CITY OF RICHLAND

STORMWATER MANAGEMENT PLAN

MARCH 2016

Richland
HDR
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City of Richland

Stormwater Management Plan

March 2016

Prepared By:

HDR

Robin Kirschbaum water {planning engineering}

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Appendices

Appendix A. National Pollutant Discharge Elimination System (NPDES) Eastern Washington Phase II Municipal Stormwater Permit

Appendix B. 2015 Stormwater Management Program Plan (SWMP Plan)

Appendix C. Interlocal Agreement

Appendix D. Redline Mark-ups of Suggested Revisions to the Design Guidelines

Appendix E. 2014 Stormwater LID Retrofit Project Pre-Design Report

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Stormwater Management Plan

Section 1. Introduction

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Section 1. Introduction

1.1 Background

This Stormwater Management Plan (Plan) provides the City of Richland (City; Figure 1-1) with a document identifying stormwater requirements and issues related both to the structural components of the stormwater system and the programmatic components adopted by the City. The City first created a Plan in 2005 to prepare for the National Pollutant Discharge Elimination System (NPDES) Eastern Washington Phase II Municipal Stormwater Permit that was issued by the Washington Department of Ecology (Ecology) and became effective in 2007.

This Plan update addresses changes in land use, development, and stormwater infrastructure that have occurred since 2005. It provides recommendations to develop or modify existing stormwater programs and invest in capital infrastructure improvements to benefit water quality, reduce localized flooding, and promote continued development throughout the City.

This Plan update also provides guidance to help the City meet the requirements of the updated Phase II Eastern Washington Municipal Stormwater Permit (Phase II Permit) that became effective August 1, 2014 and will expire July 31, 2019. The Phase II Permit regulates operation of the City's Municipal Separated Storm Sewer System (MS4). See Appendix A for a copy of the permit.

1.2 Goals

The primary goals of this Plan are to:

- Assess available conveyance capacity in the existing built stormwater system and identify Capital Improvement Projects (CIPs) to help improve system capacity.
- Evaluate stormwater programs against requirements of the Phase II Permit and recommend areas of program development for regulatory compliance.
- Develop a financial plan with recommended revenue (i.e., rate) levels that support the operating and capital needs of the City's Stormwater Utility.

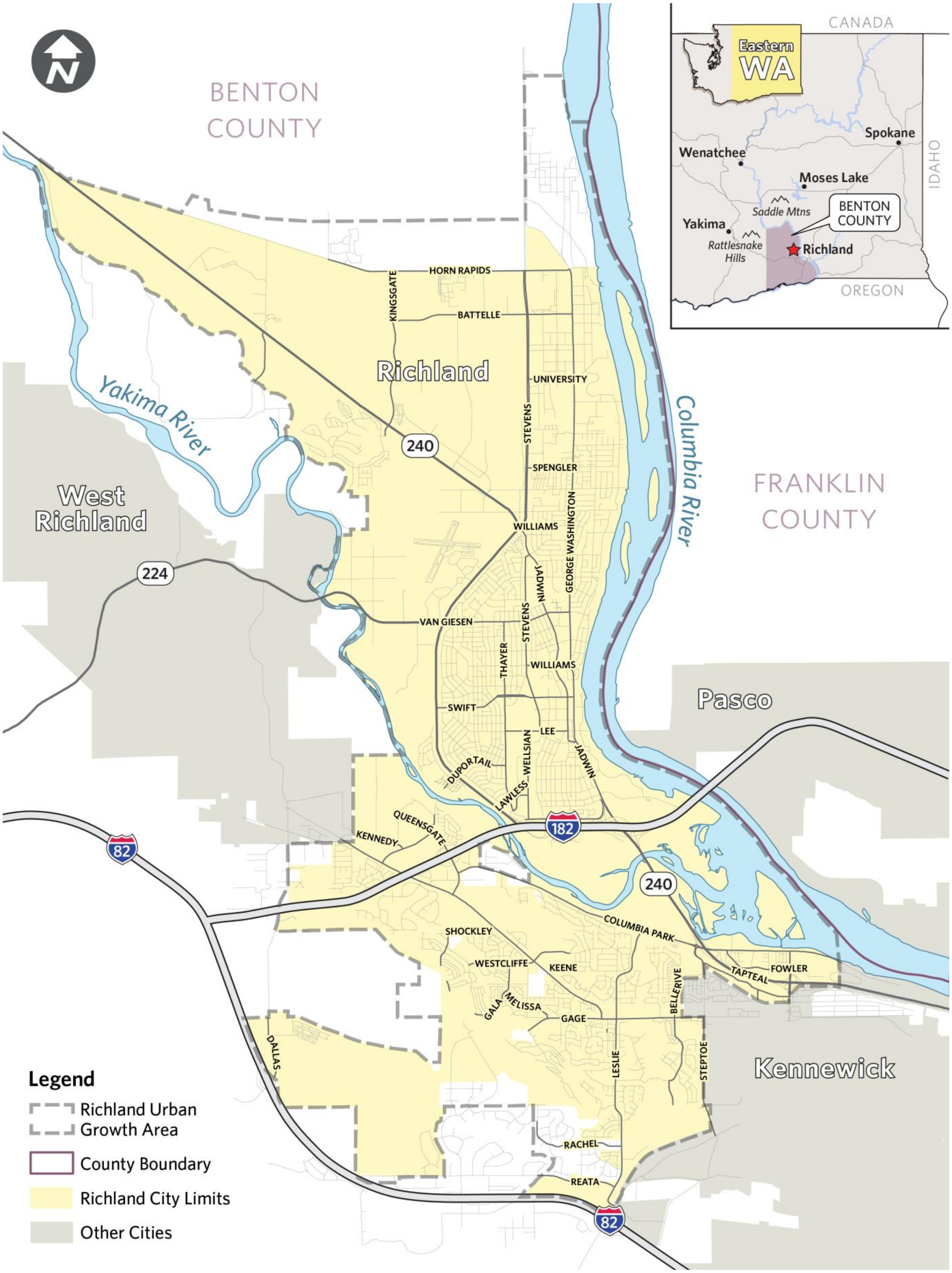

Figure 1-1. Vicinity Map

1.3 Stormwater Management Program

The Phase II Permit is comprised of six program elements. The implementation and enforcement of those elements is collectively referred to as the City's Stormwater Management Program (SWMP). The six elements include:

1. Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Stormwater Runoff Control
5. Post-Construction Stormwater Management for New Development and Redevelopment
6. Municipal Operations and Maintenance

In addition to the above six minimum elements, Ecology requires the following two additional elements:

1. Compliance with stormwater provisions of approved Total Maximum Daily Loads (TMDLs)
2. Monitoring and assessment

The SWMP is designed to reduce the discharge of pollutants from municipalities to the maximum extent practicable to satisfy the state requirement to apply “All Known Available and Reasonable Methods of Prevention, Control and Treatment” (AKART) prior to discharge and to protect water quality. The Phase II Permit requires that specified activities from each element be completed each year to achieve full compliance by the end of the first Permit term. See Appendix B for a copy of the 2015 SWMP Plan.

1.4 Interlocal Agreement

The City has entered into an interlocal agreement with the Port of Benton, located within its city limits (Figure 1-1), to provide intergovernmental cooperation of their secondary Permit and grant funding. The Port of Benton is a secondary Phase II Permittee and requires the Port to meet the same elements and timelines as the City.

Under the agreement, the City maintains the Port's stormwater infrastructure located within public Port-owned streets using funding from the City's stormwater utility. The City does not maintain facilities in Port-owned commercially developed parcels. Terms of the agreement include (City of Richland, 2007):

- The City will perform street sweeping services to Port-owned public streets to the same standards and frequency as City-owned streets.
- The City will provide stormwater conveyance system cleaning and maintenance to the same standards and frequency as City-owned conveyance systems.
- The City will apply its NPDES Permit compliance programs to Port-owned stormwater conveyance systems.
- The City will create and administer programs to achieve compliance with Section S6 of the NPDES permit for Port owned facilities.
- The Port will grant the City, without cost, easements and rights-of-way required to implement stormwater construction and maintenance activities.

The interlocal agreement is included in Appendix C.

1.5 Stormwater Utility Enterprise

The City created a separate stormwater utility enterprise with authority to own, construct, maintain, operate, and preserve stormwater infrastructure. The service area of the utility includes all land within the incorporated City limits and as modified through periodic annexations.

The utility is organized into two groups: Public Works Administration and Engineering Division and Maintenance/Operations. Both groups work under the direction of the Public Works Director.

Public Works Administration and Engineering includes engineers, technicians, surveyors, inspectors and administration staff. In addition to planning and capital improvements, staff in this group permit and inspect private development projects to ensure compliance with City standards. Capital projects are billed to the stormwater utility and other costs, such as development review, inspection, and planning are allocated to the stormwater utility from the Administration and Engineering budget. The Maintenance/Operations group includes two full time craft workers who report to the Wastewater Maintenance Supervisor. These maintenance positions are fully funded by the utility. Their duties include daily maintenance and operation of the MS4 system. Figure 1-2 displays the hierarchy of staff within the stormwater utility.

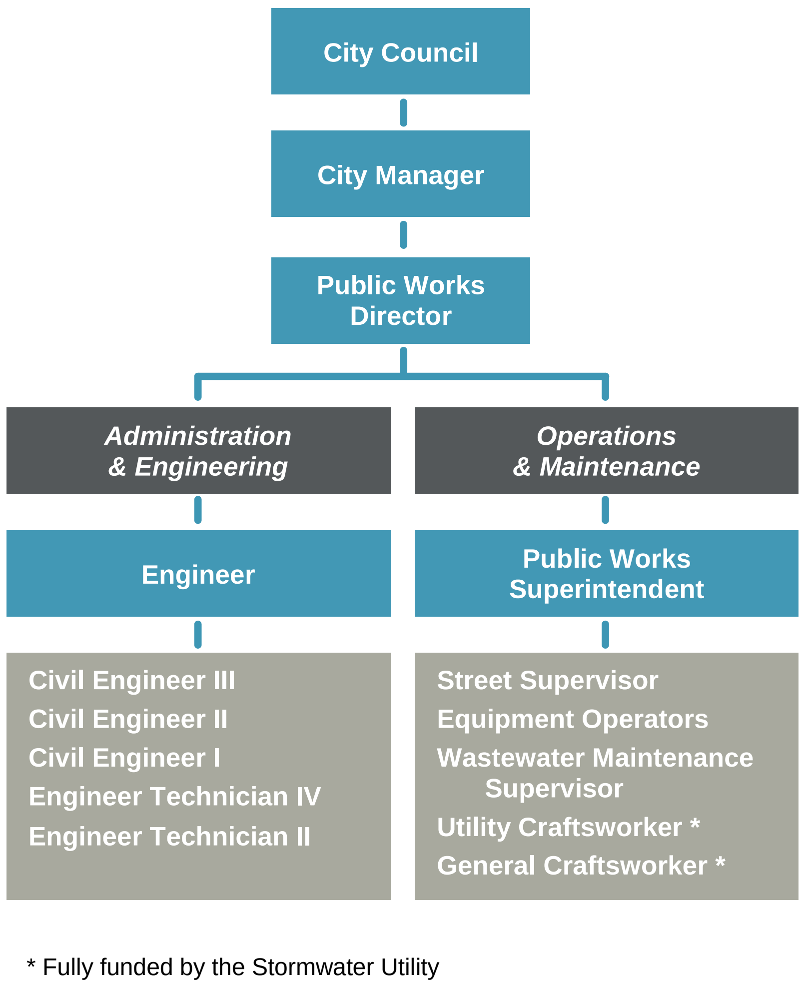

Figure 1-2. Stormwater Utility Organizational Structure

1.6 Organization of this Plan

This remainder of this Plan is organized into the following chapters:

- **Chapter 2 - Study Area Description.** Describes the physical attributes of the service area, encompassing the City and UGA boundaries, that affect stormwater planning and design.
- **Chapter 3 – Design Standards.** Provides a summary of the accepted design standards for use within the city including design storms, rainfall distributions, and best management practices
- **Chapter 4 – Existing Stormwater System Conditions.** Summarizes the existing stormwater infrastructure based on information available in the City’s Geographic Information System (GIS).
- **Chapter 5 – Stormwater Conveyance System Analysis.** Documents updates made to the City’s existing hydrologic/hydraulic Stormwater Management Model (SWMM) and use of the model to assess system deficiencies and identify and perform preliminary planning-level sizing of CIP projects.
- **Chapter 6 – Stormwater Program Elements.** Reviews program requirements, identifies potential gaps, and recommends program updates to comply with the Phase II Permit and the Underground Injection Control (UIC) Rule.
- **Chapter 7 – Structural Improvements.** Summarizes recommended CIPs and their associated opportunities, constraints, and costs.
- **Chapter 8 – Financial Plan Update.** Recommends an updated of the stormwater utility’s financial plan based on the recommended CIPs and stormwater program updates.
- **Chapter 9 – References.**

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Stormwater Management Plan

Section 2. Study Area Description

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Section 2. Study Area Description

2.1 Introduction

The City is located at the confluence of the Columbia and Yakima Rivers, in Benton County in the southeastern part of Washington State (Figure 2-1). Richland is bisected by the Yakima River, which flows southeasterly to its outlet at the Columbia River. The Columbia River forms the eastern boundary of the City, separating it from the City of Pasco.

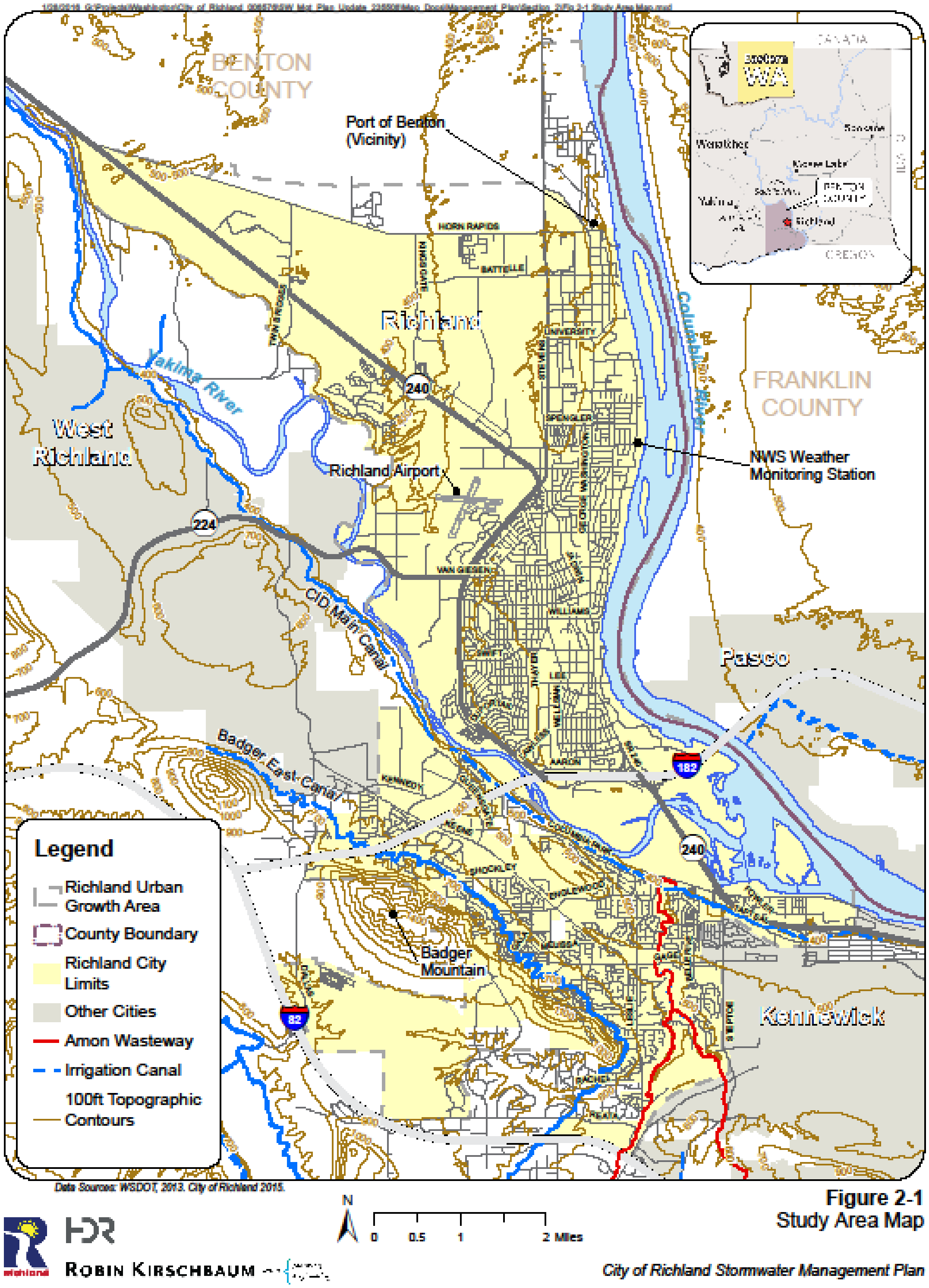
The service area for this Plan is bounded by the City limits and the Urban Grown Area (UGA) boundary and has a total area of approximately 27,263 acres. The remainder of this section focuses on the physical attributes of the service area that affect stormwater planning and design, as follows:

- ***Section 2.1 – Topography*** – Provides brief summary of major topographic features that help define the study area drainage patterns.
- ***Section 2.2 – Geology*** – Describes soil types and hydrologic soil groups and known geologic hazards in the area.
- ***Section 2.3 - Climate and Rainfall Patterns*** – Summarizes semiarid climate conditions and provides summary statistics of long-term monthly mean precipitation, temperature, and snowfall.
- ***Section 2.4 - Land Use Distribution and Urban Growth Areas*** – Defines major land use types and distributions inside and outside of the UGA.
- ***Section 2.5 – Population*** – Provides summary statistics regarding population growth over the last two decades and projected for the next two decades.
- ***Section 2.6 - Sensitive Areas*** – Discusses wetlands, floodplains, and critical habitat areas that must be considered for stormwater planning purposes.
- ***Section 2.7 – Badger Mountain Subarea Annexation*** – Describes the largest planned development in the City and summarizes the planned stormwater management facilities to help mitigate full build-out conditions.
- ***Section 2.8 - Drainage Area Delineation*** – Describes the delineation and drainage patterns of the 8 drainage areas that contribute flows to the City's stormwater management facilities.

2.2 Topography

The City is located near the center of the Pasco Basin on the Columbia plateau, a lowland between the Cascade Mountains to the west and the Northern Rocky Mountains to the east. Topography in this area is typical of a basin and a valley bottomland, with upland plateaus. Long mountain ridges that include the Saddle Mountains, Horse Heaven Hills, and Rattlesnake Hills cross the area. Slopes are predominantly flat (i.e., 3% or less) across the study area, but range from less than 1% to over 20% near the Amon Wasteway, northeast of Badger Mountain, and in the vicinity of Badger Mountain Community Park. Elevations range from approximately 300 feet along the Columbia River to over 1,500 feet in the peaks of surrounding hills (Figure 2-1).

Figure 2-1. Study Area Map



2.3 Geology

The geologic setting of the area is volcanic in origin. A deep series of basalt layers from successive Miocene eruptions are up to 3,000 meters (10,000 feet) thick in the area. Faulting and lifting account for the ridging of the Horse Heaven Hills plateau, Saddle Mountain and other uplands.

2.3.1 Soil Types

Soils in the study area are typically windblown and water deposited sediments and are generally very deep except in locations over basalt bedrock or cemented lime-silica hard pan. The majority of soils are permeable when compacted with high shear strength and low shrink-swell potential. Water erosion hazards are slight but wind erosion can be significant.

Hydrologic soil group (HSG) information is compiled by the USDA Natural Resources Conservation Service (NRCS). HSG information can be used to approximate properties of the soil, such as compaction, infiltration, and gradation. A map of the hydrologic soil groups throughout the City is located in Figure 2-2 and a summary of the different types is provided in Table 2-1.

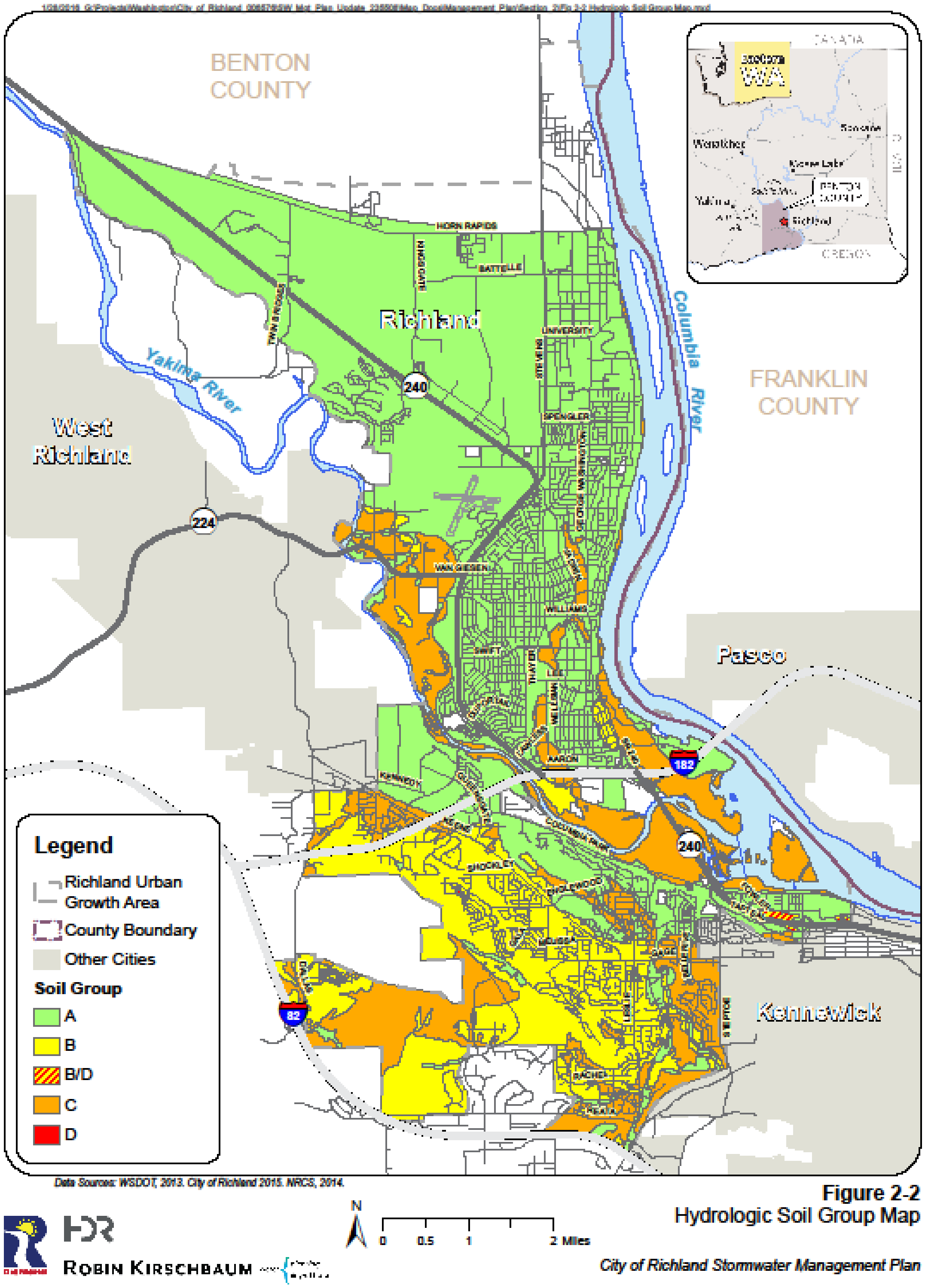
Table 2-1. NRCS Hydrologic Soil Groups

Group	Description
A	Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Some soils having loamy sand, sandy loam, loam or silt loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
B	Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. Some soils having loam, silt loam, silt, or sandy clay loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
C	Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
D	Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential. All soils with a depth to a water impermeable layer less than 50 centimeters [20 inches] and all soils with a water table within 60 centimeters [24 inches] of the surface are in this group, although some may have a dual classification, as described in the next section, if they can be adequately drained.
A/D, B/D, C/D	Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters [24 inches] of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition.

Notes:

a - Source: USDA NRCS Part 630 Hydrology National Engineering Handbook (NRCS, 2009).

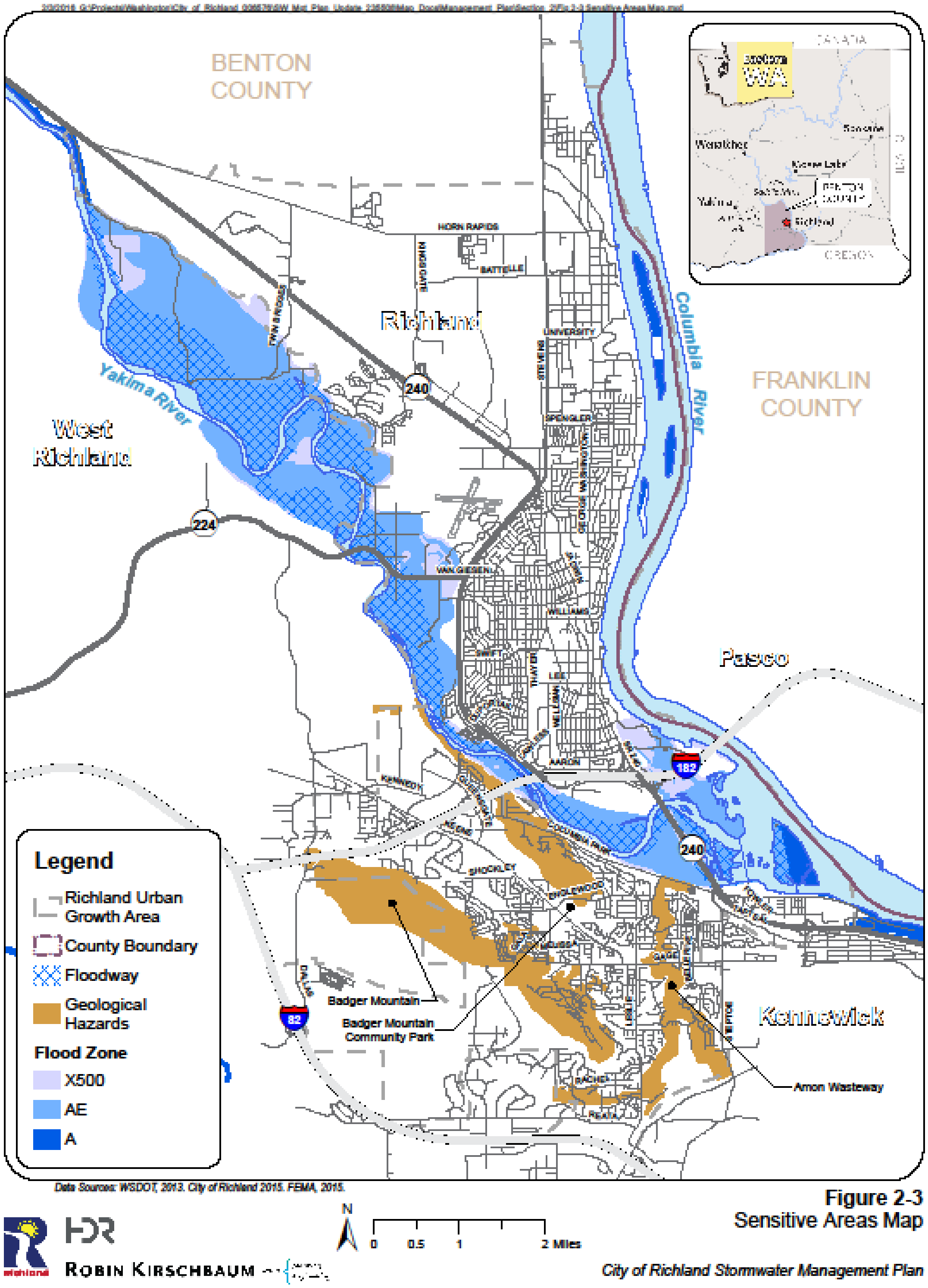
Figure 2-2. Hydrologic Soil Group Map



2.3.2 Geologically Hazardous Areas

Geologically hazardous areas exist within the city limits. These areas are characterized by geologic, hydrologic, and topographic conditions that render them susceptible to potentially significant or severe risk of landslides, erosion, or seismic activity. The steep slopes found primarily along the Amon Wasteway, Badger Mountain ridgeline, and slopes near Badger Mountain Community Park (northeast of Keene Road) are the major geologically hazardous areas (Figure 2-3).

Figure 2-3. Sensitive Areas Map



2.4 Climate and Rainfall Patterns

The regional climate in the study area is semi-arid, with total precipitation averaging approximately 7 inches per year. Most precipitation falls as rain, occurring as thunderstorms during spring and fall and rain during winter months. Snowfall averages approximately 6 inches during the winter.

Temperatures range annually from a low of 0 degrees (°) Fahrenheit (F) to greater than 100°F. Figure 2-4 shows average monthly precipitation and low and high average monthly temperatures. Table 2-2 provides other climate summary information in tabular format based on data downloaded from the National Weather Service for the Richland monitoring station (NWS, 2014).

Section 3 (Design Standards) of this Plan includes detailed information on storm hyetographs and precipitation values used for design purposes. Key design storm precipitation depths are summarized in Table 2-3.

Although detailed, standardized predictions of climate change are not yet available (NWS 2015), the future impacts of climate change should be considered over the time horizon of this Plan (i.e., 20 years). Changes in drought conditions, timing and magnitude of storms, and timing and magnitude of snowfall and snowmelt could impact the function of drainage systems over time. Future updates of this Plan as well as future updates to the City's stormwater design and operation and maintenance standards should incorporate the latest information available on climate change. The City should also monitor changes in the actual performance of the MS4 system over time and make adaptive changes as appropriate to facility design, inspection, operation, and maintenance standards and procedures.

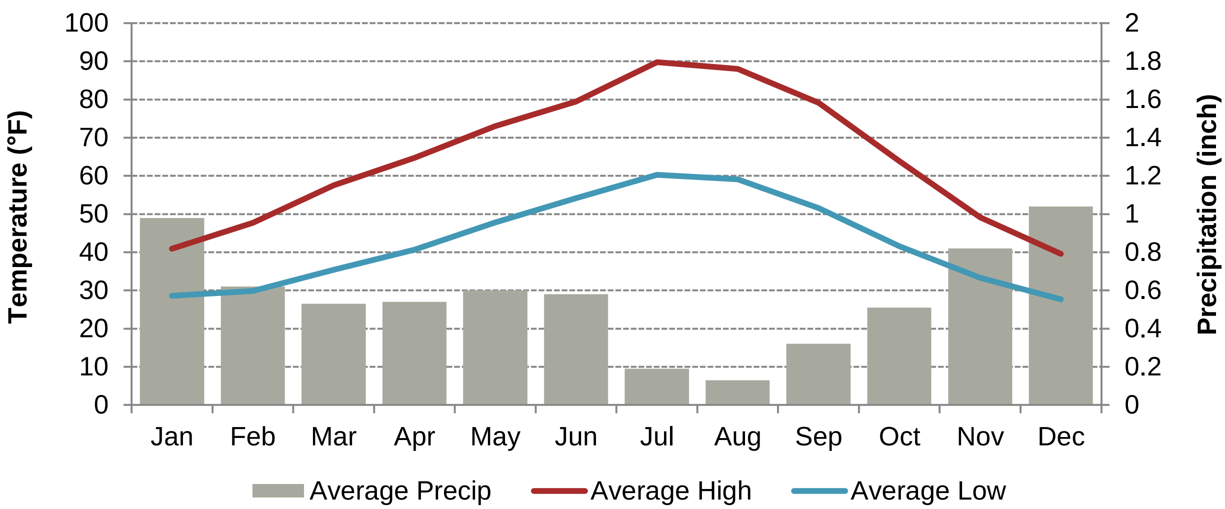


Figure 2-4. Average Monthly Precipitation and Temperature

Table 2-2. Monthly Weather Information for the City of Richland

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg Temp (°F)	34.7	38.8	46.5	52.7	60.4	66.9	75.0	73.5	65.3	52.8	41.2	33.6
Avg High Temp (°F)	40.9	47.7	57.5	64.7	73.0	79.5	89.8	88.0	79.1	63.9	49.1	39.6
Avg Low Temp (°F)	28.6	29.9	35.4	40.7	47.8	54.2	60.3	59.1	51.6	41.6	33.3	27.7
High Recorded Temp (°F)	71	73	82	92	105	110	110	113	106	89	77	66
Low Recorded Temp (°F)	-21	-22	11	23	30	38	41	39	31	13	-6	-10
Avg Precip (inch)	0.98	0.62	0.53	0.54	0.60	0.58	0.19	0.13	0.32	0.51	0.82	1.04
Avg Snowfall (inch)	1.9	1.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.3
Avg Number of Days w/ Precip	12	8	8	7	7	5	2	2	3	7	10	12

Notes:

a - Source: (NWS, 2014). See station location on Figure 2-1.

b - Monthly averages from 1994 to 2014 except for highest and lowest recorded temperature which uses data starting from 1944 to 2014.

Table 2-3. Design Storm Precipitation Depths

Storm Recurrence Interval, Duration	Precipitation Depth (inch)
6-month, 3-hour	0.26
6-month, 24-hour	0.53
2-year, 3-hour	0.42
10-year, 24-hour	1.30
25-year, 24-hour	1.60

Notes:

a - Source: NOAA Atlas 2, Volume IX, 1973 and Stormwater Management Manual for Eastern Washington.

2.5 Land Use Distribution

Richland's current UGA was adopted under the 1997 Comprehensive Plan and updated in 2008. The Comprehensive Plan indicates how land is to be used for development throughout the UGA, illustrated in the Land Use Map in Figure 2-5.

The UGA in the Comprehensive Plan covers an area of approximately 30,269 acres, while the City limit covers an area of approximately 27,263 acres. Areas in the UGA and outside of city limits, consist primarily of industrial and business research areas north of the City, and residential areas to the south of the City. Table 2-4 summarizes the distribution of land uses by acreage and percent coverage across the City and the UGA.

Table 2-4. Distribution of Land Use within City Limits and UGA

Land Use Type [a]	Within City Limits		Unincorporated UGA		Total Acreage	
	Acres	%	Acres	%	Acres	%
Agriculture	919	3%	0	0%	919	3%
Badger Mountain South	1,451	5%	0	0%	1,452	5%
Commercial [b]	2,194	8%	467	16%	2,660	9%
Industrial	4,236	16%	1,049	35%	5,284	17%
Low Density Residential	4,623	17%	775	26%	5,398	18%
Medium Density Residential	1,459	5%	0	0%	1,459	5%
High Density Residential	530	2%	0	0%	530	2%
Open Space	4,327	16%	371	12%	4,698	16%
Public Facility	1,014	4%	28	1%	1,042	3%
Yakima/Columbia Rivers	2,311	8%	157	5%	2,468	8%
Urban Reserve	1,207	4%	8	0.3%	1,215	4%
Waterfront	157	1%	0	0%	157	1%
Undesignated	2,834	10%	152	5%	2,986	10%
Total	27,263 [d]	100%	3,007	100%	30,269	100%

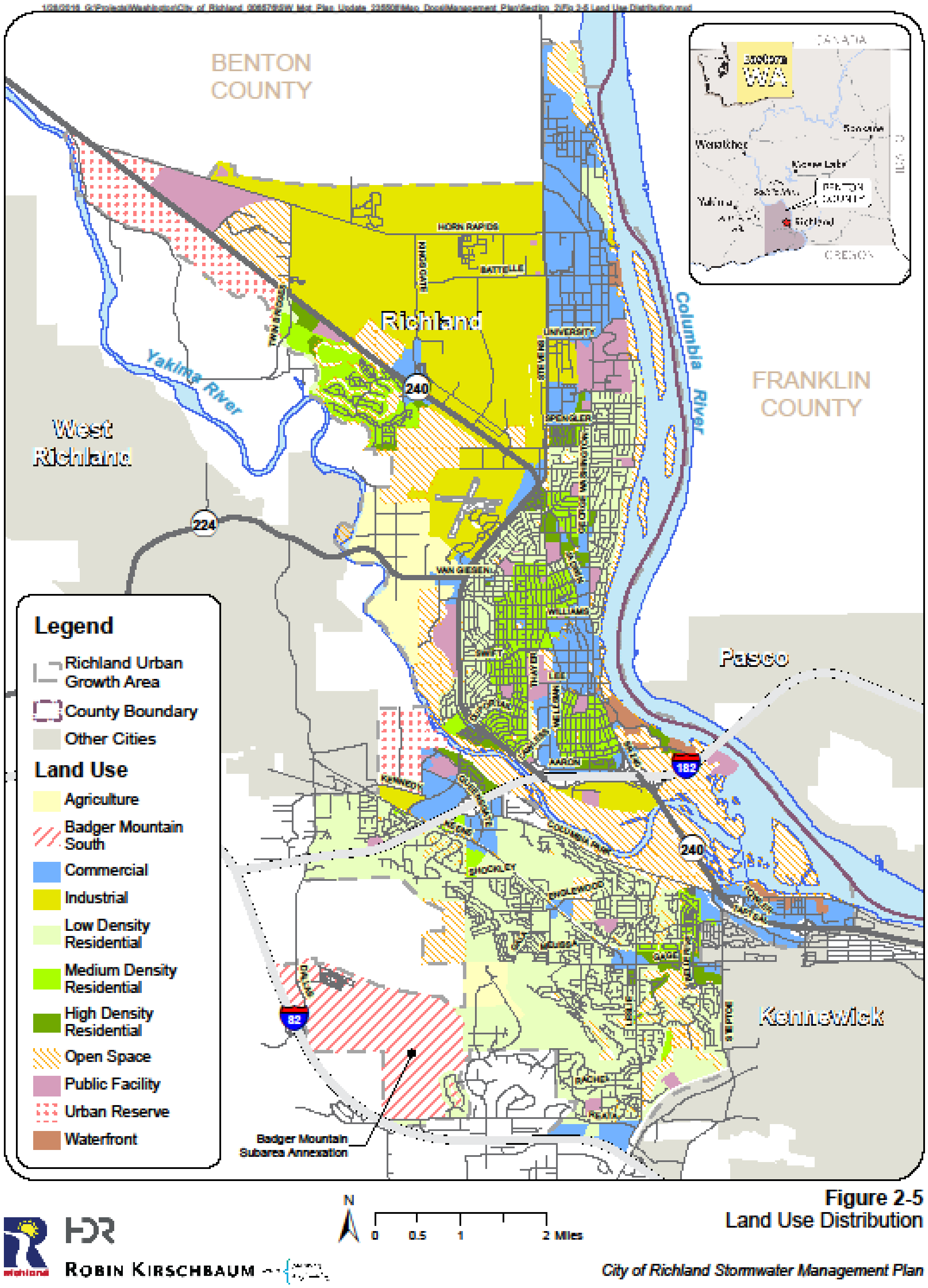
Notes:

a - Land use areas per City GIS land use layers (City of Richland, 2014).

b - Commercial compiles the GIS land use designations of Business Commerce, Business Research Park, Central Business District, Commercial, Commercial Recreation, Island View General Commercial, Island View Residential Office, and Retail Regional.

c - Areas within UGA or City limits that did not have GIS coverage of land use (includes roadways).

Figure 2-5. Land Use Map



2.6 Badger Mountain Subarea Annexation

In December 2010, the City of Richland annexed approximately 1,794 acres south of Badger Mountain (City of Richland, 2010). Before the annexation, the City developed the 2010 Badger Mountain Subarea Plan as an appendix to the City's 2008 Comprehensive Plan update (City of Richland, 2010). The properties within the subarea are primarily undeveloped with a moderately rolling topography and a gradual northern slope to the Badger Mountain saddle.

The soils in the Badger Mountain Subarea are primarily silt loam of variable thickness (City of Richland, 2010). Some existing natural drainage channels are evident in the topography generally running to the southeast and southwest, although they are typically dry due to low average annual precipitation.

Most of the land in the annexation is either planted with agricultural crops or covered in grassy vegetation; however, some development is beginning to occur. Table 2-5 gives an estimate of the planned land use distribution of the Badger Mountain Subarea at full build-out.

Table 2-5. Distribution of Land Use in Badger Mountain Subarea

Land Use	Estimated Acres	Percentage of Area	Estimated Number of All Housing Units
Low Density Residential	451	22%	571
Medium Density Residential	718	36%	3,676
High Density Residential	155	8%	2,000
Commercial, Office, Retail, Destination Retail	225	11%	N/A
Open space, parks, trails, schools, public buildings	464	23%	N/A
Total	**2,013**	**100%**	**6,247**

Notes:

a - Source: Badger Mountain Subarea Plan – Stormwater (PacWest Engineering, 2010)

It is estimated that the Badger Mountain Subarea will have a population of 14,670 by 2030 and will hold the majority of the City's population growth over the next 20 years (City of Richland, 2010).

The Badger Mountain Subarea Plan – Stormwater (PacWest Engineering, 2010) was developed as part of the Badger Mountain Subarea Plan and provides a conceptual design of stormwater facilities for the entire annexation. The plan calls for 12 infiltration ponds located throughout the area that each serves a corresponding drainage basin. The planned infiltration ponds will be designed to retain and infiltrate the 100-year, 24-hour storm. See the referenced stormwater plan for more detailed information.

2.7 Population

Population grew at a steady rate over the last 20 years with an average annual growth rate of approximately 2%. The Office of Financial Management (OFM) estimate of the City of Richland's population in 2014 was 52,090 (Washington Office of Financial Management, 2014). A graph of the City's population trends in the last 20 years is shown in Figure 2-6.

As discussed above, it is estimated that the Badger Mountain Subarea will have a population of 14,670 by 2030 and will hold the majority of the City's population growth over the next 20 years (City of Richland, 2010).

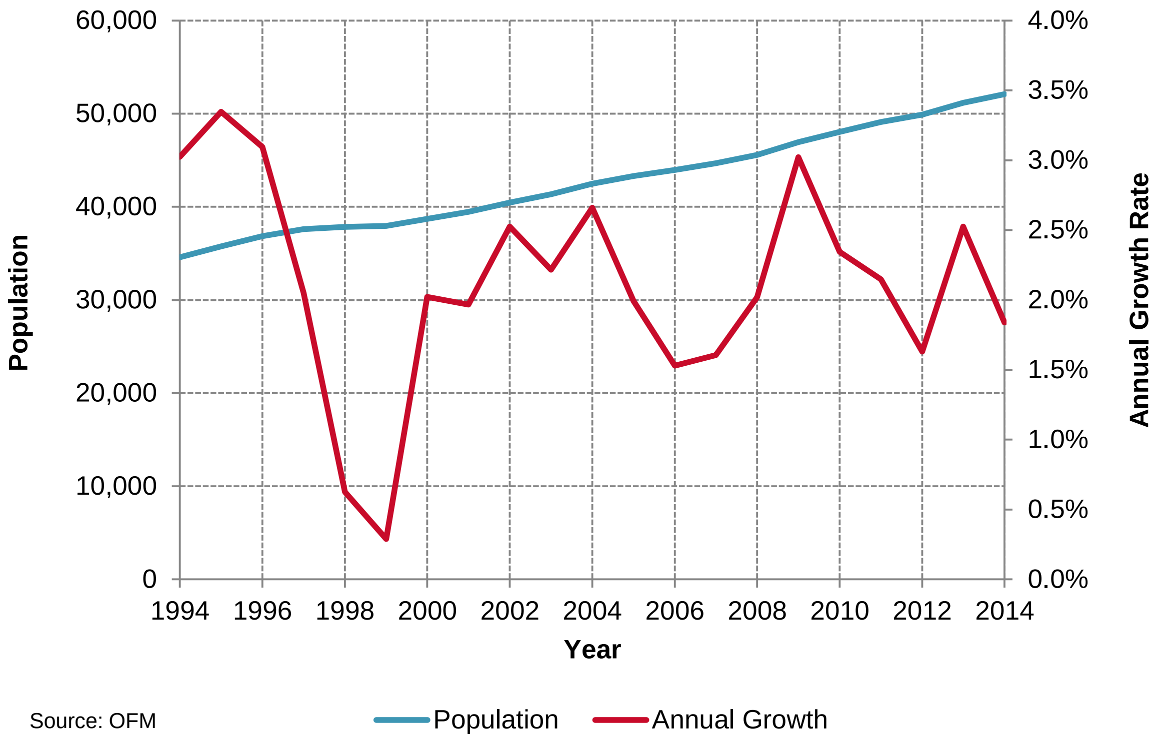


Figure 2-6. Population and Annual Growth

2.8 Sensitive Areas

Chapter 22.10 of the Richland Municipal Code (RMC) covers sensitive areas and contains standards, guidelines, criteria and requirements intended to identify, analyze and mitigate probable impacts to the City of Richland's sensitive areas and geologic hazard areas and to enhance and restore them when possible. The categories of sensitive areas are: (1) wetlands; (2) fish and wildlife habitat areas; (3) geologic hazard areas. Geologic hazards are discussed above in "Geology" (Section 2.3). Wetlands, floodplains, and habitat areas are described in the following sections.

For a more detailed review of the local environment and sensitive areas, refer to the City's 2008 Comprehensive Plan.

2.8.1 Wetlands

Wetlands are defined in the RMC 22.10 (Sensitive Areas) as areas that "…are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including but not limited to irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities. However, wetlands do include those artificial wetlands intentionally created to mitigate conversion of wetlands…"

Wetland buffer area is defined in the Code as "…a naturally vegetated and undisturbed, enhanced or revegetated zone surrounding a natural, restored or newly created wetland that is an integral part of a wetland ecosystem, and protects a wetland from adverse impacts to the integrity and value of the wetland. Wetland buffers serve to moderate runoff volume and flow rates; reduce sediment, chemical nutrient and toxic pollutants; provide shading to maintain desirable water temperatures; provide habitat for wildlife; and protect wetland resources from harmful intrusion."

There are five categories of wetlands defined in the Code. Category I, II, III, and IV are defined by the Washington State Department of Ecology's Wetland Rating System for Eastern Washington, October 1991 (Publication No. 91-58). The fifth category includes "locally significant wetlands," which are wetlands deemed important to the City because they function as part of a water quality or flood mitigation program, are planned to be or can be integrated into an identified open space plan or system, or serve other substantial public purposes.

The category of wetland determines the size of the buffer area around the wetland for low and high impact land use. "Low impact land use" means land uses that are typically associated with relatively low levels of human activity, disturbance or development and that are conducted in a manner as to minimize impacts to the buffer such as passive recreation, agriculture, or conservation activities. "High impact land use" means land uses that are generally associated with relatively high levels of human activity or disturbance, development of structures, or substantial wetland habitat impacts. This would include permanent structures, commercial and industrial land uses, and impactful recreation activities.

The alteration or destruction of wetlands can reduce or eliminate the biological and hydrologic benefits they offer. Direct impact can result from site preparation activities including clearing, grading, and filling, which can increase the volume of sediment-laden storm runoff entering wetlands. This reduces the wetland's natural capacity to remove nutrients, process chemical and organic wastes, and temporarily store floodwaters. Proper management of stormwater runoff in areas that contribute flows to wetlands is critical to maintaining proper wetland function.

The City has identified wetland-type features that are the result of irrigation return flow management (i.e., along Keene Road and the Amon Wasteway) and others near Logston Road. See the SWMMEW Core Elements #5 (Runoff Treatment) and #6 (Flow Control) for guidelines on discharging stormwater runoff to existing wetlands.

2.8.2 Floodplains and Floodways

Federal Emergency Management Agency (FEMA) produces flood insurance rate maps (FIRMs) that indicate the probability of a flood event occurring. The National Flood Hazard Layer (NFHL) is a digital database that contains flood hazard mapping data from FEMA's National Flood Insurance Program (NFIP). This map data is derived from Flood Insurance Rate Map (FIRM) databases and Letters of Map Revision (LOMRs).

Data from the NFIP indicate that floodplains in the area are located along the Yakima River and its confluence with the Columbia River as shown in Figure 2-3 (FEMA, 2015). Table 2-6 provides definitions of the flood zones shown in the figure. No floodplain areas are identified along the Columbia River because a levee was constructed in the late 1940s to protect adjacent lands.

Table 2-6. FIRM Flood Zone Types

Zone Type	Description
X500	Areas inundated by 500-year flooding; inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.
AE	Areas subject to inundation by the 1% annual chance flood event. Base Flood Elevations (BFEs) are known.
A	Areas subject to inundation by the 1% annual chance flood event. No Base Flood Elevations (BFEs) or flood depths have been determined.

Source: FEMA, 2015

Areas along the Yakima River are designated as “floodways” by FEMA. When an area is designated as a floodway, the channel of a river or other watercourse and the adjacent land areas must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height (FEMA, 2015).

The City adopted a Floodplain Ordinance in 1981 and amended it in 1990. Because the City of Richland is a member community to the National Flood Insurance Program (FEMA Community 535533), the ordinance establishes minimum NFIP standards, requirements, and permits for construction and development in areas of special flood hazard. The area of special flood hazard as defined by the ordinance is land in the floodplain subject to a one (1) percent or greater chance of flooding in any given year as identified in Section 23.60.190 of the ordinance. These areas are shown on the sensitive areas map and are consistent with the official map on which FEMA delineated the City’s areas of special flood hazards and risk premium zones.

The Comprehensive Plan designates most of the areas identified as flood hazard areas or wetlands in the Richland’s Sensitive Areas Ordinance as Natural Open Space or Agriculture. Keeping development in these areas limited to such land uses helps minimize potential risks that could occur if the area developed into more impervious or more densely populated land use types.

2.8.3 Critical Habitat

Critical habitat is defined as areas associated with threatened, endangered, sensitive, or priority species of plants and wildlife, the alteration of which could reduce the likelihood that the species will survive and reproduce over the long term. Critical habitat within the City’s UGA also includes the following types of areas (per RMC Section 22.10.170):

- Regionally rare native fish and wildlife habitat within the Mid-Columbia region;
- Fish and wildlife areas with irreplaceable ecological functions, including areas listed as a National Wildlife Refuge, National Park, natural area preserve, or any preserve or reserve designated under the Washington Department of Fish and Wildlife. This includes the Lake Wallula wildlife habitat areas managed by the U.S Army Corps of Engineers and the Yakima River Wildlife Management Area and the Hanford islands in the Columbia River that are managed by the U.S. Fish and Wildlife Service;
- Category I wetlands as defined by the City’s Sensitive Area Ordinance;
- State nature area preserves or natural resource conservation areas identified by the state and managed by the Department of Natural Resources;
- Documented habitat, other than with transient or occasional presence, of threatened or endangered species; and
- Documented habitat, other than with transient or occasional presence, of regional or national significance for migrating birds.

Development can significantly impact critical habitat, either directly by changing land uses within critical habitat areas, or indirectly, through loss or alteration of wetlands, riparian areas, and flood storage areas. Properly managing stormwater runoff in or upgradient of critical habitat areas can significantly help protect these resources.

2.9 Drainage Area Delineation

The study area is divided into 9 drainage areas, or basins, covering approximately 30,000 acres. In addition to these drainage areas located within the study area, a large drainage area south of the City contributes stormwater runoff to the Amon Wasteway. This drainage area was accounted for in the modeling of peak flow rates for sizing Capital Improvement Projects, as discussed in more detail in Section 5 (Stormwater Conveyance Model Analysis).

Table 2-7 summarizes the individual drainage areas and their predominant land use and soil types based on available GIS data (City of Richland, 2014). Figure 2-7 provides a drainage area map showing subbasin areas, while the text below briefly describes each.

Figure 2-7. Drainage Area Map

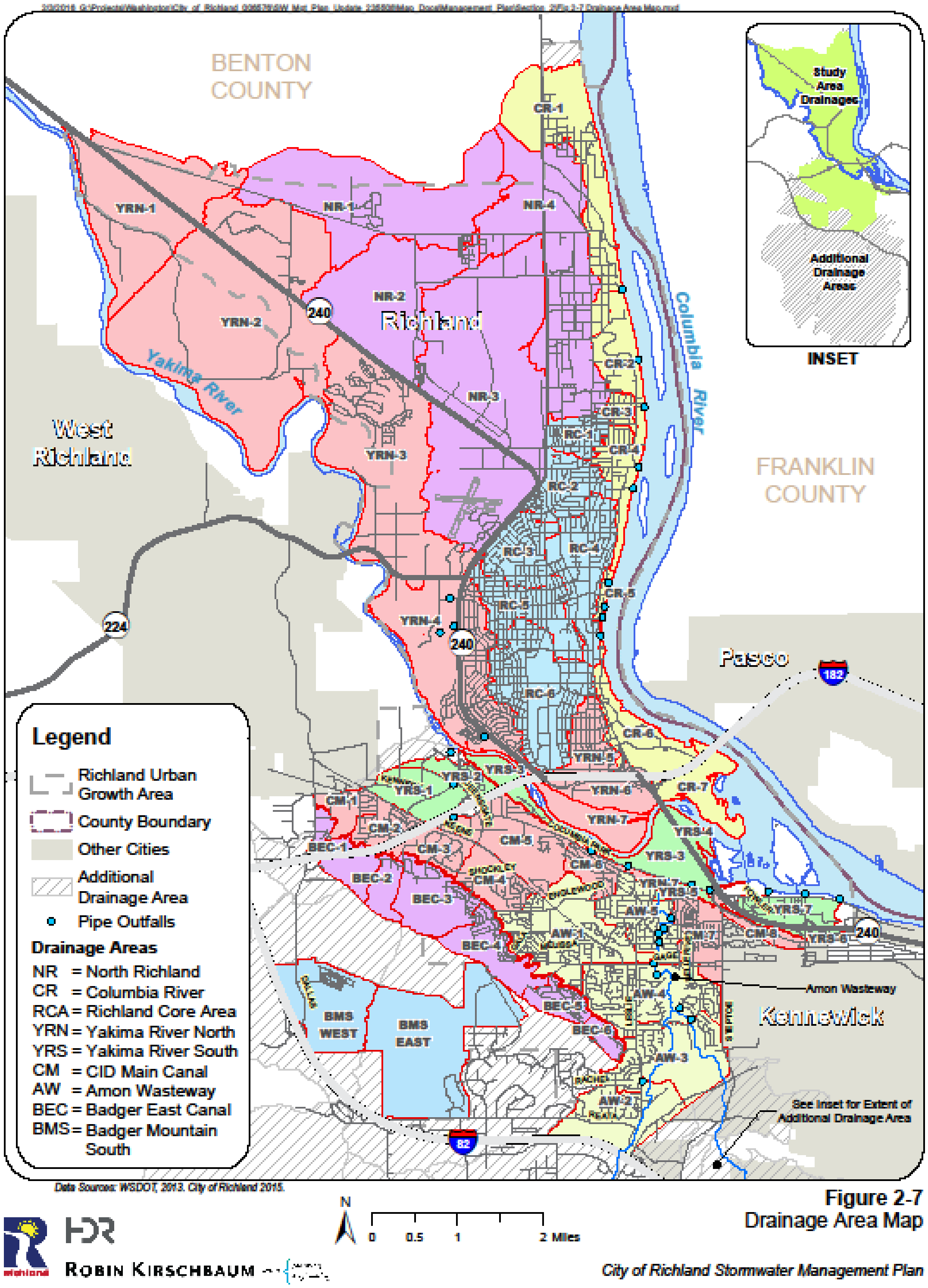


Table 2-7. Drainage Area Summary

Drainage Area	Size (acres)	Predominant Land Use Type [a]	Predominant Hydrologic Soil Group and Soils Series [b]
North Richland (NR)	7,090	Industrial	A, Quincy loamy sand
Columbia River (CR)	2,386	Open Space	A, Burbank loamy fine sand
Richland Core Area (RC)	2,750	Medium Density Residential	A, Burbank loamy fine sand
Yakima River North (YRN)	8,438	Open Space	A, Quincy loamy sand
Yakima River South (YRS)	1,344	Open Space	A, Pasco silt Loam
CID Main Canal (CM)	1,909	Low Density Residential	A, Burbank loamy fine sand
Amon Wasteway (AW)	2,974	Low Density Residential	B, Warden silt loam
Badger East Canal (BEC)	1,366	Low Density Residential	B, Warden silt loam
Badger Mountain South (BMS) [c]	1,772	Agriculture, Multi-family Residential	B, Warden silt loam
Total	**30,029**		

Notes

a - Land use types based on 2008 Comprehensive Land Use Plan (City of Richland, 2008).

b - Soil information based on National Resource Conservation Service (NRCS) for Benton County (NRCS, 2013).

c - Badger Mountain South Annexation (Dec. 2010) was 1,794 acres. A portion of the annexation was included in the CID Main Canal drainage area.

2.9.1 North Richland Basin

Table 2-8. North Richland Basin Overview

Property	Value
Receiving water body	Yakima River (via drainage ditches)
Drainage area	7,090 acres
Number of outfalls directly discharging to receiving water body	0 (infiltrates or conveyed to adjacent basins)
Number of subbasins	4

The North Richland Basin is located in the northern portion of the City and covers an area of approximately 7,090 acres. The basin is planned to be predominantly industrial, with relatively flat topography throughout. However a large portion of the basin remains undeveloped. A few areas of residential and agricultural land exist in the basin but much of the recent development in the area is associated with the Horn Rapids Industrial Park. Stormwater runoff from the majority of the basin (areas north of State Route 240) infiltrates and does not discharge to a receiving water body. Runoff from the basin south of State Route 240 in the vicinity of the Richland Airport infiltrates on site either through surface infiltration in open areas or via drywells in developed industrial/commercial areas around the airport.

Table 2-9. North Richland Subbasin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
NR-1	1,560	Industrial	A	Quincy loamy sand
NR-2	1,144	Industrial	A	Quincy loamy sand
NR-3	2,757	Industrial	A	Quincy loamy sand

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
NR-4	1,629	Commercial	A	Burbank loamy fine sand

2.9.2 Columbia River Basin

Table 2-10. Columbia River Basin Overview

Property	Value
Receiving water body	Columbia River
Basin area	2,386 acres
Number of outfalls directly discharging to receiving water body	8
Number of subbasins	7

The Columbia River Basin is also located in the northern portion of the City, covering an area of approximately 2,386 acres. The basin is bounded to the west by George Washington Way and to the east by the Columbia River. Cypress Street and the confluence of the Yakima River and Columbia River systems form the northern and southern boundaries, respectively.

The basin is comprised mainly of residential area and is predominantly flat throughout. Runoff is collected and conveyed primarily via catch basin and closed conveyance features and is generally conveyed easterly to various outfalls that discharge to the Columbia River (Figure 2-7).

Table 2-11. Columbia River Subbasin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
CR-1	949	Commercial	A	Burbank loamy fine sand
CR-2	340	Public Facility	A	Finley fine sandy loam
CR-3	78	Low Density Residential	A	Finley fine sandy loam
CR-4	270	Low Density Residential	A	Burbank loamy fine sand
CR-5	41	Low Density Residential	A	Finley fine sandy loam
CR-6	417	Open Space	C	Pasco fine sandy loam
CR-7	291	Open Space	C	Pasco silt loam

2.9.3 Richland Core Basin

Table 2-12. Richland Core Basin Overview

Property	Value
Receiving water body	Columbia River
Basin area	2,750
Number of outfalls directly discharging to receiving water body	1
Number of subbasins	6

The Richland Core Basin is located in the northern portion of the City, covering an area of approximately 2,750 acres. The basin is bounded to the west approximately near State Route 240 and to the east near George Washington Way. The approximate bounds of the north and south boundaries are Snyder Street and Interstate (I)-182, respectively. The basin is comprised mainly of residential area and is predominantly flat throughout. Runoff is collected and conveyed primarily via conventional catch basin and closed conveyance features. Flows generated within the basin are generally conveyed easterly and discharged to the Columbia River primarily through the Central Richland Ditch outfall, which is controlled and serviced by a US Army Corps of Engineers pump station.

Table 2-13. Richland Core Subbasin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
RC-1	195	Low Density Residential	A	Burbank loamy fine sand
RC-2	327	Low Density Residential	A	Burbank loamy fine sand
RC-3	348	Low Density Residential	A	Burbank loamy fine sand
RC-4	584	Low Density Residential	A	Burbank loamy fine sand
RC-5	450	Medium Density Residential	A	Burbank loamy fine sand
RC-6	845	Medium Density Residential	A	Quincy loamy sand

2.9.4 Yakima River North Basin

Table 2-14. Yakima River Basin Overview

Property	Value
Receiving water body	Yakima River
Basin area	8,438 acres
Number of outfalls directly discharging to receiving water body	0
Number of subbasins	7

The Yakima River Basin covers an area of approximately 8,438 acres and is adjacent to the Yakima River. The area is bounded to the west by the Yakima River and extends north to the northern extents of the City limits and south to the Yakima River and Columbia River confluence.

The drainage basin is comprised mainly of open space with developed areas consisting primarily of agricultural and residential uses. There are also small pockets of industrial and commercial areas. Topography is relatively flat throughout.

A few drainage ditches are dispersed through former agricultural areas in the basin that convey sheet flow runoff from nearby areas to an open ditch that parallels the westbound lanes of I-182. Based on observations by HDR staff, collected runoff typically infiltrates within the ditch alongside I-182.

Table 2-15. Yakima River North Subbasin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
YRN-1	1,346	Urban Reserve	A	Quincy loamy sand
YRN-2	3,216	Rural Lands[a] (for entire subbasin), Open Space (for area within City)	A	Quincy loamy sand
YRN-3	1,728	Agriculture	A	Quincy loamy sand
YRN-4	1,220	Open Space	A	Quincy loamy sand
YRN-5	264	Medium Density Residential	A	Finley fine sandy loam
YRN-6	309	Industrial	A	Pits
YRN-7	355	Open Space	C	Pasco silt loam

Notes

a - Rural Lands is a Benton County zoning designation and is the zoning for the subbasin outside of City limits (Benton County, 2015).

2.9.5 Yakima River South Basin

Table 2-16. Yakima River South Basin Overview

Property	Value
Receiving water body	Yakima River, Columbia River
Basin area	1,344 acres
Number of outfalls directly discharging to receiving water body	3
Number of subbasins	5

The Yakima River South Basin covers an area of approximately 1,344 acres and is located in the southern part of the City adjacent to the Yakima River. The basin is bounded to the south by I-182 (in areas west of the CID Main Canal) and the CID Main canal, to the west by Keene Road, and to the east by a highpoint in topography near the REACH Museum.

The drainage basin has relatively flat topography throughout and is comprised mostly of open space areas while developed areas consist mainly of residential, commercial, and residential. For the Queensgate Drive area of the basin, runoff flows easterly via either overland flow or conventional collection and conveyance systems. Runoff is typically conveyed to detention ponds that manage smaller flows through infiltration and/or evaporation. Larger flows that exceed the storage capacity of the ponds are conveyed by pipe under the Columbia Canal to the Yakima River. Runoff generated from the area of the basin south of the Yakima River Delta is collected and conveyed through conventional conveyance features and routed northerly where it is ultimately discharged to the Yakima River Delta or Columbia River system.

Table 2-17. Yakima River South Subbasin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
YRS-1	301	Commercial	A	Quincy loamy sand
YRS-2	140	High Density Residential	A	Quincy loamy sand
YRS-3	464	Open Space	C	Pasco silt loam

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
YRS-4	114	Open Space	C	Pasco silt loam
YRS-5	61	Open Space	A	Finley stony fine sandy loam
YRS-6	39	Undesignated/Unknown [a]	A	Burbank loamy fine sand
YRS-7	225	Commercial	A	Burbank loamy fine sand

Notes:

[a] "Undesignated/Unknown" land use signifies lack of available GIS data for area

2.9.6 CID Main Canal Basin

Table 2-18. CID Main Canal Basin Overview

Property	Value
Receiving water body	CID main canal
Basin area	1,909 acres
Number of outfalls directly discharging to receiving water body	0
Number of subbasins	8

The Columbia Irrigation District (CID) Main Canal Basin is located in the southern portion of the City and covers an area of approximately 1,909 acres. The basin extends from the western extents of the southern portion of the City (N Dallas Road) to approximately the eastern extents (N Columbia Center Boulevard). The basin is comprised mainly of residential areas with low to moderate slopes throughout.

Runoff from the basin either infiltrates or is intercepted by the CID Main Canal where water is conveyed through the canal and discharged to the Columbia River east of Kennewick. Downstream of subbasin CM-5, the CID Main Canal passes over the Amon Wasteway via an overhead flume and continues into CM-6 and CM-7.

Table 2-19. CID Main Canal Subbasin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
CM-1	156	Single-family Residential	B	Hezel loamy fine sand
CM-2	187	Single-family Residential	C	Hezel loamy fine sand
CM-3	194	Single-family Residential	B	Warden silt loam
CM-4	255	Single-family Residential	B	Warden silt loam
CM-5	552	Single-family Residential	A	Quincy loamy sand
CM-6	181	Single-family Residential	A	Quincy loamy sand
CM-7	287	Medium Density Residential	A	Burbank loamy fine sand
CM-8	96	Commercial	A	Burbank loamy fine sand

2.9.7 Amon Wasteway Basin

Table 2-20. Amon Wasteway Basin Overview

Property	Value
Receiving water body	Yakima River
Basin area	2,974 acres
Number of outfalls directly discharging to receiving water body	9
Number of subbasins	5

The Amon Wasteway Basin is located in the southern portion of the City, covering approximately 2,974 acres. The basin is bounded approximately to the west by the CID Main Canal, to the east by Steptoe Street, to the north by Columbia Park Trail, and to the south by I-82.

Predominant land uses in the basin include residential and commercial, with low to moderate slopes throughout.

The United States Bureau of Reclamation (USBR) owns an irrigation return flow easement that parallels Keene Road and conveys return flows (unused irrigation water) to the Amon Wasteway. The City has an agreement with the USBR to co-locate City stormwater runoff within the easement.

A significant amount of additional drainage area south of the City flows through the Amon Wasteway, indicated as “Additional Drainage Area” on Figure 2-7. Flows from the Amon Wasteway, including contributions from stormwater runoff, irrigation return flows, groundwater, and the additional run-on from the southern tributary areas, discharge to the Yakima River. The operational flows from the USBR and Kennewick Irrigation District (KID) are significant and need to be considered in stormwater facility sizing, as discussed further in Section 5.

Table 2-21. Amon Wasteway Basin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
AW-1	760	Low Density Residential	B	Warden silt loam
AW-2	518	Low Density Residential	C	Hezel loamy fine sand
AW-3	621	Low Density Residential	B	Hezel loamy fine sand
AW-4	677	Low Density Residential	B	Warden silt loam
AW-5	398	Low Density Residential	A	Burbank loamy fine sand

2.9.8 Badger East Canal Basin

Table 2-22. Badger East Canal Basin Overview

Property	Value
Receiving water body	Badger East Canal
Basin area	1,366 acres
Number of outfalls directly discharging to receiving water body	0
Number of subbasins	6

The Badger East Canal Basin is located in the southwestern portion of the City and covers an area of 1,366 acres. The basin boundaries are approximately formed by the canal to the northeast and by the Badger Mountain ridgeline that runs approximately parallel to (southwest of) the canal.

The basin is comprised mainly of agricultural and residential areas and has a high degree of variability in topography. Steep slopes emanate from the Badger Mountain ridgeline and transition to flat slopes near the canal.

Runoff from the steeper areas is conveyed via the natural open channel drainages to the conventional collection and conveyance systems in the residential areas. The stormwater runoff intercepted by the Badger East Canal is conveyed northwesterly through canal system where excess water discharges to a low lying depression southwest of West Richland and either infiltrates or evaporates. Stormwater discharges to the canal pre-date federal and state stormwater quality regulations and have been the subject of USBR review in recent years.

Table 2-23. Badger East Canal Subbasin Details

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
BEC-1	116	Low Density Residential	B	Warden silt loam
BEC-2	281	Low Density Residential	B	Shano silt loam
BEC-3	397	Low Density Residential	B	Warden silt loam
BEC-4	335	Low Density Residential	B	Warden silt loam
BEC-5	157	Low Density Residential	B	Shano silt loam
BEC-6	80	Low Density Residential	B	Shano silt loam

2.9.9 Badger Mountain South

Table 2-24. Badger Mountain South Overview

Property	Value
Receiving water body	Kennewick Main Canal
Basin area	1,772 acres
Number of outfalls directly discharging to receiving water body	0
Number of subbasins	2

Badger Mountain South is located in the southwestern portion of the City south of Badger Mountain and is part of a recent annexation to the City. The area covers approximately 1,772 acres, bounded to the south and west by I-82 and to the north by the City limits.

Current land uses are predominantly agricultural with pockets of new residential development. However, significant residential and commercial development is expected to occur in the area.

The area is subdivided into BMS-West and BMS-East. BMS-West drains toward Dallas Road and the I-82 interchange to a culvert that runs beneath I-82 and daylights southwest of the interchange. Flow then disperses and travels across agricultural fields before discharging to the Kennewick Main Canal operated by KID, if it did not previously infiltrate. BMS-East drains to the Reata Canyon Drainage which discharges to the Amon Wasteway.

Table 2-25. Badger Mountain South

Subbasin	Area (ac)	Dominant Land Use	Dominant Hydrologic Soil Group	Dominant Soil Type
BMS-West	573	Agriculture (current), Multi-family Residential (future developed)	B	Warden silt loam
BMS-East	1,199	Agriculture (current), Multi-family Residential (future developed)	C	Hazel loamy fine sand

Stormwater Management Plan

Section 3. Design Standards

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Section 3. Design Standards

3.1 Introduction

This section provides an overview of the design standards and practices the City has incorporated regarding the construction and maintenance of stormwater infrastructure. This section is organized as follows:

- ***Section 3.2 – Existing Codes, Ordinances, and Standards, and Rules*** – Reviews codes, ordinances, standards, and rules that regulate and guide development and management of stormwater runoff.
- ***Section 3.3 – Submittal, Permitting, Construction, and Inspection Procedures*** – Provides an overview of the steps required for design and installation of stormwater infrastructure, including review and inspection during and after construction.
- ***Section 3.4- Recommended Updates*** – Presents recommended updates for City documents including recommended updates to municipal code, standard design guidelines and construction details, standard details, and city special provisions.

3.2 Existing Codes, Ordinances, Standards, and Rules

This section reviews important codes, ordinances, standards, and rules that affect stormwater management. The discussion is organized into separate subsections: one subsection regarding stormwater codes and ordinances and another regarding related topics such as zoning, subdivision, floodplains, and critical areas.

3.2.1 City Stormwater Codes and Ordinances

Title 16 of the Richland Municipal Code (RMC) establishes minimum stormwater management requirements and controls to regulate stormwater runoff from construction, development, and redevelopment sites. This title provides methods for controlling runoff and pollutant loading to the municipal separate storm sewer system (MS4) to address requirements of the Washington State Department of Ecology Eastern Washington NPDES Phase II Municipal Stormwater Permit (Phase II Permit). RMC 16.06.010 (Administration and purpose) states the following goals:

- To regulate the contribution of runoff and pollutants to the MS4 from stormwater discharges from land-disturbing activities, construction activities, new land development, and redevelopment;
- To establish legal authority to carry out all inspection, surveillance, monitoring procedures, and enforcement necessary to comply with Title 16; and
- To provide long-term responsibility for and maintenance of stormwater BMPs (Ordinance 12-10 §1.03).

Applicability and Exemptions

RMC 16.06.020 requires application of Title 16 for all construction activity and land development within the City limits that meets one or more of the following criteria:

1. Construction activities, new development and redevelopment on sites of one acre or more;
2. Any new development or redevelopment, regardless of size, that is identified by the director to be an area where the land use has the potential to generate contaminated runoff; or

3. Land development activities that are smaller than the minimum applicability criteria set above if such activities are part of a larger common plan of development, even though multiple, separate and distinct land development activities may take place at different times on different schedules. This could include single-family home building on platted lots and development within a short plat or binding site plan.

Exemptions pertain to forest practices, commercial agriculture (excluding construction of impervious surfaces), oil and gas field activities, and road and parking area preservation and maintenance.

Design and Construction

RMC 16.06.030 (Construction) requires that all construction subject to Title 16 must comply with the standards and requirements set forth in the City of Richland Standard Design Guidelines and Construction Details (Design Guidelines)[1] and the Stormwater Management Manual for Eastern Washington (SWMMEW), as discussed further below (Section 3.3). Some projects may qualify for reduced submittal and inspection requirements if the following conditions are met:

3. The project disturbs less than five acres and the site is not part of a larger development or sale that will disturb five acres or more; and
4. The project qualifies for an erosivity waiver from the Department of Ecology

All projects, whether they meet the above criteria or not, must submit a Stormwater Pollution Prevention Plan (SWPPP).

Post-Construction

RMC 16.06.050 (Post-construction responsibilities) requires that property owners provide continual performance, operation, and maintenance of all permanent private stormwater facilities in accordance with the standards and requirements of the City. All new permanent private stormwater facilities must have a written operation and maintenance (O&M) plan and the City retains the right to inspect all permanent private stormwater facilities, BMPs, O&M plans and O&M records.

Recommended Code revisions to comply with the updated Phase II Permit are discussed below in Section 3.4.1 and in Section 6 (Program Elements).

3.2.2 Related City Codes and Ordinances

This section identifies aspects of other chapters of the RMC that relate to stormwater quantity and quality:

- Chapter 3.30 - Utility Billing and Collection – Describes the processes for billing and collection of fees for utilities services, including the stormwater utility services.
- Title 12 - Streets and Sidewalks – Provides standards and criteria for street and sidewalk construction. Due to their relatively large impervious footprint and pollutant loading characteristics, street and sidewalk standards can significantly impact stormwater runoff and water quality in receiving waters.
- Chapter 22.10 - Sensitive Areas – Contains standards, guidelines, criteria and requirements to identify, analyze and mitigate probable impacts to the City’s sensitive areas and geologic hazard areas and to enhance and restore them when possible. Chapter 22.10.125 requires new

[1] Design Guidelines are referred to as Richland Standard Design Guidelines and Construction Details in the RMC but the actual document available on the City website is titled Public Infrastructure Construction Plan Requirements and Design Guidelines.

development with 150 feet of a wetland buffer to retain all runoff within the developed portions of the site and not allow stormwater runoff to drain into the wetland.

- Chapter 22.14 - Richland Tree Ordinance - Establishes regulations and standards to ensure that the City continues to realize the benefits provided by trees, including reduction in stormwater runoff and pollutant loading.
- Title 23 - Zoning Regulations - Protects and promotes public health, safety, and general welfare through land use planning. Zoning regulations can affect tree canopy, vegetation, and impervious surfaces and can, therefore, have a large impact on stormwater management.
- Tile 26 - Shoreline Management - Establishes a shoreline master program and restricts types of land uses immediately adjacent to shorelines. Also requires that stormwater facilities be separated from sewage disposal systems.

3.2.3 Underground Injection Control (UIC)

As required by the US Environmental Protection Agency (EPA), the State has developed an Underground Injection Control (UIC) Rule and program that is administered by the Department of Ecology. The purpose of the program is to protect ground water quality by regulating the use of UIC wells which dispose of water underground.

A UIC well is defined as a “manmade subsurface fluid distribution system designed to discharge fluids into the ground and consists of an assemblage of perforated pipes, drain tiles, or other similar mechanisms, or a dug hole that is deeper than the largest surface dimension” (Ecology, 2006). Common stormwater UIC wells include drywells, french drains, drain fields, and some commercially manufactured stormwater infiltration devices. Surface infiltration facilities and infiltration trenches lacking a perforated pipe or similar mechanism are not considered a UIC well.

The two main requirements of the UIC program are to (1) register UIC wells with Ecology, and (2) to make sure that groundwater quality is protected from pollutants that may be introduced through a manmade fluid distribution system. Registration can be completed through an online form available on the Ecology website.

Installation of a commercially manufactured stormwater infiltration device which meets the definition of a UIC well

A well assessment is required for all UIC wells built and in use prior to February 2, 2006 and used to manage stormwater. Wells constructed after this date must be built to the current UIC Program rule, chapter 173-218-WAC UIC Program and the current Ecology stormwater management manual for the location of the well.

UIC wells typically require a form of pre-treatment prior to infiltrating stormwater runoff. The level of treatment is based on the pollutant loading of stormwater influent (which depends on the land use of the contributing basin) and the treatment capacity of the vadose zone of soil around the UIC well. If the contributing basin is prone to spills, such as high vehicle traffic areas, a spill control devise (e.g., turn down elbow, tee section, etc.) is required upstream of the UIC well. Depending on treatment requirements, pre-treatment may be accomplished through BMPs like swales, bio-infiltration, oil/water separators, catch basin inserts, and media filters. See the guidelines provided in Guidance for UIC Wells that Manage Stormwater (Ecology, 2006).

3.2.4 Phase II Permit

See Section 1 (Introduction) for a description of the Phase II Permit. See Appendix A for a copy of the permit and Appendix B for a copy of the City's Stormwater Management Program Plan (SWMP Plan) 2015 annual report.

3.2.5 NPDES Construction Stormwater General Permit

The Construction Stormwater General Permit (CSWGP), administered by Ecology, applies to construction sites disturbing one acre or more and discharging stormwater to a water of the State (either directly or through a stormwater system) or for any sized construction project that has been determined by Ecology to pose a significant risk or degrade water quality. Section 3.3 provides further discussion on the City's implementation of the CSWGP.

3.2.6 Endangered Species Act

The Endangered Species Act (ESA) is a federal law with the purpose of protecting critically threatened fauna and flora. The law includes requirements that prevent endangered species from being killed or harmed. Criteria relating to ESA must be met in order to be eligible for coverage under the CSWGP or the 2008 Multi Sector General Permit (EPA 2015).

3.2.7 Water Quality Assessments and 303(d) List

The 303(d) list comprises state waters that have been polluted and have been impaired for beneficial uses such as drinking, recreation, aquatic habitat, and industrial use. Special requirements and restrictions, such as total maximum daily loads (TMDLs), take affect if discharging to a 303(d) water body are described in Appendix 2 of the Phase II Permit. The reaches of the Yakima and Columbia Rivers that the City discharges to are not on the 303(d) list and therefore the City currently does not have any TMDL or other 303(d) restrictions.

3.2.8 Existing City Design Standards

All stormwater conveyance, on-site management, flow control, and treatment facilities must be designed in accordance with the latest edition of the SWMMEW as modified by the latest edition of the Design Guidelines.

A summary of key stormwater design requirements in the current Design Guidelines (dated January 7, 2015) includes:

- All stormwater systems shall be designed following the core elements defined in the SWMMEW.
- Hydrologic analysis and design of conveyance systems must be designed as described in the SWMMEW, using the Washington, Region 2, Benton County; Soil and Conservation Service (SCS) Type 1A – 24-hour storm with a 25-year return period.
- Public storm drain pipes and inlets shall be designed based on the 2-year, 3-hour short duration storm, using the SCS or Santa Barbra Urban Hydrograph (SBUH) method.
    - The resulting storm drain facilities must not modify or increase the time of concentration and must not cause or exacerbate existing surcharging of pipes or structures.
    - A 50-foot wide strip behind each right of way line should be included in the calculations to represent drainage from private property into the City system. Of that area, 50% shall be considered pervious and 50% impervious.

- If a proposed developed site will contain at least 1,000 square feet (sq.ft.) of impervious area and/or the project will increase impervious areas by 30% or more, storm drainage calculations from a licensed civil engineer are required as part of design.
- All storm drainage pipes and culverts must have at least a 12-inch diameter. Pipes shall have a minimum slope of 0.5%, a minimum velocity of 3 feet per second (ft/s), be constructed of SDR35 PVC, and shall not surcharge under design storm conditions.
- Manholes are required at all angle points and changes in slope for pipes. Curved or deflected storm drainage lines are not allowed. For 12-inch-diameter pipes, the maximum spacing between manholes is 400 ft. The required maximum spacing is 600 ft for larger diameter pipes.
- Catch basin and inlet spacing shall not exceed 500 ft between inlet structures. At low points and sag curves, twice the required inlet capacity shall be provided.
- Stormwater flow is not allowed to flow across intersections (i.e., valley gutters crossing intersections are not allowed).
- A “spill control” separator is required prior to discharging any storm drainage waters from paved surfaces into drainage ditches, ground water, or a public drainage collection system.
- Stormwater runoff from City right-of-ways is typically collected into a central collection basin. Drywells are only allowed in limited applications where a central collection basin would not function.
- A spill control separator is required prior to discharging stormwater into landscaped ponds in addition to any BMPs required for runoff or flow control per the SWMMEW.
- Surface water from a pollution-generating source (i.e., paved areas subject to regular vehicular use) shall not be collected directly into a subsurface infiltration BMP, but shall first be collected in an inlet, swale, or other means for separating suspended solids.

Recommended changes to the Design Guidelines are provided in Section 3.4.2.

3.2.9 Design Storms

Design storms are mathematical representations of storm events that reflect the frequency, duration, depth, and temporal distribution of rainfall. Table 3-1 summarizes the total rainfall depth and applicability of several design storms that must be used for sizing various types of stormwater infrastructure in Richland. The 6-month, 3-hour design storm, with a total rainfall depth of 0.26 inches must be used for designing flow-based water quality treatment BMPs, such as swales or media filters, while the 6-month, 24-hour design storm with a total rainfall depth of 0.53 inches must be used for volume-based water quality treatment BMPs, such as infiltration ponds. Refer to the SWMMEW to determine circumstances for selecting an appropriate water quality design storm.

The values shown in the table represent rainfall values specific to the City. The average daily snow depth in Richland from December to February is 0.33 inches. Because this is less than 1 inch, the rain-on-snow effect can be considered negligible for the City of Richland (Ecology, 2004).

Table 3-1. Design Storm Summary (Climate Region 2)

Design Storm	Required Use	Rainfall Depth (inch)
6-month, 3-hour [a]	Designing flow based water quality treatment BMPs per SWMMEW	0.26
6-month, 24-hour [b]	Designing volume based water quality treatment BMPs per SWMMEW	0.53
2-year, 3-hour [a]	Designing public storm drainage system pipe or inlet sizing per City Design Guidelines [d]	0.42
10-year, 3-hour [a]	Designing flow based roadway drainage and inlets per Washington State Department of Transportation (WSDOT).	0.69
10-year, 24-hour [c]	Designing site runoff retention for projects disturbing 1 acre or more per the Permit. Designing volume based roadway drainage elements (e.g., ponds) per WSDOT.	1.30
25-year, 24-hour [c]	Designing flow control facilities to limit flow between the proposed developed condition and the pre-developed condition per SWMMEW	1.60
50-year, 3-hour [a]	Designing roadway drainage and inlets at road sag points per WSDOT.	1.14
50-year, 24-hour [c]	Designing volume based roadway drainage elements at sag locations (e.g., ponds) per WSDOT.	1.80

Notes:

[a] Calculated for the City of Richland per Section 4.2.6 of the SWMMEW.

[b] Calculated for the City of Richland per Section 4.2.5 of the SWMMEW.

[c] NOAA Atlas 2, Volume IX, 1973.

[d] Section 3.4.2 provides recommendations regarding use of the 2-year, 3-hour design storm.

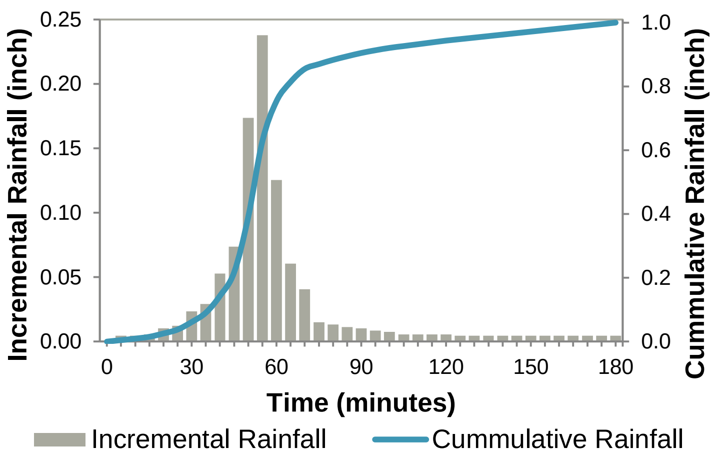

Figure 3-1. Short Duration Storm Hyetograph

Design storm hyetographs represent the temporal distribution of rainfall over the given storm duration. For example, Figure 3-1 illustrates the short duration (3-hour) hyetograph as defined in the SWMMEW. In this example, a hypothetical 1-inch rain event that last for 3 hours has a peak intensity of 0.24-inches over a 5-minute time step. This peak intensity occurs between the 55th and 60th minutes of the 30-hour-long storm. Details on hydrologic analysis and design methods are found in Chapter 4 of the SWMMEW.

The SCS Type IA storm (24-hour) distribution should be used for any volume-based design and the Short-Duration Eastern Washington storm should be used for any flow-rate-based design. The hyetographs for these storms are defined in the SWMMEW.

3.3 Submittal, Permitting, Construction, and Inspection Procedures

Construction sites must adhere to City and State submittal, permitting, construction, and inspection procedures. Stormwater calculations and designs submitted to the City to obtain a building permit must be stamped by the licensed engineer.

Some construction sites may be required to obtain a Construction Stormwater General Permit (CSWGP) through Ecology. The current CSWPG became effective in 2011 and expires at the end of 2015. A new CSWPG will be issued at the start of 2016 which all current CSWPG holders must reapply for.

A CSWGP requires the contractor to do the following:

1. Apply for coverage by submitting a Notice of Intent (NOI) to Ecology
2. Develop and use a Stormwater Pollution Prevention Plan (SWPPP)
3. Monitor stormwater discharges and inspect BMPs installed as part of SWPPP by a certified erosion and sediment control lead (CESCL)
4. Submit a monthly discharge monitoring report (DMR) to Ecology
5. Submit a Notice of Termination (NOT) to Ecology when soils are stabilized on site and all temporary BMPs have been decommissioned

The City also requires preparation of Erosion and Sedimentation Control (ESC) plans, Stormwater Site Plan, and SWPPP as outlined in the RMC 16.06 and Design Guidelines.

Post-construction structural BMPs are inspected by the City at least once every 5 years or as necessary. Figure 3-2 outlines the City's process for design submittals, permitting, construction, and inspection of development projects.

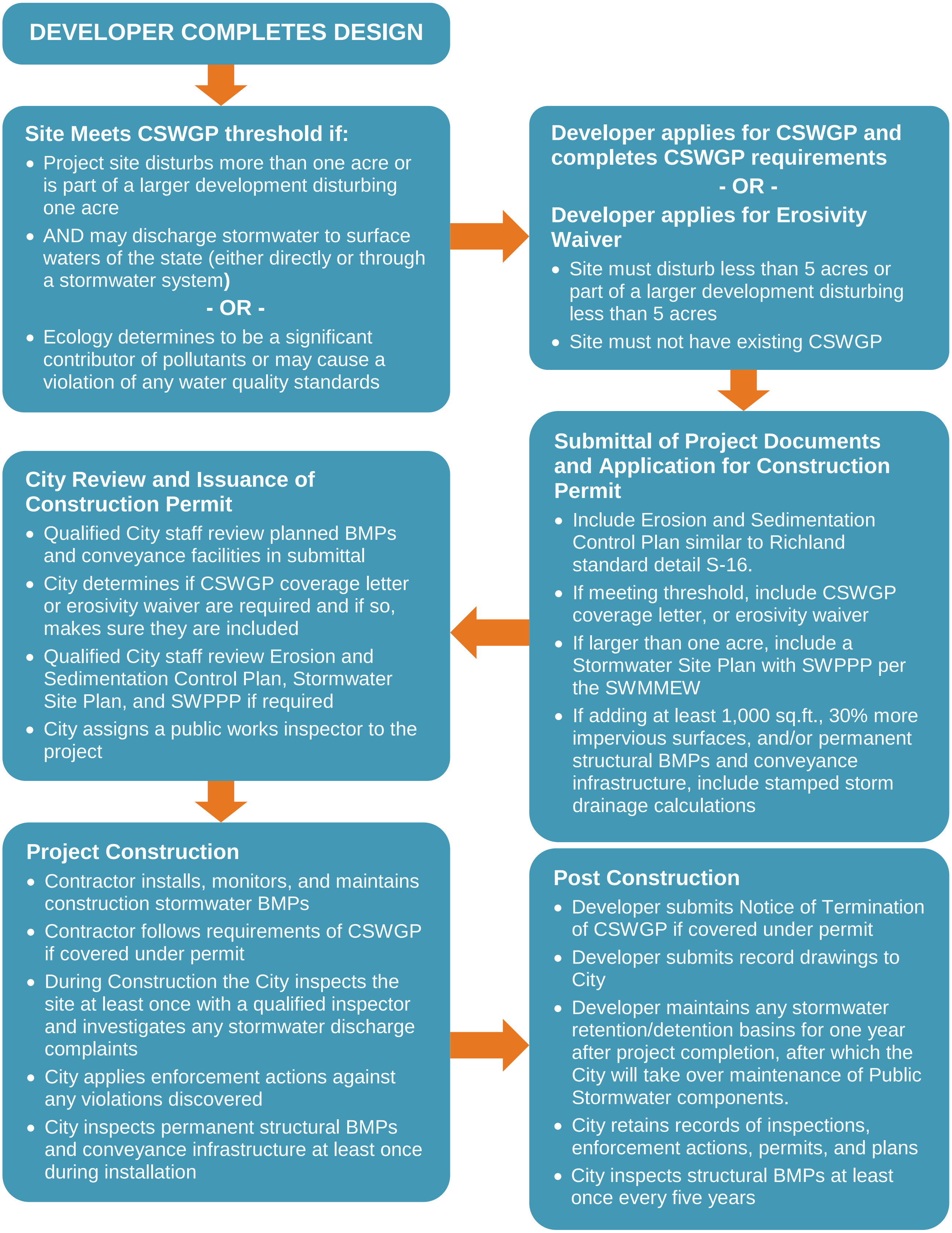

Figure 3-2. City of Richland Submittal, Permitting, Construction, and Inspection Process

3.4 Recommended Updates

A number of City documents were reviewed to determine if updates may be warranted. These include:

- Richland Municipal Code
- Standard Design Guidelines and Construction Details (Design Guidelines)
- Standard Details
- City Special Provisions

A summary of the recommendations is shown in Table 3-2. Additional details on the recommendations are found in the following subsections. See Appendix D for redline mark-ups of suggested revisions to the Design Guidelines.

Table 3-2. Recommended Updates

Recommendation	Description
RMC-01	Add a reference to Appendix 1 of the Phase II Permit in section 16.06.030.A of the Richland Municipal Code (RMC).
RMC-02	Modify section 16.06.050 of the RMC on post-construction responsibilities to match the Design Guidelines or modify the Design Guidelines to match the RMC.
DG-01	Change the full title of the Design Guidelines to match the title referenced in the RMC.
DG-02	Remove redundant statement of manhole sump requirement from construction plan section of the Design Guidelines.
DG-03	Add a reference to Appendix 1 of the Phase II Permit and the RMC into the Design Guidelines in addition to the reference to the SWMMEW.
DG-04	Revise the Design Guidelines to require the sizing of roadway inlets and conveyance to be per WSDOT design standards.
DG-05	Add requirement to the Design Guidelines that all applicable development and redevelopment sites must retain runoff on-site for storms up to the 10-year, 24-hour design storm event.
DG-06	Revise the Design Guidelines to require delineating and accounting for the actual drainage area for a system being analyzed.
DG-07	Add requirement to the Design Guidelines to have applicable projects perform a Hydrologic Analysis of the pre-development and the proposed-development condition using a 25-year, 24-hour SCS Type IA storm and to limit discharges as required by the SWMMEW.
DG-08	Specify in the Design Guidelines that the minimum velocity of 3-feet per second applies to the pipe in a full flow condition.
DG-09	Add new section in Design Guidelines specifically calling out storm precipitation depths to use for hydrologic analyses in the City.
DG-10	Add new section in Design Guidelines referencing the Eastern Washington Low Impact Development Guidance Manual (LID Guidelines) as an additional resource regarding stormwater management.
DG-11	Remove from the Design Guidelines specific pipe material callout and rely only on referencing the City of Richland Materials List for acceptable materials. Update the Materials List to include additional pipe materials to allow contractors to provide lower cost materials as market prices fluctuate.
SD-01	Add downturned elbows in catch basins and manholes as a standard detail.

Recommendation	Description
SD-02	Add to standard detail S16 for erosion control plan BMPs: • Illustration of inlet protection • Reference SWMMEW requirements for silt fencing
SD-03	Update standard detail S18 for roadside swales with check dams to match the requirements of the SWMMEW.
SD-04	Add standard details for LID BMPs.

3.4.1 Municipal Code Recommendations

RMC-01

Description: For construction and post-construction stormwater control and treatment, section 16.06.030.A of the municipal code should be modified to include "Appendix 1 of the Eastern Washington Phase II Municipal Stormwater Permit (effective August 1, 2014)" in addition to referencing the Design Guidelines and SWMMEW.

Reason: The Phase II Permit requires an ordinance or other regulatory mechanism to require applicable sites to adhere to the technical requirements of Appendix 1.

RMC-02

Description: Section 16.06.050 of the RMC on post-construction responsibilities should be modified to match the Design Guidelines statement that maintenance of stormwater retention/detention basins are the developer's responsibility for 12 months after the date of final acceptance and that after this period maintenance will be conducted by the City.

Reason: The RMC states that, "The property owner shall be responsible for the continual performance, operation and maintenance of all permanent private stormwater facilities in accordance with the standards and requirements of the city and shall remain responsible for any liability as a result of these duties." However, the Design Guidelines state that for retention/detention facilities, basins are the developer's responsibility for 12 months after the date of final acceptance and at 11 months, the developer performs a final cleaning of the basin before turning maintenance over to the City. Although the RMC applies to all private stormwater facilities, the RMC and Design Guidelines conflict on this point.

3.4.2 Standard Design Guidelines and Construction Details (Design Guidelines) Recommendations

DG-01

Description: The municipal code references the full name of the Design Guidelines as the "City of Richland Standard Design Guidelines and Construction Details." However, the title of the document as provided on the City website does not match the title in the Municipal Code verbatim. On the City's online "Document Center", the document name is displayed as "2015 Development Guidelines" and the title actually contained in the document after opening is "Public Infrastructure Construction Plan Requirements and Design Guidelines". The title should be updated to match between the municipal code and document.

Reason: The discrepancy in document name may create confusion on which document to use and how to find it.

DG-02

Description: Delete design requirement to have an 18-inch sump in stormwater manholes from Section 2 of the Design Guidelines.

Reason: The sump requirement is already shown on standard details and referenced in Section 3 of the Design Guidelines.

DG-03

Description: The stormwater section of the Design Guidelines states that public storm drainage systems shall be designed following the core elements in the SWMMEW. This section should be updated to also require designs to adhere to the municipal code and Appendix 1 of the Phase II Permit.

Reason: Adherence to the technical requirements of Appendix 1 of the Phase II Permit is required. The Design Guidelines should also reference the municipal code to ensure designers, owners, contractors, and developers review code requirements in the municipal code in addition to the Design Guidelines.

DG-04

Description: Consider revising the Design Guidelines to require the sizing of roadway inlets and conveyance to be per the WSDOT Hydraulics Manual (WSDOT, 2015). Currently, the Design Guidelines require, “the flow-rate of the public storm drainage system shall be designed using the 2-Year, 3-Hour short duration Eastern Washington storm for pipe and inlet sizing.” Figure 5-4.1 of the WSDOT Hydraulics Manual states that roadway gutters, inlets, and associated conveyance piping, should be designed for the 50-year storm at sag points and the 10-year storm for all other locations. Storms with these return intervals could be incorporated into the Design Standards for roadways with the short duration Eastern Washington storm used for inlet and pipe capacity design, and the 24 hour SCS Type IA storm used for volume based stormwater infrastructure (e.g., ponds). The allowable spread of water into the roadway could also be specified in the Design Guidelines using the spreads shown in Figure 5-4.1 of the WSDOT Hydraulics Manual. Pipe and inlet sizing outside of roadways (e.g., parking lots) can continue to be done using the City’s current 2-Year, 3-Hour short duration Eastern Washington storm.

Reason: Roadway inlet and conveyance may be undersized by comparison to WSDOT standards.

DG-05

Description: Update the Design Guidelines to require applicable development and redevelopment sites to retain runoff generated on-site for storms up to the 10-year, 24-hour design storm event. Where feasible, a regional stormwater facility may be used upon City approval.

Reason: The updated Phase II Permit requires all new development and redevelopment projects that disturb one acre or more, or disturb less than one acre but are part of a larger common plan of development disturbing more than one acre, to retain runoff generated on-site for a 10-year, 24-hour storm. Use of regional facilities to collect and retain the required runoff volume for multiple sites is allowed.

DG-06

Description: Update the Design Guidelines to require delineating and accounting for the actual contributing drainage area for systems being analyzed. The current standards are based on an assumed a 50-foot wide strip behind each right-of-way line to represent drainage from private property into the City system. Of that area, 50% shall be considered pervious and 50% impervious.

Reason: Accurate delineation of contributing drainage area is fundamentally important to accurate sizing of stormwater facilities. If actual contributing drainage area is substantially more than the assumptions in the current guidelines, facilities could be significantly undersized.

DG-07

Description: Update the Design Guidelines to require projects that do not meet the flow control exemptions for Core Element #6 (Flow Control) of the SWMMEW to perform a hydrologic analysis of the pre-development and the proposed-development condition using the 25-year, 24-hour SCS Type IA storm. The pre-development condition would be the condition of the drainage area before development and shall assume natural vegetative cover that would be found in the drainage area. When discharging to non-exempt streams (as defined in the SWMMEW) or a wetland or lake, the peak rate of runoff of the proposed-development condition for the 25-year storm would be limited to the peak runoff of the pre-development condition for the 25-year storm. If discharging to a wetland or lake and the wetland or lake does not have an outlet to a stream or has a direct outlet to the Columbia or Yakima Rivers, the peak rate of runoff of the proposed-development condition for the 25-year storm is also limited to the peak runoff of the pre-development condition for the 25-year storm

Reason: The SWMMEW under Core Element #6 provides conditions to limit runoff generated on a site from the 2-year and 25-year SCS Type IA storms given the pre-development or existing condition, and the proposed-development condition. Because of the new Phase II Permit requirement to retain the 10-year, 24-hour storm, the 2-year requirement of the SWMMEW is no longer is applicable; however, the 25-year requirement still applies. Ecology recommends the use of the pre-development, undisturbed natural condition instead of the existing condition when comparing to the post-development condition (Ecology, 2004).

DG-08

Description: Update the Design Guidelines to clarify that the minimum velocity of 3-feet per second in stormwater pipes applies to the pipe in a full flow condition.

Reason: The Design Guidelines currently state, “Pipes shall have a minimum slope of 0.5% and a minimum velocity of 3-feet per second. Pipes shall be sized so that they do not surcharge under the design storm conditions.” The change would clarify the condition for the velocity requirement.

DG-09

Description: Update the Design Guidelines to add a new section that specifies storm precipitation depths to use for hydrologic analyses for the various return intervals and storm durations.

Reason: There are a number of different sources for storm precipitation depths and these could be applied inconsistently on different projects. Specifying the precipitation depths to use will help provide that projects are designed to the same standards.

DG-10

Description: Update the Design Guidelines to reference Ecology’s 2013 Eastern Washington Low Impact Development Guidance Manual (2013 LID Guidelines) as an additional resource regarding stormwater planning and design.

Reason: The Phase II Permit requires permittees, including the City, to allow nonstructural preventive actions and source reduction approaches such as LID techniques. The 2013 LID Guidelines provide detailed, Ecology-approved guidance to help designers with planning and design of LID sites in accordance with the permit.

DG-11

Description: Update the Design Guidelines to remove specific pipe material callouts and instead reference the City of Richland Materials List for acceptable materials. The Materials List should be updated to include additional pipe materials to allow contractors to provide lower cost materials as market prices fluctuate while meeting City requirements for durability. Acceptable materials by the WSDOT Standard Specifications include plain concrete, reinforced concrete pipe (RCP), steel spiral rib, steel, aluminum, solid wall PVC, profile wall PVC, aluminum spiral rib, corrugated polyethylene, steel rib reinforced polyethylene, high-density polyethylene (HDPE), and polypropylene.

Reason: Section 3.C.13 of the Design Guidelines states, "Reference the most current City of Richland Materials List for acceptable materials," while section 3.C.14 states, "Storm mains shall be constructed out of SDR35 PVC." Removing specific material call-outs in the Design Guidelines will eliminate this confusion.

The Materials List, last updated in September 2013, only allows PVC to be used for storm sewer pipes (City of Richland, 2013). Use of PVC only may result in increased project costs when lower-priced options may be available.

SD-01

Description: Develop a standard detail for downturned elbows in catch basins and manholes. Downturned elbows can be used as a basic spill control separator. For example, the City of Seattle includes a downturned elbow (referred to as an "outlet trap") in all catch basin installations. Downturned elbows could be required at specific location or throughout the entire system like Seattle. The outlet trap used by Seattle is fabricated out of sheet metal or aluminum with a lift handle so it can be readily removed for vactor clean maintenance operations (City of Seattle, 2014).

Downturned elbows could also be retrofitted into many existing catch basins and manholes. However, the 18" minimum distance between a catch basin or manhole floor to the invert of the outlet pipe called out in the current standard details should be modified to be between the floor and inlet into the downturned elbow. This allows settling pollutants to accumulate without plugging the outlet. Some existing catch basins and manholes may not be able to accommodate a downturned elbow because of lack of clearance from the floor.

If incorporating downturned elbows into the City's standard details, an additional section needs to be added to the Design Guidelines outlining where downturned elbows are allowed and/or required. Trial installations should be conducted to determine best practices for maintaining the downturned elbows prior to full-scale deployment.

Reason: The SWMMEW identifies downturned elbows as a pretreatment Best Management Practice. Where hydraulically feasible and where maintenance can be conducted to maintain the long-term performance, downturned elbows could provide pre-treatment prior to discharge to UIC or other infiltration-type facilities.

SD-02

Description: Update Standard Detail S16 for erosion control plan BMPs to include additional information for storm drain inlet protection and silt fencing.

Sheet 2 of 3 of the detail includes a brief description of inlet protection. It is recommended to also add an illustration of inlet protection to the detail. This could be similar to Standard Plan I-40.20-00 of the WSDOT Standard Plans and/or one of the methods described in BMP C220 in the SWMMEW.

Sheet 3 of 3 of the detail provides an illustration and description of silt fences. The detail should be updated to include dimensions showing a 2-ft-minimum and 2.5-ft-maximum height for the silt fence, a minimum driven depth for the stake of 18 inches or a minimum depth of 12 inches if soft subgrade soil is not present and an 18 inch depth cannot be reached. An additional note should be added that silt fences be constructed to the standards of BMP C233: Silt Fence of the SWMMEW.

Reason: The SWMMEW provides guidance on the requirements of silt fencing. The detail should reflect these requirements. Additionally, the requirements for storm drain inlet protection are not clear and should provide additional references to clarify protection requirements.

SD-03

Description: Update Standard Detail S18 for roadside swales with check dams to match the requirements of the SWMMEW. This includes adding:

- A dimension showing a 2 ft maximum check dam height,
- A note requiring to key quarry spalls into swale banks,
- A dimension or note requiring check dams to be spaced so that the top elevation of the downstream check dam is at the lowest toe elevation of the upstream check dam.

Reason: BMP C207: Check Dams in the SWMMEW provides design guidelines for check dams. The City standard detail should incorporate these design guidelines.

SD-04

Description: Create or adopt standard details for LID BMPs, such as:

- Sidewalk permeable pavement
- Parking lot permeable pavement
- Concentrated flow dispersion
- Sheet flow dispersion
- Full dispersion

Standard details for sidewalk and parking lot permeable pavement could include permeable forms of concrete, asphalt, and/or pavers. The details would outline where permeable pavement could be used, where it is restricted, acceptable mix designs, and other design requirements.

Standard details on dispersion would combine relevant design information provided in the SWMMEW, WSDOT Highway Runoff Manual (HRM) (WSDOT, 2014), and LID Guidelines. Table 3-3 lists where design information on dispersion BMPs can be found to create standard details.

Table 3-3. Sources of Information on Dispersion BMPs

LID BMP	LID Guidelines	SWMMEW	WSDOT HRM
Concentrated flow dispersion	Section 4.3	Section 6.5, BMP F6.40	Section 5-4.2.2, FC.01
Sheet flow dispersion	Section 4.3	Section 6.5, BMP F6.41	Section 5-4.2.2, FC.01
Full dispersion	Section 4.3	Section 6.5, BMP F6.42	Section 5-4.2.2, FC.01

Reason: The Phase II Permit includes a requirement for permittees to allow nonstructural preventive actions and source reduction approaches such as LID techniques. The LID techniques included in Ecology’s 2013 Eastern Washington LID Guidance Manual can be used to reduce site stormwater runoff to meet the requirements of retaining the 10-year, 24-hour storm, and for limiting the peak runoff during the 25-year, 24-hour storm (Ecology, 2013).

Stormwater Management Plan

Section 4. Existing Stormwater System

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Section 4. Existing Stormwater System

This section is organized as follows:

- ***Section 4.1 - Storm Water Utility.*** Briefly describes the City organization responsible for maintaining, operating, and preserving public stormwater infrastructure.
- ***Section 4.2 - General Drainage Patterns.*** Summarizes general drainage patterns that underlie routing of stormwater runoff throughout the service area.
- ***Section 4.3 - Existing Stormwater Management Facilities.*** Provides overview of existing collection and conveyance facilities, pumps, drywells, regional detention/water quality facilities, and regional outfalls.
- ***Section 4.4 – Irrigation Connections with Stormwater Facilities.*** Discusses the interaction of irrigation water and stormwater within the City's stormwater conveyance facilities.
- ***Section 4.5 – Documented Drainage Problems.*** Summarizes existing drainage problems based on known flooding issues and staff reports of frequent maintenance needs.
- ***Section 4.6 – Low Impact Development.*** Provides overview of existing LID infrastructure and discusses recommendations to develop LID standards and standard details and use LID more routinely in public infrastructure projects.

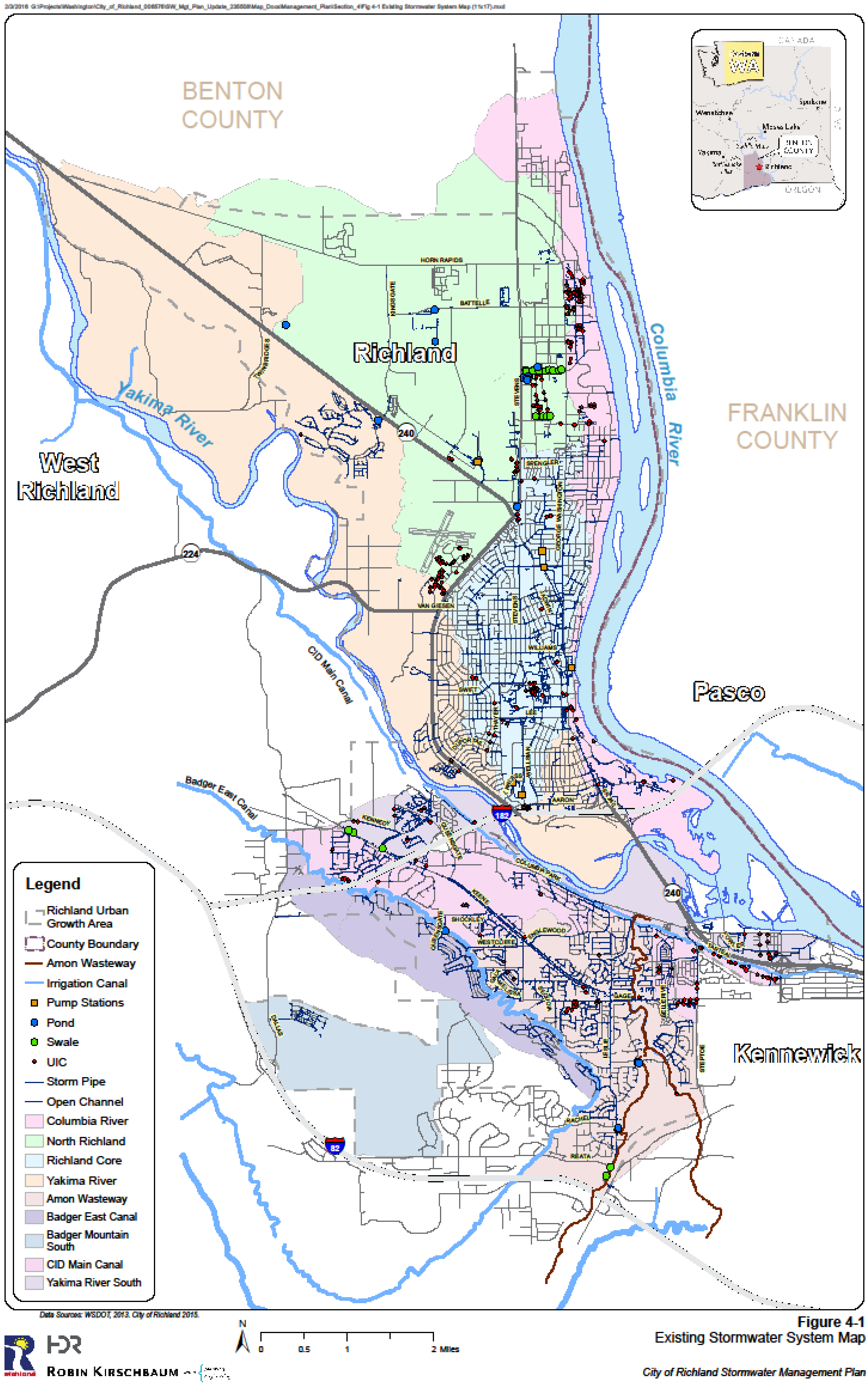
4.1 Stormwater Utility

Management of public stormwater facilities is conducted by the Stormwater Utility. This organization was created by the City in 1998, and "is authorized to own, construct, maintain, operate and preserve all stormwater infrastructure as now exist and as may be added to in the future by addition of other existing or construction of storm drainage systems. In addition to its authority over stormwater facilities, the utility is authorized to maintain, operate, and preserve the street sweeping function of the City's street maintenance program" (Ordinance No. 12-10, Section 16.04.040). The service area of the utility includes all land within the incorporated City limits and as modified through periodic annexations.

4.2 General Drainage Patterns

Within the service area, much of the stormwater runoff infiltrates into the ground via drywells and land surface infiltration. However, during peak rainfall events when infiltration capacity has been exceeded, excess rainfall contributes to stormwater runoff collected and conveyed via the City's drainage facilities to the Yakima and Columbia Rivers. Figure 4-1 shows the major drainage basin boundaries and Section 2 provided discussion of each basin.

Figure 4-1. Existing Stormwater System Map



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4.3 Existing Stormwater Management Facilities

This section provides an overview of the existing City stormwater management facilities, including collection and conveyance, pumps, UICs, regional detention and water quality facilities, and regional outfalls to surface receiving water bodies.

4.3.1 Collection and Conveyance

Table 2-1 and 4-2 summarize the existing stormwater collection system structures and conveyance facilities, respectively. City engineering standards (Section 3) prohibit the use of closed conveyance less than 12-inches in diameter. Thus the values reported are for features 12-inches in diameter or greater. Pipe material is comprised mainly of PVC, concrete, corrugated metal, and High Density Polyethylene (HDPE).

Table 4-1. Number of Existing Stormwater Collection Structures [a]

Owner	Catch Basins and Manhole Catch Basins	Catch Basins and Manhole Catch Basins with OWS [b]	Manholes	Manholes with OWS
City	3,995	166	1,928	12
Port of Benton	160	0	0	0

Notes:

a - Based on available City GIS data (City of Richland, 2014).

b - Oil Water Separator.

Table 4-2. Length of Existing Stormwater Conveyance Facilities (in Units of Miles) [a]

Gravity Pipe	Force Main	Perforated Pipe and Underdrain	Culvert	Open Chanel
127.3	0.7	2.6	3.2	11.5

Notes:

a - Based on available City GIS data (City of Richland 2014).

As discussed in Section 3, the City's Design Guidelines currently require conveyance facilities be designed to convey the 25-year, 24 hour type-1A storm event. Age or date of installation data are generally not provided in the available GIS data. Therefore, it is unknown whether the majority of infrastructure was installed prior to or after these standards were adopted.

4.3.2 Pumps

The City's stormwater system includes seven pump stations, as summarized in Table 4-3.

Table 4-3. Stormwater System Pump Information [a]

Name	Owner	Operator	Maintenance	Capacity (GPM) [b]
Carriage Pump Station	City	City	City	1,045
McMurray Pump Station	City	City	City	5,790

Name	Owner	Operator	Maintenance	Capacity (GPM) [b]
Berkshire	City	City	City	Unknown
Corps of Engineers Pump Station	USACE	USACE	USACE	Unknown
Horn Rapids Triangle Pump Station	City	City	City	Unknown
Lawless Pump Station	Private	Private	Private	Unknown
Wellsian Pump Station	Private	Private	Private	Unknown

Notes:

a - Based on available City GIS data (City of Richland, 2014) and e-mail correspondence with Jack Arnold, City of Richland Project Manager, on December 29, 2015 regarding pump station locations.

b - Capacity in Gallons Per Minute (GPM) taken from the City's hydrologic/hydraulic model, where available. See Section 5 for recommendations on incorporating additional pump station information into future model updates as the information becomes available.

4.3.3 Underground Injection Control Facilities (UICs)

Some stormwater runoff generated within the service area is infiltrated via UICs, including a total of 280 mapped UIC facilities based on the available GIS data (City of Richland, 2014).

4.3.4 Regional Detention/Water Quality Facilities

Based on available GIS data (City of Richland, 2014), the City's stormwater management system includes 22 ponds, 2 bioretention cells, 6 underground storm chambers, and 21 swales. Detailed information on the types and sizes of facilities, dates of installation, configurations, etc., are generally not available in the database; however, this information is available in record drawings retained after each facility's construction.

The City is proactively engaged in planning regional water quality retrofits to help improve water quality in the Columbia River, which is an impaired water body (URS 2014a and 2014b). Ecology has provided grant funding through the 2013-2015 Biennial Municipal Stormwater Capacity Grant Program to conduct project-specific planning and design of water quality retrofit projects for Leslie Canyon and Richardson Road. The City has also obtained a legislative proviso agreement supporting projects on Sprout, Ferry, and Park Streets.

4.3.5 Regional Outfalls

Stormwater runoff that does not infiltrate within the service area is conveyed to surface receiving waters via regional outfalls. HDR (2011) previously identified 21 of these outfalls, including 11 of which that discharge to the Columbia River, 2 that discharge to the Yakima River, and 8 that discharge to the Amon Wasteway (Figure 2-7).

4.4 Irrigation Connections with Stormwater System

Approximately 11 miles of irrigation canals are routed throughout the service area. These are owned and operated by two major irrigation districts: the Kennewick Irrigation District (KID) and the Columbia Irrigation District (CID). These canals are somewhat inter-connected with the City's stormwater systems by storm flows that enter the canals via seepage, sheet flow, and discharge through stormwater pipe outfalls to the canals. The canals, in turn, contribute flows to the City's stormwater conveyance system in certain locations via seepage and/or discharge through pipe outfalls to the stormwater conveyance system.

The irrigation canals cross over or beneath major stormwater conveyances in above-ground flumes or inverted siphons. This is the case for the CID Main Canal, which passes over the Amon Wasteway in an above-ground flume and the Badger East Canal which enters inverted siphons in multiple locations outside of the City to pass beneath major drainage courses.

The KID Main Canal appears to have a somewhat steady discharge to the Amon Wasteway during the irrigation season, based on visual observations by HDR on several occasions. During times when the KID Main Canal is fully diverted to the Amon Wasteway (i.e., for maintenance or operation purposes), the canal contributes flows up to an estimated 300 cubic feet per second (cfs) to the wasteway.

A number of irrigation local improvement districts (part of KID) exist between Keene Road and the Badger East Canal. The infrastructure in each local improvement district typically consists of a canal diversion to a pump that pressurizes the irrigation water for distribution to users. Some of the diversions include a pond for operational and equalization storage.

Flow diverted to the local improvement districts in excess of what is pumped is discharged to the Keene Road ditches. In some cases, the excess flow is routed to Keene Road via residential storm drainage systems, which contributes to localized flooding in some residential areas. Information on these irrigation flow conveyance systems was not readily available in City mapping. However, HDR staff have visually estimated a base flow on the order of approximately 1 cfs has in the Keene Road ditches during the dry weather irrigation season. The observed baseflows may be attributed to some combination of irrigation inflows and groundwater inflows. As noted by City staff, groundwater inflows have likely increased as a result of increased irrigation in recent years. Although the baseflows observed by HDR were approximately 1 cfs, the City has observed highly variable and sometimes higher flows resulting from KID operational spills and overflows. Larger spills and overflows can impact subbasins along the Keene Road corridor.

4.5 Documented Drainage Issues

This section presents a brief summary of documented drainage issues based on information from City Operations and Maintenance staff on known flooding areas and areas requiring frequent maintenance.

4.5.1 Known Flooding Areas

Flooding occurs in the southern travel lanes of Keene Road northwest of Kapalua Avenue and has become an ongoing issue for the City. A number of factors potentially contribute to the roadway ditch overflowing to the roadway, including dense vegetation growth, irrigation base flows, new development in the area, and undersized culverts. City staff has also reported relatively frequent flooding on Charbonneau Drive. Additional information describing the flooding in these areas is provided in Section 5 and Section 7.

4.5.2 Areas Requiring Frequent Maintenance

City maintenance staff has identified a number of areas that have become frequent maintenance issues in recent years. These reported issues include:

- Tree root intrusion in the stormwater conveyance piping near Waldron Street, McMurray Street, and Snyder Street.
- Debris clogging stormwater conveyance piping beneath Leslie Road south of Gage Boulevard, where a concrete slurry was discharged into the pipe system from nearby construction
- Culvert clogging associated with beaver activity near a roadway culvert beneath Columbia Park Trail that conveys flows from the Amon Wasteway to the Yakima River.

Possible solutions to these issues are presented in Section 7.

4.6 Low Impact Development

Currently, the City has limited LID facilities installed in the public rights of way. Recommendations were provided in Section 3 regarding implementing LID in public infrastructure projects and developing LID design standards and standard details. Taking these steps will build capacity among the local design community for successfully implementing LID in new and redevelopment projects, helping to meet new LID Phase II Permit requirements, as well as reducing localized flooding and improving water quality.

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Stormwater Management Plan

Section 5. Stormwater Conveyance Model Analysis

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Section 5. Stormwater Conveyance Model Analysis

5.1 Introduction

The City's hydrologic and hydraulic models were used to assess the stormwater system capacity for current and future condition flows, identify possible system deficiencies, and evaluate projects for inclusion in the Capital Improvement Plan (CIP). The remainder of this section is organized as follows:

- ***Section 5.1 – Previous Model Summary*** – Summarizes the previous model developed by the City for the 2005 Plan.
- ***Section 5.2 – Model Updates*** – Provides an overview of the model updates made to support this Plan update.
- ***Section 5.3 – Model Analysis*** – Documents the model analysis performed for the current and future build-out land use conditions for multiple design storm events.
- ***Section 5.4 – Results*** – Summarizes the modeling results and system deficiencies.
- ***Section 5.5 – Recommendations*** – Recommends additional model updates and validation that should be completed prior to detailed design of CIP projects or future planning efforts.

5.2 Previous Model Summary

The City provided their existing hydrologic and hydraulic models, developed for the 2005 Plan update (HDR 2005). The models are divided into north and south components, labeled Richland North and Richland South, separated by the Yakima River.

Land use and conveyance system attribute information was taken from the City's Geographic Information System (GIS) data. Available survey and record drawing information were used to supplement the conveyance attribute data.

Missing input data was assumed in the previous model based on attribute data of surrounding features. Examples of assumed data include pipe lengths, diameter, type, channel shape and dimensions, and elevations for catch basin rims and inverts. Assumed data is noted in the model.

A total of 88 subbasins were included in the Richland South model and 136 subbasins in the Richland North model. See Section 6 of the 2005 Plan for detailed discussion of the previous model development and validation.

5.3 Model Updates

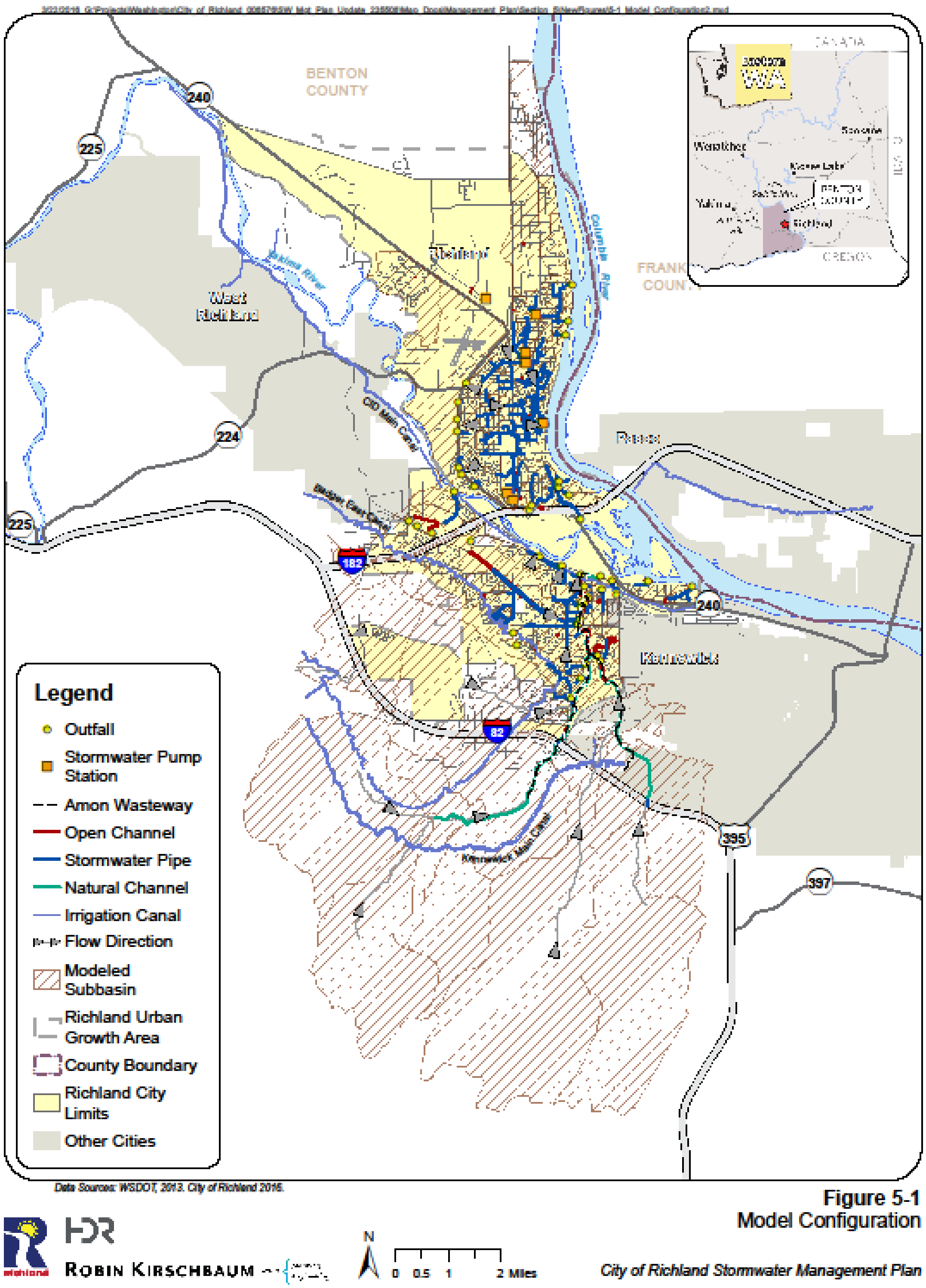
HDR updated the Richland North and South models to reflect changes in land uses and modifications made to the City's stormwater conveyance infrastructure since completion of the 2005 Plan (HDR). The main objective of the updates was to enable use of the model to identify or confirm system deficiencies and assess CIP project needs (Chapter 7). The following model updates were made:

- Updated subbasin delineation.
- Changed hydrologic calculation methodology from SWMM RUNOFF to the Soil Conservation Service (SCS) Curve Number (CN) approach. This change was made to simplify the model parameterization, as appropriate given the limited soils information available to support detailed RUNOFF model calibration.
- Updated pipe and ditch hydraulic data based on record drawings provided by the City.

- Added irrigation flow inputs.
- Used updated SWMM modeling software version 2014 (updated from the 2000 SWMM version used for the previous SMP).

Further detail is provided below on the updated subbasin boundaries and hydrologic and hydraulic updates made to the model Figure 5-1 shows a schematic diagram of the updated model network configuration.

Figure 5-1. Model Configuration



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5.3.1 Subbasin Boundaries

Subbasin boundaries were delineated using the ArcHydro geoprocessing tools within the ArcGIS software program. A 5-foot x 5-foot Digital Elevation Model (DEM) developed from the 5-foot contour topographic data supplied by the City was used. Adjustments were made to the output subbasin boundaries where needed based on review of available aerial photographs and stormwater conveyance GIS data (City of Richland, 2014).

A significant amount of additional drainage area (over 40,000 acres) was added south of the City limits (see Figure 5-1). This additional drainage area contributes stormwater runoff to the Amon Wasteway, which also receives flows from the City's stormwater conveyance system and from the Kennewick Main Canal. See additional discussion of irrigation inflows below.

5.3.2 Hydrologic Model

The rainfall runoff modeling methodology was updated, irrigation inflows were added, and routing parameters were defined to match the revised subbasin boundaries. Each of these hydrologic model updates is described in further detail below.

Rainfall Runoff

The Soil Conservation Service (SCS) Runoff Curve Number (CN) approach was used. Runoff curve numbers are empirical values that encapsulate a subbasin's hydrologic response based on soil properties (ranging from a well-draining soils to poorly draining soils), land use condition and type (grass, shrubs, range or imperviousness) and other hydrologic conditions. CN values were assessed based on Tables 9-1 and 9-5 of Part 630 of the National Engineering Handbook (NEH) (NRCS, 2009), using land use and soils data provided by the City (City of Richland, 2014; see Figure 2-2 and Figure 2-5, respectively), as well as supplementary soils data from the Soil Survey Geographic (SSURGO) database for Benton County, Washington (NRCS, 2013).

The coefficient to represent precipitation retained in surface depressions, intercepted by vegetation, losses to evaporation, infiltration, or any other natural process that affects surface water runoff is known as the initial abstraction (I_a). The model assumes that no surface runoff occurs until all of these abstractions, or storage components, are satisfied. I_a was set to 20 percent for all subbasins in the model, based on the predominantly well-draining soils across the City (Figure 2-2).

Irrigation Inflows

As discussed in Section 4.4, the Kennewick Irrigation Canal contributes flows to the Amon Wasteway up to an estimated 300 cubic feet per second (cfs) when the district conducts maintenance activities or for occasional operations. This flow diversion to the wasteway is reflected in the City's stormwater model as a tailwater condition at the point where the stormwater system connects to the wasteway.

Additionally, flows originating from the Badger East Canal are estimated to contribute up to approximately 1 cfs to the Keene Road corridor stormwater conveyance system, based on visual observations by HDR engineers made during the dry season. Although these inflows are highly variable, for planning purposes, these inflows were represented as constant inflows in the model as a simplifying assumption.

Routing

The unit hydrograph method was used to route the simulated sub-basin flow hydrographs to each subbasin outlet. The required inputs, including time of concentration and lag time parameters, were developed in accordance with Section 630.1502 of the NEH (NRCS, 2004).

5.3.3 Hydraulic Model

Within the hydraulic portion of the model, updates were made to the conveyance system network and roughness parameters for selected portions of the system, as discussed further below.

Conveyance System Attribute Information

The 2005 hydraulic model was updated with available GIS and record drawing information provided by the City. Figure 5-2 shows the project locations for the record drawings that were reviewed, while Table 5-1 summarizes the project information reviewed in tabular format.

The projects reviewed were generally represented in the model as land use changes, which affect modeled stormwater runoff volumes and peak flow rates and sizing of CIP projects. In addition, those projects that were directly relevant to modeling the trunk system deficiencies and possible CIP projects were incorporated explicitly in the hydraulic model as new or revised model structures/links. These updates were made primarily in the South Richland model, around Badger Mountain, Keene Road, Gage Boulevard, Leslie Road, and Columbia Park Trail, and in the North Richland model in the McMurray ditch vicinity. Nodes and links upstream of catchment loading points were made inactive in the hydraulic model

As noted in the previous 2005 SWMM model and within the updated electronic SWMM modeling files, some attribute input information (i.e., structure rim and invert elevations) remains missing in the model. Missing attribute data, including pipe diameters, rim elevations, and invert elevations in some locations, were assumed within the model. See the recommendations below for updating the model as needed for future use by the City.

Figure 5-2. Locations of Record Drawings Reviewed

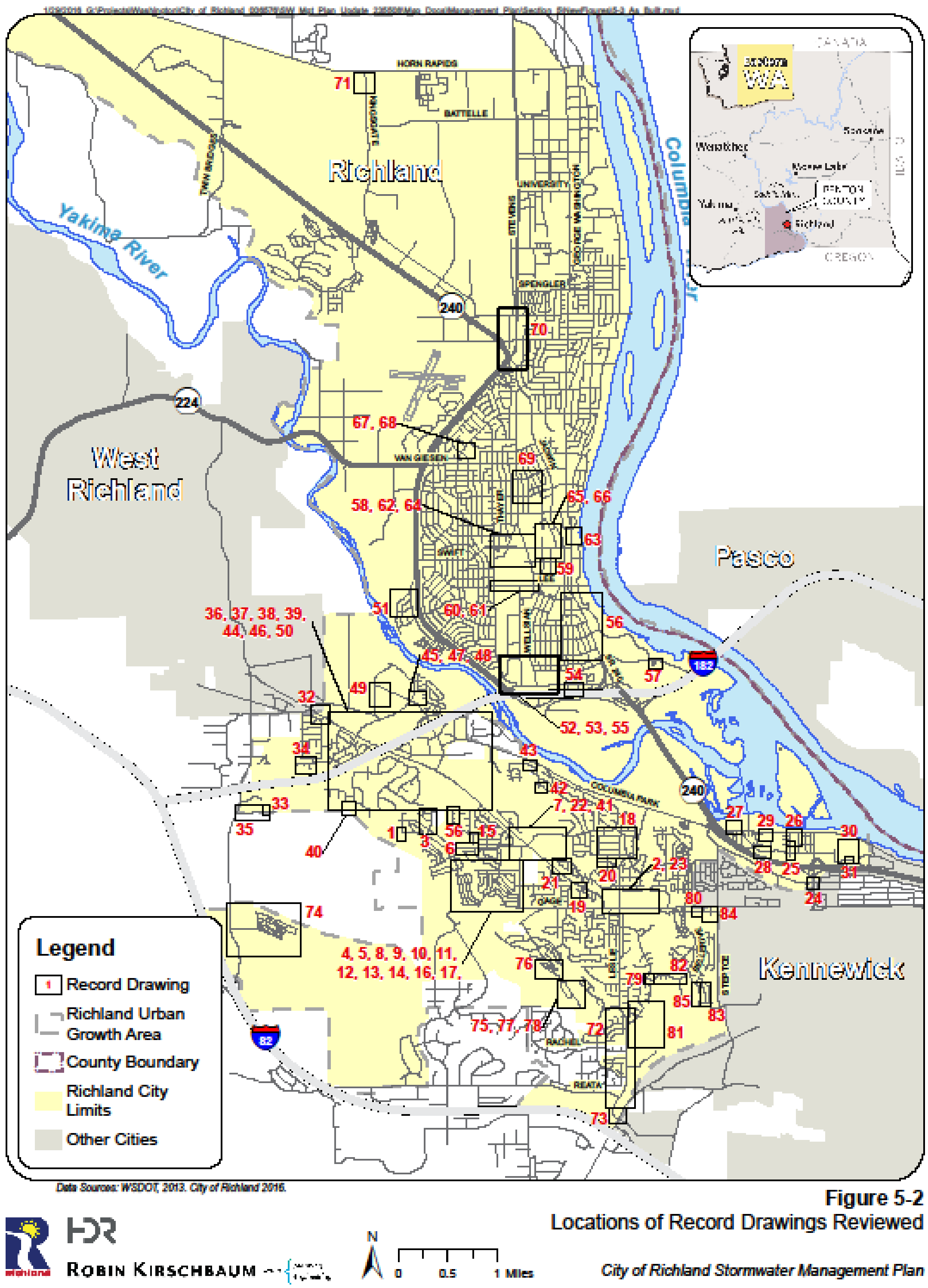

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Table 5-1. Record Drawing Summary.

ID #	Install Date	Approx. Length (ft)	Description of Objects
1	11/24/2007	159	12” PVC Pipe
2	10/12/2010	3,489	12” to 36” PVC Pipe
3	3/19/2012	384	12” to 18” Pipe
4	1/5/2009	1,076	12” PVC Pipe
5	9/3/2007	126	12” PVC Pipe
6	7/1/2009	763	12” PVC Pipe
7	5/28/2009	429	12” HDPE and 30” CMP Pipe
8	1/5/2010	1,909	12” to 15” PVC Pipe
9	3/24/2011	1,746	12” to 18” PVC Pipe
10	8/6/2008	696	8” PVC Pipe
11	10/4/2011	2,248	12” PVC Pipe
12	9/14/2011	1,957	12” PVC Pipe
13	10/4/2011	574	12” PVC Pipe
14	10/3/2011	1,031	12” PVC Pipe
15	3/19/2012	299	12” PVC Pipe
16	9/27/2012	225	12” PVC Pipe
17	3/19/2013	1,645	12” PVC Pipe
18	11/6/2008	5,665	12” to 18” PVC Pipe
19	1/22/2009	890	12” PVC Pipe
20	7/5/2011	915	12” to 24” PVC Pipe
21	5/25/2011	1,544	12” to 15” Pipe
22	7/22/2013	1,915	12” DI Pipe
23	3/13/2009	303	10” and 72” PVC Pipe
24	6/1/2006	263	8” to 24” PVC Pipe
25	9/7/2010	27	12” PVC Pipe
26	7/15/2011	116	12” PVC Pipe
27	7/15/2011	375	4” CMP Pipe
28	12/6/2012	289	12” and 18” PVC Pipe
29	12/10/2012	15	PVC Pipe
30	4/23/1981	929	15” and 18” PVC Pipe
31	2/23/2001	247	12” PVC Pipe
32	4/7/2006	921	12” and 24” PVC Pipe
33	11/1/2012	436	18” PVC Pipe
34	1/2/2013	856	12” PVC Pipe
35	1/11/2013	1,615	12” PVC Pipe
36	8/1/2009	17	36” Concrete Pipe
37	1/4/2011	75	12” PVC Pipe
38	12/22/2011	1,311	15” Pipe
39	11/19/2012	2,992	10” to 36” PVC Pipe
40	10/18/2005	177	18” PVC Pipe
41	11/19/2012	1,752	10 to 48” PVC Pipe
42	3/4/2009	14	12” PVC Pipe
43	6/12/2007	934	12” to 18” PVC Pipe
44	1/8/2007	2,967	8” to 30” PVC Pipe
45	1/8/2008	518	PVC Pipe
46	4/1/2006	2,694	Roadside Ditch, 12” PVC, 24” Concrete, 42” PVC pipe
47	2/10/2010	22	8” HDPE Pipe
48	3/19/2012	305	12” Pipe
49	12/8/2011	1,882	12” PVC Pipe
50	12/3/2012	206	12” PVC Pipe
51	2/23/2006	3,159	12” to 24” Pipe
52	10/12/2010	2,312	10” to 12” Pipe
53	1/6/2005	777	12” CMP, 18” CMP, and 18” PVC Pipe
54	7/8/2005	968	Trapezoidal Ditch
55	8/24/2007	132	6” and 12” PVC Pipe
56	4/5/2009	1,856	12” PVC, 12” ADS, 12” DI Pipe
57	7/21/2006	954	4” to 12” PVC Pipe
58	5/7/2002	276	8” PVC Pipe
59	12/4/2006	1,467	4” to 12” PVC Pipe
60	1/25/2011	1,675	12” to 24” Pipe
61	10/5/2012	127	12” PVC Pipe
62	8/30/2006	35	12” PVC Pipe
63	1/5/2009	1,047	4” to 12” PVC Pipe
64	8/1/2009	142	12” PVC Pipe
65	8/5/2005	255	10” Pipe
66	7/24/2009	2,053	12” PVC Pipe
67	1/3/2008	48	8” PVC Pipe
68	2/26/2009	307	10” DI and 12” PVC Pipe
69	10/1/2012	1,799	12” PVC, 12” DI, 12” Concrete, 15” DI Pipe
70	8/1/2009	2,065	12” and 15” Pipe
71	5/17/2013	97	12” PVC Pipe
72	2/17/2011	1,611	Trapezoidal Ditch and 12” PVC Pipe
73	4/23/2012	878	6” to 18” PVC and 18” CMP Pipe
74	1/31/2013	9,813	12” PVC Pipe
75	12/21/2011	313	12” PVC Pipe
76	10/21/2011	720	12” Pipe
77	10/11/2012	368	12” PVC Pipe
78	11/9/2012	1,030	12” PVC Pipe
79	7/18/2006	10	12” PVC Pipe
80	7/13/2006	91	10” PVC Pipe
81	10/4/2011	377	12” PVC Pipe
82	11/5/2012	427	12” PVC Pipe
83	12/21/2011	995	12” PVC Pipe
84	11/30/2010	620	8” to 12” PVC Pipe
85	10/4/2011	459	12” PVC Pipe

Notes:

a - See Figure 5-2 for locations by ID #.

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Roughness Parameters

Roughness parameters for pipes and channels were typically based on the 2005 model without update, except for the Keene Road ditch system and the Amon Wasteway. For these portions of the system, roughness parameter values were estimated based on available photographs and aerial imagery. See further discussion of the Keene Road ditch system below (Section 5.4.1).

5.4 Model Analysis

This section discusses a model test run performed to compare observed versus simulated flooding for back-to-back storms in May 2015 and modeling of existing and future build-out conditions for the 2-year and 25-year design storm events.

5.4.1 Test Run

A test run was performed for two short back-to-back storms that started on May 12, 2015. The City observed flooding on Keene Road corridor during this storm. The purpose of the test run was to compare the modeled flooding with the City's observations in this area.

Precipitation data from Badger Canyon and WSU Tri-Cities rain gauges was downloaded from http://weather.wsu.edu/ (Figure 5-3). The Badger Canyon rain gauge was applied to Richland South and the WSU Tri-Cities rain gauge was applied to Richland North. Hourly rainfall data from the National Weather Station (NWS) rain gauge at Kennewick Vista Field was reviewed but not used because the available hourly time step is too coarse for simulating peak storm events.

The first rainfall began late in the evening on May 12, 2015 and lasted approximately 12 hours, producing peak rain intensities of 0.32 inches/hour at both gauges. The second rainfall started after midnight on May 13 and ended in the morning about an hour later. This rain produced peak rainfall intensities of 0.36 inches/hour at Badger Canyon and 0.32 inches/hour at WSU Tri-Cities gauges, respectively. The total recorded rainfall amounts at both gauges were 1.23 inches and 1.36 inches, respectively.

Given the rainfall intensity and total depths observed, the storms are similar to a 25-year storm, which has a total rainfall depth of 1.6 inches and intensity 0.384 inches/hour. The observed storm, however, had a much shorter duration (i.e., total about 13 hours, as compared to the 24-hour design storm event).

The test run did not replicate the reported flooding on Keene Road. Roughness along the open channels was increased from .035 (2005 model) to .055 in the updated model, based on observed roughness conditions from photographs that showed extensive overgrown vegetation. The increased roughness to match observed conditions did increase peak modeled water surface elevations along Keene Road, but did not simulate the observed flooding still.

A sensitivity run was done to partially obstruct the Keene Road culverts. This run successfully reproduced the observed flooding. However, because the obstruction was neither observed nor reported, it was assumed to be temporary and was not maintained in the model for the remaining analysis presented below. See recommendations in Section 5.6 to obtain survey data for the Keene Road system to verify the temporary nature of any blockages and update invert elevations, which may have changed over time due to difficulty of maintaining the ditch system. Figure 5-4 shows the model test run results and Table 5-2 provides a tabular summary.

Figure 5-3. Badger Canyon and WSU Tri-Cities Observed Rainfall, May 12 and 13, 2015.

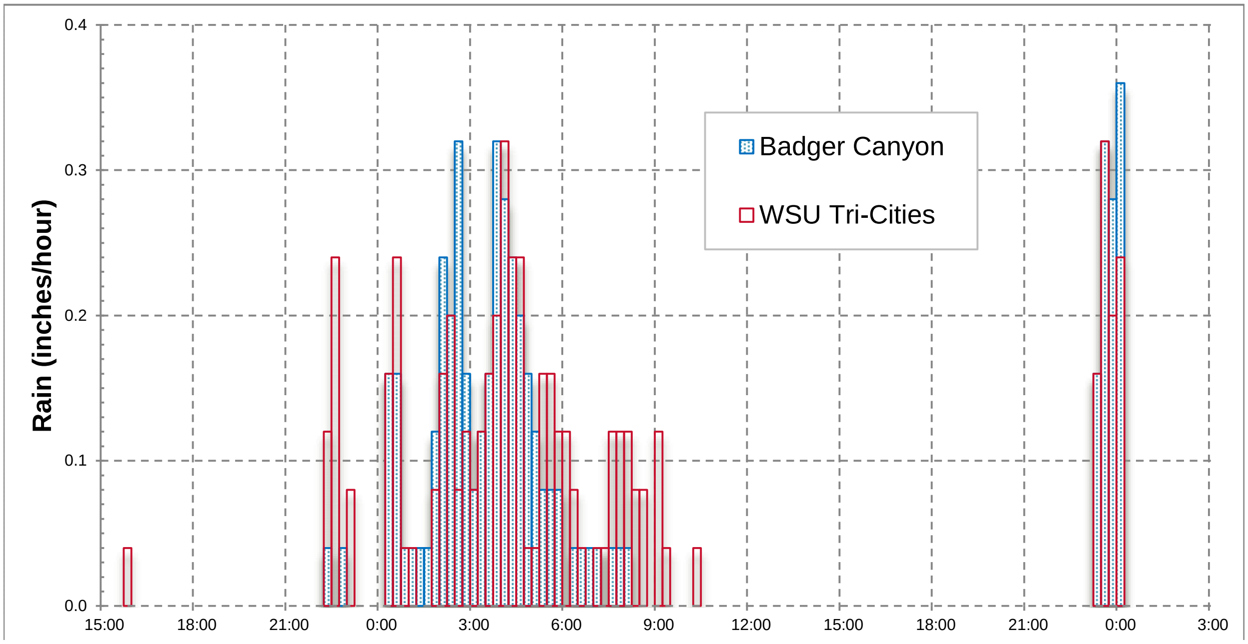

Figure 5-4. Test Run Model Results, May 12-14, 2015.

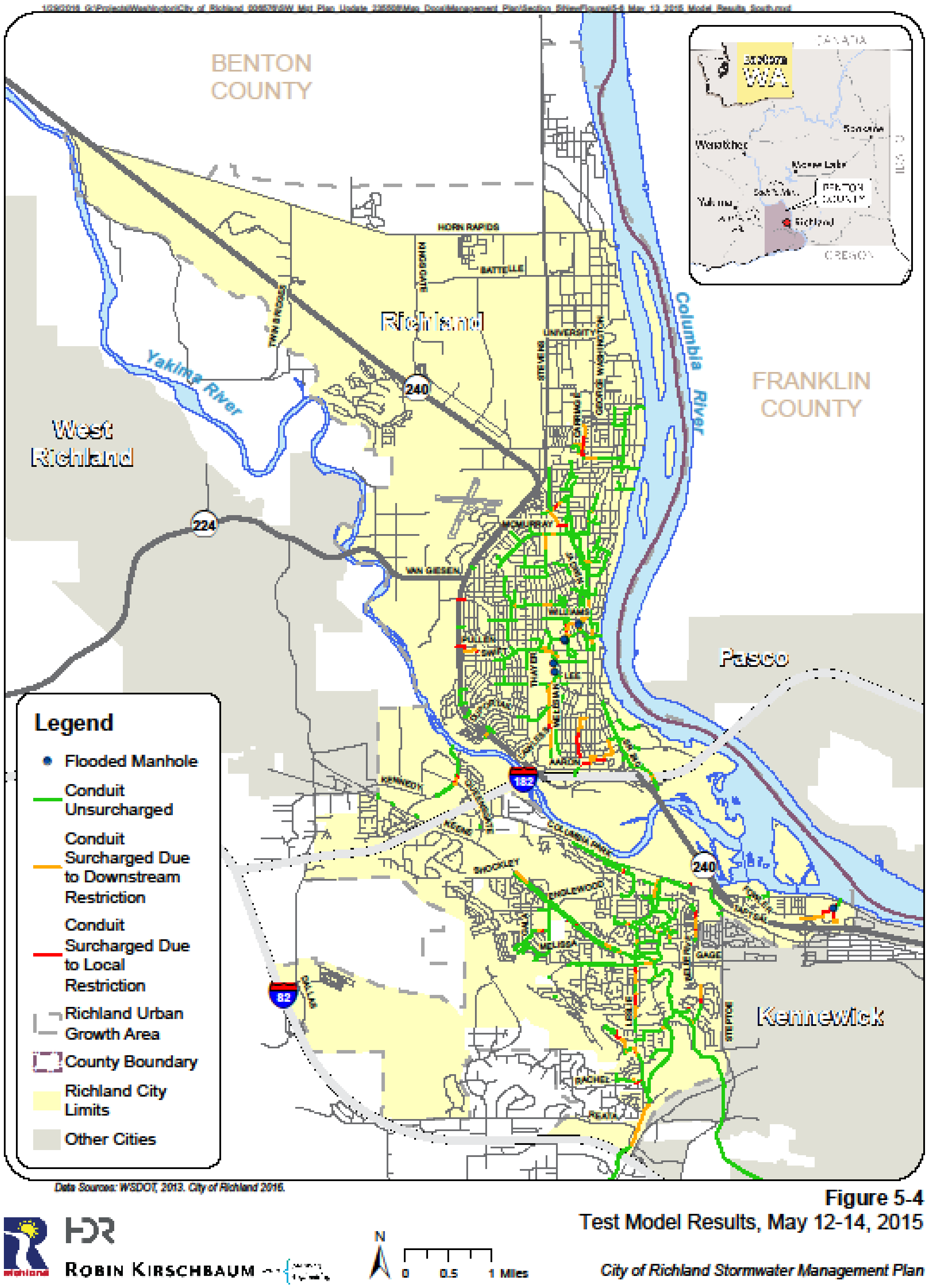

Table 5-2. Summary of Test Model Flooding Results

Location	Description	Recommendation
North Richland		
McMurray Ditch near medical center	Ditch flooding was modeled, but this may be an artifact of the USACE McMurray Ditch Pump Station not being modeled.	Determine pump parameters and include in future model updates.
Columbia Playfield ditch	Ditch flooding was modeled, but this may be an artifact of the USACE McMurray Ditch Pump Station not being modeled.	Determine pump parameters and include in future model updates.
South Richland		
Columbia Park Trail near Fowler St	Whole system under capacity	Assumed diameters in model. Survey required to confirm pipe sizes and inverts.

5.4.2 Future Land Use Condition

A future land use condition modeling scenario was modeled to help identify CIP project needs and provide preliminary sizing of those projects to support preliminary planning-level cost estimates (Section 7). The future land use condition was represented as a hypothetical increase in imperviousness of 15 percent, applied uniformly across the model domain.

5.4.3 Design Storms

The 2-year, 3-hour storm and 25-year, 24-hour storms were simulated, as shown in Figure 5-5 and Figure 5-6, respectively. These hyetographs were taken from the Washington State Department of Ecology Stormwater Management Manual for Eastern Washington, 2004).

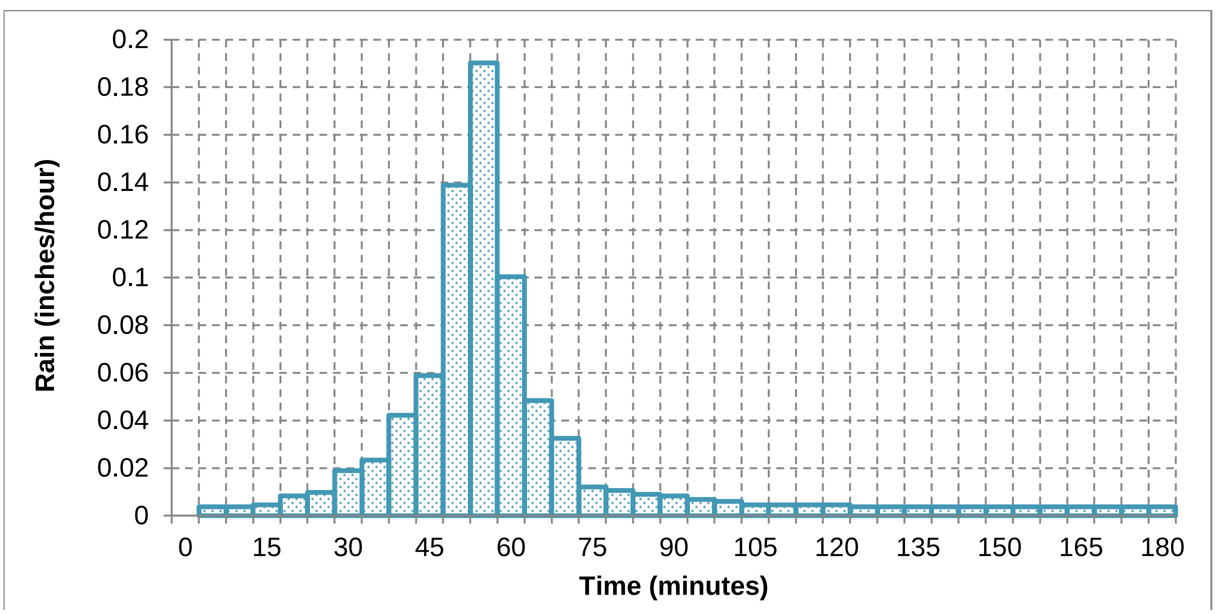

Figure 5-5. 2 Year, 3 Hour Design Storm Rainfall Hyteograph.

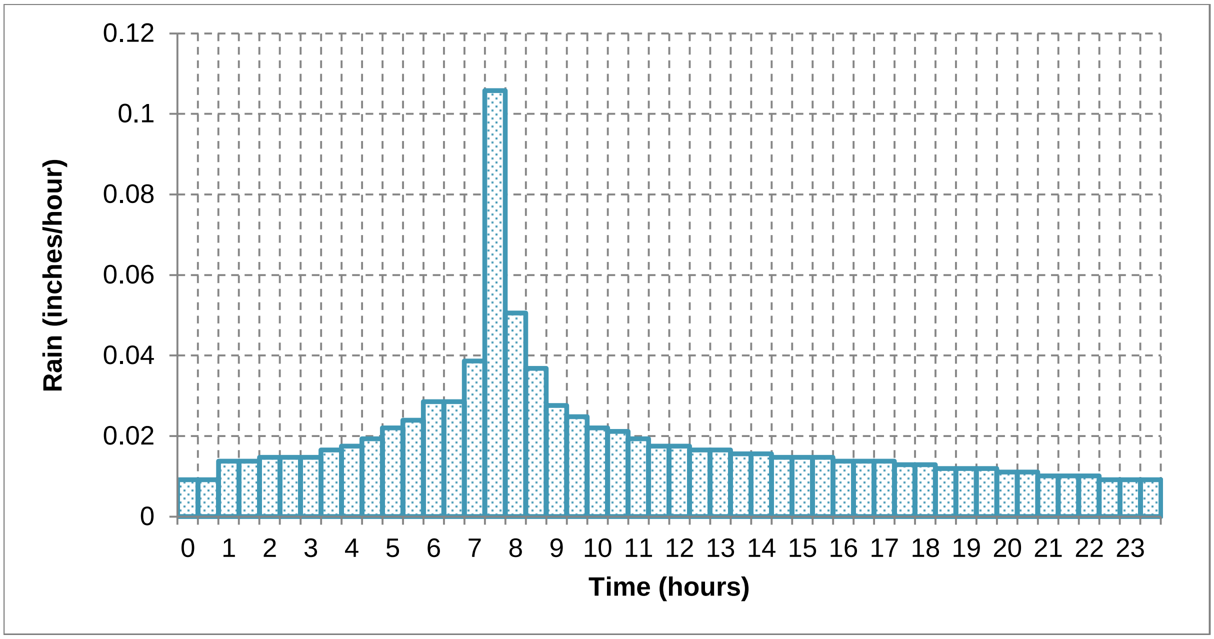

Figure 5-6. 25-year, 24-hour Design Storm Rainfall Hyetograph

5.5 Results

A pipe or open channel is considered surcharged when the modeled depth of flow (d) is greater than the diameter or height of pipe or depth of open channel (D). A pipe or open channel is considered to have insufficient capacity when the modeled flow (q) in the conduit is greater than the theoretical flow capacity (Q). The theoretical flow capacity of a conduit is calculated with manning's equation, using the cross-sectional area, slope, and roughness to determine the maximum flow that could be conveyed through that conduit under gravity before becoming surcharged.

Manholes are considered flooded when the modeled water surface elevation is above the rim elevation. Similarly, open channels are considered flooded when the modeled water surface elevation is above the set ground elevation for reporting flooding.

The flooding results of the existing and future land use condition model runs are presented in Figure 5-3, and the flooding and surcharging results shown in Figure 5-7 through Figure 5-10. The figures show red, orange, and green conduits. Red conduits represent modeled surcharging that is causing restrictions in the system (i.e., $d/D > 1.0$ and $q/Q > 1.0$). Orange conduits represent locations of modeled surcharging (i.e., $d/D > 1.0$ and $q/Q < 1.0$) caused by restrictions downstream, typically undersized conduits. Green-colored conduits do not exhibit surcharging or flooding for the design storms modeled.

The results of the modeling were factored into the CIP project identification, which was conducted in coordination with City staff (See Chapter 7). Numerous other sources of information factored into the CIP project identification, including City records of chronic maintenance needs, opportunities for retrofitting water quality treatment facilities, and opportunities to collaborate with developers for future infrastructure improvements.

Table 5-3. Summary of Modeling Identified Issues

Location	Scenario	Event	Notes
North Richland Issues			
Mansfield St near Stevens (Columbia Playfield McMurry and Stevens St)	Existing	25 year 24 hour	
Jadwin Ave	Existing	25 year 24 hour	Issue may be resolved by modeling USACE pump station.
McMurray Ditch near Goethals Dr and Carondelet Dr	Existing	25 year 24 hour	Issue may be resolved or partially resolved by modeling USACE pump station.
Berkshire St and Luther Pl	Existing	25 year 24 hour	
South Richland Issues			
Columbia Park West near Reach Museum	Existing	2 year 3 hour	Assumed diameters in model. Survey required to confirm pipe sizes and inverts.
Columbia Park Trail near fowler St	Existing Future	25 year 24 hour 2 year 3 hour	Assumed diameters in model. Survey required to confirm pipe sizes and inverts.

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Figure 5-7. Model Results Existing Conditions 2-year, 3-hour

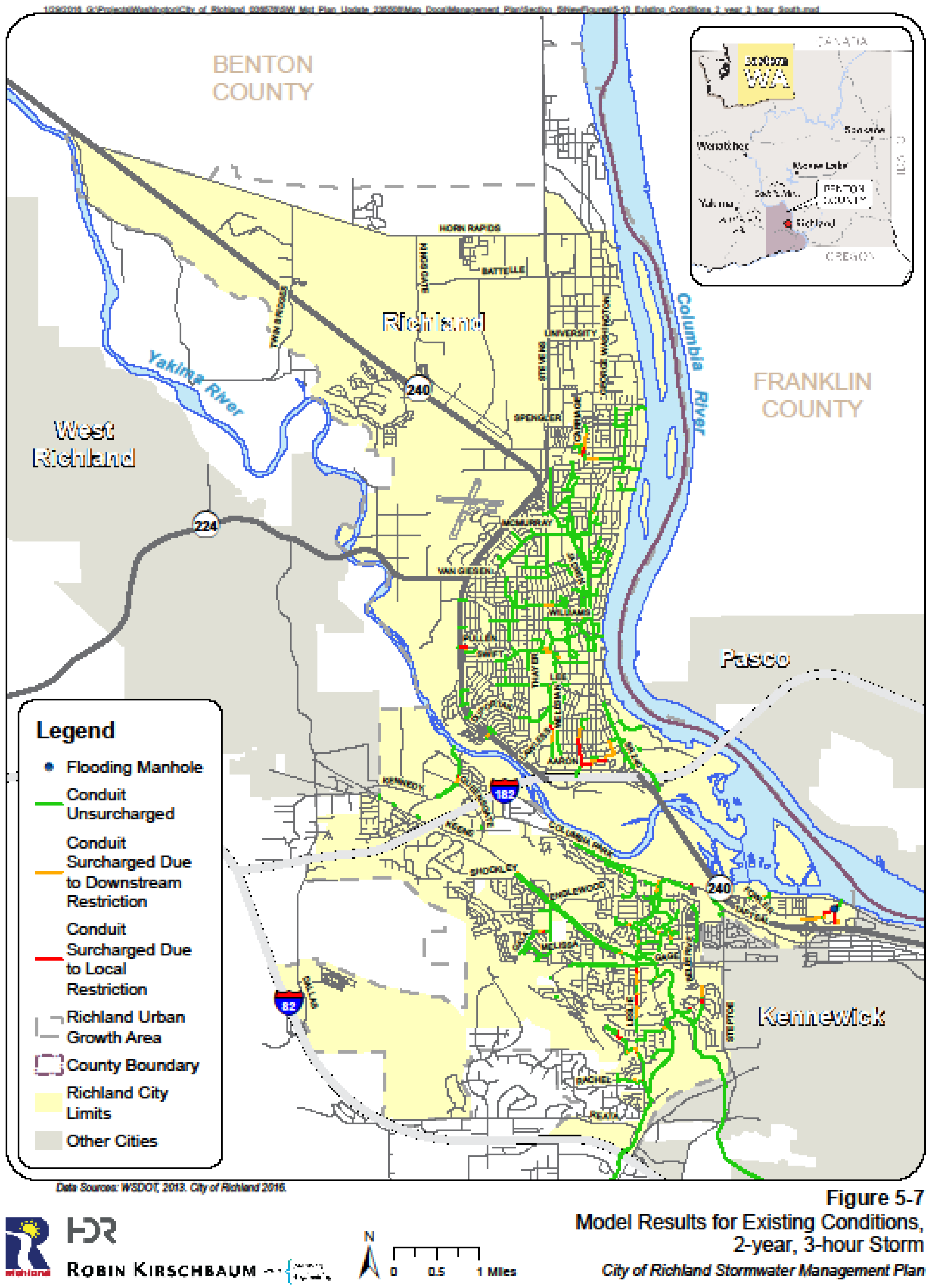

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Figure 5-8. Model Results Existing Conditions 25-Year, 24-Hour Event

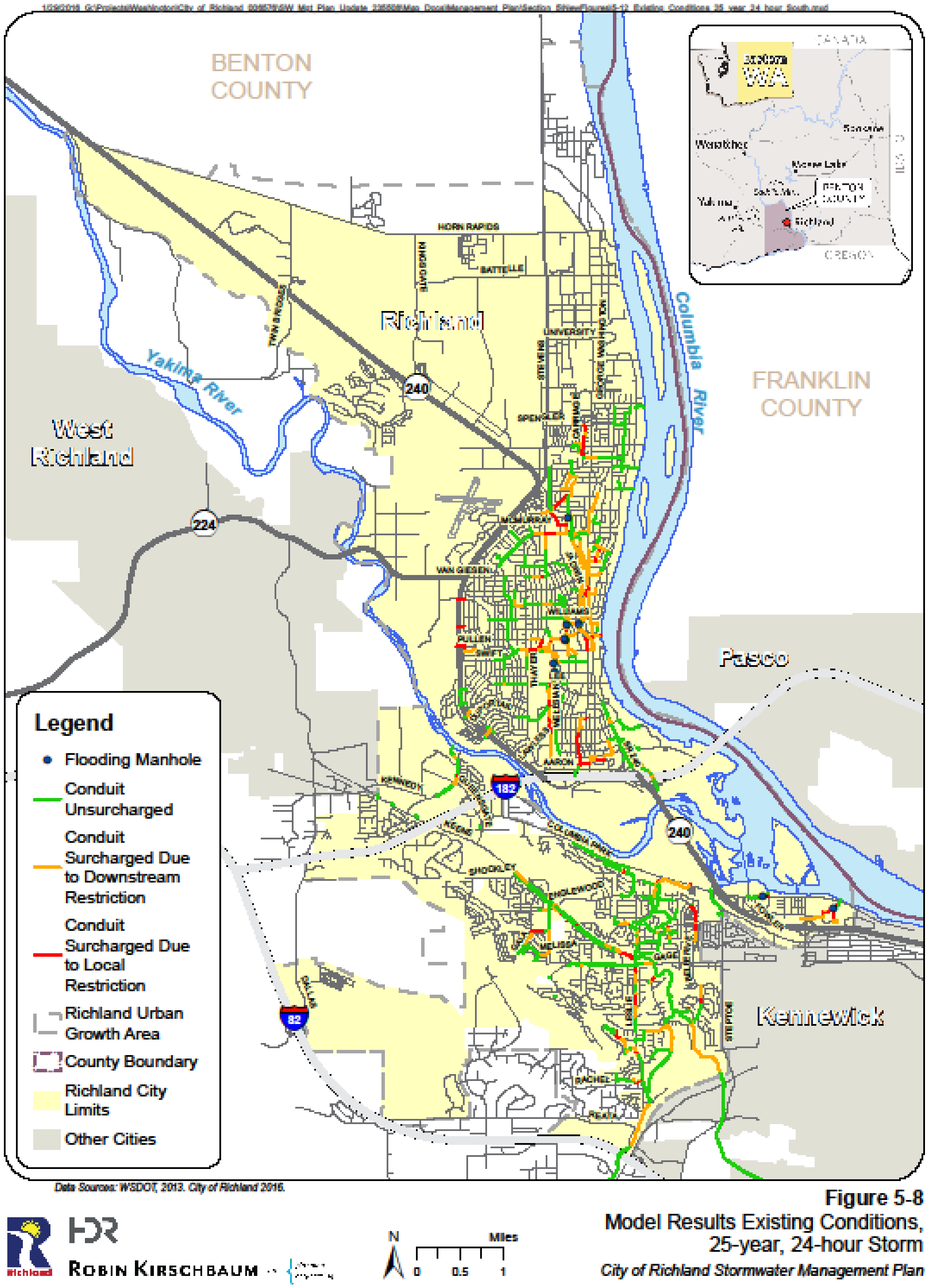

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Figure 5-9. Model Results Future Conditions, 2-year, 3-Hour Event

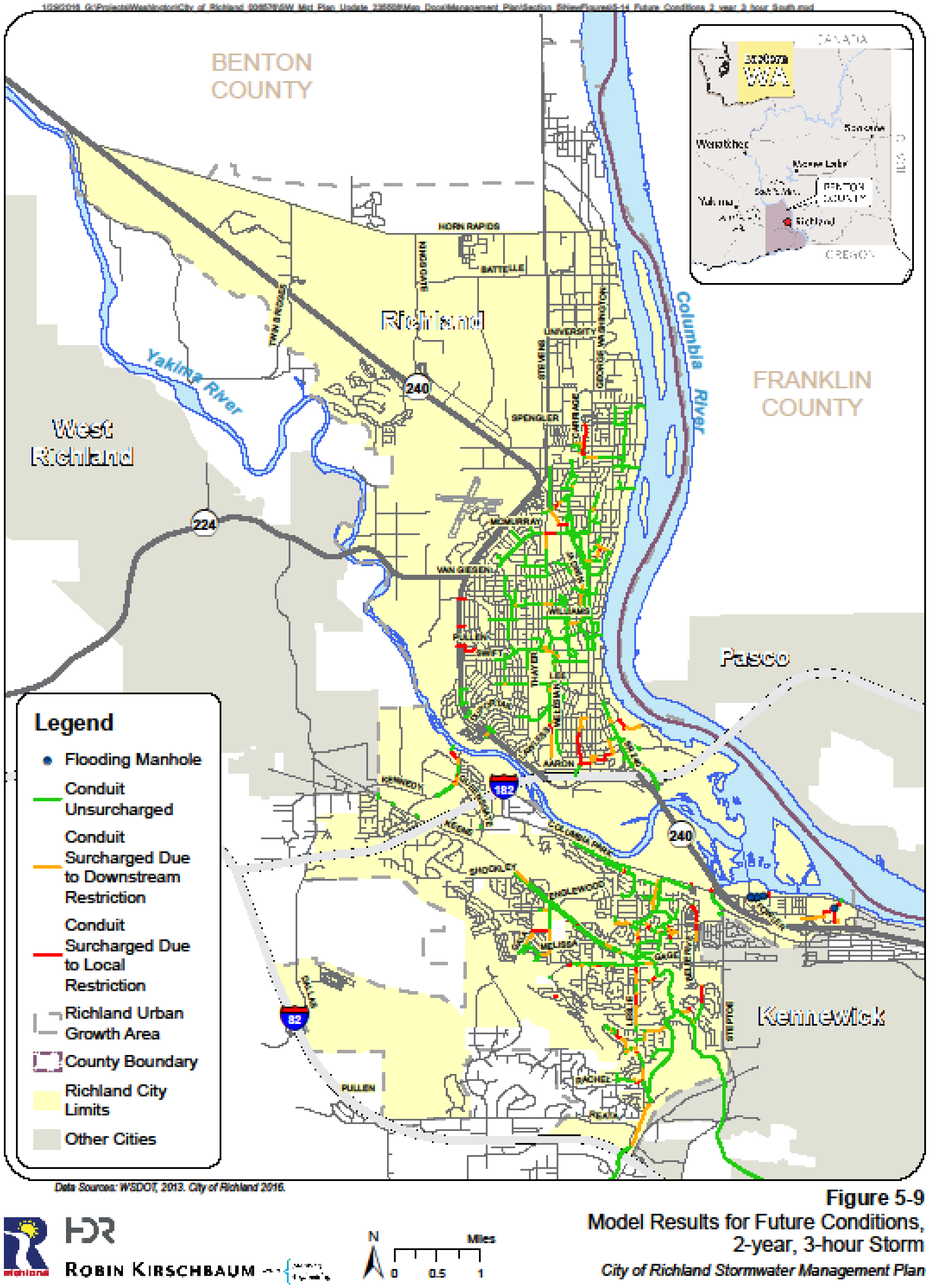

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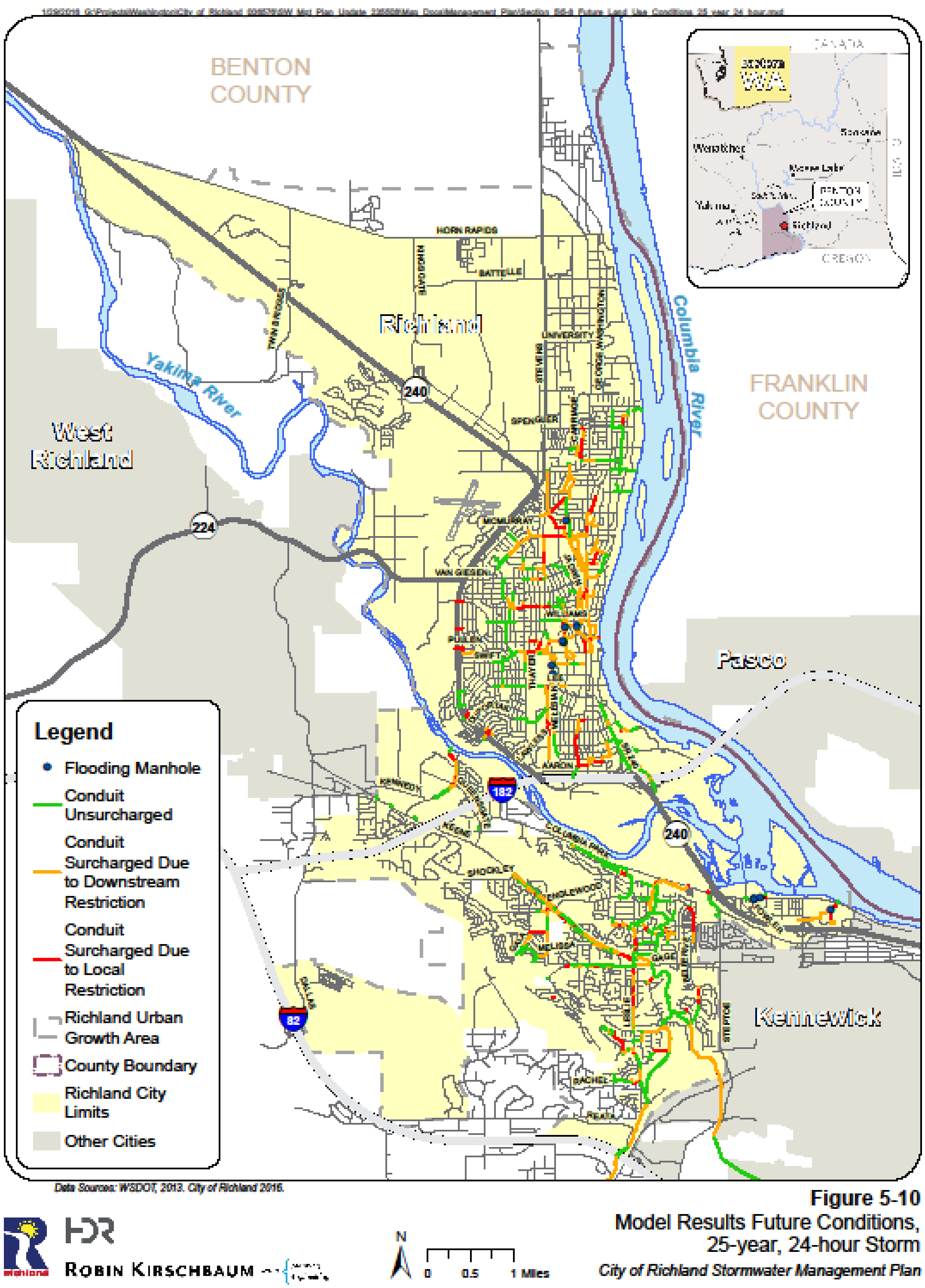
Figure 5-10. Model Results Future Conditions, 25-yr, 24-Hour Event



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5.6 Recommendations

The following recommendations are provided for further model development, prior to any future City use for more detailed CIP project planning or design (beyond the scope for this Plan update):

- Fill in missing and/or verify existing attribute data in areas where simulated flooding does not match historical observations. The Keene Road system is an important example, where maintenance is not always possible and on-going sedimentation may have changed elevations that affect the accuracy of modeling.
- Add existing or planned regional detention ponds and UIC facilities that manage runoff from significant drainage areas and could, therefore, affect CIP identification and/or sizing.
- Verify the operation of pump stations and update the model where needed. The McMurray pump station is an important example, where flooding is predicted but the pump station operation is not currently modeled.
- Verify or update model assumptions regarding locations, magnitude, and timing of irrigation inflows to the City's stormwater conveyance system.
- Prior to taking definitive action to address predicted flooding or predicted surcharged pipe conditions, refine the affected portions of the model and implement a downstream analysis to develop detailed information for sizing facilities and better understand how solving an upstream problem may affect downstream portions of the system.
- Continue to document observed flooding problems with geo-referenced photographs and other field observations. If possible, survey the high water mark of flooded locations, and use this information to continually update the model and update the list of CIP projects as warranted.

Stormwater Management Plan

Section 6. Program Elements

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Section 6. Program Elements

This section discusses stormwater program elements to support compliance with the Phase II Permit and Underground Injection Control (UIC) Rule, organized as follows:

- ***Section 6.1 – Phase II Permit***– Summarizes key changes in requirements associated with the updated Phase II Permit (as compared with the previous 2009 modification of the permit) and activities and programs needed for compliance.
- ***Section 6.2 – UIC Program***– Summarizes requirements of the UIC Rule and City programs needed to meet these requirements.

6.1 Phase II Permit Compliance

The City has a history of compliance with the previous Phase II Permit, as documented in the 2015 Stormwater Management Program Plan (Appendix B). This Plan update is the first completed since the Phase II Permit coverage began in 2007.

The recent update of the Phase II Permit (effective August 2014, see Appendix A) includes some new or changed program requirements. Therefore, the City's existing stormwater programs were reviewed to assess updates that may be needed to comply with the new or changed requirements for the following sections of the permit:

- Stormwater Management Program Plan (S5.A),
- Public education and outreach (S5.B.1),
- Public involvement and participation (S5.B.2),
- Illicit discharge detection and elimination (IDDE; S5.B.3),
- Construction site stormwater runoff control (S5.B.4),
- Post-construction stormwater management (S5.B.5),
- Municipal operations and maintenance (S5.B.6),
- Monitoring and assessment (S8), and
- Reporting and record keeping (S9).

The result of this program review was identification of 30 possible program gaps to the updated Phase II Permit, mostly pertaining to the permit general requirements, post-construction stormwater management, and IDDE. Several recommendations were developed to help fill these gaps. The recommendations generally relate to implementing an asset management system, policy development and implementation, training, documents/reports, record keeping, and operation and maintenance of municipal facilities. Table 6-1 provides a summary of the recommendations, while a separate technical memorandum (HDR and Robin Kirschbaum, 2015) provides more detailed documentation. The recommended program enhancements are largely due to new requirements found in the updated permit.

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Table 6-1. Summary of Program Recommendations [a]

ID #	Program Recommendation	Related permit Requirements	Category Type	Program Component
R-1	Develop a stormwater asset management system	S5.A.4.a.i, S5.A.4.a.ii, S5.B.3.a, S5.B.3.c.iii, S5.B.6.a.ii(a), S5.B.6.a.ii(b)	Data Management Supporting All Program Types	---
R-2	Prepare annual Stormwater Management Program Plan (SWMP Plan) in addition to the Annual Report	S5.A.3, S5.A.3.a, S5.A.3.c, S5.B.2.b, S9.D.1	Documentation	General
R-3	Conduct program implementation tracking	S5.A.4.a, S5.A.4.a.i, S5.A.4.a.ii	Record Keeping	General
R-4	Develop an Interdepartmental Coordination Document regarding permit compliance	S5.A.5.b	Documentation	General
R-5	Provide additional targeted business education	S5.B.1.a.ii	Training	Public Education and Outreach
R-6	Provide public involvement and participation opportunities in the stormwater program	S5.B.2.a	Training	Public Involvement and Participation
R-7	Continue implementing program to update GIS map of stormwater system	S5.B.3.a	Data Management	IDDE
R-8	Adopt standard operating procedures for detecting and eliminating illicit discharges and illicit connections to the public municipal separated storm sewer system (MS4).	S5.B.3.c.i, S5.B.3.c.ii, S5.B.3.d.i, S5.B.3.d.ii, S5.B.3.d.iv	O&M and Documentation	IDDE
R-9	Perform IDDE field assessment of 40% of system for illicit discharges/connections by the end of 2018 and an average 12% of the system each year after 2018	S5.B.3.c.iii	O&M	IDDE
R-10	Update stormwater ordinance regarding construction and post-construction stormwater management	S5.B.5.a.ii, S5.B.5.a.ii(b)(2)	Policy Development and Implementation	Construction Site Stormwater Runoff Control and Post-construction Stormwater Management
R-11	Adopt standard operating procedures for site inspections of construction and post-construction stormwater management practices	S5.B.4.c, S5.B.4.c.i, S5.B.5.c, S5.B.5.c.i	Policy Development and Implementation and Record Keeping	Construction Site Stormwater Runoff Control and Post-construction Stormwater Management
R-12	Incorporate low impact development (LID) techniques in the City's design guidelines and public infrastructure projects	S5.B.5.a.ii(a)	Policy Development and Implementation	Construction Site Stormwater Runoff Control and Post-construction Stormwater Management
R-13	Provide post-construction stormwater management education and record keeping	S5.B.5.e	Training and Record Keeping	Construction Site Stormwater Runoff Control and Post-construction Stormwater Management
R-14	Inspect all catch basins and inlets by the end of 2018 and on average, every two years after 2018	S5.B.6.a.ii(b)	O&M	Municipal O&M
R-15	Annually distribute stormwater education materials to all Port of Benton County (Port) tenants and residents, and train all Port staff on best management practices to prevent illicit discharges.	S6.D	Training	Public Education and Outreach

Notes:

a - Source: Stormwater Program Recommendation Technical Memorandum (HDR and Robin Kirschbaum, 2015).

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The remainder of this section provides summary information organized by the Phase II Permit components listed above. Each of the following sub-sections provides a summary of key changes from the previous Phase II Permit (modified in 2009) and a list of recommended stormwater activities and programs to help comply with the latest requirements.

6.1.1 Stormwater Management Program Plan (S5.A)

Summary of Key Changes

The previous Phase II Permit required development and implementation of a Stormwater Management Program Plan (SWMP Plan) to document the previous year's activities. The updated Phase II Permit requires a similar SWMP Plan. However, rather than documenting the previous year's activities, the updated Phase II Permit requires that the plan forecast activities planned for the upcoming calendar year to inform the public. The SWMP Plan must also include documentation of planned actions to meet the new requirements of S8 (Monitoring).

In the Annual Report to Ecology due by March 31, 2016, the City is required to submit a written description of the internal coordination mechanisms between City departments.

Recommended Activities and Programs

Implementing the following activities and programs will help meet the program requirements in Section S5.A of the Phase II Permit:

- Annually preparing a SWMP Plan document outlining the stormwater management program activities planned for the coming year.
- Using program implementation tracking for gathering, tracking, maintaining, and using information to help:
  - Evaluate SWMP development and implementation
  - Track permit compliance
  - Establish priorities
- Creating and following an Interdepartmental Coordination Document, outlining how the City departments will coordinate to comply with the Phase II Permit.
- Continuing coordination and involvement with surrounding permittees on stormwater management.

Though not explicitly required by the Phase II Permit, implementing a stormwater asset management program would help with cost-effective maintenance and operation of the system and would benefit compliance with numerous regulatory requirements.

6.1.2 Public Education and Outreach (S5.B.1)

The public education and outreach program is responsible for distributing educational materials to the community or conducting equivalent outreach activities about the impacts of stormwater discharges to water bodies. These educational materials provide steps the public can take to reduce pollutants in stormwater.

Summary of Key Changes

The previous Phase II Permit required the City to provide information to businesses about preventing illicit discharges and stormwater pollution. The updated Phase II Permit requires targeted business education with topics appropriate to the type of business, like the management of restaurant dumpsters and wastewater and the use and storage of automotive chemicals, hazardous cleaning supplies, carwash soaps, and other hazardous materials.

The updated Phase II Permit also has a new requirement to provide information for engineers, construction contractors, developers, development review staff, and land use planners about LID.

Recommended Activities and Programs

Implementing the following public education and outreach programs will help the City comply with public education and outreach requirements:

- Distributing stormwater materials and brochures to the general public regarding stormwater pollution and prevention at local events, City website, and/or through monthly billing.
- Establishing stormwater education exhibits throughout the City (City Hall, library, park information boards, City pool, etc.).
- Providing classroom education programs.
- Adding “no dumping - drains to river” (or similar) labels on stormwater system inlets
- Giving stormwater talks to local groups/clubs.
- Maintaining a stormwater pollution and prevention education page on the City website.
- Providing targeted stormwater education to businesses throughout the City that would include topics appropriate to the type of business.
- Holding regional stormwater workshops directed towards contractors, design professionals, builders, developers, local agency personnel, and the public about technical standards, stormwater site and erosion control plans, LID, and BMPs.

6.1.3 Public Involvement and Participation (S5.B.2)

This section of the Phase II Permit requires that on-going opportunities be provided for public involvement and participation, such as advisory panels, public hearings, watershed committees, participation in developing rate-structures, or other similar activities.

Summary of Key Changes

No significant changes were made in the updated Phase II Permit that are relevant to this Plan update.

Recommended Activities and Programs

Public involvement and participation programs that would benefit this section of the Phase II Permit include:

- Use of the existing Utility Advisory Committee as a forum to receive public comment on the City’s Storm Water Management Program.
- Distributing news releases announcing opportunities for public involvement and participation.
- Holding open houses for stormwater program comments.
- Holding stormwater volunteer events that schools and/or the public can participate in (e.g., storm drain marking, adopt-a-stream program, stream cleanup, wetland plantings).
- Public input during ordinance adoption.
- Speaking at and collecting input at meetings of local organizations and groups.
- Providing a comment/question form on the City’s website.
- Collect public input regarding stormwater at local events.
- Posting Annual Report and SWMP Plan each year on City website and providing a publically available hard copy (e.g., made available at City Hall and the Richland Public Library).

6.1.4 Illicit Discharge Detection and Elimination (S5.B.3)

The IDDE program is designed to prevent, detect, characterize, trace, and eliminate illicit connections and illicit discharges into the City's Municipal Separated Storm Sewer System (MS4).

Summary of Key Changes

In the updated Phase II Permit, the compliance strategy for violators must now include informal compliance actions, such as public education and technical assistance, in addition to the existing enforcement requirements already in place. Consideration must be made for adding the following compliance tools to the City's compliance strategy: 1) operational and/or structural source control BMPs and 2) maintenance of stormwater facilities with discharges into the City's municipal separated storm sewer system (MS4) where necessary to prevent illicit discharges.

Procedures for conducting investigations, including field screening to identify potential sources, must now be developed. By December 31, 2018, the City must field assess at least 40% of the system for illicit discharges and on average 12% of the system each following year.

Recommended Activities and Programs

The following IDDE programs must be implemented:

- Maintaining a map of the stormwater system and updating.
- Maintaining an IDDE hotline for reporting spills and violations and investigating any complaints or reports that indicate a potential illicit discharge/connection.
- Possessing and practicing standard operating procedures for:
    - Conducting investigations of the MS4, including field screening, to identify potential illicit discharge sources.
    - Locating priority areas likely to have illicit discharges.
    - Tracing the source of illicit discharges.
    - Characterizing the nature of, and potential threat posed by, any illicit discharge.
    - Eliminating illicit discharges.
- Performing IDDE field assessment of 40% of the stormwater system's coverage area by 2019 and 12% of the coverage area each following year.
- Providing training (and follow-up training) for all City field staff on identification of illicit discharges and connections, and procedures to follow.
- Maintaining records of IDDE training, activities, violations, and reporting.
- Maintaining City ordinances to comply with the ordinances required by the Permit.

6.1.5 Construction Site Stormwater Runoff Control (S5.B.4)

The purpose of the construction site stormwater runoff control program is to reduce pollutants in any stormwater runoff to the City's MS4 from construction activities that disturb one acre or more, and from construction projects of less than one acre that are part of a larger common plan of development.

Summary of Key Changes

No significant changes were made in the updated Phase II Permit that are relevant to this Plan update.

Recommended Activities and Programs

The following activities and programs should be implemented to help comply with construction site stormwater runoff control requirements:

- Maintaining, and adding to, the City's Standard Details BMPs for construction stormwater pollution prevention, and erosion and sedimentation control.
- Maintaining City ordinances to comply with the ordinances required by the Permit.
- Maintaining records of all training, plan submittals, inspections, and enforcement actions.
- Implementing an enforcement strategy for violations of the City's stormwater ordinance with escalating enforcement procedures.
- Reviewing required erosion and sedimentation control (ESC) plans and stormwater pollution and prevention plans (SWPPPs) as part of the building application process.
- Inspecting at least once, construction areas that disturb one acre or more for stormwater runoff compliance and retaining records of projects, inspections, and enforcement actions.
- Providing training (and follow-up training) for all staff involved in plan review and site inspection, and retaining records of training provided and attendees.
- Providing information to construction site operators about training available on how to install and maintain effective erosion and sediment controls and adhere to stormwater requirements and keeping a record of the information provided.
- Reviewing construction stormwater ordinance and requirements with design professionals, builders, developers and regional stormwater workshop.
- Holding an erosion and sediment control workshop for contractors.

6.1.6 Post-Construction Stormwater Management for New Development and Redevelopment (S5.B.5)

The purpose of the post-construction stormwater management for new development and redevelopment element is to address post-construction stormwater runoff to the MS4 from new development and redevelopment projects that disturb one acre or more, and from projects of less than one acre that are part of a larger common plan for development or sale. The program must also ensure that controls are in place to prevent or minimize water quality impacts.

Summary of Key Changes

By the end of 2017, project sites that disturb one acre or more will be required to retain runoff generated on-site for the 10-year, 24-hour rainfall event.

With the Annual Report due to Ecology no later than March 31, 2018, the City must include a summary of the criteria defining infeasibility for retaining the 10-year, 24-hour rainfall event on-site. The City may use the infeasibility criteria published in Ecology's 2013 Eastern Washington LID Manual, or may develop alternative criteria.

Recommended Activities and Programs

Activities and programs to help comply with this section of the Phase II Permit should include:

- Updating design requirements in the City's Design Guidelines as needed (e.g., retention of 10-year, 24-hour rainfall event onsite, hydrologic calculation methods).
- Maintaining and adding to the City's Standard Details BMPs for post-construction stormwater flow control and treatment.

- Providing information on how to comply with post-construction stormwater management requirements to design professionals.
- Conducting review of private site storm drainage designs using City standard review procedures.
- Implementing an inspection program that inspects all structural BMPs when they are installed and at least once every five years after installation.
- Allowing and encouraging where appropriate Low Impact Development (LID) measures to minimize the creation of impervious surfaces and impacts to native soils and vegetation.
- Implementing an enforcement strategy that includes escalating enforcement procedures and actions for violations.
- Maintaining City ordinances to comply with the ordinances required by the Phase II Permit.
- Providing training (and follow-up training) for all staff involved in plan review and site inspection, and retaining records of training provided and attendees.
- Maintaining records of all training, plan submittals, inspections, and enforcement actions.

6.1.7 Municipal Operations and Maintenance (S5.B.6)

The operations and maintenance (O&M) program must include a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations.

Summary of Key Changes

By August 1, 2017, the City needs to review and, if needed, update the O&M Plan to incorporate changes to the permit.

Ninety-five percent (95%) of all known stormwater treatment and flow control facilities (except catch basins) need to be inspected at least every two years. While inspection of 95% of the known assets was previously required, the two-year interval is new in the updated Phase II Permit.

The updated permit also requires that all catch basins and inlets be inspected at least once by the end of 2018 and every two years after 2018. Catch basins must be cleaned if inspection indicates cleaning is necessary. Alternatives to the standard approach of inspecting catch basins may be applied to all or portions of the MS4. See Section S5.B.6.a.ii.b of the Phase II Permit for details on allowed alternatives.

Recommended Activities and Programs

The following operation and maintenance programs will need to be implemented:

- Maintaining and implementing the City’s Stormwater Operations and Maintenance (O&M) Plan through all City departments.
- Inspecting at least 95% of all City maintained stormwater treatment and flow control facilities (excluding catch basins) every two years.
- Inspecting all City maintained catch basins and inlets by 2019 and at least every two years after 2019.
- Performing spot checks of the stormwater system after major storm events.
- Providing training (and follow-up training) for all City employees who have primary construction, operations, or maintenance job functions that are likely to impact stormwater quality on the use of the City’s stormwater O&M plan and the importance of protecting water quality.

6.1.8 Stormwater Management Programs for Secondary Permittees (S6)

The City entered into an interlocal agreement with the Port of Benton (Port; See Appendix C). The agreement provides intergovernmental cooperation for permit compliance and grant funding. The Port of

Benton, is a secondary Phase II Permittee and generally has the same requirements and timelines to meet as the City. Under the agreement, the City maintains the Port's stormwater infrastructure using funding from the City's stormwater utility and conducts stormwater programs on behalf of the Port as required by the Phase II Permit.

Summary of Key Changes

No significant changes were made in the updated Phase II Permit that are relevant to this Plan update.

Recommended Activities and Programs

Programs that the City will need to implement for the Port of Benton include:

- Maintaining the Port's stormwater infrastructure to the same standards and frequency as City-owned stormwater systems.
- Applying the City's Permit compliance programs to Port-owned stormwater conveyance systems including the submittal of the Port's Annual Report and SWMP Plan.
- Labeling all Port owned storm drain inlets with a message similar to "Dump no waste – Drains to water body".
- Providing training to Port staff on proper best management practices for preventing illicit discharges for all staff that have a role in prevent such discharges.
- Distributing educational information to all Port tenants and residents on reducing stormwater pollution.

6.1.9 Compliance with Total Maximum Daily Load Requirements (TMDL) (S7)

The City does not discharge to water bodies with TMDLs listed in Appendix 2 of the permit and therefore does not need to perform any of the requirements under permit section S7.

6.1.10 Monitoring and Assessment (S8)

Summary of Key Changes

All requirements contained in this section of the Phase II Permit are new. There are two main requirements. The first requires the City and the Port to implement annual reporting of any monitoring, studies, or analyses. The second requires the City to collaborate with other Permittees to select, propose, develop, and conduct Ecology-approved studies to assess the effectiveness of permit-related stormwater management program activities and BMPs.

Related Activities and Programs

Monitoring and assessment programs that the City will need to implement include:

- Continued participation in the Eastern Region Stormwater Coordinators Group (EWSCG) for phase II permittees to select, approve, develop, and conduct effectiveness studies.

6.1.11 Reporting and Recordkeeping (S9)

Summary of Key Changes

Annual reports must now be sent electronically using Ecology's WQWebDMR program. The annual report now includes the submittal of the annual report form detailing the status of implementing the requirements of the permit. The annual report also now includes various attachments including summaries, descriptions, reports, and other information to demonstrate that conditions of the permit have been met.

Related Programs

Reporting and recordkeeping programs that the City will need to implement include:

- Submitting to Ecology an Annual Report each year by March 31st using Ecology's WQWebDMR system, covering the previous calendar year's program activities, annexations, and other items required on the annual report form
- Making all records related to the stormwater program, including the Annual Report and SWMP Plan, available to the public

6.2 UIC Program

The Underground Injection Control (UIC) Program administered by the Washington State Department of Ecology protects groundwater quality by regulating discharges to UIC wells in accordance with Washington Administrative Code (WAC) Chapter 173-218. Examples of UIC wells include drywells, infiltration trenches with perforated pipe, and storm chamber systems. See Section 3.1.3 for discussion of existing UIC wells owned by the City and associated program requirements.

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Stormwater Management Plan

Section 7. Capital Improvement Program

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Section 7. Introduction

This section describes the development of recommended CIP projects to address existing and future stormwater infrastructure needs throughout the service area.

7.1 CIP Goals

The general goals of the CIP projects are to reduce:

- Existing conveyance capacity and flooding issues;
- Potential future conveyance capacity and flooding issues;
- Pollutant loading to receiving water bodies; and
- Chronic system maintenance needs.

7.2 Project Identification

Capital projects were identified based on the following 5 primary sources.

- 2005 Stormwater Management Plan – CIP projects that were identified in the past management plan but not yet constructed as of the time of this Plan update and still supported by recent modeling work.
- 2014 Updated Stormwater Treatment Retrofit Memorandum by URS – Prioritized three water quality retrofit projects for City outfalls (URS 2014a).
- 2014 Stormwater LID Retrofit Project Pre-Design Report by URS – The report identifies three potential water quality retrofit projects and provides pre-design for two of the projects (URS 2014b).
- City-reported maintenance issues – City staff provided anecdotal reporting on areas with chronic maintenance requirements.
- Hydrologic / hydraulic modeling – System capacity deficiencies identified through the modeling effort conducted for this Plan update (see Section 5 for more detailed discussion of modeling work performed).

The projects are categorized into one of four project types based on the primary objective of the project:

- Flood risk (FR) – Projects that primarily address hydraulic deficiencies to help reduce flooding or surcharging of the system.
- Renewal and replacement (RR) – Projects that primarily repair or replace existing system components to help restore the original design function.
- Water quality retrofit (WQ) – Projects that primarily address water quality through treatment of stormwater runoff prior to discharging to receiving waters.
- Development Driven (DD) – Projects that may be built based on future development. These projects are assumed to be partially paid for by developers. See Section 8 for detailed documentation on funding assumptions.

A total of 18 projects are recommended to be added to the CIP, including 1 flood risk project, 6 renewal and replacement projects, 6 water quality projects, and 5 developer driven projects. See summaries provided in Table 7-1, Table 7-2, Table 7-3, and Table 7-4. Project locations are shown in Figure 7-1.

Previous memoranda (HDR 2011 and URS 2014a) were completed that identified City outfalls that would benefit from water quality treatment retrofit. The six water quality projects included in this Plan were the highest priority projects identified in those previous memoranda. The financial plan (Section 8) makes accommodations for additional future water quality projects beyond the six included in this Plan. Information about the potential additional future water quality retrofit projects can be found the 2014 Stormwater LID Retrofit Project Pre-Design Report in Appendix E.

The designations FR, RR, or WQ are based on the primary project goal and City staff direction.

Six project sheets were developed for projects that were not previously identified in past planning efforts (HDR 2005, URS 2014a, URS 2014b). These include RR-01, RR-02, RR-03, RR-04, RR-05, and RR-06. The project sheets show the project locations and provide a brief narrative description of the issues and proposed solutions, hydraulic information from the modeling (Section 5), and estimated project costs. See Appendix F for the 6 project sheets developed for this Plan update, along with additional projects identified in past planning efforts.

Figure 7-1. CIP Project Locations

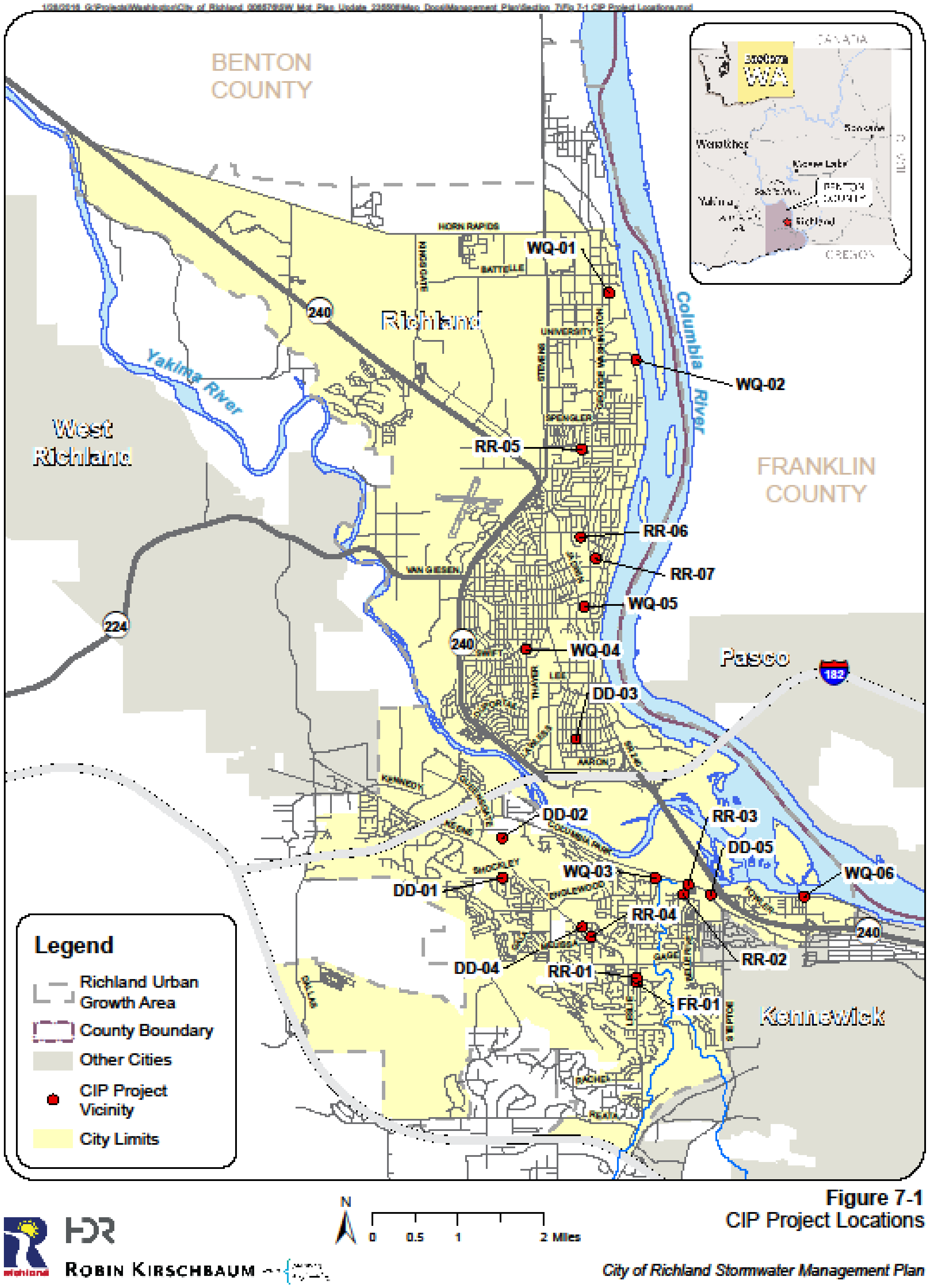

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Table 7-1. Flood Risk (FR) CIP Project Summary

Project ID	Project Name	Source [a]	Project Location	Problem Description	Project Description
FR-01	Leslie/Gage Basin Improvements	2005 Plan	Along Leslie Road, extending from Gage Boulevard to High Meadows Street	Insufficient system capacity and system filled with sedimentation.	Replace undersized conveyance pipe with larger size. Inspect upstream system for sediment sources.

Notes:

a. Source:
2005 Plan = 2005 Stormwater Management Plan (HDR 2005).

Table 7-2. Renewal and Replacement (RR) CIP Project Summary

Project ID	Project Name	Source [a]	Project Location	Problem Description	Project Description
RR-01	Charbonneau Drive Pipe Improvements	City	Charbonneau Drive, approximately 300 ft northeast of the intersection of Status Street and Charbonneau Drive	Insufficient stormwater infrastructure creates flooding condition at low point of roadway. Detention pond is overgrown and lacks overflow conveyance facilities.	Remove overgrown vegetation from detention pond, assess system for preferred alternative should flooding persist following maintenance work.
RR-02	Columbia Park Trail Culvert	City	Columbia Park Trail, approximately 2,000 feet northwest of the intersection of Columbia Park Trail and SR-240.	36-inch-diameter culvert frequently clogs due to heavy beaver activity in the upstream wetland area.	Install beaver deterrent and maintenance access.
RR-03	Keene Road Conveyance	City	West side of Keene Road, extending from Elementary Street north to Keene Court	Flooding into the westernmost travel lane due to insufficient conveyance capacity.	Increase culvert sizes.

Table 7-2. Renewal and Replacement (RR) CIP Project Summary

Project ID	Project Name	Source [a]	Project Location	Problem Description	Project Description
RR-04	Pipe Rehabilitation South of Snyder St	City	Directly south of Snyder Street, approximately 150 feet west of Carriage Avenue	Reduced system capacity due to root damage, resulting in backups onto adjacent properties and adjacent local streets. Limited access to maintain system.	Repair root damaged pipes.
RR-05	McMurray Apartments Pipe Rehabilitation	City	Approximately 1,200 ft west of the intersection of George Washington Way and McMurray Street	System capacity is reduced by root intrusion/root damage, resulting in localized flooding. Flow is now diverted to Army Corps ditch to the west which is constrained by overgrown vegetation.	Address capacity issue by removing roots and using a cured in place pipe (CIPP) rehabilitation technique.
RR-06	Waldron Street Pipe Rehabilitation	City	Waldron Street, approximately 500 ft east of the intersection of George Washington Way and Waldron Street	Reduced system capacity due to root damage resulting in localized flooding. Limited access to maintain system.	Address capacity issue by removing roots

Notes:

a - Sources:

City = City reported maintenance issue.

2005 Plan = 2005 Stormwater Management Plan (HDR 2005).

Table 7-3. Water Quality Retrofit (WQ) CIP Project Summary

Project ID	Project Name	Source [a]	Project Location	Problem Description	Project Goals
WQ-01	NR01 – Richardson	URS 2014a	Intersection of Richardson Road and 6th Street	Zoning of the basin is primarily characterized as Business/Research Park. This paired with the large area of parking lots located within the basin suggest high pollutant loading potential for this outfall.	Install an infiltration pond upstream of outfall.

Table 7-3. Water Quality Retrofit (WQ) CIP Project Summary

Project ID	Project Name	Source [a]	Project Location	Problem Description	Project Goals
WQ-02	NR02 – Sprout	URS 2014a	Eastern end of Sprout Road	Traffic in and out of the WSU campus paired with large parking areas in the project area vicinity suggest high pollutant loading potential for this outfall.	Install an infiltration trench upstream of outfall.
WQ-03	SR10 – Leslie	URS 2014a	Intersection of Columbia Park Trail and Leslie Road	Leslie Road sees higher traffic volumes and contributes some stormwater to the outfall suggesting a potentially high pollutant loading.	Install an off-line wet pond.
WQ-04	Swift Blvd Water Quality Retrofit	URS 2014b	Swift Boulevard, from Sanford Avenue to Long Avenue	Combination of traffic volumes in basin, size of basin, public visibility, and use lead to location as good candidate for a water quality retrofit project.	Install bioretention facilities.
WQ-05	Uptown Mall Bioretention Retrofit	URS 2014b	Uptown Mall parking lot	High potential pollutant loading from parking lot makes location a good candidate for a water quality retrofit project.	Install bioretention facilities.
WQ-06	Columbia Park Trail Water Quality Retrofit	URS 2014b	Columbia Park Trail, between Florida Avenue and Columbia Center Boulevard	Combination of traffic volumes in basin, size of basin, public visibility, and use lead to location as good candidate for a water quality retrofit project.	Install bioretention facilities and permeable pavement.

Notes:

a - Sources:

URS 2014a = 2014 URS Stormwater Treatment Retrofit Update TM

URS 2014b = 2014 URS Stormwater LID Retrofit Project Pre-Design Report

Table 7-4. Developer Driven (DD) CIP Project Summary

Project ID	Project Name	Source [a]	Project Location	Problem Description	Project Goals
DD-01	Shockley Storm Mainline Conveyance	2005 Plan	Along Shockley Road from Queensgate Drive to Keene Road	Anticipated increased development in basin requiring additional infrastructure.	Control future capacity issue by constructing infrastructure to convey collected flows to regional facility.
DD-02	Jericho Road Regional Facility	2005 Plan	North side of Keene Road, approx. 1,500 feet east of the intersection of Queensgate Drive and Keene Road	Anticipated increased development in basin requiring additional infrastructure.	Control future capacity issue and provide treatment by constructing a regional facility.
DD-03	Craighill Area Improvements	2005 Plan	Craighill Park and south on Craighill Avenue to Abbot Street, then east on Abbot Street.	Anticipated increased development in basin requiring additional infrastructure.	Upsize pipes and add a retention/detention facility.
DD-04	Keene Road Regional Facility	2005 Plan	North of Keene Road, approx. 200 ft from the intersection of Englewood Drive and Keene Road	Anticipated increased development in basin requiring additional infrastructure.	Install a regional detention and treatment facility.
DD-05	Steptoe Regional Facility	2005 Plan	North of Steptoe Street near the residential development around Foxglove Avenue	Anticipated increased development in basin requiring additional infrastructure.	Install a regional detention and treatment facility.

Notes:

a - Sources:

2005 Plan = 2005 Stormwater Management Plan (HDR 2005).

7.3 Planning-Level Construction Cost Estimates

Costs for projects developed as part of previous planning efforts (HDR, 2005; URS, 2014a; URS, 2014b) were escalated to 2015 dollars using the Engineering News Record (ENR) construction cost index (CCI). This was done as follows:

- Escalation of 2005 Plan project costs: Used escalation factor of 1.409, calculated by dividing the average 2015 ENR CCI of 10,025[2] by the average 2004 ENR CCI of 7,115[3].
- Escalation of water quality retrofit costs: Used escalation factor of 1.022, calculated by dividing the average 2015 ENR CCI of 10,025 by the average 2014 ENR CCI of 9,806.

Costs for projects newly identified through this planning effort were developed primarily based on unit costs from 2015 WSDOT bid tabs and based on preliminary planning-level concepts. The preliminary planning-level concept development phase represents the 2% level of project definition, for use in concept screening (AACE International, 2011). For comparison, a completed design has a level of project definition of 100%.

If 2015 year bid tabs were not available, costs were inflated to 2015 dollars using the ENR-CCI. Line item costs include material and installation costs but do not include sales tax. Items that are not direct construction costs were calculated using the methodology shown in Table 7-5. Estimates for total project costs are in 2015 dollars and are summarized in Table 7-6.

Table 7-5. Indirect Construction Cost Calculation

Line	Description	Calculation
A	Construction Subtotal	Sum of construction line items
B	Sales tax	8.6% of A
C	Mobilization/demobilization	5% of A
D	Subtotal	A+B+C
E	Contractor's fee	10% of D
F	Subtotal	D+E
G	Contractor's bonds and insurance	1.5% of F
H	Subtotal	F+G
I	Contingency	25% of H
J	Subtotal	H+I
K	Engineering, legal, administration	15% of J
L	Total Cost	J+K

[2] At the time the escalation calculations were made, ENR had not yet published the CCI for December. The 2015 annual average CCI is based on the average of all months in 2015 excluding December.

[3] Cost estimates for the 2005 Plan were created in 2004.

Table 7-5. Indirect Construction Cost Calculation

Line	Description	Calculation

Table 7-6. Summary of Preliminary Planning-Level Construction Cost Estimates

Project ID	Project Name	Cost Estimate (2015 dollars)
Flood Risk (FR) CIP Projects		
FR-01	Leslie/Gage Basin Improvements	$795,472
Renewal and Replacement (RR) CIP Projects		
RR-01	Charbonneau Drive Pipe Improvements	$164,424
RR-02	Columbia Park Trail Culvert	$29,719
RR-03	Keene Road Conveyance	$153,032
RR-04	Pipe Rehabilitation South of Snyder St	$38,644
RR-05	McMurray Apartments Pipe Rehabilitation	$373,893
RR-06	Waldron Street Pipe Rehabilitation	$23,128
Water Quality Retrofit (WQ) CIP Projects		
WQ-01	NR01 – Richardson	$118,206
WQ-02	NR02 – Sprout	$81,114
WQ-03	SR10 – Leslie	$141,612
WQ-04	Swift Blvd Water Quality Retrofit	$395,195
WQ-05	Uptown Mall Bioretention Retrofit	$625,000
WQ-06	Columbia Park Trail Water Quality Retrofit	$624,383 [a]
Water Quality Retrofit (WQ) CIP Projects		
DD-01	Shockley Storm Mainline Conveyance	$777,768
DD-02	Jericho Road Regional Facility	$1,060,977
DD-03	Craighill Area Improvements	$1,583,716
DD-04	Keene Road Regional Facility	$777,768
DD-05	Steptoe Regional Facility	$915,850
	TOTAL COST	**$8,679,901**

Notes:

a - Project cost based on Alternative 2 (see project sheets in Appendix F)

The preliminary, planning-level construction costs shown in Table 7-6 were used in the development of the finance plan. See Section 8 (Finance Plan) for recommendations on financing these projects. The quantities and unit costs used to develop the cost estimates are provided in Appendix F.

Stormwater Management Plan

Section 8. Financial Plan Update

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Section 8. Financial Plan Update

8.1 Introduction

This section presents the development of a financial plan and subsequent revenue (i.e., rate) levels that are necessary to support the operating and capital needs of the City's Stormwater Utility (utility). The City completed the Comprehensive Stormwater Rate Study in 2006 (HDR) to determine the prudent level of rates to support the utility operating and capital costs for 2007 through 2011.

This financial plan is an update of the 2006 rate study. The financial plan was developed for a projected 20-year period (2016 - 2035) to assess the City's ability to meet its stormwater capital needs, as developed in this plan, and sufficiently fund Operation & Maintenance (O&M), debt service, and target reserve levels over the time period reviewed. The remainder of this section is organized as follows:

- ***Section 8.1 –Methods*** – Highlights the methods used to prepare a 20-year (2016 - 2035) financial plan update.
- ***Section 8.2 – Projection of Revenues*** – Summarizes projected rate and other revenues for the time period reviewed.
- ***Section 8.3 – Projection of Expenses*** – Summarizes projected expenses, including O&M expenses, rate funded capital, taxes, and debt service, for the time period reviewed.
- ***Section 8.4 – Rate Assessment*** – Assesses the need for rate adjustments to prudently fund the stormwater utility operations and capital needs over the next 20-year period with the focus of the analysis on the next 10-year period for rate setting purposes.
- ***Section 8.5 – Debt Service Coverage Ratios*** – Defines target debt service coverage (DSC) ratio and discusses current levels.
- ***Section 8.6 – Reserve Levels*** – Defines prudent target minimum reserve levels for O&M and capital reserve funds.
- ***Section 8.7 – Summary Conclusions*** – Summarizes the financial analysis performed and recommendations regarding rate adjustments.

8.2 Methods

To develop the financial plan update, a projection of operating revenues and expenses, both operating and capital, was developed. This projection was based on the City's forecasted year-end O&M expenses for 2014 and the proposed 2015 O&M budget for 2015. To project O&M expenses for future years, escalation factors were developed based on the City's historical increases in O&M expenses and estimates of future inflationary increases.

Capital Improvement Projects (CIPs) were identified and cost estimates developed as discussed in Section 7. The expected construction costs for the CIPs were evaluated here to develop a plan that funds the recommended improvements while minimizing impacts to stormwater rates to the extent possible. The analysis also took into consideration prudent financial management criteria, such as adequate funding of capital improvements through rates, debt service coverage ratios, and prudent reserve fund minimum target balances (or levels).

The findings and resulting recommendations of this financial plan update are based on the assumptions developed herein. Should assumptions regarding the timing of capital improvements, the customer characteristics, or other assumptions change, the results of the analysis will also change.

8.3 Projection of Revenues

The City receives revenue related to stormwater activities from two primary sources: monthly rate revenues and other revenues. Rate revenues reflect the monthly charges to customers to provide stormwater services. Other revenues include revenues received from late fees, bad debt income, and interest earnings on reserves.

The starting point for projecting rate revenues was the stormwater utility 2015 budget of approximately $1.77 million. Of this, just under half of the revenues are received from residential customers and the remaining revenues are received from commercial customers. Rate revenues are projected to be $2.16 million in 2035 assuming an annual customer growth rate of 1.0% prior to any proposed rate adjustments.

Other revenues, provided primarily through late fees and bad debt recovery, were also projected for the 20-year period assuming an annual escalation rate of 1.0% per year. Interest earnings are calculated based on the available ending reserve fund balances each year and projected interest rates. Other revenues were projected to average approximately $70,000 per year for the 2015 – 2035 time-period reviewed.

In total, the stormwater utility was projected to receive approximately $1.83 million in 2015 increasing to $2.23 million in 2035. This increase is primarily the result of customer growth on the system. Rate revenues provide approximately 96.1% of the revenues to support stormwater operations and the remaining 3.9% is provided through other revenues (Table 2-1). Provided in below is a summary of the projected revenues for the stormwater utility through 2025.

Table 8-1. Projection of Stormwater Utility Revenues ($000s)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Rate Revenues										
Residential	$811	$819	$827	$836	$844	$852	$861	$870	$878	$887
Commercial	980	989	999	1,009	1,019	1,030	1,040	1,050	1,061	1,071
Total Rate Revenues	**$1,791**	**$1,809**	**$1,827**	**$1,845**	**$1,863**	**$1,882**	**$1,901**	**$1,920**	**$1,939**	**$1,958**
Other Revenues										
Interest Income	$55	$48	$57	$18	$6	$10	$16	$19	$21	$29
Late Fees	47	47	48	48	49	49	50	50	51	51
Total Other Revenues	**$101**	**$95**	**$104**	**$66**	**$54**	**$59**	**$65**	**$69**	**$71**	**$80**
Total Revenues	**$1,892**	**$1,904**	**$1,931**	**$1,911**	**$1,918**	**$1,941**	**$1,966**	**$1,989**	**$2,010**	**$2,038**

The technical appendix (Appendix G) includes the final 10-years of the revenue projections.

8.4 Projection of Expenses

The City incurs a variety of expenses to operate and maintain the stormwater system, including O&M expenses, rate funded capital, taxes, and annual debt service payments. Each of these expense types is discussed in more detail in the following sections.

8.4.1 Operating and Maintenance Expenses

O&M expenses are incurred annually and reflect the cost of providing stormwater services. The O&M costs include salaries, benefits, supplies, other services and charges, and interfund services. Similar to the revenues, budgeted 2015 O&M expenses were escalated over the twenty-year period based on inflationary factors to develop future O&M expenses. Factors were developed for the various costs (e.g., labor, benefits, supplies) to prudently project the various O&M costs incurred to provide stormwater services.

The 2015 budgeted O&M expenses totaled $1.19 million and are projected to increase to $2.40 million in 2035 based on inflationary factors. This includes the addition of assumed NPDES program costs the City may incur to meet future regulations and staffing requirements. This represents an average annual increase of approximately 3.1% (Table 8-2).

8.4.2 Capital Improvement Plan and Funding

For a utility to maintain the existing system, it is important to reinvest in that system at a level at least equal to depreciation. It is prudent, therefore, to have a target level of annual capital projects funded by rates greater than this target level. This is due to the upgrade and replacement costs for the system continuing to increase due to inflationary measures at a rate greater than the increase in annual depreciation expense.

The capital plan identified in Section 7 of this report was used as a starting point for the capital funding approach. HDR worked with the City to develop the timing of the necessary capital improvement projects and assumed funding sources. The City has several primary funding sources available to fund capital improvements. These are typically rates, available reserves, grants, developer contributions, and long-term debt. For the City's capital funding plan, the focus was on the use of setting rate funded capital at a level that was sufficient to reflect annual renewal and replacement needs. Additional funding was assumed through the use of available reserves, grants historically received by the City to fund capital projects, and developer contributions. Provided in Table 8-2 is a summary of the capital improvement plan and funding approach.

Table 8-2. Capital Funding Plan ($000s)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total Capital Improvements - General	$2,050	$0	$0	$0	$111	$57	$59	$60	$131	$135
Total Flood Risk	0	0	839	0	0	0	0	0	0	0
Total Renewal & Replacement	0	200	226	405	0	0	0	0	0	0
Total Water Quality Retrofit	199	154	95	122	158	452	733	752	155	159
Total Developer Related	0	0	0	0	0	0	0	0	0	989
Total Capital Projects	***$2,249***	***$354***	***$1,160***	***$527***	***$269***	***$509***	***$792***	***$812***	***$286***	***$1,283***
Funding Sources										
Connection Charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating Reserves	209	104	949	291	1	15	82	83	0	247
Capital Reserves	0	0	0	0	0	0	0	0	0	0
Department of Ecology Grant	1,510	0	0	0	0	0	0	0	0	0
Assumed Grant Funded	0	116	71	92	119	339	550	564	116	119
Assumed Developer Funded	0	0	0	0	0	0	0	0	0	742
New Low Interest Loan	400	0	0	0	0	0	0	0	0	0
Rate Funded Capital	130	135	140	145	150	155	160	165	170	175
Total Funding Sources	**$2,249**	**$354**	**$1,160**	**$527**	**$269**	**$509**	**$792**	**$812**	**$286**	**$1,283**

As can be seen in Table 8-2, in 2016 $130,000 was assumed to be funded through rates to support annual capital improvement needs. This figure is increased annually starting in 2017 by $5,000 in order to increase the annual rate funding over the time period reviewed. This level of annual funding was established around the annual depreciation expense and capital funding needs for renewal and replacement capital needs identified in this report. It is important to note that the capital plan developed as part of the financial review reflects the prioritization of the capital improvement needs developed in Chapter 7 of this report, and is funded entirely from rates, reserves, grants, and developer contributions. It should be noted that the annual capital needs was escalated annually at 2.7% to account for inflationary measures, in years 2017 – 2025 based on historical average construction cost increases.

8.4.3 Taxes

Based on rate revenues, the stormwater utility pays a 8.5% utility tax to the City's general fund and a 1.5% state utility excise tax. No increases or decreases to the tax rates have been assumed for future periods. The stormwater utility also pays property taxes and a tax on irrigation revenues.

Total taxes are approximately $190,000 in 2015 and are projected to increase as rate revenues increase, to approximately $219,000 by 2035 due to projected increases in revenues over the time-period reviewed (Table 8-2).

8.4.4 Annual Debt Service Payments

Debt service relates to the principal and interest obligations of the stormwater utility when funding capital projects through long-term financing. The City currently has two outstanding debt service obligations: a revenue bond and a loan. The 2009 revenue bond, which included a refunding of the 1999 issuance, and the additional borrowed funds were used for improvements to the stormwater system. The loan was issued through the Department of Ecology in 2004 for the regional comprehensive stormwater management plan. The City has also issued an additional short-term loan of $400,000 through the Department of Ecology for the decant facility retrofit and relocation that will add to the debt service starting in 2016.

The total debt service obligation of the stormwater utility is approximately $172,000 in 2015, prior to the proposed short-term loan. This declines annually based on the debt service schedules to approximately $66,000 in 2024 through 2035 as annual principal and interest payments decline and debt issuances are retired. No additional long-term debt is assumed in the development of the capital funding plan (Table 8-2).

8.5 Rate Assessment

The above discussion has reviewed the various revenues and expenses that are used to develop the 10-year financial plan. In developing the financial plan, consideration was given to minimizing rates, while maintaining adequate funds to support the utility's operating, maintenance, and capital programs. A summary of the financial plan is provided in Table 8-3.

Table 8-3 starts with the rate revenues, based on current rate levels, and adds in other revenues received, such as interest income, to determine the total revenues available. Next, the total expenses (O&M, rate funded capital, debt service, and transfers) are subtracted from the total available revenues for each year of the time period reviewed. The resulting balance, or deficiency, of funds is then calculated to determine if current rates are set at a level to prudently fund the stormwater utility. It should be noted that the annual balance/deficiency is cumulative as any rate adjustments will impact future balances or deficiencies of funds. Finally, the adjustment to rates can be developed by taking the balance/deficiency divided by total rate revenues. It is important to note that the balance/deficiency is divided by rate revenues only as other revenues are not adjusted by annual rate adjustments (i.e., interest income).

Table 8-3. Summary of the Stormwater Utility Financial Plan ($000s)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenues										
Rate Revenues	$1,791	$1,809	$1,827	$1,845	$1,863	$1,882	$1,901	$1,920	$1,939	$1,958
Other Revenues	101	95	104	66	54	59	65	69	71	80
Total Revenues	**$1,892**	**$1,904**	**$1,931**	**$1,911**	**$1,918**	**$1,941**	**$1,966**	**$1,989**	**$2,010**	**$2,038**
O&M Expenses										
Salaries	$143	$147	$152	$156	$161	$166	$171	$176	$181	$186
Benefits	82	87	92	96	101	105	110	115	120	125
Supplies	17	18	18	19	20	20	21	21	22	23
Other Services and Charges	92	94	97	100	102	105	108	111	114	118
Interfund Services	923	951	979	1,008	1,038	1,069	1,101	1,134	1,168	1,203
NPDES Program Assumptions	0	50	75	100	103	105	108	110	113	116
Total O&M Expenses	**$1,258**	**$1,347**	**$1,413**	**$1,479**	**$1,524**	**$1,571**	**$1,618**	**$1,668**	**$1,719**	**$1,771**
Rate Funded Capital	**$182**	**$183**	**$185**	**$187**	**$189**	**$191**	**$193**	**$195**	**$197**	**$199**
Taxes	**$130**	**$135**	**$140**	**$145**	**$150**	**$155**	**$160**	**$165**	**$170**	**$175**
Annual Debt Service Payments	**$266**	**$267**	**$268**	**$263**	**$167**	**$120**	**$78**	**$77**	**$64**	**$63**
Transfer to Reserves	**$57**	**($29)**	**($8)**	**($26)**	**$99**	**$156**	**$211**	**$182**	**$161**	**$134**
Total Revenue Requirement	**$1,892**	**$1,904**	**$1,997**	**$2,048**	**$2,129**	**$2,193**	**$2,260**	**$2,286**	**$2,310**	**$2,341**
Balance/(Deficiency) of Funds	$0	$0	($66)	($137)	($212)	($252)	($294)	($297)	($300)	($303)
Additional Tax with Rate Increase	0	0	(7)	(14)	(21)	(25)	(29)	(30)	(30)	(30)
Net Balance/(Deficiency) of Funds	**$0**	**$0**	**($73)**	**($151)**	**($233)**	**($277)**	**($324)**	**($327)**	**($330)**	**($334)**
% Adjustment of Rate Revenues	**0.0%**	**0.0%**	**4.0%**	**8.2%**	**12.5%**	**14.7%**	**17.0%**	**17.0%**	**17.0%**	**17.0%**

The results of the analysis show that rate adjustments are necessary to fund the projected operating and capital needs of the stormwater utility. The primary driver for the necessary rate adjustments is the funding of the capital improvement needs, both through annual rate funded capital and funding of reserves to provide sufficient cash flow to fund projects.

Based on the analysis, the following rate adjustments are projected over the next five year period

- 2016 – 0.0%
- 2017 – 0.0%
- 2018 – 4.0%
- 2019 – 4.0%
- 2020 – 4.0%

With the projected rate adjustments, the City will sufficiently fund annual O&M expenses and adequately fund capital through rates at a level that supports the capital needs over the time period reviewed.

It is important to note that the financial plan presented in this section is predicated upon an assumed level of growth on the system, assumptions related to inflation, and the implementation of the capital plan as developed herein (Section 7). Should these assumptions change (e.g., growth increase, slow down, or not occur), the level of rate adjustment required will be affected. Likewise, if costs escalate faster or slower than indicated in this plan, the projected rate adjustments would also be affected.

8.6 Debt Service Coverage Ratios

The debt service coverage (DSC) ratio is another indicator that is used to judge the financial status of a utility. DSC ratios are a financial measure of the utility's ability to repay outstanding debt. A DSC ratio of 1.25 is generally considered the legally acceptable minimum[4]. Therefore, this implies that the utility should have a DSC ratio that is greater than 1.25. Currently, the City targets a DSC ratio of 1.25 on all outstanding debt. At this time - assuming the proposed rate adjustments are implemented - the stormwater utility's DSC calculation is greater than the target minimum levels over the 10-year time period.

8.7 Reserve Levels

Reserve funds are a crucial part of a utility's financial picture to provide adequate funding for O&M and capital expenses. They can have many different purposes, such as funding annual deficiencies, funding capital improvements, and minimizing short-term rate adjustments. The reserve funds can also be restricted and unrestricted, meaning they can be used for specific projects or needs or for general utility costs. When a reserve drops below the minimum level, it is a signal that action should be taken to replenish and restore the balance to the target level specified.

The City has established a target minimum reserve level for O&M expenses based on forty-five (45) days of O&M expenses. This equates to an average of approximately $186,000 per year for the time period under review. Over the projected time period the reserve funds are expended to fund capital improvement

[4] "Legally" as used herein, refers to the contractual agreement between bondholders and the utility to assure repayment of the bonds, and to financially operate the utility in such a manner as to maintain the utility's debt service coverage ratio above a specified minimum. This minimum debt service coverage ratio is a specified covenant of the bond ordinance or bond resolution.

needs and reach the target minimums in 2019. Future projections maintain reserves slightly greater than the minimum target balances.

It is recommended that the City evaluate the adequacy of the current O&M minimum target ending balance as it is the only reserve fund. As noted, the City may establish additional reserve funds to meet future capital improvement needs, rate stabilization, or other specific reserve funds.

This financial plan update maintains the current target minimum ending balance for the stormwater reserve throughout the time period reviewed. However, the City will want to monitor ending reserve levels as a “trigger point” for action on an annual basis and identify actions to increase levels such as rate increases as needed.

8.8 Summary Conclusions and Recommendations

Based on the results of the financial plan update, the current level of revenues are not sufficient to fund the operating and capital needs of the stormwater utility over the review period. Rate adjustments are proposed at this time, 4.0% annually in 2018 – 2020, to maintain prudent funding of the utility over the projected time period. In addition to rates, the City may consider a stormwater connection fee in certain basins where growth is expected and basin-wide system improvements are needed.

Stormwater Management Plan

Section 9. References

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Section 9. References

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Appendix A.

National Pollutant Discharge Elimination System (NPDES)
Eastern Washington Phase II Municipal Stormwater Permit

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Appendix B.

2015 Stormwater Management Program Plan (SWMP Plan)

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Appendix C.

Interlocal Agreement

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Appendix D.

Redline Mark-ups of Suggested Revisions to the Design Guidelines

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Appendix E.

2014 Stormwater LID Retrofit Project Pre-Design Report

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Appendix F.

CIP Project Sheets

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Appendix G.

Financial Technical Appendix

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