CHAPTER 3

EXISTING AND FUTURE FLOWS AND DEMANDS

INTRODUCTION

This section presents the characteristics of McMinnville's service area, including population, land use, climate, soil types, and topography as they relate to the identification of existing flows and development of future flows and system demands. Existing and future conditions and assumptions that were used to establish flows for the analysis of the City's wastewater collection system are also described.

LAND USE/ACRES/EDUS

Much of the information presented here has been developed from work conducted as part of the *1994 Collection System Facilities Plan* (CH2M HILL, 1994), *1998 Wet Weather Overflow Management Plan* (CH2M HILL, 1998), and the *Growth Management and Urbanization Plan* (ECONorthwest, 2003).

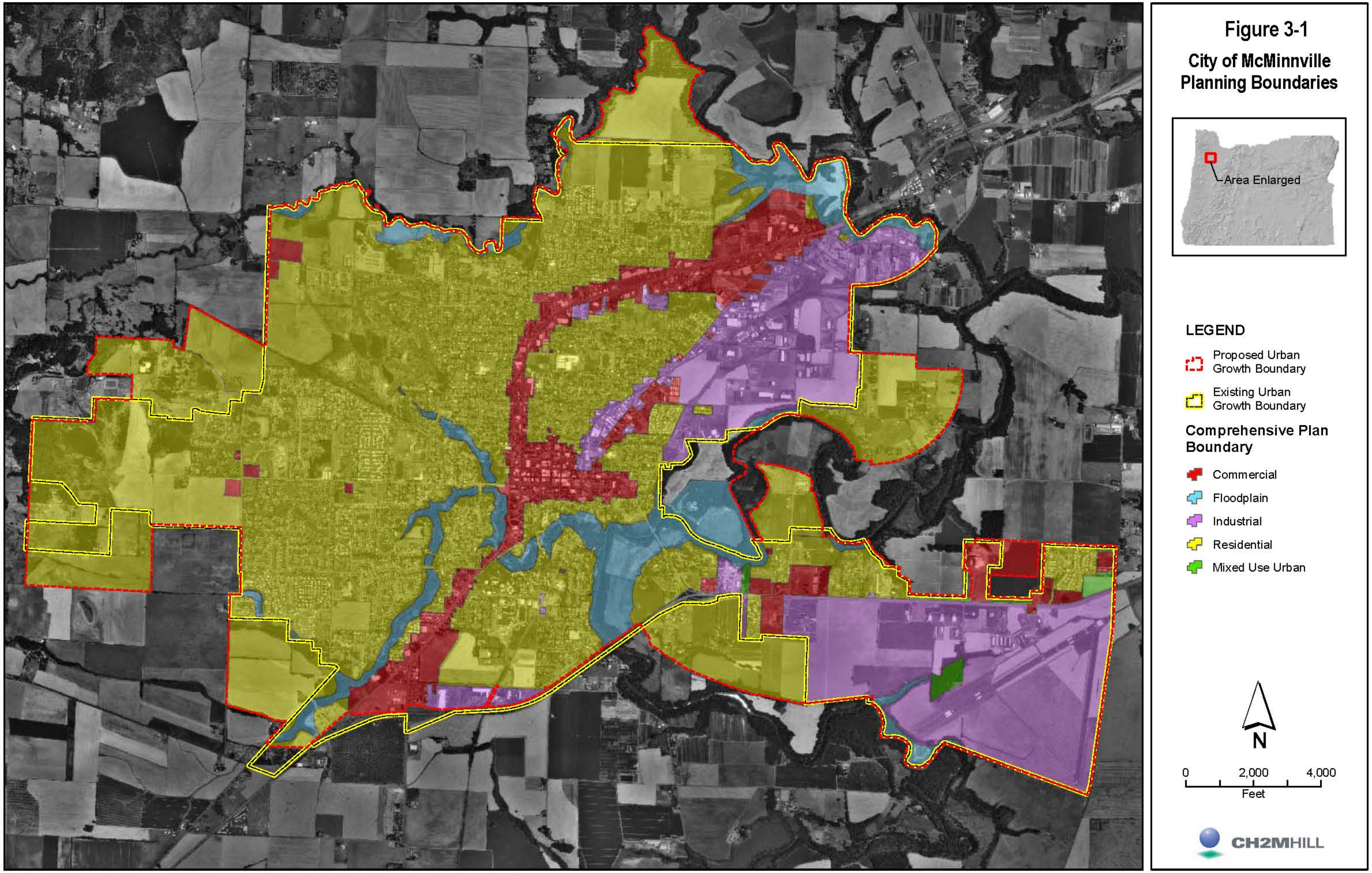
Planning Area

The planning area for the current and future service area is 8,299 acres, or approximately 13.0 square miles, and is consistent with the City's Comprehensive Plan. The planning area is the same as the City's newly proposed UGB (8,299 acres), which is 1,255 acres greater than the existing UGB (7,044 acres). The enlarged UGB has been proposed in order to account for future population and economic expansion identified in the 2003 *Growth Management and Urbanization Plan*. A request to expand the UGB was acknowledged by the Oregon Department of Land Conservation and Development (DLCD) and approved by the Land Conservation and Development Commission (LCDC) in September, 2006. Subsequently, LCDC's approval of the City's plan was appealed to the Oregon Court of Appeals in December of 2006. As of this date, the appeal still awaits decision by the Courts. For purposes of this master planning study, the planning area shall include the existing and proposed UGB, as shown in Figure 3-1.

Topography

While McMinnville is bounded by hills and low-lying mountains to the west, the City has relatively flat topography. Several local creeks drain from the City to the North and South Yamhill Rivers. The northern portion of the study area is bounded by the North Yamhill River and has greater topographic relief. The southern and eastern portions of the study area are within the flood plain of the South Yamhill River and are narrowly to moderately terraced.

The study area is divided into seven urban basins, which are defined by topography and the configuration of the sanitary collection system. These seven basins contain the City's current and future service areas. Those portions of the seven drainage basins contained within the proposed UGB are illustrated in Figure 3-2.



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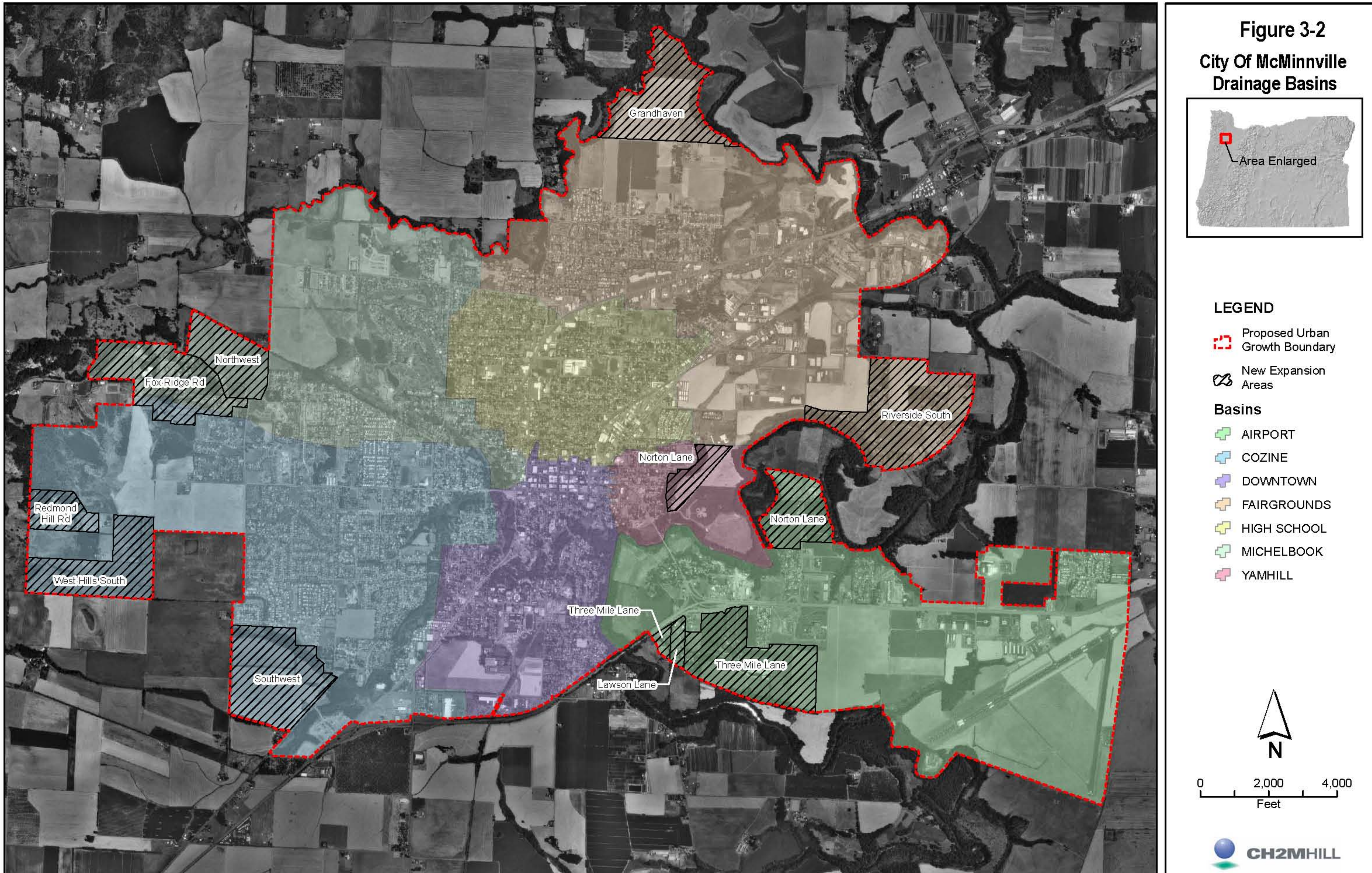

Figure 3-2
City Of McMinnville Drainage Basins

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Soils

The study area is composed primarily of one major surface geologic unit—Willamette Silt—with minor areas of recent alluvium deposits adjacent to streams and large creeks.

Recent alluvium deposits are found in areas adjacent to both forks of the Yamhill River. Stream action has cut localized valleys below the level of the Yamhill Valley, leaving meander-scarred flood plains below the initial surface of the Willamette Silt deposition. The flood plains are covered with a thin veneer of recent alluvium that varies from course gravels along the tributaries of steeper gradients to the flood plain silt that is prevalent along major streams. The recent alluvium unit is composed primarily of poorly sorted, unconsolidated to semi-consolidated deposits up to 50-feet thick of clay, silt, sand, and fine to very coarse gravel.

Climate

The Yamhill valley has a modified marine climate with moderately warm, dry summers and moist, cool winters. Precipitation and temperatures are affected by the Pacific Ocean and the Coastal Range.

Precipitation. Moisture from the Pacific Ocean is picked up from westerly winds and carried east. Precipitation decreases as it moves east due to the orographic effect of the Coastal Range as the wind flows eastward into the Willamette Valley. Rainfall decreases sharply on the east side of the Coastal Range and on the valley floors. Winter precipitation is the result of storms moving in from the Pacific Ocean, whereas summer precipitation is often the result of an occasional localized thunderstorm.

Approximately 80% of the total annual precipitation falls between November and April, but even as late as mid-June there is a 33% chance of rain on any given day. Table 3-1 summarizes monthly precipitation data from 1971-2000.

Table 3-1. Historical Precipitation (inches) – (1971-2000)

Month	Mean	Extreme (24 hr)	Average Number of Days				Snow Mean
			≥ 0.01”	≥ 0.10”	≥ 0.50”	≥ 1.0”	
Jan	6.63	2.70	16.3	11.6	4.7	1.5	1.07
Feb	5.50	2.05	15.5	11.1	3.8	1.0	0.64
Mar	4.65	1.61	15.8	11.0	3.2	0.7	0.10
Apr	2.81	1.97	12.6	7.4	1.5	0.3	0.01
May	1.94	1.76	9.3	5.7	1.1	0.1	0.00
Jun	1.14	1.07	5.7	3.2	0.7	0.1	0.00
Jul	0.43	1.05	2.5	1.2	0.2	0.0	0.00
Aug	0.52	1.69	2.5	1.4	0.3	0.0	0.00
Sep	1.37	3.10	5.8	3.6	1.0	0.1	0.00
Oct	2.96	3.58	9.8	6.0	1.9	0.4	0.00
Nov	6.23	2.50	16.6	12.1	4.4	1.4	0.12
Dec	7.48	3.50	17.0	12.4	5.6	2.0	1.20
Total	41.66	2.70	133.8	89.6	28.3	7.2	3.14

Source: Oregon Climate Service (http://www.ocs.oregonstate.edu/index.html)

Temperature. According to 1971-2000 data from the Oregon Climate Service, the normal range of temperatures is from 33°F to 82°F and the mean annual temperature is 53°F. Maximum and minimum temperatures over this time period have been recorded at 106°F and -5°F, respectively.

Historical Population Trends

The population of McMinnville has grown at a relatively steady and rapid pace over the last twenty-five years. From 1980 to 2002, the average annual growth rate was 3.2%. From 1990 to 2002 the average annual growth rate increased to 3.9%. From 2000 to 2005, however, the growth rate has slowed to an annual growth rate of 2.3%. The City's *Growth Management and Urbanization Plan* is currently using a future population growth rate of 2.2% per year. Table 3-2 summarizes the historical population growth from 1980 through 2005 and the annual growth from 2000-2005.

Table 3-2. Historical Population Trends – 1980 through 2005

Year	Population	Annual Growth Rate (%)
1980	14,080	-
1990	17,894	-
2000	26,499	-
2001	27,500	3.8
2002	28,200	2.5
2003	28,890	2.5
2004	29,200	1.1
2005	30,020	2.8

Sources: Portland State University Center for Population Research (2005), McMinnville Growth Management and Urbanization Plan (2003)

Land Use

The orderly development of land within the City is guided by the City's Comprehensive Plan and the City's implementation of ordinances and agreements. Ordinances and agreements include the McMinnville Zoning Ordinance of 1981, the Land Division Ordinance, the Annexation Ordinance, and the Urban Growth Boundary Management Agreement, which coordinates land development review between the City and Yamhill County.

Growth over the last fifteen years has resulted in the City evaluating the need to expand its UGB. Documents that have evaluated this expansion include the *McMinnville Residential Lands Need Analysis, May 2001*, *McMinnville Economic Opportunities Analysis, November 2001*, and most recently the *Growth Management and Urbanization Plan, May 2003* (as amended in January 2006). Results of these studies support the expansion of the present UGB by approximately 1,255 gross acres (of which 881 acres are buildable), approximately an 18% increase in the gross land area contained within the present UGB. This is the first significant amendment to the City's urban growth boundary since its adoption in 1981.

Existing land use within the City includes zoning for residential (single and multiple-family), commercial, industrial, and open land (park space and flood plain). The City's zoning map, based on the existing UGB, is reproduced in Figure 3-3. Table 3-3 summarizes the gross (total) acres for residential and commercial/industrial development, as designated in the Buildable Lands Analysis inventory, land designated as newly expanded areas, and other undevelopable areas. Undevelopable land primarily includes public right-of-ways and water bodies. The newly expanded area represents the additional land identified as being required in the future through the analysis conducted in the *Growth Management and Urbanization Plan*.

Table 3-3. Land Use Designation by Basin Within UGB – Gross Area

	Land Use Designation (acres)				
Basin	Residential (1)	Commercial / Industrial(2)	Expanded Areas(3)	Other Undevelopable (4)	Total
Airport	271	499	304	706	1,780
Cozine	1,192	80	331	298	1,901
Downtown	327	181	0	203	711
Fairgrounds	569	722	356	252	1,899
High School	433	128	0	113	674
Michelbook	724	22	232	157	1,135
Yamhill	56	22	0	121	199
Total	3,572	1,654	1223	1850	8,299

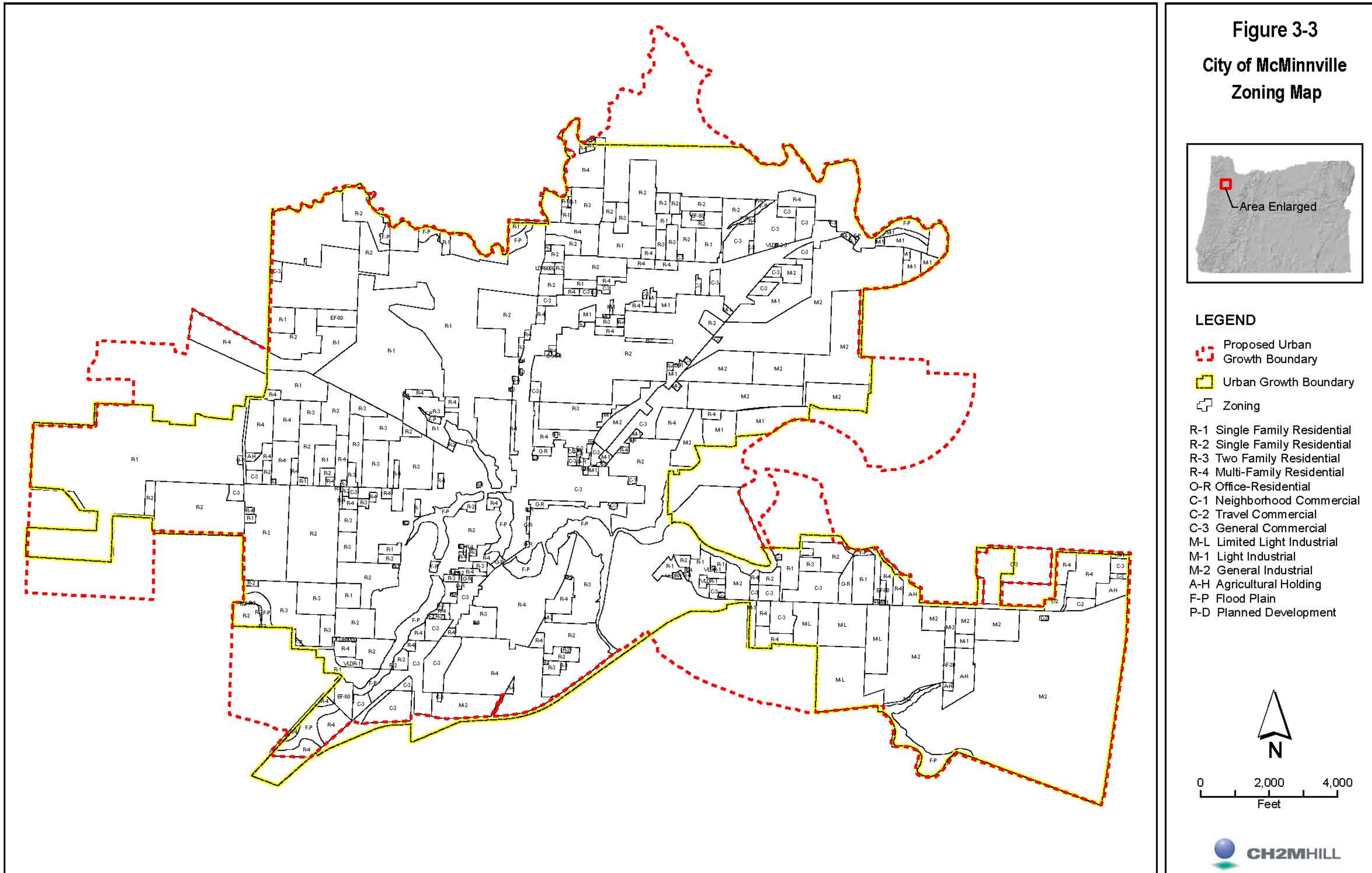
(1) Based on information from the Buildable Lands Analysis inventory. Includes zoning classifications: residential (R-1, R-2, R-3, R-4), exclusive farm use (EF-40, EF-80), agricultural holding (A-H), AF-20, VLDR-1, VLDR-2.5. Also includes parcels classified as undevelopable.
(2) Based on information from the Buildable Lands Analysis inventory. Includes zoning classifications: commercial (C-1, C-2, C-3), industrial (M-1, M-2), agricultural holding, (A-H), exclusive farm use (EF-40, EF-80), and office-residential (O-R), AF-20, VLDR-1, VLDR-2.5. Also includes parcels classified as undevelopable.
(3) Not accounted for in the Buildable Lands Analysis inventory. Nine areas have been identified for future development. Portions of these areas include what is referred to by the City Planning Department as "Neighborhood Activity Centers." The majority of this area is outside the extent of the existing UGB and represents the boundary of the proposed UGB.
(4) Represents other undevelopable area contained within the proposed UGB boundary that is not accounted for in the Buildable Lands Analysis inventory or the nine newly expanded areas such as right-of-way, water bodies, etc.

For this study, future development is expressed in equivalent dwelling units (EDUs) that have been estimated using the following design criteria and assumptions:

- Residential dwelling units – currently developed:
  - With the exception of a recent 12 year study that reflects density only for the 1988-2000 period, densities for existing development have not been determined. As a result, EDUs for existing development have not been determined.
- Residential dwelling units – future development (Source: *Growth Management and Urbanization Plan, Appendix B, Table 11, May 2003)*:
  - R-1 3.5 dwelling units per acre
  - R-2 4.3 dwelling units per acre

Figure 3-3

City of McMinnville Zoning Map



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- R-3 5.4 dwelling units per acre
- R-4 8.8 dwelling units per acre
- R-5 15.0 dwelling units per acre

- Residential dwelling units – future development (Source: *Growth Management and Urbanization Plan, Table 16 and Appendix B, Table 7, May 2003*):
  - Additional residential dwelling units needed at buildout = 6,014
- Based on an additional assessment of commercial/industrial flow contributions, this study recommends using sanitary flow equal to 12 dwelling units per developed acre which had been used in past studies and reports conducted for the City. Assuming 150 gpd (gallon/day)/dwelling unit and 12 dwelling units per acre equates to 1,800 gpad (gallon/acre-day). The typical flow rates used to estimate residential wastewater flows is between 1,000 – 2,000 gpad.

Table 3-4 shows the estimated distribution of current development by drainage basin.

Table 3-4. Developed Land Within UGB – Existing Net Area

Basin	Residential (Acres)	Commercial/Industrial (Acres)	Total Acres
Airport	112	165	277
Cozine	597	48	645
Downtown	197	141	338
Fairgrounds	294	469	763
High School	327	118	445
Michelbook	240	4	244
Yamhill	52	19	71
Total	1,819	964	2,783

Development Forecasts

A single future planning scenario, buildout (2023), is considered in this evaluation. The buildout planning scenario represents development of lands within the expanded UGB that have been classified as developable in the Comprehensive Plan. The buildout scenario is also representative of the Oregon Department of Environmental Quality's (DEQ) 20-year planning horizon for facility planning efforts. Details associated with the buildout scenario are presented below. The buildout projections assume development of all lands designated as developable in the Comprehensive Plan at the densities previously shown.

Buildout projections were developed using data in the Buildable Lands Analysis inventory and Appendix B from the *Growth Management and Urbanization Plan*. Using current and estimated zoning regulations, the *Growth Management and Urbanization Plan* estimated the 2023 population for the City to be 44,055. This is an increase of 14,035 from the 2005 population shown in Table 3-2. Future developable land distributions for residential parcels by basin were determined by applying future densities (shown previously) to developable lands and then proportioning the distribution to the required future dwelling units of 6,014. Future developable land distributions for commercial/industrial parcels by basin were determined by applying a density of 12 EDUs per acre to developable non-residential lands identified in the Buildable Lands Analysis inventory. Table 3-5 summarizes the future additional (not including existing development) distribution of development by drainage basin.

Table 3-5. Developed Land Within Proposed UGB – Future Additional

Basin	Residential		Commercial/Industrial		Total EDUs
	Acres	EDUs	Acres	EDUs	
Airport	261	831	231	2,772	3,603
Cozine	500	2,209	16	192	2,401
Downtown	11	48	28	336	384
Fairgrounds	361	1,307	192	2,304	3,611
High School	5	25	8	96	121
Michelbook	400	1,590	14	168	1,758
Yamhill	1	3	0	0	3
Total	1,539(1)	6,013	489	5,868	11,881

(1) Includes approximately 531 acres containing residential land designation that has been identified for use other than for housing—schools, parks, religious, government, semi-public services, and infrastructure.

Table 3-6 summarizes the total area distribution of developed land within the planning area at buildout.

Table 3-6. Developed Land Within Proposed UGB – Buildout Total Net Area

Basin	Residential (Acres)	Commercial/Industrial (Acres)	Total Acres
Airport	373	396	769
Cozine	1,097	64	1,161
Downtown	208	169	377
Fairgrounds	655	661	1,316
High School	332	126	458
Michelbook	640	19	659
Yamhill	53	19	72
Total	3,358	1,454	4,812

The EDU and acreage information in Table 3-5, along with flow monitoring data collected in early 2006 were used as the basis for developing sanitary sewer system flows for existing and future development conditions. Generation of those flows was conducted in subsequent master planning tasks.

Measure 37 Issues

There are currently several Measure 37 claims within the City's UGB and two outside of the UGB. Four properties located within the UGB in the southwest portion of town, with a total area of 88 acres, have been approved for residential development. Another claim is a 32 acre site in the southwest corner of town located between Old Sheridan Road and Hill Road that has been approved for residential development. This claim is outside the expanded UGB and will not be considered in the master planning analysis. The other claim outside the UGB is a 342 acre site (Abrams property) located on the northwest edge of McMinnville, west of Hill Road that has been approved for both residential and commercial development. This claim will not be considered in the master planning analysis. To determine the impact of the four claims within the UGB on future sanitary flow generation, the assumption of 7.5 EDU/acre for the 88 acre site has been used. Using this assumption results in approximately 660 EDUs, which is <6.7% of the future EDU estimation of 9,925 (Table 3-5). Thus, the claims associated with this area appear to have minimal impact to overall future sanitary sewer flow estimates. However, the 88 acres and 660 EDUs will be used in developing future sanitary flow calculations in the master planning analysis.

FLOW DEVELOPMENT

A hydraulic model of the wastewater collection system was developed using the EPA Storm Water Management Model (SWMM) Version 5 to simulate the flow conditions within the service area. The modeling task assists in the identification of areas in the collection/conveyance system where hydraulic capacity deficiencies may exist. The model was refined and calibrated to simulate the existing collection system and to reflect recent sewer rehabilitation efforts, flow monitoring, and historic pump station and treatment facility flow data. This calibrated model was used to estimate the 5-year, peak day, and 5-year peak hour wet weather regulatory design flow rates for the existing condition.

The future conditions hydraulic model is based on buildout land use, and was developed to incorporate additional areas within the planned service area boundary that are currently undeveloped.

Wet Season Average Base Flow Development

Wet season average base flow (ABF), which includes sanitary flows plus groundwater infiltration, was used as the ABF input for the hydraulic model. The ABF was established by analyzing flow records from each of the eleven monitoring sites for periods of zero precipitation during the wet season flow monitoring conducted between February and May 2006. A 24-hour diurnal flow hydrograph for ABF during the wet season was developed at each monitor location based on these data.

Existing condition wet season ABF for each tax lot (parcel) was generated based on currently developed acres, since existing EDU data were not available at the parcel level.

A detailed description of the future wet season ABF is provided in Chapter 4 of the accompanying document, *Water Reclamation Facility Plan.* To estimate flows for future conditions, the wet season ABF associated with future development was added to the existing wet season ABF. Therefore:

Future Wet Season ABF	=	Existing Wet Season ABF	+	Future Sanitary Flow	+	Future Groundwater Infiltration (GWI)

A unit rate of 57 gallons per day (gpd) per person was used for the future sanitary flow contribution. A value of 2.6 persons per EDU was used for the calculation of future sanitary flow per EDU, giving a rate of 148 gallons per EDU. When coupled with the assumed future density of 8 EDU/acre, the rate of 148 gpd/EDU is equivalent to about 1,200 gpad, still within the typical range of 1,000 to 2,000 gpad. A constant wet season groundwater infiltration of 216 gallons per acre per day was added to the sanitary flow to give the total wet season ABF. This results in:

Future Wet Season ABF = Existing Wet Season ABF
+ 57 gallons per day per person * 2.6 persons per EDU (=148 gallons)
+ 216 gallons per acre * developable parcel area

Table 3-7 summarizes average wet season ABF at each flow monitor location for existing (measured flows) and future (modeled flows) conditions.

Table 3-7. Existing and Future Wet Season ABF (Routed Flows)

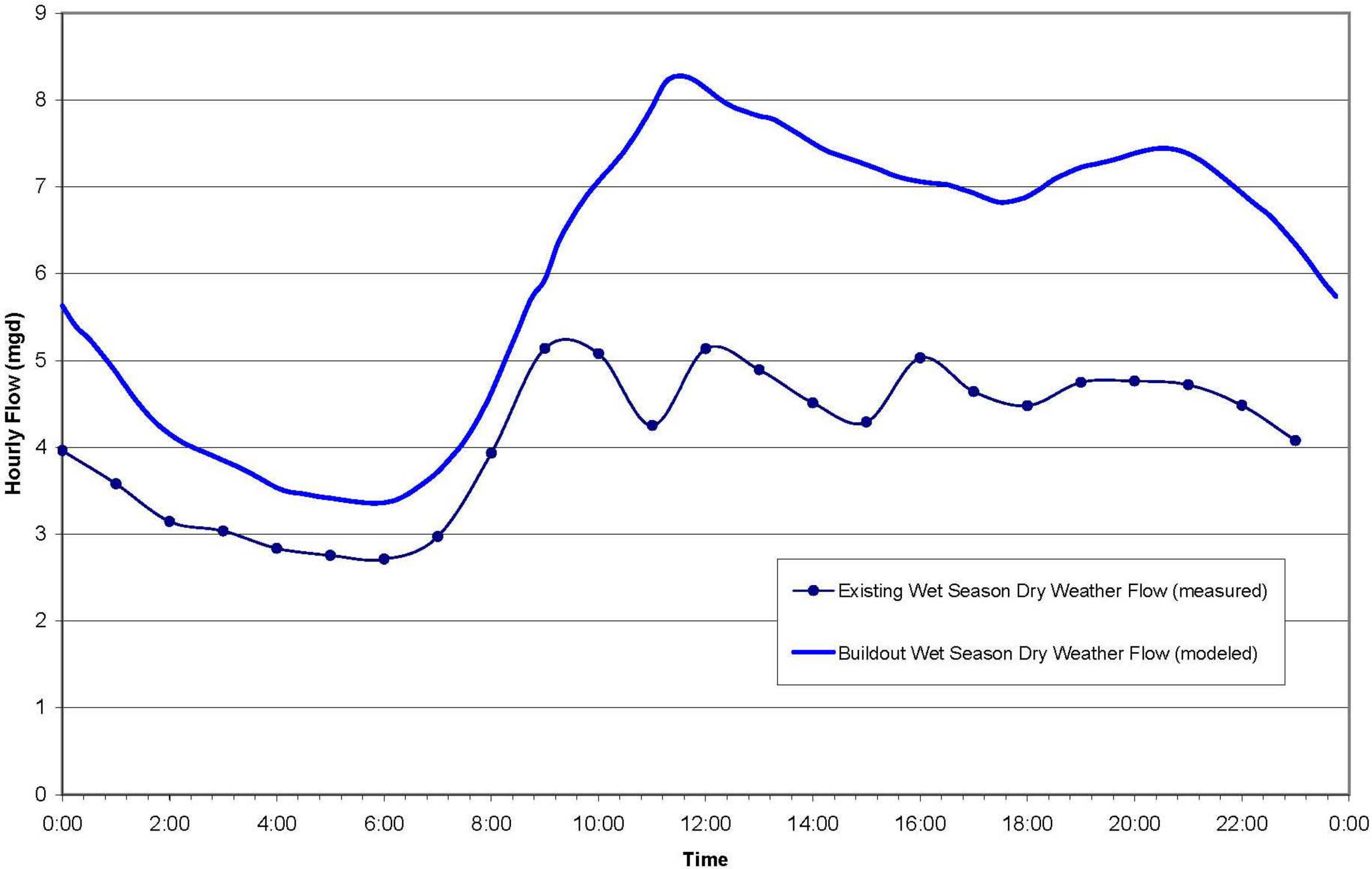
Manhole ID	Location	Existing Average Wet Season ABF (mgd)	Future Average Wet Season ABF (mgd)
J-7-20	1652 Riverside (Old WWTP)	0.47	1.03
J-7-48	1900 Riverside (Old WWTP)	0.03	0.05
J-7-44	1610 10th St	0.90	1.20
J-7-90	1516 10th St	1.70	2.74
J-7-68	Lafayette Ave @ 12th St	0.43	0.69
J-7-8	12th St @ Alpine Ave	0.08	0.15
I-7-3	11th St @ Cowls Ave	0.28	0.34
H-8-102	247 SW 2nd St	0.27	0.37
H-8-107	123 SW Elmwood	0.04	0.16
H-8-93	339 NE Adams Ave-NE side	0.19	0.79
H-8-112	339 NE Adams Ave-SW side	0.45	0.65

Figure 3-4 shows the existing and future buildout wet season diurnal ABF at the RSPS.

Wet Weather Flow Development

The most critical flow condition for the collection system occurs in response to rainfall events during the wet season when soils are saturated and the system's response to rainfall is the most direct. This section describes the process used to develop the peak wet weather flows, including design storm characteristics, the use of regression equations to convert rain to RDII, the method to distribute flows to modeled pipelines upstream of the monitor locations and the calibration process used to increase the accuracy of peak flows predicted for the selected design storms.

Figure 3-4. Wet Season Dry Weather Flow at RSPS



Design Storms

Analysis of the City's collection system was conducted using rainfall dependent infiltration and inflow (RDII) flows produced by a design storm developed for this project. Based on DEQ requirements, at a minimum the design storm must have a 5-year return interval with a 24-hour precipitation depth of 3.1 inches. This 5-year, 24-hour storm depth was obtained from the National Oceanic and Atmospheric Administration (NOAA) intensity-duration-frequency maps for Oregon. The peak RDII flow and volume is dependent upon the distribution of the 5-year, 24-hour rainfall (3.1 inches) as well as the amount and distribution of rainfall leading up to the 5-year, 24-hour rainfall event. Design storm selection therefore dictates the level of protection against potential overflows that the associated improvements will provide. Because the distribution and antecedent rainfall is not stipulated through regulatory requirements, several alternative 5-year design storm distributions were evaluated to generate RDII flows. They all meet the 5-year design storm criterion of 3.1 inches in 24-hours. Figure 3-5 presents the 5-year depth-duration curve for durations up to 96 hours in comparison to several 5-year synthetic design storms as well as historic rainfall from December 2005 through January 2006.

For purposes of this analysis durations up to 72 hours were analyzed to assess impacts of rainfall prior to the peak 24-hour period. Figure 3-6 shows the 5-year rainfall distributions used in the WWOMP and the current analysis of the collection system. The WWOMP storm was based on the distribution of an actual rainfall event and adjusted so that the rainfall for the peak 24-hour period was 3.1 inches. The 5-year, 24- and 72-hour storms are also based on the rainfall distribution of a historic rainfall event, but have been adjusted so that the total rainfall for any duration is associated with the 5-year frequency storm.

Application of Regression Analysis

RDII is well correlated with cumulative precipitation for the City collection system. As described in Chapter 2, a mathematical relationship between flows and antecedent precipitation was developed and calibrated using measured precipitation and flow monitoring data from the eleven flow monitor sites. Using this mathematical relationship, an estimate of RDII can be made for any given rainfall distribution.

The calibrated multiple-linear regression equation for RDII at each monitor was used to estimate existing 5-year RDII flows using the 5-year design storms.

RDII for future development was calculated using a peak rate of 2,000 gallons per acre-day (gpad) applied to future developed acres. This rate was selected based on analysis of flow monitor data from numerous similar projects. This rate of RDII is typical of more recently developed areas that are representative of conditions in growth basins using modern construction techniques and pipe materials. Future RDII flows were then added to the existing RDII obtained from the regression equations.

The total wet weather flow is the sum of RDII and wet season ABF.

Figure 3-5. McMinnville 5-year Frequency Rainfall Depth-Duration Curve

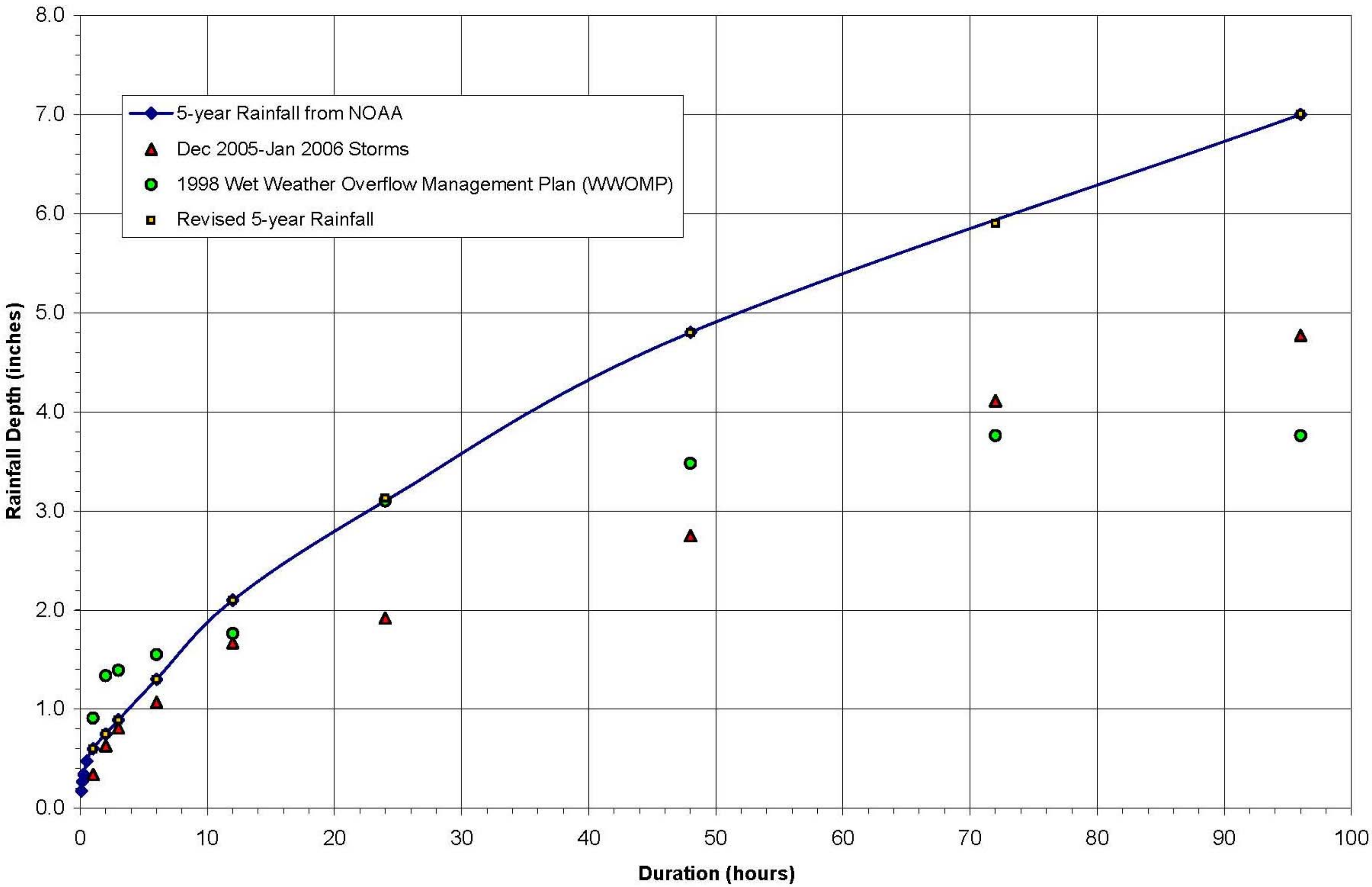
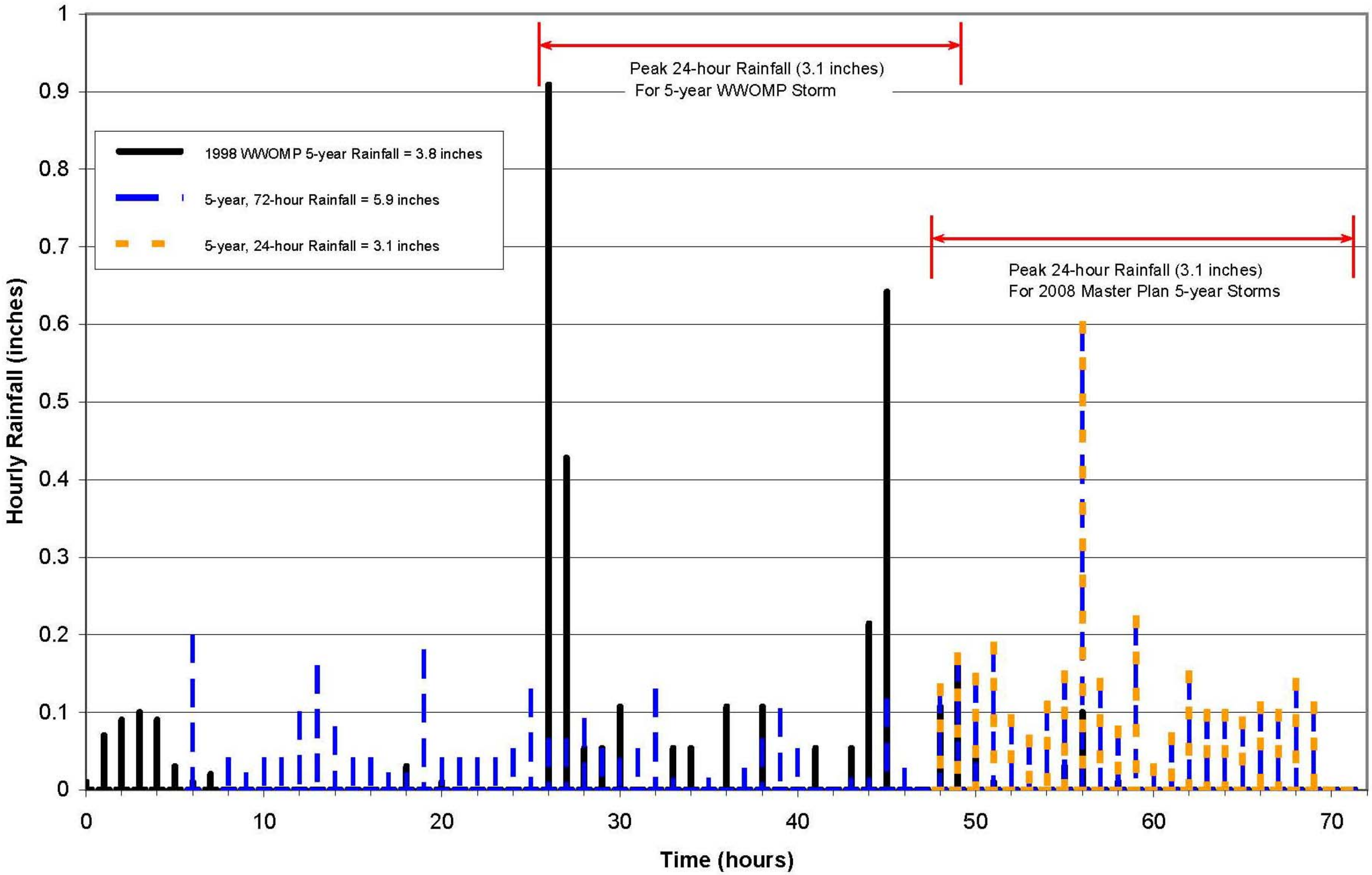


Figure 3-6. McMinnville 5-year Design Storms



Flow Distribution

Each of the flow monitor basin was divided into smaller subbasins in order to refine the distribution of model flow inputs. The two components of the flow (wet season ABF and RDII) estimated at each monitor location were distributed to selected upstream manholes (hydraulic model nodes) in proportion to the manhole's contributing area. The eleven flow monitor basins were subdivided into more than 300 subbasins using the City's GIS parcel database, with each subbasin contributing both wet season ABF and RDII to a model manhole assigned to it. Within a given subbasin, each parcel contributed its own wet season ABF and RDII. The flow contributions from all of the parcels within each subbasin were then summed to give the total subbasin flow, and subsequently the flow input at each model flow input node (manhole).

HYDRAULIC MODEL CALIBRATION

The EPA SWMM 5 hydraulic model was run for several storms that occurred during the monitoring period to verify that the routed flows at the monitor locations were approximately the same as the sum of the dry weather and RDII flows that had been calibrated outside of the hydraulic model. Model calibration includes quality control checks of the hydraulic model flow inputs, pump station configuration, model stability, and comparison of results to flow meter values. The regression model flow estimates are most accurate within the range of the rainfall and flow for which they are calibrated, and therefore it is desirable to capture as wide a range of rainfall events as possible during the flow monitoring period. Since the regression models will be used to estimate flows for a 5-year storm event, it would be ideal if one of the rainfall events used to calibrate the regression models approached the magnitude of the 5-year rainfall depth. During the typical limited duration flow monitoring study, however, a storm approaching the 5-year rainfall does not often occur, and that was the case for the February through April 2006 monitoring period. So, while the regression models were well calibrated for the storms that occurred during the flow monitoring period, there was some initial uncertainty about how accurate the model flow predictions would be for larger storms.

However, flow data were available at the RSPS and Cozine pump station during a relatively large rainfall period that occurred between December 17, 2005 and January 26, 2006. The calibrated monitor basin regression models were therefore used to generate model flow inputs to test the predictive accuracy of the basin regression models during this period. Since this series of storms occurred outside of the February through April 2006 basin flow monitoring period, the model flow inputs for the December 2005 to January 2006 storms were created entirely from the monitor basin regression models. As described previously, a rainfall time series for the December 2005 through January 2006 period was entered into each of the monitor basin regression models. Each model then produced a time series of flows at each monitor location. These flows were then distributed upstream of each monitor (as described above) and used as input to the hydraulic model. Routed flows were then compared to flows measured at the RSPS and Cozine pump station. Flow inputs for the EPA SWMM 5 hydraulic model were then adjusted as necessary, until the routed flows closely matched the measured flows at the RSPS and Cozine pump station.

The calibration process involved an iterative procedure of:

- modifying model flow input hydrographs by adjusting the basin regression model parameters,
- distributing flows to upstream manholes in the hydraulic model,
- routing the flows through the hydraulic model,
- comparing hydrograph shapes, peaks, and volumes at the RSPS and Cozine pump station to see if they matched those observed at each location during the December 2005 to January 2006 period.

Figures 3-7 and 3-8 compare the calibrated flows from the hydraulic model to measured flows at the Cozine pump station and RSPS, respectively. Calibration of the hydraulic model for the December 2005 to January 2006 period demonstrates the accuracy of the model flow inputs and hydraulic routing, as well as the predictive capability of the monitor basin regression models for large rainfall events. It also provided a sound basis for assuming that flow estimates for the 5-year rainfall event would be accurate as well.

By calibrating the basin regression models using both the detailed monitoring data from several relatively low flow events and flow data from a relatively high flow event at the Raw Sewage and Cozine pump stations, the calibrated hydraulic model was shown to accurately simulate flows for a wide range of wet season conditions.

APPLICATION OF CALIBRATED MODEL

Results from two rainfall conditions are presented, both meet the DEQ written regulatory criteria for a 5-year, 24-hour winter event. The first condition includes 48-hours of rainfall prior to the start of the 24-hour regulatory event. The amount of rainfall during this period is consistent with a 5-year frequency from 0 to 72 hours, including the 24-hour regulatory design event. The second condition assumes no prior (antecedent) rainfall to the 24-hour regulatory event. Table 3-8 presents the peak wet weather flows anticipated in the collection system during current and build-out conditions for the two rainfall conditions assuming that no collection system rehabilitation is performed, and that there are no capacity restrictions in the system, either in the pipelines or at pump stations. The hydrographs are shown for the 24 and 72 duration storms in Figures 3-9 and 3-10 respectively. The selection of the design storm used as the basis for system improvements is discussed in Chapter 6, Alternatives Analysis, and provided in Chapter 7, Recommended Plan.

Table 3-8. Model Results of the Peak Wet Weather Flows

72-Hour Duration (48 hours of antecedent rainfall prior to the 24-hour regulatory event)	Existing (mgd)	Build-out (mgd)
Peak Hour Dry Weather Sanitary Flow and Base Infiltration	5.4	6.8
Peak Hour RDI/I	46.6	55.2
Maximum Day Wet Weather Flow	47.6	54.5
Peak Hour Flow	52	62
24-Hour Duration (no antecedent rainfall)		
Peak Hour Dry Weather Sanitary Flow and Base Infiltration	5.4	6.8
Peak Hour RDI/I	37.9	42.1
Maximum Day Wet Weather Flow	35.1	45.5
Peak Hour Flow	43.3	48.9

Figure 3- 7. Raw Sewage PS Modeled vs. Measured Flow (12/1705 to 1/26/06)

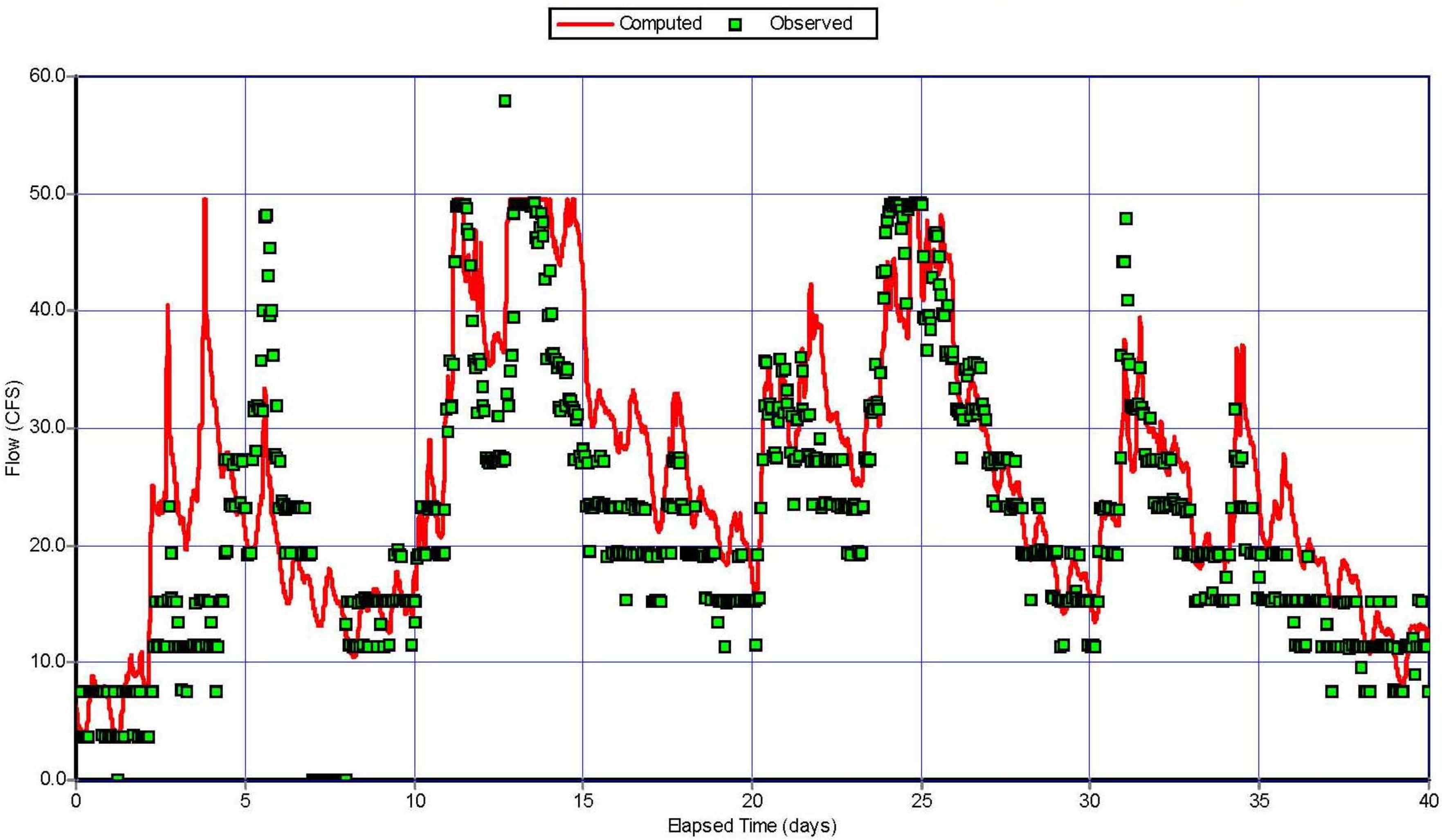
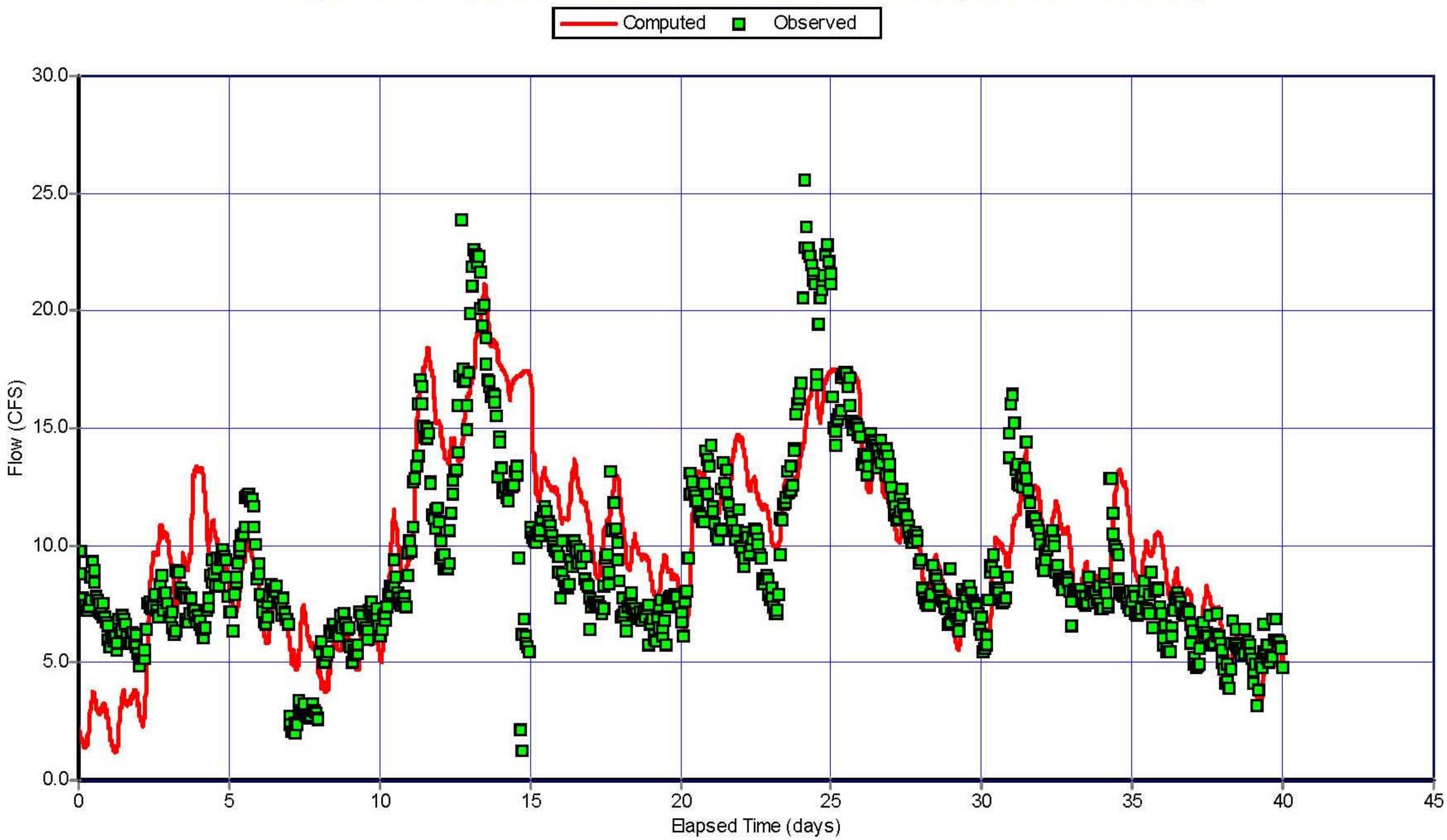


Figure 3-8. Cozine PS Modeled vs. Measured Flow (12/1705 to 1/26/06)



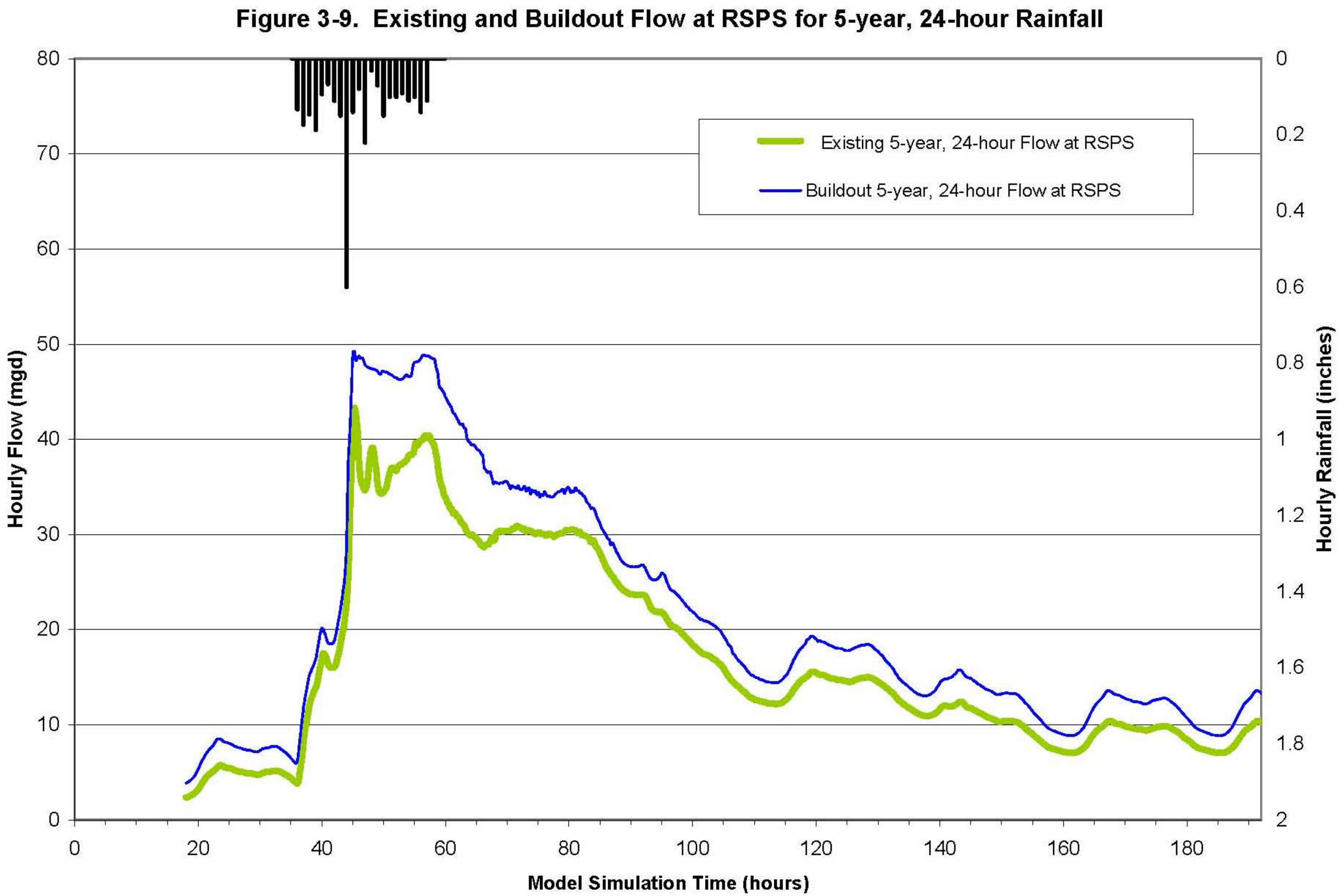


Figure 3-9. Existing and Buildout Flow at RSPS for 5-year, 24-hour Rainfall
Existing 5-year, 24-hour Flow at RSPS
Buildout 5-year, 24-hour Flow at RSPS
Hourly Flow (mgd)
Hourly Rainfall (inches)
Model Simulation Time (hours)
0
10
20
30
40
50
60
70
80
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
20
40
60
80
100
120
140
160
180

Figure 3-10. Existing and Buildout Flow at RSPS for 5-year, 72-hour Rainfall