SECTION 2

Watershed Characteristics

This section describes drainage characteristics unique to the City of McMinnville and the watersheds that drain through the City. The following drainage characteristics are summarized: location, study area parameters, climate, soil conditions, topography, groundwater, existing drainage facilities, and existing and future land use conditions. This information will be used in the master plan to evaluate the performance of the existing drainage facilities and to identify future drainage requirements.

2.1 Location

The City of McMinnville is located in Yamhill County, situated in the northern Willamette Valley between the Coastal and Cascade Mountain ranges. It is approximately 35 miles southwest of Portland and 26 miles northwest of Salem, Oregon. The City of McMinnville is mostly situated between the North and South Forks of the Yamhill River just upstream of their confluence. The Yamhill River flows northeastward from McMinnville approximately 7 miles before reaching the Willamette River.

Four major waterways drain the City of McMinnville: Cozine Creek with its branches, Baker Creek, North Yamhill River, and the South Yamhill River. Figure 2-1, Topography Map, shows the location of these four major waterways. The area of the entire watershed that drains McMinnville and drains through the McMinnville urban growth boundary (UGB) is approximately 10,727 acres, 50 percent of which is drained by Cozine Creek. Cozine Creek, in turn, discharges into the South Fork of the Yamhill River.

2.2 Study Area Delineation

While this master plan considers the runoff impact from the entire watershed that drains through the City, the specific study area for this plan is the McMinnville UGB. The UGB is delineated in the City's Comprehensive Plan and is approximately 8,403 acres in area. Approximately 79 percent of the UGB is currently incorporated by the City of McMinnville. Figure 2-2, Study Area, shows the boundaries of the study area (identical to the UGB) and the approximate extent of development as of August 2005. This map provides a visual indication of the limits of existing development and of areas within the UGB that are generally not yet developed.

Three major streets within the study area serve as references for describing locations in this plan: Highway 99 West, West 2nd Avenue, and Three Mile Lane. Highway 99 West is a major four-lane state highway that runs north-south through the downtown area and leaves the City to the northeast. West 2nd Avenue provides an east-west route from Hill Road at the base of foothills west of the City to the downtown area. Three Mile Lane crosses the South Yamhill River and connects the McMinnville Municipal Airport and surrounding easterly lands to Highway 99.

2.3 Climate

The climate of the City of McMinnville is similar to the other areas of the upper Willamette Valley. It is generally mild and marked by long wet winters and short dry summers. Its climate results from moist maritime air masses moving from the Pacific Ocean (35 miles away) inland over the Coastal Range.

On the average, 73 percent of the precipitation occurs during the winter months from November through March, while only 5 percent normally occurs during the three summer months. The average annual rainfall is approximately 41.1 inches. The maximum average monthly precipitation is approximately 7 inches and usually occurs during the month of December. Local peak runoff events are, therefore, most likely to occur during the winter months from November through March.

High water in the North and South Forks of the Yamhill River is a function of the backwater conditions induced by the Willamette River, which in turn tends to have peak flows later in the spring as the upstream dams approach capacity.

There are typically only several days with any measurable snowfall. Snowfall depths rarely exceed 2 to 3 inches and will usually melt in a day or two. Snowmelt is not considered to have a significant impact on the local watershed.

The lack of precipitation and increased irrigation during the summer months significantly reduces the flow in the major waterways. There are only 3.3 rainfall events per year, on the average, between July 1 and August 31 each year, which produce precipitation greater than 0.10 inch. Historically, no measurable precipitation has been recorded 48 percent of the time during the month of July and 43 percent of the time during August.

Precipitation is evaluated analytically in Section 5, Rainfall Analysis.

Average monthly temperatures range 50 degrees Fahrenheit (°F) between the coldest temperatures in January to the warmest temperature in July. The average maximum and minimum temperatures are 46°F and 33°F in January and 83°F and 50°F in July. Winter low temperatures generally average in the mid-30s and only rarely drop below 0°F, while average daily summer temperatures are in the mid-70s. Therefore, during the infrequent summer storm, potential runoff is often largely evaporated by hot temperatures and/or absorbed by dry soils.

2.4 Soils

Knowledge of local soil conditions and their response to precipitation is essential for evaluating a drainage system. There are various disposal paths possible for precipitation. Besides creating runoff, precipitation may evaporate, collect in depressions, be intercepted by plants, or infiltrate into the soil. When precipitation exceeds the capacity of these loss paths, surface water runoff is generated.

FIGURE 2-1

TOPOGRAPHY

City of McMinnville
Stormwater Drainage Master Plan

Legend

- Creek\River
- Proposed UGB
- Lakes

N

1 inch equals 3,000 feet

CH2MHILL

Date: 4/13/2009

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FIGURE 2-2

STUDY AREA

City of McMinnville Stormwater Drainage Master Plan

Legend

- Roads
- Creek\River
- Proposed UGB
- Lakes

N

1 inch equals 3,000 feet

Source:
City of McMinnville
Aerial Provided by USDA 2006

CH2MHILL

Date: 10/26/2007

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Runoff rates and total runoff volumes are increased by the amount of impervious ground cover such as rooftops and pavements. Runoff rates are also increased by the existing degree of soil saturation and by the slope of the watershed. Runoff potential is based on the soil's capacity to absorb precipitation. The lower the soil's infiltration capacity, the higher will be its runoff potential. Sandy soils generally have higher infiltration capacity and lower runoff potential, while impervious surfaces have limited infiltration capacity and very high runoff potential.

Soils within the McMinnville study area are listed in Table 2-1. These were compiled from the Soil Survey Geographic (SSURGO) Database published in 2003 by the Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service (SCS). The soils found in the McMinnville area are generally silt loams with low to moderate permeability. Each of the soil types are classified by runoff potential. Based on runoff potential, the soils are grouped into NRCS hydrologic groups A, B, C, or D. Soils in hydrological group A have good infiltration and low runoff potentials, while those in group D have poor infiltration and high runoff potentials. The locations of these hydrologic soil groups within the study area are shown in Figure 2-3. Within the study area, over 90 percent of the area is covered with soils of moderate or poor permeability (hydrologic group C or D). Recent development has increased the percent of impervious area, causing stormwater runoff to increase.

TABLE 2-1
Hydrological Classification of Soils
City of McMinnville Storm Drainage Master Plan

Soil Classification	Runoff Potential	Hydrological Group
Amity silt loam	Moderate	C
Carlton silt load (0 to 20% slopes)	Low	B
Chehalem silty clay loam (3 to 12% slopes)	Moderate	C
Chehalis silty clay loam	Low	B
Cloquato silt loam	Low	B
Cove silty clay loam	High	D
Dayton silt loam	High	D
Dupee silt loam (3 to 20% slopes)	Moderate	C
Panther silty clay loam (4 to 20% slopes)	High	D
Peavine silty clay loams (2 to 30% slopes)	Moderate	C
Wapato silty clay loam	High	D
Willakenzie silty clay loam	Moderate	C
Willamette silt loam (0 to 20% slopes)	Low	B
Woodburn silt loam (0 to 20% slopes)	Moderate	C
Yamhill silt loam and silty clay loam (2 to 30% slopes)	Moderate	C

2.5 Topographical Features

Although the City of McMinnville's west side lies along the eastern foothills of the Coastal Mountain Range, the majority of the City's topography is relatively flat. Figure 2-1, Topography Map, shows the McMinnville watershed boundaries and its topography.

Each of the four major waterways (Cozine Creek, Baker Creek, North Yamhill River, and the South Yamhill River) drains a portion of the study area. These waterways, with their tributaries, meander through the area's flat terrain. These drainageways have eroded deep channels in most areas over geologic time. The developed lands of McMinnville adjacent to these deep channels are situated well above high water and are provided with sufficient slope for storm drainage systems within the City. Towards the westerly reaches of the Cozine Creek watershed, the tributaries, particularly the West Fork of Cozine Creek, have much shallower channels. The flood risks in these areas from over-bank creek flow need to be considered. In other areas of the City where developed lands lie far from the deeply incised creeks, flat slopes on storm drainage pipes frequently limit discharge capacities.

The major waterways within McMinnville generally have less than a 1 percent channel slope and flow slowly under normal conditions and very slowly under summer low flow conditions. The side slopes of the drainageways are typically 2H:1V (2 feet horizontal to l foot vertical slopes).

The 100-year floodplain within the study area was established as part of the Federal Emergency Management Agency (FEMA) Flood Insurance Study for the City of McMinnville (1982). These areas are designated as "F-P" on the City of McMinnville zoning map shown in Figure 2-4.

2.6 Groundwater

Soils within the McMinnville UGB are predominantly of hydrologic type C or D. These soils have low infiltrative capacity during large events. Except in localized areas, disposal of stormwater through surface infiltration is not considered to be an effective strategy. Also for this reason, groundwater and surface water interactions are assumed to be minimal.

2.7 Existing Drainage Facilities

Stormwater runoff is drained by pipe and natural open channel systems throughout the watershed. Most of the runoff from the urbanized areas, especially the central business district, is piped. Runoff is transported through these pipes and discharged into the creeks and streams flowing through the City. The existing municipal storm drainage system configuration with pipe diameters is shown in the Section 7 hydraulic analysis figures (Figures 7-A through 7-E, located at the end of Section 7).

FIGURE 2-3

SOIL INFILITRATION CAPABILITY

City of McMinnville
Stormwater Drainage Master Plan

Berry Creek
Panther Creek
Hawn Creek
North Yamhill River
Baker Creek
HWY 99W
Yamhill River
North Branch Cozine Creek
BAKER
3RD
ADAMS
THREE MILE
THREE MILE
Cozine Creek
HWY 18
BAKER
THREE MILE
South Yamhill River

Legend

- Creek\River
- Major Roads
- **Proposed UGB**

Hydrologic Soil Class

- A
- B
- C
- D

N

1 inch equals 3,000 feet

Source:
City of McMinnville
NRCS -
Soil Survey Geographic
(SSURGO) Database

CH2MHILL

Date: 11/01/2007

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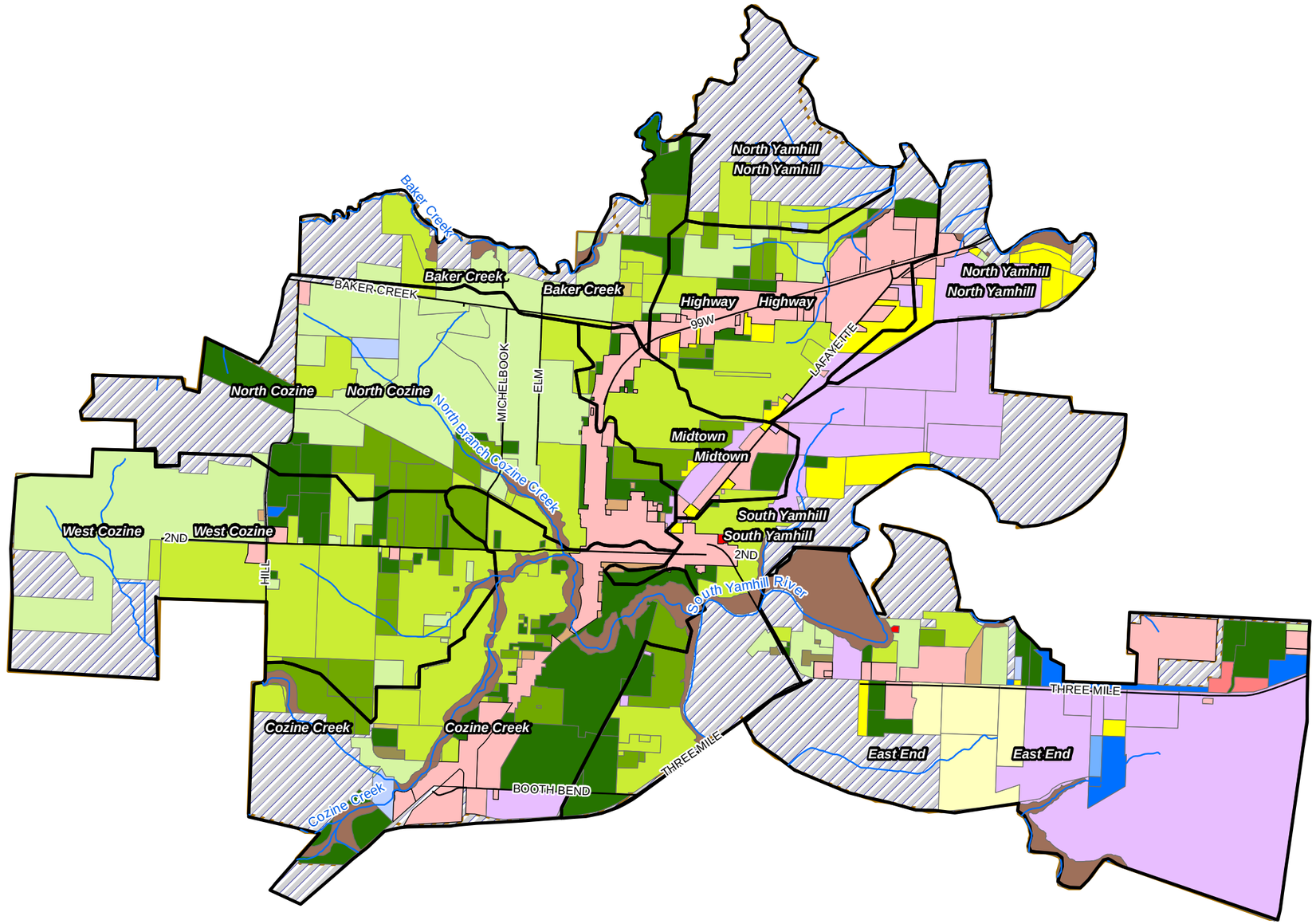
FIGURE 2-4

ZONING

City of McMinnville Stormwater Drainage Master Plan



Legend

- Major Road
- Creek\River
- Major Basin
- UGB Expansion Area

Zoning

C-1	M-L
C-2	R-1
C-3	R-2
A-H	R-3
AF-20	R-4
EF-80	F-P
M-1	LDR9000
M-2	O-R
Proposed UGB	VLDR-1
	VLDR-2.5

N

1 inch equals 3,000 feet

Source:
City of McMinnville

CH2MHILL

Date: 11/01/2007

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The major drainageways, particularly Cozine Creek, are crossed by roads in numerous locations. These crossings are typically culverted fills. Along the main stem of Cozine Creek, large diameter overflow culverts have been added at higher elevations to convey high flows and to equalize the water surface elevations when Cozine Creek is subjected to backwater flows from the South Yamhill River. According to the comprehensive plan, where possible and where it is consistent with development objectives, natural drainageways should be retained. A well-vegetated, slow-moving creek system can provide channel storage of runoff waters.

In a small section of the downtown area, stormwater is combined with sanitary sewage flows in one network of pipes and is conveyed to the sewage treatment plant. Lift stations are utilized in these systems to pump the combined flows to the treatment plant. This area is addressed in detail in the Water Reclamation Facility Master Plan (October 2008).

Besides piped and open channel flow, there are two other types of flows draining the watershed that need to be considered when estimating times of peak runoff concentration in this master plan: overland flow and street gutter flow. Overland flow occurs when storm-water runoff flows overland without channelization, such as in areas of farmland, parks, or lawns. In developed areas, overland flow distances are usually no more than 100 feet[2],[3] before the flow is intercepted by a street gutter or catch-basin. In undeveloped areas, overland flow distances can be much larger.

2.8 Existing and Future Land Use Conditions

Knowledge of local land use practices is also essential for developing a successful drainage master plan because as a watershed urbanizes, impervious areas within the drainage basin typically increase. This increase in impervious area can often dramatically increase the amount and rate of runoff within the watershed. Increases in impervious area also decrease the time of concentration within the watershed. Time of concentration refers to the time it takes for runoff from the most hydraulically distant point in the basin to reach the outlet point of interest. These parameters are explained in more detail in Section 4.8.

To minimize the risk of flooding and to protect against the loss of property, a drainage system is typically designed to accommodate both existing flows and anticipated future flows for some frequency of occurrence that is commensurate with the potential for loss. Appropriate return frequencies for the various basins are discussed in more detail in Sections 7 and 11. The basis for existing and future impervious areas is discussed below.

The McMinnville Storm Drainage Master Plan study area is delineated by the UGB. The City of McMinnville's UGB was established for the City's comprehensive plan as required by the Oregon Statewide Planning Act.

The City's estimated present extent of land development (based on August 2005 aerial photography) is shown in Figure 2-5. The remaining area within the UGB is planned for eventual incorporation by the City of McMinnville. Currently zoned and ultimate land use acreages are shown in Table 2-2. These estimates were made based on the current City

[2] Merkel, References on time of concentration with respect to sheet flow. USDA, NRCS, National Water and Climate Center. 2001

[3] Woodward and Welle, NRCS, Northeast NTC, Hydrology Technical Note N4, 1986.

comprehensive plan and on current City zoning maps, and on recent aerial photographs (2005) of the City.

Approximately three-quarters of the area within the UGB is currently within the incorporated limits of the City of McMinnville. The following sections describe the currently zoned and ultimate development (full development of the UGB) for residential, commercial, industrial land uses within the study area. See Table 2-2 for a compilation of land use acreages.

TABLE 2-2
Existing and Build-Out Land Use
City of McMinnville Storm Drainage Master Plan

Zoning Designation	Description	Developed (2005) Land Use (acres)	Build-Out Land Use (acres)
A-H	Agricultural Holding	6	61
C-1	Neighborhood Commercial	1	2
C-2	Travel Commercial	2	14
C-3	General Commercial	590	714
F-P	Floodplain	69	361
M-1	Light Industrial	119	170
M-2	General Industrial	857	1,206
M-L	Limited Light Industrial	27	158
O-R	Office-Residential	23	27
R-1	Residential 1	797	1,244
R-2	Residential 2	1,190	1,396
R-3	Residential 3	458	459
R-4	Residential 4	559	732
--	No Zoning	19	1,859
Total		**4,719**	**8,403**

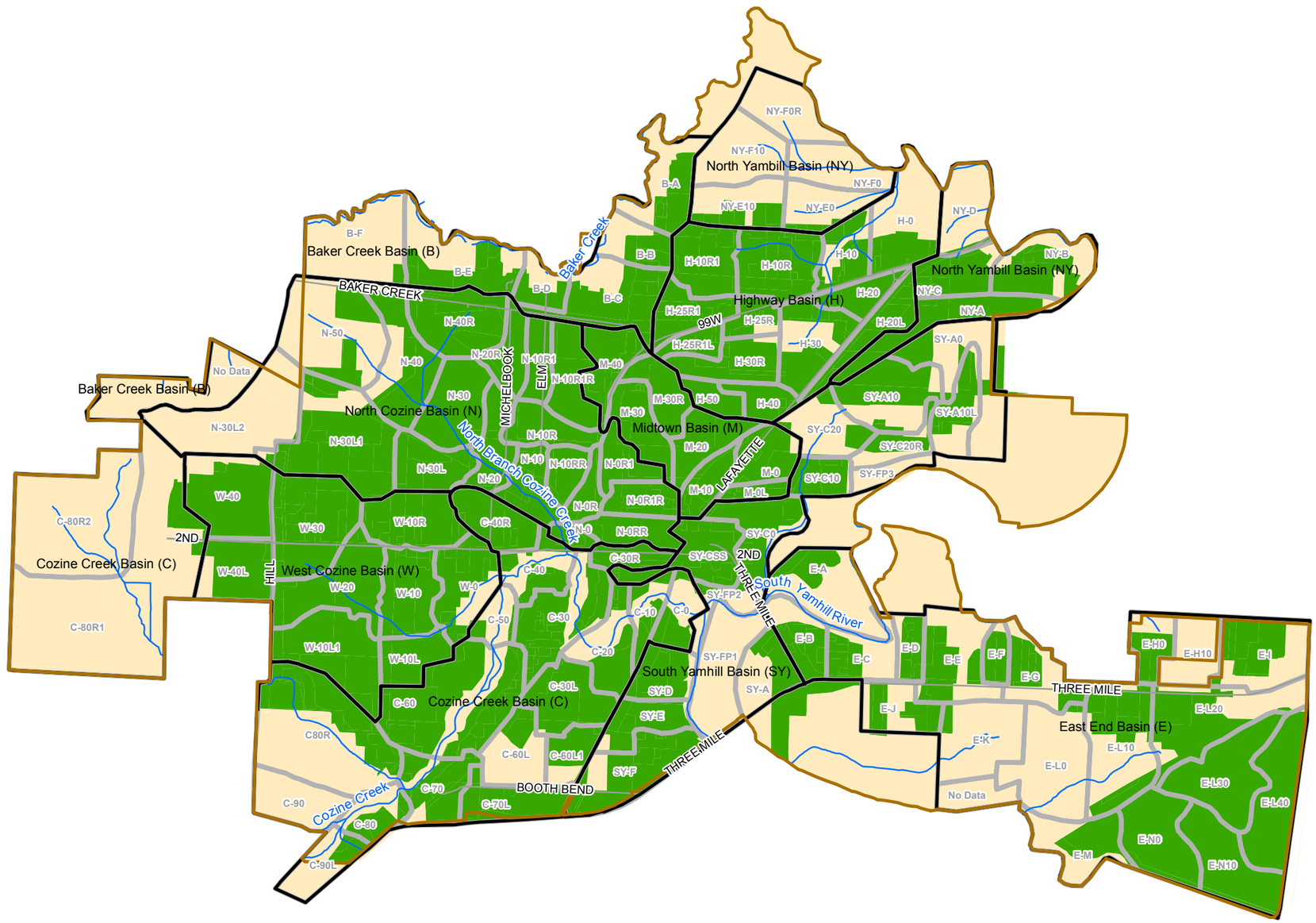
2.8.1 Residential

There are approximately 3,858 acres within the City limits zoned for residential development. Approximately 3,027 acres, or 78 percent, are currently developed. Single-family homes are the predominant residential type in the City. Approximately 70 percent of the residential land area within the UGB is zoned as single-family development (R-1 and R-2), with the remaining 30 percent zoned for duplex or multi-family residential (R-3 and R-4). Of that 70 percent, approximately 74 percent of it is already developed. Most of the single-family residentially zoned land is west of Highway 99 West. Stormwater runoff from this area is drained by Cozine Creek or one of its tributaries.

FIGURE 2-5

DEVELOPED AREAS

City of McMinnville
Stormwater Drainage Master Plan



Legend

- Roads
- Creek\River
- Subbasin
- Major Basin

Assumed Currently Developed (2005)

- No
- Yes
- Urban Growth Boundary

N

1 inch = 3,000 feet

Date: 4/10/2009

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2.8.2 Industrial

There are three major industrial areas in McMinnville. The northeast industrial area is situated generally east of Lafayette Avenue and in the vicinity of Riverside Drive. This area has been rapidly developing. The second industrial area is in the southern end of the study area, north of the Salmon River Highway in the vicinity of Booth Bend Road and the Hewlett Packard site. This area has also seen development pressure in recent years. The third, and largest, industrially designated land use in the City is in the vicinity of the McMinnville Municipal Airport. About 25 percent of the area within the UGB has been designated for ultimate industrial development. The majority of stormwater runoff from these industrial areas will drain directly into the South Yamhill River. Serving these lands with drainage services is not expected to present any unusual difficulties.

2.8.3 Commercial

Existing, zoned, and ultimate commercial development is concentrated along Highway 99 West and the central business district. Shopping centers, highway retail establishments, automobile dealerships, and warehouse sales operations are generally located to the northeast of City Center along Highway 99. These areas are characterized for drainage purposes by large expanses of parking areas. The downtown area generally tends towards shops, office space, and institutional centers with smaller parking areas and a higher density of structures.

2.8.4 Floodplain

There have been two previous flood studies within the study area. The U.S. Soil Conservation Service studied Cozine Creek (1978) and the U.S. Army Corps of Engineers studied flooding on the North and South Yamhill Rivers (1976). FEMA incorporated the information derived from these studies in creating the Flood Insurance Study (FIS) for the City of McMinnville (1982). The FIS represents the regulatory floodplain analysis and mapping for the National Flood Insurance Program (NFIP). Since the original study, the City of McMinnville has more than doubled its population by growing from 14,350 in 1978[4] to more than 30,000 in 2007, which may lead to an increase in flood flows because of the effects of urbanization, particularly in the Cozine Creek basin. Conducting a detailed restudy using current land use conditions would provide more accurate floodplain mapping and water surface profiles for the public.

Floodplain areas are shown on the City's comprehensive plan land use map and are illustrated in Figure 2-4. These areas are considered suitable for farming or public parks by the McMinnville Department of City Planning, but are restricted from habitable development. These floodplain areas serve as high flow storage areas and over-sized conveyances for peak storm events. Most of these zones are located along major waterways, such as the North and South Yamhill Rivers.

[4] FEMA, Flood Insurance Study City of McMinnville, Oregon. 1982