

CHAPTER FIVE

Clover Creek Basin

5.1 BASIN CHARACTERISTICS

Clover Creek lies in the Chambers-Clover Creek Watershed. The Chambers-Clover Creek system extends 18.6 miles from its mouth at Puget Sound to the Clover Creek headwaters six miles east of Spanaway. Major creek systems tributary to the main stem of Clover Creek include Morey Creek, Spanaway Creek, and North Fork Clover Creek. Within the Clover Creek Basin are several lakes; the largest of which are Spanaway Lake, Tule Lake, and Lake Steilacoom.

The Clover Creek Basin contains covers 47,400 acres or 74 square miles in portions of unincorporated Pierce County, including the Parkland and Spanaway communities, significant portions of the City of Lakewood, a small portion of the City of Tacoma, and portions of McChord Air Force Base and the Fort Lewis Military Reservation. Urban development is concentrated in the northern and western areas of the basin near freeway and highway corridors. The basin's land cover is a mixture of developed area, agriculture, forest, and other natural cover.

The natural drainage system has been extensively modified over the years, and is augmented by man-made collection systems, including detention facilities, conveyance pipelines, and infiltration facilities. Because of the basin's highly porous soils, most surface runoff in the basin is discharged to the subsurface system, particularly in the western half of the basin (Montgomery 1991).

The climate in the Clover Creek Basin area is typical of the coastal to upland areas of Puget Sound, with average winter temperatures above freezing and summer temperatures generally below 80°F. The basin experiences a frost-free growing season of approximately 250 days per year. The basin typically receives about 38 to 40 inches of precipitation per year, which falls almost exclusively as rain. About two-thirds of the area's annual precipitation falls between October and March. Precipitation falls occasionally as snow, but only in slight amounts and with little or no accumulation.

Because a large portion of the basin is covered by highly permeable gravelly soils derived from glacial outwash, it is estimated that 50% to 60% of area precipitation becomes groundwater recharge.

5.2 LAND USE IN THE CLOVER CREEK BASIN

To assess the hydrological characteristics of a basin and determine the potential for water quality/quantity problems, requires an accurate understanding of a basin's existing and proposed land uses. This section will look at both the existing and future land use of this basin.

5.2.1 Existing Land Use

The Clover Creek Basin is a developing basin with concentrations of urban development to the north and west and along major transportation corridors. The basin includes portions of the Cities of Lakewood and

Tacoma. Unincorporated communities in the basin include Lakeview, Parkland, Midland, Summit, Brookdale, Spanaway, Frederickson, Elk Plain, and north Graham. McChord Air Force Base and the Fort Lewis Military reservation cover a large portion of the southwestern part of the basin.

The northwestern portion of the basin is highly urban in areas near the City of Lakewood. Urban development is focused along the major transportation corridors of the basin, including 112th Avenue East, Canyon Road East, and Pacific Avenue. Beyond these main transportation routes, most land uses within the basin are residential. The density of residential development varies widely.

The central portion of the basin, between Pacific Avenue and Canyon Road, supports the highest level of agricultural activities; mostly in the form of small farms, with concentrations of dense residential development.

Commercial areas are clustered along main thoroughfares such as Pacific Highway, Pacific Avenue (State Route 7), and 112th Street. Significant commercial and industrial developments include the Lakewood Towne Center, Lakewood Industrial Park, and McChord Air Force Base. The junction of I-5 and Highway 512 is a central focus for development in the region. Clover Park Technical College and Pacific Lutheran University are also in the basin. The Boeing Company established a major parts manufacturing complex in the central eastern portion of the basin in the unincorporated community of Frederickson.

Public open space facilities include the Harry Sprinker Recreation Center, Spanaway (Lake) Park, and the Lake Spanaway Golf Course; all operated by the Pierce County Parks and Recreation Department. The Brookdale Golf Club is a private golf course in the central portion of the basin.

A breakdown of the existing land use in the Clover Creek Basin is illustrated in *Table 5-1*.

Existing Land Use	Area (acres)	Percent of Basin
Forest	9,053	21.3%
Grassland	6,804	16.0%
Houses and Grassland (1 unit/2 to 5 acres grassland)	8,382	19.8%
Houses and Forest (1 unit/2 to 5 acres Forrest)	4,846	11.4%
Suburban Development (1 to 4 units per acres)	4,727	11.2%
Medium Development (1 unit per Acres)	4,940	11.7%
High Density Development (Multifamily or >4 units per acre)	1,208	2.9%
Commercial/Industrial/Transportation Facilities	2,061	4.9%
Lakes	392	0.9%
Total	42,413	100%

5.2.2 Future Land Use

The *Pierce County Comprehensive Plan* was developed and adopted in 1994 in response to the requirements of the Washington state “Growth Management Act.” The Comprehensive Plan, codified as *Title 19A* of the Pierce County Code, indicates a general intention to allow development to the basin boundary with residential densities ranging from one unit per 10 acres to six units per acre.

A significant amount of acreage in the Frederickson area has been designated for industrial use. The Pierce County Zoning Ordinance is codified in *Title 18A* of the Pierce County Code. Current zoning indicates that most of the central portions of the Clover Creek basin are to be “Moderate Single-Family,” with densities of about four units per acre. The north central area is zoned “Rural Separator” (2.5 acres per dwelling unit), as a buffer between urban areas.

Much of the southern portion of the basin is under the jurisdiction of the Fort Lewis Military Reservation. The rest of the land is in rural or reserve zoning with low development densities (5 to 10 acres per dwelling unit). The western and northwestern areas are under the jurisdiction of McChord Air Force Base, the City of Lakewood, and the City of Tacoma. The pattern is one of gradual intensification of urban development in the vicinity of urban centers, and gradual intensification and infilling of residential lands in unincorporated areas.

The “Growth Management Act” provides goals and guidelines for development of growth management plans addressing urban growth. This Act mandates consistency between county comprehensive plans and plans of all municipalities in the county. The *Pierce County Comprehensive Plan* provides county-wide policies in cooperation with all cities and towns in the County. These 11 policies are: affordable housing; agricultural lands; economic development; education; historic, archaeological and cultural preservation; natural resources; open space and protection of environmentally sensitive lands; determining site locations for public capital facilities of a county-wide or state-wide nature; transportation facilities and strategies; urban growth areas; and amendments and transition.

The “Growth Management Act” includes the following goals for development:

- **Urban Growth**—Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner.
- **Reduce Sprawl**—Reduce the inappropriate conversion of undeveloped land into sprawling, low-density development

Pierce County has an additional goal of containing urban sprawl by designating an urban/rural boundary, and focusing infrastructure development in proposed employment centers and near cities and towns where a full range of urban services is available.

5.2.3 Community Planning Efforts

Four unincorporated community plan subareas are within the boundaries of the Clover Creek Basin: the Parkland-Spanaway-Midland (PSM) Community Plan Subarea; South Hill Community Plan Subarea; Graham Community Plan Subarea; and the Frederickson Community Plan Subarea.

The City of Lakewood was incorporated in 1996, and a portion of incorporated Lakewood is within the boundaries of the Clover Creek Basin.

The community planning process uses the existing county comprehensive plan as a foundation and allows citizens to make specific recommendations regarding such things as environmental protection, infrastructure development, transportation, housing densities, and land use patterns; all things that can directly affect surface water and groundwater resources.

5.3 FLOOD CHARACTERISTICS

The Clover Creek Basin's natural drainage system consists of Clover Creek and its major tributaries, including North Fork Clover Creek, Spanaway Creek, and Morey Creek, as well as a number of lakes, of which the largest are Spanaway Lake, Tule Lake, and Lake Steilacoom. Current GIS mapping indicates that the total length of Clover Creek and its major tributaries is nearly 20 miles.

Clover Creek suffers from severe winter flooding and from low (often nonexistent) summer flows at certain locations. Available stream flow measurements in Clover Creek near Bridgeport Way (gauge #12090500) indicate an annual mean stream flow of 47.5 cfs.

Recorded monthly mean flows for this site vary from a low of 4.19 cfs in September, to a high of 125 cfs in February. Recorded daily mean flows have ranged from a low of 0 cfs on October 20, 1949 to a high of 532 cfs on February 12, 1951. The highest recent peak flow was 418 cfs on February 9, 1996.

Table 5-2 illustrates flow characteristic in relation to the 100-year floodplain for this basin.

TABLE 5-2 CLOVER CREEK BASIN WATERCOURSE FLOW CHARACTERISTICS						
Watercourse	Modeled Existing Conditions Peak Flow (cfs)					100-Year Water Surface Elevation (feet)
	2-year	10-year	25-year	50-Year	100-Year	
Main Stem/ Reach #1	40	64	77	85	94	N/A
Main Stem/Reach #2	17	26	32	34	38	323.81
Main Stem/Reach #5	13	40	72	100	125	305.80
North Fork/Reach # 13	128	231	294	343	397	305.42
Main Stem/Reach # 15	70	127	161	192	223	298.24
Spanaway/Reach # 20	53	86	102	111	122	N/A
Spanaway/Reach #21	39	65	77	86	94	N/A
Morey/Reach #22	12	18	22	23	25	N/A
Main Stem/Reach # 23	125	223	275	310	347	N/A
Main Stem/Reach #24	132	231	285	322	362	207.44
North Fork/Reach # 73	36	65	83	96	110	N/A
North Fork/Reach #115	99	175	220	263	308	N/A

5.3.1 Known Flood Hazards

Figure 5-1 shows floodplains and wetlands in the Clover Creek Basin. The floodplain boundaries are based upon the most current mapping for Pierce County prepared by the Federal Emergency Management Agency (FEMA). The data is derived from the FEMA *Flood Insurance Rate Maps* (FIRMs).

The “A Zone” represents a 100-year flood hazard area, an area estimated to have a 1% chance of flooding in any given year, or a one-in-100 year chance.

The “X500 Zone” (formerly referred to as “B Zone”) represents the 500-year flood hazard area, an area estimated to have a 0.2% chance of flooding in any given year, or an area with a high risk of flooding that has a small drainage basin (less than one square mile).

5.3.2 Causes of Flooding

Basin-wide flooding and drainage issues are generally regulatory and programmatic issues, with the exception of flooding on Spanaway Creek and the main stem of Clover Creek that appear to have the same cause.

These flooding problems are further characterized as follows:

- **Groundwater or surface water flooding** that occurs with regularity or is expected to occur again in the future in areas not previously mapped as flood hazard areas.
- **Illegal filling and grading in wetlands and floodplains**, or filling and grading in storage areas that are unmapped and unprotected.
- **Decreased channel capacity** in segments of Spanaway Creek and the main stem of Clover Creek due to sedimentation and invasive vegetation, primarily reed canary grass.
- **Ineffective coordination** between community groups and volunteer organizations involved in protecting and enhancing the basin’s natural water resources.
- **Lack of public awareness** of the hazards associated with flooding and steps to take to protect themselves and their property.
- **Reevaluate and prioritize culverts needing replacement** as identified in the 1991 Comprehensive Storm Drainage and Surface Water Management Plan. Also many of these culverts lack trash racks on the upstream sides of culverts which is a concern regarding public safety and ease of maintenance.

5.4 FLOOD HAZARD IMPACTS

Flooding within the Clover Creek basins can have numerous impacts on the on the way of life within this basin, and Pierce County in general.

Under this section, we will assess the vulnerability of the basins, improved property, critical facilities, and assess the impact a flooding on the basin’s population and economy.

5.4.1 Public Safety and Health

There have been historical occurrences of flooding within the Clover Creek basin. However, in comparison to flood events and total damages within other basins within the County, these losses and associated damages are a small percentage of the overall damages within the County.

Since the early 1960's, there have been no reports fatalities immediately caused by flooding within this basin. Since the land uses within this basin are predominantly residential or vacant lands, the potential impact flooding can have on public health and safety within this basin would focus on potential damage to private property and life safety issues dealing with the use of potentially impacted infrastructure.

Potential impacts could be reduced via informing the public of the potential for flood damages within the basin, and refining or establishing procedures for early warning within the basin. There currently is no "real-time" flood threat recognition capability within this basin. However, it should be noted that Pierce County has been able to successfully avoid significant damages within this basin by its field monitoring protocol and physical presence within the basin during events that could cause flooding based on its flood threat recognition capability in the larger watersheds within the County.

Pierce County has experienced substantial growth recently and is expected to support more growth over the next 20 years. From a 1980 population of 485,667, Pierce County grew by 21% to 586,203 in 1990, and then by another 21% to an estimated 707,745 in 2000. The County population is expected to increase another 20%, to 850,483, by 2020.

Population growth in Pierce County has historically spread from city centers outward to rural areas. U.S. Census Bureau figures indicate that in 1920, 23% of Pierce County's population lived in unincorporated areas. By 1990, census data indicated that 57% of the County's population lived in unincorporated areas. During the 1980s, 84% of population growth occurred in unincorporated areas. Incorporation and annexation has shifted some of the County's population from unincorporated areas to new cities (Pierce County 1997).

The estimated 2000 population in the Clover Creek Basin is about 96,000 and represents about 14% of the total County population of 707,745. The population in the Clover Creek Basin is projected to increase by about 19,000, to 115,000, over the next 20 years and is expected to stay in proportion to the overall Pierce County population (Pierce County 1997).

5.4.2 Critical Facilities

Using the parameters to define "Critical Facilities" discussed in Chapter One of this risk assessment, Pierce County Water Programs, coordinating with Pierce County Emergency management has identified the critical facilities listed in *Table 5-3* that could be impacted by flooding within the Clover Creek basin.

The basis for this determination is: physical location within a mapped or known floodplain, known history of flooding, and the lack flood protection to the facility. These are facilities that are considered to be vulnerable and in need of an action(s) to mitigate the impacts of flooding. It should be noted that this list does not include critical "infrastructure".

Since the Pierce County Water Programs Division *Basin Planning Program* has such a strong capital facilities component, it has been assumed that critical infrastructure with vulnerability to flooding within each basin will be adequately addressed through the basin planning problem assessment and action

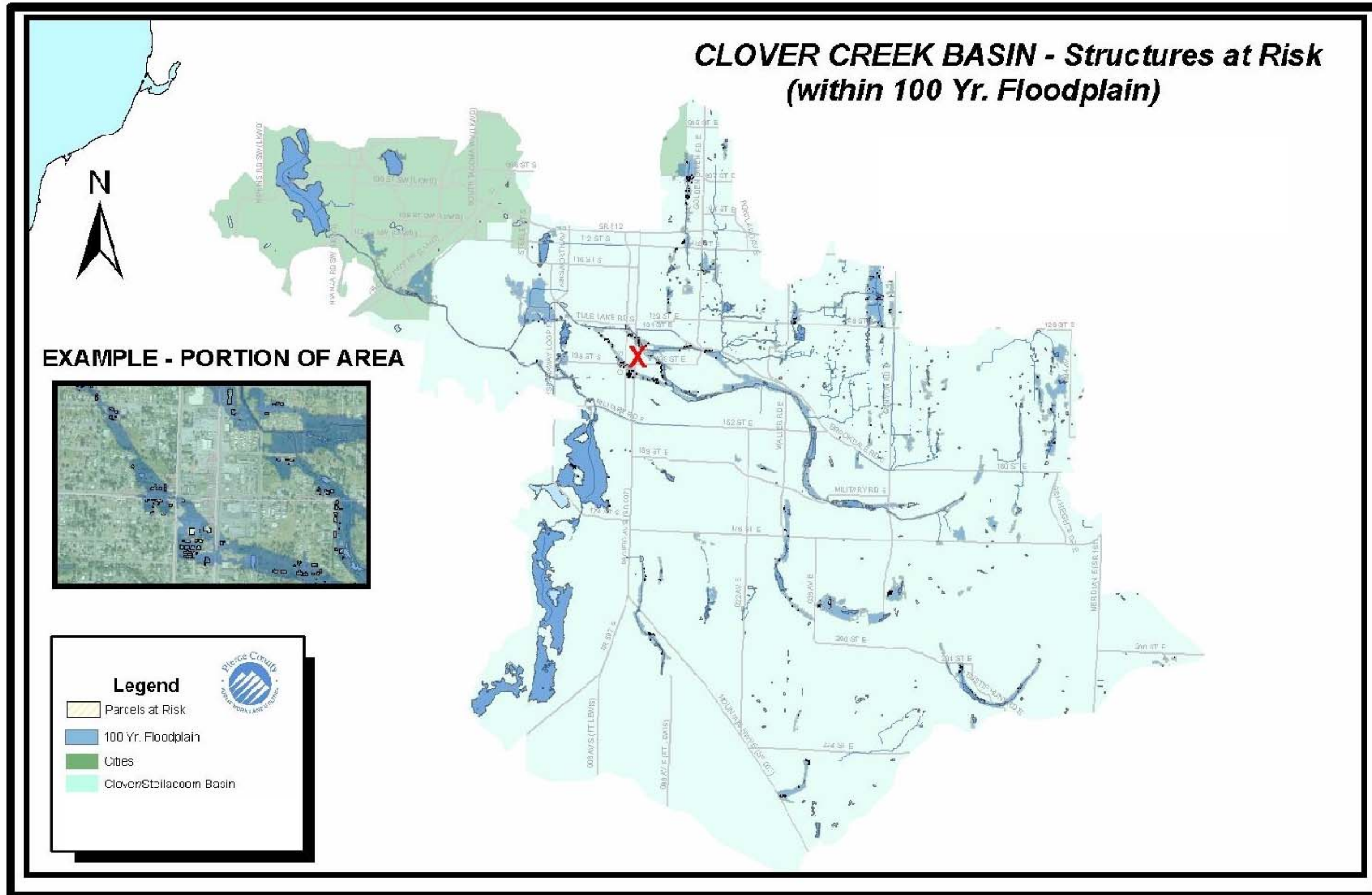


Figure 5-1
Floodplain extent and location
Clover Creek Basin

prioritization process. A detailed assessment of these facilities is not provided in this risk assessment for security purposes.

Pierce County Emergency Management has performed this assessment as part of the County-wide “Hazard Mitigation Plan” prepared pursuant to the “Disaster Mitigation Act.” The County will direct the “non-structural approach” by this plan. The focus of the Basin Planning Program as it pertains to critical facilities will be to attempt to provide flood protection to potentially vulnerable critical facilities through the structural approach identified as actions. Both programs consider it a high priority to provide protection to critical facilities, and are committed to working together to achieve this objective.

TABLE 5-3 CRITICAL FACILITIES IN THE 100-YEAR FLOODPLAIN CLOVER CREEK BASIN					
Medical and Health Services	Government Function	Hazardous Materials	Schools	Other	Total
0	0	0	1	0	1

5.4.3 Structures Impacted

Table 5-4 shows the estimated number of structures on parcels in the floodplain. These estimates were generated using Planimetric data available for this basin.

To identify the potential dollar/loss exposure for the basing, assessed values for improvements to each of the parcels shown to have structures within the 100-year floodplain were accumulated by subbasin. This value is representative of the exposure. To truly gauge vulnerability, the depth of flooding would need to be identified to apply FEMA’s depth/damage functions to this exposure. This detail of information was not available at the time of the preparation of this assessment. However, total exposure values can be a good gauge of potential flood impact for planning purposes and for identifying potential project benefits when prioritizing mitigation actions.

TABLE 5-4 STRUCTURES WITHIN THE 100-YEAR FLOODPLAIN CLOVER CREEK BASIN					
Structure Type				Total	Market Improvement Value
Commercial	Dwelling	Other			
114	977	45		1,136	\$106,310,800

5.4.4 Repetitive Loss Areas

During high-intensity or long-duration rainfall, broad flooding occurs in two areas along Clover Creek: the vicinity of 38th Avenue East and 152nd Street East; and the vicinity of “A” Street/4th Avenue East and 133rd/138th Street East, downstream of the confluence of Clover Creek and the North Fork of Clover Creek.

Five homes have been identified as repetitive loss properties within these two areas. Two of these homes have been mitigated through property acquisition by Pierce County. Surrounding homes are also within the flood hazard area; although no flood insurance claims for them have been filed. Pierce County has estimated that there are approximately 20 properties within the Clover Creek repetitive loss area subject to repetitive flooding.

Flooding in the two repetitive loss areas typically results from overflow of the creek channel during or after large rainfall events, coupled with high flows in the North Fork of Clover Creek. The scale and occurrence of flooding depends on antecedent soil moisture conditions and the duration and depth of the rainfall.

The creek overflows when the combination of backwater, flows from upstream, and runoff from surrounding areas, exceeds the creek's conveyance capacity. The backwater often begins at constrictions in the channel where the creek's capacity is lowest. Water begins to accumulate upstream of these constrictions and propagates upstream as runoff into the creek increases. Flooding problems occur when the creek water elevation exceeds the channel banks and water overflows onto nearby improved property.

Flooding is a natural process, and increasing the channel's capacity to accommodate higher flows could harm many environmental processes (i.e., salmon spawning, etc.) that depend on the existing configuration and the creek/floodplain interaction.

In some locations, artificial constrictions such as bridges and culverts could be improved to alleviate flooding problems and improve habitat. One such constriction is the culvert pipe under Pacific Avenue. However, removing artificial constrictions may also increase flooding in areas downstream of the existing constriction by increasing the peak flows downstream. As a result, removing a constriction in the creek or increasing the creek's capacity should be carefully studied to determine potential impacts.

Flood problems along Clover Creek have likely been exacerbated over time by unmitigated runoff from development within the drainage basin. At least one resident who has lived within the repetitive loss area for many years claims that flooding did not impact his property before development in the drainage basin increased (Rivard, 2000). Residents in this loss area have filed flood insurance claims in 1996 and 1997.

5.4.5 Insurance Analysis

Flood insurance statistics can help identify vulnerability by regionally isolating areas where claim activity is high and a high rate of flood insurance is in force. *Table 5-5* summarizes vital insurance statistics that can be used to help identify vulnerability within the Clover Creek Basin. The locations of these policies are identified in *Figure 1-2*.

Number of flood insurance policies in force within the basin (as of May 1, 2007)	269
Number of Policies within a mapped floodplain (FIRM)	47
Number of Policies outside of a mapped floodplain	222
Number of Claims filed within the basin	119
Number of claims filed for losses outside the 100-year floodplain	36
Estimated number of insurable, primary Structures in mapped floodplains	1091
Estimated % of at risk structures with flood insurance coverage	4.31%
% of current flood insurance coverage outside of a mapped floodplain	82.5%

Based on a review of this data, the following observations can be made:

- Based on the approximate number of primary, insurable structures in the floodplain and the insurance coverage in force within the floodplain, insurance coverage as a form of mitigation appears to be well below the national average. According to a study being conducted for the NFIP by the Rand Corporation nationwide, about 49% of single-family homes in special flood hazard areas (SFHAs) are covered by flood insurance.
- With 82.6% of the current policies in force located outside of a mapped floodplain, there appears to be some flooding issues within this basin not addressed via the existing mapping. These could be drainage related flood issues that the Basin Planning Program seeks out, that typically are not captured through standardized floodplain mapping techniques.
- With the existence of repetitive loss areas within this basin, and the low percentage of insurance coverage, flood insurance promotion could be an effective means of mitigation within the basin.
- The majority of the historical claims filed within this basin have been outside of a mapped floodplain. This once again, suggests that there are flooding issues within this basin not addressed through flood hazard mapping.

