

# CITY *of* SULTAN

## Comprehensive Flood Hazard Management Plan

### Chapters 3 and 4 (continued from chapters 1 and 2...)

*[Note: All figures and illustrations referred to are listed separately, due to size of the file.]*

### **3.0 PREVENTATIVE MEASURES –REGULATIONS AND STANDARDS**

Preventive activities help minimize flood damage by limiting the use and development of flood-prone areas. These regulations may exist through planning, land acquisition, or regulation. Sultan enforces protection of flood-prone areas through City adopted ordinances. The following sections define measures applied by the City to minimize flood damage. The adopted ordinances are briefly discussed in the following text.

#### **Planning**

- ***Zoning Districts (SMC 16.02)***. Sultan is divided into 6 zoning districts. They are as follows: low/moderate density; moderate density; high density; urban center zone; highway oriented development zone; and economic development zone. Low-density zoning reduces the potential for flood damage by reducing the amount of development in the floodplain. The City of Sultan has several low/moderate density zoning areas within the flood hazard area. However, the Building and Zoning Official calculates that more than one structure per acre is permitted under the zoning regulations.
- ***Permitted Uses and Tables of Dimensional and Density Requirements (S.M.C. 16.12)***. Establishes the maximum lot coverage for each zoning district. A low density requirement reduces development in the floodplain and subsequent flood damage during flooding events.

*Figure 6: Critical Areas*

- ***Fish & Wildlife Habitat (SMC 16.10.090)***. The streams within the area are vital habitat for numerous species of game fish and wildlife. Fish and wildlife habitats are aspects of the physical environment that affect the productivity of fish and wildlife. Streams and wetlands are those that are affected the most by floodwaters and flood control projects. Sultan has adopted this ordinance to protect and preserve the fish and wildlife in the area. Riparian wildlife habitat is usually located within the 100-year floodplain limits, which serve as storage for floodwaters. Protecting these lands for wildlife habitat ensures that floodplain storage will be maintained in the future.
- ***Stream and Wetland Areas (SMC 16.10.080)***. Sultan adopted an ordinance designed to promote regulation of development activity in designated wetland and stream areas. The objectives are to protect human life and health, generate public interest in the conservation and wise use of our lands, and secure the long-term conservation of resource lands. Riparian wetlands intercept storm runoff and store floodwaters, changing sharp runoff peaks to slower discharges over longer periods of time. Because flooding, floodplains, and wetlands are associated, decisions about flood control management will have an effect on wetland management decisions.
- ***Shoreline Management (SMC 16.10.120)***. Sultan has also adopted Snohomish County's Shoreline Management Master Program. This program consists of a comprehensive set of shoreline goals and general development policies. These goals and policies are reflective of the level of achievement believed to be intrinsically desirable for all shoreline uses, resources, needs, and development which includes flood protection.
- ***Vegetative Protection Standards (SMC 16.10.070)***. Minimum standards for the protection of natural plant communities, and the installation and maintenance of landscaping to preserve water and environmental quality, improve aesthetics, maintain valuable flood storage areas, limit development in the floodplain, maintain and increase the value of land, land clearing/vegetative protection and preservation.

### **Open Space Preservation**

- ***Parks***. Within the Sultan city limits along the eastern area of the Sultan River, four local parks (Riverside, Osprey, Sportsman, and Rudolf Reese) are preserved as open space. To keep these flood-prone areas free from development and should therefore be recognized as a regulatory activity. These areas are protected by deed restrictions and exist in a natural state to protect natural and beneficial floodplain functions. SMC 11.72.040 Recreation Design Requirement requires 75 square feet of recreation area be set-aside in each development.

- ***Residential and Commercial Property.*** Sultan has approved an ordinance that 5% of total area (not including detention ponds) must remain open space. Much of this open space will be in the riparian zone to limit development in the floodplain and reduce potential flood damage.

### **Floodplain Protection Standards**

- ***Flood Hazard Reduction (SMC 17.08.110).*** Provisions for new construction or substantial improvements to residential, nonresidential, elevated buildings, and floodways. New developments must have structures up to 100-year flood elevation. Sultan uses the Washington State Department of Ecology guidelines to prevent encroachments in floodways and is identified in the Sultan Municipal Code 17.08.110 B (5). Preventing encroachments that decrease the flood carrying capacity of flood plains, increase flood heights, or otherwise aggravate flood problems. This Municipal Code identifies regulations for development or redevelopment within the flood hazard area in relation to planning and zoning and flood plain requirements.
- ***Floodplain Protection Standards (SMC 16.10.130).*** Standards designed to protect human life and health; minimize public costs and development in flood prone areas.

### **Stormwater Management**

- ***Stormwater Management Performance Standards (SMC 16.10.110).*** The City of Sultan has adopted Washington State Department of Ecology's 1998 Stormwater Management Manual. Sultan developed a Comprehensive Storm Sewer Plan dated December 1980 to regulate the stormwater and sewer to accommodate future development and improvements. The intent of the stormwater management performance standards, as it relates to flood reduction, is to perpetuate groundwater recharge (reduce surface runoff), to encourage the protection of natural systems and the use of them in ways which do not impair their beneficial functioning, and to prevent significant loss of life and property due to flooding. The City promotes infiltration, where appropriate, as a means of stormwater disposal.

The City is currently updating their Stormwater Master Plan. As part of this effort, a stormwater utility is being recommended with a rate structure that would support the City's annual stormwater management needs. **Part of the fees collected could be used toward flood reduction projects.**

Also, as part of the Stormwater Management Performance Standards, Sultan has adopted an ordinance that prohibits dumping in the community's drainage system. This ordinance is publicized using signs at numerous locations throughout the City. The official responsible for monitoring compliance, complaints, and enforcement is the Sultan Building and Zoning Official.

- ***Erosion and Sedimentation Control.*** Erosion and sedimentation control regulations are adopted under Ecology's Stormwater Management Manual. These regulations are provided to minimize erosion from land because of construction or farming activities.

### **Drainage System Maintenance**

- Sultan has implemented an annual drainage system inspection that includes channel and basin debris removal of all natural and human-made watercourses, conduits, and storage basins to prevent flood damage to buildings from smaller more frequent storms. The City has implemented the removal aspect of the channel and basin debris removal process; a field logbook is kept to document the procedure.
- Other inspections are conducted based on a citizen's complaint or after each storm that may adversely effect or affect the drainage system. Based on the inspection, any damage to the drainage system that may require physical maintenance is documented and repaired as soon as possible.
- Sultan plans to adopt a capital improvement program that would allow the elimination or correction of problem drainage sites. Currently, the standard practice for the City is to modify the drainage system (such as culverts, etc.) when streets are added or improved.

## **4.0 FLOOD MITIGATION APPROACHES**

Federal guidelines and the NFIP-CRS Coordinator's Manual discuss strategies on how to reduce flood loss damages. There are several ways to reduce flood losses and protect the natural values of the flood plain. Three general approaches to reduce flood damage are to:

- *Modify the susceptibility to damages from flooding* by making developments in the flood hazard area more resistant to damage. This may be accomplished by using flood plain regulations, development and redevelopment, warning and preparedness, and floodproofing.
- *Modify the flood in order to keep flood waters away from developments* by decreasing runoff, increasing channel capacity, or by containing, diverting, or storing floodwaters. Modifying the flood can be accomplished by using dams and reservoirs, levees and walls, channel alterations, land treatment, and onsite detention.

- *Modify the financial impact of flooding* by providing insurance and post-flood insurance for relief and recovery.

#### **4.1 PROPERTY PROTECTION ACTIVITIES – NON STRUCTURAL FLOOD REDUCTION MEASURES**

Floodplain management in the past several years has shifted its focus. Traditional floodplain management often has stressed structural alterations to the natural environment as the best means of protecting property and human lives. In recent years, however, there has been a shift away from this tradition, toward considering non-structural alternatives as effective floodplain management strategies.

Property protection activities are reviewed on a building by building basis, at the owners request or/and at building permit application. Specific activities that are part of the City’s flood damage reduction strategy include acquisition and demolition, relocation, floodproofing, and flood insurance.

##### **Acquisition/Demolition/Relocation**

The City can purchase property within the floodplain for the purpose of demolition or relocation. Often this is the most cost-effective solution in reducing flood damages over a period of time. Additionally, acquisition and demolition usually dovetail with environmental protection measures in the form of increased open space, particularly in and around riparian habitat areas. Following are examples of the City’s commitment to reducing flood damages.

- The City has purchased at the cost of \$207,327 the pre-FIRM building and property located at 319 Main Street (tax parcel number 5888-006-005-0305 and 5888-006-007-0006). This building was demolished and the new community center has been built on this site. This building meets the existing Floodplain Protection Standards Requirements as outlined in the City of Sultan Unified Development Code, Title 16 Section 16.10.130 6., Provisions for Flood Hazard Reduction. Total acquisition and demolition cost to the City was \$235,445.
- The pre-FIRM building and property at 201 Alder (tax parcel number 5888-009-0001-0006, all of Lot 7 and the remaining fraction of Lot 8) has been purchased at a cost of \$92,875. The building has been demolished and the property has been recorded as open space. The acquisition and demolition of this property was funded through a Hazard Mitigation Grant Program (through the State of Washington Emergency Management Division). The total cost to the City was \$98,706.
- The remaining six lots (Lots 1-6 of tax parcel number 5888-009-0001-0006) have been purchased using the City’s General Fund. This property is an addition to the existing River Park. Total acquisition cost to the City was \$112,596.
- The pre-FIRM. building and property at 708 Fir Avenue (tax parcel number 588-007-012-0106) was condemned and demolished. Any new structures built on this

site will meet the provisions for Flood Hazard Reduction outlined in Sultan Municipal Code 16.100. The total cost to the City was \$37,792.

- The City has purchased Government Lot 6, Tract 999 (tax parcel number 7656-000-999-0005). This is a 35-acre extension to Osprey Park. This property is to be maintained in its natural state. The total cost to the City was \$55,846.
- The City has purchased Government Lot 11, (tax parcel number 312808-4-002-0003). This is a 15-acre extension to Rudolph Reese Park and is also to be retained in its natural state. The total cost to the City was \$139,905.

The City intends to continue purchasing properties within the repetitive flood loss areas, as funds become available.

### **Building Elevation and Floodproofing**

National Flood Insurance Program (NFIP) regulations require that structures be elevated or floodproofed (non-residential structures only) to provide protection from flood damage. However, these methods to correct the problems mentioned above, can be costly, as a retrofit to an existing building. Floodproofing techniques can modify buildings, their sites, or their contents. They can keep water out or reduce the damage caused by water entry. Floodproofing can be generally inexpensive however if incorporated into new construction. The most common floodproofing measure is raising the elevation of the site with earth fill, above the BFE. Existing flood damage reduction ordinances require that new residential construction and substantial improvements within the 100-year flood plain be elevated to the BFE.

Floodproofing an existing structure, however, is often difficult and costly depending on the type of construction, as well as its location in relation to adjoining buildings, streets, sidewalks, etc. Structures with walls and foundations that are generally impermeable can sometimes be made almost completely watertight by permanently blocking unused doorways and windows. Temporary watertight covers can be installed over the remaining openings during flooding. Structures can be raised on columns or walls, and the original foundation extended upward with walls or piers. Other measures include floodwalls or flood barriers that can be used to protect buildings or groups of properties.

As stated in the Sultan Municipal Code 17.08.110 (B) Specific Standards:

In all areas of special flood hazard where base flood elevation data have been provided, the following provisions are required:

- Non-Residential new construction or substantial improvement of any commercial, industrial, or nonresidential structure shall have the lowest floor, including basement, elevated no lower than the level of the base flood elevation.
  - (a) *Floodproofing.* Nonresidential structures located in all areas designated a zone “A” (i.e., areas of special flood hazard) may be

floodproofed in lieu of being elevated, provided that all areas of the structure, together with attendant utility and sanitary facilities, below the required elevation are watertight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effect of buoyancy. A professional engineer or architect registered in the state of Washington shall certify that these standards are satisfied. Such certification shall be provided to the building and zoning official.

(b) *Applicants*. Floodproofing nonresidential buildings shall be notified that flood insurance premiums will be based on rates that are one foot below the floodproofed level (e.g., a building floodproofed to the base level will be rated as one foot below).

- Sultan Municipal Code 17.08.110 B Specific Standards. In all areas of special flood hazard where base flood elevation data have been provided, the following provisions are required:

(3) *Elevated Buildings*. New Construction or substantial improvements of elevated buildings that include fully enclosed areas formed by foundation and other exterior walls below the base flood elevation shall be designed to preclude finished living space and designed to allow for entry and exit of floodwaters to automatically equalize hydrostatic flood forces on exterior walls.

After the 1995 flood, Sultan passed a temporary ordinance for flood damage property owners that would allow the owners to receive a free building permit as long as their structure is elevated to the BFE. This ordinance required elevation certificates and/or floodproof certificates.

## **Flood Insurance**

Flood insurance is a protection measure that can significantly reduce flood damage. Flood insurance is not required unless an individual requests a loan on a property within the floodplain. If a lending institution is federally regulated or making federally-backed loans, it must review the FIRM maps to determine if the building is located in a Special Flood Hazard Area. The SFHA is the area that is expected to be inundated by a 1% annual chance flood. If the bank makes such a determination, it must require the borrower to purchase flood insurance.

In Sultan, there are approximately 490 habitable structures in the floodplain. Of these, 227 are covered by flood insurance. Total annual premium is approximately \$113,000 with a total coverage of approximately \$26 million.

The City notifies the residents of Sultan through flyers that flood insurance is available even for those who do not live in the FEMA defined floodplain and even if their structure has been flooded in the past. These flyers are sent out biannually. The City will continue

to encourage residents to purchase flood insurance through flyers and other similar means.

## **4.2 NATURAL RESOURCE PROTECTION**

Activities that preserve or restore natural areas or the natural functions of floodplains are adopted in the City of Sultan Municipal Code. Pertinent sections found in Title 16 Unified Development Code (U.D.C.) include:

- Section 16.68, Hillside Development and Geologically Hazardous Area Performance Standards.
- Section 16.72, Recreational and Open Space Standards.
- Section 16.76, Vegetation Protection Standards.
- Section 16.80, Streams and Wetlands.
- Section 16.84, Fish and Wildlife Habitat.
- Section 16.88, Wellfield/Groundwater Protection Regulations.
- Section 16.92, Stormwater Management Performance Standards.
- Section 16.96, Shoreline Management.
- Chapter 16.12, Tables of Dimensional and Density Requirements. Note: *Maximum lot coverage.*

Fish and wildlife habitats are situated primarily on the west side of the City just east of the Sultan River and to a lesser degree on the north side of the City.

Sultan Municipal Code 17.08.110 A (7) and (8) state that on-site waste disposal systems (septic tanks) shall be located and constructed to avoid impairment to them or contamination from them during flooding.

Recent improvements by the City include raising the pump station elevation and wastewater treatment plant to protect from the 100-year flood, preserving water quality by eliminating the discharge of raw wastewater.

## **4.3 PUBLIC INFORMATION**

Providing awareness and access to information within the community is a means for protecting health, safety and property from flooding. Following are examples of measures that the City has implemented to help protect human health, safety, and property.

## **Map Information**

The City currently provides FIRM maps to developers and engineers working on large projects if the site is in or near a floodplain. Also, FISs and FIRM Maps are kept at City Hall for public use.

## **Outreach Projects**

Sultan sends out semi annual notices (flyers) regarding the hazards of floods and the importance of flood insurance to the citizens residing in the City. See Appendix C for an example.

## **Real Estate Disclosure**

Notification to potential property buyers that they are purchasing property in a known flood hazard area.

## **Library**

All flood regulations, associated documents, and flood maps are kept at the Sultan Public Library for public use.

## **Technical Assistance**

City of Sultan provides technical assistance for the citizens. City representatives make site visits on request for citizens to observe flood concerns in relation to structures, BFE calculations, and regulations. This includes assistance with LOMA's, LOMR-F, zone determinations, and elevation and floodproof certificates.

## **4.4 EMERGENCY SERVICES**

The City Council identified public awareness and safety as important tools for residents in the floodplain in determining what actions may be necessary in case of a flood. Measures taken during a flood to minimize the impact of each flood were reviewed with the Building and Zoning Official. The goal of this plan in reducing flood hazards is to save lives and reduce exposure to risk. Snohomish County's emergency services program has been integrated as part of Sultan's emergency services program.

### **Flood Warning**

The City of Sultan is reviewing the possibility of installing stream flow gages on the Sultan River to monitor river levels. Snohomish County Surface Water Management (SCSWM) is currently installing stream flow gages (telemetry) for the City of Index and has stated that the County would seriously consider installing similar telemetry gages at strategic locations along the Sultan River for the City (verbal information from Vaughn Collins, SCSWD).

The stream flow gauge(s) would require an automatic system that would provide some warning to the residents. A manual system would require volunteer gauge readers to report the readings to the Emergency Operations Center but may be a cost-effective solution.

The flood warning system is transmitted out for the use of floodplain residents and businesses. This part of the floodplain warning system uses a variety of ways to inform residents. Currently, the Emergency Broadcast System and up-to-date recorded message line and call in lines at Emergency Management are the primary ways information is made available. Door-to-door contacts, mobile sirens and public address systems are other means currently available.

Flood awareness information is provided to the floodplain residents (especially new residents) to warn of potential flood damages and possible solutions. This information is presented through brochures, news articles, and neighborhood flood audits by government agencies, and by providing assistance for individuals to develop flood evacuation plans. An example is provided on the last page of the *Sultan News*, found in Appendix C.

### **Flood Preparedness and Response**

The City currently distributes flood preparedness and response information through their biannual newsletter. An example newsletter can be found in Appendix C. A specific and comprehensive plan however does not exist. The city would benefit by developing and distributing a flood preparedness and evacuation plan for its residents.

The City supplies the residents and business property owners with the equipment to generate sandbags for their use. The sandbag equipment is located in the warehouse at City Hall on First Street behind the main building.

### **Critical Facilities Protection**

SMC 17.08.140 states that construction of new critical facilities shall be to the extent possible located outside the SFHA (100-year floodplain). If no feasible alternative site is available then construction of new critical facilities will be permissible in the SFHA. Critical facilities constructed within the SFHA shall have the lowest floor elevation three feet or greater above the BFE at the site.

## **4.5 FLOODPLAIN MAP REVISION**

The City recently purchased new base mapping, providing for more detailed accurate topographic information. The existing FIRM maps were developed in the late 1970s where topography maps (5' contour intervals) were not as accurate as the recent topographic mapping (2' contours). Therefore floodplain boundaries shown on the FIRM maps can be inaccurate. In fact, topography maps can be in error as much as half of a contour interval. If this is the case, then the Sultan FIRM map can be off by as much as 2.5 feet.

Using the new topographic mapping, the City has the option to request a Physical Map Revision from FEMA. This would update the floodplain and floodway boundaries using the new mapping and potentially reduce the burden of flood insurance for many City residents. See **Figure 7** for a comparison of existing and improved floodplain boundaries. The requirements for a Physical Map Revision are specified in Form 5 of

FEMA's 'Revisions to National Flood Insurance Program Maps', which is found in Appendix D.

Mentioned earlier, economic benefit to the community could be seen in the form of flood insurance premium reduction. There are currently 490 habitable structures in the floodplain. Of these, 227 are covered under flood insurance policies. This translates to an annual premium of \$113,420, or an average individual premium of approximately \$500. Revising the floodplain boundary to reflect the new mapping would effectively remove 93 homes from the floodplain, saving \$46,500 annually. This translates to a savings of approximately \$1 million over a period of 20 years (present value).

Funding for a map revision could be made possible with help from the Cooperating Technical Partners (CTP) initiative. In an effort to modernize floodplain mapping throughout the country, FEMA developed and implemented the CTP initiative to increase local involvement in, and ownership of, the flood mapping process. This initiative allows communities to enter into a partnership with FEMA to modernize their floodplain mapping. FEMA can fund up to a 100% of certain tasks and provide technical assistance with others. Washington agencies and communities currently entered into a partnership with FEMA are Pierce County, Whatcom County, King County, Washington Department of Ecology, and the City of Issaquah. Larry Basisch with FEMA Region X is the local CTP representative.

Before a physical map revision could occur, the City would have to purchase updated topography maps for the very western portion of the City, which would extend to the Sultan River. It is recommended that the City purchase this mapping to cover the entire City and associated floodplain.

#### **4.6 ADOPTION INTO THE CRS PROGRAM**

The NFIP's Community Rating System (CRS) recognizes community efforts beyond those minimum standards by reducing flood insurance premiums for the community's property owners. The CRS is similar to – but separate from- the private insurance industry's programs that grade communities on the effectiveness of their fire suppression and building code enforcement. CRS discounts on flood insurance premiums range from 5% to 45%. Those discounts provide an incentive for new flood protection activities that can help save lives and property in the event of a flood.

The City is currently working on an application, with the Insurance Service Office (ISO), to document floodplain management activities. These activities are used to determine credit for discounts on flood insurance premiums. The development of this plan is a requirement for acceptance into the CRS program.

#### **4.7 STRUCTURAL APPROACHES**

Although non-structural methods used in floodplain management have become more commonplace, structural mitigation measures are sometimes the best and only option. The following are examples of structural measures that would reduce flood damages in Sultan.

## Channel Modifications

Stream channel morphology has a direct effect on the type of flooding, frequency of flooding, and the capacity for sediment transport. Sediment transport characteristics for a given stream must be considered when designing flood control, drainage, or bank stabilization projects. Channel modifications reduce flooding by increasing the river storage/flow capacity and subsequently may support increases in peak discharges on the Sultan and Skykomish Rivers during the heavy rainfall and snowmelt seasons. A notice to FEMA and Ecology will be required to modify river channels. The various modification types include straightening to increase gradient, deepening or widening, removing debris, paving to reduce friction, and enlarging bridges and culverts that may restrict flow. Three potential areas of interest for channel modifications are:

- ***Sultan River.*** Sediment deposition at the confluence of the Sultan and Skykomish Rivers over the years has raised the bank elevation under the U.S. Highway 2 bridge and therefore reduced the river channel width. This river width reduction, in conjunction with the moderate decline in 100-year flood elevation downstream of the bridge, creates a backwater flood profile that significantly affects flooding in the City of Sultan. Further review of the area indicates the east bank of the river under the U.S. Highway 2 bridge could be modified to extend the river width and thus allow an increase in hydraulic flow area, resulting in lower flood elevations upstream of the Bridge.
- ***Skykomish River.*** As discussed in Section 2.1, the elimination of overflow channels on the Skykomish River on the south side near the Fifth Street bridge overpass (including Shinglebolt Slough) has promulgated the deposition of sand and gravel in the former overflow channel area. One approach to help remedy the flooding problems would be to increase the flow area of the Skykomish River by mining the sand and gravel (bar scalping) in the overflow channels. These streambed improvements could yield both salmonid habitat and a flood control option. The condition of the slough would require monitoring and documentation by a fish biologist on a regular, defined schedule. Should the monitoring indicate the necessity for maintenance of the slough grades, such work would be performed by the property owner as a priority operation on the site.

Similar proposals in the past however have been unsuccessful. Requests to mine a gravel bar on the banks of the Skykomish River at Sultan were rejected by the Department of Fish and Wildlife. Reasons for their rejection of the proposal are based on a previous Skykomish system sediment transport / gravel harvest study conducted by Snohomish County Surface Water Management Division and Thomas Dunne. Reasons provided in the report are as follows:

1. Large numbers of Salmon spawn in this reach.
2. The Sultan to Monroe reach is a gravel transport zone in a state of equilibrium.

3. There was more gravel in this reach in the '30s than now, and there was some channel down-cutting after the '90 flood events.
4. The dam on the Sultan River has reduced the amount of gravel recruitment over historic amounts by up to 20%.
5. Extensive bar scalping would change this reach into an erosional reach and bed degradation could proceed rapidly.
6. No extensive bars exist here currently and mining could quickly deplete the beds that do exist.
7. Dunne estimated an annual bed-load movement at Monroe of 21,000 cubic yards. He suggested an annual harvest could be conducted, preferable near the mouth of the Skykomish River, or 12,000 cubic yards without an adverse impact.
8. Dunne stated that gravel mining in multiple locations on a river ultimately compete for the same gravel, with upstream mining starving the gravel bars downstream. He also noted that mining was (and presently still is) being conducted in the lower Skykomish to an extent that no further annual gravel recruitment is available for harvest.

A Similar study is being performed by the Department of Natural Resources, Rivers Section, to evaluate the effect of gravel accumulation on flooding and to determine the feasibility of gravel removal on the reduction of flood hazards. This study is being coordinated with resource agencies to consider the likely impacts of gravel removal on salmonids, their habitat and use, and to consider possible mitigation approaches. Results of this study are not yet available, however it is recommended that the results be evaluated before eliminating this as an option.

- ***Use Former Oxbow Lakes on the Sultan River.*** Several former oxbow lakes are located on the Sultan River. Restoration of the former oxbow lakes would allow for the increased storage capacity of the Sultan River during peak discharge periods. This mitigation approach may be a cost-effective solution to reduce flood loss damage. Often the flooding in the City of Sultan has been from backwater from the Skykomish overtopping the banks of the Sultan River just upstream of the confluence. Creating additional storage in the upstream portions of the Sultan River may provide no benefit during these times when the flooding is controlled by the Skykomish River.

### **Manmade Barriers**

Two potential locations for permanent barriers that have been reviewed include:

- ***Raising First Street*** to an elevation three feet above the BFE as required by the U.S. Corps of Engineers (Corps) from Date Street to U.S. Route 2 that

would provide a barrier between the source of the flooding problem and the repetitive loss areas. Currently the elevation of First Street ranges between one and four feet below the BFE for the site. That means the road would have to be raised between four and seven feet to comply with the Corps requirements. This option would be very difficult to accomplish given the close proximity of the existing structures to the road and the necessary height and slope needed to comply. It may be feasible however to raise first street upon the next street overlay to provide some flooding relief, even if it doesn't meet the Corps' requirements for flood protection. The downtown area could benefit from this alternative because most downtown flooding occur when the banks of the Sultan River (just west of First Street) are overtopped, with floodwaters rising into the downtown area. First Street would become a barrier to these flood flows and protect against flooding events smaller than the 100-year.

- ***Flood Barriers/Floodwalls*** - Flood barriers and floodwalls confine floodwaters to the stream and a selected portion of the floodplain. These options reduce a wide range of flood losses with some flexibility to protect specific areas. Construction of a flood barrier, including a setback levee or a floodwall, was reviewed as a possible structural measure for keeping floodwaters away from homes and buildings. Installing a flood control wall or levee starting at a point just north of Date Street and 300 feet west of First Street, and extending south to SR-2 would prevent floodwaters from entering the downtown area. The wall or levee would be nearly 2,000 feet long and average 8-9 feet in height. See **Figure 8** for general location. Costs, benefits and impacts are described in Section 5.

## **Reservoirs**

Reservoirs store flood waters up-stream of flood-prone areas. Excess water is controlled and gradually released after the flood threat has passed. Reservoirs protect an area, rather than specific property, and involve high capital costs.

Culmback Dam is located approximately 23 miles from the confluence of the Sultan and Skykomish Rivers and provides a regulatory effect at low flows and has reduced some flood peaks (*FEMA, Flood Insurance Study, 1999*). Culmback Dam is owned and operated by the City of Everett and Snohomish County.

The FEMA Flood Insurance Study of 1983 for the then Town of Sultan identifies that Culmback Dam provides regulatory effects at low flow but the availability of storage to control large floods is uncertain as a result of limited outlet capacity. However, this 1983 study did not take into account the dam modification and increased storage capacity of Spada Reservoir in 1984. Furthermore, the 1999 FEMA Flood Insurance Study for Snohomish County does not take into account this increased storage capacity for Culmback Dam either.

*[CHAPTERS 5, 6 AND 7 (references) ARE CONTINUED IN NEXT FILE.....]*