help to protect the Foothills District from Willamette River flood waters in the future. The old access drive to the former Georgia Pacific site is the only "break" in the berm.

Kurahashi and Associates, the consulting civil engineers for the construction of Foothills Park, stated in the 2004 approval documents that the 1996 flood elevation (36.3 NGVD 29 - or 39.8 NAVD 88)[1] was used as the basis for locating park structures and that the "net cut below the floodplain elevation was 12,450 cubic yards." This creates the potential for an equal amount of fill in this area (roughly 67,230 square feet and five feet deep). The 12,450 cubic yards of fill would be more than enough to complete the berm across the old access road and could provide fill for one or more building sites.

Options - This report addresses four different flood mitigation options in the Foothills area. To implement any of the options, more technical research is needed. The information below provides an overview of some of the advantages and disadvantages of each option.

Option 1 -Construct a Berm to Protect the Foothills District from Flooding

This option would complete the berm in Foothills Park by installing additional fill to the south of the Tryon Creek Waste Water Plant at the former road access point into the park site. It is important to note the difference between a berm and a levee. A berm is a simple continuous earthen structure that could be designed to divert the flow of flood waters on a temporary basis. A levee is defined as an embankment whose primary purpose is to furnish flood protection from seasonal high water and subject to water loading for periods of only a few days or weeks to a year. For Option 1, it is assumed that berm construction would meet the same grading height, width and compaction specifications that were used when Foothills Park was constructed.

The grading plans prepared for Foothills Park by Kurahashi and Associates show that much of this site has elevations of about 39.8 feet (NAVD 1988). An earthen berm could be constructed to fill in the gap of lower elevation (approximately 38.5 NAVD 1988) between the Foothills Park bocce ball court and the Tryon Creek Wastewater Treatment Plant. Depending on flood intensity, this berm could prevent Willamette River flood water from entering the Foothills District from the park.

Berm construction would require a grading permit and an amendment to the Development Review Permit for Foothills Park. The permit would also have to address the City's Greenway criteria.

Advantages -

- Berm construction would provide some degree of physical flood protection to the Foothills District.
- The construction of an earthen berm would be a relatively simple project that would match the existing grade elevations of Foothills Park.
- Placement of fill in this area could meet Title 3 requirements and Lake Oswego Flood Management Area standards by using a portion of the "cut credit" that was established during the construction of Foothills Park. Berms and levees for flood protection are permitted uses in the City's Flood Management Area overlay zone.

[1] Flood data reported in the flood maps adopted June 6, 2008 report all of their data in North American Vertical Datum (NAVD 1988). Flood elevations reported in the 1987 Flood Insurance Rate Maps are reported in National Geodetic Vertical Datum (NGVD 29). Adding a factor of 3.5 feet converts NGVD 29 to NAVD 1988.

- Permitting for this construction would be relatively simple and would require a grading permit and an amendment to the Development Review approval for Foothills Park.

Disadvantages -

- Given construction methods for the existing park improvements, it is unlikely that a new earthen berm would be certified through FEMA as a flood control levy.
- Any development behind the berm would remain in the floodplain and would continue to be subject to regulations that require flood proofing for commercial structures. For residential structures, the habitable space would need to be elevated at least one foot above the base flood elevation (100-year floodplain).
- Flood storage would be displaced to other areas along the Willamette River floodplain.

Option 2 - Construct a Levee to Eliminate Floodplain Requirements

Construction of a FEMA certified levee would allow a change in the Flood Insurance Rate Map designation for the Foothills area and would allow for a map change that would take the area out of the City's Flood Management area.

Prior to construction of a levee, a *diking district* would need to be formed (per ORS 551.010-551.180) through the cooperation of local property owners. Diking districts must be approved by the County Commissioners. After formation of the district, a levee could be designed and constructed to meet Federal Army Corps of Engineer Standards and certified under FEMA standards.

Levee construction would need to meet Federal requirements found under 44 CFR Ch1 65.10. For a levee to be recognized by FEMA, evidence must be provided to demonstrate that adequate design and operation systems are in place to provide reasonable protection from the base flood. Operation and maintenance plans must also be provided. Levee systems must be maintained in accordance with an officially adopted maintenance plan and a copy of this plan must be provided to FEMA by the owner of the levee system.

Embankment design for levees requires detailed analysis. The US Army Corps of Engineers Design Manual (EM 1110-2-1913) uses a risk based analysis that directly accounts for hydraulic uncertainties. Deterministic analysis using physical properties of the foundation and embankment materials are used to set the final levee grade to account for settlement, shrinkage, cracking, geologic subsidence and construction tolerances. In the past, Army Corps of Engineers used a freeboard standard (a set height above the base flood) to account for hydraulic geotechnical construction operation and maintenance uncertainties. According to the Army Corps of Engineers, the concept of freeboard to account for these uncertainties is no longer used in the design of levee projects.

Fully compacted levees generally enable the use of steeper slopes than those levees constructed by semi-compacted or hydraulic means. Space limitations in urban areas often dictate narrower levee sections that require special material and proper compaction to obtain a stable section.

Based on a flood elevation of 39.8 feet (rounded to 40 feet) and an existing grade elevation at the top of bank of 30 feet, this could result in a levee that is approximately 10 feet in height,

assuming the levee height was the exact height of the base flood elevation. In reviewing the basic designs provided in the design manual, staff found that the steepest allowed slope of 2:1 could potentially yield a levee that is 10 feet high and 40 feet at the base. A 3:1 slope (the steepest slope that can be conveniently traversed with conventional mowing equipment) would yield a base of 60 feet in width. A slope design of 5:1 to prevent seepage in highly porous soils would require a base of 100 feet. Construction of a seawall is an option that would take up less land area. A seawall would also need to meet Army Corps of Engineers standards.

At present, the raised areas that were incorporated into the design of Foothills Park do not meet FEMA or Army Corps standards for levee construction. It is also believed that the existing berm along Tryon Creek does not meet the federal standards. The berms in these areas would need to be reconstructed as levees and certified by these federal agencies in order for the area to have the floodplain designation removed.

City development review and grading permits would be required for levee construction. The permitting process would need to satisfy Willamette River Greenway requirements. Additional review would be required through FEMA, the Army Corps of Engineers, and if wetland impacts occur, through the Division of State Lands (DSL). National Oceanic and Atmospheric Administration (NOAA) Fisheries and the Oregon Department of Fish and Wildlife (ODFW) would also be contacted to provide input and concurrence on any biological assessment that may be necessary for this option.

Advantages -

- The levee would protect the Foothills District from the base flood.
- Flood insurance costs to property owners could be minimized.
- Street level uses could be permitted on the ground floor instead of requiring elevated residential structures and flood proofed commercial buildings.

Disadvantages -

- The levee may require significant redesign of Foothills Park.
- Levee construction will displace floodwater storage and have some impact on downstream areas.
- Certification of a levee does not guarantee protection from future floods. Flood hazard maps with levees carry a warning that overtopping or failure is possible and that flood insurance and adherence to evacuation procedures are strongly recommended.
- Levee construction to protect the entire Foothills District would be costly. It is unknown whether a levee would require more fill than the 12,450 cubic yard fill "credit" that resulted from the construction of Foothills Park.
- The permitting and construction process will be complex and will require formation of a diking district and a high level of coordination with county, state and federal agencies.

<u>Option 3 – Fill Development Sites in the Floodplain</u>

This option would entail filling sites throughout the Foothills District to raise the existing floodplain elevation (39 feet-NAVD 1988 in most places) to one foot above the 100 year floodplain. The fill would need to be engineered to meet Federal specifications to withstand any

increase in flood velocity. Increased fill in this area would result in floodwater storage being displaced to other areas along the Willamette River.

Approximately 75 percent of the Foothills District is in the 100-year floodplain and the option of filling the entire site would require an extensive amount of outside agency review and coordination. Engineered fill throughout the Foothills District would be costly and would exceed the 12,450 cubic yards of net cut provided when Foothills Park was constructed. Without a corresponding cut within the floodplain, fill within the Foothills District may require an exception to Metro's Title 3 balanced cut and fill policy. Such an exception would be reviewed by the Metro Policy Advisory Committee (MPAC) and the Metro Council. If wetlands are filled, permits would be required through the Army Corps of Engineers and Department of State Lands (DSL) under Section 404 of the Clean Water Act. NOAA Fisheries and the Oregon Department of Fish and Wildlife (ODFW) would also be contacted to provide input and concurrence on any biological assessment for this option. A City grading permit and development review approval would be required. Willamette River Greenway requirements would also need to be met. Fill placement would allow the City to file an application for a FEMA map amendment to remove the Foothills District from the floodplain.

Advantages -

- Additional fill would raise the Foothills District out of the floodplain.
- Flood insurance costs to potential residents and financial lenders that back private development could be minimized or eliminated entirely.
- Fill throughout the Foothills District would provide level topography, optimizing development potential for this area.

Disadvantages -

- Fill in this area would result in the loss of some flood storage capacity and displace floodwater to other locations.
- Unless an exception from Metro's balanced cut and fill policy is granted, fill in the area would require the quantity of fill material to be balanced by a corresponding cut below the base flood level.
- Approval of an exception to Metro's balanced cut and fill policy may not be possible.

<u>Option 4 - Elevate Buildings and Roads</u>

Option 4 focuses on the design of buildings and infrastructure in the Foothills District. This option assumes that streets and sidewalks are rebuilt to one foot above the base flood elevation and abutting buildings are built in a podium style, with parking below, and habitable floors at street level and above. This option would not remove the area from the floodplain but would allow and encourage development that is designed to be free from flood damage at base flood levels.

Fill for building foundations would be minimized by the corresponding cuts necessary to provide the podium level parking below the buildings. Rather than using fill to elevate the roadway, a structurally elevated roadway could be installed with parking spaces under the roadway surface. This would likely include additional cutting that could be credited against fill needed elsewhere in the district.

Minimizing or eliminating fill placement would require review only by the City of Lake Oswego through the development review process. No outside agency review would be required. This option could be combined with Option 1 to provide some additional flood protection.

Advantages -

- Avoids complex permitting and outside agency approvals.
- Maintains flood storage capacity.
- Achieves land use efficiencies by placing parking in areas that are within the floodplain.
- Satisfies balanced cut and fill policies.

Disadvantages -

- Building and street construction costs will be higher due to the need to elevate structures above the base flood elevation.
- Structural support for buildings will need to be designed to withstand flooding.
- Height of individual buildings may need to be adjusted to offset the ground level parking below the street level. Height should be measured from the street rather than from the ground level.
- Most of the buildings and structures will be subject to flood insurance.

Conclusion

This report provides some initial research and ideas about how to make the Foothills area more suitable for redevelopment as a mixed use center. The four options represent a starting point for the discussion of flood protection and development strategies. Each option has advantages and disadvantages. The four options are by no means the only options available but they can help to focus attention on a key problem that must be addressed before the Foothills District can take advantage of its tremendous development potential.

OSWEGO LAKE

One of the key flooding problems for Oswego Lake is the rate at which the Oswego Lake dam can release water. In 1996, the constrained flow through the dam resulted in water backing up and overflowing the lake at Lakewood Bay, in the vicinity of the dam, and through the Bay Roc Apartment property. Three concepts for reducing flood damage around the lake include:

- Improving the outlet capacity of the Oswego Lake Dam;
- Protecting Lakewood Bay at North Shore Road; and
- Managing lake water level/dredging the lake.

Improving the Outlet Capacity of the Oswego Lake Dam

According to a 2003 study by Pacific Water Resources, the most effective flood protection strategy for the City would involve improvements to the Oswego Lake dam to increase the outlet capacity. With the planned draw down of the lake in the fall of 2009 through the spring of 2010 to replace the lake sewer interceptor, there will be an opportunity to modify the dam and increase

flows. As a part of the repairs following the February 1996 flood, a 48-inch steel outlet and bifurcation valve was added to the existing 60 inch hydropower flume leading from the dam. It is normally bolted closed, but is opened when needed to provide additional capacity to drain the lake or to allow spilling of flood flows. The study also concluded that improvements to the spillway performance at the Oswego Lake Dam would include significantly changing (or removing) the existing wooden deck on private property above the overflow weir.

The Lake Oswego Corporation is currently evaluating options for substantially increasing the cross sectional area of the dam spillway so they can pass flood water without allowing the lake to surcharge and spill into adjacent areas such as State Street and Foothills Road under certain flooding conditions. An option includes enlargement of the spillway by notching or saw cutting and construction of a modern hydraulic gate structure on the top to allow full regulation of the water surface level during all seasons of the year. With these improvements to the dam, the Corporation would be able to eliminate the majority of the inundation areas caused by lake surcharging as shown on the new FEMA maps.

The Lake Oswego Corporation's feasibility study will also address the structural integrity of the dam which was built in 1921.

Advantages -

- Reduces flood elevations on the lake.
- Improves ability to pass flood flow through the lake without impacting property owners.
- Relatively low cost.
- Allows for seismic improvements.
- Allows for Federal Energy Regulatory Commission (FERC) relicensing.

Disadvantages -

- Little benefit to canal properties.
- Flood control structures must be controlled by the City in order for changes to the Flood Insurance Rate Maps to occur. The representative from FEMA stated that the City would need to be responsible for managing outlet flows for flood control.
- Minor impacts downstream.

<u>Protecting Lakewood Bay at North Shore Road</u>

Lakewood Bay can be easily protected from flooding by blocking inflow from the main lake at the opening under the North Shore Road Bridge with a slide gate or other means. The 2003 study performed by Pacific Water Resources concluded that blocking the Lakewood Bay inflow in conjunction with the operation of the 48-inch bifurcation at the Oswego Lake Dam would result in a projected lake water level rise of 0.14 feet (less than two inches). Other areas would not be affected, as the Willamette River is downstream of the system and the Oswego Canal and the Tualatin River are upstream of backwater effects from lake flooding.

Advantages -

- Low cost means of providing adequate flood protection for properties along Lakewood Bay.

- Ensures that State Street, which is a critical emergency response route, remains open and accessible during a major flood event.

Disadvantages -

- Minor fiscal impacts associated with maintaining the future North Shore floodgate.
- Slight increase of surface elevation (approximately 2 inches) on the main lake.

Managing Lake Water Level/Dredging the Lake

Under this concept, the lake would be dredged to increase the volume of water that would be held in the lake. Prior to peak flooding on the Tualatin River, the lake would be drained to provide flood storage capacity. Managing lake water levels provides some flood mitigation, but the overall capacity of the lake limits effectiveness. Generally, flows into the lake would be quickly absorbed.

Advantages -

- Provides some flood storage capacity.
- Dredging may provide other water quality benefits.

Disadvantages -

- Limited effectiveness.
- Dredging offers little benefit unless lake can be drawn down below the level of the dredging.
- High cost for the flood mitigation benefit.
- Difficulty in finding sites to dispose of dredge spoils.

Other Concepts

A variety of flood mitigation concepts have been suggested in the past but they generally have significant problems due to increases in flood levels in nearby jurisdictions. Implementation of these concepts is highly unlikely given that they would require agreement from other jurisdictions and agencies. The following concepts were evaluated in the 2003 Pacific Water Resources study and found to be unworkable:

- Increase the Tualatin River carrying capacity by removing the downstream dam;
- Increase the floodway capacity by dredging the Oswego Canal; and
- Raise the canal headgate and build a levee at Childs Road.

Conclusion

The 2003 Pacific Water Resources study concluded that improvements to the spillway performance at the Oswego Lake Dam will be the most effective flood management strategy during major flood events. With the planned draw down of the lake in the fall of 2009 through the spring of 2010 to replace the lake sewer interceptor, there will be an opportunity to modify the dam and increase flows.